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Clouds enhance Greenland ice sheet meltwater runoff

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The Greenland ice sheet has become one of the main contributors to global sea level rise, predominantly through increased meltwater runoff. The main drivers of Greenland ice sheet runoff, however, remain poorly understood. Here we show that clouds enhance meltwater runoff by about one-third relative to clear skies, using a unique combination of active satellite observations, climate model data and snow model simulations. This impact results from a cloud radiative effect of 29.5 ($\pm$5.2) W m^{-2}. Contrary to conventional wisdom, however, the Greenland ice sheet responds to this energy through a new pathway by which clouds reduce meltwater refreezing as opposed to increasing surface melt directly, thereby accelerating bare-ice exposure and enhancing meltwater runoff. The high sensitivity of the Greenland ice sheet to both ice-only and liquid-bearing clouds highlights the need for accurate cloud representations in climate models, to better predict future contributions of the Greenland ice sheet to global sea level rise.