Geophysical Research Abstracts
Vol. 14, EGU2012-1029-1, 2012
EGU General Assembly 2012
© Author(s) 2011

Ice Core Measurements and GCM Simulation of the Spatial Distribution and Glacial-Interglacial Change of ^{17}O-excess in Antarctica

S. Schoenemann, Q Ding, E Steig, and A Schauer
Earth and Space Sciences, University of Washington, Seattle, WA, United States (schoes@uw.edu)

Stable isotope ratios of water in polar precipitation, as measured in ice cores, have been fundamental to the quantification of past climate variability and change. Recent development of techniques to measure the ^{17}O/^{16}O ratio precisely has allowed $^{17}O_{excess}$ to be added to the ice-core isotope toolbox. The combination of δ^{17}O with the conventional measurements of δ^{18}O and δD – giving the parameter $^{17}O_{excess}$ – provides valuable new information on the evaporative conditions of the oceanic moisture sources for Antarctic precipitation. We measured δ^{17}O and δ^{18}O from a number of Antarctic ice cores (West Antarctic Ice Sheet Divide, Siple Dome, Taylor Dome), and determined $^{17}O_{excess}$on modern, Holocene, and glacial timescales. These results, combined with the work of Landais et al. [2008] and Winkler et al. [2011] at Talos Dome, Dome C, and Vostok, provide the most complete spatial and temporal view of Antarctic $^{17}O_{excess}$ to date. We have added $^{17}O_{excess}$ to the independent isotope modules of two atmospheric general circulation models (CCSM CAM3 and ECHAM4.6). Both models are capable of qualitatively reproducing the observed spatial distribution of modern $^{17}O_{excess}$ in Antarctic precipitation, although our current implementation of CAM3 currently overestimates the average value of $^{17}O_{excess}$. Simulation of glacial-interglacial changes in ECHAM4.6 also realistically captures the differences in magnitude of the glacial/interglacial changes in $^{17}O_{excess}$ between different ice core sites, with the details dependent on the magnitude of sea ice changes and to a lesser degree the chosen supersaturation parameter. Both models show strong gradients in $^{17}O_{excess}$ at the ocean-sea ice boundary, associated with the strong gradient in near surface water vapor concentration (i.e., the normalized relative humidity). Our results suggest that the low $^{17}O_{excess}$ values found at Talos Dome and Siple Dome reflect their proximity to local moisture sources (e.g. from sea ice leads and polynyas) where evaporation into cold air increases the boundary layer relative humidity, lowering $^{17}O_{excess}$. Thus, $^{17}O_{excess}$ in Antarctic precipitation is strongly influenced by sea ice cover, and may provide an important constraint on past sea ice variations.