Short Comment on amt-2022-181 - effect of optical airmass
Thomas Eck


Sensitivity of aerosol optical depth trends using long term measurements of different sun-photometers
Angelos Karanikolas, Natalia Kouremeti, Julian Gröbner, Luca Egli, Stelios Kazadzis

I have a short comment related to the accuracy of the AOD analyzed in this paper. It is well known that sunphotometer measured AOD is proportional to the optical airmass (m) or pathlength through the atmosphere. The AOD error reduces by a factor of 1/m as m increases. This is reflected in your Figure 2 as the reduction in AOD differences between these two types of instruments as optical airmass increased. The most complete discussion of the accuracy of the AERONET measured AOD is given in Eck et al. (1999), where the uncertainty in measured AOD of field instruments is estimated to be 0.01 for airmass=1 (overhead sun) for visible and near-infrared wavelengths.

Therefore a potential additional analysis that could be added to this study to minimize the effects of calibration would be to utilize only data for m>3 for both instruments. Trends computed with this subset of data would therefore include only morning and afternoon data (excluding mid-day, although this would vary with season). In addition to a reduction of calibration biases between instruments by excluding mid-day data, there is also the added factor of excluding a significant portion of the mid-day data affected by fair weather cumulus clouds. All sunphotometer data sets are biased towards sampling low cloud fraction days with high atmospheric pressure. These days often show a diurnal cycle of cumulus cloud fraction related to the daily cycle of solar heating and associated convection and vertical mixing. Therefore an analysis of data with only m>3 or m>4 (in winter) would minimize the influence of a highly spatially and temporarily variable cloud type on AOD (cloud edge contamination plus cloud influence of AOD itself; see Marshak et al., 2021), while also increasing AOD data accuracy. Of course the data sample size will decrease significantly for this large airmass subset of the data, but it should still provide for an additional informative aspect of this trend comparison for these two different instrument types which employ different measurement frequencies and cloud screening methodologies.