



# Deep long-period earthquakes (DLPs) beneath Mount St. Helens

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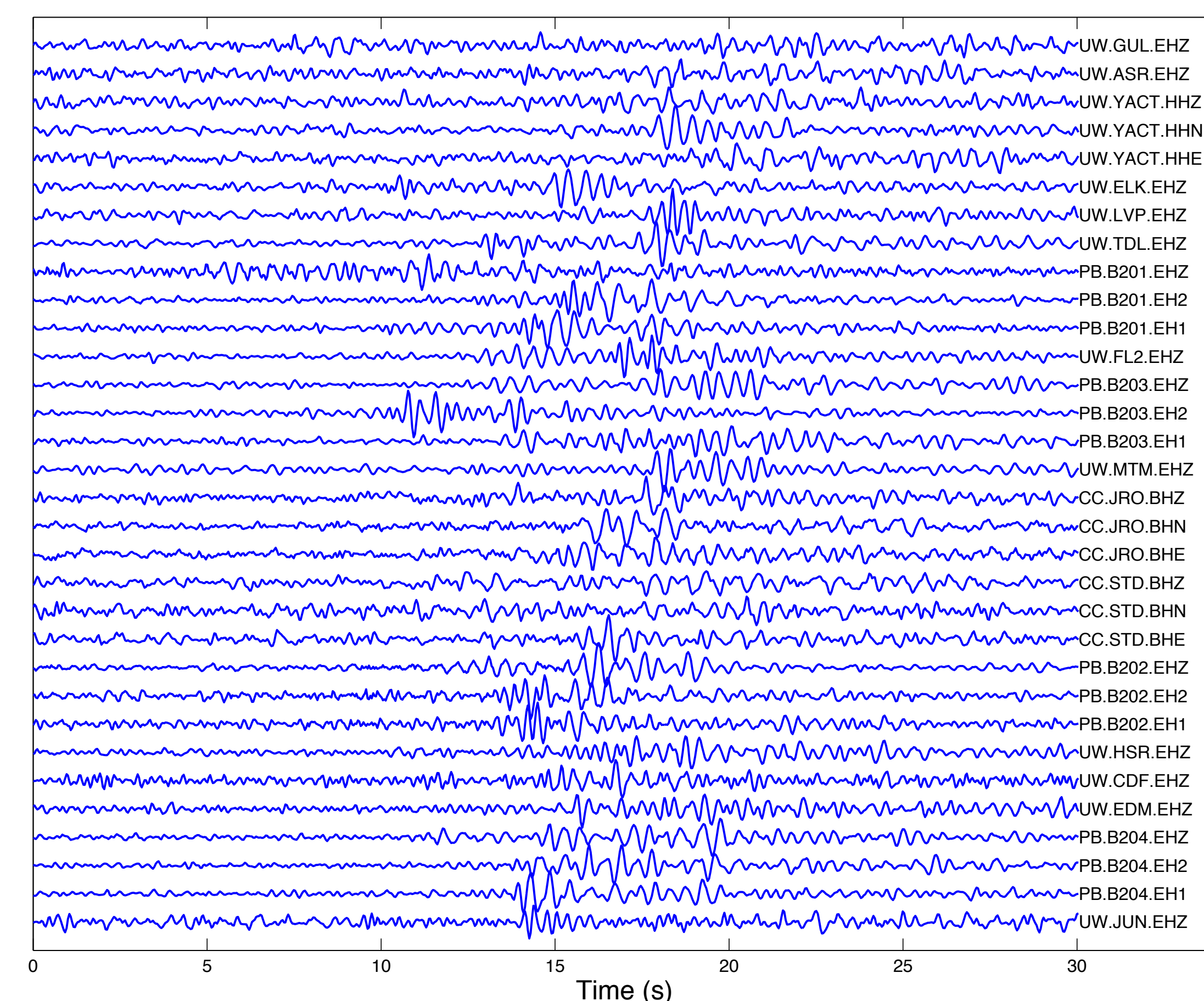
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## Background and Objectives

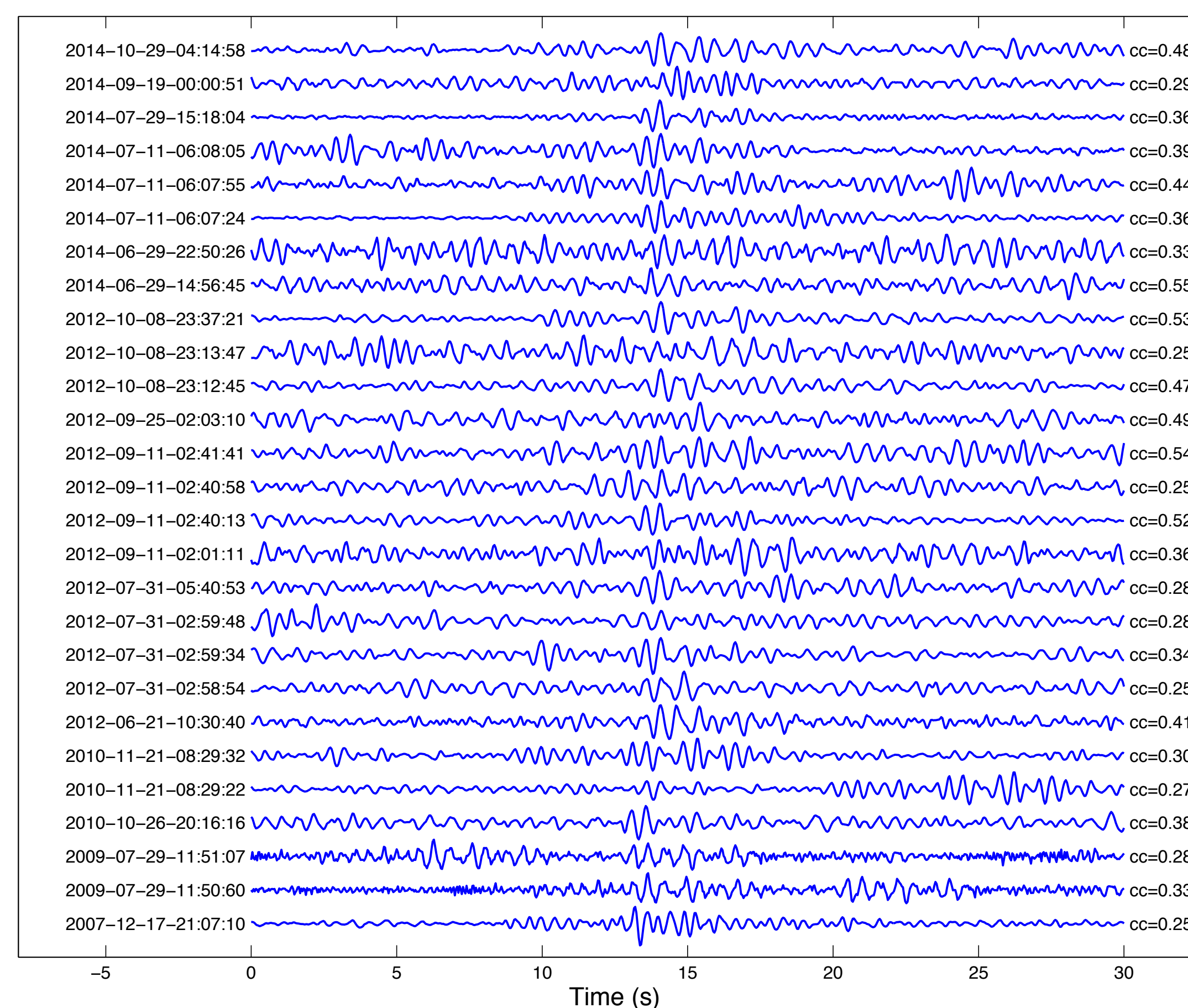
Volcanic deep long-period earthquakes (DLPs) have been observed for a long time but remain poorly understood. DLPs are commonly characterized by emergent waveforms, deficiency in high-frequency energy, long-duration coda and their rare occurrence. They are located at 10-35 km depth, in the mid- to lower-crust and/or uppermost mantle. Hypotheses associated with magmatic processes have been proposed for the mechanisms of DLPs, including dehydration embrittlement, flow of magma and/or magmatic fluid and cooling of magma.

We use cross station correlations to characterize the timeline, investigate associated driving force, and will attempt relocation and waveform analysis to get the focal mechanisms. Our goal is better understanding of DLPs and the structure complex beneath the volcano.

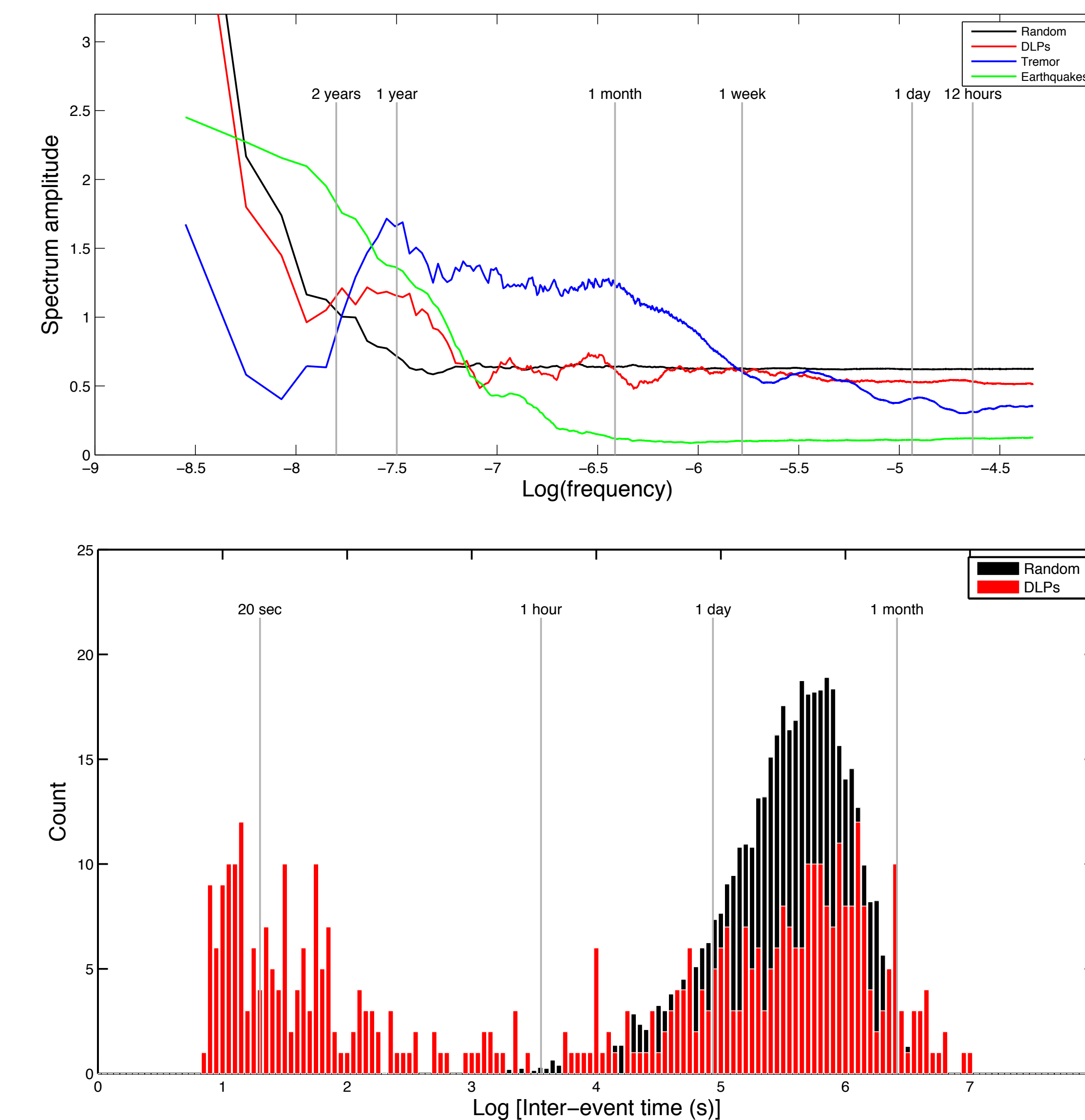
## Stacked template used for correlation detection



## DLP detection examples at station PB.B202.EHZ

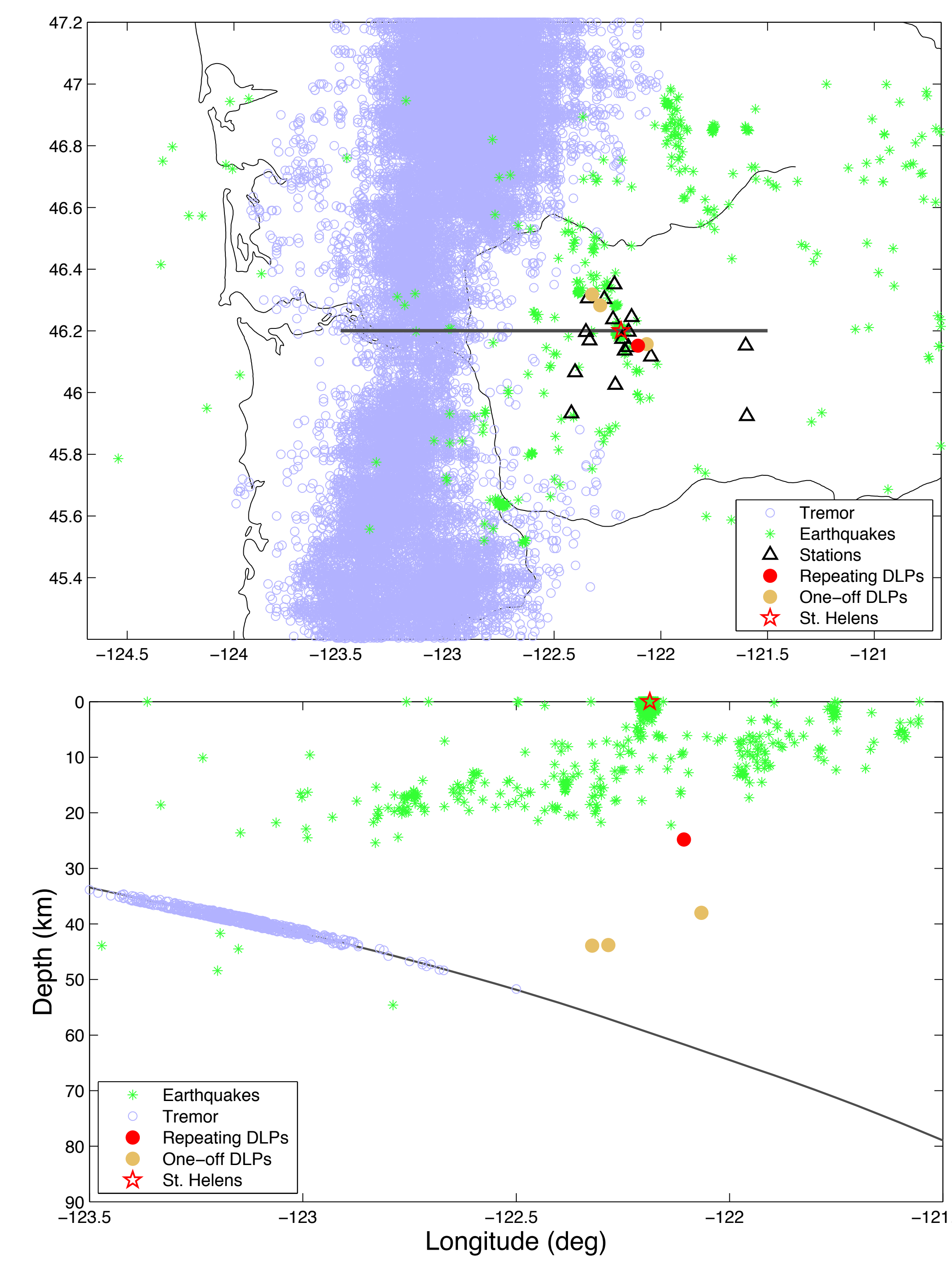


## Spectrum of DLPs, tremor and earthquakes

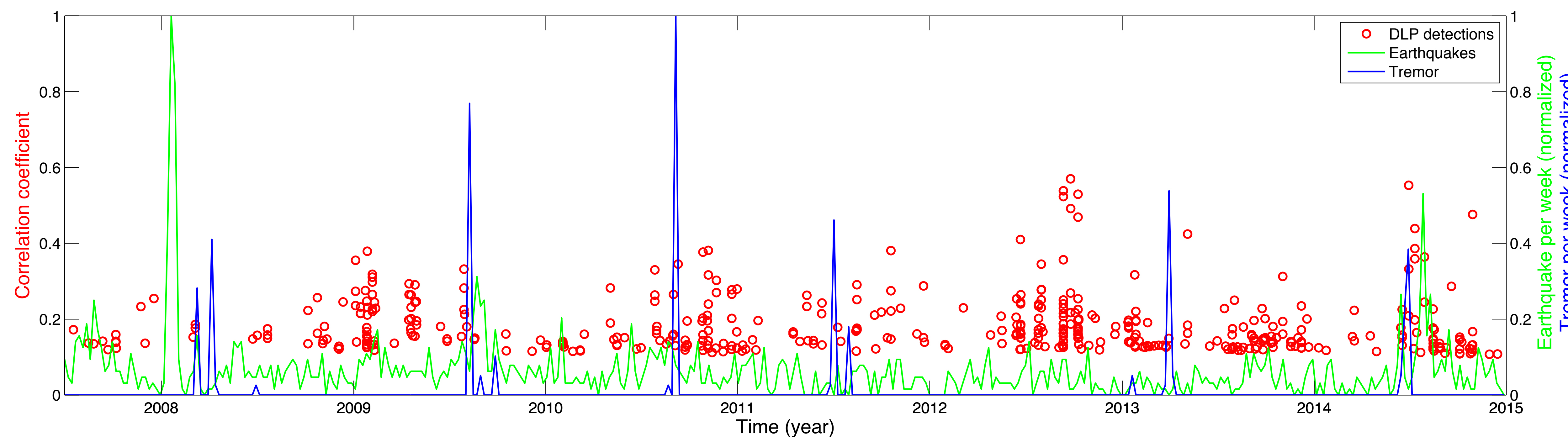


We find a second dominant time interval (red histogram) for adjacent detections, in addition to a distribution characterizing the random occurrence (black histogram).

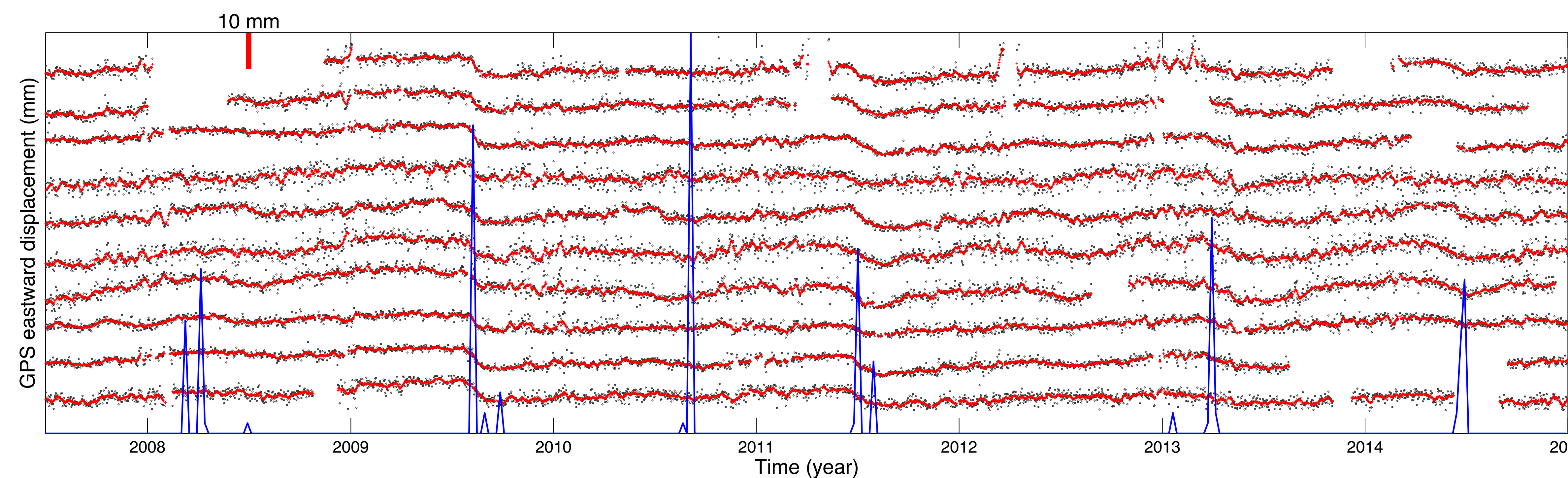
## Subduction zone tremor, seismicity and DLPs near Mount St. Helens



## Timelines of DLPs, tremor and earthquakes



## GPS displacement and tremor activity



## Summary and work in progress

- Using stacked template from initial detections, we do cross station correlation searching, which detects ~450 DLPs, compared to only 15 events in the catalog.
- Many of the DLPs occur as several bursts within tens of seconds or several minutes.
- Overall the detected DLPs show an episodic activity with a period of roughly 12 to 16 months. Several, but not all, episodes are near the time of subduction zone tremor.
- We are working on constructing a more complete DLP catalog, doing relocation, investigating associated transients and potential driving forces, and analyzing waveforms to estimate focal mechanisms and the structure complex beneath the volcano. Future work may also extend this work to other Cascadia volcanoes.

## Acknowledgments

David Schmidt, Heidi Houston and Ken Creager provided advice. Seismic data is from IRIS Data Manager Center. GPS data is downloaded from <http://www.unavco.org>.