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Methane feedbacks to the global carbon cycle in a warming climate – combining microbial and geochemical perspectives. Methane feedbacks to the global ca

Albertus J. (Han) Dolman (1), Joshua Dean (1), Rien Aerts (2), Luke Blauw (2), Mathias Egger (3,4), Mike Jetten (5), Anniek de Jong (5), Ove Meisel (1), Olivia Rasigraf (5), Thomas Roeckmann (6), Caroline Slomp (3), Michiel in 't Zandt (5), and Jack Middelburg (3)

(1) Vrije Universiteit Amsterdam, Earth Sciences, Amsterdam, Netherlands (han.dolman@vu.nl), (2) Vrije Universiteit Amsterdam, Systems Ecology, Amsterdam, The Netherlands, (3) Department of Earth Sciences-Geochemistry, Utrecht University, Utrecht, The Netherlands, (4) Center for Geomicrobiology, Aarhus University, Denmark, (5) Department of Microbiology, Radboud University Nijmegen, Nijmegen, The Netherlands, (6) Institute for Marine and Atmospheric Research, Utrecht University, Utrecht, The Netherlands

Atmospheric methane (CH4) concentrations are increasing again following a brief plateau between 1999 and 2006. CH4 is produced in many natural systems that are vulnerable to change under a warming climate, yet current CH4 budgets are not well constrained, let alone potential future shifts in CH4 emissions. Climate change has the potential to increase CH4 emissions from critical systems such as wetlands, permafrost, marine and freshwater systems, and methane hydrates, through shifts in temperature and hydrology, vegetation and landscape disturbance, and sea level rise. Increased CH4 emissions from these systems will in turn induce further climate change, forming a positive climate feedback.
Here we synthesize both biological and physically focused CH4 climate feedback literature, bringing together the key findings of these disciplines, something that has previously been missing at the global scale. We discuss environment-specific feedback processes (e.g. wetlands vs. methane hydrates), including the microbial, physical and geochemical inter-linkages and the timescales they operate on, to present the current state of knowledge on CH4 climate feedbacks in the immediate and distant future.
We will discuss the important linkages between microbial activity and climate with the aim to better constrain the sensitivity of the CH4 cycle to the future climate change.
From our synthesis, we determine that while higher emissions from wetlands will form the majority of the CH4 climate feedback up to 2100, beyond this timescale CH4 emissions from marine and freshwater systems and permafrost environments will be more important, alongside the potential for large CH4 emissions from destabilised methane hydrates. Our key findings highlight the current lack of understanding of whether CH4 consumption can counter balance CH4 production under future climate scenarios.