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Location of Nonvolcanic Tremors from Slow-slip and Nonslip Sequences in the Northern Cascadia Subduction Zone

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Surface-based deformation monitoring has recently identified episodic aseismic slip on subduction megathrust faults in Japan and the Pacific Northwest. In Cascadia, these slow-slip events last 2-3 weeks and occur periodically every 13-16 months. Although transient surface-deformation monitoring using GPS has identified the time sequence of slip events, their depths are poorly constrained. In May 2003, it was found that low-amplitude, nonvolcanic tremor is temporally associated with the slow-slip events, but recent results show that tremor during the March 2003 slow-slip event occurs over a broad depth range, from 10-50 km, and cannot be associated with the subduction thrust. Here we report the spatial distribution of tremor activity from the preceding February 2002 slow-slip event and compare these locations of tremor activity to those which occurred in September 2002, when no slow slip was inferred from GPS monitoring. We use the Source Scanning Algorithm of Kao et al. (2004) to invert for both the origin time and source location of the tremor, using the amplitude of the recorded waveforms and direct S-wave travel times calculated through a 3D velocity model. Phase identification and picking are avoided by systematically scanning through continuously recorded waveform data during the months when tremor activity occurred. Our results indicate two peaks of tremor activity during the February 2002 slow-slip event, and we highlight differences between this tremor activity and that of September 2002.