Climate and environmental change in the SW-Pacific of the last ~14,000 years using lipid biomarkers in sediments of a New Zealand lake

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We have used a multiproxy biomarker and compound-specific hydrogen isotope approach to reconstruct changes in air temperature, precipitation, vegetation, and water quality over the last ~14,000 years from the sediments of an alpine lake, Adelaide Tarn, northwestern South Island, New Zealand. The lake is located in the southern mid-latitudes and therefore records the climate variability in the Southwest Pacific, which is either affected by the tropical Pacific or the polar Southern Ocean (i.e., connection to Antarctica). Human impact is minor due to the lake's remote location and the late settlement of humans in New Zealand ~750 years ago.

High-resolution records of tetraether lipids (i.e. GDGTs) in the lake sediments indicate up to ~4°C higher mean annual air temperatures during the last ~5000 years compared to the Last Glacial Maximum and absence of the Holocene Climatic Optimum. We complemented these data with heterocyst glycolipids (HGs), diagnostic indicators of cyanobacteria, that have been proposed as alternative paleotemperature indicators in lakes. To better constrain the validity of this new proxy, we analysed HGs in surface sediments from 26 New Zealand lakes, and also investigated HG variability in cyanobacterial cultures. Past changes in precipitation were inferred from δD isotope values of high-molecular weight *n*-alkanes originating from plant waxes and indirectly from pollen and plant macrofossils, which appear to be particularly sensitive due to the lake's location close to the modern treeline. Long-chain *n*-alkanes and biomarkers indicative of vegetation (i.e, lupeol, perylene, higher plant steroids, and also more unusual arborinol and fernenol derivatives originating from Poaceae) reflect high terrestrial OM supply and changes in vegetation during the past last ~14,000 years.