Long range transport and chemical transformation of aerosols over the Aegean Sea during a recent Etesian period

E. Athanasopoulou[1], A. Protonotariou[1], E. Bossioli[1], J. Allan[2], A. Dandou[1], G. Papangelis[1], H. Coe[2], A. Bacak[2], J. Kalogiros[3], N. Mihalopoulos[4], G. Biskos[5] and M. Tombrou[1]

[1]Department of Applied Physics, National and Kapodistrian University of Athens, Athens 15784, Greece
[2]School of Earth, Atmosphere and Environmental Sciences, University of Manchester M13 9PL, UK
[3]Institute for Environmental Research and Sustainable Development, National Observatory of Athens 15236, Greece
[4] Department of Chemistry, University of Crete, Heraklion 71003, Greece
[5]Department of Environment, University of Aegean, Mytilene 81100, Greece
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Presenting author email: eathana@phys.uoa.gr

The region of the Aegean Sea is a cross road of air masses from anthropogenic and natural pollution sources, thus an ideal natural laboratory to study the interaction of gaseous species with atmospheric particles. The period of interest (28 August–10 September, 2011) corresponds to the most common synoptic situation during summer ('Etesians': strong NE winds) that transports air masses form central and E. Europe. Under these conditions, which are also characterized by a strong photochemical activity, the interaction of gaseous pollutants and aerosol particles from local maritime (ships and sea surface) and distant sources can enhance the formation of secondary aerosols (namely $NaNO_3$ and SOA) (Mihalopoulos, 2007).

The aerosol model used for this study is an updated version of PMCAMx that couples SAPRC with ISORROPIA II and VBS modules for gaseous, inorganic and organic aerosol chemistry, respectively (Fountoukis et al., 2011). Aerosols are represented by a detailed aerosol composition (K^+, Ca^{2+}, Mg^{2+}, NH_4^+, Na^+, SO_4^{2-}, NO_3, Cl^-, H_2O, EC, and OC: primary, oxidized primary, anthropogenic & biogenic secondary), distributed over 10 size bins in the diameter range 0.04-40μm.

Air quality simulations are offline coupled with the WRF/ARW model (Skamarock et al., 2005), applied over Europe. A nested simulation over Greece with a high-resolution grid (6x6km) provides the meteorological fields and a detailed boundary layer structure. Emission inputs cover all important sources: industry, transport, forest activity, as well as sea-salt aerosol and road/soil dust, calculated online with meteorology (Athanasopoulou et al., 2008; 2010).

Long-range transport of air masses is handled (as boundary conditions) through simulations during the same period by the global model GEOS-CHEM v8-03-01 nested (0.5x0.67deg) over Europe (Protonotariou et al., 2012). Sensitivity simulations reveal the role of gaseous and fine particles transported from the Balkans. Special focus is given on SOA formation (Fig. 1), because increased summer VOCs emissions from the north are transported and age over the Aegean.

These simulations are directly comparable with aerosol measurements performed during the same period (Tombrou et al., 2012) at two ground stations (on the islands of Crete and Lemnos) and with an airborne platform (BAe146-FAAM aircraft).

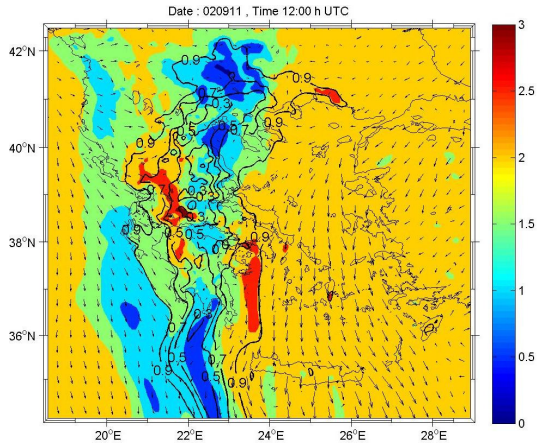

Figure 1. PMCAMx predictions for hourly ground SOA concentrations (μgm^{-3}) over Greece. Vectors show WRF/ARW predictions for U_{10}. Isolines represent the long-range transported SOA fraction.

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