Assessing ICESat-2 vertical accuracy on ice sheets with GNSS-IR

Authors: Bailey Mullett, Matthew R. Siegfried, Wilson Sauthoff

NASA's Ice, Cloud, and land Elevation Satellite 2 (ICESat-2) has been operating since September 2018 and provides global elevation data using a laser altimeter. Over the Earth's ice masses, the ICESat-2 mission success criteria require 0.05 m accuracy on 25 km by 25 km spatial scales in low-slope environments and elevation bias monitoring at 0.02 m/a or better. Here we develop a method for using global navigation satellite system interferometric reflectometry (GNSS-IR), a novel method for estimating snow-surface height from reflected GNSS signals, to assess the accuracy of ICESat-2 height retrievals over the Earth's ice sheets. We combine GNSS antenna reflector heights derived from patterns of interference between direct and surface-reflected GNSS signals (recorded in the signal-to-noise ratio) with traditional GNSS positioning to derive a high precision estimate of the snow-surface height. We compare this in situ surface-height estimate to temporally coincident ICESat-2 laser altimetry data surrounding the GNSS site. Our ground truth framework provides a path forward for using GNSS networks for high-precision validation of present and future satellite elevation datasets.