

Evaluating Models of Wetland CH₄ Emissions: How Believable Are Simulations of Future Emissions?

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An important challenge for predicting the future evolution of the global climate is representing feedback processes. One such feedback involves methane emissions from wetlands. Vast stores of carbon in the Arctic may thaw over the next centuries, and it is important to understand how wetlands will evolve over time; will the warmer temperatures lead to more CH₄ emissions, or will the wetlands drain as permafrost thaws? Changes in precipitation and land use in the tropics and mid-latitudes may also lead to significant changes in emissions, shifting the balance between respiration of CH₄ and CO₂.

Modeling CH₄ emissions from wetlands is a complicated problem since even the distribution of wetlands is subject to much uncertainty and is treated in a variety of ways in current CH₄ emission models. Nutrient cycling and small-scale processes must also be represented at scales that are large enough to be interpreted at global scales. Ultimately, confidence in models that couple greenhouse gas emissions with climate models should be dependent on the ability of the emission models to reproduce the current observed spatial distribution and variability. Global network and campaign data are critical to evaluation of bottom-up emission models. Multiple decades of surface network observations exist and provide metrics that wetland models should be able to reproduce such as the seasonal cycle, trends, gradients and inter-annual variability. Although models are commonly tested and even calibrated to flux tower data, the atmospheric observations provide an important check on how modeled emissions are represented regionally and globally. Ultimately, if models are unable to reproduce observed variability, it is unlikely that they can be expected to reliably reproduce future variability in CH₄ emissions.

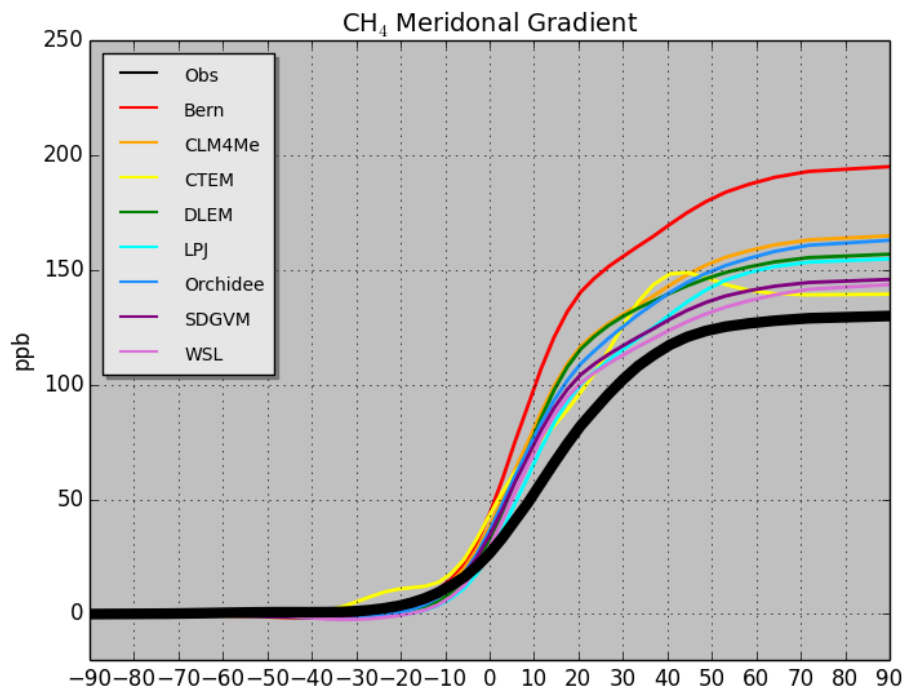


Figure 1. The observed and simulated North-South gradient of CH₄ relative to the South Pole. The thick black curve shows the zonal average marine boundary layer sites, and the colored curves show simulations sampled identically to the observations for a suite of wetland models.