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Assessing the Impact of Climate Change on Global Wetland Extent using CMIP6 multi-model analysis.

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Wetlands play a crucial role in the Earth's system, interacting with various processes such as the hydrological cycle, energy and water exchange with the atmosphere, and global nitrogen and carbon cycles. However, the historical extent of wetlands has suffered significant losses, primarily driven by human activities, particularly in Europe, North America, China, and Southeast Asia. Because of their remote locations, northern Canada and Siberia remain relatively untouched, while South America and Central Africa face current threats. The future trajectory of wetlands is anticipated to be influenced not only by direct human actions but also by climate change. Here we present our assessment of climate-driven global change in wetland extend, focusing on the main wetland complexes. We used an approach based on the Topographic Hydrological model (TOPMODEL), and soil liquid water content projections from 14 models of the Coupled Model Intercomparison Project phase 6 (CMIP6). Our analysis reveals a consistent decrease in wetland extent in the Mediterranean, Central America, and Northern South America, with a substantial long-term loss of 28% in the western Amazon Basin under high radiative forcing (SSP370). Conversely, Central and Western Africa exhibit an increase in wetland extent, excluding the Congo Basin. Nevertheless, most of the area studied (80%) presents uncertain results, due to conflicting projection of changes between the models. Notably, we show that there is significant uncertainty among CMIP6 models regarding liquid soil water content in high latitudes, due to permafrost representation and its thawing. By narrowing our focus to 10 models that seem to best represent the thawing of permafrost, we find modest decline in the overall global area (< 5%), yet significant spatial diversity, with better model agreement. Beyond 50°N, long-term losses of 13% are noted globally, with specific areas like the Hudson Bay Lowlands experiencing a 21% decrease and the Western Siberian Lowlands a 15% decrease under high radiative forcing.