Predictions of aerosol extinction coefficients over Greece by means of a new modular software system

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Atmospheric aerosols interact with electromagnetic radiation by scattering and absorbing solar radiation. By utilizing plausible assumptions about the aerosol microphysical state, it is possible to estimate the aerosol extinction coefficient, for a given aerosol size distribution and chemical composition, using either Mie-theory or semiempirical approximations (Roy *et al.*, 2007). A valuable source of data for calculating the aerosol optical properties are three-dimensional Chemical Transport Models (CTMs). The PMCAMx-2008 (Fountoukis *et al*., 2011) CTM, provides vertical profiles of the aerosol size composition distributions at high spatial and temporal resolutions.

Air quality models are typically validated using available surface measurements of the various ambient aerosol properties (Vijayaraghavan *et al*., 2008), including scattering measurements provided by nephelometers. These measurements, although highly accurate, are spatially sparse and not representative of the columnar aerosol optical properties. The aerosol Optical Depth (AOD) is a property of the total atmospheric column, directly proportional to the vertical distribution of the aerosol extinction coefficient. Local retrievals of AOD are made available by the AERONET network (Holben *et al.,* 1998) on a regular basis. Furthermore the use of satellites facilitates more complete special coverage.

In this study we present results from a new modular software system (AtmOpt), specifically developed to investigate the aerosol optical properties over Greece, using output data from the PMACAMx-2008 model and the WRF weather model. This code can also incorporate ground level measurements along with data provided by the AERONET and the MODIS satellite instruments, in order to provide automated evaluation of the performance of the PMCAMx-2008 model.

In order to create the necessary data pool we performed a number of PMCAMx-2008 and WRF runs. Details of these simulations can be found elsewhere in the literature (Fountoukis *et al*., 2011). The WRF and PMCAMx-2008 model simulations provided detailed aerosol size composition distributions and Relative Humidities (RH) over Greece. These datasets are forwarded to the AtmOpt system. Extinctions calculations are performed either directly by application of Mie theory, or by using the "reconstructed mass-extinction" (RM) method (Roy *et al.*, 2007). An example of the simulated AOD values, attributed to PM2.5 and estimated by Mie theory is presented in Figure 1.

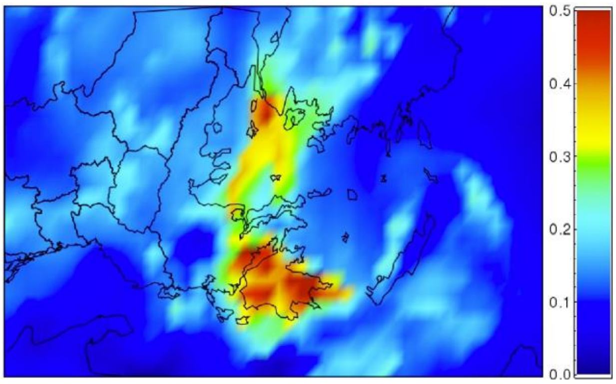

Figure 1. Simulated PM2.5 AOD over Greece using the PMCAMx-2008 output (May 14th 2008 at 9:00 UTC).

By utilizing the AtmOpt system we are able to model the aerosol optical properties. We will present a detailed and novel analysis of the various aspects of the aerosol optical state over Greece including contributions by various chemical species and assess the performance of the PMCAMx-2008 model. For this purpose we take advantage of the AERONET excellent temporal resolution and the MODIS high spatial coverage, along with the wealth of data (e.g. Angstrom exponents, cloud screening, quality assurance indicators etc.) provided by these remote sensing instruments.

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Fountoukis, C., Racherla, P. N., Denier van der Gon, H. A. C., Polymeneas, P., Charalampidis, P. E., Pilinis, C., Wiedensohler, A., Dall'Osto, M., O'Dowd, C. and Pandis, S. N. (2011) *Atmos. Chem. Phys.* **11**, 10331–10347.

Holben, B. N., et al. (1998) *Remote Sens. Environ.* **66**, 1– 16.

Roy, B., Mathur, R., Gilliland, A. B. and Howard, S. C. (2007) *J. Geophys. Res.* **112**, D14301.

Vijayaraghavan, K., Snell, H. and Seigneur, C. (2008) *Environ. Sci. Technol.* **42**, 8187-8192.