EGU21-6111, updated on 18 Jun 2022
https://doi.org/10.5194/egusphere-egu21-6111
EGU General Assembly 2021

Effect of aerosol vertical distribution on the transfer of solar radiation through the atmosphere

Ilias Fountoulakis[1], Kyriakoula Papachristopoulou[1,2], Emmanouil Proestakis[1], Antonis Gkikas[1], Panagiotis Ioannis Raptis[3], Nikolaos Siomos[1], Charalampos Kontoes[1], and Stelios Kazadzis[4]
[1]Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens (IAASARS/NOA), Greece
[2]National and Kapodistrian University of Athens, Department of Geology and Geoenvironment, Athens, Greece
[3]Institute for Environmental Research and Sustainable Development, National Observatory of Athens (IERSD/NOA), Greece
[4]Physikalisch Meteorologisches Observatorium Davos, World Radiation Center (PMOD/WRC), Switzerland

Aerosols play a key role in radiative transfer processes at the Earth's atmosphere. The complex interactions between aerosols and solar radiation cannot be easily modeled, and thus, aerosols constitute a major uncertainty factor in radiative transfer simulations. Radiative effects of aerosols depend not only on their physical and chemical properties, but also on their distribution in the atmosphere. Despite the important role of the vertical distribution of aerosols in the atmosphere, default climatological profiles are commonly used in modeling studies. Uncertainties related with the use of default profiles have been roughly analyzed and discussed in the existing bibliography.

In the context of the present study we simulated the downwelling and upwelling irradiance, heating rates, and the actinic flux at different altitudes, from 0 to 8 km, in the atmosphere. Simulations were performed for four different European sites – where aerosol mixtures constitute from quite different aerosol species – using a default climatological aerosol extinction profile, and the seasonally and annually averaged extinction profiles for each site from the LIdar climatology of Vertical Aerosol Structure for space-based lidar simulation studies (LIVAS). By comparing the results, the effect of using a more representative profile of the aerosol extinction coefficient for each of the sites, instead of a default climatological profile, was estimated. In addition to the aerosol profiles, climatological values of aerosol optical properties and water vapor from the AErosol RObotic NETwork (AERONET), the version 2 Max-Planck-Institute Aerosol Climatologyand (MACv2), the Modis Dust AeroSol (MIDAS) climatology, and atmospheric and land-surface variables from the Copernicus Atmospheric Monitoring System (CAMS), were used as inputs to the libRadtran radiative transfer model. Spectra in the range 280 – 3000 nm were simulated for different solar zenith angles, and the integrals of the spectra, as well as the integrals in the ultraviolet and visible spectral regions were analyzed.

Results of the analyses are presented and discussed in order to study the sensitivity of the radiometric quantities simulated by the model to the used aerosol extinction profile, for each of the four sites. Differences between the products of the simulations when the used aerosol optical depth (AOD) comes from different sources (LIVAS, AERONET, MIDAS, CAMS) have been also

investigated.

Acknowledgements

This study was funded by the EuroGEO e-shape (grant agreement No 820852).