Geophysical Research Abstracts
Vol. 14, EGU2012-9862, 2012
EGU General Assembly 2012

Resolving grounding line ambiguities around Antarctica from inter-comparison and driving stress mapping

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Delineating the Grounding Line (GL) in Antarctica is a challenging issue. The accurate positioning of the GL is crucial to ice sheet and GL migration modelling, to mass budget calculation of ice sheets, as well as to the planning of an Ice Penetrating Radar (IPR) or an ice coring campaign. Efforts into defining and mapping the GL have been made using a range of methodologies. Here, we analyse different GL data sets based on optical imagery, satellite altimetry, and SAR interferometry. We use driving stress mapping derived from a 1km DEM to investigate and resolve discrepancies in GL positioning around Antarctica from different methods. Typical driving stresses are calculated at GL for different ice dynamics and regions of Antarctica. The benefit of our approach to slope based technique is that we identify patterns and not only sharp linear transitions. Driving stress mapping allows us to discriminate between grounded and floating ice in a quantitative manner, as opposed to subjective interpretation. We also detect ice plains that have been reported and suggest the existence of new ones along the Siple Coast.

While the various data sets agree on slow moving ice within a few kilometres, we find that the only reliable technique to delineate GL on fast flowing ice is Differential SAR Interferometry (DInSAR). DInSAR GL data, however, are not available everywhere as they require at least two SAR image pairs. ICESat repeat tracks of the grounding zone can help in certain places but coverage is discreet and scarce for fast moving ice. We find that the Antarctic Surface Accumulation and Ice Discharge (ASAID) GL usually does a better job than MOA GL on fast flowing features.