

# How well do the latest Earth System Models capture the behaviour of biogenic secondary organic aerosol in the atmosphere?

Session AS3.1 (D3122 | EGU2020-16195)



**Cat Scott, Masaru Yoshioka, Chris Dearden, Ken Carslaw, Dominick Spracklen (University of Leeds, UK), Fiona O'Connor, Gerd Folberth, Mohit Dalvi, Jane Mulcahy (UK Met Office), Yves Balkanski, Ramiro Checa-Garcia (LSCE-IPSL), Dirk Olivie, Michael Schulz (MetNo), Martine Michou, Pierre Nabat (CNRM), Lars Nieradzic (Lund University), Twan van Noije (KNMI) Tommi Bergman, Declan O'Donnell (Finnish Meteorological Institute)**



Horizon 2020  
European Union Funding  
for Research & Innovation



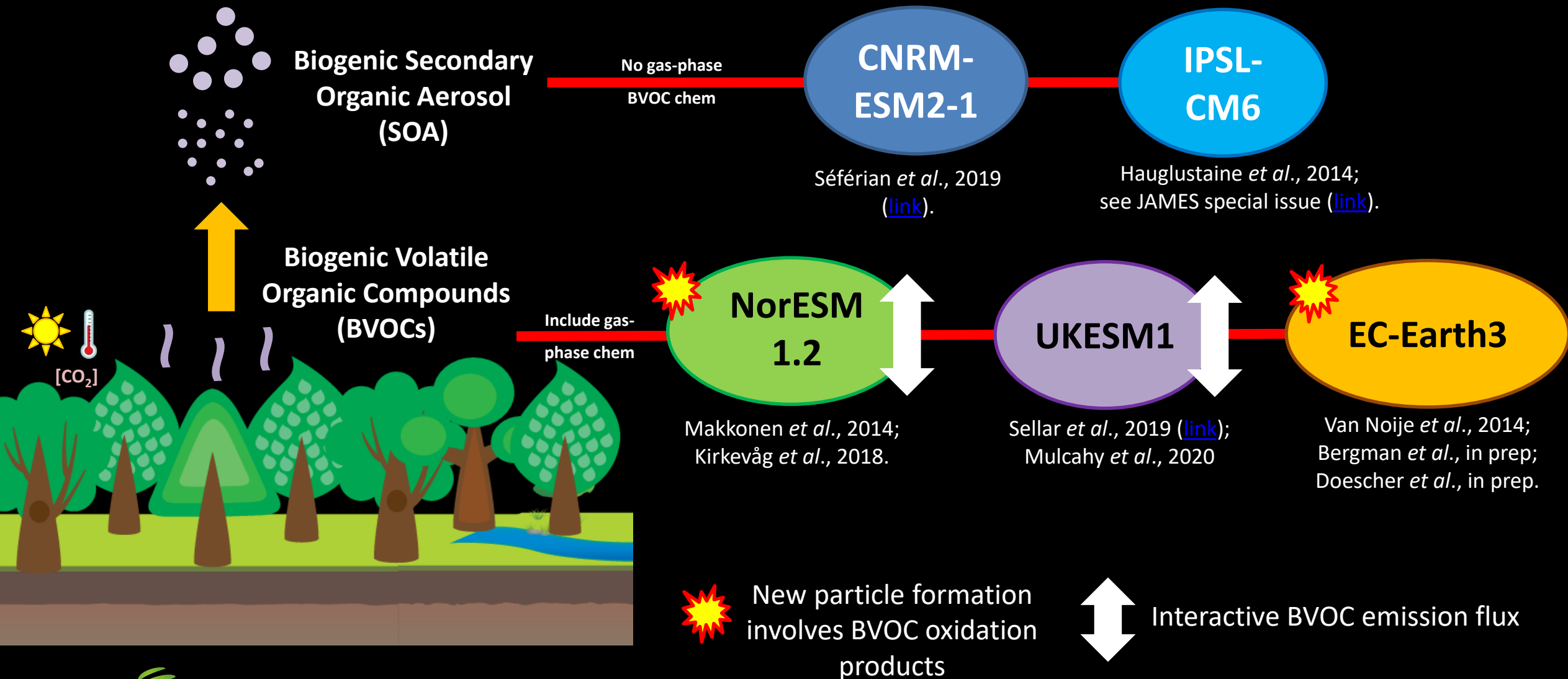
Natural  
Environment  
Research Council



UNIVERSITY OF LEEDS

- The five CRESCENDO ESMs describe biogenic secondary organic aerosol with a range of complexity (slides 3 + 4)
- Most models can reproduce the observed seasonal cycle in organic aerosol (OA) at boreal forest site (slides 6 + 7), but preliminary comparisons indicate that all five ESMs overpredict OA concentration during the Amazon wet season
- Can the models capture the observed relationship between temperature and OA concentration at a boreal site? (slide 8)
- Get in touch: [c.e.scott@leeds.ac.uk](mailto:c.e.scott@leeds.ac.uk) or [@catzigle](https://twitter.com/catzigle) on Twitter

# Biogenic secondary organic aerosol in five Earth System Models

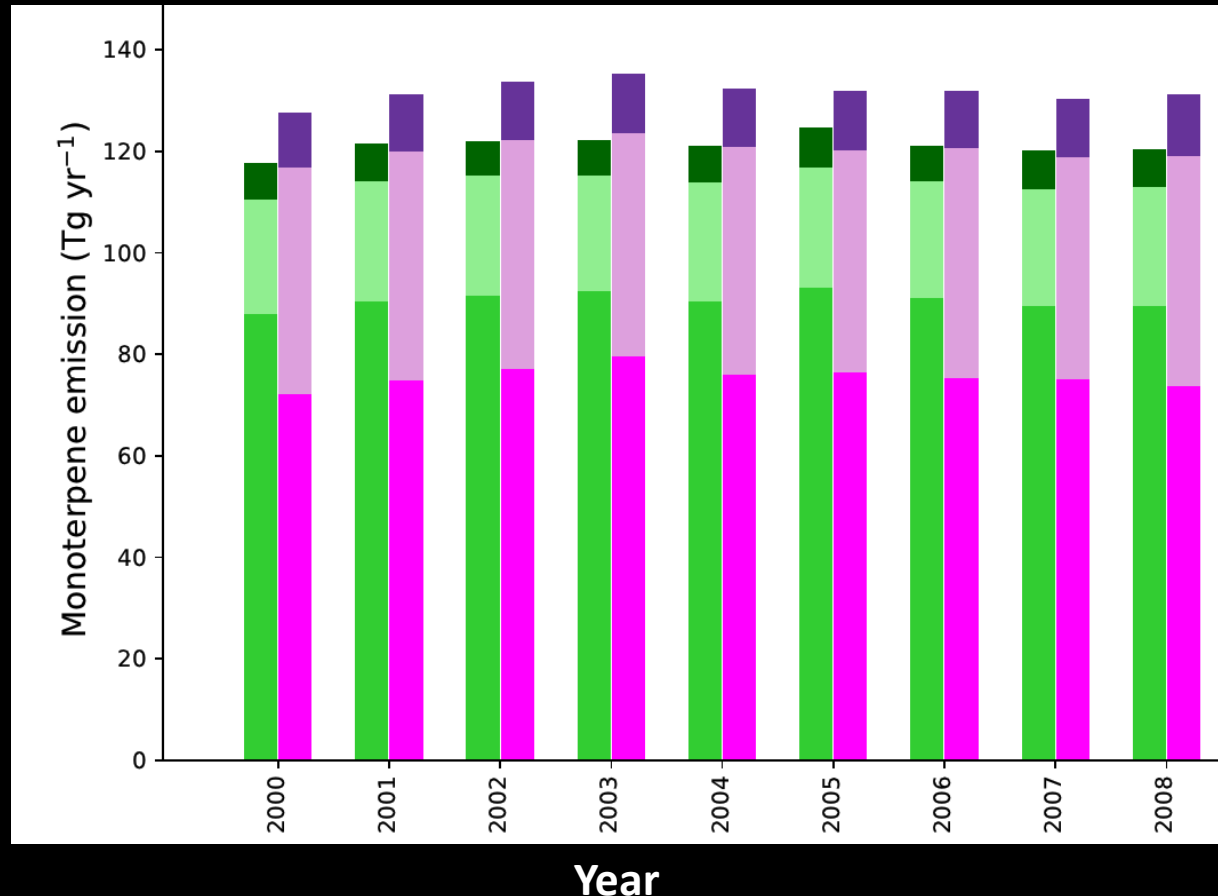


## Two models include *interactive* BVOC emissions



UNIVERSITY OF LEEDS

In NorESM & UKESM the emissions of BVOCs are calculated interactively by the land-surface model and will therefore respond to changes in climate.

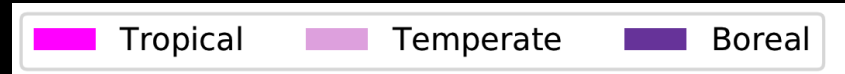


A greater proportion of the global total BVOC emissions originate from tropical latitudes in NorESM (by MEGANv2.1 in CLM4.5) than in UKESM (by iBVOC in JULES)

NorESM:



UKESM:



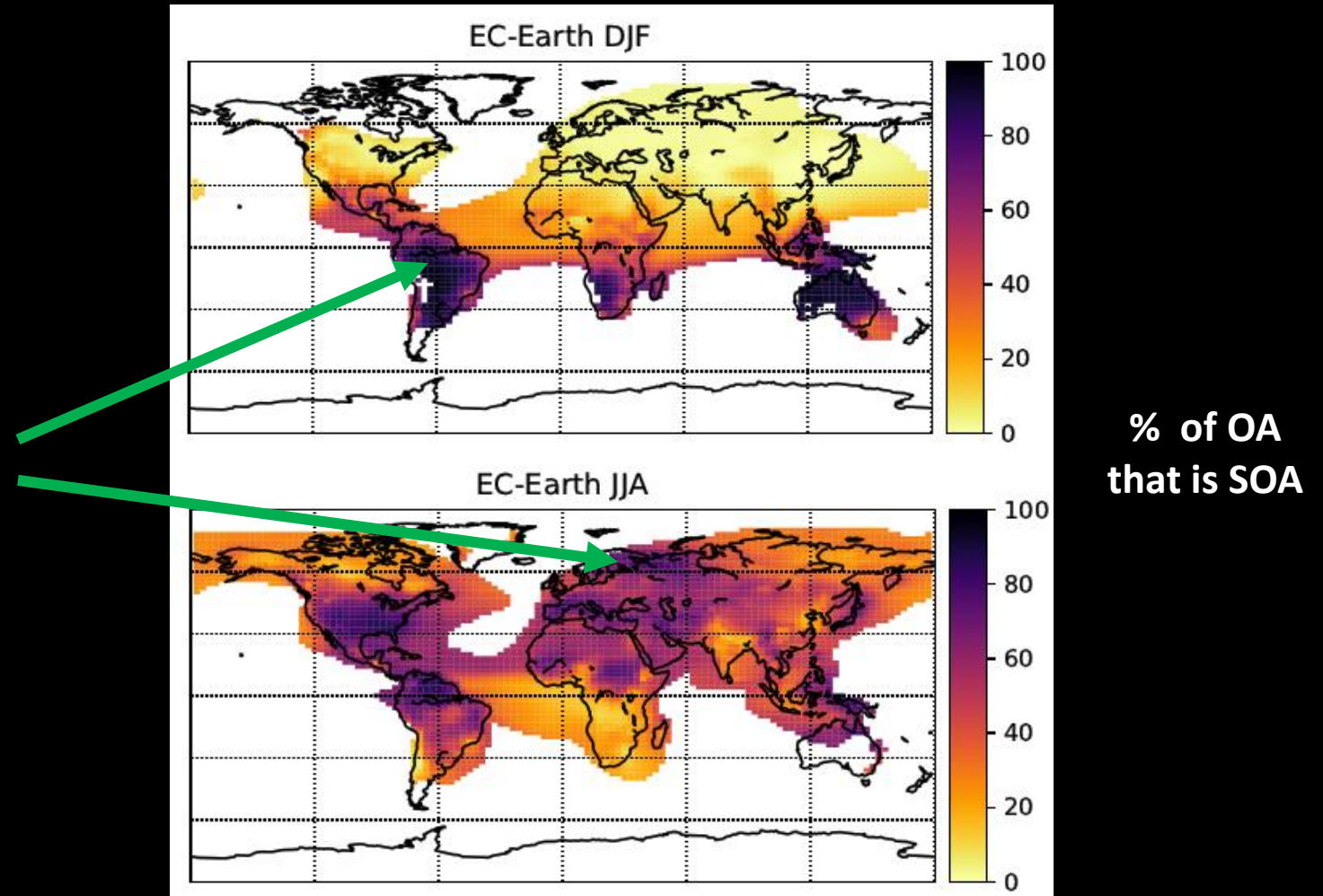
Literature values for annual monoterpene emissions span ~ 30 – 180 Tg yr<sup>-1</sup>

# How much organic aerosol is SOA?



UNIVERSITY OF LEEDS

**In EC-Earth, primary and secondary organic aerosol are tracked independently – allowing us to identify regions of the world where SOA makes up the majority of the (simulated) organic aerosol during different seasons**



# Where can we see a strong contribution from SOA?



UNIVERSITY OF LEEDS

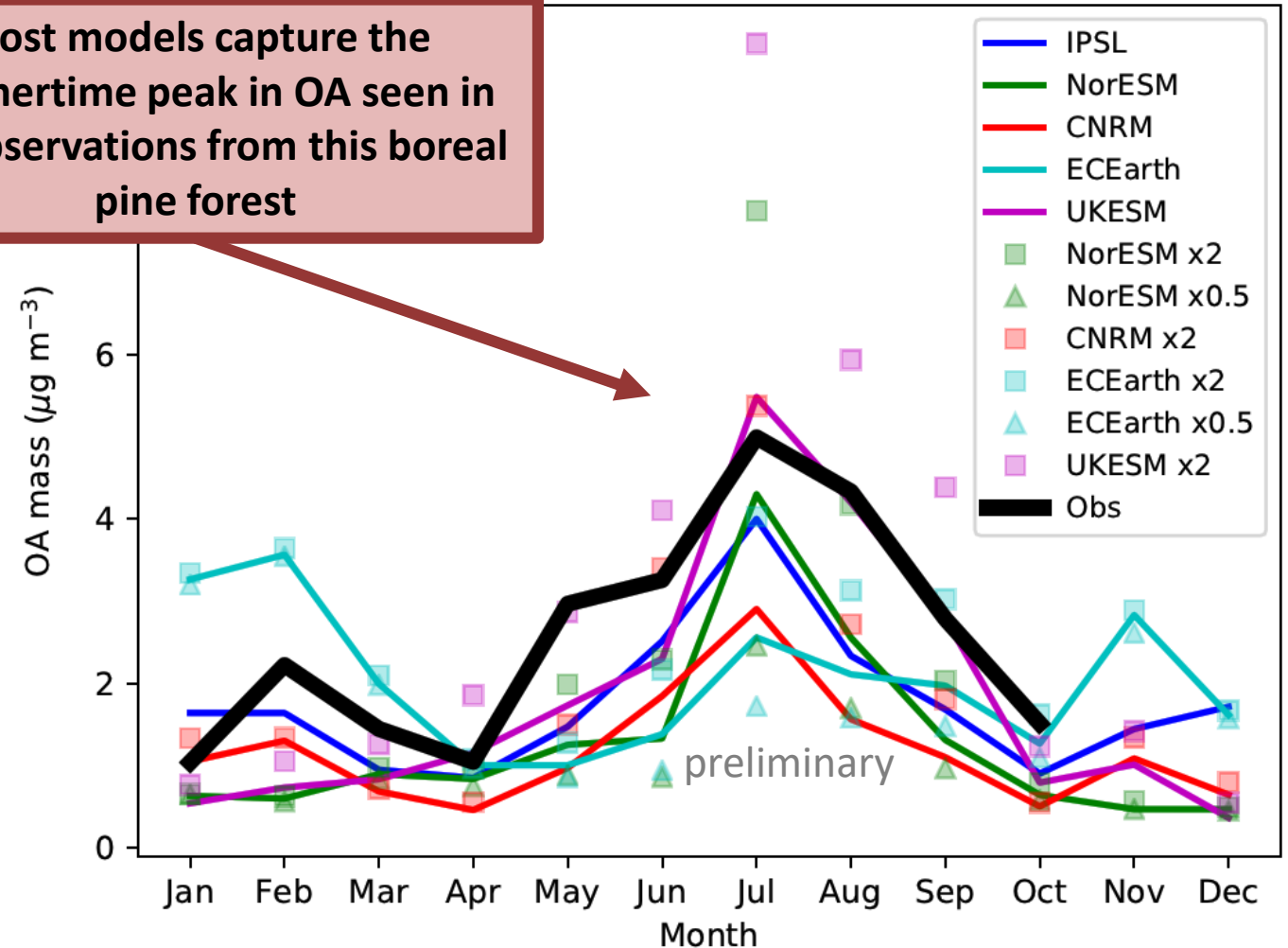
e.g. at Hyytiälä, Finland



Aerosol Chemical Speciation Monitor measurements (black line) from Heikkinen *et al.*, ACP, 2020 ([link](#)).

Most models capture the summertime peak in OA seen in the observations from this boreal pine forest

Organic aerosol concentration at surface (Hyytiälä) - nudged sims (2014)



# Where can we see a strong contribution from SOA?



UNIVERSITY OF LEEDS

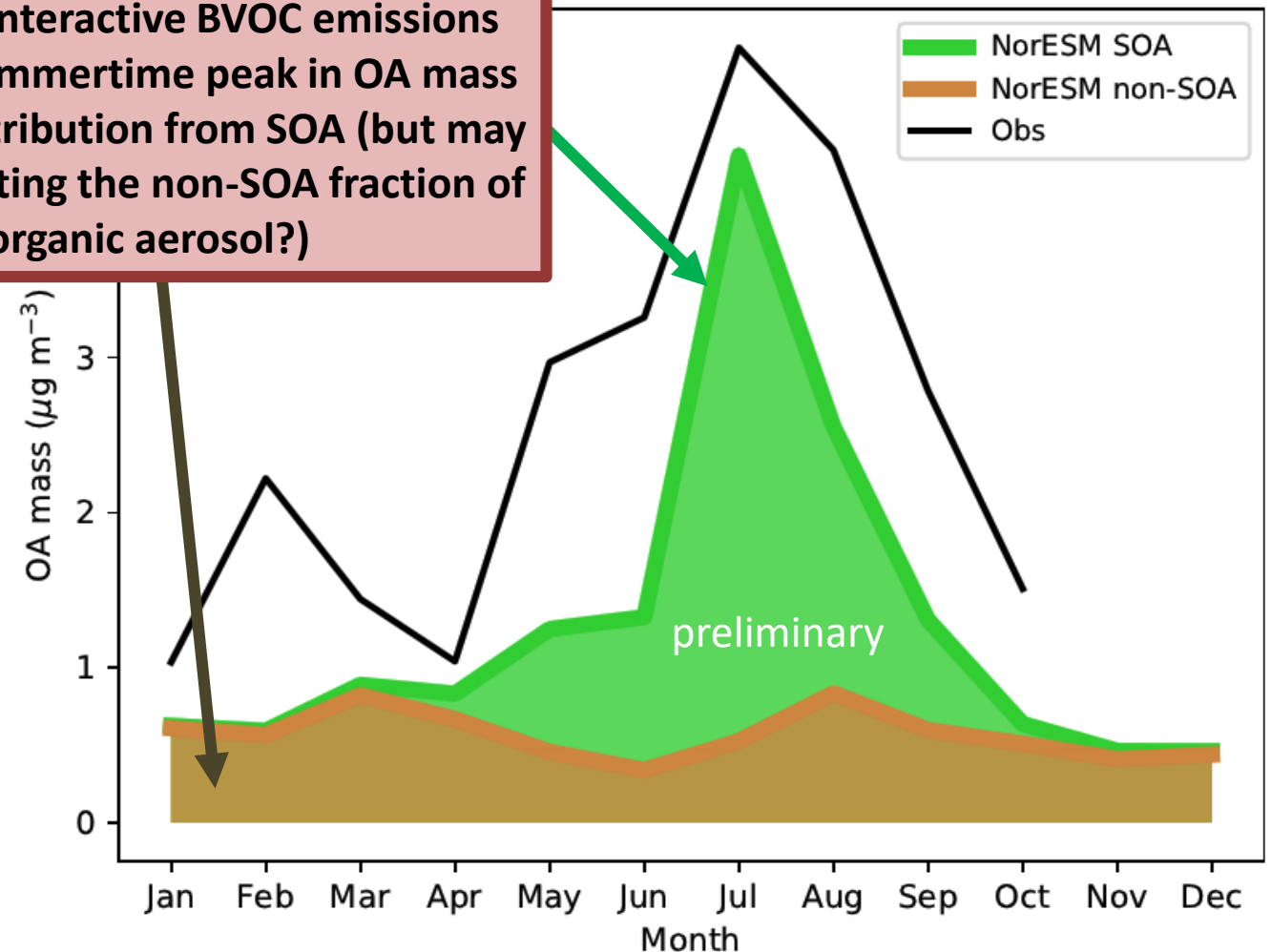
e.g. at Hyytiälä, Finland



Aerosol Chemical Speciation Monitor measurements (black line) from Heikkinen *et al.*, ACP, 2020 ([link](#)).

NorESM with interactive BVOC emissions captures the summertime peak in OA mass well due to contribution from SOA (but may be underestimating the non-SOA fraction of the organic aerosol?)

Organic aerosol concentration at surface (Hyytiälä) - nudged sims (2014)





# Can we expect these ESMs to capture climate driven changes in atmospheric composition? *Work in progress*



UNIVERSITY OF LEEDS

