

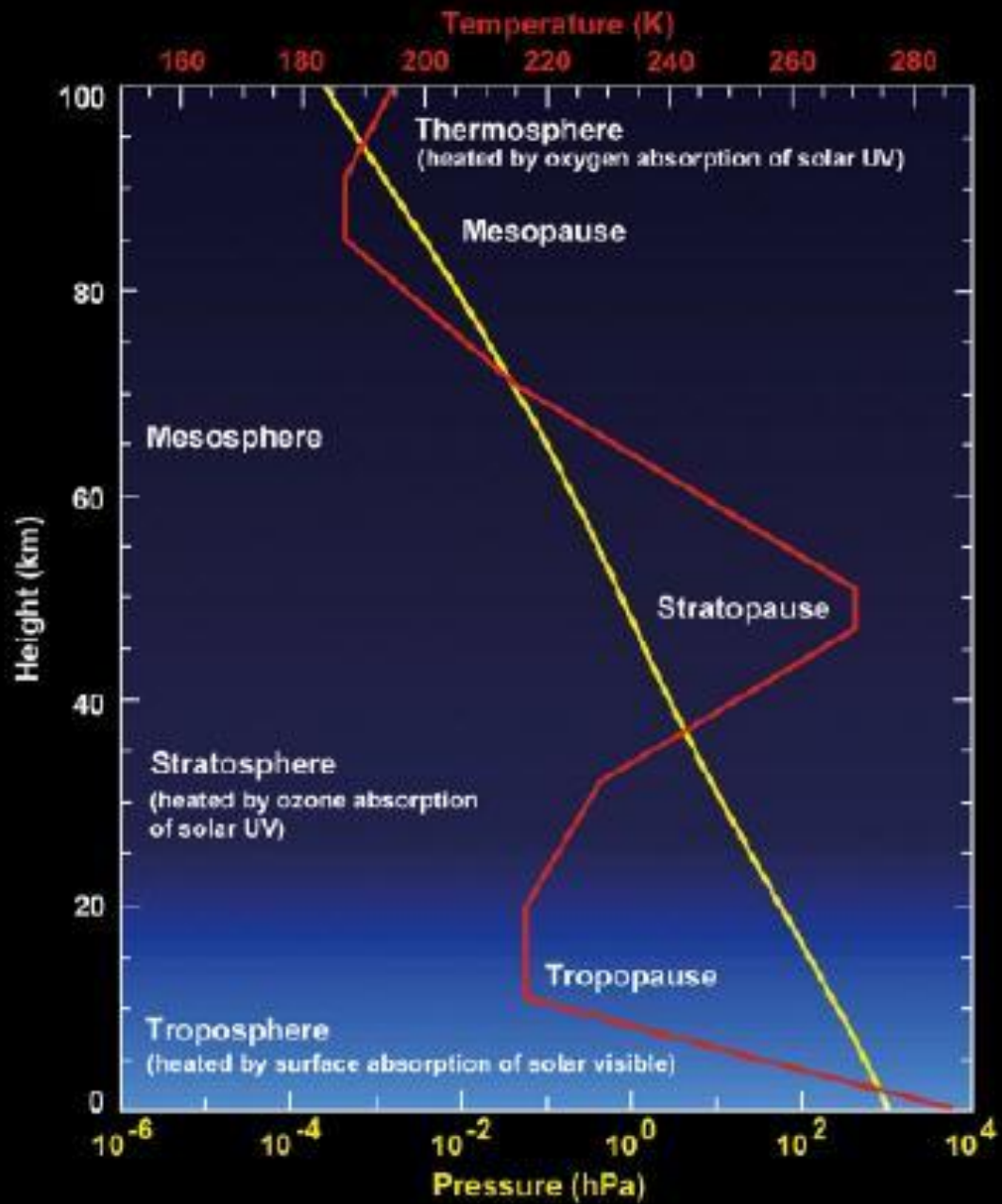


Understanding weather and the weather forecast

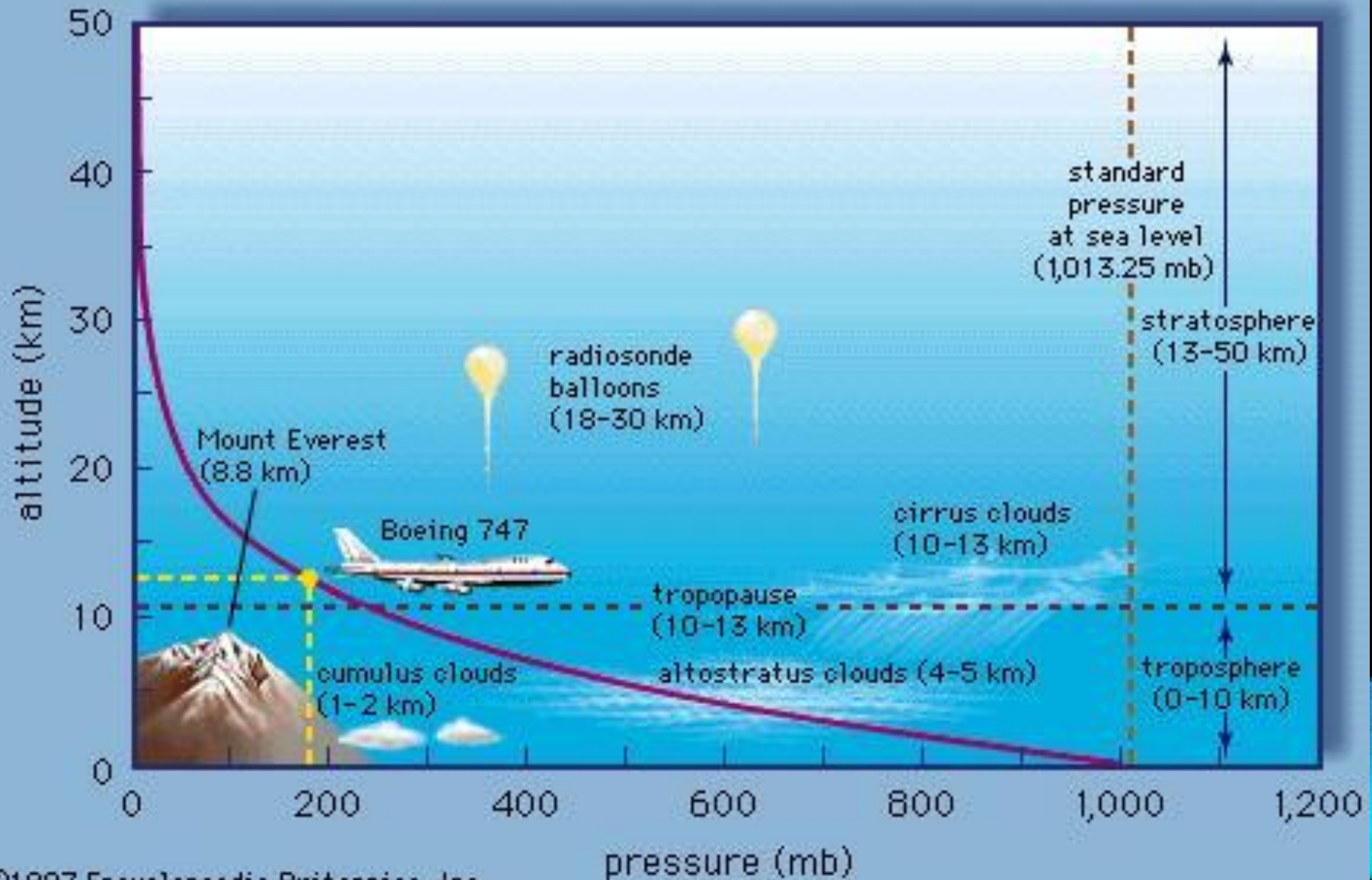
Week 12 Upper Air Measurements

Terry Hart

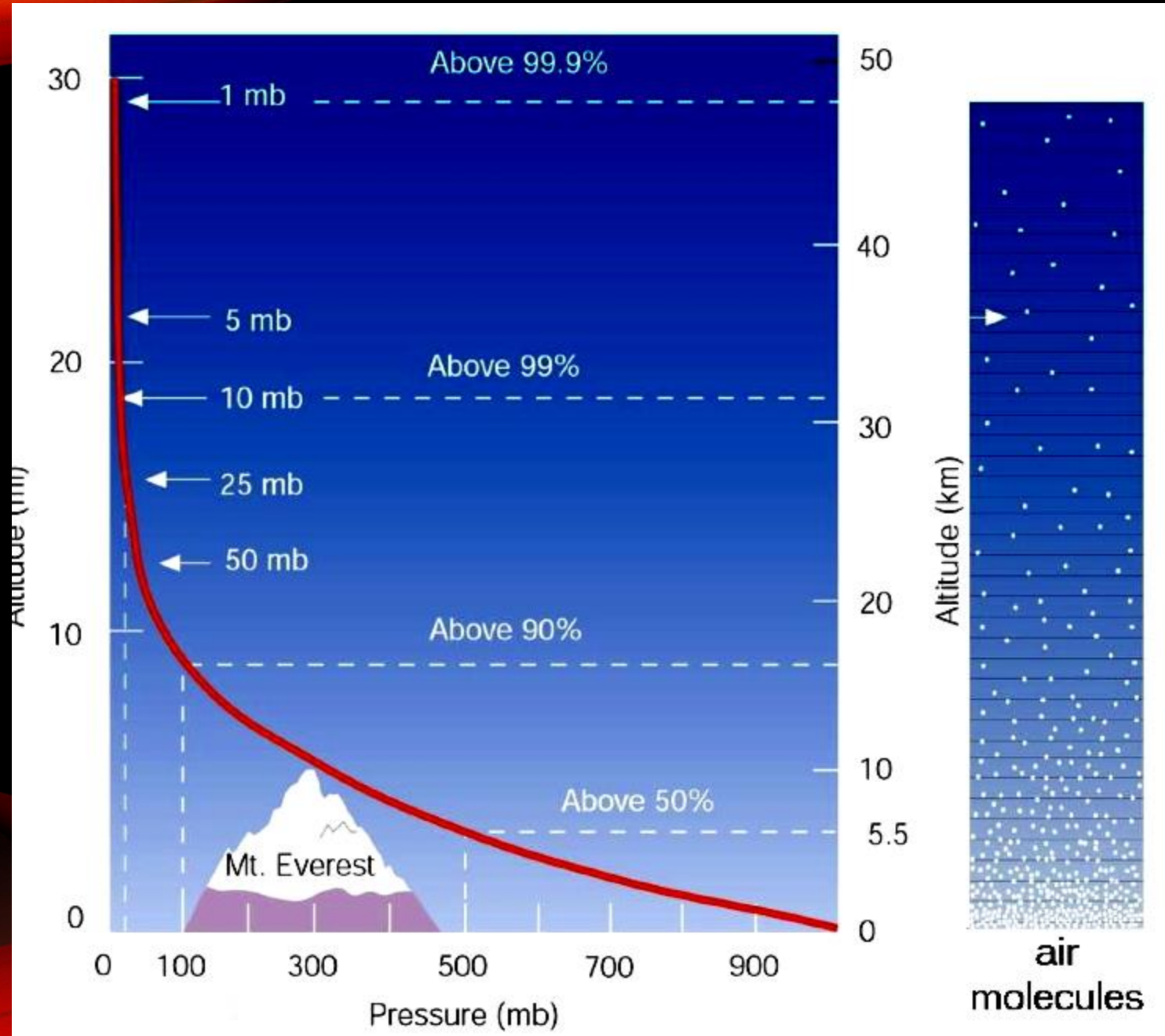
US Standard Atmosphere (1976)



Vertical structure of the atmosphere



Vertical structure of the atmosphere



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

1783 – first crewed balloon flight near Paris (Rozier and the marquis d'Alondes) ascended to about 75 metres. Beforehand a small balloon was released to measure the upper winds

1804 – Gay-Lussac (French physicist) – carried barometers, thermometers, hydrosopes, compasses (to test magnetic field) and flasks (to collect samples of air) up to 8 km. He proposed that the temperature decreased by about 0.6 degrees C for every 100 metres of altitude.

1850s – John Welsh (Kew Observatory) and pilot Charles Green ascended to around 6 km with some instruments.

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

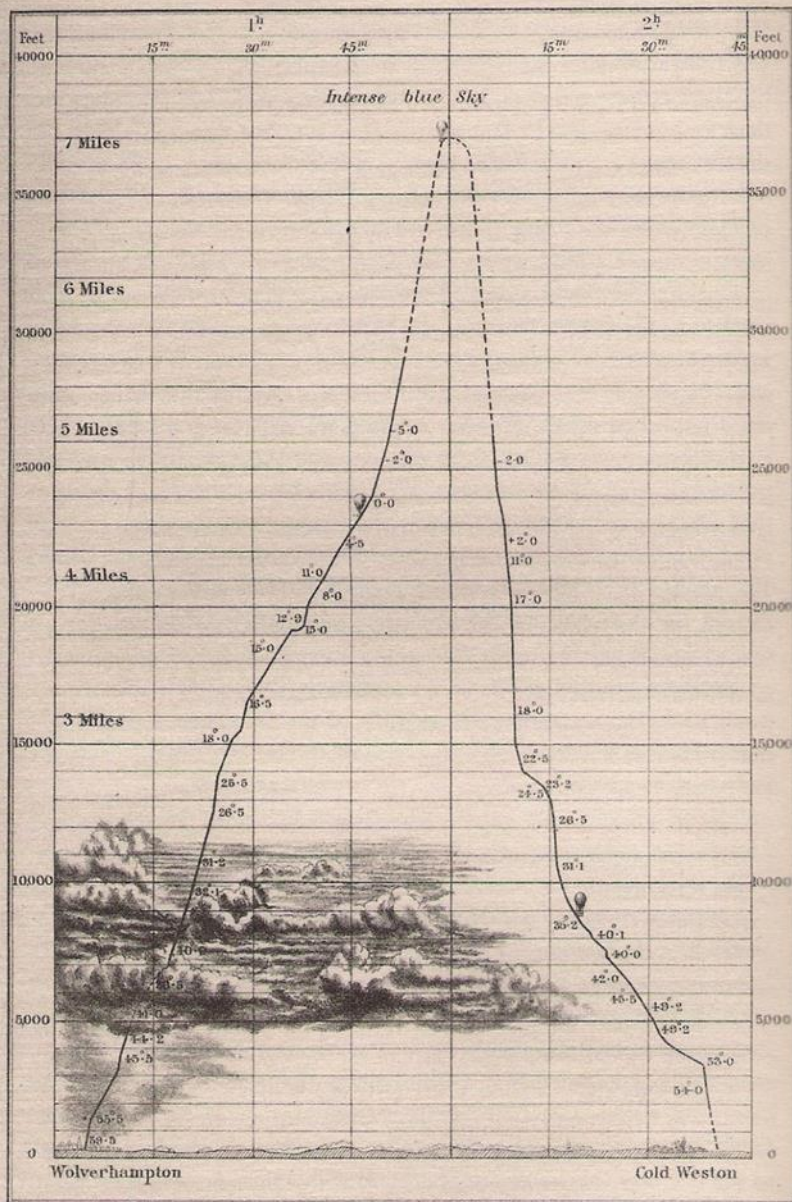
1862 – British Association for the Advancement of Science (with some of the greatest scientists of the time) established a Balloon Committee to make some systematic studies – temperatures, winds, composition, atmospheric electricity.

James Glaisher and Henry Coxwell (pilot) made several flights. The third (5 September 1862) was very dramatic. They inadvertently discovered the effects of loss of oxygen at very high altitudes. Later flights stayed below 8 km (26,000 ft)

Leon Teisserinc de Bort – French meteorologist

1896 – found that temperature above about 11 km remained relatively constant and proposed the terms “*troposphere*” (sphere of change) and “*stratosphere*” (stable sphere).

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



Path of the Balloon in its ascent from Wolverhampton to Cold Weston near Ludlow.
5th September 1862.

Paradox of the air being colder although closer to the sun.

“Had Coxwell and Glaisher known the dangers of subjecting the human body to such fluctuations in pressure they would have realised they were still in grave danger. But Glaisher was oblivious. After his brief spell of “insensibility” he had resumed his observations as before. It was as if they had suffered nothing more than an inconvenience.

At 2.40 pm they touched down in a field in the Shropshire countryside. Having tidied away their balloon and belongings they set out for the nearest village. They walked for 7 or 8 miles until they found a country inn in the village of Cold Weston, near Ludlow, where they promptly drank a pint of beer.”

(Peter Moore, *The Weather Experiment*. 2015)

THE OUTSIDE WORLD

This Is What Happened When Paraglider Ewa Wisnierska Flew Right Into A Huge Storm

Updated 2 years ago on Jul 9, 2019

By Michael Berdy



Ewa sucked into storm and lives to tell

By Linton Besser, Jano Gibson and David Braithwaite

February 17, 2007 – 3.14am



MeteoWeb.com

She was the top female paraglider in the world and held the title of world champion. But when she was suddenly caught in the midst of a huge, violent storm, she lost control.

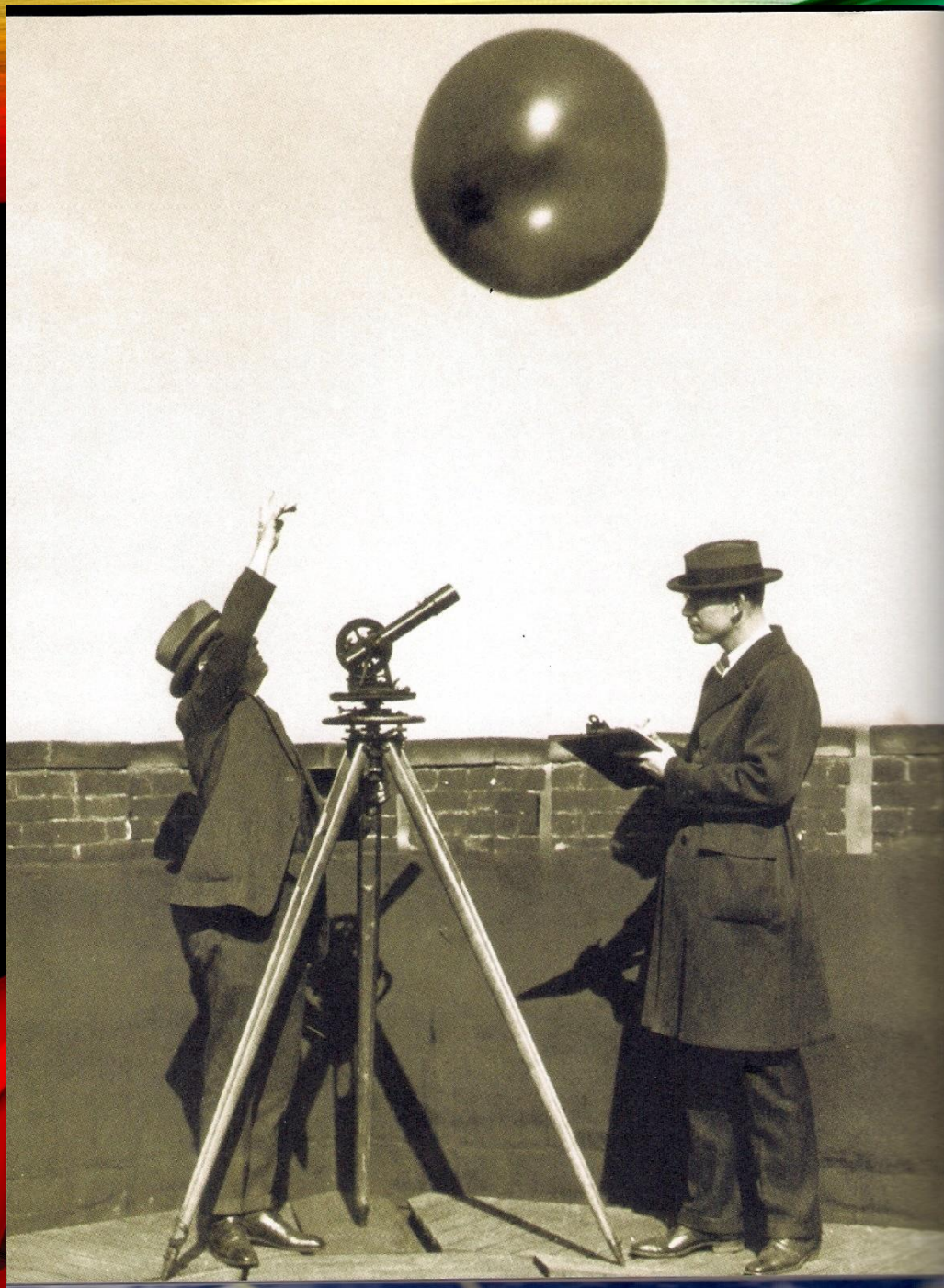
Tossed like a doll, the helpless paraglider was in the freezing cold stratosphere. All around her was a vicious velocity. She was losing oxygen.

A German paraglider survived lightning, pounding hail, minus 40-degree temperatures and oxygen deprivation after a storm system sucked her to an altitude higher than Mount Everest.

Ewa Wisnierska, 35, passed out due to a lack of oxygen and flew unconscious for up to an hour covered in ice after reaching an altitude of 9947 metres - near the cruising height of a jumbo jet.



In the late 1930s, Bureau observers took upper air temperature readings from thermometers on the struts of aircraft like this Bristol Bulldog pictured at RAAF Laverton in Victoria. Photographed on 9 October 1937 were (from left) Bureau officers Joe Walpole, Alan Martin, Errol Mizon and Keith Hannay (later Regional Director, Victoria). At rear, Fred Rose and the pilot, F/O Richard Cohen.



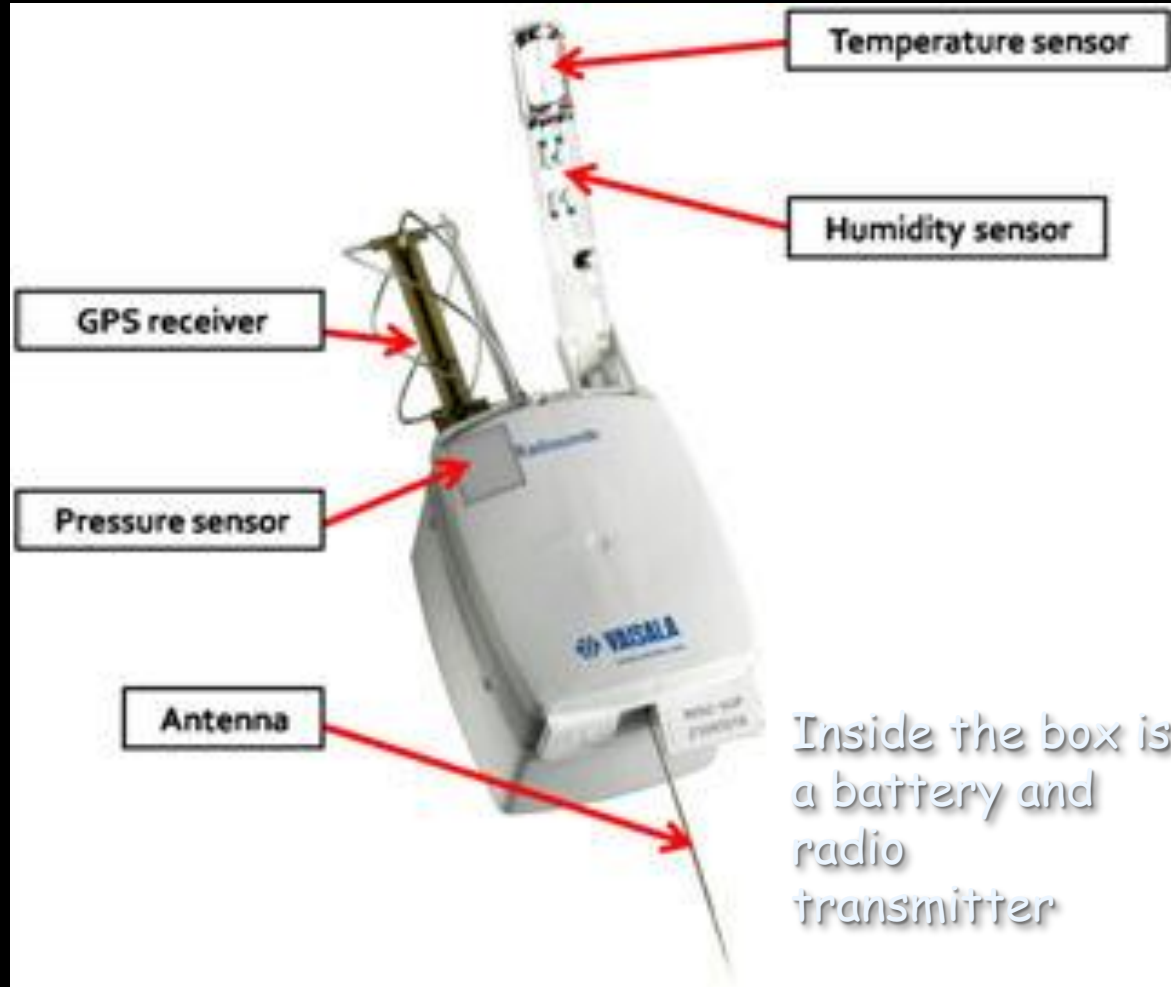
Tracking a balloon using a theodolite to measure upper winds.

They need to assume a rate of ascent (usually the balloons are designed to ascend at about 300 metres (1000 feet) per minute

Radiosonde



Balloon with parachute and radiosonde



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

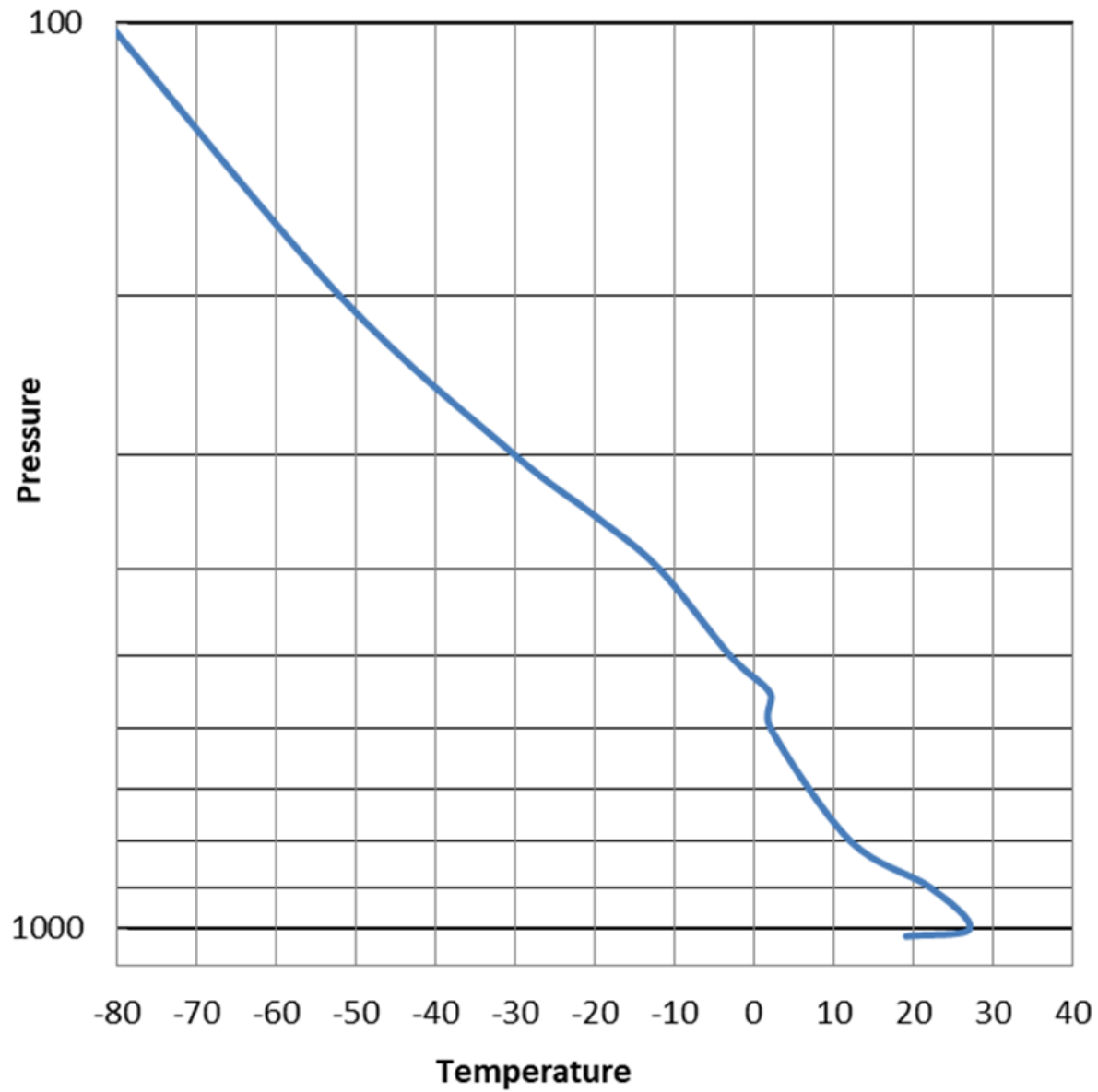
Video: [US National Weather Service - launching a radiosonde](#)

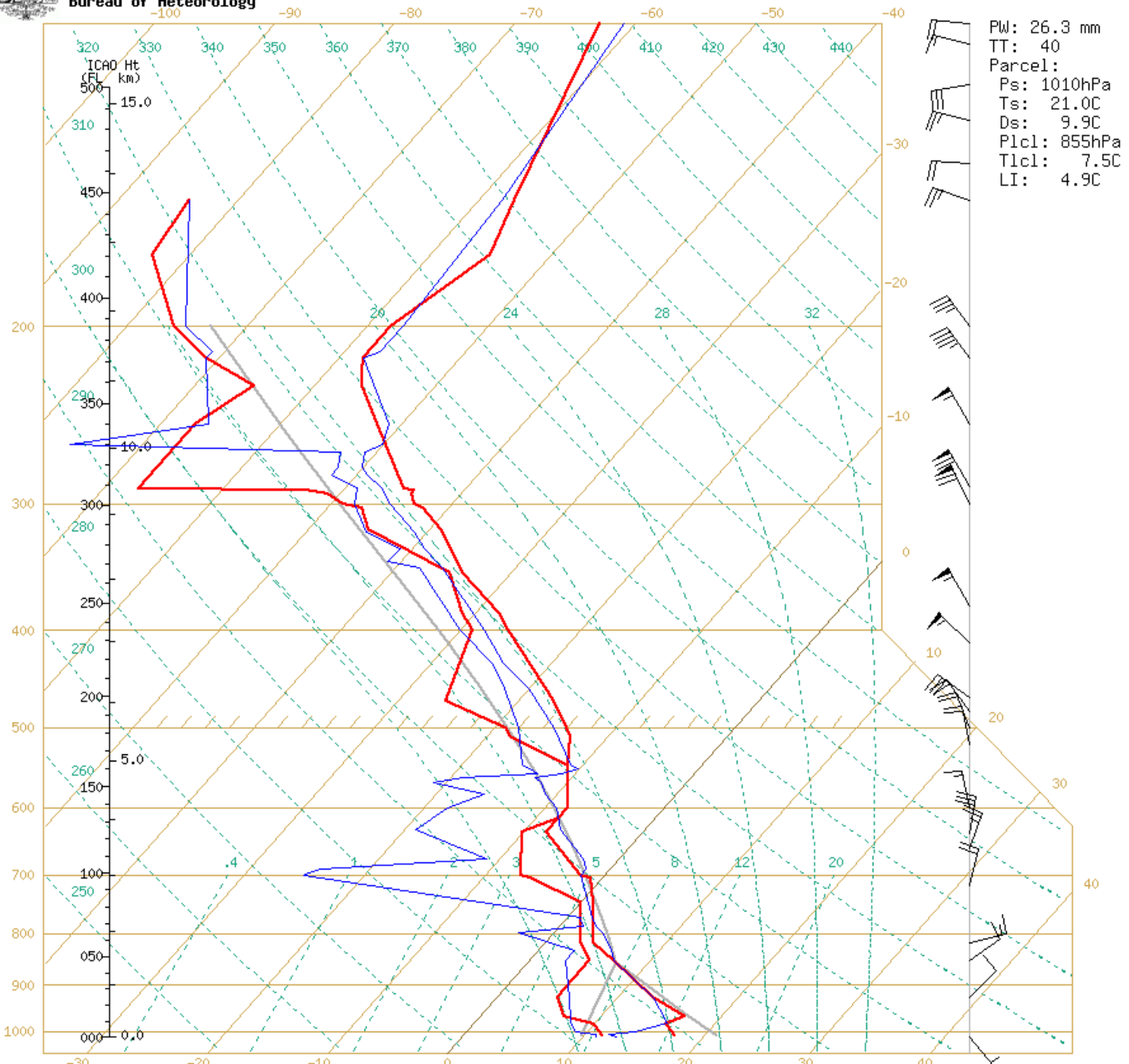
Aerological diagrams

- 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

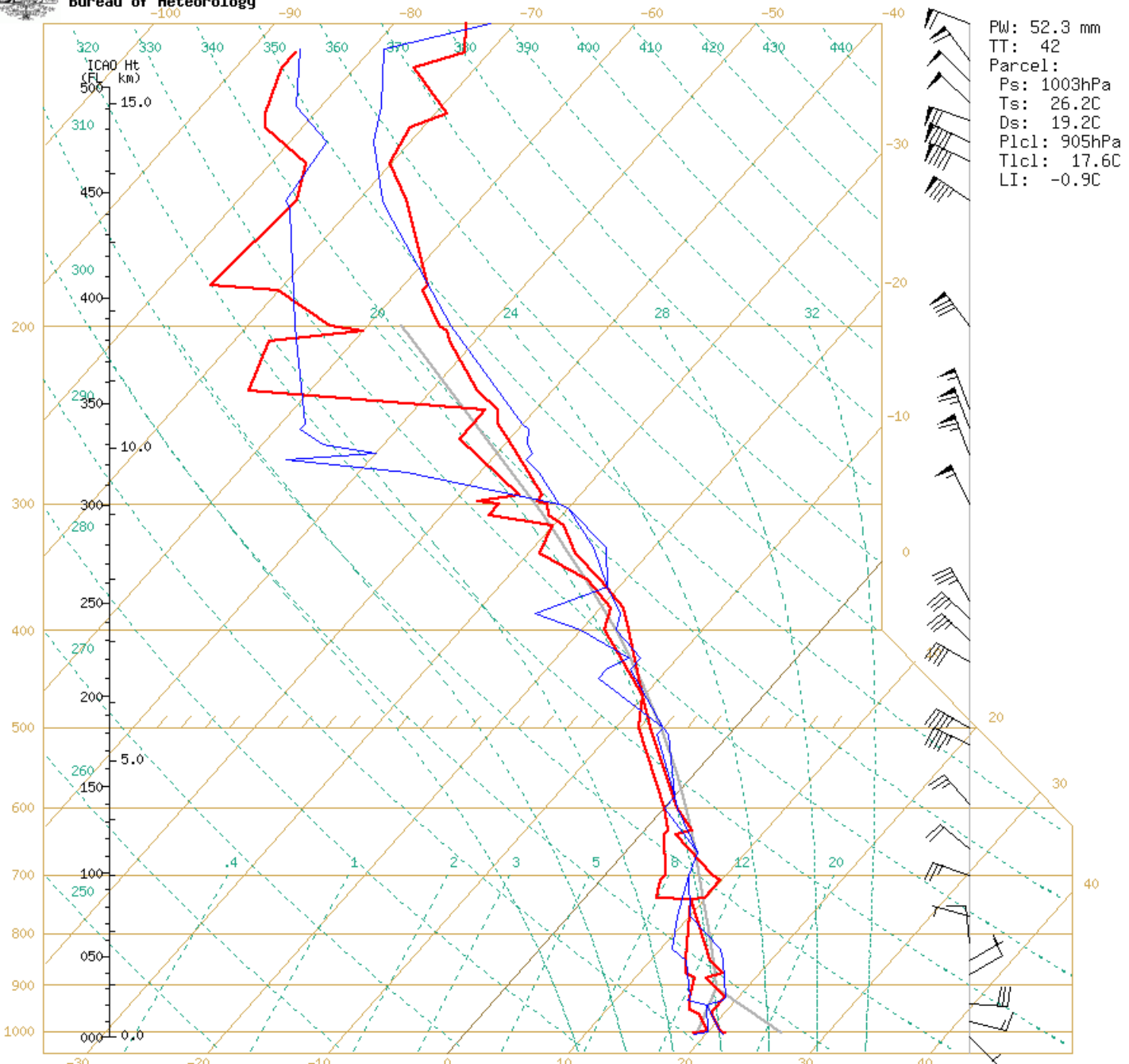




Melbourne

11 May 2022

Red 3 pm
Blue 9 am



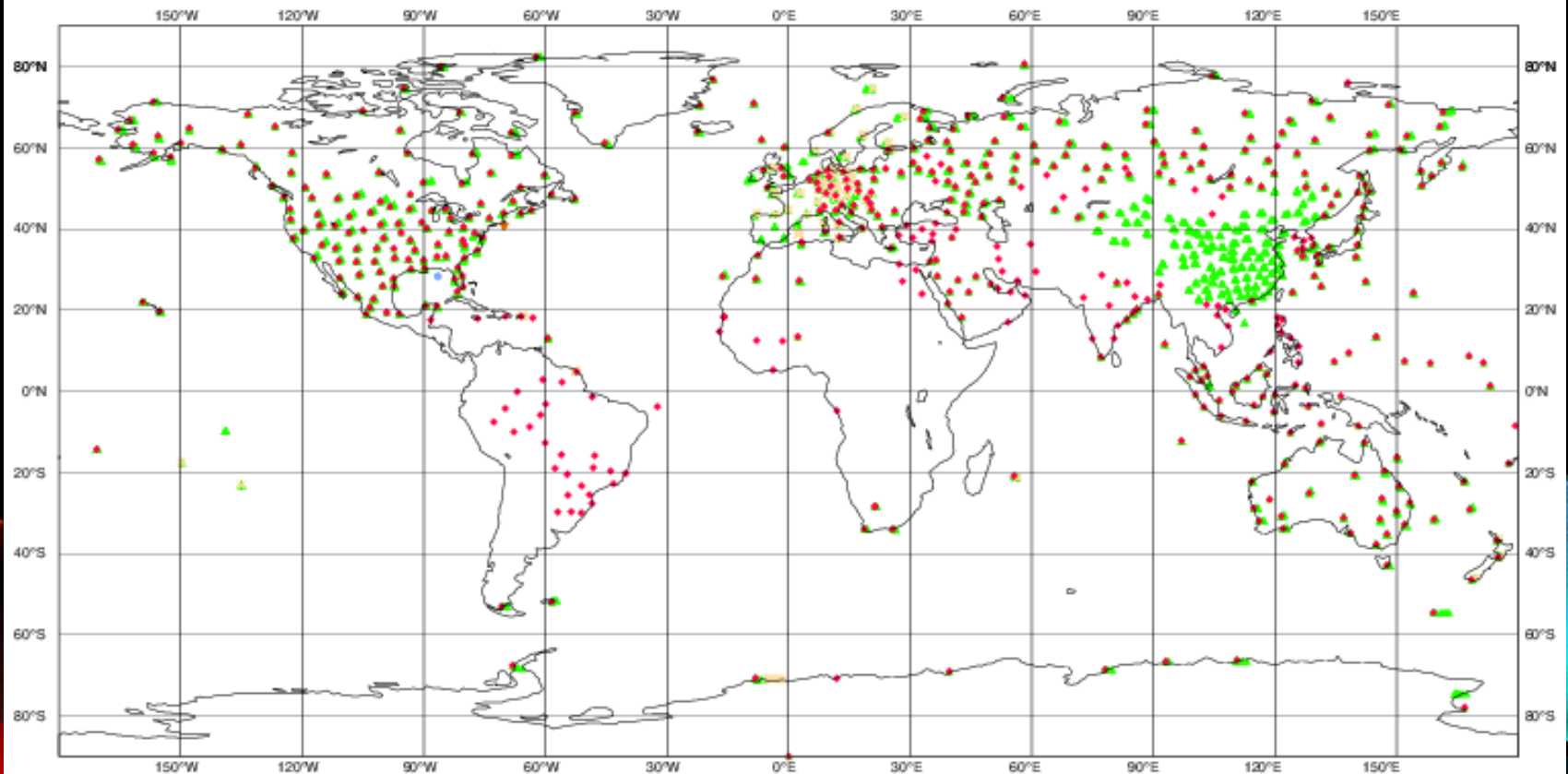
Townsville 11 May 2022

Red 3 pm
Blue 9 am

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

ECMWF data coverage (all observations) - RADIOSONDE
2022051021 to 2022051103
Total number of obs = 1087

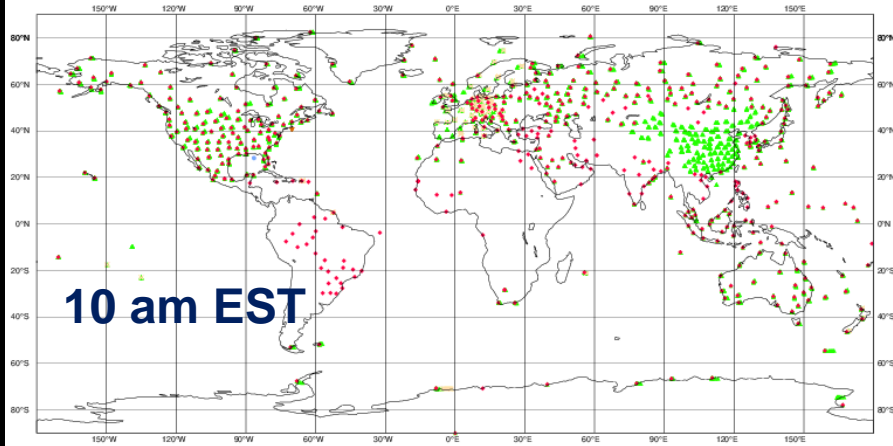
- DROP Sonde (1)
- ◆ Land TEMP (504)
- ▲ High Reso land (532)
- ▼ High Reso sea (1)
- ✕ BUFR TEMP DESCENT (49)



Global radiosonde measurements (ECMWF)

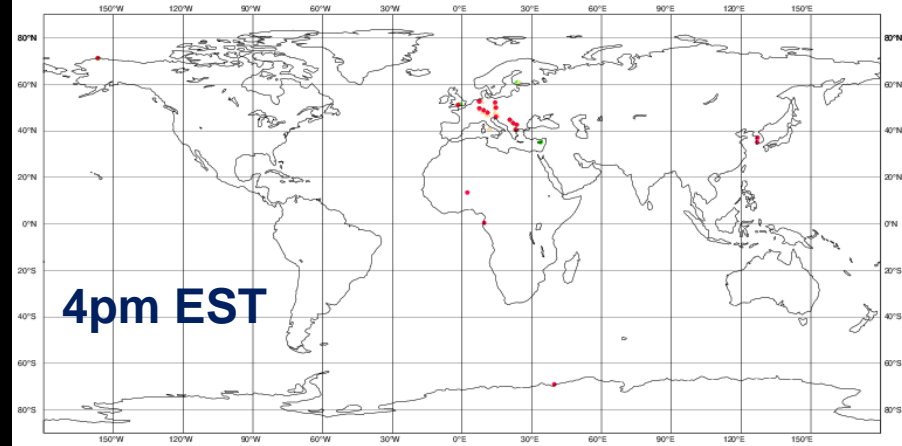
ECMWF data coverage (all observations) - RADIOSONDE
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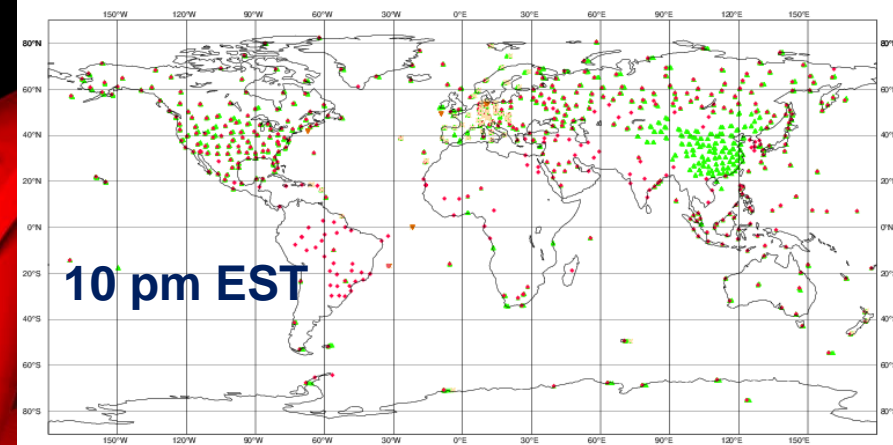
ECMWF data coverage (all observations) - RADIOSONDE
2022051003 to 2022051009
Total number of obs = 45

- Land TEMP (18)
- ◆ High Reso land (16)
- ▲ BUFR TEMP DESCENT (11)



ECMWF data coverage (all observations) - RADIOSONDE
2022051009 to 2022051015
Total number of obs = 1081

- TEMP SHIP (1)
- ◆ Land TEMP (495)
- ▲ High Reso land (526)
- ▼ High Reso sea (5)
- ✕ BUFR TEMP DESCENT (54)



ECMWF data coverage (all observations) - RADIOSONDE
2022051015 to 2022051021
Total number of obs = 39

- DROP Sonde (1)
- ◆ Land TEMP (15)
- ▲ High Reso land (18)
- ▼ High Reso sea (1)
- ✕ BUFR TEMP DESCENT (4)

