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Analysis of NOx emission sources of Bremen using WRF-Chem and DOAS

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Abstract

Anthropogenic emissions of atmospheric trace gases (eg. NO_X = NO + NO_2) have a big impact on the air quality in cities. The concentration of the pollutants influence the formation of photochemical smog. In Bremen, the main emitters of NO_X are power plants and industry.

The presentation of my master thesis will show preliminary emission results and the modeling progress over Bremen, with the following two sections:

(1) Bike differential optical absorption spectroscopy (DOAS) is used to estimate emissions from the waste incineration plant in Findorff and the airport Bremen. The sources are circled by zenith sky measurements done with a bicycle. Resulting emission fluxes are obtained via the divergence theorem of Gauss. For the waste incineration plant one retrieves a clear signal, which aligns closely with the published data from SWB. A different situation is found for the airport. A small signal with high deviation leads to the conclusion, that the airport is a less significant source for NO_X.

(2) WRF-Chem, a state-of-the-art meteorological model coupled with online chemistry, is used to simulate the atmospheric state and chemical composition over Bremen. Surface meteorological and chemical observations as well as vertical atmospheric profiles obtained from soundings are used to evaluate model results. The meteorological variables show a good agreement; however, deviations are noted in the diurnal cycles of NO, CO and O_3. Finally, results from WRF-Chem are cross-examined against simulations using a Lagrangian model, FLEXPART, to gain further insight on the local transport of emission plumes measured by the DOAS device.