Orbital forcing of wetland methane feedbacks during Paleogene greenhouse climates

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Despite the importance of methane as a greenhouse gas there are no direct or proxy methods to reconstruct its concentration in ancient atmospheres, previous to the interval where ice cores are available. Evaluations of this critical component of the climate system are availible only via estimations of ancient sources and sinks of methane through geologic time. One of the main, and variable, sources of methane is emissions from wetlands, which are sensitive to environmental conditions such as pCO_2, temperature and precipitation. As such, wetland methane emissions could be an important feedback, especially in the warmer, greenhouse worlds of the Paleogene.

Here we take a coupled model approach, utilising an advanced three dimensional modelling stategy, coupling a global climate model (HadCM3L) with an updated vegetation model (SDGVM). Our new model results confirm that wetland methane emisisons are higher during greenhouse climates and reveal that they are sensitive to boundary condition changes, particularly at high latitudes. They also reveal that methane emissions vary with orbital parameters, due to a combination of high latitude temperature and hydrological forcing, giving a possible route for the amplification of orbital signals into large climate variability during the largely ice-free Paleogene.