

# **ACCURATE - OBSERVING GREENHOUSE GASES, ISOTOPES, WIND, AND THERMODYNAMIC VARIABLES BY COMBINED MW RADIO AND IR LASER OCCULTATION**

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ACCURATE (Atmospheric Climate and Chemistry in the UTLS Region And climate Trends Explorer) is a next generation climate mission concept conceived at the WegCenter/UniGraz in late 2004, which was 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. It received, in a stringent scientific and technical peer assessment process, very positive evaluation and recommendations for further study. The concept currently undergoes scientific performance analyses and preparations for instrument breadboarding.

ACCURATE employs the occultation measurement principle, known for its unique combination of high vertical resolution, accuracy and long-term stability, in a novel way. It systematically combines highly stable signals in the MW 17-23/178-183 GHz bands (LEO-LEO microwave radio crosslink occultation) with laser signals in the SWIR 2-2.5  $\mu\text{m}$  band (LEO-LEO infrared laser crosslink occultation) for exploring and monitoring climate and chemistry in the atmosphere with focus on the UTLS (upper troposphere/lower stratosphere, 5-35 km). The MW occultation is a heritage of the ESA ACE+ concept studied in 2002-2004 for frequencies including the 17-23 GHz band, complemented by U.S. study heritage (Univ. of Arizona, Tuscon) for frequencies including the 178-183 GHz band. The U.S. ATOMMS concept (see OPAC-3 talk of R. Kursinski et al.) embodies the ACCURATE MW part and will undergo a development and demonstration project funded by the U.S. National Science Foundation (NSF) until 2010. The core of ACCURATE is tight synergy of the SWIR laser crosslinks with the MW radio crosslinks.

The observed parameters, obtained simultaneously and in a self-calibrated manner based on Doppler shift and differential log-transmission profiles, comprise the fundamental thermodynamic variables of the atmosphere (temperature, pressure/geopotential height, humidity) retrieved from the MW bands, complemented by line-of-sight wind, six greenhouse gases (GHGs) and key species of UTLS chemistry ( $\text{H}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ ,  $\text{O}_3$ ,  $\text{CO}$ ) and four  $\text{H}_2\text{O}$  and  $\text{CO}_2$  isotopes ( $\text{HDO}$ ,  $\text{H}_2^{18}\text{O}$ ,  $^{13}\text{CO}_2$ ,  $\text{C}^{18}\text{OO}$ ) from the SWIR band. Furthermore, profiles of aerosols, cloud layering, and turbulence are obtained. All profiles come with accurate height knowledge ( $< 10$  m uncertainty), since measuring height as a function of time is intrinsic to the radio occultation part of ACCURATE.

The presentation will start with an overview of ACCURATE along the lines above, with emphasis on its value for climate science and the new laser occultation capability. The focus will then be on retrieval performance analysis results, in particular regarding the profiles of GHGs, isotopes, and wind. The results provide evidence that the GHG and isotope profiles can gener-

ally be retrieved, within 5-35 km outside clouds, with an rms accuracy of  $< 2\%$  to  $5\%$  at 1-2 km vertical resolution, and wind with an accuracy of  $< 2$  m/s. Climatologic monthly mean profiles, assuming *sim40* profiles per climatologic grid box per month, are found unbiased (free of time-varying biases) and at  $< 0.5\%$  rms accuracy. These encouraging results are discussed in light of the potential of ACCURATE to provide benchmark data for monitoring of climate, GHGs, and chemistry variability and change. Planned future European activities on ACCURATE are outlined, including international participation opportunities. The partnership with ATOMMS is addressed as well.