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Supraglacial lakes advance inland on the Greenland ice sheet under warming climate

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Supraglacial lakes (SGLs) form annually on the Greenland ice sheet and, when they drain, their discharge enhances ice-sheet flow by lubricating the base and potentially by warming the ice. Today, SGLs tend to form within the ablation zone,where enhanced lubrication is offset by effcient subglacial drainage. However, it is not clear what impact a warming climate will have on this arrangement. Here, we use an SGL initiation and growth model to show that lakes form at higher altitudes as temperatures rise, consistent with satellite observations of their distribution in cooler times. Our simulations show that in southwest Greenland, SGLs spread 103 to 110 km further inland by the year 2060 under moderate (RCP 4.5) and extreme (RCP 8.5) climate change scenarios, respectively, leading to an estimated 48–53% increase in the area over which they are distributed across the ice sheet as a whole. Up to half of these new lakes may be large enough to drain, potentially delivering water and heat to the ice-sheet base in regions where subglacial drainage is inefficient. In such places, ice flow responds positively to increases in surface water delivered to the bed through enhanced basal lubrication and warming of the ice which suggests that projections of the ice-sheet dynamical imbalance should be revised to account for this expected evolution in SGL distribution.