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From Antarctic ice cores to Australia's water resources: Investigating an alternative streamflow proxy

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Past research worldwide shows that streamflow reconstructions, developed from paleoclimate proxies, provide a broader view of the range of climate variability possible relative to the comparatively short instrumental flow records on which water resource management plans are currently based. Hence there is a clear need for the development of streamflow reconstructions to allow us to better manage our water resources into the future. In Australia, however, there is a dearth of local high resolution proxies, particularly in catchments of interest, from which to develop streamflow reconstructions. This has led researchers to look beyond catchment boundaries and also Australia's borders to explore the utility of remote proxies for reconstructing Australian streamflow. Here we investigate, for a case study catchment located on Australia's eastern seaboard, the development of a millennial-length, annual streamflow reconstruction based on 1013 years of summer sea salt deposition recorded in ice cores from East Antarctica. The streamflow reconstruction realistically captures interannual to decadal variability in the gauged streamflow over the 1929-2009 calibration period. For the pre-instrumental period (i.e. pre-1900), the streamflow reconstruction shows longer wet and dry epochs than those recorded in the instrumental period. Furthermore, the variation in the distribution of the duration of wet and dry epochs between centuries suggests that water resources management and planning based on the statistics of the last 100 years of data (or less) is problematic. This information can be utilised to generate more realistic flow scenarios that better capture the range of hydroclimatic variability that Australia has experienced. This work emphasises a novel combination of ice core science, paleoclimatology and catchment-scale hydrology that is now being used to develop more robust water resources planning and management. The continuing work to further develop ice core based proxies, and explore the transferability of this approach to different locations within and outside Australia, provides exciting avenues for future research.