

Analysis of the aerosol radiative impact in the longwave spectral range for different aerosol types in Southeastern Spain

Elena Bazo^(1,2), María José Granados-Muñoz^(1,2), Roberto Román⁽³⁾, Juan Antonio Bravo-Aranda^(1,2), Alberto Cazorla^(1,2), Antonio Valenzuela^(1,2), Francisco José Olmo^(1,2) and Lucas Alados-Arboledas^(1,2)

⁽¹⁾ *Andalusian Inter-University Institute for Earth System Research (IISTA-CEAMA), Granada, Spain*

⁽²⁾ *Department of Applied Physics, University of Granada, Granada, Spain, E-mail: ebazo@ugr.es*

⁽³⁾ *Group of Atmospheric Optics (GOA-UVa), Universidad de Valladolid, Valladolid, Spain*

Aerosol particles have the ability to absorb and scatter incoming radiation. The total aerosol radiative effect (RE) has two contributions: one corresponds to the interactions between aerosols and solar radiation (RE_{SW}) and the other is related to the interactions with the radiation from the Earth's surface (RE_{LW}). The RE_{LW} is usually neglected in radiative studies, but it has been demonstrated that for large particles, such as mineral dust, it can partly counteract the effects produced by the RE_{SW} .

The city of Granada (Spain, 37.2°N 3.6°W) is frequently affected by dust intrusions due to its proximity to the African continent, so a characterization of both contributions of the RE is relevant. In this study, aerosol radiative properties for both spectral ranges are analyzed using experimental data from the AGORA-UGR station (Andalusian Global ObseRvatory of the Atmosphere) and the radiative transfer model GAME (Global Atmospheric Model). The station is equipped with a sun-sky photometer, part of AERONET (Aerosol RObotic NETwork), and with a ceilometer that belongs to ICENET (Iberian CEilometer NETwork). Data from both instruments are used as input in GRASP_{pac} (Generalized Retrieval of Aerosol and Surface Properties), allowing the retrieval of aerosol microphysical and optical properties. Output data from GRASP are then introduced in GAME for the retrieval of the aerosol radiative properties in both spectral ranges. The analysis of the LW component is specially challenging due to the lack of measured aerosol optical data in this range. Therefore, a Mie code is used in order to retrieve the aerosol optical properties from the information about the particle size distribution and the refractive index. Refractive index information in the LW is quite scarce and affected by large uncertainties. For this reason, a sensitivity study is performed in order to study the influence of this uncertainty in the retrieved RE_{LW} . The sensitivity analysis is also performed for the particle size distribution and the aerosol concentration values for the sake of completeness.

In this case, the analysis is focused on two case studies corresponding to different aerosol types: a dust event and a biomass burning transport event. As already known, aerosol optical and microphysical properties for these two aerosol types are quite different, with dust particles being much larger. These differences clearly affect the obtained results for the RE_{LW} values, that reach up to a 20% of the RE_{SW} in the case of mineral dust, whereas for smaller aerosols such as those in a biomass burning event, these values are only around a 5%, thus confirming the larger relevance of the RE_{LW} contribution to the total RE for large particles.