Representativity of Active Lidar Measurements of Methane, and Implications for Validation Strategies

J.Marshall[1], *V.Beck*[1], *C.Kiemle*[2], *A.Fix*[2]
[1]*Max Planck Institute for Biogeochemistry,* [2]*Deutsches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre*

The planned joint French-German satellite mission MERLIN aims to measure column-integrated atmospheric methane abundances using a spaceborne Integrated Path Differential Absorption (IPDA) lidar. The very small measurement footprint of the single shot measurements (~150 m) means that the sensor will be able to make measurements even in the presence of broken clouds. In order to attain the targeted measurement precision, many measurements, spaced roughly 600 m apart, will be averaged along a measurement path of approximately 50 km, resulting in a measurement footprint of 150 m by 50 km. This presents some unusual challenges for the validation of the measurement, particularly over regions with a great deal of heterogeneity in the sources. Furthermore, the planned dawn-dusk orbit results in significant time offsets with measurements from the TCCON network, particularly in the winter and at higher latitudes, as the FTS measurements require a clear line-of-sight to the sun. In order to address the representativity of various in-situ and ground-based remote sensing measurement systems with respect to the MERLIN measurement, a series of mesoscale tracer transport simulations at resolutions of up to 2 km have been sub-sampled in order to produce satellite pseudo-data. These pseudo-measurements are then compared to pseudo-data created with sampling consistent with ground-based remote sensing (TCCON-like), routine profile measurement made by passenger aircraft (IAGOS-like), balloon-based profile measurements (AirCore-like), and sampling consistent with a dedicated validation campaign. Results from mesoscale simulations over Europe, as well as regions of Western Siberia and the Amazon with significant wetland and biomass burning fluxes are considered in the study. The appropriateness of each type of measurement system for the validation of MERLIN measurements is assessed, including the length of time that would be required to develop sufficient coincidences in space and time to achieve a statistically significant comparison. Optimal strategies for dedicated validation campaigns are discussed. Finally, the results are upscaled globally, based on process-based flux maps and heterogeneity observed in simulations of XCH4 using a global atmospheric tracer transport model. Comparisons to results for XCO2 are also presented.

****