Geophysical Research Abstracts
Vol. 13, EGU2011-11343, 2011
EGU General Assembly 2011

Thermal anomalies at Volcan Villarrica and their possible effects on glacier behaviour

Andres Rivera (1,2,3), Felipe Napoleoni (1,2), Rodrigo Zamora (1), and Jorge Clavero (4)

(1) Centro de Estudios Cientificos CECS, Glaciology and Climate Change, Valdivia, Chile (arivera@cecs.cl), (2) Universidad de Chile, Department of Geography, Santiago, Chile, (3) Centro de Ingeniería de la Innovación CIN, Valdivia, Chile, (4) Energía Andina, Darío Urzúa 2165, Santiago, Chile

Volcán Villarrica (39º 25' 12" S, 71º 56' 27" W, 2847 m s.n.m.) is one of the most active stratovolcanoes of Chile, with more than 60 recorded eruptions in historical times. In the last strongest event of 1971, a lahar was generated by sudden melt of ice and snow during the paroxysmal phase of the eruption, when a high fountain of lava was formed. The generation of lahars is the most recurrent process and represents the main hazards for the population living on its surroundings, as all the casualties in recent eruptions are due to this type of floods. The volcano is covered by 30,3 km2 of ice, partially debris covered, with maximum ice thickness of 150 m yielding a total volume of water equivalent of 2,3 km3. This glacier has been retreating in recent years, presumably in response to climate driven changes, however, the volcanic activity is also playing an important role in the glacier behaviour, especially by enhancing basal melting. When the ice thickness was measured using a low frequency radio echo sounding system, the power reflection of the bedrock signals were very high in places, suggesting the presence of important quantities of water, presumably in connection to geothermal anomalies. In order to monitor the glacier-volcano interactions, for detecting possible effects of the volcano on the glacier, several satellite images (ASTER and Landsat ETM+) together with a thermal FLIR (Forward looking Infra-Red) camera have been used to map the geothermal activity; at the lava lake located a few tens of meter below the crater rim; at several spots within the volcanic caldera; and at the surroundings of the volcano and associated glacier. The satellite images were orthometrically and radiometrically rectified. The ASTER bands were co-registered using the nearest neighbour interpolation method. The applied method included the Normalized Thermal Index (NTI) and the dual band approach for sub pixel temperature determination. The detected anomalies have been analysed more closely with thermocouples, in order to detect possible increments in the geothermal heat fluxes. In doing so, the FLIR camera has been used for calibration purposes and for measuring the temperature during the night of the lava lake and other spots. Several thermal anomalies were detected and mapped for the last 12 years, including spots at the caldera ring, several points at parasite volcanic cones and the main one at the lava lake within the crater. The resulting anomaly spots have been studied together with the main geological structural lineaments of the volcano, in order to understand the magmatic activity in the area. The resulting temperatures of the anomalies are used to estimate glacier basal melting at locations where radar data suggest the presence of anomalies.