# Forecasting for Gliding

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Gliding as a sport has progressed rapidly in both popularity and technique during the last ten years. The increased availability of high performance gliders has attracted hundreds of new members to gliding clubs and flying courses organised by these clubs are usually booked up well in advance.

The majority of glider pilots do not receive a formal training in meteorology; their knowledge of the subject is usually gleaned from colleagues in their clubs, from flying instructors and from occasional discussions with forecasters. So despite their enthusiasm they usually need some help in getting the most out of whatever public and aviation forecasts are available.

Preparation of a gliding forecast calls for more detailed analyses of hourly charts, low level wind structure and inspection of upper air temperature sounding than is necessary for some aviation and public forecasts. Attention to such detail may consume too much time if the forecaster cannot anticipate the nature of the gliding enquiries he is liable to receive. Furthermore, the forecaster may inadvertently give the pilot the wrong impression of prospects for gliding if he is unfamiliar with gliding operations. Soaring can be carried out in at least six distinctive types of conditions, namely, in hill lift, convection currents, line squalls, sea breeze fronts, lee waves and anabatic winds.

## *Hill lift*

At hill sites much of the flying time is spent in hill lift generated when winds of 15 knots or more flow up steep escarpments adjoining such sites. Satisfactory hill lift can be reckoned as that in which a pilot can soar to about two or three times the height of the escarpment above the adjoining upwind valley. Such lift is usually found in airstreams with moderate to fresh winds and neutral static stability in the lowest two to three thousand feet of the atmosphere. Strong winds with such stability tend to increase the turbulence and low level eddying without producing an appreciable increase in the depth of the hill lift. In airstreams which have a low layer of neutral stability capped by a sharp inversion the hill lift in moderate winds often allows pilots to soar in less turbulent conditions to several thousand feet. Whether such lift is due to the underlying escarpment or due to lee wave flow from other upwind ridges is often not clear, but the fact remains that at many sites hill lift becomes noticeably smoother and deeper during the evening if the wind and stability conditions just described are present.

Although static stability tends to damp small scale turbulence, it also appears to favour the development of semi-permanent eddies in sheltered places. The danger of these eddies arises not so much from turbulence as from the horizontal and vertical variations of wind velocity, which may be sharp enough to cause an inexperienced pilot to stall during the approach to land.

## *Convection*

By far the majority of cross-country flights are made in the convection currents known as thermals. Well known methods are available for predicting the surface temperatures at selected times of the day and a by-product of these methods is a forecast of the depth of convection, that is the depth of the layer of neutral, or slightly negative, stability together with the depth of the convection cloud, if any. No matter whether convection cloud forms or not, the top of this convective layer is the upper limit of thermal soaring and a forecast of this limit for various times of the day is particularly appreciated by glider pilots. When the depth is 2000 feet it is often just possible but difficult to stay airborne in thermals; when the depth is 3000 feet or more experienced pilots in efficient aircraft can often stay airborne.

Laboratory experiments and gliding experience suggest that the motion within an isolated thermal ascending through a layer of neutral stability resembles that of a diffusing vortex ring. With its central core rising faster than its perimeter, the thermal is turned inside out and, as the outside air becomes entrained, the thermal expands as it ascends. Thermals in the atmosphere are seldom isolated and are frequently distorted by wind shear, but the vortex ring concept is a useful frame for discussion. So with this concept in mind let us consider the principal characteristics of convection structure.

On a hot day with light or moderate winds and direct sunshine there is likely to be a superadiabatic layer at low levels. In this layer incipient thermals rising from relatively warm sources or triggered off by low level turbulence grow quickly and accelerate upwards. Turbulent downdraughts also accelerate in this layer and the net result is rather chaotic motion at low levels. Thus the superadiabatic layer acts as a filter from which relatively durable thermals emerge and ascend up into the layer of neutral stability with the vortex ring of motion. On approaching cloud base we occasionally meet another fairly distinctive layer; a shallow stable layer called the sub-cloud layer. When this layer is present a number of thermals tend to spread out just under the layer—only the relatively strong cores appear to penetrate upwards to form the convection cloud above.

Cumulus cloud base is frequently higher than that predicted in general aviation forecasts. Inland it is not uncommon to find cumulus cloud base rising by mid-afternoon to as much as 30% and occasionally 50% higher than that predicted by methods with neglect entrainment.

In a moderately big cumulus cloud the thermal structure appears to be similar to that in the dry layers below. If turbulence is encountered, it seems to be most pronounced near the freezing level, near the tops of the convection clouds, and also near the edges of the cloud. St. Elmo's fire and lightning strikes also seem to occur more often near the freezing level than at other levels.