Oral Presentation

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Preparation for the Calibration-Validation Phase of ESA's Wind Lidar Mission Aeolus Using the ALADIN Airborne Demonstrator During the International Campaign NAWDEX in 2016

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After its launch in autumn 2018, the spaceborne wind lidar ALADIN (Atmospheric LAser Doppler INstrument) on-board ESA's Earth Explorer satellite Aeolus will allow for global observation of atmospheric wind profiles. Being the first ever satellite-borne Doppler wind lidar instrument, ALADIN will significantly contribute to the improvement in numerical weather prediction by providing one component of the wind vector along the instrument's line-of-sight (LOS) from ground throughout the troposphere up to the lower stratosphere. The vertical resolution is 0.25 km to 2 km depending on altitude, while the precision in wind speed is envisaged to be between 1 $m \cdot s^{-1}$ to 3 $m \cdot s^{-1}$.

Over the past years, an airborne prototype of the Aeolus payload, the ALADIN Airborne Demonstrator (A2D), has been developed at DLR (German Aerospace Center) and deployed in several field experiments, aiming at pre-launch validation of the satellite instrument and at performing wind lidar observations under various atmospheric conditions. The A2D features a high degree of commonality with ALADIN in terms of laser source and Doppler lidar receiver design. Thus, it represents the key instrument for the planned calibration and validation activities during the Aeolus mission, as it allows validating the instrument concept, operating procedures as well as wind retrieval algorithms.

In autumn 2016, the A2D was engaged in the North Atlantic Waveguide and Downstream Impact Experiment (NAWDEX). Based in Keflavík, Iceland, this international field campaign had the overarching goal to investigate the influence of diabatic processes, related to clouds and radiation, on the evolution of the North Atlantic jet stream. Apart from providing accurate wind observations for quantifying effects of disturbances on the downstream propagation of the jet, the research flights performed during NAWDEX considerably extended the wind dataset obtained with the A2D as well as with the 2-µm coherent wind lidar on-board the same aircraft – the DLR-Falcon F20. Hence, NAWDEX was an ideal platform for assessing the performance of the two wind lidar systems in heterogeneous atmospheric scenes including strong wind shear and varying cloud conditions.

Besides the DLR-Falcon, three additional aircraft were involved in the campaign being equipped with diverse state-of-the art remote sensing instruments which enabled the observation of a large set of atmospheric parameters, while ground stations delivered a comprehensive suite of further measurements to complement the meteorological analysis. For the first time, coordinated flights were conducted involving the DLR-Falcon, the German HALO deploying an aerosol lidar, a cloud radar and dropsondes as well as the French Falcon SAFIRE with an on-board cloud radar and a UV Doppler lidar instrument. Comparative analysis of the wind data obtained during the collocated flight legs allowed quantifying the accuracy and the precision of the various instruments and demonstrated the complementarity of the different technologies for measuring wind speeds. This work will provide an overview of the NAWDEX campaign and present the results from the wind data analysis both from a meteorological and an instrument point-of-view.