Geophysical Research Abstracts, Vol. 8, 07655, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07655

Determination of the aerosol direct radiative forcing efficiency at the surface in the Central Mediterranean

A. di Sarra (1), G. Pace (2), D. Meloni (1), L. De Silvestri (1), F. Monteleone (3), S. Piacentino (4) and D. Sferlazzo (4)

(1) ENEA, Climate Laboratory, Rome, Italy, (2) ENEA, PROT-INN, Bologna, Italy, (3) ENEA, Project Climate, Palermo, Italy, (4) ENEA, Laboratory for Climate Observations, Lampedusa, Italy (disarra@casaccia.enea.it / Fax: +39 06-30486678 / Phone: +39 06-30484986)

The effect that aerosols have on the energy budget of the atmosphere is commonly discussed in term of their radiative forcing. In this study we define and calculate the aerosol radiative forcing efficiency, ARFE, at the surface, as the derivative of net (upward-downward) radiative flux with respect to the aerosol optical depth, AOD. The shortwave ARFE has been evaluated at the Station for Climate Observations, maintained by ENEA on the island of Lampedusa (35.5˚ N, 12.6˚ E), in the Central Mediterranean. Among the various instruments deployed at the Station, data collected by a multi filter rotating shadow band radiometer (MFRSR) and two upward looking pyranometers, a Kipp & Zonen CM11 and a Epply PSP (Precision Spectral Pyranometer) during 2003 and 2004 are used.

The shortwave ARFE is directly influenced by the surface albedo, A, and by the water vapour column, wvc. A is estimated as a weighted average of the albedo of the island and that of the sea surface, and the wvc is derived from the NCEP/NCAR reanalysis dataset. The sensitivity of the surface irradiance on the expected variation of wvc have been studied by mean of a radiative transfer model.

The ARFE is calculated at solar zenith angles, θ, of 20˚, 30˚, 40˚, 50˚, 60˚, 65˚, 70˚, 75˚ ($\pm$1.5˚) for cloud-free days from May to November 2003 and 2004 for 3 different aerosol classes, representative of conditions dominated by desert dust, anthropogenic (urban-industrial/biomass burning) particles and mixed cases. The adopted classification is based on the values of AOD at 500 nm and Ångström exponent obtained from the MFRSR measurements.

The results show that the ARFE for all the 3 aerosol classes decreases with the increase of θ. The surface ARFE values for anthropogenic aerosols is systematically lower that that for desert dust. In fact, the surface ARFE at θ=20°, 40° and 60° is (-197±38), (-172±24), and (-143±13) W m^{-2} for desert dust and (-125±6), (-100±24), and (-107±14) W m^{-2} for anthropogenic aerosols.

This is primarily due to the difference in size distribution of the two aerosol types, with the preponderance of coarse (accumulation) versus accumulation (coarse) mode in the desert (anthropogenic) class. The aerosol spectral extinction is almost independent of wavelength in the visible for desert dust, while it strongly decreases with the wavelength for anthropogenic aerosols. Thus, for the same value of the AOD at 500 nm the shortwave irradiance in presence of desert dust is lower than that for the anthropogenic aerosol. The dependence of ARFE from other aerosol optical characteristics, such as the phase function, the variability with relative humidity, and the vertical distribution, are expected to induce a smaller impact on the retrieved ARFE.