Geochemical and stratigraphic evidence for late Pleistocene and Holocene hydroclimatic change related to the Southern Hemisphere westerly winds

Moy, C.M.,[1] Nichols, J.E.,[2] Burrington, P.J.,[1] Vandergoes, M.J.,[3] Gilmer, G.J.,[1] Hinojosa, J.L.,[4] Anderson, H.J.,[1] Beltran, C.,[5] Hageman, K.J.[5]

[1] *Geology Dept., University of Otago, Dunedin*

[2] *Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, USA*

[3] *GNS Science, Lower Hutt*

[4] *Div. of Geological and Planetary Sciences, Caltech, Pasadena, CA, USA*

[5] *Chemistry Dept., University of Otago, Dunedin*

The strength and position of the Southern Hemisphere westerly winds play a fundamental role in regulating New Zealand's climate. Strong westerlies not only promote the generation of mid-latitude precipitation-bearing storms over the Southern Ocean, but the mean position of the strongest winds dictate if these systems pass over and deliver rainfall to the South Island. To provide insight into how the westerlies impact New Zealand's precipitation regime, and the broader Southern Hemisphere climate system, we evaluate past hydrologic change using sediment cores collected from lakes, fjords, and peatlands on the SW portion of the South Island and the subantarctic Auckland Islands. These localities are situated either in the core (50°S) or in the northern margin (45°S) of the modern wind belt and local catchment hydrology has demonstrated links to the westerly winds. We apply stable isotope, including compound-specific (n-alkane) H isotopes, and elemental concentration data to these records to evaluate: 1) changes in carbon cycling and delivery pathways related to organic matter provenance and water column stratification, 2) changes in the dD of plant water related to precipitation origin and atmospheric temperature, and 3) changes in the isotopic composition of closed-basin lake water driven by evaporative processes.

During the Late Glacial and early Holocene (16 to 10 ka), we identify multiple millennial-scale reductions in lake level, elevated long-chain n-alkane dD values, and water column stratification that coincide with intervals of rapid deglacial warming identified in Antarctic ice cores. Combined, these results signal weakened westerly winds and/or southward shifts of the core away from New Zealand along millennial timescale. During the early Holocene (10 to 8 ka), we find evidence for an extended

period of low and variable lake levels, combined with enhanced water column stratification, that we attribute to a combination of diminished wind strength, warmer air temperatures, and reduced seasonality. After 5.5 ka, we interpret the decline in long-chain n-alkane dD observed in peatlands (50°S) and lake sediments (45°S) to indicate enhanced SW flow over the South Island combined with cooler temperatures. Our results support the idea that climate mechanisms originating in the high latitudes and the tropics work together to influence the westerlies on millennial timescales. We will further evaluate these interpretations, and place them in a broader context, through comparison of established records throughout the Pacific Basin.