What is BUNIAACIC?

Introduction to the BUNIAACIC Meeting, University of Manchester, Manchester, UK, 2nd – 3rd July, 2012

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BUNIAACIC

Brazil-UK Network for Investigation of Amazonian Atmospheric Composition and Impacts on Climate

Summary: The BUNIAACIC collaboration aims to develop a coherent strategy for UK studies of atmospheric composition and impacts in the Amazon

Immediate short-timescale material objectives by which the collaboration will be able to contribute include:

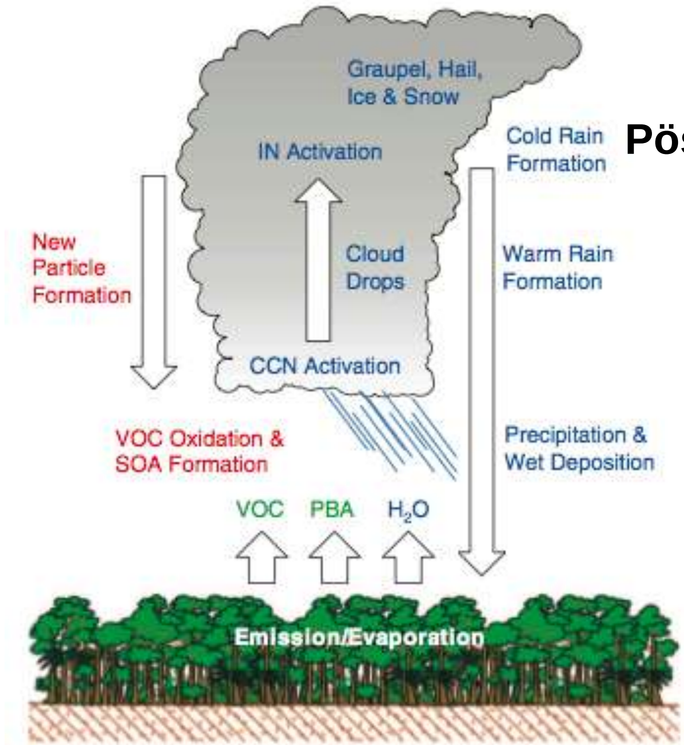
i) skill development and knowledge exchange through training in instrument operation and data analysis for University of São Paulo AMS operators, hence

iii) evaluation of the performance of the long-term monitoring instrument through comparison with intensive measurement by additional instrumentation

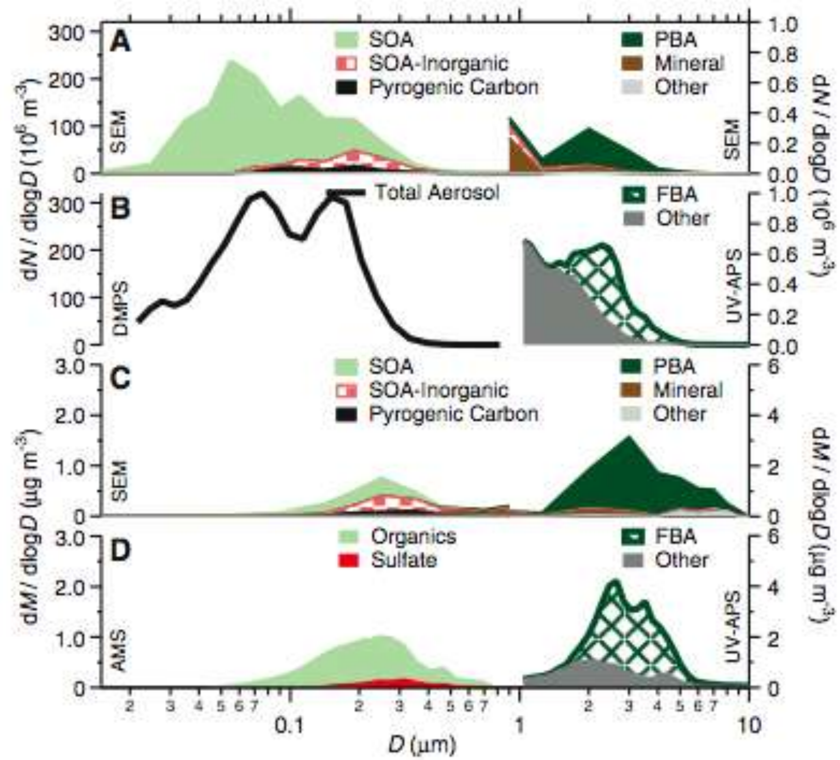
iv) intensive measurements of additional aerosol properties for direct linkage between aerosol composition and optical / microphysical properties

v) quantification of the impact of measured BSOA and BPOA on climatically important behaviour related to their potential to impact on direct and indirect radiative forcing

Natural biogenic particles substantially influence pollution, weather & climate

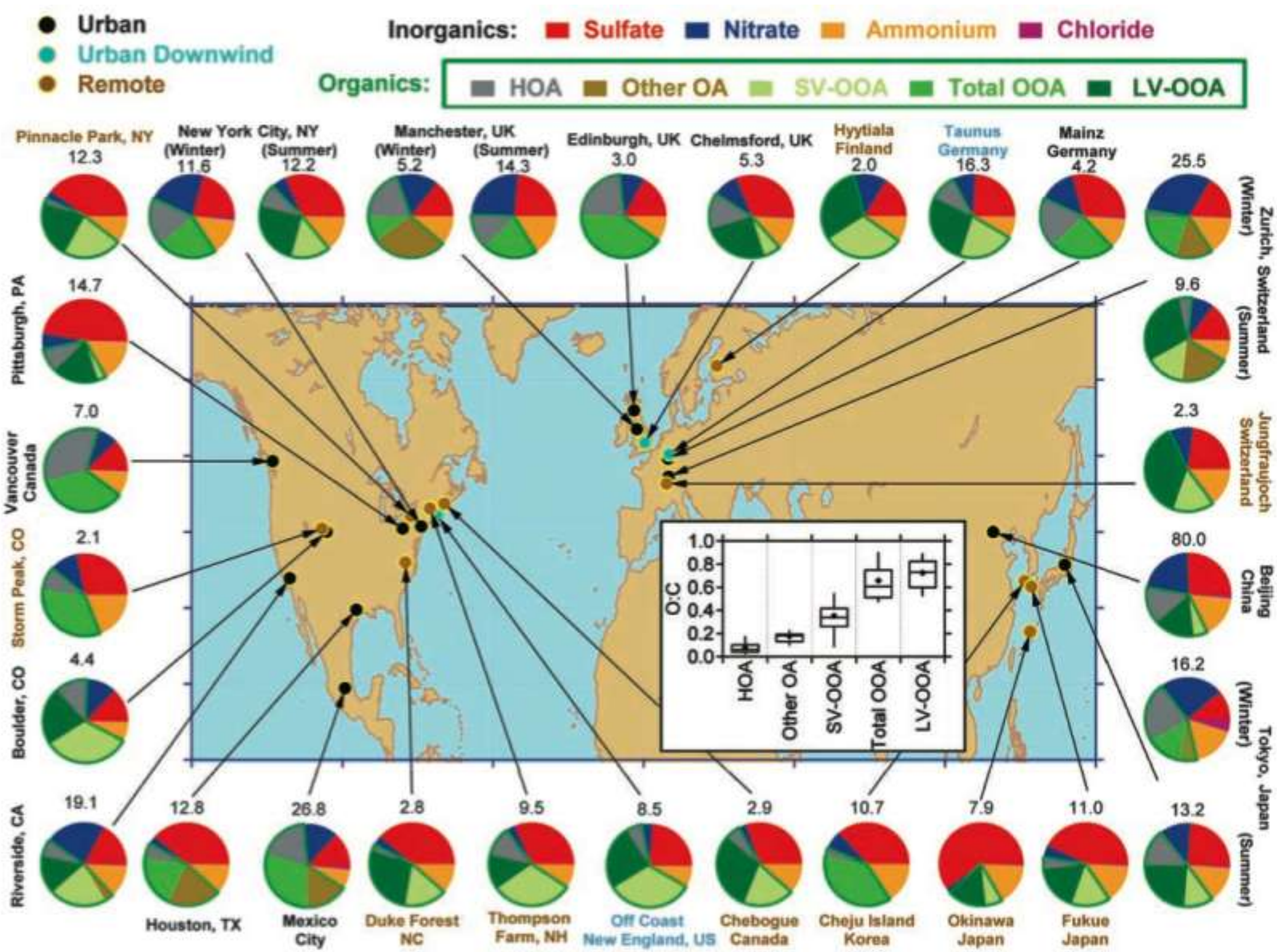


Pöschl et al., 2010, Science



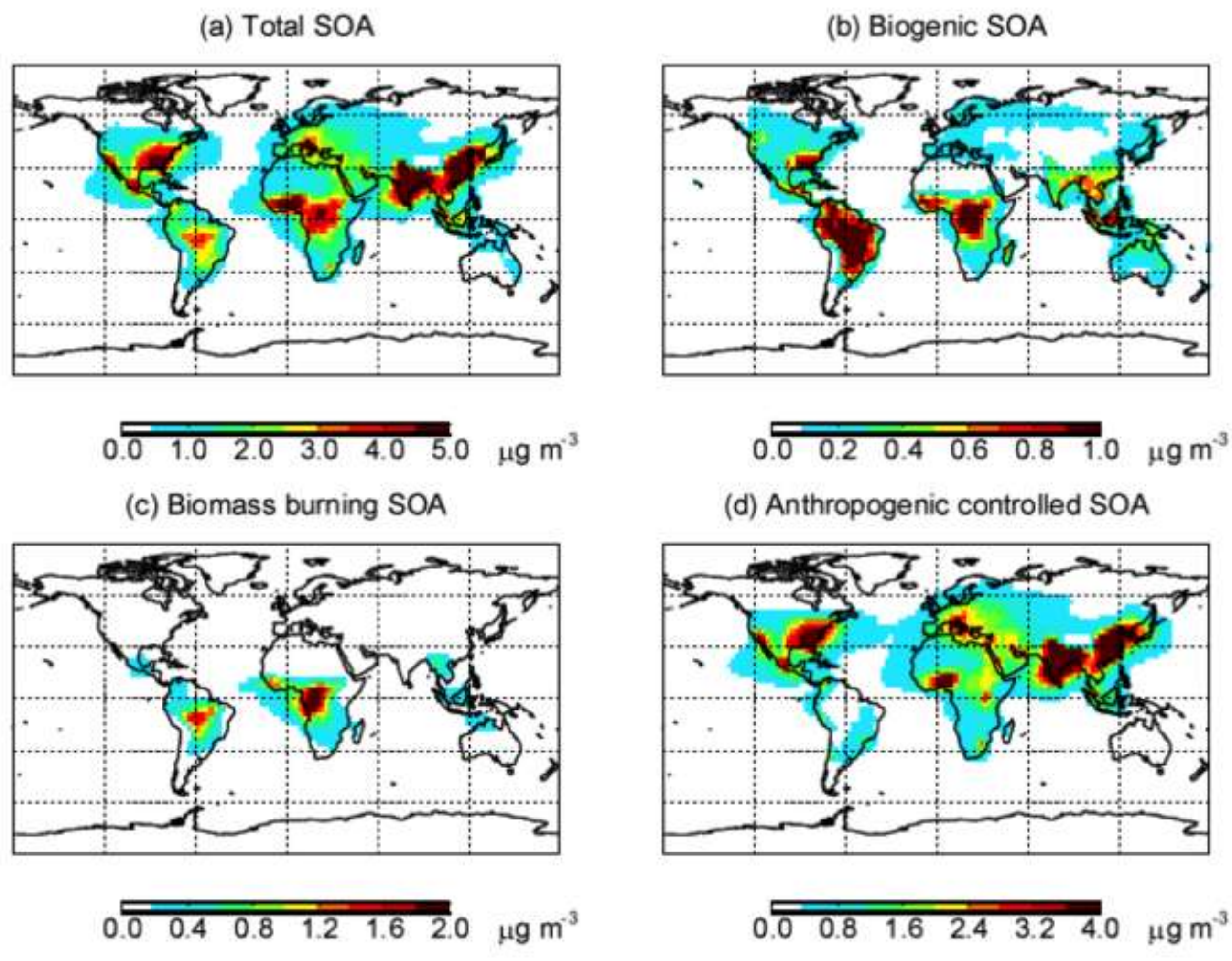
Most fine particles globally contain lots of organic material

Jimenez et al., 2009, Science



Biogenic "SOA" is massively enhanced by anthropogenic emissions

Spracklen et al., ACP, 2011



Summary: The BUNIAACIC collaboration aims to develop a coherent strategy for UK studies of atmospheric composition and impacts in the Amazon

Strategic planning and infrastructure development objectives that the BUNIAACIC programme will address include:

vi) construction of a White Paper outlining the recommended strategic methodology for UK participation in Amazonian atmospheric research

vii) appropriate planning for follow-up activities to address the research strategy on appropriate timescales, likely to include preparation of a consortium proposal.

Ongoing / Future Initiatives with which BUNIAACIC needs to explore linkages

Brazilian: LBA (specifically AEROCLIMA, but more broadly any activities of collaborative interest, including CLAIRE)

UK: CLAIRE-UK, SAMBBA

Other International: Go-Amazon 2014

New NERC-FAPESP initiative in the NERC Biodiversity & Ecosystem Processes in Human Modified Tropical Forests (HMTF)

New NERC-FAPESP initiative within (and beyond?) the NERC Biodiversity & Ecosystem Processes in Human Modified Tropical Forests (HMTF) Programme

£9·6M joint UK-Brazilian initiative to investigate effect of tropical forest degradation

"In the run up to Rio+20, the Natural Environment Research Council (NERC) and São Paulo Research Foundation (FAPESP) today announce a major £9·6m investment to investigate how changes to tropical forests affect biodiversity, ecosystem services and the climate."

Previous UK experience / expertise and initiatives upon which BUNIAACIC can draw

In tropical areas, notably the

AMMA / DABEX experiments in West Africa, 2005-2006 and
OP3 / ACES experiments in Sabah, Malaysian Borneo, 2008

Elsewhere, many person-decades of atmospheric composition related field research in all continents, from the Antarctic to Arctic, a little of which we may hear about over the next couple of days

Atmospheric Science areas of interest to UK researchers (plus many more in the area of Biodiversity & Ecosystem Processes)

Land – atmosphere interactions

Short and longer-lived atmospheric trace gas chemistry

Oxidative capacity and trace gas burden / budget

Anthropogenic perturbations to the pristine biogenic background

Gas-aerosol interactions and aerosol formation and transformation

Aerosol physical and chemical properties

Aerosol optical properties and direct / semi-direct radiative effects

Aerosol – cloud interactions

Air quality – meteorology interactions

BUNIAACIC Activities

WP1: Long-term collaboration scoping – what we're doing now!

WP2: Long-term capacity enhancement – ACSM deployment at Manaus (and Porto Velho, now that SAMBBA is funded)

WP3: Short-term pilot deployment – something we also need to explore now

WP4: Strategy Development and Network Coordination – what we do after this meeting…

Meeting Structure

Monday

Update on ongoing activities and interests of associated parties

Tuesday

i) Consolidation of ideas for response to HMTP call

ii) Looking forward – where does Brazil – UK atmospheric research focus its efforts? – White Paper production

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Previous UK Tropical Forest interests from the Aerosol Coupling in the Earth System (ACES) project

Imperial College London

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The University of York

The University of Edinburgh

Centre for Ecology & Hydrology
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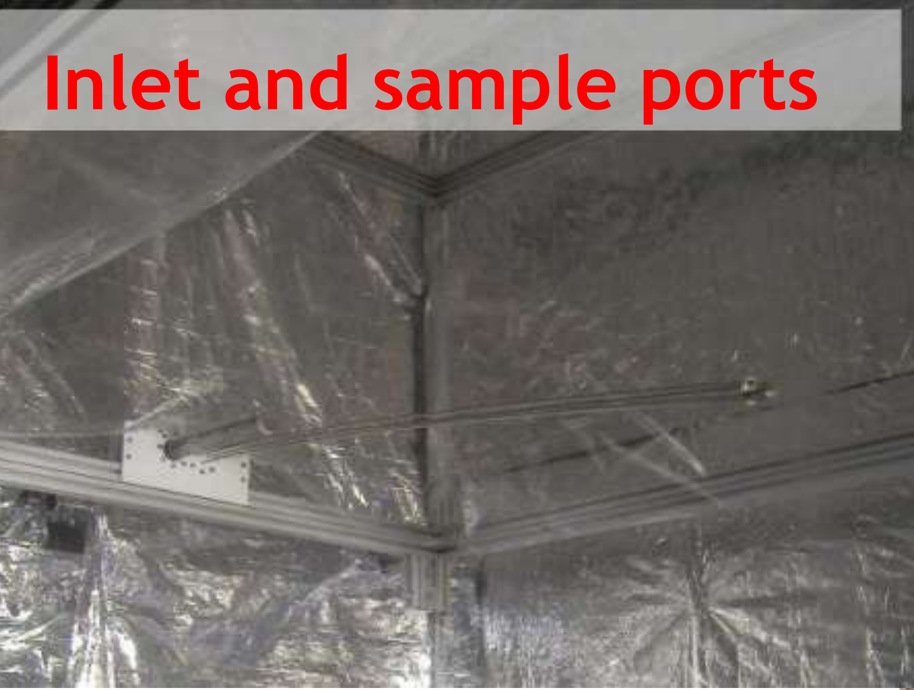
University of Leicester

LANCASTER UNIVERSITY

The Manchester Aerosol Photochemical Chamber



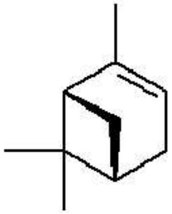
Target species for chamber and MCM development

Lifetime for reaction with

Compound	OH	O_3
α-pinene	2.6h	4.6h
Limonene	49min	2h
Myrcene	39min	50min
β-caryophyllene	42min	2min
Linalool	52min	55min

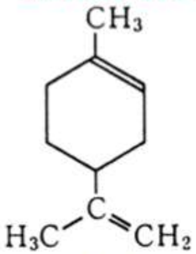
Atkinson & Arey, Atmos. Env. 2009

α-pinene



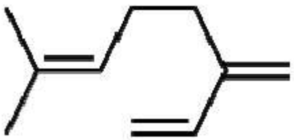
Bicyclic MT

Limonene



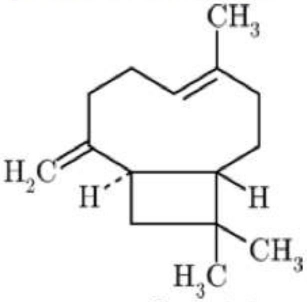
Monocyclic diene MT

Myrcene



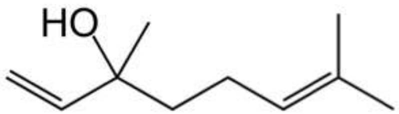
Acyclic triene MT

β-caryophyllene



Reactive SQ

Linalool



Reactive C10 oxygenates

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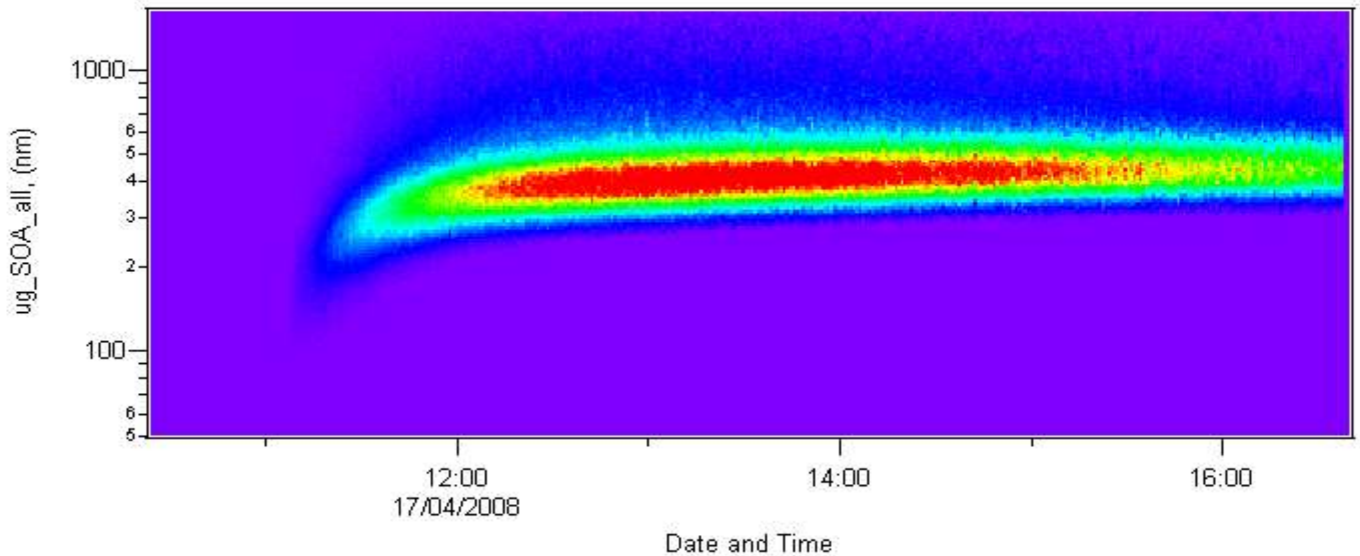
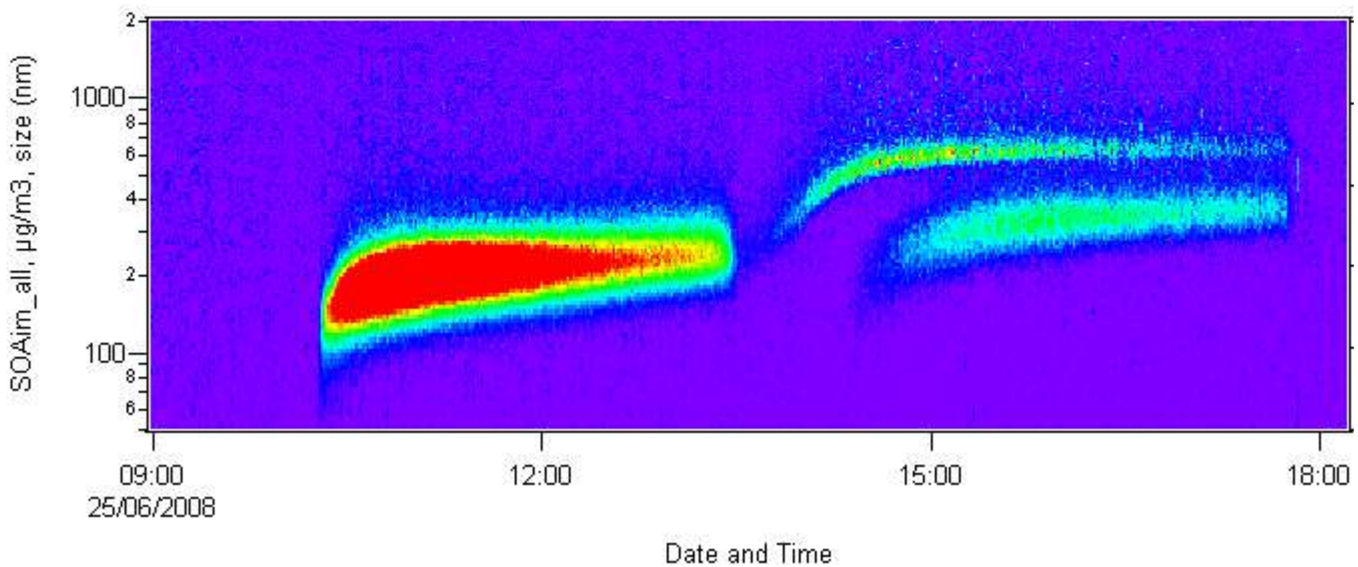
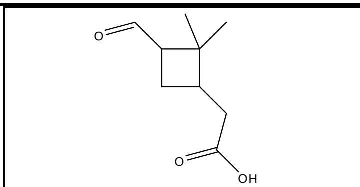
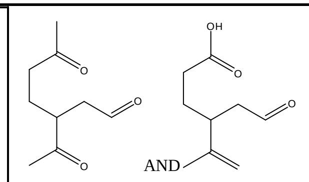
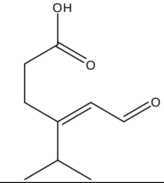
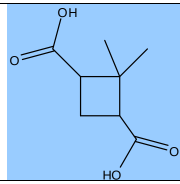
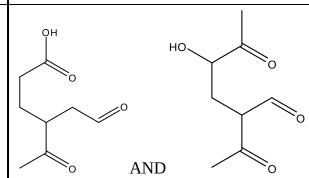
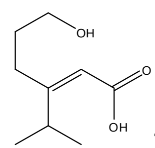
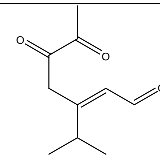
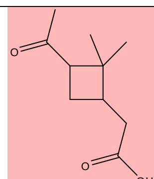
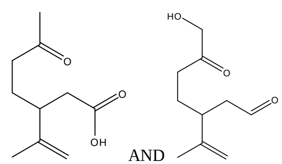
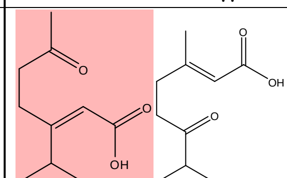
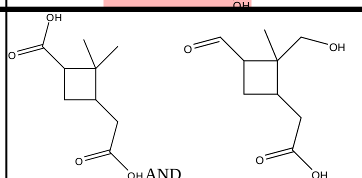
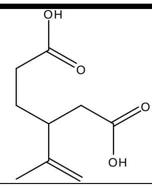
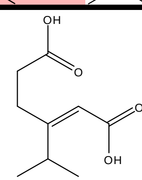
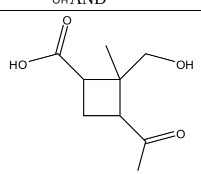
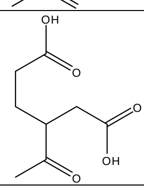
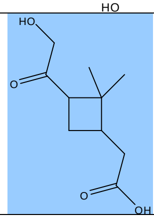
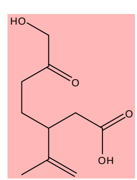
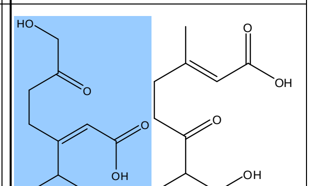
Types of experiments…



Without seeds – "nucleation"



Seeded

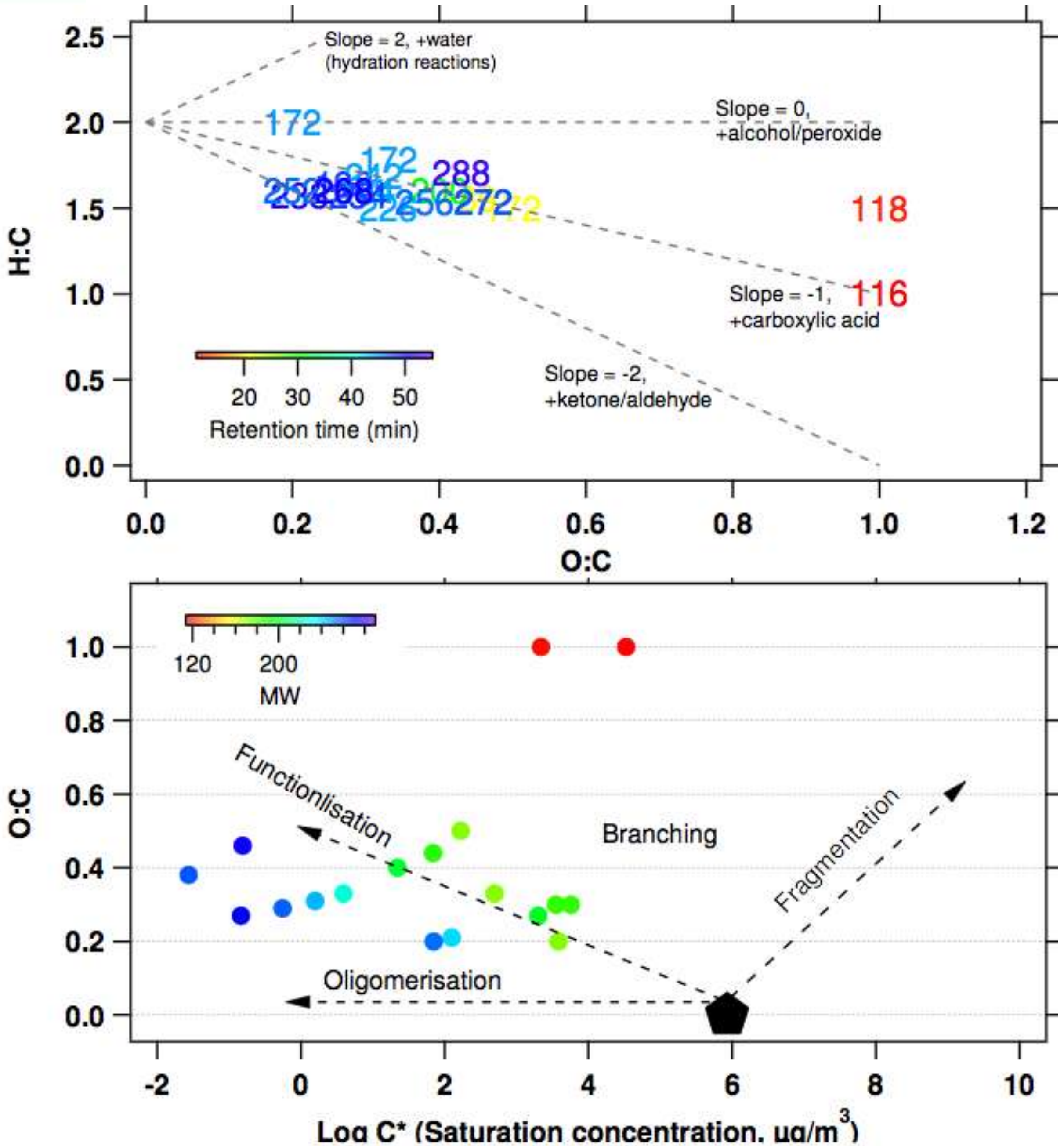
		〈-pinene	limonene	〈-terpinene
193	C9H14O3			
195	C8H12O4			 ??
205	C10H14O3	NP	NP	 ??
207	C10H16O3			
209	C9H14O4			
211	C8H12O5			P
223	C10H16O4			

RED – most abundant
BLUE – major peak

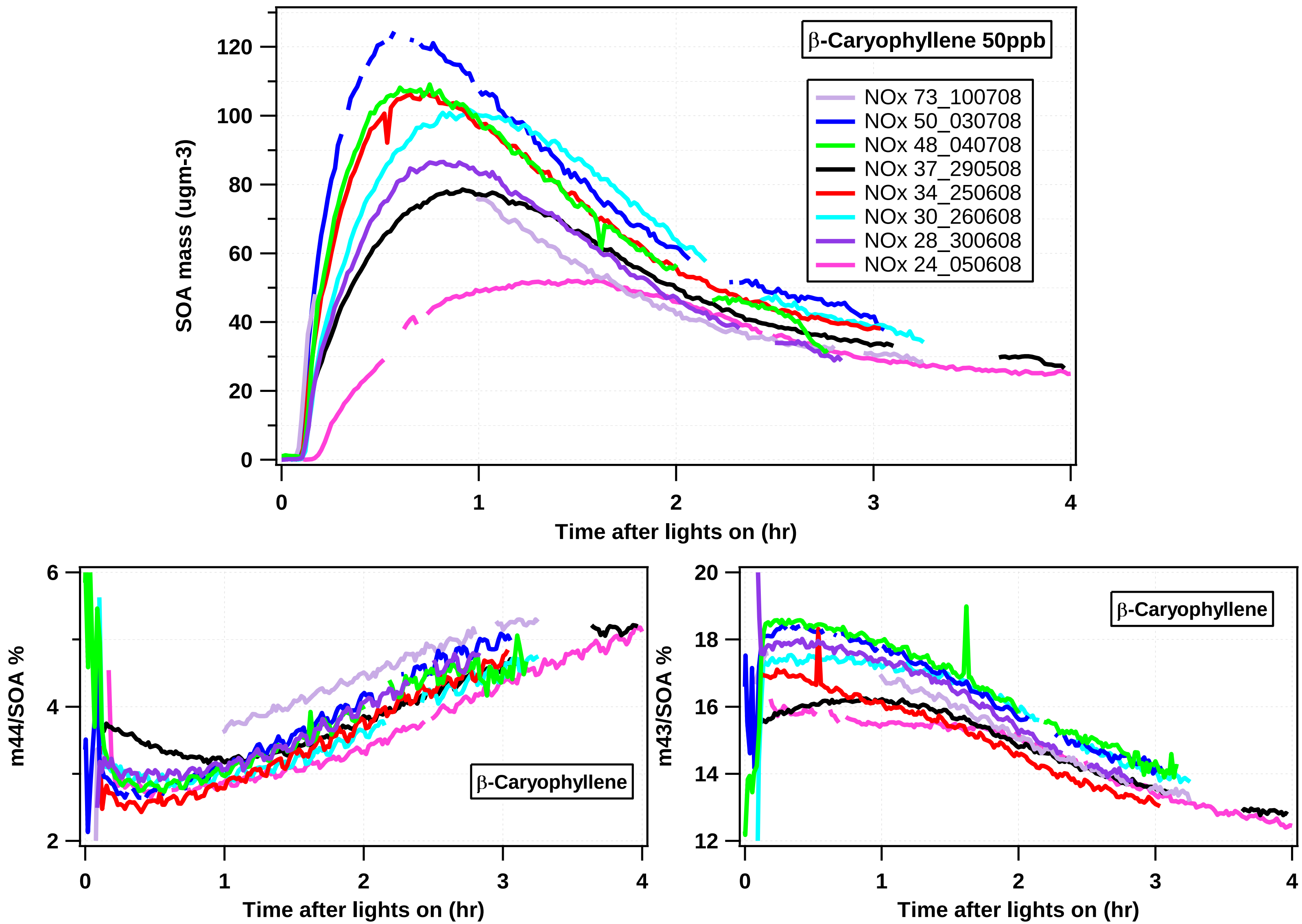
- Products are mainly isomers
- Common masses seen

- Highly oxidised β-caryophyllene also has similar masses (172, 184, 198,200 Da)

Representation of composition from e.g. β-caryophyllene

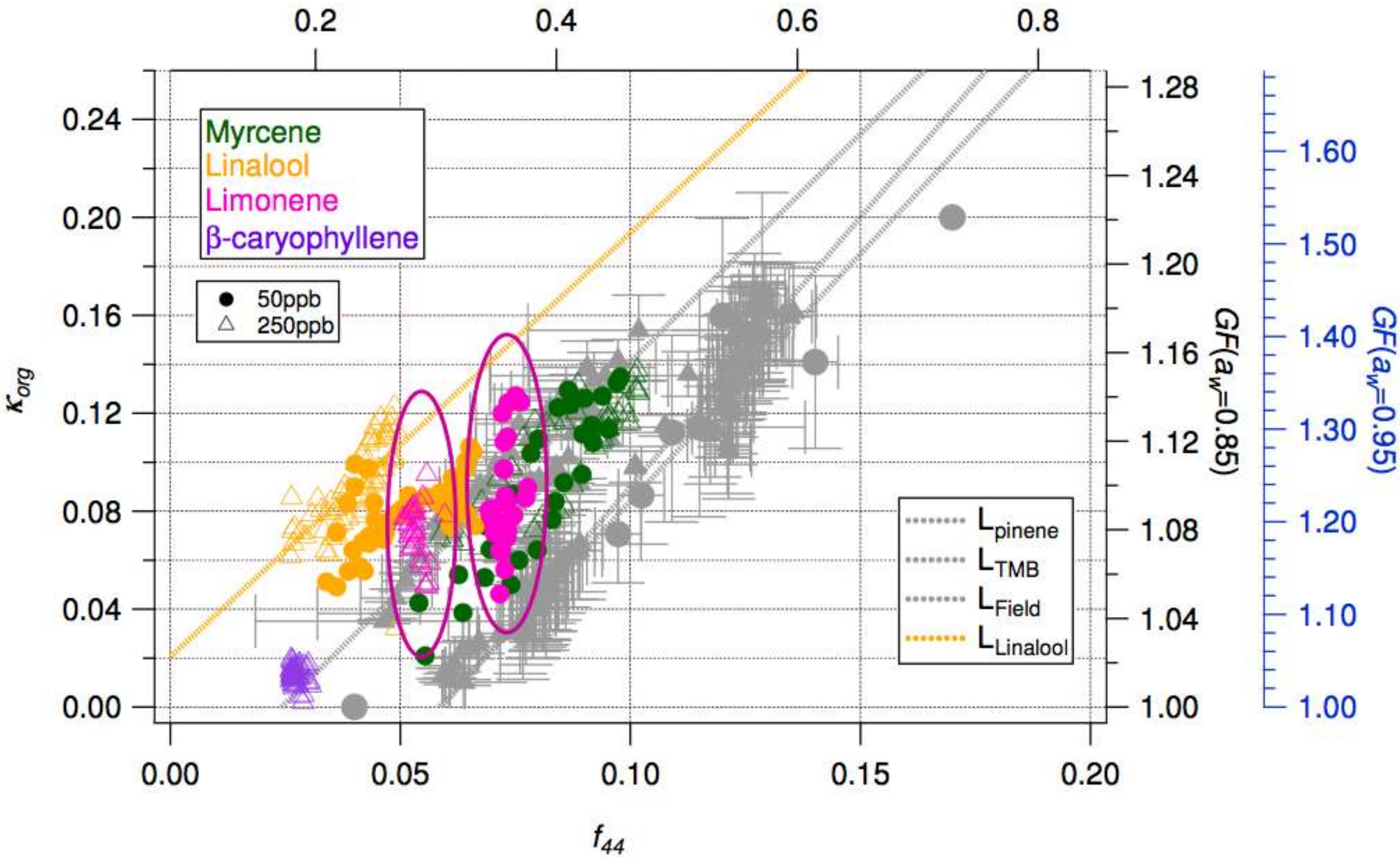


Particle mass & composition depends on NO_x



Man-made pollution will influence the amount of natural "pollution"

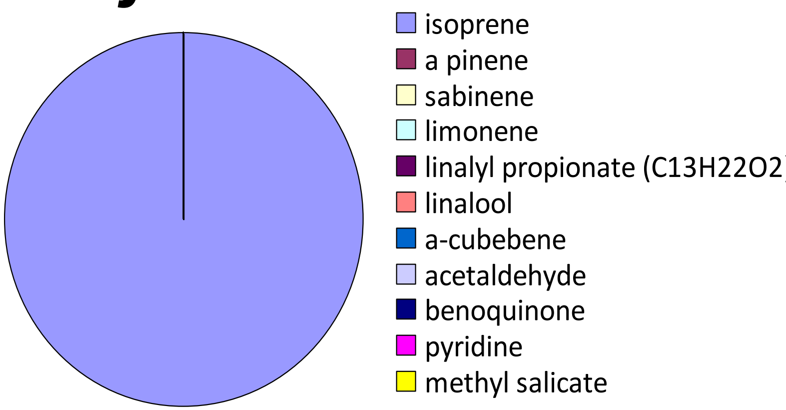
Water uptake by particles



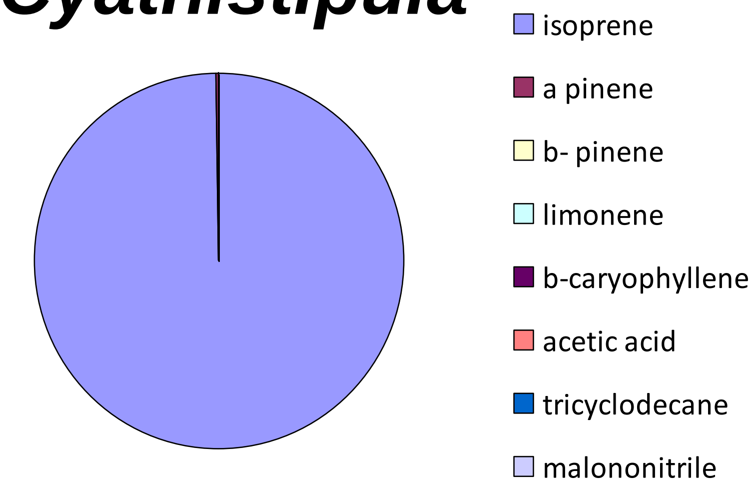
Not all particles are equally climatically important

Plant emissions: VOC composition

Benjamina

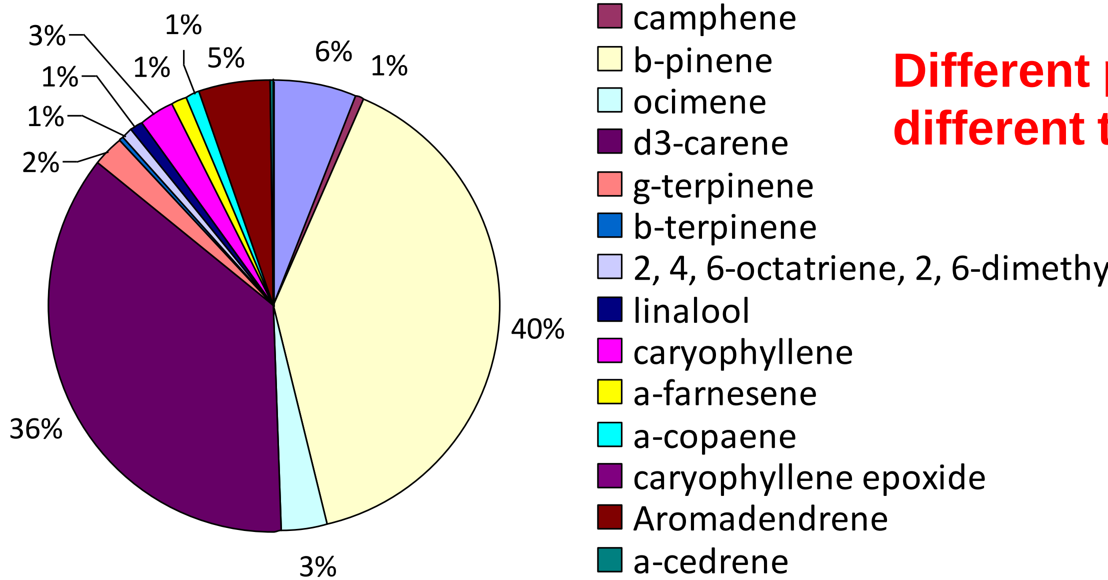


Cyathistipula



Tropical Plants

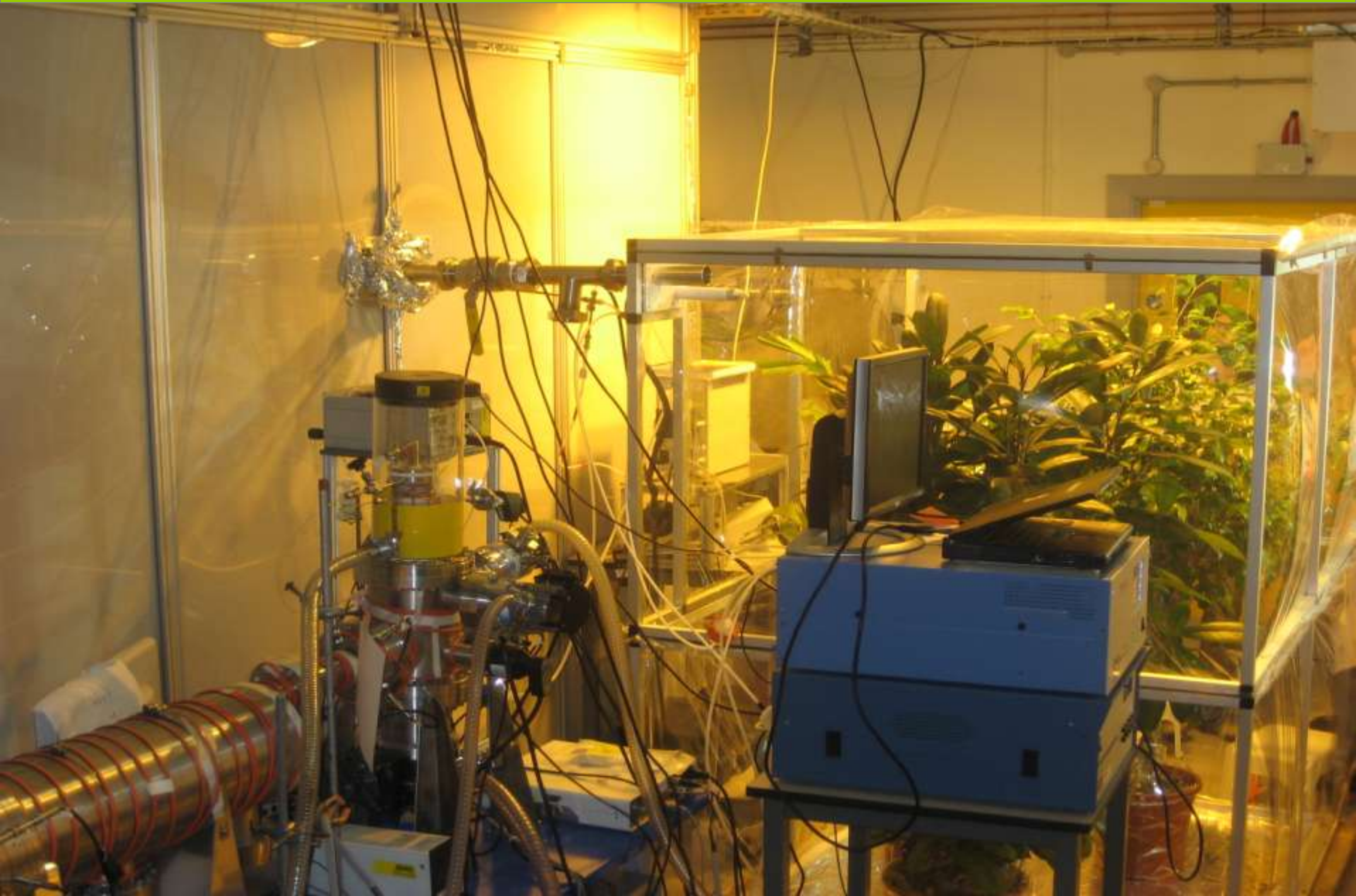
Betula Pendula



Different plants emit different things

Boreal Plant

Investigation of the formation and transformation of SOA generated from real-plant emissions – *The ACES "mesocosm" experiment*



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VOC oxidation & SOA formation

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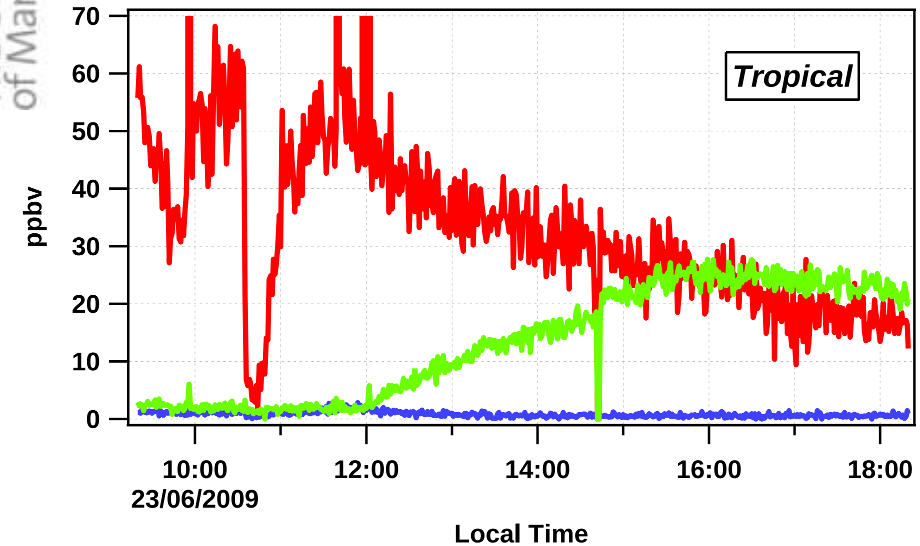
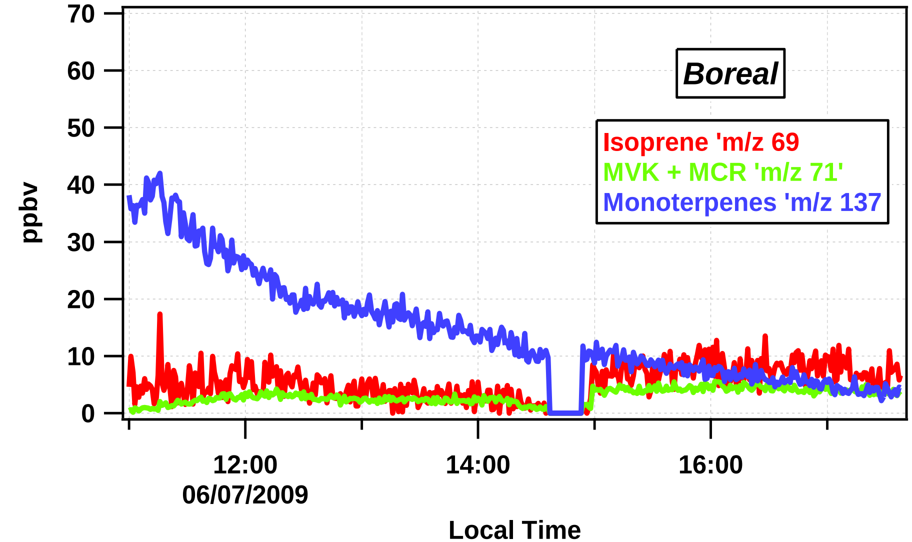
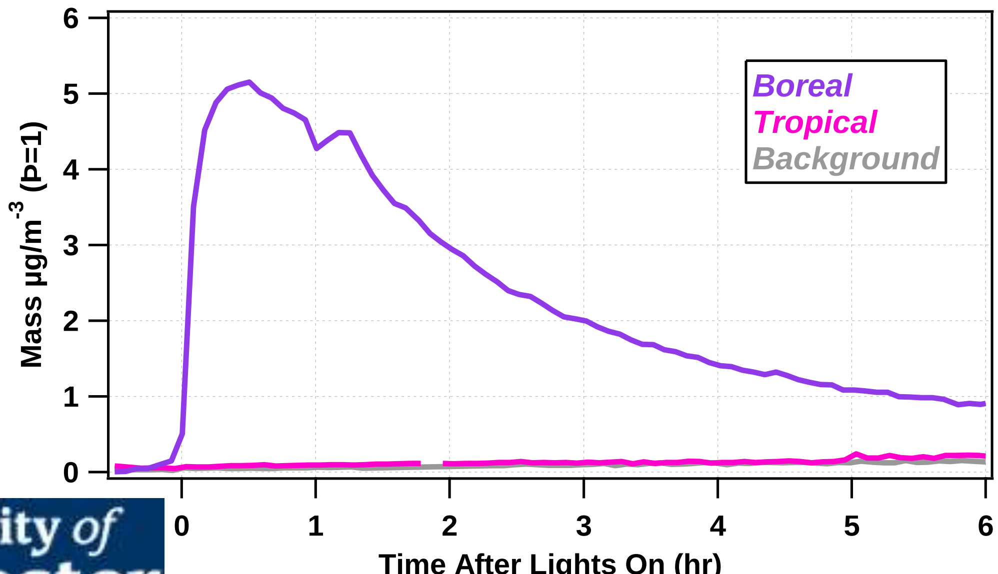


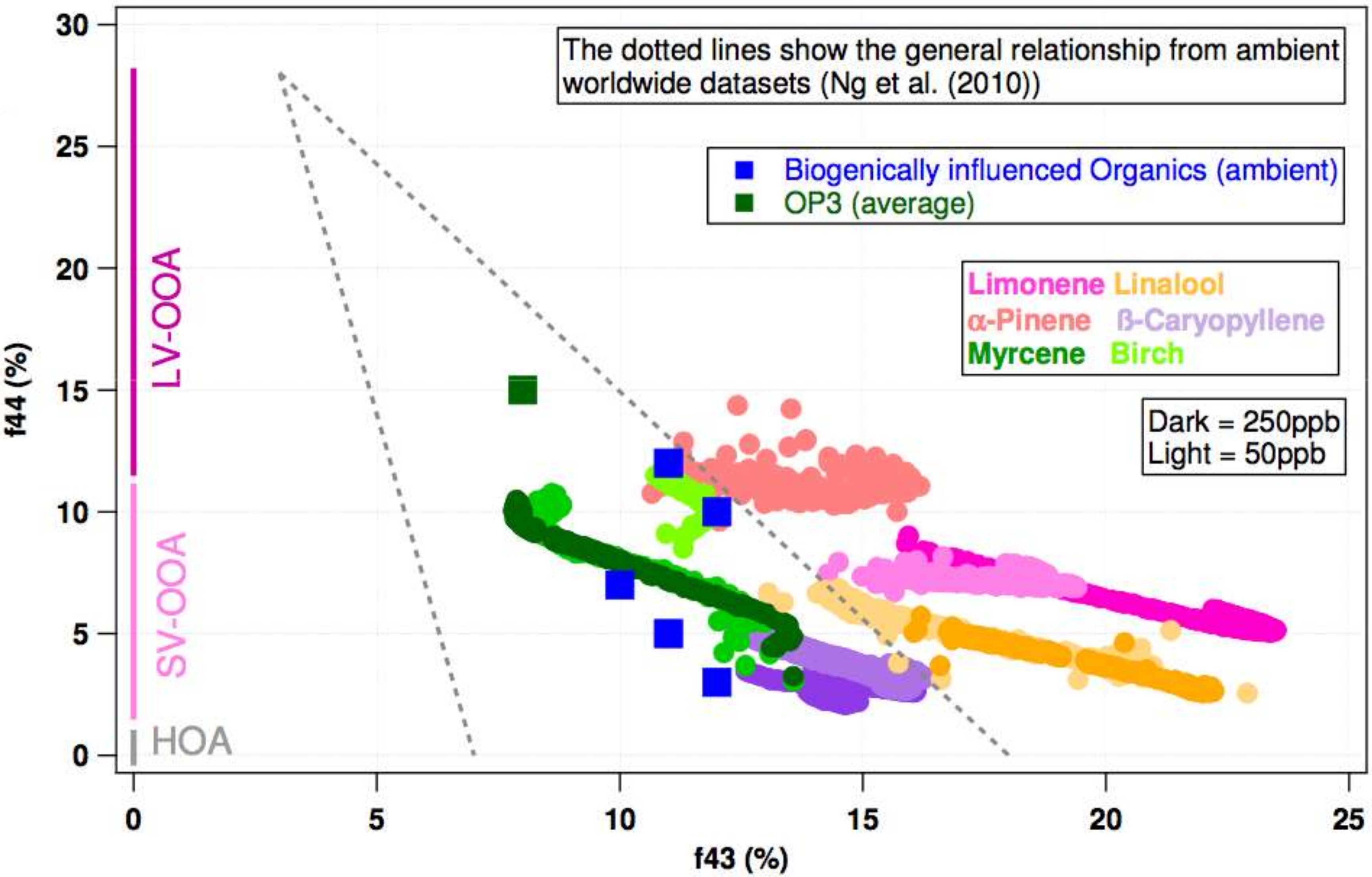




The different emission soup leads to different chemical behaviour

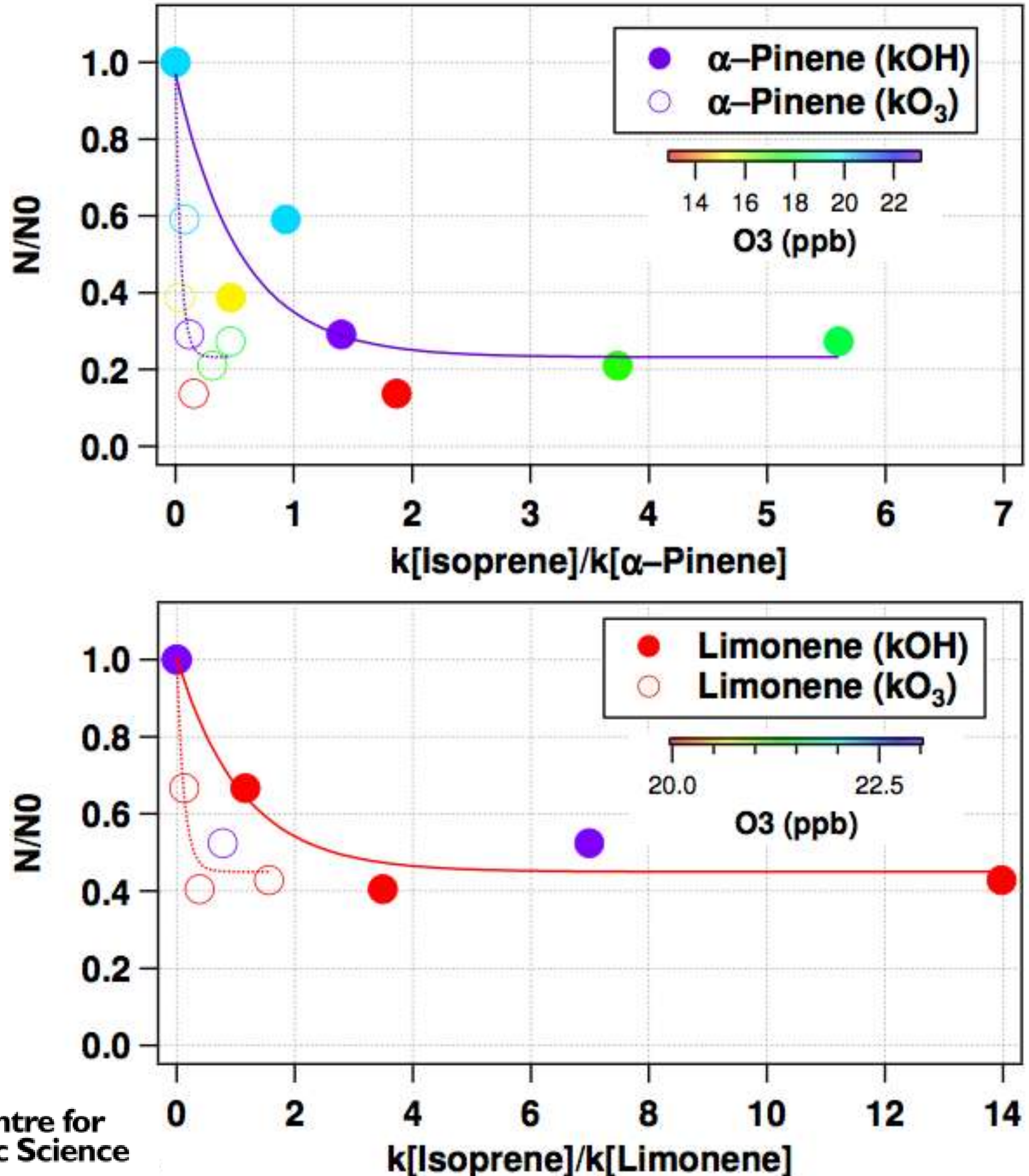
University of Leicester

Chemical characteristics of SOA



The "chemical space" in the chamber is the same as in the real world

Influence of Isoprene on MT-SOA formation



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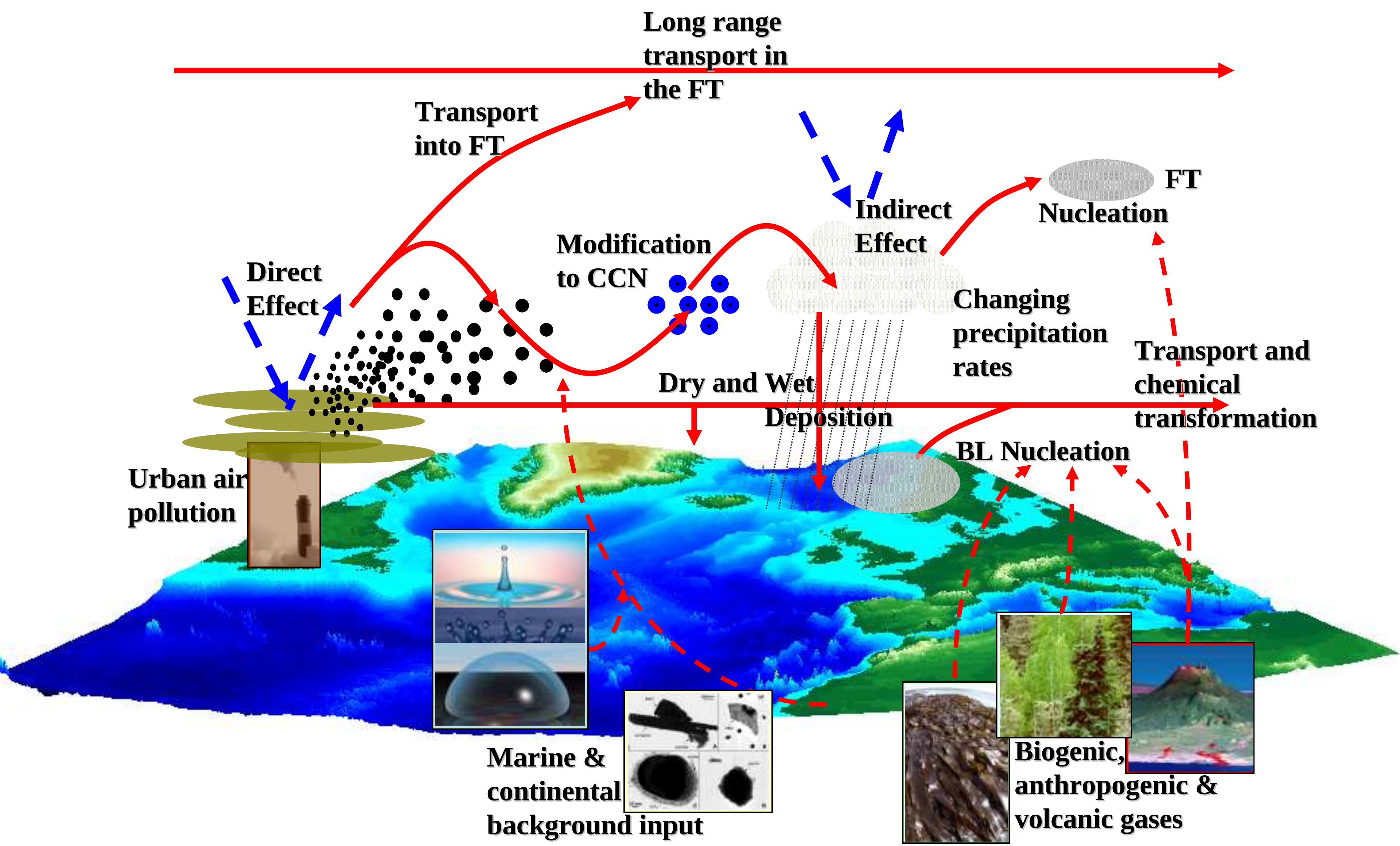
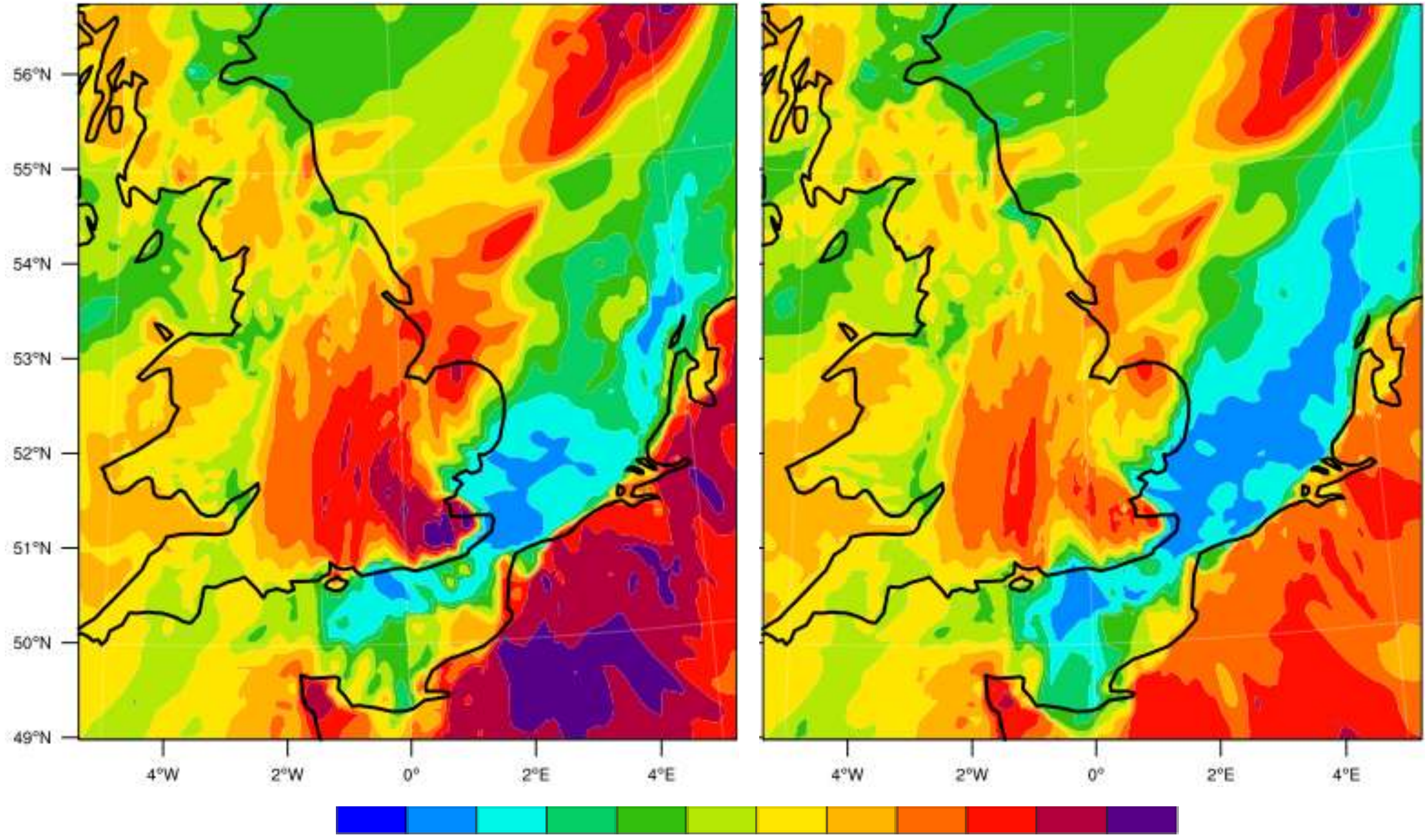
Summary

- **The studied individual biogenic precursors produced particles of widely variable characteristics**
- **Selected "tropical" plants emissions different to those of the "temperate / boreal" plants**
- **The chemistry of the isoprene-dominated emissions from the tropical plants did not lead to particle formation but they were instantly formed from boreal plant emissions.**
- **Not all plants will behave similarly in their emission response, aerosol formation and hence on pollution and climate**

Regional AQ modelling



O_3 prediction using different mechanisms



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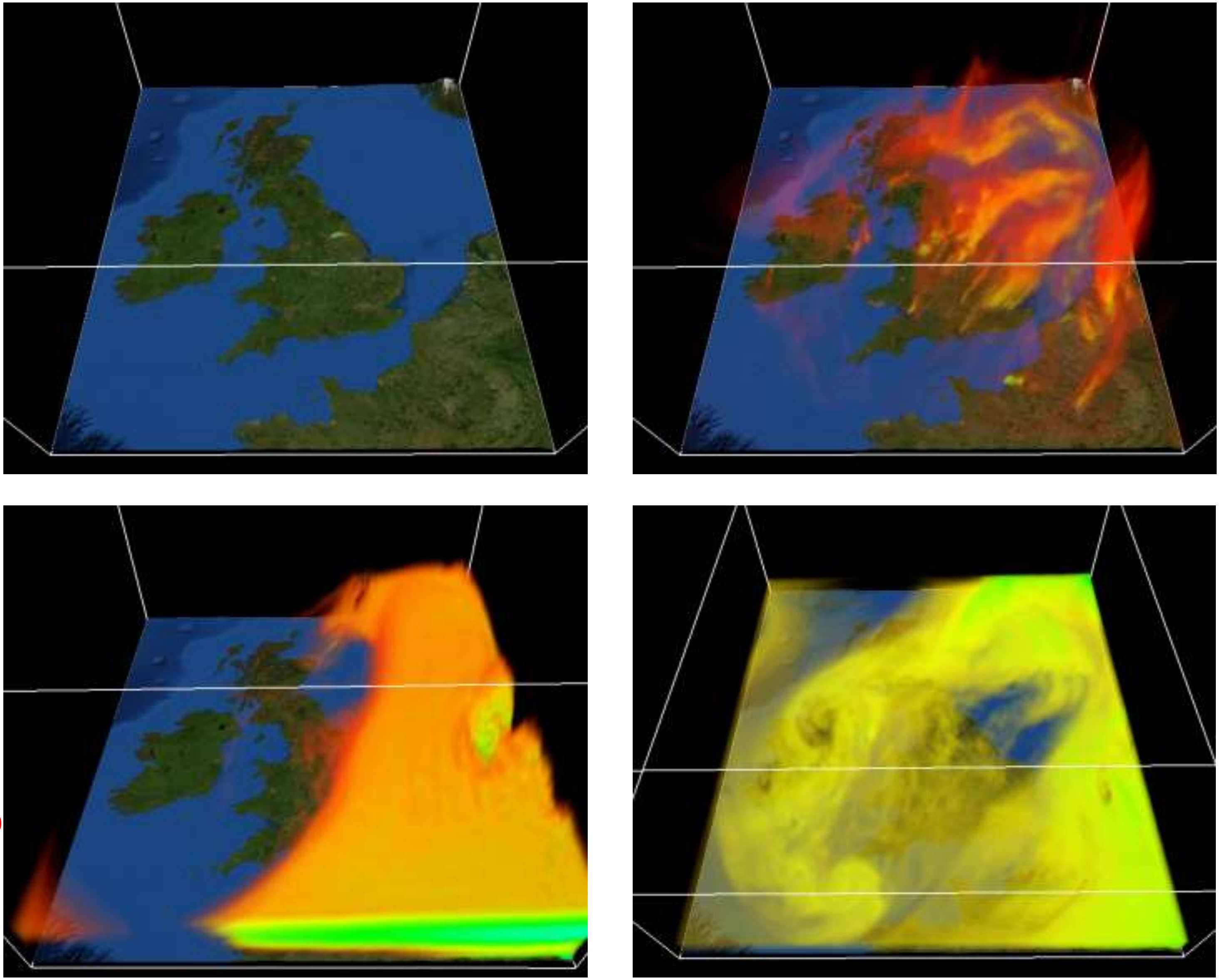
Simulated pollutants in lower atmosphere (surface to 2 km for O_3, to 8 km for others) on 21st July 2010

NO
red 0 –
blue 30 ppb

NO_2
red 0 –
blue 40 ppb



$PM_{2.5}$
transparent < 10
red 10 –
green 30 µgm^{-3}

O_3
transparent < 30
orange 30 –
green 80 ppb

00:00 03:00 06:00 09:00 12:00 15:00 18:00 21:00

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