The Dynamical Spring-slider Models of Earthquake Faults

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Abstract

Some intrinsic properties of the two-dimensional (2D) dynamical spring-slider model, subjected to linear slip- or velocity-weakening friction with a uniform, isotropic distribution of static friction strengths at all sliders and loaded by an external constant driving force are studied. First, the continuum model of the spring-slider model is constructed. A comparison between the continuum model, without the driving force and friction, and a 2D wave equation indicates that some of the model parameters are a function of elastic properties of fault-zone materials. The occurrence of P and S waves must be included in the model. Second, the velocities of waves propagating in the model are investigated for three cases: case 1 includes the external force but excludes friction; case 2 includes the external force and slip-weakening friction; and case 3 includes the external force and velocity-weakening friction. Analytical results show that there are two types of waves for the first two cases: P-type waves for case 1 and S-type waves for case 2. The velocity is higher for the former than the latter. The velocities for the two types of waves are increased when the external force is added. Slip-weakening friction results in a decrease in the velocities of the two types of waves. For case 3, there are three types of waves. Velocity-weakening friction makes the velocities of the first type of wave higher than the P-type wave velocity, while it makes the velocity of the second type of wave higher or lower than the S-type wave velocity, depending on the degree of weakening. The velocity of the third type of wave is lower than the P-type wave velocity and higher than the S-type wave velocity.