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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "An upper limit for slow earthquakes zone: self-oscillatory behavior through the Hopf bifurcation mechanism from a model of spring-block under lubricated surfaces" *by* Valentina Castellanos-Rodríguez et al.

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We appreciate all the comments and suggestions from the Anonymous Referee Num.1. These have been very supportive to improve the document. In response to the last comment we mentioned the following.

RC1 (Referee's comments): I take note of the authors' reply that the paper is a preliminary study that needs further refinements in order to be applied to real seismogenic regions. I suggest that this is explicitly stated in the conclusions, possibly indicating which are the following steps that should be made toward application. The considera-

tions that the authors make in the reply with reference to Watkins et al. (2015) indicate a possible link with observations and should be included in the paper. The dimensional problem in some equations has been solved. Misspellings have been corrected and the sentence at page 5 has been rephrased and expanded. With the above proviso, I confirm my positive opinion on the paper.

AR (authors' replay): On page 2, lines 5-10, we mention, in a summary and general way, the information that is available from observational and experimental studies for the characterization of SSEs, also the parameters involved in these investigations are mentioned (Watkins et al., 2015; Marone et al., 2015; Scuderi et al., 2016).

We agree that the following should be mentioned at the end of the conclusions (pages 17, 18):
Although this investigation is more related to the proposal of a formal pattern in the study of SSEs, and with a first approximation of the upper limit of the transition zone, this is considered as a preliminary study in order to be applied to the real seismogenic regions. However, the parameters considered for slow earthquakes are still being studied experimentally and by means of simulations, and there is still not something precise.

The study of SSEs in Cascadia (Watkins et. al. 2015) indicates a possible link between the observational and experimental data with the parameters involved in the most of models of earthquake's physic coupled to the Dieterich-Ruina's friction law. The slip amounts of SSEs are of order of cm but the average slip amount of smaller events are unknown. The effective normal stress in the range of 3-9 MPa produce fault slip consistent with some observed SSEs., $B-A$ is in the range (0.0015 to 0.003) of the slow slip section. At the top of the slow slip section $B-A$ is 0.003 and 0.001 at the base, $A \approx 0.02$, L is in the range 1-50 μm (real L is unknown), the rate of convergence (10 a 50 mm/year) represents the range of convergence rates of subduction zones where SSEs are observed with GPS. These parameters could vary depending on the region that SEEs occur. On the other hand, the critical value $K_c = (A - B)\sigma/L$ depend on L; viscosity=0.1 (nondimensional) has been used in earthquake models (Carlson et. al., 1994), but the estimation of the real viscosity depends on the region.

The proposed upper limit for the SSEs zone includes the fluids and oscillation frequency (and consequently, L), through ψ. They might be introduced into the simulations and experiments in order to see which are the implications over the recurrence times, duration and velocity of SSEs in real seismogenic regions. A final step would be using scaling laws for SSEs for real parameters that are not included nether experimental nor simulation data, such as the stiffness K_c and viscosity, take into account the specific characteristics of the fault.

Furthermore, the reference of Carlson et al. (1994) is added to the bibliography.

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