Upgrading the UK wind profiler network

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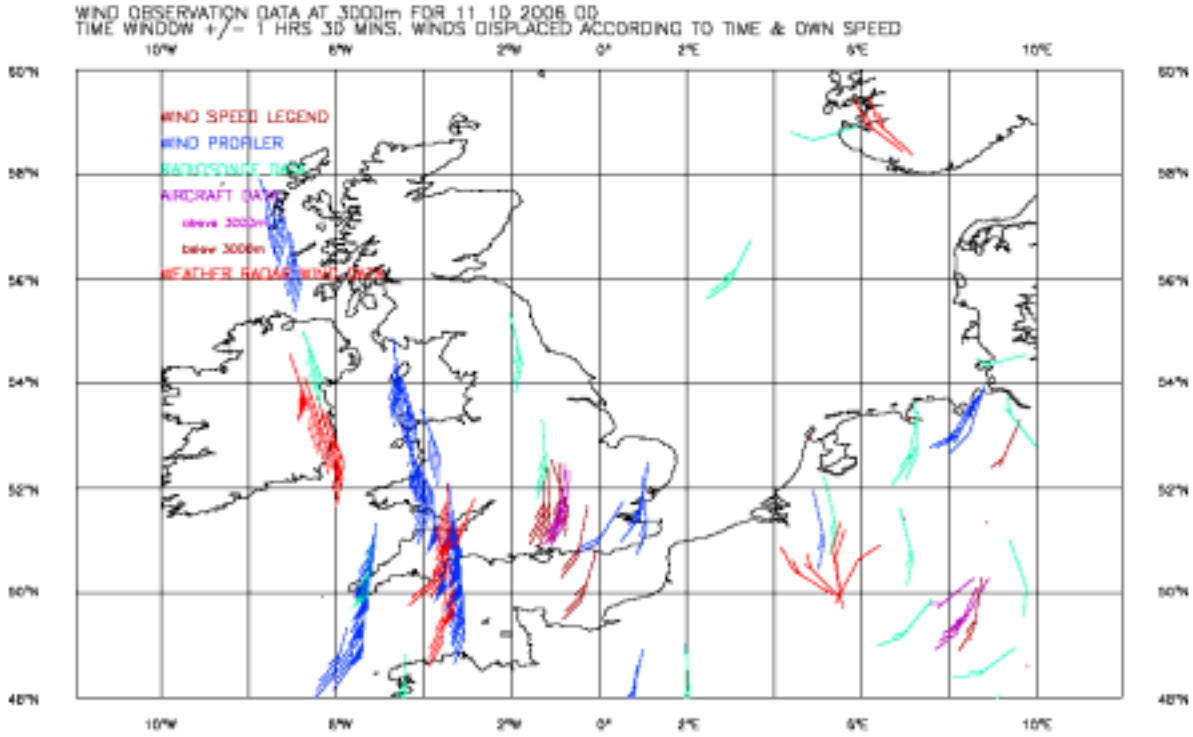
Background

Wind profiling radars have been a component of the UK Upper-Air network for more than a decade. In the late 1990's three boundary layer systems (LAP3000) were installed in the Southern regions of the mainland UK as part of a network demonstration and this has evolved into six systems (2 Tropospheric & 4 Lower Tropospheric, see plot below) by 2005. These systems are operated and monitored alongside Radiosonde, Weather Radar and Aircraft (AMDAR) measurements as part of a UK integrated upper-air design.

During 2005 the original LAP3000 systems have been upgraded to the new digital signal processing being offered by Vaisala. Whilst replacing a number of redundant units it is expected that the upgrades will offer enhanced remote control & monitoring and improved Quality Control through the improved signal processing options. (i.e. multi-peak, wavelets).

The main requirement of the wind profiler network is as a component of the Upper-Air network providing 'hourly' wind data for NWP model assimilation. The combination of radiosondes, aircraft and wind profilers systems (including weather radars) as an integrated network allows some redundancy of measurements (i.e. maintenance, failures, severe weather) but also provides a quality monitoring product to check the consistency and accuracy of the data. However there is an increasing local forecasting and nowcasting use of these systems, for aviation & ministry of defence customers and severe weather events. The plot below shows integrated winds at a height level of 3km, not only does this demonstrate the horizontal density of the wind observations but enables a direct comparison of the observations for quality monitoring purposed.



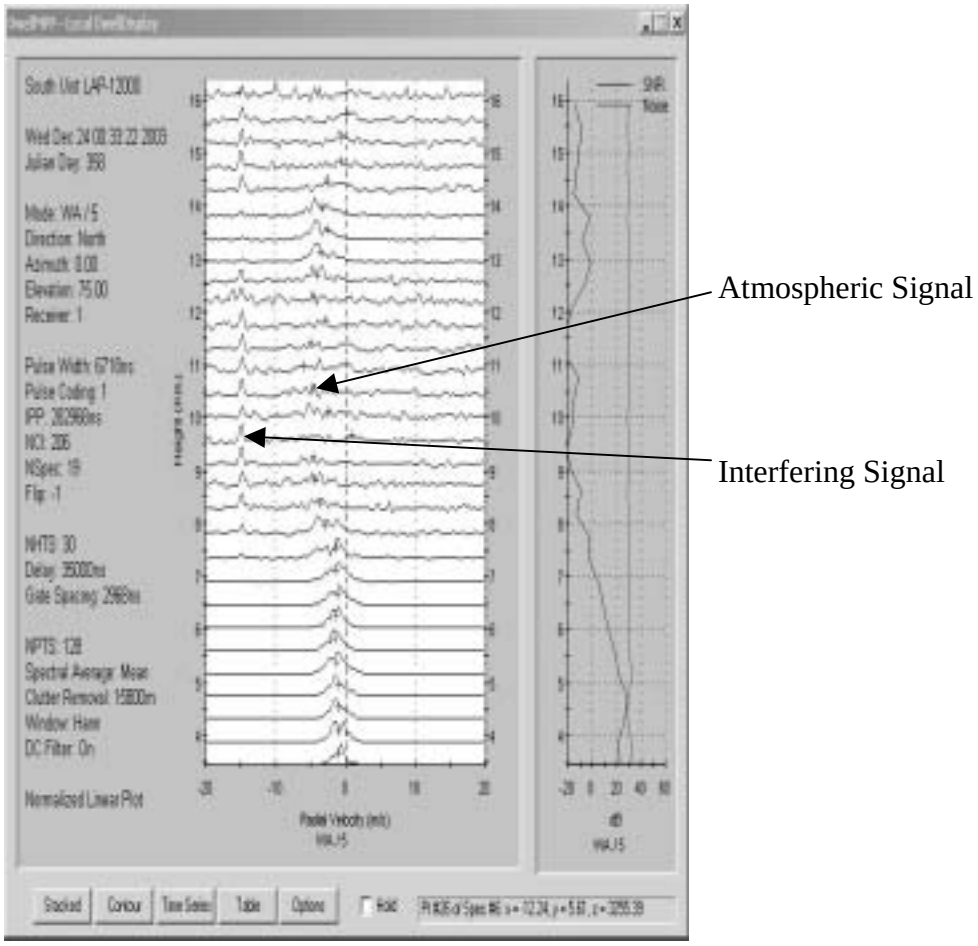
Operational Monitoring

Much of the effort over the last 2 years has been developing the systems/network to ensure that they meet the Met Office operational requirements, both with the data quality & availability and the infrastructure (i.e. hardware, software, installation, communications, training etc.) This has proved a major challenge both to the development team and manufacturers, with increasing customer expectations that these 'modern' systems will run continuously and unattended, be reliable and cost effective and produce high quality measurements.

Prior to operational acceptance it was necessary to conduct and document detailed evaluation of the data availability and quality from each site. This ranged from a general 'eyeball' of the data, checking the consistency of each measurement with previous data, direct comparison with Radiosonde data and finally monitoring against the NWP models. Initially these checks showed, on occasions, significant problems with the wind measurements, taking the system(s) outside of the contract specification.

Further evaluation identified that the problems (mainly interference, see below) were from sources both internal and external to the system. By working with the manufacturer both hardware and software solutions were implemented to reduce the occurrence and impact of the interfering signals; in addition advanced signal processing (multi-peak) and 4-beam configuration were accepted for operations.

Spectral display from 64MHz wind profiler at South Uist, UK



The Future

All systems have passed the operational acceptance procedures of the Met Office and wind data is not only been assimilated by UK NWP models but also by a number of other European centres (i.e. ECMWF). However further work is necessary to improve the peak selection, notably at times of heavy precipitation and when the atmospheric signal is very weak.

Work is ongoing to evaluate the potential of the wind profiler vertical wind and signal to noise measurements as part of an integrated 'remote sensing' system. For this work to succeed the correct peak identification and spectral width calculation at high temporal resolution (< 1min) is a crucial factor and will form the basis of future wind profiler designs and signal processing development (multi-peak, wavelets etc.)