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Quantification of point sources of carbon monoxide using satellite measurements

Iris Dekker (1,2), Sander Houweling (1,2), Ilse Aben (1), Thomas Roeckmann (2), Maarten Krol (1,2,3)

(1) SRON Netherlands Institute for Space Research, Utrecht, The Netherlands (i.n.dekker@uu.nl), (2) Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Utrecht, The Netherlands, (3) Department of Meteorology and Air Quality, Wageningen University and Research Centre, Wageningen, The Netherlands

The growth of mega-cities leads to air quality problems directly affecting the citizens. With satellite measurements becoming of higher quality and quantity, satellite instruments can more accurately retrieve the enhanced air pollutant concentrations over large cities. The aim of this research is to quantify carbon monoxide emissions from megacities and their trends using satellite retrievals, combined with an atmospheric chemistry and transport model. Earlier emission estimations of cities have been done using MOPITT satellite data only. To improve the reliability of the emission estimation, we simulate MOPITT retrievals using the Weather Research and Forecast model with chemistry core (WRF-Chem). The difference between model and retrieval is used to optimize CO emissions in WRF-Chem, focusing on the city of Madrid, Spain. A reasonable agreement is obtained between the yearly averaged model output and satellite measurements (R2=0.75) for Madrid. After optimization, the emission of Madrid is reduced by 48% for 2002 and by 17% for 2006 compared with EdgarV4.2. The MOPITT derived emission adjustments lead to a better agreement with a European emission inventory TNO-MAC-III for both years. This suggested that the downward trend in CO emissions over Madrid is overestimated in EdgarV4.2 and more realistically represented in TNO-MAC-III. However, uncertainties remain large using our satellite-based emission estimation method, in the order of 20% for 2002 and 50% for 2006. Therefore, different options to increase the degrees of freedom in the optimization are investigated, to account for the noise in the MOPITT data. We also show comparisons with IASI data, which have a higher temporal resolution. The method is developed for application to Sentinel 5P TROPOMI, to be launched in June 2017.