Advanced Ice Velocity Mapping Using Landsat 8

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Improved image-to-image cross correlation software is applied to pairs of sequential Landsat 8 satellite imagery to accurately measure ice surface velocity over ice sheets and glaciers (± 0.1 pixel displacement, 15 m pixels). The high radiometric fidelity of Landsat 8's panchromatic band (12-bit), and exceptional geolocation accuracy (typically ± 5 m) supports the generation of ice velocity fields over very short time intervals (e.g., 16-, 32-, 48-day repeat cycles of the same scene location). The high radiometry supports velocity mapping in areas with very subtle topographic detail, including un-crevassed sustrugi regions on ice dome flanks or the ice sheet interior. New Python-based software presently under development (named PyCorr) takes two sequential Landsat 8 OLI scenes (or suitably processed ETM+ or TM scenes) and matches small sub-scenes ('chips') between the images based on similarity in their gray-scale value patterns, using an image correlation algorithm. Peak fitting in the region of maximum correlation for a chip pair yields sub-pixel fits to the feature offset vector. Vector editing after the image correlation runs seeks to eliminate spurious and cloud-impacted vectors, and correct residual geolocation error. This processing is based on plausible values of ice strain rates and known areas of near-zero ice flow (rock outcrops, ice dome areas, etc.). In preliminary processing, we have examined ~800 Landsat 8 image pairs having <20% cloud cover spanning the near-coastal Antarctic ice sheet during the 2013-14 summer season.