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Evaluation of COSMO-ART in the Framework of the Air Quality Model Evaluation International Initiative (AQMEII)

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The Air Quality Model Evaluation International Initiative (AQMEII) coordinated by the EC-JRC and US-EPA, promotes since 2008 research on regional air quality model evaluation across the atmospheric modelling communities of Europe and North America. AQMEII has now reached its Phase 2 that is dedicated to the evaluation of on-line coupled chemistry-meteorology models as opposed to Phase 1 where only off-line models were considered. At European level, AQMEII collaborates with the COST Action "European framework for on-line integrated air quality and meteorology modelling" (EuMetChem).

All European groups participating in AQMEII performed simulations over the same spatial domain (Europe at a resolution of about 20 km) and using the same simulation strategy (e.g. no nudging allowed) and the same input data as much as possible. The initial and boundary conditions (IC/BC) were shared between all groups. Emissions were provided by the TNO-MACC database for anthropogenic emissions and the FMI database for biomass burning emissions. Chemical IC/BC data were taken from IFS-MOZART output, and meteorological IC/BC from the ECWMF global model.

Evaluation data sets were collected by the Joint Research Center (JRC) and include measurements from surface in situ networks (AirBase and EMEP), vertical profiles from ozone sondes and aircraft (MOZAIC), and remote sensing (AERONET, satellites). Since Phase 2 focuses on on-line coupled models, a special effort is devoted to the detailed speciation of particulate matter components, with the goal of studying feedback processes.

For the AQMEII exercise, COSMO-ART has been run with 40 levels of vertical resolution, and a chemical scheme that includes the SCAV module of Knote and Brunner (ACP 2013) for wet-phase chemistry and the SOA treatment according to VBS (volatility basis set) approach (Athanasopoulou et al., ACP 2013).

The COSMO-ART evaluation shows that, next to a good performance in the meteorology, the gas phase chemistry is well captured throughout the year; the few cases showing a systematic underestimation of chemical concentrations arise as a consequence of the boundary conditions. Through this exercise we have identified the main critical issues in the COSMO-ART performance: sea salt and dust particulate matter components.

The AQMEII exercise has provided an excellent platform to evaluate the COSMO-ART performance against both measurement data and other European regional on-line coupled models. From the analysis we have been able to identify specific model deficiencies and situations where the model cannot satisfactorily reproduce the data. Our future work will be focused on improving their modelling.