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Antarctic-like temperature variations in the Tropical Andes recorded by glaciers during the last deglaciation (20 – 10 ka BP)

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The paleoclimatic changes that occurred in the Southern and Northern hemispheres during the last deglaciation are thought to have affected the continental tropical regions. However, the respective impact of North and Southern climatic changes in the tropics are still poorly understood. In the High Tropical Andes, the Antarctic Cold Reversal (ACR, 14.3-12.9 ka BP) was reported to be more represented than the Younger Dryas (12.9-11.7 ka BP) among morainic records. However, in the Altiplano basin (Bolivia), two cold periods of the North Hemisphere (Heinrich Stadial 1a (16.5-14.5 ka) and Younger Dryas) are synchronous with (i) major advances or stillstands of paleo-glaciers and with (ii) the highstands of the giant palaeo-lakes Tauca and Coipasa. Therefore, additional results are needed to disentangle between potential North and South Hemisphere climatic influence on the glacial dynamics in the region.

We present new Cosmic Ray Exposure (CRE) ages from glacial landforms of the Bolivian Andes that extend pre-existing datasets for four different sites spreading from 16 to 21°S. We reconstruct the Equilibrium Line Altitudes (ELA) associated with each moraine with the AAR method and use them in an inverse algorithm that combines both the palaeo-glaciers and palaeo-lake budgets to derive temperature and precipitation reconstructions. Our temperature reconstruction (ΔT vs. Present) shows a consistent trend through the four glacial sites with a progressive warming from ΔT= -5°C (17 ka BP) to –2.5°C (15-14.5 ka BP, at the end of the Tauca highstand). This is followed by a return to colder conditions, around -4°C, during the ACR (15.5-12.9 ka BP). The Coipasa highstand is coeval with another warming trend followed by ΔT stabilization at the onset of the Holocene (circa 10 ka BP), around -3°C. Precipitation is mainly characterized by increases during the lake highstands, modulated by the distance from the glacial sites to the center of the paleolakes that are moisture sources (recycling processes).

These new results highlight the decorrelation of the glacier dynamics to the temperature signal in regions that are characterized by high precipitation variability. They also provide a theoretical

frame to explain how both regional and global forcings can imprint the paleo-glacial records. Our results strongly suggest that during the last deglaciation (20 – 10 ka BP), in the Tropical Andes, atmospheric temperatures follow the Antarctic variability, while precipitation is driven by the changes occurring in the Northern Hemisphere.