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First direct observation of the atmospheric CO_2 year-to-year increase from space

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Abstract. The reliable prediction of future atmospheric CO_2 concentrations and associated global climate change requires an adequate understanding of the CO_2 sources and sinks. The sparseness of the existing surface measurement network limits current knowledge about the global distribution of CO_2 surface fluxes. The retrieval of CO_2 total vertical columns from satellite observations is predicted to improve this situation. Such an application however requires very high accuracy and precision. We report on retrievals of the column-averaged CO_2 dry air mole fraction, denoted XCO_2, from the near-infrared nadir spectral radiance and solar irradiance measurements of the SCIAMACHY satellite instrument between 2003 and 2005. We focus on northern hemispheric large scale CO_2 features such as the CO_2 seasonal cycle and show - for the first time - that the atmospheric annual increase of CO_2 can be directly observed using satellite measurements of the CO_2 total column. The satellite retrievals are compared with global XCO_2 obtained from NOAA's CO_2 assimilation system CarbonTracker taking into account the spatio-temporal sampling and altitude sensitivity of the satellite data. We show that the measured CO_2 year-to-year increase agrees within about 1 ppm/year with CarbonTracker. We also show that the latitude dependent amplitude of the northern hemispheric CO_2 seasonal cycle agrees with CarbonTracker within about 2 ppm with the retrieved amplitude being systematically larger. The analysis demonstrates that it is possible using satellite measurements of the CO_2 total column to retrieve information on the atmospheric CO_2 on the level of a few parts per million.

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