A revised seismogenesis scenario implied by the discovery of a too consistent, immediate precursor - I think I've figured it out!

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Let's face it. Very short (10-100 mins.) lead time, anomaly amplitude knowing the size of the coming earthquake, and, heck, ~100% (10 of the ten recent M > 8.2 EQs) anomaly appearance rate (*AAR*). Are you kidding me, mister? Yes, I'm talking about the Heki-TEC precursor [e.g., Heki and Enomoto, 2015; He and Heki, 2017; Heki, 2018].

Such reproducibility and consistency are unprecedented. Does the Heki-TEC capture the quiet beginning of the big EQ, catching it red-handed as once dreamed of? My answer is *yes and no*. Well, this can be said red-handed arrest, but not of an extremely useful sort deserving the title of silver bullet. According to my profiling of the Heki-TEC, the anomaly or the *whole-asperity invasion process*, from which the anomaly derives, likely occurs many times during EQ cycle, but it ends up with an EQ only when it happens at the very last stage of the cycle. Hence, the Heki-TEC-based 1-hour alert, while it rarely misses the big one, would be laden with false alarms, even if by-orders more numerous false alarms coming from solar activity were wholly rejected. (Most of the sun-related TEC anomalies are traveling while those deriving from the underground invasion process stay in place.) Note that my oracle comes from profiling, not from the actual counting of intrinsic false alarms, which I have just started.

To reach this answer, I had to go through the toughest job of putting this precursor (statistics have cleanly proven that most of the anomalies preceding big EQs were precursors [Heki and Enomoto, 2015]) into the seismogenesis scenario. In fact, as long as I honor some common sense, *I had to revise the seismogenesis scenario*, rather than deriving the precursor from the standard scenario, demonstrating the side-B value of precursor study, constraints on seismogenesis. Let me start my profiling.

As in the Heki's talk, scaling relationships of the Heki-TEC with the EQ size, i.e. length L (~ width W) of the Eventual Rupture Area of Earthquake (*ERAE*), suggests some invasion process, which reduces the strength of the invaded area, propagates throughout basically the entire *ERAE* at a V_{prop} ~100 m/s. Here, 'basically entire' is required to explain the size predictability; if it affected only a small fraction of *ERAE*, the observed predictability of the size of the coming EQ would be unlikely, given the typically cascade-up (through many orders) nature of EQ dynamic ruptures. Also, I exclude the possibility that the invasion process serves as the (preslip-type) nucleation because no corresponding crustal deformation or even indication from seismicity localized to the time-window of Heki-TEC has been reported. Theoretically expected size of preslip nucleation, constrained by the fact that the locked patch of big EQs endures huge (> several meters) dislocation on the deeper creeping extension [Kato, 2012], is not so small. Thus I had to propose the invasion process as a mere 'ready to be blown,' necessary condition that prepares the whole *ERAE* so that once started dynamic rupture would not stop halfway. As an illustrative candidate of the invasion process, I suggest low-displacement (i.e., elusive) aseismic transients (SSE), which can occur within a locked portion of faults [e.g., Ito et al., 2012; Noda and Hori, 2014]. They seem to fit the profile well, including the ~100 m/s V_{prop} and the long cruising distance comparable to *ERAE*.

Our synoptic invasion model above is straightforward enough. However, two important problems require attention from above-average intelligence.

Firstly, what is *ERAE?* To explain the M dependence of the anomaly's growth rate, our model assumes the invasion front has a length of W. The invasion process or the on-fault process generating the electric precursor must proceed, *honoring the boundary* of *ERAE*. This means some physical entity corresponding to the *ERAE* must exist already when the anomaly starts. Here, I simply piggyback on Ide and Aochi [2005]. I propose the *ERAE* corresponds to the large tough patch (= asperity hosting a large earthquake), which is a *prescribed* contiguous region of relatively uniform, high fracture energy. Note that in their hierarchical/fractal asperity model, a large asperity is not the mere sum of small asperities. Small asperities are more like small brittle holes in a large tough patch (large asperity) which does exist on its own.

The last, most interesting problem. I'm saying invasion is merely a necessary condition. So, our model lacks the explanation for the very short leading time. If the invasion process reduced the strength by much, this would not be a big problem. But, here, the *mechanical elusiveness* constrains the story again. Frankly speaking, much loss of mechanical strength without causing much deformation is unlikely, if not inconceivable. My resolution is to ask the invasion process to occur quite frequently, like the in-asperity aseismic transients occurring quite a few times in the last 30% of the simulated seismic cycle of Noda and Hori [2014]. I have realized, if the invasion process occurs with an interval $\Delta T < \overline{\Delta S}/\dot{\tau}$, where $\overline{\Delta S}$ is the strength reduction by the invasion process, and $\dot{\tau}$ is the rate of stress accumulation on the locked fault, it becomes impossible that an earthquake occurs at timings other than the invasion events. You will see this if you draw strength(t) and $\tau(t)$ on graphing paper, with different phase relations. Do not forget the shallow wound from small-displacement SSEs would heal promptly. Begin the exercise with a case of a sufficiently long ΔT to get a feel. Then try with a shorter ΔT. You will have the clicking moment and notice the *new seismogenesis scenario*. Earthquakes do not occur by the slowly-accumulating stress reaching a fixed (or slowly varying) strength. The reality is, slight and quick strength reduction occurs from time to time, meeting the stress from the above to cause an earthquake if it occurs when the stress has been already very close to the strength. At least, a vast majority of M > 8.2 earthquakes must occur this way. I could not think of other scenarios to explain the short-leading time, ~100% AAR, mechanical elusiveness, and size predictability at the same time. In the meantime, Rubin [2011] has theoretically shown that the smaller the $\overline{\Delta S}$, the faster the V_{prop} of SSEs for a given slow, elusive slip velocity, with some observed examples.

Heki-TEC catches the thieve pink-handed, having cleared the way for efficient harvesting in one spell, important preconditioning job. However, this thieve does not have a discriminating nose. In most cases, he is found to be busy sweeping in the vineyard in June, for nothing.