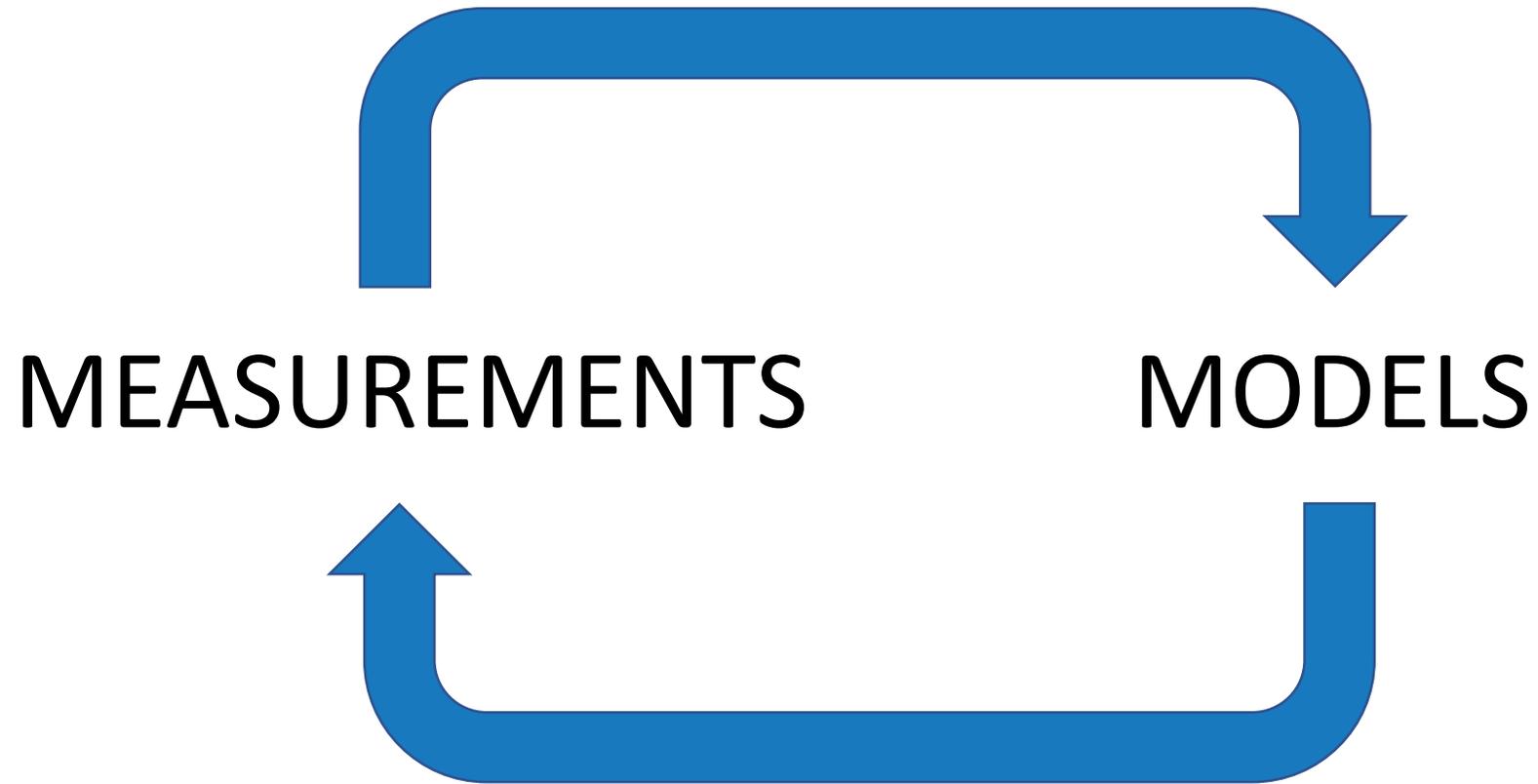


Defining domains of relevance for secondary organic aerosol formation

William C. Porter, Jose L. Jimenez, and Kelley C. Barsanti

Models rely upon measurements, and can in turn inform and guide future measurement directions



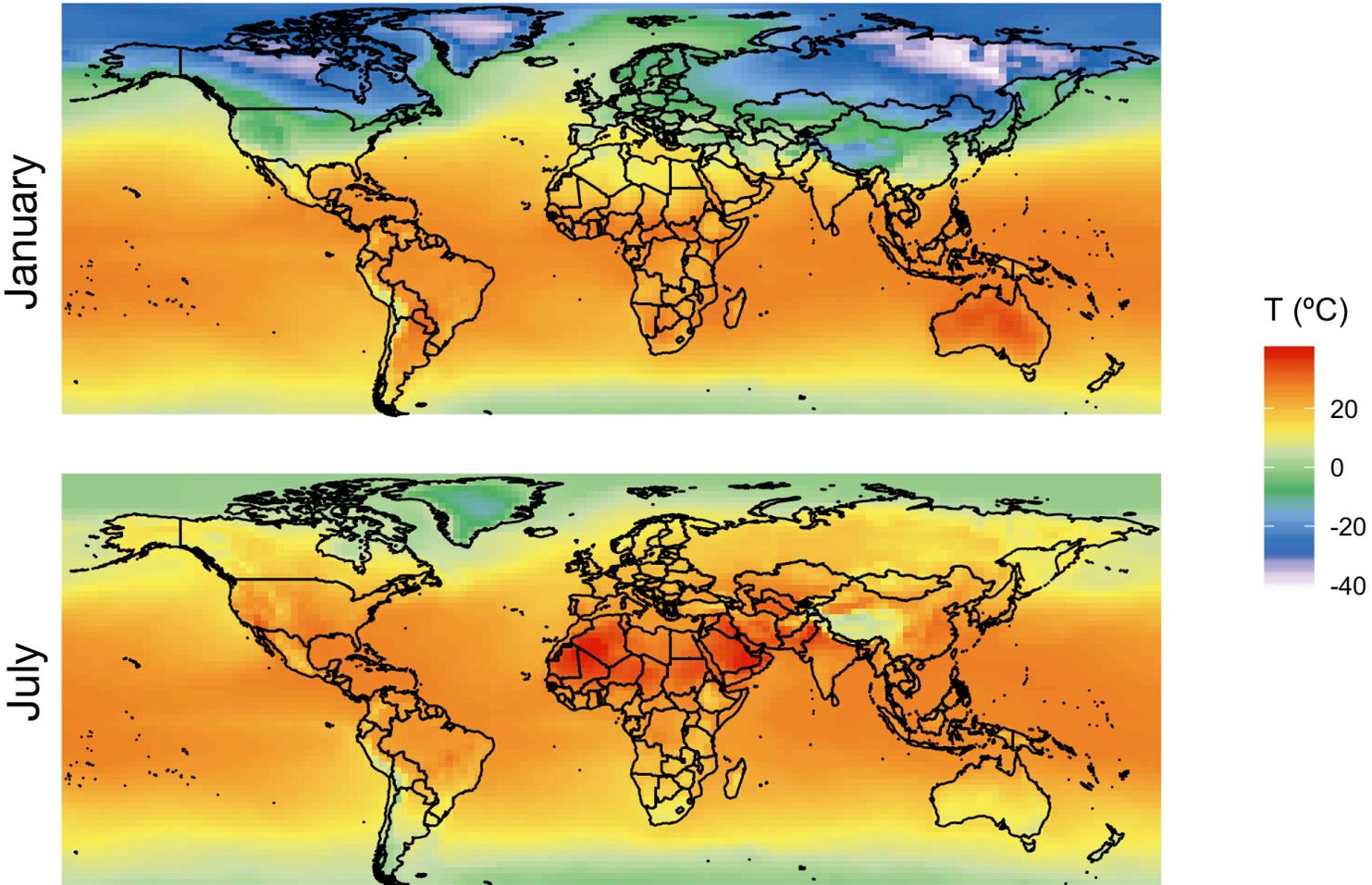
What does GEOS-Chem predict for the physical and chemical conditions relevant to SOA formation, and how do these conditions compare to those of chamber studies?



In other words, how sure are we that we are comparing SOA apples to apples?

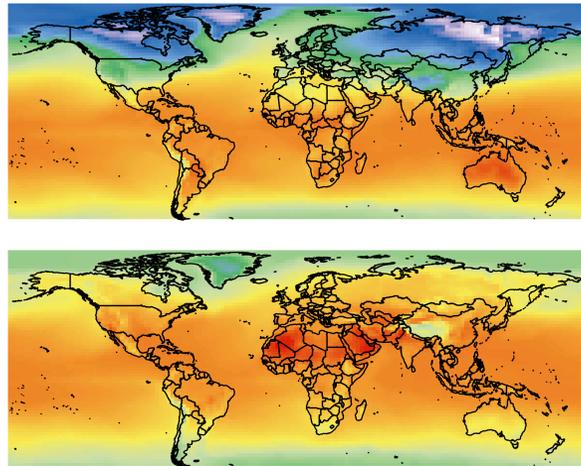
Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

Mean monthly surface temperature (2013)

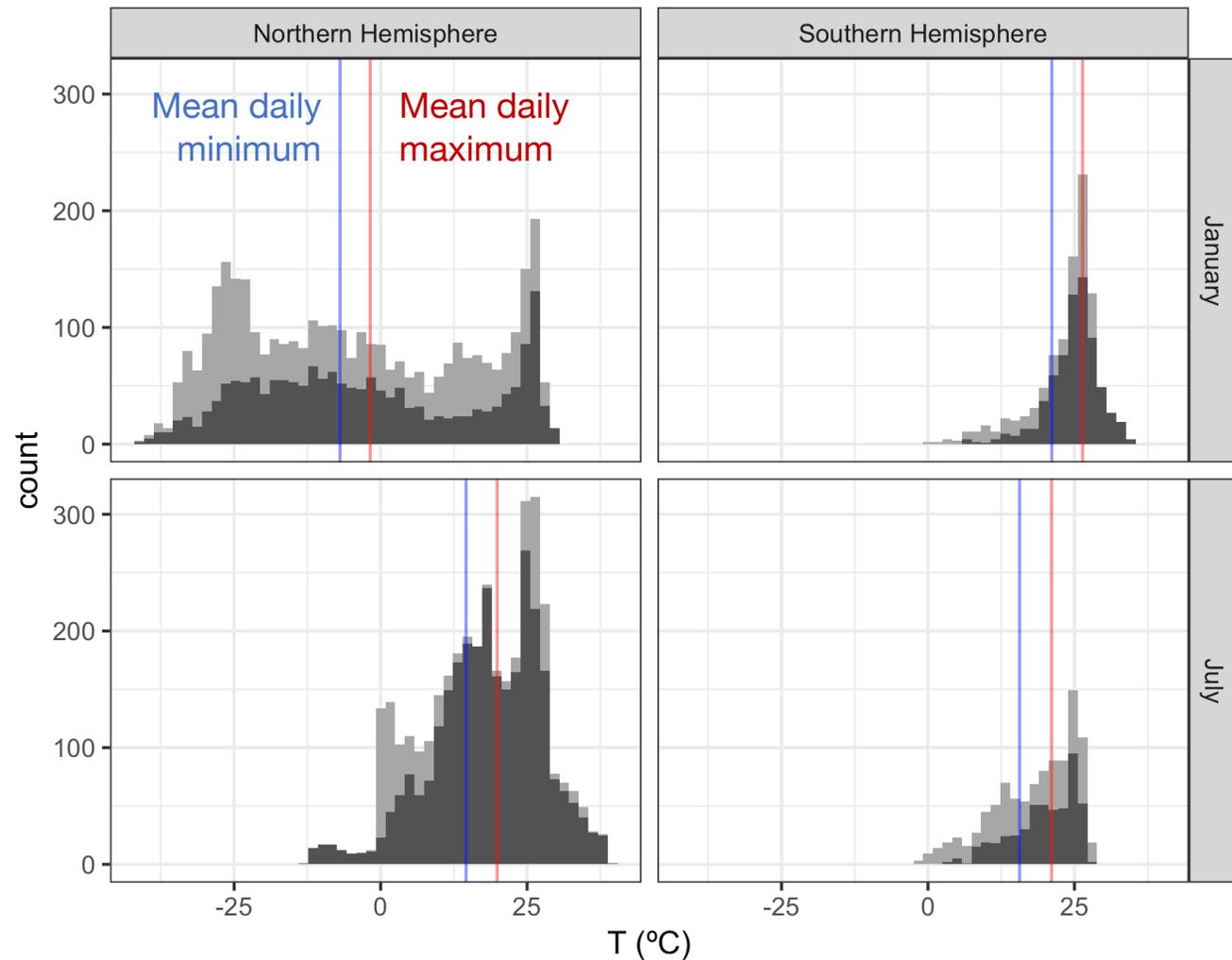
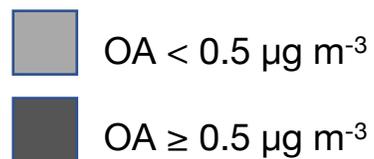


Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

Mean monthly surface temperature (2013)

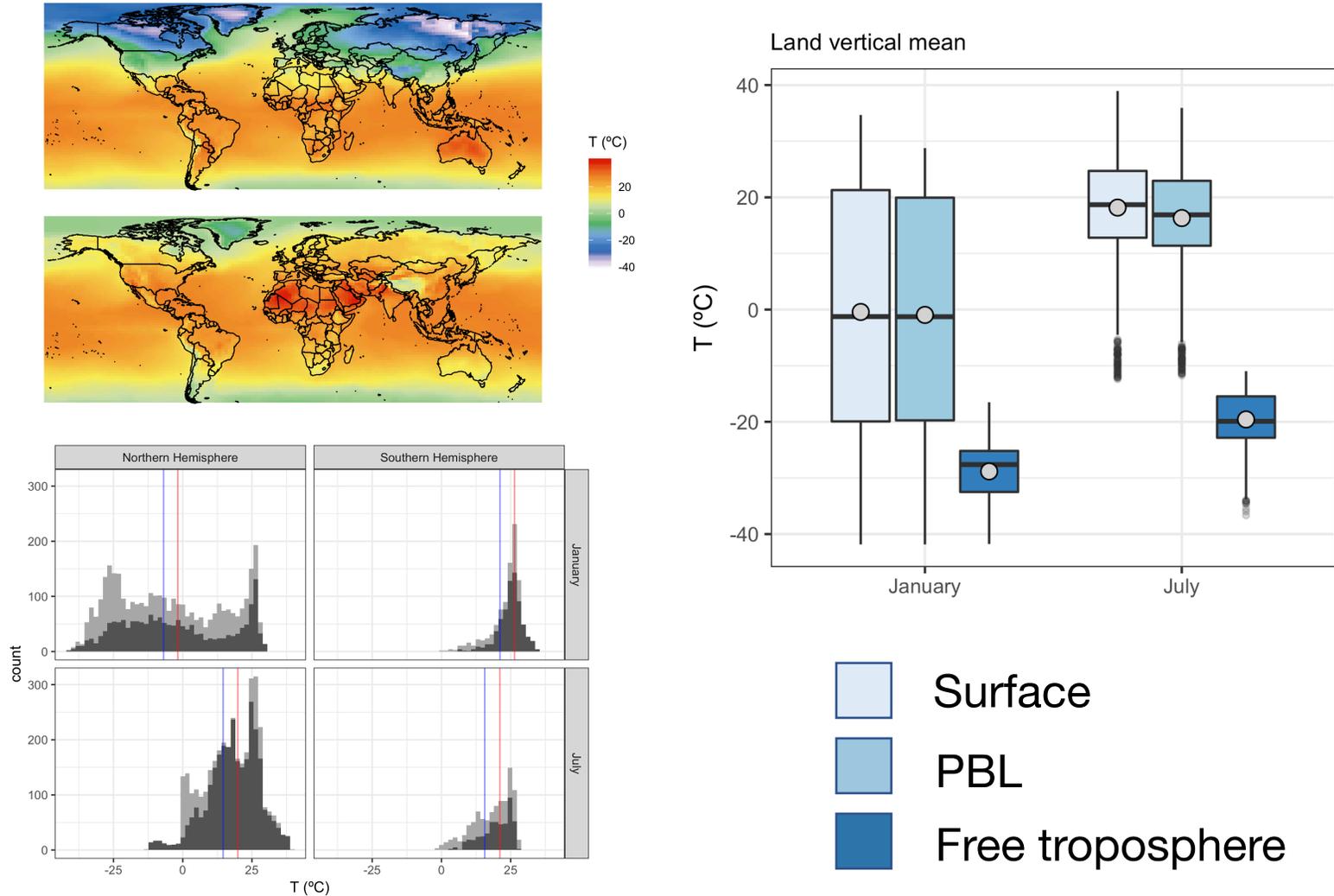


T (°C)
20
0
-20
-40



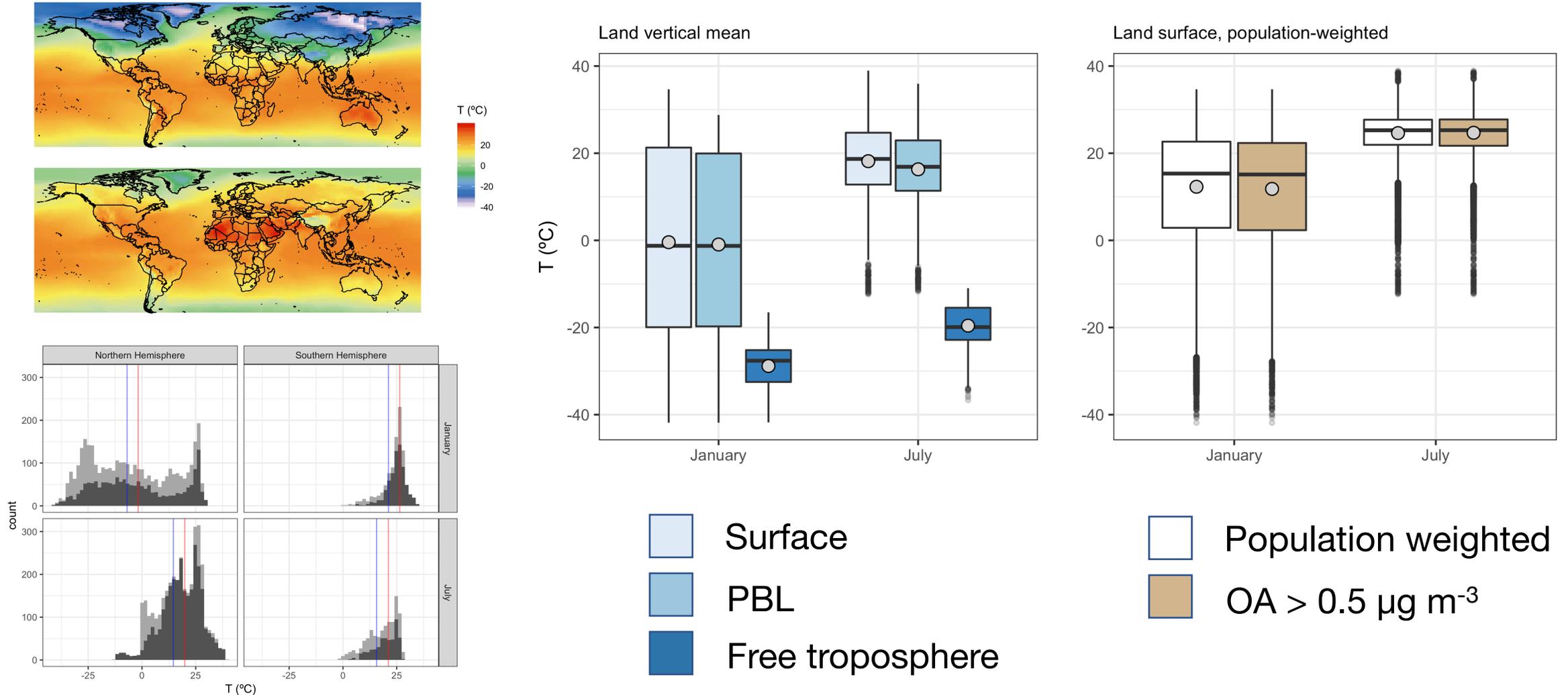
Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

Mean monthly surface temperature (2013)



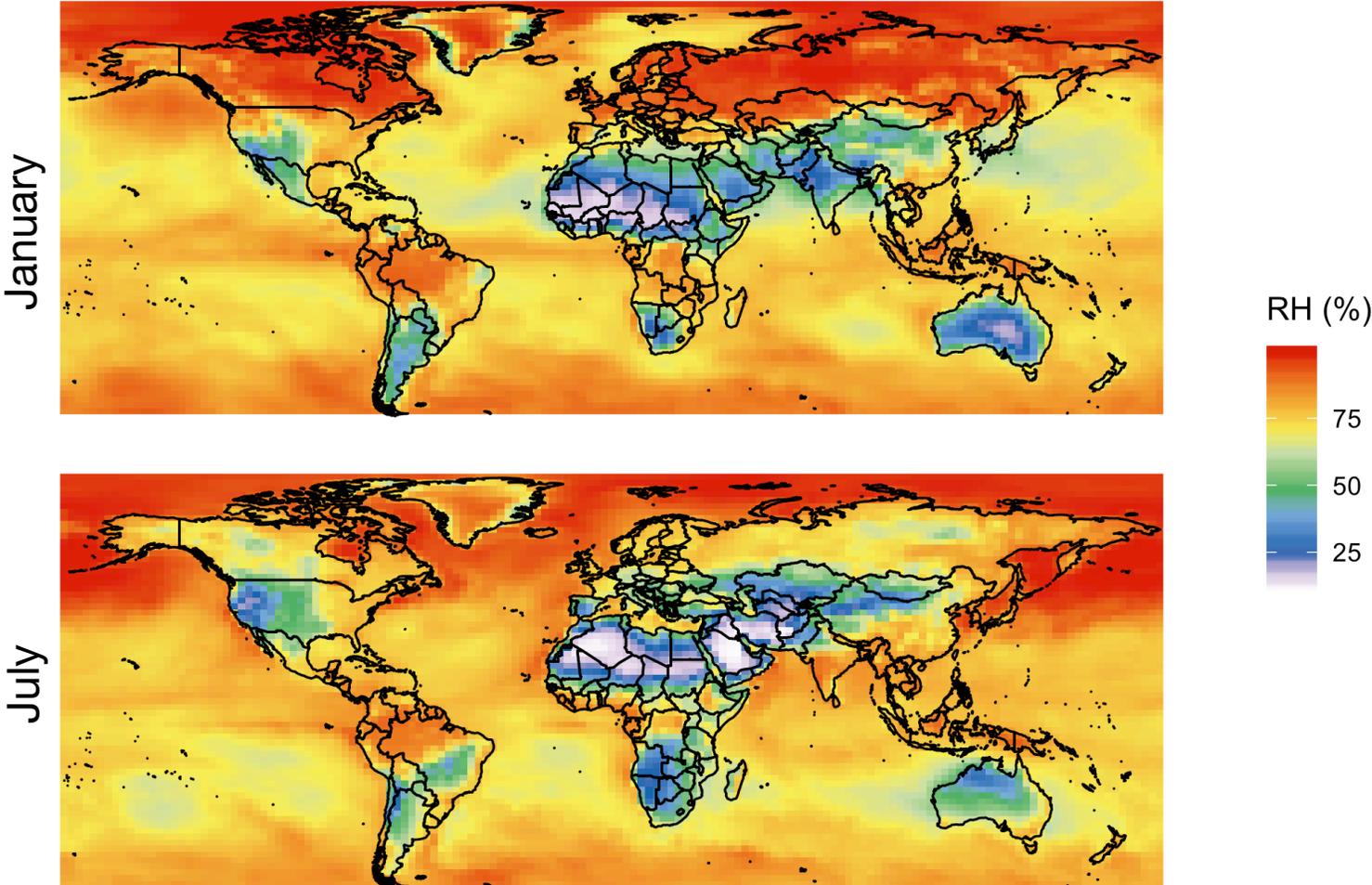
Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

Mean monthly surface temperature (2013)



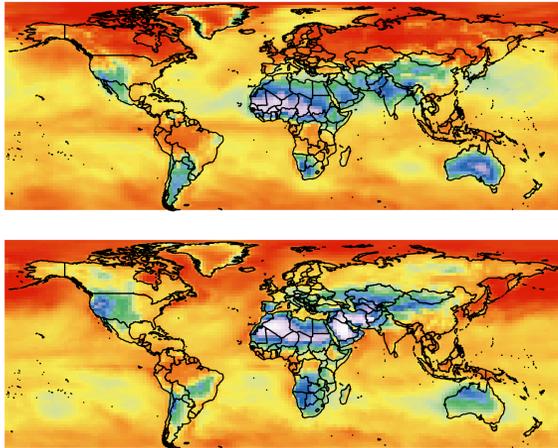
Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

Mean monthly surface humidity (2013)



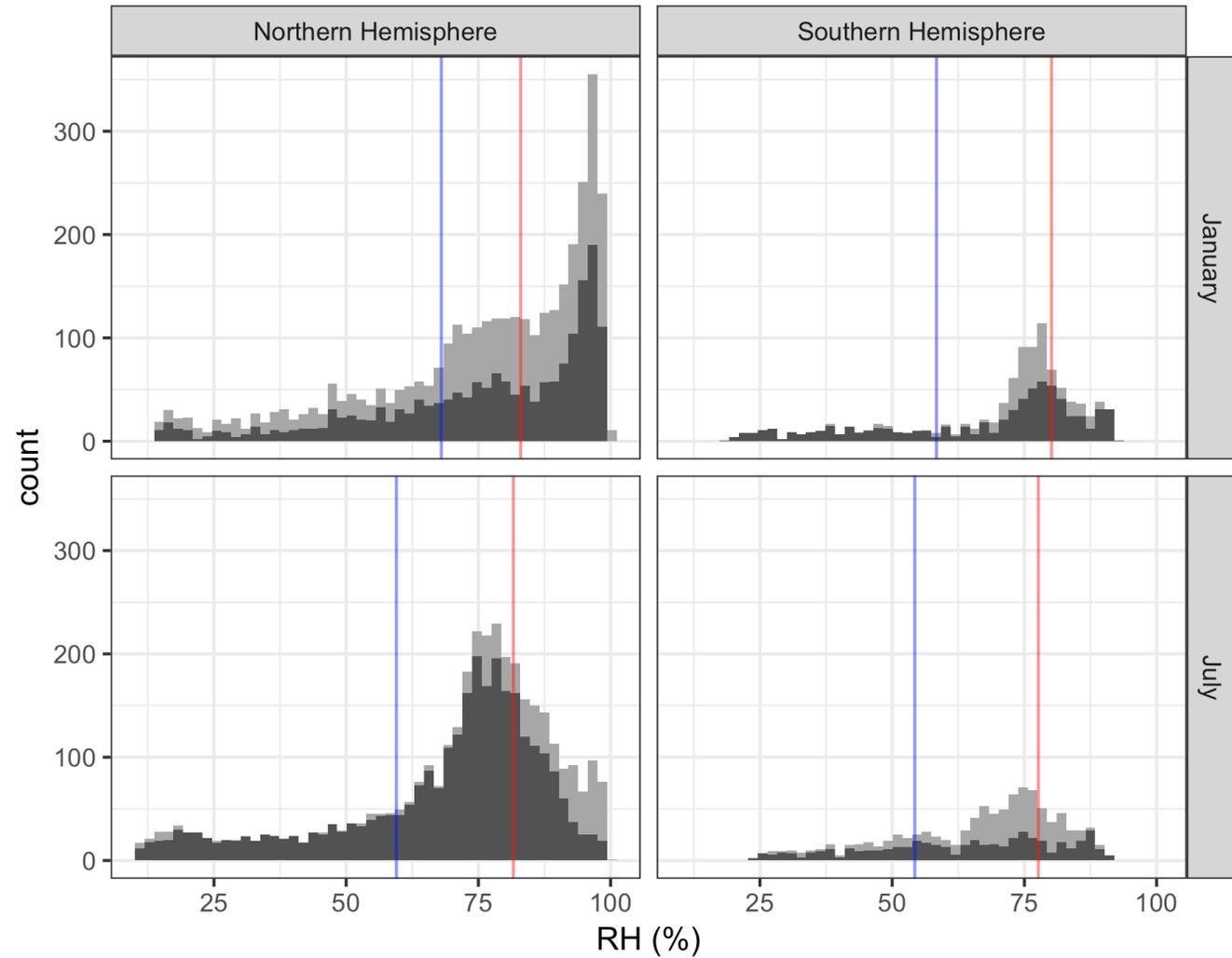
Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

Mean monthly surface humidity (2013)



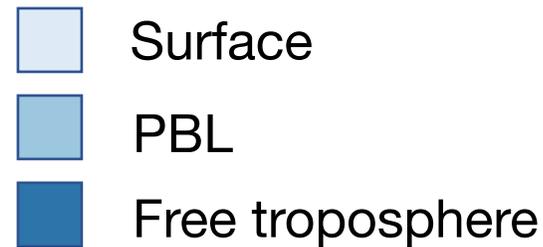
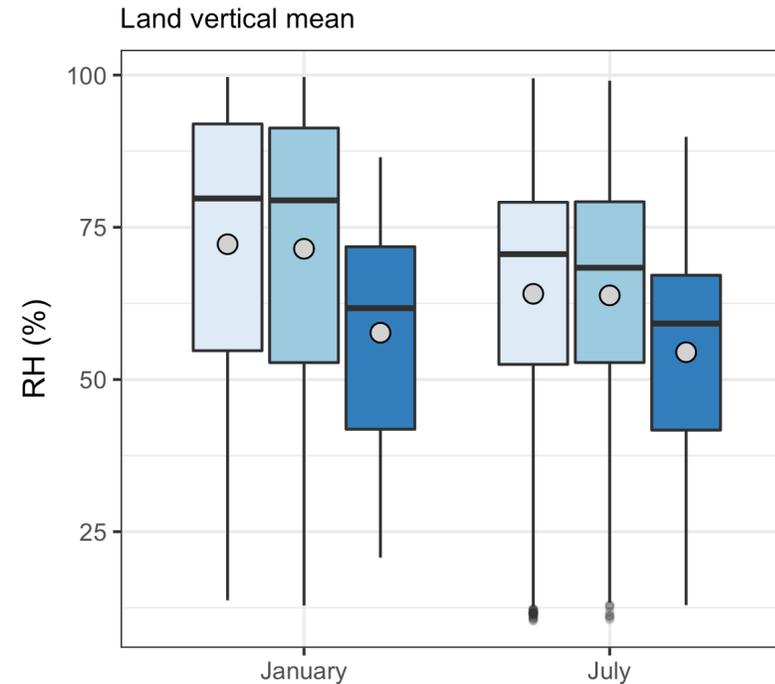
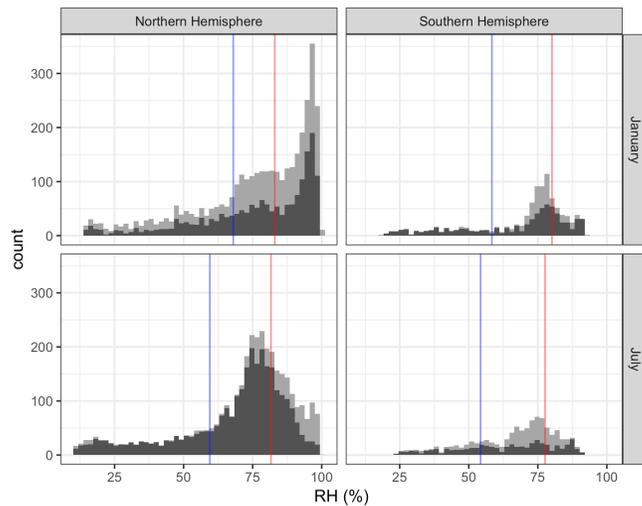
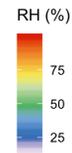
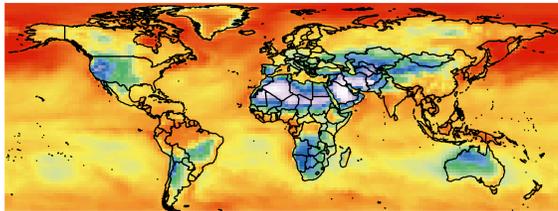
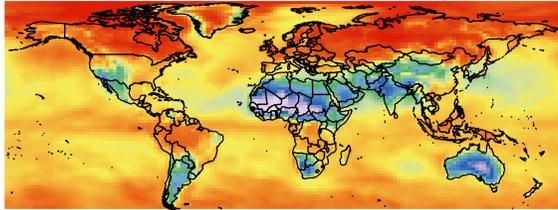
RH (%)
75
50
25

OA < $0.5 \mu\text{g m}^{-3}$
OA $\geq 0.5 \mu\text{g m}^{-3}$



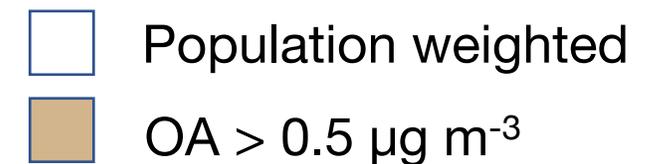
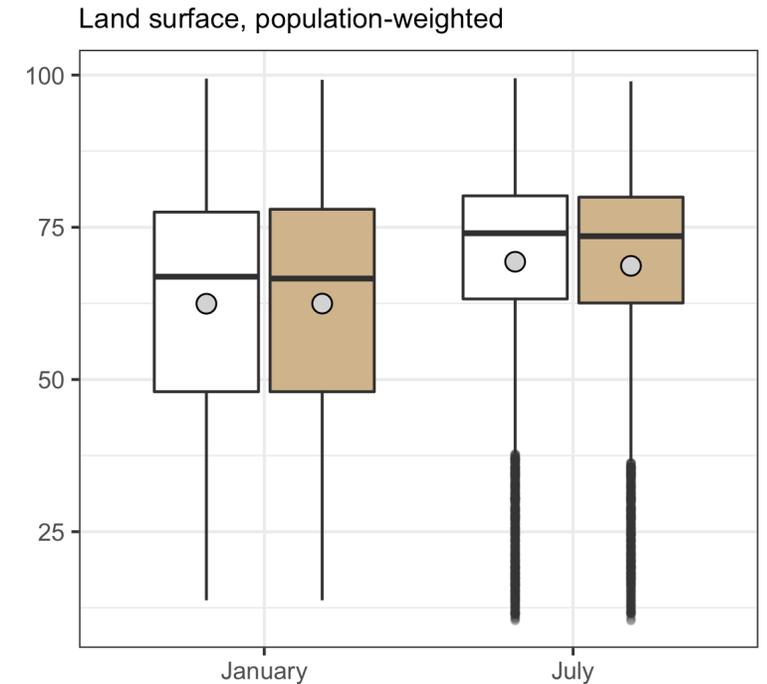
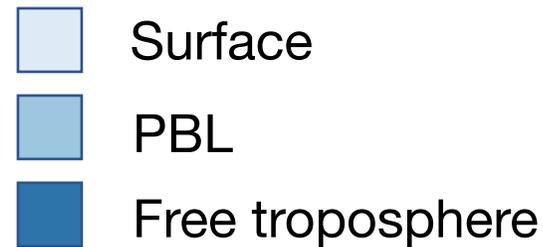
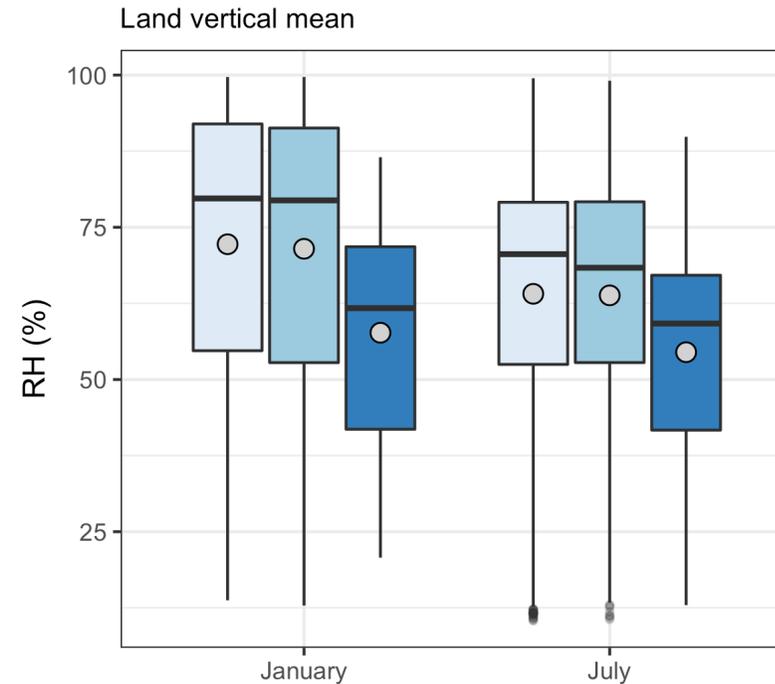
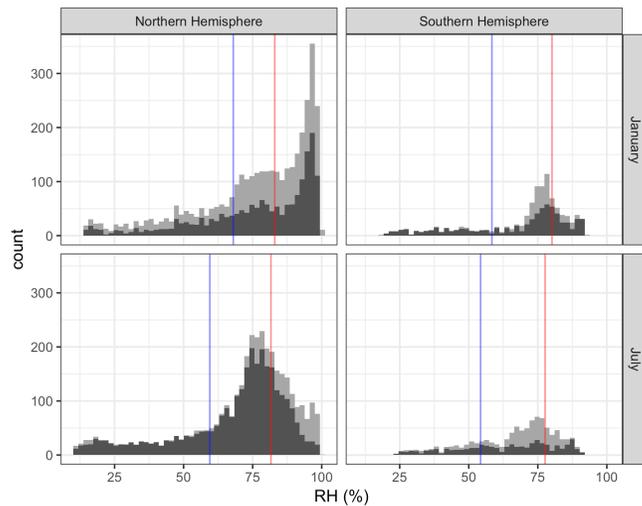
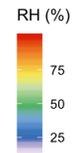
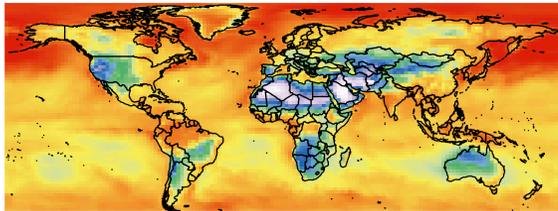
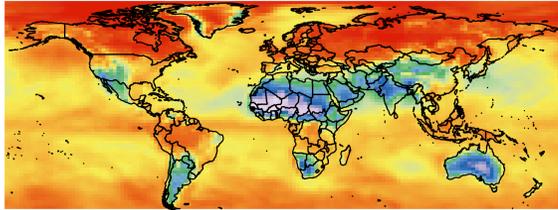
Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

Mean monthly surface humidity (2013)

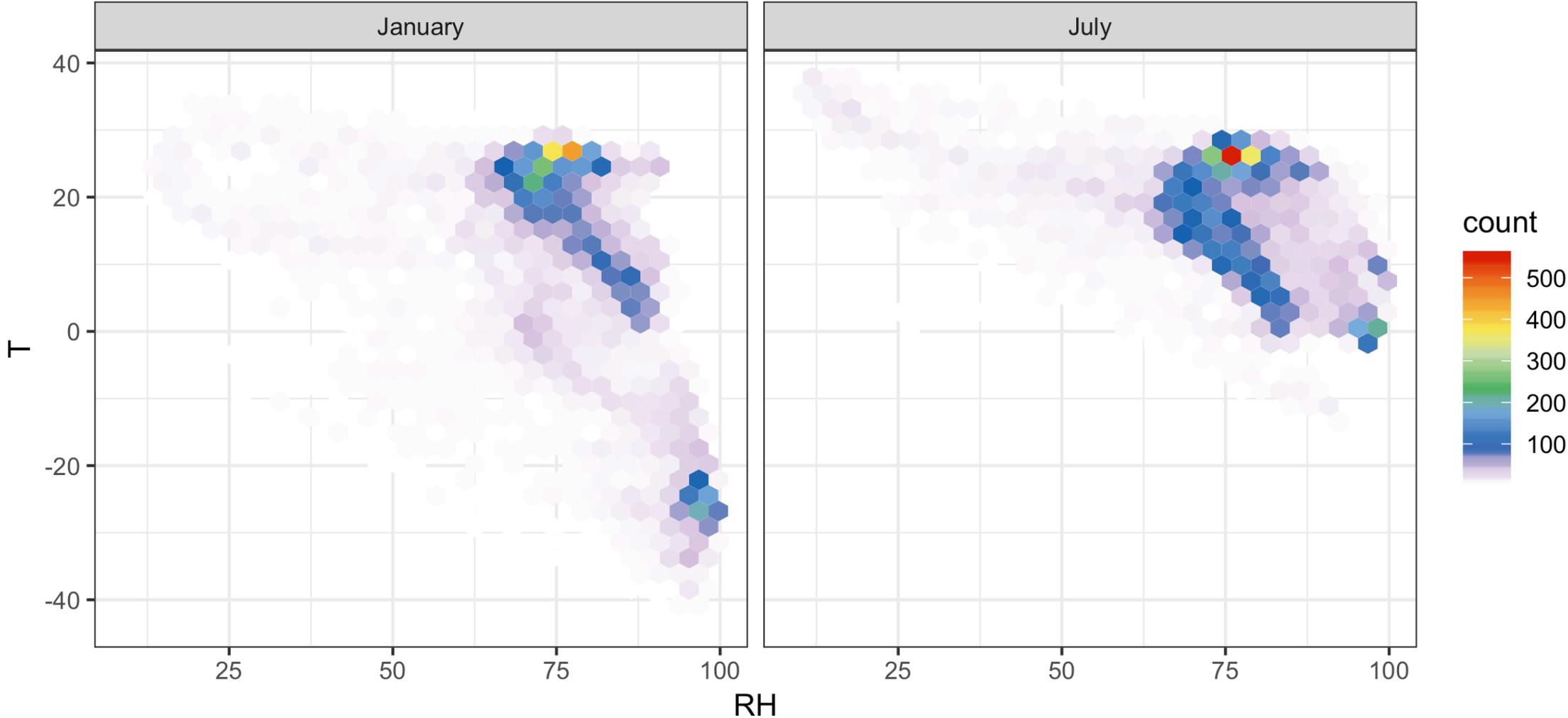


Temperature and humidity together represent key ambient conditions relevant to SOA chemistry and partitioning

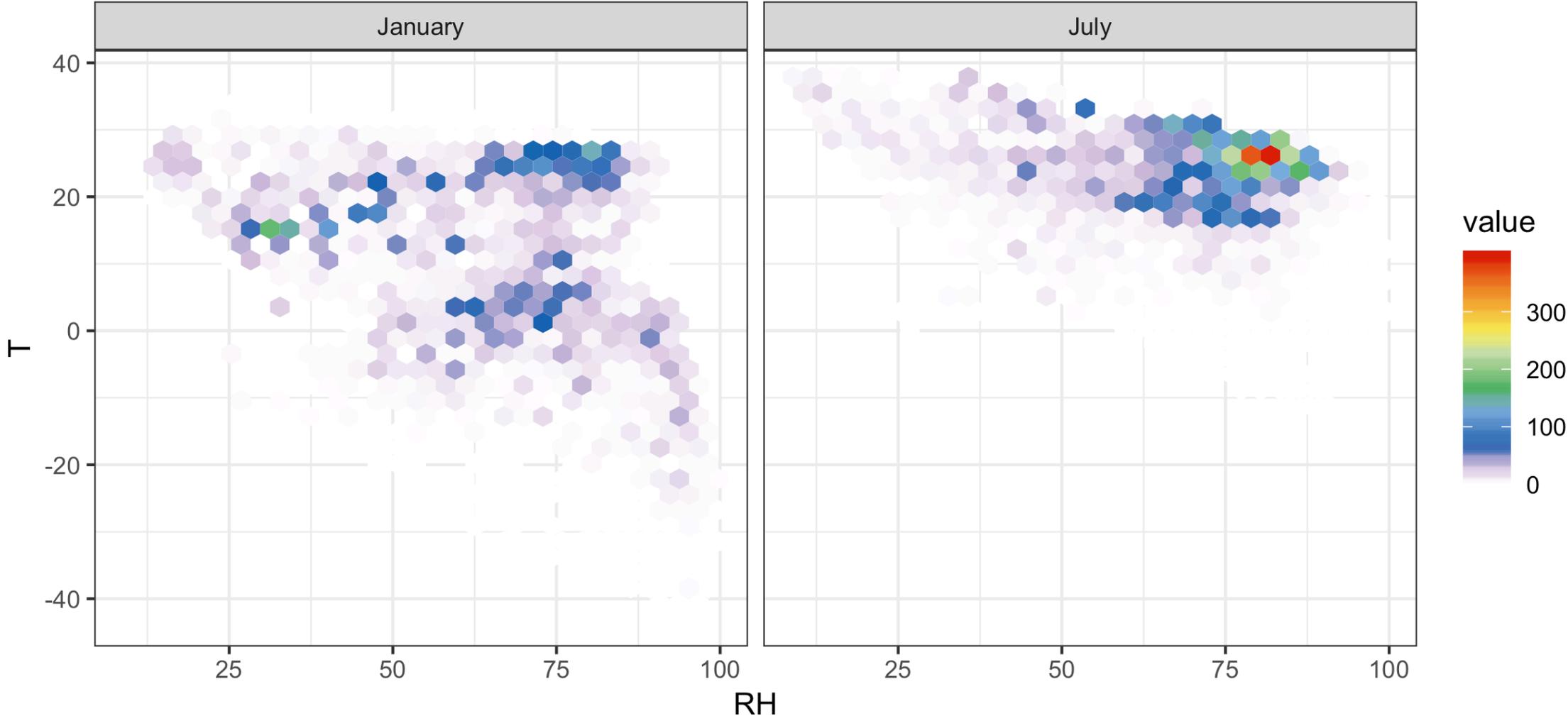
Mean monthly surface humidity (2013)



Together, frequencies of temperature and humidity levels provide a snapshot of representative conditions at the surface

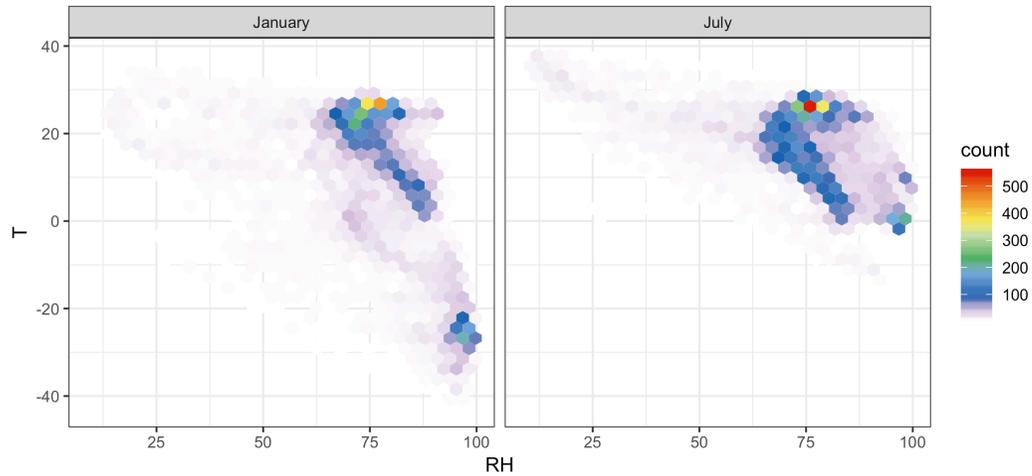


Summing population counts instead of grid cells shows relevance for the areas most people live



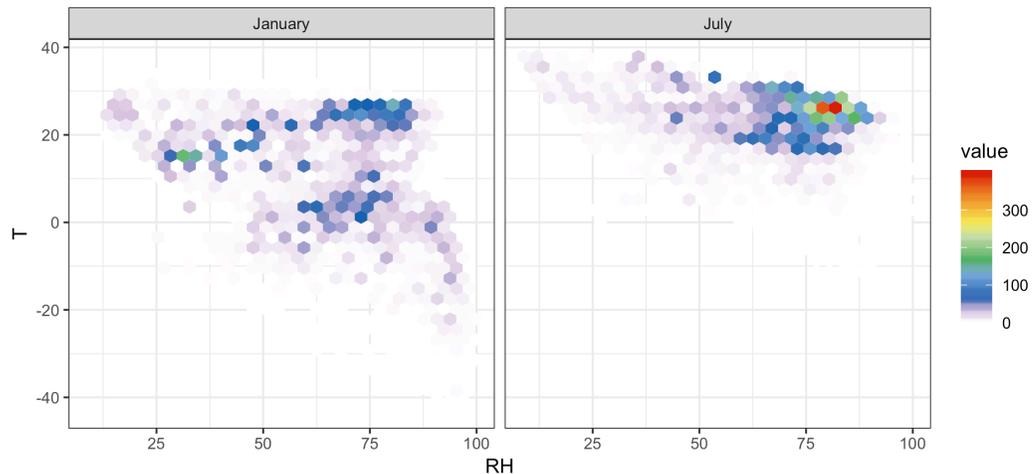
How do these representative conditions compare to the conditions used for SOA chamber studies?

Grid cell count



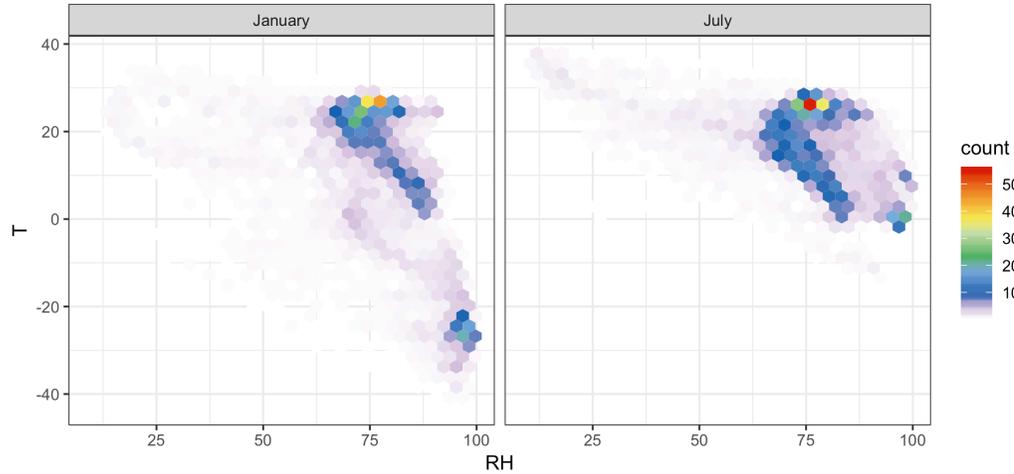
- 66 SOA chamber studies reviewed for species and ambient conditions used
- This is a work in progress – apologies if your work has not been added yet!

Grid cell population count

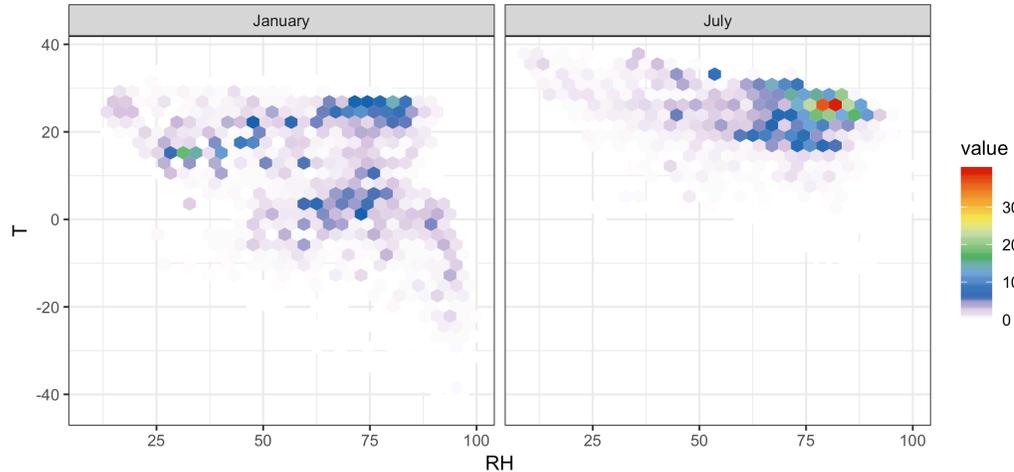


How do these representative conditions compare to the conditions used for SOA chamber studies?

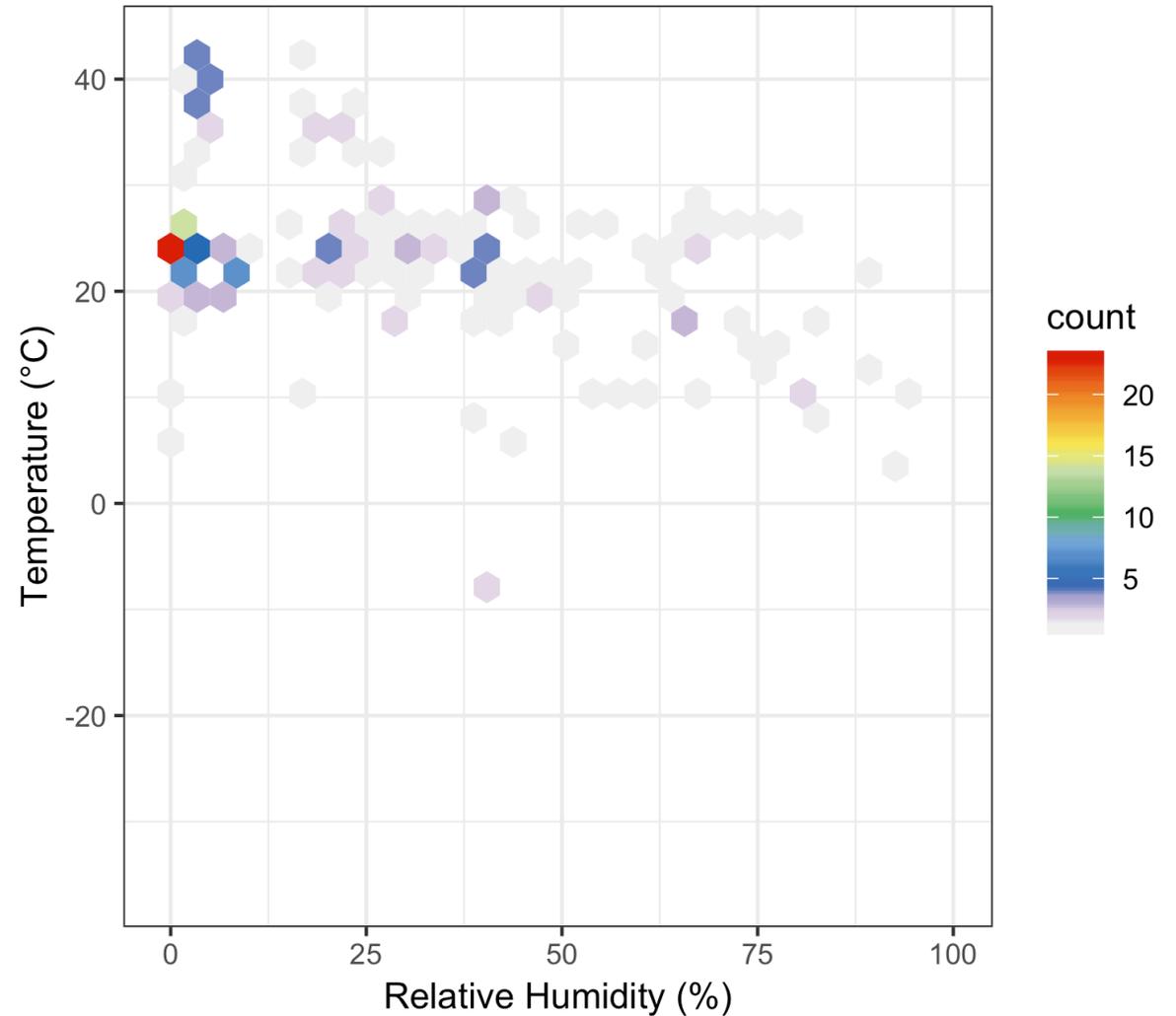
Grid cell count



Grid cell population count

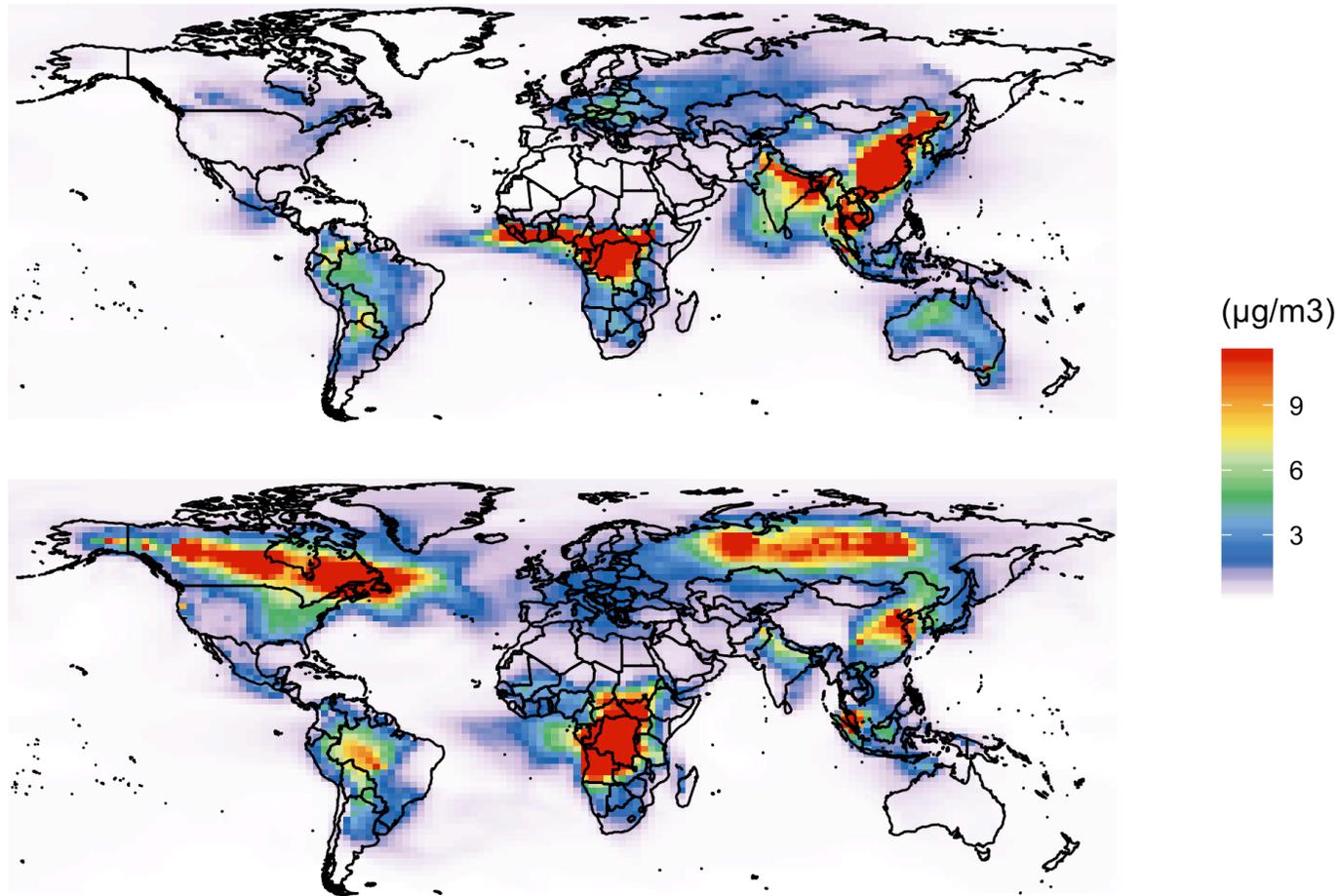


Study count by species



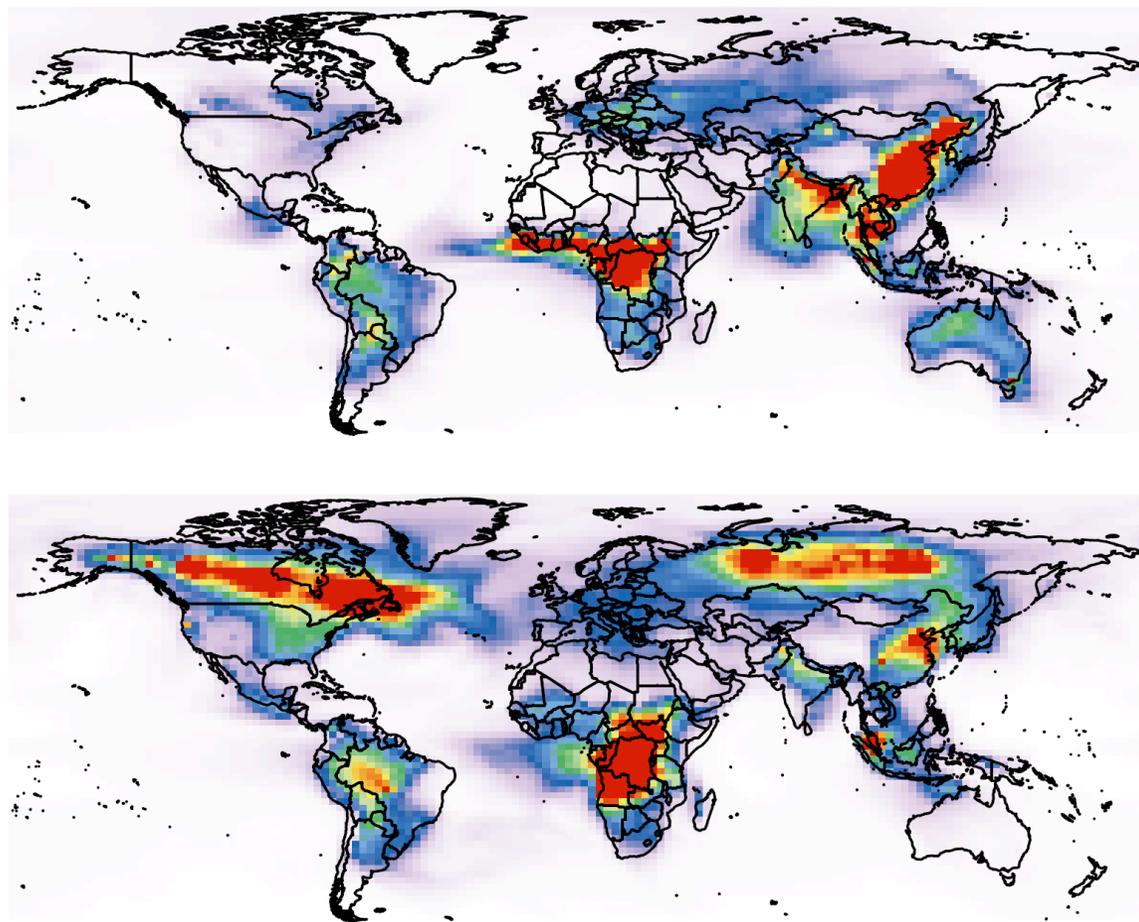
Mass loading represents another key factor of SOA formation that can be compared for modeled atmospheric relevance

Mean monthly surface OA (2013)

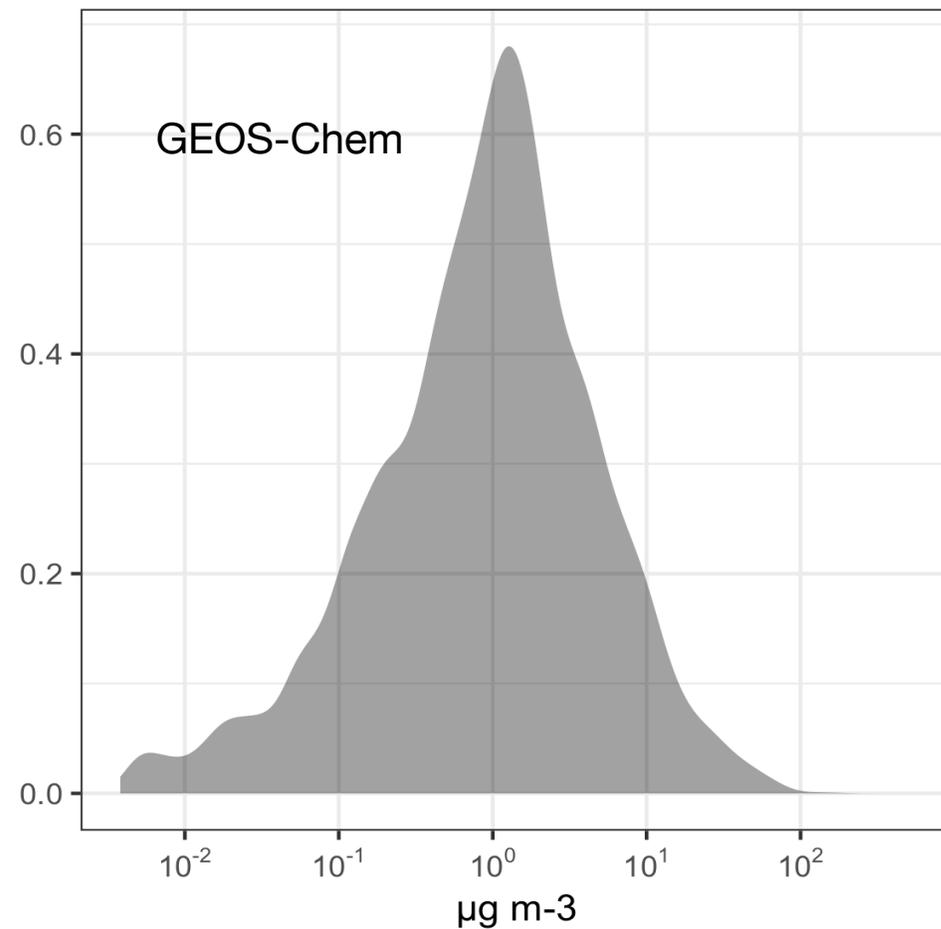


Mass loading represents another key factor of SOA formation that can be compared for modeled atmospheric relevance

Mean monthly surface OA (2013)

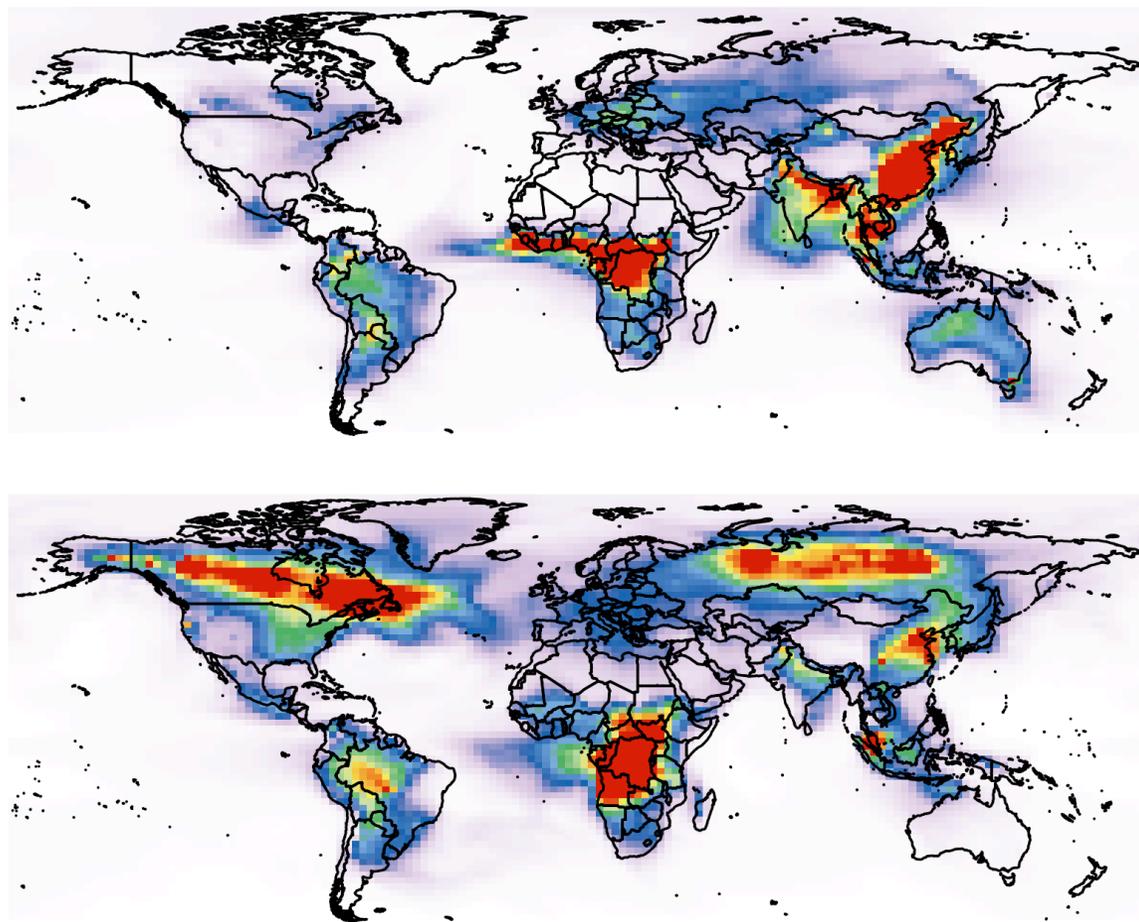


Frequency density of chamber mass loading vs. GEOS-Chem OA (population > 0)

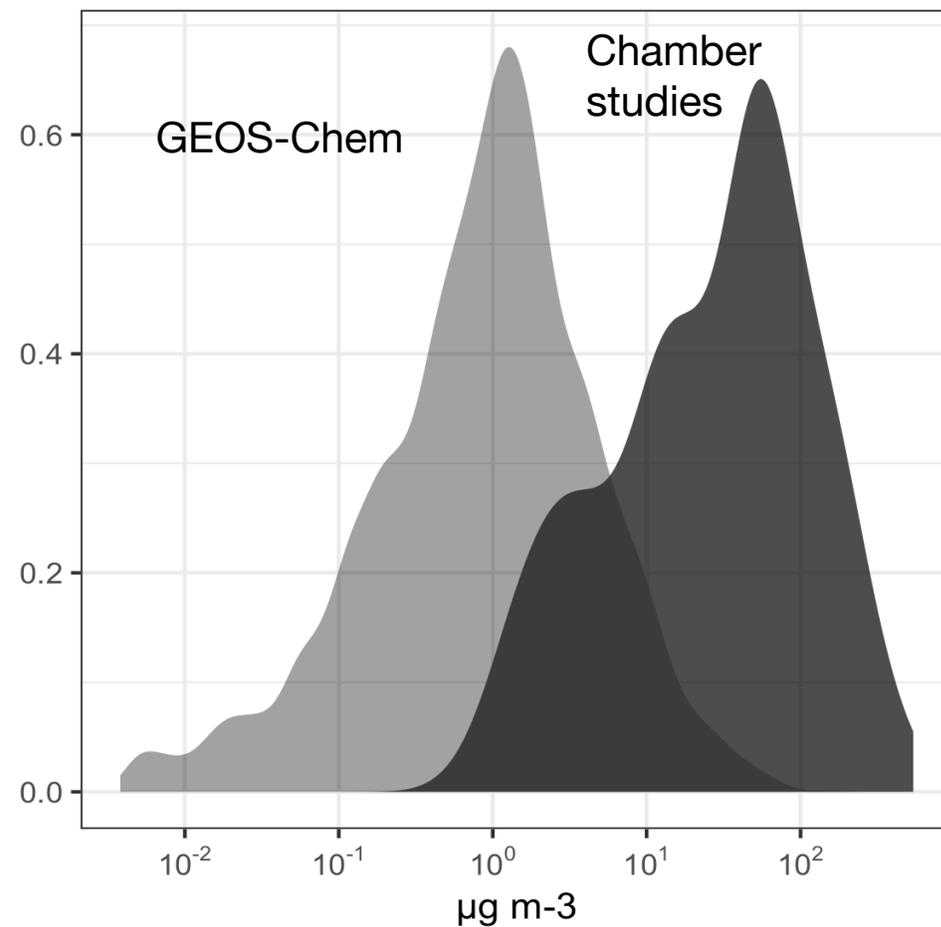


Mass loading represents another key factor of SOA formation that can be compared for modeled atmospheric relevance

Mean monthly surface OA (2013)

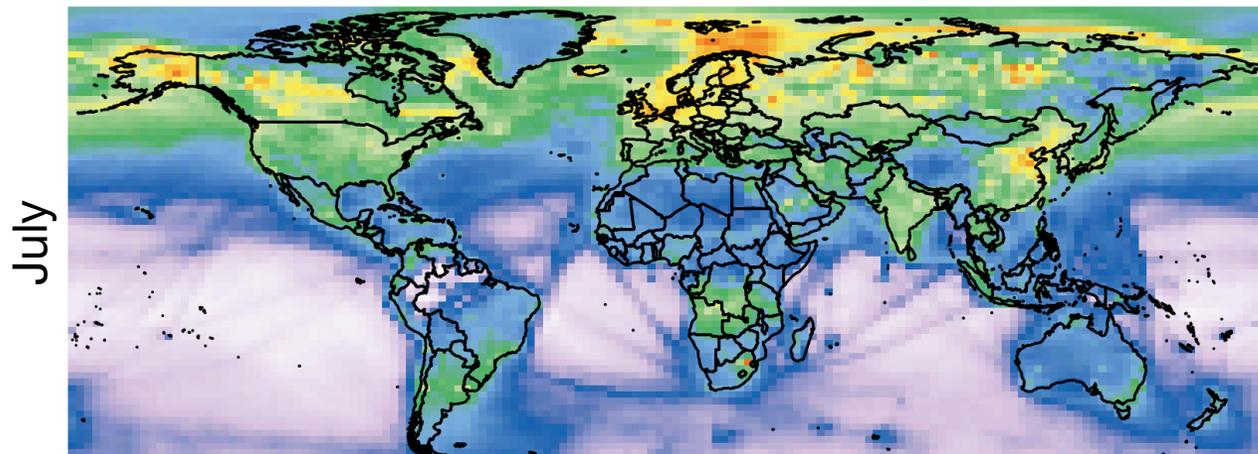
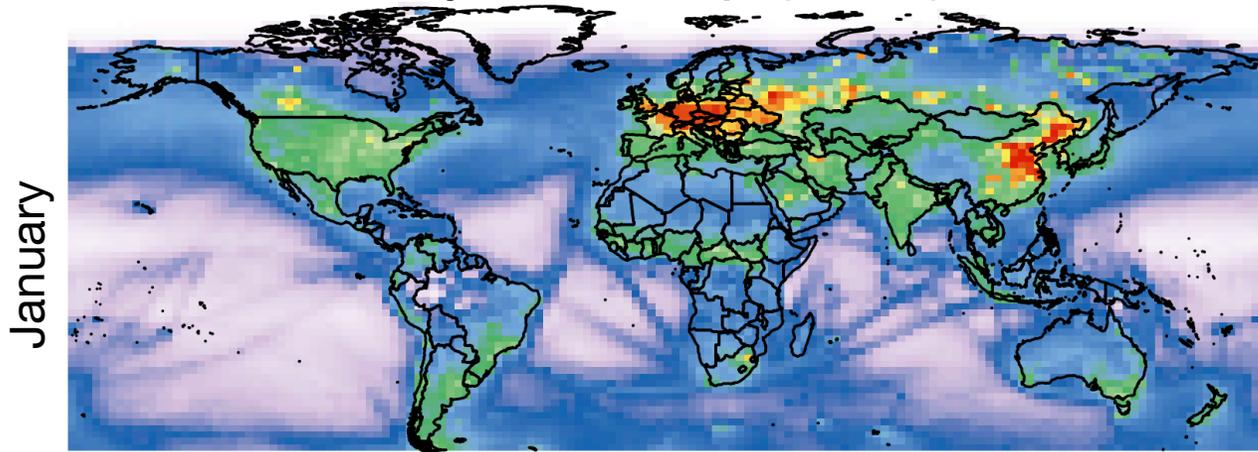


Frequency density of chamber mass loading vs. GEOS-Chem OA (population > 0)



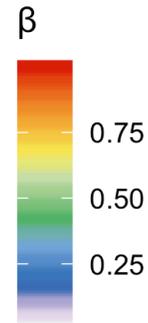
The modeled NO branching ratio varies strongly by season, location, and time of day

Mean monthly surface β (2013)



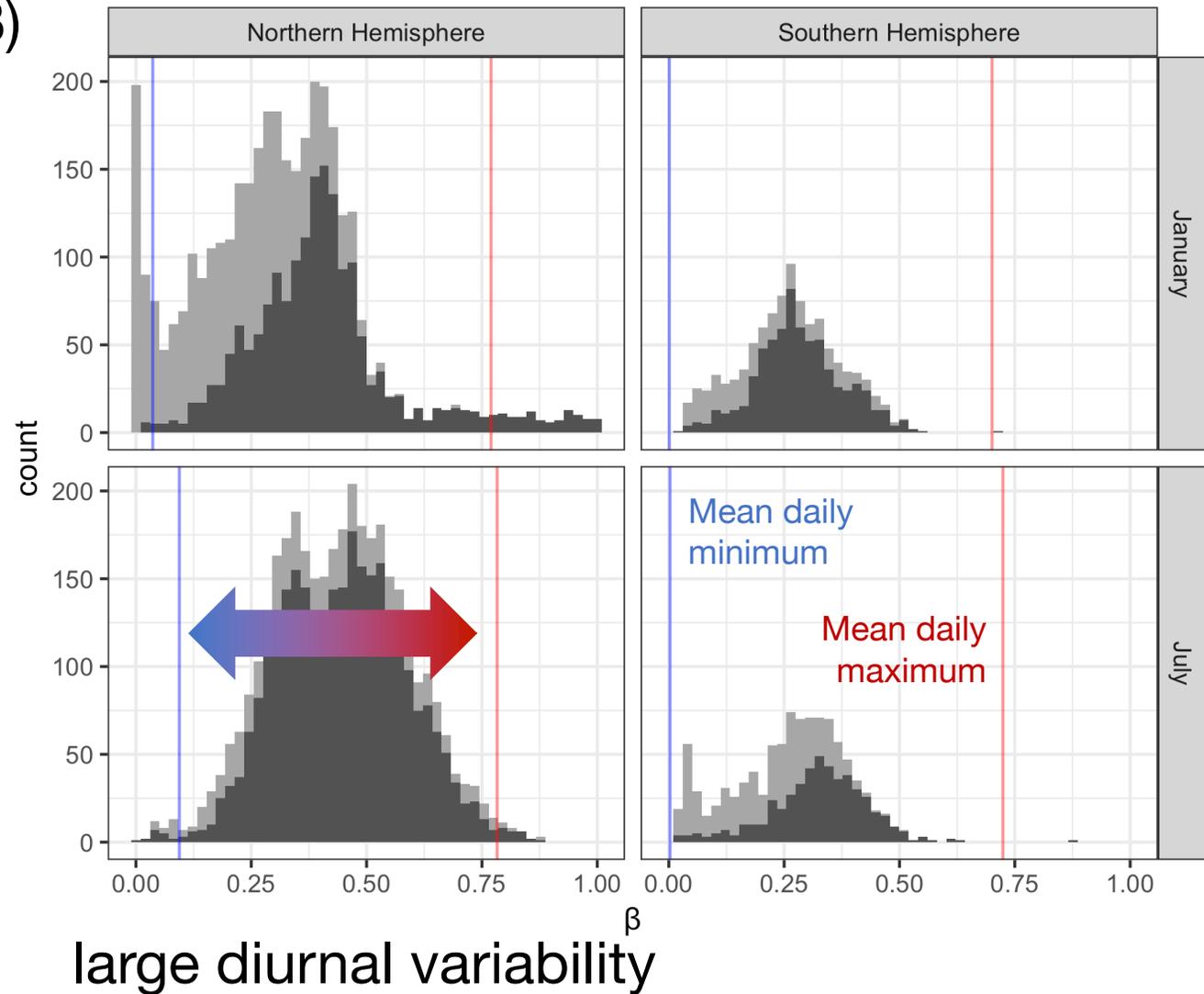
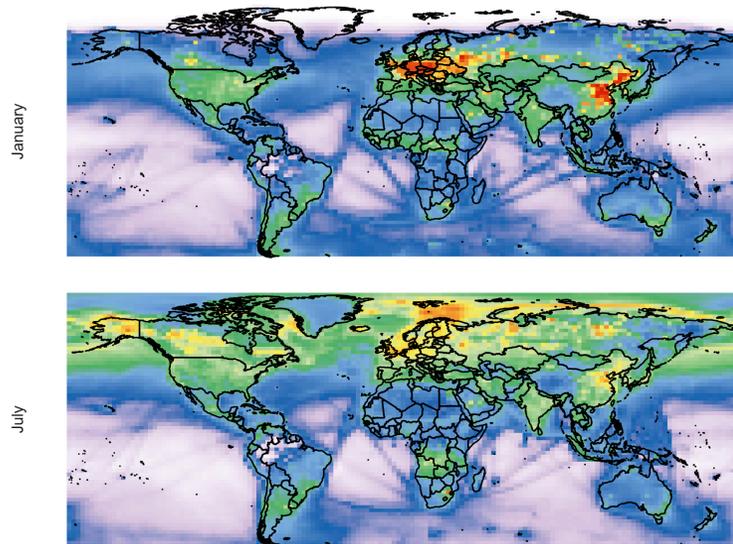
$$\beta = \frac{k_{\text{RO}_2+\text{NO}}[\text{NO}]}{k_{\text{RO}_2+\text{NO}}[\text{NO}] + k_{\text{RO}_2+\text{HO}_2}[\text{HO}_2]}$$

Pye et al., 2010



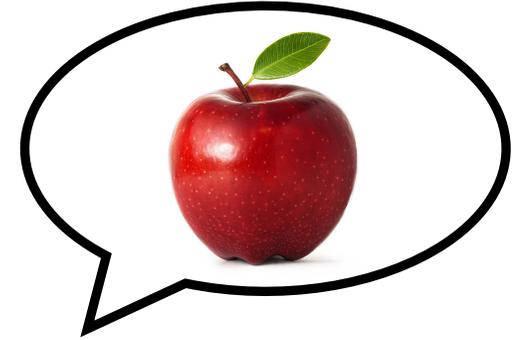
The modeled NO branching ratio varies strongly by season, location, and time of day

Mean monthly surface β (2013)



Summary

- GEOS-Chem represents a valuable tool for both applying and guiding SOA chamber studies
- Opportunities to extend and build upon parameterizations by investigating the relatively unexplored areas of “atmospherically relevant” conditions



GEOS
Chem