Gftt: an open-source tool for evaluating remotely sensed glacier velocity products

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November 23, 2022

Abstract

Glacier velocity reflects the dynamics of ice flow, and its change over time serves a key role in predicting the future sea-level rise. Glacier feature tracking (also known as offset tracking or pixel tracking) is one of the most widely-used approaches for mapping glacier velocity using remote sensing data. However, running this workflow relies on multiple empirical parameter choices such as correlation kernel selection, image filter, and template size. As each target glacier area has different data availability, surface feature density, and ice flow width, there is no one-size-fits-all parameter set for glacier feature tracking. Finding an ideal parameter set for a given glacier requires quantitative and objective metrics to determine the quality of resulting velocity maps. The objective of our Glacier feature tracking test (gftt) project is both to devise a set of widely applicable metrics and to build a Python-based tool for calculating them. These metrics can be thus used for comparing the performance of different tracking parameters. We use Kaskawulsh glacier, Canada, as a test case to compare the velocity mapping results using Landsat 8 and Sentinel-2 images, various software packages (including Auto-RIFT, CARST, GIV, and vmap), and a range of input parameters. To begin with, we calculate random error over stable terrain, a metric that has been used for evaluating the uncertainty of the velocity products. We develop two other workflows for exploring new metrics and validating existing metrics, including the test with synthetic pixel offsets and the comparison with GNSS records. These existing and new metrics, calculated through the gftt software, will help determine optimal parameter sets for feature tracking of Kaskawulsh glacier and any other glacier around the world. This work is supported by the NSF Earth Cube Program under awards 1928406, 1928374.

Not sure about the **best settings** for mapping **glacier velocity** with satellite images?

GFTT has got your back.

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Bear by OpenClipart-Vectors from Pixabay; Smartphone icon by Freepik from Flaticon

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Want to explore more? https://whyjz.github.io/glacier-ft-test/

Introduction

Large-scale glacier velocity maps are often derived from satellite images using a technique called feature tracking. Both the image pre-processing and feature tracking parameters are highly adjustable. To determine which method(s) perform best in mapping glacier movement, we develop a software package called **"glacier feature tracking test" (GFTT)** to help quantitatively compare methods and assess uncertainties.

GFTT philosophy and features

- Open source, Python ecosystem, Jupyter Notebook workflows
- Assess feature tracking performance and good input parameters
- Metrics validated using field (GNSS) data and synthetic pixel offsets
- Only requires x and y velocity component files to run
- May be used for feature tracking results from any software

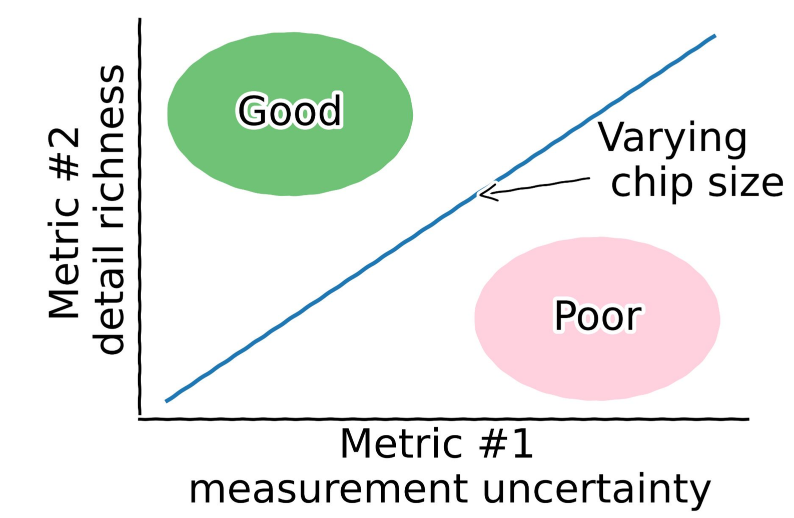

Fig 1. Using two metrics to assess good inputs: one evaluating uncertainty and the other evaluating detail richness. The blue line shows the effect of varying matching template size.

Determine ideal feature tracking parameters

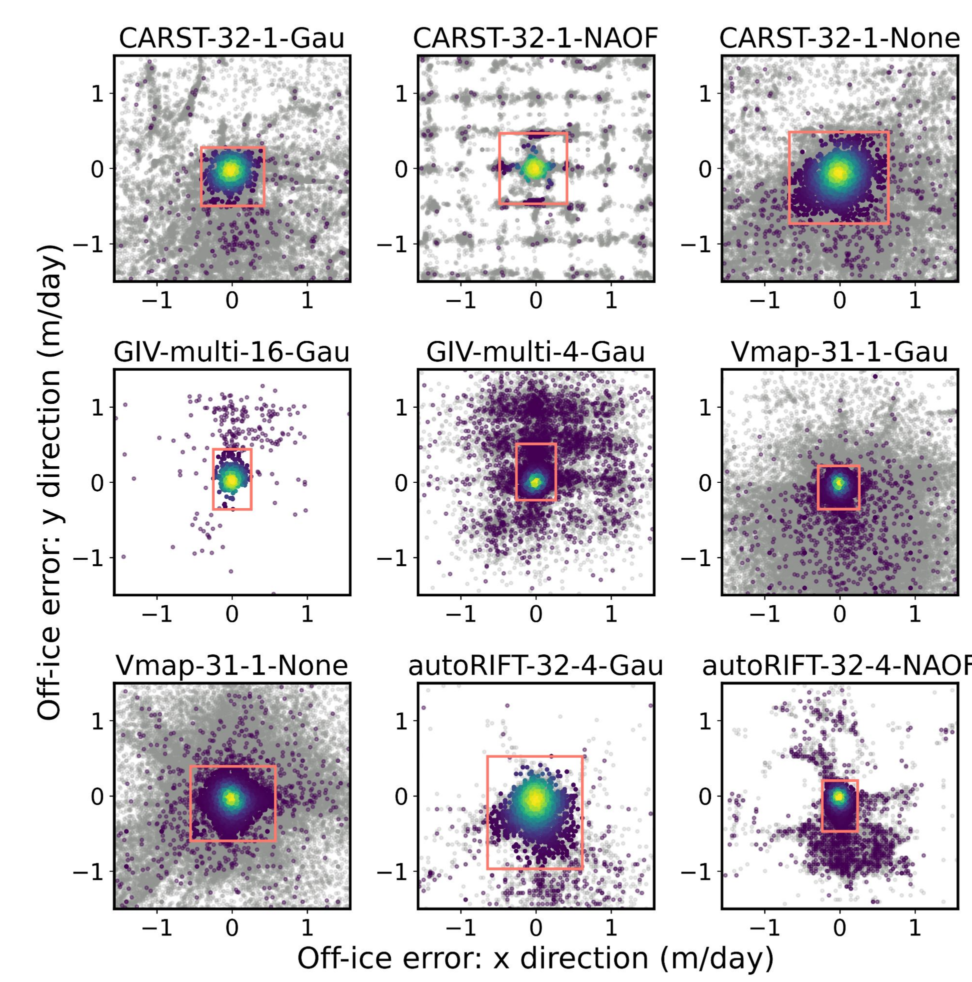

Fig 2. Representative tests for Kaskawulsh glacier, Canada, using the Landsat 8 20180304-20180405 image pair. Showing metric #1.

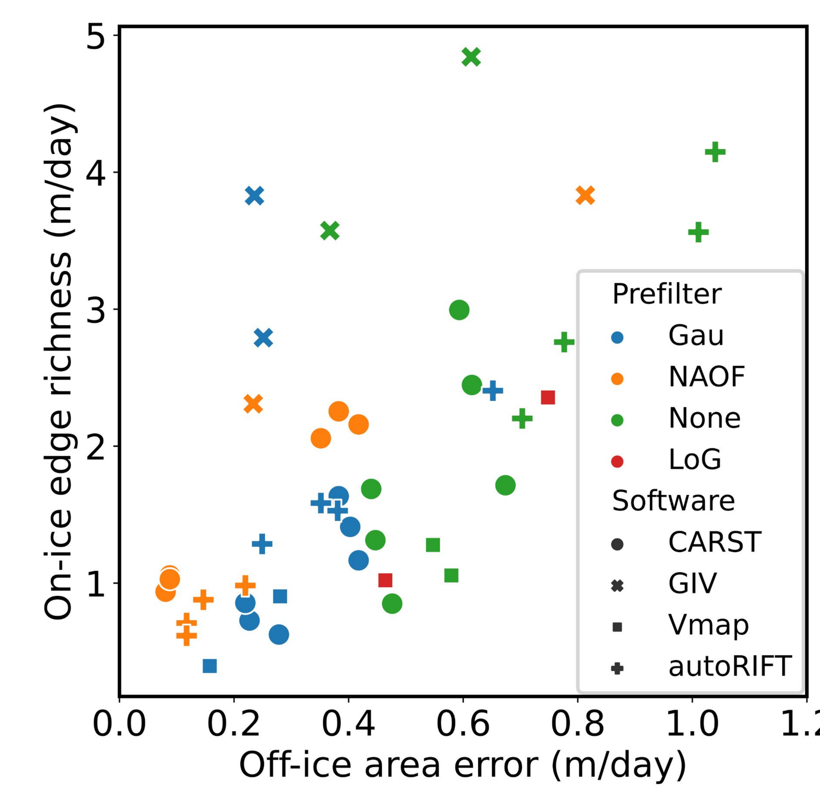

Fig 3. Same idea from Fig 1 but plotted with real data from Fig 2 and beyond (42 tests in total).

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