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Improved understanding the physics of precursory events before major earthquake in subduction zones

Subduction zones produce Earth's largest earthquakes and most tsunamis. The devastating earthquakes and tsunamis of 2004 in Sumatra and 2011 in Japan were wake-up calls that our ability to forecast these catastrophic events remains weak. Thanks to the improved geodetic observational networks on land and in the ocean, it has been observed that small earthquakes and aseismic slip sometimes precede large, damaging earthquakes in subduction zones. Examples include the 2011 M9.1 Tohoku earthquake in Japan and the 2014 M8.2 Iquique earthquake in Chile. These observations suggest that there might be a way to forecast large earthquakes in subduction zones shortly before they occur (a few days or weeks in advance). However, we still do not understand the physics of this phenomenon. Why is this not commonly observed for earthquakes on land? Here, I plan to develop a proposal to NSF to explain this. Specifically, I will test the hypothesis that the presence of fluid in the fault zone plays a major role in precursory events before large earthquakes. I will build a physics-based numerical model that is able to reproduce observations. One novel thing about this model is the inclusion of the effect of fluid in the fault zone. This project will leverage a new collaboration with Professor Socquet at the University of Grenoble, France, where I plan to spend a month this summer with travel support from NSF and the University of Grenoble. I will work with Dr. Socquet to produce a paper and develop a competitive proposal for NSF. If opportunities come up for an NSF-EU proposal, we will also try.

Award: $19,409