Geophysical Research Abstracts
Vol. 16, EGU2014-7984, 2014
EGU General Assembly 2014

Continuous methane record of abrupt climate change 10-68 ka: sighting Heinrich events in the ice core record

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The Last Glacial period was punctuated by millennial scale abrupt climate changes − Dansgaard-Oeschger (D-O) cycles and Heinrich events. Controls on the magnitude and frequency of these climate perturbations, and how they may be inter-related, remain unclear. Specific problems include the difficulty of dating Heinrich sediment layers and local bias of key paleoclimate archives. We present a highly detailed and precise record of ice core methane (CH4), a globally integrated signal, which resolves climatic features in unprecedented resolution. Abrupt CH4 increases are resolved in Heinrich Stadials (HS) 1, 2, 4 and 5 where, in contrast to all D-O cycles, there are no concurrent abrupt changes in Greenland temperature. Using modern-day tropical rainfall variability as an analog, we propose that strong cooling in the North Atlantic severely restricted the northerly range of the Intertropical Convergence Zone (ITCZ), leading to an enhanced wet season over Southern Hemisphere tropical land areas, and consequently driving production of excess CH4 in tropical wetlands. Our findings place four Heinrich events firmly within ice core chronologies and suggest maximum durations of 778 to 1606 yr. CH4 anomalies are only associated with Heinrich events of Hudson Strait provenance, indicating that the tropical impacts of Heinrich events were not uniform.