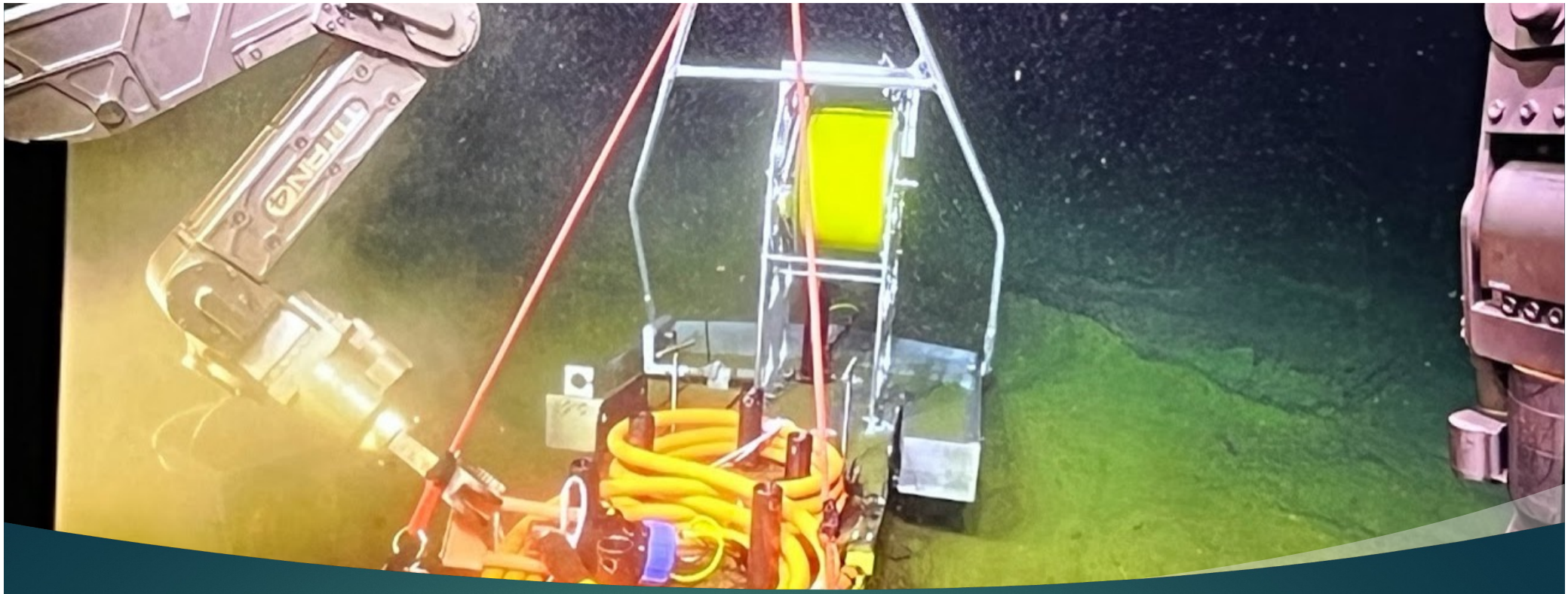

Detection of shallow slow slip with a seafloor optical fiber strainmeter

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UNIVERSITY OF KANSAS

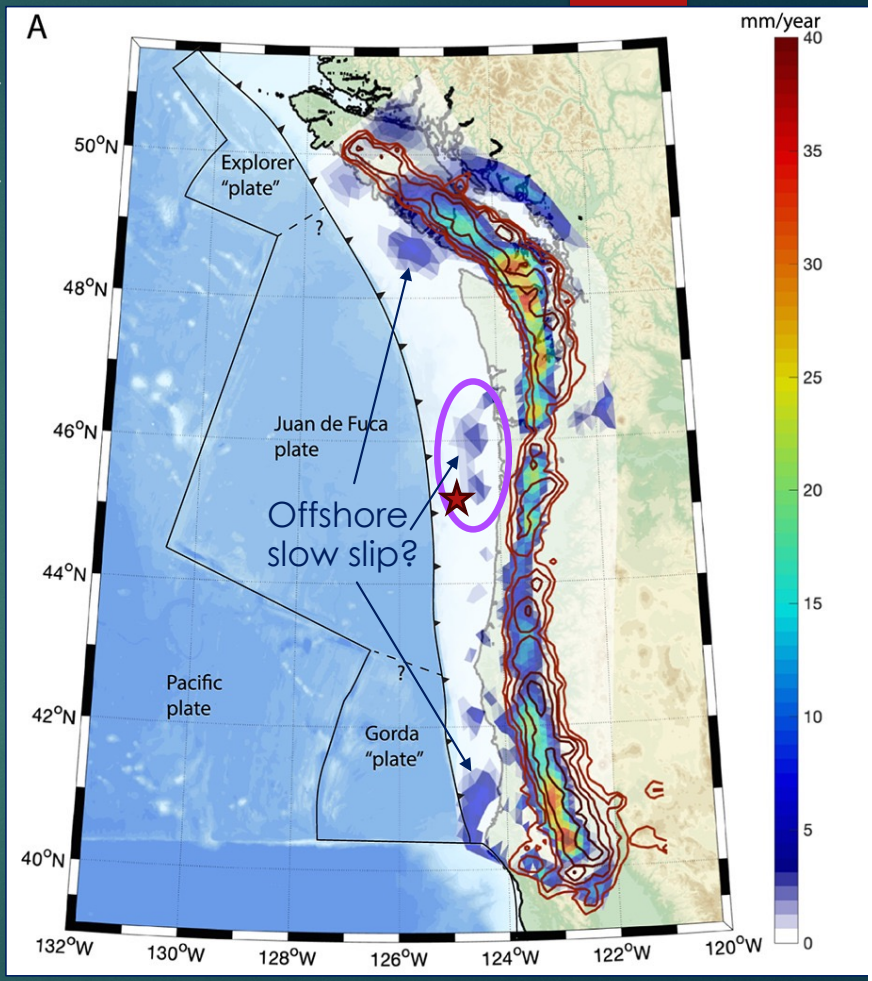
MARK ZUMBERGE
UNIVERSITY OF CALIFORNIA – SAN DIEGO

Slow Slip and Plate Interface Coupling in Cascadia

Slow slip events are well known in Cascadia in a narrow band that is significantly deeper than the base of the locked zone. These events occur regularly and are unlikely to trigger a megathrust event.

Onshore GNSS hints at the presence of a second band of slow slip offshore, which would be more prone to triggering large earthquakes. **The shallow slow slip is predicted to slip at the same time (+/- days) as onshore slow slip and tremor.** It may also occur at other times.

Bartlow, GRL, 2020

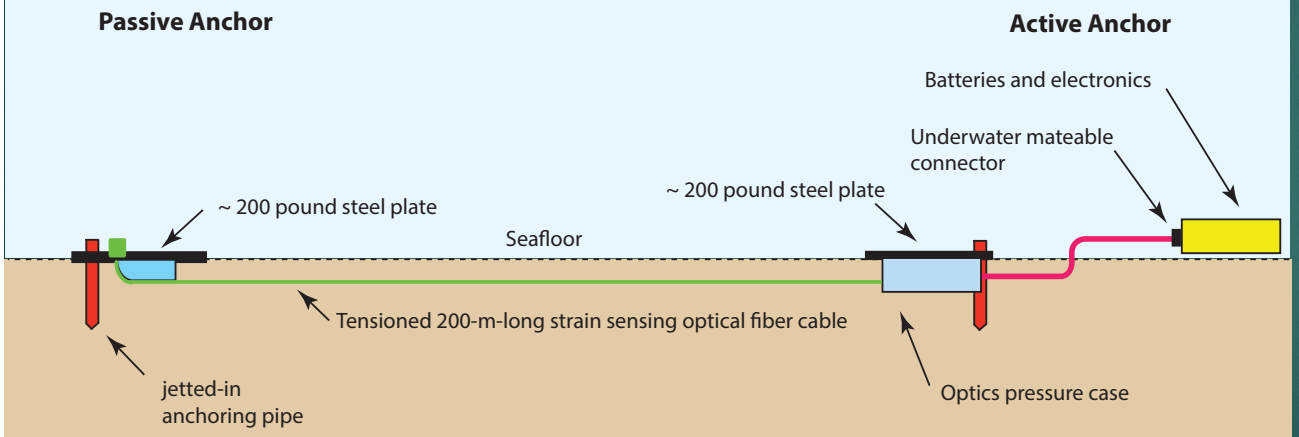


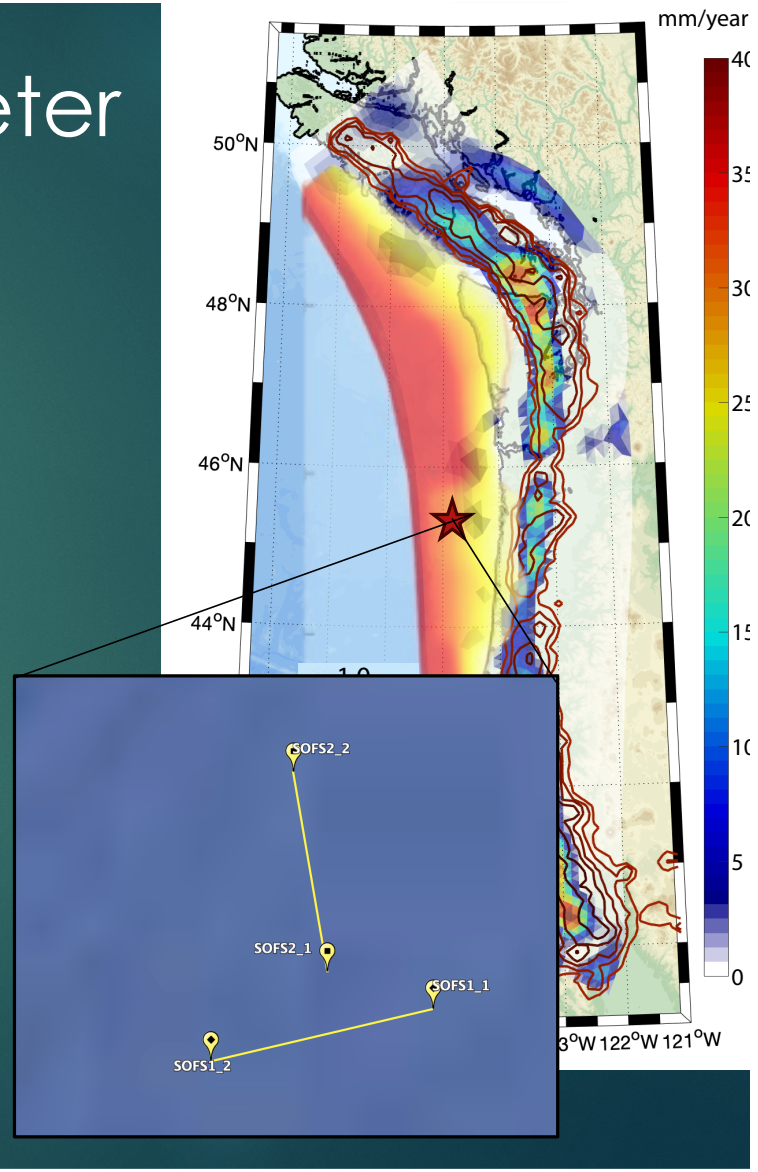
Seafloor Optical Fiber Strainmeter

Joint project with Mark Zumberge, UCSD

Funded by NSF OCE -2127938 and OCE-2004259

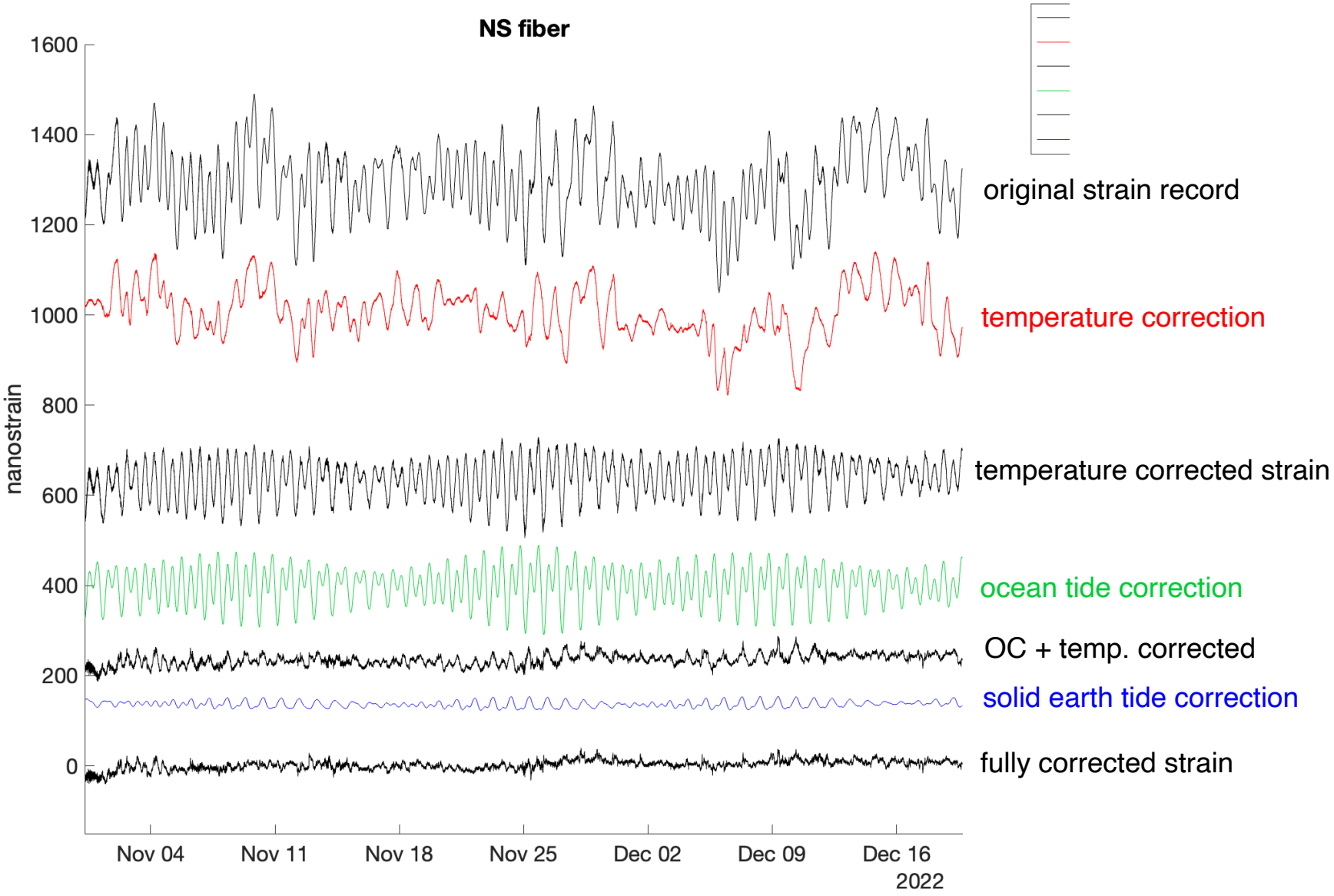
Figure and design by M. Zumberge, UCSD

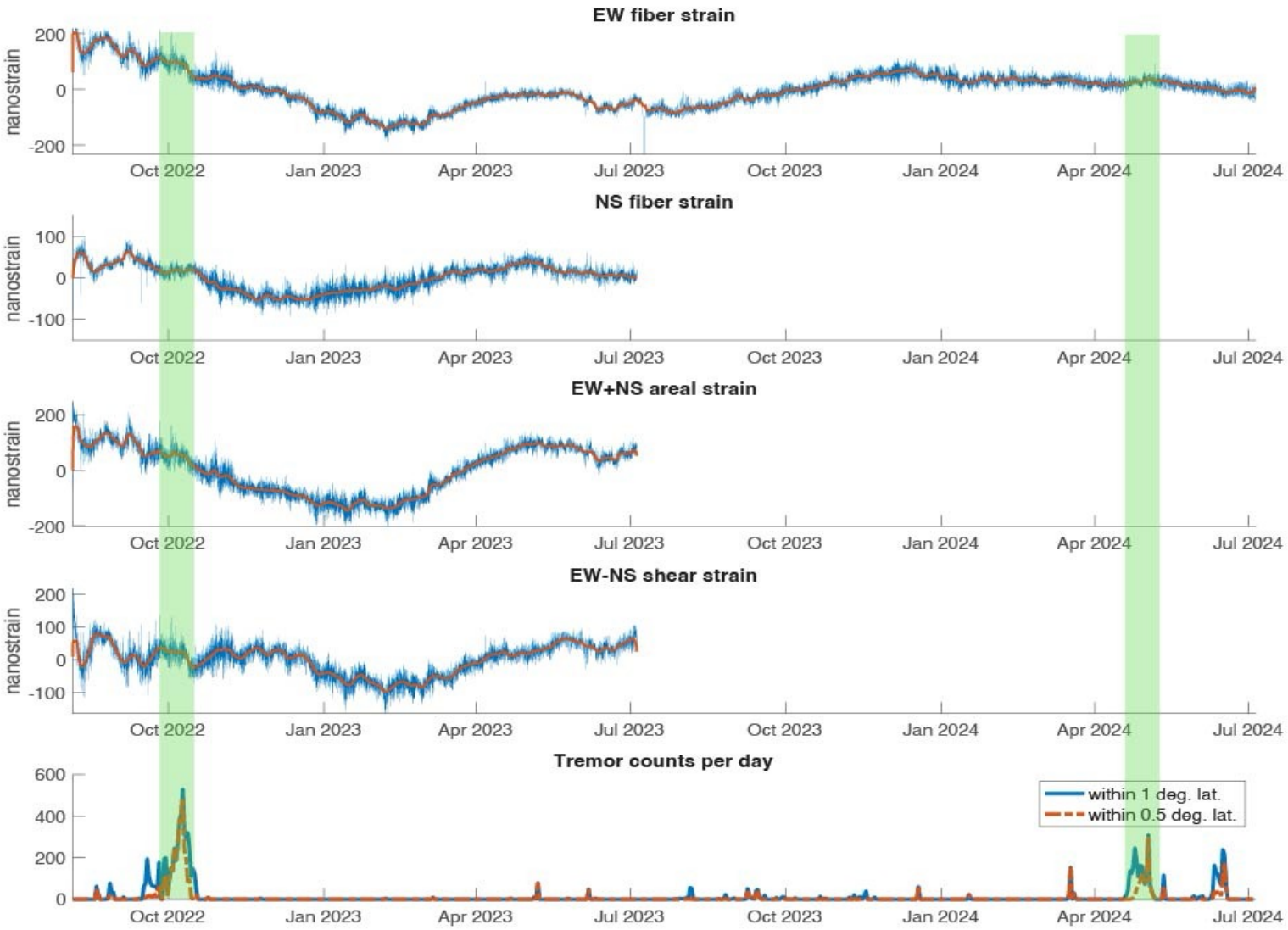




Zumberge, M. A., Hatfield, W., & Wyatt, F. K. (2018). Measuring seafloor strain with an optical fiber interferometer. *Earth and Space Science*, *5*(8), 371-379.

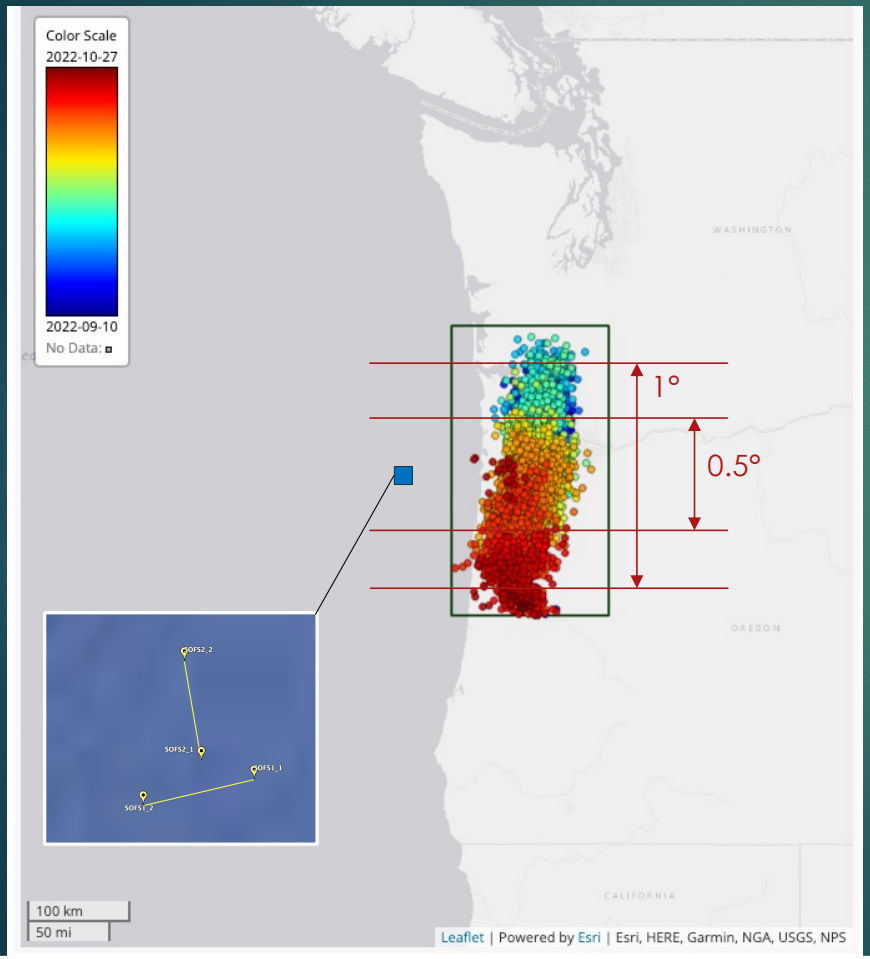
The data!!

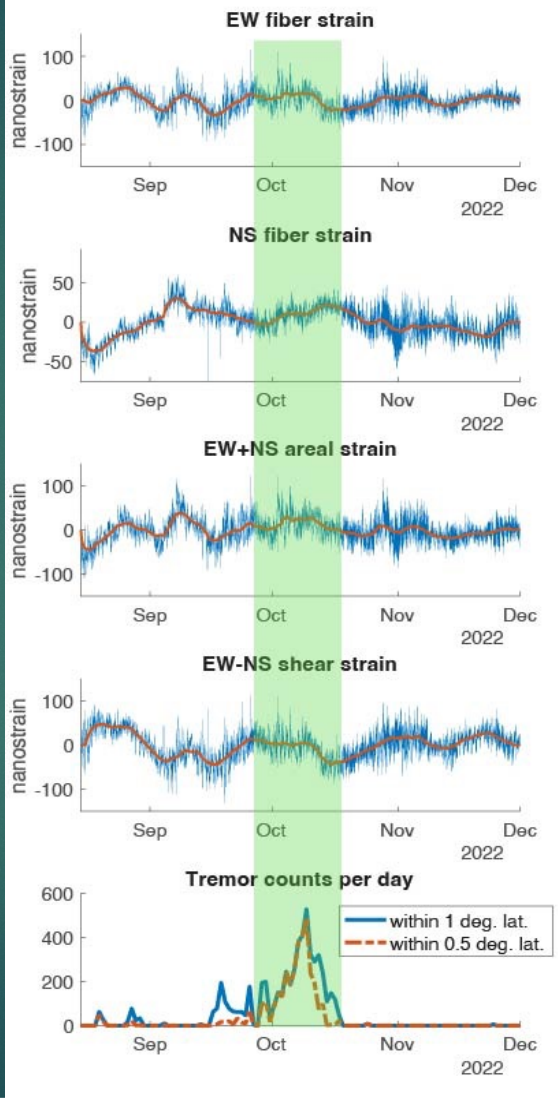

NS fiber
nanostrain
1600
1400
1200
1000
800
600
400
200
0
Nov 04
Nov 11
Nov 18
Nov 25
Dec 02
Dec 09
Dec 16
2022
original strain record
temperature correction
temperature corrected strain
ocean tide correction
OC + temp. corrected
solid earth tide correction
fully corrected strain


EW fiber strain
nanostrain
200
0
-200
Oct 2022
Jan 2023
Apr 2023
Jul 2023
Oct 2023
Jan 2024
Apr 2024
Jul 2024
NS fiber strain
nanostrain
100
0
-100
Oct 2022
Jan 2023
Apr 2023
Jul 2023
Oct 2023
Jan 2024
Apr 2024
Jul 2024
EW+NS areal strain
nanostrain
200
0
-200
Oct 2022
Jan 2023
Apr 2023
Jul 2023
Oct 2023
Jan 2024
Apr 2024
Jul 2024
EW-NS shear strain
nanostrain
200
100
0
-100
Oct 2022
Jan 2023
Apr 2023
Jul 2023
Oct 2023
Jan 2024
Apr 2024
Jul 2024
Tremor counts per day
600
400
200
0
within 1 deg. lat.
within 0.5 deg. lat.
Oct 2022
Jan 2023
Apr 2023
Jul 2023
Oct 2023
Jan 2024
Apr 2024
Jul 2024

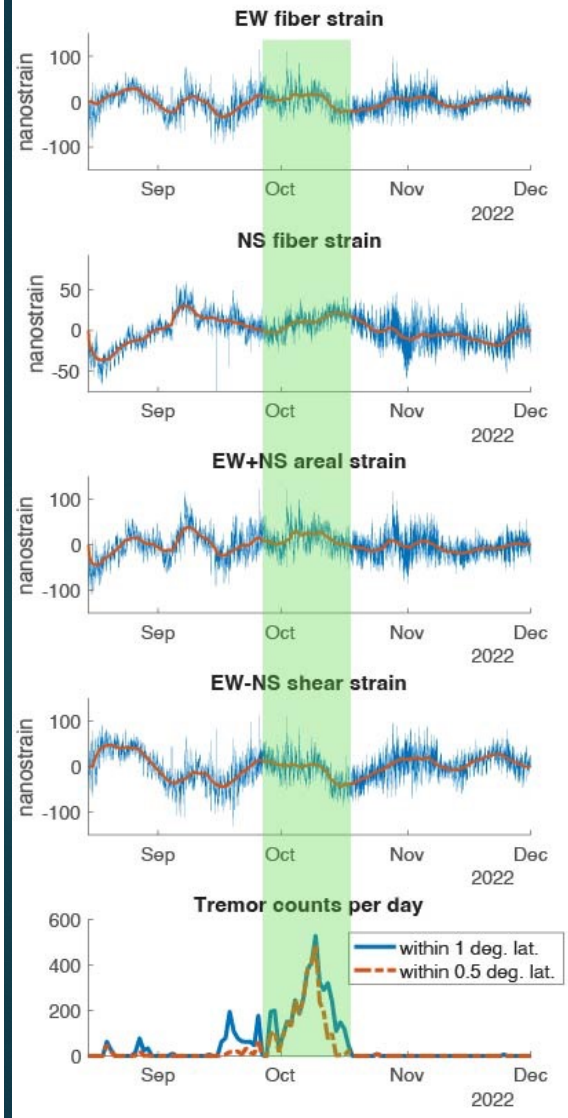
2022 ETS event

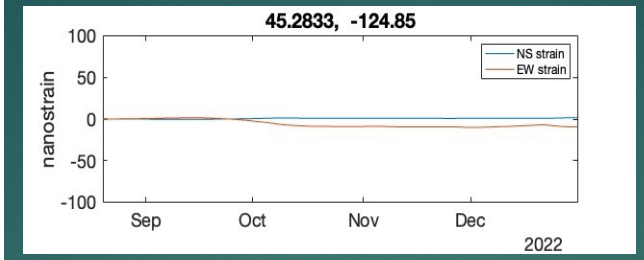
Pacific Northwest Seismic Network



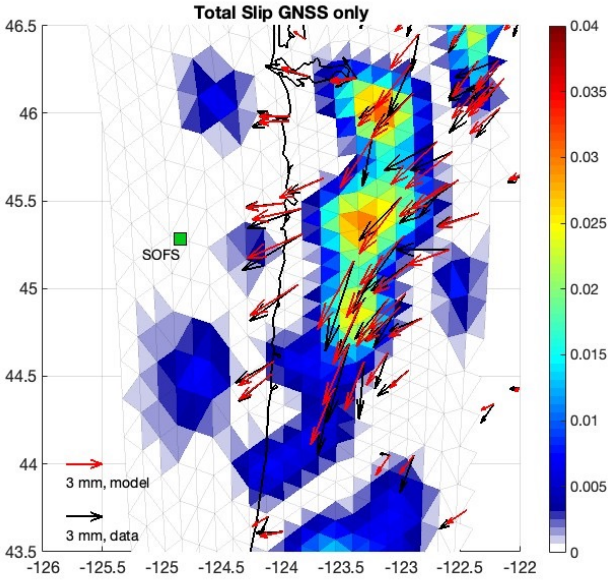


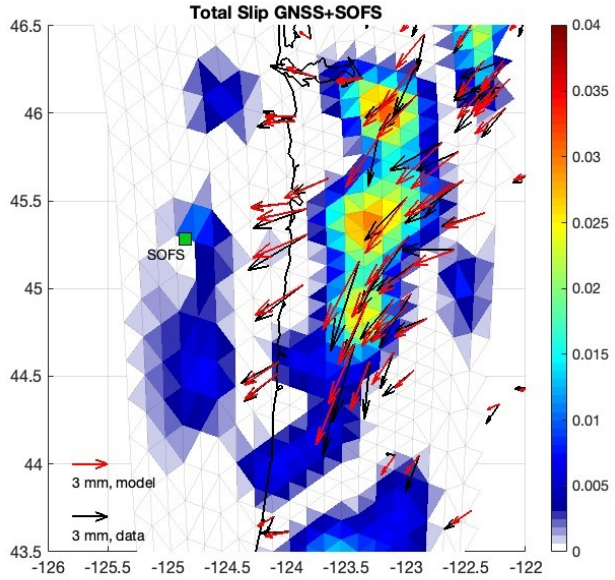
2022 ETS event



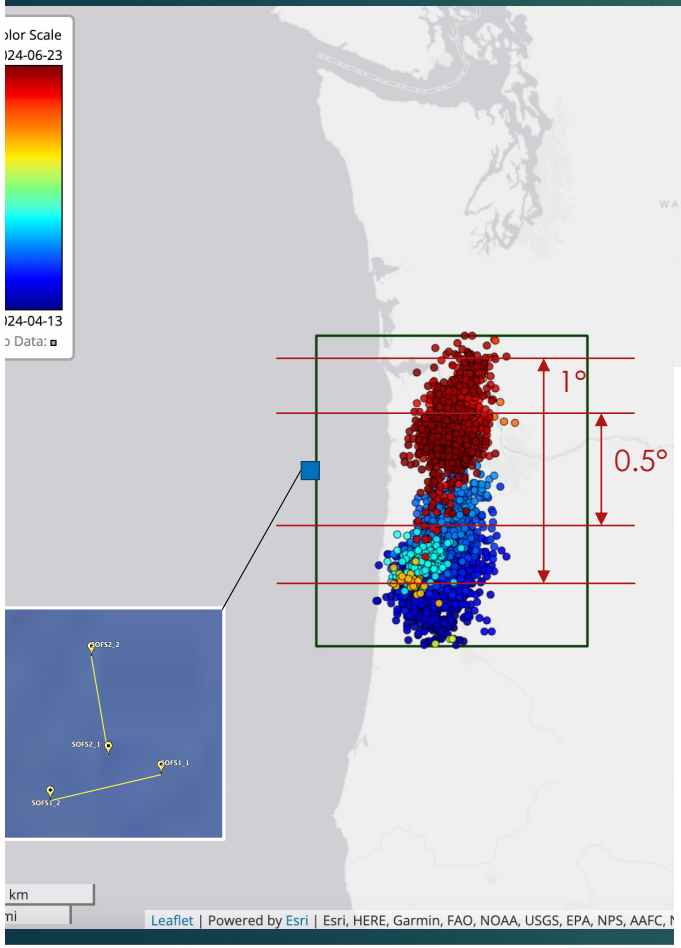


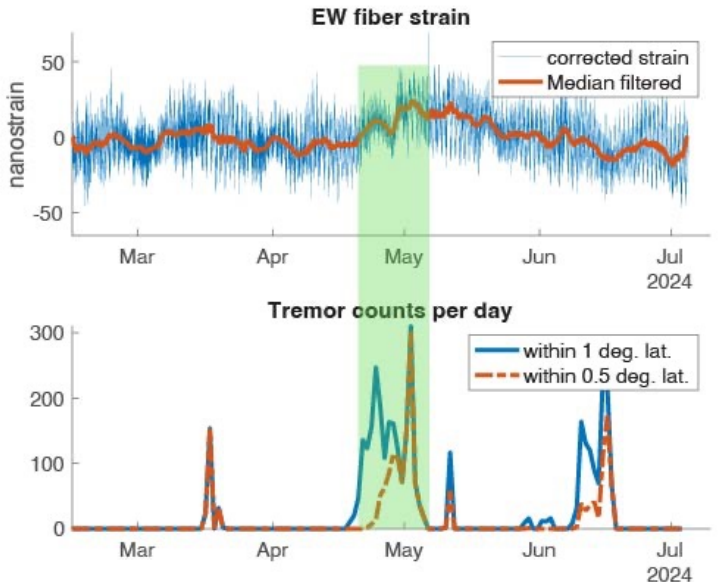
Strain modeled from onshore ETS only

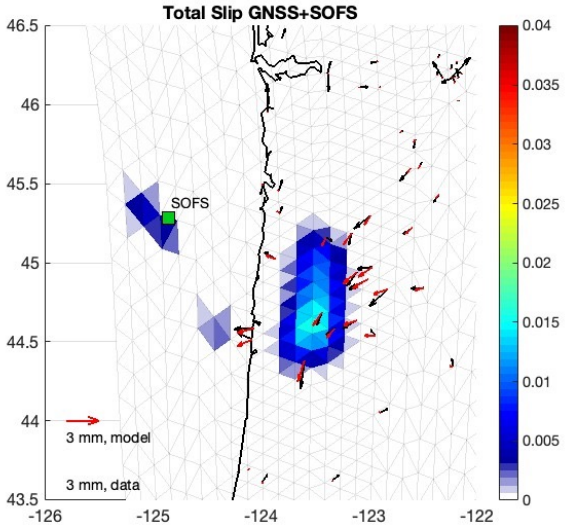


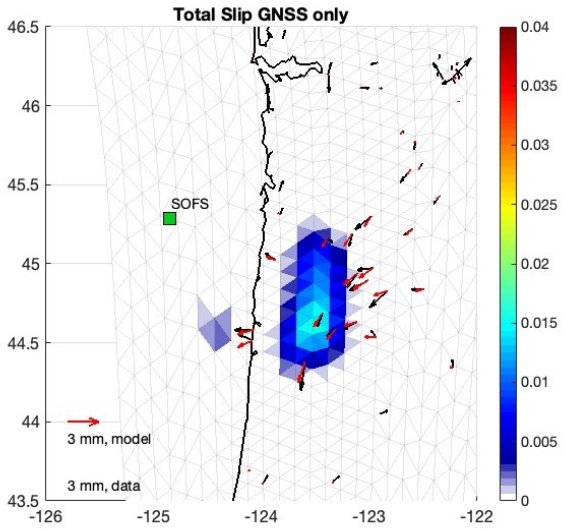


2024 ETS events









SUMMARY

- I think offshore slow slip is real and hope to submit a paper soon
- Seafloor Optical Fiber Strainmeters (SOFS) instruments work well on multi-year timescales
  - Can be corrected to 10-20 nanostrain on ETS timescales
    - Future work may improve this
- SOFS appear to be viable instruments to detect offshore slow slip in Cascadia, even when it is small (~1 cm)