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Climate change services at the urban scale: Targeting the air quality over Amsterdam/Rotterdam

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Urban SIS is a proof-of-concept project under the Copernicus Climate Change Services (C3S) Sector Information System (SIS) program that provided a large dataset of Essential Climate Variables (ECVs) and impact indicators, including air quality and health indices, on the urban scale to support long-term urban planning.
The objective of this project was to assess the present and future air quality over conurbations located in different climatic zones and distinct social and economical conditions. The Amsterdam / Rotterdam area was chosen as a demonstration example of how to analyse the drivers in pollutant concentrations over this region within a changing climate. A downscaling model approach was followed in order to achieve high resolution spatial (1x1 km2) and temporal (hourly) gridded data in meteorological forcing and concentration fields. The applied chemical transport model (CTM) is the MATCH model, with offline forcing generated by the climate model HCLIM. Local fluxes in the urban boundary layer were captured by implementing detailed land-use data in the surface model SURFEX. Downscaling started with a domain covering Europe. The obtained 4D fields were used as boundary conditions for subsequent urban downscaling.
The regional climate downscaling over Europe was driven by a RCP8.5 data set simulated by the global climate model EC-Earth (GLOBAQUA project). The simulation was done for 30 years in present climate (1980-2010) and 35 years in future climate conditions (2030-2065). To reduce the computational costs of the urban downscaling, five years were selected in each of the two windows based on summertime temperature and precipitation, representing cold/wet, cold/dry, warm/wet, warm/dry, and 'normal' seasons.
The emissions used on the European scale were interpolated from global emissions (ECLIPSE V5a) for present (2010) and near future (2030) climate scenarios. Emissions inventories on the urban scale were taken from the National Pollutant Release and Transfer Register (www.emissieregistratie.nl), representing 2013 (present) and 2030 (future).
Results show decreased air pollutant concentrations driven by the reduced emissions during normal years in future climate scenarios. Climate change is an important factor for the obtained general increase in O_3 mean concentrations, especially in warm years. Over urban centres the reductions in NO_x emissions will also contribute to a local increase in ozone mean levels. However, the high ozone peaks were shown to decrease, likely with benefits for the health impact of this pollutant.
Changes in air pollutant concentrations induced by different forcings, regional and urban climate, and regional emissions are also quantified. In spite of the highly non-linearity involved this is the best way to detach the relative contributions of each of these forcings for the concentration changes foreseen.
The data produced within Urban SIS are available on-line (http://urbansis.climate.copernicus.eu/), enabling the user to plot, download and post-process selected ECVs and indicators.