Towards an Automated Work-flow for SAR Offset-tracking and motion Information retrieval

Sina Nakhostin, Jean-Philippe Malet, David Michéa
sina.nakhostin@unistra.fr , jeanphilippe.malet@unistra.fr,
davidmichea.unistra@gmail.com

IPGS/EOST Universite de Strasbourg

Motivation

The availability of Sentinel-1 mission images, covering all global landmasses and coastal zones, makes this mission of the Copernicus initiative a relevant choice for earth surface observation and analysis including the study of Geomorphology and land Deformations.

- Necessity of automatic processing of time-series of S1 amplitude for motion pattern estimation.
- Ability to track several motion types(rigid, non-rigid) over different space and time scales thus using different matching strategies.
- HPC calculation adaptation.

Objectives

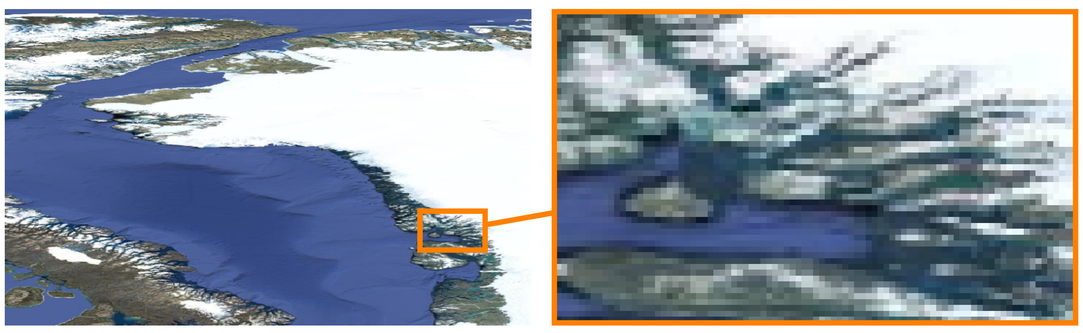
The aim of this work is to have a workflow including:

- **Co-registration**
  - This step develops upon an earlier algorithm [1] and its adaptation for exploiting Sentinel-1 SAR imagery.
- **Offset Tracking**
  - For this step, depending on the characteristics of motion, different Image matching techniques based on calculation of normalized cross correlation (NCC) measure or variations of Optical Flow offset-tracking is being utilized.
- **Motion Information Retrieval**
  - A combination of dimensionality reduction (DR) and clustering over a time-series of velocity maps are being utilized.

Level-1 Ground Range Detected (GRD)

products consist of *focused* SAR data which are *detected*, *multi-looked* and *projected* to ground range using an Earth ellipsoid model. The resulting product has approximately square spatial resolution pixels and square pixel spacing $\mathbf{(10x10)}m$, with reduced speckle at the cost of worse spatial resolution.

Dataset for Developement



(a) (b)

Figure: Rink Glacier (lat: 71 long: -52)

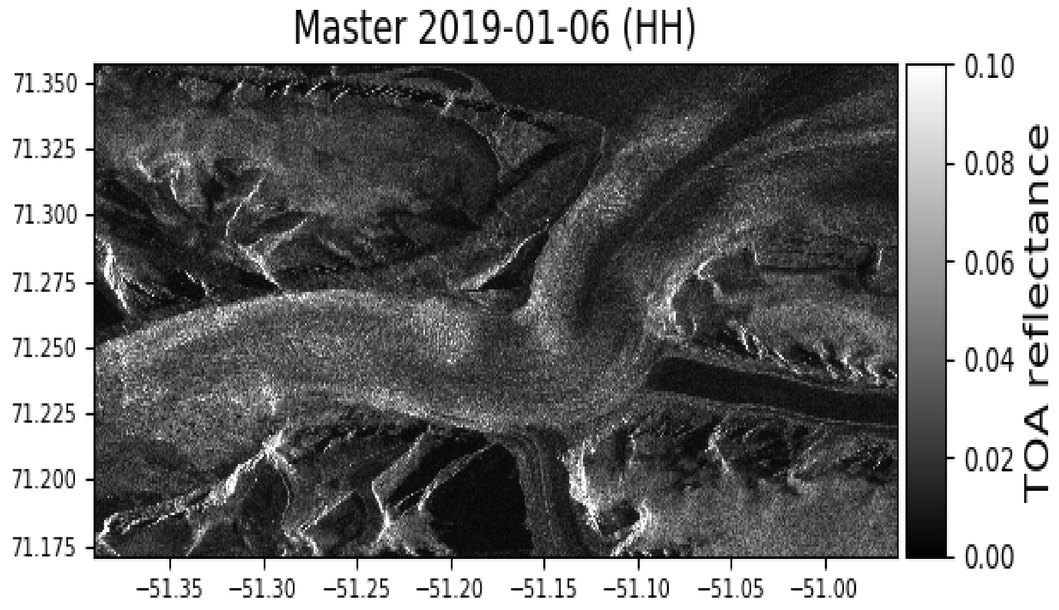
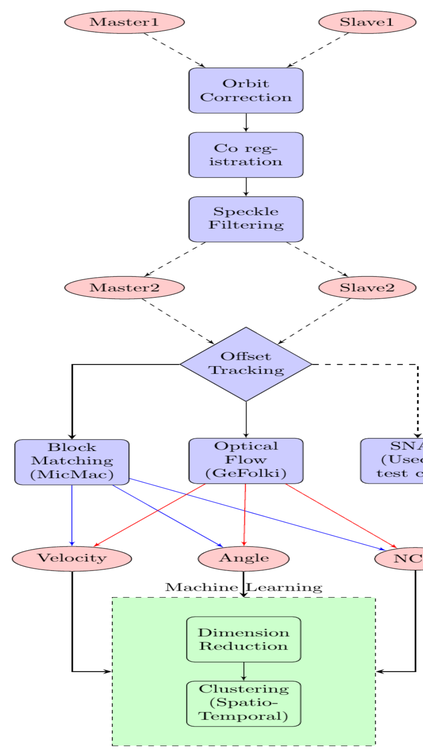


Figure: SAR amplitude image of the interesting area

Workflow



- Pre-processing
  - Orbit Correction
  - DEM assisted Co-registration
  - Terrain Correction
  - Speckle Filtering
- Offset Tracking
  - MicMac (Image Matching)
  - GeFolki (Optical Flow)
- Machine Learning
  - Dimensionality Reduction
  - Spatio-temporal Clustering for segmentation

Results: Implementation and Accuracy Evaluation

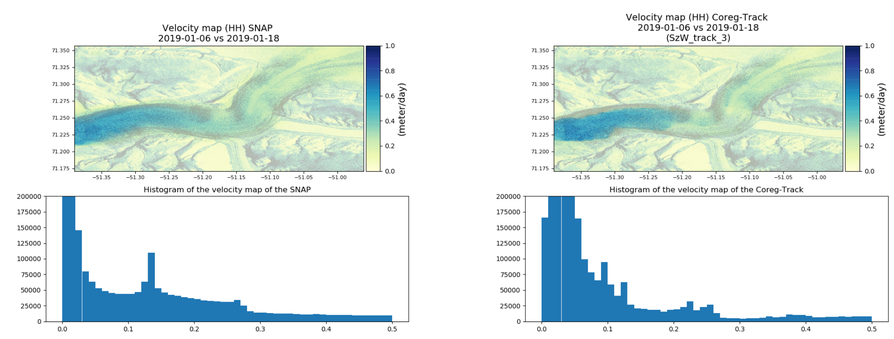


Figure: Velocity Maps produced by SNAP and coreg-track. (2019-01-06 vs 2019-01-18)

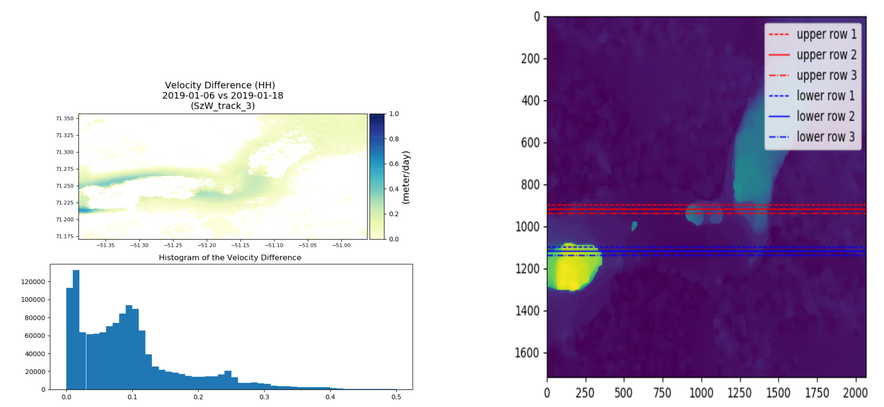


Figure: Norm of Velocity difference between SNAP and coreg-track.

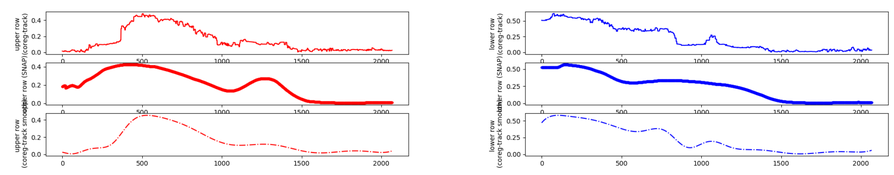


Figure: Cross-section comparison of the velocity profiles.

Conclusions

The comparisons of coreg-track with SNAP shows similarity between the performance of the two procedure. The interpretability of the results highly depends on the selection of the physically justified parameters.

References

[1] André Stumpf, David Michéa, and Jean-Philippe Malet. Improved co-registration of sentinel-2 and landsat-8 imagery for earth surface motion measurements. *Remote Sensing*, 10(2):160, 2018.

This research is funded by the Initiative of excellence of the University of Strasbourg.