Geophysical Research Abstracts
Vol. 14, EGU2012-9677, 2012
EGU General Assembly 2012

A New Design for Digital Elevation Models of Bedrock Underlying Ice Sheets

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Proper knowledge of bedrock topography is an important prerequisite in order to model ice sheet behavior and estimate their future contribution to sea level rise. Today, 5-km resolution Digital Elevation Models are commonly used by modelers to obtain bedrock elevation on their grid nodes.
This chosen resolution is questionable since most of the ice outflow goes through outlet glaciers whose size is of a similar order of magnitude, leading modelers to refine their grid with maximum mesh resolution of the order of 100 m.

In this study we show that using current 5-km regular DEMs requires an 'undermeshing' interpolation that can locally lead to up to 100% relative error on the ice thickness value as well as opposite directions of the bedrock slope. The sensitivity of such changes on 3D dynamics is also investigated emphasizing the need to rely on more constrained dataset.

We propose to modify the way DEMs are processed, moving from static DEMs with interpolated data on a regular mesh to more flexible ones that return a direct interpolation at the precise locations required by the user mesh. An illustration with the Astrolabe Glacier drainage basin (East Antarctica) is described, based on intensive ice thickness radar measurements that have been performed over the last 3 years. An application under the form of a web interface is proposed to demonstrate the feasibility of our procedure.