Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 3597-3619, 2007
www.atmos-chem-phys.net/7/3597/2007/

Assessing the near surface sensitivity of SCIAMACHY atmospheric CO_2 retrieved using (FSI) WFM-DOAS

M. P. Barkley[1,*], P. S. Monks[2], A. J. Hewitt[1], T. Machida[3], A. Desai[4], N. Vinnichenko[5,†], T. Nakazawa[6], M. Yu Arshinov[7], N. Fedoseev[8], and T. Watai[9]

[1]EOS, Department of Physics and Astronomy, University of Leicester, UK
[2]Department of Chemistry, University of Leicester, UK
[3]National Institute for Environmental Studies, Tsukuba, Japan
[4]National Centre for Atmospheric Research, Boulder, CO, USA
[5]Central Aerological Observatory, Dolgoprudny, Russia
[6]Tohoku University, Sendai, Japan
[7]Institute of Atmospheric Optics, Tomsk, Russia
[8]Permafrost Institute, Yakutsk, Russia
[9]Global Environmental Forum, Tsukuba, Japan
[*]now at: Institute for Atmospheric and Environmental Science, School of GeoSciences, University of Edinburgh, UK
[†]deceased 2006

Abstract. Satellite observations of atmospheric CO_2 offer the potential to identify regional carbon surface sources and sinks and to investigate carbon cycle processes. The extent to which satellite measurements are useful however, depends on the near surface sensitivity of the chosen sensor. In this paper, the capability of the SCIAMACHY instrument on board ENVISAT, to observe lower tropospheric and surface CO_2 variability is examined. To achieve this, atmospheric CO_2 retrieved from SCIAMACHY near infrared (NIR) spectral measurements, using the Full Spectral Initiation (FSI) WFM-DOAS algorithm, is compared to in-situ aircraft observations over Siberia and additionally to tower and surface CO_2 data over Mongolia, Europe and North America.

Preliminary validation of daily averaged SCIAMACHY/FSI CO_2 against ground based Fourier Transform Spectrometer (FTS) column measurements made at Park Falls, reveal a negative bias of about −2.0% for collocated measurements within ±1.0° of the site. However, at this spatial threshold SCIAMACHY can only capture the variability of the FTS observations at monthly timescales. To observe day to day variability of the FTS observations, the collocation limits must be increased. Furthermore, comparisons to in-situ CO_2 observations demonstrate that SCIAMACHY is capable of observing a seasonal signal that is representative of lower tropospheric variability on (at least) monthly timescales. Out of seventeen time series comparisons, eleven have correlation coefficients of 0.7 or more, and have similar seasonal cycle amplitudes. Additional evidence of the near surface sensitivity of SCIAMACHY, is provided through the significant correlation of FSI derived CO_2 with MODIS vegetation indices at over twenty selected locations in the United States. The SCIAMACHY/MODIS comparison reveals that at many of the sites, the

amount of CO_2 variability is coincident with the amount of vegetation activity. The presented analysis suggests that SCIAMACHY has the potential to detect CO_2 variability within the lowermost troposphere arising from the activity of the terrestrial biosphere.

Final Revised Paper (PDF, 1126 KB) Discussion Paper (ACPD)

Citation: Barkley, M. P., Monks, P. S., Hewitt, A. J., Machida, T., Desai, A., Vinnichenko, N., Nakazawa, T., Yu Arshinov, M., Fedoseev, N., and Watai, T.: Assessing the near surface sensitivity of SCIAMACHY atmospheric CO_2 retrieved using (FSI) WFM-DOAS, Atmos. Chem. Phys., 7, 3597-3619, 2007. Bibtex EndNote Reference Manager