Cloud Amounts

The amount of cloud observed or forecast to be present must be expressed in terms that can readily be understood by observers on the ground and pilots in the air alike. To an observer on the ground, it would appear sensible to express the amount of cloud as a fraction of the sky covered by cloud. This is indeed the method used. The amount of cloud cover is expressed in *oktas*, an okta being a unit representing one-eighth of the sky.

Many ask, Why not use tenths of the sky covered? The reason is that for international coding purposes, the figure 0 must be reserved for conditions where no cloud is present, and 9 is reserved for conditions where the sky is not visible (because of fog, for example). This leaves eight figures available, so we divide the sky into eight parts for expressing cloud amount. Thus, if a quarter of the sky is covered, we say that the cloud amount is 2 oktas, or $^2/_8$. Half of the sky covered becomes 4 oktas, or $^4/_8$. (See also Chapter 9.)

Moisture in the Atmosphere

Clouds are formed when water vapour in the atmosphere condenses into water droplets or, in below-freezing temperatures, into ice crystals. Water vapour is taken up into the atmosphere mainly by evaporation from the oceans and other bodies where water is present, or by sublimation directly from solid ice when the air overlies a frozen surface.

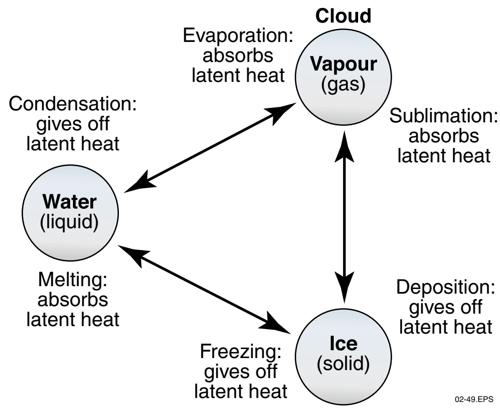

Figure 2-1 Three states of water.

Three States of Water

Water exists in three states: gas (vapour), liquid (water) and solid (ice). Water is not visible in its vapour state, but when the water vapour condenses to form water droplets, we see it as cloud, fog, mist, rain or dew. Frozen water in the form of ice crystals is also visible as high-level cloud, snow, hail, ice or frost.

Under certain conditions, water can change from one state to another, absorbing heat energy if it moves to a higher energy state (from ice to water to vapour) and giving off heat energy if it changes to a lower energy state (vapour to water to ice). This heat energy is known as *latent* (or *hidden*) heat and is a vital part of any change of state. The absorption or emission of latent heat is important in meteorological processes such as cloud formation and evaporation of rain (virga). The three states of water, the names of the various transfer processes and the absorption or giving-off of latent heat are shown in figure 2-1.

Relative Humidity

The amount of water vapour present in the air depends upon the amount of evaporation, which will be greater over wet surfaces such as oceans and flooded ground than over a desert or continent. The actual amount of water vapour in the air, known as *humidity*, is not in itself important; what matters is whether the air can support that amount of water vapour or not. When a parcel of air is supporting as much water vapour as it can, it is said to be *saturated* and have a *relative humidity* (RH) of 100%. Air supporting less than its full capacity of water vapour is said to be unsaturated, and will have a relative humidity of less than 100%. In cloud and fog, the relative humidity is 100% and the air is saturated; over a desert, relative humidity by day might be as low as 10%.

Chapter 6

Motion in the Atmosphere (Winds)

Definition of Wind

The term *wind* refers to the flow of air over the earth's surface. This flow is almost completely horizontal, with only about $\frac{1}{1,000}$ of the total flow being vertical.

Despite being only a small proportion of the overall flow of air in the atmosphere, vertical airflow is extremely important to weather and to aviation, since it leads to the formation of clouds. Some vertical winds are so strong, like those in or below a cumulonimbus storm cloud, that they are a hazard to aviation and can destroy aeroplanes. In general, however, the term wind is used in reference to the horizontal flow of air. It is a pressure difference in the atmosphere (usually resulting from temperature differences) that initiates a wind. Air flows from an area of higher pressure to an area of lower pressure. In this chapter, we will generally confine our discussion to the wind in the layer at and below about 2,000 ft above the surface.

Measuring the Surface Wind

To measure and record accurately wind velocity at the surface is difficult. The movement of the air is affected by such things as the roughness of the ground, the type of surface, and the presence of buildings. To overcome these problems, the instruments used are located over open ground at a height of 10 m. The direction of the wind is measured using a wind vane, and the speed with an anemometer. To allow for fluctuations, the surface wind is reported as the mean value over the ten-minute period leading up to the time of the observation.

Reporting of Winds

Both the direction and strength of a wind are significant and are expressed thus:

- wind direction is the direction from which the wind is blowing and is expressed in degrees measured clockwise from north; and
- wind speed is expressed in knots.

Direction and strength together describe the wind velocity, which is usually written in the form 270/35, which is a wind blowing from 270°T at a speed of 35 kt.

Meteorologists relate wind direction to true north because of the relatively large geographic areas involved, often including areas of differing magnetic variation, so all winds that appear on forecasts are expressed in °T; for example, 34012KT or 340/12 on a forecast or meteorological observation means a wind speed of 12 kt from a direction of 340°T.

Runways, however, are described in terms of their magnetic direction, so that when an aeroplane is lined up on the runway ready for take-off, its magnetic compass and the runway direction should agree.

The wind direction relative to the runway direction is important when taking off and landing. For this reason, winds passed to the pilot by ATC have direction expressed in degrees magnetic. This is also the case for the recorded messages on the automatic terminal information service (ATIS) that a pilot can listen to on the radio at some airports.