A return to winter smog?

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Background

Background

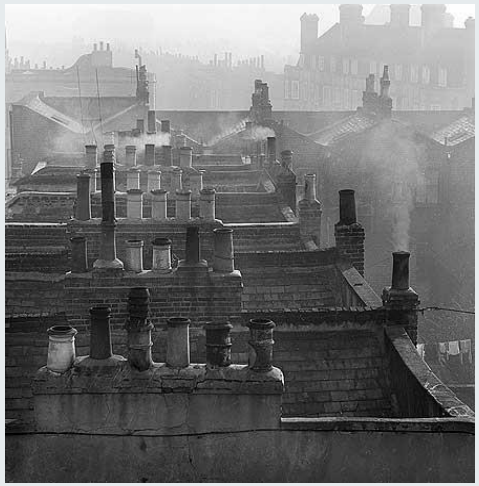
- **Smog = smoke + fog**
- First used in the 50's in London
- **Winter smog** is mainly caused by **limited dilution of air pollutants**, under unfavourable meteorological conditions (little wind, temperature inversion)

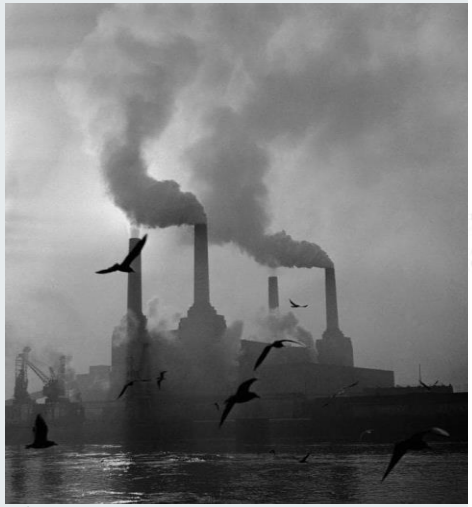
Background

- The main component of winter smog is **particulate matter**
- **Aerosols** in the atmosphere causes a **reduction in the visibility** due to scattering effects
- Recent studies also points that the **reduction in visibility** can be also partly attributed to **NO2**

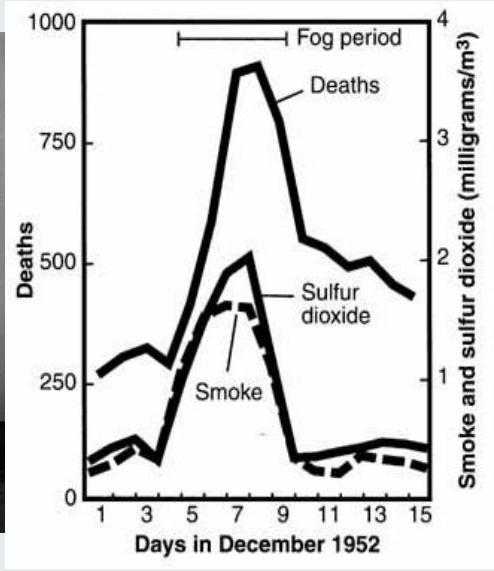
Historic winter smog episodes

- In the 50's that was originated from the use of coal for domestic heating





John Gay 1960-65 © Historic England



- Or from industrial emissions as in the Rhur valley

Table 4. Smog episodes in the Ruhr District.

Episode, duration	Dec. 1962 (*4,5*) (5 days)	Jan. 1979 (*6,7*) (1 day)	Jan. 1982[a] (*8*) (6 days)	Jan. 1985 (*1*) (5 days)
SO_2, mg/m³				
30-min value		1.4	1.1	2.2
3-hr value		1.1	0.9	1.6
24-hr value	5.0	0.6	0.6	0.8
SP, mg/m³				
3-hr value		0.5	0.6	0.8
24-hr value	2.4[b]		0.5	0.6
Increase of total mortality	15%[c] (19%)[d]	none	none[e]	6%[c] (8%)[f]

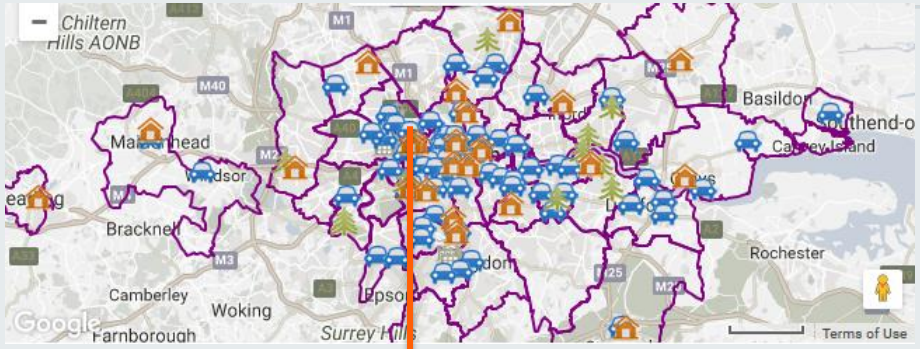
Wichnmann et al., 1989

Recent winter smogs in London

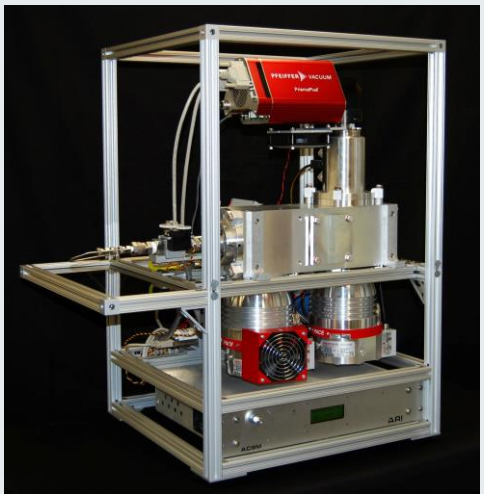
Recent winter episodes

- **London** recorded **three winter episodes in winter 2016-17** with **very high PM10** concentrations and **moderate/high PM2.5**
- Episode on **mid January 2017** was the most significant **widespread London PM2.5** episode **since 2012**
- Two of them were accompanied by **moderate NO2 concentrations**

Value network / supersite



North Kensington Urban Background supersite



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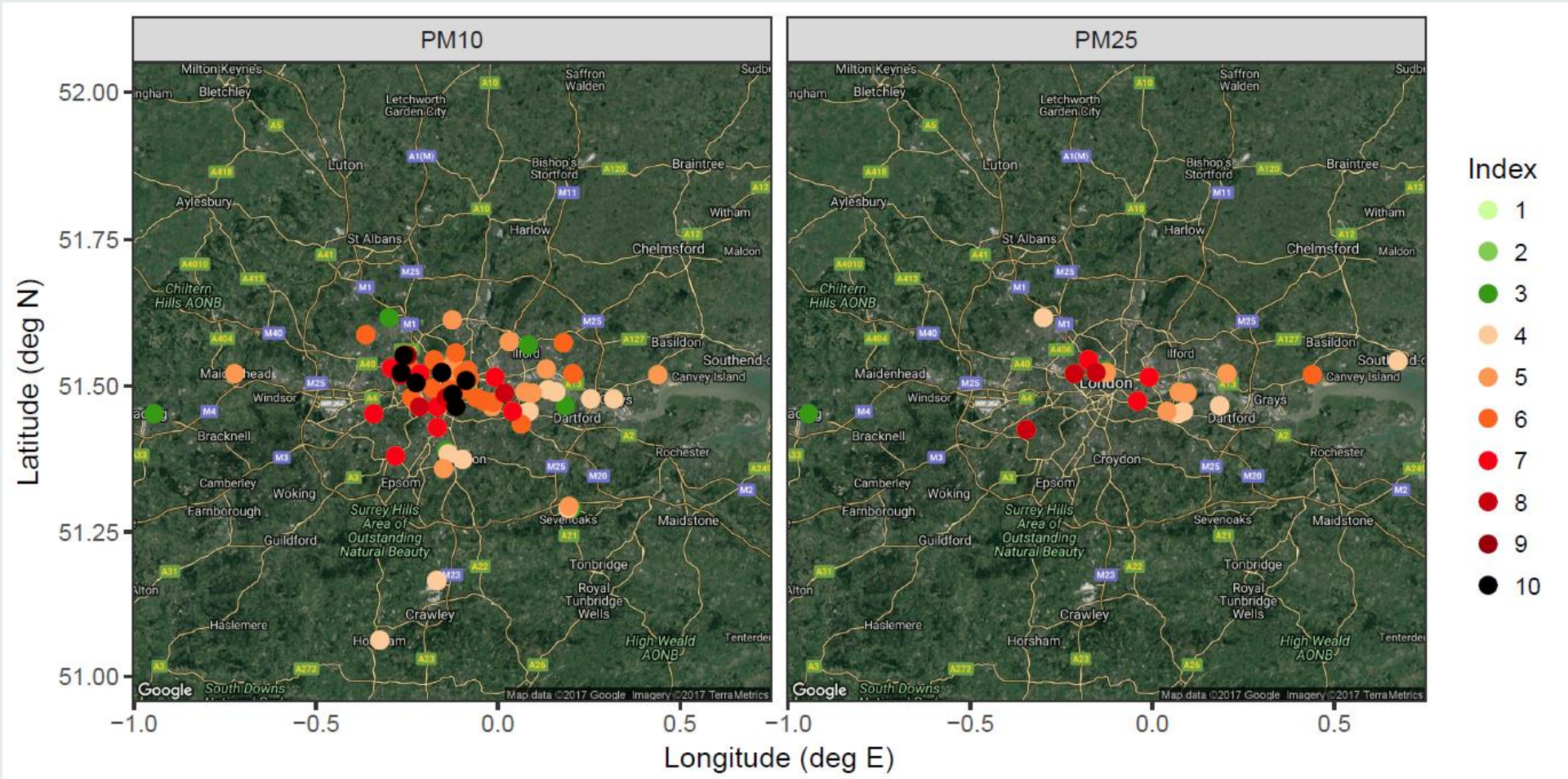

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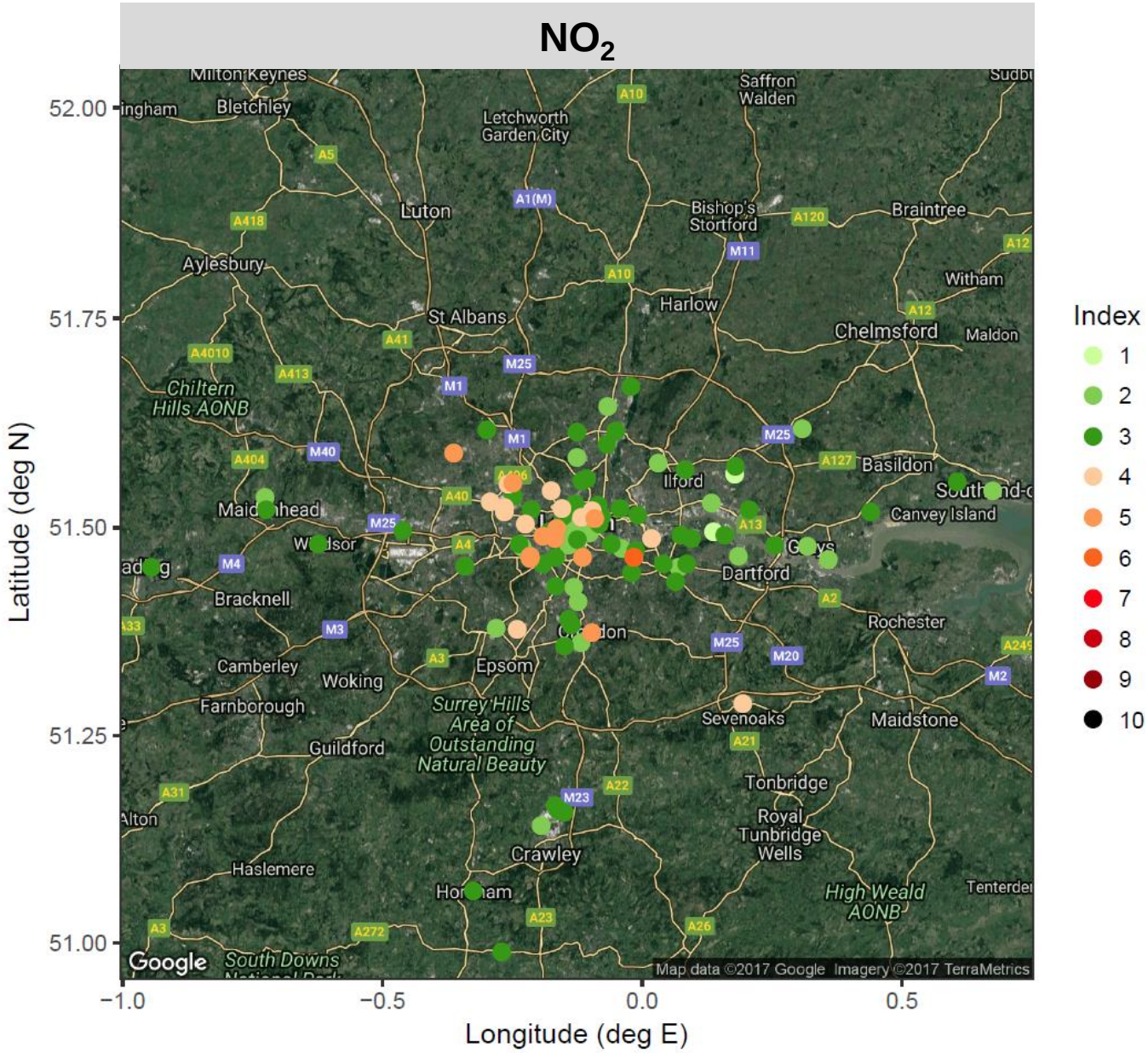

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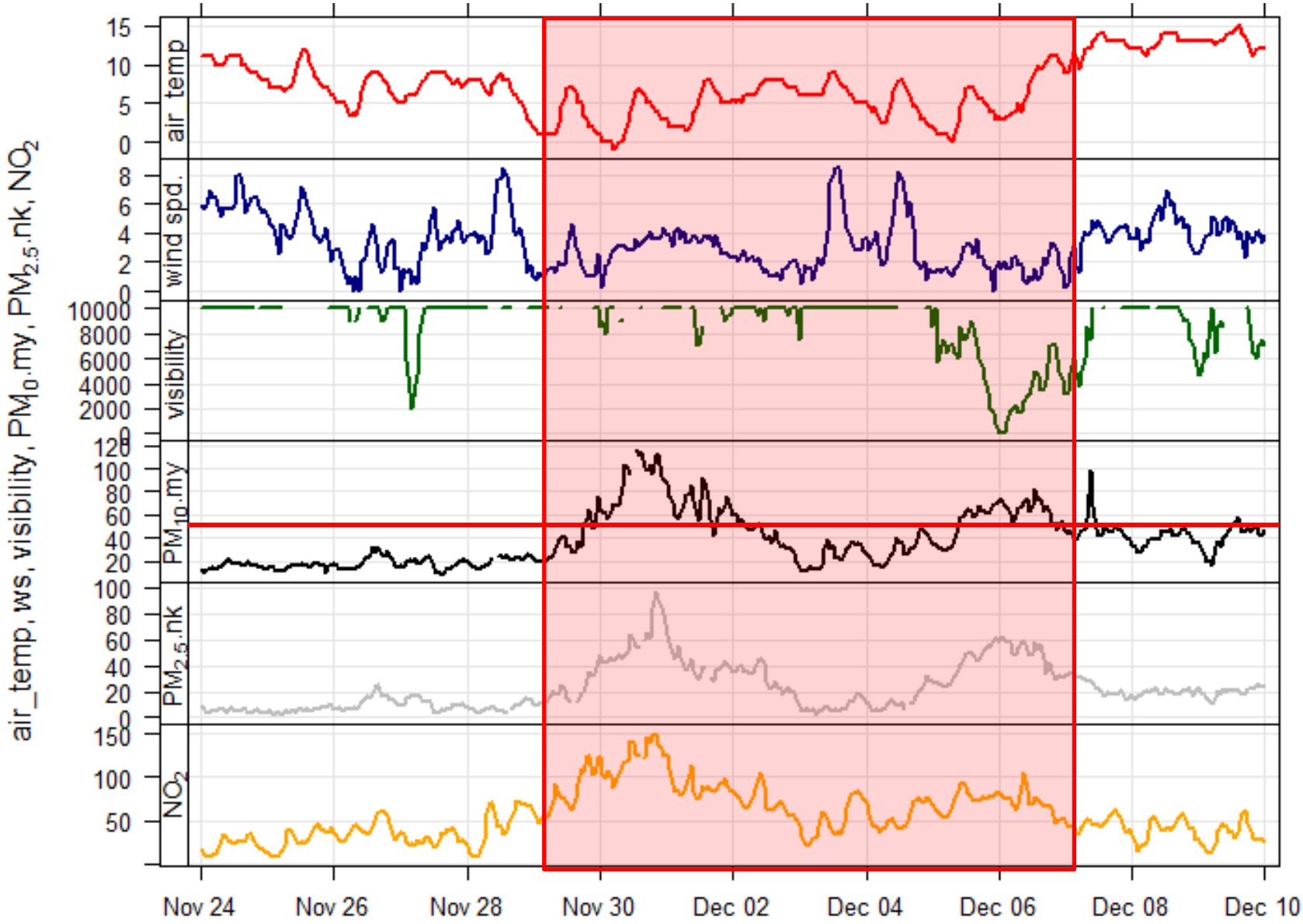

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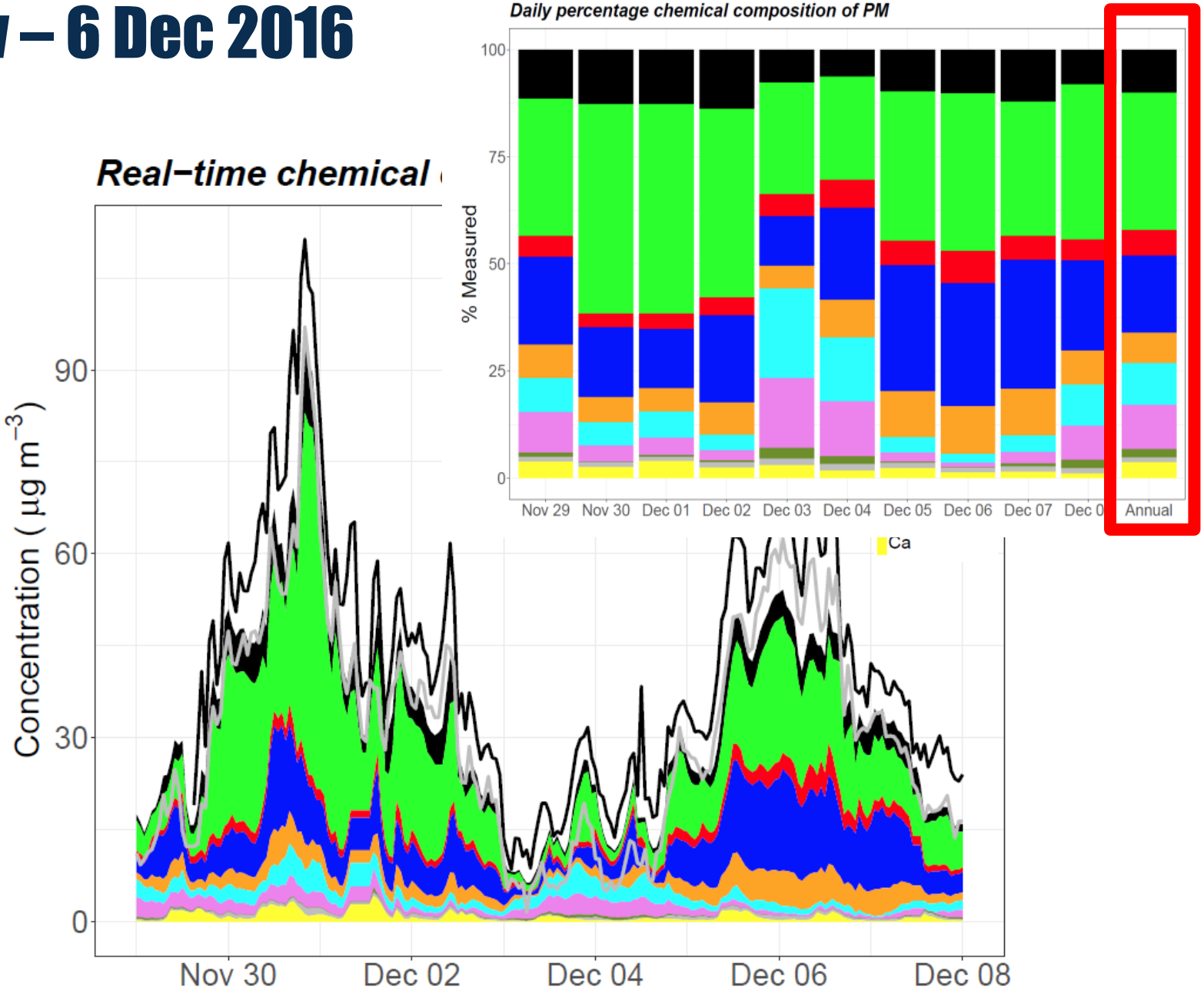

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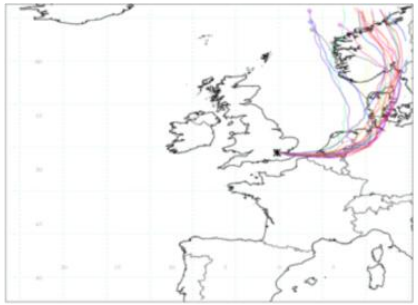

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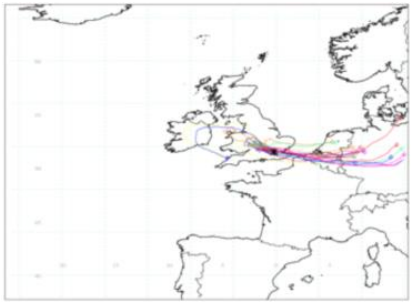
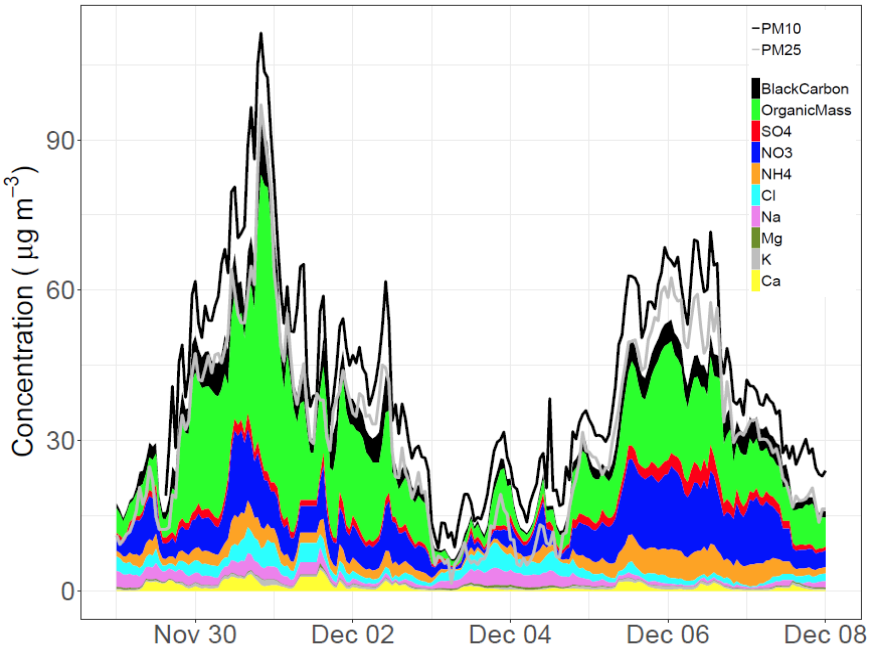
30 Nov





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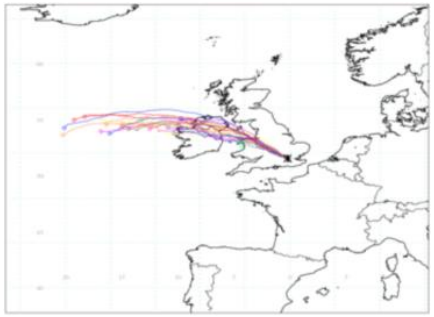

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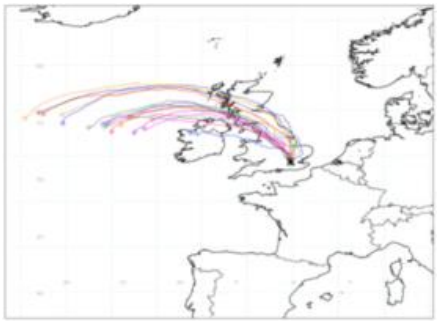

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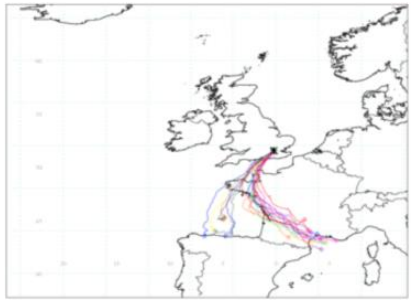

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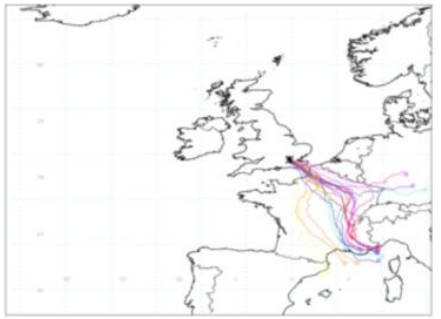

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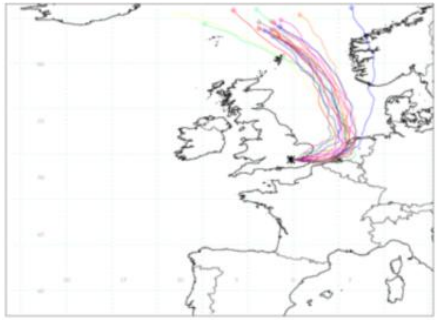
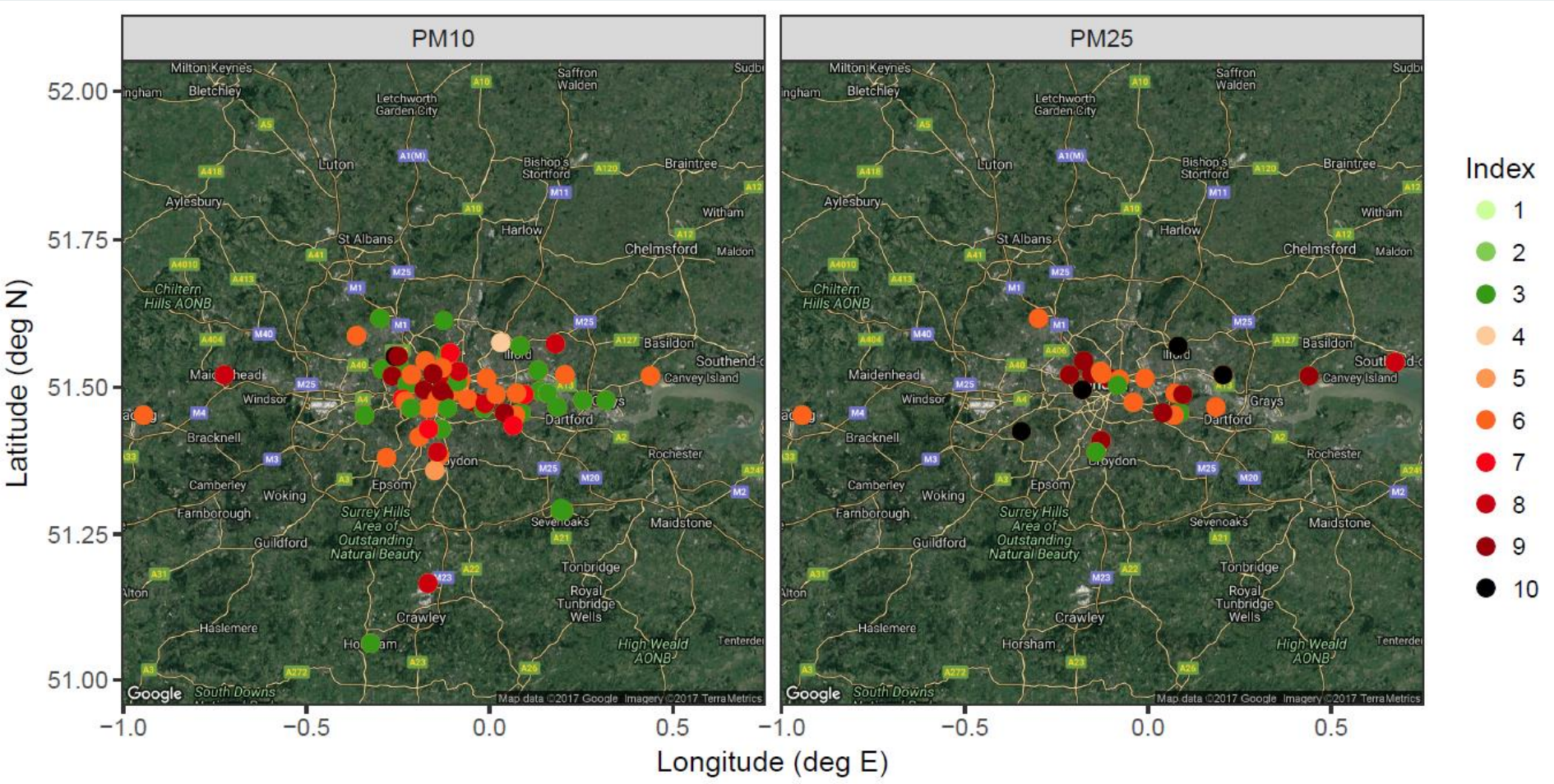


17 – 26 Jan 2017



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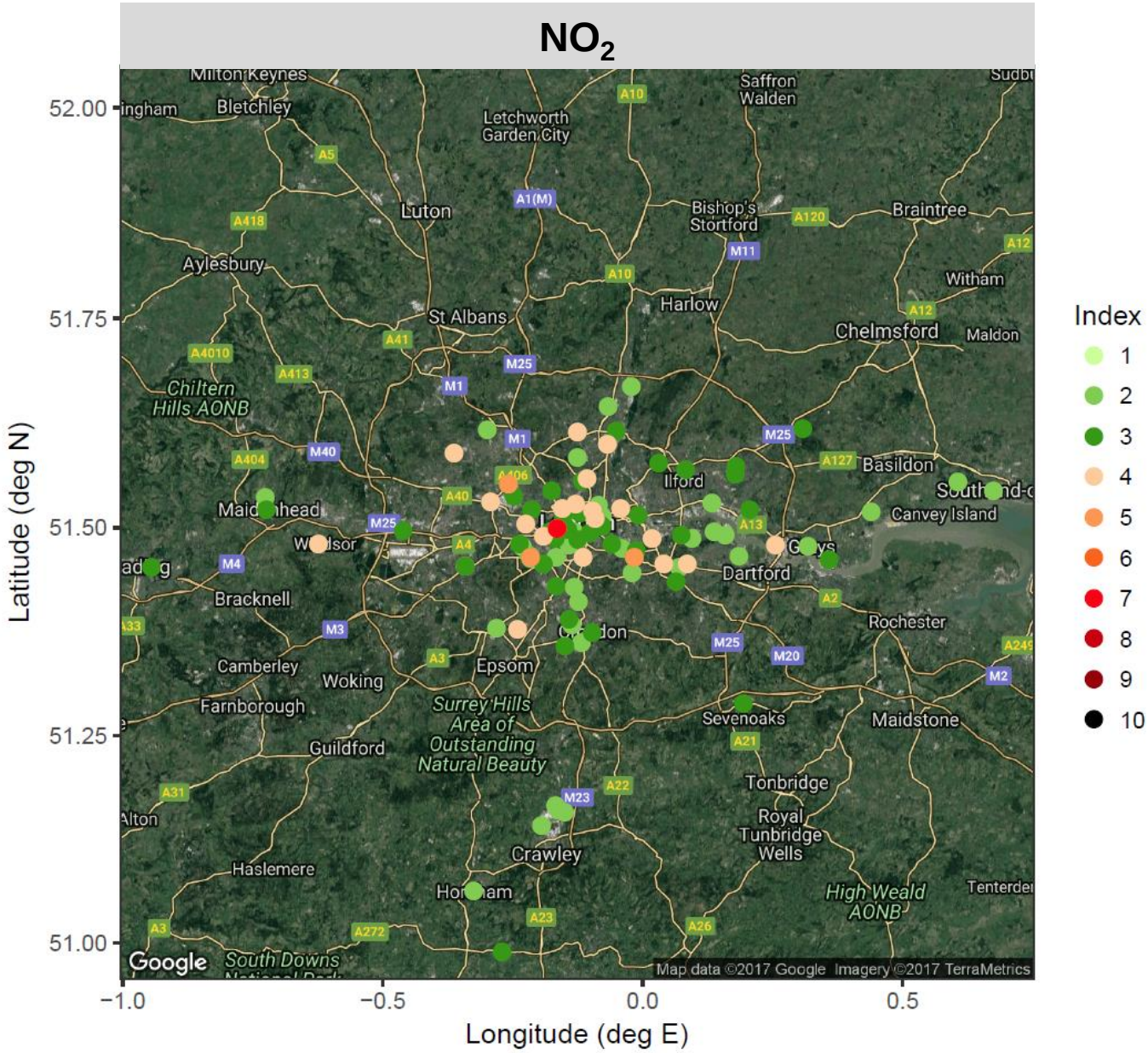

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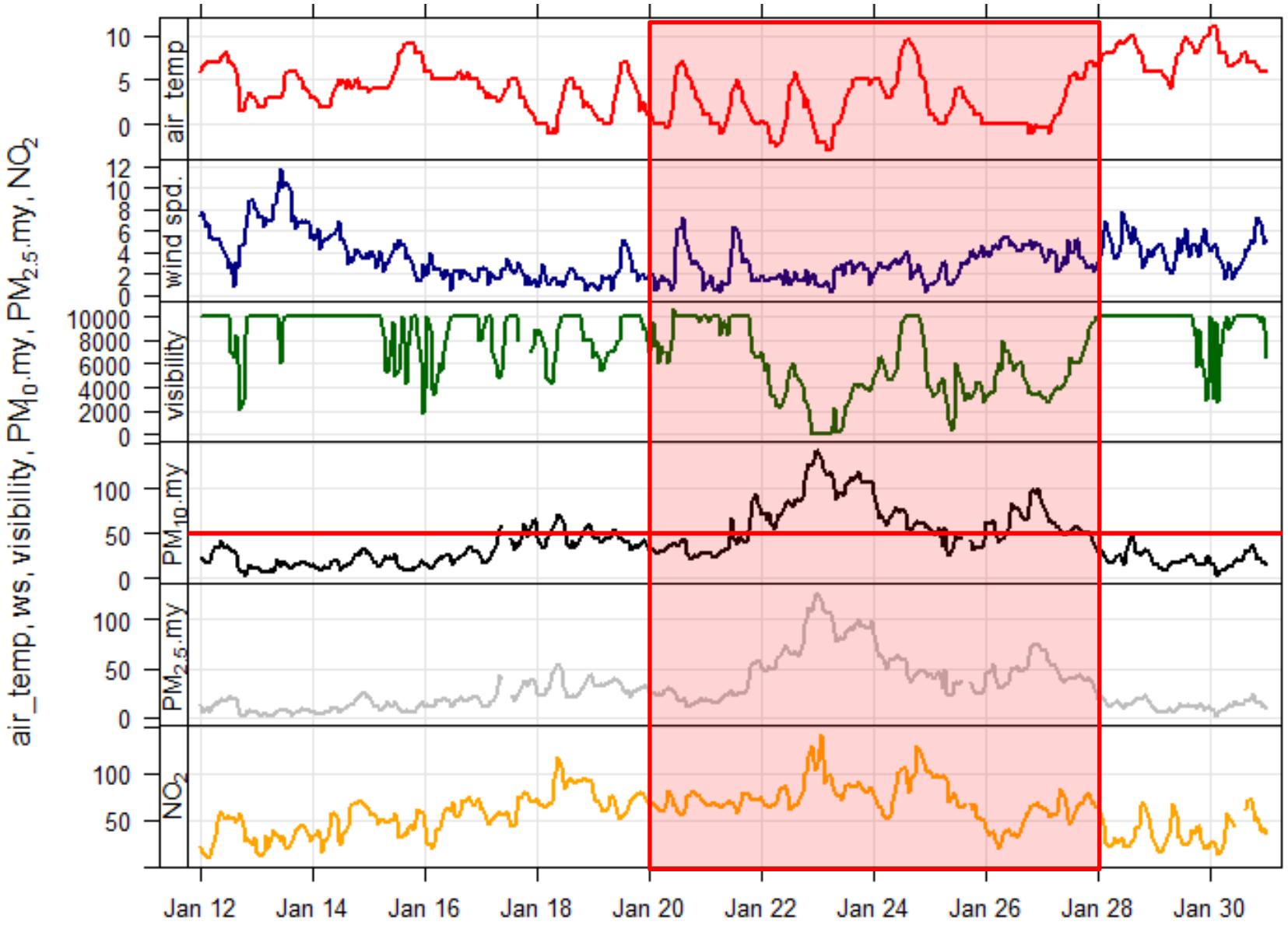

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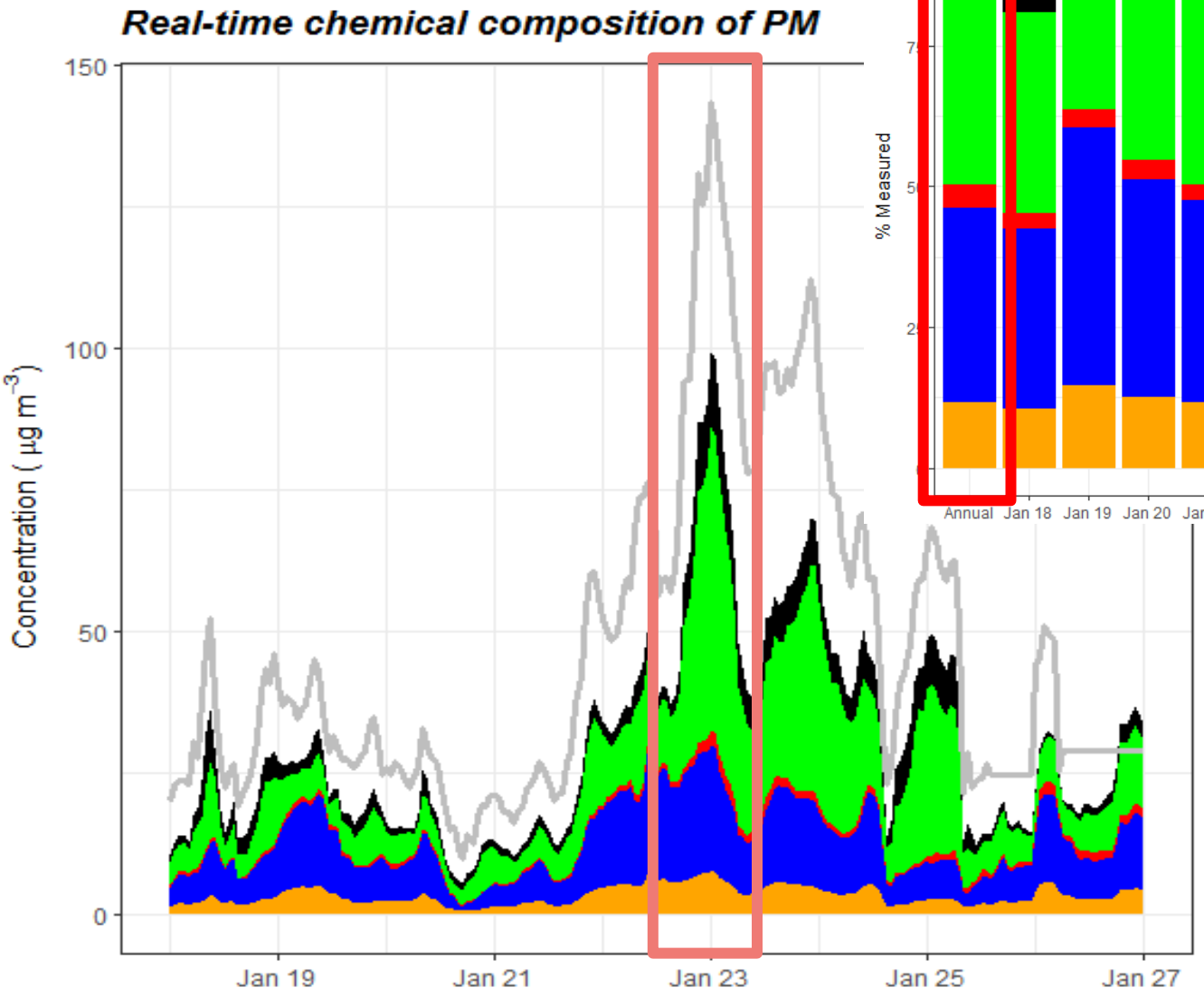

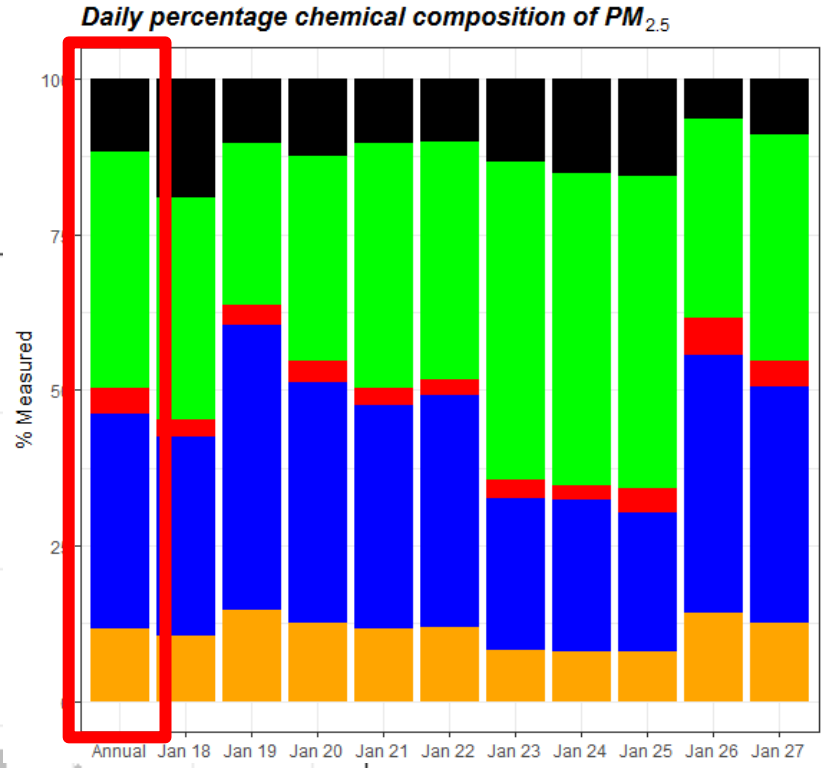

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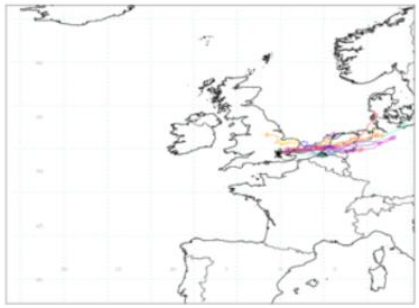

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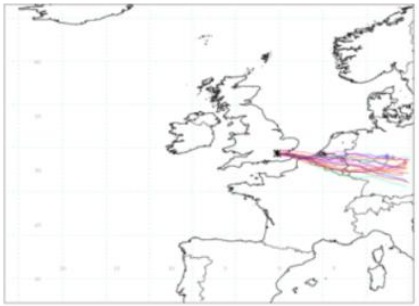

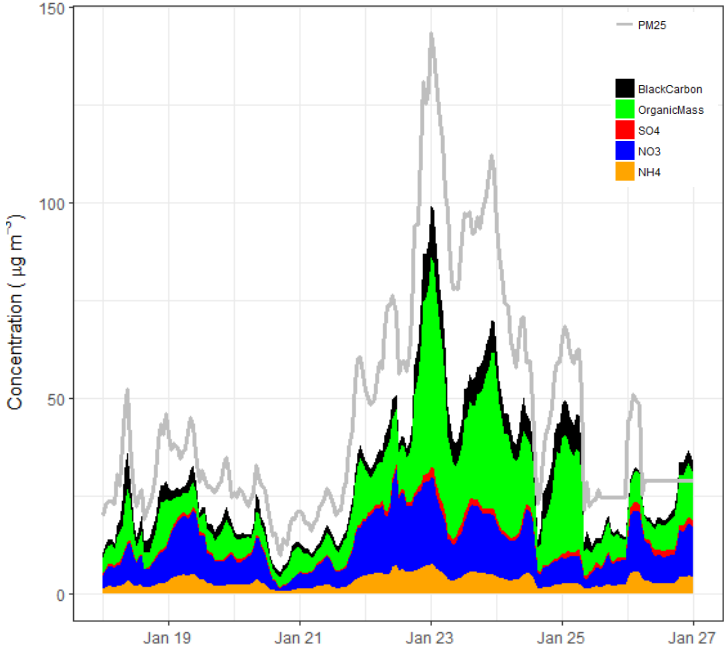

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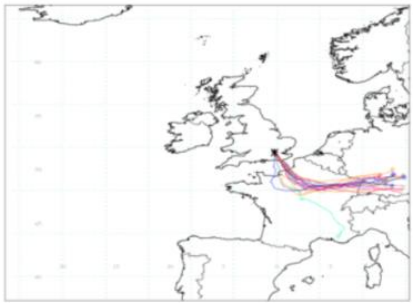

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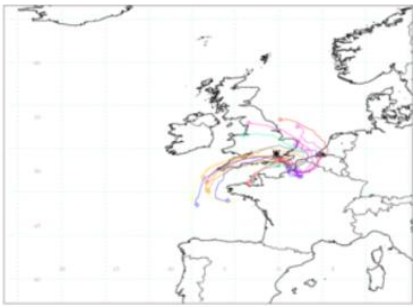

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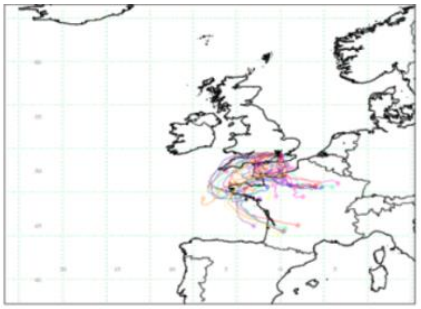

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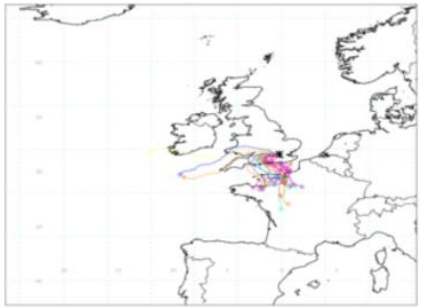

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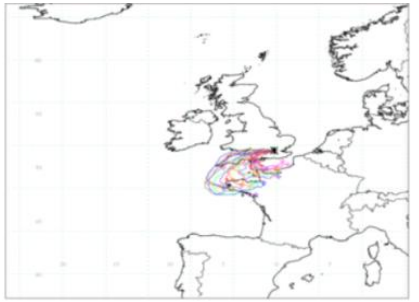
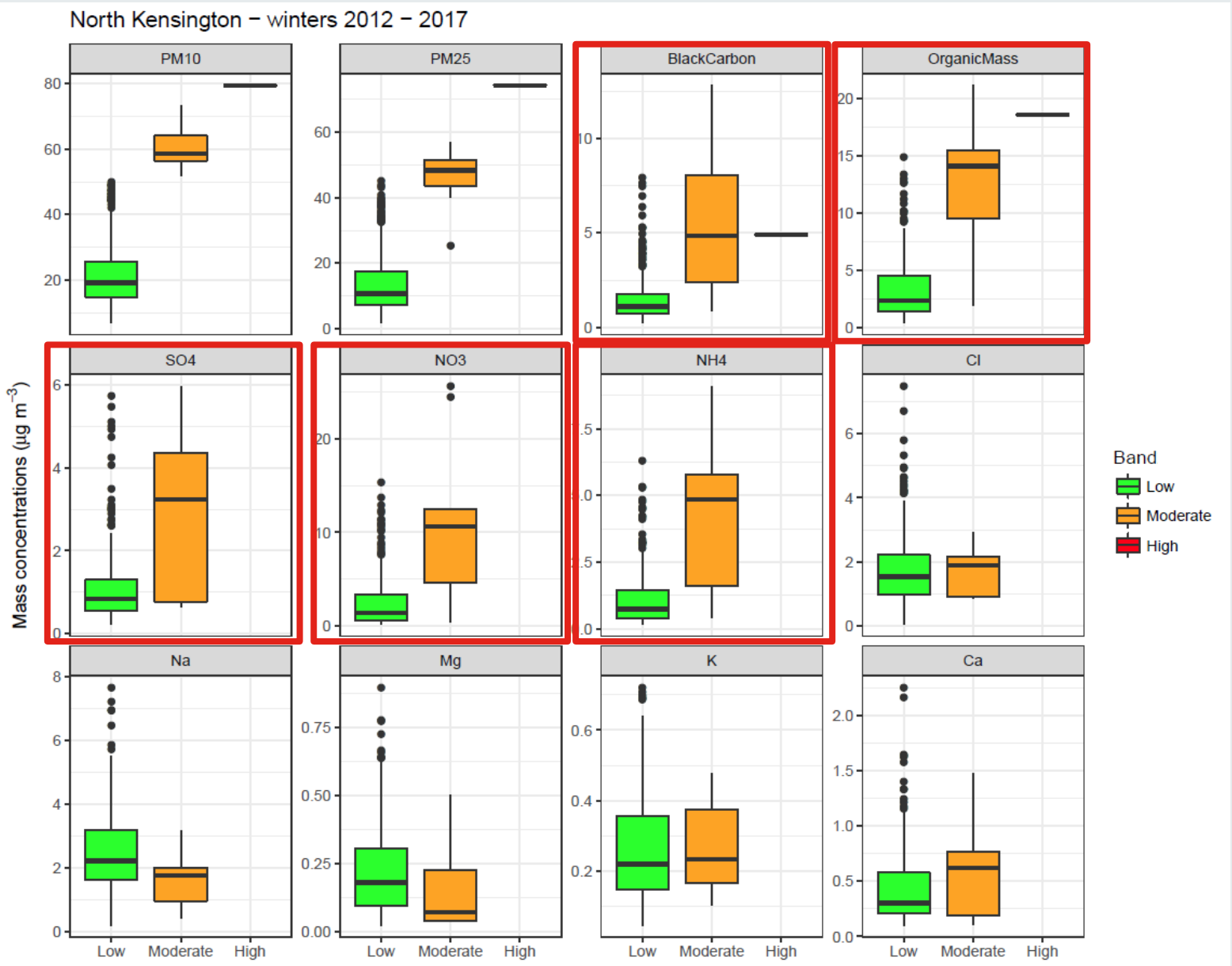


Analysis of recent smog episodes

What is the modern winter smog made of?
What were the implications in visibility?

Composition of modern winter smog

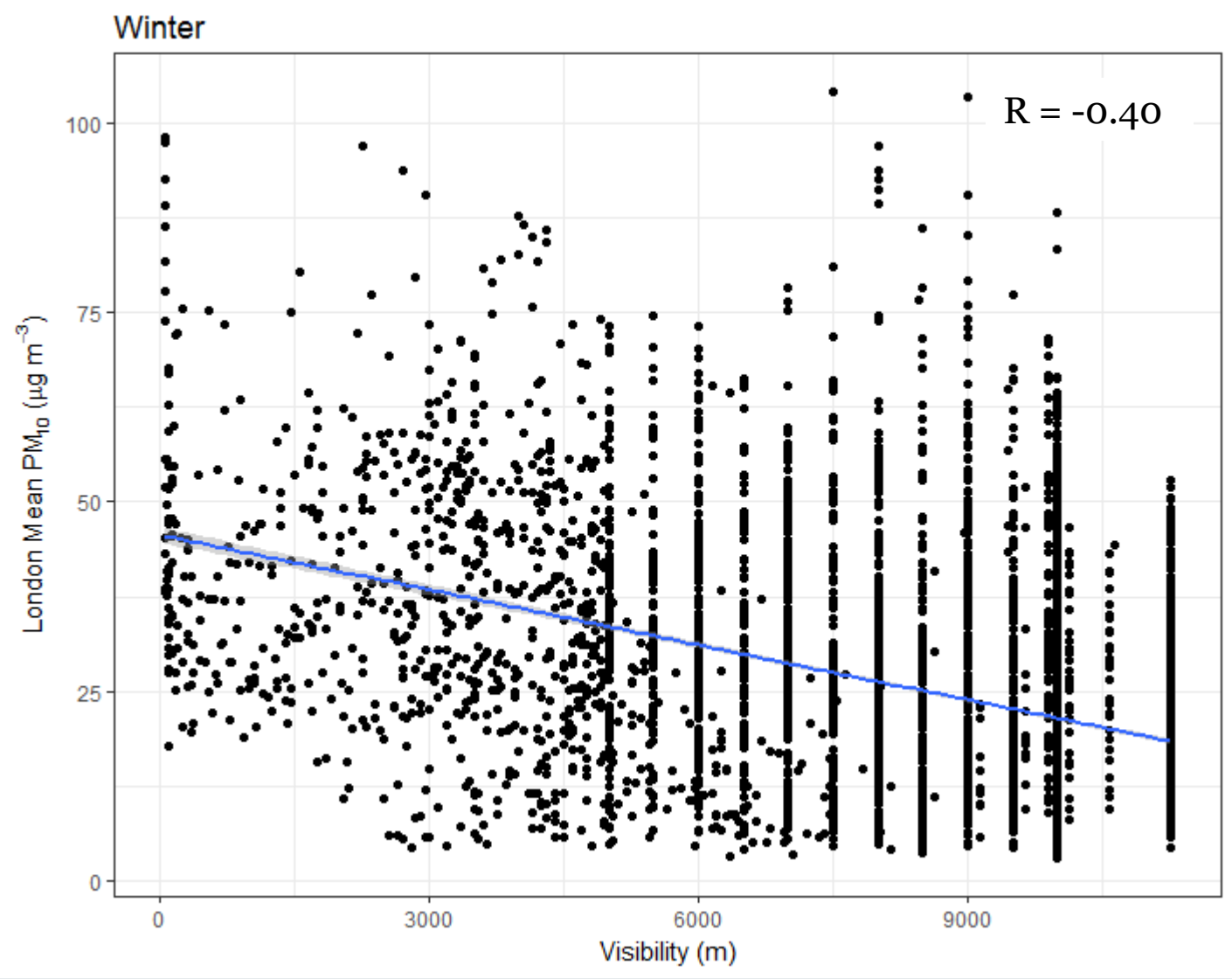


Sources of winter smog

PM in winter episodes is made of:

- **Black carbon** from **traffic emissions (local source)**
- **Organic mass** from **traffic and wood burning (local)**
- **Sulphate** from **coal & oil burning** and **nitrate from gas and traffic (diesel) (long-range transport)**
- **Ammonium** from **agriculture & farming (long-range transport)**

Winter smog and visibility (Dec'13 – Feb'17)



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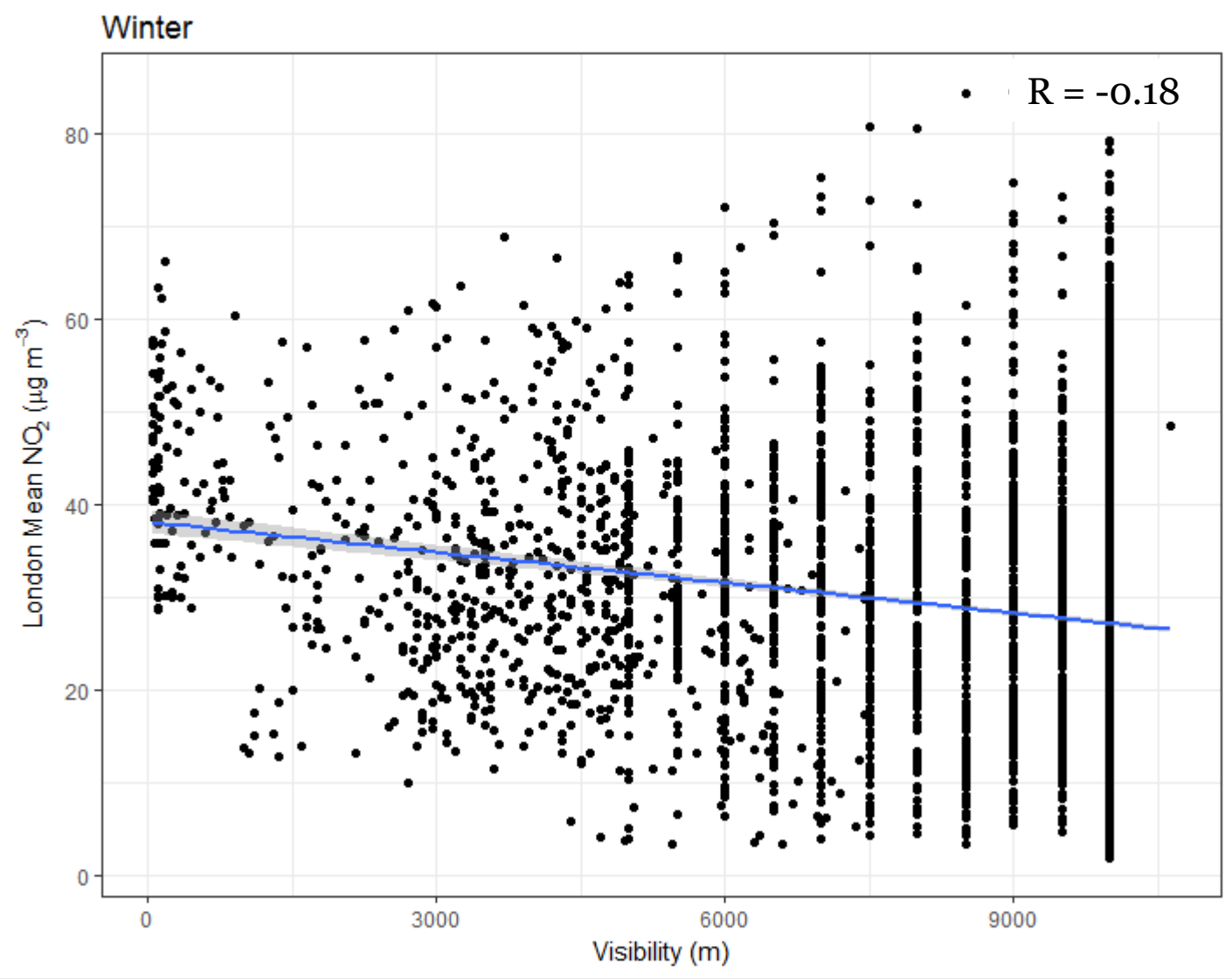
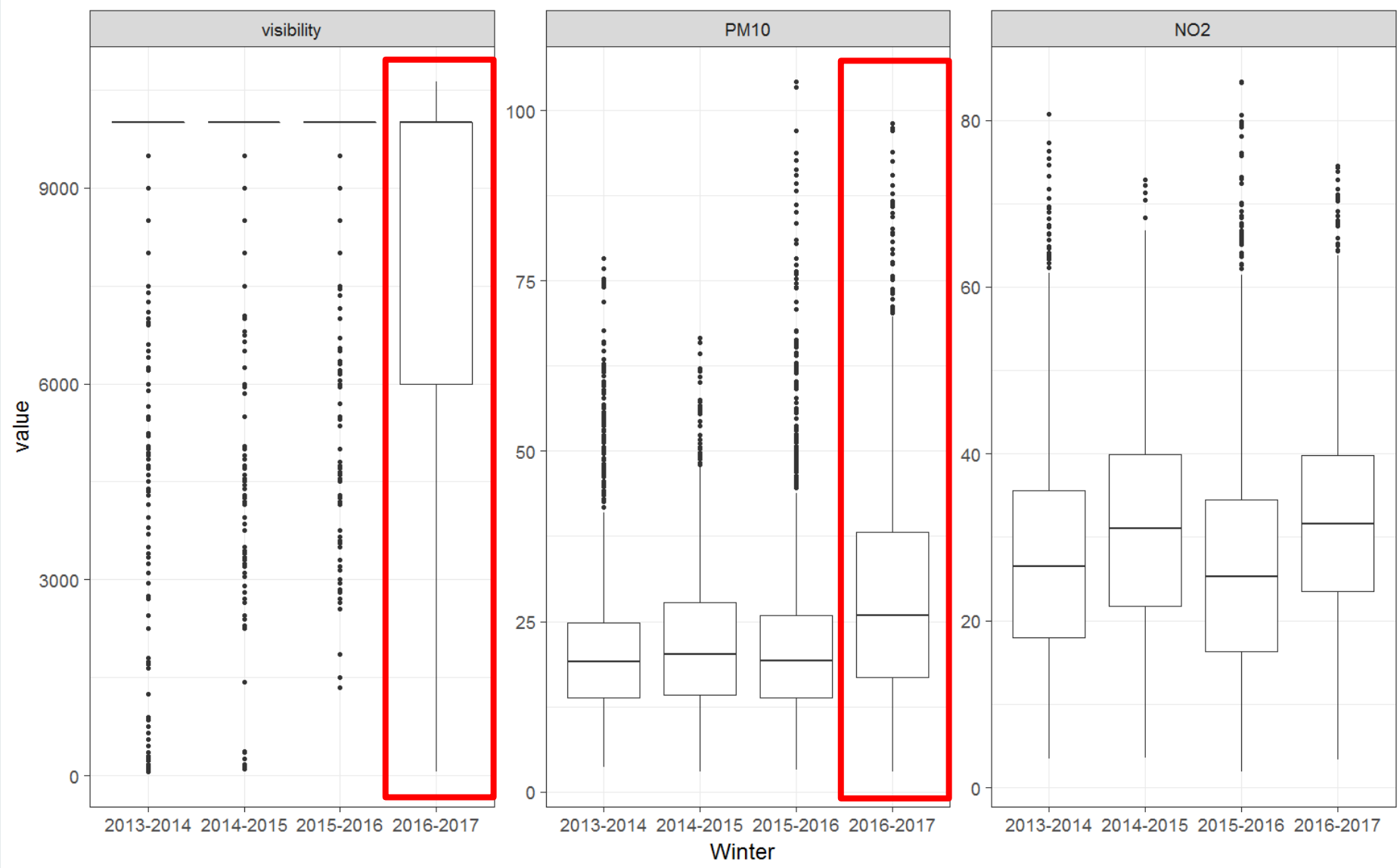


Are winter smog episodes more frequent?

Trends in recent winters



Conclusions

Conclusions

Is there an increase in the frequency of winter smogs?

- **Frequency** sites/days **with Moderate / High / V. High indexes** for **winter PM10** are increasing **since 2014**
- **PM composition** during episodes dominated by **organics, black carbon, ammonium sulphate and ammonium nitrate**
- **Traffic and wood burning** (local origin)
- **Other cities traffic, agricultural, industry** (distant origin)

Moderate correlation with winter PM_{10} concentrations and visibility

- **Increase** in the median **winter PM10** concentrations since winter 2013-14, associated **with a reduction in visibility**
- You can see winter smog if you know where to look

The eyes began to smart and in walking on pavements cartiers were met leading their horses into shops in the daytime – we can scarcely say in the daylight
Angus Smith (1872)

Discussion points

Can London control its winter smogs?

- **Other cities in Europe** and around the world have a suit of measures **during pollution episodes**
- Reduction traffic speed, free public transport, alternate day driving, restrictions on industry, …

What are the sources that we need to track?

- **Traffic and wood burning** are the local sources with major impact during the episodes
- **Secondary particles** also contributed to elevated PM
  - Long-range transport
  - SOA from wood burning (local source)

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