Modeling Air Pollution in Beijing: Emission Reduction vs. Meteorological Influence

This case study uses the Chemical Transport Model WRF-Chem to simulate and measure the efficiency of temporal large-scale emission reductions under different meteorological conditions. The Nov. 2014 Asian Pacific Economic Cooperation (APEC) summit provides a unique opportunity for this study due to the extraordinarily good and well-measured air quality which is believed to be induced by intense emission-reduction measures by the Chinese government. Four cases are simulated to inter-compare between favorable und unfavorable meteorological conditions (in terms of air quality) as well as reduced and non-reduced emissions. Key variables of the simulation results are evaluated against AERONET measurements of Aerosol Optical Depth (AOD) and air-quality measurements by the Chinese Ministry of Environment (CME). The inter-comparison is then performed on time- and volume-averaged total concentrations of the key variables Nitrogenous Oxide (NOx) and Particulate Matter ($PM_{2.5}$ and PM_{10}).

SPOILER: Evaluation of all four simulations show high correlations between all simulated cases and recorded data that are systematically biased related to the emission scenario and systematically phase-shifted, probably related to wind conditions. Results indicate that emission-reduction measures are significantly more efficient under meteorological conditions that favor bad pollution. In case of the APEC-summit, emission-reduction only had a negligible effect on the outcome.