# Methane from high latitude North America: the view using atmospheric observations

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# Outline

- How have estimates of wetland methane fluxes evolved over time?
- What can atmospheric towers tell us about the big picture across Canada and Alaska?
- Methane fluxes from Canada and Alaska in a global context.

# Evolving knowledge

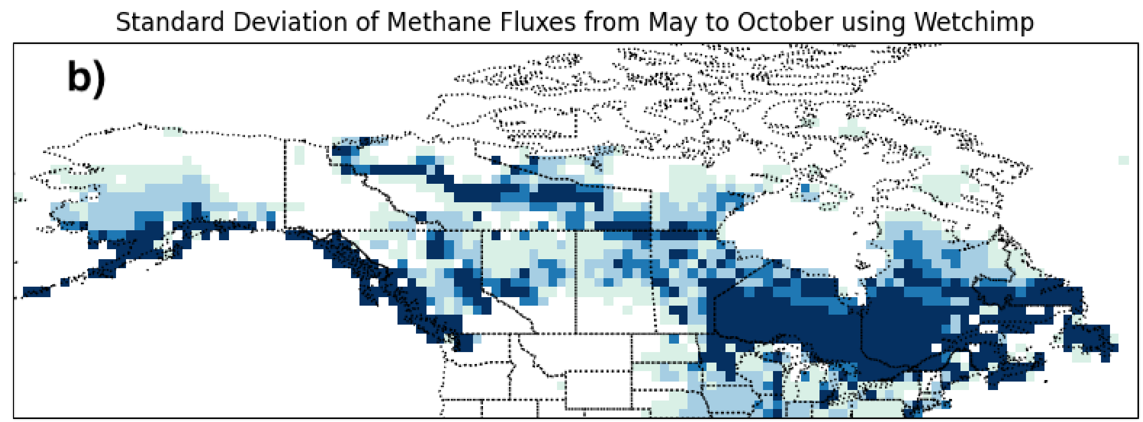
**Challenging to model methane fluxes from high latitudes:**

- Landscape heterogeneity
- Limited observations of fluxes & environment
- Complex processes/mechanisms

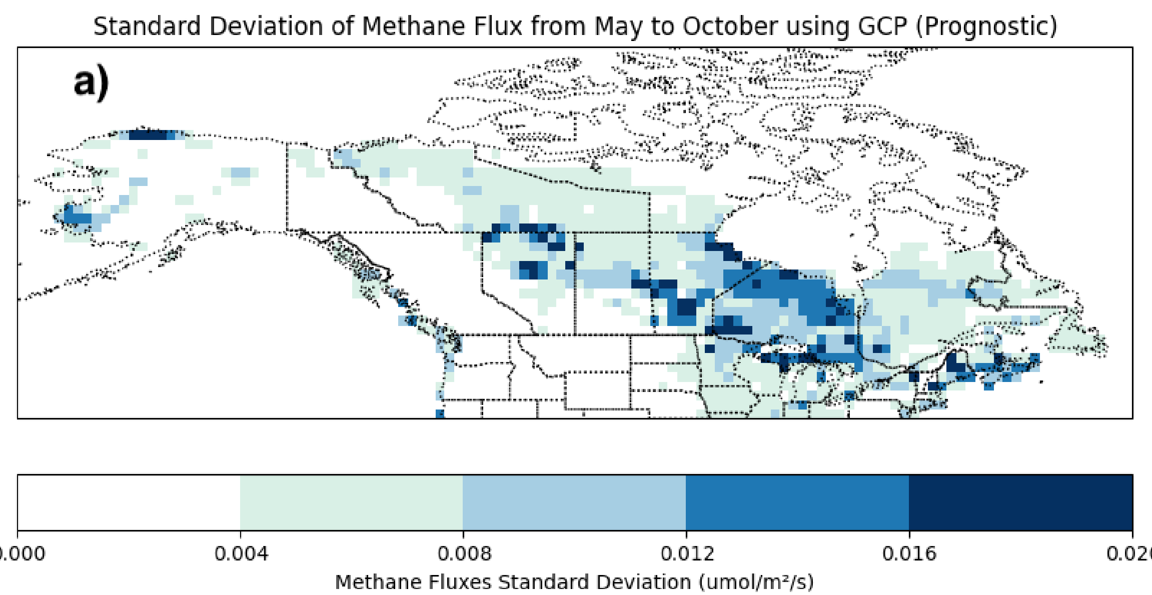
# Evolving knowledge

- Inter-model uncertainty much lower than it was!
- And in a good way! (Stay tuned.)

WETCHIMP (2013)




New GCP ensemble (2024)

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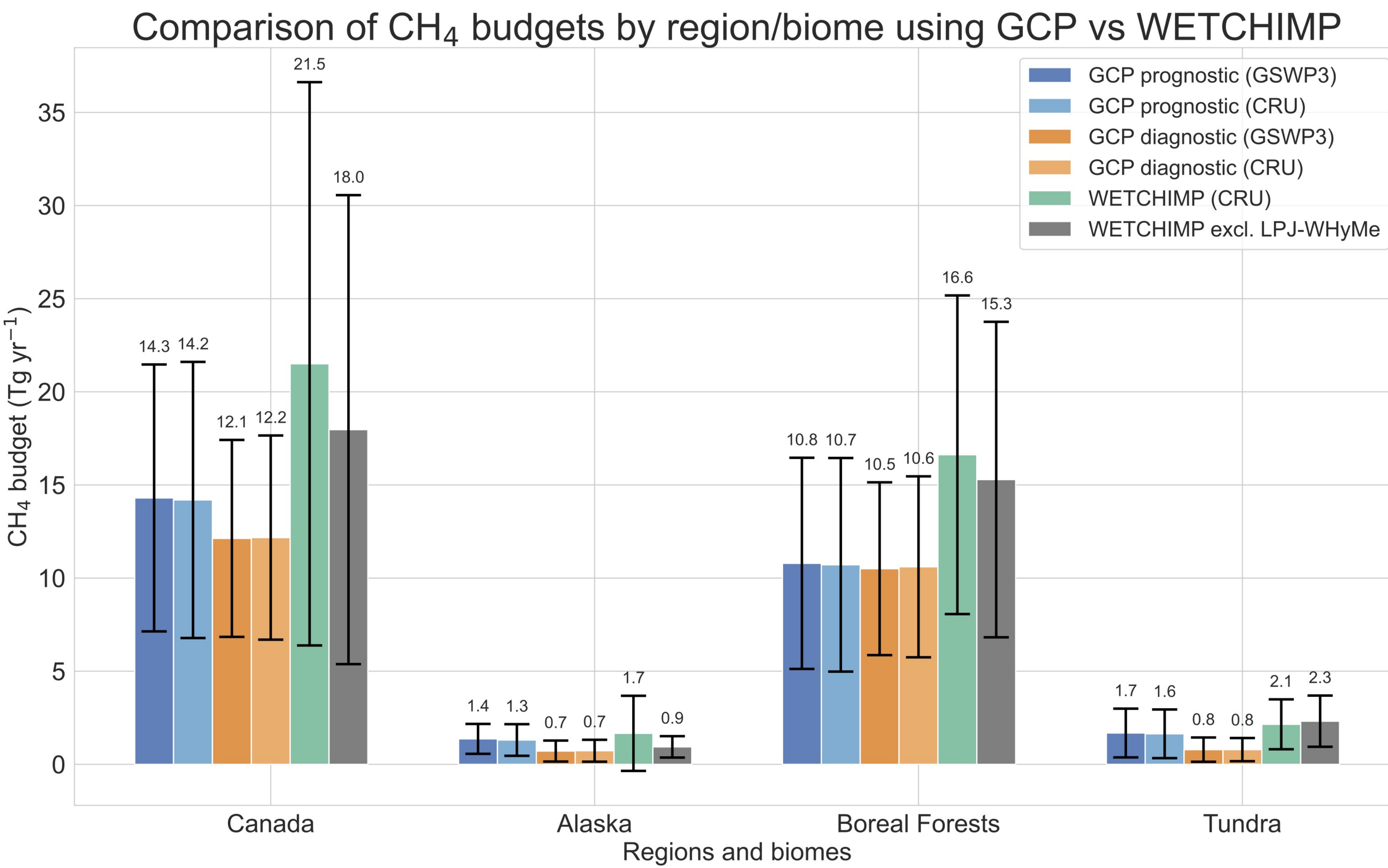
# Evolving knowledge

- Fluxes in GCP models much smaller than WETCHIMP.

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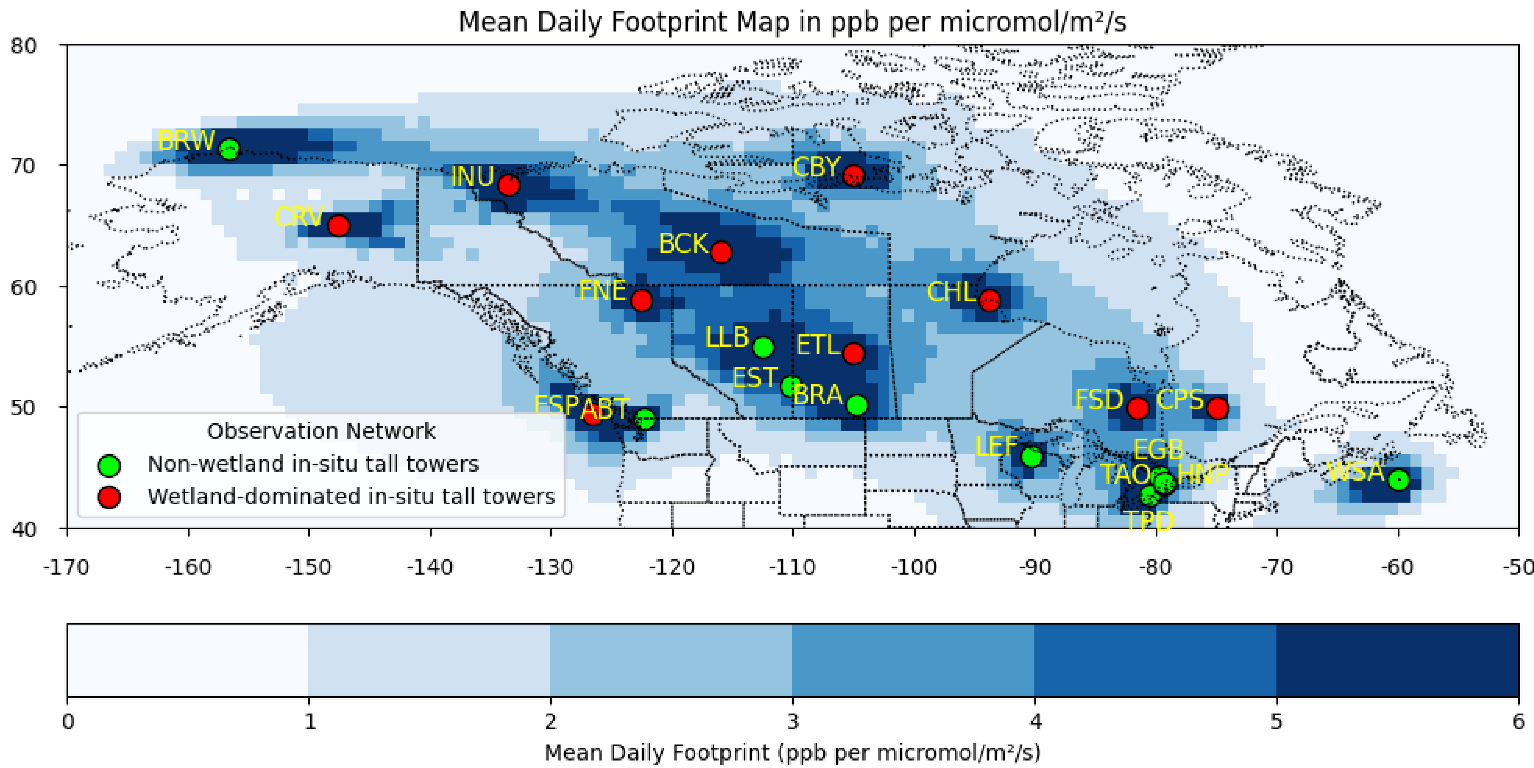
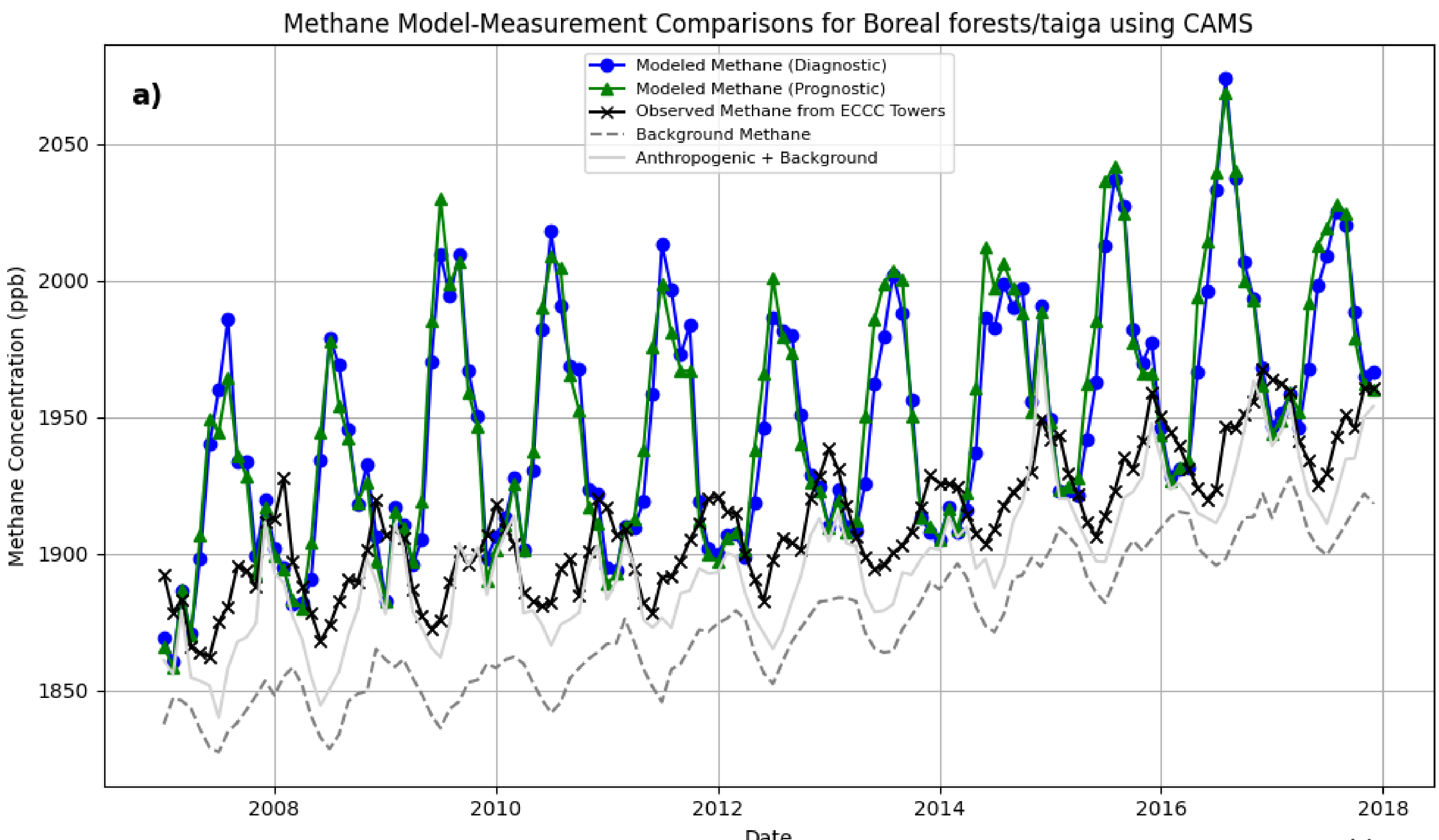
# The big picture from atmospheric obs.

- **Question**: how can we further improve estimates of wetland methane fluxes?
- Towers (early 2000s – present)
- WRF-STILT: will model methane in the atmosphere given a flux estimate.

# The big picture from atmospheric obs.

- GCP models have smaller magnitude than WETCHIMP … but still larger than implied by atmospheric obs.
- Models with complex structure often have larger magnitude (i.e., models with ebullition, diffusion, or plant-mediated transport).
- But we also see different results in different regions ….

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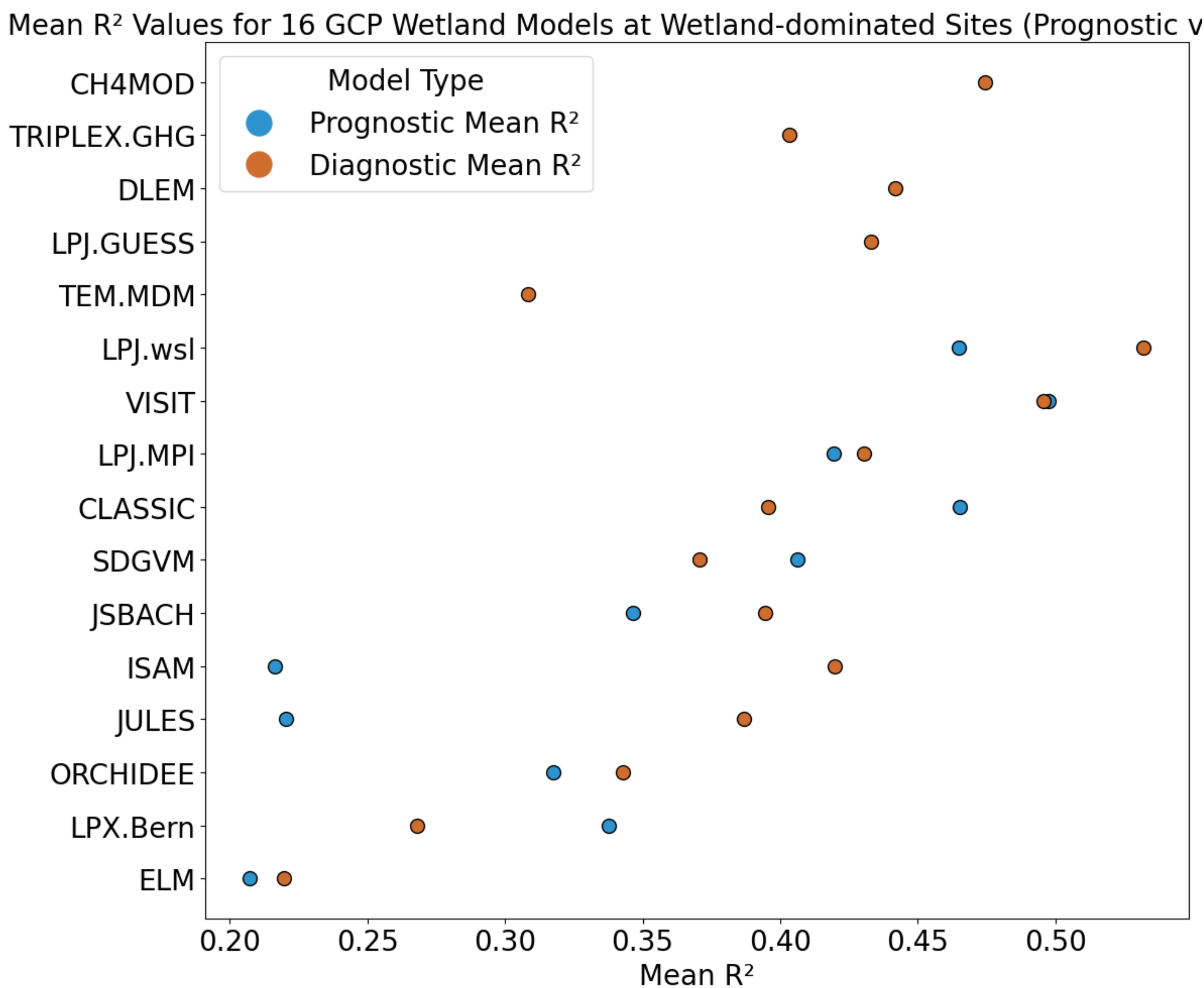
# The big picture from atmospheric obs.

- Next, let's explore the correlation between the obs vs methane modeled with different GCP models.
- We group models into high, med, and low $R^2$ groups.

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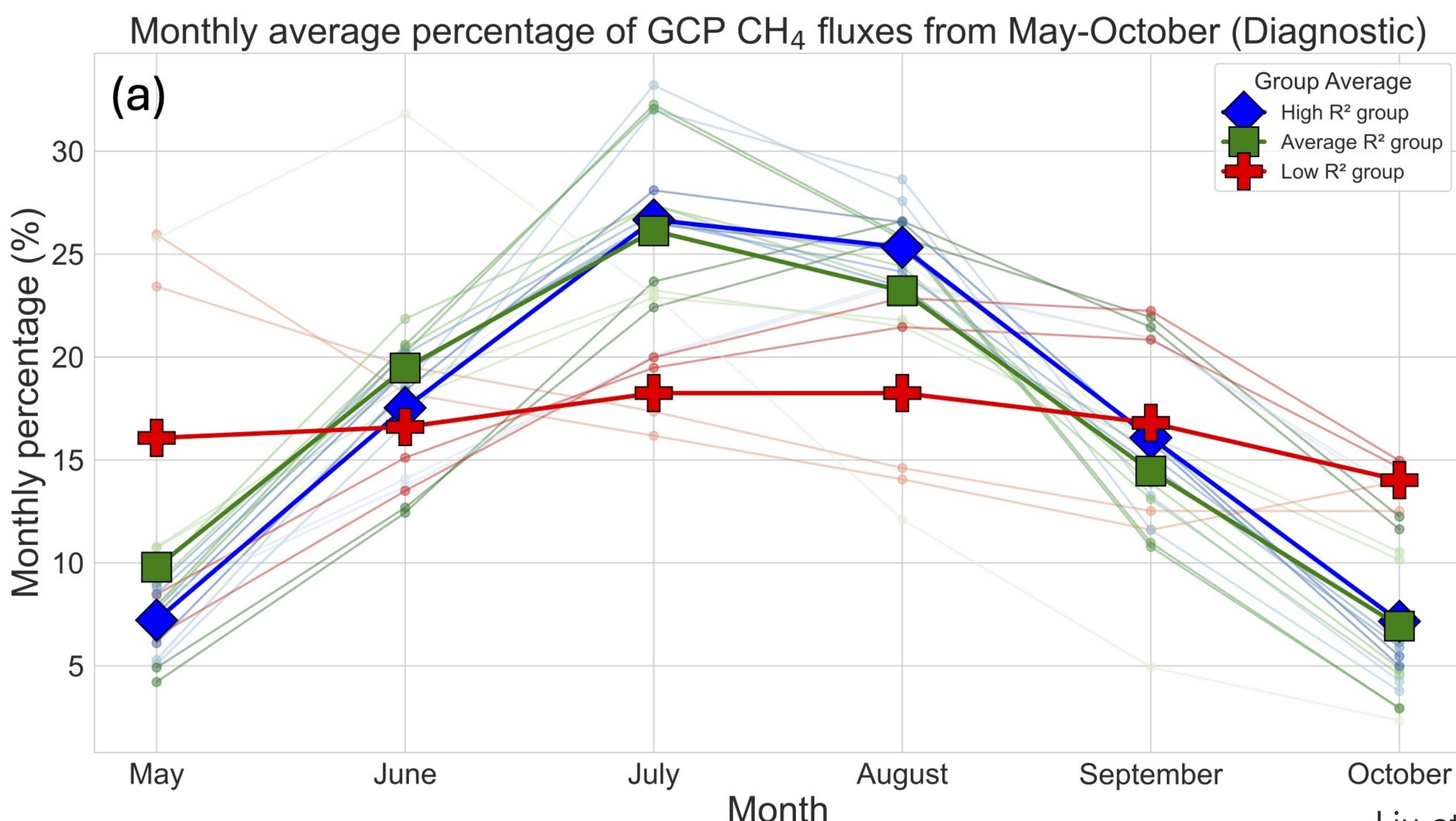
# The big picture from atmospheric obs.

- Skillful models have larger seasonal amplitude with peak in July or Aug.
- Prognostic version of each model has similar seasonality & magnitude as diagnostic version – inundation not driving disagreements among models.
- Models with smallest seasonal amplitude have small $Q_{10}$ values.

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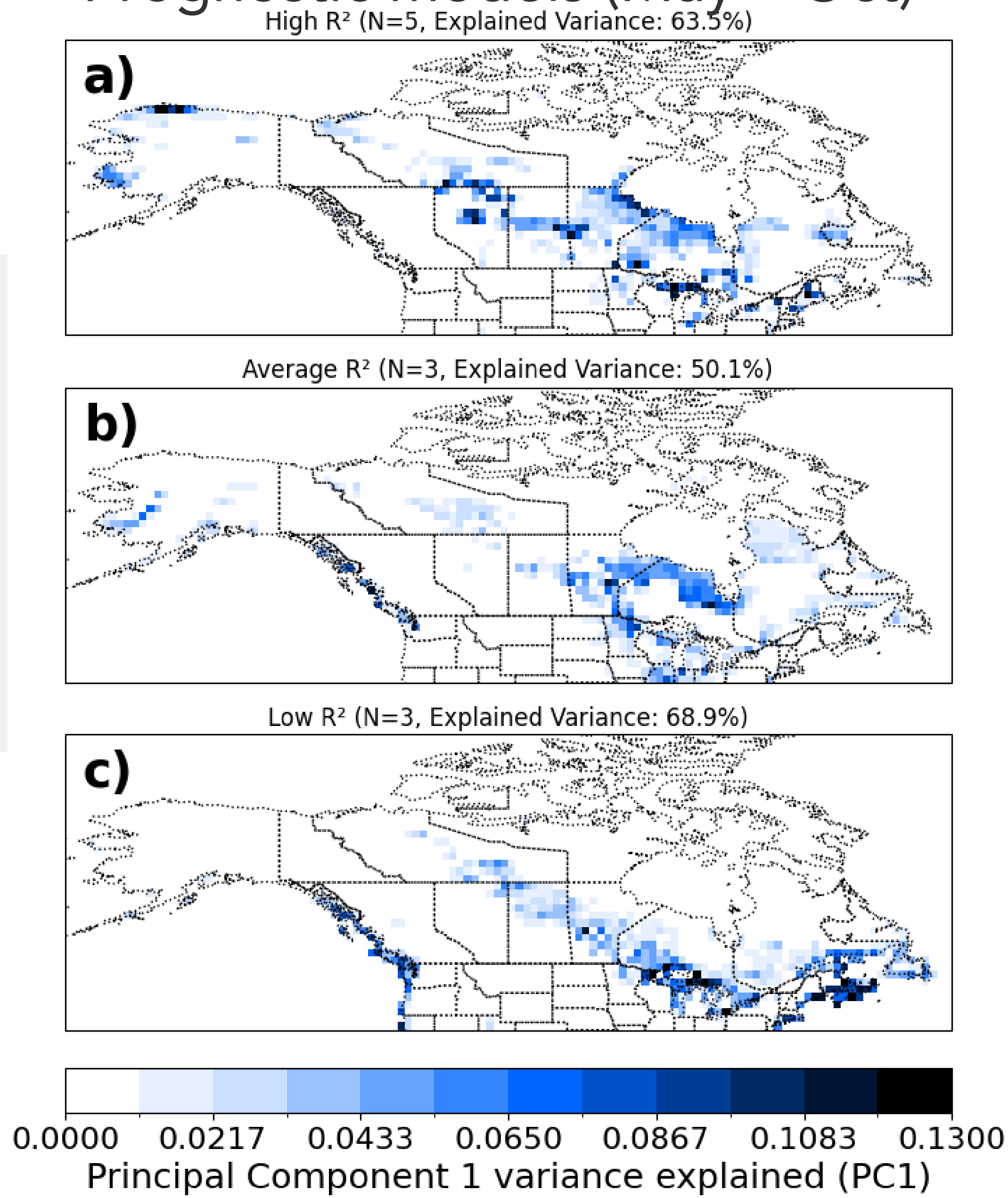
# The big picture from atmospheric obs.

- Skilled models concentrate fluxes in HBL and south of Great Slave Lake.
- Other models emphasize more southerly regions.

Prognostic models (May – Oct)

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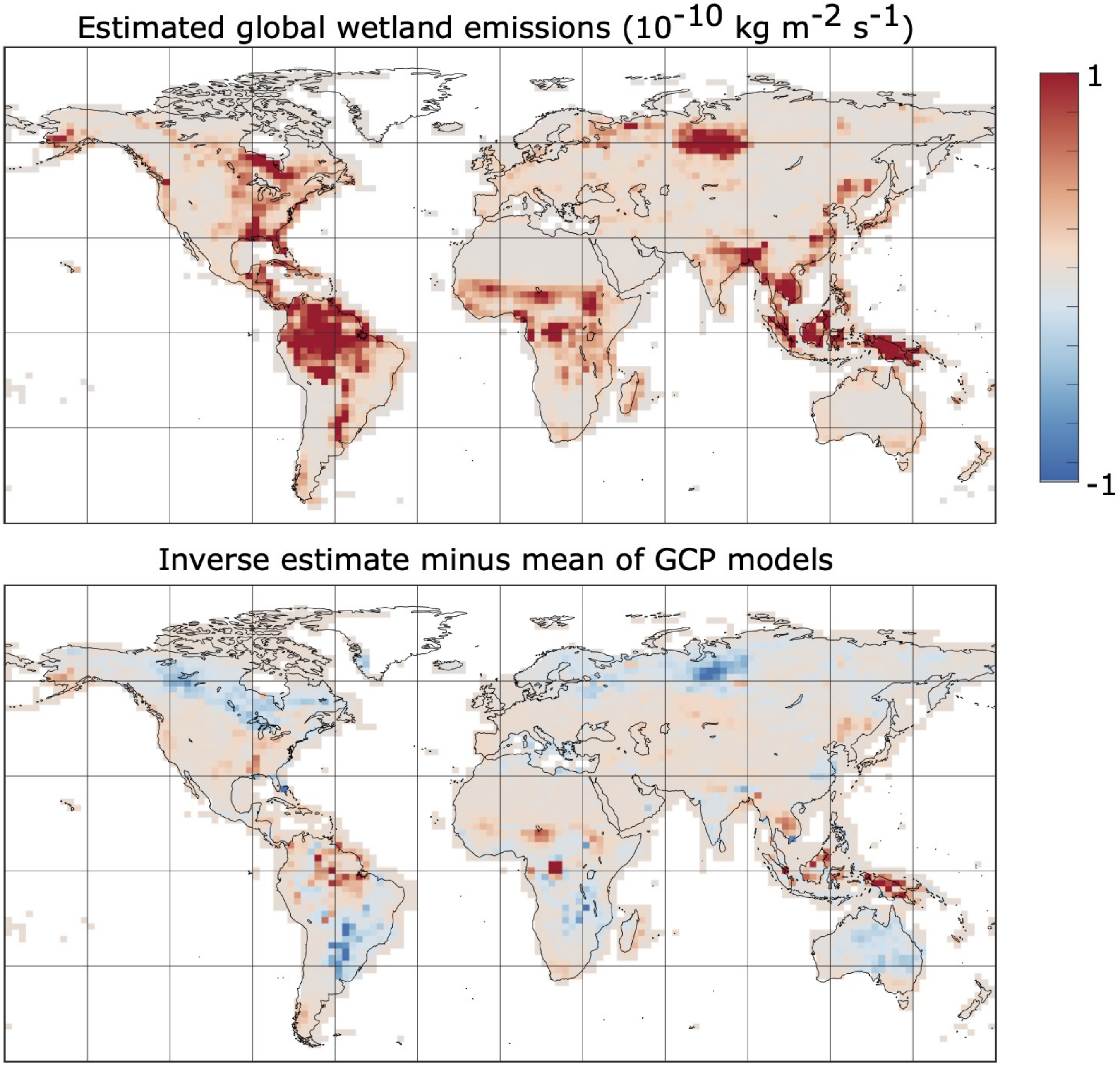
# Global context

- Let's zoom out for better global context on these results.
- Inverse model for years 2018 – 2020 using TROPOMI obs.

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# Next steps

**Take-aways:**

- **Progress**: Process methane models are converging – and so are comparisons with atmospheric observations!
- **Continued challenges**: greater model complexity can mean greater magnitude.
- **Next steps**: Zoom in using intensive aircraft data.

# Thank you!

# Questions?