# Examining the spectrum of a slow slip event in Cascadia: suggestions that a single fault zone process creates slow slip and tremor?

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**Abstract**

It has been proposed that tremor and slow slip are two components of a spectrum of slow earthquakes (e.g., Ide et al., 2007). They may even be part of a continuum of events with a range of slip speeds, all governed by a single fault zone process. Such a continuum would have important implications for the deformation mechanism that drives slow earthquakes, as only a few of the fault zone processes proposed to explain slow earthquakes are capable of creating events with slip rates that vary by four orders of magnitude, from 0.1 microns/s in slow slip to 1 mm/s in tremor.

Here we further assess the hypothesis that tremor and slow slip are part of a slow earthquake continuum by analysing how small and large slow earthquakes could contribute to variability in the moment rate during large slow earthquakes in Cascadia. We first estimate the moment rate power spectrum of month-long slow slip events over a range of periods, combining data GPS-derived slip inversions, borehole strain observations, and tremor measurements. Our results imply that the moment rate power (1) is roughly flat at periods much longer than the events but then (2) decreases by a factor of 100 before (3) apparently becoming flat at periods of 1 to 10 days. At shorter periods, the moment rate power (4) decays roughly as period^n, where n is between 0.4 and 1.5.

We then attempt to reproduce this spectrum by modelling the large slow slip event as a sum of numerous subevents with a range of sizes. We find that the data are well matched by a set of subevents with a Gutenberg-Richter magnitude distribution and with durations that scale linearly with their moments. This moment-duration scaling differs from that found for normal earthquakes but is consistent with the scaling that Ide et al. (2007) proposed for the slow earthquake continuum on the basis of individual slow earthquakes' moments and durations. Our results thus provide further, albeit still inconclusive, evidence that slow slip and tremor are created by a single fault zone process, and we briefly discuss how this possibility can be reconciled with other observations of slow slip and tremor.

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