Geophysical Research Abstracts
Vol. 20, EGU2018-13441, 2018
EGU General Assembly 2018

Comprehensive Ice Velocity and Discharge Monitoring of Polar Ice Masses by Sentinel-1 SAR

Jan Wuite, Thomas Nagler, Markus Hetzenecker, Stefan Scheiblauer, and Helmut Rott
ENVEO - Environmental Earth Observation, Innsbruck, Austria (jan.wuite@enveo.at)

Accurate ice velocity measurements are a requisite for estimating the current and future sea level rise contribution of polar ice masses. Coming from an era with sparse coverage, the systematic acquisition planning of Sentinel-1 has provided nearly uninterrupted observations of the Greenland Ice Sheet margin, key regions in Antarctica and smaller ice caps, including those in the Russian and Canadian Arctic, Svalbard and Patagonia. The launch of Sentinel-1B, in March 2016, has reduced the repeat observation period of the SAR mission from 12 to only 6 days. The dual satellite constellation has thereby changed the landscape for satellite remote sensing of the cryosphere completely, providing excellent opportunities for operational monitoring of key climate variables like ice sheet velocity and glacier discharge. Continuous coverage is now extended to include most of the Antarctic Ice Sheet margin, allowing retrieval of dense time series of ice flow for major Antarctic outlet glaciers previously only seldom observed. The ongoing acquisition of ice sheet margins is augmented by dedicated ice sheet-wide campaigns for Greenland (annually) and Antarctica (every 3 years).

In the framework of the ESA CCI and Austrian ASAP/FFG programs we have developed an automatic system for ice sheet velocity and discharge monitoring. Applying advanced iterative offset tracking we generate surface velocity maps utilizing repeat pass Sentinel-1 Interferometric Wide Swath (IWS) data. The Terrain Observation by Progressive Scans (TOPS) technology, with a spatial resolution of 4 m by 22 m in slant range and azimuth respectively and a swath width of 250 km, is well suited for velocity retrievals. Results compare very well with those derived from other high-resolution sensors (e.g. TerraSAR-X) and provide detailed coverage of ice motion even in regions with high accumulation rates, fast flow and high gradients. Combined with ice thickness, derived from airborne radio echo sounding, the velocity maps form the basis for studying glacier dynamics, calculating ice discharge and changes in mass balance.

We present ice sheet wide velocity maps of the Greenland and Antarctic mapping campaigns and show time series of velocity fluctuations of major outlet glaciers of the ice sheets and other polar regions including the latest observational data. In combination with velocity derived from other missions (e.g. ERS, ALOS, TerraSAR-X), we show how velocity and ice discharge varies spatially and temporally over time scales ranging from days to multiple years.

With this winter's 4th Greenland mapping campaign completed and the 2nd Antarctic mapping campaign commencing this austral winter, Sentinel-1 continues to provide essential information for comprehensive monitoring of polar ice masses in response to climatic changes.