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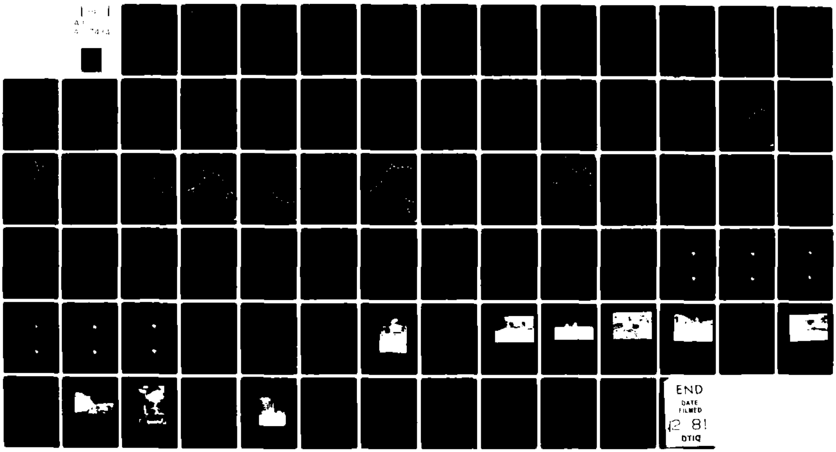

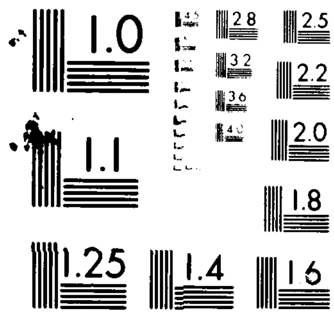

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REPLY TO
ATTENTION OF

DRSTE-AD-A

4 NOV 1981

SUBJECT: TECOM Independent Evaluation Report (IER) for the DT I of the Container Lift Adapter (CLA)

SEE DISTRIBUTION

1. The subject IER is forwarded for information and use. The report was prepared by TECOM in coordination with the AVRADCOM Red Team. The TECOM point of contact is Mr. Don Conley, AUTOVON 283-5278.

2. It was concluded that the container lift adapter is ready to enter the full-scale development phase as a subsystem of CHELS; however, the CLA hardware and concept of use have several significant problems that must be corrected or improved upon during future development to enhance productivity, safety and reliability.

3. It was recommended:

a. That the problems revealed during DT I be corrected if the CLA enters the full-scale development phase.

b. That the specific tactical use of CHELS be clearly defined to permit proper test and evaluation during future operational and development testing.

c. That a design review and cost benefit analysis be conducted on the gondola subsystem of CHELS considering two types of gondola designs. One would be designed to be transported with slings alone. The other would be designed to be transported using a CLA.

d. That testing be conducted to determine the optimum sling length with regard to safety and productivity, if the system enters the full-scale development phase.

FOR THE COMMANDER:

Ashley J. Collins Col.

1 Incl
as

for HARRY J. PETERS
Technical Director

DRSTE-AD-A 4 NOV 1981

SUBJECT: TECOM Independent Evaluation Report (IER) for the DT I of the Container Lift Adapter (CLA)

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TERMINAL FORECAST REFERENCE NOTEBOOK
Detachment 15, 25 Weather Squadron (MAC)
Luke AFB, Arizona
For Fresno Air Terminal, California
20 April 1981

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SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

ADE 850 101

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
5WW/TFRN-81/004

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (*and Subtitle*)
Terminal Forecast Reference Notebook
Fresno Air Terminal, CA

5. TYPE OF REPORT & PERIOD COVERED
Final

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Detachment 15, 25 Weather Squadron (MAC)
Luke AFB, Arizona 85309

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Det 15, 25WS
Luke AFB AZ 85309

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
25 WS/DO
Bergstrom AFB TX 78743

12. REPORT DATE
20 April 1981

13. NUMBER OF PAGES
73

14. MONITORING AGENCY NAME & ADDRESS (*if different from Controlling Office*)
5 WW/DNS
Langley AFB VA 23665

15. SECURITY CLASS. (*of this report*)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (*of this Report*)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (*of the abstract entered in Block 20, if different from Report*)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (*Continue on reverse side if necessary and identify by block number*)

Fresno Air Terminal
Weather Impacts
Synoptic Climatology
Climatic Aids
Off-base Forecast Support
Rules of thumb
Meteorology
Meteorological insturments
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20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

This terminal forecast reference notebook is for Fresno Air Termina, CA. It describes the following topics concerning forecasting weather at Fresno: location, topography, and local effects; impact of weather on supported units; synoptic climatology; climatic aids; operationally significant forecast problems; approved forecast studies; rules-of-thumb; and special synoptic studies and references.

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FOR THE COMMANDER

Robert E Black

ROBERT E. BLACK, Lt Col, USAF
Operations Officer

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CHAPTER 1

LOCATION, TOPOGRAPHY, AND LOCAL EFFECTS

1-1. Location and Topography.

a. City Location. The city of Fresno is located about midway down the San Joaquin Valley on its northwest to southeast axis and toward the valley's eastern edge. (Figure 1-1). The terrain around Fresno itself is generally level but with an abrupt upward slope about 15 miles to the east of the city leading to the foothills of the Sierra Nevada mountains. The main Sierra Nevada range is located about 50 miles to the east and rises from 12,000 to 14,000 feet in elevation. Forty-five miles to the west lie the foothills of the Coastal Range.

b. San Joaquin Valley. The San Joaquin Valley comprises the heart of a vast agricultural area which fills the great interior valley of California encompassing both the Sacramento and San Joaquin Valley systems. The valley extends on a northwest to southeast axis for 225 miles; its average width approximates 50 miles. The valley is drained by the San Joaquin River and numerous tributory systems some of which include the Merced and Toulumne, all of which originate in the Sierra Nevadas with the San Joaquin eventually emptying into the Sacramento-San Joaquin delta area and thence into Suisun Bay. The Kings River also originates in the Sierras and flows south of the city eventually emptying into Tulare Lake. The Valley is bounded on the north by the Sacramento Valley and aforementioned delta area, on the east by the Sierra Nevadas, on the south by the Tehachapi Mountains whose elevations range from 5000 to 7000 feet, and on the west by the Coastal Ranges averaging 3000 to 4000 feet in elevation. The Carquinez Straits linking San Pablo and Suisun Bays and the Pacheco Pass located west northwest of Fresno are the only breaks in the coastal mountains through which low level maritime air may enter the valley.

c. Airfield Location. Fresno Air Terminal is located about 5 miles east northeast of the city at an elevation of 328 feet above mean sea level. Geographic coordinates are 36 degrees 46' N latitude, 119 degrees 43' W longitude. (Figure 1-2). There are few sources of local pollution as the area is predominantly agricultural with few pollution producing industries. Local ordinances severely restrict the burning of agricultural residue thereby reducing this as a pollution source.

1-2. Topographic Influences.

a. Moisture Sources. The primary moisture source for the Fresno area is the Pacific Ocean. It exerts its influence mostly in the winter months. Local sources of moisture are limited to rivers and streams draining the western slopes of the Sierra Nevada and to an extensive area of irrigation canals and ditches which criss-cross the valley floor. Seasonal flow in the rivers and streams limits their influence primarily to the winter months when the addition of moisture from these sources may produce local thickening of the winter time fog. Extensive summertime irrigation has acted to increase relative humidity within the valley by a few percentage points, but produces little other effect.

b. Mountain Influences. Mountain ranges exert a strong influence on the availability of moisture, the predominant wind flow in the valley, and in moderating wintertime temperatures. The eastermost mountain chains form a barrier that protect the valley from the extremely cold air of the Great Basin in winter. There are occasions when cold air from an extensive high pressure area spreads westward and southward into the valley, but even in these cases compressional warming as the air flows down the lee slopes of the Sierras and into the valley

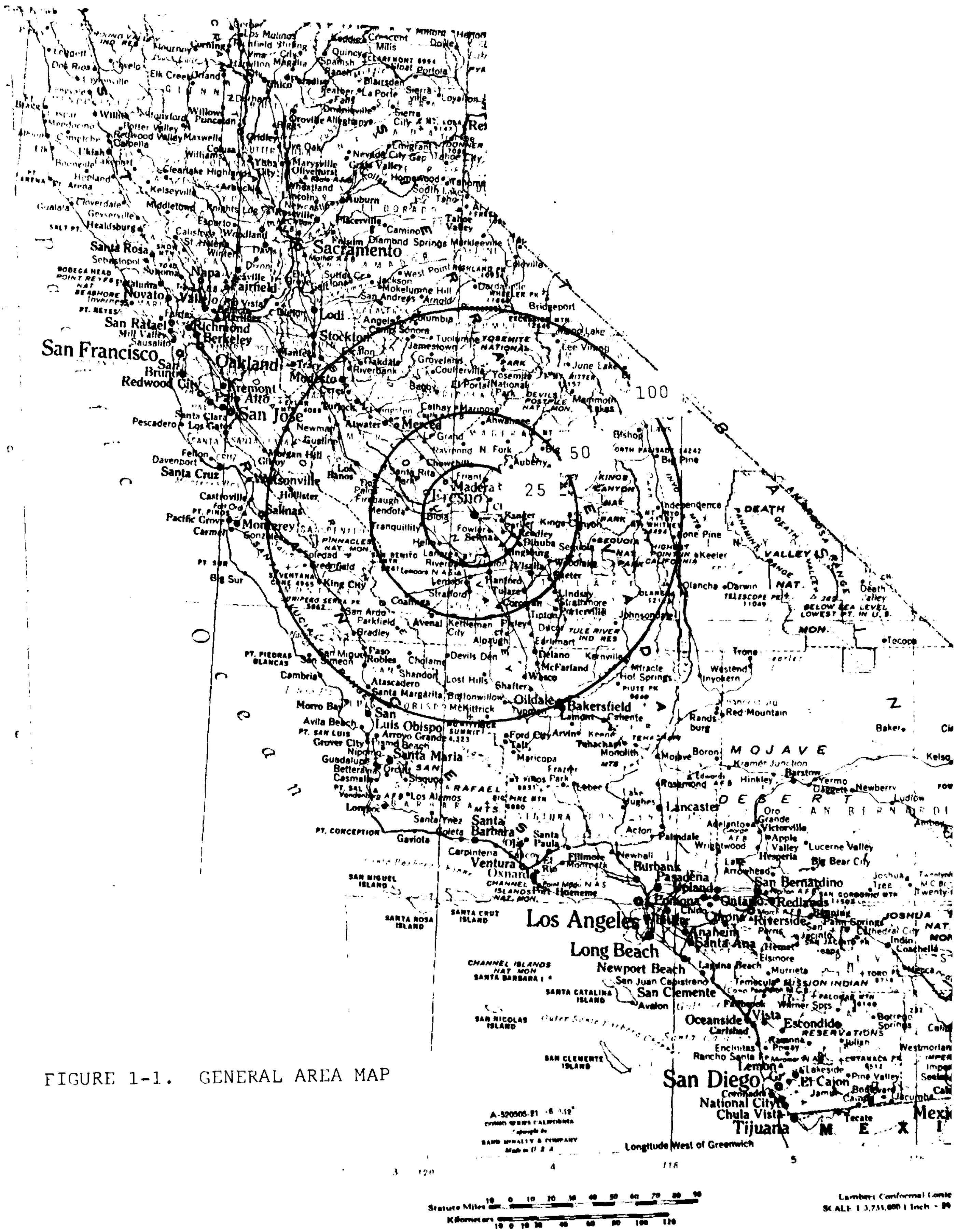


FIGURE 1-1. GENERAL AREA MAP

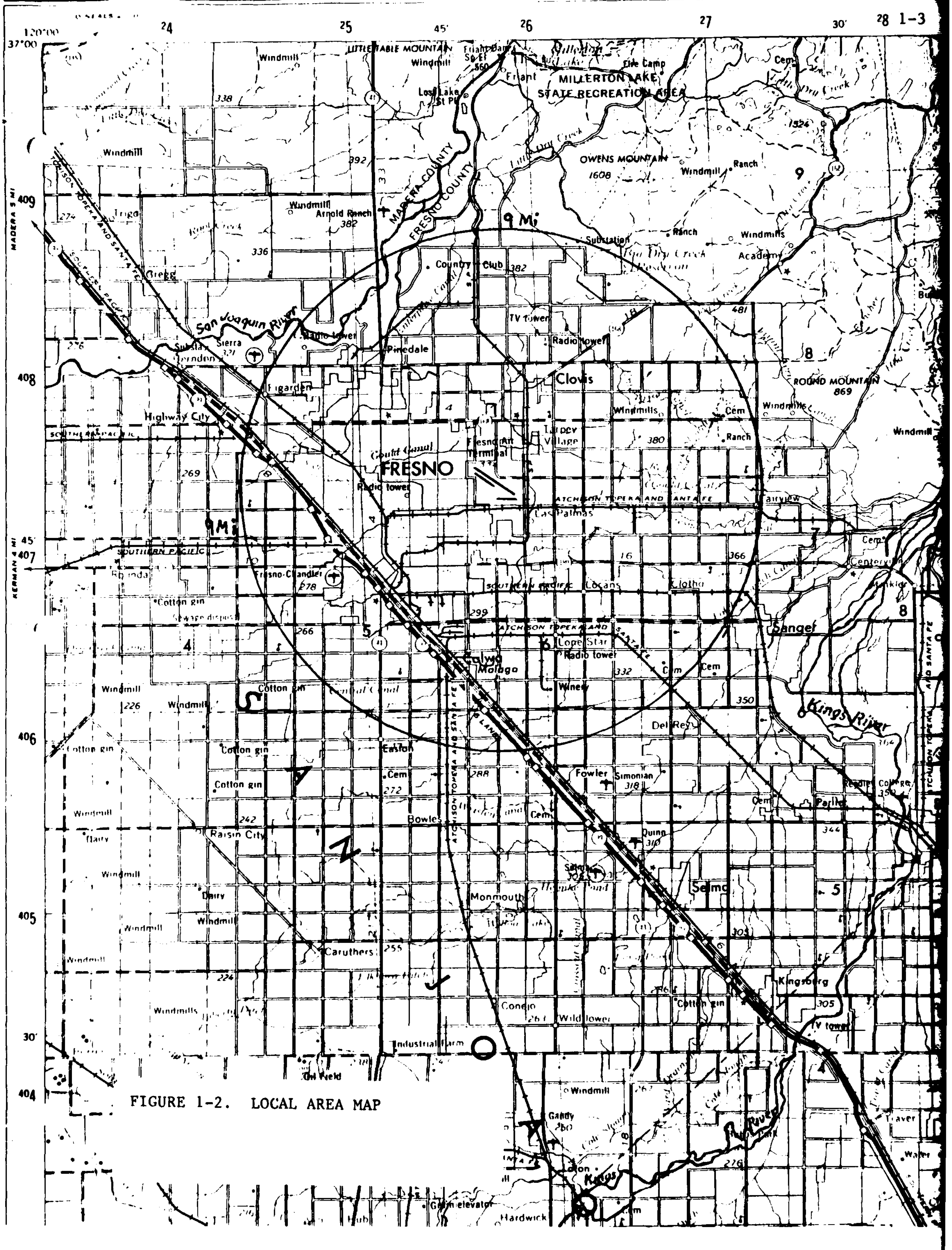


FIGURE 1-2. LOCAL AREA MAP

results in considerable moderation of temperatures. The blocking action of the Coastal Ranges protects the valley from strong on-shore winds and sea breezes throughout the year and exerts a strong influence on moisture availability. In the summertime, under the influence of the eastern edge of the semi-permanent Pacific high pressure cell, little moisture is available due to the northward track of storm systems and the strong subsidence produced by the high. The little low level moisture available is trapped beneath the subsidence induced inversion in a marine air layer of varying depth dependent upon the degree of subsidence. Under normal conditions, the marine layer is too shallow to cross the coastal range and reach Fresno. On certain occasions, such as the passage of a strong short wave trough aloft, marine layer depth can increase sufficiently to enter the valley via the Carquinez Straits or Pacheco Pass. Depending upon the depth of the layer and extent of modification by the underlying land, this air can reach Fresno as a cooling late afternoon or evening northwesterly breeze which brings relief from the sweltering summer heat. In the winter months, when ample moisture is brought from the Pacific by migratory storm systems, the Coastal Ranges can produce a pronounced rain shadow effect in the valley. The mountain ranges ringing the valley have a pronounced effect on the wind. Wind direction is normally limited to the northwest to southeast axis of the valley with the prevailing direction being northwesterly during every month save December and January when it is southeasterly. An easterly mountain drainage wind can be found on most summer mornings; however, this rapidly switches to the prevailing northwesterly flow by mid-morning.

1-3. <u>Weather Features Related to Topography.</u>

a. Winds. As stated above wind flow is typically oriented with the valleys' northwest to southeast axis. The bowl-like effect produced by the surrounding mountains serves to channel and direct the wind within the valley confines and, during the summertime, to result in a heat low forming in the southern valley extremities which induces air to flow through the Carquinez Straits and then southward. The day time northwesterly flow may be reinforced in the late afternoon or early evening hours by a sea breeze-like wind resulting from differential heating between the super hot southern valley and the cooler air in the San Francisco - Suisun Bay area. The sea breeze is usually manifest as a slight increase in the northwesterly wind speed. By late evening, the northwesterly winds abate and are gradually replaced toward morning by a southeasterly drainage wind from the Sierra Nevada. Southeasterly winter winds are the result of a reverse channeling - pressure gradient effect as the gradient induced flow moves from the relatively high pressures in the valley towards migrating troughs and storm systems traveling to the north.

b. Fronts. Wintertime frontal/storm systems approaching the San Joaquin Valley are strongly influenced by the surrounding terrain. These systems tend to drop the preponderance of their rain on the western slopes of the Coastal Range and Sierra Nevada. The valley between the two ranges suffers a marked rain shadow effect with the western side of the valley being markedly drier than the eastern (e.g. Fresno receives 10.2 inches annually while Lemore NAS about 30 miles to the west receives only 7.2). On the average coastal and coast range locations report up to 50 inches of precipitation per year, while in the valley the annual average is closer to 8 inches. Fronts often traverse the valley aloft as they skip from the top of the coastal range to the top of the Sierras, so surface indicators of frontal passage are often confusing and conflicting and sometimes non-existent.

c. Thunderstorms. While thunderstorms are of relatively little significance at Fresno, the topography of central California has a strong effect on the location and occurrence of those which do form. Winter thunderstorms occur in the cold, unstable air associated with a deep upper level trough moving over the California area.

They are normally post frontal, are generally relatively mild, and are often accompanied with soft quarter-inch hail. Greatest frequency is in the late winter/early spring in March and April. While these cold air thunderstorms can develop randomly, they often tend to form over the coastal mountains (due to orographic lift enhancing the development of building cumulus and towering cumulus in the already unstable air), and advect, with the prevailing flow, over the valley. Frontal associated thunderstorms are less frequent, and there are seldom ever any organized bands or lines of thunderstorms because of the disrupting influence of the surrounding mountains. Summer thunderstorms are a rare occurrence at Fresno; however, they do occur quite frequently over the Sierra Nevadas and to a lesser extent over the coastal ranges. Occasionally, when the upper level steering flow is favorable, these storms can be advected over Fresno. We should hasten to add, however, that this is a rare occurrence. Conditions favorable for forming these storms are associated with two distinct synoptic situations. In one case, high and, to some extent, mid-level moisture is advected around the western periphery of the Bermuda high and swept into the Sierra Nevada Ranges where orographic lift and thermal instabilities produce scattered thunderstorms. These usually occur in mid to late summer after the Bermuda high has reached its more northern limits allowing moisture to be transported from the Gulf of Mexico into the far western U.S. This happens to coincide with the maximum development of the continental thermal low over the southwestern deserts and the onset of the Arizona monsoon which draws low level moisture from the Gulf of California into the southern deserts of Arizona and California. The combination of the low and higher level moisture can enhance activity in the mountains. The second case is associated with the formation of tropical depressions/storms off the Baja California coast. The storms produce large amounts of mid and high level moisture which can be advected northward under the proper flow conditions. Again, orographic lifting over both the Sierra Nevada and more rarely over the Coastal Ranges can trigger thunderstorm activity.

d. Fog. The major forecast problem at Fresno is by far and away the occurrence of a dense, long lasting winter fog regime in the San Joaquin Valley. A full discussion of this phenomenon will be presented later in the TFRN, but it should be noted that one of the chief causes of the fog problem is the mountainous terrain surrounding the valley which places Fresno in a bowl-like entrapment where ventilation and dispersion of entrapped moisture is difficult to produce. This visibility restricting phenomenon is closely related to the presence of a subsidence inversion produced by high pressure over the Great Basin which places a lid on the valley thereby further enhancing the trapping and ventilation reducing effects of the surrounding mountains.

1-4. Airfield/Weather Station Orientation.

Fresno Air Terminal is a civilian municipal airport serving the city of Fresno and surrounding environs. It has a single main northwest-southeast oriented runway (29R/11L) measuring 150X9200 feet. There is a smaller parallel runway (29L/11R) measuring 75X3000 feet used by private and executive aircraft. (Figure 1-3). The National Weather Service (NWS) provides weather services to civilian users of the facility and observing support to military operations. Det 15 provides all military forecasting and briefing services. The NWS office is located in the general aviation terminal/airport administrative building located on the southwest side of the airfield about at the mid-point of the main runway. It is manned by NWS forecasters who provide forecast services for the Fresno area and take surface observations. Observations are presently transmitted by FSS personnel which can result in significant transmission delays especially of specials. This results in severe problems for forecasters in the winter months as they attempt to conduct a met watch of the fog and stratus conditions and issue required amendments. Future NWS plans include transmitting observations through the AFOS system which should significantly enhance their timely, reliable receipt. The California Air National Guard facility (144 FIW and 194 FIS) is located on the southwest side of the airport complex just off the southeast end of the runway. Alert aircraft are maintained on the parking apron at the east end of the Guard site. Scrambles are usually made using runway 29R.

1-5. Meteorological Equipment and Location. (See Figure 1-3)

a. Temperature-Humidity. Located due north of the National Guard base about 1000 feet from the approach end of runway 29R.

b. Wind Sensor. Same location as the temperature - humidity sensors.

c. Transmissometer. Dual transmitter/projectors, are located at the approach end of runway 29R, the other at the approach end of 11L.

d. Rain Guage. Located at base of control tower.

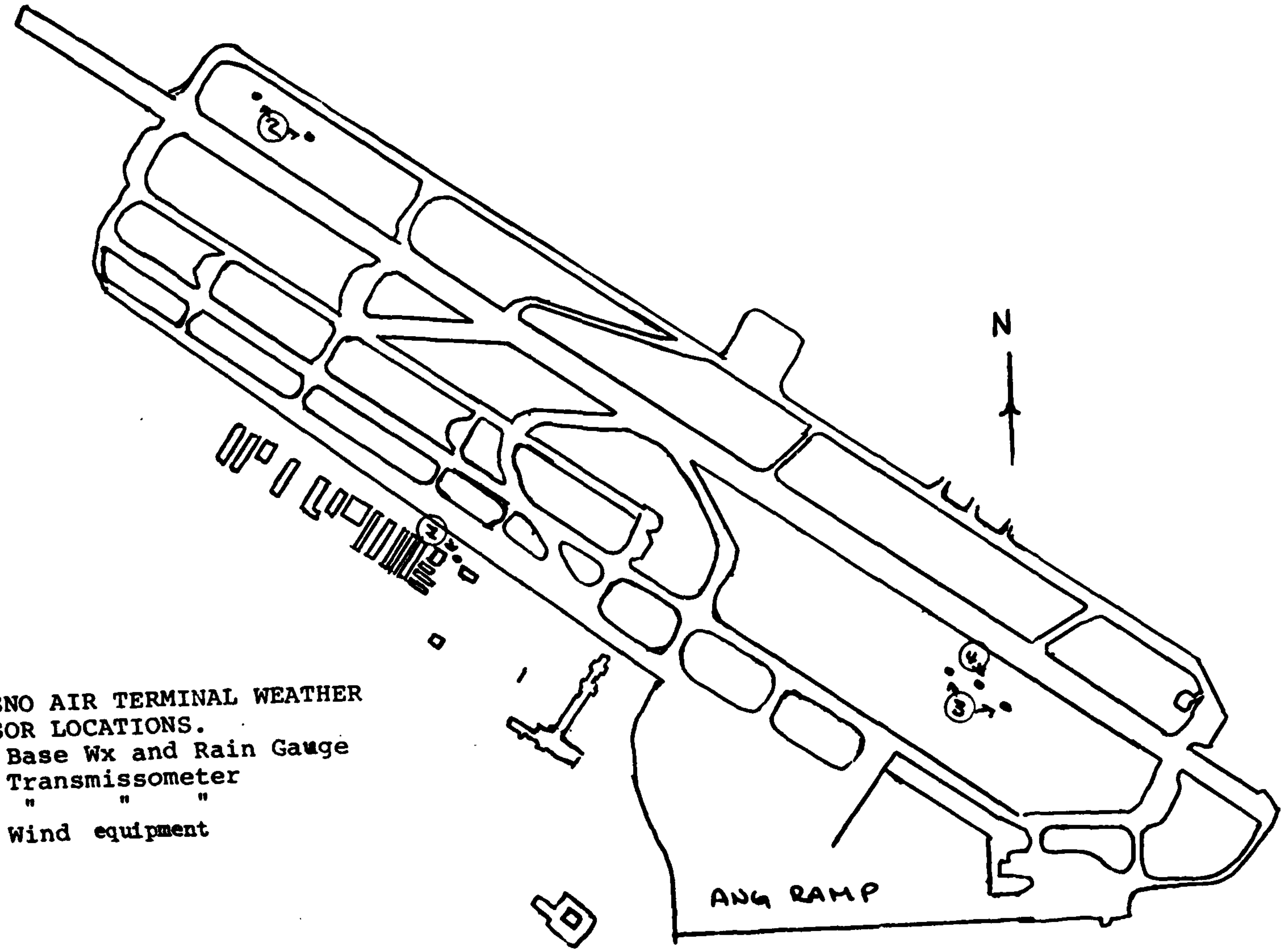
e. Barometer. Located in the NWS office.

f. Rotating Beam Ceilometer. Located off approach end of runway 29R.

1-6. Effects of Environment on Meteorological Sensors.

a. Observer's Field of Vision. The observer's vision field is partially blocked to the southwest through west to northwest by airfield buildings.

b. The rain guage is located in a somewhat sheltered location at the base of the control tower. Because of this location, measured rainfall could be somewhat less than actual rainfall.



FRESNO AIR TERMINAL WEATHER
SENSOR LOCATIONS.
1. Base Wx and Rain Gauge
2. Transmissometer
3. " "
4. Wind equipment

Figure 1-3. METEOROLOGICAL EQUIPMENT LOCATIONS

Chapter 2

IMPACT OF WEATHER ON SUPPORTED UNITS

The major supported unit at Fresno Air terminal is the 194FIS, 144FIW California Air National Guard. This unit operates and maintains F-106 aircraft in support of the 26th Air Division/NORAD Region mission to provide continental air defense of the southwestern U.S. The mission involves training flights and air defense exercises conducted off the California coast as well as actual intercepts in the Pacific Coastal ADIZ. The unit maintains an alert detachment at George AFB, CA, but weather support to this detachment is provided by the colocated AWS unit. Table 2-1 contains the customer specified threshold values for meteorological items of interest together with designated lead time, mission support, and customer specified actions.

TABLE 2-1

IMPACT OF WEATHER ON FRESNO TERMINAL

194FIS (Fighter Interceptor Squadron)

The 194FIS operates and maintains F-106 aircraft from Fresno Air Terminal, California in support of the 26th Air Division mission to provide continental air defense of the southwestern U.S. This mission involves training flights and air defense exercises conducted off the California coast.

THRESHOLD VALUES AT FRESNO	LEAD TIME	IMPACT	CUSTOMER ACTIONS
CEILING AND VISIBILITY			
300 ft/1 mile	1 Hour	Cancel training missions. Mandatory scramble.	1. Cancel training sorties. 2. Airborne aircraft divert to alternates. 3. Ground alert aircraft go on mandatory status.
500 ft/1½ miles	1 Hour	Cancel training mission, mandatory scramble for some crews.	
1000 ft/1 mile	Ø	None	No specific action required.
SURFACE WINDS			
25-34 Knots	1 Hour	Possible aircraft damage	1. Secure loose objects. 2. Close canopies.
35 knots or greater	1 Hour	Aircraft damage	1. Tie down or hanger aircraft. 2. Secure loose equipment. 3. Stop outside maintenance.
HAIL (any size)	½ Hour	Possible aircraft damage.	1. Hanger or evacuate aircraft.
THUNDERSTORMS	1 Hour	Affects training mission.	1. Avoid thunderstorms. 2. Possible diversion of aircraft. 3. Outside maintenance and refueling stopped.
FREEZING PRECIPITATION	½ Hour	Increase maintenance.	1. Mission cancellation. 2. De-ice aircraft. 3. Possible diversion to alternates.
RAIN (2" or more in 12 hours)	NA	Safety Problems.	1. Landing, stopping problems. 2. Cancel takeoffs/landings if standing water is on runway. 3. Possible diversion to alternate base.

Chapter 3

SYNOPTIC CLIMATOLOGY

3-1. Controlling Features.

The dominant factor in California's weather is the semi-permanent high pressure cell of the north Pacific Ocean. The northward migration of this system during summer deflects storm tracks far to the north. As a result, California seldom receives precipitation from Pacific storms during this season. In winter, the Pacific high decreases in intensity and retreats to the south permitting storms to move into and across the state. The storms bring widespread, though moderate, precipitation to the area. Occasionally, during the summer months, the state can come under the influence of the western section of the Bermuda high. The south to southeasterly flow aloft associated with this section of the high draws moist air northward from the Gulf of Mexico or the Gulf of California resulting in scattered, locally heavy, showers over the southern deserts and Sierra Nevadas.

3-2. Air Masses.

Four air masses dominate Fresno's weather, cool moist maritime polar (mP) air from the north Pacific, cool dry continental polar (cP) air from the Great Basin, hot dry continental tropical air (cT) from the southwestern deserts, and warm moist maritime tropical air (mT) aloft from the Gulf of Mexico and California each will be discussed below.

(1) Maritime Polar. The most prevalent air mass; it dominates the area in either modified or unmodified form all year, but is most prevalent from November through March. Relatively unstable during the winter, it becomes more stable during the summer owing to subsidence in the eastern periphery of the Pacific high. Occasionally, during the summer months, it enters the San Joaquin Valley through the Carquinez Straits and more rarely through Pacheco Pass and penetrates only moderately modified to the Fresno area. It is noticed as a freshening of the prevailing northwesterly winds in the late afternoon or early evening and markedly cooler nighttime and early morning temperatures.

(2) On rare occasions, continental polar air originating over western Canada and moving into the Great Basin crosses the eastern mountain Barriers and reaches the California central valley. Arriving from the north and far east, it undergoes appreciable modification through compressional heating as it moves down the slopes of the Siskiyou and Cascade ranges to the north and Sierra Nevadas of central California. Nevertheless, considerable temperature drop occurs, and it is under situations such as these that the central valley gets its rare dusting of snow.

(3) From June through September, continental tropical air originating over the California - Sonora Desert dominates the Fresno area for extended periods. Synoptically, the presence of this air is seen in the formation of a thermal trough west of the Sierra Nevadas northward up the central valley. Characteristically, temperatures are hot, humidity low, and skies clear.

(4) As mentioned previously, on occasion during the summer, the western branch of the Bermuda ridge extends over the southwest. This brings maritime tropical air aloft from the Gulf of Mexico and California into the southern and central California area. The most noticeable effect is the formation of thunderstorms over the Sierra Nevada and, more rarely, over the Tehachapi's. The storms rarely affect Fresno.

3-3. Seasons.

Fresno has two basic seasons; a cool, damp winter from November through March, and a hot, dry summer from June through September. Transition to winter in October coincides with the southerly displacement of the polar jet, weakening and southward retreat of the Pacific high, weakening of the thermal low over California, and increasing pressure over the Great Basin. Transition to summer in April and May accompanies a reversal of these processes and is more gradual.

3-4. Fronts.

a. During the summer months, the Pacific high provides an effective barrier to migratory systems moving out of the Pacific, forcing them to move inland well to the north of California. The transition from the summertime situation to winter is, as noted, quite rapid. The Pacific high moves to the southwest and fronts begin to move across the northern part of the state. Initially, these fronts are quite weak upon entering California, causing precipitation along the north coast and over the Siskiyou and Cascade Mountains of the north state. They are very diffuse as they move over the interior valley sections with very little in the way of clouds or other frontal indicators to mark their progress across the state.

b. As winter progresses, marked changes are noted in the character of frontal passage. Low pressure centers begin entering the continent in northern Washington or western Canada with the occluded portion of the front extending southwestward off-shore at the California-Oregon border. Waves begin forming on the frontal surface well offshore with the new wave moving northeast or east-northeast into the Washington or Oregon area. There follows a series of waves with the last wave of the series often pulling a fairly active front across California producing low ceilings (200 to 1200 feet) and moderate rain along the coast with somewhat higher ceilings (1000 to 3000 feet) and lighter precipitation amounts in the interior valleys. There is usually fairly rapid (4 to 6 hours) clearing after frontal passage depending upon the stability of the air mass behind the front and the time of day of frontal passage.

c. Still later in the season, the storm centers move onshore farther to the south entering Oregon or sometimes extreme northern California. These systems are usually accompanied by a fully occluded front which can produce heavy coastal rain and wind and moderate rain over Fresno. Often the occlusion will approach the state followed rapidly by a strong vorticity maxima. This is clearly evident on satellite pictures. As the vorticity max approaches the frontal band, rapid thickening occurs as a new frontal wave is induced. As the vorticity max overtakes and merges with the wave a so called "instant occlusion" forms and moves rapidly on shore. Clouds are again 200 to 1200 feet along the coast and somewhat higher (1000 to 3000 feet) in the interior valley. Precipitation is light to moderate at Fresno and will often oc- just before and persist for 4-6 hours after frontal passage. Clearing follows rapidly after the end of precipitation.

d. Frontal passage, particularly late in the season, does not always mark the end of the precipitation. Whenever a deep, cold trough oriented north to south is established offshore, clearing may follow passage of the front; however, the cold, unstable air associated with the trough offers prime breeding ground for showers and thunderstorms. Satellite pictures can be watched to reveal successive vorticity maxima rotating around the trough. As each vorticity max moves east of the trough line, it will set off wide spread showers and thundershowers, some accompanied with quarter inch hail. The convective activity continues until the trough moves east of the valley.

e. By far the largest amount of rain, lowest ceilings, and lowest visibilities associated with frontal systems occur when a cold low develops over the eastern Pacific between 30 and 40 degrees north latitude and works its way to the south. In this situation, a closed low or trough will eventually reside to the west or southwest of San Diego to form the so call "San Diego Low" or "California Trough". Formation of this feature results in a southward deflection of the major Pacific storm track.

Development is normally associated with formation of either a deep trough off the coast which orients itself on a northeast to southwest axis or formation of a split flow circulation pattern where the high is displaced far to the north into the Gulf of Alaska and a trough or cut-off low develops in the split flow beneath. Some clue can be gained to the formation of this feature by watching satellite photography. Frontal bands approaching the coast which split in half with part of the band proceeding northward and the lower half continuing to the east or southeast often indicate formation of the system. The southward displaced storm track results in wave cyclones approaching California from the west or southwest and moving across the state as an open wave or barely occluded system. Often a series of waves or perturbations form on the trailing frontal band resulting in successive storm systems, each spaced about 36 to 48 hours apart, striking the state. Moderate to heavy precipitation accompanies each system along with ceilings below 500 feet and visibilities below one mile. Local flooding in the Central Valley is a distinct possibility. Strong, gusty surface winds are also present throughout the area once the surface low moves within 300 miles of the coast. Imbedded thunderstorms pose an additional forecast problem as the circulation around the offshore system continues to draw warm moist air over the area; however, the predominant precipitation characteristic is one of steady rain with imbedded heavier showers. Some of the most dangerous icing conditions encountered over California may be expected with this type disturbence, and the tight pressure gradient produces considerable mechanical turbulence aloft over mountainous terrain. From a flying standpoint, this type system is the most significant for operations from Fresno.

3-5. Visibility Obstructions.

a. Fog.

(1) Major Problem. Fog is the major visibility obstruction and forecast problem in the Fresno area. This visibility restricting, winter phenomenon is closely related to the presence of a Great Basin high and related subsidence inversions.

(2) Initiation. The most extensive cases of fog in the San Joaquin Valley occur only after the first fall/winter rains have wet the ground. In fact, the occurrence of extensive fog is entirely dependent upon the ground being wet. However, the first winter season rains do not necessarily produce fog (except possibly for some localized radiation fog) as the ground is not sufficiently moist. Continued wetting, normally at least .10 inches, is required from subsequent rains to produce fog on-set. Consequently, December, January, and February are the months normally associated with the valley fog season.

(3) Ingredients. Essential ingredients for fog formation are a cool mP air mass in the valley, a high pressure cell over the Great Basin with an associated ridge aloft, and moist ground. The actual depth and extent of the fog/stratus layer is dependent upon the strength of the subsidence inversion.

(4) Characteristics. A fog regime is triggered by rainfall associated with cold frontal passage. Frontal passage is followed by a new mP air mass moving into the valley. The first night after FROPA is free of fog (except possibly for patchy, shallow ground fog in the morning hours near sunrise). As drier air aloft subsides, it caps the trapped mP air in the valley, and by the second or third night, fog begins forming before midnight with clearing occurring usually by noon. With each succeeding day, formation occurs earlier and dissipation later until eventually there is no dissipation but merely a lifting of the fog for a few hours in the afternoon to form an overcast stratus deck with bases at 100 to 200 feet. Tops of the fog/stratus layer average 1000 to 2000 feet, with higher tops

(i.e., thicker layers) normally associated with less, later, or no afternoon clearing. Above the layer, clear skies prevail. Once the fog pattern is established, the only way to clear it out is by a frontal passage of sufficient intensity to clear the valley of stagnant air and replace it with fresh mP air. From there, the cycle begins again. With onset of the fog regime, it is beneficial to keep an hourly log of ceilings and visibilities at nearby stations as a forecast aid for the succeeding day as persistence seems to be the best forecast tool.

(5) Upper Air Influences. With passage of a strong short wave trough aloft (not associated with a frontal passage), the fog and stratus over Fresno may thin out as increased vertical motion weakens the inversion. If the stratus is very deep, light rain may begin as the attendant vorticity maxima approaches and continues until it passes the station. Weaker troughs may produce only drizzle.

(6) Variations. One caution should be mentioned regarding stations such as Fresno on the eastern side of the valley. Quite often, a drainage wind from the Sierra Nevada will, in the early morning hours, produce temporary clearing between 0600 to 0700 hours PST. However, once the sun rises, it appears to provide sufficient mixing to distribute moisture upward, and in a very short time (about one hour), the fog blanket returns.

(7) Relationship to the Pacific and Great Basin Highs. There appears to be a correlation between the intensity of the fog in the Central Valley and by which high pressure systems, Pacific or Great Basin, the valley is dominated. Pacific high domination seemingly is less favorable for fog formation; hence, if the primary influence is the Pacific high, ceilings and visibilities will be greater than those expected with the Great Basin high. Domination by the Great Basin high with a northeasterly or southeasterly gradient wind tends to produce particularly low ceilings and visibilities. When the valley lies beneath a col between the two systems, it becomes particularly tricky to determine the course of events. Generally speaking, if the Pacific high is dominant and no rainfall is expected, evaporation from the wet ground will be high and the ground will dry within about one week after the last rainfall thereby inhibiting fog formation until the next rainfall.

(8) Studies. Various studies have been tried with mixed results. One states that fog will not form until the sea level pressure at San Francisco, Sacramento, and Fresno are all greater than or equal to 1020mb, and that the higher the pressure, the longer lived and more intense the fog. Another study from Castle AFB groups valley fog into three types: radiation, advection-radiation, and subsidence-radiation (or high inversion). It states that purely radiation fog occurrences are usually minimal during the winter and that both radiation and radiation-advection fog normally occur and predominate in October, early November, and late February. Subsidence-radiation fog occurs mainly in late November, December, January, and early February, is more widespread, lasts longer, and causes the most serious operational problems. It should be pointed out that all studies and rules of thumb which attempt to deal with this problem are tenuous at best (including our own) and should be used with a great deal of caution and timidity.

(9) Advection Fog. True advection fog is rare at Fresno, but radiation fog formed south of the city, over the irrigated farm lands watered by the Kings River and an extensive canal system can advect over the airfield on early morning southeasterly drainage winds (the advection-radiation fog discussed in (8) above).

(10) Summary. To summarize, the chief problems we are concerned with in fog forecasting at Fresno are the onset, intensity and duration of the fog, and timing of the removal of the stagnant airmass from the valley.

b. Stratus. Stratus formation is closely related to the wintertime fog problem in the valley. Stratus may form in either of two ways, lifting of the surface based fog to form a stratiform ceiling with bases of 100 to 1000 feet, or formation of the stratus at the inversion base around 2,000 to 3,000 above the ground. Under the latter conditions, as the stratiform ceiling persists, it tends to lower eventually setting in at about 1,000 feet above ground level.

c. Haze. Haze is a problem chiefly during the October transition period and is the precursor to onset of winter time fog. Visibility can be restricted to 1 to 3 miles under the balmy autumn skies as dust and other pollutants collect under the inversion layer. As moisture collects from early season rains, the haze provides ample hygroscopic nucleii upon which water collects eventually leading to the initial fog onset.

3-6. Hazardous Weather.

a. Icing. As the Pacific high retreats to the south, troughs moving across the eastern Pacific pull abundant moisture over the state. The clouds formed from this moisture are fertile grounds for icing above the freezing level which lies between 7,000 to 10,000 feet at this time of year. Added orographic lift provided by the many mountains throughout the state increases icing problems. As cold lows track over the area, multiple cloud layers from 3,000 to 35,000 feet may be expected with icing conditions to be found in the middle level layers. Imbedded thunderstorms increase the danger to aircraft because of associated heavy icing.

b. Turbulence. During the winter season, the mean position of the polar jet lies over the state. Consequently, areas of turbulence associated with the jet may be expected. Additionally, strong winds at lower levels associated with the numerous storm systems moving through the area strike the mountain barriers in the region producing low level mechanical turbulence and mountain wave effects which produce turbulence to surprisingly high altitudes over and to the leeward side of these obstacles. Circulation around the cold low centers aloft also produces turbulence near the area of confluence as winds upstream converge with circulation around the low center and near the diffluent zone where winds move downstream from the lows' circulation.

c. Thunderstorms. Thunderstorm occurrence is rare, but it can be a year round problem. Maximum activity occurs during March, April, and May and is post-frontal. In the late summer, the incursion of maritime tropical air aloft from the Gulf of Mexico and at lower levels from the Gulf of California will cause thunderstorms over the Sierra Nevada and, on rare occasions, over the Tehachapis. These may occasionally drift over Fresno when the steering currents are favorable. Thunderstorms associated with mid and high level moisture from tropical storms over the Gulf of California, Baja, eastern Pacific can also produce mountain thunderstorms in both the Sierras and Tehachapis. Thunderstorm occurrence was discussed in more detail in Chapter 1, paragraph 1-3c.

3-7. Synoptic Weather Patterns.

The following paragraphs will present selected weather regimes which are most representative of the synoptic situations which affect Fresno. They are broken into winter and summer regimes and are accompanied by a weather map which graphically displays each regime. The regimes were extracted from the Castle AFB TFRN and are included here as they are believed to be representative of the Fresno area as well. Our thanks to Detachment 2, 9th Weather Squadron for allowing us their use.

(1) Winter Regime 1 (Figure 3-1).

(a) Surface. No FROPA. Well established quasi-stationary cP high over Great Basin, Pacific mP ridge as in Figure 3-1, weak thermal low over southern Arizona and northern Mexico.

(b) 500mb. Weak southwesterly to westerly flow, pronounced ridge over the

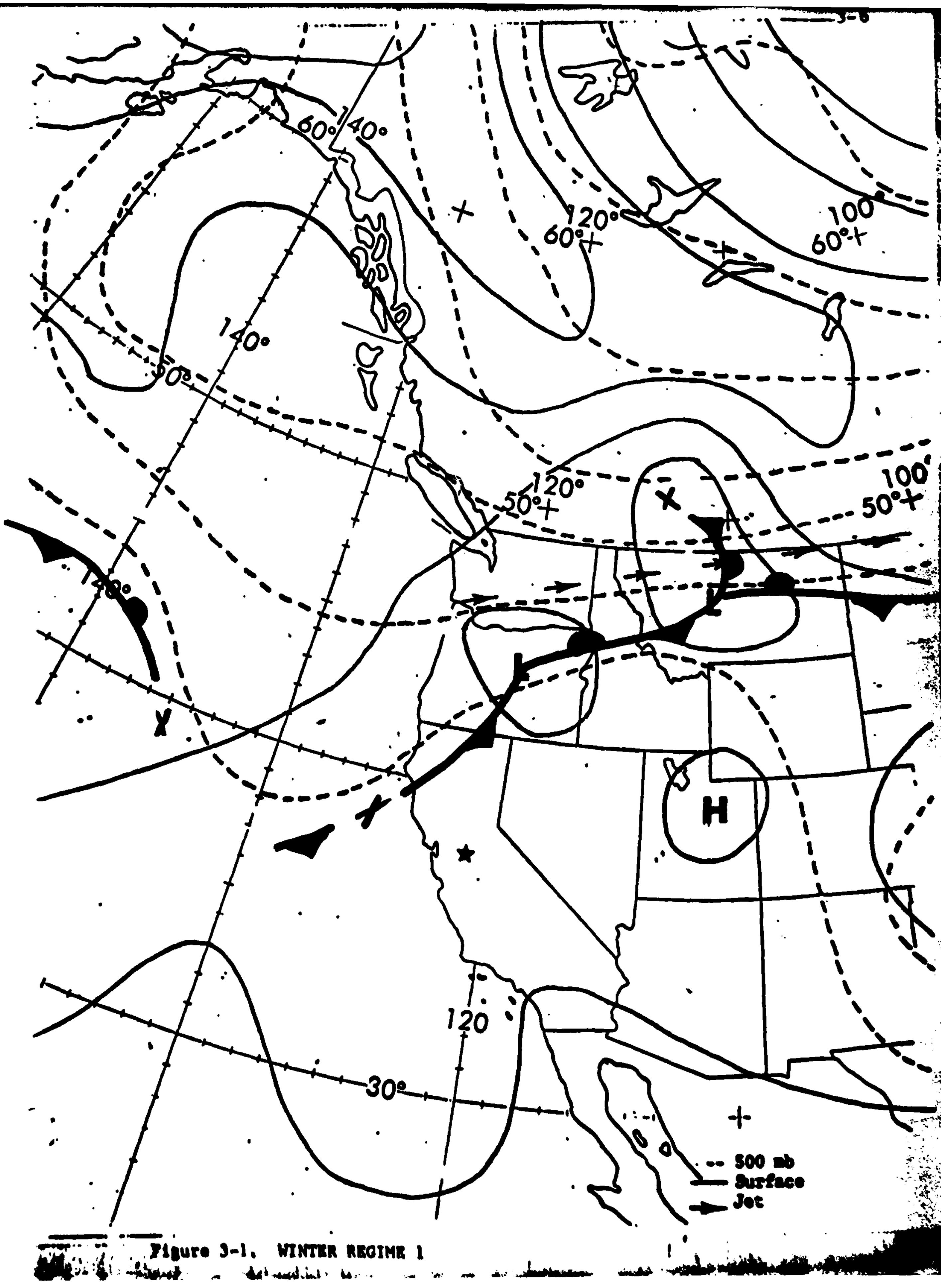


Figure 3-1. WINTER REGIME 1

Rockies or Great Basin, weak trough along west coast. Westerly polar jet over northwestern U.S.

(c) Cloud. Scattered to broken thin cirrus.

(d) Precipitation. None.

(e) Surface Wind. West to Northwest 10 knots, afternoon gusts to 15 knots.

(f) Visibility. Five to 7 miles in haze near sunrise and set, occasionally ½ to 1 mile in morning ground fog.

(g) Temperature. Below normal.

(2) Winter Regime 2 (Figure 3-2).

(a) Surface. No FROPA. Stationary cP high over Great Basin linked with mP high over Pacific and north of normal position. Weak thermal low over northern Mexico. Aleutian cyclones forced northward into Canada. Stable air over California.

(b) 500mb. Pronounced ridge over western coastal states.

(c) With partial afternoon clearing.

1 Cloud. Radiation fog forms during the night, lifts to 500 to 1000 foot stratus through diurnal heating, generally becoming scattered stratus during time of maximum temperature. Duration of fog and stratus increases each successive day this regime persists. Regime produces Fresno's worst flying weather.

2 Precipitation. Trace, light drizzle may occur during early morning.

3 Surface Wind. SE, light in morning. Northwest 6 to 10 knots in afternoon.

4 Visibility. Mornings near zero in fog. Afternoons improving to 3 miles.

5 Temperature. Near normal early in regime. Marked lowering of max temperatures on successive days as the stratus becomes more persistent.

(d) With No Clearing.

1 Cloud. Overcast stratus, ceiling 300 to 700 feet during day and 100 to 300 feet at night. During darkness, fog is common.

2 Precipitation. Trace, primarily mist and light drizzle during early morning.

3 Surface Wind. Light and variable, but usually becoming southeasterly during daylight.

4 Visibility. One to 3 miles during day, becoming zero to one-half at night.

5 Temperature. Below normal and becoming progressively cooler (1 to 2 degrees F) each day that condition persists.

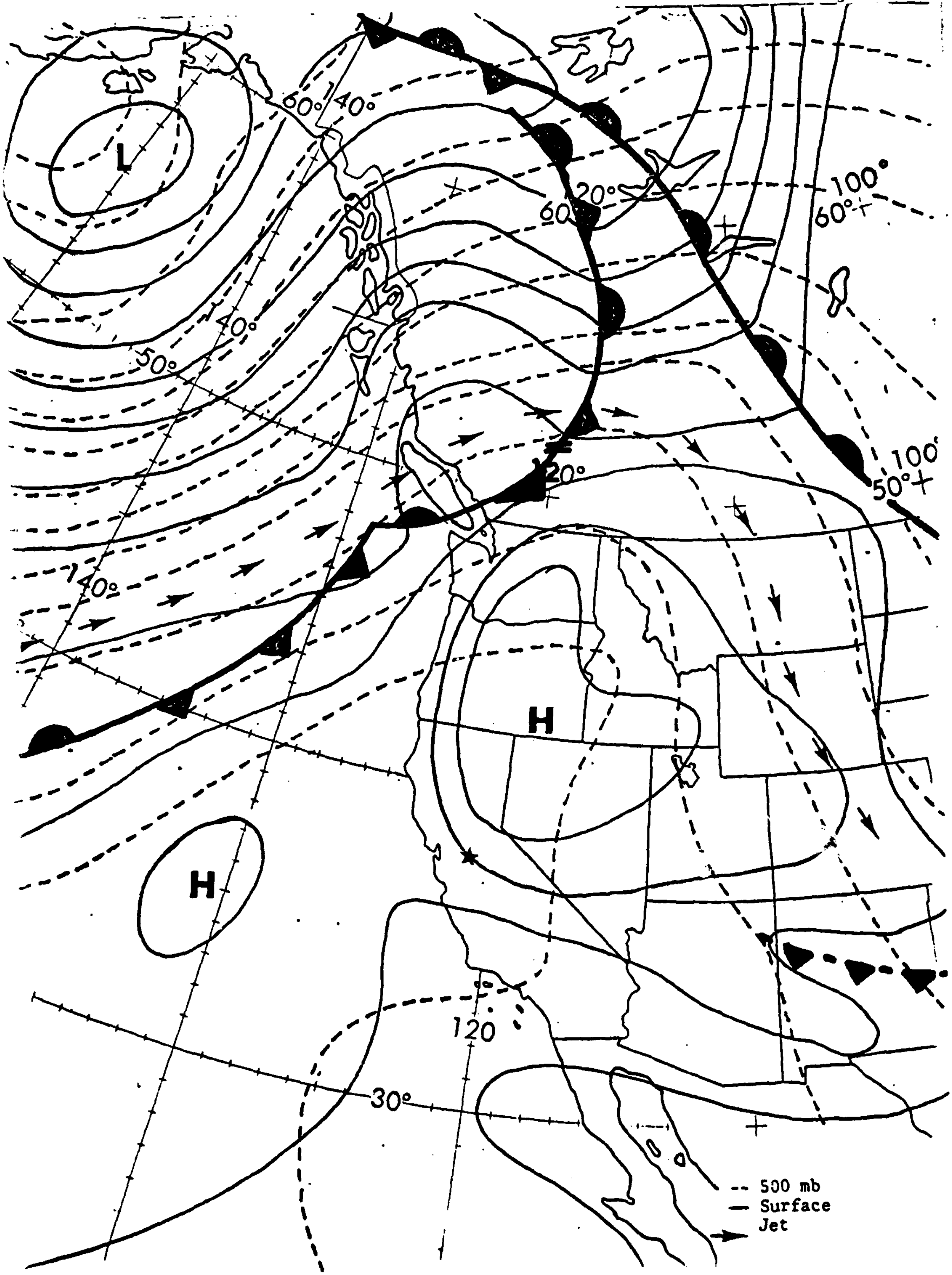


Figure 3-2. WINTER REGIME 2

(3) Winter Regime 3 (Figure 3-3).

(a) Surface. Cold FROPA from northwest. Moderate cP high moving eastward over southern Rockies. Low moving eastward through southeastward over Pacific northwest. Pacific mP high north of normal position.

(b) 500mb. Strong southwesterly flow shifting to northwesterly with trough passage. Deep trough over west coastal states. Polar jet over central California.

(c) Clouds. Marked increase of middle cloud as front approaches. Ceiling becoming 3000 to 5000 feet in vicinity of front. Rapid clearing following FROPA. Fog may form after FROPA. During March, April, and May, thunderstorms may develop in the unstable air following the front.

(d) Precipitation. Showers with FROPA. Late in season, showers and thundershowers with small hail may form in unstable air following FROPA but prior to 500mb trough passage.

(e) Surface Wind. South, increasing with gusts 25 to 35 knots likely as front approaches. Northwest with gusts to 20 to 30 knots after FROPA.

(f) Visibility. Three to 5 miles.

(g) Temperature. Below normal.

(4) Winter Regime 4 (Figure 3-4).

(a) Surface. Occluded or cold FROPA from west through northwest. Weak cP high over southern Rockies. Moderate Pacific mP high northwest of normal position. Lows move east-northeastward over California or Oregon and northeastward over the Rockies. Cold-core low offshore between 30 to 45 degrees N. When cold-core low persists with 500mb trough off coast, frequent FROPAs 18 to 30 hours apart occur.

(b) 500mb. Strong southerly to southwesterly flow. Trough or cold-core low off coast (California trough or San Diego Low). Ridge over Rockies. Cut-off low may form in trough off southern California. South to southwest polar jet over California.

(c) Cloud. Low, multilayed vicinity of front. Ceiling 2000 to 5000 feet. Scattered to broken altocumulus, 7000 to 9000 feet, after FROPA. Late in season, thunderstorms may develop in unstable, cold air following front and prior to 500mb trough passage. Small hail sometimes occurs with thunderstorms.

(d) Precipitation. Produces Fresno's heaviest rainfall, ½ to 3/4 inches in 24 hours. Local flooding occurs if regime persists.

(e) Surface Wind. Southeast 10 to 15 knots ahead of front. South to southwest 15 to 25 knots with gusts to 35 to 45 knots as front approaches. Shifting to northwest 10 knots with gusts to 20 knots after FROPA.

(f) Visibility. Three to 5 miles in rain. Intermittently 1 to 3 miles in showers.

(g) Temperature. Below normal much below normal if cold-core low/trough persists offshore.

(5) Winter Regime 5 (Figure 3-5).

(a) Surface. Cold FROPA from northeast or east. Strong polar outbreak

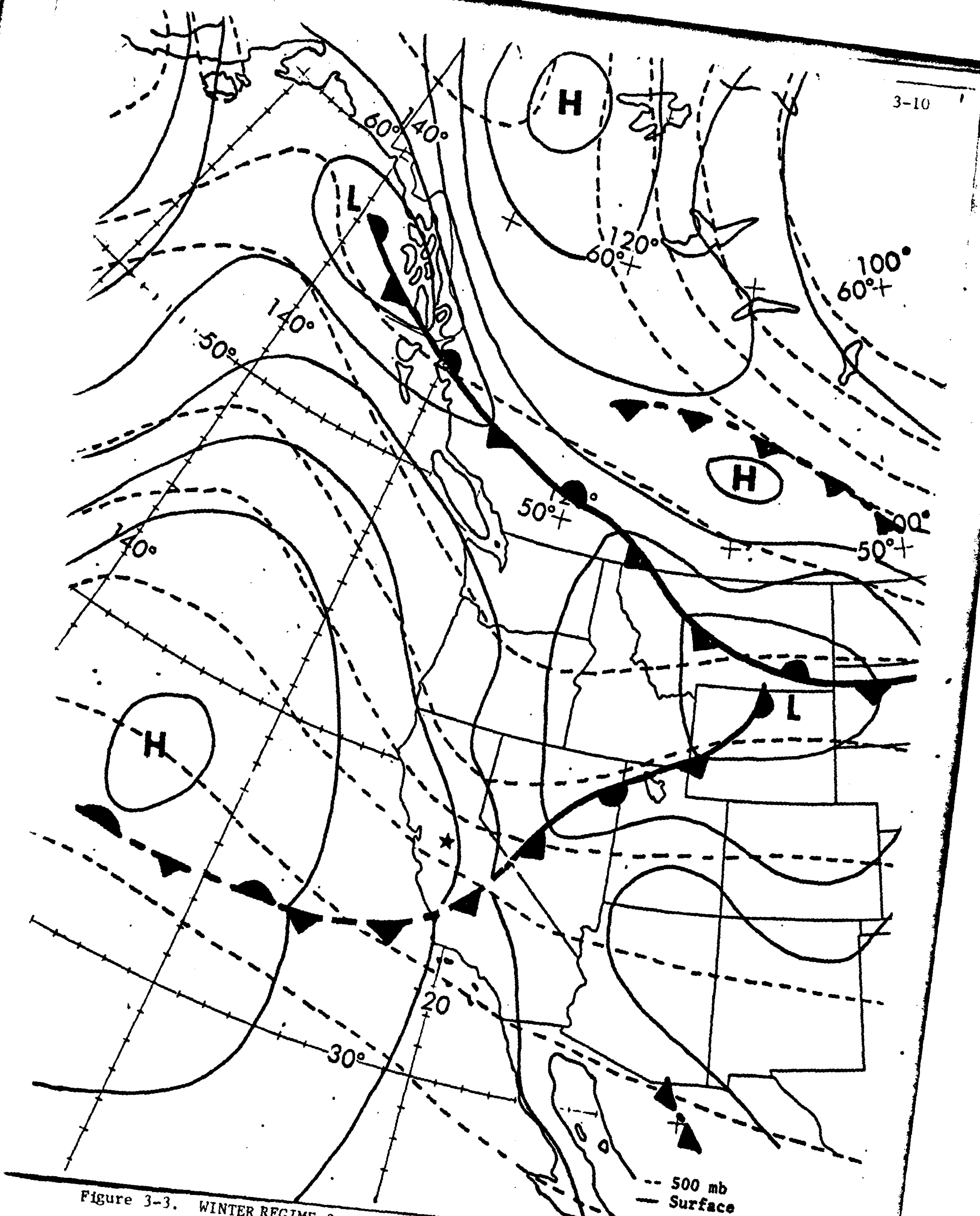


Figure 3-3. WINTER REGIME 3

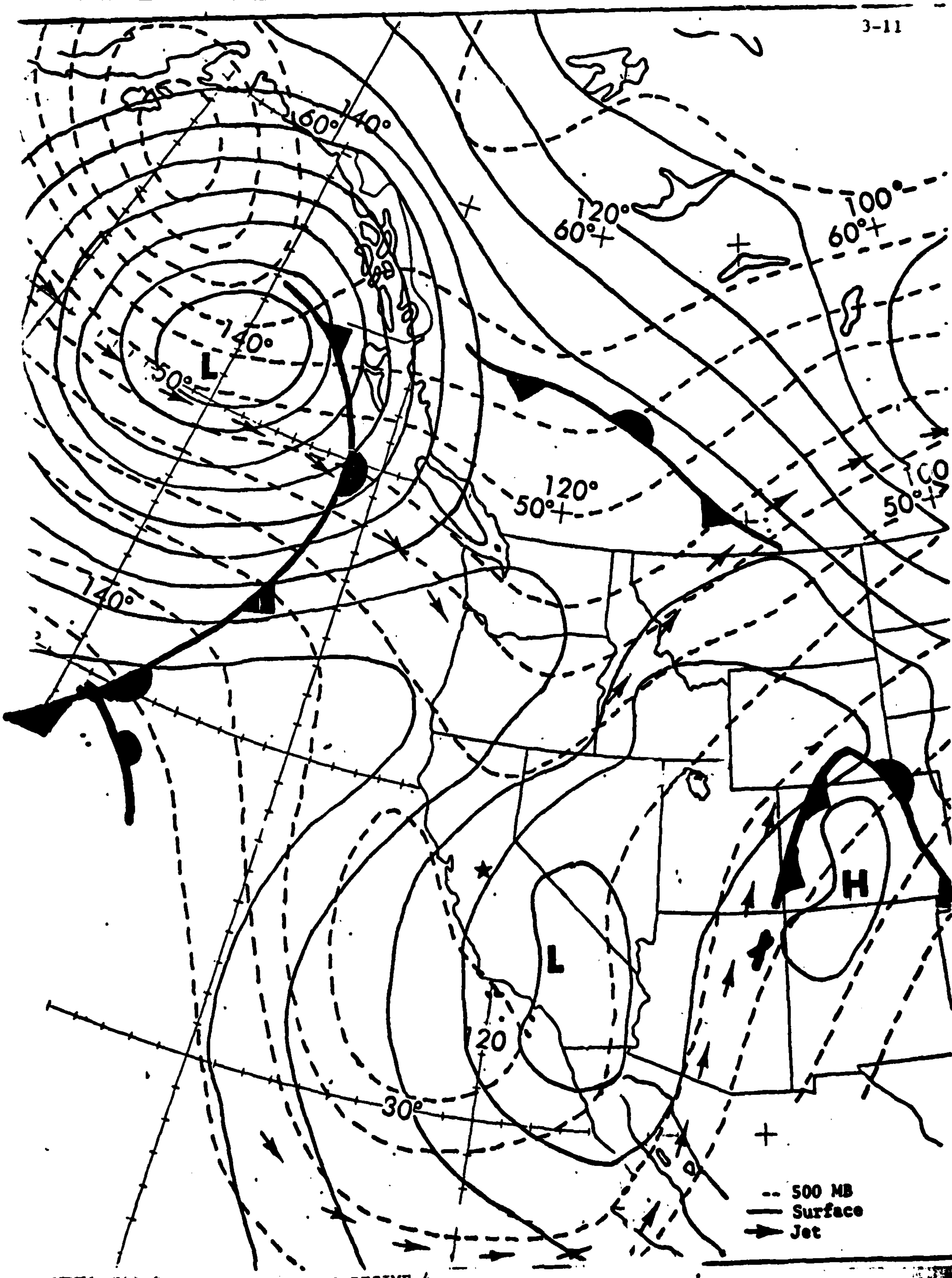


Figure 3-4. WINTER REGIME 4

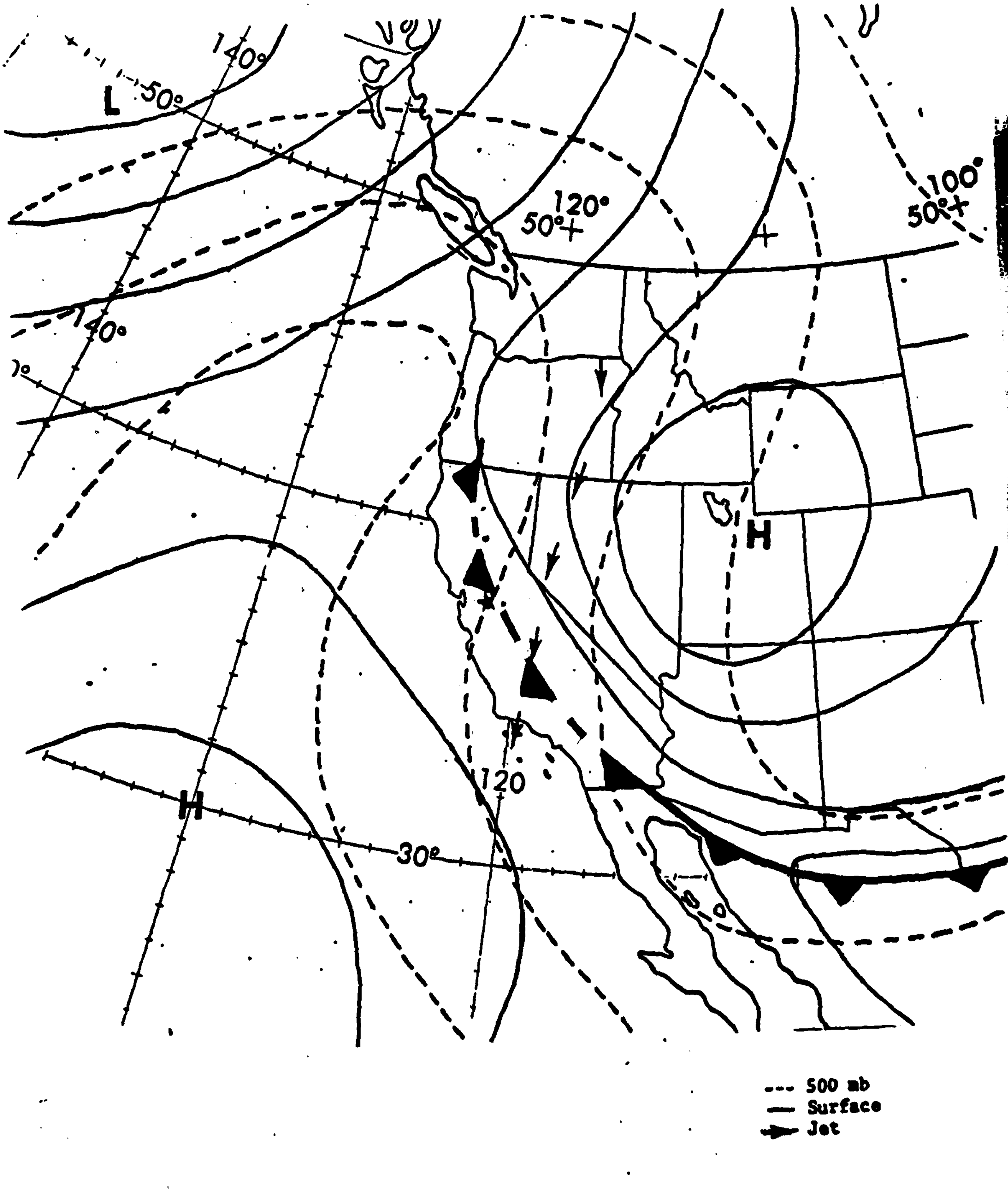


Figure 3-5. WINTER REGIME 5

west of Continental Divide moving southward. Shallow dome of cold air pushes through mountain passes east of Fresno.

(b) 500mb. Strong ridging over Pacific Northwest. Northerly jet near 120W.

(c) Cloud. Clear to high scattered.

(d) Precipitation. None.

(e) Surface Wind. Northwest to northeast 10 knots.

(f) Visibility. Unrestricted.

(g) Temperature. Much below normal. Fresno experiences coldest temperatures with this regime.

(6) Summer Regime 1 (Figure 3-6)

(a) Surface. No FROPA. Thermal trough over San Joaquin Valley. Strong Pacific high off coast with cP high over central Rockies. Weak fronts dissipate before reaching California coast.

(b) 500mb. Weak southwesterly flow. Weak anticyclonic flow in ridge over western states.

(c) Cloud. None.

(d) Precipitation. None.

(e) Surface Wind. Northwest 10 knots gusting to 15 to 20 knots in the afternoon. Strongest winds occur when Pacific high pushes eastward increasing the pressure gradient.

(f) Visibility. Unrestricted.

(g) Temperature. Near normal.

(h) Humidity. Above normal.

(7) Summer Regime 2 (Figure 3-7)

(a) Surface. No FROPA. Thermal low over San Joaquin Valley. Strong Great Basin high. Pacific high west of normal position.

(b) 500mb. Weak southerly to southeasterly flow. Strong anticyclone over southwestern states predominates. NOTE: Late in season, when regime persists for extended periods, moisture aloft from Gulf of Mexico reaches the vicinity of the San Joaquin Valley.

(c) June and July weather.

1 Clouds. None.

2 Precipitation. None.

3 Surface Wind. Light and variable becoming southeasterly during max insolation.

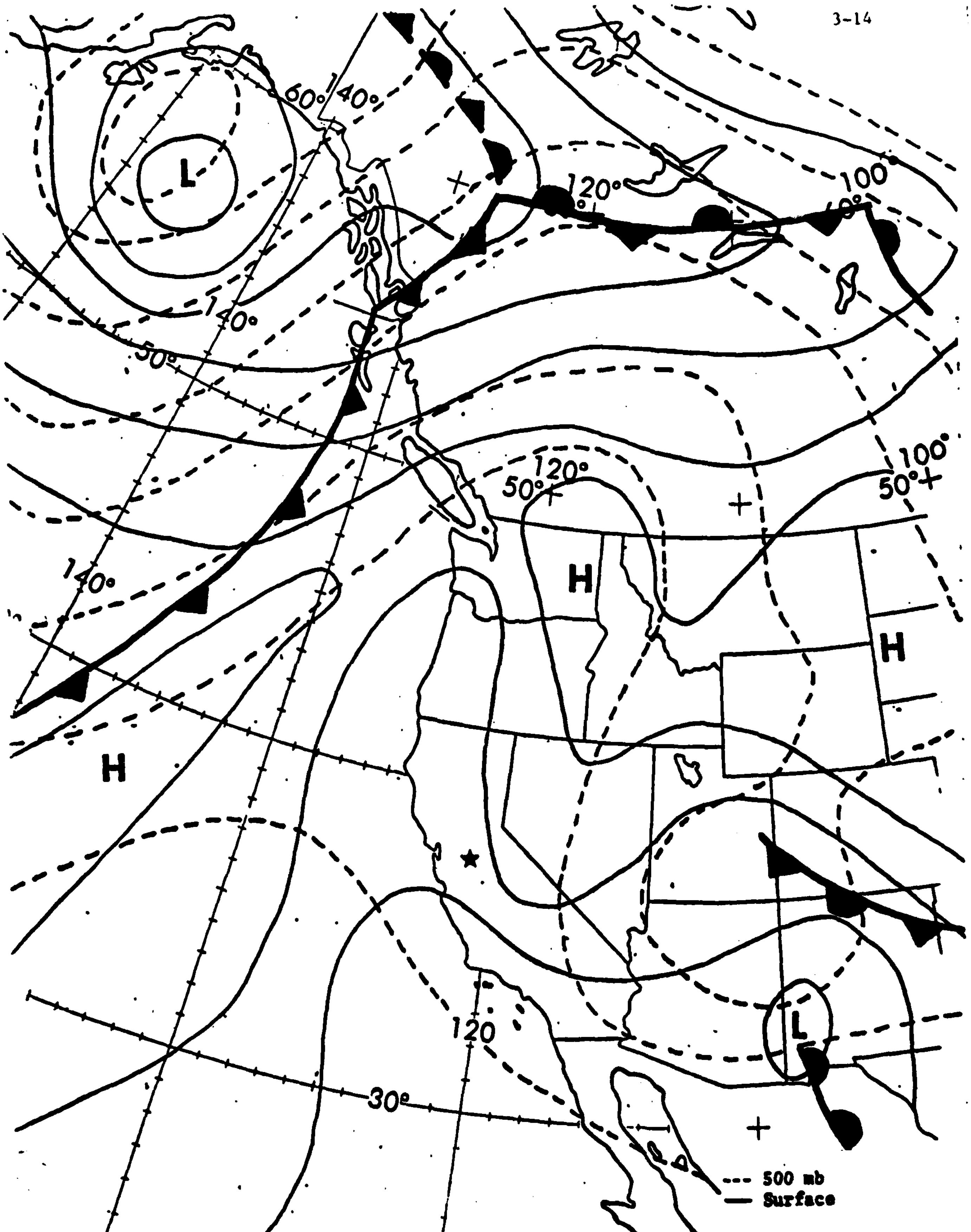


Figure 3-6. SUMMER REGIME 1

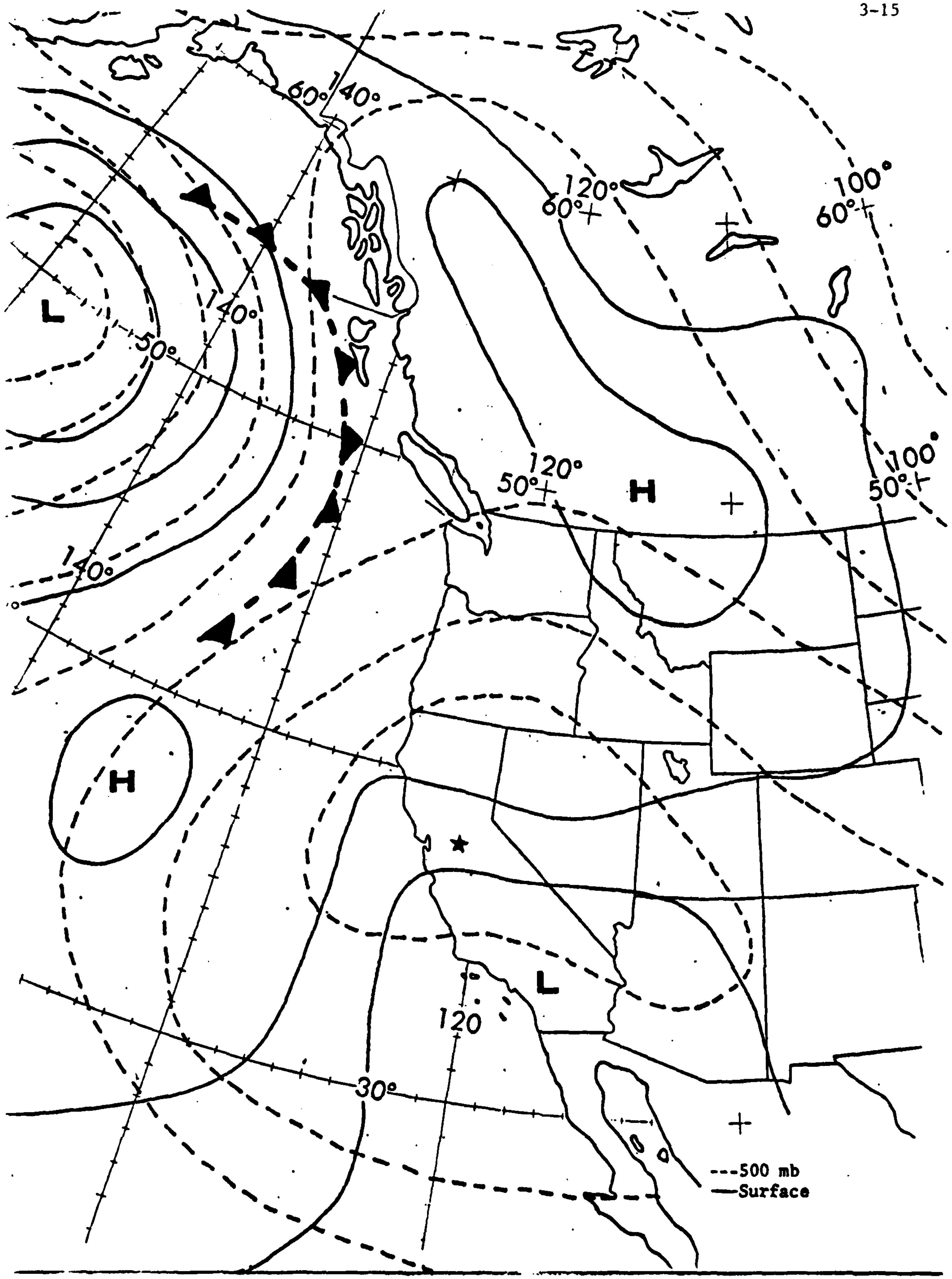


Figure 3-7. SUMMER REGIME 2

4 Visibility. Unrestricted.

5 Temperature. Max much above normal. Subsidence in anticyclone and advection of hot desert air combine to produce season's highest temperatures.

6 Humidity. Much below normal (8 to 12% at max temperature).

(d) August and September Weather.

1 Cloud. Clear 0800-1400L, becoming scattered to broken middle and broken to overcast cirrus from thunderstorms dissipating over the Sierra Nevadas. Broken middle clouds if low forms over southern California or 500mb high moves eastward.

2 Precipitation. None. Occasional very light rain from middle cloud if low forms over southern California.

3 Surface Wind. Northwest in afternoon and evening, light and variable during night and morning.

4 Visibility. Unrestricted.

5 Temperature. Near normal max. Minimum above normal.

6 Humidity. Ten to 20% above normal.

(8) Summer Regime 3 (Figure 3-8).

(a) Surface. No FROPA. Thermal low over San Joaquin Valley. Pacific high slightly west of normal position. Weak cP high over southern Rockies.

(b) 500mb. Southwesterly to westerly flow. Weak trough off coast. Southwesterly polar jet near Canadian border.

(c) Cloud. None.

(d) Precipitation. None.

(e) Surface Wind. Northwest 5 knots becoming 10 to 15 knots during late afternoon or early evening.

(f) Visibility. Unrestricted.

(g) Temperature. Below normal and becoming progressively cooler until passage of 500mb trough.

(h) Humidity. Near normal.

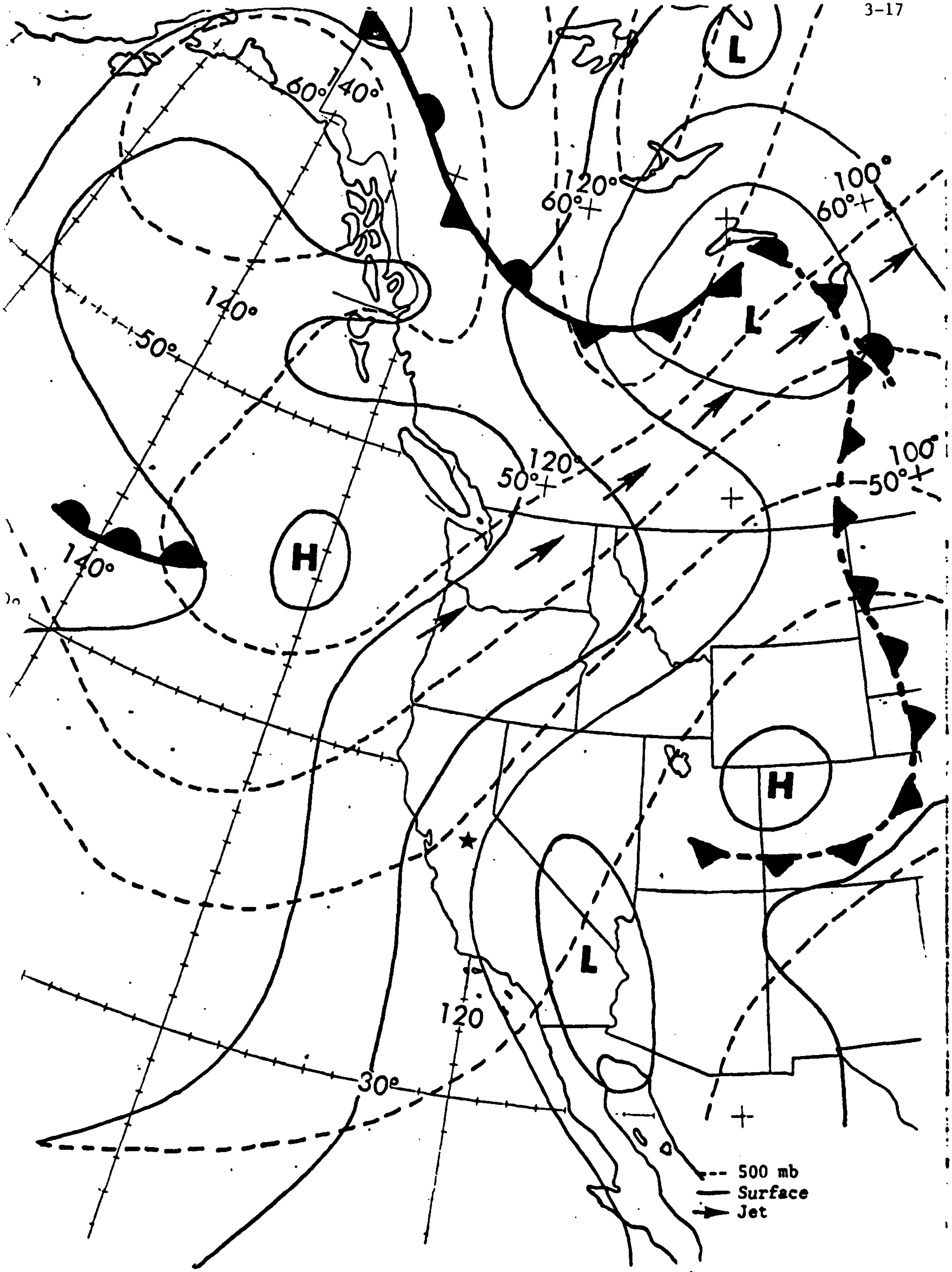


Figure 3-8. Summer Regime 3

Chapter 4

CLIMATIC AIDS

The following charts and graphs are presented to give a general insight into **average** weather conditions to be expected at Fresno. For more detailed information, refer to the Fresno RUSSWO.

Table 4-1
CLIMATIC DATA
Annual Summary
for
Fresno Air Terminal, CA
Source: RUSSWO POR 1973-1980

Temperature	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Highest	75	79	89	95	104	110	111	108	111	100	88	76
Avg Max	54	61	67	74	83	91	98	96	90	80	65	54
Avg Min	37	40	42	47	53	59	64	62	58	50	41	37
Lowest	19	25	26	32	36	44	50	49	37	33	26	21
Precipitation												
Avg Amount (in)	2.0	1.9	1.6	1.1	0.3	0.1	T	T	0.2	0.5	1.3	1.7
Avg No Days Trace	8	7	6	4	2	1	#	#	1	2	5	7
Max 24 hr Total	2.21	1.83	1.55	1.22	0.86	0.60	0.08	0.25	0.92	1.46	1.35	1.72
Extreme Amount	8.56	5.97	5.79	4.41	1.36	0.60	0.03	0.25	1.19	1.55	3.50	6.73
Ceiling Visibility (Frequency in % of time)												
≥ 1000/3	66.8	85.4	96.4	99.0	99.9	100	100	99.7	99.1	98.0	79.8	56.7
< 1000/3 but ≥ 300/1	18.8	9.3	2.3	0.7	0.1	0	0	.3	.8	1.7	14.1	28.0
< 300/1	14.4	5.3	1.3	0.3	0	0	0	0	.1	.3	6.1	15.3
Winds												
Prevailing Dir	ESE	ESE	NW	NW	NW	WNW	NW	NW	NW	WNW	ESE	ESE
Avg Speed	5	5	6	6	7	7	6	6	5	5	4	4
Max Speed	28	33	36	31	33	30	22	27	25	35	25	37

Some occurrences but too few to compute.

T Trace (less than 0.01 in)

SNOWFALL - Scattered occurrences but too few to compute.

Fig. 4-1

MEAN DIURNAL PRESSURE VARIATION FOR JANUARY.

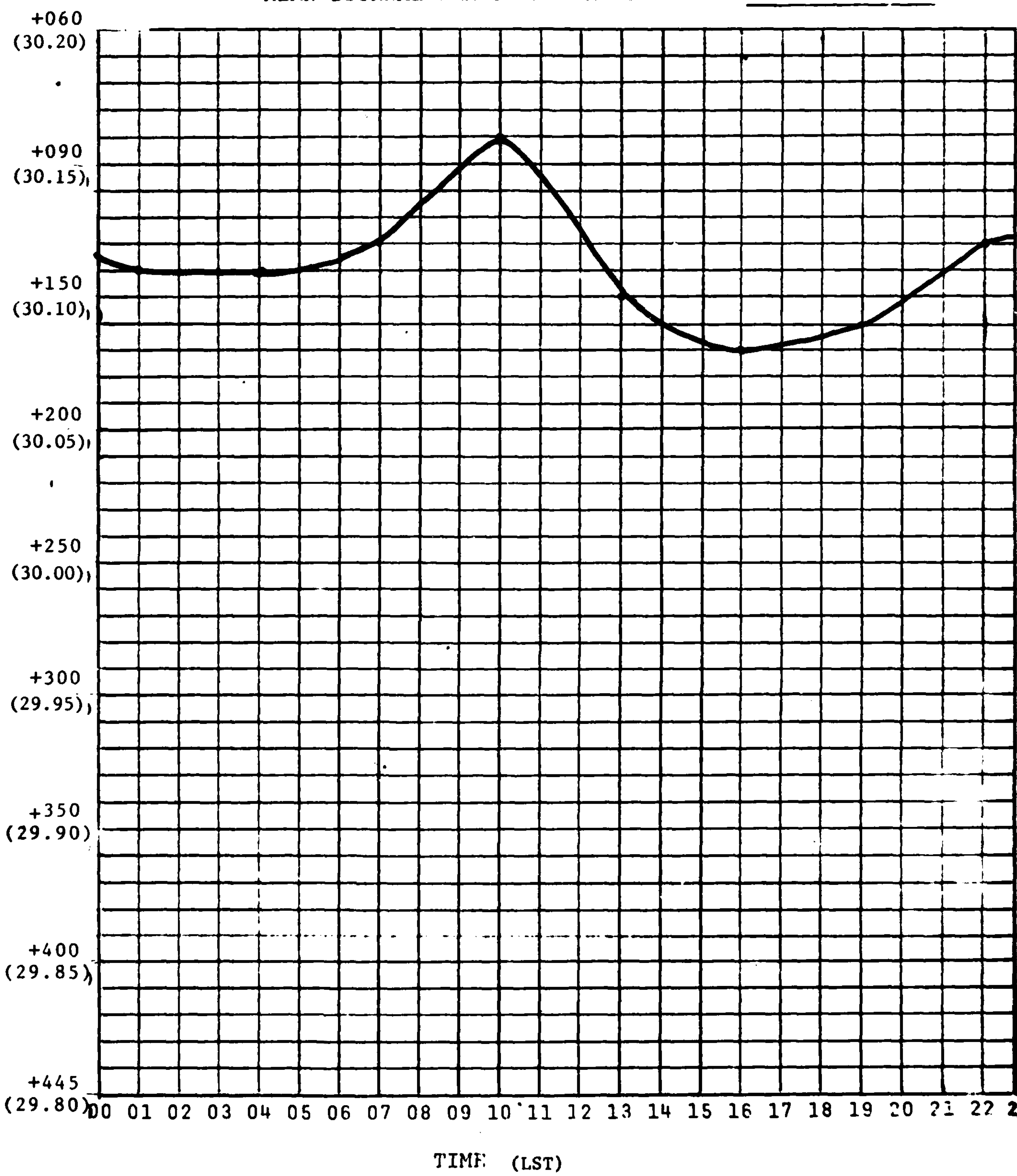


Fig. 4-2 MEAN DIURNAL PRESSURE VARIATION FOR FEBRUARY.

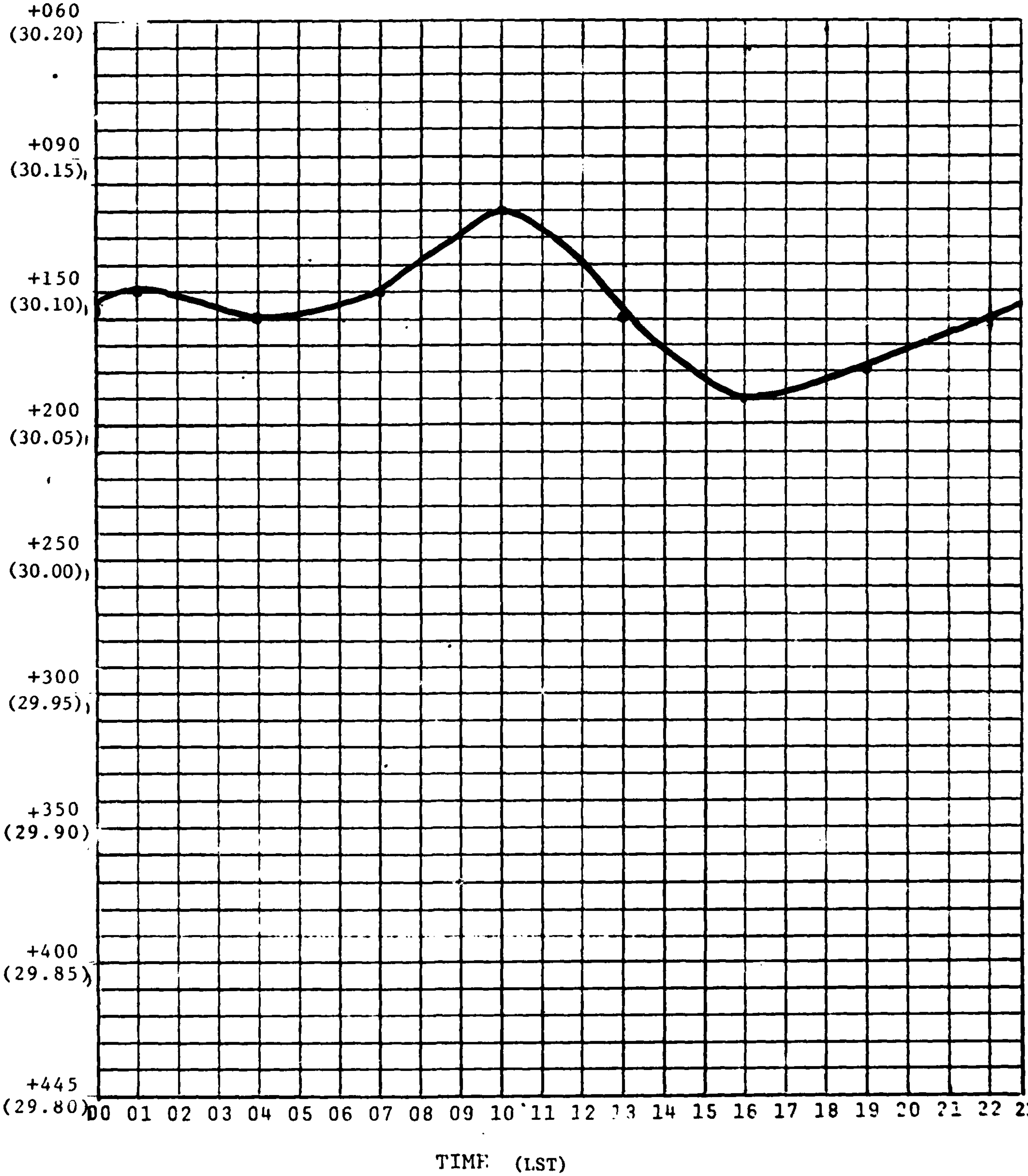


Fig. 4-3 MEAN DIURNAL PRESSURE VARIATION FOR MARCH.

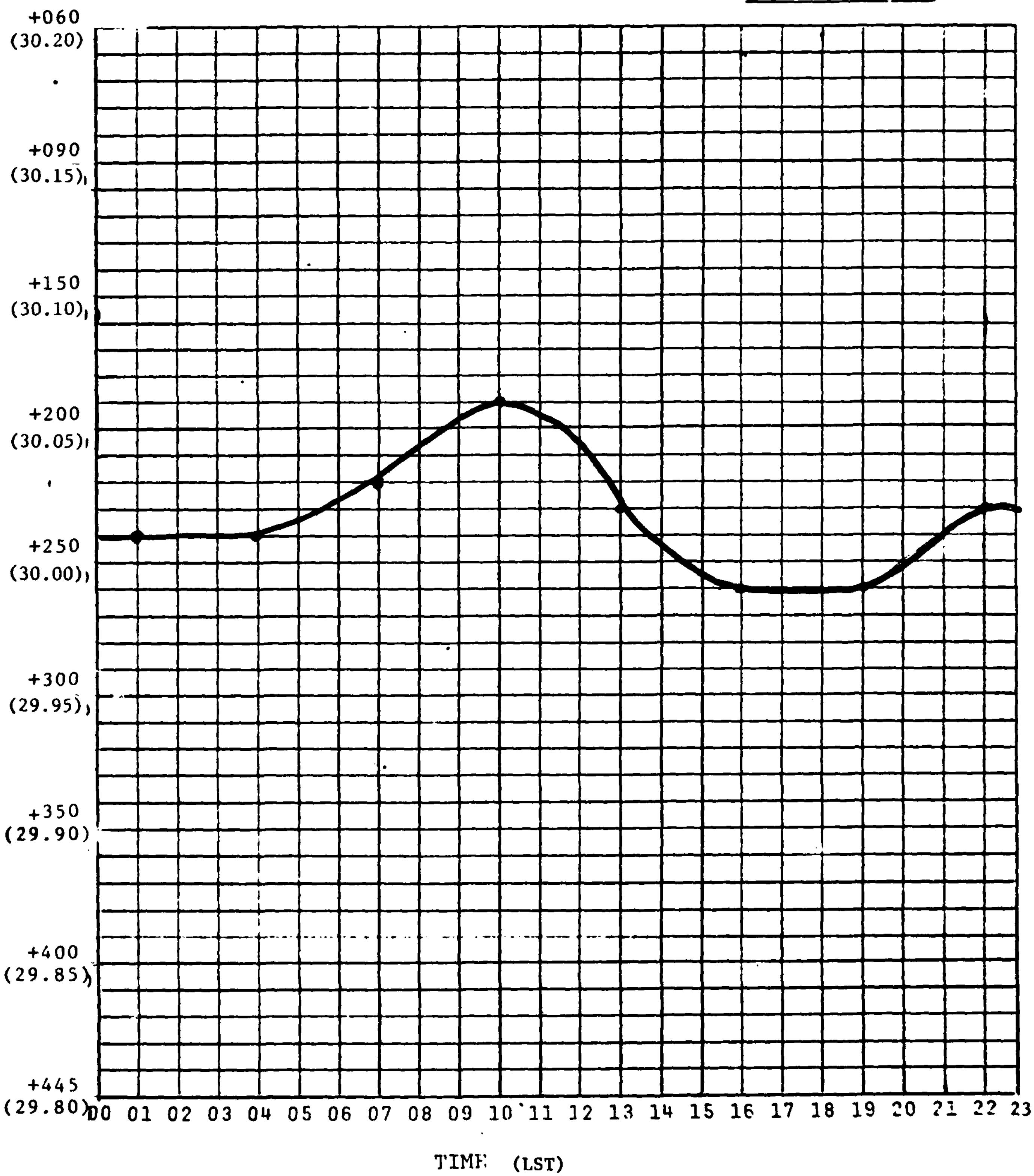


Fig. 4-4 MEAN DIURNAL PRESSURE VARIATION FOR APRIL.

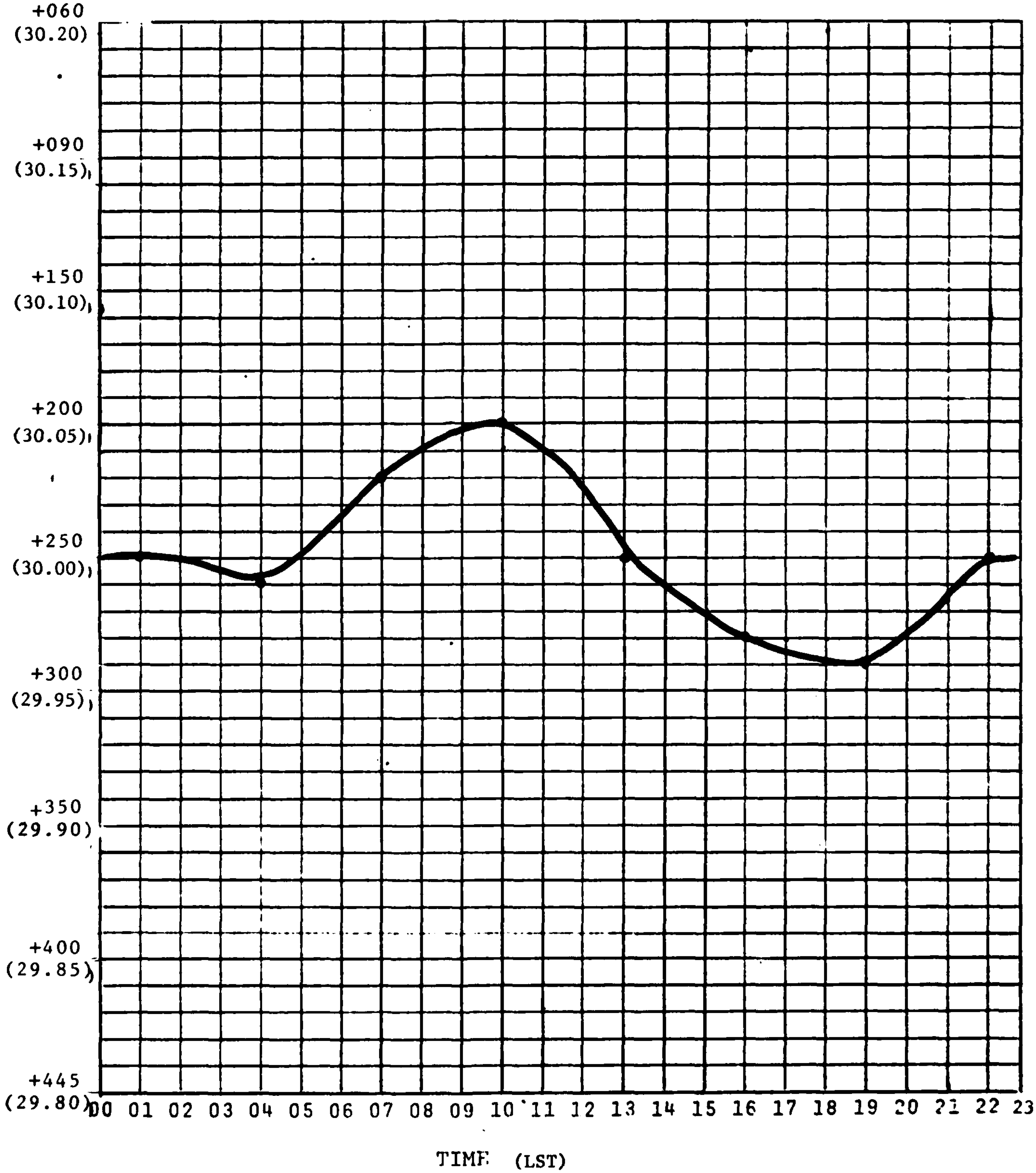


Fig. 4-5 MEAN DIURNAL PRESSURE VARIATION FOR MAY.

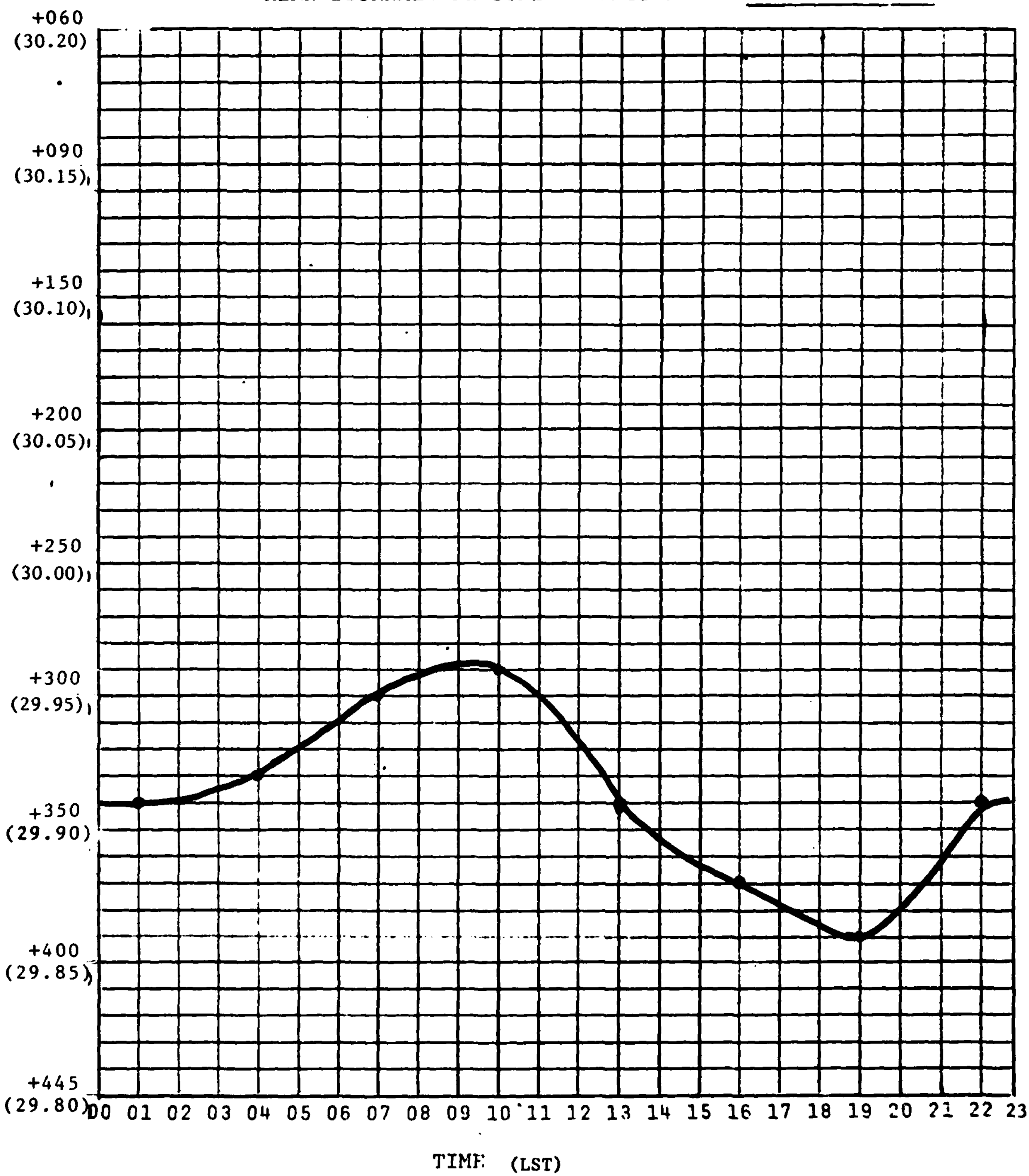


Fig. 4-6 MEAN DIURNAL PRESSURE VARIATION FOR JUNE.

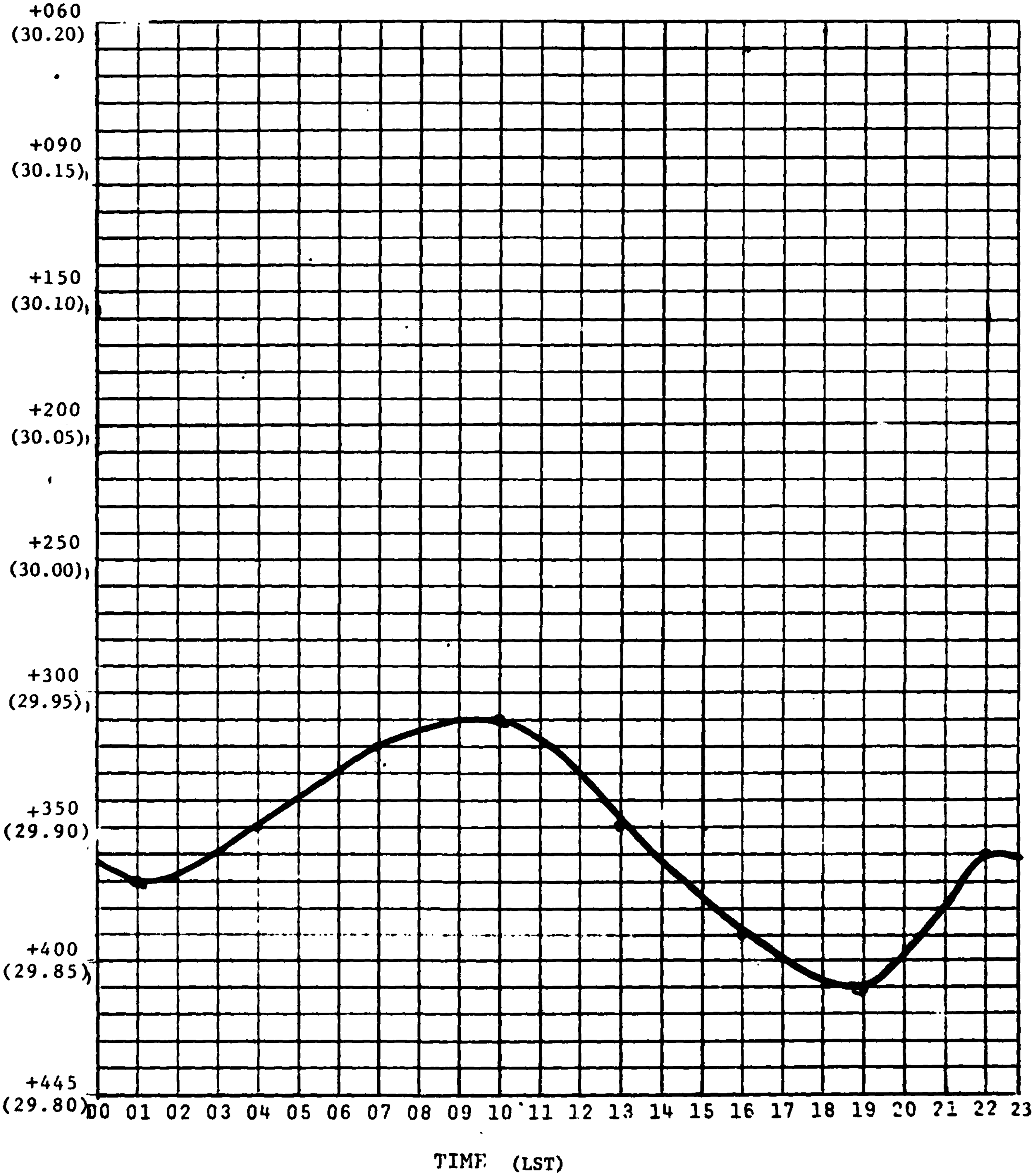


Fig. 4-7 MEAN DIURNAL PRESSURE VARIATION FOR JULY.

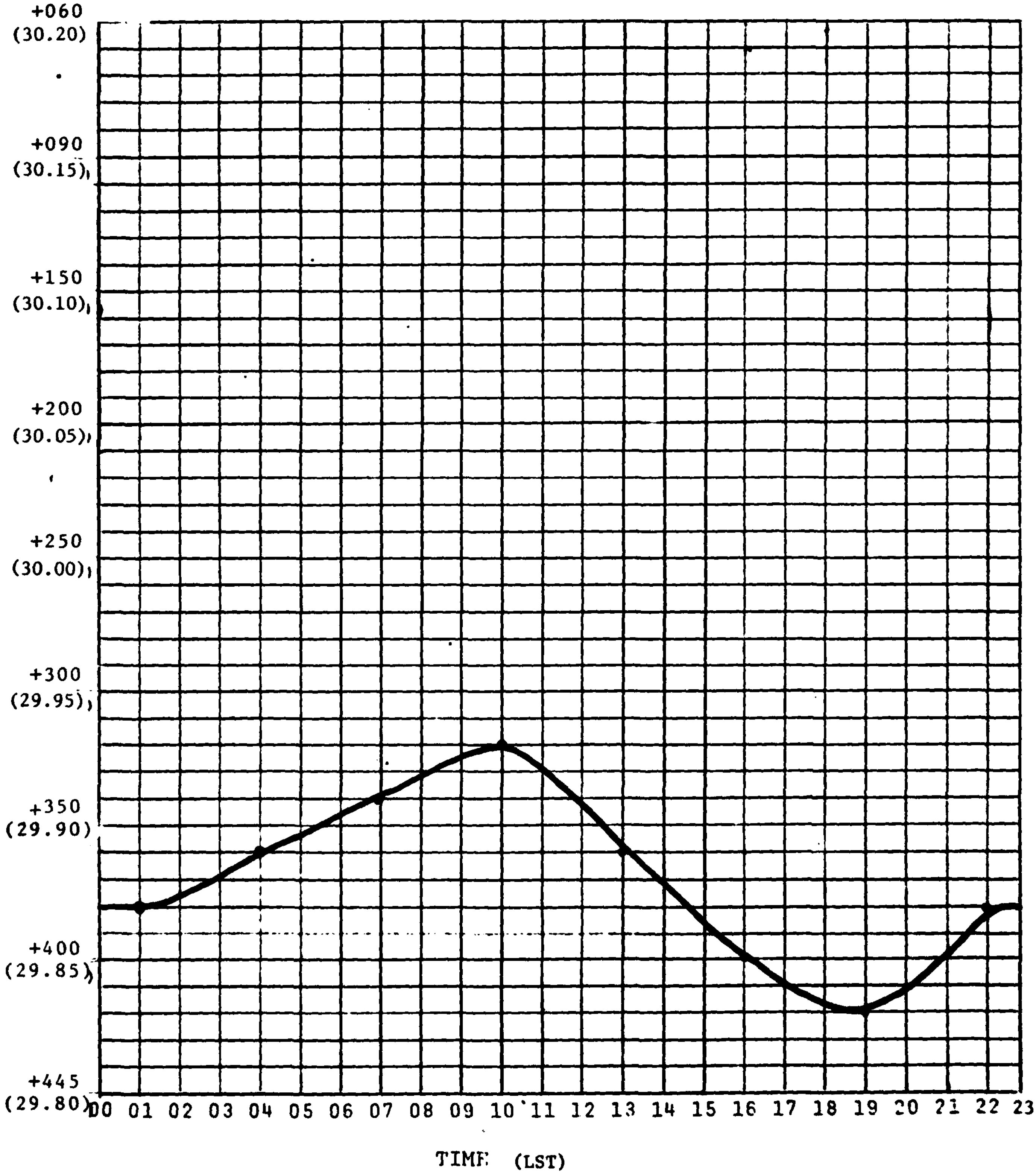


Fig. 4-8 MEAN DIURNAL PRESSURE VARIATION FOR AUGUST.

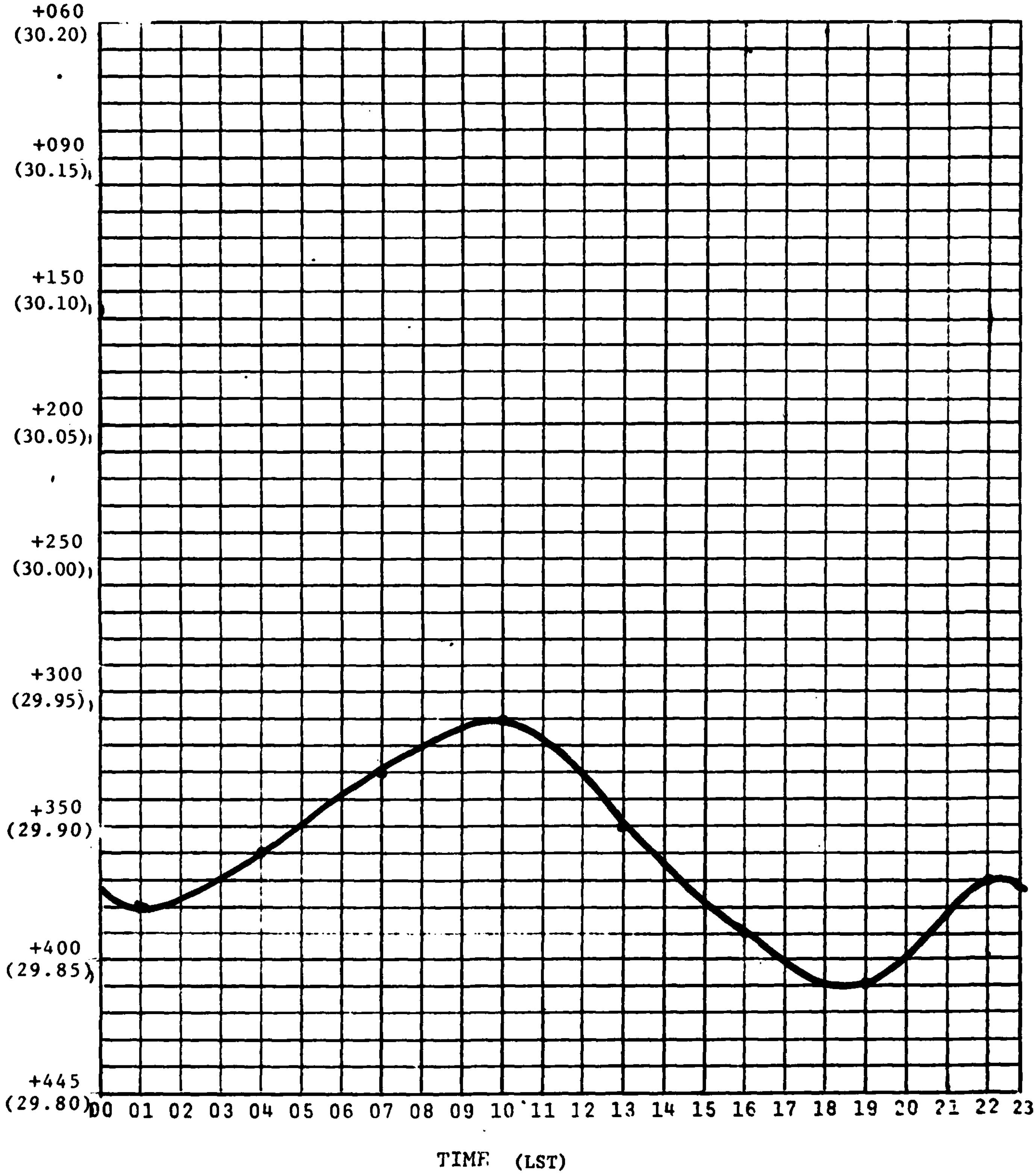


Fig. 4-9 MEAN DIURNAL PRESSURE VARIATION FOR SEPTEMBER.

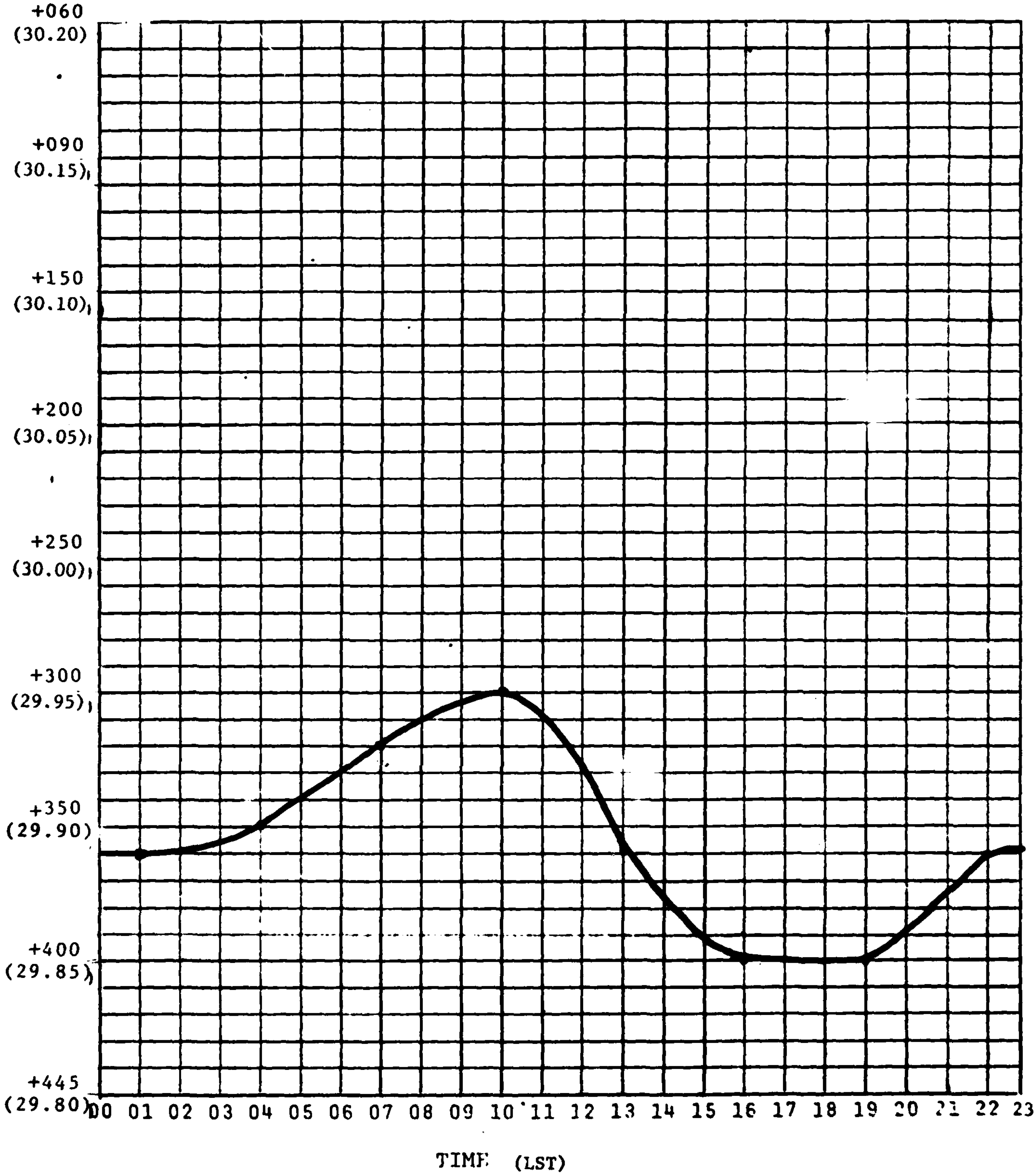


Fig. 4-10 MEAN DIURNAL PRESSURE VARIATION FOR OCTOBER

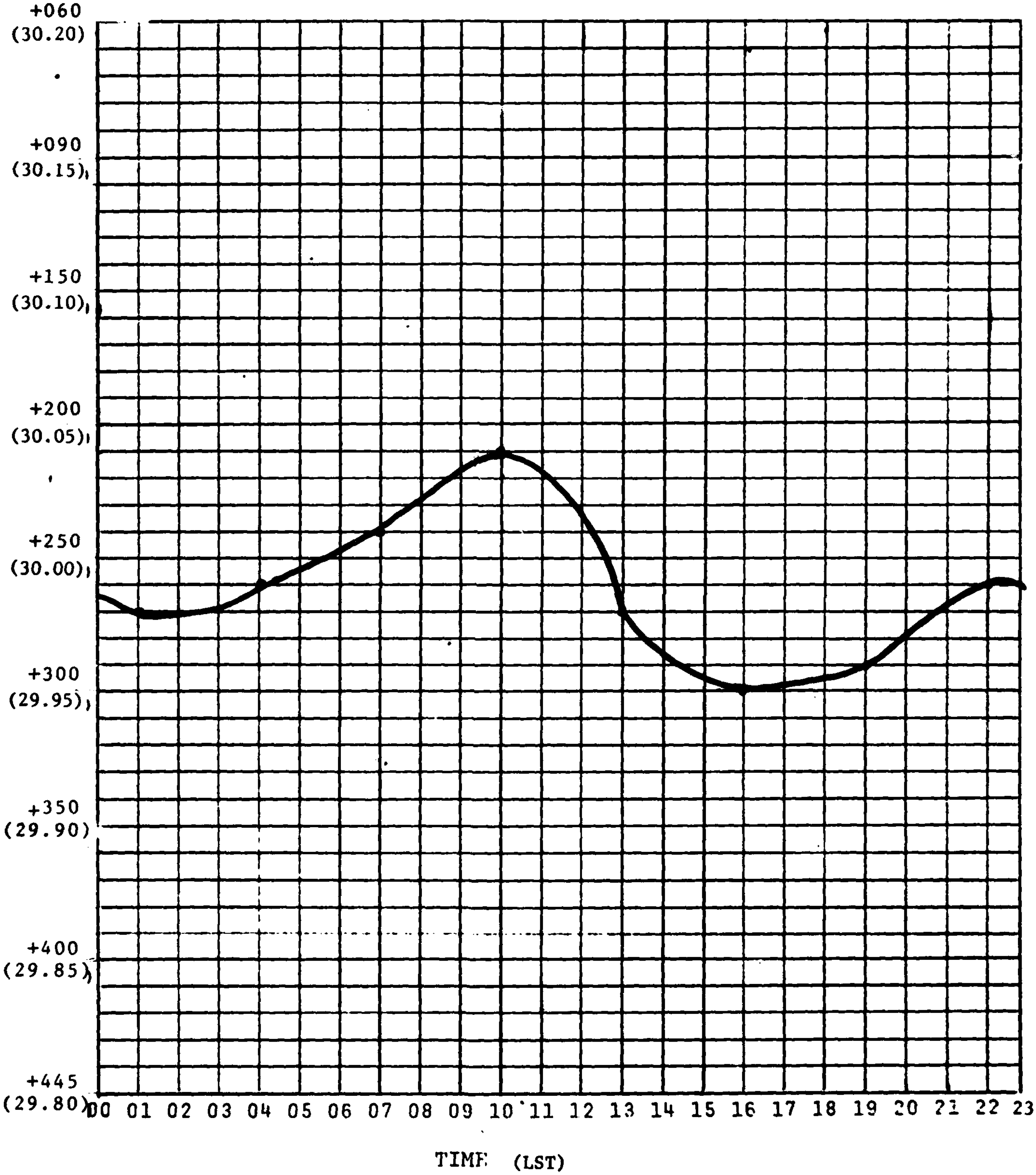


Fig. 4-11 MEAN DIURNAL PRESSURE VARIATION FOR NOVEMBER.

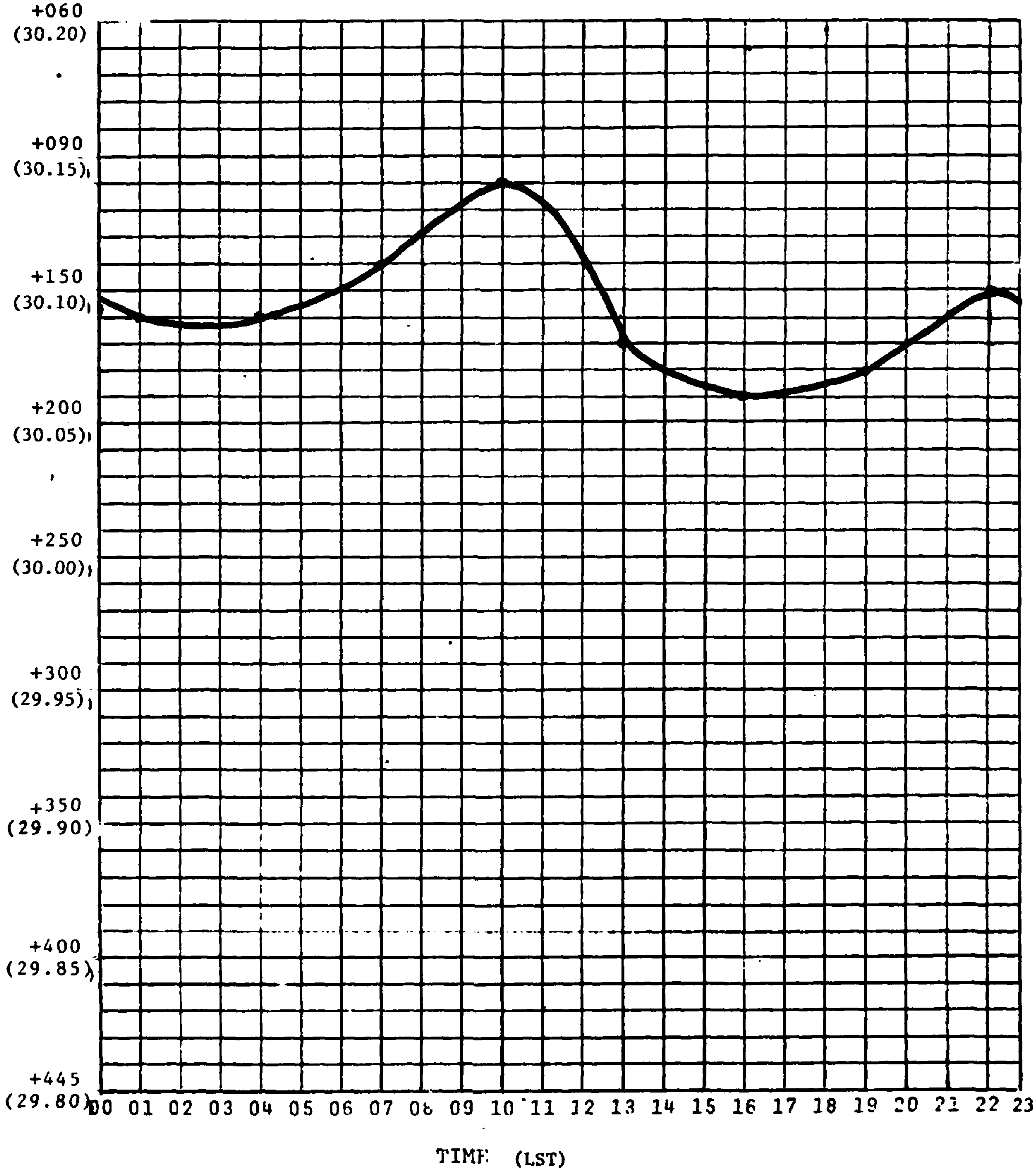
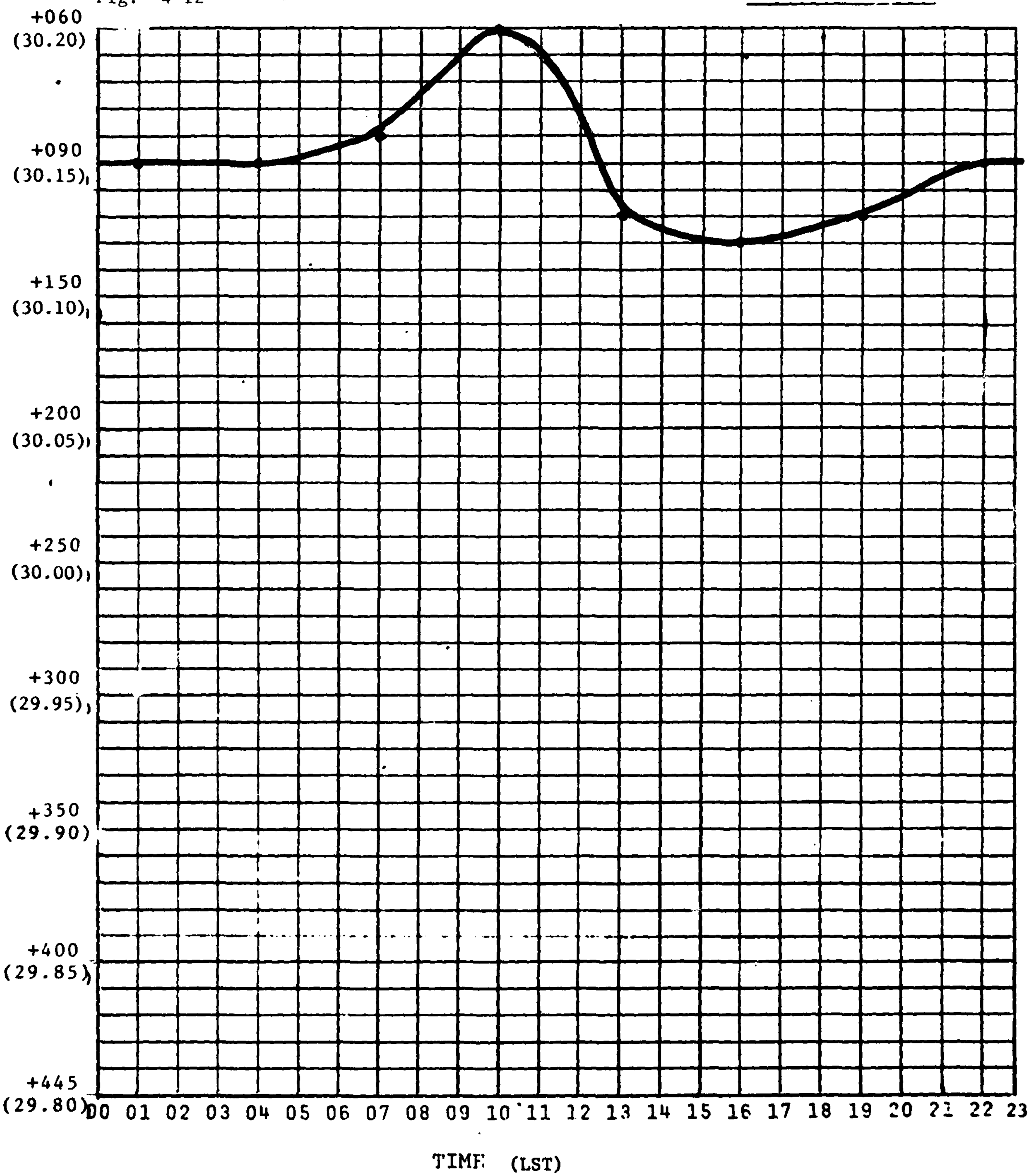


Fig. 4-12 MEAN DIURNAL PRESSURE VARIATION FOR DECEMBER.



Source: RUSSWO
POR: 1973-1980

PERCENT FREQUENCY OF OCCURRENCE OF THUNDERSTORMS

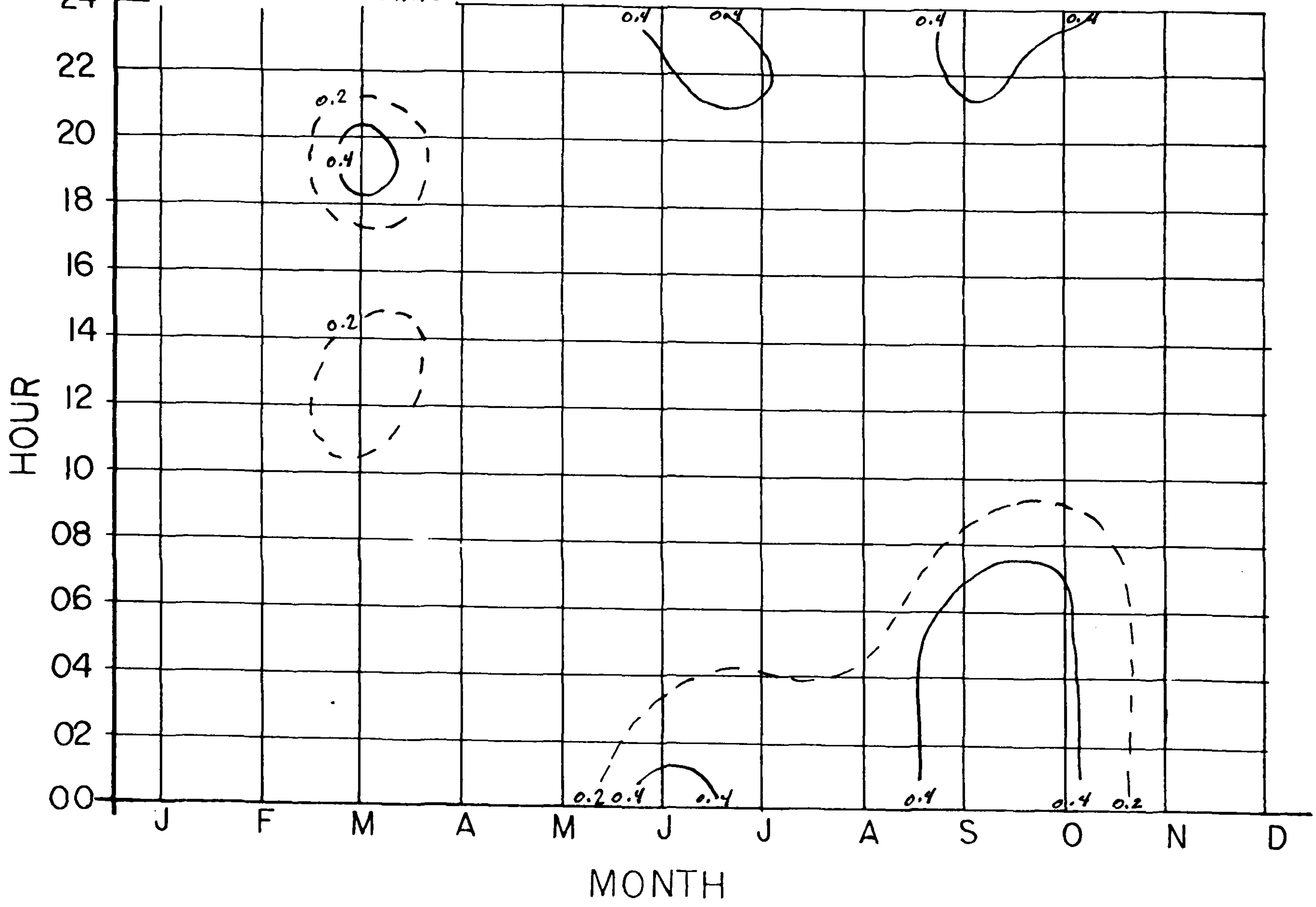
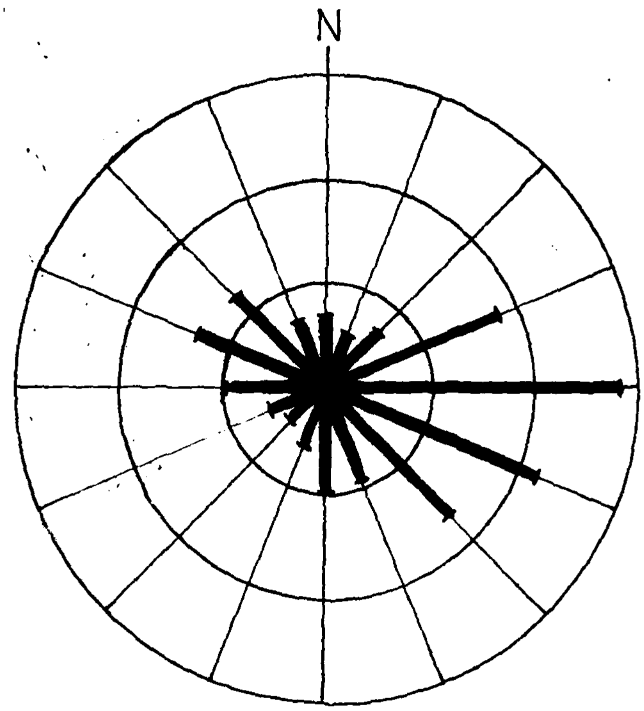
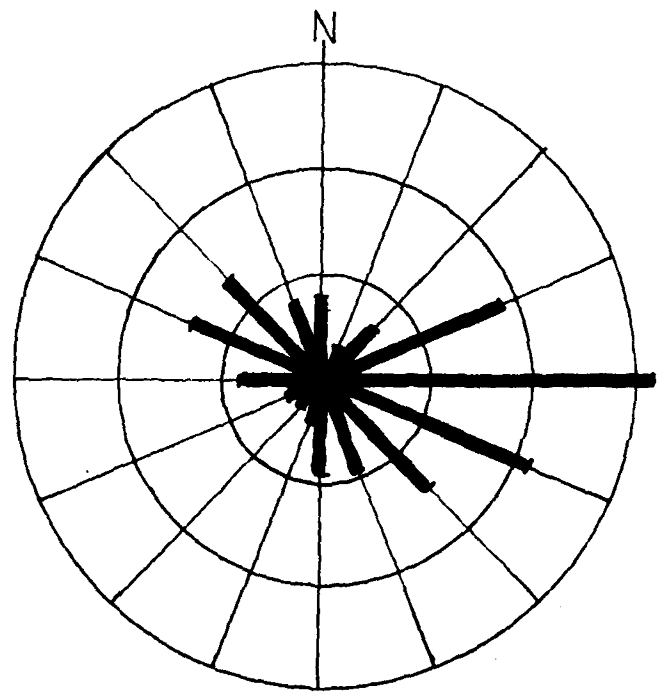


Figure 4-14
Wind Roses - All Hours
Percent Occurrence
Source RUSSWO - POR: 1973-80



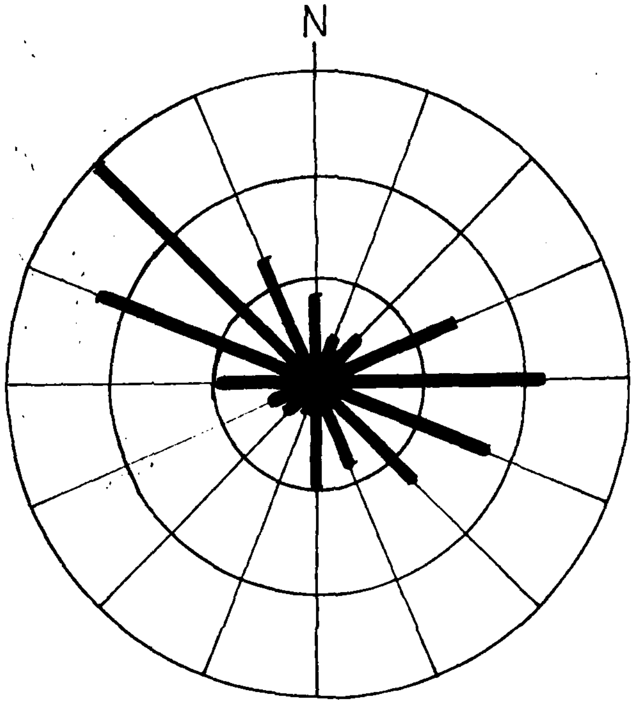
January
Calm = 12.0%



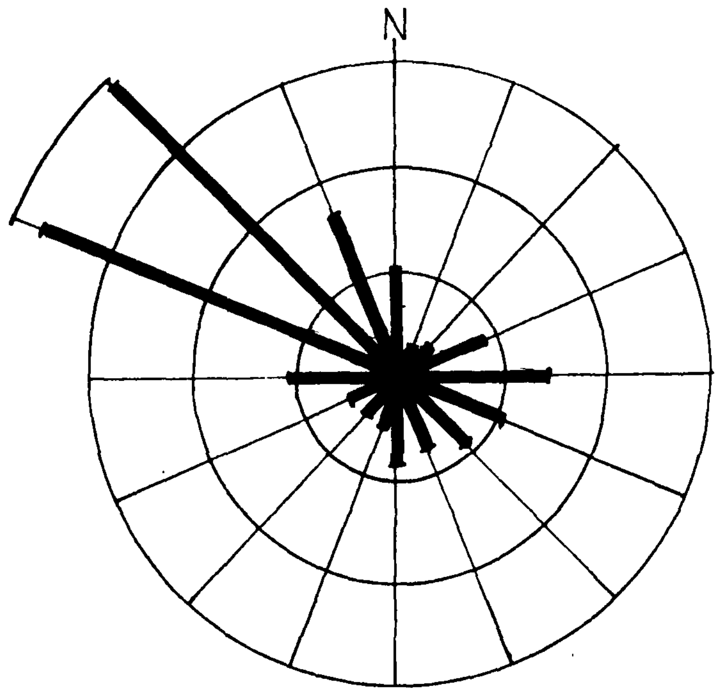
February
Calm = 9.7%

SCALE: Concentric circles represent increments of five percent

Figure 4-15
Wind Roses - All Hours
Percent Occurrence
Source RUSSWO - POR: 1973-80



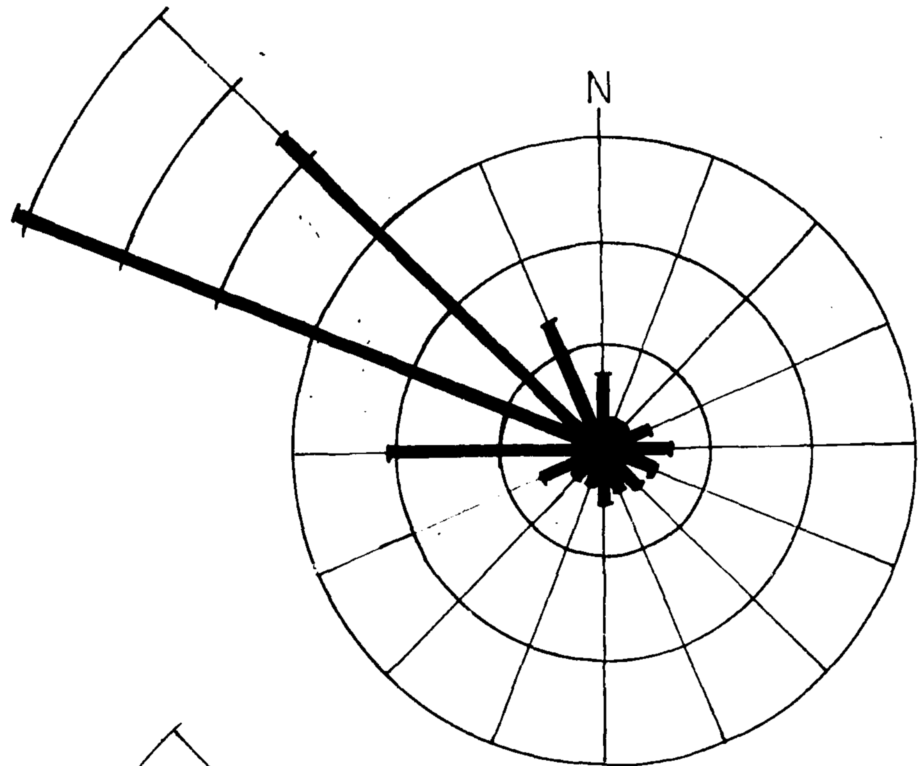
March
Calm = 6.3%



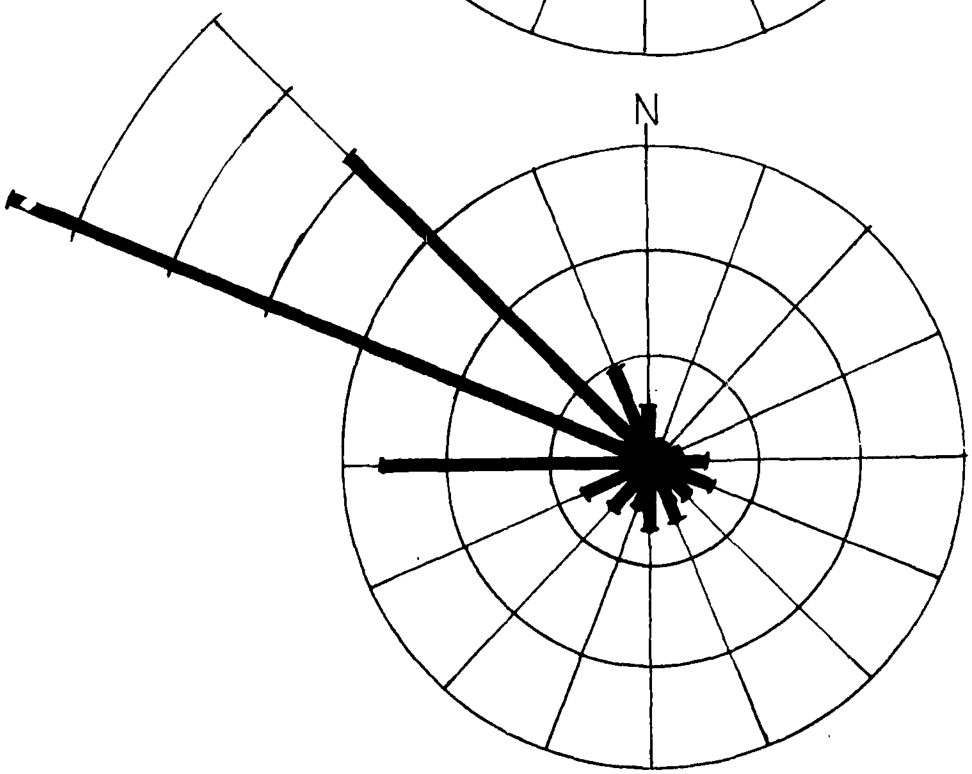
April
Calm = 4.2%

SCALE: Concentric circles represent increments of five percent

Figure 4-16
Wind Roses - All Hours
Percent Occurrence
Source RUSSWO - POR: 1973-80



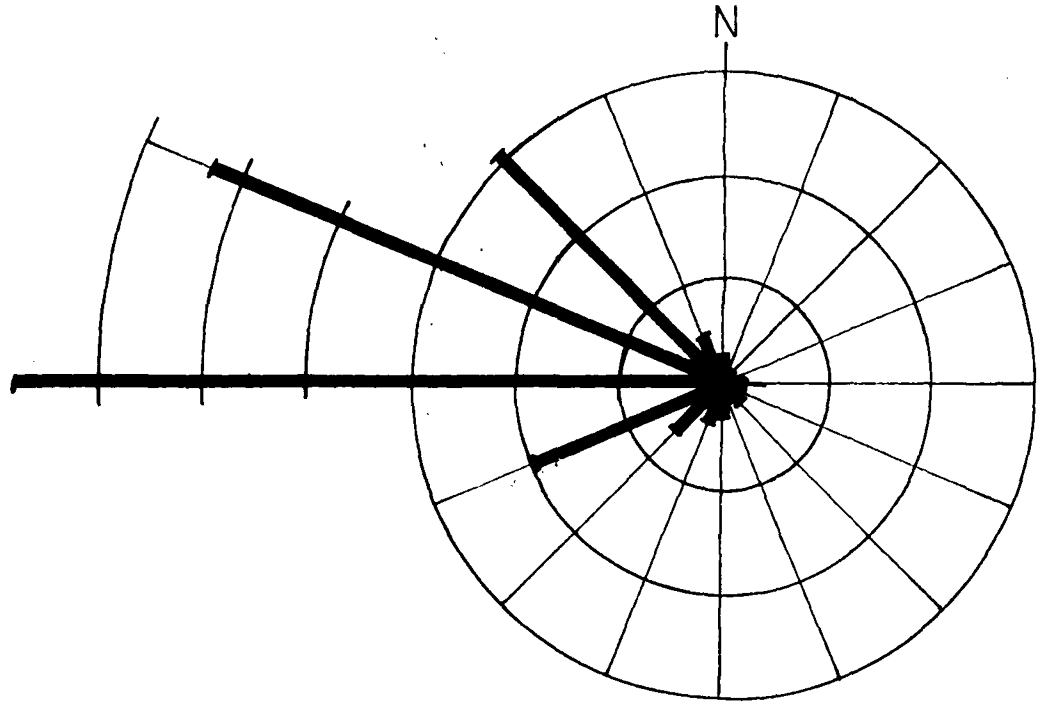
May
Calm = 2.6%



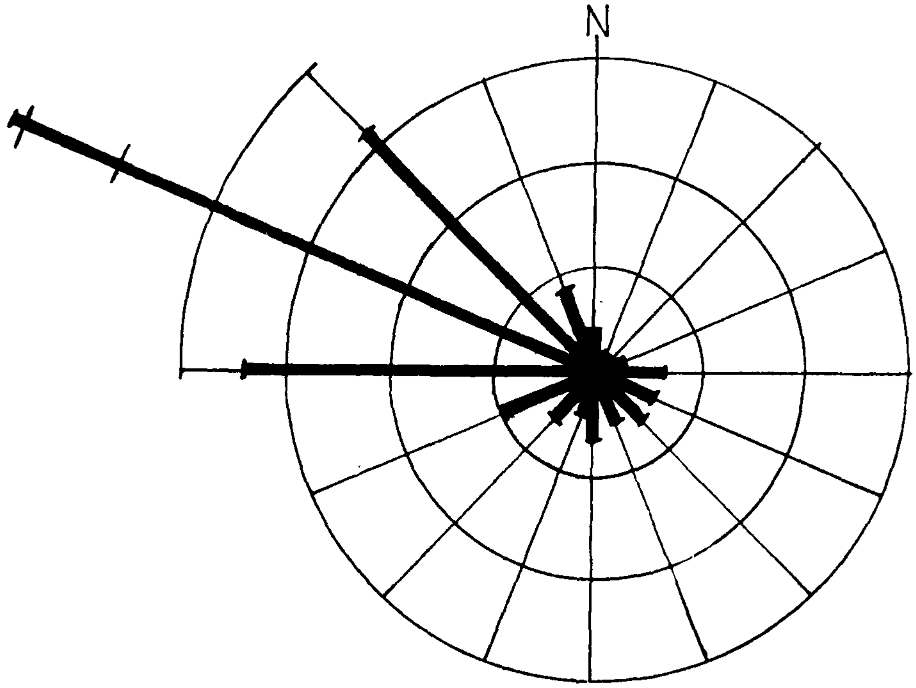
June
Calm = 2.3%

SCALE: Concentric circles represent increments of five percent

Figure 4-17
Wind Roses - All Hours
Percent Occurrence
Source RUSSWO - POR: 1973-80



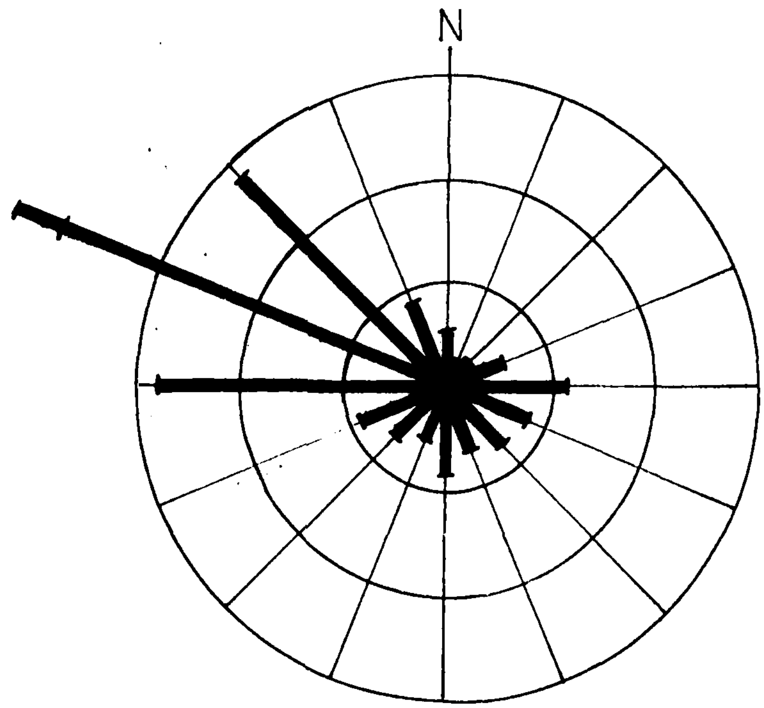
July
Calm = 0.3%



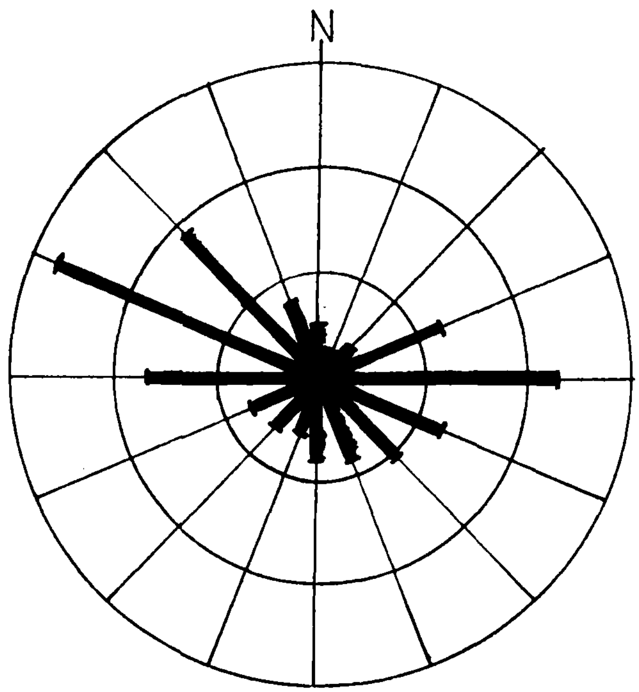
August
Calm = 3.6%

SCALE: Concentric circles represent increments of five percent

Figure 4-18
Wind Roses - All Hours
Percent Occurrence
Source RUSSWO - POR: 1973-80



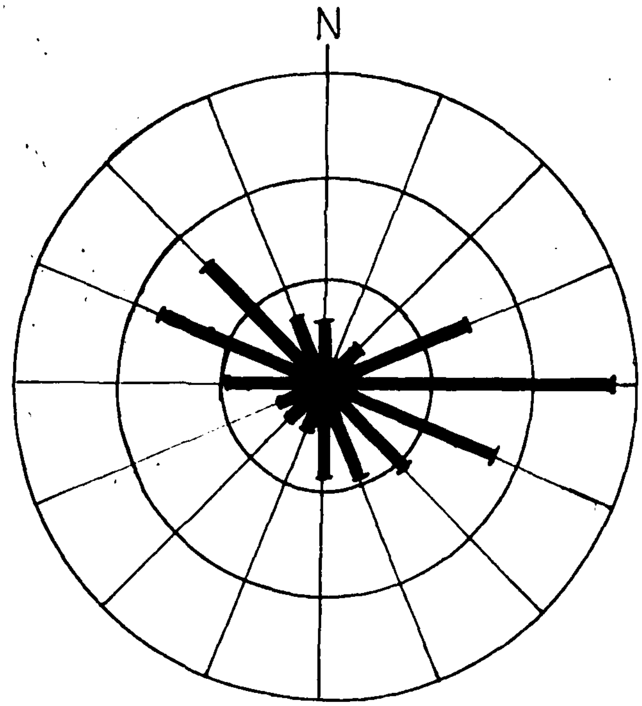
September
Calm = 7.2%



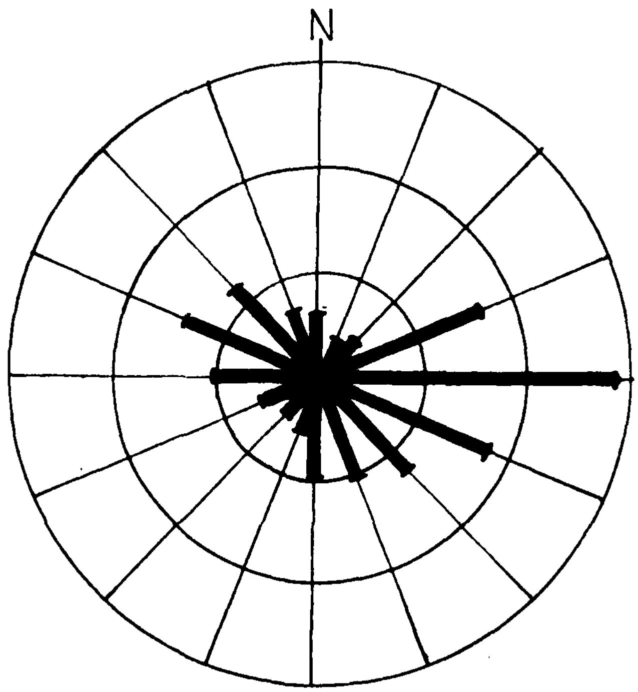
October
Calm = 12.8%

SCALE: Concentric circles represent increments of five percent

Figure 4-19
Wind Roses - All Hours
Percent Occurrence
Source RUSSWO - POR: 1973-80



November
Calm = 16.3%



December
Calm = 16.1%

SCALE: Concentric circles represent increments of five percent

CHAPTER 5

OFF-BASE FORECAST SUPPORT

Detachment 15 provides weather warning, advisory, D-value, and Anamalous Progagation support to the air defense radars supporting the 26 Air Division. The radar sites extend from Point Arena, on the northern California coast, southward to San Diego, then eastward to Odessa in Central Texas. A separate page is devoted to each radar site and includes a picture of the site, a description of the site's location, the type of equipment at the site, and a brief discussion of the most important weather impacts on the site. Figures 5-1, 5-2, 5-3, and 5-4 show the geographical location of the sites, while Table 5-1 lists the weather impacts on the sites.

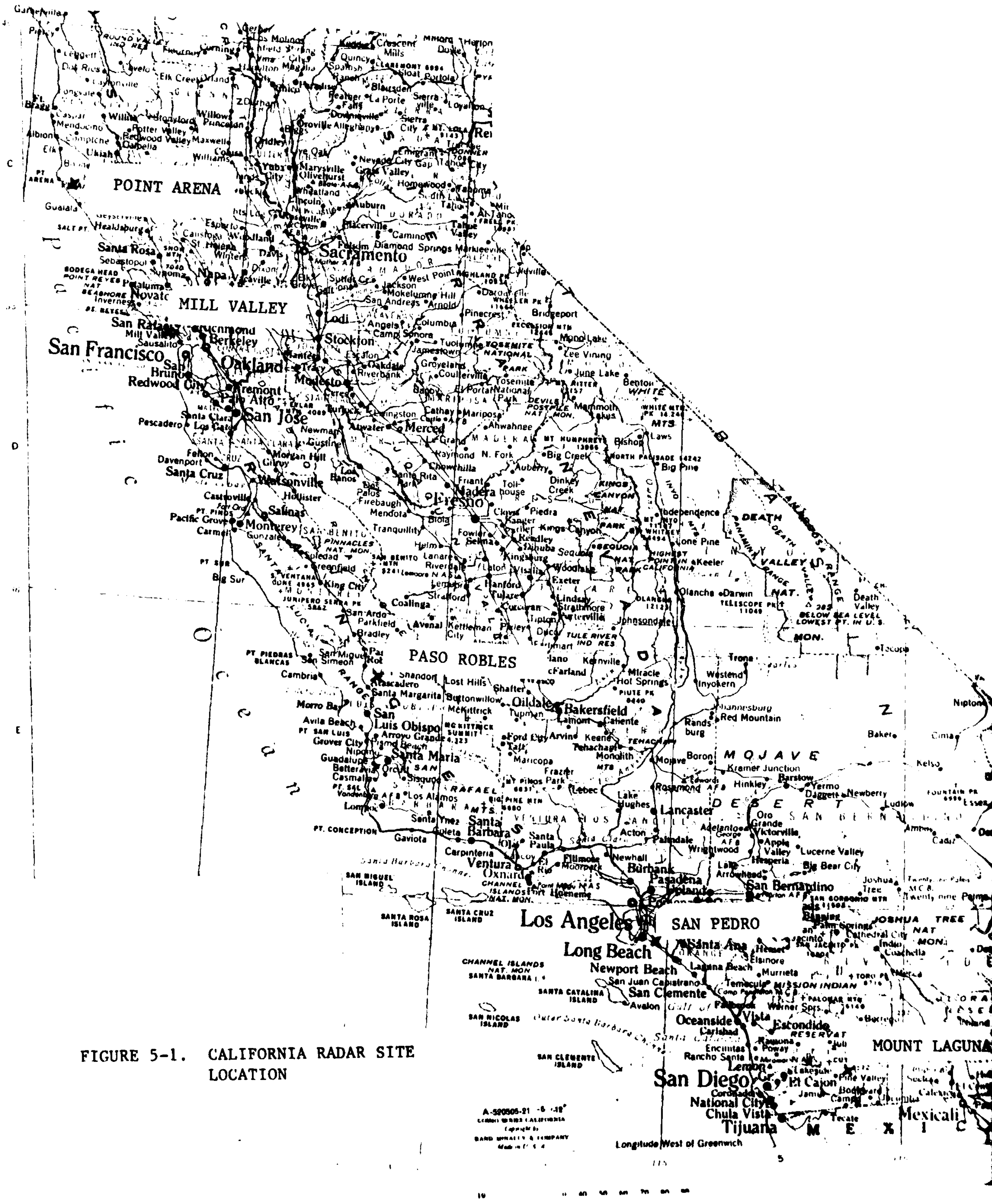


FIGURE 5-1. CALIFORNIA RADAR SITE LOCATION

TABLE 5-1

IMPACT OF WEATHER ON RADAR SITES

OLAM 26th AD, Pt Arena, CA
OLAR 26th AD, Mill Valley, CA
OLAB 26th AD, Paso Robles, CA
OLAE 26th AD, San Pedro, CA
OLAD 26th AD, Mt Laguna, CA
OLAF 26th AD, Phoenix, AZ
OLAG 26th AD, Silver City, NM
OLAH 26th AD, El Paso, TX
OLAA 26th AD, Odessa, TX

The above radar sites provide surveillance operations of aircraft approaching and/or entering U.S. air space for 26 NORAD Region.

THRESHOLD VALUE	LEAD TIME	IMPACTS	CUSTOMER ACTIONS
SURFACE WINDS			
25-49 Knots (Mill Valley only)	1 Hour	Limits maintenance.	1. Secure loose equipment. 2. Limit maintenance on outside surfaces.
50 Knots or greater (35 knots for Odessa)	1½ Hours	Possible property damage.	1. Secure non-hooded antenna. 2. Remove property that could be damaged and secure loose equipment. 3. Limit outside maintenance.
TORNADOES	ASAP	Property damage.	1. Secure property that could be damaged. 2. May interrupt mission temporarily.
THUNDERSTORMS	1 Hour	Property damage.	1. Run down some electrical equipment. 2. Remove property that could be damaged and secure loose equipment. 3. Limit outside maintenance.
HAIL			
½ inch or greater	1 Hour	Property damage.	1. Cover/store equipment that could be damaged.
FREEZING PRECIPITATION	1 Hour	Increased maintenance workload.	1. Secure non-hooded antenna

5-1. Point Arena AFS.

Point Arena AFS, OLAM 26th Air Division (Z-37)

a. Point Arena AFS is located at 38 degrees 53'N 123 degrees 32'W about 11 miles east southeast of the town of Point Arena, 150 miles north of San Francisco, and 8 miles inland from the coast. The site is located in the California Coastal Mountains at an elevation of 2455 feet. Primary equipment includes a dome covered long range search radar operated by FAA personnel, a covered height finder radar operated by military personnel, and a GATR radio complex and attendant antenna farm. The site is equipped with a GMQ 20 wind system, so wind data **are available.**

b. The principle weather effects which impact operations at Point Arena are associated with winter storm systems moving onto the northern California coast which produce high winds and the ever-present subsidence inversion which causes severe radar ducting problems and adversely affects the ability to detect and determine the height of aircraft targets. Ducting is a more severe problem during the summer months as the intensity of the subsidence inversion increases. Because of Point Arena's exposed location on a coastal mountain top, high winds associated with deep, occluded winter storm systems pose a threat of wind damage to the site, particularly to the GATR antenna farm and larger domed structures. With the more intense storms, gusty winds to nearly 70 knots can occur, while sustained winds in excess of 50 knots are not uncommon. The forecaster must maintain close contact with the site to catch the onset of wind conditions and be prepared to issue warnings based on potential for damaging winds rather than reported occurrences.

5-2. Mill Valley AFS.

Mill Valley AFS, OLAR 26th Air Division (Z-38)

a. Mill Valley AFS is located at 37 degrees 55'N 122 degrees 35'W approximately 13 miles north of San Francisco. The site is located on a mountain peak on the Marin peninsula at an elevation of 2643 feet. Equipment includes dome covered long range search radar, an uncovered height finder radar, and a GATR. The entire complex is military operated. The site is equipped with a GMQ-20 wind system.

b. Weather effects on this site are similar to those at Point Arena, high winds associated with winter storm systems and ducting problems caused by the subsidence inversion. In addition, there is a summer time wind problem caused by strong onshore pressure gradients between high pressure off the coast and a thermal trough in the California Central Valley, the funneling effects of the Golden Gate, and wind speed maxima located at or near the base of the subsidence/marine layer inversion. When the onshore gradient (measured between San Francisco and Reno) exceeds approximately 4.5mbs, gusty winds at the site can be in excess of 50 knots. An initial case study on this phenomenon which was completed in 1969 is located at Appendix 4. Because the height finder radar antenna is uncovered, this site is much more susceptible to wind damage than those sites with all antennas covered. Consequently, the initial wind advisory criteria for Mill Valley is 25 knots.

5-3. Paso Robles.

Paso Robles, OLAB 26th Air Division (Z-342)

a. Paso Robles is located at 35 degrees 23'N 120 degrees 21'W about 45 miles northeast of San Luis Obsispo. The site is in the California Coastal Mountain range atop Black Mountain at an elevation of 3665 feet and approximately 25 miles inland. Equipment includes an FAA manned search radar and a military manned height finder. The GATR is located at Lompoc, approximately 65 miles to the south. Detachment 15 has no responsibility for the GATR site. Both radar antennas are dome covered. The site is equipped with a GMQ-20 wind system.

b. As with all of the California coastal sites, the chief weather problems for Paso Robles are high winds produced by winter storms and ducting caused by a persistent subsidence inversion. The discussion in paragraph 5-1b is applicable to Paso Robles.

5-4. San Pedro Hill AFS.

San Pedro Hill AFS, OLAE 26th Air Division (Z-39)

a. San Pedro Hill AFS is located at 33 degrees 44'N 118 degrees 20'W approximately 25 miles south of Los Angeles at an elevation of 1550 feet. Equipment includes an FAA operated search radar, a military operated height finder, and a GATR. Both radar antennas are covered. The site is also equipped with a GMQ-20 wind system.

b. San Pedro is affected by subsidence inversion induced ducting problems and winter storm associated winds described in paragraph 5-1b. In addition, during the fall, strong Santa Ana winds blowing from the eastern deserts can cause problems. The Santa Ana develops when a high pressure system forms over the Great Basin reversing the normal eastward directed pressure gradient and causing a strong westward, offshore flow. The strength of the offshore flow is largely dependent upon the intensity of the Great Basin high and, correspondingly, upon the magnitude of the offshore gradient. During the Santa Ana, the air is typically very dry and the winds are strong and gusty, sometimes exceeding 100 mph, particularly near the mouths of canyons oriented along the direction of air flow.

5-5. Mount Laguna AFS.

Mt Laguna AFS, OLAD 26th Air Division (Z-76)

a. Mount Laguna AFS is located at 32 degrees 52'N 116 degrees 24'W about 45 miles east of San Diego. The site is situated along the eastern edge of the Peninsula Mountain Range at an elevation of 6268 feet. The eastern flank of this range plunges rapidly to the low desert floor just east of the site. Equipment includes military operated search and height finder radars, a GATR, and GMQ-20 wind system. Both radar antennas are covered.

b. Mount Laguna is affected by subsidence inversion induced ducting and winter storm winds described in paragraph 5-1b as well as the Santa Ana winds discussed in paragraph 5-4b. Radomes minimize wind impacts on the site. A pilot study of strong winds was completed in 1965. It offers a method for forecasting winter storm associated winds, particularly those winds produced by passage of a cold trough aloft. The study is included at Appendix 4. Also located at Appendix 4 is a 1978 ETAC produced climatological narrative for the site.

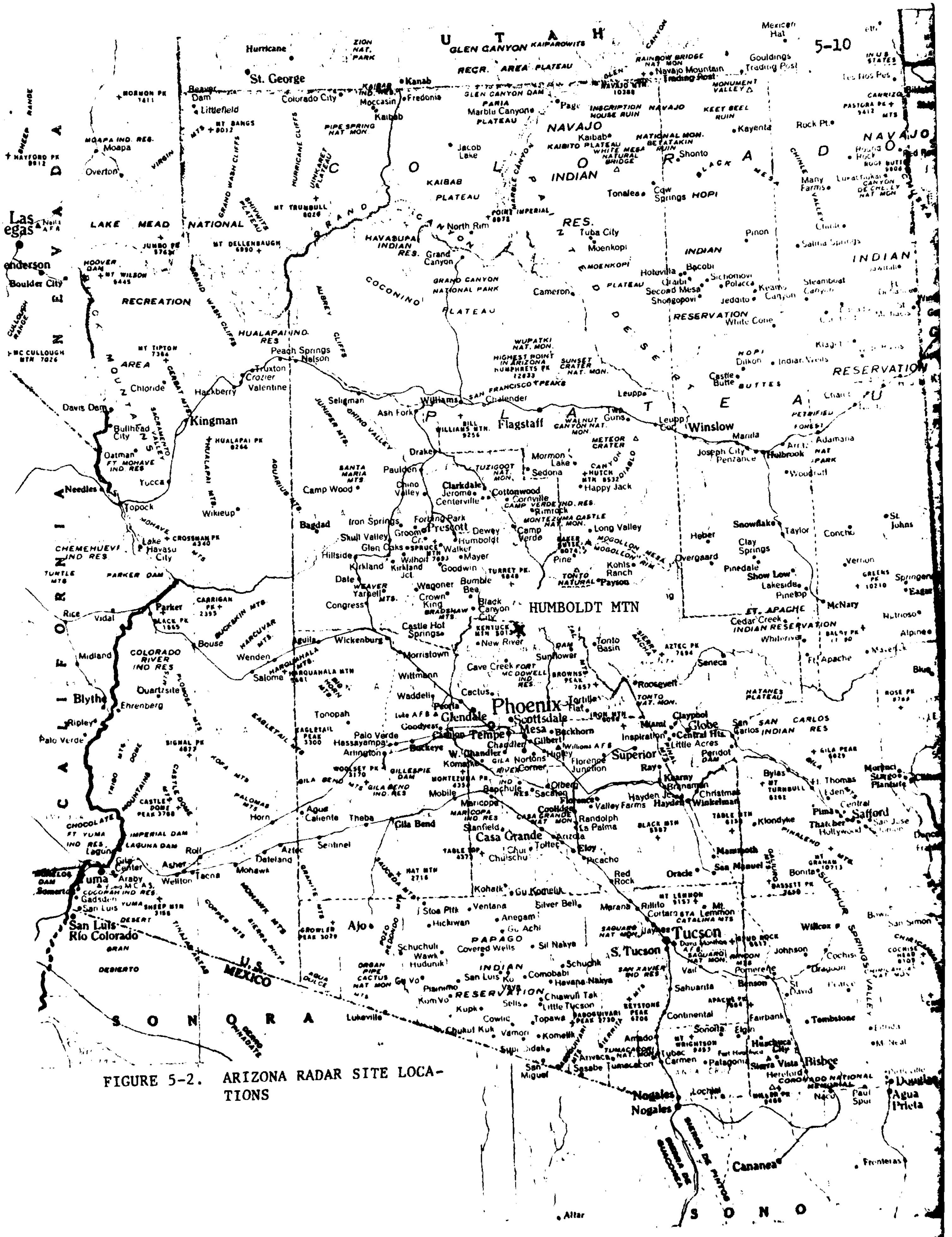
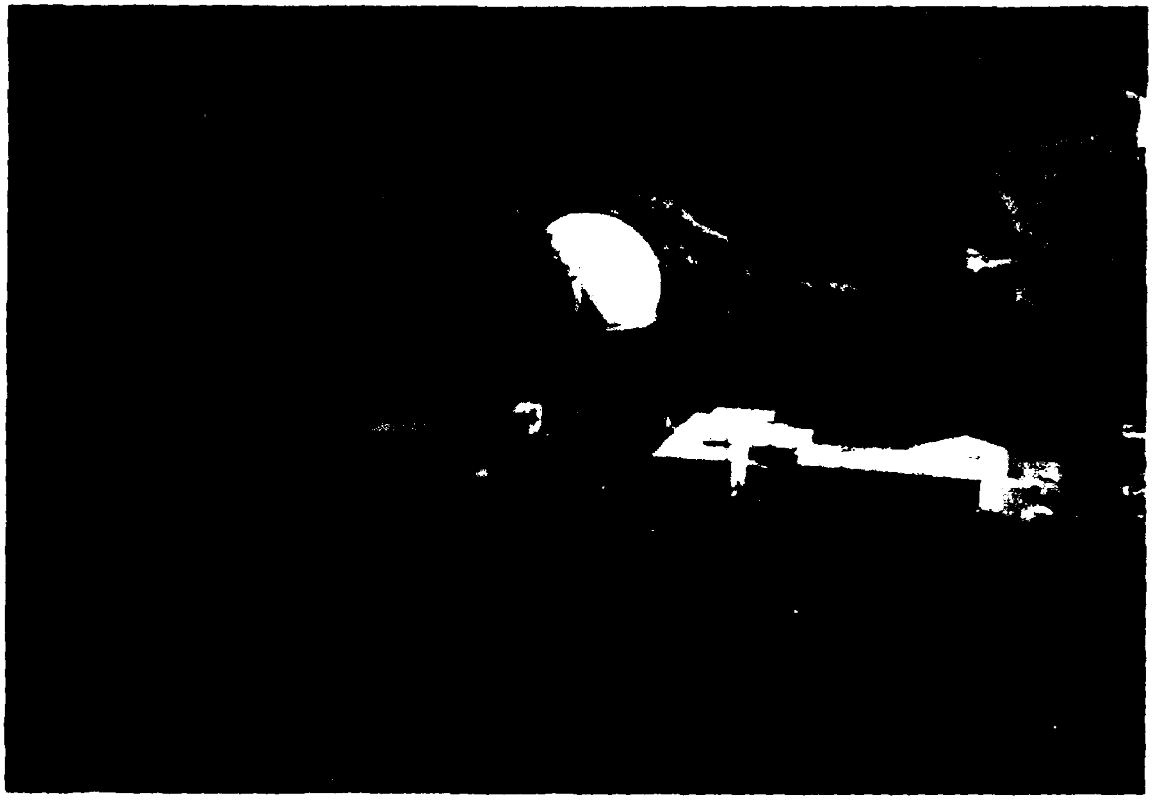


FIGURE 5-2. ARIZONA RADAR SITE LOCATIONS

5-6. Humboldt Mountain.



Humboldt Mountain, OLAF 26th Air Division (Z-247)

a. Humboldt Mountain is located at 33 degrees 58'N 111 degrees 47'W in the Tonto National Forest approximately 35 miles northeast of Phoenix. Situated in the Mazatzal Mountains, the site is at an elevation of 5239 feet. Equipment includes a covered, FAA manned search radar, and covered, military manned height finder, and a GATR. There is a GMQ-20 wind system available.

b. Chief weather threats to the Humboldt Mt facilities are high winds produced by winter storm systems and summertime thunderstorm down rushes. Wind warning criteria are 50 knots for this site. A more detailed description of the weather patterns affecting Arizona is contained in the Luke TFRN. Systems characteristics and descriptions for Luke are also applicable to Humboldt Mountain.

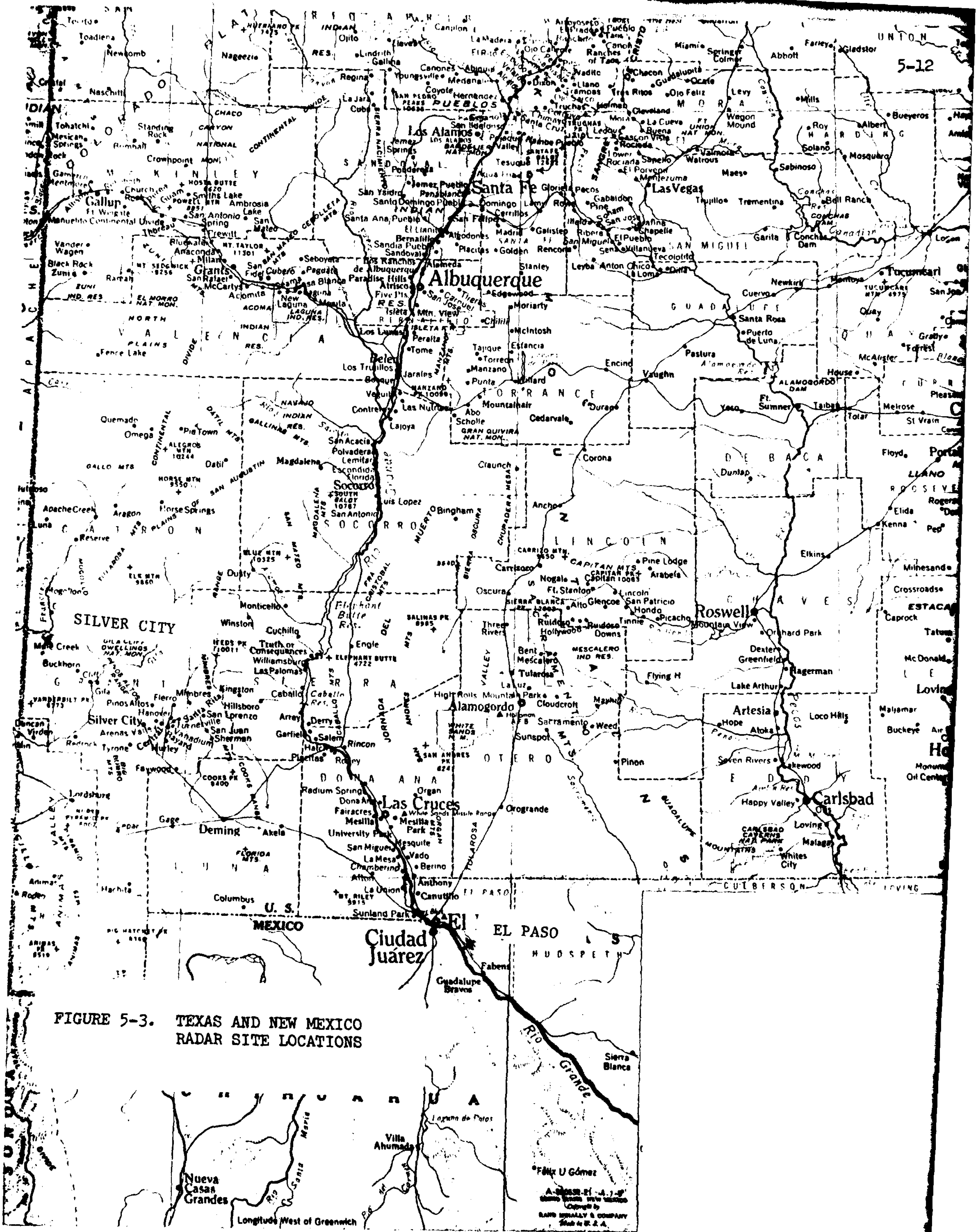


FIGURE 5-3. TEXAS AND NEW MEXICO RADAR SITE LOCATIONS

5-7. Silver City.

Silver City, OLAG 26th Air Division (Z-245)

a. Silver City is located at 32 degrees 59'N 108 degrees 57'W in the Gila National Forest approximately 76 miles northwest of Silver City. The site is at an elevation of 7608 feet. Equipment includes an FAA operated search radar, military operated height finder, and GATR. Both radar antennas are covered. A GMQ-20 wind system is available.

b. Chief weather problems include winds associated with winter storm systems and summer thunderstorm downrush and heavy snow or freezing rain produced by the winter systems. Satellite pictures provide a valuable aid in forecasting for Silver City. Winter storms which pass Luke with only minor intensity will often entrain considerable tropical moisture as they move to the east and produce much heavier precipitation as well as being stronger and better organized as they reach Silver City. Tropical moisture entrainment is readily apparent on the satellite picture.

5-8. El Paso.

El Paso, OLAH 26th Air Division (Z-244)

a. El Paso is located at 31 degrees 40'N 106 degrees 11'W approximately 18 miles southeast of the city of El Paso. The site is at an elevation of 4021 feet. Equipment includes an FAA operated search radar, military operated height finder, and a GATR. The search radar is covered, but the height finder is not.

b. There are few weather problems with El Paso. Chief problems, when they occur, are winds and occasional severe summer thunderstorms.

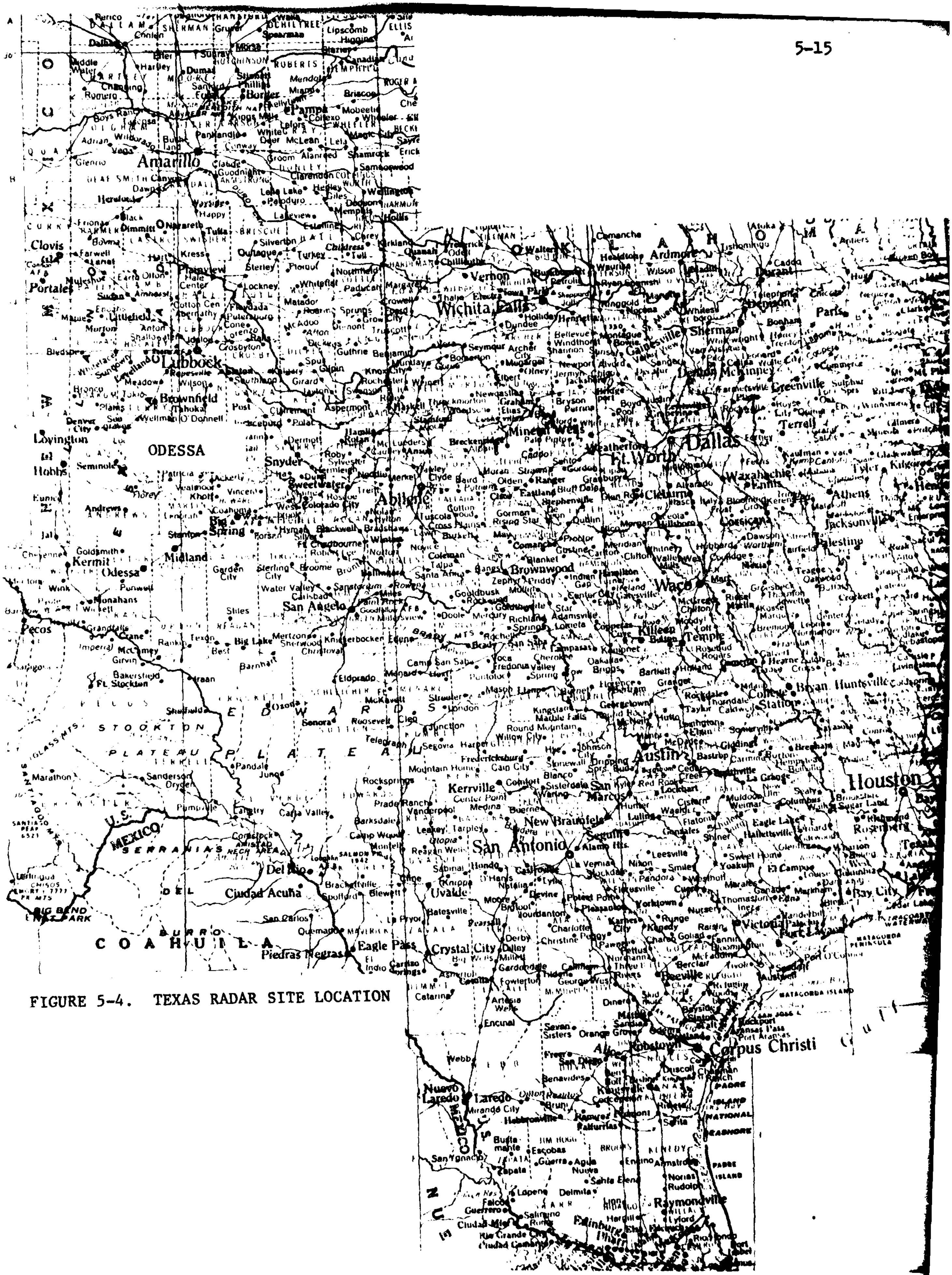


FIGURE 5-4. TEXAS RADAR SITE LOCATION

5-9. Odessa.

Odessa, OLAA 26th Air Division (Z-243)

a. Odessa is located at 32 degrees 33'N 102 degrees 24'W approximately 30 miles north of the town of Andrews. The site is at an elevation of 3118 feet. Equipment includes an FAA operated search radar, a military operated height finder, and a GATR. The height finder antenna is uncovered. Wind data are available from a GMQ-20 wind system.

b. The Odessa site suffers a number of weather problems chief among them being high winds from winter storm systems and summer thunderstorm downrush, freezing precipitation produced by winter systems, and severe summer thunderstorms. Because the height finder is uncovered the wind criteria are 35 KTS VS 50 for sites with covered antennas. Due to its more northerly and easterly location, the site is open to mid-western cold outbreaks, frontal passages, and other weather phenomena associated with the plains states. Forecasters must, therefore, be knowledgeable of mid-western forecasting techniques and storm characteristics.

APPENDIX 1

FRESNO AIR TERMINAL, CALIFORNIA

20 April 1981

OPERATIONALLY SIGNIFICANT FORECAST PROBLEMS

1. Winter fog and stratus. Forecasting winter valley fog is the chief forecast problem at Fresno. Specific problems are the forecasting of fog onset, intensity, duration, and dissipation and the timing of the removal of the stagnant air mass from the valley. This problem has already been discussed at great length in paragraph 3-5a. Suffice it to say, the forecaster must **become totally familiar with** the conditions and synoptic patterns which produce the fog regime and then closely monitor the situation for changes, some of them very minor, which will affect the fog condition. Because, once the regime has become established, persistence is such a dominant factor, monitoring of hourly conditions is a highly effective means, and perhaps the only means, of forecasting. SPECIFIC PROBLEM: To forecast the occurrence, intensity, duration, and dissipation of fog at Fresno Air Terminal. ACTION TAKEN TO RESOLVE THE PROBLEM: Numerous forecast studies and rules-of-thumb have been made/attempted. None provide a totally effective or consistent guide to forecasting for occurrence, intensity, or duration. Efforts in this area continue. In the mean time, during each fog season (1 Nov to 1 Apr), logs of the hourly observations from Fresno are maintained to keep the forecaster abreast of conditions and to provide a record of persistence upon which to base the forecast.

APPENDIX 2

APPROVED FORECAST STUDIES

No studies are currently approved for this station as of 20 April 1981.

APPENDIX 3

RULES OF THUMB

There are no approved Rules-of-Thumb for this station as of 20 April 1981.

APPENDIX 4

SPECIAL SYNOPTIC STUDIES AND REFERENCES

APPENDIX 5

OPERATIONAL VERIFICATION

Operational verification is conducted for Fresno only during the months November to March as this is the only time when weather impacts operations. October and April are included as and if the need arises.