MCRP 2-10B.6

# MAGTF Meteorological and Oceanographic Operations

US Marine Corps

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BY DIRECTION OF THE COMMANDANT OF THE MARINE CORPS

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# FOREWORD

Meteorological and oceanographic (METOC) conditions have the potential to affect every combatant, piece of equipment, and operation. Knowledge of the natural environment becomes more significant to tactical success in the modern battlespace as technologically advanced weapons and support systems that are sensitive to METOC conditions are fielded. Effective METOC operations are critical to Marine expeditionary forces as they seek broader and bolder operational opportunities to project combat power from the sea. Commanders, staffs, and operational and tactical mission planners must be aware of and consider the effects of METOC conditions during mission planning through mission execution.

Marine Corps Reference Publication (MCRP) 2-10B.6, *MAGTF Meteorological and Oceanographic Operations*, provides doctrine and guidance for Marine air-ground task force METOC operations. This publication is intended for commanders, staffs, operational and tactical mission planners, and METOC personnel who plan and execute METOC operations.

This publication supersedes MCWP 3-35.7, *MAGTF Meteorological and Oceanographic Support*, dated 30 June 1998.

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# CHAPTER 1
# FUNDAMENTALS

Per Joint Publication (JP) 3-59, *Meteorological and Oceanographic Operations*, meteorological and oceanographic (METOC) operations encompass “all meteorological, oceanographic, and space environmental factors as provided by the Services, support agencies, and other sources. These factors include the whole range of atmospheric (weather) and oceanographic phenomena, from the sub-bottom of the Earth’s oceans up through the atmosphere and into the space environment (space weather).”

Accurate and timely METOC support is critical to tactical combat operations and operational-level planning. History is replete with examples of METOC effects on the timing and the success or failure of military operations on a variety of battlefields; for example, harsh winters were instrumental in the outcomes of both Napolean’s and Hitler’s Russian offensives as well as the Battle of the Bulge and the Chosin Reservoir. More recent conflicts in Afghanistan and Iraq prove that an understanding of METOC conditions, such as heat and sandstorms, is essential for effective decision making. As history has illustrated and the battlespace of tomorrow will continue to prove, military operations are not immune to METOC effects. Successful military operations include accurate and timely METOC information. Conversely, lack of accurate and timely METOC support or inaccurate METOC information can negatively affect planned operations.

## MISSION

The mission of Marine Corps METOC personnel is to provide timely, relevant, accurate, and consistent meteorological, oceanographic, and space environmental information, products, and services required in support of joint, combined, and Marine Corps operations as directed.

## METOC PROCESS

The METOC process consists of six steps: collect, analyze, predict, tailor, integrate, and evaluate (see fig.1-1 on page 1-2). These steps define a sequential and interdependent process for the development of METOC products. During this process, collected METOC data is manipulated and processed to become METOC information. Human judgment and intelligence then places this METOC information into the specific context of the mission to optimize military decision making and operations.

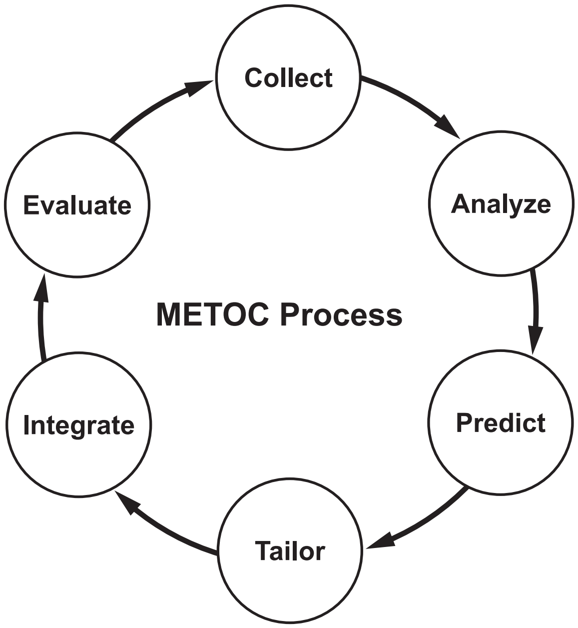

**Figure 1-1. METOC Process.**

### Collect

Successful operations depend on timely, accurate, and reliable METOC data. Thus, METOC personnel collect environmental measurements from air, land, maritime, and space, using on site and remote sensing platforms. This data populates regional, theater, and global databases from which METOC services and products are created, providing the foundation for effective METOC operations. During operational planning and operations, a sensing strategy and a collection plan must be developed. The sensing strategy leverages all possible instruments of national power to meet the commander's ongoing METOC situational awareness requirements and is included in theater plans. It includes organic Department of Defense (DOD) METOC data collection capabilities and identifies gaps in DOD METOC collection. Non-DOD METOC data also may be available and used if it is determined to be sufficiently timely, accurate, and reliable to supplement DOD METOC assets and to incorporate into theater METOC processes.

The collection plan must be developed and implemented to orchestrate the timing, distribution of collection sites, and efforts of all components within the Marine Corps. A complete plan will foster unity of effort while optimizing data collection, dissemination, and integration into METOC products from indigenous and national sources. Spreading observational resources across an area of interest (AOI) to obtain optimum coverage will significantly improve the quality of METOC services. Meteorological and oceanographic collection plans will normally be published in an Annex H (Meteorological and Oceanographic Operations) of operation plans (OPLANs)/ operation orders (OPORDs).

### Analyze

Meteorological and oceanographic production facilities, reachback centers, and on-scene METOC personnel interpret, fuse, and evaluate collected data and information to develop forecasts and recommendations in support of operational requirements and decisions. Analysis products provide coherent, integrated depictions of the past and current state of the natural environment over specific regions. Analysis transforms raw environmental data into useful METOC information and enables production of accurate forecasts of the environment. It enables identification of significant METOC features and conditions, which may require further study and monitoring to determine impacts on operations based on METOC thresholds and sensitivities. Meteorological and oceanographic information is processed and assimilated into inputs for decision making and predictions.

### Predict

Through the use of numerical models, expert systems, and human judgment, METOC personnel describe the anticipated future state of the meteorological, oceanographic, and space environment. Forecasts, computer- and human-based, include temporal and spatial assessments of atmospheric, terrestrial, marine, and space environmental features and associated elements.

### Tailor

A key role of METOC forces is to support the decision-making process of the commander and assigned forces through application of forecast products tailored to their operational requirements. It is not enough to just understand and predict the air, land, maritime, and space environments. That understanding must be transformed into relevant operational knowledge of how that environment will impact operations and military capabilities (weapons, sensors, platforms, mission profiles, tactics, techniques, and procedures [TTP], and personnel).

Meteorological and oceanographic forces tailor information into actionable decision aids and mission execution/planning forecast products by applying METOC parameter thresholds specific to a mission, platform, or system. Decision makers typically identify these operationally significant METOC threshold sensitivities impacting/affecting the employment of operations and military capabilities, providing a baseline for weather effects decision aid rules.

### Integrate

Effective integration of METOC information aids the planning of operations and enables commanders to anticipate and then mitigate or exploit environmental impacts on planned operations.

Integration of METOC information into planning and decision-making processes allows the commander to optimize the employment of military capabilities (weapons, sensors, platforms, mission profiles, TTP, and personnel) while marginalizing the benefit of the environment for the adversary, thereby creating an asymmetrical advantage for friendly forces. Commanders should ensure that environmental impacts on operations and intelligence are fully integrated into planning and decision-making processes and command and control (C2) systems. Continuous coordination between commanders and their METOC staffs ensure all available and relevant METOC information and resources, including indigenous assets, are properly considered and made available for use by all units.

By identifying METOC effects that influence the intelligence preparation of the battlespace (IPB), METOC information directly supports operations, the Marine Corps Planning Process, the commander’s situational awareness, TTP, command and control, weapons, platforms, sensors, and personnel. Meteorological and oceanographic personnel address METOC-related commander’s critical information requirements (CCIRs) and other requirements. They coordinate across staff functions to identify and document applicable critical environmental thresholds to acquire a complete and thorough understanding of METOC impacts to the mission.

### Evaluate

To determine the effectiveness of METOC information, a quality control mechanism must be in place. Mission success can often be dependent on the accuracy of METOC information and therefore should be diligently assessed to ensure the most accurate information is being provided to decision makers. This process can contribute to the development of TTP that enhance the understanding of the natural environment in a particular AOI and can be utilized and refined over time. Evaluation is a continuous process and should carry on throughout the METOC process to ensure effective products are being produced and delivered to the customer.

Operational awareness, staff coordination, METOC debriefs, and the use of the Marine Corps Center for Lessons Learned will significantly enhance the capability to evaluate METOC effectiveness. Evaluations based on Marine air-ground task force (MAGTF) requirements and/or equipment limitations identify shortfalls in the value of METOC operations as a force multiplier. Implementing timely, corrective actions enhances the overall quality of operations.

## METOC PRINCIPLES

### Accuracy

Meteorological and oceanographic information must be measurably correct, convey an appreciation of the environment and the conditions as they actually exist, and predict the best possible forecast of future environmental conditions and impacts based on sound judgment. Commanders depend on accurate METOC information to plan and direct their operations. Inaccurate information can cost lives, undermine the successful execution of a mission, unnecessarily expend resources, and impair readiness. All of the following affect the accuracy of METOC information: the capability to collect data within the AOI with sufficient spatial and temporal coverage to provide situational awareness and to model and forecast the METOC conditions; limitations of METOC data collection equipment and instrumentation; limitations of numerical modeling of the physical environment; the perishable nature of METOC data; and human error. It is essential that METOC personnel provide the most accurate predictions of METOC impacts and clearly articulate limits of confidence so that commanders can make the best decisions.

### Consistency

Operations are often supported with several echelons of command. Each echelon of command may possess an organic METOC asset. With several METOC units providing METOC information within a given AOI, it is imperative that forecast collaboration and coordination between METOC units be accomplished to provide consistent information regarding the state of the natural environment, as per the “one operation, one forecast” concept. Because METOC information supporting a commander’s decision usually comes from multiple sources, there must be unity of effort to ensure METOC personnel produce, assess, and incorporate the same basic set of data in developing METOC products applied at global, regional, and local levels in order to ensure similar results. Natural environment information provided to commanders at all echelons should be spatially and temporally consistent across the AOI, especially when METOC conditions will impact the ability of one operational unit to support a larger operation (e.g., close air support to ground maneuver forces).

### Relevancy

The principle of relevancy requires commanders to communicate to METOC personnel their specific requirements for content, form, medium, presentation, timeliness, and frequency of delivery. Relevant METOC information influences the commander's current, planned, and alternative courses of action (COAs) at each level of responsibility. Each operation requires tailored METOC information so the user can quickly identify and apply relevant information without additional analysis or manipulation. It is also important that METOC collections, analyses, and predictions provide value to the particular operation for which they are provided.

### Timeliness

Timeliness refers to the principle that METOC operations are only effective when commanders receive accurate METOC information in time to consider its impact and apply it effectively within their decision-making cycle. As such, METOC units must provide the latest available METOC information and knowledge to decision makers throughout the decision-making process and all phases of any operation. Reliable communications links among all METOC units are required to support and sustain the timely dissemination of METOC information and are essential to the overall capability of METOC units.

## METOC SUPPORT TO WARFIGHTING FUNCTIONS

### Command and Control

Command and control is the exercise of authority and direction over assigned or attached forces for the accomplishment of a mission. It is how the commander transmits intent and decisions to the force and receives feedback. Command and control involves arranging personnel, equipment, and facilities to allow the commander to extend influence over the force during planning and conduct of military operations. Good planning facilitates command and control. In order for METOC operations to be effective, they must be fully integrated with C2 systems and processes that enable mission planners, commanders, and decision makers to obtain METOC information and to integrate that information into the mission planning, decision, and operating cycles. Reliable and robust communications architectures enhance the push, pull, exchange, and management of METOC data and information. The exchange of this data and information occurs upward, downward, and laterally and ensures a consistent common operational picture of current and forecast METOC conditions in the battlespace among all echelons of command.

### Maneuver

As stated in Marine Corps Doctrinal Publication (MCDP) 1, *Warfighting*, Marine Corps doctrine is based principally on warfare by maneuver. The DOD defines maneuver as the "employment of forces in the operational area through movement in combination with fires to achieve a position of advantage in respect to the enemy." (JP 1-02, *Department of Defense Dictionary of Military and Associated Terms*, hereafter referred to as DOD Dictionary, part 4 of a 4-part definition) To gain that advantage, maneuver relies on the tenets of speed and surprise to concentrate strength against an enemy's weakness. Speed over time is tempo, and both are considered weapons with regards to combat power. Adverse METOC conditions have a direct impact on mobility and tempo. Operational and tactical planning must consider and prepare for general and specific effects of METOC conditions on a force's ability to maneuver. The commander who has a greater understanding of METOC effects on both friendly and enemy forces maintains a significant edge on the battlefield. For example, during the early stages of Operation Iraq Freedom, 25 March 2003, a severe dust storm developed. This storm initiated a 5-day pause that slowed and/or halted all US and coalition forces about 100 miles from Baghdad. Timely and accurate METOC forecasts enabled planners and decision makers to effectively adjust tactics by utilizing weapons and optics that have higher performance in dust conditions and positioning forces prior to the storm's onset to use the degraded conditions to maintain an advantage over the enemy.

### Fires

The *DOD Dictionary* defines fires as "the use of weapon systems or other actions to create specific lethal or nonlethal effects on a target." Fires are normally used in concert with maneuver to help shape the battlespace and set conditions for decisive action. Therefore, METOC effects on fires have a direct impact on a force's ability to maneuver and operate as a combined-arms force. Integrating METOC personnel into the planning will minimize the effect of adverse METOC conditions on fires and assist with exploiting the effects on the enemy. Even with the continued enhancement of weapon systems and the use of electro-optical aids to improve target acquisition, planners and decision makers still need to account for the impact METOC conditions have on the electromagnetic (EM) spectrum and adjust planning as required to gain or maintain the advantage.

### Intelligence

Intelligence provides the commander with an understanding of the adversary and the operational environment, and it identifies the adversary's center of gravity and critical vulnerabilities. It assists the commander in understanding the situation, alerts the commander to new opportunities, and helps the commander assess the effects of actions within the battlespace. This warfighting function supports and is integrated with the overall operational effort and must focus on the commander's intelligence requirements. Thus, METOC information is as much a part of intelligence as enemy and terrain data. Often, it is as significant as enemy intentions and trafficability. The MAGTF commanders and their staffs require METOC data and information to plan and execute operations. Meteorological and oceanographic intelligence results from sensing and collecting METOC data, analyzing that data, identifying METOC effects, and assessing the impact of current and forecast METOC conditions on both friendly and enemy systems, tactics, and operations.

Further, METOC information produces METOC knowledge when it is analyzed to provide understanding of the implications of METOC conditions on the mission during the decision-making process. In essence, METOC operations provide intelligence regarding the natural environment. Current or forecast METOC conditions that can influence mission accomplishment may be deemed a CCIR. Joint Publication 3-59 states that "geospatial intelligence is critically important to successful military operations planning, and METOC data is considered an intelligence layer of the [geospatial intelligence] information base." Lessons learned during Operation Iraqi Freedom have proven that METOC input to intelligence plans and collections can enhance and optimize the employment of intelligence, reconnaissance, and surveillance capabilities.

### Logistics

Logistics encompasses all activities required to move and sustain military forces. At the tactical level, logistics is combat service support (CSS) that deals with feeding, fueling, arming, and maintaining troops and equipment. Tactical logistics involves the actual performance of the logistic functions of supply, maintenance, transportation, health services, general engineering, and other services. What is asked of logistics and what logistics is able to provide is profoundly influenced by the particular circumstances of a war, campaign, or battle, including METOC conditions. A maneuvering force's ability to receive timely CSS has a direct impact on that force's ability to maintain tempo and continue to hold an advantage over the enemy. Timely and accurate METOC products and the inclusion of METOC personnel in mission planning will aid planners and decision makers in exploiting environmental conditions to gain an advantage over an enemy force and reduce the impact those same conditions will have on friendly forces and the ability to provide CSS.

### Force Protection

Force protection describes the measures taken to preserve the force's potential so that it can be applied at the appropriate time and place. It includes those measures the force takes to remain viable by protecting itself from the effects of adversary activities and natural occurrences. Force protection safeguards friendly centers of gravity and protects, conceals, reduces, or eliminates friendly critical vulnerabilities. Severe and/or adverse METOC conditions can develop rapidly with little or no warning, resulting in devastating effects on equipment, personnel, and operations. Therefore, METOC operations must detect potentially destructive weather at the earliest possible moment. Notification of forecast and imminent destructive weather must be rapidly disseminated throughout all levels of command. This, in turn, raises situational awareness and gives units as much advance notice as possible so they may prepare for, mitigate, and exploit the effects of destructive weather and continue with the mission.

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# CHAPTER 2

# ORGANIZATIONS AND RESPONSIBILITIES

The 68XX occupational field (OCCFLD) manages Marine Corps METOC capabilities. All Marines in this field are responsible for collecting, assessing, and disseminating METOC information relevant to friendly and enemy force strengths and vulnerabilities for the planning and execution of operations necessary for IPB. Marine Corps METOC capabilities are organized as an embedded capability set within selected Marine Corps units (e.g., Marine air control squadrons [MACSs], intelligence battalions, station airfield operations departments) of the operational force and operational supporting establishments to support military operations in both garrison and tactical environments. From those units, Marine Corps METOC forces deploy as task-organized teams or detachments with associated expeditionary METOC systems to support the operational requirements of each particular MAGTF or mission assignment. Marine Corps METOC capabilities include on-scene sensing/collection, assimilation and processing of raw and processed environmental data, and dissemination and integration of METOC products and services. Marine Corps METOC capabilities facilitate the dynamic characterization and understanding of both the current and future state of the operational environment for MAGTF commanders, planners, and warfighters throughout the operational planning process.

## ADVOCACY AND PROPONENCY

Although METOC capabilities are a MAGTF support asset, the OCCFLD's advocate is with the Deputy Commandant (DC), Aviation. The Marine Corps Director of Intelligence (DIRINT) serves as the proponent for the 68XX OCCFLD and assists the advocate in representing and identifying Marine Corps METOC capabilities and requirements. See Marine Corps Order (MCO) 5311.6, *Advocate and Proponent Assignments and Responsibilities*, for more information on advocacy and proponency.

## OPERATIONAL FORCE RESPONSIBILITIES

### Marine Corps Component Commands

The Marine Corps component command's METOC officer serves as a special staff officer for the Marine Corps component commander and resides within the G-2. The component command billets include assignment to Marine Forces Pacific, Camp Smith, HI, and Marine Forces Command, Norfolk, VA (see fig. 2-1 on page 2-2 and fig. 2-2 on page 2-3).

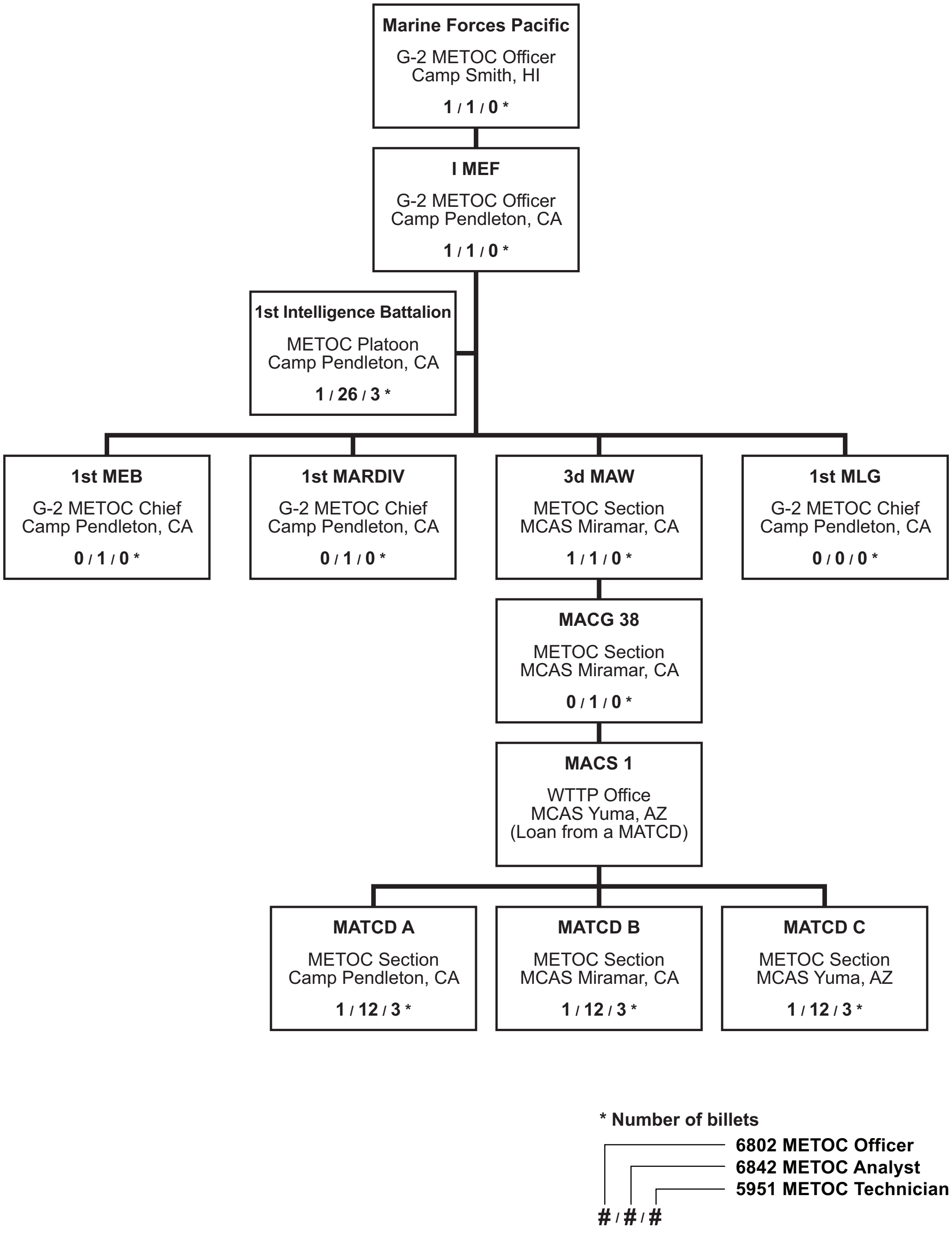

**Figure 2-1. Marine Forces Pacific/I MEF Organization.**

The primary mission of the Marine Corps component command METOC officer is to advise and assist the component commander in the development of METOC policies and the execution and management of METOC resources by planning, coordinating, and validating the collection, evaluation, interpretation, and dissemination of METOC data. Other duties include the following:

- Maintaining liaison with other Service counterparts and representing the Marine Corps component commander at joint Service METOC meetings.
- Maintaining staff cognizance and management coordination for METOC-related matters.

- Serving as the Marine Corps senior meteorological and oceanographic officer (SMO) when the Marine Corps component command headquarters deploys.
- Conducting staff studies directly related to improving MAGTF warfighting capabilities.
- Preparing and presenting staff and command level briefings.
- Providing staff support in planning for the employment and use of organic METOC assets, equipment, and capabilities.
- Providing climatological, meteorological, tidal, astronomical, and other METOC data for planning.

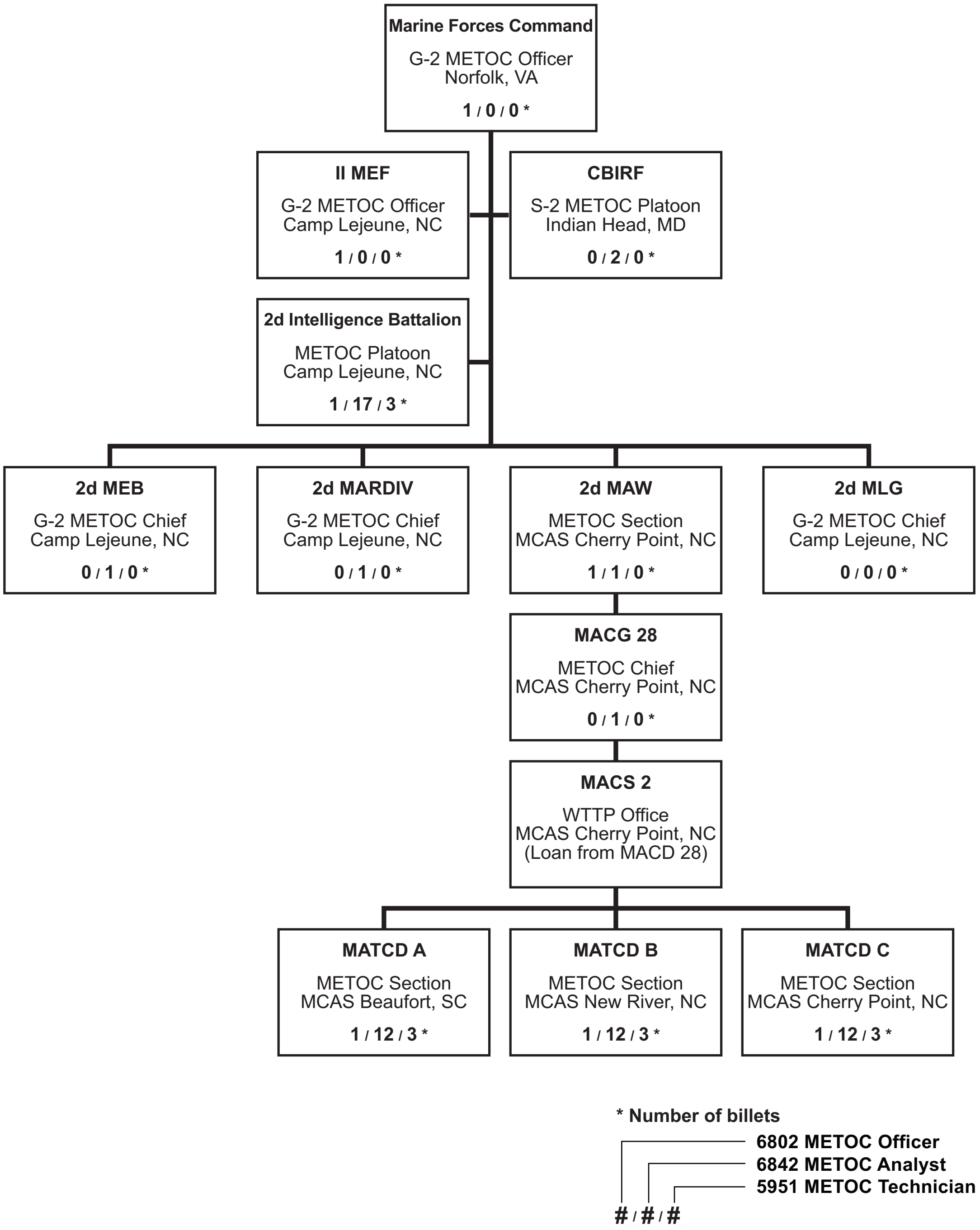

**Figure 2-2. Marine Forces Command/II MEF Organization.**

- Developing and preparing Annex H (Meteorological and Oceanographic Operations) for OPLANs or OPORDs.
- Providing METOC input into Annex K (Combat Information Systems), Annex B (Intelligence), and other annexes as necessary regarding METOC issues.

See appendix A for an example of METOC input to annex K and appendix B for an example of METOC input to the annex B.

### Marine Expeditionary Force

The Marine expeditionary force (MEF) METOC officer serves as a special staff officer for the commanding general (CG) of the MEF and resides within the G-2. The primary mission of the MEF METOC officer is to advise and assist the MEF CG in the development of METOC policies and the execution and management of METOC resources by planning, coordinating, and validating the collection, evaluation, interpretation, and dissemination of METOC data. Other duties include the following:

- Maintaining liaison with other Service counterparts.
- Representing the MEF CG at joint Service METOC meetings.
- Maintaining staff cognizance and management coordination for METOC-related matters.
- Serving as the Marine Corps SMO when the MEF headquarters deploys.
- Conducting staff studies directly related to improving MAGTF warfighting capabilities.
- Preparing and presenting staff and command level briefings.
- Providing staff support in planning for the employment and use of organic METOC assets, equipment, and capabilities.
- Providing climatological, meteorological, tidal, astronomical, and other METOC data for planning.
- Developing and preparing Annex H (Meteorological and Oceanographic Operations) for OPLANs or OPORDs.
- Providing METOC input into Annex K (Combat Information Systems), Annex B (Intelligence), and other annexes as necessary regarding METOC issues.

### Intelligence Battalion

The intelligence battalion provides the preponderance of METOC personnel outside of aviation support, but each intelligence battalion has different requirements in regards to the number of METOC personnel assigned. These battalions provide direct support and general support METOC personnel in the form of meteorological and oceanographic support teams (MSTs) to all other elements of the MAGTF. The primary mission of the METOC platoon in an intelligence battalion is to provide direct METOC support to the MEF G-2. The secondary mission is to provide task-organized MSTs to support the unique mission of each Marine expeditionary unit (MEU). The duties of the intelligence battalion METOC personnel include the following:

- Integrating into operational and mission planning to ensure environmental intelligence and impacts are provided to mission planners and decision makers.
- Acquiring, monitoring, and analyzing METOC data to produce tailored, value-added information for supported units.

- Operating METOC environmental sensors and display equipment used as the basis for collecting and forecasting environmental conditions.
- Preparing, disseminating, and briefing forecasts focused on specific missions, locations, and METOC parameters critical to current operations and future planning.
- Providing weather watches, warnings, and advisories (WWAs) in support of sustained operations ashore to ensure force protection.

The primary mission of the intelligence battalion METOC officer is to supervise the daily operations and training of the forecasters in accordance with Navy/Marine Corps Departmental Publication (NAVMC) 3500.38B, *Meteorological and Oceanographic Training and Readiness Manual,* and MCO 3500.14C, *Aviation Training and Readiness (T&R) Manual*, while ensuring the combat readiness and mission capability of METOC personnel and equipment. Other duties include the following:

- Supervising the collection of and ensuring quality control of all METOC products.
- Identifying communications and embarkation requirements to supported agencies.
- Identifying training and equipment deficiencies to higher headquarters (HHQ) via the chain of command.
- Assisting with the development of Annex H (Meteorological and Oceanographic Operations) and providing input to Annex K (Combat Information Systems) for OPORDs.
- Providing METOC information for Annex B (Intelligence) and Annex C (Operations).
- Assisting in the IPB process by developing METOC products and information.
- Coordinating METOC products and support with HHQ and adjacent units.
- Verifying critical METOC thresholds for accuracy and validity.
- Ensuring that CCIRs are known and understood by personnel and passing them on to ensure a coordinated focus of effort.
- Advising supported commanders on METOC capabilities and limitations.
- Preparing climatological studies and analysis in support of planned exercises and operations.
- Coordinating with subordinate units to gather any additional METOC requirements and support that may be needed during the course of operations.

### Marine Expeditionary Brigade

The Marine expeditionary brigade (MEB) METOC chief serves as a special staff officer for the MEB CG and resides within the G-2. The primary mission of the MEB METOC chief is to integrate into operational planning. Other duties include the following:

- Preparing and presenting METOC briefs in support of mission planning and execution.
- Forecasting and identifying environmental factors expected to impact operations.
- Providing the expertise and METOC input in the areas of doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) on behalf of the MEB CG.

### Marine Division

The Marine division (MARDIV) METOC chief serves as a special staff officer for the MARDIV CG and resides within the G-2. The primary mission of the MARDIV METOC chief is to integrate into operational planning. Other duties include the following:

- Preparing and presenting METOC briefs in support of mission planning and execution.
- Forecasting and identifying environmental factors expected to impact operations.
- Providing the expertise and METOC input in the areas of DOTMLPF on behalf of the MARDIV CG.

### Marine Logistics Group

The Marine logistics group (MLG) METOC chief serves as a special staff officer for the MLG CG and resides within the G-2. The primary mission of the MLG METOC chief is to integrate into operational planning. Other duties include the following:

- Preparing and presenting METOC briefs in support of mission planning and execution.
- Forecasting and identifying environmental factors expected to impact operations.
- Providing the expertise and METOC input in the areas of DOTMLPF on behalf of the MLG CG.

### Marine Aircraft Wing

The Marine aircraft wing (MAW) METOC officer serves as a special staff officer for the MAW CG and resides within the G-2. The primary mission of the MAW METOC officer is to integrate into operational planning and advise the CG on the capabilities and limitations of the METOC personnel and equipment with the MAW. Other duties include the following:

- Providing input to MAW OPLANs/OPORDs.
- Preparing and presenting METOC briefs in support of mission planning and execution.
- Forecasting and identifying environmental factors expected to impact operations.
- Supervising the METOC collection strategy for the air wing.
- Managing and training METOC personnel augmenting the Marine Corps tactical air command center (Marine TACC).
- Assisting subordinate commands in knowledge development for all METOC personnel in the MAW.
- Providing the expertise and METOC input in the areas of DOTMLPF on behalf of the MAW CG.

### Marine Air Control Group

The Marine air control group (MACG) METOC chief is a member of the special staff for the commanding officer of the MACG and resides within the S-3/S-5. The primary mission of the MACG METOC chief is to integrate into operational planning and to advise the commanding officer on the capabilities and limitations of the METOC personnel and equipment within the MACG. Other duties include the following:

- Assisting in the management and execution of all METOC capabilities and resources.
- Coordinating effective methods of providing METOC support for the planning and execution of MAGTF operations.

- Analyzing and interpreting centrally prepared products, alphanumeric data, satellite images, and Doppler radar coverage in order to provide forecast meteorological conditions, space weather, climatological and astronomical products, and impacts assessments for all requested operations within the scope of the MACG and its subordinate commands.

### Marine Air Control Squadron

***Marine Air Control Squadron Weapons and Tactics Training Program***. The MACS METOC Weapons and Tactics Training Program (WTTP) chief is the subject matter expert on METOC to the commanding officer of the MACS and is augmented to the WTTP section. The primary mission of the MACS METOC WTTP chief is to supervise the training progression of MACS METOC personnel in accordance with MCO 3500.14C and NAVMC 3500.38B. The MACS METOC WTTP chief continuously monitors and supervises METOC training. Completed training is entered into M-SHARP [Marine Sierra Hotel Aviation Readiness Program], an automated training and readiness management system, to ensure accurate portrayal of combat readiness of the METOC sections within the Marine air traffic control detachment (MATCD). Other duties include the following:

- Reviewing deployment and exercise after action reports to identify and document shortfalls or required changes in TTP, personnel, and equipment in order to increase mission performance and/or functionality.
- Coordinating METOC support for units within MAW as required.
- Adhering to the guidance in the Aviation Command and Control Aviation Career Progression Model; Command, Control, and Communications Course Catalog; and MCO 3500.109, *Marine Corps Aviation Weapons and Tactics Training Program*.
- Monitoring enrollment and progress of METOC Marines in military occupational specialty (MOS) enhancement courses.

***Marine Air Traffic Control Detachment***. Within the aviation command element (ACE), the majority of METOC personnel reside within the MATCD. The MATCD METOC Marines also manage the largest METOC support asset within the MAGTF: the Meteorological Mobile Facility (Replacement) Next Generation (METMF[R] NEXGEN) AN/TMQ-56. The METMF(R) NEXGEN is deployed to support sustained operations ashore and provides METOC personnel with a forward deployed data collection asset that is comparable to garrison systems. This allows MATCD METOC personnel to provide general support to the ACE, but they can be task-organized by way of MSTs to support the other elements of the MAGTF when requested or tasked by higher commands. The duties of the MATCD METOC personnel include the following:

- Acquiring, monitoring, and analyzing METOC data to produce tailored, value-added information for supported units.
- Operating all METOC equipment, including satellite receivers, radar, and other available environmental sensors and display equipment used as the basis for collecting and forecasting environmental conditions.
- Preparing and disseminating forecasts focused on specific missions, locations, and METOC parameters critical to current operations and future planning.

- Forecasting upper level winds.
- Providing aviation flight weather briefings in support of aviation missions.
- Providing WWAs in support of sustained operations ashore to ensure force protection.

Since the preponderance of METOC personnel within the MAW reside in the MATCDs, the primary mission of the MATCD METOC officer is to ensure the combat readiness and mission capability of METOC personnel and equipment and to supervise the daily operations and training of METOC analysts in accordance with MCO 3500.14C and NAVMC 3500.38B. Other duties of the MATCD METOC officer include the following:

- Managing all logistical, administrative, and fiscal functions of the section.
- Supervising and providing quality control for all METOC products.
- Providing climate and environmental studies for tactical and operational requirements.
- Employing and supervising the collection strategy provided by HHQ.
- Serving as a METOC subject matter expert to the commanding officer of the MACS.

## OPERATIONAL SUPPORTING RESPONSIBILITIES: MARINE CORPS INSTALLATIONS COMMAND

### Marine Corps Installations East and West

***Regional METOC Centers***. The regional meteorological and oceanographic centers (RMCs) are operational supporting establishments that are under the cognizance of Marine Corps Installations Command (MCICOM). There are two RMCs, one on each coast (see fig. 2-3 on page 2-9). The RMC West is located at Marine Corps Air Station (MCAS) Miramar and has the primary mission of coordinating METOC support for all Marine Corps Installations West bases and stations, thus ensuring adequate aviation METOC support for all MCASs, 3d MAW, and transient aircraft in garrison. The RMC East is located at MCAS Cherry Point and has the primary mission of coordinating METOC support for Marine Corps Installations East bases and stations, thus ensuring adequate aviation METOC support for all MCASs, 2d MAW, and transient aircraft in garrison. Due to the preponderance of METOC personnel within MCICOM being assigned to the regional METOC centers, both RMCs have the secondary mission to coordinate, supervise, and conduct the training of all METOC forecasters in the MCICOM chain of command in accordance with MCO 3500.14C and NAVMC 3500.38B. As part of the regionalization concept of the RMCs, they are responsible for 24/7 METOC support for the station they are aboard and after-field closure for all other stations within their area of responsibility (AOR). Those duties include the following:

- Collecting, analyzing, predicting, tailoring, integrating, evaluating, and disseminating METOC observations and forecasts.
- Preparing and disseminating WWAs.
- Preparing and briefing aviation flight weather briefs.
- Forecasting upper level winds.
- Preparing and disseminating yearly astronomical data.

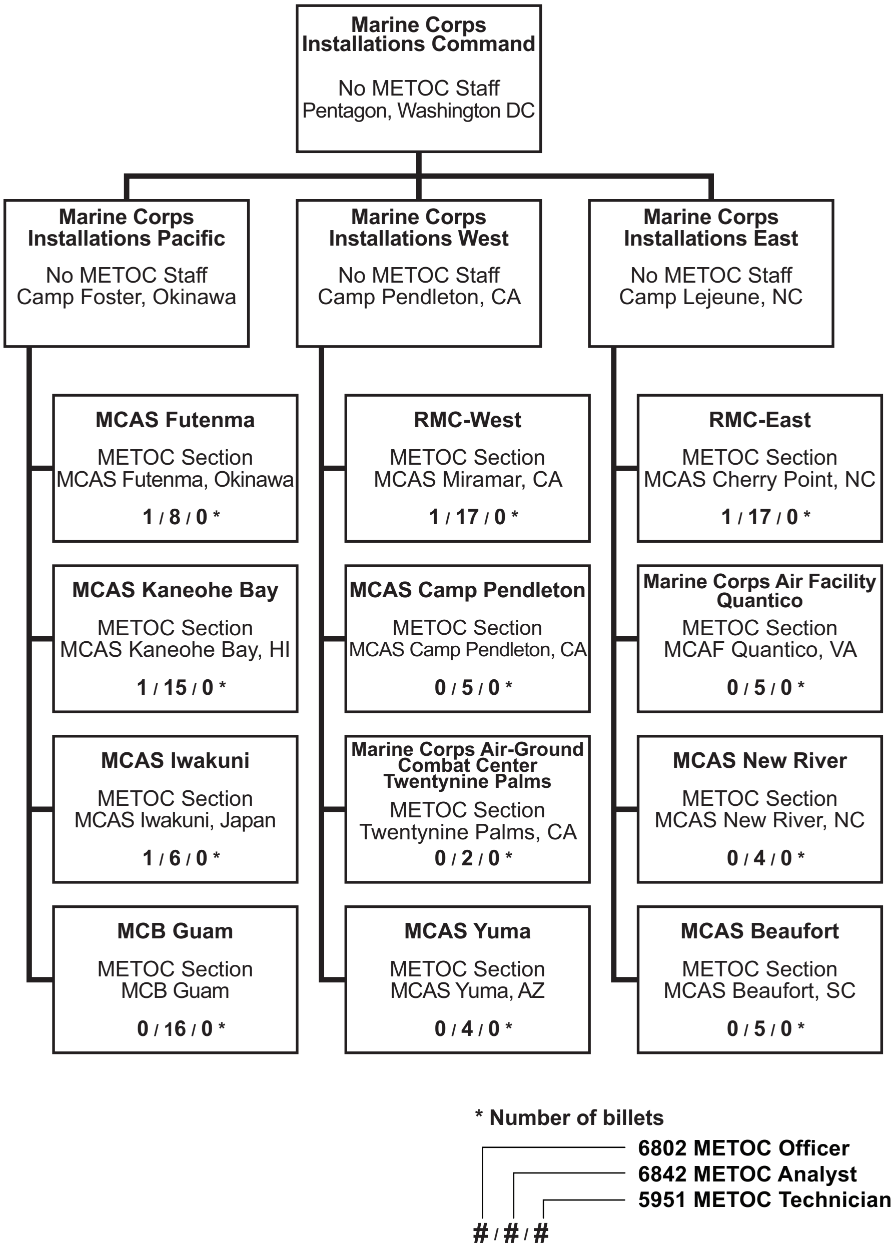

**Figure 2-3. Marine Corps Installations Command Organization.**

- Providing climatological data upon request.
- Completing all other METOC requests for information (RFIs) as required.

***Other Continental United States Marine Corps Bases and Air Stations***. Marine Corps bases and air stations require continuous METOC support for force protection and flight operations. Although continental United States (CONUS) Marine Corps METOC services have been regionalized with the establishment of the RMCs, each air station still maintains a small contingent of METOC personnel to provide onsite local area environmental expertise. Local air station METOC support responsibilities include providing METOC support to base training, tenant units, and transient aircrews; and establishing liaison with the RMC to provide a continuous meteorological watch (METWATCH). Although collaboration between the air station METOC analysts and RMC METOC analysts occurs, the RMCs have final issuing authority for all terminal aerodrome forecasts and WWAs for the bases and air stations within their respective AOR. Other duties include the following:

- Collecting, analyzing, predicting, tailoring, integrating, evaluating, and disseminating METOC observations and forecasts.
- Preparing and briefing aviation flight weather briefs.
- Forecasting upper level winds.
- Preparing and disseminating yearly astronomical data.
- Providing climatological data upon request.
- Completing all other METOC RFIs as requested.

### Marine Corps Installations Pacific

Marine Corps Installations Pacific (MCIPAC) does not have a regionalization concept established for METOC support. Therefore, the three METOC offices that fall under the cognizance of MCIPAC operate independently (see fig. 2-4 on page 2-11). The three stations are: MCAS Kaneohe Bay, HI; MCAS Iwakuni, Japan; and MCAS Futenma, Okinawa, Japan. The primary mission of the MCIPAC METOC offices is to provide continuous METOC support to all MCASs, 1st MAW units, and transient aircraft in garrison. A secondary mission is to coordinate and supervise the training of all METOC analysts within their respective chain of command in accordance with MCO 3500.14C and NAVMC 3500.38B. The duties of each air station METOC office include the following:

- Collecting, analyzing, predicting, tailoring, integrating, evaluating, and disseminating METOC observations and forecasts.
- Preparing and disseminating WWAs.
- Preparing and briefing aviation flight weather briefs.
- Forecasting upper level winds.
- Preparing and disseminating yearly astronomical data.
- Providing climatological data upon request.
- Completing all other METOC RFIs as requested.

The duties of the MCIPAC MCAS METOC officer include the following:

- Supervising and coordinating the activities of personnel engaged in the collection, evaluation, interpretation, and dissemination of weather observations and forecasts.
- Ensuring compliance with regulations governing METOC operations in order to support all host, tenant, and transient organizations.
- Advising commanders of METOC support capabilities and limitations.

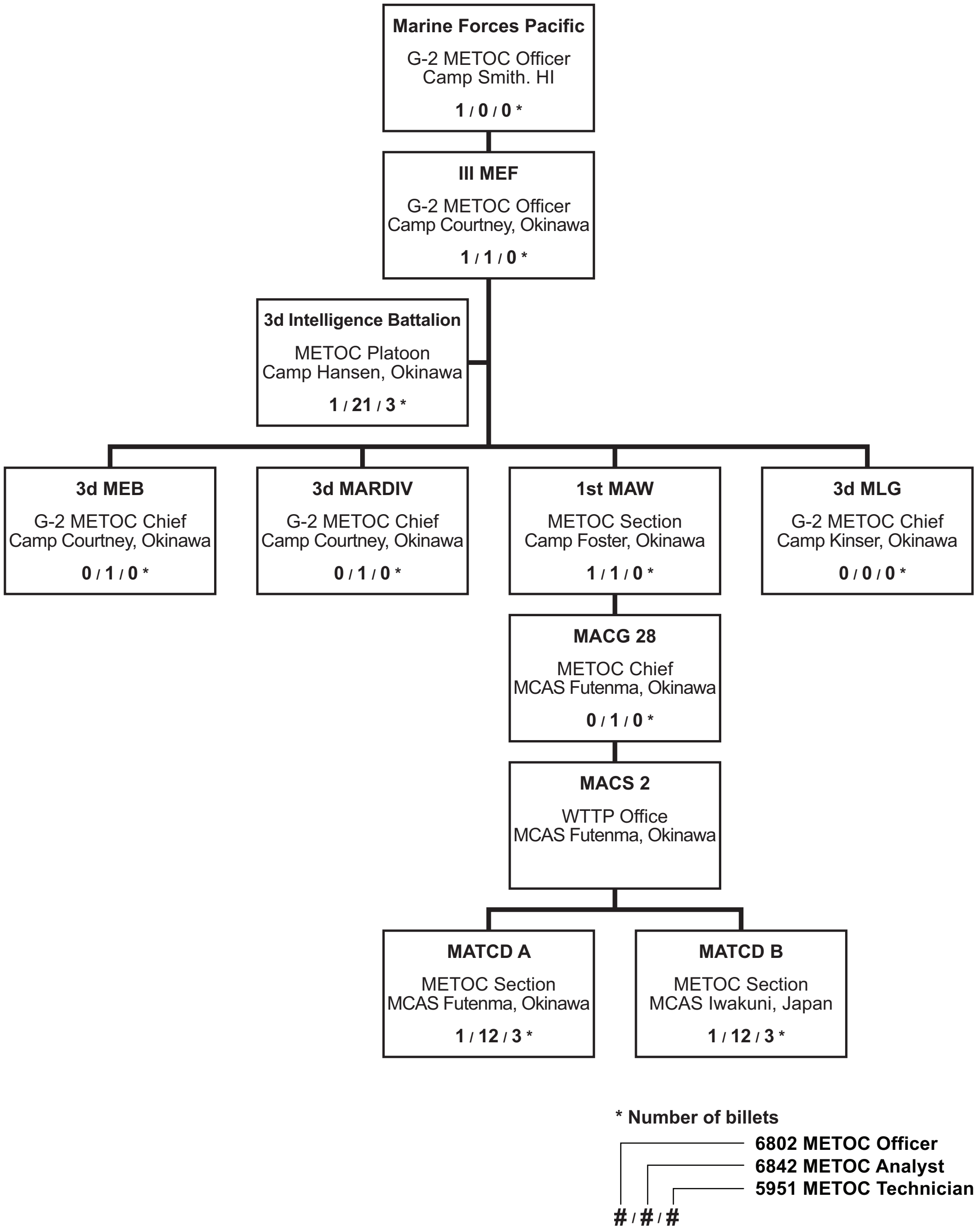

**Figure 2-4. Marine Forces Pacific/III MEF Organization.**

- Coordinating effective methods of providing METOC support to plan and carry out MAGTF operations.
- Advising and providing input to unit commanders on environmental conditions that are destructive in nature in order to protect military resources.
- Coordinating acquisition, operations, training, and maintenance of METOC equipment.

## ADMINISTRATIVE SUPPORTING ESTABLISHMENT RESPONSIBILITIES

### METOC Services Officer and Occupational Field Sponsor

The senior Marine Corps METOC officer is dual-hatted as the METOC services officer and the METOC OCCFLD sponsor. The billet resides within the Aviation Department, Headquarters, United States Marine Corps (HQMC), Washington D.C., and is physically located in the Pentagon, Aviation Expeditionary Enablers Branch (APX).

The METOC services officer is the principal advisor and subject matter expert to the DC, Aviation. The Aviation Department's mission is to assist and advise the Commandant of the Marine Corps on all matters relating to Marine aviation consistent with Marine Corps requirements. Specific duties include, but are not limited to—

- Advising the Commandant of the Marine Corps on aviation safety, aviation policies, and joint matters relating to aviation.
- Providing principal aviation staff interface with the Chief of Naval Operations.
- Ensuring Marine Corps aviation operates in compliance with naval aviation directives and programs.
- Participating as a member of the Joint METOC Board Executive Steering Group, the Battlespace Awareness Functional Capabilities Board, and the Joint Capabilities Board.
- Serving as the Marine Corps liaison to the National Oceanic and Atmospheric Administration (NOAA) and the Office of the Federal Coordinator for Meteorology.

The METOC OCCFLD sponsor establishes policies and procedures for the effective management of officers and enlisted Marines serving in METOC billets across the Marine Corps. The focus of this billet is to improve the quality and professionalism of METOC professionals by establishing a career development program for those Marines serving in the METOCOCCFLD. Specific duties include, but are not limited to the following:

- Managing all METOC OCCFLD training and education requirements in coordination with Training and Education Command (TECOM) and World Meteorological Organization (WMO) standards.
- Coordinating requirements with the operational forces; DC, Combat Development and Integration (CD&I); and the Office for Oceanography Capabilities and Requirements.
- Sponsoring the METOC Operational Advisory Group.
- Advocating for all Marine Corps METOC garrison and tactical maintenance/sustainment efforts.

### METOC Capabilities Integration Officer

The METOC capabilities integration officer serves to integrate METOC requirements across battlespace functional areas with regards to near-, mid-, and far-term requirements for the support of MAGTF, joint, and combined operations. The billet resides within the DC, CD&I, Capabilities Development Directorate, Intelligence Integration Division. Other duties include the following:

- Ensuring that DOTMLPF solutions represent a thorough analysis of capabilities needed to provide timely, relevant, and tailored METOC combat information and intelligence to commanders and staff.
- Coordinating with other integration divisions in areas of mutual interest.
- Representing the METOC community in Marine Corps, other Service, joint, and combined forums in which METOC concepts and requirements pertain.

### METOC Plans and Policy Officer

The METOC plans and policy officer resides within HQMC, Intelligence Department, Imagery and Geospatial Intelligence Branch and is the principal advisor and subject matter expert to the DIRINT on all matters pertaining to the 68XX OCCFLD. Duties of the METOC plans and policy officer include the following:

- Providing guidance and counsel on METOC functional management.
- Facilitating METOC functional area inclusion with interdepartmental intelligence disciplines.
- Developing policy for management and employment of METOC personnel and systems.
- Identifying METOC support gaps and shortfalls that affect the operating force, supporting establishment, and joint requirements.
- Assisting the 68XX OCCFLD sponsor with METOC commodity management.
- Advocating intelligence community interests concerning METOC manpower, training, equipment acquisitions, MAGTF requirements, and tactical support.
- Providing METOC subject matter expertise during functional and joint capabilities boards.
- Coordinating Marine Corps METOC-related issues within the Joint Capabilities Integration and Development System process.
- Assisting DC, CD&I, Capabilities Development Directorate, Intelligence Integration Division with identification and staffing of METOC requirements.
- Working with the Office of the Chief of Naval Operations, Deputy Chief of Naval Operations for Information Warfare (commonly referred to as N2/N6); Battlespace Awareness and Information Operations Program Office (commonly referred to as PMW-120); and Marine Corps Systems Command (MARCORSYSCOM) to align METOC programs of record with Distributed Common Ground/Surface Systems architecture.

### Marine Corps Requirements Officer to Oceanographer of the Navy

The Marine Corps requirements officer is responsible for the resourcing of programs that fulfill the validated requirements to provide METOC support to the Marine Corps. This Office of the Chief of Naval Operations staff billet resides within the Oceanography Capabilities and Requirements Branch in the Oceanographer of the Navy (OPNAV N2/N6E) working out of the

Pentagon and the U.S. Naval Observatory, Washington D.C. The OPNAV N2/N6E directorate reports directly to the Deputy Chief of Naval Operations for Information Warfare.

The duties of the Marine Corps requirements officer include the following:

- Representing the DC, Aviation in all aspects of METOC policy and procedures, requirements, acquisitions, and finance.
- Maintaining familiarization with defense acquisition, technology, and logistics life-cycle management framework.
- Monitoring Marine Corps METOC programs to ensure requirements are being met.
- Advising the program sponsor of program status and milestone accomplishments.

### Marine Liaison to Commander, Naval Meteorology and Oceanography Command

The Marine Corps liaison officer to Commander, Naval Meteorology and Oceanography Command (COMNAVMETOCCOM) is the Force Marine Officer (office code N23) and is the principal advisor and subject matter expert for all MAGTF METOC support capabilities. Duties include—

- Assisting COMNAVMETOCCOM in aligning the METOC support requirements for littoral and expeditionary warfare operations to include the proper employment and optimal utilization of MAGTF METOC capabilities in support of joint/combined operations.
- Advising and assisting COMNAVMETOCCOM in the planning, programming, budgeting, and procurement of MAGTF METOC equipment and in the preparation of concept of operations and specifications and the review of technical data for such equipment.
- Assisting in the development and review of METOC training materials, publications, instructions, and directives in support of MAGTF littoral and expeditionary warfare operations.
- Serving as direct liaison between HQMC (APX-9), the DIRINT, and COMNAVMETOCCOM for all matters requiring the concurrence of the Commandant of the Marine Corps.

### Space and Naval Warfare Systems Command METOC Officer

The Space and Naval Warfare Systems Command METOC officer serves as the assistant program manager for METOC equipment in the Battlespace Awareness and Information Operations Program Office under the Program Executive Office Command, Control, Communications, Computers, and Intelligence. Duties include the following:

- Ensuring that validated Marine Corps METOC requirements are satisfied.
- Providing technical assistance regarding Marine Corps operations to other METOC project officers within and external to the METOC systems office.
- Maintaining, organizing, and disseminating METOC software.
- Planning and managing the design, development, procurement, and life-cycle support of hardware and software systems that measure, transmit, distribute, and process METOC data.

### METOC Training Analyst

The METOC training analyst resides within the aviation ground support section of TECOM and is the principal advisor and subject matter expert to the TECOM CG on all training matters pertaining to the 68XX OCCFLD. Duties of the METOC training analyst include the following:

- Maintaining training and readiness events, qualifications, and designations in M-SHARP.
- Ensuring emerging training requirements are captured and expressed to appropriate agencies within TECOM.
- Facilitating the worldwide travel of students to MOS skill progression courses and various TECOM funded conferences.
- Assisting other training analysts within aviation ground support to ensure timely completion of tasks.
- Coordinating with METOC specialists (APX-9) in the maintenance of routine publications, such as the MOS manual, administration instructor requirements checklist, aviation training system order, Aviation Training and Readiness Program manual, etc.
- Coordinating with APX-9 in preparing for the training input plan conference.
- Assisting in the accreditation of formal courses.
- Maintaining MOS roadmaps within the Marine Corps Training Information Management System.
- Scheduling front-end analysis of MOS tasks.

### Marine Aviation Weapons and Tactics Squadron-1 METOC Officer

The Marine Aviation Weapons and Tactics Squadron (MAWTS)-1 METOC officer serves as the METOC subject matter expert for MAWTS-1 and advises the commanding officer of MAWTS-1 on OCCFLD 68XX and DOD initiatives that impact the management and employment of aviation METOC resources. Other duties include the following:

- Planning, coordinating, and providing METOC support and curriculum to the Weapons and Tactics Instructor (WTI) Course.
- Managing this publication as the doctrinal proponent.
- Maintaining NAVMC 3500.38B as syllabus sponsor.
- Creating courseware that facilitates the tactical application of METOC support to the MAGTF.
- Providing METOC periods of instruction for the WTI Course.
- Developing the Annex H (Meteorological and Oceanographic Operations) and providing input for Annex B (Intelligence) and Annex K (Combat Information Systems) of the WTI operations order.
- Maintaining liaison with METOC activities for MAWTS-1 as METOC subject matter expert.
- Conducting METOC-related staff studies to improve MAGTF warfighting capabilities.

### Marine Corps Detachment, Keesler Air Force Base, METOC Officer

The mission of Marine Corps Detachment, Keesler Air Force Base is to train entry- and career-level Marines for service with Marine Corps operating forces, to sustain their transformation process while they obtain the technical skills of their future MOS, and to mentor the students. In order to obtain the MOS 6842, all Marine Corps METOC personnel must attend the Meteorological Oceanographic Analyst Forecaster (MOAF) Course. The MOAF Course is a joint, formal school that provides entry-level instruction to develop the basic skills necessary to serve as a METOC analyst forecaster. This training includes meteorology, oceanography, computers, satellite imagery interpretation, meteorological reports, chart analysis, air mass soundings analysis, space environment, and climatology. The Marine Detachment METOC officer is responsible for the conduct of the MOAF Course. Other duties include the following:

- Directing, overseeing and mentoring MOAF instructors and students in the MOAF Course.
- Ensuring the consolidated portion of the course meets Marine Corps requirements.
- Overseeing the Marine Corps' unique METOC curriculum and training.
- Coordinating inter-Service training plans with respective Service representatives.
- Being the Marine Corps liaison officer for curriculum review boards designed to identify and implement current and future requirements for the operating forces.
- Maintaining and processing academic records and statistical data.
- Managing the Marine Corps' training and education program for the MOAF Course.
- Ensuring academic documents are provided to the Navy as required.
- Overseeing the conduct of required competency and certification evaluations on instructor staff.

### Chemical-Biological Incident Response Force METOC Analyst

The Chemical-Biological Incident Response Force (CBIRF) METOC analyst serves to provide essential meteorological and hazardous prediction information in support of CBIRF's real-world and training operations. Other duties include the following:

- Providing daily and weekly weather forecasts and climatological briefs to the appropriate staff to support planning operations and typical battalion operations.
- Researching and implementing new weather forecasting techniques or tools as well as new plume modeling software or tools.
- Coordinating and maintaining liaison with local, state, and Federal agencies such as the Defense Threat Reduction Agency or Joint Task Force-Civil Support in order to enable appropriate sharing of information and a combined-arms response to chemical, biological, radiological, nuclear, and high-yield explosive incidents that may occur within CBIRF's purview.
- Working with the battalion chemist to develop plume modeling products that are disseminated in response to training or real-world events.

# CHAPTER 3

# THE PHYSICAL ENVIRONMENT

The physical environment impacts all MAGTF elements, functional areas, planning cycles, and operational decisions, to include intelligence gathering, human performance, equipment performance, weapon accuracy, and enemy capabilities. Atmospheric and oceanographic conditions and solar activity can create prohibitive flying conditions, make roads impassable, freeze (or overheat) ground forces, limit capabilities of collections or target sensors, make amphibious assault impossible, or interrupt communications. All MAGTF elements have requirements for the same METOC parameters but differ in the level of spatial analysis required based on their unique capability sets and methods of employment.

## UNDERSTANDING CORE ENVIRONMENTAL SCIENCES AND GEOSPATIAL INFORMATION

### Environmental Sciences

A variety of scientific disciplines study the physical environment and its unique requirements and impacts on MAGTF operations. These core environmental sciences—atmospheric meteorology, oceanography, hydrography, hydrology, potamology, space weather, geology, climatology, and physical geography—provide the tools, techniques, and academic foundation upon which METOC data and information can be gathered to accurately describe the physical environment:

- Atmospheric meteorology—the science that deals with the phenomena of the atmosphere, especially weather and weather conditions. Atmospheric phenomena include not only conditions at a given point and time, but also long-term climatic averages of conditions and hazards to operations such as volcanic ash, dust, or icing/turbulence.
- Oceanography—the science that deals with the physical, chemical, geological, and biological features of the oceans and ocean basins. Oceanographic phenomena typically include the physical characteristics of the ocean such as waves, tides, and currents. However, from a military perspective, oceanography also includes biological factors (e.g., marine mammals), bathymetry, hydrography, geophysics, and astrometry.
- Hydrography—the scientific description and analysis of the physical conditions, boundaries, flow, and related characteristics of the earth's surface waters and the mapping of bodies of water.
- Hydrology—the scientific study of the properties, distribution, and effects of water on the Earth’s surface, in the soil and underlying rocks, and in the atmosphere.
- Potamology—the scientific study of rivers.

- Space weather—the science that studies conditions on the sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the performance and reliability of spaceborne and ground-based technological systems and endanger human life or health. Space weather phenomena occur within the space and near-Earth environment and typically originate from solar flares and coronal mass ejections. Highly-charged solar particles impacting the Earth's magnetic field and ionosphere can have negative consequences for military operations. These solar events can degrade terrestrial radio and satellite communications, degrade radar systems, induce electrical anomalies on spacecraft, and pose a radiation hazard to high-altitude flight and space operators. Electrical grid damage or disruptions can occur during the most intense solar storms.
- Geology—the science comprising the study of solid earth, the rocks of which it is composed, and the processes by which they change.
- Climatology—the scientific study of climate, which studies processes of climate formation, distribution of climates over the globe, analysis of the causes of differences of climate (physical climatology), and the application of climatic data to the solution of specific design or operational problems (applied climatology).
- Physical geography—the scientific study of natural features and phenomena on the Earth from a spatial perspective.

### Geospatial Information and Services

Geospatial information provides the basic framework for visualizing the operational geomagnetic, imagery, gravimetric, aeronautical, topographic, hydrographic, littoral, cultural, and toponymic data accurately referenced to a precise location on the Earth's surface. This data is used to develop information for military planning, training, and operations, including navigation, mission planning, mission rehearsal modeling, simulation, and precise targeting. This information is produced by multiple sources to common interoperable data standards. It may be presented in the form of printed maps, charts, digital files, and publications; in digital simulation and modeling databases; in photographic form; or in the form of digitized maps and charts or attributed centerline data. Geospatial information does not come only from imagery and imagery-derived products, but can come from other intelligence disciplines as well. Geospatial services include tools that enable users to access and manipulate data and also include instruction, training, laboratory support, and guidance for the use of geospatial data. For more information, see JP 2-03, *Geospatial Intelligence Support to Joint Operations*.

## DEFINING THE PHYSICAL ENVIRONMENT

Regardless of the type of operation, military forces will have to conduct operations in and through four distinct and integrated physical domains: space, air, land, and sea. Each of these domains exists within a complex METOC environment that continuously interacts with the others on a global scale. An example of this interaction and integration occurs within littoral regions, where all four domains converge. The space, atmospheric, terrestrial, and maritime environments and their associated effects can significantly influence the entire range of military operations, to include force protection, if not considered and appropriately planned for. Thus, METOC personnel must work with commanders and their staffs to develop relevant CCIRs with respect to the physical environment.

### Space (Space Environment)

Knowledge and understanding of the operational effects presented by the space environment have become increasingly more relevant within the IPB process. Historically, analysis of the space environment focused on solar and lunar prediction and their effects on tides and illumination. As the science of space weather has increased, so have the military considerations for space weather conditions and their influences increased. Space weather events can adversely affect space-based and terrestrial-based communications capabilities. As net-centric operations rely extensively on continuously available communications, understanding the influences of space weather events on communications will allow commanders to mitigate those periods of reduced availability.

### Air (Atmospheric Environment)

The atmospheric environment is the most well-known physical environment considered during the IPB process. Atmospheric considerations begin at the designated AOI and expand globally. Atmospheric conditions can influence the following:

- Terrestrial communications.
- Vertical, horizontal, and slant visibility.
- Tactical engagement ranges.
- Acoustical propagation.
- Electronic warfare capabilities.
- Radar ranges.

Oftentimes, atmospheric phenomena that can influence an AOI—such as tropical storms, frontal systems, and strong winds—have their origins hundreds to thousands of miles outside the impacted area. These influences can be seasonal (for example, frontal system passage over an AOI occurs every 5 to 7 days during the summer but occurs every 3 to 5 days during the winter), or more persistent. Meteorological and oceanographic personnel must identify and monitor origin areas for major weather systems and their associated seasonal or daily patterns in relation to the AOI to ensure commanders gain and maintain continuous situational awareness of the atmospheric environment. Additionally, the United States projects forces and combat power via a global-reach capability; therefore, atmospheric conditions must be monitored globally to identify negative effects to aviation logistical operations that may result in delayed operational execution or reduced operational capacity.

### Land (Terrestrial Environment)

The terrestrial environment encompasses the land areas of the world. It is within this environment that METOC personnel work closely with geospatial personnel and engineers to conduct their analysis. Analysis of the terrestrial environment relies on the combined analysis of the atmospheric and maritime environments and their influences on such things as soil moisture, rivers and watershed areas, trafficability, vegetation, snow pack, and sea ice. Thus, METOC personnel must identify regional areas of concern—such as mountain ranges, identified lines of communications, dams, and lakes that are outside the immediate AOI—and be prepared to identify the potential influence and impacts those areas of concern can have on the force.

### Sea (Maritime Environment)

The maritime environment encompasses the world’s oceans and seas. The maritime environment is further broken down into deep, shallow, and brown environments, terminology used by Navy METOC personnel, for whom understanding of the maritime environment is a primary function. Marine Corps METOC personnel must also have a working knowledge and understanding of the maritime environment to accurately incorporate its influences and effects into the IPB process. The maritime environment will only increase in relevance as the Marine Corps continues to develop and execute maritime concepts such as sea-basing and operational maneuver from the sea.

## UNDERSTANDING INTERACTION BETWEEN THE PHYSICAL ENVIRONMENTS

### Sea/Land Interface (Littoral)

Atmospheric and oceanic motions are results of differential heating between the land and sea interface. This differential heating is most prevalent in the littoral zone, which begins at the shoreline and extends 600 feet out into the water. The littoral zone is a complex area for predicting water conditions because so many factors affect it. Temperature differences, beach profile, coastal currents, onshore and offshore winds, reefs, bays, and the shape of the shoreline are some of the things METOC personnel have to consider when forecasting for this zone during amphibious operations.

### Air/Land Interface (Planetary Boundary Layer)

The planetary boundary layer (PBL) is the lowest part of the Earth’s atmosphere and is in direct contact with the Earth’s surface. The depth of the PBL is dependent on a number of factors, of which temperature has the greatest influence. The warmer the air mass, the thicker the PBL. It can extend from a few hundred feet to upwards of 10,000 feet above the Earth’s surface. The irregularity of the Earth’s surface causes substantial differences in temperature, moisture, and wind that are distributed across a region. The significance of the PBL is the impact it has on personnel and weapons. Large fluctuations in temperature, moisture, and wind occur throughout a 24-hour period in the PBL. These fluctuations cause mixing and turbulence that churn the air and disburse minute particles such as dust, clay, sand, and soot that become suspended just above the surface. The top of the PBL can also act as a cap that holds smoke, sea salt, and pollution near the surface. This has led to the air within the PBL being commonly referred to as “dirty air.” These minute particles suspended in the air reduce visibility and act as condensation nuclei for water vapor. The reduced visibilities degrade weapon systems’ sensor performance as the increased particulates degrade a particular wavelength. Due to the great variations that can occur throughout the PBL, lower resolution (i.e., regional and global) numerical weather prediction (NWP) models struggle to provide accurate forecasts where limited surface environmental sensing is available to initialize the model. Therefore, METOC personnel need to have a distinct understanding of the PBL and the limitations in the NWP models to provide commanders and decision makers with the most accurate impacts to operations.

### Air/Land Interface (Mountainous Regions)

Terrain acts as a geographical barrier to horizontal air motions, forcing air vertically in either direction to change its dynamic properties. These changes in air properties have an impact on the environmental conditions in and around complex terrain. High gradients and the height of terrain features dictate a host of important phenomena, such as gravity waves, wind gusts, canyon flows, Venturi effects, stagnation, rotors, cold air pooling, up and down drafts, slope and cross flows, fog, snow/ice, convective clouds, and lightning, which are highly variable and defy reliable forecasting. Each of these phenomena can have an influential impact on Marine Corps operations and the air/land interface must be considered by METOC personnel when characterizing the environment.

## CHARACTERIZING THE ENVIRONMENT

Continuous characterization of the environment is required for METOC operations and accomplished through the collection and analysis of METOC data, which is gathered by various sensors and personnel throughout the operational environment, and then analyzed to develop a coherent depiction of the natural environment. This depiction is used to provide situational awareness and to predict the future state of the natural environment. Because of the rapidly changing natural environment, METOC data is perishable and should be continuously collected, analyzed, and disseminated in order to develop accurate predictions.

Characterizing the environment consists of three main processes: collecting static and dynamic data, analyzing current and past conditions from that data, and predicting future environmental conditions. To characterize the environment, the METOC process (see fig.1-1 on page 1-2) must be engaged to identify and process many factors, some of which are discussed in the following subparagraphs.

### Geographical Area and Influencing Factors

The geographical area must be considered in order to accurately characterize the environment. It is predetermined by the areas of interest, influence, or operation and includes the entire natural environment that is influenced by the atmosphere and hydrosphere.

### Climatological Influencing Factors

Other considerations are the climatological influencing factors. Climate describes what the average weather is like in a place or area in terms of elements such as temperature, precipitation, and seasons. The average is calculated with data amassed over many years and distilled down into the range of normal conditions. The climate can be analyzed over a broad range of spatial realms and the geographical area will be the prime determining factor for the climate region. The climate will be influenced by the following factors: latitude, land and water distribution, topography, and ocean current.

### Environmental Data Source

Environmental data can be retrieved from many different sources. Over the past decade, weather data and products have become widely available across the Nonsecure Internet Protocol Router Network (NIPRNET) and the SECRET Internet Protocol Router Network (SIPRNET) for the United States, Europe, Japan, and Australia, but are much more sparse in many of the areas that the Marine Corps operates. With that in mind, METOC personnel need to identify the data source and determine its legitimacy based on sound meteorological reasoning and climatological data for a similar location with comparable conditions.

### Environmental Data

There are many different ways to collect environmental data. Some data can be collected manually or by automated sensors and retrieved via the NIPRNET and/or SIPRNET. This data can also be retrieved and displayed from organic equipment. The following subparagraphs discuss the different types of environmental data that can be collected.

***Environmental Imagery***. Environmental imagery includes topographic imagery, satellite, and radar. Topographic imagery can be retrieved via SIPRNET from multiple agencies, but may also be available from organic assets within the G-2/S-2 and those assets may have more ability to tailor products for a specific request. Satellite data can be retrieved from multiple sources and is available globally via NIPRNET and SIPRNET. Many of these sources have the ability to modify the satellite image to fit the needs for location and resolution, but must be requested from the source agency. Satellites are extremely valuable because they can provide imagery of current conditions in data-sparse areas. Radar coverage is prevalent across CONUS, but is not available for most areas in which the Marine Corps operates. Marine Corps METOC units that deploy with a METMF(R) NEXGEN will have organic satellite and radar data and have the ability to modify the imagery to provide mission-tailored products for mission planning, mission execution, and force protection.

***Land-based Surface Observations***. A vast network of land-based surface observation systems, manned and automated, exist across the globe to provide current environmental conditions. These conditions include temperature, dew point, wind direction and speed, sea-level pressure, altimeter setting, visibility, present weather, precipitation intensity, and precipitation amount. This effort is supported by the WMO and made available via multiple sources. Although the network is vast, there are still many data-sparse regions around the world that do not have surface observation systems. Many coalition, civilian, and DOD agencies can help to bridge the gap in the data-sparse regions and provide continuous, real-time, land-based surface observations. All DOD METOC agencies have the ability to provide manned and automated surface observations via organic equipment and this information is made available via NIPRNET and SIPRNET.

***Ship-based Surface Observations***. Ship-based surface observations are provided primarily by DOD agencies, specifically the Navy, United States Coast Guard, and NOAA. They are also available via the WMO’s voluntary observing ships scheme operated by the National Meteorological Service. Under the WMO’s voluntary observing ships scheme, civilian shipping personnel are taught how to collect and record a correct observation; the observation is then sent via provided radio or satellite for inclusion in the data network. These observations are used by other ships and are used to help validate NWP models over the data-sparse oceans. Due to the sensitive nature of the location of many ships, most of the data is only provided over classified networks, but it is still available and provides valuable information for those with access.

***Upper Atmospheric Observations***. The WMO coordinates a global network of high-quality, upper air observing stations, most of which are operated by the National Meteorological Service. These stations have instruments that can record atmospheric variables such as pressure, temperature, humidity, and wind speed and direction throughout the troposphere (up to 60,000 feet above ground level), and lower stratosphere (65,000–90,000 feet above ground level). One of the primary instruments for measuring upper air variables is the radiosonde. All DOD METOC agencies have the ability to provide upper air observations via organic equipment, and this information is made available via NIPRNET and SIPRNET.

***Pilot Weather Reports***. Conditions that are experienced and recorded by pilots while in flight are sent back to ground units via radio. The pilot reports (PIREPs) are then given to METOC units and transmitted as appropriate in order to be accessible all over the world via NIPRNET and SIPRNET. These PIREPs raise the situational awareness for METOC personnel and give an accurate report of what the pilots are actually experiencing as they fly through the area of operation. The PIREPs can and should be solicited from pilots to verify and/or evaluate the forecasting of meteorological conditions.

***Littoral Observations***. Because the littoral zone includes the water area closest to the shore, observation of conditions in this area is essential to amphibious operations. These observations can be performed manually or retrieved via automated sensors such as near-shore buoys. Littoral observations normally contain the same surface observation data provided by land sensors with additional information including sea height, wave height, wave period, current direction and speed, and water temperature.

***Riverine Observations***. Riverine observations are provided for rivers. They are retrieved in the same manner and can include all the same information provided for littoral observations.

## ASSIMILATING AND PROCESSING ENVIRONMENTAL DATA

Once all the environmental data is collected, it must be assimilated and processed into environmental information. This is accomplished through the use of numerical modeling, computer systems, and human judgment.

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# CHAPTER 4

# INFORMATION MANAGEMENT AND KNOWLEDGE DEVELOPMENT

## SCOPE OF METOC INFORMATION

Knowledge of the environment is a key component to characterizing the environment, as discussed in chapter 3. In order to aid in the characterization of the environment, the scope of METOC information is divided geospatially and aligned with the levels of war.

### Global METOC Information (Strategic)

Global-scale influences occur on scales starting at a few thousand kilometers and expanding to include planetary motions and the tilt of the Earth, its revolution around the Sun, the distribution of land and water on the planet, and latitude.

### Synoptic METOC Information (Operational)

Synoptic-scale influences occur on scales from a few hundred kilometers to thousands of kilometers and include wave patterns, air masses, fronts, jet streams, moisture flows, diurnal cycles, rising and sinking air (such as semi-permanent pressure systems), ocean currents, vorticity patterns, and distributions of different types of terrain, such as land and sea.

### Mesoscale to Microscale METOC Information (Tactical)

Mesoscale influences occur on scales from a few kilometers to a few hundred kilometers and include interactions between different types of terrain, locally dominant winds (such as upslope and downslope winds), and other anomalies, such as the urban heat-island effect. Microscale influences occur on scales from a few hundred kilometers to less than a kilometer and are heavily influenced by local topography, albedo, and human-influenced activities. Both mesoscale and microscale influences are short-lived events lasting from seconds to a few hours.

## REACHBACK METHODOLOGY

Reachback methodology is the process of obtaining data, products, and services from a source with considerable distance from forward deployed personnel. It is achieved through regionalized production centers capable of providing continuous support, products, and services via modern technology and subject matter experts. As such, reachback methodology reduces the manpower and equipment footprint in theater. As METOC operations all over the world store and make weather data available for hundreds of thousands of locations, they are inherently based on a reachback premise, described in the following paragraphs.

## METOC INFORMATION SUPPORT ENTERPRISE

The global crisis response capability of the MAGTF requires an extensive network of environmental sensors, METOC analysts and forecasters, and communications and information systems (CIS). The enterprise consists of the METOC services of friendly countries, NOAA, and DOD METOC units within the Army, Navy, Air Force, and Marine Corps. These METOC operations provide a sensing and collection network and related facilities. Peacetime cooperation among nations for METOC services provides global and hemispheric analyses in support of military operations anywhere in the world. During contingency operations, METOC control and other security restrictions may drastically limit the availability of other national and indigenous METOC information. Department of Defense METOC services and units are specialized organizations with worldwide capabilities that are structured to satisfy unique military requirements. They exchange METOC data with national weather services and have access to national and international weather and oceanographic databases. Characteristics of DOD METOC operations are mobility, responsiveness to command, and combat readiness. Joint forces may deploy with METOC support units and generally will be involved with MAGTF METOC operations at some level, requiring coordination. Additionally, since MAGTFs are likely to deploy and operate in remote or austere regions, Marine Corps METOC units must be prepared to operate in environments where METOC data is sparse, limited, or nonexistent.

### Marine Air-Ground Task Force Tactical Capability

The highest level of METOC capability within the MAGTF is the METMF(R) NEXGEN. The METMF(R) NEXGEN provides the MAGTF with a lightweight, highly mobile, fully integrated FORCENet [United States Navy enterprise network] compliant meteorological system capable of sustaining METOC operations in direct or general support of all elements of the MAGTF. It provides a METOC capability similar to that found in garrison METOC facilities. The METMF(R) NEXGEN provides for all functions of environmental sensing and data ingest, for the efficient collation and integration of collected data, and for user-friendly graphic user interfaces and software tools necessary for accurate interpretation and value-added production. The METMF(R) NEXGEN enables Marine METOC personnel to effectively turn relevant METOC data into actionable environmental information, which in turn can facilitate timely operational decision making.

The smallest level of METOC capability is the Naval Integrated Tactical Environmental System, Variant IV (NITES IV). The NITES IV is designed as a scalable, flexible, and mobile system for a “first in, last out” capability. The primary differences between the METMF(R) NEXGEN and NITES IV are size, logistics, scalability, mobility, and that the METMF(R) NEXGEN has integrated organic sensing capabilities, but the NITES IV’s sensing capabilities are limited. Thus, the NITES IV relies heavily on reachback communications and METOC forecast center databases for data and products. The NITES IV provides METOC personnel access to

METOC data and products, which are then analyzed and tailored for a specific mission. The METMF(R) NEXGEN and NITES IV are discussed further in chapter 6.

### Regional METOC Centers

Marine Corps regional METOC centers provide 24-hour direct (in person) and indirect (Web, e-mail, and phone) regionalized METOC information, products, and services in support of Marine Corps operations and other military operations as may be directed from a garrison environment. The RMCs may be used as a reachback source, but are not task-organized to provide operational METOC support to forward deployed personnel or to act as METOC production centers for other-than-garrison operations.

### Marine Corps Intelligence Activity

Marine Corps Intelligence Activity (MCIA) is a Service-level intelligence capability that focuses on crisis and predeployment support to expeditionary warfare. It complements the efforts of theater, other Service, and national intelligence organizations. It provides unique threat, technical, and geographic intelligence products that are tailored to Marine Corps operating forces preparing for deployment. The MCIA also coordinates Marine Corps collection, production, and dissemination requirements by acting as the Service collection, production, and dissemination manager. The MCIA is the Service intelligence center, headquartered at Quantico, Virginia, while Marine Cryptologic Support Battalion's headquarters is at Fort Meade, Maryland.

### Naval Oceanographic Office

The Naval Oceanographic Office (NAVO) is the oceanographic production center for the Navy. The NAVO's core competencies include the disciplines of hydrography, bathymetry, geophysics, acoustics, physical oceanography, and geospatial intelligence. The NAVO acquires and analyzes global ocean and littoral data to provide specialized, timely, and operationally relevant products and services for DOD warfighters as well as other civilian, national, and international customers. Utilizing space-based, airborne, surface, and subsurface platforms, as well as state-of-the-art computing and modeling techniques, NAVO synthesizes the data acquired into products and services tailored to the individual warfighter's needs. These products and services support virtually every type of fleet operation, providing mission-essential environmental information to the warfighter.

The NAVO is the parent command of the Naval Ice Center and the fleet survey teams. The NAVO is responsible for the following:

- Applying relevant oceanographic knowledge across a full spectrum of warfare through smart collection, focused analysis, and responsive delivery.
- Generating strategic, operational, and tactical worldwide oceanographic and geospatial products and services to meet the DOD's safe navigation and weapon/sensor performance requirements.
- Conducting multi-disciplinary ocean surveys.
- Collecting and analyzing all-source oceanographic data.
- Providing global numerical oceanographic observations and products.
- Implementing numerical techniques to solve oceanographic analytical and forecasting problems.

### Fleet Numerical Meteorology and Oceanography Center

The Fleet Numerical Meteorology and Oceanography Center (FNMOC) is the atmospheric production center for the Navy. The FNMOC maintains core expertise in meteorology, oceanography, and information technology to provide the necessary foundation for on-demand support to naval, joint, coalition, and national missions. The FNMOC leverages this expertise to host a suite of state-of-the-art METOC models and decision aids to provide scheduled and on-demand products specific to fleet and joint operations. The FNMOC and the National Centers for Environmental Prediction run models to produce global METOC forecasts and are the only dedicated numerical prediction production centers in the United States. The FNMOC is responsible for preparation of the Marine Corps and joint battlespace to enable successful combat operations from the sea. Commanders should exploit METOC opportunities and capabilities in order to mitigate environmental challenges for naval operations, plans, and strategy at all levels of war. The FNMOC must be charged to provide products, data, and services to the operating and support forces of DOD to create an asymmetric warfighting advantage for naval, joint, and coalition forces.

### United States Naval Observatory

The United States Naval Observatory (USNO) is a production center for precise time and astrometric production. The USNO provides a wide range of critical astronomical data and timing products. The products are available as hardcopy publications, standalone computer applications, and data services accessible via the Internet. The USNO master clock serves as the country's official time keeper, and the USNO is the sole provider of the precise time and time interval for DOD. Although a Global Positioning System (GPS) is the primary method of universal time constant time transfer for the majority of DOD users, the most demanding time transfer requirements can be met through two-way satellite time transfer. Additionally, the USNO is responsible for establishing, maintaining, and coordinating the astronomical reference frames for celestial navigation and orientation of space systems. The USNO is responsible for Earth orientation parameters (EOP) predictions for all DOD Services, agencies, and contractors, as well as the international community. Since the Earth's rotation is not even, the EOP link the International Terrestrial Reference System (currently World Geodetic System 84 [WGS-84]) to the celestial reference frame. The WGS-84 is a standard for use in cartography, geodesy, and navigation, including navigation by GPS. These parameters are essential to determine spacecraft orbital information and geolocation of data and imagery derived from space systems. The USNO is the only organization making EOP predictions operationally. The USNO's mission is to determine precise time, to determine the positions and motions of celestial bodies, including Earth, and to provide the astronomical and timing data required by the Navy and other components of the DOD for navigation, precise positioning, command, control, and communications. The USNO makes this data available to other Government agencies and to the general public for the purpose of conducting relevant research and to perform other functions or tasks as may be directed by higher authority.

### Navy Enterprise Portal-Oceanography

The Navy Enterprise Portal-Oceanography (NEP-Oc) is the naval oceanography mission extension to the Navy Enterprise Portal. The NEP-Oc serves as a single access point for all METOC Web-accessible information provided by the Navy on the NIPRNET and SIPRNET. The

NEP-Oc has the characteristics and capabilities of multiple Web sites, including the following types of traditional Web sites:

- Product/service site—providing information about, and access to, METOC Web products/services.
- Portal site—supporting the visual/interactive aggregation of products/services from multiple METOC and external partner provider sites and supporting user personalization of the interface.
- Web application site—hosting key enterprise applications (e.g., Enterprise Catalog, Managers Console, Mission Console) and launching independent provider, Web-accessible applications.
- Collaboration site—providing the ability for users to publish content and have interactions with multiple distributed users about multiple distributed products.

If a required product is not available on the NEP-Oc, a request for support or RFI may be submitted to the appropriate Naval Meteorology and Oceanography Command (NAVMETOCCOM) activity, if known. If not known, then requests for support or RFIs should be submitted to the Commander, Naval Meteorology and Oceanography Command Operational Oceanography Watch (COOW). The COOW will route the request to the appropriate NAVMETOCCOM activity for action. The COOW will also assist customers with contacting the appropriate operational support center, production center, or subject matter experts for additional assistance as required. Special support and exercise Web pages may be requested. The COOW will create the page and have the necessary NAVMETOCCOM activities populate the pages.

### Air Force Weather Agency

The mission of the Air Force Weather Agency (AFWA) is to maximize US power through the exploitation of timely, accurate, and relevant weather information. The center delivers worldwide weather products to Air Force and Army warfighters, unified commands, national programs, and the Secretary of Defense. The AFWA supplies weather products and training tools and fields equipment to Air Force operational weather squadrons and combat weather flights and provides 24-hour technical assistance on all standard weather systems and equipment.

Each day, the AFWA builds the world's most comprehensive weather database of observation, forecast, climatological, and space weather products available on the World Wide Web. The AFWA is focused on developing, evaluating, testing, and transitioning new technologies to weather teams around the world. The AFWA incorporates systematic resources to examine weather needs, explores new ideas, and tests emerging technologies. State-of-the-art science and technology offer vast opportunities to acquire and disseminate real-time weather information worldwide.

## KNOWLEDGE DEVELOPMENT

Knowledge development is the process of converting observations into validated findings through analysis. The cognitive hierarchy describes how analysis activities turn METOC data into information, knowledge, and understanding, which allows for strategic, operational, and tactical decision making (see fig. 4-1).

Data is raw, unorganized facts collected from the environment that are yet to be processed, while information is data processed into useable form. A given piece of data is largely meaningless by itself. Only when data is processed by being placed into a situational context does it gain meaning and become, by definition, information. Knowledge is derived from information that has been tested and accepted as factual through cognition (the mental process that receives or develops unverified information), through assessment or testing to prove the information, and/or by acceptance of the information as factual. Finally, understanding is achieved by using judgment to give knowledge relevance within a specific situational context. Ideally, understanding a situation supports a commander in battlefield visualization and creates the conditions from which plans can be formed and effective actions taken.

## METOC KNOWLEDGE APPLICATION

### Forecasting the Environment

All elements of the MAGTF require METOC personnel at the tactical unit level to validate and transform environmental data into relevant METOC information that facilitates knowledge and understanding. By utilizing the six steps of the METOC process discussed in chapter 1 and the cognitive hierarchy, METOC personnel are able to exploit METOC information to optimize employment of sensors, weapons, logistics, equipment, and personnel, which is crucial to successful military operations.

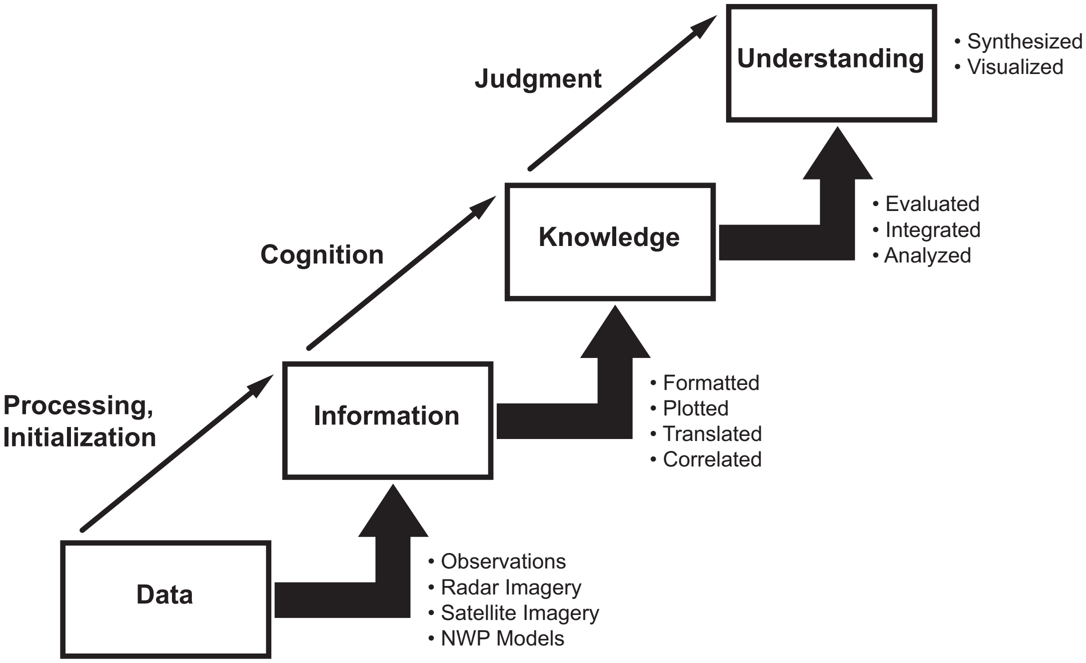

**Figure 4-1. Cognitive Hierarchy Model.**

### Knowledge Sharing

To ensure METOC knowledge and information is consistent, relevant, and effective, knowledge sharing between METOC personnel is a must. Informal knowledge sharing can be conducted between two parties, but the goal is to better the entire organization by making the knowledge available to everyone. Each Service has a unique formal knowledge sharing program that feeds into the Joint Lessons Learned Program. Per MCO 3504.1, *Marine Corps Lessons Learned Program (MCLLP)*, the Marine Corps Lessons Learned Program (MCLLP) is the official means to capture knowledge and to input experiences regarding systems and TTP to remedy deficiencies and reinforce successes. It is used to meet the Marine Corps' requirement for the Joint Lessons Learned Program. The Marine Corps Center for Lessons Learned is the single fusion center for the MCLLP and is host to the Marine Corps After Action Report Library.

### Fusion Center

A fusion center is an effective and efficient mechanism to exchange METOC information and intelligence, maximize resources, streamline operations, and improve the ability to support the warfighter by merging data from a variety of sources. Multisensor systems can provide many benefits, but also can require large amounts of data processing or result in an overload of information. Information fusion can provide, in many instances, useful and often improved information flow. The ultimate goal of a fusion center is to provide a mechanism where all the METOC communities can come together with a common purpose and improve the ability to provide a warfighter with the "best" single response to METOC queries. A Soldier, Marine, Sailor, or Airman should not have to search for bits of environmental information deemed critical to mission accomplishment. They should know where the requisite information resides and how to access it at all echelons of command. Fusion centers embody the core of collaboration, and as demands increase and resources decrease, fusion centers are an effective tool to maximize available resources and build trusted relationships. The METOC fusion center is discussed further in chapter 6.

## METOC INFORMATION AND PRODUCT MANAGEMENT

### Evaluating METOC Information Accuracy and Effectiveness

As discussed in chapter 1, evaluation of METOC data for accuracy and effectiveness is one of the six steps of the METOC process. The overall effectiveness of METOC support is based on the accuracy of the products and the successful accomplishment of specific military missions by use of those products. Each METOC unit must evaluate accuracy and effectiveness on the basis of the four METOC principles discussed in chapter 1. This requires METOC organizations at all levels to be fully integrated into all unit planning and operations. Such interaction leads to mutual understanding and trust throughout the warfighting team.

### Archiving Data and Information

Archiving data and information is the process of maintaining transmitted data and/or produced products for a period of time determined to be relevant. This archived data can be used for simulation, training, and/or re-creation of environmental conditions for mission debriefs. The Air

Force's 14th Weather Squadron and the National Climatic Data Center are two sources for archived electronic METOC information in the United States.

### Managing Climate Data

Climate data management is the process of managing the retrieval and storage of climate data for future use. The WMO has developed international guidelines and standards for climate data management to ensure data is collected and maintained globally. These guidelines are outlined in the WMO's *Guidelines on Climate Data Management*. The 14th Weather Squadron is the DOD's source for climatic data and works in coordination with the National Climatic Data Center to maintain a robust collection of climatic data to be used for research, training, simulation, and mission planning.

### Managing METOC Products

Managing METOC products ensures effective and efficient METOC products are provided in support of operations. Meteorological and oceanographic personnel must receive, review, and prioritize requests to ensure timely, accurate, and tailored products are produced and provided to mission planners and decision makers. This process combines identification of product requirements, development and lifecycle management for multiple products relating to the requirements, and delivery procedures/methods. The process includes analysis of requirements, comprehensive requirements development, risk analysis, product planning, tracking, and best practices. Product management requires coordination with other weather agencies and customers. The METOC unit needs to coordinate across all parts of the MAGTF/joint task force (JTF) to build product strategy and a prioritized concept of operation.

# CHAPTER 5

# METOC RESPONSIBILITIES IN PLANNING AND OPERATIONS

## SUPPORT OF THE MARINE CORPS PLANNING PROCESS

During operational planning, METOC support includes integrating globally, regionally, and theater-produced METOC products as well as data and products received from supporting agencies and reliable indigenous sources. This assessment is incorporated into a comprehensive sensing strategy and is included in applicable OPLANs. Meteorological and oceanographic operations are effective when fully integrated during all phases and processes of the Marine Corps Planning Process (detailed in Marine Corps Warfighting Publication [MCWP] 5-1, *Marine Corps Planning Process*) and IPB. Marine Corps planning in joint operations is also discussed in MCWP 5-1, while JP 3-59 provides information on joint METOC planning processes and procedures.

To be effective, METOC operations must be linked to the commander’s decision-making process and the resulting operational activity. Therefore, METOC operations are integrated with the planning, decision, execution, and assessment cycle and should be involved in all phases of planning. While the level of command, time available, and specific tactical situation will influence how the cycle is carried out and the degree of detail applied in performing METOC operations, the same basic METOC development process is employed in deliberate planning and rapid planning scenarios. During the rapid response planning process where time is of the essence, as is the case with a MEU, many of the planning steps are likely to be compressed, concurrent, and supplemented by standing operating procedures (SOP) to facilitate time constraints. The role of METOC operations in the six phases of crisis action planning is described in the following subparagraphs.

### Problem Framing

During problem framing, any major constraints on the employment of forces should be considered. As such, the following METOC products are developed to support IPB and are updated and used throughout the operation:

- Current and forecast conditions in the operating area.
- Climatological factors.
- Space environment.
- Suitability of sites for employment of forces.
- Degree of accuracy and limitations of forecast products.

Meteorological and oceanographic input to staff estimates provides the commander and staff with necessary information to support decision making throughout the planning process and subsequent execution of the operation. The METOC RFIs are developed for action by HHQ and also processed for the staff and major subordinate commands throughout planning and execution. During this phase, liaison is performed with adjacent, higher, subordinate, and joint METOC units to identify any shortfalls in personnel and equipment.

### Course of Action Development

As METOC conditions are monitored, they are also updated with IPB. Requests for information continue to be generated, tracked, and processed. The command element (CE) and subordinate units should work together to develop the initial concept of operations. An initial communications concept can be developed, emphasizing communications capabilities in and out of theater.

Course of action development involves IPB, preparation of the intelligence estimate, and the commander's estimate. Climatology and environmental products must be produced and summarized for operational planners. In this effort, METOC personnel must work closely with the intelligence section to provide impacts of forecast conditions on each COA. Personnel should also liaison with Navy and Air Force METOC agencies to coordinate requirements for any unique theater-specific products and external support requirements. Support should include integrating a mix of globally-, regionally-, and locally-produced products as well as data and products received from reliable foreign sources.

### Course of Action War Game

During COA war game, METOC conditions impact the following critical events and decision points:

- Duration and timing of critical events.
- Opportunities for deception and surprise using forecast METOC conditions.
- Acquisition of and desired effects on high-payoff targets.
- Required reconnaissance and surveillance.
- Required logistic support and constraints.
- Communications requirements.

### Course of Action Comparison and Decision

During the COA comparison and decision phase, METOC conditions continue to be monitored and updated. Planners and proposed subordinates who will be tasked to carry out the plan must communicate. It is also a critical time for communication between the CE and other METOC units on the major subordinate command's staff. Liaison with national and regional METOC centers for initial products and services for the MAGTF area of operations is conducted.

### Orders Development

The OPORD or OPLAN is developed during the execution planning phase. Annex H (Meteorological and Oceanographic Operations) outlines the commander's plan with respect to METOC operations. Appendix A shows an example of an annex H. Furthermore, METOC information and input must be provided for the Annex B (Intelligence) and the Annex K (Combat

Information Systems). Appendix B shows an example of METOC input for the annex B. Appendix C shows an example of METOC input for the annex K.

### Transition

A METOC team is assembled and prepares to execute the METOC support plan during the last phase. Real-time observations and forecasts are critical. This phase normally culminates with a confirmation brief that includes an update of the METOC situation just prior to mission execution; this ensures that the commander, key planners, and subordinates share a similar picture of the expected METOC conditions in the battlespace and associated impacts to the mission. Internally, it may entail an update between future plans or future and current operations.

## SUPPORT OF THE PHASING MODEL FOR OPERATIONS

### Phase 0: Shaping

During the shaping phase, METOC support is typically provided to the CE from a location a considerable distance from where shaping actions are occurring. Direct support METOC personnel may only be available to the CE, but general support is provided as requested. METOC support is heavily reliant on products received from supporting agencies and reliable indigenous sources. Daily METOC products and updates are provided to current and future operations to support continued planning, with METOC impacts to operations provided as determined through planning and SOP.

### Phase 1: Deter

During the deter phase, the crisis is defined and forces may begin moving ashore to demonstrate the force’s capabilities and resolve. The force laydown and sensing strategy from annex H may start to take shape, providing real-time environmental information from locations where forces are located. During this time, METOC personnel still provide direct support to the CE, but they may provide direct support to other units as forces go ashore. General support is still provided as requested. Although limited real-time environmental data is provided, METOC personnel are still reliant on supporting agencies and reliable indigenous sources. Daily METOC products and updates continue to be provided to current and future operations with METOC impacts to operations provided as determined through planning and SOP.

### Phase 2: Seize the Initiative

During the seize-the-initiative phase, little changes in regards to METOC support. The METOC conditions continue to be monitored; additionally, daily METOC products and updates are provided to current and future operations with METOC operational impacts provided as determined through planning and SOP.

### Phase 3: Dominate

The dominate phase focuses on breaking the enemy’s will. Though reliance on supporting agencies and indigenous sources still occurs, the primary source for METOC information comes from onsite Marine Corps METOC personnel using organic METOC sensing equipment. Direct support may be available to each element of the MAGTF, dependent on the size and scope of the operation. General support is available as part of the force laydown and sensing strategy, and tailored METOC products are provided as requested to support operations.

### Phase 4: Stabilize

The stabilize phase is required when there is no fully functional, legitimate civil governing authority present. Little change will occur with the METOC support available, and direct support and general support is still provided in accordance with annex H.

### Phase 5: Enable Civil Authority

This phase is predominantly characterized by support to legitimate civil governance in theater when combat operations have ceased and redeployment of forces is occurring. Because METOC support is still required for any forces that remain or for retrograde operations, it is provided via direct support to the CE of each MAGTF element with limited general support available. As forces draw down, most organic environmental sensing equipment is withdrawn and the remaining force relies on supporting agencies and indigenous sources for support.

## INTELLIGENCE PREPARATION OF THE OPERATIONAL ENVIRONMENT

The operational environment is the composite of the conditions, circumstances, and influences that affect the employment of capabilities and impact the decisions of the commander. Intelligence preparation of the operational environment (IPOE) is the analytical process used by intelligence organizations to produce intelligence assessments, estimates, and other intelligence products in support of the commander's decision-making process. Analyzing the interaction between the air, land, maritime, and space domains is fundamental to successful IPOE. Due to rapidly changing METOC conditions, METOC personnel continuously update the staff estimate, particularly during mission execution. The METOC conditions are considered both in terms of their ability to modify individual aspects of the operational environment and their capability to directly affect overall military operations. Thus, they are a crucial factor when completing the IPOE process.

## INTELLIGENCE PREPARATION OF THE BATTLESPACE

As stated in MCWP 2-10, *Intelligence Operations*, one of the principal tools used to support the commander's estimate is IPB. Intelligence preparation of the battlespace is a systematic, continuous process of analyzing the threat and environment in a specific geographic area. It helps to provide an appreciation for the characteristics of the area of operations as well as enemy capabilities, weaknesses, and COAs. The METOC objective throughout the IPB process is to reduce the uncertainty by providing accurate, timely, and relevant knowledge about the threat and the surrounding environment and to assist in protecting friendly forces.

# CHAPTER 6
# CONCEPT OF METOC SUPPORT

## OPERATIONAL COLLABORATION

To ensure unity of effort and consistency, METOC forces must be able to collaborate both vertically (between strategic, operational, and tactical elements) and horizontally (within the joint force and among interagency and multinational partners) not only with other METOC forces, but also with all decision makers and support functions of the joint force.

### Area of Operations

The area of operations represents an area assigned to a commander with authority and responsibility for the conduct of operations. The limits of the area of operations are normally the boundaries specified in the OPORD or HHQ order that defines the command's mission.

### METOC Area of Responsibility

The METOC AOR represents the environmental AOR established by the SMO or joint meteorological and oceanographic officer (JMO) for which the Service-level METOC component is responsible.

### METOC Area of Interest

The METOC AOI is the geographical area from which environmental information is required to permit planning or successful conduct of the command's operation. The METOC AOI is generally larger than the area of operations. The limits of the METOC AOI include each of the characteristics of the environment identified as exerting an influence on potential COAs or command decisions. The limits of the METOC AOI are based on the ability of the environmental conditions to influence the accomplishment of the command's mission. The geographical locations of other activities or characteristics of the environment that might influence COAs or the commander's decision and the resulting changes in the command's battlespace must be considered when establishing AOI limits.

### METOC Support System

The Marine Corps METOC support system is flexible, scalable, and designed to readily deploy and operate in an austere expeditionary environment. The primary objective of the Marine Corps METOC support system is to provide accurate, timely, and comprehensive METOC support that enhances MAGTF mission accomplishment through tactical exploitation of the environment. It is intended to provide comprehensive METOC support to all elements of a MAGTF, as well as to the bases and stations of the supporting establishment. This system is designed to maximize the support available from naval, joint, and other METOC sources. The system will be augmented by data that is sensed, collected, modeled, and reported by organic Marine Corps METOC assets and other assets such as topographic platoons, the MAGTF All-Source Fusion Center, and ground and aviation reconnaissance units.

## COMMANDER'S RESPONSIBILITY IN METOC OPERATIONS

The commander is ultimately responsible for the direction of METOC assets within the AOR and should direct and coordinate the activities of the METOC assets to ensure unity of effort. Normally, a senior or staff METOC officer should be designated by the commander to plan, execute, and direct METOC operations on behalf of the commander. This officer typically performs his/her duties as a special staff officer under the cognizance of the assistant chief of staff, intelligence or intelligence officer (G-2 or S-2 as appropriate).

### Focus the METOC Effort

The commander must provide the guidance and direction necessary for the effective conduct of METOC operations. Because METOC resources will rarely be sufficient to satisfy every requirement, efforts must be focused on priorities that drive the METOC concept of operations and the sensing, collection, production, and dissemination efforts. The commander provides this focus in the commander's intent. Annex H (Meteorological and Oceanographic Operations) of the OPORD articulates the commander's concept of METOC operations and support.

### Participate in the METOC Process

Although the METOC staff manages the METOC effort for the commander by planning and leading METOC operations, the commander is responsible for the results. Effective participation requires an understanding of the capabilities and limitations of METOC personnel, equipment, procedures, and products. The commander should provide guidance and direction to ensure METOC operations meet the commander's intent. The commander should focus the METOC effort on the operations and assets of greatest concern and their sensitivities to METOC conditions. The METOC sensitivities of those operations and assets qualify as critical threshold values. The commander should also identify the preferred products and formats.

### Utilize METOC Information in Decision Making

The primary purpose of METOC operations is aiding the commander's decision-making process. Although the METOC staff facilitates the use of this information throughout the command by providing timely dissemination of products, the commander makes the judgment of its operational impact. The METOC staff develops the METOC estimates for inclusion with the commander's estimate of the situation.

### Support the METOC Effort

Meteorological and oceanographic operations are a team effort. Effective operations are the result of integrating many specialized collection, processing, and analytical resources. Some of these resources are organic to the unit and are limited in effectiveness without support from throughout the command. Other resources are provided by units or agencies outside of the command, and it is especially important that procedures for acquiring METOC information from nonorganic resources be supported, such as forward-area limited observing programs, PIREPs, and access to data acquired by artillery meteorological teams. Timely and effective METOC operations rely on the use of adequate communications assets. External support must be coordinated and requested at the earliest opportunity. The designated METOC staff executes the procedures to obtain the required support, but does so in the name of the commander. When the command's support requirements go unsatisfied, the commander must intervene, lending command authority to obtain the required support.

### Evaluate the Effectiveness of METOC Operations

The commander must provide feedback to the METOC support system. Feedback should identify where operations met expectations and where and how they fell short. Key areas to evaluate include product content, relevance, presentation, accuracy, and overall usefulness. Meaningful evaluation of the METOC effort provides the basis for its continual improvement and relevance.

## METHODS OF METOC SUPPORT

### Direct Support

Direct support of METOC occurs when a MAGTF METOC unit is organized under the operational control of the supported commander. However, these units may also be tasked to provide general support or to perform specific tasks as part of the METOC support network when directed by higher authority.

### General Support

METOC operations provide general support for units without organic or directly supporting METOC units. Units will verify and relay METOC information requirements to HHQ. Some organic support may come from observations taken by the unit intelligence officer, ground reconnaissance units, or artillery regimental headquarters meteorological personnel. However, the preponderance of METOC information will be provided to such units as general support by external organizations. Improvements in communications have increased the usefulness of METOC general support. The current capability of using message text formats to satisfy METOC customer needs has also evolved to include graphics exchange. Editable graphics can be constructed from file transfers of databases. As these capabilities continue to mature, commanders and planners will be able to query the METOC database whenever necessary, construct graphics from the query, and tailor the results for their planning and decision-making needs.

## MARINE AIR-GROUND TASK FORCE OPERATIONS

Requirements for METOC vary between the operational and tactical level. Additionally, METOC requirements vary between the CE, ground combat element (GCE), ACE, and logistics combat element (LCE). Requirements for METOC information extend beyond the confines of the MAGTF. As joint forces integrate and operate with the MAGTF, METOC requirements necessary to support those forces must be validated and incorporated into the overall METOC support plan.

### Marine Air-Ground Task Force METOC Support Network

The MAGTF METOC network is tactical in organization and capability. The size and capability of the MAGTF METOC network will vary based on the size of the MAGTF. Larger MAGTFs will require METOC units to provide direct support for each CE, GCE, ACE, and LCE, while smaller MAGTFs may only give METOC units the ability to provide general support to each element. The METOC sections within the intelligence battalion and the MACS are organized and structured to support a variety of MAGTF deployments and operations. These organizations are manned and equipped to be used in a variety of ways contingent on the size, scope, and mission of the MAGTF. The MAGTF METOC support network is part of the larger global METOC support network; both are mutually dependent upon each other. The importance of mutual dependence cannot be overstated as the METOC AOI may extend well outside the MAGTF area of operations, to include the hemispheric and even global scales. However, the MAGTF METOC support network works within the larger global METOC support network to focus on the operational and tactical needs of the MAGTF.

### Command Element

The MEF headquarters requires forecasts of critical METOC elements (such as aviation and surf conditions, current and tide conditions, and warnings of extreme and/or severe METOC conditions) at least 72 hours before an operation as well as extended forecasts out to 10 days and periodic updates throughout operational execution. The CE requires a summary of all the forecasted elements and associated impacts required by the GCE, ACE, and LCE. The summary is normally developed and briefed to the commander by the senior METOC officer and/or his/her staff. It is typically comprised of current and forecast METOC conditions for the area of operations and AOI, and it often includes decision aids such as a METOC impacts matrix, which is discussed in chapter 9.

### Ground Combat Element

The GCE requires METOC support in the form of estimates and graphical depictions that can be used for planning and decision making. There are also requirements for general weather forecasts covering the 24 to 48 hours following the time of dissemination that are focused on ground combat-related METOC elements and coastal and sea data such as the following:

- Tidal, currents, and surf data.
- Beach slope, water depth, and surf zones.
- Surf breaker description.
- Severe weather warnings.
- Horizontal visibility and obstructions to vision.
- Astronomical data (sunrise, sunset, beginning of morning nautical twilight, end of evening nautical twilight, moonrise, moonset, and lunar illumination).
- Precipitation rate and type.
- Ambient air temperature and humidity.
- Extreme heat or cold.
- Surface wind speed and direction.
- Cloud cover.

- Freeze/thaw depth.
- Ice/snow depth.
- Wet bulb globe temperature index (WBGTI), which is an index used to determine heat stress conditions generally provided to ground personnel by medical personnel assigned to the unit.
- Windchill index.
- Barometric tendencies.
- Upper air refractivity indices (used in providing tactical decision aids [TDAs] for detection ranges and radars).
- Upper air temperatures, winds, and heights.

### Logistics Combat Element

The LCE's operations are heavily influenced by METOC conditions. Both extreme heat and cold can put added stress and strain on MAGTF equipment and create additional requirements for maintenance and spare parts. Heavy precipitation can make outside storage difficult. Severe weather can degrade the existing road system, affecting trafficability, mobility, and construction efforts and, in the case of snow buildup or icing, make it impassable. Unfavorable sea state conditions can make landing support and logistics over the beach much more difficult. Generally, the LCE's METOC requirements cover a larger area than those of a GCE.

### Aviation Combat Element

The ACE requires current METOC information for every aircraft sortie and forecasts for the next 72 hours in support of the air tasking order cycle, including extended outlooks up to 7 days for the entire area of operations. Aviation units are concerned with METOC conditions at widely dispersed departure airfields; en route to destinations, targets, and objective areas; and at the arrival airfield. In addition to the METOC elements required by the GCE, the ACE requires aviation-related METOC elements such as the following:

- Altimeter settings.
- Ceiling height.
- Pressure altitude and density altitude.
- Cloud base/cloud top heights and types.
- Upper air temperatures, winds, and heights.
- In-flight icing and turbulence conditions.
- Severe weather briefings.
- Slant visibility.
- Sea surface temperatures.
- Horizontal weather depictions.
- Ditch headings.
- Solar/lunar angles.
- TDAs.

### Marine Expeditionary Brigade

Support of the METOC is coordinated by the MEB METOC chief, with augmentation requested through the MEF METOC officer when necessary. The MEB's METOC support network is tailored for size and scope of the mission. The MEB CE is typically supported with the MEB METOC chief, and can be augmented by the MEF METOC officer or chief, along with an MST; the GCE can be supported with an MST, located at the GCE's command post; the ACE can be supported with METOC augmentation for the battlestaff on the Marine TACC (composition similar to an MST) and one MACS METOC section; the LCE can be supported with an MST, located at the LCE's command post.

### Marine Expeditionary Unit

The MEU's METOC support network consists of a task-organized MST. Currently, most MEUs deploy with an MST consisting of two to three METOC analysts. For tactical situations, such as a build-up of forces or split operations, additional METOC personnel may be included as part of a fly-in echelon if required. The MST operates under the cognizance of the MEU S-2. All METOC support requirements and requests for METOC information are coordinated through the MEU S-2 officer and strike group oceanography team (SGOT) officer. The senior MST Marine may be granted direct liaison authority by the MEU S-2 officer to coordinate METOC support requirements and deficiencies with appropriate METOC agencies. The SGOT officer coordinates METOC requirements and deficiencies of the amphibious ready group (ARG) through the respective fleet oceanographer. The MEU's METOC network is based on the MEUs location (i.e., afloat, ashore, and/or split operations ashore).

***Afloat***. While the MEU remains afloat as part of an ARG, MST Marines coordinate METOC support and interoperate with the ARG's SGOT while remaining under the cognizance of the MEU S-2. The SGOT officer is responsible for METOC support of the ARG, ensuring the principles and functions of METOC operations are applied while reducing duplication of effort.

***Ashore***. When the MEU transitions ashore, the MST accompanies the MEU S-2 and provides direct METOC support from the MEU's combat operations center for the entire MEU. The MEU S-2 may request additional augmentation from the MEF intelligence battalion's METOC analysis and production platoon via the MEF G-2 METOC officer. The MST provides support to the ARG SGOT by providing on-scene observations, forecasts, warnings, etc. The ARG SGOT provides METOC information and products to the MST as requested. Close collaboration and mutual support between the MST and SGOT ensures "one operation, one forecast."

***Split Operations Ashore***. During split MEU or ARG operations ashore, additional METOC personnel and equipment may be requested to provide simultaneous METOC support at each location. Such support can come from the MEU's MST fly-in echelon or an existing METOC unit ashore. If additional METOC support is required, the respective fleet oceanographer and MEF SMO coordinate external sourcing to fill the requirement. While ashore, the MST located with the MEU S-2 is designated as the lead MEU METOC unit. All METOC requirements are forwarded to the MEU S-2 for consolidation, coordination, and support.

### Special Purpose Marine Air-Ground Task Force

A special purpose Marine air-ground task force (SPMAGTF) is organized for specific missions and operations. Meteorological and oceanographic support for SPMAGTFs is requested through the MEF and task-organized to meet the unique METOC requirements based on the size and scope of the mission of the SPMAGTF.

### METOC Support Team

The MSTs are task-organized from the intelligence battalions or MATCD to provide a limited level of METOC support and/or augment the command elements of the MEF, MEB, GCE, ACE, LCE, MEU, or SPMAGTF as assigned. The MST is directly attached to the element that it is tasked to support and relies on the element for logistical and communications support. The MSTs have a limited standalone capability in the form of the NITES IV, discussed further in chapter 7.

## MARINE CORPS INSTALLATIONS, BASES, AND STATIONS

### Regional METOC Centers

As part of the regionalization concept of the RMCs, they are responsible for 24/7 METOC support for the station they are aboard and provide a continuous METWATCH for all other stations within their AOR when METOC personnel are not present at those sites. The RMCs are responsible for the following:

- Collect, analyze, predict, tailor, integrate, and evaluate METOC observations and forecasts.
- Prepare and disseminate WWAs.
- Prepare and brief aviation flight weather briefs.
- Forecast upper level winds.
- Prepare and disseminate yearly astronomical data.
- Provide climatological data upon request.
- Complete all other METOC RFIs as requested.

### Marine Corps Air Stations and Airfields

Although CONUS Marine METOC services have been regionalized with the establishment of the RMCs, each station still maintains a small contingency of METOC personnel to provide onsite, local-area environmental expertise. Although collaboration between the station METOC subject matter expert and RMC personnel occurs, the RMCs have final issuing authority for all terminal aerodrome forecasts and WWAs for the bases and air stations within their respective area of responsibility. Station METOC support responsibilities include the following:

- Provide METOC support to base training, tenant units, and transient aircrews.
- Serve as liaison with the RMC to provide a continuous METWATCH.
- Collect, evaluate, interpret, and disseminate METOC observations.
- Prepare and brief aviation flight weather briefs.
- Forecast upper level winds.
- Prepare and disseminate yearly astronomical data.
- Provide climatological data upon request.
- Complete all other METOC RFIs as requested.

### Sensor Sites

Sensor sites are those sites that do not have resident METOC support personnel, but are supported with an automated sensor to provide current real-time environmental conditions. Forecasts for these sites can be obtained from the RMC that is located nearest that site.

## JOINT AND COALITION OPERATIONS

As stated in JP 3-59, joint METOC operations are critical to a commander's awareness of the operational environment and the ability to exploit that awareness to gain an advantage during military operations. Properly applied, joint METOC operations can provide air, land, maritime, space, and special operations forces with a significant, even decisive, advantage over enemy forces. The geographic combatant commander provides guidance and is responsible for the direction of METOC assets within the AOR. In some cases, the geographic combatant commander may designate the SMO to also function as the JMO; the appointment of JMOs should be in line with the combatant command's (CCMD) METOC concept of operations. Appendix D provides an example METOC letter of instruction.

### Senior METOC Officer

Each CCDR may designate an SMO to coordinate all METOC operations within the AOR or area of functional responsibility. The SMO interacts with the CCDRs, CCMDs components, assigned/attached METOC units, other CCMD SMOs, and other agencies as applicable to ensure unity of effort.

### Joint METOC Officer

The joint force commander (JFC) should designate a joint METOC officer immediately upon initiation of planning to serve on the JFC staff as the JFC METOC advisor. The JMO plays a critical role in preparing for the success of the joint force mission by supporting all aspects of planning, deployment, and employment. The JMO interacts with the staff components, regional and partner nation (North Atlantic Treaty Organization) METOC units, and the SMO to optimize METOC operations.

### METOC Operations Support Community

The meteorological and oceanographic operations support community (MOSC) is an overarching term to describe the units/organizations available to the SMO and/or JMO. This could include (but would not be limited to) METOC forecast centers, oceanographic teams, and operational weather squadrons. METOC personnel assigned to a JTF will not normally be sufficient to provide autonomous staff support to the JTF without reachback to the MOSC. The SMO or JMO recommends one unit (a subset of the MOSC) for designation as the joint meteorological and oceanographic coordination organization (JMCO) to support a particular JTF and to coordinate the efforts of all other MOSC units to provide a full suite of products and services to the joint force.

### Joint METOC Coordination Organization

With the advice of the SMO/JMO, the JTF commander may request METOC capability from either within the CCMD through a Service component, or outside the CCMD through standard tasking channels. The JMCO is the organization designated by the tasked Service or Service component to provide or arrange for direct support to the JTF. The command relationship between the JTF and the JMCO is that of direct support, with the combined JTF being the supported command and the JMCO being the supporting command. The JMCO is normally designated as the lead METOC organization within Annex H (Meteorological and Oceanographic Operations) of the OPORD and is responsible for coordinating the activities of all MOSC organizations and facilitating METOC operations in support of the JTF. The JMCO should also be listed as a supporting organization to the JFC in Annex A (Task Organization) of the OPORD. Selection of an organization from within the MOSC to fill the JMCO role depends on location, capabilities, communications connectivity, and operational considerations. Potential JMCO production facilities and their capabilities are described in the *Joint Meteorological & Oceanographic (METOC) Handbook*.

### Joint METOC Coordination Cell

The joint meteorological and oceanographic coordination cell (JMCC) will normally designate or form a subordinate flight or section, known as the JMCC to provide support to the JTF on a day-to-day basis. Manning of the JMCC will normally be accomplished by a subset of the hosting METOC unit, with multi-Service augmentation as required. As the primary tool for achieving unity of effort within the joint operations area (JOA), the JMCC synchronizes and integrates pertinent METOC information in the JOA, leveraging component capabilities and virtually assembling the appropriate MOSC components to meet joint force requirements. The JMCC coordinates support requirements with the SMO/JMO and produces the joint operations area forecast (JOAF) and other METOC products as required by the supported joint force and staffs, on a battle rhythm established by the JMO supporting the JFC decision cycle. The JMCC and its leadership typically do not deploy to the JOA. The JMCC typically provides support to all joint forces and components in the JOA via reachback.

### Joint Operation Area Forecast

The JMCC's primary product is the JOAF; it is the official baseline forecast for operational planning and mission execution within the JOA. It provides a discussion of, and rationale for, expected METOC conditions. The JOAF is a dynamic product whose format, content, and duration are determined by operational requirements. The JOAF may have geographic "sub" areas identified within the JOA to further refine the METOC conditions. The JOAF should specify time of occurrence, duration, and intensity when certain METOC parameters are expected to meet or exceed operational thresholds and is amended as required by the JFC. Potential JOAF formats may be any combination of text and graphics as stated by the SMO/JMO. The JMCC must emphasize coordination and consensus among all joint METOC forces to successfully deconflict the JOAF, with the JMO as the final arbiter. The JOAF provides a starting point that METOC personnel use along with local data to tailor tactical-level planning and execution products. Component tactical-level forecasts may take a different form based on different mission focus and greater required level of detail. The JTF components communicate significant differences between their tactical forecasts and the JOAF with the JMO. Collaboration needs to occur between the

JMCC, JMO, and component METOC personnel to maintain a “one operation, one forecast” concept. The JMCC is responsible for making necessary changes to the JOAF, and the JMO settles any significant differences between components and/or the JMCC. Appendix E shows an example of a JOAF.

# CHAPTER 7
# METOC SYSTEMS AND EQUIPMENT

## TACTICAL EQUIPMENT: METEOROLOGICAL MOBILE FACILITY (REPLACEMENT) NEXT GENERATION AN/TMQ-56

The METMF(R) NEXGEN (see fig.7-1) was first fielded in 2012 as part of an evolutionary upgrade to the Meteorological Mobile Facility (Replacement). The METMF(R) NEXGEN is a lightweight, highly mobile meteorological data collection system capable of sustaining METOC operations in direct support of all elements of the MAGTF. The METMF(R) NEXGEN contains all the equipment necessary for environmental sensing and data ingest, for the efficient collation and integration of collected data, and for user-friendly graphic user interfaces and software tools necessary for accurate interpretation.

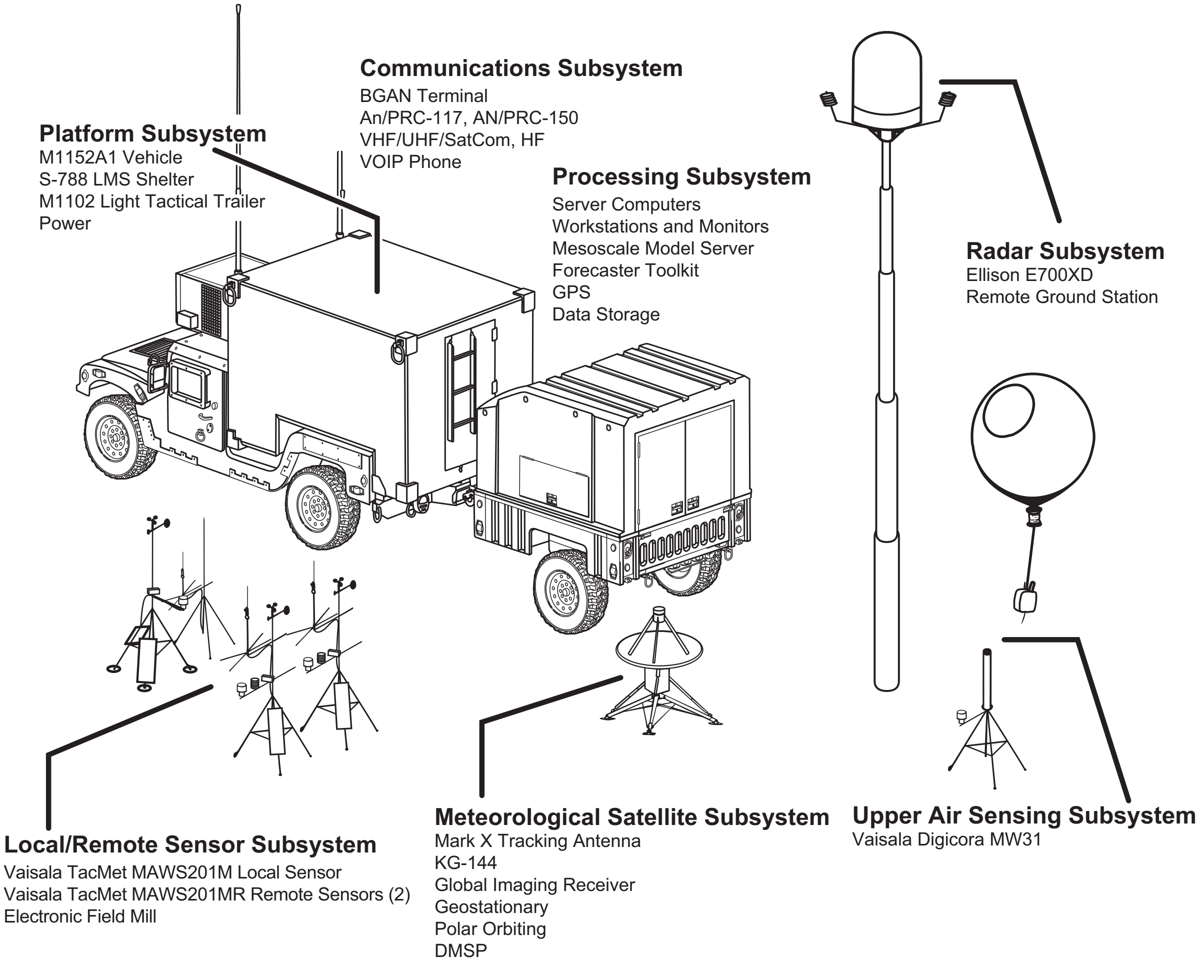

**Figure 7-1. METMF(R) NEXGEN with Subsystems.**

The METMF(R) NEXGEN permits the Marine METOC analyst to effectively transform relevant METOC data into tailored and actionable METOC products, which in turn can facilitate timely operational decision making. The METMF(R) NEXGEN can operate 24/7, in support of US and coalition forces in the full spectrum of operations worldwide.

Comprised of mostly nondevelopmental items, commercial off-the-shelf items, and government off-the-shelf items, the METMF(R) NEXGEN offers the latest technologies in data management to ensure the dynamic flow and comprehensive fusion of mission critical METOC information. Additionally, tailored products, METOC information, and detailed graphics are formatted in geo-referenced overlays for display on Marine Corps C2 systems and for availability of data sharing with joint and coalition forces.

### Operational Subsystems

The METMF(R) NEXGEN system consists of the following (see fig.7-1 on page 7-1):

- M1152A1 with B2 armored HMMWV.
- METMF(R) NEXGEN shelter.
- Light tactical trailer with cover.
- Internal data processing subsystem.
- Communications subsystem.
- Meteorological satellite subsystem.
- Local sensor subsystem.
- Remote sensor subsystem.
- Radar subsystem.
- Upper air sensing subsystem.
- Processing subsystem.

### Concept

In order to support expeditionary maneuver warfare concepts, the METMF(R) NEXGEN design is easy to deploy, fast to set up, and rugged enough to sustain the rigors of combat environments. Built into a standard shelter mounted on a HMMWV with a towable trailer, the METMF(R) NEXGEN can be transported by a single C-130 aircraft for rapid deployment. The system is capable of operations in any climate and location worldwide for 72 hours without resupply. Lightweight modular components permit the versatility to package exactly the right mix of capabilities necessary and the scalability to respond to the wide range of crises and conflict situations faced by the MAGTF. Additional flexibility is provided by enabling the upper air subsystem and meteorological radar subsystem to be capable of standalone operations, when needed, with or without the entire METMF(R) NEXGEN system. The METMF(R) NEXGEN is the primary equipment allocated for each MATCD.

### Operation

The METMF(R) NEXGEN permits the METOC analyst to sustain environmental situational awareness throughout the battlespace so that accurate assessments regarding environmental impacts to operations, tactics, and weapon performance can be made. This situational awareness is achieved through the use of on site sensors that include local and remote surface observation sensors, an upper air measuring system, and Doppler radar. This on site observation is continually fed into an on-scene, 4-km, high-resolution mesoscale model running every 30 minutes, and is used by the processor to nudge the model output and provide the analyst with a relocatable 500-by-500-by-30 km data cube that is stored, displayed, and manipulated as necessary to complete the environmental picture.

### Personnel

Although the exact number of personnel can vary according to the tactical situation, the recommended manpower to operate the METMF(R) NEXGEN for continuous, 24-hour operations is depicted in Table 7-1. This is the entire MACS table of organization for the METOC section and would normally be used if the entire MACS were to forward deploy. This manning is designed to support one forward operating base with one METMF(R) NEXGEN and the ability to support two forward arming and refueling points (FARPs) with MSTs equipped with a NITES IV system.

The MACS as a whole may not always deploy, and smaller or shorter operations and exercises will result in a task-organized manning concept to meet mission requirements. Table 7-2, on page 7-4, lists the minimum required personnel to safely and efficiently deploy and operate the METMF(R) NEXGEN. These numbers provide the bare minimum crew and provide for two separate shifts of personnel. Depending on the specific mission requirements, personnel available, and HHQ guidelines, a compromise between the two listed manning concepts may be needed.

**Table 7-1. Recommended METMF(R) NEXGEN Manning.**

| Billet | Rank | MOS | T/O |
|---|---|---|---|
| METOC officer | CWO2 | 6802 | 1 |
| METOC chief | GySgt | 6842 | 1 |
| METOC forecaster | SSgt | 6842 | 1 |
| METOC forecaster | Sgt | 6842 | 3 |
| METOC forecaster | Cpl | 6842 | 3 |
| METOC forecaster | LCpl | 6842 | 4 |
| METEM technician | Sgt | 5951 | 1 |
| METEM technician | Cpl | 5951 | 1 |
| METEM technician | LCpl | 5951 | 1 |
| Utilities technician | Sgt to LCpl | 11XX | 1 |
| Communications technician | Sgt to LCpl | 06XX | 1 |
| | | **Total Strength** | 18 |

Legend

| | |
|---|---|
| Cpl | corporal |
| CWO2 | chief warrant officer-2 |
| GySgt | gunnery sergeant |
| LCpl | lance corporal |
| METEM | meteorological equipment maintenance |
| Sgt | sergeant |
| SSgt | staff sergeant |
| T/O | table of organization |

**Table 7-2. Minimum METMF(R) NEXGEN Manning.**

| Billet | Rank | MOS | T/O |
|---|---|---|---|
| METOC chief | GySgt | 6842 | 1 |
| METOC forecaster | Sgt | 6842 | 1 |
| METOC forecaster | Cpl | 6842 | 2 |
| METOC forecaster | LCpl | 6842 | 2 |
| METEM technician | Sgt | 5951 | 1 |
| METEM technician | LCpl | 5951 | 1 |
| Utilities technician | Sgt to LCpl | 11XX | 1 |
| Communications technician | Sgt to LCpl | 06XX | 1 |
| | | **Total Strength** | 10 |

Legend

| | |
|---|---|
| Cpl | corporal |
| GySgt | gunnery sergeant |
| LCpl | lance corporal |
| METEM | meteorological equipment maintenance |
| Sgt | sergeant |
| SSgt | staff sergeant |
| T/O | table of organization |

### Site Selection

Selecting the operating site for the METMF(R) NEXGEN is a crucial component for the planning of any operation. Poor site selection hinders the ability to operate the METMF(R) NEXGEN at its full potential and may degrade data reception capabilities or provide erroneous data. Whenever possible, either the METOC officer or METOC chief should be on the site survey team. Additionally, an aviation meteorological equipment maintenance (METEM) technician should be included on the site survey team, but not in replacement of the METOC officer or chief. If this is not possible, then whoever will be conducting the site survey must be briefed on the following site selection requirements.

***Terrain Requirements***. Select a reasonably flat and level area approximately 100 by 100 feet. This amount of area allows sufficient room for placement of the HMMWV and shelter, trailer, antennas, subsystem components, Doppler radar, shipping enclosures, and overall system grounds. The surface must be capable of supporting the METMF(R) NEXGEN vehicle as well as the grounding rods and equipment anchoring spikes.

***Obstructions***. The METMF(R) NEXGEN must be located in an area that is relatively free of natural or manmade obstructions (any obscuration or blocking phenomena within 1,000 feet). Any obstruction that exceeds 5 degrees in elevation within an 80-foot radius of the antenna beam paths will cause signal degradation.

***Utility Requirements***. The METMF(R) NEXGEN requires 120/208 volts, alternating current (VAC), 60 Hz, 3-phase power. The METMF(R) NEXGEN normally operates using shore power. If operated in remote locations without the benefit of an on-shore power source, tactical generators meeting the above requirements will allow for continuous, 24-hour operations. For short-term power (up to 72 hours) the HMMWV VIPER generators are available as the alternative to operating on-shore power or with a tactical generator. When connecting to shore power, 120/240 VAC, 60 Hz, split-phase power may be used.

***Radio Frequency Interference***. Position the METMF(R) NEXGEN in an area with minimal radio frequency interference and EM interference potential, which includes any adjacent transmitting sites. Coordination is highly recommended between the METMF(R) NEXGEN METOC officer or chief and the communications officer for identification of potential interfering communications nets. Communications with nearby air traffic control units is also advisable for radio frequency interference, EM interference potential, and communications issues, as well as coordinating local and remote sensor placement.

More information for site selection can be found in EM000-CD-OMP-010, *Operation and Maintenance Manual with Parts List AN/TMQ-56 Meteorological Measuring Set METMF(R) NEXGEN*.

### Embarkation

The packing procedures for the METMF(R) NEXGEN are very specific and spelled out in an easy to follow format in 334-192046 *Embarkation Plan for the Meteorological Mobile Facility (Replacement) (METMF[R])Next Generation (NEXGEN) AN/TMQ-56*. The specifications for embarkation of the METMF(R) NEXGEN are listed in Table 7-3.

**Table 7-3. AN/TMQ-56**
**Table of Specifications.**

| Item | Description |
|---|---|
| HMMWV with Shelter | |
| Dimensions: | |
| Length (bumper to pintle) | 207.5 inches |
| Width (overall-mirror to mirror) | 131.0 inches |
| Height (with shelter) | 101.2 inches |
| Distance (axle to axle) | 130.8 inches |
| Track: | |
| Front (axle #1) | 71.4 inches |
| Rear (axle #2) | 71.7 inches |
| Gross vehicle weight (GVW) | 13,440 pounds (combat loaded) |
| Trailer with Cover | |
| Dimensions: | |
| Length | 135.0 inches |
| Width | 85.6 inches |
| Height | 101.5 inches |
| Weight (loaded) | 4080 pounds |
| Trailer curb weight (empty) | 1460 pounds |
| Payload (maximum) | 2740 pounds |

### Transportation

The METMF(R) NEXGEN shall be transported by flatbed truck, rail flat car, fixed-wing aircraft, or ship. The configuration is compact enough to fit into a single C-130 aircraft for rapid deployment operations. The HMMWV shelter and equipment trailer are also capable of withstanding the effects of movement and lifting resulting from the use of cargo cranes, lifts, and other heavy-duty cargo-handling equipment used routinely during civilian and military long-shore operations.

## TACTICAL EQUIPMENT: NAVAL INTEGRATED TACTICAL ENVIRONMENTAL SYSTEM, VARIANT IV AN/UMK-4(V)4

The NITES IV is the primary, man-portable, deployable METOC asset utilized by the Marine Corps during tactical operations. The purpose of the NITES IV is to collect, store, and disseminate environmental data and information; to assess the impact of present and future environmental conditions on operations, weapons systems, and sensor systems; and to provide METOC data and information to the warfighters' mission planning and support systems. The NITES IV enhances the capabilities of METOC units in order to provide METOC support at remote locations, often in harsh environments. The NITES IV is portable, lightweight, rugged, flexible, and independent, allowing deployment of the minimum system hardware and software configuration needed to support each mission without degraded performance.

### Operating Environment

The NITES IV is the primary METOC equipment for the MEF, MAW, and intelligence battalion, and the secondary equipment for each MATCD. The NITES IV is a portable system that is easily forward deployed and can be setup, operated, and maintained by one person or an entire MST. The NITES IV suite consists of three laptops with the same capabilities loaded with the same software. Because of this redundancy, the NITES IV is often not deployed as an entire suite and offers scalability and flexibility in its employment. Mission requirements, network availability, and embarkation space will dictate how best to employ the NITES IV.

### Capabilities

The NITES IV is designed as a scalable, flexible, and mobile system for a “first in, last out” capability. The primary differences between the METMF(R) NEXGEN and NITES IV are size, logistics, scalability, and mobility. Additionally, the METMF(R) NEXGEN has organic sensing capabilities while the NITES IV's sensing capabilities are limited. Thus, the NITES IV relies heavily on reachback communications connectivity to the METMF(R) NEXGEN and major production center databases for data and products. The NITES IV provides personnel access to METOC data and products that are then analyzed and tailored for a specific mission. Specific capabilities are as follows:

- Reachback access to METOC data and products in the METMF(R) NEXGEN and major production center databases.
- Defense information infrastructure common operating environment compliant.

- Compatible with evolving joint communications and METOC architectures like the Joint Maritime Command Information System and the C2PC [Command and Control Personal Computer].
- Secure and unsecure data connectivity.
- Automated Weather Observing System (AWOS) that measures surface winds, surface air and dew point temperatures, liquid precipitation rate, cloud heights, horizontal visibility, atmospheric pressure and altimeter settings, and electric field potential.
- Kestrel handheld weather sensor (this sensor is not certified but provides estimates of surface wind direction and speed, surface air and dew point temperatures, humidity, atmospheric pressure, altimeter setting, pressure altitude, and density altitude).
- International maritime satellite (INMARSAT) connectivity.
- Production of TDAs for electro-optical sensors and EM systems.
- Worldwide astronomical and tidal predictions.
- “First in, last out” METOC capability.

Specific support requirements for the NITES IV are based on the system configuration chosen for a particular operation. System configurations are scalable and may vary from operation to operation based on the tactical situation, mission, personnel, connectivity, and embarkation space.

### Site Selection

Site selection concerns for the NITES IV include availability of an adequate workspace for three laptop computers (e.g., a 5-foot conference table or equivalent). The site should also allow for the direct cable connection between the NITES IV laptops and outside peripherals (i.e., AWOS and/or INMARSAT). Cable connections are currently limited to approximately 100 feet.

### Embarkation

The NITES IV requires no special embarkation concerns. The equipment density list will vary based on the configuration used.

### Utilities Support

Standard 120 VAC, 60 Hz commercial or tactical power provided to the workspace is sufficient to operate the NITES IV. The NITES IV has integrated surge suppression to prevent equipment damage. It also includes international power adapter kits to accommodate the system. The AWOS can be powered via integrated solar panel or through commercial or tactical power using either 120 or 240 VAC, 60 Hz.

### Network Support

The NITES IV requires SIPRNET/NIPRNET connectivity for continuous data ingestion. Coordination should be made with the S-6, G-6, or J-6 section, as appropriate, to provide network support for each laptop being deployed. The NITES IV deploys with an INMARSAT to facilitate “first in, last out” data connectivity prior to the establishment or following disestablishment of communications and during prolonged network outages.

## SUPPORTING ESTABLISHMENT EQUIPMENT: AUTOMATED SURFACE OBSERVING SYSTEM

Federally funded, the Automated Surface Observing System (ASOS) is a joint program of the National Weather Service, the Federal Aviation Administration, and the DOD. The ASOS serves as the United States' primary surface weather observing network.

The many sensors that comprise ASOS detect different weather elements and can update the official weather observation up to 12 times each hour. The ASOS works nonstop, 24/7.

The ASOS's constant stream of data benefits the forecast and research communities and promotes more accurate forecasts of all kinds. The ASOS's sensors also perform well at night, a difficult time for human observers to make accurate observations.

Getting more information on the atmosphere, more frequently, and from more locations, is the key to improving forecasts and warnings. Thus, ASOS information helps the National Weather Service meet its goal of increased accuracy and timeliness of its forecasts and warnings.

The primary concern of the aviation community is safety, and weather conditions often threaten that safety. A basic strength of ASOS is that critical aviation weather parameters are measured where they are needed most: airport runway touchdown zones.

The ASOS routinely and automatically provides computer-generated voice observations directly to aircraft in the vicinity of airports, using Federal Aviation Administration ground-to-air radio. These messages are also available via a telephone dial-in port. The ASOS observes, formats, archives, and transmits observations automatically. Additionally, the ASOS transmits a special report when conditions exceed preselected weather element thresholds (e.g., the visibility decreases to less than 3 miles).

The basic weather parameters measured and displayed by the ASOS include the following:

- Sky condition: cloud height and amount (clear, scattered, broken, overcast) up to 12,000 feet.
- Visibility to at least 10 statute miles.
- Basic present weather information.
- Type and intensity for rain, snow, and freezing rain.
- Obstructions to vision (e.g., fog and haze).
- Pressure: sea-level pressure and altimeter setting.
- Ambient temperature.
- Dew point temperature.
- Wind: direction, speed, and character (gusts, squalls).

- Precipitation accumulation.
- Selected significant remarks concerning the following:
  - Variable cloud height.
  - Variable visibility.
  - Precipitation beginning/ending times.
  - Rapid pressure changes.
  - Pressure change tendency.
  - Wind shift.
  - Peak wind.

However, like all technology, there are limitations as to what the equipment can do. The main limitation of ASOS is its ability to see around the horizon. The sensors see only directly overhead. Should there be a storm front moving in with darkening conditions, ASOS will not detect it until the storm begins to move over the sensors. Likewise, ASOS cannot see patchy fog that is not located directly at the station location.

Therefore, weather around the airport that has not been sensed will not be measured. The system is not designed to report clouds above 12,000 feet, virga, tornadoes, funnel clouds, ice crystals, snow pellets, ice pellets, drizzle, freezing drizzle, blowing obstructions (such as snow, dust, or sand), snow fall, and snow depth. Many of these elements will be provided by other sources. Additionally, many of the ASOS stations are staffed air traffic control towers, so human observers can edit or augment the automated observations.

## SUPPORTING ESTABLISHMENT EQUIPMENT: AUTOMATED HEAT STRESS SYSTEM

The automated heat stress system provides a continuous, on-line measurement of dry bulb (DB) temperature, wet bulb temperature, globe temperature, and relative humidity (RH). These values are used to determine the WBGTI that is used to determine physiological heat exposure limits stay times. The Deban Heat Sensor Unit is a highly accurate environmental monitoring system designed to detect the parameters required for the WBGTI value of a specific location.
The automated heat stress system unit consists of a network splice box; a wet bulb globe temperature (WBGT) node; and DB, RH, and globe temperature sensors. The DB and globe temperature sensors provide a measure of the ambient and radiant temperatures. The RH sensor provides a measure of the moisture content of the air. A wet bulb value is calculated from the measured DB and RH parameters.

## SUPPORTING ESTABLISHMENT EQUIPMENT: PILOT-TO-METRO SERVICE

Military METOC units operate a pilot-to-metro service (PMSV) at selected Army, Marine Corps, Navy, and Air Force airfields to provide aircrews a direct contact with METOC personnel. The primary purpose of PMSV is for communicating various types of weather information to pilots. A PMSV is also used to update the flight weather briefing form (DD-175-1) and to receive PIREPs of significant or hazardous weather phenomena. The PMSV facilities manned by qualified METOC forecasters are listed as “full service,” and PMSV facilities manned by unqualified METOC analysts are listed as “limited service.” When an unqualified METOC analyst responds to a call, they will identify themselves as an unqualified METOC analyst, state that there are no qualified METOC forecasters available, and relay only surface observations, radar observations, terminal forecasts, and military weather advisories. If additional forecast information is necessary, the unqualified METOC analyst will refer the aircrew to a full-service PMSV facility where a qualified METOC forecaster is on duty. The radio call for PMSV is “METRO,” (i.e., *Cherry Point METRO*.)

## METOC SYSTEMS AND EQUIPMENT MAINTENANCE

### Tactical Equipment

Tactical METOC equipment is maintained by METEM technicians. The METEM technicians install, test, maintain, and repair all electronic, information technology, and other associated equipment employed by METOC units in support of MAGTF operations. The METEM technicians reside within the MATCD maintenance department and are assigned as direct support to the METOC units during operations and exercises. Additionally, METEM technicians reside within the METOC platoon at each intelligence battalion.

### Supporting Establishment Equipment

Supporting establishment equipment is maintained by either METEM technicians or other aviation equipment technicians assigned to the air station maintenance department.

# CHAPTER 8
# METOC EFFECTS

## ENVIRONMENTAL ELEMENTS

Although environmental elements tend to have different effects on different types of units and operations, many can be identified as having similar effects on a majority of combat units and operations. Many of the common effects can be derived from the climate of the theater of operations and must be considered during planning. Special attention must be given to those elements of weather that may limit operations or preclude them altogether. For instance, planning for operations in the tropics must consider the recurring cycle of the monsoon season. In continental Europe, planning must consider severe winters and the annual autumn freezes and spring thaws that affect trafficability and cross-country movement. Very early in the planning process, planners must relate the possible COAs to weather expectancies derived from climatological studies. There must be an acceptable likelihood that the weather conditions required for any proposed COA will occur. It is imperative for an operation to be deemed meteorologically feasible early in the planning process.

Furthermore, as discussed in chapter 1, METOC elements and their impacts to operations are associated with the function of exploiting environmental information. Inseparable from this is the commander's responsibility to have an understanding of METOC elements and their effects on operations and to provide guidance to focus the METOC effort.

## WEATHER AND TERRAIN

When considering the effects of environmental conditions, the impact that weather and terrain have on each other must be considered. Weather and terrain are so interrelated that they must be considered together when planning all military operations. Weather elements can drastically alter terrain features and trafficability. Conversely, terrain features may exert considerable influence on local weather. The relationship between weather and terrain must be carefully correlated in terrain studies to produce accurate terrain intelligence. This planning is an integral part of the IPB process.

Specific meteorological elements vary with the geographical area, time, and season. A description of the climate of a large area considers terrain influences only in general terms, whereas a description of a small area such as a single valley can be specific. It is important that commanders and their staffs understand and consider weather in their tactical planning. They must recognize the tactical significance of weather effects on intended operations and the risks or opportunities that they present. The effects of weather are integrated with enemy and terrain analysis through IPB. Factors that must be considered include—

- Visibility.
- Wind.
- Precipitation.
- Clouds.
- Temperature and humidity.
- Severe weather.

### Visibility

Low visibility is beneficial to offensive and retrograde operations and detrimental to defensive operations. In the offense, it conceals the concentration of maneuver of friendly forces, thus enhancing the possibility of achieving surprise.

Low visibility hinders the defense because cohesion and control become difficult to maintain, reconnaissance and surveillance are impeded, and target acquisition is less accurate. These disadvantages may be offset partially by extensive use of illuminants, radar, sound detection, and thermal and infrared devices. However, infrared devices are degraded in range by any moisture source, precipitation, or moisture-absorbing smoke. Smoke and obscurant aerosols can be expected on medium-intensity to high-intensity battlefields and may be used locally to reduce visibility. In all operations, obscurants limit the use of aircraft and aerial optical and infrared surveillance devices.

Illumination and obstructions to vision affect the visibility required for various operations and affect the overall planning for security, concealment, and target acquisition by visual, electronic, or electro-optical means. Illumination primarily concerns natural light sources such as the moon and stars. Illumination can enhance or detract from the employment of night vision devices (NVDs). Periods of twilight may affect the employment of NVDs as well. Low or no natural illumination may necessitate the use of artificial battlefield illuminants. Illumination and obstructions to vision may reduce or negate the effectiveness and employment of electro-optical sensors that utilize and exploit various portions of the EM spectrum.

### Wind

Wind speed and direction, both on the surface and aloft, usually favor the upwind force in the use of chemical, biological, radiological, and nuclear (CBRN) weapons. Winds of sufficient speed can reduce the combat effectiveness of a force downwind by blowing dust, smoke, sand, rain, or snow on personnel and equipment. The force located upwind has better visibility and can, therefore, advance and maneuver faster. Strong winds limit airborne, air assault, and aviation operations.

Strong surface winds and gusts can—

- Injure personnel.
- Damage material and structures.
- Give anomalous radar returns.
- Restrict visibility due to blowing sand, dust, and other materials.

Generally, winds above 20 knots create such effects. Smoke operations are usually ineffective at wind speeds greater than 7 knots. As surface wind speed increases, either naturally or enhanced by vehicle movement, the windchill becomes a critical factor. The windchill factor adversely affects improperly clothed personnel and impedes activity in unsheltered areas. Wind speed also affects the distance that sound will travel. Wind may prove beneficial by aiding in drying soil. See table 8-1 for a windchill index chart developed by NOAA.

**Table 8-1. Windchill Index Chart**

Windchill chart in fahrenheit and miles per hour (MPH). Use this chart for winds from 33 foot anemometer height.

Temperature (°F)

Wind Speed (mph)

| Calm | 40 | 35 | 30 | 25 | 20 | 15 | 10 | 5 | 0 | -5 | -10 | -15 | -20 | -25 | -30 | -35 | -40 | -45 | -50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 36 | 31 | 25 | 19 | 13 | 7 | 1 | -5 | -11 | -16 | -22 | -28 | -34 | 40 | -46 | -52 | -57 | -63 | -69 |
| 10 | 34 | 27 | 21 | 15 | 9 | 3 | -4 | -10 | -16 | -22 | -28 | -35 | -41 | -47 | -53 | -59 | -66 | -72 | -78 |
| 15 | 32 | 25 | 19 | 13 | 6 | 0 | -7 | -13 | -19 | -26 | -32 | -39 | -45 | -51 | -58 | -64 | -71 | -77 | -83 |
| 20 | 30 | 24 | 17 | 11 | 4 | -2 | -9 | -15 | -22 | -29 | -35 | -42 | -48 | -55 | -61 | -68 | -74 | -81 | -88 |
| 25 | 29 | 23 | 16 | 9 | 3 | -4 | -11 | -17 | -24 | -31 | -37 | -44 | -51 | -58 | -64 | -71 | -78 | -84 | -91 |
| 30 | 28 | 22 | 15 | 8 | 1 | -5 | -12 | -19 | -26 | -33 | -39 | -46 | -53 | -60 | -67 | -73 | -80 | -87 | -94 |
| 35 | 28 | 21 | 14 | 7 | 0 | -7 | -14 | -21 | -27 | -34 | -41 | -48 | -55 | -62 | -69 | -76 | -82 | -89 | -96 |
| 40 | 27 | 20 | 13 | 6 | -1 | -8 | -15 | -22 | -29 | -36 | -43 | -50 | -57 | -64 | -71 | -78 | -84 | -91 | -98 |
| 45 | 26 | 19 | 12 | 5 | -2 | -9 | -16 | -23 | -30 | -37 | -44 | -51 | -58 | -65 | -72 | -79 | -86 | -93 | -100 |
| 50 | 26 | 19 | 12 | 4 | -3 | -10 | -17 | -24 | -31 | -38 | -45 | -52 | -60 | -67 | -74 | -81 | -88 | -95 | -102 |
| 55 | 25 | 18 | 11 | 4 | -3 | -11 | -18 | -25 | -32 | -39 | -46 | -54 | -61 | -68 | -75 | -82 | -89 | -97 | -104 |
| 60 | 25 | 17 | 10 | 3 | -4 | -11 | -19 | -26 | -33 | -40 | -48 | -55 | -62 | -69 | -76 | -84 | -91 | -98 | -105 |
| 65 | 24 | 17 | 10 | 2 | -5 | -12 | -19 | -27 | -34 | -41 | -49 | -56 | -63 | -70 | -78 | -85 | -92 | -99 | -107 |
| 70 | 24 | 16 | 9 | 2 | -6 | -13 | -20 | -27 | -35 | -42 | -49 | -57 | -64 | -71 | -79 | -86 | -93 | -101 | -108 |
| 75 | 23 | 16 | 9 | 1 | -6 | -13 | -21 | -28 | -36 | -43 | -50 | -58 | -65 | -72 | -80 | -87 | -95 | -102 | -109 |

| | | | | |
|---|---|---|---|---|
| Risk for Frostbite within | 30 minutes | 10 minutes | 5 minutes | 23 Jan 02 |

***Note:*** Trench foot and immersion foot may occur at any point on the chart.

## Precipitation

Precipitation has significant impact on the functioning of ground maneuver units, aviation, logistic operations, and electro-optical and infrared systems. Rain and snow affect the soil, visibility, and personnel effectiveness. The state of the ground affects trafficability; heavy rain can make some unsurfaced roads and off-road areas impassable. Precipitation can greatly reduce–

- Personnel effectiveness by limiting visibility, increasing fatigue, and causing discomfort and other physical and psychological problems.
- The persistence of chemical agents (or can create CBRN hot spots).
- The range of lasers, NVDs, and thermal tank sights.
- The effectiveness of aircraft.

Precipitation also degrades the quality of supplies in storage. Snow accumulation of greater than 1 inch degrades trafficability and reduces the impact of mines and the blast effects of point munitions. Generally, precipitation in excess of 0.10 inches per hour or 2 inches in a 12-hour period is considered critical for tactical operations. Snowfall exceeding 18 inches reduces tracked vehicle speed; movement on foot is very difficult without snowshoes or skis.

### Clouds

The type and amount of cloud cover, as well as the height of cloud bases and tops, influence friendly and enemy aviation operations. Extensive cloud cover reduces the effectiveness of air support. This effect becomes more pronounced as cloud cover increases, cloud bases lower, and conditions associated with clouds (such as icing, turbulence, and poor visibility aloft) increase. In a relatively unstable air mass, clouds are associated with strong vertical currents, turbulence, and restricted visibility aloft. Generally, close air support missions and aerial resupply missions require a ceiling of at least 1,000 feet. Clouds affect ground operations by limiting illumination and the solar heating of targets for infrared systems. Clouds limit the use of infrared-guided artillery by decreasing the envelope in which it can seek and lock on to laser-designated targets. Cloud-free line of sight is required for delivery of electro-optical precision-guided munitions from aircraft.

### Temperature and Humidity

Temperature and humidity affect air density. Air density decreases as the temperature or humidity increases; thus, the efficiency of aircraft propulsion is reduced in areas of high temperature or high humidity. Although temperature and humidity may not directly affect a particular tactical operation, extremes will reduce personnel and equipment capabilities and may necessitate a reduction of aircraft payloads (e.g., fuel, weapons, personnel). Tactics that are effective in one climate may be ineffective when applied in another. The high temperatures and humidity in the tropics are conducive to the growth of dense foliage, which greatly affects tactical operations. Desert climates can range from extremely hot in the daytime to very cold at night, requiring added protective measures. In arctic climates, cold weather periods create an almost constant need for heated shelters; cause difficulty in constructing fortifications; increase the dependence on logistical support; and necessitate special clothing, equipment, and survival training.

Windchill factors are produced by a combination of temperature and wind speed. A windchill factor of -26 °F (-32 °C) is considered to be the critical value for equipment and personnel operating in cold weather (see table 8-1). The opposite extreme, 120 °F (49 °C), is the critical value for personnel operating in hot weather. The critical WBGTI value for personnel operating in hot weather is 90. Similar restrictions occur in desert terrain, where the temperature from day to night may vary as much as 100 °F (37 °C). Personnel operating in warm temperatures are more susceptible to becoming heat casualties when wearing mission-oriented protective posture gear.

Temperatures of targets and objects on the battlefield at night are important for the use of thermal sights and forward-looking infrared devices. A difference in temperature or thermal contrast is required for these devices to see a target. Normally, the target and background heat and cool at different rates. Twice a day, in the morning and evening, targets without internal heating come to relatively the same temperature as the background. At this point, thermal crossover occurs and the thermal device does not have the capability to see the target. The duration of thermal crossover may be only a few seconds when the morning sun strikes a target or several minutes on other days; this depends on the threshold temperature contrast required by the thermal device. Tactical decision aids can be used to predict these temperature differences for planners and to estimate lengths of thermal crossover periods.

### Severe Weather

Severe weather affects most operations by presenting a threat of injury to personnel, damaging equipment and structures, limiting ground and air mobility and air operations, and threatening troop morale. Electrical storms often accompany severe weather conditions and add the hazard of lightning strikes at munitions storage areas and fueling points. Lightning may also interrupt landline communications and both communications and noncommunications using the EM spectrum.

## EFFECTS ON OPERATIONS

Tables 8-2 through 8-16 describe generalized METOC planning factors that are unique to specific operations. Though not all encompassing, the commander determines on which operations the METOC effort will be focused. This provides a baseline for which specific METOC thresholds need to be developed.

### Amphibious Operations

METOC effects on amphibious operations may be beneficial or detrimental. Certain METOC conditions may help to conceal landing operations. Other conditions may hinder beaching and unloading, task force movement, and essential air support operations. See tables 8-2 through 8-4 on pages 8-5 through 8-7.

**Table 8-2. Amphibious Operations Effects.**

| Element | Impact |
|---|---|
| Severe weather | Hampers debarkation and landing craft operations<br>Creates unacceptable surf conditions<br>May preclude landing<br>Interferes with construction support |
| Wind (surface) | May cause postponement of landings<br>Affects the state of the sea and handling of landing craft |
| Windchill | May cause a requirement for special equipment and rigging for landing and for special supplies and equipment to support operations afloat and ashore |
| Extreme temperature (surface) | May cause a requirement for special equipment and rigging for landing and for special supplies and equipment to support operations afloat and ashore |
| Tide | May cause postponement of landings<br>May conceal beach obstacles |
| Ceiling: cloud and sky cover | May hamper air support operations and landing craft navigation<br>May offer concealment from air reconnaissance |
| Fog | Reduces visibility and increases landing craft navigation problems and water and terrain hazards<br>May provide concealment |
| Illumination | May dictate the time of landing and support operations |
| Lunar phase | Affects tidal conditions |

### Table 8-2. Amphibious Operations Effects. (Continued)

| Element | Impact |
|---|---|
| Freeze or thaw depth | May hamper movement over the beach and construction support |
| Sea state | May preclude landing or resupply of landing forces and may cause debarkation to be canceled<br>May endanger the use of landing craft<br>Severe conditions can degrade naval gunfire support |
| Temperature (water) | Cold temperatures decrease survivability of personnel in the water<br>Survival in seawater temperatures in excess of 70°F depends more on fatigue factors than hypothermia |

### Table 8-3. Fifty Percent Survival Rate Times (Hours) for Personnel in Water (Various Temperatures °F).

| **Seawater Temperature** | **30** | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** |
|---|---|---|---|---|---|---|---|---|---|---|
| Without immersion suit | 1.20 | 1.28 | 1.36 | 1.44 | 1.52 | 1.60 | 1.68 | 1.76 | 1.84 | 1.92 |
| With immersion suit | 1.50 | 1.70 | 1.90 | 2.10 | 2.29 | 2.50 | 2.70 | 2.90 | 3.10 | 3.30 |
| **Seawater Temperature** | **40** | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** |
| Without immersion suit | 2.00 | 2.15 | 2.29 | 2.45 | 2.60 | 2.75 | 2.90 | 3.05 | 3.20 | 3.35 |
| With immersion suit | 3.50 | 3.95 | 4.40 | 4.84 | 5.30 | 5.75 | 6.20 | 6.65 | 7.10 | 7.55 |
| **Seawater Temperature** | **50** | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** |
| Without immersion suit | 3.50 | 4.34 | 5.20 | 6.05 | 6.90 | 7.75 | 8.60 | 9.44 | 10.30 | 11.15 |
| With immersion suit | 8.00 | 9.19 | 10.40 | 11.60 | 12.80 | 14.00 | 15.20 | 16.39 | 17.60 | 18.80 |
| **Seawater Temperature** | **60** | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** |
| Without immersion suit | 12.00 | 12.85 | 13.70 | 14.55 | 15.40 | 16.25 | 17.10 | 17.95 | 18.80 | 19.64 |
| With immersion suit | 20.00 | 21.20 | 22.40 | 23.60 | 24.80 | 26.00 | 27.20 | 28.40 | 29.60 | 30.80 |

### Table 8-4. Beaufort Wind Force Description Related to Sea State.

| Wind | | | | Sea | | |
|---|---|---|---|---|---|---|
| Beaufort Number | Mean Velocity (knots) | Wind Description | Effects Observed at Sea | Descriptive Term | Wave Height (Feet) | Sea State |
| 0 | Less than 1 | Calm | Sea like a mirror | Calm, glassy | 0 | 0 |
| 1 | 1 to 3 | Light air | Ripples with the appearance of scales<br>No foam crests | Calm, glassy | 0.25 | 0 |
| 2 | 4 to 6 | Light breeze | Small wavelets<br>Crests of glassy appearance not breaking | Calm, rippled | 0.25 to 0.75 | 1 |
| 3 | 7 to 10 | Gentle breeze | Large wavelets<br>Crests begin to break<br>Scattered whitecaps | Smooth wavelets | 1 | 2 |

**Table 8-4. Beaufort Wind Force Description Related to Sea State. (Continued)**

| Wind | | | | Sea | | |
|---|---|---|---|---|---|---|
| **Beaufort Number** | **Mean Velocity (knots)** | **Wind Description** | **Effects Observed at Sea** | **Descriptive Term** | **Wave Height (Feet)** | **Sea State** |
| 4 | 11 to 16 | Moderate breeze | Small waves becoming larger<br>Numerous whitecaps | Slight | 1 to 3 | 3 |
| 5 | 17 to 21 | Fresh breeze | Moderate waves taking longer form<br>Many whitecaps<br>Some spray | Moderate | 4 to 8 | 4 |
| 6 | 22 to 27 | Strong breeze | Larger waves forming<br>Whitecaps everywhere<br>More spray | Rough | 8 to 10 | 5 |
| 7 | 28 to 33 | Near gale | Sea heaps up<br>White foam from breading waves begins to be blown in streaks | Rough | 10 to 13 | 5 |
| 8 | 34 to 40 | Gale | Moderately high waves of greater length<br>Edges of crests begin to break into spindrift<br>Foam is blown in well-marked streaks | Very rough | 13 to 15 | 6 |
| 9 | 41 to 47 | Strong gale | High waves<br>Seas begin to roll<br>Dense streaks of foam<br>Spray may reduce visibility | Very rough | 15 to 20 | 6 |
| 10 | 48 to 55 | Storm | Very high waves with overhanging crests<br>Sea takes white appearance as foam is blown in very dense streaks<br>Rolling is heavy and visibility is reduced | High | 20 to 30 | 7 |
| 11 | 56 to 63 | Violent storm | Exceptionally high waves<br>Sea covered with white foam patches<br>Visibility even more reduced | Very high | 30 to 45 | 8 |
| 12 | 64 and over | Hurricane | Air filled with foam<br>Sea completely white with driving spray<br>Visibility is greatly reduced | Phenomenal | Over 45 | 9 |
| Note: Data modified from *The American Practical Navigator*, Volume 1. | | | | | | |

## Ground Maneuver Operations

Armor and infantry operations are influenced primarily by those METOC elements that degrade trafficability and visibility. Furthermore, METOC conditions affect the optimal use and employment of combined arms including the integration of aviation operations with ground operations. See table 8-5.

## Artillery Operations

Artillery operations are heavily weather-dependent Artillery not only must contend with those weather effects that are common to all units, but also may compensate for a number of special effects pertinent to their operations. Environmental conditions at the target location affect the accuracy of smart munitions. Smart munitions are subject to the same effects of wind, temperature, and humidity as a free-flight projectile. These effects are moderated by the ability of smart munitions to make in-flight corrections using passive guidance methods. The greatest effect of environmental conditions on smart munitions is the effect of conditions on the ability of the smart munitions acquiring targets. Smart munitions that acquire targets by visual means can have difficulty identifying targets when the target area is obscured by clouds or blowing sand and other adverse conditions. See table 8-6 below and on page 8-9.

**Table 8-5. Ground Maneuver Operations Effects.**

| Element | Impact |
|---|---|
| Visibility | May affect visual acquisition and may degrade laser range finding and target designation |
| Precipitation | Degrades trafficability and effectiveness of target acquisition and weapon control systems and limits visibility |
| Wind (surface) | High crosswinds cause degradation of trajectory data and first-round hit capability and cause smoke to disperse quickly |
| Windchill | Influences the type of lubricants to be used, determines engine warm-up periods, and affects the sustained rate of fire for weapons as well as personnel effectiveness and safety |
| Temperature (surface) | Extreme temperatures decrease the habitability of vehicles and reduce personnel effectiveness<br>Low temperatures degrade the ballistics of main guns and require frequent starting of vehicles |
| Humidity | Decreases the effectiveness of crews in closed vehicles and the stamina of unmounted Marines when coupled with high temperatures<br>The effectiveness of smoke agents increases as humidity increases, making them more effective for screening |
| Barometric pressure | Affects M1 gunnery computations |

**Table 8-6. Artillery Operations Effects.**

| Element | Impact |
|---|---|
| Ceiling: cloud and sky cover | Affects target acquisition terminally guided munitions |
| Visibility | Affects target acquisition and fire adjustment as well as electro-optical target designation |
| Electrical storms and thunder | Restrict munitions handling |
| Refractive index | Affects radar, laser, and infrared distance measuring techniques |
| Wind (surface) | Affects the accuracy of rocket fires |

**Table 8-6. Artillery Operations Effects. (Continued)**

| Element | Impact |
|---|---|
| Wind (aloft) | Wind profiles are used to calculate ballistic wind correction |
| Altimeter setting and atmospheric pressure | Are important factors in ensuring altitude accuracy, in barofuzing, and in making fire control calculations |
| Density profile | Affects fire control computations |
| Pressure profile | Is used for baroarming and barofuzing techniques and for calculating densities |
| Temperature (surface) | Information is used in making fire control surface density determinations and in estimating ballistic atmosphere pressure and densities aloft |
| Temperature profile | Calculates ballistic temperature and air density |
| Moisture profile | Determines virtual temperature and atmosphere ducting conditions; affects electro-optical target designation |

## Aviation Operations

Marine aviation is involved in multifaceted operations over the length and breadth of the battlespace. These operations include aerial weapons, reconnaissance and surveillance, and routine logistic support. Missions are varied and require the operation of fixed-wing, rotary-wing, and tiltrotor aviation assets in various flight modes and altitudes. See table 8-7 below and on page 8-10.

**Table 8-7. Aviation Operations Effects.**

| Element | Impact |
|---|---|
| Ceiling: cloud and sky cover | Limits operations where aircraft are required to operate clear of clouds<br>May preclude landings or increase danger in takeoffs<br>May preclude close air support missions |
| Visibillity | Affects landing and takeoff capabilities, reconnaissance and target acquisition, electro-optical target designation, and terminally guided munitions<br>Low visibility increases flight hazards |
| Electrical storms and thunder | Hazardous to in-flight operations, refueling operations, and rearming operations |
| Precipitation | Affects visibility, flight safety, and density altitude<br>Powdery snow may preclude hover operations |
| Snow depth | Affects ground maneuver and takeoff/landing |
| Refractive index | Affects optical, radar, laser, and infrared range finding techniques |
| State of the ground | Influences the effectiveness of air-delivered munitions |
| Turbulence | Affects reconnaissance and surveillance; shear affects systems performance<br>May cause aircraft structural damage and affect aircraft control<br>Severe turbulence may cause cancellation of operations |
| Wind (surface) | Affects aircraft control near the ground<br>Affects landing and takeoff as well as ground speed for low-level flights |
| Blowing dust and sand | May affect hydraulic systems and windscreens |
| Wind (aloft) | Affects navigation and ground speed at higher flight altitudes |
| Density altitude | Affects lift capabilities and reciprocating engine performance<br>Limits fuel and weapons load |

Table 8-7. Aviation Operations Effects. (Continued)

| Element | Impact |
|---|---|
| Pressure altitude | Affects reciprocating engine performance |
| Pressure profile | Affects terrain avoidance |
| Temperature (surface) | High temperatures reduce lift capabilities<br>Cold temperatures increase maintenance requirements and time to perform<br>Temperature extremes can also reduce the number of personnel carried because of weight and bulk of protective gear |
| Dew point | Affects engine efficiency calculations and serves as a warning of possible fog formation or icing conditions |
| Illumination | Affects operations using night vision devices |

### Communications and Information Systems Operations

Communications and information systems operations are affected by a number of weather elements. All of the special weather conditions that apply to CIS operations also affect EM propagation. See table 8-8 below and on page 8-11.

### Air Defense Operations

Air defense operations require environmental information for deployment and employment. Deployment requires climatological data, trafficability, and severe weather forecasts. Environmental elements affecting employment vary according to the type of weapons systems used. When missile systems require radar surveillance, elements such as refractive index and precipitation must be known. Other systems require visual target acquisition. See table 8-9 on page 8-11.

### Engineer Operations

Engineer operations are influenced by current environmental conditions, forecasted conditions, and climatology. See table 8-10 on page 8-11.

Table 8-8. Communications and Information Systems Operations Effects.

| Element | Impact |
|---|---|
| Dust | Affects EM propagation |
| Electrical storms and thunder | Affects radio and wire communications and may disrupt synchronization for data communications |
| Fog | Affects EM propagation |
| Precipitation | Affects EM propagation |
| Blowing sand or snow | Builds static discharge, which may affect EM propagation |
| Ionospheric disturbance | Affects the reliability of radio communications systems |
| Refractive index | Affects EM propagation characteristics of the atmosphere |
| Icing | May damage cable lines and antennas<br>Decreases the efficiency of microwave systems |
| Wind (surface) | May damage antennas and transmission lines<br>May cause cable blow-down<br>Interferes with antenna installation |

**Table 8-8. Communications and Information Systems Operations Effects. (Continued)**

| Element | Impact |
|---|---|
| Temperature (surface) | High temperatures adversely affect electronic circuits and may increase maintenance requirements<br>Extreme cold may snap cable lines<br>Cold decreases the life of battery-operated equipment |
| Humidity | Humidity may cause fungal growth within circuits, which can result in premature system failure |

**Table 8-9. Air Defense Operations Effects.**

| Element | Impact |
|---|---|
| Refractive index | Degrades target acquisition and radar tracking performance, especially during super-refraction |
| Fog | Degrades visual acquisition and tracking |
| Ceiling: cloud and sky cover | May degrade visual acquisition and tracking |
| Precipitation | Degrades or prevents visual acquisition and tracking and infrared homing<br>May weaken radar signals |
| Surface pressure | Affects calibration of equipment |
| Electrical storms | Degrade the effectiveness of electronic systems |
| Light data | Affects visual acquisition and tracking |
| Temperature | High temperatures degrade the effectiveness of electronic systems<br>Very low temperatures may affect mechanical devices<br>Extreme cold can produce detectable ice-fog exhaust trails from certain weapons systems and vehicles |
| Humidity | Affects refraction and may degrade radar effectiveness |

**Table 8-10. Engineer Operations Effects.**

| Element | Impact |
|---|---|
| Visibility | Affects survey operations |
| Precipitation | Influences river current, water depth, and bridge construction<br>Complicates construction and maintenance operations<br>Affects flooding, river crossing operations, and soil bearing strength |
| Snow depth | Affects site selection and construction, flood prediction, and mobility and countermobility operations |
| Freeze or thaw depth | Affects site selection and construction and complicates excavation |
| Temperature (water) | Affects the survivability of troops in the water during port construction, river crossings, and beach operations |
| Tide | Affects site selection and port and beach operations, to included the timing of beach operations |
| Wind (surface) | Affects river crossings, port and watercraft operations, operations using smoke to mask unit movements, and structural strength requirements<br>Hinders certain construction operations |
| Humidity | Affects the handling, storage, and use of building materials |
| Temperature (surface) | Affects trafficability, flood potential, ice thickness, and river crossing capabilities<br>May affect the use of certain construction materials |

### Intelligence Operations

Many intelligence operations such as collection and dissemination may be hindered by certain weather conditions. All-source intelligence processing requires evaluation of all weather conditions, current and forecasted, as they affect enemy and friendly operations. See table 8-11.

### Logistic Operations

Logistic operations include the supply, maintenance, and transportation required to support the MAGTF. Numerous weather factors affect the planning and activities required for each operation. Those weather factors that influence logistic operations subsequently affect the supported combat force. If logistic units are prevented from supporting forward combat elements, the success of the combat mission may be jeopardized. See table 8-12 on page 8-13.

### Medical Support Operations

Air medical evacuation requires the same weather support as other aviation elements. Besides aviation operations, weather influences are considered in establishing field hospitals and anticipating pre-stockage and workloads. Requirements for METOC support for ground evacuation of casualties are the same as for land transportation, including considering patient comfort under extreme weather conditions. See table 8-13 on page 8-13.

**Table 8-11. Intelligence Operations Effects.**

| Element | Impact |
|---|---|
| Ceiling: cloud and sky cover | May affect aerial infrared and photographic collections systems and restrict use of upper air subsystems<br>May increase the effectiveness of illumination devices |
| Visibility | May affect visual, photographic, infrared, and electronic data collection systems |
| Electrical storms and thunder | Affect the efficiency of electronic systems and dissemination through radio and wire communications systems |
| Precipitation | Obstructs vision<br>Degrades photographic and infrared collection systems<br>May degrade radar collection systems |
| Severe weather | May prevent employment of aerial collection systems<br>May damage or prevent installation of collection system antennas |
| Ionospheric disturbances | May degrade electronic collection and communications and radar collection systems |
| Light data | Required for planning collection operations and for long-range planning |
| Icing | May degrade the performance of aerial collection systems if permitted to coat antennas |
| Wind (surface) | May affect the employment of aerial collection systems<br>May damage or prevent the installation of electronic collection system antennas |
| Temperature (surface) | May affect collection system reliability |
| Inversion | May provide false indications to certain electronic collection systems |

**Table 8-12. Logistic Operations Effects.**

| Element | Impact |
|---|---|
| Visibility | Reduced visibility<br>May slow ground movement of munitions and supplies forward<br>May preclude aerial resupply operations<br>May conceal ground transportation operations |
| Electrical storms and thunder | Endanger storage, handling, and transportation of munitions and fuels<br>May interrupt computerized inventory operations<br>Can damage storage facilities and stored material |
| Precipitation | May affect storage of munitions and supplies<br>May preclude ground transportation over unpaved surfaces |
| Snow depth | Affects the ability to move supplies forward<br>Affects the forward deployment of maintenance teams |
| Freezing precipitation | Has a severe impact on logistical and maintenance support (air and surface) |
| Surf and tide conditions | Affect the movement of supplies ashore and amphibious operations |
| Temperature (surface) | Cold may affect vehicle starting and warm-up periods and may increase maintenance requirements (as a result of temperature-induced failures)<br>Cold creates ice, which may preclude the use of waterways for transportation<br>Temperature affects the storage of perishable supplies; affects snow melting, which can cause flooding, reduce trafficability, and hinder ground transportation; and affects freeze or thaw depth, which may determine the use of supply routes<br>Temperature information is required for calibration of artillery systems |
| Humidity | Affects the storage of munitions and other supplies<br>May increase equipment failure rates and affect maintenance operations |

**Table 8-13. Medical Support Operations Effects.**

| Element | Impact |
|---|---|
| Precipitation | Affects available water supply<br>Influences hospital site selection<br>May damage unprotected supplies |
| Severe weather | May produce an increased nonbattle casualty load |
| Temperature (surface) | Extreme temperatures may require special protection of medical supplies, increase patient load because of heat and cold injuries, and affect seasonal diseases |
| Humidity | May affect storage of medical supplies |

## Military Police Operations

Military police are involved in weather-sensitive operations (see table 8-14 on page 8-14), such as—

- Route and area reconnaissance.
- Security.
- Traffic and movement control.

- Rear area protection.
- Refugee control.
- Enemy prisoner of war control.
- Civil disturbance control operations.

Acoustical propagation can significantly affect the use of loudspeakers in civil disturbance control operations. Acoustical propagation is a function of attenuation and refraction, which in turn are influenced by temperature gradient, density, wind, and sky cover.

### Chemical, Biological, Radiological, and Nuclear Operations

Chemical, biological, radiological, and nuclear operations are extremely sensitive to environmental conditions that affect the movement and diffusion of chemical or biological fallout. See table 8-15.

**Table 8-14. Military Police Operations Effects.**

| Element | Impact |
|---|---|
| Severe weather | May affect security operations and refugee control |
| Wind (surface) | Affects the use of riot control agents |
| Inversion | May affect the use of riot control agents |

**Table 8-15. CBRN Operations Effects.**

| Element | Impact |
|---|---|
| Ceiling: cloud and sky cover | Information on cloud and ground albedo, sky cover, and visibility are required to estimate thermal levels resulting from nuclear bursts |
| Precipitation | Affects the persistence of chemical agents<br>Snow may cover and render ineffective certain liquid agent<br>Precipitation may produce radioactive rainout and hot spots |
| Sunlight | Shortens the life span of biological agents |
| State of the ground | Influences the effectiveness of chemical agents and affects fallout concentration levels<br>Wet soil degrades the effectiveness of smoke munitions |
| Turbulence | Affects the length of time that chemical agents and smoke will remain in the target area |
| Wind (surface) | Wind measurements from the surface to 98,424 feet (50,000 meters) or higher are needed for fallout pattern prediction (nuclear weapons)<br>Wind affects chemical/biological agent dispersion and may decrease chemical agent persistence |
| Wind (aloft) | Affects the aerial delivery of chemical/biological agents<br>May degrade the effectiveness of smoke operations |
| Humidity | A high level of humidity increases the effectiveness of smoke and some chemical agents<br>Combined with high temperatures, humidity reduces the time in which troops in protective gear are effective<br>High humidity levels destroy some chemical agents<br>Humidity affects biological agents; the effect varies depending on humidity level and the type of agent |
| Inversion | Affects aerosol dispersion and the persistence of chemical/biological agents |

### Military Information Support Operations

Tactical military information support operations are influenced primarily by those weather elements that degrade the audibility of loudspeaker broadcasts and affect the distribution of leaflets. See table 8-16.

**Table 8-16. Military Information Support Operations Effects.**

| Element | Impact |
|---|---|
| Ceiling: cloud and sky cover | May affect aerial loudspeakers and leaflet delivery by restricting visibility and access to the target |
| Visibility | The delivery of leaflets by aircraft may be hampered when the pilot cannot see the target |
| Electrical storms and thunder | Electrical storms and thunder reduce the audibility of loudspeakers and interfere with radio broadcasts |
| Precipitation | May force the target audience under cover, where they are not receptive to leaflet drops or loudspeaker broadcasts<br>Reduces the audibility of loudspeakers and destroys leaflets |
| Snow | Reduces the effectiveness of leaflet dissemination and durability |
| Wind (surface) | Reduces the audibility of loudspeakers<br>Wind speed and direction will affect the distribution of leaflets by air or artillery |
| Humidity | Affects the distance sound will travel |

## CRITICAL VALUES

Meteorological critical values significantly reduce the effectiveness of operations, equipment, and weapons systems. Significant variations above or below critical values can prevent the successful completion of a mission. Therefore, METOC personnel must be included in the planning stages of all operations. Commanders must be aware of meteorological critical values and consider them in all planning. Once the commander provides guidance on which operations to focus the METOC effort, METOC personnel will then research and determine critical values for those operations for approval by the commander.

Tables 8-17 through 8-29, on pages 8-16 through 8-27 provide a baseline of critical values for specific and branch operations. It does not, however, provide absolute values for every operation or weapons system in the battlespace. Critical values must be weighed against the tactical situation and the mission. Although METOC personnel forecast and call attention to critical factors, commanders and operators must validate which values are critical for each operation. The tables may be used as a starting point to develop meteorological critical threshold values. In reaching a decision, the commander weighs environmental impact data and information provided by the MST, as well as additional input from terrain analysis teams and other sources, to factor the criticality of the mission versus risks. This METOC information and the resultant impacts to operations are frequently organized in the form of a METOC impacts matrix, which is discussed in appendix F.

**Table 8-17. Amphibious Operations Critical Values.**

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <1,000 feet | Concealment; close air support planning |
| Visibility (surface) | <1 mile | Target acquisition |
| Wind (surface) | >7 knots | Personnel landing and smoke operations |
| | >35 knots | Wave and surf limits |
| Temperature (surface) | >90 °F | Personnel and equipment support |
| | <32 °F | Planning and logistic support, fuels, and expendable supplies |
| Windchill | <-25 °F 1-minute exposure<br><-74 °F 1-second exposure | Troop safety |
| Precipitation | >0.1 inch/hour liquid | Shore trafficability |
| Effective illumination | <0.0022 lux | Planning for night landing operations and concealment |
| Littoral current | Any underlying current or riptide<br>>3 knots | Mission planning |
| Tides | Variable threshold of watercraft | Type of watercraft required<br>Timing of mission |
| Temperature (water) | <60 °F | Personnel safety |
| Sea state | >3-foot waves | Mission planning |
| Surf breaker description | Surging surf >4-foot breakers | Mission planning |
| Surf zone | Area covered by surf | Mission planning |

**Table 8-18. Intelligence Operations Critical Values.**

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <200 feet | Engagement range |
| | <1,000 feet | Aerial observation |
| Surface visibility at the following wavelengths:<br>1.06 microns, 3 to 5 microns,<br>8 to 12 microns | <1 mile | Determination of the ability to conceal actions<br>Location and identification of targets |
| Wind (surface) | >60 knots | Equipment damage |
| Precipitation | >0.1 inch/hour liquid | Audio sensors and radar effectiveness |
| | >0.5 inch/hour liquid | Speed of personnel and equipment movement |
| | >2 inches within 12 hours | Speed of personnel and equipment movement<br>Trafficability and storage of equipment |
| Snow depth and cover | >6 inches | Trafficability |
| Thunderstorms and lightning | Any occurrence within 3 miles | Troop and equipment safety<br>False alarms and false readings |
| Temperature (surface) | >122 °F<br><-58 °F | Emplacement site selection |
| Temperature (ground) | <32 °F | Trafficability assessment |
| WBGT index | >85 °F | Troop safety |
| EM propagation | Subrefraction and super-refraction | Ducting of radar transmission and returns |
| Effective illumination | <0.0022 lux | Target acquisition |
| River stage and current strength | >6-foot depth | Enemy’s ability to cross rivers or streams |

### Table 8-19. Ground Maneuver Operations Critical Values.

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <1,000 feet | Concealment and cover from threat surveillance<br>Tactical air and aerial supply support<br>Background contact for target acquisition or using thermal devices |
| Surface visibility at the following wavelengths: 1.06 microns, 3 to 5 microns, 8 to 12 microns | Dragon <800 feet<br>TOW <1,600 meters | Target acquisition<br>System selection |
| Wind (surface) | >7 knots | Smoke operations<br>Background radar noise |
| | >20 knots | Visibility restriction in blowing sand and snow<br>Soil drying speed<br>Aerial resupply<br>Windchill effect on equipment and personnel |
| | >30 knots | Accuracy of antitank missiles |
| | >75 knots | Antenna failure |
| | >125 knots | Equipment (van) failure |
| Precipitation | >0.1 inch/hour liquid<br>>2 inches within 12 hours | Soil type (affected by temperature and moisture)<br>Vehicle movement<br>Site location<br>River levels<br>Runoff<br>Flooding<br>Delays in resupply<br>Demolitions<br>River crossing<br>Visibility<br>Target acquisition<br>Radar effectiveness |
| Snow depth and cover | >2 inches within 12 hours<br>>6 inches<br>>24 inches | Effectiveness of mines<br>Choice of construction materials<br>Trafficability |
| Freeze and thaw depth | <6 inches | Off-road employment of wheeled and tracked vehicles |
| Thunderstorms and lightning | Any occurrence within 3 miles | Munitions safety<br>Personnel communications equipment safety |
| Temperature (surface) | >122 °F | Thermal sights |
| | >90 °F | Lubricants, personnel, and infrared sensors |
| Humidity | | Smoke screen effectiveness |

### Table 8-19. Ground Maneuver Operations Critical Values. (Continued)

| Element | Critical Value | Impact |
|---|---|---|
| Temperature (surface) | >32 °F | River crossing sites and off-road movements (affected by melting snow and ice) |
| | <32 °F | Drying of soil<br>Freeze or thaw depth |
| | Any change of 50 °F within 24 hours | Munitions trajectories |
| Sea/shore conditions | Current and tide >5 knots | Beach and port sea-to-shore loading and offloading operations |
| | Waves >3 feet<br>Swell >3 feet<br>Surf >5 to 6 feet | Landing operations |

Legend

| | |
|---|---|
| TOW | Tube launched, optically tracked, wire command link guided missile |

### Table 8-20. Field Artillery Operations Critical Values.

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <600 feet | Target acquisition<br>Copperhead performance |
| Surface visibility at the following wavelengths: 1.06 microns, 3 to 5 microns, 8 to 12 microns | <1 mile | Target acquisition |
| Wind: vertical profile | >5-knot change/3,280 feet | Nuclear fallout prediction |
| Thunderstorms and lightning | Any occurrence within 3 miles | Safety and storage of munitions |
| Effective illumination | <0.0022 lux | Mission planning for night artillery operations |

**Table 8-21. Aviation and Air Assault Operations Critical Values.**

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <300 feet (90 miles) | Nap-of-the-earth planning and acquisition—rotary wing |
| | <300 feet (90 miles) flat terrain | Daylight target acquisition—fixed wing |
| | <500 feet (150 miles) mountain terrain | Daylight target acquisition—fixed wing |
| | <500 feet (150 miles) flat terrain | Night target acquisition—fixed wing |
| | <1,000 feet mountain terrain | Night target acquisition—fixed wing |
| Visibility (surface) | <0.25 miles (400 meters) | Navigation and target acquisition—rotary wing |
| | <1 mile (1,600 meters) | Landing and takeoff minimums for mission planning |
| | <3 miles (4,800 meters) | Landing and takeoff minimums for mission planning |
| Visibility (slant range) | <0.25 miles (400 meters) | Navigation and target acquisition—rotary wing |
| | <3 miles (4,800 meters) mountain terrain | Navigation and target acquisition—rotary wing |
| Wind (surface) | >30 knots | Mission planning |
| | >15-knot gust spread | Aircraft safety |
| Wind (aloft) | >30 knots | Mission planning—duration |
| Precipitation | Any freezing | Rotor blade icing<br>Aircraft survivability and damage |
| | >0.5 inch/hour liquid | Target acquisition |
| Hail | >0.25-inch diameter | Aircraft damage |
| Snow depth and cover | >l inch (2.54 centimeter) powder | Location of landing zone and drop zone<br>Vertigo |
| Icing | >Light (clear/rime) | Mission planning and safety<br>Ordnance delivery restrictions—rotary wing |
| Turbulence | Moderate | Mission planning<br>Aircraft survivability |
| Thunderstorms and lightning | Any occurrence within 3 miles of site | Refueling and rearming operations |
| Density altitude: variable with aircraft, weight, power, and temperature | >6,900 feet | Flight control, runway limits, takeoff, and landing |
| Effective illumination | <0.0022 lux | Mission planning for night operations |

**Table 8-22. Air Defense Operations Critical Values.**

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <500 feet | Selection of weapons systems and positioning for convoy |
| | <5,000 feet | Aircraft detection and identification |
| Visibility (surface) | <2 miles | Aircraft detection and identification for short-range air defense systems |
| | <3 miles | Weapons system selection and placement for the Stinger system |
| Wind (surface) | >30 knots | Communications and radar antenna |
| | >50 knots<br>>57-knot gusts | Weapons system selection and planning |
| Wind (aloft) | >50 knots | Aiming and tracking |
| Precipitation | >0.5 inch/hour liquid | All radar > 10 gigahertz (degraded)<br>All infrared sensors |
| Thunderstorms and lightning | Any occurrence within 2 miles of site | Communications, radar, and storage and protection of missile systems |
| Temperature (surface) | >120 °F<br><-45 °F | Mission planning for use of a man-portable air defense system |
| Windchill | <-25 °F<br>1-minute exposure | Personnel protection<br>Planning gear and equipment needs |
| | <-74 °F<br>1-second exposure | Personnel protection<br>Planning gear and equipment needs |
| Effective illumination | <0.0022 lux | Target acquisition of aircraft |

**Table 8-23. Engineer Operations Critical Values.**

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <500 feet | Area of operations and location of facilities<br>Personnel safety<br>Aerial reconnaissance<br>Camouflage needs |
| Visibility (surface) | <0.25 miles | Mission planning<br>Concealment and cover |
| Wind (surface) | >13 knots | Construction and stability of bridges and structures |
| Precipitation | >0.5 inch/hour liquid | Need for mines (reduced)<br>Loading and offloading operations |
| Snow depth and cover | >2 inches within a 12-hour period | Some areas of operations and locations of facilities<br>Stability of bridge structures<br>Types of demolitions to be used and size and charge<br>Blast from trigger mechanisms (may render mines ineffective) |
| Freeze and thaw depth | <6 inches | Trafficability determination |
| Thunderstorms and lightning | Any occurrence within 1 mile of site | Equipment and personnel safety<br>Munitions protection |
| Temperature (ground) | <-32 °F | Freeze or thaw depth determination<br>Construction material<br>Operations, personnel, and structures (threatened as a result of precipitation at or below 32 °F) |
| Humidity | >35 percent | Comfort, equipment operations, and site selection planning |

**Table 8-24. Airborne Operations Critical Values.**

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <300 feet (90 meters) flat terrain | Mission planning (day)—jump altitude, aircraft penetration |
| | <500 feet (150 meters) flat terrain | Mission planning (night)—jump altitude, aircraft penetration |
| | <500 feet (150 meters) mountain terrain | Target acquisition (day) |
| | <1,000 feet (300 meters) mountain terrain | Target acquisition (night) |
| | <10,000 feet mountain terrain | Mission planning for landing zone or drop zone |
| Surface visibility at the following wavelengths: 1.06 microns, 3 to 5 microns, 8 to 12 microns | <0.25 miles (400 meters) | Mission planning—infrared sensors<br>Navigation and target acquisition—rotary wing |
| | <1 mile (1,600 meters) | Day mission planning—minimum takeoff or landing, minimum fixed wing |
| | <3 miles (4,800 meters) | Night mission planning— minimum takeoff or landing, minimum fixed wing |
| Wind (surface) | >13 knots | Troop safety for paradrop operations<br>Limiting value for operations during training |
| | >15 knots (>21 knots for C-12 and U-21) | Mission planning and aircraft safety and recovery |
| | >25 knots | Mission planning and aircraft safety and recovery |
| | >30 knots and/or gust speeds | Mission planning and aircraft safety and recovery |
| Wind (aloft) | >40 knots | Jump point<br>Planning for flight route and duration |
| Precipitation | Any intensity or type | Rate of troop fall and target acquisition |
| Thunderstorms and lightning | Any occurrence | Aircraft performance<br>Aircraft refueling<br>Reliability of communications systems<br>Pre-detonation of certain munitions |
| Temperature (surface) | <32 °F | Ground conditions |
| Pressure altitude | <100 feet | Parachute opening altitude |
| Density altitude: variable with aircraft, weight, power, temperature | >6,900 feet | Planning<br>Cargo limits |
| | >4,000 feet | Weight limits for attack and MV-22s |
| | >2,000 feet | CH-46 troop configuration (limited) |
| Effective illumination | <0.0022 lux | Planning of night missions<br>Navigation safety |

**Table 8-25. CBRN Operations Critical Values.**

| Element | Critical Value | Impact |
|---|---|---|
| Ceiling: cloud and sky cover | <5,000 feet | Aerial deployment agents<br>Thermal effects (enhanced if burst is below clouds)<br>Thermal and electromagnetic pulse effects (reduced if burst is above clouds) |
| Wind | >3 knots but <7 knots | CBRN operations (favorable) |
| | >10 knots | CBRN operations (unfavorable) |
| | >15 knots | First-round munitions accuracy |
| Precipitation | Any intensity or type | Washing of agents and smoke out of the atmosphere<br>Nuclear hot spot creation |
| Thunderstorms and lightning | Any occurrence within 3 miles | Troop and munitions storage safety |
| Temperature (surface) | >95 °F | Rate of evaporation of liquid chemical agents<br>Dispersion of aerosols (high risk of injury in MOPP IV) |
| | >68 °F | Risk of heat illness in persons in MOPP IV (moderate) |
| | <32 °F | Type of shelter (determined by climate extremes)<br>Troop vulnerability to nuclear radiation (indirectly affected)<br>Thermal radiation effect (indirect) due to type of troop clothing |
| Temperature (vertical gradient profile) | Reversal from stable to unstable | Time agents or smoke will remain in an area (reduced) |
| | Reversal from unstable to stable | Time agents or smoke will remain in an area (increased) |
| Humidity | >60% | Agent effectiveness and dispersion for blister agents (very effective in hot, humid weather) |
| Effective illumination | <0.0022 lux | Night operation of CBRN equipment |

Legend

| | |
|---|---|
| MOPP | mission-oriented protective posture |

### Table 8-26. Logistic Operations Critical Values.

| Element | Critical Value | Impact |
|---|---|---|
| Snow depth and cover | >2 inches | Trafficability |
| Freeze and thaw depth | <6 inches | Site and equipment selection<br>Mobility |
| Thunderstorms and lightning | Any occurrence within 3 miles | Equipment, personnel, and munitions safety |
| Temperature (surface) | >122 °F<br><-25 °F | Storage and required temperature control for movement of medicines<br>Munitions storage |
| Humidity | >70% | Storage of selected supplies and munitions |

### Table 8-27. Communications and Informations System's Operations Critical Values.

| Element | Critical Value | Impact |
|---|---|---|
| Wind (surface) | >7 knots | Radar background noise |
| | >25 knots | Safety and stability for installing line of sight and troposcatter antennas |
| | >69 knots | Wind damage to main communications antenna—linear pole |
| | >78 knots | Safety and stability of single channel radio and short-range, wideband radio antennas |
| Precipitation | Any occurrence of freezing | Damage to equipment and antennas<br>Wind tolerances of antennas<br>Troop safety |
| | >0.5 inches/hour liquid | Blocking of troposcatter transmission<br>Radar range (decreased)<br>Signal for single channel radio, short-range wideband radio, and line of sight communications (attenuated by precipitation) |
| Thunderstorms and lightning | Any occurrence within 3 miles | Damage to equipment<br>Interference with radio signals, especially high frequency signals |
| Temperature (vertical gradient or profile) | All significant inversions | Fading during use of troposcatter equipment |
| Ionospheric disturbances | Not applicable | Dictation of most usable frequencies for communications |

**Table 8-28. Waterborne Surface Assault (General) Critical Values.**

| **Element: Sea State** | | | |
|---|---|---|---|
| **Platform** | **Favorable** | **Marginal** | **Unfavorable** |
| CRRC | 1 | 2 | >2 |
| LCM8 | 2 | 3 | >3 |
| LCU | 2 | 3 | >3 |
| LCAC | 3 | 4 | >4 |
| **Element: Maximum Surf** | | | |
| **Platform** | **Favorable** | **Marginal** | **Unfavorable** |
| CRRC | <2 feet | 2 to 3 feet | >3 feet |
| LCM8 | <6 feet | 6 to 7 feet | >7 feet |
| LCU | <6 feet | 6 to 7 feet | >7 feet |
| LCAC | <7 feet | 7 to 8 feet | >8 feet |
| **Element: Modified Surf Index** | | | |
| **Platform** | **Favorable** | **Marginal** | **Unfavorable** |
| LCM8 | <7 | 7 to 8 | >8 |
| LCU | <11 | 11 to 12 | >12 |
| LCVP | <4 | 4 to 5 | >5 |
| **Element: Littoral Current** | | | |
| **Platform** | **Favorable** | **Marginal** | **Unfavorable** |
| LCU | <1 knot | 1 to 2 knots | >2 knots |
| **Element: Miscellaneous** | | | |
| **Platform** | **Favorable** | **Marginal** | **Unfavorable** |
| LCAC: | | | |
| Significant breaker height | 0 to 4 feet | 4 to 8 feet | 8 to 12 feet |
| Significant breaker type | Spilling | Surging | Plunging (steep) |
| Allowable load size | 75 tons | 60 tons | 45 tons |
| Temperature restrictions | 25–99° F | 16–24° F | <15° F or >100° F |
| Pressure limitations | N/A | N/A | N/A |

Legend

| | |
|---|---|
| CRRC | combat rubber reconnaissance craft |
| LCAC | landing craft, air cushion |
| LCM | landing craft, mechanized |
| LCU | landing craft, utility |
| LCVP | landing craft, vehicle, personnel |
| N/A | not applicable |

**Table 8-29. Critical Values for the Amphibious Assault Vehicle.**

| Load | Maximum Surf Height | Wave Interval (Not Less Than) |
|---|---|---|
| **100% Plunging Surf** | | |
| Combat load | 6 feet | 9 seconds |
| Troop load | 6 feet | 9 seconds |
| Combat equipped | 6 feet | 13 seconds |
| **50% Plunging Surf, 50% Spilling Surf** | | |
| Combat load | 6 feet | 8 seconds |
| Troop load | 6 feet | 8 seconds |
| Combat equipped | 6 feet | 10 seconds |
| **100% Spilling Surf** | | |
| Combat load | 6 feet | 5 seconds |
| Troop load | 6 feet | 5 seconds |
| Combat equipped | 6 feet | 7 seconds |
| Note: Criteria apply to the AAVP-7A1; AAVC-7A1 and AAVR-7A1. Criteria are based on the following three load conditions; combat load—10,000 pound; troop load—5,600 pound; combat equipped—no load.<br>Planning for combat operations should be predicated on the AAVP-7A1's demonstrated capability of negotiating 10-foot plunging waves in combat-load and troop-load conditions and 8-foot plunging waves in combat-equipped conditions. | | |

Legend

| | |
|---|---|
| AAVC | amphibious assault vehicle, command model |
| AAVP | amphibious assault vehicle, personnel model |
| AAVR | amphibious assault vehicle, recovery model |

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# CHAPTER 9

# PRODUCTS AND DECISION AIDS

Meteorological and oceanographic products and decision aids are the end result of the functions of characterizing and exploiting the environment as described in chapter 1. Though examples are provided in this chapter and appendices E through H, the commander, situation, and method of communications dictate in what format the products are assembled and disseminated. Some are produced routinely and can be easily tailored to suit a variety of operations while others require greater detail and a more complex effort to produce. All are tailored to the level of command and the mission; from the MAGTF commander to the mission or aircrew commander.

The mission, level of command, and scope of operations dictate which products and decision aids are applicable and the level of detail of each. Generally, the higher the level of command, the broader and more generalized the product will be due to the larger scope of operations, longer planning timeframes, and size of the AOI. To assess METOC conditions and impacts 96 hours or more in advance requires METOC data over a large area often covering several thousand miles. In contrast, the lower the level of command, the more detailed the product may be due to increased attention to detail and focus on a more specific operation or mission, with also smaller or shorter time and space dimensions. The intent of all METOC products and decision aids is to convey an accurate picture of METOC conditions and impacts, both current and forecast, in the area of operations upon which decision makers can make informed decisions.

## METOC IMPACTS MATRIX

Environmental elements and their associated impact on operations are the primary focus of the METOC impacts matrix. It is normally part of the IPB and assists commanders and planners in COA development and maintaining situational awareness of environmental conditions during the planning and execution phases of an operation. It may also be used in confirmation briefs to assist decision makers in making *GO/NO GO* decisions for mission execution based on previously determined thresholds for METOC elements. The impact of METOC conditions on specific mission areas will be defined as favorable, marginal, or unfavorable.

The METOC impacts matrix is tailored and adapted to meet specific operational criteria or mission parameters as discussed in chapter 8. Though the commander and mission drive the format and content of the matrix, units should strive to establish standard METOC thresholds and formats as part of the OPORD and SOP in order to facilitate a common understanding of the METOC impacts matrix amongst members of the unit. Doing so can significantly reduce the coordination required to develop the matrix for standard missions, operations, and systems, thereby promoting operational tempo and ongoing IPB. The METOC impacts matrix is typically color coded to help the decision maker quickly assess the impact of METOC conditions on impending operations and decisions. An example of a METOC Impacts Matrix is available in appendix F.

## CLIMATOLOGICAL SUPPORT PRODUCTS

As discussed in chapter 3, climatological products can be prepared for any location of interest for any time of year. They may be confined to a specific location and season or month of the year, or cover large areas for an entire year and all seasons. Climatological products require the collection of historical data and in depth research of available references to identify METOC patterns, trends, averages, and extremes of METOC elements and conditions for the AOI observed over a period of time. The requirement for climatological products needs to be identified as early as possible to allow time to gather and research relevant references. Generally, a minimum of one week is required to produce a climatological package depending on the time and space considerations for the AOI. These products provide a first glimpse of METOC conditions in the AOI during the initial IPB and are normally prepared as part of predeployment and deliberate planning for OPORDs and OPLANs. A climatological summary and operational assessment is usually included in annex B of OPORDs and OPLANs. It is important to note that while climatological information is based on historical conditions, current and future conditions and trends may vary or deviate from the historical averages.

## MARINE AIR-GROUND TASK FORCE STANDARD TACTICAL METOC SUPPORT PRODUCTS

This plan provides for a common baseline of standardized products and services that may be provided during MAGTF operations. These tactical support products are normally developed for large scale operations and tailored or modified as necessary by on-scene METOC personnel to meet specific operational requirements and tactical situations. The format and method of dissemination are dictated by the situation. The METOC support products are described in the following subparagraphs.

### Standard Tactical Summaries

***Marine Air-Ground Task Force Environmental Forecast.*** The MAGTF weather forecast is based on the standard NAVMETOCCOM weather forecast format and shall include a meteorological situation, 24-hour forecast, and outlook to 96 hours for each METOC zone of interest. Astronomical data and a radiological fallout forecast should be appended as required. Appendix A contains an example of a weather forecast.

***Tactical Atmospheric Summary***. The tactical atmospheric summary (TAS) provides information to exploit the EM and electro-optical regions of the spectrum. The TAS should include an atmospheric refractive summary, tactical assessment, EM sensor performance predictions, infrared sensor detection range predictions, communications range predictions, and an M-unit summary. Radiosonde calibration data should be appended when upper air capable units are operating in close proximity. Appendix A contains an example of a TAS.

### Special Tactical Summaries

***Strike Forecast***. The strike forecast is designed to provide a coordinated forecast whenever multiple strike platforms are operating as an integrated force under one tactical commander. It includes a plain language meteorological situation, 24-hour forecast of en route and target weather, outlook to 48 hours, tactical assessment, and electro-optical and EM sensor performance predictions. Appendix A contains an example of a strike forecast.

***Assault Forecast***. The assault forecast is designed to provide a coordinated forecast whenever multiple assault support platforms are operating as an integrated force under one tactical commander. It includes a plain language meteorological situation, 24-hour forecast of en route weather, FARP, rapid ground refueling and landing zone weather, outlook to 48 hours, tactical assessment, and electro-optical sensor performance predictions. Appendix A contains an example of an assault forecast.

***Amphibious Objective Area Forecast***. The amphibious objective area forecast is designed to provide support for exercise/real-world amphibious landings and rehearsals. It includes a plain language meteorological situation, 24-hour forecast for the amphibious objective/landing area, surf forecasts for target beaches, tactical assessment, abbreviated atmospheric summary, and astronomical data. A radiological and chemical fallout forecast would be appended as the tactical situation dictates. Appendix A contains an example of an amphibious objective area forecast.

### Graphical Forecasts

Graphical forecasts are designed to provide a 96-hour forecast with impacts to specified locations determine by the commander. Appendix A contains an example of a graphical forecast.

## METOC BRIEFS

Meteorological and oceanographic briefs are prepared and presented in support of operational or tactical objectives. Various types of media can be used to produce these briefs; electronic is the most popular. Prior planning and coordination with the G-2/S-2 and G-3/S-3 is recommended to ensure consistency, continuity, and relevancy of the type of brief to be conducted. Briefs are most often given when a detailed explanation of the contents is required by METOC personnel or the presence of METOC personnel is required to answer any questions from the commander or decision makers. There are two types of METOC briefs: climatological briefs and operational briefs.

### Climatological Briefs

Climatological briefs are usually a graphical and verbal presentation of information derived from a climatological study and are used for mission planning. See appendix G for an example of a climatological brief.

### Operational Briefs

Operational briefs may be developed for standard missions that are routinely produced according to a battle rhythm, such as commander's brief or targeting boards. They may also be developed for specific task-organized missions such as aviation strike missions, logistical convoy operations, or raids. Operational briefs may include any combination of products and decision aids discussed in this chapter or other tailored products required by the mission. In each case, METOC personnel use the briefing to graphically and verbally characterize relevant METOC conditions over time and space. Appendix H contains an example of an operational brief.

## OCEANOGRAPHIC PRODUCTS

Several oceanographic products and services are available to aid MAGTF commanders and planners. The focus of oceanographic products is amphibious operations. Tailored products can be provided on request to accommodate many missions and situations. These products must be requested from the Warfighting Support Center at NAVO in Stennis Space Center, MS. Imagery support and products derived from imagery should be requested from the Warfighting Support Center with as much lead time as possible since the imagery is often derived from the tasking of national assets. Some of the more common products and services are discussed in the following subparagraphs.

### Annotated Imagery of Littoral Areas

Images obtained from land satellite, the French *Satellite Pour l'Observation de la Terre*, or other national technical means are analyzed to extract oceanographic parameters. Detected obstructions, reefs, shoals, nearshore currents, water clarity, and sea surface temperatures are typically annotated.

### Environmental Support Packet

An environmental support packet describes nearshore oceanographic conditions by providing evaluated data on nearshore hydrography, tides, currents, marine life, and water clarity. It normally includes an oceanographic executive summary to highlight significant features.

### Hydrographic Survey

The purpose of a hydrographic survey is to systematically collect information about the foreshore and nearshore sea approaches to a designated landing beach. This information will be transferred to a hydrographic sketch, which may be used by the commander, landing force. The survey normally encompasses the nearshore area from the 3-fathom line to the water's edge; the foreshore, backshore, and hinterland for about 100 yards; and the length of the beach as designated by the commander, landing force. The hydrographic survey and beach survey overlap in that they both cover the foreshore.

## TACTICAL DECISION AIDS

### Target Acquisition Weapons Software

The effects of weather on sensor performance of various weapon systems and platforms are complex. Although new technology continues to offer advantages that increase performance of "smart" weapons, an unavoidable and intangible factor is the weather and its impact on them. Target Acquisition Weapons Software is a program composed of various physical models that predict the performance of air-to-ground weapon systems and direct-view optics based on environmental and tactical information. The resultant product is an electro-optical decision aid.

Performance is expressed primarily in terms of maximum detection or lock-on range with recognition and identification range predictions also available. Execution products are available for a specific time versus view direction and planning products are available for a specific view direction versus time. The latter provides times of best and worst performance for the given view direction while the former provides the direction of best and worst performance. Planning products are also a useful tool to determine thermal crossover of a target with its background. Target Acquisition Weapons Software supports systems in three regions of the spectrum: infrared (3 to 5 microns; 8 to 12 microns); visible (0.4 to 0.9 microns); and laser (1.06 microns). The visible includes both television and NVD systems. It provides the capability to determine times of thermal crossover for given targets and backgrounds, times of best and worst sensor performance for a given ingress azimuth, or ranges for 360 degrees of azimuth at a specific location and time for a specific target. Results are displayed in graphic and tabular formats, as well as map overlays. These products are classified according to the classification of the sensor involved and must be treated accordingly.

### Advanced Refractive Effects Prediction System

The Advanced Refractive Effects Prediction System (AREPS) was developed to exploit the EM spectrum by predicting the performance of EM systems with regard to the refractive effects of the environment on EM energy. The AREPS computes and displays a number of decision aids using historical meteorological information, locally-collected meteorological information, or numerical forecast model data. The AREPS-generated decision aids include the following:

- Airborne and surface-based radar probability of detection.
- Electronic surveillance measure (ESM) vulnerability.
- Ultra-high frequency/very high frequency communications.
- Simultaneous radar detection and ESM vulnerability.
- Modified refractivity summary.
- Range-dependent raytrace.
- Surface-search range table.

All decision aids are displayed as a function of height, range, and bearing. Detection probability, ESM vulnerability, communications, and surface-search range assessments are based on EM system parameters stored in a user-changeable database. Paths containing land features depend on terrain data either obtained from the National Geospatial-Intelligence Agency digital terrain elevation data or specified from an alternate source.

### Geophysics Fleet Mission Program Library

The Geophysics Fleet Mission Program Library (GFMPL) is a software library established by the COMNAVMETOCCOM to provide meteorological, oceanographic, hazard avoidance, and acoustic software for fleet, air, surface, planning, amphibious, and antisubmarine warfare operations. It is a rapid response, on-scene, environmental prediction system used to quickly determine the effects of the environment on fleet sensors, platforms, and weapon/sensor systems. The GFMPL is available via the Web through a Web-based application or as standalone software. Though not all inclusive, GFMPL is composed of the software applications and programs discussed in the following subparagraphs.

***Surf Forecast***. The surf forecast predicts surf conditions of ocean waves that have moved from deep water through the surf zone and on to the shore. A calculated, modified surf index is compared with the operational limits of various landing craft to judge the craft's suitability under projected surf conditions. This program is available via Web-based and standalone GFMPL.

***Solar/Lunar Almanac Prediction***. Solar/lunar almanac prediction produces monthly or daily summaries of ephemeral data for the sun and moon. This program is available via Web-based and standalone GFMPL.

These summaries include the following:

- Times for sunrise/set, moonrise/set, beginning/ending of civil/nautical/astronomical twilights.
- Total daylight and daily illuminance.
- Phase of the moon in percent illumination.
- Time and altitude of sun/moon meridional passage.
- 24-hourly solar/lunar positions (altitude and azimuth).
- Light-level planning calendar.

***Tidal Prediction***. Tidal prediction calculates hourly tidal heights from local harmonically analyzed constituents or from nonlocal constituents by means of corrections applied to the times and heights predicted for a nonlocal station. This program is available via Web-based and standalone GFMPL.

***Pressure Altitude/Density Altitude***. Pressure altitude/density altitude computes the pressure and density altitudes (as well as the altimeter setting) and sea-level pressure based on the air and dewpoint temperature, station elevation and pressure, and the 12-hour mean station temperature entered by the user. This program is available via Web-based and standalone GFMPL.

***Temperature Utility***. Temperature utility provides the user with the capability to determine the relative humidity based on the air and dewpoint temperatures and the comfort temperatures (heat stress or equivalent chill) based on the temperature and dewpoint and the temperature and wind speed, respectively. The user may also calculate the dewpoint temperature using air temperature, WBGT, and pressure. This program is available via Web-based and standalone GFMPL.

***Wind Conversion***. This program computes true wind, wind speed and direction relative to a fixed point. On a moving ship, true wind may be computed given the ship's speed and heading, and the wind speed and direction relative to the moving ship (known as relative wind). This program is available via Web-based and standalone GFMPL.

***Radiosonde Initial Analysis***. The radiosonde initial analysis module takes meteorological upper air data, performs an analysis, and computes numerical thermodynamic indices and stability parameters for use in the EM/electro-optic modules. An upper air sounding, either locally derived or received in a WMO-format from other sources, is processed for output product and data display. Previous upper air data entries may be recalled for editing and/or reuse. An upper air sounding can be exported in a WMO format as a text file for use in other applications. This program is only available via the standalone GFMPL.

***Beach Survey Chart***. With the beach survey chart (BSC) module, the user can create, display, and edit a digital beach chart. This chart, as surveyed by a sea-air-land team, consists of an array of soundings in the surf zone, a set of observed shore features, and other information. The user enters the grid of depths, positions a complete set of shore features, and annotates the chart using a mouse or trackball and keyboard. After the user enters the soundings, the program contours the depth field. The user can retrieve and display existing charts, edit them, archive them, and read them from removable media. The user can also access a database of previously digitized BSCs. The soundings in a beach chart created or edited using the BSC program can be used for surf predictions in the surf forecast program. This program is only available via the standalone GFMPL.

***Naval Search and Rescue***. Naval search and rescue is a program to assist the search mission coordinator in decisions concerning searching for a target, such as how many assets to use and how to assign those assets to maximize their effectiveness. This program is only available via the standalone GFMPL.

***Tropical Cyclone***. The tropical cyclone program tracks tropical cyclone movements and conditions on an operator-specified map. It also provides the capability to enter storm data (windspeed radii and maximum wind speed) into the environmental data files for later use. Functions include the entry/edit of storm data, calculation and display of historical and predicted storm information, and deletion of forecast records. The seven forecast display options include storm current warning, storm history and forecasts, wind radii, danger areas, forecast tracks comparison, high winds probability, and closest point of approach. This program is only available via the standalone GFMPL.

***Ambient Noise***. The basic function of the ambient noise module is to compose the omni and directional noise levels at a geographic point, for a given frequency, and season. Information used in the computation comprises the summer 50 Hz shipping noise at the point, the frequency correction relative to 50 Hz, the seasonal correction, the historical or user-supplied wind speed, and, for location in the marginal ice zone, historical ice edge information. The historical position of the ice edge relative to the point of interest may be overridden by the operator. This program is only available via the standalone GFMPL.

***Oceanographic and Atmospheric Master Library Data Viewer***. The Oceanographic and Atmospheric Master Library (OAML) contains databases that are accessed through the OAML data viewer, which can perform three types of queries into the OAML databases. These are point, trackline, and rectangle. The databases that are included are surface marine gridded climatology, generalized digital environmental model variable, digital bathymetric database-variable resolution, low frequency bottom loss, high frequency bottom loss, and volume scattering strength. This program is only available via the standalone GFMPL.

***Pilot Balloon***. The pilot balloon computes a vertical profile of wind speed and direction based on the observation of a pilot balloon. Input includes the angles of elevation and azimuth to the balloon at whole-minute time intervals. Output is a listing of the wind's speed and direction at 300-meter intervals. This program is available via Web-based and standalone GFMPL.

***Meteorological Ballistic Message***. A meteorological ballistic message accepts/reads soundings from the library populated by the upper air utility and generates computer meteorological ballistic messages of the standard and tactical fire variety. This program is available via Web-based and standalone GFMPL.

***Upper Air Utility***. The upper air utility takes as an input mini-rawinsonde data and archives this data for the purpose of the meteorological ballistic message application. This program is only available via the Web-based GFMPL.

# APPENDIX A
# ANNEX H EXAMPLE

The following list of acronyms and abbreviations appear in and are applicable to this appendix only. Acronyms or abbreviations not found in this list are located in Section I of the glossary. All nomenclature is located in Section III of the glossary.

> ***Note:*** There are multiple entries consisting of subject matter specific terms and short forms for timely order writing and briefings. These short forms are applicable to this appendix only.

| | |
|---|---|
| AAV | amphibious assault vehicle |
| AFW-WEBS | Air Force Weather Web Services |
| AO | area of operations |
| | |
| BDA | battle damage assessment |
| BKN | broken (*cloud cover condition*) |
| BMCT | beginning morning civil twilight |
| BMNT | beginning morning nautical twilight |
| BGAN | Broadband Global Area Network |
| | |
| CATF | commander, amphibious task force |
| CJCSI | Chairman of the Joint Chiefs of Staff instruction |
| CLF | commander, landing force |
| CLR | clear (*cloud cover condition*) |
| CNSL | Commander, Naval Surface Forces, Atlantic |
| CNSP | Commander, Naval Surface Force, Pacific |
| COC | combat operations center |
| COMNAVMETOCCOMINST | Commander, Naval Meteorology and Oceanography Command instruction |
| | |
| DA | density altitude |
| DAS | deep air support |
| DASC | direct air support center |
| DD | Department of Defense (form) |
| DSN | Defense Switched Network |
| | |
| EECT | ending evening civil twilight |
| EENT | ending evening nautical twilight |

| | |
|---|---|
| FSCC | fire support coordination center |
| FT | feet |
| FWD | forward |
| $g/m^3$ | grams per meter cubed |
| HF | high frequency |
| hFT | hundreds of feet |
| HMH | Marine heavy helicopter squadron |
| HML | Marine light attack helicopter squadron |
| HMM | Marine medium helicopter squadron |
| HQ | headquarters |
| ICAO | International Civil Aviation Organization |
| INS | inches of mercury |
| ISR | intelligence, surveillance, and reconnaissance |
| KT | knots |
| LZ | landing zone |
| MAG | Marine aircraft group |
| MCIWEST | Marine Corps Installations West |
| MCRP | Marine Corps reference publication |
| MFC | meteorological and oceanographic (METOC) forecast center |
| MMFC | Marine air-ground task force (MAGTF) meteorological and oceanographic (METOC) fusion cell |
| MTACS | Marine tactical air command squadron |
| N/A | not applicable |
| NATOPS | Naval Air Training and Operating Procedures Standardization |
| NM | nautical mile |
| NOOC | Naval Oceanography Operations Command |
| NTS | night targeting system |
| OAAW | offensive antiair warfare |
| OPNAVINST | Chief of Naval Operations instruction |
| OPTASK | operation task |
| OVC | overcast (*cloud cover condition*) |
| PA | pressure altitude |
| POD | probability of detection |
| SCT | scattered (*cloud cover condition*) |
| SEAD | suppression of enemy air defenses |

| | |
|---|---|
| SITREP | situation report |
| SM | statute miles |
| TAF | terminal aerodrome forecast |
| TAOC | tactical air operations center |
| TBD | to be determined |
| TF | task force |
| UHF | ultrahigh frequency |
| UTC | Coordinated Universal Time |
| VMA | Marine attack squadron |
| VMAQ | Marine tactical electronic warfare squadron |
| VMFA | Marine fighter/attack squadron |
| VMGR | Marine aerial refueler transport squadron |
| VMU | Marine unmanned aerial vehicle squadron |
| VOSIP | voice over secure Internet protocol |
| WEAX | weather forecast |

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ANNEX H TO Task Force (TF) Talon OPERATION ORDER (OPORD) 2-16 (Operation GUNSMOKE) (U)
METEOROLOGICAL AND OCEANOGRAPHIC (METOC) OPERATIONS (U)

(U) REFERENCES

(a) CJCSI 3810.01E, Meteorological and Oceanographic (METOC) Operations
(b) JP 3-59, Meteorological and Oceanographic Operations
(c) MCRP 2-10B.6, MAGTF Meteorological and Oceanographic Support
(d) MCWP 5-1, Marine Corps Planning Process
(e) MCWP 5-11.1, MAGTF Aviation Planning
(f) MCRP 2-3A, Intelligence Preparation of the Battlefield/Battlespace
(g) OPNAVINST 3140.24, Adverse and Severe Weather Warnings and Conditions of Readiness
(h) OPNAVINST 3710.7, NATOPS General Flight and Operating Instructions
(i) NAVMETOCCOMINST 3140.14M, U.S. Navy Meteorological and Oceanographic Support Manual
(j) NAVMETOCCOMINST 3142.2, Surface Weather Observation Procedures (SWOP)
(k) NAVMETOCCOMINST 3143.1H, Terminal Aerodrome Forecast (TAF) and the FM 51-XII TAF Code
(l) NAVMETOCCOMINST 3142.1A, Procedures Governing Pilot Weather Reports (PIREPS)
(m) Station Order 3145.1K, Warnings and Conditions of Readiness Concerning Hazardous or Destructive Weather
(n) Station Order 6200.2, Heat Casualties and Prevention

TIME ZONE: Tango

TASK ORGANIZATION: Annex A (Task Organization)

1. (U) Situation

a. (U) General

(1) (U) This is the METOC Operations Plan for the TF Talon Operations Order 2-16 (Operation Gunsmoke).

(2) (U) A Marine air-ground task force (MAGTF) METOC support force will deploy to establish METOC operations in support of TF Talon objectives in accordance with references (a) through (c).

(3) (U) Concept of METOC Support. METOC operations include collection, processing, derivation, and dissemination of information describing past, present, and future atmospheric, oceanographic, and terrestrial conditions. Marine Corps METOC personnel, organic to the aviation combat element (ACE), will provide environmental support to forward deployed TF Talon and Blue Force units as required. A MAGTF METOC fusion cell (MMFC) will be established to support headquarters (HQ), TF Talon. The MMFC will serve as the centralized collection point and the lead for the management of METOC data, products, and information in support of TF Talon. The Marine Corps Installations West (MCIWEST) Regional METOC center (RMC) will serve as a notional joint METOC coordination cell (JMCC). Mina Al Yuma METOC will serve as a collocated coalition METOC capability.

(4) (U) METOC support, as outlined in this annex, is provided through the use of tailored products originating from METOC forecast centers (MFCs) located outside the theater of operation per references (a) through (c). Organic and nonorganic surface and upper atmospheric observations, data, and imagery to include those from non-METOC sources and indigenous weather reporting stations must be collected and disseminated rapidly to allow for accurate forecasts and support products used by all MAGTF and joint METOC forces supporting combat operations in the TF Talon area of operations (AO).

b. (U) Battlespace. The geographic region of METOC responsibility includes the TF Talon AO as outlined in the TF Talon 2-16 basic order.

c. (U) Assumptions

(1) (U) Indigenous weather facilities and services are available, but cannot provide detailed tactical METOC support.

(2) (U) Meteorological satellites will be available to provide imagery and data to forces in and out of the theater of operations.

(3) (U) Meteorological and oceanographic observations from all areas under military and political control of the enemy are available.

(4) (U) METOC data of all types may continue to be made available by friendly and neutral countries under World Meteorological Organization (WMO) agreements.

(5) (U) Host nation and joint METOC facilities and services are available.

(6) (U) METOC support depends upon the use of interoperable communications for exchange of METOC data, products, and services. METOC personnel must

have access to SECRET Internet Protocol Router Network (SIPRNET) and Nonsecure Internet Protocol Router Network (NIPRNET).

(7) (U) Loss of SIPRNET and NIPRNET connectivity will significantly degrade the accuracy and availability of METOC products.

d. (U) Planning Factors. The ocean, air, and space environments impact the composition, deployment, employment, sustainment, and redeployment of military forces and a commander's courses of action. METOC conditions such as winds, seas, precipitation, cloud cover, temperature, and visibility can affect operations. These conditions can also provide opportunities for tactical operators to exploit.

(1) (U) Climatology. In March, the Pacific ridge begins to move northward and gradually intensify as the thermal trough (or heat low) begins to move over northwestern Mexico, western Arizona, and southeastern California. Due to the influx of warm air, resulting from the migration and development of these pressure systems, the high pressure center located over the northwestern United States has weakened and almost disappeared, allowing Nevada Low Pressure Systems to affect the local area. A "Nevada Low" is a local name given to the surface reflection of an upper level closed low or deep trough over Nevada. The Nevada Low is typically a "cold" low that develops between February and April, producing strong pressure gradients over western Arizona, Nevada, Utah, and southern California. The primary concern with a Nevada Low is the strong gusty winds associated with the pressure system. With a well-developed Nevada Low centered over southern Nevada, Yuma can expect southwesterly winds in advance of the associated cold front and westerly to northwesterly winds sustained at 15 to 20 knots with 30 to 40 knot gusts following frontal passage. As with any lower desert region, blowing sand and dust can be a significant problem to flight operations. The sand dunes, located west-northwest of Yuma, become a factor with sustained surface winds of 22 knots or greater from the west through northwest. Reduced visibility to less than 3 miles in blowing dust or sand will result. A climatological study is also provided in annex B, appendix 18, tab B.

(2) (U) Impacts to Operations. Guidance for developing and assessing METOC impacts to MAGTF operations are contained in references (b), (c), and (m). TF Talon impact thresholds and matrices are shown in tabs A and B of appendix 4 to this annex.

CLASSIFICATION

e. (U) Resource Availability

(1) (U) TF Talon METOC personnel will deploy to the tactical aircrew combat training system (TACTS) Airfield and establish coordination/collaboration with the senior METOC officer (SMO), JMCC, and coalition METOC forces. An initial operating capability will be established no later than 31 Mar 2016 with a full operating capability of 1 Apr 2016. Follow-on METOC forces will forward deploy with the supported command.

(2) (U) Conventional NIPRNET and SIPRNET resources will be available.

2. (U) Mission. On order, TF Talon establishes a METOC support network in the AO and conduct METOC operations that provide timely meteorological, oceanographic, and space environmental information, products, and services required in support of TF Talon planners, decision makers, and operators.

3. (U) Execution

a. (U) Commander's Intent. We will aggressively and creatively apply a variety of organic, theater, and national METOC assets in order to allow planners and decision makers to exploit environmental information and gain a tactical advantage through windows of opportunity; and to preserve forces using time-relevant information concerning the past, present, and future states of the space, air, and ocean environments. Focus will be on the integration of METOC information with intelligence preparation of the battlespace for decision makers and environmental impacts to personnel, weapons, sensors, and system performance for tactical mission planning and execution.

b. (U) Concept of Operations. The TF Talon METOC support organization and overall operations will be led and directed by the SMO. The 557th Weather Wing, formerly Air Force Weather Agency (AFWA) and the Fleet Numerical Meteorology and Oceanography Center (FNMOC), which comprise the two primary METOC production centers, will provide routine centralized environmental support as required or special environmental support as tasked for the AO. The joint METOC officer (JMO) will organize METOC operations and support for TF Talon and perform such other tasks as directed by the SMO to coordinate METOC support for TF Talon objectives. METOC personnel will establish an MMFC at TACTS Airfield under the direction of the JMO and tasking by the SMO.

(1) (U) Development of METOC information. METOC information will be developed by fusing global, regional, and tactical data and imagery and products to characterize and exploit the physical environment. Environmental characterization will be accomplished through the processes of sensing, collection, analysis, and

Page number

CLASSIFICATION

prediction of METOC conditions. Environmental exploitation will be accomplished through the processes of tailoring and disseminating accurate and timely METOC information relevant to the context, time, and space involved in the supported mission or operation and by integrating environmental information with decision making processes per references (d) through (f). The 557th Weather Wing, FNMOC, and MFCs will provide initial environmental support until METOC communications are established and the MMFC is operational. Once operational, the MMFC will be the primary METOC forecast agency for military forces in Wasabi and provide tailored theater-level products for the AO (see annex H, appendix 1). METOC personnel at all echelons will further tailor these products, as necessary, to support their customers.

(2) (U) METOC Coordination with Higher and Adjacent Commands. METOC operations will integrate and leverage tactical on-scene capabilities with regional and global capabilities to characterize and exploit environmental information in the AO. Division of specific assigned tasks will promote efficiency, maximize training value and realism, and reduce redundancy while maintaining compliance with appropriate directives. The Marine Air Control Squadron-8 (MACS-8) Marine Air Traffic Control Detachment (MATCD) METOC Section will integrate its METOC operations with the overall MAGTF, MCIWEST RMC (notional JMCC), and Mina Al Yuma METOC (notional coalition capability) for the development of routine and warning forecast products. The MACS-8 MATCD METOC Section will provide nonroutine tactical and operational products per this annex and as may be directed by the SMO or JMO.

(3) (U) METOC Sensing and Collection. TF Talon will execute a theater sensing and collection plan (see annex H, appendix 3) to build a METOC picture of current and forecast conditions in the AO for situational awareness. It is essential that this information be readily available to provide METOC situational awareness for consideration by decision makers and planners during mission planning and execution. Though there is a robust national sensing network in place, the MACS-8 MATCD METOC Section shall exercise and rely on organic sensing and collection capabilities to the maximum extent practical. However, national capabilities shall be considered as well so as not to compromise safety.

(4) (U) TF Talon METOC Organization

(a) (U) METOC Forecast Centers. The 557th Weather Wing and the FNMOC comprise the two primary Department of Defense (DOD) METOC production centers and will provide routine centralized environmental support as requested for the AO. Additional specialized DOD METOC support is available from Naval Oceanography Operations Command (NOOC) activities to include the Warfighting Support Center (WSC).

(b) (U) MCIWEST RMC. The MCIWEST RMC is a notional joint METOC coordination cell (JMCC). MCIWEST RMC fulfills the role as JMCC while retaining responsibility for routine METOC products and services. The MCIWEST RMC facilitates collaboration and coordination of forecast development with the MACS-8 MATCD METOC Section and Mina Al Yuma METOC.

(c) (U) Mina Al Yuma METOC. Mina Al Yuma METOC is a notional collocated allied/coalition METOC agency. They provide routine garrison METOC services for Mina Al Yuma in coordination with MCIWEST RMC.

(d) (U) MACS-8 MATCD. The MACS-8 MATCD establishes an MMFC at TACTS Airfield under the direction of the JMO and SMO to characterize and exploit environmental information in the AO and assumes the role as the lead theater Marine Corps forces METOC capability. The MACS-8 MATCD METOC Section provides direct support to the ACE.

c. (U) Tasks and Responsibilities

(1) (U) MCIWEST RMC

(a) (U) Act as notional JMCC by facilitating forecast and warning coordination and collaboration with the participating MACS-8 MATCD METOC Section and Mina Al Yuma METOC.

(b) (U) Retain responsibility for preparation and dissemination of the terminal aerodrome forecast (TAF) for Mina Al Yuma under the International Civil Aviation Organization (ICAO) KNYL in accordance with reference (l).

***Note:*** KNYL is the airport code for Yuma Marine Corps Air Station/Yuma International Airport.

(c) (U) Retain responsibility for preparing and disseminating weather advisories for KNYL in accordance with references (h) and (n).

(d) (U) Retain responsibility for the conduct of the wet bulb globe temperature index (WBGTI) measurements and dissemination in accordance with reference (g).

(e) (U) Retain responsibility for the preparation and dissemination of aviation flight weather briefs in accordance with references (i) and (j).

(2) (U) Mina Al Yuma METOC

(a) (U) Retain responsibility for official surface meteorological observations at KNYL in accordance with reference (j).

(b) (U) Act as notional collocated allied/coalition METOC agency and participate in forecast coordination and collaboration with MCIWEST RMC and the MACS-8 MATCD METOC Section.

(c) (U) Conduct METOC operations as prescribed by the MCIWEST RMC to include surface meteorological observations, TAFs, weather advisory and warning dissemination, WBGTI measurements and dissemination, and aviation flight weather briefs, as required.

(3) (U) SSMO

(a) (U) Coordinate all component METOC support requirements and inter-Service support procedures to ensure maximum exchange of essential METOC information.

(b) (U) Coordinate overall theater sensing strategy among TF Talon components to optimize the frequency and location of observations to meet theater forecast requirements.

(c) (U) Track, compile, and submit an after action report for TF Talon. The report may be submitted to the Marine Corps Lessons Learned System upon approval of the commander.

(4) (U) JMO

(a) (U) Support the TF Talon Commander by assessing the METOC and space environments in which friendly and threat weapon systems and/or forces operate.

(b) (U) Perform forecast coordination for the AO with supporting components and commands under the commander, joint task force and provide direction to the Joint METOC Coordination Organization in order to provide fused joint METOC support to TF Talon.

(c) (U) Modify and review joint METOC product requirements as necessary.

(d) (U) Provide/arrange METOC support to HQ, TF Talon and coordinate and direct overall METOC support for operations in the TF Talon AO with the SMO.

(e) (U) Coordinate and task METOC capabilities and METOC forecasts and product support requirements with the MFC's and METOC components.

(f) (U) Establish forecast coordination with supporting components and TF Talon commands.

(g) (U) Coordinate weather warnings and advisories for the TF Talon AO in accordance with reference (f) and in conjunction with host nation METOC operations at Mina Al Yuma and TACTS Airfield.

(h) (U) Track, compile, and submit an after action report to the SMO no later than 25 Apr 2016 in the "Item, Discussion, and Recommendation" format.

(5) (U) MACS-8 MATCD METOC Section

(a) (U) Establish the METMF[R] NEXGEN as an MMFC at TACTS Airfield.

(b) (U) Prepare and disseminate a weather forecast (WEAX) for the AO no later than 0600T using the example in appendix 2 of this annex as a baseline. The media and format will be dictated by customer needs whether graphical, alphanumeric, or a combination of both.

(c) (U) Conduct upper air observations once daily between 0430T and 0500T and disseminate no later than 0600T via the Air Force Weather Web Services (AFW-WEBS) NIPRNET Web site (primary) or AFW-WEBS SIPRNET Web site (secondary).

(d) (U) Establish and maintain a METOC SIPRNET Web page fusing all current METOC products and collected data for the AO in a centralized METOC database.

(e) (U) Monitor a METOC chat room using Transverse Chat (tactical SIPRNET).

(f) (U) If available, monitor a METOC chat room using Defense Collaboration Services (tactical NIPRNET).

(g) (U) Conduct, record, and disseminate surface meteorological observations in accordance with reference (k) and appendix 2 to this annex utilizing expeditionary sensors. Be prepared to conduct remote and mobile surface meteorological observations and provide support for up to two forward arming and refueling points (FARPs).

(h) (U) Participate in forecast and weather advisory and warning coordination and collaboration with the MCIWEST RMC (notional JMCC) and Mina Al Yuma METOC (notional coalition). Notify the JMO upon issuance of advisories and warnings.

(i) (U) Prepare and disseminate TAFs in accordance with reference (l) utilizing the location identifiers provided in appendix 2 of this annex.

(j) (U) Centrally manage METOC information, data, and products required in support of TF Talon operations on a secure accessible Web site.

(k) (U) Maintain awareness of imminent or forecast destructive weather in the TF Talon AO based on criteria in reference (e) and alert and keep the JMO informed of the threat as it occurs and the situation develops.

(l) (U) Complete a daily operational check of the METMF(R) NEXGEN major systems per appendix 5 and post to the METMF(R) NEXGEN SIPRNET and battle command display Web pages daily at 0600T and 1800T.

(m) (U) Track, prepare, and submit an after action report to the SMO no later than 29 Apr 2016 in “Item, Discussion, and Recommendation” format.

(n) (U) Monitor radio communications using organic communication assets, to include establishing METRO services.

(6) (U) Marine Tactical Air Command Squadron 58 (MTACS-58)

(a) (U) Be prepared to provide one 6802 METOC officer or 6842 METOC analyst to the Marine Corps tactical air command center (Marine TACC).

(b) (U) Be prepared to host and monitor a METOC chat room using Transverse Chat (tactical SIPRNET).

(c) (U) Be prepared to maintain the MAW battle command display.

(7) (U) 557th Weather Wing and FNMOC provide centralized and theater specific METOC products in support of TF Talon.

(8) (U) Joint Space Operations Center provides specialized space environmental products as required in support of TF Talon.

d. (U) Coordinating Instructions

(1) (U) Units at all echelons will follow the steps below to determine and fill METOC support requirements. Higher echelon units identifying shortfalls will look within their resources for the required capability.

(a) (U) Determine environmental service support requirements.

(b) (U) To the extent possible, provide resources from organic organizations to satisfy requirements.

(c) (U) When unable to satisfy requirements, notify the next highest echelon of the shortfall.

(2) (U) Intelligence units at all echelons of command will ensure that all target weather and intelligence is passed to the MMFC/JMCC in a timely manner.

(3) (U) Report all conflicts or significant issues to the SMO for resolution.

(4) (U) Pilot reports (PIREPs) received by METOC/ATC [air traffic control] personnel will be forwarded to the MMFC/JMCC in a timely manner.

(5) (U) Direct coordination is authorized and encouraged between all echelon staff METOC officers. Staff METOC officers will coordinate special METOC support requirements with the JMO.

(6) (U) The TF Talon (Blue Land) WEAX is the official forecast for the area of operations (see appendix 1, tab A). METOC units should tailor the TF Talon WEAX to meet specific operational requirements. Coordinate significant deviations from the TF Talon (Blue Land) WEAX with the JMO, except to satisfy an immediate operational need or under conditions affecting the safety of personnel or equipment. In these cases, coordinate with the JMCC after the fact.

(7) (U) The host nation METOC agency at Mina Al Yuma will retain responsibility for issuing and disseminating weather warnings and advisories for Mina Al Yuma per reference (n). TF Talon units are responsible for establishing internal procedures for further dissemination of weather warnings and advisories within their commands and supported units.

(8) (U) All METOC units with forecast requirements will prepare and disseminate METOC TAFs in accordance with NAVMETOCCOMINST 3143.1H utilizing appendix 3 of this annex for station identifiers. TAFs shall be uploaded to the unclassified AFW-WEBS.

(9) (U) Remote mobile surface meteorological observations at forward arming and refueling points (FARPs) shall be uploaded to unclassified AFW-WEBS via Broadband Global Area Network (BGAN) in accordance with reference (k) and appendix 3. In the absence of BGAN capability, observations shall be disseminated to the MMFC via available communication methods for uploading to unclassified AFW-WEBS in accordance with reference (k) and appendix 2.

(10) (U) All METOC units shall prepare an after action or lessons learned report in "Item, Discussion, and Recommendation" format no later than 25 Apr 2016. The JMO shall compile subordinate reports and forward to the SMO for a hotwash discussion and action.

(11) (U) All surface meteorological observations, upper air observations, and TAFs shall be unclassified and disseminated to unclassified global databases.

4. (U) Administration and Logistics

a. (U) Administration. The MCIWEST RMC and/or Mina Al Yuma METOC shall retain responsibility for completing DD Form 175-1, *Flight Weather Briefs*, for all flights requiring such a brief in accordance with references (i) and (j).

b. (U) Logistics. The MACS-8 MATCD METOC Section is responsible for coordinating the funding, requisitioning, transportation, and provision of all consumable supplies with the responsible MALS [Marine aviation logistics squadron]. Logistics of METOC equipment and supplies will be conducted as outlined in unit standing operating procedures (SOPs) and annex D. METOC units are expected to deploy with a minimum of a 30-day supply of materials. Report problems with logistic support for METOC units through the operational chain of command.

5. (U) Command and Control. Use theater and tactical nets in addition to established METOC circuits to pass data and forecast guidance. Internet, Intranet, and homepage technology will be used to the greatest extent possible. See annex K.

a. (U) Environmental command and control includes normal environmental services augmented with tailored forecasts to support operational and tactical commanders. Regional METOC data streams provide observations, general forecasts, and special products as requested. Exploit all other data sources including US and foreign satellite, teletype, and facsimile broadcasts.

b. (U) Loss of METOC communications circuits will critically degrade the control of environmental services. Copy joint Service, allied, or other nation's data sources to continue accurate and consistent support. Supplement data with local observations taken by tactical units in theater.

c. (U) Environmental services are available to echelons where special circuits are not available. Commercial telephone lines, unclassified weather broadcasts sent in-the-blind, and computer homepages will be utilized to provide information.

d. (U) Control of divulging METOC data will be in accordance with applicable operations security instructions. See annex L.

e. (U) Points of Contact

(1) (U) Senior METOC Officer

(a) (U) Capt Corps, MAWTS-1, Defense Switched Network (DSN): 269-xxxx, voice over secure Internet protocol (VOSIP): to be determined (TBD), NIPRNET e-mail: xxx.xxxx@usmc.mil, SIPRNET e-mail: xxx.xxxx @usmc.smil.mil.

(b) (U) GySgt Devildog, MAWTS-1, DSN: 269-xxxx, VOSIP: TBD, NIPRNET e-mail: xxx.xxxx@usmc.mil, SIPRNET e-mail: xxx.xxxx@usmc.smil.mil.

(c) (U) SSgt Marine, MAWTS-1, DSN: 269-xxxx, VOSIP: TBD, NIPRNET e-mail: xxx.xxxx@usmc.mil, SIPRNET e-mail: xxx.xxxx@usmc.smil.mil.

(2) (U) Joint METOC Officer. TBD, MAWTS-1, Mission Planning Room, DSN: 269-xxxx, NIPRNET e-mail: xxx.xxxx@usmc.mil; SIPRNET e-mail: xxx.xxxx@ usmc.smil.mil.

(3) (U) Marine TACC METOC. TBD, MTACS-58, DSN: TBD, VOSIP: TBD, e-mail: TBD.

(4) (U) MACS-8 MATCD.Web site: http://bcd.mawts1.usmc.smil.mil/Site%20Pages/metoc.aspx.

(a) (U) TACTS Airfield, METMF(R) NEXGEN Compound or Marine unmanned aerial vehicle squadron (VMU) command operations center, DSN: TBD, VOSIP: TBD, NIPRNET e-mail: TBD (Web site), SIPRNET e-mail: TBD (Web site).

(b) (U) Speed Bag Airfield, VMU COC, DSN: TBD, VOSIP: TBD, NIPRNET e-mail: TBD, SIPRNET e-mail: TBD.

(c) (U) Laguna Army Airfield, Air Boss Tent and METMF(R) NEXGEN Compound, DSN: TBD, VOSIP: TBD, NIPRNET e-mail: TBD, SIPRNET e-mail: TBD.

(5) (U) MCIWEST RMC. Commercial 858-577-xxxx or xxxx, DSN 267-xxxx or xxxx.

ACKNOWLEDGE RECEIPT

W.X. WEATHER
Capt USMC
METOC Officer

APPENDICES:

1–MAGTF Standard Tactical Meteorological and Oceanographic (METOC) Support Plan
2–TF Talon METOC Sensing and Collection Plan
3–TF Talon METOC Impacts Thresholds
4–TF Talon Daily METOC Situation Report

OFFICIAL:

s/
D.D. MARINE
Capt USMC
METOC Officer

CLASSIFICATION

TF TALON
YUMA WASABI
232200Z SEP 13

APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16
(Operation GUNSMOKE) (U)
MAGTF STANDARD TACTICAL METEOROLOGICAL AND OCEANOGRAPHIC (METOC) SUPPORT PLAN (U)

1. (U) Upon the employment of a MAGTF (MEU/MEB/MEF[FWD]/MEF), as part of a larger naval, joint, or combined force, responsibility for the provision of tactical METOC support will transition from “garrison-based” to “on-scene” METOC support assets under the direction and control of the ACE commander. Naval METOC centers will retain responsibility for the provision of centrally produced METOC products, field data, wind, sea and tropical cyclone warnings/advisories, area oceanographic support, and detailed local forecasts/tactical support products for naval units operating independently.

2. (U) Tailored on-scene METOC support is available from METOC assets organic to the ACE. The MACS, equipped with a METMF(R) NEXGEN, are normally deployed to a forward operating base in direct support of that airfield. The MSTs, from the MEF intelligence battalion, are assigned to provide direct support to commanders/staff of the MAGTF command element, the ground combat element, and the logistics combat element. The MAGTF elements should forward unique tactical METOC support requirements, via the chain of command, to the MAGTF command element vice requesting personnel and equipment directly.

3. (U) The MAGTF commander shall coordinate all tactical METOC support requirements for each element and task supporting elements to provide the timely dissemination of local warnings/advisories, observations/forecasts, and tactical support summaries/products and liaise with naval METOC centers for special tactical support requirements. In order to provide a common baseline within the MAGTF, tailored tactical METOC support should be developed in accordance with this appendix.

4. (U) The MAGTF Standard Tactical METOC Support Plan consists of the following:

a. (U) OPERATION TASK (OPTASK) METOC. Operational tasks are developed using NATO APP-4 standards to provide a standard message for coordination of tactical METOC services and reporting responsibilities within a MAGTF. A standing Marine Corps-wide OPTASK METOC has yet to be promulgated by the commanders, Marine Forces Pacific and Marine Forces Command. Once published, MAGTF commanders will issue serialized OPTASK METOC supplements detailing specific requirements for all operations and exercises.

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b. (U) Standard Tactical Summaries. These summaries are designed to provide minimum levels of tactical METOC support to MAGTF elements during routine operations. They include the MAGTF environmental forecast (WEAX) and TAS. These support products are normally transmitted daily or as required.

(1) (U) TF Talon WEAX. The TF Talon (Blue Land) WEAX is based on the standard NAVMETOCCOM WEAX/AVWX [aviation route weather forecast] format and shall include a meteorological situation, 24-hour forecast, and outlook to 96 hours for each METOC zone of interest. Astronomical data and a radiological fallout forecast should be appended as required. See enclosure 1 to tab A of this appendix for METOC zones.

(2) (U) Tactical Atmospheric Summary. The TAS shall include an atmospheric refractive summary, tactical assessment, electromagnetic sensor performance predictions, infrared sensor detection range predictions, communications range predictions, and an M-unit summary. Radiosonde calibration data should be appended when upper air-capable units are operating in close proximity.

c. (U) Special Tactical Summaries. These summaries are designed to provide minimum levels of tactical METOC support for specific operations and/or functions of Marine aviation. They include the amphibious objective area forecast, strike forecast, and assault forecast.

(1) (U) Amphibious Objective Area Forecast. The amphibious objective area forecast is designed to provide support for exercise/real-world amphibious landings and rehearsals. It shall include a meteorological situation, 24-hour forecast for the amphibious objective area/landing area, surf forecast for target beaches, tactical assessment, abbreviated atmospheric summary, and astronomical data. A radiological and chemical fallout forecast should be appended as the tactical situation dictates. The initial forecast should be issued at least 24 hours prior to the commencement of amphibious operations.

(2) (U) Strike Forecast. The strike forecast is designed to provide a coordinated forecast whenever multiple strike (OAAW/SEAD/DAS) platforms (VMFA/VMA/VMAQ) are operating as an integrated force under one tactical commander. It shall include a meteorological situation, 24-hour forecast of en route and target weather, outlook to 48 hours, tactical assessment, and electro-optical sensor performance predictions.

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(3) (U) Assault Forecast. The assault forecast is designed to provide a coordinated forecast whenever multiple assault support platforms (VMGR/HMH/HMM/HMLA) are operating as an integrated force under one tactical commander. It shall include a meteorological situation, 24-hour forecast of en route, FARP/RGR [rapid ground refueling] and landing zone weather, outlook to 48 hours, tactical assessment, and electro-optical sensor performance predictions.

d. (U) Graphical Forecast. These slides are designed to provide a 96-hour forecast with impacts for all TF Talon locations that have a meteorological sensor.

ACKNOWLEDGE RECIEPT

W.X. WEATHER
Capt USMC
METOC Officer

TABS:

A–TF Talon Weather Forecast (WEAX)
B–Tactical Atmosphere Summary (TAS)
C–Strike Forecast
D–Assault Forecast
E–Amphibious Objective Area Forecast
F–TF Talon Graphical Forecast Slide

OFFICIAL:

s/
D.D. MARINE
Capt USMC
METOC Officer

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CLASSIFICATION

TF TALON
MINA AL YUMA
232200Z SEP 13

TAB A TO APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
TF TALON WEATHER FORECAST (WEAX) (U)

MSGID/GENADMIN/UNIT/SERIAL/JAN/2016//
SUBJ/TF TALON(FWD) WEAX//
REMARKS/

1. (U) Meteorological Situation at 1200Z. There is an area of low pressure centered over San Diego that will bring an increase in mid- and high-level cloudiness, areas of precipitation, and isolated thunderstorms to the area of operations over the next 24 to 48 hours. Expect marginal to unfavorable conditions with significant impacts to METOC zones.

2. (U) 24-hour forecast commencing 1200Z in the vicinity of Mina Al Yuma, Wasabi (located in the southeast METOC zone).

a. (U) Sky/weather: scattered to broken at 10,000 FT and overcast at 15,000 FT with moderate rain showers and isolated thunderstorms.

b. (U) Visibility (statute miles [SM]): 6 SM with haze, but 3 SM in moderate rain showers.

c. (U) Surface winds (knots): south southwesterly at 10–12 KT with gusts to 19 KT.

d. (U) Maximum/minimum temperatures (degrees F): 96ºF/76ºF.

e. (U) Relative humidity (%): 41%.

f. (U) Absolute humidity (grams per meter cubed [$g/m^3$]): 10.4 $g/m^3$.

g. (U) WBGT heat index/flag condition: yellow flag.

h. (U) Aviation parameters.

(1) (U) Cloud/ceilings (in hundreds of feet [hFT]): SCT020CB BKN025 OVC080.

(2) (U) Winds/temperatures aloft:
FL/DIR/KT/DEG (ºC)

010/220/12KT/25 ºC
020/220/13KT/24 ºC
030/240/15KT/23 ºC
040/240/17KT/19 ºC
050/240/20KT/16 ºC
100/260/22KT/06 ºC
150/270/29KT/M04 ºC
200/310/45KT/M13 ºC
300/320/65KT/M36 ºC

(3) (U) Turbulence: light (LGT) surface (SFC)-040/moderate (MDT) 180–350.

(4) (U) Minimum freezing level (FT): 13,000 FT.

(5) (U) Icing: LGT mixed (MXD) 150–250.

(6) (U) Contrails (FT): possible 29,563 FT/probable 34,350FT.

(7) (U) Minimum altimeter setting (INS): 29.76 INS.

(8) (U) Maximum pressure altitude (PA)/density altitude (DA): +890/+3500.

3. (U) Outlook to 48 Hours. The area of low pressure will slowly push across the area over the next 48 hours with mid and high-level cloudiness, areas of precipitation, and isolated thunderstorms.

4. (U) Astronomical Data (Local)

a. (U) Sunrise/sunset/sunrise: 0642/1801/0643.

b. (U) BMNT/BMCT/EECT/EENT/BMNT/BMCT: 0548/0616/1827/1856/0548/0617.

c. (U) Moonrise/moonset/illumination (percentage): 1045/2130/22%.

5. (U) Released by: Sgt Marine//

ENCLOSURE:

1–METOC Zones

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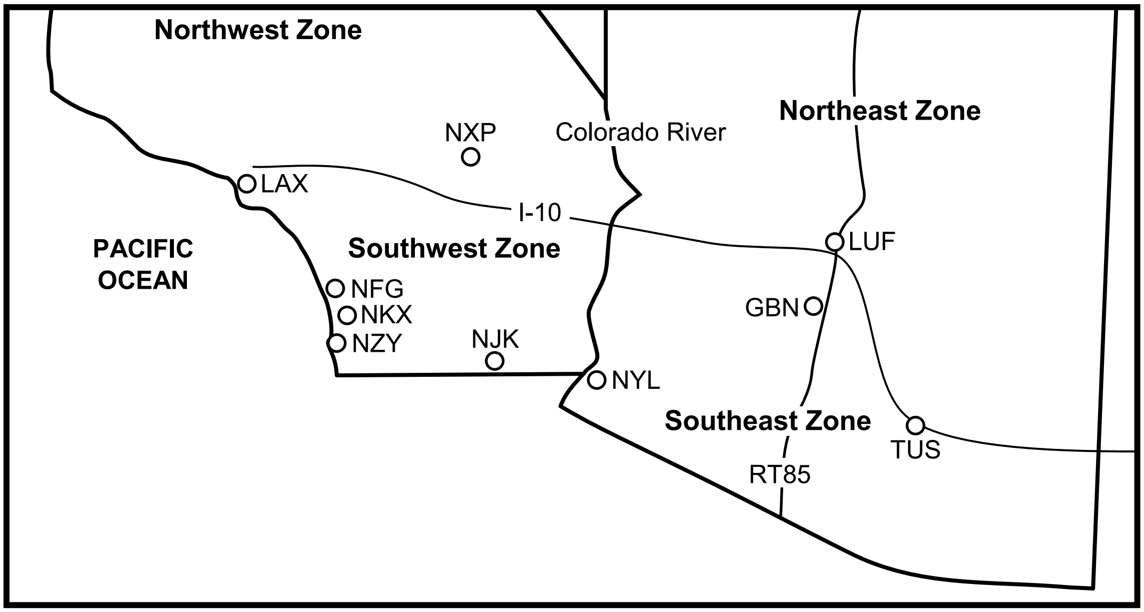
ENCLOSURE 1 TO TAB A TO APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
METOC ZONES (U)

METOC ZONES



**Note:** Map not to scale.

The area of operations is divided into four METOC zones. The Colorado River running north and south and Interstate 10 running east and west divides the METOC zones.

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232200Z SEP 13

TAB B TO APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
TACTICAL ATMOSPHERIC SUMMARY (TAS) (U)

MSGID/GENADMIN/UNIT/SERIAL/JAN/2016//
SUBJ/TACTICAL ATMOSPHERIC SUMMARY(TAS)//
REMARKS/

1. (U) Atmospheric Refractive Summary. Based on 1200Z upper-air sounding taken at in the vicinity of Mina Al Yuma, Wasabi (Located in the Southeast METOC Zone).

   a. (U) Surface-based duct height (feet): None.

   b. (U) Elevated ducts (bottom-top) (feet): 17,665–22,559.

2. (U) Tactical Assessment. Normal ranges are expected for surface to surface communication and surface to air communication. Possible extended ranges are possible for transmitters between 17,665 and 22,559 feet due to an elevated duct. Possible reduced ranges are expected for transmitters above 22,559 feet.

3. (U) Atmospheric refractive conditions are forecasted to improve after 1600Z today and normal ranges for all frequencies at all levels are expected.

4. (U) Electromagnetic Sensor Performance Predictions

   a. (U) This is whether detection will occur at the specified range of 60 NM for F-5 at various altitudes, based on 90 percent probability of detection (POD):

| Altitude (hFT) | (010) | (050) | (100) | (200) | (300) |
|---|---|---|---|---|---|
| RADAR | | | | | |
| AN/TPS-59 | No | Yes | Yes | No | No |
| AN/TPS-63 | No | Yes | Yes | No | No |

***Note:*** For classified products or more in-depth information for specific radars, submit a request to the MMFC at 928-269-XXXX or DSN 94-312-269-XXXX.

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b. (U) Electronic surveillance measure (ESM) intercept ranges (NM) for various emitters:

Emitter: ESM receiver (AN/ALQ-99-17,500FT)

(Surface) 25–60NM
(Airborne) 45–90NM
(Missile) 31–41NM

> ***Note:*** For classified products or more in-depth information for specific radars, submit a request to the MMFC at 928-269-XXXX or DSN 94-312-269-XXXX.

c. (U) ESM counter detection ranges (NM) for various threat ESM receivers:

| US emitter | ESM receiver |
|---|---|
| (Surface) | (Airborne) |
| 60–105NM | 75–120NM |

> ***Note:*** For classified products or more in-depth information for specific radars, submit a request to the MMFC at 928-269-XXXX or DSN 94-312-269-XXXX.

5. (U) FLIR [forward-looking infrared] detection range predictions WFOV [wide field of view]/NFOV [narrow field of view] (NM) for black sport utility vehicle at various altitudes, based on 50 percent POD, visibility 14 NM, wind speed 13 knots, absolute humidity 4.56 g/m$^3$:

| Altitude (hFT) | (005) | (010) | (050) | (100) | (200) |
|---|---|---|---|---|---|
| Sensor | | | | | |
| Litening II | 5.0 | 7.0 | 7.6 | 8.8 | 9.3 |
| NTS | 7.0 | 5.1 | 6.2 | 6.7 | 8.0 |
| AAQ-27 | 4.3 | 6.2 | 6.4 | NA | NA |
| AAQ-29 | 8.1 | 9.0 | 7.6 | NA | NA |

6. (U) <u>Communication Range Predictions</u>

a. (U) UHF communication range is normal/extended/greatly extended.

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b. (U) HF Radio Propagation Condition/Forecast

(1) (U) HF communications are expected to be optimal throughout the day. HF ranges will reduce after sunset as the F1 and F2 layers combine and the D layer disappears.

(2) (U) 10.7 CM FLUX [centimeter solar radio emission flux]: 200 SFU [Solar Flux Unit].

7. (U) Released by: Sgt Marine//

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TF TALON
MINA AL YUMA
232200Z SEP 13

TAB C TO APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
STRIKE FORECAST (U)

(PASS TO [MAG/MARINE TACC/DASC/FSCC/MATC/TAOC/SADC])
MSGID/GENADMIN/UNIT/SERIAL/JAN/2016//
SUBJ/STRIKE FORECAST//
REMARKS/

1. (U) Meteorological situation at 1200Z.

2. (U) 24-hour forecast commencing 1200Z.

   a. (U) En route weather: Mina Al Yuma, Wasabi to Las Vegas, Chipotle.

      (1) (U) Sky/weather: SCT070 BKN150 OVC220.

      (2) (U) Visibility/slant range visibility (NM): 5SM HZ.

      (3) (U) Sea surface temperature (SST) 66 º/in water survival time: w/suit 27.2 hours, w/o suit 17.1 hours.

      (4) (U) Cloud tops/ceilings (hFT): 070–100, 150–190, 220–40/BKN150.

      (5) (U) En route winds/temperatures aloft (FL/Dir/Spd in KTS/temperatures in degrees C): 130/260/25/M01.

      (6) (U) Turbulence: LGT-MOD SFC-040.

      (7) (U) Minimum freezing level (FT): 12,500.

      (8) (U) Icing: LGT MXD 150–240.

      (9) (U) Minimum altimeter setting (INS): 29.74.

      (10) (U) Contrail formation: possible 29,563FT/probable 34,350FT.

      (11) (U) Ditch headings (degrees T): N/A.

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b. (U) Target Area Weather

(1) (U) Sky/weather: FEW100 SCT150 BKN200/haze.

(2) (U) Visibility/slant range visibility (SM): 5.

(3) (U) Surface winds (KTS): 22014G19.

(4) (U) Maximum/minimum temperatures (degrees F): 91/67.

(5) (U) Cloud tops/ceilings (hFT): 100–120, 150–170, 200–250/BKN200.

(6) (U) Winds/temperatures aloft (FL/DIR/SPD IN KTS/TEMPS IN DEG C): 130/260/25/M01.

(7) (U) Turbulence: LGT-MOD SFC-040.

(8) (U) Freezing level (FT): 12,500.

(9) (U) Icing: LGT MXD 150–250.

(10) (U) Minimum altimeter setting (INS): 29.72.

(11) (U) D-values (FT): -66.

(12) (U) Contrail formation: 29,789FT and probable 32,584F.

(13) (U) Astronomical data (coordinated universal time [UTC]) at 2300Z: sunrise/sunset/sun angles (elevation/azimuth): 1409/0010/01 117º BMNT/BMCT/EECT/EENT: 1310/1342/0038/0109 moonrise/moonset/percent illumination/moon angles (elevation/azimuth)/LUX values: 1830/0636/39%/-43 034º/N/A.

3. (U) Outlook to 48 Hours. An area of low pressure will continue to influence the area for the next 48 hours with convective low clouds and variable mid to high clouds expected over the target area. The ceiling will vary between 020 and 080.

4. (U) Tactical Assessment. The ceiling is expected to remain above the strike altitude, but will impact battle damage assessment (BDA) from any intelligence, surveillance, and reconnaissance (ISR) assets that must remain above 15,000FT. Otherwise, minimal impacts from weather are expected throughout the forecast period.

5. (U) Electro-Optical Sensor Performance Predictions. The atmosphere remains relatively dry with an expected absolute humidity of 4.87 g/m$^3$. Sensor performance is expected to be optimal.

6. (U) Released by: Sgt Marine//

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TF TALON
MINA AL YUMA
232200Z SEP 13

TAB D TO APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
ASSAULT FORECAST (U)

(PASS TO [MAG/TACC/DASC/FSCC/MATC/TAOC/SAAWC])
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/ASSAULT FORECAST//
REMARKS/

1. (U) Meteorological situation at 1200Z.

2. (U) 24-Hour forecast commencing 1200Z.

   a. (U) En route weather: Mina Al Yuma to Wasabi to Chipolte:

      (1) (U) Sky/weather: SCT020CB BKN025 OVC080/isolated thunderstorms.

      (2) (U) Visibility/slant range visibility (NM): 5SM HZ/1SM TSRA.

      (3) (U) SST (degrees F)/in water survival time: N/A.

      (4) (U) Cloud tops/ceilings (FT): 080–120, 200–300/025.

      (5) (U) En route winds/temperatures aloft (location/flight level/wind direction/wind speed in knots/temperatures in degrees C): KNYL-KLSV/080/180/25/05.

      (6) (U) Turbulence: MDT 100–220.

      (7) (U) Minimum freezing level (feet): 13,000.

      (8) (U) Icing: LGT MXD 130–240.

      (9) (U) Minimum altimeter setting (inches): 29.65.

      (10) (U) Contrail formation: possible 30,728 feet/probable 36,530 feet.

      (11) (U) Ditch headings (degrees T): N/A.

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b. (U) FARP/RGR weather (as required, include for return leg if necessary):

(1) (U) Sky/weather: SCT030 BKN050 OVC100 TEMPO SCT020CB BKN025 OVC080.

(2) (U) Visibility/slant range visibility (NM): 5SM HZ TEMPO 1SM TSRA.

(3) (U) Surface winds (knots): 20012G18 TEMPO VRB20G45KT.

(4) (U) Cloud tops/ceilings (feet): 250/025.

(5) (U) Maximum/minimum temperatures (degrees F): 95/70.

(6) (U) Minimum altimeter setting (inches): 29.62.

(7) (U) Maximum PA/DA: 478/2895.

c. (U) Assault landing zone (LZ) weather:

***Note:*** Repeat for each assault LZ.

(1) (U) Sky/weather: SCT035 BKN050 OVC150 TEMPO SCT025 BKN040 OVC120.

(2) (U) Visibility/slant range visibility (NM): 4SM HZ.

(3) (U) Surface winds (knots): 20015G25 TEMPO 20020G30.

(4) (U) Maximum/minimum temperatures (degrees F): 99/73.

(5) (U) Maximum PA/DA: 679/3378.

(6) (U) Cloud tops/ceilings (feet): 050–150/040.

(7) (U) Winds/temperatures aloft (flight level/wind direction/wind speed in knots/ temperatures in degrees C): 080/230/25/04.

(8) (U) Turbulence: MDT SFC-080 & 100–180.

(9) (U) Freezing level (feet): 13,500.

(10) (U) Icing: LGT MXD 130-240.

(11) (U) Minimum altimeter setting (inches): 29.62.

(12) (U) D-values: -72.

(13) (U) Contrail formation: possible 30,982 feet/probable 37,120 feet.

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(14) (U) Astronomical data (UTC) at 2300Z:

Sunrise/sunset/sun angles (elevation/azimuth): 1411/0015/10 120º
BMNT/BMCT/EECT/EENT: 1415/1447/0108/0204
moonrise/moonset/percent illumination/moon angles (elevation/azimuth)/LUX values: 1915/0715/49%/-40 044º/N/A

3. (U) Outlook to 48 Hours. An area of low pressure will continue to influence the area for the next 48 hours with convective low clouds and variable mid to high clouds expected over the target area. The ceiling will vary between 020 and 080.

4. (U) Tactical Assessment. The ceiling is expected to remain below the strike altitude, and will impact BDA from any ISR assets that must remain above 15,000FT. Marginal impacts from weather are expected throughout the forecast period.

5. (U) Electro-Optical Sensor Performance Predictions. The atmosphere remains relatively dry during the morning hours, but increased convection throughout the daytime an expected absolute humidity of 11.75 g/m$^3$. Sensor performance is expected to be optimal in the morning, but degraded during the afternoon into the evening.

6. (U) Released by: Sgt Marine//

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TF TALON
MINA AL YUMA
232200Z SEP 13

TAB E TO APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
AMPHIBIOUS OBJECTIVE AREA FORECAST (U)

(PASS TO [CATF/CLF/MST/ACE])
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/AMPHIBIOUS OBJECTIVE AREA FORECAST//
REMARKS/

1. (U) Meteorological situation at 1200Z.

2. (U) 24-hour forecast commencing 1200Z for amphibious objective area:

   ***Note:*** Include forecast for landing area if significantly different from AOA weather.

   a. (U) Sky/weather: SCT020CB BKN025 OVC080/isolated thunderstorms.

   b. (U) Visibility (NM): 5SM HZ/1SM TSRA.

   c. (U) Surface winds (knots): 17012/TEMPO 18015G25.

   d. (U) Maximum/minimum temperatures (degrees F): 90/67.

   ***Note:*** Include wind chill factor if applicable.

   e. (U) Sea surface temperature (degrees F): 66.

   f. (U) Combined seas (feet): 26.2.

   g. (U) In water survival time (hours): w/suit 27.2 hours, w/o suit 17.1 hours.

   h. (U) Aviation parameters:

   (1) (U) Clouds/ceilings (feet): SCT020CB BKN025 OVC080 TEMPO BKN020CB OVC050.

   (2) (U) Winds/temperatures aloft (flight level/wind direction/wind speed in knots/ temperatures in degrees C): 080/230/25/04.

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(3) (U) Turbulence: LGT-MDT SFC-080 & MDT 100-180.

(4) (U) Freezing level (feet): 13,500.

(5) (U) Icing: LGT MXD 130–240.

(6) (U) Minimum altimeter setting (inches): 29.64.

(7) (U) Maximum PA/DA: 267/2333.

(8) (U) Contrail formation: possible 30,728 ft/probable 36,530 ft.

(9) (U) Slant range visibility (NM): 5SM HZ/1SM TSRA.

3. (U) Surf forecast for Red/Blue Beach:

> ***Note:*** Output format included in GFMPL [Geophysics Fleet Mission Program Library] surf module.

a. (U) Alpha–significant breaker height (feet): 8.

b. (U) Bravo–maximum breaker height (feet): 12.

c. (U) Charlie–dominant breaker period (S): 15.

d. (U) Delta–dominant breaker type: plunging.

e. (U) Echo–breaker angle (degrees): 040.

f. (U) Foxtrot–littoral current (knots): 1.0.

g. (U) Golf1–number of surf lines: 3 and Golf2–surf zone width (feet): 5.

h. (U) Modified surf index: 8.

i. (U) High/low tides (UTC or local): 1459/2012.

j. (U) Beach conditions of Red Beach has a fairly steep gradient and a short surf zone which provides strong littoral currents. Bottom topography is made up of silt and during low tides can significantly impact trafficability to landing crafts. The west side of the beach has old drainage piping that must be considered during night landings.

> ***Note:*** Provide summary of hydrographic reconnaissance data to include bottom type, beach slope/type/trafficability, significant obstacles (locations) ashore and in shallows.

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4. (U) Tactical Assessment. LCM8, LCU And LCVP will have marginal to unfavorable impacts due to modified surf index of 8 and littoral current of 1 knot. LCAC will have marginal to unfavorable impacts due to significant breaker height of 8–12 feet. AAV critical values met with 50 percent plunging surf of 8–12 feet, but wave interval is not less than 8–10 seconds.

> ***Note:*** See CNSP/CNSL Instruction 3840.1, *Joint Surf Manual,* for a discussion of modified surf limits for various landing craft types. Discuss NO GO criteria, LCAC limitations, etc.

5. (U) Atmospheric Refractive Summary. Super-refractive conditions exist with extended ranges for all frequencies.

a. (U) Evaporative duct height (feet): none.

b. (U) Surface-based duct height (feet): 1,290.

c. (U) Elevated duct heights (bottom-top) (feet): none.

d. (U) Radar propagation conditions summary:

(1) (U) Surface-to-surface radar ranges: for transmitters from surface to 1,290 feet and extended ranges from surface-based duct to all frequencies.

(2) (U) Surface-to-air radar ranges: extended ranges from transmitters from surface to 1,290 feet and possible reduced ranges for transmitters above 1,290 feet.

(3) (U) Air-to-air radar ranges: extended ranges from transmitters from surface to 1,290 feet and possible reduced ranges for transmitters above 1,290 feet.

(4) (U) Air-to-surface radar ranges: extended ranges from transmitters from surface to 1,290 feet and possible reduced ranges for transmitters above 1,290 feet.

e. (U) Communications range predictions:

(1) (U) UHF communications range is extended (normal/extended/greatly extended).

(2) (U) HF radio propagation summary is marginal for minor geomagnetic storming.

6. (U) Astronomical Data (Local)

a. (U) Sunrise/sunset: 0711/1715.

b. (U) BMNT/BMCT/EECT/EENT: 0715/0747/1908/2004.

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c. (U) Moonrise/moonset/percent illumination: 1215/0015/49%.

d. (U) Night vision effectiveness (Lux): optimal due to cloud cover.

7. (U) 24-Hour radiological fallout (RadFo)/chemical fallout (ChemFo) forecast: N/A.

***Note:*** Include as tactical situation dictates.

a. (U) Effective downwind direction (T)/speed in knots: N/A.

b. (U) Distance (NM): N/A.

8. (U) Released by: Sgt Marine//

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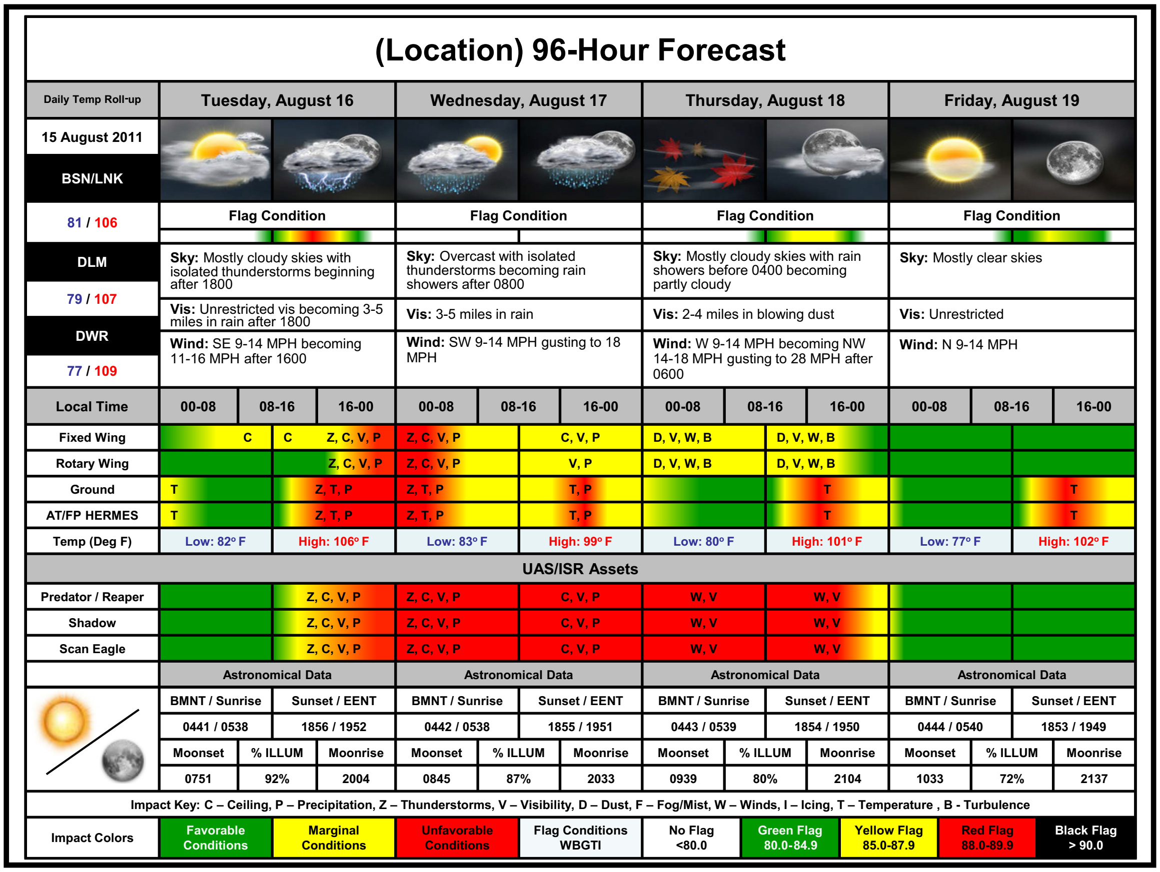
TF TALON
MINA AL YUMA
232200Z SEP 13

TAB F TO APPENDIX 1 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
TF TALON GRAPHICAL FORECAST SLIDE (U)



## (Location) 96-Hour Forecast

| Daily Temp Roll-up | Tuesday, August 16 | Wednesday, August 17 | Thursday, August 18 | Friday, August 19 |
|---|---|---|---|---|
| 15 August 2011<br>BSN/LNK | | | | |
| 81 / 106 | Flag Condition | Flag Condition | Flag Condition | Flag Condition |
| DLM | **Sky:** Mostly cloudy skies with isolated thunderstorms beginning after 1800 | **Sky:** Overcast with isolated thunderstorms becoming rain showers after 0800 | **Sky:** Mostly cloudy skies with rain showers before 0400 becoming partly cloudy | **Sky:** Mostly clear skies |
| 79 / 107 | **Vis:** Unrestricted vis becoming 3-5 miles in rain after 1800 | **Vis:** 3-5 miles in rain | **Vis:** 2-4 miles in blowing dust | **Vis:** Unrestricted |
| DWR<br>77 / 109 | **Wind:** SE 9-14 MPH becoming 11-16 MPH after 1600 | **Wind:** SW 9-14 MPH gusting to 18 MPH | **Wind:** W 9-14 MPH becoming NW 14-18 MPH gusting to 28 MPH after 0600 | **Wind:** N 9-14 MPH |

| Local Time | 00-08 | 08-16 | 16-00 | 00-08 | 08-16 | 16-00 | 00-08 | 08-16 | 16-00 | 00-08 | 08-16 | 16-00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fixed Wing | C | C Z, C, V, P | Z, C, V, P | C, V, P | D, V, W, B | D, V, W, B | | |
| Rotary Wing | | Z, C, V, P | Z, C, V, P | V, P | D, V, W, B | D, V, W, B | | |
| Ground | T | Z, T, P | Z, T, P | T, P | | T | | T |
| AT/FP HERMES | T | Z, T, P | Z, T, P | T, P | | T | | T |
| Temp (Deg F) | Low: 82° F | High: 106° F | Low: 83° F | High: 99° F | Low: 80° F | High: 101° F | Low: 77° F | High: 102° F |
| UAS/ISR Assets | | | | | | | | |
| Predator / Reaper | | Z, C, V, P | Z, C, V, P | C, V, P | W, V | W, V | | |
| Shadow | | Z, C, V, P | Z, C, V, P | C, V, P | W, V | W, V | | |
| Scan Eagle | | Z, C, V, P | Z, C, V, P | C, V, P | W, V | W, V | | |
| | Astronomical Data | | Astronomical Data | | Astronomical Data | | Astronomical Data | |
| | BMNT / Sunrise | Sunset / EENT | BMNT / Sunrise | Sunset / EENT | BMNT / Sunrise | Sunset / EENT | BMNT / Sunrise | Sunset / EENT |
| | 0441 / 0538 | 1856 / 1952 | 0442 / 0538 | 1855 / 1951 | 0443 / 0539 | 1854 / 1950 | 0444 / 0540 | 1853 / 1949 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Moonset | % ILLUM | Moonrise | Moonset | % ILLUM | Moonrise | Moonset | % ILLUM | Moonrise | Moonset | % ILLUM | Moonrise |
| | 0751 | 92% | 2004 | 0845 | 87% | 2033 | 0939 | 80% | 2104 | 1033 | 72% | 2137 |

Impact Key: C – Ceiling, P – Precipitation, Z – Thunderstorms, V – Visibility, D – Dust, F – Fog/Mist, W – Winds, I – Icing, T – Temperature , B - Turbulence

| Impact Colors | Favorable Conditions | Marginal Conditions | Unfavorable Conditions | Flag Conditions WBGTI | No Flag <80.0 | Green Flag 80.0-84.9 | Yellow Flag 85.0-87.9 | Red Flag 88.0-89.9 | Black Flag > 90.0 |
|---|---|---|---|---|---|---|---|---|---|

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TF TALON
YUMA WASABI
232200Z SEP 13

APPENDIX 2 TO ANNEX H TO TF TALON OPERATION ORDER 2-16
(Operation GUNSMOKE) (U)
TF TALON METOC SENSING AND COLLECTION PLAN (U)

1. (U) A variety of unclassified environmental sensor data may be available from host nation assets to include meteorological Doppler radar, environmental satellite imagery, surface observations, weather related PIREPs, and upper air observations. METOC units shall collect as much of this environmental information as possible and use it characterize and exploit current and forecast METOC conditions in the TF Talon AO. Additionally, the MMFC will collect and consolidate such information into a classified METOC database and make it available via SIPRNET Web page. The METMF(R) NEXGEN will be established at TACTS Airfield, Wasabi and provide organic capabilities in the form of surface observations from local and remote sensors, meteorological Doppler radar, and satellite imagery to augment and cover gaps in host nation capabilities.

2. (U) Depending on availability of capabilities, limited observations may be conducted at select FARP sites as necessary to provide on-scene METOC information required to conduct aviation operations and support the TF Talon scheme of maneuver. These observations will be conducted in accordance with reference (k) and shall be provided to onsite Marine air traffic control mobile team and aviation ground support personnel to facilitate FARP layout, ingress and egress of aircraft, and safety of flight operations. These observations will be uploaded via BGAN or, if BGAN is not available or functional, relayed to the MMFC by the most expeditious available communications method and made available to all units through existing command, control, and communications architecture. This includes global METOC databases such as AFWA’s AFW-WEBS and population of the MMFC theater METOC database. The following mobile observation location identifiers (subject to change due to availability) assigned by AFWA are available and shall be activated to best support aviation operations, the MAGTF scheme of maneuver, and build situational awareness of METOC conditions in the TF Talon AO:

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| Identifier/ NMIL | Classification | Location Name | Latitude (minutes) | Longitude (minutes) | Elevation (feet) | Perm/Temp | Military Branch | Type Reports |
|---|---|---|---|---|---|---|---|---|
| KQOS | Unclassified | AUX-2 FARP | 32 33 N | 114 30 W | 269 | Temporary | USMC | Mobile Automated Remote Surface Observation |
| KQBK | Unclassified | Baker Peaks | 32 39 N | 114 00 W | 1,141 | Temporary | USMC | Mobile Automated Remote Surface Observation |
| KQCX | Unclassified | Bull FARP | 33 04 N | 115 01 W | 755 | Temporary | USMC | Mobile Automated Remote Surface Observation |
| KGBN | Unclassified | Gila Bend AFAF | 32 53 N | 112 43 W | 883 | Permanent | USAF | Surface Observations |
| KLGF | Unclassified | Laguna AAF | 31 52 N | 114 24 W | 422 | Permanent | USA | Surface Observations/TAFs |
| KNJK | Unclassified | NAF El Centro | 32 50 N | 115 40 W | -42 | Permanent | USN | Surface Observations/TAFs |
| KQDA | Unclassified | Stoval AF | 32 44 N | 113 38 W | 384 | Temporary | USMC | Mobile Automated Remote Surface Observation |
| KQDB | Unclassified | Speed Bag AF | 33 16 N | 115 25 W | 305 | Temporary | USMC | Surface Observations/TAFs |
| KQOT | Unclassified | TACTS AF | 32 30 N | 114 09 W | 814 | Temporary | USMC | Surface Observations/TAFs |
| 69110 | Unclassified | TACTS AF | 32 30 N | 114 09 W | 814 | Temporary | USMC | Mobile Upper Air |

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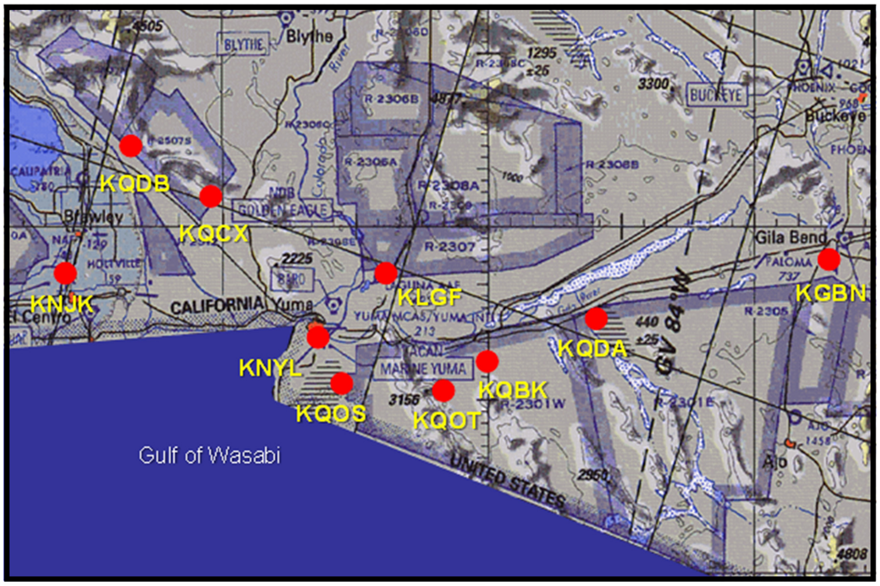
## Meteorological Elements



● Meteorological reporting locations with station identifiers

ACKNOWLEDGE RECIEPT

W.X. WEATHER
Capt USMC
METOC Officer

OFFICIAL:

s/
D.D. MARINE
Capt USMC
METOC Officer

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TF TALON
YUMA WASABI
232200Z SEP 13

APPENDIX 3 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
TF TALON METOC IMPACTS THRESHOLDS (U)

1. (U) A METOC impacts matrix will be developed and updated daily to provide commanders with a rapid assessment of the impact of forecast METOC conditions on future operations. Tab A shows specific METOC parameters that will be used as criteria in determining METOC impacts to TF Talon systems, operations, and personnel. The following color scheme is adopted to represent the degree that the operation, system, or personnel are assessed to be impacted by the weather during a particular window of time:

   a. (U) Green. METOC conditions favorable for operations (capability 75% or > effective).

   b. (U) Yellow. Marginal METOC impact to operations (capability degraded; 25%–74% effective).

   c. (U) Red. METOC conditions unfavorable for operations (capability degraded; 0%–24% effective).

2. (U) Recommendations or requests to modify, change, or add operational categories or threshold criteria should be directed to the SMO. The commander is the approval authority for any changes to the METOC impacts thresholds table.

3. (U) Tab B shows an example of the METOC impacts matrix. Units may modify the format to suit specific requirements. However, modifications of operational categories and thresholds must be approved by the commander via routing through the JMO. Units may develop their own METOC impacts thresholds and matrices for internal use.

ACKNOWLEDGE RECIEPT

W.X. WEATHER
Capt USMC
METOC Officer

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TABS:

A–TF Talon METOC Impacts Parameters
B–TF Talon METOC Impacts Thresholds Matrix Example

OFFICIAL:

s/
D.D. MARINE
Capt USMC
METOC Officer

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TF TALON
MINA AL YUMA
232200Z SEP 13

TAB A TO APPENDIX 3 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
TF TALON METOC IMPACTS PARAMETERS (U)

(U) Green–METOC conditions favorable for operations (capability 75% or > effective).

(U) Yellow–Marginal METOC impact to operations (capability degraded; 25%–74% effective).

(U) Red–METOC conditions unfavorable for operations (capability degraded; 0%–24% effective).

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| Operation | Favorable | Marginal | Unfavorable | Remarks |
|---|---|---|---|---|
| **Aerial Reconnaissance** | | | | |
| Sky cover | SCT ≥ 15,000 feet | BKN ≤ 15,000 feet | OVC ≤ 15,000 feet | Fixed-wing deconfliction |
| Ceiling | ≥ 5,000 feet | 1,000 feet–5,000 feet | < 1,000 feet | |
| Visibility | ≥ 5 miles | 3–5 miles | < 3 miles | |
| Thunderstorms | > 25 miles | Within 25 miles | Within 10 miles | |
| Wind (sustained) | < 15 knots | 15–24 knots | ≥ 25 knots | Fixed-wing limit for ejection |
| **Antiair Warfare** | | | | |
| Sky cover | SCT ≥ 15,000 feet | BKN ≤ 15,000 feet | OVC ≤ 15,000 feet | Fixed-wing limit for ejection |
| Ceiling | ≥ 5,000 feet | 1,000 feet–5,000 feet | < 1,000 feet | |
| Visibility | ≥ 5 miles | 3–5 miles | < 3 miles | |
| Thunderstorms | > 25 miles | Within 25 miles | Within 10 miles | |
| Wind (sustained) | < 15 knots | 15–24 knots | ≥ 25 knots | Fixed-wing limit for ejection |
| Turbulence | Light | Moderate | Severe | |
| **Assault Support** | | | | |
| **Rotary-Wing (CH-53)** | | | | |
| Ceiling | ≥ 2,000 feet | 1,000 feet–2,000 feet | < 1,000 feet | |
| Visibility | ≥ 4 miles | 3–4 miles | < 3 miles | |
| Winds (surface) | ≤ 25 knots | 26–35 knots | > 35 knots | MAWTS-1 flight SOP 2014 |
| Winds (aloft) | < 35 knots | 35–50 knots | > 50 knots | |
| Thunderstorms | None | Within 25 miles | Within 10 miles | |
| Turbulence | Light | Moderate | Severe | |
| **Rotary-Wing (UH-1)** | | | | |
| Ceiling | ≥ 2,000 feet | 1,000 feet–2,000 feet | < 1,000 feet | |
| Visibility | ≥ 4 miles | 3–4 miles | < 3 miles | |
| Winds (aloft) | < 25 knots | 25–40 knots | > 40 knots | |
| Thunderstorms | None | Within 25 miles | Within 10 miles | |
| Turbulence | Light | Moderate | Severe | |
| **TiltRotor (MV-22)** | | | | |
| Ceiling | ≥ 3,000 feet | 1,000 feet–3,000 feet | < 1,000 feet | Low altitude tactics |
| Visibility | ≥ 5 miles | 3–5 miles | < 3 miles | Low altitude tactics |
| Winds (surface) | ≤ 25 knots | 26–35 knots | > 35 knots | MAWTS-1 flight SOP 2014 |
| winds (aloft) | < 25 knots | 25–40 knots | > 40 knots | |

| **Operation (continued)** | **Favorable (continued)** | **Marginal (continued)** | **Unfavorable (continued)** | **Remarks (continued)** |
|---|---|---|---|---|
| Thunderstorms | None | Within 25 miles | Within 10 miles | |
| Turbulence | Light | Moderate | Severe | |
| **Fixed-Wing (KC-130)** | | | | |
| Ceiling | ≥ 2,000 feet | 1,000 feet–2,000 feet | < 1,000 feet | |
| Visibility (surface) | ≥ 4 miles | 3–4 miles | < 3 miles | |
| Winds (surface) | ≤ 25 knots | 26–35 knots | > 35 knots | MAWTS-1 flight SOP 2014 |
| Crosswind component | ≤ 25 knots | 26–34 knots | ≥ 35 knots | Dry runway conditions |
| Thunderstorms | None | Within 25 miles | Within 10 miles | |
| Turbulence | Light | Moderate | Severe | |
| **Electronic Warfare** | | | | |
| sky cover | sct ≥ 15,000 feet | bkn ≤ 15,000 feet | ovc ≤ 15,000 feet | Fixed-wing deconfliction |
| Ceiling | ≥ 5,000 feet | 3,000 feet–5,000 feet | < 3,000 feet | |
| Visibility | ≥ 5 miles | 3–5 miles | < 3 miles | |
| Thunderstorms | ≥ 25 miles | Within 25 miles | Within 10 miles | |
| Crosswind component | < 10 knots | 11–20 knots | > 20 knots | |
| Wind (sustained) | < 15 knots | 15–24 knots | > 25 knots | Fixed-wing limit for ejection |
| Turbulence | Light | Moderate | Severe | At flight level |
| **Offensive Air Support** | | | | |
| Sky cover | SCT ≥ 15,000 feet | BKN ≤ 15,000 feet | OVC ≤ 15,000 feet | Fixed-wing deconfliction |
| Ceiling | ≥ 5,000 feet | 1,500 feet–5,000 feet | < 1,500 feet | |
| Visibility | ≥ 5 miles | 3–5 miles | < 3 miles | |
| Thunderstorms | > 25 miles | Within 25 miles | Within 10 miles | |
| Wind (sustained) | < 15 knots | 15–24 knots | ≥ 25 knots | Fixed-wing limit for ejection |
| Turbulence | Light | Moderate | Severe | at flight level |
| **Precision-Guided Munitions (PGMs)** | | | | |
| Sky cover | FEW ≤ flight level | BKN ≤ flight level | OVC ≤ flight level | |
| Rain | Light | Moderate | Heavy | |
| Visibility | ≥ 5 miles | 3–5 miles | < 3 miles | |
| sand storm | | light | moderate | |
| Absolute humidity | < 10 g/cm$^3$ | 10–19 g/cm$^3$ | 20+ g/cm$^3$ | IR PGMs only |
| **Ground (Personnel)** | | | | |
| Temperature | (-15 °F)–84 °F | 85 °F–94 °F | > 95 °F | |
| Precipitation | Light | Moderate | Heavy | |
| Thunderstorms | > 25 miles | Within 25 miles | Within 10 miles | |

| **Operation (continued)** | **Favorable (continued)** | **Marginal (continued)** | **Unfavorable (continued)** | **Remarks (continued)** |
|---|---|---|---|---|
| MOPP IV | < 60 °F | 60 °F–67 °F | ≥ 68 °F | |
| Wind gusts | < 25 knots | 25–39 knots | ≥ 40 knots | |
| **Unmanned Aircraft Systems (UASs)** | | | | |
| Wind (surface) | < 20 knots | 20–24 knots | > 25 knots | |
| Wind (aloft) | < 40 knots | 40–60 knots | > 60 knots | |
| Headwind/crosswind | < 15 knots | 15–20 knots | > 20 knots or<br>> 25 knot gusts | RQ-7B |
| Ceiling | > 4,000 feet | 2,000 feet–4,000 feet | < 2,000 feet | |
| Visibility | > 3 miles | 2–3 miles | < 2 miles | |
| Sky cover below 5,000' | FEW | SCT | BKN | |
| Gust spread | < 15 knots | 15–25 knots | > 25 knots | |
| Target visibility | > 5 miles | 3–5 miles | < 3 miles | |
| Precipitation | None | Light | Moderate to heavy | |
| Thunderstorms | | FEW within 25 miles | SCT within 10 miles | |
| **HF Communications** | | | | |
| Solar activity | Quiet | Active | Very active | |
| Geomagnetic storming | Low | Moderate | Severe | |
| **UHF Communications** | | | | |
| Ionospheric scintillation | Light | Moderate | Severe | |
| Geomagnetic storming | | Minor | Major | |
| **GPS Error** | | | | |
| Solar activity | Quiet | Active | Very active | |
| Charged particle environment | Quiet | Active | Very active | |
| Ionospheric scintillation | Light | Moderate | Severe | |
| Geomagnetic storming | | Minor | Major | |
| GPS error | < 10 miles | 10–20 miles | < 20 miles/<br>No solution | |

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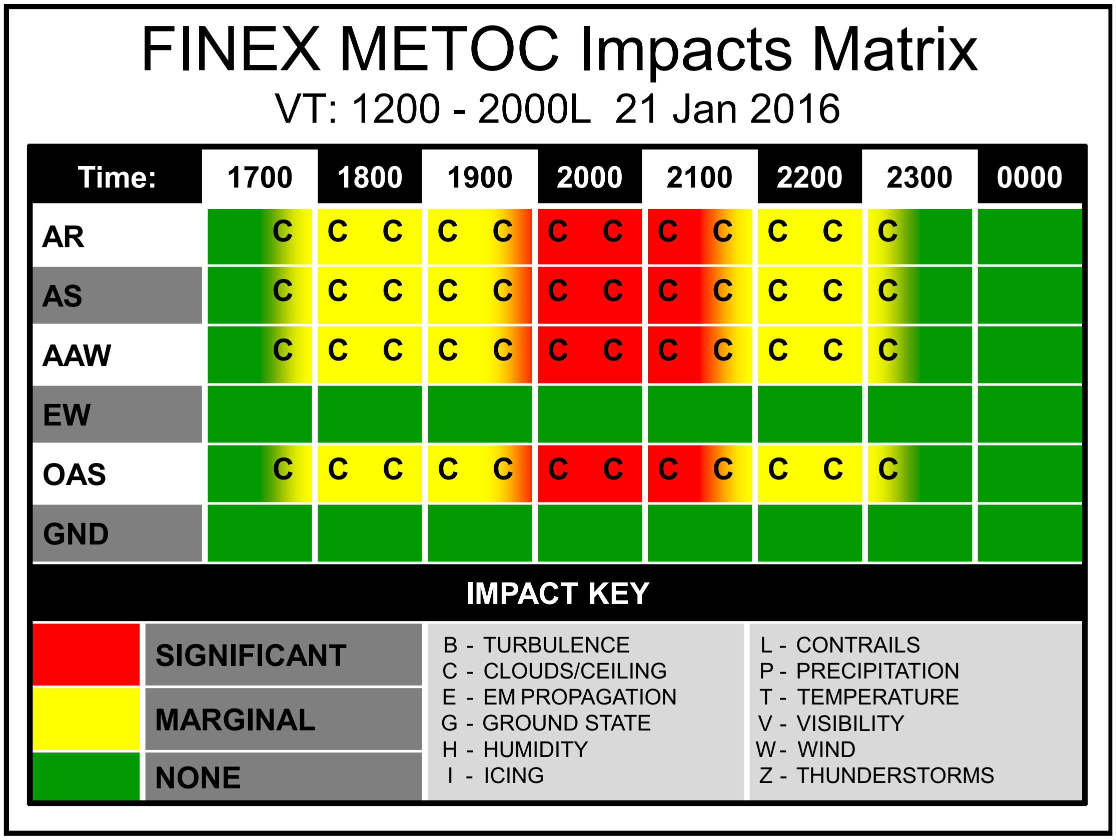
TAB B TO APPENDIX 3 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
TF TALON METOC IMPACTS MATRIX EXAMPLE (U)



# FINEX METOC Impacts Matrix

VT: 1200 - 2000L 21 Jan 2016

| Time: | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 0000 |
|---|---|---|---|---|---|---|---|---|
| AR | 🟩🟨 C | 🟨 C C | 🟨🟥 C C | 🟥 C C | 🟥🟨 C C | 🟨 C C | 🟨🟩 C | 🟩 |
| AS | 🟩🟨 C | 🟨 C C | 🟨🟥 C C | 🟥 C C | 🟥🟨 C C | 🟨 C C | 🟨🟩 C | 🟩 |
| AAW | 🟩🟨 C | 🟨 C C | 🟨🟥 C C | 🟥 C C | 🟥🟨 C C | 🟨 C C | 🟨🟩 C | 🟩 |
| EW | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |
| OAS | 🟩🟨 C | 🟨 C C | 🟨🟥 C C | 🟥 C C | 🟥🟨 C C | 🟨 C C | 🟨🟩 C | 🟩 |
| GND | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |

IMPACT KEY

| | | | |
|---|---|---|---|
| 🟥 | SIGNIFICANT | B - TURBULENCE<br>C - CLOUDS/CEILING | L - CONTRAILS<br>P - PRECIPITATION |
| 🟨 | MARGINAL | E - EM PROPAGATION<br>G - GROUND STATE<br>H - HUMIDITY | T - TEMPERATURE<br>V - VISIBILITY<br>W - WIND |
| 🟩 | NONE | I - ICING | Z - THUNDERSTORMS |

Legend

| | |
|---|---|
| AAW | antiair warfare |
| AR | air reconnaissance |
| AS | assault support |
| EW | electronic warfare |
| GND | ground state |
| OAS | offensive air support |

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APPENDIX 4 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)
TF TALON DAILY METOC SITUATION REPORT (U)

1. (U) A daily TF Talon METOC situation report (TF Talon METOC situation report [SITREP]) shall be POSTED TO THE METMF(R) NEXGEN SIPRNET WEB SITE NO LATER THAN 1600T DAILY USING tab A to appendix 5 to annex H of the TF Talon OPORD. In addition, the information shall be included in the MACS Detachment Daily SITREP for command visibility. The format for the MACS Detachment Daily SITREP is at the discretion of the command. The Daily METOC SITREP posted to the METMF(R) NEXGEN Web site shall show:

a. (U) The METMF(R) NEXGEN is the primary METOC collection, analysis, and production capability for TF Talon. As such, it is imperative that situational awareness of METMF(R) NEXGEN readiness be monitored to ensure optimal METOC support to TF Talon. The following color scheme is adopted to represent the readiness of the major METMF(R) NEXGEN subsystems:

(1) (U) Green. Fully operational. No impact to mission readiness.

(2) (U) Yellow. Partial or marginal degradation in capability. Impacts mission readiness but does not prevent mission accomplishment.

(3) (U) Red. Completely nonoperational. Mission accomplishment critically jeopardized or nonmission capable.

b. (U) Major subsystems annotated as yellow or red shall include remarks as to the status of effort to restore the item to full operational capability. Such remarks shall include customer service request numbers and a brief status of efforts for resolution as appropriate.

2. (U) Products and activities performed on a daily basis shall be annotated in the products section of the METOC SITREP as shown in tab A to appendix 5 to annex H of the TF Talon OPORD.

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TABS:

A–TF Talon METOC Daily SITREP

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## TAB A TO APPENDIX 4 TO ANNEX H TO TF TALON OPERATION ORDER 2-16 (Operation GUNSMOKE) (U)

TF TALON METOC DAILY SITREP (U)

| System | Status | CSR | Remarks |
|---|---|---|---|
| **Shelter Subsystem** | | | |
| Shelter subsystem | 🟩 | | |
| **Meteorological Satellite Subsystem (MSS)** | | | |
| MSS | 🟩 | | |
| **Meteorological Radar Subsystem (MRS)** | | | |
| MRS | 🟩 | | |
| **Upper Air Subsystem (UAS)** | | | |
| UAS | 🟩 | | |
| **Local Sensor Subsystem (LSS)** | | | |
| LSS | 🟩 | | |
| **Remote Sensor Subsystem (RSS) #1** | | | |
| RSS | 🟩 | | |
| **Remote Sensor Subsystem (RSS) #2** | | | |
| RSS | 🟩 | | |
| **Communications Subsystem (CSS)** | | | |
| HF | 🟩 | | |
| UHF | 🟩 | | |
| VHF | 🟩 | | |
| BGAN | 🟩 | | |
| **Processing Subsystem (PCS)** | | | |
| PCS | 🟩 | | |
| **Naval Integrated Tactical Environmental System (NITES) Mobile Variant IV** | | | |
| NITES IV | 🟩 | | |
| **Automated Weather Observing System (AWOS)** | | | |
| AWOS | 🟩 | | |
| **Environmental Control Unit (ECU)** | | | |
| ECU | 🟩 | | |

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| System (continued) | Status | CSR | Remarks |
|---|---|---|---|
| **Web page** | | | |
| MRS imagery | 🟩 | | |
| MSS imagery | 🟩 | | |
| UAS products | 🟩 | | |

| Product | Daily | To Date | Remarks |
|---|---|---|---|
| METOC RFIs | | | |
| Briefs | | | |
| GFMPL | | | |
| TAWS | | | |
| AREPS | | | |
| WEAX/daily forecast | | | |
| TAFS | | | |
| Local surface observations | | | |
| RAOBs | | | |
| FARP observations | | | |
| xMet observations | | | |

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# APPENDIX B
# METOC INPUT TO ANNEX B EXAMPLE

The following list of acronyms and abbreviations appear in and are applicable to this appendix only. Acronyms or abbreviations not found in this list are located in Section I of the glossary. All nomenclature is located in Section III of the glossary.

> ***Note:*** There are multiple entries consisting of subject matter specific terms and short forms for timely order writing and briefings. These short forms are applicable to this appendix only.

| | |
|---|---|
| BKN | broken (*cloud cover condition*) |
| BMCT | beginning morning civil twilight |
| BMNT | beginning morning nautical twilight |
| CLR | clear (*cloud cover condition*) |
| DST | daylight saving time |
| EECT | ending evening civil twilight |
| EENT | ending evening nautical twilight |
| IFR | instrument flight rules |
| Max | maximum |
| Min | minimum |
| MST | mountain standard time |
| OVC | overcast (*cloud cover condition*) |
| SCT | scattered (*cloud cover condition*) |
| TF | task force |
| UTC | Coordinated Universal Time |
| VFR | visual flight rules |

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TAB B TO APPENDIX 18 TO ANNEX B TO TF TALON OPERATION ORDER (1-14) (Operation GUNSMOKE) (U)
ASTRONOMICAL AND CLIMATOLOGICAL DATA (U)

1. (U) All times are listed as local times or mountain standard time (MST). Local time (Tango) is -7 hours from UTC (Zulu). Portions of Wasabi and Chipotle east of the Colorado River remain in MST throughout the year and do not observe daylight savings time (DST). Those portions of the AO west of the Colorado River are in Uniform time zone and observe DST and must be considered during planning. Contact the METOC section for specific lux values and light levels. The following are terms and definitions necessary for interpreting the exhibited data.

a. (U) Sunrise/Moonrise. The instant when the upper edge of the sun/moon appears on the sea-level horizon.

b. (U) Sunset/Moonset. The instant when the upper edge of the sun/moon disappears below the sea-level horizon.

c. (U) Nautical Twilight. When the center of the sun’s disk is 12 degrees below the sea-level horizon.

BMNT–Beginning morning nautical twilight.
EENT–Ending evening nautical twilight.

d. (U) Civil Twilight. When the center of the sun's disk is 6 degrees below the sea-level horizon.

BMCT–Beginning morning civil twilight.
EECT–Ending evening civil twilight.

e. (U) Lunar Illumination. Given in percentage of the “actual” lunar disk visible at midnight of each given day.

2. (U) Astronomical data for Mina Al Yuma, Wasabi, (32º 37' N, 114º 36' W) is contained in exhibits 1 through 4.

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3. (U) All climatological data is based on observations from 1942 through 2014. Terms and definitions are as follows.

a. (U) Temperature. Temperature is listed in degrees Fahrenheit, for conversion to Celsius: (ºF-32) divided by 1.8 = ºC.

b. (U) Sky Condition:

CLR–Clear; absence of clouds or obscuring phenomena.
SCT–Scattered; 1/8 to 4/8 sky coverage.
BKN–Broken; 5/8 to 7/8 sky coverage.
OVC–Overcast; 8/8 sky coverage.

c. (U) Field Condition:

VFR–Visual Flight Rules; ceiling 1,000' or greater and visibility 3 miles or greater.
IFR–Instrument Flight Rules; ceiling below 1,000' and/or visibility below 3 miles.

d. (U) Visibility. Visibility is the greatest visibility equaled or exceeded throughout at least one-half of the horizon circle.

e. (U) Ceiling. Ceiling is the height ascribed to the lowest broken or overcast layer aloft which is predominately opaque, or the vertical visibility into a surface-based obstruction.

4. (U) Climatological Data for September (1942–2014)

| **Temperature** | | **Humidity** | **Precipitation** | |
|---|---|---|---|---|
| Average Max | 102 ºF | 0500L 32% | | |
| Average Min | 78 ºF | 1400L 52% | | |
| Absolute Max | 115 ºF | 1700L 43% | Absolute Max | 5.1" |
| Absolute Min | 57 ºF | | Absolute Min | 0.0" |
| *Average 89 ºF* | | *Average 42%* | *Average 0.6"* | |

| **Sky Condition** | **Field Condition** | | **Ceiling/Visibility** |
|---|---|---|---|
| CLR 64% | VFR | > 99.5% | <3,000 feet & 3 miles < 0.1% |
| SCT 22% | IFR | < 0.5% | <1,500 feet & 3 miles < 0.1% |
| BKN 10% | | | <1,000 feet & 3 miles < 0.1% |
| OVC 4% | | | |

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| Surface Winds | | | Thunderstorms |
|---|---|---|---|
| 0800L | NNE | 10.4 knots | Average # of Days 0.3 |
| 1400L | S | 8.2 knots | |
| 2000L | WSW | 5.4 knots | |
| All Hours | S | 6.0 knots | |
| Max | SE | 66.0 knots | |

5. (U) Climatological Data for October (1942–2014)

| Temperature | | Humidity | | Precipitation |
|---|---|---|---|---|
| Average Max | 91 ºF | 0500L | 33% | |
| Average Min | 67 ºF | 1400L | 46% | |
| Absolute Max | 109 ºF | 1700L | 38% | Absolute Max 3.0 inches |
| Absolute Min | 46 ºF | | | Absolute Min 1.0 inches |
| *Average* | *78 ºF* | *Average* | *39%* | *Average 2.0 inches* |

| Sky Condition | | Field Condition | | Ceiling/Visibility |
|---|---|---|---|---|
| CLR | 63% | VFR | >99.5% | <3,000 feet & 3 miles <0.4% |
| SCT | 19% | IFR | <0.5% | <1,500 feet & 3 miles <0.2% |
| BKN | 12% | | | <1,000 feet & 3 miles <0.1% |
| OVC | 6% | | | |

| Surface Winds | | | Thunderstorms |
|---|---|---|---|
| 0800L | N | 6.0 knots | Average # of Days 2.7 |
| 1400L | W | 8.3 knots | |
| 2000L | W | 5.3 knots | |
| All hours | W | 7.2 knots | |
| Max | N | 49.0 knots | |

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EXHIBITS:

1—Astronomical Data for September 2013
2—Lite Level Planning Calendar for September 2013
3—Astronomical Data for October 2013
4—Lite Level Planning Calendar for October 2013

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EXHIBIT 1 TO TAB B TO APPENDIX 18 TO ANNEX B TO TF TALON OPERATION ORDER (1-14) (Operation GUNSMOKE) (U)
ASTRONOMICAL DATA FOR SEPTEMBER 2013 (U)

| Date | BMNT | BMCT | Sunrise | Sunset | EECT | EENT | Moonrise | Moonset | % Illum |
|---|---|---|---|---|---|---|---|---|---|
| Sep 1 | 0519 | 0548 | 0613 | 1903 | 1928 | 1957 | 0247 | 1637 | 15 |
| Sep 2 | 0519 | 0549 | 0614 | 1901 | 1926 | 1956 | 0341 | 1714 | 8 |
| Sep 3 | 0520 | 0550 | 0615 | 1900 | 1925 | 1954 | 0436 | 1749 | 4 |
| Sep 4 | 0521 | 0550 | 0615 | 1859 | 1924 | 1953 | 0532 | 1823 | 1 |
| Sep 5 | 0522 | 0551 | 0616 | 1857 | 1922 | 1952 | 0628 | 1857 | 0 |
| | | | | | | | | | |
| Sep 6 | 0522 | 0552 | 0617 | 1856 | 1921 | 1950 | 0726 | 1931 | 1 |
| Sep 7 | 0523 | 0552 | 0617 | 1855 | 1920 | 1949 | 0825 | 2008 | 4 |
| Sep 8 | 0524 | 0553 | 0618 | 1853 | 1918 | 1947 | 0926 | 2047 | 9 |
| Sep 9 | 0525 | 0554 | 0619 | 1852 | 1917 | 1946 | 1027 | 2130 | 17 |
| Sep 10 | 0525 | 0554 | 0619 | 1851 | 1916 | 1945 | 1129 | 2217 | 26 |
| | | | | | | | | | |
| Sep 11 | 0526 | 0555 | 0620 | 1849 | 1914 | 1943 | 1231 | 2310 | 36 |
| Sep 12 | 0527 | 0556 | 0620 | 1848 | 1913 | 1942 | 1331 | ---- | 47 |
| Sep 13 | 0527 | 0556 | 0621 | 1847 | 1911 | 1940 | 1427 | 0008 | 58 |
| Sep 14 | 0528 | 0557 | 0622 | 1845 | 1910 | 1939 | 1518 | 0111 | 69 |
| Sep 15 | 0529 | 0558 | 0622 | 1844 | 1909 | 1938 | 1606 | 0216 | 79 |
| | | | | | | | | | |
| Sep 16 | 0529 | 0558 | 0623 | 1843 | 1907 | 1936 | 1649 | 0322 | 88 |
| Sep 17 | 0530 | 0559 | 0624 | 1841 | 1906 | 1935 | 1729 | 0428 | 94 |
| Sep 18 | 0531 | 0600 | 0624 | 1840 | 1905 | 1933 | 1807 | 0533 | 98 |
| Sep 19 | 0532 | 0600 | 0625 | 1839 | 1903 | 1932 | 1845 | 0637 | 99 |
| Sep 20 | 0532 | 0601 | 0626 | 1837 | 1902 | 1931 | 1922 | 0739 | 98 |
| | | | | | | | | | |
| Sep 21 | 0533 | 0602 | 0626 | 1836 | 1901 | 1929 | 2001 | 0840 | 95 |
| Sep 22 | 0534 | 0602 | 0627 | 1835 | 1859 | 1928 | 2042 | 0939 | 89 |
| Sep 23 | 0534 | 0603 | 0627 | 1833 | 1858 | 1926 | 2124 | 1036 | 82 |
| Sep 24 | 0535 | 0604 | 0628 | 1832 | 1857 | 1925 | 2210 | 1130 | 74 |
| Sep 25 | 0536 | 0604 | 0629 | 1831 | 1855 | 1924 | 2257 | 1221 | 65 |
| | | | | | | | | | |

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| Date | BMNT | BMCT | Sunrise | Sunset | EECT | EENT | Moonrise | Moonset | % Illum |
|---|---|---|---|---|---|---|---|---|---|
| Sep 26 | 0536 | 0605 | 0629 | 1829 | 1854 | 1922 | 2347 | 1308 | 56 |
| Sep 27 | 0537 | 0606 | 0630 | 1828 | 1853 | 1921 | ---- | 1352 | 47 |
| Sep 28 | 0538 | 0606 | 0631 | 1827 | 1851 | 1920 | 0039 | 1433 | 37 |
| Sep 29 | 0538 | 0607 | 0631 | 1825 | 1850 | 1918 | 0132 | 1511 | 28 |
| Sep 30 | 0539 | 0608 | 0632 | 1824 | 1849 | 1917 | 0226 | 1546 | 20 |

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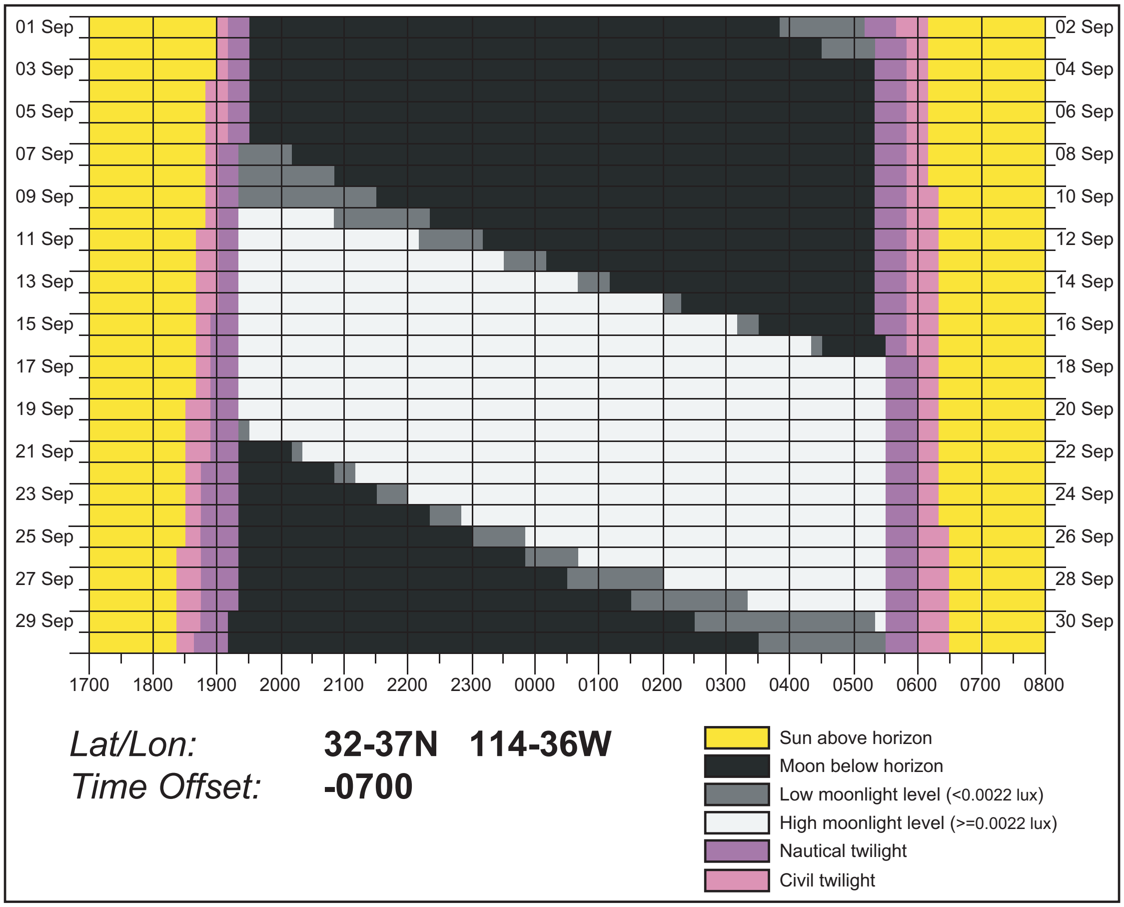
## EXHIBIT 2 TO TAB B TO APPENDIX 18 TO ANNEX B TO TF TALON OPERATION ORDER (1-14) (Operation GUNSMOKE) (U)

LITE LEVEL PLANNING CALENDAR FOR SEPTEMBER 2013 (U)



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## EXHIBIT 3 TO TAB B TO APPENDIX 18 TO ANNEX B TO TF TALON OPERATION ORDER (1-14) (Operation GUNSMOKE) (U)

## ASTRONOMICAL DATA FOR OCTOBER 2013 (U)

| Date | BMNT | BMCT | Sunrise | Sunset | EECT | EENT | Moonrise | Moonset | % Illum |
|---|---|---|---|---|---|---|---|---|---|
| Oct 1 | 0540 | 0608 | 0633 | 1823 | 1847 | 1916 | 0321 | 1621 | 13 |
| Oct 2 | 0540 | 0609 | 0633 | 1821 | 1846 | 1914 | 0417 | 1655 | 7 |
| Oct 3 | 0541 | 0610 | 0634 | 1820 | 1845 | 1913 | 0515 | 1730 | 2 |
| Oct 4 | 0542 | 0610 | 0635 | 1819 | 1843 | 1912 | 0614 | 1806 | 0 |
| Oct 5 | 0542 | 0611 | 0636 | 1817 | 1842 | 1911 | 0715 | 1845 | 0 |
| | | | | | | | | | |
| Oct 6 | 0543 | 0612 | 0636 | 1816 | 1841 | 1909 | 0818 | 1927 | 2 |
| Oct 7 | 0544 | 0612 | 0637 | 1815 | 1840 | 1908 | 0921 | 2014 | 7 |
| Oct 8 | 0544 | 0613 | 0638 | 1814 | 1838 | 1907 | 1024 | 2107 | 14 |
| Oct 9 | 0545 | 0614 | 0638 | 1812 | 1837 | 1906 | 1125 | 2204 | 23 |
| Oct 10 | 0546 | 0614 | 0639 | 1811 | 1836 | 1904 | 1223 | 2305 | 33 |
| | | | | | | | | | |
| Oct 11 | 0546 | 0615 | 0640 | 1810 | 1835 | 1903 | 1315 | ---- | 44 |
| Oct 12 | 0547 | 0616 | 0641 | 1809 | 1833 | 1902 | 1403 | 0008 | 56 |
| Oct 13 | 0548 | 0616 | 0641 | 1808 | 1832 | 1901 | 1446 | 0113 | 67 |
| Oct 14 | 0549 | 0617 | 0642 | 1806 | 1831 | 1900 | 1526 | 0217 | 77 |
| Oct 15 | 0549 | 0618 | 0643 | 1805 | 1830 | 1859 | 1604 | 0321 | 85 |
| | | | | | | | | | |
| Oct 16 | 0550 | 0619 | 0643 | 1804 | 1829 | 1857 | 1641 | 0423 | 92 |
| Oct 17 | 0551 | 0619 | 0644 | 1803 | 1828 | 1856 | 1718 | 0525 | 97 |
| Oct 18 | 0551 | 0620 | 0645 | 1802 | 1827 | 1855 | 1756 | 0625 | 99 |
| Oct 19 | 0552 | 0621 | 0646 | 1801 | 1825 | 1854 | 1836 | 0725 | 99 |
| Oct 20 | 0553 | 0622 | 0647 | 1759 | 1824 | 1853 | 1918 | 0823 | 97 |
| | | | | | | | | | |
| Oct 21 | 0554 | 0622 | 0647 | 1758 | 1823 | 1852 | 2002 | 0919 | 93 |
| Oct 22 | 0554 | 0623 | 0648 | 1757 | 1822 | 1851 | 2049 | 1012 | 87 |
| Oct 23 | 0555 | 0624 | 0649 | 1756 | 1821 | 1850 | 2139 | 1101 | 80 |
| Oct 24 | 0556 | 0625 | 0650 | 1755 | 1820 | 1849 | 2230 | 1146 | 72 |
| Oct 25 | 0556 | 0625 | 0650 | 1754 | 1819 | 1848 | 2322 | 1228 | 64 |
| | | | | | | | | | |

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| Date | BMNT | BMCT | Sunrise | Sunset | EECT | EENT | Moonrise | Moonset | % Illum |
|---|---|---|---|---|---|---|---|---|---|
| Oct 26 | 0557 | 0626 | 0651 | 1753 | 1818 | 1847 | ---- | 1307 | 54 |
| Oct 27 | 0558 | 0627 | 0652 | 1752 | 1817 | 1846 | 0015 | 1343 | 45 |
| Oct 28 | 0559 | 0628 | 0653 | 1751 | 1816 | 1845 | 0109 | 1418 | 36 |
| Oct 29 | 0559 | 0628 | 0654 | 1750 | 1815 | 1844 | 0204 | 1451 | 26 |
| Oct 30 | 0600 | 0629 | 0655 | 1749 | 1815 | 1844 | 0300 | 1525 | 18 |
| | | | | | | | | | |
| Oct 31 | 0601 | 0630 | 0655 | 1748 | 1814 | 1843 | 0358 | 1601 | 11 |

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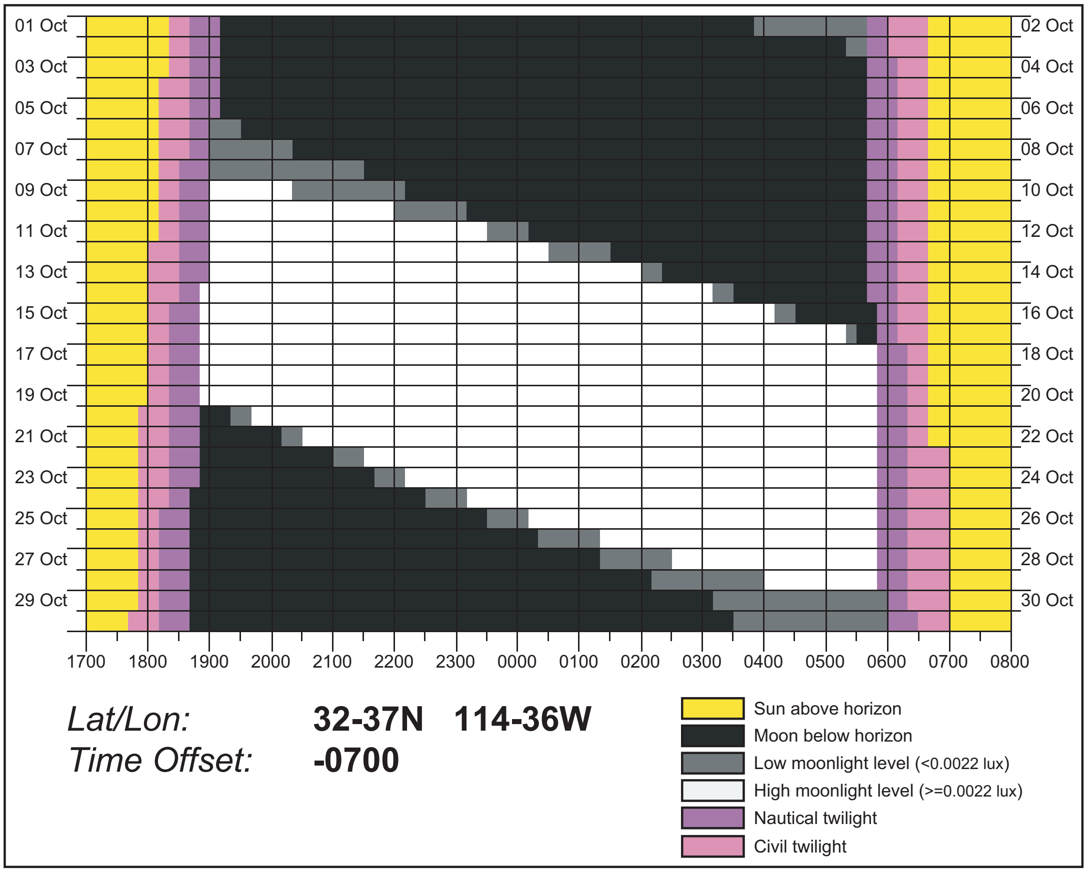
<u>EXHIBIT 4 TO TAB B TO APPENDIX 18 TO ANNEX B TO TF TALON OPERATION ORDER (1-14) (Operation GUNSMOKE) (U)</u>
LITE LEVEL PLANNING CALENDAR FOR OCTOBER 2013 (U)



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METOC Officer

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# APPENDIX C

# METOC INPUT TO ANNEX K EXAMPLE

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TAB A TO APPENDIX 20 TO ANNEX K TO TF TALON OPERATION ORDER (1-14) (Operation GUNSMOKE) (U)
METEOROLOGICAL IMPACTS TO COMMUNICATIONS AND INFORMATION SYSTEMS (U)

1. (U) General. Communications and information systems (CIS) operations are affected by a number of weather elements. Virtually all of the special weather conditions that apply to CIS operations affect electromagnetic (EM) propagation.

2. (U) Meteorological Elements

a. (U) Dust. Affects EM propagation.

b. (U) Electrical Storms and Thunder. Affects radio and wire communications and may disrupt synchronization for data communications.

c. (U) Fog. Affects EM propagation.

d. (U) Precipitation. Affects EM propagation.

e. (U) Blowing Sand or Snow. Builds static discharge, which may affect EM propagation.

f. (U) Ionospheric Disturbance. Affects the reliability of radio communications systems.

g. (U) Refractive Index. Affects EM propagation characteristics of the atmosphere.

h. (U) Icing. May damage cable lines and antennas; also decreases the efficiency of microwave systems.

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i. (U) Wind (Surface). May damage antennas and transmission lines, may cause cable blowdown, and interfered with antenna installation.

j. (U) Temperature (Surface). High temperatures adversely affect electronic circuits and may increase maintenance requirements. Extreme cold may snap cable lines. Cold decreases the life of battery-operated equipment.

k. (U) Humidity. Humidity may cause fungal growth within circuits; this can result in premature system failure.

3. (U) Meteorological critical values on CIS operations are in exhibit 1.

ACKNOWLEDGE RECEIPT

W.X. WEATHER
Capt USMC
METOC Officer

EXHIBIT:

1—Meteorological Critical Values on CIS Operations

OFFICIAL:

s/
D.D. MARINE
Capt USMC
METOC Officer

CLASSIFICATION

TF TALON
YUMA WASABI
232200Z SEP 13

EXHIBIT 1 TO TAB A TO APPENDIX 20 TO ANNEX K TO TF TALON OPERATION ORDER (1-14) (Operation GUNSMOKE) (U)
METEOROLOGICAL CRITICAL VALUES ON CIS OPERATIONS (U)

| Element | Critical Value | Impact |
|---|---|---|
| Wind (surface) | >7 knots | Radar background noise |
| | >25 knots | Safety and stability for installing line of sight and troposcatter antennas |
| | >69 knots | Wind damage to main communications antenna—linear pole |
| | >78 knots | Safety and stability of single channel radio and short-range, wideband radio antennas |
| Precipitation | Any occurrence of freezing | Damage to equipment and antennas; wind tolerances of antennas; troop safety |
| | >0. 5 inches/hour liquid | Blocking of troposcatter transmission; radar range (decreased); signal for single channel radio, short-range wideband radio, and line of sight communications (attenuated by precipitation) |
| Thunderstorms and lightning | Any occurrence within 3 miles | Damage to equipment; interference with radio signals, especially high frequency signals |
| Temperature (vertical gradient or profile) | All significant inversions | Fading during use of troposcatter equipment |
| Ionospheric disturbances | Not applicable | Dictation of most usable frequencies for communications |

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ACKNOWLEDGE RECEIPT

W.X. WEATHER
Capt USMC
METOC Officer

OFFICIAL:

s/
D.D. MARINE
Capt USMC
METOC Officer

Page number

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# APPENDIX D
# METOC LETTER OF INSTRUCTION EXAMPLE

The following list of acronyms and abbreviations that appear in and are applicable to this appendix only. Acronyms or abbreviations not found in this list are located in Section I of the glossary. All nomenclature is located in Section III of the glossary.

> ***Note:*** There are multiple entries consisting of subject matter specific terms and short forms for timely order writing and briefings. These short forms are applicable to this appendix only.

| | |
|---|---|
| AAI | after action item |
| AAR | after action report |
| AC/S | assistant chief of staff |
| AFB | Air Force base |
| AFDD | Air Force doctrine document |
| AFJI | Air Force joint instruction |
| AFMAN | Air Force manual |
| AO | area of operations |
| AR | Army regulation |
| BKN | broken (*cloud cover condition*) |
| C-2 | combined intelligence staff section |
| C-3 | combined operations staff section |
| C-6 | combined communications system staff section |
| Capt | captain |
| CG | commanding general |
| CJCSI | Chairman of the Joint Chiefs of Staff instruction |
| CTF | combined task force |
| DCS | Defense Collaboration Services |
| DSN | Defense Switched Network |
| Ex14 | Exercise 2014 |
| FM | field manual |
| FMC | full mission-capable |
| FTX | field training exercise |
| G-2 | intelligence staff section |

| | |
|---|---|
| HCA | humanitarian and civic assistance |
| HWD | horizontal weather depiction |
| ICAO | International Civil Aviation Organization |
| INOP | inoperable |
| ISOLD | isolated |
| KQ ID | tactical location identifier code |
| LOI | letter of instruction |
| MCEN | Marine Corps Enterprise Network |
| MSL | mean sea level |
| NM | nautical mile |
| OPSEC | operations security |
| OWS | operational weather squadron |
| PACAFI | Pacific Air Forces instruction |
| PMC | partial mission-capable |
| POC | point of contact |
| SCT | scattered (*cloud cover condition*) |
| SITREP | situation report |
| SLS | senior leaders seminar |
| SWO | staff weather officer |
| USPACOMINST | United States Pacific Command instruction |

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

UNITED STATES MARINE CORPS
X MEF HEADQUARTERS GROUP
X MARINE EXPEDITIONARY FORCE
MARINE FORCES XXXX COMMAND

Jan 14

**MEMORANDUM FOR U.S. METOC UNITS**

**FROM: X MEF METOC Officer (Exercise 14 JMO)**

**SUBJECT: Letter of Instruction (LOI) for Meteorological and Oceanographic (METOC) Operations Supporting Exercise 2014 (Ex14)**

**1. Overview:** This instruction outlines METOC organization and procedures during Ex14. This LOI is required reading for all U.S. METOC units supporting Ex14 and compliance with this LOI is mandatory unless otherwise directed by the Joint METOC Officer (JMO). Component and subordinate level METOC forces will supplement this document through coordination with the JMO as needed.

**2. General Instructions:**

2.1. All METOC units will send contact information to include unit name, telephone number and e-mail address to the JMO. Failure to do so in a timely manner will limit the ability to pass on critical information pertaining to humanitarian and civic assistance (HCA), the command post exercise and field training exercise (FTX). The JMO e-mail address is jmo@usmc.mil.

2.2. All METOC units should ensure they have access to and an account on Defense Collaboration Services (DCS). This will be the main vehicle for conducting forecast coordination and mission collaboration.

2.3. Due to limited resources, scheduled phone conferences will not be held. Any METOC unit(s) desiring phone communication with the JMO should send a request via e-mail or DCS with the appropriate phone number and a time (Z) of availability.

**3. Ex14 Exercise Concept for METOC Operations:** Ex14 will consist of a multinational command post exercise, which includes a senior leaders seminar (SLS) to perform multi-national force planning and a FTX using real-world data to conduct real-world missions.

3.1. Field training exercise weather support will be provided in the form of reachback to the 17th Operational Weather Squadron (OWS) at Hickam Air Force Base (AFB), HI. They will provide real-world METOC products for the exercise area with specific emphasis on FTX bed-down locations. Products can be found at https://17ows.hickam.af.mil.

3.1.1. A graphical Joint Operational Area Forecast (JOAF) will be produced by the 17th OWS daily, initially posted to the Web site by 2200Z. Charts are in increments of 3 hours, updated every 3 hours. Horizontal weather depiction (HWD) and clouds are fully automated starting at the 00 Hour.

3.1.2. A text JOAF (amendable) will be produced by the 17th OWS daily with valid times for each region being 00–12 hour, 12–24 hour, 24–36 hour, 36–48 hour, and 48–72 hour. The JOAF will be posted on the 17th OWS NIPRNET Web site at 2200Z.

3.2. A DCS meeting room will be available for METOC discussion, inquiries, and requests for amendment of the JOAF. The DCS meeting room is called Ex14 METOC and will be monitored by the JMO and the 17th OWS (https://conference.apps.mil/home).

3.3. Watches, warnings, and advisories (WWAs) will be produced for each exercise location as needed. All weather advisories and warnings will be posted to the 17th OWS NIPRNET Web site.

3.3.1. The JMO will be notified via e-mail when weather advisories and warnings are issued for the exercise AOI.

3.3.2. Additional product support will be coordinated directly with the JMO via phone, e-mail, or DCS communication.

**4. Operations Security (OPSEC):** Good OPSEC procedures will be adhered to both on and off-duty as the exercise area is subject to constant intelligence gathering efforts by outside sources. METOC forces will know the critical indicators of their supported units. Maintain vigilance when communicating via any medium and when handling information, classified or unclassified. Ensure all documents are properly labeled.

**5. Command Relations:** The Marine Corps component command is the executive agent for Exercise 2014. The JMO position was filled by X MEF, and will not establish a base of operations in the exercise theater.

5.1. The JMO is responsible for overall execution of METOC support to joint forces operating in the exercise theater.

5.2. The joint METOC coordination organization (JMCO) is the 17th OWS located at Hickam AFB, Hawaii. The JMCO coordinates support requirements with the JMO and produces METOC products supporting the battle rhythm established by the JMO supporting the combined task force (CTF) decision cycle.

**6. JMO Responsibilities:**

6.1. Interacts directly with the CTF commander and the commander’s staff to relay situational awareness of theater operations to joint METOC forces.

6.2. Ensures horizontal consistency between the coalition METOC forces and joint METOC forces.

6.3. Resolves all conflicts pertaining to issues related to the JOAF when JMCC, JMCO, component METOC organizations and/or subordinate units are in disagreement with the forecast.

6.4. Determines the lead forecast unit in support of a joint operation/mission as necessary.

6.5. Tasks the JMCO to provide weather support to units operating within the theater. This includes any special requests for support.

6.6. Interacts with the CTF staff (primarily C-2, C-3, and C-6), METOC units, component METOC forces, the JMCO, and the METOC operations support community (MOSC) to monitor METOC operations, coordinate resources, communications, and requirements for the theater.

**7. Component Level METOC Unit Responsibilities:** Component level METOC units are those providing direct support to Army forces, naval forces, Marine Corps forces, joint special operations task force, and Air Force forces. Component METOC units will:

7.1. Contact the JMO with POC information upon reaching operational capability and relay any significant changes to their operations as necessary. Report subordinate METOC unit arrivals/departures in/out of the theater to the JMO.

7.2. Staff/component METOC officers will provide support and briefing products to their staffs as required and send copies to the JMO via Marine Corps Enterprise Network (MCEN) internet Web page or e-mail, depending on available resources.

7.3. Coordinate all METOC issues with their subordinate METOC units.

7.4. Coordinate between METOC units on weather forecast products used for missions in which two or more separate warfighting units of the same component (wing, brigade, etc.) conduct operations together. This includes mission planning and execution forecasts.

7.5. Assist in data collection and dissemination issues for subordinate METOC units without communications capabilities.

7.6. Participate in, and provide input to, the daily real-world METOC discussions via DCS.

7.7. If any deviations to instructions are required during the exercise, the concerned METOC unit should contact the JMO.

7.8. Submit after action report (AAR) to include after action items (AAIs) to jmo@usmc.mil prior to departure from theater. The AAIs will be tracked for resolution and will be closed within 60 days after the end of the exercise or contingency. (See Attachment 3.)

**8. Subordinate Level METOC Unit Responsibilities:**

8.1. Request tactical location identifier (KQ ID) prior to STARTEX by e-mailing jmo@usmc.mil (See Attachment 2 for KQ procedures.)

8.2. Take and transmit surface weather observations via service METOC systems using KQ ID or standing WMO/ICAO identifiers as required.

8.3. Contact METOC component staff weather officer (SWO) upon establishing operational capability and relay communications and contact information.

8.4. Provide JOAF input to the component METOC SWO. If tactical level units have the ability to access DCS Chat, they should participate in METOC discussions.

8.5. Provide after action inputs to component level METOC SWO prior to departure from theater. After action items will be tracked for resolution and will be closed within 60 days after the end of the exercise or contingency. (See Attachment 3.)

**9. METOC Operations Support Community:** The MOSC is an overarching term to describe the units/organizations available to the JMO.

9.1. The 17th OWS, Hickam AFB, HI., is designated the JMCO and will provide real-world and exercise reach-back support to the JMO and US METOC teams. The JMCO will ensure NIPRNET availability of METOC products and information. https://17ows.hickam.af.mil/

9.2. Air Force Weather Agency (AFWA) provides strategic level METOC products on NIPRNET. https://weather.af.mil/AFW_WEBS/

9.3. 14th Weather Squadron Strategic Climatic Center provides climatological data on NIPRNET. https://www.afccc.af.mil/

9.4. Host Nation Meteorological Department provides METOC data available on the unclassified internet.

**10. Situation Reports (SITREPs):** All component-level METOC units will send consolidated SITREPs to their component SMO each day no later than1830L. The component SMO will forward any non-routine SITREP information to the JMO.

10.1. Component level METOC unit SITREPs should include subordinate METOC unit's SITREP inputs. Additionally, general impacts to operations should be included in all SITREPs. The JMO will coordinate SITREP fix actions with the JMCO. (See Attachment 4 for SITREP procedures.)

**11. Change Request:** The information in this LOI is subject to change at any time in order to facilitate mission accomplishment and to accommodate suggestions from all exercise participants. Submit all comments to the JMO at jmo@usmc.mil.

//signed//
W. X. WEATHER
Capt USMC
Marine Expeditionary Force
METOC Officer
Exercise 14 Joint METOC Officer

Attachments:

1. Technical References
2. KQ Identifiers
3. After Action Report and After Action Items
4. SITREP Format

Attachment 1

**Technical References**

1. Exercise 2014 (Ex14) Exercise Directive
2. CJCSI 3810.01E, *Meteorological and Oceanographic Operation,* September 2009
3. Joint Publication 3-59, *Joint Doctrine, Tactics, Techniques and Procedures for Meteorological and Oceanographic Operation,* 7 December 2012
4. USPACOMINST 3140.4, *Joint Manual for Meteorological and Oceanographic Support,* June 1994
5. MCWP 3-35.7, *MAGTF Meteorological and Oceanographic Support,* June 1998
6. AFJI 15-157/AR 115-10, *Weather Support for the US Army.* June 1996
7. Army FM 34-81, *Weather Support for Army Tactical Operations.* August 1989
8. Army FM 34-81-1, *Battlefield Weather Effects*, December 1992
9. *Joint METOC Handbook*, April 2011
10. AFMAN 15-111, *Surface Weather Observations*, March 2009
11. AFI 15-128, *Air and Space Weather Operations–Roles and Responsibilities*, February 2011
12. AFMAN 15-129V1, *Air and Space Weather Operations–Characterization*, December 2011
13. AFMAN 15-129V2, *Air and Space Weather Operations–Exploitation*, December 2011
14. PACAFI 15-101, *Weather Support for PACAF*, June 2009
15. AR 380-5, *Department of the Army Information Security Program*, September 2000
16. AFDD 3-59, *Weather Operations*, July 2011

Attachment 2

**Tactical Location Identifiers**

1. Background. Classification of weather information is usually at the sensitive unclassified level, unless specifically classified by an Original Classification Authority through guidance contained in an OPLAN, contingency plan or similar document. METOC information when associated with a KQ ID is unclassified and can be transmitted using unclassified communications means. However, the means of acquiring the data or the location of the data when tied to a sensitive operation may be classified. The correlation of a KQ ID to a classified location or operation, using unclassified media (e.g., unclassified telephone conversation, e-mails, messages, etc.) constitutes a breach of security, requiring swift action to mitigate any compromise to military operations.

2. Procedures. Any METOC team taking tactical observations as part of the exercise will contact the appropriate component SWO for KQ ID assignment prior to STARTEX who will then contact AFWA to have the KQ ID activated. To request or activate a KQ ID, submit the following information using the example below:

Classification: UNCLAS (send classified location via NIPRNET/SIPRNET)

Name:
KQ ID Category: Exercise
Unit:
Ops Unit Supported: 2 CAB
Location Name:
Latitude: 38°01' N
Longitude: 127 15' E
Elevation: 243 Feet
Observation: METOC team
Start Date:
Stop Date:

3. Changing or Rotating KQ Identifiers. If your METOC team needs to change an existing KQ ID or requires assignment of additional KQ IDs during the exercise, contact your component SWO. Any changes to KQ IDs will be coordinated with the JMO. Current KQ ID assignments and any updates or changes will be posted.

Attachment 3

## After Action Report and After Action Items

From: Joint Meteorology and Oceanography Officer, Joint Task Force
To: Senior Meteorology and Oceanography Officer, US Pacific Command
Via: Commanding General, Joint Task Force
Subj: METEOROLOGY AND OCEANOGRAPHYAFTER ACTION REPORT (AAR) FOR METEOROLOGICAL AND OCEANOGRAPHIC (METOC) OPERATIONS SUPPORTING EXERCISE 2014 (EX14)

Ref: (a) MCO 3504.1, *Marine Corps Lessons Learned Program (MCLLP)*

1. Background. Meteorological and Oceanographic (METOC) personnel from the Marine Corps, Air Force, and Navy supported Exercise 2014, a humanitarian assistance/disaster relief effort resulting from the effects of the super typhoon over the western Pacific. The 3d Marine Expeditionary Force (III MEF) METOC officer was designated as the joint METOC officer at the outset of the operation; subsequently the Air Force 17th Operational Weather Squadron (17th OWS) at Joint Base Pearl Harbor-Hickam was designated as the joint meteorological and oceanographic coordination organization (JMCO), providing METOC products and support throughout the operation. The joint meteorological and oceanographic coordination cell (JMCC) was established at the III MEF G-2 METOC section with support from the 3d Intelligence Battalion, providing direct support to the joint METOC officer, the 3d Marine Expeditionary Brigade (MEB) forward command element, as well as the joint task force headquarters.

2. Topic. Detailed support requirements at all levels of the Marine air-ground task force (MAGTF).

a. Discussion. When a contingency, such as a disaster relief operation, arises, time does not always allow for the development of a comprehensive METOC support plan.

Each MAGTF element has scalable requirements for support operations pertaining specifically to their units and mission. Relying on follow-on requests for forces or equipment is counterintuitive and does not bring the appropriate capability to the operation in a timely manner.

b. Recommendations. Each METOC section supporting a particular element of the MAGTF should have a “playbook,” a detailed accounting of support requirements that are scaled to the anticipated mission. These plans should be scalable and modular in nature according to the level of support requirements needed for the operation being conducted. A starting point is the “light”, “medium” and “heavy” capabilities that are identified in the 3d MEB tactical standing operating procedure as well as the similar aviation combat element support construct. Interaction with the planning phases should enable the activation and integration of the appropriate level METOC capability required.

3. Point of Contact. POC for topics found in this after action report is Captain W. X. Weather, III MEF METOC Officer, at DSN 315-xxx-xxxx or email at w.x.weather@usmc.mil.

W.X. WEATHER
Capt USMC
METOC Office

Copy to:
CG, III Marine Expeditionary Force (AC/S G-2)
CG, 3d Marine Expeditionary Brigade (AC/S G-2)
CG, 1st Marine Aircraft Wing (AC/S G-2)

Attachment 4

## SITREP Format

1. Status.

1.1 Personnel. List all personnel that are participating from your team.

| **Rank** | **Name** | **Home unit** | **NIPRNET/SIPRNET e-mail** | **Phone** | **Shift** |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

1.2 Facilities. Describe living and working conditions.

1.3 Equipment. List what equipment was taken and its condition. Is it operational? Use FMC (full mission-capable), PMC (partial mission-capable), or INOP (inoperable) under status. If it is not FMC, explain why.

| **Equipment** | **Quantity** | **Status** |
|---|---|---|
| | | |
| | | |

1.4 Communications. Do you have phone, fax and internet/intranet (NIPRNET, SIPRNET) lines? How are you communicating with your customer and others in the unit? List phone numbers, fax numbers, and e-mail addresses (NIPRNET, SIPRNET). If it is not FMC, explain why.

| **Comm** | **Status** |
|---|---|
| | |
| | |

1.5 Operations. Do you have any changes to your operation or mission? What is the type of mission change? What are the anticipated weather impacts?

> ***Note:*** This section should change little from day to day. Highlight changes from the previous SITREP in yellow and precede new lines with date.

2. Issues. State any problems with personnel, facilities, equipment, communications, operations, or other significant issues that need resolution. List each issue separately in the format provided below.

2.1 Issue. List any problem that needs resolution.

2.2 Discussion. State in detail how the issue will impact operations.

2.3 Solution. State (in plain language) what the owner of the issue has done to troubleshoot. Does this issue need to go up the chain or can it be resolved in the field.

> ***Note:*** In this section list the issues in order of importance from most important to least important. Highlight unresolved issues that are potential show stoppers in red. 🟥
>
> Highlight all other unresolved issues in yellow. 🟨
>
> Identify resolved issues by highlighting in green. 🟩

3. Remarks. State in plain language any items of interest. Name the SITREP file with a date and component (e.g., 26MarNCCSitrep).

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# APPENDIX E
# JOINT OPERATIONS AREA FORECAST EXAMPLE

The following list of acronyms and abbreviations appear in and are applicable to this appendix only. Acronyms or abbreviations not found in this list are located in Section I of the glossary. All nomenclature is located in Section III of the glossary.

> ***Note:*** There are multiple entries consisting of subject matter specific terms and short forms for timely order writing and briefings. These short forms are applicable to this appendix only.

| | |
|---|---|
| BKN | broken (*cloud cover condition*) |
| BLDU | blowing dust |
| DU | dust |
| ISOLD | isolated |
| NM | nautical mile |
| SCT | scattered (*cloud cover condition*) |
| SHRA | rain showers |
| SHSN | snow showers |
| SNRA | precipitation of snow and rain |
| TSRA | thunderstorm rain |

FXXX000 KYUM 211015

PRODUCED BY MAWTS-1 METOC CENTER MCAS YUMA AZ

SUBJ/OPERATION SAMPLE JOINT OPERATIONS AREA FORECAST (JOAF)//

RMKS/1. INTENT OF THIS MESSAGE IS TO ALIGN WEATHER FORECASTS THROUGHOUT THE AREA OF INTEREST FOR OPERATION SAMPLE JOAF. THIS FORECAST WILL BE PRODUCED ONCE DAILY AT 1100Z AND WILL BE DYNAMICALLY UPDATED/AMENDED THROUGHOUT THE DAY AS NEEDED. ALL SIPRNET CAPABLE FORECASTING UNITS WILL ENGAGE CHAT AT WWW.MAWTS1.USMC.SMIL.MIL (///.22.///.000) ROOM #OIJ AT 1015Z AND UPDATE CHAT AT 2030Z TO ALIGN FORECAST REASONING AND OPERATIONAL IMPACTS ON ALL UPCOMING EVENTS. CONTRAIL FORECAST IS FOR LOW-BYPASS TURBOFAN ENGINES. SEVERE TURBULENCE AND ICING ARE IMPLIED WITH THUNDERSTORMS FORECAST IN THE VICINITY. CLOUDS ARE FORECASTED LAYERS (NOT SUMMATION PRINCIPLE). ALL HEIGHTS ARE ABOVE MEAN SEA LEVEL (MSL).

1. FCST FM 21/1200Z NOV 03 TO 27/0000Z NOV 03

12 HOUR

VALID: 21/1200Z-22/0000Z INCREASING MOISTURE ADVECTING IN FROM THE WEST, AHEAD OF MAJOR S/W TROF AND REMAINING BOUNDARY IN NORTHERN STANS PRODUCES SCT MID AND HIGH LEVEL CLOUDINESS IN CENTRAL, SOUTHERN, EASTERN AND NORTHEASTERN AO. ALONG THE NEW MEXICO AND ARIZONA BORDER, AREAS OF HIGH WIND SPEED GENERATES AN AREA OF BLOWING DUST, WHICH WILL LOWER VISIBILTY 2–4 AND ISOLATED AREAS OF .5–2 NM IN NORTHERN NEW MEXICO. MOSTLY CLEAR SKIES AND NO SIGNIFICANT WEATHER DOMINATES THE MAJORITY OF WESTERN ARIZONA.

24 HOUR

VALID: 22/0000Z-22/1200Z A MATURE LOW ADVECTS INTO THE NORTHERN AREA OF RESPONSIBILITY PRODUCING SCT MID AND HIGH LEVEL CLOUDINESS IN CENTRAL, SOUTHERN, EASTERN, AND NORTHEASTERN AO. ALONG THE CALIFORNIA AND SOUTHERN ARIZONA BORDER, AREAS OF HIGH WIND SPEED DUE TO TEMPERATURE ADVECTION ALONG COLD FRONTAL BOUNDARY HELPS GENERATE AN AREA OF BLOWING DUST, WHICH WILL LOWER VISIBILITY 2–4 AND ISOLD AREAS OF .5–2 NM IN NORTHERN NEW MEXICO. MOSTLY CLEAR SKIES AND NO SIGNIFICANT WEATHER DOMINATES THE MAJORITY OF WESTERN ARIZONA.

36 HOUR

VALID: 22/1200Z-23/0000Z THE MATURE LOW ADVECTS TO THE NORTH EAST, AS COLD FRONT ADVECTS THROUGH NORTHERN ARIZONA, UNDERGOING FRONTOLYSIS. IN THE NORTH EASTERN PORTION OF AO UPSLOPE CONDITIONS

HELP GENERATE SHRA AND SNRA. ALONG THE CALIFORNIA, (WESTERN) AND ARIZONA BORDER, AREAS OF HIGH WIND SPEED CONTINUE THE AREA OF BLOWING DUST, WHICH HAS LOWERED VISIBILITY 2–4 AND ISOLD AREAS OF .5–2 NM. MOSTLY CLEAR SKIES AND NO SIGNIFICANT WEATHER DOMINATES THE MAJORITY OF SOUTH WESTERN ARIZONA.

48 HOUR

VALID: 23/0000Z-24/0000Z REMNANT OF THE MATURE COLD FRONTAL SYSTEM CONTINUES TO UNDERGO FRONTOLYSIS AS IT STALLS IN TERRAIN. BROKEN (BKN) MID AND HIGH LEVEL CLOUDINESS AND EXTENSIVE AREA OF SHRA/SHSN REMAIN IN CENTRAL, EASTERN, AND NORTHEASTERN MOUNTAINS, ISOLD TSRA BETWEEN 23/12Z-23/21Z. COLD AIR ADVECTION, STRATIFORM CLOUDINESS, AND GUSTY WINDS ADVECT INTO EXTREME NORTHERN ARIZONA, VISIBILITIES REDUCED TO 1–3 ISOLD .5–2 MILES IN DU/BLDU. AS COLD AIR SPILLS INTO WESTERN AND SOUTHERN ARIZONA, EXPECT WINDS TO INCREASE TO NW-N 25–30G40KT AND VISIBILITY TO DECREASE TO 1–3 ISOLD .5–2 IN DU/BLDU.

72 HOUR

VALID: 24/0000Z-25/0000Z THE FRONTOLYSISING COLD FRONT LOOSES UPPER LEVEL SUPPORT AS IT IS OVER RUN BY THE 500MB TROUGH. AS A RESULT, UPSLOPE CONDITIONS PRODUCE SCT-BKN MID AND HIGH LEVEL CLOUDINESS OVER EXTREME NORTHEASTERN MOUNTAINS. VISIBILITY IN EXTREME SOUTHWESTERN NEW MEXICO WILL IMPROVE AS WINDS LIGHTEN, BUT LINGERING DU/BLDU WILL REMAIN WITH VISIBILITY AT 1–3 MILES THROUGH THE PERIOD. MOSTLY CLEAR SKIES AND NO SIGNIFICANT WEATHER WILL DOMINATE FOR THE REMAINDER OF ARIZONA.

96 HOUR

VALID: 25/0000Z-26/0000Z IN THE NORTHERN STANS A FRONTOLYSISING COLD FRONT MOVES THROUGH THE AREA, PRODUCING BKN MID AND HIGH LEVELS IN NORTH EASTERN PORTION OF AO. U/L TROF ADVECTING THROUGH THE FLOW AND UPSLOPE CONDITIONS PRODUCE SCT-BKN MID AND HIGH LEVEL CLOUDINESS OVER EXTREME NORTHEASTERN MOUNTAINS. VISIBILITY IN EXTREME SOUTHWESTERN NEW MEXICO WILL IMPROVE AS WINDS LIGHTEN, BUT LINGERING DU/BLDU WILL REMAIN WITH VISIBILITY AT 1–3 MILES THROUGH THE PERIOD. MOSTLY CLEAR SKIES AND NO SIGNIFICANT WEATHER WILL DOMINATE FOR THE REMAINDER OF ARIZONA.

120 HOUR

VALID: 26/0000Z-27/0000 U/L TROF ADVECTING THROUGH THE FLOW AND UPSLOPE CONDITIONS PRODUCE SCT-BKN MID AND HIGH LEVEL CLOUDINESS OVER EXTREME NORTHEASTERN MOUNTAINS. VISIBILITY IN EXTREME SOUTHWESTERN NEW MEXICO WILL IMPROVE AS WINDS LIGHTEN, BUT

LINGERING DU/BLDU WILL REMAIN WITH VISIBILITY AT 1–3 MILES THROUGH THE PERIOD. MOSTLY CLEAR SKIES AND NO SIGNIFICANT WEATHER WILL DOMINATE FOR THE REMAINDER OF ARIZONA.

2. DETAILED BEDDOWN FORECASTS CAN BE FOUND ON THE CLASSIFIED WEB SITE AT: HTTP://XXX.00.XX.111

3. IONOSPHERIC PREDICTIONS/HF PROPAGATION SUMMARY/FORECAST CAN BE FOUND ON THE FXXX01 KBOU BULLETIN OR ON THE UNCLASSIFIED WEB SITE: HTTPS://WEATHER.MAWTS1.USMC.MIL/

CLASSIFIED WEB SITE:

HTTP://WWW.MAWTS1.USMC.SMIL.MIL/

4. CLIMATIC AND LIGHT DATA FOR KEY LOCATIONS CAN BE FOUND AT: HTTP://WWW.MAWTS1.USMC.SMIL.MIL/METOC/CLIMATOLOGY/CLIMO.HTM

5. THIS MESSAGE AND GRAPHICAL JOAF PRODUCTS CAN BE VIEWED ON THE CLASSIFIED WEB SITE: HTTP://XXX.//.//.///

OR THE UNCLASSIFIED WEB SITE: HTTPS://777.//.///.//

FOR ADDITIONAL INFORMATION CONTACT THE LEAD METEOROLOGIST BY PHONE: DSN 269-2534 OR 2571 COMM 928-269-2534 OR 2571

SIPR EMAIL: WWW.MAWTS1.USMC.SMIL.MIL

6. FORECASTER: I.M. MARINE

RELEASED BY: I.M. MARINE TOO//

BT

#0003

NNNN

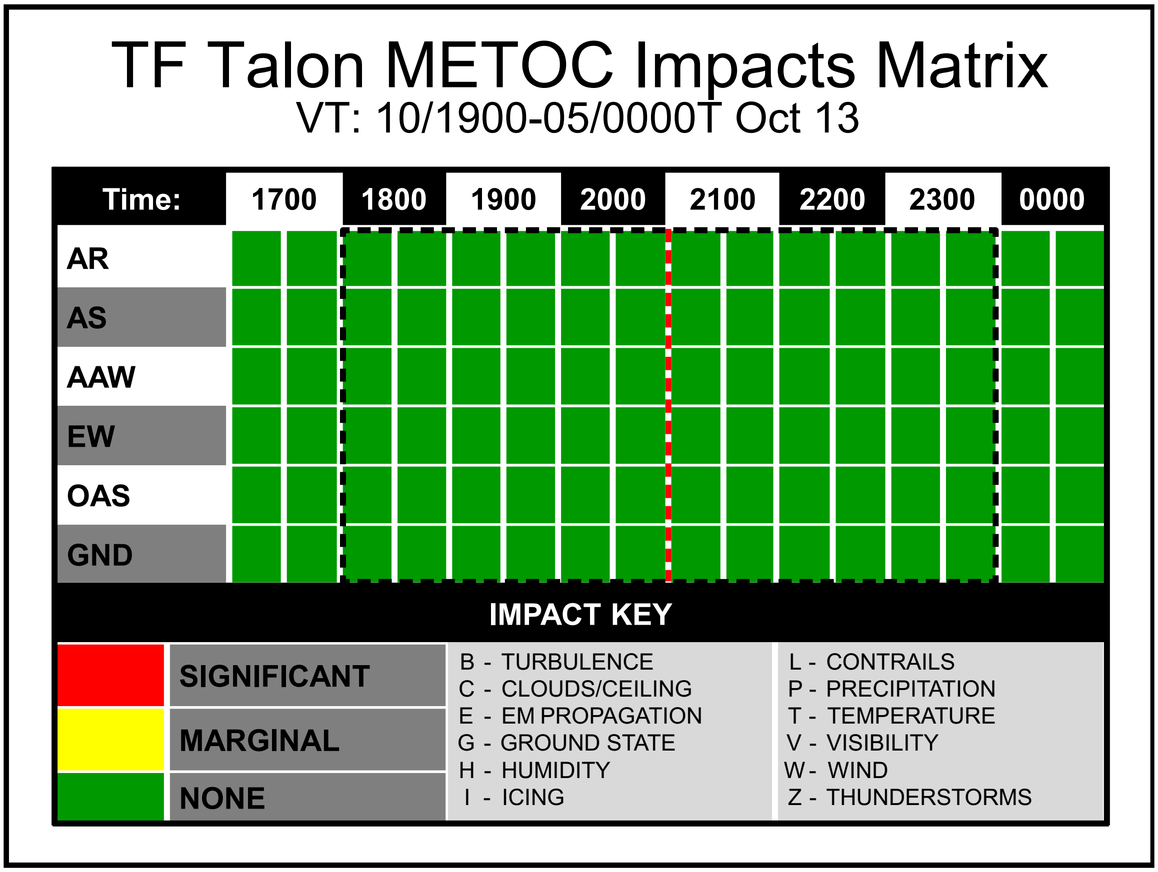
# APPENDIX F
# METOC IMPACTS MATRIX EXAMPLES

The following color code is suggested for consistency:

Green (favorable)–Minimal or no impact of METOC conditions to the operation.

Yellow (marginal)–METOC conditions degrade or limit the operation.

Red (unfavorable)–METOC conditions significantly affect or prohibit the operation.



TF Talon METOC Impacts Matrix

VT: 10/1900-05/0000T Oct 13

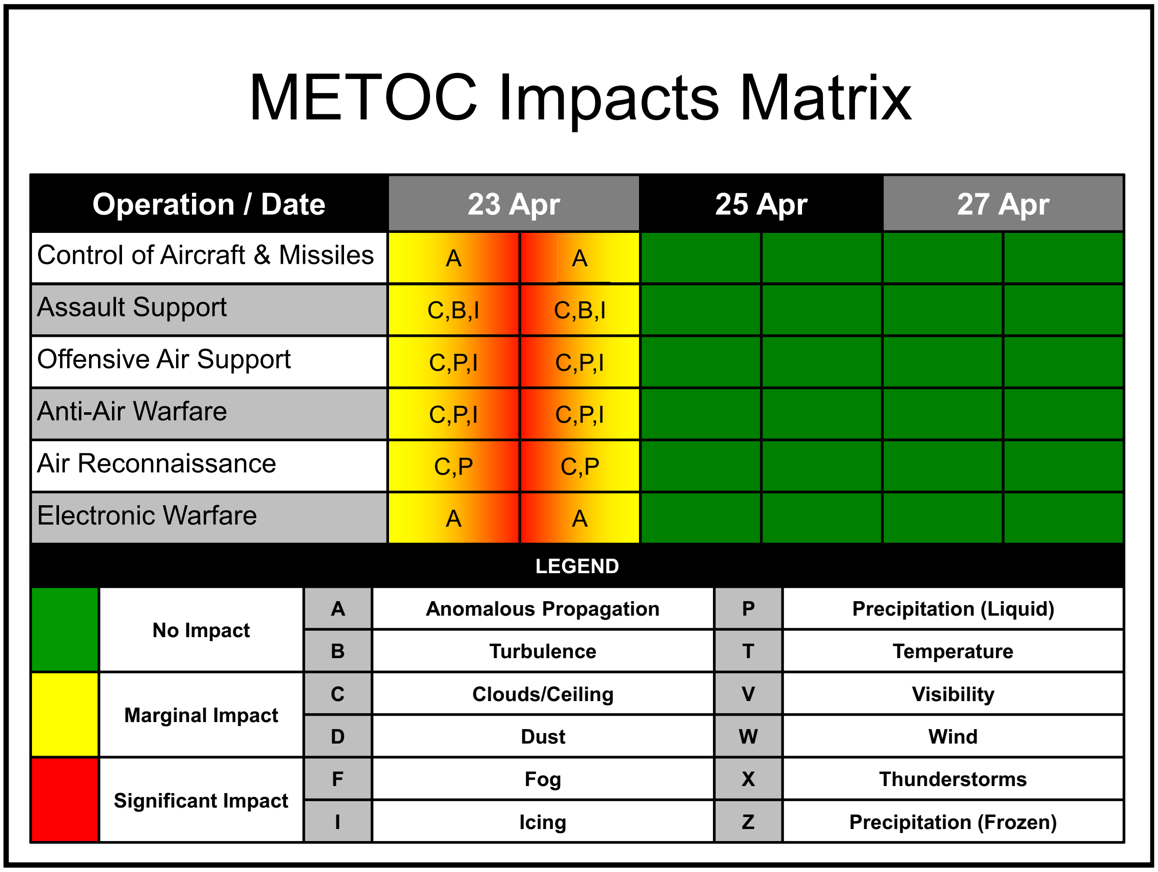
| Time: | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 0000 |
|---|---|---|---|---|---|---|---|---|
| AR | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 |
| AS | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 |
| AAW | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 |
| EW | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 |
| OAS | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 |
| GND | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 | 🟩🟩 |

IMPACT KEY

| | | | |
|---|---|---|---|
| 🟥 | SIGNIFICANT | B - TURBULENCE<br>C - CLOUDS/CEILING | L - CONTRAILS<br>P - PRECIPITATION |
| 🟨 | MARGINAL | E - EM PROPAGATION<br>G - GROUND STATE | T - TEMPERATURE<br>V - VISIBILITY |
| 🟩 | NONE | H - HUMIDITY<br>I - ICING | W - WIND<br>Z - THUNDERSTORMS |

Legend

| | |
|---|---|
| AAW | antiair warfare |
| AR | air reconnaissance |
| AS | assault support |
| EW | electronic warfare |
| GND | ground state |
| OAS | offensive air support |

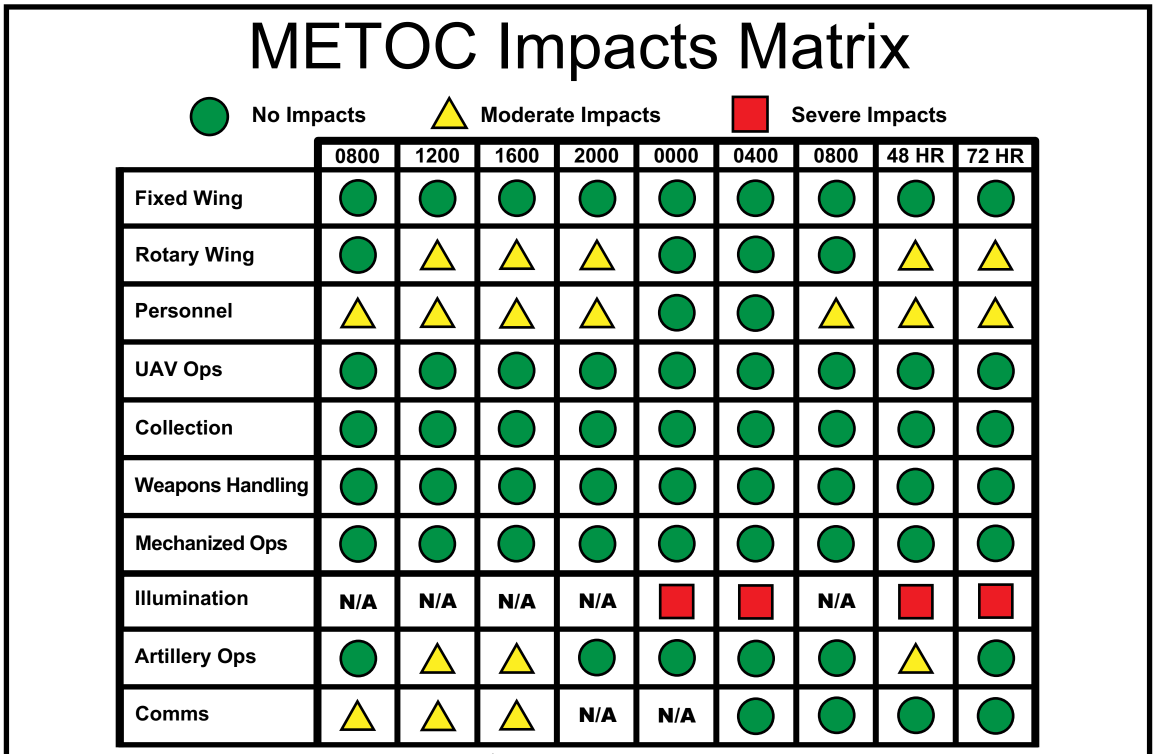


## METOC Impacts Matrix

| Operation / Date | 23 Apr | | 25 Apr | | 27 Apr | |
|---|---|---|---|---|---|---|
| Control of Aircraft & Missiles | A | A | 🟩 | 🟩 | 🟩 | 🟩 |
| Assault Support | C,B,I | C,B,I | 🟩 | 🟩 | 🟩 | 🟩 |
| Offensive Air Support | C,P,I | C,P,I | 🟩 | 🟩 | 🟩 | 🟩 |
| Anti-Air Warfare | C,P,I | C,P,I | 🟩 | 🟩 | 🟩 | 🟩 |
| Air Reconnaissance | C,P | C,P | 🟩 | 🟩 | 🟩 | 🟩 |
| Electronic Warfare | A | A | 🟩 | 🟩 | 🟩 | 🟩 |

**LEGEND**

| | | | | | |
|---|---|---|---|---|---|
| 🟩 | No Impact | A | Anomalous Propagation | P | Precipitation (Liquid) |
| | | B | Turbulence | T | Temperature |
| 🟨 | Marginal Impact | C | Clouds/Ceiling | V | Visibility |
| | | D | Dust | W | Wind |
| 🟥 | Significant Impact | F | Fog | X | Thunderstorms |
| | | I | Icing | Z | Precipitation (Frozen) |

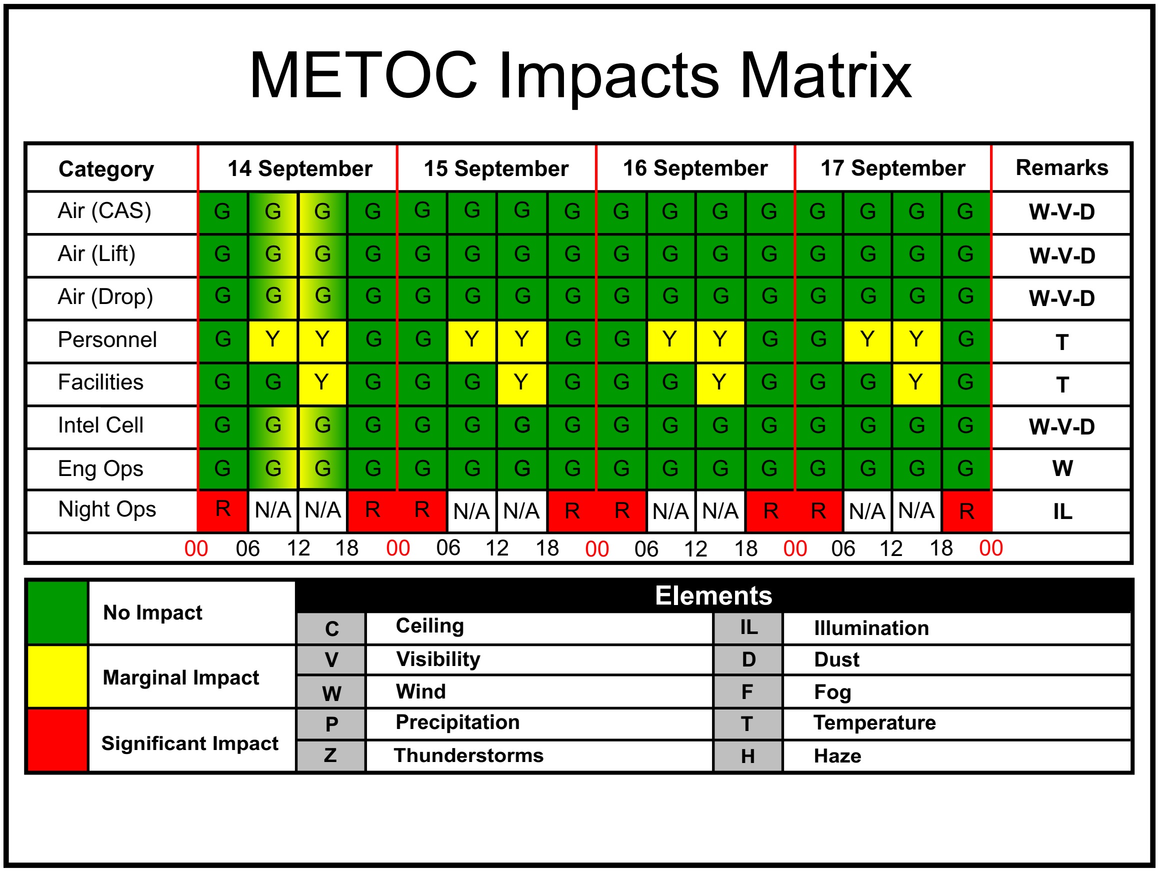


## METOC Impacts Matrix

● No Impacts △ Moderate Impacts 🟥 Severe Impacts

| | 0800 | 1200 | 1600 | 2000 | 0000 | 0400 | 0800 | 48 HR | 72 HR |
|---|---|---|---|---|---|---|---|---|---|
| Fixed Wing | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Rotary Wing | ● | △ | △ | △ | ● | ● | ● | △ | △ |
| Personnel | △ | △ | △ | △ | ● | ● | △ | △ | △ |
| UAV Ops | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Collection | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Weapons Handling | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Mechanized Ops | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Illumination | N/A | N/A | N/A | N/A | 🟥 | 🟥 | N/A | 🟥 | 🟥 |
| Artillery Ops | ● | △ | △ | ● | ● | ● | ● | △ | ● |
| Comms | △ | △ | △ | N/A | N/A | ● | ● | ● | ● |

Personnel - Moderate (Heat Index of 96˚F)
Rotary Wing - Moderate due to decreased lift capability and occasional visibility restrictions
Illumination - Moderate due to periods of no lunar illumination
Artillery - Moderate due to gusty winds
HF Comm - Moderate due to a short lived solar disturbance (Unfavorable north of 80 degrees latitude)



# METOC Impacts Matrix

| **Category** | **14 September** | | | | **15 September** | | | | **16 September** | | | | **17 September** | | | | **Remarks** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Air (CAS) | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | **W-V-D** |
| Air (Lift) | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | **W-V-D** |
| Air (Drop) | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | **W-V-D** |
| Personnel | G | Y | Y | G | G | Y | Y | G | G | Y | Y | G | G | Y | Y | G | **T** |
| Facilities | G | G | Y | G | G | G | Y | G | G | G | Y | G | G | G | Y | G | **T** |
| Intel Cell | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | **W-V-D** |
| Eng Ops | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | **W** |
| Night Ops | R | N/A | N/A | R | R | N/A | N/A | R | R | N/A | N/A | R | R | N/A | N/A | R | **IL** |

00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00

| | |
|---|---|
| 🟩 | **No Impact** |
| 🟨 | **Marginal Impact** |
| 🟥 | **Significant Impact** |

| **Elements** | | | |
|---|---|---|---|
| **C** | **Ceiling** | **IL** | **Illumination** |
| **V** | **Visibility** | **D** | **Dust** |
| **W** | **Wind** | **F** | **Fog** |
| **P** | **Precipitation** | **T** | **Temperature** |
| **Z** | **Thunderstorms** | **H** | **Haze** |

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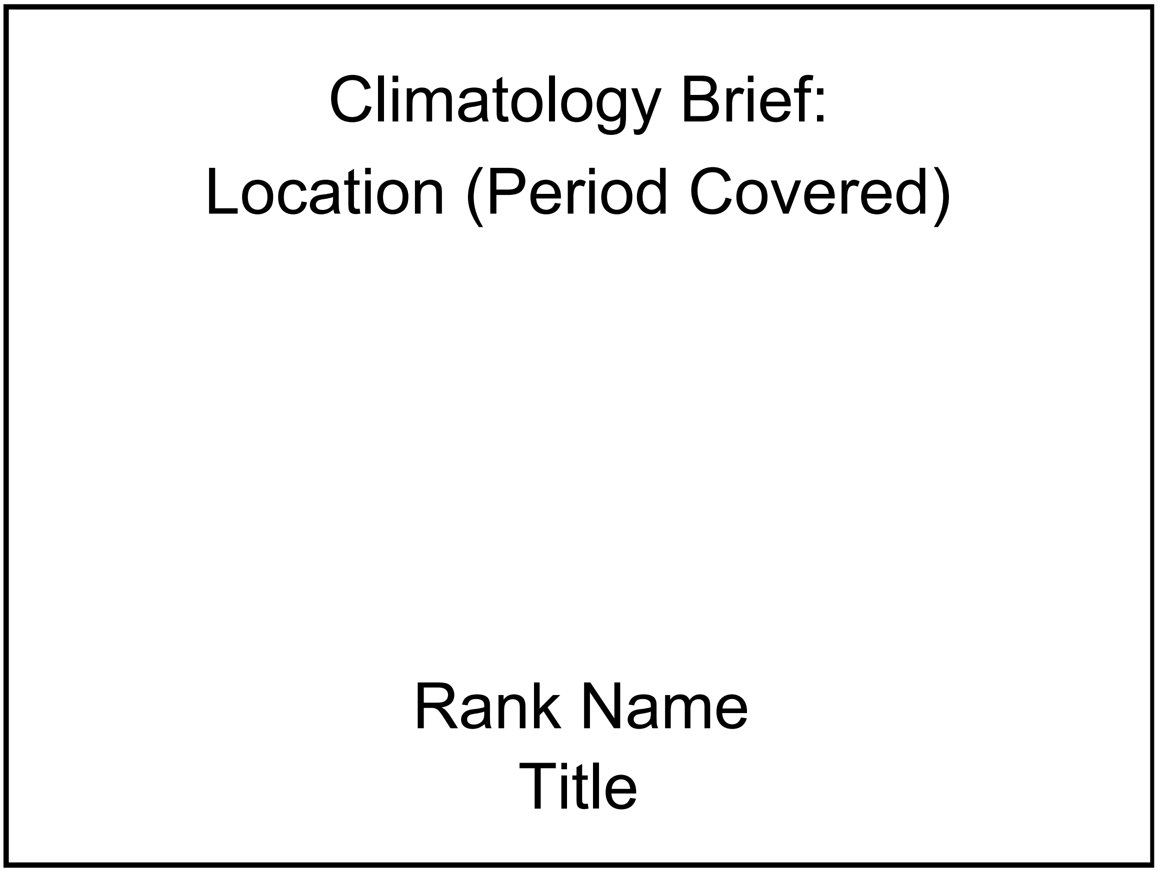
# APPENDIX G
# CLIMATOLOGY BRIEF EXAMPLE

The following list of acronyms and abbreviations appear in and are applicable to this appendix only. Acronyms or abbreviations not found in this list are located in Section I of the glossary. All nomenclature is located in Section III of the glossary.

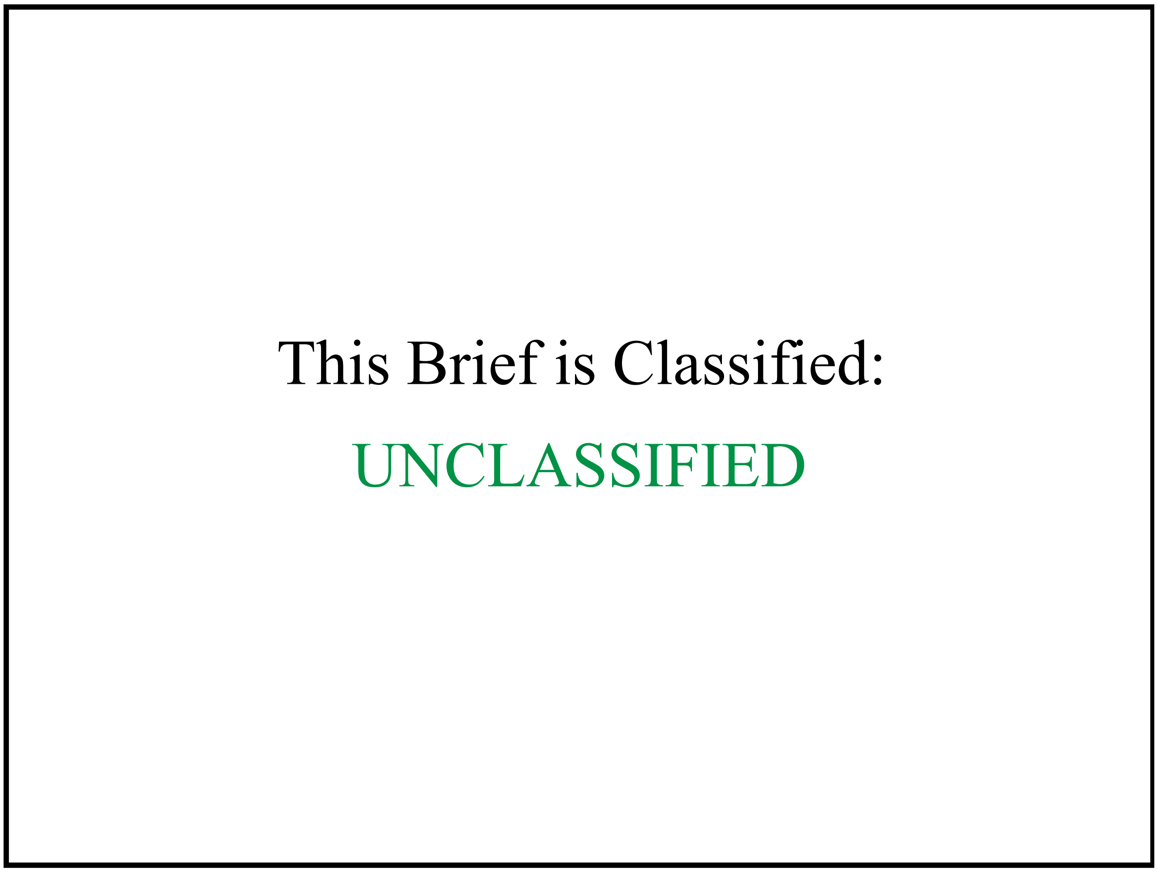
> ***Note:*** There are multiple entries consisting of subject matter specific terms and short forms for timely order writing and briefings. These short forms are applicable to this appendix only.

| | |
|---|---|
| ºC | Celsius |
| FT | feet |
| IFR | instrument flight rules |
| NM | nautical mile |
| SM | statute miles |



Climatology Brief:
Location (Period Covered)

Rank Name
Title



This Brief is Classified:

UNCLASSIFIED

# Purpose

To provide the audience with a general understanding of the historical weather and associated impacts experienced in Yuma, Arizona, during September and October

# Objectives

- Identify the local geography and associated topographic influences
- Identify the seasonal weather patterns during this time of year
- Identify the WTI operational meteorological sensitivities and limitations
- Understand the expected impact on operations

# References

- 14th Weather Squadron, Operational Climatic Data Summary for Yuma International
- 14th Weather Squadron, Operational Climatic Data Summary -II for MCAS Yuma
- 14th Weather Squadron, Yuma Proving Grounds: A full year study, dated 17 Mar 2004
- MCAS Yuma Forecaster's Handbook

# Outline

- Data Considerations
- Geographic Orientation
- Topographic Influences
- Seasonal Periods
- Climatic Discussion
- Meteorological Elements
- Potamological Considerations
- Impact Assessment
- Summary

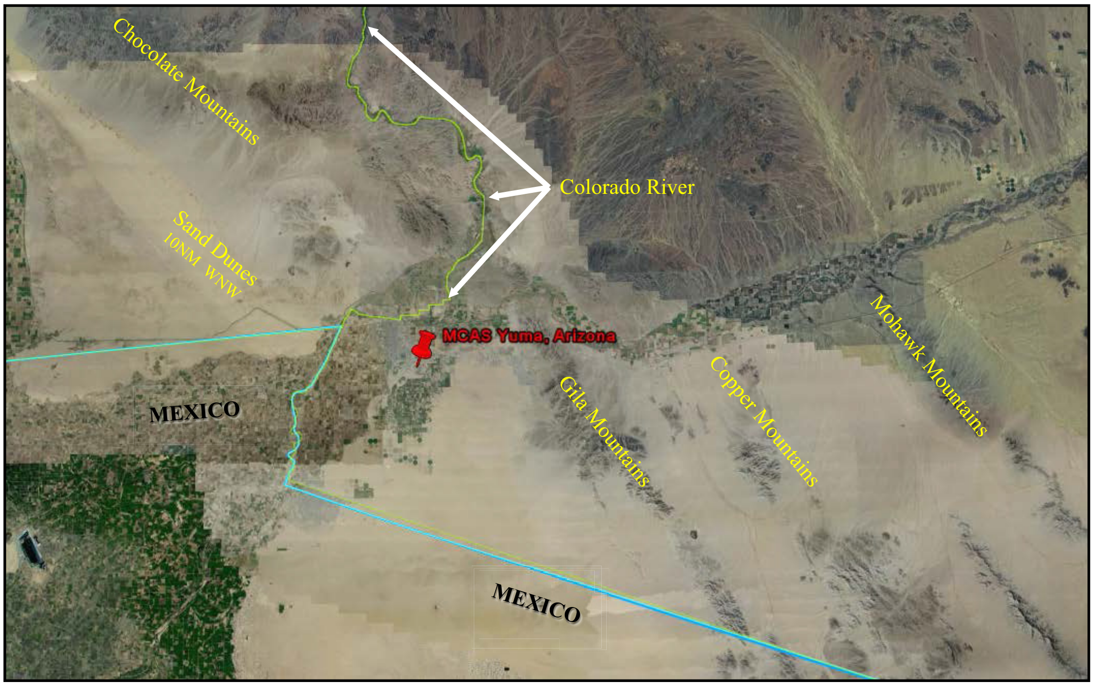
# Data Considerations

- Strengths
  - Extreme Period of Record 1977/01/27-2011/10/31
  - Mean Period of Record 1999/01/01-2008/12/31
- Weaknesses
  - Location where data was recorded/observed

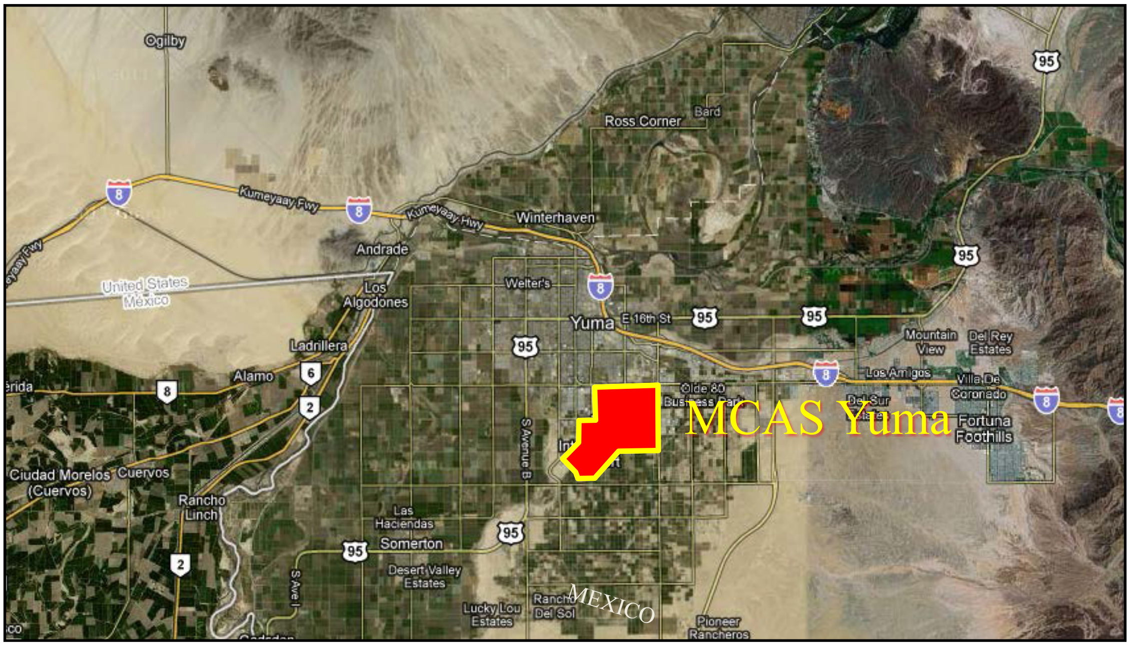
# Geographic Orientation

# Geographic Orientation

# Geographic Orientation



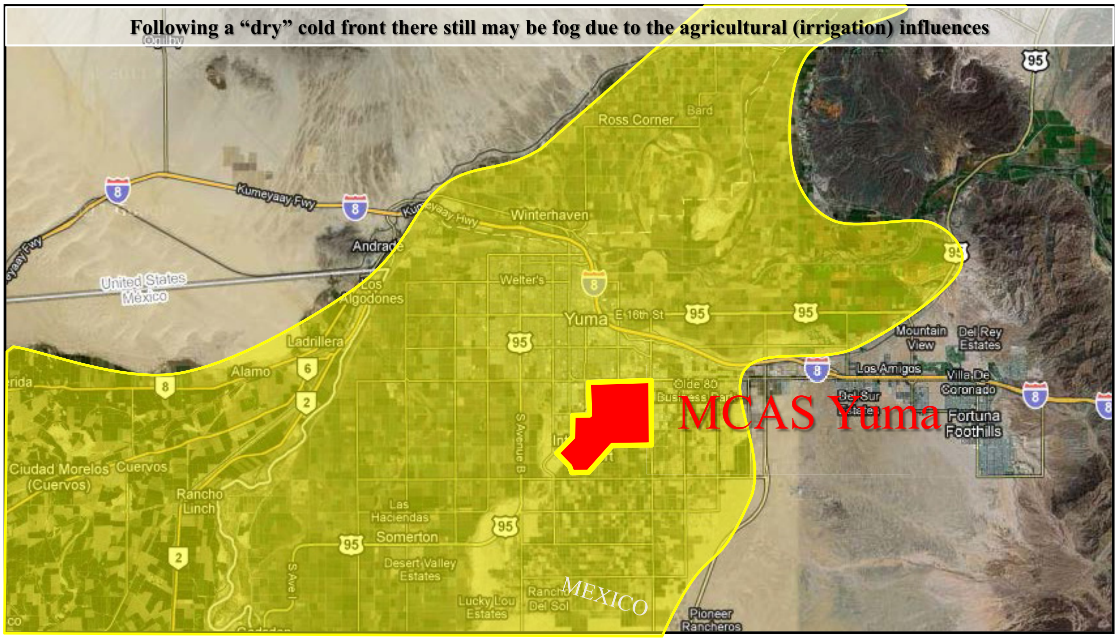
# Geographic Orientation



# Topographic Influences

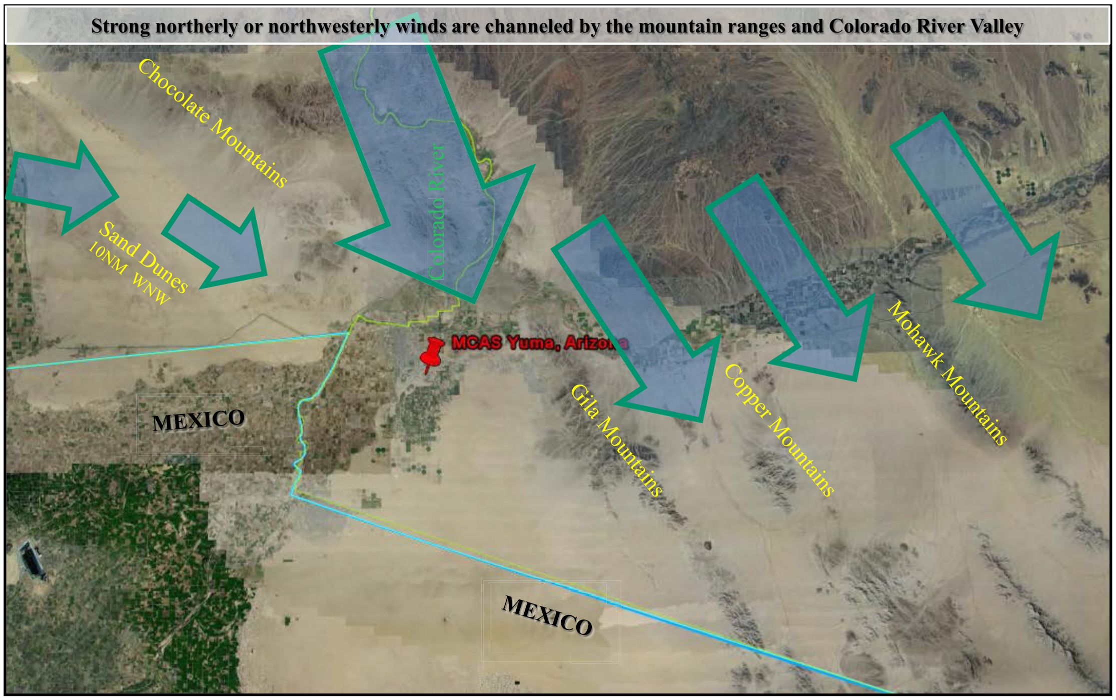
- 4 Major Regions
  - Yuma Valley
  - Mountain Ranges
  - Sand Dunes
  - Gulf of California
- Valley area reclaimed for farming
- Flood prone

## Topographic Influences



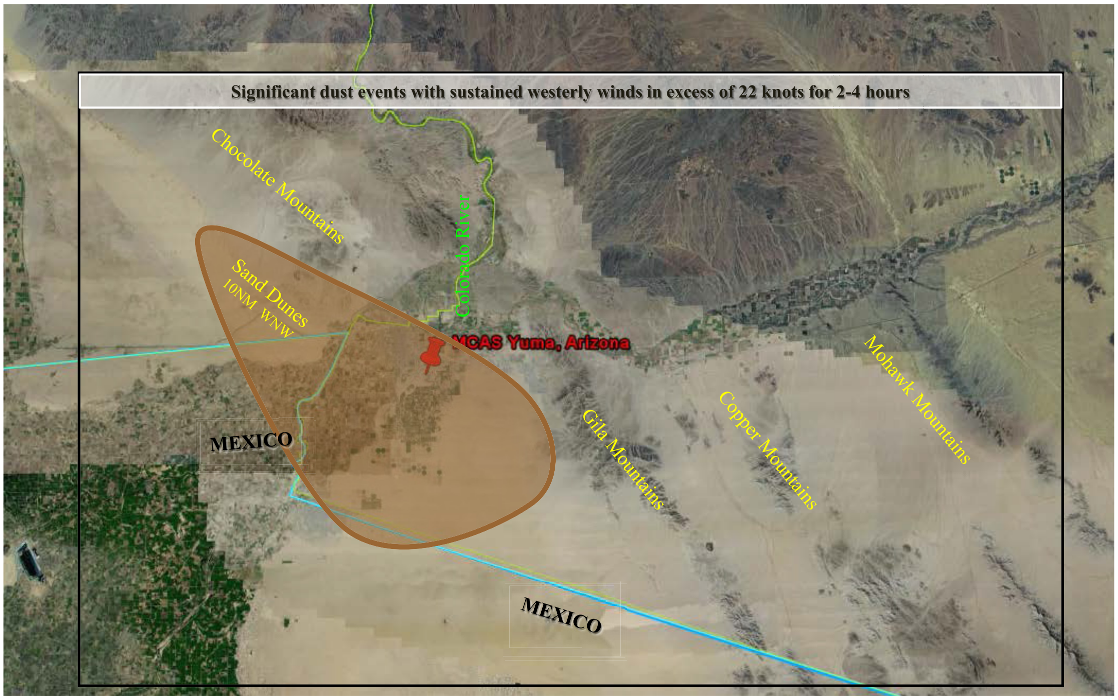
Following a "dry" cold front there still may be fog due to the agricultural (irrigation) influences

## Topographic Influences



Strong northerly or northwesterly winds are channeled by the mountain ranges and Colorado River Valley

# Topographic Influences



# Seasonal Periods

- Winter (November - February)
- Spring (March - May)
- Summer Monsoon (June - September)
- Fall Transition (October)

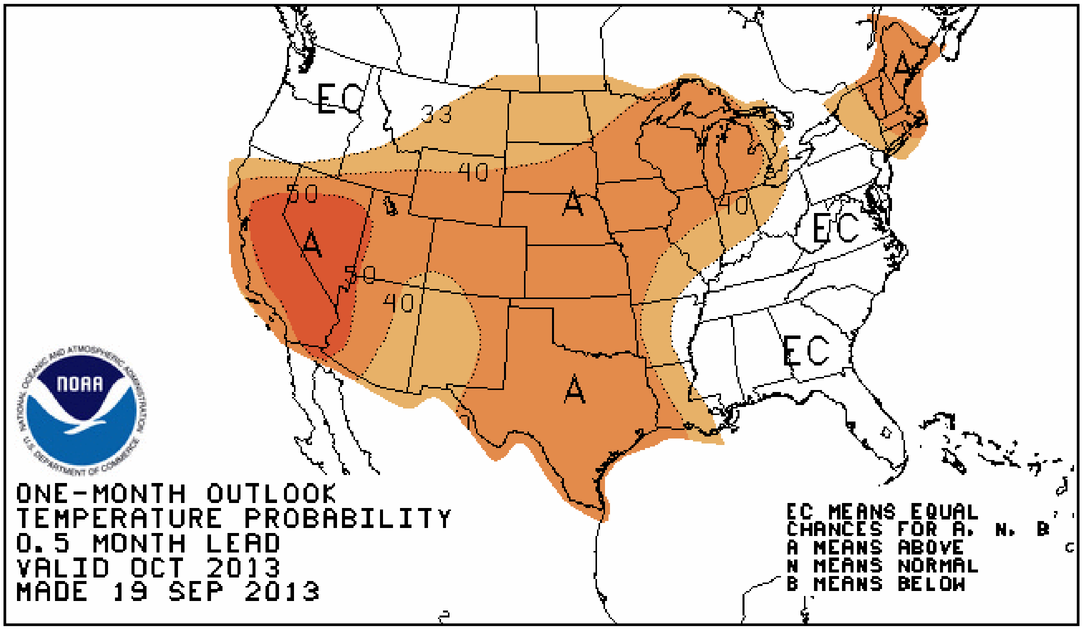
## Seasonal Periods

- Fall Transition (October)
  - Summer heat lasts through the month
  - North Pacific and Bermuda highs weaken and retreat
  - Monsoonal thunderstorms disappear to the east
  - Aleutian low begins to deepen and expand
  - Winter cold fronts begin to push through north of Yuma
  - Cut-off lows and wave trains start to develop
  - Rainfall increases on the west coast
  - Low pressure gradually shifts farther and farther south

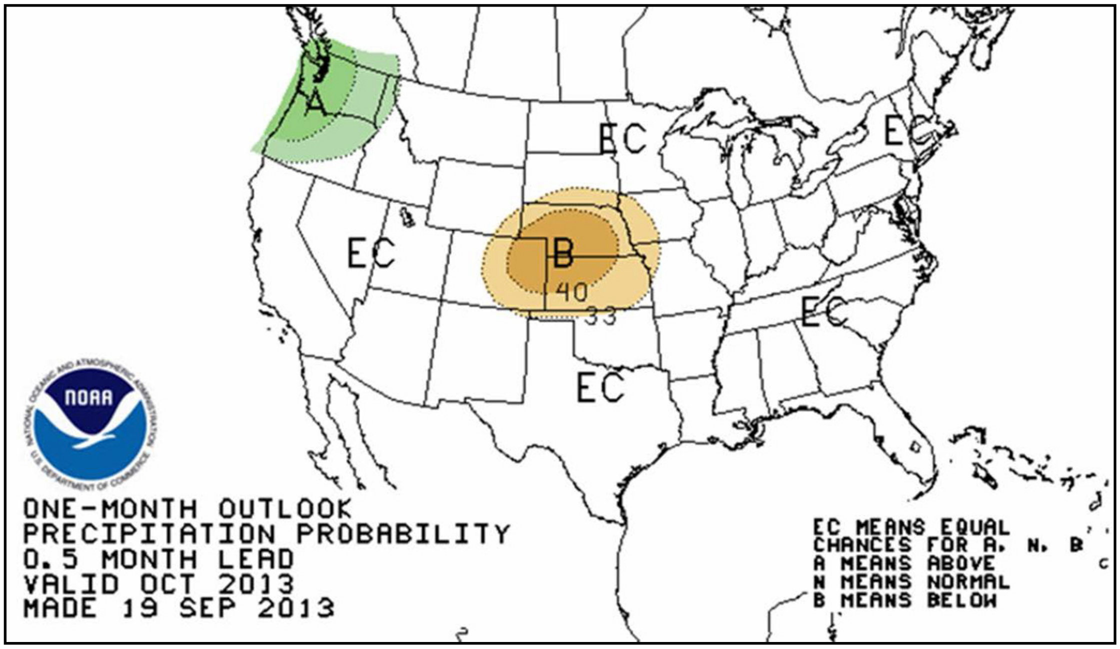
## Climatic Discussion

- El Niño Southern Oscillation Conditions
  - Neutral conditions across the equatorial central Pacific
    - Sea surface temperatures were close to 0°C deviation from the mean
  - Continuation of neutral conditions expected to continue into winter 2013 - 2014

# Monthly Outlook



# Monthly Outlook



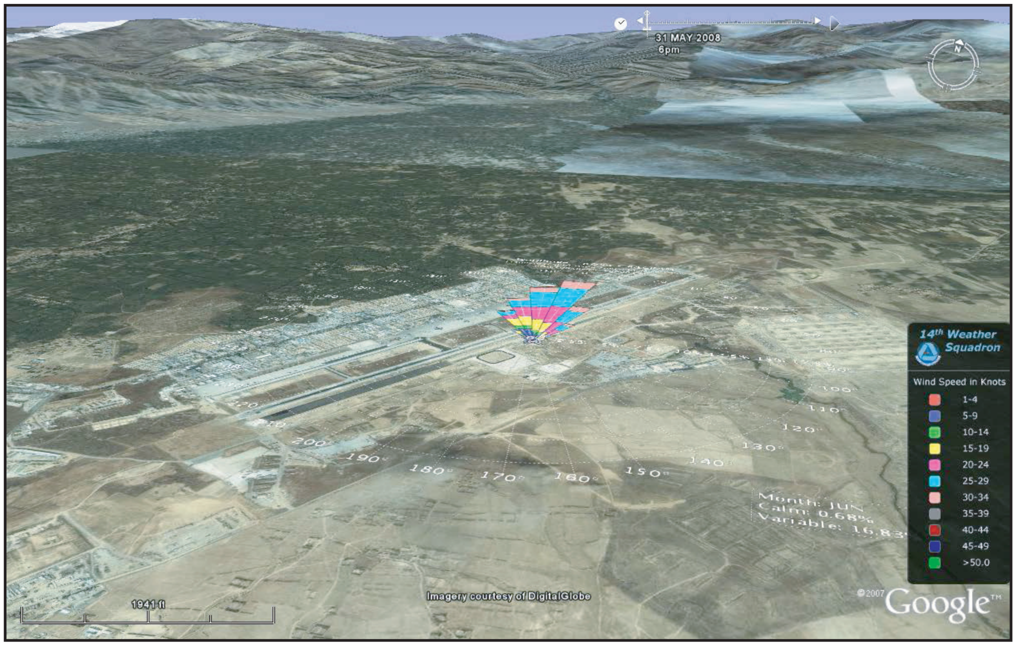
# Meteorological Elements

- Wind
- Visibility and Clouds/Ceiling
- Temperature
- Pressure

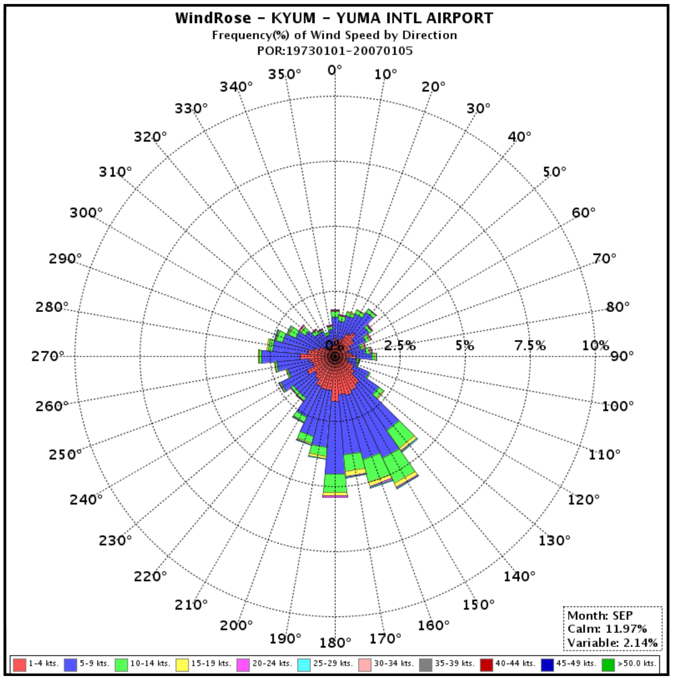
# Wind

- Late September to early October a shift occurs
  - Southerly to northerly
- After the shift
  - Calm winds as often as northerly winds
- Strongest winds associated with:
  - High-based thunderstorms
  - Cold frontal passage late in October

# Wind Rose Examples

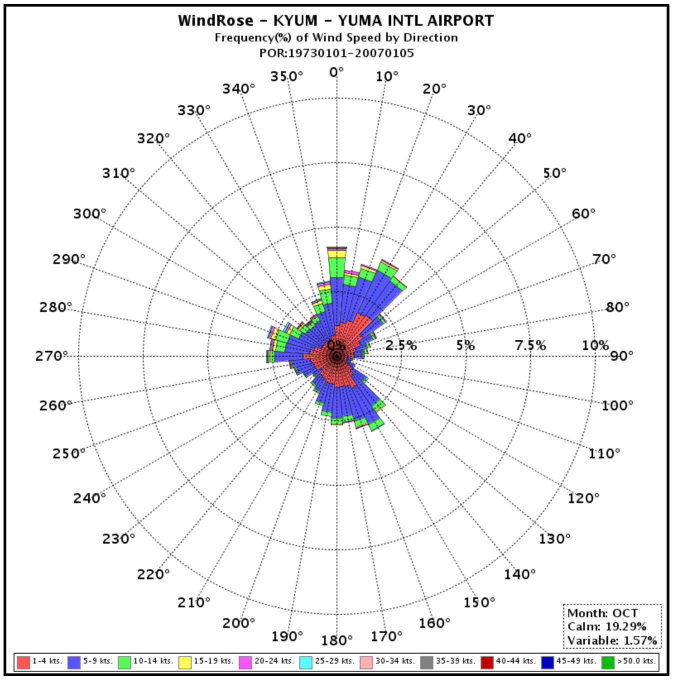


# Wind Rose (September)



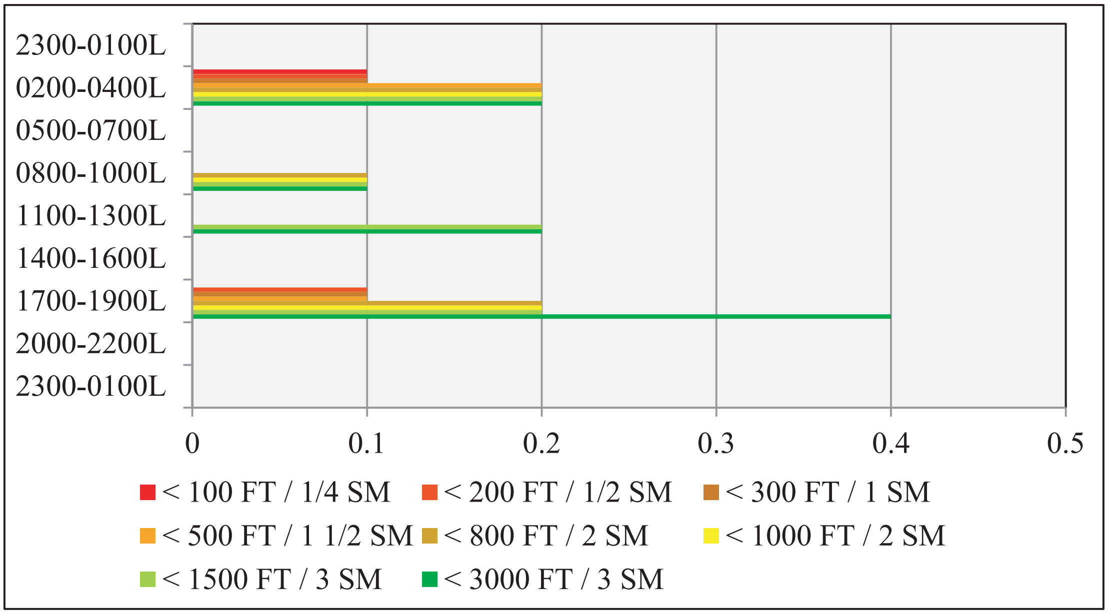
Note:  Calm winds 11.97% of the time

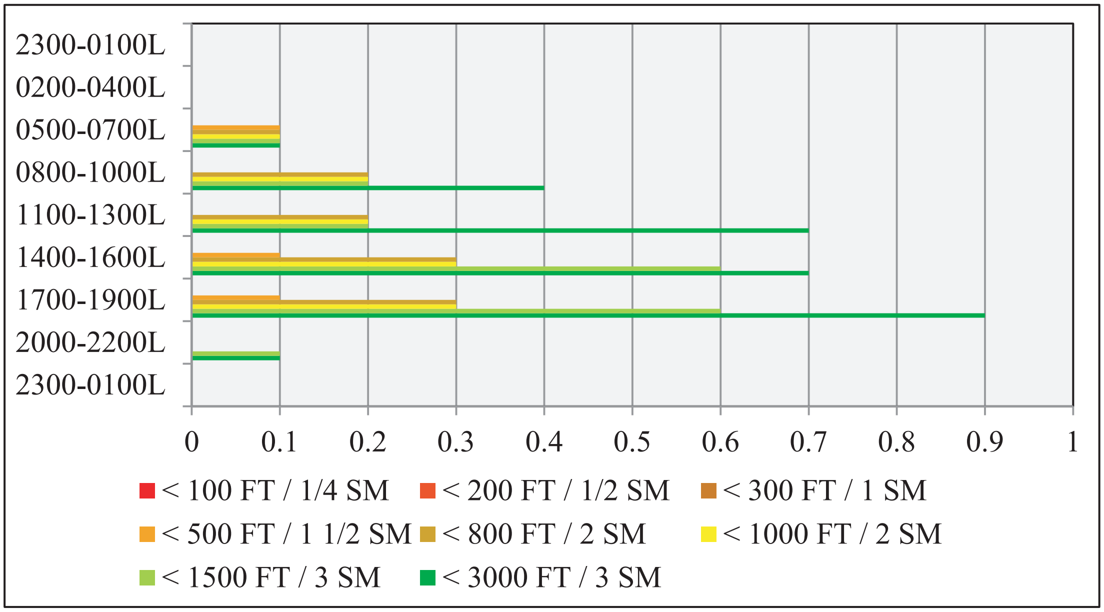
# Wind Rose (October)



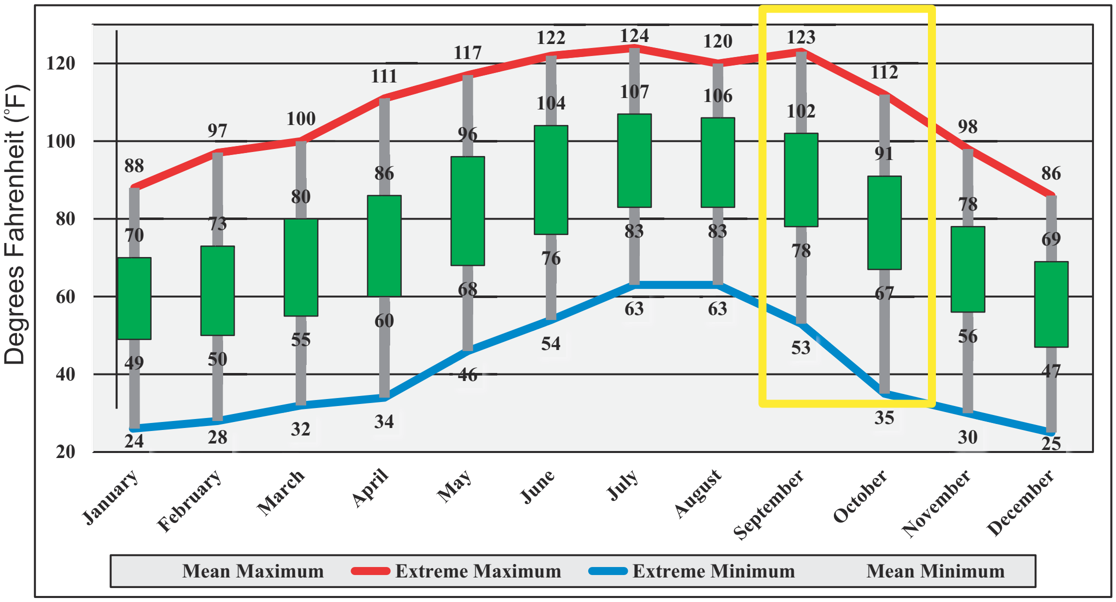
Note: Calm winds 19.29% of the time

# September
# Ceiling and Visibility (%)

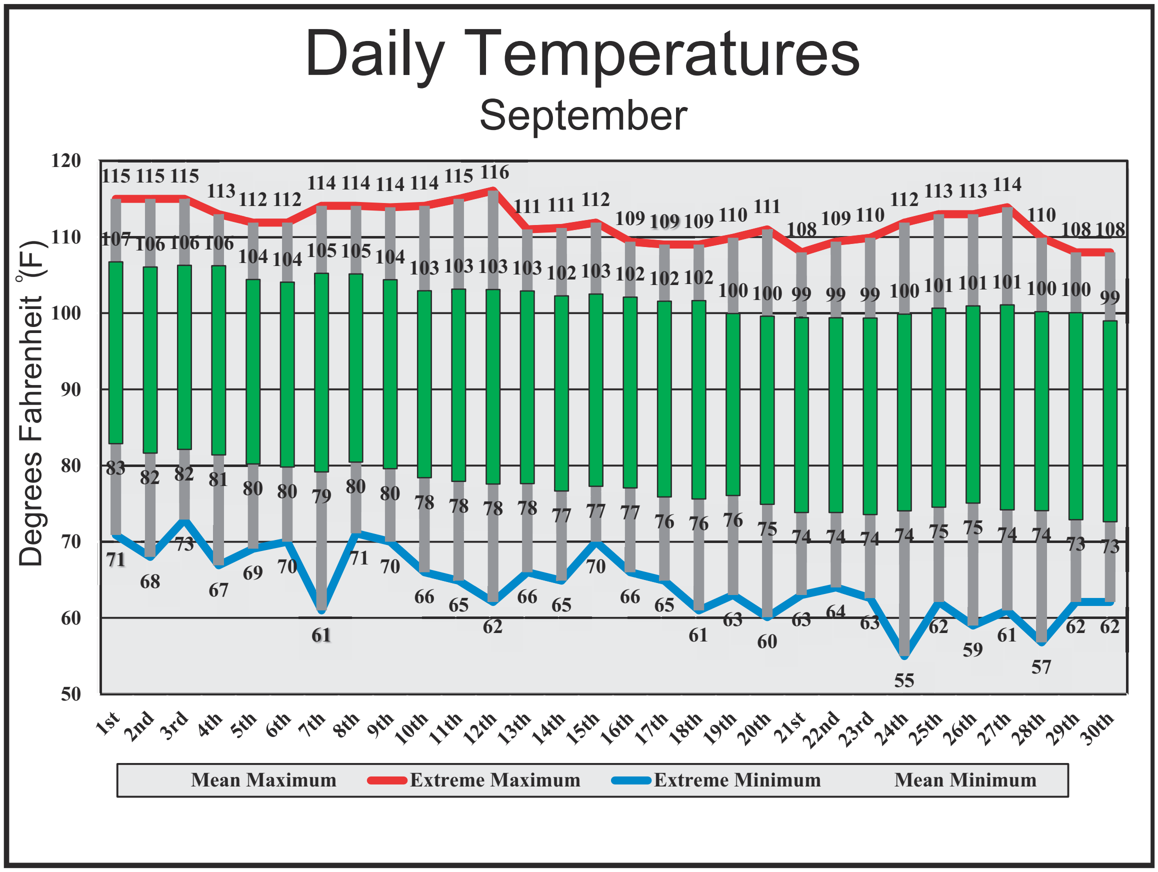


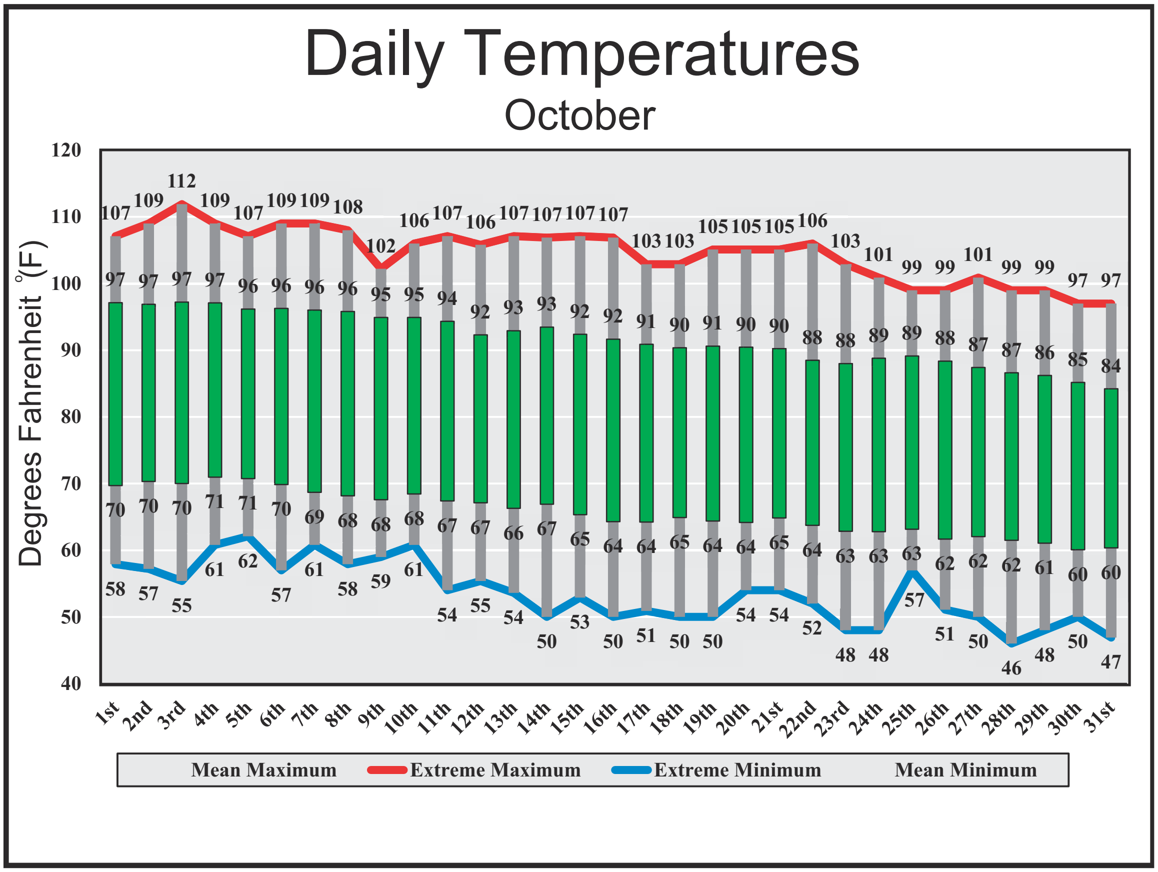


October
Ceiling and Visibility (%)

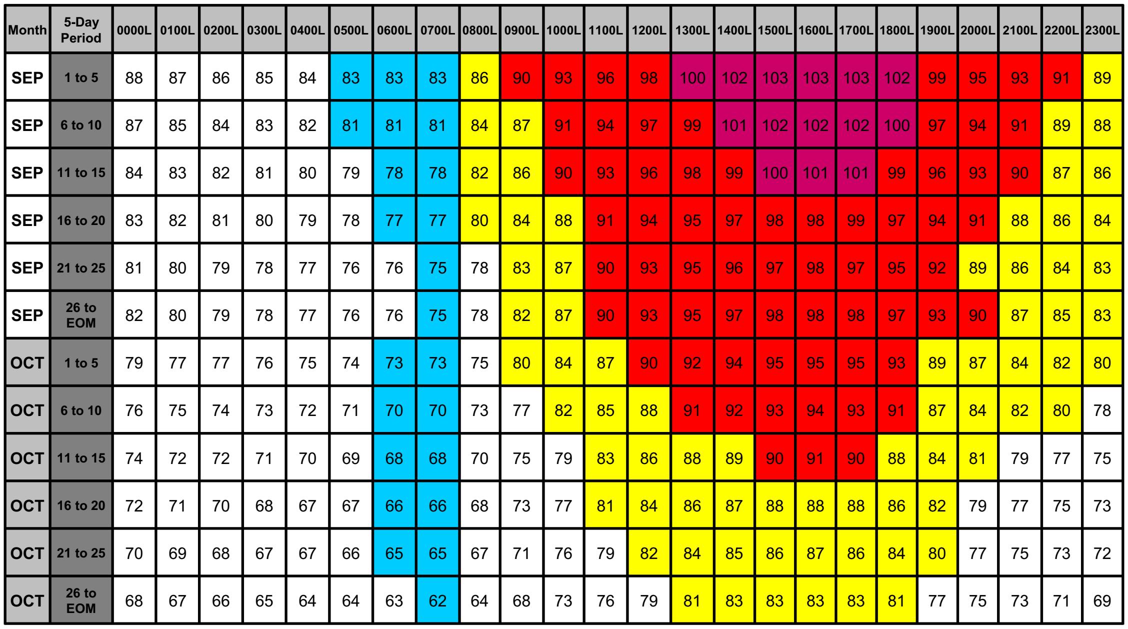


Yearly Temperature Profile


Daily Temperatures
September
Degrees Fahrenheit °(F)
120
110
100
90
80
70
60
50
115 115 115 113 112 112 114 114 114 114 115 116 111 111 112 109 109 109 110 111 108 109 110 112 113 113 114 110 108 108
107 106 106 106 104 104 105 105 104 103 103 103 103 102 103 102 102 102 100 100 99 99 99 100 101 101 101 100 100 99
83 82 82 81 80 80 79 80 80 78 78 78 78 77 77 77 76 76 76 75 74 74 74 74 75 75 74 74 73 73
71 68 73 67 69 70 61 71 70 66 65 62 66 65 70 66 65 61 63 60 63 64 63 55 62 59 61 57 62 62
1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th 13th 14th 15th 16th 17th 18th 19th 20th 21st 22nd 23rd 24th 25th 26th 27th 28th 29th 30th
Mean Maximum
Extreme Maximum
Extreme Minimum
Mean Minimum

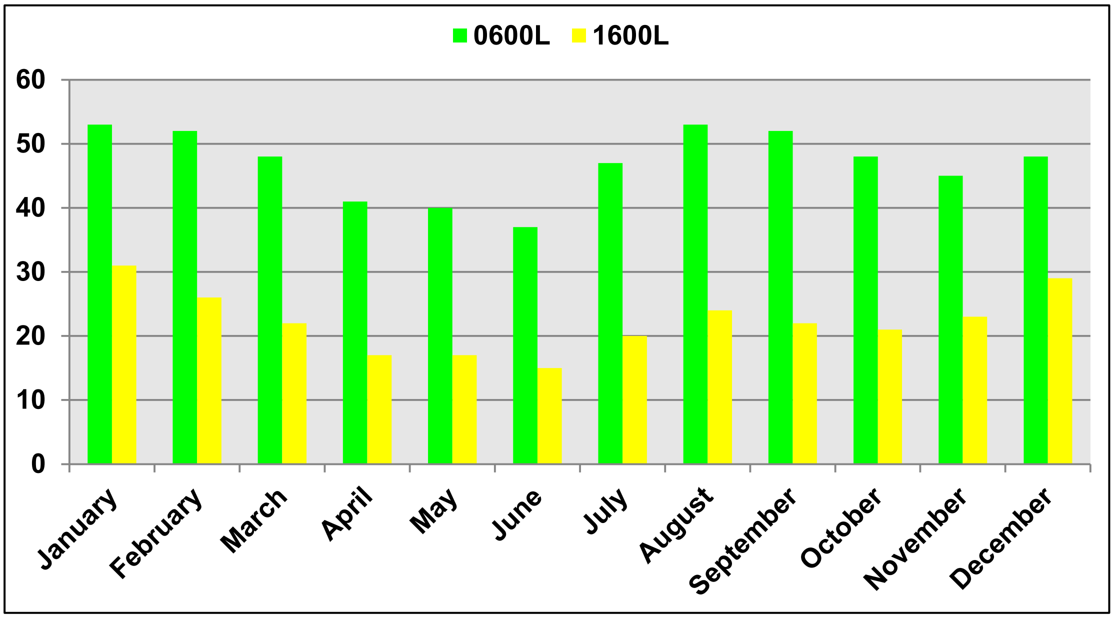

Daily Temperatures
October
Degrees Fahrenheit °(F)
120
110
100
90
80
70
60
50
40
107 109 112 109 107 109 109 108 102 106 107 106 107 107 107 107 103 103 105 105 105 106 103 101 99 99 101 99 99 97 97
97 97 97 97 96 96 96 96 95 95 94 92 93 93 92 92 91 90 91 90 90 88 88 89 89 88 87 87 86 85 84
70 70 70 71 71 70 69 68 68 68 67 67 66 67 65 64 64 65 64 64 65 64 63 63 63 62 62 62 61 60 60
58 57 55 61 62 57 61 58 59 61 54 55 54 50 53 50 51 50 50 54 54 52 48 48 57 51 50 46 48 50 47
1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th 13th 14th 15th 16th 17th 18th 19th 20th 21st 22nd 23rd 24th 25th 26th 27th 28th 29th 30th 31st
Mean Maximum
Extreme Maximum
Extreme Minimum
Mean Minimum

# Mean Diurnal Temperatures
# September - October



| Month | 5-Day Period | 0000L | 0100L | 0200L | 0300L | 0400L | 0500L | 0600L | 0700L | 0800L | 0900L | 1000L | 1100L | 1200L | 1300L | 1400L | 1500L | 1600L | 1700L | 1800L | 1900L | 2000L | 2100L | 2200L | 2300L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEP | 1 to 5 | 88 | 87 | 86 | 85 | 84 | 83 | 83 | 83 | 86 | 90 | 93 | 96 | 98 | 100 | 102 | 103 | 103 | 103 | 102 | 99 | 95 | 93 | 91 | 89 |
| SEP | 6 to 10 | 87 | 85 | 84 | 83 | 82 | 81 | 81 | 81 | 84 | 87 | 91 | 94 | 97 | 99 | 101 | 102 | 102 | 102 | 100 | 97 | 94 | 91 | 89 | 88 |
| SEP | 11 to 15 | 84 | 83 | 82 | 81 | 80 | 79 | 78 | 78 | 82 | 86 | 90 | 93 | 96 | 98 | 99 | 100 | 101 | 101 | 99 | 96 | 93 | 90 | 87 | 86 |
| SEP | 16 to 20 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 77 | 80 | 84 | 88 | 91 | 94 | 95 | 97 | 98 | 98 | 99 | 97 | 94 | 91 | 88 | 86 | 84 |
| SEP | 21 to 25 | 81 | 80 | 79 | 78 | 77 | 76 | 76 | 75 | 78 | 83 | 87 | 90 | 93 | 95 | 96 | 97 | 98 | 97 | 95 | 92 | 89 | 86 | 84 | 83 |
| SEP | 26 to EOM | 82 | 80 | 79 | 78 | 77 | 76 | 76 | 75 | 78 | 82 | 87 | 90 | 93 | 95 | 97 | 98 | 98 | 98 | 97 | 93 | 90 | 87 | 85 | 83 |
| OCT | 1 to 5 | 79 | 77 | 77 | 76 | 75 | 74 | 73 | 73 | 75 | 80 | 84 | 87 | 90 | 92 | 94 | 95 | 95 | 95 | 93 | 89 | 87 | 84 | 82 | 80 |
| OCT | 6 to 10 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 70 | 73 | 77 | 82 | 85 | 88 | 91 | 92 | 93 | 94 | 93 | 91 | 87 | 84 | 82 | 80 | 78 |
| OCT | 11 to 15 | 74 | 72 | 72 | 71 | 70 | 69 | 68 | 68 | 70 | 75 | 79 | 83 | 86 | 88 | 89 | 90 | 91 | 90 | 88 | 84 | 81 | 79 | 77 | 75 |
| OCT | 16 to 20 | 72 | 71 | 70 | 68 | 67 | 67 | 66 | 66 | 68 | 73 | 77 | 81 | 84 | 86 | 87 | 88 | 88 | 88 | 86 | 82 | 79 | 77 | 75 | 73 |
| OCT | 21 to 25 | 70 | 69 | 68 | 67 | 67 | 66 | 65 | 65 | 67 | 71 | 76 | 79 | 82 | 84 | 85 | 86 | 87 | 86 | 84 | 80 | 77 | 75 | 73 | 72 |
| OCT | 26 to EOM | 68 | 67 | 66 | 65 | 64 | 64 | 63 | 62 | 64 | 68 | 73 | 76 | 79 | 81 | 83 | 83 | 83 | 83 | 81 | 77 | 75 | 73 | 71 | 69 |

# Mean Relative Humidity (%)



# Potamological Considerations

- Colorado River Basin
  - "America's Nile"
  - Extends from Colorado to the Gulf of California
  - North - South orientation (south of Hoover Dam)

# Impact Assessment

- Little METOC impact on planned operations
- Acclimation
  - Feels much cooler
  - Dehydration is common
- Localized flash floods are common during rainshowers/thunderstorms but are rare
  - Don't sleep in dry wash areas (wadis)
  - Don't store equipment in dry wash areas

## Assessment and Recommendations

- Occasional light to moderate low level turbulence
  - Especially vicinity higher terrain/passes
- Periods of high winds/reduced visibility from blowing dust/sand
  - Hazardous driving conditions = caution
  - Objects may become airborne projectiles and may pose danger to personnel/equipment
- Turbulence and IFR hazard to aircraft

## Summary

- Data Considerations
- Geographic Orientation
- Topographic Influences
- Seasonal Periods
- Climatic Discussion
- Meteorological Elements
- Potamological Considerations
- Impact Assessment
- Summary

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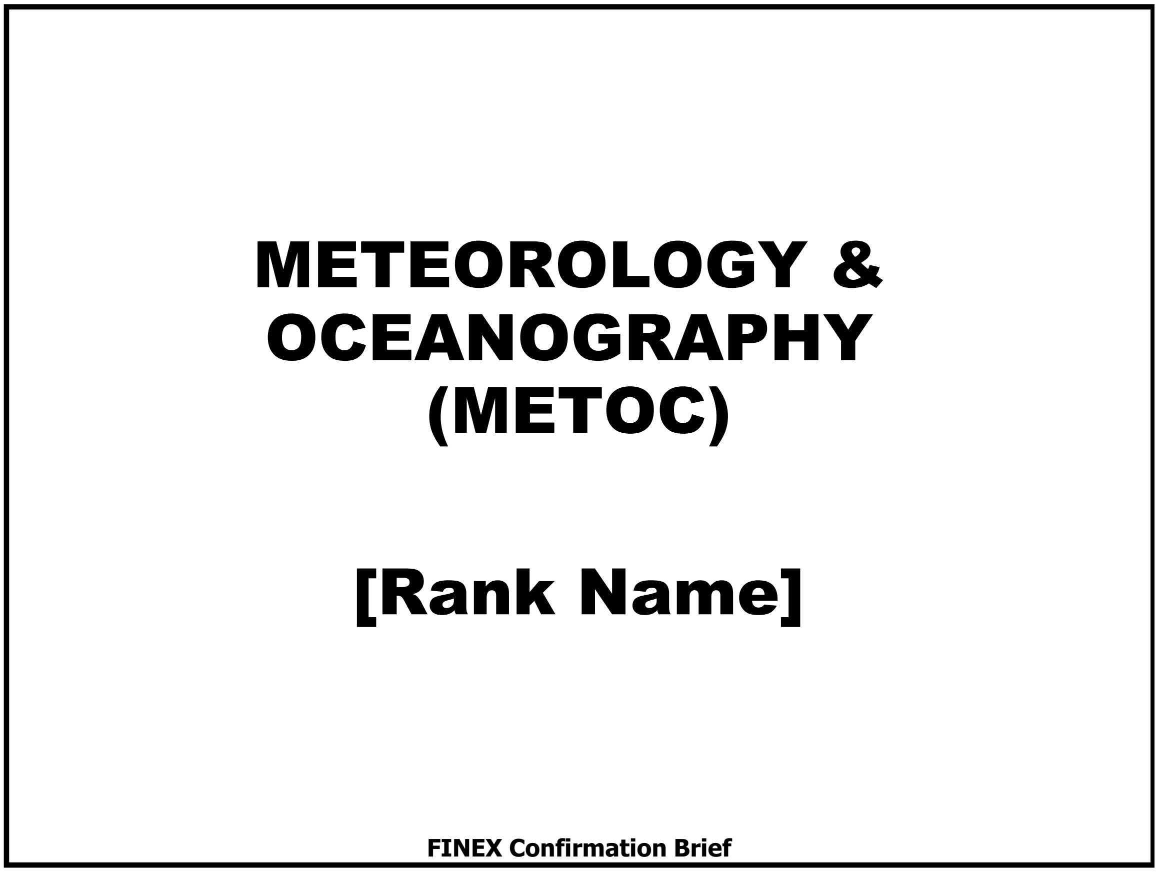
# APPENDIX H
# OPERATIONAL BRIEF EXAMPLE



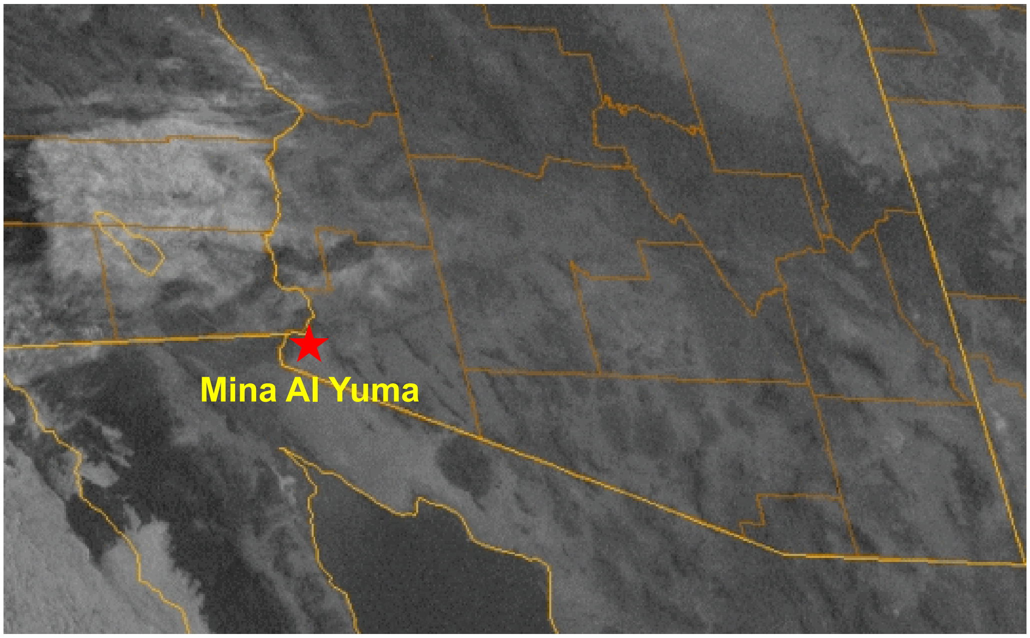
**METEOROLOGY &**
**OCEANOGRAPHY**
**(METOC)**

**[Rank Name]**

**FINEX Confirmation Brief**

# Satellite Imagery

## VT: 05/0700T Oct 13

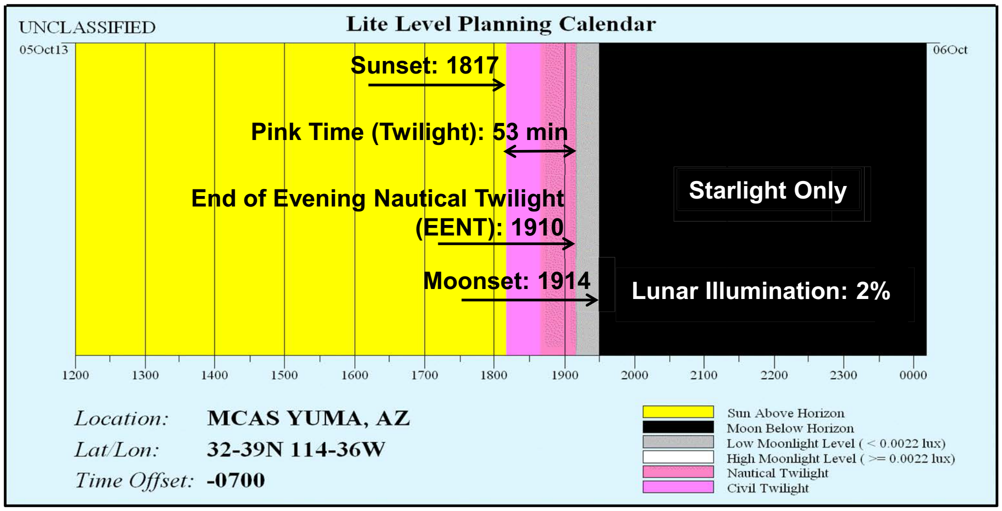


**FINEX Confirmation Brief**

# Day/Night Transition

## East Pass Airfield

## VT: 05/1200–06/0015T Oct 13



Sunset: 1817

Pink Time (Twilight): 53 min

End of Evening Nautical Twilight (EENT): 1910

Moonset: 1914

Starlight Only

Lunar Illumination: 2%

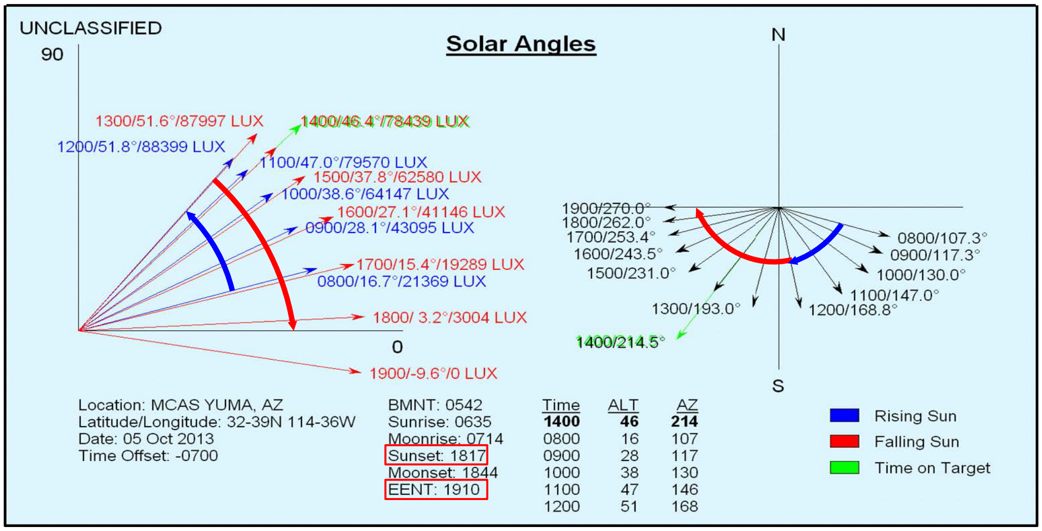
*Location:* **MCAS YUMA, AZ**
*Lat/Lon:* **32-39N 114-36W**
*Time Offset:* **-0700**

**FINEX Confirmation Brief**

# Solar Elevation/Azimuth Angles

## East Pass Airfield

### VT: 05/0800–1900T Oct 13



Location: MCAS YUMA, AZ
Latitude/Longitude: 32-39N 114-36W
Date: 05 Oct 2013
Time Offset: -0700

BMNT: 0542
Sunrise: 0635
Moonrise: 0714
Sunset: 1817
Moonset: 1844
EENT: 1910

| Time | ALT | AZ |
|---|---|---|
| **1400** | **46** | **214** |
| 0800 | 16 | 107 |
| 0900 | 28 | 117 |
| 1000 | 38 | 130 |
| 1100 | 47 | 146 |
| 1200 | 51 | 168 |

**FINEX Confirmation Brief**

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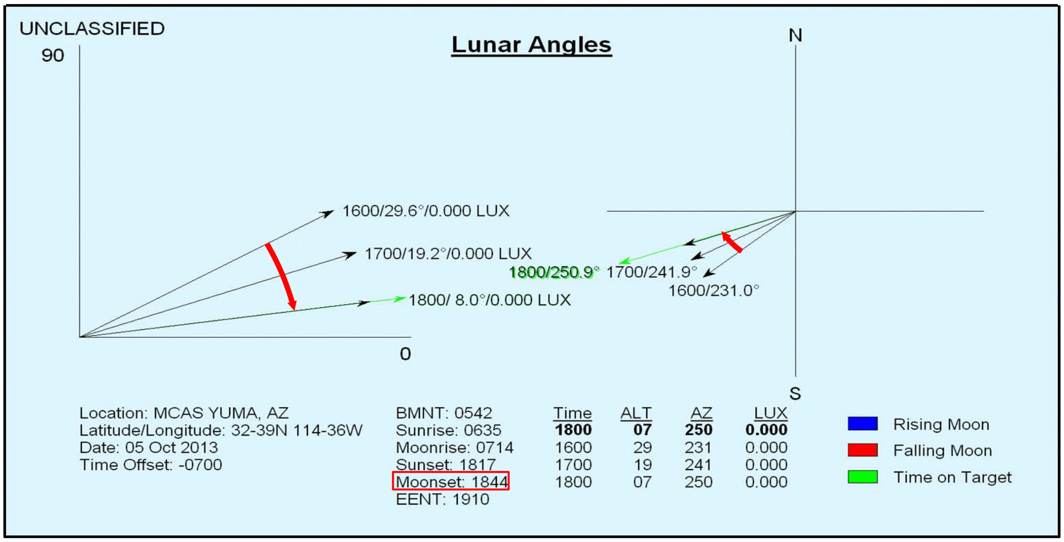
# Lunar Elevation/Azimuth Angles

## East Pass Airfield

### VT: 05/1600–1844T Oct 13



Location: MCAS YUMA, AZ
Latitude/Longitude: 32-39N 114-36W
Date: 05 Oct 2013
Time Offset: -0700

BMNT: 0542
Sunrise: 0635
Moonrise: 0714
Sunset: 1817
Moonset: 1844
EENT: 1910

| Time | ALT | AZ | LUX |
|---|---|---|---|
| **1800** | **07** | **250** | **0.000** |
| 1600 | 29 | 231 | 0.000 |
| 1700 | 19 | 241 | 0.000 |
| 1800 | 07 | 250 | 0.000 |

**FINEX Confirmation Brief**

# Departure Forecast

## Mina Al Yuma (Elev. 213 ft)

### VT: 05/1900T Oct 13

| | |
|---|---|
| Sky Condition: | FEW150 BKN250 |
| Visibility & Weather: | 7SM / NSW |
| Surface Wind ($^{o}$mag): | 35010KT |
| OAT: | 80°F / 27°C |
| Min ALTSTG: | 29.96INS |
| Max PA: | +169 |
| Max DA: | +1651 |

**FINEX Confirmation Brief**

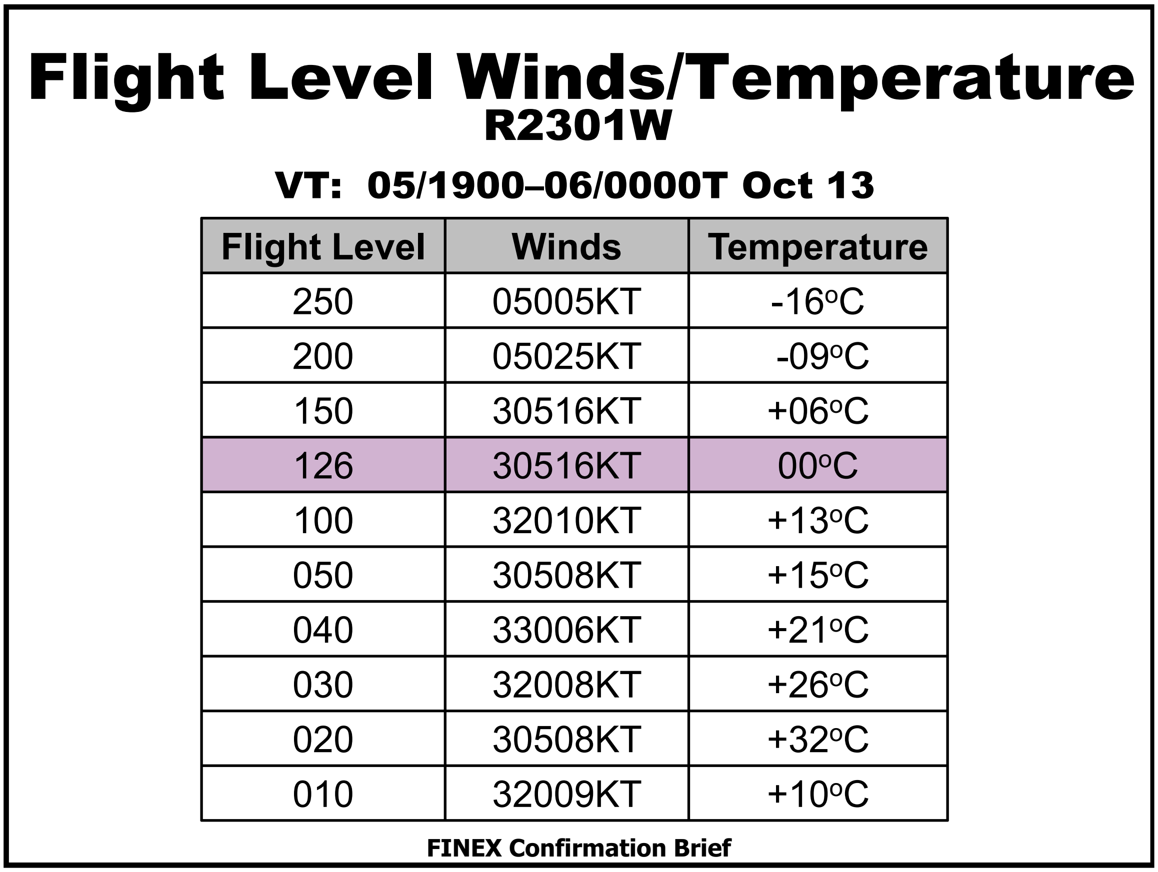
# Pick-up Zone Forecast

## AUX II (Elev. 269 ft)

### VT: 05/1900T Oct 13

| | |
|---|---|
| Sky Condition: | FEW150 BKN 250 |
| Visibility & Weather: | 7SM / NSW |
| Surface Wind ($^{o}$mag ): | 35010KT |
| OAT: | 80 °F / 27 °C |
| Min ALTSTG: | 29.96INS |
| Max PA: | +169 |
| Max DA: | +1651 |

**FINEX Confirmation Brief**



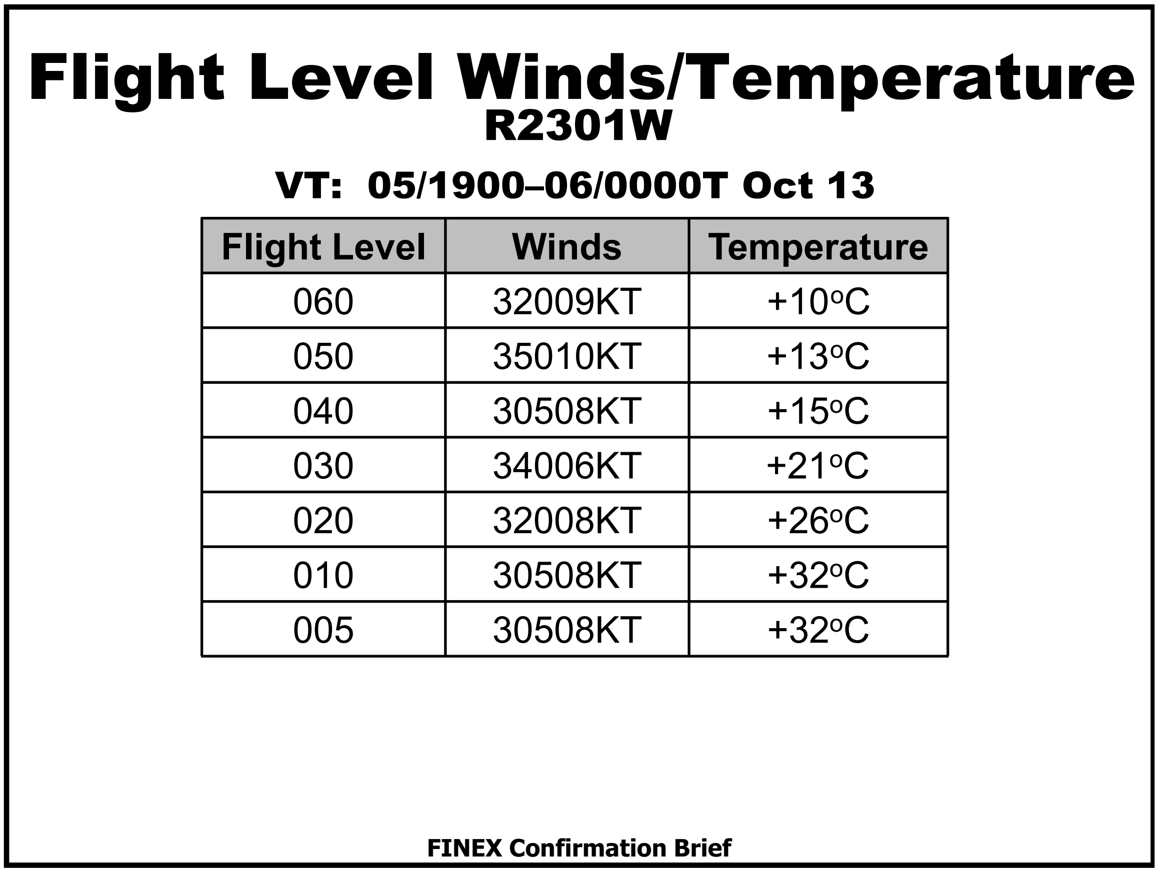
# Flight Level Winds/Temperature

## R2301W

**VT: 05/1900–06/0000T Oct 13**

| Flight Level | Winds | Temperature |
|---|---|---|
| 250 | 05005KT | -16°C |
| 200 | 05025KT | -09°C |
| 150 | 30516KT | +06°C |
| 126 | 30516KT | 00°C |
| 100 | 32010KT | +13°C |
| 050 | 30508KT | +15°C |
| 040 | 33006KT | +21°C |
| 030 | 32008KT | +26°C |
| 020 | 30508KT | +32°C |
| 010 | 32009KT | +10°C |

**FINEX Confirmation Brief**



# Flight Level Winds/Temperature

## R2301W

**VT: 05/1900–06/0000T Oct 13**

| Flight Level | Winds | Temperature |
|---|---|---|
| 060 | 32009KT | +10°C |
| 050 | 35010KT | +13°C |
| 040 | 30508KT | +15°C |
| 030 | 34006KT | +21°C |
| 020 | 32008KT | +26°C |
| 010 | 30508KT | +32°C |
| 005 | 30508KT | +32°C |

**FINEX Confirmation Brief**

# Flight Level Winds/Temperature

## R2301W

### VT: 05/1900 – 06/0000T Oct 13

| Flight Level | Winds | Temperature |
|---|---|---|
| 120 | 30516KT | +00C |
| 100 | 05009KT | +06C |
| 090 | 32009KT | +10C |
| 080 | 35010KT | +13C |
| 070 | 30508KT | +15C |
| 060 | 34006KT | +21C |
| 050 | 32008KT | +26C |
| 040 | 30508KT | +32C |
| 030 | 30516KT | +00C |
| 020 | 05009KT | +06C |
| 010 | 05009KT | +06C |

**FINEX Confirmation Brief**

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# En route Forecast

## VT: 05/1900-06/0000T Oct 13

### Contrails

| | |
|---|---|
| Possible (ft): | 38,000 |
| Probable (ft): | 35,000 |

### Flight Hazards

| | |
|---|---|
| Icing (ft): | None [Intensity Type Alt-Alt] |
| Turbulence (ft): | None [Intensity Type Alt-Alt] |

**FINEX Confirmation Brief**

# ADGR/FARP Site Forecast

## Stoval Airfield (Elev. 384 ft)

### VT: 05/1900–2050T Oct 13

Sky Condition: FEW150 BKN 250
Visibility & Weather: 7SM / NSW
Surface Wind (°mag ): 35010KT
OAT: 80 °F / 27 °C
Min ALTSTG: 29.96INS
Max PA: +169
Max DA: +1651

**FINEX Confirmation Brief**

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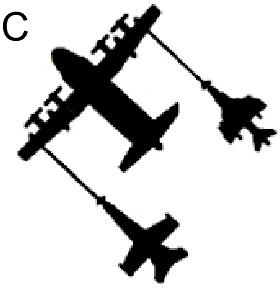
# FWAAR Forecast

## Texaco Track

### VT: 05/2000-2200T Oct 13

Sky Condition: FEW150 BKN250
Visibility & Weather: 7SM / NSW
13K Winds/Temperature: 35010KT/04$^{o}$C
12K Winds/Temperature: 35010KT/06$^{o}$C
11K Winds/Temperature: 35010KT/08$^{o}$C
Icing: None
Turbulence: None



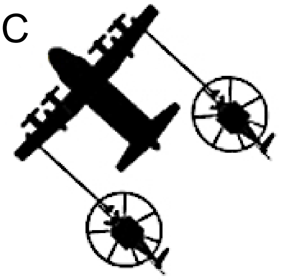
**FINEX Confirmation Brief**

# HAAR Forecast

### Texaco Track

**VT: 05/2000-2200T Oct 13**

| | |
|---|---|
| Sky Condition: | FEW150 BKN250 |
| Visibility & Weather: | 7SM / NSW |
| 13K Winds/Temperature: | 35010KT/04$^{o}$C |
| 12K Winds/Temperature: | 35010KT/06$^{o}$C |
| 11K Winds/Temperature: | 35010KT/08$^{o}$C |
| Icing: | None |
| Turbulence: | None |



**FINEX Confirmation Brief**

# TAAR Forecast

### Texaco Track

**VT: 05/2000-2200T Oct 13**

| | |
|---|---|
| Sky Condition: | FEW150 BKN250 |
| Visibility & Weather: | 7SM / NSW |
| 13K Winds/Temperature: | 35010KT/04$^{o}$C |
| 12K Winds/Temperature: | 35010KT/06$^{o}$C |
| 11K Winds/Temperature: | 35010KT/08$^{c}$ |
| Icing: | None |
| Turbulence: | None |

**FINEX Confirmation Brief**

# Objective Area Forecast

## East Pass Airfield (Elev. 900 ft)

**VT: 05/2000–2200 Oct 13**

Sky Condition: FEW150 BKN250
Visibility & Weather: 7SM / NSW
Surface Wind (°mag): 35010KT
OAT: 80°F / 27°C
Min ALTSTG: 29.96INS
Max PA: +169
Max DA: +1651
Absolute Humidity: #.##g/$m^3$
Max PDOP: If applicable (or delete)

**FINEX Confirmation Brief**

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# Divert Airfield Forecast

## Laguna AAF (Elev. 422 ft)

**VT: 05/1900–05/0000T Oct 13**

Sky Condition: FEW150 BKN250
Visibility & Weather: 7SM / NSW
Surface Wind (°mag): 35010KT
OAT: 80°F / 27°C
Min ALTSTG: 29.96INS
Max PA: +169
Max DA: +1651

**FINEX Confirmation Brief**

# Recovery Forecast

## Mina Al Yuma (Elev. 213 ft)

### VT: 05/1900 Oct 13

| | |
|---|---|
| Sky Condition: | FEW150 BKN250 |
| Visibility & Weather: | 7SM / NSW |
| Surface Wind ($^{o}$mag): | 35010KT |
| OAT: | 80°F / 27°C |
| Min ALTSTG: | 29.96INS |
| Max PA: | +169 |
| Max DA: | +1651 |

**FINEX Confirmation Brief**

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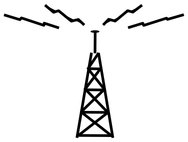
# Tactical Atmospheric Summary

### VT: 04 Oct 13

## Ducting

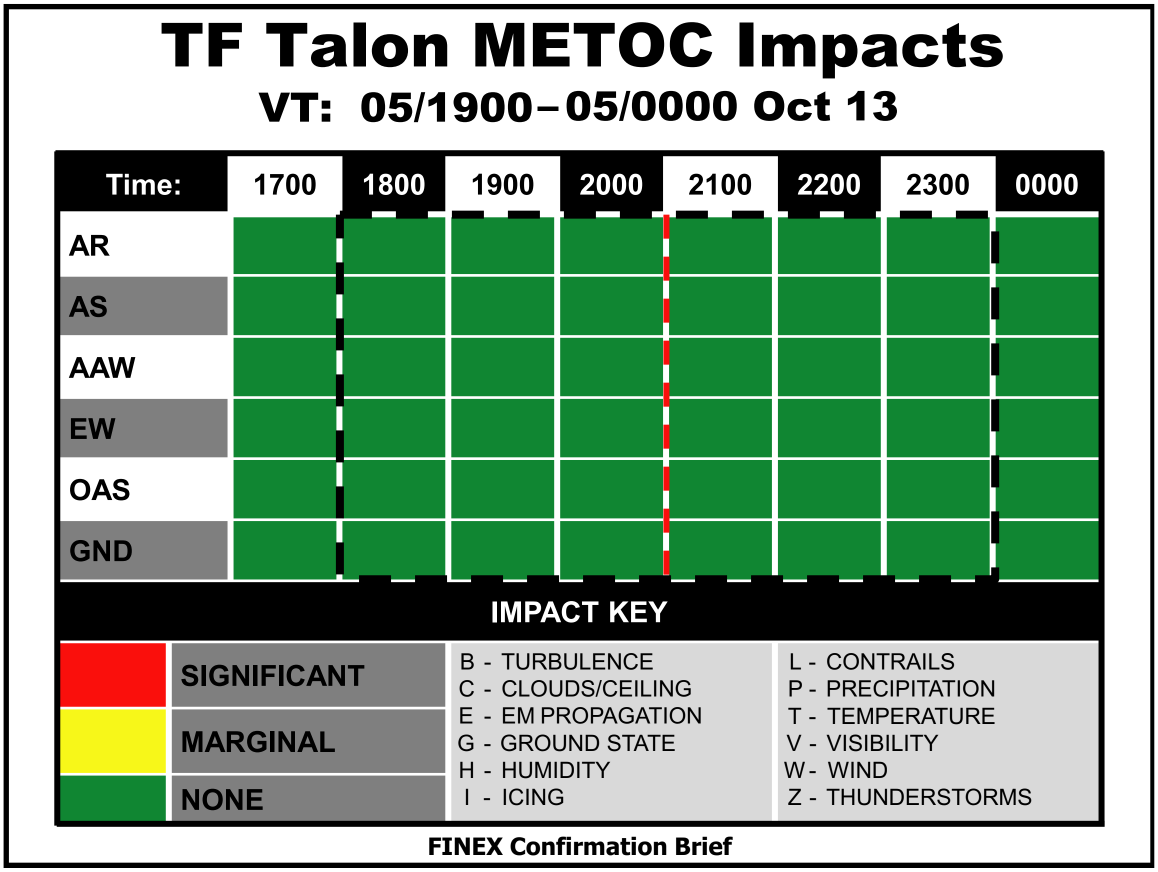


| | |
|---|---|
| Surface Ducts: | None |
| Elevated Ducts: | None |

## Communications Operations

| | |
|---|---|
| Surface to Surface: | Normal ranges for all frequencies |
| Surface to Air: | Normal ranges at all altitudes |
| Air to Air: | Normal ranges at all altitudes |

**FINEX Confirmation Brief**



# TF Talon METOC Impacts

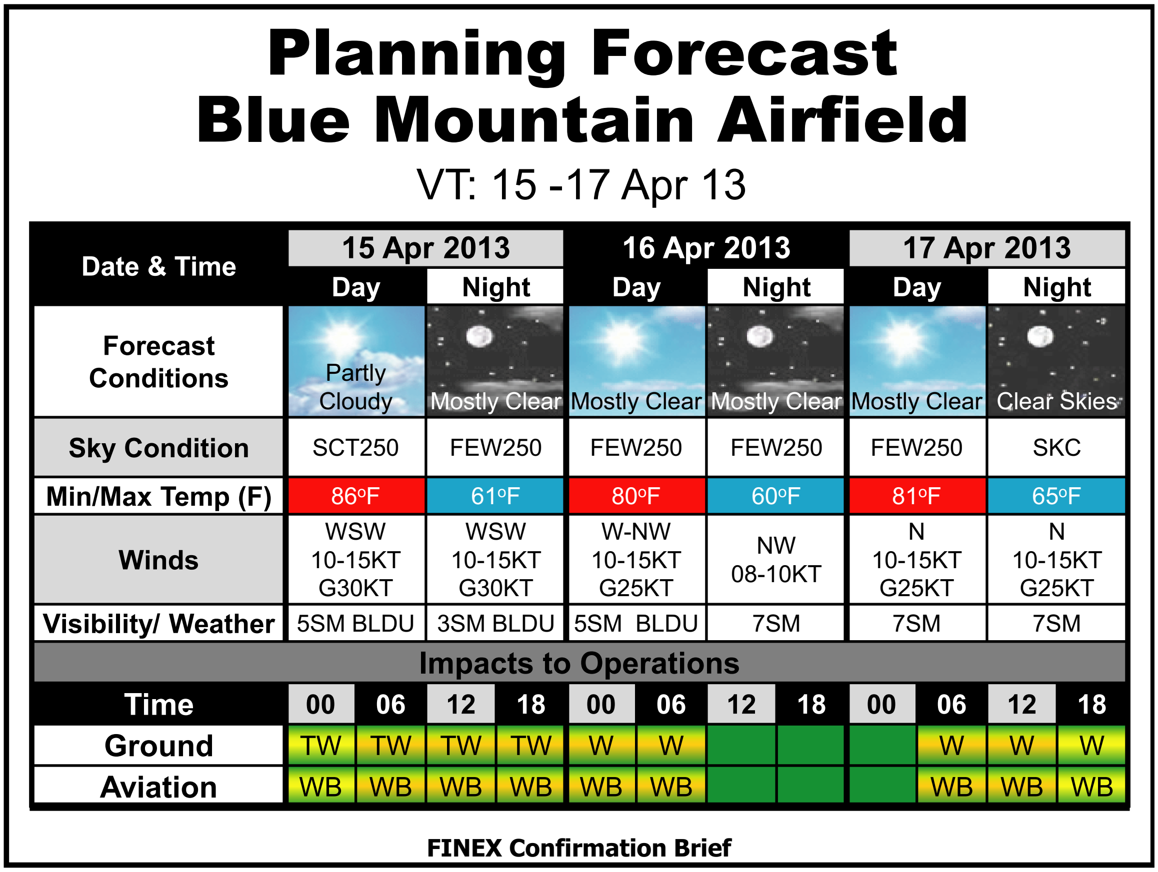
## VT: 05/1900–05/0000 Oct 13

| Time: | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 0000 |
|---|---|---|---|---|---|---|---|---|
| AR | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |
| AS | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |
| AAW | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |
| EW | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |
| OAS | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |
| GND | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 | 🟩 |

**IMPACT KEY**

| | | | |
|---|---|---|---|
| 🟥 | SIGNIFICANT | B - TURBULENCE<br>C - CLOUDS/CEILING | L - CONTRAILS<br>P - PRECIPITATION |
| 🟨 | MARGINAL | E - EM PROPAGATION<br>G - GROUND STATE<br>H - HUMIDITY | T - TEMPERATURE<br>V - VISIBILITY<br>W - WIND |
| 🟩 | NONE | I - ICING | Z - THUNDERSTORMS |

**FINEX Confirmation Brief**



# Planning Forecast Blue Mountain Airfield

VT: 15 -17 Apr 13

| Date & Time | 15 Apr 2013 | | 16 Apr 2013 | | 17 Apr 2013 | |
|---|---|---|---|---|---|---|
| | Day | Night | Day | Night | Day | Night |
| Forecast Conditions | Partly Cloudy | Mostly Clear | Mostly Clear | Mostly Clear | Mostly Clear | Clear Skies |
| Sky Condition | SCT250 | FEW250 | FEW250 | FEW250 | FEW250 | SKC |
| Min/Max Temp (F) | 86°F | 61°F | 80°F | 60°F | 81°F | 65°F |
| Winds | WSW<br>10-15KT<br>G30KT | WSW<br>10-15KT<br>G30KT | W-NW<br>10-15KT<br>G25KT | NW<br>08-10KT | N<br>10-15KT<br>G25KT | N<br>10-15KT<br>G25KT |
| Visibility/ Weather | 5SM BLDU | 3SM BLDU | 5SM BLDU | 7SM | 7SM | 7SM |

**Impacts to Operations**

| Time | 00 | 06 | 12 | 18 | 00 | 06 | 12 | 18 | 00 | 06 | 12 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ground | TW | TW | TW | TW | W | W | 🟩 | 🟩 | 🟩 | W | W | W |
| Aviation | WB | WB | WB | WB | WB | WB | 🟩 | 🟩 | 🟩 | WB | WB | WB |

**FINEX Confirmation Brief**

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# GLOSSARY

## Section I. Acronyms and Abbreviations

| | |
|---|---|
| ACE | aviation combat element |
| AFWA | Air Force Weather Agency |
| AOI | area of interest |
| AOR | area of responsibility |
| APX | Aviation Expeditionary Enablers Branch (*HQMC*) |
| AREPS | Advanced Refractive Effects Prediction System |
| ARG | amphibious ready group |
| ASOS | Automated Surface Observing System |
| AWOS | Automated Weather Observing System |

| | |
|---|---|
| BSC | beach survey chart |

| | |
|---|---|
| °C | Celsius |
| C2 | command and control |
| CBIRF | Chemical-Biological Incident Response Force |
| CBRN | chemical, biological, radiological, and nuclear |
| CCDR | combatant commander |
| CCIR | commander's critical information requirement |
| CCMD | combatant command |
| CD&I | Combat Development and Integration |
| CE | command element |
| CG | commanding general |
| CIS | communications and information systems |
| COA | course of action |
| COMNAVMETOCCOM | Commander, Naval Meteorology and Oceanography Command |
| CONUS | continental United States |
| COOW | Commander, Naval Meteorology and Oceanography Command Operational Oceanography Watch |
| CSS | combat service support |

| | |
|---|---|
| DB | dry bulb |
| DC | deputy commandant |
| DIRINT | Director of Intelligence (*USMC*) |
| DOD | Department of Defense |
| DOTMLPF | doctrine, organization, training, materiel, leadership and education, personnel, and facilities |

| | |
|---|---|
| EM | electromagnetic |
| EOP | Earth orientation parameters |

| | |
|---|---|
| °F | Fahrenheit |
| FARP | forward arming and refueling point |
| FNMOC | Fleet Numerical Meteorology and Oceanography Center |
| G-2 | intelligence staff section |
| G-3 | operations staff section |
| G-6 | communications system staff section |
| GCE | ground combat element |
| GFMPL | Geophysics Fleet Mission Program Library |
| GPS | Global Positioning System |
| HHQ | higher headquarters |
| HQMC | Headquarters, United States Marine Corps |
| Hz | hertz |
| INMARSAT | international maritime satellite |
| IPB | intelligence preparation of the battlespace |
| IPOE | intelligence preparation of the operational environment |
| J-6 | command, control, communications, and computer systems staff section |
| JFC | joint force commander |
| JMCC | joint meteorological and oceanographic coordination cell |
| JMCO | joint meteorological and oceanographic coordination organization |
| JMO | joint meteorological and oceanographic officer |
| JOA | joint operations area |
| JOAF | joint operations area forecast |
| JP | joint publication |
| JTF | joint task force |
| km | kilometer |
| LCE | logistics combat element |
| LUX | luminous flux per unit area |
| MACG | Marine air control group |
| MACS | Marine air control squadron |
| MAGTF | Marine air-ground task force |
| MARCORSYSCOM | Marine Corps Systems Command |
| MARDIV | Marine division |
| MATCD | Marine air traffic control detachment |
| MAW | Marine aircraft wing |
| MAWTS | Marine aviation weapons and tactics squadron |
| MCAS | Marine Corps air station |
| MCDP | Marine Corps doctrinal publication |
| MCIA | Marine Corps Intelligence Activity |
| MCICOM | Marine Corps Installations Command |
| MCIPAC | Marine Corps Installations Pacific |

| | |
|---|---|
| MCLLP | Marine Corps Lessons Learned Program |
| MCO | Marine Corps order |
| MCWP | Marine Corps warfighting publication |
| MEB | Marine expeditionary brigade |
| MEF | Marine expeditionary force |
| METEM | meteorological equipment maintenance |
| METMF(R) NEXGEN | Meteorological Mobile Facility (Replacement) Next Generation |
| METOC | meteorological and oceanographic |
| METWATCH | meteorological watch |
| MEU | Marine expeditionary unit |
| MLG | Marine logistics group |
| MOAF | meteorological oceanographic analyst forecaster |
| MOS | military occupational specialty |
| MOSC | meteorological and oceanographic operations support community |
| MST | meteorological and oceanographic support team |

| | |
|---|---|
| NAVMC | Navy/Marine Corps departmental publication |
| NAVMETOCCOM | Naval Meteorology and Oceanography Command |
| NAVO | Naval Oceanographic Office |
| NEP-Oc | Navy Enterprise Portal-Oceanography |
| NIPRNET | Nonsecure Internet Protocol Router Network |
| NITES IV | Naval Integrated Tactical Environmental System, Variant Four |
| NOAA | National Oceanic and Atmospheric Administration |
| NVD | night vision device |
| NWP | numerical weather prediction |

| | |
|---|---|
| OAML | Oceanographic and Atmospheric Master Library |
| OCCFLD | occupational field |
| OPLAN | operation plan |
| OPNAV N2/N6E | Oceanographer of the Navy |
| OPORD | operation order |

| | |
|---|---|
| PBL | planetary boundary layer |
| PIREP | pilot report |
| PMSV | pilot to metro service |

| | |
|---|---|
| RFI | request for information |
| RH | relative humidity |
| RMC | regional meteorological and oceanographic center |

| | |
|---|---|
| S-2 | intelligence office |
| S-3 | operations office |
| S-5 | plans office |
| S-6 | communications staff office |
| SGOT | strike group oceanography team |
| SIPRNET | SECRET Internet Protocol Router Network |
| SMO | senior meteorological and oceanographic officer |

| | |
|---|---|
| SOP | standing operating procedure |
| SPMAGTF | special purpose Marine air-ground task force |
| TACC | tactical air command center (USMC) |
| TAS | tactical atmospheric summary |
| TDA | tactical decision aid |
| TECOM | Training and Education Command |
| TTP | tactics, techniques, and procedures |
| US | United States |
| USNO | United States Naval Observatory |
| VAC | volts, alternating current |
| WBGT | wet bulb globe temperature |
| WBGTI | wet bulb globe temperature index |
| WMO | World Meteorological Organization |
| WTI | weapons and tactics instructor |
| WTTP | Weapons and Tactics Training Program |
| WWA | watch, warning, and advisory |

## Section II. Definitions

**atmospheric environment**—The envelope of air surrounding the Earth, including its interfaces and interactions with Earth's solid or liquid surface. (DOD Dictionary)

**joint meteorological and oceanographic coordination cell**—A subset of a joint meteorological and oceanographic coordination organization, which is delegated the responsibility of executing the coordination of meteorological and oceanographic support operations in the operational area. Also called **JMCC**. (DOD Dictionary)

**joint meteorological and oceanographic coordination organization**—A Service meteorological and oceanographic organization that is designated within the operations order as the lead organization responsible for coordinating meteorological and oceanographic operations support in the operational area. Also called **JMCO**. (DOD Dictionary)

**littoral**—(See JP 1-02 for core definition. Marine Corps amplification follows.) A zone of military operations along a coastline, consisting of the seaward approaches from the open ocean to the shore, which must be controlled to support operations ashore, as well as landward approaches to the shore that can be supported or defended directly from the sea. (MCRP 5-12C)

**littoral current**—A current running parallel to the beach and generally caused by waves striking the shore at an angle. (www.nws.noaa.gov)

**meteorological and oceanographic operations support community**—The collective of electronically connected, shore-based meteorological and oceanographic production facilities/centers, theater and/or regional meteorological and oceanographic production activities. Also called **MOSC**. (DOD Dictionary)

**space environment**—The environment corresponding to the space domain, where electromagnetic radiation, charged particles, and electric and magnetic fields are the dominant physical influences, and that encompasses the earth's ionosphere and magnetosphere, interplanetary space, and the solar atmosphere. (DOD Dictionary)

## Section III. Nomenclature

| | |
|---|---|
| AAQ-27 | mid-wavelength infrared imaging system |
| AAQ-29 | forward-looking infrared sensor |
| AN/ALQ-99 | tactical jamming system |
| AN/TPS-59 | long-range air surveillance radar system |
| AN/TPS-63 | transportable air surveillance radar system |
| C-130 | cargo aircraft (Hercules) |
| CH-46 | medium assault support helicopter (Sea Knight) |
| Dragon | wire-guided antitank missile |
| HMMWV | high mobility multipurpose wheeled vehicle |
| LCM | landing craft, mechanized |
| LCU | landing craft, utility |
| LCVP | landing craft, personnel vehicle |
| M1152A1 | expanded capacity high mobility multipurpose wheeled vehicle |
| MV-22 | medium lift, vertical takeoff and tiltrotor aircraft (Osprey) |
| TOW | tube-launched, optically tracked, wire-command link guided missile |

# REFERENCES AND RELATED PUBLICATIONS

## Chairman of the Joint Chiefs of Staff Publications

### Chairman of the Joint Chiefs of Staff Instruction (CJCSIs)

| | |
|---|---|
| 3150.25_ | Joint Lessons Learned Program |
| 3810.01_ | Meteorological and Oceanographic Operations |

## Joint Issuances

### Joint Publications (JP)

| | |
|---|---|
| 2-03 | Geospatial Intelligence Support to Joint Operations |
| 3-59 | Meteorological and Oceanographic Operations |

### Miscellaneous

DOD Dictionary of Military and Associated Terms

Joint Meteorological & Oceanographic (METOC) Handbook

## Marine Corps Publications

### Marine Corps Doctrinal Publications (MCDPs)

| | |
|---|---|
| 1 | Warfighting |

### Marine Corps Warfighting Publications (MCWPs)

| | |
|---|---|
| 2-1 | Intelligence Operations |
| 5-1 | Marine Corps Planning Process |
| 5-11.1 | MAGTF Aviation Planning |

### Marine Corps Reference Publications (MCRPs)

| | |
|---|---|
| 2-3A | Intelligence Preparation of the Battlefield/Battlespace |
| 2-10.2 | Operational Level Integration of METOC Capabilities |
| 1-10.2 | Marine Corps Supplement to the Department of Defense Dictionary of Military and Associated Terms |

Marine Corps Orders (MCOs)

| | |
|---|---|
| 3500.109 | Marine Corps Aviation Weapons and Tactics Training Program |
| 3500.14_ | Aviation Training and Readiness (T&R) Manual |
| 3504.1 | Marine Corps Lessons Learned Program (MCLLP) and the Marine Corps Center for Lessons Learned (MCCLL) |
| 5311.6 | Advocate and Proponent Assignments and Responsibilities |

Navy/Marine Corps Departmental Publication (NAVMC)

| | |
|---|---|
| 3500.38_ | Meteorological and Oceanographic Training and Readiness Manual |

Miscellaneous

Technical Manual 334-192046, *Embarkation Plan for the Meteorological Mobile Facility (Replacement) (METMF[R]) Next Generation (NEXGEN) AN/TMQ-56.*

## Naval Publications

Commander Naval METOC Command Instructions (NAVMETOCCOMINSTs)

| | |
|---|---|
| 3140.1_ | U.S. Navy Meteorological and Oceanographic Support Manual |
| 3140.17_ | Policies Concerning the Provision of Meteorology and Oceanography Products and Services |
| 3141.2_ | Surface Weather Observation Procedures |
| 3142.1_ | Procedures Governing Pilot Weather Reports (PIREPS) |
| 3143.1_ | Terminal Aerodrome Forecast (TAF) and the FM51-XII TAF Code |

Space and Naval Warfare System Command

EE100-FF-OMI-010 Rev 7, *Organizational Level Maintenance Instructions for the AN/UMK-4(V)4 Tactical Environmental Support System/Naval Integrated Tactical Environmental System (TESS/NITES) MOBILE VARIANT- NITES IV.*

Technical Manual EM000-CD-OMP-010, *Operation and Maintenance Manual with Parts List AN/TMQ-56 Meteorological Measuring Set (METMF[R] NEXGEN).*

Miscellaneous

Naval Research Laboratory, NRL/MR/7320-10-9214. Littoral Environment Sensing Architecture (LESA) Report-The Current State of Sensing Capability for Naval Special Warfare METOC Support.

## Air Force Weather Technical Library and Technical Notes (AFWTL/TC and AFWA TN)

| | |
|---|---|
| 06/001 | Catalog of Air Force Weather Technical Documents 1941-2006 |

## Miscellaneous

Pub. No. 9, *The American Practical Navigator*, Vol. 1. 2002 ed. National Geospatial-Intelligence Agency.

WCDMP-No. 60/WMO-TD No. 1376, *Guidelines on Climate Data Management*, World Meteorological Organization, Geneva, March 2007.

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    - Paragraph number (if applicable)
    - Line number
    - Figure or table number (if applicable)
- Nature of change
    - Addition/deletion of text
    - Proposed new text

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