(79-240418-C) **Advancements in Bottom-up Estimates of Global Wetland CH 4 Emissions to Support Atmospheric Chemistry Transport Modeling**

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Wetlands are the largest natural source of atmospheric methane (CH4), responsible for around 30% of total surface CH4 emissions. However, uncertainties in estimating these emissions pose significant challenges for understanding their variations over time and space, and for the scientific community to monitor surface CH4 emissions from space. To grain quantitative understanding of these challenges, we conduct a comprehensive review of recent advancements, validations, and applications in bottom-up estimates of global wetland CH4 emissions. These estimations employ diverse methodologies, including empirical modeling, process-based modeling and data-driven machine learning, and hybrid modeling. Then we showed the GEOS-Chem transport modeling results to highlight large uncertainty stemming from wetland CH4 emissions on the seasonality of atmospheric CH4 concentration. To move forward, we suggest continuous, long-term surface measurements in representative wetland areas, coupled with high-fidelity wetland mapping and an appropriate modeling framework, as essential steps to enhance bottom-up estimates of wetland CH4 emissions.

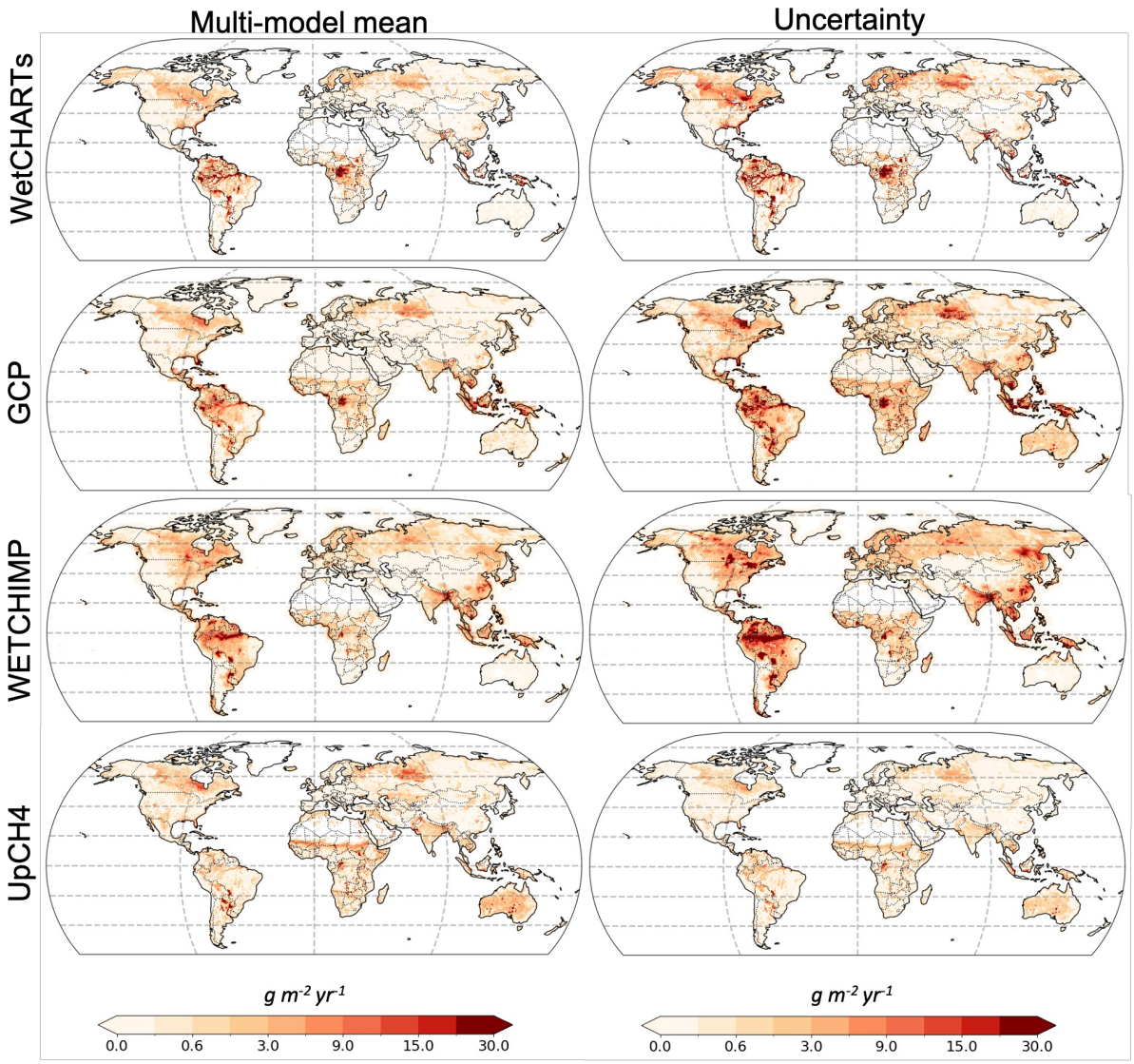


**Figure 1.** Spatial distributions of prevailing bottom-up inventories of wetland CH4 emissions, in terms of multi-model ensemble mean and uncertainty (95 percentile minus 5 percentile across all ensemble members).