Atmos. Meas. Tech. Discuss., 2, C1107–C1110, 2010
www.atmos-meas-tech-discuss.net/2/C1107/2010/

Atmospheric Measurement Techniques Discussions

Interactive comment on "A method for improved SCIAMACHY CO_2 retrieval in the presence of optically thin clouds" *by* M. Reuter et al.

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Received and published: 15 January 2010

The referee had some minor comments and raised several interesting questions and gave useful recommendations which we discuss in the following. The review was profound and constructive and helped us to strengthen the paper.

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Interactive Discussion

Discussion Paper

1 Minor comments

Referee: *Please put in a definition of XCO2.*
Authors: Within the abstract we already explain the meaning of XCO2 as "column averaged mixing ratio of atmospheric CO2". Additionally, we state within the introduction: "...column averaged dry air mole fraction (XCO2)..."
Referee: *Please mention that OCO was an unsuccessful launch and cite the article by Palmer and Rayner (Nature, 2009) which discusses this event.*
Authors: Done. We included the following text: "Another carbon dioxide observing satellite was OCO (Orbiting Carbon Observatory). OCO was designed to measure within the same spectral region. Unfortunately, the satellite was lost shortly after lift-off on 24 February 2009 (Palmer and Rayner, 2009)"
Referee: *Page 2486 Line 10: Typo. Something has gone amiss with brackets around the references.*
Authors: Done.
Referee: *Page 2488, Lines 16-24: Please rephrase the following paragraph as it contains unnecessary information...*
Authors: Done (as suggested by the Referee).
Referee: *Style: Please make sure all acronyms are capitalized e.g, "...NOAA (National Oceanic and Atmospheric Administration)..." and elsewhere.*
Authors: Done.
Referee: *Please state what 'ASP' is, as it introduced without a definition (I assumed it is aerosol scaling profile).*
Authors: Done. We tried to reduce misunderstandings due to similar acronyms and are now consistently using APS (aerosol profile scaling) instead of ASP (aerosol scaling profile).
Referee: *Page 2495 Line 1: Typo: "These elements are better constrainted because simultaneous fitting implicitly utilizes the knowledge that the retrieved quantity..."*
Authors: Done.

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Referee: *Page 2498 Paragraph starting line 24 : It is not clear to me how the ECMWF profiles are interpolated with regards to the surface pressure; is it the radiosonde station or the satellite ground pixel? Please provide a better explanation.*
Authors: We performed no interpolation of the ECMWF profiles. We tried to explain this better now: "The exact SCIAMACHY sub pixel composition of surface elevations is not perfectly known. For this reason, we used unmodified ECMWF profiles i.e. we performed no interpolation of the surface height within the ECMWF profiles. Therefore, the surface elevation within a radiosonde profile may differ from the surface elevation within the profile of the corresponding ECMWF grid box. This means, our estimate combines two uncertainties: The ECMWF surface pressure uncertainty and the sub grid box surface pressure variability due to topography which is most times much larger."
Referee: *Page 2500 Line 13: Typo: "...as the fraction of air molecules..."*
Authors: Done.
Referee: *Question: How good is the spectroscopy in the O2-A fit window? How does this impact the subsequent retrieved parameters?*
Authors: Within this theoretical study, we restrict to simulated measurements, i.e., the simulation use the same spectroscopy as the retrieval. Therefore, we expect that our results are valid even if the true spectroscopy differs slightly from the HITRAN 2008 spectroscopy. However, the question surely aims at the application on real SCIAMACHY data. In this case, minor errors of the used spectroscopy can of course influence the retrieval results. Analysis with the WFM-DOAS retrieval scheme e.g. indicate that a systematic error of 1% in the HITRAN line width parameter can results in an error of approximately 1% of the retrieved number of O2 molecules.
Referee: *Question: Is the any benefit, with regards to the retrieval of aerosol and cloud parameters, from using a full spherical radiative transfer model rather than by assuming a plane parallel atmosphere?*
Authors: In the case of an optically thick cloud at a large altitude where only minor parts of the atmosphere is lying above the cloud, the differences between the spherical

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and the plan parallel assumption will probably be small. However, under large viewing or sun zenith angles and in cases with a significant fraction of photons traveling also through the lower atmosphere where more gaseous absorption and Rayleigh scattering happens, the difference will become larger.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 2483, 2009.