Glacier retreat and related natural hazards in Cordillera Blanca, Peru.

Walter Silverio¹, Jean-Michel Jaquet², Stéphane Kluser²

Abstract

Multi-temporal mapping of glaciers is a key-tool to estimate freshwater reserves and to follow climate change. Based on Landsat TM images, the glaciated surface of Cordillera Blanca (Peru) has been estimated at 643 km² for 1987 and at 600 km² for 1996. The development of three potentially dangerous glacial lakes in the Northern part of this area was surveyed using these images, together with additional ones for 1975 (MSS) and 2000 (ETM+).

Keywords: Remote Sensing; Landsat; snow index; Andes; climate change; glaciology.

1. Introduction

In Peru, glaciers of the Cordillera Blanca play a significant role as freshwater resource during the dry season (6 months per year) for agriculture, drinking water and electrical production through hydro-power. Moreover, these glaciers were associated with several natural hazards, which caused material damages and causalities in the region.

Satellite imagery is a precious source of information on the temporal evolution of land cover, providing a timely inventory of key-parameters for resource management and habitability such as snow and ice cover, natural hazard occurrences and environmental impact of human activities.

¹ Remote Sensing and GIS Unit, Earth Sciences Section, University of Geneva, 13, rue des Maraîchers, CH-1205 Geneva, Switzerland.
Email: silveri9@etu.unige.ch
² Earth Observation Section, UNEP/DEWA-Europe GRID Geneva, 11 Chemin des Anémones, CH-1219 Geneva, Switzerland
Email: Jean-Michel.Jaquet@grid.unep.ch
2. Glacier Retreat From Landsat TM

In 1970, Peruvian glaciers covered an area of 2042 km², approximately 35% of their surface was located in the Cordillera Blanca. Landsat Satellite imagery was used for glacier cover mapping in the Cordillera Blanca for the years 1987 and 1996. According to the results, the mountain range has lost 43 km² of its iced cover during this period. Between 1970 and 1996, the Cordillera Blanca lost more than 15% of its glacier area.

3. Ice avalanches

Between the years 1702 and 2000, more than 20 natural hazards linked with the Cordillera Blanca’s glaciers were recorded. However, the events of 1962 and 1970, originating from Huascarán northern summit, were particularly deadly: on May 31, 1970, a 7.7 magnitude earthquake triggered a huge avalanche, 30 km long and moving at 280 km/h, which wiped out the city Yungay, claiming 18000 lives.

4. Lake development monitoring from satellite imagery

In the Cordillera Blanca, the lake outburst phenomenon is known as “aluviones” (debris flows), and several events have occurred. In 1941, Palcacocha’s debris flows destroyed 1/3 of the city of Huaraz and caused 5000 casualties. In March 2003, another event linked to this lake has had negative consequences for the drinking water in Huaraz for one week period.

In the harsh and high altitude regions, like the one of the Cordillera Blanca, satellite imagery is an excellent source of information that can be used for the monitoring of dangerous lakes and be a helpful tool for prevention. In the Cordillera Blanca, during the ’80s and ’90s, many lakes have been increasing in size, and other ones have appeared.