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Treatments of static friction force in numerical simulation for mass movements

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Authors proposed a set of constitutive equations based on kinematic energy balance in the sediment-water mixture flows such as debris flows, and suggested that Coulomb type's quasi-static friction stress were dominant. In case of debris flow over the erodible bed, the static friction stress should be balanced with the external shear stress on the bed surface and the depth averaged sediment concentration of the mixtures are uniquely determined by the bed slope. Therefore, the termination of debris flow usually appears as sediment deposition, and the equation of erosion/deposition rate is necessary to introduce into the governing equation set for numerical simulation. On the other hand, in case of soil block movement, the static friction stress is not in balance with the external shear stress on the bed surface and the movement can be treated as the movement of sediment-water mixture flow with some unchangeable sediment concentration over rigid bed. The termination of soil block movement appears as over all stopping. This means that the static friction stress changes discontinuously in the direction and the magnitude before and after the termination of movement. In present study, we will discuss the differences between debris flow and soil block movement and the terminations considering the difference of treatment of the static friction force on the bed surface.