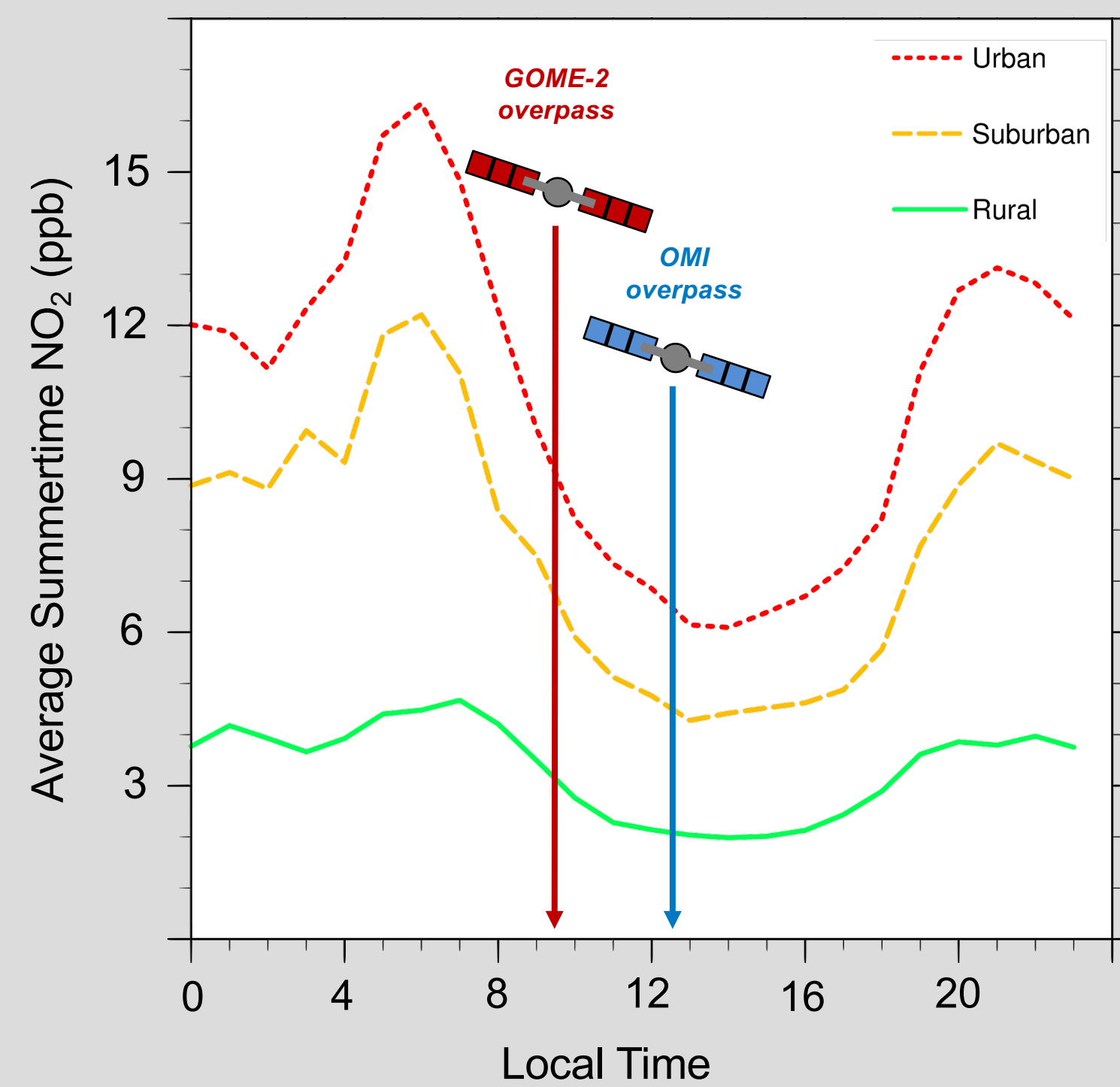


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What are nitrogen oxides?

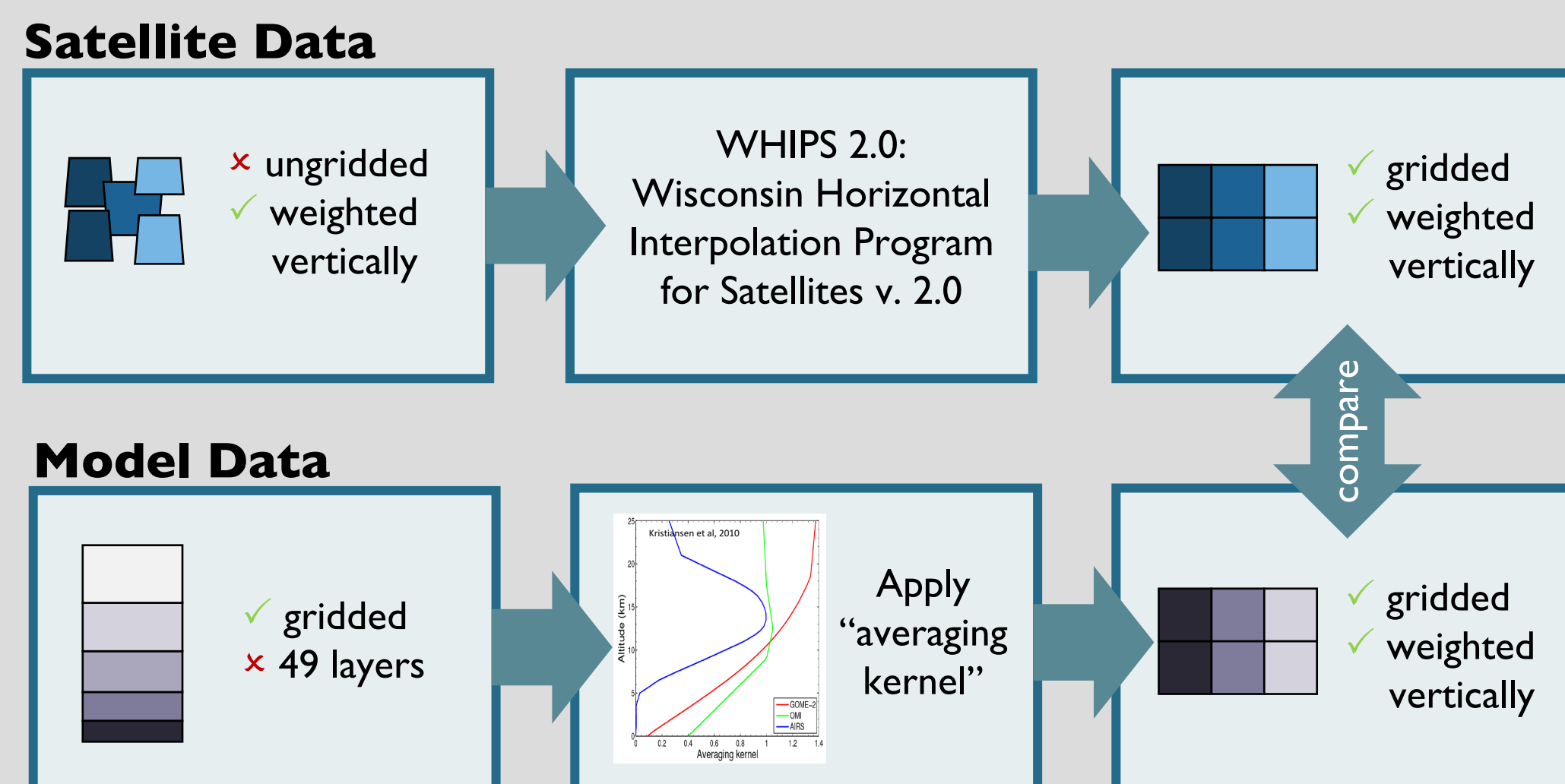
- Nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$) contribute to the creation of **ozone** and nitrate **particulate matter**
- These pollutants **corrode lungs, exacerbate chronic lung diseases, and increase mortality and morbidity.**
- Air pollution causes an estimated **200,000 premature deaths** each year in the U.S.¹



Median AQS measurements of NO_2 across the U.S. in summer 2007. 73 urban, 67 suburban, and 93 rural monitors are considered (Penn and Holloway, in prep).

Methods

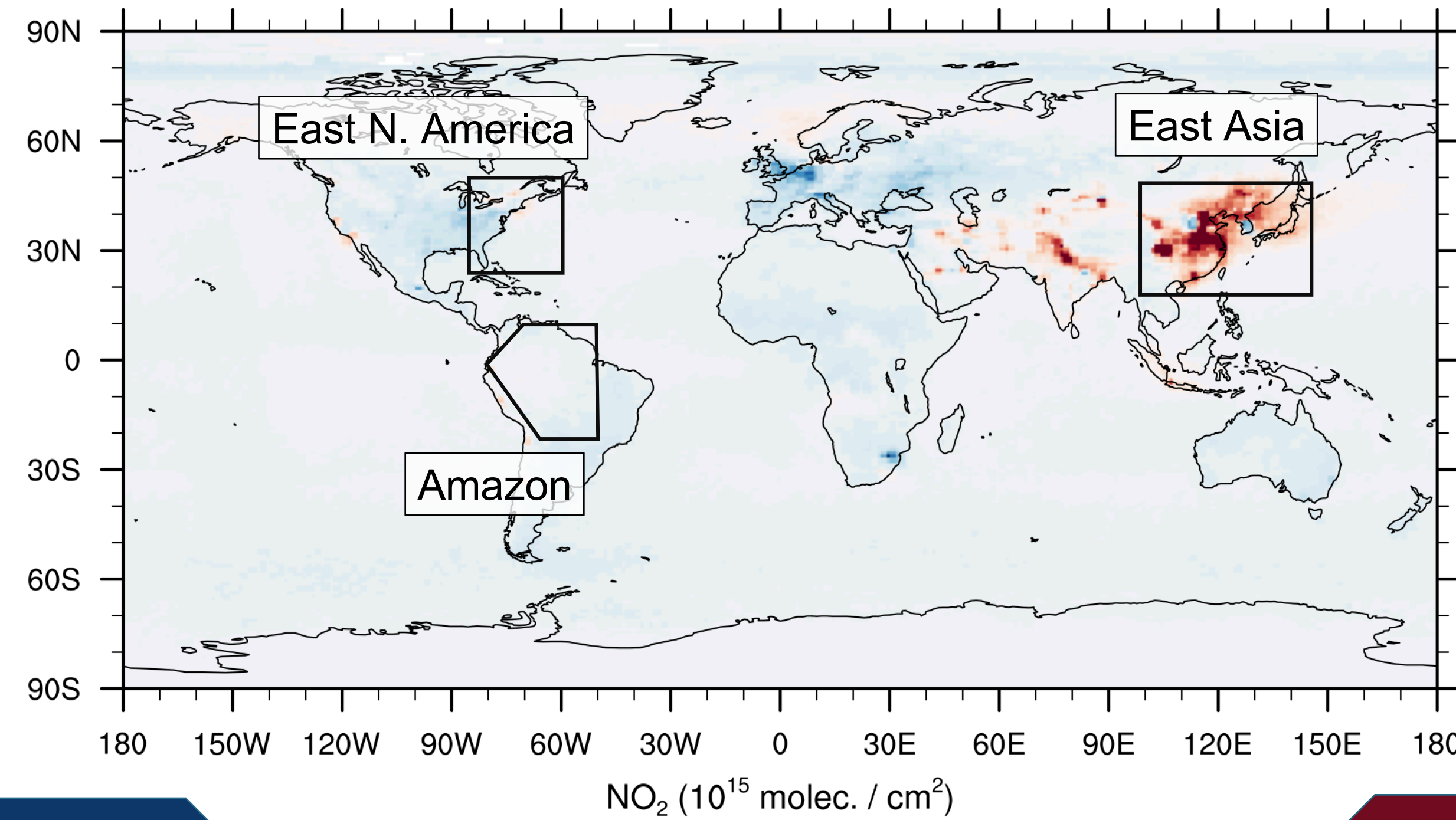
- OMI satellite data was gridded to the 1×1.25 degree grid of the GFDL AM4 model
- The averaging kernel from the OMI satellite was applied to the
- We compared 36 months of data: **January 2013 – December 2015.**



How does the model compare to the satellite?

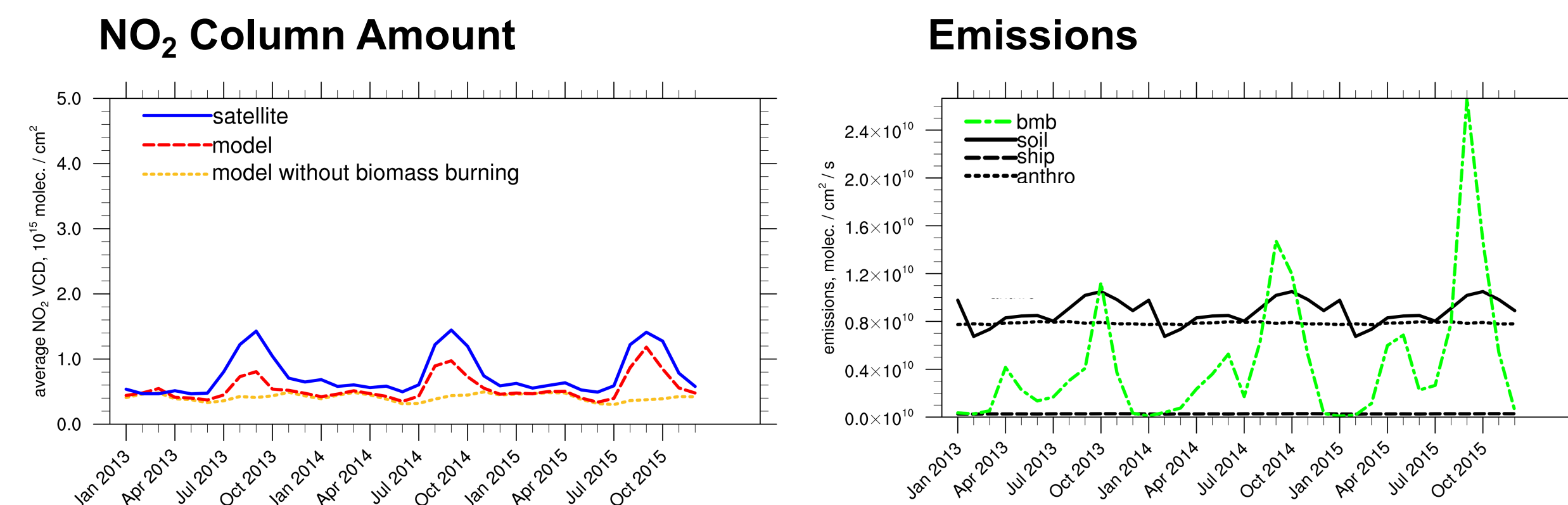
- Model bias varies by region and season.
- Model captures seasonal cycle well in biomass-burning regions.
- Model exaggerates seasonal cycle in anthropogenic regions.

AM4 Model - OMI Satellite, Average 2013-2015

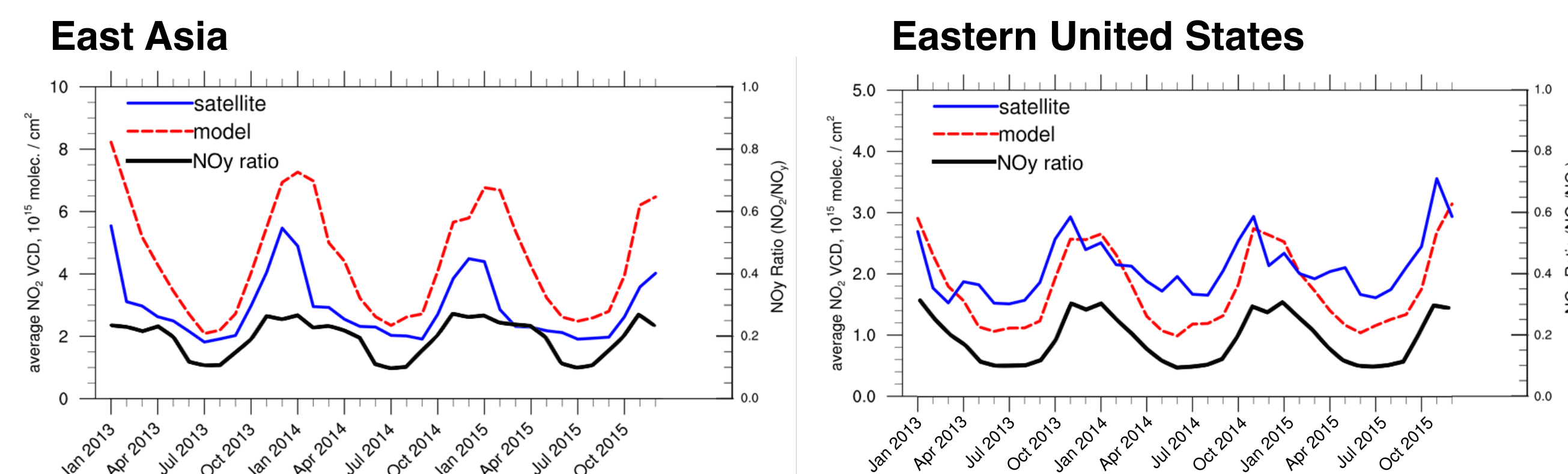


What controls the seasonal cycle of NO_2 ?

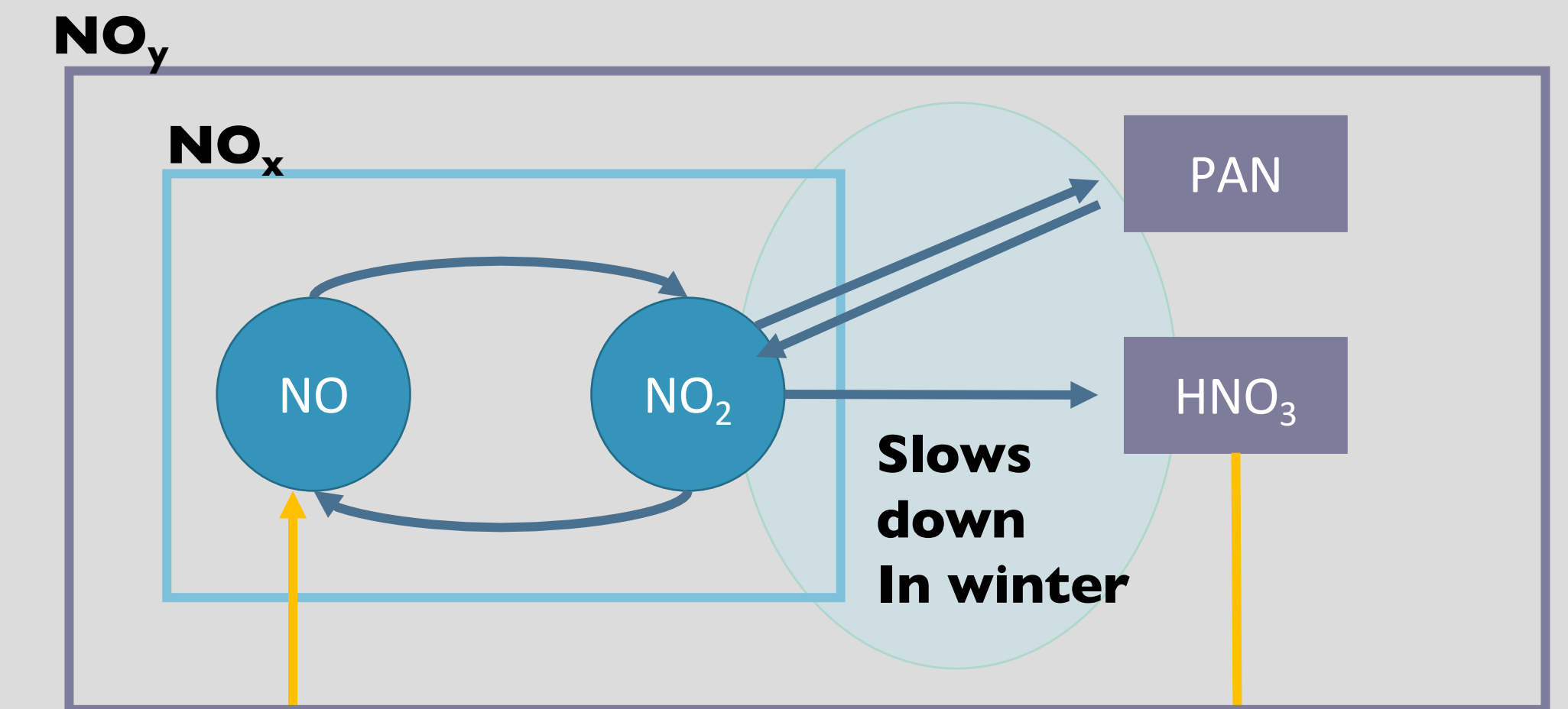
- In regions dominated by biomass-burning emissions, these emissions control the seasonal cycle.



- In regions dominated by anthropogenic emissions, seasonal changes in chemistry control the seasonal cycle



How does NO_x chemistry change in the winter?



- Reactions from NO_2 to NO_y slow down in the winter
- This causes NO_2 to build up to higher concentrations in the winter
- This chemistry controls the seasonal cycle in biomass burning regions.

What's next?

- Extend analysis to **10 years**
- Compare with additional observations
 - GOME-2**, overpass at 9:30AM
- Long term questions:
 - How do NO_x lifetimes vary spatially and temporally?
 - How do these loss pathways affect NO_x lifetimes?
 - How do NO_x lifetimes affect lifetimes of other tropospheric pollutants?

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Citations

- Caiazzo, et al. (<http://doi.org/10.1016/j.atmosenv.2013.05.081>)
- Tropospheric Emissions Monitoring System (<http://temis.nl/airpollution/no2.html>)
- NOAA Geophysical Fluid Dynamics Laboratory AM4 – currently under development. (AM3 is available here: <https://www.gfdl.noaa.gov/am3-model/>)
- Oberman, Maki, Scotty, Holloway, and Jin, Wisconsin Horizontal Interpolation Program for Satellites 2.0 (<https://nelson.wisc.edu/sage/data-and-models/software.php>)