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Similar response in δD(CH4) during Holocene, Eem, MIS 11 and antecedent terminations

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Methane (CH4) is the third most important greenhouse gas after water vapour and carbon dioxide (CO_2). Since the industrial revolution the mixing ratio of CH4 in the atmosphere rose to $\sim$1800 ppb, a value never reached within the last 800 000 years. Nowadays, CH4 contributes $\sim$20% to the total radiative forcing from all of the long-lived greenhouse gases. This CH4 increase can only be assessed compared to its natural changes in the past. Firn air and air enclosures in polar ice cores represent the only direct paleoatmospheric archive. The latter show that atmospheric CH4 concentrations changed in concert with northern hemisphere temperature during both glacial/interglacial transitions as well as rapid climate changes (Dansgaard-Oeschger events). Since the different sources of atmospheric methane exhibit distinct carbon and hydrogen isotopic composition (δ13CH4 and δD(CH4)) reconstructions of these parameters on ice cores allow to constrain individual CH4 source/sink changes. δD(CH4) also reflects water cycle changes as hydrogen of precipitation is traced into methane produced from wetland/thermokarst/permafrost systems (Bock et al. 2010, Science).

Using an improved technique (GC/P/irmMS) for analysis of δD(CH4) based on earlier developments (Bock et al. 2010, RCM) we produced high precision records for the penultimate termination and interglacial (marine isotope stages (MIS) 6 to 5) from the EDML (European Project for Ice Coring in Antarctica, Dronning Maud Land) ice core and for MIS 11 from the EDC ice core (European Project for Ice Coring in Antarctica, Dome Concordia). We compare our data sets with the last termination and the Holocene by means of own measurements and published records (Sowers 2006, 2010). The principle response of δD(CH4) is similar for the three investigated time periods which allows to identify main natural drivers.

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