Geophysical Research Abstracts, Vol. 9, 06384, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06384


# Annual assessment of levels and composition of anthropogenic and natural particulate matter in southern Europe

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The particularities of southern Europe, such as the complex topography, climatic patterns, the marked differences Atlantic-Mediterranean behaviour, etc. make the background levels of aerosols in the region higher that the regions in the centre and northern Europe (Lelieveld et al., 2002). Furthermore, a number of studies show that southern Europe exceeds the thresholds of air quality established in the EU legislation. Up to date, air quality modelling in southern Europe have rarely taken into account the inclusion of atmospheric particulate matter (both with anthropogenic and natural origin) and just allowed to perform episodic simulations with a coarse spatial and temporal resolution. Under the aforementioned perspective, the WRF-ARW/EMEP/CMAQ/DREAM modelling system has been developed, implemented in MareNostrum Supercomputer and validated in the area of study for an annual simulation covering the entire year 2004. The whole system is currently operating daily forecasts (http://www.bsc.es/projects/earthscience/aqforecast-en/)

The results have been validated against data from ten air quality stations belonging to EMEP air quality monitoring network. Boylan and Russell (2006) have proposed model performance goals and criteria for PM modelling. The performance goal and criteria are achieved on every station during the year 2004 during the episode in the case of considering the Saharan dust contributions with DREAM model.

The simulations results for the chemical composition of PM10 and PM2.5 in southwestern Europe depict and important seasonal and geographical variability. For the background areas, during wintertime the carbonaceous aerosol is the major contribution to PM10 and PM2.5 size fractions. The winter episodes are fundamentally dominated by stable anticyclonic situations, favouring the high levels of particulate matter (especially nitrates), nitrogen oxides and EC+OC. Meanwhile, the summertime concentration is dominated by sulphates, due to the higher rate of oxidation of sulphur dioxide the summer months, which are characterised by higher temperatures and solar radiation leading to the formation of secondary aerosols that contribute to the particulate matter levels.

The levels of nitrates decrease in summer as a consequence of their thermal instability, as outlined with experimental results by Querol et al. (2006). In addition, this component shows a particular spatial distribution, increasing towards the western and eastern coasts (Portuguese Atlantic coastal areas and the Spanish Mediterranean), being the highest annual contributions depicted in the northwestern Mediterranean basin (up to 4-5 ug m-3 as an annual average) as a consequence of the NH4NO3 formation caused by emission from intensive cultivation and farming.

Saharan dust outbreaks have a high influence in the mineral particulate matter in the Spanish regions close to Africa where the annual means are also highly influenced by natural contributions. The simulation results indicate that the contribution of the mineral fraction to the PM10 and PM2.5 levels in southern Spain may exceed the 15% (west) to 30% (east) of the total particulate matter. However, this contribution is limited in northern Spain, where the annual mineral fraction barely reaches 6-8%.

Increases in annual mean particulate matter levels form rural to urban sites are mainly due to the increase in local/regional mineral load and OC+EC, as stated by Querol et al. (2006). The chemical composition of particulate matter in urban areas is dominated by the organic fraction (OC+EC), exhibiting annual averages over 15 ug m-3 for PM10 and PM2.5 in the largest cities.

References

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