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Atmospheric methane and carbon dioxide from SCIAMACHY satellite data: initial comparison with chemistry and transport models

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Abstract. The remote sensing of the atmospheric greenhouse gases methane (CH_4) and carbon dioxide (CO_2) in the troposphere from instrumentation aboard satellites is a new area of research. In this manuscript, results obtained from observations of the up-welling radiation in the near-infrared by SCIAMACHY on board ENVISAT are presented. Vertical columns of CH_4, CO_2 and oxygen (O_2) have been retrieved and the (air or) O_2-normalised CH_4 and CO_2 column amounts, the dry air column averaged mixing ratios XCH_4 and XCO_2 derived. In this manuscript the first results, obtained by using the version 0.4 of the Weighting Function Modified (WFM) DOAS retrieval algorithm applied to SCIAMACHY data, are described and compared with global models. For the set of individual cloud free measurements over land the standard deviation of the difference with respect to the models is in the range ~100–200 ppbv (5–10%) for XCH_4 and ~14–32 ppmv (4–9%) for XCO_2. The inter-hemispheric difference of the methane mixing ratio, as determined from single day data, is in the range 30–110 ppbv and in reasonable agreement with the corresponding model data (48–71 ppbv). The weak inter-hemispheric difference of the CO_2 mixing ratio can also be detected with single day data. The spatiotemporal pattern of the measured and the modelled XCO_2 are in reasonable agreement. However, the amplitude of the difference between the maximum and the minimum for SCIAMACHY XCO_2 is about ±20 ppmv which is about a factor of four larger than the variability of the model data which is about ±5 ppmv. More studies are needed to explain the observed differences. The XCO_2 model field shows low CO_2 concentrations beginning of January 2003 over a spatially extended CO_2 sink region located in southern tropical/sub-tropical Africa. The SCIAMACHY data also show low CO_2 mixing ratios over this area. According to the model the sink region becomes a source region about six months later and exhibits higher mixing ratios. The SCIAMACHY and the model data over this region show a similar time dependence over the period from January to October 2003. These results indicate that for the first time a regional CO_2 surface source/sink region has been detected by measurements from space. The interpretation

of the SCIAMACHY CO_2 and CH_4 measurements is difficult, e.g., because the error analysis of the currently implemented retrieval algorithm indicates that the retrieval errors are on the same order as the small greenhouse gas mixing ratio changes that are to be detected.

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