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Responses of global soil methane consumption to changes of climate, land-use and land-cover, and atmospheric chemistry deposition during the 20th century

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Great uncertainty of net methane exchanges between the atmosphere and biosphere limits the capability of the Earth system models in projecting climate changes. More accurate quantification of methane consumption is needed as methanotrophy, next to atmospheric hydroxyl oxidation, plays a vital role in determining the atmospheric methane concentrations. Here we use a process-based biogeochemistry model, the Terrestrial Ecosystem Model (TEM), to conduct a series of factorial simulations considering effects of changes of climate, land-cover and land-use, atmospheric methane concentrations, and atmospheric chemistry deposition on soil methane consumption on the globe. With an assumption of no land-use change and constant atmospheric methane concentrations, we estimate that the global soil consumption is 35 Tg CH_4 yr^{-1} in the 1990s and the consumption rate has increased 0.01 Tg CH_4 per year during the last century. Our factorial simulations indicate that the changes of climate, land-use and land-cover, and atmospheric deposition alter the capacity of methanotrophs. When factoring these influences into our future global methane budget quantification, the roles of methane in atmospheric radiative forcing and chemistry should be re-evaluated.