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Quantifying the time function of non-volcanic tremor based on a stochastic model

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Non-volcanic tremor is the seismically observable component of slow earthquakes, which have been recently discovered in subduction zones around the world, including major study areas at the Nankai and Cascadia subduction zones. Although tremor appears to occur randomly in both areas, Cascadia tremor has a longer duration than Nankai tremor. In the present study, this difference in tremor duration is quantified using a Brownian slow earthquake model that explains several features of tremor and slow earthquakes. A previous Brownian model is improved and applied to explain the cumulative distribution function of tremor amplitude, which is approximated by a chi-square distribution. The model also shows that the power spectrum of tremor amplitude has a simple analytic formula, including a characteristic time. An inversion method is developed to measure the characteristic time from the tremor spectrum in the presence of non-Gaussian background noise. The method is applied to several tremor sequences in the Nankai and Cascadia subduction zones to quantitatively confirm the apparent differences in tremor behavior between the two areas. The constants for Cascadia and Nankai tremor are 1000-3000 s and 100-1000 s, respectively, with temporal increases in these values observed over the course of 1-day records of activity. The difference in characteristic time between the two areas may reflect geometric constraints such as the width of the tremor region.

Keywords: Non-volcanic tremor, Nankai subduction zone, Cascadia subduction zone, Brownian walk, power spectrum