Persistent Changes in the Global Methane Cycle Under Aggressive Mitigation

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Abstract

To achieve the goals under the Paris climate agreement comprehensive mitigation of greenhouse gas emissions is required. In this effort methane can play a crucial role. It is imperative that our understanding of the global methane cycle is improved substantially in order to deliver robust climate projections and assessments of multi-gas mitigation strategies. In this work we simulate the global methane cycle fully interactively over the period 1850-2100, including a Shared Socioeconomic Pathway with strong mitigation action (SSP1-2.6). For these ensemble simulations we apply the methane emission-driven configuration of UKESM. We show that under SSP1-2.6 the atmospheric methane burden recovers to almost pre-industrial levels, but wetland methane emissions show a persistent upward trend from 166 $Tg(CH_4)$ yr^{-1} in the 1850s to 221 $Tg(CH_4)$ yr^{-1} in the 2090s. Similarly, the atmospheric methane lifetime exhibits a persistent downward trend from 9.3 to 7.3 years. We identify the trend in net primary productivity as the dominant driver behind the trend in wetland methane emissions, with a pattern correlation coefficient of 0.7. Significantly, our work demonstrates that important components of the global methane cycle such as wetland methane emissions and the methane lifetime are subject to feedbacks in the Earth system which elude methane mitigation action. Therefore, future methane mitigation strategies will need to take into account feedbacks in the Earth system.

Early Career Scientist

NO, I am not an early career scientist.