

# WEATHER ANTICIPATION

FOR GENERAL AVIATION PILOTS

SAFETY PROMOTION LEAFLET



# GA 3



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# INTRODUCTION



Aviation forecasts are important, and pilots must always expect to meet the forecast conditions. However, a forecast only describes what is most likely to happen, and pilots must consider other possible outcomes. This leaflet should help pilots to recognise the approach of worsening weather before they fly into it.

Pilots should expect some weather from particular situations. A synoptic forecast chart, or information from a forecast on television, can prepare you even before you have your aviation forecast. Some pilots have difficulty understanding weather information, including TAFs and METARs (which are international). National Meteorological Offices, and others, produce leaflets, and sometimes applications for mobile phones, which can help.

## GENERAL ASSESSMENT - AIR MASS

The **'air mass'** over your route will bring certain types of general weather. A *'tropical maritime'* air mass, coming perhaps from the Azores, has high humidity at low altitudes and is generally stable, with poor visibility. In the warm sector of a depression, there is often also low stratus cloud and possibly drizzle, although visibility above the cloud may be good. Advection fog is also possible. In a summer anticyclone, you will usually find either clear skies or overcast stratocumulus cloud. *'Returning polar maritime'* air, starting from Canada but travelling across the warmer parts of the Atlantic, will give similar conditions, but usually less pronounced. These air masses are frequently found in Western Europe.

*'Tropical continental'* air, from North Africa or Arabia, brings stable conditions. There is a deep and thick haze layer, with little cloud. *'Polar continental'* air, from Siberia, brings clear skies and often overnight frost. Visibility is generally good except in any showers (often sleet or snow) from the moisture it may have collected if it has travelled across water. Any cloud is likely to be cumulus type.

*'Polar maritime'* air, direct from Canada, is generally unstable, with good visibility outside precipitation, but because it has collected moisture there is usually much more cloud. In summer, the base of "fair weather cumulus" may be high, but especially in winter frequent, possibly heavy showers from deeper cumulus are likely. Thunderstorms are also possible if there is a suitable

‘trigger’ to start them. In winter, cumulus may form over the sea and coastal areas even when the land is too cold to produce convection.

If ‘*arctic maritime*’ air from North of Norway, is forecast, the cold unstable air will include cumulonimbus clouds which form over the sea and drift a short distance over land, and snow will almost certainly fall in coastal areas. Although the visibility outside showers will be excellent, snow will reduce that dramatically.

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# PRESSURE PATTERNS

**ANTICYCLONES** produce settled weather. However, the air becomes progressively more stable, and surface visibility becomes steadily worse (and the inversion at the top of the haze layer lower) unless the air mass changes. There may be no cloud, but especially in winter stratocumulus cloud may form daily, dispersing at night. In summer, with no cloud (or thin cumulus) temperatures may increase daily and slow down the visibility reduction, but in winter the clear skies may lead to radiation fog which takes daily longer to clear.

**RIDGES** tend to move away quickly, so although the weather will again be settled for a time, the disadvantages are less likely to take effect.

**DEPRESSIONS** move quickly, and their effects are mainly associated with their frontal systems. However, even if no frontal system is marked on a chart, the centre of a depression generally contains thick convective cloud with few gaps, and often showers with a low cloud base.

**TROUGHS** are often a combination of fronts. Lines of showers or periods of continuous precipitation are common. Especially over or near high ground there will be a lot of cloud at low altitude, possibly triggering thunderstorms.

**COLS** may encourage radiation fog in autumn or winter, and thunderstorms in summer.

# READING REPORTS



Although you may have considered the likely conditions before flight, you will never have all the information which a forecaster has, and you must **never** fly without an aviation forecast. You must check the area forecast for your route, and also TAFs and METARs for all aerodromes you expect to pass, and any which might be useful as diversion aerodromes. Compare the actual weather with the forecast; if it is worse now, what will happen later?

However, the forecaster will only tell you what he/she (or his/her computer) believes is most likely. He will seldom tell you what he thinks might happen if he is wrong. Study the forecasts for “PROBs”, which indicate uncertainty.

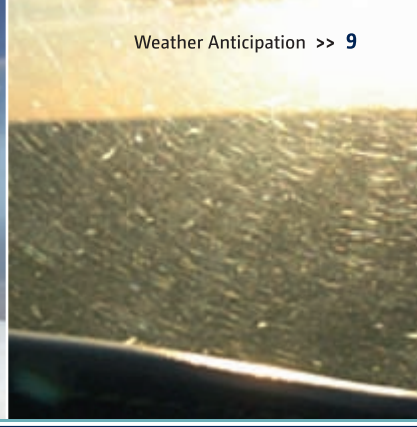
“TEMPO”, “OCNL”, and even “ISOL” will almost certainly affect your flight, as will any gusts in the forecast wind. Always be ready to divert to another aerodrome if you cannot land at your intended destination, but take note of the possible weather problems and know which other aerodrome is most suitable. Carry enough fuel to get there and fly some circuits before you must land.

Local features will affect the reported weather. For example, high ground may reduce the surface wind and increase the cloud base downwind of it, but not at other nearby places.





↑ ABOVE HAZE



↑ GLARE ON APPROACH

Always expect the weather to be about 30% worse than the forecast. If the wind (including gusts) is forecast to be near your crosswind limit, be ready to fly to a diversion with a runway much closer to the wind. If the cloud base is a little low, either avoid high ground altogether, or plan alternative routes over low ground which you can fly if necessary. Carry enough fuel for the alternative route.

**IF VISIBILITY IS NOT VERY GOOD**, plan your route so that the best navigation features are always down sun from you, and approach your destination from the direction of the sun. If you can, select a flying altitude above the haze layer. If you expect to arrive at your destination when the sun is low in the sky, check the forecast wind and available runways to try to avoid landing into sun.

# CLOUD PATTERNS FROM THE GROUND

## ↑ STORMY WEATHER WITH 'ANVIL'

**Clouds** can provide information about the weather in the distance. Increasing amounts of thickening upper cloud are the classic sign of an approaching warm front. However, often the cloud changes come in different forms. More frequently, small amounts of stratus type cloud will appear in bands, far in advance of the surface front. The rain which we expect about fifty miles before a surface warm front often comes in surges, not a progressively increasing amount. The picture shows a sky with a warm front coming from the direction of a range of hills which has broken up the theoretical cloud pattern.

You will seldom see an approaching **cold front**; it will be hidden by low cloud in the warm sector. However, when it has arrived, perhaps giving heavy rain, often rays of sunlight can be seen in the distance to indicate the clearance behind it. The actual passage of the cold front will be indicated by the surface wind veering as the air temperature and dew point drop, even if the sky does not immediately clear.

**Thunderstorms** bring many hazards for aviation, including surface wind changes a long distance away, and can spread rapidly. Light aircraft pilots should avoid them by at least 10 nautical miles. Especially in frontal zones, cumulonimbus clouds are sometimes "embedded" (hidden by other clouds). However, individual distant cumulonimbus will often be indicated either by the cirrus cloud of an 'anvil' (a flat top), or by towering cumulus with large vertical extent, which will themselves turn into storm clouds. Cumulus type clouds at high altitudes, "altocumulus castellanus", will often turn into cumulonimbus very soon.

# ESTIMATING CLOUDBASE FROM THE GROUND

## ↑ A WARM FRONT APPROACHING

It is often difficult to decide the height of the cloud base from the ground. If you have no direct cloud base measurement at your location, and cannot receive reports from nearby aerodromes, it is often tempting to take-off and find the base yourself. Pilots often mistakenly think that the area forecast is too pessimistic.

If cloud is touching a mast or other obstruction, the height of the cloud base is obvious. However, experienced pilots can also estimate cloud base by watching patches of cloud drifting in the wind. The relative movement of the patches as you watch is affected by wind speed and cloud height. If you practise watching cloud moving across the sky when you already know both the wind speed and cloud height, you can develop the skill of estimating cloud height. Practise and check on good weather days. Fast moving cloud patches when the wind is moderate are very low! Forecasts of gradient (2000 feet) wind speed are usually more accurate than forecasts of cloud base. Pilots should also learn the relationship between the windsleeve at their own airfield and the actual wind strength.

If you can find temperature and dew point measurements, high humidity (temperature and dew point close together) indicates that cloud will form at very low heights.

**Precipitation** often indicates a lowering cloud base. Rain may fall from relatively high cloud, but drizzle usually indicates a very low base, and likely carburettor icing.

# CLOUD PATTERNS FROM THE AIR

## ↑ DARKENING CLOUD AND RAINBOW

When you are flying, the same information is usually available as from the ground, although nearby cloud may hide some indications such as cumulonimbus anvils. However, if a pilot looks ahead and around, he can see other clues to possible problems. Darkening clouds suggest precipitation, and a rainbow guarantees it!

In generally good visibility, if the visibility changes around the horizon warn, either cloud is below the aircraft's present altitude, or precipitation is falling there. Neither is good news for a private pilot, so descend, but not below your planned minimum VFR altitude. **IF YOU CANNOT SEE A CLEAR HORIZON, CHANGE YOUR ROUTE, AWAY FROM THE PRECIPITATION.** "Curtains" of cloud which appear to be falling from above indicate precipitation, which may obscure the horizon. Precipitation may spread quickly, especially around the base of a large cumulus, so have another safety option (preferably a diversion aerodrome in sight) before you try to fly around precipitation from an overcast (or even broken) cloudbase.

In good visibility under broken cloud, the areas of sunlit ground, or beams of sunlight shining through gaps, can indicate how much cloud is in that direction. This can help to plan possible route changes if the cloud base starts to lower. A large area of sunlit ground may indicate a gap which is big enough to allow you to



## ↑ PRECIPITATION AHEAD

## ↑ BECOMES THIS WHEN CLOSER

climb away from dangerously low cloud (small gaps are unlikely to allow a safe climb). If the gaps line up across the wind, however, they may be the result of wave motion. The surface wind strength will vary, and you must expect your rate of climb to reduce in the gap, especially at the upwind end.

**Cloud shapes** can give warning of hazards. Cloud which forms below the main cloudbase usually indicates not only precipitation, but often turbulence. 'Funnel' cloud may indicate an embedded cumulonimbus which must be avoided. A cloud which 'rolls', or forms a 'hook' as you see it, is an indication of at least moderate turbulence at cloud level and below.

# THE GROUND FROM THE AIR

## ↑ CLOUD CLOSING IN

It is good to fly above a haze layer. However, if the air to ground visibility reduces, expect the visibility when the aircraft descends, to also become worse. If you fly above scattered cloud, watch for gaps closing, not only ahead but also behind you.

**Patches of low cloud** or mist may be seen in valleys; these warn of probable radiation fog ahead. Any cloud below your cruising altitude should be treated as a potential hazard. Often you will see the first low cloud on hill slopes, but further cloud is likely to form over flatter terrain. Patches of cloud close to cruising altitude indicate probable carburettor icing conditions, and so does the top of a haze layer.

A pilot may become used to poor conditions, and not notice that visibility is gradually becoming worse. Occasionally note an object on the ground ahead that has just become visible and record the time until you are over it. If the time reduces you should consider whether to turn back or divert. At low heights, you must be able to see the ground beyond the next ridge before crossing it. If the same objects remain at the limit of your vision as you fly towards them, that indicates a fog bank or very low cloud.

The forecast **wind velocity** is likely to be quite accurate at cruising altitudes, but be aware of any changes. You should consider the local surface wind, not only in case a forced landing is required, but also to indicate possible crosswind problems at your destination.

Wind strength is difficult to estimate, although if it becomes very strong dust or snow may be blown around. However, cloud



↑ SEE THE GROUND BEYOND THE NEXT RIDGE

↑ SMOKE INDICATES LOCAL SURFACE WIND

shadows moving across the ground can indicate the speed of the gradient wind, as can an aircraft's drift when flying crosswind, or its groundspeed when flying into or down wind.

Valleys usually 'funnel' wind along them, and the direction often changes during the day. Smoke can indicate the direction of the local surface wind. However, if convection is taking place in generally light wind conditions, the actual surface wind may be very different from the gradient wind, and may change rapidly. This may cause problems when attempting a forced landing; a pilot may approach into the wind indicated by a single smoke column, and find he is landing from the wrong direction. It may be better to remember the forecast surface wind and plan accordingly.

If you cannot remember the forecast surface wind, or the actual wind on take-off, you may discover the gradient wind by flying a steady 360 degree turn; see which way the aircraft drifts. Unfortunately, if the engine has already failed, you may not have enough time! It is therefore useful to mark the surface wind you find at take-off on a spare instrument indicator, so you can refer to it in an emergency. Try to remember (or calculate) the position of the sun when you are flying into wind; it should be there when you are on final approach.

However, if several sources of smoke indicate a different surface wind to the forecast, think of possible reasons. Is a front moving faster or slower than forecast? Is a cumulonimbus cloud affecting the winds? Has a sea breeze arrived? Is the **valley** wind changing?

# USE OF RADIO

## ↑ ADVECTION FOG



Pilots who do not talk to air traffic service units lose a useful source of information. A Flight Information Service must provide the METARs, SPECIs and TAFs which the pilot asks for. Ask for these when conditions are not ideal. Check the METARs for your intended destination and possible diversion aerodromes every half hour.

However, pilots can detect changes in weather patterns by listening to the radio without talking. Major aerodromes transmit ATIS (automated terminal information service) messages, and you can expect similar conditions at nearby aerodromes. ‘VOLMET’ groups the many weather reports on published frequencies. A ‘TREND’ at the end of a report may mention reducing cloud base or visibility; that can indicate general deterioration. Reducing pressure also suggests that weather is becoming worse. If surface wind backs and increases earlier or later than forecast, this can warn that an approaching front is changing speed.

In summer, wind changes at coastal aerodromes indicate the presence of sea breezes, possibly bringing advection fog or low stratus. Wind changes elsewhere may be caused by nearby showers or thunderstorms. In autumn and winter, reported temperatures and dew points provide useful indications of possible radiation mist or fog, especially at low lying aerodromes, even before the visibility reduces. When the gradient wind is strong, light winds in the lee of a ridge of hills indicate lee wave or rotor turbulence in the area, and much stronger winds can be expected when the wave length changes. When the wind changes at aerodromes in valleys, any bad weather which has previously been at some distance may arrive soon.



## SUMMARY

- » Understand weather patterns and their likely effects on your flying
- » Always obtain an aviation forecast
- » Look for and consider PROBs, TEMPOs, OCNL and ISOL
- » Expect conditions to be worse than forecast
- » Check actual conditions against the forecast
- » Identify alternative routes and suitable diversion aerodromes
- » Carry enough fuel
- » Scan the sky and horizon for possible problems
- » Note local surface winds
- » Check weather reports while flying
- » Be prepared to divert

# GLOSSARY AND METEOROLOGICAL ABBREVIATIONS

**Glossary:**

<b>ANTICYCLONE</b>	An area of higher surface pressure than its surroundings
<b>COL</b>	Area surrounded by 2 ridges and 2 troughs
<b>DEPRESSION</b>	An area of lower surface pressure than its surroundings
<b>METAR</b>	MÉTéorologique Aviation Régulière <i>(english: Aviation Routine Weather Report)</i>
<b>RIDGE</b>	High pressure between 2 areas of low pressure
<b>TAF</b>	Terminal Aerodrome Forecast
<b>TROUGH</b>	Low pressure between 2 areas of high pressure
<b>VOLMET</b>	meteorological information for aircraft in flight

**Meteorological Abbreviations :**

<b>DRIZZLE</b>	very small raindrops
<b>ISOL</b>	Isolate
<b>OCNL</b>	Occasional
<b>PRECIPITATION</b>	Rain, drizzle, snow, or hail
<b>PROB</b>	Probability Forecast <i>(The probability or chance of thunderstorms or other precipitation events occurring)</i>
<b>SEA BREEZE</b>	Wind from the sea after land heating and convection
<b>TEMPO</b>	Temporary

# IMPRINT

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David Cockburn; Vasco Morao/Page 16: David Cockburn

## Contact details for enquiries:

European General Aviation Safety Team  
E-mail: [egast@easa.europa.eu](mailto:egast@easa.europa.eu)  
[www.easa.europa.eu.int/essi/egast](http://www.easa.europa.eu.int/essi/egast)



**EUROPEAN GENERAL  
AVIATION SAFETY TEAM (EGAST)**  
Component of ESSI

**European Aviation Safety Agency (EASA)**  
Safety Analysis and Research Department  
Ottoplatz 1, 50679 Köln, Germany

**Mail** [egast@easa.europa.eu](mailto:egast@easa.europa.eu)

**Web** [www.easa.europa.eu.int/essi/egast/](http://www.easa.europa.eu.int/essi/egast/)