Air pollution is already killing us and doesn't need the help of COVID-19!
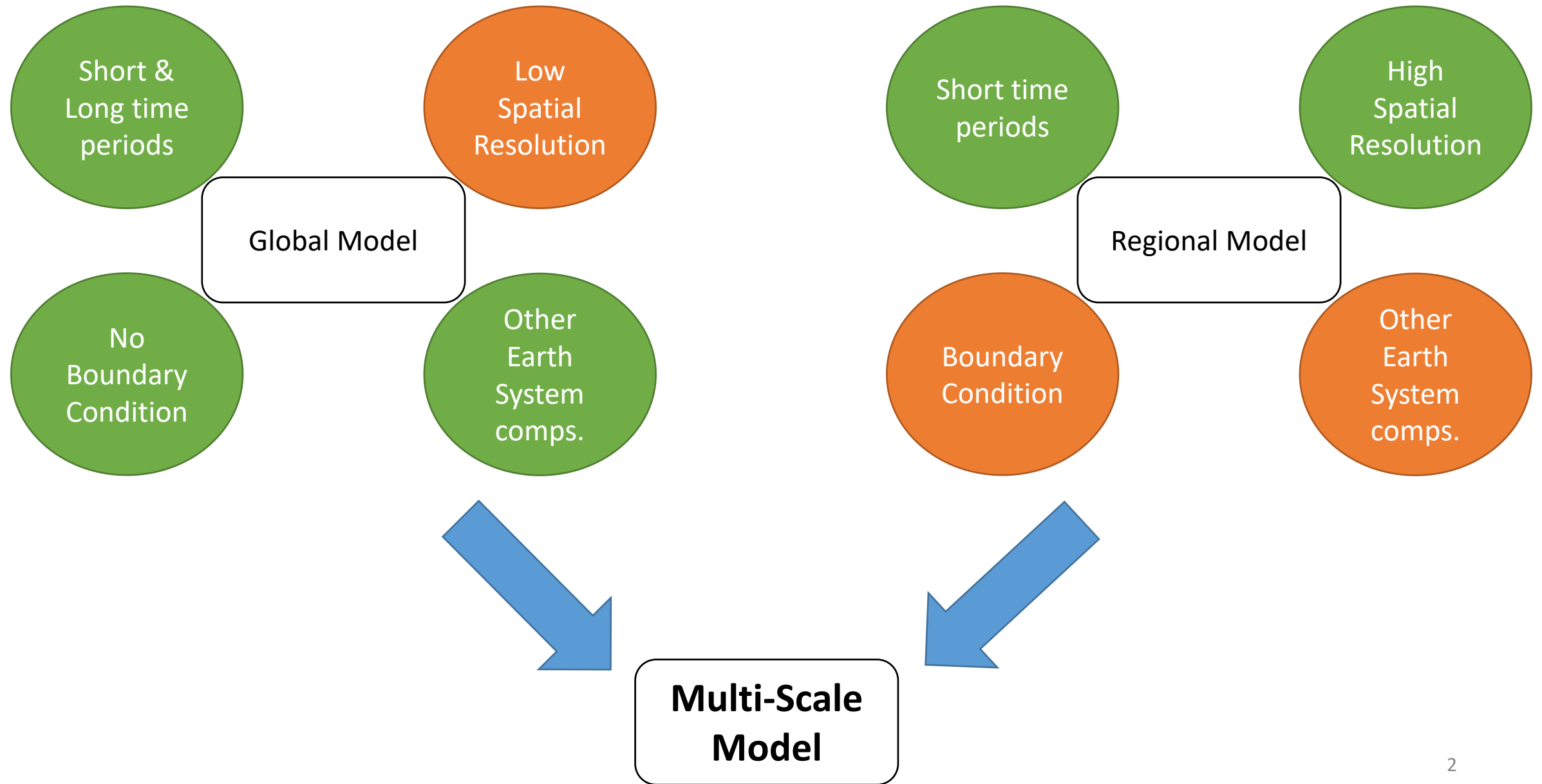
By:
- Behrooz Roozitalab
- Saeideh Mohammadi

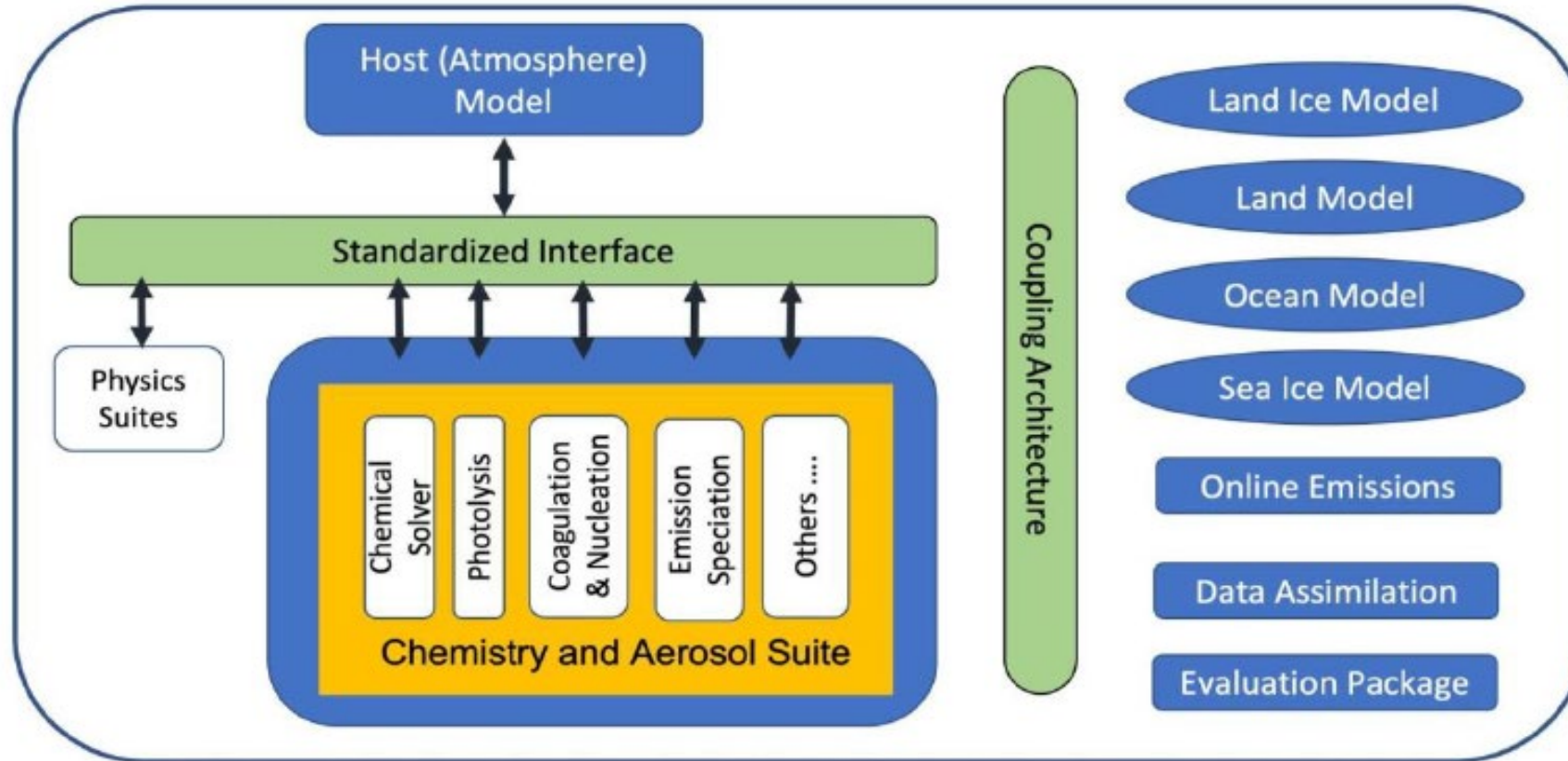# Online Global-Regional air quality modeling using MUSICA – Case Study of India

Behrooz Roozitalab[1], Louisa Emmons[2], Simone Tilmes[2], Gabriele Pfister[2], Gregory R. Carmichael[1]

[1]The University of Iowa, [2]National Center for Atmospheric Research

Models usually have to compromise some of the scientific knowledge we already have because of computational costs!

Short & Long time periods

Low Spatial Resolution

Global Model

No Boundary Condition

Other Earth System comps.

Short time periods

High Spatial Resolution

Regional Model

Boundary Condition

Other Earth System comps.

Multi-Scale Model

MUlti-Scale Infrastructure for Chemistry and Aerosols (MUSICA) uses the capabilities of both regional and global models.
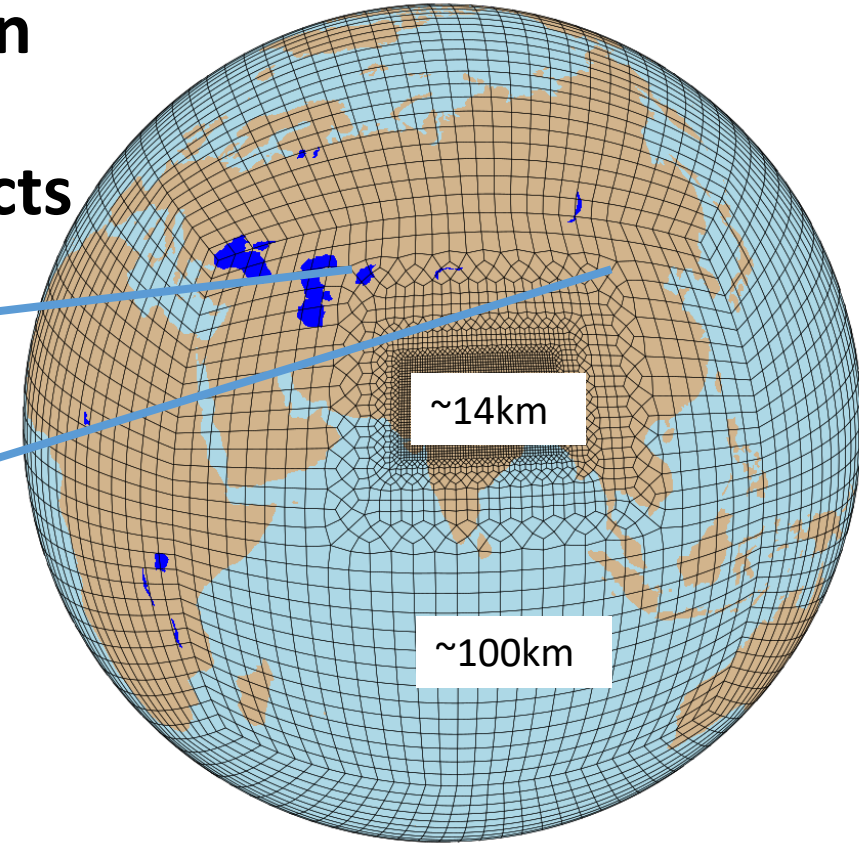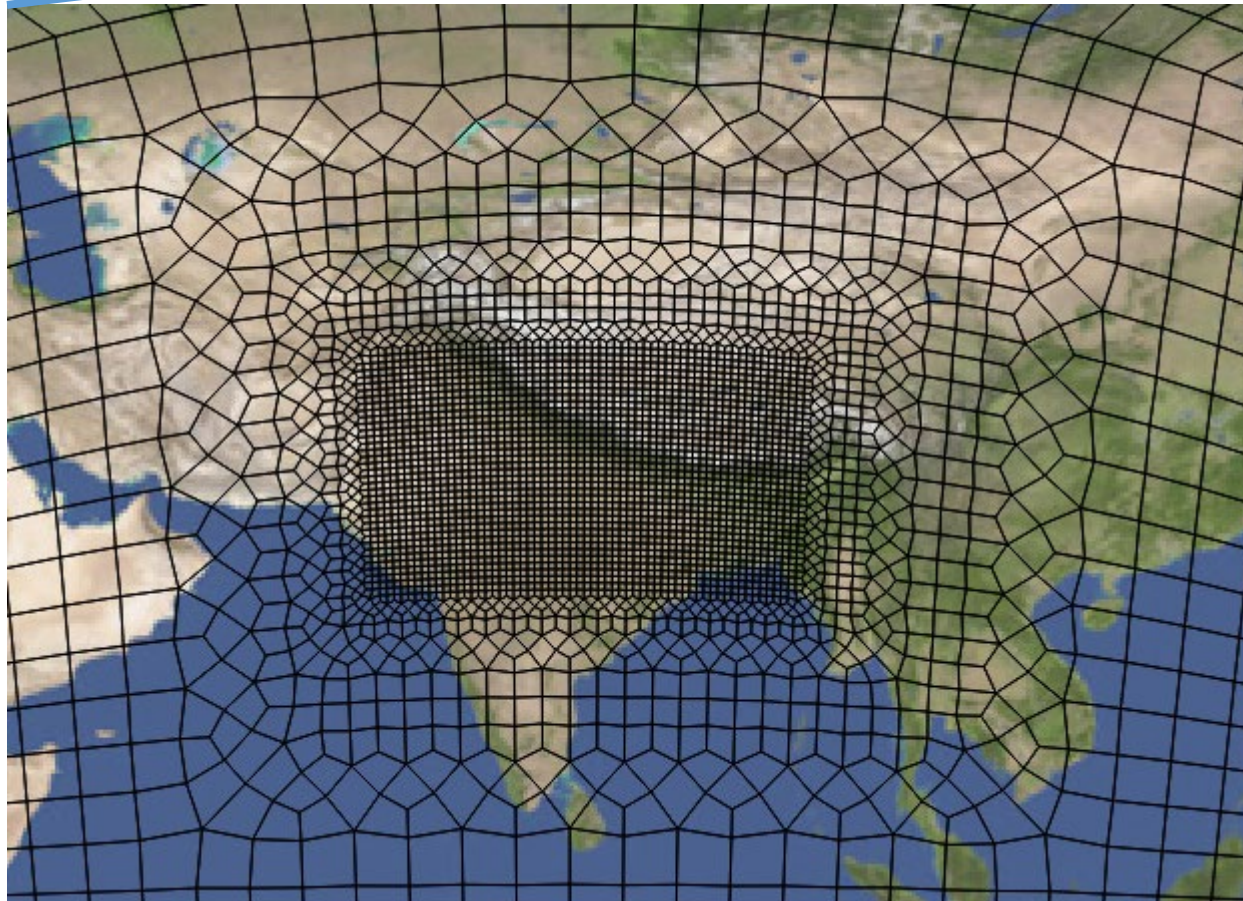

Explore new scientific questions
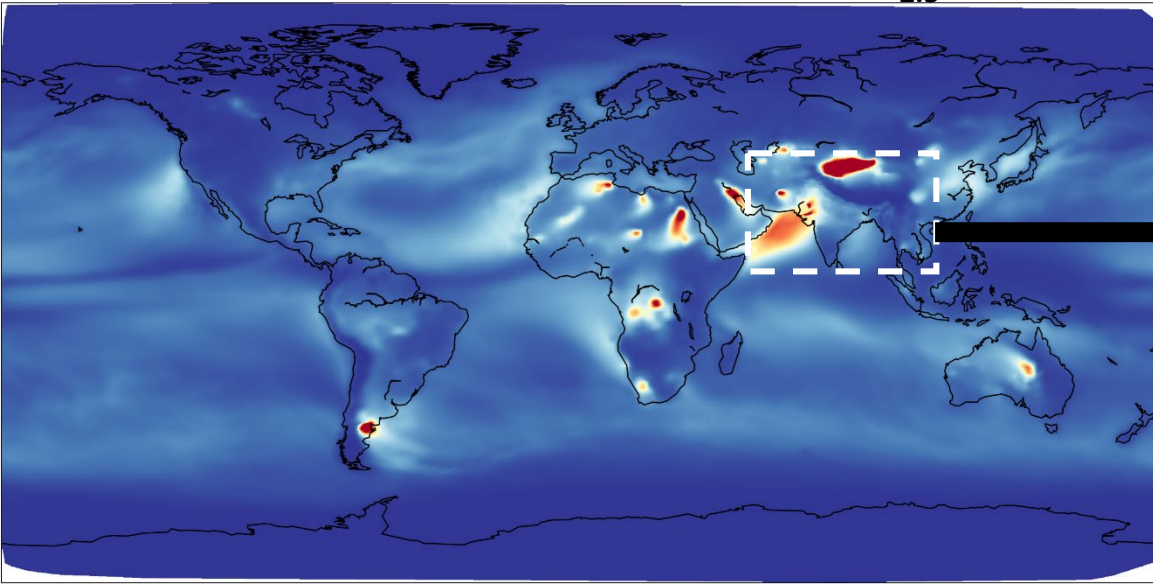
Long range transport effects on regional air pollution
&
regional scale chemistry and dynamic treatment effects on global modeling results
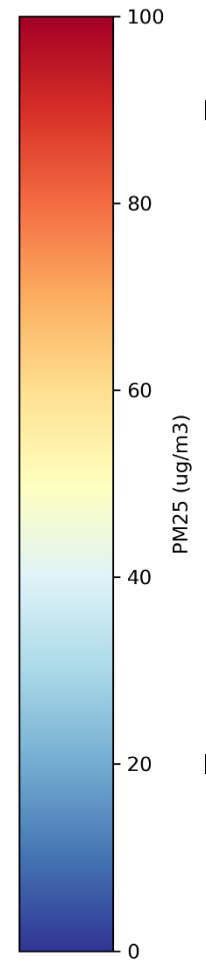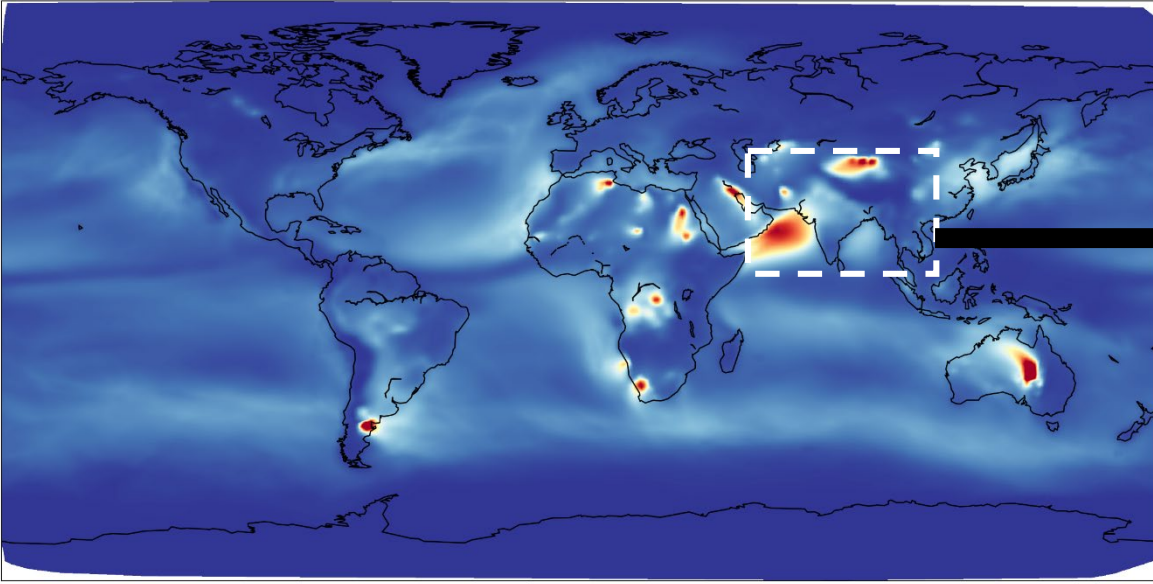

~14km

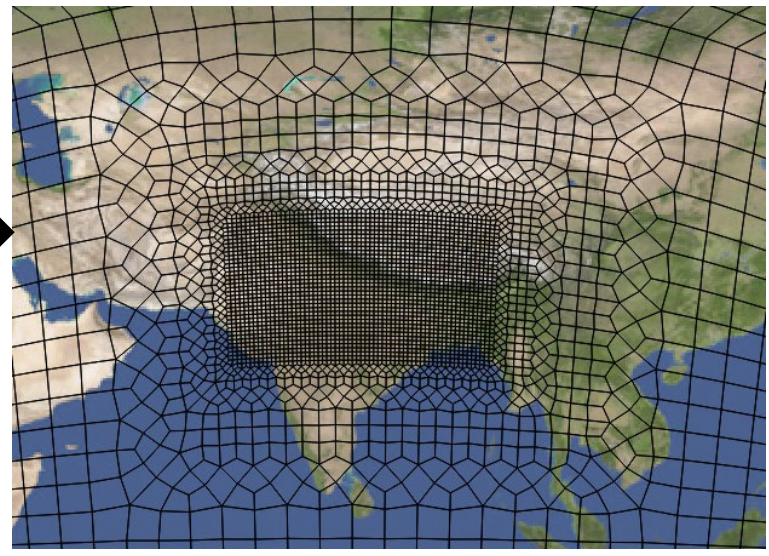~100km

Higher resolution over a region has global impacts!

ne30x8 - June 2010 - Surface PM$_{2.5}$
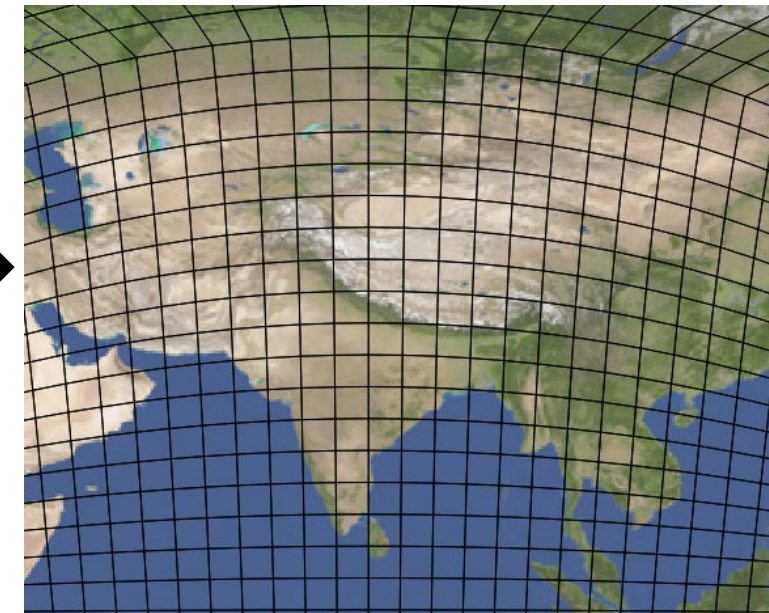
ne30 - June 2010 - Surface PM$_{2.5}$

ne30x8

ne30

PM25 (ug/m3)

Higher Resolution can lead to increased emissions and different concentration variability.
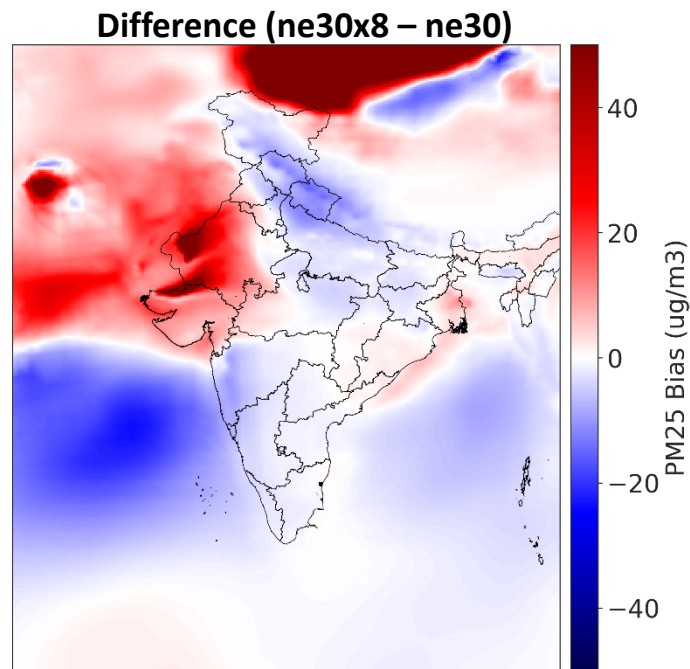

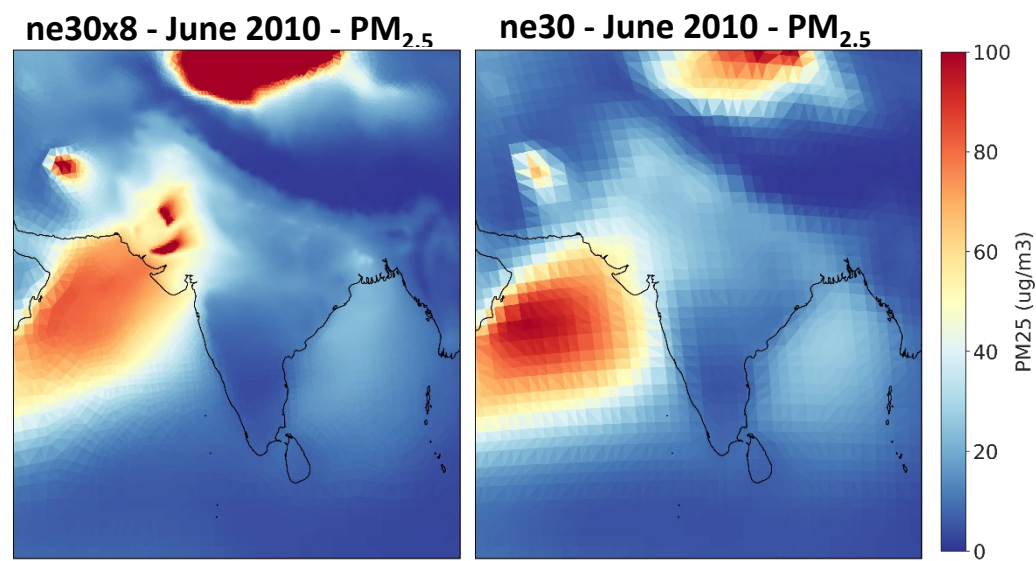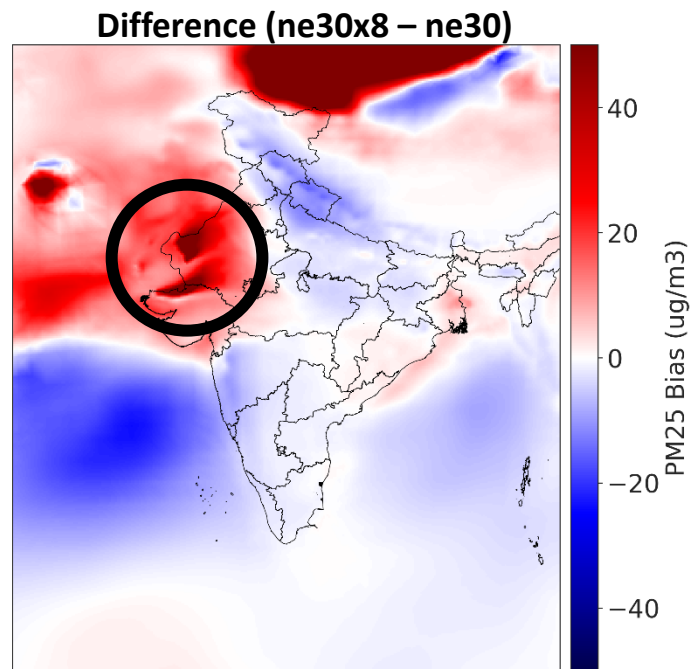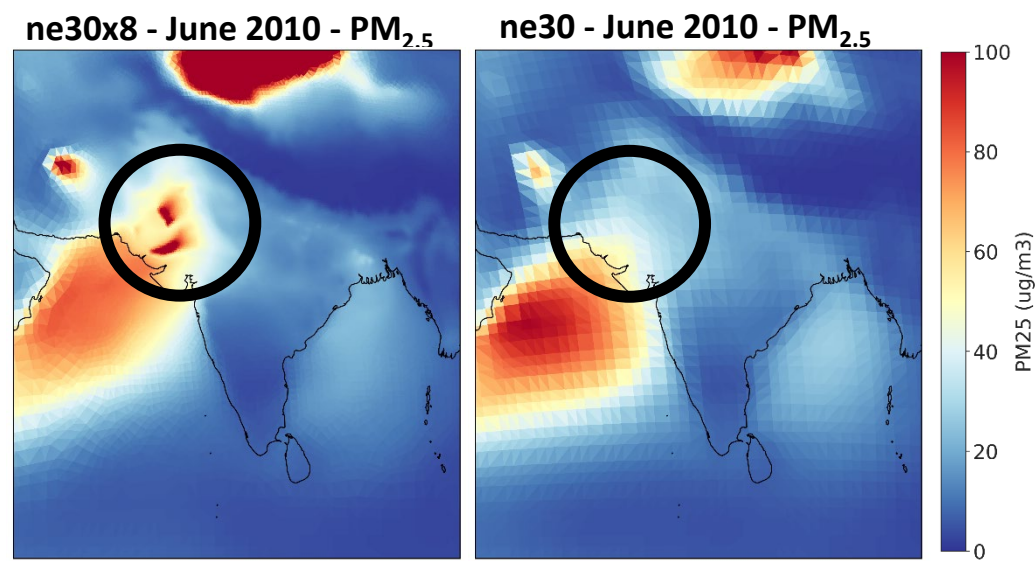NOTE: Results are preliminary and not validated. Please do not cite!

Higher Resolution can lead to increased emissions and different concentration variability.

ne30x8 - June 2010 - PM$_{2.5}$

ne30 - June 2010 - PM$_{2.5}$

Difference (ne30x8 − ne30)

NOTE: Results are preliminary and not validated. Please do not cite!

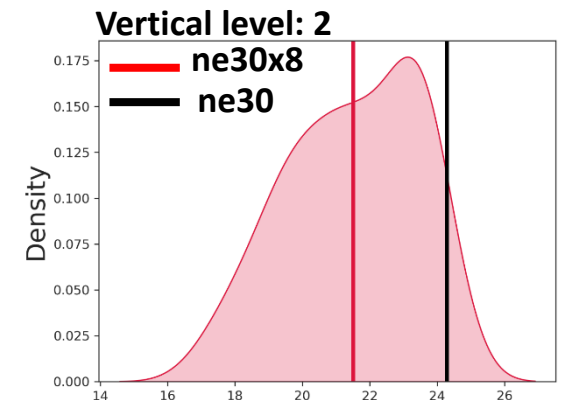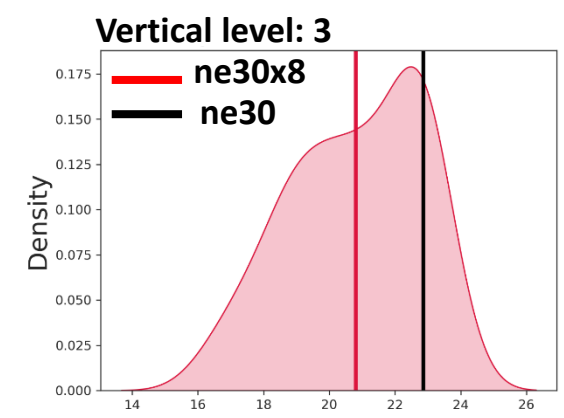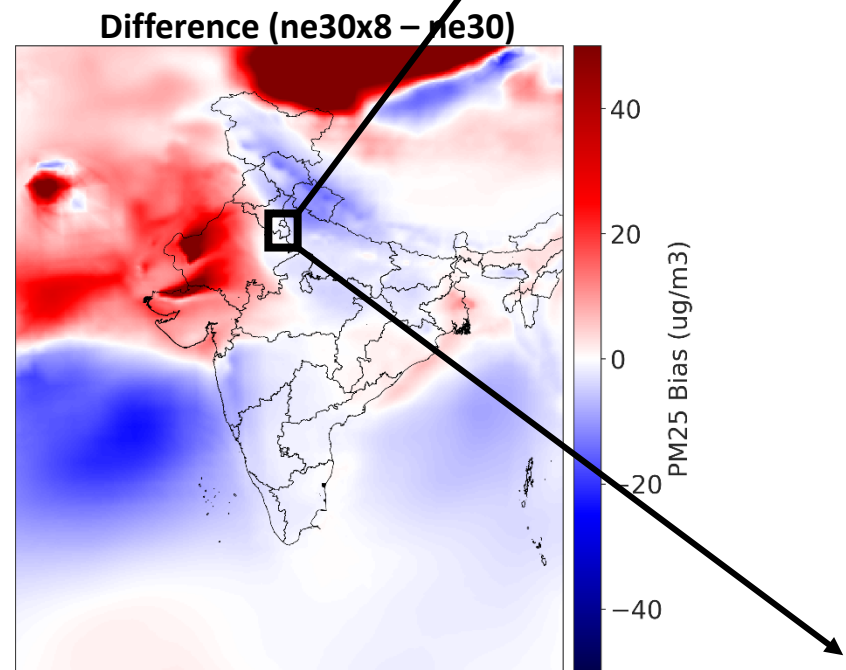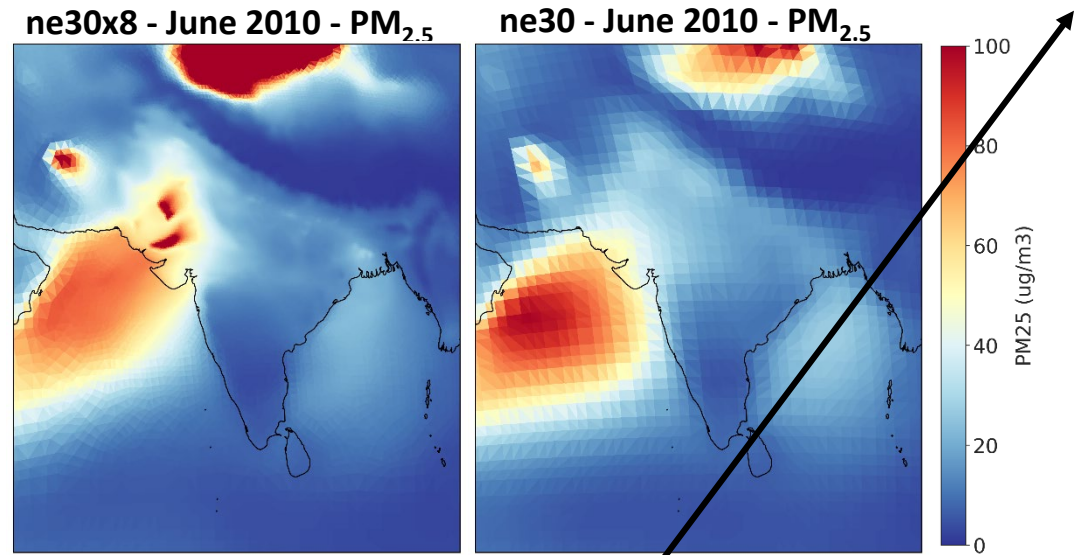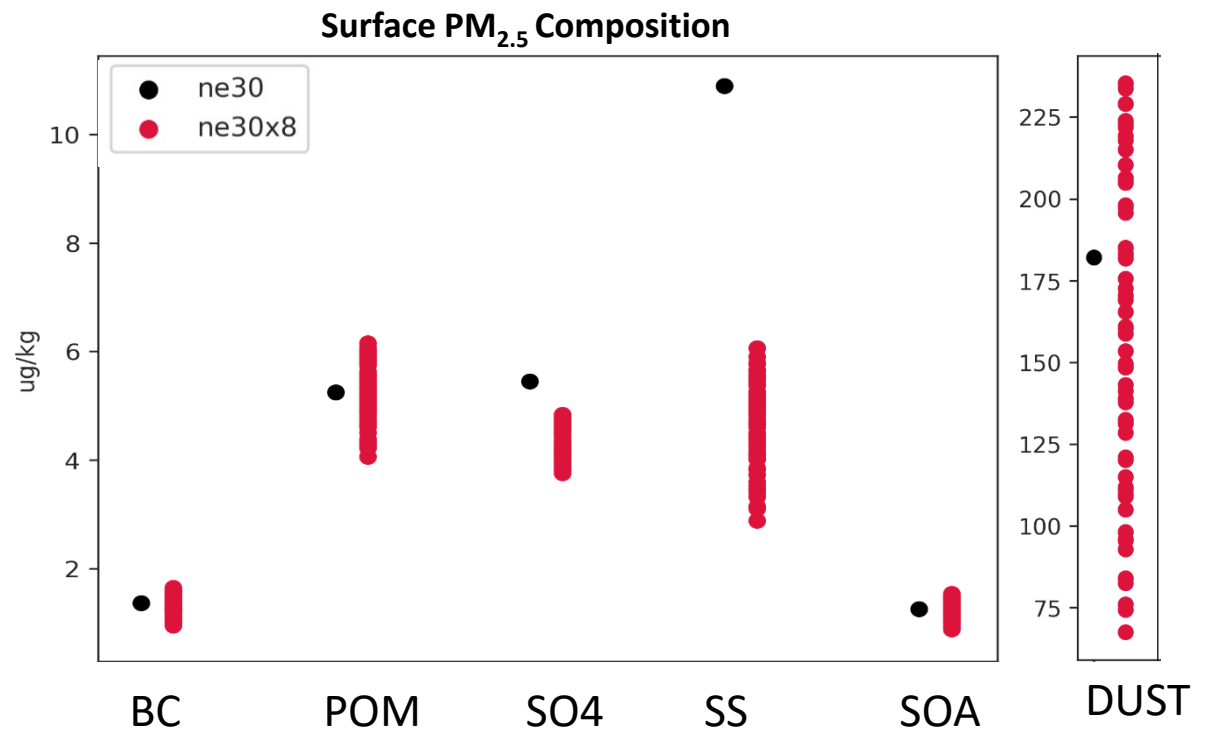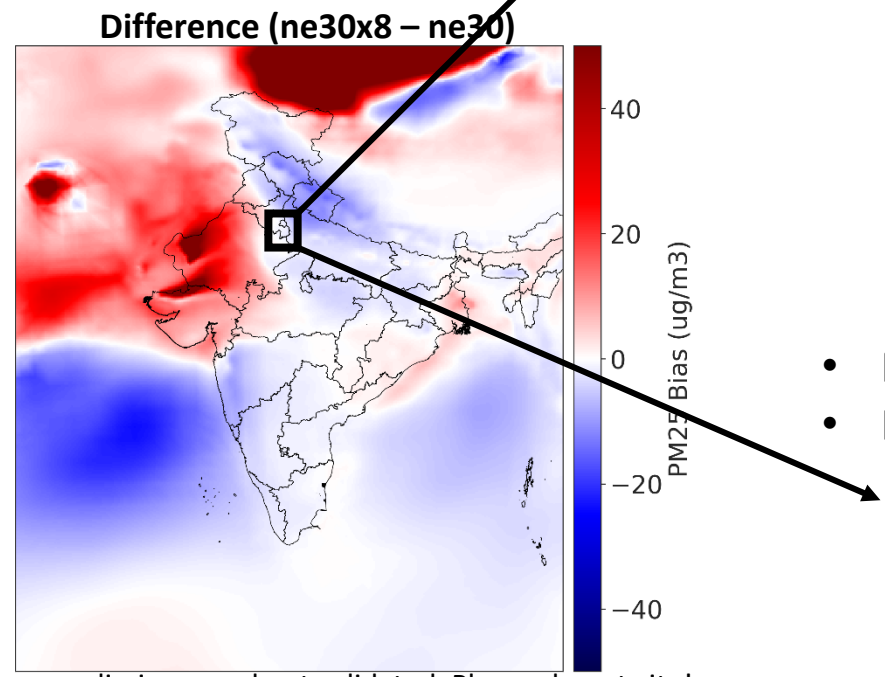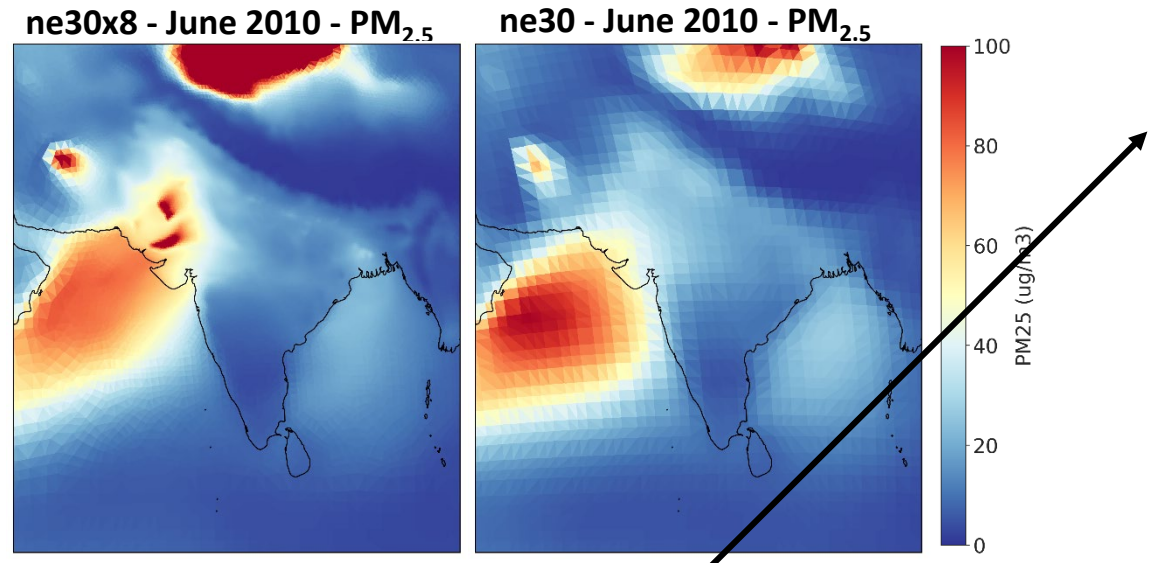# Higher Resolution can lead to increased emissions and different concentration variability.

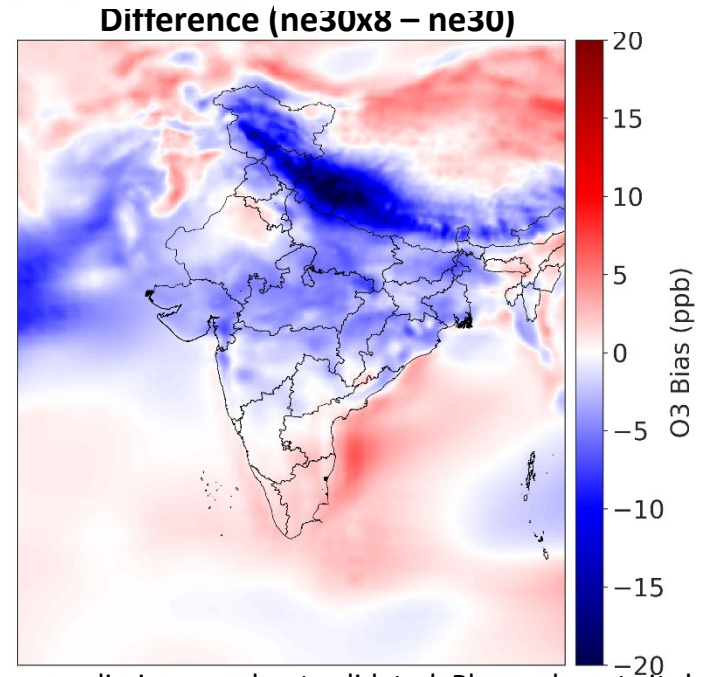NOTE: Results are preliminary and not validated. Please do not cite!

Higher Resolution can lead to increased emissions and different concentration variability.

ne30x8 - June 2010 - PM$_{2.5}$

ne30 - June 2010 - PM$_{2.5}$

Difference (ne30x8 – ne30)

Surface PM$_{2.5}$ Composition

- Natural sources (e.g. sea salt (SS) and dust) show larger spatial variability.
- Higher resolution model (ne30x8) show lower sea salt reached Delhi.
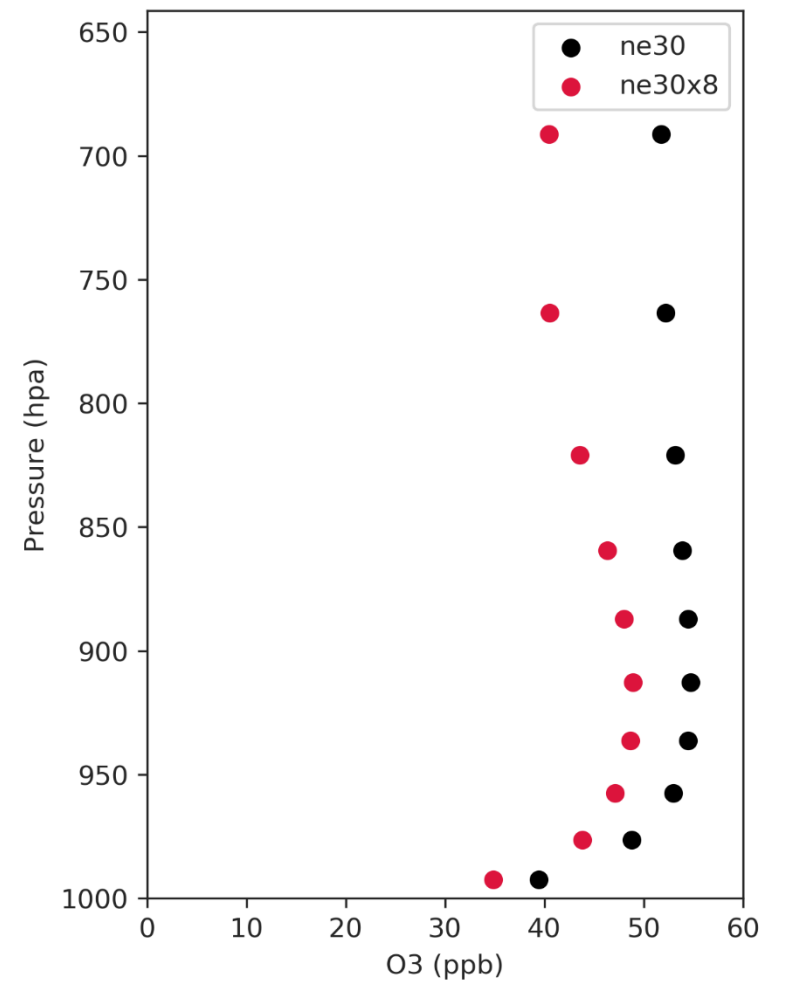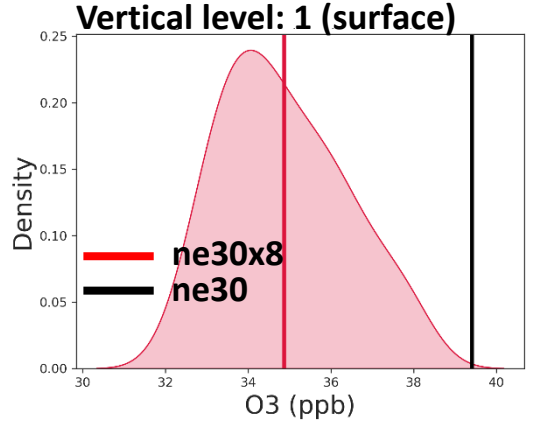
Higher Resolution may decrease global ozone burden estimates!

ne30x8 - June 2010 - ozone

ne30 - June 2010 - ozone

Difference (ne30x8 − ne30)

O3 (ppb)

O3 Bias (ppb)
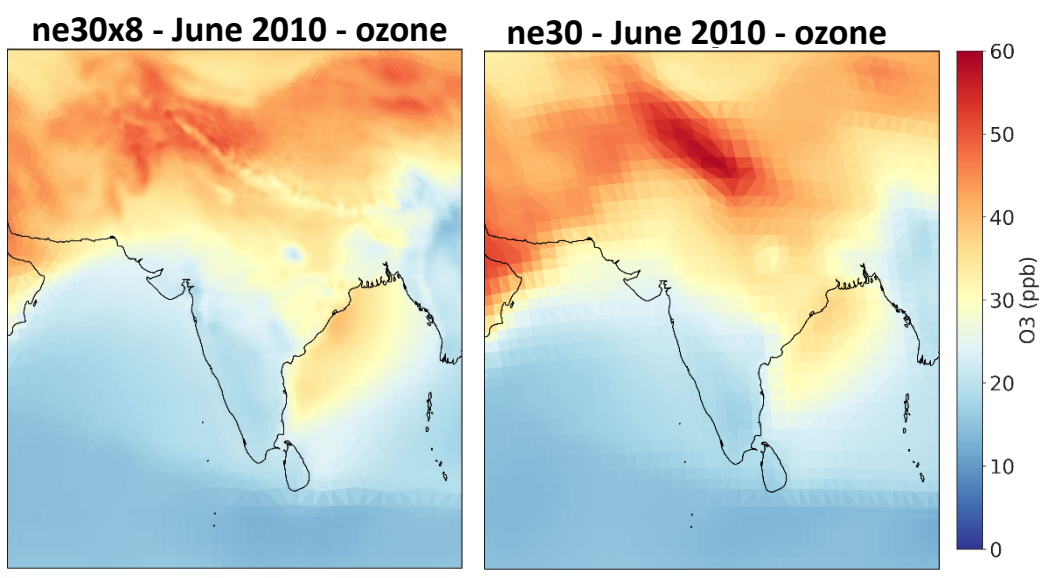
NOTE: Results are preliminary and not validated. Please do not cite!

Higher Resolution may decrease global ozone burden estimates!

NOTE: Results are preliminary and not validated. Please do not cite!

Higher Resolution may decrease global ozone burden estimates!

ne30x8 - June 2010 - ozone

ne30 - June 2010 - ozone

Difference (ne30x8 − ne30)

Some surface ozone precursors
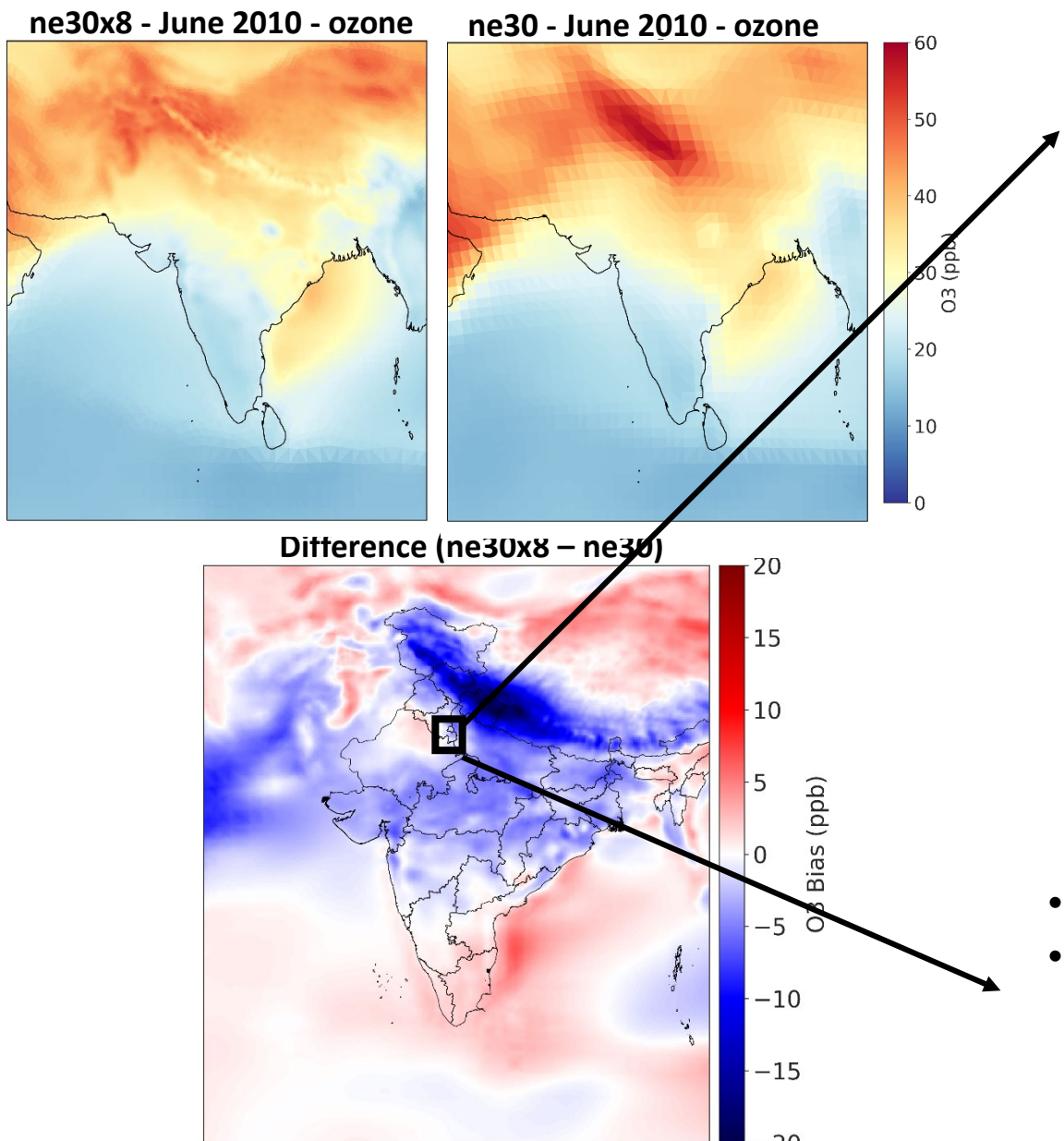
- **NO2, CO, and OH show large spatial variability.**
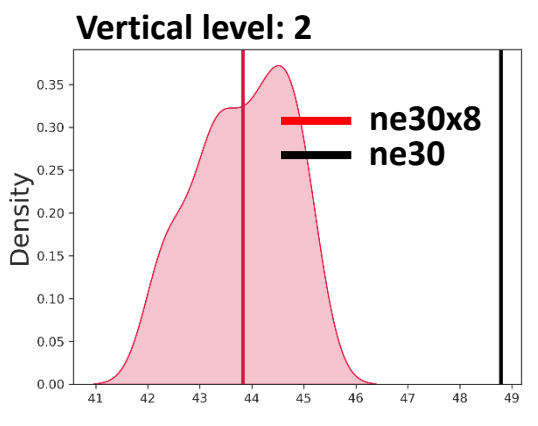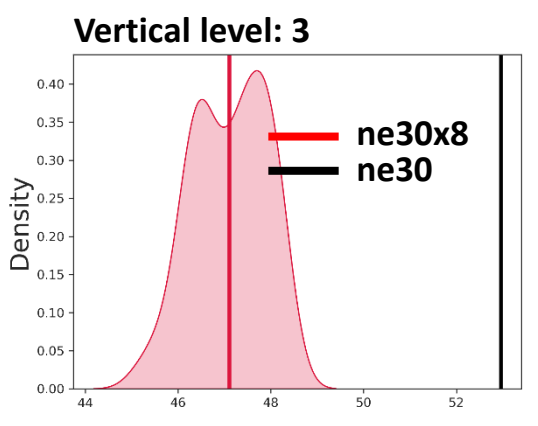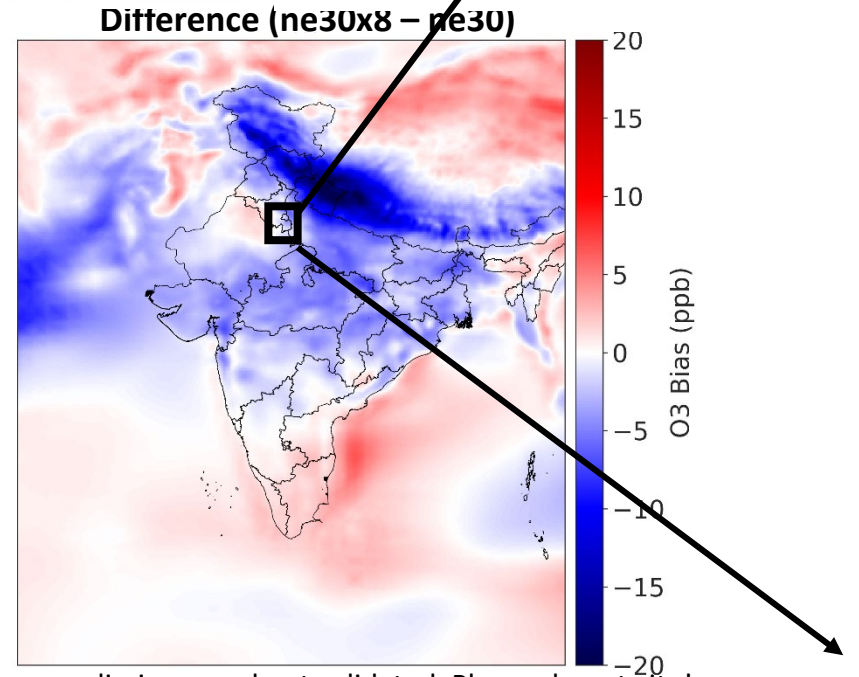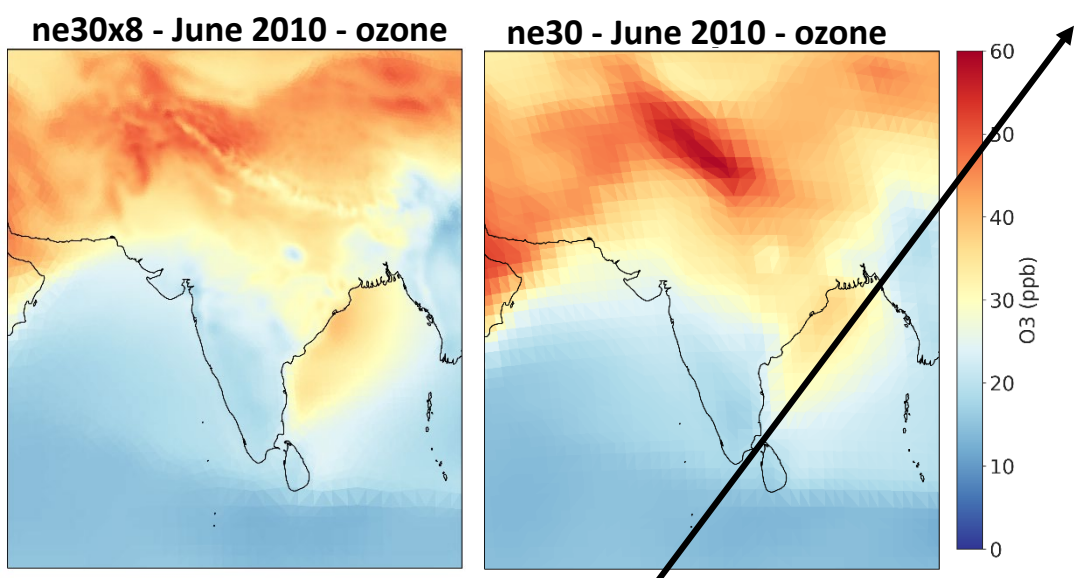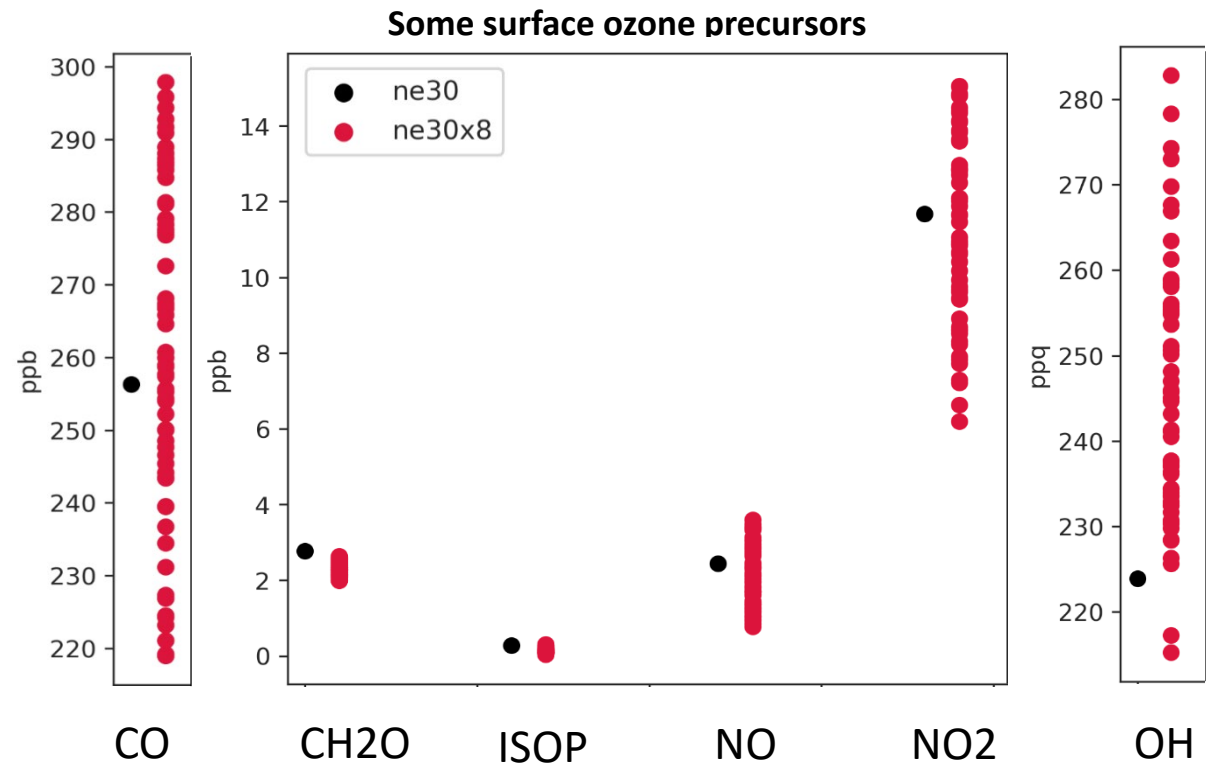- **Higher resolution didn't change Isoprene and formaldehyde.**

NOTE: Results are preliminary and not validated. Please do not cite!

Summary

- MUSICA enables exploring new multi-scale dependent questions.
- Higher resolution modeling may lead to more emission sources.
- Higher resolution can have different effects on different vertical layers.
- Using higher resolution modeling, the variability of composition and precursors can change.

Next Steps:

- Prepare emissions and atm/land initial conditions for year 2017.
- Impacts of long-range transported dust on India.
- Study the extreme air pollution episode in November 2017 and compare with WRFChem results.

Thank you for your time :)