



The Origin of Antarctic
Precipitation: A Modeling
Approach

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Isotope concentrations in polar ice cores have long been used to estimate paleotemperatures. Underlying the use of this isotope paleothermometer is the assumption that the relationship between surface temperature and isotope concentration over time at a single geographical point is the same as that observed over space during the present-day climate. The validity of this assumption may in fact be compromised by several factors related to climate change. The specific factor studied in this paper involves the evaporative sources for polar precipitation. Climatic changes in the relative strengths of these sources would imply a need for a recalibration of the paleothermometer. To quantify such changes, we performed two GCM simulations, one of present-day climate and the other of the climate during the Last Glacial Maximum (LGM), roughly 18000 years ago. Evaporative sources of Antarctic precipitation were established using special tracer diagnostics. Results suggest that polar precipitation during the LGM does indeed consist of (relatively) more water from tropical oceans, a direct reflection of the LGMs increased equator-to-pole temperature gradient and its increased sea ice extent, which reduces high latitude evaporation. This result implies that an uncalibrated ice core paleothermometer would produce LGM temperatures that are biased slightly low. Because LGM boundary conditions are still under debate, we performed a third GCM simulation using a modified set of LGM boundary conditions. Using this simulation gives some qualitatively similar results, though the tropical contribution is not quite as high. Uncertainties in the LGM boundary conditions does hamper success in calibrating the paleothermometer.

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