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Impact of source region on the δ18O signal in snow: A case study from Mount Wrangell Alaska

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The stable isotopic composition of water in ice cores is an important source of information on past climate variability. At its simplest level, the underlying assumption is that there is an empirical relationship between the normalized difference in the concentration for these stable isotopes and a specified local temperature at the ice core site. There are however non-local processes, such as a change in source region or a change in the atmospheric pathway, that can impact the stable isotope signal thereby complicating its use as a proxy for temperature. Here we investigate the importance of these non-local processes through the analysis of the synoptic-scale circulation during a snowfall event at the summit of Mount Wrangell, in south-central Alaska just to the east of the Gulf of Alaska. During this event there was, over a one-day period in which the local temperature was approximately constant, a change in δ18O that exceeded half that normally seen to occur between summer and winter in the region. As we shall show, this arose from a change in the source region, from the sub-tropical eastern Pacific to northeastern Asia for the snow that fell on Mount Wrangell during the event. The recognition that non-local processes play a role in the stable isotope record from the Gulf of Alaska region suggests that these records, in addition to a local temperature signal, also contain signals of large-scale modes of climate variability that impact the North Pacific region such as the Pacific North America teleconnection and the El-Nino Southern Oscillation.