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Interesting differences between CH4 and d18Oatm records of bipolar see-saw activity

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Abrupt changes in atmospheric methane concentration have long been used to infer changes in low-latitude hydrology. A lesser-used tracer is the oxygen-18 content of atmospheric dioxygen (d18Oatm), which is produced by photosynthesis and records the O-18 content of chloroplast water among other variables. Observations from ice core trapped air records suggest that strong Asian monsoons produce dioxygen with a relatively negative d18Oatm, whereas periods of weak Asian monsoon rainfall and strong southern hemisphere monsoons are characterized by relatively positive d18Oatm (Severinghaus et al., 2009, Science). Generally, CH4 and d18Oatm are anticorrelated, with high CH4 and negative d18Oatm during times of northern hemisphere warmth, strong Asian monsoons, and the bipolar seesaw in its "warm north" mode.

However, interesting exceptions to this pattern occur during Heinrich Stadials and during the initial phases of the last deglaciation. Here, ice core data suggest episodes in which CH4 rise is not associated with negative d18Oatm, but instead positive d18Oatm. It is suggested that these intervals can be explained as being times of strong southern hemisphere low-latitude rainfall, which creates the positive values in d18Oatm. We hypothesize that dioxygen produced in southern hemisphere locales generally has higher O-18 content, due to the higher O-18 content of chloroplast water and the prevailing precipitation O-18 in those regions. In summary, we hypothesize that d18O of photosynthetic O_2 is a more monotonic function of latitude, compared with methane production, which can be bimodally produced in the low latitudes of both hemispheres.