Long-term mass loss from the accumulation zone of the Llewellyn Glacier, SE Alaska

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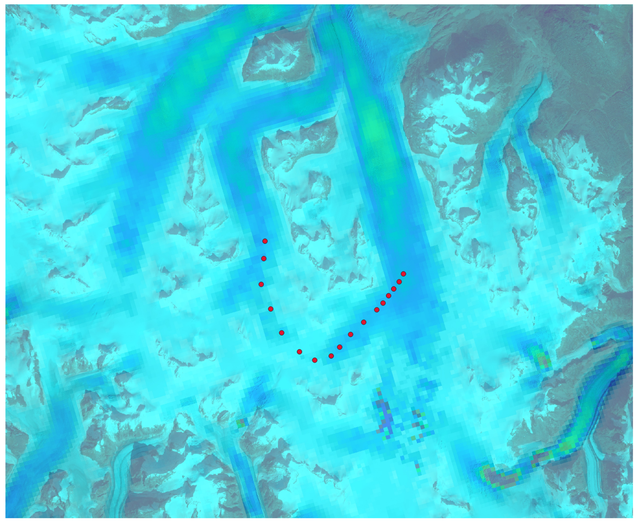
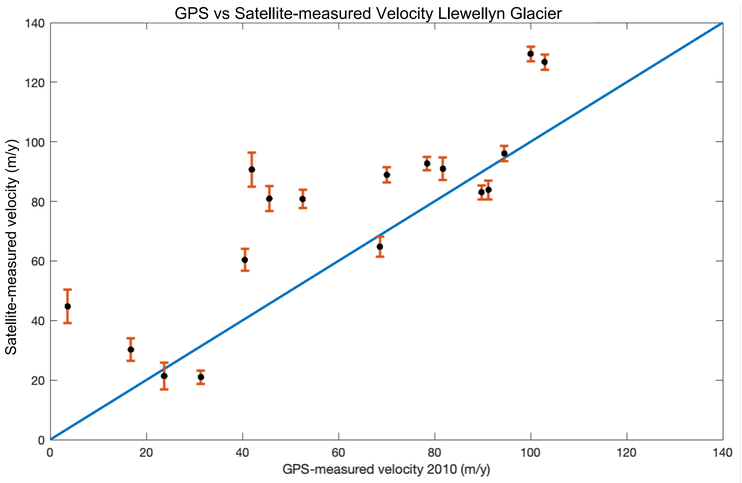
JIRP and the Long K Transect

The Juneau Icefield Research Program (JIRP) conducts regular fieldwork and monitoring across the Juneau Icefield in Alaska and British Columbia. In the summer, students, staff, and faculty complete a 75-mile ski traverse from Juneau, AK to Atlin, BC while engaging in fieldwork. Regular monitoring of the icefield has allowed for the development of an ongoing record of its properties including ice thickness and flow velocities. GPS surveys of the Llewellyn Glacier on the northeast end of the icefield are conducted annually by JIRP including in the 2023 field season. Here we report the results of the repeated 'Longitudinal K' transect across the high accumulation zone of the glacier. Surface elevation data has been collected along the Long K transect since 2010, and flow velocity measurements were conducted once in 2010.



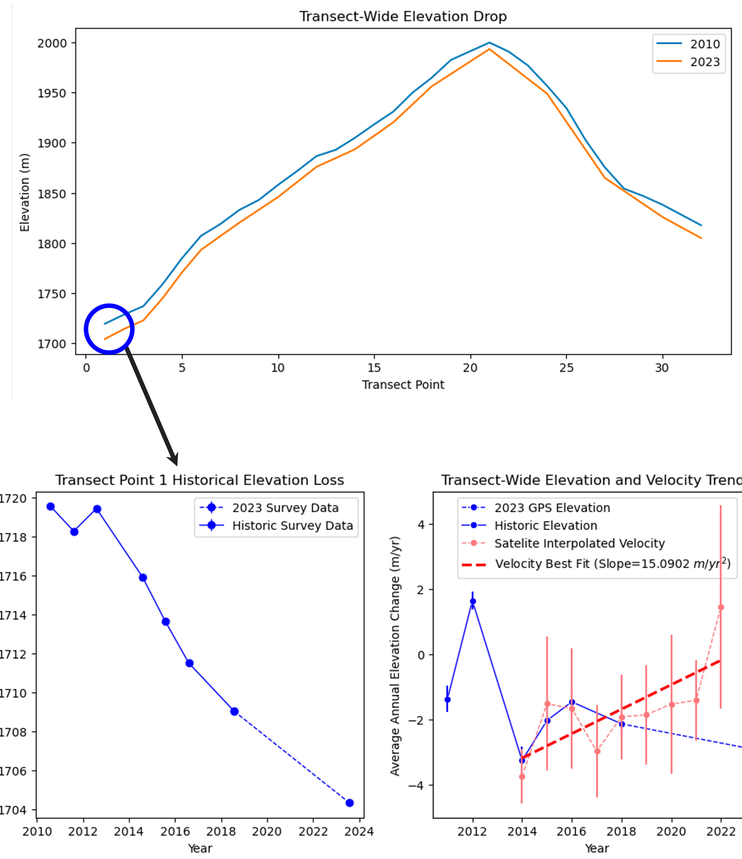
Satellite versus GPS-derived velocity

Satellite-derived velocity data products and mass loss estimates can be problematic when applied to slow-moving systems with smaller magnitude changes such as the accumulation zone of the Llewellyn Glacier of the Juneau Icefield. As a result, interannual variability may be systematically over or under predicted. Ground survey data has the potential to provide a long term, higher resolution record of slow but significant changes in the accumulation zones of glaciers. Here we compare satellite-based velocity data with GPS data collected in a 2010 ground survey across the Llewellyn Glacier.



Mass Loss in the Accumulation Zone

Glaciers are expected to gain mass in the accumulation zone. However, long term elevation change suggests mass loss in the accumulation zone of the Llewellyn Glacier. Although the volume of mass loss from this zone is typically lower than in other portions of the glacier, it is of particularly high consequence.



Even at its highest elevations, the Llewellyn Glacier demonstrates a significant decrease in surface elevation. Across the Long K profile, the glacier has lost an average of 11.9 m since 2010. Additionally, satellite-derived velocity shows that the surface velocity along the transect has almost doubled over this same period.

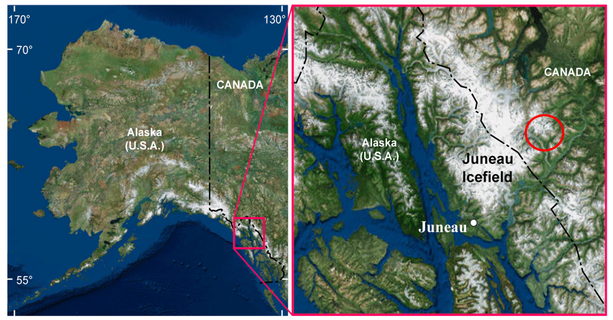
Photo taken during 2023 Long K GPS survey

Llewellyn Glacier accumulation zone

The Llewellyn Glacier

The Llewellyn Glacier is located on the Juneau Icefield in Southeast Alaska. It is the second largest glacier on the icefield, behind the Taku Glacier. In recent years, the Llewellyn has dramatically receded, leaving newly-formed glacial moraines in its wake. The widespread impacts of glacial melt are felt across ecosystems and communities, shaping the surrounding environment.

Llewellyn Glacier terminus



Location of Juneau Icefield and Llewellyn Glacier. Modified from USGS (2017). Map background: ESRI World Imagery.

Works Cited

"Velocity data generated using auto-RIFT (Gardner et al., 2018) and provided by the NASA MEaSUREs ITS_LIVE project (Gardner et al., 20XX)."

Future Work

Mass loss and flow velocity changes in the accumulation zones of glaciers will continue to be valuable indicators of how glacial systems are impacted by climatic changes. Using GPS data from ground surveys on the Llewellyn Glacier in conjunction with satellite imaging will provide higher resolution data which is valuable to assess small magnitude changes in glacier velocity and thickness. Additionally, repeated GPS surveys will enable more precise comparison of satellite trends versus ground survey data, providing additional insight into the reliability of satellite-derived velocity products for slow-moving glaciers.

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