Use of Chemical Transport Models for development of emission control strategy

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Implementation of cost-efficient emission control strategies is one of the main goals of air quality protection policies for which testing of different methodologies is useful. To assess the impact of emission changes on surface concentration levels, the chemical transport model (CTM), as well as the screening methodology SHERPA (Screening for High Emission Reduction Potential on Air) developed by Joint Research Centre can be used.

In this study LOTOS-EUROS chemical transport model with a source apportionment module with a labeling approach was used for emission reduction scenarios of NO_2, PM_{10}, and $PM_{2.5}$ for Croatia (the year 2018). ECMWF meteorological data (F1280 grid, resolution of 0.07°x 0.07°) and CAMS-REG-AP version 2.2 emission data aggregated by GNFR sectors provided by TNO were used. Outer domain (0.5°x0.25° resolution) covered 10°W – 45°E; 30°N – 60°N while nested domain covered the area 13°E – 23.5°E; 41.5°N – 47°N, with spatial resolution 0.1° x 0.05°. Emission reduction scenarios (10, 20, 30, 40, 50, 60, 80 and 100 %) were used for the traffic sector (F), residential combustion sector (C) and both sectors (C and F) combined. Hence, 25 model runs were made: the base model run without emission reductions and model runs with three scenarios. The base case is run with a source apportionment module. In run, chosen labels are sectors C and F for Croatia and for outside Croatia. These results were compared with 100 % reduction runs. Afterwards, the same scenarios approach was used with the SHERPA tool and results were compared. To complete the LOTOS-EUROS scenario runs took more time then the SHERPA tool runs. Both methodologies provide comparable results with respect to annual average concentration values, however, spatial distributions differ considerably. Spatial distribution differences show that both SHERPA and CTM are highly sensitive to the underlying emission gridding assumptions (proxies). Since CTM used the latest update of the emission inventory results for areas of highways and roads, especially for NO_2 compared to SHERPA look much more realistic. SHERPA overestimates the influence of population density in rural areas and does not depict the road traffic influence. As expected, surface concentrations of NO_2 are more affected by reductions of road transport emissions while PM concentrations are more affected by reductions in the sector of other stationary combustion. Combined scenario results show that linearity is conserved in case of emission reduction by 10 and 20 %. SHERPA tool provided semi-adequate general screening results but should be used with caution in case of need for specific and detailed spatial analysis.

Key words: LOTOS-EUROS, source apportionment, emission reduction