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Improved carbon dioxide and methane retrieved from SCIAMACHY onboard ENVISAT: Validation and land-atmosphere related applications

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Carbon dioxide (CO_2) and methane (CH_4) are the two most important anthropogenic greenhouse gases contributing to global climate change. Despite their importance, there are still many gaps in our understanding of the sources and sinks of these greenhouse gases and their biogeochemical feedbacks and response in a changing climate. Satellite measurements combined with inverse modelling can significantly reduce surface flux uncertainties, if the satellite data are accurate and precise enough. The significant reduction of regional-scale flux uncertainties additionally requires high sensitivity to the lowest atmospheric layers where the variability is largest. Sensitivity to all altitude levels, including the boundary layer, can be achieved by using reflected solar radiation in the near-infrared/shortwave-infrared (NIR/SWIR) spectral region. SCIAMACHY onboard ENVISAT (launched in 2002) was the first and is now with TANSO onboard GOSAT (launched in 2009) one of only two satellite instruments currently in space yielding measurements of the relevant absorption bands of both gases in this spectral range.

Improved global data sets of atmospheric carbon dioxide and methane column-averaged mole fractions – which are the quantities needed for inverse modelling to get information on the sources and sinks – retrieved from SCIAMACHY nadir observations are presented upgrading pre-existing greenhouse gas information derived from European EO data. The multi-year data sets are validated with ground-based Fourier Transform Spectrometer (FTS) measurements and compared with model results at Total Carbon Column Observing Network (TCCON) sites providing realistic error estimates of the satellite data which is a prerequisite to assess the suitability to be used in inverse modelling. These validation results will be briefly summarised. The subsequent discussion focuses on land-atmosphere related applications including an analysis of the atmospheric greenhouse gas variability on a spatial and temporal basis induced by the biogeosphere.