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Methane emission from wetlands and its role in present day and paleoclimate

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Methane is the second most important green house gas after CO2. Today, among all the natural and anthropogenic sources of methane, wetland emission is the single largest source and represents ∼20-45% of total emissions (∼500 Tg). Even under preindustrial conditions methane emission from wetland contributed mainly to a large share of atmospheric methane concentration. The location of wetlands and its role in the global methane budget at Last Glacial Maximum (LGM) was also different from the present day. Despite their importance, considerable uncertainties exist in the quantification of current wetland emissions as well as their distribution on the global scale. The wide spectrum of vegetation covers and hydrological regimes in the wetland characteristics make it difficult even to define wetlands unanimously. In order to specify wetland emission in a chemistry climate model like ECHAM5-MOZ that would also be used in paleo-simulations, a simplified parameterization is needed. Here we present our work on the development of such a wetland emission model in combination with the modeling of global wetland areal extent at a seasonal scale. In the first step, high resolution land cover data of terrain elevation gradient is used along with soil water content from CARAIB dynamic vegetation model to identify potential wetlands in the present-day climate. For both of these parameters, a set of threshold values favorable for potential wetland formation are defined (separately for northern latitudes and tropics) after comparison with available global wetland maps. This rapprochement leads to a well constrained potential global wetland map for the present day as well for paleoclimate modeling where the input data are available in coarser resolution. Comparison of our results of modeled wetland area and its seasonality with available observational studies at different regions show the suitability of our modeling approach. In the next step, soil temperature and available decomposable carbon are used to parameterize the strength of methane emissions for the potential wetland areas. The new wetland emission model will be used to obtain the atmospheric concentration of methane in present and paleoclimate in a series of comprehensive chemistry climate simulations with ECHAM5-MOZ.

Keywords: Methane; wetland emissions; present day; paleoclimate; ECHAM5-MOZ climate model; slope gradient; soil water content; CARAIB; soil temperature; decomposable carbon.