LOCAL AREA
FORECASTER'S HANDBOOK FOR
NAVAL AIR STATION LEMOORE, CALIFORNIA

PREPARED BY:
OFFICER IN CHARGE
NAVAL PACIFIC METEOROLOGY AND OCEANOGRAPHY DETACHMENT LEMOORE, CALIFORNIA

PREPARED FOR:
COMMANDER
NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND
STENNIS SPACE CENTER, MS 39529

From: Officer in Charge, Naval Pacific Meteorology and Oceanography Detachment, Lemoore

To: Distribution

Subj: FORECASTER'S HANDBOOK

Ref: (a) NAVMETOCCOMINST 3140.2()

Encl: (1) Local Area Forecaster's Handbook

1. Enclosure (1) was revised in accordance with reference (a) in February 1999 and is forwarded for your information.

D.F. YOUNG

Distribution List	Number of copies
COMNAVMETOCCOM (Code N312) Stennis Space Center	1
NAVOCEANO (Code N2513) Stennis Space Center	1
NAVPACMETOCCEN Pearl Harbor	1
NAVPACMETOCFAC San Diego	1
FLENUMETOCCCEN Monterey	1
NRL Monterey	1
NAVPGSCOL (Code 63) Monterey	1
NAVPACMETOC DET El Centro	1
NAVPACMETOC DET Fallon	1
NAVPACMETOC DET Whidbey Island	1
NAVPACMETOC DET Bangor	1
NAVPACMETOC DET Barbers Point	1
USS Abraham Lincoln	1
USS Constellation (CV-64)	1
USS Nimitz (CVN-68)	1
USS Carl Vinson (CVN-70)	1
USS Lincoln (CVN-72)	1
USS Kitty Hawk (CV-63)	1
USS John C. Stennis (CVN-74)	1
USAFETAC/LD Scott AFB	1
NWS Hanford	1

Table of Contents

Section I - OVERVIEW I-1

Meteorological Support Service Functions I-1
- General **I-1**
- Aviation Operations I-1
- Local Warnings I-1
- Specialized Products I-1
- Climatological Studies I-1

Location and Description of Detachment Spaces **I-2**
- Location of Naval Air Station Lemoore I-2
- Forecasting/Flight Briefing Area I-2
- Observation Area I-3
- Administrative Area I-3
- Restricted Area I-3
- Storage Room I-3

Meteorological Equipment **I-4**
- Automated Surface Observing System I-4
- Operations Area I-4
- Transmissometer (AN/GMQ-10C) I-5
- Aerovane (AN/UMQ-5) I-5
- Aneroid Barometer (ML-448/UM) I-5
- WSR-88D (NEXRAD) I-5
- Instrument Shelter I-5
- Rain Gauge I-5

Computer Equipment **I-5**
- Meteorology and Oceanography Integrated Data Display System I-5
- Personal Computers I-5

Communications Equipment **I-6**
- CMW I-6
- Facsimile I-6

Other Communications Related Equipment **I-6**
- Dial-a-Forecast Recorder I-6
- Pilot-to-Forecaster Metro Service I-6

SECTION II - CLIMATOLOGY II-1
- Storm Tracks II-1
- Thermal Trough II-1
- Stationary High II-2
- The Nevada Low II-3
- Statistical Weather Summary II-3

SECTION III - FORECASTING III-1
- General III-1
- Winter III-1
- Spring III-1
- Summer III-1
- Fall III-2
- Subjective Rules III-2
- Summer Rules III-2
- Winter Rules III-3

Objective Techniques	**III-4**
Summer Maximum Temperature	III-4
Precipitation associated with 500mb Height and Vorticity Progs	III-6
Precipitation associated with West to East Type Frontal System	III-7
Precipitation associated with North to South Type Frontal System	III-7
Fog Formation	III-7
Fog Dissipation	III-7
Local Weather Phenomena	**III-7**
Snow	III-7
Fog	III-7
San Joaquin Valley Eddy	III-9
San Joaquin Valley Low Level Jet	III-9
Marine Air	III-10
Runway Crosswinds	III-11
Cold Front (North to South Type)	III-11
Frontal System (West to East Type)	III-12
Cutoff Low	III-12
Hazardous Weather Phenomena	**III-12**
Tornadoes	III-12
Thunderstorms	III-13
Gulf of Mexico Air	III-13
Mountain Waves	III-14
Forecast Verification	**III-14**
SECTION IV - SPECIALIZED FORECASTS	**IV-1**
OPTIMUM PATH AIRCRAFT ROUTING SYSTEM (OPARS)	IV-1
INTEGRATED REFRACTIVE EFFECTS PREDICTION SYSTEM (IREPS)	IV-1
SOUND FOCUS FORECASTS	IV-1
ELECTRO-OPTICAL TACTICAL DECISION AIDS (EOTDA)	IV-1
RADIOLOGICAL FALLOUT FORECASTS	IV-1
SECTION V - ENVIRONMENTAL EFFECTS	**V-1**
Fog	V-1
Thunderstorms and Tornadoes	V-1
Specific Effects	V-1
SECTION VI - REFERENCES	**VI-1**

List of Figures

Figure I-1 NAS Lemoore and Surrounding Area	I-2
Figure I-2 Physical Features of California	I-2
Figure I-3 NAS Lemoore Operations and Admin Area Map	I-3
Figure I-4 NPMOD Floor Plan of Spaces	I-4
Figure II-1 Pacific Storm Tracks	II-1
Figure II-2 Thermal Trough	II-2
Figure II-3 Stationary High at the Surface	II-2
Figure II-4 Stationary High at the 500 MB Level	II-2
Figure II-5 Nevada Low at the 500 MB Level	II-3
Figure II-6 Nevada Low at the Surface	II-3
Figure II-7 Temperature by Month	II-4
Figure II-8 Humidity by Month	II-4
Figure II-9 Flying Condition by Month	II-4
Figure III-1 East-West Precipitation Nomogram	III-3
Figure III-2 North-South Precipitation Nomogram	III-4
Figure III-3 Fog Formation Nomogram	III-5
Figure III-4 Fog Dissipation Nomogram	III-5
Figure III-5 Typical “Tule fog” as seen by Satellite	III-6
Figure III-6 North-South Front at the Surface	III-8
Figure III-7 North-South Associated 500 MB Trough	III-9
Figure III-8 East-West Front at the Surface	III-10
Figure III-9 East-West Associated 500 MB Trough	III-11
Figure III-10 Cut-Off Low at the Surface	III-12
Figure III-11 Cut-Off Low at500 MB	III-11
Figure III-12 Thunderstorm Development at the Surface	III-12
Figure III-13 500 MB Associated TSTM Development	III-13
Figure III-14 700 MB Associated TSTM Development	III-13

SECTION I- OVERVIEW

Meteorological Support Service Functions

General

The Naval Pacific Meteorology and Oceanography Detachment (NAVPACMETOC DET) Lemoore is an element of the Naval Meteorology and Oceanography Command under an Officer in Charge and assigned to the U.S. Naval operating forces. The Naval Pacific Meteorology and Oceanography Facility, San Diego, California is responsible for military command and technical direction of this detachment. CNMOC instruction 3140.1() defines the meteorological and oceanographic services available from the Naval Meteorology and Oceanography Command. The primary services provided by this detachment are support of aviation operations and local weather warnings.

Aviation Operations

This detachment provides flight forecasting services to ten fleet strike fighter squadrons, two fleet replacement squadrons, Commander Strike Fighter Wing Pacific (COMSTRKFIGHTWINGPAC), Naval Air Station Lemoore, and an Air National Guard unit in Fresno, CA. Forecasting services are available 24 hours a day, seven days a week. There are four ways to obtain a flight weather briefing: over the counter, by telephone, by FAX, or by METRO radio. To support aviation operations, the observers take and transmit observations each hour from two (2) hours prior to field opening until field closure. Observations are transmitted over the AWN/CMW circuit, as are Terminal Aerodrome Forecasts (TAF), transmitted by forecasters four times a day.

Local Warnings

The forecaster recommends the setting of local wind and storm warnings for the Naval Air Station to the Operations Duty Officer (ODO).

Specialized Products

This detachment, upon request, will provide the following specialized forecasts: Integrated Refractive Effects Prediction System (IREPS) conditions, Optimum Path Aircraft Routing System (OPARS) flight plans, Radiological Fallout (RADFO) plots, and Electro-Optical Tactical Decision Aid (EOTDA) forecasts. EOTDA Ver 3.1 supports precision guided munitions (PGM) including Infrared (FLIR), Laser (LGB), and Visual Systems (CATEYES).

Climatological Studies

Special climatological studies are available upon request. This detachment will refer certain requests requiring information beyond our capabilities to Fleet Numerical Meteorology and Oceanography Detachment, Asheville, North Carolina. They maintain the archives for the Naval Meteorology and Oceanography Command and have an extensive computerized climatological library.

Location and Description of Detachment Spaces

Location of Naval Air Station Lemoore

*T*he location of Naval Air Station Lemoore is in the center of the southern San Joaquin Valley, about thirty miles south of Fresno, California (figure I-1). The terrain around Lemoore is flat and level, consisting mainly of irrigated agricultural land. As shown in figure I-2, the foothills of the Sierra Nevada Mountains begin their abrupt rise forty miles east of Lemoore. Some of the higher peaks range from 12,000 to 14,000 feet. Twenty miles west of Lemoore, the Diablo Range foothills rise to elevations of 3,000 to 5,000 feet. The exact location of the Naval Air Station (Reeves Field) is at latitude 36 20'N, longitude 119 57'W. Field elevation is 237 feet above sea level. The Naval Air Station has 2 parallel runways, 32L/14R and 32R/14L. These runways are 13,500 feet long and 200 feet wide. Figure (I-3) shows a detailed plan of Naval Air Station Lemoore. The location of the operations complex is about seven miles northwest of the Naval Air Station Administrative area. The detachment is in the Operations Complex, in the east wing of the Operations Building (Building 001), adjacent to the flight clearance/flight planning spaces. The Naval Air Station has assigned 1,458 square feet of work/storage space to this detachment. The space is laid out as depicted in figure I-4 and described below.

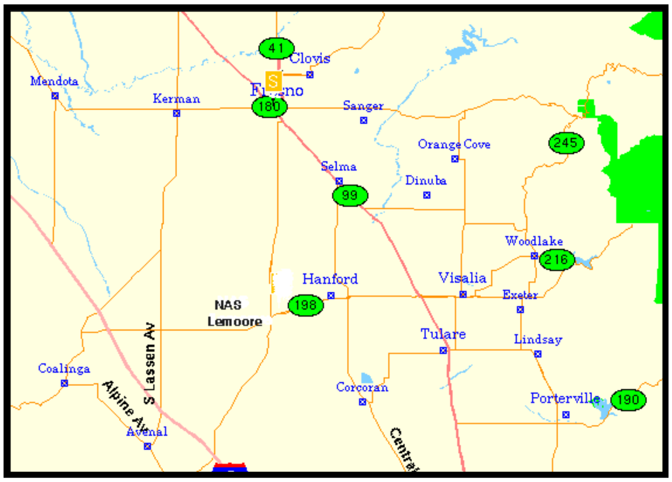

Figure I-1- NAS Lemoore and Surrounding Area

Forecasting/Flight Briefing Area

*F*orecasters conduct over-the-counter, radio, FAX, and telephone briefings within this area. The Wall of Thunder bank of computer monitors is used to display computer based weather information of use to the forecaster and to walk-in customers. Weather information is available to pilots from the pilot-to-forecaster service at a frequency of 317.0 MHz. Equipment located in this area

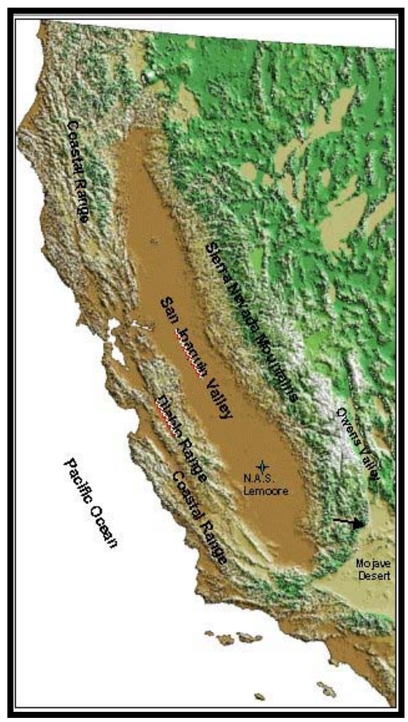

Figure I-2- California Topography

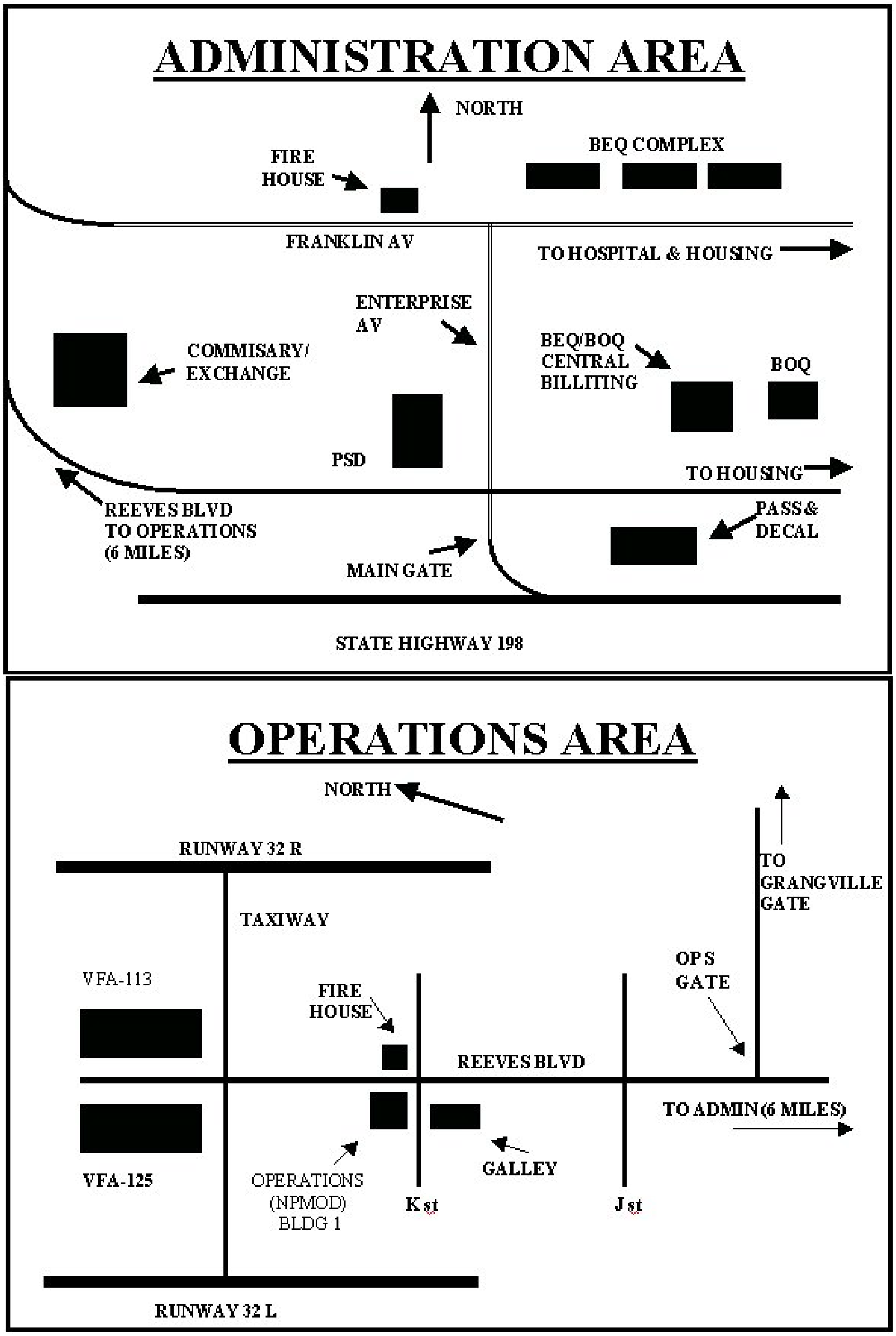

Figure I-3- NAS Lemoore Map

includes a CONTEL Meteorologist Workstation (CMW), the Meteorological Information Data Display System (MIDDS) Server, a PC workstation, the aforementioned Wall of Thunder, and a NEXRAD WSR-88D workstation.

Observation Area

All instruments and recording equipment required to record and transmit a complete weather observation are located in this area. These include a Contel Meteorological Workstation (CMW) and the ASOS Display Unit described later in this Handbook.

Administrative Area

Two spaces comprise this area, the OIC/LCPO office and the administrative workspace.

Restricted Access

Room 107 is designated a restricted area. The door is closed and locked at all times. This area is used for secure communications, the processing of classified material, the receipt/transmittal of message traffic on the GateGuard terminal, and tactical support production. The command's security container is also located in this space.

Storeroom

This satellite space is used to store office supplies and helium bottles. Mini-Rawinsonde (MRS) balloons are inflated in this room.

Meteorological Equipment

Operations Area

The installation of all equipment is on a flat surface 235 feet above mean sea level with best exposure. The following paragraphs explain the location of meteorological equipment.

Automated Surface Observing System (ASOS)

Installed in February 1997, the ASOS sensors are located 2 miles south-southwest of the Operations Building along the approach end of runway 32L. The unit sensors provide information regarding sky conditions, visibility, present weather, precipitation amounts, temperature, dewpoint, and wind speed and direction. The Acquisition Control Unit, (ACU) located in Room 107 of the detachment, receives the data from the field sensor unit. The ACU software processes the weather data then generates reports, archives data, and transfers data to the external display unit, located in the

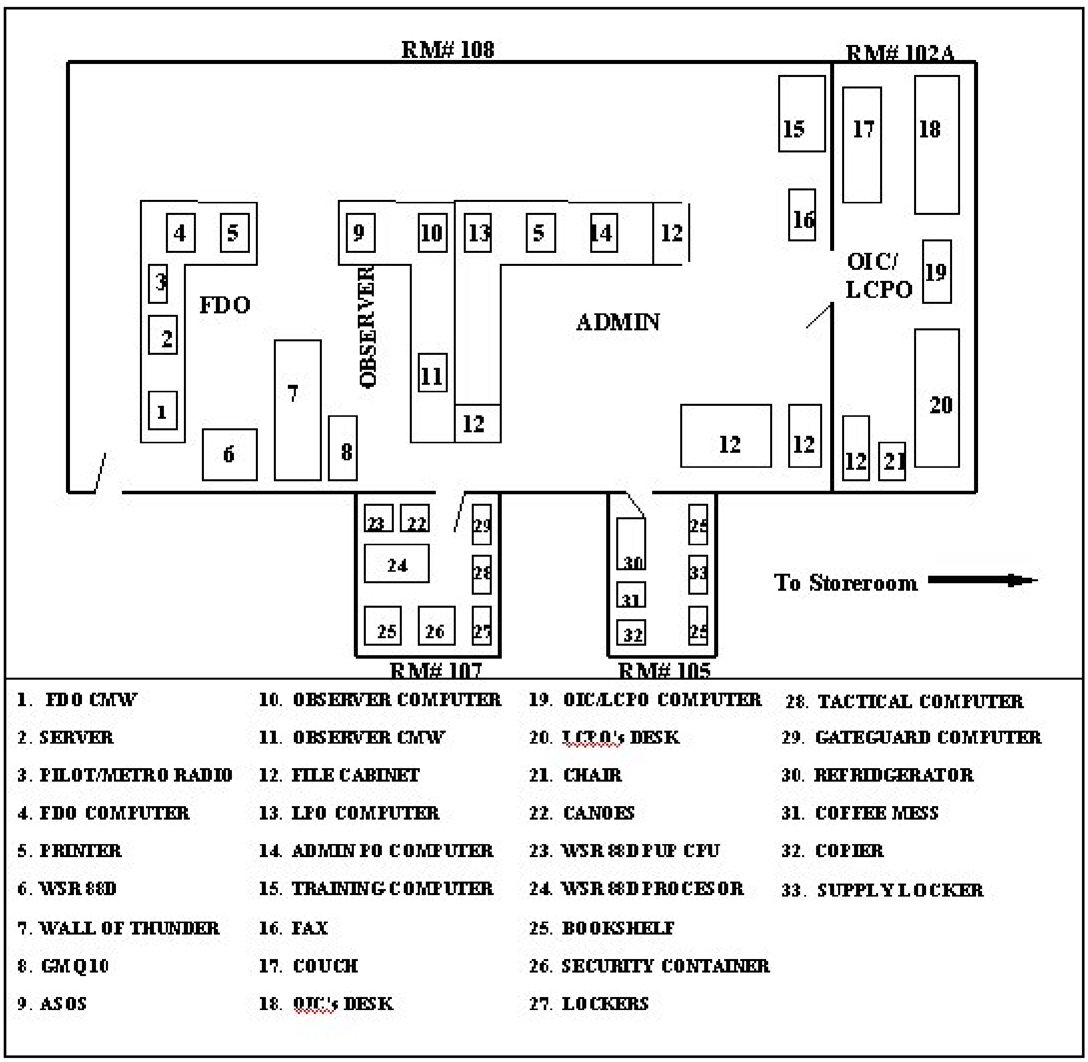

Figure I-4- NAS Lemoore Floor Plan

observer area. The unit displays updating information regarding time, sky condition, visibility, present weather, precipitation amounts, temperature, dewpoint, pressure values, relative humidity and wind.

Transmissometer (AN/GMQ-10C)

Installed in September, 1960, the AN/GMQ-10C measures surface visibility using units located near the touchdown points of both runways; 650 feet east of runway 32L, and 650 feet east of runway 32R). The equipment cabinet for the system is located in the observer area of the detachment. Remote RVR digital indicators are located in the Radar Air Traffic Control Facility (RATCF) and the Control Tower.

Aerovane (AN/UMQ-5)

The aerovane transmitter is located 500 feet west of the mid-point of runway 32L. Wind indicators are located in RATCF, the Control Tower and the forecaster area. This system was installed in September 1960.

Aneroid Barometer (ML-448/UM)

The detachment's aneroid barometer, mounted on the AN/GMQ-10C equipment cabinet in the observation area, is the detachment's secondary tool for recording pressure. Observers make frequent comparisons with the pressure values from the ASOS unit.

WSR-88D (NEXRAD)

The WSR-88D Principal User Processor (PUP)is used to track severe weather in the local area. The PUP is located in Room 107 and the graphics interface table is located in the forecaster area.

Instrument Shelter

This shelter is located on the north side of the Operations building and houses thermometers and an electric psychrometer.

Rain Gauge

A ten-inch rain gauge is mounted next to the instrument shelter on the north side of the Operations Building.

Computer Equipment

Meteorology and Oceanography Integrated Data Display System (MIDDS)

The MIDDS system is located in the forecaster workspace. MIDDS consists of four PCs with associated software: a server, a forecaster workstation, an observer workstation, and a PC with four monitors called the "Wall-of-Thunder". MIDDS software modules are designed to ingest meteorological and oceanographic data from several sources. The data can then be displayed on the server or on one of several workstations connected to MIDDS. The data from MIDDS is used to populate the detachment Internet homepages.

Personal Computers (PCs)

Other than MIDDS, NPMOD Lemoore has several PCs that are used to process day-to-day administrative paperwork, download message traffic, conduct Upper Air Soundings, and to complete training requirements.

Communications Equipment

CMW

Within the detachment's spaces there are two CMW terminals. One CMW is located in the forecaster area and the second unit is located in the observation area (observer use). Both units have a keyboard, a VGA monitor for data display, and an internal hard drive for data storage. An EPSON FX-850 provides print capabilities. The forecaster CMW is connected to the MIDDS system and provides alphanumeric weather data to MIDDS.

DIFAX Controller

National Weather Service Digital Facsimile (DIFAX) charts are received from the National Weather Service through the DIFAX Controller box located in the forecaster area. The controller unit is connected to the MIDDS system and provides DIFAX charts to MIDDS.

Other Communications Related Equipment

Dial-a-Forecast Recorder

The telephone recording system is in the observation area. The system allows military personnel and their dependents to obtain a 36-hour local area forecast and a summary of the past 24 hour weather via phone 24 hours a day. This service is provided in addition to the locally prepared 36-hour forecast.

Pilot-to-Forecaster Metro Service

The Pilot-to Forecaster Metro Service provides, via a radio transmitting frequency of 317.0 MHz, voice weather information to pilots. The transmitter is located in the forecaster are

SECTION II CLIMATOLOGY

Storm Tracks

Figure II-1 illustrates the primary and secondary cyclone storm tracks (by season) that affect the Pacific Northwest and California. The cyclones, which influence the local area, occur during the winter months.

Thermal Trough

By late spring, intense heating occurs over the desert areas of southern California, Arizona, and Mexico. As the atmosphere heats, it expands vertically and creates a thermally induced trough at the surface (Figure II-2). This trough often extends northward over the central California valley and is limited to levels below 5,000 feet. By mid-summer, it occasionally extends as far north as southern British Columbia.

The thermal trough is a relatively permanent summertime feature. Occasionally, it

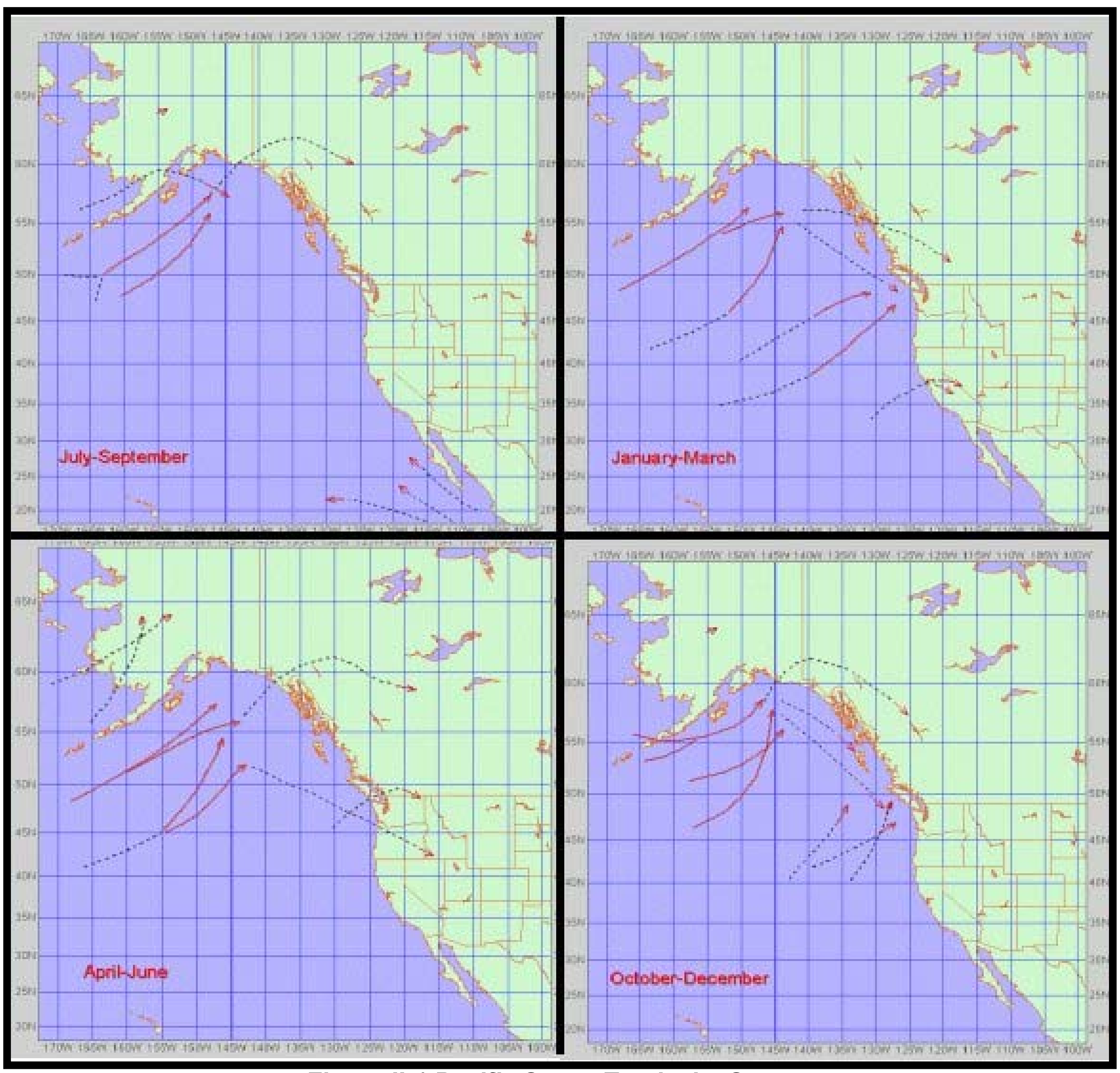

Figure II-1 Pacific Storm Tracks by Season

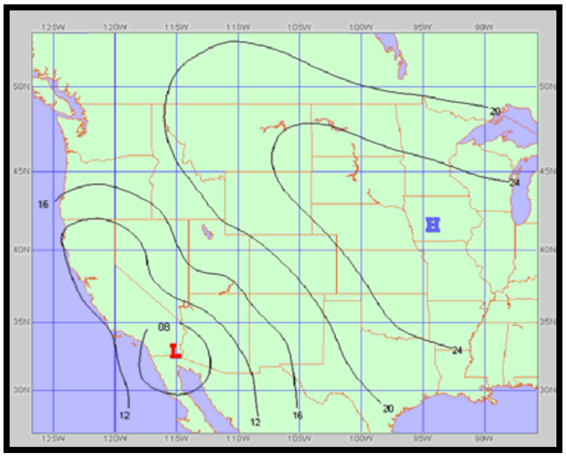

Figure II-2 Thermal Trough

weakens due to the intrusion of cool marine air into the valley. This intrusion occurs on a 3 to 5 day cycle and is the only relief from the persistent heat experienced during the summer months. The degree of cooling is dependent on the height of the marine inversion near the coast. A description of this occurrence is in the special features section of this handbook.

The rule associated with the thermal trough is clear skies. The only significant cloud cover observed during the summer is a persistent line of orographic cumulonimbus which forms along the Sierra Nevada during the afternoon hours. In addition, during the summer months, valley haze may reduce visibilities to 3 to 5 miles.

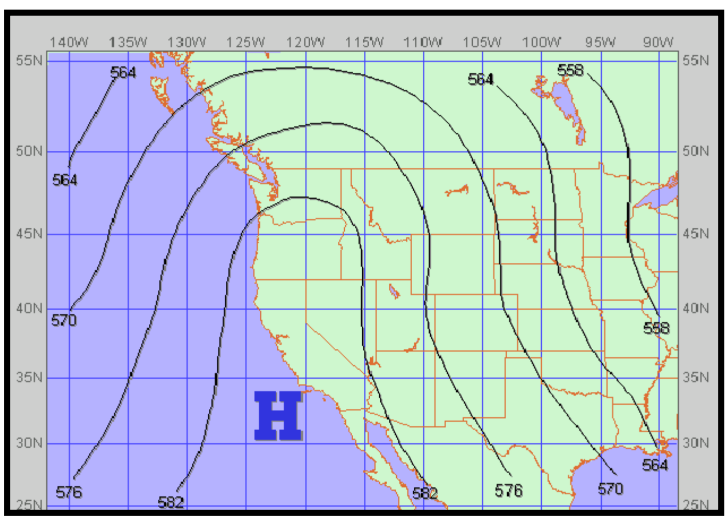

Figure II-4 Stationary High at the 500 mb Level

Stationary High

Figures II-3 and II-4 depict a quasi-stationary high-pressure system both at the surface and aloft. This feature

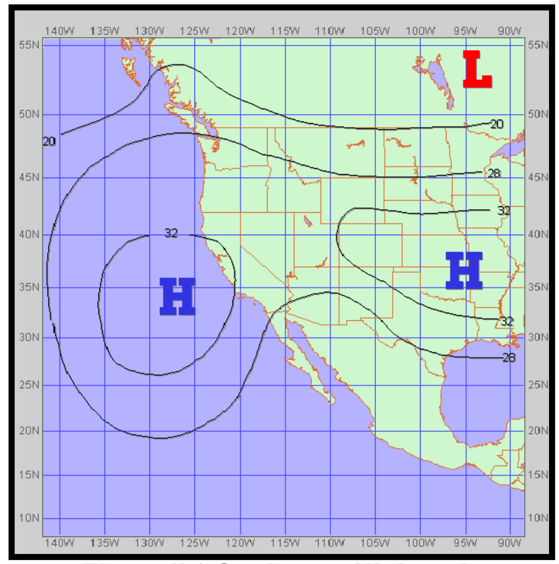

Figure II-3 Stationary High at the Surface

frequently occurs over the West Coast during the winter months. The effect of this stationary high on the San Joaquin Valley is persistent radiation fog (Tule Fog). Further description of this major wintertime occurrence is in the special features section of this handbook. There are many variations in the position of this high-pressure system, which will affect the persistence of fog in the valley. The more stationary the high becomes, the more dense and extensive the fog becomes. Likewise, when a blocking high exists over the West Coast, dense fog will remain in the valley for many days with little or no clearing. During these periods, the airfield may be below minimums throughout the morning and occasionally all day.

The Nevada Low

The "Nevada" or "Tonopah" Low is a synoptic feature that occurs when a low-pressure center deepens over the Great Basin and southern Nevada. This formation occurs during fall and winter months, but is most commonly, spring. Coincident with the development of the Nevada Low, a stronger than normal high pressure system develops off the California coast with ridging located over the Pacific Northwest into southwestern Canada. The resultant flow diverts cold air from the interior of Canada into the warmer airmass over the Great Basin. This unstable situation is intensified by one of the following situations:

- a wave on an east to west oriented front.
- a secondary low in an unstable airmass following the passage of a frontal low.
- beneath a cut-off low.
- at the base of a long wave trough which has a jet maximum over the area?

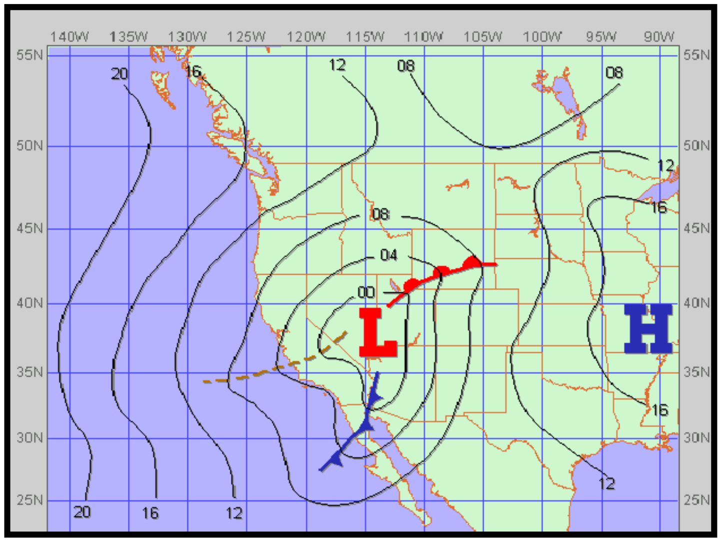

Figure II-5 Nevada Low at the Surface

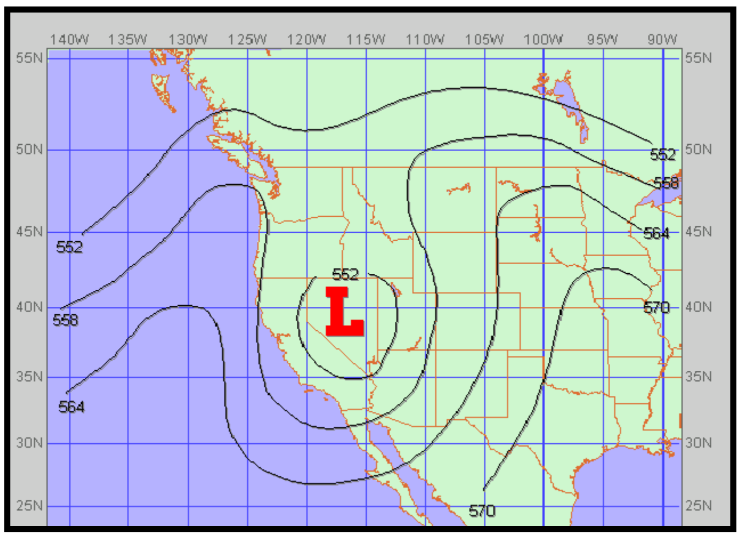

Figure II-6 Nevada Low at 500 mb

The strong pressure gradient associated with this synoptic situation typically produces strong winds in the valley and up to gale force winds along the entire California coast. Towering cumulus and thunderstorm activity also develop along the Sierra Nevada Mountains. On the eastern slopes of the Sierras and extending into central Nevada, widespread low ceilings and heavy precipitation occur. The Nevada Low moves eastward and intensifies, causing severe weather east of the Rockies. Figures II-5 and II-6 illustrate the Nevada Low at the surface and at the 500-mb level.

Statistical Weather Summary

NAS Lemoore's statistical summary is contained in Figures II-7 through II-9.

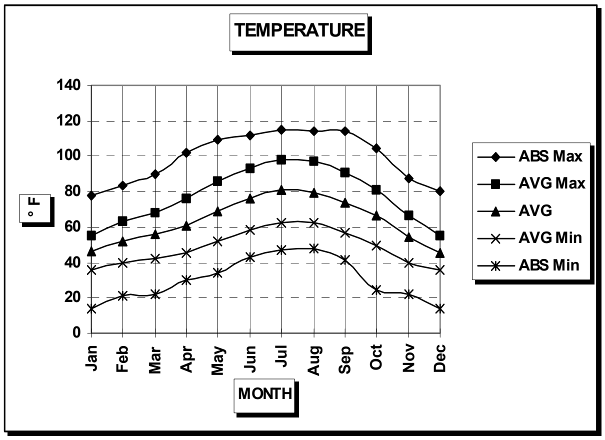

Figure II-7 Temperature by Month

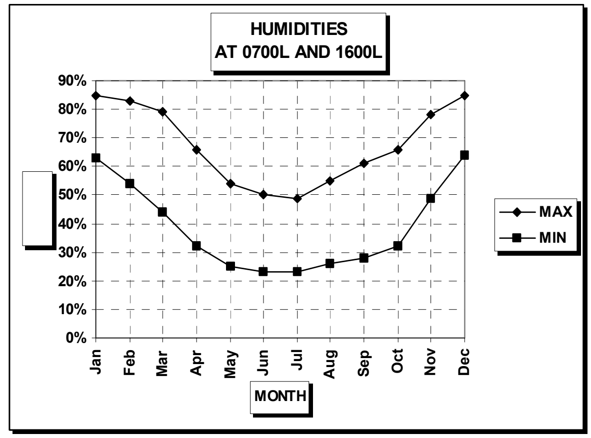

Figure II-8 Humidity by Month

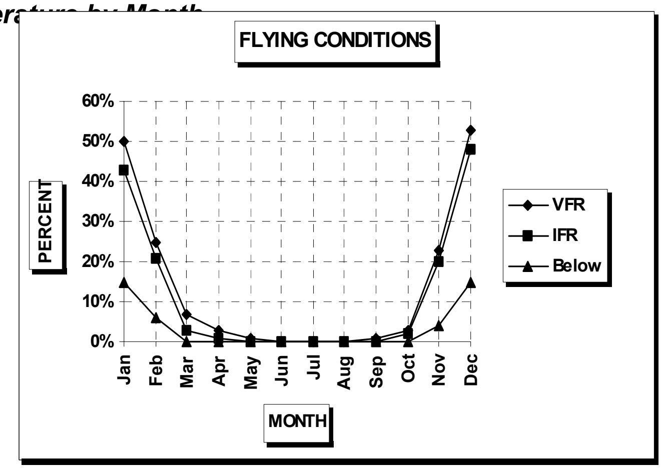

Figure II-9 Flying Conditions by Month

SECTION III-FORECASTING

General

Despite being near the Pacific Ocean, Lemoore's local climate displays many continental traits. Winters are cool and humid, and summers are hot and dry. In fact, the diurnal temperature range can be as much as 50°F degrees.

Winter

The winter or fog season as it is referred to in the San Joaquin Valley (November to February), accounts for most of the annual precipitation and IFR weather. Many forecasting problems are presented to one who has not experienced this season in its entirety. After observing clear skies, warm temperatures and excellent flying weather for months, the start of heavy fog, clouds, rain and, on rare occasions, even snow, greatly challenges the local forecaster.

November marks the beginning of the fog season. During this time, the thermal trough over California has weakened considerably and the influx of maritime polar air begins. By the end of the month, weak frontal passages produce cloudiness and precipitation. Fog causes the first lengthy periods of IFR weather. The temperature decreases steadily during the month, and frost or light freezing conditions normally occur on several days. During December and January, the weather continues to deteriorate. Extensive fog and frontal passages become more frequent, and temperatures continue to decline. February marks the end of the fog season, with a gradual decrease in IFR days toward the latter half of the month. Temperatures remain cool throughout the month.

Spring

An abrupt change in weather occurs at the beginning of the spring transition season (March - May). Temperatures remain cool, but, by the end of March, the fog and extensive cloudiness of the winter months have nearly disappeared. During April and May, temperatures rise steadily and the best weather of the year is experienced, both from an operational and a comfort aspect. Several weak frontal systems may pass through the area leading to several days of showery precipitation. One or two thunderstorms may enter the local area, but, for the most part, clear skies are prevalent during this season.

Summer

Extremely high temperatures and low humidity define the summer, or dry season (June-August). Afternoon temperatures are frequently more than 100°F degrees and humidity less than 30%. Flying conditions are excellent with clear skies and VFR present weather nearly 100% of the time. The only hindrances to flight operations are the density factor (resulting from the extremely high temperatures) and the orographic thunderstorm activity along the Sierra Nevada. Occasionally, the influx of cool marine air into the valley brings a slight relief from the unrelenting heat.

Fall

The fall transition season (September-October) is very similar to the spring transition. Flying conditions are excellent and temperatures begin to fall. Near the end of this period, cloud amounts gradually increase, and several days of fog and IFR weather may be experienced. Precipitation, caused by airmass shower activity, is usually light.

Subjective Rules

Summer Rules

The following summer rules apply:

- When the marine inversion exceeds 300 meters/985 feet, an influx of marine air can be expected from the San Francisco Bay area through the northwest end of the San Joaquin Valley.
- When the marine inversion exceeds 500 meters/ 1640 feet, an influx of marine air can be expected to enter the San Joaquin Valley through the lower passes along the coastal range (Pacheco Pass (420 meters/1380 feet) and Cholame Pass (520 meters/1700 feet)).
- Any marine air influx into the Central Valley is enhanced when a short-wave trough aloft or a weak cold front moves through the valley.
- When strong westerly surface winds are reported at Travis AFB (SUU), marine air will flow into the Sacramento and northern San Joaquin Valleys.
- When the surface wind at Sacramento becomes 15 to 20 knots or more (with a westerly component), marine air is flowing into the Sacramento and northern San Joaquin Valleys. Cooling will occur in the Central San Joaquin Valley within the next 12 to 18 hours.
- The thermal trough is best defined just prior to the influx of marine air into the central valley, where surface temperatures are almost always in excess of 100°F.
- When the marine air flows into the interior valley, the thermal trough weakens.
- Cooling generally persists for about two days following the influx of maritime air into the central San Joaquin Valley.
- An abrupt increase in local surface winds from the west or southwest and an increase in relative humidity indicates that the marine air is entering the valley through the Cholame Pass (located northeast

of Paso Robles (PRB)). In this situation, the maximum temperature for the following day is expected to decrease by 10<198>F or more.

- When northwesterly surface winds are observed 10 knots or more before mid-morning, sustained surface winds of 20 knots or more can be expected later in the day.
- Maximum heating usually occurs between 1600 and 1700 PDT.
- When the surface flow into the San Joaquin Valley is from an easterly direction, adiabatic compressional heating of the descending air from the Sierra Nevada Mountains produces higher temperatures.
- Under static thermal trough conditions, the maximum afternoon temperatures during August can be forecast by assuming a 3.5°F per hour increase from the minimum temperature reached at sunrise.

Winter Rules

The following winter rules apply:

- When a cold front passes through the San Joaquin Valley and a measurable amount of precipitation occurs, fog will usually form the following night.
- When a fast moving cold front passes through the San Joaquin Valley with little or no precipitation, fog will not generally form for 1 or 2 days after frontal passage.
- Even with 100% humidity and maximum radiational cooling, early morning fog occasionally will be shallow or patchy and visibilities relatively good. This is usually due to calm surface winds. However, expect fog to rapidly form when the surface wind is only 2 or 3 knots.
- Occasionally, the field will be VFR during the early morning, yet dense fog can be observed to the east. A wind shift to an easterly component will cause the field to be rapidly engulfed with fog to near below minimum conditions.
- If broken or overcast mid-level cloudiness exists above the fog or stratus layer and the field is IFR or below minimums, very slow improvement can be expected and the dissipation of the fog or stratus is not likely to occur.
- After the fog or stratus has burned off, VFR conditions will generally be marginal due to visibility restrictions in haze.

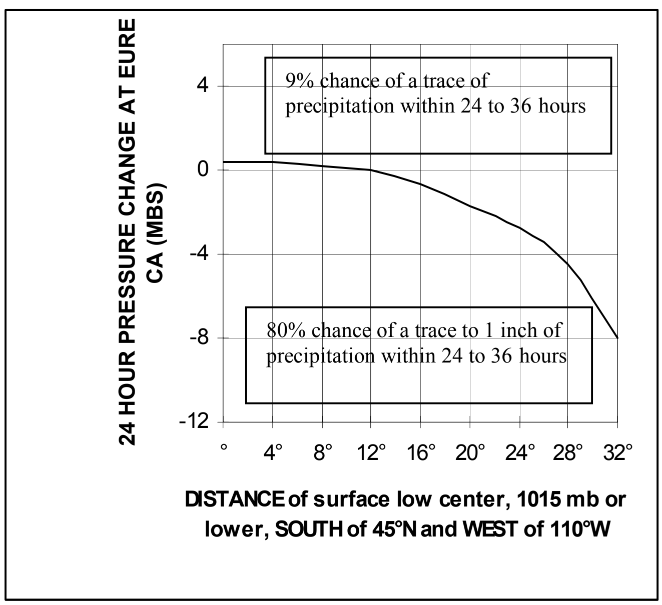

Figure III-1 East-West Precipitation Nomogram

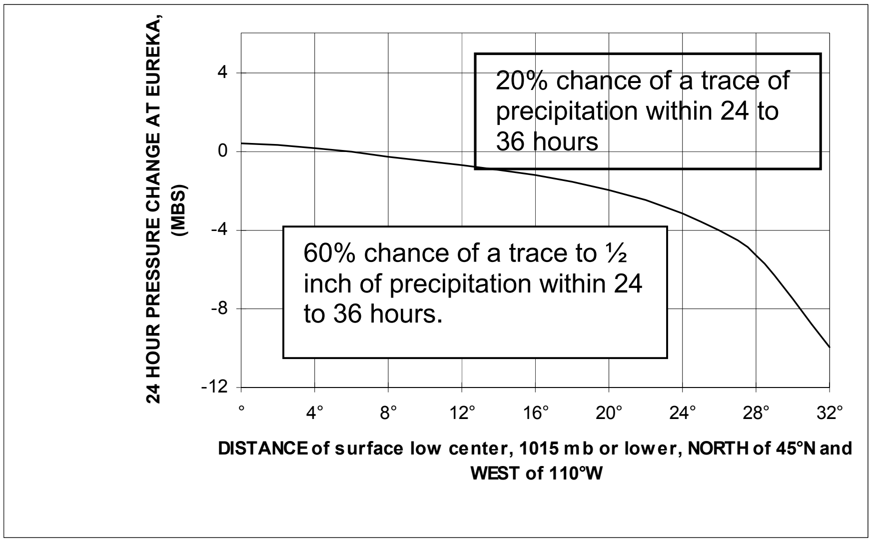

Figure III-2 North South Precipitation Nomogram

- Once the fog or stratus has burned off, reformation will not generally occur for several hours after sunset.
- When air mass conditions are ideal for persistent fog (stable upper level high pressure following frontal passage), prolonged periods of moderate surface winds will produce stratus ceilings instead of fog.
- If heavy fog is accompanied by frequent periods of light drizzle, look for lifting to occur at an earlier time than the previous day.
- When a stratus overcast forms due to moderate surface winds, dissipation will usually occur later in the day or not at all.
- The earlier the fog forms at night, the later dissipation will occur the following day. The reverse is also true and when the dewpoint spread is <<25<198>F (fog will not form on the following morning).
- The Kings River and local irrigation canals have a definite effect on the depth of the fog, especially when associated with a light southeasterly component surface wind. When the Kings River and local irrigation canals are low or dry, fog is generally shallow and patchy.
- If the top of the fog layer extends to 2,500 feet or above, afternoon clearing should not be expected.

Objective Techniques

Summer Maximum Temperature

One of the first indications of an impending hot spell in the San Joaquin Valley is a 24-hour surface pressure rise of 5 to 10 millibars over Washington, Oregon, and Idaho. A progressive southward shift of the 24-hour surface center into Nevada causes, in response to the pressure gradient, strong east-northeast desiccating winds through the Sierra Nevada mountain passes. The extreme case occurs when the surface center shifts southward to a central position over southern Nevada, representing the forerunner of the Santa Ana condition over the Los Angles Basin.

Local forecasters have recognized the

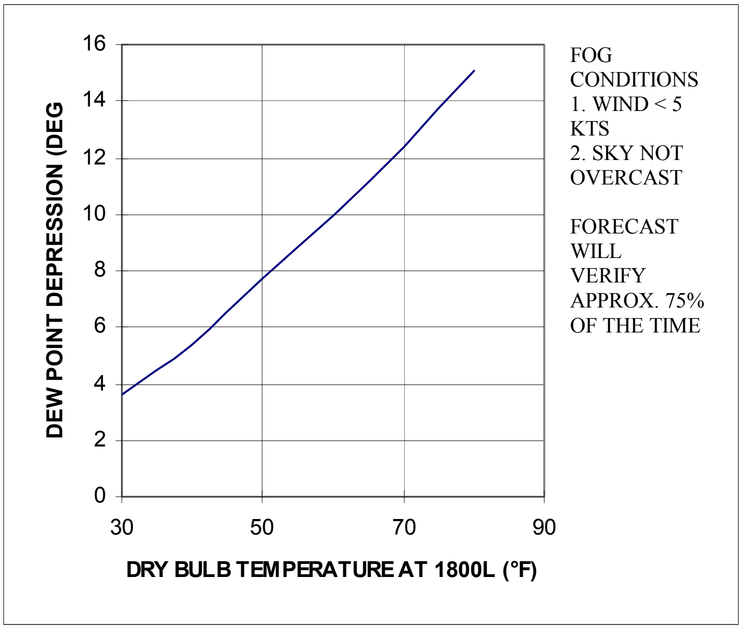

Figure III-3 Fog Formation Nomogram

connection between 24-hour pressure rises over Nevada and warming in the Central San Joaquin Valley. Conversely, expansion in the marine coastal air depth and subsequent cooling in the valley have generally accompanied pressure falls over the plateau. In the course of attempting to develop pressure gradient guidelines a rough thumbrule was found: an average of surface pressures from three coastal and three plateau stations, subtracting the averages, and using the difference between this value and that of the previous day for one parameter. Accordingly, the first parameter is defined as follows:

$$X = \frac{((A-A')+(B-B')+(C-C')+(D-D')+(E-E')+(F-F'))}{3}$$

A, B, C, D, E, and F are the 0000Z surface pressures in millibars and tenths for the current day at SFO, MRY, SMX, LOL, WMC, and TPH respectfully. The primed quantities are the pressures obtained the previous day at 0000Z. The resultant "X" is the 24 hour change in the average surface pressure between the central California coastal region and the Nevada Plateau.

Locally, early morning, low-level smoke stratification accompanied by a low subsidence inversion often results in rising daytime temperatures. This empirical knowledge furnished the basis for the second parameter. Radiosonde information is used to determine the inversion base pressure change as the second parameter:

$$Z = Ip - Ip'$$

Ip represents the 1200Z pressure of the subsidence inversion base at Lemoore in millibars and <MI>Ip'<D> is the pressure of the inversion base at 1200Z the previous day. "Z" is the 24-hour change in the Lemoore inversion base.

Using the parameter

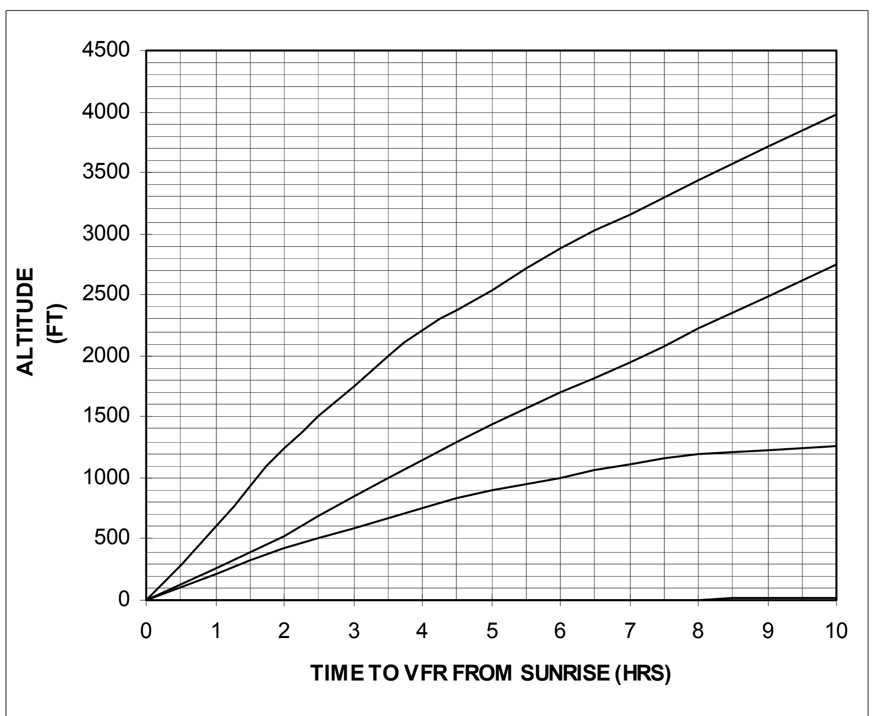

Figure III-4 Fog Dissipation Nomogram

"X" and "Z", the following equations may be used in estimating the change in the maximum temperature from one day to the next:

JUNE

$$T24= (-7.7X-.1Z+1.8) / 10$$

JULY

$$T24= (-6.7X-.5Z-1.8) / 10$$

AUGUST

$$T24= (-6.5X-.5Z+ .03) / 10$$

SEPTEMBER

$$T24= (8.1X+.4Z-4.0) / 10$$

T24 is the forecast change in maximum temperature for the following day in degrees F. When two inversions exists at Lemoore, the lower inversion is used in all calculations. By adding T24 to the maximum temperature of the current day, the forecast maximum temperature for the following day is obtained. Best results are obtained when T24 approaches or exceeds a value of two degrees F.

An important exception to the above formula occurs when a change in air mass is experienced, such as the advection of marine air into the valley. In this case, maximum temperatures will drop regardless of the value derived from this formula.

Precipitation Associated with 500 mb Height and Vorticity Progs

The LFM (Limited Fine Mesh) and NOGAPS 500mb progs, available from DIFAX and JMV respectively, have proven to be useful in forecasting upper

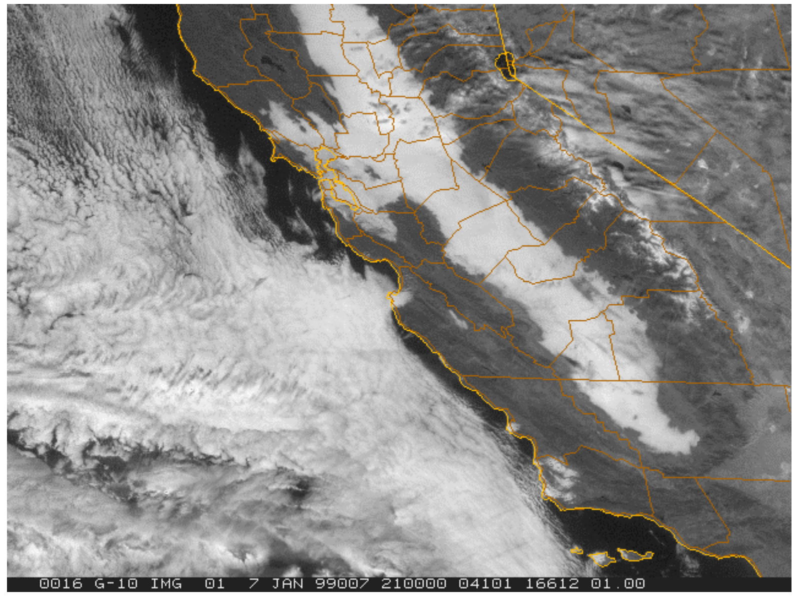

Figure III-5 Typical Tule Fog as Seen by Satellite

level moisture and precipitation over the south central San Joaquin Valley. Local application works best when a well-defined progressive upper-level trough proceeds across the west coast.

The basic approach is to forecast mid-level clouds and precipitation whenever the predicted 500mb heights are less than 5,460 gpm, positive vorticity values (isopleths) exceed +10 and the 500mb-wind flow is westerly or southwesterly. If there is no evidence of a cold front associated with the 500mb short wave trough, a greater vorticity value and lower 500mb height may be required to produce precipitation over the local area. This technique has been used with good success. Vorticity data should be carefully checked due to the proximity of the west coast and a lack of observing stations over the ocean (upstream).

Precipitation Associated with West to East Type Frontal System

The nomogram in figure III-1 is used to forecast precipitation when a long wave trough is positioned near the west coast and a west to east type frontal system is approaching the California coast.

Precipitation Associated with North to South Type Frontal System

The nomogram in figure III-2 is used to forecast precipitation when a long wave ridge is positioned over the western U.S. and a north to south type frontal system is approaching northern California.

Fog Formation

The nomogram in figure III-3 is used to determine whether fog will or will not form during the night based on the dry-bulb temperature and the dew point depression at 1800 local time.

Fog Dissipation

The nomogram in figure III-4 is used to determine the time of fog dissipation after sunrise and based on forecast wind direction, speed, and the thickness of the fog or stratus.

Local Weather Phenomena

Snow

The only snowfall recorded at this station since its commissioning in July 1961 occurred on 21 and 22 January 1962, with an accumulated total of 3.3 inches. This snowfall was associated with a well-defined cut-off low aloft that formed over the North American continent and moved SSW over central California to a point offshore southern California. With continental polar air pouring into the area from the north in the lower levels and moist unstable air overrunning it at higher levels, the ideal situation for snow had developed.

Fog

Radiation fog or *Tule* fog as it is commonly referred to in the San Joaquin Valley, is the only fog of consequence, which occurs at this station. It occurs mainly during the months November through February, frequently reducing field conditions to below GCA

MINIMUMS during the morning hours.

The first day of fog usually occurs in maritime polar (MP) air a day or two after the passage of a wet cold front (precipitation occurring). With rising pressures occuring behind the cold front, a subsidence inversion forms. This inversion, combined with the mountain ranges that encircle the valley, completely traps the MP air mass in the valley. From this point on, the entire air mass is cooled by radiation, promoting the formation of fog.

Of the many variables involved, estimating the time when turbulence will lessen to allow fog to form is the primary consideration. The turbulence, or wind movement factor, appears to act slightly differently following frontal passage. Frequently, at night and following the passage of a cold front, no fog will form because of the presence of excessive air movement. In other instances, a rapidly moving front has moved far enough beyond the station to decrease turbulence and allow heavy fog to form the first night.

Once a thick fog has formed, dissipation is slow. While the ceiling does lift as the lower layers are heated, clearing usually does not occur until noon. During he next night, because of the reduced number of hours of heating, fog will form earlier and build to greater heights during the night. This increases the possibility of later clearing the next day. With no changes in the synoptic situation, the trapped air mass gradually becomes colder each day until its vertical extent allows little or no clearing.

When the top of the inversion has increased to considerable depth, above 2,500 feet, fog is not dissipated by surface heating. A stable layer remains its base usually below 1,000 feet, with an unstable lapse rate beneath. After the heating hours and before stabilization can take place in the lower layers, stratus forms below the inversion, quickly forming an overcast. The overcast inhibits the formation of fog in the lower layers and, unless it builds down to the surface, horizontal visibility remains good for the period. This occurrence is likely to repeat during the following nights.

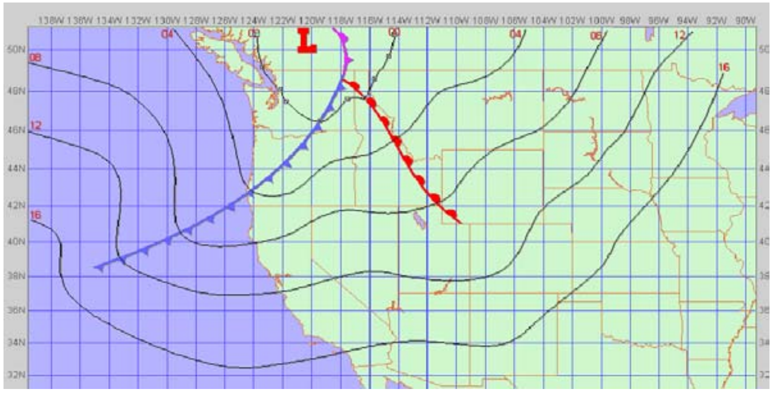

Figure III-6 North-South Front at the Surface

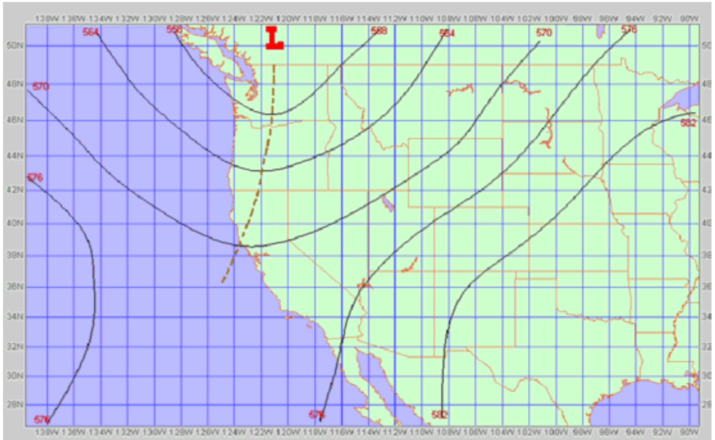

Figure III-7 North-South Associated 500 mb Trough

One feature that intensifies fog in the valley is the lowering of the subsidence inversion. Three to five days after

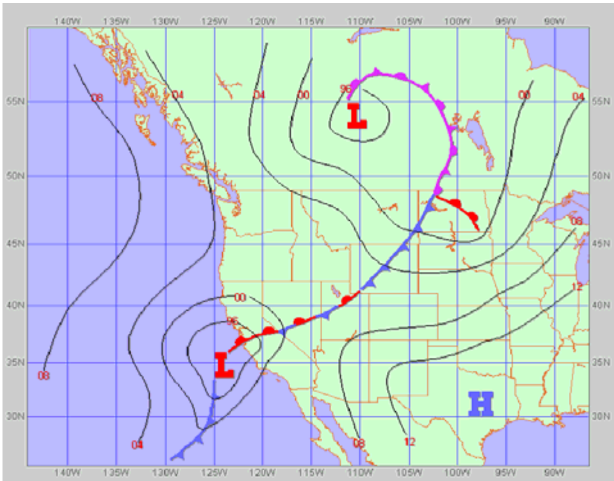

Figure III-8 East-West Front at Surface

pressures begin to rise over the Pacific Northwest, the wind direction changes at the 8,000 to 10,000 levels from a westerly to an easterly component, indicating air is settling from the stationary basin High. This lowering of the subsidence inversion and capping of the MP air mass reduces the vertical extent of the fog. This in turn often forces the stratus deck to build down to the surface during the night.

Estimating the time of fog dissipation is dependent on the thickness of the layer and the velocity of the surface wind. When a surface wind has a southerly component, dissipation time increases with thickness. However, this does not hold true with a surface wind that has a northerly component. Under static conditions, fog will form earlier and dissipate later succeeding nights until the trapped air mass is removed.

In order to end the fog cycle, a complete removal of the MP air mass trapped in the valley is required. This occurs with the passage of a frontal system, a surface low, or an upper trough through the area. The resultant instability effectively destroys the inversion and sweeps the trapped air from the valley.

San Joaquin Valley Eddy

A northerly pressure gradient can produce a wind eddy in the San Joaquin Valley, resulting in light and variable or light southerly winds in the east-central portion of the valley. This phenomenon extends southward from Madera to Tulare and eastward from the Lemoore area to the Sierra Nevadas. When the eddy is active, Stockton (SCK), Merced (MER), and Bakersfield (BFL) report northwesterly to northerly winds of about 10 to 20 knots while Fresno (FAT) and Visalia (VIS) report light and variable or light southerly winds at or about 2 to 7 knots.

San Joaquin Valley Low Level Jet

The summer nocturnal jet over the San Joaquin Valley has been known to exist for several years. Knowledge of the strength of this low-level jet, its vertical extent, and its

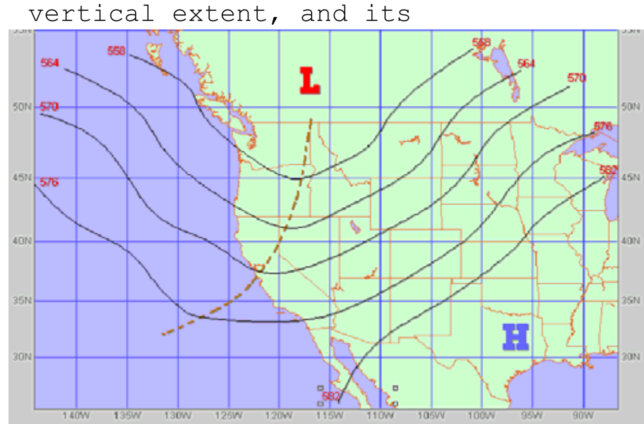

Figure III-9 East-West Associated 500 MB Trough

wind speed distribution through the valley is of interest to aviators, fire fighting officials, and air pollution control agencies.

During the summer, the low-level jet frequently occurs at night. It forms near sunset, reaches maximum strength during the evening and continues to exist for most of the night, gradually diminishing in intensity.

The nocturnal jet is related to the afternoon marine air invasion through the San Francisco Bay area into the delta region and is caused by large-scale thermal and pressure patterns. The jet is dependent on the intensity of the eastern Pacific High cell and the southwest desert thermal low. Maximum intensity occurs during the hottest time of the summer when the thermal trough is best defined. The jet is less developed when the marine inversion along the west coast becomes deep enough to allow cool air to spill into the valley, thereby weakening the thermal low over the interior.

The vertical structure of the jet during maximum inflow periods shows surface wind speeds of 10 to 15 knots, gradually increasing to a maximum of 25 to 35 knots between 1,000 to 2,000 feet and gradually decreasing to 10 to 15 knots at 4,000 feet. Information available about the horizontal extent of the jet shows it to be present over the entire San Joaquin Valley and of equal strength from east to west. From north to south, the maximum velocities will be found in the north or central portion of the valley. The wind direction is from the west to northwest in the northern end of the valley and northwest through the majority of the remainder of the valley (the exception is the extreme southern end of the valley where the eddy effect is occurring).

Marine Air

In the San Joaquin Valley, the hot summer temperatures are unrelenting except for an intermittent influx of marine air into the valley. This influx of marine air occurs when the thermal trough over the California interior is well defined and the base of the marine inversion along the coast extends above 984 feet. The principle route for marine air to enter the San Joaquin Valley is through the San Francisco Bay area into the delta region in the northwest part of the valley. At this point, the marine air splits into two cool streams: one flows northward into the Sacramento Valley, and the other pushes southward. Usually, when Sacramento is being cooled by the marine air influx, the Lemoore area will experience a somewhat modified cooling the following day. When the base of the marine air inversion extends to 1,640 feet or greater, cool marine air may spill into the San Joaquin Valley from the lower portions of the coastal ranges to the west, especially through the Pacheco Pass (1,380 feet) and Cholame Pass (1,700 feet).

Runway Crosswinds

Because the runways at NAS Lemoore are orientated parallel to the San Joaquin Valley, crosswinds occur less than one percent of the time. These few occurrences take place primarily in the afternoon, with crosswind components of 10 to 15 knots. The average crosswind component at this station is usually less than 15 knots. When it does exceed 15 knots, it is usually associated with gusty winds.

Hazardous crosswind components occur with northeasterly winds when the ridge aloft exists with a surface high over the plateau. A surface low-pressure system located off the California coast

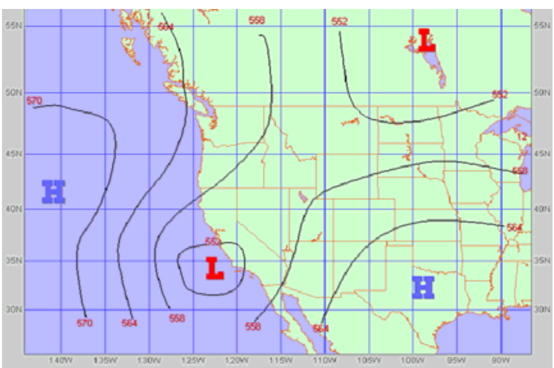

Figure III-11 Cut Off Low at 500 MB

may produce moderate to strong southwesterly winds that create a crosswind hazard. In this case, the morning surface wind at Sandberg, California (SDB) is a very good indication of the afternoon wind at NAS Lemoore. Pre-frontal southwesterly winds associated with a fast moving cold front also may produce hazardous crosswinds for a short period.

Cold Front (North to South Type)

Figure III-6 and III-7 illustrates a fast moving cold front and its associated 500mb trough. This frontal system, orientated north to south, is the most common type and may occur during any season of the year. During the summer months, a front of this type is usually so weak by the time it reaches the San Joaquin Valley no significant change in air mass occurs. During other times of the year, pre-frontal shower activity of short duration may occur. This usually occurs during the winter months when cold frontal passages are experienced on a 3 to 5 day cycle. A moderate post-frontal surface wind will usually sweep any fog out of the valley. The associated instability will inhibit fog formation for the next 24 to 48 hours. Post-frontal surface wind may be strong enough to require a wind warning, but, in general, sustained winds will be less than 20 knots.

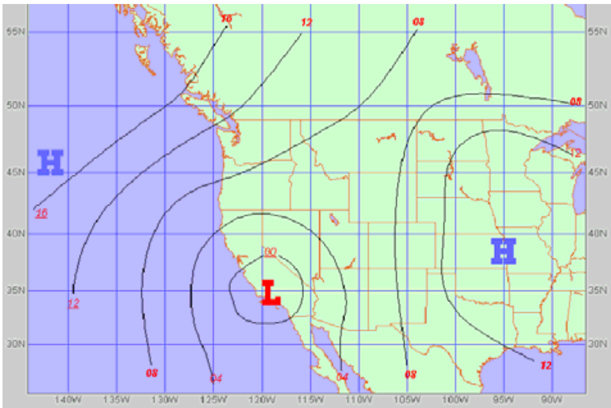

Figure III-10 Cut Off Low at Surface

Frontal System (West to East Type)

Figure III-8 and III-9 illustrates a west to east frontal system and it has associated 500mb trough. This slow moving frontal system occurs infrequently during the winter and early spring. However, when this system does develop, multi-layered cloud cover, intermittent rain, and a few embedded thunderstorms may be expected for one or 2 days. The forecaster is usually forewarned of this system when the long wave trough position is located west of the California coast and a wave forms along the front off the southwest California coast.

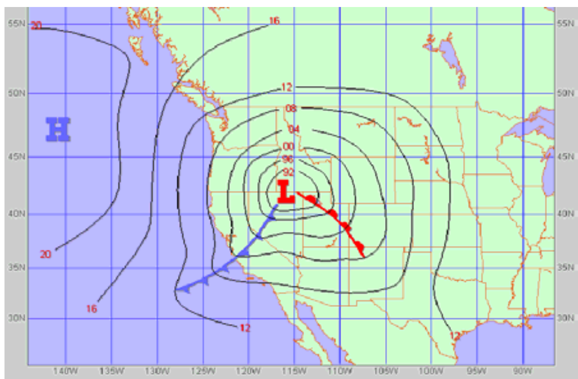

Figure III-12 Thunderstorm Development at Surface

Cutoff Low

Figure III-10 and III-11 illustrates a cut-off low at the surface and 500mb levels. This low usually forms during the winter or early spring. These cut-off lows generally begin to form over land in the northwestern United States and move south or southwest to a position off the California coast. When this low is well defined central and southern California will experience multi-layered cloud cover and heavy rain for prolonged periods. Embedded thunderstorms also may be associated with this system. This inclement weather may persist for more than a week.

Hazardous Weather Phenomena

Tornadoes

Tornadoes found here are classified as Pacific or West Coast Type. Though the occurrence of tornadoes in the San Joaquin Valley is rare, these phenomena presents the greatest single meteorological hazard to this station. Tornadoes found in this area form in relatively cold, moist air and occur singularly rather than in families. The freezing level is usually low and wind gusts are often masked by strong gradient flow. These tornadoes have a comparatively brief life cycle, with short narrow paths. It is believed that the comparative rarity of surface destruction

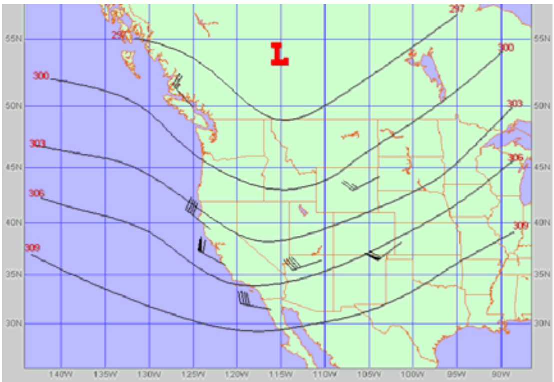

Figure III-13 700 mb Associated T-storm Development

associated with the West Coast Type Tornado may be due to the cushioning effect of the cool surface air.

West Coast Type Tornadoes are always associated with a cold core low aloft. The most favorable areas for development of these tornadoes are to the rear of maritime polar cold fronts and in very cool air behind squall lines.

Thunderstorms

Thunderstorm activity is infrequent in the local area. When thunderstorms pass over the station, the resulting ceiling can lower to 1,000 feet or less, restrict visibility in heavy rainshowers or small hail, and introduce a moderate gusty surface wind. These conditions exist for only short periods.

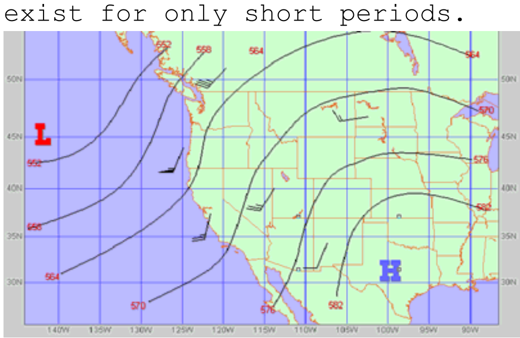

Figure III-14 500 mb Associated T-storm Development

Thunderstorms are likely to occur in the spring and fall and are not characteristic of the prevailing air mass at this station. They are associated with upper level troughs and lows, fast moving cold fronts, pre-frontal squall lines, or an intruding Gulf of Mexico airmass.

Upper level troughs and lows account for the greatest thunderstorm threat to NAS Lemoore. The surface and 700mb charts shown in figures III-12 trough III-14 illustrate an ideal synoptic situation favorable for the development of thunderstorms under this condition. One of the most favorable areas for this type of thunderstorm development is along a path from the Kerman-Biola area (30 miles north of NAS Lemoore) to the San Joaquin River.

Fast moving cold fronts and pre-frontal squall lines account for the second greatest thunderstorm threat, and are likely to occur anywhere in the valley.

Gulf of Mexico Air

When the westerly retreat to the northern latitudes and the continental high-pressure cell moves over the western U.S., warm moist Gulf of Mexico air flows around the periphery of the high-pressure cell. This rare summertime situation usually produces the greatest weather activity at NAS Lemoore and usually occurs the third day after broken to overcast skies first appear on the southern side of the Tehachapi Range. However, the thunderstorm activity is usually confined to the Sierra Nevada and Tehachapi mountain ranges, with only a broken middle cloud deck drifting over the station for two or three days.

Mountain Waves

The Lemoore forecaster must pay particular attention to this phenomenon since all exits from this valley require flight over mountains. Mountain waves are nearly stationary features occurring on the leeward side of most mountain ranges, and are generally associated with the higher ranges where the necessary wind speeds of 50 knots or more at mountain top level are found. The direction of the wind must be within 30 degrees of the perpendicular to the mountain range. Cap, rotor, and lenticular clouds identify mountain waves. Cap clouds hug the mountain top, rotor clouds form on the leeward side parallel to the range, and lenticular clouds, which are the most significant type to an observer, appear in layers up to very high levels. There are times when the wind is favorable for a wave condition, but the lack of moisture may prevent clouds from forming. This cloudless type wave produces as much turbulence as the cloud type, and is extremely difficult for a pilot to identify. Occasionally, the cloudless type can be distinguished by dust extending to great heights on the leeside of the mountain range.

Turbulence is the greatest hazard produced by the mountain wave. Associated areas of steady updraft and downdraft may extend to heights from 2 to 20 times the height of the mountain peaks. Almost as hazardous are the erroneous readings registered on pressure altimeters near the mountain peaks (errors as much as 2,000 feet are possible). Reduced visibility in blowing dust and cloud-shrouded mountains tops are additional hazards associated with this phenomenon.

Severe turbulence frequently can be found extending 150 miles downwind of the mountain range, when the winds are greater than 50 knots at the mountain top level. Moderate turbulence often can be experienced up to 300 miles downwind of the range under the previously stated conditions. When winds are less than 50 knots at the mountain peak level, a lesser degree of turbulence may be experienced. Pilots, if possible, should fly clear of the areas where wave conditions exist. If this is not feasible, one should fly at a level that is at least 50 percent higher than the height of the mountain range.

Forecast Verification

Forecast verification is completed in accordance with the Naval Pacific Meteorology and Oceanography Facility San Diego, California Instruction 3147.1(). The Forecast Duty Officer will enter either the 09Z or 21Z 24 hour Terminal Aerodrome Forecast (TAF) on the forecast verification form at the time it is issued. The

Forecast Verification Petty Officer will be responsible for verifying the forecasts submitting monthly averages to the Officer in Charge.

A warning verification form verifies local warnings (wind, storm and thunderstorm). The duty observer will enter all record and special observations taken during the time the warning is in effect.

SECTION IV - SPECIALIZED FORECASTS

Optimum Path Aircraft Routing System (OPARS)

The Optimum Path Aircraft Routing System (OPARS) consists of a set of computer programs designed to help an aircraft select the safest, fastest, and most fuel efficient route possible. NPMOD forecasters require approximately 2 hours lead-time before scheduled departure in order to process an OPARS request. For involved cross-country flights, earlier requests are advised (one day lead-time).

Integrated Refractive Effects Prediction System (IREPS)

IREPS is a shipboard environmental data processing and display system designed to aid in the assessment of the impact of lower atmospheric refractive effects on naval EM systems. IREPS has been developed to give comprehensive refractive effect assessments for naval surveillance, communications, electronic warfare, and weapons guidance systems. IREPS has been successfully used under operational conditions aboard CV/CVNs to assess and exploit refractive effects in tactical situations. After the proper environmental data has been entered into IREPS, four products are available:

Electro-Optical Tactical Decision Aids (EOTDA)

EOTDA is a software model that predicts the performance of Precision Guided Munitions (PGM) and direct view optics based on environmental and tactical information. The output is expressed in terms of maximum detection and lock-on range. Results are displayed in alphanumeric and graphic formats. EOTDA supports systems in the infrared, TV (visible), and laser wavelengths. NPMOD Lemoore requires a minimum lead-time of 2 hours for this product. Secure communications are available using STU-III PH: 998-1019.

Radiological Fallout Forecasts

Radiological Fallout messages are received at NAVPACMETOC DET Lemoore via GATEGUARD from NAVPACMETOCFAC San Diego and from FLENUMMETOCCEN Monterey. NPMOF's messages contain pre-burst predictions for pre-selected locations and are used to construct fallout contours for the Lemoore area. FNMOC's messages provide a 24-hour forecast for effective fallout for the western Pacific and the western United States. RADFO messages are received on the first Sunday of the month, and in the case of DEFCON TWO being set, would be received twice daily.

SECTION V - ENVIRONMENTAL EFFECTS

Fog

Fog is the most significant weather phenomena that develops over the local area, often restricting flight operations. It most often occurs during the winter months (November to February). Fog frequently reduces ceiling and/or visibility below single pilot and/or below field minimums during late night and early morning hours. At times, the field has remained below single pilot minimums four days at a time.

Thunderstorms and Tornadoes.

Thunderstorms in the local area occur only a few times a year. Temporary IFR conditions, locally gusty surface winds, and occasional funnel clouds may accompany heavier thundershowers. Aircraft fueling and weapons loading is at the discretion of the Operations Duty Officer (ODO) during Thunderstorm Condition II and is curtailed during Thunderstorm Condition I.

Specific Effects

Temperature extremes affecting safe Takeoff/Landing

AIRCRAFT	MAXIMUM	MINIMUM
F/A-18	60°C	-35°C
C-12	51°C	-54°C

All icing conditions are critical to the F/A-18 aircraft. This aircraft is prone to FOD damage because its engine intakes are close to the leading edge where icing is most prevalent. Additionally, all aircraft require greater runway distances and more acceleration time during hot weather conditions because the air is less dense.

Cross-Wind limitations

AIRCRAFT	Begins to affect A/C performance	AIRCRAFT CAN NOT take off
F/A-18	15 Kts at 90°	30 kts at 90°
C-12	7 Kts at 90°	10 kts at 90°

SECTION VI - REFERENCES

ATP 45 (Reporting Nuclear Detonations, Biological and chemical Attacks)

Berry, Bollay, and Beers, Handbook of Meteorology, McGraw-Hill, New York, 1945

EOTDA User's Manual

GEOPHYSICS FLEET MISSION PROGRAM LIBRARY (GFMPL)

OPARS User's Manual