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Spatial variations in Fault Coupling on the northern portion of the Great Sumatran Fault

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The Great Sumatran Fault system in Indonesia is a major right-lateral strike-slip trench-parallel system that can be divided into several segments, most of which have ruptured within the last century. This study focuses on the northern portion of the fault system which contains a 200-km-long segment that has not experienced a major earthquake in at least 170 years. In 2005, we established the Aceh GPS Network for the Sumatran Fault System (AGNeSS) across this segment. AGNeSS observes large displacements which include significant postseismic deformation from recent large megathrust earthquakes as well as interseismic deformation due to continued elastic loading of both the megathrust and the strike slip system. We parameterize the displacements due to afterslip using a model based on a rate- and state-dependent friction formalism. Using this approach, we are able to separate post-seismic and inter-seismic contributions. From the interseismic component, we infer the depth of shallow aseismic creep and deeper locked segments for the Great Sumatran Fault. In the northern portion of this fault segment, we infer aseismic creep down to 7.3+-4.8 km depth at a rate of 2.0+-0.6 cm/year. In the southwestern portion of the segment, we estimate a locking depth of 14.8+-3.4 km with a downdip slip rate of 1.6+-0.6 cm/year. This portion of the fault is capable of producing a magnitude 7.0 earthquake.

Keywords: Sumatran fault, fault coupling, Monte Carlo method