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ADM-Aeolus – ESA's wind profile lidar and its contribution to numerical weather predictions and climate research

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The European Space Agency (ESA) is developing a direct detection Doppler wind Lidar for the measuring of wind profiles from space. The pulsed UV Lidar, with high spectral resolution capability, shall deliver horizontally projected single line-of-sight wind measurements at 24 vertical layers from each of its two channels; one molecular (clear air) and one particle (aerosol and cloud backscatter) channel. The instrument will measure the zonal wind component of the wind field in clear and particle-rich air (aerosol layers and transparent clouds), and down to the top of optically dense clouds. The required accuracy of the wind measurements, including representativeness errors, is 2 m/s in the planetary boundary layer, 2-3 m/s in the free atmosphere, and 3-5 m/s in the lower stratosphere (up to 30 km). The wind observations will be provided as 50 km averages, spaced by 150 km along the satellite track. The satellite will fly in a polar dusk/dawn orbit, providing a global coverage of $\sim$16 orbits per day. The measurements will be delivered near-real-time (NRT) for direct ingestion in operational numerical weather prediction (NWP) models.

Impact studies have shown that the largest impact of Aeolus is expected in regions with few other direct wind profile observation, e.g. over the oceans, in the Tropics and in the Southern Hemisphere. Climate monitoring based on reanalysis data are expected to benefit from Aeolus observations through improvements of NWP analyses. One example is the detection of wind driven circulation changes in Arctic regions. Climate model processes involving wind dynamics, such as convectively coupled tropical waves, El Nino circulations and Monsoons, could be validated with tropical wind profiles from Aeolus.

The Aeolus mission will be presented here together with results from impact studies on NWP and general circulation modelling using simulated Aeolus data and results from campaigns with the Aeolus airborne demonstrator.