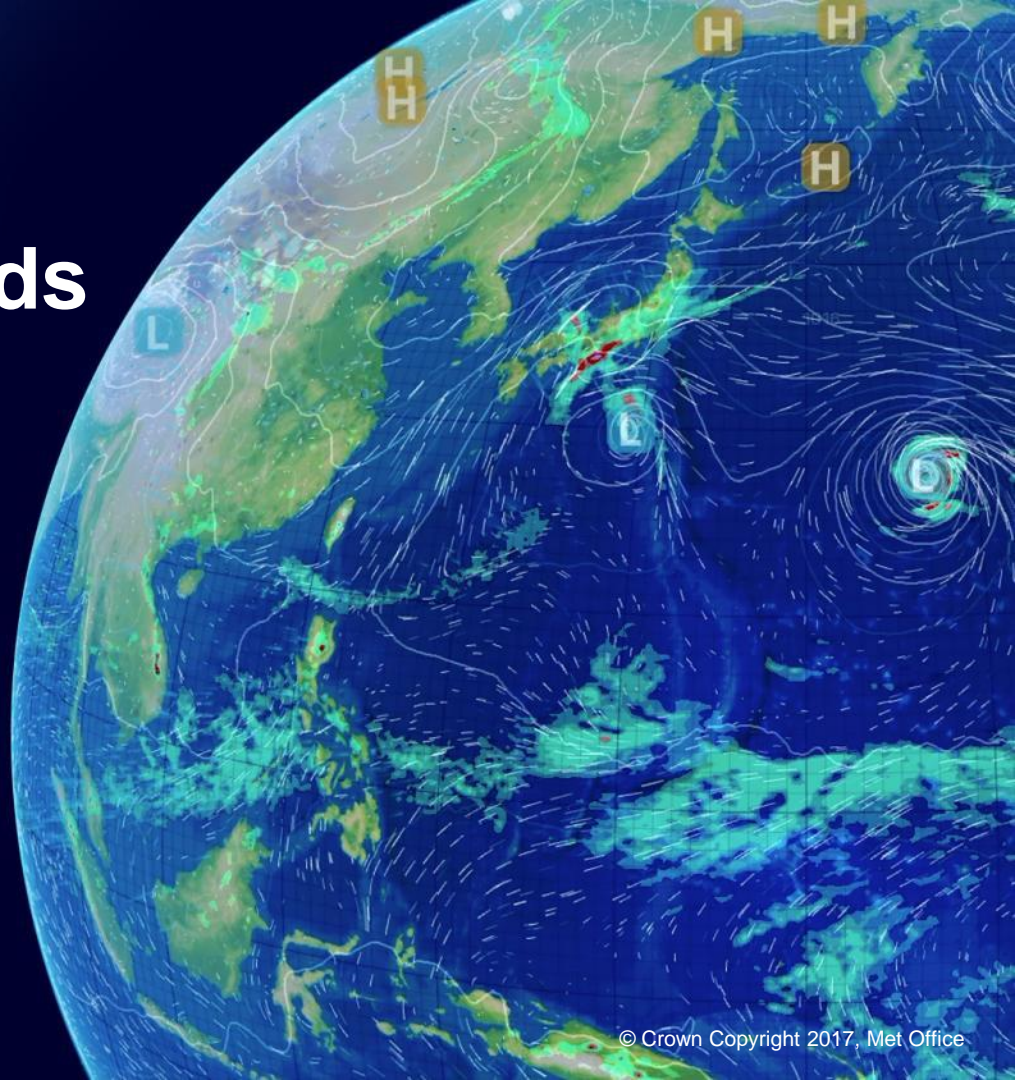




# Radiosonde – Met Aids

Neil Bewley

Spectrum Policy Manager



# Contents

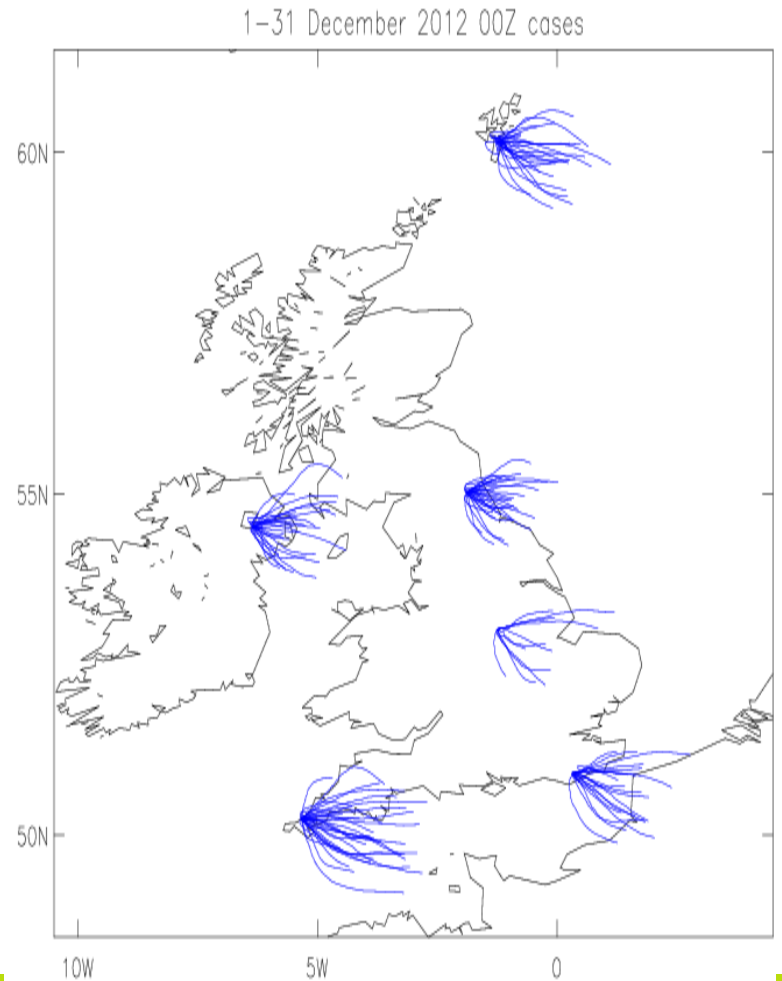
- What is a radiosonde
- How useful are they to Operational Meteorologists

# A radiosonde being launched

<https://www.youtube.com/watch?v=BfvTa8SKyyo&feature=youtu.be>



# Typical tracks, at the mercy of the wind



# What do we do with radiosonde data?

- Data ingested directly into NWP
- Used to plot vertical profiles of temperature and moisture in the atmosphere.
  - makes the tricky mathematics associated with thermodynamics easy!
  - very helpful for forecasters – lots of forecasting techniques make use of thermodynamic diagrams

# Equations used by NWP

- The First Law of thermodynamics can be put in terms of changes to temperature and pressure

$$dq = C_p dT - \alpha dp$$

- The Thermodynamic Equation is used in NWP models

$$\frac{dq}{dt} = C_p \frac{dT}{dt} - \frac{RT}{p} \frac{dp}{dt}$$

# Entropy

- Entropy is a tricky concept!
- It has many, apparently different, definitions

It is known as the “arrow of time”

- In meteorology, we define entropy,  $\phi$ , as follows:

*If, in a reversible thermodynamic process, a system absorbs a quantity of heat  $dq$  at absolute temperature  $T$ , then the ratio  $dq/T$  represents the increase in entropy of the system*

$$d\phi = \frac{dq}{T} \quad \phi = \int \frac{dq}{T}$$

# Entropy & $\theta$

From the 1st Law of thermodynamics :

$$dq = C_p dT - RT \frac{dp}{p}$$

Divide through by T:

$$\frac{dq}{T} = C_p \frac{dT}{T} - R \frac{dp}{p}$$

If we substitute  $\theta$  for  $T$  using Poisson's equation, then substitute in the expression for  $\phi$  and then integrate it:

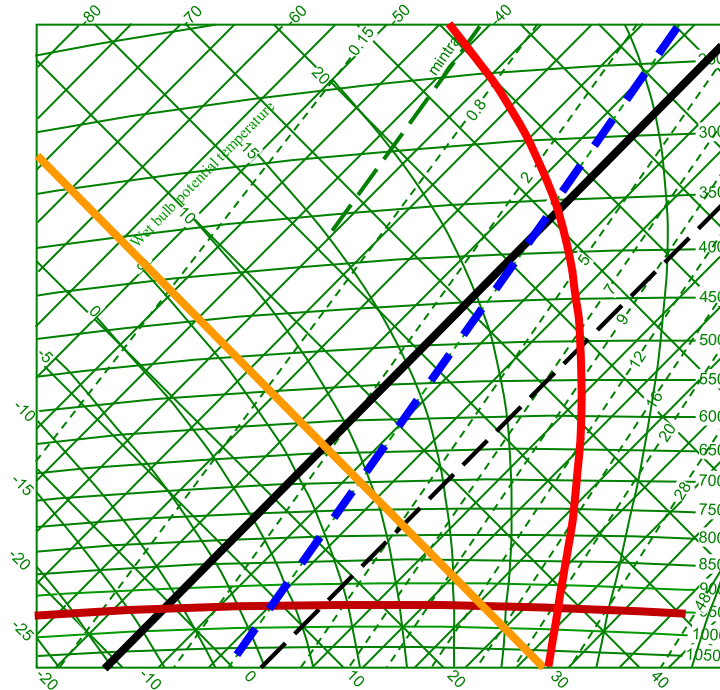
“It can be shown that...”

$$\phi = C_p \ln \theta + \text{const}$$

Entropy and the log of  
potential temp.  
are linearly related



# A thermodynamic diagram



- Temperature (C)
- Dry Adiabats
- Pressure (hPa)
- Humidity mixing ratio (%)
- Saturated Adiabats

- How useful are they to Operational Meteorologists

# but, in the mean time!

## WRC 2019 Agenda item 1.7

*“to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution **659 (WRC-15)**.”*



# Questions?



**[www.metoffice.gov.uk](http://www.metoffice.gov.uk)**



**[mike.banks@metoffice.gov.uk](mailto:mike.banks@metoffice.gov.uk)**



From the UK    **07753 880371**

From outside the UK    **+44 7753 880371**