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Numerical simulation of the dynamics of a glacier using a "volume-of-fluid" formulation.

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We propose a novel Eulerian algorithm to compute the changes of a glacier geometry for given mass balances. The surface of the glacier is obtained by solving a transport equation for the Volume Of Fluid (VOF) function. The surface mass balance is taken into account by adding an interfacial term in the transport equation. Two different meshes are used. An unstructured mesh with standard stabilized finite elements is used to solve the non linear Stokes problem. The VOF function is computed on a structured grid with high resolution. From a numerical point of view, the scheme is unconditionally stable without any restriction of the CFL number, and it conserves mass to high accuracy. This method is well suited to simulate the motion of a glacier during a long period. Indeed, since the meshes are fixed, no re-meshing procedure is needed. Moreover, the VOF model allows complex topological shapes to be handled. The potential of the algorithm is demonstrated with an application to reconstructed late glacial states of a glacier, Vadret Muragl, in the Swiss Alps. Our goal is to find a set of climatic data for which the shape of the glacier fits the moraines that have been observed. This could provide information about the climate during the moraines formation.