MARINE CORPS AIR STATION

YUMA, ARIZONA

WEATHER SERVICE DIVISION

FORECASTER'S HANDBOOK

UPDATED JANUARY 2004

3140
02 Jan 04

From: Weather Service Officer, MCAS Yuma, AZ
To: Weather Service Personnel

Subj: MCAS YUMA FORECASTERS HANDBOOOK

1. This publication was revised in accordance with COMNAVMETOCOMINST 3140.2_, and is a complete revision dated 02 Jan 2004.

2. The Forecasters Handbook is an unclassified publication setting forth, in some detail, climatological summaries and local forecasting rules employed by the meteorological section when forecasting local weather.

3. One of the primary purposes of a Forecaster's handbook is to provide inexperienced or newly assigned Forecasters with guidelines on local area weather conditions associated with typical synoptic scale developments. The Handbook also serves as a ready reference and review for Forecasters already familiar with the weather conditions in the Yuma area. This handbook includes topography, local climatology, special features and forecasting rules as well as aids used by MCAS Yuma Forecasters. It is primarily an empirical study of weather patterns that affect the local flying area at Marine Corps Air Station, Yuma, Arizona.

4. This Handbook is not the work of any one individual, but a compilation of many past and present Yuma Forecasters. Their contributions are appreciated. Each Forecaster attached to Marine Corps Air Station, Yuma will be issued a hand-book and is encouraged to recommend changes or additions to improve the effectiveness of the forecasting methods discussed in the handbook. In addition, this publication will be reviewed at least annually and revised per the reference. Local reproduction of this data is authorized and encouraged. For additional information contact MCAS Yuma Weather Office DSN 269-3230 or commercial (928) 269-3230/2266.

J.H. GLASS

RECORD OF CHANGES

Change Number	Date of Change	Date Entered	Sig. of Person Incorporating Change

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BASIC DESCRIPTION

1. **The Geographic Region**

a. Marine Corps Air Station (MCAS) Yuma, Arizona. Located at 32° 39' North; 114° 37' West, at an elevation of 213 feet above sea level. The field is located in the Yuma Valley. The city of Yuma borders the air station to the northwest. The Yuma Valley is for the most part a flat desert region with elevations generally less then 500 feet MSL. The area depends on farming for much of the local industry. Extensive irrigation canals cover the area providing water for citrus, cotton and assorted vegetables. Mountains surround the Yuma valley except for 50 miles to the south where it reaches the Gulf of California. The Gila Mountains, 13 miles east, are the closest mountains to the air station. The Imperial sand dunes are 8 miles west of Yuma. The sand dunes extend to the northwest for a distance of 47 miles. This area of fine sand has an average width of 6 miles.

b. Local Flying Area. The MCAS YUMA local flying area is defined as that area bound by a line as follows: from MCAS Yuma westward along the U.S. border to the Pacific coast, northwest along the California coastline to San Luis Obispo Vortac, Northeast to NAS Lemoore, direct to Coaldale Vortac, east to Milford Vortac, direct to Zuni Vortac, south to the U.S. border then westward along the U.S. border to MCAS Yuma.

2. **Local Effects.** MCAS Yuma is generally an area of dry streams and little rainfall. During the winter, November through March, the skies are abundant with sunshine. Weak winter systems will migrate through with mostly high clouds and very little precipitation. Strong northerly winds can occur after frontal passage causing reduced visibility. Summer time is generally clear and hot (above 105 is common). Late summer thunderstorms will develop with potential flash flooding.

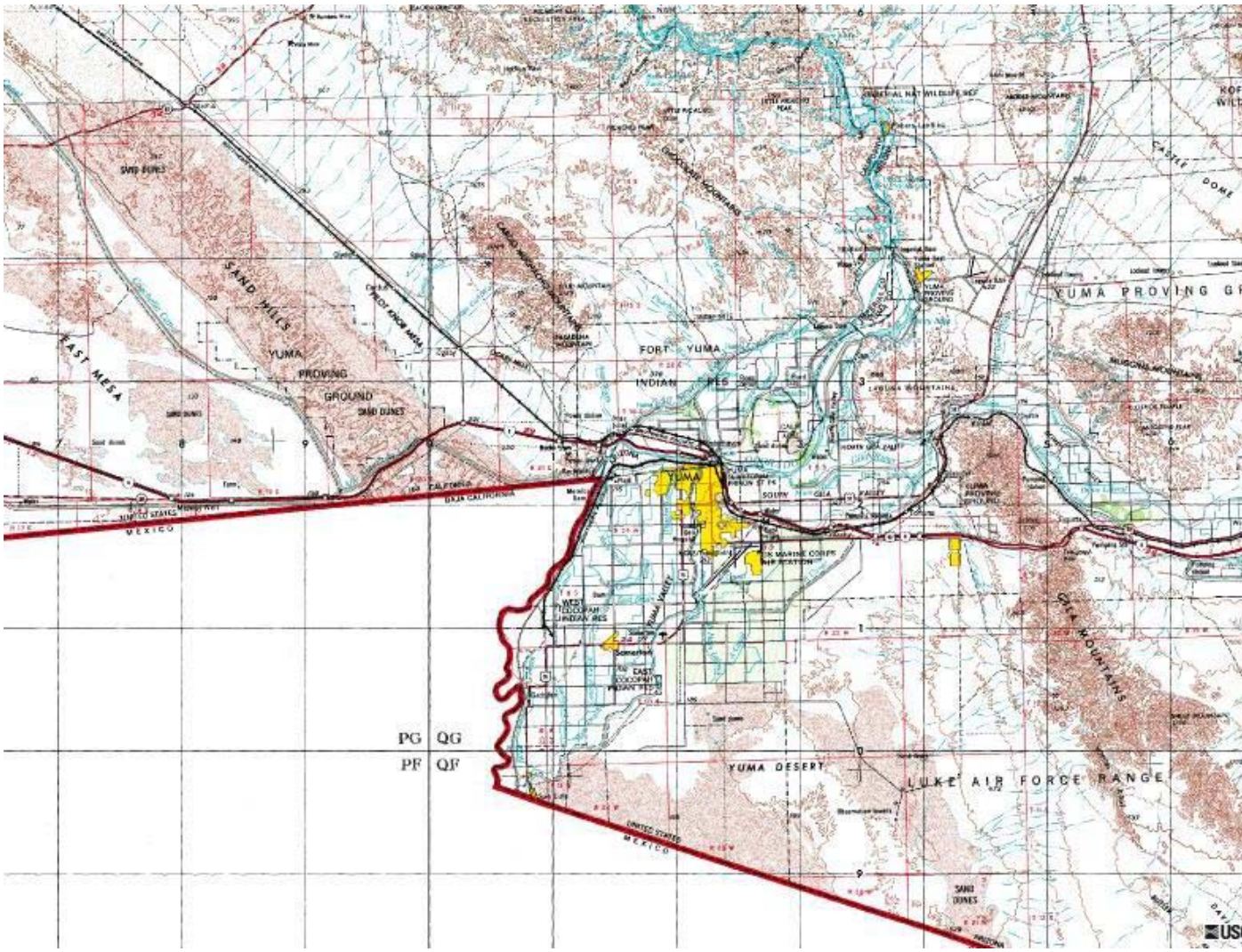


Figure 1.1 Geography of MCAS Yuma

3. **Meteorological Equipment**

a. Navy Marine Corps Intranet (NMCI). NMCI a enterprise-wide administered service that utilizes a plasma screen has replaced the Metoc Integrated Data Display System (MIDDS)that consists of muliple monitors. Notable improvements include the following:

-increased network security
-dependable worldwide access to voice, video, and data services
-ability to share knowledge worldwide

The NMCI is a valuable tool in the dissemination of alphanumeric wather data, radar data. Also know as the Wall of Thunder (WOD) the plasma screen enables the forecaster to display multiple weather data charts and manipulate them as needed.

b. Automated Surface Observing System (ASOS). ASOS is the official instrument for measuring and recording temperature/dew point, pressure, precipitation and wind direction/speed. It is also equipped with a laser ceilometer and visibility sensor to aid observers in evaluating sky condition and visibility. The Sensors & Data Collection Package (DCP) is located approximately mid field. The Acquisition Control Unit (ACU), Operator Interface Device (OID) and Video Display Unit (VDU) are located within the weather office spaces. The ASOS replaces the AN/GMQ-29 Semi Automatic Weather Station, RO362/UMQ-5 Wind Measuring Set, AN/GMQ-32 Runway Visual Range and the AN/GMQ-13 cloud Height Set.

c. Weather Surveillance Radar (WSR-88D). It combines conventional Doppler radar utilizing various scanning strategies and volume coverage patterns to provide forecasters with the most accurate representation of the storm environment. MCAS Yuma System includes a PUP group only at Yuma. It is located in the Weather Office. The actual radar site is located 9NM south of MCAS Yuma.

d. Aneroid Barometer. Serves as a back up to the ASOS for pressure readings. The ML-448 is a wall mounted precision aneroid barometer located on the wall of the observer's area at an elevation of 213 feet MSL.

e. OPTIMUM PATH AIRCRAFT ROUTING SYSTEM (OPARS). OPARS is located on the main server and workstation one.

f. (JOINT METOC VIEWER) JMV. Located on the forecasters desk and in Observer areas utilizing the same CPU's as OPARS.

4. **Communication Equipment**

a. Optimum Aircraft Routing System (OPARS). Prepared in support of aviation to aid the aircrew in flight planning and navigation. The data can be retrieved using the network or a modem to connect to the FLENUMMETOCCEN in Monterey, California. Information the system displays will help the requestor determine the best routing, fuel efficiency and cargo depending on the type of aircraft and maximum weight allowance. This database will also prepare a wind forecast for specified points along the aircraft route and time between NAVAIDS/WAYPOINTS for a given altitude. The forecaster will utilize the reference material located in the forecaster ready reference to prepare an OPARS worksheet for the product requested. The types of aircraft supported at MCAS Yuma may not always be in the OPARS database. In this instance the forecaster must request additional data from the requestor to aid in the input of information so the flight plan may be completed.

5. **Pilot to Forecaster Service (Metro)**

a. The pilot to forecaster frequency for MCAS Yuma is 349.9 MHz, normally referred to as "Yuma Metro". The transmitter is located on forecasters briefing counter.

b. The radio unit and all associated components are the responsibility of the Air Traffic Control Maintenance Branch (ATCMB) at MCAS Yuma.

6. **Telephones**

a. Tower Phone. Located in the Observer area and connected directly to the Tower or Radar.

b. Telephone Extensions

OIC	269-3230	AREA CODE:	928
NCOIC	269-3571	DSN:	269

BRIEFING COUNTER	269-2266
FCSTRS DESK/FAX	269-2250
TRAINING NCO	269-2382
OBSERVERS DESK	269-2265

7. **Organizational Support**

a. Tenant units aboard Marine Corps Air Station Yuma, Arizona consist of the following squadrons:

SQUADRON	CALLSIGN	TYPE A/C	READY-ROOM	OPS
VMA-211	WAKE	AV-8	5406	5339
VMA 214	BLACKSHEEP	AV-8	2776	5222
VMA-311	CAT	AV-8	2334	3013
VMA-513	NIGHTMARE	AV-8	2810	3373
VMFT-401	SNIPER	F-5	2681	2644
SAR	RESCUE	UH-1	2300	2533
ATCO	YUMA	C-12	5234	3429

Transient aircraft at the Air Station includes all aircraft up to and including C-5B. The following information is provided to these aircraft, by the forecaster on duty, on a daily basis or as needed:

1 DD 175-1's
2 Terminal Aerodrome Forecasts (TAFs)
3 Weather Warnings and Advisories

b. Primary Aviation support is provided to the flying squadrons attached to Marine Aircraft Group 13, tenant squadrons and Department of Defense assets visiting the air station. Additional support to aviation operations is given to Laguna AAF, Yuma Proving Grounds (YPG).

c. Primary Aircraft at MCAS:

AV-8B Harrier II

Figure 1.2 AV-8B

Primary function: Attack and destroy surface targets under day and night visual conditions.
Manufacturer: McDonnell Douglas
Propulsion: One Rolls Royce F402-RR-406 or F402-RR-408 turbofan engine
Thrust:
F402-RR-406: 21,500 pounds
F402-44-208: 23,400 pounds
Length: 46.3 feet (14.11 meters)
Wing span: 30.3 feet (9.24 meters)
Cruise speed: Subsonic to transonic
Ferry range: 2100 nautical miles (2416.64 miles)
Combat radius:
close air support: 163 nautical miles (187.45 miles) with 30 minutes time on station
interdiction: 454 nautical miles (522.45 miles)
Armament: Seven external store stations, comprising six wing stations for AIM-9 Sidewinder and an assortment of air-to-ground weapons, external fuel tanks and AGM-65 Maverick missiles; one centerline station for DECM pod or air-to-ground ordnance. A GAU-12 25MM six-barrel gun pod can be mounted on the centerline and has a 300 round capacity with a lead computing optical sight system (LCOSS) gunsight.
Crew: 1
Introduction date: 12 January 1985, AV-8BII(Plus) introduced in June 1993
Unit Replacement Cost: $23,700,000

Mission: The mission of the VMA STOVL squadron is to attack and destroy surface and air targets, to escort helicopters, and to conduct other such air operations as may be directed. Specific tasks of the AV-8B HARRIER II include:
- Conduct close air support using conventional and specific

weapons.
- Conduct deep air support, to include armed reconnaissance and air interdiction, using conventional and specific weapons.
- Conduct offensive and defensive anti-air warfare. This includes combat air patrol, armed escort missions, and offensive missions against enemy ground-to-air defenses, all within the capabilities of the aircraft.
- Be able to operate and deliver ordnance at night and to operate under instrument flight conditions.
- Be able to deploy for extended operations employing aerial refueling.
- Be able to deploy to and operate from carriers and other suitable seagoing platforms, advanced bases, expeditionary airfields, and remote tactical landing sites.

Features: The AV-8B V/STOL strike aircraft was designed to replace the AV-8A and the A-4M light attack aircraft. The Marine Corps requirement for a V/STOL light attack force has been well documented since the late 1950's. Combining tactical mobility, responsiveness, reduced operating cost and basing flexibility, both afloat and ashore, V/STOL aircraft are particularly well-suited to the special combat and expeditionary requirements of the Marine Corps. The AV-8BII+ features the APG-65 Radar common to the F/A-18, as well as all previous systems and features common to the AV-8BII.

Inventory: 7 squadrons with 20 aircraft each and 1 training squadron with 20 AV-8B and 15 TAV-8B aircraft for a total 175 aircraft.

Background: Operation Desert Storm in 1991 was highlighted by expeditionary air operations performed by the AV-8B. The Harrier II was the first Marine Corps tactical strike platform to arrive in theater, and subsequently operated from various basing postures. Three squadrons, totaling 60 aircraft, and one six-aircraft detachment operated ashore from an expeditionary airfield, while one squadron of 20 aircraft operated from a sea platform. During the ground war, AV-8Bs were based as close as 35 nautical miles (40.22 miles) from the Kuwait border, making them the most forward deployed tactical strike aircraft in theater. The AV-8B flew 3,380 sorties for a total of 4,083 flight hours while maintaining a mission capable rate in excess of 90%. Average turnaround time during the ground war surge rate flight operations was 23 minutes.

UH-1N Huey Helicopter

1.3 UH-1N

Primary function: Utility helicopter
Manufacturer: Bell Helicopter Textron
Power plant: Pratt and Whitney T400-CP-400
Power:
Burst: 1290 shaft horsepower (transmission limited)
Continuous: 1134 shaft horsepower (transmission limited)
Length: 57.3 feet (17.46 meters)
Height: 14.9 feet (4.54 meters)
Rotor Diameter: 48 feet (14.62 meters)
Speed: 121 knots (139.15 miles per hour) at sea level
Ceiling: 14,200 feet (4331 meters) (limited to 10,000 feet (3050 meters) by oxygen requirements)
Maximum takeoff weight: 10,500 pounds (4,767 kilograms)
Range: 172 nautical miles (197.8 miles)
Crew:
Officer: 2
Enlisted: 2
Armament: M-240 7.62mm machine gun or the GAU-16 .50 caliber machine gun or the GAU-17 7.62mm automatic gun. All three weapons systems are crew-served, and the GAU-2B/A can also be controlled by the pilot in the fixed forward firing mode. The helicopter can also carry two 7-shot or 19-shot 2.75" rocket pods.
Introduction date: 1971
Unit Replacement Cost: $4,700,000

Mission: Airborne command and control, combat assault, medical evacuation, maritime special operations, supporting arms control and coordination, fire support and security for forward and rear area forces.

Features: The UH-1N is a twin-piloted, twin-engine helicopter

used in command and control, resupply, casualty evacuation, liaison and troop transport. The Huey provides utility combat helicopter support to the landing force commander during ship-to-shore movement and in subsequent operations ashore.
The aircraft can be outfitted to support operations such as command and control with a specialized communication package (ASC-26), supporting arms coordination, assault support, medical evacuation for up to six litter patients and one medical attendant, external cargo, search and rescue using a rescue hoist, reconnaissance and reconnaissance support, and special operations using a new navigational thermal imaging system mission kit.
Considered to be the most widely used helicopter in the world, with more than 9,000 produced from the 1950s to the present, the Huey is flown today by about 40 countries.

F-5 TIGER II

Figure 1.4 F-5

The F-5E is the much upgraded version of the F-5A Freedom Fighter offering better performance and weapons capabilities. The type first flew in March 1969 for operational service in April 1973. The F-5F is the tandem two-seat version and is slightly more than a meter longer. More than 1,400 aircraft were exported before production ended in 1986, although the aircraft continues to be actively upgraded. The F-5 is currently in service with over 50 air forces around the world for both combat duty and training.

Manufacturer: Northrop
Nation of origin: USA

Function: Fighter
Crew: 1

Year: 1969
In-service year: 1973

Engine: Two General Electric J85-GE-21 turbojets, 5,000 lb thrust each

Dimensions
Wing span: 8.13 m / 28 ft 8 in
Length: 14.45 m / 47 ft 5 in
Height: 4.06 m / 13 ft 4 in

Weight: 9,723 lb empty / 24,722 lb max. take off
Ceiling: 51,800 ft
Speed: 1,743 km/h / 1,083 mph
Range: 2,860 km / 1,777 miles

Armament: Two 20mm M39A2 cannons with 280 rounds each, plus up to 7,000 lb including ASMs, AAMs, freefall bombs, ECM pods, and drop tanks on seven external points

C-12 HURON

Figure 1.5 C-12

Description: Twin-engine logistics aircraft carrying passengers and cargo between military installations.

Features: The C-12F *Huron* provides logistics support between Navy air stations. Powered by two PT-6A-42 turboprop engines, the C-12F can deliver a total payload of up to 4,215 pounds. The cabin can readily accommodate cargo, passengers or both. It is also equipped to accept litter patients in medical evacuation missions.

General Characteristics

Primary Function: Passenger and cargo airlift
Contractor: Raytheon Aircraft Company (Formally Beech Aircraft)
Unit Cost: $2 million
Propulsion: Two Pratt & Whitney PT-6A-42 turboprop engines; 850 shaft horsepower each
Length: 43 feet 10 (13.3 meters)
Height : 15 feet (4.57 meters)
Weight: Max. gross, take-off: 15,000 lbs (6,750 kg)
Cruising Speed: Max.: 294 knots (334 miles, 544 km, per hour)
Ceiling: 35,000 feet (10,668 meters)
Range: 1,974 nautical miles (3,658 km)
Crew: Two
Armament: None
Date deployed: 1994

d. Common transient aircraft

(1) ***AH-1W Super Cobra Helicopter***

Primary function: Attack helicopter
Manufacturer: Bell Helicopter Textron
Power plant: Two General Electric T700-GE-401 engines

Thrust: *Full:* 2082 shaft horsepower for 30 minutes (transmission limited),
Continuous: 1775 shaft horsepower
Length: 58 feet (17.67 meters)
Height: 13.7 feet (4.17 meters)
Rotor Diameter: 48 feet (14.62 meters)
Speed: 147 knots (169.05 miles per hour) in basic combat attack configuration
Maximum takeoff weight: 14,750 pounds (6,696.50 kilograms)
Range: 256 nautical miles (294.4 miles) in basic combat attack configuration
Ceiling: 18,700 feet (5703.5 meters) in basic combat attack configuration (limited to 10,000 feet (3050 kilometers) by oxygen requirements)
Crew: 2 officers
Armament: One 20MM turreted cannon with 750 rounds; four external wing stations that can fire 2.75"/5.0" rockets and a wide variety of precision guided missiles, to include TOW/Hellfire (point target/anti-armor), Sidewinder (anti-air) Sidearm (anti-radar).

FIG 1.6 AH-1W Super Cobra Helicopter

(2) ***UH-1N Huey Helicopter***

Primary function: Utility helicopter
Manufacturer: Bell Helicopter Textron
Power plant: Pratt and Whitney T400-CP-400
Power:
Burst: 1290 shaft horsepower (transmission limited)
Continuous: 1134 shaft horsepower (transmission limited)
Length: 57.3 feet (17.46 meters)
Height: 14.9 feet (4.54 meters)
Rotor Diameter: 48 feet (14.62 meters)
Speed: 121 knots (139.15 miles per hour) at sea level
Ceiling: 14,200 feet (4331 meters) (limited to 10,000 feet (3050 meters) by oxygen requirements)
Maximum takeoff weight: 10,500 pounds (4,767 kilograms)
Range: 172 nautical miles (197.8 miles)
Crew:
Officer: 2
Enlisted: 2
Armament: M-240 7.62mm machine gun or the GAU-16 .50 caliber machine gun or the GAU-17 7.62mm automatic gun. All three weapons systems are crew-served, and the GAU-2B/A can also be controlled by the pilot in the fixed forward firing mode. The helicopter can also carry two 7-shot or 19-shot 2.75" rocket pods.

FIG 1.7 UH-1N HUEY HELICOPTER

(3) ***CH-46E SEA KNIGHT HELICOPTER***

Primary function: Medium lift assault helicopter
Manufacturer: Boeing Vertol Company
Power plant: (2) GE-T58-16 engines
Thrust:
Burst: 1870 shaft horsepower (SHP)
Continuous: 1770 SHP
Length:
Rotors unfolded: 84 feet, 4 inches (25.69 meters)
Rotors folded: 45 feet, 7.5 inches (13.89 meters)
Width:
Rotors unfolded: 51 feet (15.54 meters)
Rotors folded: 14 feet, 9 inches (4.49 meters)
Height: 16 feet, 8 inches (5.08 meters)
Maximum takeoff weight: 24,300 pounds (11,032 kilograms)
Range: 132 nautical miles (151.8 miles) for an assault mission
Speed: 145 knots (166.75 miles per hour)
Ceiling: 10,000 feet (+)
Crew:
Normal: 4 - pilot, copilot, crew chief, and 1st mechanic
Combat: 5 - pilot, copilot, crew chief, and 2 aerial gunners
Payload:
Combat: maximum of 14 troops with aerial gunners
Medical evacuation: 15 litters and 2 attendants
Cargo: maximum of 4,000 pound (2270 kilograms) external load

FIG 1.8 CH-46E Sea Knight Helicopter

(4) ***F-18 HORNET***

Primary function: Intercept and destroy enemy aircraft under all-weather conditions and attack and destroy surface targets.
Manufacturer: McDonnell Douglas
Propulsion: Two General Electric F404-GE-400 afterburning, low bypass turbofan engines
Thrust: 16,000 pounds per engine
Length: 56 feet (17.06 meters)
Wing span: 37.5 feet (11.43 meters)
Cruise speed: High subsonic to supersonic
Ferry range: Over 2,000 nautical miles (2300 miles)
Combat radius:
Fighter mission: 400 nautical miles (460 miles)
Attack mission: 575 nautical miles (661.25 miles)
Armament: Nine external wing stations, comprising two wingtip stations for an assortment of air-to-air and air-to-ground weapons, including AIM-7 Sparrows, AIM-9 Sidewinders, AMRAAMs, AGM-84 Harpoons and AGM-65 Maverick missiles; two inboard wing stations for external fuel tanks or air-to-ground stations; two nacelle fuselage stations for Sparrows or AN/AAS-38 Forward Looking Infrared Radar (FLIR) pods; and a center station for fuel tank or air-to-ground weapons. Air-to-ground weapons

include GBU-10 and -12 laser guided bombs, Mk 80 series general purpose bombs, and CBU-59 cluster bombs. AN M61 20mm six-barrel gun is mounted in the nose and has a McDonnell Douglas director gun sight.

Crew 1

FIG 1.9 F-18

(5) ***KC-130***

Primary function: In-flight refueling; tactical transport
Manufacturer: Lockheed
Power plant: Four Allison T56-A-16 engines
Power: 4,910 shaft horsepower per engine
Length:
Aircraft: 97 feet, 9 inches (22.16 meters)
Cargo compartment: 41 feet (12.49 meters)
Width of Cargo compartment: 10 feet, 3 inches (3.12 meters)
Height:
Aircraft: 38 feet, 4 inches (11.68 meters)
Cargo compartment: 9 feet (2.74 meters)
Wing span: 132 feet, 7 inches (40.39 meters)
Maximum takeoff weight: 175,000 pounds (79,450 kilograms)
Ceiling: 30,000 feet (9,140 meters)
Speed: 315 knots (362.25 miles per hour)
Operating weight: 83,300 pounds (37,818 kilograms)
Total fuel capacity:
KC-130T and KC-130: 13,280 gallons (50,331 liters)/86,320 pounds (32,715 liters)
KC-130F: 10,183 gallons (38,594 liters)/ 66,190 pounds (25,086 liters)
Range:
Tanker mission: 1000 nautical mile (1150 mile) radius with 45,000 pounds of fuel (20,430 kilograms) (KC-130R/T)
Cargo mission: 2875 nautical miles (3306.25 miles) with 38,258 pounds (17,369 kilograms) of cargo (KC-130R/T) or 92 combat troops or 64 paratroopers or 74 litters
Landing distance: Less than 2,600 feet

Crew: 2 pilots, 1 navigator/systems operator, 1 flight engineer, 1 first mechanic, 1 loadmaster (total of 6)

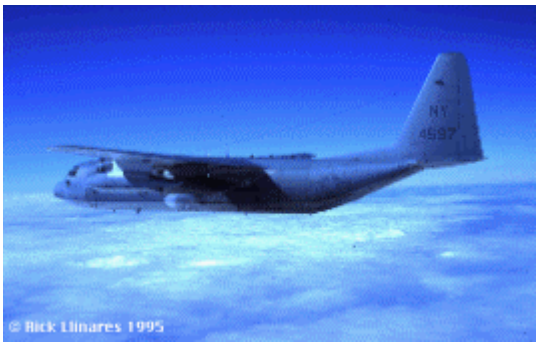


FIG 1.10 C-130

8. **Additional Aviation Support**

a. Additional aviation support units are located in the vicinity of MCAS Yuma as part of the 3rd Marine Aircraft Wing Aviation element. These units are as follows

MWSS - 371 MACS-1 MAWTS-1

NAF El Centro Aerostat Site

b. The following products are provided to the above units aboard MCAS Yuma on a REQUEST basis only:

1 Horizontal Weather Depictions (Cross Sections)
2 Change of Seasons Briefs
3 Safety Stand Down Briefs
4 Instrument Ground School Briefs
5 OPARS
6 TAWS
7 HPAC

9. OPERATING AND RESTRICTED AREAS

A. MILITARY OPERATING AREAS

The Yuma and Imperial Valley contains 25 Military Operating Areas (MOA) and ranges. KANE MOA comprises the western half of the Imperial Valley and contains the restricted areas 2521 and 2510. ABLE MOA comprises the eastern half of the Imperial

Valley and contains restricted areas 2507 and 2510. The Dome MOA/ATCAA is special-use airspace located approximately 10 NM south of the MCAS Yuma. The Quail MOA/ATCAA is special-use airspace located approximately 70 NM north of the MCAS Yuma. The Turtle MOA/ATCAA is special-use airspace located approximately 115 NM north of the MCAS Yuma. The military operating Areas cover approximately 350,000 acres of land. Figure 1-5 Illustrates the Military Operating Areas of the Yuma and Imperial Valley.

B. RESTRICTED AREAS AND BOMBING RANGES

The restricted areas and bombing ranges covered in this chapter exist in the Yuma and Imperial Valley. Restricted 2510 and 2512 are managed by the Commanding Officer, Naval Air Facility, El Centro. All other restricted areas and bombing ranges are managed by MCAS Yuma. A forecasting requirement is needed for those areas. They are commonly utilized by all aircraft stationed permanently and visiting the MCAS Yuma. The exact locations at all the restricted areas mentioned in this chapter are more readily displayed in Figure 1-5. The Restricted Areas are described fully below:

1. Restricted Area 2510

a. Restricted Area 2510 is located 11 miles northwest of the Naval Air Facility, El Centro. It contains two target areas and drop zones.

b. Listed below is a brief description of the target areas and drop zones:

(1) Target 101 is located in the southeast quadrant of R2510. The target elevation is 105' MSL. The target complex includes:

(a) Air-to-ground bombing.
(b) Rocket firing and strafing.
(c) Bomb Dummy Unit (BDU) drops.
(d) Mobile land targets.

(2) Target 103 is located in the southwest quadrant of R2510. The target elevation is 130' MSL. The target is an unmanned remotely controlled conventional air-to-ground rocket and bombing target consisting of a 40' diameter bull’s-eye with concentric circles of 75', 150', and 300’.

(3) Both drop zones are used for personnel and equipment drops only. No ordnance drops are authorized. The Superstition Drop Zone is located near the Superstition Mountains in the center of R2510. The Camelot Drop Zone is located between the two targets 101 and 103. Figure 3-3 depicts the exact positions of the targets and drop zones in R2510.

2. Restricted Area 2512

a. Restricted Area 2512 is located east of Brawley, CA and north of Holtville, CA.

b. This area contains two targets similar in design to target 103 in Restricted Area 2510. These targets are numbered 68 and 95.

c. The elevation of both targets is 90’, MSL.

d. Both targets consist of unmanned conventional air-to-ground rockets and a bomb target, with a 200ft diameter bull’s-eye and concentric circles of 75'.

3. Restricted Area 2521

a. Restricted Area 2521 surrounds the Salton Sea. This area is used for the spin testing of aircraft and is authorized to be used for personnel and equipment parachute drops.

4. Restricted Area 2507

a. Restricted Area 2507 surrounds the Chocolate Mountain range located 37 miles from this station.

b. This area contains air-to-air gunnery range, an air-to-air dart gunnery range and the Chocolate Mountains impact area.

c. Within the impact area there are:

(1) Five target complexes and assorted search and attack target locations consisting of more than 200 individual targets, including three surface-to-air missile sites, one surface-to-surface missile site and three simulated airfields.

d. Both air-to-air and air-to-ground ordinance are dropped and utilized in Restricted Area 2507. Laser designating is authorized in specific portions of the northern half of Restricted Area 2507.

5. Turtle MOA

a. The Turtle MOA/ATCAA is special-use airspace located approximately 115 NM north of the MCAS. This area extends from the Mohave Mountains (west of Lake Havasu) to Ward Valley CA.

b. This area is used for ACM, maneuvering and air refueling. No ordnance is authorized. The MOA includes no targets.

6. Quail MOA

a. The Quail MOA/ATCAA is special-use airspace located approximately 70 NMI north of the MCAS Yuma. This area extends from the Plomosa mountain range to the McCoy mountain range, in California.

b. Quail MOA is used for ACM, tactical air maneuvers, air intercepts and instrument training. No ordnance is authorized. The MOA/ATCAA includes no targets.

7. Dome MOA

a. The Dome MOA/ATCAA is special-use airspace located approximately 10 NMI south of the MCAS Yuma. This area extends south if MCAS Yuma to the Mexican boarder and is flanked by the Colorado river and the Gila mountains.

b. The MOA/ATCAA is used for ACM, maneuvering, and air refueling. No ordnance is authorized. The MOA/ATCAA includes no targets.

8. R2306

a. 2306 is special-use airspace located approximately 30 NMI northeast of MCAS Yuma. This area boarders the Colorado river on the east and encompasses Kofa Mountains.

b. R2306 is only used during VFR conditions. Air intercepts, ACM, instrument training and tactical air maneuvers

are authorized. No ordnance or flare expenditure is authorized. R-2306 includes no targets.

9. R2308

a. R2308 is special-use airspace located approximately 40 NMI northeast of MCAS Yuma. This area encompasses the Kofa game refuge. R2306 boards this range to the west.

b. R2308 is only used during VFR conditions. Air intercepts, tactical air maneuvers, ACM and instrument training are authorized. No ordnance or flare expenditure is authorized.

10. R2309

a. R2309 is special-use airspace located approximately 20 NMI northwest of MCAS Yuma.

b. R2309 is used continuously by U.S. Customs Service for deploying a tethered Aerostat-borne radar system. No ordnance or flares are authorized.

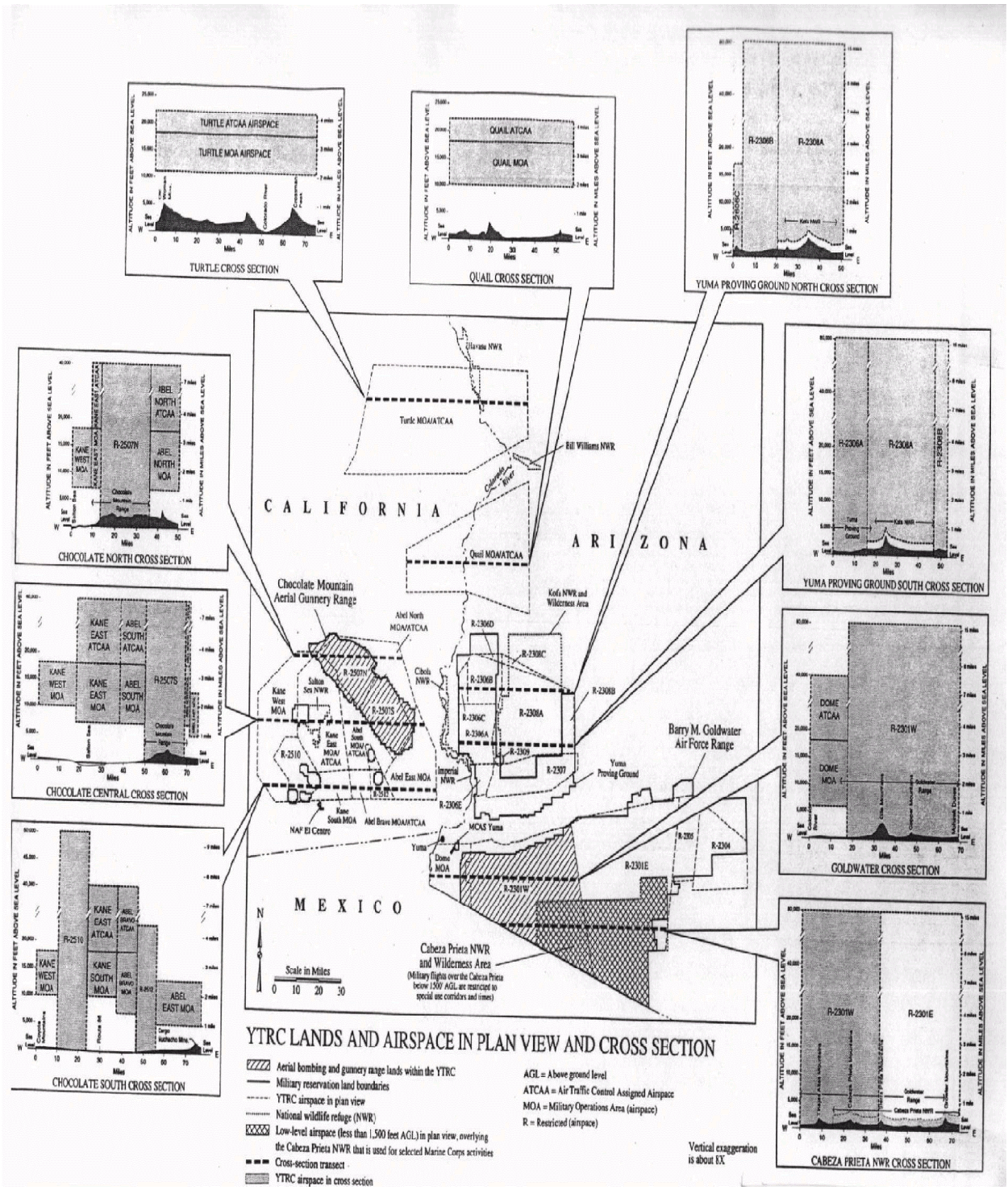


Fig 1-11 RESTRICTED AREAS AND RANGES

CHAPTER 2

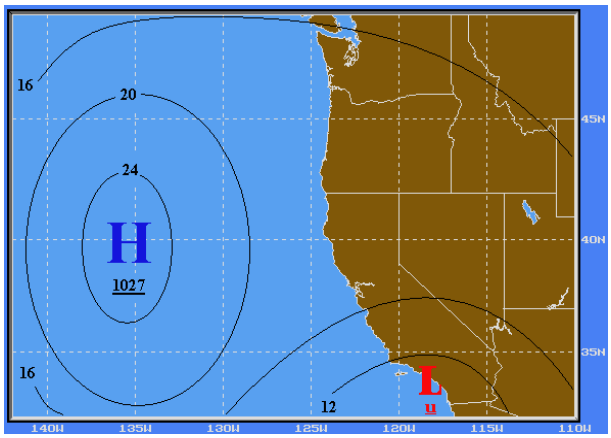
Climatology

1. General

a. Summer (June - August). During the summer the Eastern Pacific High is quasi-stationary approximately 2000 miles west to northwest of MCAS Yuma. The anticyclonic flow around the High persists, providing a northwest flow over Southern California. A thermal trough enhances this flow over the California/Arizona desert regions. On occasion a shower or thunderstorm will form over the mountains and deserts. This occurs when moisture from the Gulf of Mexico is advected over this region. These thunderstorms infrequently will drift toward MCAS Yuma when there is a strong westerly flow (see figures 2.1 and 2.2).

AVG POSITION OF PACIFIC HIGH JUN-AUG

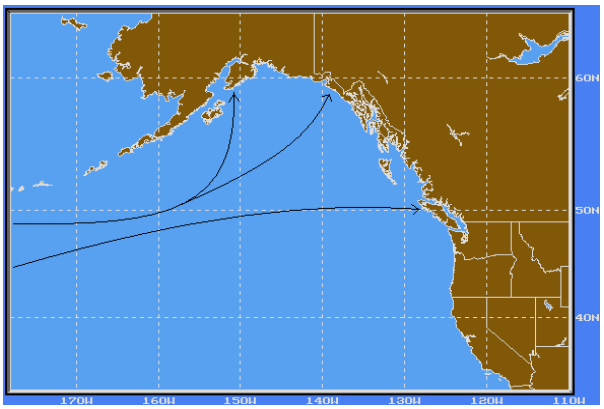
FIGURE 2.1



&

AVG LOW PRESSURE CENTER TRACKS JUN-AUG

FIGURE 2.2



b. Fall (September - November). The fall season is marked by improved flying conditions. Cold frontal passage may begin to happen as the Eastern Pacific High begins its migration equatorward to its wintertime position.

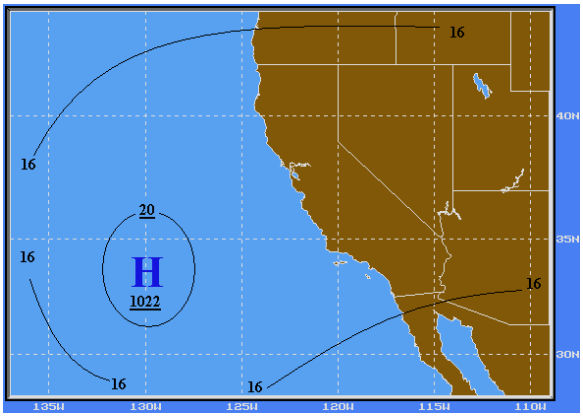
c. Winter (December - February). The winter season is usually mild with mostly VRF weather. Cutoff Lows, Nevada Lows and cold frontal passages are the main causes for adverse weather. Frontal systems continue to influence the weather

pattern even more as the position of the Eastern Pacific High is established further south (approx. 1200 miles west-southwest of MCAS Yuma). As these fronts move south they lose energy and as a result MCAS Yuma's winter seasons are very moderate (see figure 2.3 and 2.4).

AVG POSITION OF PACIFIC HIGH & TRACKS

DEC-FEB

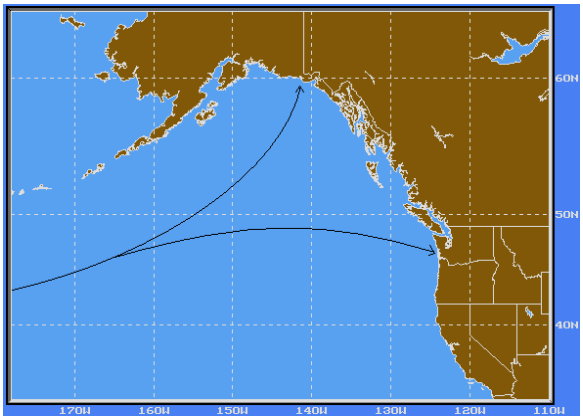
FIGURE 2.3



AVG LOW PRESSURE CENTER

DEC-FEB

FIGURE 2.4

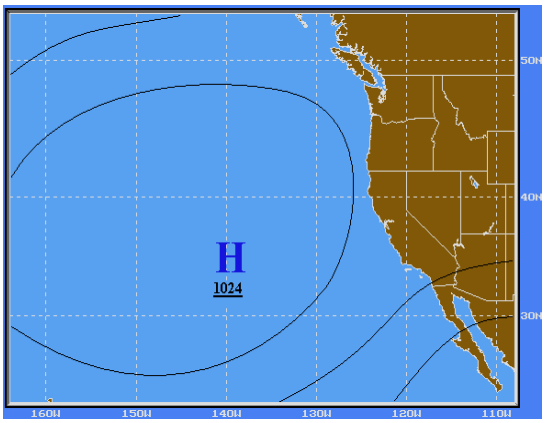


d. Spring (March - May). The spring season brings a decrease in precipitation and frontal passage becomes less pronounced and does not progress as far south. The low stratus clouds that are a normal presence in the summer during the early morning hours begin to influence the southern California weather pattern. The Eastern Pacific High begins its migration north to its summertime position (see figure 2.5 and 2.6).

AVG POSITION OF PACIFIC HIGH

Mar-May

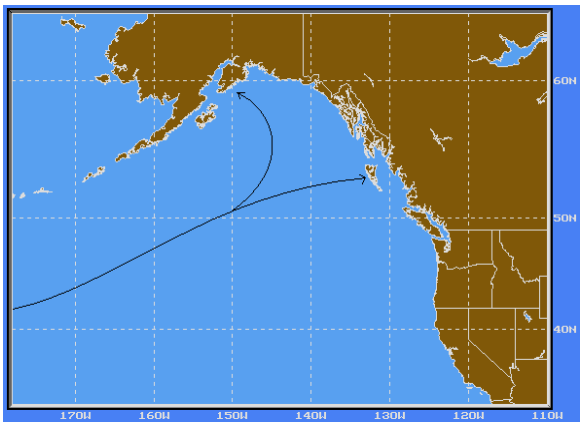
FIGURE 2.5



AVG LOW PRESSURE TRACKS

Mar-May

FIGURE 2.6



2. **Climatology Discussion**

The Desert Southwest region of the United States is a hot dry climate with summer temperatures in excess of 108 degrees Fahrenheit. The Pacific high-pressure system is the dominating feature. This high, when well developed, forms the principal circulation control forcing most of the low-pressure systems to follow a course to the north of the contiguous United States. This action damps out weather changes that might otherwise occur and brings a stability factor that would not otherwise exist. A strong thermal low will set up over MCAS Yuma during the summer months. This will generally disrupt the surface wind flow.

Air, which reaches the coast as a result of the prevailing westerly winds, acquires much moisture during its ocean passage. As this air reaches the mountains along the southern California coast it is lifted and condenses on the windward side. As the air converges these mountains it is adiabatically warmed resulting in very little precipitation and hot temperatures.

Winds in the Yuma area are strongest from November through April when they blow 17 knots or more about 2 percent of the time.

There are four climate anomalies which warrant attention. One is tropical cyclone: another, Santa Ana winds, the El Nino/Southern Oscillation (ENSO) and Sonora.

Tropical cyclones originate south of the area off the Mexican coast in summer and autumn. About fifteen form each season of which seven reach hurricane intensity. Few come far enough north to affect U. S. coastal waters. The ones that do have usually lost their hurricane intensity and are short-lived, however, these storms can be dangerous and have generated winds of more than 120 knots in the operating area.

The Santa Ana is an offshore desert wind that occurs along the California coast. While infrequent it may be violent; speeds have been measured at more than 50 knots. The funneling of the mountains throughout the desert can redirect these winds causing severe turbulence and wind shear conditions. They are most likely in fall or winter.

The ENSO represents an environmental extreme in the eastern boundary regions of the Pacific Ocean and is a coupled atmospheric/ oceanographic phenomenon. The oceanic component of the ENSO begins in the western Pacific and propagates eastward. It manifests itself by first causing a large change in the sea surface temperature of the equatorial Pacific. This large temperature change causes major changes in the position and strength of the atmospheric pressure patterns affecting the California Current system with somewhat unpredictable results. This can cause a strengthening of the Aleutian Low with associated southward movement causing severe storms along the California coast. At other times, the Low strengthens but remains farther offshore diverting storms to the north of their normal track (e.g. a drought). A strong ENSO event seems to occur every 1 to 20 years.

The Sonora (Summer Monsoon) occurs during the summer (primarily July, August and September). Sonora is the local name given-to the thunderstorm condition created by an easterly flow of moist air across the Sonora province of Mexico from either the Gulf of Mexico or the Gulf of California. The advection of this warm moist air is a result of a high pressure cell that is persistently located in the central United States. This advection may also be caused by the strong easterly flow from the western extent of the Bermuda High, in this situation, extreme high temperatures and high humidity become commonplace in the desert regions. Mature and active thunderstorms develop during this pattern with activity starting during the morning and continuing until midnight. Another source of upper level easterly flow is the presence of a low pressure center over the Gulf of California.

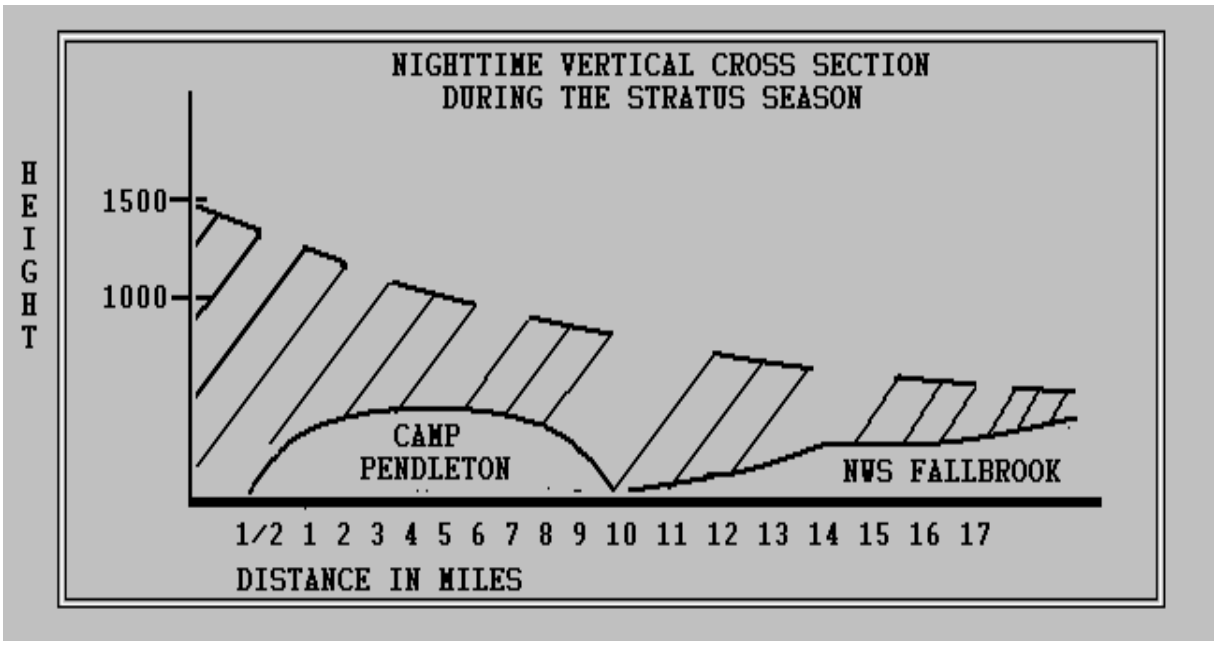
With pronounced heating, instability and significant moisture to at least the 700 mb level thunderstorms will develop to the east or southeast of the station. Thunderstorms also frequently develop over the mountains to the west through to the northwest. These thunderstorms usually circumnavigate the station, although if the conditions are right they can move over the station. A good indication of the formation of these thunderstorms is the appearance of cumulus or towering cumulus during the morning hours over the mountains to the west. Thunderstorms in the Imperial Valley are either going to seek out the heat of the desert by moving over it or they are going to seek out the lifting action provided by the orographic features surrounding the Imperial and Yuma Valleys and travel along the mountain ranges.

These thunderstorms are tropical in nature. Ceilings average between 2000 and 5000 feet, depending on their severity, accompanied by light to moderate rain showers which reduce visibility to between 3 and 5 miles. Visibility can be reduced to as little as 1/2 to 1 mile in blowing sand if the conditions permit. This usually occurs just prior to passage of a thunderstorm The most hazardous threat to operations is the strong, gusty winds that accompany these storms. Direction is very difficult to forecast. Variable winds sustained at 20 to 30 knots with gusts to 40 to 50 knots are not uncommon. As mentioned previously these high winds can reduce visibility quite a bit, even if no rainfall has occurred at the station. With the more severe thunderstorms expect visibility to be near 1/2 mile and expect the wind to gust near 50 knots. Flash flooding is also common with the more severe storms near the mountains.

3. **Persistent and Transitory Weather Regimes Affecting Southern California and Southwest Arizona**

A. Pacific High. The North Pacific Subtropical Ridge (PACIFIC HIGH) is a large area of high pressure that seasonally dominates the northern Pacific Ocean areas. The Pacific High is a semi-permanent feature but its exact position and intensity are variable, especially during the winter when it migrates to the south to approximately 30^0N, and weakens, allowing upper-level troughs to become more active and influential in Yuma's weather pattern. During the summer, the Pacific High increases intensity and persistence as it shifts to its northern location to approximately 40^0N, forcing the effects of extra- tropical lows to remain north of the desert southwest. Generally, the intensity and displacement of the Pacific High is directly related to the amount of solar insulation. The air which flows around the ridge of the Pacific High from the northwest approaches the coast subsides from above and heats at the adiabatic rate of about 5.5 degrees Fahrenheit per 1000 feet of descent arriving at lower levels as a hot dry air mass. A shallow stratum of surface-based marine air protects the coastal area from this hot, dry air. This forms a very pronounced subsidence inversion which is strongest on the eastern edge. This results in the creation of the Southern California Marine Layer.

b. Marine layer. The Southern California Marine Layer is a shallow layer of relatively cool, moist air. A constant



mixing of low-level air with a marine trajectory forms it. It is normally restricted to a depth of 2000 feet or less by a temperature inversion created by the subsiding air from the Pacific High. This inversion caps the maritime air, often trapping pollutants and smog as well as moisture and salt particles within the Marine Layer. As the maritime air cools through mixing and radiation to saturation, stratus and fog are formed by condensation of moisture on the numerous salt and pollution particles present. The Marine Layer helps maintain the coastal air temperature near that of the sea surface (see figures 2.7 & 2.8).

FIGURE 2.7

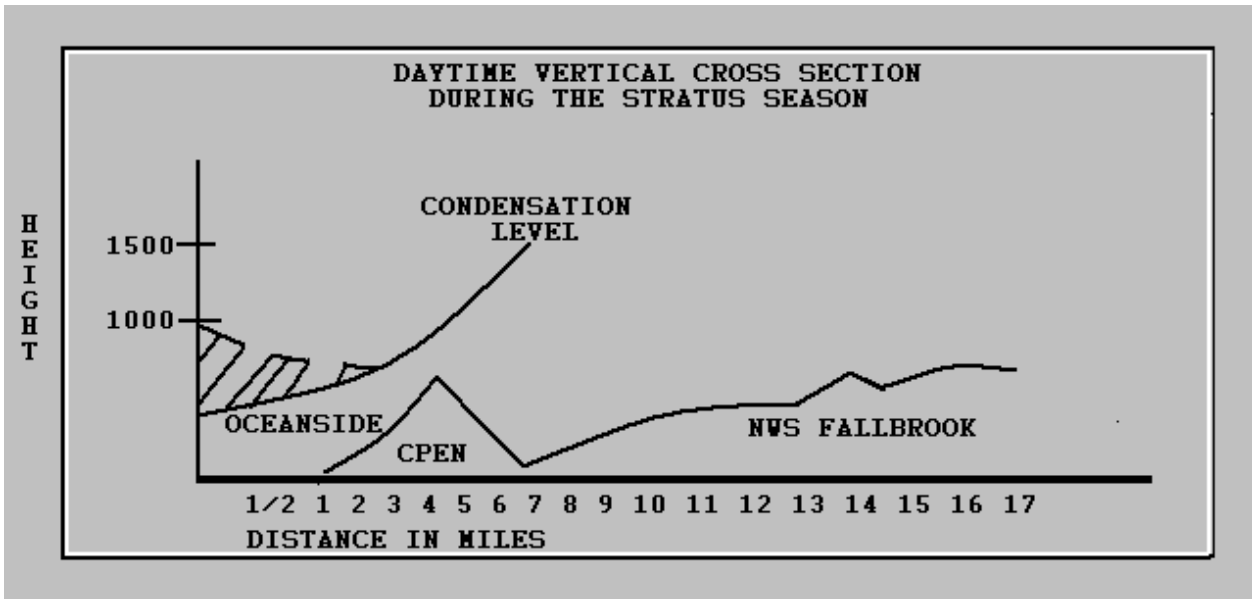
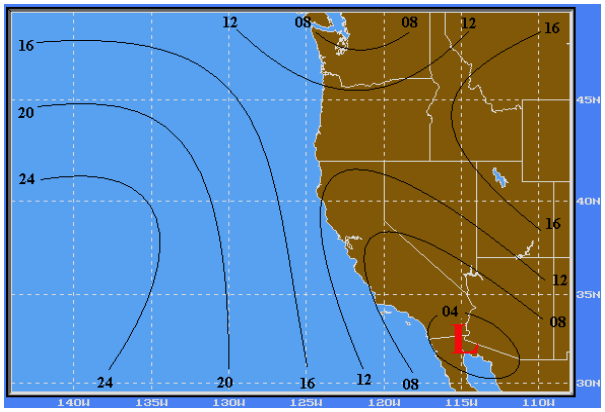


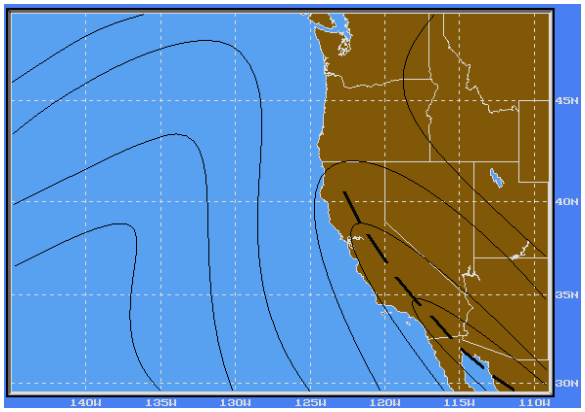
FIGURE 2.8

c. Thermal Low/Thermal Trough. The hot, dry air that results from intense daytime heating over the sandy and rocky areas of the Desert Southwest produce a stationary heat induced surface low pressure cell or thermal trough that seldom extends above 8,000 feet. The thermal trough is a semi-permanent feature which is located over Northern Mexico in the interior desert region during summer extending into Oregon and at times into Canada by midsummer. (see figure 2.09 and 2.10).

THERMAL LOW
FIGURE 2.09



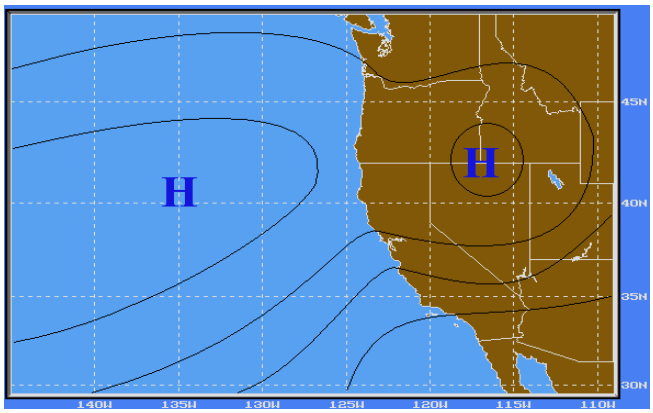
THERMAL TROUGH
FIGURE 2.10



4. **Santa Ana**. The Santa Ana or Foehn wind may occur in almost any month of the year, however, it is predominantly a winter phenomenon. The normal season runs from October through April, reaching a maximum frequency in the months of December, January and February. The geographic region for formation is the upper plateau of Northern Nevada flanked on the west by the Sierra Nevada Mountain range and on the east by the Rocky Mountains. There are three main canyons or passes that channel the flow from the plateau to the coastal region. These are the El Tejon (Newfall/Gorman) Pass, the El Cajon (San Bernardino) Pass and the San Gorganio (Banning) Pass and the San Gorgonio Pass. The effect on MCAS Yuma is rapid increase in winds, severe turbulence and low-level wind shear conditions.

a. Synoptic Features

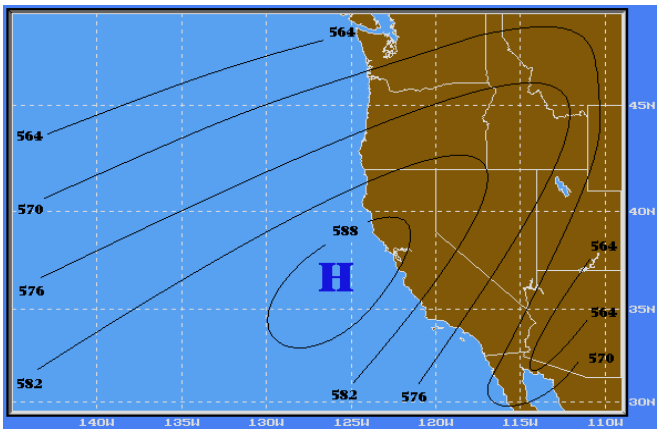
(1) Great Basin High. A primary synoptic feature associated with the Santa Ana is the Great Basin High. This is a relatively cool, dry air mass with the highest pressure situated over the plateau of Northern Nevada (see figure 2.11). The most common source for this air mass is Pacific Maritime, usually part of the Pacific High, which moves eastward behind a frontal system. The density of this air mass is less than the air mass in the Los Angeles basin, due to orographic and adiabatic processes, causing weak offshore flow, which seldom reaches the surface in the Los Angeles basin. The second source is either polar or arctic in origin, being much colder and dryer in its original stages. This air mass is much denser than the Los Angeles basin air mass causing the Santa Ana flow to under run the Los Angeles Basin air mass, reaching and affecting the surface. The Great Basin High reverses the usual onshore pressure gradient to offshore. This results in a subsiding outflow of air from the Great Basin, across the desert, through the passes to the coastal area where it arrives as a dry adiabatically warmed wind. The colder the Great Basin and the higher the pressure, the stronger the wind flow will be.



SANTA ANA SURFACE PATTERN
FIGURE 2.11

(2) Frontal Passage. The movement of a new air mass of high pressure into the Great Basin is preceded by the passage of a frontal zone representing the leading edge of new air. The associated front can be either active or inactive as evidenced through empirical observations. Sometimes, there is no physical evidence other than wind shear while at other time's shower activity has accompanied the passage. The orientation of the front is a strong factor regarding the time of onset. This will be discussed in greater detail later in this chapter.

(3) Ridge/Aloft. Nearly every Great Basin High has the vertical support of a pronounced upper-level ridge situated over, or just off, the west coast, which feeds subsiding air into the low-level outflow of the Great Basin High. The stronger the subsidence from the ridge, the more enhanced are the Santa Ana winds at the coast. When a long wave ridge, steered by the belt of westerlies toward the coast, becomes entrenched over the West Coast short wave troughs moving through the ridge may temporarily weaken it. These short wave troughs normally support a surface frontal system, such that the ridge and associated Great Basin High usually rebuilds sharply following passage, often resulting in the establishment, or re-establishment of a Santa Ana (see figure 2.11).



SANTA ANA 500 MB PATTERN
FIGURE 2.12

(4) Santa Ana Termination. When the Great Basin High begins to weaken and move eastward toward the Rocky Mountains (usually in response to the upper air pattern), warming of the desert interior usually takes place. This heating leads to the formation of a surface thermal trough. The offshore pressure gradient in coastal Southern California greatly relaxes and finally reverses to onshore, thus ending the Santa Ana. Since the decrease in wind is gradual, Santa Ana's do not end nearly as dramatically as they begin. With the return of the moist onshore flow at the surface, a strong inversion is immediately established along the coast; the temperatures lower and dew points become higher than those observed during the Santa Ana. The upper-level wind normally shifts from north to northeasterly back to a westerly direction with the abatement of the Santa Ana.

b. Associated Weather. Santa Ana conditions seldom have a significant effect upon the weather at the Air Station, but do affect the inner portion and higher elevations aboard Yuma. The main factor for this is the local topography.

(1) Wind. The north to northeast wind exhibits a diurnal dependency being stronger at night and early morning enhanced nighttime cooling and can obtain gusts in excess of 60 to 70 knots by midday. The daytime heating, may decrease the effects rapidly. Mid-day Santa Ana wind speeds increase rapidly

with height over the air station, creating a strong Low Level Wind Shear (LLWS) and severe turbulent conditions.

(2) Temperature. Generally, the higher temperatures will occur during Santa Ana's. However, a Santa Ana will occasionally be "Cold" due to differences in air mass temperatures, and the amplitude of upper level troughs and ridges. If a cold trough at the 850MB and 700MB level is located over the coastal region, the subsidence is shallow and the area affected by Santa Ana wind is close to the source region; thus producing colder than normal wind.

(3) Humidity. Because of the already dry conditions of the desert, there is very little effect on the humidity.

(4) Visibility. The effects of Santa Ana's on visibility are complicated and, at times, contradictory. With weaker Santa Ana's, visibility's are usually excellent because of the lack of dust particles that are suspended in the air. However, if the wind is strong, a layer of blowing dust and sand may extend several hundred feet above the surface and severely restrict visibility, often times to less than one mile.

5. **Fronts**. Frontal passage is normally experienced during the months of October through April. Fronts, which traverse the local area, are usually weak and diffuse, except during the months of December through February. Systems passing through the area are noted for unstable air masses with no definite zones and usually account for diffuse and scattered precipitation. Forecasting of frontal passages often prove difficult as no definite rate of movement can generally be determined once the system moves on shore in California. Local weather associated with frontal passage varies widely with each front. Some fronts progress through with little or no indication of their passage, while others are marked with multi-layered fluctuations.

a. Frontal Guidelines

(1) The tendency of cold fronts is to pivot into a north-south orientation in the vicinity of southern California and approach Yuma from the west.

(2) Fronts move southward 30% to 50% slower once on shore.

(3) The Laguna Mountain Range retards fronts and can stall them out over southern California for around 12 to 24 hours.

(4) Gusty surface wind will accompany the front if it is in phase with the pressure trough aloft.

(5) Stronger wind and more intense shower activity usually accompany secondary fronts.

(6) Rapid clearing behind a cold front occurs only with an associated cold tongue of air aloft.

(7) If the trailing edge of a cold front approaching the coast does not extend below 30^0 north, precipitation will be rare with passage.

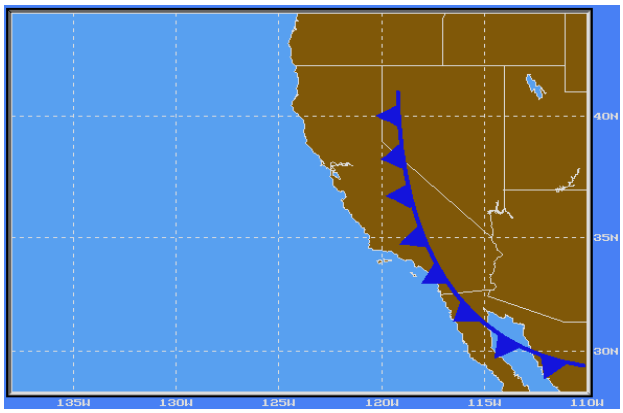
(8) If a transiting cold front is weak and diffuse and a Nevada Low is well established, frontal intensification can be expected. Precipitation will be governed by the strength of the intensifying front. Frontal systems, which pass through the Yuma area, may be categorized as either "wet" or "dry" depending upon the amount of cloudiness and precipitation associated with the front at the time of passage. Cold fronts tend to dissipate on the surface before reaching the Yuma area during the summer.

(9) As the fall season transitions to winter, fronts begin to pass through with greater regularity and increased intensity. Eventually, the fronts will maintain their intensity all the way south past the northern edge of Baja, California. The fronts slow drastically as the frontal surface becomes relatively shallow and the east-west oriented mountainous terrain provides an orographic barrier. Most forecasters will arbitrarily decrease the frontal speed by 50 percent in order to forecast a reasonable speed of movement for the front over southern California. The more active fronts having large temperature and wind discontinuities will pass over the area in a rather smooth and unbroken track.

b. East-West Frontal Orientation. Cold fronts passing through Southern California with an east-west orientation usually precede a Santa Ana condition by 6 to 18 hours. The high pressure behind the front is usually a blend of maritime air and counterparts. As high pressure moves southward from Canada toward the Great Basin, less building of pressure is required to produce a Santa Ana. However, the timing of the onset of a Santa Ana from this type of front is complicated.

The front moves southward more slowly than the northeast-southwest oriented front and there is usually less visible "weather" associated with east-west fronts making tracking extremely difficult.

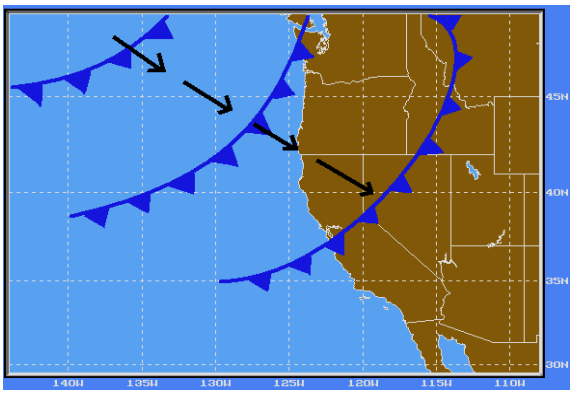
c. "Backdoor" Frontal Orientation. "Backdoor" fronts are those that approach Southern California from the east and are orientated either southeast through northwest or south through north. Although infrequent, this situation generally occurs when the front is oriented along the eastern slopes of the Sierra Nevada mountain range bordering California and Nevada. Due to the completely continental nature of the high pressure behind the front, these highs are usually cold, dry, and intense and are already positioned over the Great Basin when the front reaches Southern California. The onset of Santa Ana wind may be forecast to begin with the frontal passage (see figure 2.13).



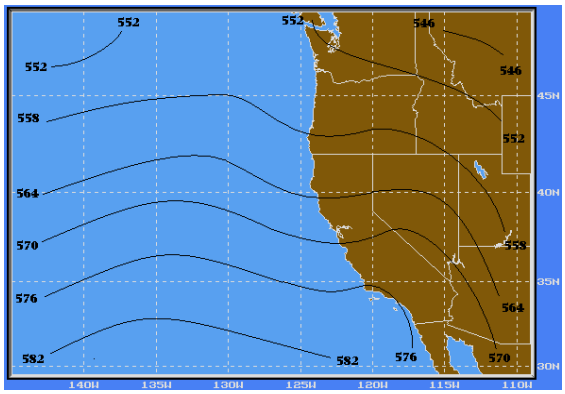
BACKDOOR FRONT
FIGURE 2.13

d. Northeast-Southwest Frontal Orientation. This is the most frequently observed frontal orientation in the desert southwest, and is indicative of westerly or northwesterly flow aloft. Generally weak and faster moving. (see figures 2.14 and 2.15).

COLD FRONT APPROACHING FROM NW
FIGURE 2.14



TYPICAL 500 MB FLOW FOR COLD FRONT APPROACHING FROM NW
FIGURE 2.15



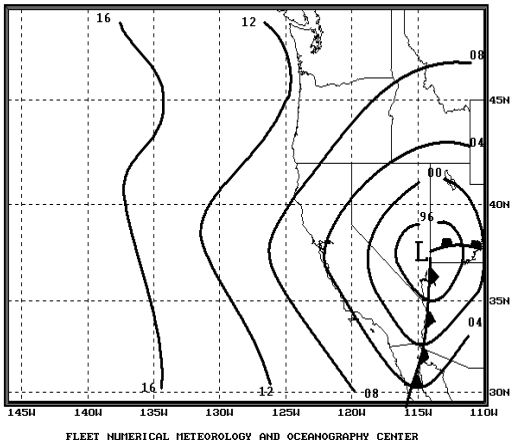
e. "Active" Fronts. An active cold front can be thought of as the leading edge of an unmodified surge of polar air. Accompanied by a relatively strong upper-level cold trough, this type of front produces precipitation as it moves through Southern California then into the desert southwest. This severe frontal weather is infrequent in the Yuma area, but does occur. The more active winter fronts may contain gusty wind in excess of 25 knots in heavy showers and thunderstorms. Thunderstorms accompanied by hail and/or snow pellets have been observed in the more severe fronts. With the approach of an active front from the west or northwest, middle and high clouds associated with the trough aloft will move into the local area, thicken, and lower with low scattered stratocumulus clouds forming over the water off the Southern California coast. This indicates large-scale vertical motion within the frontal zone and rain showers at Yuma are forthcoming. Frequently, a secondary trough or convergence line will follow the actual passage by twelve to twenty four hours, such that the forecaster should not forecast clearing behind the front until the post frontal trough passes. The air mass between the frontal passage and the postfrontal trough is usually conditionally unstable, producing scattered thunderstorms. The wind ahead of a well-defined front will normally become south to southwesterly 8 to 16 hours preceding frontal passage, veering west to northwest immediately following frontal passage. If the front is followed by a post frontal trough as mentioned above, the wind will remain westerly, or southwesterly behind the front until passage of the post frontal trough. The winds vary in velocity and gustiness, depending upon the intensity of the front. The strongest wind normally occurs within four hours of frontal passage. Satellite pictures are an excellent aid in determining frontal location and characteristics. Forecasters should take into account the general weakening of the front as it moves into the Southern California area and also the slowing of frontal speed as mentioned earlier in this section.

f. "Inactive" Fronts. The majority of fronts, which pass through Yuma, are inactive. At time of passage, there is no precipitation and little cloudiness associated with these fronts . During the cooler months, inactive fronts are frequently marked by variable high cirrus and scattered to broken middle clouds. In the summer, the middle and high clouds may be absent from inactive fronts, and the fronts serve only to temporarily raise the height of the inversion and associated stratus, occasionally dissipating the stratus in the process. The inactive front is usually associated with a weak, low amplitude trough aloft. When the inactive front is fast moving, the wind

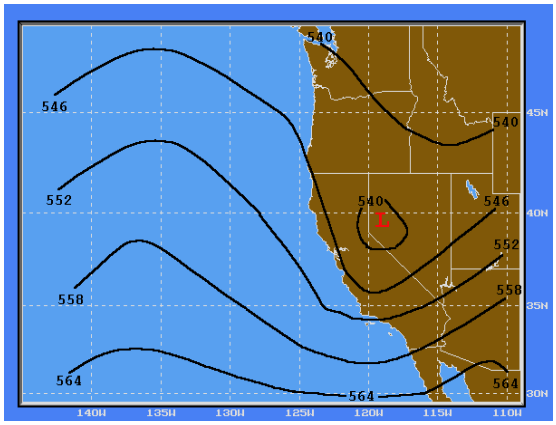
will be moderate ahead of the front, and usually has strong west to northwesterly wind immediately behind the front. The slow moving inactive front has little effect on the seasonal wind pattern. Many of the wintertime inactive fronts are initially active and wet, but they dry out because of subsidence caused by the northern extension of the Subtropical Ridge before reaching Southern California.

6. **Nevada Low**. "Nevada Low" is the local name given to the surface reflection over Southern Nevada of a closed low or deep trough aloft over inland California. This low system has been given the name "Tonopah Low", since the weather station at Tonopah, Nevada (THP), appears to be very sensitive to the formation of the low. The Nevada Low is typically a "cold" low, which develops during the late winter and early spring months, producing a strong onshore pressure gradient and resulting in strong, gusty, west or west-northwest wind desert area (see figure 2.16). The conditions for the formation of a Nevada Low are similar to conditions for the establishments of both a cut-off low and Santa Ana (see figure 2.17).

NEVADA LOW
FIGURE 2.16



NEVADA LOW 500 MB PATTERN
FIGURE 2.17



Yuma may or may not experience frontal passage prior to Nevada Low formation; however, a well-defined frontal zone is usually observed over the desert region once the Nevada Low is well established. Although slight amounts of precipitation and cloudiness are normally experienced at Yuma in conjunction with a Nevada Low, occasionally a trough associated with the Nevada Low will pass over the local area, producing cumuliform build-ups and thunderstorms. The primary forecasting problem with the Nevada Low is the intense wind associated with the system. Generally, if the low is well south (can extend into Southern California), the strongest wind will be south of a line from Los

Angeles to Las Vegas. If the low is in a more normal position (extreme Southern Nevada), the wind will be strongest along the Colorado river basin. The best forecasting tool to determine the wind speed and area is a constant check of the gradient level wind and the surface pressure gradient. The Nevada Low will normally develop:

(1) As a wave on an east through west oriented front.

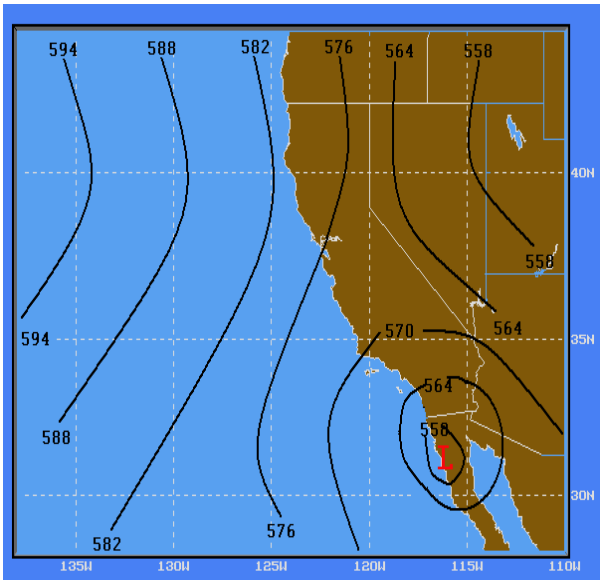
(2) As a secondary Low in an unstable air mass following the passage of a frontal low.

(3) Beneath a cut-off Low, or at the base of a long wave trough which has a jet maximum over the area.

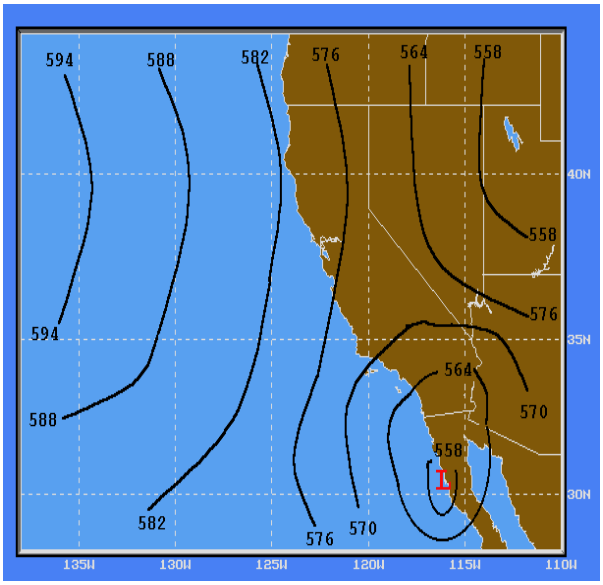
7. **Cut-off Low**. A long wave trough, which is often slow moving or nearly stationary, will sometimes become situated off the coast. A series of short-wave troughs traverse the area, new surges of cold air enter upwind of the long-wave trough and the trough undergoes deepening. When cold advection is very pronounced in the rear of the trough, an isolated pool of cold air (closed Low) aloft may form. As this closed, cold Low, originally within the westerlies, becomes displaced equatorward, it gets pushed out of the westerly current and becomes "cut-off". Once the height contours and the isotherms become closed and nearly in phase, vorticity is no longer advected out of the low, which becomes essentially stationary. Cut-off lows are usually associated with a blocking situation at upper-levels; such that a sharp ridge, located west of the long-wave trough (or cut-off low) positions oriented southwest to northeast at 500 millibars. Cut-off lows tend to occur just offshore of the California coast, as cold air plunges down the eastern side of a large amplitude ridge in the Gulf of Alaska (see figure 2.18 & 2.19).

A strong ridge located in the Gulf of Alaska, which has shown a pronounced tendency of moving eastward onto the coast to produce a Santa Ana, suddenly stops and builds. As the ridge in the Gulf region intensifies, the anticyclonic curvature around the crest of the ridge becomes so great that the strong wind associated with the jet stream "overshoot" the top of the ridge and "cut-off" the trough forming a closed low aloft over the area. With the formation of this cold cut-off low is the presence of a strong (1040mb or higher) stationary surface high at higher latitudes of the Gulf of Alaska. A well-defined surface low center, which is a reflection of an upper level cut-off low, seldom forms over the ocean areas. When sufficient

moisture is advected into the coastal areas from the southwest around a cut-off low, Southern California will experience some of its heaviest most prolonged rains. The longer the low remains over the water, the greater the quantity of precipitable water vapor. Also, the colder the air aloft, the more unstable the atmosphere becomes; thus, enhancing the production of cumulonimbus build-ups. The cut-off lows follow the general schedule of 24 to 48 hours for formation, 24 hours to a week in the operating areas, then 72 hours to 2 weeks for dissipation. Once the forecaster has determined that conditions are favorable for the formation of a cut-off low, they must determine if the low will occur over water or over land. If it forms over water, the forecaster must determine at what point sufficient moisture will be advected into the low to cause heavy rain showers. If the low develops directly south of San Diego, a situation resembling the Sonora may develop.



CUT-OFF LOW
FIGURE 2.18



CUT-OFF LOW SOUTH OF SAN DIEGO
FIGURE 2.19

8. **<u>Thunderstorms.</u>** Thunderstorms in the primary Yuma vicinity are rather infrequent (7 thunderstorm days per year). The thunderstorm activity, which occurs in the desert southwest, is usually very scattered throughout the desert. This is because of mountainous terrain, the convective instability of orographic lifting, the solar heat of the terrain elevation, and to a higher air temperature compared to free air, at the same height.

The occurrence of thunderstorm activity can generally be placed into two basic periods: Summer and Winter.

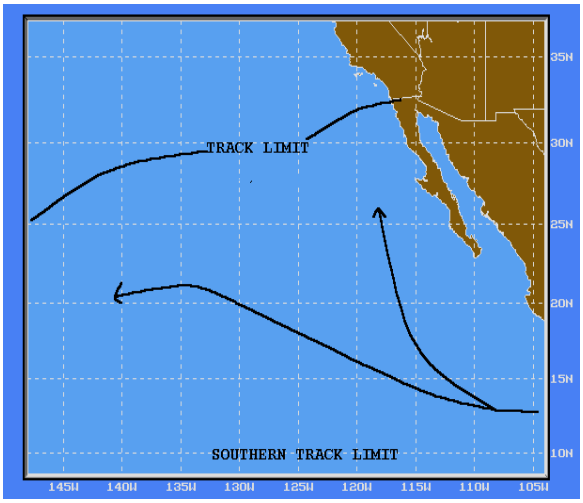
a. Summer. During the summer and early fall, the waters of the Gulf of Mexico and the Gulf of California is the source region for Maritime Tropical air (mT). Thunderstorms appear to have a diurnal preference for the period from late afternoon until midnight, although on occasion, appeared during daylight hours prior to noon.

b. Winter. Thunderstorms during the winter are uncommon, but can occur over the Yuma area. They occur to the rear of a rapidly moving cold front, often in coincidence with a cold low aloft. The vertical air structure is cold, moist, and conditionally stable with a low freezing level.

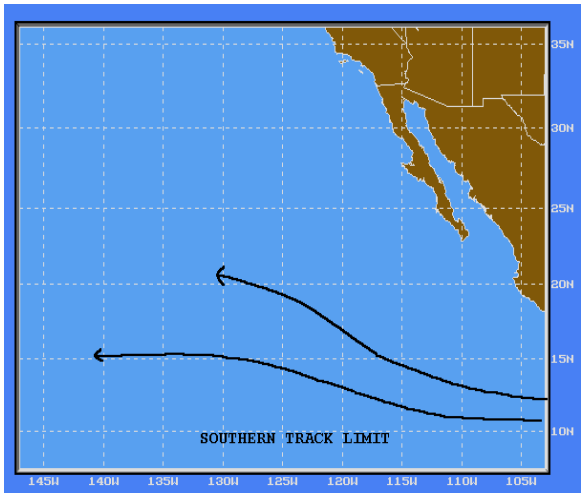
c. Sonora. Sonora is a local name given to the thunderstorm condition created by an easterly flow of moist air across the Sonora Desert in Southeastern California. The easterly flow normally occurs when the high-pressure cell aloft persists over the central United States. In this situation, extreme temperatures and high humidities in the mountain and desert regions become commonplace. High-level thunderstorms, with bases 5000' to 10000', appear on the eastern slopes of mountains as moisture is advected from the Gulf of Mexico, across the southern states, and into California. When the upper level flow has sufficient east to west energy, thunderstorms will move towards the coastal areas during the late afternoon. Another less frequent occurrence generates as an upper level easterly flow and the presence of a low center over Baja California, advecting moist air over the Gulf of California. During a Sonora, low-level flying conditions become extremely hazardous, usually to the extent that adverse weather warnings are issued. High-level flights are possible with circumnavigation of the individual thunderstorm areas.

9. **Tropical Storms**. Tropical storm development in the Eastern Pacific is most frequent during the summer and early fall, with the majority forming off the west coast of Mexico between 10^0N and 20^0N and moving west or northwest. Tropical storms, or their remnants, occasionally move north toward the Southern California coast. They tend to dissipate before crossing 30^0N due to strong vertical wind shear and cold surface water temperature (see figures 2.20 - 2.22). The moist tropical air from these storms is advected into higher latitudes at upper levels, resulting in the appearance of middle and high clouds, with possible showers and thunderstorms in the Yuma area. When

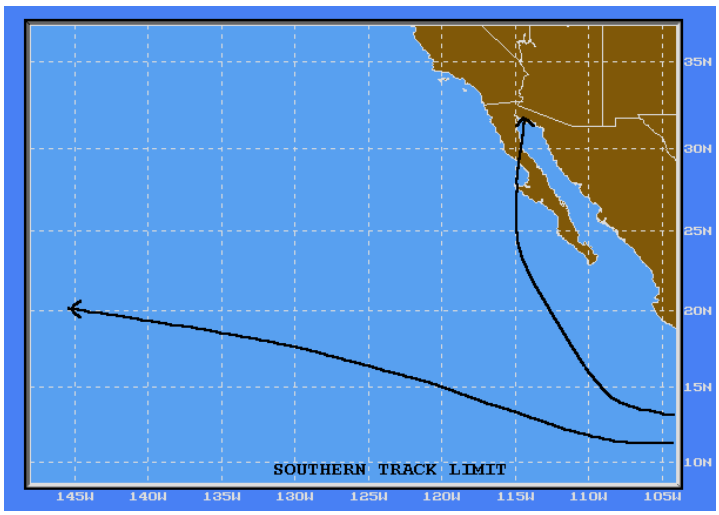
a tropical storm recourses to the northwest and crosses the Mexican mainland coast, or Baja California, it frequently results in impulses of tropical moisture into the local area. During tropical storm activity southwest of Yuma, the forecaster should always be alert for possible hazardous surf conditions resulting from southerly swells generated in the storm area.



AVG TROPICAL CYCLONE TRACKS FOR MAY-JUL
FIGURE 2.20



AVG TROPICAL CYCLONE TRACKS FOR THE MONTH OF AUG
FIGURE 2.21



AVG TROPICAL CYCLONE TRACKS FOR MONTHS OF SEP-OCT
FIGURE 2.22

CHAPTER 3

FORECASTING

1. **Introduction**. The mountains ranges that follow the pacific coast mainly modify weather at MCAS Yuma. These mountains will separate the moist pacific air mass from the dry desert air mass.

2. **Forecasting Considerations**. To arrive at the most accurate forecast, forecasters must take into consideration all techniques and rules that apply to a given synoptic situation. It is imperative to pilots and to supported organizations that the forecaster applies their experience and knowledge to produce a reliable and sound forecast.

3. **Weather Types**. Climate has often been defined as average weather. This definition is unsatisfactory because it needlessly eliminates the irregular and short-term weather events that are concealed in averages.

4. **Subjective Rules for Local Forecasting**. The following is a list of thumb rules and empirically derived forecast aids which have been developed by various activities in the local area. There will be exceptions to all of these rules. They all have merit and provide valuable guidelines for the forecaster to use.

a. Broken cirrus will form when the dew point value at the 400mb level is -30°c or warmer

b. A southeasterly and southwesterly converging flow over Yuma at 500mb will produce layered clouds with bases at 10,000 feet and tops extending upwards to 30,000 feet accompanied by occasional shower activity at the surface.

c. Tertiary winds occur daily just after sunrise and sunset. They may produce a rapid change of wind direction with marked increase in speed, with a duration of about 30 minutes. Direction depends on the thermal low, and speed depends on the gradient.

d. When pressure gradient between El Centro and North Island reaches 7-10mb in conjunction with a temperature gradient of 18’f or more, Yuma will experience westerly surface winds of 15-25 knots. However, the passage of a well-developed trough

at 700 mb through the local area my drop the gradient required to as little as 3-5mb.

e. Thunderstorm will form along the leading edge of a tight dew point gradient (warm side), at 500mb when the wind flow is perpendicular to that gradient (cold to warm).

f. When a Sonora condition is in evidence, and the low level flow is easterly at 15kts or greater, thunderstorms will intensify over the Gila Mountains to the southeast of Yuma. This activity normally develops by mid-afternoon with possibility of some cells moving over the station.

g. Winds aloft(between 2,000-5,000 feet), of 35-30 knots showing on an early morning VAD wind profile will generally result in strong wind gusts(20-25kts) on the surface after 0800L-1000L, when the inversion breaks.

h. With dry surface conditions and sustained westerly surface winds of 22 knots or greater for 2-4 hours, the surface visibility will frequently be reduced to less than 3 miles in blowing sand.

i. Intense thunderstorms moving northwestward across the sand dunes to the southwest of west of the station will often reduce surface visibility to less then 3 miles in blowing dust for 15-20 minutes.

5. **Routine Forecasts**. On a daily basis, forecasts are issued to specific customers aboard MCAS Yuma. The following are daily products issued by this office:

a. Daily Forecast. Prepared year round and posted to the web page, via the Local Area Network (LAN) by 0600L daily.

b. DD-175-1 Flight Weather Briefing. Performed in accordance with NAVOCEANCOMINST 3140.14_. Briefings are conducted by the duty forecaster in person, and are available to tenant aircrews via phone or fax when a completed flight plan is received.

c. Horizontal Weather Depiction (HWD's). These products are prepared when requested by tenant aircrews and submitted as part of a flight weather packet for a specified route of flight. The duty forecaster will follow guidelines set forth in accordance with the same directive as listed above.

d. Terminal Aerodrome Forecast (TAF). This forecast is prepared and disseminated longline every 6 hours at 03, 09, 15, and 21 ZULU. The proper format and procedures are contained in NAVOCEANCOMINST 3143.1_.

6. **Warnings/Advisories and Conditions of Readiness**. MCAS Yuma weather section issues significant weather warnings for the immediate local area and local flying area.

a. Local Flying Area. (Area of Responsibility = 100NM).

b. Local Area. Is defined as the geographical area within 25 nautical miles of MCAS Yuma

c. Local Advisory. Advisories are issued by the MCAS Yuma weather office for destructive weather occurring or forecast to occur at general location(s) within the local flying area during a specified time.

d. Watches/Warning. Weather watches/warnings are more specific and require action of a greater urgency than weather advisories. They are issued by the MCAS Yuma weather office for the local area only.

e. Types of Weather Warnings/Watches and Advisories

(1) Thunderstorm Condition 1. Thunderstorms are occurring or imminent within 10 nautical miles of the Air Station during the specified time.

(2) Thunderstorm Condition 2. Thunderstorms are occurring or imminent within 25 nautical miles of the Air Station during the specified time.

(3) Thunderstorm Advisory. Thunderstorms are forecast to occur at general locations within the local flying area during the specified time.

f. Wind Warning. Sustained wind of 15 - 33 knots and/or frequent gust in excess of 20 knots are occurring or are forecast to occur in the local area during the time specified. Under these conditions, higher or lower sustained wind and gust are possible due to terrain effects as wind is funneled in and around obstructions.

g. Gale/Storm Warning. Wind 34 to 47 knots (Gale), and wind 48 to 63 (Storm) warning. Follow the action for a Wind Warning

.

h. Hurricane/Storm Condition. The National Weather Service sets conditions whenever sustained winds of 34 knots or greater are anticipated. Hurricane/Storm conditions are set as follows:

(1) Hurricane/Storm Condition 4. Destructive wind is possible within 72 hours.

(2) Hurricane/Storm Condition 3. Destructive wind is anticipated within 48 hours.

(3) Hurricane/Storm Condition 2. Destructive wind is anticipated within 24 hours.

(4) Hurricane/Storm Condition 1. Destructive wind is presently occurring or anticipated within 12 hours.

i. National Weather Service Warnings

(1) Tornado Watch. Conditions are favorable for tornadoes and severe thunderstorms within and close to the watch area.

(2) Tornado Warning. A tornado/waterspout has actually been sighted or indicated by weather radar.

(3) Severe Thunderstorm Watch. Severe thunderstorm (wind gust to 50 knots or greater and/or hail of 3/4 inch diameter or greater at the surface) development is possible within or adjacent to the watch area.

(4) Severe Thunderstorm Warning. The occurrence of a severe thunderstorm has been confirmed by observation or weather radar.

(5) Hurricane Watch. A hurricane poses a possible threat to a specified coastal area within 36 hours.

(6) Hurricane Warning. Hurricane force wind is expected at a specified coastal area within 24 hours.

(7) Tropical Storm Watch. A tropical storm poses a threat to a specified coastal area within 36 hours.

(8) Tropical Storm Warning. Tropical storm force wind is expected at a specified coastal area within 24 hours.

(9) Flash Flood Watch/Warning. Heavy rainfall may result in, or has produced, flash flooding in the area.

(10) Winter Storm Advisory/Watch/Warning. Issued for a variety of winter storm phenomena, including: blizzards, freezing rain, freezing drizzle, heavy snow and ice.

CHAPTER 4

SPECIALIZED FORECASTS

1. **Introduction**. There are a number of different products requested by customers on both the aviation and groundside of Marine Corps Commands. These products vary according to mission tasking. This section in response to specific requests provides the following types of forecasts:

a. HPAC. The patterns of deposit of contaminated particles vary greatly with the upper winds, vertical currents, clouds and precipitation. Prediction of fallout areas depends upon the weapon yield, burst type, surface type and features, and the weather. All of these factors are estimated. NBC and Intelligence sections may assist in determination of these factors. Weather forecasters input upper air or Skew-T data into the HPAC program to find out where and how much RADFO will occur. Planners and commanders must at least have an approximate warning of the areas of serious contamination.

b. Earthquake Reports. The duty forecaster shall evaluate any earthquake felt or reported for MCAS Yuma by loging into the SEISMO website at HTTP://NEIC.USGS.GOV/NEIS/FELT/REPORT.HTLM, and fill out the earthquake questionnaire. If this is not possible, complete an Earthquake Report Form and foreword it to the METOC Chief for processing.

c. TAWS. TAWS's predict the performance of air-to-ground weapon systems and night vision goggles based on environmental and tactical information. This program supports three types of systems: Infrared (IR), Visible (TV), and Laser, and can be used in two modes: Execution and Planning. In the below listed modes, the following is provided:

(1) IR Planning TDA
Narrow Field of View (NFOV) Detection Range
Wide Field of View (WFOV) Detection Range
Medium Field of View (MFOV) Detection Range
Lock-on Ranges
Temperature Contrast
4-Km Transmittance
Absolute Humidity
Solar/Lunar Position

(2) IR Execution TDA
Narrow Field of View (NFOV) Detection Range

Wide Field of View (WFOV) Detection Range
Medium Field of View (MFOV) Detection Range
Lock-on Range

(3) TV Planning TDA
Narrow Field of View (NFOV) Detection Range
Wide Field of View (WFOV) Detection Range
Medium Field of View (MFOV) Detection Range
Lock-on Range
Solar/Lunar Position

(4) TV Execution TDA
Narrow Field of View (NFOV) Detection Range
Wide Field of View (WFOV) Detection Range
Medium Field of View (MFOV) Detection Range
Lock-on Range

(5) Laser Planning TDA
Receiver Range
Designator Range
Collocated Range
Ranging Range

The products most frequently requested by aviators assigned to the squadrons of Marine Aircraft Group 13, home based at MCAS Yuma are the ANVIS-6, NTS FLIR Wide, Narrow and Medium Fields of View and the Hellfire. In addition the forecaster will, in conjunction with the requester, prepare a TAWS worksheet for the types of sensors that will be utilized and for the specified time frame.

d. GFMPL Products. This program is utilized on the computer located within the Secondary Control Point. The type of data compiled in the following format depends upon the user request.

(1) COVER. Cover provides the capability to determine how an EM system will perform under atmospheric conditions in detecting or communicating with a target or receiver. It also provides the information necessary to plan flight profiles for airborne systems to achieve maximum probability of detecting targets. The following are limitations of the program:

· Cover assumes horizontal homogeneity (horizontal changes in the refractivity structure of the atmosphere are not accounted for).

· Cover is valid only for EM systems with frequencies between 100 MHz and 20 GHz.

· Cover does not include any effects produced by sea or land clutter in the calculation of detection or communication ranges.

(2) LOSS. The LOSS program is used to assess the performance of a user specified EM system under given atmospheric conditions. Path loss versus range is displayed with the system's path-loss thresholds. The following are limitations of the program:

· LOSS assumes horizontal homogeneity.

· LOSS is valid only for EM systems with frequencies between 100 MHz and 20 GHz.

· LOSS does not include any effects produced by sea or land clutter in the calculation of detection or communication ranges.

(3) SLAP. The Solar/Lunar Almanac Program (SLAP) produces monthly or daily summaries of ephemeral data for the sun and moon and a light level-planning calendar for the evening sky, including times for sunrise/set, moonrise/set and illumination, and beginning and end of civil/nautical twilight's.

(4) TIDES. The tidal predictions module calculates hourly tidal heights from local harmonically analyzed constituents, or from non local constituents, by means of corrections applied to the times and heights of extreme predicted for a non local station.

e. Chemical Downwind Message (CDM). The chemical downwind message contains all the weather information needed to calculate a chemical downwind hazard. The CDM provides the local wind speed, wind direction, stability category, and relative humidity in a short concise statement. This message is issued every six hours and is valid for three consecutive two-hour periods. To calculate CDMs use the Chemical Downwind Message Template provided in Excel spreadsheet format. This is an easy way to input the weather data and have the program prepare the CDMs.

f. Surf and Sea Conditions. Periodically station squadrons conduct operations off the coast of Southern California. MCAS Yuma forecasters may provide the sea-surface temperature and survival rates for personnel stranded in the water with an immersion suit and without an immersion suit off

the coast of Southern California . These forecasts and conditions are derived using the GFMPL program. Surf and sea states for the inner operating areas adjacent to Southern California are also available. These forecasts and conditions may be derived from several sources. One and most importantly is the FOPN KNZY bulletin received via the METCAST. The other source the forecaster may utilize is GFMPL for tidal information and NODDS for sea swells/height and direction and temperatures. There are also many Internet sights available with this information.

g. Forecasting Pressure Altitude. Daily, along with the maximum temperature, the forecaster may derive the forecast pressure altitude from the below listed information as part of the formula. See Figures 4.1

LOCATION STA ELEV

KCRQ	+ 328	KNKT	+29	KNZJ	+383
KDMA	+ 2705	KNLC	+234	KNZY	+26
KHIF	+ 4789	KNRC	+165	KOAR	+135
KIPL	- 56	KNRS	+24	KPSP	+448
KLSV	+ 1868	KNSI	+504	KRIV	+1548
KNFG	+ 78	KNTD	+12	KSLI	+33
KNFL	+ 3934	KNTK	+54	KTCM	+323
KNGZ	+ 14	KNUC	+ 182	KTRM	+117
KNID	+ 2283	KNXP	+ 2055	KVBG	+367
KNJK	-43	KNYL	+ 213	KVCV	+2875

FIGURE 4.1

(Heights in feet above/below MSL) * -- Not listed in FLIP.
Reference: IFR-Supplement, {FLIP}, effective 20 JUL 1995;
Example: KNFG forecasts the ALSTG at 0500Z to be 29.85. Convert inches to feet using the chart in figure 4.1. 29.85 inches = +66 feet. Add +66 feet to the station elevation (+78 feet)
EX. KNFG station elevation +78
Conversion (inches to feet) + +66
Pressure Altitude for KNFG at 0500Z = +144

If the previous charts are unavailable, use the following formula:

Pressure Altitude= 29.92 – current altimeter X 1000= Pressure Altitude Variation (PAV) + Station Elevation

Density Altitude= Pressure Altitude + Standard Temperature Deviation X 120

The standard temperature deviation is 15 degrees C. Any change in elevation would equal a 2-degree change per 1000 feet. Example= 29 Palms temperature deviation would be 11 degrees C.

NOTE: See Appendix A for Monthly and Annual Altimeter and Pressure Altitude Variations.

Reference: Meteorological Tables

CHAPTER 5

ENVIRONMENTAL EFFECTS

1. **Introduction**. The effects of natural phenomena on personnel, as well as aircraft, are a primary concern when planning any event. Alerting commanders in a timely manner of the occurrence, or probability of occurrence, is paramount for the Weather Service (METOC) mission. Yuma's weather largely consists of clear skies and light winds.

2. **Field Minima and Weather Affecting Weapons System and Sensors**

a. Field Minima

(1) Special Instrument Rating. No takeoff ceiling or visibilities apply. Takeoff shall depend on the judgment of the pilot and urgency of flight.

(2) Standard Instrument Rating. For further information see Department of Defense flight information publication manual volume three.

b. Weather Effects on EO/IR Sensors

(1) Visibility is a phenomena caused by small particles in the atmosphere that scatter radiation in a manner that strongly impacts the short visible wavelengths. It has an impact on IR wavelengths and almost none on MMW wavelengths. Haze is a good example of this phenomenon.

(2) Rain drops are phenomena that scatter radiation in a manner that impacts the visible and IR bands about the same and start to have less of an impact as the MMW wavelengths are approached.

(3) Absolute humidity of water vapor in the air is a phenomenon that absorbs radiation in predominantly the IR bands and the high frequency MMW band (220 GHz).

(4) Fog and clouds, which are characterized by the liquid water content, are cases of very low visibility in which the suspended water droplets are scattering the radiation. The impact on the spectral bands is between that of visibility and rain.

3. **Phenomena and Operating Constraints**

a. Thunderstorm Condition 2 Ordnance, Fuels, and Aircraft Units prepare for Thunderstorm Condition 1.

(1) Ordnance begins to secure its ordnance.

(2) Fuels continue normal operations.

b. Thunderstorm Condition 1

(1) Ordnance suspends all operations.

(2) Fuels suspend all operations.

c. X-Wind factors for Aircraft

Aircraft	Crosswinds	Cannot Take Off
AV-8B	19 Kts at 090	20 Kts at 090
F/A-18 Hornet	20 Kts at 090	30 Kts at 090
KC-130 Hercules	10 Kts at 090	15-20 Kts at 090
UC-12B Beachcraft	15 Kts at 090	25 Kts at 090
C-141B Starlifter	25 Kts at 090	25 Kts at 090 (dry)
		15 Kts at 090 (wet)
F-5	20 Kts at 090 (Chute) (dry)	
	35 Kts at 090 (w/o chute) (dry)	
	10 Kts at 090 (chute) (wet)	
	20 Kts at 090 (w/o chute) (wet)	
UH-1 Huey	45 Kts relative wind/60 Kts in emergency	
AH-1 Cobra	45 Kts relative wind/60 Kts in emergency	

d. Turbulence/Icing factors for Aircraft

(1) H-l/AH-lJ+W/CH-53+46&C-12 are not allowed to file into areas of known extreme turbulence.

(2) Icing capabilities of different aircraft

Type	De-ice	Anti-ice	Max icing	Wx Radar
AV-8B	X	X	Moderate	No
F-5		X	Light	No
UH-1				No
F/A18	X	X	Moderate	Yes
KC-130	X		Severe	240 NM
UC-12B	X	X	Light	200 NM

CHAPTER 6

References

1. General

a. Joint Doctrine, Tactics, Techniques, and procedures for Meteorological and Oceanographic Operations Joint Pub 3-59

b. Sailing Directions (Planning Guide), Pub 152, Third Edition, Defense Mapping Agency Hydrographic/Topographic Center Bethesda, MD, 1989

c. Local Area Forecasters Handbook for NAS North Island, San Diego, CA. Naval Oceanography Command Facility San Diego, 1989

d. Defense Mapping Agency Chart 2549: San Diego, 2nd Edition, 1991

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x. NAS El Centro Forecaster Handbook

y. MCAS Camp Pendleton Forecasters Handbook

Z. GFMPL Users Manual

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bb. JMV Users Manual

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2. Directives

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b. NAVAIR 06-5-502

c. SEAOPS S9LCA-AA-SSM-010

d. OPNAVINST 3710.7_

e. Station Order 3145.1_

f. StaO P3710.7_

g. NAVMETOCCOMINST 3140.2_

h. OPNAVINST 3140.24_

i. NAVOCEANOCOMINST 3140.1_

j. NAVOCEANOCOMINST 3441.1_

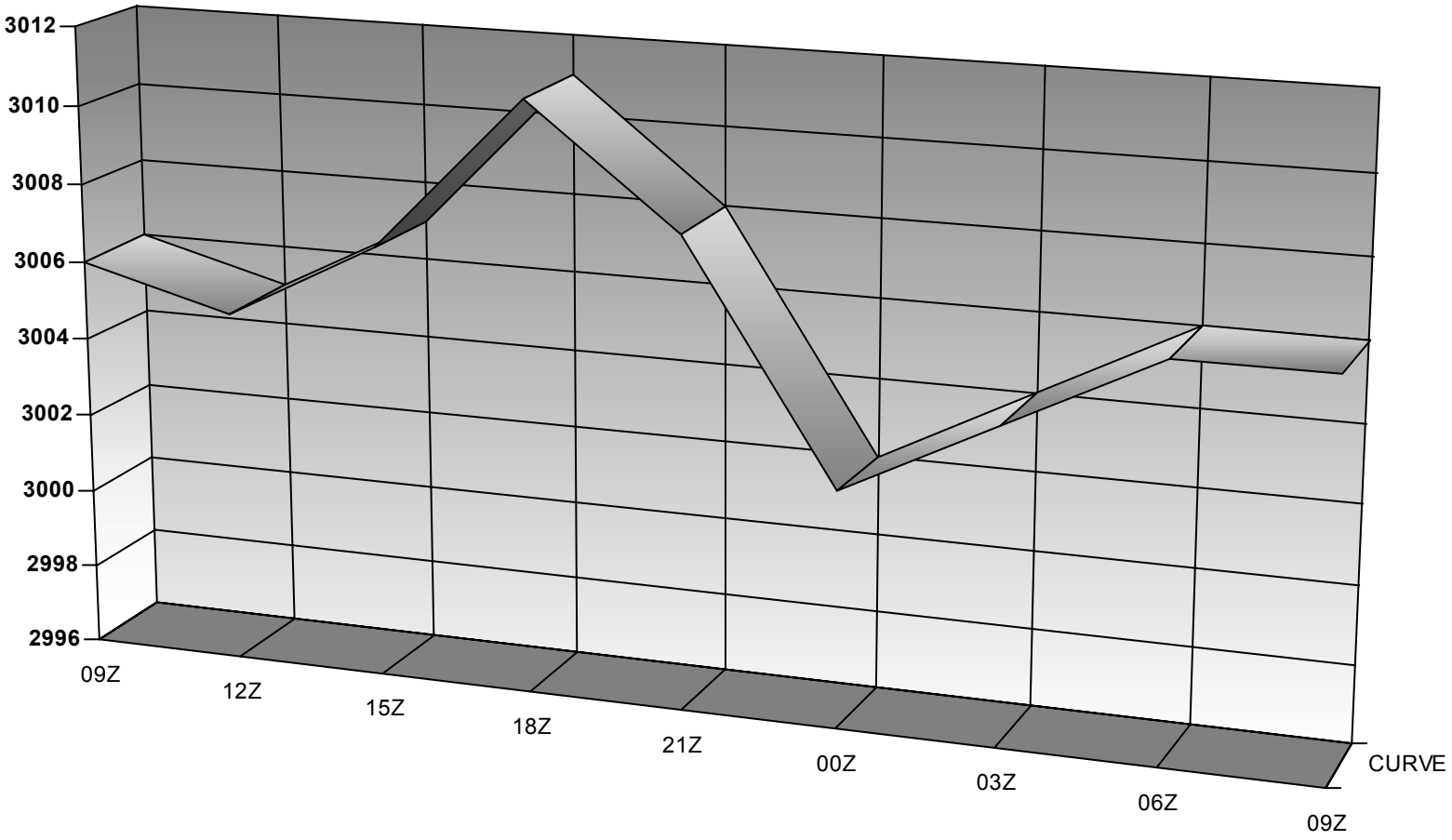
k. NAVOCEANOCOMINST 3141.1_

l. FM 3-3

APPENDIX A

DIURNAL PRESSURE CHANGES

JANUARY
ALTIMETER CURVE



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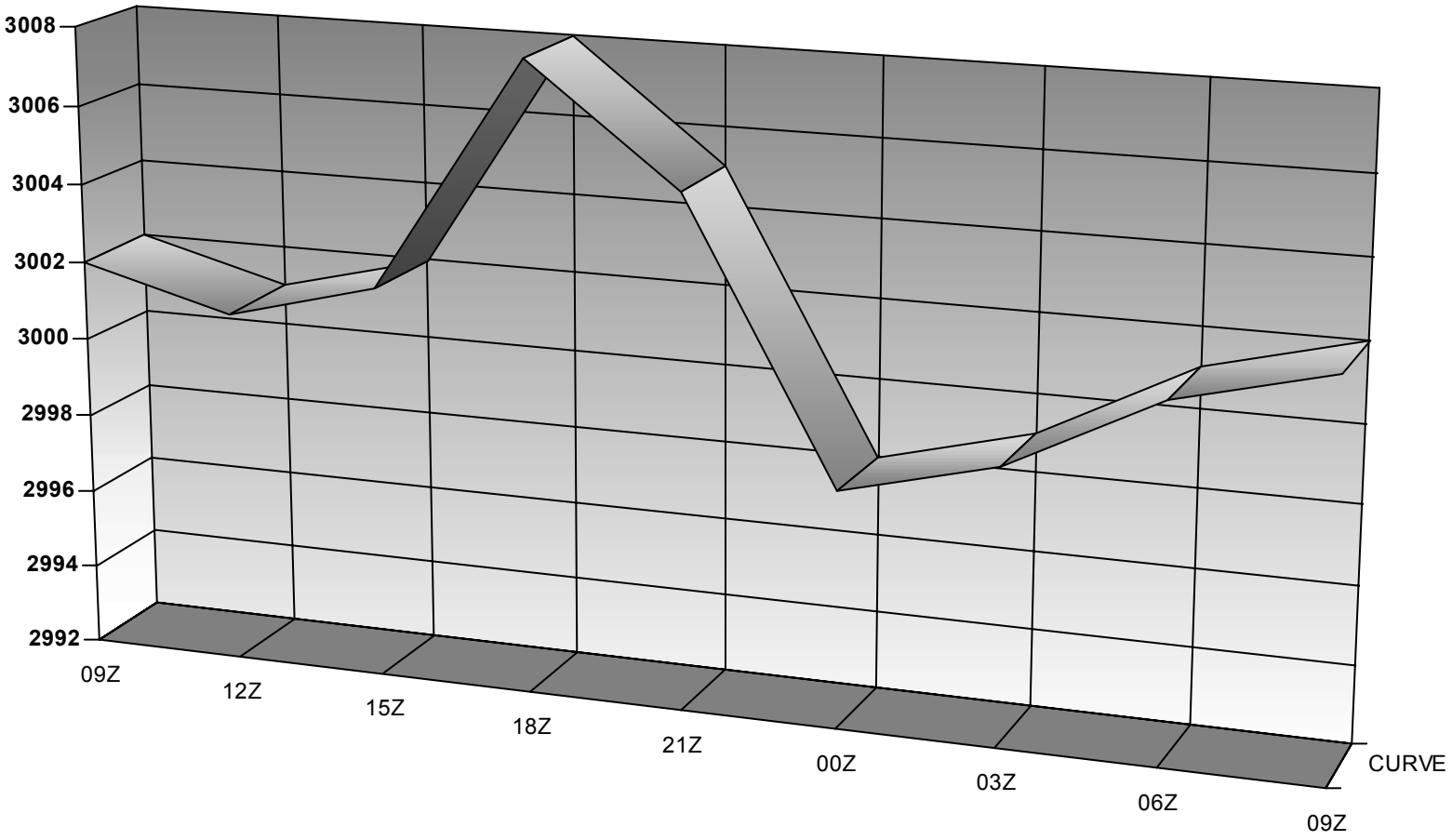
ALTIMETER CURVE



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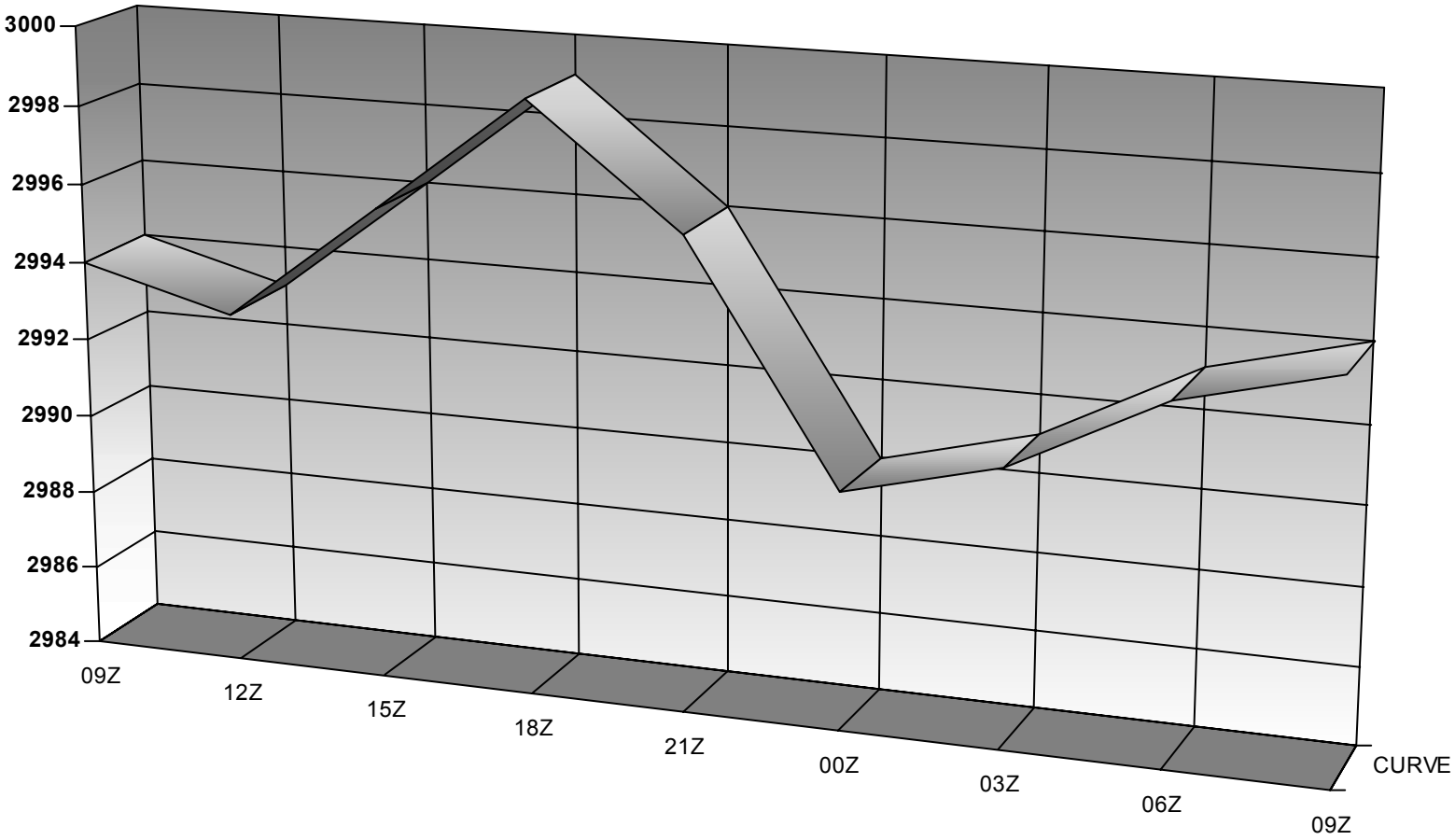

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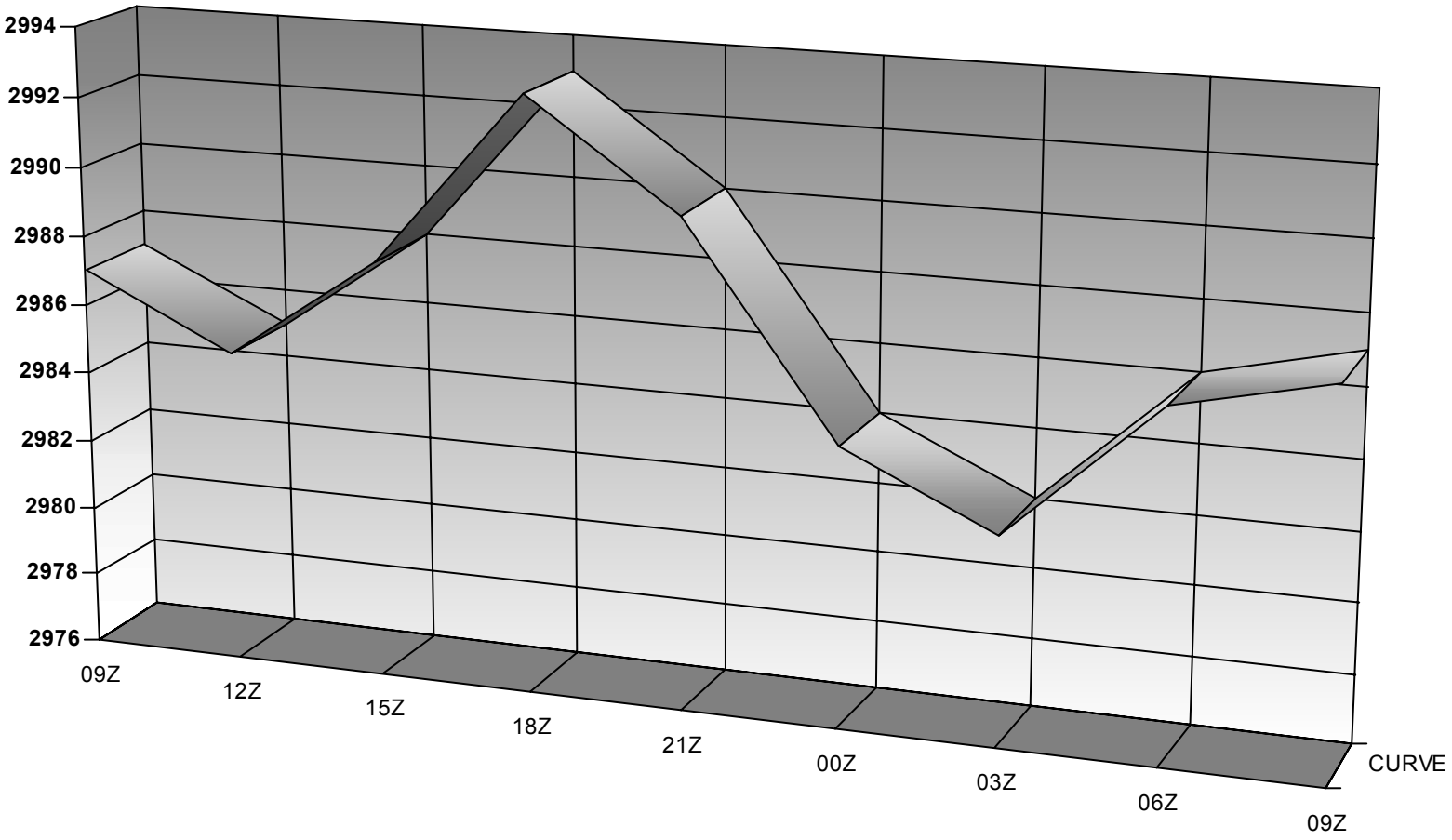

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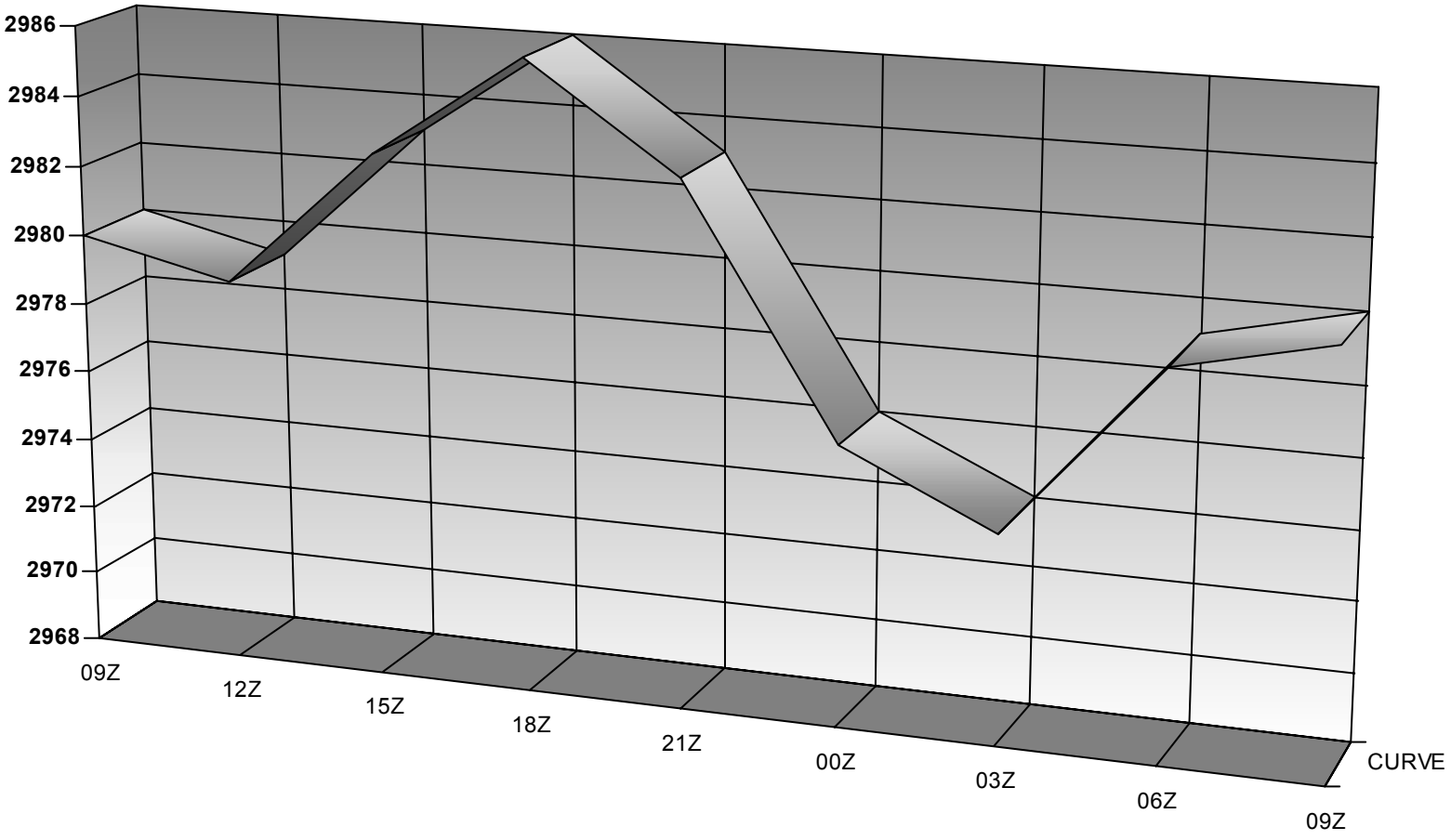

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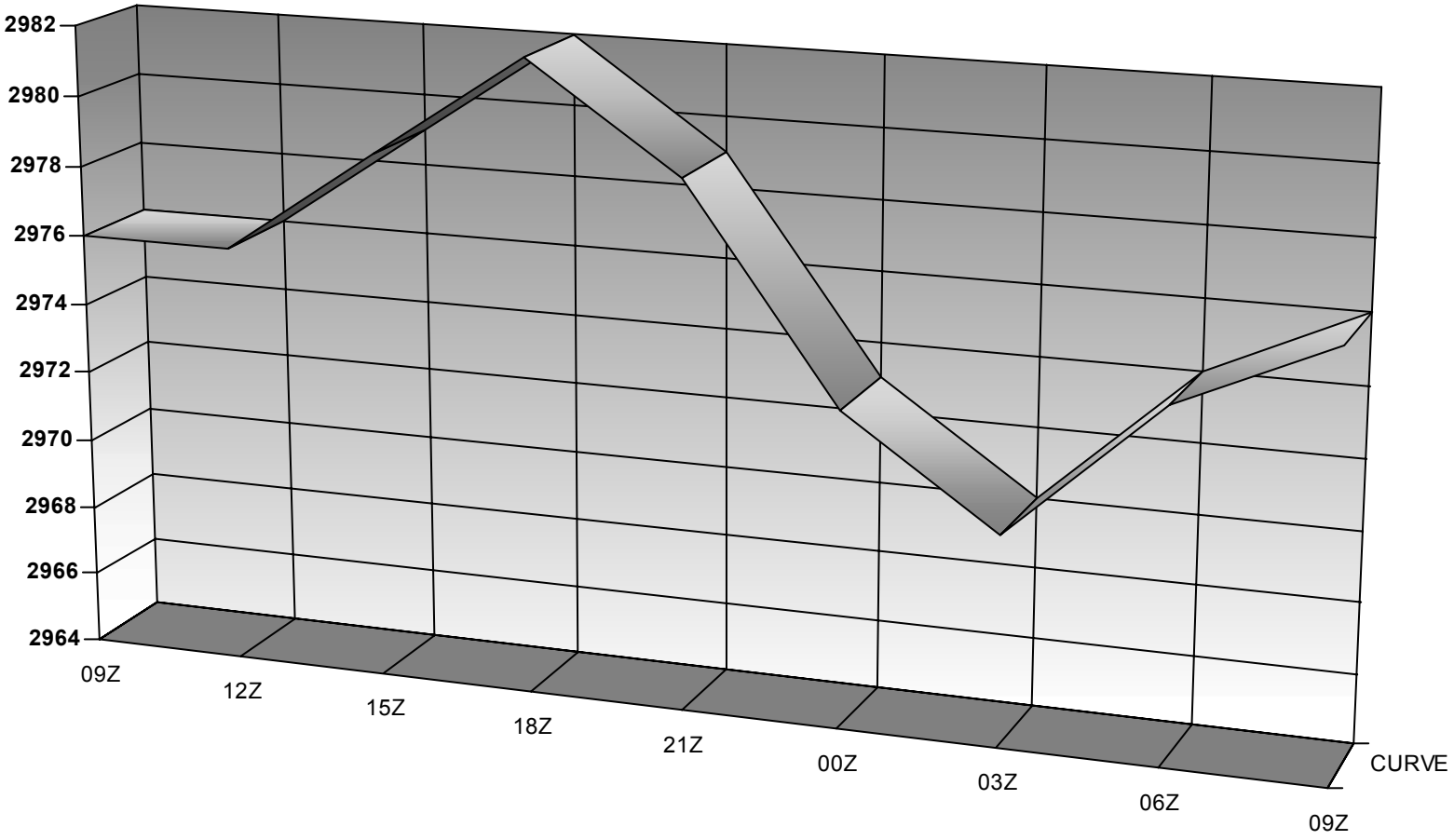

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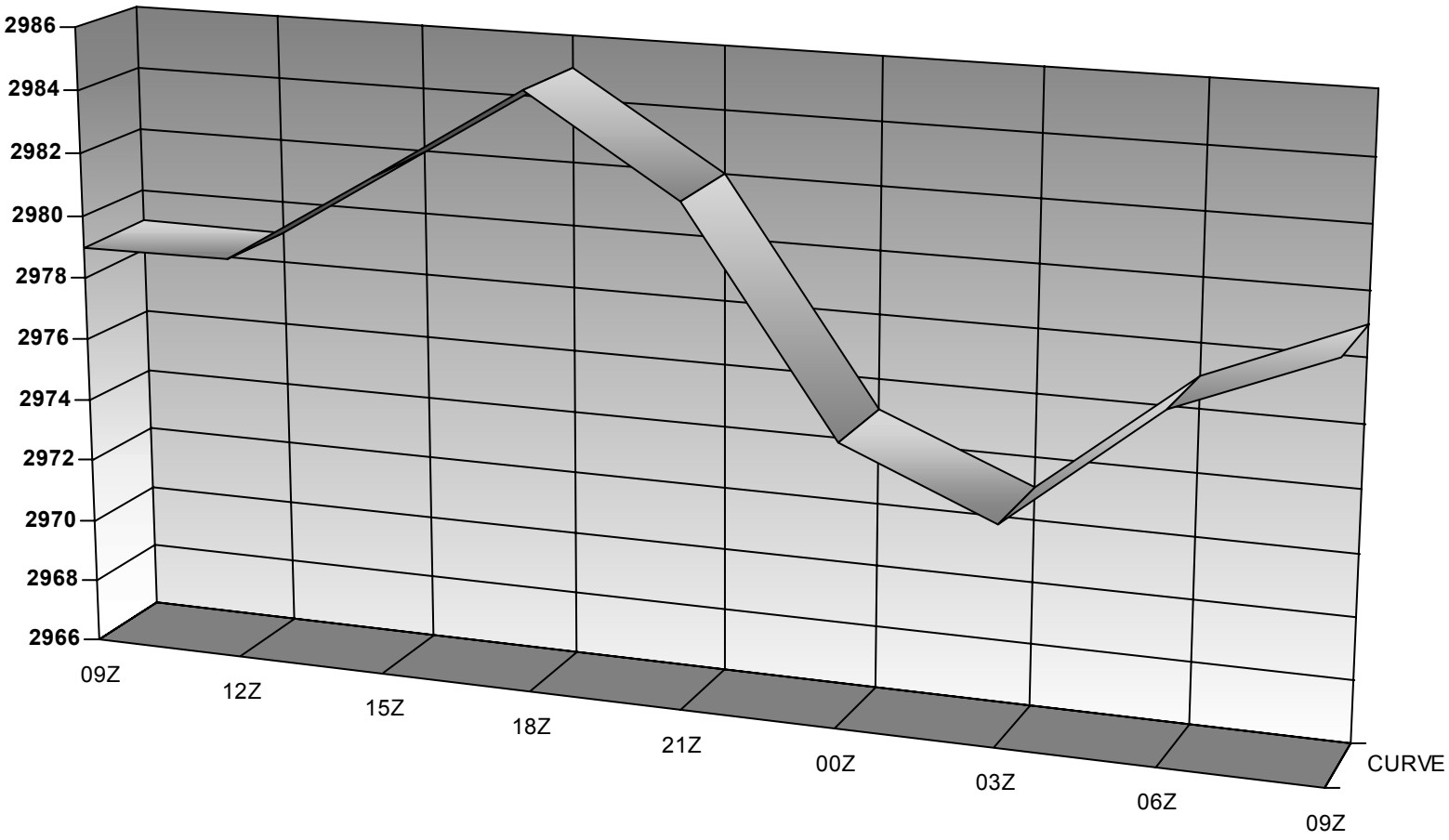

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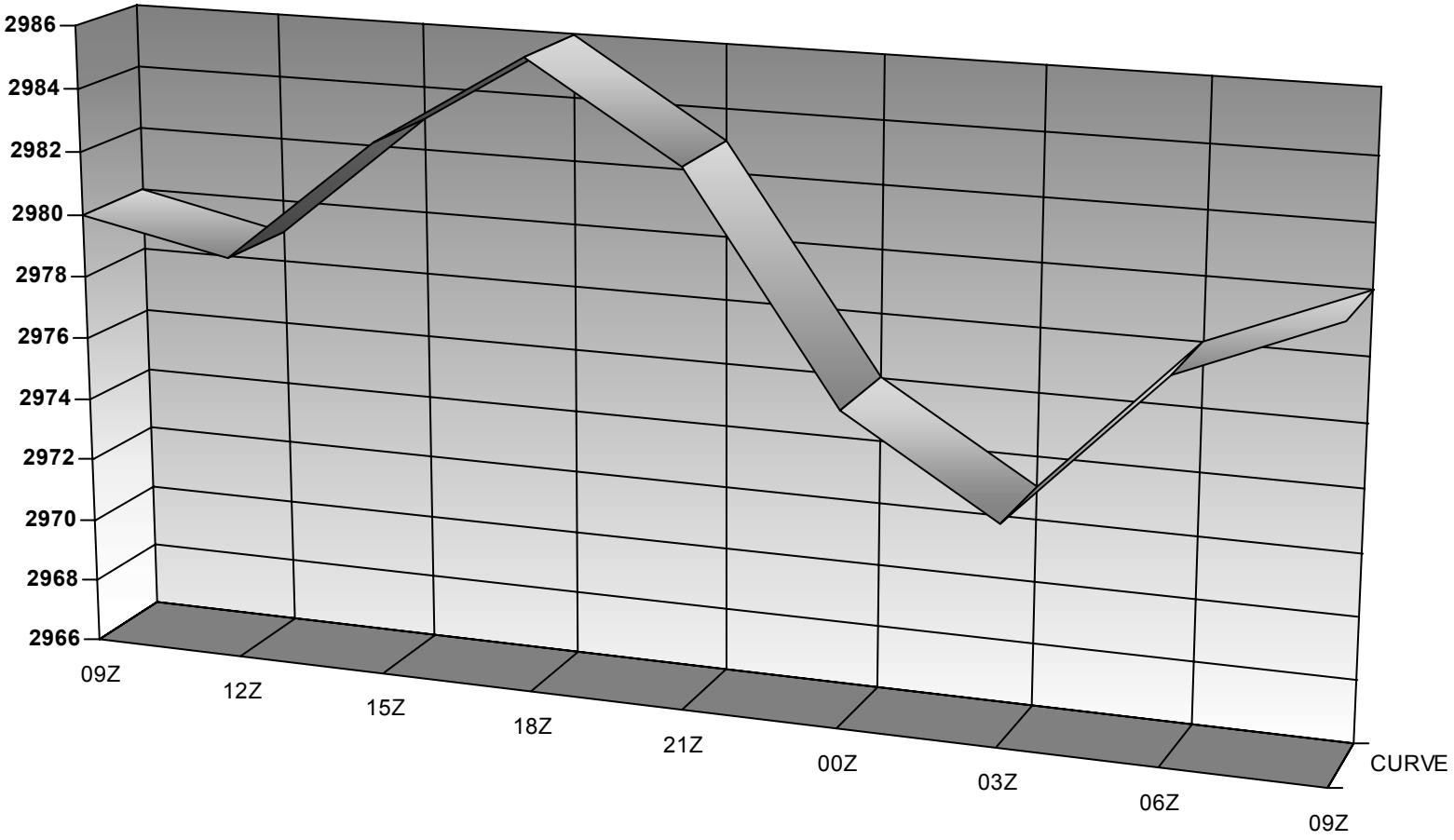

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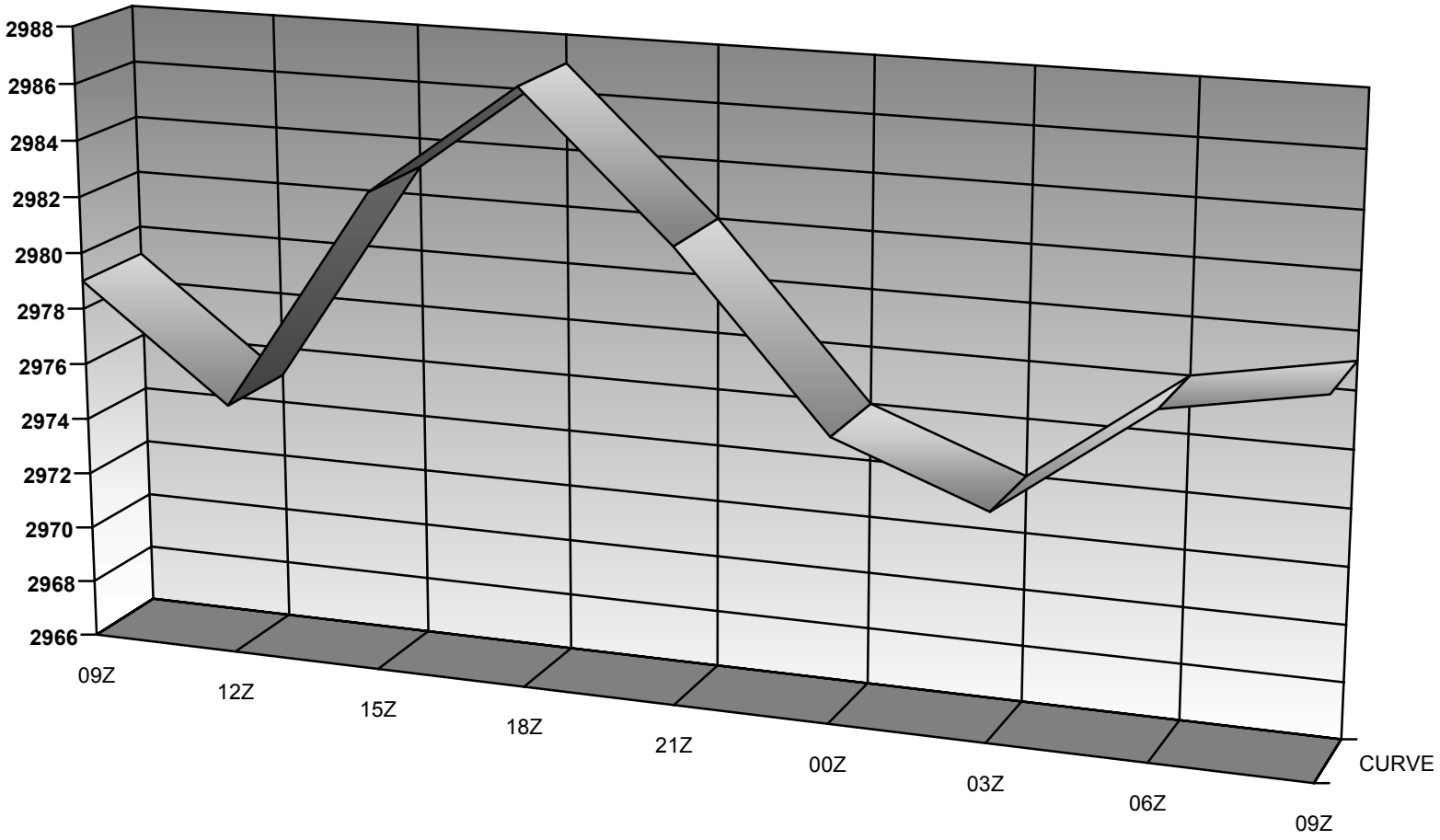
ALTIMETER CURVE



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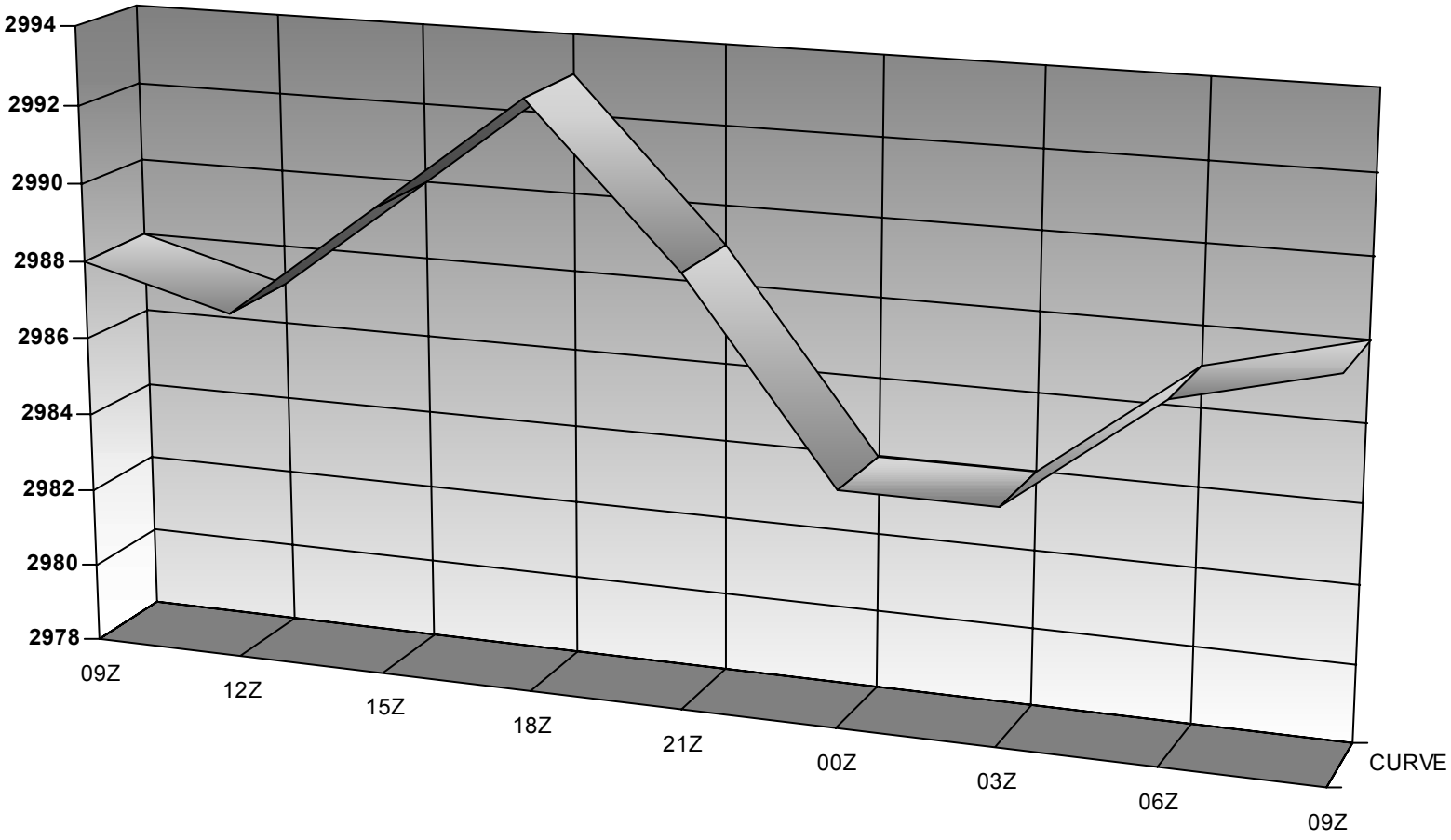

NOVEMBER
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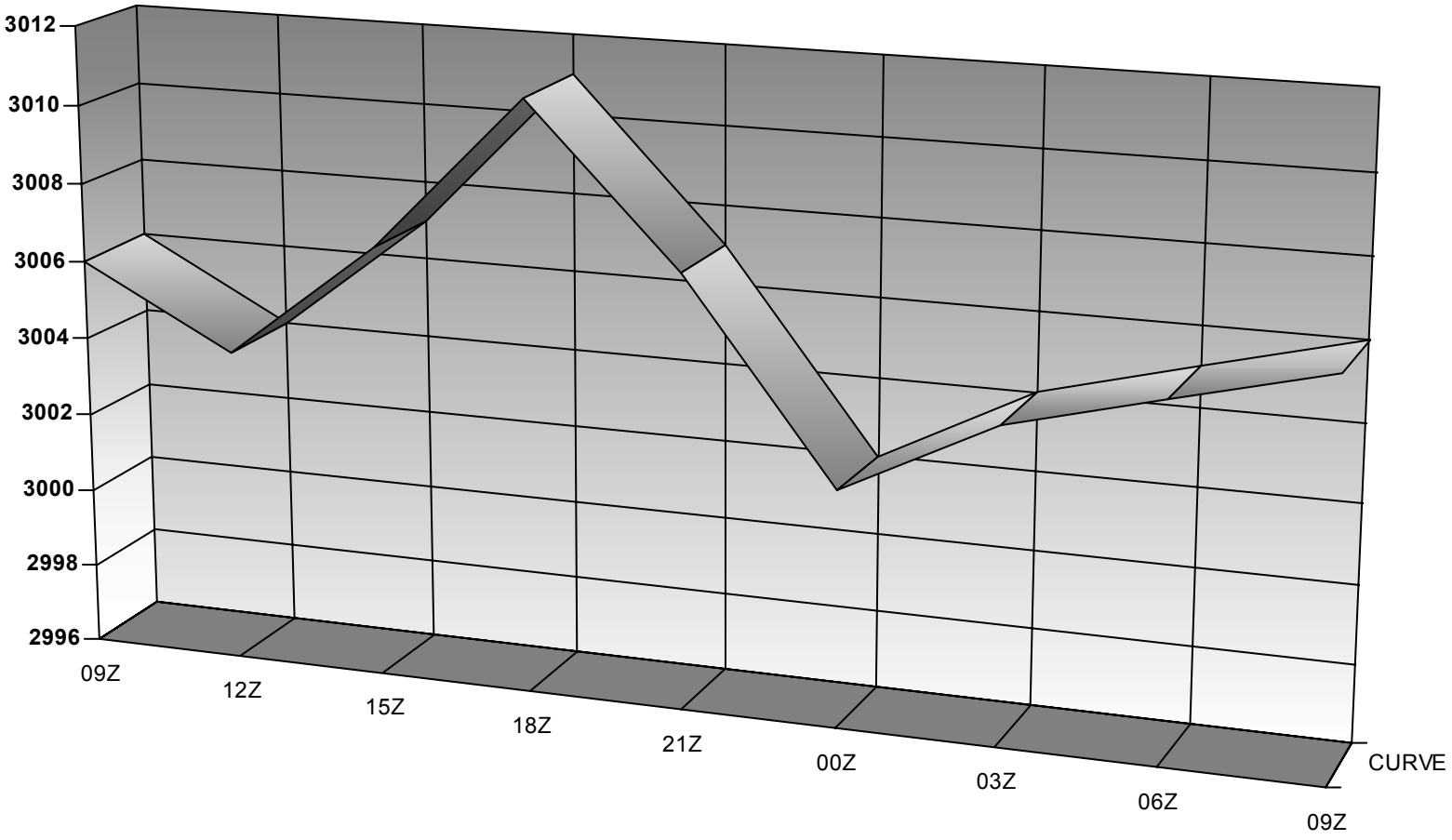
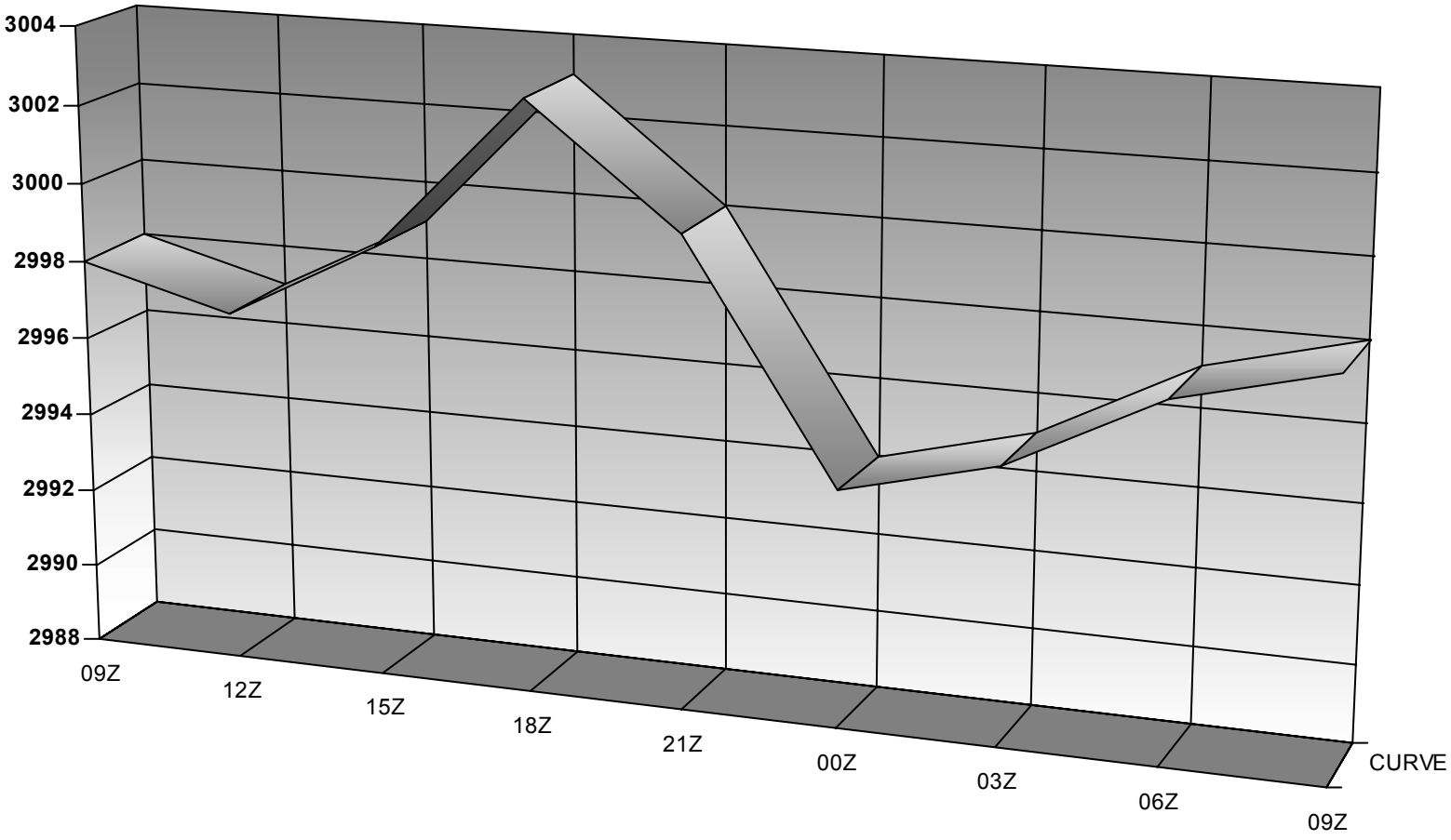


DECEMBER
ALTIMETER CURVE



APPENDIX B

AIRCRAFT SENSITIVITIES

APPENDIX C

USMC METOC OVERVIEW

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U.S. Marine Corps METOC

This chapter describes U.S. Marine Corps organizational structure, command relationships, capabilities, equipment, and support requirements.

10.1 Marine Corps Forces (MARFOR)
10.1.1 Marine Air Ground Task Force (MAFTF).

• Structure. Marine Corps METOC is structured to support the Marine Air Ground Task Force (MAGTF). The MAGTF is a task organization consisting of a Ground Combat Element (GCE), an Aviation Combat Element (ACE), a Combat Service Support Element (CSSE), and a Command Element (CE). A MAGTF will vary in size based on the mission. The Marine Corps has three structured MAGTFs which include a Marine Expeditionary Force (MEF) built around a Division, a Marine Expeditionary Brigade (MEB) built around a reinforced Regiment, and a Marine Expeditionary Unit (MEU) built around a reinforced Battalion.

• Employment. Upon the employment of a MAGTF, tactical METOC support will transition from garrison-based to on-scene METOC support as either a Meteorological Mobile Facility (METMF) or a MEF Weather Support Team (MST). These tactical METOC elements will forward deploy by attaching to the GCE, ACE, CSSE, and CE as required.

- The METMF unit is a fully capable METOC facility, supported from the regional offices (maritime theater centers), the large production centers (FNMOC, NAVOCEANO, AFWA), and any other available sources (foreign facsimile, force weather). They are organic to the Marine Wing Support Squadron (MWSS) and normally deploy in direct support of the ACE.

- The MST is a five man METOC team task organized to the mission with limited stand-alone capability. The MST is also organic to the MWSS and is normally deployed to support the Command Elements of a MEF, MEB, or MEU, as well as the GCE and CSSE. When attached, the MST is organized within the Intelligence Section (G-2) of the supported command and provides staff level METOC support for mission planning and operational execution.

• Personnel. USMC METOC Military Occupational Skills (MOS):

MOS 6802 - Weather Service Officer. All 6802s are prior enlisted (Warrant Officers

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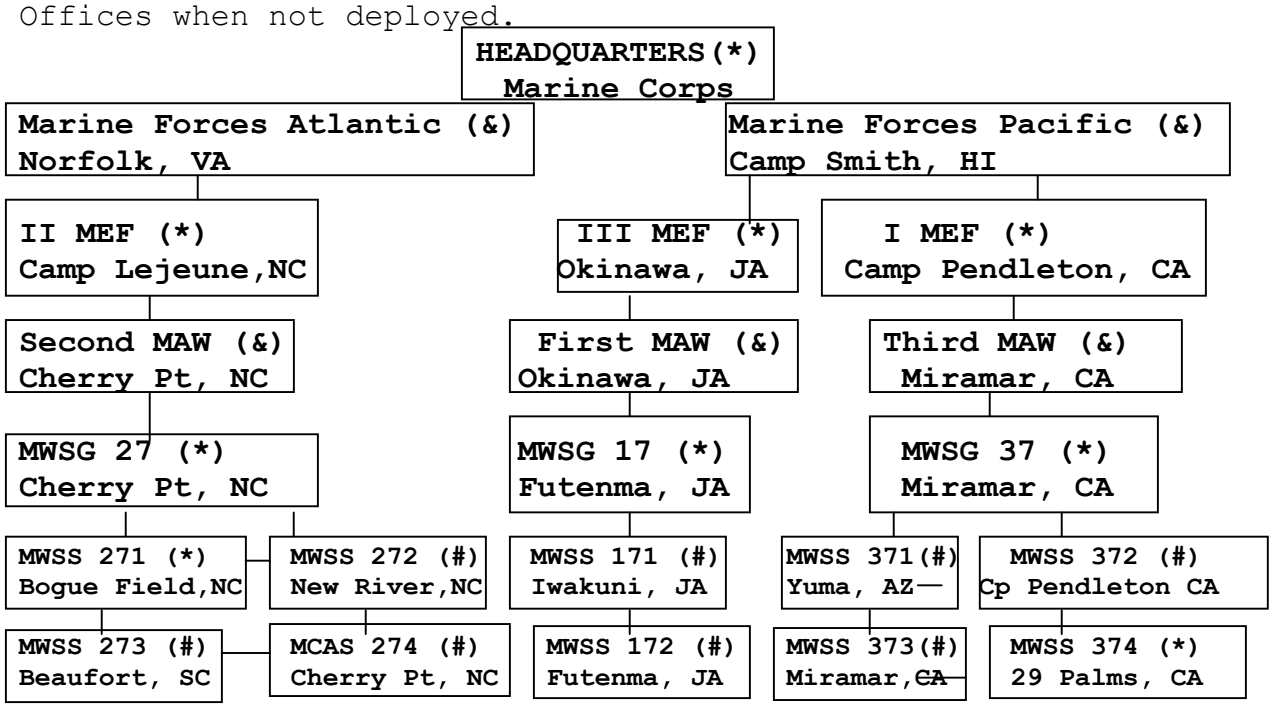
or Limited Duty Officers)
MOS 6877 - (Secondary MOS) Weapons and Tactics Instructor (WTI)
MOS 6821 - Weather Observer
MOS 6842 - Weather Forecaster
MOS 6493 - Meteorological Equipment Technician

10.1.2 Fleet Marine Force (FMF) METOC Structure.

The structure and location of Fleet Marine Forces (FMF) is shown below in Figure 10-1.
The majority of Marine Corps METOC personnel are organized within the Marine Wing
Support Squadron Table of Organization (T/O) and participate in the Fleet Assistance
Program (FAP) to augment Marine Corps Air Station Weather Offices when not deployed.



*** Weather Officer Assigned**
& Collateral Duty for closest assigned Weather Officer
 # Weather Officer FAPed to MCAS/MCAF Weather Office

Figure 10-1. Location of Fleet Marine Force Activities

10.1.2.1 Marine Expeditionary Force (MEF) METOC Structure.

There are three MEFs within the Marine Corps: I and II MEF each have four MWSSs, while III MEF has two. Both I MEF and II MEF have 10 Weather Officers, 31 Weather Forecasters, and 48 Weather Observers, while III MEF has 6 Weather Officers, 16

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Weather Forecasters, and 24 Weather Observers. The total FMF METOC force consists of 26 Weather Officers, 78 Weather Forecasters, and 120 Weather Observers. Figure 10-2 depicts FMF METOC personnel within a given MEF.

MEF T/O Total (By MOS)
6802/Weather Officer (10)
6842/Weather Forecaster (31)
6821/Weather Observer (48)

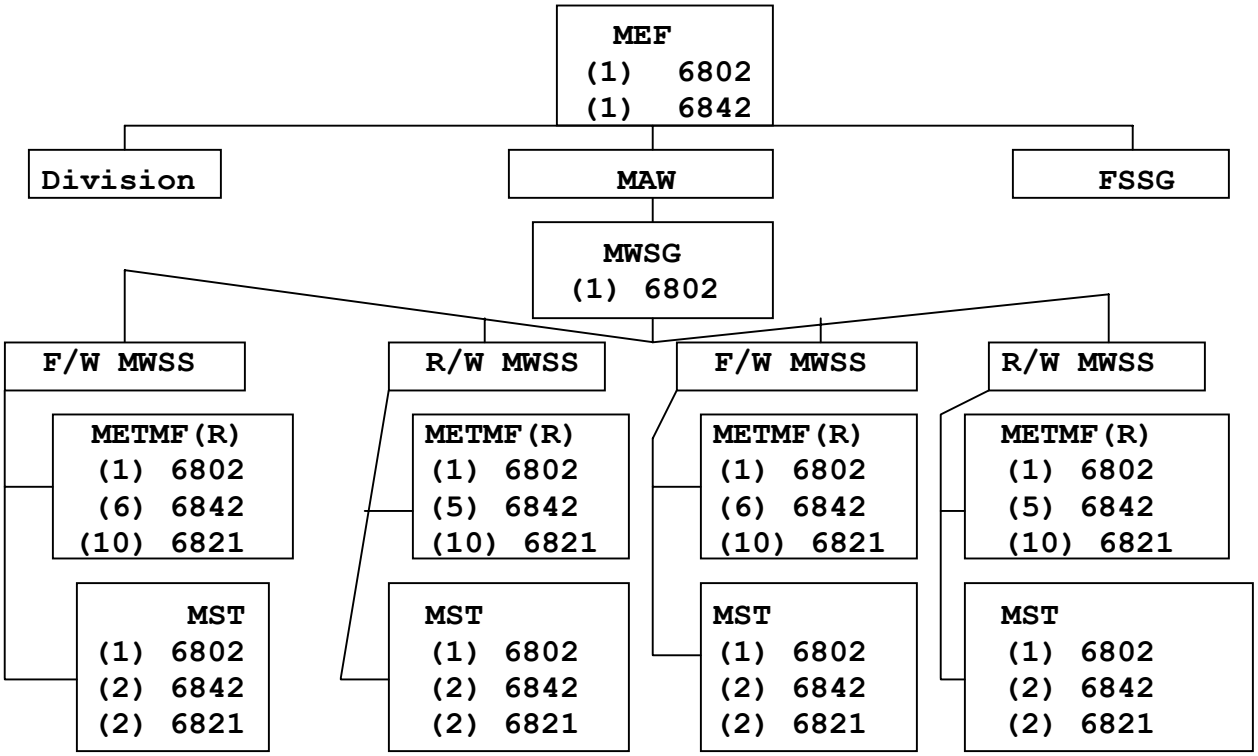

Figure 10-2. Current FMF METOC Organization

10.1.2.2 FMF METOC Command Relationships and Responsibilities.

• MEF Staff Weather Officer (SWO). Each MEF has established staff billets for 1 Weather Officer and 1 Weather Forecaster. These Marines serve in the G-2 section under the cognizance of the Intelligence Operations Officer and provide METOC support to the MEF Commanding General and his staff. As such, they serve as the Subject Matter Expert (SME) on all METOC related issues, ensuring that relevant, timely and accurate METOC

support is provided throughout the MAGTF. Additionally, the MEF SWO maintains liaison with other Service counter-parts and represents the Commanding General at Joint Service METOC meetings.

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• Marine Wing Support Group (MWSG) Weather Officer. The MWSG Weather Officer is the senior Weather Officer within the Marine Air Wing (MAW), responsible for coordinating all METOC personnel and assets to meet support requirements validated by higher HQ, to include METOC training within the MAW. Additionally, the MWSG Weather Officer serves as the Subject Matter Expert (SME) on all METOC related issues for the MAW.

• Marine Wing Support Squadron (MWSS) Weather Element. The MWSS Weather Element is the primary source for METOC support. Manning at the MWSS consists of 1 officer, 5 forecasters, 10 observers, and 3 meteorological equipment technicians. Odd numbered MWSSs are designated as fixed wing support squadrons and have an additional forecaster and technician assigned. While in-garrison, all weather personnel FAP to the co-located MCAS/MCAF weather office in order to augment the Air Station work force and to maintain technical proficiency. Each MWSS also has one MST within its structure. The MWSS Weather Element can provide:

- An in-theater METOC production and processing facility using the Meteorological Mobile Facility (Replacement) (MetMF(R)), TMQ-44A, as a central hub to maintain a
- common METOC database.
- A continuous surface weather observation program
- Doppler Radar observations/imagery
- DMSP and NOAA satellite imagery in Fine/Smooth resolution
- Two remote weather sensors for surface weather observations
- Upper atmospheric soundings
- Receive Fleet Multi-Channel Broadcasts
- Terminal Aerodrome Forecasts for airfield and local area (25 NM radius)
- Local area severe weather warnings/advisories
- Climatological, astronomical, and tidal data
- Sea and surf conditions, current and forecast
- Secure and Non-Secure Pilot to METRO Services (PMSV)
- Aviation weather briefs as required by OPNAVINST 3710.7
- Electro-optic TDAs for Mission Planning and weapons system optimization
- Electro-Magnetic effects (IREPS) for mission planning and

optimization of Electronic Warfare Support (ES), Electronic Attack (EA), and Electronic Protection (EP)
- Target area, enroute, mission, and staff weather briefings

• MEF Weather Support Team (MST). The MST is a task-organized METOC team developed to provide direct support to elements of the MAGTF other than the Aviation Combat Element (ACE). The MST is normally employed within a Command Element's

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Intelligence Section in order to integrate METOC impacts into the staff's deliberate and contingency planning as well as the execution phase of an operation. Manning consists of 1 weather officer, 2 forecasters, and 2 observers, although a full team is not always required to provide adequate METOC support. The number of personnel deployed is primarily based on the operational battle rhythm expected during the operation and anticipated METOC requirements. Although the MST is organic to the MWSS, the MST manning is additional structure separate from the manning required for the MetMF(R) and is requested via the MEF G-2/SWO.

- The MST has a very limited stand-alone capability and relies heavily on NIPRNET/SIPRNET connectivity in order to ingest required METOC products from the MetMF, regional centers, and HHQ METOC elements. MST organic equipment includes the Interim Mobile Oceanographic Support System (IMOSS), which can receive Weather Facsimile (WEFAX), APT Satellite, and HF Radio Broadcast. Each MST has the capability to provide:

> A continuous surface weather observation program
> 24 – 96 hour Forecasts
> Severe weather warnings/advisories
> Climatological, astronomical, and tidal data
> Sea and surf conditions, current and forecast
> Electro-optic TDAs for mission planning and weapons system optimization
> Electro-Magnetic effects (IREPS) for mission planning and optimization of Electronic Warfare Support (ES), Electronic Attack (EA), and Electronic Protection (EP)
> Target Board, impact, amphibious objective area (AOA), and staff weather briefings

10.2 USMC METOC Key Equipment and Software

USMC METOC has two primary pieces of equipment for meteorological communications, data processing, and sensing: the Meteorological Mobile Facility (MetMF) and the Interim Mobile Oceanographic Support System (IMOSS).

10.2.1 Meteorological Mobile Facility (MetMF).

Each MWSS is equipped with a METMF. These facilities are in the process of being replaced with the new MetMF(Replacement) (METMF(R)). Currently 6 of 10 active duty MWSSs have the new MetMF(R) with delivery scheduled to be complete by late FY-01.

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10.2.1.1 MetMF(R) Overview. The MetMF(R) is a transportable system designed to provide tactical METOC support to the MAGTF. It is a fully integrated system capable of automatic data acquisition from communication channels providing METOC data, meteorological satellite down links, and local and remote meteorological sensors. The MetMF(R) is capable of disseminating METOC data and products via communication links and an indigenous video briefing system. The MetMF(R) consists of ten subsystems: Processing Subsystem (PCS), Communications Subsystem (CMS), Meteorological Satellite Subsystem (MSS), Rawinsonde Subsystem (RWS), Local Sensor Subsystem (LSS), Remote Sensor Subsystem (RSS), Video Subsystem (VDS), Meteorological Radar Subsystem (MRS), Portable Meteorological Subsystem (PMS), and Shelter Subsystem (SSS).

10.2.1.2 MetMF(R) Subsystems.

• Processing Subsystem (PCS). The PCS is a modular, software-intensive system designed to process METOC data and produce METOC products. The PCS consists of a resident master database and receives raw and processed data from local and remote meteorological sensors, meteorological satellites and meteorological radar. Presently, the PCS is operating with the Tactical Environmental Support System/Next Century (TESS/NC) Transition and Global Command and Control System – Maritime (GCCSM). During FY00, the PCS will be replaced by the Navy Integrated Tactical Environmental Subsystem (NITES) version I, principal METOC analysis and fusion system, and NITES version II, GCCS-M, METOC input to mission planners. It will be Defense Information Infrastructure (DII)/Common Operating Environment (COE) compliant and compatible with evolving joint communication and METOC architectures.

• Communications Subsystem (CMS). The CMS enables the MetMF(R) to transmit and receive secure and non-secure METOC data from meteorological channels, worldwide meteorological broadcast frequencies, and satellite communications. The CMS will have interoperable connectivity between the various other subsystems of MetMF(R), the MAGTF C4I Local Area Network (LAN), and joint/government agencies and allied nations via the GCCS-M. Two-way communications is accomplished through existing Marine Corps communication infrastructure, normally the SIPRNET.

• Meteorological Satellite Subsystem (MSS). The MSS receives both high and low resolution meteorological imagery from polar orbiting satellites and low-resolution meteorological imagery from geostationary satellites.

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• Rawinsonde Subsystem (RWS). The RWS collects upper air soundings and will automatically be ingested by the PCS.

• Local Sensor Subsystem (LSS). The LSS is installed within close proximity of the MetMF(R) (within 150 feet) shelter and collect weather parameter measurements for automatic ingestion into the PCS. The LSS will be a “WeatherPak” sensor suite designed to measure and report: surface wind direction and speed, surface air and dew point temperature, liquid precipitation rate, cloud height, visibility, atmospheric pressure and altimeter setting.

• Remote Sensor Subsystem (RSS). The RSS consist of two sets of sensors capable of being installed at separate sites located up to 200 nautical miles from the MetMF(R). Each set of “WeatherPak” sensors measures and reports: surface wind direction and speed, surface air and dew point temperature, liquid precipitation rate, atmospheric pressure and altimeter setting. The RSS transmits its measurements to the MetMF(R) by use of Meteorburst (VHF) communications. During periods of low meteorite shower activity, an alternate means of communications may be required. The PMW-185 METOC office is presently working to resolve the issue.

• Video Subsystem (VDS). The VDS is capable of disseminating weather products, meteorological imagery, and alphanumerics to one monitor located within 2000 feet of the MetMF(R).

• Meteorological Radar System (MRS). The MRS (AN/TPS-76) provides real-time surveillance and advanced warning of

potentially hazardous atmospheric conditions in the vicinity of the MetMF(R). The Doppler weather radar will measure rainfall intensities and predict the likelihood of hazardous activity, such as conditions for hail, potential flooding, and analyze the behavior of winds inside convective storm activity. The radar has a max range of 200 nm with a severe weather range of 60 nm.

• Portable Meteorological Subsystem (PMS). The PMS will consist of two Navy Integrated Tactical Environmental Subsystem (NITES) version IV systems networked with the MetMF(R) PCS through the MAGTF C4I LAN and SIPRNET. METOC data and products received will be obtained from deployed MetMF(R)'s, Navy shipboard OA divisions, or directly from METOC regional and processing centers. NITES IV is currently under development and is expected to be ready for Fleet introduction during FY03. In the meantime, two Interim Mobile

Oceanography Support Systems (IMOSS) are provided as adequate substitutions for the PMS.

• Shelter Subsystem (SSS). The SSS consist of an Electromagnetic Interference (EMI) International Organization for Standards (ISO) shelter, a Joining Corridor (8ft X 8ft X 10ft) to provide the forecaster with a work/briefing area, two B0013 Environmental Control Units, a power distribution system, and a grounding system.

10.2.1.3 MetMF(R) Communications Requirements.

10.2.1.3.1 Frequency Requirements.

Approval must be granted for primary and secondary frequencies in the following bands:

Band	Equipment	Description	Range	Transmitting Power
HF	RT 7000	Transceiver	1.6-29.999 MHz	125 watts
UHF	AN/GRC-171B(V)4	METRO	200-399.999 MHz 50 watts	50 watts
VHF	MCC-520B	Meteor Burst	41.7 MHz (fixed)	250 watts
	MCC-545A	Master Station Meteor Burst Remote Terminals	41.7 MHz (fixed)	100 watts
	AN/VRC-90A	SINCGARS	30-87.975MHz	50 watts
SHF	AN/TPS-76	SWR	5.3-5.7 GHz	250 Kwatts

Table 10-1. MetMF(R) Frequency Requirements

10.2.1.3.2 COMSEC Equipment.

KWR-46	UHF SATCOM	Fleet Multi-channel Broadcast (FMCB)
KY-58	UHF LOS	Secure Pilot to Forecaster METRO
KG-44	DMSP	Meteorological Satellite Imagery
USC-43(V)1	ANDVT	Secure Voice
KG-84A	SIRPRNET MAGTFC4I	Secure LAN

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KG-84C	HF data	Air Force High Frequency Regional Broadcast
SECTEL 1100	AT&T STU III w/Key	Secure voice/data, landline

10.2.1.4 METMF Siting Considerations.

• Sensor Placement - location must be free of obstructions, which might block or alter wind flow

• High Energy Emissions - due to high-energy radio frequency emissions from the complex, ordnance, fuel, and personnel areas must be located a minimum of 100 yards away
• Radio Frequency Interference - other high-energy radiation sources must be placed at least 1/2 mile away from the complex
• Signal Blocking - a clear line of sight must be maintained for the operation of the weather radar and satellite receivers
• Security - communications security (COMSEC) equipment and classified material storage require tactical security measures to provide protection for Top Secret materials
• Power - requires 120/208 VAC, 3 phase, 60 HZ Class L Power from either a commercial source or dedicated generators(s) (100amp)

10.2.2 Interim Mobile Oceanographic Support System (IMOSS).

Each MWSS and MST is equipped with an IMOSS to provide forward support. The IMOSS 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.

10.2.2.1 System Configuration.

The IMOSS consists of three sub-systems, the main sub-system, the communication subsystem and the satellite sub-system. Each subsystem can be a stand-alone system depending upon mission requirements. Network Interface Cards (NIC) included in each sub-system allows them to be networked together for easy file transfer and data communications. The ability to network also allows the IMOSS user to tie into Local Area Networks (LANs) or Wide Area Networks (WANs) to obtain products and data from remote sources.

10.2.2.2 Main Module.

The main module is designed to be used primarily for briefing support and the production of products from the GFMPL-NT suite of software.

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• Hardware. The Main Module consists primarily of a laptop computer, classified and unclassified hard drives, printer, and network interface devices.

- Laptop Computers. The main sub-system can be one of several types of laptop computers that have been fielded. Due to rapidly changing technology and the procurement cycle for the IMOSS, current laptop types and configurations may vary.

• Software. Due to rapidly changing technology and the procurement cycle for the IMOSS, liaison with the Marine METOC officer will be required to learn what products are currently available.

10.2.2.3 Communications Module.

The Communication Module receives alphanumeric weather data and facsimile broadcast via the HF receiver. The receiver of the module has the capability to connect to the host ship's HF antenna system or be deployed independently with its own antenna. The communication sub-system consists of a laptop computer (any of several that have been fielded), an HF radio, HF receiving antenna, interface devices, Weather Fax for Windows software, and associated cabling.

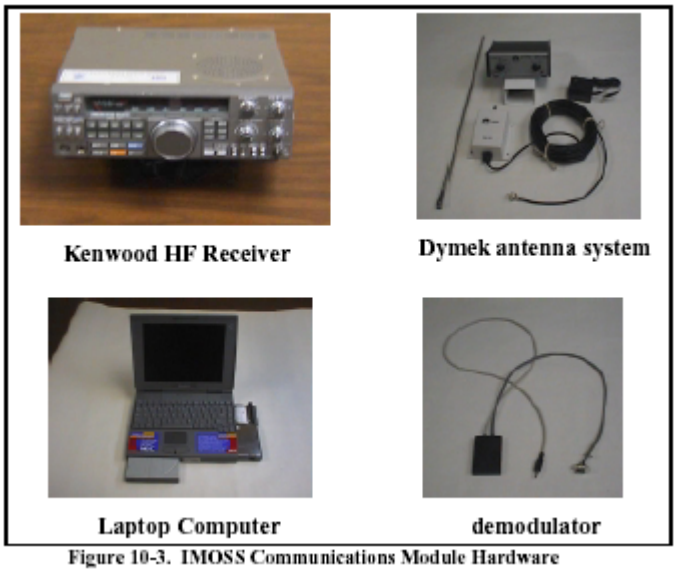

Figure 10-3. IMOSS Communications Module Hardware

• Communications equipment

- HF Receivers

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> Kenwood R-5000 HF Receiver

. HF all band short-wave multimode receiver
. Double conversion superheterodyne receiver

. Frequency range of 100KHz to 30MHz
. Receives all AM (Amplitude Modulation), USB (Upper Sideband), LSB (Lower Sideband), FM (Frequency Modulation), CW (Continuous Wave), and RTTY (Radio Teletype)

> Drake R8A/B communication receiver
. Frequency ranges 100 - 30,000 kHz
. Modes AM, LSB, USB, CW, RTTY, FM
. Microprocessor controlled, synthesized, all mode, world wide receiver
. RS 232 compatible interface
. Programmable memory

• Interface Devices

- DYMEK DA100D Tuner/Power Supply receiver antenna
> Receives frequencies between 50KHz and 30MHz
> Four foot fiberglass whip antenna
> HF pre-amp doubles as the whip antenna mount
> Tuner/power supply supplies 12VDC to the pre-amp and acts as a pre-selector, amplifying only the frequencies desired

- DYMEK DA 100E all wave receiving antenna
> General coverage antenna
> Performance from 0.5 to 30 MHz
> Outdoor pre-amp with 4’8” telescopic element
> 50 foot of RG-58/U coax lead-in and control box
> Output impedance is selectable at 50, 100 or 500 ohms

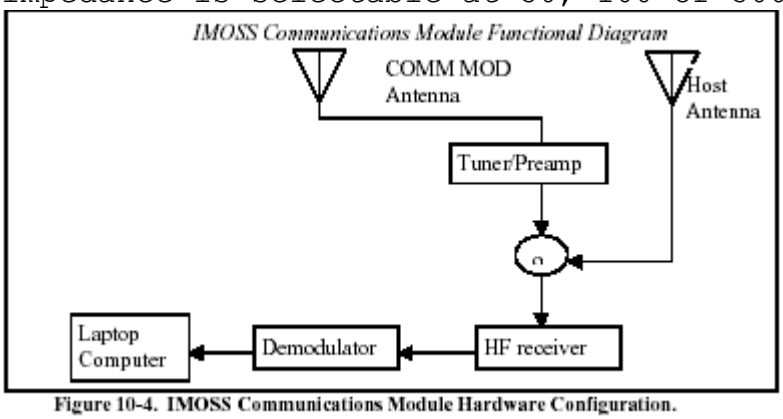

Figure 10-4. IMOSS Communications Module Hardware Configuration.

• Software. IMOSS includes the Weather Facsimile System for Windows (version 3) with Demodulator

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- Works with Windows NT 4.0

- Multitasking windows 3.1 and Windows 95 multiple document interface program
- Operates while other programs are running
- Unattended operations either by timer or by schedule
- Supports Weather Fax 60, 120, 240-LPM IOC 288 and 576
- Supports Fax tones 1500-2300 Hz and 600-900 Hz
- Supports TELEX, Baud 45, 50, 75 and 100 Baud
- Stores pictures in windows standard DIB format with 256 gray shades
- Printing and print preview
- Written in C++
- All processing is done off line
- Software configurable to run on COM1 through COM4

10.2.2.4 Satellite Module.

The IMOSS SAT MOD receives, stores, and displays data from meteorological satellites. Depending on the antenna selected, Automatic Picture Transmissions (APT) data from polar orbiters, as well as WEFAX data from geostationary satellites, can be received and managed by WEATHERTRAC software. The SAT MOD can be linked to the COM MOD and the MAIN MOD to provide data transfer and briefing support. It may also be independently deployed. The network interface card (NIC) and modem, which are included in the laptop computer, allow for Local Area Network (LAN) and Wide Area Network (WAN) connectivity.

• Equipment Description. The SAT MOD contains (4) major components:

- Laptop computer (may be one of several different types that have been fielded)

- Worldport satellite receiver/demodulator
  > Measures 9.5” deep x 7.5” wide x 1.5 “ high and weighs approximately 1 lb. Metal encased VHF receiver and demodulator, capable of receiving weather satellite imagery signals from APT, WEFAX, and wideband WEFAX sources. It can also demodulate, but cannot receive, HF-FM/FSK from external SSB communications receivers

- APT receiving antennas (V20 or Quadrifilar)
  > High-performance volute APT WeatherTrac model V20A, with integral preamp--totally enclosed in a 6” x 44” PVC pipe shell with no exposed radials; includes an integral 20dB nominal low noise preamp. This antenna has an Ntype

connector, and the internal preamp can be bypassed with a BNC barrel adapter.

> ¼ wave Quadrifilar antenna with external pre-amp--constructed of stainless steel and designed to withstand the hardships of the marine environment.

- WEFAX receiving antenna. A six foot diameter, mesh parabolic antenna (see Figure 10-5). The antenna mounts to a "Patio Mount" and must be oriented toward a geostationary satellite to receive WEFAX. The Integrated 1691 MHz Linear Feed/Downconverter, manufactured by Quorum Communications, receives the signal at 1691 MHz and converts it to 137.5 MHz.

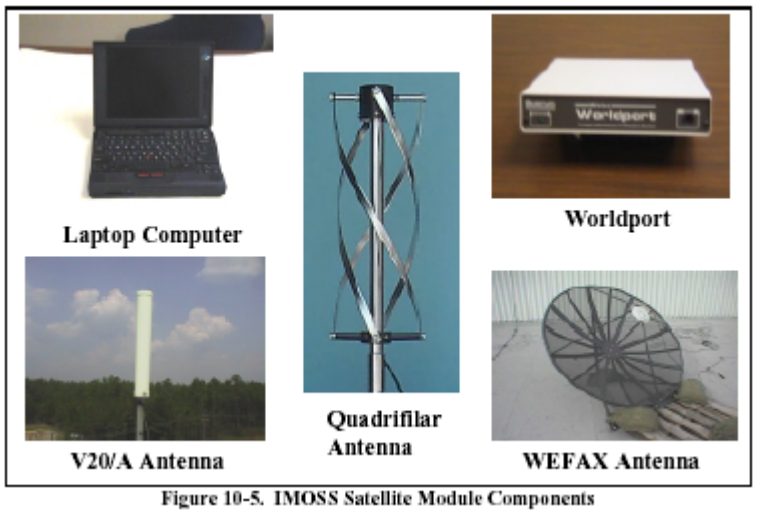

Figure 10-5. IMOSS Satellite Module Components

• Software. Three applications are necessary to capture, ingest and display the satellite data. These are WtCap, WtView, and WtAnim. The GPS0183 Utility is available but is not necessary to receive data. Each application's function is apparent in its name. For example, the primary function of WtCap is to configure the SAT MOD to capture the data. WtView allows image display and analysis. WtAnim is used to loop WEFAX images. The GPS0183 Utility allows IMOSS to receive time and location data from a GPS instrument (not currently an IMOSS allowance item).

10.2.3 Software.

METOC software used by the USMC is comparable, and in most instances identical to, that used by the USN.

10.3 USMC METOC Data

10.3.1 USMC METOC Data Sources.

Appendix C

The Marine Wing Support Squadron (MWSS) is the primary source for weather observations from the Marine Corps participants in joint operations. Aviation operations conducted at expeditionary airfields will be supported by MWSSs, which are equipped with Meteorological Mobile Facilities (MetMFs). These facilities can operate semiautonomously or participate in a weather network. Figure 10-6 illustrates common data sources available to the MWSS.

Basic observational capabilities of the MWSS include temperature, dewpoint, wind speed/direction, weather phenomena, pressure, altimeter settings, cloud height/amounts/ types, and upper air data.

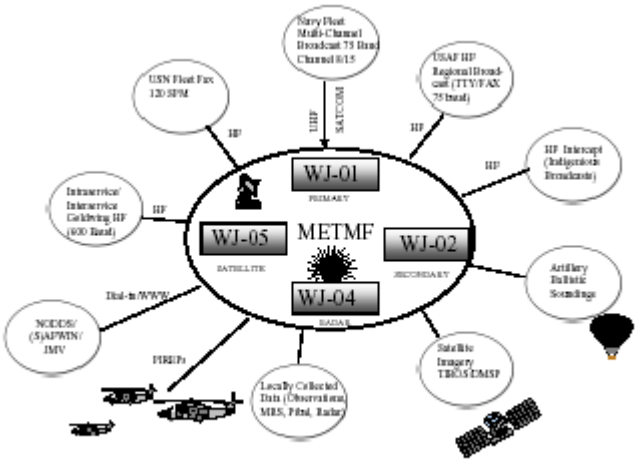

Figure 10-6. Marine Corps Data Sources

10.3.2 USMC METOC Data Products

10.3.2.1 USMC METOC Centralized Products.

- The US Marines have no centralized METOC facility; instead, METOC organizations use theater and centralized US Navy and US Air Force support.

10.3.2.2 USMC METOC Theater Products.

The following products are produced at the discretion of the senior weather officer when not provided by higher headquarters or to provide greater detail:

• MAGTF WEAX. Includes the current METOC situation, 24 hour forecast, and 48-hour outlook. Astronomical data and radiological fallout data is appended as required

Appendix C

• Tactical Atmospheric Summary (TAS). Includes an atmospheric refractive summary, tactical assessment, electromagnetic sensor performance predictions, infrared sensor detection range predictions, and communication range predictions

• Amphibious Objective Area (AOA) forecast. Includes meteorological situation, 24-hour forecast for objective area, surf forecast for target beaches, tactical assessment, abbreviated atmospheric summary, and astronomical data

• Strike forecast. Provides a coordinated forecast whenever multiple strike (OAAW/SEAD/DAS) platforms are operating as an integrated force under one tactical commander.

• Assault forecast. Provides a coordinated forecast whenever multiple assault support platforms (VMGR/HMH/HMM/HMLA) are operating as an integrated force under one commander.

10.4 Key USMC METOC Organizations

• III MEF METOC Officer
- CWO3 J.D. Lewis, DSN 267-7210 / email LewisJD@3maw.usmc.mil

APPENDIX D

SAMPLE METOC FORMS

Appendix D - Joint Operational Area Forecast (JOAF) Examples

D.1 JOAF Format

Consider use of existing bulletins as the JOAF. If a new product is required, a suggested format could include:

?Remarks
?Prognostic Discussion
?Forecast out 24 hours (for Area 1, Area 2, *etc*. Include clouds, winds, temperature, weather, visibility, etc.)
?Forecast out 48 hours (for Area 1, Area 2, *etc*.)
?Impacts on warfare areas (air, ground, amphibious, etc.)
?Astronomical data
?Tides/sea data
?TAFs available:
?Next JOAF / coordination

D.2 JOAF Examples

D.2.1 JOAF Example 1.

EXER/JTFEX 95-1//
SUBJ/JOINT OPAREA FORECAST//
POC/FURZE/CDR/J335/(804) 322-5990 EXT 7744/DSN 836-5990 EXT 7744//
RMKS/1. INTENT OF THIS MESSAGE IS ALIGNMENT OF WEATHER FORECASTS THROUGHOUT THE JOINT TASK FORCE. DAILY UPDATES TO THIS OPAREA FORECAST WILL BE ISSUED PRIOR TO 1700Z. DIRECT QUESTIONS TO CJTF 950 METOC.
2. PROGNOSTIC DISCUSSION: HIGH PRESSURE OVER KARTUNA, KORONA AND TELARI MOVES NORTH-NORTHEAST INTO THE LABRADOR SEA. AN INTENSE ARCTIC LOW OVER THE WESTERN GREAT LAKES MOVES EASTWARD. ASSOCIATED COLD FRONT EXTENDING SOUTH THROUGH TELARI MOVES RAPIDLY OFF THE EAST COAST BY SATURDAY EVENING. A NEW LOW DEVELOPS OVER SOUTHEAST KORONA SATURDAY MORNING. MERGES WITH THE FRONTAL SYSTEM (FORE MENTIONED) AND MOVES RAPIDLY NORTH-NORTHEAST ALONG FRONT. 1038MB HIGH OVER MIDWEST MOVES EASTWARD TO WESTERN TELARI SUNDAY, PRODUCING STRONG NORTHWEST FLOW OVER THE OPAREA. HIGH REMAINS IN PLACE THROUGH WEDNESDAY.
3. FORECAST FOR COASTAL REGION AND 150 NAUTICAL MILES OFFSHORE FROM

KORONA NAVAL BASE 1 (NORFOLK, VA) TO SABANI AIR BASE 1:
A. SATURDAY- CLOUDY WITH MIXED AND FROZEN PRECIPITATION IN NORTHERN TELARI, NORTHEAST KORONA AND KARTUNA. HEAVY RAIN/ EMBEDDED SHOWERS THROUGHOUT REMAINDER OF THE OPAREA. MODERATE SOUTHEAST FLOW AHEAD OF FRONT WILL VEER AND BECOME STRONG WEST-NORTHWEST AFTER FRONTAL PASSAGE. SEA STATE 5 BECOMING 6, EXCEPT COASTAL, SEA STATE 2.
B. SUNDAY- CLEARING RAPIDLY OVER ENTIRE OPAREA AS HIGH PRESSURE RIDGES SOUTHEAST. STRONG NORTHWEST WINDS OVER NORTHERN TELARI AND ADJACENT WATERS; MODERATE NORTHERLY FLOW OVER SOUTHERN TELARI, KORONA AND KARTUNA; STRONG NORTHERLY FLOW OVER GULF OF SABANI. TEMPERATURES 18-22F,

WIND CHILLS -11F INLAND, 28-32F COASTAL. SEA STATE 5 BECOMING 6 OVER THE GULF STREAM, EXCEPT COASTAL.
C. MONDAY- CLEAR TO PARTLY CLOUDY. WINDS LIGHT AND VARIABLE OVER LAND, MODERATE NORTHERLY FLOW OFFSHORE. SEA STATE 5, 4 IN SOUTHERN GULF OF SABANI.
D. TUESDAY- CLEAR TO PARTLY CLOUDY WITH COASTAL MORNING FOG OVER SOUTHERN KORONA AND SOUTHEASTERN TELARI. WINDS LIGHT AND VARIABLE OVER LAND REGIONS OF OPAREA. MODERATE NORTHERLY FLOW OVER GULF OF SABANI. SEA STATE 5 DIMINISHING TO 4 NOON.
E. WEDNESDAY- CLEAR TO PARTLY CLOUDY WITH COASTAL MORNING FOG. WINDS LIGHT AND VARIABLE OVER ENTIRE OPAREA. SEA STATE 4 DIMINISHING TO 2.
4. WEATHER IMPACTS ON WARFARE THRU FIVE DAYS :

	SAT	SUN	MON	TUE	WED
AIROPS	RED	GREEN	GREEN	GREEN	GREEN
AMPHIB OPS	RED	YELLOW	GREEN	GREEN	GREEN
AIR/LAND OPS	RED	YELLOW	GREEN	GREEN	GREEN
MARITIME	RED	RED	YELLOW	GREEN	GREEN//

D.2.2 JOAF Example 2.

/OPER/UPHOLD DEMOCRACY/
MSGID/GENADMIN/NAVLANTMETOCDET GTMO//
SUBJ/JOINT OPAREA FORECAST/ JOAF (PART TWO)//
RMKS/1. SYNOPTIC SITUATION AT 050000Z: AREA OF LOW PRESSURE NR 29N 76W IS MVG EAST AT 08 KTS. ASSOCIATED TROF XTNDS SWD FROM LOW THROUGH THE FL STRAITS INTO THE EASTERN GULF OF MEXICO AND IS SLOWLY MVG SOUTH, AND WILL INFLUENCE THE HAITI AND GTMO OPAREAS ON THURSDAY. EASTERLY TRADES PREVAIL OVER THE CARIBBEAN WITH RIDGING FROM THE MIDDLE ATLANTIC HIGH INFLUENCING THE NORTH-CENTRAL AND NORTHEASTERN CARIBBEAN. WAVE PREVIOUSLY ALONG 70W IS NOW NR 75W SOUTH OF 17N MVG W AT 12 KTS AND WILL NOT AFFECT THE HAITI OR GTMO OPAREAS. ANOTHER WAVE ALONG 64W MVG W AT 10-15 KTS WILL WEAKEN AS IT MOVES UNDER AN AREA OF UPPER LEVEL CONVERGENCE AND WILL NOT AFFECT THE OPAREAS. ELSEWHERE, WAVES ARE LOCATED ALG 53W, AND 35W MVG W AT 10-15KTS.//
2. 24 HR FCST COMMENCING AT 050600Z OCT 94 FOR THE FOLLOWING AREAS:
3. CITY OF PORT-AU-PRINCE:
A. SKY/WX: PTLY CLDY OCNL MSTLY CLDY WITH ISOLD RASH/TSTMS THRU EARLY AFTN AND EVENING HOURS.
B. VIS (NM): UNRSTD, 1-3 IN PRECIP
C. SFC WINDS (KTS): ESE 4-8, INCRG 6-12 BY MID MRNG, THEN BCMG WESTERLY 10-15 BY MID AFTN (SEABREEZE). ESE 4-8 AFT SUNSET.
D. MAX/MIN TEMP (F/C): 95/35, 78/26.
E. ASTRONOMICAL DATA (ALL TIMES ZULU) COMPUTED FOR 18.5N 72.3W
SUNRISE: 05/1041 SUNSET: 05/2235

MORNING NAUTICAL TWILIGHT: 05/0954
EVENING NAUTICAL TWILIGHT: 05/2322
MOONRISE: 05/1100 MOONSET: 05/2300
PCT MOON ILLUM: 00
SUNRISE: 06/1041 SUNSET: 06/2234
MORNING NAUTICAL TWILIGHT: 06/0954
EVENING NAUTICAL TWILIGHT: 06/2321
MOONRISE: 06/1204 MOONSET: 06/2351
PCT MOON ILLUM: 04
D-JOAF
D-3
F. PORT-AU-PRINCE TIDES (FT) VALID 05 OCT - 08 OCT (ALL TIMES ZULU)
HIGH: TIME HEIGHT LOW: TIME HEIGHT
05/1318 1.91 05/0636 .22
06/0112 1.44 05/1942 .48
06/1412 2.02 06/0718 .12
07/0154 1.39 06/2036 .52
08/0242 1.34 07/1506 2.08
4. 24 HR FCST COMMENCING 050600Z FOR FOLLOWING AREAS:
THE GULF OF GONAIVES TO INCLUDE SEAWARD OF PORT-AU-PRINCE (EAST OF A LINE FROM 19.6N 73.4W TO 18.4N 74.5W).
NORTH OF HAITI AND NORTHERN WINDWARD PASSAGE (NORTH COAST OF CUBA AT 75.4W TO 21.5N 75.4W TO 21.5N 70.6W TO NORTH COAST OF HAITI AT 70.6W COASTAL TO 19.6N 73.4W TO 20.2N 74.2W COASTAL TO COAST OF CUBA AT 75.4W) SOUTH OF HAITI (18.4N 74.5W TO 18.4N 75.4W TO 17.3N 75.4W to 17.3N 70.6W TO SOUTH COAST OF DOMINICAN REPUBLIC AT 70.6W COASTAL TO 18.4N 74.5W)
A. SKY/WX: PTLY CLDY OCNL MSTLY CLDY WITH ISOLD RASH/TSTMS OVER LAND AREAS MID AFTN/'EARLY EVENING, AND OVER WATER AREAS MIDNIGHT TO SUNRISE.
B. VIS (NM): UNRESTRICTED, 1-3 IN PRECIP.
C. SFC WINDS (KTS): ESE 10-15 KT, XCPT SSW 10-15 KTS NORTH OF HAITI AND THE WINDWARD PASSAGE DUE TO RIDGING FROM THE MIDDLE ATLANTIC HIGH.
D. SEAS (FT): ESE 2-4, XCPT EAST 1-2 IN EASTERN GULF OF GONAIVES. SSW 2-4 NORTH OF HAITI AND WINDWARD PASSAGE.
5. 24 TO 48 HR OUTLOOK: DEVELOPING WAVE ALONG SURFACE TROF NR 25N 74W WILL CREATE AN AREA OF LOW LEVEL CONVERGENCE OVER HAITI AND EASTERN CUBA ENHANCING CONVECTIVE ACTIVITY THURSDAY. EXPECT MSTLY CLDY SKIES WITH SCATTERED RASH/ISOLD TSTMS. WINDS SSW 10-15 KTS, SEAS SSW 3-5 FT.
6. 48 TO 72 HR OUTLOOK: NORMAL DIURNAL CONDITIONS RETURN AS WAVE TRACKS NE AND WEAKENS. PTLY CLDY TO MSTLY CLDY SKIES WITH ISOLD RASH/TSTMS. WINDS E 10-15 KTS, SEAS E 2-4 FT.
7. 3 TO 5 DAY OUTLOOK: XPCT CONTD NORMAL DIURNAL CONDITIONS THROUGH THE PERIOD. WAVE NEAR 53W WILL APPROACH THE HAITI OPAREA BY SUNDAY WITH MOST OF THE CONVECTIVE ACTIVITY REMAINING SOUTH OF 18N.
8. REQ SHIPS IN OPAREA AND WATERS SURROUNDING HISPANIOLA PROVIDE 6 HRLY/3HRLY WX OBS AND UA SOUNDINGS TO:
NAVLANTMETOC DET GUANTANAMO BAY CU//00//JMFU//
9. 24 HR TAFS (02Z, 08Z, 14Z, 20Z) AND HOURLY OBS FOR PORT AU PRINCE AND CAP HATIEN ARE AVAILABLE UNDER HEADERS KQUU AND KQUW, RESPECTIVELY.
10. NEXT JOAF 060202Z.
11. MINIMIZE CONSIDERED. RELEASED BY LCDR HELM//
SUBJ/JOINT OPAREA FORECAST/JOAF (PART THREE)//
RMKS/24 HR TAFS FOR THE FOLLOWING LOCATIONS:
1. PORT AU PRINCE:
TAF 1818 27005KT 9999 SCT010 SCT030 BKN100 QNH 2980INS CIG100 BCMG 2223 09005KT 9999 SCT010 BKN030 BKN100 QNH2984INS CIG030 VCTSRA TILL 03
2. CAMP D APPLICATION:

TAF 1818 2800515KT 9999 SCT015 SCT030 BKN080 QNH2980INS CIG100 VCSHRA
TEMPO 2203 3200 TSRA BKN020 OVC030 CIG020 BCMG 0506 12009KT 9999 SCT030 SCT080 BKN250 QNH2983INS CIG250
3. CAP HAITIEN:
TAF 1818 32007KT 9999 SCT030 BKN080 QNH2980INS CIG080 VCSHRA WND VRBO4 AFT 05
TEMPO 2002 VRB10G15KT 4800 TSRA SCT020 BKN030CB OVC055 CIG030 BCMG 1415 03009KT 9999 SCT030 SCT250 QNH2984INS
4. GONAIVES:
TAF 1818 27005KT 9999 BKN030 BKN100 BKN250 QNH2985INS CIG030 VCSHRA
TEMPO 2202 VRB10G15KT 4800 -TSRA BKN020CB BKN030 OVC080 CIG020 BCMG 0405 12003KT 9999 SCT030 SCT080 BKN250 QNH2985INS
D-JOAF
D-4
5. JACMEL:
TAF 1818 16012G15KT BKN030 BKN080 BKN250 QNH2985INS CIG030 VCSHRA
TEMPO 2003 VRB15G20KT 3200 TSRA BKN015CB BKN030 OVC080 CIG015 BCMG 0506 18005KT 9999 SCT030 BKN080 BKN250 QNH2983INS CIG080
6. TAFS WILL BE ISSUED AT 00Z, 06Z, 12Z, 18Z
7. MINIMIZE CONSIDERED. RELEASED BY CAPT REINS//
BT

D.2.3 JOAF Example 3.

SUBJ/JOINT AREA FCST (JOAF)//
RMKS/ THE MISSION PLANNING FORECAST WILL BE METWATCHED AND AMENDED AS REQUIRED//
1. FLIGHT MINIMUM DEFINITIONS:
VFR: GTE CIG040, VIS 8000
MVFR: CIG039-020, VIS 7000-6000
IFR: LT CIG020, VIS 6000
2. JOAF NUMBER 347. VALID 100900Z TO 110900Z DEC 95.
A. SYNOPTIC SITUATION: HI PRES CONTS TO RDG SOUTHEAST ACRS REGION PRDCG XTNSV LO CLDS AND HVY FOG.
B. MARITIME ADRIATIC FORECAST
WEATHER: MSTLY CLDY OCNLY OVC
WIND (KTS): NORTH: NORTHEAST 10-15 CNTRL/SOUTH: EASTLY 6-12
TURBC: NONE
ICING: NONE
MAX/MIN TEMP (F/C): 50/10 46/08
MIN ALTSTG: 30.49
SEAS (FT): NORTH: NORTHLY 1-3 CNTRL/SOUTH: NORTHEAST 1-2
SEA SURFACE TEMP (C): NORTH: 15 CNTRL: 15-16 SOUTH: 16
DITCH HEADING (MAGNETIC): NORTH: 330 CNTRL/SOUTH: 110
C. COASTAL REGION UP TO DINARIC ALPS
AREA FORECAST: 2000 BR SCTVBKN050/010 BKNOVC020/040 TEMPO 0921 0800 FG OVC006 BECMG 2123 0800 F BKNOVC005/010 TEMPO 2109 2000 BR SCTVBKN 010/020
TURBC: NONE
ICING: NONE
MAX/MIN TEMP (F/C): 46/08 43/06
MIN ALTSTG: 30.47
D. CENTRAL MOUNTAIN REGION AROUND SARAJEVO AND TUZLA
AREA FORECAST: 0400 FG BKNVOVC005/008 BKNOVC 015/030 TEMPO 1021 2000 BR SCTVBKN010/030
TURBC: NONE
ICING: NONE
MAX/MIN TEMP (F/C): 36/02 32/00

MIN ALTSTG: 30.39
E. ZAGREB AND NORTHERN REGION
AREA FORECAST: 0400 FG BKNVOVC010/030 TEMPO 1120 2000 BR SCTVBKN010/030
TURBC: NONE
ICING: NONE
MAX/MIN (F/C): 34/02 30/M01
MIN ALTSTG; 30.38
F. 48 HOUR OUTLOOK VALID 110900Z DEC 95: HI PRES CONTS TO RDG SOUTHEAST DOMINATG REGION PRDCG 15-20KT BORA WINDS ACRS ENTIRE EASTRN SHORE EARLY IN PRD. FOG AND XTNSV LO CLDS LIFT OVR WATER WHILE LO CLDS AND HVY FOG RMN OVR MTN AREAS.
D-JOAF
D-5
G. 72 HOUR OUTLOOK VALID 120900Z DEC 95: HI PRES PRESISTS THRU PRD PRDCG SLIGHTLY INCRG BORA WNDS. HVT FOG RMNS OVR MTN REGIONS.
H. FOR ADDITIONAL INFORMATION CONTACT NAVEURMETOCCEN ROTA SP BY MSG OR DSN 727-2410/3985.
FORECASTER: SMITH//

I MARINE EXPEDITIONARY FORCE
CAMP PENDLETON BLUELAND
012200T MAR 98
Tab A (WEAX) to Appendix 2 (MAGTF Standard Tactical METOC Support Plan) to Annex H (METOC Services) to I MEF Operation Order 2-98 (Operation Backup) (U)
I MEF WEAX (U)
(PASS TO (CE/ACE/GCE/CSSE))
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/I MEF 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, areas, or established METOC zones. When in doubt, use latitude/longitude.)
2. ( ) 24-HOUR FORECAST COMMENCING Z (ALONG TRACK FROM N(S)/ E(W) TO N(S)/ E(W)) OR VICINITY OF N(S)/ E(W) (Note: Area of operations should be omitted if the Marine Forces commander prefers an unclassified forecast.
a. Sky/Weather (Plain-Language Format)
b. Visibility (NM)
c. Surface Winds (kt)
d. Maximum/Minimum Temperatures (°F/°C)
e. Relative Humidity (%)
f. Absolute Humidity (g/m³)
g. WBGTI/Flag Condition
h. Aviation Parameters
(1) Cloud/Ceilings (ft) (Note: TAF format is recommended.)
(2) Winds/Temperatures Aloft (Flight Level/Direction/Speed (kt)/Temperatures (°C))
(3) Turbulence (Note: Include discussion of all known CAT.)
(4) Minimum Freezing Level (ft)
(5) Icing
(6) Contrails (ft)
MAGTF Meteorological and Oceanographic Support G-13
(7) Minimum Altimeter Setting (inches of Mercury)
(8) Maximum PA/DA
3. ( ) OUTLOOK TO 48 HOURS
4. ( ) ASTRONOMICAL DATA (UTC OR LOCAL)
a. Sunrise/Sunset/Sunrise

b. BMNT/BMCT/EECT/EENT
c. Moonrise/Moonset/Illumination (%)
5. ( ) 24-HOUR RADIOLOGICAL FALLOUT FORECAST FOR (AIR BURST/SURFACE BURST)
Weapon Yield (Kilotons)
a. Effective Downwind Direction (True (T))/Speed (kt) __ /__ __/__ __/__
b. Sector Angle/Distance to Zone 1 (NM) __/__ __/__ __/__
(Note: Radiological fallout forecast should be included for actual/exercise defense readiness condition (DEFCON) 3 or MOPP level 2; otherwise at senior forecaster's discretion.)
6. ( ) RELEASED BY (Note: Include when MINIMIZE imposed.)//
DECL/ // (As required.)

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I MARINE EXPEDITIONARY FORCE
CAMP PENDLETON BLUELAND
012200T MAR 98

Enclosure 1 (METOC Zones) to Tab A (WEAX) to Appendix 2 (MAGTF Standard Tactical METOC Support Plan) to Annex H (METOC Services) to I MEF Operation Order 2-98 (Operation Backup) (U)

METOC Zones (U)

Figure G-3. METOC Zones.

MAGTF Meteorological and Oceanographic Support G-15

I MARINE EXPEDITIONARY FORCE
CAMP PENDLETON BLUELAND
012200T MAR 98

Tab B (Tactical Atmospheric Summary) to Appendix 2 (MAGTF Standard Tactical METOC Support Plan) to Annex H (METOC Services) to I MEF Operation Order 2-98 (Operation Backup) (U)

Tactical Atmospheric Summary (U)
(PASS TO (MAG/TACC/DASC/MATC/TAOC/SAAWC))
MSGID/GENADMIN/UNIT/SERIAL/MON/YR//
SUBJ/TACTICAL ATMOSPHERIC SUMMARY//
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 that are significantly degraded/enhanced. Focus on tactical guidance that will enable the tactical air coordinator, sector antiair warfare coordinator, 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) Square Meter Targets at Various Altitudes, Based on 90% Probability of Detection
Altitude (100 ft^2) (005) (010) (050) (100) (200) (300)
Radar
AN/TPS-59 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/TPS-63 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/TPS-73 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/MPQ-50 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/MPQ-62 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/UPS-3 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/MPQ-53 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/APS-138 __/__ __/__ __/__ __/__ __/__ __/__ __/__
AN/APY-1/2 __/__ __/__ __/__ __/__ __/__ __/__ __/__

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(Note: Radar cross sections should be tailored to the expected threat. Naval Oceanography Systems Command Technical Document (NOSC TD) 1195, *Selected Electromagnetic System Parameters for Use in the Tactical Environmental Support System*/Air Force Tactical Training Publication (AFTTP) 3-1, *Threat Manual*, provide representative values of typical U.S./threat platforms. Include all air-search radars organic to or in support of the MAGTF.

b. Electronic Support Measure (ESM) Intercept Ranges (NM) for Various Emitters

ESM Receiver

Emitter (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. ES Counterdetection Ranges (NM) for Various Threat ES Receivers:

U.S. Emitter ES Receiver

(Surface) (Airborne)

_____ _____ _____

_____ _____ _____

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

4. ( ) FLIR DETECTION RANGE PREDICTIONS WIDE FOCUS OF VISION (WFOV)/NARROW FOCUS OF VISION (NFOV) (NM) FOR TARGET AT VARIOUS ALTITUDES, BASED ON 50% PROBABILITY OF DETECTION, VISIBILITY NM, WIND SPEED kt, ABSOLUTE HUMIDITY g/m³

Altitude (100 ft2) (005) (010) (050) (100) (200) (300)

Sensor

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/

(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

MAGTF Meteorological and Oceanographic Support G-17

a. Ultrahigh Frequency Communication Range (Normal/Extended/Greatly Extended)

b. High Frequency Radio Propagation Condition/Forecast

(1) High Frequency Propagation Condition/Forecast

(2) 10.7-cm Flux

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

Height (ft) M-Unit Type (Subrefractive/Normal/Superrefractive/Trapping)

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

(Note: Include enough significant levels to enable MEF weather support teams to generate representative coverage diagrams using IREPS.)

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

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

DECL/ //

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I MARINE EXPEDITIONARY FORCE

CAMP PENDLETON BLUELAND

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Tab C (Strike Forecast) to Appendix 2 (MAGTF Standard Tactical METOC Support Plan) to Annex H (METOC Services) to I MEF Operation Order 2-98 (Operation Backup) (U)

Strike Forecast (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. En Route Weather to to
(1) Sky/Weather
(2) Visibility/Slant Range Visibility (NM)
(3) Sea Surface Temperature (°F)/In-Water Survival Time
(4) Cloud Tops/Ceilings (ft)
(5) En-route Winds/Temperatures Aloft (Location/Flight Level/Direction/Speed (kt)/ Temperatures (°C))
(6) Turbulence
(7) Minimum Freezing Level (ft)
(8) Icing
(9) Minimum Altimeter Setting (inches of Mercury)
(10) Contrail Formation
(11) Ditch Headings (Degrees T)
b. Target Area Weather (Note: Repeat for each target area.)
(1) Sky/Weather
(2) Visibility/Slant Range Visibility (NM)

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(3) Surface Winds (kt)
(4) Maximum/Minimum Temperatures (°F)
(5) Cloud Tops/Ceilings (ft)
(6) Winds/Temperatures Aloft (Flight Level/Direction/Speed (kt)/Temperatures (°C))
(7) Turbulence
(8) Freezing Level (ft)
(9) Icing
(10) Minimum Altimeter Setting (inches of Mercury)
(11) D-Values
(12) Contrail Formation
(13) Astronomical Data (UTC) at Z:
Sunrise/Sunset/Sun Angles (Elevation/Azimuth):
BMNT/BMCT/EECT/EENT:
Moonrise/Moonset/Percent Illumination/Moon Angles (Elevation/Azimuth)/Lux Values:
3. ( ) OUTLOOK TO 48 HOURS
4. ( ) TACTICAL ASSESSMENT (Note: Correlate the current/forecasted weather to major concerns such as aerial refueling track cloud layers and ceilings, severe weather, target ceilings and visibilities, battle damage assessment (BDA), impact on electro-optical systems/weapons, IFR conditions, etc.)
5. ( ) ELECTRO-OPTICAL SENSOR PERFORMANCE PREDICTIONS (Note: Include representative electro-optical sensor performance predictions for strike sensors/weapons systems and key METOC assumptions.)
6. ( ) RELEASED BY (Note: Include when MINIMIZE imposed.)//
DECL/ //

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I MARINE EXPEDITIONARY FORCE
CAMP PENDLETON BLUELAND
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Tab D (Assault Forecast) to Appendix 2 (MAGTF Standard Tactical METOC Support Plan) to Annex H (METOC Services) to I MEF Operation Order 2-98 (Operation Backup) (U)

Assault Forecast (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. En Route Weather to to
(1) Sky/Weather
(2) Visibility/Slant Range Visibility (NM)
(3) Sea Surface Temperature (°F)/In-Water Survival Time
(4) Cloud Tops/Ceilings (ft)
(5) En-route Winds/Temperatures Aloft (Location/Flight Level/Direction/Speed (kt)/ Temperatures (°C))
(6) Turbulence
(7) Minimum Freezing Level (ft)
(8) Icing
(9) Minimum Altimeter Setting (inches of Mercury)
(10) Contrail Formation
(11) Ditch Headings (Degrees T)
b. FARP/RGR Weather (As required, include for return leg if necessary.)
(1) Sky/Weather
(2) Visibility/Slant Range Visibility (NM)

(3) Surface Winds (kt)
(4) Cloud Tops/Ceilings (ft)
(5) Maximum/Minimum Temperatures (°F)
(6) Minimum Altimeter Setting (inches of Mercury)
(7) Maximum PA/DA
c. Assault Landing Zone Weather (Note: Repeat for each assault landing zone.)
(1) Sky/Weather
(2) Visibility/Slant Range Visibility (NM)
(3) Surface Winds (kt)
(4) Maximum/Minimum Temperatures (°F)
(5) Maximum PA/DA
(6) Cloud Tops/Ceilings (ft)
(7) Winds/Temperatures Aloft (Flight Level/Direction/Speed (kt)/Temperatures (°C))
(8) Turbulence
(9) Freezing Level (ft)
(10) Icing
(11) Minimum Altimeter Setting (inches of Mercury)
(12) D-Values
(13) Contrail Formation
(14) Astronomical Data (UTC) at Z:
Sunrise/Sunset/Sun Angles (Elevation/Azimuth):
BMNT/BMCT/EECT/EENT:
Moonrise/Moonset/Percent Illumination/Moon Angles (Elevation/Azimuth)/Lux Values:
3. ( ) OUTLOOK TO 48 HOURS

4. ( ) TACTICAL ASSESSMENT (Note: Correlate the current/forecasted weather to major concerns such as FARP/RGR ceilings and visibilities, severe weather, landing zone ceilings and visibilities, BDA, impact on electro-optical systems/weapons, IFR conditions, etc.)
5. ( ) ELECTRO-OPTICAL SENSOR PERFORMANCE PREDICTIONS (Note: Include representative electro-optical sensor performance predictions for associated assault platforms and key METOC assumptions.)
6. ( ) RELEASED BY (Note: Include when MINIMIZE imposed.)//
DECL/ //

I MARINE EXPEDITIONARY FORCE
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012200T MAR 98
Tab E (Amphibious Objective Area Forecast) to Appendix 2 (MAGTF Standard Tactical METOC Support Plan) to Annex H (METOC Services) to I MEF Operation Order 2-98 (Operation Backup) (U)
Amphibious Objective Area Forecast (U)
(PASS TO (CATF/CLF/MEF WEATHER SUPPORT TEAM/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 amphibious objective area weather.)
a. Sky/Weather
b. Visibility (NM)
c. Surface Winds (kt)
d. Maximum/Minimum Temperatures (°F) (Note: include windchill factor if applicable.)
e. Sea Surface Temperature (°F)
f. Combined Seas (ft)
g. In-Water Survival Time (h)
h. Aviation Parameters
(1) Clouds/Ceilings (ft)
(2) Winds/Temperatures Aloft (Flight Level/Direction/Speed (kt)/Temperatures (°C))
(3) Turbulence
(4) Freezing Level (ft)
(5) Icing
(6) Minimum Altimeter Setting (inches of Mercury)

(7) Maximum PA/DA
(8) Contrail Formation
(9) Slant Range Visibility (NM)
3. ( ) SURF FORECAST FOR (RED)/(BLUE) BEACH (Note: Output format included in Mobile Oceanography Support System 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 (% Spilling, Plunging, Surging).
e. ECHO. Breaker Angle (°).
f. FOXTROT. Littoral Current (kt).
g. GOLF1. Number of Surf Lines.
GOLF2. Surf Zone Width (ft).
h. MSI
i. High/Low Tides (UTC or Local)
j. Beach Conditions (Note: Provide summary of hydrographic reconnaissance data, including bottom type, beach slope/type/trafficability, and significant obstacles (locations) ashore and in shallows. Marine METOC personnel will be unable to provide without external assistance from reconnaissance units or NAVOCEANO.)
4. ( ) TACTICAL ASSESSMENT (Note: See COMNAVSURFPAC/COMNAVSURFLANT 3840.1B 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 PCS

(1) Surface-to-Surface Radar Ranges (Note: Expand on the guidance contained in EM PCS module.)
(2) Surface-to-Air Radar Ranges
(3) Air-to-Air Radar Ranges
(4) Air-to-Surface Radar Ranges
e. Communication Range Predictions
(1) Ultrahigh Frequency Communication Range (Normal/Extended/Greatly Extended)
(2) High Frequency Radio Propagation Summary
6. ( ) ASTRONOMICAL DATA (UTC OR LOCAL)
a. Sunrise/Sunset
b. BMNT/BMCT/EECT/EENT
c. Moonrise/Moonset/Percent Illumination
d. Night Vision Effectiveness (Lumens)
7. ( ) 24-HOUR RADIOLOGICAL FALLOUT/CHEMICAL FALLOUT FORECAST (Note: Include as tactical situation dictates.)
a. Effective Downwind Direction (T)/Speed (kt)
b. Distance (NM)
8. ( ) RELEASED BY (Note: Include when MINIMIZE imposed.)//
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APPENDIX E

DEFINITIONS

ACOUSTICS. The total effect of sound.

ABSOLUTE MAX. Highest recorded value for an area.

ABSOLUTE MIN. Lowest recorded value for an area.

ANNUAL MEAN. Yearly average of historical data.

ANNUAL MAX. Highest recorded value for the year.

ANOMALIES. The deviation of, usually, temperature or precipitation in a given region over a specified period from the normal value for the same region.

AVERAGE. The mean of historical data.

AVG SPEED. Mean speed recorded in knots (1.15 statute miles per hour).

BATHYMETRY. The study of water depths.

BIOFOULING. Infestations.

BREAKWATER. A barrier that protects a harbor or shore from the full impact of waves.

BREAKER. A sea-surface wave which is too steep to be stable.

BROACH. To veer or cause to veer broadside to the wind and waves.

CEILING. The height above the ground ascribed to the lowest broken or overcast layer; or the vertical visibility into obscuring phenomena.

CLIMATOLOGY. The meteorological study of climate.

CIVIL TWILIGHT. The interval of incomplete darkness between sunrise or sunset and the time when the center of the sun's disc is 6 degrees below the sea-level horizon.

BCT - Beginning Civil Twilight
ECT - Ending Civil Twilight

DAYLIGHT SAVINGS TIME. Time which clocks are set one hour or more ahead of standard time to provide for more daylight at the end of the working day during late spring, summer, and early fall.

EDDY. A small volume of air (or any fluid) that behaves differently from the larger flow in which it exists.

EXTRA-TROPICAL CYCLONES. A cyclonic storm that most often forms along a front in middle and high latitudes. Also called a form of a middle latitude storm, a depression, and a low.

FETCH. The area in which ocean waves are generated by the wind.

FOG. A visible accumulation of minute water droplets which are based at the Earth's surface.

GALES. In the Beaufort wind scale a wind whose speed is from 28-55 knots and categorized as follows: moderate, 28-33 Kts;

fresh gale, 34-40 Kts; strong gale, 41-47 Kts; and whole gale, 48-55 Kts.

GRADIENT. The space rate of decrease of a function.

HEIGHT. Elevation.

IFR. Instrument flight rules. A flight conducted by use of navigational instruments that permits the flight crew to proceed without reference to visual landmarks or celestial fixes.

IMC. Instrument Meteorological Conditions, ceiling <1000 and/or visibility <3 miles.

KNOT. A unit of speed equal to 1 nautical mile per hour (1 knot equals 1.15 mi/hr).

LI%. Lunar Illumination Percentage.

LITTORAL. A shore or coastal region.

METOC. Meteorological and Oceanographic.

MIXED LAYER (SONIC LAYER). The surface layer of virtually isothermal water.

MOONRISE (MR). The instant when the upper edge of the moon appears on the sea-level horizon.

MOONSET (MS). The instant when the upper edge of the moon disappears below the sea-level horizon.

NAUTICAL MILES. 1852 meters, 1.15 statute miles.

NAUTICAL TWIGLIGHT. The interval of incomplete darkness between sunrise or sunset and the time when the center of the sun's disc is 12 degrees below the sea-level horizon.

BNT - Beginning Nautical Twilight
ENT - Ending Nautical Twilight

OBSERVATIONS. An evaluation of one or more meteorological elements that describe the state of the atmospheric either at the Earth's surface or aloft.

PERIOD. The time interval between passages, at a fixed point.

PRECIPITATION. Any or all forms of water particles, whether liquid or solid, that falls from the atmosphere and reach the ground.

RELATIVE HUMIDITY. The ratio of the amount of water vapor actually in the air compared to the amount of water vapor the air can hold at that particular temperature and pressure.

SALINITY. A measure of dissolved salts in seawater.

SEAS. The condition of the ocean's surface with regard to its course, flow, swell, or turbulence.

SEA SURFACE TEMPERATURE. A measure of translational molecular kinetic energy at the sea surface.

SEDIMENTS. Material carried in suspension by water; or deposits of waterborne materials.

SHOALING. A sandy elevation of the bottom of a body of water constituting a hazard to navigation.

SUNSET (SS). The instant when the upper edge of the sun disappears below the sea-level horizon.

SUNRISE (SR). The instant when the upper edge of the sun appears on the sea-level horizon.

SURF. The sea-surface wave activity between the outermost line of breakers and the shores.

SURFACE WIND. Direction is given on a 16-point compass in relation to TRUE NORTH and speed is given in knots (KT).

SWELL PERIODS. A long wave which moves continuously without breaking.

TEMPERATURE. A measure of translational molecular kinetic energy (Degree of hotness or coldness). Listed in degrees Fahrenheit. To convert to Celsius: $C = (f-32)/1.8$.

TIDES. The periodic rise and fall of the water resulting from gravitational interactions between the Sun, Moon, and Earth.

UPWELLING. The rising of water (usually cold) toward the surface from the deeper regions of a body of water.

VFR. Visual flight rules. A set of regulations set down by the U. S. Civil Aeronautics Board to govern the operational control of aircraft during visual flight.

VISIBILITY. A measure of the opacity of the atmosphere and is expressed in terms of the horizontal distance at which you are able to see and identify specified objects.

VMC. Visual Meteorological Conditions, ceiling $\geq$1000 and visibility $\geq$3 miles.

WAVES. Any pattern with some roughly identifiable periodicity in time and/or space.

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