Geophysical Research Abstracts
Vol. 21, EGU2019-5198, 2019
EGU General Assembly 2019

Assessment of anthropogenic emissions in central Beijing via Eddy Covariance.

Freya Squires (1), James Lee (1,2), Jacqui Hamilton (1), Will Drysdale (1), Adam Vaughan (1), Eiko Nemitz (3), Oliver Wild (4), Michael Holloway (4), Stefan Metzger (5), Dave Durden (5), Natchaya Durden (5), and Qiang Zhang (6)

(1) Wolfson Atmospheric Laboratories, University of York, UK, (2) National Centre for Atmospheric Science, University of York, UK, (3) Centre for Ecology and Hydrology, Edinburgh, UK, (4) Lancaster Environment Centre, Lancaster University, UK, (5) National Ecological Observatory Network, Boulder, USA, (6) Department of Earth System Science, Tsinghua University, China

Poor air quality is an urgent issue for the modern world. Residents of megacities, such as Beijing, are particularly affected as high population density and rapid economic growth inevitably result in high levels of air pollution. Chinese cities regularly breach World Health Organisation (WHO) air quality guidelines, which are associated with severe health risks including cancer and cardiovascular disease. In 2010, 1.2 million premature deaths were attributed to outdoor air pollution in China.

Considerable efforts have been made to reduce atmospheric pollutant concentrations in China within the past few years. Regulatory changes require the identification of the sources of air pollution and as such there is a pressing need for reliable measurements of pollutant emissions. In comparison to concentration alone, the determination of pollutant emission using the eddy-covariance technique requires fast-response measurements. For the first time in Beijing, NO_x and CO flux were observed in this way as part of the 'Air Pollution and Human Health (APHH) in Beijing' research programme.

During two field campaigns in November-December (winter) 2016 and May-June (summer) 2017, 5 Hz measurements of NO_x and CO concentrations were made. Sampling took place from a gas inlet co-located with a sonic anemometer at an elevation of 102 m on a meteorological tower in central Beijing. Analysis of the covariance between vertical wind speed and concentration enabled the calculation of emission flux, with an estimated footprint extent between 1 – 2 km upwind of the tower (which typically included some major ring roads and expressways). Observed 30-minute emissions were compared to modified emissions estimates from the Multi-resolution Emission Inventory for China (MEIC).

For both NO_x and CO, calculated flux was almost entirely positive indicating emission dominates over deposition as expected for an urban environment. The magnitude of the NO_x flux was similar between the winter and summer campaigns, with an average value of 3.8 $\pm$ 1 mg m^{-2} h^{-1} and 3.2 $\pm$ 0.8 mg m^{-2} h^{-1} respectively. CO flux showed considerably more variability between the two seasons with a measured value of 28 $\pm$ 8 mg m^{-2} h^{-1} in the winter and 13 $\pm$ 4 mg m^{-2} h^{-1} in the summer. Analysis of diurnal variation in NO_x and CO flux suggest that these species have a dominant traffic source for both seasons. The variability in CO flux may be attributed to inefficiencies in engine combustion caused by cooler ambient temperatures in winter.