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Effective aerosol optical depth from pyranometer measurements of global solar radiation at Thessaloniki, Greece

A.V. Lindfors (1), A. Arola (1), S. Kazadzis (2), N. Kouremeti (3), and A. Bais (3)

(1) Finnish Meteorological Institute, Kuopio Unit, Finland (anders.lindfors@fmi.fi), (2) National Observatory of Athens, Greece, (3) Aristotle University of Thessaloniki, Greece

Pyranometer measurements of global radiation (300–3000 nm) are available on many locations worldwide. These data often cover a period of several decades, as many stations were founded during the International Geophysical Year 1957–1958. These historical measurements have already provided a suite of interesting results on, for example, the decadal variations of the downwelling solar radiation at the surface and their connection to variations in aerosols and clouds, as discussed in the global dimming/brightening literature.

There are, however, indications that also more detailed aerosol information may be available in the pyranometer data. Under cloud free skies, aerosols are one of the main factors determining the solar irradiance at Earth's surface. Therefore, pyranometer data of global radiation could perhaps be used for inferring the atmospheric aerosol load, which would provide a possibility of extending the aerosol record several decades into the past.

The aim of the present paper is to evaluate the potential of pyranometer measurements for quantifying the atmospheric aerosol load. In order to do this, we use recent data from Thessaloniki, Greece, where global radiation measurements of high temporal resolution are available. These data are suitable for developing our method, and for testing our results against co-located AERONET measurements of aerosol optical depth. We also use the total water vapor column from the ECMWF analysis for accounting for absorption by atmospheric water vapor.

Our preliminary results do look promising, with performance as compared to ground-based AERONET data similar to state-of-the-art satellite methods.