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Quantifying the methane atmospheric concentration during the warm and wet climate of the Middle Miocene Climatic Optimum (17-15 Ma)

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The warm periods, as the Cenomanian, the Eocene or the Middle Miocene correspond almost always to a very weak Equator to Pole thermal gradient. Recent studies demonstrate that it was possible to simulate the Middle Miocene climate (17-15 Ma) using atmospheric CO_2 around 2 PAL (1PAL = 280 ppm) (Krapp and Jungclaus, 2011; Hamon et al., accepted). However, these estimates are in disagreement with the reconstructions from marine sediments (13C, Bore) that suggest a much lower atmospheric CO_2 (Pagani et al., 1999; Hendericks and Pagani, 2007; Pearson and Palmer, 2000).

Here we investigate an alternative view which is to explore and quantify the methane concentration in the atmosphere. In fact, during the warm and wet climate of the Middle Miocene Climatic Optimum (MMCO), the sources of methane could have been much larger than during the preindustrial period and could have lead to larger concentrations that the one commonly used to perform the MMCO modelling experiments. To get a first order value of the change in methane sources in such a climate, we perform a realistic MMCO experiment using coupled atmosphere-ocean general circulation model (FOAM). Sensitivity tests on the CO_2 concentration have been performed. Then we use the simulated climate fields to drive a global vegetation model (SDVGM) and simulate the wetland methane emissions.

The key question is therefore:
Is it possible that methane plays a role and explains the apparent disagreement between the low value of CO_2 as described by the data and the high radiative forcing necessary in the model to explain the vegetation distribution reconstructed by pollen data and megafloras?

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