A high-resolution bedrock map for the Antarctic Peninsula

Matthias Huss (1,2) and Daniel Farinotti (3)

(1) Department of Geosciences, University of Fribourg, Fribourg, Switzerland (matthias.huss@unifr.ch), (2) Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETH Zurich, Zurich, Switzerland, (3) German Research Centre for Geosciences (GFZ), Potsdam, Germany

Glaciers on the Antarctic Peninsula show a high sensitivity to changed climatic and oceanic conditions and are expected to significantly contribute to sea-level rise over the next decades. So far, the best bedrock data set for the region is the recently released Bedmap2 providing ice thickness on a 1 km grid. Whereas for large-scale ice sheet modelling the spatial resolution provided by Bedmap2 is sufficient, detailed considerations of surface mass balance, ice flow and grounding line dynamics of Antarctic Peninsula glaciers necessitate the application of models that are able to cope with the high spatial variability of the governing processes. For ice flow models used to predict future glacier response to climate change and/or ice shelf break-off, a high-resolution bedrock topography is required as an essential boundary condition.

Here, we derive a complete bedrock data set for the Antarctic Peninsula north of 70°S on a 100 m grid. We further develop an established method to invert surface topography using simple ice dynamic modelling to obtain distributed ice thickness. Our approach makes use of a high-resolution digital elevation model, catchment boundaries for all glaciers of the Peninsula, and RACMO-based surface mass balance data. The results are constrained with all available thickness measurements from Operation IceBridge and gridded ice flow speeds for the entire study region.

The new data set resolves the rugged subglacial topography in great detail, indicates deeply incised troughs with thicknesses of up to 1500 m, and shows that 32% of the ice volume is grounded below sea level. The Antarctic Peninsula has the potential to raise global sea level by 71.9±5.8 mm. In comparison to Bedmap2 we find a significantly higher mean ice thickness (+47%) which is attributed to the approach used to calculate thickness in regions not covered with direct measurements. Our high-resolution bedrock data set offers new possibilities for studying the contribution of the Antarctic Peninsula to sea-level rise with state-of-the-art glacier models.