Aerosol variability and direct radiative forcing in the Adriatic from optical field and satellite data

Geophysical Research Abstracts, Vol. 8, 08513, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08513

M. Clerici (1), F. Melin (1), G. Zibordi (1) and B. Bulgarelli (1)
(1) Join Reasearch Centre of the European Commission, Italy

The aerosol distribution in the Mediterranean Sea, conditioned by diverse sources representing marine, desert and continental aerosols, impacts the basin atmospheric deposition and radiative budgets. The aerosol optical properties and direct radiative effect for the Adriatic are presented using 7-year time series (1997-2004) of automated optical measurements collected by a sun-photometer on the Acqua Alta Oceanographic Tower (AAOT) in the northern Adriatic Sea and SeaWIFS derived aerosol optical thickness.

First, the main characteristics of the aerosols at the AAOT are illustrated and serve to define an aerosol model suitable for radiative transfer calculations. The aerosol type appears to be mainly continental. The overall averages (1803 measurement days) of aerosol optical thickness τ_a at 500 nm and Ångström exponent α are 0.29$\pm$0.21 and 1.51$\pm$0.34, respectively. The average single scattering albedo varies from 0.957 at 440 nm to 0.910 at 1022 nm. The aerosol size distribution derived by optical data inversion exhibits 2 size modes, with the radius of the accumulation mode increasing with an increase in τ_a. The aerosol model defined by these properties is used in radiative transfer calculations by a complete coupled ocean-atmosphere radiative transfer code. Look-up tables of the aerosol direct radiative effect are generated. Top-of-atmosphere and surface radiative efficiencies, referred to τ_a at 500 nm, are found approximately equal to -23 and -50 W m^{-2} τ_a^{-1}, respectively, for clear sky equinox illumination conditions.

Satellite derived τ_a are obtained by an atmospheric correction scheme adapted for European seas and compared with the field measurements. On the basis of 402 coincident records, the comparison between satellite and field τ_a shows a remarkable agreement with an average relative absolute difference of 17-20% in the 412-870 nm spectral range. On the other hand, the satellite record tends to filter out occurrences of high τ_a. The satellite derived seasonal cycle over the Adriatic basin exhibits minima in winter (τ_a(500)=0.06) and maxima in summer (τ_a(500)=0.23). At monthly time scales, the aerosol load and type display spatial homogeneity. The Adriatic seasonal cycles of τ_a and cloud fraction are combined with the radiative transfer look-up tables to determine the direct radiative effect resulting from aerosols. At the surface, the aerosol load results in a cooling effect ranging from -0.9 W m^{-2} in winter up to -9.6 W m^{-2} in August. The corresponding top-of-atmosphere interval is -0.4 W m^{-2} to -5 W m^{-2}.