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Dating of a coastal East Antarctic ice core and reconstructing past multicentennial-scale variability in snow accumulation and storm events

Content

Ice cores from coastal Antarctic sites provide highly resolved records of climate and environmental changes involving variability in snow accumulation rates (SAR) and storm events over the past millennium. To interpret these ice core records, it is essential to establish the most reliable and accurate depth-age chronology of the ice. This study presents a 900-year chronology for the top 108.6 m of a 210.5 m-deep ice core drilled at the Styx Glacier plateau (SGP; 163º 41.22′E, 73º 51.10′S; 1,623 m above sea level) in northern Victoria Land, East Antarctica. The top 47.03 m, covering the period 1791–2014 CE, was dated by counting annual layers of highly resolved impurity records. The depth-age relationship was further constrained by using well-known time markers of three 239Pu peaks from atmospheric nuclear tests and 10 volcanic events identified by pronounced peaks of non-sea-salt SO42−. The lower part of the ice core (47.3–108.6 m), covering 1150–1790 CE, was dated using an age-depth model based on an absolute age tie point of the Rittmann tephra layer at a depth of 99.18 m, assigned to be 1252 CE, and gas chronology. The obtained ice core dating allowed a reconstruction of variability in the SAR for the last 230 years and storm events for the last 900 years at the SGP. The 230-year mean SAR was 163 ± 18 mm yr-1 in water-equivalent, showing an increasing trend until 1950 CE and then a decline during recent decades. The temporal variability of storm events showed that the average frequency per decade began to rise after 1800 CE, reaching a 6-fold increase above pre-1800 levels. In this study, we investigated the potential mechanism of changes in the SAR and storm events at the SGP.

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