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Modelling snow avalanches dynamics by Cellular Automata: a case study in Davos (Swiss Alps)

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A Cellular Automata model was developed for modelling the flow of snow avalanches. The model is based on SCIDDICA SS2, a numerical code recently developed for the simulation of subaerial and subaqueous flow-like landslides. Basically, the model is based on a regular division of the space in cells, each one embedding an identical finite automaton (fa), whose state accounts for the features attributed to the cell. The fa input is given by the states of neighbouring cells. Mass movement from one cell to another is ruled, step by step, by specific transition functions. The model is able to simulate the dynamics of avalanches flowing over a real 3D topography and to determine the final runout, the final deposit distribution as well as several features of the mass during the propagation (i.e. velocity, thickness, snow cover entrainment, energy etc). Erosion and entrainment of mass during the flow are computed by the model when the kinetic head value exceeds an opportune threshold which depends on the snow cover features. Then a mobilisation of the snow occurs proportionally to the quantity overcoming the threshold. The model was validated and calibrated by back-analysing real events that occurred in the Davos area, eastern Swiss Alps, during the winter 2005/2006. Detailed data of snow avalanches were available, among them the release area and volume, avalanche path, the spatial distribution and local thickness of the final deposit, the snow density in the snow cover and in the deposit. Furthermore, in a few cases the propagation velocities could be estimated at specific points. The simulated avalanches comprise both open-slopes and channelled flows, snow-cover entrainment occurred in all of them, and in several cases traces of fluidized flow were detected. However, the model simulates, as first attempt, only dense flows. Simulation results will be presented for two selected events which permitted to demonstrate the efficiency of the model.