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The influence of meteorological fields on air pollution concentrations

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Three dimensional meteorological fields as wind speed, temperature and moisture in the lower troposphere and a comprehensive description of the Planetary Boundary Layer (PBL) are of paramount importance in order to correctly describe the transport of pollutants and their impact on the surface. Different descriptions of the PBL parameter, especially of the friction velocity, the Monin-Obukhov-Length and the Mixing Height, vary greatly depending mainly on different assumptions concerning the vertical extent of the turbulence and the roughness of the surface. In this work different meteorological models are used to drive the chemical transport model REM-CALGRID (RCG) to simulate air pollutants concentrations over Germany. The COSMOS-DE-model's output of the German Weather Service (DWD) combined with a post-processed mixing height estimate (Fay et al., 1997) is compared to meteorological fields obtained with the FU-Berlins diagnostic objective analysis method (Reimer et al., 1992). Furthermore, a method based on Batchvarova and Gryning (1994) to estimate the friction velocity, the Monin-Obukhov-Length and the mixing height has been applied to the COSMOS-DE-data in order to obtain another description of the boundary layer stability. COSMOS-DE friction velocities are on average higher than FU-Berlin-analyses, especially over mountains. On the other hand COSMOS-DE mixing heights are on average lower than FU-Berlin data. COSMOS-DE mixing heights are also lower than mixing heights estimated with the Batchvarova-Gryning-method during day times, but higher during night times and over sea. Strongest differences are seen again over mountains. Consequently, simulated PM10 pollutants concentrations are lowest with COSMOS-DE data and highest with FU-Berlin data. Three-dimensional meteorological fields above the atmospheric boundary layer are all very similar between the data sets. All considered meteorological methods follow different

philosophies in their description of the atmospheric boundary layer. Thus, differences in simulated air pollution concentrations give a range of confidence dependent on differences in the meteorological fields. The models sensitivity toward meteorology has been analysed as the variance from the mean concentration field. Primary PM10 components whose concentration pattern depend mainly on meteorological fields show the strongest uncertainty with respect to meteorology. Also the long-range marker sulphate exhibits a remarkable dependency on meteorology. Elemental carbon shows the lowest variance. On average, the biggest differences are seen over maintains and sea, while the smallest differences are observed over non-urbanised flat-land regions. The concept of mixing layer and the methodology to describe it are fundamental for RCGs transport properties. Currently, vertical exchange coefficients are calculated on-the-fly based on the externally provided boundary layer parameters. A new approach is presented, which uses diffusion coefficients directly calculated by the meteorological driver.