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Initiating the Northeast Greenland Ice Stream with Geothermal Heat

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The Northeast Greenland Ice Stream (NEGIS) currently drains more than 10% of the area of the Greenland Ice Sheet, making it an important feature to simulate when assessing the potential future contribution of Greenland to sea level rise. At present, NEGIS is mostly reproduced in ice sheet models by inferring for basal conditions using observed surface velocities. NEGIS is suggested to be triggered by a geothermal heat flux anomaly at the ice divide. However, the heat flux underneath the ice sheet is largely unknown, except for a few direct measurements from deep ice core drill sites. Models point to a geothermal heat flux anomaly left behind by movement of Greenland over the Icelandic plume. Using the Ice Sheet System Model (ISSM), with ice dynamics coupled to a subglacial hydrology model, we investigate the possibility of initiating NEGIS by inserting various hotspot configurations with values ranging from 120 mW/m2 (Dahl-Jensen et al. 2017) to 917 mW/m2 (Fahnestock et al. 2001). When inserting the hotspot, we observe a shift in the thermal regime from cold to thawed, followed by an acceleration of the system. The hotspot impacts the downstream flow of the ice in broadly the same region as the present day NEGIS. By including high geothermal heat flux, and the effect of water on sliding, we are one step closer to representing NEGIS in ice sheet models.