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Time-scale reliability and climate features in a network of East Antarctic water isotope records

Content

Stable water isotope ratio records (δD and δ18O) from ice cores are used for investigating historical climate variations, predominantly fluctuations in site temperature. Due to the ability of ice cores to archive information in high temporal resolution, it is tempting to interpret raw isotope measurements directly. However, records contain post-depositional and stratigraphically-derived noise in addition to the climate signal. Furthermore, regional variation in accumulation leads to vastly differing temporal reliability of the signal in different cores. Trench, snow-pit and firn-core studies in low accumulation areas show that single cores do not accurately represent local short term changes. They reveal the need to combine records to sufficiently determine sub-decadal climate variations. On orbital and millennial time-scales, records from multiple sites (within hemispheres) show variations are in general agreement for continental spatial scales. The finer extent to which climatic conclusions can be drawn from isotope records of deep ice cores, spatially and temporally, is uncertain.

Here we present δD and δ18O records from ice samples from Little Dome C, East Antarctica, drilled in the 2017/18 Austral summer using the British Antarctic Survey's Rapid Access Isotope Drill (RAID). Using a network of local (< 50 km apart) sites around the Dome C region, water isotope records from 20 ka to present are compared. The records are dated independently of the water isotope records themselves using volcanic synchronisation and the alignment of 10Be variations, thus preserving the independent variability of the water isotopic signal. We demonstrate that approximately centennial-scale isotopic variations can reliably represent climatic changes, increasing possibly to multi-decadal scale through direct comparison of increasingly proximal cores. Using these time-scales, the climatic variations are compared spatially.

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Track Classification: The Oldest Ice challenge, and the preservation of climatic signals in the deepest ice