



# Airborne Flux Measurements of Volatile Organic Compounds and $\text{NO}_x$ over London

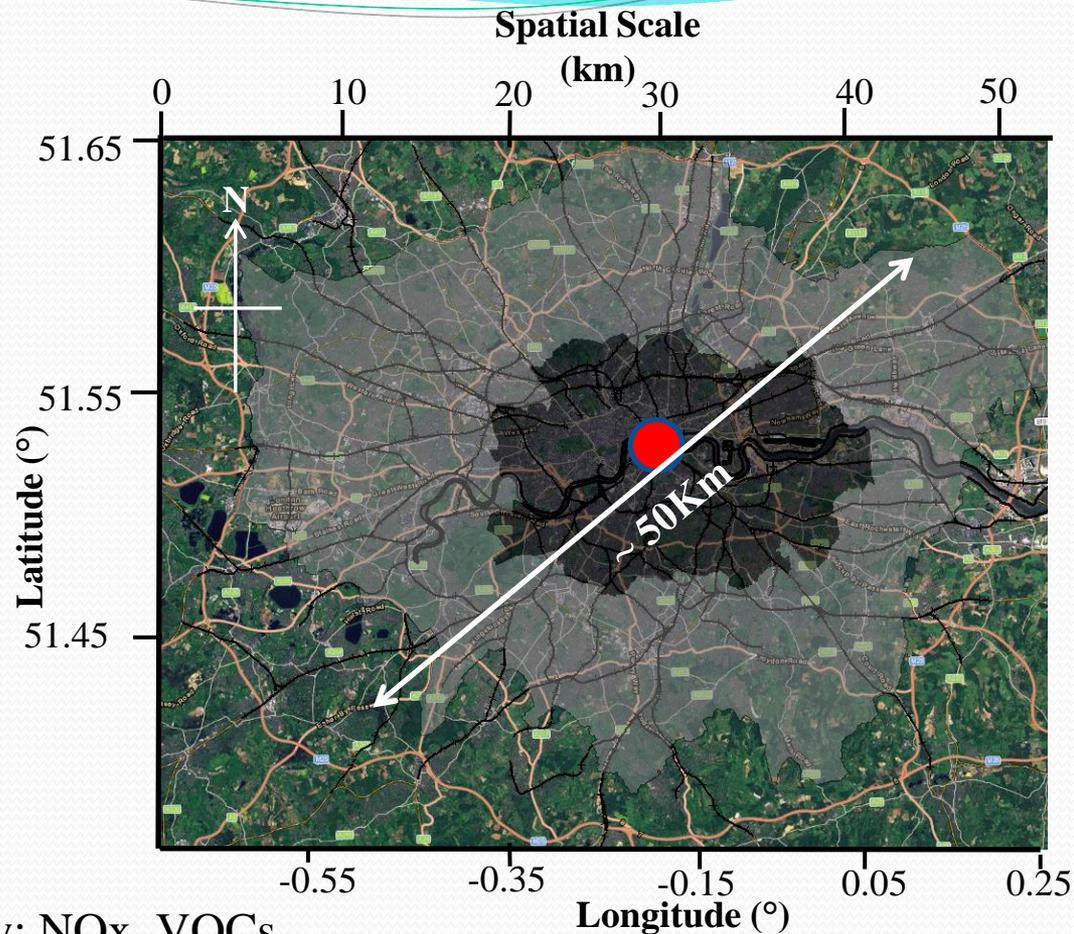
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- Airborne flux measuring capability; NO<sub>x</sub>, VOCs
- ~300m a.g.l at ~80 m/s
- PTR/MS (2Hz) - Ionicon
- NO<sub>x</sub> Chemiluminescence (10 Hz) - Air Quality Designs
- AIMMS-20, 3D wind vectors (20 Hz) – Aventech
- July 2013, 15 hours of data

# Airborne Eddy Covariance flux derivation



Two independent methods:

$$F = \overline{w'c'}$$

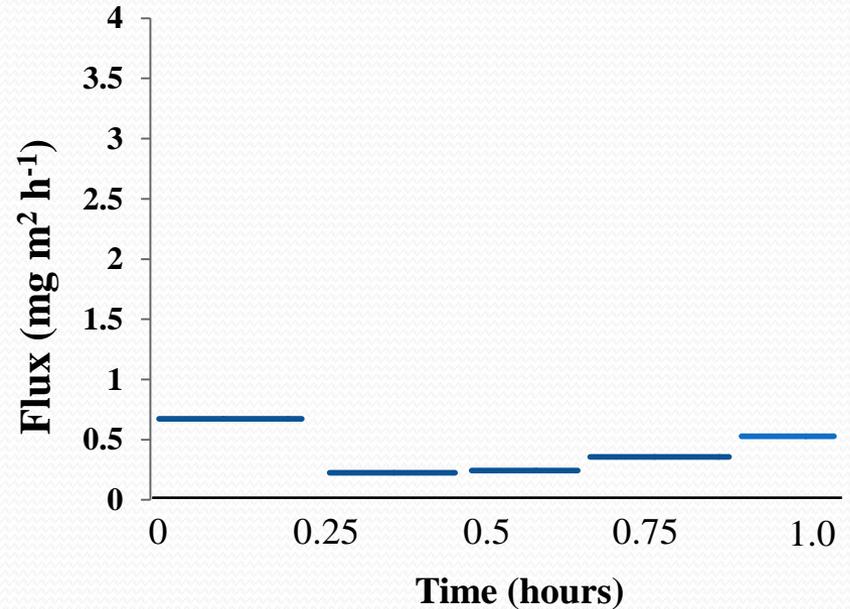
# Airborne Eddy Covariance flux derivation



Two independent methods:

- 1) **Fast Fourier Transform (FFT)** – provides flux averaged over entire leg.

$$F = \overline{w'c'}$$



# Airborne Eddy Covariance flux derivation



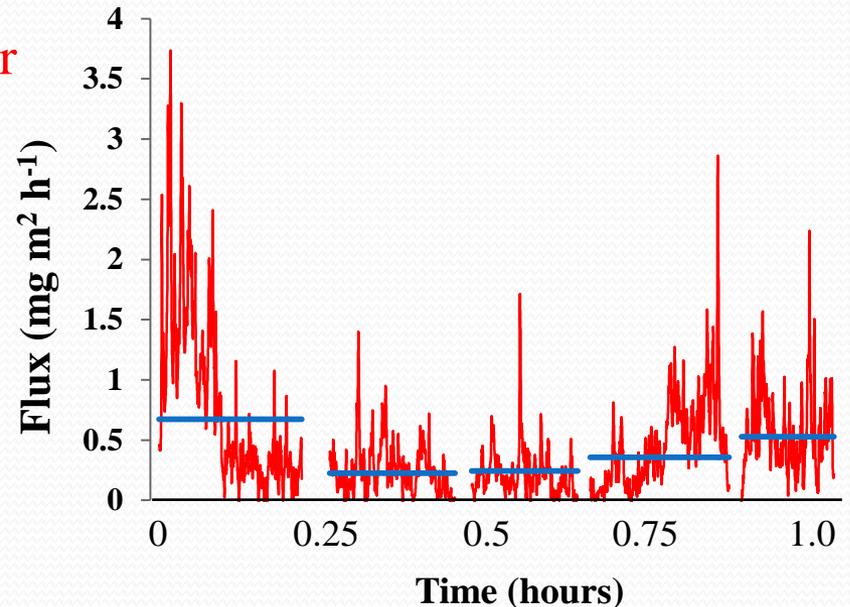
Two independent methods:

1) **Fast Fourier Transform (FFT)** – provides flux averaged over entire leg.

2) **Continuous Wavelet Transformation (CWT)** - delivers instantaneous flux over chosen bandwidth . Both frequency and time can be localized.

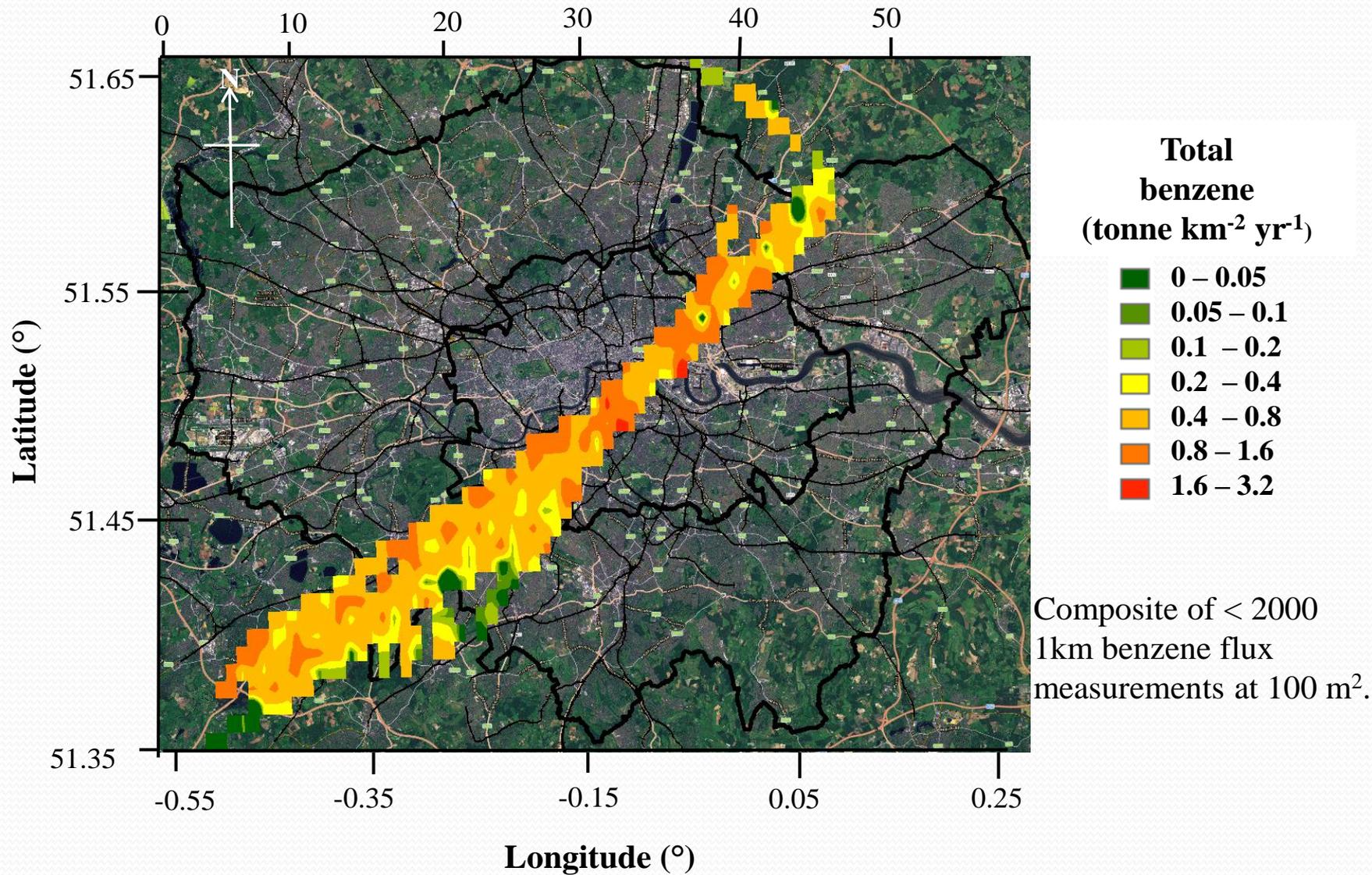
- **Preliminary Flux uncertainty**  
 PTR-MS:  $\pm 30\%$   
 NO<sub>x</sub> Chemiluminescence : in progress

$$F = \overline{w'c'}$$



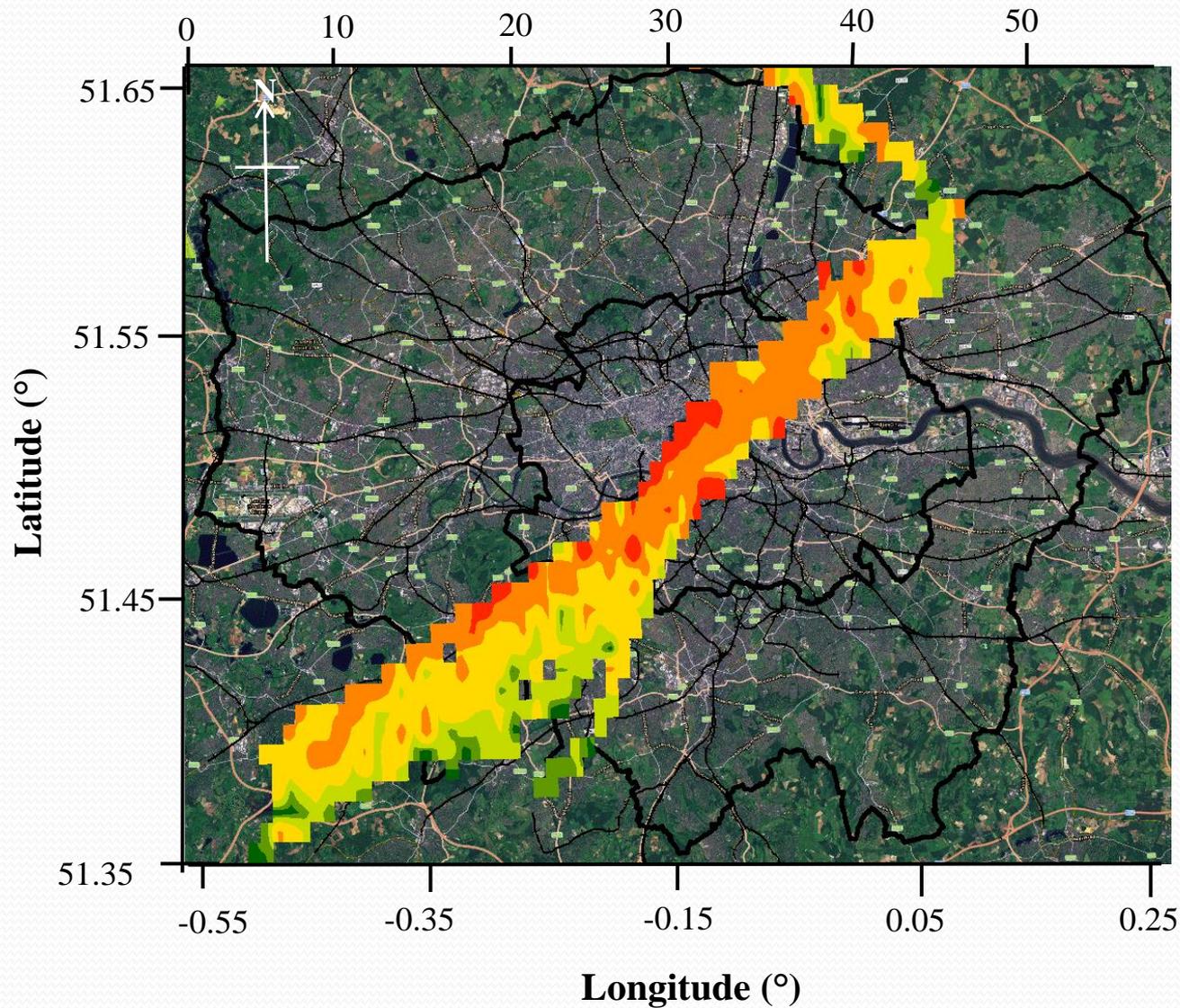
# Preliminary Benzene Flux Spatial Distribution over London

Spatial Scale (km)

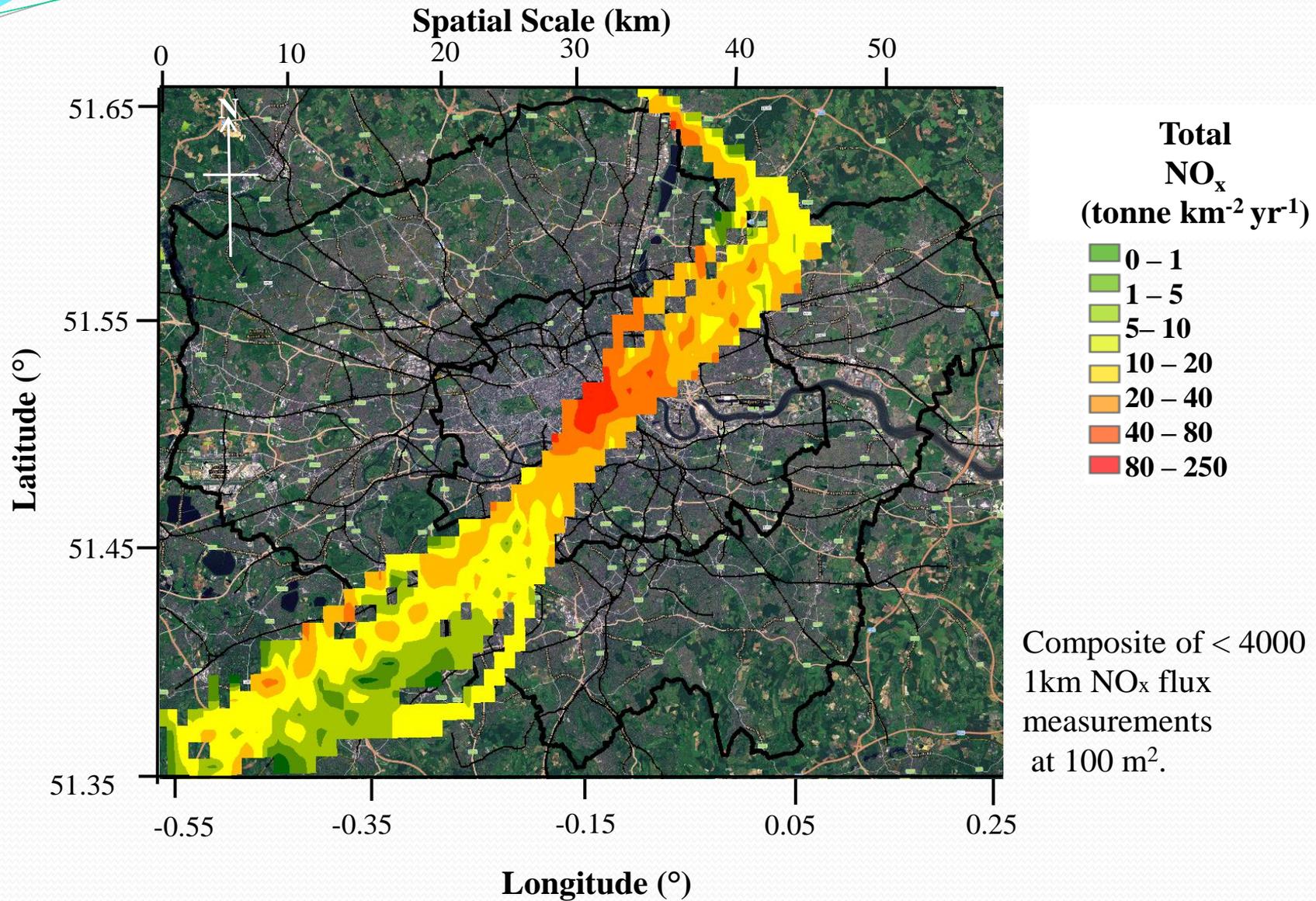


# Preliminary Toluene Flux Spatial Distribution over London

Spatial Scale (km)

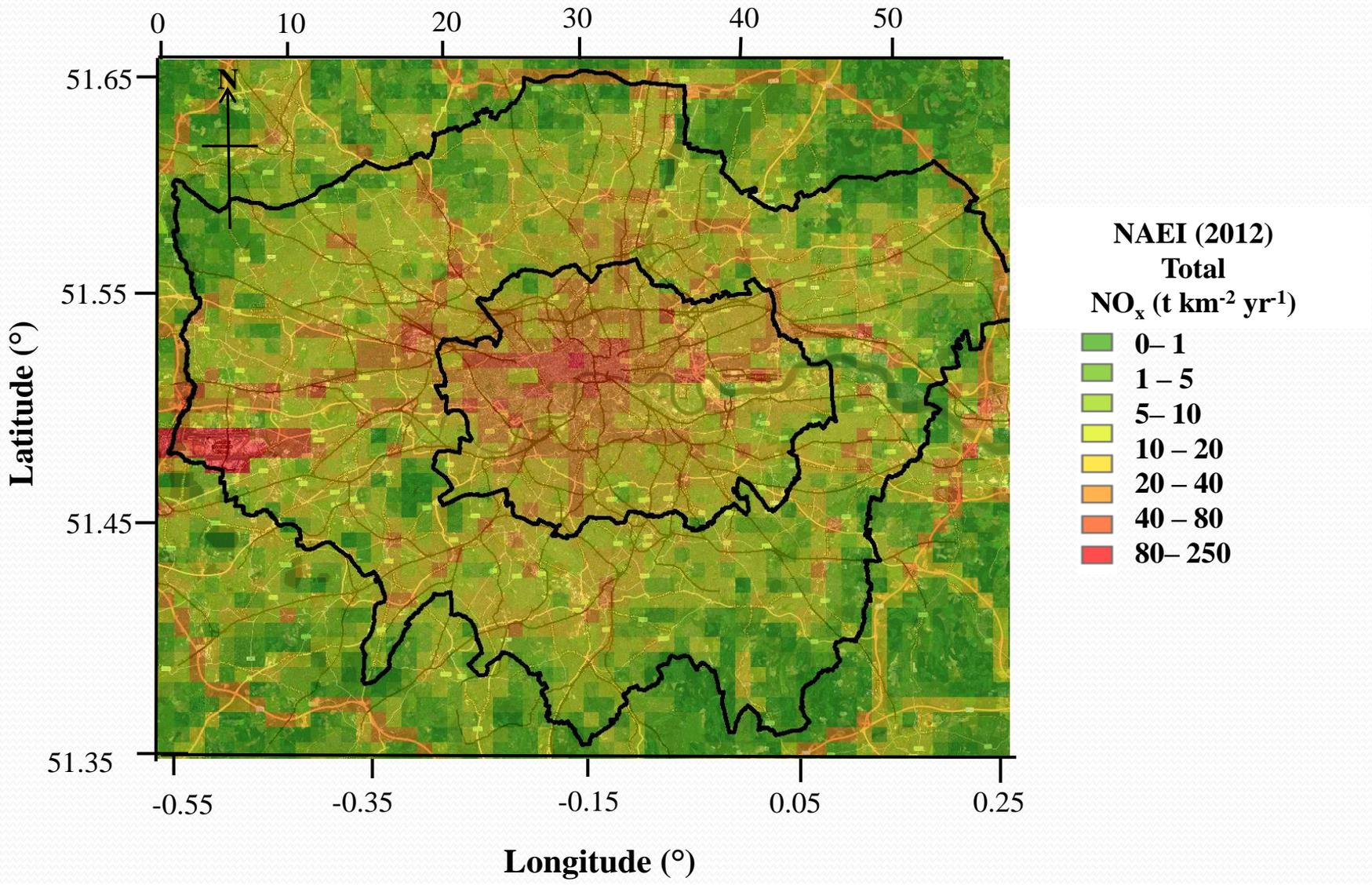


# Preliminary NO<sub>x</sub> Flux-Spatial Distribution over London

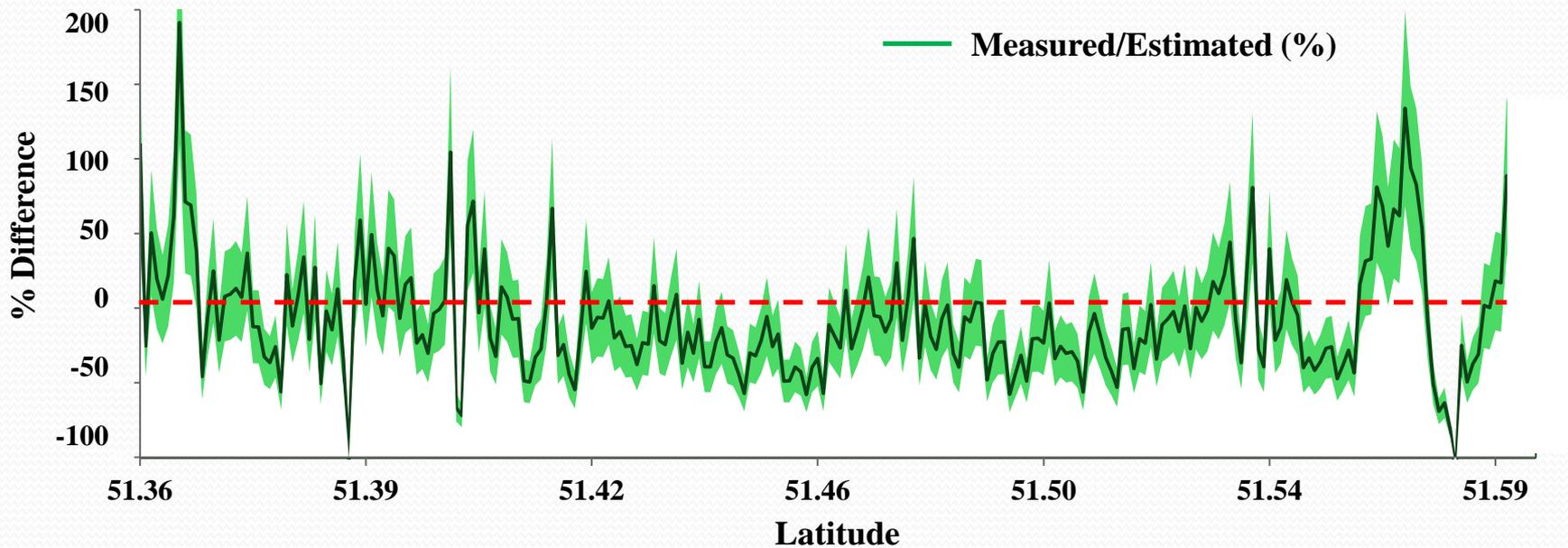
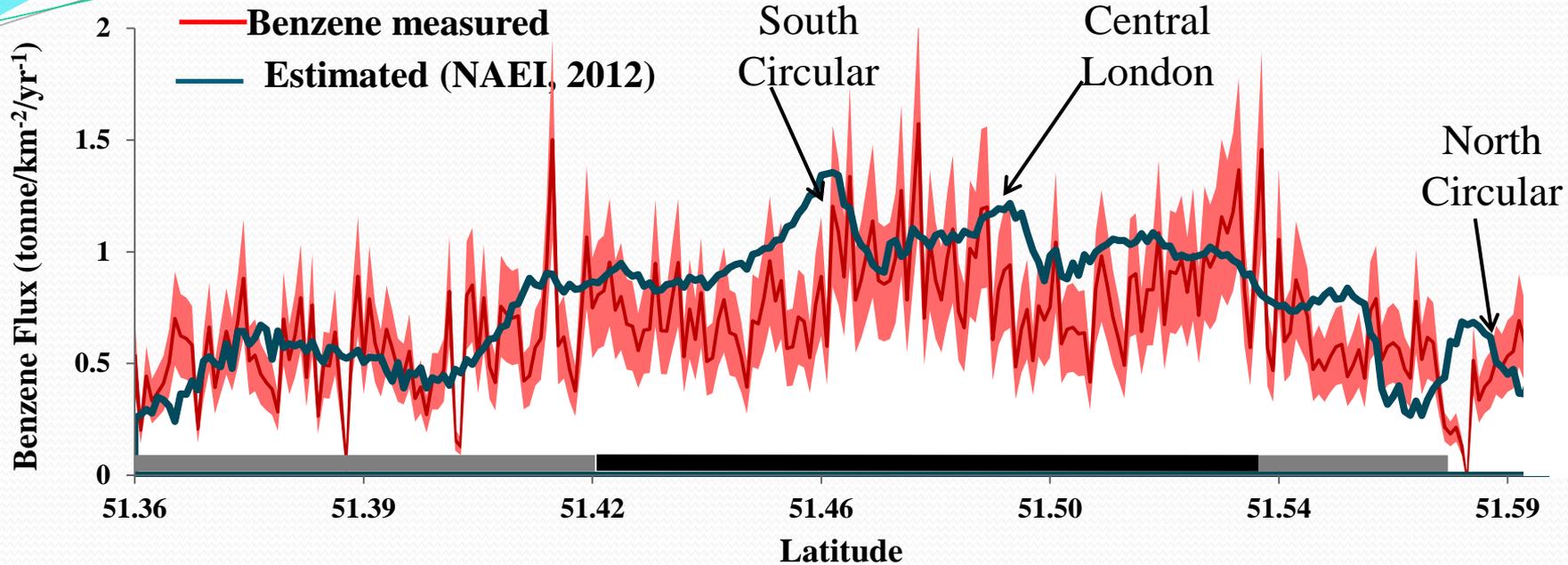


# National Atmospheric Emission Inventory

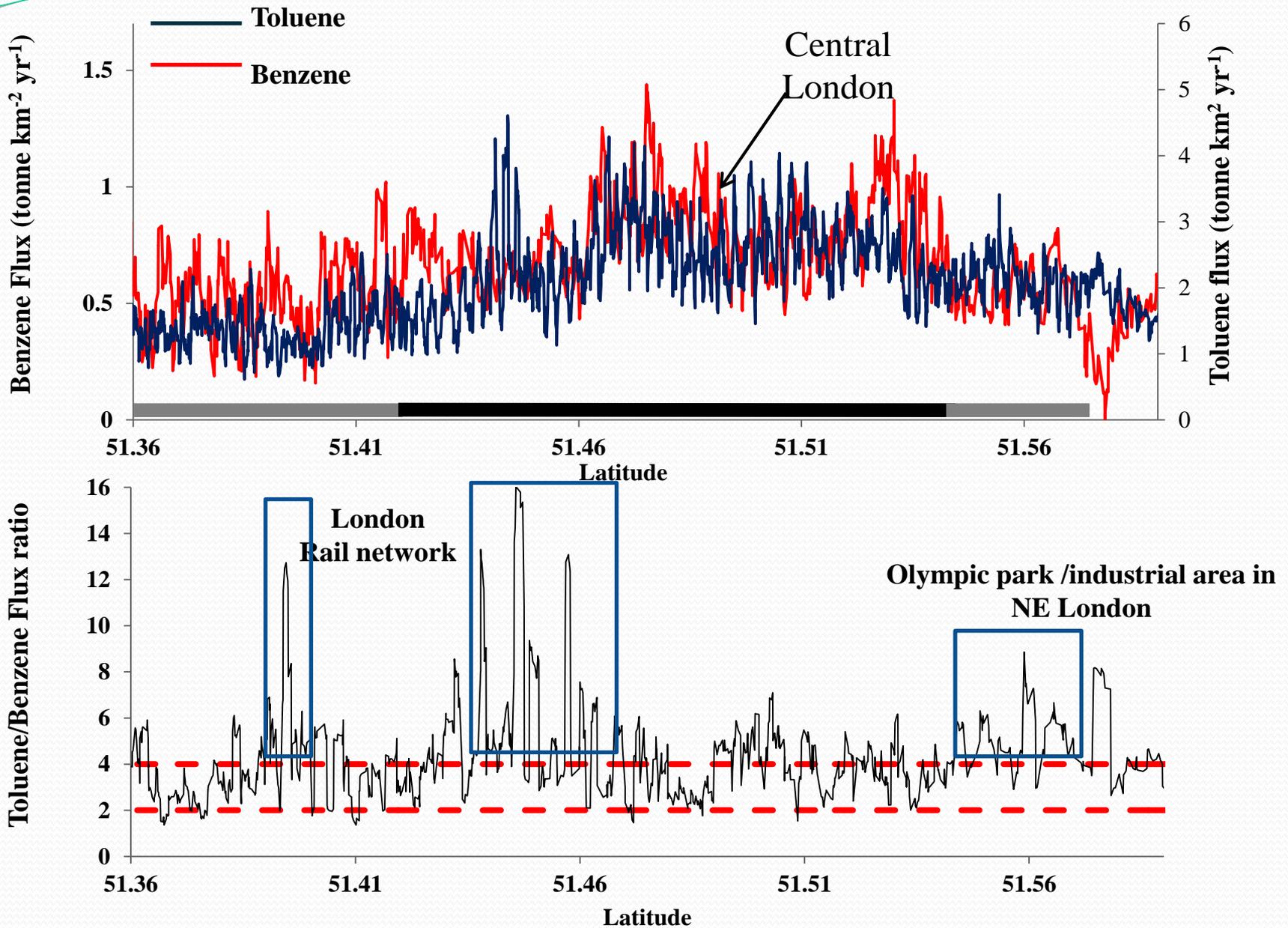
Spatial Scale (km)



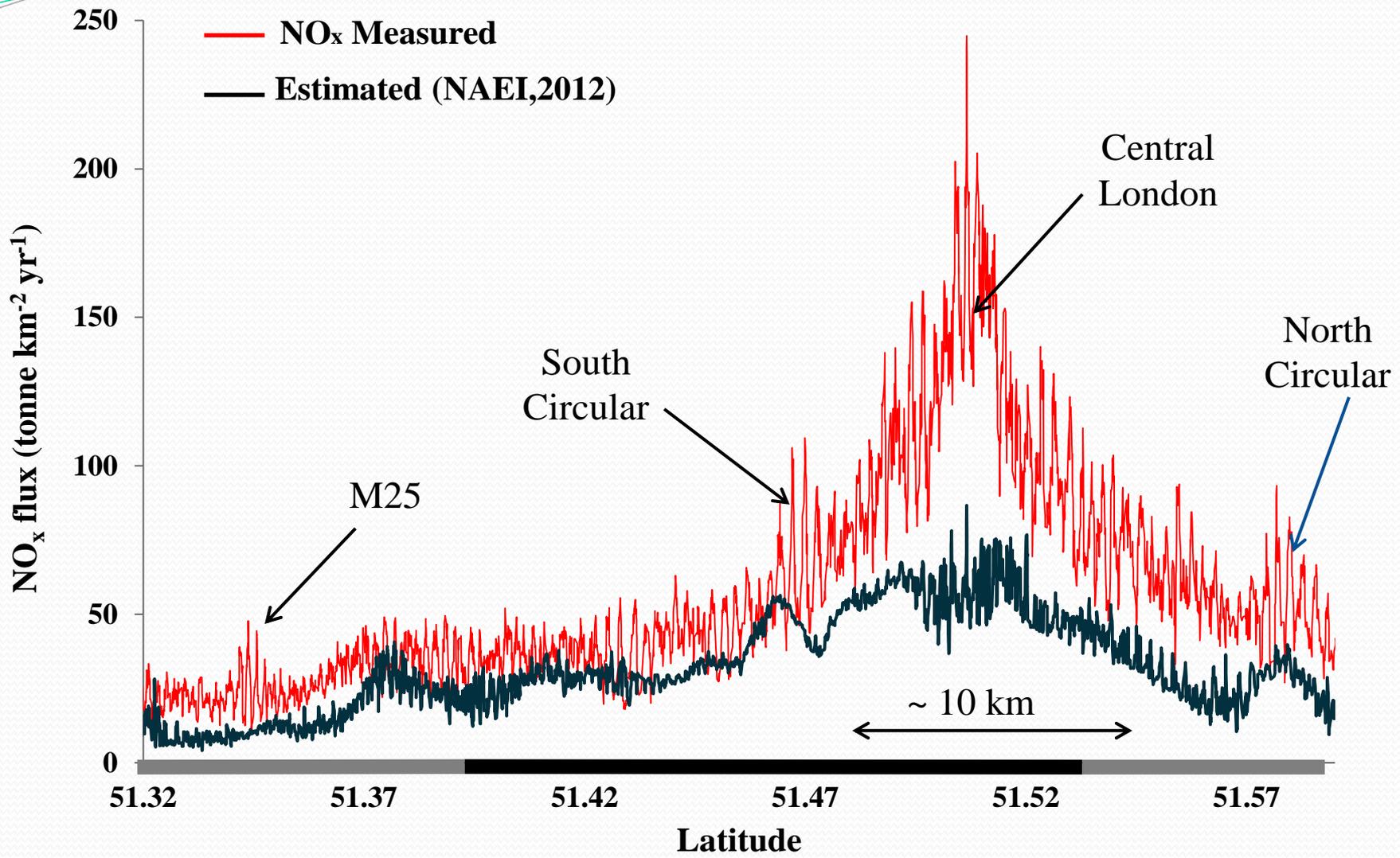
# Preliminary Benzene Flux Comparisons with NAEI over London



# Toluene/Benzene Flux Ratios over London



# NO<sub>x</sub> Flux Comparisons with NAEI over London



## Summary

**Analysis remains a work in progress.....**

- 1) Demonstrate the development and application of airborne flux measurement capability.
  - NO<sub>x</sub> and VOCs (benzene, toluene, isoprene, monoterpenes).
  - 1km spatial resolution using continuous wavelet transformation
  - Preliminary VOC flux uncertainty  $\pm 30\%$
  
- 2) National Atmospheric Emission Inventory appears to estimate benzene fluxes well.
  
- 3) NAEI appears to substantially underestimate NO<sub>x</sub> fluxes in central London.

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- James Johnson (Co-Pilot)



Thankyou