



GREENLAND ICE SHEETS

Howat, Noh build algorithm to generate digital surface model mosaics

Using the computing power at the Ohio Supercomputer Center, researchers at The Ohio State University are constructing a first-of-its-kind, time-stamped, high-resolution digital surface model of the Greenland Ice Sheet.

The vast body of ice – which covers roughly 80 percent of Greenland’s surface – is of particular scientific interest. With record melting in recent years, the ice sheet is likely to contribute substantially to sea level rise.

“Digital surface models such as the one we are creating for the Greenland Ice Sheet will be transformational in glacier and climate-change related studies,” said Ian Howat, associate professor at Ohio State’s School of Earth Sciences. “It will provide a complete benchmarking map of the ice sheet that can be compared to both past and future measurements from various altimetry data.”

Current digital surface maps, which create 3-D representations of the terrain’s surface from elevation data, have resolutions of only 10’s to 100’s of meters, with a vertical accuracy comparable to the resolution. Additionally, they lack a definite time stamp, hindering comparative studies.

This new model builds on previous work by Howat and his Byrd Polar Research Center colleague Myoung-Jong Noh. They successfully demonstrated that their Surface Extraction from Tin-based Search Minimization (SETSM) algorithm could automatically generate high-quality digital surface model mosaics

over large regions, at very fine resolutions. Using data from Worldview 1 and 2 satellites, which take new photos of any place on Earth every 1.1 days, the algorithm retrieved high-quality elevation data over a range of terrains, from very high relief mountain areas to flat expanses of the ice sheet.

“Our test data production revealed a major benefit of our approach: the high-resolution imagery enables surface extraction over relatively featureless expanses of ice and snow, including the interior of glaciers and ice sheets,” Howat said.

SETSM’s search minimization strategy enabled this result, in tandem with the very high spatial resolution and 11-bits-per-pixel of the Worldview imagery, which captures subtle features such as wind patterns in the snow and variations in grain size.

“This is a major breakthrough because conventional imagery and digital surface model extraction methods fail in these areas,” Howat added. “When our project is complete, we will have constructed a 3-D model of the Greenland Ice Sheet that will provide a major data set for polar and climate-change related studies.”

Above and Cover: Howat’s team applied their software to produce a complete Digital Surface Model of the Greenland Ice Sheet and its periphery at two-meter resolution. The process produced this visualization of the crevassed, tidewater glaciers of the Uummannaq region in coastal Greenland.

