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Glacial recession in the Tropical Andes from the Little Ice Age: the case of Ampato Volcanic Complex (Southern Peru

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Data published over the last decade reveal substantial glacial recession in the tropical Andes since the Little Ice Age (LIA), (Ramirez, et al., 2001; Rabatel, et al., 2005; Rabatel, et al., 2008; Vuille, et al., 2008; Hastenrath, 2009; Jomelli, et al., 2009), and a growing rate of recession since the 1980's caused by global warming (Ramirez, et al., 2001; Vuille, et al., 2008). Today there is great interest in the evolution of these ice masses due to heightened awareness of climate change and of the strategic importance that glaciers have as a hydrologic resource for communities in arid climate zones in the tropical Andes (Mark, 2008; Vuille et al., 2008).
Cordillera Blanca forms part of the Andes Mountains of northern Peru, and is a chosen site for many studies on glacier evolution. Vuille et al. 2008 determined that a considerable area of ice mass was lost at Huascarán-Chopicalqui glacier (18% from 1920-1970) and Astesonraju glacier (20% from 1962-2003). Studies at Coropuna volcano, which has the most extensive glacier field in the western range of southern Peru, also report a strong melting trend that began with only minimal recession from 1955-1986 (4%), but increased to 14% from 1986-2007 (Úbeda et al., 2009). Only a few of the Andes glaciers are consistently monitored, and the most comprehensive data are for Chacaltaya and Zongo glaciers (16º S) in Bolivia. Since the maximum LIA, Chacaltaya has lost 89% of its surface area, particularly in recent years. By 1983, the totaled loss was five times the shrinkage for the period 1940-1963 (Ramirez, et al., 2001). Zongo glacier maintained equilibrium from 1956-1975, but later experienced a period dominated by continuous recession (Soruco, et al., 2009).
This study expands current knowledge of glacier evolution since the LIA in the Central Volcanic Zone (CVZ; 14º - 27º S) (Stern, 2004) of the Andes. The study site was chosen in an area that had never been used for preliminary research of this type, concretely the Ampato volcanic complex (15º24´- 15º 51´ S, 71º 51´ - 73º W; 6.288 masl), one of the most important complexes of the northern sector of the CVZ. Photointerpretation of aerial photographs and teledetection through satellite images of Huayuray Valley (15º 41´ 14´´ S – 71º 51´ 53´´ W), located to the north of the complex, aided in accurately reconstructing the area occupied by the ice mass at different times (LIA, 1955, 2000 and 2008). Also the paleo-ELA (Equilibrium Line Altitude) and the ELA were calculated using the Accumulation Area (AA) method (Kaser and Osmaston, 2002; Osmaston, 2005) in a GIS. The ELA shows the relationship between climate and glacier mass balance (González Trueba, 2005).
The data from Huayuray Valley show that the glaciers reached a minimum altitude of 5400 masl and covered an area of ∼2.81 Km2 during the LIA. The paleo-ELA was located at ∼5780 masl, ∼120 m below the current ELA (∼5900 m). Based on a vertical thermal gradient of 0.65ºC/100 m, the temperature during this event would have been about 0.7º C colder than present temperature in the Ampato volcanic complex. In 1955, Huayuray glacier covered ∼2.45 km2, 12.8% less than in the LIA. In the same year, the glaciers in the Huayuray valley reached a minimum elevation of ∼5660 masl and the ELA rose ∼20 m, to 5800 masl. In only 45 years (1955 - 2000) the surface area of the ice was significantly reduced (∼1 km2), i.e. 40.8%. The ELA continued to rise, until it reached 5890 masl in 2000. From 2000 - 2008, the Huayuray glacier was reduced to ∼0.78 km2 and the ELA rised ∼10 m to reach the 5900 masl
These results from the CVZ confirm the dramatic recession of the glaciers in the tropical Andes during recent decades. They also suggest that if the rate of recession associated with the period 2000-2008 continues, glaciers in the Ampato volcanic complex will disappear in 10 years approximately.

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