Manchester ToF-CIMS on the FAAM Aircraft

Thomas Bannan
Archit Mehra
Emily Matthews
Hugh Coe

with contributions from York University and FAMM

Mass Spectrometry

Mass Spectrometry

Chemical Ionisation MS

$CH_3I + N_2 \rightarrow I^-, I.H_2O^-$

Detection according to the following reactions;

$I.H_2O^- + HNO_3 \rightarrow IHNO_3^-$

$I^- + HNO_3 \rightarrow IHNO_3^-$

Mass Spectrometry

Sample inlet → Ionisation → Analyser → Detector → DAC

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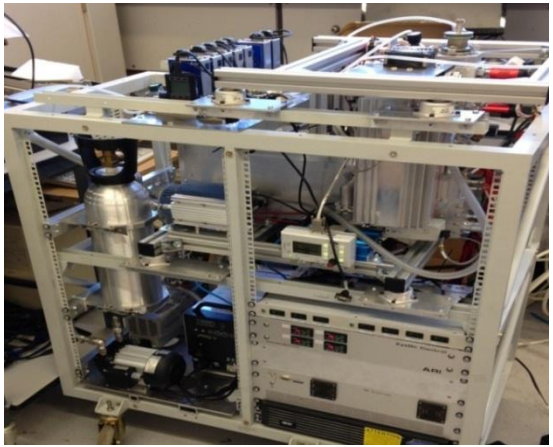
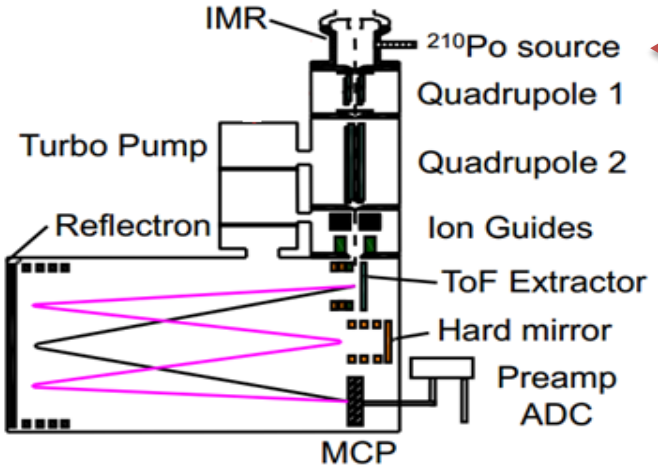


Inflight calibration – HCOOH and Cl_2

Pressure and mass flow stabilised

Zero addition at front and back of inlet

ToF CIMS – Iodide Reagent Ion



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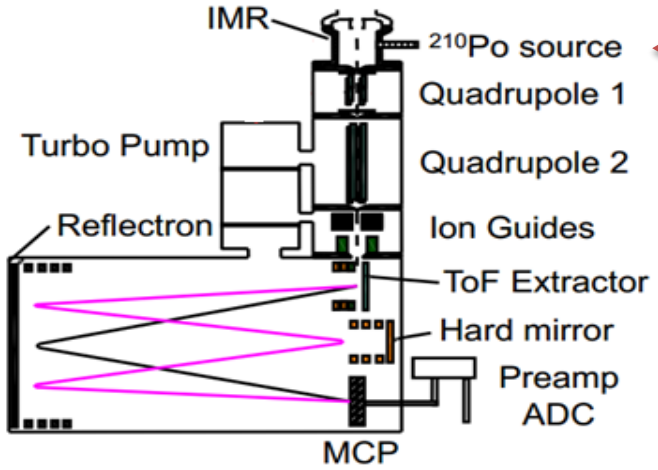

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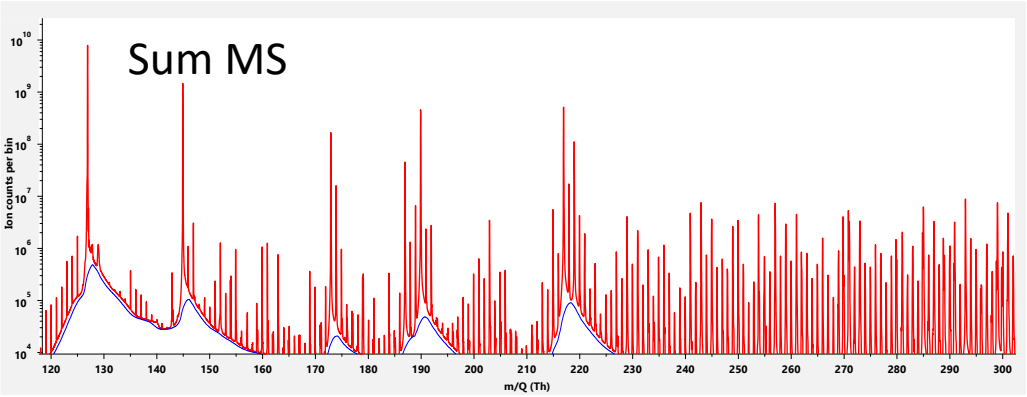

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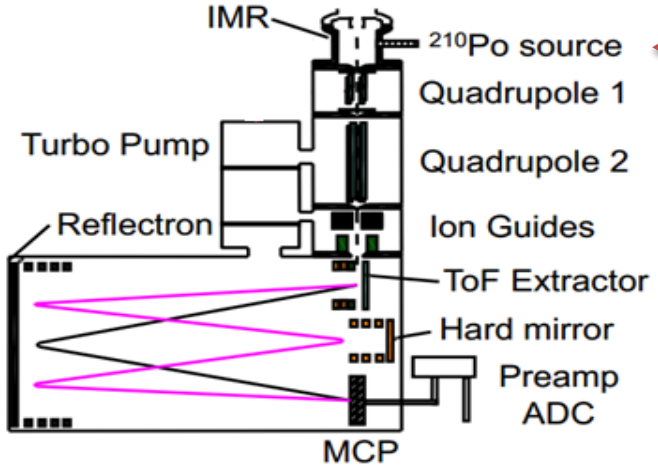

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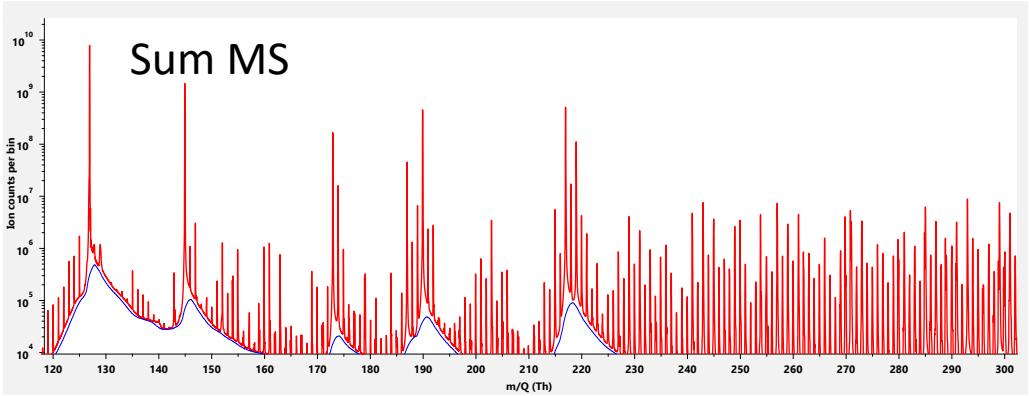
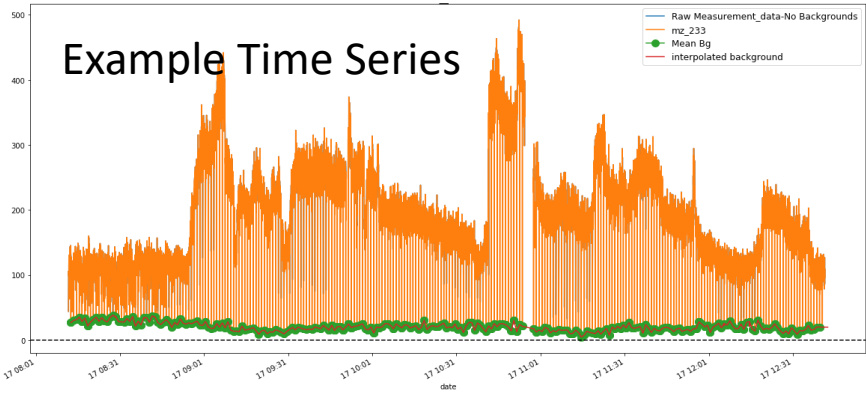
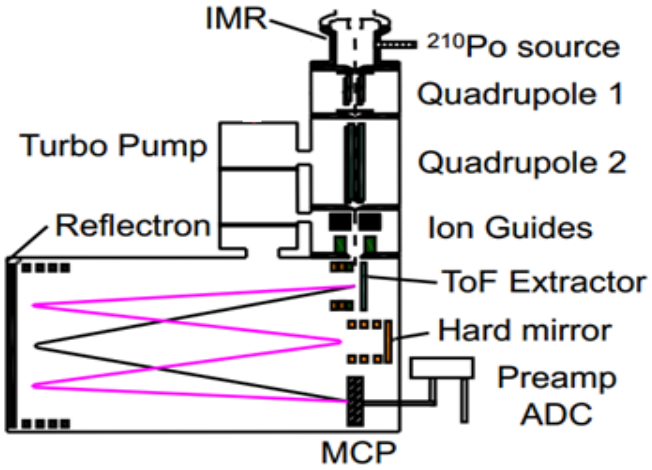
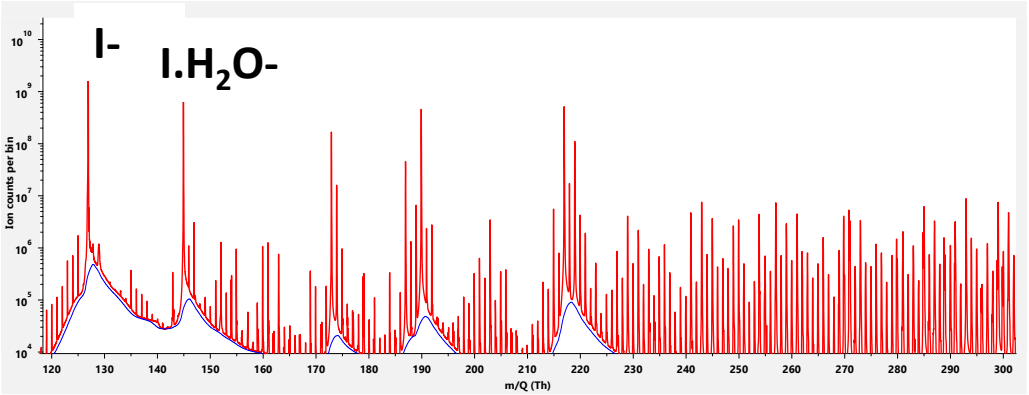


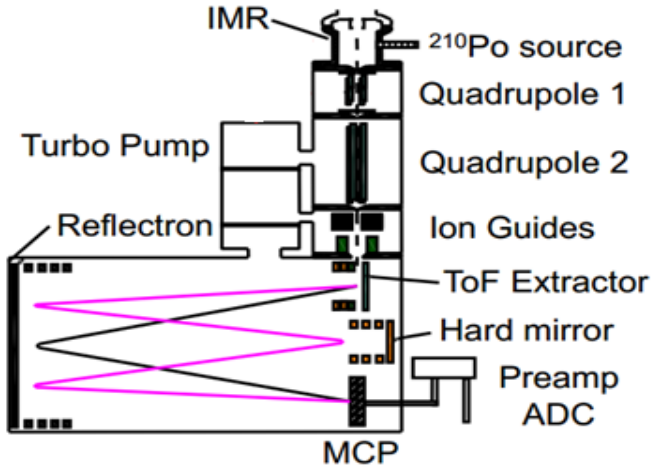


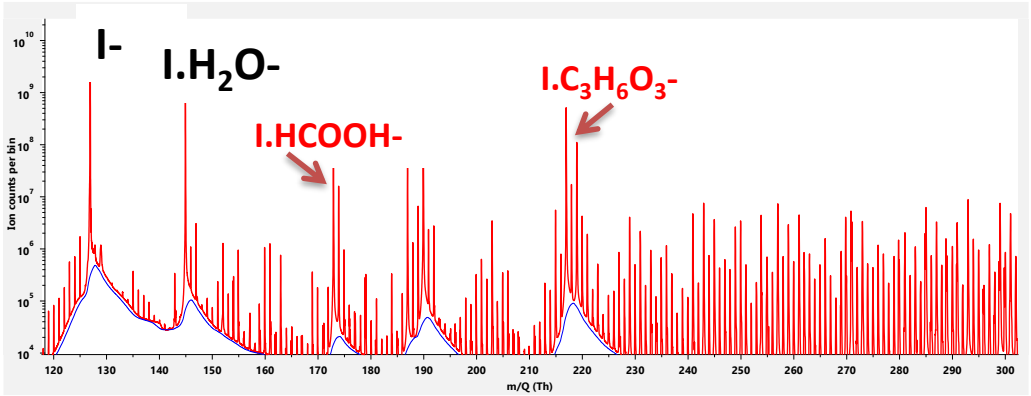
ToF CIMS


IMR
^{210}Po source
Quadrupole 1
Turbo Pump
Quadrupole 2
Reflectron
Ion Guides
ToF Extractor
Hard mirror
Preamp
ADC
MCP

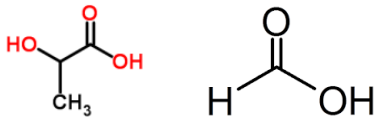

I-
I.H2O-
Ion counts per bin
m/Q (Th)

ToF CIMS





Organics



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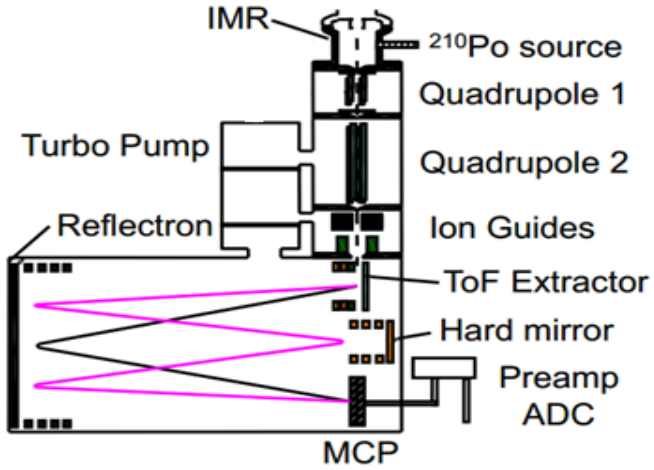

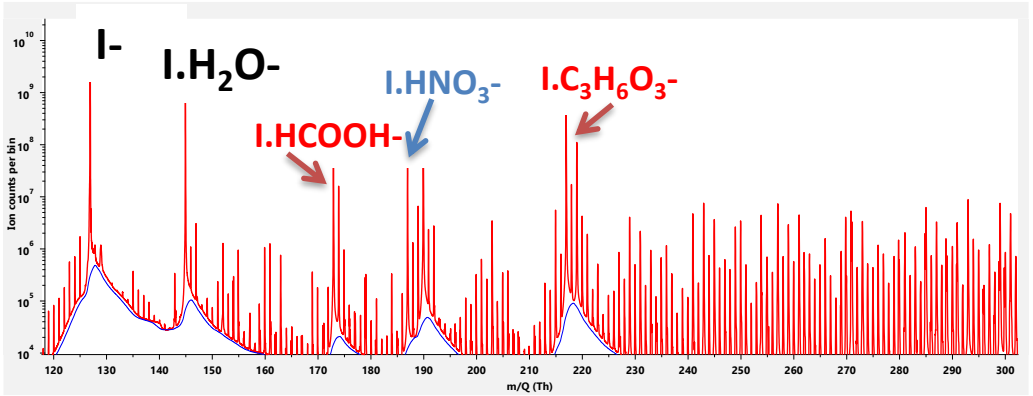

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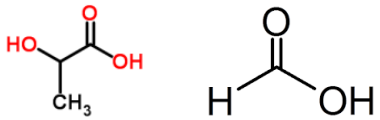
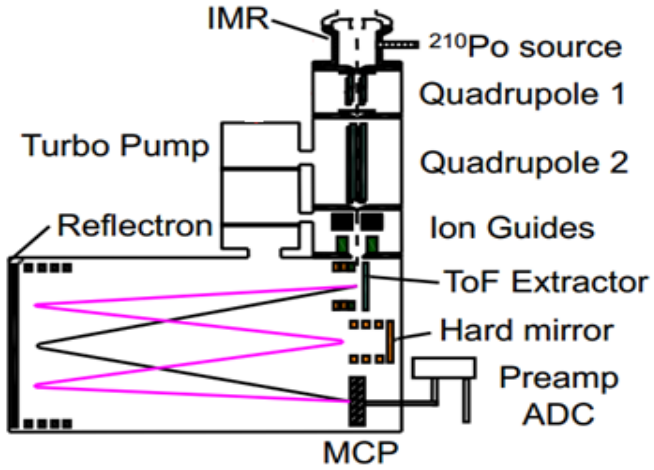
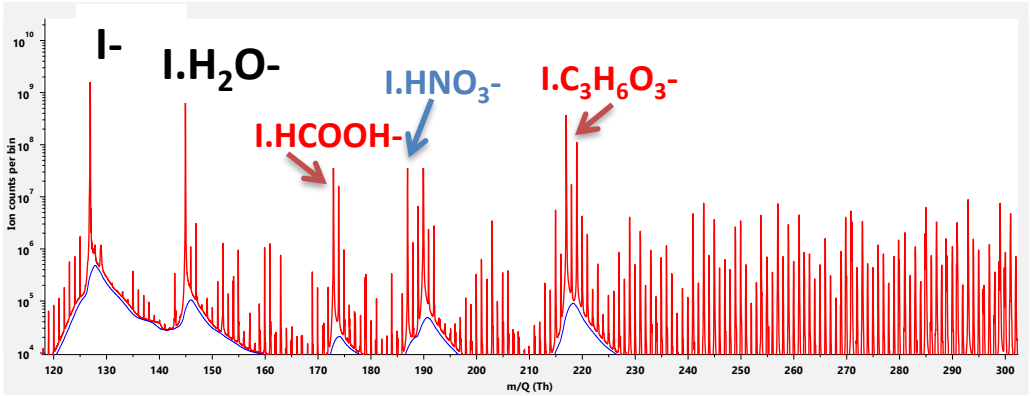


N-Species

HNO_3 HONO N_2O_5
HCN HNCO

ToF CIMS





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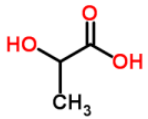

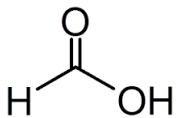

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Halogens

$ClNO_2$ BrO Cl_2
Br_2 HOBr

Organic Aerosol Field Measurements

Prof. Hugh Coe & Dr James Allan

- APHH Beijing **(FIGAERO-CIMS)**
- Manchester Bonfire Night **(I-CIMS)**
- Brazil ZF2 **(FIGAERO-CIMS)**
- Wintertime Urban Manchester**(I-CIMS)**

Chamber Measurements

Prof. Gordon McFiggans & Dr Rami Alfarra

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- Isoprene Ozolonlysis **(FIGAERO-CIMS)**
- Julich Plant Chamber Benzene Oxidation **(I-CIMS)**

Fundamental Aerosol Properties

Dr David Topping

- PEG Volatility Experiments **(FIGAERO-CIMS)**

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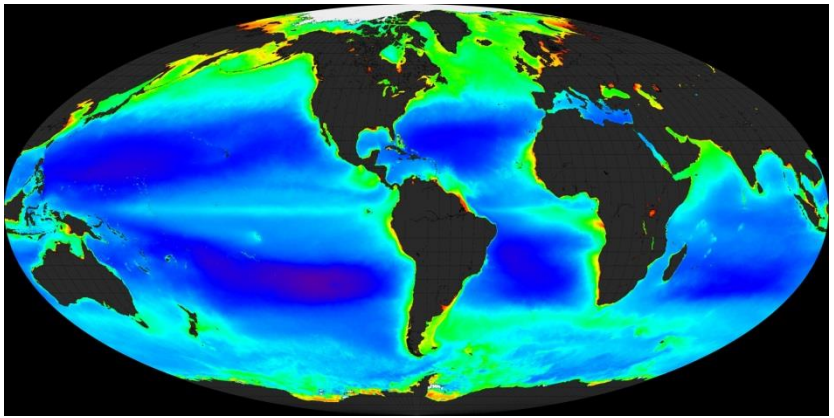
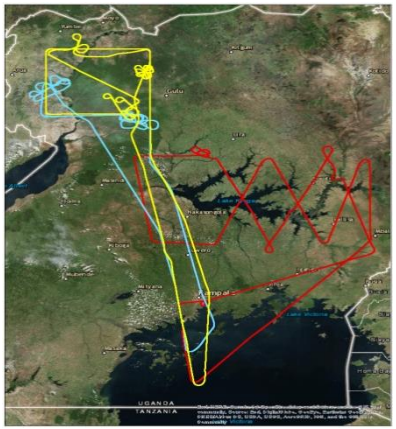
Aircraft Observations

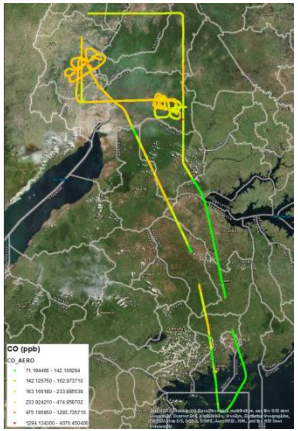
Prof. Hugh Coe

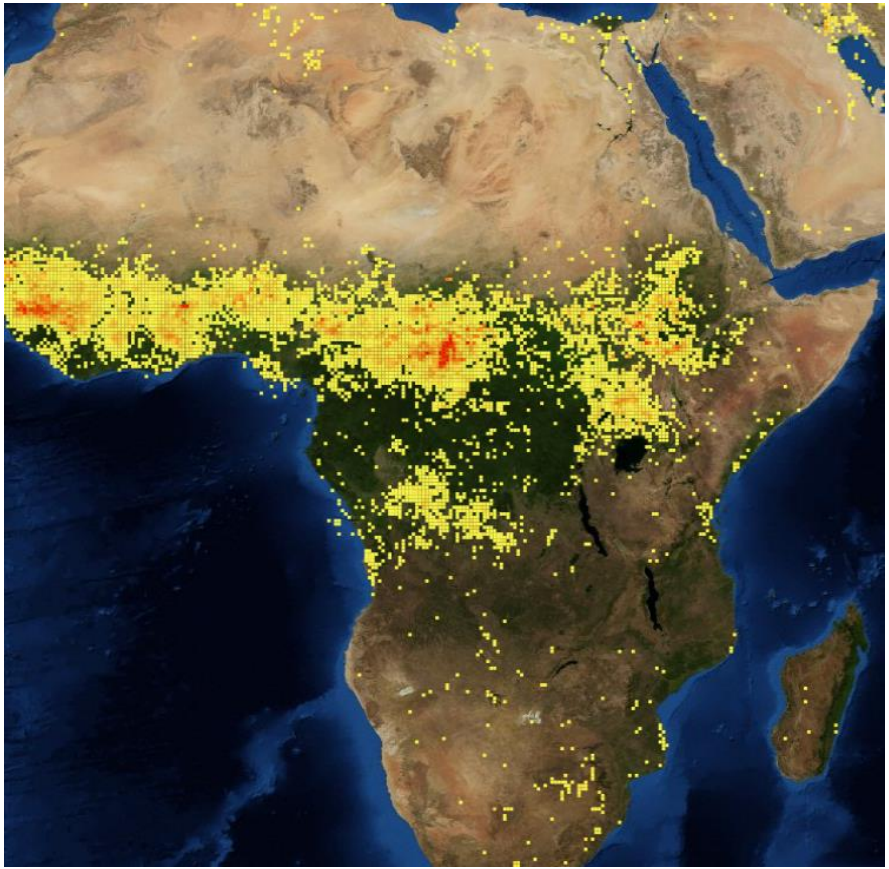
- ACSIS Flights
- Moya Flights **(I-CIMS)**

MOYA Flight Project

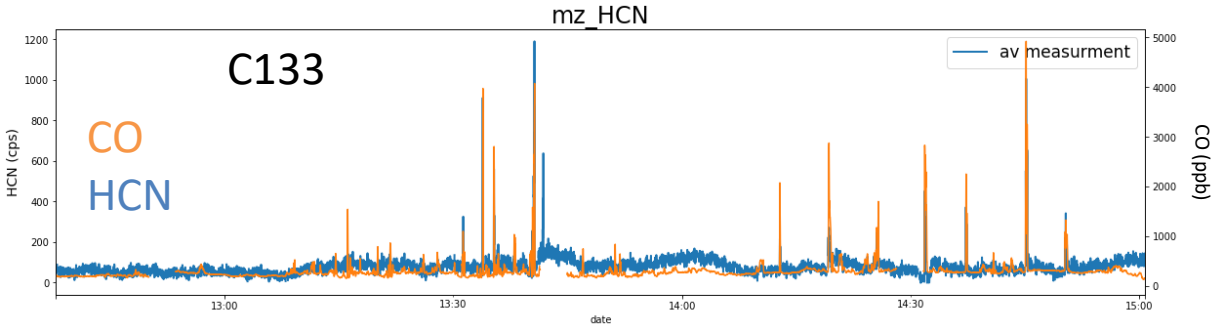


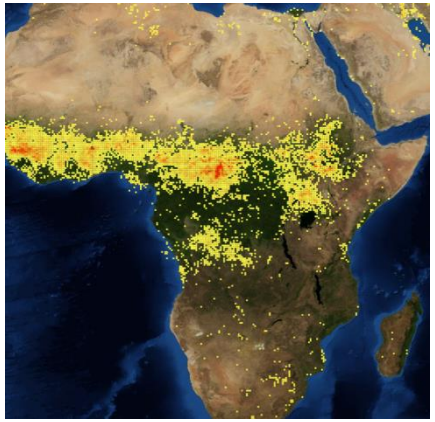


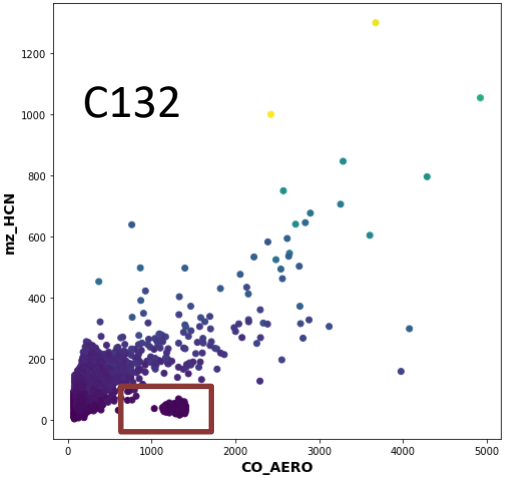


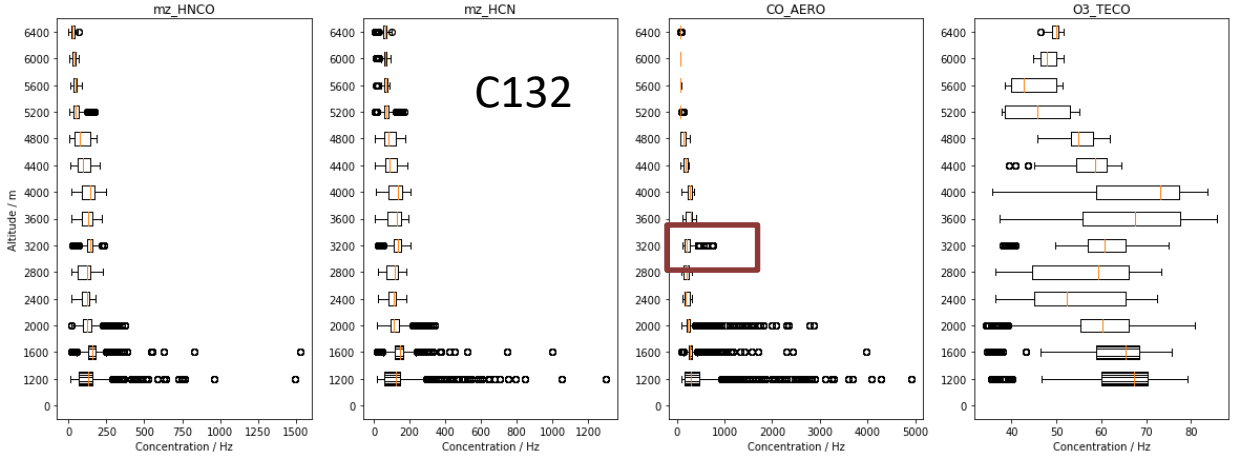


Burning Markers during the MOYA Campaign









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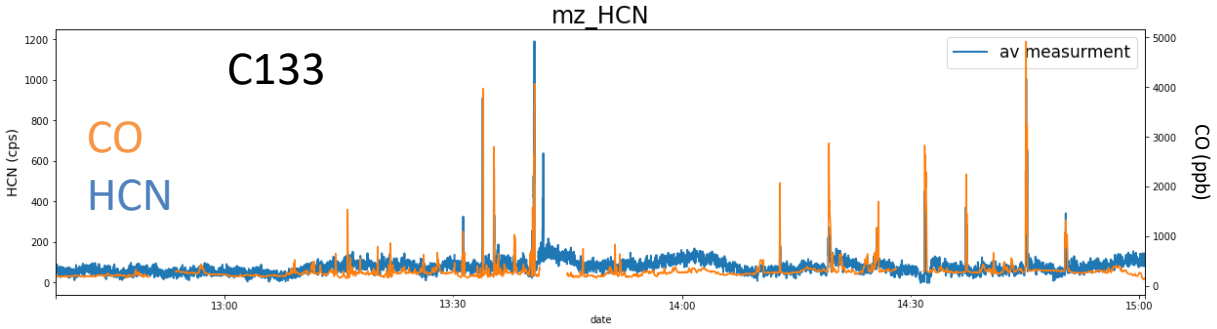

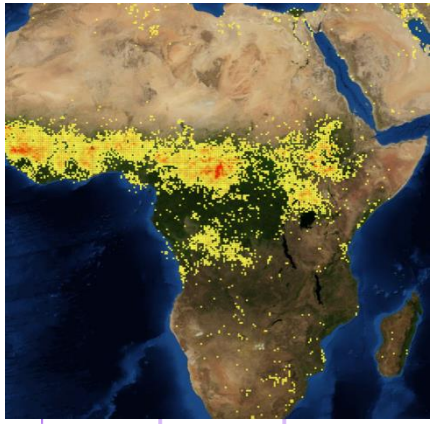

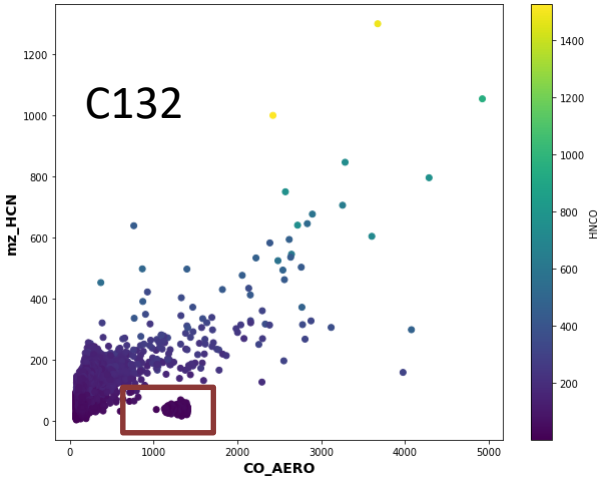

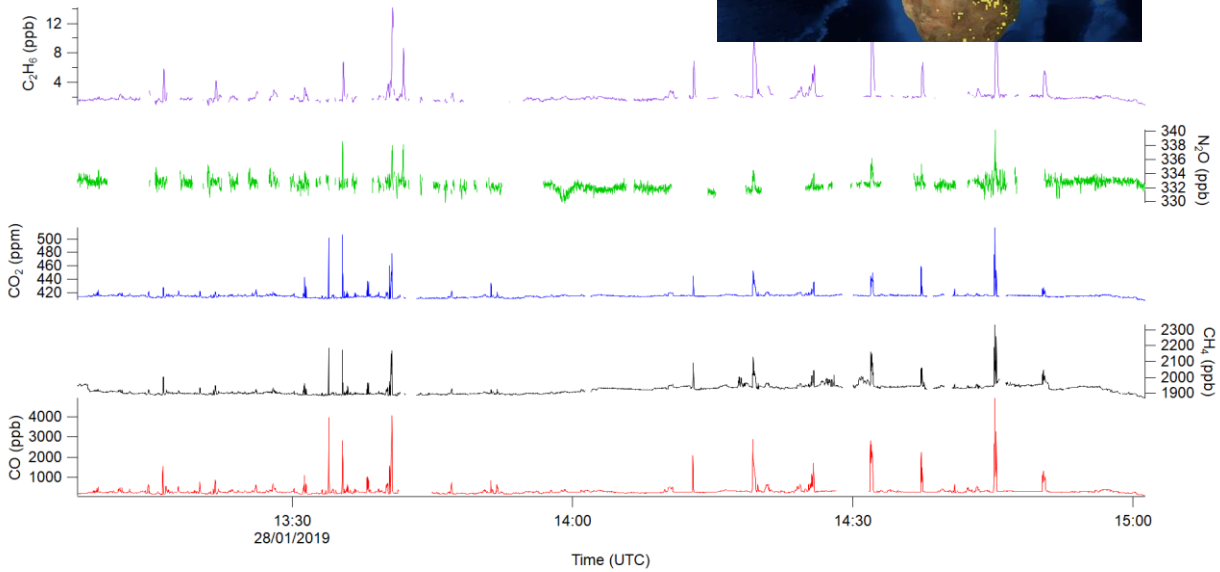

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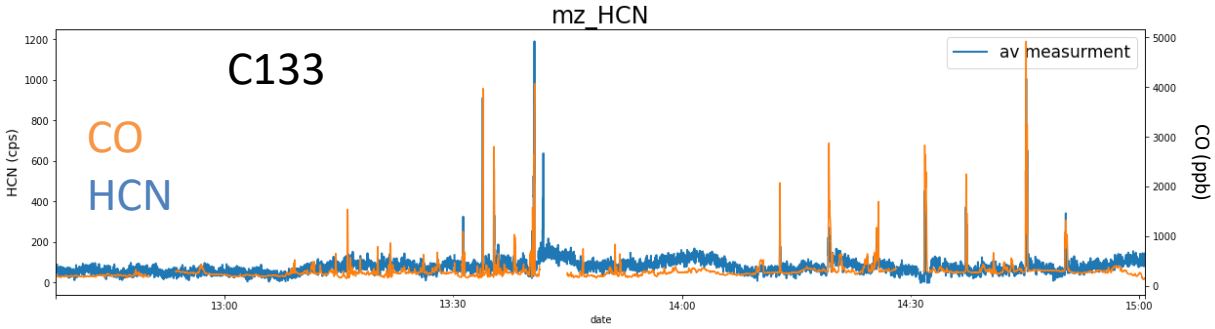

AGU PUBLICATIONS
JGR
Journal of Geophysical Research: Atmospheres
RESEARCH ARTICLE
10.1002/2017JD027316

Observations of Isocyanate, Amide, Nitrate, and Nitro Compounds From an Anthropogenic Biomass Burning Event Using a ToF-CIMS

Michael Priestley[1], Michael Le Breton[1,2], Thomas J. Bannan[1], Kimberly E. Leather[1], Asan Bacak[1], Ernesto Reyes-Villegas[1], Frank De Vocht[3], Beth M. A. Shallcross[4], Toby Brazier[5], M. Anwar Khan[5], James Allan[1,6], Dudley E. Shallcross[5], Hugh Coe[1], and Carl J. Percival[1,7]

[1]Centre for Atmospheric Science, School of Earth and Environmental Sciences, University of Manchester, Manchester, UK,

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Key Points:
- ToF-CIMS identifies isocyanates, amides, nitro-organics, and nitrates with mixing ratio enhancements between 2 and 13 times during bonfire night
- Low wind speeds and poor mixing favor pollutant accumulation with
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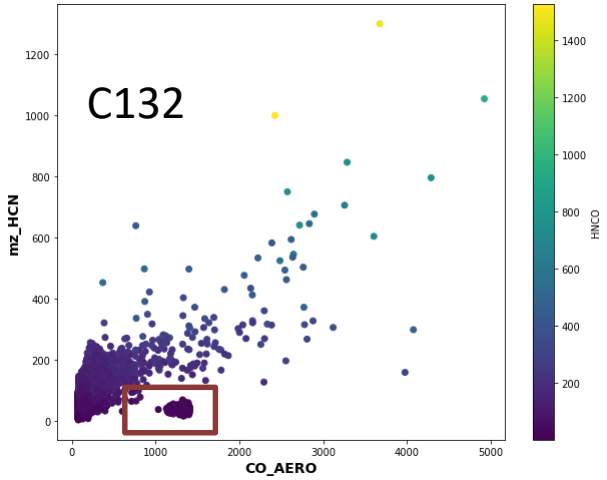
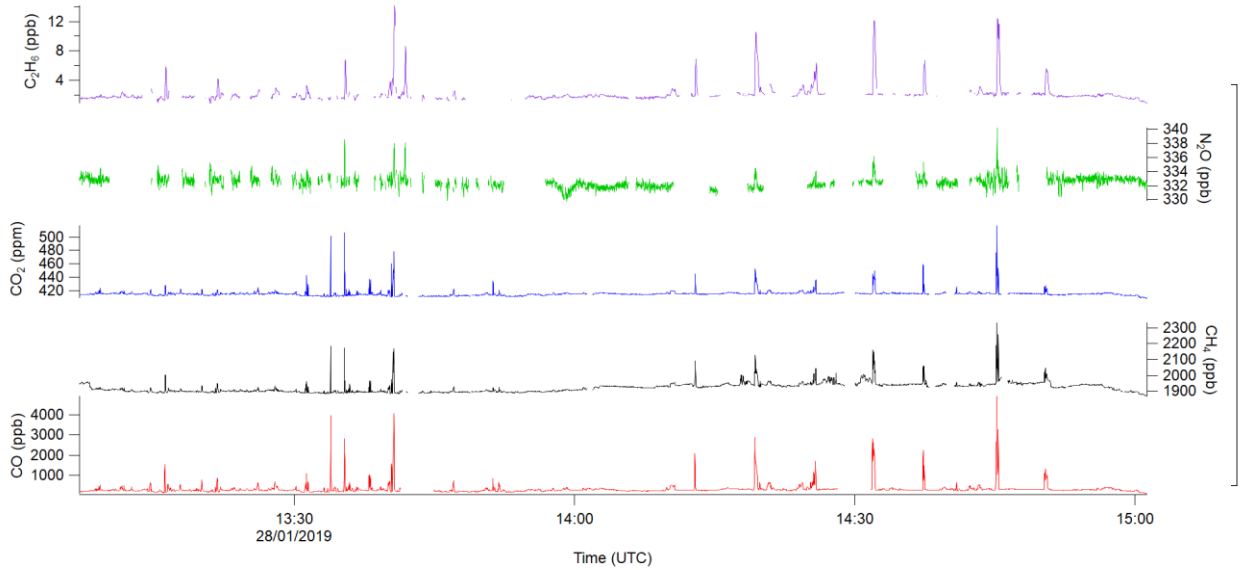




VOC Oxidation

Biogenic VOCs (BVOCs) constitute major fraction of organic mass in the atmosphere

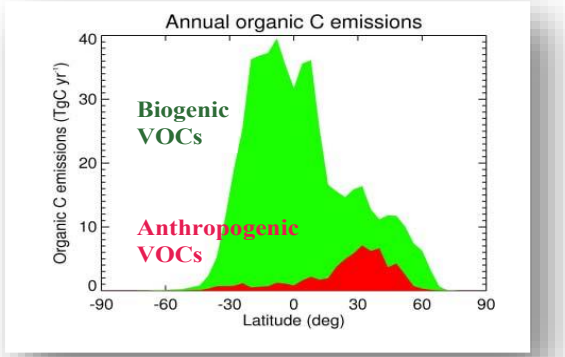
Processing in atmosphere impacts oxidizing capacity and aerosol formation

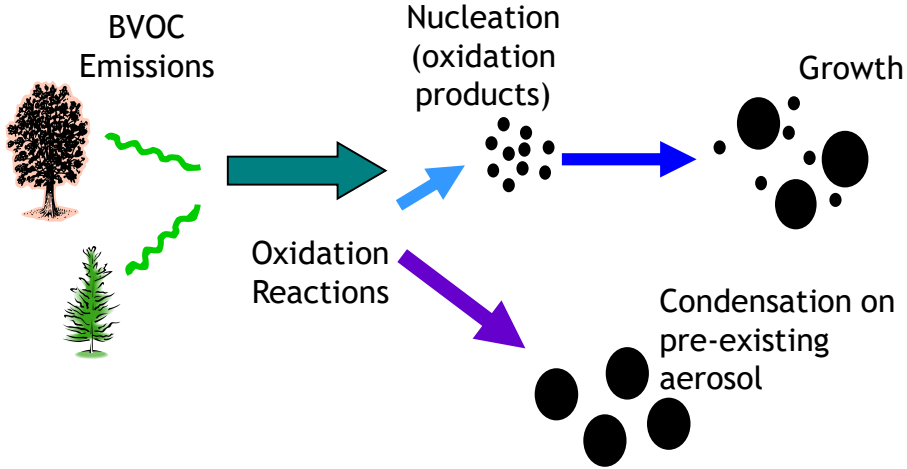
- Climate
- Air quality
- Human health

BVOCs sources are poorly quantified and much of its behaviour in the atmosphere in both the gas and particle phase is poorly understood.

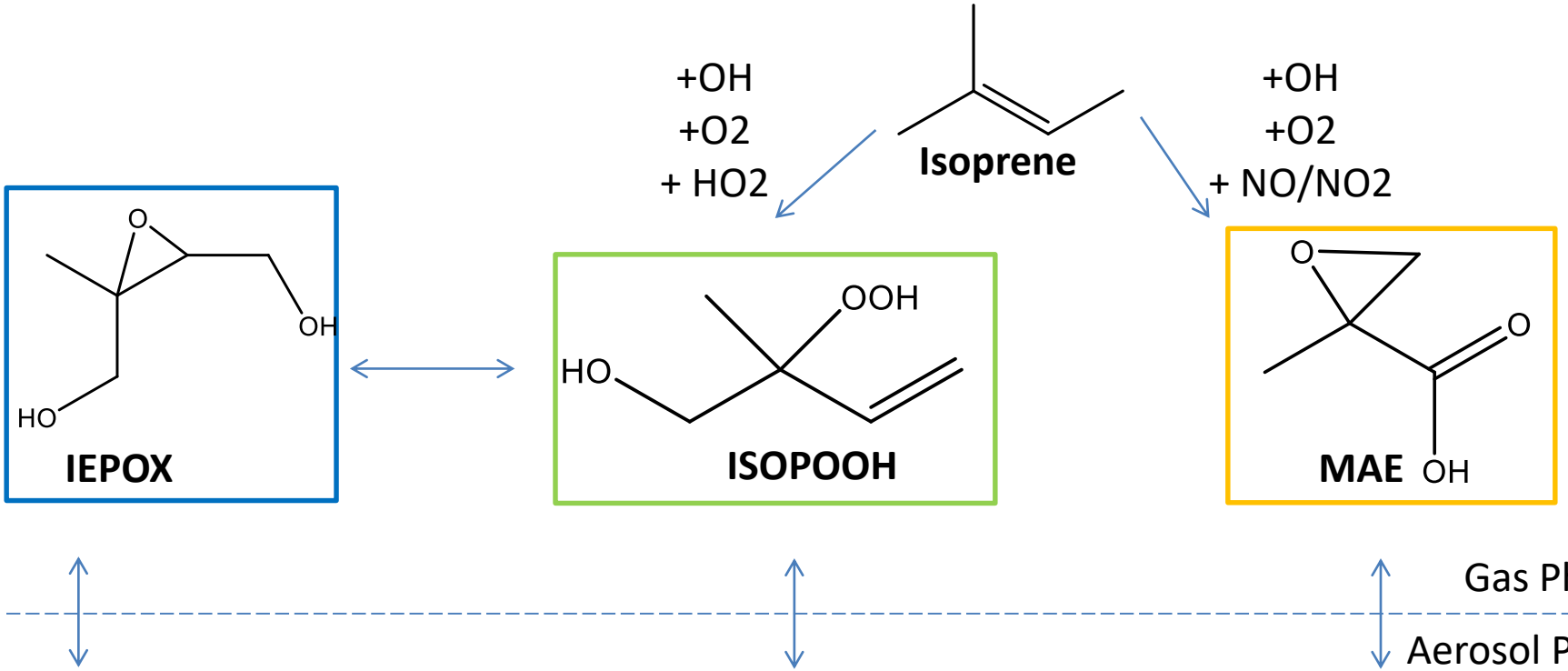
This is especially so in large parts of Africa where SOA loadings are most poorly recreated by models

Obvious lack of process understanding





Isoprene Oxidation Products



NOx concentrations and the NO2 to NO ratio at high NOx appear to dictate which pathways of isoprene oxidation dominate.

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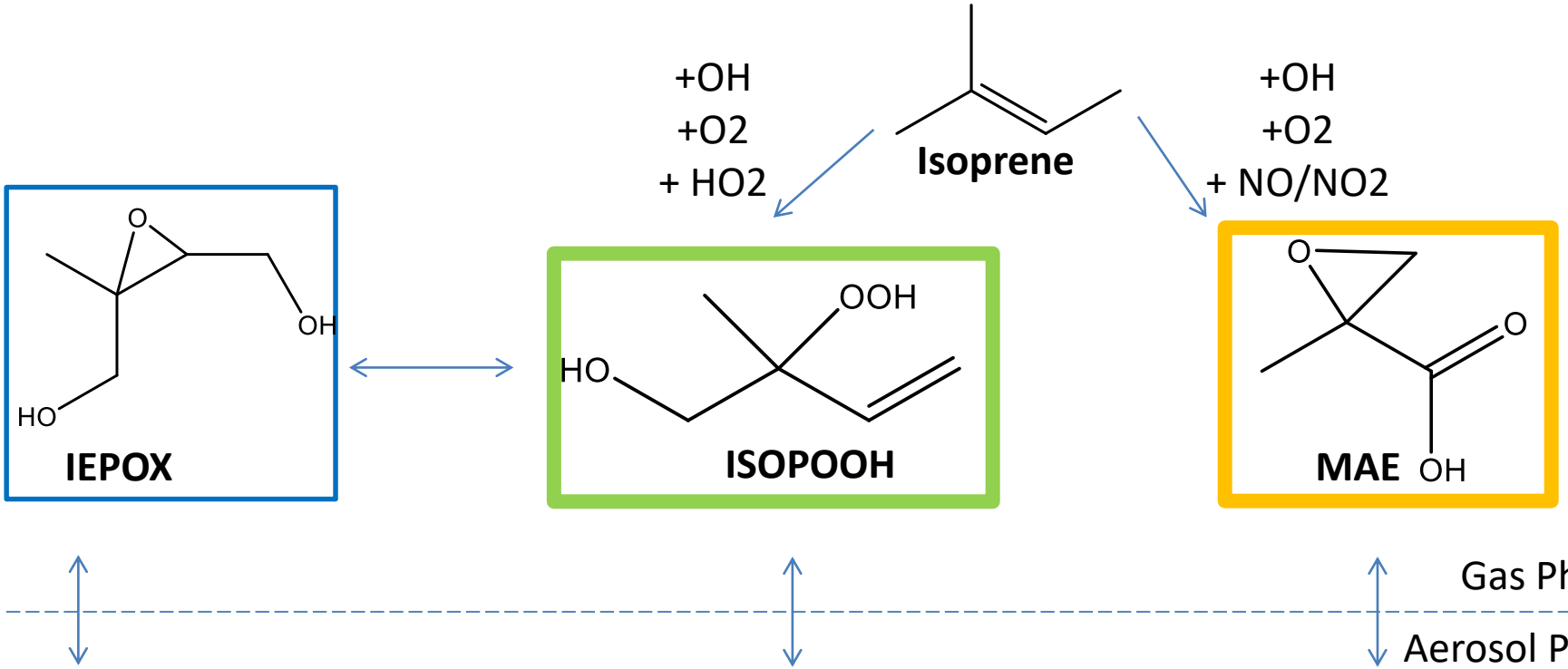

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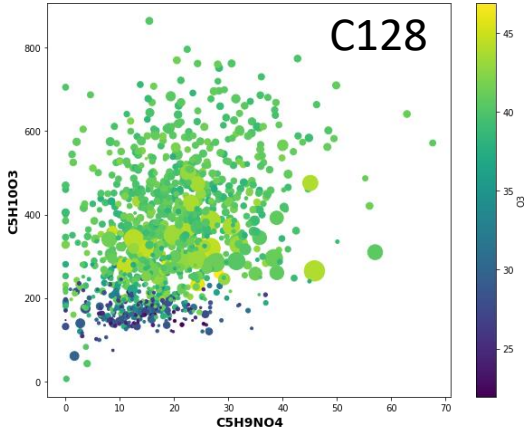
Isoprene Oxidation Products – Low NOx products Vs High NOx

High Nox Vs Low NOx products
Sized to NOx

Coloured to ozone



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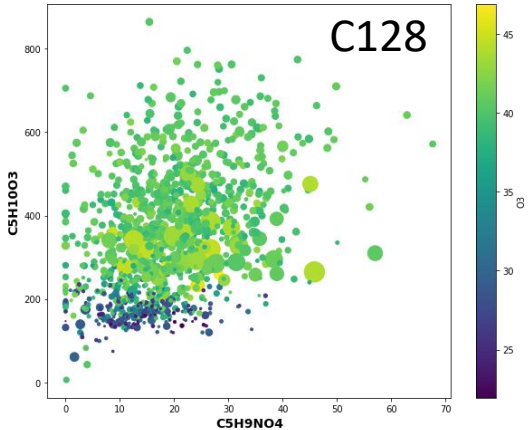
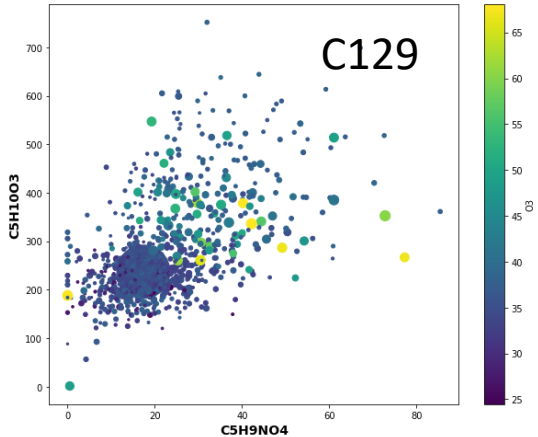
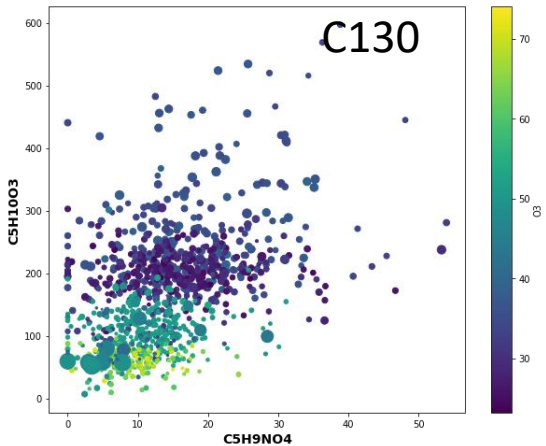
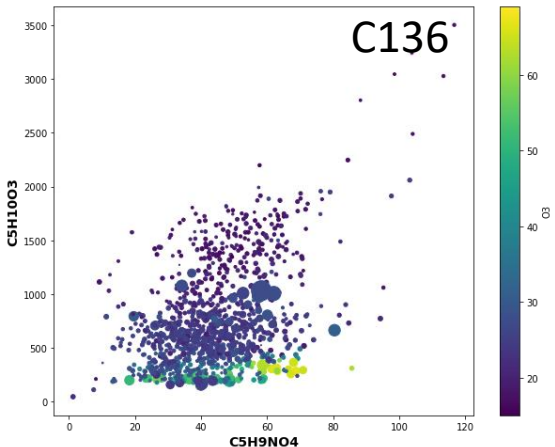
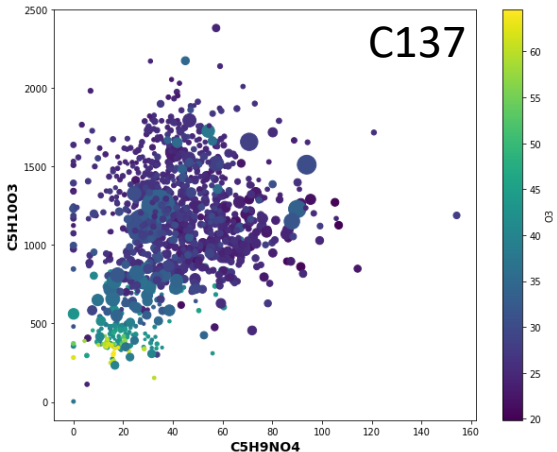


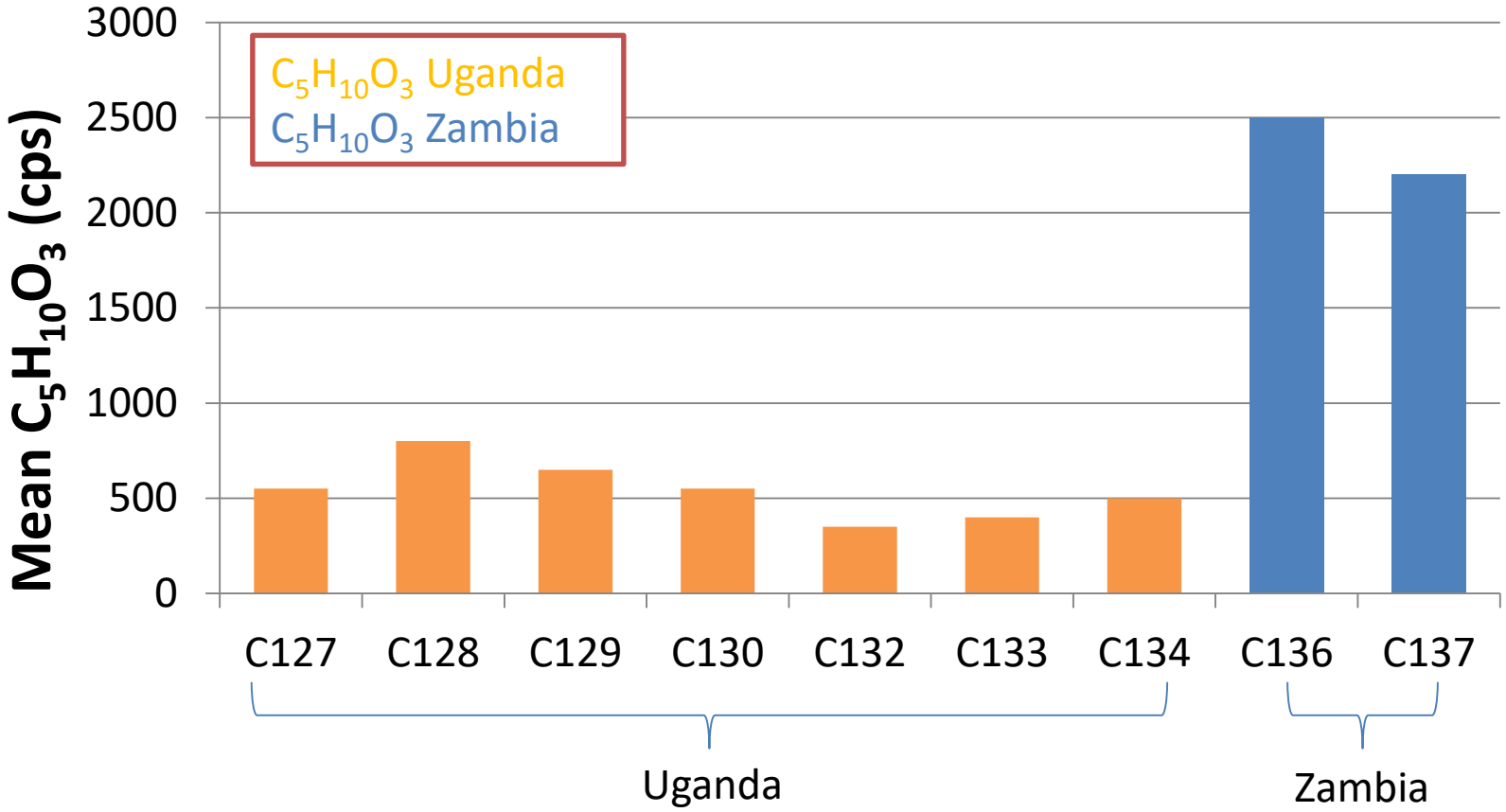








Uganda vs Zambia - Isoprene Oxidation



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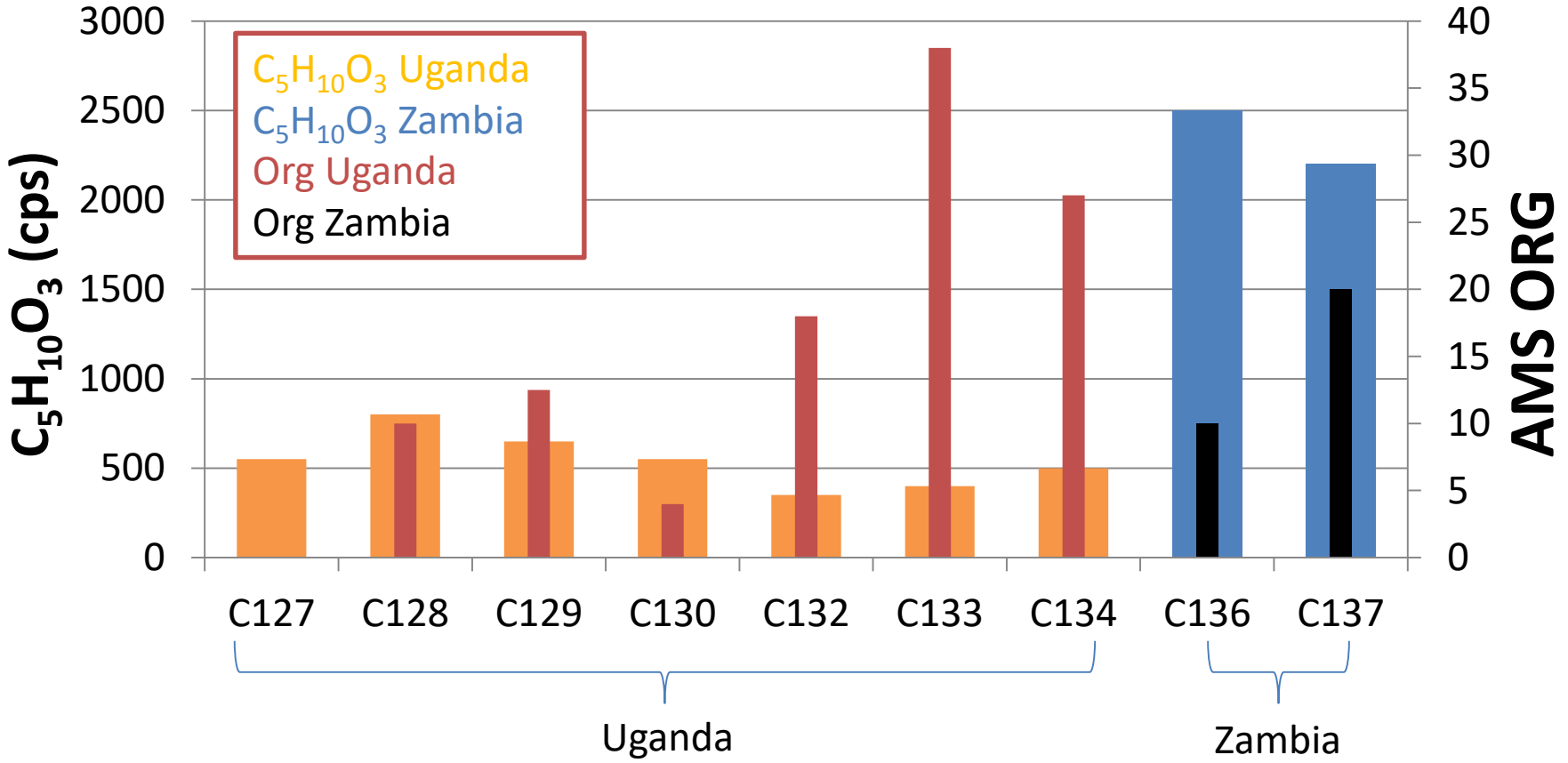
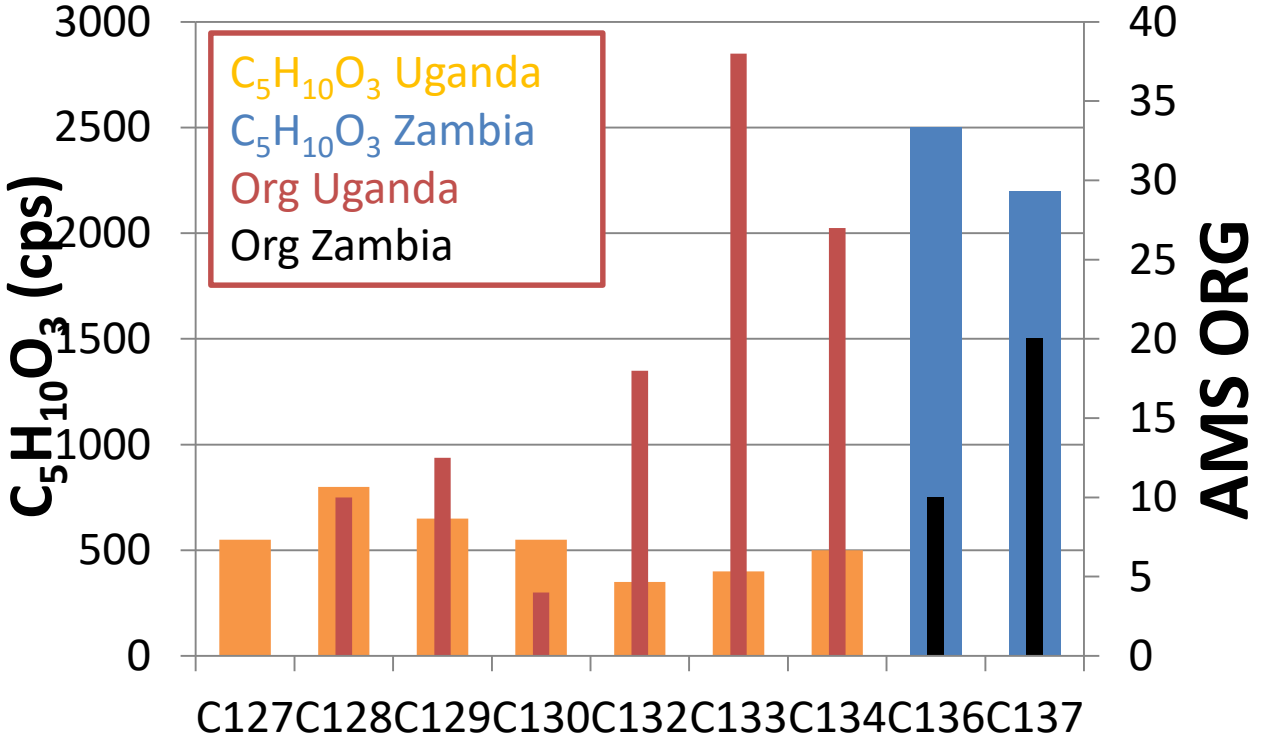
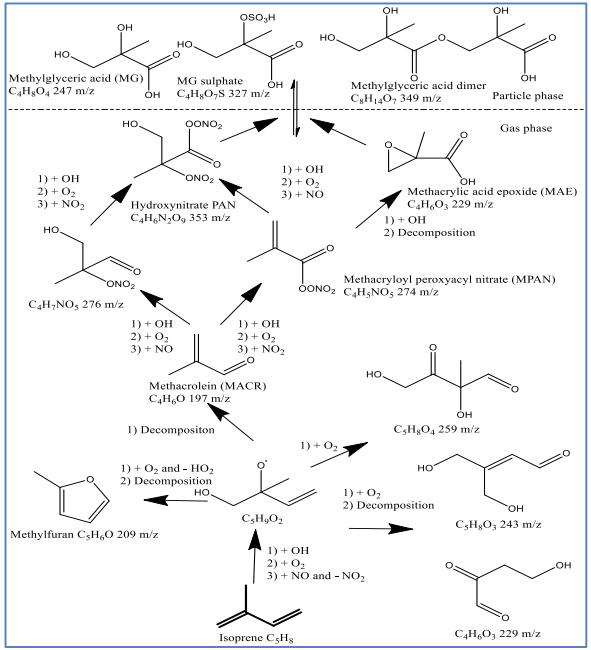
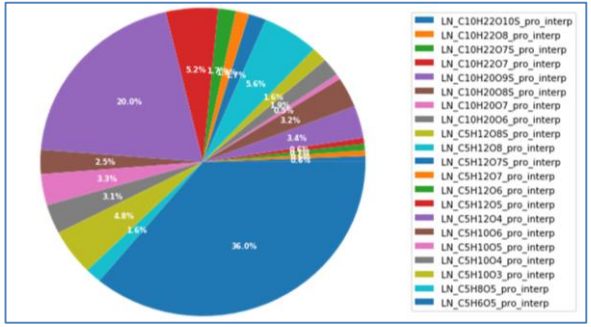


Uganda vs Zambia - VOC Oxidation

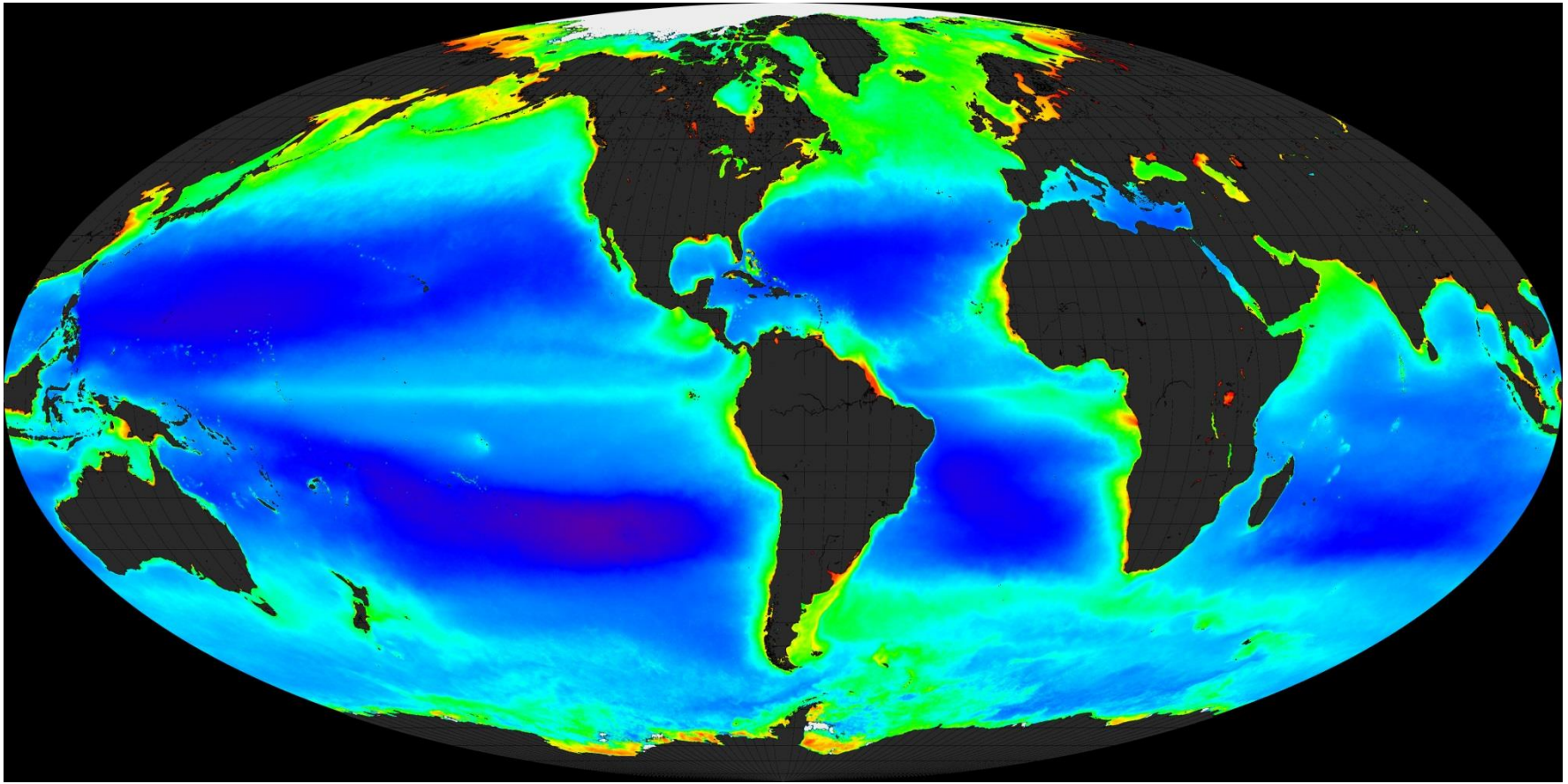






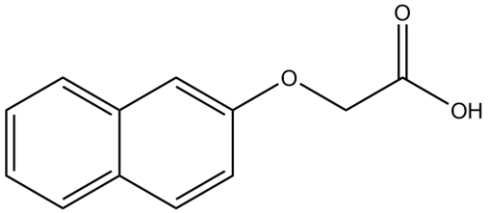
MANCHESTER 1824
The University of Manchester

Biological Activity of Lake Vic

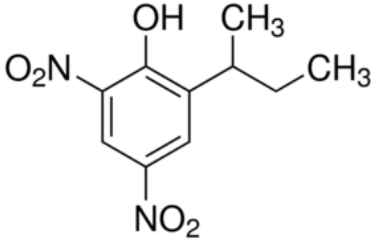


Fertilisers and Pesticides

Pesticides

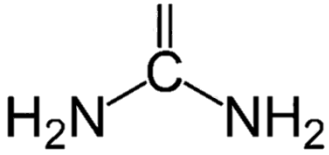


Naphthoxyacetic Acid



Dinoseb (toxic and banned in EU)

Fertilisers



Urea

Urea Derivatives

Fertilisers and Pesticides

C132