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Systematic investigation of slump source dynamics using viscoplastic models on tsunami generation

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In the present study, we analyse the influence of submarine slump source dynamics on tsunami generation. Slump induced tsunamis have traditionally been treated using block sources with prescribed velocities as tsunami sources, such as for describing the tsunami generation due to important historical events like the 1998 Papua New Guinea and the 1929 Grand Banks events. However, our intention is to model the slump motion as a viscoplastic flow where the material behaviour determines the landslide dynamics directly. To this end, we use a new landslide model labelled BingClaw that incorporates a Herschel-Bulkley rheology, formulated numerically in a depth-averaged Riemann formulation. For the wave propagation we use the Boussinesq equations including linear and dispersive effects, conveying the landslide tsunami generation using full potential flux sources. We alter mechanical soil parameters such as yield strength, dynamic viscosity, flow exponent, as well as sea bed inclination below the sliding mass, and show relations between these parameters, angular momentum and bed parallel velocity of the sliding mass, and frontal wave height. We illustrate that weaker sliding materials that have lower viscosity, lower yield strength, higher flow exponent, and higher sea bed inclination, generate higher frontal wave heights. Finally, we show that the wave generation correlates with kinematic properties such as the landslide angular momentum and spin, which indicate how the rotational motion of the slump is important for the wave generation.