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Performance assessment of the space-borne Raman Lidar ATLAS – Atmospheric Thermodynamic LidAr in Space

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The Atmospheric Thermodynamic LidAr in Space (ATLAS) is a mission concept proposed to the European Space Agency in the frame of "Earth Explorer-11 Mission Ideas" Call by a team of researchers, with the aim to develop the first Raman Lidar in space capable to measure simultaneously atmospheric temperature and water vapour mixing ratio profiles with high temporal and spatial resolutions. Accurate measurements of these profiles are essential to understand water and energy cycles, as well as the prediction of extreme events, that nowadays still show huge deficiencies on all temporal and spatial scales (1). Such measurements would have a revolutionary impact on our understanding of the Earth system and would close the gap in our observational capabilities from the surface to the lower troposphere.

The specifications of the different lidar sub-system, as well as the expected capability to provide measurements with high temporal and spatial resolution in the low and middle troposphere, have already been established with an analytical simulation model (2,3). These simulations considered different atmospheric models and conditions to estimate the statistical uncertainty on water vapour and temperature measurements. New studies have been now performed to estimate the performances along several dawn-dusk orbits. An end-to-end simulator has been developed and used to estimate the statistical and systematic uncertainties. The input data, comprehensive of thermodynamic and optical parameters, have been extracted from the GEOS-5 Nature Run and have been chosen to perform simulations with different solar zenith angles and therefore different background contributions. The model includes information on cloud fraction and optical thickness, so it was also possible to consider the performances in cloudy conditions. The simulations show promising results, both in clear and cloudy conditions and with different background contributions. A comprehensive study of the assessed performances will be presented at the conference.

The simulated measurements obtained from the simulator will be also used as input observations in the Weather Research and Forecasting model (WRF). The aim is to estimate the impact of global measurements from a space-borne Raman Lidar in terms of skill-scores, obtained by the comparison of the weather forecast output with and without the assimilation of the simulated

lidar data.

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3 - Di Girolamo, Behrendt, Wulfmeyer. Spaceborne profiling of atmospheric temperature and particle extinction with pure rotational Raman lidar and of relative humidity in combination with differential absorption lidar: performance simulations. Appl Opt, AO. 10 aprile 2006; 45(11):2474–94.