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Decreased precipitation intensity in the South Pacific Convergence Zone during the Little Ice Age inferred from dinosterol hydrogen isotope ratios

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The South Pacific Convergence Zone (SPCZ) is the most prominent precipitation feature in the southern hemisphere, extending southeast from Papua New Guinea to French Polynesia. Changes in SPCZ precipitation dynamics can have major impacts on local communities and ecosystems, as well as the global hydrologic balance and ocean circulation. Variability in SPCZ precipitation can be characterized as changes in precipitation intensity throughout the entire rainfall band, or as changes in its mean annual position. Proxy reconstructions of precipitation rates from single sites within the SPCZ region cannot distinguish changes in SPCZ intensity from changes in SPCZ location, and the low density of proxy-based precipitation records from the pre-instrumental era makes it challenging to characterize past SPCZ dynamics.

To address this gap, we present quantitative records of rainfall rates derived from sediment cores collected from five freshwater lakes in the western portion of the SPCZ (from Tetepare and Rendova Islands in Solomon Islands, and from Thion Island in northern Vanuatu), spanning the past 500 to 1000 years, depending on the site. Our records are based on the hydrogen isotope composition of the dinoflagellate biomarker dinosterol, which is quantitatively related to mean annual precipitation. Our dinosterol records are complemented by analyses of magnetic susceptibility, pollen, and leaf wax hydrogen isotopes. We pair our new dinosterol-based precipitation reconstructions with previously published, comparable records from lakes in Samoa, Wallis, and southern Vanuatu to demonstrate that precipitation rates were systematically lower throughout the western and central SPCZ during the Little Ice Age (1450 – 1850 CE), indicating a decrease in precipitation intensity. The earlier Medieval Climate Anomaly (950 – 1250 CE) is also

characterized by a tendency to drier conditions than in the modern period, but with more spatial heterogeneity. This networked reconstruction of precipitation rates in the SPCZ region provides the opportunity to better assess how rainfall dynamics in the region have changed through time, and how modes of variability within the SPCZ are related to global climate change.