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A velocity-displacement weakening rotational slider block model for rockslides

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We consider a simple rotational slider block model (with pore pressure) as in Brueckl and Parotidis [2004]. However, the relationship for the sliding velocity is here obtained through the Dieterich-Ruina law. In contrast to Sornette et al.[2004], we consider a function of rockslide displacement as a state variable, so as to take into account the dependence of the frictional coefficient on displacement weakening. The rotation of the rockslide mass leads to a decrease of the slope angle and the velocity a relationship, which is nearly linear. At the same time, the increase in the displacement leads to a weakening or smoothing of contact surfaces and hence to an increase in the velocity. We suggest an exponential relationship between frictional coefficient and displacement. These two factors are in competition. The first relationship is determined by pore pressure, geometrical parameters of rotational model and the initial frictional coefficient of the rockslide under consideration. The second factor is determined by the reduction rate of the frictional coefficient. The ratio of these factors will lead to either an acceleration or a deceleration of the movement. Finally, in our model, the velocity depends on the displacement and the equation describing this process can be analytically integrated. As a result, the displacement can be described by the inverse error function (shifted and scaled) of the time from the initiation of the rockslide. The shift and scale are determined by the parameters of the model. The inverse of the error function is nearly linear for arguments less then 0.8, but tends to infinity as the argument approaches 1. Thus, in cases where the range of possible displacements (from zero to maximum displacement in the lowest point of sliding) lies completely within the linear part of the inverse of the error function, the rockslide will be stable until the lowest point of sliding. Otherwise, after a critical displacement, it will be become unstable, with a very rapid acceleration of the displacement. The parameters necessary to

calculate the critical displacement can be derived from the geometry of the rockslide and the present day displacement and velocity. Furthermore the sensitivity of velocity versus pore pressure supplies additional data for the calibration of the model.