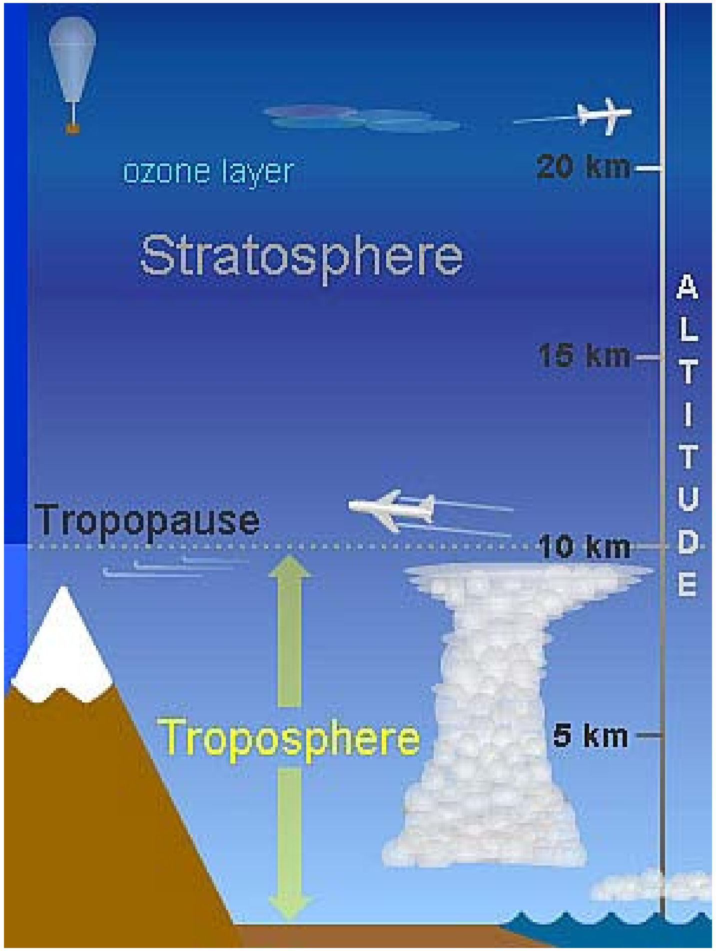
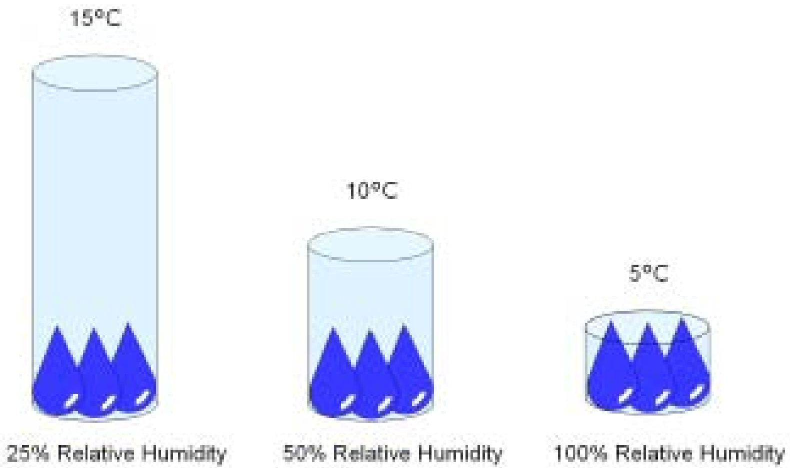
Meteorology

Most types of clouds are found in the troposphere, and almost all weather occurs within this layer.



Air pressure and the density of the air also decrease with altitude. That's why the cabins of high-flying jet aircraft are pressurized.



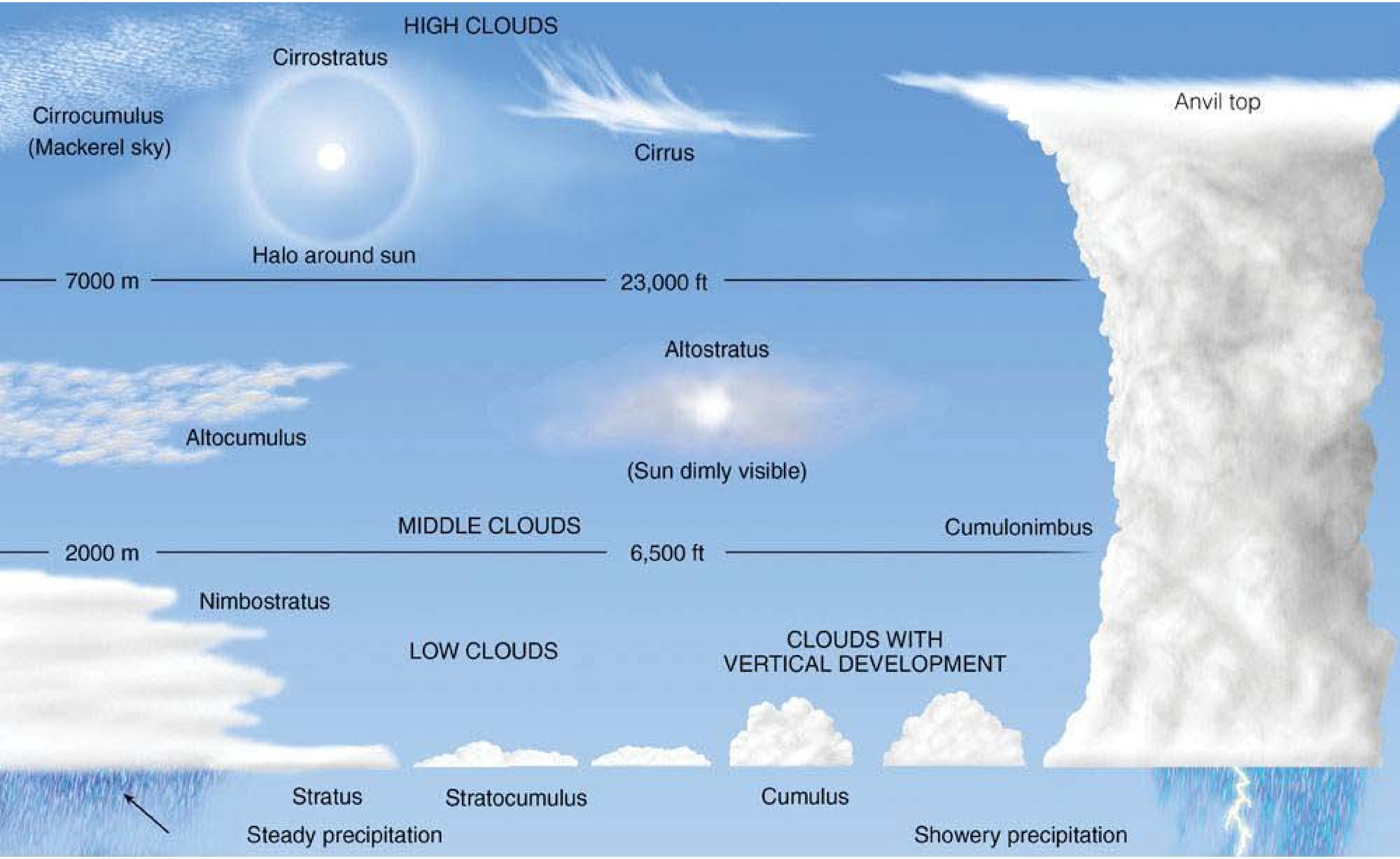
Clouds form when the invisible water vapour in the air condenses into visible water droplets or ice crystals.

Clouds form when the air is saturated and cannot hold any more water vapour, this can happen in two ways:

The amount of water in the air has increased - for example through evaporation - to the point that the air cannot hold any more water.

The air is cooled to its dew point - the point where condensation occurs - and the air is unable to hold any more water.

The **dew point** is the temperature at which the water vapour in air at constant barometric pressure **condenses** into liquid water


HIGH CLOUDS
Cirrostratus
Cirrocumulus
(Mackerel sky)
Cirrus
Anvil top
Halo around sun
7000 m
23,000 ft
Altostratus
Altocumulus
(Sun dimly visible)
MIDDLE CLOUDS
Cumulonimbus
2000 m
6,500 ft
Nimbostratus
LOW CLOUDS
CLOUDS WITH
VERTICAL DEVELOPMENT
Stratus
Stratocumulus
Cumulus
Steady precipitation
Showery precipitation

Alto Cloud

Altocumulus clouds are mid-level, greyish-white with one part darker than the other. Altocumulus clouds usually form in groups and are about one kilometre thick. Altocumulus clouds are about as wide as your thumb when you hold up your hand at arm's length. If you see altocumulus clouds on a warm, humid morning, there might be a thunderstorm by late afternoon.

Altostratus clouds are mid-level, grey or blue-grey clouds that usually covers the whole sky. The Sun or moon may shine through an altostratus cloud, but will appear watery or fuzzy. If you see altostratus clouds, a storm with continuous rain or snow might be on its way. Occasionally, rain falls from an altostratus cloud. If the rain hits the ground, then the cloud has become a nimbostratus.

Cirrus

Cirrus clouds are made of ice crystals and look like long, thin, wispy white streamers high in the sky. They are commonly known as "mare's tails" because they are shaped like the tail of a horse. Cirrus clouds are often seen during fair weather. But if they build up larger over time and are followed by cirrostratus clouds, there may be a warm front on the way.

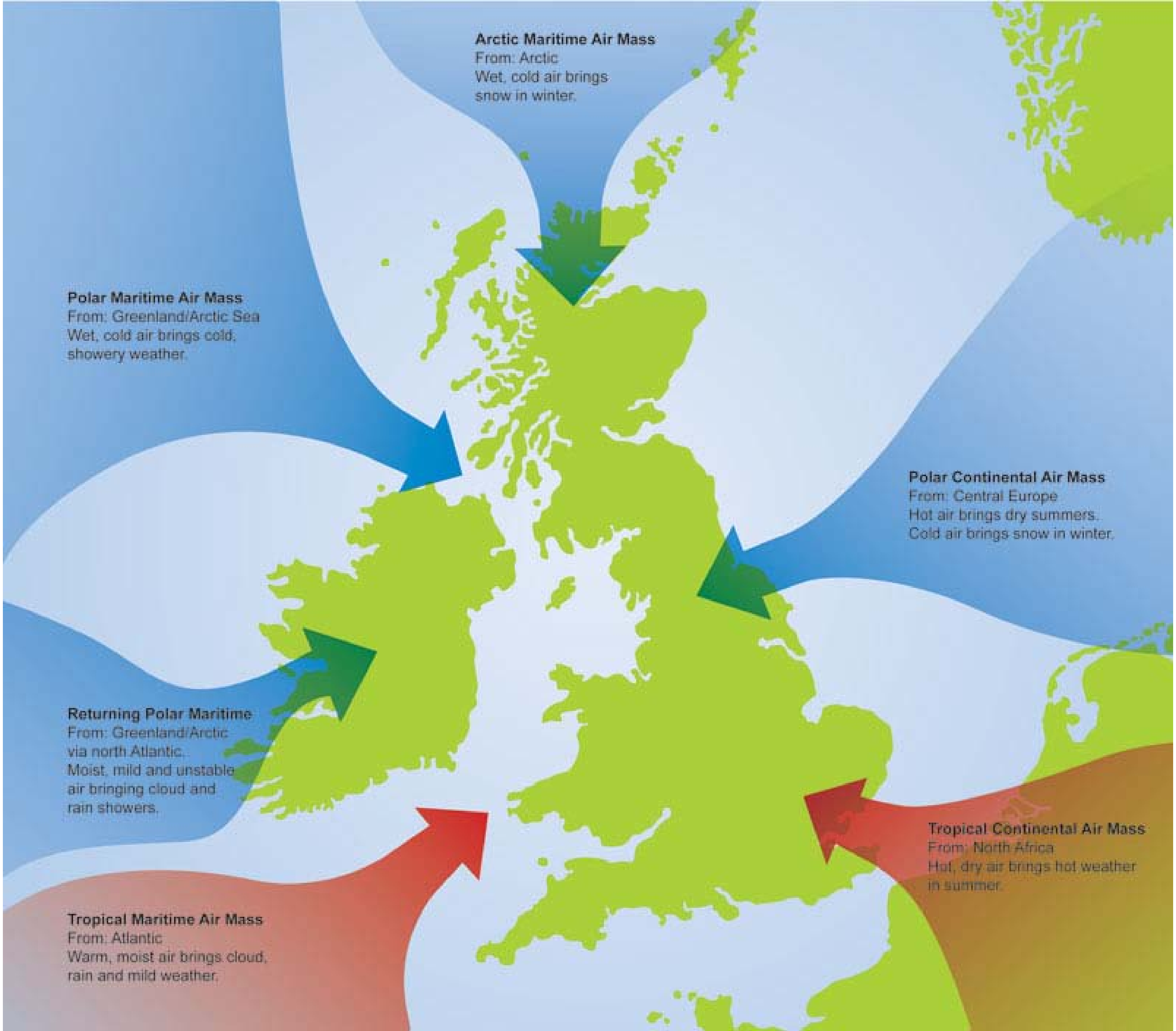
Cumulus Cloud

Cumulus clouds have vertical growth. They are puffy white or light gray clouds that look like floating cotton balls. Cumulus clouds have sharp outlines and a flat base at a height of 1000m. They are generally about one kilometre wide which is about the size of your fist or larger when you hold up your hand at arm's length to look at the cloud. Cumulus clouds can be associated with fair or stormy weather. Watch for rain showers when the cloud’s tops look like cauliflower heads

Lenticular clouds, technically known as altocumulus standing lenticularis, are stationary lens-shaped clouds that form at high altitudes, normally aligned at right-angles to the wind direction.

Where stable moist air flows over a mountain or a range of mountains, a series of large-scale standing waves may form on the downwind side. Lenticular clouds sometimes form at the crests of these waves. Under certain conditions, long strings of lenticular clouds can form, creating a formation known as a wave cloud.

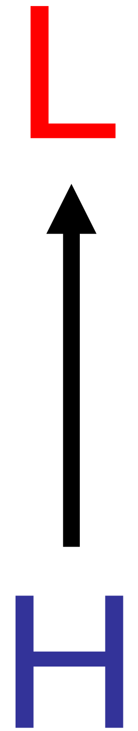
Pilots tend to avoid flying near lenticular clouds because of the turbulence of the rotor systems that accompany them



Arctic Maritime Air Mass
From: Arctic
Wet, cold air brings
snow in winter.
Polar Maritime Air Mass
From: Greenland/Arctic Sea
Wet, cold air brings cold,
showery weather.
Polar Continental Air Mass
From: Central Europe
Hot air brings dry summers.
Cold air brings snow in winter.
Returning Polar Maritime
From: Greenland/Arctic
via north Atlantic.
Moist, mild and unstable
air bringing cloud and
rain showers.
Tropical Continental Air Mass
From: North Africa
Hot, dry air brings hot weather
in summer.
Tropical Maritime Air Mass
From: Atlantic
Warm, moist air brings cloud,
rain and mild weather.

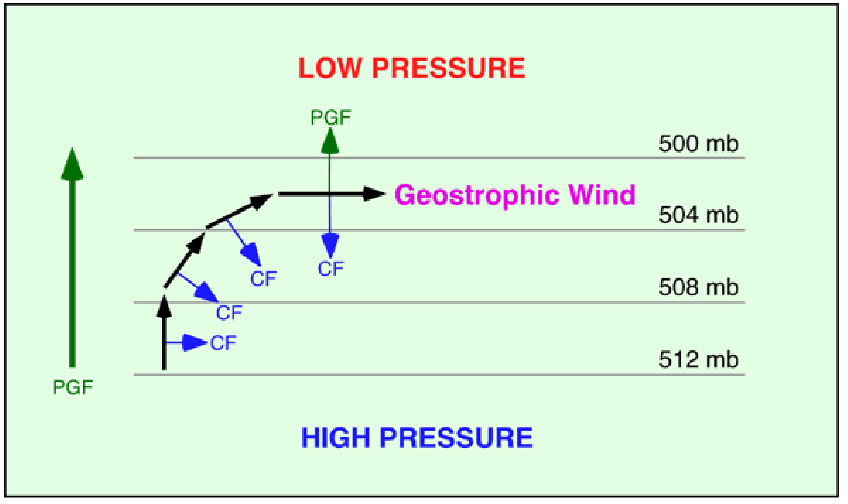
The Wind

Air moves from high to low pressure. This is called the Pressure Gradient Force.



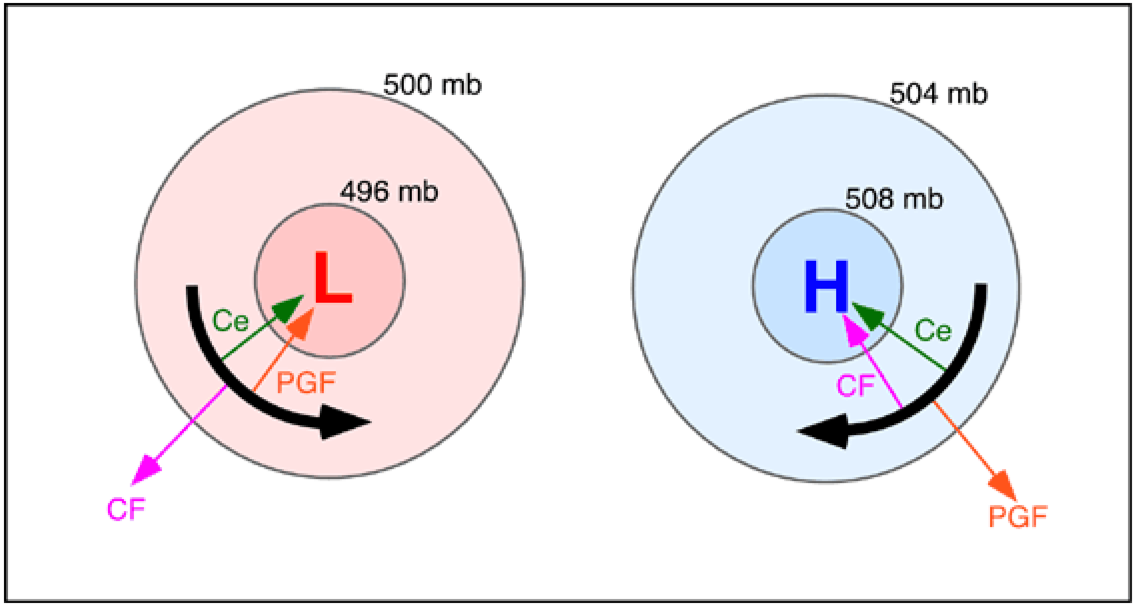
The rotation of the Earth creates another force, termed Coriolis force, which acts upon wind and other objects in motion in very predictable ways. According to Newton's first law of motion, air will remain moving in a straight line unless it is influenced by an unbalancing force. The consequence of Coriolis force opposing pressure gradient acceleration is that the moving air changes direction. Instead of wind blowing directly from high to low pressure, the rotation of the Earth causes wind to be deflected off course. In the Northern Hemisphere, wind is deflected to the right of its path.

Air under the influence of both the pressure gradient force and Coriolis force tends to move parallel to isobars in conditions where friction is low (1000 meters above the surface of the Earth) and isobars are straight. Winds of this type are usually called geostrophic winds. Geostrophic winds come about because pressure gradient force and Coriolis force come into balance after the air begins to move (Figure 7n-7).



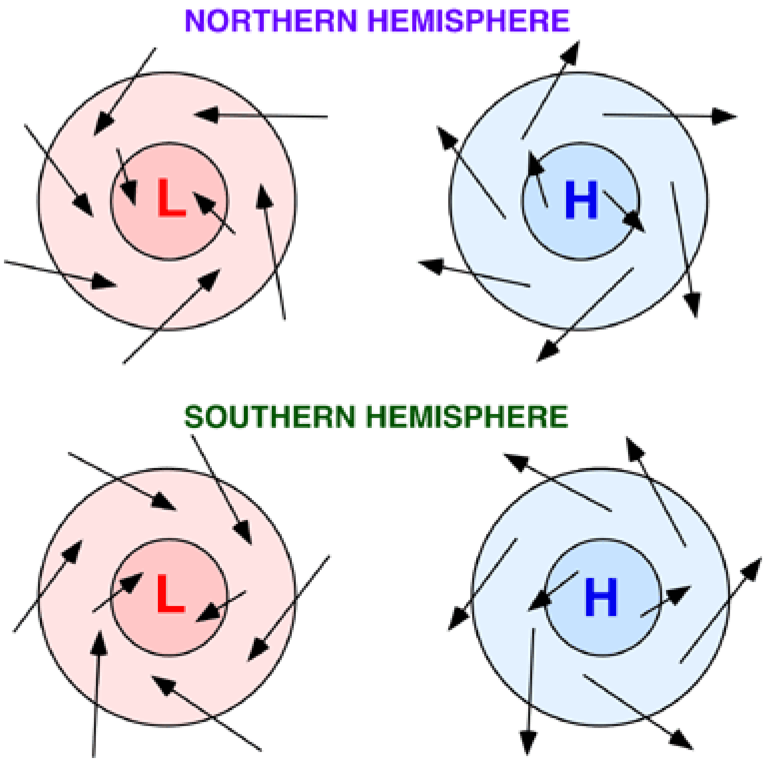
Gradient Wind

Wind above the Earth's surface does not always travel in straight lines. In many cases winds flow around the curved isobars of a high (anticyclone) or low (cyclone) pressure centre. A wind that blows around curved isobars above the level of friction is called a gradient wind. Gradient winds are slightly more complex than geostrophic winds because they include the action of yet another physical force. This force is known as centripetal force and it is always directed toward the centre of rotation. The following figure shows the forces that produce gradient winds around high and low pressure centres. Around a low, the gradient wind consists of the pressure gradient force and centripetal force acting toward the centre of rotation, while Coriolis force acts away from the centre of the low. In a high pressure centre, the Coriolis and centripetal forces are directed toward the centre of the high, while the pressure gradient force is directed outward.



Friction Layer Wind

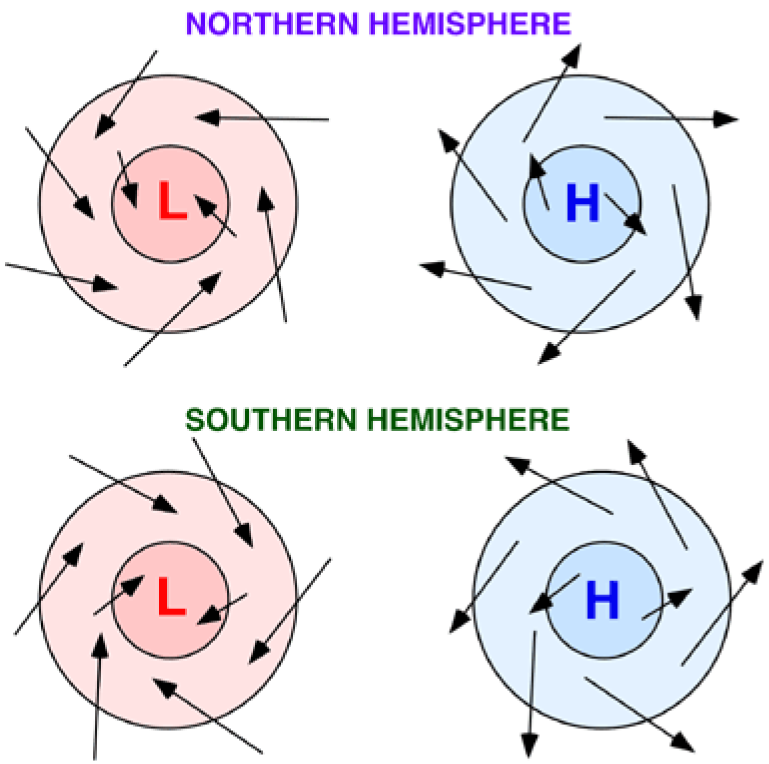
Surface winds on a weather map do not blow exactly parallel to the isobars as in geostrophic and gradient winds. Instead, surface winds tend to cross the isobars at an angle varying from 10 to 45°. Close to the Earth's surface, friction reduces the wind speed, which in turn reduces the Coriolis force. As a result, the reduced Coriolis force no longer balances the pressure gradient force, and the wind blows across the isobars toward or away from the pressure centre. The pressure gradient force is now balanced by the sum of the frictional force and the Coriolis force. Thus, we find surface winds blowing anticlockwise and inward into a surface low, and clockwise and out of a surface high in the Northern Hemisphere. In the Southern Hemisphere, the Coriolis force acts to the left rather than the right. This causes the winds of the Southern Hemisphere to blow clockwise and inward around surface lows, and anticlockwise and outward around surface highs



Now you know that when flying towards an area of Low Pressure you will experience drift to the right.

Due to friction on the surface – wind tend to be half the strength of those at 2000 feet on average 'back' by 30 degrees.

When winds 'veer' they change direction clockwise around the points of the compass.



When winds 'back' they change direction anti-clockwise around the points of the compass.

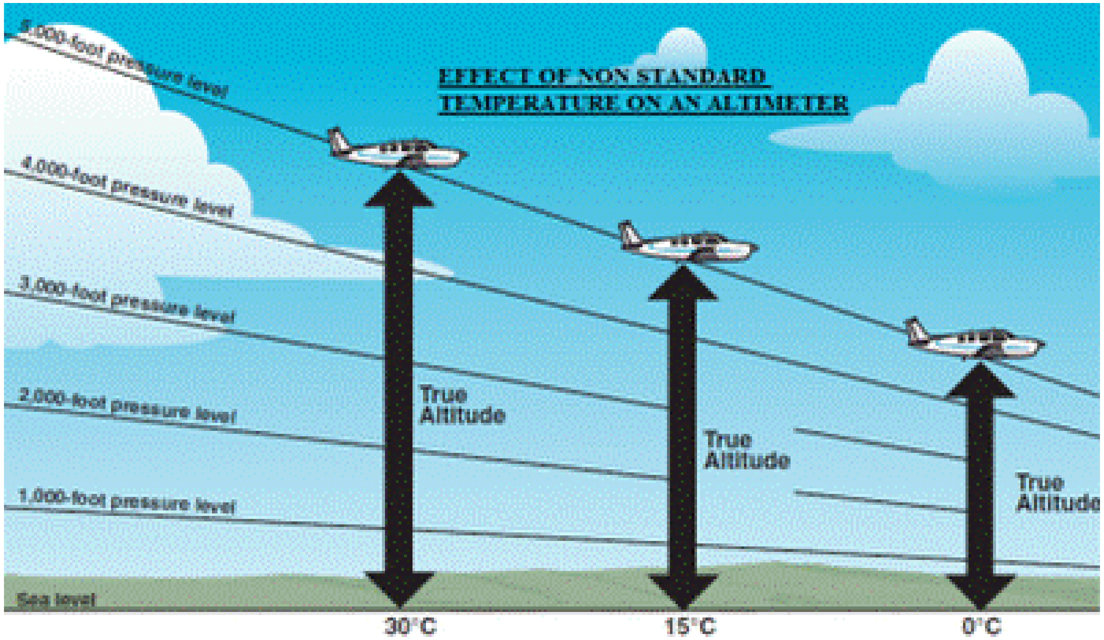
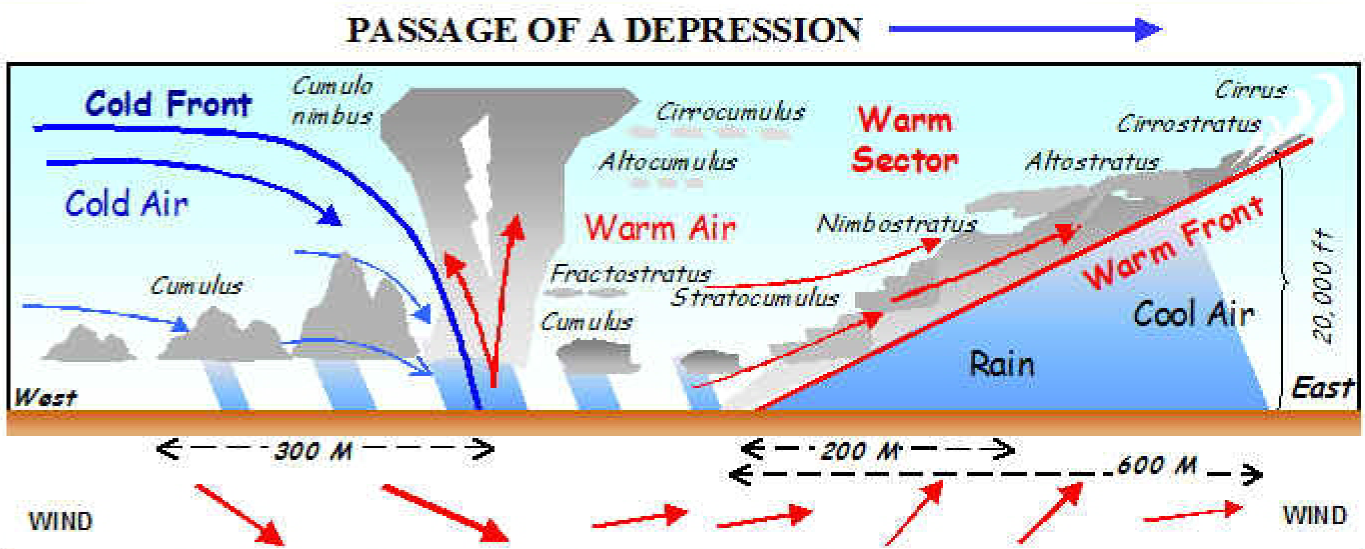


FIGURE SHOWS HOW VARIATIONS IN AIR TEMPERATURE ALSO AFFECT THE ALTIMETER. ON A WARM DAY, A GIVEN MASS OF AIR EXPANDS TO A LARGER VOLUME THAN ON A COLD DAY, RAISING THE PRESSURE LEVELS. FOR EXAMPLE, THE PRESSURE LEVEL WHERE THE ALTIMETER INDICATES 5,000 FEET IS HIGHER ON A WARM DAY THAN UNDER STANDARD CONDITIONS. ON A COLD DAY, THE REVERSE IS TRUE, AND THE PRESSURE LEVEL WHERE THE ALTIMETER INDICATES 5,000 FEET IS LOWER. THE ADJUSTMENT TO COMPENSATE FOR NONSTANDARD PRESSURE DOES NOT COMPENSATE FOR NONSTANDARD TEMPERATURE.

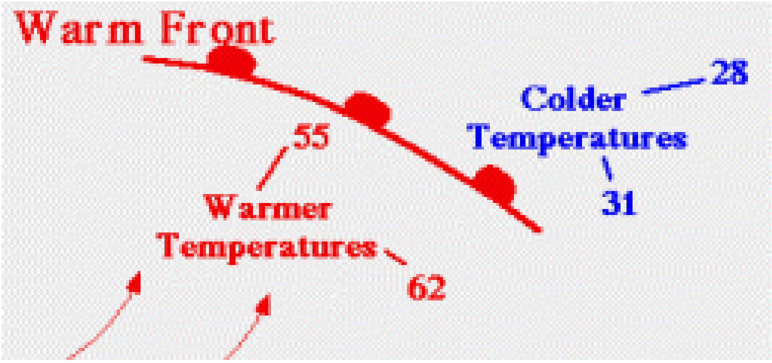
Frontal System

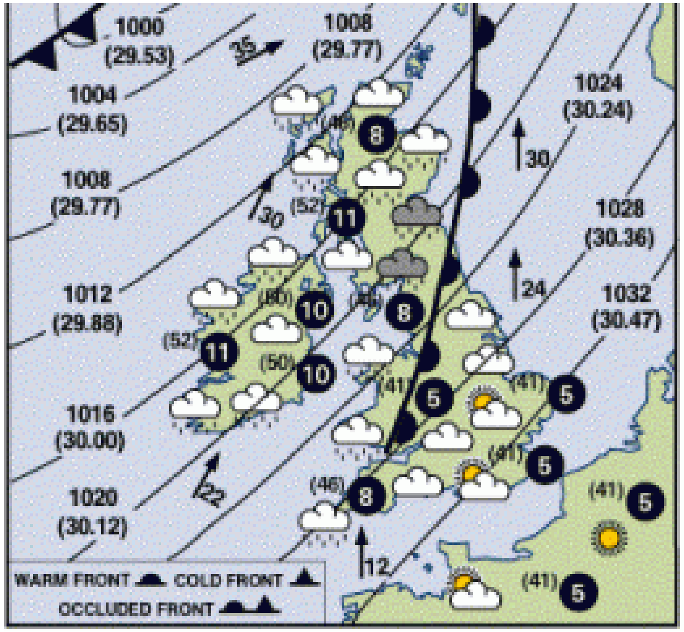


WIND	Strong gusts	Veering sharply Squalls	Steady	Veering	Backing & increasing	**WIND**
PRESSURE	Rising, then steady	Rising quickly	Steady	Steady	Falling	**PRESSURE**
RAIN	Sunny, squally showers	Heavy rain, thunder, hail	Light rain	Drizzle	Becoming heavier and prolonged	**RAIN**
VISIBILITY	Good except in showers	Poor in rain	Poor, Fog	Poor	Deteriorating	**VISIBILITY**
TEMP	Cold	Falls	Warm	Warm	Rising	**TEMP**

Warm Fronts 1:150

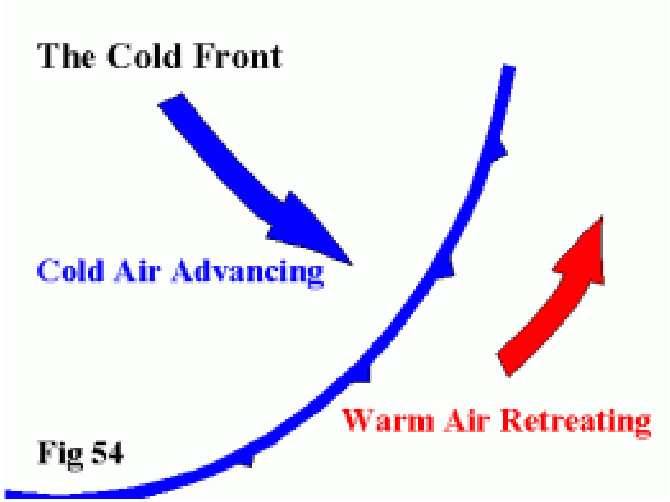
A warm front marks the boundaries between warmer and cooler air. The cooler air will be ahead of the warm front with warmer air behind it. When a Warm Front moves in it brings milder air to the area it passes over. When a Warm Front passes through, it'll often bring a spell of extended rain, and generally bring cloudier weather before the cloud eventually clears to brighter skies. Warm Fronts generally bring light-moderate rainfall. Warm Fronts can are easy to spot on weather charts. They're generally a line with semi-circles on the front edge of the front. The pictures below demonstrate a warm front at work. In the first picture we see what a warm front looks like, and how it replaces cooler air. In the second picture we see a warm front crossing the United Kingdom. Notice how the temperatures behind it are warmer than the temperatures in front of it. Warm Fronts are associated with Low Pressure Systems.

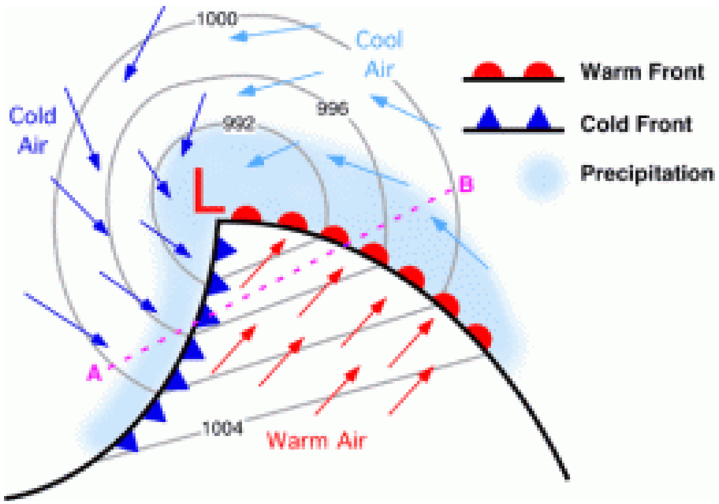




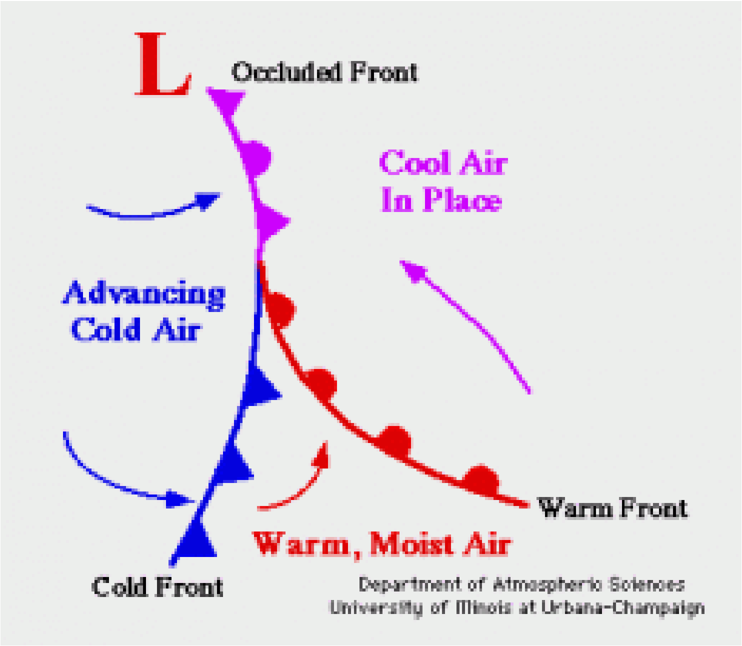
Cold Fronts 1:50

Cold Fronts, as you might have already guessed are the complete opposite to Warm Fronts. Cold Fronts mark the boundary between warm and cold air, the warmer air is ahead of a Cold Front, and the cooler air behind. As a Cold Front pushes through, it'll usually bring a spell of heavy rain but often clears leaving clear, sunny spells or showers. During the summer Cold Fronts can cause severe thunder activity as it pushes into some very warm air. During the winter cold fronts can mark the start of a cold, snowy spell. Cold Fronts typically bring a short period of heavy rain. Cold Fronts can be seen on the charges indicated by a blue line with triangles on its front side. The First image below shows a cold front replacing milder air. The Second image shows an area of low pressure with a warm front being quickly followed by a Cold Front. The image also shows where the Precipitation will be on both fronts. Cold Fronts are associated with Low Pressure systems.

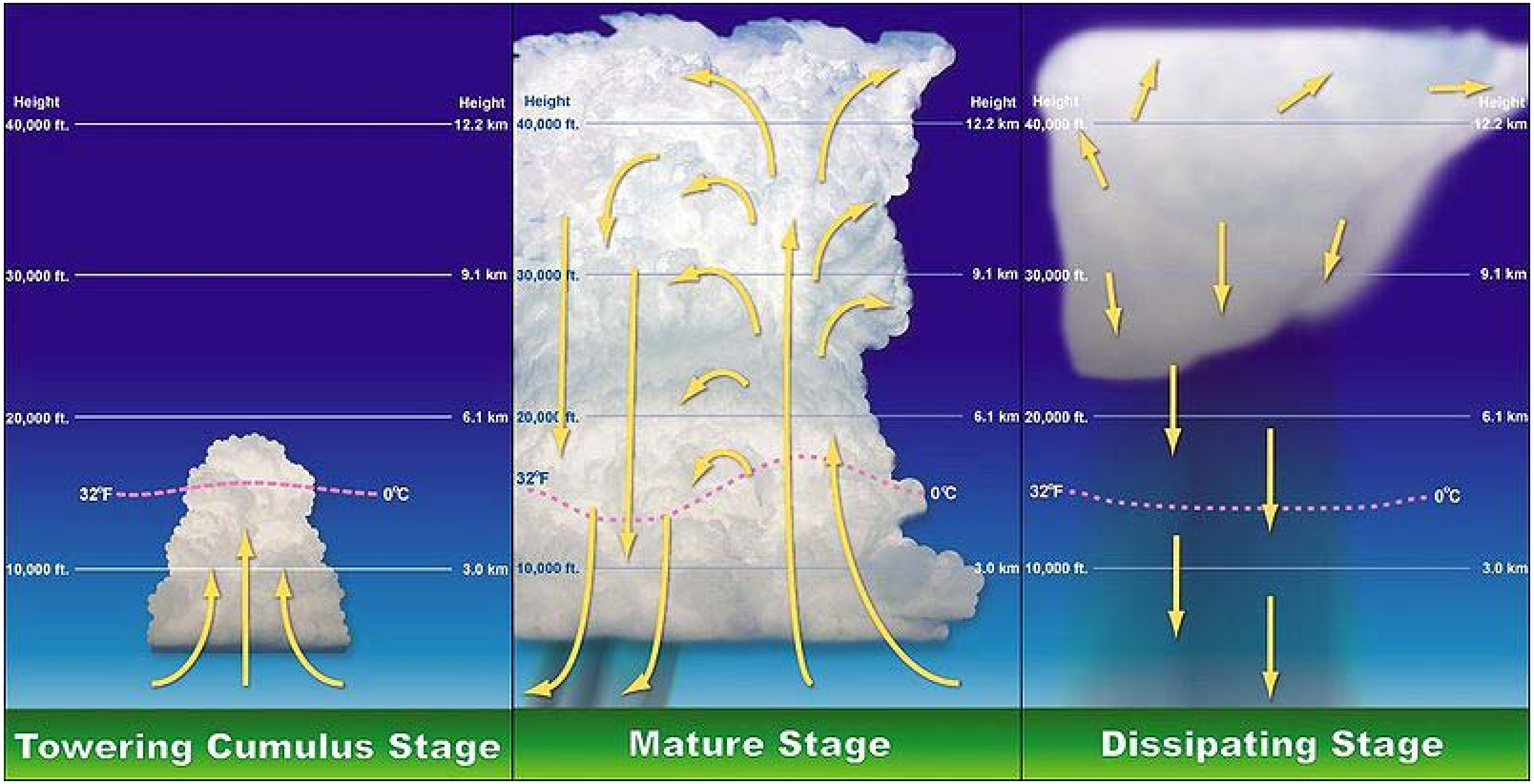


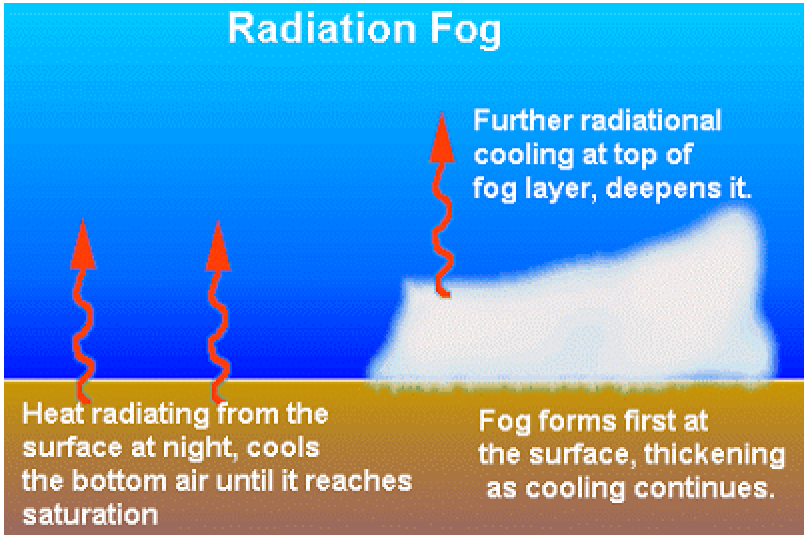


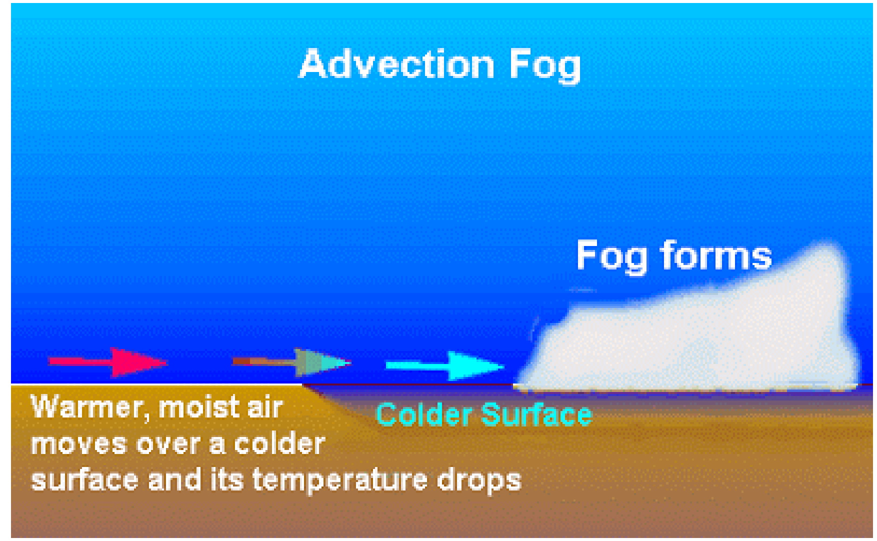
An Occluded front forms when a Warm Front and a Cold Front catch up with each other and merge. An Occluded front can be either a Warm Occluded Front, which in tern would act very similar to a Warm Front, or a Cold Occluded front, which in tern would act very similar to a Cold Front. The picture below demonstrates what an Occluded Front looks like, and how it is formed. Occluded Fronts are associated with areas of low pressure. A Cold Occluded Front forms when a Cold Front catches up with a Warm Front. A Warm occluded front forms when a Warm Front catches up with a Cold Front.

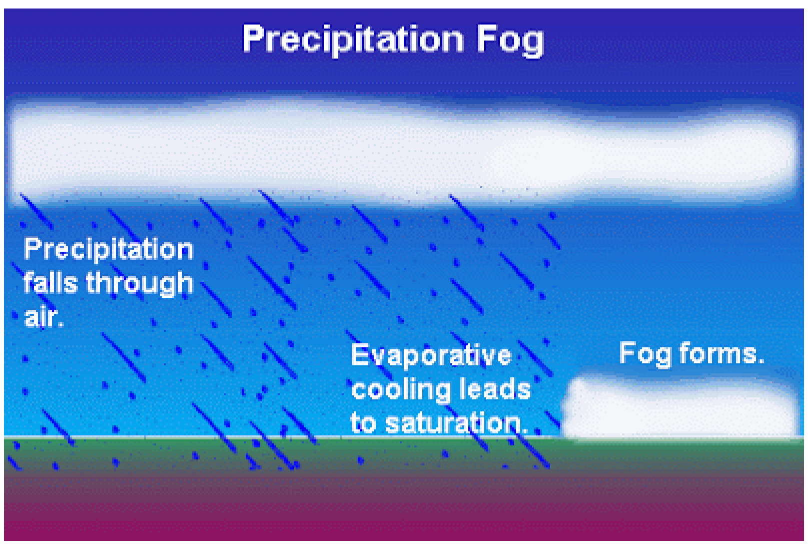


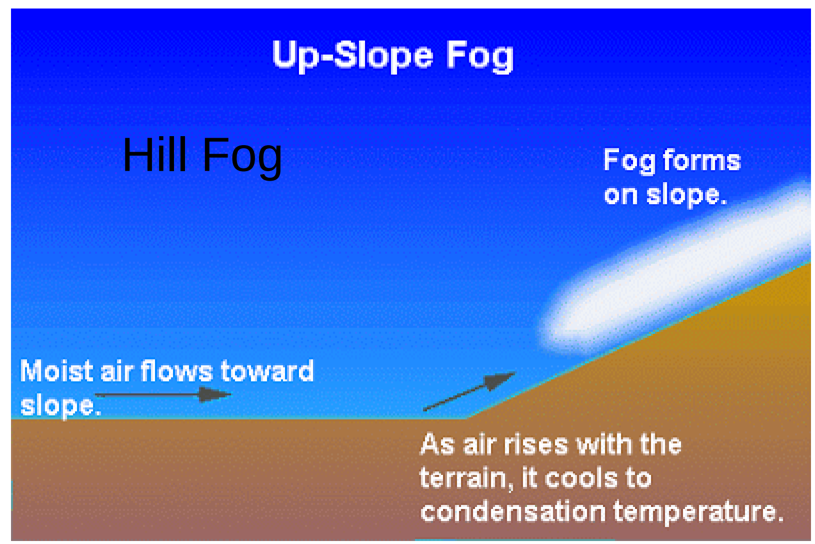
Danger: Thunderstorm Activity can be masked by Stratiform Cloud.

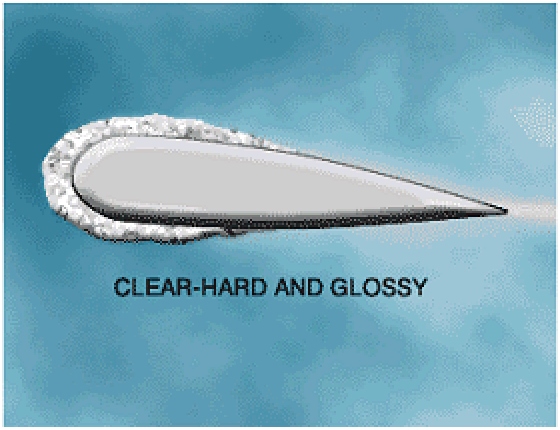

Height
40,000 ft.
30,000 ft.
20,000 ft.
10,000 ft.
Height
12.2 km
9.1 km
6.1 km
3.0 km
32°F
0°C
Towering Cumulus Stage
Mature Stage
Dissipating Stage


Radiation Fog
Further radiational cooling at top of fog layer, deepens it.
Heat radiating from the surface at night, cools the bottom air until it reaches saturation
Fog forms first at the surface, thickening as cooling continues.


Advection Fog
Fog forms
Warmer, moist air moves over a colder surface and its temperature drops
Colder Surface


Precipitation Fog
Precipitation falls through air.
Evaporative cooling leads to saturation.
Fog forms.

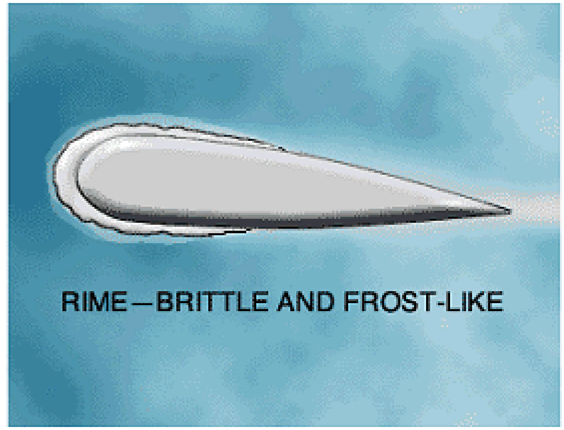

Up-Slope Fog
Hill Fog
Fog forms on slope.
Moist air flows toward slope.
As air rises with the terrain, it cools to condensation temperature.



Sideview of wing with clear ice

clear ice

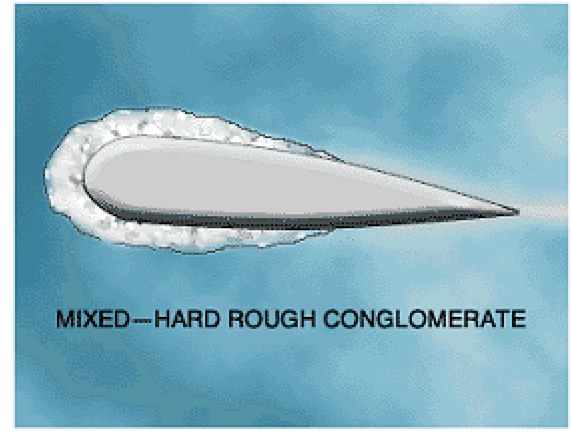
After the initial impact of supercooled droplets from large raindrops strike the surface, the remaining liquefied portion flows out over the surface and freezes gradually. This freezes as a smooth sheet of sold ice. It is hard and heavy and is difficult to remove



Sideview of wing with rime.

rime ice

Formed from small supercooled droplets when the remaining liquefied portion after initial impact freezes rapidly before the drop has time to spread over the surface. This traps air between the droplets, and gives the ice a white appearance. It is lighter in weight than clear ice. Its formation is irregular and its surface is rough. It is brittle and more easily removed than clear ice.

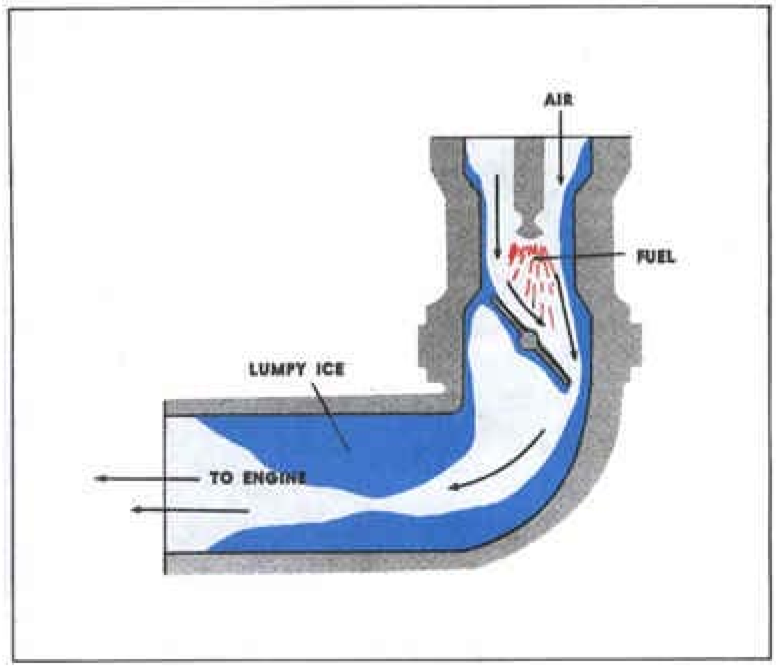


Sideview of wing with mixed ice

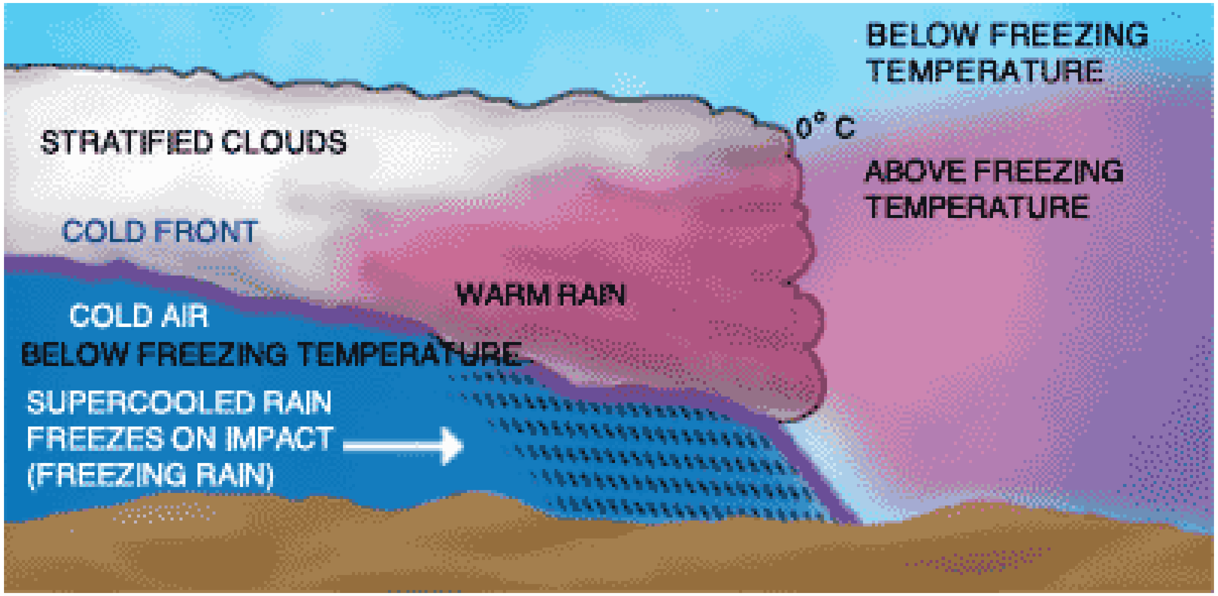
mixed ice

Formed when supercooled water droplets are of various sizes or are intermingled with snow or ice particles. After initial impact, the remaining portion freezes rapidly and forms a mushroom shape on the leading edges of a wing. Ice particles are imbedded in clear ice and form a hard and rough-edged mass.

Carb Icing

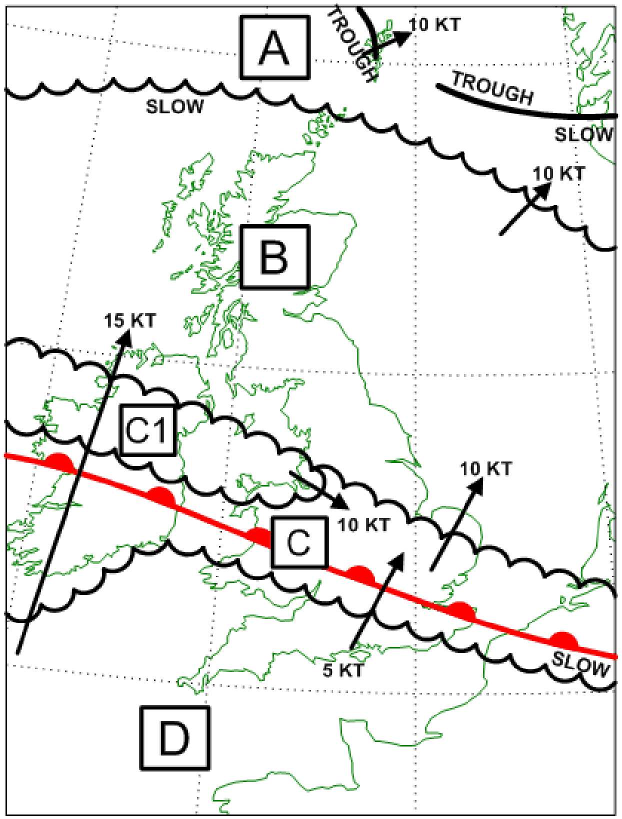


Carb Icing can be encountered when flying in clear air. As can Hoar Frost, which is formed the same way as dew except in temperatures below freezing.



FREEZING RAIN WITH A COLD FRONT WILL CAUSE ICING

Met Office



All heights in 100s of feet above mean sea level

XXX means above chart upper limit
Speed of movement in KT
Hill FG implies VIS <200 M

Cloud amount (Oktas)
FEW: 1-2 SCT: 3-4
BKN: 5-7 OVC: 8

MOD / SEV ICE
MOD / SEV TURB
TS / CB implies GR
FZ precipitation implies

This forecast may be amended at any time.

Issued by Met Office Exeter at 130405 Z

Contact telephone 0370 900 0100 F215

Forecaster: Duty Forecaster

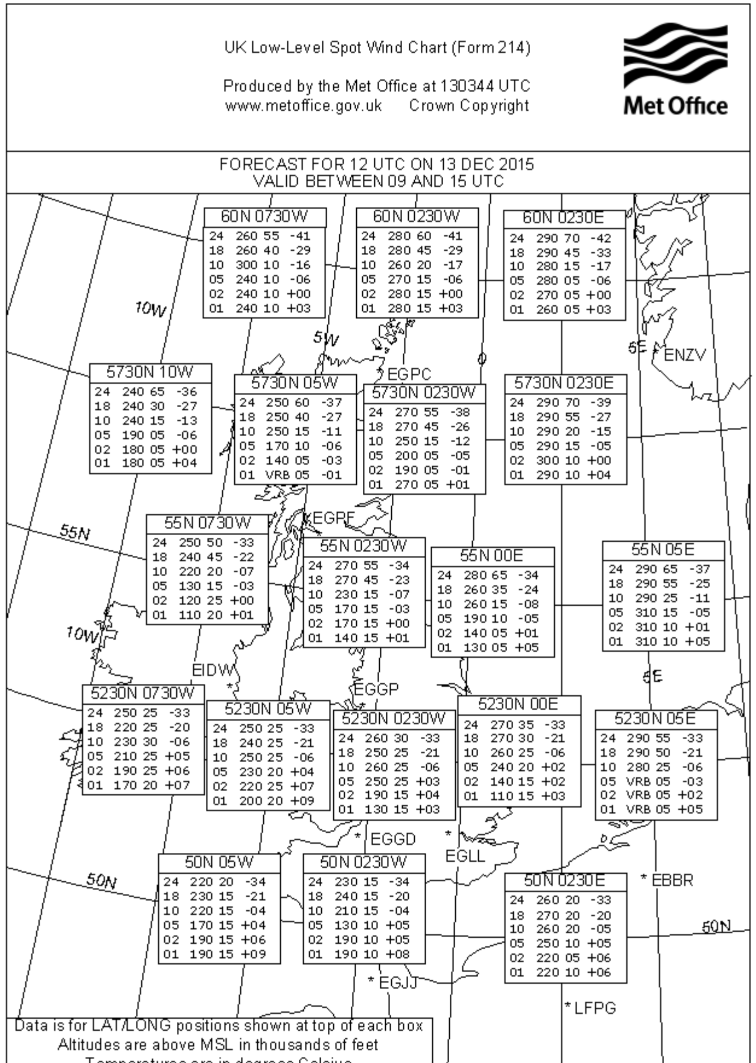
Forecast Weather below 10000 FT AMENDED

Met Office Valid 130800 to 131700 Z DEC 15 Fronts/zones valid at 131200 Z

AREA	SURFACE VIS AND WX	CLOUD	0 C
A	40 KM NIL ISOL (OCNL TROUGHS) 6 KM ... ... SHRA/SHRASN ISOL 2000 M +SHRA/+TSGS ... ... MAINLY TROUGHS ISOL 200 M +SHSN MON ISOL HILL FG	ISOL SCT/BKN AC 080 / XXX ... ... MAINLY TROUGHS OCNL SCT/BKN CU SC ... ... 020-030 / 070-XXX ISOL CB 015-020 / XXX MAINLY TROUGHS ISOL SCT/BKN ST 005-010 / 015 (LCA ... ... BASE 002 +SHSN)	015-025
B	25 KM NIL ISOL 7 KM SHRA MAINLY SEA COT ISOL (OCNL S TL 12 Z) 2000 M BR LAN LCA 1000 M SN MON ISOL 200 M FG/FZFG LAN TL 12 Z ISOL HILL FG	ISOL SCT/BKN AC 080 / XXX W ISOL (OCNL SEA COT) SCT/BKN CU SC ... ... 020-030 / 060-080 (XXX N) ISOL SCT/BKN ST 005-010 / 015 MAINLY ... ... LAN (BASE 000 FG/FZFG)	020-030 ... ... LCA ... ... 005-010 ... ... LAN N
C	15 KM NIL/-RA OCNL (WDSPR FRONT) 7 KM ... ... RA/-RADZ/HZ ISOL (OCNL FRONT) 2000 M RADZ/BR ISOL 1200 M DZ/(+RA **C1**) LCA 200 M +SN MON **C1** ISOL MAINLY W OF 08 W OCNL (WDSPR FRONT) HILL FG	BKN/OVC (SCT FAR E) AC AS ... ... 080 / XXX BKN/OVC CU SC / *(N OF WARM ...* *... FRONT)* 015-030 / 080-XXX AREAS BKN/OVC ST 005-010 / 015 ... ... (OCNL BASE 001-003 FRONT)	030-040 N 050-070 S
D	15 KM NIL ISOL (OCNL LAN) 7 KM HZ ISOL 2000 M -DZ/BR ISOL 200 M FG/FZFG LAN CONTINENT ... ... TL 12 Z OCNL HILL FG	OCNL BKN/OVC CU SC ... ... 015-025 / 040-060 OCNL SCT/BKN ST 008-012 / 015 ... ... MAINLY LAN (BASE 000 FG/FZFG)	070

Outlook Until 140000 Z: COLD FRONT ARRIVES IN FAR SW FM 18Z, SPREADING SLOWLY NE, BRINGING OCNL RA, WITH ISOL HVY RA ON FRONT, AND BKN/OVC LYR CLD. OTHERWISE SIMILAR.

Met Office



UK Low-Level Spot Wind Chart (Form 214)
Produced by the Met Office at 130344 UTC
www.metoffice.gov.uk Crown Copyright
Met Office
FORECAST FOR 12 UTC ON 13 DEC 2015
VALID BETWEEN 09 AND 15 UTC
60N 0730W
24 260 55 -41
18 260 40 -29
10 300 10 -16
05 240 10 -06
02 240 10 +00
01 240 10 +03
60N 0230W
24 280 60 -41
18 280 45 -29
10 260 20 -17
05 270 15 -06
02 280 15 +00
01 280 15 +03
60N 0230E
24 290 70 -42
18 290 45 -33
10 280 15 -17
05 280 05 -06
02 270 05 +00
01 260 05 +03
10W
5W
5E
ENZV
EGPC
5730N 10W
24 240 65 -36
18 240 30 -27
10 240 15 -13
05 190 05 -06
02 180 05 +00
01 180 05 +04
5730N 05W
24 250 60 -37
18 250 40 -27
10 250 15 -11
05 170 10 -06
02 140 05 -03
01 VRB 05 -01
5730N 0230W
24 270 55 -38
18 270 45 -26
10 250 15 -12
05 200 05 -05
02 190 05 -01
01 270 05 +01
5730N 0230E
24 290 70 -39
18 290 55 -27
10 290 20 -15
05 290 15 -05
02 300 10 +00
01 290 10 +04
55N
EGPF
55N 0730W
24 250 50 -33
18 240 45 -22
10 220 20 -07
05 130 15 -03
02 120 25 +00
01 110 20 +01
55N 0230W
24 270 55 -34
18 270 45 -23
10 230 15 -07
05 170 15 -03
02 170 15 +00
01 140 15 +01
55N 00E
24 280 65 -34
18 260 35 -24
10 260 15 -08
05 190 10 -05
02 140 05 +01
01 130 05 +05
55N 05E
24 290 65 -37
18 290 55 -25
10 290 25 -11
05 310 15 -05
02 310 10 +01
01 310 10 +05
10W
EIDW
EGGP
5E
5230N 0730W
24 250 25 -33
18 220 25 -20
10 230 30 -06
05 210 25 +05
02 190 25 +06
01 170 20 +07
5230N 05W
24 250 25 -33
18 240 25 -21
10 250 25 -06
05 230 20 +04
02 220 25 +07
01 200 20 +09
5230N 0230W
24 260 30 -33
18 250 25 -21
10 260 25 -06
05 250 25 +03
02 190 15 +04
01 130 15 +03
5230N 00E
24 270 35 -33
18 270 30 -21
10 260 25 -06
05 240 20 +02
02 140 15 +02
01 110 15 +03
5230N 05E
24 290 55 -33
18 290 50 -21
10 280 25 -06
05 VRB 05 -03
02 VRB 05 +02
01 VRB 05 +05
* EGGD
* EGLL
50N
50N 05W
24 220 20 -34
18 230 15 -21
10 220 15 -04
05 170 15 +04
02 190 15 +06
01 190 15 +09
50N 0230W
24 230 15 -34
18 240 15 -20
10 210 15 -04
05 130 10 +05
02 190 10 +05
01 190 10 +08
50N 0230E
24 260 20 -33
18 270 20 -20
10 260 20 -05
05 250 10 +05
02 220 05 +06
01 220 10 +06
* EBBR
50N
* EGJJ
* LFPG
Data is for LAT/LONG positions shown at top of each box
Altitudes are above MSL in thousands of feet
Temperatures are in degrees Celsius

Met Office

DONCASTER SHEFFIELD	**EGCN 131450Z VRB02KT 3900 -RA BR BKN024 BKN029 04/04 Q1019**
HUMBERSIDE	**EGNJ 131450Z 08005KT 8000 FEW015 06/06 Q1019**

DONCASTER SHEFFIELD	**EGCN 131107Z 1312/1412 32006KT 9999 SCT020 TEMPO 1312/1315 8000 PROB30 TEMPO 1312/1315 4000 BR BECMG 1315/1317 8000 -RA BKN010 TEMPO 1315/1318 4000 RADZ BKN004 BECMG 1318/1321 4000 BR BKN005 TEMPO 1320/1402 1400 BKN002 PROB30 TEMPO 1321/1402 0700 FG BKN001 BECMG 1402/1405 9999 NSW FEW004 SCT025 TEMPO 1405/1412 7000**

NOSIG: No Significant Change expected in next 2 hours after observation time.