Local to Regional Hydroclimate Changes in the Tropical Andes Since the Mid-Holocene

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Abstract:

Climate changes during the mid- to late-Holocene, after the last vestiges of glacial ice sheets dwindled, provide important context for climate change today. In the tropical Andes, most of the continuous paleoclimate records covering the late Holocene are derived from the oxygen isotope composition of ice cores, speleothems, and lake carbonates. These archives are powerful recorders of large-scale changes in circulation and monsoon intensity, but they do not necessarily capture local moisture balance, and so reconstructions of local precipitation and aridity remain scarce. Here we present contrasting histories of local effective moisture vs. regional circulation from several new biomarker records preserved in lakes and peat in the Colombian and Peruvian Andes. We focus on the hydrogen isotope composition of long-chain plant waxes, which reflects precipitation δ^2H similarly to $\delta^{18}O$ from ice cores and speleothems; and the $\delta^{13}C$ of waxes and the δ^2H of mid-chain waxes, which reflect local water stress and effective moisture. In both the Northern and Southern Hemisphere tropical Andes, fairly gradual δ^2H shifts during the late Holocene indicate a progressive intensification of circulation in the South American lowlands. On the other hand, plant wax $\delta^{13}C$ and mid-chain δ^2H records indicate abrupt transitions into and out of intervals of water stress and aridity – similar to findings from pollen and sediment lithology from elsewhere in the tropical Andes. We draw on climate models and proxy data syntheses to help reconcile these curiously different accounts of effective moisture in the tropical Andes since the mid-Holocene and discuss implications for modern climate research.