Geophysical Research Abstracts
Vol. 21, EGU2019-13858, 2019
EGU General Assembly 2019

Ice Velocity and Discharge Monitoring of the Polar Ice Sheets

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

The Greenland and Antarctic ice sheets are losing ice mass at an accelerating rate in response to atmospheric, oceanic and internal dynamic forcing. Detailed knowledge on ice flow dynamics and processes leading to the depletion of glacier mass is essential for future scenarios on contributions of polar ice masses to sea level rise. Satellite Earth observation data from Copernicus Sentinel-1, Sentinel-2 and TerraSAR-X/TanDEM-X play a key role hereby in providing spatially and temporally detailed climate data records on ice flow and surface elevation change. A recent and major advancement, emerging from the ESA CCI and Austrian ASAP/FFG programs, is the development and implementation of an automatic system for generation of ice velocity maps from repeat pass Sentinel-1 SAR data. In combination with a dedicated polar acquisition strategy, this marked a transition from traditional campaign-style observation to true operational monitoring of ice flow in polar regions.

We generated time series of ice velocity from weekly repeat pass Sentinel-1 Interferometric Wide Swath and TerraSAR-X/TanDEM-X Stripmap data by applying customized iterative offset tracking tools. The ice velocity maps, in combination with high-resolution digital elevation models, derived from the bistatic interferometric radar mission TanDEM-X, and available ice thickness from radio echo sounding, form the basis for studying glacier dynamics, ice discharge and mass balance of Greenland and Antarctic outlet glaciers.

Including the latest observational data, we present detailed ice sheet wide velocity maps of the Greenland and Antarctic mapping campaigns. The continuous 6 to 12-day repeat acquisitions of the ice sheet margins by Sentinel-1 are used to produce monthly-averaged ice velocity maps that, supplemented with ice thickness data, allow for calculating sub-annual discharge variations in order to distinguish short-term fluctuations from trends. Time series of ice velocity are combined with volumetric changes calculated from DEM differencing to analyse the evolution of outlet glaciers along the Weddell Coast of the Antarctic Peninsula. Our results reveal a complex and versatile pattern of mass balance and ice flow.

This presentation highlights some of the capabilities of the satellite missions and emphasizes the importance of long-term comprehensive monitoring of polar ice masses, which is essential for understanding and predicting their response to climatic changes.