UNITED STATES MARINE CORPS
WEATHER SERVICE
MARINE CORPS AIR STATION
BEAUFORT, SOUTH CAROLINA 29904-5010

LOCAL AREA FORECASTERS HANDBOOK

Revised this date: 15 September 1997

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SNCOIC USMC	OIC USMC

FOWARD

This Forecasters Handbook was prepared in accordance with NAVOCEANCOMINST 3140.2E and is a revision of the 1 May 1995 Forecasters Handbook prepared by MCAS Beaufort, South Carolina.

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.

The specified purpose of the Forecasters Handbook is to provide newly assigned weather 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 the seasoned forecaster in the Beaufort area.

This handbook is not the work of any one individual, but a compilation of many past and present Beaufort forecasters. Their contributions are appreciated.

All recommendations concerning changes, additions or deletions to improve the effectiveness of this handbook are encouraged. Additional copies may be obtained, upon request, from the Weather Service Officer, Marine Corps Air Station, Beaufort, South Carolina 29904-5010.

J. F. HALEY

WEATHER SERVICE OFFICER

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RECORD OF CHANGES

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d. Location of the Weather Office
e. Local Flying Area
f. Special Operating Areas

2. Meteorological Instruments and Communications Equipment

a. General

(1) MIDDS
(2) ASOS
(3) WSR-88D PUP
(4) LPATS
(5) CMW
(6) AN/GMQ-27M
(7) ML-448UM
(8) ML-3
(9) WSDI/DASI
(10) IVCSS
(11) Thermoscreen
(12) WBGTI
(13) ML-217
(14) ML-247
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3. Environmental Support Services

a. Mission
b. Units Supported

(1) Headquarters and Headquarters Squadron
(2) MAG-31
(3) FMF Units

Section I: Basic Description

1. STATION DESCRIPTION

a. GENERAL: Marine Corps Air Station, Beaufort, South Carolina is located on the northwest portion of Port Royal Island at 32^{o} 28' 38" north latitude and 80^{o} 43' 22" west longitude. The airfield is designated Merritt Field, regional block number 72, international index number 2085, station identifier KNBC. (See Figure 1.1)

b. FIELD DESCRIPTION: Field elevation is 38' above mean sea level. Airfield runway layout is as follows: (Runway 23 is the primary instrument runway) See Figure 1.2

c. TOPOGRAPHY AND EXPOSURE: MCAS Beaufort is located on the northwest portion of Port Royal Island. The Coosaw River lies 3$^{1}/_{2}$ miles to the north, while McCalley's Creek lies 2$^{1}/_{2}$ miles north. The Coosaw river joins the Whale Branch River 4$^{1}/_{2}$ miles to the north-northeast. The Whale Branch flows southward joining the Broad River 5 miles to the west of the station. Approximately 7 miles southeast of the station, the Broad River flows into the Port Royal Sound. The Beaufort River extends northward 1$^{3}/_{4}$ miles south of the station and Brickyard Creek (Inter Coastal Waterway) extends northward coming within 1$^{3}/_{4}$ miles due east of the station. Brickyard Creek continues northward and joins the Coosaw River. Mulligans Creek, which branches westward of Brickyard Creek, has been formed about 700 feet southeast of the end of runway 23. The Atlantic Ocean lies 18 miles east through southeast of the field. Tidal swampland is abundant in the area. The surrounding land is level and covered with scrub pines and brush. (See figure 1.1)

d. LOCATION OF THE WEATHER OFFICE: The Weather Section office spaces are located on the first and second decks of the Operations building (Bldg. #600). The largest room is comprised of Forecasting/Observation spaces. A second enclosed room serves as the Secondary Control Point, which contains a safe and a 486/66 MHz PC with removable hard drive used to generate GFMPL/EOTDA products. A third enclosed room on the first deck houses the Systems Console and PUP cabinets of the WSR-88D, and the ASOS Acquisition Control Unit. An administrative/Training office and two storage rooms are also maintained on the first deck (See Figure 1.3). The OIC and NCOIC are located on the west wing of the second deck, Bldg. #600.

e. LOCAL FLYING AREA: The local flying area is defined as that area contained within a 350 nautical mile radius of MCAS Beaufort. (See Figure 1.4)

f. SPECIAL OPERATING AREAS: SOA 1X, Y, Z thru 8X are the offshore operating areas used by tactical aircraft aboard MCAS Beaufort and are defined by longitude and latitude. (See Figure 1.5)

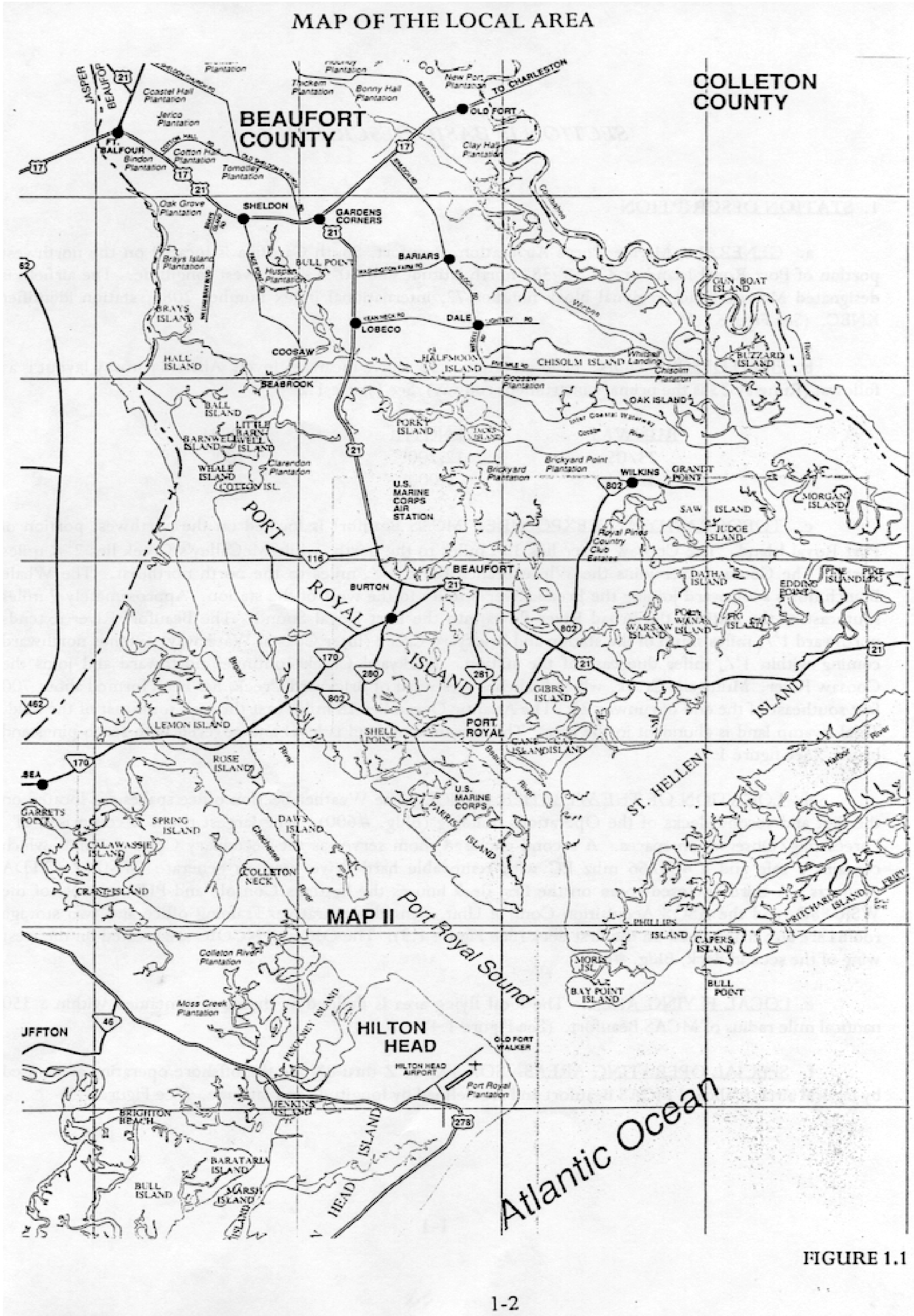

MAP OF THE LOCAL AREA
COLLETON
COUNTY
BEAUFORT
COUNTY
SHELDON
GARDENS
CORNERS
LOBECO
DALE
SEABROOK
U.S.
MARINE
CORPS
AIR
STATION
BEAUFORT
BURTON
PORT
ROYAL
ISLAND
ST. HELLENA
ISLAND
Port Royal Sound
MAP II
HILTON
HEAD
Atlantic Ocean
FIGURE 1.1
1-2

Figure 1-2

AIRFIELD RUNWAY LAYOUT/LOCATION OF REMOTE SENSING EQUIPMENT

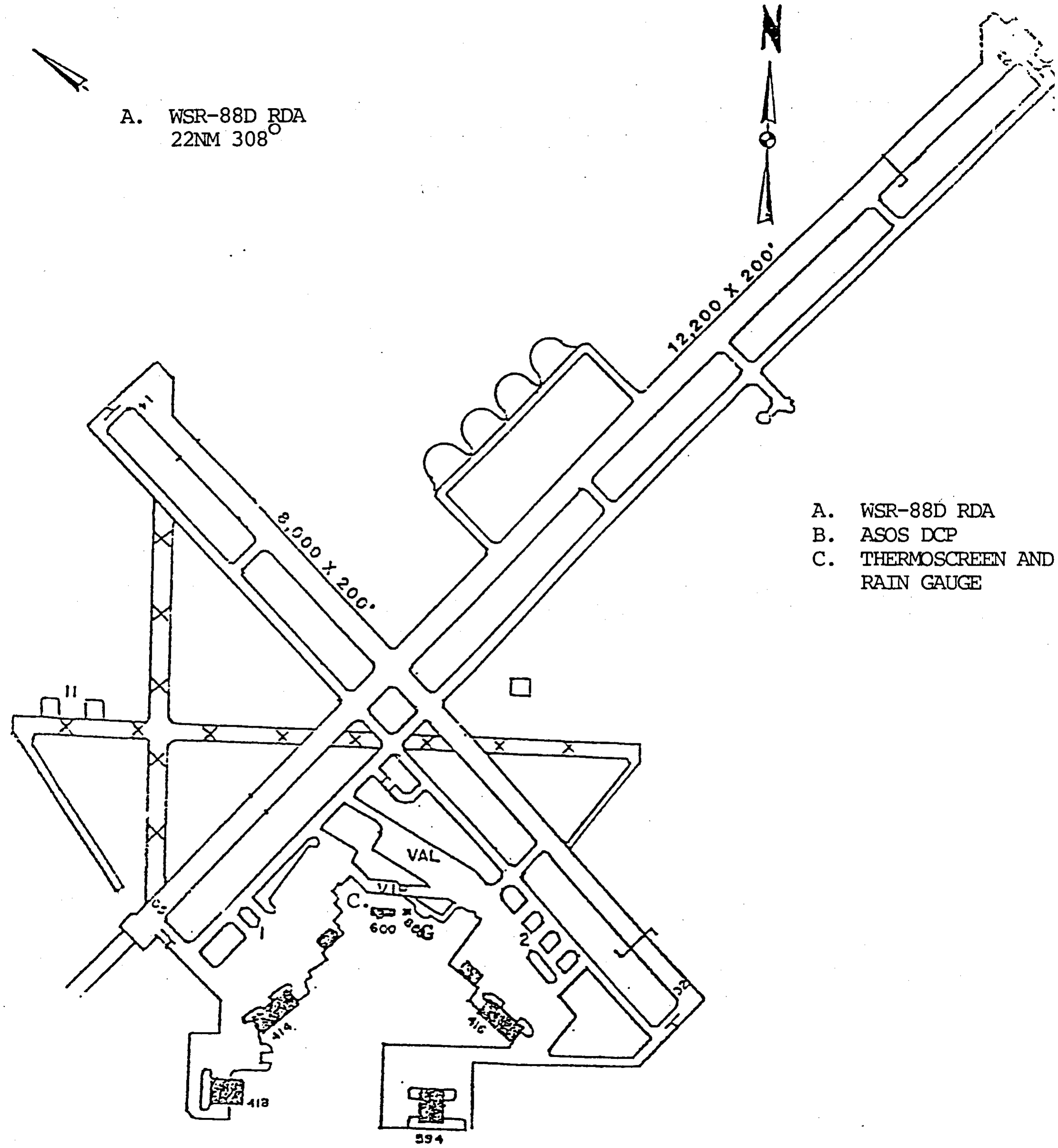


FIGURE 1.2

MAP OF OFFICE

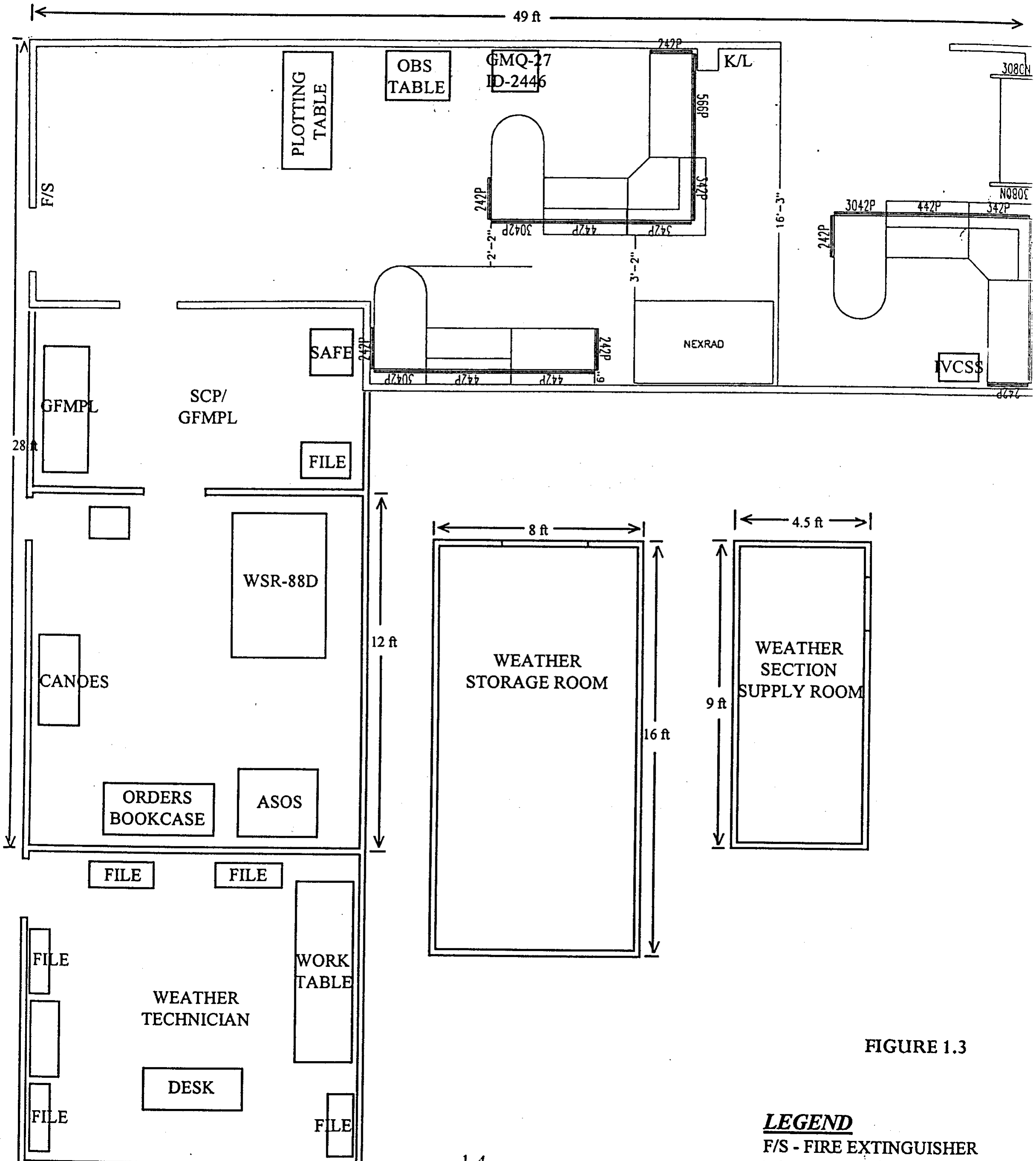


FIGURE 1.3

LEGEND
F/S - FIRE EXTINGUISHER
K/L - KEY LOCKER

1-4

LOCAL FLYING AREA

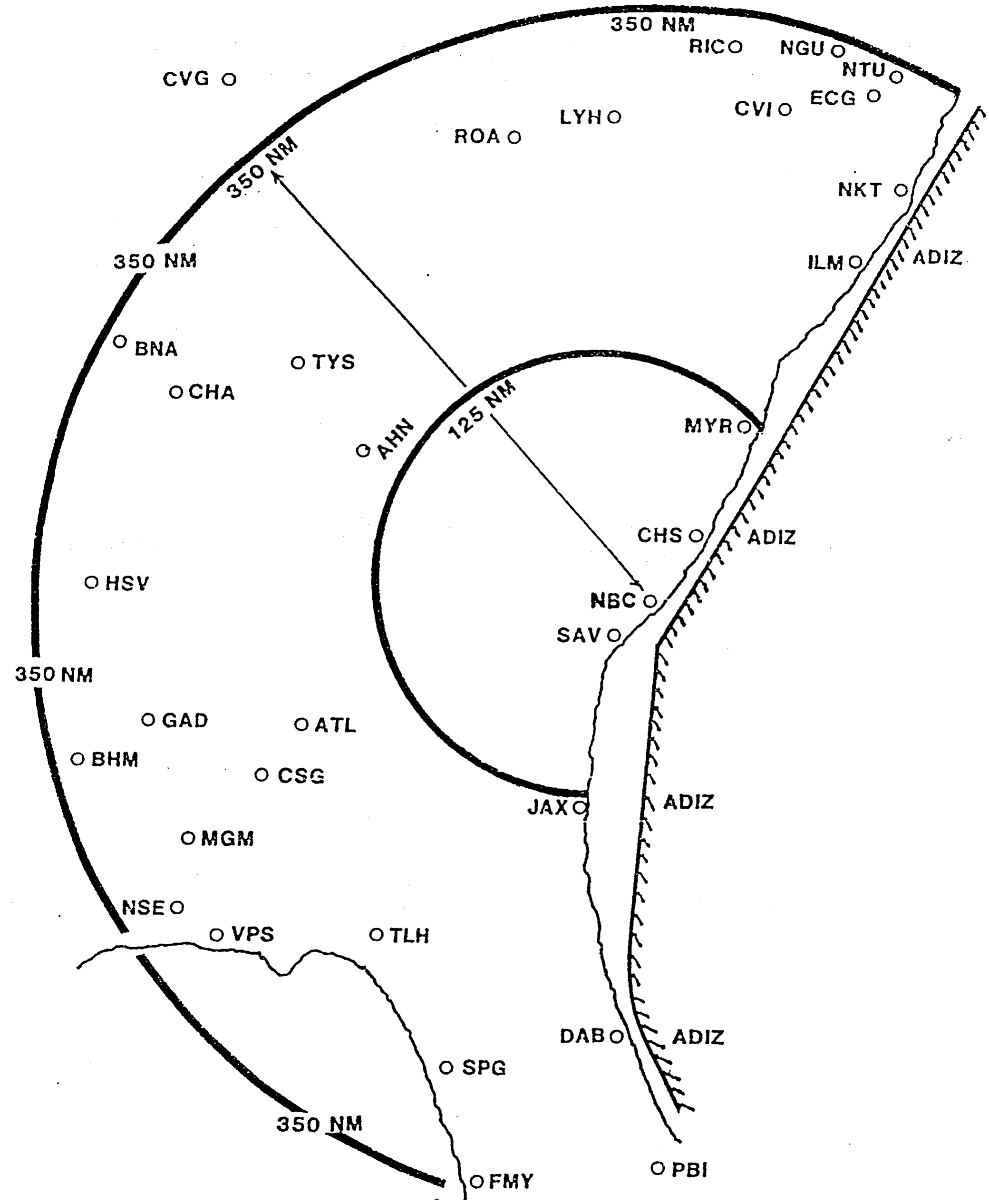
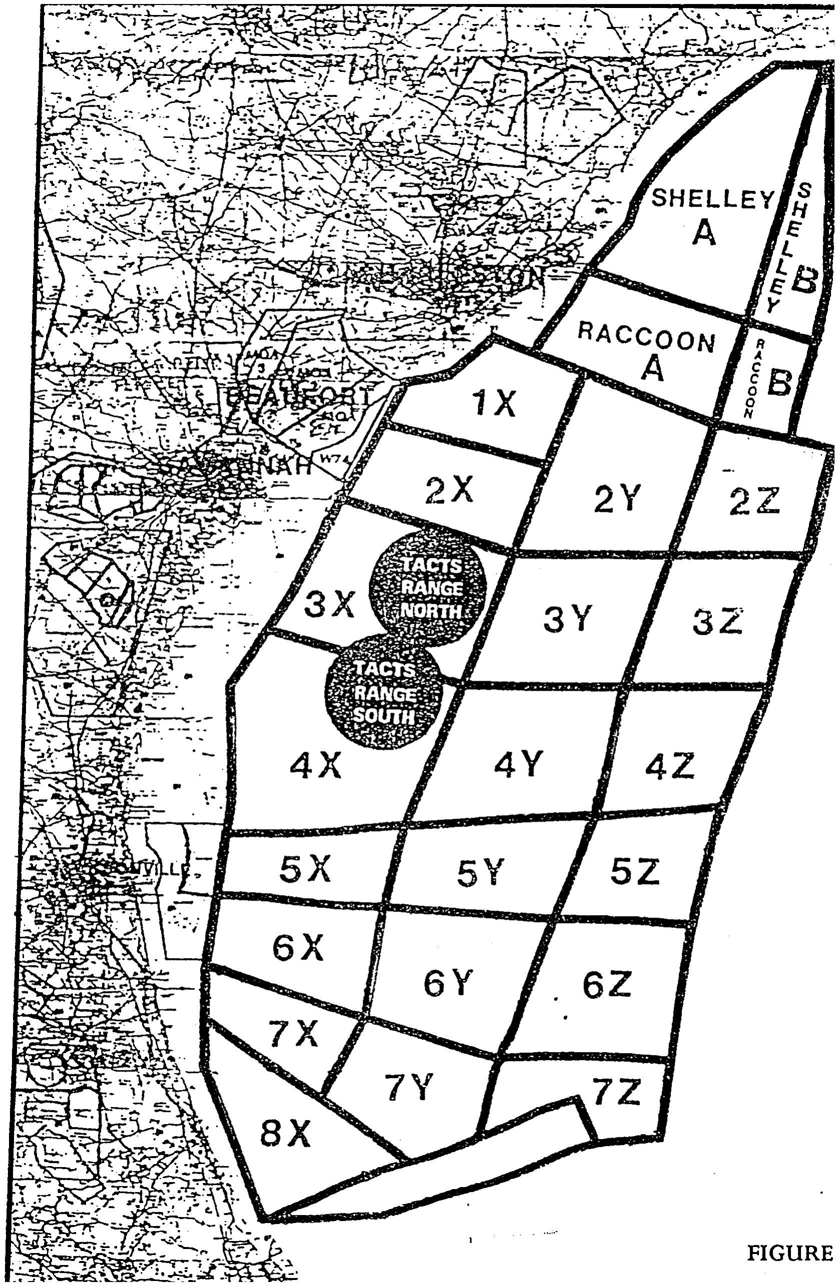


FIGURE 1.4


SHELLEY A
SHELLEY B
RACCOON A
RACCOON B
CHARLESTON
BEAUFORT
SAVANNAH
W74
1X
2X
2Y
2Z
3X
3Y
3Z
TACTS RANGE NORTH
TACTS RANGE SOUTH
4X
4Y
4Z
5X
5Y
5Z
6X
6Y
6Z
7X
7Y
7Z
8X

FIGURE

2. METEOROLOGICAL INSTRUMENTS AND COMMUNICATIONS EQUIPMENT

a. GENERAL: The office spaces in Bldg. #600 house a majority of the meteorological equipment. Remote equipment and sensing instruments are annotated on the map in Figure 1.2. Meteorological instruments and communications equipment utilized by MCAS Beaufort Weather Service personnel are as follows:

(1) METOC INTERGRATED DATA DISPLAY SYSTEM (MIDDS): MIDDS is a client server based state-of-the-art system for simultaneous ingestion, display and dissemination of meteorological data. MIDDS currently ingests satellite imagery, digital facsimile (DIFAX charts), alphanumeric weather data, radar data, NODDS/OPARS, AFDIS, and unclassified GFMPL modules. This WEB server is automatically updated by the MIDDS Briefing/BBS Support modules. The server is driven by Microsoft Windows NT 3.51 and has four separate workstations. Workstation number one is the primary station and operates in the Windows NT environment. It controls the ingest of METOC data for display on the other workstations and the MCAS Beaufort Weather Service Homepage on the World Wide Web (204.223.63.74). It is equipped with a 21" monitor for displaying METOC data and runs off a 133 MHz CPU with a 2 GB storage capacity. The forecasters workstation also operates in the Windows NT environment and serves as a backup to the primary workstation for the ingest of METOC data. It is equipped with a 17" monitor and runs off a 133 MHz CPU with a 2 GB storage capacity. A third workstation operating in Windows 95 controls the "Wall of Thunder." This workstation controls four separate monitors from one location and is the primary tool for displaying METOC data. The Wall of Thunder has essentially eliminated the need for paper charts by allowing multiple charts to be easily displayed, manipulated and transferred from one screen to another, or to be spread over several monitors at the same time. The fourth terminal is the observers' workstation. This is a Windows 95 system operating at 100 MHz with a 812 Mb storage capacity. It can be used to view all data ingested by the server or to access NODDS. The entire MIDDSsystem replaces the PCGRAFX.

(2) 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 a visibility sensor to aid observers in evaluating sky condition and visibility. The Data Collection Package (DCP) is located at the approach end of runway 23, 200 feet southeast of the runway 23/05 centerline (See Figure 1.2.) 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.

(3) WEATHER SURVEILLANCE RADAR (WSR-88D): The WSR-88D is the latest state of the art weather radar. It combines conventional and Doppler radar, utilizing various scanning strategies and volume coverage patterns to provide forecasters with the most accurate representation of the storm environment. MCAS Beaufort is an associated PUP for both the Charleston (KCLX) and Columbia (KCAE) RDA and can easily change between the two utilizing the SWITCH command at the Systems Console. Further, the WSR-88D has dial-up capability for selected CONUS radar sites. The WSR-88D replaces the AN/FPS-106 and RADIDS. (See Figure 1.2)

(4) LIGHTNING POSITIONING AND TRACKING SYSTEM (LPATS): The LPATS is a nationwide lightning detection system that graphically displays cloud to ground lightning strikes. The strokes are color coded to indicate age of the strike and can be replayed in a time lapse mode. Users can zoom in on areas of interest and establish range alarms to alert them to the lightning activity. LPATS is also equipped with a Field Mill that measures the difference in the electrical field of the ground and atmosphere.

(5) CONTEL METEOROLOGICAL WORKSTATION (CMW): The CMW is the primary means of disseminating and receiving alphanumeric weather data. It is equipped with Automatic Response to Query (ARQ) capabilities and is capable of graphically displaying selected alphanumeric data. CMW also automatically routes NOTAM's to Flight Clearance, eliminating the need for paper copies. MCAS Beaufort has two separate CMW terminals, one designated for use by forecasters and one for observers.

(6) WEATHER TELEVISION SYSTEM AN/GMQ-27 MODIFIED: Is a modified GMQ-27 which cycles through several screens displaying current weather, divert weather if necessary, warnings and advisories and airfield status. This information is routed directly to the Air Traffic Control facility and to Channel 33 for dissemination on the base television system.

(7) ANEROID BAROMETER (ML-448UM): Serves as a back-up to the ASOS for pressure readings. The ML-448 is a wall mounted precision aneroid barometer located on the north wall of the operation area with a field elevation of +38 feet.

(8) MARINE BAROGRAPH (ML-3): A Marine Microbarograph is located in the observational spaces. It also provides back-up pressure indications for the ASOS.

(9) DIGITAL ALTIMETER SETTING INDICATOR (WSDI/DASI): Interfaces the analog wind direction and speed signal from the AN/UMQ-5 and the digital signal from the ASOS winds, allowing the user to view wind data from either source graphically on a digital wind rose with a flip of the switch. It also displays a digital readout of the current altimeter setting from the ASOS. This system replaces the ID-586 Wind Indicator and the ML-661/F Digital Altimeter Setting Indicator (DASI.)

(10) AN/FSC-119(V) INTEGRATED VOICE COMMUNICATIONS SWITCHING SYSTEM (IVCSS): A digital communications system that provides access to multiple radiophone, interphone and landline channels through one console/handset. This system replaces the FSA-52 (V) intercom system and the Pilot-to Forecaster Metro.

(11) THERMOSCREEN (ML-42): A Cotton Region type thermoscreen with standard air thermometers is located 113 feet northwest of the operations building serves as a back-up to the temperature and dew point sensors in the ASOS. (See Figure 1.2)

(12) WET BULB GLOBE THERMOMETER (WBGT): The WBGTI instrumentation is located adjacent to the thermoscreen, 113 feet northwest of the operations building. (See Figure 1.2)

(13) RAIN GAUGE (ML-217): Standard 4" rain gauge used as a back-up to the ASOS, located adjacent to the thermoscreen, 113 feet northwest of the operations building. (See Figure 1.2)

(14) THEODOLITE (ML-247): The primary location for set-up is near the thermoscreen. Secondary location is at the end of the sidewalk in back of building 600 near the taxiway.

(15) PMQ-3 Wind Measuring Set: The PMQ-3 serves as a back-up to the ASOS for wind direction and speed readings.

(16) MTI 486 PC: Equipped with removable hard drives and used to produce GFMPL and EOTDA products.

(17) EVEREX 386 PC: Used with U.S. Robotics 28.8 bps modem for access to NODDS/OPARS and AFDIS.

3. METOC SUPPORT SERVICES

a. MISSION: The mission of the Weather Service is to provide meteorological services to the Air Station, tenant organizations, transient aircrews, Beaufort Naval Hospital and Parris Island.

b. UNITS SUPPORTED: The following units aboard the air station are supported:

(1) HEADQUARTERS AND HEADQUARTERS SQUADRON:

a. (2) UC-12B's
b. (2) CH-46D's (SAR)

(2) MARINE AIRCRAFT GROUP (MAG) -31:

a. VMFA-115, (12) F/A-18C's
b. VMFA-122, (12) F/A-18C's
c. VMFA(AW)-224, (12) F/A-18D's
d. VMFA-251, (12) F/A-18C's
e. VMFA-312, (12) F/A-18C's
f. VMFA(AW)-332, (12) F/A-18D's
g. VMFA(AW)-533, (12) F/A-18D's

(3) FMF UNITS:

a. MWSS-273
b. MALS-31
c. MACS-2
d. CSSD-23

SECTION II
CLIMATOLOGY

1. Types of cyclones

    a. Texas Low
    b. Gulf Low
    c. South Atlantic Low

2. Types of Anticyclones

    a. Alberta Type I
    b. North Pacific Type II
    c. Plateau Region Type III
    d. South Pacific Type IV

3. Typical Synoptic Developments

    a. Winter
    b. Summer
    c. Spring and Fall

4. Weather Patterns Associated with each Typical Development

    a. Texas Type Ia
    b. Texas Type IIb
    c. South Atlantic Type
    d. Eastern Gulf Type IIa
    e. Western Gulf Type IIb

5. Hurricane Hugo

6. Monthly Climatological Summaries

7. IMPACT OF TEMPERATURE ON MILITARY OPERATIONS AT MCAS BEAUFORT

8. IMPACT OF THUNDERSTORMS ON MILITARY OPERATIONS AT MCAS BEAUFORT

SECTION II: Climatology

1. **TYPES OF CYCLONES:** There are three major types of cyclones that affect MCAS Beaufort. They are the Texas Low, Gulf Low and the South Atlantic Low.

a. TEXAS LOW: Is classified as types Ia and Ib depending on their location.

(1) Texas Low Type Ia: Is classified type Ia if it tracks to the west of the Appalachians. (See figure 2.8 on pg. 2-6)

(2) Texas Low Type Ib**:** Is classified type Ib if the track is to the east of the Appalachians. (See figure 2.9 on pg. 2-7)

b. GULF LOW: Is classified East Type IIa and West Gulf Type IIb dependent upon the location of cyclogenesis.

(1) East Gulf Type IIa: Originates in the northeastern Gulf of Mexico, usually forming on a stationary front. This cyclone usually develops into the most severe winter storm encountered in the southeastern United States with the apex of the associated fronts passing very near Beaufort. (See figure 2.11 on pg. 2-9)

(2) West Gulf Type IIb: Forms on a stationary front over eastern Texas or the Northwestern Gulf of Mexico. This is commonly triggered by a jet stream flowing across southern Arizona and New Mexico, and remains west of the Appalachian Mountains creating little, if any adverse weather at Beaufort. (See figure 2.12 on pg. 2-10)

c. SOUTH ATLANTIC LOW: Forms rapidly off the northern coast of Florida and will follow the southerly steering current and, except during summer, stay well offshore. This track is still sufficiently close to the coastline of South Carolina and will cause extensive cloudiness over Beaufort because of the northeasterly flow. (See figure 2.10 on pg. 2-8)

2. **TYPES OF ANTICYCLONES:** MCAS Beaufort's weather is controlled predominantly by the Bermuda High during the period of mid spring through late autumn. Migratory anticyclones become most active during the winter months. (See Figures 2.2, 2.4 and 2.6)

a. ALBERTA TYPE I: Being the most frequent anticyclone observed at Beaufort. It is most active during the winter months and is associated with cold outbreaks.

b. NORTH PACIFIC TYPE II: The second most frequent anticyclone to affect the Beaufort area. It is most active during the winter months, but is associated with cool and mild weather.

c. PLATEAU REGION TYPE III: Rarely penetrates the Beaufort area, but does have a tendency to create east/west stationary frontal conditions through South Carolina.

d. SOUTH PACIFIC TYPE IV: Produces the same conditions as the Plateau Region Type III when it does occur, but is very rare for this area.

3. TYPICAL SYNOPTIC DEVELOMENTS

a. WINTER

(1) Cold Fronts: As the Bermuda High shifts southward and the Polar FrontJet becomes more predominant, cold frontal activity is at a maximum for the Beaufort area. Normally, wintertime cold fronts approach the local area from the northwest, however orientation may vary from north/south to east/west, depending on the track of the high-pressure cell that follows it. A high-pressure cell with a track over the northern United States will generally result in an east/west orientation, while a southerly track will tend to orient the front on a more north/south line. The movement of these fronts can be forecast with good accuracy using the rules as described by “George”. After the passage of a cold front, clearing will occur depending primarily on the speed and type of front. However when the low level, (Sfc - 10,000 ft.), wind flow shifts east to north after frontal passage, a low stratus deck can be expected within 6 hours. This is an excellent example of the synopsis observed with the East Coast Wedge Type Cold Front.

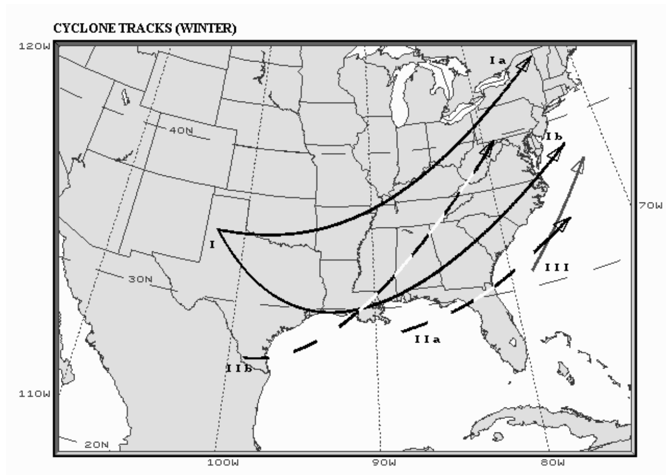


Figure 2.1

(2) Warm Fronts: Warm frontal activity is also at a maximum during the winter months, approaching the Beaufort area from the south. A Polar Front Jet locate near the Gulf Coast, coupled with a stationary front, will usually initiate wave development in the Gulf of Mexico. This criteria provides ideal conditions for Beaufort to experience warm frontal activity. the extent and range of this activity will vary depending on the track of the cyclone

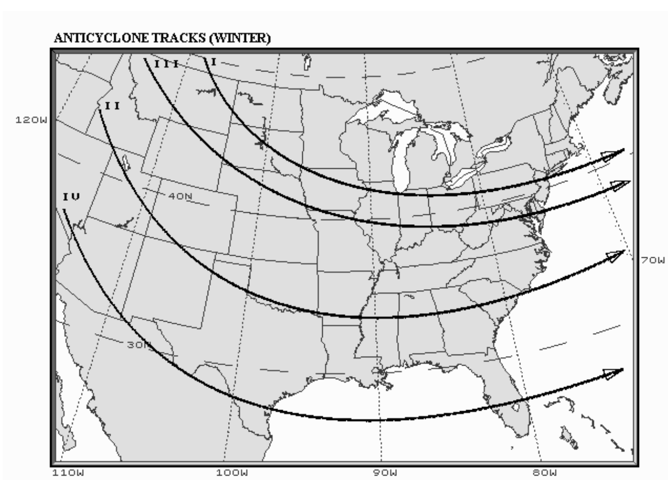


Figure 2.2

(3) Occluded Fronts: The occurrence of an occluded frontal system, (cold occlusion), in the Beaufort area is rare, normally occurring two of three times a year. The only systems that can produce this phenomenon are the eastern Gulf Type with a track south of Beaufort, and the South Atlantic Type. The associated weather may result in increased thunderstorm development in the local area.

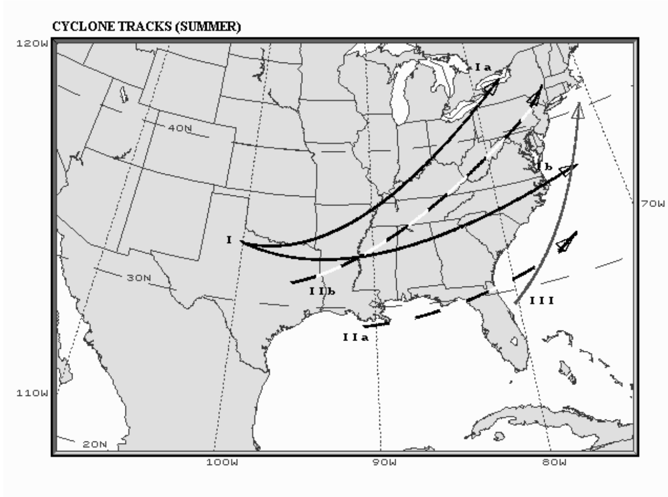


Figure 2.3

b. SUMMER: Frontal activity of any sort is normally rare during the summer months, with the controlling synoptic feature being the Bermuda High. When this rarity does occur, it is usually due to a strong continental air mass moving into the east central United States from Canada. The result is a quasi stationary front, oriented east/west, over central Georgia and South Carolina. Normally, in advance of this front, increased early afternoon thunderstorm development can be expected. Some of this activity may occur in lines or clusters. With the passage of the front, clearing and reduced humidity occurs. Thunderstorm activity north of this front is usually non-existent, with shower activity also greatly reduced. However, air mass modification occurs quite rapidly, usually within two or three days, and once again Beaufort is under the influence of a warm, moist southerly flow.

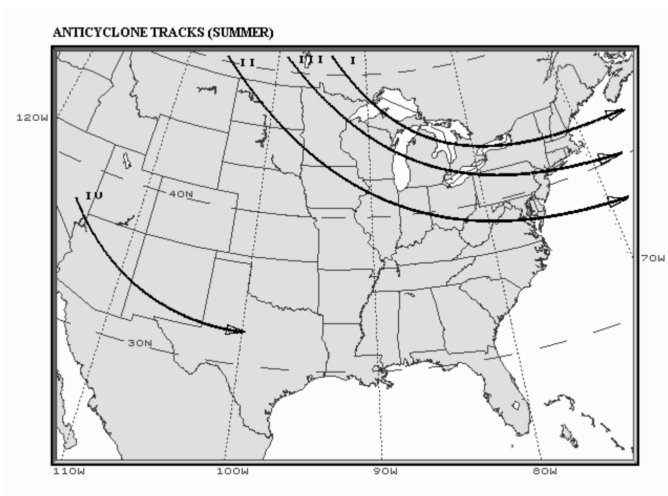


Figure 2.4

c. SPRING AND FALL: These seasons are generally transitional with a combination of both winter and summer rules applying, with some modifications.

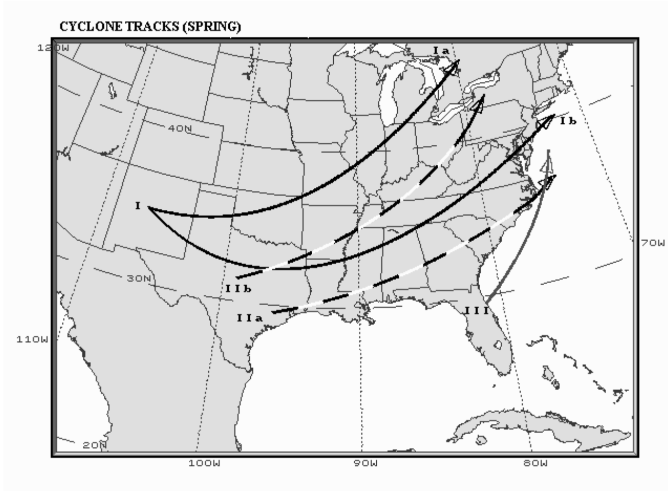


Figure 2.5

(1) Spring: Frontal activity becomes less frequent as the Bermuda High begins its northward shift. However, when an inactive cold front moves into an unstable air mass located over the southeast, explosive thunderstorm development may occur, often resulting in squall line activity. This is why Beaufort's destructive weather season commences April 1. The occurrence of severe thunderstorms and tornadoes is most common in the months of April, May and June.

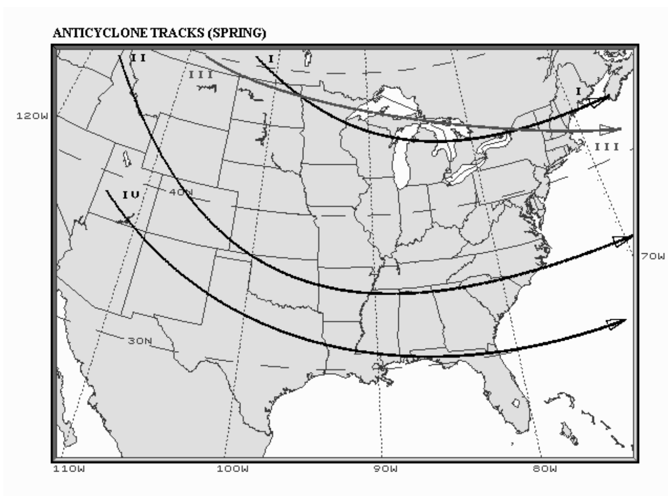


Figure 2.6

(2) Fall: Air mass activity is reduced with the retreat of the Bermuda High. Frontal activity starts occurring in October, but is usually not accompanied by severe weather.

The most serious threat to the area in the fall is the effects of tropical cyclones. The hurricane season commences 1 June and continues through 30 November. The greatest frequency for the effects of a tropical cyclone for Beaufort are during the months of August, September and October.

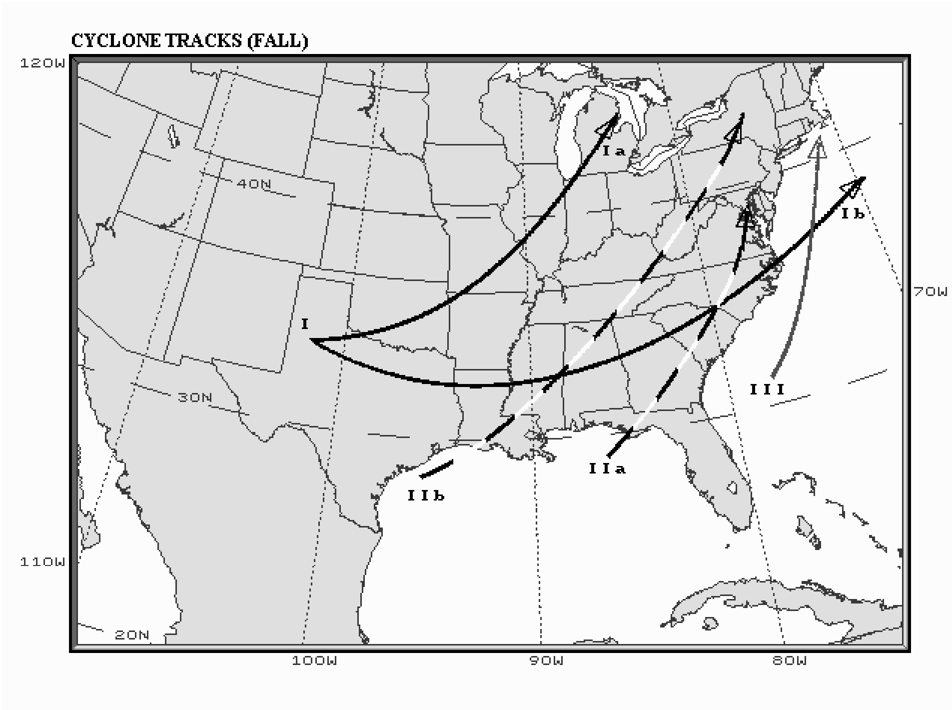


Figure 2.7

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4. **WEATHER PATTERNS ASSOCIATED WITH EACH TYPICAL DEVELOPMENT**:

a. TEXAS TYPE Ia: The weather associated with this cyclone remains to the west of the Appalachian Mountains. However, the warm front extending eastward has a tendency to accelerate northward rapidly due to the strong southeasterlies aloft that are normal with the synoptic pattern. Extensive middle cloudiness and variable low cloudiness, intermittent light rain and fog are normal weather patterns associated with this system. There is one exception that the forecaster must be aware of. When the warm front accelerates along the coast with that portion along the base of the Appalachian Mountains lagging behind creating a shallow pool of cool air between a Raleigh, Shaw, Columbia line and the eastern slopes of the Appalachians. The weather within this area will consist of extensive fog and stratus with light rain and drizzle. This condition may persist for several days until complete modification occurs. The following reports of local weather conditions were taken during a typical Texas Type Ia synoptic situation.

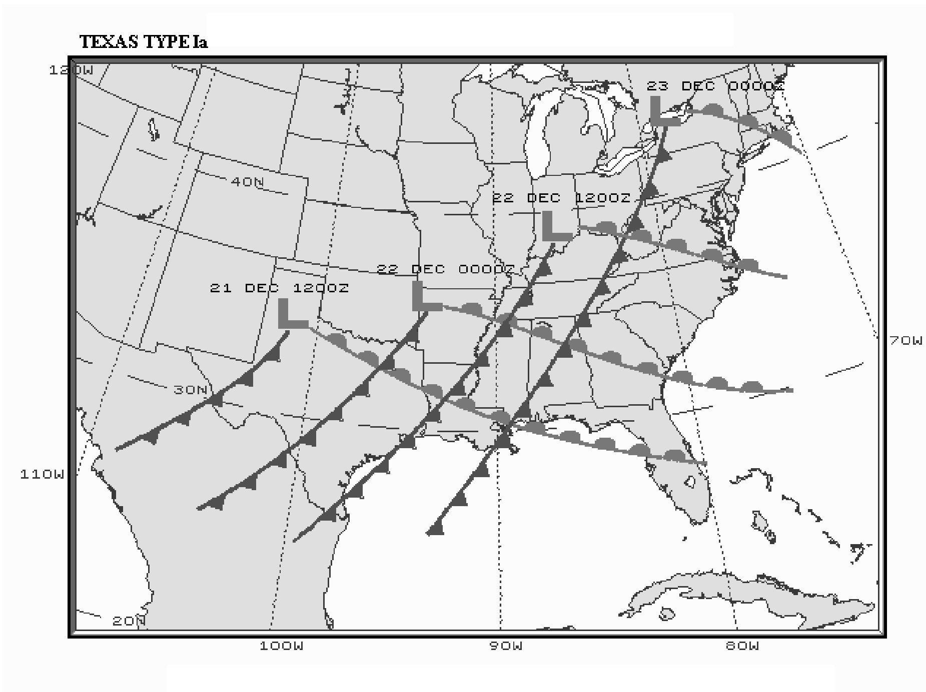


Figure 2.8

21 December:
1200Z -- 40 SCT E80 BKN 6H 1208KT
1800Z -- 10 SCT E40 BKN 80 OVC 5R—F 1009KT
22 December:
0000Z -- --X M6 BKN 20 OVC 2R—F 0906KT
0600Z -- 8 SCT M15 BKN 30 BKN 5H 1806KT
1200Z -- 15 SCT 30 SCT 250 SCT 6H 1907KT
1800Z—E35 BKN 7 2108KT
23 December:
0000Z -- 30 SCT 100 SCT 250 SCT 7 2205KT
0600Z -- 30 SCT E100 BKN 250 BKN 5RW-- 2405KT

b. TEXAS TYPE Ib: This cyclone follows a track east of the Appalachian Mountains. The range of associated weather in the local area depends upon the extent of the cyclone’s eastward movement before northward movement begins. If the cyclone moves west of Beaufort, the area will be affected by extensive middle and low cloudiness, rain and fog. Partial clearing will occur as the warm front passes, with rain showers and thunderstorms accompanying the cold front. If the cyclone tracks south, then east of Beaufort, extensive stratus and fog can be anticipated due to the long over water trajectory of the low level flow. As the cyclone passes to the north of Beaufort, rapid clearing will occur as the low-level winds back to the northwest. The following observational sequence was recorded at Beaufort for a Texas Type Ib cyclone with a track west of Beaufort.

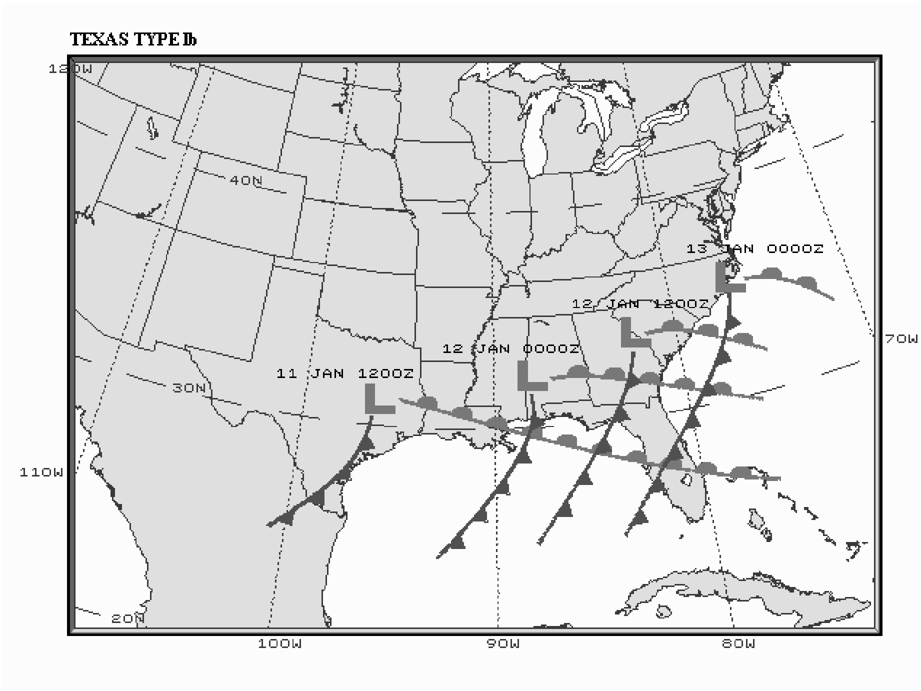


Figure 2.9

11 January:
1200Z -- 20 SCT 80 SCT 250 BKN 5H 0806KT
1800Z -- 20 SCT E80 BKN 250 OVC 6H 1008KT

12 January:
0000Z—E20 BKN 80 BKN 250 OVC 5R—F 1107KT
0600Z—M8 BKN 20 BKN 80 OVC 2R—F 1208KT
1200Z -- 10 SCT 20 SCT E80 BKN 5F 1708KT
1800Z -- 15 SCT E30 BKN 80 BKN 6H 2910KT

13 January:
0000Z -- 30 SCT 80 SCT 7 3108KT

c. SOUTH ATLANTIC TYPE: This cyclone develops on a stationary front over or just east of northern Florida. Cyclogenesis occurs rapidly, and the associated weather pattern is similar to the Texas Type Ib, with a track east of Beaufort. The extent of the low cloudiness, fog and precipitation will depend on the proximity of the cyclone to Beaufort. The following observational sequence was recorded at Beaufort during a South Atlantic Type Cyclone.

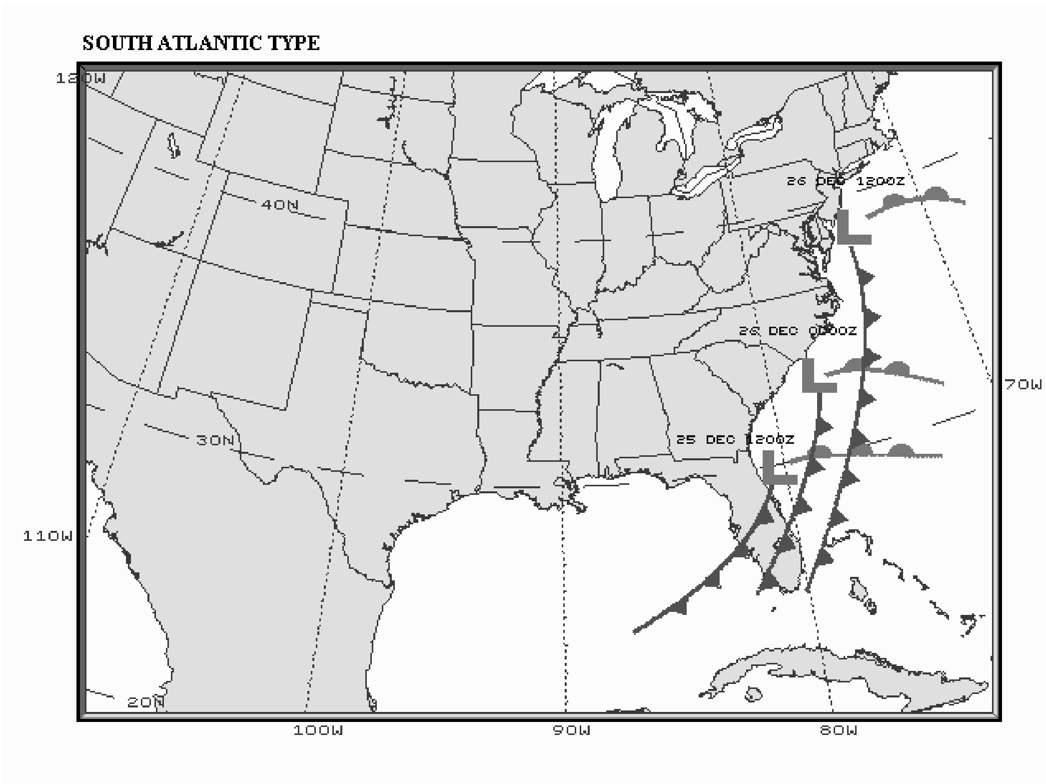


Figure 2.10

25 December:
1200Z -- 25 SCT E80 BKN 250 BKN 5R—F 0706KT
1800Z -- 8 SCT E20 OVC 2RF 0310G15KT

26 December:
0000Z—M6 BKN 15 OVC 4R—F 0109KT
0600Z -- 15 SCT E30 BKN 6F 3507KT
1200Z -- 20 SCT 7 3310KT

d. EASTERN GULF TYPE IIa: This cyclone can develop into the most severe storm, with the exception of hurricanes or tornadoes, encountered in the southeastern United

States. Cyclogenesis occurs slowly in the Gulf of Mexico, developing as wave action on a stationary front. As the cyclone moves across northern Florida, rapid deepening generally occurs and the cyclone accelerates northward, parallel to the coastline. Extensive multiple layered cloudiness occurs at Beaufort from the time the cyclone moves into the Atlantic until it passes Cape Hatteras to the north. Light to moderate rain, fog, and embedded thunderstorms are characteristic of this system. Surface winds may reach gale force near the center of the cyclone, with strong winds often affecting the Beaufort area. The following observational sequence was recorded at Beaufort during an Eastern Gulf Type IIa Cyclone.

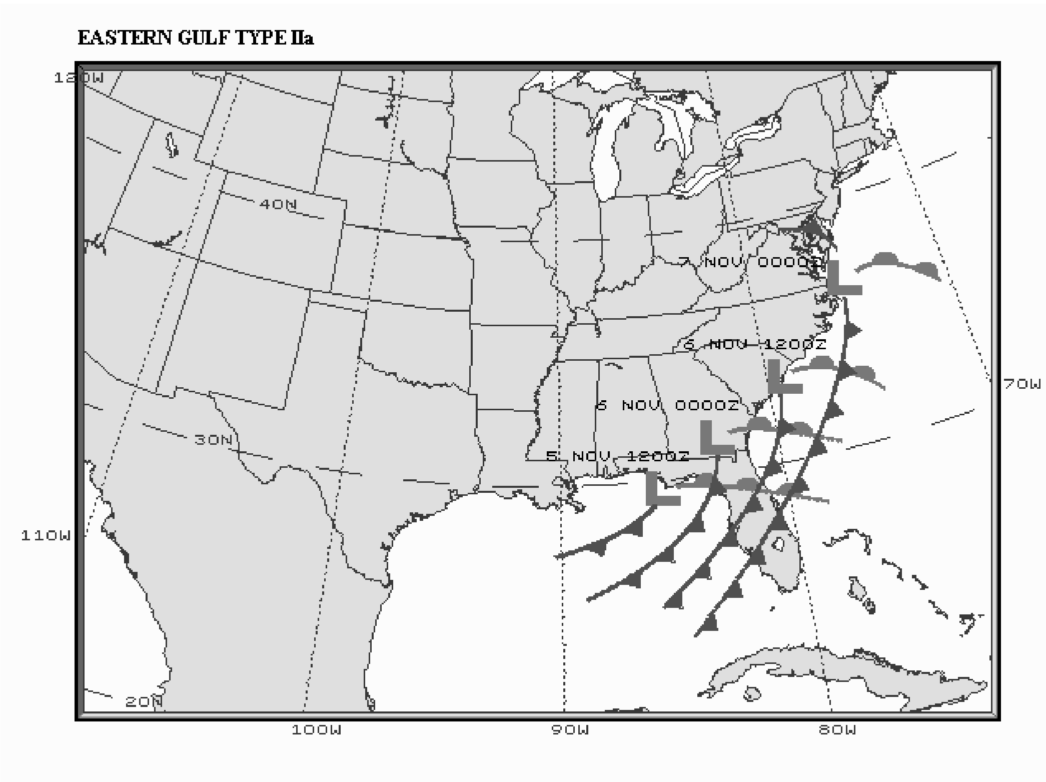


Figure 2.11

5 November:
1200Z—E7 BKN 12 OVC 7R-- 0312KT
1800Z—M5 BKN 10 OVC 5R-- 0312G20KT

6 November:
0000Z—M8 BKN 12 OVC 2RF 0224G33KT
0600Z—M7 BKN 12 OVC 4R—F 3622G36KT
1200Z—M4 BKN 8 OVC 5R—F 3424G31KT
1800Z—M8 OVC 7 3320G30KT

7 November:
0000Z—M12 OVC 7 3218KT
0600Z—M15 OVC 7 3112KT
1200Z—E15 BKN 7 3008KT

e. WESTERN GULF TYPE IIb: Cyclogenesis will occur on a stationary front in east Texas or the northwestern Gulf of Mexico. The trajectory of the cyclone is up the western side of the Appalachian Mountains, with little inclement weather occurring at Beaufort. Scattered low, broken middle, and high cloudiness are generally the prevalent features, with visibilities often reduced by fog or haze as the warm front moves rapidly through South Carolina. The trailing cold front will usually be dry with passage reflected through a wind shift. The following observational sequence was recorded at Beaufort during a Western Gulf Type IIb Cyclone.

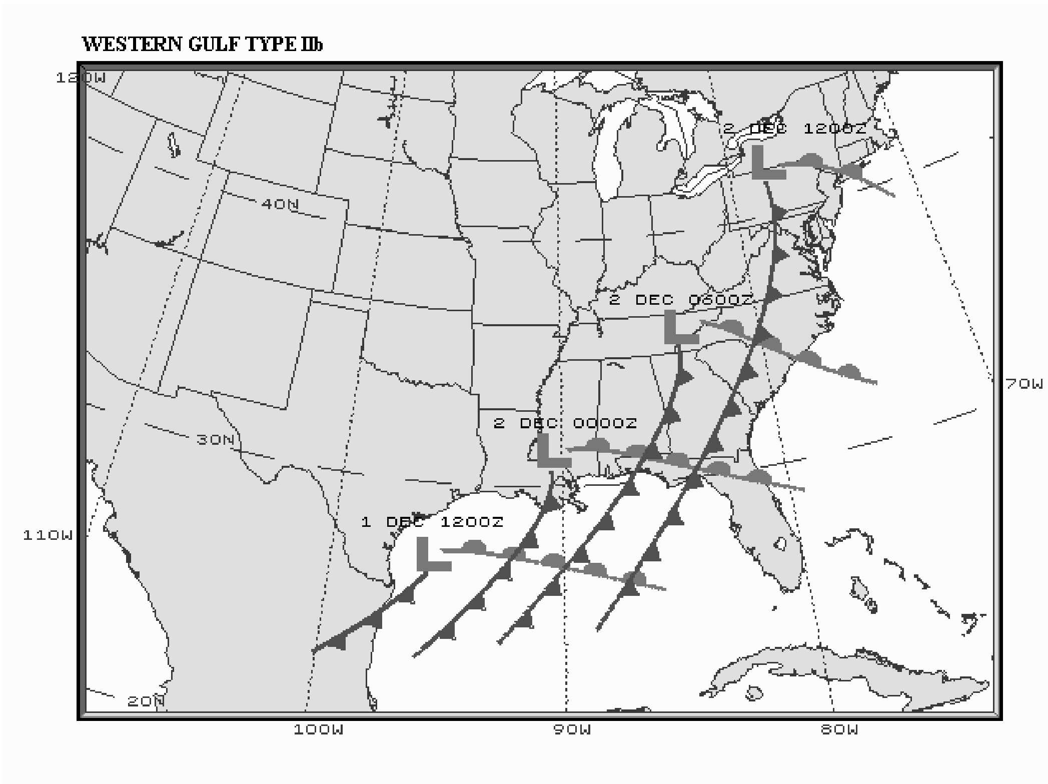


Figure 2.12

1 December:
1200Z -- 20 SCT 100 SCT E250 BKN 6H 1206KT
1800Z -- 20 SCT 100 SCT E250 BKN 5H 1207KT

2 December:
0000Z -- 20 SCT E100 BKN 250 BKN 4H 1308KT
0600Z -- 20 SCT 100 SCT 250 SCT 6H 2005KT
1200Z -- 25 SCT E100 BKN 250 BKN 6H 2510KT
1800Z -- 30 SCT 250 SCT 7 3007KT

5. HURRICANE HUGO: Hurricane Hugo, although recorded as one of the most powerful and devastating tropical cyclones of the century, left little, if any damage to MCAS Beaufort. Despite hitting landfall within 50 air miles of the station. Official meteorological records indicate landfall on 22 Sep 89 at 0400Z. Precipitation totals during the period 21-22 Sep are somewhat misleading (6.75 inches), more than five inches were do to a stationary wave over the state of South Carolina. The wave persisted for 48 hours, prior to the effects of Hugo. Gust in excess of 110 knots was reported in Charleston S. C. (50 air miles to the north), while the peak wind at MCAS Beaufort was recorded on 22 September 1989 at 0729Z of 42 knots. Due to rapid northwesterly movement upon landfall, Hugo soon became Extratropical and dissipated by 23 Sep 89 0000Z. Sparing MCAS Beaufort from a highly probable natural disaster.

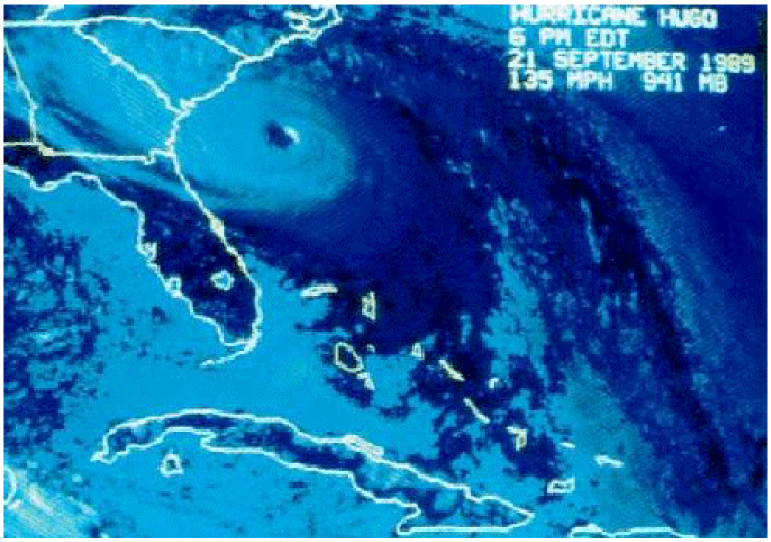


Figure 2.13

a. <u>OBSERVATIONS FROM MCAS BEAUFORT DURING HURRICANE HUGO</u>:
18/1600Z 100 SCT 250 SCT 5H 151/82/65/0207/998
18/2200Z 30 SCT 120 SCT 250 -BKN 6H 134/82/63/0210/993
19/1000Z 25 SCT E80 BKN 250 BKN 5H 134/69/63/0208/993
19/2200Z M15 BKN 25 OVC 3H 149/73/64/3604/997
20/1000Z M9 BKN 20 OVC 4H 143/69/62/3303/995
20/1600Z M9 BKN 10 OVC 4H 160/70/64/3002/000
20/2200Z M16 OVC 5H 155/73/67/0204/999
21/0400Z 7 SCT 20 SCT E100 BKN 250 OVC 6H 150/73/68/3503/998/DSNT LTG E T2
21/1000Z M5 BKN 10 OVC 3RWF 136/73/70/0207/993/CB NW-NE MOVG NW T DISPTD T1
21/1600Z 5 SCT E20 BKN 100 OVC 6F 128/75/73/2802/991/CB NW MOVG NW T1
21/1900Z 17 SCT E25 OVC 3RW-F 091/79/74/0108G15/980/CB DISPTD T1
21/2200Z 11 SCT E25 BKN 40 OVC 3R-F 045/76/73/3512G17/966
22/0200Z -X 4 SCT M9 BKN 16 OVC 1RF 923/74/71/3124G33/930/R2F2 PRESFR
22/0400Z -X 7 SCT M9 BKN 11/4R-F 855/74/71/3122G32/910/R2F2 DSNT LTG E PRESFR
22/0600Z -X M9 OVC 13/4R-F 894/73/70/2425G35/922/R2F2 PRESRR PK WND 2741/36/ 31073 17/79
22/0800Z 9 SCT 20 SCT E80 OVC 4F 983/74/68/1920G33/948/PRESRR PK WND 2742/29 T1
22/1000Z 12 SCT 25 SCT E120 BKN 250 OVC 6H 036/74/66/2114G28/964/ PRESRR PK WND
22/1300Z 25 SCT E250 BKN 6H 088/78/72/2010/979
22/1600Z 15 SCT E250 BKN 7 106/82/68/2108/985
22/1900Z 30 SCT E250 BKN 7 103/83/60/1808G18/984

TRACK OF HURRICANE HUGO

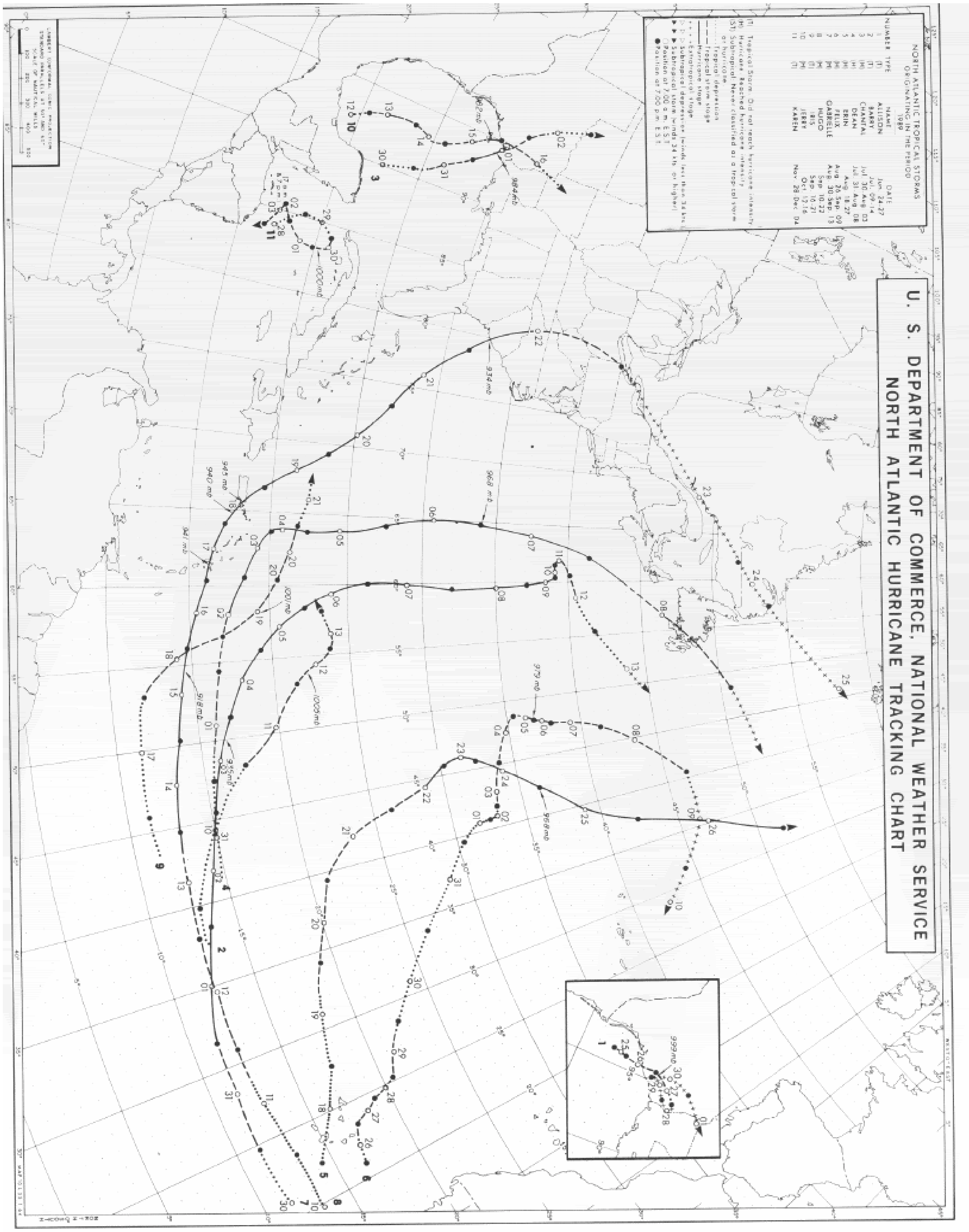


Figure 2.14

6. <u>**Monthly Climatological Summaries**</u>:

a. JANUARY: The synoptic situation is dominated by the northern edge of the Bermuda ridge located southeast of South Carolina. The weak ridge cannot hold the polar/arctic outbreaks, so frontal systems routinely move through the area producing showers. The close proximity of the ocean keeps the area temperatures mild, limiting most precipitation to rain, with the chance for snow limited to arctic outbreaks only. January is one of the coldest months and the worst month for IFR flying conditions.

SELECTED CLIMATE SUMMARY
AT :STA 722085 I KNBC I BEAUFORT MCAS ,SC,US
DURING JANUARY

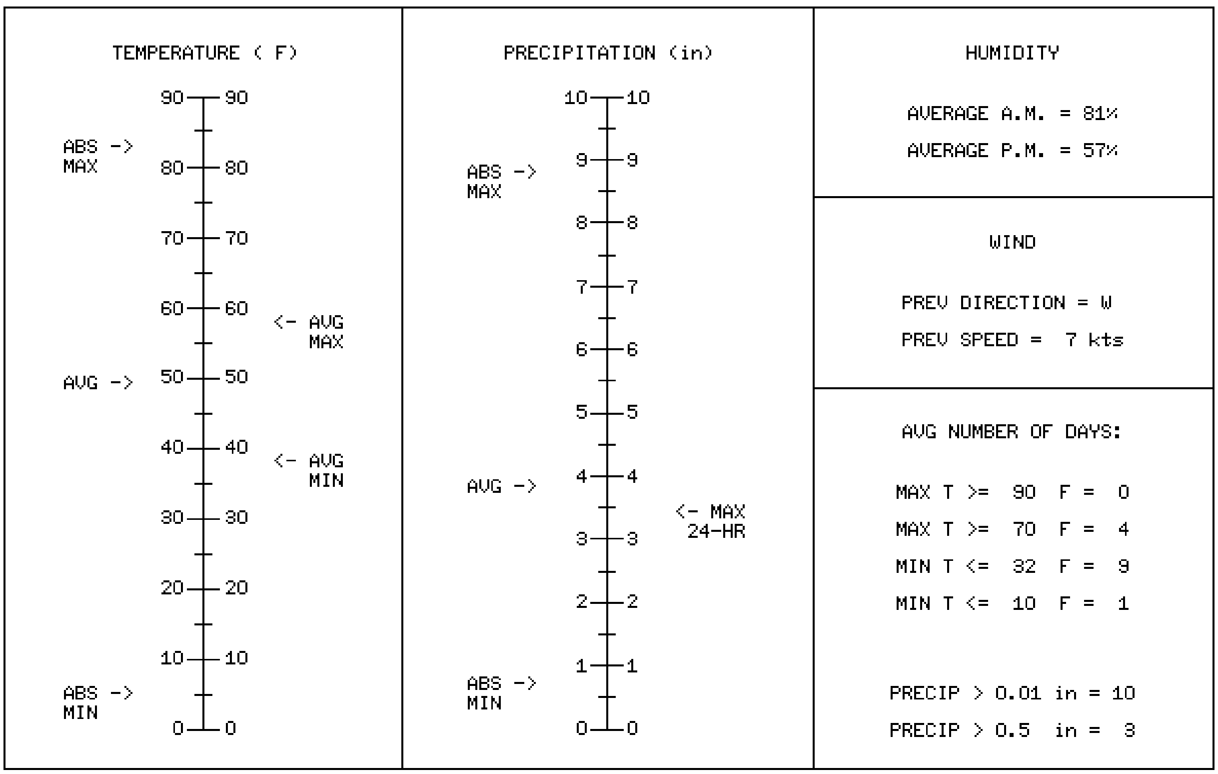


Figure 2.15

b. FEBRUARY: The Bermuda ridge is still weak and systems continue to move through the area. The close proximity of the ocean continues to keep temperatures mild and precipitation in the form of rain, however snow can occur early in the month. Temperatures increase slightly and flying conditions improve by the middle of the month.

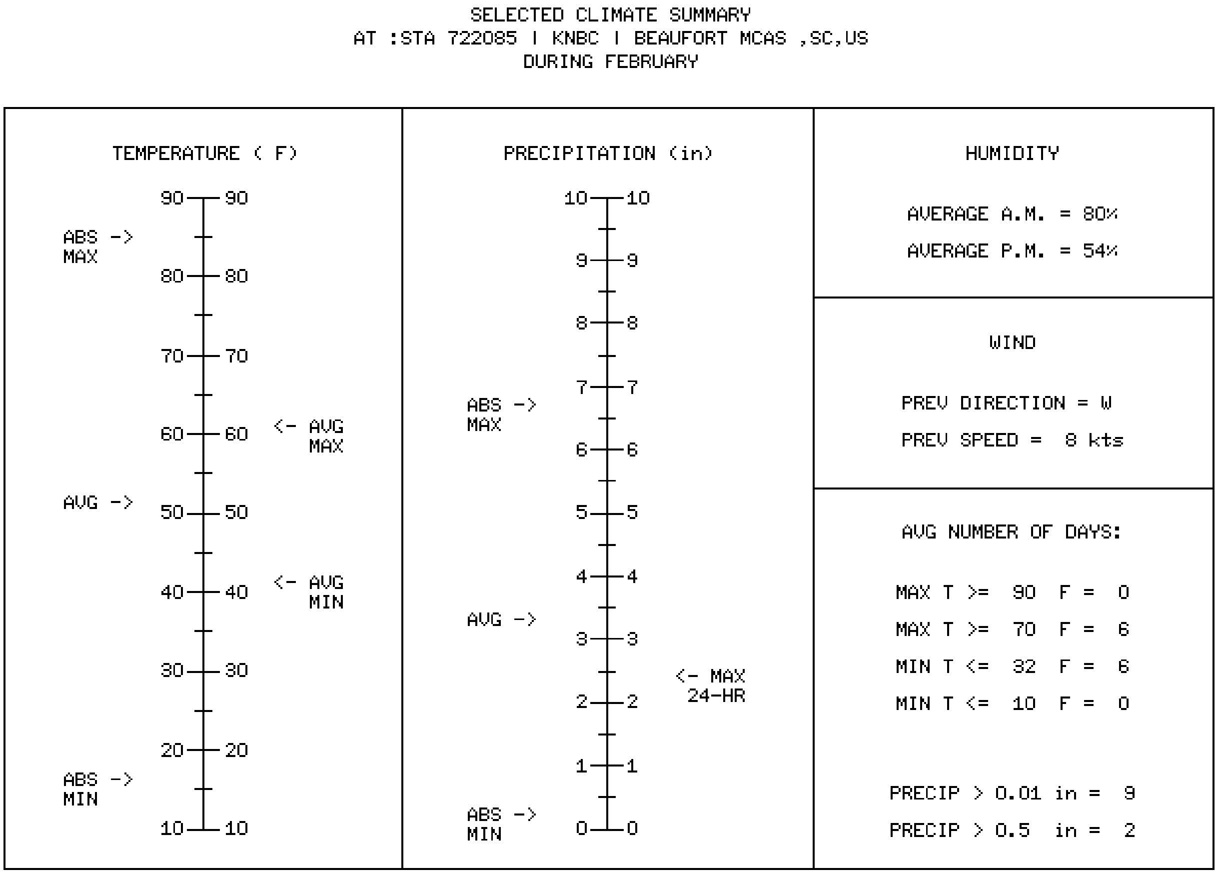


Figure 2.16

c. <u>MARCH</u>: March begins the first month of transition into spring with a combination of winter and summer conditions. In the spring frontal activity becomes less frequent as the Bermuda High begins its northward shift. However, while cold blasts of polar air continue to move over the area, warm tropical air is beginning to move up from the south.

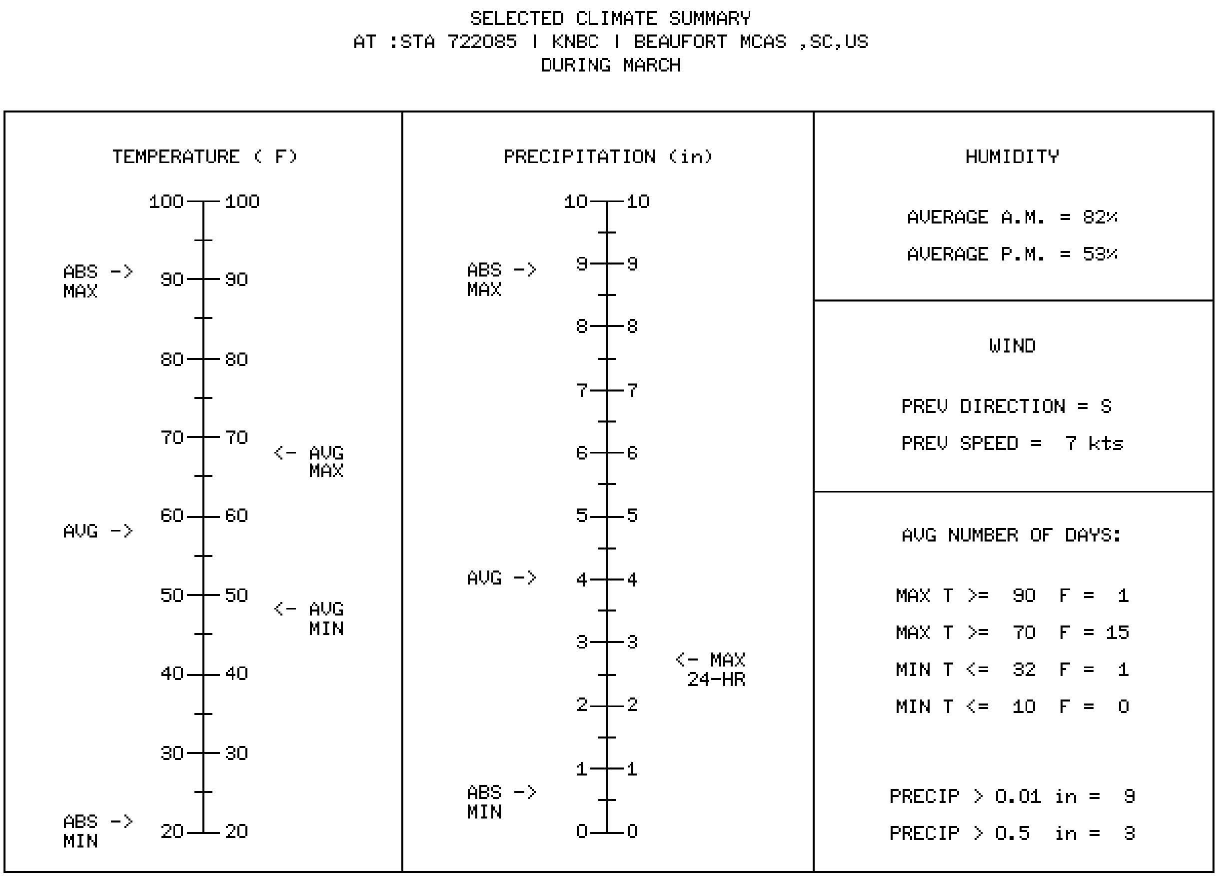


Figure 2.17

d. <u>APRIL</u>: April is still a transitional period with usually spectacular weather conditions. This is why Beaufort's destructive weather season commences April 1st. The reaction of cold polar air blasts and warm tropical air beginning to move up from the south produces thunderstorms and gusty surface winds.

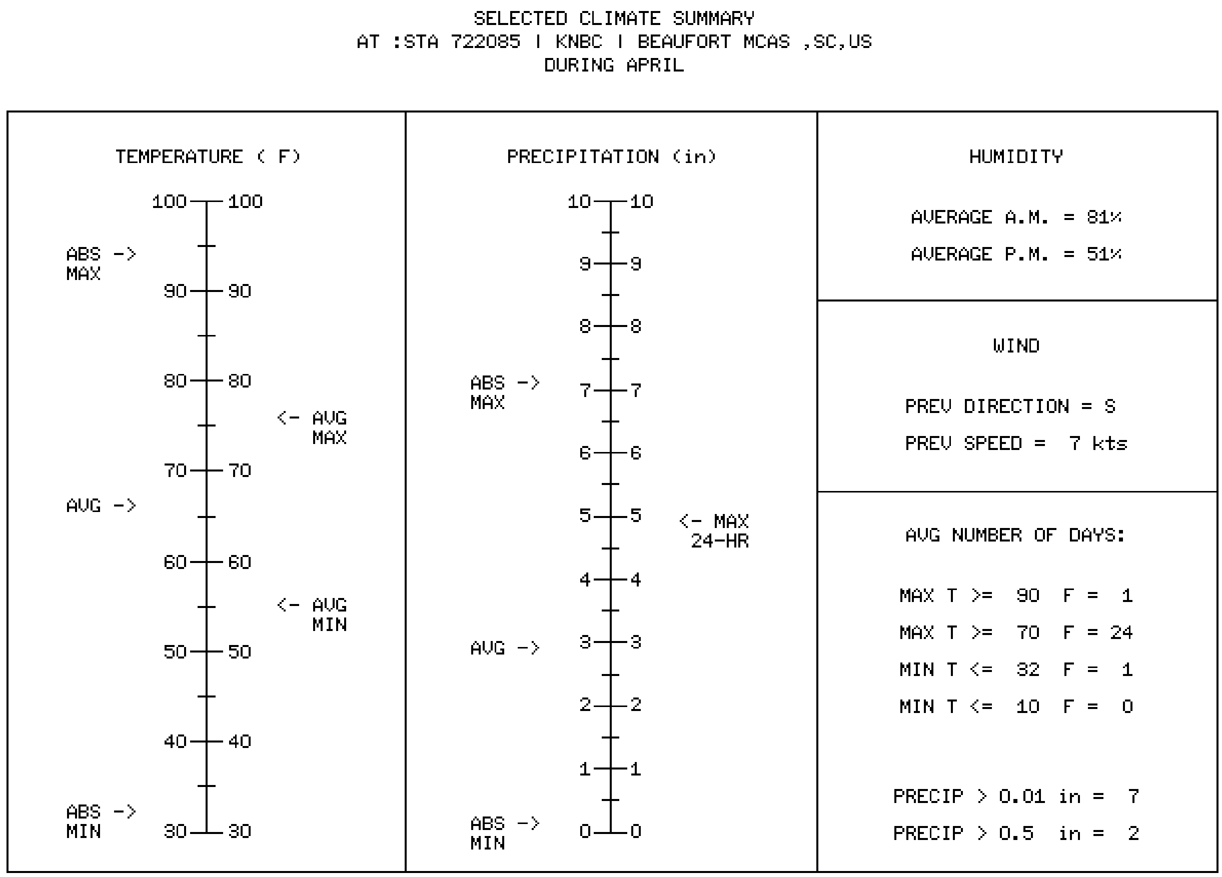


Figure 2.18

e. MAY: During May the Bermuda High begins to develop northward as the Iceland Low begins to weaken thunderstorms are more predominant than in April. Severe thunderstorms and tornadoes occur during the month of May due to inactive cold fronts moving through the southeast and encountering an unstable air mass and becoming stationary across South Carolina and Georgia. May is the middle of the destructive weather season.

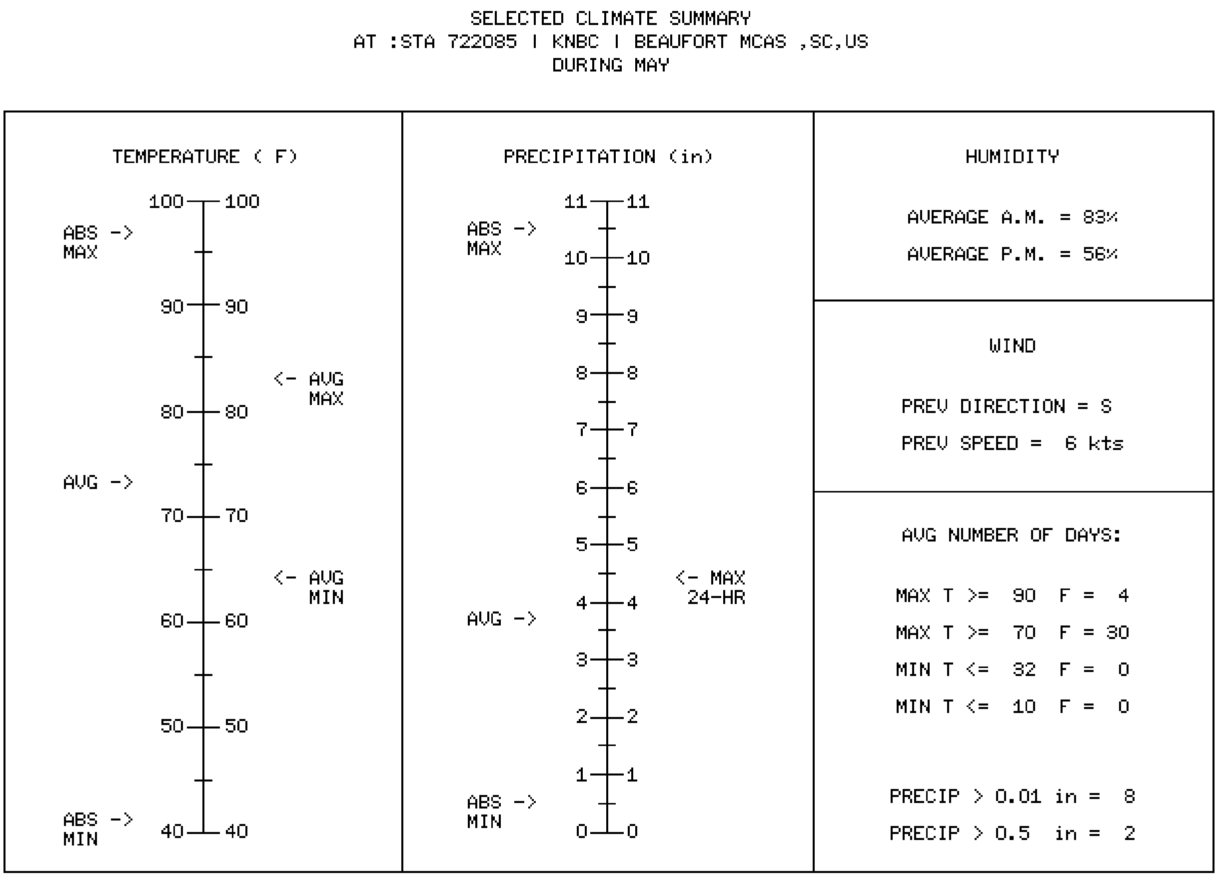


Figure 2.19

f. JUNE: June is the official onset of hurricane season. The Bermuda High axis has migrated further north of the May position, centered between the eastern United States and Africa. Frontal activity is rare but occasionally occurs due to strong continental air masses moving into the east central Untied States from Canada. The fronts usually become stationary through the Carolinas and are orientated east west. June is considered the last month that severe thunderstorms are common. Thunderstorm activity is more common during the evening than daytime, occasionally severe as in May.

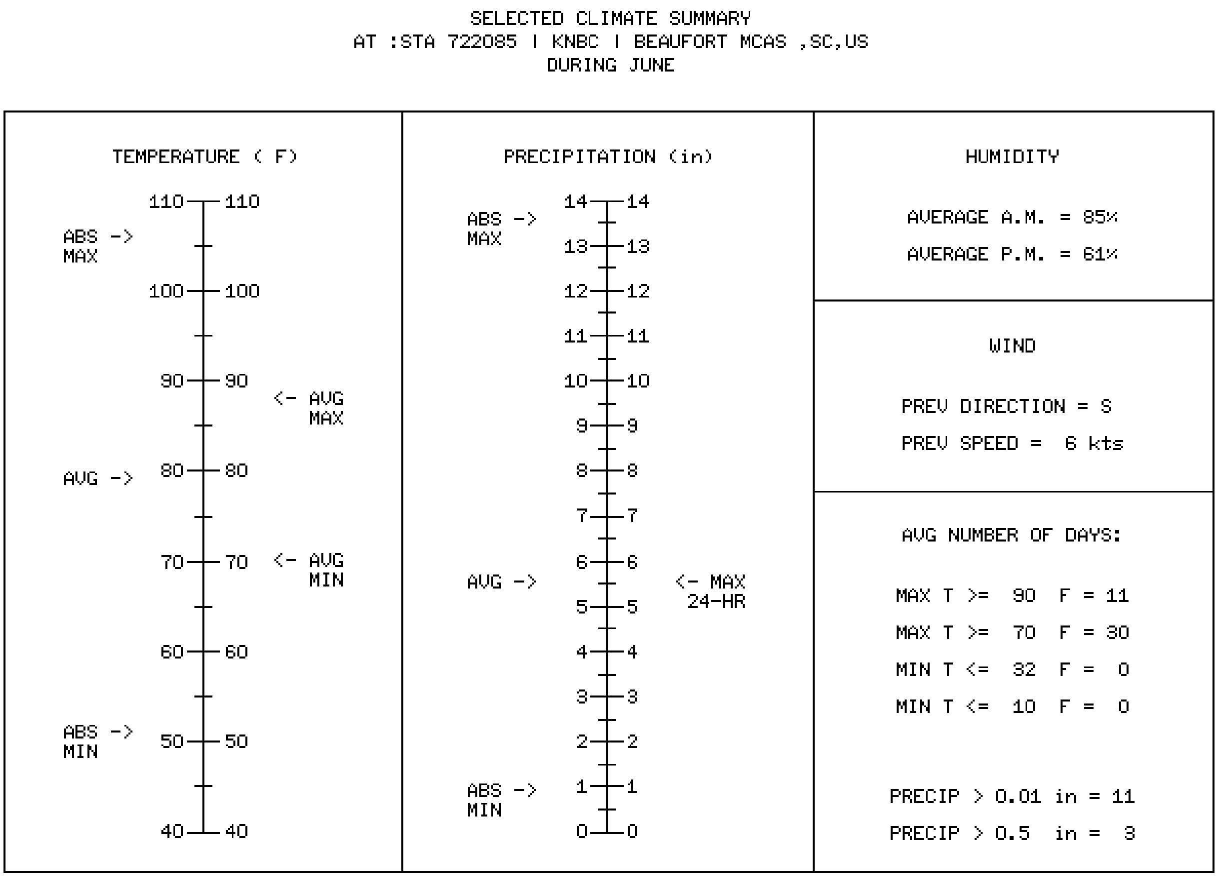


Figure 2.20

g. <u>JULY</u>: The local area weather is dominated by the Bermuda High and normally an upper level ridge. High daily temperature and warm humid nights are the norm. Southerly breezes prevail with an afternoon sea breeze causing mid afternoon and evening thunderstorms to develop over I-95 and move through the local area. Almost all weather is air mass showers/thunderstorms. Although it is the second month of the hurricane season, very few if any affect the air station.

SELECTED CLIMATE SUMMARY
AT :STA 722085 | KNBC | BEAUFORT MCAS ,SC,US
DURING JULY

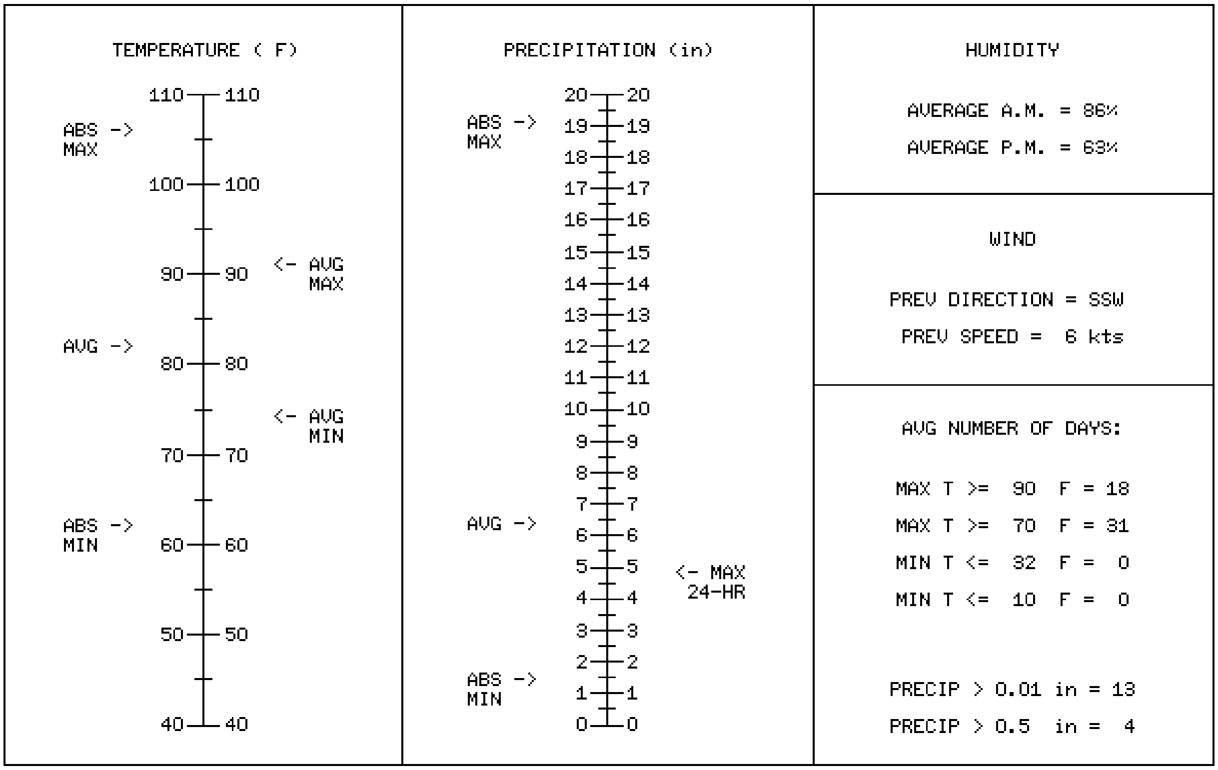


Figure 2.21

h. AUGUST: During August the local weather is much the same as July, with southerly winds, high daily temperatures and warm humid nights. Afternoon/evening thunderstorm activity can be expected with the interaction of the sea breeze front and the typical southwest flow. There is normally an increase in tropical cyclone activity, which the forecaster should be prepared for. Particular attention to the 500mb (588 contour) and the 300mb flow should be addressed when steering hurricanes in the vicinity of Beaufort. An increase in IFR conditions (ie. fog) will begin to occur in late August.

SELECTED CLIMATE SUMMARY
AT :STA 722085 | KNBC | BEAUFORT MCAS ,SC,US
DURING AUGUST

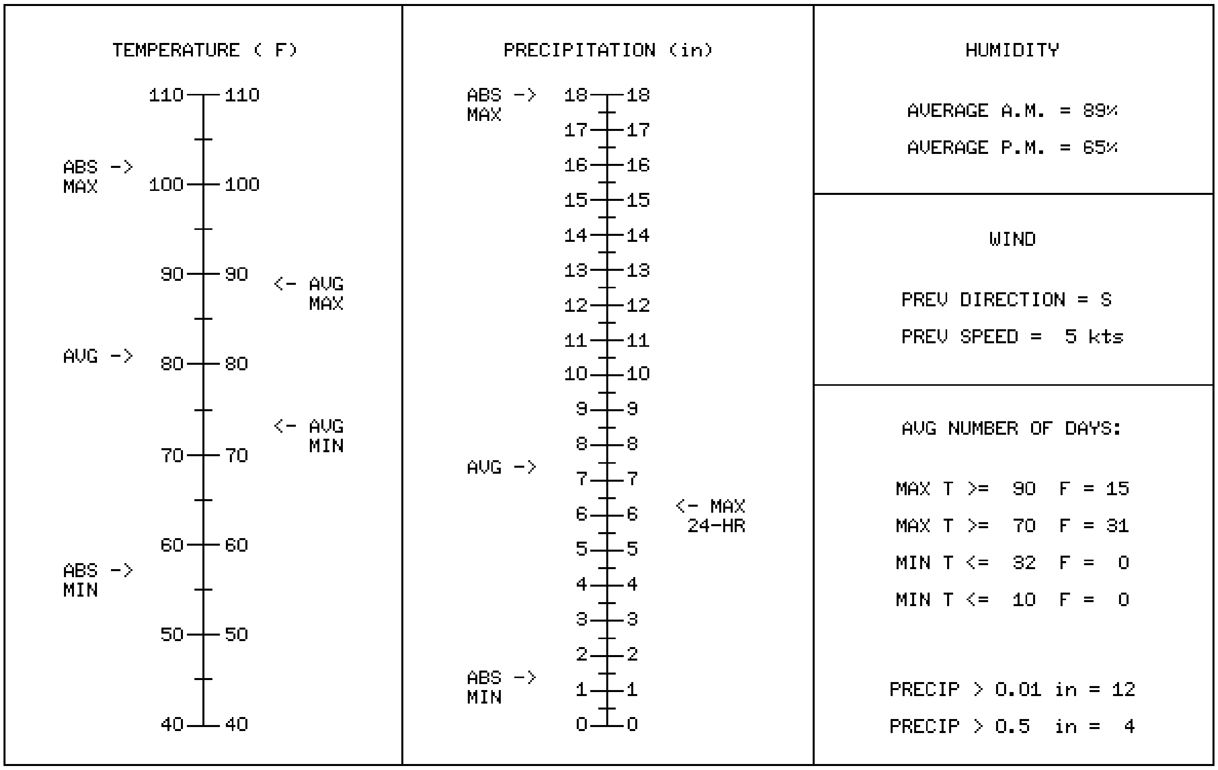


Figure 2.22

i. SEPTEMBER: Weather for September is dominated by the Bermuda High. The high, however, has begun to weaken which plays a major role in this being one of the most favorable months for an increased threat of tropical cyclone occurrence. A unique occurrence during this month is a low level jet, 2,000’-5, 000’ over the southeast numerous thunderstorms develop along and to the left of the jet axis. A sea breeze, which rarely exceeds 15kts, will moderate and effect the time of max heating which in turn is a determining factor for the strength and time of airmass activity.

SELECTED CLIMATE SUMMARY
AT :STA 722085 | KNBC | BEAUFORT MCAS ,SC,US
DURING SEPTEMBER

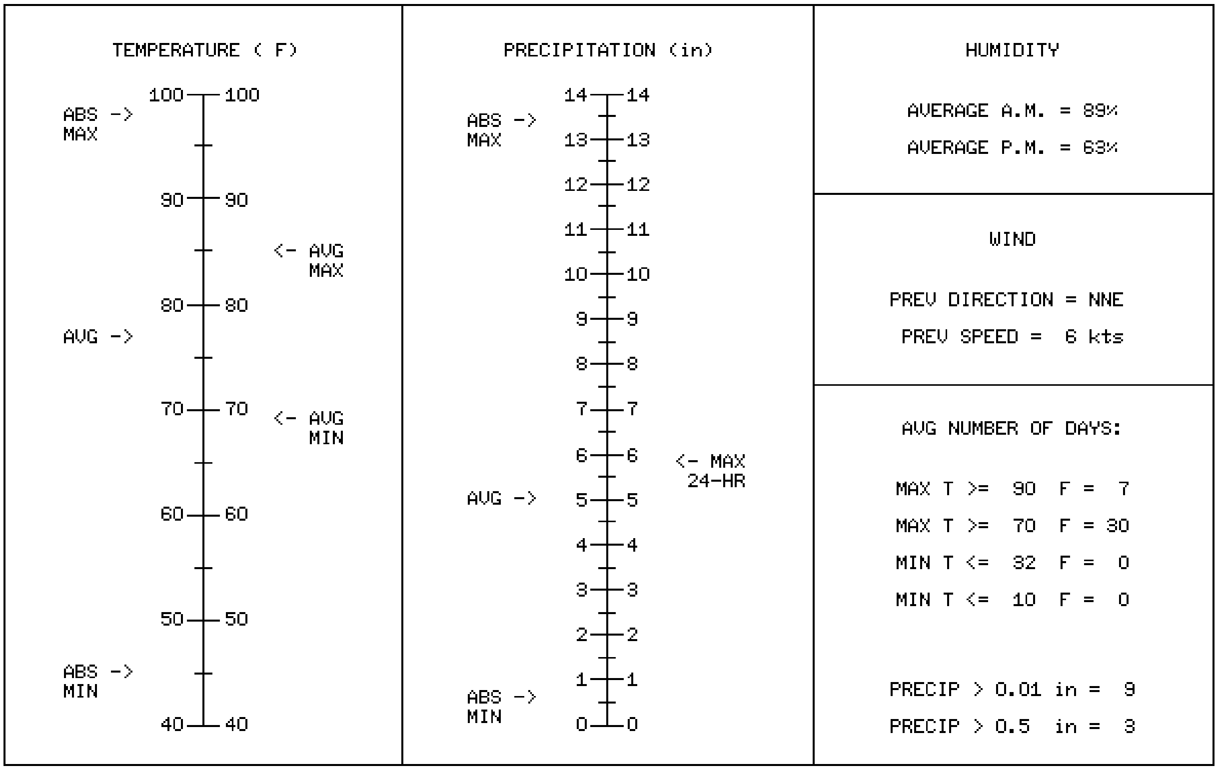


Figure 2.23

j. OCTOBER: October has a significant reduction in rainfall and thunderstorm activity. The Bermuda High, which continues to play a major role on the local weather, has now begun its southerly retreat. Once again this phenomenon enhances the threat of hurricane occurrence. Frontal activity begins in October, but is rarely accompanied with severe weather. Cold Frontal thunderstorms are preceded by 24-72 hours of airmass activity. The formation of a low-level jet is favorable as in September.

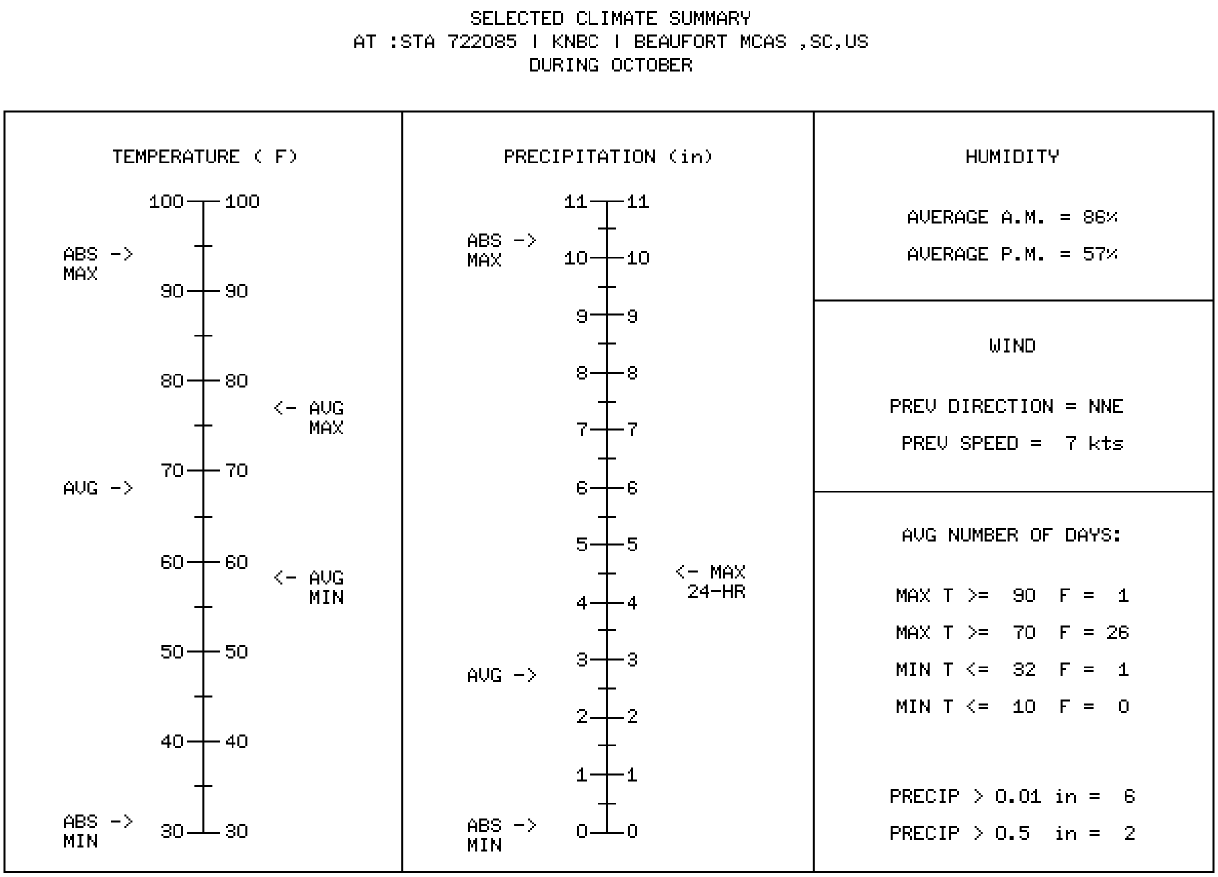


Figure 2.24

k. <u>NOVEMBER</u>: In November the synoptic pattern generally consists of successive cold frontal passages with an occasional warm frontal passage. Air mass type weather is rare as the Atlantic ridge is moving toward the south now and is not a player in the local weather pattern. The prevailing westerlies become stronger as the Polar Front Jet migrates southward. Severe weather outbreaks are not common when compared to the Spring transition. The worst weather for aviators will originate in Texas or in the Gulf of Mexico as a wave on a stationary front. November is the last month of hurricane season, however, weather of a tropical nature is not common.

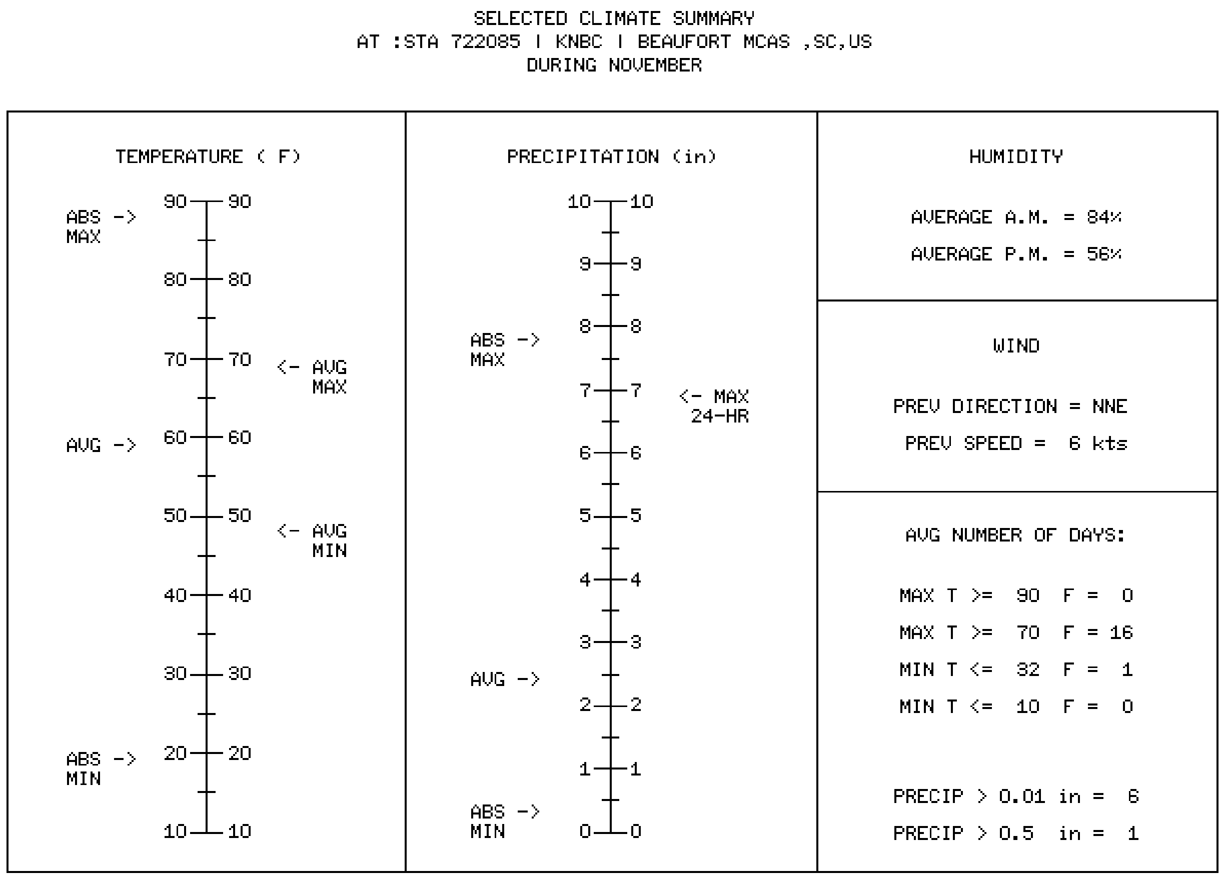


Figure 2.25

l. <u>DECEMBER</u>: The prevailing westerlies are nearing their peak strength as the Polar Front Jet is thoroughly entrenched in the middle latitudes. Frontal activity is vigorous. Wintertime systems that develop in the Gulf of Mexico and Texas can bring low ceilings, poor visibility and substantial precipitation to the local area for prolonged periods of time. The occurrence of snow at Beaufort is rare during December.

SELECTED CLIMATE SUMMARY
AT :STA 722085 | KNBC | BEAUFORT MCAS ,SC,US
DURING DECEMBER

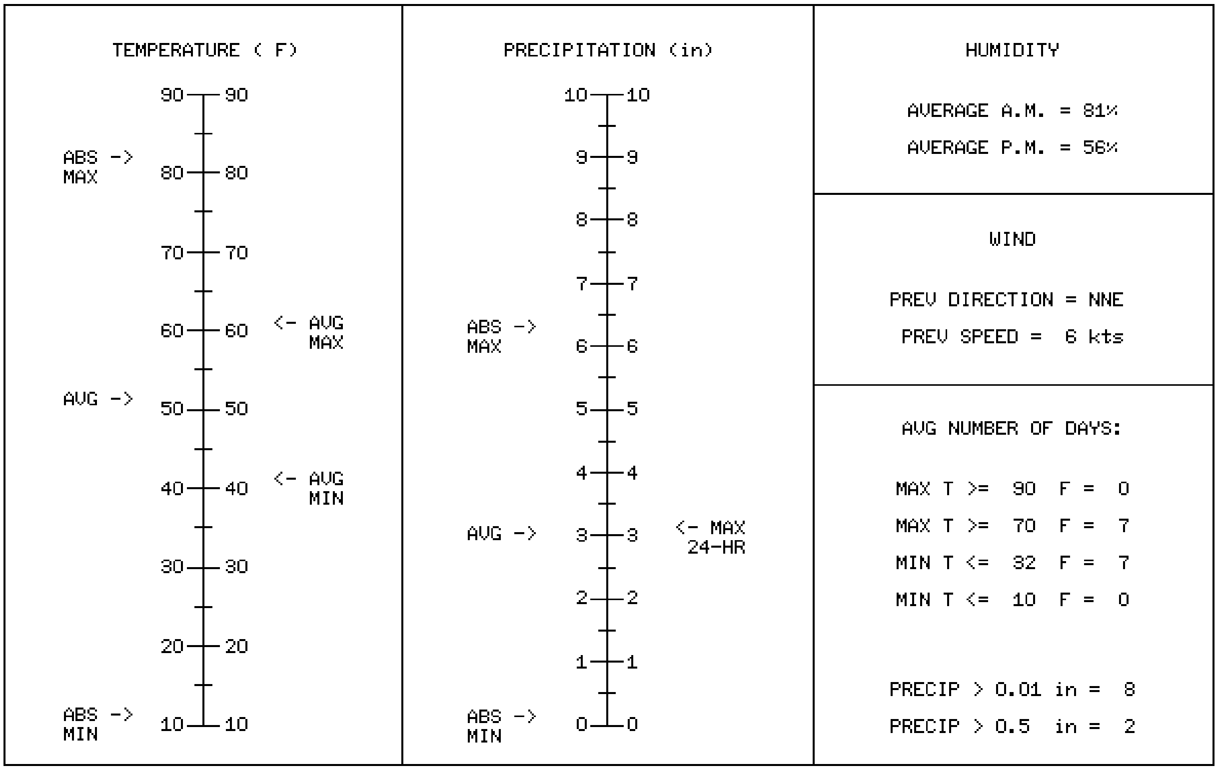
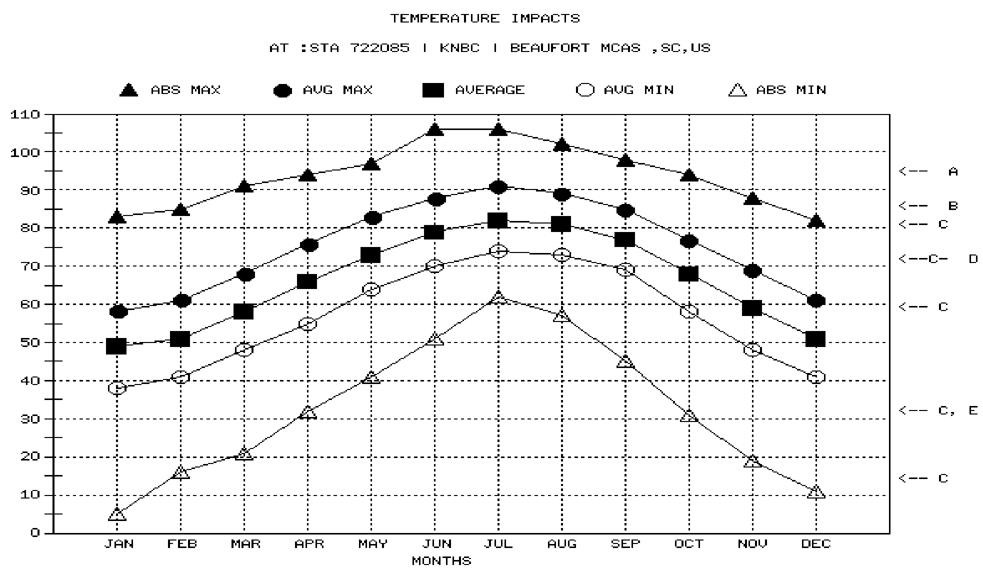
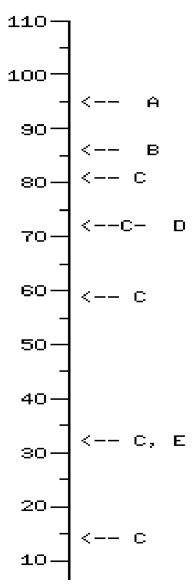


Figure 2.26

IMPACT OF TEMPERATU

ON MILITARY OPERATIONS AT MCAS BEAUFORT





-------------- IMPACTS -----------

A: HEAT STRESS ON PERSONNEL BECOMES SEVERE

B: PAYLOAD RESTRICTIONS FOR APACHE COBRA, BLACKHAWK, KIOWA

C: CRITICAL THRESHOLDS FOR CHEMICA OPERATIONS

D: HEAT STRESS PROBLEMS BEGIN FOR PERSONNEL IN MOPP GEAR

E: VEHICLE START PROBLEMS BEGIN, COLD STRESS ON PERSONNEL

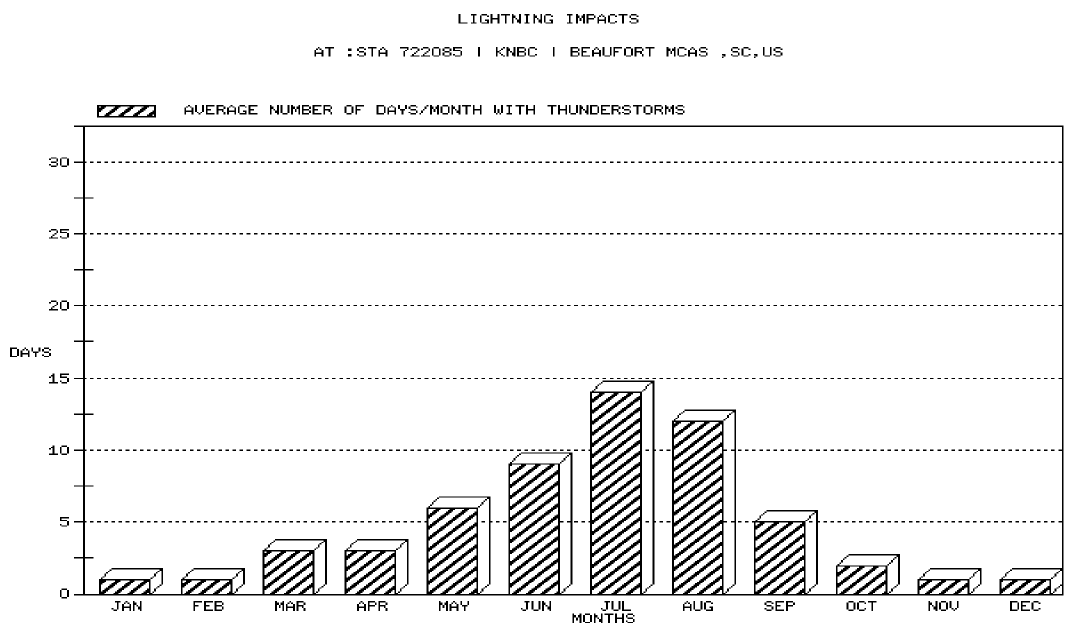
F: COLD STRESS ON PERSONNEL BECOMES SEVERE

SOURCE: Army Tactical Weather Dat Requirements, USAICS, Aug

Figure 2.27

IMPACT OF THUNDERSTORMS

ON MILITARY OPERATIONS AT MCAS BEAUFORT



----------------- IMPACTS -----------------

- AIR DEFENSE: AFFECTS TARGET ACQUISITION RADAR
- AVIATION: AFFECTS REFUELING, SAFETY AND COMPUTER OPERATIONS
- MEDICAL: PERSONNEL SAFETY, TRAFFICABILITY OF EVAC AND LOGISTIC VEHICLES
- MILITARY POLICE: COMMUNICATION, NIGHT VISION DEVICES, AND PERSONNEL SAFETY
- ORDNANCE AND QM: AFFECTS SAFE STORAGE AND HANDLING OF EXPLOSIVES

SOURCE: Army Tactical Weather Data Requirements, USAICS, Aug 90.

Figure 2.28

SECTION III
FORECASTING

1. Subjective Rules
2. Objective Rules
3. Special Features

Section III Forecasting

1. Subjective Rules:

a. After cold frontal passage in Summer, do not forecast air mass thunderstorms for two days following the frontal passage, as it takes this long before the dry, cool polar air behind the front is modified sufficiently to allow the warm moist southerly low level flow most conducive to convective activity to become dominant again.

b. Early morning stratus over the field during the summer is an indication that a southeasterly low level flow is in effect and thunderstorm activity can be expected by late morning.

c. With a low level southerly flow, no fog or visibilities no less than five miles.

d. Winds at 3000 ft of 18 kts or greater, no fog.

e. If a cold front moves east of the Appalachians by early afternoon, chances of a squall line formation are minimal. Forecasters should be aware that a trough line often lies east of the mountains while the surface front lies along or west of the mountains. Double check facsimile charts for accuracy.

f. Squall line will not form if a surface anticyclone is centered so as to produce an easterly flow over the coastal areas of South Carolina.

g. Hail seldom falls at this station but since large thunderstorms occur frequently throughout the local area, forecasters should not discount the possibility of damaging hail over the airfield.

h. Small hail will occur occasionally during the winter with cold frontal thunderstorms.

i. It is known through empirical methods that the occurrence of low tide during the early morning hours in the winter season will result in a two to four degree lower minimum temperature than would normally occur.

j. MCAS Beaufort lies between three large rivers. It has been found that cumulonimbus developing to the south and southwest often align and develop along the Savannah River before moving northward. If a southerly flow exists at the steering level these cells will move northward to the intersection of the Broad River where they split northwest and west. Those cells moving northwest track up the Broad River to the convergence point of the Pocataligo, Tulifiny and Coosawhatchie Rivers. These cells will then resume a normal north to northeast track and pass over Yemassee or as close as the approach end of runway 23.

k. Maximum effects of thunderstorm activity will be felt over the airfield by thunderstorms that form to the east or northeast and move onshore, then track up the Coosaw River until they reach a point approximately one mile to the northwest of the station, then continue their movement across the runway layout.

(l) Checklist for forecasting airmass thunderstorms at MCAS Beaufort**. Determine the following:**

ortant single predictor of daytime thunderstorms is:

AIRMASS THUNDERSTORM CHECKLIST	
Low Level Moisture present in the morning?	Y - N
CCL	FAV / UNFAV
Convective Temperature: _______ Forecast Maximum Temperature: _______	FAV / UNFAV
Inversion Present? STG - MDT - WEAK - NONE	
Cap Strength _______ ^{o}C	
Is inversion strong enough to retard convective activity?	N - Y
PEA extend well above the freezing level? (preferably -10^{o}C)	Y - N
Does moist layer extend to 10,000' ?	Y -N
Stability Indices: SSI: ______ KI: ______ TT: ______ B+: ______ LI: ______	FAV / UNFAV
Thunderstorms or TCU's present the previous day?	Y - N
Changes at lower or upper levels will (ENHANCE/RETARD) further development?	ENH / RET

NOTES
1. Most important single predictor of daytime thunderstorms is: ***LOW LEVEL MOISTURE PRESENT IN THE MORNING.***
2. Inversions are of prime consideration must decide if heating/lift is enough to overcome inversions.
3. Consideration of synoptic situation changes should also be addressed.

Figure 3.1

2. Objective Rules:

a. When a weak pressure gradient exists during the summer, a southeasterly sea breeze will occur during the afternoon. After sunset, a northwesterly drainage or land breeze will set in and last until shortly after daybreak.

b. During the summer when a long wave trough stagnates over the Rocky Mountains or the great plains states a ridge of high pressure will be over or just off the east coast and a heat wave will result.

c. Two prerequisites for a cold wave over the Southeastern United States are cP air and an anticyclone near 1040 Mb or higher over west central Canada. A strong northwesterly flow will spread the cP air mass southward. Often two polar outbreaks will follow each other in rapid succession. When this occurs the second outbreak will move more rapidly than the first and spread the cold air further south.

d. Cold waves are usually not persistent. Temperatures will warm after 36 to 48 hours.

e. When an enclosed anticyclone aloft exists over the central United States the easterlies on the South side of this high rarely extend to the equatorial zone. A second anticyclone is commonly located over the Gulf of Mexico or the western Caribbean. Between these two highs is an upper shear line oriented northeast—southwest. This is a prime area for cyclogenesis to occur.

f. A cold front will be inactive if the 700-Mb flow is perpendicular to the surface front.

g. A cold front will be active if the 700 Mb flow is parallel to the surface front. Generally, the clouds and precipitation will extend behind the front as far as the 700-Mb wind flow parallels the front.

h. Cloudiness and precipitation will occur with a warm front when the 700-Mb flow is across the front from the warm to the cold side and either turning cyclonically or moving in a straight line.

i. Warm fronts will have no weather and few clouds if the 700-Mb flow above them is anticyclonic. Frontolysis is generally in progress.

j. If an anticyclone is moving over the eastern United States from the south in a straight line or curving cyclonically cloudiness and precipitation can be abundant under the trailing edge.

k. Mostly clear skies will prevail in an air mass moving from the north in a straight line or curving anticyclonically.

l. Elongated troughs will have extensive cloudiness and precipitation in the southerly flow ahead of the trough line with clearing behind the trough line.

m. During periods of southerly flow from 10,000 feet to 20,000 feet along the East Coast look for cyclogenesis, particularly if a cold front parallels the East Coast.

n. If there is more than one wave along a front the one with the most intense positive vorticity advection will develop at the expense of others. This is most often the one nearest the axis of the trough aloft.

o. If a jet stream flows across the southeastern United States into the Atlantic, lows developing south of the jet will not move northward.

p. The second night after a cold frontal passage during winter will be colder than the first.

q. Light northerly winds at night will bring morning fog and or stratus.

r. When a cyclone becomes stationary the area of precipitation tends to be extended to the rear of the system, with a simultaneous tendency for the precipitation to decrease in the forward part of the storm.

s. In cPk and cAk air masses in winter, look for low broken to overcast cloudiness with wide spread snow on the lee side of the Great Lakes and on the windward side of the Appalachian Mountains.

t. Cyclones developing in the Gulf of Mexico pursue a northeasterly path, either to the east or the west of the Appalachian Mountains but seldom cross them.

u. Circular or nearly circular cyclonic centers move in the direction of the isallobaric gradient, whereas anticyclonic centers move in the opposite direction. The speed is directly proportional to the isallobaric gradient and inversely proportional to the curvature of the pressure gradient.

v. Although tornadic activity in the immediate vicinity has been at a minimum in the past, careful monitoring of the synoptic situation should be maintained. Some parameters to look for include:

(1) Is there a layer of moist air of moderate thickness near the surface, topped by a deep layer of dry air that has a steep lapse rate; that is, a sharp decrease in temperature with altitude?
(2) Does the horizontal moisture distribution within the moist air exhibit a distinct maximum along a relatively narrow band; or, is there a moisture wedge where dewpoints of 55 F or higher are present?
(3) Does the horizontal distribution of the wind aloft exhibit a maximum speed along a relatively narrow band at some level between 10,000 feet and 20,000 feet, with the maximum speed exceeding 35 knots?

(4) Does the vertical projection of the axis of maximum wind intersect the axis of the moisture ridge?

(5) Is the temperature distribution of the air column as a whole indicative of conditional instability?

(6) Is the upper surface of the moist air subject to appreciable lifting? If all six conditions prevail simultaneously, then tornadoes can be anticipated. If at least four conditions are met the remainder will become satisfied by the time of tornadic outbreak. The Showalter's Stability Index is a good indicator of thunderstorm formation and intensity. It is determined from the LCL for the 850mb level. Follow the saturation adiabatic from the 850mb LCL to the 500mb level. Read the isotherm at that point and label its value as 'T'. The Showalter Index is equal to the temperature at the 500mb level minus the value labeled 'T'.

Values for Convective Cloudiness

Value	Result
+4 or Higher	Little chance
+2 to +3	RW probable, TRW possible
+1 to -2	TRW probable to increase rapidly
-3 to -4	Severe TRW
-5 or less	Tornadic Conditions

w. The 500mb Lifted Index is another good indicator of thunderstorm formation and intensity. It is determined using the mean mixing ratio for the lowest 3000 ft. and the forecast maximum temperature lifted dry adiabatically to the intersection with the mean mixing ratio. From the LCL formed by this intersection, follow the saturation adiabat to the 500mb level. Label the value of the isotherm as 'T'. The lifted index is equal to the 500mb temperature minus the value labeled 'T'. Evaluate as you would the Showalter Index. (see above)

3. Special Features:

a. TORNADOES: Most frequent occurrence of tornadic activity occurs during the spring transitional months of March and April, as a result of interaction between the Polar Continental high pressure cells and the Atlantic ridge. April is known as tornado month in South Carolina. Most tornadic activity occurs 10 miles inland; however funnel clouds have been observed by weather personnel at this station and evidence of tornadic destruction has been seen in the city of Beaufort.

b. SEA BREEZE: Sea breezes are of course most predominant during the summer months during periods of maximum heating. Sea breeze direction will be from the southeast and rarely exceed 15 knots at MCAS Beaufort. The effects of the sea breeze are inconsequential except that it affects the time of occurrence of the maximum temperature, which is in turn a determining factor of the timing and intensity of afternoon thunderstorm activity.

c. LAND BREEZE: The land breeze may occur year round but is most predominant during the summer months during the evening. Direction is from a northerly quadrant rarely exceeding 8 knots.

d. TROPICAL CYCLONES: Hurricane season last from 1 June through 30 November. Although tropical cyclone activity can occur during any month. Tropical Cyclone Conditions of Readiness are set by the Commander, Disaster Control Group (DCG) 6.1, Naval Base, Charleston, S. C. MCAS Beaufort falls in the Sub Area ALPHA 1 of the Sixth Naval District storm areas map. Aircraft Hurricane Evacuation Conditions of Readiness (HUREVAC) are set by COMSEABASEDASWWINGSLANT. The weather office functions during periods of tropical cyclone activity are to disseminate the conditions of readiness being set, to the various commands aboard the Air Station and Marine Corps Recruit Depot, Parris Island. Also, to advise the commands of readiness as actual conditions may require.

e. FOG: Advection fog is most common in the Beaufort area with the most dense fog occurring during the early morning hours followed by rapid "burning off" as heating occurs. Light northerly winds are most optimum for the formation of dense fog. Fog producing visibility of 1 mile or less has a maximum frequency of occurrence during the months of November through March. Fog reducing visibility to 1 -- 3 miles occurs year round with least frequency during the months of June and July. Less dense fog, reducing visibility to 3 -- 6 miles occurs throughout the year with highest frequencies during the months of May through November with September being the peak month.

f. Thunderstorms:

(1) Air Mass Thunderstorms: The air mass thunderstorm season begins in late April and lasts through early October, with the greatest frequency occurring from late May through early September. During this period conditions are the most favorable for the thunderstorm development under a warm, moist south to southwest flow from the surface through all levels aloft. Unfavorable conditions exist when the flow above 25,000 feet is north through east and becomes progressively more favorable as these winds veer into the southeast and then around to south through southwest. Several stations take upper air soundings for SKEW T LOG-P DIAGRAM plotting and the facsimile chart depicting stability indexes is transmitted twice daily. Thunderstorms may exist throughout the night off the coast east and southeast of KNBC and usually dissipate by midmorning. Only rarely will these thunderstorms move over the station and then between the hours of 0500 and 1000, seemingly in conjunction with the northern portion of an Easterly Wave or an inverted trough (surface or aloft) moving westward. A strong 35 to 50 knot low level flow at 2,000 to 5,000 feet from the south to southwest will cause numerous thunderstorms along and to the left of the path of this jet. This is especially true in the late spring and early fall. The general movement of the thunderstorms is toward the northeast through southeast following the general flow pattern of the steering level. The steering level found to be most useful is the mean vector wind between 10,000 feet and 20,000 feet when the average velocity in this stratum is greater than 10 knots. Air mass cumulus clouds usually form near 3000 feet from late spring through early fall regardless of the height of the convective condensation level. A closed high of 1018 Mb or more, or a strong ridge, oriented in the Central or Eastern Gulf of Mexico will tend to drastically reduce or even eliminate thunderstorm activity through most of the Southeastern United States. A closed high in the Western Gulf of Mexico will aid in the formation of a low level trough along the Southeastern United States which in turn will increase thunderstorm activity in the local area.

(a) Role of the Sea Breeze Front in Producing/Enhancing Thunderstorms: The Sea Breeze Front can have a significant impact on thunderstorm development at MCAS Beaufort and should be monitored closely along with the onset of high tide when forecasting thunderstorm probability. Generally, if conditions are favorable, air mass thunderstorms will develop prior to the onset a sea breeze due to surface heating. However, if instability is only marginal for thunderstorm development then the sea breeze front will sometimes act as a trigger to initiate convection. The WSR-88D enables forecasters to easily track the sea breeze front, in both the clear-air mode and the precip mode, using spectrum width and base reflectivity products utilizing the time lapse. The Sea Breeze Front will show up as a very thin line oriented parallel to the coast, and on occasion, can be tracked as far as 50 NM inland. Forecasters should pay particular attention to this boundary if other storms or boundaries are in the area. As seen in Figures 3.2-3.5 the Sea Breeze Front can interact with outflow boundaries from other storms and produce devastating results in a very short period of time. In this particular case, the storms that extended from Augusta, GA - Florence, SC were associated with a short wave moving through the northern and central portions of the state. Initially it appeared as though most of the dynamics associated with these storms would remain to our north sparing the Air Station from the severe weather that was being experienced. However, if the forecaster is aware of the location and intensity of the Sea Breeze Front, and is tracking the outflow boundaries from the storms to the north, then it is obvious that the potential for severe weather extends well south of Savannah. Note the Sea Breeze Front in Figure 3.2 and the outflow boundary that extends from Augusta eastward through Orangeberg. As these two boundaries converged, intense thunderstorms were initiated along the Sea Breeze Front. Here at KNBC, within 30 minutes a severe storm developed just west of the Air Station that produced maximum tops several thousand feet above the Troposphere and hail with ¾ “ diameter. In this case the forecaster had over three hours of lead time to alert units as to the threat of severe weather, by monitoring the Sea Breeze Front and understanding how it can initiate or enhance thunderstorm activity.

(2) Frontal Thunderstorms: Warm frontal thunderstorms are rare occurrences at KNBC. When they do occur it is generally in conjunction with a Gulf Wave apex moving northeastward from near Pensacola. In this instance, the thunderstorm activity will appear approximately 150 NM in advance of the frontal surface. Cold frontal thunderstorms are common at KNBC, with late spring and early fall cold frontal thunderstorms preceded by 24 to 72 hours of air mass thunderstorm activity in the Southeastern United States.

(3) Squall Line Thunderstorms: Forms most often on a north-northeast / south-southwest orientation in Mississippi and Alabama and occasionally east of the Appalachians. Their path of movement is most evident in late February through March and extending sporadically through April. A favorable situation for squall line development occurs when the 8000 foot flow between Tallahassee, Athens, and Lake Charles or Shreveport show either speed or directional convergence, even if the surface maps show no evidence of squall line development, or indication of such development.

g. Temperature:

(1) Maximum: With no other factors taken into consideration, the maximum temperature during the summer will normally be within the range of the 850 Mb temperature brought to the surface dryadiabatically plus 3 degrees. Modifications to apply:

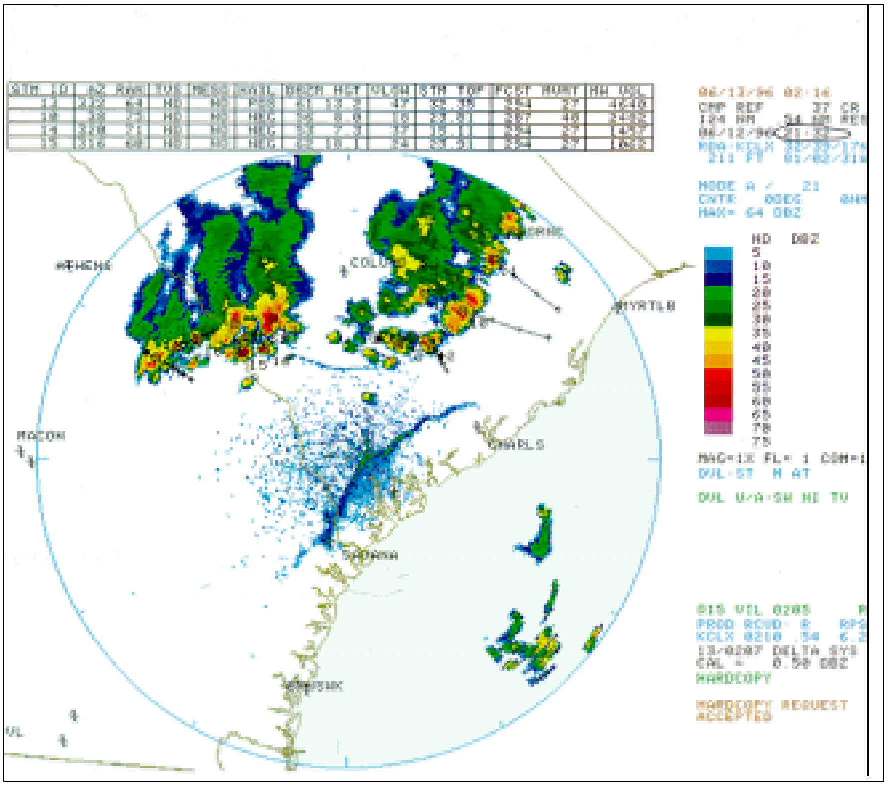


FIGURE 3.2

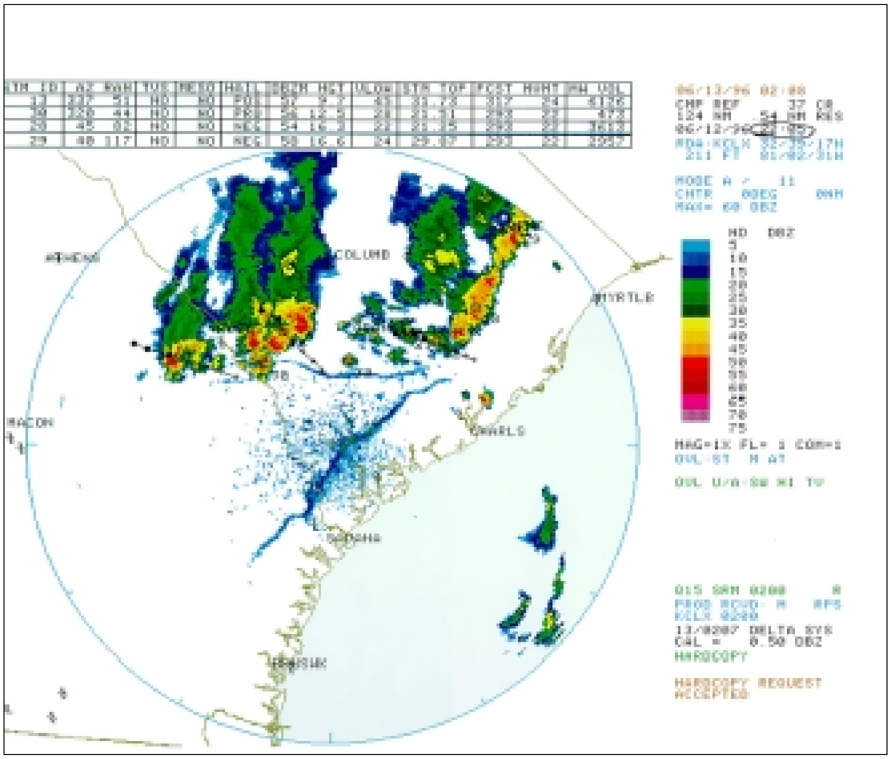


FIGURE 3.3

(a) When KNBC is under a low-level northeasterly flow the maximum temperature will normally be at or slightly below the “surface point”.

(b) When KNBC is under a low-level westerly flow, the maximum temperature will normally be at the “surface point” +3 to +5 degrees.

(c) When a strong inversion is present below the 850-Mb level and it is evident that this inversion will not dissipate during morning, the base of the inversion should be used instead of the 850-Mb level. During the winter under cloudless skies, the maximum temperature may exceed the 850 Mb temperature brought dry adiabatically to the surface by 5 to 10 degrees unless KNBC is under strong, cold air advection or in an area of strong cold temperatures behind a surface cold front. Modifications to apply:

(d) With broken or overcast middle and/or high cloudiness the maximum temperatures will be considerably suppressed.

(e) Maximum temperatures in Northeast Texas after a northeast/southwest oriented cold frontal passage will be very close to our maximum temperatures after the same frontal passage at KNBC.

(f) The radiosondes from AHN, JAX, and MGM are excellent aids for an upstream look into the advection pattern moving toward KNBC.

(2) Minimum: The average dew point between 0900 and 1000 may be used to forecast the next morning’s minimum temperature within 5 degrees regardless of changes in weather, sky cover or wind, provided that the air mass over KNBC does not change due to any frontal passage. This rule is good from May through October, with an exceptional amount of accuracy from June through the end of August, and poor accuracy the remainder of the year due to the rapidity of air mass changes. During the winter months, the standard advection methods will normally apply. An average nighttime cooling for June, July, August and September is 16 degrees with an average of less than 1-degree difference from this figure per month. Again the rapidity of the air mass changes precludes the use of this rule much of the remainder of the year. During the winter some modifications to consider:

(a) The minimum temperature may be 2 to 5 degrees above the forecast if a high tide occurs between 0400 and 0800.

(b) Minimum temperature in northeastern Texas after passage of a north/northeast, south/southwest oriented cold frontal system is representative of what the minimum temperature will be at KNBC with passage of the same system.

SECTION IV
SPECIALIZED FORECASTS

1. AVIATION SERVICES

a. OPARS

b. Horizontal Weather Depictions

2. SPECIALIZED PRODUCTS

a. Drop Zone Forecast

b. Solar/Lunar Almanac

c. D-Values

d. Sound Focusing

e. Radiological Fallout

3. METOC SUPPORT FOR THE SIX FUNCTIONS OF MARINE AVIATION

a. Anti-Air Warfare (AAW)

(1) Weather Matrix

(2) Electro-Optic Tactical Decision Aid (EOTDA)

(3) Integrated Refractive Effects Prediction System (IREPS)

a. Cover

b. Offensive Air Support (OAS)

(1) Aviation Strike Forecast

(2) Integrated Refractive Effects Prediction System (IREPS)

a. Cover

b. Path-Loss

c. Platform Vulnerability

(3) Electro-Optic Tactical Decision Aid (EOTDA)

c. Aerial Reconnaissance

Section IV Specialized Forecasts

1. AVIATION SERVICES:

a. OPTIMUM PATH AIRCRAFT ROUTING SYSTEM (OPARS): **OPARS** is a computerized flight planning system designed to provide automated flight planning services for Naval/Marine Corps aircraft. This system is designed to optimize in terms of time and/or fuel consumption, and will, if input parameters allow, choose the optimum route and altitude between two or more airfields. The OPARS system utilizes environmental forecast data with specific aircraft profiles and generates a recommended flight plan. Individual OPARS requests rarely require more than 1 hour response time. However, it is requested that a 2-hour lead-time be provided whenever possible to allow for format verification and adequate time for telephone access to the central computer located in Monterey, CA. At least 85% of the requests processed at MCAS Beaufort are from Station or transient aircrews.

b. HORIZONTAL WEATHER DEPICTIONS (HWD'S): HWD packets, or Navy Flight Forecast Folders, are prepared in accordance with NAVMETOCCOMISNT 3140.14D for all flights transiting across large continental or oceanic areas. These packets consist of charts displaying flight level weather, winds, turbulence, icing and freezing level. Also included for over water flights, are ditch headings and forecasted altimeter setting charts. This package is usually requested in conjunction with OPARS. A 24-hour notification is desired to ensure maximum accuracy and thoroughness of product preparation. However, a complete packet can be supplied with a minimum 2 hours notice for transcontinental flights, and 3 hours for flights terminating outside the CONUS. Additionally, VIP packets (color HWD) are generated upon request for Flag Officers with flights departing MCAS Beaufort. On average, 1-3 HWD/OPARS packages are processed each month. The majority of the requests are from Marine Corps C-130's on transcontinental flights, or squadrons of F/A-18's departing for deployment.

2. SPECIALIZED PRODUCTS:

a. DROP ZONE FORECASTS: These forecasts are provided for special evolutions, which involve parachute operations. They are custom tailored to meet the specific needs of the user, but generally include basic meteorological data, upper level wind data and solar/lunar data.

b. SOLAR/LUNAR ALMANAC: The SLAP module of the GFMPL is used to generate daily or monthly summaries of ephemeral data for sun and moon locations worldwide. These summaries are custom tailored to meet the specific needs of the user, but generally include times for sunrise/sunset, moonrise/moonset, beginning/ending times of nautical and civil twilight, phases of the moon and percent illumination, total daylight, time and altitude of sun/moon meridianal passage, and 24 hour solar/lunar positions. The SLAP module also generates NVG performance predictions based on cloud cover and user defined lux thresholds.

c. D-VALUES: D-Value profiles are generated using the GFMPL and are used in the setting of pressure-bomb detonation altitudes.

d. SOUND FOCUSING: Forecasters will occasionally use the SOCUS module of the GFMPL program to forecast sound propagation in the atmosphere. Using a current sounding and the SOCUS module, forecasters can determine whether conditions favor large scale refraction of sound toward populated areas during explosive exercises.

e. RADIOLOGICAL FALLOUT: Forecasters will occasionally be required to utilize the RADFO module of the GFMPL to predict patterns of radiological fallout. These patterns are used to determine unit maneuvering in the event of a nuclear burst.

3. METOC SUPPORT FOR THE SIX FUNCTIONS OF MARINE AVIATION: The Weather Service is capable of providing METOC support to all six functions of Marine Aviation. However, only those functions whose primary mission is conducted by fixed-wing aircraft are supported by forecasters stationed aboard MCAS Beaufort on a regular basis. Each function regularly supported is explained below.

a. ANIT-AIR WARFARE (AAW):

(1) Weather Matrix: Weather elements and their associated impact on AAW operations are the primary focus of the Weather Matrix. The Weather Matrix is part of the Intelligence Preparation of the Battlefield (IPB) process and will assist mission planners in making GO/NO GO decisions. The impact of weather on specific mission areas will be defined as FAVORABLE, MARGINAL OR UNFAVORABLE based on the limitations provided to us by our users.

(2) Electro-Optic Tactical Decision Aid (EOTDA): This product is used to determine how susceptible the vital area is to enemy precision guided Munitions (PGM's). Maximum acquisition ranges for the TAOM, generators, vehicles etc. can be determined. The results will help minimize the effects of hostile air action.

(3) Integrated Refractive Effects Prediction System (IREPS): The IREPS software was developed to provide an environmental data processing and display capability for the comprehensive assessment of refractive effects upon surveillance, communications, electronic warfare, and weapon guidance system.

a. Cover: The most important task of air defense is to develop a "total" air picture through surface based and airborne surveillance (TPS-59/63/73, E-2C, HAWK IPAR/CWAR, etc.) The IREPS coverage diagram (COVER) provides a display of radar detection or communication coverage in the vertical plane based on the current environmental conditions. The diagram will alert units to "holes" in their radar coverage against attacking aircraft or missiles. MCAS Weather Service personnel are routinely tasked to provide Cover diagrams to the Marine Air Control Squadron (MACS) in support of the semi-annual AAW exercise conducted in conjunction with Operation Hornets Nest, hosted by MAG-31.

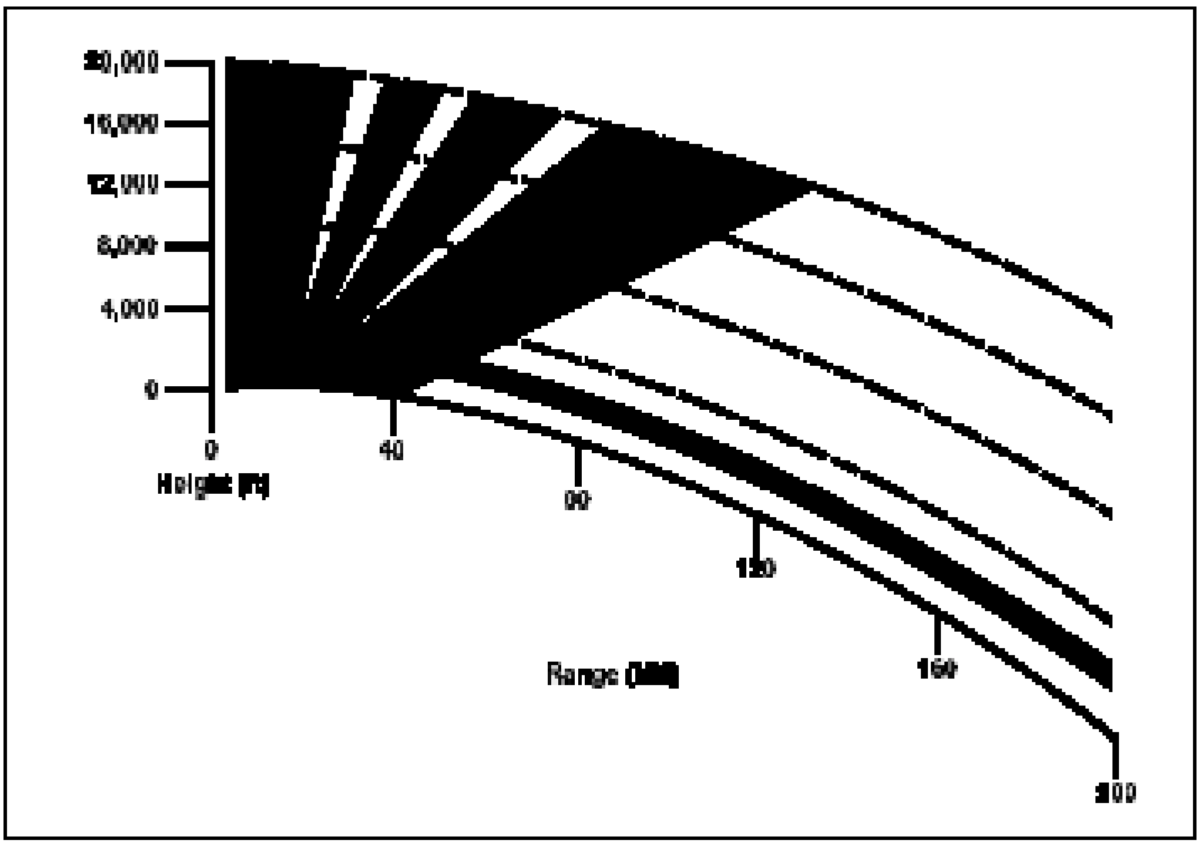


Figure 4.2

b. OFFENSIVE AIR SUPPORT (OAS):

1. Aviation Strike Forecast: Includes synoptic discussion, 24 hour forecast (including specific Launch, Enroute, Target and Bingo weather), outlook to 48 hours, Solar/Lunar data, and EOTDA sensor performance predictions.

2. Integrated Refractive Effects Prediction System (IREPS):

a. Cover: This is the most versatile IREPS product and includes many tactical uses. When used for threat SAM's, the Cover diagram will show the threat radars area of coverage on a curved earth and plots range vs. height. Cover incorporates the effect of the atmosphere on a threat system and therefor compliments TAMPS data. Another tactical use of Cover is for attack aircraft positioning. Knowledge of the existence and the height of a surface-based duct would enable the mission planner to select the optimum altitude for penetration. Likewise, an ECM aircraft cam adjust its position to maximize the effectiveness of its jammers by using the coverage display. By flying within a duct, the aircraft will enhance its standoff range. (See Figure 4.3)

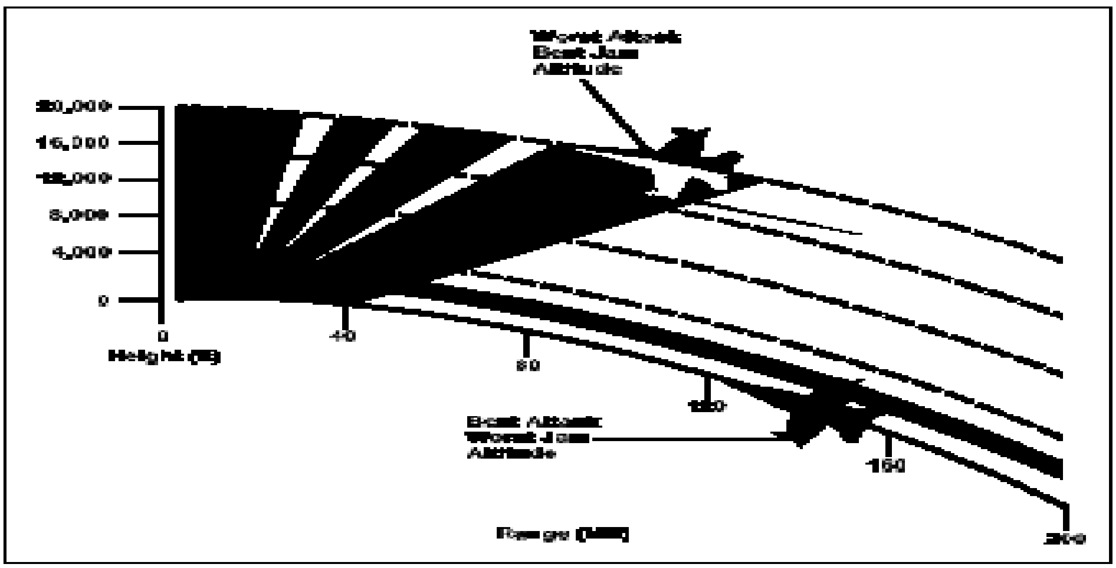


FIGURE 4.3

b. Path-Loss: This IREPS product shows one way path loss in dB's versus range due to spreading, diffraction, scattering and anomalous propagation. Can be used for long-range air-search radars (surface based or airborne), surface search radars when employed against low flying targets, and to determine the intercept range of a radar or communication system by an ESM receiver. Once an altitude is specified, the path-loss curve is simply a slice through the Cover display at the specified altitude. MCAS Weather Service personnel are routinely tasked to provide Path-Loss curves to the Navy /Marine aircraft in support of the semi-annual OAS exercises conducted in conjunction with Operation Hornets Nest, hosted by MAG-31.

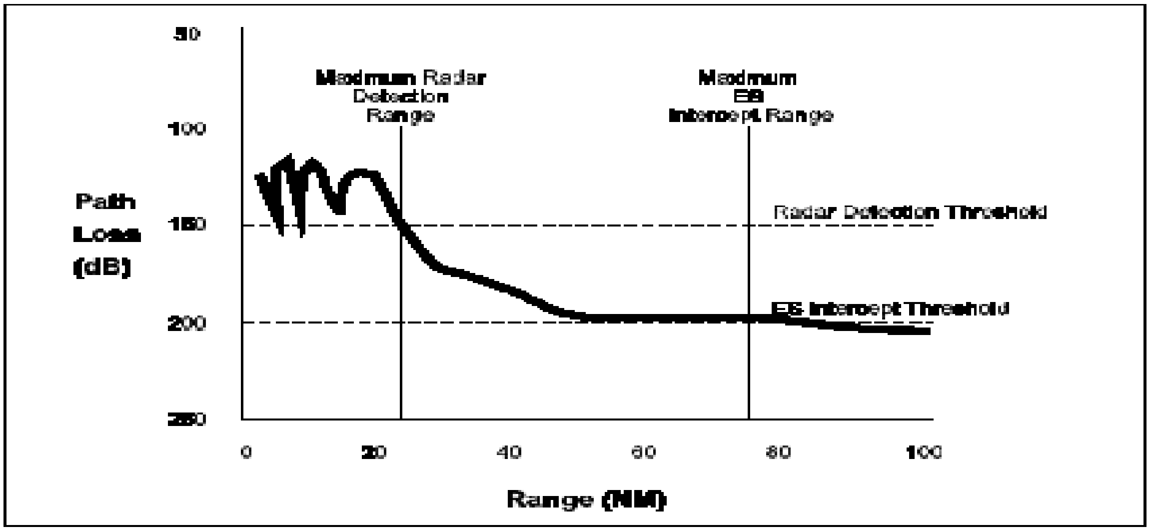


Figure 4.4

c. Platform Vulnerability (PV): PV is useful in evaluating EMCON posture. This IREPS product assesses the relative vulnerability of the various emitters within the Marine Air Control Group versus their value in surveillance or communication. A bar graph shows the maximum range that a specified receiver can detect these emitters under given atmospheric conditions. From this display it is immediately obvious which emitter within the MACG is most vulnerable to intercept. By selectively silencing varies emitters, the C3 mission planner can customize an EMCON plan to a particular mission. PV is normally employed against aircraft flying at altitudes higher that 10,000 feet. MCAS Weather Service personnel are routinely tasked to provide PV Charts to the Marine Air Control Squadron (MACS) in support of the semi-annual AAW exercise conducted in conjunction with Operation Hornets Nest, hosted by MAG-31.

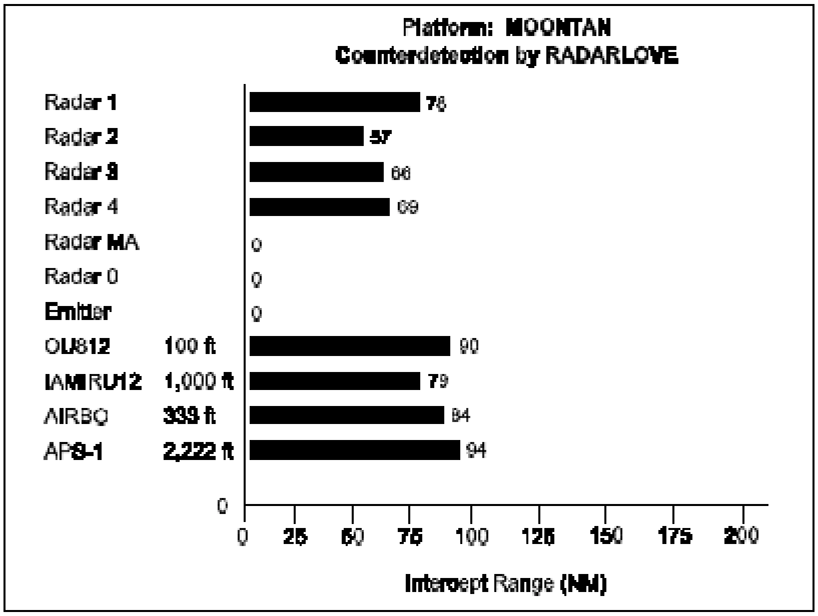


Figure 4.5

(3) Electro-Optic Tactical Decision Aid (EOTDA): Historically the most difficult task associated with the USMC OAS mission has been target acquisition. EOTDA is a software model that predicts the performance of air-to-ground weapons systems and direct view optics based on environmental and tactical information. Performance is expressed primarily in terms of maximum detection or lock-on range. EOTDA supports systems in three regions of the electromagnetic spectrum: infrared (IR Maverick, FLIR), visible (CATEYES, WALLEYES, CAM), and laser (LTD/R, PAVEWAY, Laser Maverick). Forecasters must be thoroughly familiar with the EOTDA program, as it is our most frequently requested specialized product. In addition to an extensive working knowledge of the program, forecasters must understand the assumptions and limitations associated with the EOTDA output.

c. AERIAL RECONNAISSANCE: Aerial reconnaissance plays a vital role in the planning and execution of military operations. It provides a major means of collecting current information and it provides the target acquisition information used in the targeting process. Aerial reconnaissance planning considerations incorporate many of the factors previously mentioned: SAM's/AAA, EW, acquisition/identification (visual, multi-sensor imagery), etc. Mission planners will find the Weather Matrix, IREPS and EOTDA's useful for tactical/operational or strategic reconnaissance planning.

SECTION V
ENVIRONMENTAL EFFECTS

1. INTRODUCTION

2. TERRAIN EFFECT ON FOG AND TEMPERATURES

3. TERRAIN EFFECT ON THUNDERSTORMS

4. FIELD MINIMUMS

5. SUMMARY

Section V Environmental Effects

1. <u>INTRODUCTION</u>: The local terrain has many unique effects on the weather and flying conditions at MCAS Beaufort. The information that follows is by no means complete, but hopefully will help the forecaster to better understand some of the problems that will be faced at this station. The difficult situation of forecasting here is often times compounded by the interaction of the various parameters involved.

2. <u>TERRAIN EFFECT ON FOG AND TEMPERATURES</u>: MCAS Beaufort is virtually surrounded by water, i.e., the Atlantic Ocean, several large rivers, and vast areas of tidal marshlands. Under certain synoptic situations the height of the tide will affect the occurrence of fog, the duration of the fog, and the maximum and minimum temperatures for the day, etc. The forecaster must constantly be aware of: the time of high/low tide, the prevailing wind direction, the land/water temperature contrast, etc.

3. <u>TERRAIN EFFECT ON THUNDERSTORMS</u>: Thunderstorms are also affected by the abundance of water in the vicinity of the Air Station. Thunderstorms will form over the water and move along the rivers near the station, so consideration must be given to the steering currents present, as well as the initial location of the cells. Ordnance handling and aircraft fueling/defueling are prohibited when cells are within 5 miles or lightning is observed.

4. <u>FIELD MINIMUMS</u>: The lowest published minimum conditions are 100 foot ceilings/ 1/4 mile visibility (with MAG--31 aircraft further restricted to 200 foot ceilings and 1/2 mile visibility). These conditions can occur rapidly and persist for some time with thunderstorms and fog. Additionally MCAS Beaufort hosts several Antiaircraft Warfare Exercises (AAWEX) annually, occurring on station and the adjacent coastal waters. 5000 foot ceilings / 5 miles visibility are required for these events.

5. <u>SUMMARY</u>: These are some of the negative aspects of the local terrain. On the positive side, the moderating affects of the surrounding water make for pleasant winters, with little threat of any significant frozen precipitation for any length of time.

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