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A long-range link experiment demonstrating infrared-laser occultation for measurement of atmospheric greenhouse gases

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The infrared-laser occultation technique (LIO) is a powerful, active occultation method for the measurement of various atmospheric trace gases. This technique exploits narrowband laser signals in the short-wave infrared spectral range (SWIR, 2 μm to 2.5 μm) to derive the concentrations of a range of trace species via differential absorption spectroscopy. Recent studies showed that the accuracy of trace gas profiles measured using LIO will be very high. In particular, using the signals which are foreseen for the so-called ACCURATE mission for climate benchmark profiling of greenhouse gases and thermodynamic variables and wind from space, the volume mixing ratios of H_2O, CO_2 ($^{12}CO_2$, $^{13}CO_2$, $C^{18}OO$), CH_4, N_2O, O_3, and CO can be determined accurate to within 1 % to 4 % individual-profile rms error over the upper troposphere and lower stratosphere (UTLS). Together with the high vertical resolution, unbiasedness and good global coverage of the data—characteristics which are intrinsic to the occultation method—the LIO technique is highly complementary to currently operated measurement methods.

This presentation will deliver insight into an experiment which will demonstrate the LIO technique for the first time. The experiment will be ground based and be performed at an altitude of about 2.4 km between two observatories at the Canary Islands which are about 144 km apart. The instrumentation needed, i.e., transmitter and receiver for testing the infrared-laser occultation, is currently constructed and tested at the Univ. of York, UK, together with the Univ. of Manchester, UK, with scientific support from the Univ. of Graz, AT. Optionally also cameras for additional analysis of the data are considered (focus scintillation studies), scientifically supported by M. Gorbunov and A. Gurvich from the Inst. of Atmospheric Physics, Russian Acad. of Sciences, RU. The measurement campaign, together with related in-situ greenhouse gas measurements for validation supported by the MPI for Biogeochemistry Jena, DE, is foreseen in July 2011. This experiment, focused in terms of parameters on the key species CO_2 ($^{12}CO_2$, $^{13}CO_2$, $C^{18}OO$), CH_4, and H_2O, will deliver important insight into the LIO technique and be an essential step towards operation of the LIO technique in space.