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SOUTHWEST TEXAS SOARING WEATHER

by

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FOREWORD

The following article, Southwest Texas Soaring Weather, by Mr. David H. Owens, WBAS, Midland, Texas will be of interest to station people at other places where soaring is an increasing recreational activity. In addition to describing meteorological factors responsible for good soaring weather in southwest Texas, the write-up demonstrates the development of a station technique to meet a particular service activity. The method used at Midland incorporates sound meteorological principles, the use of specialized guidance products of our National Meteorological System, and local data and forecast tools to give a systematized approach to a local weather analysis and prediction problem. From this perspective it may stimulate development or formalization of techniques for other types of local office forecasting and service programs.

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SOUTHWEST TEXAS SOARING WEATHER

INTRODUCTION:

In recent years, Southwest Texas has become a popular gathering place for soaring enthusiasts on both a National and International basis. Several distance records were set in 1964, and in 1965 more than a dozen 500KM triangles were flown in this area. Previous to 1965, a 500KM triangle had not been flown in the United States. In the past two years soaring pilots have come to Southwest Texas from England, Israel, New Zealand, and Canada; and from locations in the U. S. ranging from California to New Jersey. All have been favorably impressed with the excellent soaring weather and the potentials which this area offers.

The two focal points of this activity are Ector County Airport, Odessa, Texas; and Presidio County Airport, Marfa, Texas. The personnel at the Weather Bureau Airport Station, Midland, handle the pilot weather briefings for both locations. Through continued personal contact, much of the soaring pilot's enthusiasm has been absorbed by the local Weather Bureau personnel. Obviously, weather is a major factor since the soaring pilot is largely at the mercy of the elements. Selecting the day and hour when all factors are most favorable becomes essential for any attempt at a soaring record.

It is hoped that the following pages will offer some background and perhaps a little insight to the Meteorologist who may be called upon to brief soaring pilots in this area.

TYPES OF FLIGHTS

Most of the soaring pilots who request information have either one of two flight plans in mind. A pilot may wish merely to fly in the local area, landing at or near his point of departure; or he may wish to journey cross-country, landing several hundred miles from his home base. Since each type of flight plan requires special consideration, it will be best to handle them separately.

LOCAL AREA SOARING

Practically any day during the summer, in southwest Texas, is favorable for soaring, and a sail plane is able to find all the lift necessary to remain aloft for several hours. Why is southwest Texas so conducive to soaring? The answer lies in the combination of many favorable factors. A few of the more prominent which will be discussed include: strong surface radiation, high potential temperature, unstable lapse-rate, favorable cloud cover and low level synoptic features.

As we have heard so frequently, "the sun is the primary source of all energy". Therefore, the sun must be the initial source of energy required to keep a sail plane aloft. Solar radiation, as such, is useless to the glider pilot. However, solar radiation is absorbed by the earth raising its surface temperature. In turn, heat is conducted to the adjacent air which rises from the surface to give energy in a usable form for the glider pilot. We see that the amount of solar radiation and its conversion into sensible heat are important factors. Southwest Texas rates high in both of these categories. The Weather Bureau at Midland measures an average of 620 langleys of incoming solar radiation per day during the summer months of June, July, and August. This is about seventy percent greater than the average radiation over the Northern Hemisphere during the same period.

The terrain, which is composed of a light sandy soil with only a minimum of foliage and no trees, is suitable for high surface heating. This is reflected in the fact that the average Summer maximum temperature is 94°F. Although this temperature is not exceptionally high, it is significant since the average elevation of the region is near 3,000 FT. above sea level. The terrain around Odessa is generally flat with only slight undulations. However, Marfa is slightly cooler and lies on a mesa near the Davis Mountains, some 4,850 FT ASL. Many of the pilots prefer the Marfa area due to the additional lift of prevailing winds riding up the slopes of the mountains.

As mentioned, the average maximum temperature of 94°F is not in itself particularly outstanding, but, when coupled with the fact that it is measured at 3,000 FT ASL, it is probably the single most significant contribution. 94°F (34.4°C) is an unusually warm temperature for 3,000 FT ASL, and since the 700MB level temperature is not significantly affected by the surface heating, the temperature lapse-rate becomes quite unstable. In fact, the average lapse-rate from the surface to 700MB is 1°C per 100m at the time of maximum heating. Since the theoretical maximum lapse-rate (called the dry adiabatic lapse-rate) is also 1°C per 100m we see that southwest Texas rates perfect in the realm of low level instability.

Some of the local area soaring pilots have a rule of thumb not to venture east of the 100° meridian due to a significant loss of instability. This becomes readily understandable when we note that, even though the average maximum temperature (June, July and August) is nearly as warm (93.5°F), the general height of the terrain is more than one thousand feet lower than Odessa. The net result is that the temperature lapse-rate 150 miles east of Odessa is 1°C per KM more stable. This paradox holds true even when we consider locations which are noted for their exceptionally high temperatures. For example, Yuma, Arizona, and Thermal, California, often have maximum temperatures in the range of 110°F to 115°F. However, both of these cities are very near sea level and when a surface temperature of 114°F is projected dry adiabatically to a height of 3,000 FT ASL it is the same as the 94°F surface temperature at Odessa. More technically we would say the potential temperature of the two areas are equal. Bear in mind, however, that the 94°F temperature used for Odessa is a three month average temperature, and that on days most favorable for soaring the temperature is usually in the 95°F to 100°F range, while any significant departure below the normal is caused by either heavy cloud cover or precipitation, and a day unfavorable for soaring at any rate.

As we might expect, cloud cover and cloud type are also important factors in briefing soaring pilots. Most favorable cloud cover in this area seems to range between 2/10 and 5/10 of cumulus with no significant cloud layer above. Clouds covering more than one-half of the total sky restrict surface heating enough to appreciably reduce the strength of the thermals. During the daylight hours of June, July and August, Odessa averages twenty-five days per month of clear to partly cloudy skies with a mean sky cover of 4/10. Even though heavy sky cover greatly reduces the soaring potential, the complete lack of any cumulus cloud cover is even more onerous to the soaring pilot. At least a few fair weather cumulus are essential to an inexperienced pilot, and certainly very desirable to the veteran, before an attempt is made at soaring. These cumulus clouds always develop above the stronger thermals and become the pilot's "eyes" for finding the updrafts which are essential to sustained flight. Any building cumulus is an excellent indication of a well developed thermal. However, if the cloud becomes over-developed, that is, producing rain showers, or is in the dissipating stage it no longer indicates updrafts and more than likely will produce down-drafts. Dust devils are also excellent indications of thermal activity and are quite prevalent in southwest Texas. Although they are very turbulent up to a height of 1,000 FT above the surface, they are extremely helpful to mark thermal activity of the pilot in the critical stages of low level flight.

Southwest Texas has one more major contribution to its reputation as excellent soaring country. This is a built-in feature to be found on the large scale surface weather map. It is known as the thermal low, and its near-stationary position is about 100 miles southwest of Presidio, Texas. During the summer this low is a semi-permanent feature of the surface synoptic chart and is the center of a continental tropical air mass. It is characterized by exceptionally warm dry air. Southwest Texas is often under the influence of this air mass, and therefore, a large scale area of convergence and positive vertical motion. On a smaller scale and not quite so prevalent, but still a common feature of the surface chart, is the Marfa trough. This trough is most prevalent in the Spring and early Summer, but may occasionally be apparent in the late Summer. It is a transition zone between the dry air of the Southwest desert region and the moist air from the Gulf of Mexico. For this reason it is sometimes called the dew-point trough or, colloquially by the soaring pilots, "the Marfa dew line". Along this trough there is additional convergence and positive vertical motion. As a result, it is the area most favorable for convective activity. Forecasting the location of this trough is beneficial to the soaring pilot; however, when it is active it can be located visually at great distances.

Local area soaring is always good during the summer in southwest Texas, but on days when all these factors are working together, "this region is a good as any in the world". (As quoted from Mr. Philip Wills, several times President of the British Soaring Society.)

SOARING FOR DISTANCE

Southwest Texas has been proven to be an ideal starting point for any attempt at soaring for distance. Most of the favorable features which were discussed for southwest Texas continue, nearly undiminished, through a narrow corridor about 150 miles wide northward to the South Dakota border, or about 800 statute miles. The terrain is fairly level and averages between 2,800 FT and 3,600 FT ASL. Prevailing winds are southerly at least to 12,000 FT, potential temperature remains high, and the low level lapse-rate is fairly unstable. At times, western Kansas and Nebraska are as hot as southwest Texas, and on these days conditions are favorable for long distance flights up this corridor. However, most favorable conditions occur when a Pacific cool front is approaching from the west. The front should be orientated NNE-SSW from a well developed low pressure center tracking eastward across the U. S. at a latitude near 45°N. (Fig. 1) As the low crosses the Continental Divide and moves onto the high western plains, a weak pressure trough has a tendency to develop southward between this low and the thermal low. When this situation develops, conditions are most favorable for distance soaring. Instability and vertical motion are high along the trough line; surface and potential temperatures are higher than normal. Ahead of the trough sufficient moisture is available and prevailing southerly winds are racing toward the low pressure center in the Dakotas. This is the synoptic situation the soaring pilot has been anticipating, but still there are obstacles to overcome. A pilot attempting a record must take-off no later than mid-morning due to the great distance to be covered. Thermals are just beginning and cumulus clouds have yet to develop. In this case, if the thermal activity is forecast to increase substantially and cumulus clouds are forecast to develop within an hour, the flight may be initiated. Needless to say, this first hour will demand the utmost in soaring dexterity. The next major obstacle is over-development of cumulus, for nearly all the factors which make this synoptic situation ideal for soaring are also criteria in forecasting areas of thunderstorm activity. Even if there are no areas of severe thunderstorms, large areas of showers will terminate the flight just as surely. Vertical currents and thermals are poor or non-existent in areas where heavy showers have occurred. This is probably the most common cause for failure to attain the distance goal. Assuming showers are well scattered and the pilot is able to circumnavigate them, the next problem is to determine the exact location of the trough, the front, and the low pressure center. It has been perhaps nine hours since the pilot has seen a weather map. The entire system has probably shifted to the east. As he flies northward, the trough and the front become more closely orientated and at some point he may wish to leave the trough and take advantage of the instability along the front. If the front is now out of the mountains and on the plains, it will probably give better lift than the trough. However, quite often there is negative vertical motion, or at least reduced positive vertical motion between these two areas of convergence and rising air currents. Either the trough or the front is usually adequate for sustained flight, but in no case may the pilot cross the front, for here potential temperature falls off rapidly in the cold air and a head-wind component is sure to prevail.

An accurate forecast of the positions of the various synoptic map features is essential to the pilot on a long flight of this nature.

At 9:46 AM, July 21, 1964, Mr. Al Parker was launched at Odessa, Texas and at 8:19 PM he landed his sail plane at Kimball, Nebraska for a total sustained distance of 647.17 statute miles....Without a motor!

BRIEFING FORMAT

Through the combined efforts of the local soaring pilots, and the personnel at the Midland Weather Station, a format has been agreed upon which is both expedient and informative. This form (Fig 2) is filled out each morning and is completed and available by 8:30 AM. The data is recorded on tape, via telephone, at Presidio County Airport. Any particulars or specific information are discussed with interested pilots at the end of the recording. The form is then kept at the station as a ready reference to brief pilots at Ector County Airport, or those who stop by the Weather Station personally.

The form is short, to the point and mostly self explanatory, but a few of the less obvious entries are described here. The data in the section at the top of the page is obtained from the 1200Z Midland rawinsonde, except the location of the Marfa Dew Line which is taken from the 1200Z surface synoptic analysis.

The Inversion is a surface inversion or any significant inversion which would prevent heating to a height of at least 10,000 FT. The soaring pilot is interested in the height of the inversion, the surface temperature required to "break" the inversion, and the approximate time at which that temperature will occur.

In the Winds Aloft section we have observed winds (1200Z) and forecast winds and temperatures (FD WBC 18-24Z) at selected levels for the stations indicated. In this section, the Showalter stability index, as available on the UXUS teletype collection at 1250Z, has also been included.

The data in the bottom section of the page is taken almost entirely from facsimile charts and guides. Convective Outlook-Severe is taken either from the AS MKC teletype collection or Fax chart 58, Severe Weather Outlook. Heavy Rain Areas Last 24 Hours is obtained from the High Plains AGMET teletype circuit and from the 1200Z synoptic (SM) teletype collection. For Overdevelopment Areas-Saturation, the Quantitive Precipitation Forecast (Fax chart 61, 1200Z) has proven most useful.

Over a period of two years this format has proven quite acceptable to both the Midland Weather Bureau forecasters and the local soaring pilots. The regular pilots term the quality of the forecasts, for the Ector County flying area, as very good; however, more refinement could be used for the forecasts for the Marfa area. The major problem here is the lack of surface and upper air observations. The closest regularly scheduled aviation observations are taken at Wink, Texas, 125 miles to the north; El Paso, 180 miles northwest; and Del Rio, 200 miles to the east. None of these stations report weather necessarily representative of the Marfa area. There is no data available to the south or west. Upper air data is fair since Marfa is located near the center of a square bounded by four radiosonde stations: El Paso, Midland, Del Rio and Chihuahua. Except for low level inversions and moisture, an average between the upper air data at Midland and Chihuahua seems adequate. But, as we have seen, the low level inversion and moisture are two of the critical factors in preparing a good soaring forecast. The most practical solution to this problem would be to seek the assistance of the soaring people themselves. Perhaps they could use a local airplane to measure the ambient temperature at, say, each 500 FT up to an altitude of 3,000 FT above the surface. A few surface measurements such as dew point and wind velocity might also be added. Then this data, in conjunction with data from surrounding Radiosonde Stations, would produce an improved upper air picture and increase the forecast performance substantially.

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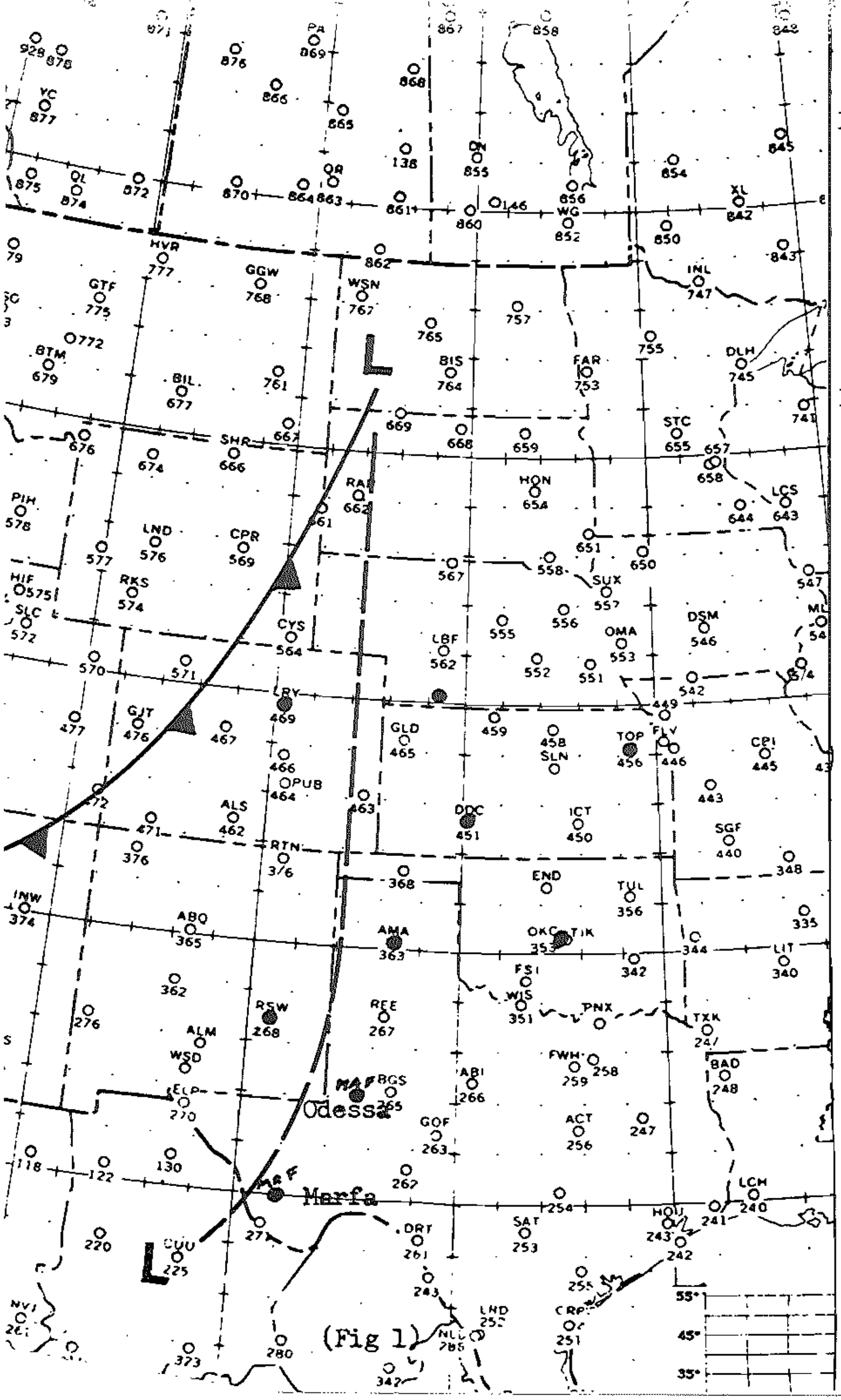

(Fig 1)

SOARING WEATHER DATA DATE ____

MAF Temp. Low ____ Fcst. High ____ Time ____
Inversion: Alt. ____ Time & Temp. -Break ____
Lapse Rate-Normal ____ Steep ____ Absolute ____
Est. Cu. Base Min. ____ Max. ____
Location Marfa Dew Line ____

WINDS ALOFT

MAF	Sur.	6	8	10	12	14	
	Fcst. 5	T.	10	T.	15	T.	
ROW	Sur.	6	8	10	12	14	
	Fcst. 5	T.	10	T.	15	T.	
AMA	Sur.	6	8	10	12	14	
	Fcst. 5	T.	10	T.	15	T.	
DDC	Sur.	6	8	10	12	14	
	Fcst. 5	T.	10	T.	15	T.	
TOP	Sur.	6	8	10	12	14	
	Fcst. 5	T.	10	T.	15	T.	
DEN	Sur.	6	8	10	12	14	
	Fcst. 5	T.	10	T.	15	T.	
OKC	Sur.	6	8	10	12	14	
	Fcst. 5	T.	10	T.	15	T.	

Convective Outlook - Severe ____

Frontal Activity ____

Heavy Rain Areas Last 24 Hours ____

Overdevelopment Areas - Saturation ____

Low Pressure Areas - Troughs ____

High Pressure Areas - Ridges ____

(Fig 2)