Atmos. Chem. Phys. Discuss., 3, S567–S569, 2003
www.atmos-chem-phys.org/acpd/3/S567/
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A fast H_2O total column density product from GOME - validation with in-situ aircraft measurements" *by* T. Wagner et al.

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Received and published: 19 May 2003

We want to thank Rüdiger Lang very much for his very good general comments on the usefulness of satellite observations, in particular in the visible spectral range. We also thank him very much for the positive assessment of our study and for his very constructive additional comments, which helped us to improve our manuscript. Our detailed comments are:

1) Apart from extreme weather situations like e.g. strong cyclones the errors introduced by atmospheric pressure changes are relatively small: about $>$ ś5%. Thus in our present study we did not apply an respective correction, because other error sources, especially the influence of clouds still have a much larger effect. Nevertheless, advanced future algorithms might of course include an appropriate correction, which can be solely based on the knowledge of the surface pressure. We added this information in the text.

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2) In general we expect the influence of a potential albedo change from 630 nm (O4 absorption) to 650 nm (H2O absorption) to be very small. This is because strong albedo changes within this short wavelength interval are very improbable (see e.g. Koejlemeier et al., 2003). Nevertheless, we can not rule out that over specific surface types even such strong changes might appear. We therefore included this information in the text.

It is also suggested that the apparent overestimation of the modelled H2O VCD by our retrieval between 22°N and 57°N might be caused by such potential albedo effects. While this is in principle a very good suggestion, we think that it does not serve to explain all observed features:

a) The overestimation nearly continuously exists over the entire range between 22°N and 57°N. Within this range GOME flies over ocean (from about 22° to 30°N) as well as over continent (from about 30° to 57°N).

b) Especially over extended clouds the influence of the ground albedo should become negligible. Large cloud fractions are observed between about 30 and 42°N, but no specific correlation of the observed overestimation to this cloud pattern is found.

3) We already shortly discussed this potential problem in the first version of our manuscript: ..."First, the cloud correction is only valid under the assumption that the H2O profile is horizontally homogeneous throughout the whole GOME ground pixel. This is in general not the case; especially for measurements with cloud fractions close to 100% the respective error can become large."... We agree that more information/discussion would be very helpful and we added the following information to the text: "In the case of large cloud fractions only very limited or even no information on the water vapour concentration below the cloud can be retrieved. It turned out that even for large cloud fractions between 50% and 100% our algorithm underestimates the true atmospheric values by only 18% (see section 3). Nevertheless, it could be a good procedure for a routine operation to exclude GOME H2O observations with cloud

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fractions above a certain threshold." Concerning the potential influence of multiple scattering due to aerosols and clouds we think that the main advantage of our algorithm is just that it takes such effects automatically into account. Since the absorptions of O4 and H2O can be expected to be influenced by such effects very similarly, the application of our measured AMFs automatically yields the appropriate correction. We stated this already in different parts of the original version of our manuscript: ..."In particular "subtle" cloud effects like multiple scattering inside clouds or horizontal light paths within the large ground pixels - which are difficult to model - are automatically taken into account..." ...."A similar but generally smaller effect can be also due to multiple Mie scattering inside the clouds or reflections between the cloud layer and the surface...." In the last sentence we added that a similar effect can occur on aerosol layers.

4) We apologise that we did not correctly report on the work of Lang et al. (2003). We thank very much for this hint and corrected the respective part of our manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 323, 2003.

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