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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effect of water vapour on the determination of Aerosol Direct Radiative Effect based on the AERONET fluxes" *by* J. Huttunen et al.

Anonymous Referee #2

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This paper provides with a relatively simple but effective analysis of the problem of evaluating the aerosol-free surface shortwave radiative flux and its implication in the estimation of the aerosol radiative effect, as well as the role of water vapour. I find the objective and the results of the paper interesting, as well as potentially useful to the whole scientific community working with radiometric measurements and aerosol radiative effect estimation. I consider the paper to deserve publication, however I have some comments mainly concerning the analysis and extrapolation of the results which I think the author should take into account to improve the impact of their paper. Details are given in the following.

General comments

At first, I basically agree with some of the comments of reviewer #1. In particular:

- Concerning the use of F0 fluxes from AERONET and the fact that the assumptions at the base of the model calculations are not described. To add some details would help the discussion.

- What do you mean with “cosine correction of the SZA?”

- The fact of not using pyranometer data is explained, however to add direct measurements of surface irradiance from few sites with different aerosol and reflectance conditions would be useful to compare and possibly validate your results.

- The third comment with which I agree is the fact that it is not clear, after having read the paper, how your results could be extrapolated to be used by other researchers. In order to improve the significance of the paper, I consider this aspect of great importance.

- Figure 2 is not at all readable; I would suggest to split it in two, based on the discussion you do in the text.

I have also another comment. You state in page 753 that in your analysis you cover different aerosol types and reflectance conditions. However, by reading your Results section, I have the impression this part should be extended a little. In particular, the linear and non-linear fits are expected to be very sensitive to changes in aerosol properties (associated also to aerosol types), as well as to reflectance conditions. For example, if you consider a sea salt aerosol or biomass burning you will have significantly different slopes of the curves, as well as Fzero estimates from AERONET (see also as an example Stone et al., 2011 for the non-linear effect of biomass burning). How the different optical properties of aerosols may affect the calculations is not very well investigated. This point could be useful also associated to a possible more general extrapolation of the results. The surface reflectivity, also, has been shown to affect the

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radiative impact of aerosols, and the radiative transfer of solar radiation, especially at high latitude sites (e.g., Shine 1984, Grenfell and Perovich 2008, Di Biagio 2012). As you also include Arctic sites in your work (Fig. 4), I guess this is an aspect you should take into consideration.

I also apologize for the delay of my review.

References

Di Biagio, C., A. di Sarra, P. Eriksen, S.E. Ascanius, G. Muscari and B. Holben, Effect of surface albedo, water vapour, and atmospheric aerosols on the cloud-free shortwave radiative balance in the Arctic, Clim. Dyn., 39 (3), 953-969, doi: 10.1007/s00382-011-1280-1, 2012.

Grenfell TC, Perovich DK (2008) Incident spectral irradiance in the Arctic Basin during the summer and fall. J Geophys Res 113:D12117. doi:10.1029/2007JD009418

Shine KP (1984) Shortwave flux over high albedo surfaces. Q J R Meteorol Soc 110:747–764

Stone, R. S., J. A. Augustine, E. G. Dutton, N. T. O'Neill, and A. Saha (2011), Empirical determinations of the longwave and shortwave radiative forcing efficiencies of wildfire smoke, J. Geophys. Res., 116, D12207, doi:10.1029/2010JD015471.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 751, 2014.