Characterising Organics and Aerosol Loading of Australia (COALA)

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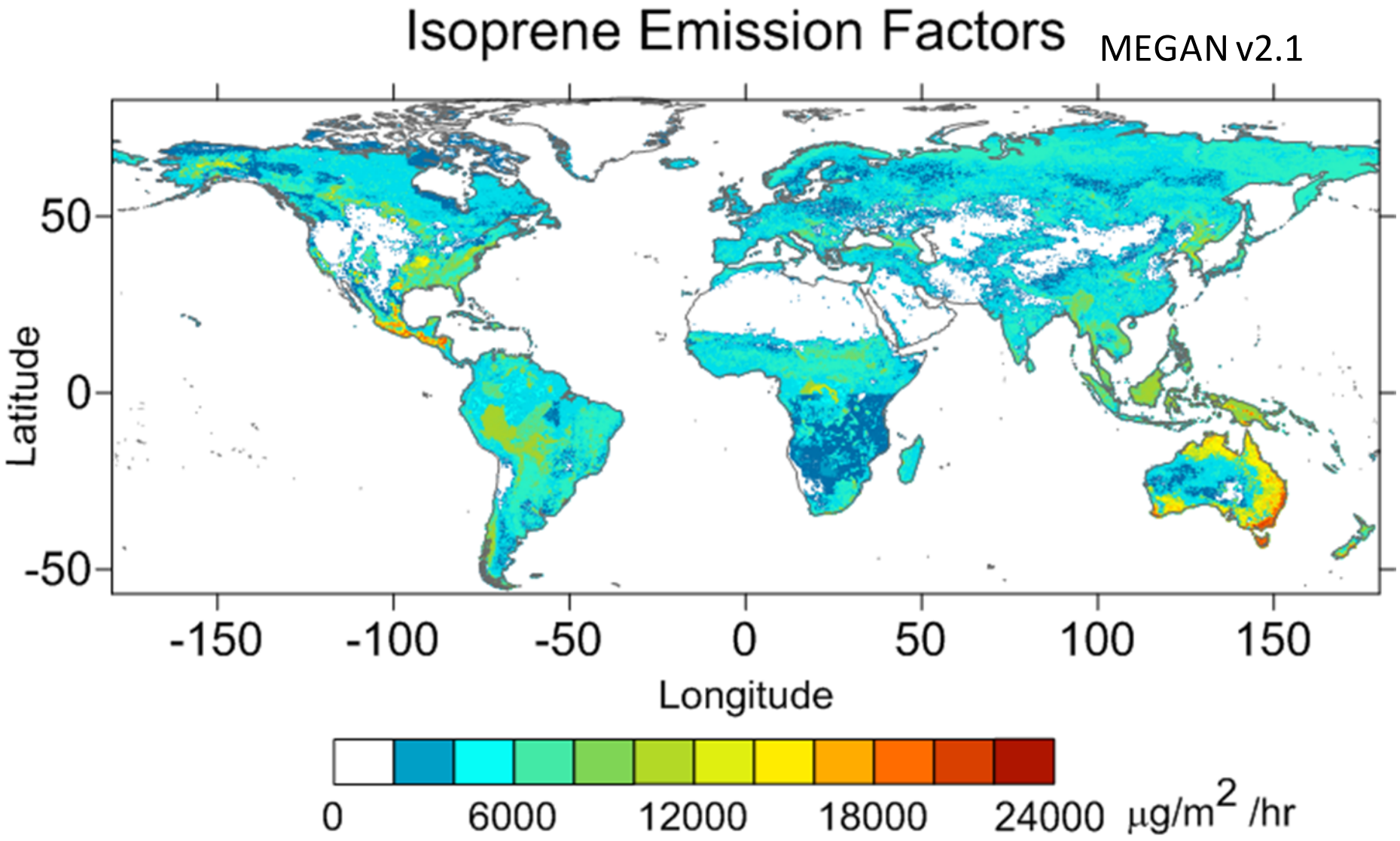
COALA

Characterising Organics and Aerosol Loading of Australia

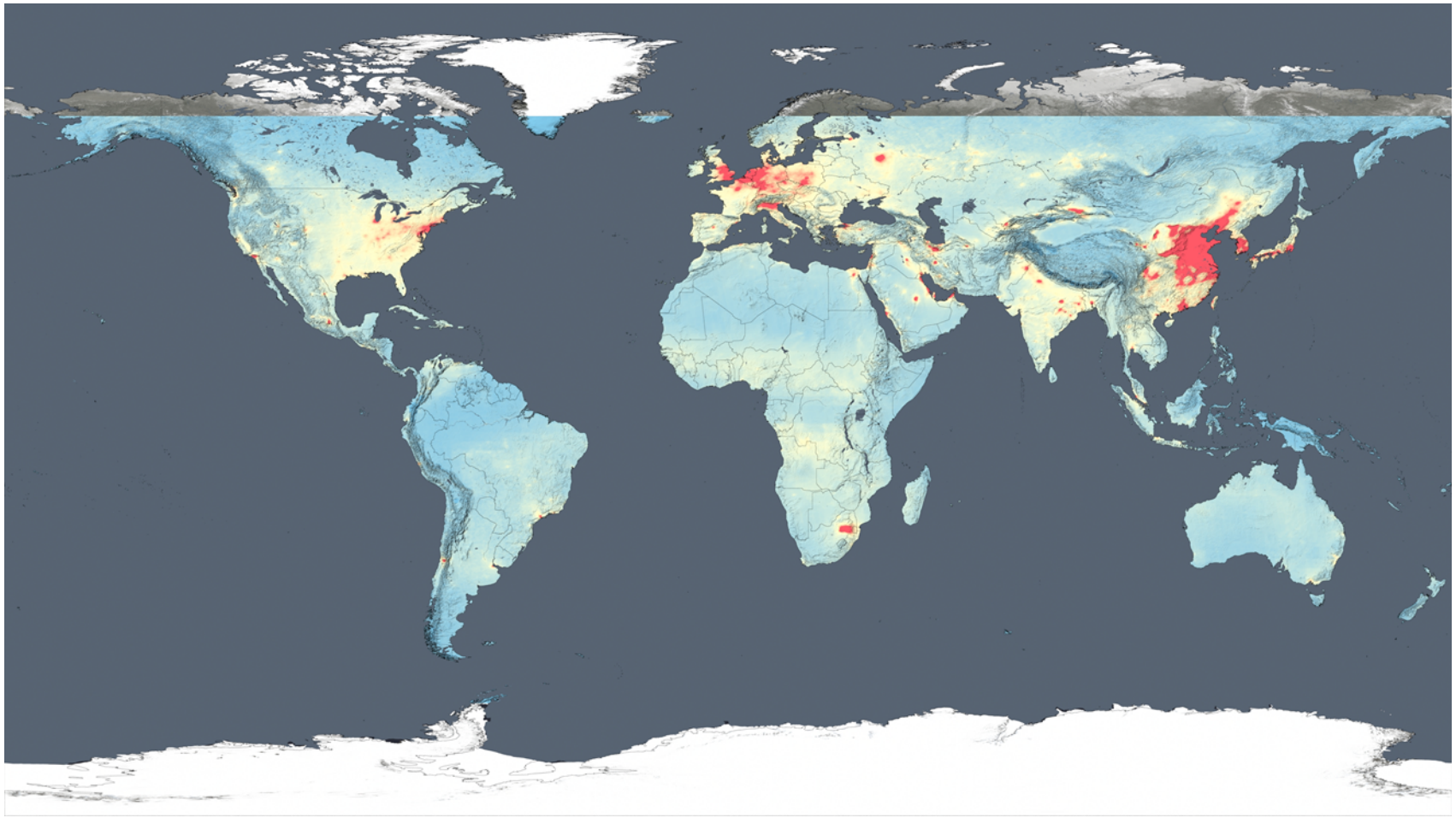
A study of the reactive carbon budget, quantifying biogenic emissions of isoprene, monoterpenes and sesquiterpene emissions over southeast Australia, and their mixing with isolated anthropogenic sources, using the NCAR C-130 & FAAM BAe-146.

Wollongong, and eucalypts

Australian isoprene stands out



Tropospheric NO2 from OMI, averaged 2014

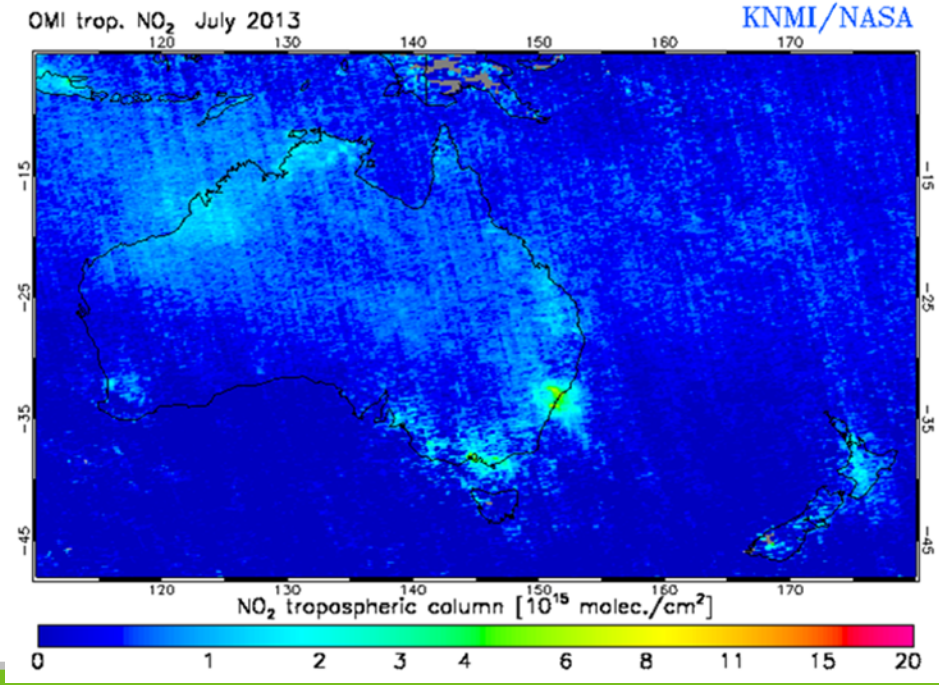


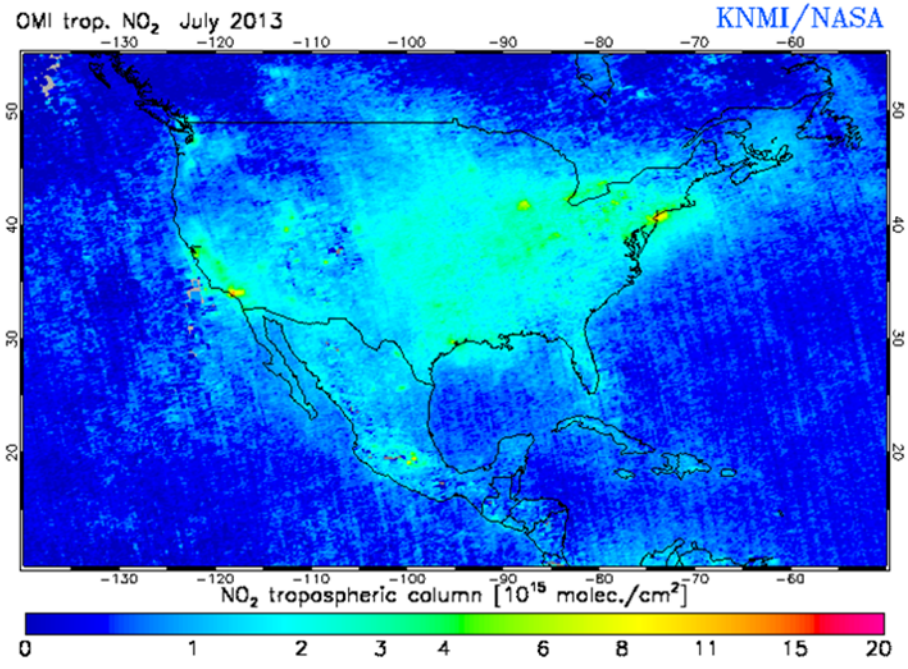
Credit: NASA

Low NOx Australia ideal laboratory

The isolation of anthropogenic NOx sources in SE Australia means that this region provides an ideal natural laboratory to study the impact of variable NO_X amounts on BVOC chemistry (from upwind of urban areas, through a gradient at the urban interface, to the downwind outflow).

Australia is a natural laboratory for the emerging science of **lower NOx regimes** in the mature industrialized world of the Northern Hemisphere.





Four field campaigns provide evidence

Isoprene and monoterpene concentrations were of a broadly similar magnitude. Southeast Australia may hold an unusual position where neither chemical species dominates, which may affect particle formation potentials.

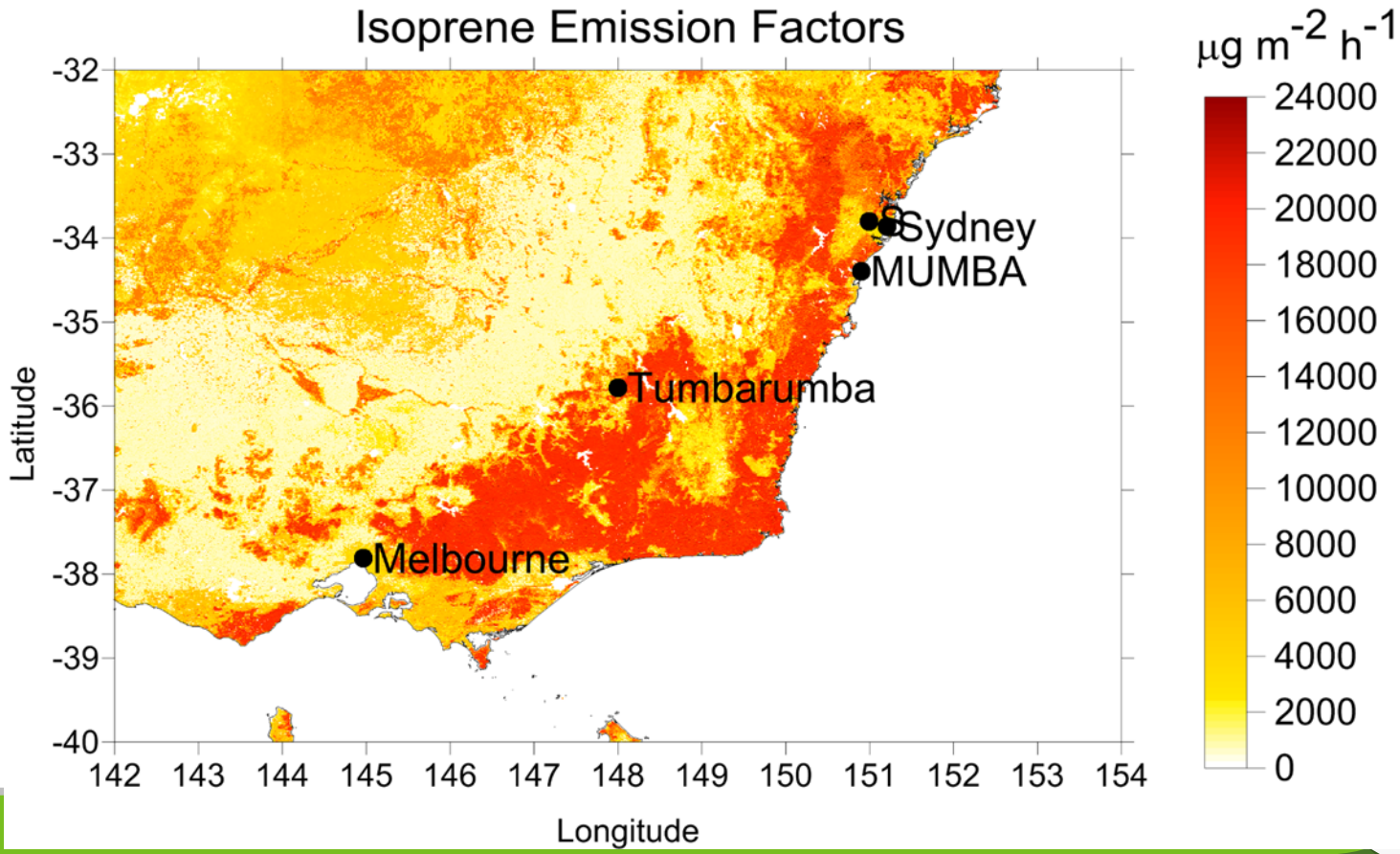
Observations	Isoprene ppb	Monoterpenes ppb
Sydney, summer SPS1	0.76	0.44
Sydney, autumn SPS2	0.63	0.46
Wollongong, MUMBA	0.28	0.12
Tumbarumba	0.15	0.20

Amazon/ Michigan/Borneo isop >> terps, Finland terps >> isop.

BVOCs are strong precursors for O_3 and PM

Regions with low radical activity at night have enabled isoprene to persist, travelling into urban areas to form smog the next morning (Millet et al. ES&T. 2016).

Impacts on Australian cities surrounded by eucalypts, are not fully known.



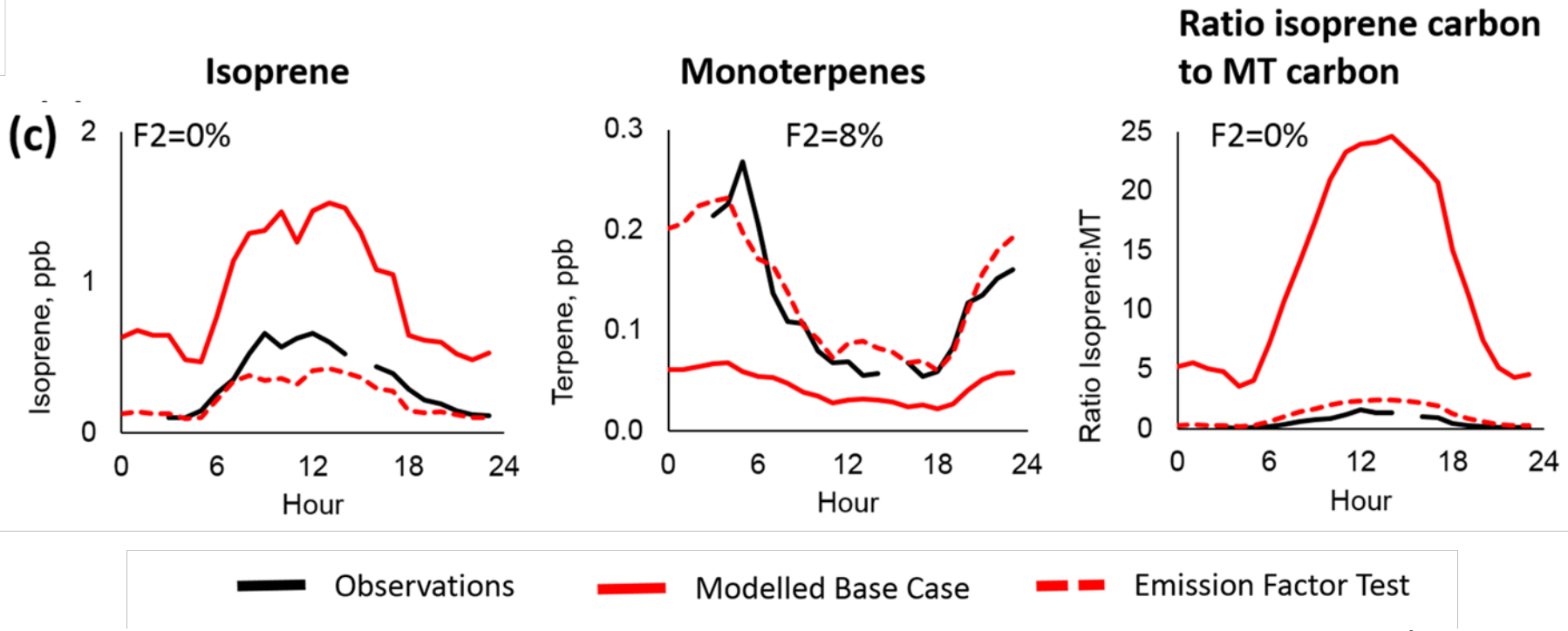
Key science questions

1. How have emissions changed since pre-industrial conditions?
2. How are BVOC emissions chemically processed on local and regional scales?
3. How will climate change and extreme weather (drought and temperature) impact biogenic emissions?

Beach at Wollongong, where one might relax after a hard day on fieldwork……

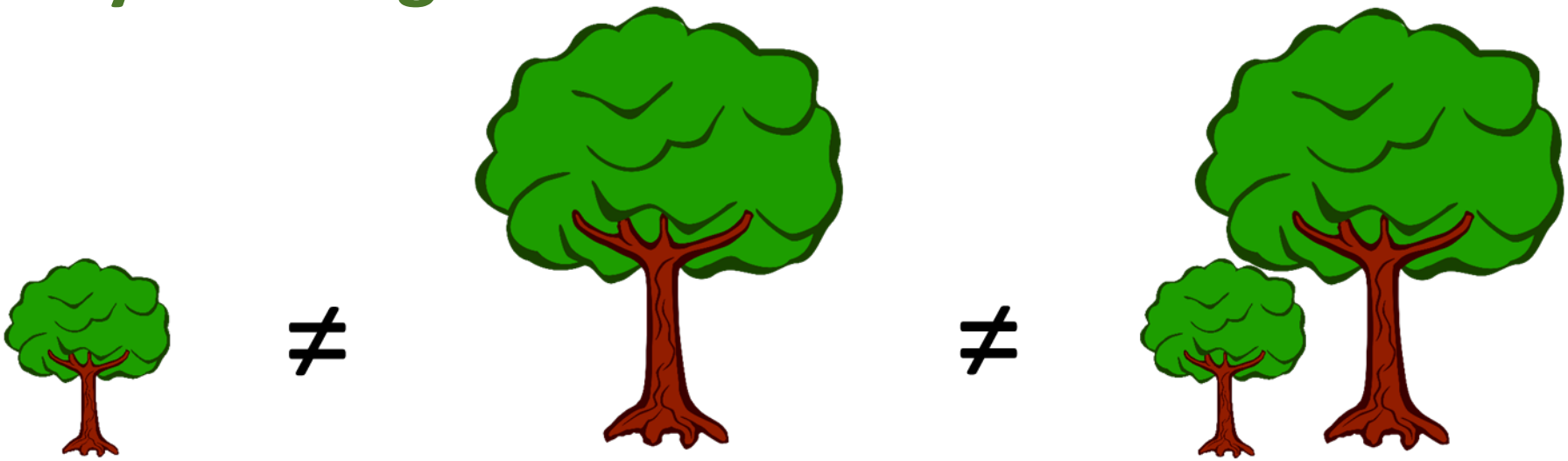
1. Emissions since pre-industry

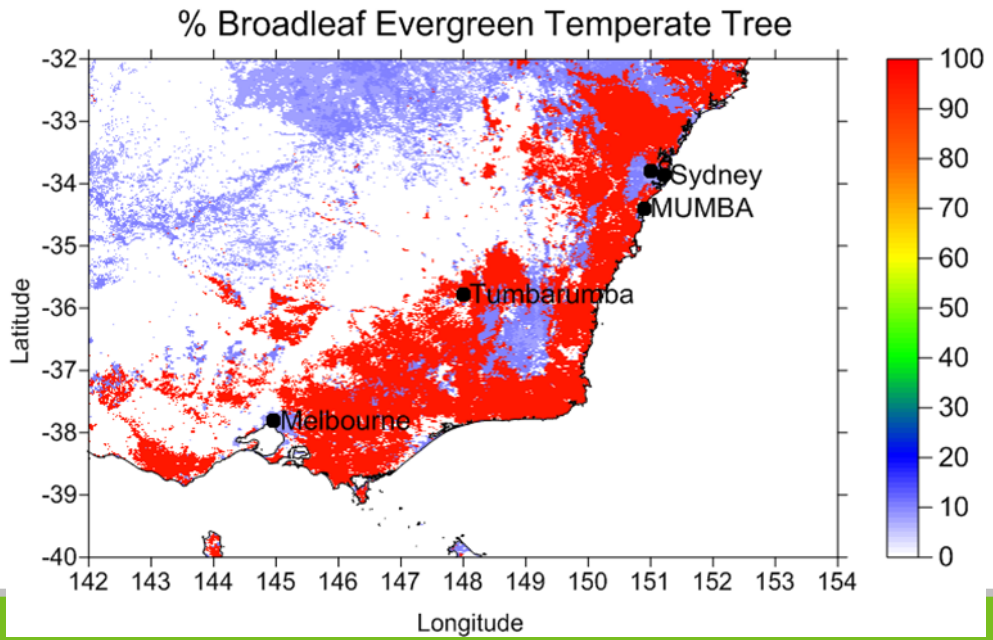
1. What are the gaseous and particulate emissions from natural sources in SE Australia including biogenic, wildfire and marine emissions?
2. What are the magnitude and trends of anthropogenic emissions in the region



Emmerson et al ACP, 2016

Why this might be





A re-mapping is required

Chemical processing

1. How do low NOx environments affect the mechanism for BVOC oxidation?
2. How do organic nitrates form in high BVOC low NOX environments
3. How does BVOC chemistry drive air quality in cities downwind of forests?
4. Can isoprene emissions be inferred from satellite HCHO in low NOx conditions
5. What conditions can we expect in the future from declining NOx emissions in the NH?

Blue Mountains, NSW

Nocturnal/homogeneous nucleation?

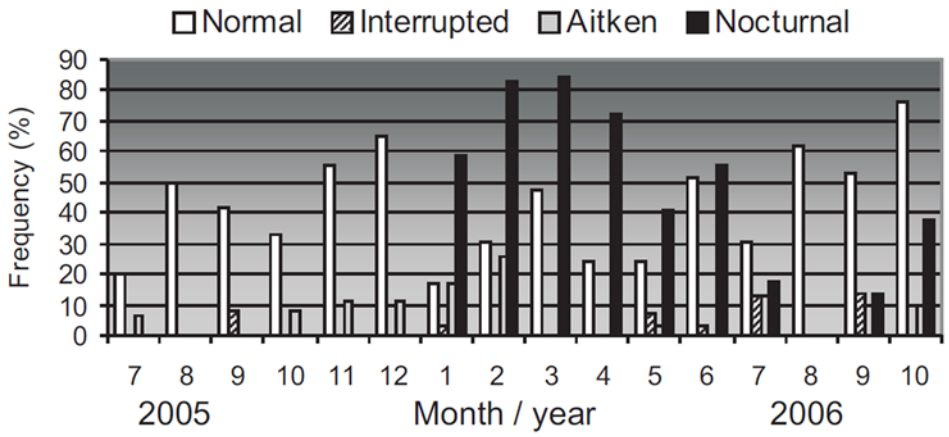


Fig. 3. Frequency of daytime and night-time formation events during July 2005–October 2006; event classification as in Fig. 2.

Night-time formation of aerosol at Tumbarumba

Suni et al ACP., 8, 129–139, 2008

Highly oxygenated molecules (HOMs) from α-pinene may nucleate in pristine environments (low sulfate) and transport to urban areas. Potentially this happens in our eucalypt forests Kirkby et al. Nature. 553,521-526. 2016.

Can't predict reasonable amounts of SOA if the gas phase precursors aren't right.

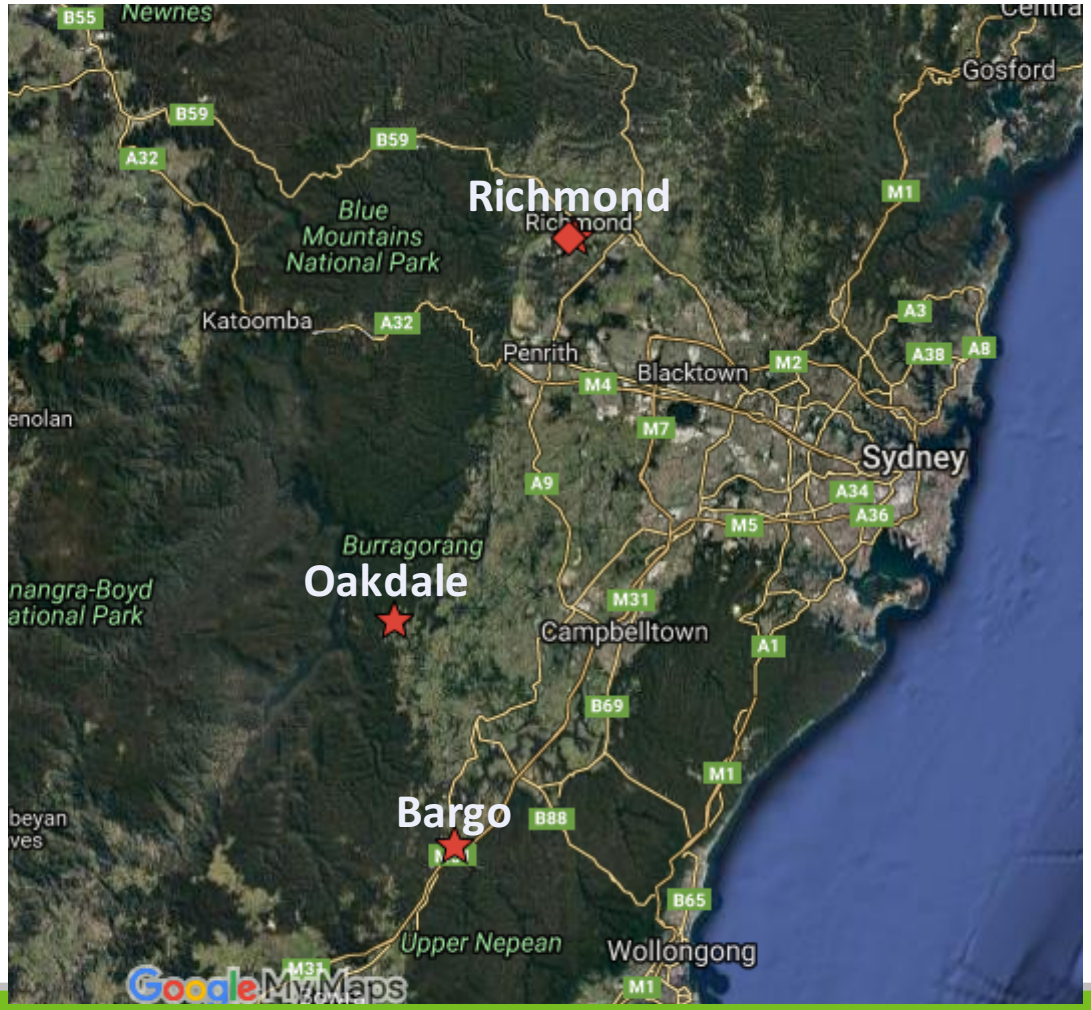
COALA

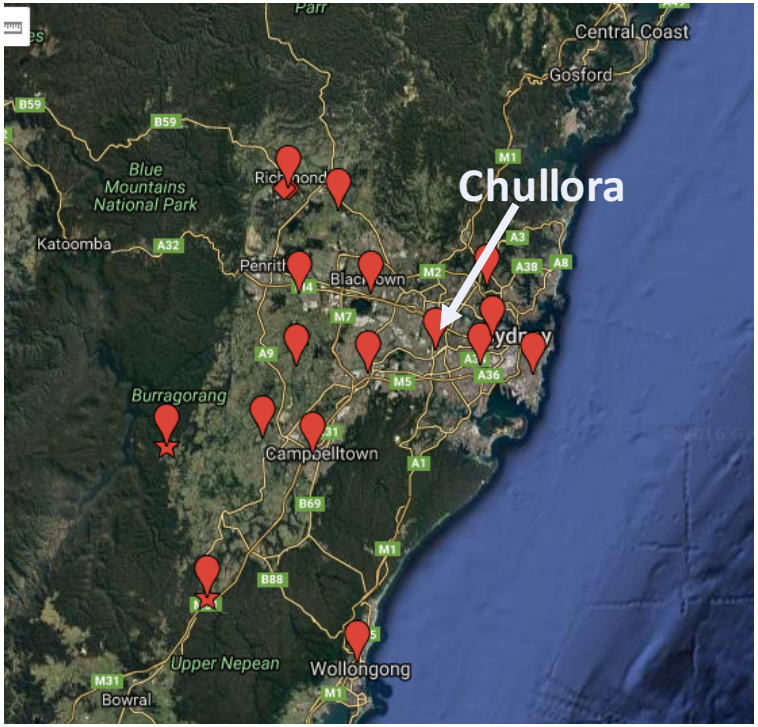
Characterising the Organics and Aerosol Loading of Australia

COALA aimed for austral summer of 2019 (jan/feb). BVOC emissions will be peaking, and there is the possibility of capturing wildfire events. In addition, ground based measurements are proposed from 2017 onwards, to capture seasonal cycles in BVOC concentrations before the large campaign.

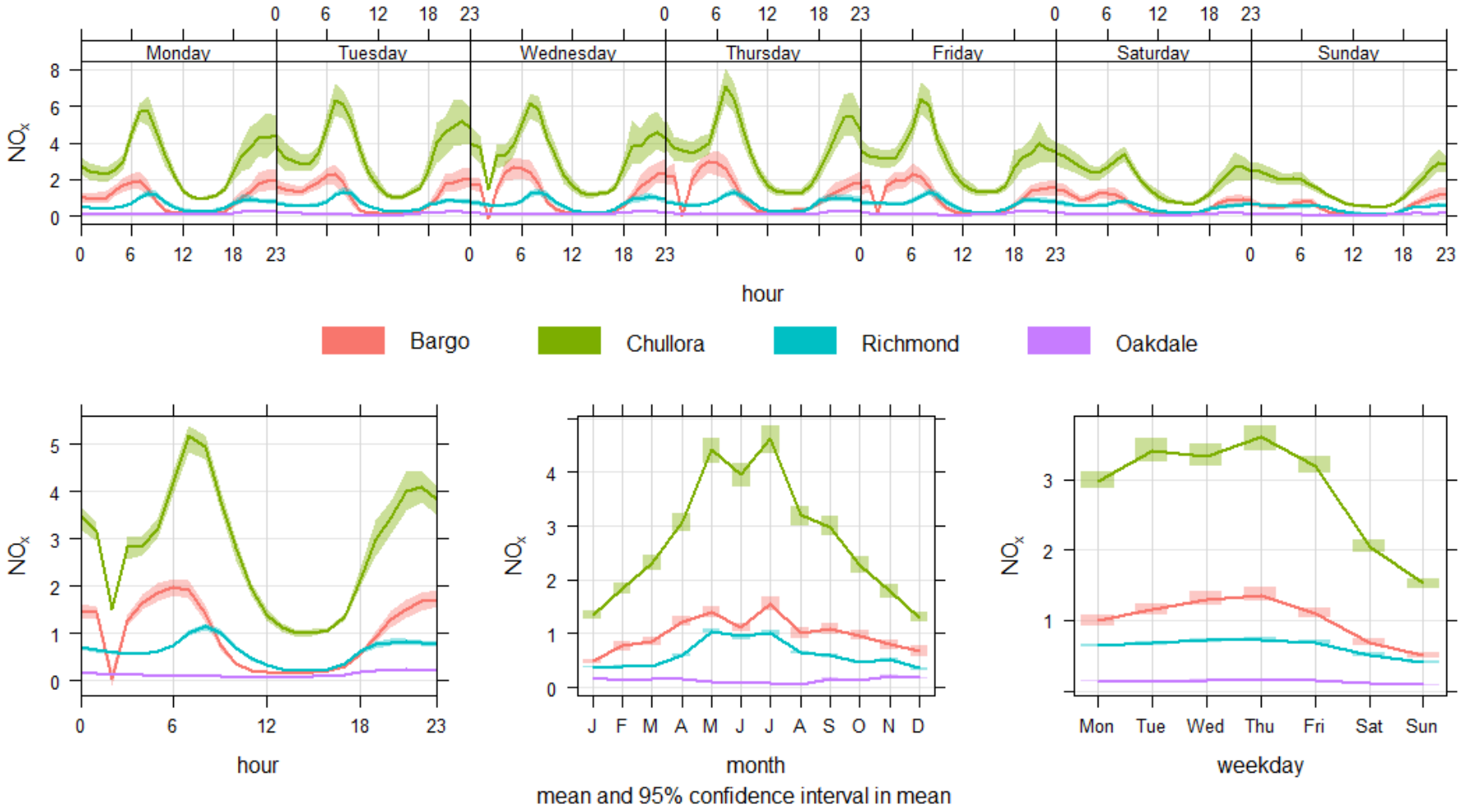
https://www2.acom.ucar.edu/sites/default/files/accord/COALA_whitepaper_20160707.pdf

Potential ground sites New South Wales

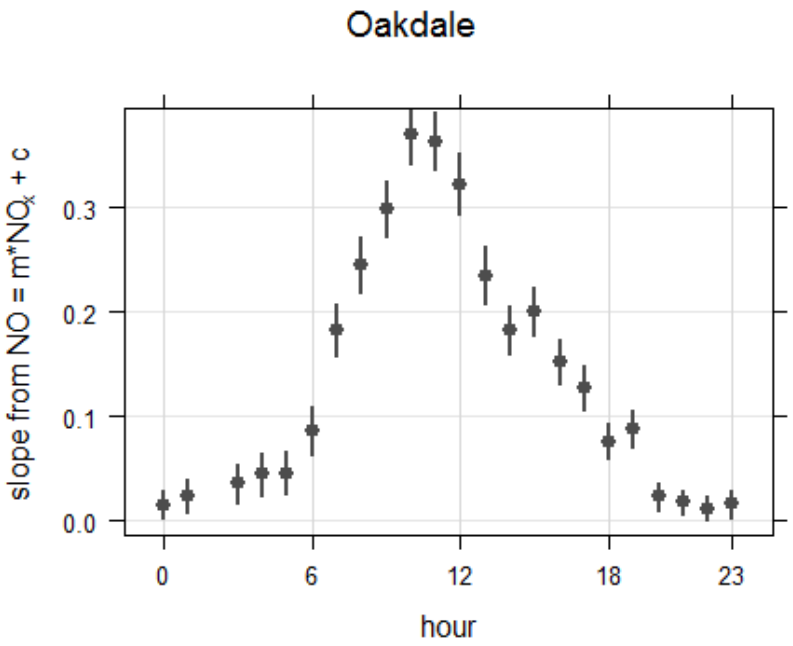


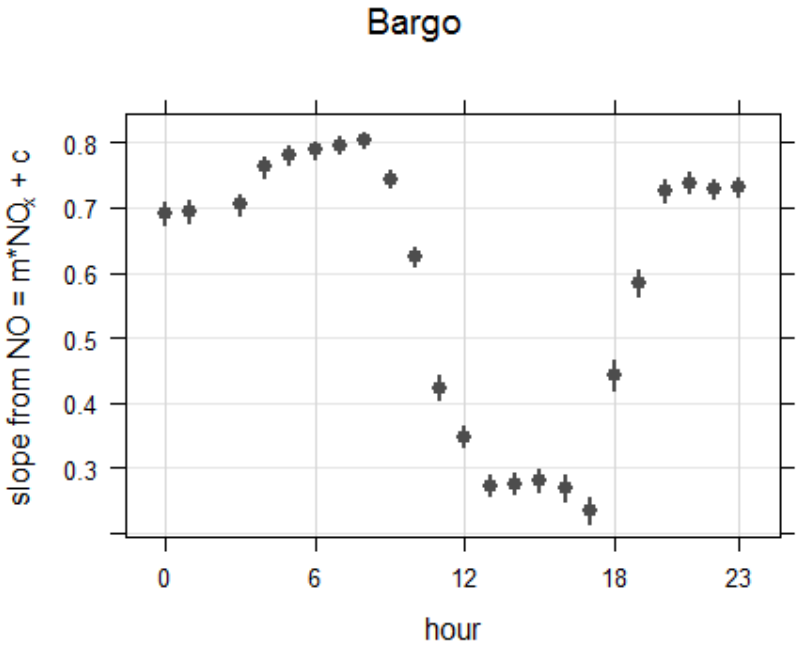


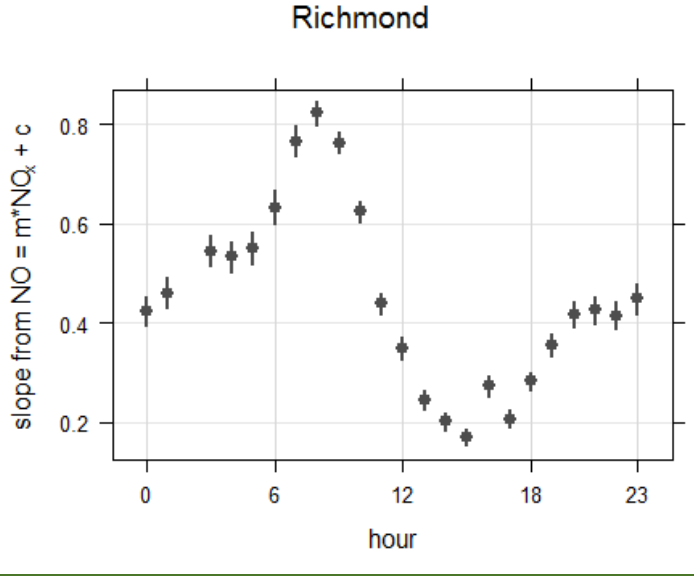
NOx weekly and daily variation at AQ sites



NO/NO_x ratio - diel variation

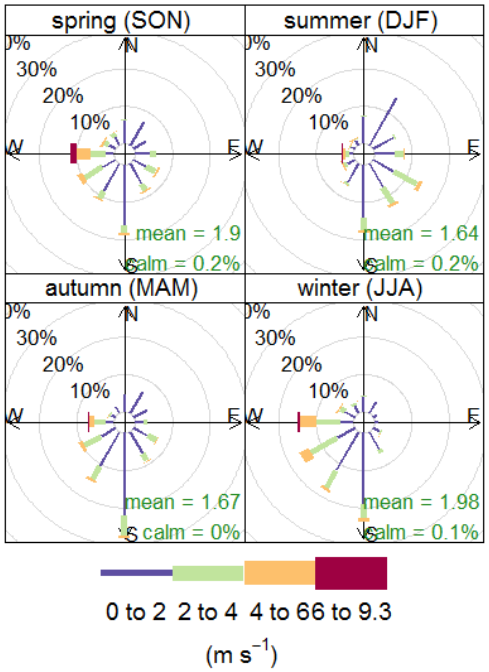






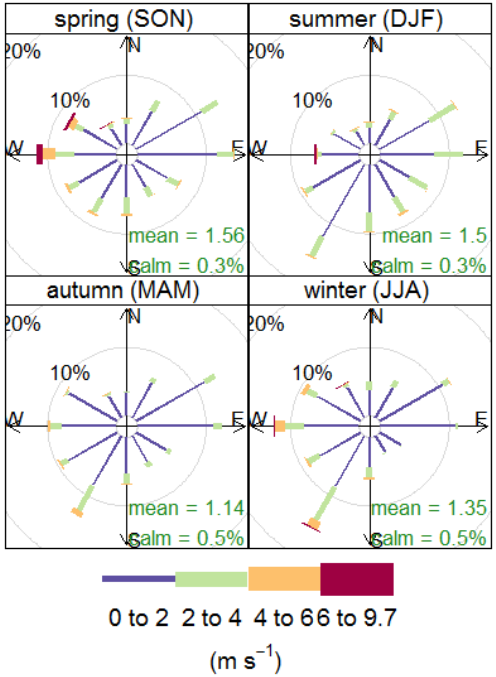
Wind roses for each season

Bargo



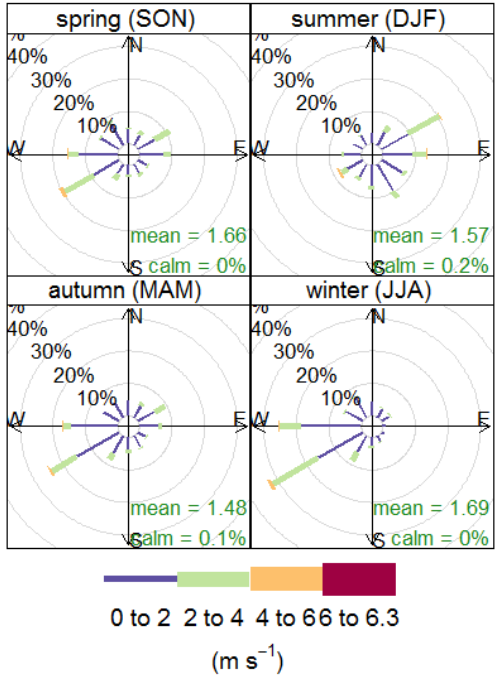
Frequency of counts by wind direction (%

Richmond



Frequency of counts by wind direction (%)

Oakdale



Frequency of counts by wind direction (%)

Contact info

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