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Atmospheric Measurement Techniques Discussions

Interactive comment on "Explicit and consistent aerosol correction for visible wavelength satellite cloud and nitrogen dioxide retrievals based on optical properties from a global aerosol analysis" *by* Alexander Vasilkov et al.

Anonymous Referee #3

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This manuscript describes at method to account for aerosol effects in retrievals of tropospheric NO2. The method is based on a combination of modeled aerosol fields and measured reflectance spectra. A single case study is presented to demonstrate the method.

Main comments

The method that is presented for the aerosol correction seems highly similar to the method presented by Lin et al (2014). Therefore, the claim that is made in the conclu-

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sions that this is new approach is not correct. It is a minor step forward compared to previously published work.

Although the authors claim that the method can be applied globally, there are computational problems to be resolved (line 312-319). The current description of the method is therefore incomplete for its global purpose. I believe it would be better to postpone publicatios until these problems are solved and a complete description can be given.

The one case that is presented is far too limited. Given that the authors claim to present a globally applicable method, global results for representative time periods need to be presented (e.g a few months). It is impossible to base any conclusions on the one case study that is presented.

As described in the literature and section 3.1, the aerosol effect depends on both the aerosol vertical profile and the NO2 vertical profile. Whereas it is clear that the work uses Merra-2 profiles for the aerosols, it is not clear where the NO2 profiles are coming from. This should be described clearly, and in case there are not coming from Merra -2, it should be made clear why not.

The fact that this method brings even more model information into the satellite retrievals is a concern. How can a user judge how much of the final retrieval product is model and how much is based on the measurements? This should be addressed in detail. Related to this, current NO2 retrievals include averaging kernel information which allow users to replace the assumed NO2 profile with their own profiles. It is preferable if a similar approach is implemented for the assumed aerosol profiles. This should also be addressed in the manuscript.

The sophistication of the aerosol and the cloud model seems to be out of balance. Whereas for the aerosol model a state-of-the-art aerosol model is applied, clouds are represented by a simple Lambertian clouds. The choice of this cloud model should be substantiated. Note that the retrieval results be as good as the weakest link in the chain.

Detailed comments

Section 2.5.1 This section should also describe cases for which the a-priori information is inconsistent with the measurements. For example, the following cases may occur: -The ECF becomes less than zero; -The ECF becomes larger than one; -The ECF is zero, but the SCD for O2-O2 is not consistent with aerosol profile. These are important details and all known geophysical situations should be covered in an algorithm paper.

Section 2.5.1, line 183. Details shall be provided on how the equation is solved. What numerical methods are used?

Section 2.2, line 121 How does Merra-2 deal with the very strongly non-linear growth of aerosol particles for relative humidities > 90%. This may be a frequently occurring at the top of the boundary layer for partly cloudy conditions and have significant effectson the AMF.

Section 2.3 Provide detailed information on the setup of the RT calculations wrt the aerosol optical properties, such as the number of streams used in calculations, etc.

Section 3.2, line 249 The demonstrated effect is clearly not only because of BRDF effects. The largest effect is due to different source of the surface reflectivity data. If non BRDF effects were taken into account a similar effect could be expected.

Section 3.2 line 261 Also calibration differences between OMI and MODIS and atmospheric correction in MODIS should be discussed here.

Section 3.2 line 298: “An interesting feature of the explicit aerosol correction on OCP is that the OCP can be reduced for a small fraction of the pixels.” This sentence is not understood.

Section 3.2 line 297: At low cloud fractions the errors in the OCP will explode. What is the assumed error in the OCPs? How does an increase of 50 hPa relate to the expected accuracy of the OCP?

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