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Case studies on aerosol feedback effects in online coupled chemistry-meteorology models during the 2010 Russian fire event

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Aerosol particles are known to have an impact on weather and climate directly via radiation and via their impact on cloud formation and subsequent modified optical properties of clouds. Integrated or "online" coupled regional meteorology-chemistry models like WRF-Chem, COSMO-ART, COSMO-Muscat, EnviroHIRLAM, NMMB/BSC-CTM, RAMS/ICLAMS or WRF-CMAQ are able to account for this impact of aerosol on simulated meteorological variables. However, besides of the meteorological situation simulated effects may also depend on model configuration.

In order to analyse these effects and to compare their representation in different models currently used in Europe, multi model simulations were performed for two episodes with high aerosol loads as a coordinated exercise of the COST Action ES1004 (EuMetChem). Here we analyze the first of these two case studies, the severe Russian forest fires in summer 2010. Emission data, boundary conditions, simulation strategy and data output format were harmonized as much as possible to maximize the comparability of the results from the different models.

The high aerosol emissions during the summer 2010 Russian wildfire episode led to pronounced feedback effects. For example, the direct aerosol effect lowered the summer mean solar radiation by 20 W m^{-3} and seasonal mean temperature by 0.25 degrees. This might be considered as a lower limit as it must be taken into account that aerosol concentrations were generally underestimated by the WRF-Chem simulations by up to 50%. The high aerosol concentrations emitted from the wildfires over Russia were found to decrease the small amount of precipitation over Russia during this episode by another 10% to 30% when aerosol cloud interactions were taken into account. The focus of the discussion will be on case study results from WRF-Chem and a comparison with results from COSMO-ART, COSMO-Muscat, and NMMB/BSC-CTM.