Geophysical Research Abstracts
Vol. 16, EGU2014-7219, 2014
EGU General Assembly 2014

Monitoring of time and space evolution of glaciers' flow at the scale of the Karakoram and Himalayas

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Climate warming over the 20th century has caused drastic changes in mountain glaciers globally, and of the Himalayan glaciers in particular. The stakes are high; glaciers and ice caps are the largest contributor to the increase in the mass of the world's oceans, and the Himalayas play a key role in the hydrology of the region, impacting on the economy, food safety and flood risk to a large population. Partial monitoring of the Himalayan glaciers has revealed a mixed picture; while many of the Himalayan glaciers are retreating, in some cases locally stable or advancing glaciers in this region have also been observed. But recent controversies have highlighted the need to understand the glaciers dynamic and its relationship with climate change in this region.

Earth Observation provides a mean for global and long-term monitoring of mountain glaciers' dynamics. In the frame of the Dragon program, a partnership between the European Space Agency (ESA) and the Chinese Center for Earth Observation (NRSCC), we begun a monitoring program aimed at quantifying multidecadal changes in glaciers' flow at the scale of the entire Himalayas and Karakoram from a 40 years' archive of Earth Observation. Ultimately, the provision of a global and time-sensitive glaciers velocity product will help to understand the evolution of the Himalayan glaciers in lights of glaciological (e.g. presence of debris-cover, surges, proglacial lakes) and climatic conditions.

In this presentation, we focus on the analysis of the Landsat archive spanning the 1972 to 2012 period, which is global and provide multidecadal and continuous observation. We present the processing strategy including preprocessing of the images, image-matching and merging of the various results obtained from the repetitivity of the acquisitions in order to obtain a more robust, precise and complete glaciers velocity fields. We show that the recent archive (Landsat 4, 5 and 7, from 1982 to 2013) allows an estimate of the velocity for most of the Himalayan glaciers, except for the parts moving at rates inferior than the sensitivity of the method of about 15m/year. Geometric inaccuracies for the earlier missions (1 to 3, from 1972 to 1993), restrict the sensitivity to the largest glaciers but is sufficient enough to derive changes in the dynamic of those glaciers at decadal scales.