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Aerosol Optical Depth over Europe: Evaluation of the CALIOPE air quality modelling system with direct-sun AERONET observations

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In the frame of the CALIOPE project (Baldasano et al., 2008), the Barcelona Supercomputing Center (BSC-CNS) currently operates a high-resolution air quality forecasting system based on daily photochemical forecasts in Europe (12km x 12km resolution) with the WRF-ARW/HERMES/CMAQ modelling system (http://www.bsc.es/caliope) and desert dust forecasts over Southern Europe with BSC-DREAM8b (Pérez et al., 2006; http://www.bsc.es/projects/earthscience/DREAM). High resolution simulations and forecasts are possible through their implementation on MareNostrum supercomputer at BSC-CNS.

As shown in previous air quality studies (e.g. Rodríguez et al., 2001; Jiménez-Guerrero et al., 2008), the contribution of desert dust on particulate matter levels in Southern Europe is remarkable due to its proximity to African desert dust sources. When considering only anthropogenic emissions (Baldasano et al., 2008) and the current knowledge about aerosol physics and chemistry, chemistry-transport model simulations underestimate the PM10 concentrations by 30–50%. As a first approach, the natural dust contribution from BSC-DREAM8b is on-line added to the anthropogenic aerosol output of CMAQ.

The aim of the present work is the quantitative evaluation of the WRF-ARW/HERMES/ CMAQ/BSC-DREAM8b forecast system to simulate the Aerosol Optical Depth (AOD) over Europe. The performance of the modelled AOD has been quantitatively evaluated with discrete and categorical (skill scores) statistics by a comparison to direct-sun AERONET observations for 2004. The contribution of different types of aerosols will be analyzed by means of the O'Neill fine mode AOD products (O'Neill et al., 2001). A previous aerosol characterization of AERONET data was performed (Basart et al., 2009) in order to discriminate the different aerosol source contributions within the study region.

The results indicate a remarkable improvement in the discrete and skill-scores evaluation (accuracy, critical success index and probability of detection) of AOD when using CMAQ+DREAM8b compared to CMAQ-alone simulations. An accurate analysis of the relative contributions of anthropogenic aerosols and desert dust to AOD over Europe and their seasonality will be also presented.

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