Geophysical Research Abstracts
Vol. 15, EGU2013-9060, 2013
EGU General Assembly 2013

Estimate of the Saharan dust shortwave and photosynthetic radiative forcing efficiency at the surface during the propagation of a gravity wave in the central Mediterranean

Alcide di Sarra (1), Daniele Fuà (2), and Daniela Meloni (1)

(1) ENEA, UTMEA-TER, Rome, Italy (alcide.disarra@enea.it), (2) Department of Physics, Sapienza University of Rome, Italy

This study is based on measurements made at ENEA Station for Climate Observations (35.52° N, 12.63° E, 50 m asl) on the island of Lampedusa, in the Southern part of the Central Mediterranean. A quasi periodic oscillation of aerosol optical depth, column water vapour, shortwave (SW) and photosynthetic active radiation (PAR) is observed to occur during the morning of 7 September 2005. The quasi-periodic wave is present from about 6 to 10 UT, with solar zenith angles (SZA) varying between 77.5° and 37.2°. In this period the aerosol optical depth at 500 nm, τ, varies between 0.29 and 0.41; the column water vapour, cwv, varies between 2.4 and 2.8 cm. The oscillations of τ and cwv are in phase, while the modulation of the downward surface irradiances is in opposition of phase with respect to τ and cwv. The period of the oscillation is about 13 min. The oscillation is attributed to the propagation of a gravity wave which modulates the structure of the planetary boundary layer. The measured aerosol optical properties are typical of cases dominated by Saharan dust, with the Ångström exponent comprised between 0.5 and 0.6. The backtrajectory analysis for that day shows that airmasses overpass Northern Libya (trajectories arriving below 2000 m), Tunisia and Northern Algeria (trajectories arriving above 2000 m), carrying Saharan dust particles to Lampedusa. The combined modulation of downward irradiance, water vapour column, and aerosol optical depth is used to estimate the aerosol effect on the irradiance. From the irradiance-optical depth relation, the aerosol surface direct forcing efficiency (FE) is derived, under the assumption that during the measurement interval the aerosol microphysical properties do not appreciably change. As a first step, all SW irradiances are reported to the same cwv content (2.6 cm), by using radiative transfer model calculations. Reference curves describing the downward SW and PAR irradiances are constructed by using measurements obtained at a fixed τ values. The radiative perturbation produced by dust is thus obtained as the difference between the measured irradiances, reported at cwv = 2.6 cm, and the reference curve at the same SZA. The radiative forcing efficiencies are then determined in different intervals of SZA as the slope of the linear fit of the radiative perturbation versus the measured aerosol optical depth. The estimated values of the dust FE are -188$\pm$18 Wm^{-2} for the SW, and -93$\pm$7 Wm^{-2} for PAR at about 70° SZA, -163$\pm$16 Wm^{-2} for the SW and -112$\pm$3 Wm^{-2} for PAR at about 37° SZA. The estimated daily average FE is -79 Wm^{-2} for the SW range, and -46 Wm^{-2} for PAR. The obtained values are in good agreement with previous estimates for desert dust over the ocean.