Geophysical Research Abstracts
Vol. 21, EGU2019-12391-1, 2019
EGU General Assembly 2019

Determining the imprint of Heinrich stadials and Greenland stadial/interstadial cycles on the latitudinal distribution of methane sources using the inter-polar methane difference from the WAIS Divide and GISP2 ice-cores

Jon Edwards (1), Edward Brook (1), James Lee (1,2), Christo Buizert (1), Benjamin Young (), and Jenna Epifanio ()

(1) College of Earth Ocean and Atmospheric Sciences, Oregon State University, Corvallis, USA (jedwards@oregonstate.edu), (2) Los Alamos National Laboratory, Los Alamos, USA

Ice core records of atmospheric methane show that on orbital and millennial timescales methane closely follows changes in Greenland temperature, presumably driven by variations in tropical precipitation/hydrology. Over the last glacial period, warm events referred to as Greenland Interstadials (GI), noted in Greenland ice core $\delta^{18}O$ records and other global climate archives, are characterized by a coeval rise in atmospheric methane. At the onset of these events methane rises by 50-300ppb from Greenland Stadial (GS) concentrations. In addition to the GI/GS methane variations, there are distinct, though smaller, increases in methane during Heinrich Stadials 1, 2, 4 and 5. These Heinrich Stadial features in the methane record are unique as there is no coeval change in Greenland water isotopes.

Using the Inter-Polar Difference (IPD) of atmospheric methane, we investigate these periods and determine how latitudinal source distributions change between GS/IS cycles, to test a hypothesis that the Inter-Tropical Convergence Zone, normally positioned north of the equator, shifted southward during Heinrich Stadials, causing an intensification of monsoons and tropical wetland methanogenesis in the southern hemisphere and drying in the northern hemisphere.

We measured high-resolution records of CH_4 from the GISP2 and WAIS Divide ice cores and calculated the IPD for the periods, GS 10 through GI 8 and GI 13 through GI 11. We also reanalyzed previous IPD measurements covering the LGM and Bølling/Allerød. For the first time, our records incorporate a correction for excess methane production associated with dust in Greenland cores. This correction implies an overall reduction in the IPD relative to previous studies. We furthermore resolve centennial-scale CH_4 variability in both records for the first time, greatly reducing chronological uncertainties.

We show that the tropical to boreal source ratio between GS and GI periods remains relatively constant, indicating a coeval response in both regions during a GS warming event. Heinrich Stadials by contrast are characterized by a significant increase in the tropical to boreal source ratio, suggesting a likely shut down the boreal sources and a potential increase in Southern Hemisphere or tropical sources.