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Climate Interpretations from the WAIS Divide Water Isotope Record

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Ultra-high resolution water isotope measurements (δD, δ18O and deuterium excess) from the WAIS Divide ice core have been analyzed using a continuous flow system (CFA). The CFA measurements (INSTAAR, University of Colorado) have been averaged to 1 cm and compared with 50 cm discrete measurements (Isolab, University of Washington). Downsampling the CFA data, we find significant (>99%) multi-taper coherence between the two measurement techniques (δD and δ18O). The deuterium excess measurements are more difficult to reproduce at high-resolution, but are significantly coherent at longer time scales (100-1000 years).

Frequency analysis of the CFA water isotope signal (δD and δ18O) shows 1-year power persists throughout the Holocene and part-way into the Glacial. At 5 ka bp about 50% of the initial water isotope annual amplitude remains, whereas at 9 ka bp about 20% remains. By 15 ka bp yearly power has mostly disappeared. We use the exceptional preservation of the water isotope signal to undertake various analyses including: 1) Interpretation of abrupt climate changes (e.g. AIM events), 2) Frequency analysis of ENSO-type climate oscillations throughout the Holocene and the late-Glacial (e.g. 2-7 year periodicities), and 3) The effects of diffusion on the water isotope signal (e.g. diffusion constrains the temperature, accumulation during firn densification, and dynamic thinning history, which could be used to invert for these parameters). These analyses are ongoing as we continue to develop our methodologies and CFA system processing code.