Combined use of Sentinel-1 A/B interferometry and corner reflectors for glacier and surrounding moraines monitoring in the Chamonix Valley (France)

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Résumé

The monitoring of Alpine glaciers is crucial to assess the local impact of global warming. Glacier displacement and slopes instabilities are markers of glacial conditioning changes, which can represent a major issue of risk and requires the development of monitoring techniques. In this way, the systematic acquisition strategy of the Sentinel-1 radar mission offers new perspectives. With the two Sentinel-1A and 1B satellites launched respectively in April 2014 and April 2016, this mission provides free data every 6 days over Europe, which makes it now possible to construct 6-day S1-A/S1-B interferograms. This reduction in revisit time limits temporal decorrelation, which is often present in SAR data due to rapid surface changes. Therefore, Sentinel-1A/1B data provide an opportunity for measurements of glacier displacement by means of SAR interferometry (InSAR). However, the particular acquisition mode of Sentinel images requires a very precise co-registration between interferometric pairs, especially in azimuth, which makes the interferometric processing of Sentinel-1 images challenging.

In this work, a series of 31 Sentinel-1 images acquired between October 2016 and April 2017 are used to form 30 6-day interferograms. We show that some of these interferograms have a sufficient level of coherence to measure the surface displacement of Argentière Glacier in the Chamonix valley and to investigate the potential instabilities of the surrounding moraines. The average glacier flow velocity measured by InSAR is about a few centimeters per day. These early results have shown that some adaptations should be considered to get velocities consistent with previous studies. Complementary to InSAR techniques, artificial corner reflectors have been installed and GPS measurements have also been performed in this area. All these measurements are combined together in order to better understand the phenomenon of moraine and further the evolution of the environment of the Argentière glacier, which has been monitored by different research groups since more than 50 years.

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