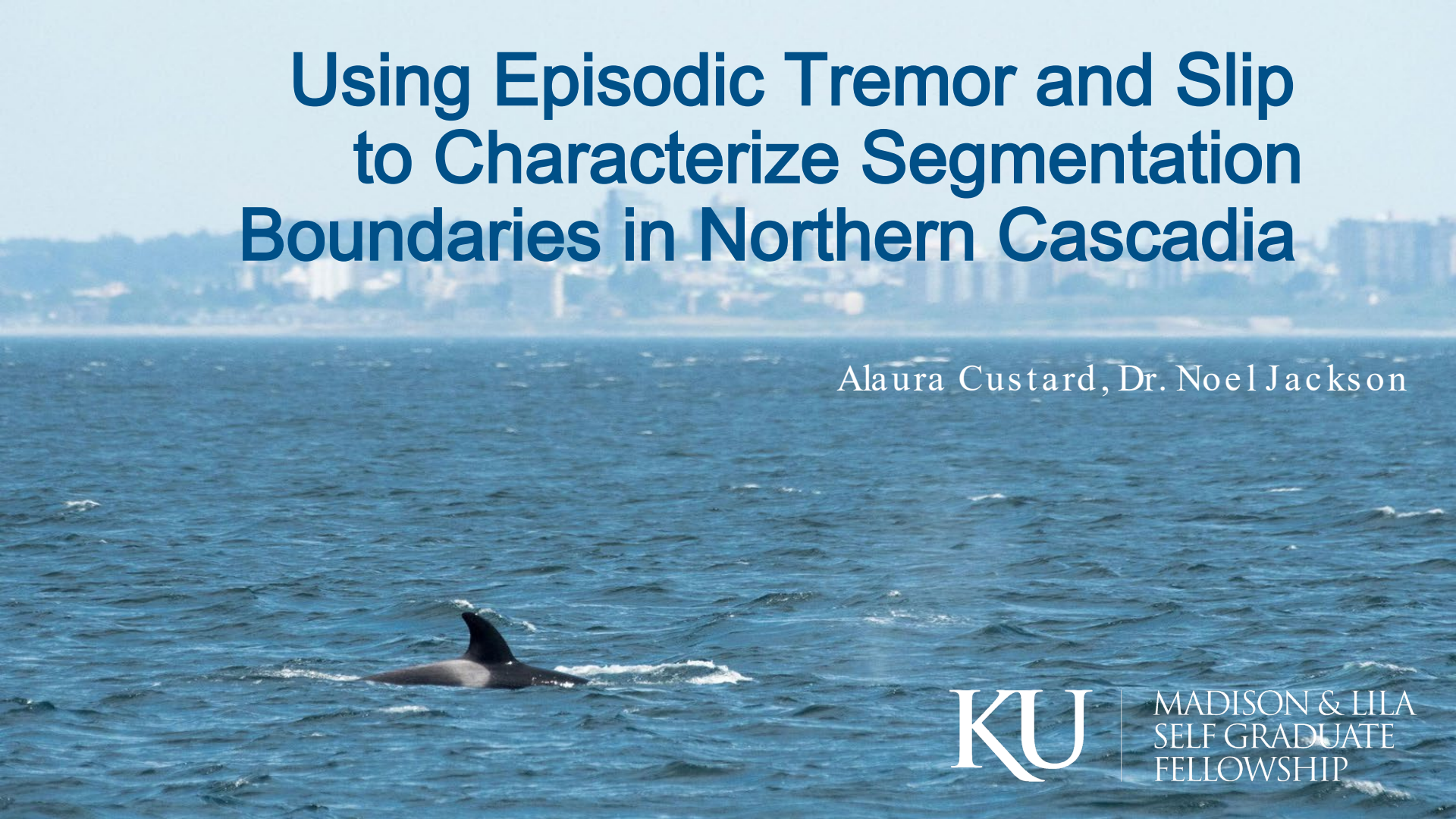
Using Episodic Tremor and Slip to Characterize Segmentation Boundaries in Northern Cascadia

Alaura Custard, Dr. Noel Jackson



KU | MADISON & LILA SELF GRADUATE FELLOWSHIP

1. Previous Study Crash Course

2. How My Study Differs

3. Results

4. Known Structures

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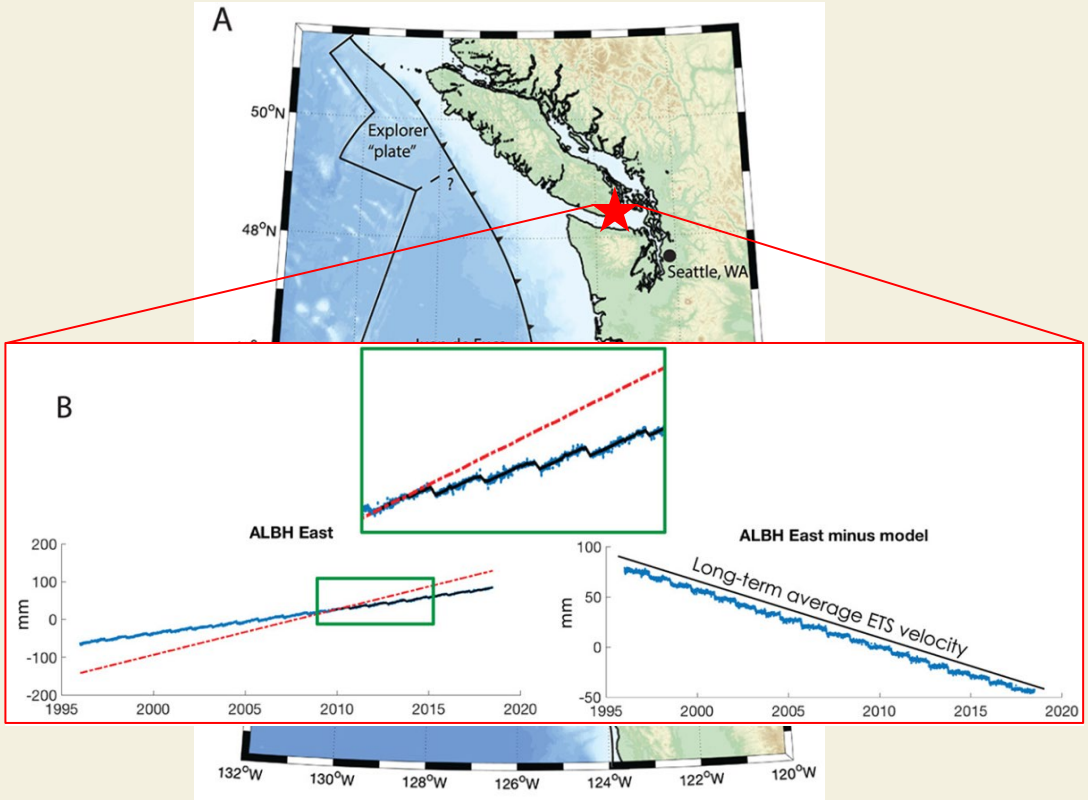
Previous Study Crash Course

New method for separating GNSS time series in Cascadia into ETS and inter-ETS components, deriving long-term average (LTA) ETS velocities.

Uses a tremor detections to identify times of possible ETS events at each station.



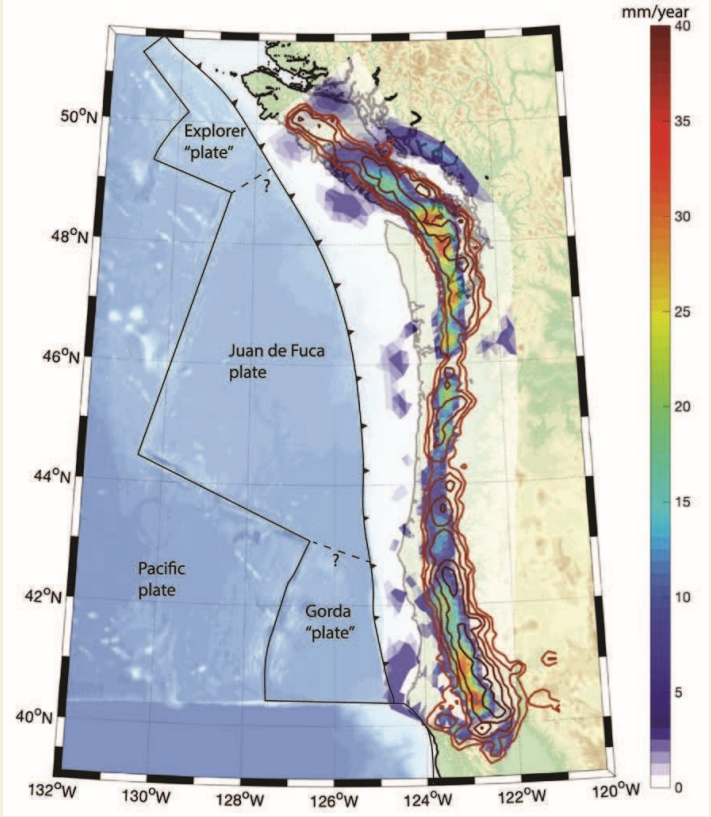
Bartlow, 2020

Previous Study Crash Course

Inverted LTA-ETS velocities to find LTA-ETS slip rate on plate interface.

Persistent offshore patches implying a second updip ETS zone.

LTA-ETS slip rate and tremor accumulation correspond spatially and temporally across the margin...



Bartlow, 2020

Previous Study Crash Course

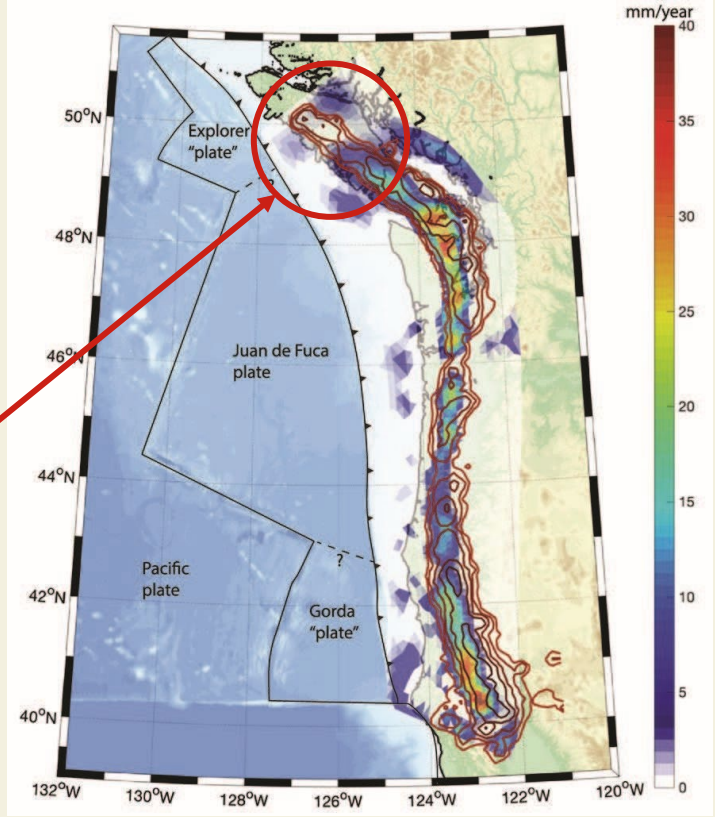
Inverted LTA-ETS velocities to find LTA-ETS slip rate on plate interface.

Persistent offshore patches implying a second updip ETS zone.

LTA-ETS slip rate and tremor accumulation correspond spatially and temporally across the margin...

EXCEPT for in northern Vancouver Island?

Bartlow, 2020



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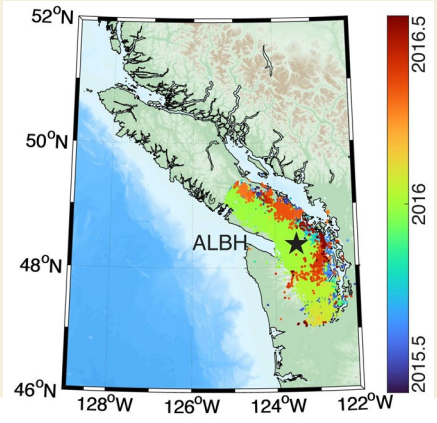
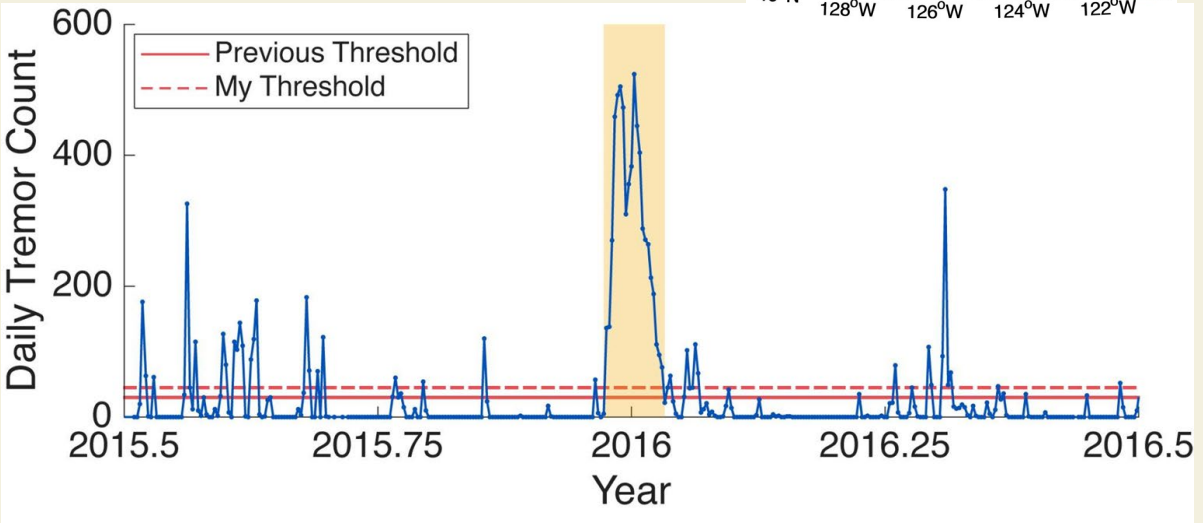
How My Study Differs

Previous study used a static definition of what is considered a tremor burst across the entire margin.

OLD Tremor Burst Variables

- *Radius around GNSS station (150km)*
- *Minimum tremor counts/day (30/day)*
- *Minimum duration (5days)*





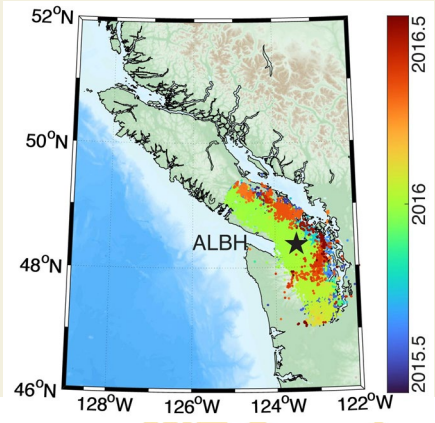
How My Study Differs

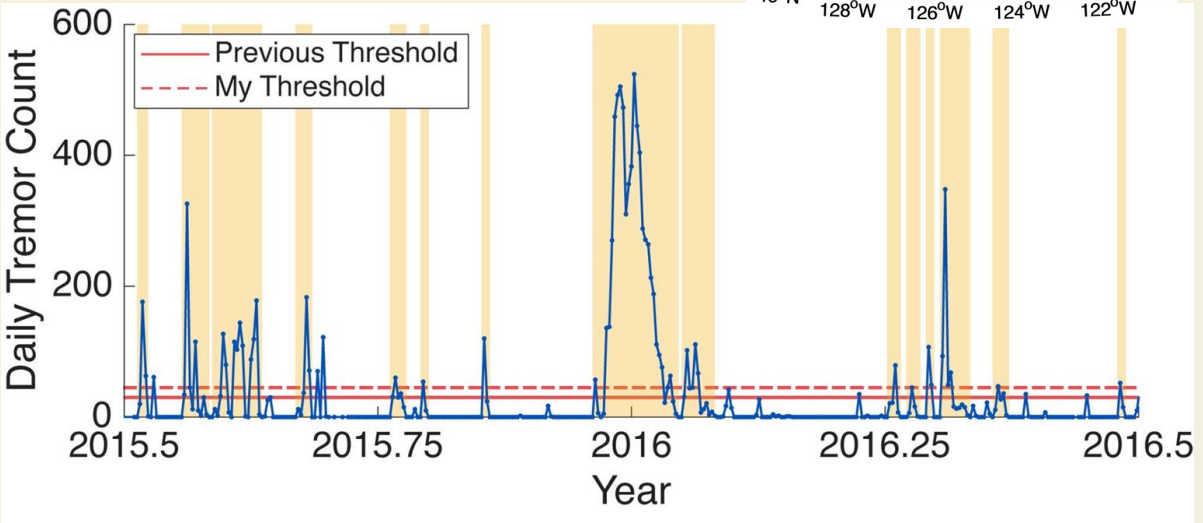
Previous study used a static definition of what is considered a tremor burst across the entire margin.

My study allows the definition to vary based on the ‘average’ amount of tremor near a station, identifying instances of ‘excess’ tremor as bursts.

NEW Tremor Burst Variables

- *Radius around GNSS station (150km)*
- ***Percentile Threshold (50%)***
- *Daily count > 0 surrounding peak*





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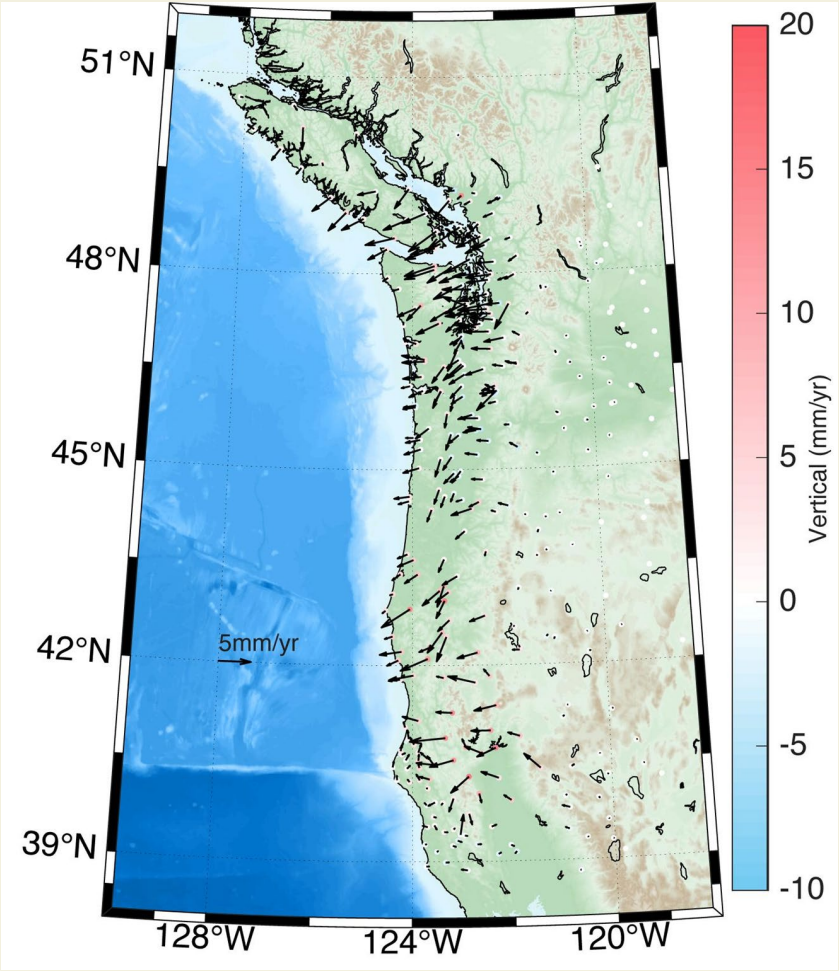
Results

Long-Term Average ETS Velocities found using new methodology!



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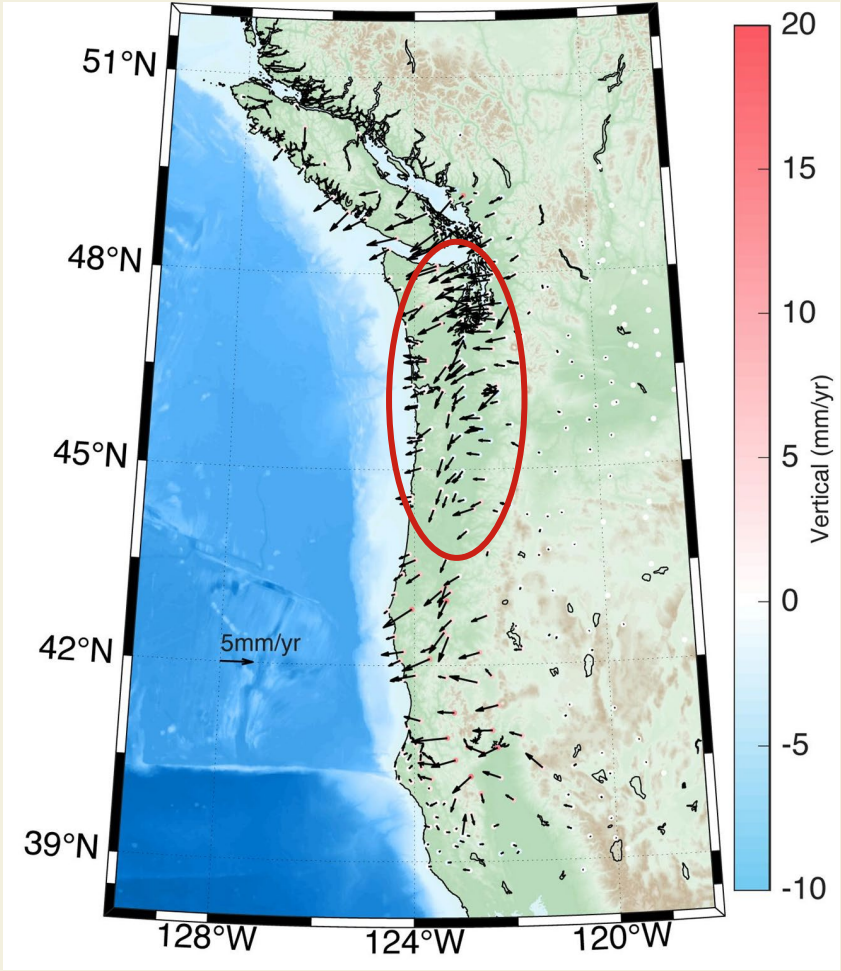
Signs these velocities are consistent with previous work:

- Rotation in central Cascadia

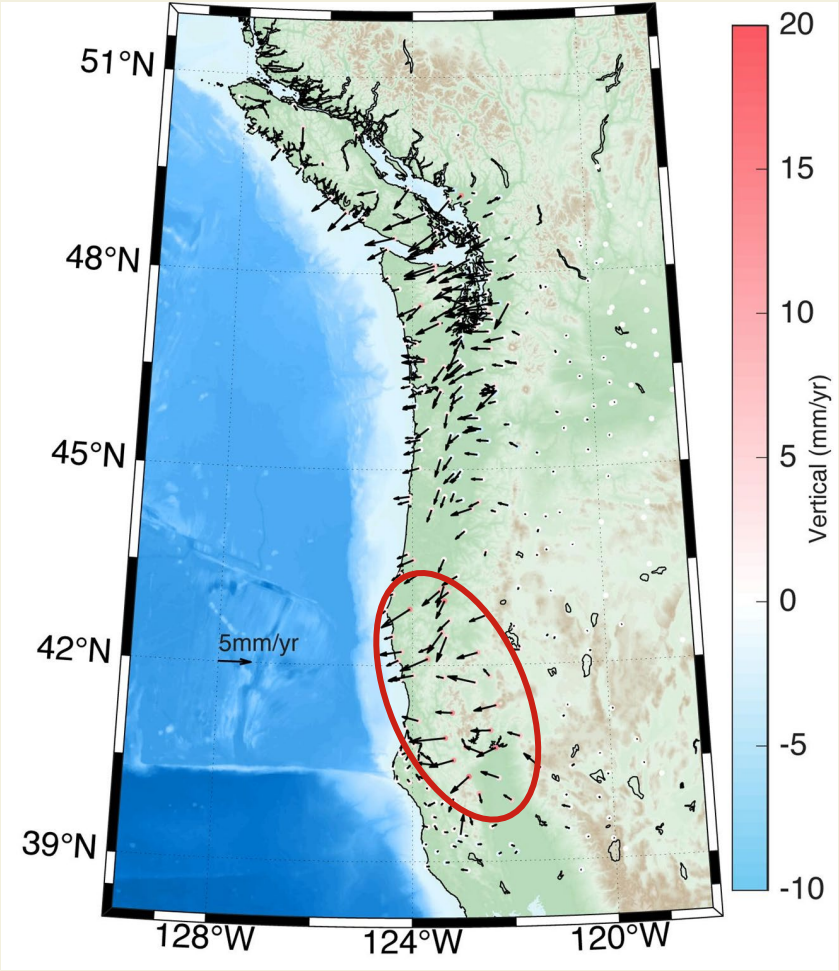


Results

Long-Term Average ETS Velocities found using new methodology!

Signs these velocities are consistent with previous work:

- Rotation in central Cascadia
- Uplift in southern Cascadia



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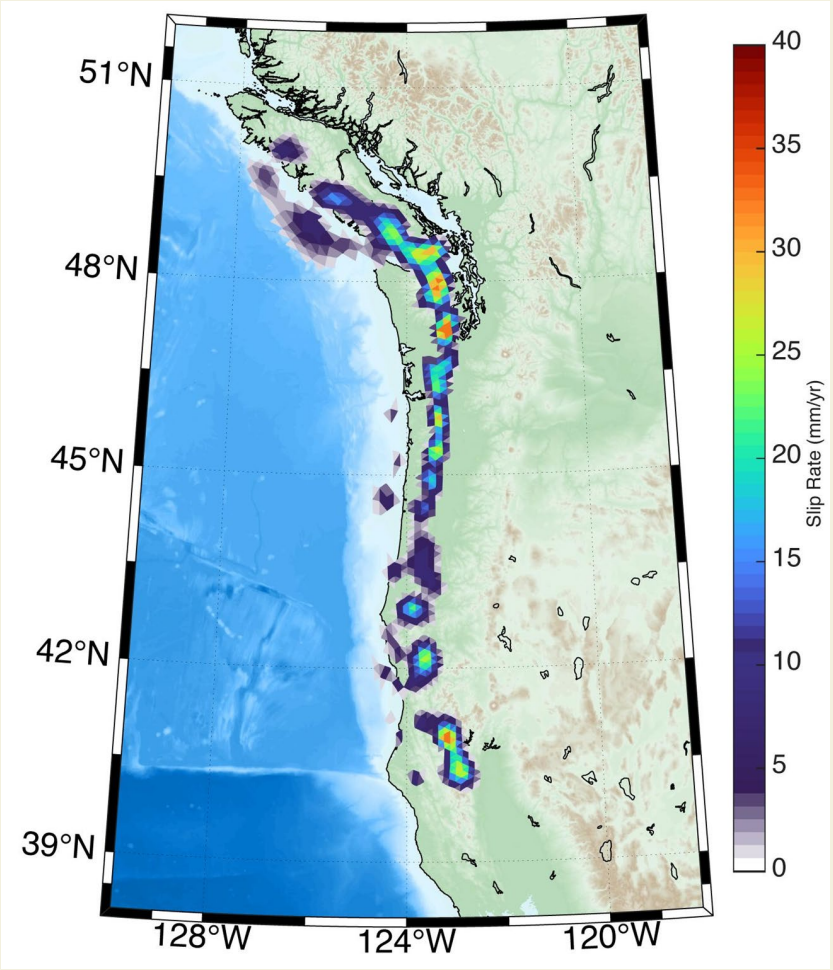
Long-Term Average ETS Slip Rates found using new methodology!



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Long-Term Average ETS Slip Rates found using new methodology!

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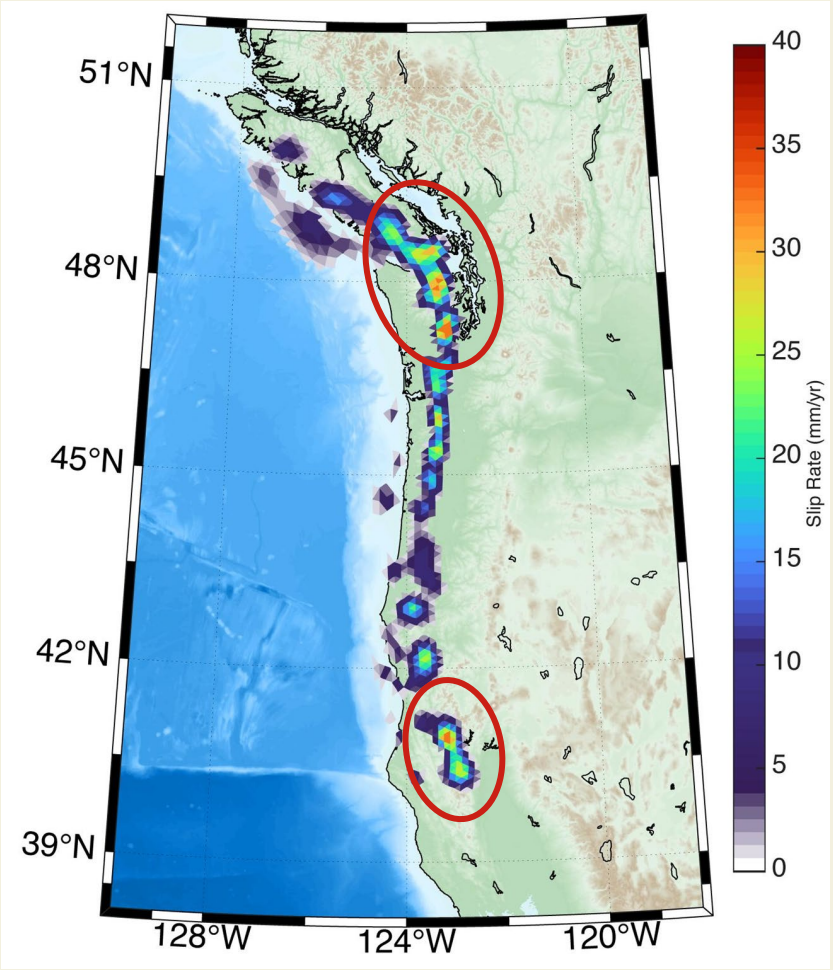
- High slip rates in central and southern Cascadia



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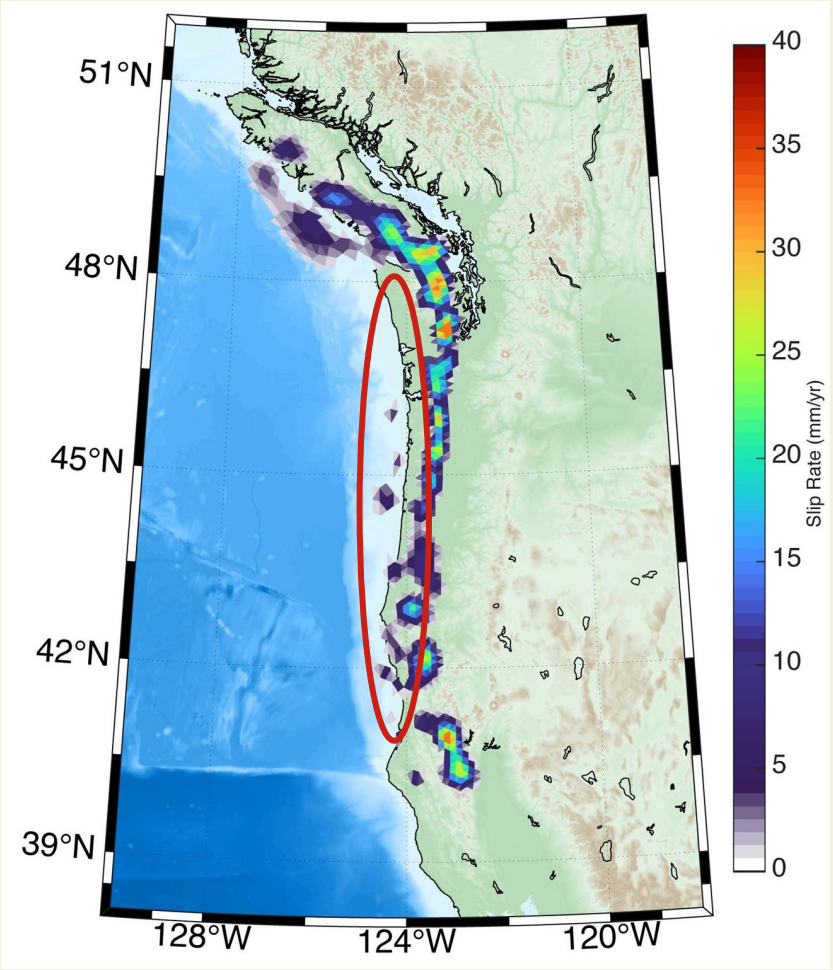
- High slip rates in central and southern Cascadia
- Offshore slip patches in central Cascadia



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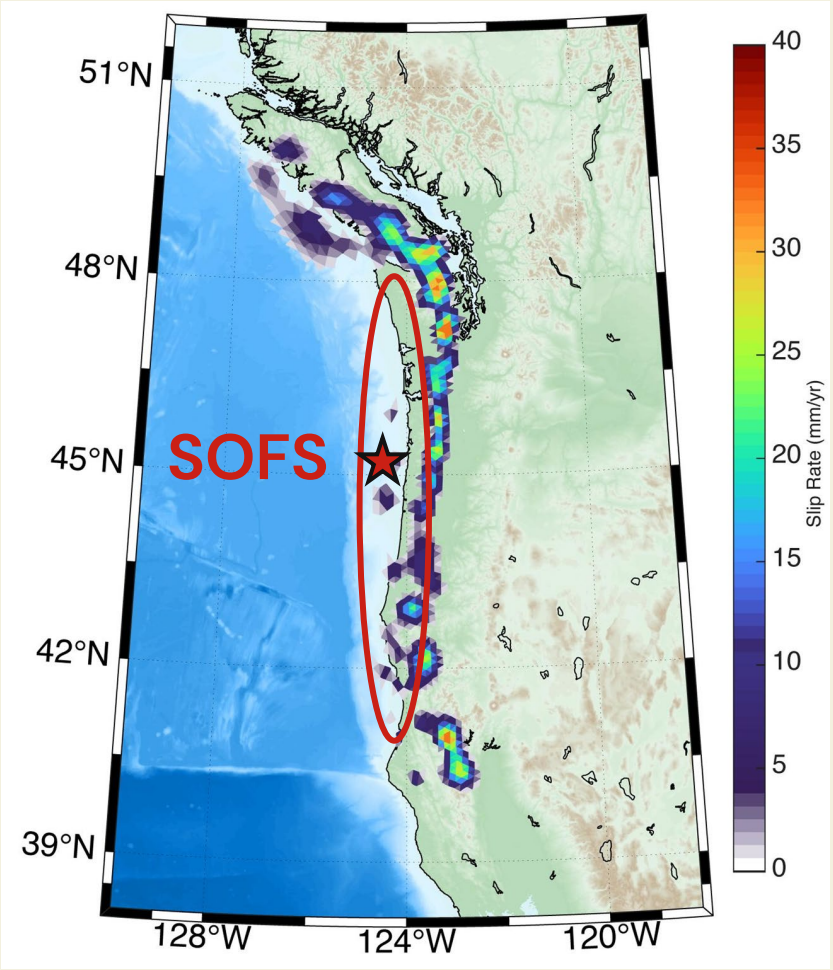

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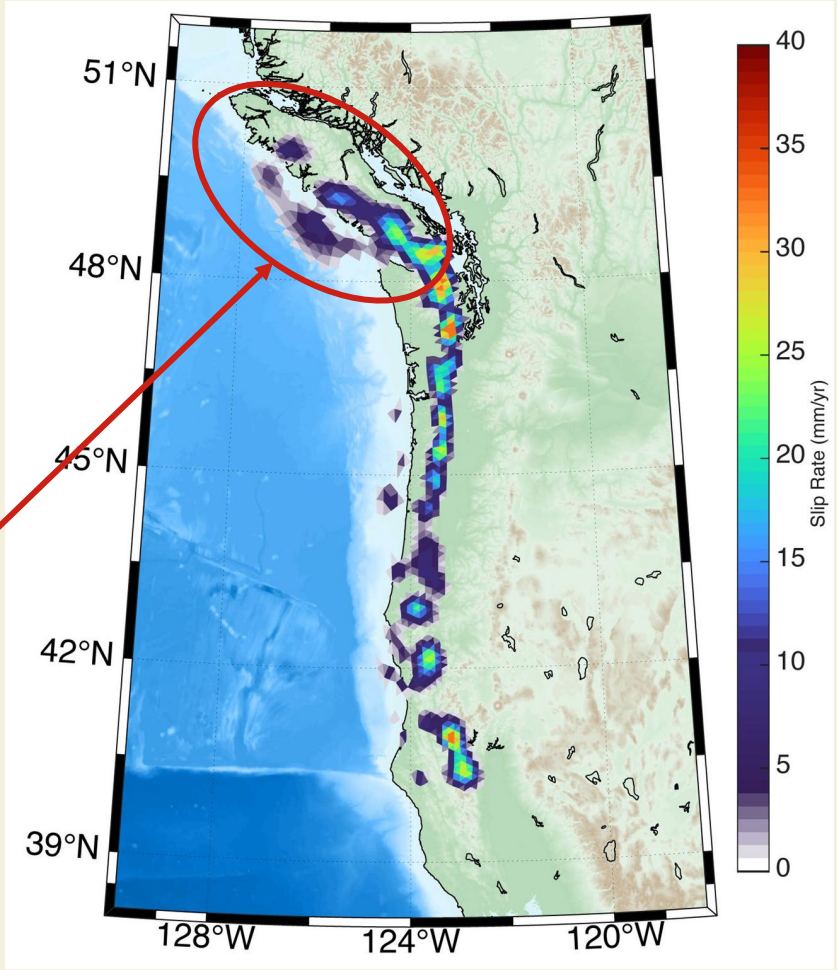
Improvements we see with these slip rates: more slip in northern Cascadia!



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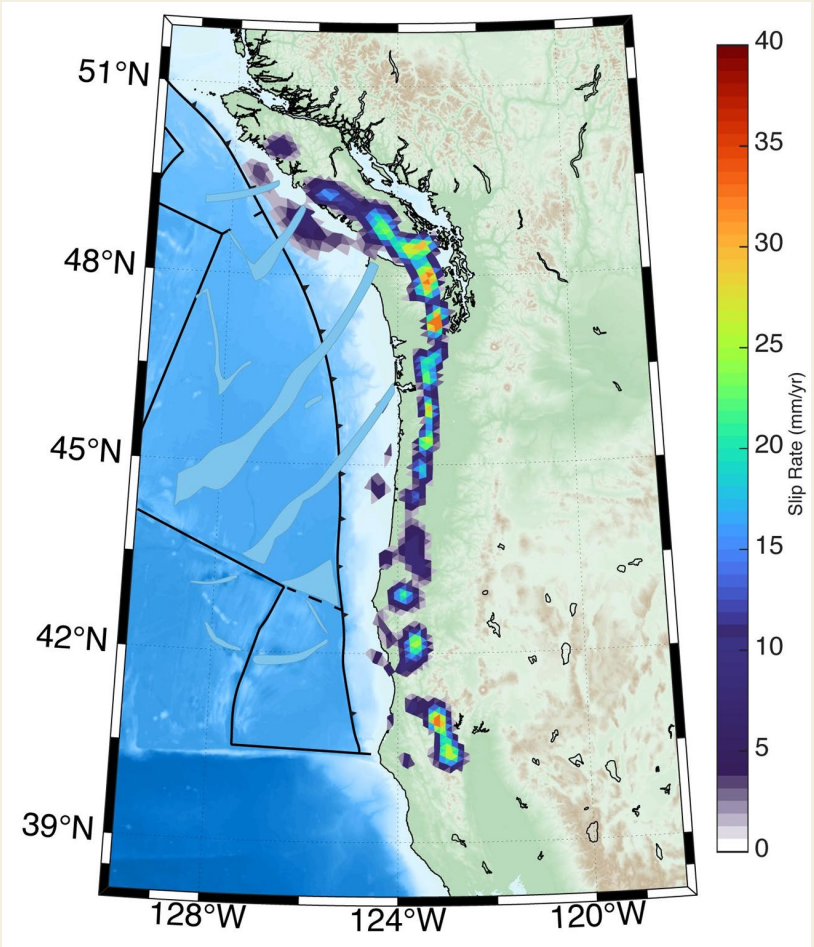
Known Structures

Propagator wakes are scars left over from past spreading ridges, producing regions of weaker oceanic crust.



Wilson, 2002

Known Structures

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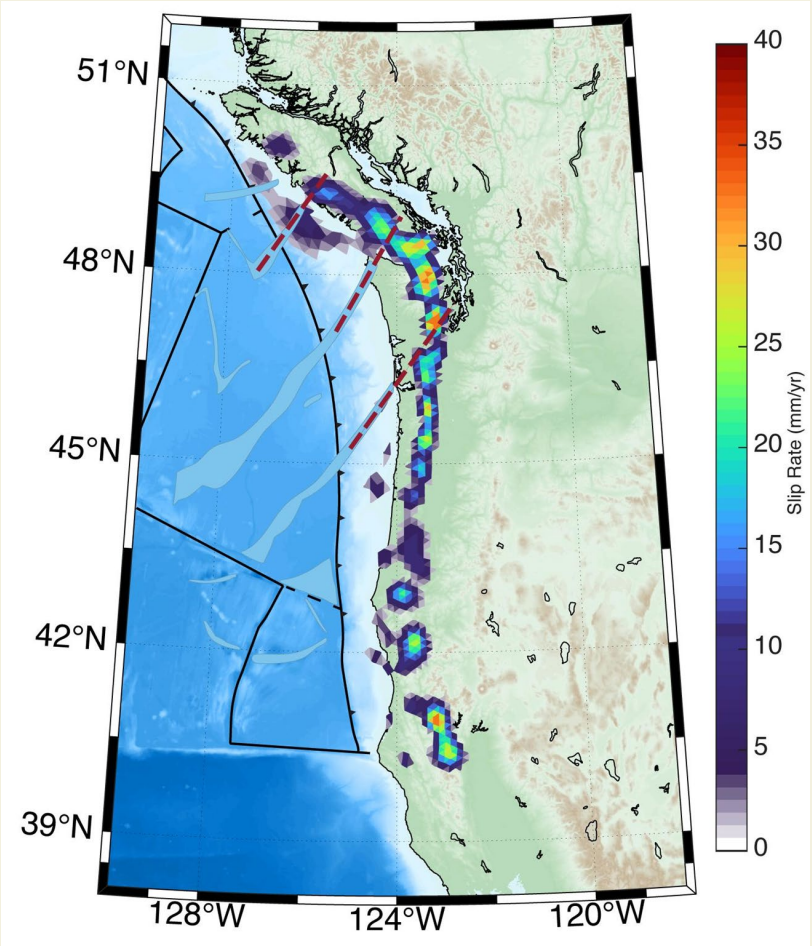
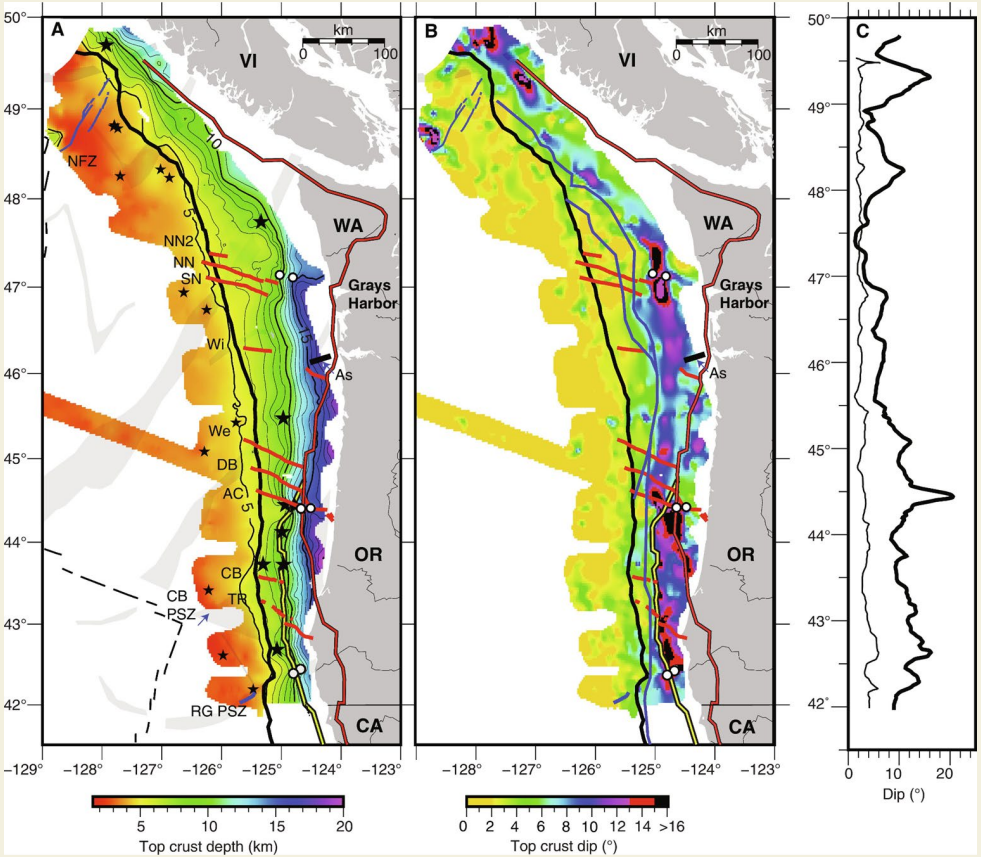
Visually identifiable correlation between apparent segmentation boundaries and propagator wakes.



Wilson, 2002

Known Structures

CASIE21 seismic reflection survey measured depth to top of crust and top of crust dip angle of the subducting plate.



Carbotte et al, 2024

Known Structures

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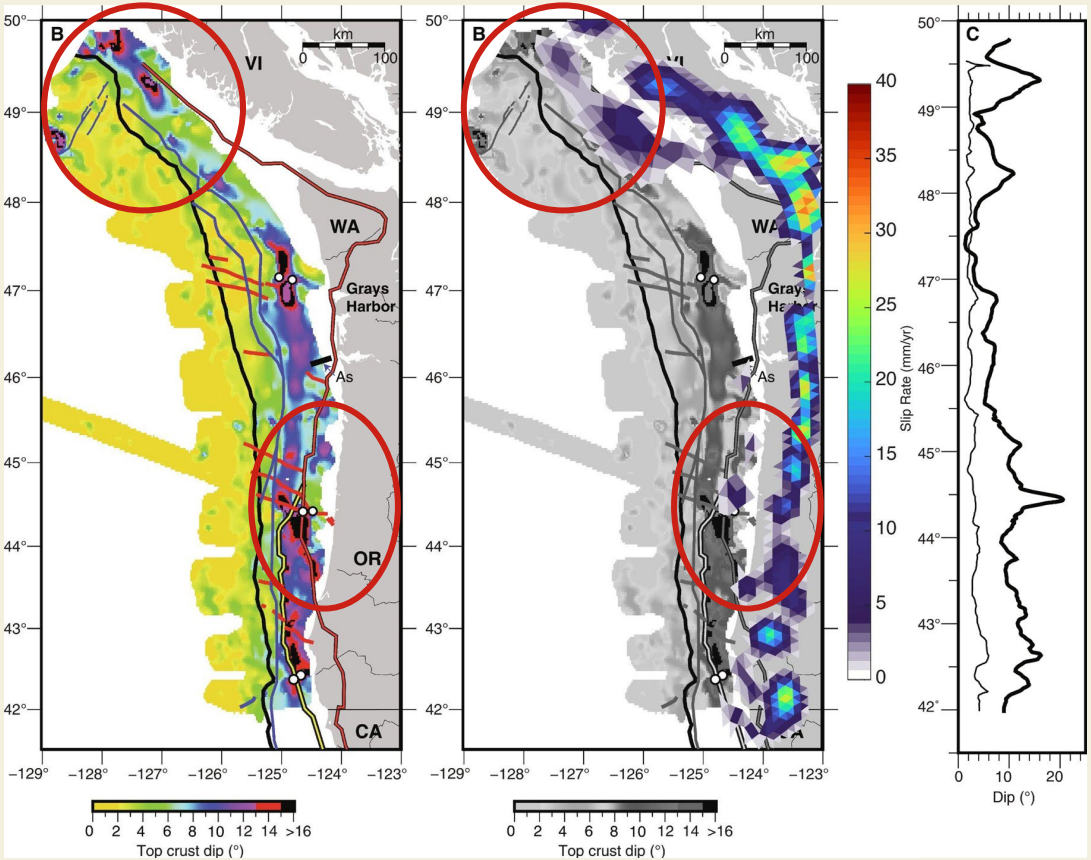
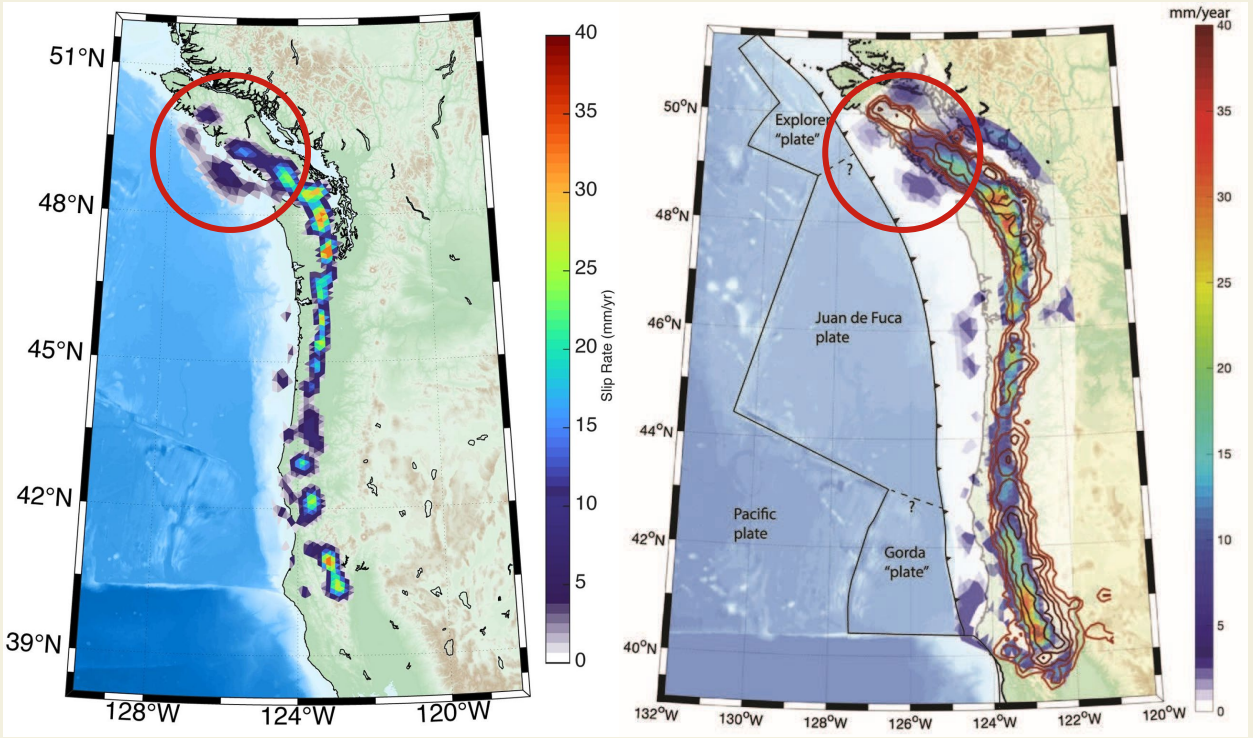
Some regions of higher dip angle roughly correspond to shallower slip patches.



Carbotte et al, 2024

Offshore Implications

Greater resolution in northern Cascadia, with resolvable offshore slip!



Bartlow, 2020

My Study

Previous Study

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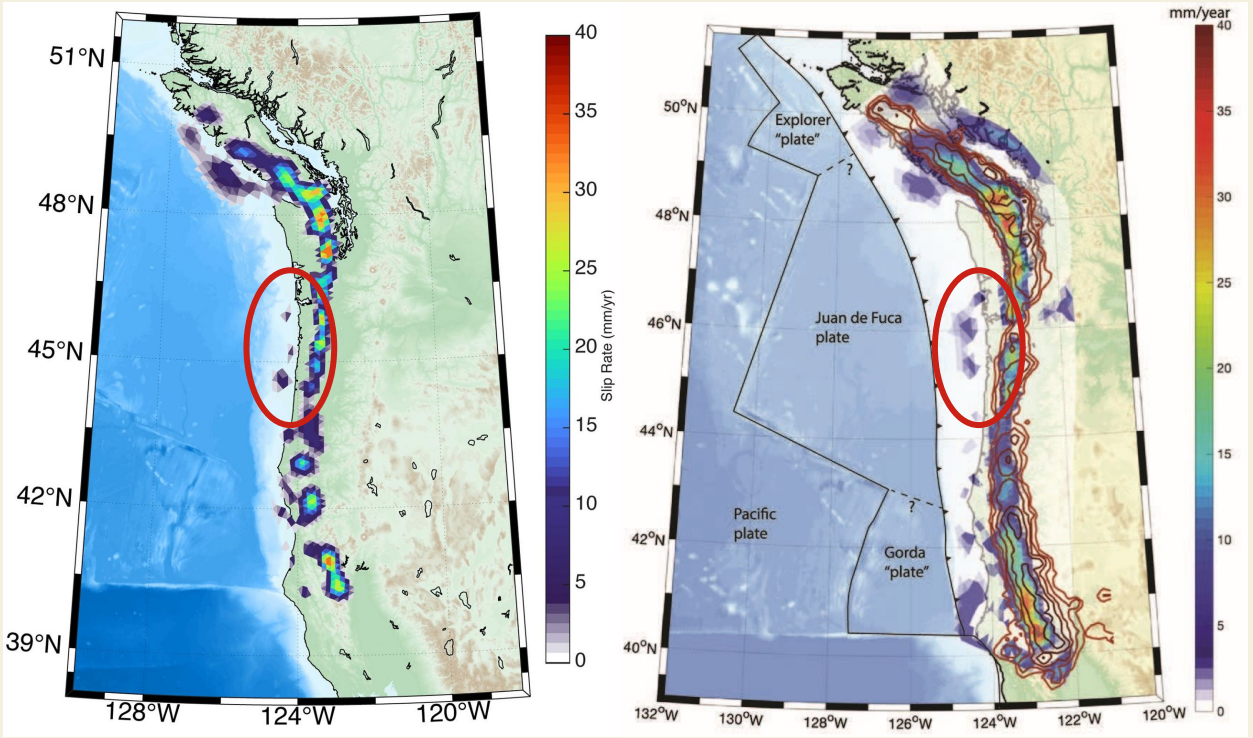
Offshore slip patches are in similar locations across studies.



Bartlow, 2020

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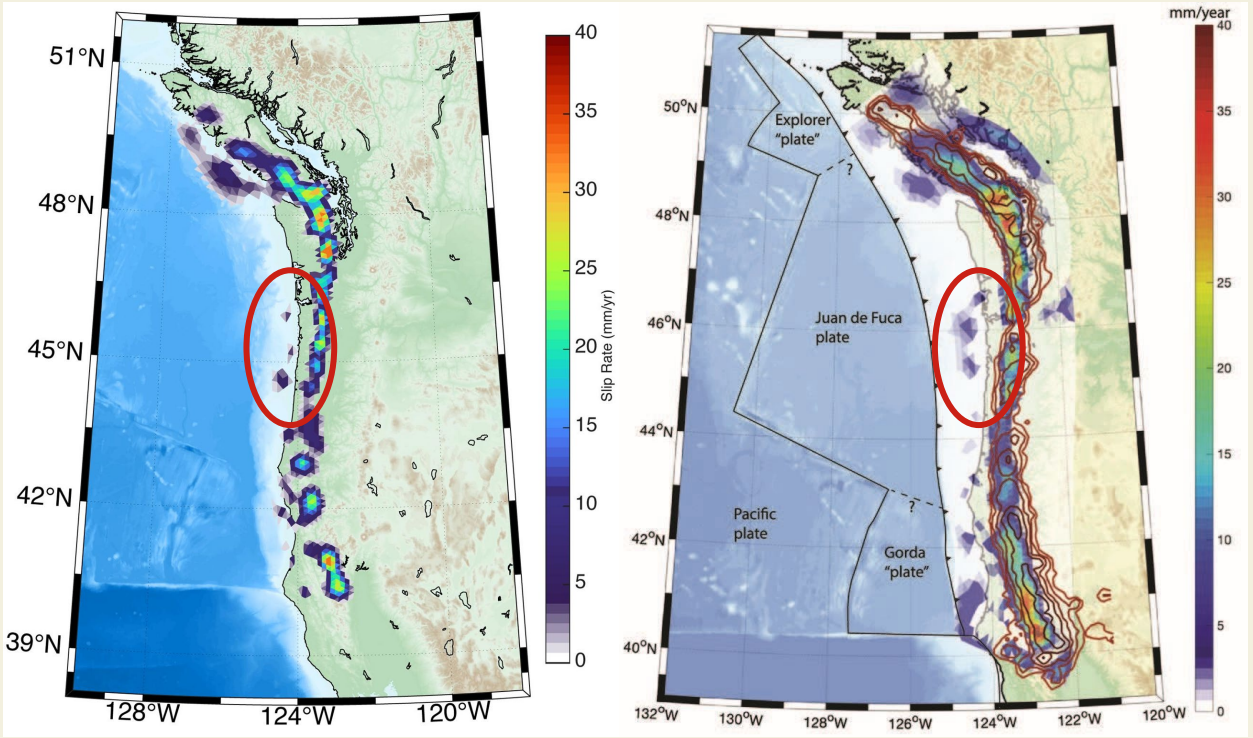
Central offshore patches have shrunk and seem to have shifted more landward? :(



Bartlow, 2020

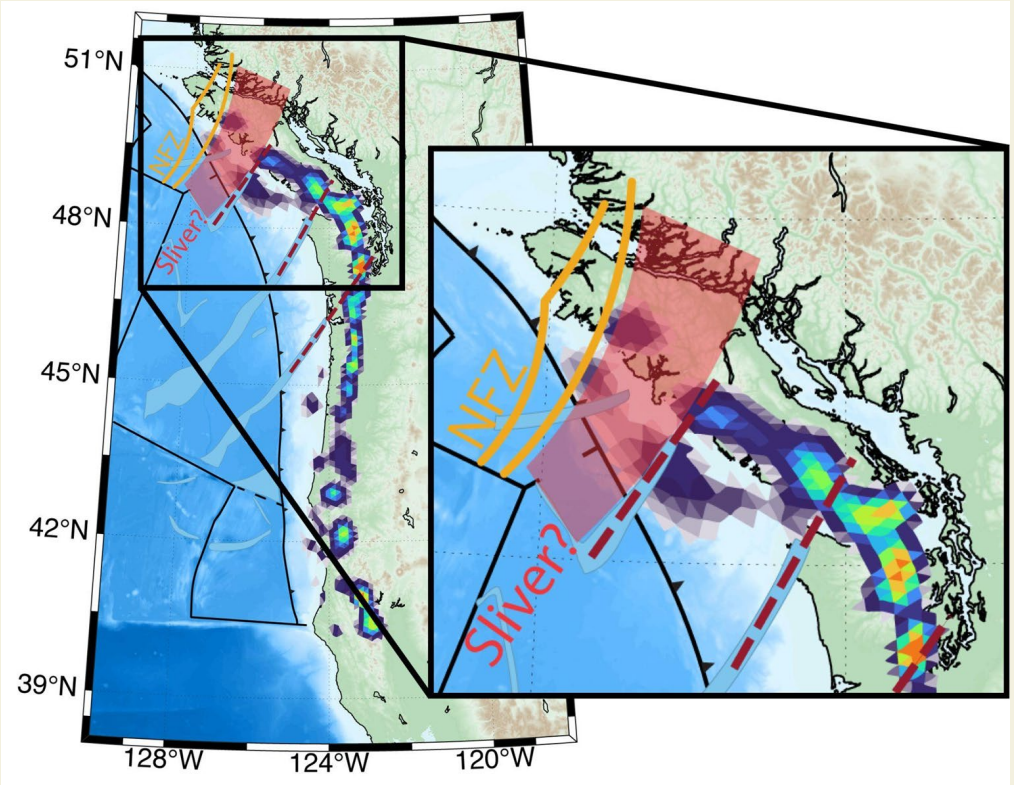
My Study

Previous Study

Proposed Tectonic Setting

Nootka Fault Zone (NFZ) represents end of subduction for the Explorer plate.

We propose a sliver of a tectonic plate between the NFZ and the main Juan de Fuca that is subducting slower than the rest of the region.



Savard et al, 2020

Thank you!