Horizontal deformation rates near the Cascadia subduction zone trench revealed by offshore GNSS-Acoustic time series

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16 December 2022

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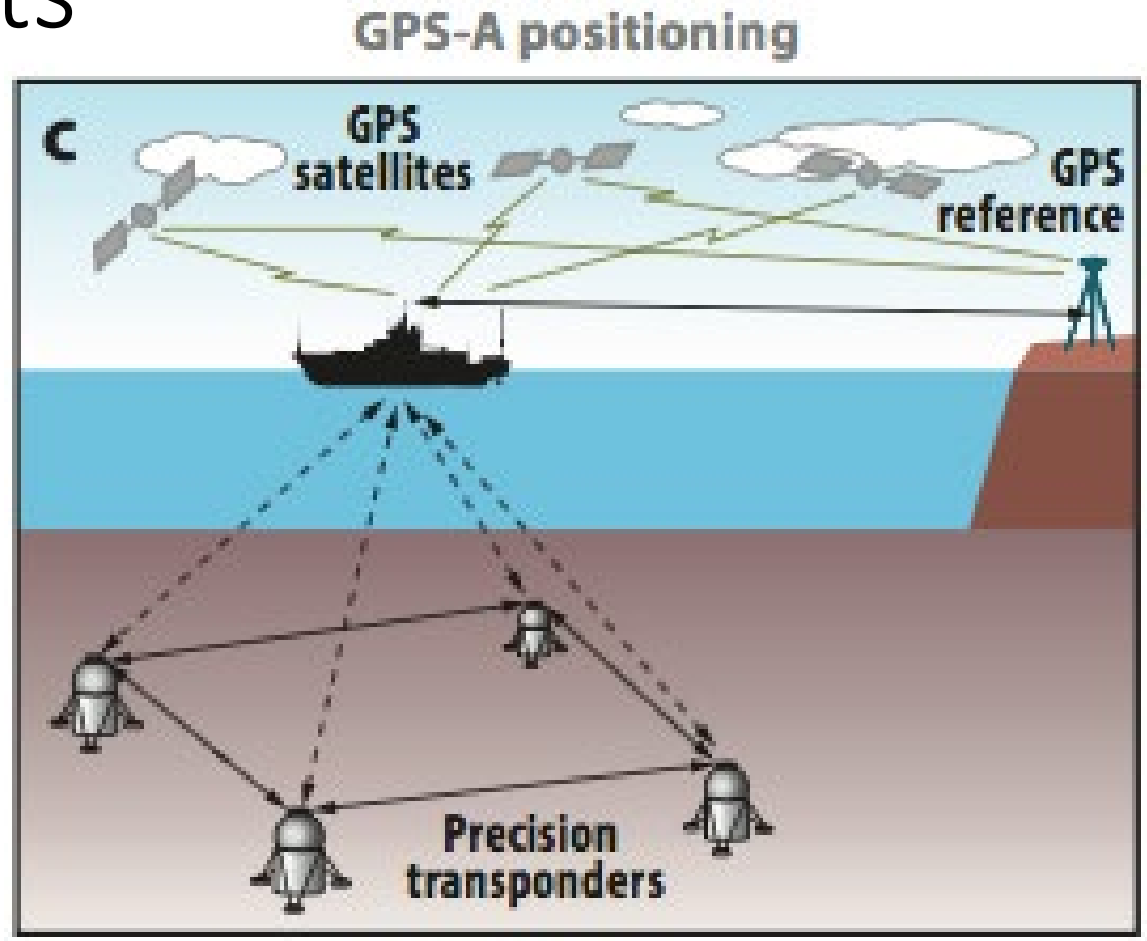
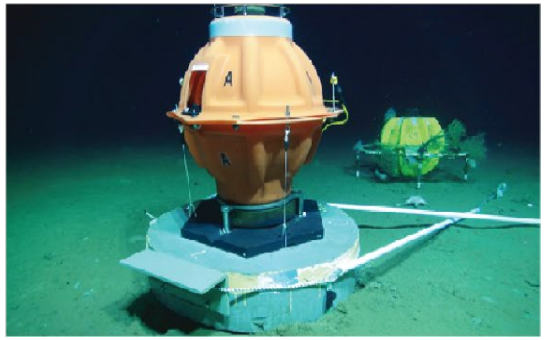
Geo PRISMS
Geodynamic Processes at Rifting and Subducting Margins

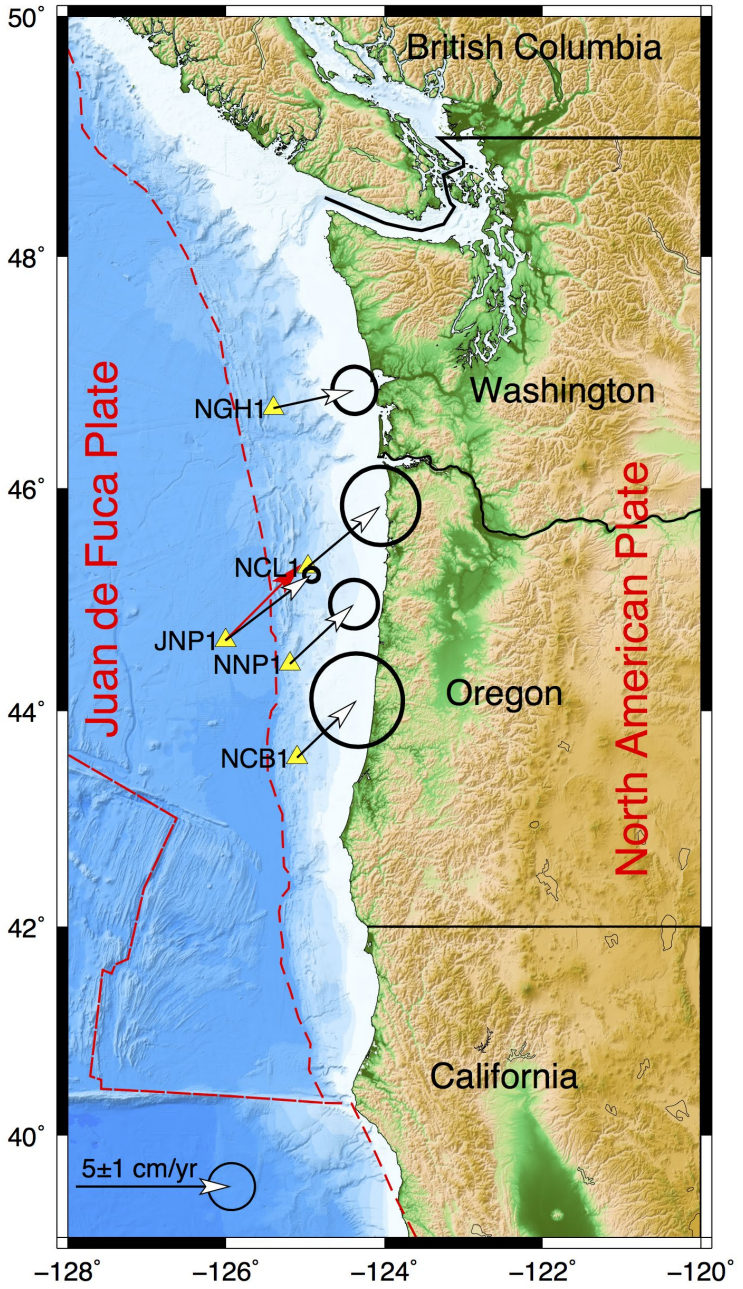
GNSS-Acoustic Instruments

- Seafloor transponders: listens for and replies to acoustic pulses
- Autonomous Wave Glider: uses wave energy and can stay at sea for months at a time, interrogates seafloor transponders





[Burgmann and Chadwell, 2014]



Current State of the Cascadia GNSS-A Network

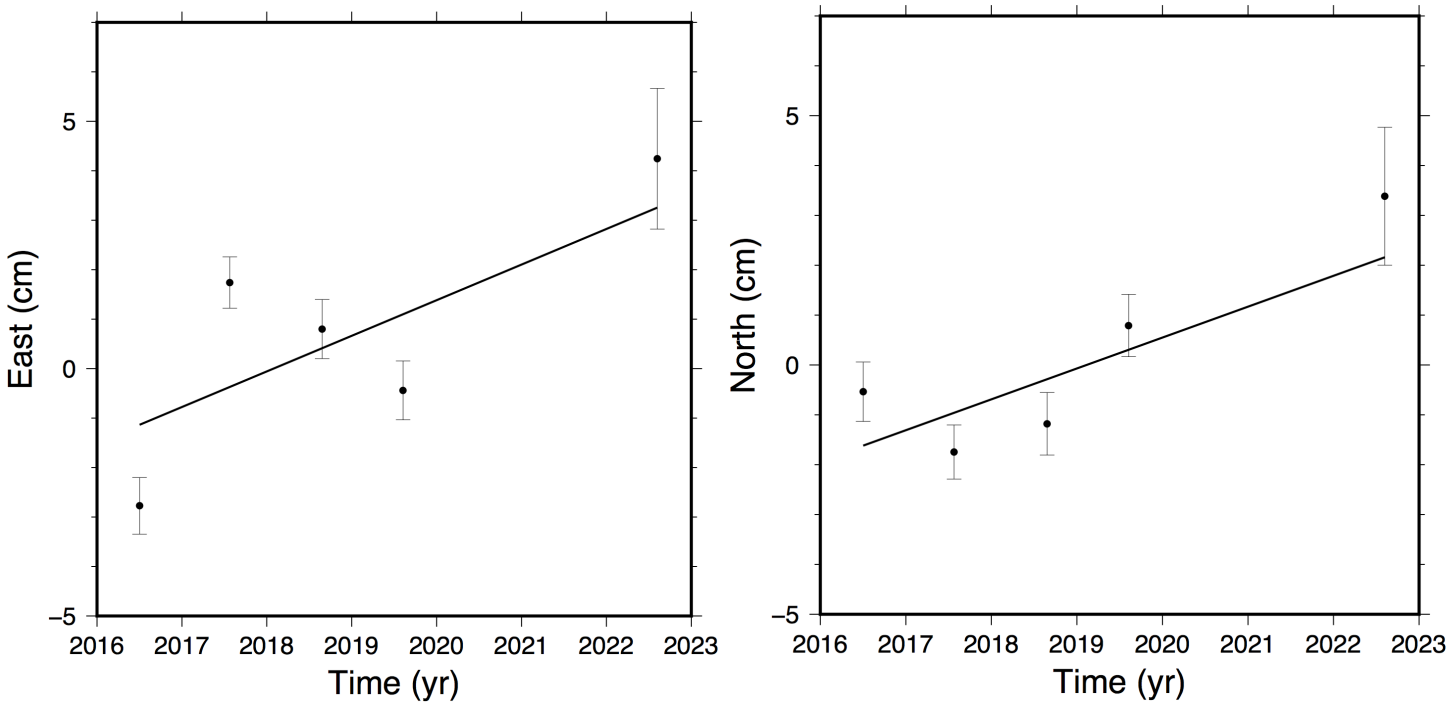
- Legacy site on the Juan de Fuca plate
  - JNP1 has a ~20 year long time series
- Sites along the trench offshore Oregon installed by Chadwell and Schmidt
  - **Goal: infer shallow locking along the subduction zone interface**

Site	2016	2017	2018	2019	2020	2021	2022
NGH1	Y	Y	Y	N	N	N	N
NCL1	N	N	Y	Y	N	Y	Y
NNP1	Y	Y	Y	Y	N	N	Y
NCB1	N	N	Y	N	N	Y	Y

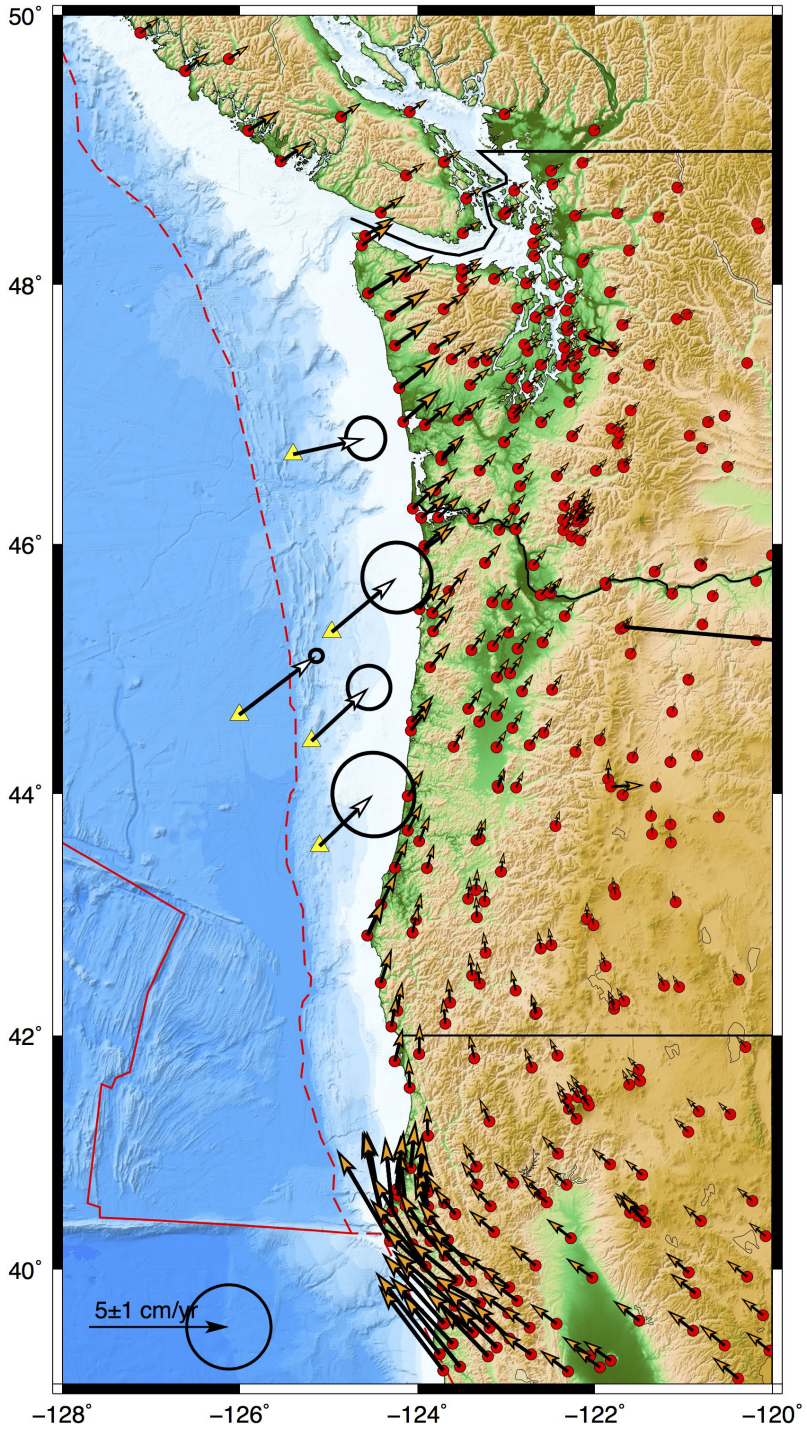
*All velocities shown are wrt the North American plate

GNSS-A Velocity Estimate Offshore Newport (NNP1)

Measured Offsets (ITRF)



- Site velocity is estimated by fitting a linear trend through annual positions
- Velocities rotated from ITRF to North American reference frame (Altamimi et al., 2017)
- **Longer time series required to better constrain the site velocity!**

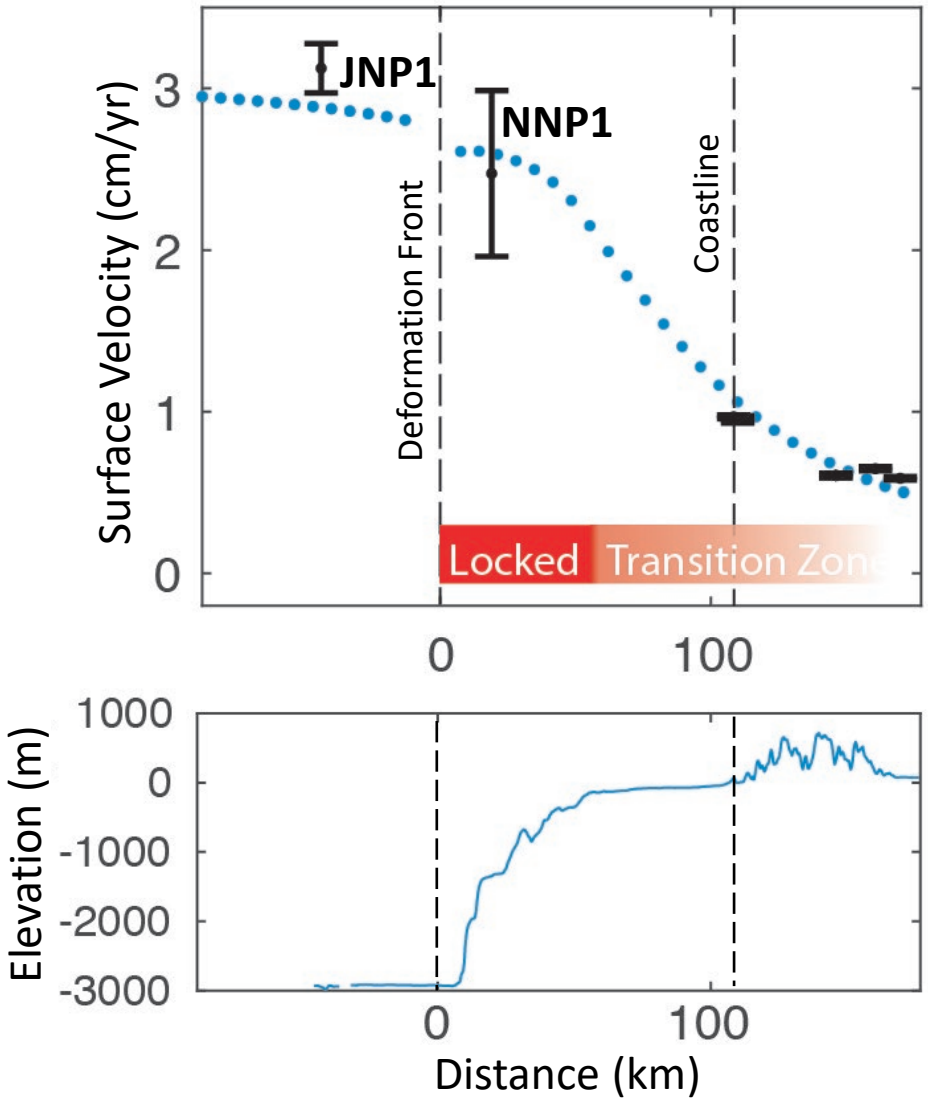


Comparison with Land Stations

- Offshore uncertainties much greater than land stations
  - ~3-5 campaign positions vs ~10 yrs of daily positions
- Seafloor sites are moving primarily with the subducting Juan de Fuca plate.

*All velocities shown are wrt the North American plate

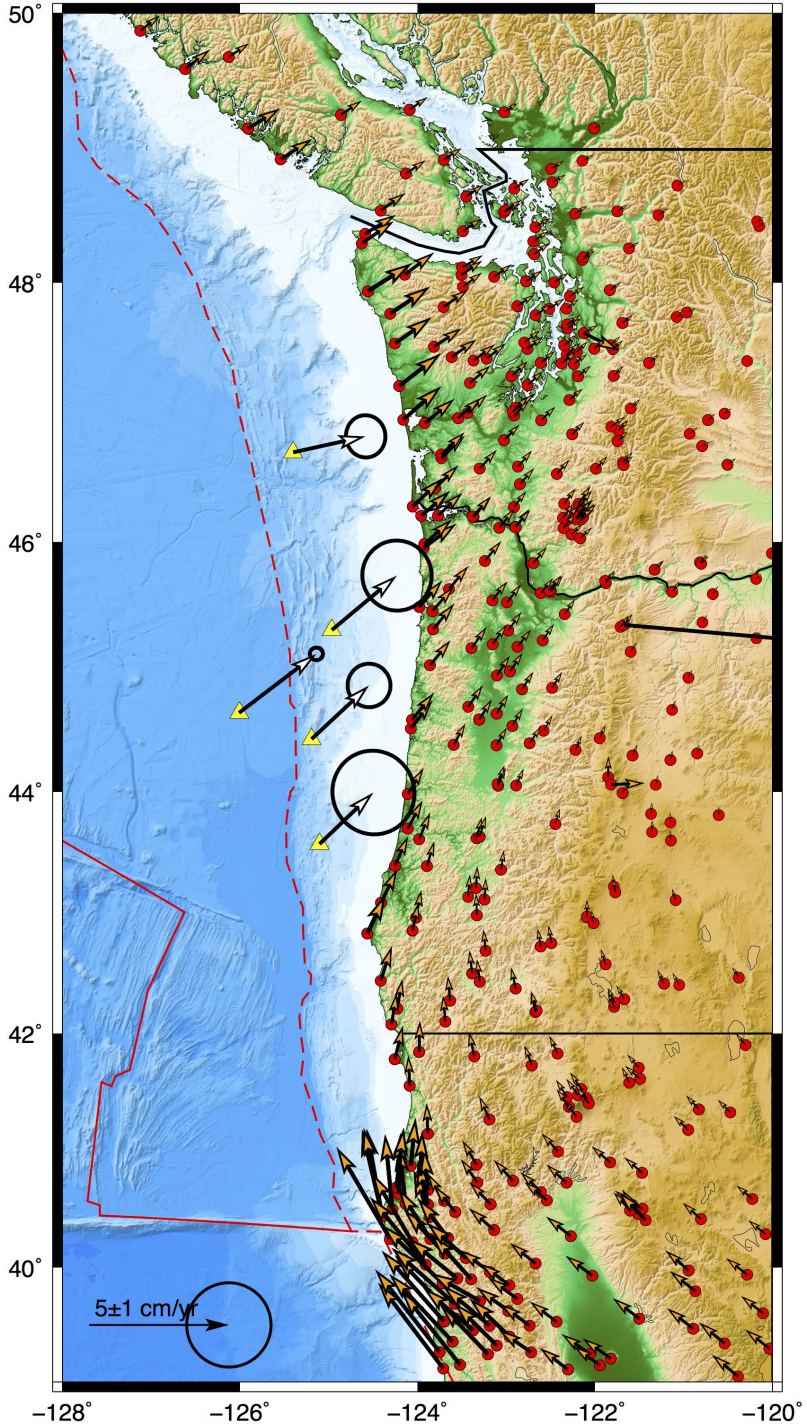
Fault Locking Models Offshore Newport, OR



- Locking models created using Poly3D (Thomas, 1993)
- Explored a range of locking models, including those with shallow stress shielding.
- Interface must have high locking near the trench to account for change in velocity from offshore to onshore

Conclusions

- Offshore geodetic stations are moving much faster than the onshore stations
- There must be a high degree of locking in the shallow Cascadia subduction zone
- This shallow locking extends throughout offshore Oregon
- We will collect more measurements at these sites in tandem with the seafloor geodesy community experiment



Questions?

Acknowledgements:

Scripps Institution of Oceanography

- Surui Xie (now at University of Houston)
- Dave Price
- Dennis Rimington
- Joel White

The Wave Glider pilots at Liquid Robotics

The crews of the R/V Roger Revelle, R/V Thompson, & R/V Elakha