Interactive comment on “Improving Langley calibrations by reducing diurnal variations of aerosol Ångström parameters” by A. Kreuter et al.

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General response:

The diurnal stability of the spectral shape of the AOD is very easily verified by plotting alpha against time.

We actually start out with a sun photometer which is calibrated by comparison to a Langley calibrated standard instrument, which has been added in line 8, 6485. The implication of starting out with a calibrated sun photometer is included in the revised manuscript at the end of the discussion section:

Finally, we note that our method does not in principle rely on a pre-calibrated instrument. Without any a priori knowledge of \( V_0 \), however, the number of required MC trials may be too large to be tractable for computation. A deterministic optimization procedure would be better suited in such a case.

Detailed response:

Page 6480, Line 18: The sentence "Ensuring a constant filter and detector response, the main challenge in sun photometry lies in the calibration (Shaw, 1976)." is misleading. In fact it is mostly the instability of the filters that cause a change of the calibration of sun photometers in the first place.

The sentence is indeed misleading, as also noted by referee #2, but the accurate determination of the calibration and its invariance over time are two different issues. The sentence has been modified accordingly:

The main challenges in sun photometry are the calibration as well as ensuring a constant filter transmission [Shaw, 1976].


This important reference has been included. However, we would also like to keep the reference Holben et al. who also show results of several lamp and Langley calibrations (tables 3 and 4).

Page 6482, Line 10. Is the German word “Ansatz” really used in English as well?

The word “Ansatz” is used in English as well, but only in the context of the mathematical sciences.
The authors’ claim that the quadratic equation has only recently been used is not correct. M. King has used the quadratic form in a publication in 1980. King, Michael D., Dale M. Byrne, John A. Reagan, Benjamin M. Herman, 1980: Spectral Variation of Optical Depth at Tucson, Arizona between August 1975 and December 1977. J. Appl. Meteor., 19, 723–732. doi: http://dx.doi.org/10.1175/1520-0450(1980)019<0723:SVOODA>2.0.CO;2

This is a valid point and “more recently” has been deleted.

The wavelength cited here are not similar as the authors claim. We have rewritten the sentence, including in the list 380 nm as an additional common wavelength amongst AERONET channels:

For comparison, commonly used wavelengths measured by the AEROSol Robotic NETwork (AERONET) are 380 nm, 440 nm, 500 nm, 670 nm and 870 nm [Holben et al., 1998].

This is true and we have corrected the sentence:

King et al. [1978] have introduced a numerical inversion of the spectral AOD to obtain the aerosol size distribution.

The statement “Furthermore, the Rayleigh scattering contribution to the total optical depth becomes dominant at smaller wavelengths, and leads to decreasing sensitivity to calibration errors for short wavelength channels.” seems incorrect. An calibration error of say 2% will lead to an error in AOD of 0.02 for m=1 regardless of the Rayleigh AOD.

This is a valid point and we have therefore omitted the complete sentence.

Why would the spectral shape of the AOD show better diurnal stability in Innsbruck than elsewhere?

Actually, we have not stated that the diurnal stability of spectral AOD is better in Innsbruck compared to other places but compared to the stability of AOD itself. In any case, this statement is an important point about why our method can practically improve Langley calibrations. A similar question is asked by reviewer #2, so we have carefully rephrased the corresponding paragraph to make this point more clear:

The reduction of the calibration uncertainty achieved here stems from the consideration of the spectral AOD, i.e. the combination of all channels as opposed to each channel individually in the Langley methods. The spectral AOD relations are more sensitive to calibration errors and independent of natural AOD variations. Langley conditions (constant AOD) are hardly met at low elevation stations, while constant spectral AOD conditions do occur more frequently. This is an empirical observation based on our aerosol climatology in Innsbruck and we do not see any principal reason why it should not be more generally applicable to other stations.