MCWP 3-35.7

MAGTF Meteorological and Oceanographic Support

U.S. Marine Corps

DRAFT

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DEPARTMENT OF THE NAVY
Headquarters United States Marine Corps
Washington, DC 20380-1775

FOREWORD

Marine Corps Warfighting Publication (MCWP) 3-35.7, *Marine Air-Ground Task Force* (*MAGTF) Meteorological and Oceanographic Support*, provides the information needed by Marines to understand, plan, and conduct Marine air-ground task force (MAGTF) meteorological and oceanographic (METOC) operations.

The focus of MCWP 3-35.7 is METOC effects on operations and missions. It addresses METOC planning requirements, command relationships, METOC support capabilities, and external support requirements. Detailed information is provided on:

- METOC support organization and structure
- Sample METOC support products
- Weather and oceanographic effects on MAGTF operations
- Meteorological critical values
- Sample Annex H (METOC Services) for operation orders and plans.

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

BY DIRECTION OF THE COMMANDANT OF THE MARINE CORPS

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CHAPTER 1

INTRODUCTION

"The day my meteorological came in and said at the morning brief; "Sir I am hesitant to say for sure, but I think we have good weather for ten more days". That's when I knew the war was won".

LtGen T Conway Commanding General, I MEF, during the conflict Operation Iraqi Freedom.

1001. GENERAL

Meteorological and Oceanographic (METOC) conditions are factors over which commanders have no control but that have the potential to affect every combatant, piece of equipment, and operation. Knowledge of the natural environment becomes more significant to success in the modern battlespace as advanced technological weapons and support systems that are vulnerable to adverse METOC conditions are fielded. Effective oceanographic information and support is especially critical to Marine Expeditionary Forces (MEFs) as they seek broader and bolder operational opportunities to project combat power from the sea. Many battles and campaigns have been won or lost as a result of the impact of METOC. Although commanders have no control over these factors, they can take advantage of METOC conditions or minimize their effects through planning and training. To do so, commanders and planners need support from METOC elements operating from the tactical to the national and international levels.

1002. MISSION

The mission of the Marine Corps METOC Service is to provide meteorological, oceanographic, climatological (historical), current, and forecast conditions of atmosphere, ocean, land, and space environments in the form of information, products, and services required to support Marine Corps operations and other military operations as may be directed.

1003. HISTORICAL PERSPECTIVE

Weather support is critical to tactical combat operations and operational level planning. History is replete with examples of the weather's effects on the timing, as well as the success or failure of military operations on a variety of battlefields. Some examples are the Spanish Armada, the Battle of Trenton, Hitler's attempt to take Moscow, the Battle of Stalingrad, Tarawa, Operation Overlord, the Battle of the Bulge, the Chosin Reservoir, and the Inchon Landing. More recent conflicts where weather support has been critical to the success of combat tactics include Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom in Iraq. The Battle space of tomorrow will provide examples of victories and defeats that are attributable to the skillful integration, or lack of integration, of weather in military planning and the execution of combat operations.

1004. GENERAL PRINCIPLES

The following principles comprise the cornerstone of METOC support in all operations. By applying these principles, METOC support is better prepared to enhance and sustain operations. These principles include;

- Accuracy of data information
- Timeliness of data and information
- Relevance to the operational user
- Unity of effort
- Readiness
- Evaluation of effectiveness

a. Accuracy of Data and Information

During military operations, adverse and or unfavorable METOC conditions are sometimes encountered. Accurate, timely, and reliable METOC information can provide the commander with the knowledge necessary to anticipate and exploit the best window of opportunity to plan, execute, support, and sustain specific operations. This is true anytime whether at peace or at war. The rapidly changing and perishable nature of METOC data, mission complexity and human error all effect accuracy. The fact that METOC conditions are constantly changing METOC forecasts will never be totally free of inaccuracies and places increased importance on timely submission of relative information. Inaccuracy can cost lives, undermine the successful execution of the mission, waste resources, and impair readiness. These factors must be explained and quantified to the decision makers so that they may place an appropriate weight and level of confidence on the information when making decisions.

b. Timeliness of Data and Information

MAGTF METOC support is effective when a commander receives accurate METOC information to make a decision in time to consider its impact on operations. METOC information that could influence an operation is not useful when the commander receives it after an opportunity has passed, an irreversible decision has been made, or an operation is complete. Communication links are vital to support and sustain the timely dissemination of METOC information and are key to the overall capability and success of MAGTF METOC operations.

c. Relevance to the Operational User

METOC support provides commanders and planners with an understanding of the weather, sea, and coastal situations and the impact of these on threat operations. METOC support bears on each echelon’s current, planned, and alternate courses of action (COAs). METOC personnel and those supporting METOC operations must tailor the information for specific applications and missions so that the user can quickly identify and apply relevant information without additional analysis or manipulation. Attaining this goal requires METOC personnel to understand operational user needs and implies a user’s responsibility to identify specific METOC information requirements for content, form, medium, presentation, timeliness, and frequency of delivery.

d. Unity of Effort

METOC information that influences a commander's decision usually cannot be derived from data obtained from a single source. Instead, METOC data from many sources must be assembled into a database. That database contains a complete and integrated summary of weather and oceanographic conditions over an extended region and time that affect the area of interest to the commander. To accomplish this task, METOC organizations at all levels must have clearly defined missions and functions that eliminate duplication, maximize sharing of information, and are mutually supportive of the overall METOC support concept. The responsibilities of each organization must be clear, explicit, and understood by all.

e. Readiness

METOC units, databases, products, and equipment must be responsive to the requirements of commanders and their forces. All METOC resources must be maintained in a degree of readiness that ensures employment capability commensurate with the unit's mission.

f. Evaluation of Effectiveness

The overall effectiveness of METOC support is based on the successful and effective accomplishment of specific military missions. Each METOC or supporting unit must evaluate effectiveness on the basis of the principles stated above. 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.

g. Methods of Providing Weather Support

(1) Direct Support. Direct weather support occurs when a MAGTF METOC unit is organized under the operational control of the supported commander. Traditionally, most MAGTF METOC support has been located within the aviation combat element (ACE) and focused on providing meteorological support. Other MAGTF units requiring METOC support for tactical operations would request support through the chain of command to the MAGTF command element (CE). If directed, the ACE would provide METOC support elements, such as the MEF

METOC Support Team (MST), based on mission priorities, or other support arrangements.

(2) General Support. At units without organic or direct support METOC elements, METOC support is provided via general support. Units will verify and relay METOC information requirements to higher headquarters (HQ). Some organic support may still come from observations that may be taken by the unit intelligence officer, ground reconnaissance units, or artillery regimental HQ meteorological personnel. However, the preponderance of METOC information to such units will be provided via general support by external organizations. Communications capabilities are improvements on the usefulness of METOC general support. The current capability of using message text formats to satisfy weather customer needs will evolve to include graphics exchange. Editable graphics are constructed from file transfers of the databases. When this capability matures, commanders and planners will be able to query the METOC database when desired, construct graphics from the query, and tailor the results for their planning and decision making needs.

1005. Planning Considerations

METOC information is as much a part of intelligence as enemy and terrain data. It is often as significant as enemy intentions and trafficability. It affects enemy actions and the decisions of both forces. Adverse weather and oceanographic conditions affect mobility; decrease the ability to see and attack deep; degrade electro-optical systems; increase the requirement for thoroughly integrated air, ground, logistic, and command and control operations; and slow the movement of supplies and reinforcements. Therefore, commanders must be aware of and prepare for general and specific effects of the weather and oceanographic conditions on enemy and friendly major weapons systems and operations. This includes evaluating plans to minimize adverse METOC effects on friendly forces and to maximize the effects on the enemy. Timely and accurate METOC estimates enable commanders to effectively plan and execute the operations.

a. Combat Power

Combat power is the total destructive force that we can bring to bear on our enemy at a given time. It is made up of many components, each with its own unique weather and oceanographic sensitivities. To employ these components for maximal effect in the battlespace, commanders must be knowledgeable of weather and oceanographic conditions and their effects on the different aspects of combat power.

b. Concentration and Speed

If commanders are knowledgeable of METOC effects on the enemy and friendly forces, then timely and accurate METOC estimates and support will enable them to consolidate their forces and respond more rapidly than the enemy.

c. Opportunities and Vulnerabilities

Changing METOC conditions provide both sides with windows of opportunity and vulnerability. Defenders use these windows to set the terms of battle, defeat the enemy attack, and seize the initiative. Attackers use these windows to enhance the attack and carry the battle to the enemy through bold but calculated offensive operations.

d. Exploiting Vulnerability and Opportunity

Vulnerability is often uncertain, and opportunity is fleeting. As the depth of the battlefield is extended in space and time, it becomes more likely that Weather and oceanographic conditions will vary, opening and closing windows of opportunity and vulnerability.

Conclusions

The weather and oceanographic conditions affect military operations. Each has different effects on various types of forces and, in some cases, dictates the types of forces that can be employed effectively. METOC data is part of the intelligence required by MAGTF commanders and staffs to plan and execute operations. That intelligence results from analyzing weather data, identifying weather effects, and assessing the impact of weather on Marine Corps systems, tactics, and operations to provide vital information for commanders to optimally employ their forces. As such, the requirement for on-scene dedicated METOC support cannot be overstated. Weather and changing oceanographic processes can affect all types of Marine Corps operations, including operational maneuver across the range of military operations. Each element of a MAGTF, as well as each echelon of command, has a wide range of functions and responsibilities with many unique METOC information and support requirements. MAGTF METOC operations, products, and services must support them all.

Chapter 2

METOC Support Systems and Functions

2001. MAGTF METOC Support Requirements

2001. Requirements for METOC support vary between the operational and tactical level and between the CE, GCE, ACE, and CSSE.

a. The Command Element

The MEF HQ 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 periodic updates throughout execution.

b. The Ground Combat Element

The GCE requires METOC support in the form of estimates and graphic products that can be used for planning and decision-making. There is also a requirement for general weather forecasts that cover the following 24 - 48 hours and are focused on ground combat-related weather elements and coastal and sea data such as:

- Tidal, current, 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 (BMNT), end of evening nautical twilight (EENT), moonrise, moonset, 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
- (WBGTI)—an index used to determine heat stress conditions
- Wind-chill 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.

c. The Aviation Combat Element

The ACE requires precise current METOC information for every aircraft sortie and forecasts up to 72 hours, including extended outlooks out to 7 days for the entire area of operations. Aviation units are concerned with METOC conditions at widely dispersed departure airfields, METOC conditions enroute to destinations and targets, and conditions at the arrival airfield or over the target areas. In addition to the weather elements required by the GCE, the ACE requires precise aviation-related weather elements such as:

- Altimeter settings
- Ceiling height
- Pressure altitude (PA) and density altitude (DA).
- Cloud base/cloud top height.
- Upper-air temperatures, winds, and heights
- In-flight icing and turbulence conditions
- Severe weather briefings.

d. The Combat Service Support Element

The CSSE's operations are heavily influenced by extreme weather 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, thereby affecting trafficability, mobility, and construction efforts and, in the case of heavy icing or snow buildup, making it impassable. Unfavorable sea state conditions can make landing support and logistics over the shore operations much more difficult. Generally, the CSSE's specific weather and oceanographic information requirements are the same as those of the GCE.

2002. Joint Forces METOC Support Requirements

Requirements for METOC information and support extend beyond the confines of the MAGTF. As joint forces integrate and interoperate with the MAGTF, METOC requirements necessary to support those forces must be incorporated within the overall METOC support plan. This level of mutual support will serve to enhance METOC support to both the MAGTF and Joint Forces. Joint Forces deploy with METOC support units. Joint Publication 3-59, Joint Doctrine for METOC operations, should be referred to when providing and/or integrating METOC support with joint forces.

2003. Tasks and Responsibilities

a. The Command Element
The CE has limited METOC data collection assets or forecasting capability. During combat operations, the CE can suited with additional METOC support assets. Such support will be coordinated and obtained by the SWO within the MEF intelligence section. The MAGTF commander's responsibilities are to:

- Coordinate with the ACE commander to ensure that the ACE's METOC support requirements are met.
- Provide logistical and communications support to the attached METOC support team.
- Integrate METOC analysis into future planning and current operations.
- Provide critical or threshold values for determining and assessing the METOC effects on threat weapons systems, tactics, capabilities, and estimated COAs.
- Integrate climatological, meteorological, and oceanographic estimates into IPB and analyze resulting intelligence products.

Marine ground reconnaissance forces may conduct special missions to gather meteorological, geographic, and hydrographic reconnaissance in support of specific aerospace, land, or maritime operations (beach gradients, obstacles (natural and manmade), tide and surf, depths of water, contour of the sea bottom, routes of exit from the beaches, and soil trafficability).

b. The Ground Combat Element
The GCE provides limited but vital METOC support in the form of upper-air data from its artillery forces and surface METOC observations from all GCE forces (particularly ground reconnaissance and combat engineer forces), however; it depends on the ACE for specialized METOC support. The GCE commander's responsibilities are to:

- Identify METOC requirements to the MAGTF CE and coordinate with the ACE to ensure that tactical METOC support requirements are known and satisfied.
- Provide logistical and communications support to the attached METOC support team.

- Provide surface observations and all upper air observations beyond forward troops and relay the data to the ACE and MAGTF CE.
- Provide critical or threshold values for determining the METOC effects on GCE weapons systems, tactics, and operations.
- Assess the impact of METOC effects on GCE weapons systems, tactics, and operations.
- Integrate METOC and oceanographic analysis into future planning.
- Provide Hydrographic forecasts.

c. The Aviation Combat Element

The ACE provides the majority of METOC support required by the MAGTF. To do so effectively, it requires numerical products from the FNMOC, regional center support, satellite data, and access to both surface and upper-air data from the Air Force, Navy, and allied meteorological services, as well as data furnished by MAGTF sources. The ACE commander’s responsibilities are to:

- Plan and coordinate tactical METOC support requirements for the ACE and, as directed, elements of the MAGTF in accordance with the MAGTF commander’s priorities
- Provide METOC support teams to support each element, as required.
- Provide METOC personnel with the technical training and skills necessary to support MAGTF operations.
- Integrate METOC analysis and estimates into future planning and current operations.
- Assess the general effect of METOC on weapons systems, tactics, and operations on the basis of critical values identified by each element.
- Provide METOC observations (the MAGTF has no organic equipment to take oceanographic observations), forecasts, staff support, and timely advisories or warnings of expected METOC conditions that may adversely affect MAGTF operations or that could be a hazard to personnel or materiel.
- Ensure rapid dissemination of METOC products and services.
- Provide METOC support products for use in soil trafficability and hydrographical predictions.
- Provide climatological support for tactical missions, IPB, and

tactical decision making aids.
- Provide light and tidal data.
- Provide atmospheric and astronomical information affecting radar, communications, and electro optical weapons systems.
- Conduct liaison with naval and air force METOC centers and other external METOC elements for special tactical support requirements beyond inherent capabilities.
- Collect and disseminate METOC data obtained from mission reports and in flight reports by using the target METOC information (TARWI) code.

d. The Combat Service Support Element
The CSSE provides limited but vital METOC support in the form of surface METOC and trafficability reports. However, it depends on external units for most METOC support. The CSSE commander's responsibilities are to:

- Coordinate with the MAGTF CE and ACE to ensure that its METOC support requirements are identified and satisfied
- Provide logistical and communications support to the attached METOC support team
- Integrate METOC analysis and estimates into future planning and current operations
- Provide critical or threshold values for determining the METOC effects on CSSE systems and operations
- Assess the impact of METOC effects on CSSE systems and operations and MAGTF wide combat service support (CSS).

2004. METOC Support Network

The global crisis response capability of the MAGTF requires an extensive network of weather observers, analysts, and forecasters. The network consists of the weather and oceanographic services of friendly countries, the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), and Department of Defense (DOD) METOC units within the Army, Navy, Air Force, and Marine Corps.

2005. Capabilities and Limitations

METOC services provide observation network and related facilities. Peacetime cooperation among nations for weather services provides global and hemispheric analyses in support of military operations anywhere in the world. During wartime, METOC control and other security restrictions may drastically limit the availability of other national and indigenous METOC information. Allied units can receive U.S. METOC data via SIPRNET or other classified electronic methods. U.S. military 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 the military METOC services are mobility, responsiveness to command, and combat readiness.

2006. Naval METOC Support System

The Naval METOC Support System includes all Navy and Marine Corps units that contribute METOC, and hydrographic observations or services; the activities assigned to the Naval METOC Command (NAVMETOCCOM); and a very limited number of other meteorology-or oceanography-oriented activities, such as the Naval Oceanographic and Atmospheric Research Laboratory and it's Atmospheric Directorate.

a. Commander Naval METOC Command, (CNMOC), Stennis Space Center, MS.

The NAVMETOCCOM, located at Stennis Space Center, Mississippi, is organized to collectively provide global METOC support to the fleet through its regional centers, which include: The Naval Atlantic METOC Center (NAVLANTMETOCCEN), which is located in Norfolk, Virginia The Naval Pacific METOC Center NAVPACMETOCCEN), which is located at Pearl Harbor, Hawaii, The Naval Pacific METOC Center (NAVPACMETOCCEN), which is located in San Diego, Ca The Naval Pacific Meteorology Center, (NAVPACMETOCCEN) which is located in Yokosuka, Japan, the Naval European Meteorology and Oceanography Center, which is located in Rota, Spain, and the Naval Central

Meteorology and Oceanography Center, (NAVCENMETOCCEN) which is located in Bahrain, and the Naval Meteorology and Oceanography Professional Development Center, (NAVMETOCPRODEVCEN) which is located in Gulfport, Ms. These regional centers have subordinate facilities and detachments throughout their geographical areas of responsibility. The regional centers are the primary sources of METOC support for forces afloat.

b. Fleet Numerical METOC Center

The Fleet Numerical METOC Center (FNMOC), located in Monterey, California, is the master computer center for the Naval METOC Support System and the hub of the Naval Environmental Data Network. It is linked with the data collection and distribution networks of the Air Force, NOAA, and the World Meteorological Organization (WMO). It is responsible for generating and distributing basic and applied numerical (computer) METOC products for use by regional centers and other users throughout the fleet and the DOD. The Naval Research Laboratory, (NRL) Atmospheric Assimilation Variational Data System (NAVDAS) is the primary means of distributing the center's products.

c. Naval Oceanographic Office

The Naval Oceanographic Office (NAVOCEANO), located at Stennis Space Center, plans, organizes, and executes multidisciplinary ocean surveys and geospatial information and services (GI&S) programs in support of DOD and Department of the Navy (DON) operational requirements and other assigned technical programs by using assigned ships, aircraft, and other platforms, including spacecraft. It is the primary oceanographic production center for the Navy and is responsible for receiving and processing satellite data in support of fleet operations. The NAVOCEANO also provides near real time oceanographic products, including detailed front and eddy analysis, and guidance to naval regional METOC centers and command centers worldwide in support of fleet operations.

2007. Marine Corps METOC Support System

The Marine Corps METOC Support System is designed to readily deploy and operate in an austere

expeditionary 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 interconnect and maximize the support available from naval, joint, and other METOC sources. The system will be augmented by
data that is observed, collected, modeled, and reported by organic Marine Corps METOC assets and other Marine Corps assets, such as the topographic platoons, MAGTF all-source fusion center (MAFC), and ground and aviation reconnaissance units. The primary function 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.

2008. Marine Corps Staff METOC Personnel

a. Commandant of the Marine Corps, Deputy Chief of Staff, Aviation, Aviation Logistics Support Branch (ASL-37)

The senior weather service officer in the Marine Corps staffs this position. This special staff officer acts as the 6800 occupation field specialist and action officer. This is the cognizant officer for Marine Corps METOC support requirements.

b. Commandant of the Marine Corps, Deputy Chief of Staff, Aviation, Aviation Logistics Support Branch (ASL-37A)

This position is staffed by the senior enlisted weather Marine in the Marine Corps. This Marine acts as the 6800 occupation field specialist assistant to the ASL-37 action officer. This is the cognizant enlisted Marine for Marine Corps METOC support

c. Space and Naval Warfare Systems Command

This external billet is responsible for ensuring that validated U.S. Marine Corps (USMC) METOC requirements are satisfied. This officer also provides technical assistance regarding USMC operations to other METOC project officers within and external to the METOC Systems Office. The METOC Systems Office plans and manages the design, development, procurement, and life cycle support of hardware and software systems that measure, transmit, distribute, and process METOC data.

d. Marine Liaison, Commander, Naval METOC Command

This special staff officer acts as the liaison for METOC programs and policies between the Navy and the Marine Corps. This officer is responsible for advising the commander on issues that affect littoral and expeditionary warfare operations; the Marine Corps’ METOC support requirements for the CE, ACE, ground combat element (GCE), and combat service support element (CSSE); and interaction with joint command staffs. This billet is located within the joint operations division of the operations directorate (N-3).

f. Marine Liaison, Oceanographer of the Navy (OPNAV-N61)

The Oceanographer of the Navy is the resource sponsor for all Marine Corps METOC equipment and systems. Located at the U.S. Naval Observatory in Washington, D.C., the METOC officer assigned to this position serves as the contact point within OPNAV for matters related to Marine Corps METOC equipment and system requirements, test and evaluation, and resources that support Fleet Marine Force (FMF) and Supporting Establishment operations and emerging warfighting concepts. This action officer also maintains close contact with Marine operating forces to keep abreast of current METOC equipment/system deficiencies and concerns. Additionally, this officer coordinates; with the assistance of the Program Manager, appropriate programming documents and budget data required of the resource sponsor in conjunction with the Planning Programming and Budgeting System (PPBS) and budget execution. This officer also acts as a liaison for METOC programs and policies between the Navy and Marine Corps. This position resides in the Warfare Requirements Division (Code: N962C5).

g. U.S. MARINE CORPS LIAISON (NAVMETOCPRODEVCEN (PDC). Serves as special liaison to the Commanding Officer, Naval METOC Development Center, Gulfport, MS for METOC support for the U.S. Marine Corps. This Marine's specific duties include advising and assisting the Training Department in the development and review of meteorological training materials, publications, directives, and requirements in support of the Marine Air Ground Task

Force (MAGTF). This Marine is instrumental in coordinating with the Training and Education Command, (TECOM) and CNET in the development and management of METOC sustainment training for all Marines serving in OccFld 68XX, Weather Service, providing initial and refresher training to the MAGTF for METOC systems and applications upon request or as directed, and provides staff assistance to the Commander, Naval Meteorology and Oceanography Command (N314) as required. This liaison reports directly to the NAVMETOCPRODEVCEN Commanding Officer.

2009. MAGTF METOC Personnel

MAGTF METOC personnel provide information on the past, present, and future states of the METOC environment within which aircraft, weapons systems, and Marines operate. Resident within the MEF CE’s intelligence section and Marine Wing Support Squadrons (MWSSs), they are an integral part of the MAGTF. The Marine Corps weather organization consists of two operational chains of command one for the Fleet Marine Force (FMF) and the other for the Marine Corps Air Station (MCAS) and Marine Corps air facility (MCAF). (**See Appendix C**.)

a. Marine Forces Pacific/ Marine Forces Atlantic METOC Officer

The Marine Corps Forces, Pacific (MARFORPAC) and Marine Corps Forces, Atlantic (MARFORLANT) METOC officer billet is currently an additional duty for the senior weather service officer closest to these HQ. The MARFORPAC/ MARFORLANT METOC officer performs the following functions:

(1) Advises and assists the Commanding General in the execution and management of METOC resources by planning, coordinating, and validating the collection, evaluation, interpretation, and dissemination of METOC data.

(2) Maintains liaison with other Service counterparts and represents the Commanding General at joint Service METOC meetings.

(3) Maintains staff cognizance and management coordination for weather-related matters.

(4) Serves as the Marine Corps senior METOC officer when the HQ deploys.

(5) Conducts staff studies directly related to improving MAGTF Warfighting capabilities.

(6) Prepares and presents staff and command level briefings.

(7) Provides staff support in planning for the employment and utilization of organic METOC assets, equipment, and capabilities.

(8) Provides climatological, meteorological, tidal, astronomical, and other METOC data for planning.

(9) Develops and prepares the METOC annex (Annex H) for operation plans/orders and provides input into the communications and information systems annex (Annex K), the intelligence annex (Annex B), and other annexes, as necessary, regarding METOC issues.

b. MEF METOC Officer
The Staff Weather Officer (SWO) serves within the G-2 section under the cognizance of the Intelligence Operations Officer. As such, he serves as a technical expert for the MEF commander on all METOC-related matters. The MEF METOC officer performs the following functions:

(1) Advises and assists the Commanding General in the execution and management of METOC resources by planning, coordinating, and validating the collection, evaluation, interpretation, and dissemination of METOC data.

(2) Coordinates with the MARFORPAC/MARFORLANT METOC officer on METOC related matters.

(3) Maintains liaison with other-Service counterparts and represents the Commanding General at joint Service METOC meetings.

(4) Maintains staff cognizance and management coordination for METOC-related matters.

(5) Provides METOC support to intelligence and staff studies directly related to improving MAGTF Warfighting capabilities.

(6) Provides staff support in planning for the employment and utilization of organic METOC assets, equipment, and capabilities.

(7) Provides climatological, meteorological, tidal, astronomical, and other METOC data for planning.

(8) Develops, prepares, and updates the METOC annex (Annex H) for operation plans/orders and provides input into the communications and information systems annex

(Annex K), the intelligence annex (Annex B), and other annexes, as necessary, regarding METOC issues.

(9) Serves as the joint METOC officer (JMO) during joint operations/exercises when the MEF CE is assigned the role and responsibilities of joint task force (JTF) HQ.

c. Marine Aircraft Wing METOC Officer

The Staff Weather Officer (SWO) serves within the G-2 section under the cognizance of the Operations Officer. As such, he serves as a technical expert for the Wing Commander on all METOC-related matters. The Marine Wing Support Group Weather Officer fills this billet during Operations. The Wing METOC officer performs the following functions:

(1) Advises and assists the Commanding General in the execution and management of METOC resources by planning, coordinating, and validating the collection, evaluation, interpretation, and dissemination of METOC data.

(2) Coordinates with the MWSG/MWSS METOC officer on METOC related matters.

(3) Maintains liaison with other-Service counterparts and represents the Commanding General at joint Service METOC meetings.

(4) Maintains staff cognizance and management coordination for METOC-related matters.

(5) Provides METOC support to intelligence and staff studies directly related to improving MAGTF Warfighting capabilities.

(6) Provides staff support in planning for the employment and utilization of organic METOC assets, equipment, and capabilities.

(7) Provides climatological, meteorological, tidal, astronomical, and other METOC data for planning.

(8) Assists the MEF METOC Officer in the preparation of the METOC annex (Annex H) for operation plans/orders and provides input into the communications and information systems annex (Annex K), the intelligence annex (Annex B), and other annexes, as necessary, regarding METOC issues.

d. Marine Wing Support Group METOC Officer

The Marine Wing Support Group (MWSG) METOC officer is a special staff officer:

(1) Coordinates all METOC assets that reside in the ACE.

(2) Provides METOC briefings to ACE commanders and their staffs to support current and future operations.

(3) Provides METOC effects information with particular attention to critical weather threshold values that limit systems, operations, or tactics.

(4) Advises commanders of METOC support capabilities and limitations and coordinates effective methods of providing support to plan and carry out MAGTF operations.

(5) Prepares METOC annexes to operation plans and orders and reviews METOC annexes of senior and subordinate commands to ensure that stated responsibilities are coordinated and met.

(6) Prepares climatological studies and analyses in support of planned exercises, operations, and commitments.

(7) Provides METOC support to elements of the MAGTF other than the ACE as directed.

(8) Assists in determining METOC support data requirements.

(9) Coordinates METOC training.

(10) Acts as the Wing SWO during garrison and exercise and garrison/wartime operations.

e. Marine Wing Support Squadron METOC Officer

This officer is responsible for training and carrying out the plans and missions as prepared by higher HQ. Responsibilities include:

(1) Receiving, monitoring, and analyzing METOC data to produce tailored, value added information for supported units.

(2) Operating all METOC equipment, including satellite receivers, radar, or other available weather display equipment used as the basis for weather forecasting and observing.

(3) Preparing and disseminating forecasts. Forecast services include providing:

- Forecasts focused on specific missions,

- Locations, and weather parameters critical to
- current operations and for future planning
- Forecasts of upper-air winds
- Forecasts of temperature and precipitation amounts to support terrain team hydrographic and trafficability predictions
- Data for chemical downwind messages
- Tailored forecasts for dissemination to supported MEF weather support teams
- Forecasts and observations to air traffic control (ATC)
- Weather products for intelligence preparation of the battle space (IPB)
- Weather warnings for mission areas and deployed locations
- Aviation flight weather briefings in support of ACE missions.

(4) Ensuring the combat readiness and mission capability of METOC personnel and equipment.

(5) Coordinates with squadron personnel the overall embarkation of METOC related assets that relate specifically to maintenance and supply requirements.

(6) Coordinates with the supporting MALS to receive aviation supplies and METMF(R) material and parts support.

(7) Responsible for validating and coordinating communication support requirements.

f. Meteorological and Oceanographic Support Team (MST) Officer.

The MST Officer (MSTO) is a Special Staff Officer generally attached to a Major Subordinate Command (MSC). The MSTO is a member of the Commander's special staff under the supervision of the G/2 or S2. The MSTO's primary duty is to advise the Tactical Commander and staff on all matters pertaining to METOC support. The MSTO is responsible for (but not limited to) the following duties:

(1) Provides METOC impacts for Commanding Officers and staff during tactical operations concerning critical METOC threshold values that limit systems, operations, or tactics.

(2) Provides METOC briefings to the Commanders and the Staff personnel required. Typical

briefings include but are not limited to:

(a) Commander’s Brief, which provides general conditions and specific impacts out to 96 hours.

b) The Targeting Board brief, which provides detailed targeting impacts for up to 72 hours. This brief may also provide a 96-hour outlook.

c) An H-Hour forecast that provides detailed conditions and estimated impacts to sky conditions, temperatures, visibilities, etc, for a specific event.

(3) Ensures quality control of all METOC products.

(4) Identifies communication and embarkation requirements to the supported agencies, G-6 and G-4 shops.

(5) Identifies METOC resource agencies and initiates product request procedures.

(6) Identifies training and equipment deficiencies to higher headquarters via the chain of command.

(7) Assists with the development of the Weather Operations Annex H, and provides input to the Communications Annex K for Operation Orders.

(8) The MSTO provides METOC information into Intelligence Annex B and Operations Annex C.

(8) Assists in the IPB process by developing METOC products and information.

(9) Coordinates METOC product and support with higher headquarters and adjacent units.

(10) Verifies critical METOC thresholds for accuracy and validity.

(11) Ensures that CCIRs are known and understood by MST personnel and passes them on to ensure a coordinated focus of effort.

(12) Advises the supported commander on METOC capabilities and limitations.

(13) Prepares climatological studies and analysis in support of planned exercises and operations.

(14) Coordinates with subordinate units to gather any additional METOC requirements and support that may be needed during the course of operations.

(15) Submits any Situational Reports (SITREPS) or Operational

Reports (OPREPS) as directed.

(16) Supervises the collection and analysis of METOC information.

CHAPTER THREE

METOC Support to the MAGTF

3001. Overview

This chapter describes the primary operations that METOC units perform in order to support/enhance MAGTF operations, in combat, during training evolutions, and non-combat operations. Additionally, MAGTF METOC functions, SMO responsibilities, MAGTF METOC Production Center, (MMPC) operations, and functional operations are described. The integration of METOC capabilities during all phases of OPLAN development and the ability to provide accurate and timely METOC information as an operation unfolds is critical to the success of MAGTF operations.

3002. MAGTF METOC Support Principles

METOC support for MAGTF operations is based on the following principles:

- METOC effects must be considered by commanders and planners during all operational phases to determine the best COA to accomplish the mission and METOC effects on estimated threat operations.
- Accuracy of forecasts depends on the density and timeliness of observations. Because of continuously changing atmospheric conditions, METOC information is highly perishable. Forecasts must be validated and updated continually. All observations, surface and aloft, particularly those taken in support of forward units, must have high priority and be rapidly disseminated to all MAGTF elements.
- The accuracy of oceanographic, particularly surf zone, estimates must be confirmed shortly before any surface assault (e.g., by ground reconnaissance, sea-air-land (SEAL) teams, or unmanned aerial vehicle (UAV) forces).
- Timely, reliable communications
- During joint and combined operations, warfighters must be presented with a common operational and

tactical picture of the environment. Close coordination between METOC support providers throughout and supporting the JTF is required.

3003. MAGTF METOC Support Functions

a. Sensing and Collection
METOC operations depend on the timely collection of high quality METOC data. The foundation for effective METOC operations is set by observations from aerospace, land, and at sea by sensors or platforms such as upper air sounding devices; meteorological satellites; meteorological radar; lightning detection systems; atmospheric profilers; ionospheric sounders; space-based space environment sensors; buoys; unmanned aerial vehicles (UAVs); remote surface sensors; tide gauges; current meters; and topographic and bathymetric data collection devices. These observations, gathered from friendly and unfriendly areas of interest, are the essential components of theater and/or regional and worldwide databases from which METOC services and products are derived. Due to the rapidly changing nature of the METOC environment, these observations are extremely perishable and must be continuously updated and available to METOC organizations. The Senior METOC Officer (SMO), or JMO, (Joint METOC) usually the senior METOC Officer, assigned to the MAGTF must develop and implement a sensing and collection strategy for METOC data management that orchestrates the timing, distribution of collection sites, and efforts of all METOC forces within the MAGTF, as well as reliable sources of foreign data. The Annex H is the formal document prepared and distributed by the SMO/JMO that clearly defines that strategy. Complete strategy will ensure unity of effort while optimizing data collection, dissemination, and integration into forecast products. Spreading observational resources across an area of interest with regard to climatic zones to obtain optimum coverage will significantly improve the quality of METOC information.

b. Analysis

After collection of available data, METOC forces develop a coherent picture of the current state of the METOC environment for their area of interest. Analysis is the critical function, which enables production of accurate forecasts of the METOC environment.

c. Forecasting

Through timely analysis, evaluation, interpretation, and distribution of METOC data, the MMPC and other forecast elements develop specific METOC products to enhance operations and to meet the MAGTF's requirements. METOC forecasts can be developed for the near or far term to cover global, theater, and tactical scales. These forecasts vary from generalized planning forecasts issued several days in advance of an operation to forecasts issued to support the execution of a specific mission or operation immediately prior to their launch or start. Within the MAGTF, the SMO ultimately determines which METOC activity provides what forecast products. The WEAX provides the official forecast for operational planning and should be used by all operational planners in the MAGTF. It provides a discussion and rationale for the expected METOC conditions that impact MAGTF operations during the forecast period. It is expected that the tactical level forecast may take a different form because of a difference in mission focus. Subordinate activities communicate significant differences between their forecasts and the WEAX with the SMO to maintain a "one theater, one MAGTF, one forecast" concept. The SMO is the final authority for the WEAX. Any significant differences regarding the WEAX will be submitted to and handled by the SMO. METOC personnel will use the WEAX as a starting point and fuse in-situ data (e.g., target METOC and intelligence [TARWI], pilot reports [PIREPs]) and local observations to produce tailored mission specific forecasts.

d. Tailored Application

A key role of the MAGTF's METOC community is to enhance the decision making process of the MAGTF Commander and subordinate commanders through tailored application of forecast products. By receiving METOC information, and its impacts to operations, decision makers can evaluate operational limitations of both friendly and enemy weapon systems as well as associated tactics, techniques, and procedures. For example, integration of METOC information into the planning process allows the MAGTF Commander and subordinate commanders to make informed decisions with regard to the design and operation of a plan and the use of various weapon systems. Early integration of information from METOC studies developed from climatological data bases can aid the long-range planning of military operations as well. In another example, METOC information is included as part of the intelligence estimate of the enemy's probable COA and capabilities, based on the enemy's ability to perform in given METOC conditions.

e. Dissemination

Due to the perishable nature of METOC information, current and forecast information must have dedicated and reliable communications to reach the MAGTF Commander and subordinate commanders in time to be of operational and planning value. Therefore, observing and forecasting functions must process and disseminate METOC information to MAGTF users by the fastest and most reliable means available. Passing METOC information from the tactical and operational levels to the MFC, "METOC Forecast Center," is vital for inclusion in METOC numerical model runs. Reliable communications is the key-supporting element for the METOC community to successfully perform its mission. METOC personnel and users of METOC information must determine, within the MAGTF's theater information strategy, what information merits distribution, to whom, when, and the format and media required. This will ensure that users receive the right information at the right time. Users of METOC information must also be able to quickly define and request unique products required for specific operations or weapon systems.

f. Evaluation

Operational awareness, staff coordination, METOC debriefs, and the use of the Joint Uniform Lessons Learned System (JULLS) will significantly enhance the capability to evaluate METOC effectiveness. Evaluations based upon 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 METOC operations.

3004. Command Relationships

In order for MAGTF METOC units to effectively apply the supporting principles and functions previously discussed, a fundamental understanding of operational control (OPCON) and tactical control (TACCON) have to be defined and implemented. Unlike Navy and Air Force METOC units, MAGTF METOC units are structured within subordinate commands.

a. Operational Control

Operational control of METOC units will reside with the senior MAGTF unit or element that is geographically co-located

3005. MAGTF METOC Support Concept of Operations

Upon the employment of a MAGTF, tactical METOC support will be task organized to deploy with a MAGTF. Naval METOC centers will retain responsibility for the provision of weather facsimile support; METOC gridded field data; wind, sea, and tropical cyclone warnings and advisories; and area oceanographic support. Tailored on-scene METOC support is available from METOC assets organic to the MAGTF CE and ACE. METOC support teams from the MWSSs are task organized to provide direct support to commanders and staffs of

with the METOC unit. This is required to ensure that METOC support is tailored to meet operational planning and execution requirements.

b. Tactical Control

Tactical control of METOC units will reside with the designated MAGTF METOC Officer (MMO). This level of control is necessary to ensure coordination and commonality with METOC products and support.

MAGTF elements other than the ACE, that is, the CE, the GCE, the MEU, and the CSSE. MAGTF elements should forward unique tactical METOC requirements via the chain of command to the ACE instead of requesting personnel and equipment directly. The MWSS, equipped with a meteorological mobile facility (METMF) complex, is normally deployed to a forward operating base (FOB) in direct support of that airfield.

a. Senior METOC Officer (SMO).

The Senior METOC Officer (SMO) will normally be the METOC Officer assigned to the MAGTF's Command Element (CE). In the case of a

Marine Expeditionary Unit (MEU) the SMO will be a Gunnery Sergeant or Staff Sergeant until a METOC officer arrives via a Fly-In-Echelon. This officer will coordinate the METOC support effort within the MAGTF and Joint Forces.

3006. MMPC Operations

The MMPC concept is based off of the Joint METOC Forecasting Unit (JMFU) principle and will be established when multiple MAGTF METOC units are deployed. This concept will be most applicable during MEB or MEF level MAGTF operations. The MMPC's primary mission is ensuring MAGTF METOC requirements are met while maintaining a single and coherent METOC picture throughout the MAGTF. Using applicable annexes and/or an LOI as the blueprint, the MMPC, under the SMO's direction, provides overarching support to the MAGTF. The SMO determines the requirements for the MMPC and designates an in-theater MAGTF METOC unit as the MMPC for the operation. The MMPC should be capable of producing the products necessary for the MAGTF. The MMPC, in most cases, will be required to provide support directly to tactical forces. The MMPC is one of the tools the SMO uses to implement the principles of METOC operations. The focus is on the integration of METOC data from within the MAGTF and other sources then fusing the data into operationally relevant information.

With connectivity to other METOC units for data and/or information, joint forces, and available indigenous assets for tactical data, the MMPC normally has access to information to produce METOC information and products meeting the requirements of the MAGTF. Adequate communications and coordination between the SMO, JMO, service component METOC units, and MFC are required for effective METOC operations.

a. MMPC Operations

The MMPC operates 24 hours per day integrating and analyzing METOC information to assess the state of METOC conditions. Synthesis of this information results in the planning forecast for MAGTF METOC personnel to use when developing tailored METOC information for mission execution support. With this in mind, MMPC information, which can be packaged in different "product" formats, must be constructed with an understanding of specific METOC thresholds (restricted and/or unrestricted recommendation and/or decision matrix) that affect capabilities and MAGTF operations. This requires complete knowledge and understanding of the MAGTF operation, the overall objective, and specific METOC thresholds that affect MAGTF operations. This requirement will be difficult to achieve if the MMPC is not collocated with the MAGTF CE. If the MMPC cannot collocate with the MAGTF CE, a minimum requirement for the MMPC is to have reliable and effective C4I connectivity to ensure a smooth flow of operations data necessary to produce accurate, relevant, and timely METOC information.

3007. METOC Support Capabilities

The METOC section within the MEF intelligence section and the MWSS weather section in the ACE are organized and structured to support a variety of MAGTF- and ACE-specific operations/ deployments. These organizations are manned and equipped to be used in a variety of ways, contingent on the size, scope, and mission of the MAGTF. Dedicated METOC support is available for all MAGTF elements from within the ACE. However, a greater level of METOC support is normally required by, and therefore dedicated to, ACE operations.

a. Meteorological Mobile Facility

The highest level of METOC support to the MAGTF is the deployment of the METMF. The METMF provides a METOC support capability similar to that found in garrison METOC facilities, is normally deployed as part of an entire MWSS, and is the only realistic option for large-scale MAGTF operations. Once established ashore, the MWSS may task organize to forward base personnel and equipment in support of ACE units that are separated from the main airbase. This redeployment also provides the METMF with a forward data collection capability that significantly enhances overall support efforts to the entire MAGTF.

b. METOC Weather Support Team, (MST)

Part of the MWSS table of organization (T/O) is dedicated to the formation of METOC support teams. These MEF weather support teams are task organized to provide a limited level of

METOC support. Consisting of a weather officer, two forecasters, and two observers, these teams are directly attached to the elements that they are tasked to support and rely on those elements for logistical and communications support. METOC weather support teams have a standalone METOC capability in NITES IV. Instead, during operations, they get METOC products from the nearest deployed METMF or other METOC support organizations to satisfy the supported units' METOC information requirements.

3008. METOC Communications and Information Systems Requirements

An area of METOC operations that is currently undergoing substantial change is METOC communications and information systems architectures. The efforts of METOC personnel depend heavily on a secure, reliable, and fast communications and information systems architecture to exchange METOC information with the joint METOC forecast unit (JMFU), other component METOC units, METOC regional and production centers, and MAGTF elements.

Integration of METOC communications and information systems requirements into MAGTF communications planning will provide the conduit for reliable exchange of situational and forecast information and ensure that time-perishable METOC information may be obtained, processed, and disseminated when needed. Each mission and situation is unique and, therefore, requires some modifications to the supporting communications and information systems architecture. Detailed planning and close coordination between the SWO, the MAGTF G-2/S-2, and the G-6/S-6 are critical for establishing a reliable and effective METOC communications and information systems architecture.

Specific systems and technical architectures (equipment, frequencies, communications nets, local area networks/wide area networks, and systems) are addressed in Marine Corps Warfighting Publication (MCWP) 6-22, *Communications and Information Systems*.

3009. MAGTF METOC Support

The MAGTF's METOC support network is tactical in organization and capability. The size and capability of the MAGTF's METOC network will vary based on the size of the MAGTF. Larger MAGTF's will require METOC units to provide direct support for each element (CE, GCE, ACE, and CSSE) of the MAGTF.

a. Marine Expeditionary Force (MEF)

The MEF constitutes the largest MAGTF, single or combined, and as such has the largest METOC support network. METOC support will be requested and coordinated through the MEF G-2 SWO. The METOC support network will consist of:

- CE - MEF SWO, MEF SWC, and an MST
- GCE - MST, located at the CE
- ACE - METOC augmentation for the battlestaff (composition similar to an MST) and at least one MWSS Weather section
- CSSE - MST located at the CE

b. Marine Expeditionary Brigade (MEB)

The MEB's METOC support network will be tailored similarly to the MEF's. METOC support will be requested and coordinated through the MEB G-2.

- CE - MEF SWO or MEF SWC, and an MST
- GCE - MST, located at the GCE's CP
- ACE - METOC augmentation for the battlestaff (composition similar to an MST) and one MWSS Weather section
- CSSE - MST located at the CSSE's CP

c. Marine Expeditionary Unit (MEU)

The MEU's METOC support network will consist of a tasked organized MST. Currently, all MEUs float with an MST(two forecasters and one observer) with the remaining Marines of the MST assigned as part of a Fly-In-Echelon (FIE). The MST will operate under the cognizance of the MEU S-2. All METOC support requirements will be requested and coordinated through the MEU S-2 Officer and OA Division Officer. The senior MST Marine may be granted DIRLAUTH by the MEU S-2 Officer for the purposes of coordinating METOC support requirements and deficiencies with appropriate METOC agencies.

The Amphibious Ready Group's (ARG) OA Officer will coordinate METOC support requirements and deficiencies of the ARG through the respective Fleet Oceanographer as required. The MEU's METOC support network will be based on the MEUs location, i.e. afloat, ashore, and/or split operations.

(1). Afloat

While the MEU remains afloat as part of an ARG, MST Marines will coordinate METOC support and interoperate with the ARG's OA Division while remaining under the cognizance of the MEU S-2. During this time, the OA Officer will be responsible for the METOC support of the ARG. This will ensure the principles of METOC support are applied while reducing duplication of efforts.

(2). Ashore

When the MEU goes ashore, the MST will accompany the MEU's S-2 and provide direct METOC support from the MEU's COC for the entire MEU. Additionally, the MEU S-2 may request the remaining MST Marines augment on-scene METOC support via the FIE. The MST will provide support to the ARG's OA Division by providing on-scene observations, forecasts, warnings, etc. The ARG's OA Division will provide METOC information and products to the MST as requested. While ashore, the senior MST Marine will assume the duties as the SMO and conduct METOC support operations appropriately.

(3). 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 FIE or a Navy Mobile Environmental Team (MET). If additional METOC support is required, the respective Fleet Oceanographer and respective MEF SWO will coordinate external sourcing to fill the requirement. While ashore, the MST located with the MEU S-2 will be designated as the lead MEU METOC support unit and all METOC requirements will be forwarded to the MEU S-2 for consolidation, coordination, and support.

d. Special MAGTF (SPMAGTF)

SPMAGTFs are organized for specific missions and operations. METOC support for SPMAGTFs will be requested through the MEF SWO and will be task organized to meet the METOC requirements.

Chapter 4

MAGTF Planning Process R2P2

4001. General

Due to the influences METOC conditions can have on operations, METOC conditions have to be considered and properly weighted during all phases of operational planning and execution. METOC Marines may be requested via the chain of command to provide METOC products and services for planning purposes.

4002. Crisis Action Planning Support (CAP)

METOC personnel should be involved in every CAP phase. However, due to geographical location, time-consuming request procedures, and lack of available resources, METOC Marines may not be included until the end of Phase V or during Phase VI. METOC resources may be required on very short notice to help assess the crisis, determine and make known to decision makers the impact of the environment on possible courses of action, and to provide forecasts for the execution area. Crisis action Planning is used to develop the Staff Estimates, which are used to form the Commander's Estimate. Six phases occur during the CAP process. The following sections will describe what the METOC role would be during the CAP process.

a. Phase I Situational Development

During Situation Development, any major METOC constraints on the employment of forces should be considered. This includes current and forecast METOC conditions in the crisis area, climatological factors, the space environment, the suitability of sites for employment of forces, and the degree of accuracy and limitations of forecast products.

b. Phase II Crisis Assessment

During Crisis Assessment, METOC conditions are monitored while higher headquarters assess the situation. The MEF SWO should interact with the MWSG WxO. An initial communication concept can be developed, with emphasis on communications capabilities both in and out of theater.

c. Phase III COA Development

COA development involves Intelligence Preparation of the Battlefield and preparation of the Intelligence Estimate and the Commander's Estimate. Climatological and environmental databases must be searched and summarized for operational planners. METOC personnel must work closely with the Intelligence section to provide the impacts of METOC on the COA. Within OPSEC constraints, liaison with Navy and Air Force METOC Agencies, to coordinate METOC requirements for any unique theater specific products. TPFDD development begins.

d. Phase IV COA Selection

During COA Selection, continue monitoring METOC conditions and TPFDD development. This phase is a time for communication between the planners and the proposed subordinates who will be tasked to carry out the plan. This is also a critical time for communication between the MMO and other METOC Officers, present or to be assigned, on the staff of the MSC. Liaison with National and Regional METOC Forecast Centers for initial products and services for the MAGTF operation area.

e. Phase V Execution Planning

The OPORD is developed during the Execution planning phase. Formats for the required METOC inputs (Annex H and other annexes) to the OPORD are contained in Appendix C. Coordinate with supporting commands for identification of METOC requirements. Liaison with adjacent, higher, and joint METOC units to identify any shortfalls in personnel and equipment.

f. Phase VI Execution

During the execution phase, the METOC Officer assembles his/her team and implements METOC operations. Real-time observations and forecasts will be critical during the execution phase. The EXECUTE ORDER will deploy forces and commence operations.

4003. COA Analysis (War-Gaming)

Be prepared to contribute to the process of war-gaming by mentally “fighting the battle” in time and space. The process may use the structure of “action”, “reaction”, and “counteraction” sequences for critical events (*i.e.* D-Day actions). Listed below are the METOC concerns during role-playing.

- METOC impacts on critical events and decision points
- METOC impacts on the duration and timing of critical events
- Opportunities for deception and surprise using expected METOC conditions
- METOC impacts on high payoff targets
- METOC impacts on required reconnaissance and surveillance
- METOC impacts on required logistics support and constraints

- METOC impacts on communications requirements.

4004. Intelligence Preparation of the Battlefield (IPB)

This section will describe the IPB process in order to give a fundamental understanding of what the term means and processes associated with IPB as well as describe the METOC role within the process.

a. General

IPB is a systematic, continuous process of analyzing the threat and environment in a specific geographic area. It is designed to support staff estimates and military decision-making. Applying the IPB process helps the commander selectively apply and maximize his combat power at critical points in time and space on the battlefield by

- Determining the threat’s likely COA.
- Describing the environment the unit is operating within
- Determining the effects of the environment on the unit.

IPB is a continuous process, which consists of four steps that are performed each time IPB is conducted.

- Define the battlefield environment.
- Describe the battlefield’s effects.
- Evaluate the threat.
- Determine threat COAs.

The IPB process is continuous. You conduct IPB prior to and during the command’s initial planning for an operation, but you also continue to perform IPB during the conduct of the operation. Each function in the process is performed continuously to ensure that

- The products of IPB remain complete and valid.
- Provide support to the commander and direction to the intelligence system throughout the current mission and into preparation for the next.

b. Step 1: Define the Battlefield Environment

Step 1 focuses the command’s initial intelligence collection efforts and the remaining steps of the IPB process.
In step 1 of the IPB process, the G2/S2

- Identifies characteristics of the battlefield which will influence friendly and threat operations
- Establishes the limits of the area of interest (AI)

- Identifies gaps in current intelligence holdings

c. Step 2: Describe the Battlefield's Effects

Step 2 evaluates the effects of the environment with which both sides must contend. The G2/S2 identifies the limitations and opportunities the environment offers on the potential operations of friendly and threat forces. This evaluation focuses on the general capabilities of each force until COAs are developed in later steps of the IPB process. This assessment of the environment always includes an examination of terrain and METOC but may also include discussions of the characteristics of geography and infrastructure and their effects on friendly and threat operations. Characteristics of geography include general characteristics of the terrain and METOC, as well as such factors as politics, civilian press, local population, and demographics. An area's infrastructure consists of the facilities, equipment, and framework needed for the functioning of systems, cities, or regions. Products developed in this step might include, but are not limited to

- Population status overlay
- Overlays that depict the military aspects and effects of terrain
- METOC analysis matrix
- Integrated products such as modified combined obstacle overlays (MCOOs)

d. Step 3: Evaluate the Threat

In step 3, the G2/S2 and his staff analyze the command's intelligence holdings to determine how the threat normally organizes for combat and conducts operations under similar circumstances. When facing a well-known threat, the G2/S2 can rely on historical databases and well developed threat models. When operating against a new or less well-known threat, the need to develop intelligence databases and threat models concurrently. The G2/S2's evaluation is portrayed in a threat model that includes doctrinal templates, which depict how the threat operates when unconstrained by the effects of the battlefield environment. Although they usually emphasize graphic depictions (doctrinal templates), threat models sometimes emphasize matrices or simple narratives.

e. Step 4: Determine Threat COAs

Step 4 integrates the results of the previous steps into a meaningful conclusion. Given what the threat normally prefers to do, and the effects of the specific environment in which the threat is operating now, what are his likely objectives and the COAs available to him?

In step 4, the G2/S2 develops enemy COA models that depict the threat's available COAs. Also prepared are event templates and matrices that focus intelligence collection on identifying which COA the threat will execute. The enemy COA models developed in step 4 are the products that the staff will use to portray the threat in the decision making and targeting processes. The G2/S2 cannot produce these models, effectively predicting the threat COAs, unless

- Adequately analyzed the friendly mission throughout the time duration of the operation
- Identified the physical limits of the AO and AI
- Identified every characteristic of the battlefield environment that might affect the operation (step 1)
- Identified the opportunities and constraints the battlefield environment offers to threat and friendly forces (step 2)
- Thoroughly considered what the threat is capable of and what he prefers to do in like situations if unconstrained by the battlefield environment (step 3).

In short, the enemy COA models which drive the decision making process are valid only if the G2/S2 establishes a good foundation during the first three steps of the IPB process.

CHAPTER 5

JOINT METOC OPERATIONS

1000. **Purpose**: This section provides guidance and procedures for transitioning from the role of MAGTF METOC weather support to a METOC organization in support of Joint Task Force (JTF) operations.

1002. Responsibilities: Upon designation of a MAGTF Command Element as the JTF Headquarters, the senior METOC Officer, (normally assigned to the MEF G-2) assumes the duties and responsibilities of the Joint METOC Officer (JMO). These duties and responsibilities are delineated in the references. In general, the JMO is responsible for planning and directing METOC operations, ensuring JTF component forces have adequate information/data and products to support planning requirements and execution of the operational mission. Specific duties include:

(1) Assemble the joint force METOC staff and equipment within the joint force AO, consisting of the personnel and resources assigned by the Combatant Commander and consistent with the scope of the mission. Figures 5-1 and 5-2 depict typical joint METOC structure and organization.

(2) Coordinate with the Combatant Command's Senior METOC Officer (SMO) for the establishment of a Joint METOC Forecast Unit (JFMU) within the joint force AO upon deployment or associated with transitioning the JMFU from one initially established in a central facility outside the AOR.

(3) Assist the JFC and staff in developing and executing operational METOC support plans and procedures.

(4) Establish and publish requirements and format. Coordinate METOC support services for the joint force.

(5) Coordinate with the Combatant Command's SMO, METOC manning, communications, information, and service requirements beyond the capabilities of assigned METOC assets and request additional resources through the JFC.

(6) During the execution phase, coordinate with USCINCPAC SMO on updates to the Annex H (METOC Products and Services) to supporting joint force OPLAN or OPORD. (See Appendix G for an example of an Annex H).

(7) Coordinate METOC communications requirements down to the component level that are not addressed at the theater combatant command level with the SMO, J-6 and

service component G-6 members. Assist in the development of Annex K (Command, Control, and Communications) of each support JFC OPORD, OPLAN, or CONPLAN as appropriate.

(8) Coordinate with the SMO to ensure all available METOC information and resources, as well as indigenous assets and data, are properly considered and made available for use by joint forces.

1003. Joint Operation METOC Planning: This section provides an overview of the minimum support required from the J-2 METOC section during each phase of Crisis Action Planning (CAP). The MEF G-2 METOC section will normally be involved in each one of these phases. During CAP, METOC resources may be required on very short notice to help access the crisis, determine and make known to decision makers the impact of the environment on possible courses of action, and to provide forecasts for the execution area. During joint training exercises, it is important that the MEF Staff Weather Officer (as the JMO) be involved in the deliberate planning process by attending all scheduled planning conferences to provide leadership, guidance, and present the joint METOC support plan. Attending these planning conferences will assist with team building, enhance understanding of component/service unique requirements, and ensure successful METOC support to the joint force. (See Figure 5-3 METOC Data Management) and Figure 5-6 METOC Operation Plan Development).

(a) **Phase One**: During situational development, any major METOC constraints on the employment of forces should be considered. This includes current METOC conditions in the crisis area, forecast weather, climatological factors, potential impact on the situation, to include suitability of sites for employment of forces, and degree of accuracy and limitations of forecast products.

(b) **Phase 2**: During crisis assessment, METOC conditions are monitored while the National Command Authority (NCA) and the Chairman of the Joint Chiefs of Staff (CJCS) assess the situation. The USCINCPAC SMO can interact with the JMO and component Staff Weather Officers/Oceanographers at this time.

(c) **Phase 3**: Course of Action (COA) development involves intelligence preparation of the battlespace (IPB) and preparation of the Intelligence Estimate and the Commander's Estimate. Climatological and environmental databases must be searched and summarized for operational planners. III MEF METOC personnel must work closely with the G-2 to provide impacts on COA. Time Phased Force Deployment Data

(TPFDD) development also begins as well as, within OPSEC constraints, liaison with component commands to begin METOC requirements for personnel and equipment. (See Figure 5-6 METOC Planning Requirements).

(d) **Phase 4**: During COA selection, continue monitoring METOC conditions and TPFDD development. This phase is a time for communicating between the planners and the planners and the proposed subordinates who will be tasked to carry out the plan. This is also a critical time for communication with the SMO. (See Figure 8 METOC communication structure).

The MEF SWO should communicate and discuss manning requirements for the JTF HQ and functional JTF component commands. Liaison with METOC Forecast Centers (MFCs) for initial products and services for the Joint Operational Area (JOA).

(e) **Phase Five**: The OPORD is developed during the Execution planning phase. Formats for the required METOC inputs are contained in the references. Actual forces are identified at this time. Coordinate with supporting commands for identification of METOC personnel and equipment. Liaison with subordinate METOC planners to identify shortfalls in personnel and equipment. (See Figure 5-7 Joint METOC Requirement List).

(f) **Phase Six**: During the execution phase, the JMO assembles his organization and implements METOC operations. Real-time observations and forecasts will be critical during this phase. The executive order will deploy forces and commence operations. The USCINCPAC SMO and JTF JMO (III MEF SWO) detail the duties and responsibilities during the execution phase of a joint operation. (See Figure 5-4 Dissemination of METOC Data).

1004. Joint METOC Forecast Unit (JMFU): The JMFU is the JMO's principal tool for ensuring effective METOC operations to joint forces. It is the cornerstone to the three pronged structure identified in JP 3-59 for providing overarching METOC information for the components of the joint force. (See Figure 5-5 Tactical JMFU Structure). An invaluable aspect of the JMFU is the ability to fuse METOC information from Air Force and Navy "Strategic Level" METOC Forecast Centers with tactical information received from components into a coherent and common operational picture as the operation unfolds. The MEF as the JTF HQ must provide the nucleus of the JMFU. Great care and attention to detail should be paid when planning for METOC equipment and personnel composition of the JMFU. JF mission and implied tasks will dictate the size of the JMFU. The JMFU should be activated and placed as far forward with the JTF HQ, preferably with the JTF HQ. As an alternative, a JMFU can be assigned/designated outside the theater of operation such as Navy Regional METOC center. However, more detailed planning to overcome communications, collaboration, and coordination issues, JMFU manning, available bandwidth for non-centric operations, etc, must be conducted.

(a) **Organization**: The JMFU is normally composed of members from the components/services. The JMFU can be created from the ground up or by tasking and existing MFC, service or functional component within the joint force to perform the duties of the MSC. The JMFU usually operates 24 hours so the JMFU must be staffed accordingly. JP 3-59 provides the recommended manning for a JMFU.

(b) **Equipment**: METOC equipment/assets and resources, can be drawn from Marine Aircraft Wings (MAWs), specifically Marine Wing Support Squadrons (MWSS). Each MWSS is equipped with a Meteorological Mobile Facility (METMF)/TMQ-44A. The METMF is normally deployed to a forward operating base (FOB) in direct support of that airfield. The TMQ-44A is a fully integrated system capable of automatic data acquisition from communication channels providing METOC data, local and remote meteorological sensors, meteorological satellite imagery and meteorological radar. The TMQ-44A is capable of disseminating METOC data and products via communication links to MAGTF elements and theater METOC activities and an indigenous video briefing system to a collocated command center/HQ. It is the most robust MAGTF METOC asset available to the JMFU. The METMF can be designated to host the JMFU and is generally located at the nearest airfield or FOB in support of JMFU operations. Detailed capabilities are outlined in Appendix D.

(JOINT METOC OPERATIONS FIGURES)

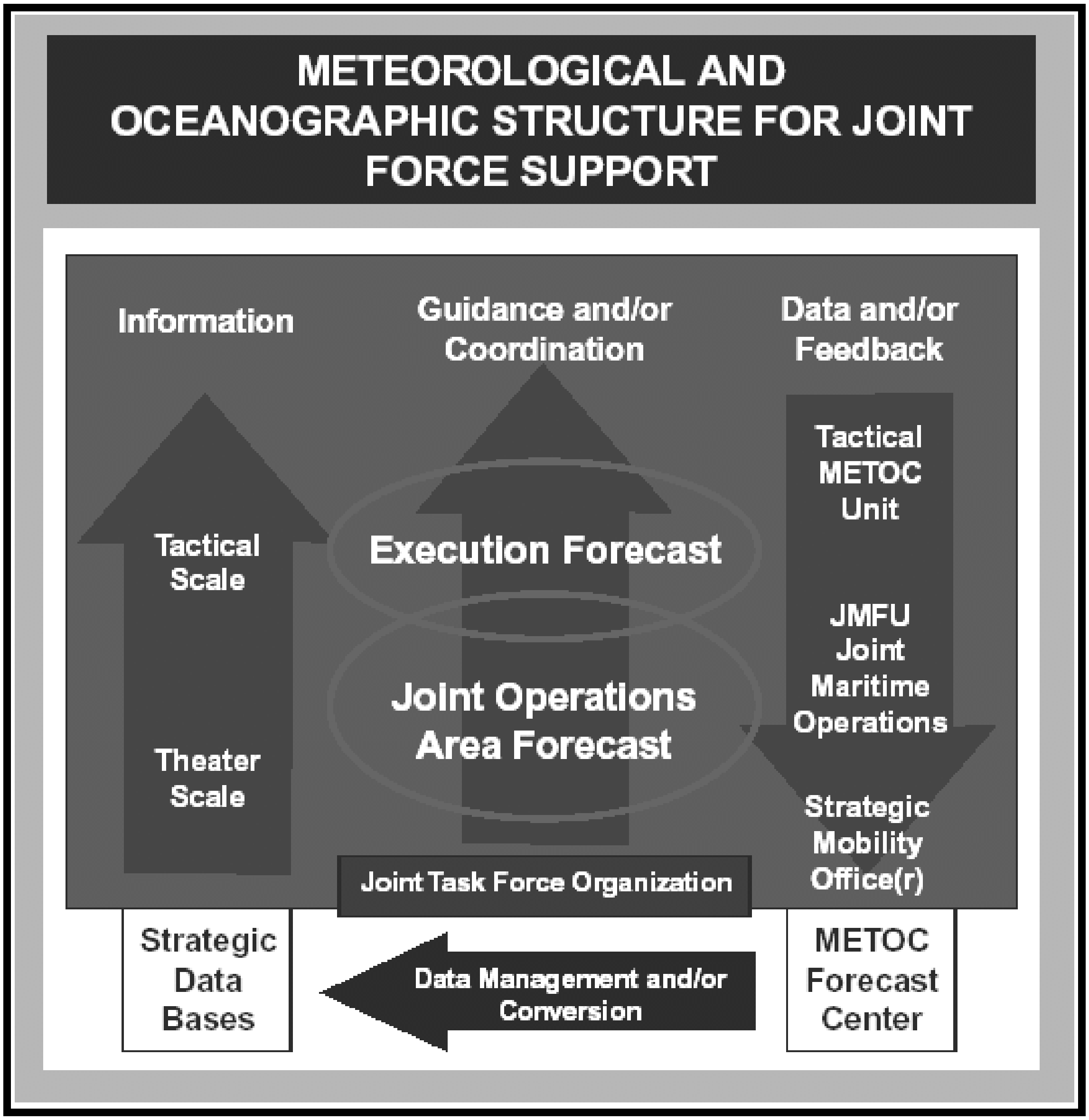


Figure 5-1 Joint Force Structure for METOC Support

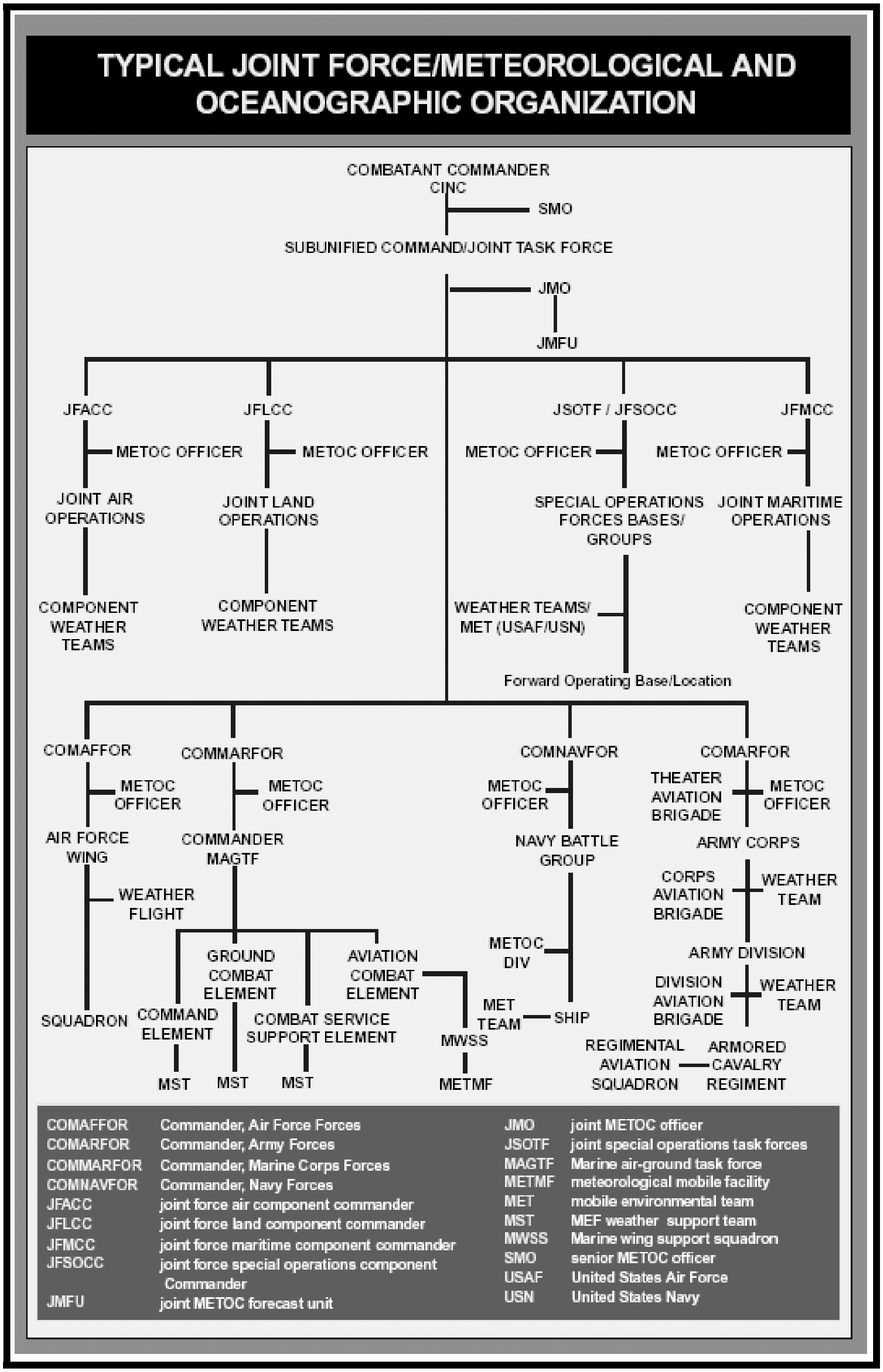


Figure 5-2 Typical Joint Organizational Structure

MANAGEMENT OF METEOROLOGICAL AND OCEANOGRAPHIC DATA AND APPLICABLE OPERATIONS

RESPONSIBLE LEVEL	MANAGEMENT	OPERATIONS
METOC FORECAST CENTER (MFC)	REQUESTS DATA FOR MODEL EFFORTS	MONITORS AND PROCESSES WORLDWIDE, REGIONAL, THEATER, AND SPACE ENVIRONMENT DATA
SENIOR METOC OFFICER AND/OR JOINT METOC OFFICER	DEVELOPS PLAN	IMPLEMENTS PLAN
JOINT METOC FORECAST UNIT	REQUESTS AND FORWARDS DATA	INTEGRATES MFC, COMPONENT, AND TACTICAL DATA
COMPONENT AND TACTICAL METOC ACTIVITIES	COLLECTS, PROCESSES, FORWARDS	

Figure 5-3 Management of METOC Data applicable to Operations

DISSEMINATION OF METEOROLOGICAL AND OCEANOGRAPHIC INFORMATION

RESPONSIBILITY	TYPES OF INFORMATION	TO WHOM
METOC FORECAST CENTER (MFC)	WORLDWIDE AND/OR REGIONAL ATMOSPHERIC, OCEANIC AND SPACE DATA BASE	JMFU, JOINT FORCES
SENIOR METOC OFFICER AND/OR JOINT METOC OFFICER (JMO)	APPLICABLE ANNEXES, LETTER OF INSTRUCTION METOC GUIDANCE	JOINT FORCE COMMANDER, JOINT FORCES, MFCs
JMO, JOINT METOC FORECAST UNIT (JMFU)	JOINT OPERATIONS AREA FORECAST, SPECIFIC PRODUCTS	JOINT FORCES AND MFCs
COMPONENT	APPLICABLE COMPONENT ANNEXES, LETTER OF INSTRUCTION	COMPONENT ELEMENTS AND/OR JMO, JMFU
TACTICAL LEVEL	LOCAL OBSERVATIONS AND TAILORED FORECAST PRODUCTS	LOCAL CUSTOMER AND/OR COMPONENT, JMFU, AND MFCs

Figure 5-4 METOC Data Dissemination

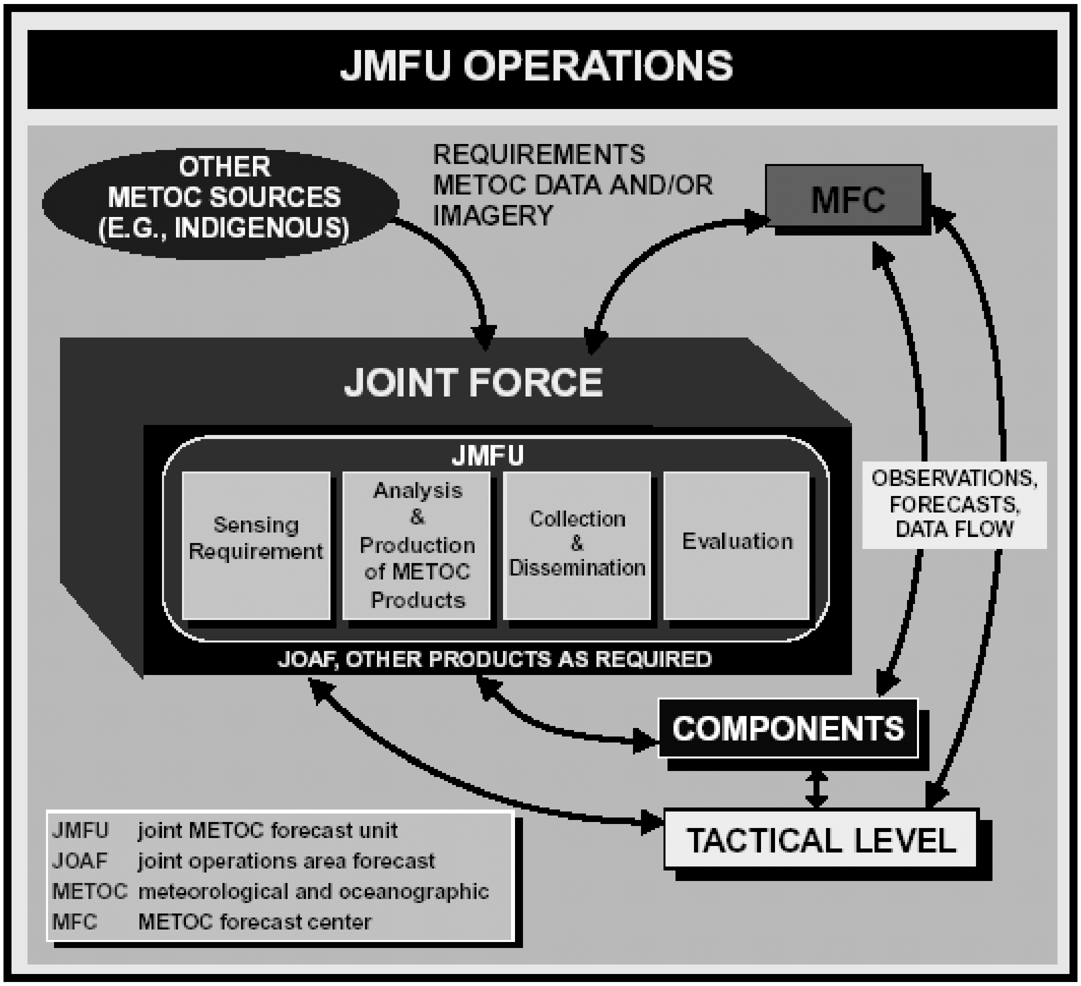


Figure 5-5 Components of JMFU Operations

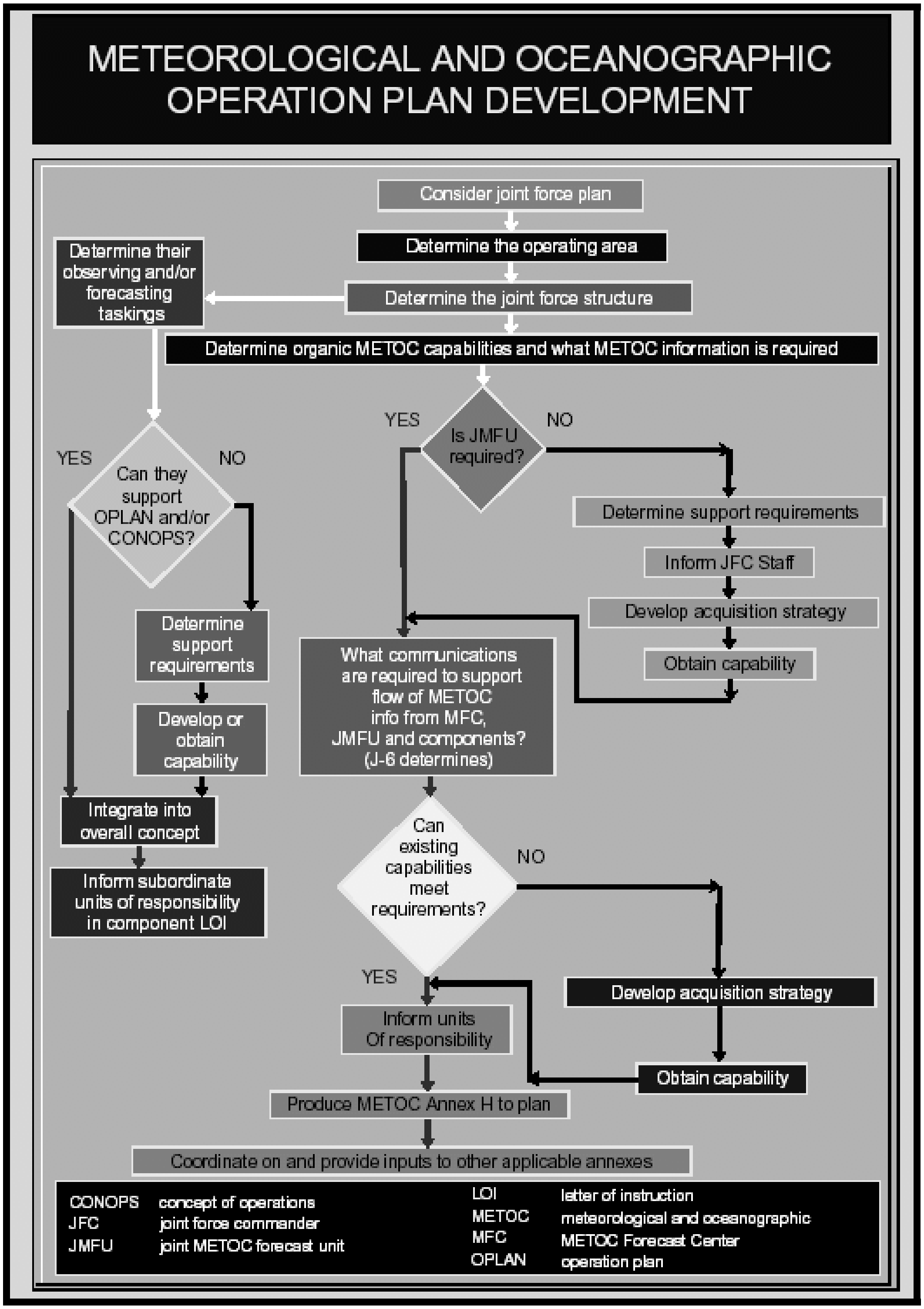


Figure 5-6 METOC Operational Plan Development

EXAMPLES OF METOC INFORMATION REQUIREMENTS AND RESPONSIBILITIES WITHIN A JOINT FORCE			
Information (see instructions at end of Appendix)	JMFU/ MFC	Functional or Service Component	Tactical Level
Air Refueling Track Forecasts			
Altimeter			
ASW Products (Acoustics, Bottom Cond., etc.)			
Ballistic Winds			
Bathythermograph and/or Sound Profiles			
Ceilings and/or Cloud Layers a/o Bases and Tops			
CHAFF Forecast			
Chemical Downwind Message			
Cloud Free Line of Sight Forecasts			
Clouds			
Computerized Flight Plan			
Contrails			
Currents, Speed, and Direction			
Customer Threshold Forecasts			
D-Values			
Deep Layer Mean Winds			
Ditch Headings			
Drop Zone and Landing Zone Forecasts			
Ducting and/or Refractivity Index			
EO-TDA and/or Automated			
Forward Looking Infrared (IR) Forecast			
Freezing Level			
Fronts and Eddies			
Geomagnetic Conditions			
HF, Radar, and/or Radio Propagation Forecasts			
High Resolution Forecast Database			
High Seas Warnings			
Horizontal Weather Depiction			
Ice Edge and/or Bergs			
Ice and/or Snow Coverage			
Icing			
Ionospheric Scintillation			
IR Thermal Crossover Times			
IR Transmissivity			
Integrated Refractive Effects Prediction System			
Jet Stream (Location and Strength)			
Joint Operations Area Forecast			
Lighting Detection			
Longwaves, 500mb			
Moisture and/or Humidity			

Figure 5-7 JMFU Requirement Request

EXAMPLES OF METOC INFORMATION REQUIREMENTS AND RESPONSIBILITIES WITHIN A JOINT FORCE (cont'd)			
Information (see instructions at end of Appendix)	JMFU/ MFC	Functional or Service Component	Tactical Level
Nighttime Illumination			
Optimum Track Ship Routes			
Pilot Weather Reports			
Precipitation (Type and Amount)			
Radar Observations			
Relative Humidity and/or Moisture Fields (Sfc-10,000 ft)			
Sea Surface Conditions			
Search and Rescue			
Severe Weather Advisory and/or Forecast			
Shore Conditions			
Shortwaves, 500mb			
Soil Surface Temperature			
Soil and/or Ground Moisture Fields (6 in. depth)			
Solar Activity			
Solar Wind Conditions			
Sound Focus			
Surf Forecasts			
Synoptic Charts			
Synoptic Discussions			
Temperature Forecasts (Max and/or Min, etc.)			
Terminal Aerodrome Forecasts			
Tidal Data			
Thickness, 1000-500mb			
Thunderstorms			
Tropical Storm Advisories			
Tropopause Heights and/or Winds			
Upper Air Charts			
Upper Air Observations			
Upper Trop Mean Winds			
Visibility			
Vorticity (500mb)			
Winds			
Weather Observations			
Wet Bulb Globe Temperature Index			
Turbulence			
Windshear			

Use of this Appendix:
1. Use the above items as a list of parameters in which one or more of the METOC agencies listed above may have a need or interest. Mark which agency or agencies would have an interest in a specific METOC parameter.
2. The above list is not intended to be all-inclusive, but to serve as a memory-jogger when establishing METOC information requirements. Feel free to copy it and use as is, or to fold it in as part of your Annex H and OPORD writing process.

Figure 5-7 JMFU Requirement Request (Continued)

Appendix A
Glossary

Section I. Acronyms

Note: Acronyms change over time in response to new operational concepts, capabilities, doctrinal changes, and other similar developments. The following publications are the sole authoritative sources for official military acronyms: 1. Joint Pub 1-02, *DOD Dictionary of Military and Associated Terms*.

2. Fleet Marine Force Reference Publication (FMFRP) 0-14, *Marine Corps Supplement to the DOD Dictionary of Military and Associated Terms*.

55SXS ....55th Space Weather Squadron
AAV ....assault amphibious vehicle
AAVC ....assault amphibious vehicle, command model
AAVP ....assault amphibious vehicle, personnel model
AAVR...................assault amphibious vehicle, recovery model
ACCI ....Air Combat Command instruction
ACCM.....................................Air Combat Command manual
ACE ....aviation combat element
AFCAT ....Air Force catalog
AFCCC.........................Air Force Combat Climatology Center
AFDIGS ....Air Force digital graphics system
AFI ....Air Force instruction
AFJI...................................Air Force joint instruction
AFP ....Air Force publication
AFTTP.....................Air Force tactical training publication
AFWA.....................................Air Force Weather Agency
AMCI..............................Air Mobility Command instruction
AOAFCST........................amphibious objective area forecast
AR . . . . Army regulation
AREPS . . . . .advanced refractive effects prediction system
ARTYMET . . . . artillery meteorological
ASLTFCST . . . . assault forecast
ATC . . . . .air traffic control
AVWX . . . . aviation route weather forecast
AWDS . . . . automated weather distribution system
AWN . . . . Automated Weather Network
AWSR . . . . Air Weather Service regulation
BDA . . . . battle damage assessment
BKN . . . . broken
BMCT . . . . begin morning civil twilight
BMNT . . . . begin morning nautical twilight
BSSG . . . . brigade service support group
CAT . . . . clear air turbulence

CCIR . . . . .commander's critical information requirements
CE . . . . command element
CJCSI . . . . . .Chairman of the Joint Chiefs of Staff instruction
CJCSM . . . . .Chairman of the Joint Chiefs of Staff manual
CLF . . . . commander, landing force
CLR . . . . clear
CNMOC . . . . Commander, Naval METOC Command
COA . . . . course of action
COMNAVSURFLANT . . . . . .Commander, Naval Surface Force, Atlantic
COMNAVSURFPAC . . . . . . .Commander, Naval Surface Force, Pacific
CONOPS . . . . concept of operations
COVER . . . . AREPS coverage diagram
CRRC . . . . combat rubber raiding craft
CSS . . . . .combat service support
CSSE . . . . .combat service support element
DA . . . . .density altitude
DAS . . . . .direct air support
DMS . . . . defense message system
DMSP . . . . .Defense Meteorological Satellite Program
DOD . . . . .Department of Defense
DON . . . . Department of the Navy
DSN . . . . Defense Switched Network
EECT . . . . end evening civil twilight
EENT . . . . .end of evening nautical twilight
EM . . . . electromagnetic
EMCON . . . . emission control
EMP . . . . electromagnetic pulse
EOTDA . . . . .electro-optical tactical decision aid
EWS .electronic warfare support
ESM . . . . electronic warfare support measure
ESP . . . . environmental support packet
FAA . . . . .Federal Aviation Administration
FALOP . . . . forward area limited observation program
FARP . . . . .forward arming and refueling point
FLIR . . . . .forward-looking infrared
FLTNUMMETOCCENINST . . . .Fleet Numerical METOC Center instruction
FLTNUMMETOC DET . . . . .Fleet Numerical METOC Detachment
FM . . . . field manual
FMF . . . . Fleet Marine Force
FNMOC . . . . Fleet Numerical METOC Center
FOB . . . . forward operating base
FTS . . . . Federal Telecommunication System
GCE . . . . ground combat element
GI&S . . . . geospatial information and services
HMH . . . . Marine heavy helicopter squadron
HMLA . . . . Marine light attack helicopter squadron
HMM . . . . .Marine medium helicopter squadron

HQ . . . . .headquarters
IFR .instrument flight rules
IPB . . . . .intelligence preparation of the battlespace
JMFU .joint meteorological and oceanographic (METOC) forecast unit
JMO . . . . joint meteorological and oceanographic (METOC) officer
JOTS . . . . Joint Operational Tactical System
JTF . . . . joint task force
LCAC . . . . landing craft air cushion
LCM .landing craft, mechanized
LCU . . . . landing craft, utility
LCVP . . . . landing craft, vehicle, personnel
MACG . . . . Marine air control group
MAFC Marine air ground task force (MAGTF) all-source fusion center
MAG . . . . .Marine aircraft group
MAGTF . . . . Marine air-ground task force
MARFORLANT . . . . Marine Corps Forces, Atlantic
MARFORPAC . . . . Marine Corps Forces, Pacific
MCAF . . . . Marine Corps air facility
MCAS .Marine Corps air station
MCRP . . . . .Marine Corps reference publication
MCWP . . . . .Marine Corps warfighting publication
MEF . . . . Marine expeditionary force
MEF(FWD) . . . . .Marine Expeditionary Force (forward)
METMFR . . . . .meteorological mobile facility replacement
METOC . . . . meteorological and oceanographic
METSAT .meteorological satellite
MEU . . . . Marine expeditionary unit
MOPP . . . . mission-oriented protective posture
MRS . . . . Mini-Rawinsonde System
MSI . . . . .modified surf index
MST . . . . Mountain Standard Time
MWSG . . . . Marine wing support group
MWSS . . . . .Marine wing support squadron
NAI . . . . named area of interest
NATO . . . . .North Atlantic Treaty Organization
NAVEURMETOCCEN .Naval European Meteorology and Oceanography Center
NAVLANTMETOCCEN Naval Atlantic Meteorology and Oceanography Center
NAVMETOCCOM . . . . . . Naval Meteorology and Oceanography Command
NAVMETOCCOMINST . . . Naval Meteorology and Oceanography Command instruction
NAVOCEANO . . . . Naval Oceanographic Office
NAVPACMETOCCEN . Naval Pacific Meteorology and Oceanography Center
NBC . . . . .nuclear, biological, and chemical
NESDIS . . National Environmental Satellite, Data and Information Service
NFOV . . . . .narrow field of view
NOAA . . . . National Oceanic and Atmospheric Administration

NOGAPS . . . Navy Operational Global Atmospheric Prediction System
NWS . . . . National Weather Service
OAAW . . . . offensive antiair warfare
OFCM . . . . .Office of the Federal Coordinator of Meteorology
OPORD . . . . .operation order
OPTASK . . . . .operational task
OWS . . . . operational weather squadron
OVC . . . . overcast
PA . . . . pressure altitude
PCS . . . . propagation conditions summary
PSYOP . . . . .psychological operation
PV . . . . Platform Vulnerability
RGR . . . . rapid ground refueling
RP . . . . reference publication
SAM . . . . surface-to-air missile
SCT . . . . .scattered
SEAD . . . . suppression of enemy air defenses
SEAL . . . . sea-air-land team
STRKFCST . . . . .strike forecast
STU-III . . . . secure telephone unit III
SWO . . . . .staff weather officer
T/O . . . . .table of organization
TAF . . . . .terminal aerodrome forecast
TAMPS . . . . .tactical aviation mission planning system
TARWI . . . . target weather and intelligence
TAS . . . . tactical atmospheric summary
TC . . . . technical catalog
TDA . . . . .tactical decision aid
TN . . . . .technical note
TOW . . . . tube-launched, optically tracked, wire-guided missile
UAV . . . . .unmanned aerial vehicle
UGDF . . . . .uniform gridded data field
USMC . . . . .United States Marine Corps
UTC . . . . Coordinated Universal Time
VFR . . . . .visual flight rules
VMA . . . . Marine attack squadron
VMAQ . . . . Marine tactical electronic warfare squadron
VMFA . . . . .Marine fighter attack squadron
VMGR . . . . Marine aerial refueler transport squadron
WBGTI . . . . wet bulb globe temperature index
WEAX . . . . weather
WFOV . . . . .Wide Field of View
WMO .World Meteorological Organization
WSR . . . . Weather Surveillance Radar

SECTION II Definitions

Note: Definitions of military terms change over time in response to new operational concepts, capabilities, and doctrinal changes, and other similar developments. The majority of METOC terms are not defined in Joint Pub 1-02. Accordingly, the following publications are the authoritative sources for official of METOC terms used within this publication:

1. Joint Pub 3-59, Joint Doctrine for Meteorological and Oceanographic Support.

2. COMNAVSURFPAC/COMNAVSURFLANT 3840.1B, Joint Surf Manual.

A

absolute humidity-The mass of water vapor in a given volume of air. It represents the density of water vapor in the air.

aerosols-Tiny suspended solid particles (dust, smoke, etc.) or liquid droplets that enter the atmosphere from either natural or human (anthpgenic) sources, such as burning of fossil fuels.

air pressure (atmospheric pressure)-The pressure exerted by the weight of the air above a given point, usually expressed in millibars or inches of mercury.

atmosphere-The air surrounding the Earth. (Joint Pub 3-59)

B

backwash- An even layer of water that moves along the sea floor from the beach through the surf zone and caused by the pile-up of water on the beach from incoming breakers (JP 1-02)

bar- A submerged or emerged embankment of sand, gravel, or mud created on the sea floor in shallow water by waves and current. A bar may be composed of mollusk shells. (JP 1-02)

berm- The nearly horizontal portion of a beach or backshore having an abrupt fall and formed by deposition of material by wave action. A berm marks the limit of ordinary high tides. (JP 1-02)

breaker- A wave in the process of losing energy where offshore energy loss is caused by wind action and nearshore energy loss is caused by the impact of the sea floor as the wave enters shallow (shoaling) water. Breakers either plunge, spill, or surge. See also breaker angle (JP 1-02).

breaker angle- The angle at which a breaker makes the beach. (JP 1-02)

C

ceiling- The height above the Earth’s surface of the lowest layer of clouds or obscuration phenomena that is reported as “broken”, “overcast”, or “obscured” and not classified as “thin” or “partial”. (JP 1-02)

clear air turbulence (CAT)-Turbulence encountered by aircraft flying through cloudless skies. Thermals, wind shear, and jet streams can be factors in producing CAT.

climatological forecast- A weather forecast solely based on historical meteorological records. The forecast is based regional climate rather than on current weather conditions.

contrail (condensation trial)- A cloud-like streamer frequently seen forming behind aircraft flying in clear, cold, humid air.

D

deep water-where water depth is greater than one-half the wave length. Deep water conditions are said to exist when the surface waves are not affected by bottom topography. (*Joint Surf Manual*)

density- The ratio of mass of a substance to the volume occupied by it.

dew- water that has condensed onto objects near the ground when their temperatures have fallen below the dewpoint of the surface air.

dewpoint temperature- The temperature to which the air must be cooled (at a constant pressure and constant water vapor content) for saturation to occur.

diffraction- The bending of light around objects, such as a cloud of fog droplets, producing fringes of light and dark or colored bands.

E

electromagnetic propagation- The transmission of a wave between a transmitter and a receiver in free space.

environmental services- The various combinations of scientific, technical, and advisory activities (including modification processes, i.e., the influence of manmade and natural factors) required to acquire, produce, and supply information on the past, present, and future states of space, atmospheric, oceanographic, and terrestrial surroundings for use in military planning and decisionmaking processes, or to modify those surroundings to enhance military operations. (Joint Pub 1-02)

F

fetch- The area over which ocean waves are generated by a wind with a constant direction and speed. Also known as the generating area. (*Joint Surf Manual*)

G

gradient- The rate of inclination to horizontal expressed as a ratio, such as 1:25, indicating a one unit rise to 25 units of horizontal distance. (JP 1-02)

I

infrared radiation- Radiation emitted or reflected in the infrared portion of the electromagnetic spectrum. (JP 1-02)

inversion- An increase in air temperature with an increase in height.

isobar- A line connecting points of equal pressure.

isotach- A line connecting points of equal wind speed.

isotherm- A line connecting points of equal temperature.

J

joint meteorological and oceanographic forecast unit- An organization consisting of a jointly supported collective of meteorological and oceanographic support to the joint force commander. Also called JMFU. See also meteorological and oceanographic. (JP 1-02)

K

knot- A unit of speed equal to one nautical mile per hour. One knot equals 1.15 miles per hour. (MCRP 5-12C)

L

littoral- 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- Current moving generally parallel to and adjacent to the shoreline. (*Joint Surf Manual*)

longshore bar- A ridge of sand, gravel, or mud generally parallel to shoreline, which may become exposed at low tide.

M

Meteorological and Oceanographic Forecast Center- The collective of electronically connected, shore-based meteorological and oceanographic (METOC) production facilities that includes centers such as Air Force Weather Agency, Navy Fleet Numerical METOC Center, 55th Space Weather Squadron, Naval Oceanographic Office, Warfighting Support Center, Air Force Combat Climatology Center, Fleet Numerical METOC Center Detachment, Asheville, North Carolina, and the Air Force and Navy theater and/or regional METOC production activities. Also called MFC. (JP 3-59)

meteorological data- Meteorological facts pertaining to the atmosphere, such as wind, temperature, air density, and other phenomena that affect military operations. (JP 1-02)

modified surf index (MSI)- A single dimensionless number that provides a relative measure of conditions likely to be encountered in the surf zone. The MSI is a calculated value based on breaker type, period and height, speed of any littoral current, relative wind speed, and secondary wave height.

modified surf limit- The modified surf limit is the height at which limiting surf conditions shall not exceed the modified surf index. The commander involved generally sets this limit.

O

offshore bar- A comparatively flat portion of a beach profile that generally runs parallel to the shore extending seaward from beyond the breaker zone to the edge of the continental shelf.

P

plunging breaker- The peak period of a wave that advances as a vertical wall of water. This type of breaker sometimes causes an explosive sound as trapped air escapes behind the wave. It is usually found on a medium to steep sloping beach, with little wind or an offshore wind.

precipitation- Any form of water particle, liquid or solid, that falls from the atmosphere and reaches the ground.

R

refraction- The deflection of a wave moving in shallow water at an angle to the depth contours that causes the advancing wave to bend toward alignment with the depth contours (as opposed to facing the shoreline directly). (*Joint Surf Manual*)

rip current- A rip current is strong narrow channel of water that flows from the surf-zone out to sea. It develops when breaking waves push onshore, then gravity pulls the water backs out to sea. If the water converges into a narrow river like channel moving away from shore, a Rip Current forms.

S

space environment- The region beginning at the lower boundary of the Earth's ionosphere (approximately 50 km) and extending outward that contains solid particles (asteroids and meteoroids), energetic charged particles (ions, protons, electrons, etc), and electromagnetic and ionizing radiation. (*Joint Surf Manual*)

space weather- Describes the environment and other natural phenomena above a 50-km altitude. (3-59)

swash- The rush of water up onto the beach following the breaking of a wave. Also known as an uprush. (*Joint Surf Manual*)

swell- Ocean waves that have traveled out of their fetch. Swell characteristically exhibits a more regular and longer period with flatter crests than sea waves. (*Joint Surf Manual*)

W

wave Crest- The highest part of a wave. (*Joint Surf Manual*)

wave height- The vertical distance between a wave trough and a wave crest. (*Joint Surf Manual*)

wavelength- The horizontal distance between successive wave crests or troughs measured perpendicular to the wave crests. (*Joint Surf Manual*)

wave period- The time required for a wave crest to traverse a distance equal to one wavelength. (*Joint Surf Manual*)

wave steepness- The ratio of wave height to wave length. (*Joint Surf Manual*)

wave trough- The lowest part of a wave between successive wave crests. (*Joint Surf Manual*)

wave velocity- The speed at which a wave form advances, usually expressed in knots. (*Joint Surf Manual*)

weather- the condition of the atmosphere at any particular time and place.

weather elements- The elements of air temperature, air pressure, humidity, clouds, precipitation, visibility, and wind that determine the present state of the atmosphere.

wind wave- A wave resulting from the action of wind on a water surface. While the wind is acting on it, it is a sea wave; thereafter, it is a swell. (*Joint Surf Manual*)

Appendix B

References and Related Publications

Joint Publications

Joint Pub 3-0	*Doctrine for Joint Operations*
Joint Pub 3-59	*Joint Doctrine for Meteorological and Oceanographic Support*
Joint Pub 5-03.1	*Joint Operation Planning and Execution System Vol. I, Planning Policies and Procedures*
Joint Pub 6-05.3	*Employment of Joint Tactical Communications Systems*
	Joint Meteorology and Oceanography (METOC) Training Handbook

Chairman of the Joint Chiefs of Staff Instruction (CJCSI)

CJCSI 3810.01	*Meteorological and Oceanographic Operations*

Chairman of the Joint Chiefs of Staff Manual (CJCSM)

CJCSM 3122.03 *Vol. II,*	*Joint Operation Planning and Execution System Planning Formats and Guidance*

Marine Corps Publications

Marine Corps Warfighting Publications (MCWPs)

MCWP 2-1	*Intelligence Operations*
MCWP 3-1	*Ground Combat Operations*
MCWP 2-1	*Aviation Ground Support*
MCWP 3-2	*Aviation Operations*
MCWP 3-16.5	*Field Artillery*
MCWP 4-1	*Logistic Operations*
MCWP 5-1	*Marine Corps Planning*

Navy Publications

CNMOC METOC Concept of Operations (CONOPS)

CNMOC METOC CONOPS	Naval Meteorology and Oceanography Command ltr 3140 ser 3/255 of 22 Oct 96

NAVMETOCCOM Instructions (NAVMETOCCOMINSTs)

NAVMETOCCOMINST 3140.1L	*United States Navy Meteorological & Oceanographic Support System Manual Policies Concerning the Provision of Meteorology*
NAVMETOCCOMINST 3140.17A	*Oceanography Products and Services*
Asheville Notice 3146	*Atmospheric Climatic Summaries, Products, and Services*

Commander, Naval Surface Force Pacific COMNAVSURFPAC/Commander, Naval Surface Force Atlantic COMNAVSURFLANT Manual

COMNAVSURFPAC/ COMNAVSURFLANT 3840.1B	*Joint Surf Manual*

Reference Publications (RPs)

RP 1	*Environmental Effects on Naval Weapons Systems and Naval Warfare* (Unclassified)
RP 33	*Fleet Oceanographic and Acoustic Reference Manual*
RP 50	*Catalog of Classified Naval Oceanographic Office Publications*
RP 51	*Catalog of Naval Oceanographic Office Unclassified Publications*

Naval Oceanographic Office Catalog

NAVOCEANO N03140	*METOC Products Available from Warfighting Support Center Classified Services Branch*

Army Publications

U.S. Army Field Manuals (FMs)

FM 1-230	*Meteorology for Army Aviators*
FM 6-15/MCWP 3-16.5	*Tactics, Techniques and Procedures For Field Artillery Meteorology*
FM 34-81	*Weather Support for Army Tactical Operations*
FM 34-81-1	*Battlefield Weather Effects*
FM 34-130	*Intelligence Preparation of the Battlefield*
FM 100-5	*Operations*

Army Regulation (AR)/Air Force Joint Instruction (AFJI)

AR 115-10/AFJI 15-157	*Meteorological Support for the U.S. Army*

Air Force Publications

Air Force Instruction (AFI)

AFI 15-118	*Requesting Specialized Weather Support*

Air Force Catalog (AFCAT)

AFCAT 15-152	*Space Environmental Products*

Air Force Publication (AFP)

AFP 105-34	*JFACC*

Air Weather Service (AWS) Technical Catalog

AWS/TC-91/001	*Catalogue of AWS Technical Documents (1941-1991)*

Air Force Combat Climatology Center (AFCCC) Technical Note (TN)

AFCCC/TN-95/005	*Capabilities, Products and Services of Air Force Combat Climatology Command*

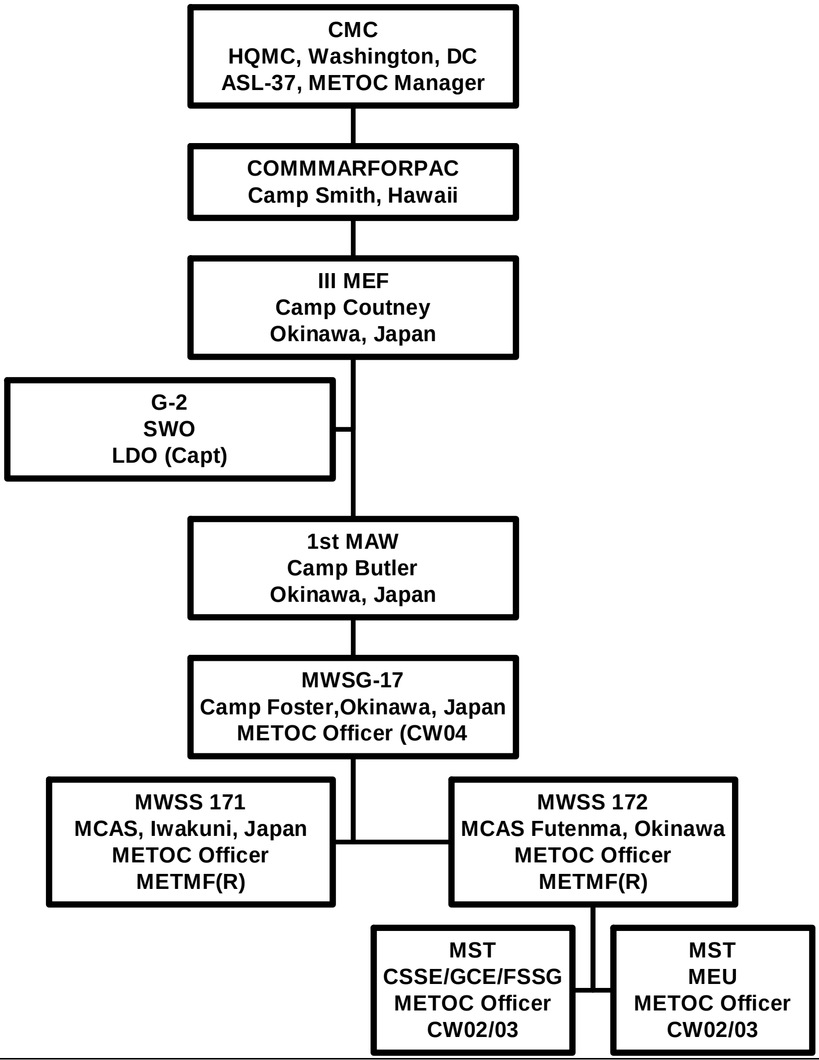
Air Combat Command Instruction (ACCI)

ACCI 15-150	*Air Combat Command Weather Operations*

Air Combat Command Manual (ACCM)

ACCM 15-151	*Air Combat Command Weather Readiness*

APPENDIX C
(III MEF)

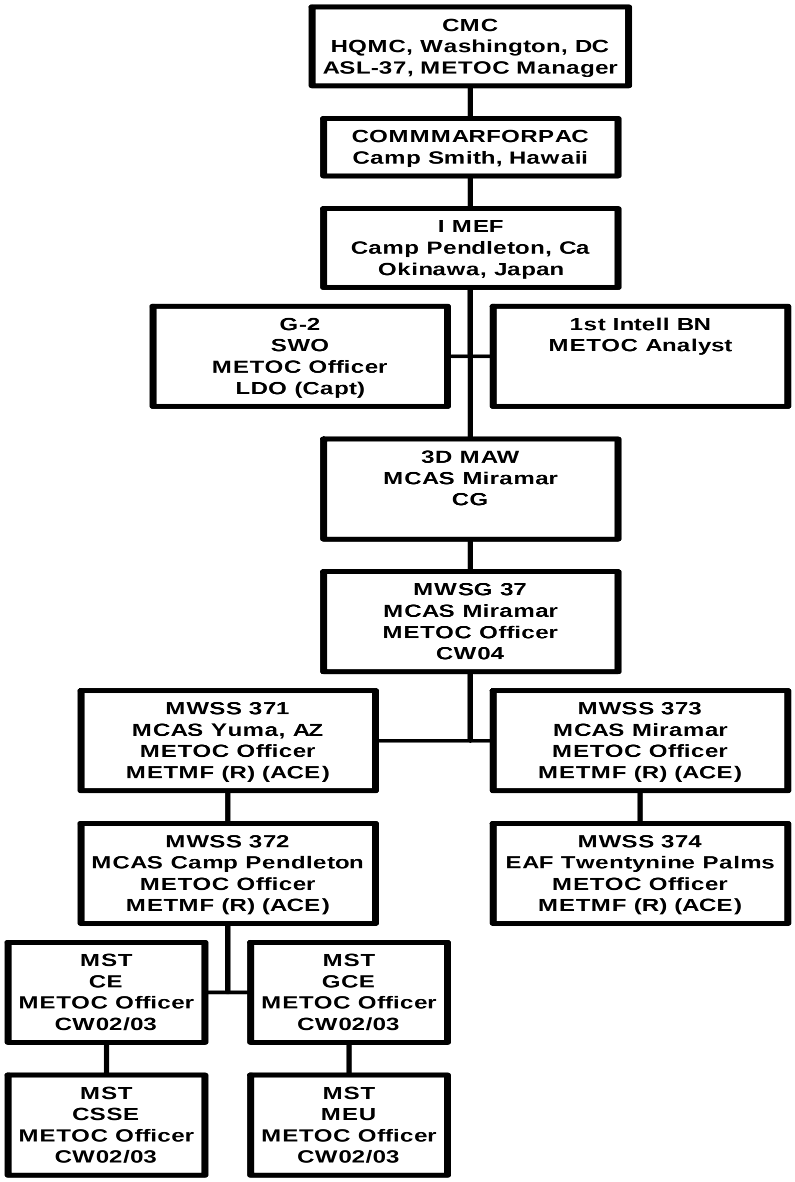


Legend

CMC: Commandant of the Marine Corps
HQMC: Headquarters Marine Corps
COMMARFORPAC: Commander Marine Forces Pacific
METOC: Meteorology and Oceanography
SWO: Staff Weather Officer
MEF: Marine Expeditionary Force
MAW: Marine Aircraft Wing
MWSG: Marine Wing Support Group
MWSS: Marine Wing Support Squadron
METMFR: Meteorological Mobile Facility Replacement
MST: METOC Support Team

Figure C-1

(I MEF)



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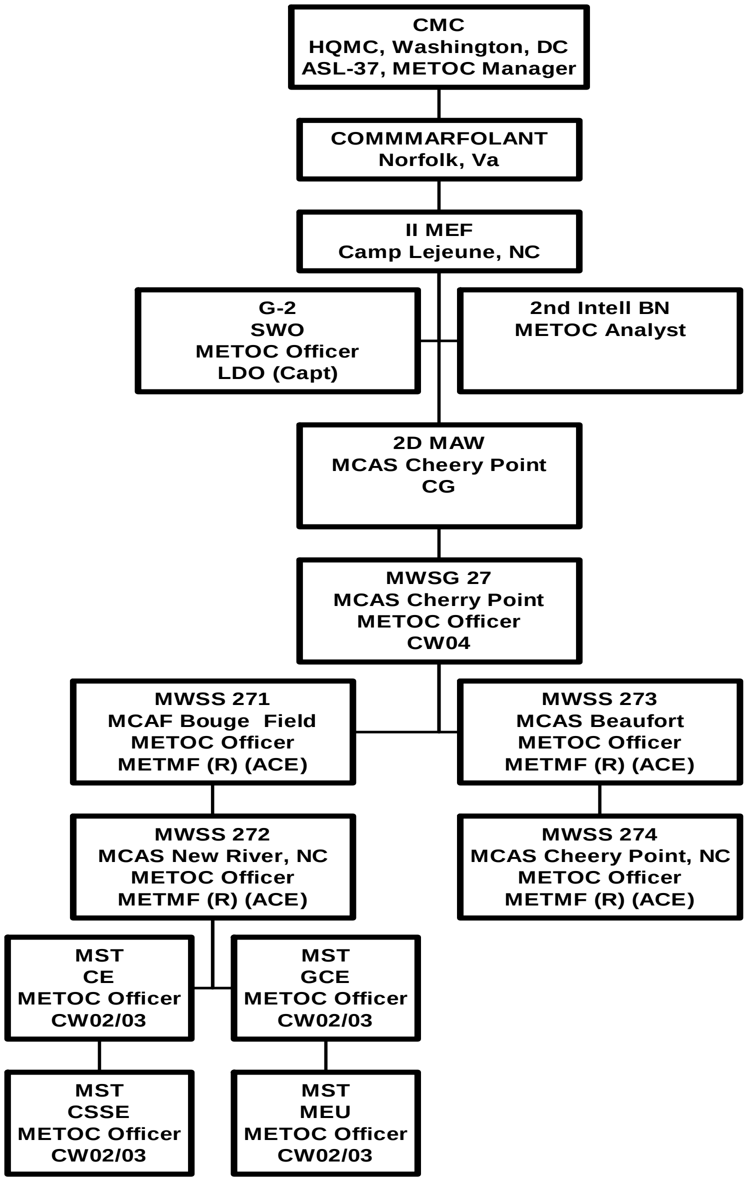
MST: MEF Support Team

Figure C-2

METOC organization and Structure MAGTF Relationship MCWP 3.35.7 Draft

(II MEF)



Legend
CMC: Commandant of the Marine Corps
HQMC: Headquarters Marine Corps
COMMARFORLANT: Commander Marine Forces Atlantic
METOC: Meteorology and Oceanography
SWO: Staff Weather Officer
MEF: Marine Expeditionary Force
MAW: Marine Aircraft Wing
MWSG: Marine Wing Support Group
MWSS: Marine Wing Support Squadron
METMFR: Meteorological Mobile Facility Replacement
MST: METOC Support Team

Figure C-3

APPENDIX D
METOC SUPPORT PRODUCTS AND SERVICES

SECTION I: SAMPLE METOC Support Products and Services

Several METOC products and services are routinely available to aid MAGTF commanders and Planners. Tailored products can be provided upon request to accommodate many tactical situations or missions. A brief discussion of some of the more common products and services will be presented here.

Solar/Lunar Almanac. Provides monthly or daily summaries of emphemeral data for the sun and moon locations worldwide. These summaries include times for sunrise/sunset, moonrise/moonset, beginning/ending times of nautical and civil twilight, total daylight and percent illuminance, phases of the moon in percent illumination, time and altitude of sun/moon meridianal passage, night vision goggle (NVG) illumination data,and 24 hour solar/lunar positions (altitude and azimuth). This can be produced in tabular or graphical format.

Weather Effects Matrix. Weather elements and their associated impact on operations are the primary focus of the Weather Effects Matrix. It is part of the Intelligence Preparation of the Battlefield (IPB) process and will assist commanders and planners in making GO/No GO decisions. The impact of weather on specific mission areas will be defined as FAVORABLE, MARGINAL or UNFAVORABLE. This product can be tailored or adapted to meet specific operational criteria or mission parameters. See Figure D-1 and D-2 for an example of the Weather Effects Matrix.

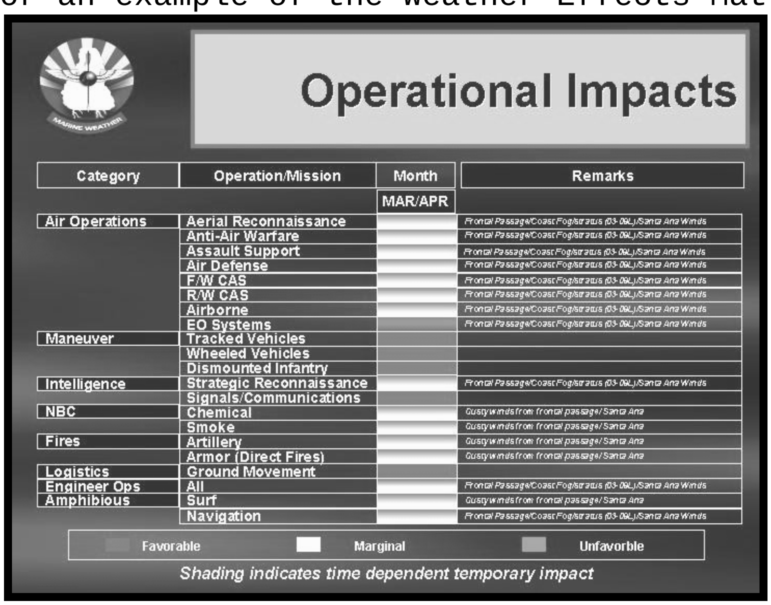


Figure D-1 Sample METOC Impacts Matrix

Weather Impacts
(San Pendleton, Ca.)

Category	SEPT 04				SEPT 05				SEPT 06				SEPT 07				SEPT 08				Rmks
Air	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	--
Ground	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	--
Wet Bulb Temp.	G	Y/R	R/Y	G	G	Y/R	R/Y	G	G	Y/R	R/Y	G	G	Y/R	R/Y	G	G	Y/R	R/Y	G	T
Intelligence	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	--
NBC Def	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	W/T
Laser	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	--
HF	G	G/Y	Y/G	G	G	G/Y	G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	SF
VHF	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	SF
SATCOM	G/Y	Y	Y	Y/G	G/Y	Y	Y	Y/G	G/Y	Y	Y	Y/G	G/Y	Y	Y	Y/G	G/Y	Y	Y	Y/G	SF
NVG	G	N/A	N/A	G	G	N/A	N/A	G/Y	G/Y	N/A	N/A	G	G	N/A	N/A	G	G	N/A	N/A	G	--
IR	G	G/Y	Y/G	G	G	G/Y	Y/G	G	G	Y/G	Y/G	G	G	G/Y	Y/G	G	G	G/Y	Y/G	G	T

Timeline (Hrs) 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00

No Impacts
Marginal Impacts
Significant Impacts

Elements

C - Ceiling	T - Temp
V - Visibility	H - Humidity
W - Wind	TB - Turbulence
P - Precip	I – Icing
SF- Solar Flares	LL- Low Light Lvl

Date	Moderate (M) Flare Potential	Extreme (X) Flare Potential
26 Aug 02	50%	5%

Comments:
M Flares: Temporarily Degrade HF Communications in Sunlit Sector
X Flares: Temporarily Black Out HF Communications in Sunlit Sector
Radio bursts are usually associated with flares

Figure D-2 Weather Impacts Matrix

MAGTF Standard Tactical METOC Support Plan. This plan provides for a common baseline of standardized products and services to be provided at a minimum during MAGTF operations. These tactical support products are tailored or modified as necessary by on-scene METOC forces to meet specific operational requirements and tactical situations. The METOC support plan consists of the following three areas:

Tactical Atmospheric Summary (TAS). Provides an atmospheric refractive summary, tactical assessment, electromagnetic sensor performance predictions, infrared sensor detection range predictions and communication range predictions. (See Appendix G for an example of a TAS)

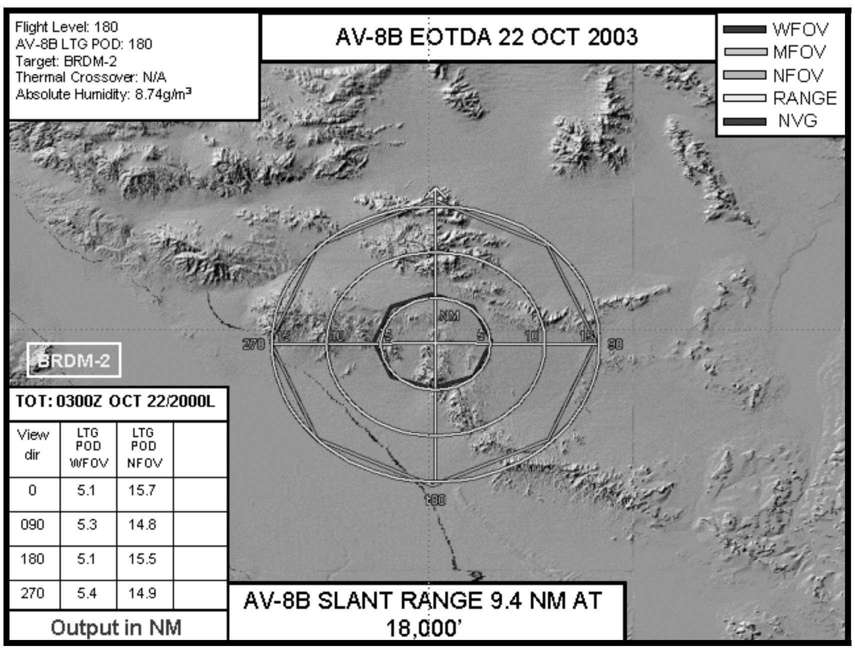
Special Tactical Summaries. These summaries are designed to provide minimum levels of tactical METOC support for specific operations and/or functions of Marine aviation. They include the Amphibious Objective Area Forecast (AOAFCST),Strike Forecast (STRKFCST), and Assault Forecast (ASLTFCST).

Amphibious Objective Area Forecast. The AOAFCST 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. (See Appendix G for an example of an AOAFCST)

Strike Forecast. The STRKFCST is designed to provide a coordinated forecast whenever multiple strike (OAAW/SEAD/DAS) platforms (VMA/VMFA/VMAQ) are operating as an integrated force under one tactical commander. It includes a plain language meteorological situation, 24-hour forecast of enroute and target weather, outlook to 48 hours, tactical assessment, and electro-optical sensor performance predictions. (See Appendix G for an example of a STRKFCST)

Assault Forecast. The ASLTFCST 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 includes a plain language meteorological situation, 24-hour forecast of enroute, FARP/RGR and landing zone weather, outlook to 48 hours, tactical assessment, and electro-optical sensor performance predictions. (See Appendix G for an example of an ASLTFCST).

<u>Electro-Optical Tactical Decision Aids (EOTDA)</u>. The effects of weather on sensor performance of various weapon systems and platforms is complex and does not lend itself to easy treatment. 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. EOTDA is a software model that predicts the performance of air-to-ground weapon systems and direct view optics based on environmental and tactical information. Performance is expressed primarily in terms of maximum detection or lock-on range. The EOTDA supports three regions of the spectrum: infrared, visible and laser. Most Marine Corps aviation platforms, weapons, and systems are supported by the database contained in the program. Systems not supported can be defined by the user to work with the EOTDA program. Figure D-3 provides examples of EOTDA products integrated with Falcon view software.



Sample EOTDA Product Figure D-3

ADVANCED REFRACTIVE EFFECTS PREDICTION SYSTEM (AREPS)

The AREPS software program was developed to compute and display a number of Tactical Decision Aid (TDA)s using locally collected meteorological information. These TDAs are airborne and surface-based radar probability of detection, electronic surveillance measure (ESM) vulnerability, UHF/VHF communications, simultaneous radar detection and ESM vulnerability, range-dependent raytrace, and a surface-search range table. All decision aids are displayed as a function of height, range, and bearing. Detection probability, ESM vulnerability, communication, and surface-search range assessments are based on electromagnetic (EM) system parameters stored in a user-changeable database. Paths containing land features depend on terrain data either obtained from the National Imagery and Mapping Agency's (NIMA) Digital Terrain Elevation Data (DTED) or specified from an alternate source.

Common products include the following:

Coverage Display. Coverage decision aids of radar detection, ESM intercept, or communications are shown in a coverage display, illustrated in figure D-4.

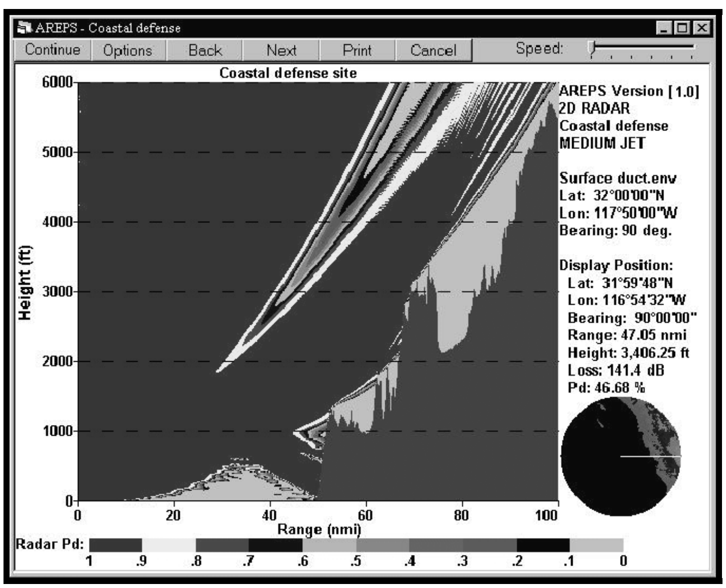


Figure D-4: Coverage display.

For coverage decision aids, beneath the diagram is a color bar legend for the type of data being presented. For radar only displays, the colors represent either probabilities of detection (POD) (0-100%) or propagation loss (dB). For simultaneous radar and ESM displays, the colors represent >90% and >50% POD and a binary (yes/no) ESM intercept. For the ESM only and communications displays, the colors represent ESM intercept or communications, yes or no.

Loss Versus Range Display. Rather than a height versus range coverage display, propagation loss or signal-to-noise ratios may be shown in a decibel versus range display, illustrated in figure D-5 and D-6. This display is for a constant height. Unlike the coverage display, horizontal lines represent the contours of electric field strength. For an EM system to function, the propagation loss must not exceed the threshold, whereas the signal-to-noise ratio must exceed the threshold.

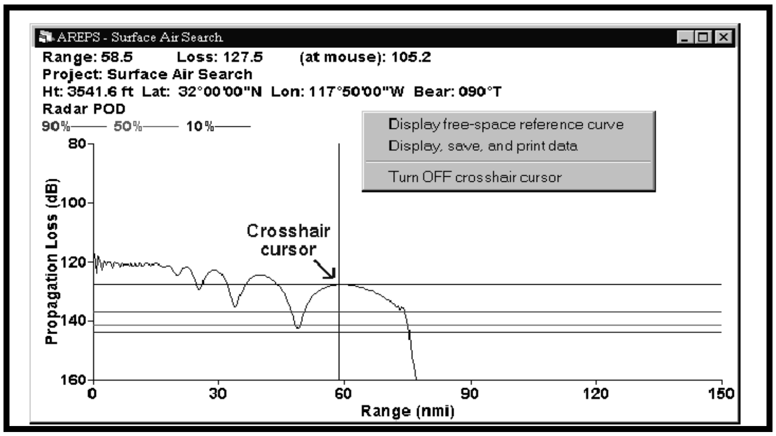
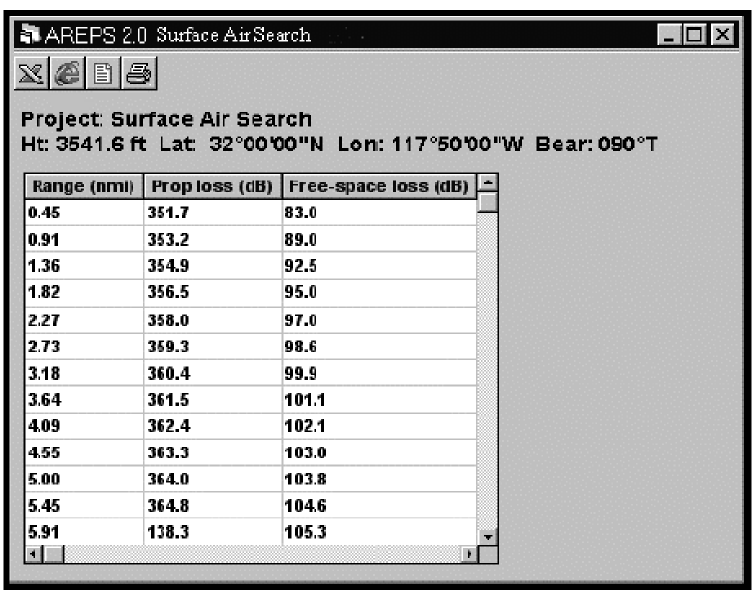


Figure D-5: Propagation loss versus range display.


AREPS 2.0 Surface Air Search

Project: Surface Air Search
Ht: 3541.6 ft Lat: 32°00'00"N Lon: 117°50'00"W Bear: 090°T

Range (nmi)	Prop loss (dB)	Free-space loss (dB)
0.45	351.7	83.0
0.91	353.2	89.0
1.36	354.9	92.5
1.82	356.5	95.0
2.27	358.0	97.0
2.73	359.3	98.6
3.18	360.4	99.9
3.64	361.5	101.1
4.09	362.4	102.1
4.55	363.3	103.0
5.00	364.0	103.8
5.45	364.8	104.6
5.91	138.3	105.3

Figure D-6: Propagation loss data tabular display.

Loss Versus Height Display. Rather than a height versus range coverage display, propagation loss or signal-to-noise ratios may be shown in a decibel versus height display, illustrated in figure D-7. This display is for a constant range. Contours of electric field strength are represented by vertical lines. For an EM system to function, the propagation loss must not exceed the threshold, whereas the signal-to-noise ratio must exceed the threshold.

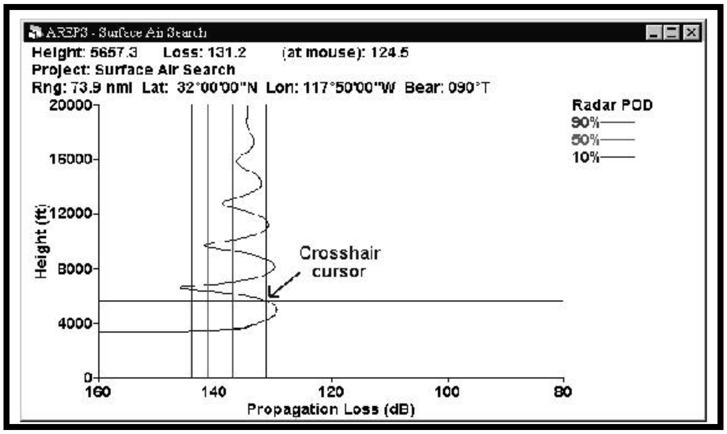


Figure D-7: Propagation loss versus height display.

Radar Detection Range Table. By selecting Options from the toolbar of the Coverage Display window or by right clicking anywhere within the coverage display graphic, you may select the radar detection range tables decision aid (figure D-8).

AREPS 2.0 Coastal defense

Coastal Defense Example

Maximum detection range (nmi) for a 90 percent probability of detection

Height (ft)	Project Target	Target 2	Target 3	Target 4
	MEDIUM JET			
15.7	5.9			
600	45.5			
1000	30.2			
1800	29.1			
2400	26.8			
3000	31.1			
3600	29.5			
4200	28.2			
4800	31.4			
5400	30.0			
6000	29.1			

AREPS 2.0
2D RADAR
Ant ht: 20. ft
Coastal Defense

Surface duct.env
Lat: 32°N
Lon: 117°50'W
Bear: 90°T

Figure D-8: Radar detection range table.

Figure D-9 illustrates the relationship between the coverage decision aid, the propagation loss decision aid, and the detection range decision aid. The numbers shown in red represent the 90 percent probability of detection for a medium-sized jet at an altitude of 1000 feet.

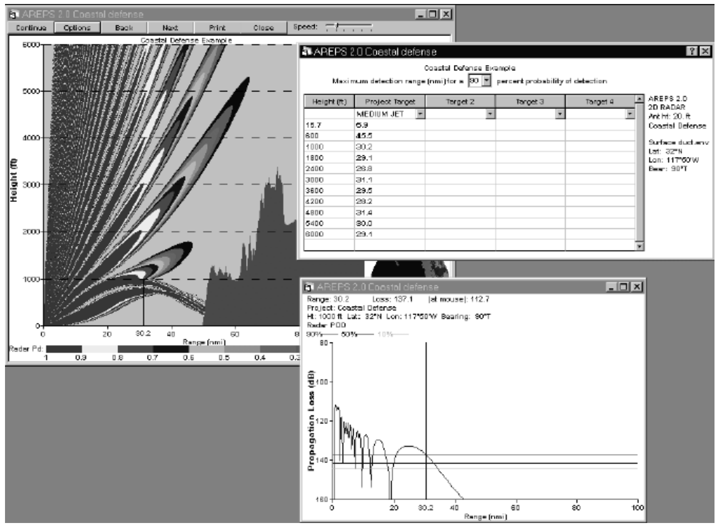


Figure D-9: Relationship between coverage, propagation loss, and detection range table decision aid.

In addition to the detection range table format, a graphical picture of the detection ranges is also available. By selecting “Show detection as bar graph,” the table is shown as illustrated in figure D-10.

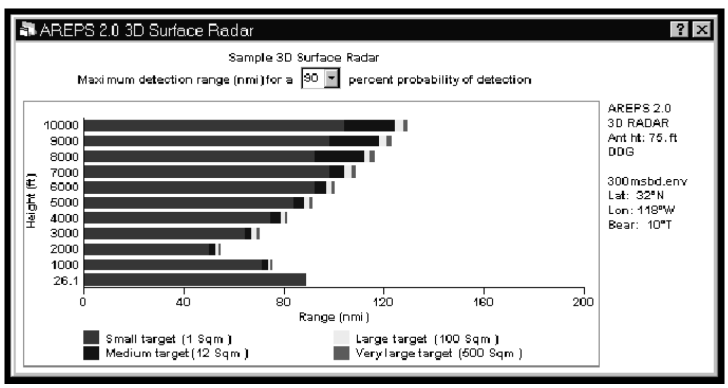


Figure D-10: Detection range versus height bar graph display.

<u>Early Warning Aircraft Stationing Considerations</u>. By using the coverage decision aid, the optimum altitude for early warning aircraft can be determined, which will minimize the effects of radar “holes” or “shadow zones” created by elevated ducts or terrain features. It should be remembered that although the duct acts like a wave-guide for the energy, this waveguide does not have rigid and impenetrable boundaries, except for the earth’s surface in the case of surface-based ducts. Therefore, energy is continually “leaking” from the duct into the hole. In addition, surface-reflected energy may propagate into this hole. While the energy level within a radar hole may be insufficient for radar detection, it may be sufficient for ESM intercept.

The coverage decision aid, figure D-11, illustrates the principles discussed above. For this case, there is an elevated duct between 19,000 and 20,000 feet. The aircraft is flying within the duct. Extended ranges for high probability of detection can be seen within the duct.

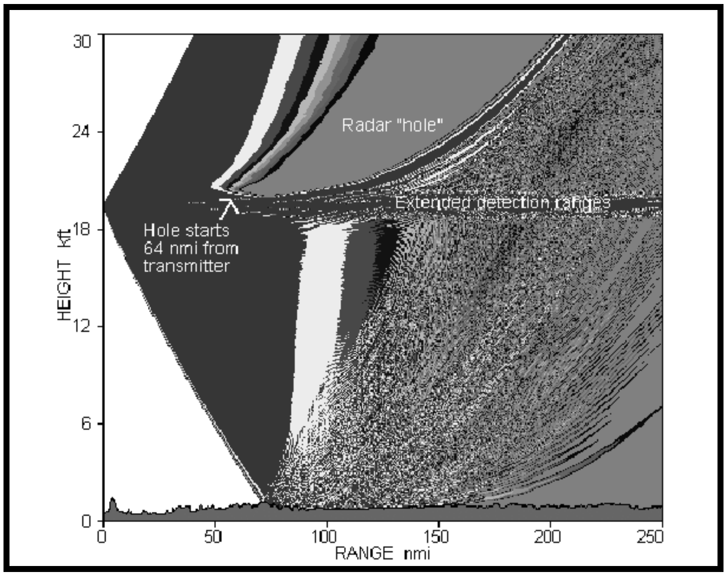


Figure D-11: Early warning aircraft within an elevated duct.

The radar hole is evident above the duct. In addition, you can see energy leaking upward from the duct, defining a down-range boundary for the hole, and you can see surface-reflected energy reaching the atmosphere above the duct and beyond the down-range hole boundary. Note that for this case, the hole starts at 64 nautical miles from the transmitter.

Tactically, flying within an elevated duct is not desirable, as the aircraft will experience the greatest area of reduced coverage. While it’s true the extended ranges within the duct do exist, the likelihood of the target also being within the duct cannot be counted on. In addition, an ESM intercept aircraft could tactically exploit these extended ranges by stationing himself at ranges beyond radar detection but still within ESM intercept ranges.

Now consider the AEW aircraft ascending to an altitude of 25,000 feet, illustrated in figure D-12. While the radar hole is still present, it starts 95 nautical miles from the transmitter. The higher the transmitter is above the duct, the farther in range the hole will begin. Also notice that extended ranges within the duct are not present. Here again, there is a tactical tradeoff, i.e., no extended ranges but better overall coverage.

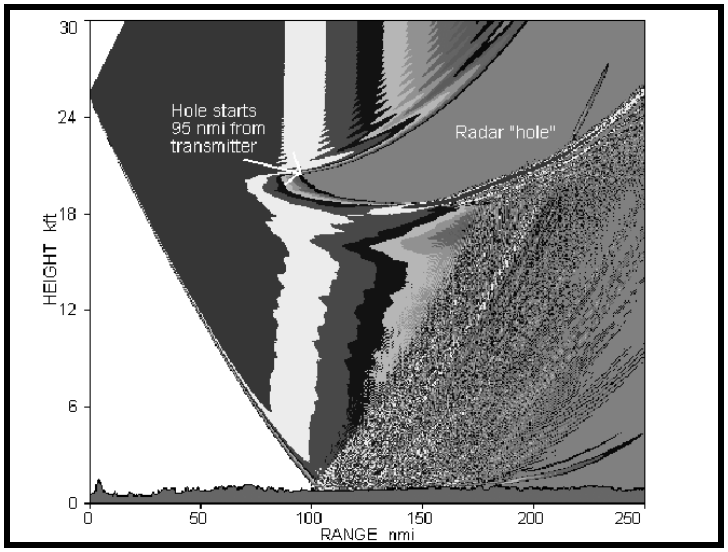


Figure D-12: Early warning aircraft above an elevated duct.

In figure D-13, the early warning aircraft positions itself at an altitude of 15,000 feet. Notice that since the transmitter is now below the elevated duct, there are no anomalous propagation effects from the duct, i.e., no extended ranges and no radar hole. Thus, as a rule-of-thumb, the positioning of an early warning aircraft in relation to the elevated duct is to fly as high above the duct as possible or fly anywhere below the duct, consistent with other mission objectives including radar/communication horizon, fuel usage, height assignments by traffic control, etc.

While not a part of the tactical application, figure D-12 illustrates a limitation of the current APM propagation model. Any area of the display that is colored white indicates an area for which no propagation calculations were made. In this case, it is for high angles. A conscious decision was made to ignore these high angles due to computer execution time and memory considerations when employing the parabolic equation model. This limitation should not be a hindrance to tactical applications, however, as refractive effects are negligible above a few degrees from the horizontal. This limitation of the advanced propagation model will be overcome in a future version of APM with the inclusion of the airborne parabolic equation model. No detection of a high-flying target will be a tactical problem when the target is outside the antenna pattern of the transmitter.

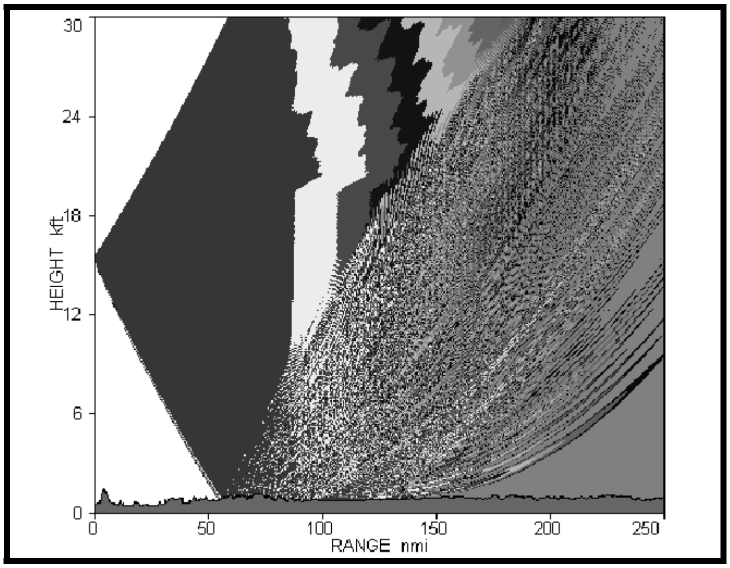


Figure D-13: Early warning aircraft below an elevated duct.

Electronic Surveillance Measures (ESM). Oftentimes it is advantageous to know not only the detection ranges of threat targets but your own vulnerability to ESM intercept by an enemy. For example, you are concerned about detecting a low-flying anti-radiation missile (ARM) but, at the same time, you are concerned about providing the missile's seeker with extended detection range. Likewise, when creating an emissions control plan, for example, a task force, it is of great value to know which systems are most vulnerable to intercept. A tradeoff study of emitters can be made to determine placement and use of emitters to defend your position yet remains undetected for as long as possible. These considerations can be made with the radar/ESM vulnerability display.

The tactical situation could also be applied in a reverse sense. For example, you may be airborne, trying to approach a heavily defended area, giving as little advance notice as possible. You do this by not radiating an EM system except for your downward looking terrain following radar. Using the radar/ESM vulnerability display, you will be able to assess the effects of diffraction over terrain features. While the main beam of the radar is pointed toward the ground, energy is still being radiated outward through the sidelobes. The sidelobe energy could be diffracted forward over steep terrain to an ESM receiver at the defended area, thereby giving unsuspected advanced notice of your arrival. Consider a mission to approach a hostile coastline and provide AAW surveillance for the protection of an amphibious landing force, illustrated in figure D-14.

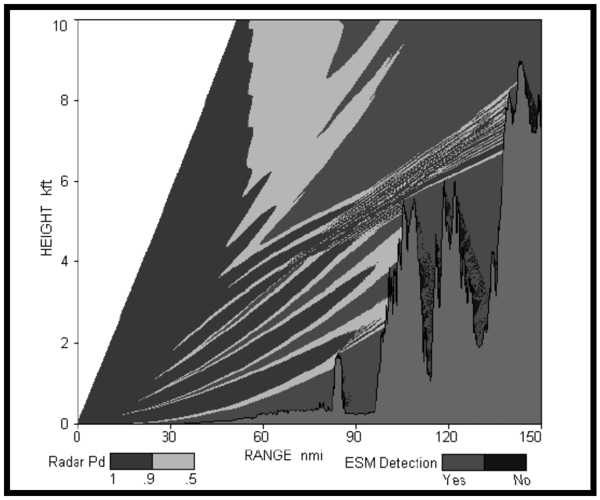


Figure D-14: Radar and ESM intercept decision aid.

For this mission, it is highly desirable to remain undetected for as long as possible. You anticipate the coastal mountain ranges will provide you cover from ESM intercept. Using the combination radar detection and ESM vulnerability decision aid, you can visualize your detection ranges for the anticipated threat aircraft and also see the vulnerability of your air surveillance radar to a hostile ESM receiver. In this example, the environment is a surface-based duct at your ship's location that rises to become an elevated duct over the coastal terrain. This ducting condition provides fairly reasonable detection for targets at ranges of 100 nautical miles. As you would expect, your radar is vulnerable to intercept at even greater ranges. You can see, however, an ESM receiver that is located 120 nautical miles away and within a valley beyond 2 mountain ranges, is still capable of intercepting your radar's energy. The coastal mountains do not provide the intercept protection you were expecting. For this case, the mission commander may choose to use an airborne platform for AAW surveillance instead of a ship platform.

UHF/VHF Communications. It is commonly thought that UHF/VHF communications is a line-of-sight event. This is true under standard atmospheric conditions. Consider a tactical application such as a ship trying to communicate with ground troops over a water and terrain path. The communications decision aid shown in figure D-15, for a standard atmosphere indicates a loss of surface communications at a range of approximately 8 nautical miles. Communications is not regained until 25 nautical miles from the ship with the troops at an altitude of 250 feet. By examining the areas of no communications, the ashore forces can determine a good location to establish a command center with adequate communications to the afloat platform or to aid in troop positioning.

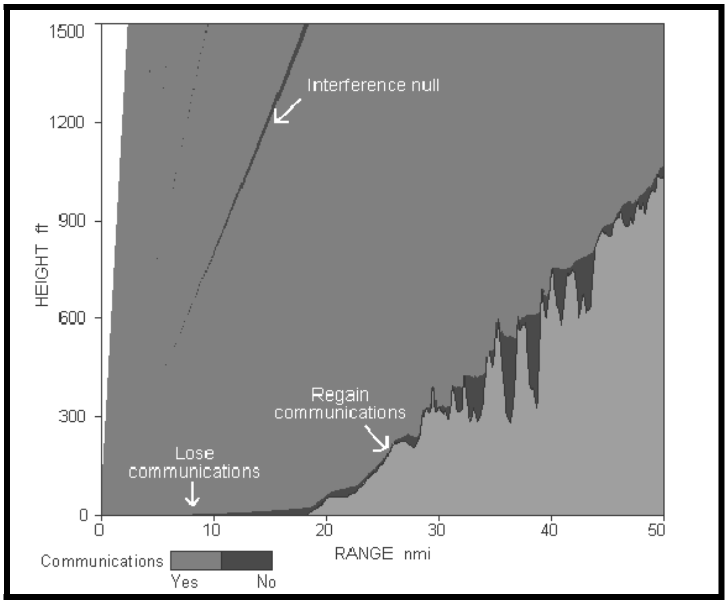


Figure D-15: UHF communications decision aid.

Tactics for ASW helicopter operations may also benefit from the knowledge of ducting or nonducting conditions. For example, under standard atmospheric conditions as illustrated in figure D-16, the helicopter (at an altitude of approximately 50 feet) can maintain both ASW surveillance with its dipping sonar and communicate with the ship at a range of approximately 33 nautical miles.

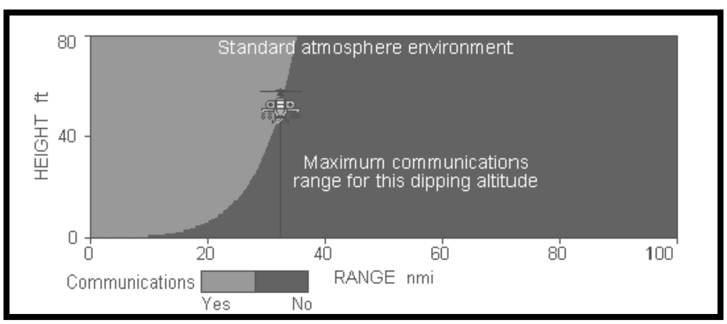


Figure D-16: UHF communications under standard atmosphere conditions.

Under surface-based ducting conditions, figure D-17, the helicopter at the same altitude could extend the communication ranges well beyond 60 nautical miles. In addition, the decision aid shows surface-based ducting skip zones that could preclude communications at certain ranges.

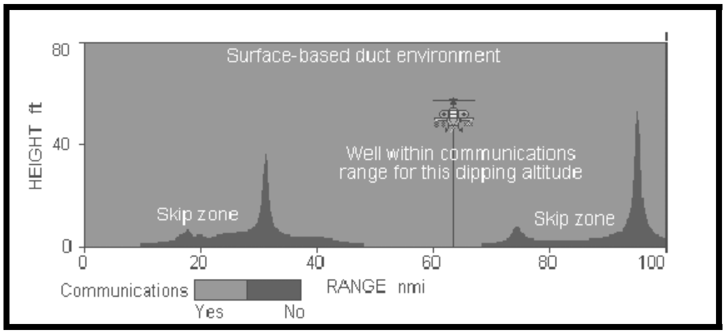


Figure D-17: UHF communications under surface-based ducting conditions.

METOC Briefings. Stand-up METOC briefings can be conducted to support operational or tactical objectives. A variety of medium can be used in preparing these briefs ranging from overhead transparencies to computer/electronic presentations. Prior planning and coordination with G/S-2 and G/S-3 is recommended to ensure consistency, continuity and appropriateness of the type of brief to be conducted. Two common types of METOC briefings will be discussed here. (See figures D-18 through D-20 for examples of METOC briefing products).

Climatological Briefs. These briefs can be conducted for any geographical area or location of interest for any time of year. They are normally conducted as part of pre-deployment work-ups to normal operations, exercises, or actual contingencies. Climatological briefs should be requested in advance of initial planning sessions to allow all planners time to consider the historical environmental effects.

SAMPLE CLIMATOLOGICAL BRIEF

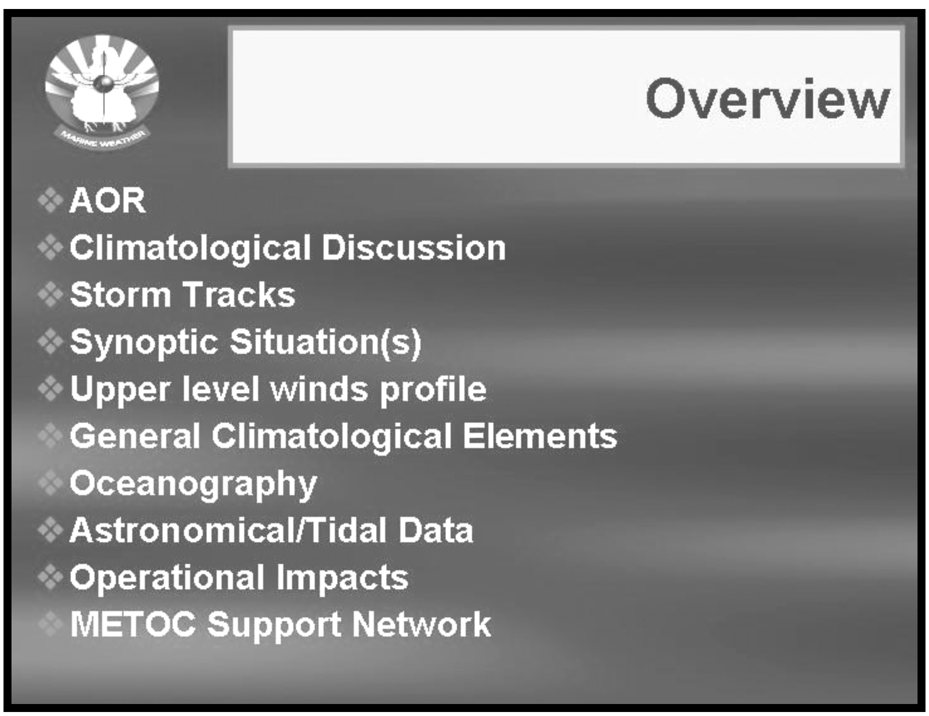
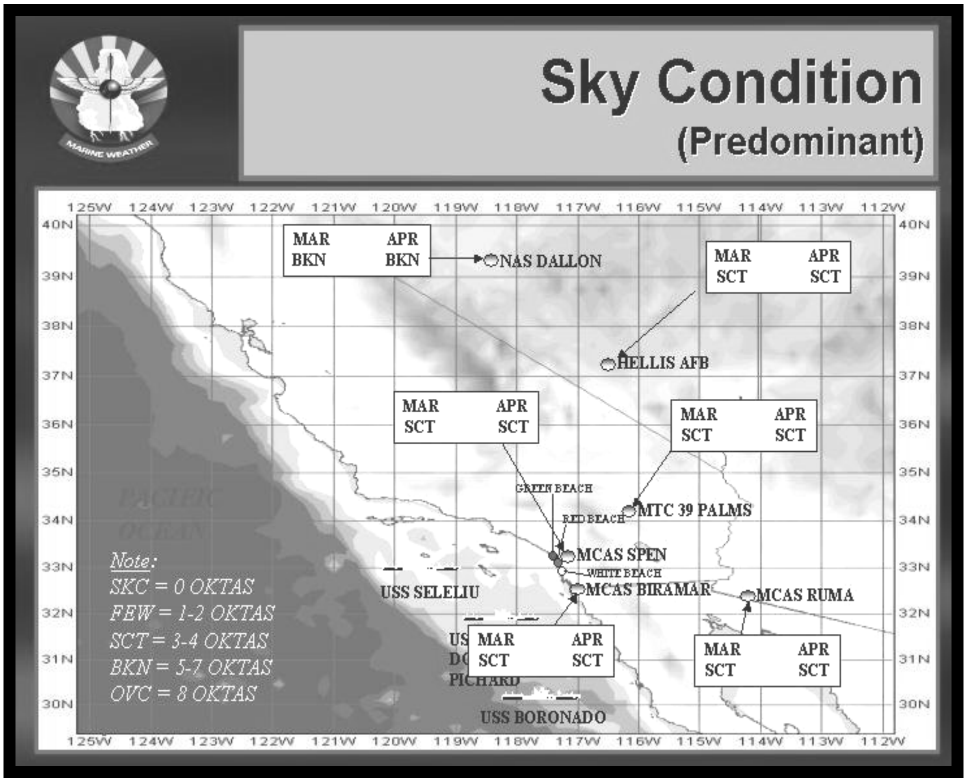


Figure D-18 Sample Climatology Brief (Continued)



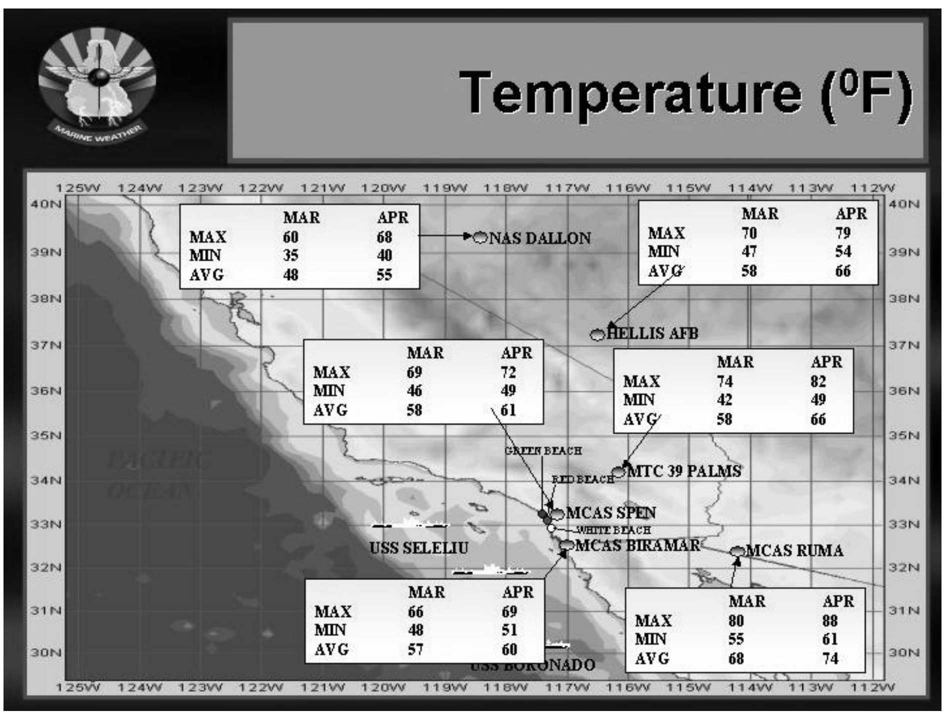
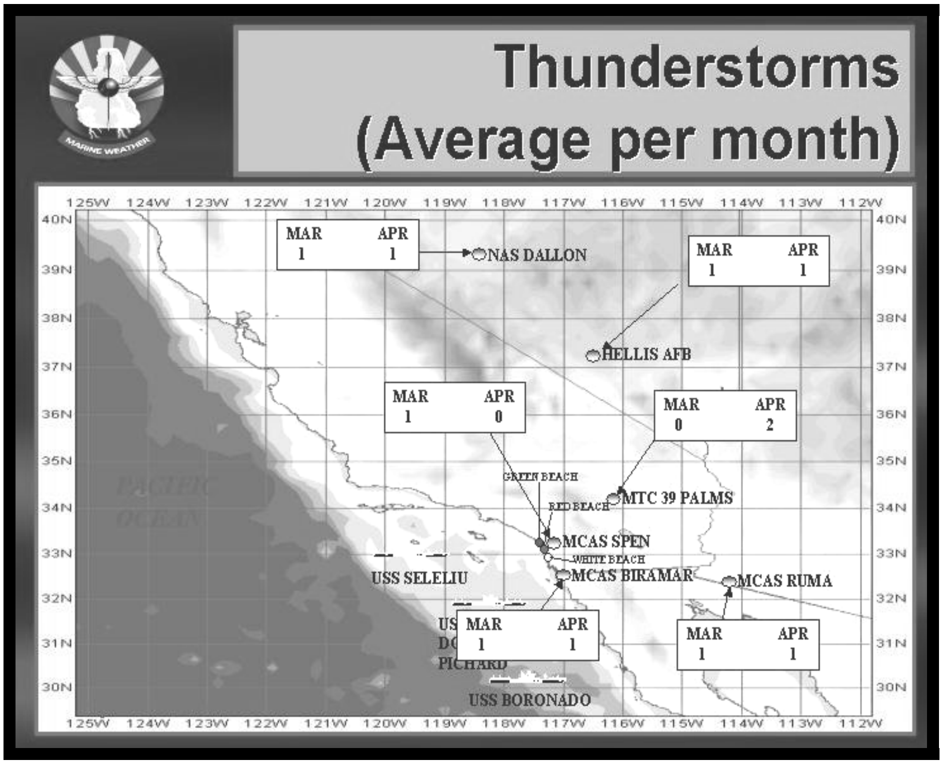
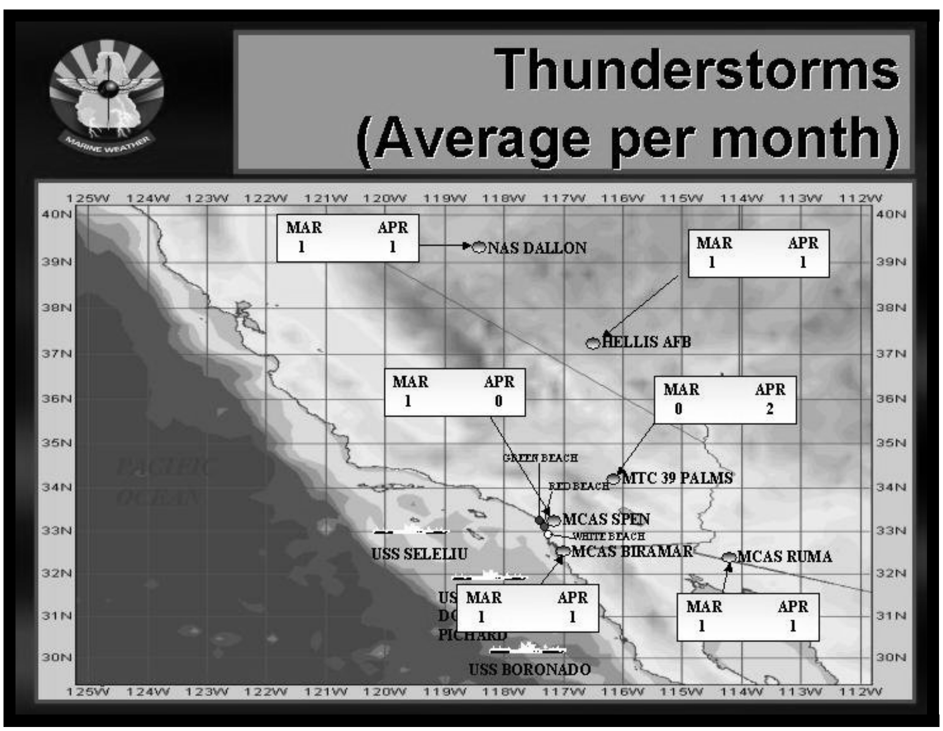


Figure D-18 Sample Climatology Brief (Continued)





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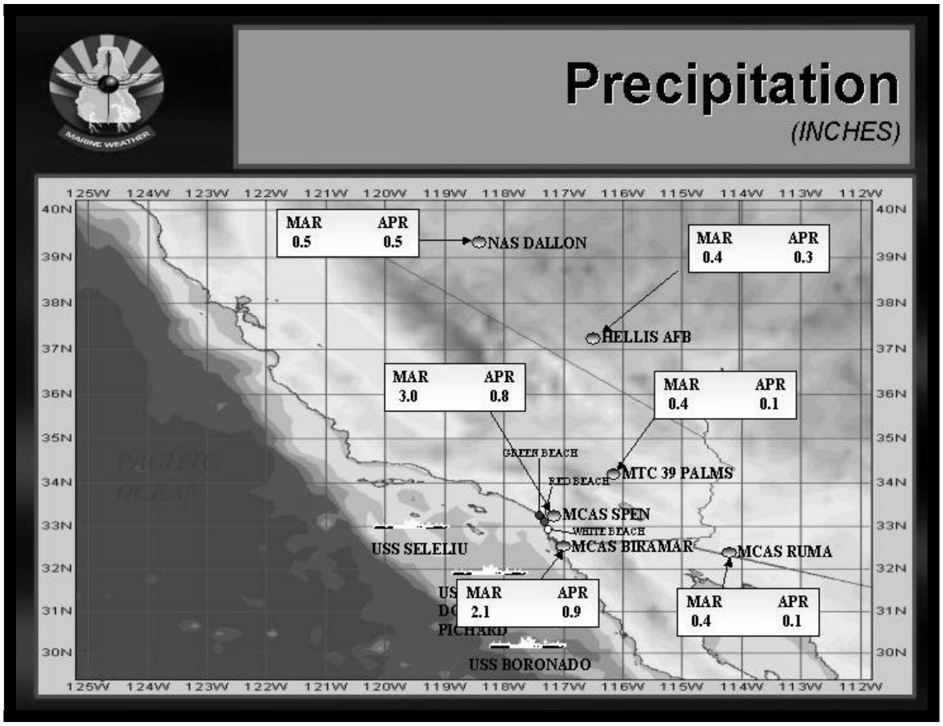

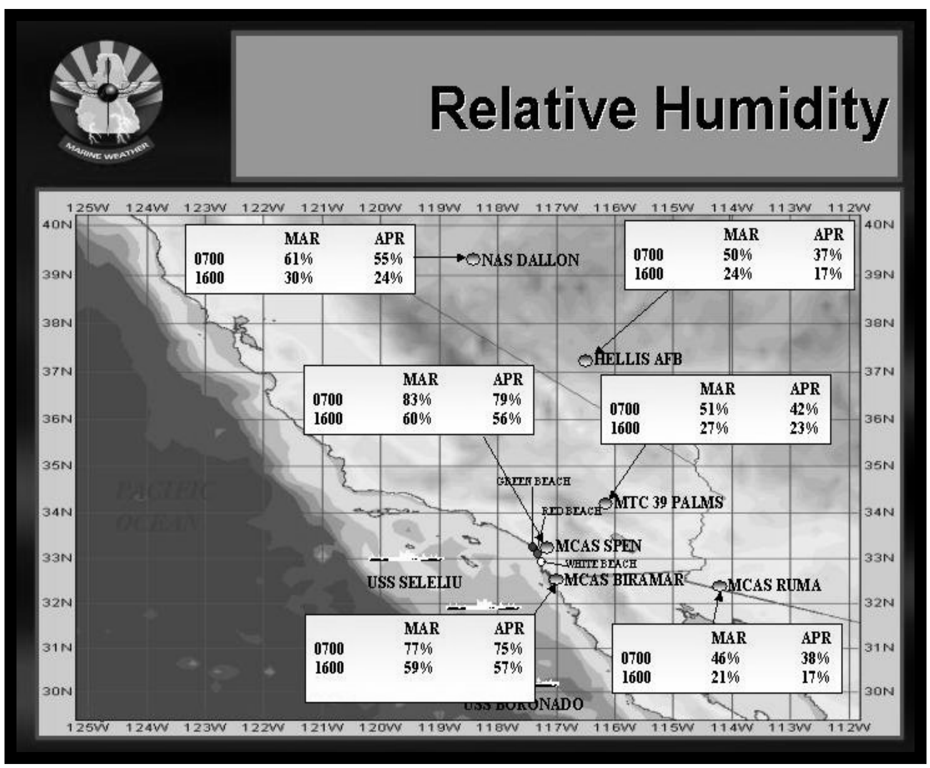

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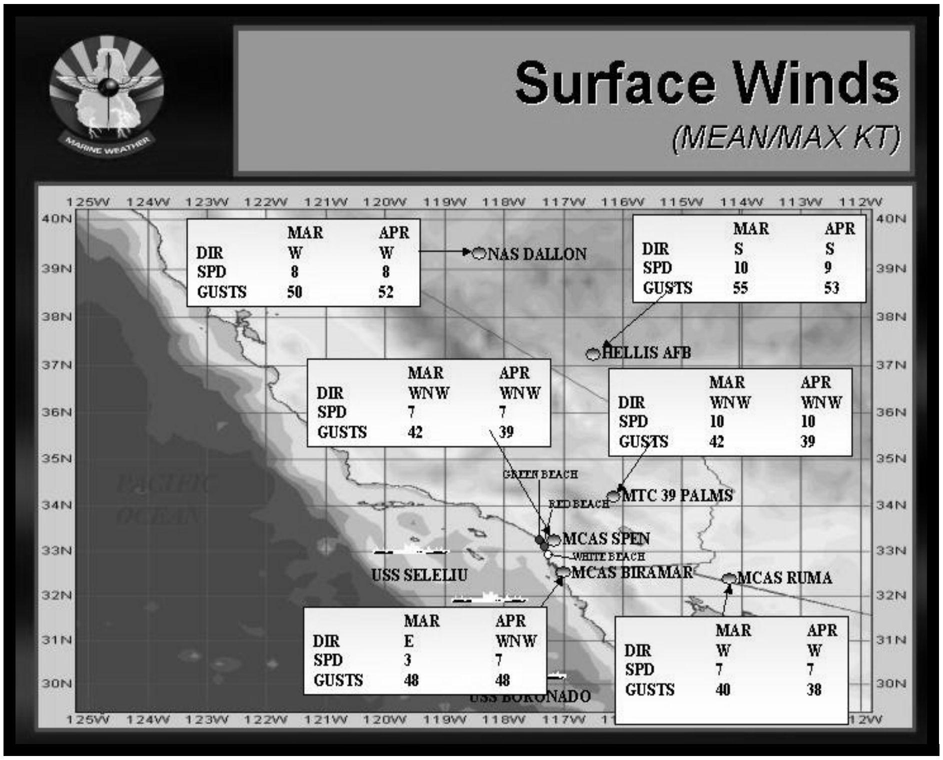

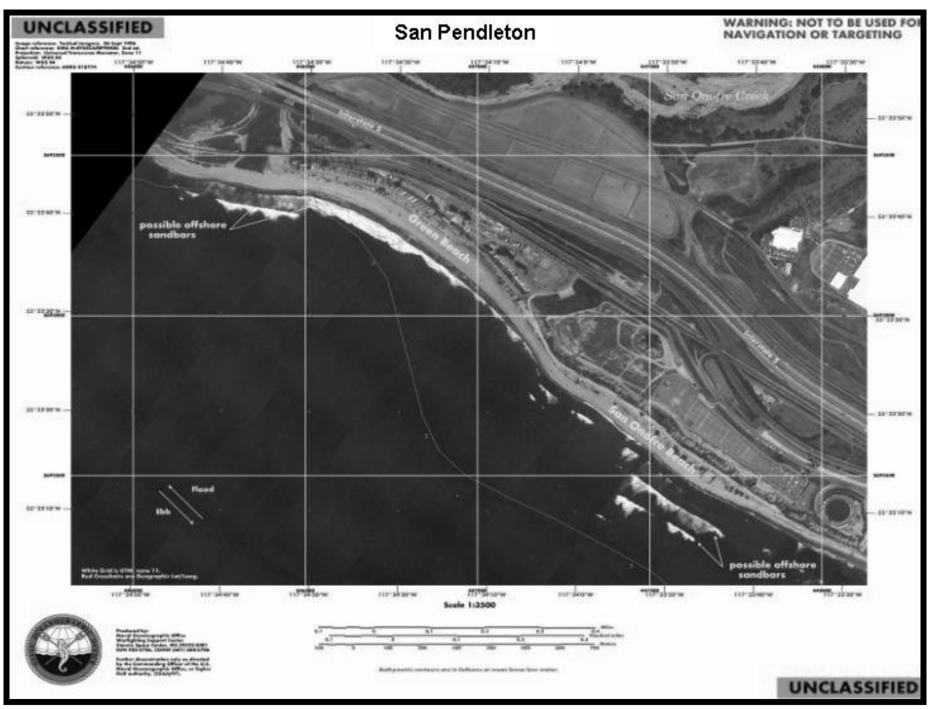

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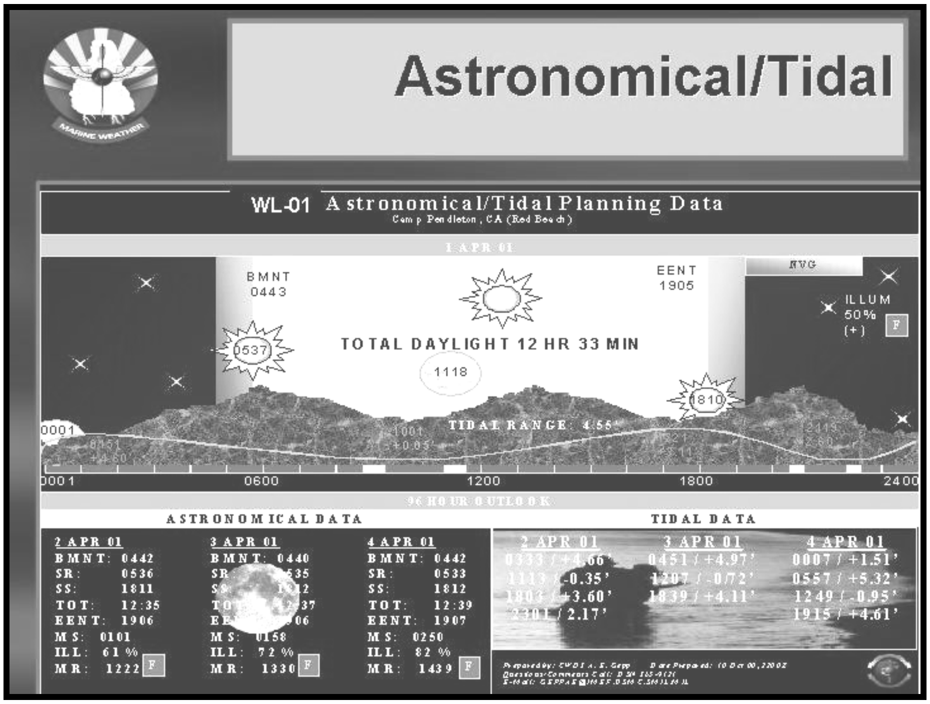


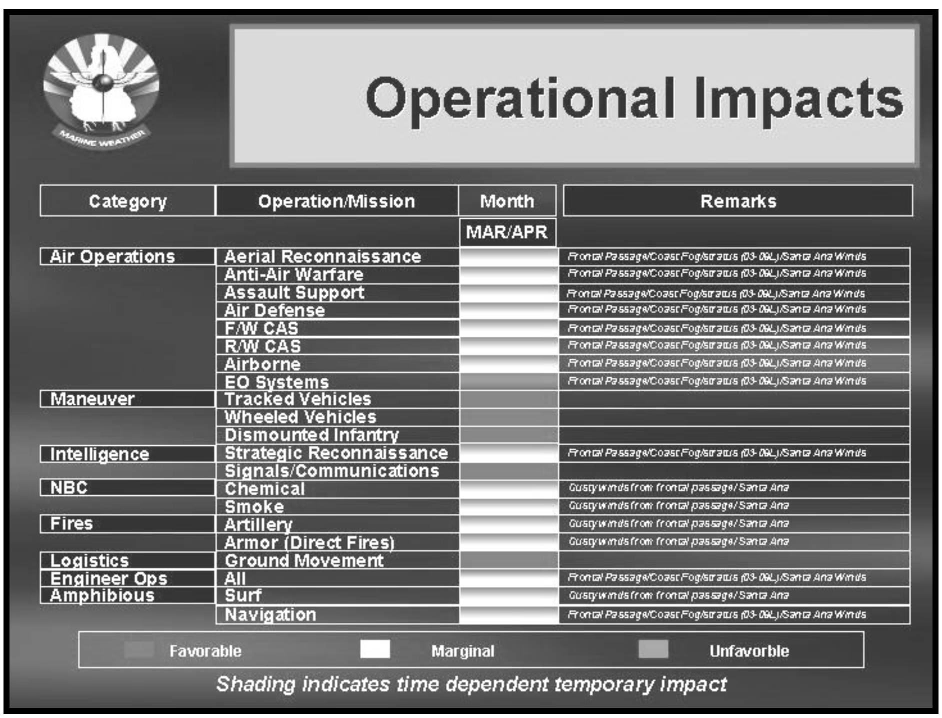


Figure D-18 Sample Climatology Brief (Continued)

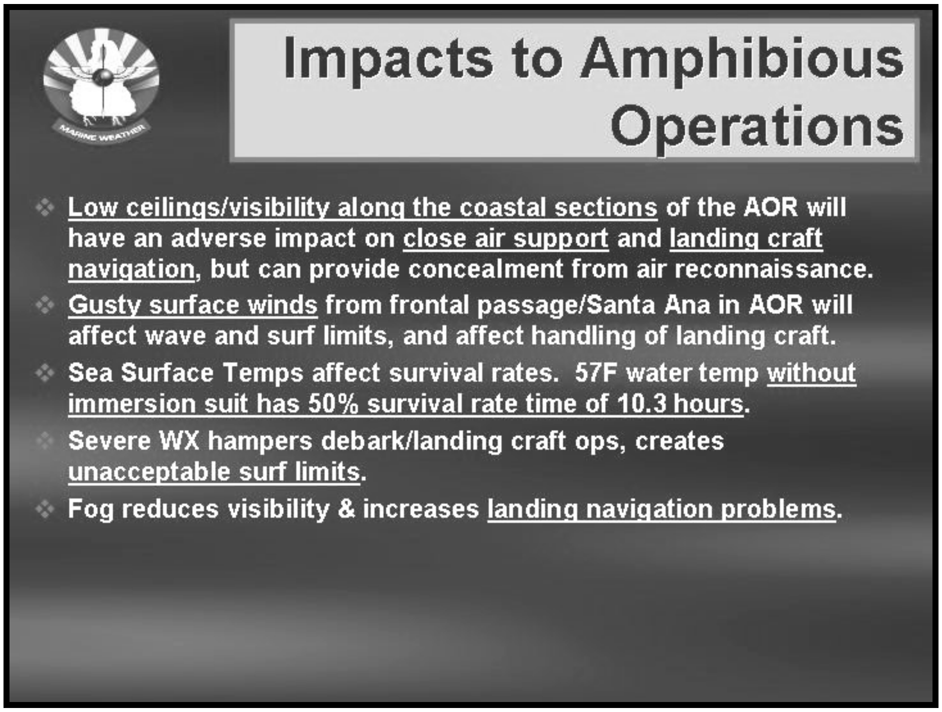
Impacts to Air Operations

- Persistent low clouds and patchy fog along coastal sections may limit operations. May preclude landings or increase danger in takeoffs. May preclude CAS missions.
- Visibility affects landing/takeoff capabilities, AR, and TGT AQ. Low visibility increases flight hazards. Suspended dust, haze, and extensive heating will restrict EO capability.
- Gusty winds associated with frontal passage/Santa Ana will affect aircraft control near the ground, take-off, landing, and ground speed for low level flights. Mechanical turbulence near mountains affects aircraft handling during frontal passage.
- Infrequent thunderstorms and lightning will affect refueling and re-arming operations.

Impacts to Ground Operations

- Low ceilings along the coast will have an adverse impact on close air support, but can provide concealment from air reconnaissance.
- Low visibility may affect target acquisitions and degrade laser range finding/target designation.
- Precipitation degrades trafficability.
- Gusty winds from frontal passage/Santa Ana will cause smoke to disperse quickly and degrade trajectory data and first-round hit capability.
- Low visibility's along coastal sections of AOR will affect visual acquisition and degrade laser range finding and target designation.

Figure D-18 Sample Climatology Brief (Continued)



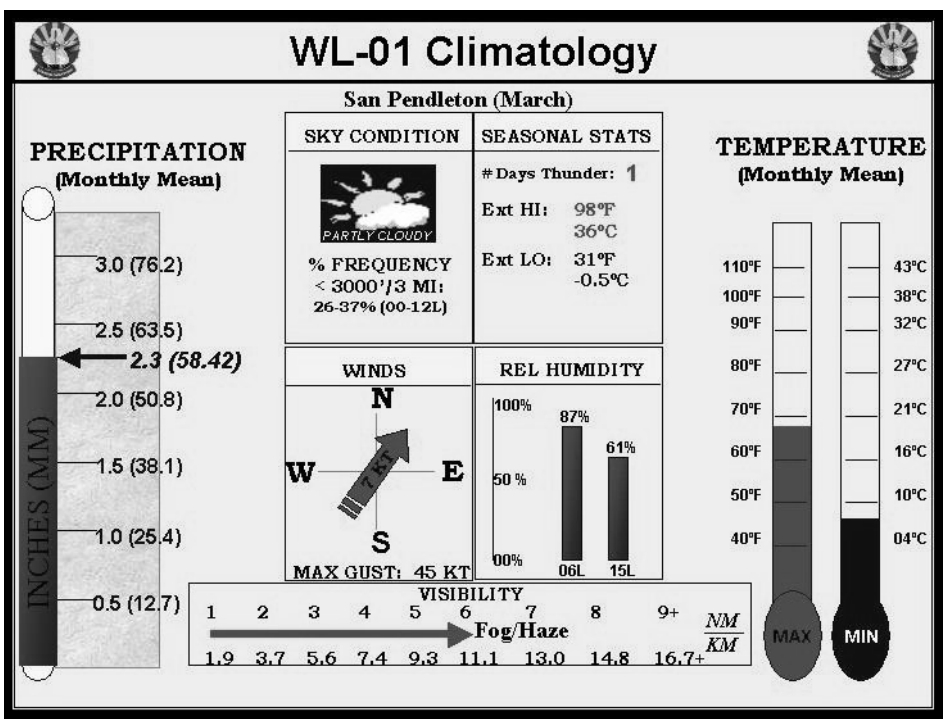


Figure D-18 Sample Climatology Brief (Continued)

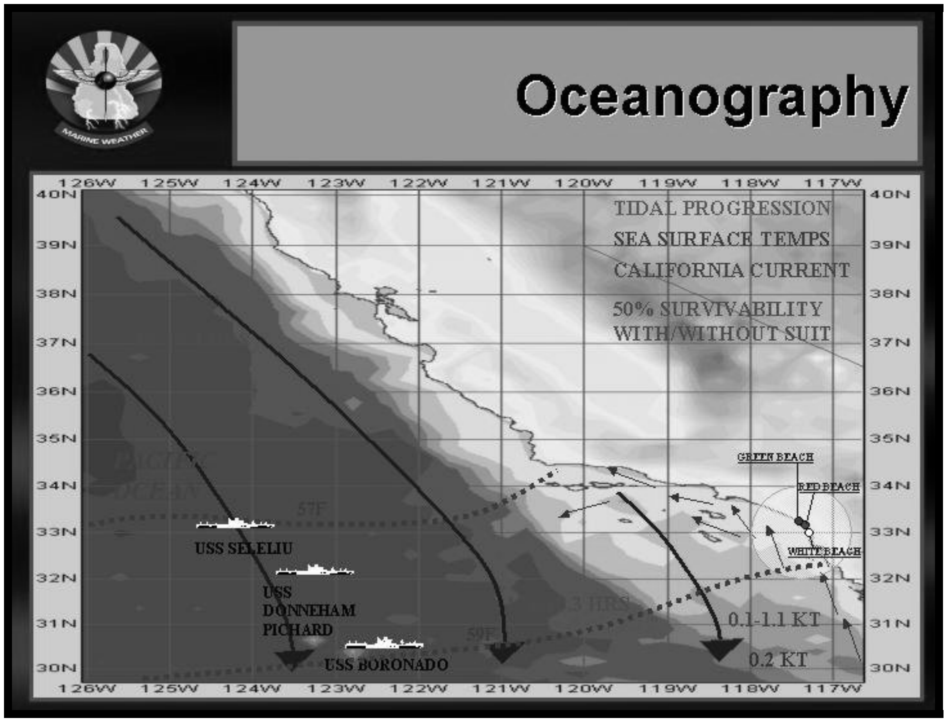


Figure D-18 Sample Climatology Brief (Continued)

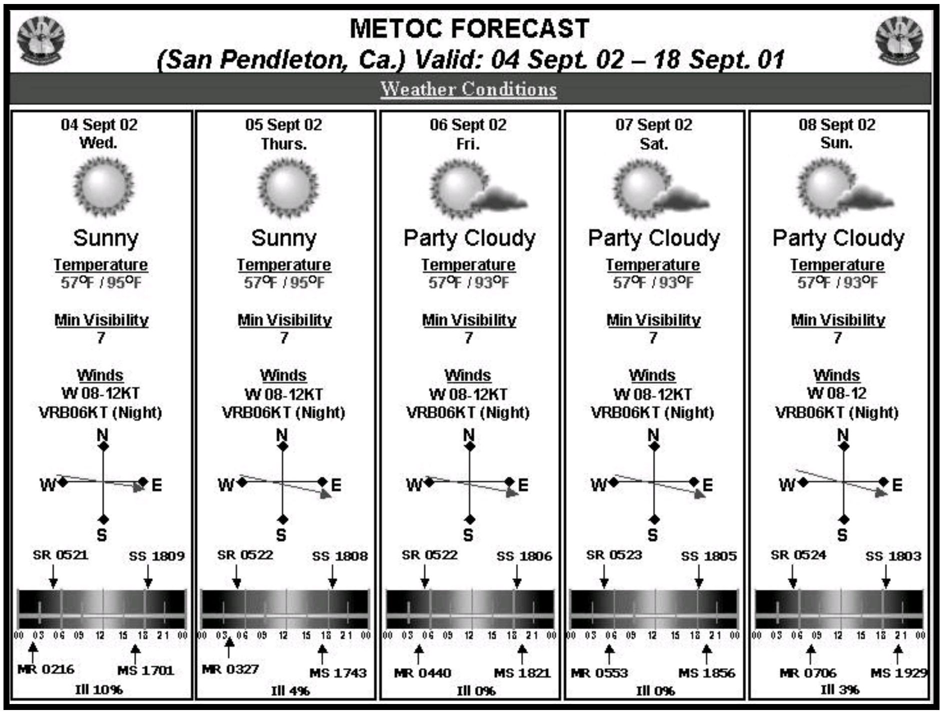
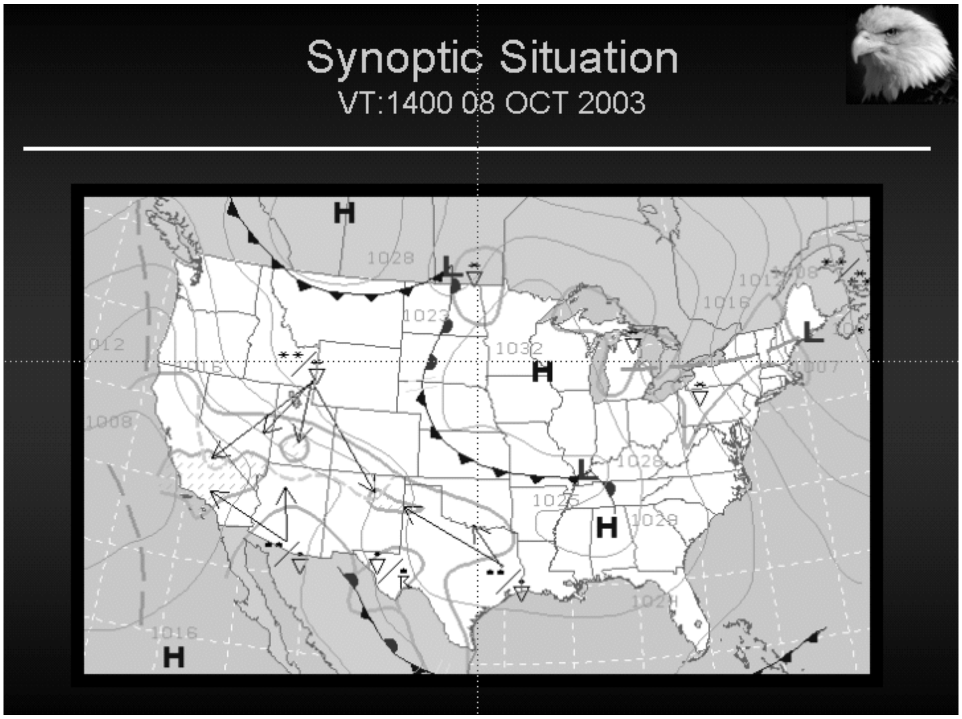
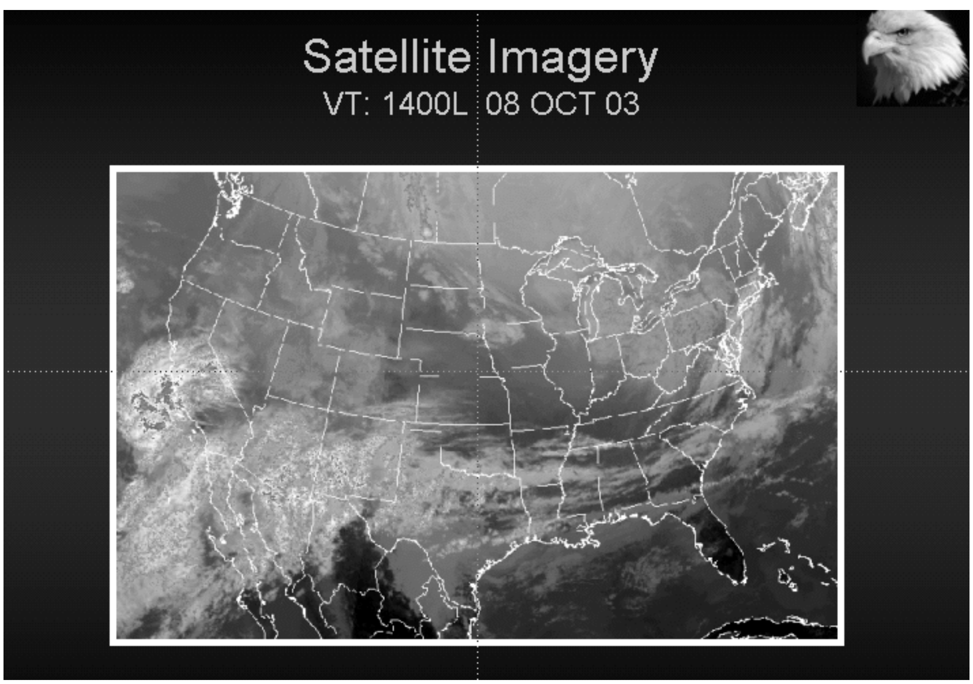
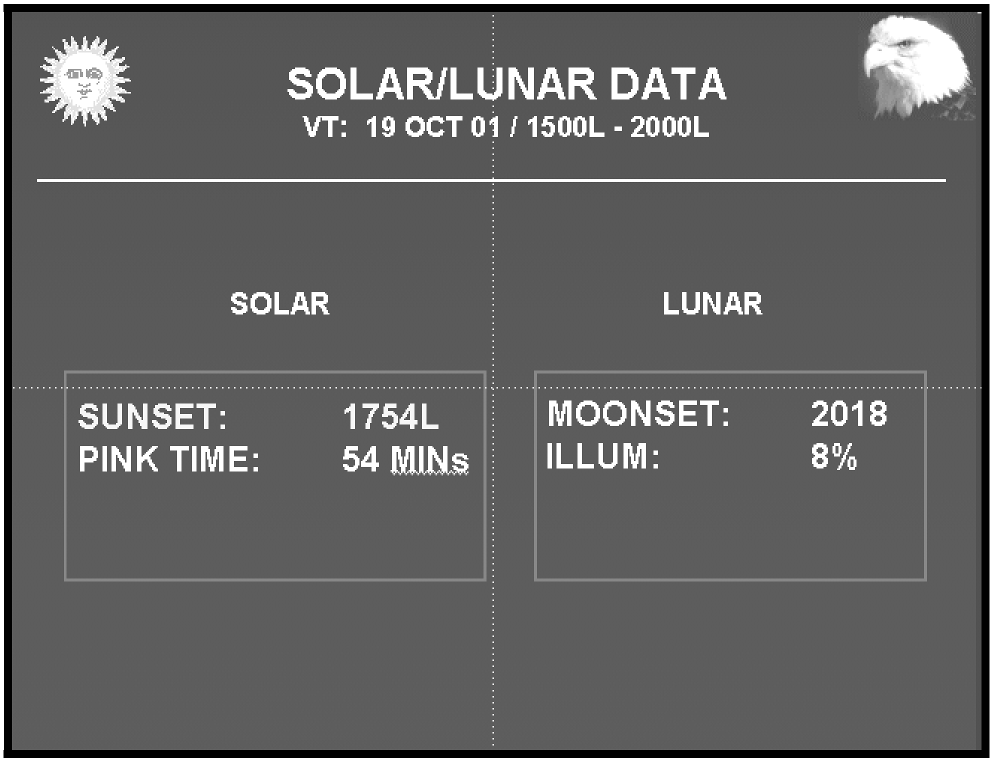


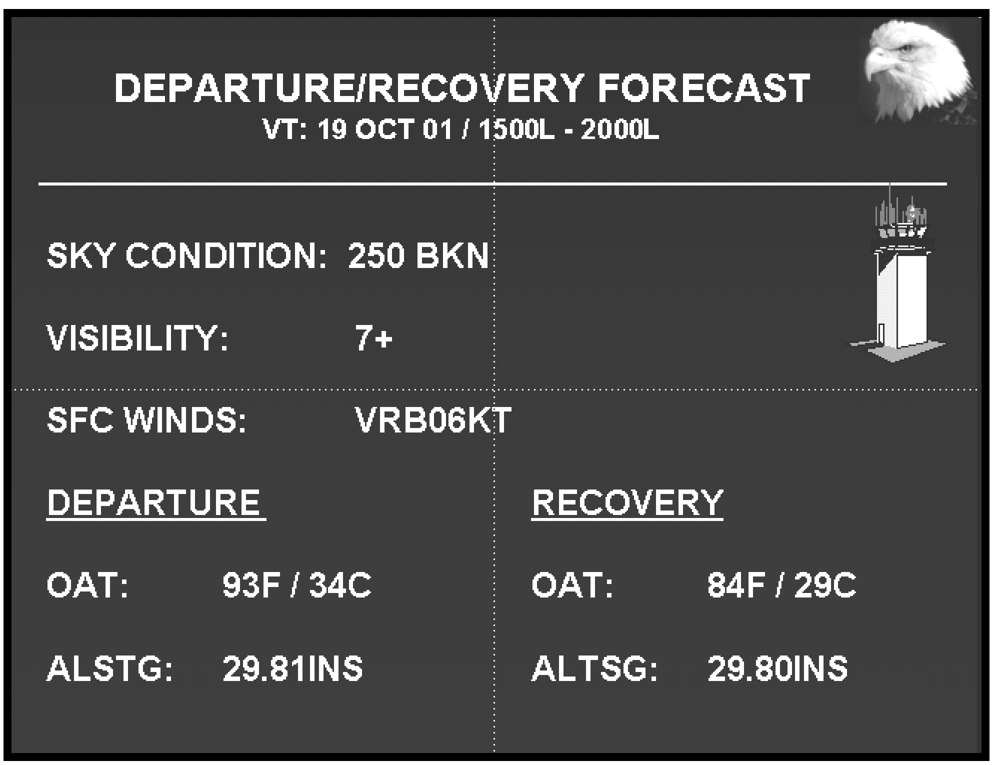
Figure D-19 Sample METOC Forecast





D-20 Sample METOC Operational Brief (Aviation)





D-20 Sample METOC Operational Brief (Aviation)

FLIGHT LEVEL DATA

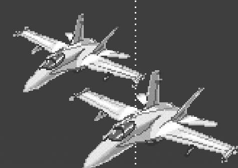
VT: 19 OCT 01 / 1500L - 2000L

CONTRAILS: POS: 33,200' PROB : 37,600'

MIN FREEZING LVL: 15,000'

ICING: NONE

TURBULENCE: NONE

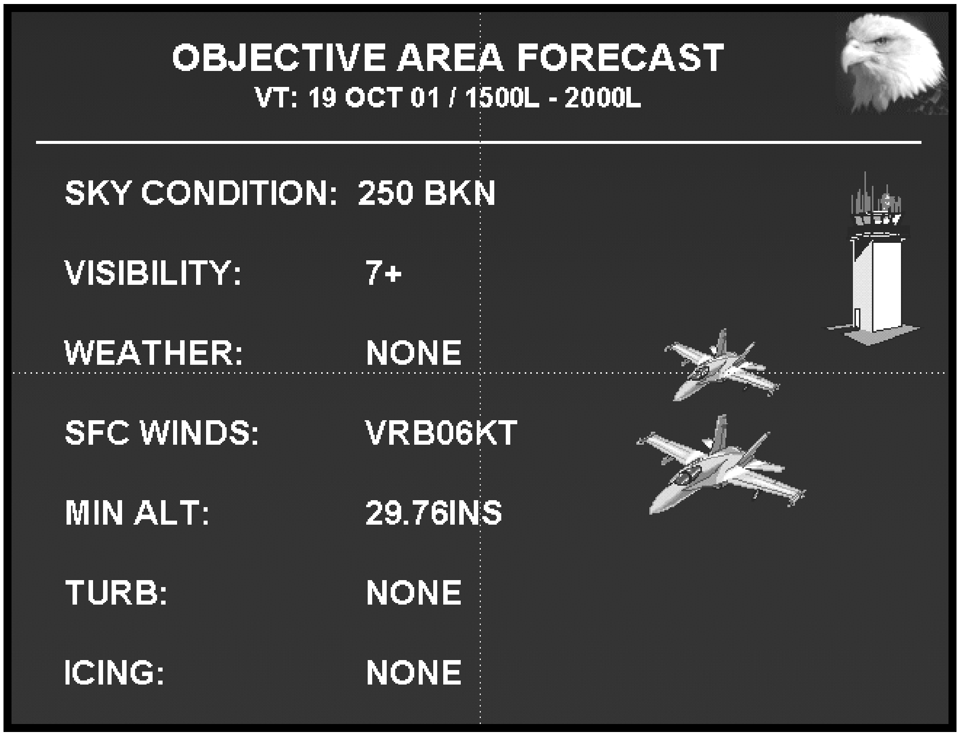


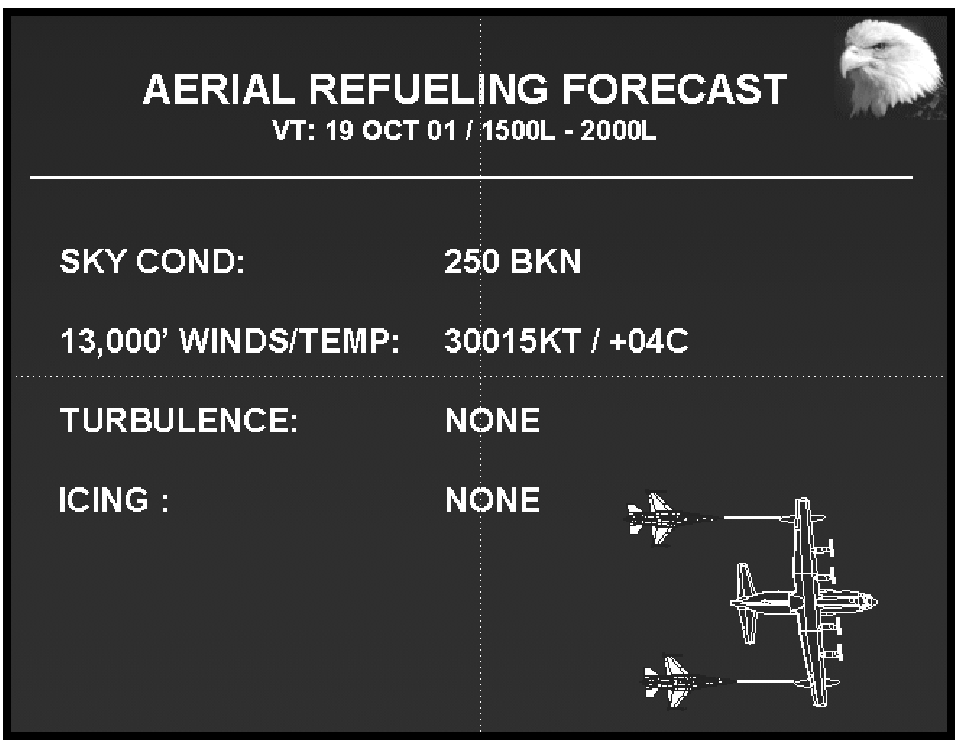
FLIGHT LEVEL WINDS/TEMP

VT: 19 OCT 01 / 1500L - 2000L

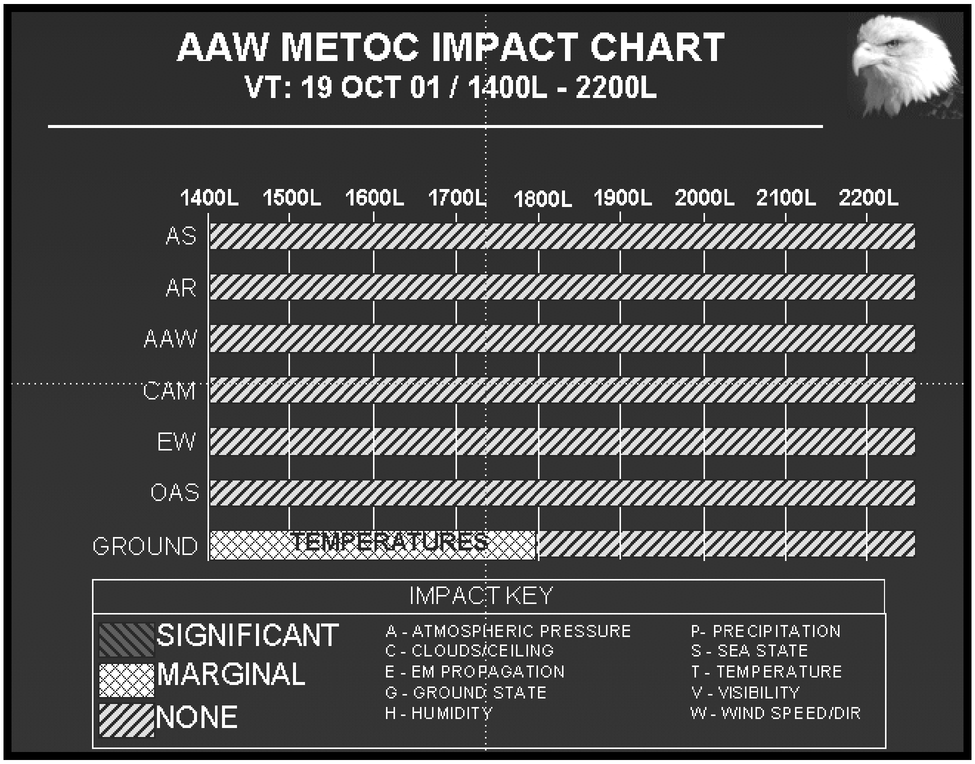
FLT LVL	WINDS	TEMPS
400	29050KT	- 57C
350	29040KT	- 47C
300	29035KT	- 36C
250	30025KT	- 23C
200	30020KT	- 12C
150	30015KT	- 01C
100	31010KT	+ 09C
050	34005KT	+ 22C

D-20 Sample METOC Operational Brief (Aviation)





D-20 Sample METOC Operational Brief (Aviation)



D-20 Sample METOC Operational Brief (Aviation)

SECTION II OCEANOGRAPHIC PRODUCTS

Section II: Oceanographic Products

Several oceanographic products and services are available to aid MAGTF commanders and planners. Tailored products can be provided on request to accommodate many missions and situations. Some of the more common products and services are listed below.

Tides

This product provides a summary of tidal range, heights, and times of high and low tides. Exact site location is required for accurate output. Output is available in tabular or graphical format.

Annotated Imagery of Littoral Areas

Images obtained from land satellite, the French *satellite pour l'observation de la terre* (SPOT), 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

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

Sea Surface Conditions

Surface conditions in the operating area can affect both divers and other reconnaissance personnel. These conditions are influenced by time of year, wind, waves, tides, current, cloud cover, temperature, visibility, and the presence of other ships. A significant factor is the sea state. Wave action can affect everything from the stability of the moor to the vulnerability of the crew to seasickness or boat drifts or swings around an anchor, fouling lines and dragging divers. In addition, surface waves may become a problem when the diver enters or leaves the water and during decompression stops near the surface. Table D-1 provides a sample sea state chart.

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 (CLF), survey normally encompasses the nearshore area from the three-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 CLF. The hydrographic survey and beach survey overlap in that they both cover the foreshore.

TABLE D-1. Sea State Chart

Sea State	Description	Wind Force (Beaufort)	Wind Description	Wind Range KT	Wind Velocity (Knots)	Average Wave Height Meters/Feet	
0	Calm (glassy)	**0**	Calm	<1	0	0	0
1	Calm (rippled)	**1**	Light Air	1-3	2	2	0.05
2	Smooth (wavelets)	**2**	Light Breeze	4-6	5	0.01	0.033
3	Slight	**3**	Gentle Breeze	7-10	8.5-10	0.1-0.5	0.33-1.66
4	Fresh	**4**	Fresh Breeze	11-16	12-16	0.5-1.125	2-4
5	Moderate	**5**	Moderate Breeze	17-21	17-20	1.25-2.5	4-8
6	Rough	**6**	Strong Breeze	22-27	21-26	2.4-4	8-13
7	Very rough	**7**	Moderate Gale	28-33	27-32	4-6	13-20
8	High	**8**	Fresh Gale	34-40	33-39	6-9	20-30
9	Very high	**9**	Strong Gale	41-47	41-46	9-13	30-45
10	Exceptional	**10**	Whole-Gale	48-55	48-54	14-19	45-59
11	Exceptionally High	**11**	Storm	56-63	55-61	20-24	60-73
12	Phenomenal	**12**	Hurricane	64-71	62-70	Over 26	80 and Up

Appendix E
Weather Effects on MAGTF Operations (Draft)

This appendix describes common weather elements and weather effects on specific types of units and selected operations.

Common Effects

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 elements and operations.

Many of the common effects can be derived for planning purposes from the climate of the theater of operations. Special attention must be given to those elements of weather that may limit operations or preclude them altogether. For instance, operations in the tropics must be planned to consider the recurring cycle of the monsoon season. In continental Europe, strategies must consider severe winters and the annual autumn freezes and spring thaws, which 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 meteorologically feasible at the operational level of warfare and for planning for seasonal weather changes to be considered early in the planning process.

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 ground and air 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.

Weather Elements

Terrain features affect weather, climate, and weather elements such as:

- Visibility
- Temperature
- Humidity
- Precipitation
- Wind
- Clouds.

Specific 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 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
- Illumination and obstructions to vision.

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.

Wind

Wind speed and direction, both on the surface and aloft, usually favor the upwind force in the use of nuclear, biological, and chemical (NBC) 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 by blowing sand, dust, and other material.

Generally, winds above 20 nautical miles per hour create such effects. Smoke operations are usually ineffective at wind speeds greater than seven nautical miles per hour. As surface wind speed in-creases, 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. A windchill index chart developed by the U.S. Army Research Institute of Environmental Medicine is shown as figure E-1. Trench foot and immersion foot may occur at any point on the chart.

Precipitation

The primary significance of precipitation is its effect on soil; visibility; personnel effectiveness; and the functioning of ground maneuver units, aviation, CSS operations, and electro-optical and infrared systems. The state of the ground affects trafficability; heavy rain can make some unsurfaced roads and off-road areas impassable. Rain and snow 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 NBC hot spots)
- The range of lasers, night vision devices, and thermal tank sights
- The effectiveness of aircraft.

Precipitation also degrades the quality of supplies in storage. Snow accumulation of greater than one 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 two 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.

Appendix E
Weather Effects on MAGTF Operations (Draft)

WIND SPEED (M/S)

TEMP C	0	3	5	8	10	13	15	18	21	23
-22	-22	-27	-37	-43	-47	-50	-53	-54	-55	-55
-19	-19	-23	-33	-39	-43	-46	-48	-49	-50	-51
-16	-16	-20	-29	-35	-39	-41	-43	-45	-45	-46
-13	-13	-17	-25	-31	-34	-37	-39	-40	-41	-41
-10	-10	-14	-22	-26	-30	-32	-34	-35	-36	-36
-7	-7	-10	-18	-22	-25	-28	-29	-30	-31	-31
-4	-4	-7	-14	-18	-21	-23	-25	-26	-26	-27
-1	-1	-4	-10	-14	-17	-19	-20	-21	-21	-22
2	2	-1	-6	-10	-12	-14	-15	-16	-17	-17
5	5	3	-3	-6	-8	-9	-11	-11	-12	-12

Level:	Little Danger	Increasing Danger	Great Danger
Range:	> -31 deg C	-32 to -58 deg C	< -59 deg C

Figure E-1. Windchill Index Chart

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 sup-port. 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 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 (for example, fuel, weapons, and 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; in-crease the dependence on logistical support; 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. 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 °F. 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 in mission-oriented protective posture (MOPP) gear. (See **Figure E-1**)

Temperatures of targets and objects on the battlefield at night are important for the use of thermal sights and forward looking infrared (FLIR) de-vices. 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 her days; this depends on the threshold temperature contrast required by the thermal device. TDAs 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 land- line communications and both communication and non-communication use of the EM spectrum.

Illumination and Obstructions to Vision

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.

Meteorological Products

Meteorological products are categorized as either primary products or tactical weather products. Primary products are used by the weather service officer in preparing tactical weather products. They are usually received in the form of weather observations, forecasts, gridded data, and clima-tological studies. Primary products are received from indigenous sources, other Marine Corps weather units, the Navy, the Air Force, and in-flight aircraft in wartime and from the National Weather Service (NWS) and Federal Aviation Administration (FAA) in peacetime. Although some primary weather products are passed directly to MAGTF users, many need to be modified or updated to reflect local observation, local terrain, and mission requirements. Weather observations contain information on existing weather conditions and specific weather elements at specific locations and times. The basic types of observations are surface and upper air.

Surface Observations

Surface observations are taken hourly or as re-quired by the Marine Corps Weather Service. Observations include:

- Surface winds
- Precipitation type and intensity
- Prevailing visibility
- Obstructions to vision
- Clouds/ceiling
- Temperature
- Dewpoint temperature
- Surface atmospheric pressure
- Remarks
- Altimeter setting

- Humidity.

Additional elements may include:

- Snow depth
- Precipitation amounts
- State of the ground
- Maximum and minimum temperatures.

Other information such as windchill, PA, and DA can be derived from the surface observation. The wet bulb globe temperature is obtained from weather units and provides information on heat casualty potential. Freeze-thaw depth, ice thick-ness, current water depth, river stages, and trafficability are obtained from engineer units.

Upper-Air Observations

Upper-air observations are taken by METMFs and artillery meteorological (ARTYMET) sections at established time intervals. They measure temperature, pressure, relative humidity, and wind speed and direction. From these observations, fall-out wind estimates, ballistics information, and computer meteorological messages are prepared.

Weather Planning Factors

This paragraph describes weather planning factors that are unique to specific units or selected operations.

Effects of Weather on Amphibious Operations

Weather effects on amphibious operations may be beneficial or detrimental. Certain weather conditions may help to conceal landing operations. Other conditions may hinder beaching and unloading, task force movement, and essential air support operations. Figure E-2 (pages E-8 and E-9) shows effects of weather on amphibious operations. Table E-1 (page E-9) shows 50% survival rate times for personnel in water of various temperatures.

Effects of Weather on Ground Maneuver Operations

Armor and infantry operations are influenced primarily by those weather elements that degrade trafficability and visibility. Figure E-3 (page E-10) shows the effects of weather on armor in infantry operations.

Effects of Weather on 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. Figure E-4 (page E-11) shows the effects of weather on artillery operations.

Effects of Weather on Aviation Operations

Marine aviation is involved in multifaceted operations over the length and breadth of the battlefield. These operations include aerial weapons, reconnaissance and surveillance, and routine logistic support. Missions are varied and require the operation of both fixed-wing and rotary-wing aviation assets in a variety of flight modes and altitudes. Figure E-5 (pages E-12 and E-13) shows the effects of weather on aviation operations.

Effects of Weather on Communications and Information Systems Operations

Communications and information systems operations are affected by a number of weather elements. Virtually all of the special weather conditions that apply to communications and in-formation systems operations affect EM propagation. Figure E-6 (page E-14) shows the effects of weather on communications and information systems operations.

Appendix E
Weather Effects on MAGTF Operations (Draft)

Effects of Weather on Air Defense Operations

Air defense operations require environmental in-formation for both 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 tar-get acquisition. Figure E-7 (page E-15) shows the effects of weather on air defense operations.

Effects of Weather on Engineer Operations

Engineer operations are influenced by current environmental conditions, forecasted conditions, and climatology. Figure E-8 (page E-16) shows the effects of weather on engineer operations.

Effects of Weather on 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. Figure E-9 (page E-17) shows the effects of weather on intelligence operations.

Effects of Weather on Logistic Operations

Logistical 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. Figure E-10 (page E-18) shows the effects of weather on logistical operations.

Effects of Weather on 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. The requirements for weather support for ground evacuation of casual-ties are the same as for land transportation, including considering patient comfort under extreme weather conditions. Figure E-11 (page E-19) shows the effects of weather on medical support operations.

Effects of Weather on Military Police Operations

Military police are involved in weather-sensitive operations 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. Figure E-12 (page E-19) shows the effects of weather on military police operations.

Effects of Weather on NBC Operations

NBC operations are extremely sensitive to environmental conditions that affect the movement and diffusion of chemical or biological fallout. Figure E-13 (page E-20) shows the effects of weather on NBC operations.

Effects of Weather on Psychological Operations

Tactical psychological operations (PSYOPs) are influenced primarily by those weather elements that degrade the audibility of loudspeaker broadcasts and affect the distribution of leaflets. Figure E-14 (page E-21) shows the effects of weather on PSYOPs.

Severe Weather

Severe weather hampers debarkation and landing craft operations, creates unacceptable surf conditions, may preclude landing, and interferes with construction support.

Wind (Surface)

Surface wind may cause postponement of landings. It affects the state of the sea and handling of landing craft.

Windchill

Windchill may cause a requirement for special equipment and rigging for landing and for special supplies and equipment to support operations afloat and ashore.

Temperature (Surface)

Extreme surface temperatures may cause a requirement for special equipment and rigging for landing and for special supplies and equipment to support operations afloat and ashore.

Tide

Tide conditions may cause postponement of landings and may conceal beach obstacles.

Ceiling—Cloud and Sky Cover

Cloud and sky cover may hamper air support operations and landing craft navigation and may offer concealment from air reconnaissance.

Fog

Fog reduces visibility and increases landing craft navigation problems and water and terrain hazards. It may provide concealment.

Illumination

Illumination may dictate the time of landing and support operations.

Lunar Phase

The lunar phase affects tidal conditions.

Figure E-2. Effects of Weather on Amphibious Operations.

Freeze or Thaw Depth

Freeze or thaw depth may hamper movement over the beach and construction support.

State of the Sea

State of the sea may preclude landing or resupply of landing forces and may cause debarkation to be canceled. It may endanger the use of landing craft. Severe conditions can degrade naval gunfire support.

Temperature (Water)

Cold temperatures decrease survivability of personnel in the water. Survival in sea water temperatures in excess of 70 °F depends more on fatigue factors than on hypothermia.

Figure E-2. Effects of Weather on Amphibious Operations (Continued).

Sea Water Temperature F)	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
Without Immersion Suit	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.8	1.9
With Immersion Suit	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3
Sea Water Temperature(F)	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**
Without Immersion Suit	2.0	2.2	2.3	2.5	2.6	2.8	2.9	3.0	3.2	3.3
With Immersion Suit	3.5	4.0	4.4	4.8	5.3	5.8	6.2	6.7	7.1	7.6
Sea Water Temperature F)	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**
Without Immersion Suit	3.5	4.3	5.2	6.1	6.9	7.8	8.6	9.4	10.3	11.1
With Immersion Suit	8.0	9.2	10.4	11.6	12.8	14.0	15.2	16.4	17.6	18.8
Sea Water Temperature F)	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
Without Immersion Suit	12.0	12.9	13.7	14.6	15.4	16.3	17.1	18.0	18.8	19.6
With Immersion Suit	20.0	21.2	22.4	23.6	24.8	26.0	27.2	28.4	29.6	30.8

Table E-1. 50% Survival Rate Times (hours).

Visibility

Visibility may affect visual acquisition and may degrade laser range finding and target designation. Poor visibility increases the survivability of light infantry.

Precipitation

Precipitation degrades trafficability and the 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

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. Low temperatures degrade the ballistics of main guns and require frequent starting of vehicles.

Humidity

When coupled with high temperatures, humidity decreases the effectiveness of crews in closed vehicles and the stamina of unmounted Marines.

Barometric Pressure

Barometric pressure affects M1 gunnery computations.

Figure E-3 Effects of Weather on Ground Maneuver Operations.

Ceiling—Cloud and Sky Cover

Cloud and sky cover affect target acquisition and terminally guided munitions.

Visibility

Visibility affects target acquisition and fire adjustment as well as electro-optical target designation.

Electrical Storms and Thunder

Electrical storms and thunder restrict munitions handling.

Refractive Index

Refraction affects radar, laser, and infrared distance measuring techniques.

Wind (Surface)

Surface wind affects the accuracy of rocket fires.

Wind (Aloft)

Wind profiles are used to calculate ballistic wind correction.

Altimeter Setting and Atmospheric Pressure

Altimeter setting and atmospheric pressure are important factors in ensuring altitude accuracy, in barofuzing, and in making fire control calculations.

Density Profile

The density profile affects fire control computations.

Pressure Profile

The pressure profile is used for baroarming and barofuzing techniques and for calculating densities.

Temperature (Surface)

Surface temperature information is used in making fire control surface density determinations and in estimating ballistic atmosphere pressure and densities aloft.

Temperature Profile

The temperature profile is used to calculate ballistic temperature and air density.

Moisture Profile

The moisture profile is used to determine virtual temperature and atmosphere ducting conditions. It affects electro-optical target designation.

Figure E-4. Effects of Weather on Artillery Operations.

Ceiling—Cloud and Sky Cover

Cloud and sky cover limit operations in which aircraft are required to operate clear of clouds, may preclude landings or increase danger in takeoffs, and may preclude close air support missions.

Visibility

Visibility affects landing and takeoff capabilities, reconnaissance and target acquisition, electro-optical target designation, and terminally guided munitions. Low visibility increases flight hazards.

Electrical Storms and Thunder

Electrical storms are hazardous to in-flight operations, refueling operations, and rearming operations.

Precipitation

Precipitation affects visibility, flight safety, and density altitude. Powdery snow may preclude hover operations.

Snow Depth

Snow affects ground handling.

Refractive Index

Refraction affects optical, radar, laser, and infrared range finding techniques.

State of the Ground

The state of the ground influences the effectiveness of air-delivered munitions.

Turbulence

Turbulence affects reconnaissance and surveillance; shear affects systems performance. Turbulence may cause aircraft structural damage and affect aircraft control. Severe turbulence may cause cancellation of operations.

Wind (Surface)

Surface wind affects aircraft control near the ground. It affects landing and takeoff as well as ground speed for low-level flights.

Turbulence

Turbulence affects reconnaissance and surveillance; shear affects systems performance. Turbulence may cause aircraft structural damage and affect aircraft control. Severe turbulence may cause cancellation of operations.

Wind (Surface)

Surface wind affects aircraft control near the ground. It affects landing and takeoff as well as ground speed for low-level flights.

Blowing Dust and Sand

Blowing dust and sand may affect hydraulic systems and windscreens.

Figure E-5. Effects of Weather on Aviation Operations.

Wind (Aloft)

Wind aloft affects navigation and ground speed at higher flight altitudes.

Density Altitude

DA affects lift capabilities and reciprocating engine performance. It also limits fuel and weapons load.

Pressure Altitude

PA affects reciprocating engine performance.

Pressure Profile

Pressure affects terrain avoidance.

Temperature (Surface)

High temperatures reduce lift capabilities. Cold temperatures increase maintenance requirements and time to perform. Temperature extremes can also reduce the number of personnel carried because of weight and bulk of protection gear.

Dewpoint

Dewpoint affects engine efficiency calculations and serves as a warning of possible fog formation or icing conditions.

Illumination

Illumination affects operations using night vision devices.

Figure E-5. Effects of Weather on Aviation Operations (Continued).

Dust

Dust affects EM propagation.

Electrical Storms and Thunder

Electrical storms interfere with radio and wire communications and may disrupt synchronization for data communications.

Fog

Fog affects EM propagation.

Precipitation

Precipitation affects EM propagation.

Blowing Snow

Blowing snow builds static discharge, which may affect EM propagation.

Ionospheric Disturbance

Ionospheric disturbance affects the reliability of radio communications systems.

Refractive Index

Refraction affects EM propagation characteristics of the atmosphere.

Icing

Icing may damage cable lines and antennas; it decreases the efficiency of microwave systems.

Wind (Surface)

Surface wind may damage antennas and transmission lines, may cause cable blowdown, and interferes with antenna installation.

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.

Humidity

Humidity may cause fungal growth within circuits; this can result in premature system failure.

Figure E-6. Effects of Weather on Communications and Information Systems Operations.

Refractive Index

Refraction degrades target acquisition and radar tracking performance, especially during superrefraction.

Fog

Fog degrades visual acquisition and tracking.

Cloud Cover and Ceiling

Cloud cover may degrade visual acquisition and tracking.

Precipitation

Precipitation degrades or prevents visual acquisition and tracking and infrared homing. It may weaken ra-dar signals.

Surface Pressure

Surface pressure affects calibration of equipment.

Electrical Storms

Electrical storms degrade the effectiveness of electronic systems.

Light Data

Light affects visual acquisition and tracking.

Temperature

High temperatures degrade the effectiveness of electronic systems. Very low temperatures may affect mechanical devices. Extreme cold can produce detectable ice-fog exhaust trails from certain weapons systems and vehicles.

Humidity

Humidity affects refraction and may degrade radar effectiveness.

Figure E-7. Effects of Weather on Air Defense Operations.

Visibility

Visibility affects survey operations.

Precipitation

Precipitation influences river current, water depth, and bridge construction; complicates construction and maintenance operations; and affects flooding, river crossing operations, and soil bearing strength.

Snow Depth

Snow depth affects site selection and construction, flood prediction, and mobility and countermobility operations.

Freeze or Thaw Depth

Freeze or thaw depth affects site selection and construction and complicates excavation.

Temperature (Water)

Water temperature affects the survivability of troops in the water during port construction, river crossings, and beach operations.

Tide

The tide affects site selection and port and beach operations, including the timing of beach operations.

Wind (Surface)

Surface wind affects river crossings, port and watercraft operations, smoke operations, and structural strength requirements. It also hinders certain construction operations.

Humidity

Humidity affects the handling, storage, and use of building materials.

Temperature (Surface)

Surface temperature affects trafficability, flood potential, ice thickness, and river crossing capabilities. It may affect the use of certain construction materials.

Figure E-8. Effects of Weather on Engineer Operations.

Ceiling—Cloud and Sky Cover

Cloud and sky cover may affect aerial infrared and photographic collections systems, restrict use of UAVs, and increase the effectiveness of illumination devices.

Visibility

Visibility may affect visual, photographic, infrared, and electronic data collection systems.

Electrical Storms and Thunder

Electrical storms affect the efficiency of electronic systems and dissemination through radio and wire com-munications systems.

Precipitation

Precipitation obstructs vision, degrades photographic and infrared collection systems, and may degrade radar collection systems.

Severe Weather

Severe weather may prevent employment of aerial collection systems and may damage or prevent installation of collection system antennas.

Ionospheric Disturbances

Ionospheric disturbances may degrade electronic collection and communications and radar collection systems.

Light Data

Light data is required for planning collection operations and for long-range planning.

Icing

Ice may degrade the performance of aerial collection systems if permitted to coat antennas.

Wind (Surface)

Surface wind may affect the employment of aerial collection systems and may damage or prevent the instal-lation of electronic collection system antennas.

Temperature (Surface)

Surface temperature may affect collection system reliability.

Inversion

Inversion may provide false indications to certain electronic collection systems.

Figure E-9. Effects of Weather on Intelligence Operations.

Visibility

Reduced visibility may slow ground movement of munitions and supplies forward, may preclude aerial re-supply operations, and may conceal ground transportation operations.

Electrical Storms and Thunder

Electrical storms endanger storage, handling, and transportation of munitions and fuels; may interrupt computerized inventory operations; and can damage storage facilities and stored material.

Precipitation

Precipitation may affect storage of munitions and supplies and may preclude ground transportation over un-paved surfaces.

Snow Depth

Snow depth affects the ability to move supplies forward and affects the forward deployment of maintenance teams.

Freezing Precipitation

Freezing precipitation has a severe impact on logistical and maintenance support (air and surface).

Surf and Tide Conditions

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). It creates ice, which may preclude the use of waterways for transportation. 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. Temperature information is required for calibration of artillery systems.

Humidity

Humidity affects the storage of munitions and other supplies and may increase equipment failure rates and affect maintenance operations.

Figure E-10. Effects of Weather on Logistic Operations.

Precipitation

Precipitation affects available water supply, influences hospital site selection, and may damage unprotected supplies.

Severe Weather

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

Humidity may affect storage of medical supplies.

Figure E-11. Effects of Weather on Medical Support Operations.

Precipitation

Precipitation may require additional protection for enemy prisoners of war.

Severe Weather

Severe weather may affect security operations and refugee control.

Wind (Surface)

Wind affects the use of riot control agents.

Inversion

Inversion may affect the use of riot control agents.

Figure E-12. Effects of Weather on Military Police Operations.

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

Precipitation affects the persistence of chemical agents. Snow may cover and render ineffective certain liquid agents. Precipitation may produce radioactive rainout and hot spots.

Sunlight

Sunlight shortens the life span of biological agents.

State of the Ground

The state of the ground influences the effectiveness of chemical agents and affects fallout concentration levels.
Wet soil degrades the effectiveness of smoke munitions.

Turbulence

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 ft (50,000 m) or higher are needed for fallout pattern prediction (nuclear weapons). Wind affects chemical/biological agent dispersion and may decrease chemical agent persistence.

Wind (Aloft)

Wind aloft affects the aerial delivery of chemical/biological agents and may degrade the effectiveness of smoke operations.

Humidity

A high level of humidity increases the effectiveness of smoke and some chemical agents. Combined with high temperatures, it reduces the time in which troops in protective gear are effective. High humidity levels destroy some chemical agents. Humidity affects biological agents; the effect varies depending on humidity level and the type of agent.

Inversion

Inversion affects aerosol dispersion and the persistence of chemical/biological agents.

Figure E-13. Effects of Weather on NBC Operations.

Ceiling—Cloud and Sky Cover
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
Precipitation may force the target audience under cover, where they are not receptive to leaflet drops or loudspeaker broadcasts. It reduces the audibility of loudspeakers and destroys leaflets.
Snow
Snow reduces the effectiveness of leaflet dissemination and durability.
Wind (Surface)
High winds will reduce the audibility of loudspeakers. Wind speed and direction will affect the distribution of leaflets by air or artillery.
Humidity
Humidity affects the distance that sound will travel.

Figure E-14. Effects of Weather on PSYOPs.

Appendix F

Meteorological Critical Values

Meteorological critical values are those values that 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, the MAGTF SWO must be included in the planning stages of all operations. Commanders must be aware of meteorological critical values and consider them in all planning.

This appendix provides tables of critical values for specific 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 weather personnel forecast and call attention to critical factors, only commanders decide which values are critical for each operation. The commander in reaching a decision weighs additional input from NAVOCEANO, terrain analysis teams, and other sources and the criticality of the mission. Tables within this appendix show some meteorological critical values for specific and branch operations. Weather information is frequently color coded to help the decision maker quickly assess the impact of weather on impending operations and decisions. This person normally is the tactical unit commander to whom the weather service personnel provide support. The following color code is suggested for consistency within the operational commands:

- Green (favorable)—there are no weather restrictions.
- Amber (marginal)—weather degrades or limits.
- Red (unfavorable)—weather significantly affects or prohibits.

The following tables provide meteorological critical values for a variety of military operations and functions.

TABLE 1 AMPHIBIOUS OPERATIONS

Amphibious Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	$\leq$ 1,000 ft	Concealment; close air support planning
Visibility (surface)	$\leq$ 1 mile	Target acquisition
Wind (surface)	$\geq$ 7 knots	Personnel landing and smoke operations
	$\geq$ 35 knots	Wave and surf limits
Temperature (surface)	> 90 °F	Personnel and equipment support
	< 32 °F	Planning and logistic support, fuels, and expendable supplies
Wind-chill	$\leq$ -25 °F 1-min exposure $\leq$ -74 °F 1-sec exposure	Troop safety
Precipitation	> 0.1 in/h liquid	Shore trafficability
Effective illumination	< 0.0011 lux (lx)	Planning for night landing operations and concealment
Littoral current	Any Underlying current or riptide > 3 knots	Mission planning
Tides	Variable threshold of watercraft	Type of watercraft required; timing of mission
Temperature (water)	> 86 °F	Personnel safety
State of the sea	> 3-ft waves	Mission planning
Surf breaker description	Surging surf> 4-ft breakers	Mission planning
Surf zone	Area covered by surf	Mission planning

Table F-2. Intelligence Operations.

Intelligence Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	≤ 200 ft	Engagement range
	≤ 1,000 ft	Aerial observation
Surface visibility at the following wavelengths: 1.06 m, 3 - 5 m, 8 - 12 m	< 1 mile	Determination of enemy's ability to conceal actions; location and identification of targets
Wind (surface)	> 60 kt	Equipment damage
Precipitation	> 0.1 in/h liquid	Audio sensors and radar effectiveness
	> 0.5 in/h liquid	Speed of personnel and equipment movement
	> 2 in within a 12-h period	Speed of personnel and equipment movement; trafficability and storage of equipment
Snow depth and cover	> 6 in	Trafficability
Thunderstorms and lightning	Any occurrence within 3 miles	Troop and equipment safety; false alarms and false readings
Temperature (surface)	>122 °F <-58 °F	Emplacement site selection
Temperature (ground)	<32 °F	Trafficability assessment
Wet bulb globe temperature	>85 °F	Troop safety
EM propagation	Subrefraction and superrefraction	Ducting of radar transmission and returns
Effective illumination	< 0.0011 lx	Target acquisition
River stage and current strength	> 6-ft depth	Enemy's ability to cross rivers or streams

Table F-3. Ground Maneuver Operations.

Ground Maneuver Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	≤1,000 ft	Concealment and cover from threat surveillance; tactical air and aerial supply support; background contact for target acquisition or using thermal devices.
Surface visibility at the following wavelengths: 1.06 m, 3 - 5 m, 8 - 12 m	Dragon < 800 ft Tube launched, optically tracked, wire command link guided missile (TOW) < 1,600 m	Target acquisition; system selection
Wind (surface)	> 7 kt	Smoke operations; background radar noise
	> 20 kt	Visibility restriction in blowing sand and snow; soil drying speed; aerial resupply; windchill effect on equipment and personnel
	> 30 kt	Accuracy of antitank missiles
	> 75 kt	Antenna failure
	> 125 kt	Equipment (van) failure
Precipitation	> 0.1 in/h liquid > 2 in within a 12-hour period	Soil type (affected by temperature and moisture); vehicle movement; site location; river levels; runoff; flooding; delays in resupply; demolitions; river crossing; visibility; target acquisition; radar effectiveness
Snow depth and cover	> 2 in within a 12-hour period > 6 in > 24 in	Effectiveness of mines; choice of construction materials; trafficability
Freeze and thaw depth	< 6 in	Off-road employment of wheeled and tracked vehicles
Thunderstorms and lightning	Any occurrence within 3 miles	Munitions safety; personnel communications equipment safety
Temperature (surface)	≥ 122 °F	Thermal sights
	> 90 °F	Lubricants, personnel, and infrared sensors
	> 32 °F	River crossing sites and off-road movements (affected by melting snow and ice)
	<.32 °F	Drying of soil; freeze or thaw depth
	Any change of 50 °F	Munitions trajectories
Wind-chill	≤ -25 °F 1-min exposure ≥ -75 °F 1-sec exposure	Time before exposed flesh will suffer frostbite

Table F-3. Ground Maneuver Operations (Continued).

Ground Maneuver Operations		
Element	**Critical Value**	**Impact**
Effective illumination	< 0.0011 lx	Use of night vision devices
Sea/shore conditions	Current and tide > 5 kt	Beach and port sea-to-shore loading and offloading operations
	Waves > 3 ft Swell > 3 ft Surf > 5 - 6 ft	Landing operations

Table F-4. Field Artillery Operations.

Field Artillery Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	≤ 600 ft	Target acquisition; Copperhead performance
Visibility—slant range at the following wavelengths: 1.06 m, 3 - 5 m, 8 - 12 m	≤ 1 mi	Target acquisition
Wind—vertical profile	> 5-kt change/3,280 ft	UAV operations; nuclear fallout prediction
Thunderstorms and lightning	Any occurrence within 3 mi	Safety and storage of munitions
Effective illumination	< 0.0011 lx	Mission planning for night artillery operations

Table F-5. Aviation and Air Assault Operations.

Aviation and Air Assault Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	≤ 300 ft (90 m)	Nap-of-the-earth planning and acquisition—rotary wing
	≤ 300 ft (90 m) flat terrain	Daylight target acquisition—fixed wing
	≤ 500 ft (150 m) mountain terrain	Daylight target acquisition—fixed wing
	≤ 500 ft (150 m) flat terrain	Night target acquisition—fixed wing
	≤ 1,000 ft mountain terrain	Night target acquisition—fixed wing
Visibility (surface)	≤ 0.25 mi (400 m)	Navigation and target acquisition—rotary wing
	≤ 1 mi (1,600 m)	Landing and takeoff minimums for mission planning
	≤ 3 mi (4,800 m)	Landing and takeoff minimums for mission planning
Visibility (slant range)	≤ 0.25 mi (400 m)	Navigation and target acquisition—rotary wing
	≤ 3 mi (4,800 m) mountain terrain	Navigation and target acquisition—rotary wing
Wind (surface)	> 30 kt > 15-kt gust spread	Mission planning; aircraft safety
Wind (aloft)	> 30 kt	Mission planning—duration
Precipitation	Any freezing	Rotorblade icing; aircraft survivability and damage
	> 0.5 in/h liquid	Target acquisition
Hail	≥ 0.25-in diameter	Aircraft damage
Snow depth and cover	> 1 in (2.54 cm) powder	Location of landing zone and drop zone; vertigo
Icing	≥ Light (clear/rime)	Mission planning and safety; ordnance delivery restrictions—rotary wing
Turbulence	Moderate	Mission planning; aircraft survivability
Thunderstorms and lightning	Any occurrence within 3 mi of site	Refueling and rearming operations
DA: variable With aircraft, weight, power, and temperature	> 6,900 ft	Flight control, runway limits, takeoff, and landing
Effective illumination	< 0.0011 lx	Mission planning for night operations

Table F-6. Air Defense Operations.

Air Defense Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	$\leq$ 500 ft	Selection of weapons systems and positioning for convoy
	$\leq$ 5,000 ft	Aircraft detection and identification
Visibility (surface)	< 2 mi	Aircraft detection and identification for short-range air defense systems
	< 3 mi	Weapons system selection and placement for the Stinger system
Wind (surface)	> 30 kt	Communications and radar antenna
	> 50 kt > 57-kt gusts	Weapons system selection and planning
Wind (aloft)	> 50 kt	Aiming and tracking
Precipitation	> 0.5 in/h liquid	All radar $\geq$ 10 GHz (degraded); all infrared sensors
Thunderstorms and lightning	Any occurrence within 2 mi of site	Communications, radar, and storage and protection of missile systems
Temperature (surface)	> 120 °F < -45 °F	Mission planning for use of a man-portable air defense system
Windchill	$\leq$ -25 °F 1-min exposure	Personnel protection; planning gear and equipment needs
	$\leq$ -74 °F 1-sec exposure	Personnel protection; planning gear and equipment needs
Effective illumination	< 0.0011 lx	Target acquisition of aircraft

Table F-7. Engineer Operations.

Engineer Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	≤ 500 ft	Area of operations and location of facilities; personnel safety; aerial reconnaissance; camouflage needs
Visibility (surface)	≤ 0.25 mi	Mission planning; concealment and cover
Wind (surface)	≥ 13 kt	Construction and stability of bridges and structures
Precipitation	> 0.5 in/h liquid	Need for mines (reduced); loading and offloading operations
Snow depth and cover	> 2 in within a 12-h period	Some areas of operations and locations of facilities; stability of bridge structures; types of demolitions to be used and size and charge; blast from trigger mechanisms (may render mines ineffective)
Freeze and thaw depth	< 6 in	Trafficability determination
Thunderstorms and lightning	Any occurrence within 1 mi of site	Equipment and personnel safety; munitions protection
Temperature (ground)	< -32 °F	Freeze or thaw depth determination; construction material; operations, personnel, and structures (threatened as a result of precipitation at or below 32 °F)
Humidity	> 35%	Comfort, equipment operations, and site selection planning

Table F-8. Airborne Operations.

Airborne Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	≤ 300 ft (90 m) flat terrain	Mission planning (day)—jump altitude, aircraft penetration
	≤ 500 ft (150 m) flat terrain	Mission planning (night)—jump altitude, aircraft penetration
	≤ 500 ft (150 m) mountain terrain	Target acquisition (day)
	≤ 1,000 ft (300 m) mountain terrain	Target acquisition (night)
	≤ 10,000 ft mountain terrain	Mission planning for landing zone or drop zone
Surface visibility at the following visible wavelengths: 1.06 m, 3 - 5 m, 8 - 12 m	≤ 0.25 mi (400 m)	Mission planning—infrared sensors; navigation and target acquisition—rotary wing
	≤ 1 mi (1,600 m)	Day mission planning—minimum takeoff or landing, minimum fixed wing
	≤ 3 mi (4,800 m)	Night mission planning—minimum takeoff or landing, minimum fixed wing
Wind (surface)	≥ 13 kt	Troop safety for paradrop operations; limiting value for operations during training
	≥ 15 kt (≥ 21 kt for C-12 and U-21)	Mission planning and aircraft safety and recovery
	≥ 25 kt (OV-1) ≥ 30 kt and/or gust speeds	Mission planning and aircraft safety and recovery
Wind (aloft)	≥ 40 kt	Jump point; 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; aircraft refueling; reliability of communications systems; predetonation of certain munitions
Temperature (surface)	≤ 32 °F (0 °C)	Ground conditions
PA	< 100 ft	Parachute opening altitude
DA: variable with aircraft, weight, power, and temperature	> 6,900 ft	Planning; cargo limits
	> 4,000 ft	Weight limits for attack and OH-58s
	> 2,000 ft	OH-58 troop configuration (limited)
Effective illumination	< 0.0011 lx	Planning of night missions; navigation safety

Table F-9. Nuclear, Biological, and Chemical Operations.

NBC Operations		
Element	**Critical Value**	**Impact**
Ceiling—cloud and sky cover	≤ 5,000 ft	Aerial deployment agents; thermal effects (enhanced if burst is below clouds); thermal and electromagnetic pulse (EMP) effects (reduced if burst is above clouds)
Wind	> 3 kt but < 7 kt	NBC operations (favorable)
	> 10 kt	NBC operations (unfavorable)
	> 15 kt	First-round munitions accuracy
Precipitation	Any intensity or type	Washing of agents and smoke out of the atmosphere; nuclear hot spot creation
Thunderstorms and lightning	Any occurrence within 3 mi	Troop and munitions storage safety
Temperature (surface)	> 95 °F	Rate of evaporation of liquid chemical agents; 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); troop vulnerability to nuclear radiation (indirectly affected); 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	< 0.0011 lx	Night operation of NBC equipment

Table F-10. Logistic Operations.

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

Table F-11. Communications and Information Systems Operations.

Communications and Information Systems Operations		
Element	**Critical Value**	**Impact**
Wind (surface)	> 7 kt	Radar background noise
	> 25 kt	Safety and stability for installing line of sight and troposcatter antennas
	> 69 kt	Wind damage to main communications antenna—linear pole
	> 78 kt	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 in/h 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 mi	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

Table F-12. Waterborne Surface Assault (General) Critical Values.

Element: Sea State (As Defined in Appendix A)			
Platform	**Favorable**	**Marginal**	**Unfavorable**
Combat rubber reconnaissance craft (CRRC)	1	2	> 2
Landing craft, mechanized (LCM)8	2	3	> 3
Landing craft, utility (LCU)	2	3	> 3
Landing craft air cushion (LCAC)	3	4	> 4
Element: Maximum Surf			
Platform	**Favorable**	**Marginal**	**Unfavorable**
CRRC	< 2 ft	2 - 3 ft	> 3 ft
LCM8	< 6 ft	6 - 7 ft	> 7 ft
LCU	< 6 ft	6 - 7 ft	> 7 ft
LCAC	< 7 ft	7 - 8 ft	> 8 ft
Element: MSI			
Platform	**Favorable**	**Marginal**	**Unfavorable**
LCM8	< 7	7 - 8	> 8
LCU	< 11	11 - 12	> 12
Landing craft, vehicle, personnel (LCVP)	< 4	4 - 5	> 5
Element: Littoral Current			
Platform	**Favorable**	**Marginal**	**Unfavorable**
LCU	< 1 kt	1 - 2 kt	> 2 kt
Element: Miscellaneous			
Platform	**Favorable**	**Marginal**	**Unfavorable**
LCAC			
- Significant breaker height	0 - 4 ft	4 - 8 ft	8 - 12 ft
- Significant breaker type	Spilling	Surging	Plunging (steep)
- Allowable load size	75 tons	60 tons	45 tons

Table F-13. Critical Values for the Assault Amphibious Vehicle (AAV).

Load	Maximum Surf Height	Wave Interval (Not Less Than)
100% Plunging Surf:		
Combat load	6 ft	9 sec
Troop load	6 ft	9 sec
Combat equipped	6 ft	13 sec
50% Plunging Surf, 50% Spilling Surf:		
Combat load	6 ft	8 sec
Troop load	6 ft	8 sec
Combat equipped	6 ft	10 sec
100% Spilling Surf:		
Combat load	6 ft	5 sec
Troop load	6 ft	5 sec
Combat equipped	6 ft	7 sec

Note: Criteria are applicable to the AAV, personnel model (AAVP)-7A1; AAV, command model (AAVC)-7A1; and AAV, recovery model (AAVR)-7A1. Criteria are based on the following three load conditions: combat load—10,000 lb; troop load—5,600 lb; combat equipped—no load.

Planning for combat operations should be predicated on the AAVP-7A1's demonstrated capability of negotiating 10-ft plunging waves in combat-load and troop-load conditions and 8-foot plunging waves in combat-equipped conditions.

APPENDIX G

Sample Annex H (METOC Services)

8TH MEB
FORWARD
YUMA GREEN
192200Z MAR 02

ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U)

REFERENCES:

(a) (U) CJCSI 3810.01, Meteorological and Oceanographic (METOC) Operations

(b) (U) Joint Publication 3-59, Joint Doctrine for Meteorological and Oceanographic Support

(c) (U) Joint Publication 3-59.1, Joint Tactics, Techniques, & Procedures for Meteorological and Oceanographic Support

(d) (U) NAVOCEANCOMINST 3140.1J, U.S. Navy Oceanographic & Meteorological Support System Manual

Time Zone: T

1. (U) SITUATION

a. (U) Concept of Environmental Support. Environmental support under this Annex includes collection, processing, derivation, and dissemination of information describing past, present, and future atmospheric, oceanographic, and terrestrial conditions. U.S. Marine Corps METOC personnel, organic to the Aviation Combat Element (ACE), will provide environmental support to forward deployed elements/units of 8th MEF (FWD)/Blue Force. A Joint METOC Forecast Unit (JMFU), composed of U.S. Marine Corps and Blue Force METOC personnel, will be established to support HQ, 8th MEB (FWD), 8th MAW (FWD), 18th MAR, and BSSG-8. The JMFU will be under the direction of the Joint METOC Officer (JMO).

b. (U) Assumptions.

(1) (U) Indigenous weather facilities and services are available.

(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 will be denied.

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

c. (U) Planning Factors. 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 U.S. 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 which develops during February to April period, 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. (See Appendix 1.)

2. (U) MISSION. Provide or arrange timely environmental services for units supporting/participating in operations under all situations of the basic order.

3. (U) EXECUTION

a. (U) Concept of Operations. The METOC support organization will be directed by the Joint METOC Officer (JMO). The Air Force Global Weather Central (AFGWC) 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.

In addition, AFGWC and FNMOC will provide initial environmental support until METOC communications are established and the Joint METOC Forecast Unit (JMFU) is operational. Once established, the JMFU will be the primary METOC forecast agency for military forces in BLUELAND and provide tailored theater-level products for the AO. (See Appendix 2.) METOC personnel at all echelons will further tailor these products, as necessary, to support their customers.

b. (U) Tasks and Responsibilities.

(1) (U) The JMO is responsible for providing/arranging METOC support to HQ, 8th MEF(FWD) and for coordinating and directing overall METOC support for operations in BLUELAND.

(2) (U) The JMO is responsible for providing METOC support to all forces in theater, as outlined by references a through d.

(a) (U) The senior weather officer of 8th MEF(FWD) will serve as the JMO.

(b) (U) The JMO will task METOC capabilities and will coordinate METOC support during implementation of the OPORDER.

(c) (U) The JMO will appoint the weather officer of MWSG-87 to serve as the assistant or alternate JMO.

(d) (U) The JMO will appoint the weather officer of MWSS-371 to serve as the 8th MAW(FWD) Staff Weather Officer (SWO).

(3) (U) When directed by the CG, 8th MEB (FWD) MWSS-371 and Blue Force METOC personnel will combine to form the Joint METOC Forecast Unit (JMFU).

(a) (U) The JMFU will be established at Yuma, BLUELAND.

(b) (U) MWSS-371's Meteorological Mobile Facility (Replacement) (METMF(R)), will be the alternate JMFU. The alternate JMFU is responsible for producing and disseminating JMFU products:

(1) When directed by the JMO.

(2) If connectivity with the primary JMFU is lost for a period of six hours.

(4) (U) MWSS-371 will provide METOC support to all forward deployed units.

(5) (U) The Air Force Weather Agency and the Naval Meteorological and Oceanographic Command will, through their centralized facilities, provide centralized products.

(6) (U) The Air Force Space Forecast Center will provide specialized space environmental products.

(7) (U) Units at all echelons will follow the steps below to determine and fill METOC support requirements. Higher echelon units receiving 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 their requirements.

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

(8) (U) Intelligence units at all echelons of command will ensure that all Target Area Reconnaissance Weather Information (TARWI) are passed to the JMFU in a timely manner.

(9) (U) Pilot Reports (PIREPS) received by METOC/ATC personnel will be forwarded to the JMFU in a timely manner.

(10) (U) METOC Reports:

(a) (U) All METOC units with forecast requirements will issue a METOC Terminal Aerodrome Forecast (TAF) every six (6) hours or as directed by the JMFU.

(b) (U) All METOC units will take and disseminate surface observations every (1) hour and upper-air soundings every twelve (12) hours, or as directed by the JMFU.

c. (U) Coordinating Instructions.

(1) Direct coordination is authorized and encouraged between all echelon SWOs. SWOs will coordinate special METOC support requirements with the JMO.

(2) The 8th MEF(FWD) WEAX is the official forecast for the AO. (See Appendix 2, Tab A.) METOC units may tailor the 8th MEF (FWD) WEAX to meet specific operational requirements. Coordinate significant deviations from the 8th MEB (FWD) WEAX with the JMFU OIC, except to satisfy an immediate operational need or under conditions affecting the safety of personnel or equipment. In these cases, coordinate with the JMFU OIC after-the-fact.

4. (U) ADMINISTRATION AND LOGISTICS. Logistics of METOC equipment and supplies will be conducted as outlined, in unit SOPs and Annex D. METOC units are expected to deploy with enough materials to last until resupply can be reasonably expected. 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 the operational and tactical commanders. Regional METOC data streams provide observations, general forecasts, and special products as requested. Exploit all other data sources including U.S. and foreign satellite, teletype and facsimile broadcasts.

b. (U) Loss of METOC communication 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. MEF Weather Support Teams

(MSTs) are available to accompany operational commanders to provide on-scene METOC support.

d. (U) Control of divulging METOC data will be in accordance with applicable OPSEC instructions. (See Annex L.)

M. POST
Col, U. S. Marine Corps
Commanding

APPENDIX G

Sample Annex H (METOC Services) Draft

Appendixes:

1 - Astronomical and Climatological Data
2 - MAGTF Standard Tactical Meteorological/Oceanographic (METOC) Support Plan

OFFICIAL:

R. ROSS
MAJ USMC

APPENDIX G

Sample Annex H (METOC Services) Draft

8TH MEB
FORWARD
YUMA GREEN
192200Z MAR 02

APPENDIX 1 (ASTRONOMICAL AND CLIMATOLOGICAL DATA) TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U)

1. All times are listed as Local Times or Mountain Standard Time (MST). Local Time (Tango) is -7 hours from UTC (Zulu). Arizona remains in MST throughout the year. Terms and definitions:

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

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

c. 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. 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. Lunar Illumination (% LUM): Given in percentage of the "actual" lunar disk visible at midnight of each given day.

2. Astronomical Data for Yuma, Arizona, (32°39'N, 114°37'W):

APPENDIX G

Sample Annex H (METOC Services) Draft

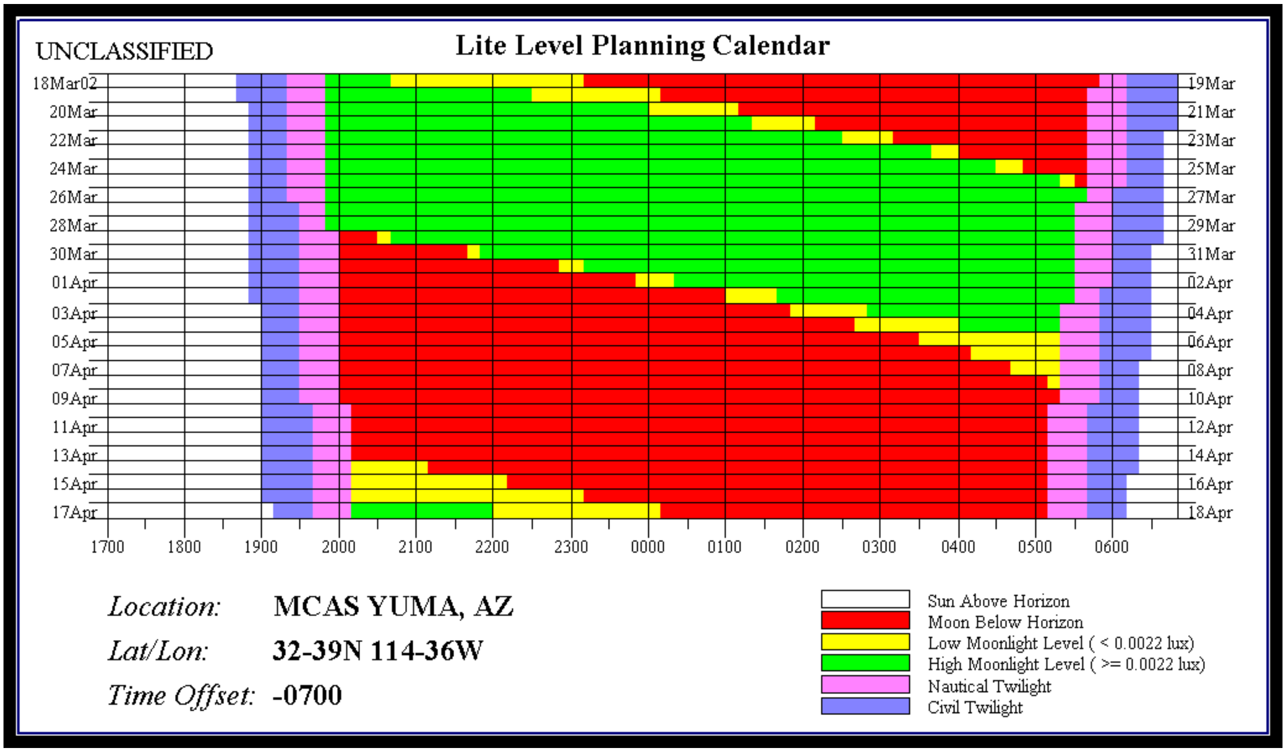
a. Astronomical Data for March 2002:

DATE	BMNT	BMCT	SUN RISE	SUN SET	EECT	EENT	MOON RISE	MOON SET	% ILUM
Mar 1	0613	0641	0706	1836	1900	1929	2136	0855	94
Mar 2	0612	0640	0705	1837	1901	1930	2244	0930	87
Mar 3	0611	0639	0704	1837	1902	1931	2351	1007	78
Mar 4	0609	0638	0703	1838	1903	1931	-------	1045	68
Mar 5	0608	0637	0701	1839	1904	1932	0057	1127	58
Mar 6	0607	0635	0700	1840	1904	1933	0200	1214	47
Mar 7	0606	0634	0659	1840	1905	1934	0258	1304	37
Mar 8	0605	0633	0658	1841	1906	1934	0352	1357	28
Mar 9	0603	0632	0656	1842	1907	1935	0439	1453	19
Mar 10	0602	0631	0655	1843	1907	1936	0521	1550	12
Mar 11	0601	0629	0654	1843	1908	1937	0558	1646	7
Mar 12	0600	0628	0653	1844	1909	1937	0631	1741	3
Mar 13	0558	0627	0651	1845	1909	1938	0701	1836	0
Mar 14	0557	0625	0650	1846	1910	1939	0729	1930	0
Mar 15	0556	0624	0649	1846	1911	1940	0756	2023	1
Mar 16	0554	0623	0647	1847	1912	1940	0823	2118	4
Mar 17	0553	0622	0646	1848	1912	1941	0852	2213	9
Mar 18	0552	0620	0645	1849	1913	1942	0923	2310	15
Mar 19	0550	0619	0644	1849	1914	1943	0957	-------	23
Mar 20	0549	0618	0642	1850	1915	1943	1037	0009	31
Mar 21	0548	0616	0641	1851	1915	1944	1123	0109	41
Mar 22	0546	0615	0640	1852	1916	1945	1217	0209	52
Mar 23	0545	0614	0638	1852	1917	1946	1318	0306	62
Mar 24	0544	0612	0637	1853	1917	1946	1425	0359	73
Mar 25	0542	0611	0636	1854	1918	1947	1535	0447	82
Mar 26	0541	0610	0634	1854	1919	1948	1637	0530	90
Mar 27	0540	0608	0633	1855	1920	1949	1759	0610	96
Mar 28	0538	0607	0632	1856	1920	1949	1910	0647	99
Mar 29	0537	0606	0630	1856	1921	1950	2021	0743	99
Mar 30	0535	0604	0629	1857	1922	1951	2121	0759	96
Mar 31	0534	0603	0628	1858	1923	1952	2240	0838	90

b. Astronomical data for April 2002:

DATE	BMNT	BMCT	SUN RISE	SUN SET	EECT	EENT	MOON RISE	MOON SET	% LUM
Apr 1	0533	0602	0626	1858	1923	1952	2347	0920	82
Apr 2	0531	0600	0625	1859	1924	1953	-------	1006	73
Apr 3	0530	0559	0624	1900	1925	1954	0050	1056	63
Apr 4	0529	0558	0623	1901	1925	1955	0147	1150	53
Apr 5	0527	0556	0621	1901	1926	1956	0238	1246	43
Apr 6	0526	0555	0620	1902	1927	1956	0322	1343	34
Apr 7	0524	0554	0619	1903	1928	1957	0400	1440	25
Apr 8	0523	0553	0618	1903	1928	1958	0434	1536	17
Apr 9	0522	0551	0616	1904	1929	1959	0504	1630	11
Apr 10	0520	0550	0615	1905	1930	2000	0533	1724	5
Apr 11	0519	0549	0614	1905	1931	2000	0600	1818	2
Apr 12	0518	0547	0613	1906	1931	2001	0627	1913	0
Apr 13	0516	0546	0611	1907	1932	2002	0655	2008	0
Apr 14	0515	0545	0610	1908	1933	2003	0725	2105	2
Apr 15	0514	0544	0609	1908	1934	2004	0758	2204	5
Apr 16	0512	0542	0608	1909	1934	2005	0836	2304	11
Apr 17	0511	0541	0607	1910	1935	2005	0920	-------	18
Apr 18	0510	0540	0605	1910	1936	2006	1010	0003	27
Apr 19	0509	0539	0604	1911	1937	2007	1107	0100	36
Apr 20	0507	0538	0603	1912	1938	2008	1210	0153	47
Apr 21	0506	0536	0602	1913	1938	2009	1317	0242	58
Apr 22	0505	0535	0601	1913	1939	2010	1426	0325	69
Apr 23	0503	0534	0600	1914	1940	2011	1536	0404	79
Apr 24	0502	0533	0559	1915	1941	2011	1646	0441	88
Apr 25	0501	0532	0558	1916	1941	2012	1756	0516	94
Apr 26	0500	0531	0557	1916	1942	2013	1906	0551	98
Apr 27	0459	0530	0555	1917	1943	2014	2017	0629	99
Apr 28	0457	0528	0554	1918	1944	2015	2127	0709	97
Apr 29	0456	0527	0553	1918	1945	2016	2234	0754	93
Apr 30	0455	0526	0552	1919	1945	2017	2335	0844	86

Sample Annex H (METOC Services) Draft



3. All climatological data is based on observations from 1948 through 1996. Terms and definitions:

a. Temperatures: Are listed in degrees Fahrenheit, for conversion to Celsius: (°F-32) divided by 1.8 = °C.

b. Sky Condition: CLR - Clear; absence of clouds or obscuring phenomena. SCT - Scattered; 1/10 to 5/10 sky coverage. BKN – Broken: 6/10 to 9/10 sky coverage. OVC - Overcast; 10/10 sky coverage.

c. 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. Visibility: The greatest visibility equaled or exceeded throughout at least one-half of the horizon circle.

e. Ceiling: The height ascribed to the lowest broken or overcast layer aloft which is predominately opaque, or the vertical visibility into a surface-based obstruction.

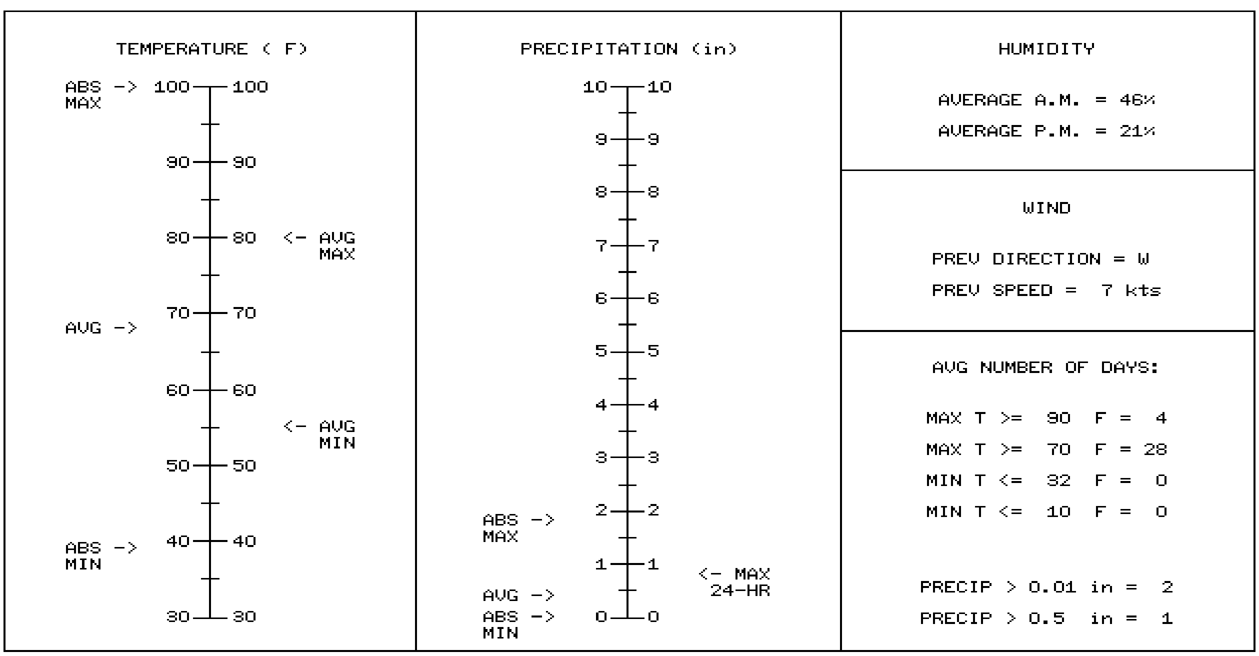
4. Climatological Data for March:

TEMPERATURE		**HUMIDITY**		**PRECIPITATION**	
AVERAGE MAX	79°F	0500L	48%	ABSOLUTE MAX	1.8"
AVERAGE MIN	51°F	1400L	28%	ABSOLUTE MIN	0.0"
ABSOLUTE MAX	100°F	1700L	19%	AVERAGE	0.2"
ABSOLUTE MIN	32°F	AVG	34%		
AVERAGE	65°F				

SKY CONDITION		**FIELD CONDITION**		**CEILING/VSBY**
CLR	50%	VFR	99.0%	< 3,000' & 3MI < 1.0%
SCT	21%	IFR	1.0%	< 1,500' & 3MI < 0.5%
BKN	16%			< 1,000' & 3MI < 0.5%
OVC	13%			

SURFACE WINDS			**THUNDERSTORMS**	
0800L	NNE	6.0 KTS	AVG NO.# DAYS	1
1400L	W	9.5 KTS		
2000L	W	7.8 KTS		
ALL HOURS	W	8.4 KTS		
MAX	NW	52.0 KTS		

SELECTED CLIMATE SUMMARY
AT :STA 722805 | KNYL | YUMA MCAS ,AZ,US
DURING MARCH



5. Climatological Data for April:

TEMPERATURE

AVERAGE MAX	87°F
AVERAGE MIN	57°F
ABSOLUTE MAX	109°F
ABSOLUTE MIN	41°F
AVERAGE	72°F

HUMIDITY

0500L	44%
1400L	17%
1700L	16%
AVG	29%

PRECIPITATION

ABSOLUTE MAX	1.2"
ABSOLUTE MIN	0.0"
AVERAGE	0.1"

SKY CONDITION

CLR	58%
SCT	20%
BKN	14%
OVC	08%

FIELD CONDITION

VFR	99.0%
IFR	1.0%

CEILING/VSBY

< 3,000' & 3MI < 1.0%
< 1,500' & 3MI < 0.5%
< 1,000' & 3MI < 0.5%

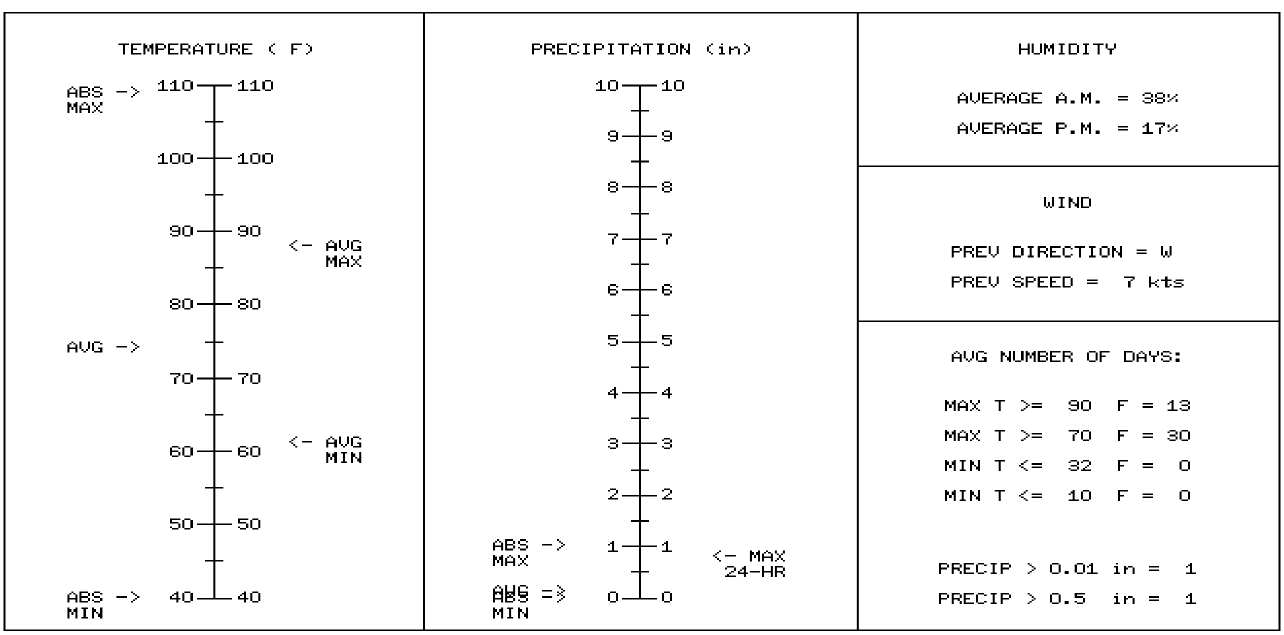
SURFACE WINDS

0800L	N	6.4 KTS
1400L	W	9.6 KTS
2000L	W	8.1 KTS
ALL HOURS	W	8.7 KTS
MAX	N	52.0 KTS

THUNDERSTORMS

AVG NO.# DAYS 1

SELECTED CLIMATE SUMMARY
AT :STA 722805 | KNYL | YUMA MCAS ,AZ,US
DURING APRIL



APPENDIX G

Sample Annex H (METOC Services) Draft

8TH MEB
FORWARD
YUMA GREEN
192200Z MAR 02

APPENDIX 2 TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U) MAGTF STANDARD TACTICAL METEOROLOGICAL/OCEANOGRAPHIC [METOC] SUPPORT PLAN (U)

1. Upon the employment of a MAGTF (MEU/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 Commander, Aviation Combat Element (ACE). Naval METOC Centers will retain responsibility for the provision of weather facsimile support, METOC 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. Tailored on-scene meteorological and oceanographic support is available from METOC assets organic to the ACE. The Marine Wing Support Squadrons (MWSSs), equipped with a Meteorological Mobile Facility (MetMF) Complex, are normally deployed to a Forward Operating Base (FOB) in direct support of that airfield. MEF Weather Support Teams (MSTs), from the MWSSs, are assigned to provide direct support to commanders/staff of MAGTF elements other than the ACE, i.e., the Command Element (CE), the Ground Combat Element (GCE), and the Combat Service Support Element (CSSE). MAGTF elements should forward unique tactical METOC support requirements, via the chain-of-command, to the ACE vice requesting personnel and equipment directly.

3. The MAGTF ACE commander shall coordinate all tactical METOC support requirements for each element, designate MWSSs to provide MSTs, provide for the timely dissemination of local warnings/advisories, observations/forecasts, tactical support summaries/products, and liaise with Naval METOC Centers for special tactical support requirements. In order to provide a common baseline within each MAGTF, tailored tactical METOC support should be developed in accordance with this Appendix.

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

a. OPTASK METOC (Meteorology/Oceanography): 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, Fleet Marine Force (FMF) Pacific/Atlantic. Once published, MAGTF commanders will issue serialized OPTASK METOC supplements detailing specific requirements for all operations and exercises.

b. 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 Weather Forecast (WEAX) and Tactical Atmospheric Summary (TAS). These support products are normally transmitted daily or as required.

(1) 8th MEF(FWD) WEAX: The 8th MEF(FWD) WEAX is based on the standard NAVMETOCCOM WEAX/AVWX format and shall include a meteorological situation, 24-hour forecast, and outlook to 48 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) Tactical Atmospheric Summary: The TAS shall include an atmospheric refractive summary, tactical assessment, electromagnetic sensor performance predictions, infrared sensor detection range predictions, communication range predictions, and an M-unit summary. Radiosonde calibration data should be appended when air-capable units are operating in close proximity.

b. 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 (AOAFCST), Strike Forecast (STRKFCST), and Assault Forecast (ASLTFCST).

(1) Amphibious Objective Area Forecast: The AOAFCST 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) Strike Forecast: The STRKFCST 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 enroute and target weather, outlook to 48 hours, tactical assessment, and electro-optical sensor performance predictions.

(3) Assault Forecast: The ASLTFCST 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 enroute, FARP/RGR and landing zone weather, outlook to 48 hours, tactical assessment, and electro-optical sensor performance predictions.

2. Tabs A through E of this Appendix include drafting guides for each of the tactical summaries discussed in this plan. They provide METOC forecasters with a baseline for development of tailored tactical support summaries that meet minimum support requirements. On-scene tactical support products should be modified as required to meet specific operational requirements and tactical situation. Additionally, METOC forecasters should strive to maintain a balance between full-spectrum support to MAGTF elements and communications efficiency. Under normal conditions, tactical summaries should not exceed 2-3 pages in length.

APPENDIX G

Sample Annex H (METOC Services) Draft

8TH MEB
FORWARD
YUMA GREEN
192200Z MAR 02

TAB A (WEATHER FORECAST) TO APPENDIX 2 (MAGTF STANDARD TACTICAL METEOROLOGICAL/OCEANOGRAPHIC [METOC] SUPPORT PLAN) TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U) 8TH MEB (FWD) WEATHER FORECAST (WEAX) (U)

[PASS TO (CE/ACE/GCE/CSSE)]
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/8TH MEF(FWD) WEAX//
RMKS/1. ( ) METEOROLOGICAL SITUATION AT   Z. (Note: Include the location/movement/development of synoptic high and low pressure centers and associated fronts referenced to common geographical points, area, or established METOC zones. When in doubt, use lat/long.)
2. ( ) 24-HOUR FORECAST COMMENCING   Z [ALONG TRACK FROM
      N(S)/   E(W) TO   N(S)/   E(W)] OR VCNTY OF
      N(S)/   E(W). (Note: AO should be omitted if COMMARFOR prefers an UNCLAS forecast.
A. SKY/WEATHER: (Note: Plain language format.)
B. VSBY (NM):
C. SURFACE WINDS (KTS):
D. MAX/MIN TEMPS (DEG F):
E. RELATIVE HUMIDITY (%):
F. ABSOLUTE HUMIDITY (g/m3):
G. WBGT HEAT INDEX/FLAG CONDITION:
H. AVIATION PARAMETERS:
(1) CLOUD/CEILINGS (FT): (Note: TAF format recommended.)
(2) WINDS/TEMPS ALOFT (FL/DIR/SPD IN KTS/TEMPS IN DEG C):
(3) TURBULENCE: (Note: Include discussion of all known CAT.)
(4) MINIMUM FREEZING LEVEL (FT):
(5) ICING:
(6) CONTRAILS (FT):
(7) MINIMUM ALTIMETER SETTING (INS):
(8) MAXIMUM PA/DA:
3. ( ) OUTLOOK TO 48 HOURS:
4. ( ) ASTRONOMICAL DATA (UTC OR LOCAL):
A. SUNRISE/SUNSET/SUNRISE:
B. BMNT/BMCT/EECT/EENT/BMNT/BMCT:
C. MOONRISE/MOONSET/ILLUMINATION (PCT):
5. ( ) 24-HOUR RADFO FCST FOR (AIR BURST/SFC BURST):
      WEAPON YIELD (KILOTONS)

A. EFF DOWNWIND DIR(T)/SPD(KTS):   /   /   /

B. SECTOR ANGLE/DIST TO ZONE 1 (NM):   /   /   /
(Note: RADFO forecast should be included for actual/exercise DEFCON 3 or MOPP Level 2. Otherwise at senior forecaster's discretion.)
6. ( ) RELEASED BY: (Note: Include when MINIMIZE imposed.)//
DECL/   // (As required.)

8TH MEB
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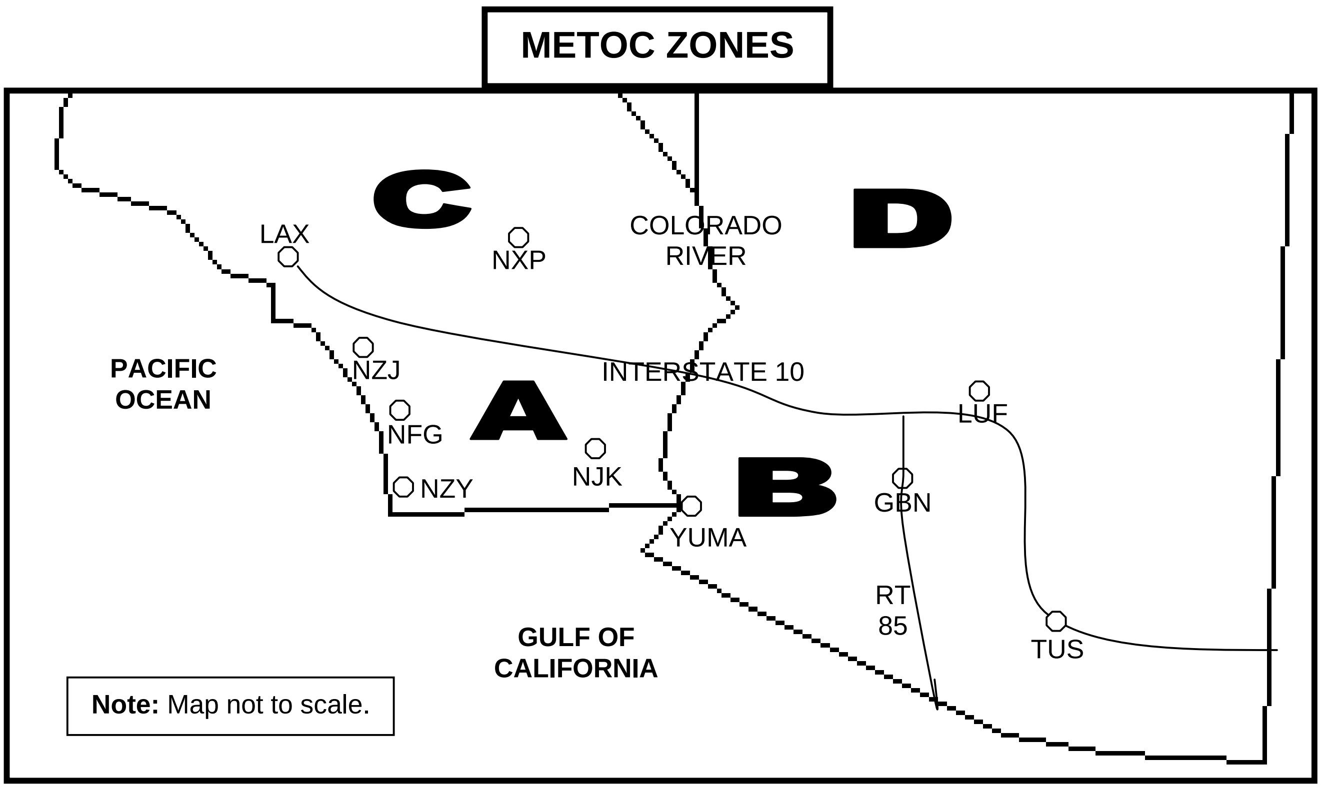
192200Z MAR 02

ENCLOSURE 1 (METOC ZONES) TO TAB A (WEATHER FORECAST) TO APPENDIX 2 (MAGTF STANDARD TACTICAL METEOROLOGICAL/OCEANOGRAPHIC [METOC] SUPPORT PLAN) TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U)



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

APPENDIX G

Sample Annex H (METOC Services) Draft

8TH MEB
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TAB B (TACTICAL ATMOSPHERIC SUMMARY) TO APPENDIX 2 (MAGTF STANDARD TACTICAL METEOROLOGICAL/OCEANOGRAPHIC [METOC] SUPPORT PLAN) TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U) TACTICAL ATMOSPHERIC SUMMARY (TAS) (U)

(PASS TO [MAG/TACC/DASC/MATC/TAOC/SAAWC])
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/TACTICAL ATMOSPHERIC SUMMARY (TAS)//
RMKS/1. ( ) ATMOSPHERIC REFRACTIVE SUMMARY: BASED ON   Z
UPPER-AIR SOUNDING TAKEN AT   N/   W.
A. SURFACE-BASED DUCT HEIGHT (FT):
B. ELEVATED DUCTS (BOTTOM-TOP) (FT):
2. ( ) TACTICAL ASSESSMENT: (Note: 1. Expand on the guidance contained in the Propagation Conditions Summary (PCS) Module. Specifically, discuss the atmospheric impact on MAGTF EM systems with respect to sensor-target-duct geometry (i.e. aircraft positioning, optimum altitudes for jamming, attack, EM surveillance, etc.). Highlight those sensors which are significantly degraded/enhanced. Focus on tactical guidance which will enable the TAC, SAAWC, and combat mission planners to effectively exploit a given atmospheric environment.
2. As feasible, include an analysis/forecast of atmospheric refractivity conditions in the projected operating area.)
3. ( ) EM SENSOR PERFORMANCE PREDICTIONS:
A. AIR SEARCH RADAR RANGES (NM) FOR   (MISSILE)/   (FIGHTER - BOMBER) SQ METER TARGETS AT VARIOUS ALTITUDES, BASED ON 90 PCT POD:

ALT (100S FT)	(010)	(050)	(100)	(200)	(300)
RADAR					
AN/TPS-59	/	/	/	/	/
AN/TPS-63	/	/	/	/	/
AN/TPS-73	/	/	/	/	/
AN/MPQ-62	/	/	/	/	/
AN/UPS-3	/	/	/	/	/
AN/MPQ-53	/	/	/	/	/
AN/APS-138	/	/	/	/	/
AN/APY-1/2	/	/	/	/	/

(Note: Radar x-sections should be tailored to the expected threat. NOCD TD 1195/MCM3-1, Vol. II provide representative values of typical U.S./Threat platforms. Include all air-search radars organic to or in support of the MAGTF.

B. ESM INTERCEPT RANGES (NM) FOR VARIOUS EMITTERS:

EMITTER	ESM RECEIVER (AN/ALQ-99 - FT)
(Surface)	
(Airborne)	
(Missile)	

(Note: A representative set of emitters tailored to the expected threat is preferable to listing every emitter available.)

C. ESM COUNTER DETECTION RANGES (NM) FOR VARIOUS THREAT ESM RECEIVERS:

U.S. EMITTER	ESM RECEIVER
(Surface)	(Airborne)

(Note: A representative list of U.S. emitters and threat ESM receivers is recommended.)

4. ( ) FLIR DETECTION RANGE PREDICTIONS WFOV/NFOV (NM) FOR TGT AT VARIOUS ALTITUDES, BASED ON 50 PCT POD, VSBY NM, WIND SPEED KTS, ABSOLUTE HUMIDITY g/m3:

ALT (100S FT) SENSOR	(005)	(010)	(050)	(100)	(200)	(300)
AN/AAR-51	/ NA	/ NA	/ NA	NA/ NA	NA/ NA	NA/ NA
AN/AAS-38A	/	/	/	/	/	
AN/AWS-1	/	/	NA/ NA	NA/ NA	NA/ NA	NA/ NA

(Note: Include FLIR sensors available within the MAGTF. Target types should be tailored to expected threat. Flight levels should be consistent with platforms supported.)

5. ( ) COMMUNICATION RANGE PREDICTIONS:

A. UHF COMMUNICATION RANGE: (NORMAL/EXTENDED/GREATLY EXTENDED)

B. HF RADIO PROPAGATION CONDITION/FORECAST:

(1) HF PROPAGATION CONDITION/FORECAST:

(2) 10.7 CM FLUX:

6. ( ) M-UNIT SUMMARY (PROVIDED FOR INPUT INTO IREPS):

HGT (FT)	M-UNIT	TYPE (SUB/NORM/SUPER/TRAP)

(Note: Include enough significant levels to enable MSTs to generate representative coverage diagrams using IREPS.)

7. ( ) MRS CALIBRATION DATA: (Note: Include this section only if MRS-capable units are operating in close proximity.)

8. ( ) RELEASED BY: (Note: Include when MINIMIZE imposed.)//

DECL/ //

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TAB C (STRIKE FORECAST) TO APPENDIX 2 (MAGTF STANDARD TACTICAL METEOROLOGICAL/OCEANOGRAPHIC [METOC] SUPPORT PLAN) TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U) STRIKE FORECAST (STRKFCST) (U)

(PASS TO [MAG/TACC/DASC/FSCC/MATC/TAOC/SAAWC])
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/STRIKE FORECAST (STRKFCST)//
RMKS/1. ( ) METEOROLOGICAL SITUATION AT Z.
2. ( ) 24-HOUR FORECAST COMMENCING Z.
A. ENROUTE WX: TO TO .
(1) SKY/WEATHER:
(2) VSBY/SLANT RANGE VSBY (NM):
(3) SST (DEG F)/IN WATER SURVIVAL TIME:
(4) CLOUD TOPS/CEILINGS (FT):
(5) ENROUTE WINDS/TEMPS ALOFT (LOCATION/FL/DIR/SPD IN KTS/TEMPS IN DEG C):
(6) TURBULENCE:
(7) MINIMUM FREEZING LEVEL (FT):
(8) ICING:
(9) MINIMUM ALTIMETER SETTING (INS):
(10) CONTRAIL FORMATION:
(11) DITCH HEADINGS (DEG T):
B. TARGET AREA WX: (Note: Repeat for each target area.)
(1) SKY/WEATHER:
(2) VSBY/SLANT RANGE VSBY (NM):
(3) SURFACE WINDS (KTS):
(4) MAX/MIN TEMPS (DEG F):
(5) CLOUD TOPS/CEILINGS (FT):
(6) WINDS/TEMPS ALOFT (FL/DIR/SPD IN KTS/TEMPS IN DEG C):
(7) TURBULENCE:
(8) FREEZING LEVEL (FT):
(9) ICING:
(10) MINIMUM ALTIMETER SETTING (INS):
(11) D-VALUES:
(12) CONTRAIL FORMATION:
(13) ASTRONOMICAL DATA (UTC) AT Z:
SUNRISE/SUNSET/SUN ANGLES (ELE/AZ):
BMNT/BMCT/EECT/EENT:
MOONRISE/MOONSET/PCT ILLUMINATION/MOON ANGLES (ELE/AZ)/LUX VALUES:
3. ( ) OUTLOOK TO 48 HRS:

4. ( ) TACTICAL ASSESSMENT: (Note: Correlate the current/forecast weather to major concerns such as aerial refueling track cloud layers and ceilings, severe weather, TGT ceilings and visibilities, bomb damage assessment (BDA), impact on EO systems/weapons, IFR conditions, etc.)
5. ( ) ELECTRO-OPTICAL SENSOR PERFORMANCE PREDICTIONS: (Note: Include representative EO sensor performance predictions for strike sensors/weapon systems and key environmental assumptions.)
6. ( ) RELEASED BY: (Note: Include when MINIMIZE imposed.)//
DECL/ //

APPENDIX G

Sample Annex H (METOC Services) Draft

8TH MEB
FORWARD
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TAB D (ASSAULT FORECAST) TO APPENDIX 2 (MAGTF STANDARD TACTICAL METEOROLOGICAL/OCEANOGRAPHIC [METOC] SUPPORT PLAN) TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEF(FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U) ASSAULT FORECAST (ASLTFCST) (U)

(PASS TO [MAG/TACC/DASC/FSCC/MATC/TAOC/SAAWC])
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/ASSAULT FORECAST (ASLTFCST)//
RMKS/1. ( ) METEOROLOGICAL SITUATION AT Z.
2. ( ) 24-HOUR FORECAST COMMENCING Z.
A. ENROUTE WX: TO TO .
(1) SKY/WEATHER:
(2) VSBY/SLANT RANGE VSBY (NM):
(3) SST (DEG F)/IN WATER SURVIVAL TIME:
(4) CLOUD TOPS/CEILINGS (FT):
(5) ENROUTE WINDS/TEMPS ALOFT (LOCATION/FL/DIR/SPD IN KTS/TEMPS IN DEG C):
(6) TURBULENCE:
(7) MINIMUM FREEZING LEVEL (FT):
(8) ICING:
(9) MINIMUM ALTIMETER SETTING (INS):
(10) CONTRAIL FORMATION:
(11) DITCH HEADINGS (DEG T):
B. FARP/RGR WX: (As required, include for return leg if necessary.)
(1) SKY/WEATHER:
(2) VSBY/SLANT RANGE VSBY (NM):
(3) SURFACE WINDS (KTS):
(4) CLOUD TOPS/CEILINGS (FT):
(5) MAX/MIN TEMPS (DEG F):
(6) MINIMUM ALTIMETER SETTING (INS):
(7) MAXIMUM PA/DA:
C. ASSAULT LZ WX: (Note: Repeat for each assault LZ.)
(1) SKY/WEATHER:
(2) VSBY/SLANT RANGE VSBY (NM):
(3) SURFACE WINDS (KTS):
(4) MAX/MIN TEMPS (DEG F):
(5) MAXIMUM PA/DA:
(6) CLOUD TOPS/CEILINGS (FT):
(7) WINDS/TEMPS ALOFT (FL/DIR/SPD IN KTS/TEMPS IN DEG C):
(8) TURBULENCE:
(9) FREEZING LEVEL (FT):

(10) ICING:
(11) MINIMUM ALTIMETER SETTING (INS):
(12) D-VALUES:
(13) CONTRAIL FORMATION:
(14) ASTRONOMICAL DATA (UTC) AT Z:
SUNRISE/SUNSET/SUN ANGLES (ELE/AZ):
BMNT/BMCT/EECT/EENT:
MOONRISE/MOONSET/PCT ILLUMINATION/MOON ANGLES (ELE/AZ)/LUX VALUES:
3. ( ) OUTLOOK TO 48 HRS:
4. ( ) TACTICAL ASSESSMENT: (Note: Correlate the current/forecast weather to major concerns such as FARP/RGR ceilings and visibilities, severe weather, LZ ceilings and visibilities, bomb damage assessment (BDA), impact on EO systems/weapons, IFR conditions, etc.)
5. ( ) ELECTRO-OPTICAL SENSOR PERFORMANCE PREDICTIONS: (Note: Include representative EO sensor performance predictions for associated assault platforms and key environmental assumptions.)
6. ( ) RELEASED BY: (Note: Include when MINIMIZE imposed.)//
DECL/ //

APPENDIX G

Sample Annex H (METOC Services) Draft

8TH MEB
FORWARD
YUMA GREEN
192200Z MAR 02

TAB E (AMPHIBIOUS OBJECTIVE AREA FORECAST) TO APPENDIX 2 (MAGTF STANDARD TACTICAL METEOROLOGICAL/OCEANOGRAPHIC [METOC] SUPPORT PLAN) TO ANNEX H (ENVIRONMENTAL SERVICES) TO 8TH MEB (FWD) OPERATION ORDER 2-02 (OPERATION BACKUP) (U)
AMPHIBIOUS OBJECTIVE AREA FORECAST (AOAFCST) (U)

(PASS TO [CATF/CLF/MST/ACE])
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/AMPHIBIOUS OBJECTIVE AREA FORECAST (AOAFCST)//
RMKS/1. ( ) METEOROLOGICAL SITUATION AT Z.
2. ( ) 24-HOUR FORECAST COMMENCING Z FOR AMPHIBIOUS OBJECTIVE AREA. (Note: Include separate forecast for landing area if significantly different from AOA weather.)
A. SKY/WEATHER:
B. VSBY (NM):
C. SURFACE WINDS (KTS):
D. MAX/MIN TEMPS (DEG F): (Note include wind chill factor if applicable.)
E. SST (DEG F):
F. COMBINED SEAS (FT):
G. IN WATER SURVIVAL TIME (HRS):
H. AVIATION PARAMETERS:
(1) CLOUDS/CEILINGS (FT):
(2) WINDS/TEMPS ALOFT (FL/DIR/SPD IN KTS/TEMPS IN DEG C):
(3) TURBULENCE:
(4) FREEZING LEVEL (FT):
(5) ICING:
(6) MINIMUM ALTIMETER SETTING (INS):
(7) MAXIMUM PA/DA:
(8) CONTRAIL FORMATION:
(9) SLANT RANGE VISIBILITY (NM):
3. ( ) SURF FORECAST FOR (RED)/(BLUE) BEACH: (Note: Output format included in MOSS surf module.)
A. ALPHA - SIGNIFICANT BREAKER HEIGHT (FT):
B. BRAVO - MAXIMUM BREAKER HEIGHT (FT):
C. CHARLIE - DOMINANT BREAKER PERIOD (S):
D. DELTA - DOMINANT BREAKER TYPE: (i.e. % Spilling, Plunging, Surging)
E. ECHO - BREAKER ANGLE (DEG):
F. FOXTROT - LITTORAL CURRENT (KTS):
G. GOLF1 - NUMBER OF SURF LINES:
GOLF2 - SURF ZONE WIDTH (FT):
H. MODIFIED SURF INDEX:

APPENDIX G

Sample Annex H (METOC Services) Draft

I. HIGH/LOW TIDES (UTC OR LOCAL):
J. BEACH CONDITIONS: (Note: Provide summary of hydrographic reconnaissance data to include bottom type, beach slope/type/trafficability, significant obstacles (locations) ashore and in shallows.)
4. ( ) TACTICAL ASSESSMENT: (Note: See CNSP/CNSLINST 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. ( ) ATMOSPHERIC REFRACTIVE SUMMARY:
A. EVAPORATIVE DUCT HEIGHT (FT):
B. SURFACE-BASED DUCT HEIGHT (FT):
C. ELEVATED DUCT HEIGHTS (BOTTOM-TOP) (FT):
D. RADAR PROPAGATION CONDITIONS SUMMARY:
(1) SFC TO SFC RADAR RANGES: (Note: Expand upon the guidance contained in EM
(2) SFC TO AIR RADAR RANGES: PCS module.)
(3) AIR TO AIR RADAR RANGES:
(4) AIR TO SFC RADAR RANGES:
E. COMMUNICATION RANGE PREDICTIONS:
(1) UHF COMMUNICATION RANGE: (NORMAL/EXTENDED/GREATLY EXTENDED)
(2) HF RADIO PROPAGATION SUMMARY:
6. ( ) ASTRONOMICAL DATA (UTC OR LOCAL):
A. SUNRISE/SUNSET:
B. BMNT/BMCT/EECT/EENT:
C. MOONRISE/MOONSET/PCT ILLUMINATION:
D. NIGHT VISION EFFECTIVENESS (LUMENS):
7. ( ) 24-HOUR RADFO/CHEMFO FCST: (Note: Include as tactical situation dictates.)
A. EFF DOWNWIND DIR(T)/SPD (KTS):
B. DISTANCE (NM):
8. ( ) RELEASED BY: (Note: Include when MINIMIZE imposed.)//
DECL/   //

Appendix H

METOC CENTERS

Introduction

METOC centers are Air Force and Navy centralized production sites and climatology centers. METOC centers are broken down into two categories Strategic forecast and climatology centers and theater, regional, and component forecast centers. See Joint Pub 3-59 for more information.

Strategic Forecast and Climatology Centers

Headquarters, Air Force Weather Agency

The HQ AFWA is located at Offutt Air Force Base, Nebraska.

Primary Mission. The primary mission of the HQ AFWA is to focus on weather support worldwide to theater JTF land and air operations. To do this, the AFWA ingests atmospheric and satellite observations to build an accurate, worldwide weather database to produce gridded analysis and forecast fields of parameters that feed specific application programs for the warfighter. The AFWA also provides tailored support products. See AFI 15-118, *Requesting Specialized Weather Support*, for procedures to request support and AFCAT 15-152, *Space Environmental Products*, Volumes 1, 2, and 3 for a detailed product and station listing.

Capabilities. Weather reports from meteorological sources throughout the world are gathered and relayed to the HQ AFWA. These reports are combined with information that is available from military and civilian meteorological satellites (METSATs) to construct a near-real-time integrated environmental database. The AFWA is the DOD center for defense METSAT data processing and the only U.S. agency that provides automated worldwide cloud depictions and forecasts. Computer programs model the resident atmospheric database and project changes. These models form building blocks for worldwide tailored weather support to warfighters.

Communications Connectivity. Access to numerical weather prediction METOC fields is gained through landline connectivity with the FNMOC. The AFWA data acquisition is chiefly through the Automated Weather Network (AWN); observations, forecasts, and advisories are relayed through high-speed circuitry. Satellite data from the Defense Meteorological Satellite Program (DMSP) and the National Environmental Satellite Data and Information Service (NESDIS) polar orbiting and geostationary satellites are relayed to the HQ AFWA through communications satellite or direct readout.

Foreign geostationary satellite imagery is relayed over landlines. Worldwide data and product dissemination is through the Air Force Digital Graphics System (AFDIGS) for facsimile graphics, through the AWN for alphanumeric data, and through the Automated Weather Distribution System (AWDS) for both graphics and alphanumerics.

The automated Defense Switched Network (DSN) delivers HQ AFWA computer flight plans, mission-tailored products, and other alphanumeric products to users in the field. The Air Force Global Weather Central Dial-In Subsystem (AFDIS) provides worldwide access to the AFWA products through phone lines. The AFWA graphics products to which the AFDIS provides access, through computer modem link, include high-resolution analysis and forecast fields, observations, bulletins, and satellite imagery.

General Product Types. Cloud depiction, forecast products, and military operation support products (electro-optical TDA and soil moisture) are generated at the HQ AFWA. The basic output is data in the format of the uniform gridded data field (UGDF). This format provides the basis for AFWA support to JTF operations. This support product achieves consistency through the use of common numerical weather prediction data fields from the FNMOC.

55th Space Weather Squadron

The 55SXS is located at Falcon Air Force Base, Colorado.

Primary Mission. The primary mission of the 55SXS is to collect, maintain, analyze, and forecast space environmental conditions that can affect any location worldwide in support of DOD forces.

Capabilities. 55SXS support includes event notifications and warnings; routine observations; analyses; and forecasts for the ionosphere, the Earth's geomagnetic field, the magnetosphere, and the sun. Additionally, the Air Force Space Forecast Center provides assessments of space environmental conditions with respect to satellite, communications, and radar anomalies. See AFI 15-118 on procedures to request support and AFCAT 15-152, Volume 5, for a detailed product listing. General product types include:

- Alert notification of events (solar flares, radio bursts, geomagnetic storms, and proton events)
- Tailored support to exercises and contingencies, as required (radio propagation forecasts, solar and geomagnetic forecasts, and corrections for isonospheric refraction)
- Routine observation, analysis, and prediction of the space environment (planetary geomagnetic indices, solar flux, and radio propagation)
- Anomaly assessments (communications and satellite operations).

Fleet Numerical METOC Center

The FNMOC is located in Monterey, California.

Primary Mission. The primary mission of the FNMOC is to provide numerical weather prediction METOC data fields to other production centers and operating forces worldwide. The data fields include global and higher resolution regional atmospheric and oceanographic analyses and forecasts. The FNMOC is the DOD's center for worldwide numerical weather prediction and is the center of expertise for microwave satellite data. Consistency among all DOD forecast products is provided through the common baseline numerical weather prediction dataset generated by the FNMOC. Submit requests for support in accordance with NAVMETOCCOMINST 3140.1K. For the latest Navy Oceanographic Data Distribution System (NODDS) product listings, see FLTNUMMETOCCENINST 3147.1, *Navy Oceanographic Data Distribution System Products Manual*.

Capabilities. The FNMOC's primary numerical forecast model is the Navy Operational Global Atmospheric Prediction System (NOGAPS), an 82 kilometer resolution spectral wave model. The high resolution regional numerical forecast model is the Navy Operational Regional Atmospheric Prediction System (NORAPS), which provides atmospheric data at 45 kilometer resolution. Higher resolution nested regions can be located to cover contingency regions worldwide on short notice. FNMOC provides another model, Coupled Ocean Atmosphere Mesoscale Prediction System, (COAMPS). The resolution varies between 108 and 3 km. The NODDS provides worldwide dial-in access to FNMOC products through various computer modem links. Products available from the FNMOC include unclassified analysis and numerical forecast fields of the Earth's geomagnetic field, the magnetosphere, and the sun. Additionally, the 55SXS provides assessments of space environmental conditions with respect to satellite, communications, and radar anomalies. See AFI 15-118 on procedures to request support and AFCAT 15-152, Volume 5, for a detailed product listing. General product types include:

- Alert notification of events (solar flares, radio bursts, geomagnetic storms, and proton events)
- Tailored support to exercises and contingencies, as required (radio propagation forecasts, solar and geomagnetic forecasts, and corrections for ionospheric refraction)
- Routine observation, analysis, and prediction of the space environment (planetary geomagnetic indices, solar flux, and radio propagation)
- Anomaly assessments (communications and satellite operations).

Communications Connectivity.

Access to the worldwide METOC database is gained through connectivity to the FNMOC. Data and product dissemination are provided through a landline to the FNMOC; Automatic Digital Network (AUTODIN) to users, as required; standard Navy command, control, communications, computers, and intelligence (C4I) systems; the Joint Operational Tactical System (JOTS); and dial-in computer access through modem. Database summaries are available on CD-ROM.

General Product Types. General product types include:

- Three dimensional oceanographic analyses Ocean front and eddy analyses
- Bathymetric profiles and databases
- Enclosed ocean basin circulation analyses and forecasts
- Mine drift predictions
- Oil spill dispersion predictions
- Tactical oceanographic summaries

- Specialized exercises and mission support
- Specialized oceanographic publications.

Air Force Combat Climatology Center

The AFCCC is located at Scott Air Force Base, Illinois.

Primary Mission. The primary mission of the AFCCC is to collect and store global environmental observations in its climatic database. It analyzes and applies information from the database, the HQ AFWA technical library, and other sources to prepare tailored environmental studies and analyses for DOD forces worldwide.

Capabilities. The AFCCC can prepare tailored environmental studies on almost any facet of meteorology affecting military operations from the Earth’s surface through 400,000 feet above mean sea level. All studies and analyses are tailored to user requests. See AFI 15-118 to request support. Special product request procedures are provided in Chapter 2 and Appendix A of USAFETAC/TC-95/001, *Catalogue of Air Force Weather Technical Publications (1992 - 1995)*. Contingency support needed before JMFU activation should be requested from the AFCCC director of operations. After normal duty hours, contact the command post. Air Force and Army requests for Navy METOC support will be coordinated between the AFCCC and the FLTNUMMETOC DET. Responses are provided through the AFCCC in accordance with the AWS and the CNMOC memorandum of agreement. See AFCAT 15-152, Volume 4, for a detailed product listing. Additionally, a complete listing is published periodically as an AFCCC technical catalog.

Communications Connectivity. Communications connectivity includes DSN and commercial phone (both secure telephone unit III (STUIII) and nonsecure), nonsecure and secure facsimile, and the Defense Message System (DMS) through Scott Air Force Base.

General Product Types.

General product types include:

- Airfield summary packages
- Surface observation climatic summaries
- Climatic briefs
- Specialized precipitation and temperature studies
- Descriptive (narrative) climatology studies
- Engineering design and construction studies
- Environmental simulation studies
- Low-level route climatologies
- Mission success indicators
- Wind duration studies.

Fleet Numerical METOC Detachment

The FLTNUMMETOC DET is located in Asheville, North Carolina.

Primary Mission. The primary mission of the FLTNUMMETOC DET is to provide METOC climatological services. To request support, see NAVMETOCCOMINST 3140.1L or FLTNUMMETOC DET Asheville Notice

3146, *Guide to Naval Meteorology and Oceanography Command Atmospheric Climatic Summaries, Products, and Services*, or coordinate directly by phone. Support requests requiring AFCCC climatological input will be coordinated. See FLTNUMMETOC DET Asheville Notice 3146 for a detailed product listing.

Communications Connectivity. Communications connectivity is through commercial phone lines and the Federal Telephone System (FTS). Real-time DMS message receipt and transmission is through a personal computer-based GATEGUARD system.

Operational, Theater, and Regional Component Forecast Centers

Operational, theater, and regional component forecast centers, shown below, include Air Force theater METOC centers and Navy METOC centers.

- Combined METOC Operations Center, Yongsan Army Installation, Seoul, Republic of Korea
- Alaskan Weather Operations Center, Elemendorf Air Force Base, Alaska
- European Command Forecast Unit, Traben-Trarbach, Germany
- Latin American Weather Operations Center, Howard Air Force Base, Panama
- Tanker Airlift Control Center, Scott Air Force Base, Illinois
- United States Naval Atlantic Meteorology Station Norfolk, Virginia
- United States Naval European Meteorology and Oceanography Center, Rota, Spain
- United States Naval Pacific Meteorology and Oceanography Center, Pearl Harbor, Hawaii
- United States Naval Pacific Meteorology and Oceanography Center West/Joint
- Typhoon Warning Center, Guam
- U.S. Air Forces, U.S. Central Command Weather Support Center, Shaw Air Force Base, South Carolina
- Air Combat Command Weather Support Unit, Langley Air Force Base, Virginia.

Air Force Theater METOC Centers

Primary Mission. The primary mission of Air Force theater METOC centers is to function as the Air Force, Army, and special operations forces component hubs for disseminating tailored METOC information to Air Force and Army component forces within their areas of responsibility. The mission also includes joint forces upon request or tasking from the commander in chief's senior METOC officer or JMO supporting the JTF.

Capabilities. Air Force component METOC centers produce tailored analysis and forecast guidance products that focus on the individual component's air-land areas. Products are based on numerical weather prediction guidance from HQ AFWA and other agencies. These centers routinely produce:

- Weather advisories and warnings
- Analyses and forecasts for particular operations and other tailored METOC data
- Products and services to support peacetime training
- Support to exercise and contingency operations.

Information on how to obtain specific support and detailed product descriptions can be obtained by contacting the individual center directly.

Product Descriptions. These centers produce alphanumeric and graphic products such as cloud and visibility forecasts; drop zone forecasts; hazard forecasts; air refueling forecasts; and various other tailored METOC data, products, and services. These centers are the Army point of contact for Army weather support requirements, including sea state information.

Navy Theater METOC Centers

Primary Mission. The primary mission of Navy theater METOC centers is to function as the Navy theater component hub for dissemination of METOC data and to provide full support services to naval component forces and joint forces on request. These METOC centers administer Navy METOC operations within their assigned area of responsibility.

Capabilities. Theater METOC centers provide tailored analyses and forecast guidance products focused on an individual component's maritime and littoral areas of responsibility. These centers routinely produce:

- Significant weather and sea advisories and warnings and individual ship route forecasts
- Aviation weather forecasts
- Optimum track ship routing
- Weather across your track services.

Navy METOC centers provide deployable mobile environmental team services; ocean frontal position analyses; acoustic prediction services; and tailored METOC data, products, and services to support exercise and contingency operations. Theater METOC centers function as the primary communications node for transmitting data to fleet users through Navy C4I systems. Support may be requested in accordance with NAVMETOCCOMINST 3140.1K or by contacting the supporting theater center directly to request services.

Primary METOC Production Center Integration

The two primary METOC production centers supporting joint operations are the FNMOC and HQ AFWA. In combination, these two centers provide most of the central site data and products needed to support in-theater requirements. Operationally, they produce an integrated product set for the theater and are available for transmission to supported components through existing component communications and information systems.
Consistency within the integrated product set is achieved through use of common numerical weather prediction data fields from the FNMOC in the generation of all application products.

Intelligence Preparation of the Battlespace

Introduction

The commander uses IPB to understand the battlespace and to integrate information on the enemy, weather, and terrain as well as the options presented to friendly and threat forces. IPB is the primary responsibility of the J-2, G-2, and S-2; however, the IPB process is not limited to the intelligence section and units. All commanders and staff officers participate in the IPB process and use its products for planning and decision-making. (See FM 34-130, *Intelligence Preparation of the Battlefield*, for a complete discussion of IPB.)

What Is IPB?

IPB is a systematic, continuous process of analyzing the threat and environment in a specific geographic area. It is designed to support staff estimates and military decision-making. Applying the IPB process helps the commander to selectively apply and maximize his combat power at critical points in time and space on the battlefield by:

- Determining the threat's likely COAs
- Describing the environment within which the unit is operating and the effects of the environment on the unit's operations.

IPB consists of four steps:

- Define the battlespace environment.
- Describe the battlespace's effects.
- Evaluate the threat.
- Determine the threat's COAs.

The IPB process is continuous. IPB is not just conducted before and during the command's initial planning for an operation, but is continued and further refined during the conduct of the operation. Each function in the process is performed continually to ensure that:
The products of the IPB remain complete and valid

- The support provided to the commander remains relevant to direct the intelligence system throughout the current mission and into preparation for the next.

An overview of each function is presented below.

Step 1: Define the Battlespace Environment

In steps 1 of the IPB process, the G-2/S-2:

- Establishes the limits of the area of interest in four dimensions: depth, width, height, and EM spectrum.
- Identifies characteristics of the battlespace that will influence friendly and threat Operations.
- Identifies gaps in current intelligence holdings.

This focuses the command's initial intelligence operation efforts and the remaining steps of the IPB process. To further focus the remainder of the IPB process, the G-2/S-2 identifies characteristics of the battlespace that require in-depth evaluation of their effects on friendly and threat operations, such as terrain, weather, logistical infrastructure, and demographics. Generally, these are analyzed in more detail for areas within the command's area of operations and battlespace than for other areas in the area of interest. By convention, intelligence collection includes sensing or obtaining data other than weather. Weather data collection is not considered to be a part of the intelligence collection process. IPB uses climatology and oceanographic information to determine maneuver and trafficability estimates and other effects on MAGTF and threat operations.

The G-2/S-2 establishes the limits of the area of interest to focus intelligence collection efforts on the geographic areas of significance to the command's specific mission. The limits of the area of interest are based on the amount of time estimated to complete the unit's mission and the location and nature of the characteristics of the battlespace that will influence the operation. If the command has not been assigned an area of operations, the G-2/S-2 coordinates with the G-3/S-3 to develop a joint recommendation on its limits for the commander's approval. Similarly, the G-2/S-2 confers with the G-3/S-3 on recommendations for the command's battlespace during the development of friendly COAs. The area requiring monitoring by the MAGTF METOC units is considerably larger than the area defined by the G-2/S-2. Weather systems and their associated effects will continue to influence and cross the battlespace regardless of the military situation. Weather systems that are perhaps thousands of miles upstream of the area of interest may affect the area of interest in time. Defining the significant characteristics of the battlespace environment also aids in identifying gaps in current intelligence holdings and the specific intelligence required to fill them. The MAGTF SWO's inputs on METOC information requirements and resulting shortfalls in meteorological sensing strategy are part of this definition and identification process. Similarly, the G-2/S-2 identifies gaps in the command's knowledge of the threat and the current threat situation. Once approved by the commander, the specific intelligence that is required to fill gaps in the command's knowledge of the battlespace environment and threat situation becomes the command's initial intelligence requirement.

Step 2: Describe the Battlespace's Effects

Step 2 evaluates the effects of the environment on friendly and threat operations. The G-2/S-2 identifies the limitations and opportunities that the environment offers for the potential operations of friendly and threat forces. This evaluation focuses on the general capabilities of each force until COAs are developed in later steps of the IPB process.

This assessment of the environment always includes an examination of terrain, including oceanographic conditions and weather. This part of the IPB process provides the basis on which concepts of operations are built and plans are made. Discussions of the characteristics of geography and infrastructure and their effects on friendly and threat operations may also be included.

The characteristics of geography include general characteristics of the terrain and weather such as climate, elevation, soil, vegetation, wind, moisture, and temperature. An area's infrastructure consists of the facilities, equipment, and framework needed for the functioning of systems, cities, or regions. Products developed in this step might include, but are not limited to:

- Population status overlay
- Overlays that depict the military aspects and effects of terrain
- Weather analysis
- Hydrographic and beach studies
- Integrated products such as modified combined obstacle overlays.

The weather analysis may include weather analysis overlays of specific parameters or meteorological conditions as well as graphic displays correlating weather events. In addition, weather effects matrices are provided based on climatology and expected conditions. These may include TDAs for electro-optical systems affecting the performance of threat and friendly forces. The SWO plays a key role in recommending what products are to be included depending on the mission, geographical region, climate, and influence that the potential weather conditions could have on the planning and execution of the mission.

Regardless of the subject or means of presentation, the G-2/S-2 ensures that these products focus on the effects of the battlespace environment.

Step 3: Evaluate the Threat

In step 3, the G-2/S-2 and staff analyze the command's intelligence holdings to determine how the threat normally organizes for combat and conducts operations under similar circumstances. When facing a well-known threat, the G-2/S-2 can rely on historical databases and well developed threat models. When operating against a new or less well-known threat, the G-2/S-2 may need to develop the intelligence databases and threat models concurrently. The G-2/S-2's evaluation is portrayed in a threat model that includes doctrinal templates that depict how the threat operates when unconstrained by the effects of the battlespace environment. Although these usually emphasize graphic depictions (doctrinal templates), threat models sometimes emphasize matrices or simple narratives. The SWO provides the expected range of METOC parameters to allow the G-2/S-2 staff to evaluate limitations of threat capabilities and potential threat actions. It is important for the SWO to be an integral part of the G-2/S-2 staff and know as much as possible about threat and friendly forces, capabilities, and systems and how weather and oceanographic conditions affect these systems.

Step 4: Determine Threat COAs

Step 4 integrates the results of steps 1 through 3 into intelligence estimates and supporting products. Given what the threat normally prefers to do and the effects of the specific operating environment, the threat's likely objectives and available COAs are analyzed. In step 4, the G-2/S-2 develops COA models that depict these threat COAs and prepares event templates and matrices in an effort to identify or estimate indicators that will reveal the threat COA being executed. This permits focusing intelligence collection and production efforts on those areas/events defined as named areas of interest (NAIs). Weather events, both actual and anticipated, are critical in determining the location of these NAIs and in estimating their effectiveness and reliability.

The enemy COA models developed in step 4 are the products that the staff uses in the planning and decision making processes to enhance effectiveness. The G-2/S-2 cannot produce these models and accurately predict the threat COAs without having:

- Adequately defined and analyzed the friendly mission throughout the estimated duration of the operation; clearly identified the physical limits of the area of operations and the area of interest; and identified every characteristic of the battlespace environment that might affect the operation (These characteristics are also quantified by objective means, when possible, or by subjective means if qualitative assessments are not available (step 2).)

- Identified the opportunities and constraints that the battlespace environment offers to adversaries and friendly forces (Again, such information is also quantified by objective means, when possible, or by subjective means if qualitative assessments are not available (step 2).)

- Thoroughly considered what the threat is capable of and prefers to do in similar situations if unconstrained by the battlespace environment (step 3).

In short, the enemy COA models that drive the decision making process are valid only if the G-2/S-2 establishes a good foundation during the first three steps of the IPB process. IPB identifies facts and assumptions about the battlespace environment and the threat. It is imperative that these facts and assumptions are presented as separate entities.

This permits objective decisions to be made regarding facts and identifies where subjective decisions need to be made regarding assumptions. The SWO helps the G-2/S-2 define weather conditions and uses TDAs, either manual or electronic, to show potential effects of the weather and oceanographic conditions and how these could affect the COAs of both threat and friendly forces. IPB is the basis for synchronization.

Weather and oceanographic conditions affect the timing of operations and are an essential part of the overall battle synchronization. The G-2/S-2

completes the initial intelligence estimate, and other staff members build their estimates based on this information. Weather information integrated into the intelligence estimate is provided to other staff users, either in the same format or in another format designed for more effective use by that functional area. The information provided for the initial intelligence estimate is only the starting point and may require extensive efforts for application to other users. The intelligence estimate includes five standard paragraphs defining the mission, areas of operation, enemy situation, enemy capabilities, and conclusions. The results and products of IPB, conveyed in the intelligence estimate, are essential elements of the Marine Corps Planning Process. Accordingly, the major IPB effort occurs before and during the six steps of the planning process.
The steps are:

- Mission analysis
- COA development
- COA analysis
- COA comparison/decision
- Orders development
- Transition.

Consideration of weather is part of each of the above steps and requires SWO support. The information that is necessary to execute operations is provided to users via a number of means. The SWO must know this process completely, including each type of unit's or staff section's unique METOC information requirements, and must work to integrate METOC support into all supporting and follow on steps and procedures throughout the command. For example, the fire support and communications and information systems plans can be greatly affected by METOC conditions. The SWO should ensure that weather products in the IPB process meet all of the command's requirements.

Although a standard analysis process is used to conduct a METOC analysis for the step describing battlespace effects, it is adapted to the specific tactical situation. Weather and oceanographic condition analysis cannot be viewed as a single step within the IPB process; rather, it is included at many steps throughout this iterative process. The SWO must understand the IPB process to provide effective support to the command's METOC information requirements. The initial METOC analysis plays a large part in describing effects anticipated in the battlespace. The terrain influences on the battlespace also help to shape the forecast. Weather and terrain must be considered when analyzing the battlespace because they complement each other and enhance the IPB process.

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THIS IS A 3 SECTION MESSAGE COLLATED BY DMDS

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SIC: N03800
SUBJ: EXERCISE ZEBRA STRIKE FORCE 2003 (ZSF 2003) METEOROLOGICAL AND
OCEANOGRAPHIC (METOC) LETTER OF INSTRUCTION (LOI)//
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FM CG XXX MEF//G2//
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INFO USCINCPAC HONOLULU HI//J319//
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353SOG KADENA AB JA//SOG//
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SUBJ/EXERCISE ZEBRA STRIKE FORCE 2003 (CG 2003) METEOROLOGICAL AND
/OCEANOGRAPHIC (METOC) LETTER OF INSTRUCTION (LOI)//
REF/A/DOC/CJCSI 3810.01A /YMD:19990225//
REF/B/DOC/JP 3-59/YMD:19990323//
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REF/D/DOC/NAVMETOCCOMINST 3140.1L/YMD:20020915//
REF/E/DOC/MCWP 3-35.7/YMD:19980630//

NARR/REF A ESTABLISHES POLICY AND ASSIGNS RESPONSIBILITIES FOR CONDUCTING JOINT METOC OPERATIONS. REF B SETS FORTH JOINT DOCTRINE, TACTICS, TECHNIQUES AND PROCEDURES FOR THE PLANNING AND EXECUTION OF METEOROLOGICAL, OCEANOGRAPHIC AND SPACE ENVIRONMENTAL OPERATIONS THROUGH THE RANGE OF MILITARY OPERATIONS.
PAGE 05 RUEOMFC3627 UNCLAS
REF C IS ANNEX H (METOC SERVICES) TO CTF ZEBRA STRIKE FORCE 2003 EXPLAN.
REF D IS U.S. NAVY OCEANOGRAPHIC AND METEOROLOGICAL SUPPORT SYSTEM MANUAL. REF E IS MAGTF METEOROLOGICAL AND OCEANOGRAPHIC SUPPORT PUBLICATION.//
POC/BROWN S.S./1STLT/XXX MEF G2/-/TEL:DSN 433-9999
/EMAIL:BROWNSS@XXXMEF.USMC.MIL//
RMKS/1. PURPOSE: THIS LOI PROVIDES A FINAL METOC CONOPS AND LOI FOR METOC FORCES ASSIGNED TO ZEBRA STRIKE FORCE 03 AND SUPPLEMENTS REFERENCES A THROUGH C. REFERENCES D AND E, UNIT SOP'S AND DESKTOP PROCEDURES SHOULD ALSO BE USED AS APPLICABLE TO SUPPORT SERVICE COMPONENT OPERATIONS. THAI WEATHER OPERATIONS AND SERVICES WILL BE IN ACCORDANCE WITH ESTABLISHED RTN AND RTAF DIRECTIVES. FOR PURPOSES OF THIS EXERCISE, JOINT METOC TERMINOLOGY PER REFS A THROUGH C WILL BE REFERRED TO AS COMBINED.
2. SITUATION:
   A. ZEBRA STRIKE FORCE 03 IS A COMBINED TRAINING EXERCISE CONSISTING PRIMARILY OF FORCES FROM AFRICA, INDIA AND THE UNITED STATES. ZEBRA STRIKE FORCE 03 IS DESIGNED TO DEMONSTRATE USPACOM ABILITY TO RAPIDLY DEPLOY A JOINT TASK FORCE TO CONDUCT JOINT/COMBINED OPERATIONS, PROMOTE REGIONAL COOPERATION, IMPROVE INTEROPERABILITY OF FORCES,
PAGE 06 RUEOMFC3627 UNCLAS AND ENHANCE MULTI-NATIONAL PLANNING AND EXECUTION.
   B. ASSUMPTIONS:
      (1) THERE WILL BE READY ACCESS TO COMMUNICATIONS IN ORDER TO TRANSMIT DATA AND PROVIDE COMPREHENSIVE AND COORDINATED METOC SUPPORT TO CTF FORCES.
      (2) STANDARD METOC DATA/PRODUCTS WILL BE AVAILABLE FROM USN/USAF METOC FORECAST CENTERS (MFC), THAI MIL/CIV WEATHER SERVICE AND GMS, NOAA, DMSP SATELLITES.
   C. PLANNING FACTORS: ZEBRA STRIKE FORCE 03 WILL TAKE PLACE DURING THE SPRING MONSOON TRANSITION PERIOD. BASED ON CLIMATOLOGICAL STUDIES AND HISTORICAL DATA, CONDITIONS ARE GENERALLY FAVORABLE FOR CONDUCTING ALL MILITARY OPERATIONS. MODERATE TO SOMETIMES HEAVY RAINSHOWERS AND ACCOMPANYING THUNDERSTORMS OCCUR THROUGHOUT THE KINGDOM OF INDIA. GENERALLY THEY ARE OF BRIEF DURATION AND CAN PRESENT SIGNIFICANT HAZARDS TO AIR, LAND AND SEA OPERATIONS. REAL WORLD WEATHER WILL BE USED DURING THE CPX PHASE UNLESS OTHERWISE DIRECTED.
   D. METOC FORCE LOCATIONS: FOR PLANNING PURPOSES, THE FOLLOWING KNOWN FORCE LOCATIONS ARE PROVIDED:
      (1) SENIOR METOC OFFICER (SMO) WILL BE LOCATED AT
PAGE 07 RUEOMFC3627 UNCLAS HQ, PACOM. POC IS CDR GONAVY, PACOM STAFF WEATHER OFFICER, DSN 315-322-5444, E-MAIL: RIMOFF@HQ.PACOM.MIL
      (2) COMBINED METOC OFFICER (CMO) WILL BE LOCATED AT CTF HQ, UTAPHAO, INDIA. POC IS CAPT I. MARINE, XXX MARINE EXPEDITIONARY FORCE, STAFF WEATHER OFFICER, DSN 333-7777, FAX EXT. 5555 E-MAIL: MARINEI@XXXMEF.USMC.MIL.
      (3) COMBINED METOC FORECAST UNIT (CMFU) WILL BE LOCATED AT THE NAVAL PACIFIC METEOROLOGY AND OCEANOGRAPHY CENTER (NPMOC), YOKOSUKA, JAPAN. POC IS CDR I. NAVY, DSN 222-8888, E-MAIL: N7@YOKO.NPMOC.NAVY.MIL.

(4) ALTERNATE CMFU WILL BE LOCATED AT CTF HQ, UGGOGO, AFRICA. POC IS CWO2 I. MARINE, MWSS-XXX WEATHER OFFICER, DSN 253-4435, E-MAIL: MARINEI@IWAKUNI.USMC.MIL.

(5) COORDINATING METOC FORECAST CENTER (CMFC) WILL BE LOCATED AT THE NAVAL PACIFIC METEOROLOGY AND OCEANOGRAPHY CENTER (NPMOC), YOKOSUKA, JAPAN. CDR M. GETWEATHER, DSN 200-6662, E-MAIL: 73@YOKO.VVMOC.NAVY.MIL.

(6) A USN STAFF METEOROLOGY AND OCEANOGRAPHY OFFICER WILL BE LOCATED AT THE CNAVFOR HQ IN UTAPHAO/BAN CHANG. POC IS LT B. METOC, E-MAIL: N22@CTF55.NAVY.MIL

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(7) A USN WEATHER FORECASTER WILL BE LOCATED AT CTF HQ, UTAPHAO, AFRICA. POC IS AGC(SW) R. BROWN, MET YOKOSUKA, QQQQ DSN 222-7777, E-MAIL:METOC@YOKO.NPMOC.NAVY.MIL.

(8) ONE USMC WEATHER FORECASTER WILL BE LOCATED WITH CMARFOR HQ, SAULF, AFRICA. POC IS GYSGT M. MARINE, DSN 611-7775, E-MAIL: MARINE@XXXMEF.USMC.MIL.

(9) A USAF WEATHER TEAM WILL BE LOCATED AT CAFSOF HQ, UDAN THANI, AFRICA. POC IS SSGT M. HERMAN, DSN 600-5555.

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(10) ONE USAF WEATHER FORECASTER WILL BE LOCATED AT CAFFOR HQ, UTAPHAO, INDIA. POC IS TSGT G. AIRFORCE, DSN 722-0909.

(11) ONE USMC WEATHER FORECASTER AND ONE WEATHER OBSERVER FROM MWSS-XXX WILL BE LOCATED AT UTAPHAO AIRFIELD, AFRICA IN SUPPORT OF MARINE AIR. POC IS CWO2 D.MARINE, MSGT W. MARINES, DSN 777-1111, E-MAILS: MARINE@IWAKUNI.USMC.MIL, MARINES@IWAKUNI.USMC.MIL.

(12) ONE USMC WEATHER FORECASTER AND ONE WEATHER OBSERVER FROM MWSS-XXX WILL BE LOCATED KORAT AIR BASE, AFRICA IN SUPPORT OF MARINE AIR. POC IS CWO2 D.MARINE, MSGT S. MARINES, DSN 777-1111, E-MAILS: MARINE@IWAKUNI.USMC.MIL, MARINES@IWAKUNI.USMC.MIL.

3. MISSION: PROVIDE TIMELY AND COORDINATED METOC SUPPORT TO CTF AND ASSIGNED AIR, GROUND, AND SEABORNE FORCES. PRIMARY METOC OBJECTIVES ARE SAFETY (FORCE AND RESOURCE PROTECTION), AND OPTIMUM TACTICAL METOC SUPPORT TO ALL CTF FORCES.

4. EXECUTION:

A. PERIOD: THE EXERCISE EMPLOYMENT DATES FOR ZSF 2003 ARE 15 DEC 03 THROUGH 22 DEC 03. COMPONENT TRAINING PERIOD 02 - 13 DEC 03, COMMAND POST EXERCISE (CPX) 16 - 19 DEC 03, FIELD TRAINING EXERCISE (FTX) 14 - 21 DEC 03.

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B. TASKS AND RESPONSIBILITIES:

(1) THE CMO WILL COORDINATE AND DIRECT ALL METOC SUPPORT. THE CMO WILL BE THE FINAL AUTHORITY FOR ALL ADMINISTRATIVE AND OPERATIONAL METOC ISSUES IN THE KINGDOM OF INDIA DURING ZSF 2003.

(2) NPMOC YOKOSUKA, JAPAN WILL CONDUCT CMFU OPERATIONS ON OR ABOUT 9 DEC 03. NPMOC YOKOSUKA WILL ISSUE TWICE DAILY COMBINED OPERATIONAL AREA FORECAST (COAF) AND ENSURE THAT MAXIMUM METOC DATA AND PRODUCTS FOR ZSF 2003 OPAREA ARE INSERTED ON LOCAL WEBPAGES (NIPRNET AND SIPRNET) THROUGHOUT THE EXERCISE PERIOD. SPECIAL METOC PRODUCTS WILL BE REQUESTED BY THE CMO.

(3) THE CMFC (NPMOC YOKOSUKA) WILL PROVIDE DATA AND FORECAST SERVICES TO CMFU, ALTERNATE CMFU, CMO AND ACT AS A CENTRAL HUB FOR TRANSMITTING AND PASSING METOC DATA. THE CMFC WILL DISSEMINATE HIGH WINDS, SEAS, AND TROPICAL WARNINGS, METOC GRIDDED DATA, OPTIMUM SHIP TRACK ROUTING (OSTR) SERVICES AND ADMINISTER CLASSIFIED AND UNCLASSIFIED FORECASTS. CMFC WILL COORDINATE WITH APPROPRIATE

AGENCIES ORGANIZATIONS AND AGENCIES FOR SPECIAL METOC PRODUCTS THAT CANNOT BE SATISFIED BY THE CMFU AND WHEN DIRECTED BY THE CMO.

(4) CAFFOR WILL COORDINATE AND PROVIDE SPECIALIZED WEATHER PRODUCTS (AERIAL REFUELING FORECAST, DROP ZONE FORECASTS ETC.) AS

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APPROPRIATE TO SUPPORT THEIR OPERATIONS. ENSURE THESE PRODUCTS ARE DISSEMINATED TO CMO, CMFU, CMFC, CARFOR, CMARFOR, AND CSOTF.

(5) ALL CTF METOC UNITS CAPABLE OF PROVIDING SURFACE, UPPER AIR, AND/OR SURF OBSERVATIONS WILL DO SO AS MUCH AS PRACTICAL AND PER APPLICABLE SERVICE MANUALS. PROVIDE AT A MINIMUM, 3 AND 6 HOURLY SURFACE OBSERVATIONS TO CTF, CMFU, AND CMFC.

(6) ALL METOC UNITS WILL IMMEDIATELY REPORT SIGNIFICANT WEATHER TO CMO, ALTERNATE CMFU AND CMFC FOR FURTHER DISSEMINATION TO ALL CTF FORCES. MINIMUM CRITERIA INCLUDES, THUNDERSTORMS, TORNADIC ACTIVITY, HAIL, OBSERVED OR IMMINENT LOCAL FLOODING, HEAVY RAINFALL (1 INCH OR MORE IN AN HOUR), REPORTED SEVERE TURBULENCE, OR ANY OTHER PHENOMENA THE FORECASTER CONSIDERS POTENTIALLY HAZARDOUS TO GROUND, AIR, OR SEABORNE OPERATIONS OR PERSONNEL.

(7) COMPONENT AND THEIR SUBORDINATE METOC UNITS WILL PASS PERTINENT DATA THROUGH THE ALTERNATE CMFU OR BY OTHER CONTROLLED MEANS. COORDINATE SUCH ARRANGEMENTS WITH THE CMO. THE ZSF 2003 CMFU METOC WEB PAGES WILL CONTAIN BOTH REAL TIME AND NEAR REAL TIME SATELLITE IMAGERY, RADAR PRODUCTS, LATEST COMBINED OPERATIONAL AREA FORECAST PAGE 06 RUEOMFC3628 UNCLAS

(COAF), TAFS AND OBSERVATIONS COLLECTED FOR THE AO, OCEANOGRAPHIC, CLIMATOLOGICAL AND ASTRONOMICAL DATA, CTF METOC BRIEFS, AND OTHER RELATED PRODUCTS AS DIRECTED BY THE CMO.

(8) THE AIR WEATHER SERVICE AND NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND WILL, THROUGH THEIR CENTRALIZED FACILITIES, PROVIDE CENTRALIZED PRODUCTS.

5. COORDINATING INSTRUCTIONS:

A. DIRECT LIAISON BETWEEN METOC SUPPORT UNITS AND AGENCIES IS AUTHORIZED AND ENCOURAGED.

B. SERVICE COMPONENTS WILL BE RESPONSIBLE FOR INTERNAL PRODUCT COORDINATION, BRIEFINGS, AND DISSEMINATION. EACH COMPONENT STAFF METOC OFFICER IS RESPONSIBLE FOR DECONFLICTING AND RESOLVING METOC ISSUES FOR THEIR RESPECTIVE COMMANDS.

C. ALL REQUESTS FOR SPECIAL PRODUCTS WILL BE MADE TO THE CMO, WHO WILL TASK THE CMFU. IF THE CMFU CANNOT SATISFY THE REQUEST, IT WILL BE PASSED TO THE CMFC FOR ACTION OR FURTHER TASKING TO AN APPROPRIATE AGENCY. REQUEST THAT ALL METOC ACTIVITIES IDENTIFY THEIR KNOWN SPECIAL REQUIREMENTS AS SOON AS POSSIBLE DUE TO THE LIMITED CMFU STAFFING. IT IS DESIRED THAT THESE REQUIREMENTS BE KNOWN PRIOR TO EXECUTION OF THE EXERCISE.

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6. COMMUNICATIONS:

A. NETWORKS: ALL METOC UNITS ARE REQUESTED TO COORDINATE WITH THEIR RESPECTIVE G,N,S-6 ORGANIZATIONS PRIOR TO STARTEX TO ENSURE THAT THEIR COMPUTER SYSTEMS, EQUIPMENT AND SOFTWARE ARE COMPATIBLE AND INTEROPERABLE WITH THE CTF COALITION WIDE AREA NETWORK (CWAN) ARCHITECTURE. ALL METOC PARTICIPANTS SHOULD ENSURE THEY HAVE CURRENT NIPRNET USER ACCOUNTS AND PASSWORDS FOR ACCESSING DOD METOC WEBSITES SUCH AS THE JOINT AIR FORCE AND ARMY WEATHER NETWORK (JAAWIN) AND FLEET NUMERICAL METEOROLOGY AND OCEANOGRAPHY CENTER (FNMOC) PRIOR TO DEPLOYMENT.

B. CWAN WILL BE USED AS THE PRIMARY MEANS OF METOC DATA PASSAGE FOR ZSF 2003. THE ALTERNATE CMFU WILL HOST AND ADMINISTER A CWAN METOC

HOMEPAGE DURING THE EXERCISE. THE IP AND URL ADDRESSES WILL BE PROMULGATED, AS THEY BECOME KNOWN.

(1) NIPRNET WILL BE USED AS A SECONDARY MEANS OF METOC DATA PASSAGE. THE CTF HQ METOC CELL WILL HOST AND ADMINISTER A NIPRNET METOC HOMEPAGE AT THE FOLLOWING URL ADDRESS:
HTTP:XXXMEFMETOCO.ZEBRA.COM

(2) SIPRNET WILL BE USED AS A TERTIARY MEANS OF METOC DATA PASSAGE. THE CTF HQ METOC CELL WILL HOST AND ADMINISTER THIS SITE AT
PAGE 08 RUEOMFC3628 UNCLAS
THE FOLLOWING URL ADDRESS: HTTP: WWW-G2.XXXMEF.USMC.SMIL.MIL WEATHER.
QQQQ

(3) NPMOC YOKOSUKA AS THE CMFC AND CMFU WILL ALSO HOST A WEBSITE AT THE FOLLOWING ADDRESS: HTTP: WWW.YOKO.NPMOC.NAVY.MI
L

C. TELEPHONE: C6 WILL PUBLISH A TACTICAL PHONE DIRECTORY. UPON RECEIPT, THE CTF METOC CELL WILL DEVELOP AND DISTRIBUTE A METOC ONLY TACTICAL PHONE DIRECTORY VIA CMFU, CWAN AND NIPRNET METOC WEBSITES.
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7. CENTRALIZED PRODUCTS:

A. COMBINED OPERATIONAL AREA FORECAST (COAF). THE COAF WILL PROVIDE FORECAST INFORMATION FOR THE EXERCISE AREA. IT WILL INCLUDE 12-24/24-48 HOUR FORECASTS FOR SKY, WEATHER, VISIBILITY, TEMPERATURES, RELATIVE HUMIDITY, MAX PA AND DA, CLOUD AND CEILINGS, WINDS ALOFT, TURBULENCE, ICING, MIN ALTIMETER SETTING, MAX SEAS, TIDES AND SURF DATA, ASTRONOMICAL DATA, AND 48-72 HOUR OUTLOOK DISCUSSIONS OF SYNOPTIC SITUATION AND WEATHER. THE BATTLE WEATHER EFFECTS MATRIX WILL BE APPENDED TO THE COAF USING ESTABLISHED CRITERIA. IT WILL BE PRODUCED TWICE DAILY AND DISTRIBUTED VIA AUTODIN MSG AND POSTED TO THE NPMOC YOKOSUKA WEBSITE AND THE ALTERNATE CMFU, CWAN, NIPRNET AND SIPRNET WEBSITES. THE COAF IS THE OFFICIAL FORECAST DURING CG 2003.

B. OTHER CENTRALIZED PRODUCTS ARE AVAILABLE FROM THE AIR WEATHER SERVICE'S AND NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND'S THEATER AND PRODUCTION CENTERS.

8. ADMINISTRATION: AFTER ACTION REPORTS: ALL METOC UNITS WILL SUBMIT COPIES OF FINAL REPORT NARRATIVES AND JULLS, AS APPROPRIATE TO THE CMO NLT 12 FEB 03. CTF ZEBRA STRIKE FORCE 2003 CMO WILL ISSUE REVISIONS OR MODIFICATIONS TO THIS LOI AS APPROPRIATE AND NECESSARY.
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9. LOGISTICS: LOGISTICS OF METOC EQUIPMENT WILL BE PER ANNEX D OF THE ZEBRA STRIKE FORCE 2003 EXPLAN AND PER APPLICABLE UNIT DIRECTIVES.

10. COMMAND AND CONTROL:

A. COMMAND: CTF ZEBRA STRIKE FORCE 2003 HAS OPCON OF TASK ORGANIZATION AND DEPLOYED METOC RESOURCES.

B. CONTROL: CTF CWAN WILL BE THE PRIMARY MEANS OF TRANSMITTING METOC DATA AND SUPPORT PRODUCTS TO DEPLOYED FORCES.

11. SECURITY: CONTROL AND DISSEMINATION OF METOC DATA WILL BE IN ACCORDANCE WITH APPLICABLE OPSEC PROCEDURES. REFER TO ANNEX L OF THE CTF ZEBRA STRIKE FORCE 2003 EXPLAN.//
BT
#3629
NNNN

ACTION:
G3 DMDS MESSAGES
XXXMEF DMS MESSAGES
DMS MESSAGES - 2003

APPENDIX K SAMPLE JOINT OPERATIONAL AREA FORECAST (DRAFT)

FXXX000 KYUM 211015

PRODUCED BY MAWTS-1 METOC CENTER MCAS YUMA AZ
SUBJ/OPERATION SAMPLE JOAF OPAREA FORECAST (JOAF)//
RMKS/1. INTENT OF THIS MESSAGE IS TO ALIGN WEATHER FORECASTS THROUGHOUT THE AREA OF INTEREST (AOI) 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. SVR TURBC/ICG IMPLIED VCNTY TSTMS. 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 ISOLD 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 AOR 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. 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 AFGHANISTAN.

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 WEBSITE: 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 WEBSITE: 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//

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Appendix L

(Draft)

METOC Equipment

This appendix will describe the various types of METOC equipment available, the concept of employment for each, and the specific capabilities that can be provided to the MAGTF commander and METOC personnel. Each "package" requires a different level of external support; therefore, this appendix can serve as an excellent planning tool when weighing the pros and cons of potential COAs.

Meteorological Mobile Facility (Replacement)

The Meteorological Mobile Facility (Replacement) [MetMF(R)], AN/TMQ-44A(V)1 was first provided to FMF units in 1997 as part of an evolutionary upgrade to the four and five van configurations that made up the Meteorological Mobile Facility of the time. The system brought with it software and hardware upgrades to replace the antiquated equipment of the old MetMFs at a greatly reduced deployment footprint.

Operating Environment

The MetMF(R), inherent to the Marine Wing Support Squadron (MWSS) is designed to operate within its transportable shelter under deployment conditions within an Expeditionary Airfield (EAF) environment. It will provide tactical METOC support to the MAGTF in general, and the Air Combat Element (ACE) specifically in garrison, or while engaged in Operational Maneuver from the Sea (OMFTS), Sustained Operations Ashore (SOA), or Military Operations Other Than War (MOOTW). Capable of full operations within twenty-four hours of arriving on station, the MetMF(R) will provide continuous meteorological observations, forecasts, satellite and radar imagery, and other tactical decision aids and products. The MetMF(R) is able to sustain operations for up to thirty days without re-supply. Additionally, the information systems within the MetMF(R) are interoperable with the Marine Corps Command and Control, Communications and Computers, and Intelligence (C4I) systems and the METOC systems of other services and government agencies.

Capabilities

The MetMF(R) enables the forecaster to collect and correlate METOC data in order to provide customers with the best "environmental picture" to support ongoing and future operations on a virtual real-time basis. The specific capabilities that the MetMF(R) brings to the battlespace are as follows:

- Automated processing for the ingest, manipulation, and dissemination of METOC data. The system is Defense Information Infrastructure (DII) Common Operation Environment (COE) compliant and is compatible with evolving joint communications and METOC architectures like the Joint Maritime Command Information System (JMCIS) and the Global Command and Control System - Maritime (GCCS-M).

- Secure data connectivity.

- Automatic ingestion of the Fleet Multi-Channel Broadcast channels 8 and 15.

- Secure HF, UHF, and VHF voice communications.

- Automatic local sensors which measure and record surface winds, surface air and dew point temperatures, liquid precipitation rate, cloud heights, horizontal visibility, atmospheric pressure and altimeter settings, and electric field potential.

- Two individual sets of remote weather sensors which measure and record surface winds, surface air and dew point temperatures, liquid precipitation rate, and atmospheric pressure and altimeter settings. Each remote sensor can report its measured data back to the MetMF(R) from sites located up to 250 nautical miles away.

- A meteorological satellite terminal capable of receiving both high and low resolution imagery from polar orbiting DMSP and NOAA satellites as well as low resolution imagery from the network of geo-stationary satellites around the globe.

- Doppler weather radar that provides real-time environmental surveillance and advanced warning of potentially hazardous atmospheric conditions. Capable of receiving returns up to 480 kilometers and velocity information up to 120 kilometers from the MetMF(R) location.

- Upper-air soundings that provide winds, air and dew point temperatures, and atmospheric pressure every ten seconds as the balloon rises through the atmosphere.

- A Local briefing system that utilizes closed-circuit television in conjunction with whether computer generated products or live video feed to provide any pertinent information data to a nearby location (i.e. Ready Room, G-3, etc.).

These capabilities bring the full spectrum of METOC services to the operational area and provide forecasters with basically the same information they would have when working in a Marine Corps Air Station/Facility Weather Office. Of all the METOC equipment available to personnel, the MetMF(R) gives the most in capabilities and products, however, the support requirements (see below) and footprint size really only make deployment of the MetMF(R) beneficial in operations lasting thirty days or more.

Support Requirements

Personnel

Although the exact numbers of personnel can vary from deployment to deployment, the recommended manpower to operate the MetMF(R) for continuous, twenty-four hour operations is as depicted in *Table L-1* on the following page. The manning concept from *Table L-1* provides sufficient personnel to provide twenty-four hour METOC support for long-term operations. This is the entire MWSS T/O for the METOC Services Branch, and would normally be utilized if the entire MWSS were to be forward deployed.

Obviously, the MWSS as a whole will not always deploy, smaller or shorter operations and exercises will have this manning concept trimmed to meet mission requirements. *Table L-2* on the following page lists the minimum required personnel to safely and efficiently deploy and operate the MetMF(R). These numbers would provide the bare minimum crew, and would give two separate shifts of personnel. Depending on the specific mission requirements, T/O available, and higher headquarter guidelines, a compromise between the two listed manning concepts will be adequate for any operation.

Table L-1 MetMF(R) Manning Concept (Whole)

BILLET DESCRIPTION	RANK	MOS	T/O
METOC Services Officer	CWO-3	6802	1
METOC Services Chief	GySgt	6842	1
METOC Forecaster	SSgt	6842	1
METOC Forecaster	Sgt	6842	3
METOC Observer	Sgt	6821	1
METOC Observer	Cpl	6821	3
METOC Observer	LCpl	6821	6
METOC Maintenance Chief	Sgt	6493	1
METOC Technician	LCpl	6493	2
		TOTAL STRENGTH	**19**

Table L-2 MetMF(R) Minimum Manning Requirements

BILLET DESCRIPTION	RANK	MOS	T/O
METOC Services Chief	GySgt	6842	1
METOC Forecaster	Sgt	6842	1
METOC Observer	Cpl	6821	2
METOC Observer	LCpl	6821	2
METOC Maintenance Chief	Sgt	6493	1
METOC Technician	LCpl	6493	1
		TOTAL STRENGTH	**8**

Site Selection

Selection of the operating site for the MetMF(R) is a crucial component for the planning of any operation. A poorly selected site can greatly hinder the ability to operate, data reception capabilities, or the overall customer satisfaction with the end product. Whenever possible, either the METOC Officer, Chief, or Senior Technician should be on the Site Survey Team. If this is not possible then whoever will be conducting the site survey MUST be briefed on the following critical needs:

- **Space.** The van and all of the ancillary equipment requires at least a 100' X 100' clear, flat area. This will provide adequate room to place the van, external sensors, and keep transmitting antennas at a safe distance.
- **Obstructions.** The site for the MetMF(R) should be relatively free from trees and other obstructions that could cause a partial or total loss of data reception for the Radar and Satellite subsystems. Care must also be taken when selecting where the Local Sensors are to be placed so as not to be recording false wind measurements due to obstructions blocking the prevailing winds. Due to safety concerns, the MetMF(R) should not be placed closer than forty-eight feet from any building that is at least as high as the radar antenna (approximately twelve feet from the base of the van).
- **Horizon.** It is desirable to have a clear view of the East and West horizons to increase the total reception time of polar orbiting satellite passes.

Embarkation

Table L-3 Example UDL for MetMF(R) Embarkation

DESCRIPTION	LEN	WID	HT	CUFT	WT	REMARKS
MetMF(R) Shelter	240	96	96	1280	16500	Standard Conex Box
Bard P1236A	68	47	71	132	600	ECU #1
Bard P1236A	68	47	71	132	600	ECU #2
MEP105	87	36	59	107	4400	Generator #1 - May not be required
MEP105	87	36	59	107	4400	Generator #2 - May not be required
Standard Pallet	57	40	48	64	400	12 Bottles of Helium
Cube Box	84	42	36	78	350	Standard Pellet size cube

Perhaps the greatest drawback to utilizing the MetMF(R) is the embarkation requirements for the van. The packing procedures for the van are very specific, and spelled out in an easy to follow format in EM000-AX-SUP-A20 *Embarkation Guide to the Meteorological Mobile Facility (Replacement).* An example of a typical Unit Deployment Listing (UDL) for embarkation of the van is listed in *Table L-3* above. Note that the generators listed in the table may not be required for every operation; they may also be a different type of generator. This is further explained in *Utilities Support* on page L-X.

The actual embarkation of the van from a garrison environment to the deployment site can be accomplished via a single C-130 (or larger aircraft) sortie, rail, road, and commercial or Naval sealift vessel. Transportation by road is described *Motor Transport Support* below.

Motor Transport Support

Ground transportation of the MetMF(R) can be accomplished in several ways; the Embarkation Officer, Motor Transport Officer, and METOC Officer will determine the mode of transportation based on local Motor-T asset availability and mission requirements. The following list describes the different forms of ground transportation available:

- **Self Loading LVS.** This is an OPTIONAL method of transporting the van by road because it removes the requirement for heavy equipment to lift the van.

- **M-1022 Mobilizer.** The M-1022 Mobilizer is often used by Marine Aviation Logistics Squadrons (MALS) to transport their avionics vans. The M-1022 is a removable set of wheels that attach to both ends of the van and allow it to be towed by a 5-Ton truck. The mobilizer is equipped with air brakes and is rated for speeds of up to 50 mph. The drawback to using the M-1022 is that they are cumbersome to work with, require a great deal of preventive maintenance, and must be removed before the van can be utilized.

- **Air Cushioned Flatbed Truck.** Either military or commercial flatbed trucks can be used to transport the MetMF(R) however, coordination will have to be made to provide for a crane or RTCH to lift the van onto the truck, see *Heavy Equipment Support* below.

The remaining UDL items (ECUs, Generators, and helium) will be transported by whatever means determined by the Embarkation Officer.

Heavy Equipment Support

The MetMF(R) requires several heavy equipment vehicles both before embarkation, and after arrival on site. This heavy equipment (HE) is required not only for lifting the van, but also for moving ECUs, generators, helium, and for placing the radar antenna pedestal on top of the van. To accomplish this, the following HE support is required:

- 25K Crane, RTCH, or 25K Forklift with 8 foot forks (Only required if lifting the van.
- Extended Boom Forklift (EBFL) or TRAM, for radar antenna, helium, generators, and ECUs.

Table L-4 MetMF(R) Frequency Requirements

BAND	EQUIPMENT	RANGE	TX PWR	HERP	HERO	HERF
HF	RT 7000 XCVR	1.6 - 29.9 MHz	125 w	3.5 m	55.1 m	15 m
UHF	AN/GRC-171 XCVR	200 - 399.9 MHz	50 w	1 m	4 m	15 m
VHF	MCC-520 Master	41.7 MHz (fixed)	250 w	3.5 m	30 m	15 m
	MCC-545 Remote	41.7 MHz (fixed)	100 w	2 m	8 m	15 m
	AN/VRC-90 SINCGARS	30 - 87.975 MHz	50 w	1 m	13 m	15 m
SHF	AN/TPS-76 Radar	5.3 - 5.7 GHz	250 Kw	15 m	45 m	300 m

Utilities Support

The cognizant MALS maintains two MEP-105 generators (W/C 990) specifically for the MWSS METOC section. However, if the MWSS is providing base camp support, their Utilities section can provide for power as long as the following requirements can be met, this power can be either tactical or commercial:

- 120/208 VAC
- 3 Phase
- 60 Hz
- Class L

If the MetMF(R) is deploying with generators, and if they are available, it is recommended to utilize MEP-806A tactical quiet generators over the aging MEP-105s, they are a far more efficient and reliable source of power.

Communications Support

The MetMF(R) brings to the battlefield a wide array of communications equipment. *Table L-4* above provides a detailed list of frequency requirements for each type of transmitting equipment, as well as power, and HERP/HERO/HERF information.

In addition to the frequency support, the van contains an internal LAN that must be connected to the SIPRNET. Depending on local COMSEC availability, SIPRNET may be decrypted with a KG-84A (or C), at KG-175, or a Network Encryption System (NES). The MetMF(R) requires twelve to fourteen static SIPRNET IP addresses. NIPRNET support may also be required for any unclassified assets, but all of the computers internal to the MetMF(R) are classified SECRET. Coordination with the supporting Information Systems

Officer will be required to determine the most appropriate network plan for specific operations.

Navy Integrated Tactical Environmental System

The Navy Integrated Tactical Environmental System IV (Nites) was the result of a program to upgrade the hardware and software of the obsolete IMOSS system with modern information system technology. The Nites IV is the primary man-portable deployable asset utilized by the Marine Corps during tactical operations.

Operating Environment

NITES suites are the T/E for the MSTs operating in the fleet. One suite is issued to each team with the exception of the teams overseas, which have two. In addition, each MetMF(R) is equipped with one full NITES suite to support operations.

The NITES is a portable system that is easily forward deployed and can be setup, operated, and maintained by one person or the entire MST. The IMOSS suite consists of three laptops, each designed to perform a different function but all three are loaded with the same software and can each perform the tasks of another. Because of this redundancy, the IMOSS is often not deployed as an entire suite. Mission requirements, network availability, and embarkation space will dictate how best to employ the NITES.

Capabilities

The NITES IV provides the forward deployed METOC forecaster with SIPNET/NIPRNET connectivity for data ingestion, as well as the following stand-alone capabilities:

- High and low resolution satellite imagery from polar orbiting NOAA satellites as well as low-resolution imagery from the network of geo-stationary satellites around the globe.
- HF Facsimile and RTTY data reception.

The NITES IV is equipped with the current versions of METOC software and is capable of operating in either a classified or unclassified environment based on customer needs. Because of the redundancy in software on each laptop, there will be no loss of data ingestion should a laptop fail.

Support Requirements

Each of the specific support requirements will be based of the system configuration chosen for a particular operation. System configurations will vary from operation to operation based on a number of factors; personnel, connectivity, and embarkation space are all factored in. *Table L-5* provides the most common configurations that have been employed by MST personnel.

Site Selection

The only site selection concern for the NITES IV will be if the suite is to be deployed as a whole. If this is the case, their must be a clear field of view for two satellite antennas, and if possible, a clear horizon for maximum reception of polar orbiting satellites.

Embarkation

The NITES IV requires no special embarkation concerns. The UDL will vary based on the configuration used, refer to *Table L-6* for embark information of each box.

Utilities Support

Standard 120 VAC, 60 Hz commercial or tactical power provided to the workspace is sufficient to operate the NITES IV. METOC personnel should be prepared to provide their own surge suppression to prevent equipment damage. It is also recommended that METOC personnel purchase international power adapter kits to accommodate the system.

Network Support

Although the NITES IV has stand-alone capabilities, the primary data ingest method is thru NIPRNET and/or SIPRNET. Coordination should be made with the S/G/J-6 section to provide network support for each laptop being deployed. If possible, an international dial-up account should be established to facilitate providing METOC support before data connectivity is established as well as after it is removed.

Table L-5 Common NITES IV System Configurations

CONFIG	EQUIPMENT	REMARKS
A	Entire Suite (4 Boxes)	Used when network connectivity will be sporadic, when team will be moving often, or for long-term operations.
B	1 Laptop (Soft case)	Ideal for short, one forecaster ops that require only a small amount of METOC support. Eliminates embark requirements because forecaster can hand carry the laptop. Can be modified with a second hard drive to support both SIPRNET and NIPRNET.
C	2 Laptops (Soft cases)	Adding a second laptop to CONFIG B to provide simultaneous SIPRNET and NIPRNET support.
D	B or C with Printer (1 Box and soft case)	This configuration is useful when METOC personnel will be required to produce a large amount of paper products.
E	Primary/Secondary Modules (2 Boxes)	Provides for full reception and manipulation of satellite imagery when data connectivity is not available. Also provides Main Module computer and printer.
F	Tertiary Workstation (1 Boxes)	Same as CONFIG E except without Main Module box and assets.

NOTE: These configurations are merely examples of what METOC Teams have utilized in past operations. They can easily be modified in a number of different ways to meet specific mission support requirements.

Table L-6 Embark Information for NITES IV Boxes

DESCRIPTION	LEN	WID	HT	CUFT	WT	REMARKS
CASE 1	34	20	12	5	50	PRI WS/SEC WS
CASE 2	34	20	12	5	50	Tertiary WS/Printer
CASE 3	34	20	12	5	50	AWOS
CASE 4	27	27	13	6	15	WEFAX Flat Panel Antenna

The Meteorological and Oceanography Integrated Data Display System - Tactical (MIDDS-T) prototype was designed as a "first-in" system to satisfy JMFU/CMFU support requirements for Navy MET Teams during contingency operations. The system has since been fielded to MEF G2 METOC Cell designed to provide for small, mobile, ruggedized JMFU/CMFU capabilities in support of JTF/CTF operations. This system will be phased out once the NITES IV system is completely fielded.
contingency operations. The system has since been fielded to MEF G2 METOC Cell designed to provide for small, mobile, ruggedized JMFU/CMFU capabilities in support of JTF/CTF operations. This system will be phased out once the NITES IV system is completely fielded.

Operating Environment

The MEF Staff METOC Officer and his/her assistant will use operate and maintain the MIDDS-T in garrison. When forward deployed, the MIDDS-T is designed and capable of providing JMFU/CMFU support and will normally be augmented by Navy, Air Force, and/or allied METOC personnel.

Capabilities

The MIDDS-T is capable of providing the full spectrum of METOC support and services. It has the ability to serve as a stand-alone METOC Office, or a forward deployed METOC Center. Below is a list of specific MIDDS-T capabilities:

- Utilizes exact same software as the MIDDS system being used by Navy and Marine Corps METOC personnel at bases and stations throughout the world. Software is fully compatible with tactical METOC systems around the world.
- Secure and Non-Secure Data ingest connectivity.
- International Mobile Satellite (INMARSAT-B) inherent to the system to allow for 64 KBPS data connectivity when network support is unavailable or down.

Table L-7 Embark Information for MIDDS-T Boxes

DESCRIPTION	LEN	WID	HT	CUFT	WT	REMARKS
BOX 1	34	20	12	5	50	Laptop/Printer
BOX 2	34	20	12	5	50	Laptop/Projector
BOX 3	34	20	12	5	50	Laptop/APT Ant.
BOX 4	23	19	8	3	50	Power Inverter/UPS
BOX 5	38	17	9	5	30	Organic Sensors
BOX 6	27	27	13	6	15	WEFAX Ant.
BOX 7	46	39	10	11	150	Smart Board
BOX 8	27	13	20	4	60	INMARSAT

- High and low resolution satellite imagery from polar orbiting NOAA satellites as well as low-resolution imagery from the network of geo-stationary satellites around the globe.
- Automatic local sensors which measure and record surface winds, surface air and dew point temperatures, atmospheric pressure and altimeter settings.
- Enhanced briefing system with Smart Board and projector (similar to Wall of Thunder) and Video Teleconferencing capability.
- Uninterruptible Power Supply (UPS) for system and data protection in the event of power loss.
- DC to AC power inverter; allows system to be powered from the DC outlet of most tactical vehicles.

Support Requirements

As with the NITES IV, the MIDDS-T could be broken down into smaller configurations to meet mission requirements but this is not recommended; the MIDDS-T is designed to operate in the JMFU/CMFU roll, and removing one or more computers from the package greatly reduces ingest capabilities and efficiency, as this severely tax the system's resources. The majority of the support requirements are the same as the IMOSS with just a few exceptions:

Site Selection

The site for the MIDDS-T has the same obstruction concerns as the NITES IV or MetMF(R) with regards to the satellite receiving antennas. Also included is the organic local weather sensor with the MIDDS-T, which offers approximately 150 feet of cabling. If the distance from the METOC Cell's workspace is too great, one solution offered is to set up a remote laptop near the sensor and transmit the received data to the main workspace via modems or the network.

Embarkation

Like the IMOSS, the MIDDS-T has no special embarkation concerns. The information on MIDDS-T Boxes can be found in *Table L-7* above.

Utilities Support

Because the MIDDS-T will usually be co-located with the G/J/C-2, the power applied to their office spaces will be sufficient to operate the systems. Delivered with the MIDDS-T is an international power and telephone adapter kit for every major section of the world.

The MIDDS-T is also delivered with a DC to AC power inverter, which allows the system to be powered from any 12 or 28 VDC power source. This is especially helpful if the system is to be deployed with the MEF/MEB Forward.

Communications Support

Although the MIDDS-T does not have any transmitting radios inherent to the system, the INMARSAT-B terminal does require a significant amount of communications support. Each terminal must be commissioned, enrolled, and have a Program Designator Code (PDC) before a Request for Service (RFS) can be started. There are very specific procedures for accomplishing this, and it should be done as soon as the terminal is received. The point of contact for initiating this process is:

COMNAVSPACECOM
Dahlgren, VA
POC: Mr. Mike Brady
DSN: 249-6929
comm: (540) 653-6929
email: mbrady@semcor.com

Funding for the INMARSAT-B is as follows:

- **VOICE/FAX** - $3.38/min
- **DATA** - $10.50/min

Point of contact for INMARSAT billing concerns is:

Doris Ambry
DISA/DSC22
Scott AFB, Il
DSN: 779-8994
comm: (618) 229-8994
email: ambryd@scott.disa.mil

METOC Officers should ensure that they budget accordingly for INMARSAT-B airtime based on mission requirements.

Once the needed validations, approvals, and funds are received, an RFS can be submitted. Normal lead-time for this process is thirty days. The point of contact for assistance in this matter is:

Mr. John Szoke
DISA/DSC33
Scott AFB, Il
DSN: 779-8856
comm: (618) 229-8856
email: szokej@scott.disa.mil

After these processes are completed, the INMARSAT terminal is ready for use. For JMFU/CMFU operations, METOC Officers should plan for at least ten to fifteen hours of data air time to allow for data reception and transmission before and after command networks are established and to allow for any unforeseen network down time.

The only other communication requirement for the MIDDS-T is the network support required. Basically, the same support that is required with the IMOSS. Spare hard drives are delivered with the system so support from SIPRNET or NIPRNET is required. Because of the ingest methods through METOC channels, the three laptops of the MIDDS-T should have static IP addresses vice using DHCP. In addition, coordination must be made with the Information Systems Security Officer (ISSO) to have the following firewall ports opened for the Automated Weather Network (NIPRNET):

- 131.7.251.36 Ports 1450 thru 1454 (WPMDS-3)
- 131.7.251.37 Ports 1450 thru 1454 (WPMDS-4)

Planning for METOC Operations

Each and every exercise or real-world operation will have different METOC requirements. Currently, METOC personnel have the equipment described above at their disposal. *Table L-8* on the following page can be used as a planning tool for providing METOC support. Every operation will be different from the previous, and each "package" of METOC equipment may be task tailored to meet the mission and logistical support requirements.

EQUIP	LOC	SPT FOR	SETUP TIME	T/O REQ'D	PROS	CONS
MetMF(R)	MWSS	ACE (> 30 Days) or JMFU/CMFU	< 24 Hrs	19 (MWSS T/O) 8 minimum	▪ Self-Sustaining for 30 days ▪ Full METOC Office capabilities ▪ High speed data ingest ▪ Software compatible with other ship and shore METOC and C4I systems ▪ Complete stand-alone capabilities ▪ Higher quality satellite imagery than the other METOC systems ▪ Doppler Radar ▪ Local and Remote Weather Sensors ▪ Secure and Non-Secure voice and data comm ▪ Upper air soundings	▪ Large deployment footprint ▪ Requires a significant amount of HE/MT support ▪ Requires more personnel to operate and maintain ▪ Most of the computer assets are SIPRNET only.
NITES IV	MST and MWSS	MST - GCE, CSSE, etc. MWSS - ACE (< 30 Days)	< 2 Hrs	1 - 5	▪ Easily deployed and operated ▪ Limited stand-alone capabilities ▪ Provides for a wide variety of system configurations to meet mission needs ▪ NIPRNET and/or SIPRNET	▪ Laptops are ruggedized ▪ Relies heavily on network support

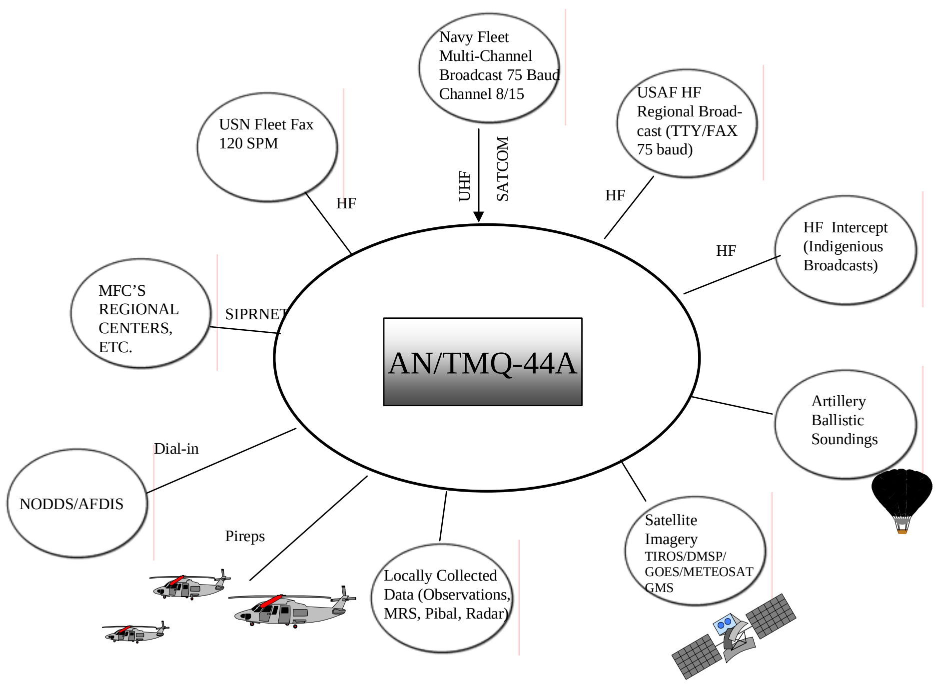
Table L-8 METOC Equipment Quick Look - 14 -

Appendix M

METMF(R) Capabilities

Capabilities and Features of the Meteorological Mobile Facility Replacement METMF(R)

1. Within each Marine Aircraft Wing (MAW) there are assigned up to four MetMF's and are the primary sources for providing full spectrum METOC support to MAGTF operations. They specifically reside within each Marine Wing Support Squadron (MWSS). Normally, the MetMF will be deployed as part of an entire MWSS in support of ACE operations conducted at Forward Operating Bases (FOBs). The MetMF(R) is also very capable of hosting a Joint METOC Forecasting Unit (JMFU) during Joint Task Force (JTF) and Combined operations. With proper planning and service personnel augmentation, it can provide a robust and on-scene JMFU capability that supports the full spectrum of Joint/Combined operations. The MetMF(R) can operate semi-autonomously or participate in a weather network. The figure below illustrates common data sources available to the MetMF.



2. Key features of the MetMF are described below:

- <u>Data processing</u>. The TMQ-44A processing subsystem (PCS) processes METOC data with the tactical environmental support system next century transition software running on a common tactical advanced computer hardware. The PCS contains a resident METOC master database and receives raw and processed data from local and remote meteorological sensors, the meteorological radar, meteorological satellite, and METOC communications circuits. This multi-source, near real-time data, used in conjunction with resident historical databases, provides a stand-alone, full-spectrum METOC support system.

- Communications. The TMQ-44A receives secure and non-secure data (SIPRNET/NIPRNET)from meteorological channels of the fleet multi-channel broadcast, United States Air Force (USAF) high frequency regional broadcast, worldwide HF World Meteorological Organization meteorological broadcast, and satellite communications, such as VSAT or global positioning system (GPS). TMQ-44A interoperable connectivity includes:

  - ⇒ MAGTF C4I wide area network
  - ⇒ U.S. Navy, U.S. Air Force, U.S. Army, and other government agencies, via defense information infrastructure common operating environment compliant systems
  - ⇒ Secure and non-secure net connectivity via HF, very high frequency, and ultra high frequency radio

- Meteorological satellite imagery. The TMQ-44A receives real time high and low-resolution satellite imagery from polar orbiting satellites and low-resolution satellite imagery from geostationary satellites via the TERASCAN satellite receiver hardware and software.

- Upper atmospheric data. TMQ-44A ingests and processes upper-air soundings.

- Meteorological sensor data. The TMQ-44A includes sensors located in close proximity to the shelter that measures and reports meteorological observations on:

  - ⇒ Surface wind direction and speed
  - ⇒ Surface air and dew point temperature
  - ⇒ Liquid precipitation rate
  - ⇒ Cloud height
  - ⇒ Visibility
  - ⇒ Atmospheric pressure and altimeter setting
  - ⇒ Electric field potential (lightning)

- Remote meteorological sensor data. The TMQ-44A has two sets of sensors, which can be installed, at separate sites located up to 200 nautical miles from the shelter. Data from these sensors is automatically ingested, processed, and displayed in the MetMF(R) . Each set of sensors measures and reports:

  - ⇒ Surface wind direction and speed
  - ⇒ Surface air and dew point temperature
  - ⇒ Liquid precipitation rate
  - ⇒ Atmospheric pressure and altimeter setting.

- Video briefing. The TMQ-44A is capable of originating and displaying video and providing two way audio via landline, where provided, for the purpose of briefing METOC conditions and forecasts to elements of the MAGTF.

- ➢ <u>Meteorological radar data</u>. The TMQ-44A will provide real-time weather surveillance and advanced warning of potentially hazardous atmospheric conditions, in the vicinity of the shelter.

- ➢ <u>Controlled environment</u>. The TMQ-44A is housed in an international organization for standards shelter, which is provided with an environmental control unit, power distribution system, and a grounding system. The shelter houses the permanently installed TMQ-44A equipment and provides an atmosphere conducive to operating electronic systems.

- ♦ <u>Naval Integrated Tactical Environmental System (Nites IV)</u>. Each MetMF is equipped with two Portable METOC Systems (PMSs) known as Nites IV to provide limited forward support. The MEF (Weather) Support Team (MST) at each MWSS reserves one Nites IV system for use to support MSCs other than the ACE. The Nites IV is a modular system, which provides the capability to provide limited METOC support in a stand-alone mode with increasing capabilities realized with the addition of SIPRNET/NIPRNET connectivity.

  - ➢ <u>Primary Workstation (U1)</u>. Consisting of a laptop and network protocol firmware. Used for the management and processing of METOC data and production of briefing products,

  - ➢ <u>Secondary Workstation (U2)</u>. Consisting of a laptop, PRINTER, and Projector. Used for the receipt and processing of METOC data worldwide.

  - ➢ <u>Tertiary Workstation (U5)</u>. Consisting of a Surge and Lighting Protector, USB Hub, LAN cable, and Battery Charger. The Tertiary Workstation also comes with an additional laptop module.

3. Time Phased Force and Deployment Data (TPFDD). The below information applies for the MetMF:

ITEM ID	DESCRIPTION	LEN	WID	HGT	UPTT	WT	QTYPER	CuFt	JCS
STDPA	Helium	57	40	48	14	1810	12	64	J3B
W0031	MEP105A	108	68	69	22	2850	1	294	A2B
W0031	MEP105A	108	68	69	22	2850	1	294	A2B
B0009	AIR COND	17	17	32	05	175	1	6	J3B
B0009	AIR COND	17	17	32	05	175	1	6	J3B
CONTAINER	METMF(R)	240	96	96	22	18000	1	1281	J2D
C5105	Corridor,(7x7)		132	86	86	05	660	1	565
J2D									

UIC Codes are as follows:

MWSS-171 – M00171 MWSG 27-M00275 MWSS 272-M00272 MWSS 274-M00274
MWSS-172 – M00172 MWSS 271-M00271 MWSS 273-M00273
Add as appropriate.