Atmospheric Composition Studies for the Balkan Region

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The main scientific challenge of local to regional atmospheric composition pattern modelling probably is the accounting for the strong dependence of concentrations on fluctuations of local and regional meteorological conditions, the complex interaction of transport scales (different life times of the pollutants make it even more complex), uncertainties and responses to emission forcing and boundary conditions, both introducing information noise. Multi-scale numerical experiments have to be carried out, which to clarify to some extend different scale processes interaction, but also to further specify requirements for input data (emissions, boundary conditions, large scale forcing). Shortly speaking, extensive sensitivity studies have to be carried out, tailoring the model set-up and parameters a possible forerunner of single model ensemble forecasts. The present work aims at studying the local to regional atmospheric pollution transport and transformation processes over the Balkan Peninsula and at tracking and characterizing the main pathways and processes that lead to atmospheric composition formation in the region. The US EPA Model-3 system is chosen as a modelling tool because it appears to be one of the most widely used models with proved simulation abilities. The system consists of three components: MM5 - the 5th generation PSU/NCAR Meso-meteorological Model used as meteorological pre-processor; CMAQ - the Community Multiscale Air Quality System CMAQ; SMOKE - the Sparse Matrix Operator Kernel Emissions Modelling System the emission model. As the NCEP Global Analysis Data with 1 degree resolution is used as meteorological background, the MM5 and CMAQ nesting capabilities are applied for downscaling the simulations to a 9 km resolution over Balkans. The TNO emission inventory is used as emission input. Special pre-processing procedures are created for introducing temporal profiles and speciation of the emissions. The biogenic emissions of VOC are estimated by the model SMOKE. The air pollution transport is subject to different scale phenomena, each characterized by specific atmospheric dynamics mechanisms, chemical transformations, typical time scales etc. The specifics of each transport scale define a set of requirements for appropriate treatment of the pollutants transport and transformation processes, respectively for suitable modelling tools, data bases, scenarios and time scales for air pollution evaluation. The air pollution pattern is formed as a result of interaction of different processes, so knowing the contribution of each for different meteorological conditions and given emission spatial configuration and temporal behaviour is important for clarifying the atmospheric composition formation. Therefore the Models-3 Integrated Process Rate Analysis option is applied to discriminate the role of different dynamic and chemical processes for the pollution from road and ship transport. The processes that are considered are: advection, diffusion, mass adjustment, emissions, dry deposition, chemistry, aerosol processes and cloud processes/aqueous chemistry. Some results from several emission scenarios which make it possible to evaluate the contribution of different SNAP categories in

many different terms spatial pattern, averaged over the Balkans, typical and extreme impacts, seasonal behaviour are demonstrated as well.