Can we estimate fault instability from prior phase of nucleation?

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We investigate the relation between interseismic stress accumulation and fault instability by numerically modeling of nucleation processes on a two-dimensional finite fault in a three-dimensional body. We assume an isolated circular homogeneous fault and the rate and state dependent friction law with both the aging and the slip types of the state evolution law. The parameter range in which we tried setting is \( \frac{a}{b} \geq 0.5 \). To focus on the “prior” phase of nucleation, we define \( S_c \) as a relative size of the locking center area to the whole fault, when the slip velocity on the inward creeping front reaches ten times as large as the loading rate. For the ordinary slip events, \( S_c \) can be expressed as a function of non-dimensional stability parameters, \( l_b \) and \( l_b - a \). Both parameters are proportional to the product of rigidity and \( L \), and inversely to the product of effective normal stress and fault radius. The former \( l_b \) is inversely proportional to \( b \), and the latter \( l_b - a \) is to \( b - a \). \( S_c \) is approximately given by \( 0.35(b_b)^{-1} \) and \( 0.35(l_b - a)^{-2} \) in case of the aging law and \( 0.003(b_b)^{-3} \) in case of the slip law. It implies that we can certainly estimate the fault instability (particularly \( l_b \)) from the area of the prior phase of nucleation. However, considering the results of the slow events in case of the aging law with \( 1.8 < l_b - a [b/(b - a)] \), the relation may not be rather simple, to our regret. For the same size of \( S_c \), there always appear two possibilities of the ordinary event and the slow event.