Depth of the source of the tectonic tremor in the eastern Olympic Peninsula, Washington

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Key Points:

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Abstract

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1 Introduction

General question - Description of tremor and slow slip

Specific question - Depth of the low-frequency earthquake on the plate boundary. More difficult for the tremor because no phase onset

La Rocca et al. (2009)) stacked seismograms over all stations of the array for each component, and for three arrays in Cascadia. They then computed the cross-correlation between the horizontal and the vertical component, and found a distinct and persistent peak at a positive lag time, corresponding to the time between P-wave and S-wave arrivals. Using a standard layered Earth model, and horizontal slowness estimated from array analysis, they computed the depths of the tremor sources. They located the sources near or at the plate interface, with a much better depth resolution than previous methods based on seismic signal envelopes, source scanning algorithm, or small-aperture arrays. They concluded that at least some of the tremor consisted in the repetition of low-frequency events as was the case in Shikoku. A drawback of the method was that it could be applied only to tremor located beneath an array, and coming from only one place for an extended period of time. Part of the specific question - Just on the plate boundary or overlying layer and how thick the layer is?

If the source is on the plate boundary, you should have a constant time lag between P-wave and S-wave arrivals, and a peak in the cross correlation between the vertical component and the horizontal component.

Explain here why it is going to work (No problem with tremor streaks)

2 Data

The data were collected during the Array of Arrays experiment. Eight small-aperture arrays were installed in the northeastern part of the Olympic Peninsula, Washington. The aperture of the arrays was about 1 km, and station spacing was a few hundred meters. The arrays were around 5 to 10 km apart from each other (Figure 1). Most of the arrays were installed for more than a year, between June 2009 to September 2010, and were able to record the main August 2010 ETS event. Some of the arrays were also recording during the August 2011 ETS event. Ghosh et al. (2012) used a multibeam-backprojection (MBBP) technique to detect and locate tremor. They bandpass filtered the seismic data between 5 and 9 Hz. They divided the data into one-minute-long sliding independent (no overlap) time windows. They performed beam forming in the frequency domain at each array to determine the slowness vectors, and backprojected the slownesses in the 3-D space to locate the source of the tremor for each time window. We thus have two catalogs of tremors. The first one is a catalog of 28902 one-minute-long time windows during which tremor was detected between June 20th 2009 and September 30th 2010. For each time window, we have the beginning time, the end time, and the location (latitude and longitude) of the source of the tremor. The second one is a catalog of 5600 one-minute-long time windows between August 10th 2011 and September 6th 2011.

3 Method

Grid cells

Cross correlation HV Stack cross correlation over arrays

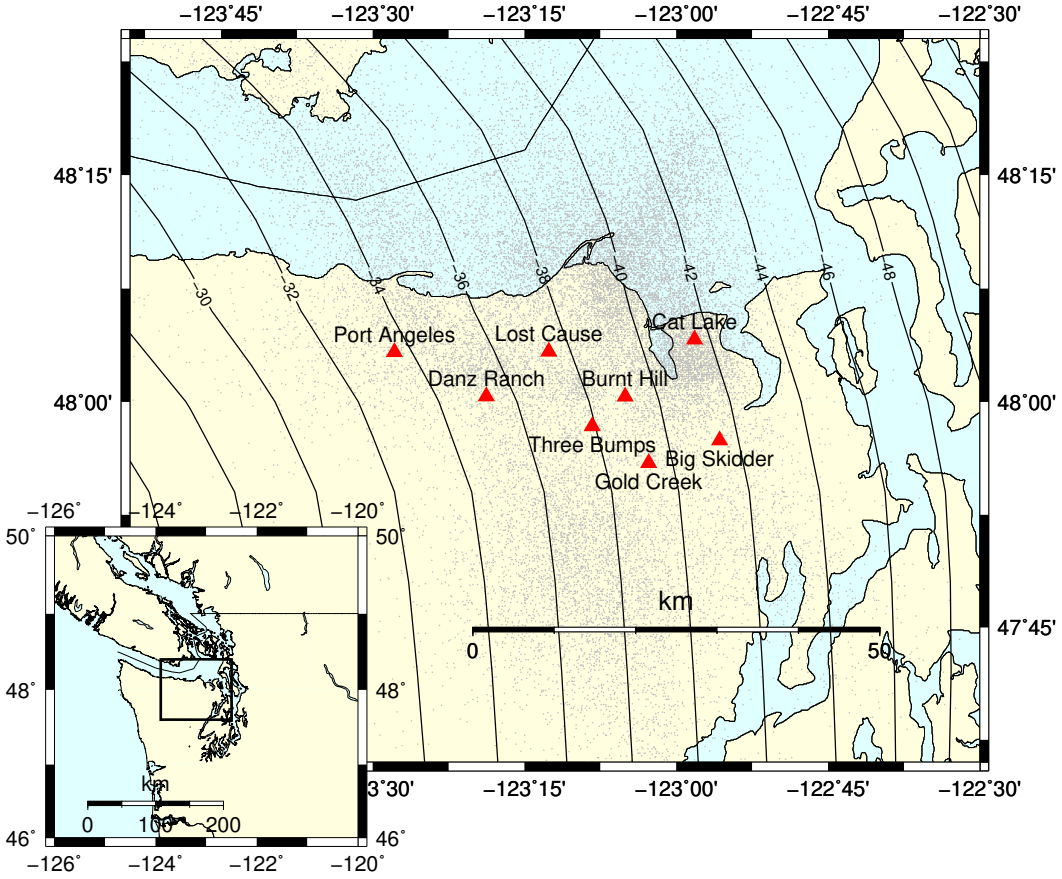

Figure 1. Map showing the location of the eight arrays (red dots) used in this study. Blue dots are the locations of the source of the tremor recorded by the arrays. Inset shows the study area with the box marking the area covered in the main map. Contour lines represent a model of the depth of the plate interface (McCrory et al., 2006).

Stack cross correlation over time windows

peak about 5-6 s

Divide time windows into two clusters based on

New stack with only the good one

One image here to show the stacking

Time lag betwee direct P and direct S wave

Velocity model -¿ tremor depth

4 Results

use all data

Quality of depth

Some sort of least square regression

One image here to show the depth

5 Discussion and Conclusion

Where are the other tremor? Not wee located? Not on the plate boundary?

How analysis addresses the part of the specific question

How analysis addresses the specific question

How analysis addresses the general question

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