The NERC MST Radar Facility at Aberystwyth

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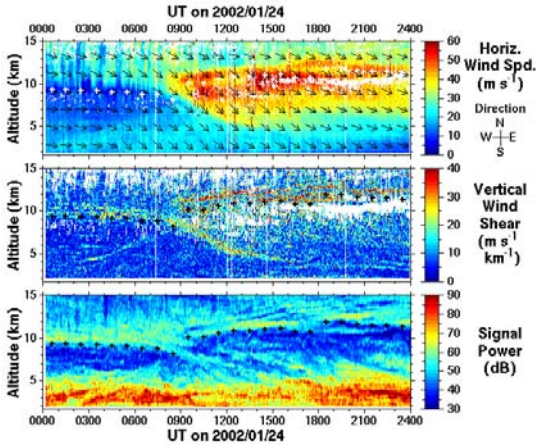
NATURAL ENVIRONMENT RESEARCH COUNCIL

MESOSPHERE–STRATOSPHERE–TROPOSPHERE–RADAR FACILITY AT ABERYSTWYTH

http://mst.nerc.ac.uk

The NERC MST Radar Facility is located at Capel Dewi, 6 km to the East of Aberystwyth in West Wales. Its mission is to provide high-quality atmospheric data products to the UK academic community in support of environmental research and education. The data products are freely available through the British Atmospheric Data Centre: http://www.badc.rl.ac.uk

The NERC MST Radar is a 46.5 MHz pulsed Doppler radar that is ideally suited for studies of atmospheric winds, waves and turbulence. It provides continuous measurements of the three-dimensional wind vector over the altitude range 2 – 20 km at typical resolutions of 300 m in altitude and 2 – 3 minutes in time.



As can be seen from the example above, which shows a tropopause fold as it is advected over the radar site, MST radars provide more than just wind-profile data. The radar return signal power, from the upper-troposphere and above, is closely related to the Brunt-Väisälä frequency, i.e. to the static stability of the atmosphere. Tropopause folds, which are characterised by enhanced static stability as well as high vertical wind shear, can therefore show up as regions of increased radar return signal power. Moreover, the altitude of the tropopause, indicated by the crosses, and its sharpness can be determined from the radar return signal power by an objective algorithm.

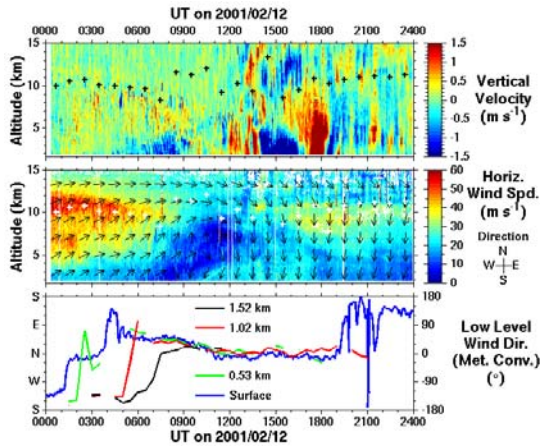
Measurements of surface meteorological parameters are made at the MST Radar site using a (Met Office approved) "Climate Data Logger" from Campbell Scientific. This has recorded

- temperature
- pressure
- relative humidity
- rainfall
- solar radiation

at 10 minute intervals since July 2000.

The Met Office input wind-profile data from the MST Radar into their numerical weather prediction models. Between November 1999 and March 2002 they operated one of their 915 MHz boundary-layer wind-profilers (upper picture) at the MST Radar site in order to fill-in the altitude range 0.2 to 2.0 km which is not otherwise covered. The new 1290 MHz UFAM (University Facilities for Atmospheric Measurement) mobile boundary-layer wind-profiler (lower picture) arrived at the MST Radar site in July 2002; it will be operated there in-between campaigns. The principles of operation of these profilers are very similar to those of the MST Radar with observations being made at typical resolutions of 100 m in altitude and a few minutes in time.

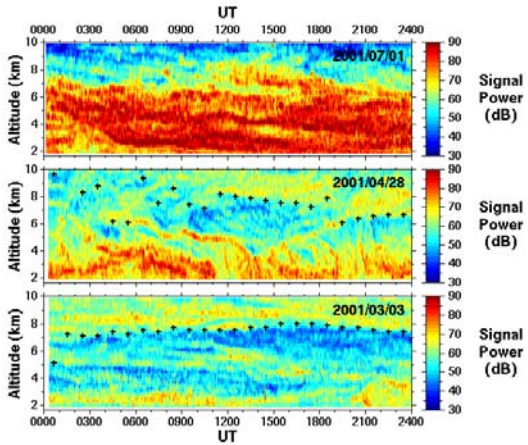
The example below demonstrates how the information from the different instruments (i.e. from the Met Office's boundary-layer wind-profiler and the wind tower measurement equipment) can reveal details which would not be obvious from the MST Radar observations alone. For studies of mountain lee waves, which are apparent as strong fluctuations in the vertical velocity after 1200 UT, it is often assumed that the wind vector at the lowest levels observed by the MST radar, i.e. around 2 km, are representative of the surface winds which generate the waves. In this particular case, however, a sharp rotation of the wind vector with altitude leads to large differences. The direction of the surface wind can be seen to rotate from approximately south-westerly to north-easterly shortly after 0100 UT. Although there are gaps in the boundary-layer wind-profiler coverage, the rotation can be seen to occur at progressively later times with increasing altitude, before continuing up through the altitude region covered by the MST radar to approximately 8 km at 1200 UT.



Further information about all of the topics and instruments covered in this poster, including relevant links, can be found through the NERC MST Radar Facility's web site:

http://mst.nerc.ac.uk

The MST Radar site is located (see red arrow on the map) at 50 m above mean sea level in a valley which rises up to over 140 m on the North and South sides. Since this terrain can have a significant effect on the low-level winds, surface wind measurements are made from Fongoch Farm which is 140 m above mean sea level and 3 km to the west of the radar site; its location is indicated by the blue arrow on the map. Between November 1995 and November 2001, the wind measurements were made at 1 minute intervals from a 5 m tower. A new 10 m hinged tower (pictured) was installed in December 2001.



One of the areas of on-going research is to better understand the radar return signals so that additional atmospheric parameters can be extracted. For example, the signal power (for radar returns from the lowest few kilometres of the atmosphere) depends on (amongst other factors) the specific humidity and its vertical gradient. As can be seen from the plots above, the "signature of the humidity field" can be highly variable from day to day. Complementary data from another instrument would be necessary in order to use the radar data in a quantitative fashion for this purpose.

The GPS water vapour receiver at the MST Radar site is one of several operated by the Met Office in the UK. The data are used as part of a Europe-wide network to assess the operational potential for for a ground-based system to provide near-real-time observations of integrated water vapour.