Geophysical Research Abstracts
Vol. 15, EGU2013-8605, 2013
EGU General Assembly 2013

Warm climate isotopic simulations: What do we learn about interglacial signals in Greenland ice cores?

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Measurements of last interglacial stable water isotopes in ice cores show that central Greenland $\delta^{18}O$ increased by at least 3 ‰ compared to present day. Current orbitally driven interglacial simulations do not show $\delta^{18}O$ or temperature rises of the correct magnitude, leading to difficulty in using only these experiments to help understand what might have raised interglacial $\delta^{18}O$. Here, analysis of greenhouse gas warmed simulations from two isotope-enabled general circulation models, in conjunction with a set of last interglacial sea surface observations, indicates a possible cause of the interglacial $\delta^{18}O$ rise. A reduction in the winter time sea ice concentration around the northern half of Greenland, together with an increase in sea surface temperatures over the same region, is found to be sufficient to drive a > 3 ‰ interglacial enrichment in central Greenland snow. We find that local sea surface warming and a shrunken sea ice extent can dramatically increase the proportion of water vapour from local (isotopically enriched) sources, compared to that from distal (isotopically depleted) sources. However, we also show that current uncertainty about last interglacial sea surface conditions leads to a wide range of possible interpretations (+4 to +14K) of last interglacial temperature from current Greenland $\delta^{18}O$ ice core measurements (Sime et al, accepted, QSR; Sime et al., in press, PAGES).