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Evaluating the performance of the REMBOv2 over Greenland for present-day and future scenarios

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The intermediate complexity regional climate and surface mass balance model REMBOv2 (version 2) has been developed for studying the medium and long-term evolution of ice sheets. It is computationally efficient, allowing large-ensemble paleo and future simulations on multi-millennial time scales. Compared with its predecessor, REMBOv2 includes an improved representation of precipitation and the surface energy balance, both of which are critical for determining the surface mass balance of an ice sheet. Here we describe the key model components and validate the model's performance against observations and regional climate model results. We also highlight the advantages of the new version compared to previous approaches. We show that on a climatological scale (decadal to multi-decadal average), REMBOv2 is able to reproduce important features of the climate and surface mass balance over the Greenland ice sheet. We also perform an ensemble of projections for the 21st century forced by GCM boundary conditions. While uncertainty exists in the near-term projection of sea level rise, the absolute contribution from Greenland's surface mass balance is likely to be relatively small on this time scale. However, we also show the trend in surface mass balance of individual regions of Greenland. We find that if the surface mass balance turns negative in Northern Greenland, even while other regions remain positive, this has strong implications for the future stability of the ice sheet on longer time scales.