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Air quality modeling for the city of Munich using POLYPHEMUS/DLR at high-resolution

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Air pollution is a principal concern for big cities. Due to the complexity of emission sources, small-scale transport and chemical processes of pollutant formation, it is difficult to investigate at urban scale. Chemical-transport models (CTM) are useful tools to study air pollution. However, air quality modeling over urban areas requires a reliable estimate of meteorological conditions and pollutant emission rates at high-resolution to be compatible with the scale of the study area.
In this study, the POLYPHEMUS/DLR chemistry-transport model is used for simulating gas and aerosol pollutants transform and transport over Munich, which is driven by WRF 3.5 meteorological forecasts. Therefore, the one-way grid nesting method with four domains is performed, where the coarsest domain covers Europe and the finest covers Munich city area.
To attain a high-resolution anthropogenic emission data set, which is an essential input for the CTM model, the 2 km resolution Bavarian Emission Kataster (EKATBY) 2004 emission dataset is downscaled down to 100 m for the Munich area. Several datasets are applied in the downscaling approach, including the high-resolution OpenStreetMap roads paths for traffic emissions, VIIRS NOAA satellite-derived night light data and the EEA CORINE 2012 land use data (100 m resolution) for redefining location of other emission sources over a 100 m resolution gridded map. In addition, the horizontal and vertical position and levels of emissions from specific point sources such as power plants are considered. Furthermore, the biogenic emissions are estimated with respect to vegetation dynamics and meteorological conditions.
The simulations are carried out for two unstable and stable periods, including the first week of June 2015 and the first week of December 2015 respectively. The results are compared with four available in-situ stations over Munich city. The results found sensitive to the wind direction due to the different location of stations and major emission sources near each station.