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Optimization of simulated CO2 & NO2 concentrations for a detailed infrastructure map in the Middle East

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Atmospheric chemistry models play a major role for relating greenhouse gases and pollutants concentrations to emissions at high temporal resolutions over large areas. On that account, it is fundamental to use up-to-date anthropogenic emissions maps as model inputs. Despite efforts by researchers to create global emission datasets with high temporal resolutions, for countries with no national data, generic activity maps and emission factors are used, thus the accurate representation of the anthropogenic emissions in a local scale still remains challenging. This study presents an improved spatially explicit dataset for anthropogenic emissions of CO2 and NOx over the Middle-East, a region characterized by extensive gas power plants and heavy industries operations. Our dataset was developed by combining a detailed infrastructure map for point sources in the area and it is used to simulate the distribution of CO2 and NO2 using the WRF-Chem mesoscale atmospheric transport chemistry model. Furthermore, the chemistry scheme of the WRF-Chem model in the simulation of CO2 and NO2 plumes is examined, in comparison with satellite observations.

In the framework of the Eastern Mediterranean and Middle East – Climate and Atmosphere Research (EMME-CARE) project, our new detailed infrastructure map for power plants and gas flaring has been implemented in WRF-Chem simulations for the Middle-East region to complete the Emission Database for Global Atmospheric Research (EDGAR) as input. The EDGAR data consists of emissions by various sectors such as power plants, industry, residential, transportation and agriculture. Furthermore, hourly scaling factors have been applied to the anthropogenic emissions according to the electricity consumption of the particular urban areas, taking into account the weekly as well as the monthly variations. The periods under study are January 2021 and June 2021. By comparing the WRF-Chem outputs to TROPOMI satellite observations for NO2, the results show that the addition of point sources was crucial for the detection of some NO2 plumes. Moreover, the WRF-Chem model systematically overestimated the NO2 concentrations in the area with the current EDGAR dataset, therefore we introduced a new relationship between

monthly and annual emissions for the Middle-East region. By carrying out WRF-Chem simulations with NO2 acting as a passive tracer it was also possible to examine the impact of the model chemistry in NO2 plumes development. Finally, CO2 was also simulated by the WRF-Chem model as a passive tracer and the results showed a good agrement with XCO2 data observed by the OCO-2 and OCO-3 instruments.