Atmos. Chem. Phys. Discuss., 5, S4108–S4111, 2005
www.atmos-chem-phys.org/acpd/5/S4108/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Intercomparison exercise between different radiative transfer models used for the interpretation of ground-based zenith-sky and multi-axis DOAS observations" *by* F. Hendrick et al.

F. Hendrick et al.

Received and published: 24 November 2005

At first, we would like to thank Dr A. Sarkissian for his comments and suggestions.

Specific Comments

Referee comment: This comment can be taking into account but is not determinant for the quality of the paper. At the end of chapters 5 and 6, concerning interpretation of differences between models for aerosol impact and ground albedo impact, the authors are involving further tests to find out the detailed reasons of differences. Some

effort can be done, using existing results and main author's own model to propose solution (s) or to explore solutions. Next intercomparisons will be able to validate author's propositions.

Reply: In the revised version of the manuscript, we have discussed in more details the results on the aerosols and surface albedo effects. However, as mentioned by Referee U. Friess in his comments, further calculations by all participants cannot easily be done and therefore it is not possible in the present study to find out the detailed reasons of the discrepancies obtained between the different models concerning these effects. In the case of the aerosols effect, we have tested with our own model UVspec/DISORT the possible impact of the altitude grid on the HCHO and NO2 SCDs calculated with aerosol scattering in MAX geometry. In order to achieve that, we have used altitude grids with a thinner layer thickness (0.1 km for HCHO and 0.2 km for NO2). The SCDs calculated with these new altitude grids do not differ significantly from those calculated with the previous altitude grids. An interpolation effect could therefore not explain the discrepancies obtained between the models regarding the aerosols impact. These discrepancies may be related to the different approximations used in the models for resolving the RT equation. For example, the UBRE and UHEI models are spherical whereas the NILU and IASB models use the pseudo-spherical approximation. Fourier expansion are also applied in the NILU and IASB models, which could lead to a lost of angular information if too less Fourier terms are considered. Without any doubt, the new intercomparison exercise currently led by the University of Heidelberg in the framework of the EU Network of Excellence ACCENT is more appropriate to test the consistency of the RT models concerning the impact of the aerosols on simulated SCDs/AMFS. The reasons are that (1) the four models involved in our study are, together with others, also involved in this new exercise and (2), the new exercise is addressing more thoroughly the aerosol issue through several tests carried out using different aerosol settings. More information concerning this new exercise as well as preliminary results can be found on the following web page: http://satellite.iup.uni-heidelberg.de/index.php/RTM_Workshop/149/0/. In the case of the surface albedo ef-

ACPD

5, S4108–S4111, 2005

fect, the UHEI model results differ from the others. For low (0.0) and medium (0.2) surface albedo conditions, the UHEI model results agree well with the results from other models. For high (0.9) surface albedo conditions, the UHEI model gives significantly larger SCD values, especially above 70° SZA. However, in the case of HCHO SCDs, the differences between the UHEI model results and the analytical models results are similar to the differences found between the SCDs calculated by the three analytical models. Due to the larger SCD values obtained when surface albedo is fixed to 0.9, the UHEI model gives significantly larger relative increase in SCDs than the other models: when the surface albedo increases from 0.0 to 0.9, the SCD increases at 80° SZA for 5° and 20° elevation reach 32% and 84% for HCHO, and 12% and 35% for NO2. This behaviour is likely to be attributed to the different concepts used in the Monte Carlo model as compared to the analytical codes. The modelling of the absolute radiance still poses a challenge to backward Monte Carlo approaches, which is also under investigation by other groups. At high albedo, light reflected off the ground is unattenuated and increases the signal of absorbers near the ground, so the absolute radiance begins to play a significant role in the SCD calculations. The present intercomparison exercise was aimed at detecting those subtle effects, and the results will help to optimize the modelling. So will comparison against measurements, e.g., as performed in Weidner et al. (2005).

Technical Corrections

Referee comment: Abstract: "Concerning the MAX simulations, ...relative azimuth effects" should come before the last sentence of the abstract to have all zenith sky and Max presented separately and in the same order as in the paper.

Reply: We have modified this.

Referee comment: End of part 4.1: the author should indicate the % of MS in the total, justifying conclusion in Wittrock et al., 2004.

Reply: In the revised version of the manuscript, we have withdrawn the Wittrock et al.

ACPD

5, S4108–S4111, 2005

(2004) reference in the discussion on the relative azimuth effect (see reply to the comments from Referee U. Friess). So the present comment from Referee A. Sarkissian is not relevant anymore.

Referee comment: Table 4. Mie scattering is included in part 5. It should be indicated somewhere as a note.

Reply: We have added a comment on this in the Table 4 caption.

References

Weidner, F., Bösch, H., Bovensmann, H., Burrows, J. P., Butz, A., Camy-Peyret, C., Dorf, M., Gerilowski, K., Gurlit, W., Platt, U., von Friedeburg, C., Wagner, T., and Pfeilsticker, K.: Balloon-borne Limb profiling of UV/vis skylight radiances, ozone and nitrogen dioxide: Technical set-up and validation of the method, Atm. Chem. Phys., 4, 1409-1422, 2005

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 7929, 2005.