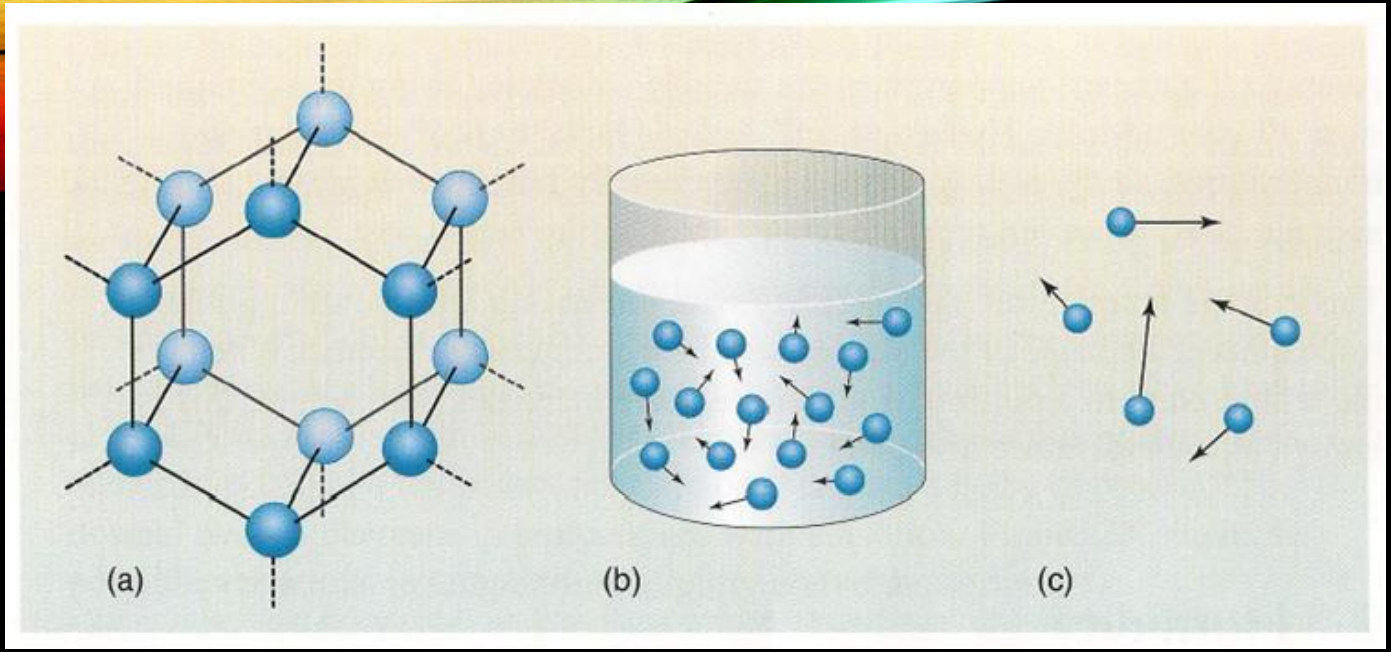
# Understanding weather and the weather forecast

Week 13 Upper Air Measurements (2)

Terry Hart

Ruth’s question

How does washing dry?




In Ice - Molecules tightly held in a "crystalline" structure

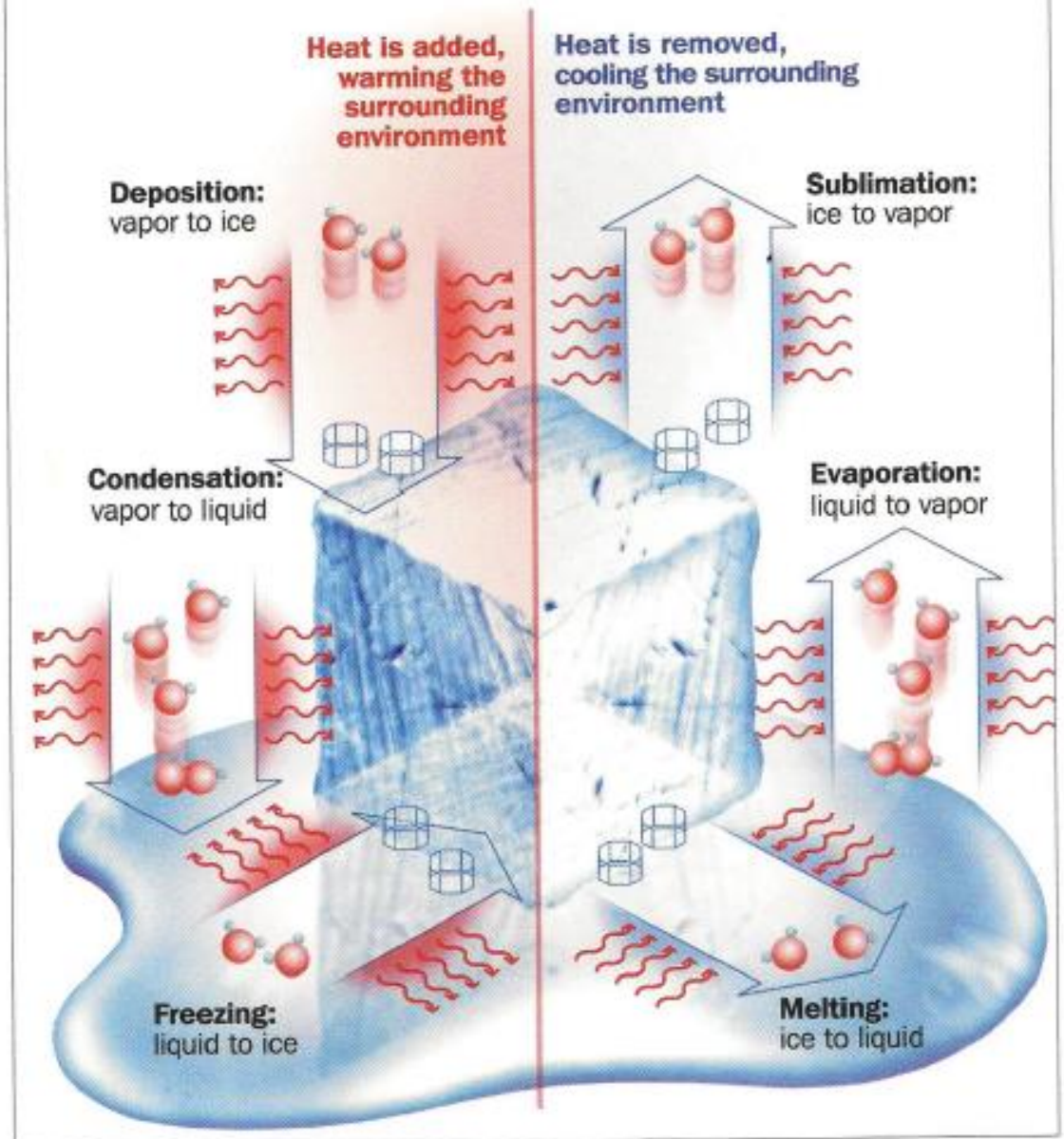
In Water, molecules free to move but there is still strong attraction among molecules

Water Vapour - molecules are further apart and the bonds to other molecules are weak, especially for the faster moving molecules

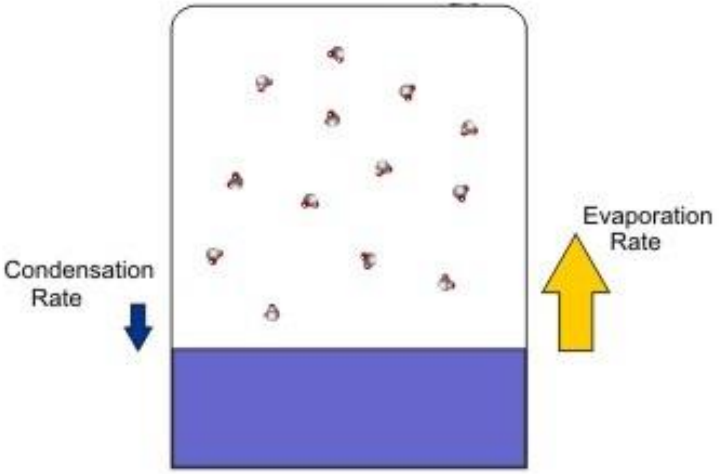
But – some fast-moving molecules are able to escape from water into the air (but also for ice – but less so) – called **evaporation.**

## Water's phase changes

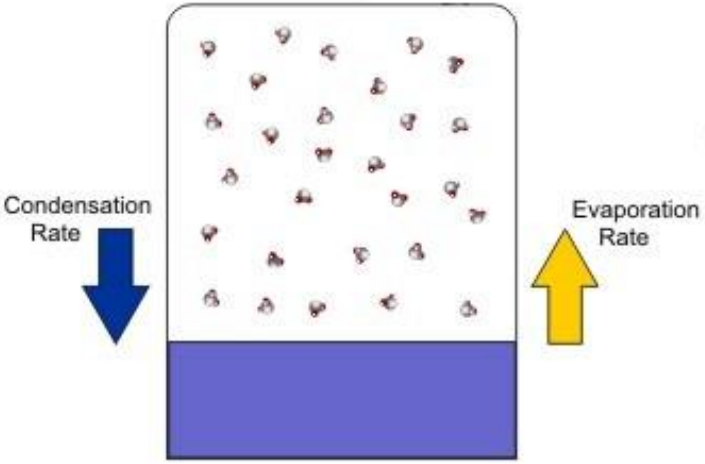
A block of ice sitting in a puddle surrounded by air with water vapor in it helps you see which of water's phase changes add heat to the surroundings, and which cool the surroundings.

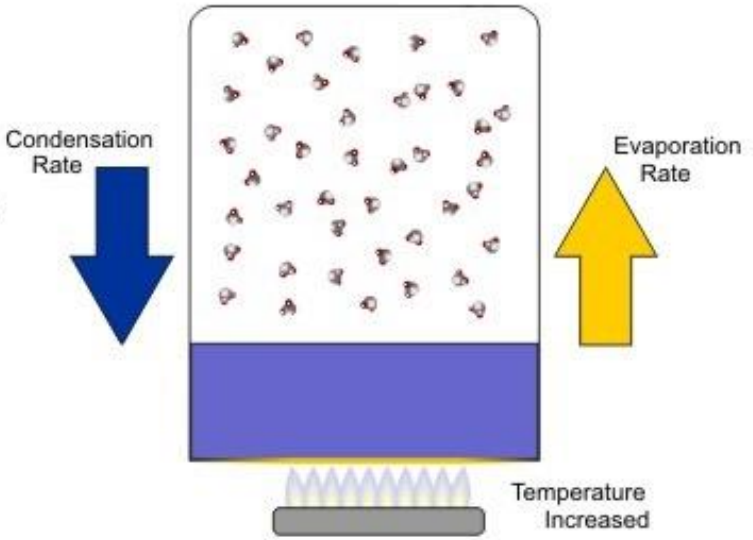


A closed container

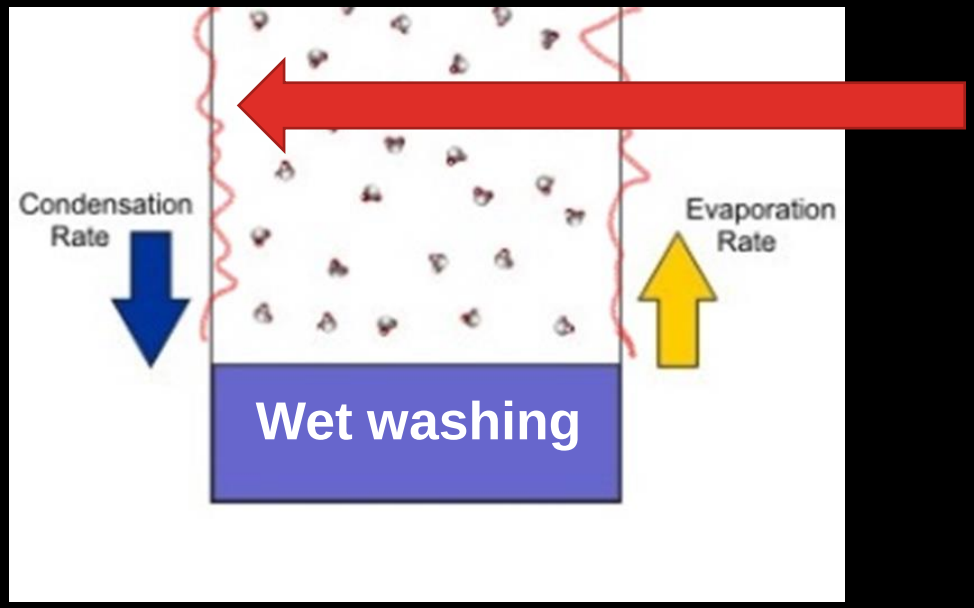

When there is a balance between evaporation and condensation the air is said to be **saturated.**



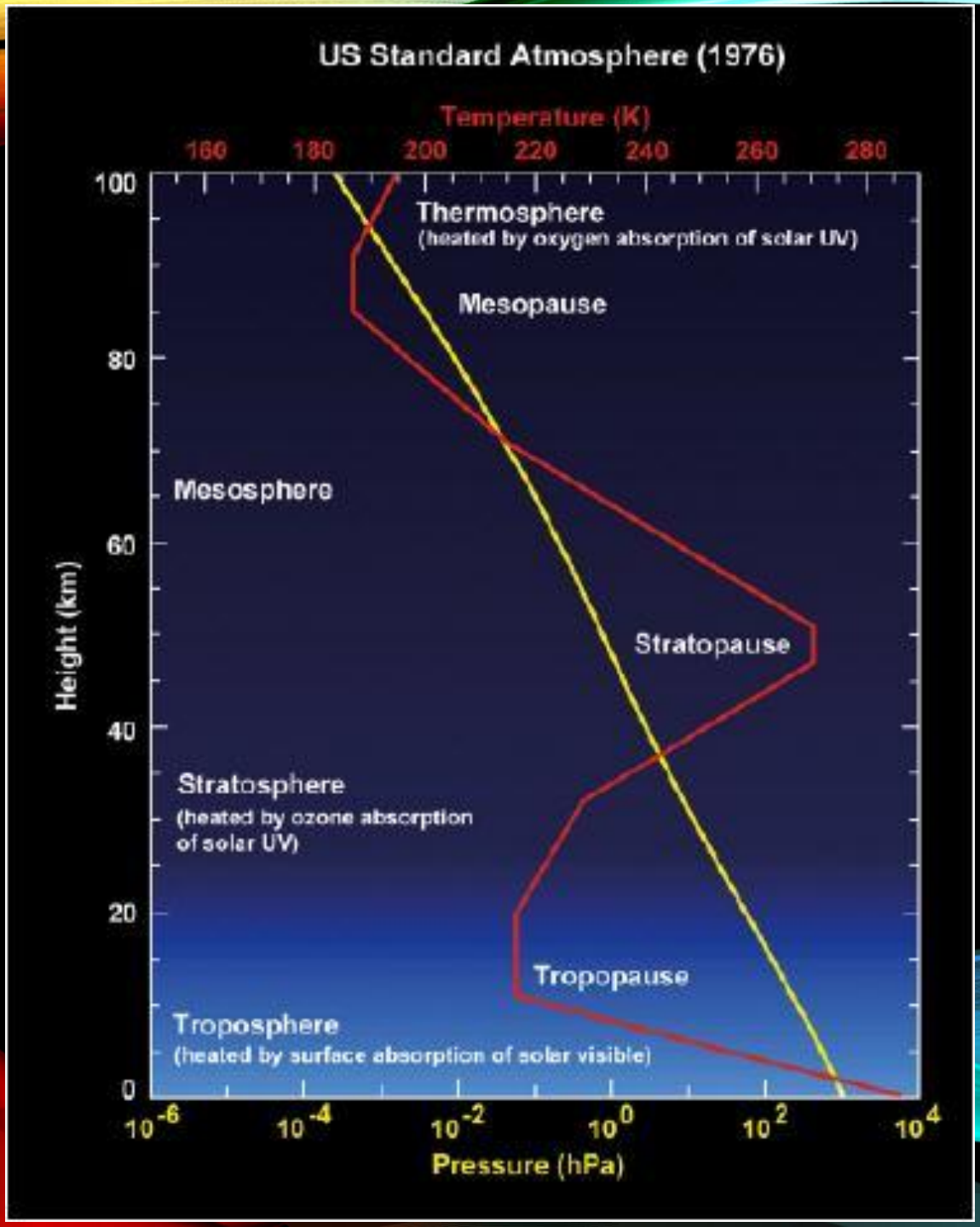



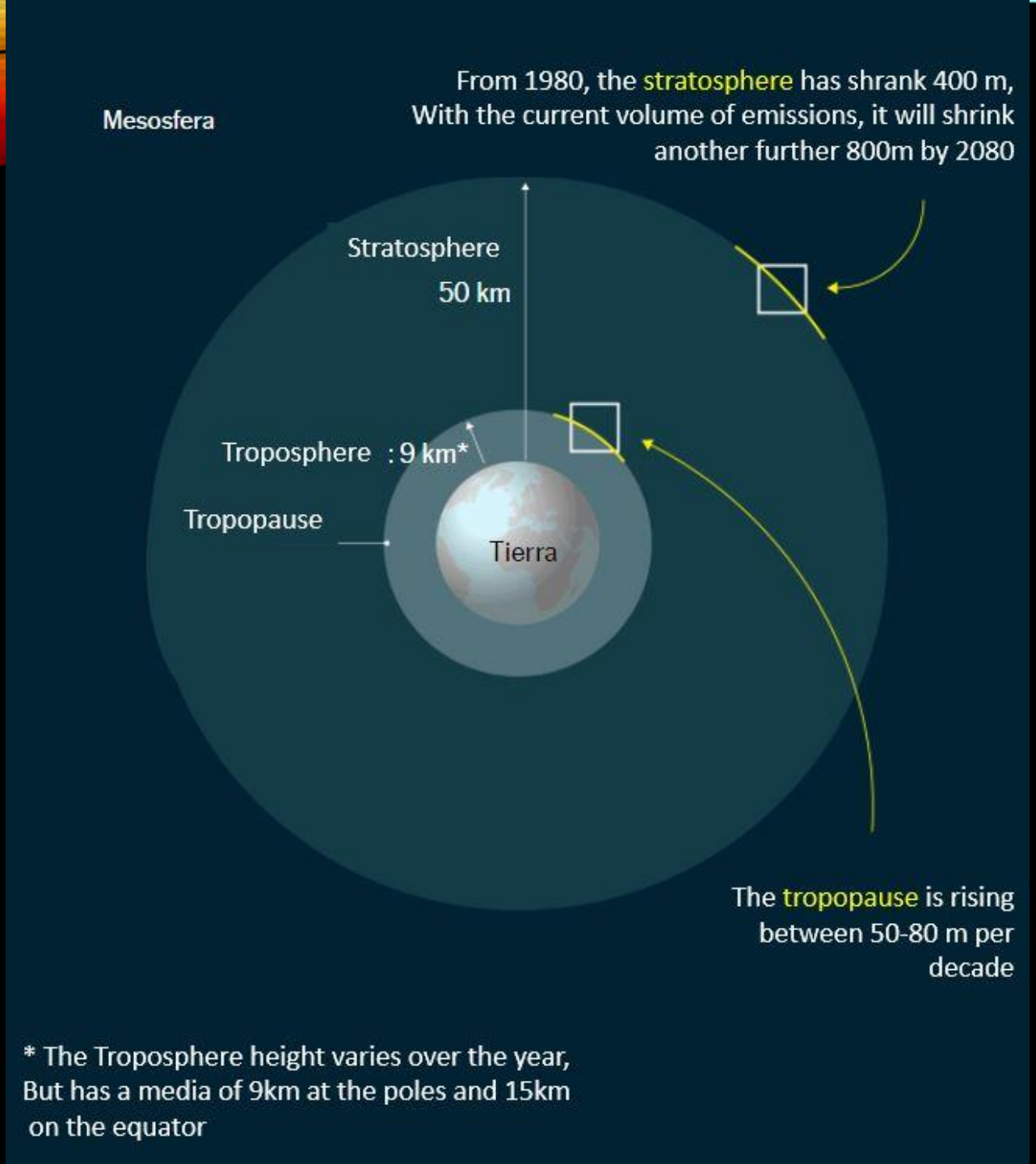

https://www.e-education.psu.edu/meteo3/l4_p4.html


In open air the water vapour can move away.




If dry air moves across the water the evaporation rate will be greater than the condensation and water will just continue to evaporate.


US Standard Atmosphere (1976)
Temperature (K)
160
180
200
220
240
260
280
100
80
60
40
20
0
Height (km)
Thermosphere
(heated by oxygen absorption of solar UV)
Mesopause
Mesosphere
Stratopause
Stratosphere
(heated by ozone absorption
of solar UV)
Tropopause
Troposphere
(heated by surface absorption of solar visible)
10^-6
10^-4
10^-2
10^0
10^2
10^4
Pressure (hPa)


From 1980, the stratosphere has shrank 400 m,
With the current volume of emissions, it will shrink another further 800m by 2080
Mesosfera
Stratosphere
50 km
Troposphere : 9 km*
Tropopause
Tierra
The tropopause is rising between 50-80 m per decade
* The Troposphere height varies over the year,
But has a media of 9km at the poles and 15km on the equator

From René

**How do you measure the temperature, humidity and winds in the air above the ground?**

1. Take instruments up mountains

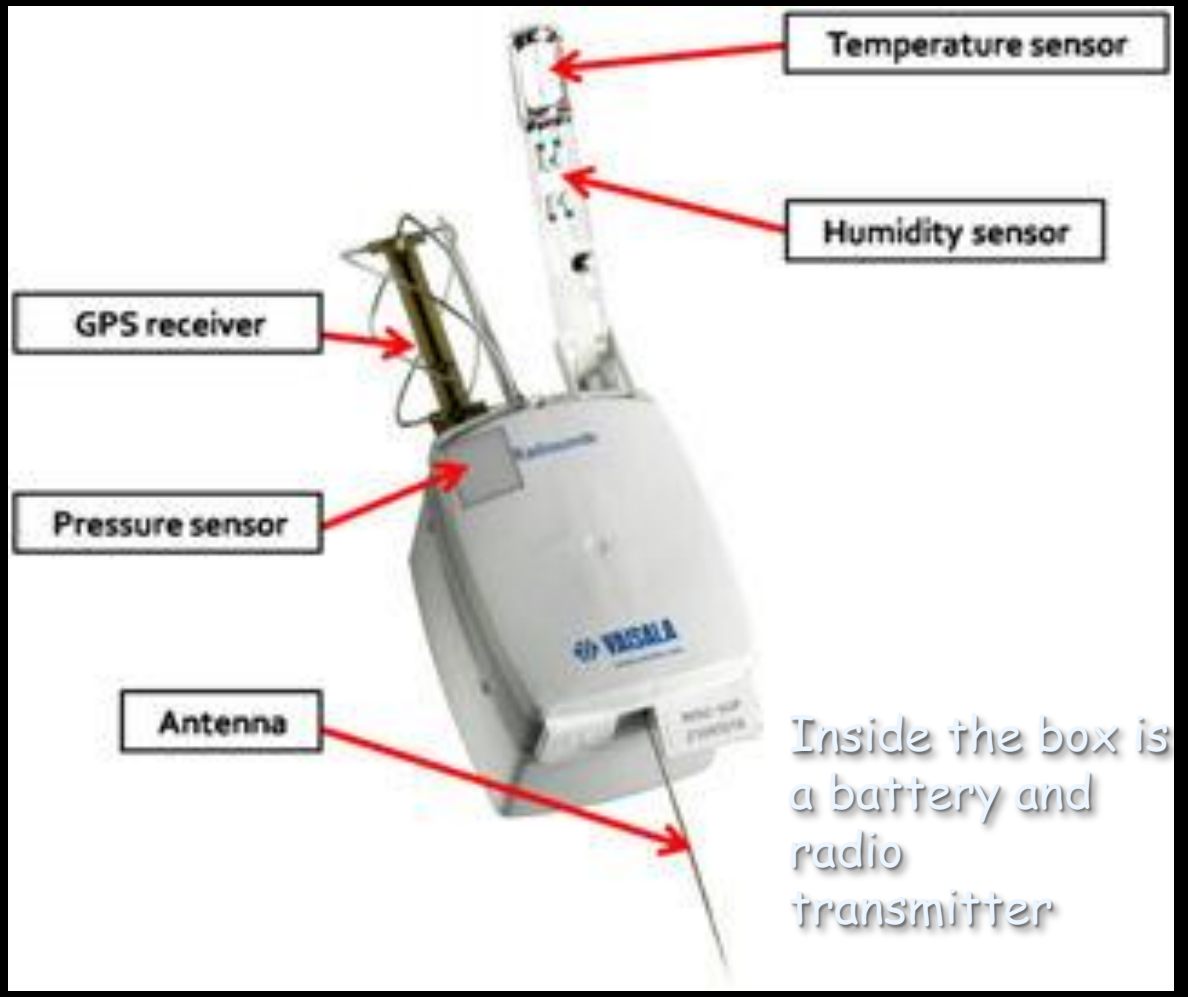
2. Take instruments in a crewed balloon

3. Measure from aircraft

4. Once the technology had been developed use balloons with some telemetering capability

# Radiosonde

Balloon with parachute and radiosonde




The altitude and the wind and direction are now mostly derived from GPS tracking

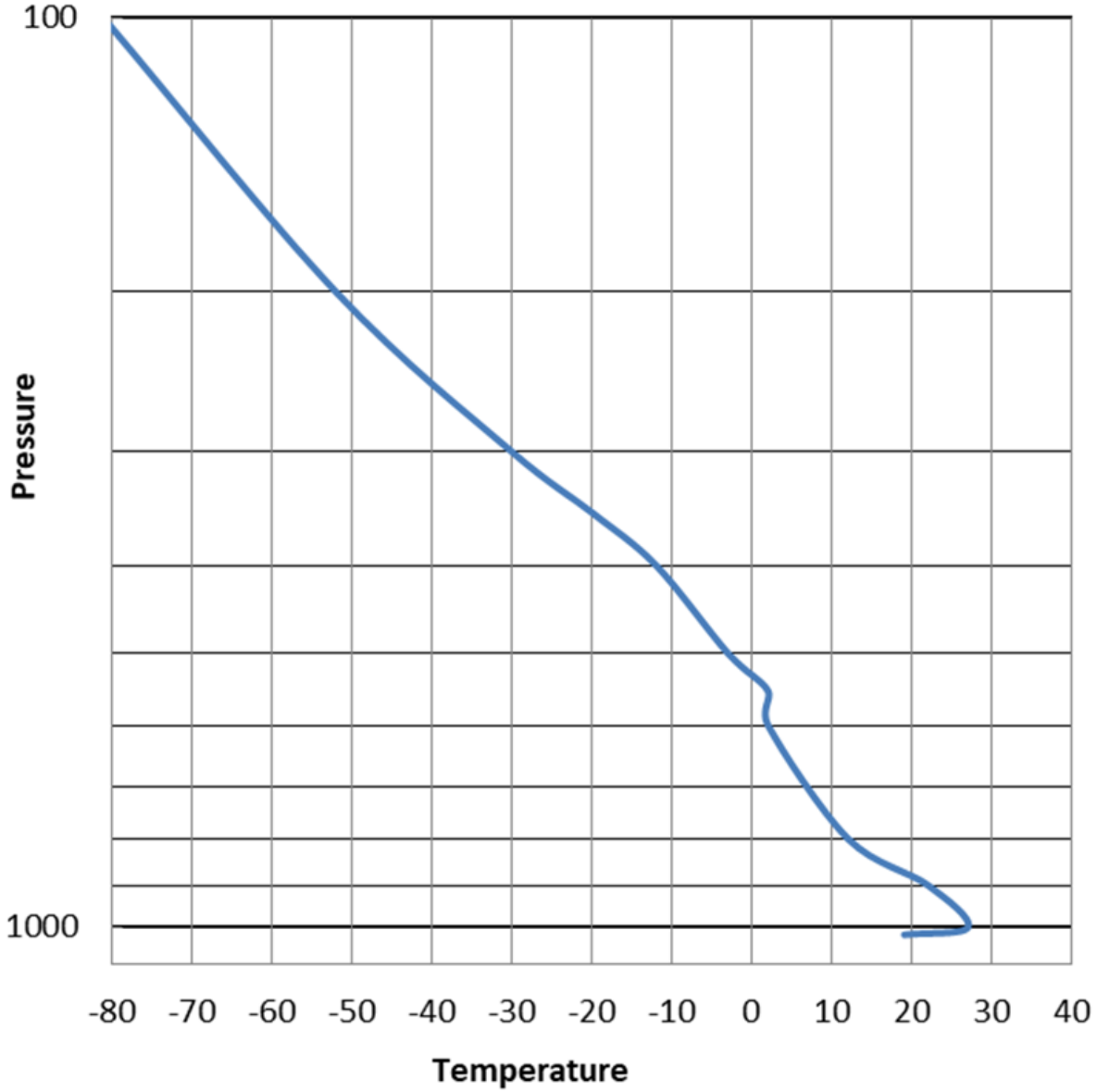
Video: US National Weather Service – launching a radiosonde

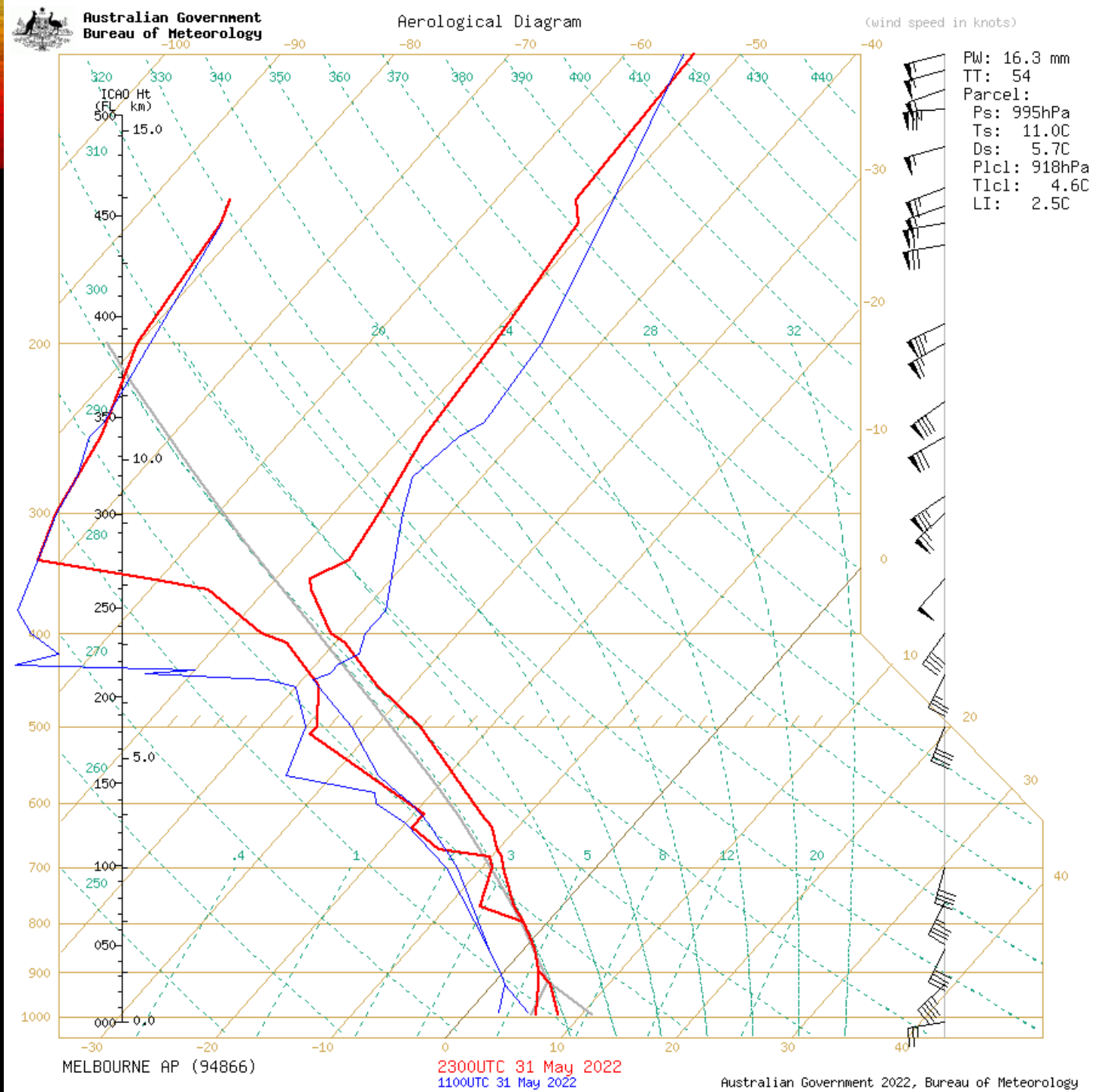
# Aerological diagrams

- Plots of data obtained from radiosonde flights
- They show air temperature and dew point in the upper atmosphere
- Upper winds are also plotted on the diagram
- Used in general forecasting but are also vital in aviation forecasting
- Data plotted on to a Skew T – log P diagram

**Video: Weather Balloons and Radiosondes**
(apologies for the cartoon approach!)

# Aerological Diagram

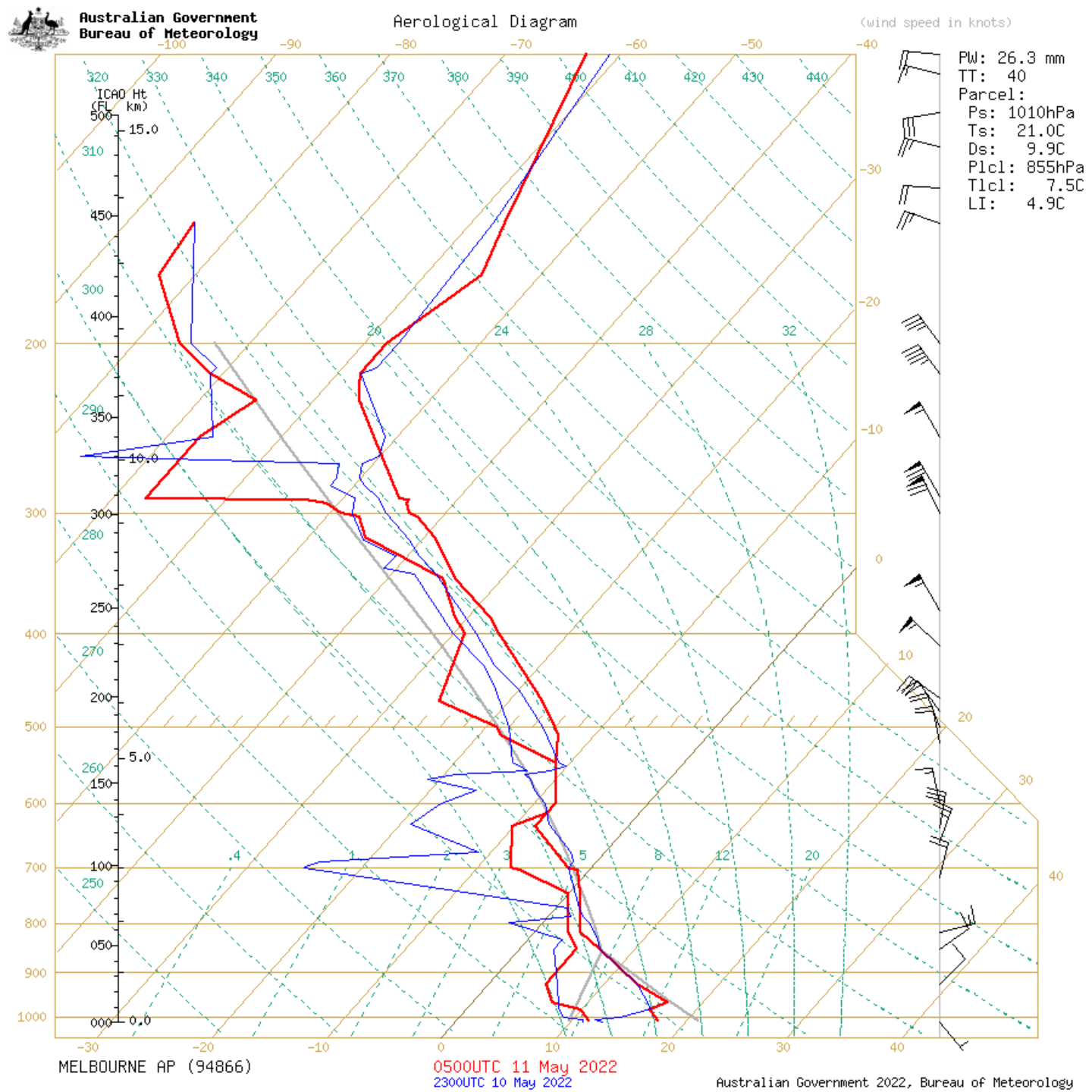





**Melbourne**

Red
9 am 1 June

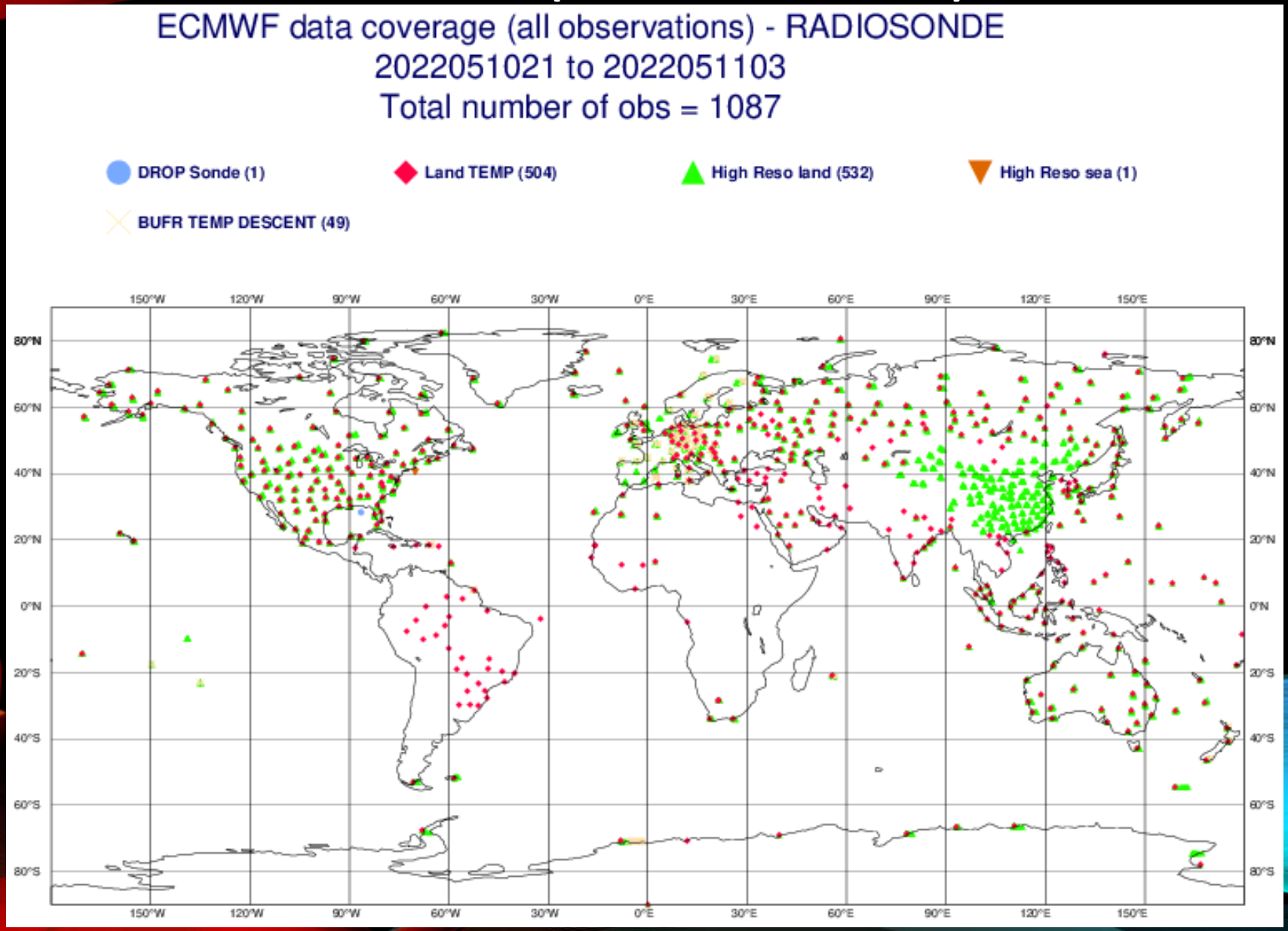
Blue
9 pm 31 May




**Melbourne**
11 May 2022

Red 3 pm
Blue 9 am

# Global radiosonde measurements (ECMWF) 00 UTC (around 10 am EST)



# Global radiosonde measurements (ECMWF)