Title: Validation and calibration of greenhouse gas satellite observations by ground-based remote sensing measurements

Speaker: Thorsten Warneke

Institute: University of Bremen

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Abstract:

Greenhouse gas fluxes can be inferred from atmospheric concentration measurements by inverse modelling. Until recently such inverse modelling studies were solely based on a network of surface in situ measurement stations. This approach is limited by the sensitivity of the flux estimates to vertical transport and by the sparse spatial coverage of the sampling sites. Remote sensing measurements overcome some of the limitations of the in situ network. Remote sensing measurements provide a column integral, a different kind of information than the in situ measurements. The column is not sensitive to vertical transport and space-borne sensors provide global coverage. Remote sensing measurements of the atmospheric CO_2 and CH_4 became available only 15 years ago. The accuracy and precision of the first greenhouse gas retrievals from these measurements were not sufficient for advancing the understanding the global carbon cycle. However, the situation has changed over the years and several publications have used remote sensing measurements to improve the flux estimates of these gases. It is expected that the quality of the remotely sensed greenhouse gas data will continue to improve and that these data will become increasingly important for constraining greenhouse gas fluxes. A critical point for the future success of the remotely sensed greenhouse gas data is its calibration against the in situ reference scale. The ground-based Total Carbon Column Observing Network (TCCON) plays a vital role for the calibration of the column measurements and the validation of satellite retrievals. TCCON records solar absorption spectra and measures the same quantity as the satellites. TCCON measurements can be directly compared to vertical resolved in situ measurements and this calibration can be transferred to the satellite retrievals.