Improving Forecasting Using Doppler Wind Lidar

Forecasters use Doppler wind data from NEXRAD and radar wind profilers to detect the onset of convective storms and severe weather events and predict their evolution and motion. With satellite imagery, *in situ* data, and model guidance, these observations are critical for nowcasting and issuing short-term warnings for severe weather. By measuring the frequency shift of electromagnetic radiation back-scattered by atmospheric particles that move with the wind, range-resolved Doppler velocities are derived, and wind vectors determined by combining the Doppler shifts from multiple lines of sight.

For ground-based wind profiling, radar wavelengths provide reliability and the capability to measure wind and backscatter within and beyond clouds. To make Doppler wind measurements from space, lidar (light detection and ranging) technology at infrared or ultraviolet (UV) wavelengths must be used to build instruments compact enough for satellites and sufficiently sensitive to detect backscattered light from orbit.

The first space-based Doppler Wind Lidar (DWL), called the Atmospheric Dynamics Mission-Aeolus (ADM-Aeolus), is scheduled to be launched into a polar orbit by the European Space Agency in 2009. Operating in the UV, ADM will provide radial wind measurements along a single line of sight over the entire globe, albeit with large gaps at low latitudes. Secondary data products will include the location and thickness of cloud layers and the distribution of aerosols. Details about the mission may be found at http://www.esa.int/esaLP/LPadmaeolus.html.

Satellite-based lidar wind measurements are expected to result in improved short-to-medium-range numerical weather forecasts, and may be particularly valuable for improving tropical cyclone track forecasts by providing a direct measure of the large-scale steering current. Recent forecast impact results (Figure 1, from Weissman and Cardinali 2006) obtained with the European Centre for Medium-range Weather Forecasting (ECMWF) global model indicated that adding DWL data collected during a 2003 airborne campaign over the North Atlantic to the control experiment reduced the 72-hour forecast error by ~3.5%. This is comparable to ~10% of the improvement realized at the operational NWP centers in the past 10 years from *all* of the improvements in modeling, observing systems, and computing power. Thus, for forecasters, the availability and use of space-based DWL data is likely to provide a significant enhancement to their forecast tools.

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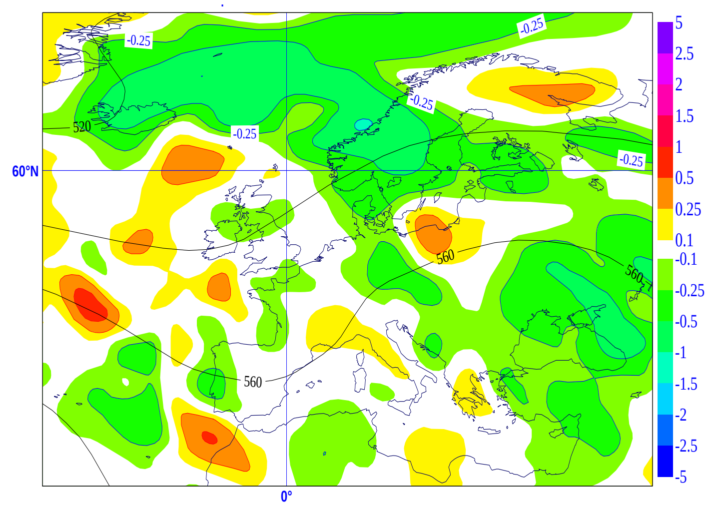

Fig. 1. Mean (29 cases) 96 h 500 hPa height forecast error difference (Lidar Experiment minus Control Experiment) for 15 - 28 November 2003 with actual airborne DWL data. The green shading means a reduction in the error with the additional Lidar data compared to the Control data alone.