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Lateglacial climate reconstruction on the Bolivian Altiplano inferred from paleoglaciers and paleolakes

Léo Martin (1,2), Pierre-Henri Blard (1), Jérôme Lavé (1), Mélody Prémaillon (2), Vincent Jomelli (3), Daniel Brunstein (3), Maarten Lupker (4), Julien Charreau (2,1), Véronique Mariotti (1), Thomas Condom (5), and Didier Bourles (6)

(1) CRPG - CNRS, Vandoeuvre-lès-Nancy, France, (2) Université de Lorraine, France, (3) LGP - CNRS, Meudon, France, (4) ETH, Zurich, Switzerland, (5) LTHE - IRD, Grenoble, France, (6) CEREGE, Aix-en-Provence, France

Recent insights shed light on the global mechanisms involved in the abrupt oscillations of the Earth climate for the Late Glacial Maximum (LGM) to Holocene period (Zhang et al., 2014; Banderas et al., 2015). Yet the concomitant patterns of regional climate reorganization on continental areas are for now poorly documented. Particularly, few attempts have been made to propose temporal reconstructions of the regional climate variables in the High Tropical Andes, a region under the influence of multiple global climate forcings (Jomelli et al., 2014).

We present new glacial chronologies from four sites of the Bolivian Altiplano: the Wara-Wara valley (17.3°S - 66.1°W), the Zongo valley (16.3°S - 68.1°W), the Cerro Tunupa (19.8°S - 67.6°W) and the Nevado Sajama (18.1°S 68.9°W). These chronologies are based on Cosmic Ray Exposure dating (CRE) from an exceptional suite of recessive moraines. These new data permitted to refine existing chronologies of Smith et al., 2005; Zech et al., 2010 and Blard et al., 2009. In both sites, glaciers recorded stillstand episodes synchronous with cold events such as the Henrich 1 event, the Younger Dryas and the Antarctic Cold Reversal. Since the nearby Altiplano basin registered lake level variations over the same period, we were able to apply a joint modelling of glaciers Equilibrium Line Altitude (ELA) and lake budget. This method permits to derive a temporal evolution of temperature and precipitation for the four sites.

These new reconstructions show for all sites that glaciers of the Tropical Andes were influenced by the major climatic events of the Northern and Southern Hemispheres. Furthermore, the temperature variability observed at high latitudes results in these tropical latitudes in major precipitation variability whereas the lateglacial temperature patterns remain globally monotonic. This conversion of global temperature variability into regional precipitation variability support the idea that North Hemisphere cold events are coeval with an important southward deflexion of the Intertropical Convergence Zone (ITCZ) due to the inter-hemispheric temperature gradient (Schneider et al., 2014). Such a southward shift would lead to an increased moist supply of the subequatorial Amazonian basin (Montade et al., 2015) and thus an increased easterly driven moist transport over the Altiplano.