Development of an Air Quality Modeling System for Zagreb, Croatia

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Poor air quality has been recognized as an important factor in causing adverse health effects for a log time. While concentrations of particulate matter and nitrogen oxides continue to exceed EU limit values, it is important to improve information about air quality, especially in the cities where the exposure of the population is the largest. Zagreb is the capital of Croatia with a population of nearly 800.000 and as such comprises 18 % of the Croatian population. In cities, pollutant concentrations have strong gradients, in particular those related to traffic. Since continuous air quality measurements are usually representative of several square kilometers for urban background locations, or for a specific street, authorities are encouraged to use dispersion models to complement the observations for a city.

This study combines knowledge gained from analysis of 14 urban, urban-background and near-traffic sites with the first results of the high resolution modeled data. Measurements were fully analyzed, seasonal and diurnal cycles were investigated, yearly averages and exceedances regulated by the EU were calculated. For the first time, the ADMS dispersion model was set up for Zagreb agglomeration. Within the model, measurement data from Desinić site (40 km NE from Zagreb) were used as background data representing the contribution of long-range transport to the city. Gridded emissions (500 m by 500 m resolution) were obtained from the Croatian National Emission Inventory. Also, emissions using the detailed road-level emissions using a street map were used. Meteorological parameters from the Zagreb-Maksimir measurement site were used in the model and there were considered as representative for the whole modeling domain. The focus of this analysis were main pollutants usually found to exceed EU limit values within the city and the surrounding area: particulate matter and nitrogen oxides.

In Zagreb, clear decreasing trend in concentration of PM_{10} was found (roughly 2 $\mu gm^{-3}year^{-1}$) through the period 2003 – 2018, although, exceedances are still present. Exceedances for PM_{10} are mainly related to wintertime episodes with stable conditions due to low boundary layer heights combined with high emissions caused by wood combustion. Spatial distribution given by the model for the year 2017 shows high gradients of concentrations near the sources, as well as influence of meteorological parameters on pollution dispersion.

The observed concentrations of PM_{10} and NO_2 are increased over the city within the range of 6 – 11 μgm^{-1} and 22 – 37 μgm^{-1} respectively. Modelled concentrations for the year 2017 show characteristic high values representing the main roads.

The next step will imply the coupling of ADMS with the LOTOS EUROS CTM that is currently being tested for the regional area.

Key words: air quality, city, Zagreb, ADMS, particulate matter, nitrogen oxides