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Long time series of stable oxygen isotopes in seawater: records of ocean circulation and atmospheric hydrology

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Palaeoceanographic records based on stable oxygen isotope values provide some of the most robust evidence of past ocean and atmospheric states due to the temperature dependence of stable isotope fractionation and variability in seawater stable oxygen isotope values ($d^{18}O_{sw}$). However, limited temporal $d^{18}O_{sw}$ data, particularly from remote, tropical oceans, still hinders our ability to interpret the drivers of $d^{18}O_{sw}$ variability. Such variability could serve as an indicator of ocean salinity, but it is still an open question whether variability in $d^{18}O_{sw}$ and salinity is coherent, and driven by ocean circulation or atmospheric moisture balance. A decade of continuous stable isotope seawater monitoring in the Galápagos Islands (Ecuador) and Palau shows that the contribution of atmospheric forcing to the surface $d^{18}O_{sw}$ varies by locale, but at both sites there is a strong signature of major ocean current strength in monthly average $d^{18}O_{sw}$ values. Palau $d^{18}O_{sw}$ strongly covaries with Palau precipitation $d^{18}O$, but also covaries with the strength of the southward Mindanao current. In the Galápagos, there is no relationship between precipitation $d^{18}O$ or atmospheric moisture variables and $d^{18}O_{sw}$. Here, the strength of the eastward Pacific Equatorial Undercurrent is the dominant control on $d^{18}O_{sw}$ values. In both locations, seawater stable oxygen isotope values have a strong relationship with salinity in large areas surrounding the sampling sites, but the salinity-isotope relationship is more temporally variable in Palau, where $d^{18}O_{sw}$ also has a stronger relationship with key ocean-atmosphere variables relative to salinity. Thus $d^{18}O_{sw}$ values appears to hold more, or different, information than paired salinity values.