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Air quality modelling over the Eastern Mediterranean using the WRF/Chem model: Comparison of gas-phase chemistry and aerosol mechanisms

George K. Georgiou (1), Theodoros Christoudias (2), Yiannis Proestos (2), Jonilda Kushta (1), Panos Hadjinicolaou (1), Jos Lelieveld (1,3)

(1) Energy, Environment and Water Research Centre (EEWRC), The Cyprus Institute, Nicosia, Cyprus, (2) Computation-based Science and Technology Reasearch Centre (CaSToRC), The Cyprus Institute, Nicosia, Cyprus, (3) Max Planck Institute for Chemistry, Mainz, Germany

A comprehensive analysis of the performance of three coupled gas-phase chemistry and aerosol mechanisms included in the WRF/Chem model has been performed over the Eastern Mediterranean focusing on Cyprus during the CYPHEX campaign in 2014, using high temporal and spatial resolution. The model performance was evaluated by comparing calculations to measurements of gas phase species (O_3, CO, NO_x, SO_2) and aerosols (PM_{10}, $PM_{2.5}$) from 13 ground stations. Initial results indicate that the calculated day-to-day and diurnal variations of the aforementioned species show good agreement with observations.

The model was set up with three nested grids, downscaling to 4km over Cyprus. The meteorological boundary conditions were updated every 3 hours throughout the simulation using the Global Forecast System (GFS), while chemical boundary conditions were updated every 6 hours using the MOZART global chemical transport model. Biogenic emissions were calculated online by the the Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2.1). Anthropogenic emissions were based on the EDGAR HTAP v2 global emission inventory, provided on a horizontal grid resolution of $0.1^o \times 0.1^o$. Three simulations were performed employing different chemistry and aerosol mechanisms; i) RADM2 chemical mechanism and MADE/SORGAM aerosols, ii) CBMZ chemical mechanism and MOSAIC aerosols, iii) MOZART chemical mechanism and MOSAIC aerosols. Results show that the WRF/Chem model satisfactorily estimates the trace gases relative concentrations at the background sites but not at the urban and traffic sites, while some differences appear between the simulated concentrations by the three mechanisms.

The resulting discrepancies between the model outcome and measurements, especially at the urban and traffic sites, suggest that a higher resolution anthropogenic emission inventory might help improve fine resolution, regional air quality modelling. Differences in the simulated concentrations by the three chemical mechanisms are attributed to the different chemical species and reaction rate constants used.