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Mapping Glacial Hazards Using CBERS CCD/HRC Imagery

R. Ribeiro (1), E. Ramirez (2), J. Simões (1), E. Júnior (1), and C. Simões (1)

(1) Centro Polar e Climático, Universidade Federal do Rio Grande do Sul, (2) Instituto de Hidráulica e Hidrología, Universidad Mayor de San Andrés

Glacial environments natural disasters usually affect human populations living in high mountains. As an example, we may recall the 2007 glacier detachment in the Pakuni mine, Inquisivi Province, Department of La Paz (Bolivia), where sediments moved from the Jacha Pakuni hill resulting in 16 buried houses, destruction of machinery and large material losses. This study proposes to identify risk areas affected by flow movements of glacial origin, using a Geographic Information System (GIS) model-based, integrated with remote sensing data, in cordillera Tres Cruces (67°22'–67º32'W and 16º47'–16º09'S), where the Pakuni mine is located. Firstly, we created a Digital Elevation Model (DEM) for the study area, using the bands 3n (nadir) and 3b (back ward) bands, level 1b ASTER sensor. From a DTM, we were able to extract data (layers) for the topographic features of the analysed sector: the flow , direction and slope of the terrain. The flow layer allowed the identification of 11 drainage basins. For the extraction of snow and ice features we used a CBERS 2B CCD composition 4,3,2 (RGB). Using this colour composite, glaciers and lakes margins were identified and classified by the maximum likelihood method. However, lakes areas blended with shadow areas, so it made advisable a manual vectorization. In the next step, the hydrographic and snow/ice areas data were compared, overlaying the glaciers, hydrographic basins and orientation layers. Subsequently, we use the gradient layer (only from 0 to 24° slope, which could effectively build up a rock slide). In the last step, we added the flow layer (with a 30 m buffer) to the previous layer. We opted for this procedure, as the original "flow" layer "flow" is not representative of actual ground conditions, being too "close." To verify our method, we performed a procedure that is called fusion. Using a high-resolution image (in this case, an 2.5 m HRC 2.5 image) to enlarge the spatial resolution of a low resolution multispectral (20 m CCD). We chose the method of principal components, since this keeps the spectral features of the scenes. In this last step, the layer obtained in the previous procedures was overlaid on the image generated by the fusion of the HRC and CCD CBERS-2B images. The lakes layer was also superimposed on this information, the "fused" image identified the area where the alluvium event occurred (mine Pakuni). In this area, an internal sector of the glacier broke off and dragged rocks and unconsolidated sediments. It was possible to assess satisfactorily the Cordillera Tres Cruces.