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Modeling of snow avalanche dynamics using open source software OpenFOAM

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The work is devoted to the comparison of different approaches for modeling the dynamics of dense and powder snow avalanches. Various 3D and 2D approaches are considered. The accuracy of determining the avalanche run-out zone, the interaction of the flow with obstacles, the front speed, and various distributed parameters are evaluated. As objects for comparison, an experiment on the interaction of a slushflow with a combination of protective structures and a powder snow avalanche in the Khibiny mountains are modeled.

Taking into account the advantages and disadvantages of various approaches based on basic solutions available in the OpenFOAM package, a specialized software avalancheFoam is being developed for three-dimensional modeling of the dynamics of snow avalanches, taking into account the complex turbulent regime and multiphase structure of the flow. Machine learning techniques are used to refine turbulent stresses. The neural network is trained on a dataset obtained from high-precision supercomputer simulation of the flow, and sets the form of additional refinement members of the mathematical model of less computational complexity. Various avalanche sites in the Khibiny mountains are modeled to validate the developed software.