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Atmospheric Measurement Techniques Discussions

Interactive comment on "Contiguous polarisation spectra of the Earth from 300–850 nm measured by GOME-2 onboard MetOp-A" *by* L. G. Tilstra et al.

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General Comments

This paper presents, for the first time, high resolution and high quality atmospheric polarization data from satellite measurements. The data are unique in the sense that their spatial and wavelength coverage are unprecedented. In spite of their sparsity (only one orbit per month taken in the PMD high resolution mode) they contain a wealth of information that can be of great value to the community, both for the radiometric

calibration as well as atmospheric constituents retrieval. The paper is well written and clearly structured. It aims at the demonstration of the quality of the data by

- Validating the polarization sensitivity and calibration by comparing to modeled data for clear sky events, and by studying the dependence on cloud fraction.
- Studying cases where no polarization is expected and thereby showing that systematic effects arising from relative calibration or misalignment of the polarization axis are small.

In addition the spectral behavior of the polarization in the UV is discussed which has not been measured at this detail before and the calibration of polarization sensitive instruments had to purely rely on models.

However, the validation of the polarization sensitivity it is by no means "extensive", as the authors suggest in the conclusion. An extensive (and comprehensive) validation would be if a rigorous and consistent statistical analysis had been performed on a large fraction of the data (if not all), rather than just a few selected examples. Given the uniqueness of these new data, I do think that the approach taken by the authors is for the moment sufficient to demonstrate the data quality. I would suggest, though, that the authors include a paragraph on why they have chosen this approach, and if possible, a statement on how the quality of the examples relates to that of a comparable, larger sample. This would prevent assertions that the selected examples have been chosen for their overly good performance compared to others.

I am also missing a more profound discussion on the origin of spectral structures in the UV. If they are related to O_3 absorption spectra, then why do they not show up in the simulated data? Also, in this case this may be very relevant information for DOAS-like atmospheric constituent retrievals in this wavelength region and therefore deserves to be discussed in more detail. Related to this is the impact of errors due to the low spectral resolution of the normal PMD measurements on the radiometric calibration

of GOME-2 spectra. A discussion on this may exceed the scope of this article, but even then I would suggest that an outlook on further investigation be included in the summary.

Specific comments

Section 3.1

page 11315, lines 12-19:
I'd suggest to move this paragraph to the top of this section, in order to clarify that the article is about GOME-2 on Metop-A (is it?) and avoid confusion by mentioning all these different satellites.

Section 3.2

page 11316, line 4:
The mentioning of OMI (and only OMI) feels a little unmotivated, I suggest to write "Other instruments such as OMI ..."
page 11316, line 14:
Have any studies been performed yet to show that the instrument is indeed largely insensitive to U? One way to obtain a limit on the sensitivity of the PMDs at least is to separate the special cases of the left panel of figure 6 into cases with positive and negative U and look for systematic differences. However, this does not not necessarily need to be done for this paper, it's just an idea.
page 11317, lines 18-24: The referenced document (Munro and Lang 2010) is not, or not readily, available to the public. Therefore it would not hurt to include a comprehensive summary on the steps undertaken to obtain the calibrated Stokes fractions (and radiances?).
page 11317,lines 26/27: It is not clear from this sentence that the reflectance is also

derived from the PMD signals rather than the spectrometer.

Section 4

Would it be possible to include an additional case over sea surface? I suppose it would be quite different at the red/NIR wavelengths and give some more information on the spectral features there?

section 4.1, figure 2: I suggest to plot this case 1 consistently with the other 2 cases, i.e., with the addition of the convoluted simulated spectra for the other 2 options for the LER.

Section 5

For the left panel of figure 6 I would expect a similar effect in the UV-VIS as for the right one. At least my simulations indicate this. Can you explain why you do not see this large offset from 0 there, as opposed to the backscattering case. Could you perhaps include some (or a typical) simulation for the left as well?

page 11323, line 27: The term "symmetry breaking" is very clearly defined as the destruction of an existing symmetry by a phase transition, so it should not be used in the explanation of this feature. It is simply caused by an anisotropic distribution of multiply scattered light, and the effect is decreasing as the multiple scattering decreases (which is also what the simulation shows).
page 11323, line 33: I would rather give 0.01 as an accuracy margin.

Section 6

Figure 8: It seems to me that this spectral feature around 800 nm gets to be smaller

with increasing polarization. Could it be that the feature is only in one of the PMDs?

Section 7

Here it would certainly not hurt to discuss the impact of the differences of fit vs. parametrization as well as O3 features on GOME-2 radiances.

Section 8

Would it be possible already to estimate the radiometric accuracy of GOME-2 due to polarization, given this new study?

page 11328, line 7: As mentioned, the validation here is limited to a few examples with RTM simulations and special cases with hardly any polarization, so it certainly provides valuable information but is by no means extensive.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 11309, 2013.