7th International Workshop on Sand/Duststorms and Associated Dustfall
2-4 December 2013, Frascati (Rome), Italy

Modelling of Saharan dust transport to the Southern Italy

Mihaela Mircea [a,*], Gino Briganti [a], Antonella Malaguti [a], Sandro Finardi [b], Camillo Silibello [b], Christos Spyrou [c], Christina Kalogeri [c], George Kallos [c] and Gabriele Zanini [a]

[a] *ENEA, Via Martiri di Monte Sole 4, 40129 Bologna, Italy*
[b] *ARIANET s.r.l. via Gilino, 9, 20128 Milan, Italy*
[c] *School of Physics, University of Athens, Athens, Greece*

[*] *e-mail: mihaela.mircea@enea.it*

In the Mediterranean area, Saharan dust outbreaks often contribute to substantial increases of particulate matter levels to the point where it can exceed the limits requested by the last air quality directive 2008/50/EC for inhalable particulate matter (PM10). The possibility to take into account desert dust contribution in regional air quality models through their coupling with operational dust models is of great interest for applications from local to national scales. This study investigates the ability of the Atmospheric Modelling System of MINNI project (AMS-MINNI) (Mircea et al., 2010) to reproduce the measured dust and PM10 concentrations through its coupling with the dust model Skiron (Spyrou et al., 2010). The different formulations of physical and chemical atmospheric processes, aerosol microphysics in particular, in the two models impact on preparing the dust boundary conditions. The former model uses the modal representation for aerosol particles considering fine particles with diameters less than 2.5 μm (PM2.5) described by two log-normal distributions (modes) called Aitken and accumulations modes, and a coarse mode for particles with diameters greater than 2.5 μm (AERO3, Binkowski et al., 2003). AERO3 was extended to include the dust component in accumulation mode. The latter model considers eight size bins for dust particles with effective radii of 0.15, 0.25, 0.45, 0.78, 1.3, 2.2, 3.8, and 7.1 μm. Several simulations were carried out with AMS-MINNI to test the effect of remapping bins over modes. This was evaluated at three horizontal spatial resolutions (20 km, 4km, 1 km) in relation to the changes of transport, dispersion, deposition processes and emissions distribution.

The model output was compared to fine and coarse dust aerosol derived from measurements performed in Trisaia, ENEA Center, during May – June 2010. The aerosol particles were sampled with two high volume samplers equipped with size selective inlets for collecting the aerosol particles with diameters below 10 (PM10) and 2.5 μm (PM2.5) respectively. The dust elements were identified and quantified in the daily aerosol samples by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and ion chromatography (IC).

The results show that the dust component during the Saharan transport is relatively well reproduced by the air quality system AMS-MINNI when dust is added at the boundaries of domain. The model performances are highly dependent on both model coupling approach and horizontal spatial resolution used in the simulations.

Binkowski FS, Roselle SJ. Models-3 Community Multiscale Air Quality (CMAQ) model aerosol component 1. Model description. J Geophys Res 2003; 108(D6): 4183. doi:10.1029/2001JD001409.

Mircea M, Zanini G, Briganti G, Cappelletti A, Pederzoli A, Vitali L, et al. Modelling Air Quality over Italy with MINNI Atmospheric Modelling System: from regional to local scale. In: Steyn DG and Trini Castelli S, editors. Proceedings of the thirty-first NATO/SPS International Technical Meeting on Air Pollution Modelling and its Application, 27 Sept. – 1 Oct. 2010, Torino, Italy; 2010a. ISBN: 978-94-007-1358-1. DOI 10.1007/978-94-007-1359-9_82a.

Spyrou, C., C. Mitsakou, G. Kallos, P. Louka, and G. Vlastou (2010), An improved limited area model for describing the dust cycle in the atmosphere, J. Geophys. Res., 115, D17211, doi:10.1029/2009JD013682.