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Validation Campaigns of a new 1.5μm Doppler Wind Lidar for PBL Continuous Profiling

Laurent Sauvage, Matthieu Boquet, Jean-Pierre Cariou, and Simone Lolli
LEOSPHERE SAS

To fully understand atmospheric dynamics, climate studies, energy transfer and weather prediction, the wind field is one of the most important atmospheric state variables. Studies indicate that a global determination of the tropospheric wind field to an accuracy of 0.5 m/s is critical for improved numerical weather forecasting.

LEOSPHERE recently developed a long range compact, eye safe and transportable wind Lidar capable to fully determine locally the wind field in real time in the planetary boundary layer (PBL). The WLS70 is a new generation wind Lidar developed for meteorological applications. The Lidar is derived from the commercial Windcube™ widely used by the wind industry and has been modified increasing the range up to 2 km.

In this paper are presented results of the inter comparison measurement campaigns EUCAARI, LUAMI and WAVES in which the WLS70 participated together with both up-to-date active and passive ground-based remote-sensing systems for providing high-quality meteorological parameters reference or ground-truth e.g. to satellite sensors.

In May 2008, the first WLS70 prototype started retrieving vertical wind speed profiles during the EUCAARI campaign at Cabauw, the Netherlands. First results were very promising with vertical profiles up to 2km showing high frequency updrafts and downdrafts in the boundary layer.

From November 2008 to January 2009, a WLS70 was deployed in Germany, together with an EZ Lidar™ ALS450, in the frame of the Lindenberg Upper Air Methods Intercomparison (LUAMI) campaign. During 62 days, the WLS70 Lidar retrieved 24/24 hours vertical profiles of the 3 wind components, putting in evidence wind shears and veers, as well as gusts and high frequency convective effects with the raise of the mixing layer or with incoming rain fronts. In-cloud and multilayer measurements are also available allowing a large range of additional investigations such as cloud-aerosol interactions or cloud droplet activation.

From March to May 2009, LEOSPHERE deployed a WLS70 prototype unit at the Howard University Research Campus in Beltsville, Maryland, for the Water Vapor Validation Experiments (WAVES) from the initiative of the NOAA. The presence of numerous wind profilers, lidars and radio soundings was a perfect opportunity to test and improve this new compact and autonomous long range wind Lidar. The WLS70 showed Low Level Jet phenomena which have strong impact on air quality.

In July 2009, the WLS70 took its definitive configuration with a new optical device installed on it allowing enhanced measurement range. New measurements were done at PNNL in Richland, Washington, and NASA Langley in Hampton, Virginia. These results are now processed and will bring a further proof on reliability and accuracy.

During these intensive inter comparison campaigns the WLS70 Wind Lidar was validated against Lidars, Radars, Sodars and anemometers. The results show mostly a very good agreement between the instruments. Moreover, the measurements put in evidence both horizontal and vertical wind speed and wind direction vertical profiles and atmosphere structure (PBL height , clouds base) derived from Lidar data with good time resolution

(10s/profile), good range resolution (50m from 100m to 2000m), and good velocity accuracy (<0.2m/s).