

Observations

SOEE1400 : Lecture 4

Sources of Data

- Surface-based measurements
 - Surface observations
 - Radiosondes
 - Aircraft
- Remote Sensing
 - Satellites
 - Radar profilers, lidar, sodar
- Numerical Model Analyses
 - Closely linked with forecasts

Synoptic Observations

Observations synchronised worldwide at:
0000, 0600, 1200, 1800 UTC.

- Some stations report more frequently: every 3 hours or hourly, some at only some of the above times.

Two main sets of measurements:

- Surface Observations
- Upper air observations (radiosondes)

Surface Observations

Basic measurements:

- Temperature, dew-point temperature, pressure, rainfall, wind speed & direction.
- Manual observations of cloud cover & current weather: precipitation type, visibility,....

Also:

- Automated measurements of solar & IR radiation, visibility









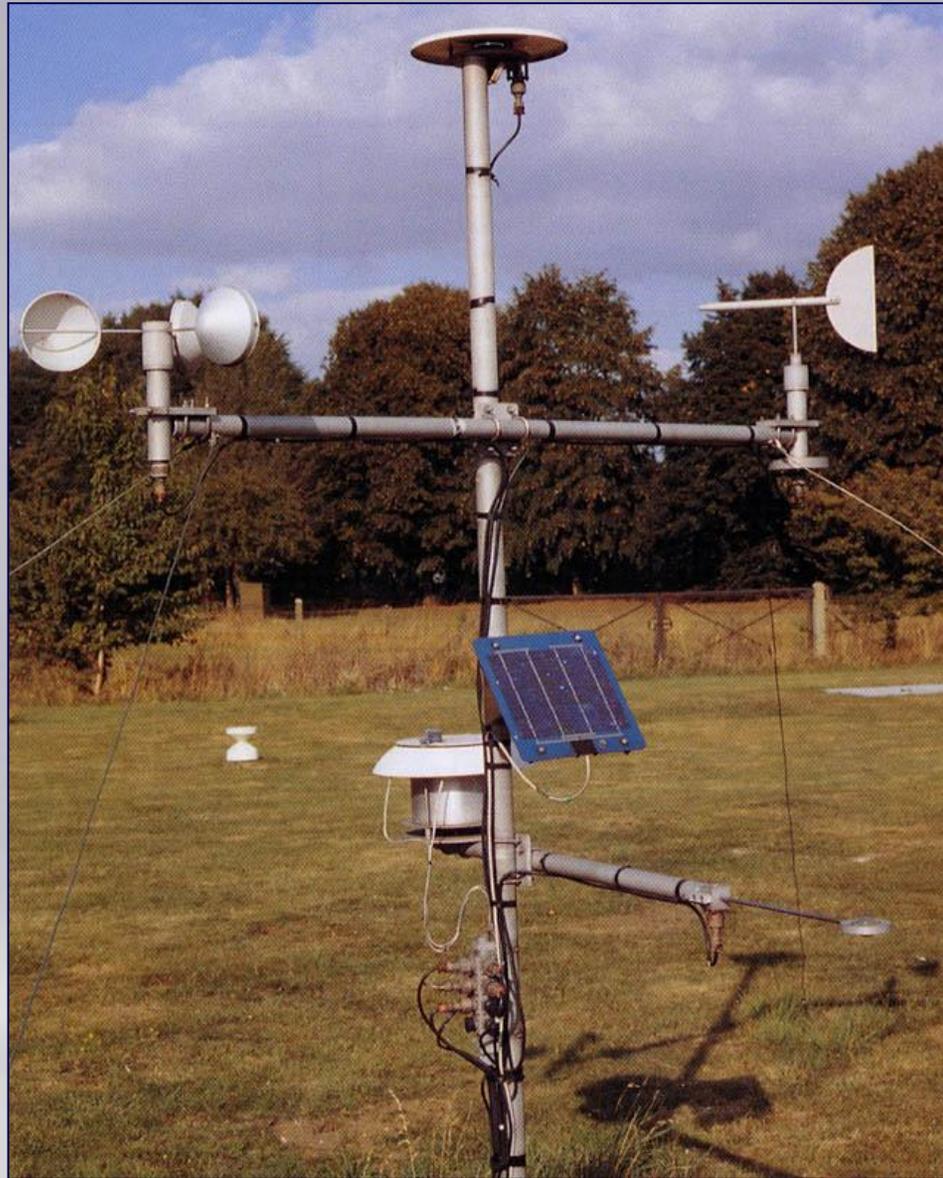




Pyranometer – solar radiation



Pyrgeometer – infra red radiation



Beaufort Scale

Beaufort Force	Wind Speed (kts)	Description	Sea Condition
0	0	Calm	Sea is like a mirror
1	1 – 3	Light air	Ripples but without foam crests
2	4 – 6	Light breeze	Small wavelets. Crests do not break
3	7 – 10	Gentle breeze	Large wavelets, perhaps scattered white-caps
4	11 – 16	Moderate breeze	Small waves. Frequent white-caps
5	17 – 21	Fresh breeze	Moderate waves. Many white-caps
6	22 – 27	Strong breeze	Large waves begin to form. White foam crests, perhaps some spray
7	28 – 33	Near gale	Sea heaps up. White foams blown in streaks along wind
8	34 – 40	Gale	Moderately high waves. Crests begin to break into spindrift
9	41 – 47	Strong gale	High waves. Dense foam along the direction of the wind. Crests of waves begin to roll over. Spray may affect visibility
10	48 – 55	Storm	Very high waves with long overhanging crests. The surface of the sea takes a white appearance. The tumbling of the sea becomes heavy and shock like. Visibility affected
11	56 – 63	Violent storm	Exceptionally high waves. The sea is completely covered with long white patches of foam lying in the direction of the wind. Visibility affected
12	64+	Hurricane	The air is filled with foam and spray. Sea completely white with driving spray. Visibility very seriously affected.

Defined by Admiral Sir Francis Beaufort (1774-1857)

Beaufort scale for land

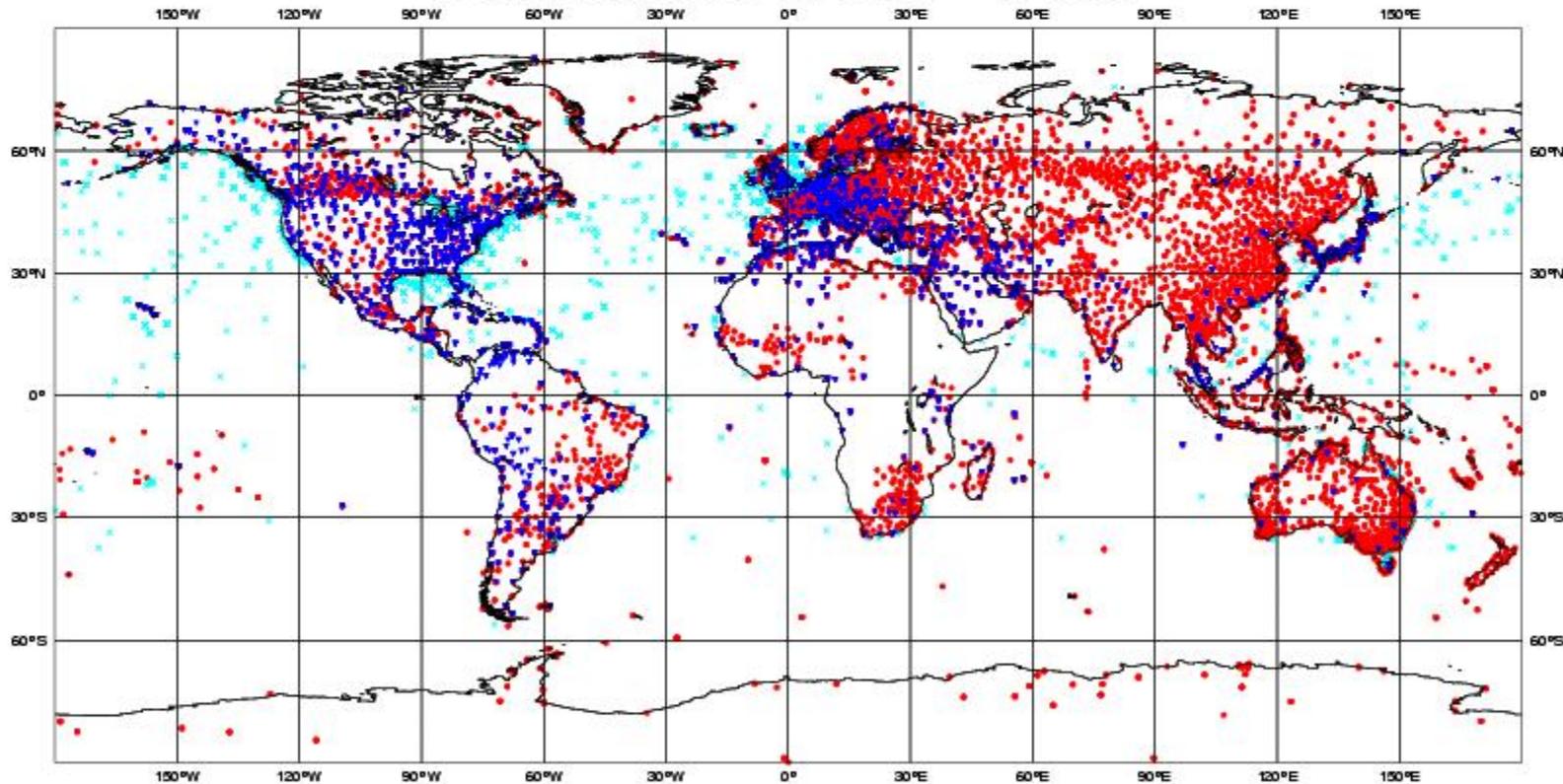
Beaufort Force	Wind Speed (kts)	Description	Conditions on Land
0	0	Calm	Calm; smoke rises vertically
1	1 – 3	Light air	Direction of wind shown by smoke drift, but not by wind vanes.
2	4 – 6	Light breeze	Wind felt on face; leaves rustle; ordinary wind vanes moved by wind.
3	7 – 10	Gentle breeze	Leaves and small twigs in constant motion; wind extends light flags.
4	11 – 16	Moderate breeze	Raises dust and loose paper; small branches are moved.
5	17 – 21	Fresh breeze	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	22 – 27	Strong breeze	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
7	28 – 33	Near gale	Whole trees in motion; inconvenience felt when walking against the wind.
8	34 – 40	Gale	Breaks twigs off trees; generally impedes progress.
9	41 – 47	Strong gale	Slight structural damage occurs (chimney-pots and slates removed).
10	48 – 55	Storm	Seldom experienced inland; trees uprooted; considerable structural damage occurs.
11	56 – 63	Violent storm	Very rarely experienced; accompanied by wide-spread damage.
12	64+	Hurricane	-

Surface observations

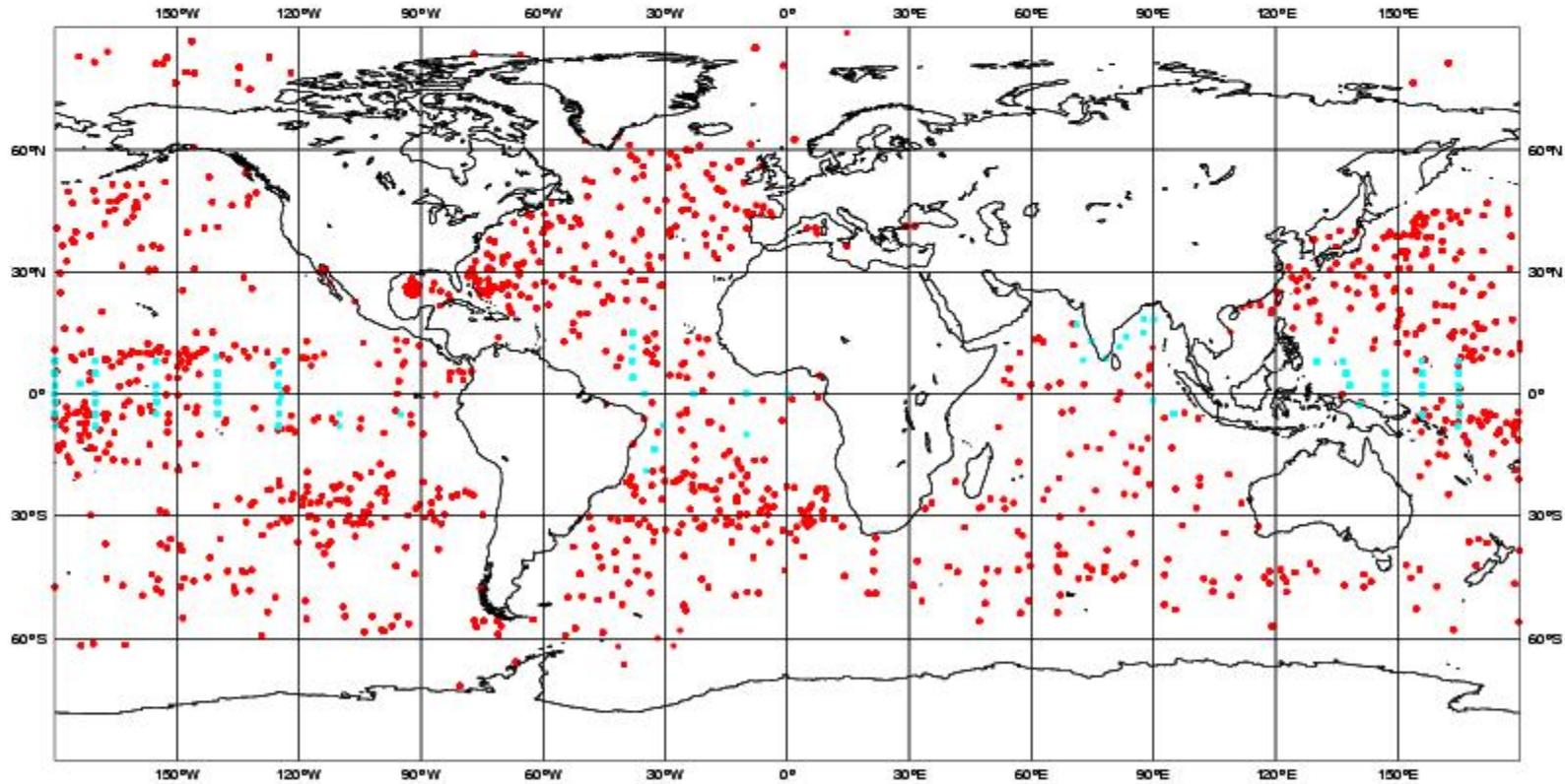
ECMWF Data Coverage (All obs) - SYNOP/SHIP
14/JUN/2004; 00 UTC
Total number of obs = 24651

Obs Type

- 13731 SYNOP
- 1626 SHIP
- 9294 METAR



ECMWF Data Coverage (All obs) - BUOY
27/SEP/2005; 00 UTC
Total number of obs = 7000



Surface Observation Charts

Charts of surface observations use a set of standard symbols to represent the meteorological conditions:

- Wind speed and direction
- Temperature
- Humidity (dew point)
- Cloud cover
- Precipitation type & (approximate) amount
- Pressure

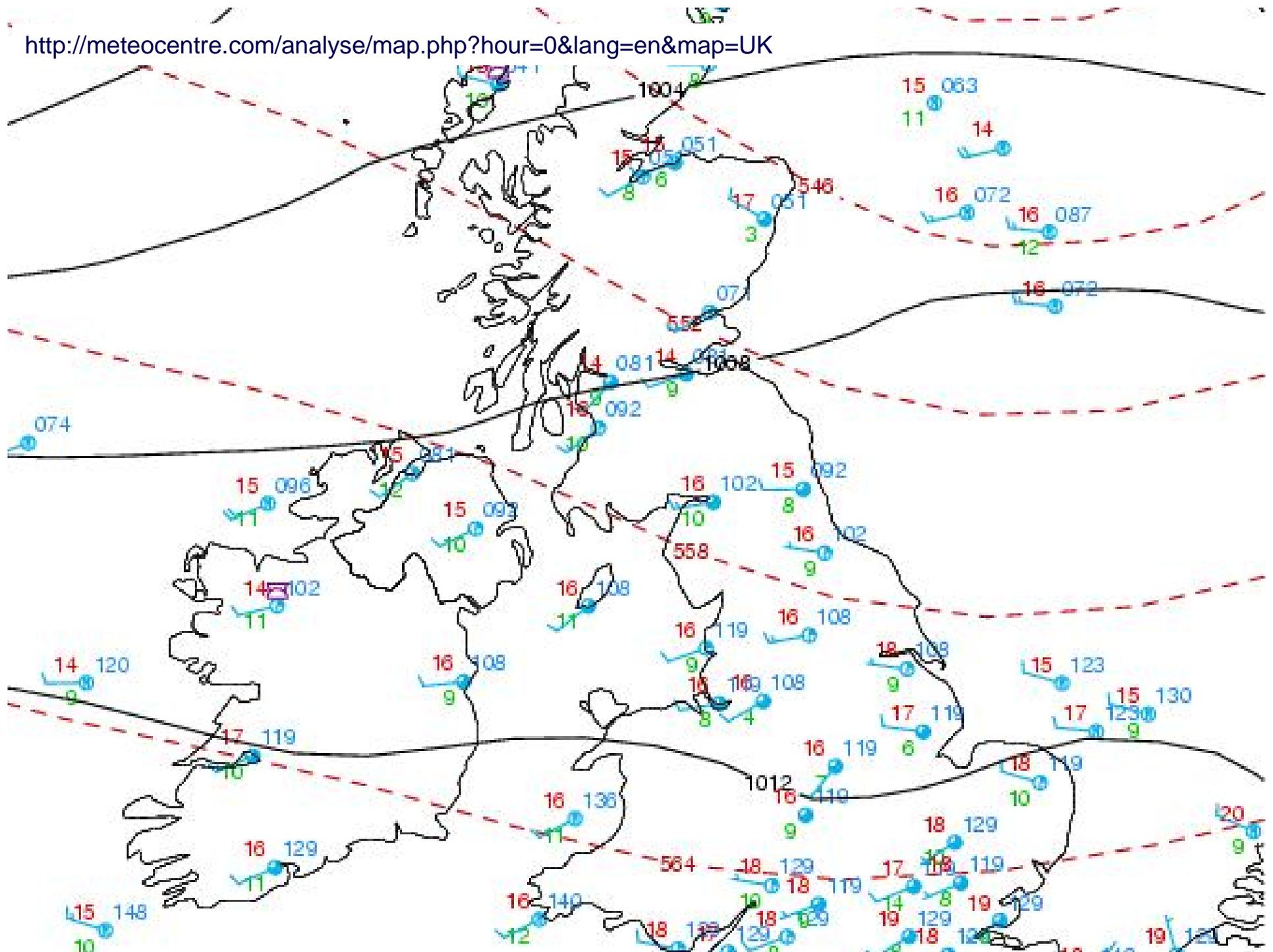
Symbols are defined by the World Meteorological Organisation (WMO), but feature some national additions or modifications.

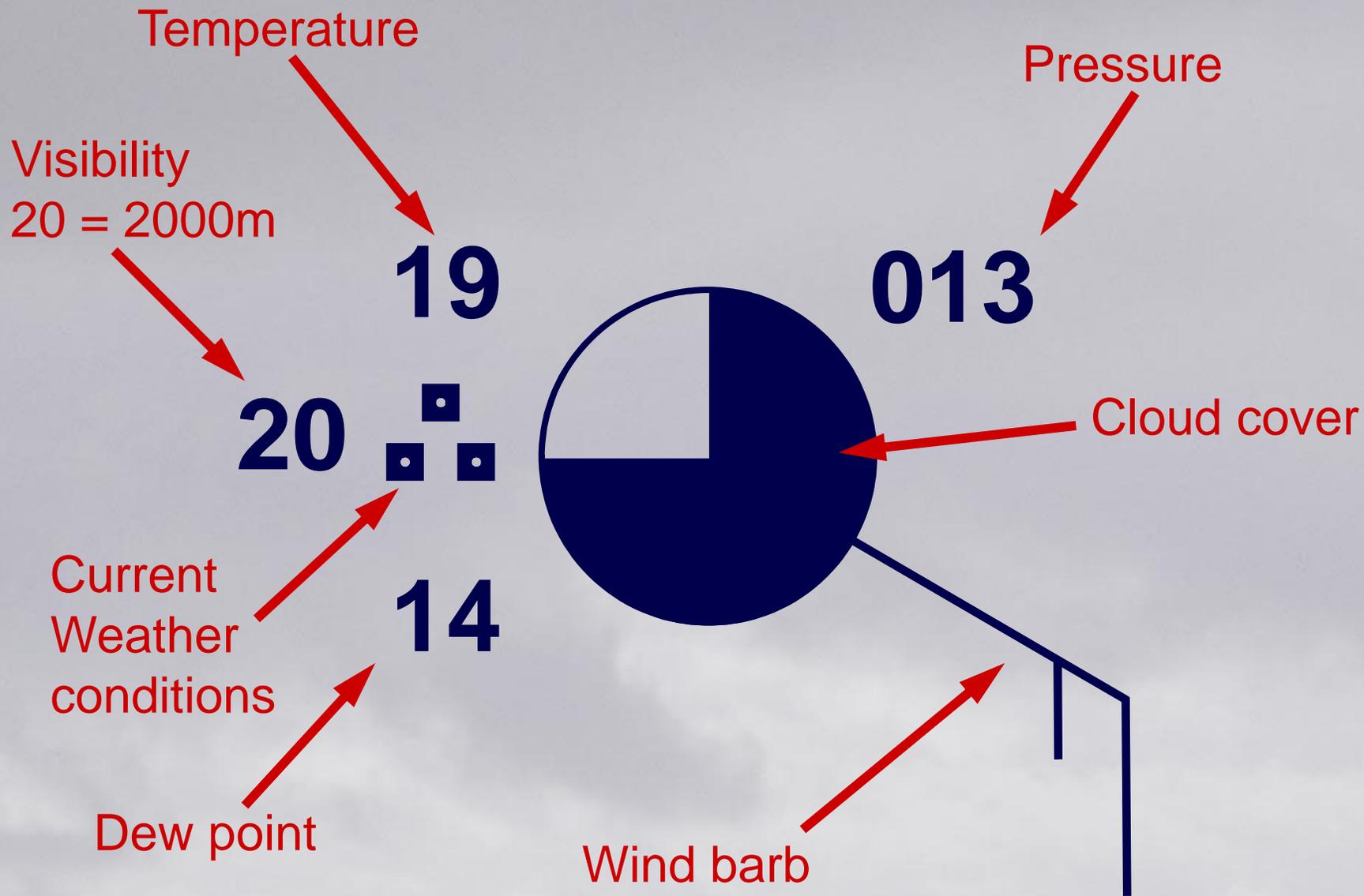
For UK surface maps see:

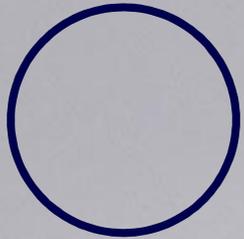
www.medvale.demon.co.uk/weather/charts.htm

<http://meteocentre.com/analyse/map.php?hour=0&lang=en&map=UK>

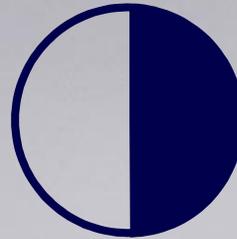
<http://meteocentre.com/analyse/map.php?hour=0&lang=en&map=UK>



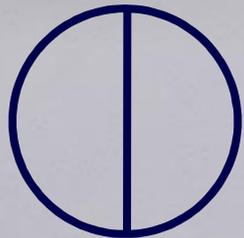




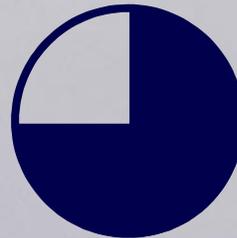
Clear skies



4/8 (50%) cloud cover



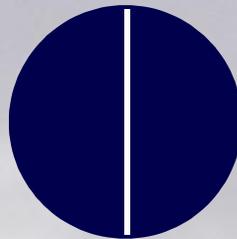
1/8 or less



6/8 (75%) cloud cover



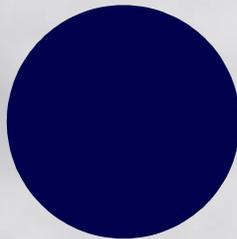
2/8 (25%) cloud cover



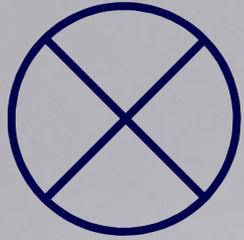
7/8 or more cloud cover



3/8 cloud cover



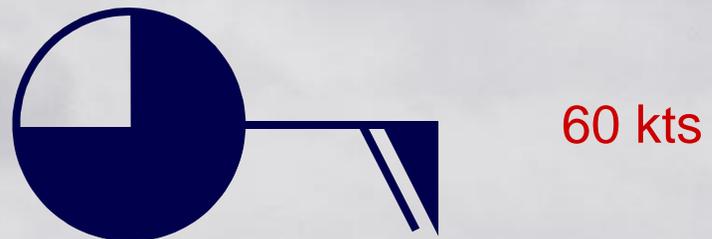
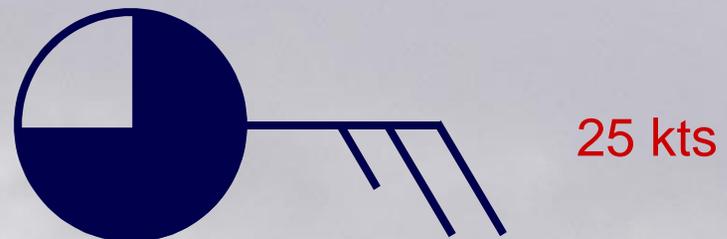
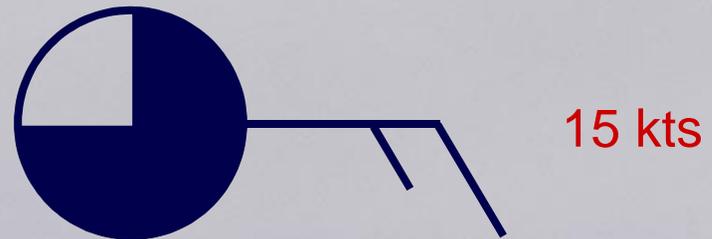
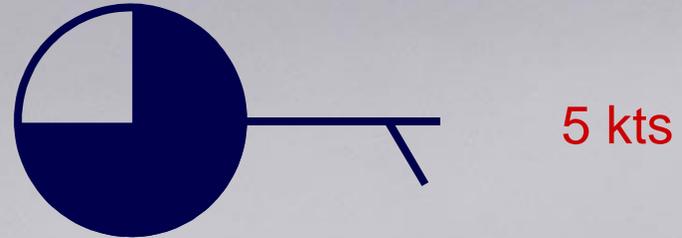
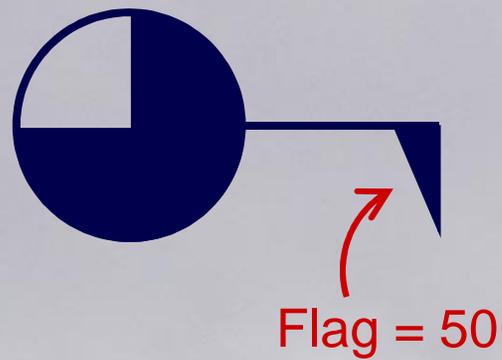
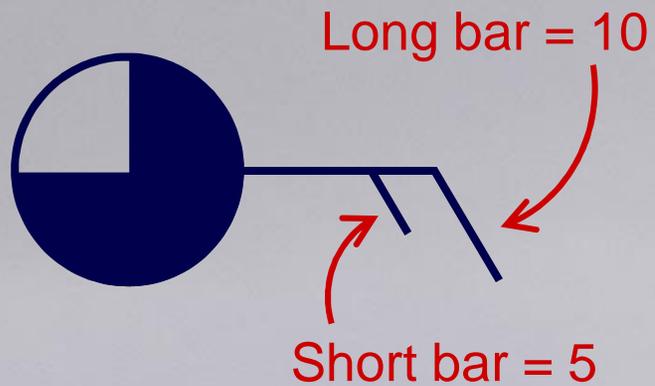
100% cloud cover



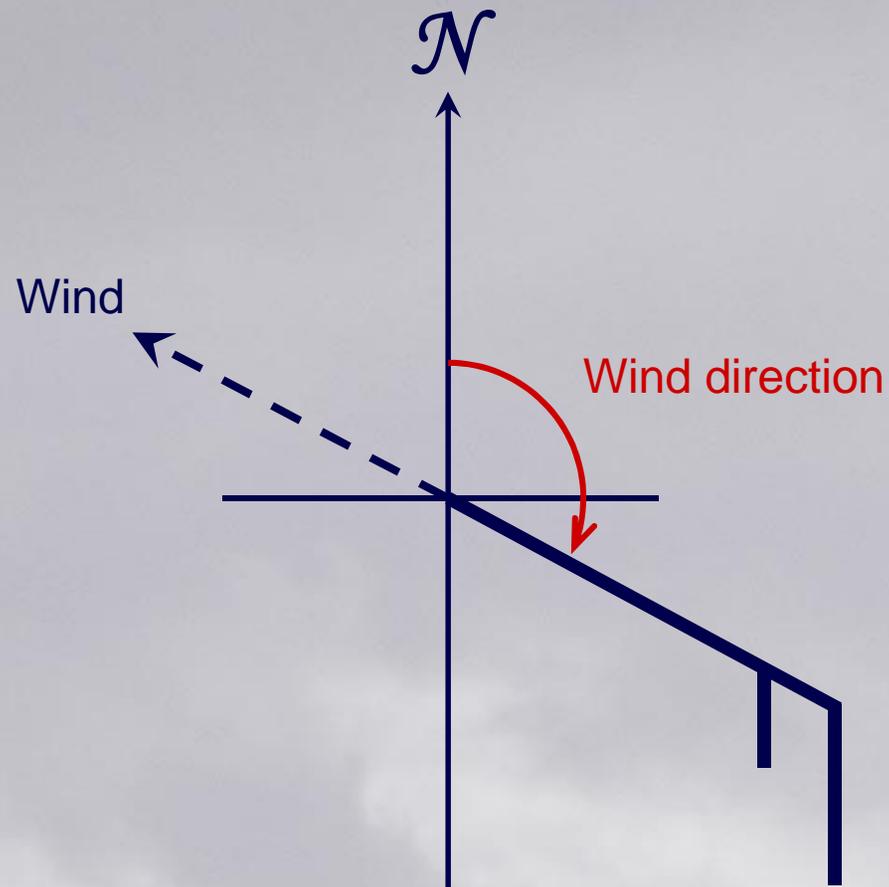
Visibility obscured

M

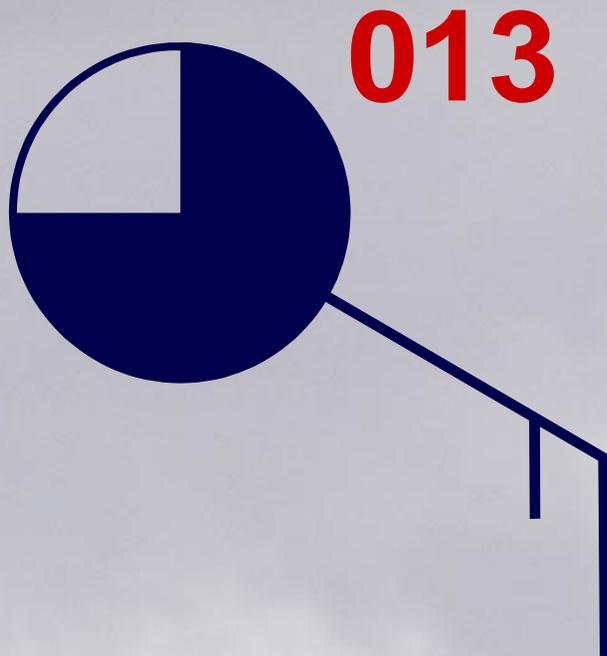
Missing data



Units are **KNOTS** or m s^{-1}
(usually knots)



N.B. Wind barb points in the direction the wind is blowing, but direction is quoted as angle wind is coming **from (eg 135°, or southeasterly)**.



Interpreting Pressure Reports

If reported value > 500 :

Initial 9 is missing. Place it on left and divide by 10.

e.g. **827** becomes **982.7** mb

If reported value < 500

Initial 10 is missing. Place it on left and divide by 10.

e.g. **027** becomes **1002.7** mb

RAIN



light



moderate



heavy



light rain shower



moderate rain shower

DRIZZLE



light



moderate



heavy

FREEZING RAIN



light

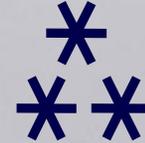


moderate

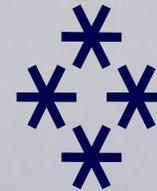
SNOW



light



moderate



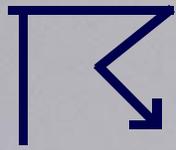
heavy



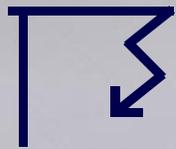
light snow shower



moderate snow shower



thunderstorm



Heavy
thunderstorm



Hail



Haze



Fog



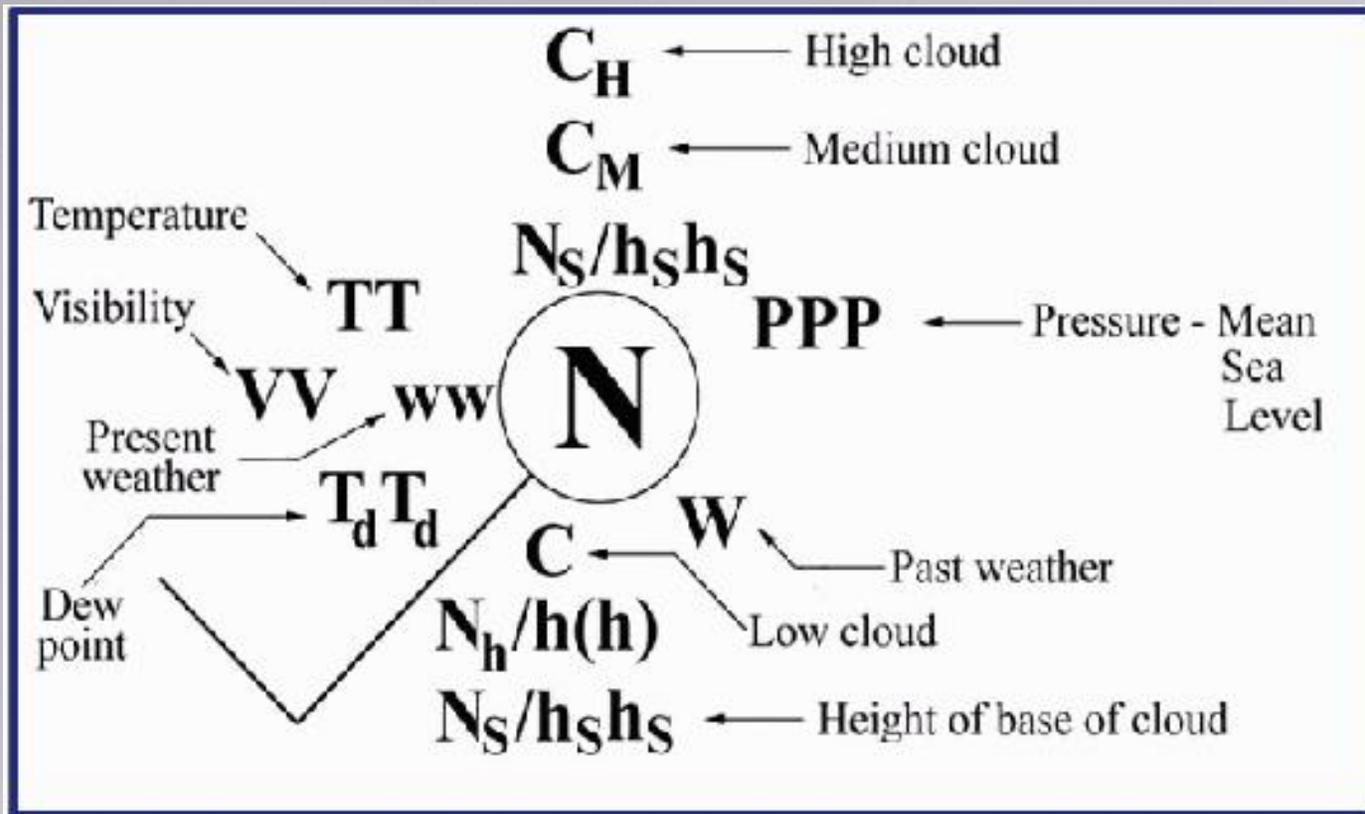
Ice crystals



Tropical Storm



Hurricane



PRESENT WEATHER (ww)

Sandstorm

Fog

Drizzle

Rain

Snow

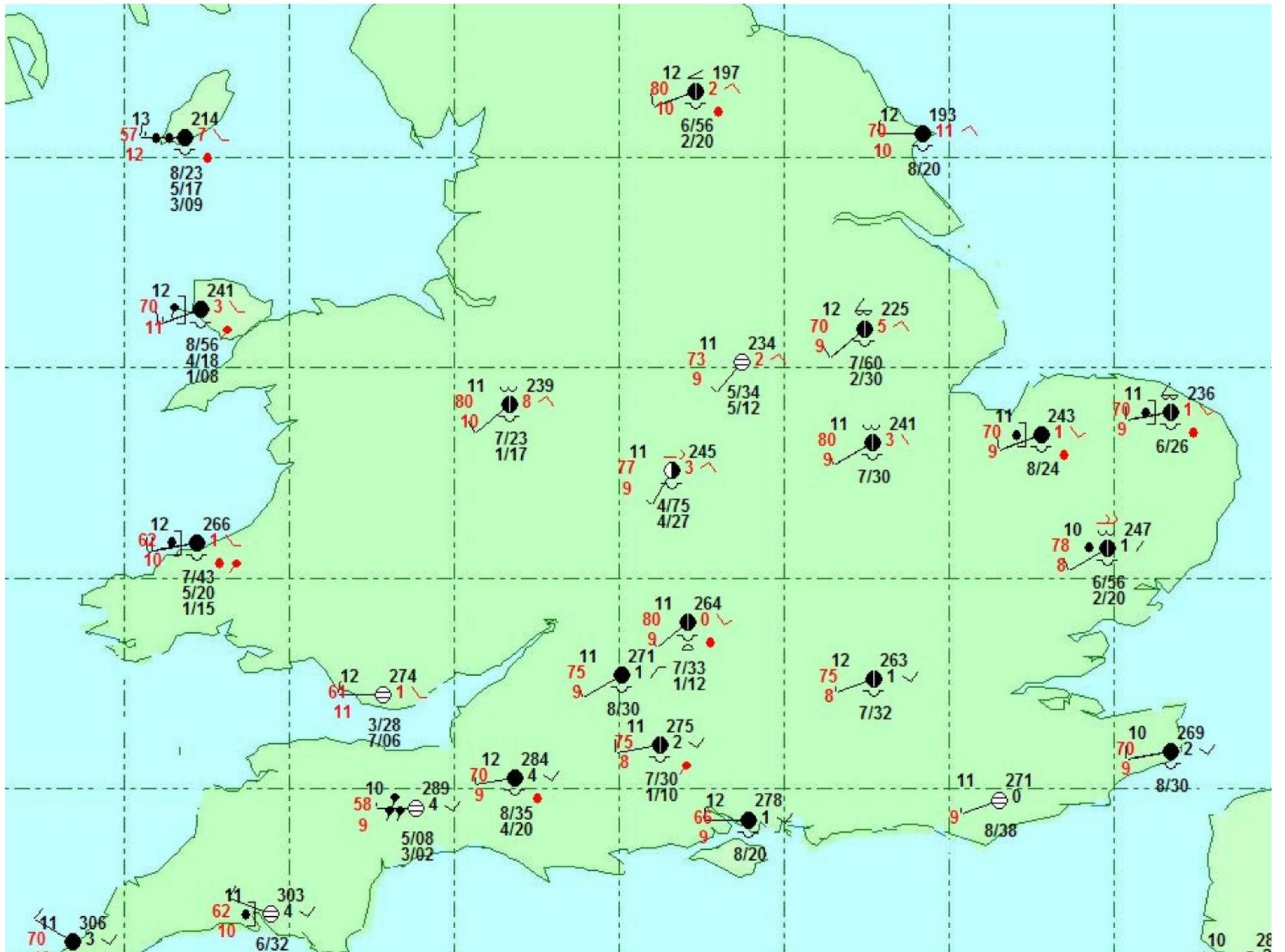
Showers

Thunderstorm

ww	0	1	2	3	4	5	6	7	8	9
0					☰		S	☰	☰	(☰)
1	=	≡	≡	☰	☰	☰	☰	☰	☰	☰
2	☰	☰	☰	☰	☰	☰	☰	☰	☰	☰
3	☰	☰	☰	☰	☰	☰	☰	☰	☰	☰
4	(☰)	≡	≡	≡	≡	≡	≡	≡	≡	≡
5	☰	☰	☰	☰	☰	☰	☰	☰	☰	☰
6	☰	☰	☰	☰	☰	☰	☰	☰	☰	☰
7	*	**	*	**	*	**	*	**	*	**
8	☰	☰	☰	☰	☰	☰	☰	☰	☰	☰
9	☰	☰	☰	☰	☰	☰	☰	☰	☰	☰

- ☰ rain
- ☰ freezing rain
- ☰ drizzle
- ☰ freezing drizzle
- * snow
- * snow pellets (formally called 'soft hail')
- * snow grains
- △ ice pellets, type (a) (formally called 'grains of ice')
- △ ice pellet, type (b) (formally called 'small hail')
- ▲ hail
- ↔ ice prisms
- ≡ fog
- ≡ ice fog
- ≡ wet fog
- ≡ patches of shallow fog
- ≡ more or less continuous fog
- = mist
- ↔ drifting or blowing snow
- ↔ blowing snow
- ↔ drifting snow
- ☰ drizzle and rain
- ☰ rain and snow (sleet)
- ☰ hail and snow
- ☰ hail and rain
- ☰ shower (used in combination with the type of precipitation)
- ☰ haze
- ☰ dust haze
- ☰ smoke
- ☰ duststorm or sandstorm
- ☰ wall of dust or sand
- ☰ dust whirl or sand (dust devil)
- ☰ thunderstorm
- ☰ lightning
- ☰ thunder
- ☰ squall
- ☰ drifting or blowing dust or sand
- ☰ drifting dust or sand
- ☰ blowing dust or sand

	Cloud amount	Past weather	Low cloud	Medium cloud	High cloud
Code figure	N	W	C _L	C _M	C _H
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
/					



Radiosondes

- Balloon-borne, ascent from surface to ~25km
- Measure Temperature, humidity, pressure
- Wind speed & direction are derived from change in GPS measured position
- In past, position determined from radar reflection, or manual tracking with theodolite



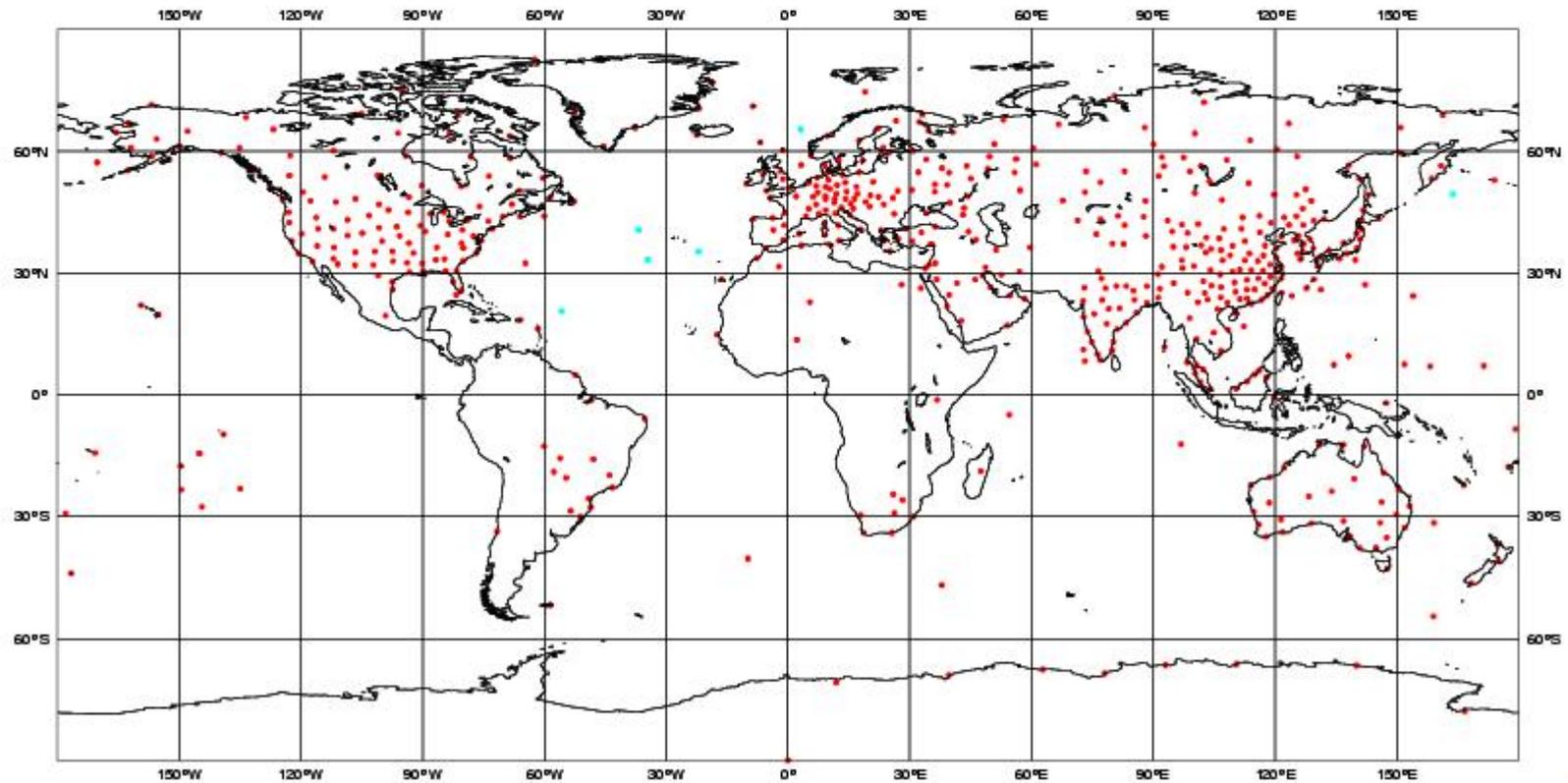


Upper air observations

Obs Type

• 572 LAND • 6 SHIP • 0 DROPSONDE

ECMWF Data Coverage (All obs) - TEMP
14/JUN/2004; 00 UTC
Total number of obs = 578



Other Measurements

An increasing variety of automated measurements are available:

- Instruments fitted to commercial airliners
 - Weather radar
 - Radar wind profilers
 - Sodar wind profilers
 - RASS temperature profilers
- Satellite remote sensing:
 - Surface temperatures
 - Cloud height
 - Water vapour concentration
 - Aerosol loading
 - Temperature profiles
 - Chemical concentrations (ozone, CO,...)
 - Surface winds over oceans

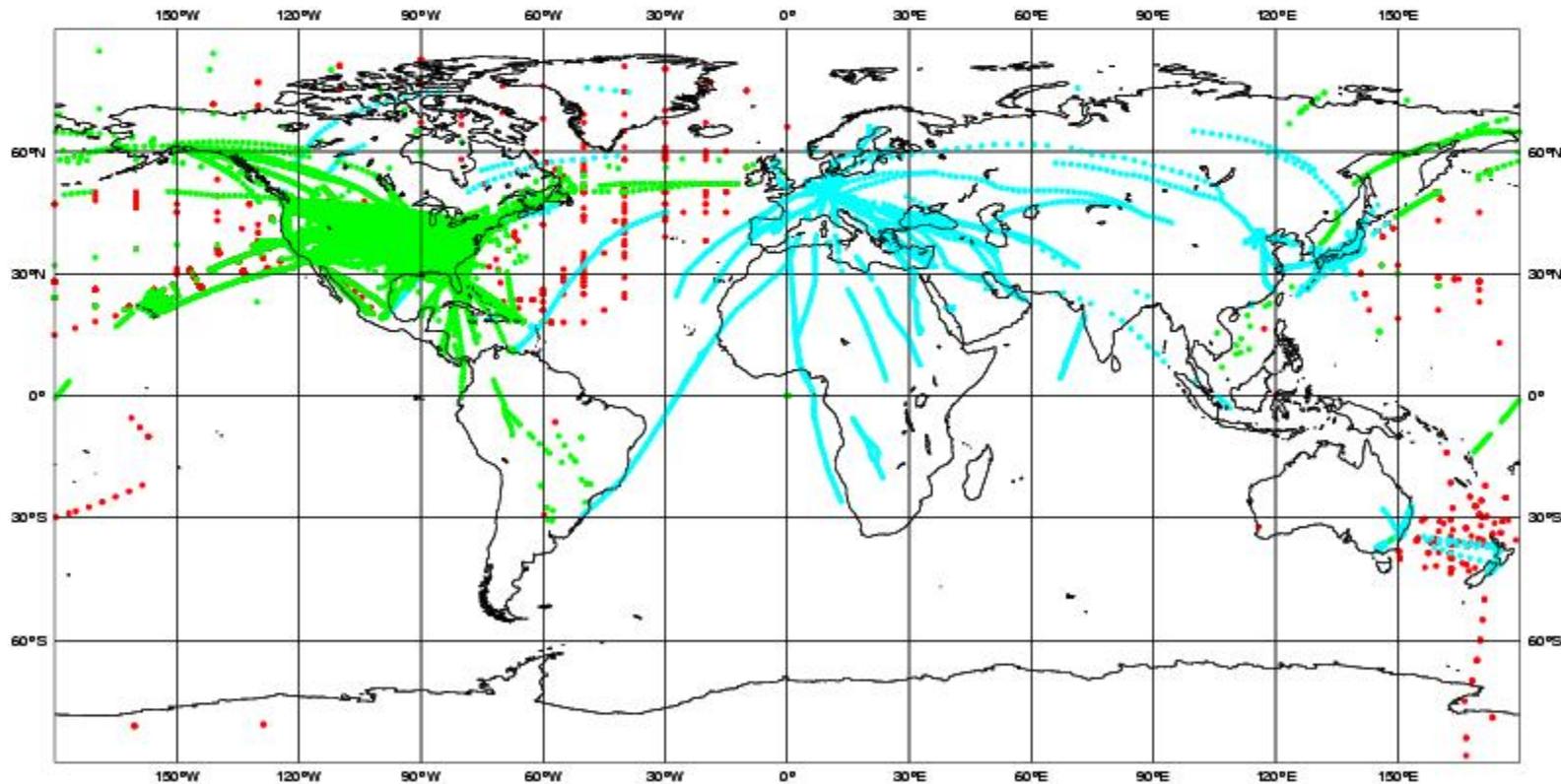
ECMWF Data Coverage (All obs) - AIRCRAFT

17/NOV/2004; 00 UTC

Total number of obs = 40925

Obs Type

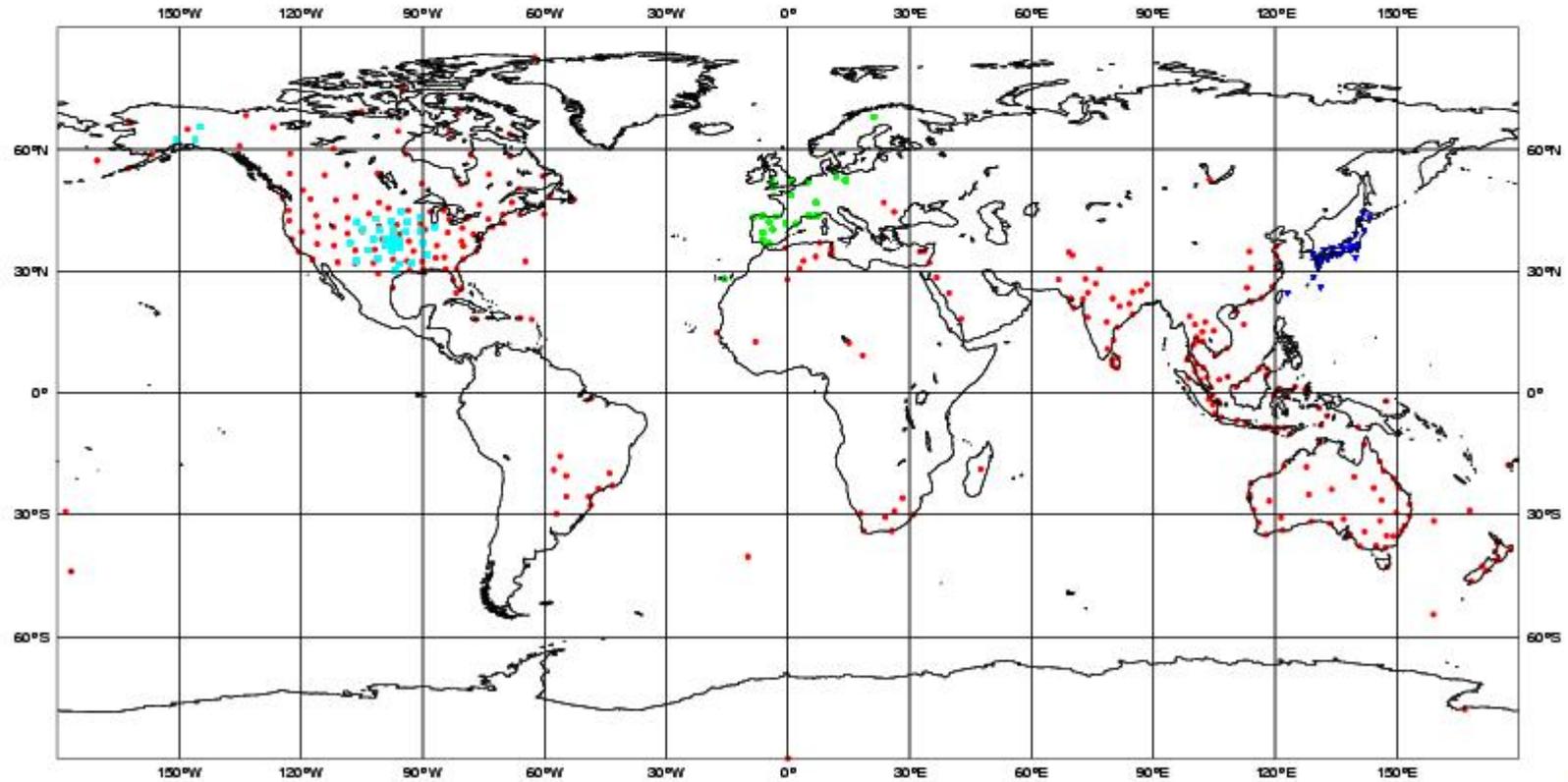
- 6772 AIREP
- 7283 AMDAR
- 26870 ACARS



Obs Type

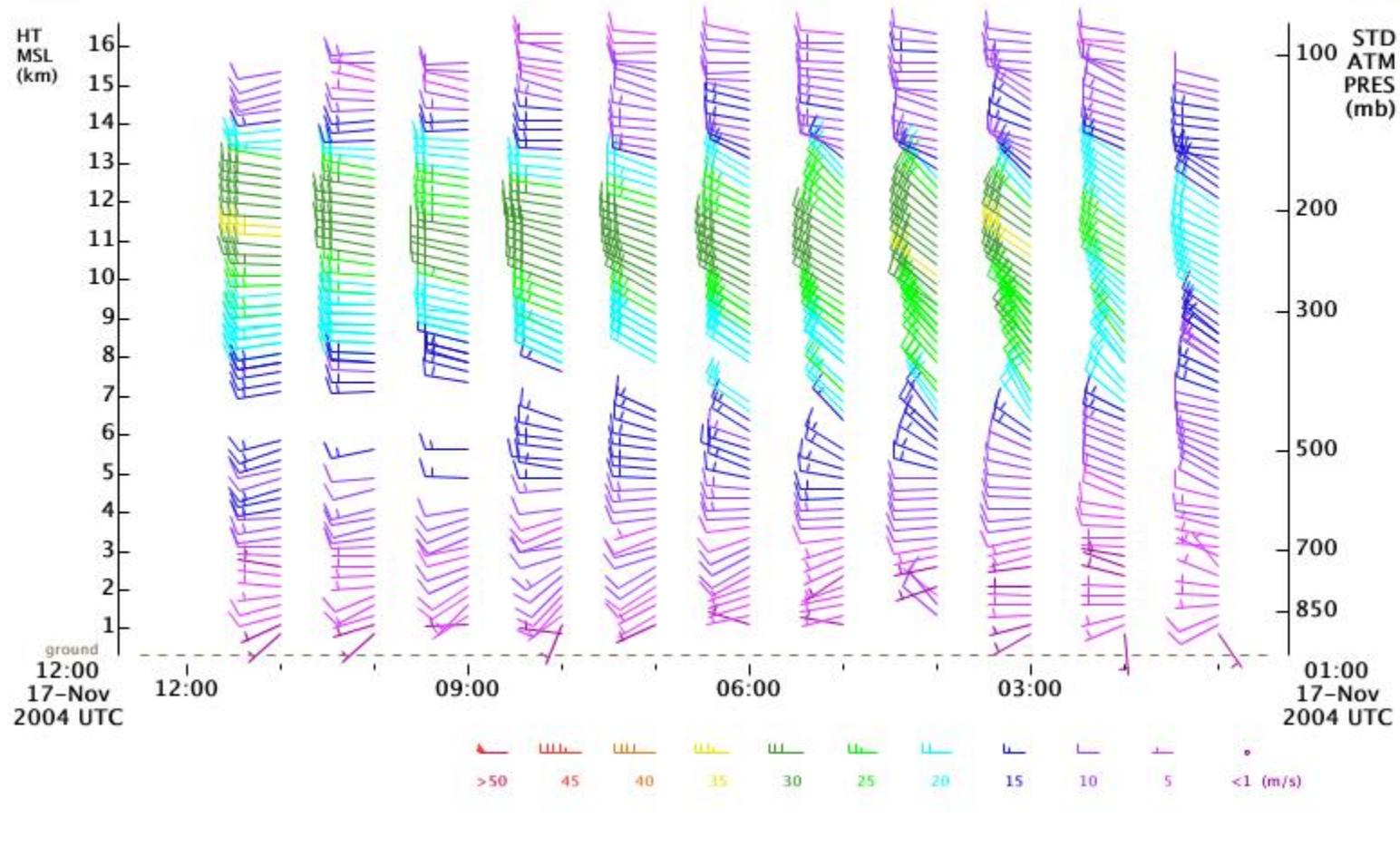
• 294 PILOT • 192 PROFILER • 347 E-PROF • 186 J-PROF

ECMWF Data Coverage (All obs) - PILOT/PROFILER 27/SEP/2005; 00 UTC Total number of obs = 1019





WOOD LAKE, MN US Lat:44.67 Lon:-95.44 Elev:319m
WindSpeedDirection| Mode:900m,310m | Res:60min | QC:good only
NOAA PROFILER NETWORK



Wind profiler time-series