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## Basal Melt of the Greenland Ice Sheet: The Invisible Mass Budget Term

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The Greenland ice sheet has been one of largest sources of sea-level rise since the early 2000s. The total mass balance of the ice sheet is typically determined using one of the following methods: estimates of ice volume change from satellite altimetry, measurements of changes in gravity, and by considering the difference between solid ice discharge and surface mass balance (often referred to as the input–output method). In spite of an overall agreement between the different methods, uncertainties remain regarding the relative contribution from individual processes, and to date the basal melt has never been explicitly included in total mass balance estimates. Here, we present the first estimate of the contribution from basal melting to the total mass balance. We partition the basal melt into three terms; melt caused by frictional heat, geothermal heat and viscous heat dissipation, respectively. Combined, the three terms contribute approximately 25 Gt per year of basal melt to the total mass loss equivalent to 5% of the average solid ice discharge (average value of 1986-2018 discharge). This is equivalent to the ice discharge from the entire northeastern sector. We find that basal melting also accounts for between 5% and 30% of observed thinning in most major glacier outlets. Over our observation period (winter 2017/18), close to 2/3 of the basal melt is due to frictional heating from fast moving ice. This term is expected to increase in the future, as ice streams are likely to expand and speed up in response to rising temperatures.