

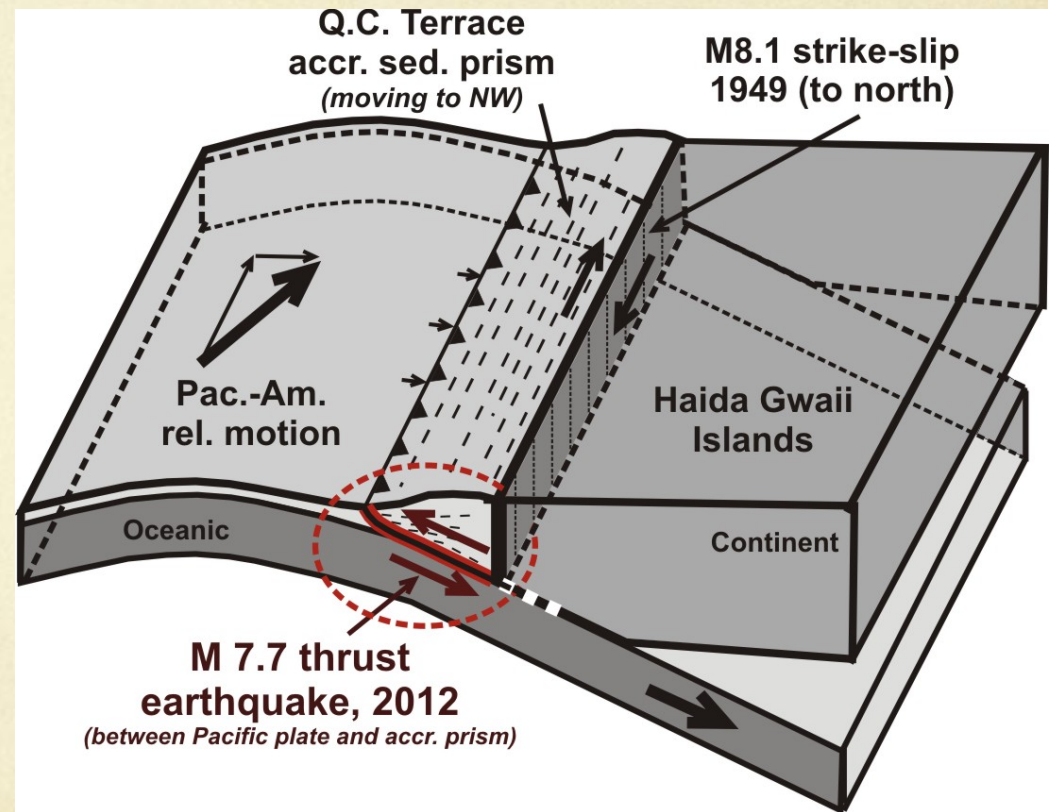
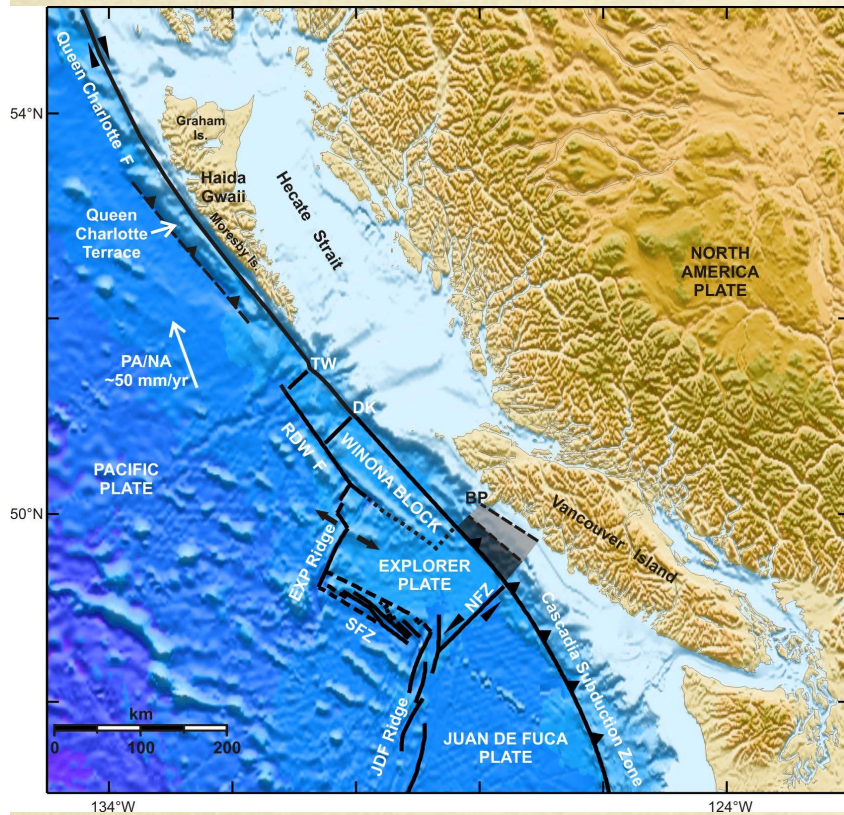
Analysis of the 2012 Oct 27 Haida Gwaii Aftershock Sequence

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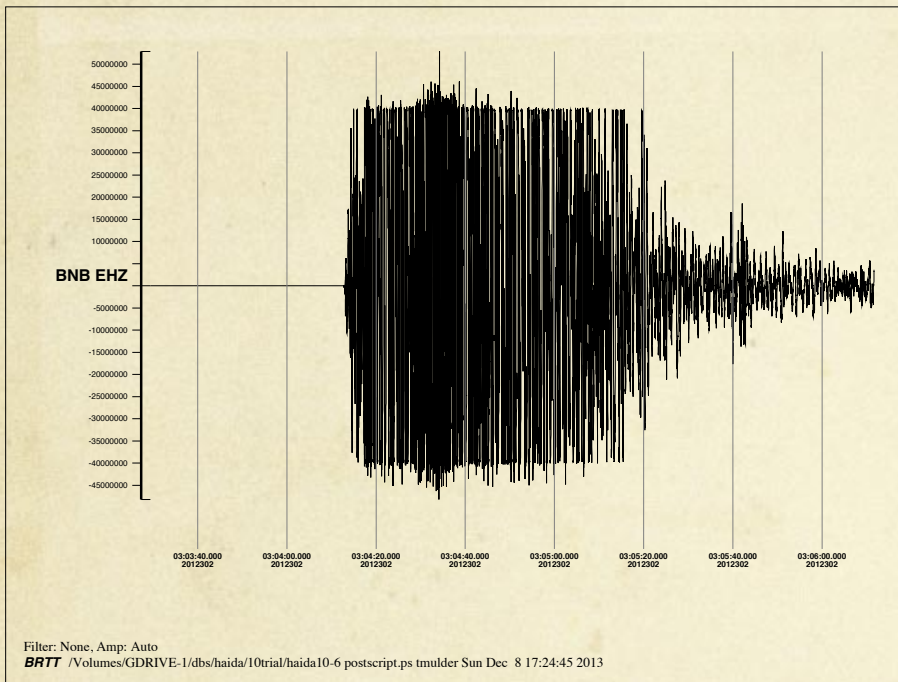
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Tectonic background

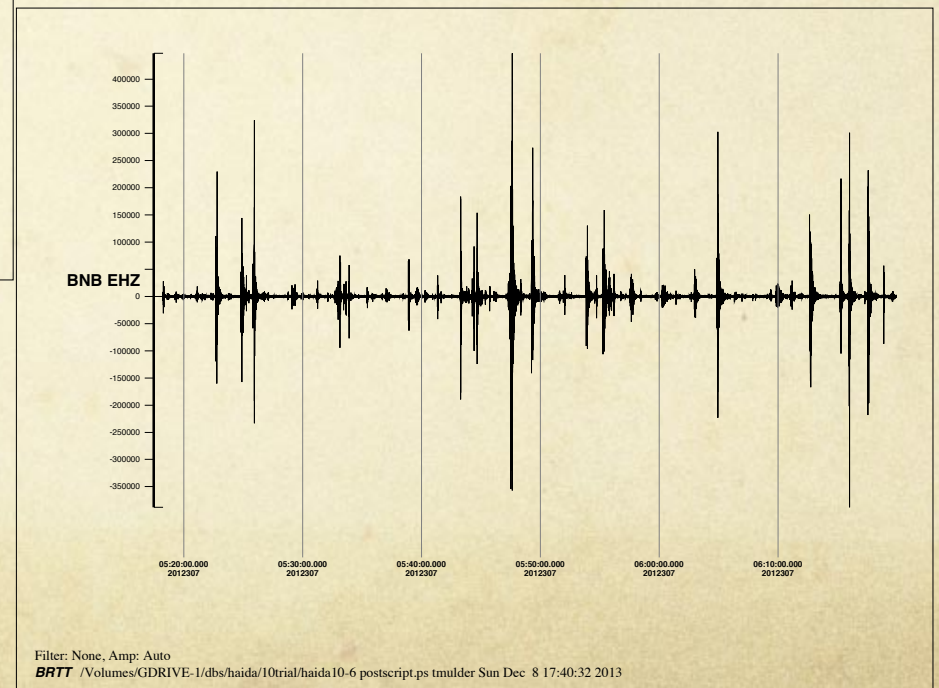


Situation

2012 October 28 03:04 UT
M7.7 earthquake



← 1 hour →



Produced a rich aftershock sequence

Challenge

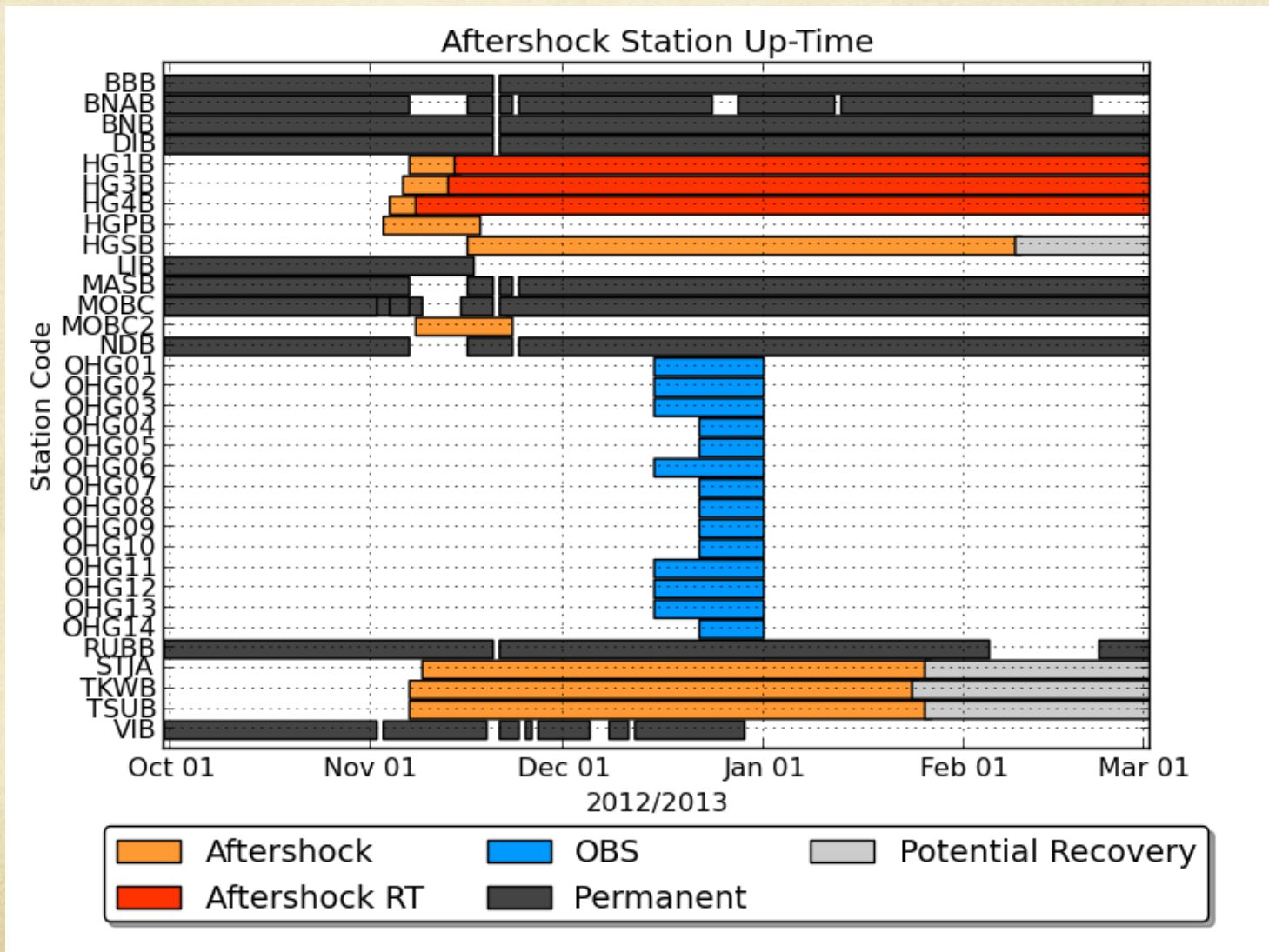
Create a dataset of automated solutions for potential analysis.

- Option 1: STA/LTA detection over specified frequency band (2 Hz, high pass, integrated filter)
- Option 2:
 - Apply Rosenberger (2010) Singular Value Decomposition
 - Apply Kurzon et al. (submitted), re-tuning and cleaning methods.

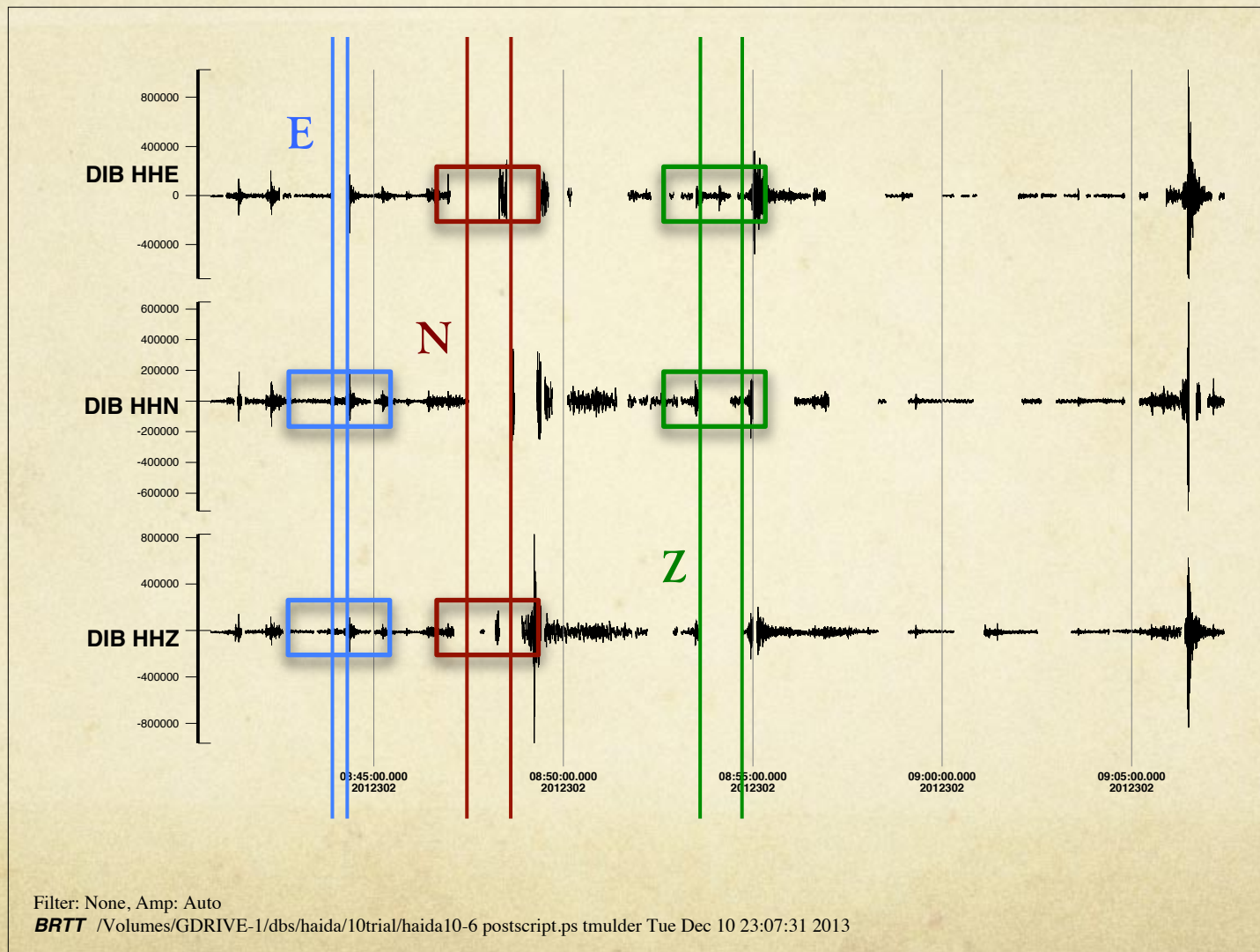
Stations



Data Coverage



Data Issues



Process waveform data for SVD P & S detections

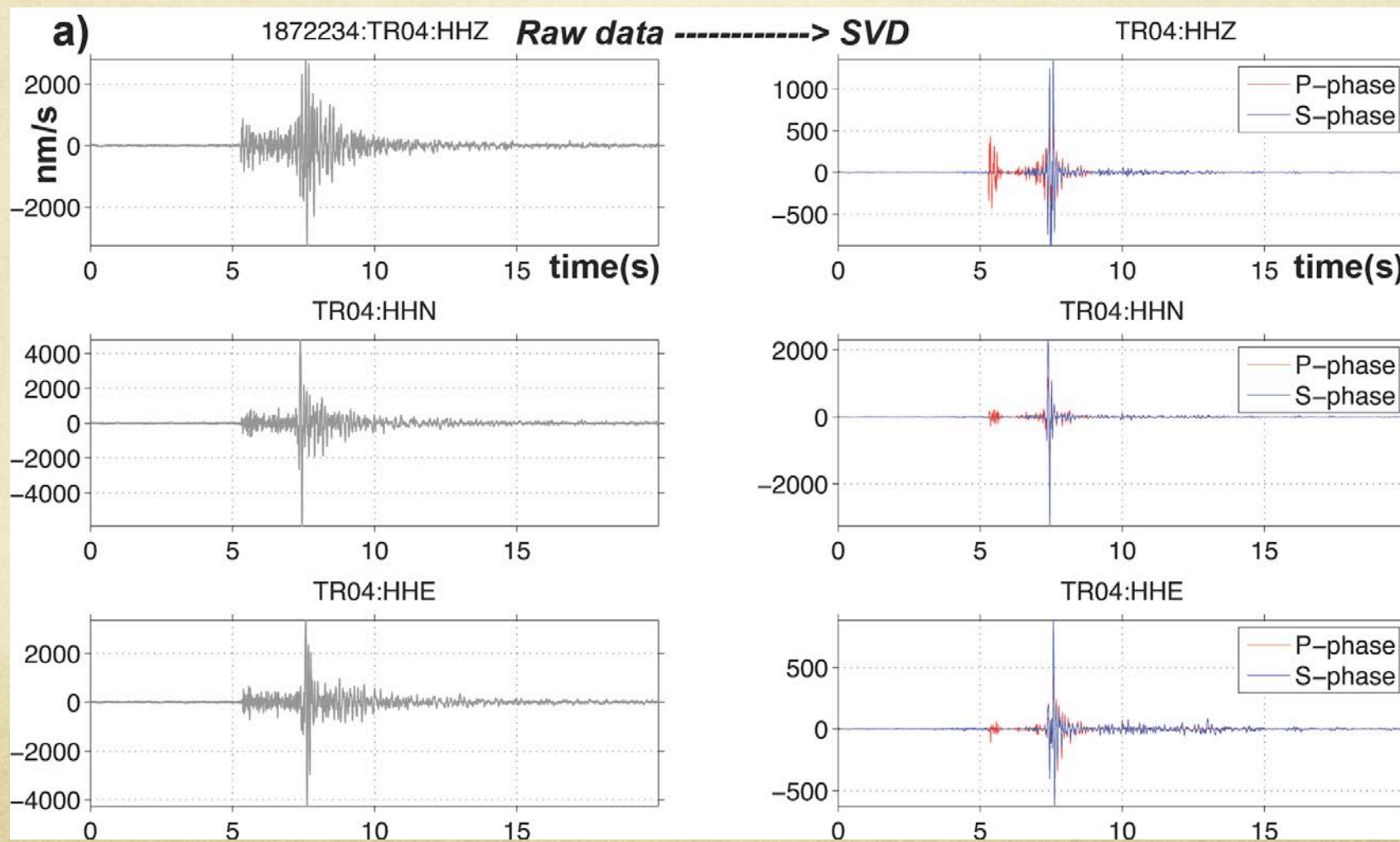
- Subset data to desired stations
- Limit waveforms by removing gaps.
- Find stations with 3 components (Z,N,E) of data.
- Run SVD filter and output eigenvectors with rectilinearity = 1.
- Add white noise to SV1, SV2, SV3 output.
 - For the background noise portions of the Z,N,E traces, the SVD output is so small that the $\lim(LTA) \rightarrow 0$.
 - This poses a problem as $STA/LTA \rightarrow \text{infinity}$.

- Save rotated waveforms
 - SV1 → new “P” waveform
 - SV2 → new “S” waveform
- Run STA/LTA detector over rotated waveforms.
- Remove duplicate detections and identify as P or S based on the particle motion angle of incidence.
- Run location program over the P & S detections.

For more details...

“Real-time Automatic Detectors of P and S Waves Using Singular Values Decomposition”; Ittai Kurzon et al.

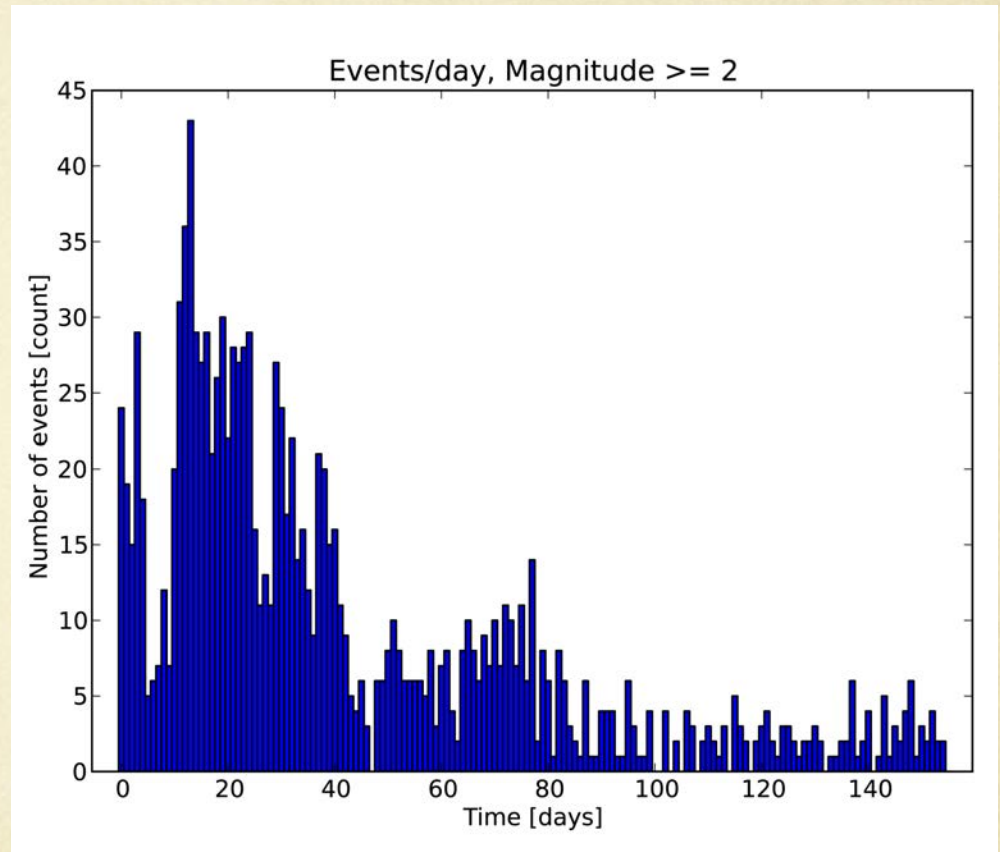
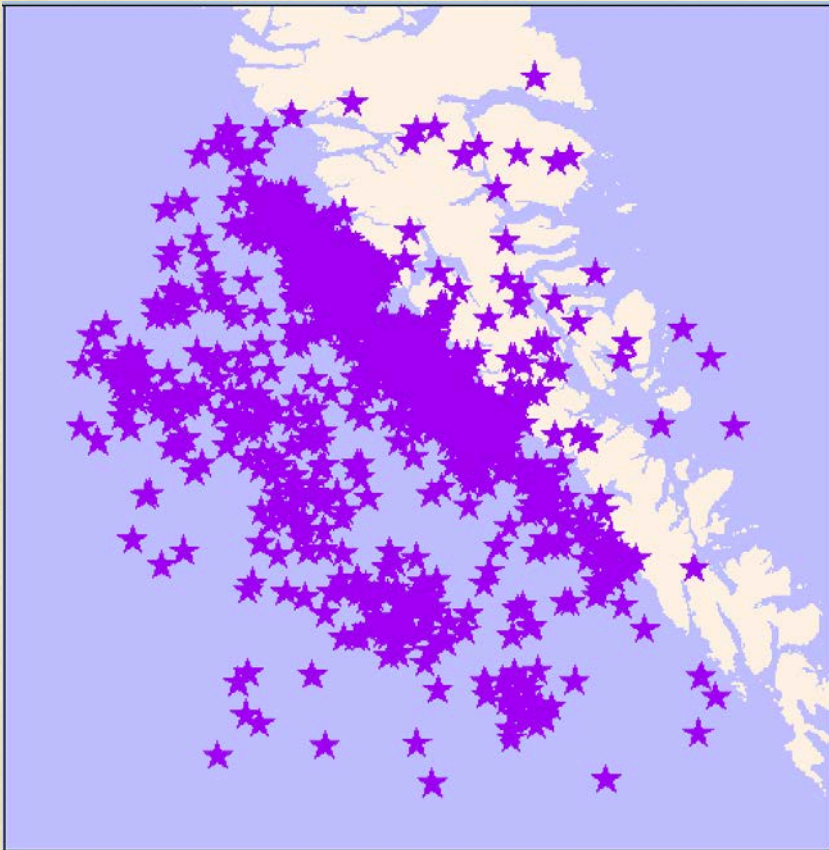
Example of real-time Singular Value Decomposition on a local earthquake separating 3-channel waveforms into P and S phases (Rosenberger, 2010)



Location grid



Z,N,E detection/location (140 days)



Dataset issues

Due to the complexity of the waveform data and in particular the difficulty encountered by the requirement of continuous (no gap) data on all 3-components (Z,N,E) for the SVD...

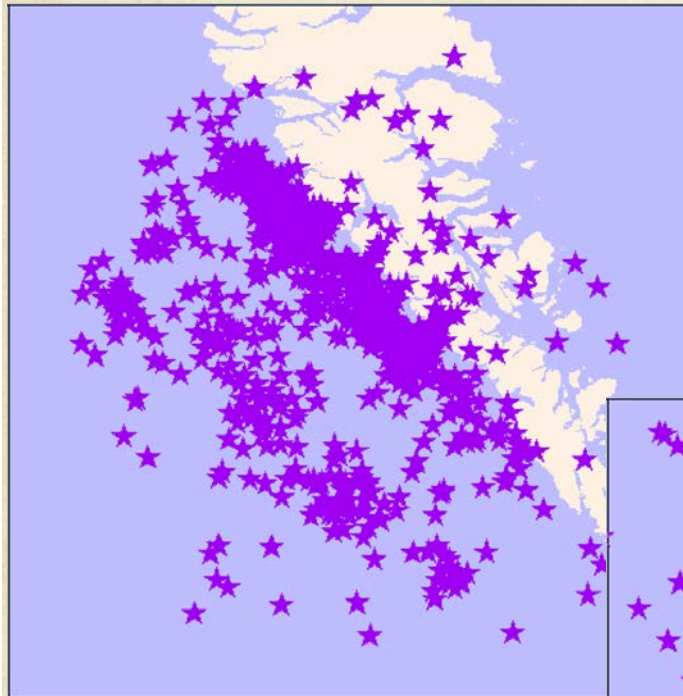
Best dataset

Best dataset - error ellipsoid
M > 2
number defining phases ≥ 5
major axis < 4 km
minor axis < 3 km
depth error < 2 km
rms error of solution < 1.0

- 2012 Oct 28 – Dec 31
- 64 days

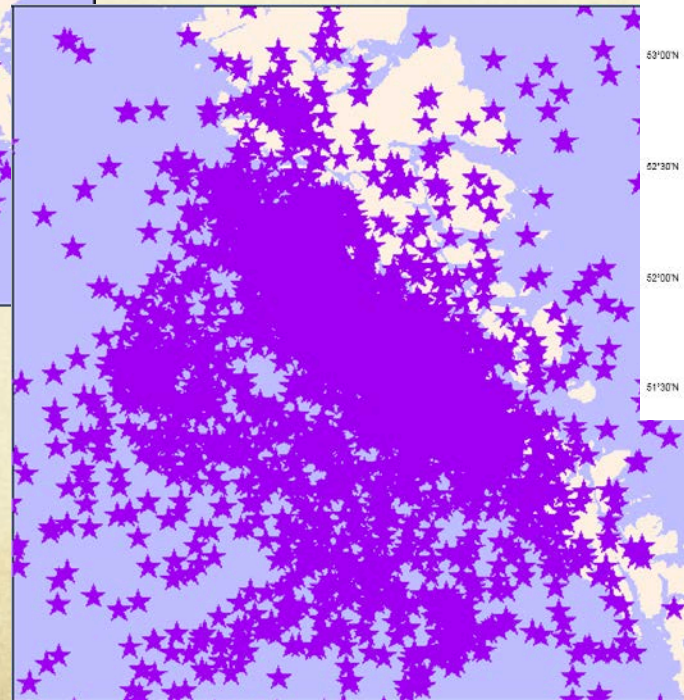
	ZNE origins – 2 mos	SVD origins
All events	11957	10655
Best events	974	4259

2012 Oct 28 - Dec 31
(64 days)

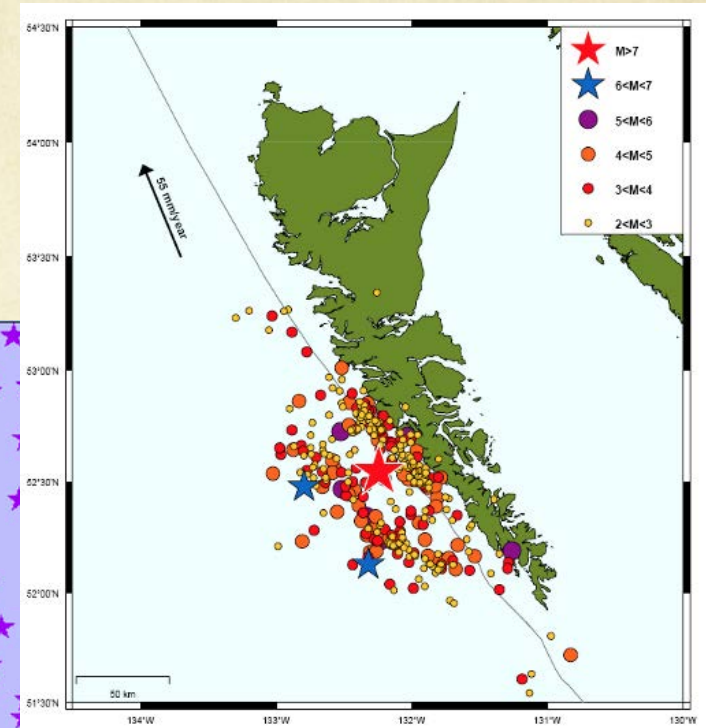


Z, N, E

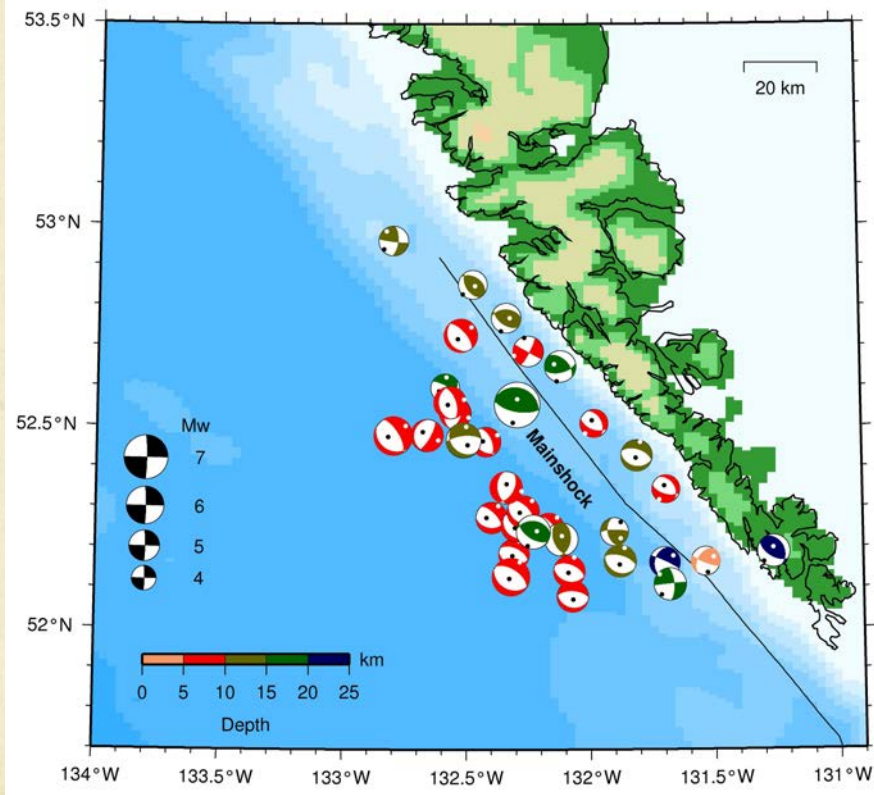
SVD



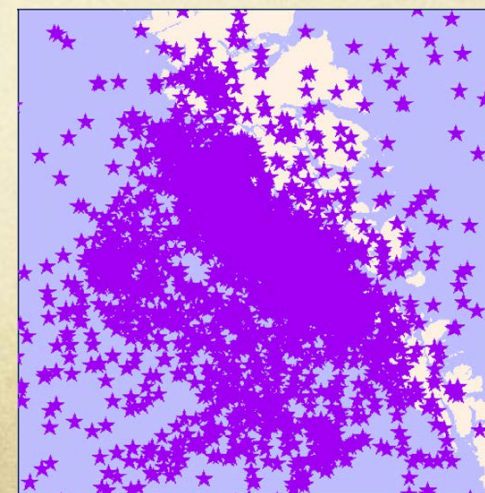
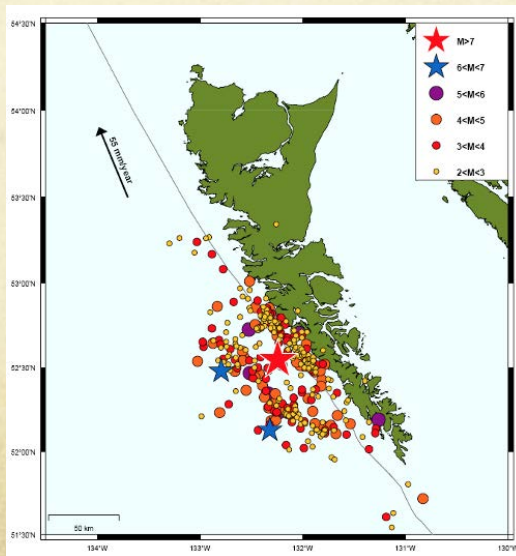
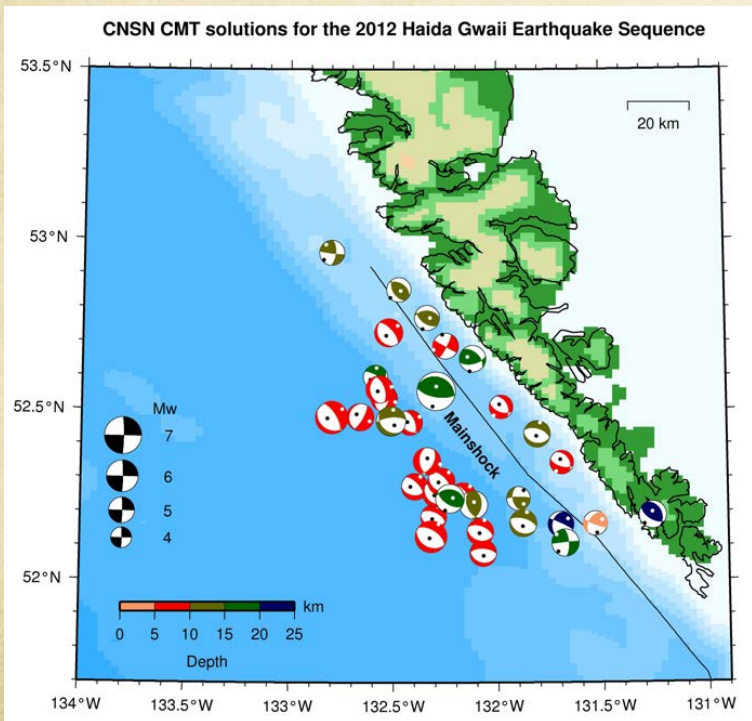
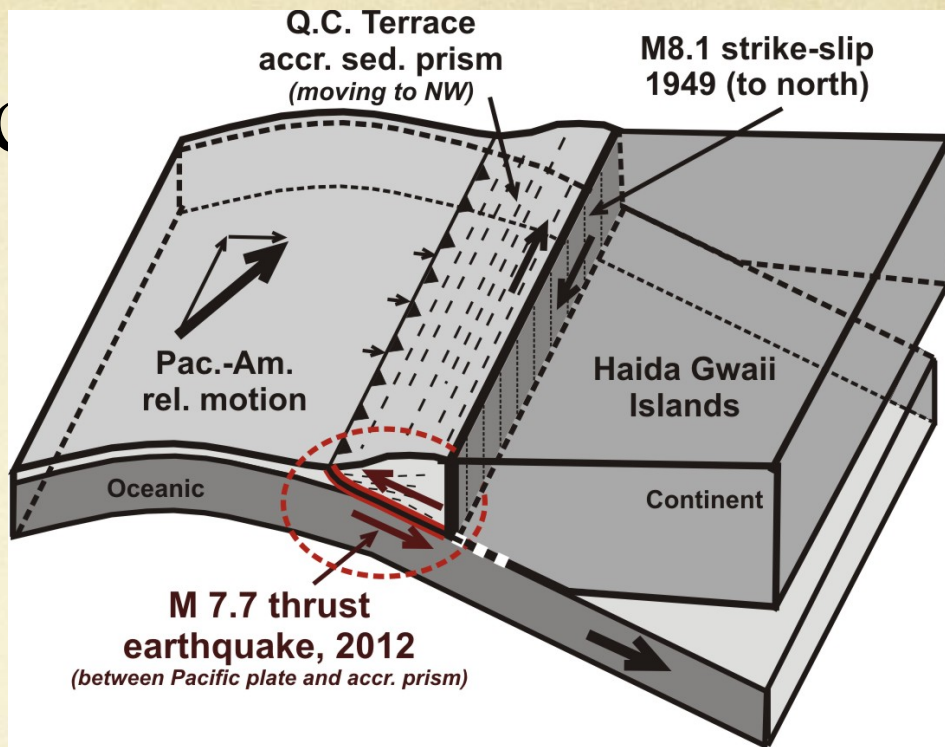
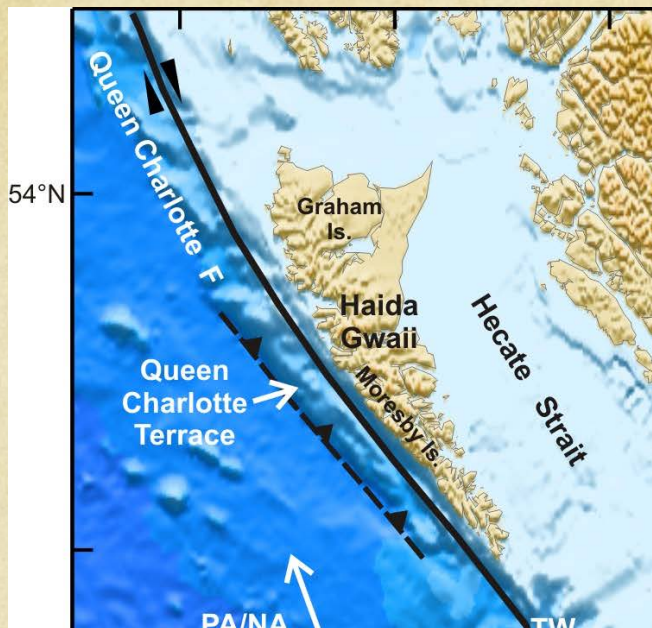
Analyst Reviewed



CNSN CMT solutions for the 2012 Haida Gwaii Earthquake Sequence



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Honn Kao

CONCLUSIONS

- SVD method improves identification of S phases.
- Consequently, the SVD method produces 4 times more good automatic origins than automatic origins from Z, N, E waveform channels.
- SVD rotation (Rosenberger, Kurzon) is a viable method of analyzing aftershock sequences.
- With tuning, can be used in real-time to improve automatic locations for early warning.

ANTELOPE NEEDS

- Better ways of combining databases.
 - Inspection and comparison of databases from before and after the svd inversion.
- Antelope toolbox for Matlab.
 - This was critical to the development and testing of the svd rotation.

Thank You!