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Role of wetland methane emissions under paleoclimatic conditions

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Methane is the second most important green house gas after CO2 and a key tracer in atmospheric chemistry. Perhaps even more important than today, methane possibly played a crucial role in past climates particularly for interglacial-glacial changes. In the present study, we explore the role of wetlands, the most dominant natural source of atmospheric methane and a possible instigator behind paleo climatic changes. Wetlands are highly climate sensitive methane source and involves intimately in a positive climate feedback loop. Low ice core methane records during Last Glacial Maximum (LGM) could largely be explained by wetlands as its distribution was completely different from present day. Similarly the abrupt cooling during mid-miocene and at Eogocene-oligation transitions cannot be explained only by CO2 feedback and could be attributed to methane variability by wetland source. We developed a parameterization for wetland methane emissions at these different time periods that is coupled to the chemistry climate model ECHAM5-MOZ. The parameterization uses four basic drivers from CARAIB, a dynamic vegetation model particularly adept for paleo-simulations: soil water, soil temperature, carbon content and terrain slope. The parameterization was tested with high resolution data for the present day and adapted for coarse resolution simulations that are affordable for paleo climate runs. The model results are evaluated in comparison with ice-core data and observations from the NOAA-CMDL flask network. We discuss the uncertainties of our model simulations and will try to quantify the potential role that wetland methane emissions could have played in extreme climatic events of the past. Keywords: Methane; Wetland emission; Last Glacial Maximum, Eogocene-oligation; ECHAM5-MOZ climate model; Paleo climate simulations, CARAIB vegetation model; soil water content; soil temperature; carbon content