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Spatial climatology of air pollution in Slovenia using data fusion

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Spatial variability of air pollutants is very high and depends on spatial distribution of emissions on one hand and meteorological conditions on the other hand. Beside the forecast of air pollutant concentrations, the photochemical dispersion models can give us the insight on the characteristics of spatial distribution of pollutants from emission points in complex terrain due to photochemical reactions, dispersion and meteorological condition. A weak point of the model output is relatively poor spatial resolution for further use of the results and model bias. Both could be improved by data fusion of model results and monitoring data.

The Eulerian photochemical dispersion model CAMx (Comprehensive Air Quality Model with Extensions) was offline coupled with the operational meteorological model ALADIN-SI to produce operational ozone and particulate matter forecasts over Slovenia. The ALADIN-CAMx modelling system (the CAMx version 6.10) is currently running with double nesting. The coarse horizontal grid with spatial resolution of 13.2 km and 135x135 points is covering approximately the same area as an operational ALADIN-SI domain. The finer grid (4.4 km, 185x167 points) surrounds Slovenia covering also important heavy industrial regions in neighbouring countries, such as for example industrial area in Po Valley. The vertical grid consists of 68 levels up to the 14 km in the troposphere. Initial chemical conditions are obtained from the previous model run, while the chemical boundary conditions are taken from global 3h CAMS (Copernicus Atmosphere Monitoring Service) 5-daily forecast.

The updated highly resolved anthropogenic emission inventory for the Slovenia region (year 2011) and TNO-MACC-II data for Europe are included as anthropogenic emission input. Biogenic emissions are prepared separately with emission model SMOKE (Sparse Matrix Operator Kernel Emissions). The hindcasting of the CAMx 6.10 version was performed for the year 2011, where MACC reanalysis were used as the chemical boundary conditions.

Monthly mean concentrations from the model output were compared to monthly mean concentrations from 21 measuring points on Slovenian territory. Most of the measuring points were located on sites with high emissions, however, there was one site with characteristic of background measurements. The model output was first downscaled to 1 km resolution using the regression relationship between modelled concentrations and terrain parameters (elevation, longitude and latitude). In second step, regression kriging model was built to interpolate concentration measurements into 1 km grid, taking into account the correlation between modelled and measured pollutant concentration. The quality of final monthly mean pollutant concentration grids was assessed using cross validation procedure.