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A slip pulse model for low frequency earthquakes along plate boundaries

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Deep non-volcanic low frequency earthquakes (LFEs) and tremors are recently observed to have distinctive characteristics including strong anisotropy of the migration velocity and the source spectrum inverse linearly decaying with increasing frequency, showing strict differences from usual earthquakes. By using a physics-based 3-D dynamic simulation we show that these independent features are naturally explained in a single mechanical framework considering the slow-slip-triggered and heterogeneity-originated slip pulse. The basic ingredient to generate slip pulse is that a LFE source area is consisted of unstable patches heterogeneously distributed following a normal distribution. This heterogeneity might reflect differences in the onset temperatures of the plasticity and/or of dehydration among spatially distributed various minerals forming fault rocks. Heterogeneity of the permeability might be also responsible through pore pressure and thermal pressurization effects. The different migration speeds along dip and strike was reproduced by introducing observed streak-like LFE alignments and lateral propagation of slow slip without any anisotropic frictional properties. The key aspect to reproduce the inverse linear decay of high frequency source spectra is mean of the moment rate is temporally invariant as the slip pulse, which is stochastically satisfied. Detailed parameter studies on the patch distribution and resulting source spectra are presented in the paper by Nakata, Ando and Hori (this meeting). This model gives us new insights into the physical source process of LFEs and will be practically used to assess the state of the deep plate interface.

Keywords: low frequency earthquake, model, dynamics, source spectrum, migration, tremor