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The Savage-Hutter model for the avalanche dynamics in inclined channels: analytical solutions

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The Savage-Hutter model is applied to describe gravity driven shallow-water flows in inclined channels of parabolic-like shapes modeling avalanches moving in mountain valleys or landslide motions in underwater canyons. The Coulomb (sliding) friction term is included in the model. Several analytical solutions describing the nonlinear dynamics of avalanche are obtained: the nonlinear deformed (Riemann) wave, the dam-break problem, self-similar solutions and others. Some of them extend the known solution for an inclined plate (1D geometry). The cross section shape of the inclined channels significantly influences the speed of avalanche propagation and characteristic time of dynamical processes. Obtained analytical solutions can be used to test numerical models and to give insights into the structure of avalanche flow and to highlight basic mechanisms of avalanche dynamics.