

Rapid ablation zone expansion amplifies north Greenland mass loss

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Since the 1990s, large-scale summertime circulation change in the Arctic, promoting southwesterly advection of warm air, has significantly raised atmospheric temperatures (+0.9°C) over the Greenland ice sheet (GrIS). As a result, the GrIS has been losing mass at an accelerating pace, mainly due to enhanced runoff of meltwater. Here we show that a pronounced latitudinal contrast exists in the GrIS response to recent circulation changes. In the southwest, persistent high atmospheric pressure reduced cloud cover, increasing runoff through enhanced absorption of incoming solar radiation; in contrast, increased summer cloudiness in northern Greenland triggered atmospheric warming through decreased longwave heat loss. Rapid snowline retreat in summer prevents active refreezing of percolating meltwater and causes early exposure of dark, bare ice, amplifying runoff. As a result, the northern ablation area has expanded by 46% post-1990, enhancing the relative contribution of the northern ice sheet to total GrIS mass loss.