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## **The ACCURATE Mission and the new Infrared Laser Occultation Technique: Measuring Principle, Capabilities, and Performance Simulation Results**

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The ACCURATE (Atmospheric Climate and Chemistry in the UTLS Region And climate Trends Explorer) mission was conceived at the WegCenter/Univ. of Graz in late 2004 and subsequently proposed in 2005 by an international team of more than 20 scientific partners from more than 12 countries to an ESA (European Space Agency) selection process for next Earth Explorer Missions. While the mission was not selected for formal pre-phase A study, it received very positive evaluation and was recommended for further study.

ACCURATE enables simultaneous measurements of greenhouse gases, isotopes, wind and thermodynamic variables (i.e. temperature, pressure/geopotential height, humidity) from space. Since the measurement principle is a combination of different kinds of the occultation technique, the measured data are evenly distributed around the Earth and have high vertical resolution and high accuracy. In addition, the measurements are stable over long time periods. The kinds of occultation techniques used are the novel infrared laser occultation (ILO) and the well-studied but not yet flown microwave occultation (MWO) technique. Concerning the MWO part of the ACCURATE mission, heritage from the preceding ACE+ mission project of ESA (2002-2004) and from various U.S. studies led by R. Kursinski (Univ. of Arizona, Tucson) is included.

The ILO uses near-monochromatic laser signals in the short-wave infrared range ( $\sim 2$ - $2.5 \mu\text{m}$  in the case of ACCURATE), which are absorbed by various trace species of

the Earth's atmosphere. This allows retrieval of vertical profiles of the concentration of these absorbing species from transmission measurements of the signals. The current mission design of the ACCURATE mission is arranged for the measurement of six greenhouse gases (i.e. H<sub>2</sub>O, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, O<sub>3</sub>, CO) and four isotopes (<sup>13</sup>CO<sub>2</sub>, C<sup>18</sup>OO, HDO, H<sub>2</sub><sup>18</sup>O), with focus on the upper troposphere/lower stratosphere region (UTLS, 5-35 km). In addition, wind speed in the line-of-sight may be derived by exploiting small differences in the transmission induced by Doppler shift caused by the wind. Also information on aerosol extinction, cloud layering and turbulence can be deduced. The application of ILO is greatly facilitated when combining it with MWO, since the evaluation of transmission for retrieving trace gas concentrations relies on the knowledge of pressure and temperature (and humidity below 12 km) in the sounded air volumes, the latter being accurately retrievable from the longer-wavelength microwave signals (within 17-23 GHz and 178-184 GHz in the case of ACCURATE).

The ACCURATE mission and the ILO technique have been investigated over the last two years. This contribution will present the main results of this research, such as mission characteristics, the principles of the ILO and its capabilities, as well as an assessment of the trace species measurement accuracy. Recent end-to-end simulation results concerning retrieved wind velocity will also be included.