1.121 Developing a new urban air quality model for Beijing.

Early Career Scientist

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Abstract:

Quantifying the impact of policies aimed at improving air quality, to reduce the risk to human health, requires numerical modelling that simulates the complex atmospheric processes occurring in the urban environment. We have performed air quality simulations for Beijing using the urban-scale Gaussian dispersion and chemistry model, ADMS-Urban. ADMS-Urban simulates dispersion as individual plumes emitted from explicitly modelled sources and is able to calculate air pollution concentrations at street-scale resolution. The model includes a simplified fast chemistry scheme (NO_x, O_3 and VOCs) and accounts for the influence of urban morphology (including street canyons) and the urban heat island (UHI) on atmospheric composition.

We use a high-resolution emissions inventory, derived from the new sector-based 1km x 1km Multi-resolution Emission Inventory for China (MEIC), and compare simulated and observed diurnal and seasonal concentration profiles for NO_x, PM and O_3 across 12 sites and during the recent Air Pollution and Human Health (APHH) field campaigns. Emissions and local meteorological conditions combine to control each species’ profile, with rush hour traffic and domestic heating/cooking emissions interacting with boundary layer dynamics to produce morning and evening NO_2 and $PM_{2.5}$ concentration maxima. An afternoon O_3 peak is related to lower NO_2 concentrations and peak solar irradiance. However, diurnal NO_2 cycles show an earlier and stronger evening peak compared to measurements. By incorporating stability effects relating to Beijing’s UHI, through replicating the release of heat stored in the urban fabric, we are generally able to reproduce the observed annual and seasonal NO_2 and O_3 diurnal cycles for 2014. $PM_{2.5}$ concentrations are underestimated at all sites, suggesting missing emission sources and we discuss the most likely of these.

Currently we are assessing the sensitivity of model results to underlying meteorology. We are further developing our model to include a more advanced urban morphology and to treat haze effects.