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Outlet-glacier flow dynamics estimation combining in-situ and spaceborne SAR measurements

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Terminus retreat and flow acceleration changes of ocean-terminating outlet glaciers contribute significantly to the current mass loss of the Greenland Ice Sheet and therefore to global sea level rise. In order to constrain models ice dynamics, detailed knowledge of geometry, ice-flow velocity and strain fields of such calving glaciers is needed. Of specific importance is the near terminus flow dynamics, as the flow fields there are highly influential on the glacier's calving rate. With the current temporal resolution of spaceborne radar systems, it is difficult to accurately capture the near terminus flow fields for fast moving outlet glaciers glaciers, while in-situ measurements using ground based radar interferometers are limited in coverage and constrained by distance and geometric shading of the glacier.
We present and analyze the combined continuous velocity fields from a ground based, portable radar system as well as from spaceborne SAR scenes for Eqip Sermia, a medium-sized ocean terminating outlet glacier in western Greenland. The flow fields for the spaceborne data are calculated using feature tracking with a temporal resolution of 12 and 24 days for Sentinel-1 (Interferometric Wide Swath) and RADARSAT-2 (Ultra Fine/Fine Quad) respectively. The in-situ terrestrial radar data were recorded at one minute intervals were additionally processed using interferometry.
The combination of in-situ and spaceborne radar enables a spatially continuous assessment of the strain fields of the ocean terminating outlet glacier. An assimilation of the data based on areas with both in-situ and spaceborne measurements is carried out and the results are compared to historical strain field data sets. These data ultimately provide constraints for a physical fracture and damage model.