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Towards an improved CO_2 retrieval algorithm for inverting satellite near-infrared nadir spectra

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Atmospheric CO_2 is the dominant anthropogenic greenhouse gas. Satellite measurements of the CO_2 mixing ratio (XCO_2) derived from the SCIAMACHY instrument aboard ENVISAT and in the future from OCO or GOSAT can provide valuable information to quantify regional CO_2 sources and sinks. Such an application requires high accuracy and precision, on the order of 1% or better, to provide an added value compared to the highly accurate but spare ground-based measurement network.

The WFM-DOAS algorithm developed at the Institute of Environmental Physics (IUP) of the University of Bremen is based on the simultaneous retrieval of CO_2 and O_2 column amounts to derive XCO_2 from SCIAMACHY. The CO_2 column amount is derived from the CO_2 absorption band at around 1580nm while O_2 is derived from the O_2A-band at around 760nm. The retrieval requires extremely precise radiative transfer (RT) forward calculations in these bands. High computational costs of these calculations stand in contrast to a large amount of satellite measurements. In general this problem is solved by applying approximations to the forward model.

The present implementation of WFM-DOAS is very fast ($\sim$1 minute/orbit) as it avoids online RT simulations by using a look-up table (LUT) of pre-calculated radiances and their derivatives. The current approach is however not very flexible. Relevant additional information, such as meteorological data, cannot be fully considered, which limits the accuracy. In order to take additional information better into account, we are developing a more flexible LUT approach. In addition, we have implemented a reference retrieval scheme based on online RT simulations. The presentation will show the current status of development.