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SOARING METEOROLOGY[1]

Daniel Gudgel
National Weather Service Forecast Office
Bakersfield, California

With "soaring season" gearing up, a review of soaring operations and what the weather briefer should be aware of are needed. This knowledge will help provide enlightened service for this segment of the aviation community.

Except for commercial soaring operations where rides are given and instruction is taking place, soaring is recreational flying at its finest. Sailplanes are considered a separate category of aircraft, and sailplane pilots must be examined and licensed by the FAA. Because the engine of a sailplane is the air itself, good soaring pilots tend to observe the atmosphere more attentively than their power counterparts. Further, in the course of their training, soaring pilots must study and show proficiency in understanding basic meteorology and relating it to sailplane performance and limitations. Weather information which the soaring pilot is required to know is attached.

Especially in the Western Region, where some of the best soaring conditions in the world exist, many weather offices receive requests for weather briefings for soaring. Just like airplane, rotorcraft, and balloon category pilots, soaring pilots must have a complete weather briefing to meet Federal Aviation Regulation (FAR) 91.5(a). The recommended standard weather briefer format for all pilots includes the following:

1. Pilot/flight background information.

2. Adverse weather, i.e., AIRMET's, SIGMET's, CWA's.

3. Weather synopsis.

4. Current weather.

5. Enroute forecast.

6. Destination forecast.

7. Winds aloft.

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1 Reprinted from Western Region Technical Attachment No. 88-23, June 28, 1988, with permission of National Weather Service Western Region, Scientific Services Division.

The briefer should touch upon the enroute and destination forecasts to give the soaring pilot an idea of flight conditions rather than soaring conditions. After the "standard" briefing is given, the decision can be made by the soaring pilot to continue or abort plans for the flight. It is interesting to note that some flight precautions, such as severe turbulence associated with mountain wave activity, may actually be keys for the soaring pilot to want to continue the briefing when many power pilots may seek an alternate flight route or cancel plans for a flight.

Should the pilot wish to continue, the briefer may want to concentrate on flying weather information which may enable the pilot to determine the feasibility of soaring flight. In essence, this adds one more area to the briefing format: soaring indicators. In reviewing weather information for soaring, the briefer needs to assess the possible types of lift. An excellent manual, not only for pilots, but for briefers as well, is chapter 10 of Aviation Weather (AC 00-6A), entitled "Soaring Weather." Briefly, four types of lift are identified: thermal, ridge, mountain wave, and convergence. Most of the time, pilots will want thermal activity since that is the type of lift preferred for long distance or "task" flying. However, excessive cloud cover, or a very stable air mass, which inhibits thermal activity, may lead the briefer to look for an alternate means of lift.

Winds over ridges, mountain wave, and convergence all provide alternate means of lift. Mountain wave and ridge lift are covered well in Aviation Weather. I would like to add a statement regarding convergence. Local effects will provide an interesting phenomenon which can enable the sailplane to stay aloft when none of the other types of lift are working. Conservation of mass dictates that any convergence will provide a lift zone. Flow through valleys to a convergence line or point and sea breeze are but two types of convergent flow, and this type of local knowledge can greatly enhance the capability of the briefer to aid soaring pilots.

When providing briefings to soaring pilots, one of the best tools available is the upper air sounding. For thermal soaring, upper air stability factors provide key information. Good lapse rate conditions aloft during the afternoon hours (nearly adiabatic through a fairly deep surface layer) provide generally good thermal production. However, the presence of a strong stable layer within 2,000 to 3,000 feet AGL will almost undoubtedly lead to a poor soaring day (by Western standards). As a general rule, an unstable air mass will provide thermal lift. However, there are problems with an air mass which is too unstable. While initial conditions in such an air mass will provide spectacular thermals, continued instability will lead to too much cloud cover. This results in inhibiting thermal production at the least, or widespread thunderstorms and their associated dangers at the worst.

Excessive wind and vertical wind shear will shear terminals so that they are unworkable or provide so much downwind translation of the sailplane that cross-country flight is undesirable.

In the course of the weather briefing, the soaring pilot should be given information regarding the lapse rate between 850 and 500 mb, the maximum altitude of the thermals during afternoon heating, the initial time of thermal production (those capable of penetrating 2,000 to 4,000 feet AGL), and some idea of thermal strength. The Thermal Index often is mentioned as a way of giving thermal strength, but it is not in widespread use in the West. The Thermal Index is based on temperatures at 850 and 700 mb. The high terrain found at many western soaring locations means that the 850 mb temperature may also be the surface temperature, or there may be no 850 mb temperature at all. However, the concept behind the Thermal Index--the larger the difference between the rising parcel's temperature, and the ambient temperature as represented by the morning sounding, does give the briefer a hint of the thermal potential for the day.

I do not propose to give any hard and fast rule for predicting thermal strength because it varies for sites around the Western Region. An example of a thermal strength predictor, the Soaring Index, as developed by Chris Hill and Doug Armstrong at WSFO Reno in the mid-1970's, works very well for the Great Basin. Again, the concept behind the Soaring Index is worth noting: thermal strength is a function of (1) temperature differential between the rising air parcel and the ambient air as indicated from a morning temperature sounding, and (2) a function of the maximum altitude of the thermal.

The following rough guide is given to help the soaring weather briefers at WSO Bakersfield:

1. Select an upwind RAOB representative of the air mass.

2. Know the altitude of the soaring site AGL.

3. From the forecast maximum temperature for the site, proceed upward along a dry adiabat until contacting the sounding temperature. This is the maximum altitude of the thermals.

4. Trigger temperature is that temperature which reflects when thermal activity will be occurring through the bottom 2,000 to 4,000 feet of the atmosphere. The trigger temperature is derived by coming down a dry adiabat (from 2,000 to 4,000 feet AGL) to the surface. The trigger time is the time at which the mixing through the lowest thousand feet AGL will occur (time of trigger temperature).

5. Any condition which will make the atmosphere more unstable can lead to good thermal development, i.e., warm air advection at the lower levels and/or cold air advection aloft. An indicator of atmospheric instability is the 850-500 mb lapse rate (°C). A value of 28 is potentially good, with higher numbers reflecting even better conditions.

6. A very rough rule-of-thumb for the Kern (near Bakersfield) area for the strength of the thermals is to divide the maximum altitude of thermals in feet ASL by 20. This gives lift in feet per minute.

Attachment

ATTACHMENT

Weather Requirements for a Glider Rating

Applicants for a glider rating are expected to know the following:[2]

A.* Commercial pilot knowledge of aviation weather information, including high altitude weather and weather activity over wide geographical areas, by promptly and systematically obtaining, reading and analyzing:

1. weather reports and forecasts,
2. weather charts including stability charts,
3. significant weather prognostics,
4. pilot weather reports, and
5. notices to Airmen.

B. Commercial pilot knowledge by explaining thoroughly the relationship of the following factors to the lifting process:

1. pressure and temperature lapse rates,
2. atmospheric instability,
3. thermal index,
4. thermal production,
5. cloud formation and identification,
6. frontal weather,
7. land and sea breezes,
8. valley breezes,
9. orographic lift, and
10. mountain waves.

C.* Aviation weather hazards.

D. The expected lifting action based on available weather information.

E.* Uses critical judgment in making a competent go/no-go decision based on the weather information.

* This information is also required by other category pilots.

2 From the commercial pilot Practical Test Standards.