Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 6, 697-713, 2006
www.atmos-chem-phys.net/6/697/2006/

Aerosol optical properties at Lampedusa (Central Mediterranean). 1. Influence of transport and identification of different aerosol types

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Abstract. Aerosol optical depth and Ångström exponent were obtained from multi filter rotating shadowband radiometer (MFRSR) observations carried out at the island of Lampedusa, in the Central Mediterranean, in the period July 2001–September 2003. The average aerosol optical depth at 495.7 nm, τ, is 0.24±0.14; the average Ångström exponent, α, is 0.86±0.63. The observed values of τ range from 0.03 to 1.13, and the values of α vary from −0.32 to 2.05, indicating a large variability in aerosol content and size. In cloud-free conditions, 36% of the airmasses come from Africa, 25% from Central-Eastern Europe, and 19% from Western France, Spain and the North Atlantic. In summer, 42% of the airmasses is of African origin. In almost all cases African aerosols display high values of τ and low values of α, typical of Saharan dust (average values of τ and α are 0.36 and 0.42, respectively). Particles originating from Central-Eastern Europe show relatively large average values of τ and α (0.23 and 1.5, respectively), while particles from Western France, Spain and the North Atlantic show the lowest average values of τ (0.15), and relatively small values of α (0.92). Intermediate values of α are often connected with relatively fast changes of the airmass originating sector, suggesting the contemporary presence of different types of particles in the air column. Clean marine conditions are rare at Lampedusa, and are generally associated with subsidence of the airmasses reaching the island. Average values of τ and α for clean marine conditions are 0.11 and 0.86, respectively. The largest values of α (about 2) were observed in August 2003, when large scale forest fires in Southern Europe produced consistent amounts of fine combustion particles, that were transported to the Central Mediterranean by a persistent high pressure system over Central Europe. Smoke particles in some cases mix with desert dust, producing intermediate values of α. The seasonal distribution of the meteorological patterns over the Mediterranean, the efficiency of the aerosol production mechanisms, and the variability of the particles' residence time produce a distinct seasonal cycle of aerosol optical depths and Ångström exponent values. Particles originating from all sectors show a summer maximum in aerosol optical depth. The summer increase in optical depth for European aerosols is linked with an increment in the values of α, that indicates an enhancement in the number of fine particles. The summer maximum of τ for African particles is associated with a weak reduction in the Ångström exponent, suggesting an increase in the total number of particles and a relatively more intense transport of large

particles. The observations were classified according to the aerosol optical properties, and two main classes have been identified: desert dust and biomass burning/urban-industrial aerosols. Values of τ and α averaged over the whole observing period are 0.37 and 0.15 for desert dust, and 0.27 and 1.77 for urban-industrial/biomass burning aerosols.

Final Revised Paper (PDF, 2172 KB) Discussion Paper (ACPD)

Citation: Pace, G., di Sarra, A., Meloni, D., Piacentino, S., and Chamard, P.: Aerosol optical properties at Lampedusa (Central Mediterranean). 1. Influence of transport and identification of different aerosol types, Atmos. Chem. Phys., 6, 697-713, 2006. Bibtex EndNote Reference Manager