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Comparisons between SCIAMACHY atmospheric CO_2 retrieved using (FSI) WFM-DOAS to ground based FTIR data and the TM3 chemistry transport model

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Abstract. Atmospheric CO_2 concentrations, retrieved from spectral measurements made in the near infrared (NIR) by the SCIAMACHY instrument, using Full Spectral Initiation Weighting Function Modified Differential Optical Absorption Spectroscopy (FSI WFM-DOAS), are compared to ground based Fourier Transform Infrared (FTIR) data and to the output from a global chemistry-transport model.
Analysis of the FSI WFM-DOAS retrievals with respect to the ground based FTIR instrument, located at Egbert, Canada, show good agreement with an average negative bias of approximately −4.0% with a standard deviation of 3.0%. This bias which exhibits an apparent seasonal trend, is of unknown origin, though slight differences between the averaging kernels of the instruments and the limited temporal coverage of the FTIR data may be the cause. The relative scatter of the retrieved vertical column densities is larger than the spread of the FTIR measurements. Normalizing the CO_2 columns using the surface pressure does not affect the magnitude of this bias although it slightly decreases the scatter of the FSI data.

Comparisons of the FSI retrievals to the TM3 global chemistry-transport model, performed over four selected Northern Hemisphere scenes show reasonable agreement. The correlation, between the time series of the SCIAMACHY and model monthly scene averages, are 0.7 or greater, demonstrating the ability of SCIAMACHY to detect seasonal changes in the CO_2 distribution. The amplitude of the seasonal cycle, peak to peak, observed by SCIAMACHY however, is larger by a factor of 2–3 with respect to the model, which cannot be explained. The yearly means detected by SCIAMACHY are within 2% of those of the model with the mean difference between the CO_2 distributions also approximately 2.0%. Additionally, analysis of the retrieved CO_2 distributions reveals structure not evident in the model fields which correlates well with land classification type.

From these comparisons, it is estimated that the overall bias of the CO_2 columns retrieved by the FSI algorithm is <4.0% with the precision of monthly 1°×1° gridded data close to 1.0%.

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