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# Southern Hemisphere Westerly Wind Changes during the Last Glacial Maximum: Paleo-data Synthesis

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Changes in the strength and position of Southern Hemisphere westerly winds during the last glacial cycle have been invoked to explain glacial-interglacial climate fluctuations. However, neither paleo models nor paleodata agree on the magnitude, or even the sign, of the change in wind strength and latitude during the Last Glacial Maximum (LGM), compared to the recent past. This study synthesizes paleo-environmental data that have been used to infer changes in winds during the LGM compared with the late Holocene. These compilations include changes in terrestrial moisture, dust deposition, and ocean productivity, along with summaries of previously published information on sea surface temperatures (SSTs) and ocean dynamics in the Southern Hemisphere.

Our compilations of terrestrial moisture from 94 sites and dust deposition from 87 sites show generally drier conditions for the LGM between 0 and 40°S, with wetter conditions along the west coasts and drying along the east coasts of continents. LGM dust deposition rates ranged from 2 to 4.5 times higher over the Southern Ocean and about 13 times higher over the Antarctic continent. For the oceans, reconstructed changes in SSTs show maximum cooling (>4ºC) in the modern-day Subantarctic Zone, coincident with a region of enhanced export production during the LGM compared with today.

We find that any hypothesis of LGM wind and climate change needs to provide a plausible explanation for increased moisture on the west coast of continents, cooler temperatures and higher productivity in the Subantarctic Zone, and reductions in Agulhas leakage around southern Africa. Our comparison suggests that an overall strengthening, an equatorward displacement, or no change at all in winds could all be interpreted as consistent with observations. If a single cause related to the southern westerlies is sought for all the evidence presented, then an equatorward displacement or strengthening of the winds would be consistent with the largest proportion of the data evidence. However, other processes, such as weakening or poleward shifts in winds, a weakened hydrological cycle, extended sea-ice cover, and changed buoyancy fluxes, cannot be ruled out as potential explanations of observed changes in moisture, surface temperature, and productivity.

We contend that resolving the position and strength of westerly winds during the LGM remains elusive based on data reconstructions alone. However, we believe that these data reconstructions of environmental conditions can be used in conjunction with model simulations to identify which processes best represent westerly wind conditions during the LGM.