# Understanding weather and the weather forecast

Week 3 - Why is pressure in the atmosphere so important?

Terry Hart

- What elements are most important?
- how far ahead are you interested?
- Imagine you are sailing on Port Phillip or in Bass Strait….
- Imagine you are an aircraft pilot..
  - Aerodrome forecast
- …. A bushfire-fighter
- …. a farmer
- (Fill in table)

| | T | rain | cloud | wind | Storms | MSLP | How far out? | Detail |
|---|---|---|---|---|---|---|---|---|
| **You** | x | x | x | ? | x | | 7 days | Broad |
| **Sailor** | x | x | ? | X | X | | 1-2 days | Local detail |
| **Farmer** | x | X | ? | x | x | | Days-seasons | Local |
| **Bushire fighter** | X | X | ? | X | X | | Days | Site specific |
| **Aircraft Pilot** | x | x | X | X | X | X | Now – 24 Hours | Very detailed |

* MELBOURNE YMML

TAF YMML 121714Z 1218/1400
16005KT 9999 -DZ BKN012
BECMG 1222/1300 24005KT CAVOK
FM130300 17012KT CAVOK
BECMG 1310/1312 29005KT CAVOK
FM131600 36010KT CAVOK
TEMPO 1218/1222 BKN010
RMK
T 19 19 23 28 Q 1012 1013 1013 1011

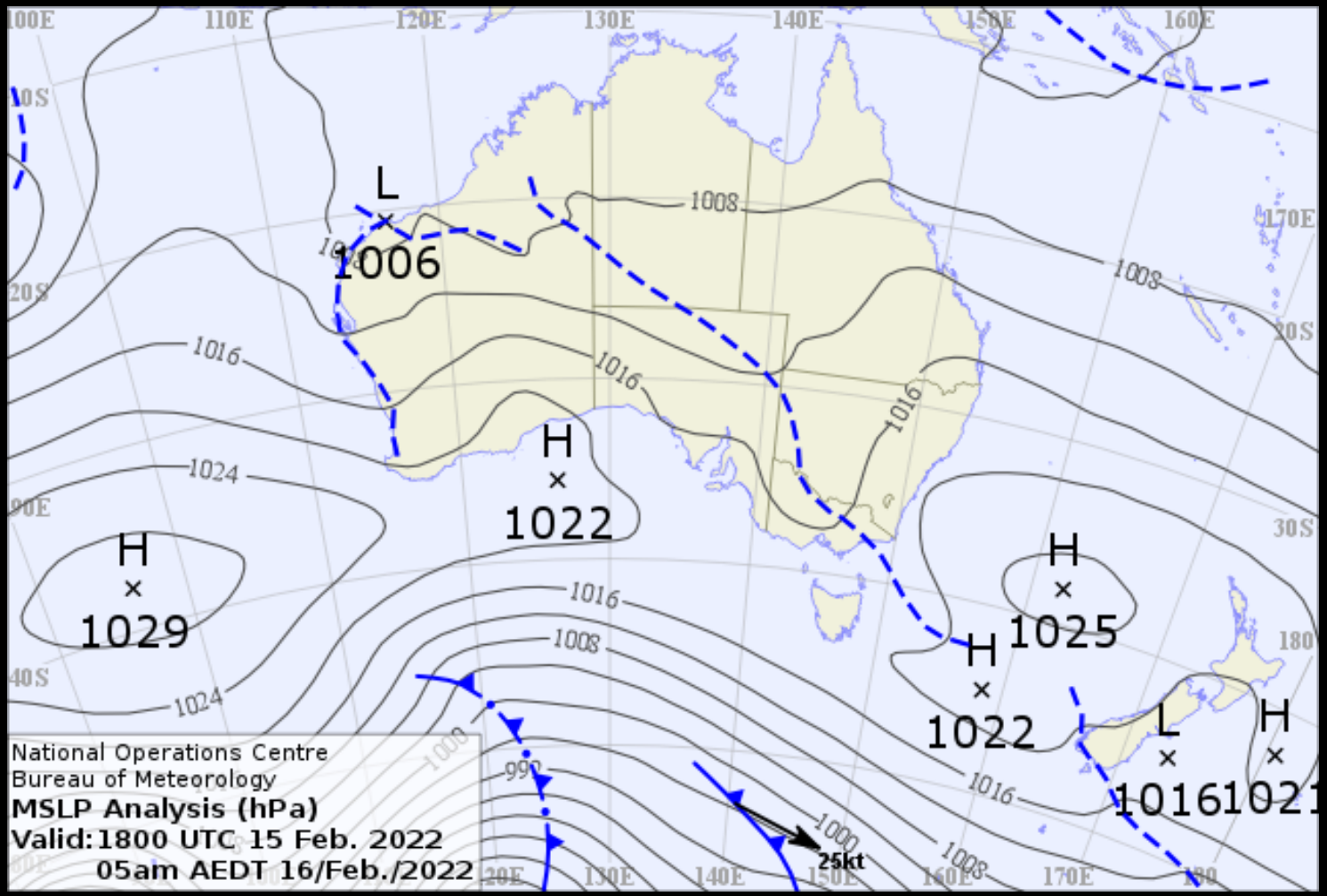
This like Mean Sea Level Pressure. It is important for setting the altimeter so the pilot knows how far he/she is above sea level

TTF SPECI YMML 122130Z 30006KT 9999 SCT010 SCT012 20/17 Q1013
RMK RF00.0/000.2
FM2230 24005KT 9999 SCT020

* **Note:** The latest TTF automatically supersedes the TAF for the 3 hr validity of the TTF, unless otherwise

This weather map shows lines of equal Mean Sea Level Pressure (MSLP).

**Why is MSLP so important?**



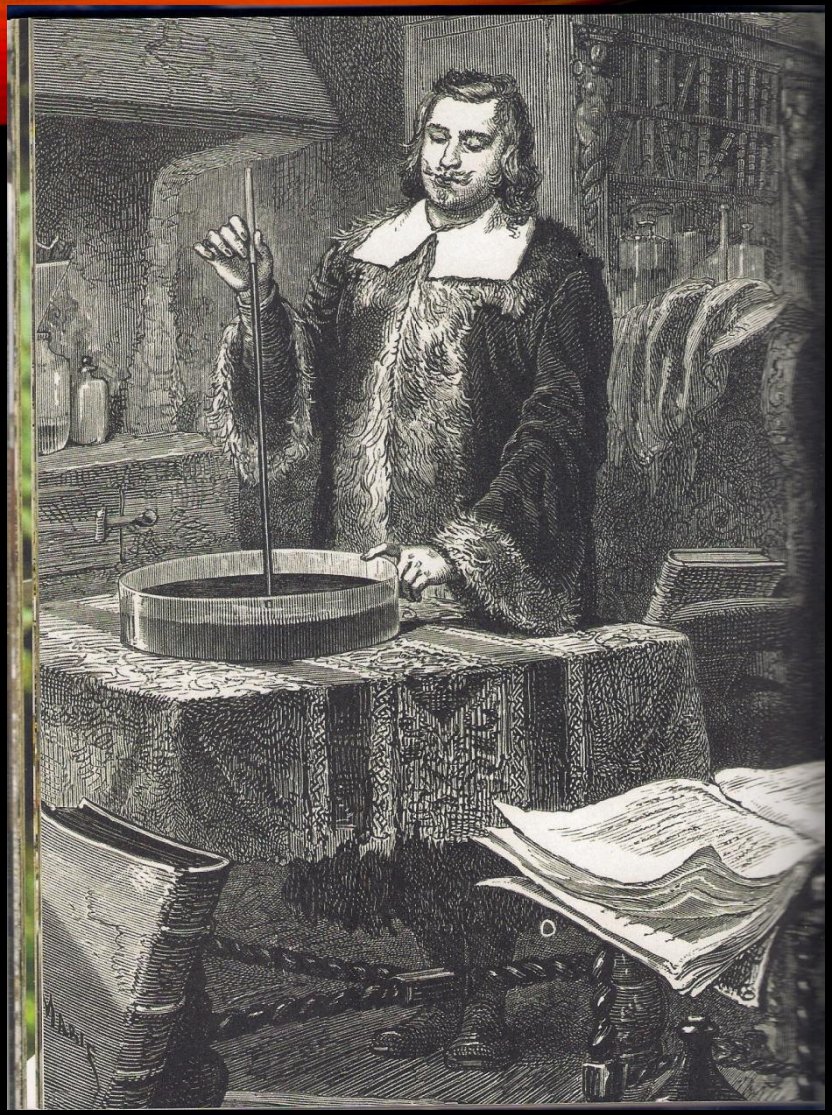
We looked at what makes up weather and ended up with **pressure**. It is not something we feel day to day but it is a crucial weather element. **Why?**

Weather maps show lines of equal atmospheric pressure at sea level, called **isobars. Why is air pressure so important?**

Air pressure is due to the fact that air has weight.

Galileo was puzzled why a suction pump could only raise water to about 9 metres.

His associate, Evangelista Torricelli (1608-47), reasoned that air had weight and when the weight of the water column equalled that of the atmosphere, an equilibrium had been reached and the water column could not be raised any more.



Torricelli also recognised that for a denser liquid, the column would be shorter. He used mercury and showed that a column of only about 760 mm (30 inches) could be supported.

*"We live immersed at the bottom of a sea of elemental air, which by experiment undoubtedly has weight, and so much weight that the densest air in the neighbourhood of the surface of the earth weighs about one four-hundredth part of the weight of water."*

Torricelli, 1644

Torricelli observed that the mercury level changed from day to day and he noticed a link between pressure and weather.

*“Winds are produced by differences of air temperature , and hence density, between two regions of the earth.”*

Scientists after him (including Blaise Pascal) used his barometer to show that pressure was lower at higher altitudes.

The metric unit of pressure is the Pascal (Newton per square metre).

For convenience the hectoPascal (hPa) is used (100 $N/m^2$) which is numerically the same as the millibar (mb).

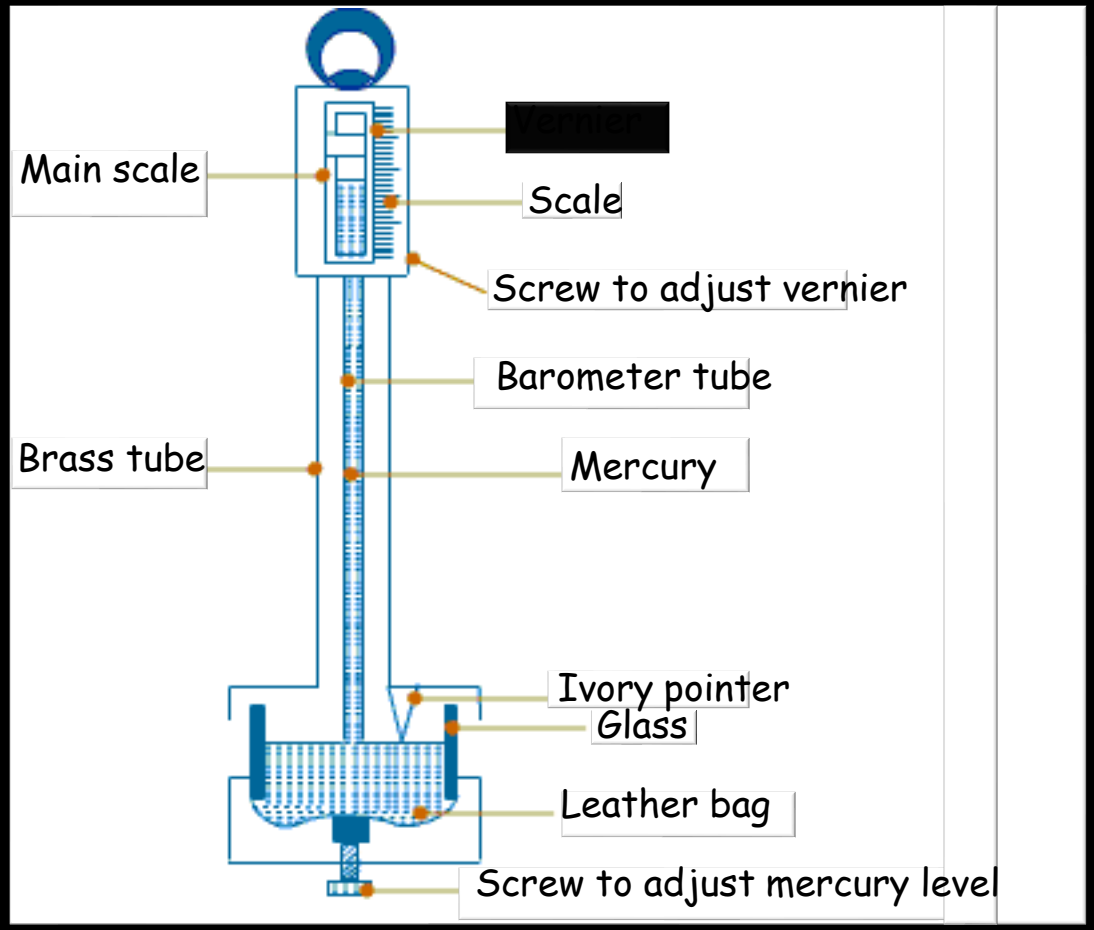
The Newton is a unit of force - the force required to accelerate a mass of 1 Kilogram at a rate of 1 metre per second per second (1 m $s^{-2}$)

Global average is 1013.25 hPa
i.e. about 10,130 kilograms per square metre
14.7 pounds per square inch

**Harvard Pressure Video**

# Air Pressure: Mercury (Fortin) barometer

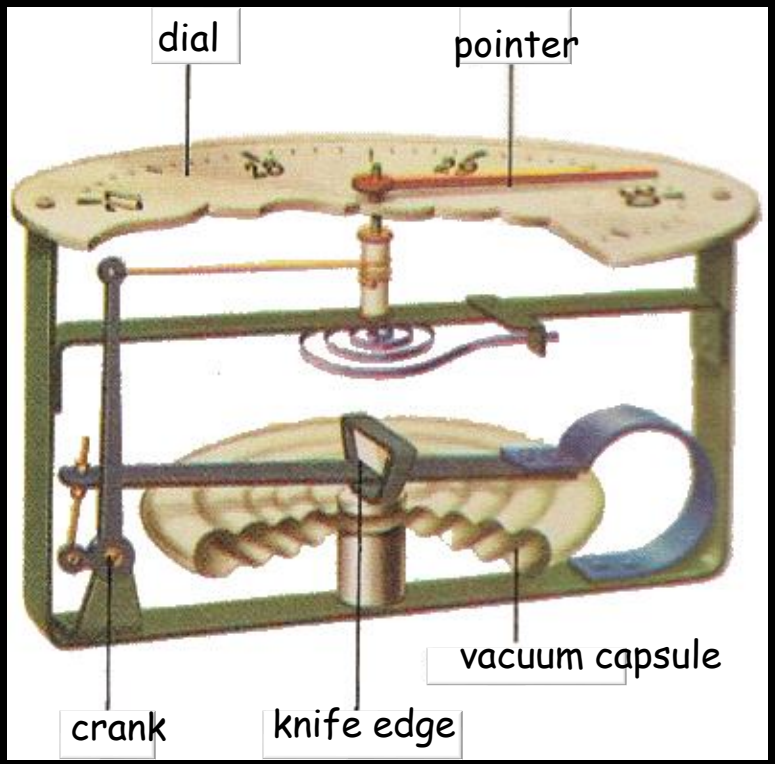
- Consists of a column of mercury in an evacuated glass tube
- height of top of mercury column above datum ➔ atmospheric pressure




**Courtesy:**
**Peter Jackson**

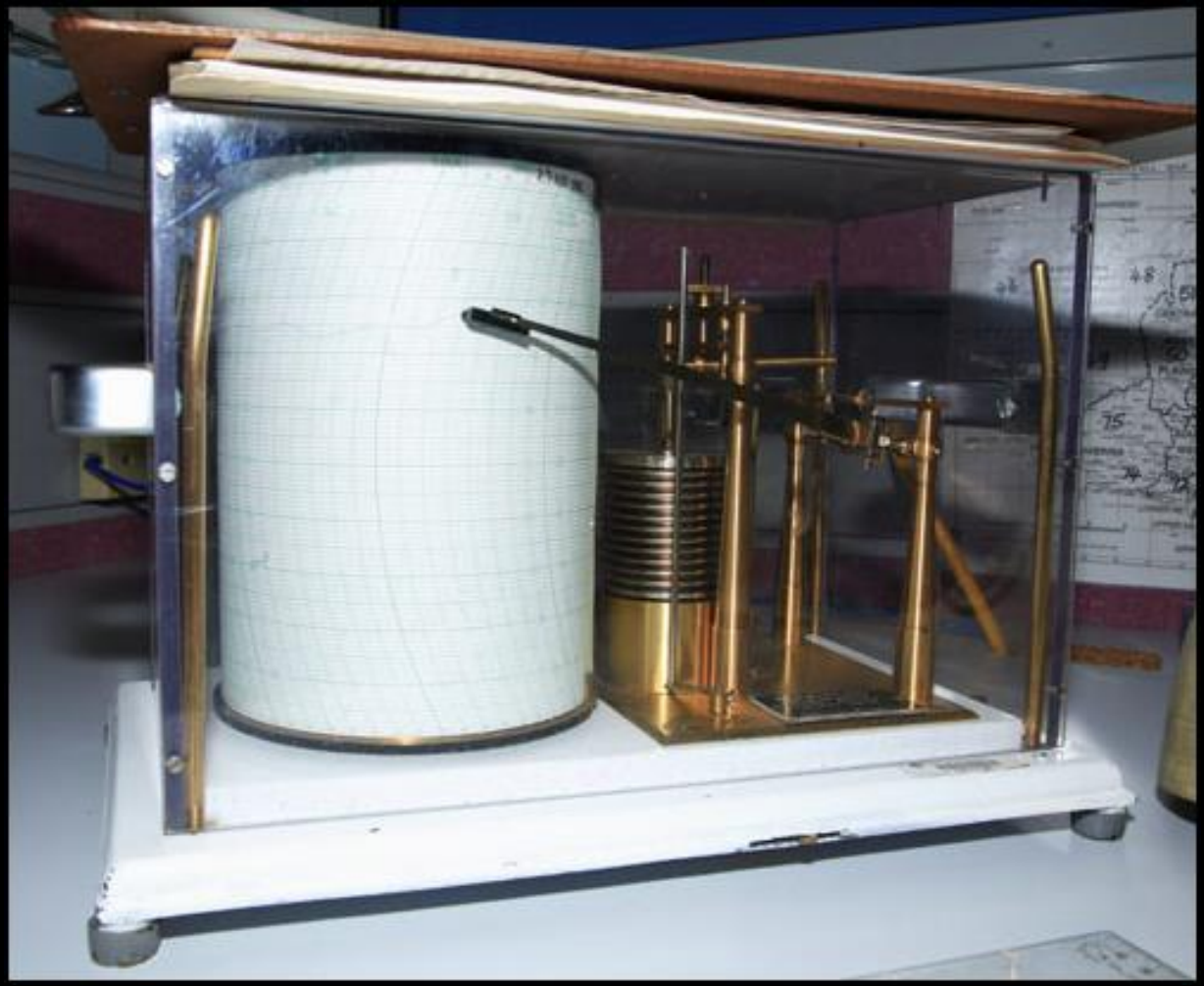
# Aneroid barometer

- Flexible corrugated metallic cell dilates and compresses with change in pressure
- levers magnify movement

# Barograph

- A barograph provides a continuous record of variations in air pressure
- comprises a series of aneroid barocells



# Barograph

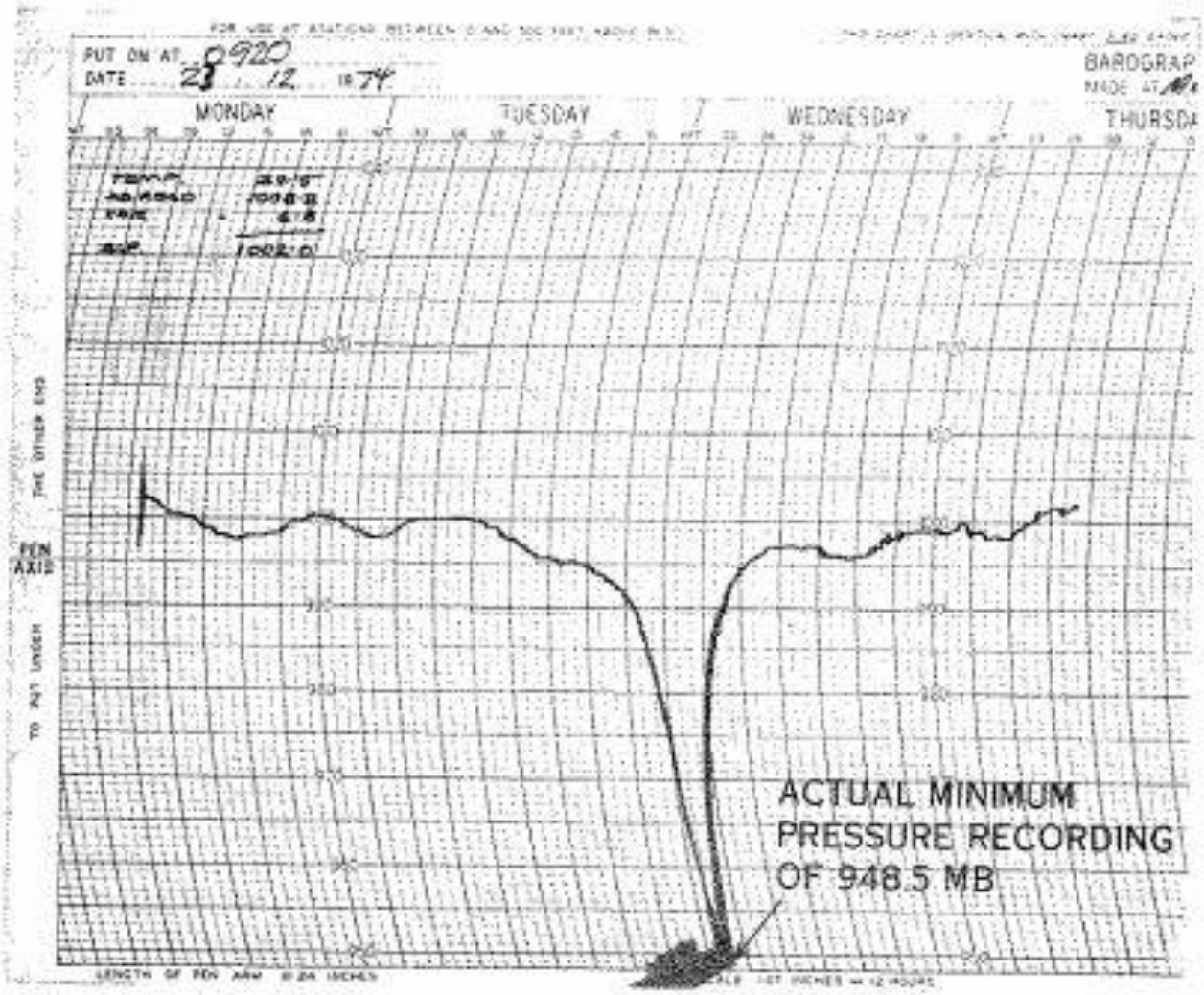



Fig 24(a) Barograph trace at Darwin City Regional Office, 23–26 December 1974 (Station level pressure).

**MEMS Barometers**

Micro Electro Mechanical Systems

- extremely small devices between 1 and 100 micrometres in size (0.001 to 0.1 mm).
- created via photolithography or photochemical machining.
- Typical applications include miniaturized weather stations, electronic barometers and altimeters.
- Included in some Smartphones.

Barometers measure the pressure where they are, which is generally at some altitude

This pressure is called the station level pressure

However, to be able to isolate the effect of weather systems the station level pressures need to be adjusted to a standard level

Mean Sea Level (MSL) is the most common standard level and the pressure is called the **Mean Sea Level Pressure** (MSLP)

MSLP is a hypothetical value obtained by imagining that the column of air extends down through the land to mean sea level.

The adjustment depends on the temperature assumed for the hypothetical air column below the ground.

The process works over moderately flat land (up to about 500 metres) but over mountains there can be anomalies and MSLP is only useful for mapping the broad-scale pattern, not microscale variations.
(e.g. An MSLP map for Antarctica is not very useful).

Atmospheric pressure decreases with altitude – so a barometer can be used to measure altitude (if you know what the pressure at the ground is).

The most common application is in an aircraft altimeter (although other systems are also used these days – e.g. radar, or GPS)


# Effect of temperature on pressure.


https://youtu.be/_e9L8F2eYXM