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Air pollution modeling over complex terrain: WRFchem applied for Switzerland

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This study attempts to model air pollution for entire Switzerland for two specific years (1991 and 2002). The output will provide exposure data to a Swiss cohort study on air pollution and lung diseases in adults (SAPALDIA). The state-of-the-art Weather Research and Forecasting (WRF) model with a chemistry extension (WRFchem) is used. A specialty of this model combination is the online coupled approach where the meteorology and the chemistry are calculated at the same grid points and time steps. The high resolution domain of Switzerland (2 km) is nested into a coarser European domain. Preliminary results and the evaluation of different chemical and meteorological boundary and initial conditions on the coarser domain have been presented at the EGU 2010. Therefore we focus on preliminary results of the Swiss domain. To be able to calculate this high horizontal resolution over very complex terrain (Switzerland) a smoothing algorithm has to be applied to the digital elevation model for regions with steep slopes. Gas phase chemistry and aerosols are simulated with the Carbon bond mechanism version Z (CBMZ) and the Model for Simulating Aerosol Interactions and Chemistry (MOSAIC) using 4 sectional aerosol bins, respectively. Emissions of the chemical species PM10, PM2.5 and NO2 for the year 2005 are obtained from the Swiss Agency for the Environment Forests and Landscape (SAEFL). Other needed anthropogenic emissions are generated with a similar approach similar to SAEFL and all emissions are scaled to the intended years. The yearly emissions are disaggregated to hourly data using conversion factors from the GENEMIS project. This particular approach for anthropogenic emissions had to be chosen due to the absence of more detailed emission data, especially for the year 1991. Biogenic emissions can be derived from the global biogenic emission model (MEGAN) or from the Guenther scheme. Boundary and initial conditions for chemical and meteorological input parameters are taken from the coarser European mother domain. For verification purposes correlations with Swiss ground-based measurements (O3, NO2 and PM10) are analyzed. The framework already exists and the runs for the two years are currently being computed. Several case studies of specific months of the two intended years will be presented with focus on the methodology and the validation with observations. If calculation time permits, an additional comparison of a different gas phase chemistry module as well as its corresponding aerosol module will be presented. As the European simulations showed very encouraging results we expect good results for the Swiss domain as well.