



Impact of different Aeolus sampling scenarios on the stratospheric analysis

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ESA's Earth Explorer Atmospheric Dynamics Mission Aeolus will provide global line-of-sight wind profiles after its launch planned for 2013. The instrument consists of a Doppler-wind lidar receiving back-scattered light by air molecules and cloud/aerosol particles. The vertical sampling is limited to 24 range gates in both receiver channels up to a height of about 30 km. In this study, it is examined how different vertical sampling scenarios for Aeolus affect the analysis of stratospheric winds. Since stratospheric dynamics are strongly influenced by vertically propagating waves, it is possible that high-quality tropospheric wind observations yield a higher impact on stratospheric analysis than low-quality stratospheric wind observations. This hypothesis is tested using a new data assimilation ensemble technique which allows to estimate the impact of future observing systems. The assessment is carried out with the 4D-variational data assimilation of the ECMWF operational system for January 2007. Aeolus observations are generated artificially by combining the short-range UK Met Office forecasts with CALIPSO aerosol and cloud observations. The usage of CALIPSO data reduces the simulated Aeolus observations to night-time orbits only. Several assimilation ensembles with different vertical sampling scenarios are created. The information content of sampling scenarios is related to the ensemble forecast spread: The sampling scenario with Aeolus observations yielding largest ensemble spread reduction is most informative in the sense of improving the stratospheric analysis.

It is demonstrated that the impact of Aeolus in the troposphere and stratosphere is comparable to the impact of the radiosonde observations. For the chosen experiment configuration, Aeolus provides tropospheric impact especially over the oceans, in the Tropics and in the Arctic. The Aeolus impact propagates vertically into the stratosphere related to gravity waves on short time-scales and to large-scale Rossby waves on longer time-scales. The strongest impact on the stratospheric analysis is provided by the Aeolus sampling scenario which focuses on the Upper Troposphere/Lower Stratosphere region.