

Abstract Submitted
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Meltwater percolation and refreezing in compacting snow¹ COLIN MEYER, Harvard University, IAN HEWITT, Oxford University — Meltwater is produced on the surface of glaciers and ice sheets when the seasonal surface energy forcing warms the ice above its melting temperature. This meltwater percolates through the porous snow matrix and potentially refreezes, thereby warming the surrounding ice by the release of latent heat. Here we model this process from first principles using a continuum model. We determine the internal ice temperature and glacier surface height based on the surface forcing and the accumulation of snow. When the surface temperature exceeds the melting temperature, we compute the amount of meltwater produced and lower the glacier surface accordingly. As the meltwater is produced, we solve for its percolation through the snow. Our model results in traveling regions of meltwater with sharp fronts where refreezing occurs. We also allow the snow to compact mechanically and we analyze the interplay of compaction with meltwater percolation. We compare these models to observations of the temperature and porosity structure of the surface of glaciers and ice sheets and find excellent agreement. Our models help constrain the role that meltwater percolation and refreezing will have on ice-sheet mass balance and hence sea level.

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