Geophysical Research Abstracts
Vol. 20, EGU2018-10245, 2018
EGU General Assembly 2018

Opportunities for glacier monitoring with new and up-coming satellite data

Frank Paul
Department of Geography, University of Zurich, Zurich, Switzerland (frank.paul@geo.uzh.ch)

As a complement to field-based glacier monitoring, satellite data are now widely used for regular determination of glacier changes at large and up-to global scales. At the heart of this development are (1) a change of data distribution policy (offering free and open access to satellite and other data) and (2) the development and sharing of automated processing lines in combination with cloud-based processing (allowing large spatial coverage along with near real time processing). Whereas deriving accurate glacier outlines still requires a substantial effort and expertise for manual corrections (debris, clouds, water, shadow), products such as elevation changes, flow velocities and snow cover of glaciers can be created more or less automatically. This has not only led to an extended spatial coverage with glaciological data, but also to an unprecedented increase in glaciological knowledge and insight in glacier dynamics.

For example, in the recent past variations in glacier flow velocity had been analysed by comparing mean annual (from optical sensors) or monthly values (from SAR data). Today, we can follow such changes over 5-10 day intervals with Sentinel 1 and 2, revealing dense time series and thus completely new insights in very fast changes such as the dynamics of glacier surges. Similarly, automated processing of time-series from satellite optical stereo data provides much more robust trends in glacier surface elevation over longer time periods than differencing of two DEMs (ASTER) or reveals changes at high temporal and spatial resolution for regions that have been barely covered before (ArcticDEM). The 10 m spatial resolution of Sentinel 2 is also a game changer as glacier crevasses are resolved and debris-covered regions are much better visible; both leading to an improved quality of (manually corrected) glacier outlines.

The current key problem when studying glaciers with their rapidly changing geometries are out-dated, different and coarse-resolution DEMs that are used by space agencies for orthorectification of recent high-resolution satellite data such as Landsat 8 and Sentinel 2. The resulting spatial mismatch in steep high-mountain topography can be larger than 4 to 5 pixels and hinders the combined use of datasets and cross-sensor time-series analysis. However, it is very difficult to overcome this problem as historic datasets such as Landsat from the 1980s have to be orthorectified consistently as well and global-scale DEMs with a sufficient quality from that time do not exist.

Considering planned (Landsat 9, Sentinel 1C/D and 2C/D) and up-coming (ICESat-2, NISAR) satellite missions and datasets (global DEM from TanDEM-X), it can be expected that space-based glacier monitoring has a solid future and exciting new insights in glacier dynamics are ahead.