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The satellite mission ACCURATE: Observing greenhouse gases, isotopes and climate trends from space

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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 Wegener Center/Uni Graz 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; also other potentially interested organizations were informed. Whilst as mission proposal under scientific and technical review, ACCURATE currently undergoes scientific performance analyses and observational/system requirement refinements at Uni Graz and preparations for satellite instrument breadboarding.

The ACCURATE mission employs the occultation measurement principle, known for its unique combination of vertical resolution, accuracy and long-term stability, in a novel way. It systematically combines use of highly stable signals in the K band (LEO-LEO radio crosslink occultation) with laser signals in the SWIR 2-2.5 μm band (LEO-LEO infrared laser crosslink occultation) for exploring and monitoring climate and chemistry in the atmosphere with focus on the UTLS region (upper troposphere/lower stratosphere, 5-35 km). The K band radio occultation is an advanced and at the same time compact version of the LEO-LEO X/K band occultation concept studied in 2002-2004 for the ACE+ mission project of ESA. The core of ACCURATE is tight synergy of the SWIR laser crosslinks with the K band crosslinks.

The observed parameters, obtained simultaneously and in a self-calibrated manner based on refraction angle profiles and differential log-transmission profiles, comprise the fundamental thermodynamic variables of the atmosphere (temperature, pres-

sure/geopotential height, humidity) from K band, complemented by six greenhouse gases (GHGs) and key species of UTLS chemistry (H_2O, CO_2, CH_4, N_2O, O_3, CO) and four H_2O and CO_2 isotopes (HDO, $H_2{}^{18}O$, $^{13}CO_2$, $C^{18}OO$) 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 the ACCURATE observing system.

The presentation will start with an overview of the ACCURATE mission along the lines above, with emphasis on the climate science rationale and the new laser occultation capability. The focus will then be on scientific performance analysis results obtained so far, in particular regarding the retrieval of profiles of GHGs and the H_2O and CO_2 isotopes. The results provide evidence that the GHG and isotope profiles can generally be retrieved within 5-35 km (outside clouds) with $<$ 1% to 5% rms accuracy (at 1-2 km vertical resolution). Monthly mean climatological profiles, assuming $\sim$30 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 future monitoring of climate, GHGs, and chemistry variability and change.