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Interactive Comment

Interactive comment on "Improved total atmospheric water vapour amount determination fromnear-infrared filter measurements with sun photometers" *by* F. Mavromatakis et al.

F. Mavromatakis et al.

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The referees' comments are in bold face.

Response to Referee 2.

We also thank this referee for his/her comments and for pointing out the aerosol channel effect.

"I wonder how typical is the problem, what is the rejection rate of the state-of-the art interference filters. Also how OOB affects other channels used for aerosol optical depth determination and what blocking is sufficient in that case. I wonder if the authors would consider adding a paragraph where they show how out-of-

band leakage can affect Langley plot and corresponding calibration constants and aerosol optical depth computations. What is the percentage of the extra light in the total signal?"

The OOB rejection of the filters used in the current study are as follows:

- One of the filters used in this study shows negative values of transmission close to a level of 0.02% (2E-4), which we might consider as a typical level of OOB rejection. However, it is not clear if this due to the actual OOB rejection or if the scanning equipment was not sensitive down to this limit.
- Another filter used in this study shows an average OOB rejection of 1E-5.
- Recently, our institute purchased a number of interference filters for which the measured OOB rejection is below 1E-5.
- Schmid et al. (1998, Applied optics vol. 37, No 18, p. 3923) show in their Figs. 2 and 3 the filter curves for the 862 nm and 500 nm bands. They comment that "A severe broad leak as high as 1E-3 of the peak transmittance was found as well as smaller leaks as high as 1E-4."

Usually, OOB limits of less than 1E-4 are quoted but much lower OOB rejections can be found in the market (e.g. 1E-6). So, it is not entirely clear that all filters involved in SPMs share the same OOB characteristics. It would be better to take into account the OOB response of each individual filter when calculating its coefficients.

The OOB effect is expected to affect aerosol channels too, although we haven't performed such calculations. (This was not the purpose of this paper, but would be worth a separate contribution.) Langley plots at high altitude sites are also used for the aerosol channels. It is clear that if two filters were identical but one had an OOB of zero and the second a non-zero OOB, then the zero airmass voltage would be higher for the

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non-zero OOB filter since a higher signal would be recorded. The actual contribution would indeed depend upon the blocking of the filter.

During actual aerosol measurements at low altitude sites, the recorded signal will be higher for a filter with non-zero OOB rejection, leading to lower aerosol optical depth estimates. The measured Vo (through Langley plots) will not be proportionally higher than V (for a non-zero OOB) since at low altitude sites the aerosol content may be large. Note that AOD at 675 nm at Mauna Loa is typically below 0.01, while at the FORTH site in Crete values are around 0.15-0.17.

In such cases, the aerosol effect will be quite strong and clearly, wavelength dependent. The solar intensity at bluer wavelengths will be much more attenuated than in red ones, while at the calibration sites this effect is significantly suppressed. In addition, we should keep in mind variations in the AOD over the year. For example, AOD measurements at the GSFC site display variations by a factor of 10 between winter and summer.

A paragraph was added about the OOB effect related to the aerosol channels. We could have discussed this more (e.g., per our detailed response above), but this would have increased the length of the paper and adversely affected its focus on water vapour.

"I think some papers published previously should be acknowledged, e.g. M.A.Box, Applied Optics, 20, 2215-2219, 1981; R.E.Basher and W.A.Matthews, J.Appl.Met. 16, 795-802, 1977; Y.V.Villevalde, V.M.Volgin, and K.S.Shifrin, Soviet Meteorology and Hydrology, N6, 116-120, 1988. To some extent they all contributed to the subject considered."

Available references were added in the text.

"I do not quite agree with the authors on the necessity of using exact site's altitude because the uncertainty in the coefficient computations associated with the model uncertainty (US standard, Tropical etc.) is very close to the dependence

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on site altitude. However, if any additional information on atmospheric profiles is available it is worth of taking exact site's altitude into account."

Ingold et al. (2000) utilized only the midlatitude summer, winter and subartic winter atmospheres to calculate the filter coefficients for observations in Switzerland. Their Table 2 shows large differences in the filter coefficients between Bern (560 m) and Jungfraujoch (3580 m). Other scientists may as well limit the choice of the atmospheric profiles according to the specific (fixed) location of their SPM. In such cases, the variation in the filter coefficients due to the different atmospheric profiles will be rather limited. In many cases (e.g., in the case of a large network such as AERONET), the exact location of an instrument or its filters may vary over time. Furthermore, the network's sites may have a wide range of elevations.

Consequently, the site's altitude will most likely play a role (per the paper's discussion) and should be taken into account in the calculation of the filter coefficients; otherwise a systematic error will be introduced. As Ingold et al. and we have shown, the change in the coefficients increases with altitude. Since altitude is common information, its inclusion as a parameter in the filter calculations is an easy way to improve the accuracy of the water vapour retrievals.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 6113, 2007.