

How to read a barometer

(MetService Weather Ambassador, Bob McDavitt)

That barometer you got last Christmas can be put to use as a weather forecaster. OK, all it does is read air pressure, or the weight per unit area of the column of air above it. But by following these readings you can tune into the vibrations of the weather pattern as it changes.

Why measure pressure?

Pressure. Why is it so important? Because imbalances in air pressure cause wind and weather. You want to know about wind and rain, but weather forecasters talk about isobars and fronts. This is because isobars and fronts are easier to draw and follow. Isobars are those lines on a weather map joining together places with the same surface pressure. The shape of the isobars describes the weather pattern, so changes in the weather can be forecast by tracking the changing isobar pattern or by observing **pressure change**.

Pascals

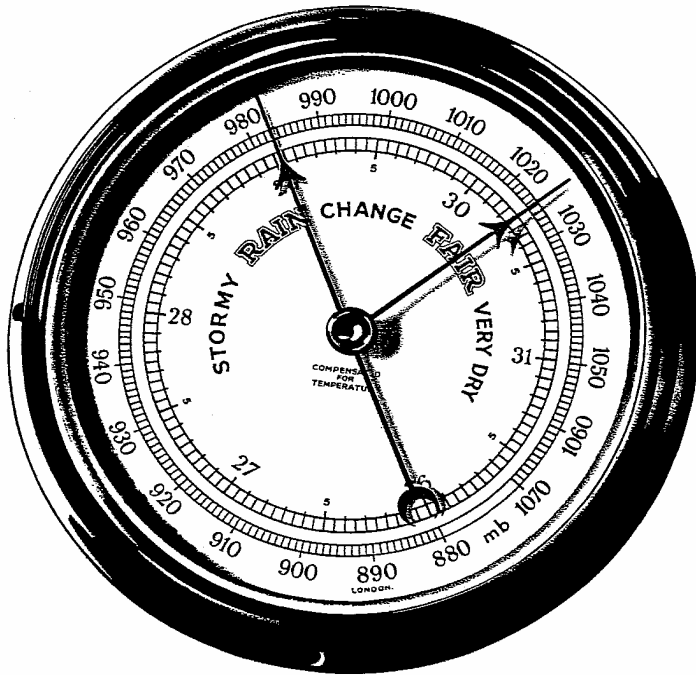
Most barometers measure pressure in hectoPascals (hPa). These may sometimes also be called millibars. A hectoPascal is one hundred Pascals, and a Pascal is the metric unit for pressure, named to recall an experiment done under the direction of Blaise Pascal in September 1648 that used a barometer to show how pressure changed with height. This experiment was historically important for it showed the limitations of Aristotelian philosophy and showed how thinking and experimenting can win out over simply modifying an explanation (see <http://www.strange-loops.com/scibarometer.html>).

Other common pressure units are inches and millimetres of mercury. They refer to the height of mercury which can be supported by the air pressure. To convert a pressure reading from hectoPascals to **inches** divide the hectoPascals by **33.86**. And to convert from hectoPascals to **millimetres** multiply the hectoPascals by **0.75**.

Types of barometers

Your barometer is most likely an aneroid (= without fluid) or digital (using a pressure transducer) type.

Aneroid Barometers



Inside there is a metal cell only partially filled with air. The size of this airtight cell varies with changes in the surrounding air pressure, and these variations are passed on to an indicator needle by a series of levers. It is all mechanical, so no batteries are needed. If the metal chamber cracks then the barometer will no longer work.

These barometers usually have words such as “Stormy” for low pressures (980 to 1000 hPa) and “Dry” for high pressures (1020 to 1030 hPa). These words are at best only a first guide to the weather and date back to Vice-Admiral (Royal Navy) Robert Fitzroy (1805-65) who first visited New Zealand with Charles Darwin on the *Beagle* in 1835. Fitzroy later became New Zealand’s second Governor (in 1845) and Superintendent of the British Meteorological Department (in 1853).



Digital Barometers

These have the advantage that they can display a graph of recent pressure change and the disadvantage that they require batteries and do not have the words such as “stormy” written on their face. Some may give a read out to the nearest tenth of hectoPascal, but their accuracy is usually to within one hectoPascal.

Will it rain? Tap the (aneroid) barometer!

It is OK to tap the outer glass of an aneroid barometer (firmly but lightly). By so doing you shift any recent pressure change stored in the mechanical linkage to the measuring needle. The resulting slight movement indicates whether the pressure is rising, steady, or falling. If the measuring needle goes to the left then there has been a drop in pressure recently. Most digital barometers also indicate if the pressure is rising or falling.

Where to put it?

Anywhere that is most convenient. But when deciding where to put your barometer there are places that you should **avoid**...



- **Avoid** placing a barometer in draughty places such as near a door. In such places the air pressure is too variable.
- **Avoid** direct sunlight on a barometer. This will warm and expand the metal cell causing a false recording of falling pressure. For the same reason, do NOT position your barometer near a heater.
- **Avoid** placing a barometer in a well sealed or air-conditioned room. Such places do not respond well to changes in pressure.

Getting it adjusted (calibrated)

This only needs to be done if you want to compare your readings with others or with the weather map. To do this, adjust your barometer so that it reads Mean Sea Level (MSL) pressure. Mean Sea Level is the standard datum level to which all barometers should be adjusted. This adjustment will automatically apply a correction to your barometer that takes into account the variation of pressure with height above sea level. Pressure drops off at the rate of about 3hPa per 25 metres of altitude near the ground.

Adjusting your barometer is easy. All you have to do, once you position your barometer in a new location, is look for the latest MSL pressure at a location near you from our website

at <http://www.metservice.com/default/index.php?alias=nzobservations> or click on MAPS& OBSERVATIONS on the left hand side of www.metservice.com and then select observations. Then tweak your barometer to read this value. For aneroid barometers there is normally an adjustment screw found at the back of the barometer. Try to do these adjustments at a time when the pressure is not changing much and is neither very high nor very low (say about 10 am or 4pm, with no fronts coming).

Your barometer may slowly drift out of adjustment so check it every six months or so. You also need to do this adjustment whenever you change the height location of the barometer by more than about 5 metres (15 feet).

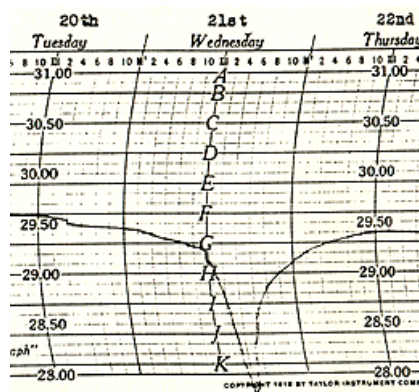
Setting a Barometer



The main use for a barometer is not so much to read pressure, but to measure CHANGES in pressure over time. Digital barometers usually display this as an arrow or as a bar graph. In an aneroid barometer there are normally two needles. The needle connected to the insides of the barometer is called the *measuring hand*. The second needle is a movable pointer (sometimes called the *setting hand*) which is free to be moved around by means of twirling a knob at the centre of the glass. When you arrange it so the setting hand is directly over the measuring hand you have *set* your barometer. The idea is that

you set your barometer at a certain time of the day. Then, later, you need only glance at your barometer to see how far the measuring hand has moved. If it has moved to the left (of the setting hand) then pressures are falling.

What causes pressure to fall?



Several things can cause this...

- maybe there is an approaching low pressure system (marked as an L on a weather map)
- maybe the air is getting warmer (and less dense)

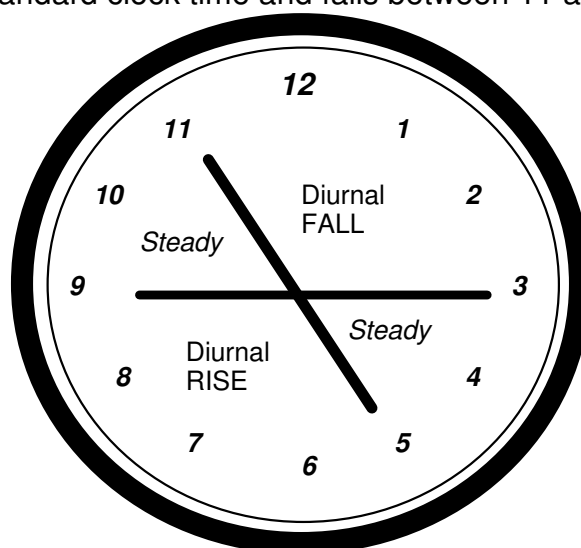
- maybe there has been an increase in the moisture or cloudiness in the air (YES- damp air weighs less than dry air!).
- maybe there has been a decrease in the amount of air above (this happens when rising air is removed by strong winds aloft faster than it can be replaced)
- maybe it is just the time of the day (this is called *diurnal pressure change*)

As a rule of thumb,
 a sustained **DROP** in pressure is a sign of **more** chance of rain
 a sustained **RISE** in pressure is a sign of **less** chance of rain

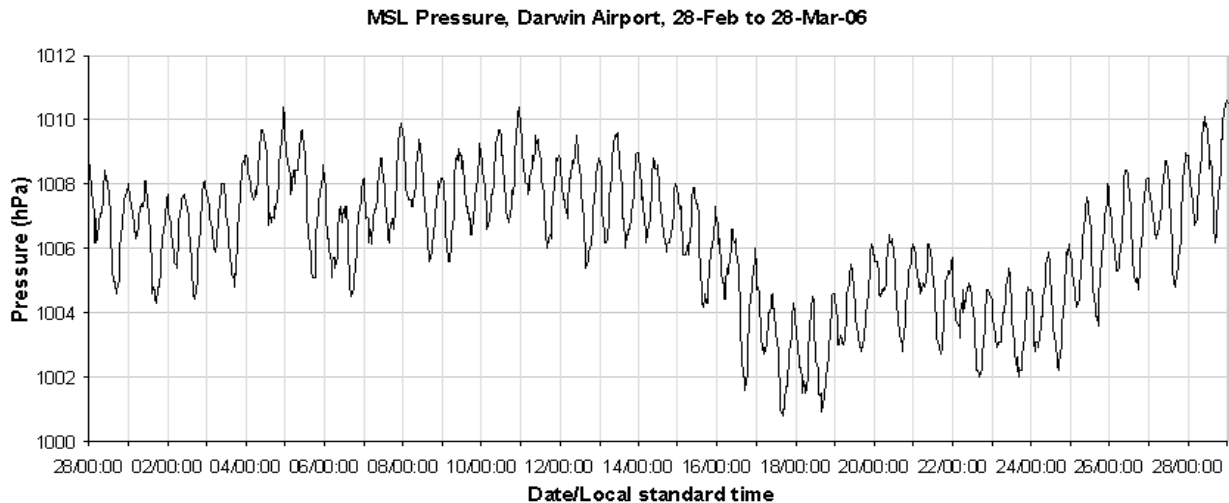
If the pressure is changing rapidly this suggests that an approaching weather system is moving quickly or becoming more intense. In this case isobars are moving quickly across your area and are possibly getting closer together. This usually results in strong winds, and can be taken as a **STRONG WIND WARNING**. But sometimes the isobars in your area may not change position much even though they are close together, in which case you may have strong winds and only small pressure changes.

When to read (Diurnal Change)

Beware of the normal twice-daily ups and downs of air pressure, which are due to a solar-induced atmospheric tide and called the “**diurnal pressure change**”. Pressure rises between about 5 to 9 standard clock time and falls between 11 and 3 standard clock time.



The amount of this diurnal change is more in the tropics (about 3 hPa per tide) than over New Zealand (about 1 hPa). The easiest way to remove diurnal change from your calculations is to read your barometer at the SAME TIME of the day, preferably at about 10 or 4 (am or pm NZST).

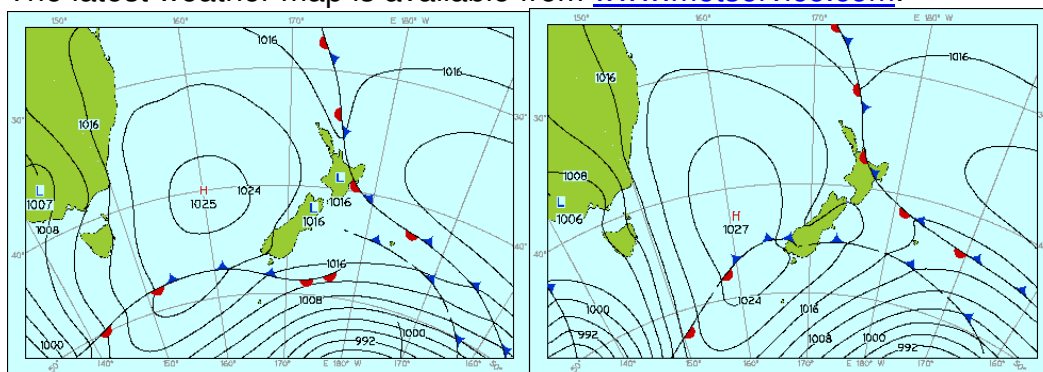


Barograph from Darwin for a month showing the daily ups and downs of the pressure.

Your barometer as an alarm-clock

Your adjusted barometer can be used along with a weather map to help monitor the progress of something such as an approaching wind change.

The latest weather map is available from www.metservice.com.



The map on the right above is a forecast for a time twelve hours later than the map on the left. The map on the left shows the pressure at Invercargill to be 1019. The map on the right shows a cold front having crossed Invercargill bringing a southerly change and raising the pressure to 1023. Eyeballing the cold front it looks as though the part of it that is approaching Invercargill has a pressure reading of around 1021. The weather

sequence will follow that given in the weather map, but the timing may change. Adjust the movable setting hand of your aneroid barometer to be at this 1021 target pressure value, and then you need only glance at the barometer later to monitor the approaching front and wind change. It needs to be mentioned though that this is only a rough alarm clock and can easily be three hours out. The isobars on a weather map are just smoothed out estimates and should not be taken to be exact.

Your barometer is a friend.

So, your barometer is more than just a decoration. You can tap it to check the chance of rain or strong winds. You can use it to monitor incoming wind changes and help to fine tune the weather forecast. Your barometer is indeed your own Met pet, helping you make weather related decisions from a more informed point of view. Use it wisely and it will help you avoid any messy and unnecessary confrontations with the unruly elements.

Weather Foretelling

Once your barometer has been adjusted (to read Mean Sea Level Pressure) it can be used for weather forecasting. Some digital barometers display a weather forecast based on how the pressure is changing (sometimes augmented by temperature change). The following scheme uses the pressure reading and its trend as well use some wind direction observations. These forecasts are rules-of-thumb based on observed weather pattern, and do not take into account the modifying effects on land. . They should be reasonably OK for the west coast and northern part of New Zealand, and least reliable for eastern or central New Zealand. These forecasts should be used as guidance only, and will NOT be as accurate as the latest available weather forecast.

Only use in mid-latitudes of the Southern Hemisphere

RISING PRESSURE

Barometer	WIND	WEATHER FORECAST
More than 1015	S, SW	Continued fair for 24 hours, Slightly cooler
	W, NW	Continued fair for 12 hours
	N, NE	Fair Weather
	E, SE	Rain/showers at first, Diminishing over next 18 hours, Cooler; winds decreasing.
1010-1015 (rapid rise)	SW, W, NW	Fair, followed by rain within 48 hours.
(normal rise)	SW	Fair for 48 hours, cooler by 3-5 C
(normal rise)	W, NW	Fair for 48 hours, cooler by 2-4 C
(slow rise)	NW, N	Clearing within a few hours, Then fair for days
(normal rise)	N, NE	Fair
	E, SE	Clear(ing) and cooler
	S	Rain likely for 6-12 hours Then clear(ing) and cooler
Less than 1000	S, SW	Clearing within a few hours, Cooler by 3-6 C
	W, NW	Clearing within six hours
	N, NE	Clearing
	E, SE	Clearing and cooler

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STEADY PRESSURE

Barometer	WIND	WEATHER FORECAST
More than 1015	S, SW	Continued fair for 48 hours
	W, NW	Continued fair for 12 hours.
	N, NE	Rain within 24-48 hours
	E, SE	Continued fair, Cooler
1010-1015	SW, W, NW	Fair for 1-2 days
	N	Rain within 18-24 hours
1000-1010	SW	Continued (rainy) conditions
	W, NW	Fair for 12 hours
	N	Rain within 12-18 hours
1000-1015	NE	Rain within 12-18 hours Foggy in Spring/early summer
	E, SE, S	No change next 6-12 hours If a front has just passed, Then rain/gales for 6-12 hours
Less than 1000	S, SW	Continued (threatening?) weather. Cooling by 3-5 C.
	W, NW	Continued (stormy) weather
	N, NE	Front coming with rain and a South to southwest wind change Within six hours.
	E, SE	No change until pressure Rises or falls

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FALLING PRESSURE

Barometer	WIND	WEATHER FORECAST
More than 1015	SW, W	Continued fair for 24 hours Slowly rising temperatures by 1-3 C.
	NW	Fair for 6-12 hours Rising temperatures by 2-4C
	N, NE	Rain within 18-24 hours, wind Increasing, temp rise by 1-3 C.
	SE, S	Rain within 24-48 hours
1010-1015 (slow fall)	N, NE	Rain within 12-18 hours (or more rain) Wind gradually increasing Perhaps foggy.
(rapid fall)	N, NE	Strengthening winds Rain in 9-15 hours, or continued rain
(slow fall)	E	In summer, light winds, Possibly DRY for several days In winter, rain in 24 hours.
(rapid fall)	E	In summer, rain probable Within 12-24 hours In winter, Rain or Snow, Wind swinging southeasterly And then rising.
(slow fall)	SE	Rain within 12-18 hours, Or continued rainy. Wind might increase.
(rapid fall)	SE	Rain within 9-15 hours Wind increasing Followed within 36 hours by clearing. Conditions, then if winter, frosty

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FALLING PRESSURE (cont.)

Barometer	WIND	WEATHER FORECAST
1000-1010	SW	Fair for 12-24 hours
	W	Continued fair for 12-15 hours Then possible southerly
	NW	Fair for 18-24 hours, front coming?
	N, NE	Rain within 6-12 hours
	E	wind increasing, rising minimum temperatures by 3-5 C.
	SE, S	Rain within 12 hours But if front has just passed...and Pressure is still falling. then rain and gales next 6-12 hours (in comma head).
Less than 1000	SW, W	Fair for 6-9 hours with dry air, Then possible southerly
	NW, N	Rain within six hours Winds reaching gale Minimum temps rising by 1-2 C
	NE, E	Rain within six hours
	SE, S	Rain, or rain imminent. (snow in winter).