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Understanding the weather map

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The weather map is one of the most familiar images in the community. The best-known map is the **mean sea level pressure analysis**, compiled from hundreds of weather observations (synoptic data) taken simultaneously around the Australian region. It is seen daily on television and in the newspapers.

Its dominant features are the smooth, curving patterns of sea level isobars (lines of equal atmospheric pressure), which show the central elements of our weather systems: highs, lows (including tropical cyclones) and cold fronts.

Television and newspapers also often carry forecast weather maps, which indicate how the surface weather patterns are expected to develop.

Meteorologists use a wide range of information and techniques to formulate weather forecasts. The weather map does not and cannot show all of these factors. It is a fairly simple representation of past and probable future locations of surface weather systems. Nevertheless, it's a useful guide to the weather.

Preparing the weather map

The weather map can be likened to a giant jigsaw puzzle assembled several times a day (usually three-hourly) from thousands of observations taken at internationally agreed times. The Bureau of Meteorology, like all the world's Meteorological Services, operates a network of its own stations to gather surface and upper air observations. More than 500 synoptic stations and over 5500 rainfall stations also make daily surface observations essential to the national picture.

Surface reports usually comprise observations of mean sea level pressure, wind direction and speed, present and past weather, temperature, dew-point (a measure of atmospheric moisture), cloud and visibility. Complementary (if less detailed) surface data come from the Bureau's expanding system of more than 300 automatic weather stations, from ship reports, and from drifting buoys in the surrounding oceans. Specialist observers gather **upper air** information on wind speed and direction by radar-tracking weather balloons, which may also carry instrument packages to transmit temperature and dew-point information at various heights (pressures) in the atmosphere. Some aircraft also transmit upper-air data.

Weather satellite data are a vital part of the analysis process. Australian meteorologists focus on hourly images from the Japanese Geostationary Meteorological Satellite operating in geostationary orbit 36 500 kilometres over the equator. Computer enhancement adds colour for easier interpretation. The animated sequences often shown on television and in Internet pages are a particularly powerful analysis tool.

The Bureau of Meteorology also draws on similarly enhanced images from US and European geostationary satellites, as well as on high-resolution images and atmospheric temperature profiles from polar-orbiting US satellites.

Fine-scale surface weather maps are prepared from the above data in Bureau forecasting offices.

What do weather maps show?

The most obvious features of the media's weather maps (the Figure below is an example) are the patterns of high and low pressure, and the barbed lines identifying cold fronts. In the southern hemisphere, the earth's rotation causes air to flow clockwise around low pressure systems and anticlockwise around high pressure systems. Friction over the earth's surface causes winds to be deflected slightly inwards towards low pressure centres, and slightly outwards from high pressure systems.

Wind strength is directly proportional to the distance between isobars; the closer the lines, the

stronger the winds. This rule does not apply in the tropics, where the effect of the earth's rotation is weak. For this reason, tropical meteorologists usually replace isobars with streamline arrows and isotachs (which indicate wind speed and direction) without directly relating to the pressure gradient. Hatched areas on weather maps show where there has been rain in the previous 24 hours, and wind direction is shown with arrows that have a series of barbs on their tails to indicate speed.

The coverage on media weather charts is usually limited to the continent and surrounding oceans. The Bureau also produces global charts to take account of weather systems interacting with each other over great distances. Global charts are necessary when preparing forecasts up to four days ahead and for framing the monthly climate monitoring bulletins.

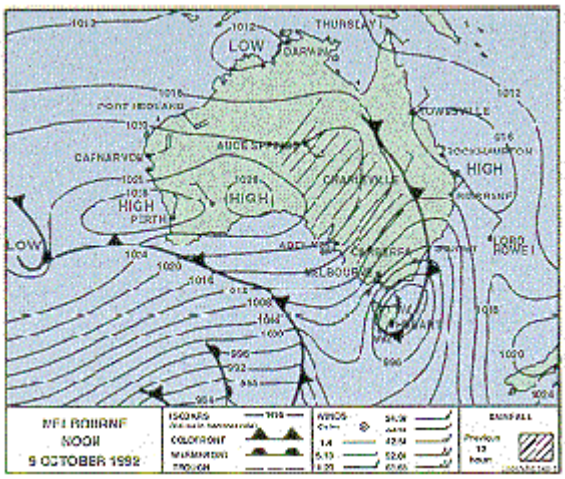

Figure 1. A typical newspaper weather map

Typical weather map patterns

To interpret a map you need an understanding of some systematic weather patterns, such as the following.

Easterly winds over the tropics and subtropics incorporate wave-like disturbances which usually travel westward. Important features of the tropical easterlies include the south-east trade winds, monsoon lows and sometimes tropical cyclones (known as hurricanes in the Americas and typhoons in Asia).

High pressure belts in the mid-latitudes (usually 30–50º latitude) contain centres of varying strengths, which generally move from west to east.

The belt of westerly winds south of the high pressure region contains disturbances which usually travel from west to east. Barbed lines indicate the leading edge of travelling cold (and the rare warm) fronts – the boundaries between different types of air. The term 'front' was applied during World War I by European meteorologists, who saw similarities between atmospheric structures and the large-scale conflict along battle fronts. Nearer the pole, a series of deep subpolar lows is usually centred between latitudes 50–60º south.

A high pressure area over Antarctica – associated with extremely cold and dense air – is ringed by easterly winds, which form the boundary with the subpolar low pressure belt.

These typical features vary in intensity and location according to the season. For instance, in summer, the high pressure belt is usually found just south of Australia, while the subtropical easterlies cover most of the continent. Monsoon flows and associated lows over the tropics bring significant summer rain, and tropical cyclones may develop. In winter, the high pressure belt is usually located over the continent, allowing westerlies and strong cold fronts to affect southern Australia.

It is important to be alert to significant exceptions to this 'normal' situation, when, for example, strong high pressure systems move slowly across the oceans well south of Australia. Closed or 'cut off' lows may then move across southern Australia or intensify over the Tasman Sea, possibly causing prolonged heavy rain.

It is also important to remember that all weather systems have a life cycle of development, maturity and decay. They occasionally show unusual behaviour. They may become stationary or even briefly reverse their usual direction of travel.

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