Untangling the influence of air-mass origin in interpreting composition trends

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The measurement stations

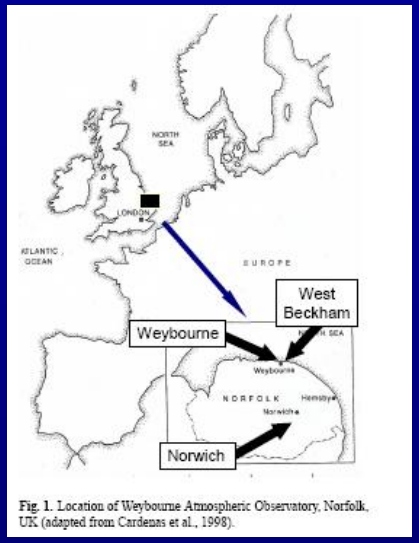

Fig. 1. Location of Weybourne Atmospheric Observatory, Norfolk, UK (adapted from Cardenas et al., 1998).

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The NAME model

- Originally NAME stood for Nuclear Accident ModEl
- **Lagrangian** transport/dispersion model

Numerical

Atmospheric Dispersion

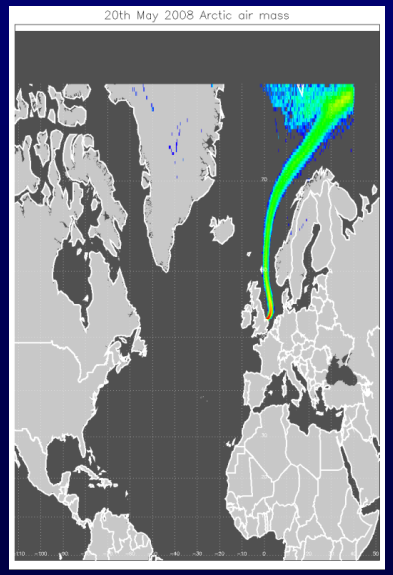
Modelling

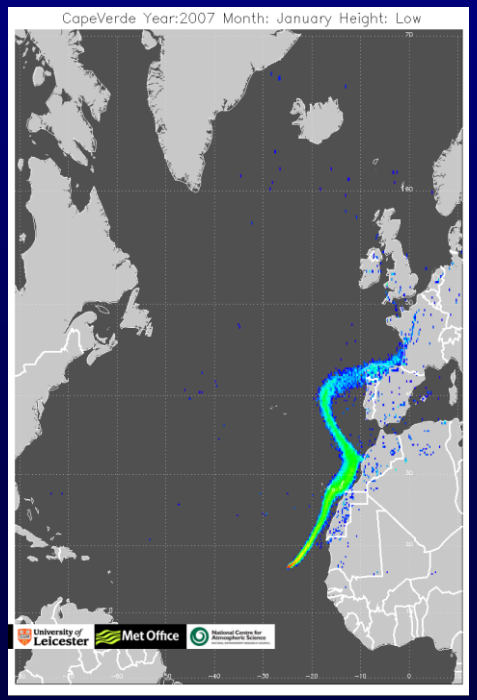
Environment

- Uses Unified model met data and can run with chemistry or for neutral inert particle releases

Run conditions

- 3 hourly release of particles backwards ten days in time (1 or 5 days for London)
- Run at 2 or 3 height ranges (most interested in low level to show interaction with surface emissions)





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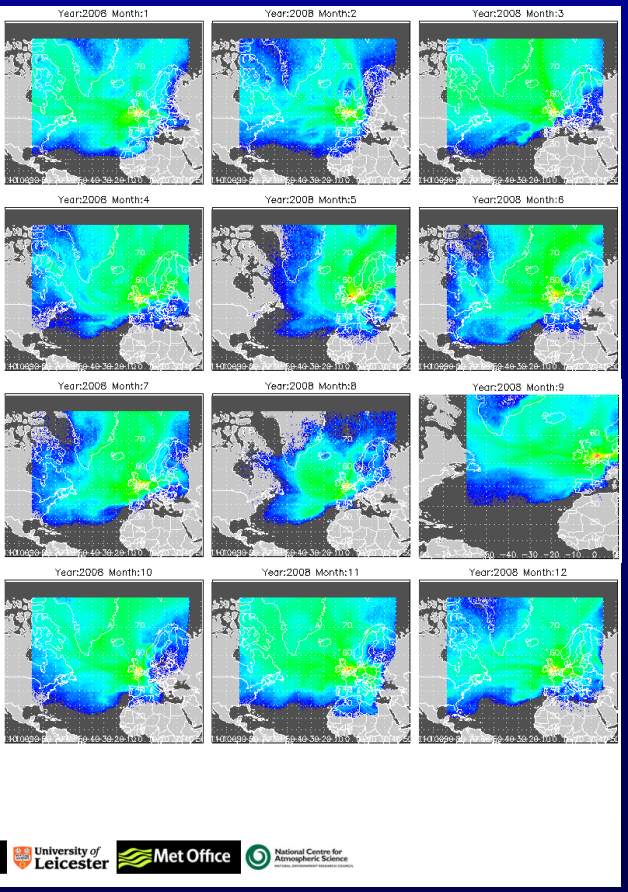
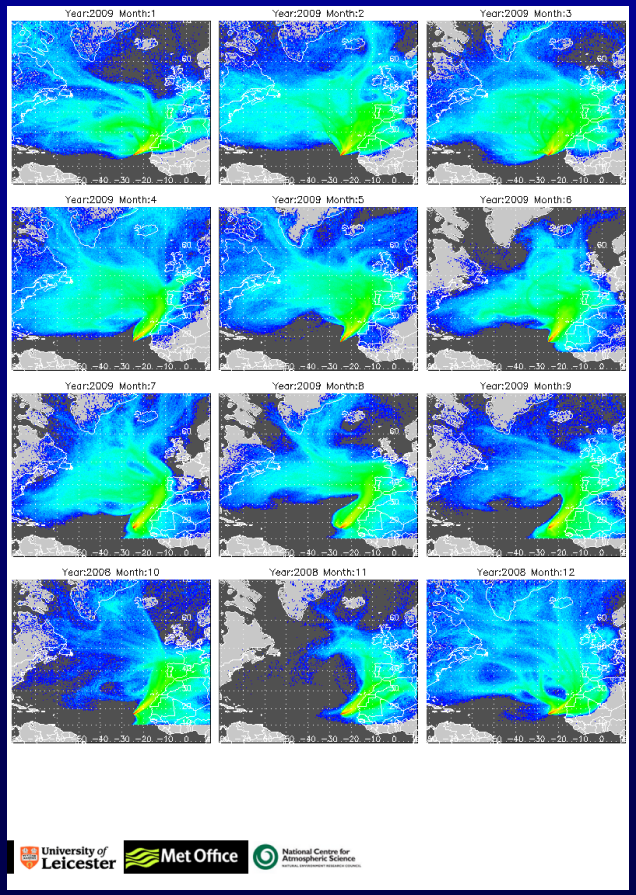
Monthly footprints

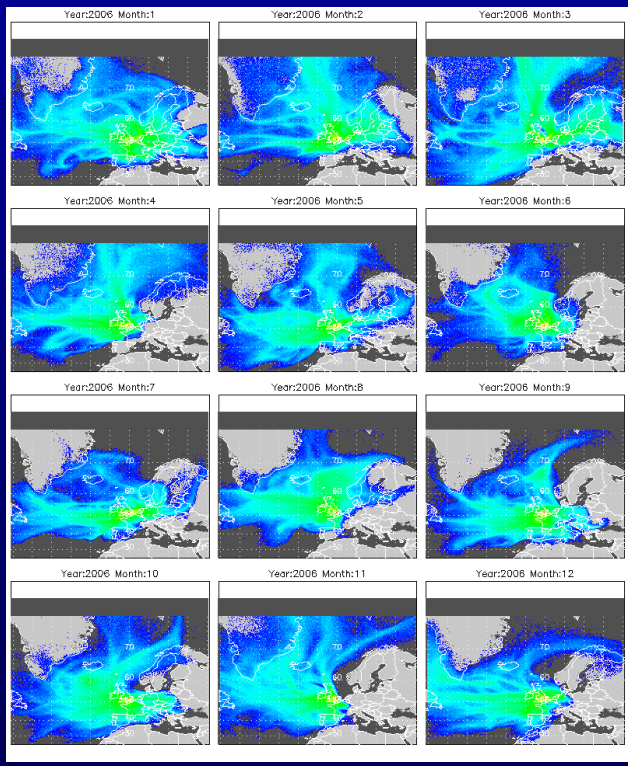
Weybourne



Cape Verde



BT tower



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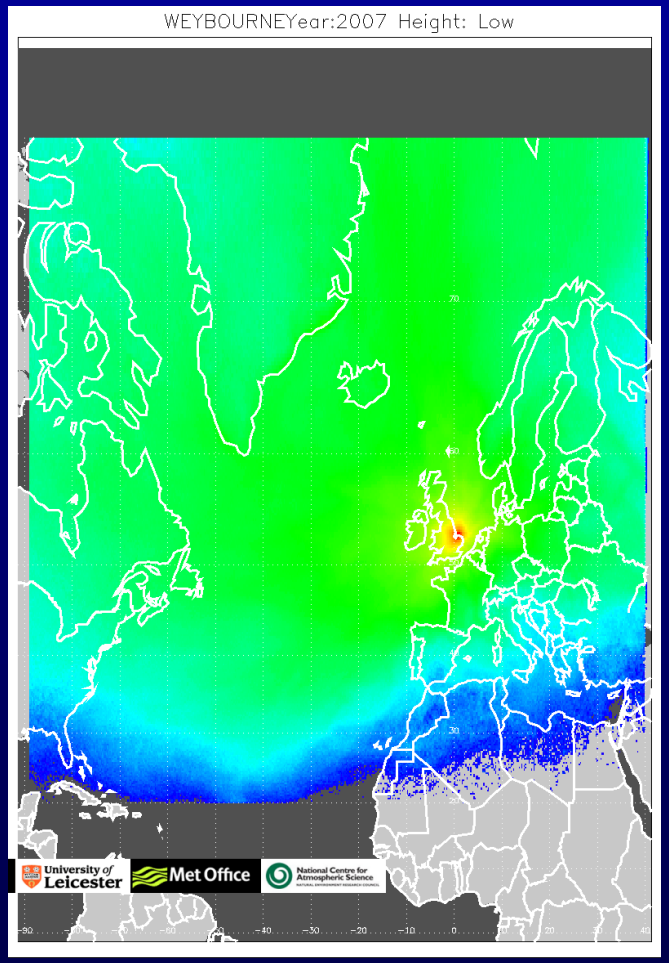
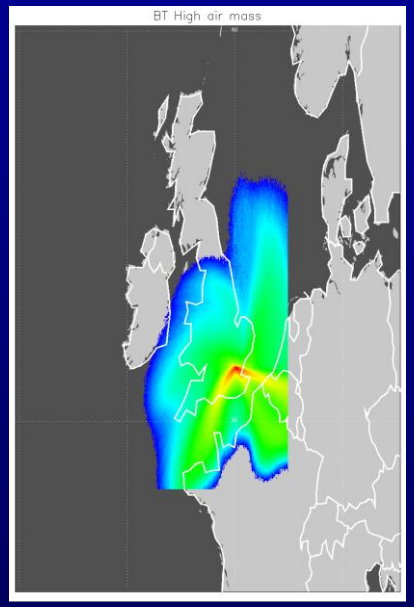
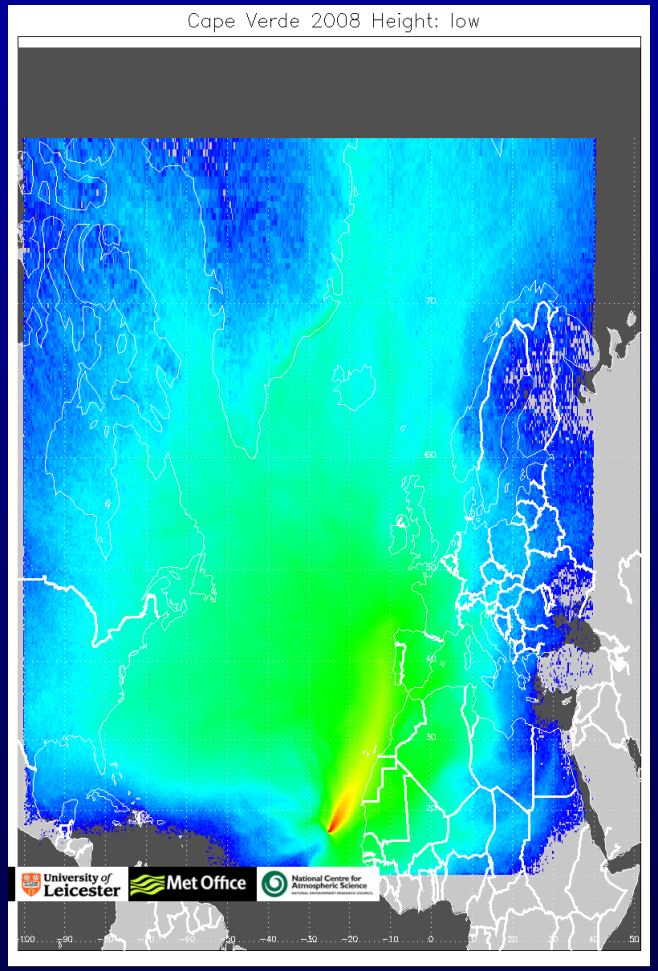
Yearly averaged







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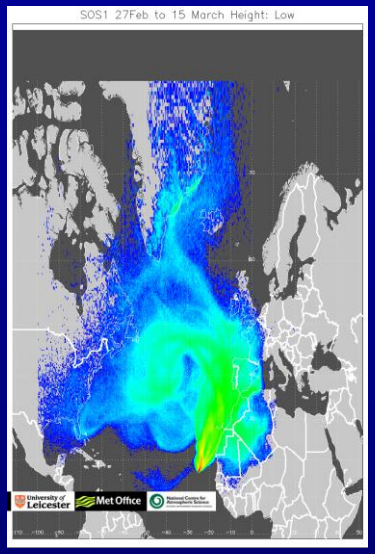
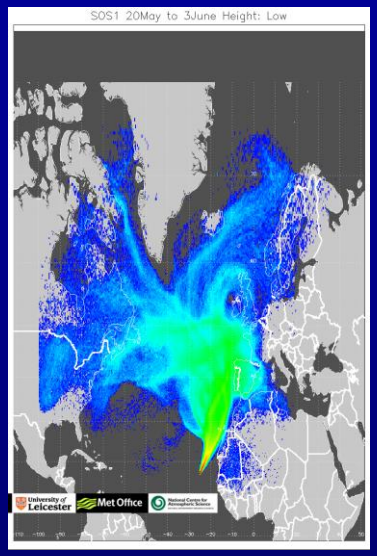
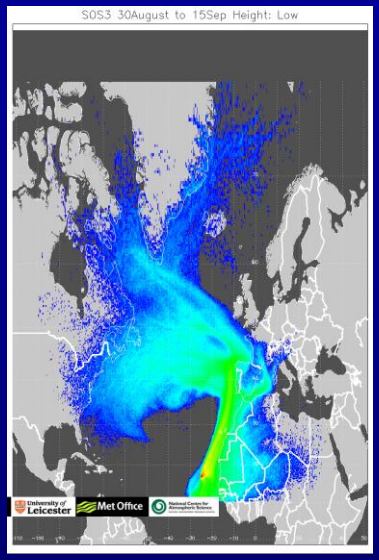
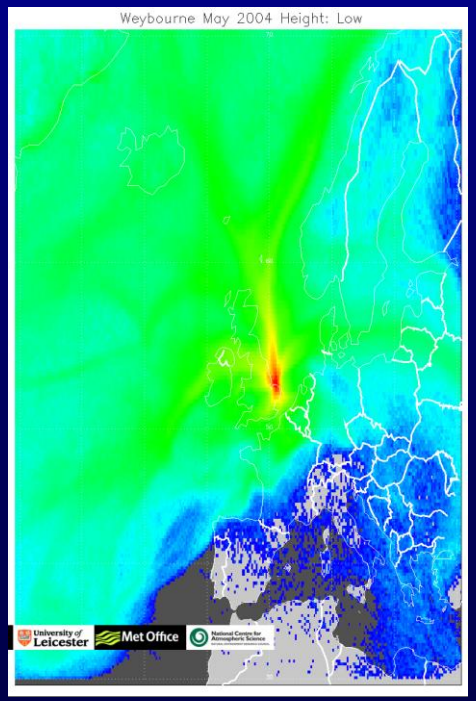
Campaigns: SOS, Cape Verde and TORCH2, Weybourne



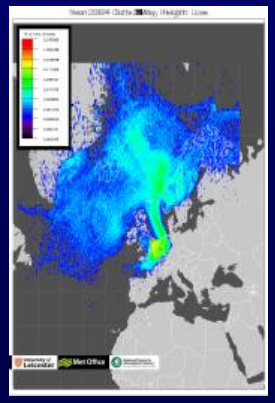


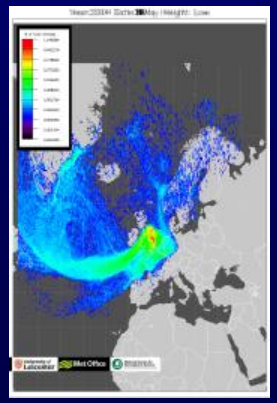


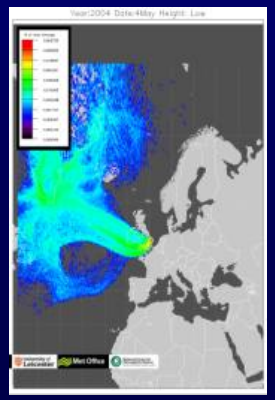
Campaign averaged



Individual days







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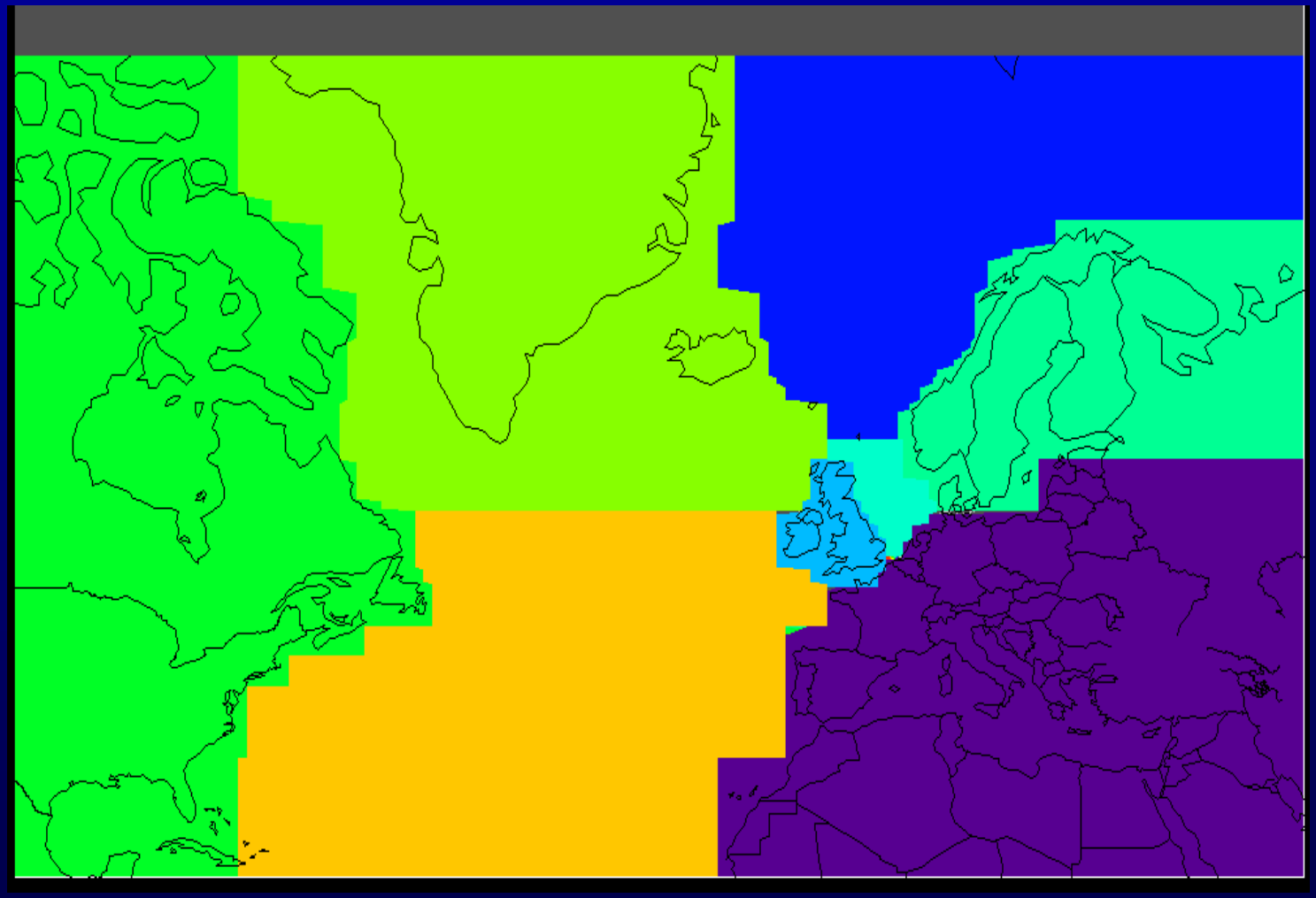
Weybourne air mass sectors



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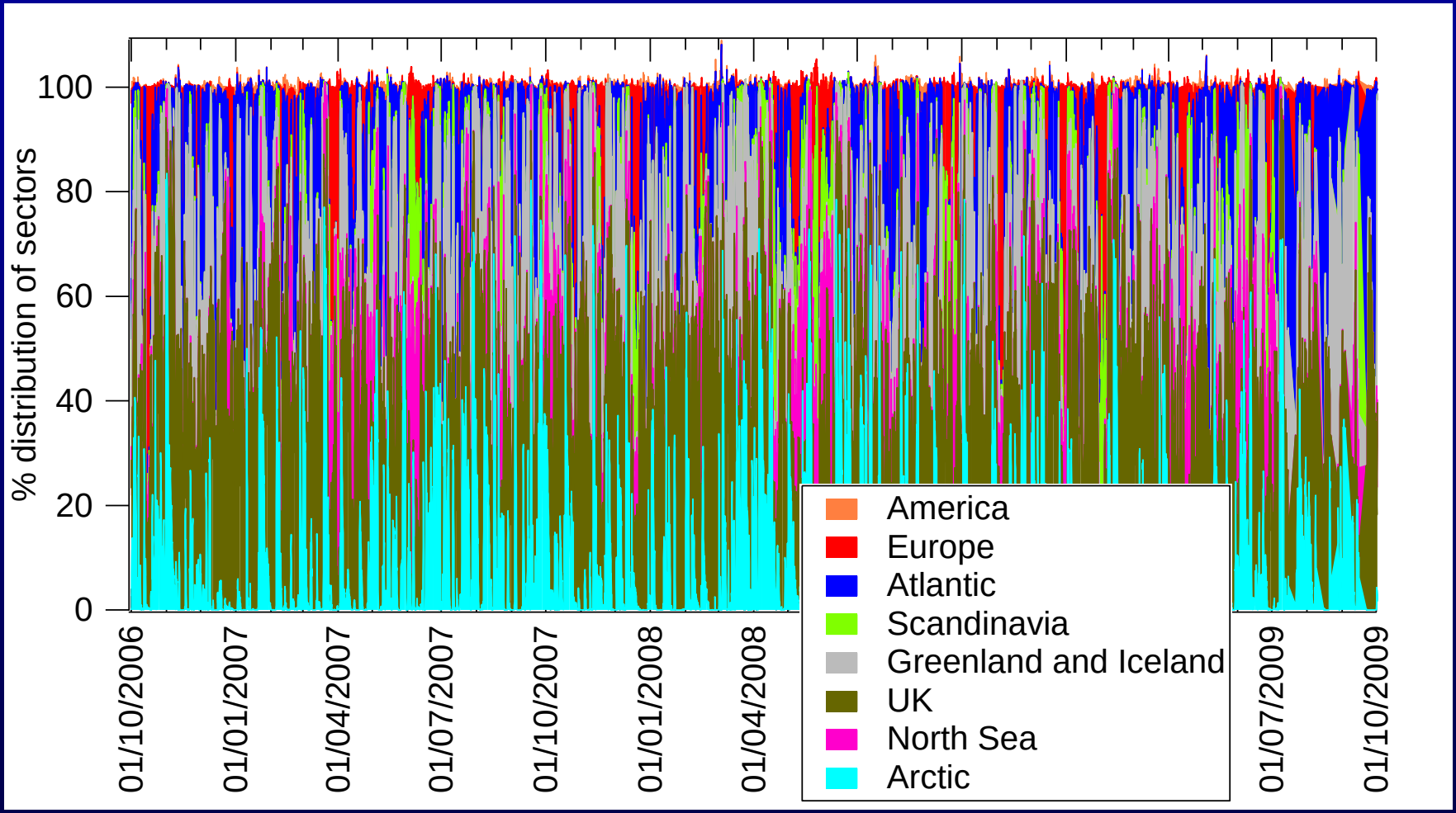
Weybourne regional distribution



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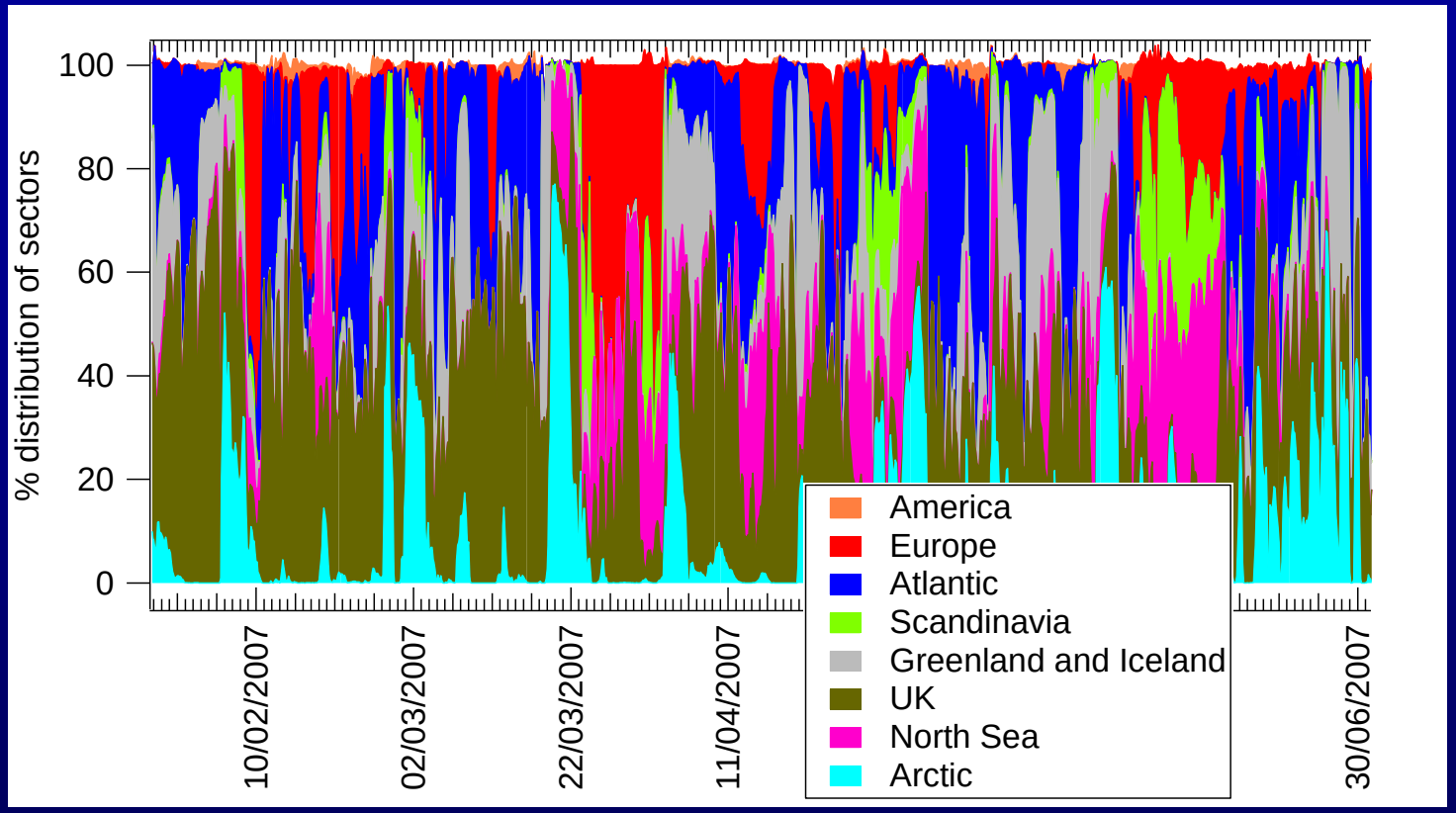
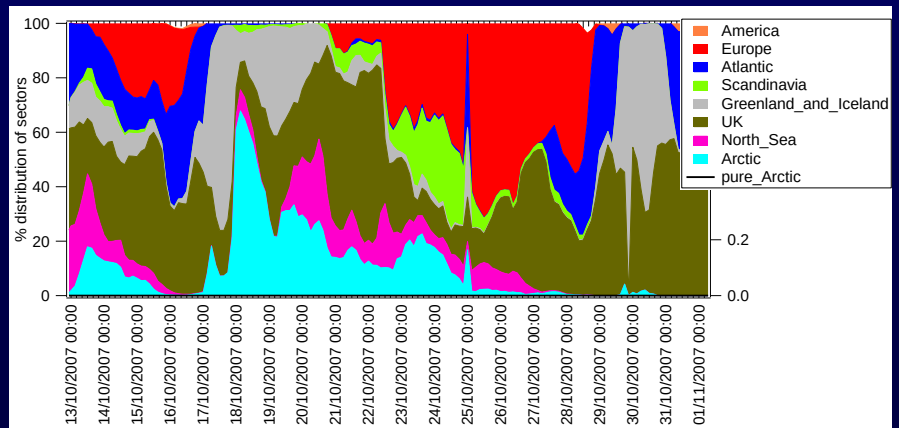
Weybourne regional variations





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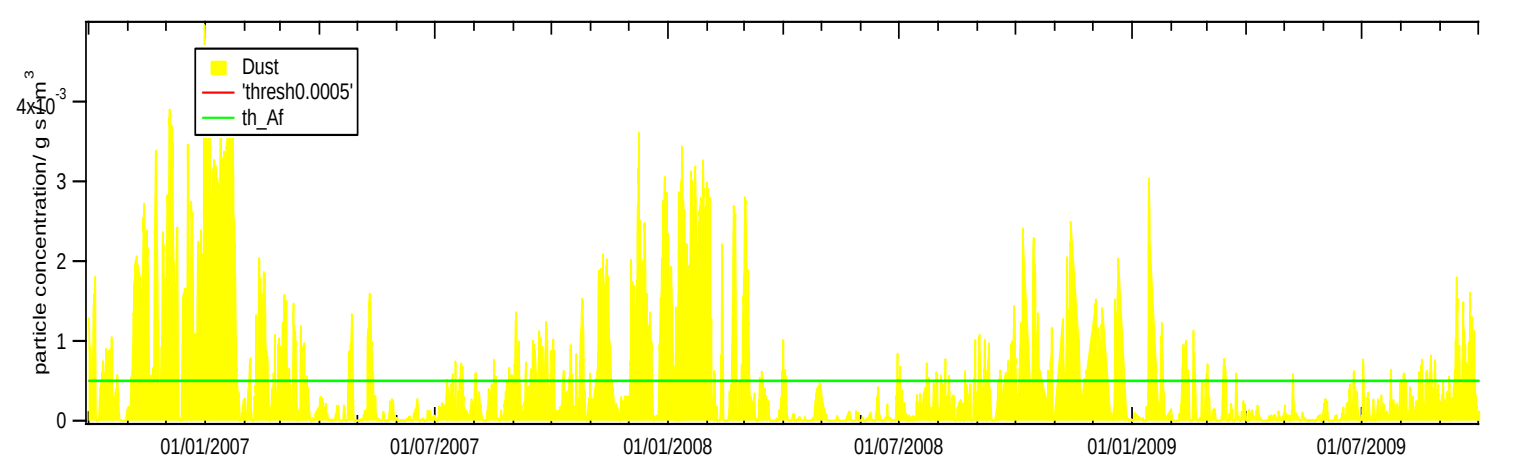
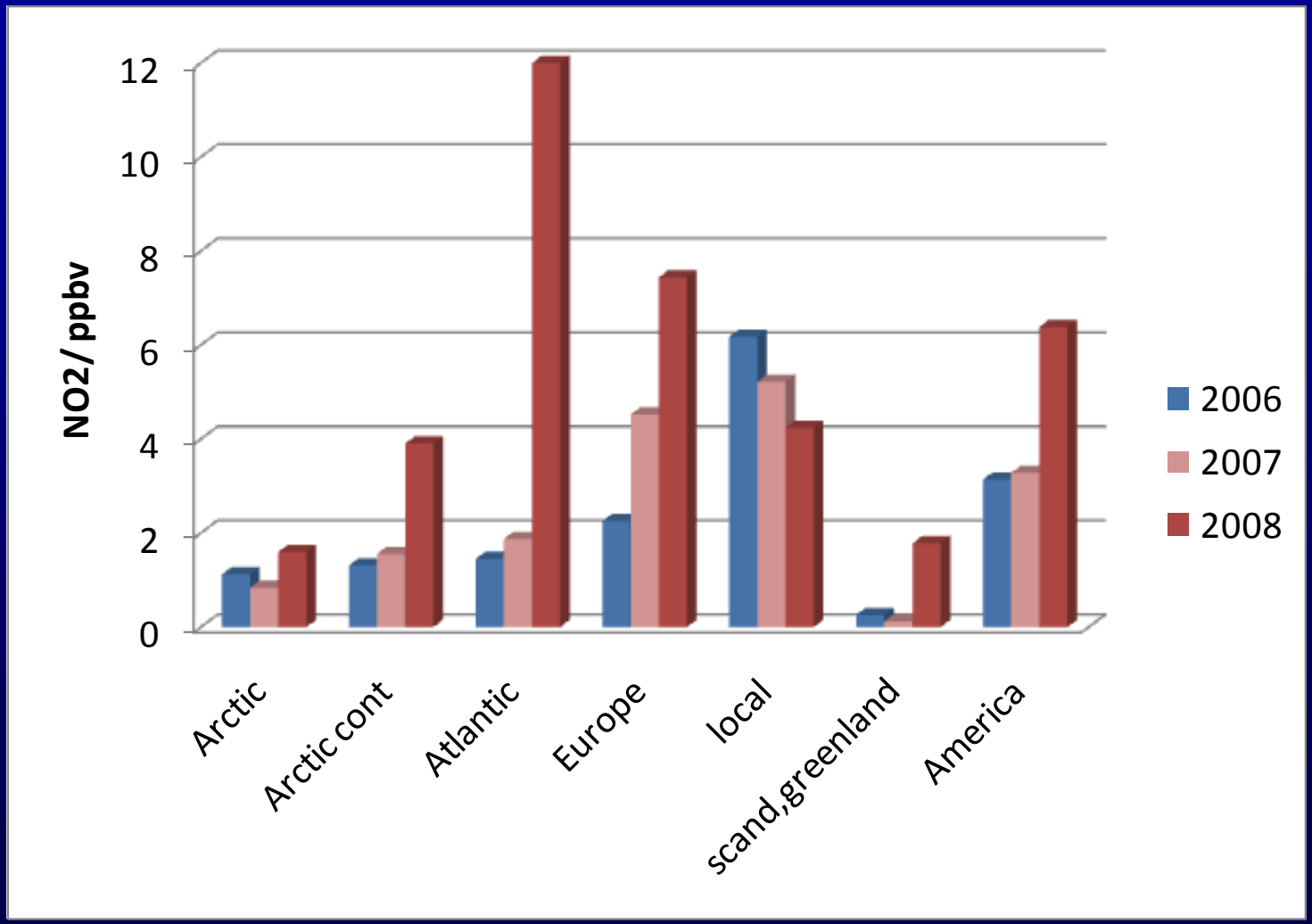
From Regional division to trajectory type

- Derive threshold for each region to decide whether significant influence or proportion of total particle journey
- Combination of which regions covered in transport decides which trajectory type



NO_2: 2006-2008 sectors



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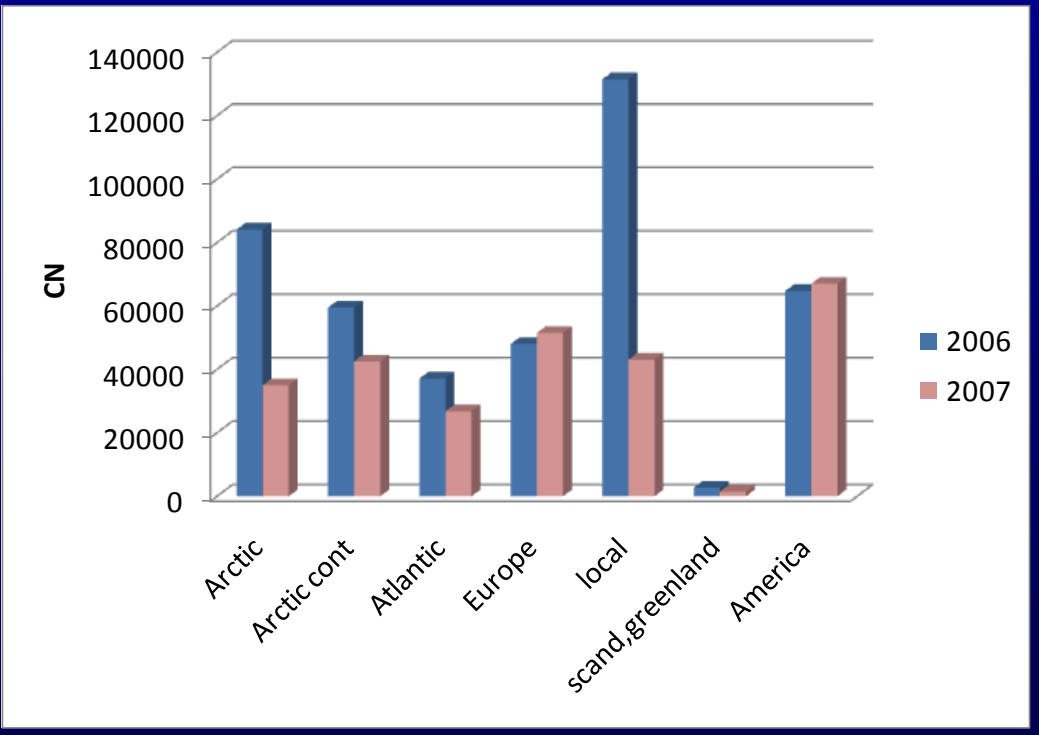
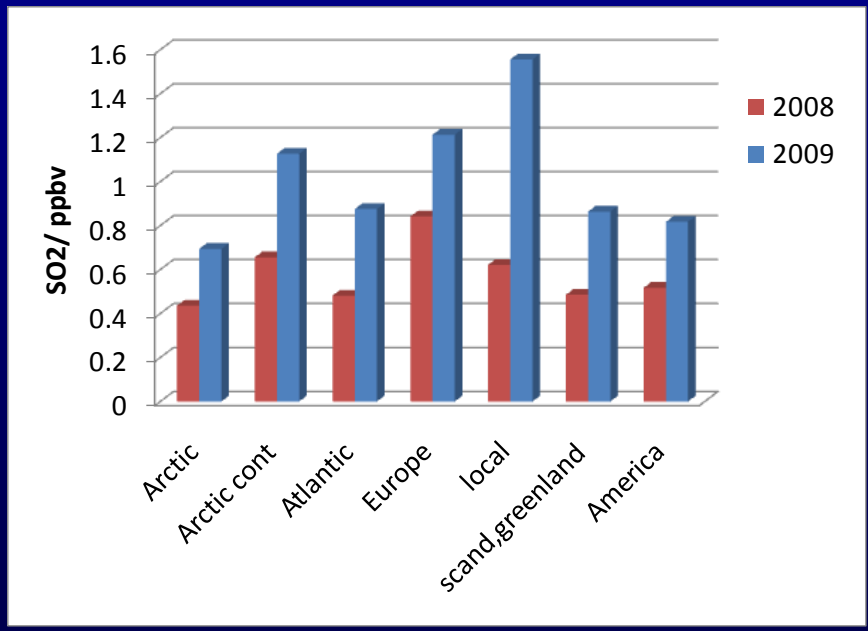
CN and SO2





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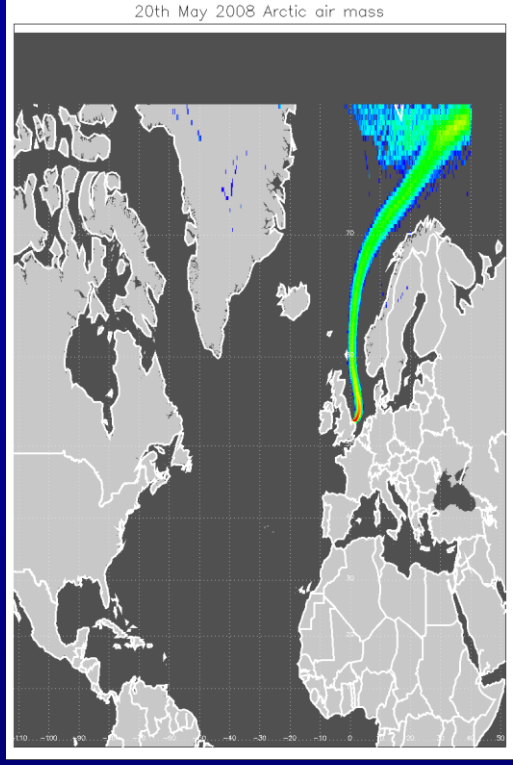
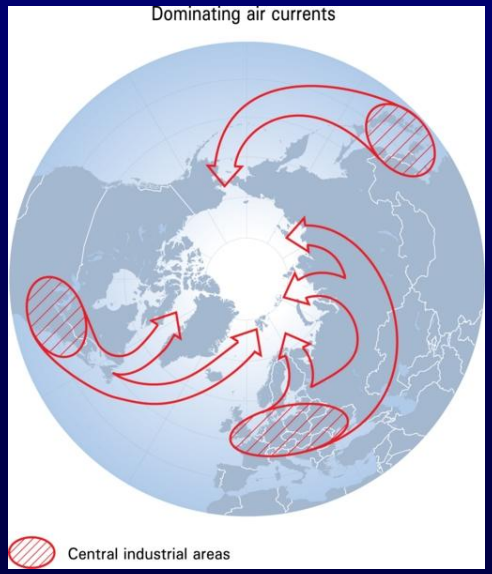
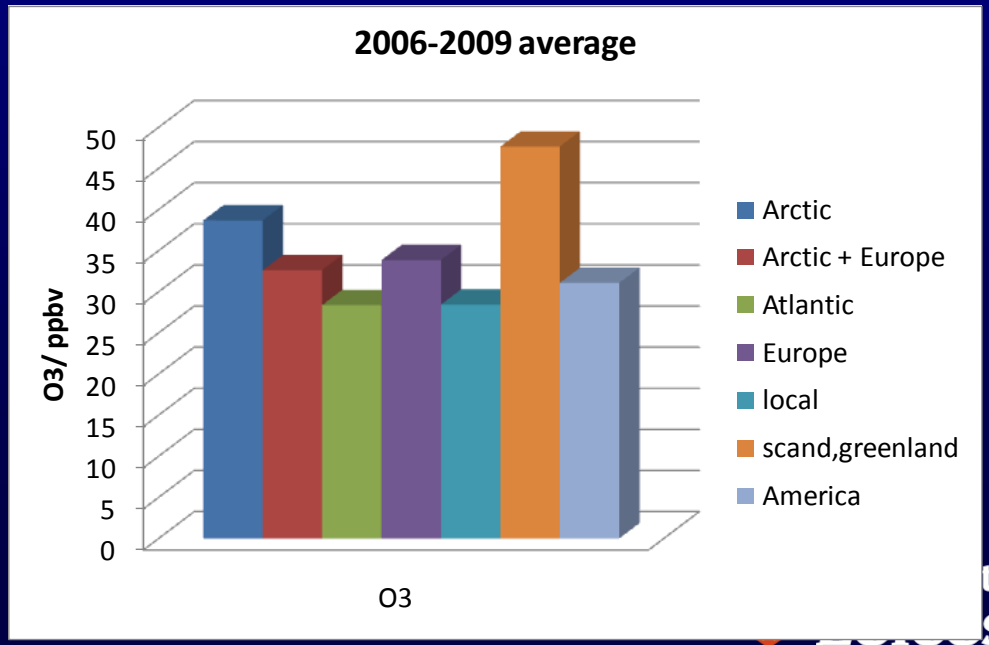
Arctic air masses

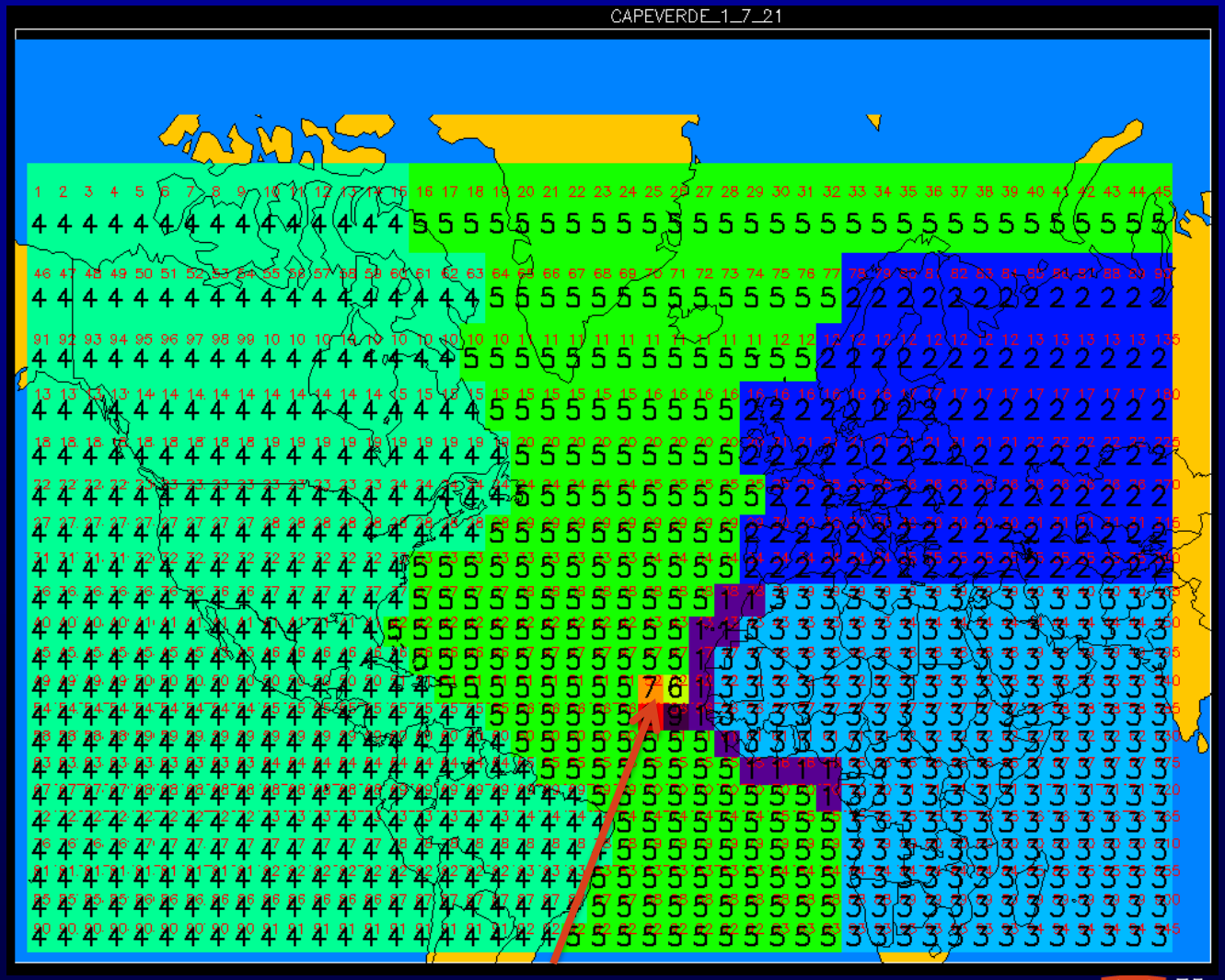
- Arctic and Scandinavian ozone highest
- Run on global model domain to track back 20 days to Asia up to 5000 m elevation



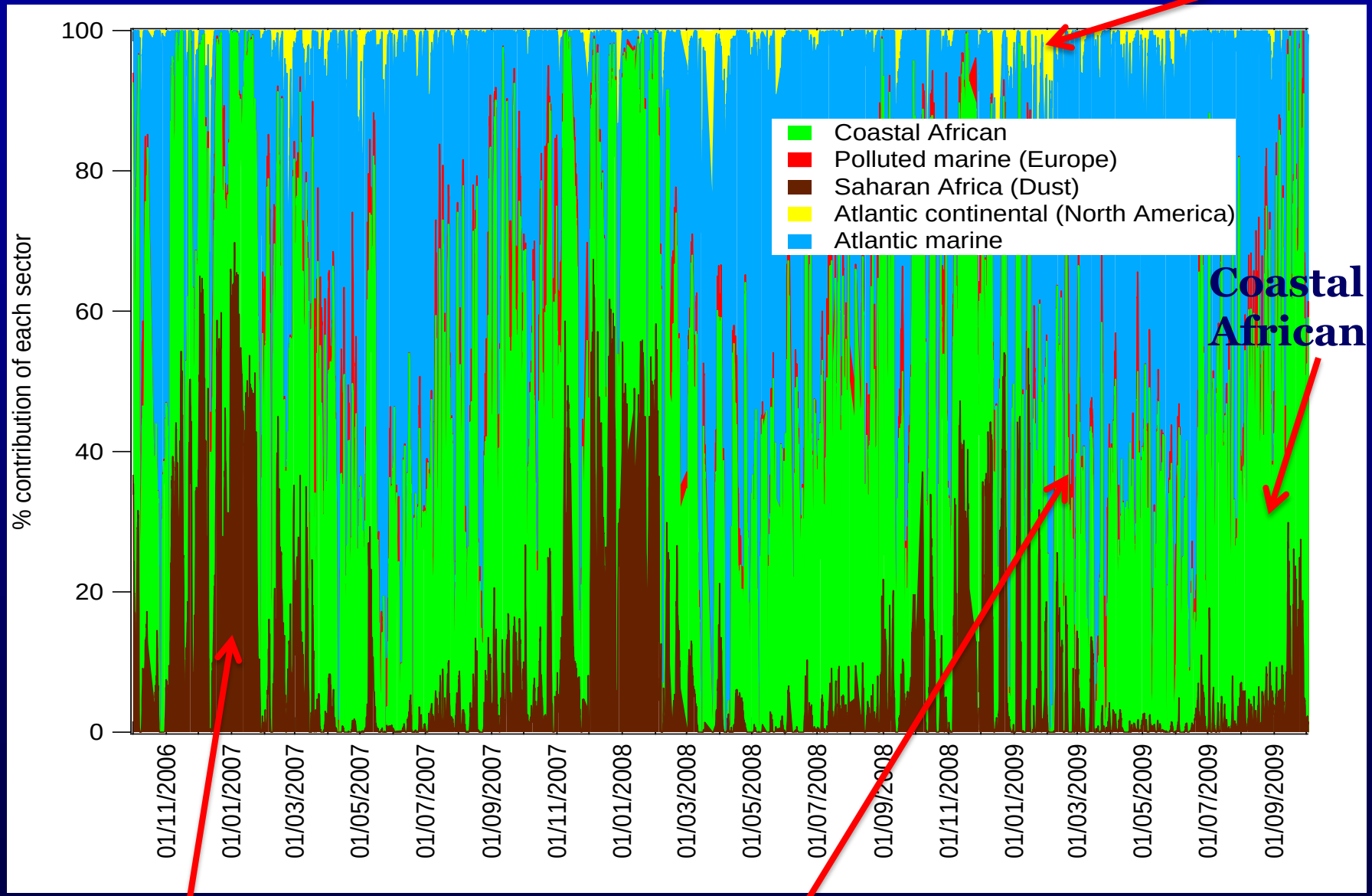




Cape Verde air mass division



Cape Verde air mass division



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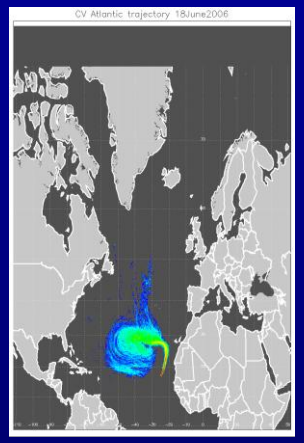
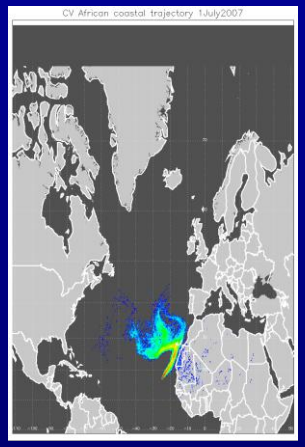
Classification into 7 major trajectory types

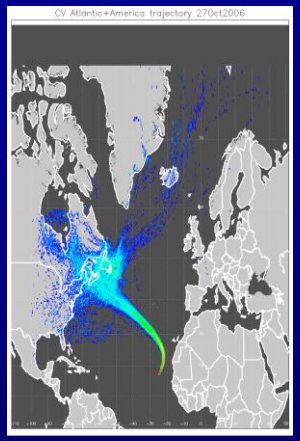
Atlantic Marine



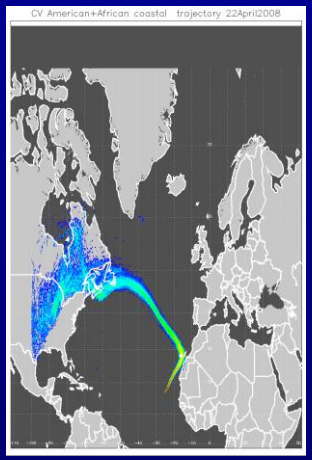
Atlantic and African coast



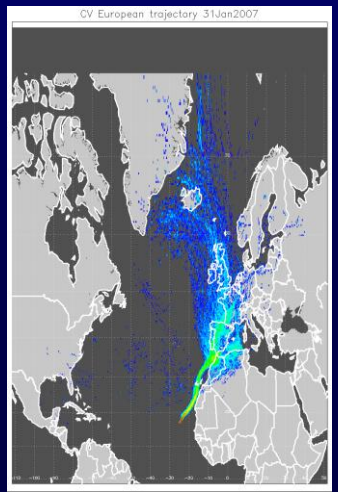
American Continental and Atlantic



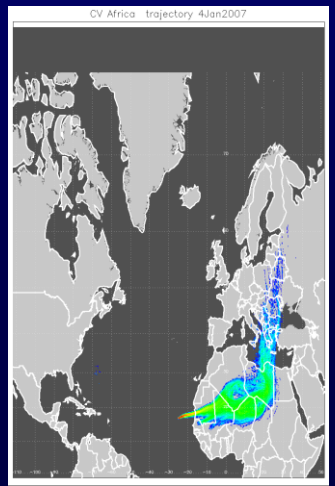
American, Atlantic and African coast



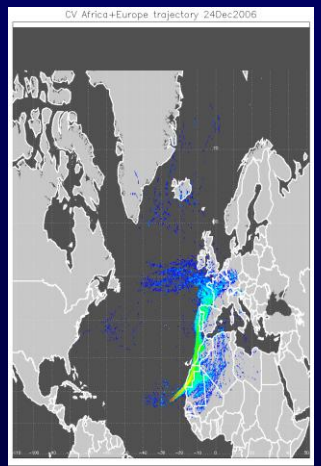
Polluted and marine



Saharan and no Europe



Saharan and Europe



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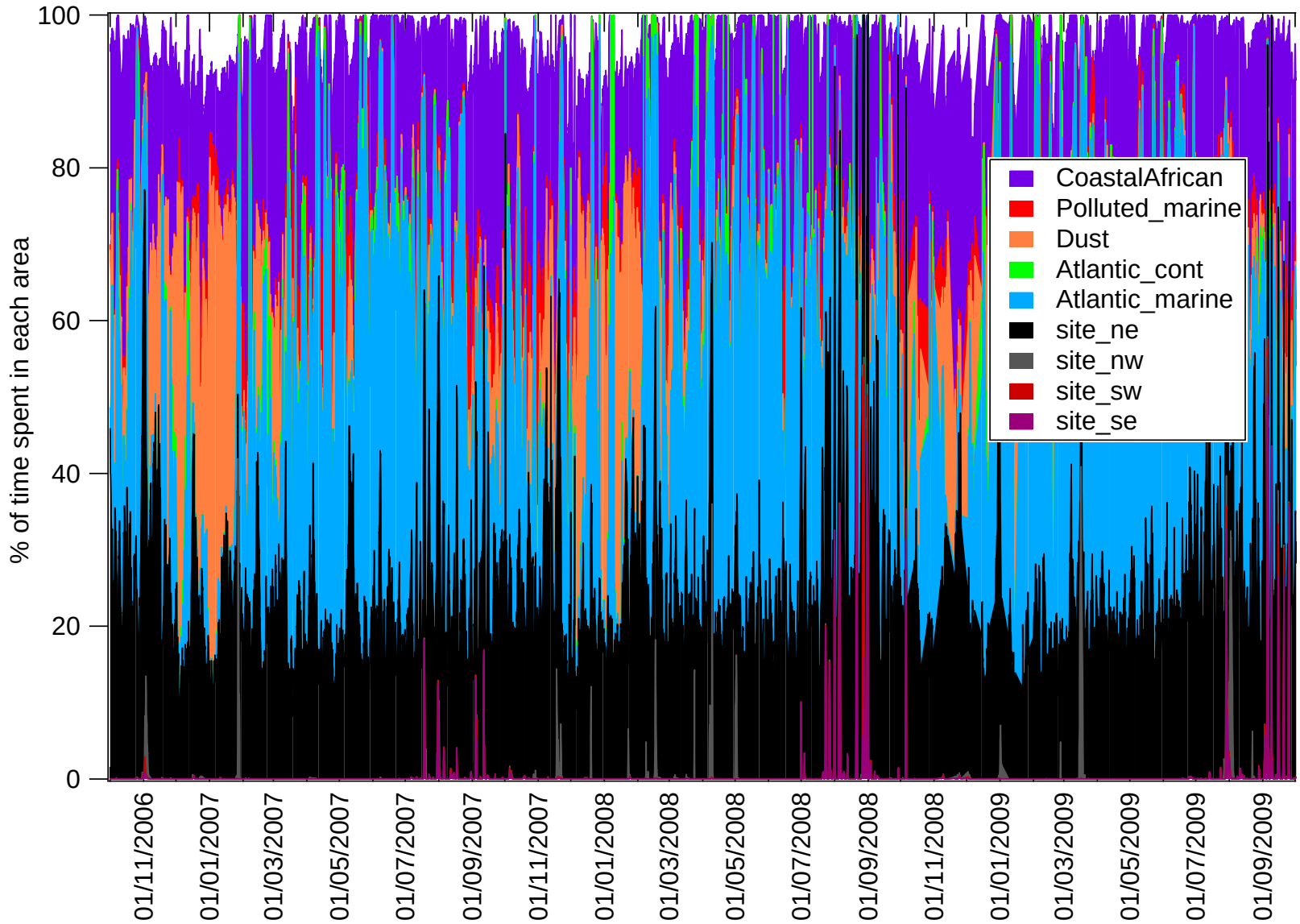
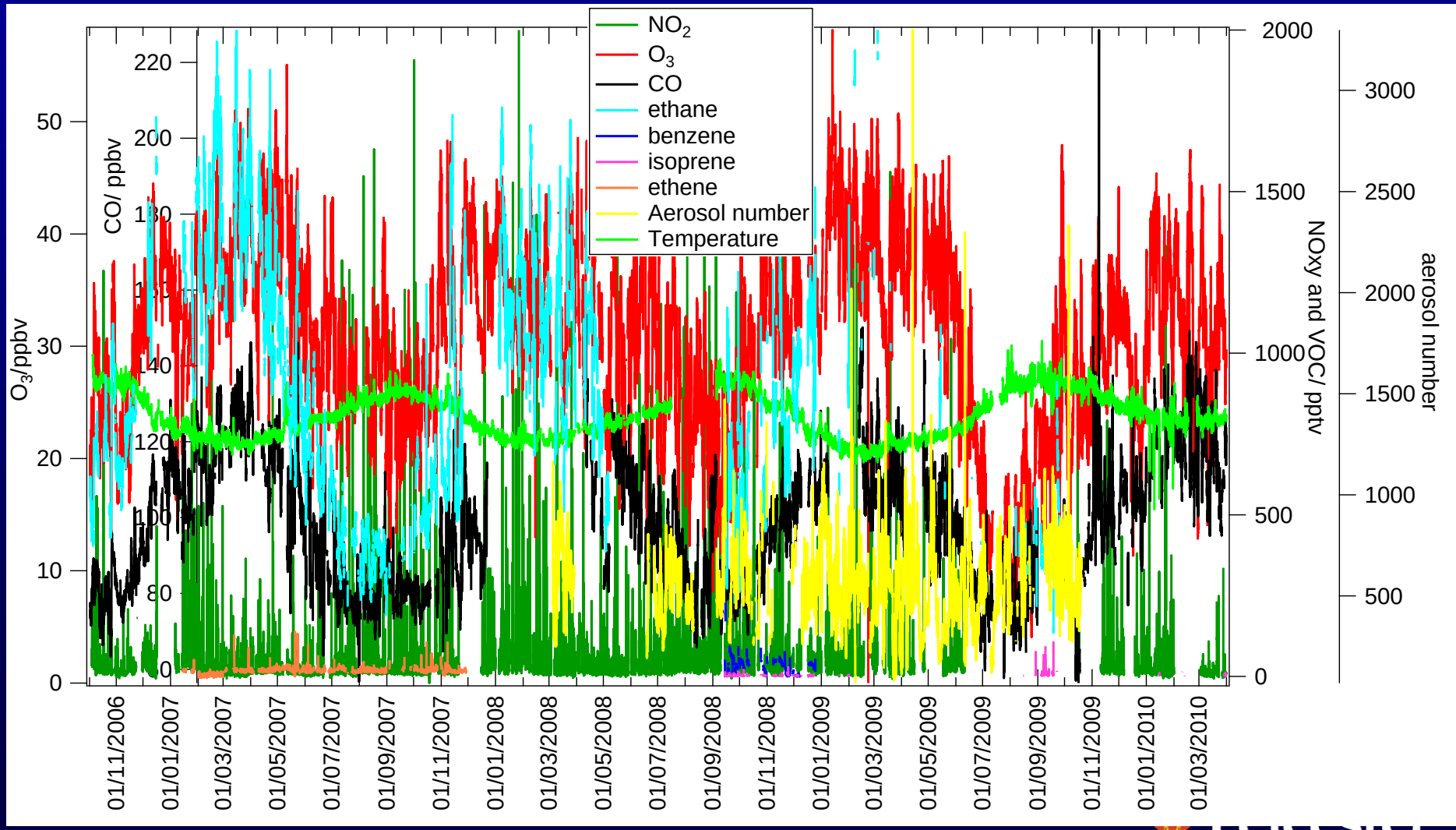
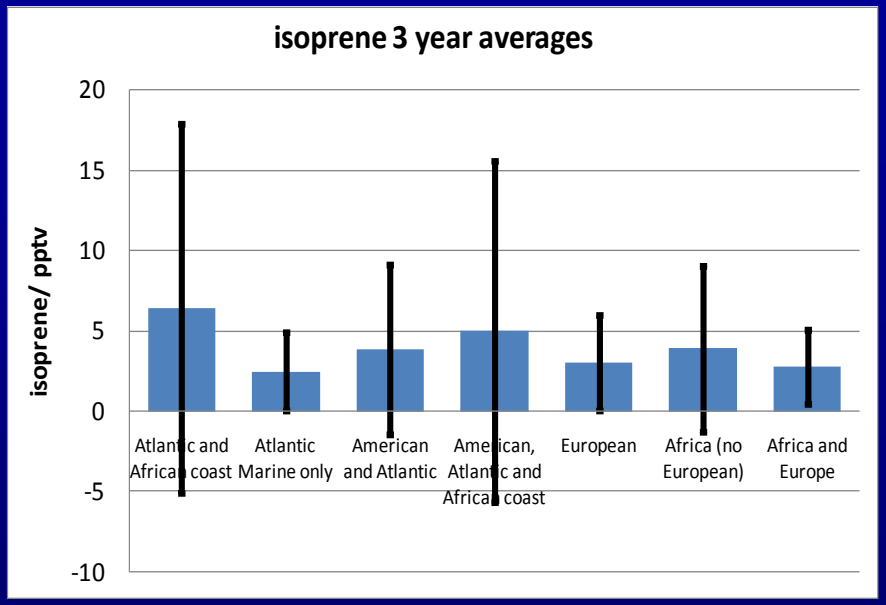
Local air (flag for contamination or slow transport)

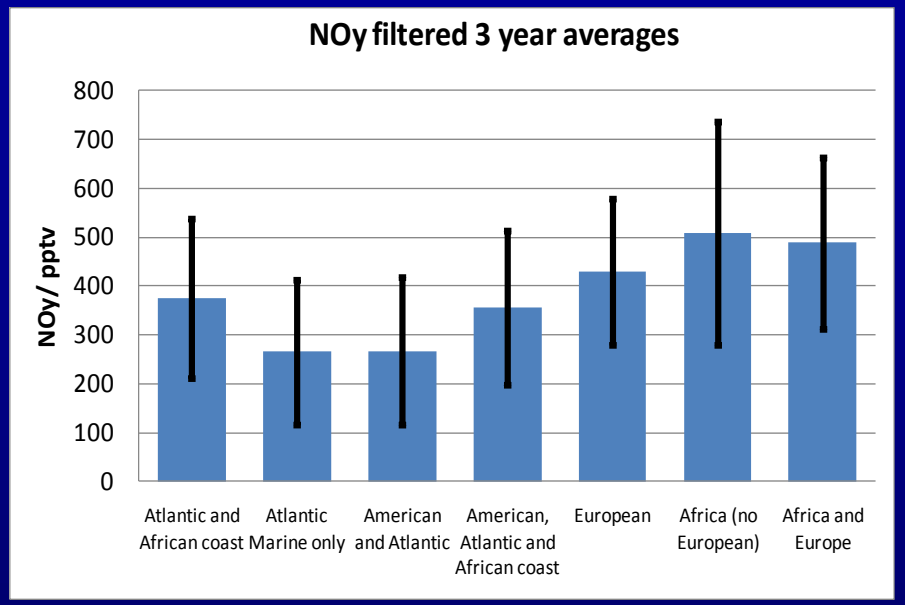


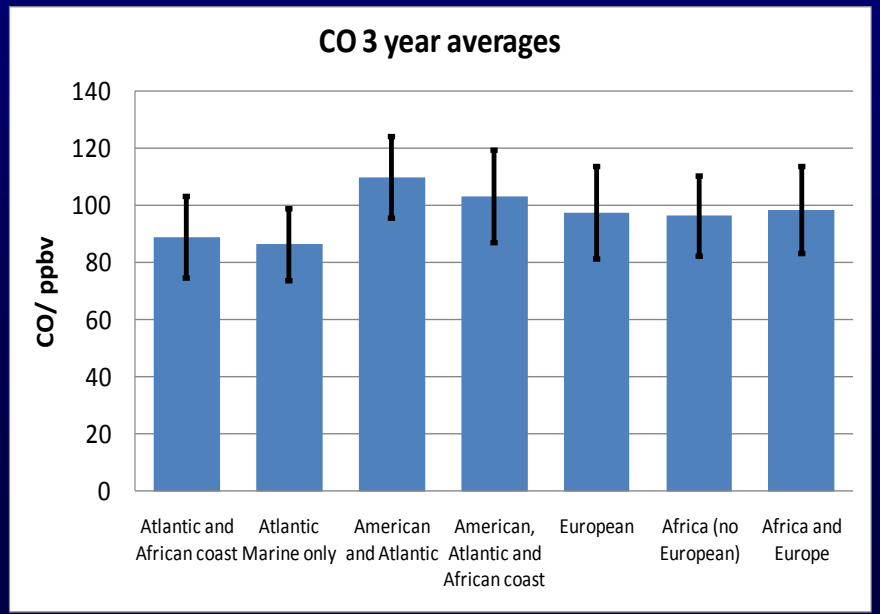
Relating to back to chemistry (harmonised timeseries of 56 parameters)

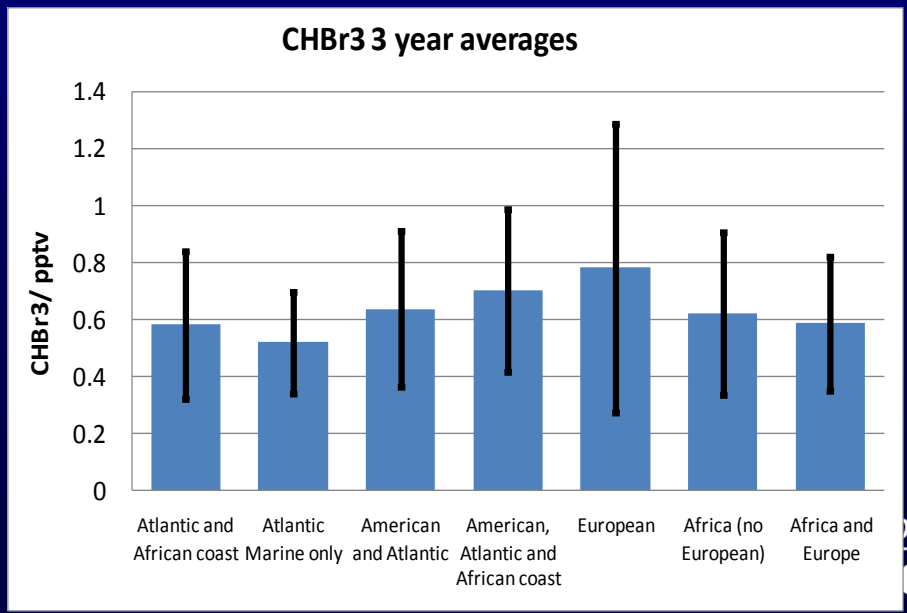


Averaging/binning by trajectory type

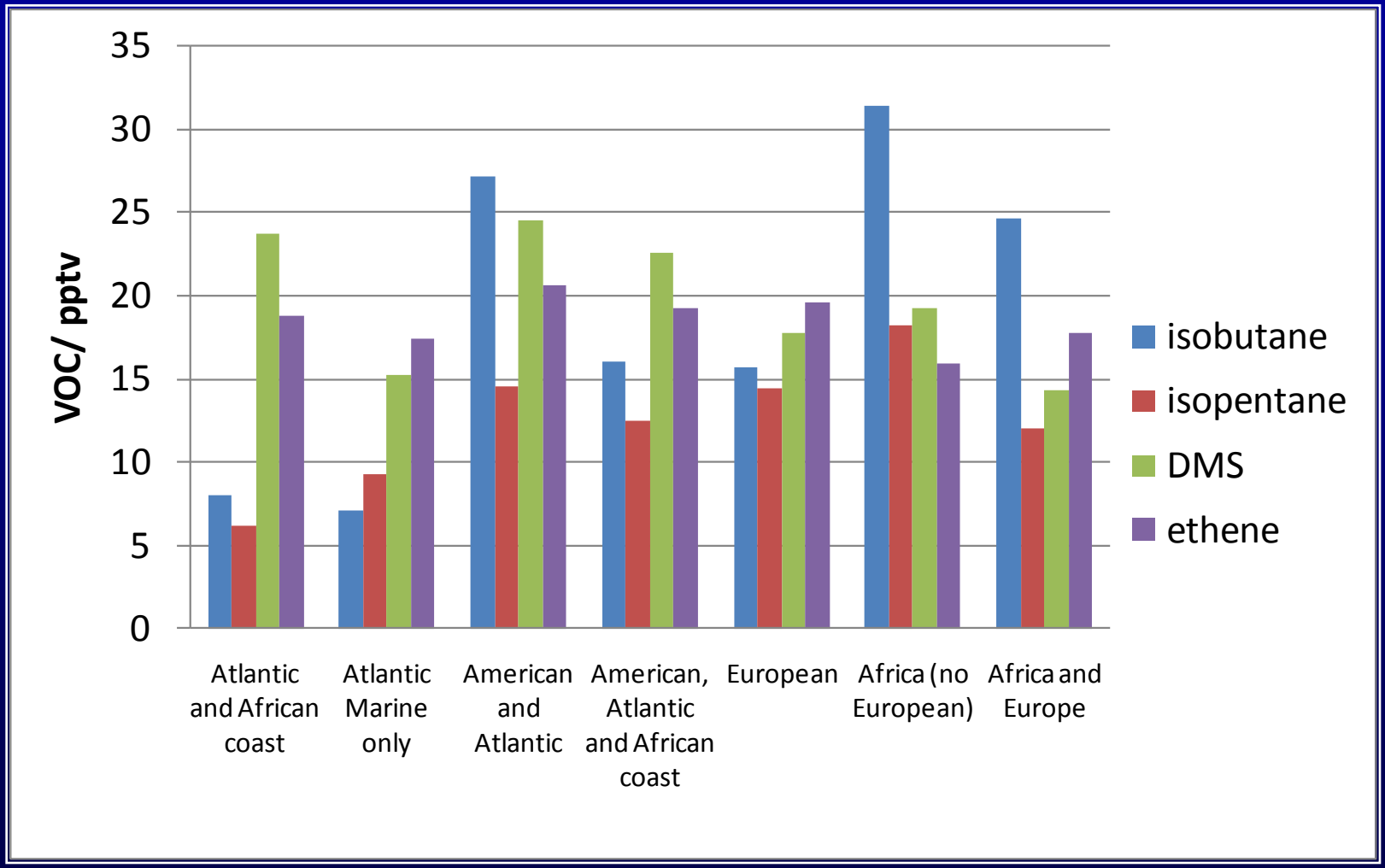




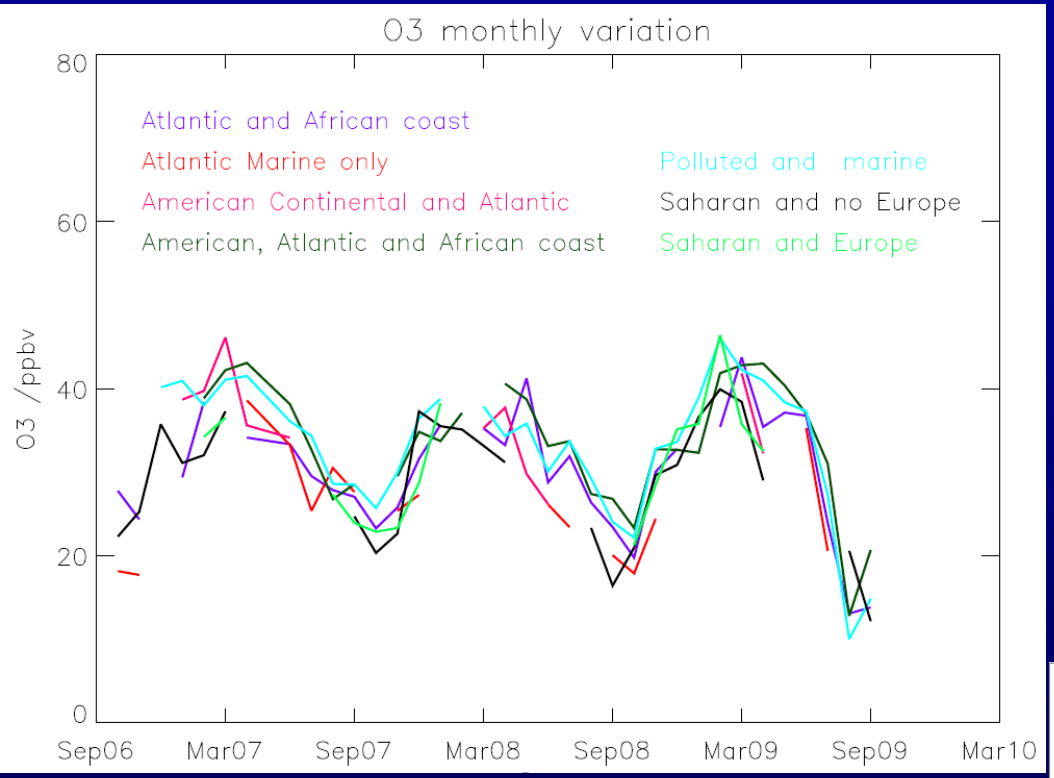


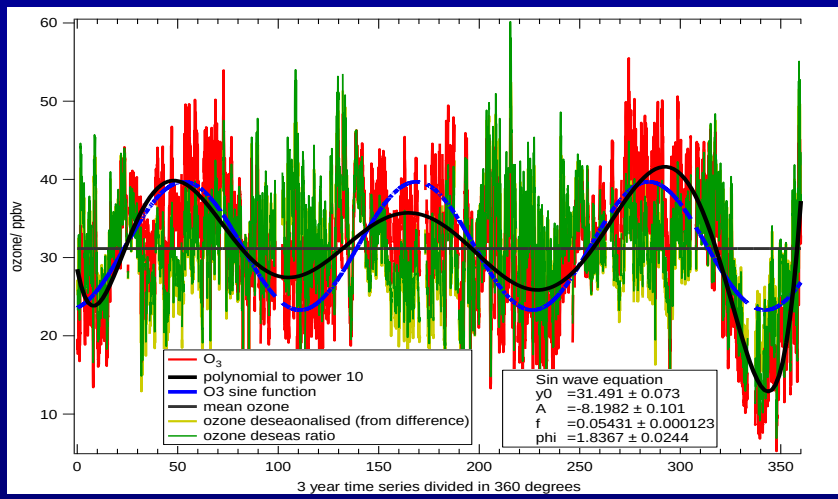


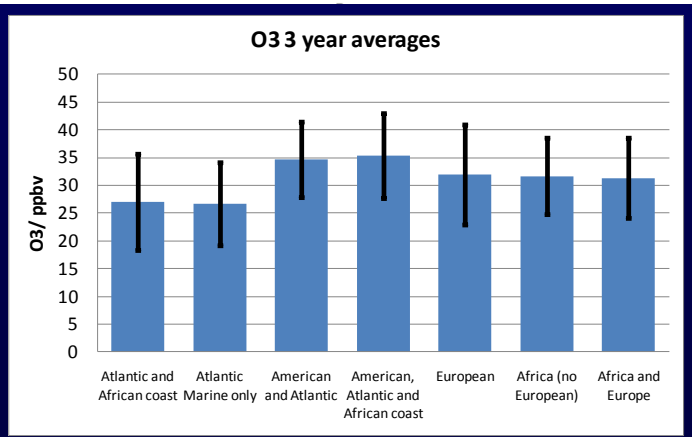
VOCs

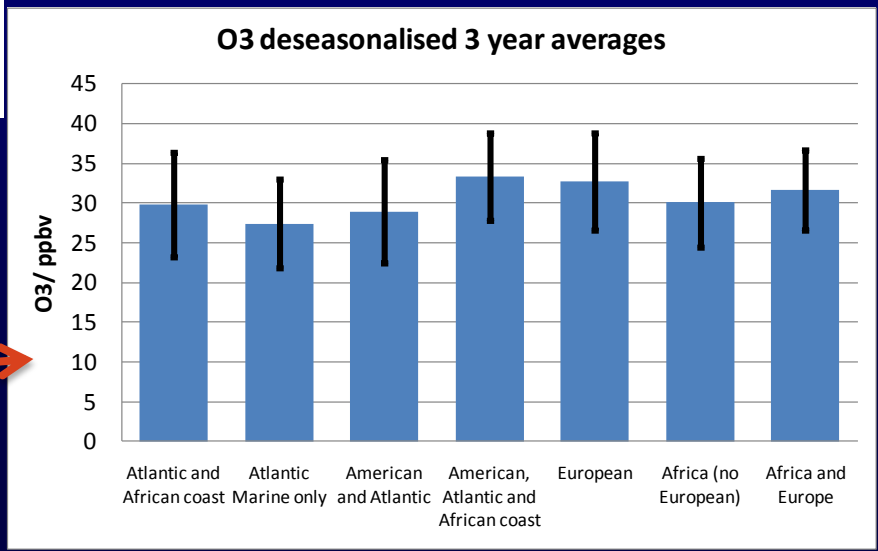


Ozone monthly averaging and de-seasonalisation

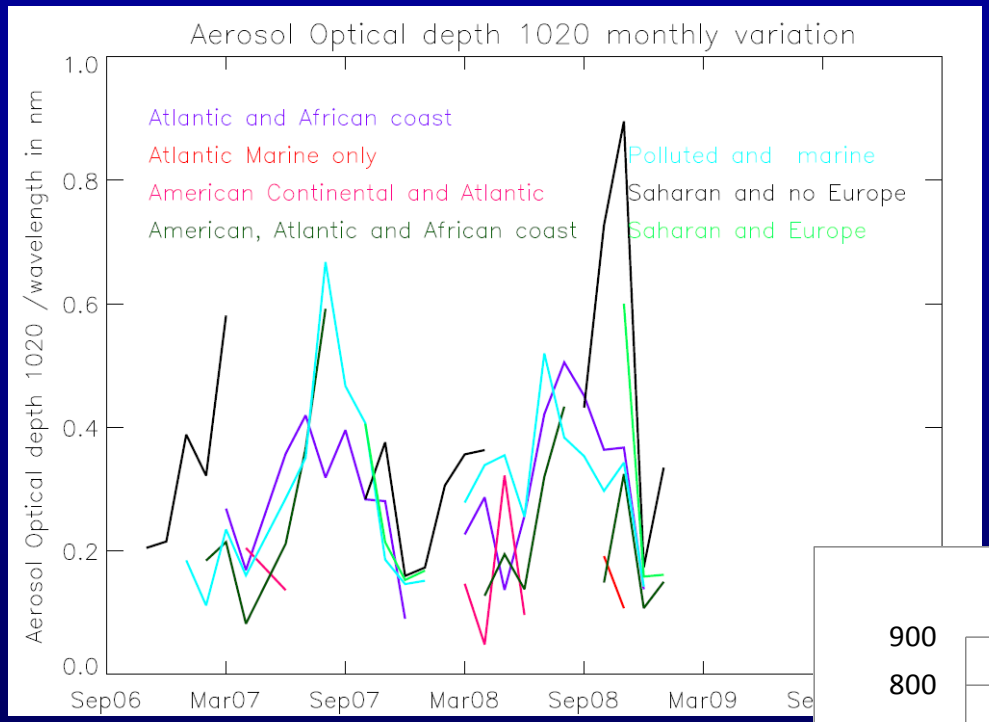




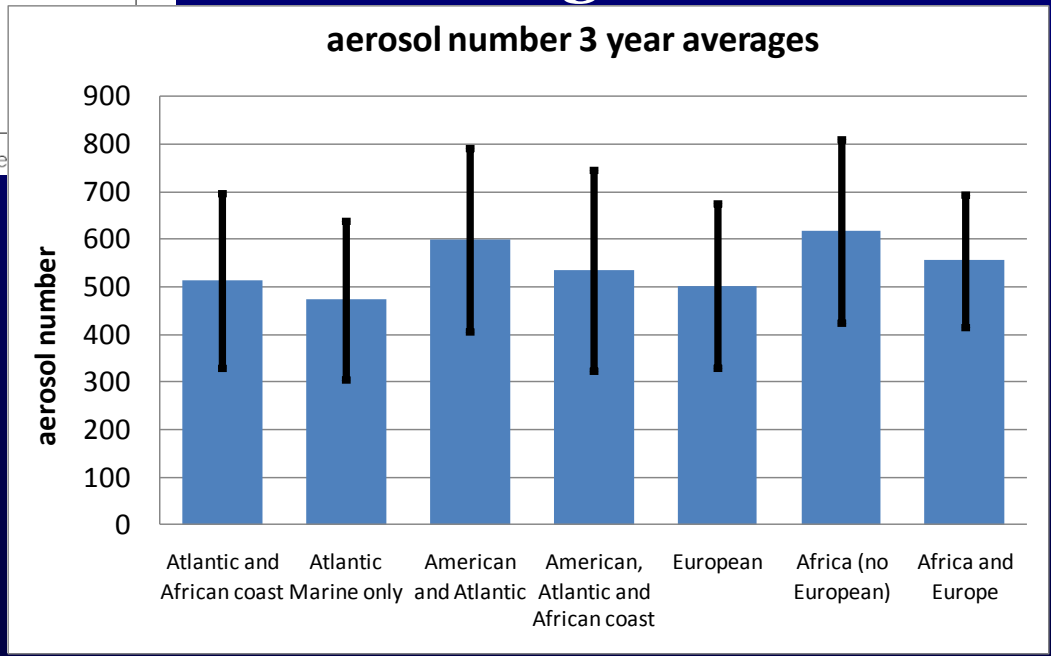




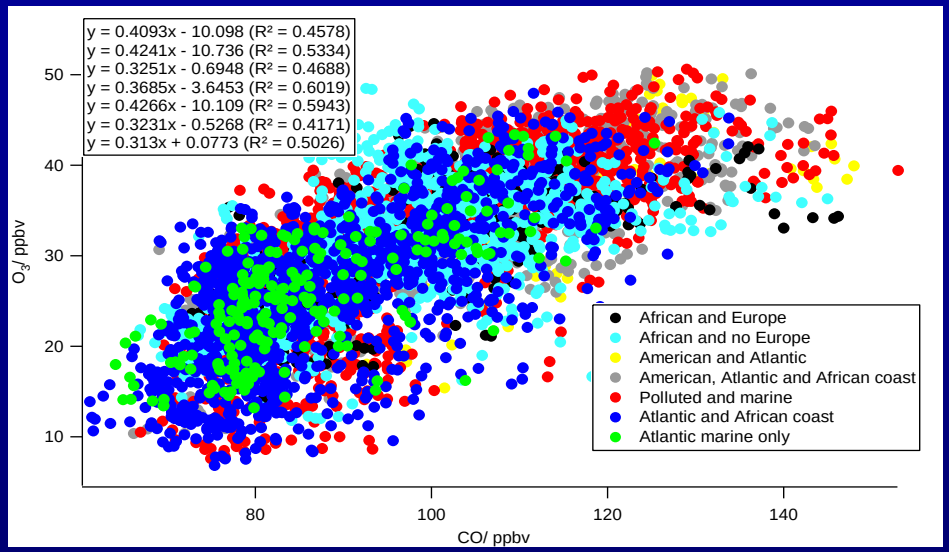
Aerosol monthly averages



- **Saharan and European have highest aerosol loading**

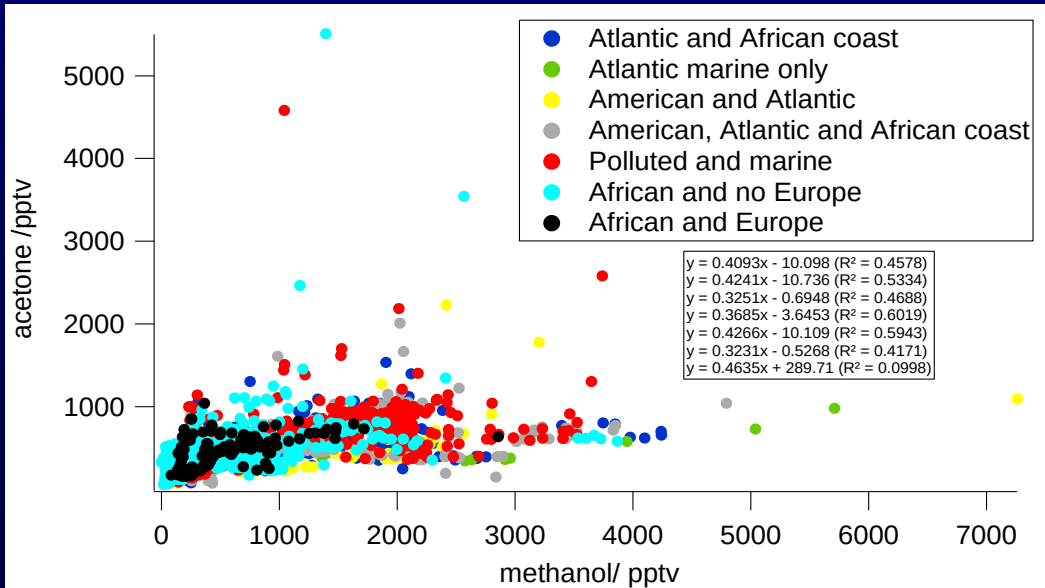


Ratio analysis between trajectory types

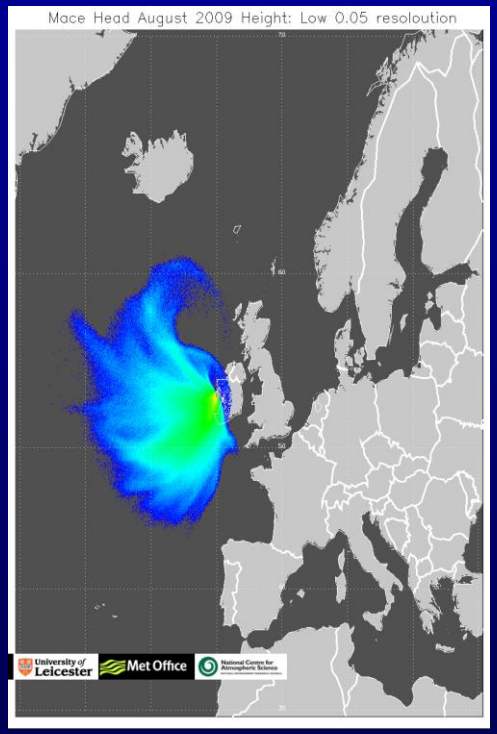


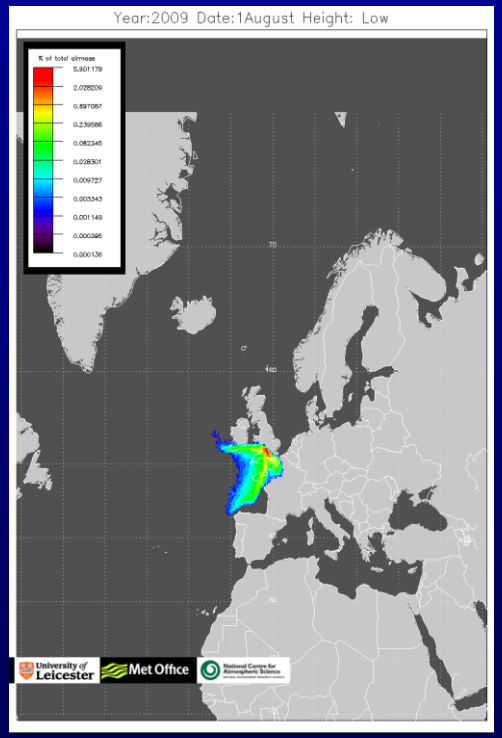
- O_3 : CO ratios show a large spread but higher gradients for European and African

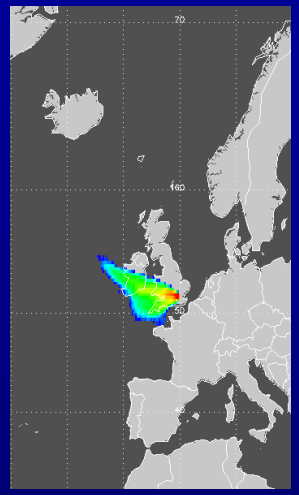
- O-VOC ratios different between marine and terrestrial sources

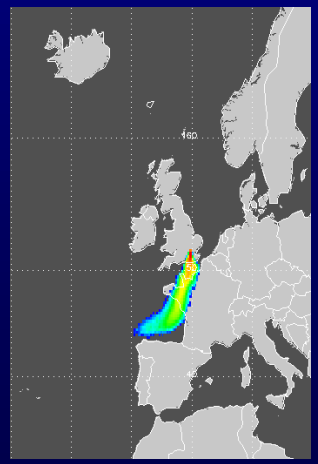


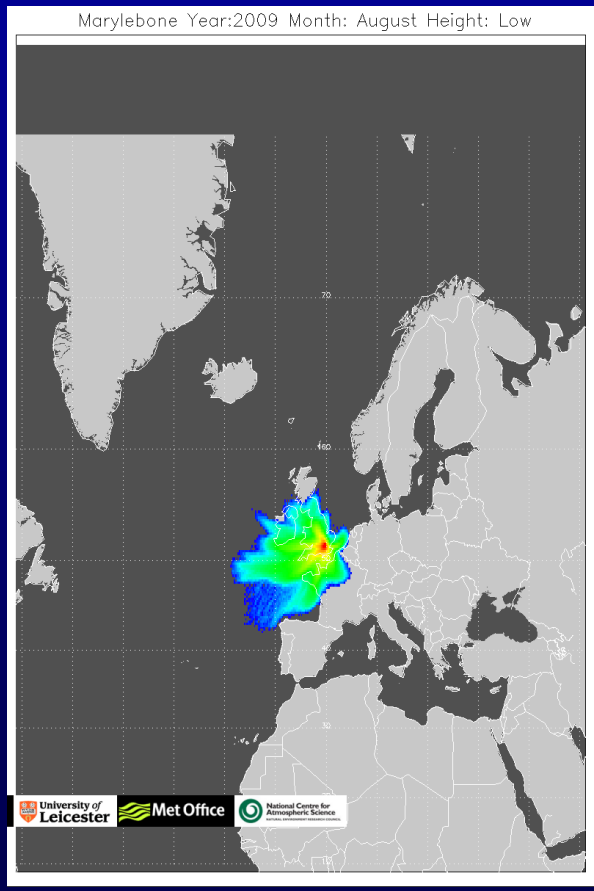
Mace Head, Harwell and Marylebone road and Eltham 1 day backwards











- Mace Head
- Harwell
- Eltham
- Marylebone rd

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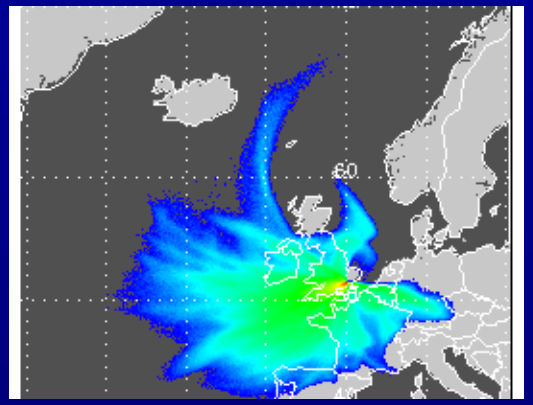
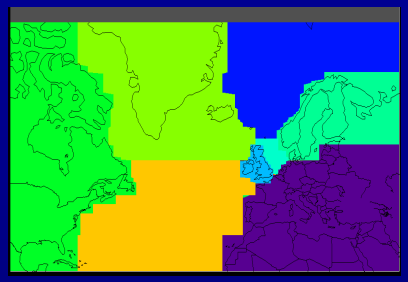
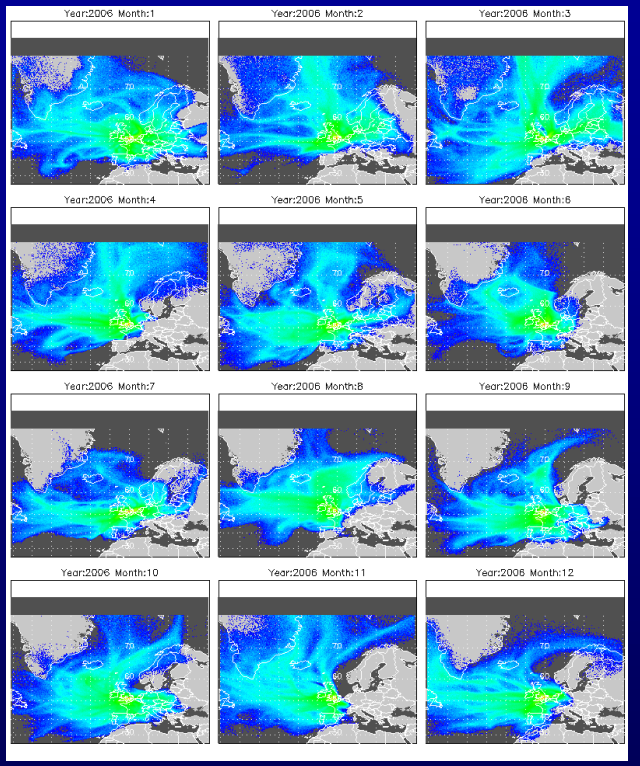
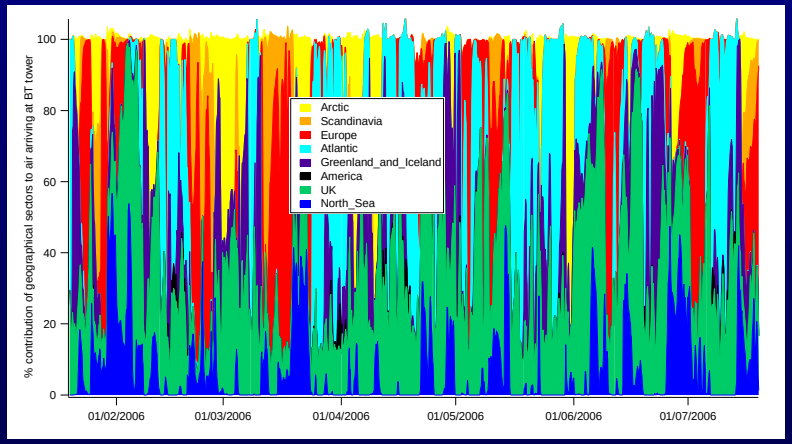
BT tower 1 day back runs

- 5 day backwards split into sectors









- 1 day backwards split the UK and North Sea, northern France/ Benelux into 10 regions

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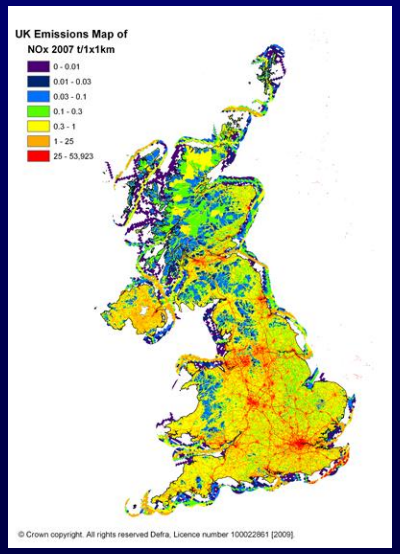
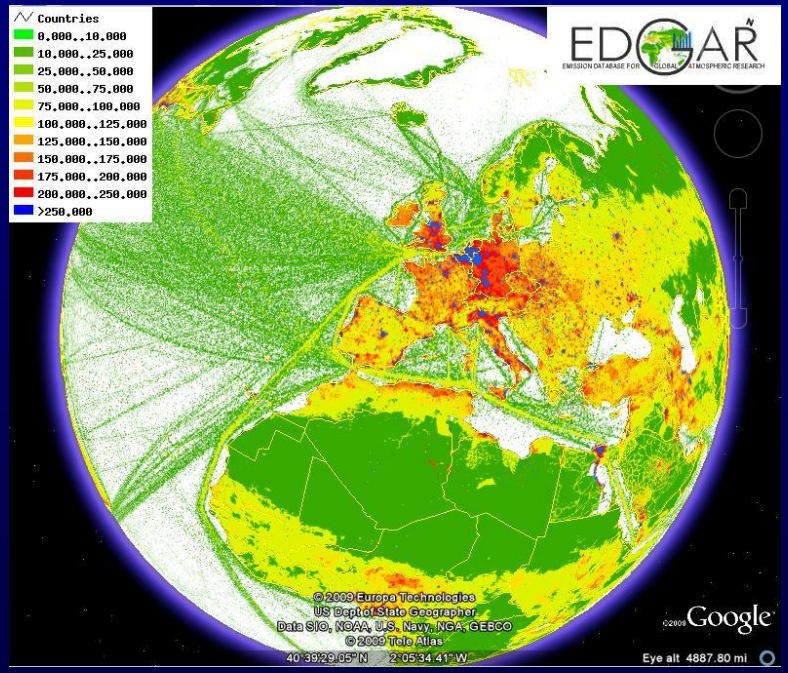
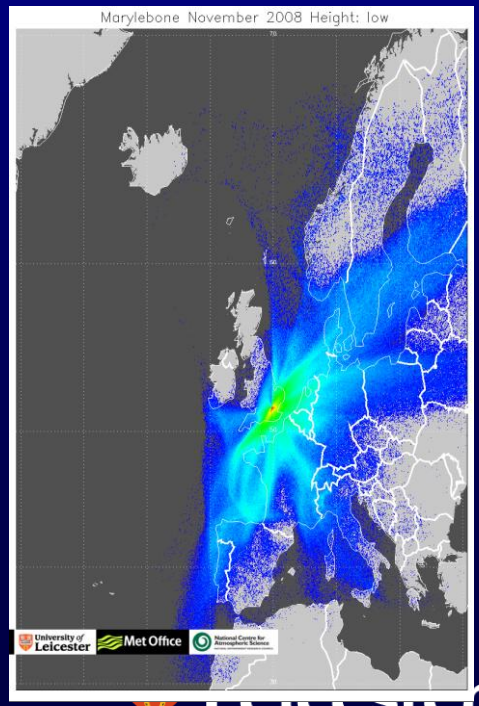
Running forwards from London

- Forward run combined with NAEI emission inventory to track chemistry emissions from London affecting the surrounding areas
- Run forwards from surrounding areas towards BT tower







Conclusions

- Have built up a library of successive 3 hourly back trajectories from NAME for 3 sites
- Analysis of regional distribution of transport shows how quickly and when air mass direction changes
- Combination of regional influences can define trajectory types
- Can provide footprints or detailed 3 hourly influence regional distribution for campaigns or one off events
- Can look at long term changes / seasonal changes or variations in chemistry between trajectory types
- Future project to run NAME forwards with chemistry and combining with emission inventories

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