Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-48-RC1, 2016

Atmospheric Measurement Techniques Discussions

Interactive comment on "Improvements of the OMI O_2-O_2 Operational Cloud Algorithm and Comparisons with Ground-Based Radar-Lidar Observations" *by* J. Pepijn Veefkind et al.

Anonymous Referee #1

Received and published: 4 May 2016

Review of "Improvements of the OMI O2-O2 Operational Cloud Algorithm and Comparisons with Ground-Based Radar- Lidar Observations" by Veefkind et al.

General comments

This paper describes a number of improvements of the OMI operational O2-O2 cloud algorithm which provides important input data for OMI trace gas algorithms. The authors carry out comparisons of the new version of cloud products with the old version. They also compare the retrieved effective cloud pressures with ground-based radar data. The authors conclude that while the impact of the improvements on effective cloud fraction is small the impact on effective cloud pressure can be as large as 200 hPa. The paper contains significant original material that can be of interest for the

developers of cloud algorithms for satellite sensors. The paper subject is appropriate to AMT. Earlier work is adequately recognized and credited. The abstract provides a sufficiently complete summary of the paper. The paper is well organized. I recommend the paper for publication after that the authors address to the following comments.

Specific comments

Line 85. Please specify the wavelength grid.

Line 90. Please explain how the synthetic radiance Raman spectrum was computed.

Lines 128-130. Provide details of retrieving cloud pressures for very small cloud fractions and for snow/ice covered areas. What values of cloud fraction are used over snow/ice? For instance, for Greenland (see Fig. 4a)?

Line 130. "In such cases, the LER method may be a good fallback". However, the authors state in Section "Scene albedo and scene pressure" that they do not recommend using scene pressures over dark areas. What could be recommended for such areas if the cloud fraction is very small?

I have also a more general question. How the LER method, i.e. scene albedo and scene pressure, can be used in trace gas algorithms?

Line 131. What ozone amounts are used in the radiative transfer simulations? Do you have nodes for ozone amounts in your lookup table? Do you include Raman scattering in your radiative transfer simulations to be consistent with the DOAS fit performed on the measured reflectances?

Lines 138-140. It would be beneficial for a reader to clarify what variables are used in the lookup table generated as a result of radiative transfer simulations. Please provide corresponding equations.

Line 145, Fig. 2. Effective cloud pressures may seem to be strange for reflectances less than 0.15 and slant column O2-O2 amounts less than 0.25*10ˆ44. Please provide some details of the extrapolation procedure for those values.

Line 147, Table 2. Please explain why you need so many reflectance nodes in the reflectance range of 1.0 to 2.0. Where do you get so large values of reflectance geographically?

Line 160. Can Eq. 2 be derived from the exact radiative transfer equation? If yes, please provide details in your response.

Line 163. It would be useful to provide an equation for the altitude resolved air mass factor.

Line 186, Fig.3. How large is the corresponding temperature correction factor? Please provide numbers.

Line 223, Fig. 4c. Why orbit swath footprints can be seen on the cloud fraction difference map?

Line 282, Fig. 7b. Please explain why the dependence of cloud pressure on cloud fraction is almost flat. One could expect lower cloud pressures for higher cloud fractions. Deep convective clouds in the tropics and frontal zone clouds can be examples of such cases. I think that a plot of cloud pressures vs cloud fractions in the tropics (-20<lat<20 deg) would be clarifying the issue.

Line 285. The authors state that they "have no physical explanation" for cloud pressures increasing towards lower cloud fractions. The cloud algorithm is based on an approach that treats aerosols as clouds. Low cloud fractions can be related to cloud-free scenes with tropospheric aerosols. In that case it is reasonable to anticipate higher cloud pressure retrievals. This could be a physical explanation.

Line 288. Please clarify the improvements of the interpolation scheme. It is particularly important to explain the improved performance of the scheme for low reflectance scenes.

Line 346. "... the retrieved scene pressure is significantly larger than the sea level pressure". Please characterize the difference quantitatively.

Section "Comparison with ground-based radar". It is quite desirable to compare the previous version of cloud pressure retrievals with ground-based radar data to answer a question which version of OMCLDO2 better agrees with the radar data. I think that such a question of a potential reader should be answered.

Line 392. Why not to use temperature profiles to convert cloud pressures to altitude?

Line 417. A "radar-lidar" appears in this line and elsewhere. What lidar do you mean?

Technical notes

Line 48. "the cloud pressures ... , which are sensitive near the actual cloud top". Please reword.

Line 99. Typo. Should be "all".

Fig. 2 caption. The continuum reflectance has been denoted as R in Line 85. The Greek "ro" was used for air density in Line 167.

Line 167. Greek "ro" is missing.

Line 220. Should be Table 3.

Lines 264-268. Fig. 2? Probably Fig. 3?

Line 331. Typo. Should be "pressure" instead of "fraction".

Line 175. Typo. The O2-O2 cross section appears twice in Eq. 4.

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