Use of Multiple Small Aperture Arrays to Study Deep Subduction–Related Tremor in Cascadia

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Three small aperture (~600 m) seismic arrays were deployed between April and July, 2004, in the northern Puget Sound to observe tremor during an episodic tremor and slip event (ETS). Tremor has been recognized in real-time using stations of the Pacific Northwest Seismograph Network (PNSN) since mid-February, 2003. Approximate epicenters of tremor bursts have been determined using band-passed, rectified and smoothed versions of the signals. Using small aperture arrays of 6 to 7, 3-component short-period seismometers spaced at approximately 200 m we can correlate phases in the dominant frequency band (2-6 Hz) across individual arrays. Array processing techniques (beam forming and zero-lag cross-correlation) are used to determine the slowness and back-azimuth of tremor bursts. Tremor bursts lasting a few seconds can be identified across the stations of each array. Individual bursts from different back-azimuths often occur within five seconds of one another, indicating the presence of spatially distributed but near simultaneous tremor. Earthquake signals have been used to determine the resolution capabilities of the arrays: 0.01 and 0.02 s/km in slowness and 5-10 degrees in back-azimuth. Polarization analyses indicate that the signals are predominantly SH waves, with minor contributions from P and SV waves. Further analyses are ongoing to determine the hypocentral locations of the tremor bursts, and to track their spatial and temporal progression.

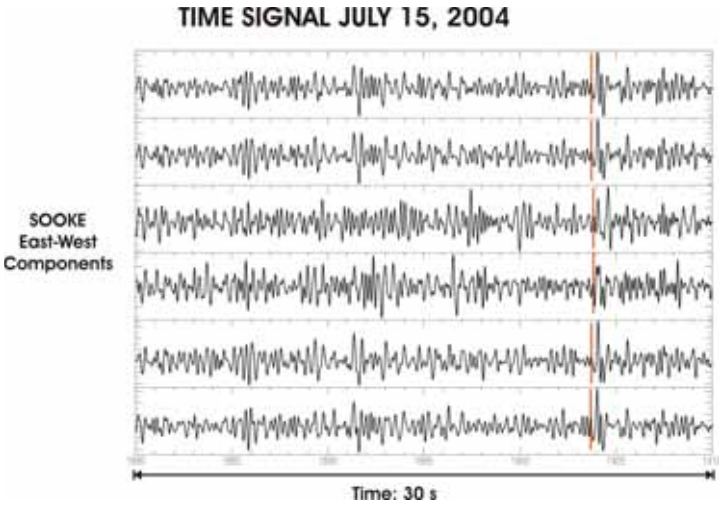

Figure 1. Sample waveforms from six horizontal components of the Sooke array for a 30 second time window during a strong period of tremor. Note the coherence of much of the waveform across the array. A strong burst near the end is marked showing the start of a five second window used for the beam-forming analysis shown in Figure 2.

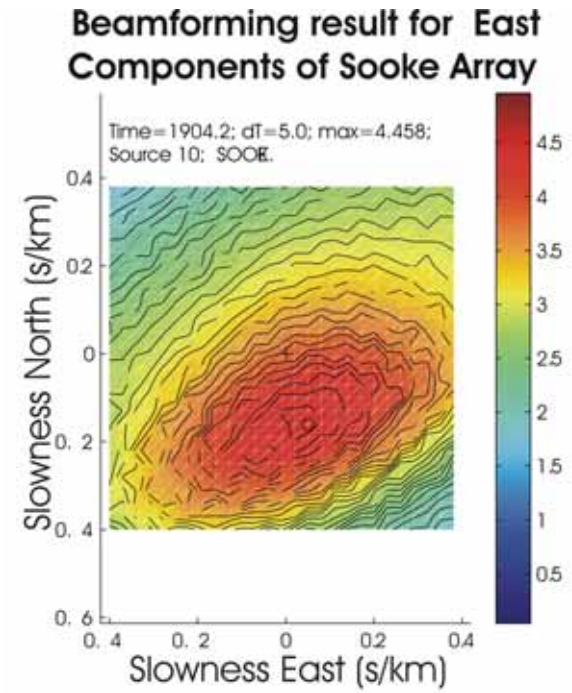

Figure 2. The beam-formed relative amplitude (color shading) is shown on an east-west/north-south plot of slowness for a five second period of tremor shown in Figure 1. The center of the pattern indicates that energy is arriving from the south south-east with a slowness of about 0.18 sec/km.

La Rocca, M, S. Malone, G. Soccorotti, W. McCausland, D. Galluzo, and E. Del Pezzo (2004), Small Apeerture Array Resolution Capabilities for Use in Locating Deep Tremor, *Eos Trans. AGU, 85(47)*, Fall Meet. Suppl., Abstract S53A-0190.

McCausland, W., S. Malone, K Creager, R Crosson, M La Rocca, and G. Saccoretti (2004), Array observations and analyses of Cascadia deep tremor, *Eos Trans. AGU, 85(47)*, Fall Meet. Suppl., Abstract S42B-05.

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