[EE] Evening Poster | S (Solid Earth Sciences) | S-CG Complex & General

[S-CG53]Science of slow earthquakes: Toward unified understandings of whole earthquake process

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Accumulating observational studies on various types of slow deformation events, such as tectonic tremors, very low frequency events, and slow slip events, portrays some universal characteristics in generally complex behavior, including interaction among events and influence by various outer loadings. Some of these phenomena seem to have causal relation with the occurrence of very large earthquakes. A unified understanding of these slow and fast earthquake processes requires an approach integrating geophysics, seismology, geodesy, geology, and non-equilibrium statistical physics. We welcome presentations based on, but not limited to, geophysical observation, data analysis, analytical theory, numerical simulation, field study, and laboratory experiments.

[SCG53-P22]Are slow earthquakes spatio-temporal chaos?-Reproducing slow earthquakes as the Benjamin-Feir instability

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A slow earthquake [1] is a type of shear slip observed at plate boundaries similar to regular earthquakes. However, slow earthquakes show different scaling from regular earthquakes, not only their characteristically long durations [2]. It is also known that their cumulative number of observation is an exponential function of the released energy [3]. This shows distinctive contrast with regular earthquakes that have Gutenberg-Richter law. Since slow earthquakes release the energy stored, simple description of their dynamics will be helpful to predict the spatio-temporal dynamics of the stress distribution along subduction zones.

In order to understand physical aspects of slow earthquakes, we analyze the rate and state friction model [4]. The rate and state friction model is a widely used mathematical model for a rock friction, which was introduced by Dietrich. Interestingly, it is known to reproduce slow earthquake near the instability threshold. To understand underlying mechanisms, we first derive a simplified expression of the rate and state model near Hopf bifurcation point. This simplified expression can be used to adopt spatial dimension as well.

We, as a first step, incorporate the rate and state friction model into a thin 1-dimensional elastic layer, which has local coupling [5]. We simplify the thin 1-dimensional elastic layer with the rate and state friction into the complex Ginzburg Landau equation. We confirm that this simplified equation shows the Benjamin-Feir instability at an appropriate condition, leading to spatio-temporal chaos. We further discuss some characteristic features of slow earthquakes from the view point of such spatio-temporal chaos.

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