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An implicit physical water percolation model

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The parametrization in numerical models of the behavior of water in snow is either oversimplified - the bucket method – or hugely complicated – the Richardson equation. The latter faithfully resembles the general behavior of water in snow, when a dual domain approach, representing slow matrix and fast preferential flow, is taken. However, this type of models are unsuitable for application in climate models due to their high computation costs.

Therefore, an implicit Richardson equation model is developed, which is able to run on time steps of several minutes, typical for climate models, and snow layer thickness down to a few centimeters. In order to reach to a differentiable governing equation, required for iterative implicit time stepping, with as few as possible discontinuities in the derivatives, favorable for convergence, modifications are made in the governing equations when the water content approaches the irreducible water content or water almost fills the available pore space. Here, we show the first results of this model, with a focus on the impact of parameterization choices on the modelled water flow, refreezing profile and melt water buffering capacity.