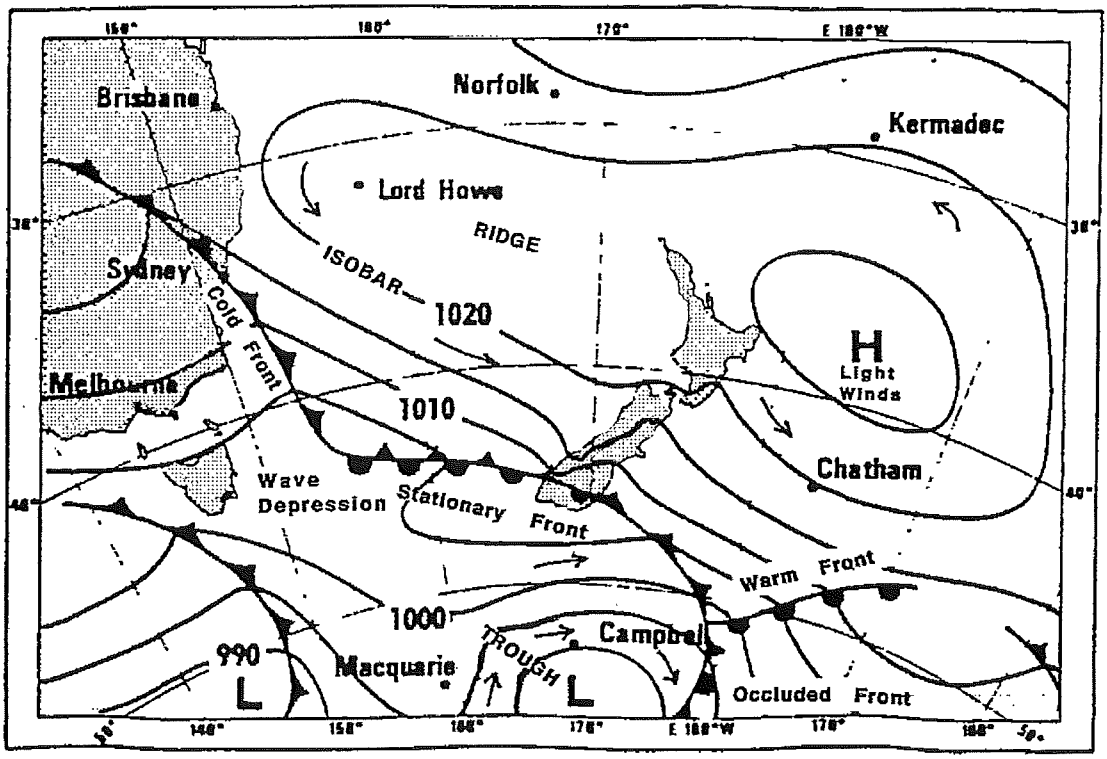
HOW TO READ A WEATHER MAP



How to read an MSL weather map

Surface analysis (ANAL) or mean sea level (MSL) maps show what is happening at a set time where most of us need it — at the earth's surface. They do NOT show what is happening at higher levels, where the wind flow may be doing something entirely different.

You want to know about wind and rain, and weather maps only offer isobars and fronts. Why? Meteorologists have found that air pressure usually makes smoothly changing patterns whose future shape can be forecast. Wind and rain can be surmised from the changing pressure pattern, but do not change as smoothly.
But in the tropics there are few isobars or fronts. This is because air can only move in straight lines at the equator, and any pressure imbalance is relieved as soon as it forms. Sailors crossing equatorial waters, therefore, are better off with wind maps (streamlines and isotachs) rather than isobars.

WHAT'S ON A WEATHER MAP

The Isobars

Those plain lines that curve across the map are called isobars (iso = equal, bar = pressure). They join together places with the same (MSL) air pressure (weight per square area of air above). Some have numbers on them, showing this value in hectoPascals (same as millibars). Named after Blaise Pascal (1623–62), one Pascal is the metric unit of pressure, equal to one Newton per square metre, or one kilogramme per metre per square second.
Isobars tell us about the wind, which is covered in the next section.

Pressure Systems: the Lows

Isobars draw shapes and patterns. When they enclose an area of low pressure, this is called a "**low**" or "**depression**", and its centre is labelled on a weather map with an "**L**". The term depression comes from the jargon used in describing features on a contour map, not from its emotional or economic meaning! Another name for a low is "**cyclone**" from the Greek word *kuklos* (to rotate), referring to the winds around the low, or possibly from *cyclops* (a one-eyed monster).

Wind goes **clockwise around lows** in the **Southern Hemisphere** (and counter-clockwise in the Northern Hemisphere). A **shallow** low has a central pressure above 1000 hPa, **moderate** 980–1000 hPa, and **deep** or **intense** means below 980 hPa. If there are two or more centres, the low system is said to be **complex**. If the central pressure is rising, the low is said to be **filling**. If the central pressure is falling, the low is said to be **intensifying** or **deepening**. Generally speaking, the deeper the low, the stronger its winds and heavier its rain.

What makes lowering pressure? The main cause over the ocean is air rising and being drawn off by upper winds faster than it can be replaced by the lower winds. Also, moist air is less dense than dry air, so a build-up of moist air "weighs less" and causes lower surface pressures.
A low-pressure system is like a giant funnel of wind spiralling inwards and upwards, forcing warmish air ahead of the centre to rise and cool, thus forming clouds.

Pressure Systems: the Highs

When isobars enclose an area of high pressure, this is called a "**high**" or "**anticyclone**", and an "H" labels its centre on a weather map. Winds go round them **counter-clockwise** in the **Southern Hemisphere** (and clockwise in the Northern Hemisphere), "leaking" outwards a little across the isobars.

A **weak** anticyclone has a central pressure about 1015 hPa, **strong** or **intense** is above 1030 hPa. **Intensifying** means a rising central pressure, and **weakening** means a falling central pressure.

What makes rising pressure? The main contributor over the ocean is sinking air. When light surface winds do not carry this sinking air off as fast as it arrives, the air pressure rises. Also, air weighs more when it becomes colder or drier.

A high-pressure system is like a mountain of cool-ish air spiralling outwards and downwards. As the air sinks it warms, so that clouds mostly clear.

Nine reasons to hate a high:

- Near the centre are "dead" winds and usually an area of low cloud, called "anticyclonic gloom", or dirty air, which causes fog.
- Round the rim, winds are strong with uncomfortable swells. If the central pressure is over 1030, look for a gale somewhere on the outside of a high.
- Highs intensify the trade winds. It may take about a week for a high to travel eastwards past New Zealand, and during this time the stronger trade winds tend to give nighttime rain to the eastern side of the larger Fiji Islands; this is called BOGI WALU.
- Intensifying highs tend to "squeeze" the isobars together, creating areas of gales.
- As air flows around a high, it spins out, and has a speed as much as 20% MORE than that indicated by the isobar spacing.
- If a range of mountains blocks the air flowing around a high, the air tends to squeeze around the mountains rather than over them. This causes a zone of strong winds over the sea at the downwind end of the mountains.
- In winter a high may bring frost.
- In summer a high may bring thunderstorms and hail.
- The bigger the highs are, the slower they move, blocking the fronts that are trying to follow them.

Ridges, Troughs, and Cols

When isobars turn a sharp corner around a high, they form what is called a **ridge of high pressure**, which is often shaped like a tongue extending from the high centre. This is usually simply referred to as a **ridge**, a term coming from the jargon used to describe contour charts. The weather in a ridge is an extension of the weather in the high, but an unexpected feature of an approaching ridge (especially near land) may be a zone of strong winds.

When isobars make a bend around a low, this bend area is called **a trough of low pressure**, or simply a **trough**. Troughs are often shaped like tongues and usually contain weather similar to lows and fronts.

A **col** is the name for the area without isobars that lies between two neighbouring pressure systems. Often

this area of light variable winds contains either fog or thunderstorms.

The Fronts

An airflow originating from a prescribed location (warm, cold, moist or dry) is called an **air mass**. These are named according to where they have come from, and each has its own characteristic temperature and humidity.

- A tropical air mass consists of air flowing from the tropics (**WARM**).
- A polar air mass consists of air flowing from polar regions (**COLD**).
- A maritime air mass is one flowing over a large sea area (**MOIST**).
- A continental air mass is one flowing over a large land area (**DRY**).

Inevitably, air flowing from one region meets air coming from another region. But these airflows are of different density and so they do not mix — they clash, twisting around each other to make low pressure systems, and bumping into each other to make fronts. A **front** marks the boundary between two air masses, and appears on the weather map as a line with triangles or semicircles attached. The word "front" usually refers to the abrupt surface wind change that occurs along this boundary line, but it can also be used simply to refer to the whole band of cloud and rain that lies in a trough.

A dry front only contains cloud, a weak front has patchy rain. An intense or active front has rain all along its length, heavy in places, and also divides air masses, which have temperatures more than 5° C apart.

A **cold front** is the leading edge of an invading colder air mass and is marked by a line with triangles pointing to where it is moving. Cold fronts push in underneath the warmer air ahead of them, forcing the warm air upwards and making cloud and areas of heavy rain. The cloud band is usually about 50 to 400 kilometres (30 to 200 nautical miles) wide. As a cold front passes you: any rain clears but showers may appear, humidity drops, air temperature usually drops, pressure rises and the wind changes direction. If there is static on the radio, be prepared for a thundery front.

A **warm front** is the leading edge of an invasion of warmer air. Its surface position is marked by a line with semicircles pointing to where it is moving. The advancing warm air rises over a zone of retreating cooler air, making a cloudbank that slopes forwards from ground level upwards, usually bringing prolonged steady rain. This cloudbank is usually 500 to 1000 kilometres (270 to 540 nautical miles) wide. As a warm front crosses you: any rain becomes patchy but humidity remains high, air temperature may rise a little, pressure steadies, and the wind changes direction.

An **occluded front**, or occlusion, occurs when a cold front overtakes a warm front, so that all that remains of the original warm air is trapped above where it cools, making dense cloud and rain. It is marked by a line with triangles and semicircles on the same side, pointing to where the front is moving. As it passes by: any rain becomes patchy, wind eases, the rate of pressure fall may level out but air temperature does not change much.

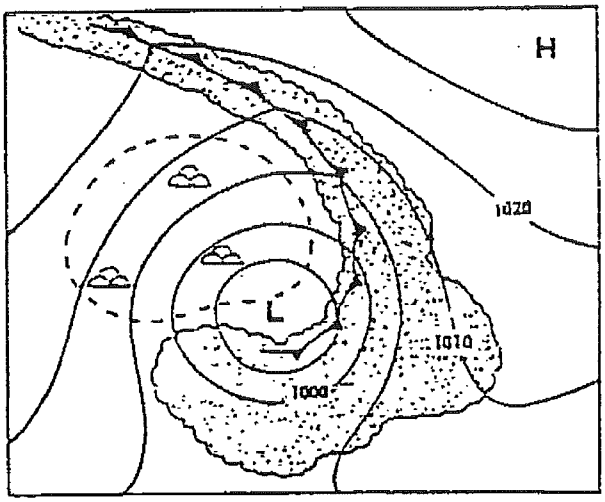
A **stationary front** is one, which has lost its impetus for movement, so that neither air mass is making much progress. It is marked by a line with alternate triangles and semicircles on opposite sides. The triangles protruding into the warmer air mass and the semicircles protruding into the cooler air mass. It takes a while for a stationary front to cross you: any rain clears only slowly, and temperature and pressure do not change much.

The Patterns of Cloud and Rain

Highs: High pressure and dry weather go together as a rule of thumb, but not always. In a high, fog may form overnight, or heavy showers may form over land in the afternoon heat. The centre of a high may fill with low cloud or build up with dirty polluted air, a condition some call "anticyclonic gloom".

Fronts and Lows: With each front or trough there is usually one band of cloud and rain, maybe more. These bands may spiral into the centre of an accompanying low-pressure system. Note that not all parts of a low system are cloudy or wet: some parts are showery and some are cloud-free.

Over the open sea in the mid-latitudes there is usually a cloud-free "**dry slot**" immediately following the passage of a cold front. BUT DO NOT RELAX for there may be more to come — a bunch of squally showers (see diagram opposite). These are located underneath what is called the "upper trough" which can be seen on a 500 hPa chart (see page 73), and are most active under the coldest area of an upper trough. Showers bring gusts to the ground which are fed by the strong winds aloft, and the speed of these gusts may be estimated from a 500-hPa chart. Note that there may be NO indication on a surface weather map of the location of this shower area. Use the diagram below as a general indicator.



Typical cloud pattern in a low system in the Southern Hemisphere:
- Speckled area is where cloud and rain is thickest
- Front is close to eastern edge of cloud band in the tropics
- Front is close to western edge of cloud band in the mid-latitudes
- Cloud band is immediately followed by a "**dry slot**"
- Dashed area is often accompanied by squally shower clouds.