Atmos. Meas. Tech. Discuss., 5, C2941–C2944, 2012
www.atmos-meas-tech-discuss.net/5/C2941/2012/

Atmospheric Measurement Techniques Discussions

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

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Received and published: 20 November 2012

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 instru-

ment. Without any a priori knowledge of V0, 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].

Page 6481, Line 18: The Holben et al. (1998) reference does not really discuss the accuracy of Langley plots. A more appropriate reference is Schmid et al. (1998) as they thoroughly discuss the error budget of mountain-top Langley calibrations (see their Table 5). Schmid, B., P. R. Spyak, S. F. Biggar, C. Wehrli, J. Sekler, T. Ingold, C. Mätzler, and N. Kämpfer, Evaluation of the applicability of solar and lamp radiometric calibrations of a precision Sun photometer operating between 300 and 1025 nm. Appl. Opt., 37(18), 3923-3941, 1998.

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.

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Page 6482, Line 12. 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.

Page 6482, Line 23: The wavelength cited here are not similar as the authors claim

This is true. We 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]. Page 6483, Line 18: The King et al (1978) paper is not represented correctly here. King et al (1980) use an actual inversion on the entire spectral shape and not just based on alpha and no mode radii are preset.

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.

Page 6487 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.

Page 6487 Line 24: Why would the spectral shape of the AOD show better diurnal

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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.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 6479, 2012.