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ENSO in a warming world: interannual climate variability in the early Miocene Southern Hemisphere

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The El Niño—Southern Oscillation (ENSO) is the dominant source of interannual variability in the modern-day climate system. ENSO is a quasi-periodic cycle with a recurrence interval of 2–8 years. A major question in modern climatology is how ENSO will respond to increased climatic warmth. ENSO-like (2–8 year) cycles have been detected in many palaeoclimate records for the Holocene. However, the temporal resolution of pre-Quaternary palaeoclimate archives is generally too coarse to investigate ENSO-scale variability.

We present a 100-kyr record of ENSO-like variability during the second half of the Oligocene/Miocene Mi-1 event, a period of increasing global temperatures and Antarctic deglaciation (∼23.032–2.93 Ma). This record is drawn from an annually laminated lacustrine diatomite from southern New Zealand, a region strongly affected by ENSO in the present day. The diatomite consists of seasonal alternations of light (diatom bloom) and dark (low diatom productivity) layers. Each light-dark couplet represents one year's sedimentation. Light-dark couplet thickness is characterised by ENSO-scale variability. We use high-resolution (sub-annual) measurements of colour spectra to detect couplet thickness variability. Wavelet analysis indicates that absolute values are modulated by orbital cycles. However, when orbital effects are taken into account, ENSO-like variability occurs throughout the entire depositional period, with no clear increase or reduction in relation to Antarctic deglaciation and increasing global warmth.