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Potential of the space-borne Doppler wind lidar measurements in a limited-area model for Europe

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Mesoscale models for numerical weather prediction (NWP) in Europe have reached the horizontal resolution close to 1 km. A large resolution increase in the last decade has not been accompanied by a sufficient increase in a number of observations to initialize the models. In particular, there is a large need for the direct wind observations as well as for humidity data in order to improve mesoscale analyses.

The ADM-Aeolus mission of the European Space Agency, scheduled for launch in 2017, will contribute the global wind profiles from the Doppler wind lidar measurements of the horizontal line-of-sight (HLOS) winds. A number of studies addressed the potential impact of the ADM-Aeolus wind profiles in the global ECMWF model and showed significant benefits of the new data in the tropics where the analysis uncertainties are currently largest.

Our study is the first effort to evaluate the potential of the ADM-Aeolus HLOS wind profiles in a limited-area NWP model for Europe. We present a special observing system simulation experiment (OSSE) framework involving the limited-area NWP Weather Research and Forecasting (WRF) model with the ensemble Kalman filter data assimilation system nested into the 50-member ensemble prediction system of ECMWF.

The results are presented from a number of OSSE experiments that compare the information content of the HLOS winds with the two wind components and temperature observations with respect to dynamics and the flow-dependent background-error covariances. The results show that the ADM-Aeolus HLOS winds are on average more beneficial for the assimilation than any of the two components. We demonstrate how the application of the HLOS wind profiles in the ensemble Kalman filter data assimilation can improve the analysis of the baroclinic development in the northern Atlantic that leads to severe weather events over Europe.