Measurement of NO$_x$ and CO Fluxes from a Tall Tower in Beijing

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Why do we care about air pollution?

• Pollutant emissions impact on human health (in 2010, 1.2 million premature deaths were attributed to outdoor air pollution in China).
• Many pollutants influence climate (i.e. through aerosol or ozone formation).
• Air pollution can influence the price of beer!
Institute for Atmospheric Physics
2 campaigns; **Winter** (05/11/2016–11/12/2016) and **Summer** (22/05/2017–25/06/2017).

- NO$_x$ measured with fast chemiluminescence instrument (Air Quality Designs).
- CO measured with fast resonance fluorescent instrument (AeroLaser).
- Wind data (Gill Windmaster Pro Sonic Anemometer).
Flux Measurements

Flux measurements enable us to quantify NO$_x$ and CO emission and therefore identify emission sources!
Eddy Covariance

Assumptions

• Measurements are carried out within the boundary layer.

• Flux is fully turbulent – most of the net vertical transfer is done by eddies.

**NO$_x$ Emission Time Series**

- Winter has more data gaps (lack of turbulence) and due to some instrument issues.
- Magnitude very similar between the two campaigns, suggesting common sources during the campaigns.
CO Emission Time Series

- Delayed in getting the CO instrument online so data gaps at start of the campaign.
- Additional source in winter. Emissions seem to be ~3 times higher in winter (on average).
NO$_x$ Emission Flux

![Graph showing NO$_x$ Emission Flux over hours with two lines: Summer (light blue) and Winter (dark blue).]
CO Emission Flux

The graph shows the CO emission flux in mg m\(^{-2}\) h\(^{-1}\) over a period of 24 hours, distinguishing between summer and winter conditions. The data indicates significantly higher emissions during winter compared to summer, with peaks around midday and troughs during early morning and late evening.

- **Summer**: Generally lower emissions, with a slight increase in the afternoon.
- **Winter**: Higher emissions, especially during the afternoon and evening, with significant spikes at around 10 AM and 4 PM.

This graph suggests that environmental policies and interventions might need to be more stringent during winter to control CO emissions.
Consider wind direction...
• October 2010 Multi-Resolution Emissions Inventory for China (MEIC).
• 3 km$^2$ resolution.
• Scaled down by 25% to reflect expected change in NO$_x$ emission for October 2016.
• Average emission from surrounding 4 squares and multiplied by time-of-day scaling factor.
NO$_x$ Emission Flux and MEIC Inventory
Next steps


- Create a weighting matrix that predicts the ground influence of a particular cell contributing to the observed emission flux.

- Footprint is then calculated by multiplying inventory grid by this weighting matrix.

- Future work will involve this analysis carried out using a higher resolution inventory (1 km$^2$ resolution for 2013).
Comparison with London (May – June ‘17)
Eddy Covariance Measurements Assessing $\text{NO}_x$ Emission in London

Will Drysdale

Eddy Covariance Measurements Assessing $\text{NO}_x$ Emission in London
Poster Board 14
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