

## The required model resolution for resolving the SMB of the Greenland Ice Sheet

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For reliable estimates of past, current and projected mass changes of the Greenland Ice Sheet and its peripheral glaciers and ice caps, the surface mass balance (SMB) must be determined with sufficient spatial detail, which could be carried out with a global or regional climate model or statistical downscaling. This raises a number of questions: Which resolution is sufficient? Which method is appropriate for the SMB refinement at this resolution? Can we assess which method is most accurate?

In order to answer these questions, the polar version of the regional climate model RACMO2.3 is run at 4 different resolutions ranging from 2.2 to 60 km for South Greenland. The results of these runs are statistically downscaled. Analysis of the downscaled products from various model resolutions shows that statistical downscaling improves the estimates of runoff and hence of SMB compared to interpolation, but has no beneficial effect on the other SMB components. From the comparison with observations it can be concluded that 20 km resolution is sufficient to represent the ice sheet accumulation zone. In the ablation zone, RCMs outperform statistical downscaling although the performance gain for a certain refinement factor decreases for finer resolutions. Furthermore, we show that for RCMs run at resolutions finer than 20 km, snow pack initialization, snow model tuning and cloud physics are of equal importance for the quality of model results as resolution.