NHM-SMAP 極域気候モデルで計算されたグリーンランド氷床表面質量収支の初期評価結果

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Initial evaluation of the NHM-SMAP-simulated surface mass balance of the Greenland ice sheet

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We present initial evaluation results of the Greenland ice sheet (GrIS) surface mass balance (SMB) simulated by the NHM-SMAP (Non-hydrostatic atmospheric model – Snow Metamorphism and Albedo Process) regional climate model (RCM). The atmospheric part of the NHM-SMAP is Japan Meteorological Agency's operational regional atmospheric model JMA-NHM (Saito et al., 2006), while temporal evolution of physical states of snow and ice are calculated by the physical snowpack model SMAP (Niwano et al., 2015). The GrIS area set in the NHM-SMAP is 1807228 km^2. The Characteristics of temporal evolution of the GrIS SMB simulated by the prototype NHM-SMAP (Fig. 1a) are basically as same as results from other existing RCMs; however, orders of the accumulated SMB at the end of each mass balance year are different from previous studies: the NHM-SMAP tends to simulate lower SMB compared to other models in general. One possible reason is that the GrIS area employed by the NHM-SMAP (mentioned above) are a bit larger than other models, which implies that more ablation area is considered by the model. In addition, it has been clarified that choice of the vertical water movement scheme significantly affects the SMB estimates. Figure 1b compares modeled SMB obtained by the NHM-SMAP with the realistic Richards equation (RE) scheme and the simple so-called "bucket" scheme (melt water can fill up to 6 % of the pore volume) during the 2011-2012 mass balance year. When the RE scheme is employed, mass loss is enhanced by about 200 Gt compared to the results by the bucket scheme. The RE scheme tends to allow more water retention in the near-surface layer, which often develop ice layers near the surface. Therefore, more melt water tends to runoff from relatively upper layers compared to the results with the bucket scheme. In the presentation, we will also discuss adequacy of the NHM-SMAP-simulated SMB by comparing against in-situ measurements.

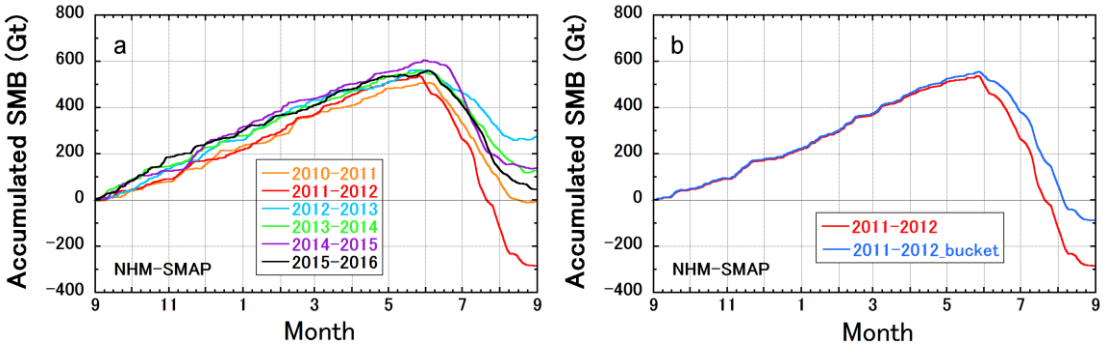

Figure 1. The NHM-SMAP-simulated (a) accumulated GrIS SMB during the 2010-2016 mass balance years, and (b) comparison of the model simulated accumulated SMB during the 2011-2012 mass balance year, where vertical water movement in snow and firn are calculated by the Richard equation (red solid line) or the bucket scheme (blue solid line) in the SMAP model.

References

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