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# Mathematical modeling of slope flows with entrainment as flows of non-Newtonian fluids

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Non-Newtonian fluids in which the shear stresses are nonlinear functions of the shear strain rates are used to model slope flows such as snow avalanches, mudflows, debris flows. The entrainment of bottom material is included into the model basing on the assumption that in entraining flows the bed friction is equal to the shear stress of the bottom material (Issler et al, 2011). Unsteady motion down long homogeneous slopes with constant inclines is studied numerically for different flow rheologies and different slope angles. Variation of the velocity profile, increase of the flow depth and velocity due to entrainment as well as the value of the entrainment rate is calculated. Asymptotic formulae for the entrainment rate are derived for unsteady flows of different rheological properties.

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