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I. BASIC DESCRIPTION

A. Location and description.

1. Base location. The Naval Air Station Kingsville is located at 27 degrees 30 minutes' north latitude and 97 degrees 49 minutes west longitude which is 28 air miles southwest of Corpus Christi, Texas and three miles east of the city of Kingsville. The nearest body of water is Baffin Bay, which is five miles southeast of the Air Station. This bay extends approximately 23 miles southeastward to the Laguna Madre (Intracoastal Waterway) along the Gulf of Mexico.

2. Office location and description. The Detachment spaces are located on the West Side of the first deck of the south wing of the Air Operations building (Bldg. 1770). These spaces occupy approximately 984 square feet of floor space with 84 square feet of display space. A storage room is also provided. Naval Training Meteorology and Oceanography Detachment Corpus Christi is the Sub-Regional Forecast Center (SRFC) for NAS Kingsville and NAS Dallas. The SRFC provides weather forecasts and flight weather briefings after 2100 local and periods of field closure, when no forecaster is present.

B. Topography. Kingsville lies on the border of two sub-regions of the Gulf Coastal Plain. Immediately to the north and northeast is the sub-region known as the Coastal Plain. This land is very flat with elevations less than 100 feet MSL. Marsh and salt grasses grow immediately at the tide water, while a little farther inland are coarse grasses. Outside the tide water, a portion of the land is in cultivation (cotton, feed grains, corn and vegetables), but most of the area is devoted to livestock pasture, while the Coastal Plain is largely level grassland. A variety of trees grow along the bottomlands of the numerous rivers and creeks which traverse this area. The area south of San Antonio and lying between the Gulf Coast and the Rio Grande is called the South Texas or Rio Grande Plain. It is part prairie, but much of it is covered with a dense growth of prickly pear cactus, mesquite, dwarf oak, and other wild shrubs. Extreme South Texas is known as the Lower Rio Grande Valley and is the most extensive agricultural area in the state. In the flat coastal area surrounding Kingsville some land is under cultivation, however most of the land is devoted primarily to livestock raising. It is in this area that lies some of the largest ranches in Texas, notably the million-acre King Ranch in Kleberg and Kenedy Counties. From sea level, the South Texas Plain slopes gradually upward toward the northwest, reaching an elevation of

about 900 feet MSL at the base of the Balcones Escarpment in San Antonio. Kingsville's station elevation is 50 feet MSL and due to the flat, dry character of the terrain, the local weather is not affected by orographic influences with the exception of the sea breeze.

C. Runway description. The Air Station has two sets of dual runways 8000 feet long and 200 feet wide with 1000-foot overruns on each end. The runways are hard surfaced with asphalt except the first 1000 feet on each end, which is concrete. The runways are on magnetic headings 35-17 and 31-13.

2. Heliport. A portion of the NAS Kingsville Apron has been marked off for a heliport. It is marked in such a manner as to accommodate three helicopters.

D. Alternate Airports within 100 miles

1. NAS Corpus Christi. NGP, 30 air miles east-northeast of Kingsville is designated all-weather field open 24 hours a day. Pilot-to-Forecaster voice circuit (344.6) is available 24 hours a day.

2. NALF Orange Grove. NQ5, 35 air miles north-northwest of Kingsville, is used as a practice landing field.

E. Field Minimums. Due to the various NAV-AIDs, aircraft categories, runway lighting, and proposed changes to the Field refer to the established field minimums in the High/Low Altitude Approach Procedures Publication and the IFR Enroute Supplement. It behooves every forecaster to be familiar with the published minimums of NAS Kingsville. To avoid confusion, it is the policy of the detachment to provide Clearing Authorities with observed and forecast weather conditions. It then becomes the responsibility of the Clearing Authority to establish the field condition.

F. Meteorological Equipment

1. Pressure Instruments

a. The Precision Aneroid Barometer (ML-448/UM) is located in the detachment spaces near the observation station,

56 feet above mean sea level.

b. The Marine Barograph is located on the observer's desk in the detachment spaces 56 feet above mean sea level.

c. The Digital Altimeter Setting Indicators (DASI) are located in the detachment spaces, radar room, and ATC tower.

d. The Automatic Sensing Observation System (ASOS) sensor is located 1225 feet from runway 31R with the readout located in detachment spaces.

2. Temperature and Humidity Instruments

a. ASOS has a temperature and dew point sensor located 1225 feet from runway 31R with a readout located in detachment spaces.

b. An Electric Psychrometer (ML-450A/UM) is kept in the detachment spaces for comparison purposes.

3. Rain Gauge. A plastic 4" type rain gauge is mounted on the roof of Bldg. 1770.

4. Wind Instruments

a. The AN/UMQ-5C, Wind Measuring Set, transmitter is located across the aircraft parking area adjacent to Bldg. 1770 on a 20 foot mast well above any surface eddy effects. Remote slave indicators are located in the detachment, Flight Clearance, Tower, and two indicators in RATTC. The RD/108B recorder is located in the detachment spaces. The detachment indicator and recorder are calibrated to read true north and all others are calibrated to read magnetic north.

b. An AN/PMQ-3, Portable Hand Held Anemometer, is kept in the detachment spaces as a standby to the AN/UMQ-5C.

5. Cloud Height Indicators

a. The ML-121, Ceiling Light, is located across the aircraft parking area adjacent to Bldg. 1770. Observations are taken approximately 15 feet from the East Side of the Operations building thus providing a 627 foot baseline. The light is controlled from within the detachment.

b. The ASOS unit has a display located in the

detachment spaces.

7. Radar

a. A RADAR Information Display (RADID) is installed above the detachment's flight briefing counter. This is a remote picture from the Corpus Christi International Airport weather office (NWS). For cloud tops/movement NAVTRAMETOCDET Corpus Christi can provide information from their AN-FPS 106 radar. NAS Kingsville does not have Weather Radar, but is scheduled for NEXRAD'S PUPS installation in December 1995.

b. RATTC radar located on the second deck of Bldg. 1770 provides a 60-mile range and may be used at the discretion of the forecaster.

G. Communication Equipment

1. Voice Communication

a. A Pilot to Forecaster circuit, (344.6) is located in the detachment spaces

b. An AN/GMQ-27(V) Weather Television system is located in the detachment spaces. It is a closed circuit television system used to provide audio/visual presentations to Training Squadrons 21, 22, 23, T45, Strike Ops, Training Air Wing Two, Tower and RATTC. All are equipped with a color monitor. Switching is available for three channels to all, except the Tower and RATTC, for displaying the current weather, RADAR picture and camera display on a timed interval. All audio presentations are accomplished via a "Raspberry" intercom circuit, located above the AN/GMQ-27(V).

c. Hot line telephone communication is provided between the detachment, the Tower and RATTC, via a phone located in the observer spaces next to the plotting table.

d. A RAPICOM 120 telefax is located in the detachment spaces for transmitting and receiving data. The phone number is (A) 861-6131 or Comm. (512) 595-6131.

e. Telephones

(1) The office is equipped with six Comdial Executech II phones. There are two lines to each phone, (A) 861-6350/6186 and Comm. (512) 595-6350/6186.

(2) An automatic recorded message telephone is located in the detachment spaces for a 24 hour recorded

forecast. The telephone number is (512) 595-6336. The forecast is updated at least twice a day.

(3) A STU-III is located in the LCPO's office for voice communication. The phone number is (a) 861-6886 and Comm. (512) 595-6886. This is a shared line and prior coordination is required to initiate secure voice communication.

2. Facsimile Equipment

(1) Two Okidata 293 printers are located in the Communications space along with a modem that comprises a micro earth station. DIFAX charts are received via microwave dish located on the roof of Bldg. 1770.

3. Computer Equipment. The weather office has a total of seven computer systems.

II. Climatology

A. Climatological Summary. According to the Koeppen Theory of Climate Classification, Kingsville is on the border between Dry Steppe and Oceanic Moderate Humid Meso-thermal. The climate is characteristic of subtropical regions, in that there is no sharply established delineation of the four seasons. Summer and winter predominate, with shortened spring and fall transition periods often possessing the characteristics of either winter or summer. The general circulation is governed by the southeasterly wind flow of the Bermuda High which ridges into the southeastern United States and the Gulf of Mexico from the Atlantic Ocean. Polar air masses move through the area during the winter months giving the climate a continental flavor, and disrupting the normal southeasterly flow from the Gulf of Mexico. These polar air masses undergo considerable modification as they proceed southward, and the temperature changes a short distance north of the Kingsville area, for example, are much more pronounced than they are locally. Precipitation is spread over the year with one significant wet month and one significant dry month. September is the wet month and is the result of tropical cyclone activity in the Gulf of Mexico, while the dry month is normally March. It is not unusual for South Texas to experience periods of long drought (up to one year) in which desert climatic conditions prevail.

B. Monthly Climatology: January

1. The winter is in full evidence during January with frequent passage of the polar front. Normally, about six frontal passages can be expected with half of them of the modified maritime polar variety and half of them of the continental polar/arctic variety, locally known as "Northers." The polar front reaches its extreme southern limit and begins its transition northward. With the frequent frontal passages, modified polar/arctic air remains over Texas much of the time, thus January has the lowest mean temperature of the year. The minimum temperature drops to 32 degrees Fahrenheit (F) or below on an average of three times, however, some years will show no such drop at all. The average diurnal range of temperature is 20 degrees F from a mean low of 46 degrees F to a mean high of 66 degrees F.

2. Frequent wave formation on the polar front in the western Gulf of Mexico creates some of the poorest flying conditions that occur at Kingsville. These wave cyclones will remain in their formative stage just off shore for 1 to 3 days before deepening and/or moving east and northeast out of the

area.

3. Aloft, the westerlies continue their southward migration and the pattern is one of strong low index with frequent passage of long and short waves over the local area. The subtropical high is reflected as a closed contour over the West Indies, Caribbean Sea, Central America and the Yucatan Peninsula.

4. Drizzle is the predominant form of precipitation with an average of eight days of .01 inch or more. An average of one thunderstorm can be expected and a trace of snow and/or freezing rain may fall in some years.

5. Fog is the main restriction to visibility and occurs on an average of 18 days, which is more than any other month.

6. There is only a slight increase in total sky cover from December as cloudy skies predominate more than 50% of the time.

7. Surface winds continue to prevail from the North at a mean velocity of nine knots.

Monthly Climatology: February

1. The polar front continues its northward migration and prevailing surface wind veers from a north-northeast direction to the familiar southeast as the mean position of the front lies just north of the local area. Surface wind velocity averages ten knots. Cold frontal passages and invasions of modified polar air are still frequent with an average of one every five to six days. Cyclogenisis continues in the western Gulf of Mexico but with slightly greater frequency than January due to the greater contrast in the land and water temperature. With the increased persistence of a southeasterly wind, temperatures moderate accordingly. The minimum temperature drops to 32 degrees F or below only once on the average, and then before the 10th of the month. The average diurnal temperature range is 20 degrees F from a mean low of 49 degrees F to a mean high of 70 degrees F. The temperature can be expected to reach 90 degrees F or above at least once during the month.

2. Aloft, the westerlies continue to drift southward with strong low index persisting as the main pattern.

3. Rain and drizzle are the predominant forms of precipitation. While the number of days of occurrence of .01

inch or more decreases to six, the average monthly total increases slightly. This is because of a slight increase in showery type of precipitation associated with maritime tropical air brought in from the Gulf of Mexico with the prevailing southeasterly flow. An average of one thunderstorm can be expected and in some years a trace of snow may fall.

4. Fog continues as the main restriction to visibility and occurs on an average of 15 days of the month, which is only slightly less than the previous month. There is not much change in total sky cover, however, a few more clear periods can be expected than occurred in January. Cloudy skies are the rule 50% of the time.

Monthly Climatology: March

1. The polar front continues its northward transition with the mean position well north of the local area. As a result, frontal passages decrease to about three or four and are extremely modified when they do reach this area. Cyclogenisis ceases over the adjacent Gulf and moves to the land area of South Texas where convergence of maritime tropical air in this area occasionally creates a low-pressure cell. These lows do not linger however, and move rapidly northeast and east across the southern Gulf Coast states.

2. Aloft, the westerlies reach their southern most limit and begin to drift slowly northward by the end of the month. The flow pattern begins its transition from low to high index over the southern United States.

3. The surface wind continues from the southeast but increases to 11 knots in average velocity. As a result, low cloud ceilings are higher and visibilities are greater, although fog still occurs on an average of 14 to 16 days of the month. With the increased wind velocity fog is also not as persistent as in previous months, and will normally burn off or lift into stratus by mid morning.

4. March is considered transitional from winter to summer and as a result it is the driest month of the year with less than one inch of precipitation on average. Rain and drizzle continue as the predominant form of precipitation and a measurable amount occurs on only five days of the month. One thunderstorm can be expected. Snow has never fallen during the month of March.

5. Due to the retreating polar air and the influx of Gulf air, there is slightly more cloudiness than the

previous month. There is less frequency of mostly clear skies while cloudy skies increase to 55% frequency.

6. March is the first month with record temperatures over 100 degrees F although the maximum temperature can be expected to reach 90 degrees F or above only once or twice during the month. Freezing temperatures have never been recorded. The average diurnal temperature range increases slightly to 21 degrees F from a mean low of 56 degrees F to a mean high of 77 degrees F.

Monthly Climatology: April

1. By the end of April the transition from winter to summer is complete as the Bermuda High-pressure ridge becomes firmly established over the Gulf of Mexico as it moves northward. The polar front takes up a mean position through southern Oklahoma and the Texas Panhandle and passage through the local area is limited to about two occasions, as it usually dissipates prior to reaching South Texas. Low-pressure cells are common on the front in the Panhandle and in combination with the onshore flow of maritime tropical air creates super gradient surface winds of 20 to 30 knots or higher. These "Panhandle lows" literally "suck up" the air from the Gulf of Mexico. As a result, April is the windiest month of the year with an average speed of 12 knots. This influx of moist tropical air also creates instability conditions over the state, especially over the northern portion where severe thunderstorms and tornadoes are quite frequent.

2. Aloft, the westerlies continue northward approaching high index.

3. Flying weather continues to improve although restrictions on visibility due to fog, smoke and haze still occur an average of 15 days. The duration of the restrictions, however, continues to become less and minimum visibilities are better than in March. Prevailing IFR conditions during the month are at night and early morning in low stratus clouds, which persist until noon on many occasions. Due to this stratus condition, April has the greatest frequency of ceilings 2,000 feet or below, but due to the strong surface winds ceilings less than 1,000 feet continue to be less frequent than previous months.

4. With the northward movement of the Bermuda ridge, the prevailing surface wind is from the east-southeast to south-southeast 57% of the time. Also, the warming land mass gives rise to more frequent sea breeze effects.

5. Rain, rainshowers, and drizzle are about equal as the predominant form of precipitation. With the increased instability over the land area, thunderstorm activity triples from the previous month and can be expected about three times during the month. Tornadoes and funnel clouds are fairly common with the instability conditions. Measurable precipitation occurs on about five days of the month and increases slightly in mean total amount.

6. April is the cloudiest month of the year due to the night and morning stratus conditions, however, days are generally partly cloudy. The temperature is quite pleasant ranging from a mean low of 64 degrees F to a mean high of 83 degrees F. The temperature reaches 90 degrees F or higher four times during the month. The record high temperature for Kingsville of 107 degrees F occurred in April 1988.

7. All things considered, April is the most pleasant month of the year in Kingsville although the gusty surface wind is a source of irritability for some people.

Monthly Climatology: May

1. As May begins, summer is in full evidence and the polar front is no longer a problem as only one or two weak frontal passages can be expected. Flight conditions reflect the summer season by being VFR 93% of the time.

2. Aloft, the westerlies continue moving northward and high index across the southern United States is the general flow pattern. By late May easterlies begin to make an occasional appearance over South Texas.

3. Cloudiness decreases slightly from April and sky condition terms are fairly well divided in their frequency of occurrence although mostly cloudy skies predominate slightly more with about 40% frequency. Rain showers are the predominant form of precipitation and the average amount more than doubles from the previous month. Days of occurrence also increase slightly. Due to the increased convective activity associated with the warming of the landmass, thunderstorm activity increases also and occurs on an average of five times during the month.

4. May is the last of the "windy" months as the mean speed remains high at 12 knots. Surface wind direction prevails 64% of the time from the east-southeast to south-southeast in association with the firmly entrenched

subtropical ridge in the Gulf of Mexico.

5. The main restriction to visibility is smoke and haze. Restrictions to visibility (which includes fog) occur on an average of 15 days but consist of much shorter periods of duration than the previous month. In other words, restriction to visibility poses very little problem to local flight conditions except during brief periods during the sunrise hour and in thunderstorm activity.

6. The diurnal temperature range decreases to only 17 degrees F from a mean low of 70 degrees F to a mean high of 87 degrees F. This short diurnal range is due to the increased moisture content of the atmosphere. The maximum temperature can be expected to reach 90 degrees F or higher on about nine occasions during the month.

Monthly Climatology: June

1. Summer continues with little change in the daily weather and the persistent Bermuda ridge. Some years may see one weak passage of the polar front, but as a rule it dissipates prior to reaching South Texas. Easterly waves and troughs in the easterlies begin to occasionally disrupt the mundane conditions and some years will experience tropical cyclone activity moving ashore from the breeding grounds in the Gulf of Mexico and Caribbean Sea. The official hurricane season begins on 1 June of each year.

2. Aloft, the westerlies make a strong surge farther north as high index becomes well established over most of the United States. Over South Texas the flow is weak and disorganized as easterlies occur periodically, however, by the end of the month they are firmly established and provide the predominant upper air pattern.

3. Cloudiness continues to decrease and conditions are reversed from May as mostly clear skies predominate 40% of the time followed by partly cloudy and cloudy skies 33% and 27% of the time respectively. Rainshowers continue as the most frequent form of precipitation and days of occurrence and thunderstorm activity also remain the same. Average precipitation amount increases slightly to 3.1 inches.

4. East-southeast to south-southeast surface winds prevail 67% of the time and the average speed decreases slightly to 11 knots as "Panhandle lows" seldom contribute to the gusty daytime winds experienced during the previous few months.

5. The main restriction to visibility is ground fog, but does not significantly affect aircraft operations. Other restrictions include smoke and haze, and blowing sand and dust. Occurrence of visibility restriction is limited to only 11 days.

6. The diurnal temperature range is 18 degrees F (74 to 92 degrees F average range). The most significant change from May is the occurrence of maximum temperatures of 90 degrees F and above.... 23 days can be expected.

Monthly Climatology: July

1. The term that best describes July in South Texas is "Hot" and "Dusty". Subsidence from the upper subtropical high-pressure ridge tends to put a lid on convective activity more effectively than in previous months.

2. July is unique in that it:

a. Is the most cloud-free month of the year with an average sky cover of four tenths.

b. Is the month with the least frequency of ceilings below 3,000 feet. July also shares with August the distinction of having the least frequency of ceilings below 2,000 feet and 1,000 feet.

c. Is the hottest month of the year in terms of highest daily maximum temperature (94.1 degrees F). Frequency of maximum temperatures 90 degrees F or above occur on 29 days of the month. July shares with August the highest mean temperature of the year (85.4 degrees F).

d. Is the summer month with the fewest number of days of thunderstorm activity, four days, and shares with March the least number of days with measurable precipitation, five days.

e. Experiences the best flying conditions of the year, VFR 99.3% of the time.

3. With the subsidence mentioned above and the occasional influence of the thermal low over Mexico, the atmosphere becomes drier than previous months. This causes slightly higher temperatures, but the diurnal temperature range remains the same at 18 degrees F (76 to 94 degrees F). Precipitation amounts decrease to about 2.0 inches. Predominance of mostly clear skies is 49% of the time.

4. East-southeast to south-southeast surface winds reach their maximum frequency of 69% although south to southwest winds associated with the Mexican heat low increase significantly to 15% occurrence. Average speeds continue near 11 knots.

5. Aloft, the westerlies reach their northernmost position by the end of the month and are not significant to the local situation of predominately easterly flow.

Monthly Climatology: August

1. With a significant northward movement of the Bermuda high in the Atlantic and its influence extending over a larger area, the pressure gradient over South Texas decreases slightly resulting in a decrease in the average wind speed to an eight knot value.

2. Aloft, the easterlies continue to prevail as the westerlies remain at high latitudes. The westerlies begin to drift slowly southward after the middle of the month with a transition from high to low index commencing by the end of the month. This beginning transition phase allows the westerlies to make an occasional brief appearance in this area by late August or early September.

3. August shares the high monthly mean temperature of 85.4 degrees F with July. Maximum temperatures continue to reach 90 degrees Fahrenheit or higher on all but two or three days of the month.

4. Average rainfall (2.73 inches) and thunderstorm activity (five days) increases significantly in August due to a higher incidence of easterly waves passing the Station and the increased appearance of tropical cyclones in the Gulf of Mexico. While the primary breeding ground for tropical disturbances lies well to the east in the Antilles and eastern Atlantic, primary storm tracks bring them into the Gulf of Mexico and a secondary storm track aims directly at the coastal bend section of Texas.

5. Prevailing surface wind remains from the east-southeast to south-southeast, however, the frequency decreases slightly to 59% due to the increased tropical disturbance activity in the Gulf. This activity also causes an increase in surface wind frequency from the northeast quadrant (14%).

6. Only a very slight increase in mean cloudiness occurs in August. In addition there is also a slight increase in ceilings below 3,000 feet due to the increased convective activity. Restrictions to visibility remain insignificant except for brief periods in showers and thunderstorms. Flying conditions remain excellent as VFR prevails over 98% of the time.

Monthly Climatology: September

1. This is the "wettest" month of the year with a mean precipitation value of 4.48 inches. As the Bermuda high reaches its northernmost position over the middle Atlantic state, more tropical disturbances are "steered" into the Gulf of Mexico creating increased precipitation over South Texas.

2. September is the last month with record temperatures over 100 degrees F; however, the mean temperature remains high at 82 degrees F and the maximum temperature reaches 90 degrees F or higher about two-thirds of the time (19 days). A sharp increase in relative humidity combined with a decrease in the average surface wind (nine knots) and a continued high temperature account for a noticeable increase in personal discomfort. This personal discomfort coupled with a high degree of anxiety created by tropical cyclone activity cause most people to regard September as the most unpleasant month of the year.

3. Aloft, the westerlies remain at high latitude and continue their slow southward drift and transition from high to low index. The westerlies and the polar front often move into north Texas by the end of the month. At least one cold frontal passage can be expected in this area.

4. Surface wind becomes more diversified than previous months. The prevailing direction remains southeasterly 15% of the time.

5. Mean cloudiness remains nearly the same, although there is a slight increase in frequency of ceilings below 3,000 feet and below 2,000 feet due to the increased precipitation. The number of days with measurable precipitation increases sharply to nine, which is the high for the year. Thunderstorm activity increases to six days.

6. Flight conditions remain excellent with VFR about 97% of the time. There is an increase in restrictions, other than precipitation, as ground fog begins to make a more frequent appearance by the end of the month with 12 days of

occurrence.

Monthly Climatology: October

1. October begins the transitional phase to winter as indicated by a seven to eight degree drop in the mean temperature to a pleasant 74 degrees F a definite increase in polar frontal passages, and an occasional frontal wave formation in the northwestern Gulf of Mexico.

2. The southward movement of the subtropical high and the hemispheric westerlies cause tropical storm and hurricane tracks to be limited to a southwest to northeast orientation over southern Florida. As a result tropical cyclone activity rarely affects South Texas after the first few days of the month.

3. The diurnal temperature range increases to 20 degrees F (64 to 84 degrees F). Maximum temperatures reach 90 degrees F or above on only five occasions.

4. Precipitation amounts return to their "pre-tropical cyclone season values" of about 3.1 inches. Days of measurable precipitation decrease to six days and thunderstorm activity drops sharply to two occurrences. Rain and showers occur with about equal frequency.

5. Cloudiness amounts decrease slightly. Mostly clear skies prevail over 50% of the time. Stratus conditions begin to increase late in the month; however, ceiling heights show little change from September.

6. Restrictions to visibility occur on about 15 days of the month with fog and ground fog occurring about equal frequency. (ground fog early in the month and fog late in the month as a general rule). Although fog and stratus conditions increase, flight conditions remain VFR over 95% of the time.

7. There is little change in the wind direction from the previous month with southeast prevailing 15% of the time. Winds also remain diversified as in the previous month between the northeast and the southeast quadrants. The mean speed remains the same with an average of nine knots.

Monthly Climatology: November

1. November continues as a month of transition with the polar front moving well into Texas and showing a mean position over the San Antonio/Austin area. Frontal passage over the local area can be expected once every seven to eight days or about four times during the month. The mean temperature continues to drop sharply with the increased occurrence of continental air to a value of 65 degrees F (55 to 75 degrees F range). Only one occurrence of temperatures 90 degrees F or above can be expected.

2. Aloft, the westerlies continue their strong surge and frequent low index patterns are the rule.

3. Precipitation amounts decrease by more than half to a total of about 1.4 inches which makes November second only to March as the driest month of the year. Measurable amounts of precipitation occur on five days, thunderstorms on one day, and rain predominates over drizzle and rainshowers.

4. Surface winds are equally divided between north and northeast and east-southeast and south-southeast with northerly being the prevailing direction closely followed by southeast. The average wind speed remains at nine knots.

5. Cloudiness increases to a mean of five tenths and there is a sharp increase in ceilings below 2,000 feet. Cloudy skies predominate about 44% of the time with mostly clear skies close behind at 40% frequency.

6. Occurrence of days with visibility restrictions decreases to 14 days, however, values are lower and persist longer as fog becomes predominant over ground fog and other restrictions. As a result of the lower ceilings and visibilities, VFR conditions frequency drops sharply to just over 88%.

M. Monthly Climatology: December

1. With the mean position of the polar front just south of Kingsville winter makes its appearance in South Texas. Although little in the way of cold weather is experienced before the middle of the month. Frontal passages occur about once every six days accompanied by a gusty northerly surface wind. The western Gulf of Mexico shows frequent wave formation on the polar front, which aids in the 16% frequency of IFR flight conditions during the month.

2. Aloft, the southward migrating westerlies are strong low index with a strong contour gradient over the southern United States.

3. Temperatures continue to decrease as would be expected to a mean value of 59 degrees F (49 to 69 degrees F range). One day of minimum temperature 32 degrees F or below can be expected. Some years may see one day with a maximum temperature of 90 degrees F or above.

4. Precipitation averages 1.1 inches with six days of measurable amounts experienced. Drizzle predominates over rain and showers and thunderstorms are rare.

5. Prevailing surface wind is northerly with an average speed of eight knots.

6. Cloudiness increases to a mean value of six tenths and low cloudiness also continues to increase from the previous month. Skies are either cloudy (50%) or mostly clear (37%) much of the time.

7. Restrictions to visibility increase to become significant with occurrence on 17 days. Fog by far predominates over ground fog and other restrictions and visibility values are lower and exist for longer periods than the previous month.

III. Forecasting

A. Controlling Features

1. Broadscale pattern and trend aloft.
2. Long waves.
3. Blocks and closed circulation aloft.
4. Regional Jet stream.
5. Short waves.

NOTE: Read chapters 2 and 3 of Meteorological Monographs, Forecasting in Middle Latitudes, and NA50-1P-520, for the foregoing items and how they are controlling features.

6. Gulf of Mexico. The factors having the greatest effect on the local weather are the Gulf of Mexico, the inlet waterways, lakes and bays. The close proximity of these bodies of water has a very pronounced effect on nearly every type of weather situation and every measurable weather factor.

a. Influence on cold fronts. During the fall and winter, while water temperatures are still above 60 degrees F, the Gulf has a definite weakening effect on cold fronts. As a result the front passes the station and moves into the Gulf where it tends to take the shape of the coastline. In some cases the front will become stationary about 100 miles off shore where modification takes place. After sufficient modification of the cold front and intensification of the warm air mass to the south, this front will move north as a warm front. Under these conditions a prolonged period of IFR conditions can be expected. To make these fronts more perplexing, about twice annually a "blocking high" will develop to the east of the cold front. Under these conditions a natural rainmaking machine is developed, and rain over a prolonged period of six to eight days producing amounts of 4 to 6 inches is not uncommon. If the cold front is intense (above 6,000 feet) the front will move far to the south and modification will take place over southern portion of the Gulf. Under these conditions a strong northerly component of winds to levels up to 40,000 feet is shown. This is the only condition that prevails in the winter where clear skies will be evident.

b. Influence on fog and stratus formation. When the sea water temperature is below 60 degrees F. and the ambient air near the sea temperature, advection fog and low stratus will occur almost daily when the predominant southeasterly flow around the extension of the Bermuda High brings moisture upslope to the coastal plain of Texas. Stratus usually forms between the hours of 2200 and 0400 CST with bases between 600

and 1000 feet near sunrise the stratus becomes fog when the wind velocity is less then 5 knots. Stratus overcast layers generally lift to no more than 900 to 1,300 feet, then breaking and eventually clearing takes place.

In the winter the stratus resulting from the southeasterly return flow from migratory, polar high pressure cells usually covers all of central as well as South Texas. Stratus resulting from this return flow may not break during the day and even persist for several days. As the Gulf sea temperature rises in the spring, stratus appears less regularly and is less persistent than in the winter. Compared to the stratus of winter and spring, fall stratus forms later in the day, breaks earlier, and has higher ceilings.

c. Influence on other cloud formations. During the summer months, when the water temperature is in the high 70's and low 80's cumulus clouds begin forming over the water after 0300 CST. These clouds build into cumulonimbus, move shoreward, and appear to be imminent over the station, but only on rare occasions do these nocturnal thundershowers reach the station as the majority of them begin to dissipate as they move over the land. During the late forenoon or early afternoon cumulus clouds begin to form along the boundaries of the sea breeze. The clouds will build to heights in excess of 45,000 feet, producing scattered to numerous showers and thunderstorms usually southwest through north of the station. Almost without exception, these air mass thunderstorms will dissipate within one to two hours after sunset.

d. Influence on temperature. The normal nighttime low temperature during all seasons follows within four to six degrees of the sea water temperature when the prevailing winds are from east to south-southeast. This modification of temperature aids in preventing freeze damage, as temperature will seldom drop below 32 degrees F for more than eight hours at a time.

7. Lee-side Trough

a. General. The trough in the lee of the Rockies is well known, however, little has ever been published concerning the southern extremity of this trough. At times the lee trough extends southward across west Texas into the Gulf of Mexico just south of Brownsville. This trough is a very significant synoptic feature in that it marks the westward extent of the moist air flowing inland from the Gulf of Mexico, this is characterized by a sharp dewpoint discontinuity and is often referred to as "The Dewpoint Front". The trough can exist at all times of the year. The length is determined by the

strength of zonal westerly flow above 7,000 feet across the Rockies from Idaho to Mexico. Whenever the flow over a region of the Rockies exceeds 25 knots a trough may be expected in that region. In the summer it marks the westward extent of the Bermuda High, while in winter it forms behind the migratory highs moving across from Arizona. The eastward movement of the trough results in a shifting of winds to the west or southwest and a drying trend in the lower levels. It is necessary for the forecaster to closely observe the three-hourly position of the trough in order to detect the beginning of an eastward movement.

b. Effects on cold fronts. When the lee trough precedes a cold front, low-level winds shift to west or southwest prior to frontal passage and no low ceilings or precipitation occurs. This often leads to erroneous logging of frontal passage two to four hours prior to the arrival of the cold air mass. When the cold air mass does penetrate the station, the surface winds will shift rapidly to the northwest and increase in speed by 15 to 25 knots. When the lee trough follows a cold front, the front retains its moisture and it is frequently accompanied by low cloudiness and precipitation.

B. Cyclone and Anticyclone Tracks. Figures 9 and 16 illustrate, by season, the probable formation areas and primary tracks of cyclones and anticyclones.

C. Predominant Synoptic Patterns by Season and Types. Several types of weather situations that occur with sufficient frequency to be characteristic of the weather at Kingsville and have forecasting value are presented. Whereas only the main types of synoptic situations are presented here, it should be noted that there are many variations of these patterns. As an example, the severity of the terminal weather associated with wave cyclones depends upon the location of the wave center relative to the local area.

1. Winter (December through February)

a. The Polar High

(1) Identifying features. This is a Continental or Maritime air mass, which moves southeastward or southward from Canada, the U.S. Pacific Northwest or the U.S. Rocky Mountains. In addition, this air mass ridges into Texas from the northeast on its east or southeast track toward the U.S. East Coast. It rarely pushes into South Texas before October or after April, but is frequent during the winter and early spring months. It undergoes rapid modification in this area. When this air mass pushes out over the Gulf of Mexico the

return flow of modified cP and mT air almost always produces low stratus clouds over South Texas.

(a) The terminal weather experienced at Kingsville depends largely on the location of the high center or ridge following frontal passage.

(b) Equally important is the flow pattern at 500 MBS and the location of long and short waves.

(c) Figure 17 depicts four zones from which polar highs move or ridge into South Texas and together with the 500 MB pattern determine the weather in this area.

(2) Weather at Kingsville

(a) Zone I

1. 500 MB trough 12 hours behind surface front. Low cloudiness will persist but ceilings will rise slowly until passage of the upper trough at which time rapid clearing occurs. Skies will then be clear or there will be variable scattered to thin broken cirrus depending on moisture content of the upper atmosphere and the location of the jet stream isotach maximum.

2. Northwest flow aloft. Mostly clear skies with a few 25-30 sct during the day on some occasions.

(b) Zone II

1. 500 MB trough remaining west of local area. If the upper flow is southwest at 50 knots or more, expect 5-10 OVC and 4 to 7 miles in haze with occasional 1 to 3 miles in light rain, drizzle and fog for at least 24 hours following the frontal passage then gradual clearing. If the upper airflow is less than 50 knots, expect 15-20 OVC and 4 to 7 miles with occasional light rain. If the high center is in Texas, expect 40-60 OVC with occasional light rain.

2. 500 MB flow from the northwest. Expect clear skies as a general rule, but variable high cloudiness depending on moisture aloft and the jet maximum position. Also expect occasional ground fog after midnight if the surface winds are less than 5 knots. Conditions will range from -x 1/4GF to CLR 2-3GF near sunrise.

(c) Zone III

1. 500 MB trough moving through area

shortly after frontal passage. With the upper flow becoming northwesterly, expect 30 SCT V BKN 60-80 BKN 250 BKN with middle and high cloudiness slowly dissipating by the time the high reaches the East Coast.

2. 500 MB trough remaining west of area with southwest flow aloft over Kingsville. If the high is weak (less than 1020 MBS) skies will gradually become 80-100 BKN V OVC. If the high is moderate (1020-1030 MBS) skies will gradually become 15-20 OVC and 4 to 6 miles in light rain and drizzle. Lowering at night to 8-12 OVC and 1 to 3 miles in moderate rain and fog. If the high is strong (greater than 1030 MBS) then expect 5-8 OVC and 3 to 5 miles in light rain and fog during the day lowering at night to 3-5 OVC and 1 to 3 miles in rain and fog.

3. If the 500 MB low is located in Texas in association with an upper trough, expect moderate thunderstorms with the passage of the upper trough. No clearing will occur until at least 12 hours following the passage of the upper trough.

(d) Zone IV (greatly modified air mass) Associated with Northwest flow aloft. Expect Clear skies with south to southwest winds 8 to 15 knots during the day and south 4 to 8 knots at night. Some brief ground fog may occur near sunrise. The diurnal temperature range will be at least 30 degrees F and may be as high as 40 degrees F.

b. The Subtropical High Pressure Ridge

(1) Identifying features. This is a maritime tropical air mass, which ridges into South Texas only during early or late winter accompanying frontal passage or frontal surface moving into the local area. When the ridge does penetrate this area a front is usually stationary well to the West and northwest. Generally this high is reflected at 500 MBS as a closed circulation in the southern Gulf resulting in a southwest to westerly zonal flow over South Texas.

(2) Weather at Kingsville

(a) Early Winter. During the day expect 15-20 BKN with variable high clouds becoming 35 SCT by mid-afternoon and clear by early evening. After midnight expect dense fog, W0X0F improving to 3 OVC and 1 mile in fog by 0800 and 10 BKN and 5 miles in haze by 0900. Surface winds will be south to southeast 10 to 20 knots during the day becoming 8 to 15 knots or lighter at night.

(b) Late Winter. Same as early winter except

conditions during the night are reduced to only 5-8 OVC and 3 miles in fog.

(c) Over-running of polar air by this air mass is a common occurrence. This situation almost always results in stratus clouds with accompanying low ceilings and visibilities.

c. The Arctic High. The invasion of South Texas by this air mass is not frequent, and is normally confined to the months of January and February.

Although it has been modified considerably by the time it reaches South Texas, the accompanying low temperatures are disastrous to most vegetation. In addition, few dwellings or buildings in the area are properly insulated against the cold. This air mass is usually shallow and produces some of the worst flying weather in the form of low ceilings and freezing rain. Snow has occurred at times but is very infrequent.

d. Fronts

(1) Cold Front Approaching Kingsville from the Northwest (see Figure 18).

(a) Identifying features. This is generally a steadily moving frontal system with a steep slope that gives little or no weather. Aloft, a moderate to strong low index exists with the 500 MB trough a short distance behind the cold front. A long wave ridge is frequently present between the West Coast and the Rockies, while conditions east of the trough lean toward higher index. At the surface a high is generally over the 4 Corners area moving southeast. South Texas is under the influence of a flat ridge extension of the Bermuda High. The strength of the post frontal winds aloft will provide tip-offs on the likelihood of this front slowing or stalling or deteriorating to another type.

(b) Weather at Kingsville. With the long wave situation, conditions in advance of the front are similar to the northwest cold front but lower at the frontal surface with 4-7 OVC and 2-4 miles in rain and fog. Winds back from the southeast ahead of the front to the north or northeast (depending on the location of the surface high) with frontal passage. Within two hours ceilings lower to 3-5 OVC and are multi-layered to above 20,000 feet with visibilities 1-3 miles in rain and fog. This condition will persist until the front has passed 25 N 95 W or the upper wind flow shifts to a northwest direction. With the short wave situation, general flow aloft is westerly; ahead of the front conditions will be

15-25 SCT V BKN, 50-80 BKN and 250 BKN with occasional light rain. As the front passes ceilings lower briefly to 800 feet then becomes 25-40 BKN V OVC with a middle overcast and visibilities 7 miles in occasional light rain. Occasionally the flow aloft over the front is northwest in which case low ceilings are brief and become 3000 feet within 4 hours after frontal passage and clear within 8 hours.

(3) Northwest Cold Front followed by a "Norther" (see figure 20)

(a) Identifying features. A 500-MB trough usually lies over the Rockies or just to the east with the South Texas flow from the southwest.

The main surface high is usually centered in Montana or Canada north of the Dakotas.

(b) Weather at Kingsville. With the northwest frontal passage, ceilings lower to 5 OVC and 1-3 miles in light rain or fog but lift within a few hours to 20 OVC and 7 miles visibility with occasional light rain. If the second front remains to the north, conditions will improve in 24 hours to 40-60 BKN V OVC, 120 BKN and 250 BKN with 7 miles visibility and occasional light rain. When the winds aloft become northwest rapid clearing occurs as it does when the second front continues south and passes Kingsville.

(4) Quasi-Stationary Front (see figure 21)

(a) Identifying features. South Texas is a favored location for the polar front to become stationary, as the invading air mass attempts to move against a strong flow of maritime tropical air from the south or southeast. Gusty northerly surface winds must continue for 18 to 24 hours following the passage of a sharp cold front at Kingsville to insure continued southward movement out of Texas. Diminishing winds in less time usually indicate wave formation or the front becoming stationary along the warm coastal waters. The quasi-stationary front is one of the most important synoptic features of the weather in South Texas.

(b) Weather at Kingsville. Flying activity may be hindered for periods as long as a week because of low stratus ceilings and low visibilities, while thunderstorms and showers persist intermittently. A great variability of intensity, frequency, and persistency of these fronts is experienced from year to year. Surface winds are light to moderate and vary from the southeast to northeast with

oscillations of the front. As a general rule, when the front is north of Kingsville, terminal weather will consist of 20 SCT V BKN during the day lowering in the evening to 15 OVC and 2-3 miles visibility in fog, after midnight becoming 5-8 OVC and 2 to 3 miles in fog with occasional drizzle. By sunrise conditions deteriorate to W0X0F although some days will find this dense fog moving in from the Gulf of Mexico during the early evening hours and persisting all night. By mid morning fog lifts and conditions become 15 BKN and 6 miles in haze and the cycle is repeated until the front dissipates. When the front is south of Kingsville terminal weather conditions usually are 8-10 SCT V BKN with multiple broken to overcast layers to above 20,000 feet. Visibility ranges from 4 to 7 miles in occasional light to very light rainshowers. Thunderstorms occur in conjunction with an upper short wave in the South Texas area.

(5) Wave Formation

(a) Identifying features. When any significant frontal discontinuity lies in South Texas, and a 500-MB trough moves into Arizona, wave formation usually occurs on the front in South Texas within 12 hours. When the front is in the Gulf of Mexico, the wave develops in the vicinity of the intersection of the front and the Texas or Mexican coast. At the surface a moderate to strong high usually is in the Kentucky/Tennessee area. Early indications of frontal wave formation include the 500-MB trough over Arizona with a constant or lowering ceiling in the local area. The wind will be strong northeasterly or northerly with continued or increased precipitation. Galveston's winds will be east to southeast while the winds at Brownsville will be from the west or northwest.

(b) Weather at Kingsville. When a wave develops, ceilings and visibilities remain low during the day and further decrease at night. Approximately 36 hours with continuous light to moderate rain, drizzle and fog can be expected. Ceilings range from 5-10 BKN V OVC during the day to 3-5 OVC at night. Visibility ranges from 2-5 miles during the day to 1-3 miles at night. With a deep trough or low over west Texas and a strong southerly flow above the frontal surface, high-level thunderstorms and short duration heavy showers result. As the wave moves off to the east or northeast ceilings lift to 10-15 BKN 25 OVC and visibility 4 to 6 miles with occasional light rain. Gradual clearing will occur as the wave passes 90 W.

(6) Warm Fronts. Typical warm frontal weather conditions are generally confined to the winter season, although there have been occurrences in the spring and fall. Winter warm fronts move northward through this area at a speed of 8 to 13 knots. Indications of a returning warm front are lowering ceilings and visibility with increasing dew point. Surface winds will veer to the east and southeast while there is a strong southerly flow above the frontal surface.

Spring (MARCH AND APRIL)

a. The Polar High

(1) Identifying features. This air mass is so modified and so shallow that the location of the center or direction from which it ridges has very little influence on the South Texas weather. Generally the controlling features are the flow aloft, including position of troughs and ridges, the vorticity pattern, moisture and jet stream position.

(2) Weather at Kingsville. Regardless of the surface high location skies will be mostly clear whenever the upper trough has passed east of Kingsville and there is no other trough between Kingsville and western Arizona. With light winds, morning ground fog will reduce visibility to 2 to 4 miles occasionally as low as 1/2 mile in a partial obscuration. If an upper trough lies between Kingsville and Arizona, expect variable middle and high cloudiness at 10,000 feet and above. When the trough is in central Texas expect variable low, middle and high clouds in various combinations sometimes scattered or broken and sometimes overcast with brief light rain.

b. The Subtropical High Pressure Ridge

(1) Identifying features. This is the predominant air mass over the local area in the spring and enters South Texas from the south and southeast, as a result of the circulation around the Bermuda High. Upper air conditions are varied and play an important role in the local weather, especially as regards to high cloudiness.

(2) Weather at Kingsville. Dividing the day into four periods the terminal weather closely follows the below pattern. Night- Dense fog ranging from W2X to W5X and 1/2 to 3 miles visibility. Forenoon- 6-10 OVC with visibility 4 to 6 miles in haze. Afternoon- 15-20 OVC and 7 miles visibility with clouds sometimes becoming scattered in late afternoon. Evening- Return of low stratus, 5-8 OVC and visibility 3 to 5 miles in haze. Afternoon thunderstorms are possible whenever stability and vorticity conditions are

favorable. This is true more so in April than in March.

c. Fronts

(1) Northwest Cold Front Preceded by a Squall Line.

(a) Identifying features. This maritime polar front in the spring is frequently preceded by a squall line which produces the most violent weather in South Texas other than tornadoes and tropical cyclones. The surface high is usually over the southern Rockies or the Great Basin with a short wave and closed low aloft between southern California and New Mexico. The upper level flow over Kingsville is southwest to west-southwest.

(b) Weather at Kingsville. In advance of the squall line, increasing middle and high clouds begin to form by the time the line moves in to Texas. Surface winds increase slowly from the southeast and ceilings gradually lower to 10-20 BKN V OVC with occasional light rainshowers.

As the squall line approaches and passes, violent thunderstorm activity can be expected with surface wind gusts to 40 knots or higher, tornadoes, funnel clouds, occasional hail, and very heavy rain. Surface winds shift to westerly and become light as a small high frequently forms between the squall line and the cold front. Clouds gradually clear with the approach of the cold front and its passage is noted only by a wind shift to the northwest or north.

(2) Series of Northwest Cold Fronts (no Squall line)

(a) Identifying features. These maritime polar fronts are usually associated with a series of short wave troughs, which move them through the South Texas area. Weak surface highs are associated with the fronts moved by the short waves while a long wave trough and a large high in the Pacific Northwest are associated with the last front in the series.

(b) Weather at Kingsville. When the first front in the series enters west Texas, expect 25-50 BKN V OVC with early morning shower activity moving in from the Gulf reducing visibilities to 4 to 6 miles. Afternoon conditions will usually see only scattered clouds. As the front approaches, ceilings become 20 OVC and then 10 OVC and visibility 5 to 7 miles in light rain with the frontal passage. Surface winds shift from the south to the north. It usually takes about 18 hours for a front to traverse the State. With the frontal passage, skies will remain overcast if another

short wave associated cold front is moving into West Texas, there will then be a repeat of the weather pattern. If only the final front remains it usually will be located from Wyoming southwestward to California and conditions following the frontal passage of the short wave associated front will become 250 SCT V BKN as the main front approaches West Texas. As the front moves well into Texas, Kingsville ceilings lower to 15-20 BKN during the day, 5-8 OVC with visibility 5 miles in haze during the evening and 1-3 OVC and visibility 1/2 to 2 miles in fog at night. Very little weather is associated with the frontal passage and only brief light rainshowers occur. Normally the long wave trough is well behind the surface front; therefore skies remain 25-40 OVC for 24 hours or more following the frontal passage. It usually takes about 36 hours for the final front to traverse the state. Some occasions will see these cold fronts moving through under a northwest flow aloft, in which case only scattered to broken high cloudiness can be expected with a shift in surface winds denoting frontal passage.

(3) Cold Front Approaching Kingsville from the North (Norther).

(a) Identifying features. Same as in winter, except a slower moving system.

(b) Weather at Kingsville. By the time the front reaches central Texas, expect 35 BKN V OVC with broken to overcast middle and high clouds. Eight hours prior to frontal passage, conditions lower to 20 OVC with visibility 4 to 6 miles in light rainshowers. At the frontal surface, expect 8 OVC and visibility 1/2 to 2 miles in showers and thunderstorms and the winds shifting from the southeast to the north. Rainshowers usually continue in the area for 3 to 4 hours. Ceilings remain 10-20 BKN 50 OVC and visibility 2 to 5 miles in fog and haze for at least 24 hours after frontal passage.

(4) Quasi-Stationary Fronts

(a) Identifying features. During the spring, fronts moving into South Texas frequently become quasi-stationary when the upper level flow is parallel to the surface front. A quasi-stationary 500-MB trough is located over the Arizona/New Mexico area.

(b) Weather at Kingsville. When the front becomes stationary to the north of the local area, expect daytime ceilings ranging from 300 feet to 1000 feet and visibilities 1/2 to 2 miles in fog with temporary periods of

afternoon thunderstorms. Night conditions will usually find the station below minimums in rain and fog. When the front is stationary to the south of the local area, expect morning drizzle and fog below minimum conditions improving to 400 to 1,000 foot broken variable overcast and visibility 2 to 4 miles in fog by mid morning and 20 BKN 50 BKN 100 BKN and 7 miles visibility in the afternoon. During late evening expect nocturnal showers and thunderstorms to produce IFR conditions prior to the fog returning again during the early morning hours.

3. Summer (May through September)

a. The Polar High

(1) Identifying features. This air mass rarely pushes into South Texas during this period, however, early May or late September may see a highly modified air mass of this origin manage to struggle into the local area as a ridge or weak high center. Upper airflow is normally from the northwest, however, northeasterly flow is possible, especially in May.

(2) Weather at Kingsville

(a) Early May. With northwest flow aloft, regardless of the zone from which the high is ridging, expect scattered to broken high clouds, which occasionally break and produce clear skies.

With northeast flow aloft, expect the diurnal cumulus cycle during the day with scattered showers and thunderstorms in the vicinity of the Station between 1100 and 1300 CST. After midnight, stratus will move over the Station at 400 to 1200 feet depending on the strength of the low level flow. Visibility will lower to 1/2 to 2 miles in ground fog after 0400 CST, but lift rapidly after 0800 CST.

(b) Late September. Upper airflow is usually disorganized and light. Regardless of the zone from which the high ridges, expect 30-40 OVC following a frontal passage for 12 hours then become 60-80 BKN during the next 6 hours and clear to 250 SCT V BKN at the end of 24 hours following the frontal passage. After the second day under this air mass, expect scattered daytime cumulus at 35-40 with occasional scattered middle and high clouds.

b. The Subtropical High Pressure Ridge

(1) Identifying features. During the summer this maritime tropical air mass dominates the weather over Texas almost entirely. Many variations and combinations of

associated upper level flow are experienced. In the typical weather patterns which are presented in the following paragraphs only the low clouds will be treated in detail since the complexity of middle and high cloudiness is beyond the scope of this publication. (Jet Stream, upper troughs, vorticity, etc.)

(2) Weather at Kingsville

(a) No Fronts in Texas

1. Westerly component flow aloft. When vorticity is increasing or shows no change downstream expect the normal cumulus cycle, 10-20 SCT V BKN becoming 20-30 BKN V SCT by early afternoon and SCT to CLR by late afternoon. If surface winds are light at night expect 4 to 6 miles in ground fog near sunrise. When vorticity is decreasing downstream, expect slightly more cloudiness with scattered nocturnal thunderstorms. If positive vorticity center or upper level trough is in South Texas, expect more frequent shower and thunderstorm activity.

2. Easterly component flow aloft. When vorticity increases or shows no change downstream, expect 10-20 BKN during the forenoon becoming 25-30 SCT in the afternoon and clear during the evening. With light surface winds, expect 1 to 2 miles in fog near sunrise. When vorticity decreases downstream, expect 20-25 BKN most of the day and evening becoming occasionally SCT at night. When a positive vorticity center is over South Texas or the western Gulf of Mexico, expect considerable cloudiness at various levels from 1,000 to 10,000 feet with showers from sunrise through the forenoon and scattered thunderstorms around noon or early afternoon. Expect some partial clearing during the late afternoon and early evening then a repeat of the cycle.

(b) Front between Central and North Texas

1. Westerly component flow aloft. When vorticity increases or shows no change downstream, expect early morning cloudiness, 8-15 SCT V BKN during the forenoon, and 30 SCT by late afternoon. When vorticity decreases downstream, expect slightly more cloudiness with a few rainshowers in the vicinity during the afternoon hours. Skies will become 10-15 BKN 25 OVC with visibility 2 to 4 miles in thunderstorms a few hours either side of sunrise and remaining cloudy all day and evening with multiple cloud layers.

2. Easterly component flow aloft. When vorticity increases or shows no change downstream, expect 8-15 SCT V BKN with visibility 1/2 to 2 miles in fog near sunrise if winds are light, becoming 15-25 SCT and 7 miles by 0800, and

clear by early evening. When vorticity decreases downstream, expect 10-15 BKN V OVC during the morning and forenoon, becoming 25-30 BKN by early afternoon, SCT by mid afternoon, and CLR by late afternoon. Mid evening low clouds again form around 10-15 BKN and become variable OVC after midnight with visibility 3 to 5 miles in ground fog near sunrise. When a positive vorticity center is in the local area, expect 8-15 BKN 30 OVC and visibility 2 to 4 miles in rainshowers near sunrise becoming 15-30 BKN for the remainder of the day, except for temporary periods of 8 BKN and 2 miles in rainshowers and or thunderstorms. As a general rule under this latter situation rainshowers and thunderstorms can occur anytime during the day or night but rainshowers are common from midnight to noon and thunderstorms are common from noon to midnight.

(c) Front between Kingsville and central Texas. When a front reaches this position it is normally under a westerly component flow aloft and is very weak. When vorticity increases downstream, expect the normal cumulus cycle. When vorticity decreases downstream or a positive vorticity center is in the local area, expect 8-12 OVC with showers near sunrise becoming 30-50 SCT V BKN during the day, and clear during the evening. Considerable cloudiness and thunderstorm activity can be expected with the passage of a short wave trough aloft associated with the surface front.

c. The Thermal Low

(1) Identifying features. This semi-permanent thermal low-pressure center, often referred to as the Mexican Heat Low, is normally positioned over the mountainous region of northwest Mexico and extends into southern California.

(2) Weather at Kingsville. In its normal position, the Mexican Heat Low has very little influence on the local weather, however, when the Bermuda High ridges strongly into the Gulf of Mexico, the pressure gradient becomes steeper producing moderate to strong south to southeasterly winds. On a few occasions during the summer, the heat low will drift eastward from its normal position and Kingsville will come under its cyclonic influence. When this happens, local surface winds shift to the southwest and abnormally high temperatures result.

d. Easterly Waves

(1) Identifying features. Weather from these disturbances may affect the South Texas region any time from June through October, but the maximum occurrence is in August and September. Determining how quickly these waves will dissipate, once they have moved inland, presents a difficult

forecasting problem. Most easterly waves average 5 degrees longitude per 24 hours movement. Deceleration indicates development while acceleration indicates weakening. Local weather associated with an easterly wave depends primarily upon the time of day and whether the wave is approaching a convergent or divergent low level flow in the coastal area. Easterly waves can be expected to pass the station at the rate of two or three per month, however wide variances have been noted in this from year to year.

(2) Weather at Kingsville

(a) Wave approaching an area of divergent flow (see the Lee Trough of the Rockies), places the western Gulf of Mexico and South Texas in a region of low level divergence over 80% of the time during the season of easterly waves.

1. Wave reaching the coast in the afternoon. In this case, waves are generally weak and ill defined over water but generate numerous showers and thunderstorms inland up to 25 miles (Kingsville area). Preceded by broken to overcast middle and high clouds, conditions generally remain VFR but are temporarily reduced in heavier showers and thunderstorms to 8-12 BKN V OVC and visibility 1 to 3 miles. The showers and thundershowers usually dissipate after sunset.

2. Wave reaching the coast after dark. These waves are usually retarded and remain offshore, becoming most active after sunrise. The wave then passes over the local area during the forenoon with IFR conditions in thunderstorms for about three hours. The thunderstorms weaken as they move inland, then regenerate to the west of Kingsville after 1300 CST.

3. Wave reaching the coast during the morning weather tends to dissipate as the wave moves inland with only light showers in the vicinity of Kingsville, however, regeneration occurs and thunderstorms develop to the west of the local area in the afternoon.

4. Those waves which reach the coast during the night or forenoon and pass inland are usually followed by another line of instability which develops offshore on the second morning. These secondary lines of instability pass the station between 0800 and 1100 with brief periods of IFR in heavy showers and thunderstorms. Subsequent mornings will see continued but gradually weakened instability conditions.

(b) Wave approaching an area of convergence (see figure 26). This situation usually occurs in September when a trough in the westerlies, with or without an associated surface front, merges with an easterly wave from the Gulf of Mexico. The easterly wave intensifies as it moves toward the coast and the weather between the trough and the wave deteriorates rapidly. Showers occur frequently and ceilings remain 1,000 to 1,500 feet with visibilities 3 to 5 miles for 4 to 6 hours as far as 150 miles in advance of the wave. The most severe weather is experienced after the wave axis passes. Thunderstorms are frequent and unusually heavy rains cause flooding of low-lying areas, tornadoes are present, surface wind gusts of 35-40 knots occur in squalls. While aloft, extreme turbulence exists with heavy icing and medium to large hail above 13,000 feet. The weather improves to intermittent IFR conditions about 8 to 12 hours after passage of the wave with general clearing in 24 to 36 hours.

e. Tropical Storms and Hurricanes

(1) Discussion. Much has been written about the formation, development, and movement of tropical storms and hurricanes. During World War II, and since, a large amount of upper air and surface data has been collected in and around tropical storms, hurricanes and typhoons. These collections are still being analyzed. With the advent of weather satellites and the operation of the National Hurricane Research Project, more and more timely information is being made available to the meteorologist for use in detecting and forecasting these storms and to the researcher for his investigations into their origin and development. Because they are well covered in other texts, which apply equally as well for the Kingsville area as for other areas, no attempt will be made to set forth forecast rules and techniques for these storms. Instead, material of a climatological nature, based on years 1901 through 1963, concerning areas of origin, formation and mean tracks is provided as an aid to forecasters who have had little or no experience with this type phenomena.

(2) Weather at Kingsville. The weather relationship to storm centers of major hurricanes, which affect the Kingsville area. Scalloped area indicates the overcast area with bases 10,000 feet and tops in excess of 30,000 feet. The hatched area includes the area of heavy squalls and low ceilings. Generally, IFR conditions may develop very rapidly when the storm moves to within 300 miles of the local area. The few miles of tidal protection afforded Kingsville must not be allowed to minimize the many precautions required to be prepared for such storms. Wind and flood damage to Texas

cities, both on the beach and up to 200 miles inland, by Hurricane Carla in September 1960, Hurricane Beulah in September 1967 and Hurricane Celia in August 1970 amounted to many hundreds of millions of dollars (454 million in Celia).

The weather that can be experienced at this station as the result of a passing hurricane depends not only upon the size and intensity of the storm, but more acutely upon the relative position of the eye when it passes the station. As long as the eye remains north of the 090-degree radial from the station, a mild passage can be expected. Storms that form in the Gulf nearly always form along the axis of an easterly wave and have been shown to retain a major portion of the weather characteristics of the easterly wave in which they were originally spawned. Therefore, the axis of the easterly wave, which may become a band of spiral clouds, brings the most intense weather into the area. Storms that pass to the east or northeast at a distance greater than 100 to 150 miles do not normally create any severe weather. Generally a low-pressure trough will develop near the local area joining the storm and the Mexican Thermal Low to the west.

(3) Tracks. Prevailing tracks and areas of storm genesis or intensification of tropical storms and hurricanes in the North Atlantic Ocean for the months of June through November (the Hurricane season). It may be noted that, only June, July and August do these tracks approach close enough to really affect the Kingsville area. This is not to imply that these are the only months during which a tropical storm or hurricane will affect the Kingsville area as the worst hurricanes have hit Kingsville during the month of September, such as Hurricane Gilbert in 1988.

IV. SPECIALIZED RULES

A. Subjective Rules

1. Temperatures

a. One reliable method of forecasting maximum and minimum temperatures when no air mass change is expected is the trend method. First determine the trend from the previous days observations then apply the trend for a first approximation. For a final figure consider the expected change as a result of cloud coverage or moisture content as compared to the previous day and any expected changes due to advection.

b. Another method is to use the 850mb (or top of the subsidence inversion on the morning skew-T) temp, advect the temp adiabaticly from the surface, dry adiabaticly if forecasting CLR or SCT, moist adiabaticly if forecasting BKN to OVC conditions.

c. When a frontal is expected during the forecast period a reliable method for determining the minimum temperature is to prog the 850-MB isotherms by using 50% of the effective wind. The minimum surface temperature on the first morning after a cold frontal passage will approximate the 850-MB temperature over the station.

d. Another means of determining the minimum temperature for the first morning after a cold frontal passage and for the succeeding mornings after a moderate to severe "norther" is to go upwind for 24 hours using the surface winds and adding seven degrees to the minimum temperature recorded at or near that point.

e. Whenever the water temperature offshore is 65 degrees or higher and wind flow during the night is from the east through the southeast, the minimum temperature will be within a few degrees of the water temperature.

f. Extreme low temperatures are produced whenever a very cold air mass plunges into the Gulf with rapid post-frontal clearing. Usually wind direction and velocity or sky cover prevent below freezing temperatures on the first night following the frontal passage. On the second night, if skies are clear and surface winds are light from the north or are moderately northwesterly, forecast below freezing temperatures.

g. Forecast above normal maximum temperatures only when Kingsville comes under the influence of the thermal low and the low-level wind is offshore.

2. Clouds

a. Cirrus

(1) The area to the left front and right rear of jet stream maxima are favorable for cirrus formation. The areas, looking downstream, to the right front and left rear of the maxima are unfavorable for cirrus formation.

(2) Areas of mass convergence aloft are favorable for cirrus formation. The most extensive cirrus will be found when the two factors are working together. Occasionally an extensive cirrus overcast may be found in the area to the left front of a jet maxima under anticyclonic flow. (This being the case of the favorable factor being stronger than the unfavorable factor)

b. Stratus

(1) During the winter and spring months when a migratory high pressure center passes north of San Antonio, crosses the Mississippi River on the 0000z surface chart, forecast stratus to form the following night.

(2) During February, March and April when sea surface temperatures are less than 68 degrees, low stratus (600 to 1,200 feet) may be expected whenever the surface wind direction is east through south.

(3) During the winter months, in the first night of return flow from over the Gulf in both maritime and continental polar highs, the stratus layer is generally lower and thicker than in the late spring, and dissipation will also be much later.

(4) During the spring and summer, ideal conditions for nocturnal stratus formation are:

(a) Deep southeast flow veering with height.
(b) Increasing velocity from surface to 3,000 feet.
(c) Noon dewpoint of 60 degrees F or higher.
(d) Convergence at 700 MBS.
(e) Spread of no more than 20 degrees F at time of maximum temperature.

(5) During the summer months, significant pressure rises of a magnitude of 3 to 5 millibars in 12 hours after an easterly wave passage will normally indicate formation of nocturnal stratus.

(6) During the summer months, stratus will form near 0800 CST when a shallow, moist flow from the Gulf veers to light west or northwest at 10,000 feet. Skies must have been clear the night before with a 4 degree or less spread at sunrise. Stratus will form below the level of maximum wind discontinuity (either direction or velocity shear).

(7) In summer, from 24 to 48 hours prior to the passage of a significant easterly wave over South Texas, the weather is usually characterized by extensive subsidence and a minimum of nocturnal stratus and daytime cumulus.

(8) In the spring, ceilings below 1,000 feet should be forecast to occur by dark along the coast (1 hour later at Kingsville) if dew points are around 70 degrees F in the afternoon. It will usually break to scattered near midnight, but possibly come in lower again by daybreak.

3. Fog

a. During periods of flood tide when water temperatures are 62 degrees F or lower and air trajectory ranges from northeast to southeast, advection fog may be expected unless wind speed exceeds 12 knots. It is most likely to occur when the dew point is above 56 degrees F.

b. During the winter and spring months when a migratory high center, which passed to the South of San Antonio, crosses the Mississippi River on the 0000z surface chart, forecast fog to form on the following night.

c. Do not expect fog to form when the local pressure is lower than Brownsville pressure.

d. When the 1200 CST dew points in the winter along the coast are 70 degrees F or higher and there has been a light on-shore flow for 24 to 48 hours, sea fog conditions are indicated and sea fog will move into Corpus Christi by 1700 CST, with ceilings lowering rapidly to near zero at Kingsville by 2000 CST regardless of strength of the gradient wind on the first night. The second night, the ceiling will be near 300 feet. Once the sea fog situation has developed, disregard gradient wind except for forecasting rate of onshore movement around sunset.

e. Forecast fog the night before a cold frontal passage, which is expected during the day.

f. In winter, forecast fog the first night after

surface winds veer from the northeast quadrant to the southeast quadrant and prevail at a moderate speed for most of the day (surface winds must be expected to become light at night).

4. Fronts

a. With the 5880-meter contour at 500 MBS in the mid-Gulf, fronts tend to stagnate near San Antonio with southernmost penetration to near Victoria.

b. Whenever the 3139 to 3170 meter 700 MB ridge is over Mexico and South Texas, cold fronts will not pass the station.

c. With the 700-MB trough line ahead of the surface front, only slight cloudiness and no precipitation accompany the frontal passage. However, winds will shift to the north prior to actual cold frontal passage and squall lines may develop below the 700-MB trough.

d. Clearing following a cold frontal passage may be forecast as follows providing the front does not become stationary:

(1) If the front is moving less than 10 knots, add 12 hours to the time San Antonio becomes scattered and/or 3 hours to the time Victoria becomes scattered.

(2) If the front is moving at a speed of 10 to 20 knots, add 6 hours to the time San Antonio becomes scattered and/or 11/2 hours to the time Victoria becomes scattered.

(3) If the front is moving in excess of 20 knots, scattered sky conditions will occur 2 to 3 hours after the ceiling reaches 4,000 feet provided upper winds show the 4,000 foot frontal surface not more than 75 miles behind the surface front.

e. In winter and spring, when any significant frontal discontinuity lies in South Texas, and a 500-MB trough reaches the California/Arizona border, forecast a wave to form on the front in South Texas within 12 hours. If the front lies in the Gulf of Mexico, the wave will develop in the vicinity of the intersection of the front with the Texas or Mexican coast.

f. Rapidly moving cold fronts with east-west orientation will tend to stagnate along the coast if winds at 700 MBS and 500 MBS are southwest to west-southwest over the station.

g. After a cold frontal passage, backing winds are indicative of wave formation close offshore and subsequent deterioration of the local weather.

h. After a cold frontal passage, a mid-two or mid-seven cloud deck moving in from the Gulf is an excellent indication of an offshore wave formation and subsequent deterioration of the local weather.

i. In the winter and spring, with an Arctic front quasi-stationary anywhere from North Texas to Nebraska, large rises at 500 MBS developing in the vicinity of Montana northward into Canada indicate rapid southward movement will soon begin with the front continuing to move rapidly into the Gulf of Mexico.

j. If the 200 MB temperature at Salt Lake City (SLC) is -60 degrees C or colder, fronts passing through South Central Texas will continue south-eastward without wave formation. If the 200-MB temperature is warmer than -60 degrees C, fronts passing through the San Antonio area will have a tendency to slow down and form waves over South Texas.

k. When an active wave is off the Texas coast and large pressure falls develop in southern Louisiana, with gusty easterly surface winds at Galveston and Beaumont, forecast rapid northeast movement of the wave with possible thunderstorms in southeast Texas, and rapid clearing (within 12 to 24 hours) moving into South Texas from the west.

l. Winter warm fronts average 8-13 knots northward movement through South Texas.

m. The passage of an active low center through North Texas or Oklahoma is a prerequisite for a polar outbreak into South Texas.

n. Gusty northerly winds should continue for 18 to 24 hours following the passage of a sharp cold front at Kingsville to insure continued southward movement of the cold front out of the local operating area. Diminishing winds in less time usually indicates wave formation or the front becoming stationary along the warm coastal waters.

5. Surface wind

a. The prevailing wind direction is between east and south turning briefly to the east-northeast ahead of easterly waves and shifting to between northwest and northeast

with a cold frontal passage.

b. When the winds are in phase from the surface to 5000 feet, the average afternoon speeds will be 60% of the 1000-foot winds as indicated on the morning sounding. The high hour will be 80% of the same 1000-foot winds. The maximum gust will approximate the 1000-foot winds.

c. The wind direction will back 20 to 30 degrees with the onset of the afternoon seabreeze, which penetrates the local area near 1300 CST.

d. Night winds, with no change in pressure gradient, will be 60% of the afternoon average.

e. Of the winds between 2000 CST and 0800 CST, 86% are less than 12 knots. Of the winds between 0800 CST and 2000 CST, 92% are less than 20 knots.

f. When the pressure differential between Kingsville and New Orleans is seven millibars, south to southeast winds of 20 knots with gusts to 30 knots can be expected during the day and evening, decreasing after 2200 CST.

g. Wind speeds during frontal passage may be obtained by averaging the winds observed at San Antonio and Victoria with frontal passage when sea temperatures are below 60 degrees F. When sea temperatures are greater than 60 degrees F, add 5 knots to this average.

h. With the 700-MB trough line ahead of a surface cold front, winds will shift to the north prior to actual frontal passage.

i. Forecast super-gradient winds from the southeast quadrant when a low-pressure system exists in the panhandle region.

6. Precipitation

a. Drizzle should be expected when strong southerly winds aloft (2000 to 10,000 feet) are prevalent with a stratus overcast. Horizontal convergence of winds enhances the possibility of drizzle, and the first return of tropical air (dew point 63 degrees F) mixing with polar air, and warm front effects, also add to the probability of drizzle.

b. Freezing rain is a rare occurrence in the local area, but it should be forecast when rain is expected to fall through a stratum of subfreezing temperatures that is over

3000 feet thick.

c. When precipitation is expected and the 850-MB temperature is below 0 degrees C, snow can also be expected.

d. Heavy, steady rainfall (over 2 inches in 24 hours) is associated with either an easterly wave entering a convergent region in the western Gulf or the close passage of a slow moving tropical disturbance.

e. Showers and thunderstorms can be forecast between 0800 CST and 1600 CST when the 24 hour 700 MB and 500 MB height rises exceed 60 meters with no appreciable change in the advection pattern.

f. When the stability index is plus 2 or plus 3, forecast scattered showers with only a slight chance of thunderstorms, if lifting is expected. Use the average of Brownsville and Victoria to obtain stability index.

7. Severe Weather

a. Severe thunderstorms are infrequent in the immediate area (average about one every two or three years with hail and gusts over 40 knots), however, the frequency increases rapidly 30 miles to the northeast.

b. Tornadoes and funnel clouds are always observed under conditions of extreme instability and are usually associated with an instability line. Ideal conditions for tornado development are:

(1) A layer of moist air near the earth’s surface with a deep layer of dry air above.

(2) The horizontal moisture distribution within the moist layer must exhibit a distinct maximum along a narrow band.

(3) The horizontal distribution of winds aloft must show a maximum along a narrow band at some level between 10,000 and 20,000 feet with a maximum speed in excess of 35 knots.

(4) Vertical projection of the axis of maximum wind must intersect the axis of the moisture wedge.

(5) The air must be conditionally unstable.

(6) The moist layer must be subjected to

appreciable lifting.

(7) All the above conditions must occur simultaneously.

c. When the average Victoria/Brownsville stability index is plus one, zero, or minus one, expect scattered thunderstorms. When the stability index is minus two to minus five, expect numerous thunderstorms, some approaching severe limits. When the stability index is minus six or lower, expect severe thunderstorms and tornadoes.

d. For hail to fall to the ground the wet bulb freezing level must be at about 8,000 feet. If it is below 5,000 feet, hail may occur aloft but not at the surface. If it is above 11,000 feet, large hail may occur aloft with small hail reaching the surface.

e. Small radar echoes move with the winds at the 5,000 foot level and larger echoes move with the 11,000 to 12,000 foot level.

f. The average of all wind directions measured at 2,000 foot intervals from the gradient level to 20,000 feet equals the average movement of the thunderstorm.

g. Unusual thunderstorm movement occurs when there is strong vertical sheer between the levels in which the thunderstorm is embedded.

h. For the wind direction of the peak gusts in air mass thunderstorms, add 20 degrees to the direction of the 14,000 to 16,000 foot winds.

i. Severe aircraft icing conditions in the Kingsville area are infrequent. When the freezing level is 5000 feet or below, and moderate over-running is evident, severe icing can be expected.

j. Extreme turbulence has seldom been reported in the Kingsville area, but light to severe turbulence has been reported under the following conditions:

(1) Below 5,000 feet in clear, dry polar air which is heated over land during the day and over water at night. The most frequent occurrence is late spring and early fall. The 1200Z sounding will usually indicate this type of instability.

(2) Low level turbulence induced by the strong southerly flow prior to approaching polar fronts.

(3) Except for the incidence of associated isotherm packing near the jet stream, clear air turbulence presents very little problem in this area, but the threat increases considerably north of the jet core on cross country flights. When turbulence is reported in the local area, cumulus build-ups, cumulonimbus or mammatus clouds are usually present.

V. ENVIRONMENTAL EFFECTS

A. Temperature. The annual mean temperature for NAS Kingsville is just less than 73 degrees F. The mean temperature increases from a low of 57.6 degrees F in January to 85.4 degrees F in July and August, then starts to decline to January. People in South Texas perform work outdoors at high temperatures that would seem intolerable to people accustomed to more moderate climates. On the other hand, low temperatures in winter are as likely to cause loss of efficiency among workers as do extremely high temperatures in summer, although these low temperatures would seem mild to people living in the northern United States. In South Texas, subfreezing temperatures associated with Arctic air masses are ordinarily confined to several hours prior to sunrise, and seasons may pass with no subfreezing temperatures at all. Temperatures of 32 degrees F or below have been recorded from November through February, with December holding the extreme low temperature of 15 degrees F. Extreme cold spells were experienced in South Texas in 1951, 1962, and again in 1963, with an extreme high temperature of 107 degrees F recorded in April 1989. Southwesterly surface wind caused from the thermal low moving into South Texas from Mexico became strong enough to counteract the sea breeze allowing the temperature to soar.

B. Surface Winds. The predominant low level flow across all of South Texas is from an east-southeast to a south-southeasterly direction with a percentage frequency of about 46%. Surface winds from the southwest through west-northwest are most effective in removing moisture from the area and in producing clear skies. Winds blow from these directions about 5% of the time. The east-southeast to south-southeasterly flow off the Gulf of Mexico is prominent in all months of the year except December and January when north to northeasterly winds prevail. During the November transition period, the east-southeast to south-southeast winds and the north to northeast winds prevail equally about 28% of the time. During late winter and spring, east-southeast tosouth-southeast winds increase in frequency from month to month and reach a maximum frequency of about 60% during June and July coincident with the building and strengthening of the Bermuda High westward. Winds from this direction are not quite so dominant in August with the frequency gradually decreasing through the fall. The absence of southwest to west-northwesterly winds noticeable in the annual frequency, is characteristic of all seasons. Wind velocity averages 8 to 12 knots with the 10-knot average in March and April and the 8-knot average in December. September, the only month with sustained one-minute wind speeds over 40 knots, holds the record maximum gust, 79 knots,

which occurred during Hurricane Beulah in 1967. All months have gusts recorded over 40 knots. Other than during hurricanes, the maximum-recorded gust was 69 knots in March 1952.

C. Visibility. Visibility in South Texas is considered very good during all months of the year and at NAS Kingsville it is greater than 6 miles 89.5% of the time. During the winter and early spring months, fog is often a problem but restriction to visibility is usually confined to early morning hours. During the summer months of June through August, the percentage frequency of unrestricted visibilities is very high as the occurrence of fog is greatly reduced. Fog is still the primary reason for low visibilities. Heavy rainshowers and thunderstorms reduce the visibility to low values, but the number of occurrences is quite small compared to fog frequencies. The intensity and persistence of fog varies diurnally and with the season; consequently so does the visibility. Fog begins to appear occasionally in September and is confined to the hours of 0700 to 0800 CST. During November the occurrence of low visibilities increases significantly as fog becomes more frequent, but is confined primarily to the hours of 0600 to 0900 CST. From December through February the occurrence of low visibilities begins to increase significantly around midnight and persists longer to about 1100 CST. The "foggiest" period is from 0500 to 1000 CST. There is a sharp decrease in the persistence of low visibilities from February to March and the occurrence of low visibilities continues to decrease during April. The highest frequency of low visibilities occurs with northerly component surface winds. This may be explained by the fact that (1) frontal fogs in winter and early spring are usually associated with light northerly component winds; (2) the synoptic weather pattern that favors maximum radiation cooling at night is often characterized by light (almost calm) northerly component winds; (3) South and southeast winds off the Gulf of Mexico are frequently too strong for fog formation; or (4) the maritime tropical air mass carried inland by these winds is too unstable for fog to form.

D. Ceilings. The frequency of ceilings of 3,000 feet or less is about 27% on an annual basis. This increase to about 43% during the 0900 to 1100 CST period and decreases to about 16% during the 1800 to 2300 CST period. The highest monthly frequency of ceilings of 3,000 feet or less is 58% in April during the 0600 to 0800 CST period. This drops to a low of about 3% during July and August during the 1800 to 0200 CST period. Ceilings of 1,000 feet or less occur about 9% of the time annually with a maximum occurrence of 20.9% in January and

a minimum of 0.7% in July.

E. Precipitation. The average annual rainfall for Kingsville is 26.0 inches, however, this can be misleading since it is much less during years of severe drought and considerably more during periods of above normal tropical cyclone activity in the Gulf of Mexico. Monthly totals can be misleading as well since it is possible for a single thunderstorm to account for the entire month's rainfall.

Since a large portion of the annual rainfall occurs within a short period of time, flooding occurs frequently along the streams that traverse the flat south Texas plain (The maximum recorded 24 hour rainfall occurred on 20 November 1967 during Hurricane Beulah when 6.9 inches fell). Snowfall is limited to December, January and February, then only a trace occurs on the average. Many years pass with no snowfall at all. A record 2.3 inches of snow fell on 9 January 1967.

F. Fog and Stratus.

1. General. The weather phenomena causing the greatest and most persistent interference with local air operations are fog and low stratus clouds. Because of the proximity of the Gulf of Mexico and the prevailing low-level wind flow from this moisture source, the formation and dissipation of fog and low stratus are major problems for weather forecasters in South Texas. Of the two, stratus causes the greater interference with air operations since it occurs more frequently than fog. Stratus occurs during all seasons and almost always produces IFR flying conditions except in the hottest part of the summer. The processes governing the formation of fog can be applied with satisfactory results. An important fact that should be emphasized is that all fog or stratus forecasts are for short term periods. While good approximations of flying weather conditions can generally be made 24 hours in advance, practically all fog and stratus forecasting techniques require data that are usually available less than 14 hours prior to formation. Beyond 14 hours, the forecaster must depend largely on the persistence of the current synoptic pattern. Thus, the weather conditions that cause the greatest hindrance to local flying operations in South Texas can be accurately forecast only for short periods in advance.

2. Fog. South Texas experiences a large number of advection-radiation fogs, a few purely radiation fogs, and a large number of post-cold frontal fogs. Fogs occur frequently from about 15 October to 1 May. Advection type fog reaches a peak during the winter months and a minimum in summer. Post-cold frontal fogs reach their peak in the spring and late

fall coincident with the period when cold fronts slow down or stagnate in this area. Fog is a minor operational problem when it is not associated with a low stratus ceiling. Summer is almost free of fog because of the warm ground temperatures. Stratus clouds usually form instead of fog during this season.

a. Advection-Radiation Fog. This fog, as the name implies, forms in the lower humid layer of air that has experienced a long trajectory across the Gulf of Mexico and is subjected later to radiational cooling as it moves across the cooler land surface at night. Advection fog occurs during all months of the year, but it rarely interferes with normal flight operations before mid-October or after May 1.

Prior to the formation of dense advection-radiation fog in South Texas, the surface synoptic chart usually shows a flat high-pressure cell in the vicinity of Florida. This cell may be over Georgia, the East Gulf, and Florida or between Florida and Bermuda, but in each case the result is the same, a weak anti-cyclonic circulation over the West Gulf. The most common situation observed is that of a weak high pressure ridge extending westward from Florida to Texas with the ridge line along the Gulf Coast or slightly off shore. A weak low-pressure area through central Texas will also produce an on-shore circulation that favors advection-radiation fog. In this case, the circulation is weakly cyclonic, and the synoptic chart usually features a weak warm front through east Texas. There are fewer cases of fog with a circulation of this type because the cyclonic circulation does not often remain weak during the winter months. In almost every case, this type fog forms in what would certainly be classified as maritime tropical air. The air mass may have been continental polar originally, but it has later acquired characteristics of the tropical source region. Ordinarily 50 to 60 hours history over the Gulf of Mexico is necessary to transform a dry continental polar air mass into maritime tropical air. However, a particularly moist continental polar air mass may take up sufficient moisture to form advection-radiation fog within 20 to 24 hours after reaching the Gulf.

b. Pre-warm Frontal Fog. Confined generally to the winter season, pre-warm frontal fogs are fairly rare, but when they do occur, the fog is widespread and homogeneous as to depth and density.

c. Post-Cold Frontal Fog. Since many cold fronts decelerate or become quasi-stationary in the South Texas area, post-cold frontal fogs occur rather frequently. They reach their maximum occurrence in March and April and a secondary

peak in late fall. Frontal fog is more of an operational problem than is the air mass type. It persists long and when associated with low stratus clouds, may disrupt flying operations for several days at a time.

d. Upslope Fog. Upslope fog does not affect the local area but is significant along the Balcones Escarpment near San Antonio to the Northwest.

e. Radiation Fog. When the air over South Texas has not had a recent trajectory over water, pure radiation fogs are rare. Usually this type occurs only when an all day overcast breaks in the evening and surface dew point depressions are less than 5 degrees F. An air mass shower or thunderstorm during the late afternoon or evening may produce the same result.

3. Stratus. As previously mentioned, the presence of low stratus clouds causes the greatest interference with local flying in South Texas of any weather phenomenon. Local flying implies take-offs and landings, since stratus clouds are not a problem for over-flights. For the purpose of this manual, "low" stratus is defined as stratus with a base 2,000 feet or less above the ground. Stratus may be classified as either air mass or frontal. Frontal stratus is more of an operational problem than the air mass type. It persists longer and may produce lengthy periods of IFR weather. It is much more difficult to forecast than air mass stratus because of the added complication of forecasting frontal movement, over-running, and precipitation. Air mass stratus forms in the moist air flowing inland at low levels from the Gulf of Mexico. Time of formation in this area, from about October through April is between 2100 and 0400 CST with bases 300 to 1,000 feet. Near sunrise the stratus often becomes fog, lifting again to stratus by 0900 CST and usually becoming scattered between 1100 and 1400 CST. A broken to overcast cloud layer above the stratus, or stratus depth in excess of 1,500 feet, often prevents the stratus from "burning off" at all. Between Kingsville and the coast, stratus and fog no longer appear regularly when water temperatures off shore reach 70 degrees F. As both water and land surface temperatures rise during late spring, stratus gives way to stratocumulus or cumulus with higher bases.

G. Thunderstorms.

1. General. While thunderstorms occur during all months of the year, they are much more frequent during the warm season of April through September, the period when convective activity is at a maximum. In general, maximum thunderstorm

activity occurs during the afternoon, but in all coastal sections of South Texas there is a high frequency of nocturnal thunderstorms. The most stable portion of the (the period of least thunderstorm activity) day in South Texas is from about 0800 to 1100 CST.

2. Air Mass Thunderstorms. Air mass thunderstorms in the mature stage seldom affect the Station due to the proximity of the Gulf and the diurnal sea breeze in the afternoon. On days of high instability (stability index +1 or less), with sufficient moisture in the higher levels, heavy cumulus clouds appear along the Gulf coast during the late morning as diurnal heating increases. These clouds move inland with the developing sea breeze, reaching Kingsville near noon as scattered to widely scattered showers. The clouds continue inland and reach their maximum development during late afternoon primarily to the southwest through north of the station. On days when the sea breeze is weak and the general low level flow is southerly, thunderstorms will affect the Station during the afternoon but rarely will they produce more than .10 inches of rain or gusts above 30 knots.

3. Nocturnal Thunderstorms. From May through September, Thunderstorms frequently occur from 0300 to 0700 CST, especially at coastal stations. They form along the Gulf Coast in connection with a weak land breeze during these early morning hours then drift a short distance inland on the prevailing southeasterly gradient aloft before dissipating. Only rarely do they reach the Kingsville area in the mature stage. When they do arrive at the station, thunderstorms of this variety are usually in late stages of dissipation.

4. Frontal and Squall Line Thunderstorms. These thunderstorms are experienced primarily during the fall and spring, and to a much lesser extent during the winter. They are usually more severe than the air mass type and are of longer duration. The most severe ones are usually associated with squall lines of late spring and early summer. Precipitation in the amounts of 2 inches or more and wind gusts in excess of 35 knots are not uncommon from these thunderstorms.

H. Land and Sea Breeze. The annual temperature range of Gulf and bay waters is about 33 degrees F. (from 52 to 85 degrees F). During the summer months with inland temperatures reaching the mid and upper 90's, the sea-land temperature differential produces an on-shore component of about 12 knots commencing between 1100 and 1300 CST. This causes subsidence off shore and at the coastline and a movement inland of the

cumulus of cumulonimbus clouds present. The sea breeze component continues until about 2000 to 2200 CST. Little or no land component is noted, and the seasonal southeasterly wind continues throughout the night, keeping temperatures within about 3 degrees of the sea surface temperature. Pronounced land and sea components are observed during the spring and fall seasons, depending on the sea-land temperature differential. During the early spring, daytime temperatures often climb into the high 80's, and as a result, on-shore components of 8 to 12 knots are maintained all night. During the winter months, on-shore components are usually weak, 4 to 6 knots, high 60's in conjunction with a weak pressure gradient (high cell) over Texas. Moderate off-shore components, 8 to 10 knots, are observed at night during the winter whenever a cold high pressure cell is centered inland near the coast. The latter situation will produce the lowest temperatures on a cloudless night. The sea breeze appears to have a strong influence on the movement of squall lines that form in advance of rapidly moving cold fronts. Along the coast, these squall lines reach maximum intensity during the afternoon at about the same time the sea breeze is strongest. Consequently, as these squall lines near the coast, they are retarded. In the spring and fall, the cool sea breeze seems to modify their intensity. This is true especially in the spring as long as water temperatures remain low.

I. Freezing Rain. This phenomenon is confined entirely to the winter months December through February and occurs so infrequently in South Texas that it is of little concern operationally.

J. Snow and Sleet. Measurable amounts of snow fall infrequently in South Texas and it usually melts as it falls. Sleet occurs more often than snow but in most cases is very light.

K. Hail. Hail of damaging intensity seldom occurs in South Texas, but light hail is frequent in connection with springtime thunderstorms. Surface hail usually averages 1/4 inch in diameter and occurs only for very brief periods. Flight forecasters should be aware of the increase in frequency of damaging hail over the northern half of Texas during the April to June period of severe thunderstorm activity. Occurrence of hailstones 3 to 4 inches in diameter are not uncommon. It should be mentioned also that hailstones frequently fall from the cirrus anvil extending away from the parent cumulonimbus, so that an aircraft flying in clear air beneath one of these cirrus anvils may encounter damaging hail.

L. Blowing Sand and Dust. During dry years, the first day of surface winds from the southeast of 15 to 18 knots gusting to 25 to 30 knots, surface visibility is reduced to 2 to 3 miles in blowing sand or dust improving to 5 to 7 miles on the second day. Scattered light showers will again loosen top soil and poor visibility will continue. When an intense low moves out of the Panhandle region, it will carry suspended sand and dust to South Texas and as far east as the Tennessee/Alabama line. Tops of the sand and dust will be around 9,000 feet with both in-flight and surface visibilities reduced to less than 3 miles. Blowing sand and dust frequently accompanies fast moving cold fronts reducing the visibility to less than 2 miles.

M. Dust Devils. Known locally as "Whirl-Winds", dust devils form typically as a result of strong convection during sunny, hot afternoons under conditions of absolute instability and very light surface winds. They are well developed, rapidly rotating columns of air over a dry and dusty surface, carrying dust and light material picked up from the ground. Some of them reach an intensity severe enough to un-roof lightly constructed buildings. Generally they are small with a width of several yards and extend to a height of 100 to 300 feet. On unusually hot, relatively calm afternoons, dust devils may be much larger in diameter and extend as high as 2,000 feet. They move slowly, rather erratically, and rotation may be either clockwise or counter-clockwise. It is not unusual to observe several dust devils at one time; all are usually short-lived.

N. Dry Haze. Under proper atmospheric conditions fine dust, salt or smoke particles produce haze that can be quite bothersome to pilots in this area. Dry haze is distinguished from fog or mist by its slightly brownish or bluish color. Fog or mist is of course, grayish in tone. Usually, haze layers are associated with fairly low level subsidence inversions that are not common, but may persist for several days when they do form.

These occur more frequently in late spring and early fall than in other seasons of the year. Haze may reduce visibilities to as low as 2 miles, although values of 4 to 5 miles are more common. Pilots report that visibilities aloft, within the haze layer, are almost always considerably lower than at the surface. Haze layers usually cover wide areas and may, at times, include several states.

O. Tornadoes. Previously considered rare in South Texas, tornadoes are seemingly on the rise in this area as more and more are being observed and reported each year. They are usually associated with severe thunderstorms and/or hurricanes

and are of a very short duration. Funnel clouds are common with intense thunderstorm activity. Tornadoes can occur at any hour of the day or night in any month of the year, but they are more frequent in the late afternoon hours during the late spring and early summer. The tornado "season" begins about 1 April and ends about 30 June. Waterspouts are fairly common over the Gulf of Mexico and Baffin Bay during the summer months in association with shower and thundershower activity. Normally, they are small funnels that dissipate rapidly after crossing the coastline and cause little or no damage. However, large waterspouts can be dangerous to small boats and to poorly constructed buildings.