Rupture parameters and visualizations of CoPes Hub CSZ earthquake scenarios

Compiled by Audrey Dunham

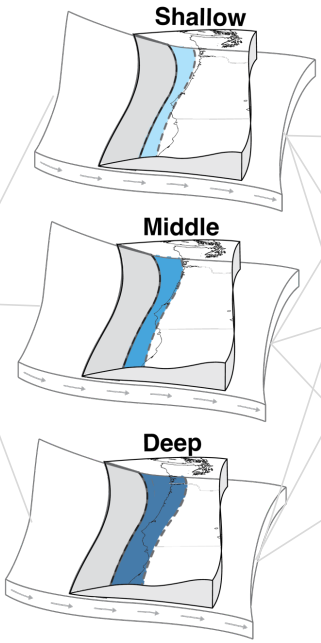
August 2026

Part 1: Explanation of earthquake scenario rupture parameters

Logic tree containing 36 earthquake scenarios

Full Margin Rupture Scenarios

Downdip Limits of Slip

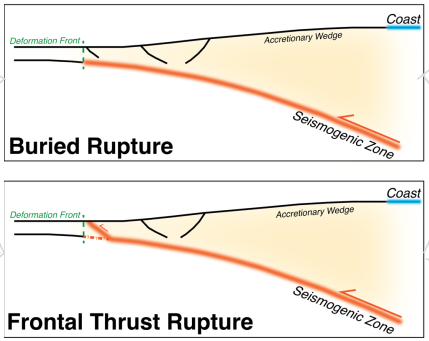


Magnitude

- Skarlatoudis et al., 2016
- Murotani et al., 2013
- Strasser et al., 2010

M8.7-9.2 based on Magnitude-Area relationships

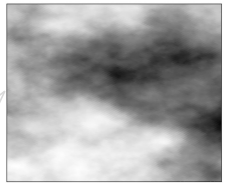
Updip Limits of Slip



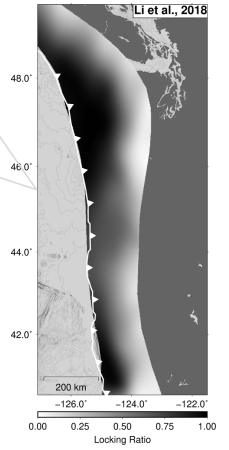
From fault mapping using CASIE21 data by Madeleine Lucas and Anna Ledeczi @UW

Slip distribution

Random

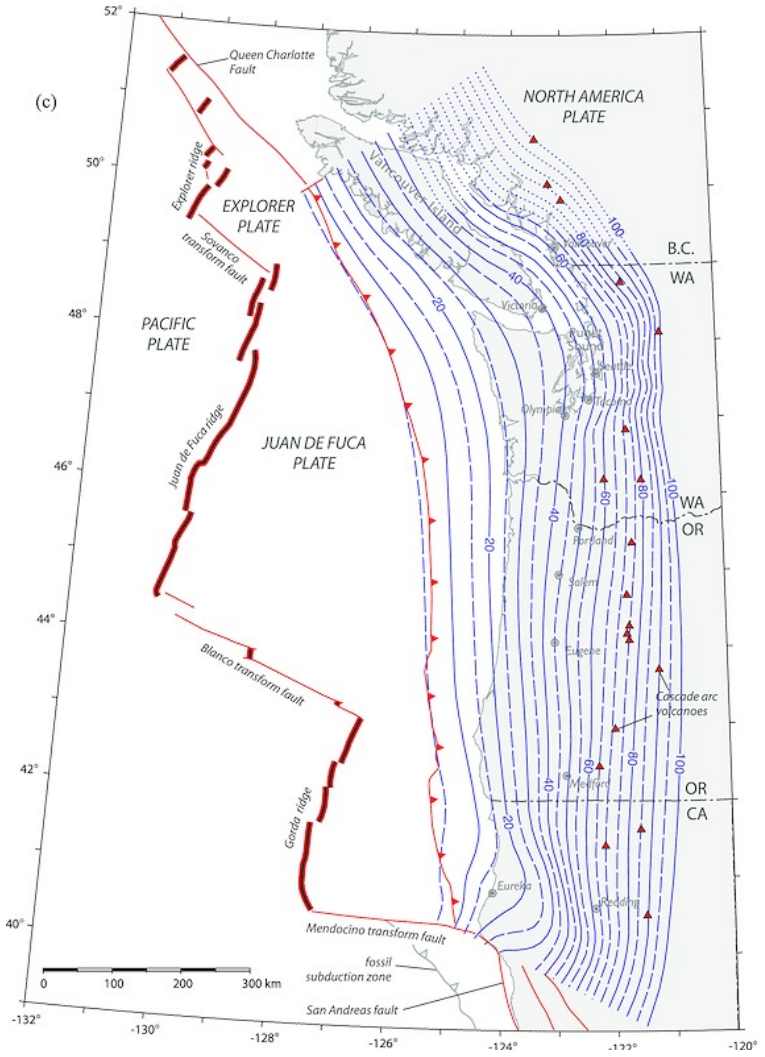


Geodetic Locking



Slab geometry

McCrory et al., 2012 slab geometry is used to construct the sources. We choose this geometry because it aligns with the slab geometry within the 3D velocity model.



McCrory et al., 2012

Downdip limits

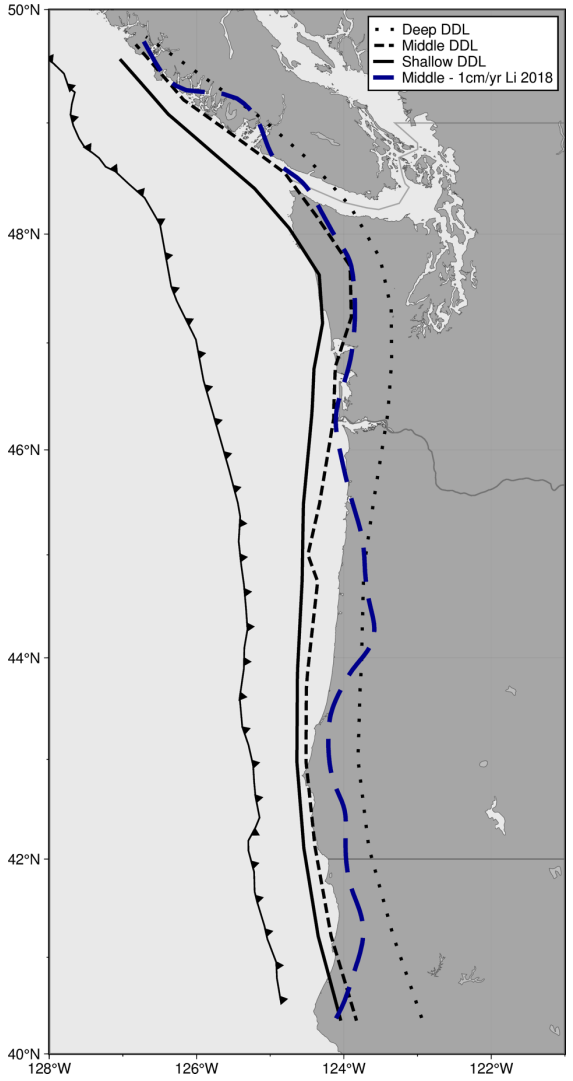
Controls how far inland the rupture extends. From the National Seismic Hazard Model (NSHM):

Shallow: midway between the 1cm/yr locking contour and fully locked zone

Middle: 1cm/yr locking contour from a combination of the McCaffrey et al., 2013 and Burgette et al., 2009 locking models

Middle - 1cm/yr Li 2018: Modified middle downdip limit used for current scenarios with the 1cm/yr locking contour from Li et al., 2018

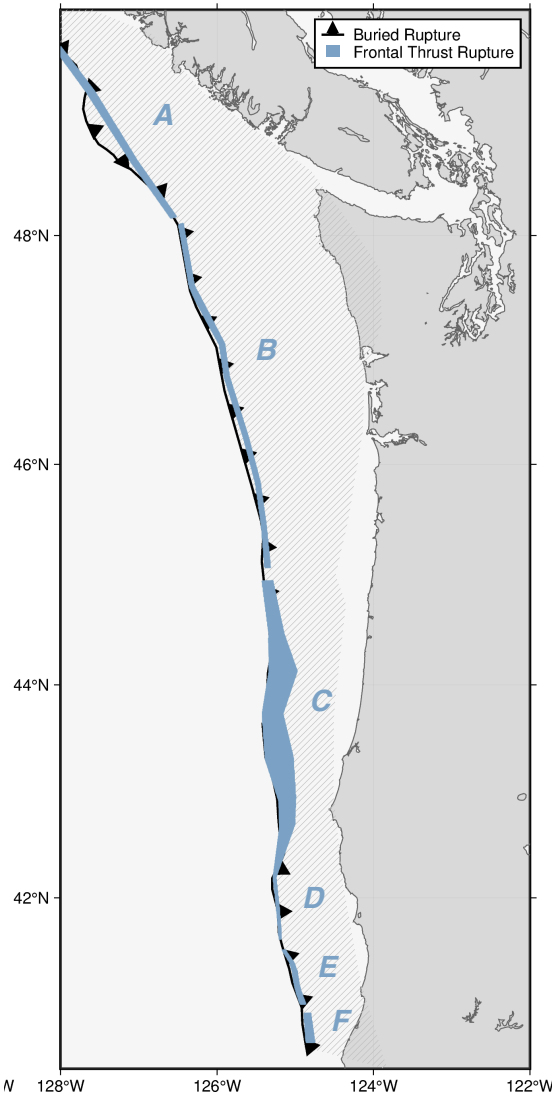
Deep: Top of the tremor zone



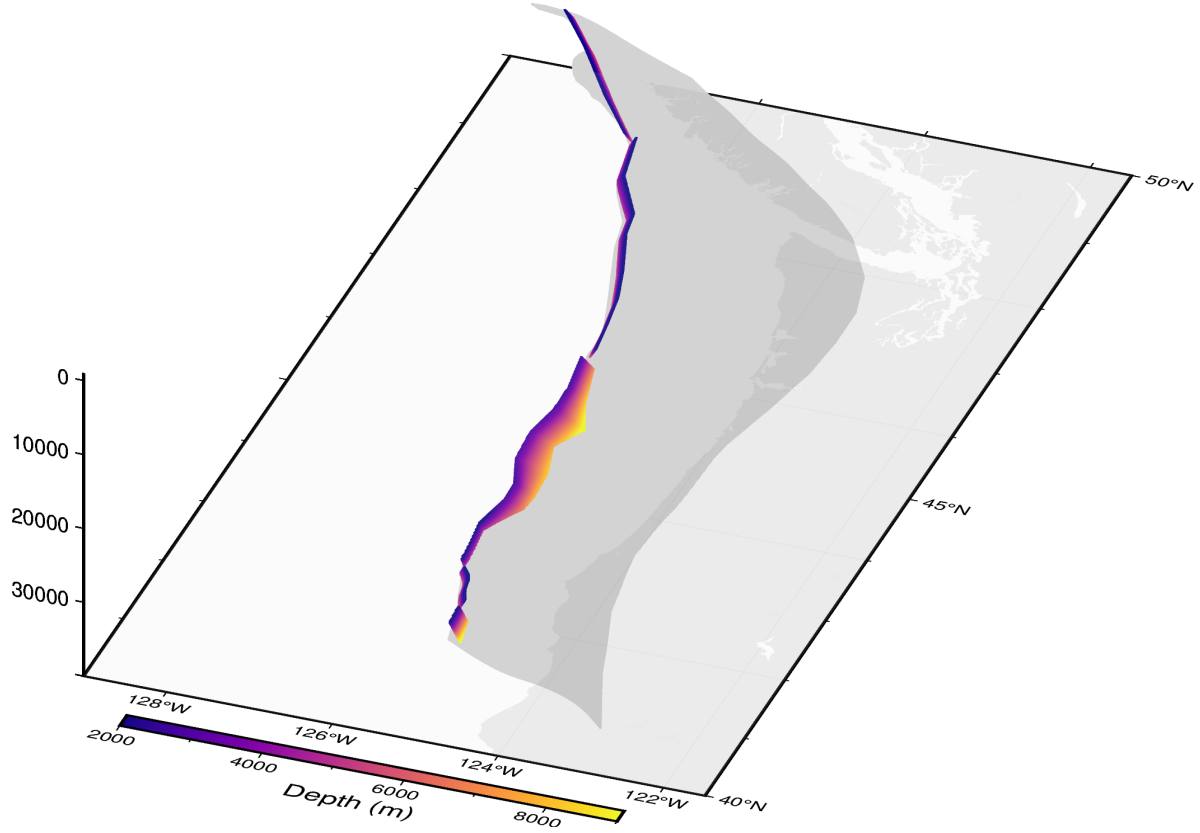
Updip limits

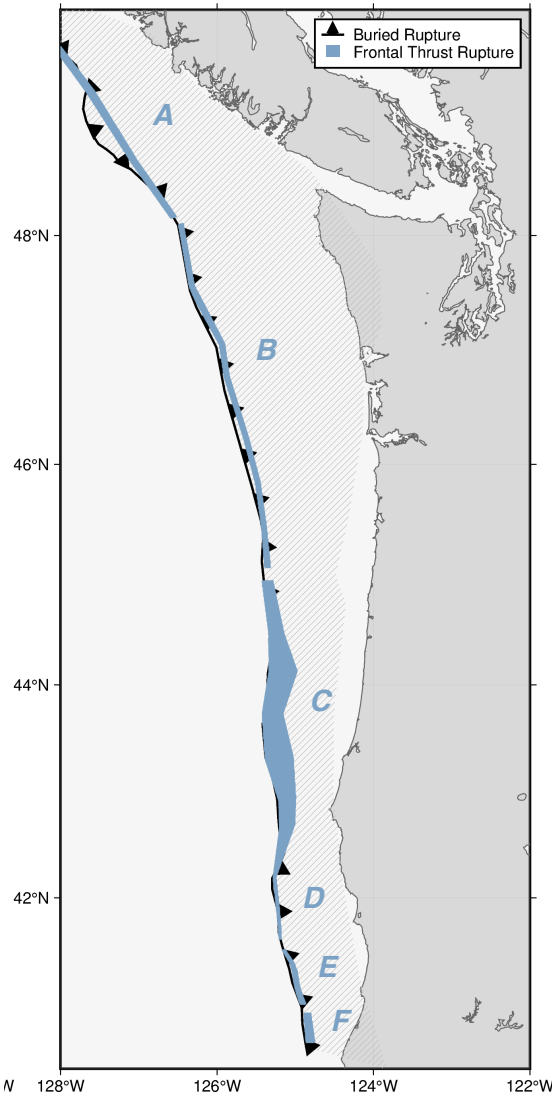
Buried: slip propagates to the deformation front (i.e., trench). The slip is buried because it does not reach the surface.

Frontal Thrust: slip propagates from the megathrust onto the westernmost activate splay fault (i.e., first splay fault east of the deformation front). These were mapped using the CASIE21 seismic survey north of 40N. South of 40N, legacy seismic information was used (Gullick et al., 1998) to infer frontal thrusts.



Updip limits

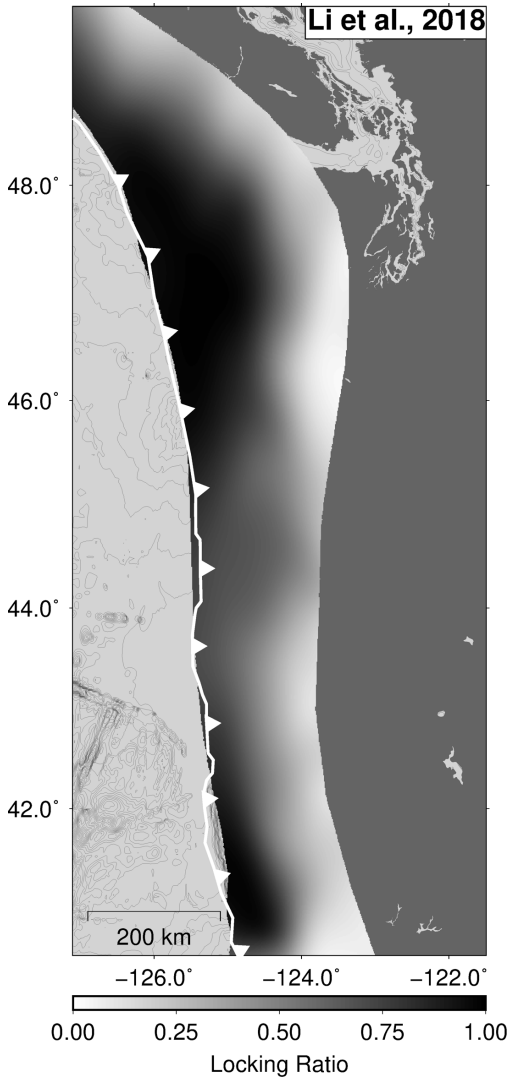




Slip Distribution

Random: a slip distribution is computed randomly using a Von Karmen correlation function.

Locking: a random slip distribution is weighted by the Li et al., 2018 geodetic locking model (shown in the figure), making higher slip more likely where there is a higher locking ratio.



Magnitude-Area Relationships

To calculate the magnitude of each earthquake, we use 3 different empirical magnitude-area relationships for subduction zone interface earthquakes. These were chosen from the National Seismic Hazard Model and span a magnitude range of ~M8.7-9.2

Skarlatoudis et al., 2016 (Skl16)– Global study of subduction zone area-magnitude relationships, generates the smallest magnitudes per area

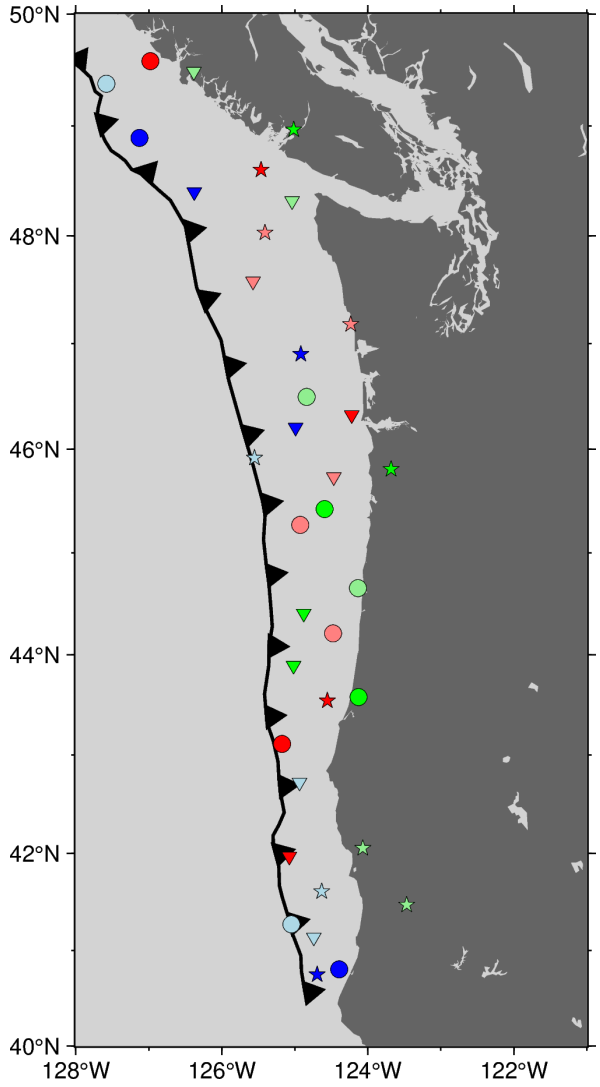
Murotani et al., 2013 (Mur13) – Regional for Japan with the largest global subduction zone earthquakes added

Strasser et al., 2010 (Str10) – Global study, older and does not include Tohoku and Maule, gives the largest magnitudes per area

Hypocenter location

Hypocenters are chosen randomly but distributed equally between the northern, central, and southern segments.

Hypocenter location is a parameter outside of the logic tree.

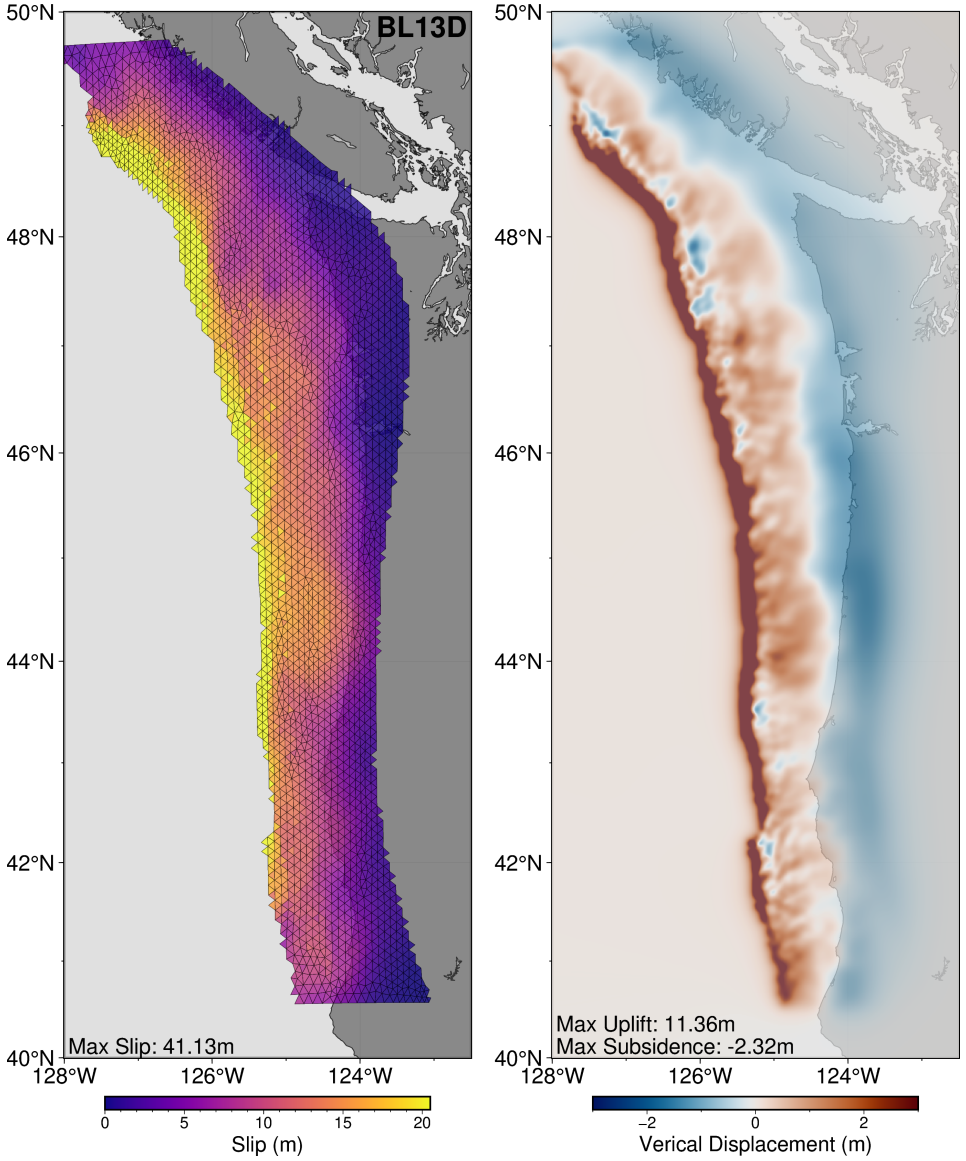


Part 2: Visualization of each earthquake scenario and resulting final (static) deformation

Naming Convention for EVID (event ID)

Updip limit of slip	Slip Distribution	Magnitude-Area	Downdip limit of slip
B: Buried	R: Random	16: Skl16	S: Shallow
F: FrontalThrust	L: Locking	13: Mur13	M: Middle
		10: Str10	D: Deep

Example: buried-random-mur13-deep is now BR13D



EVID: BL13D

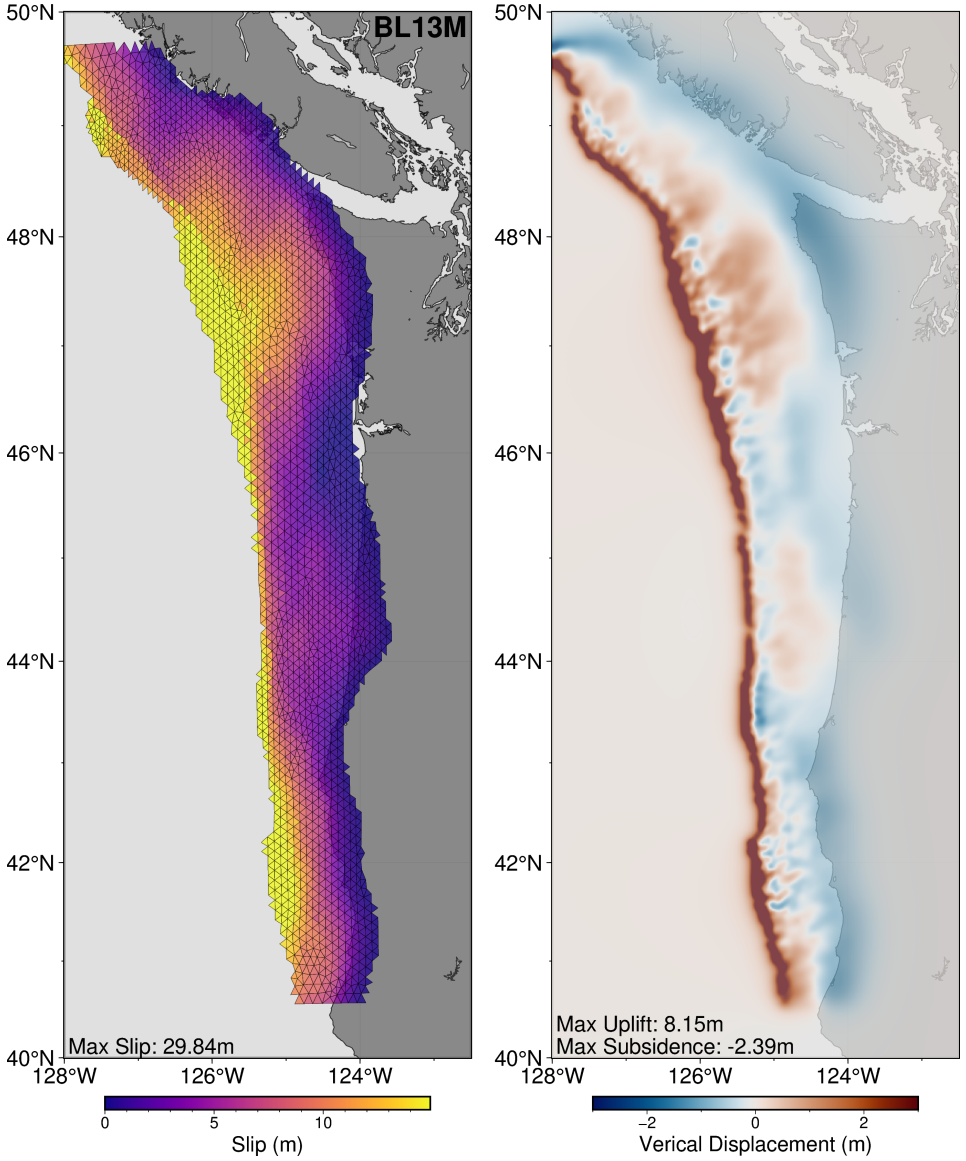
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Deep

Magnitude: 9.1



EVID: BL13M

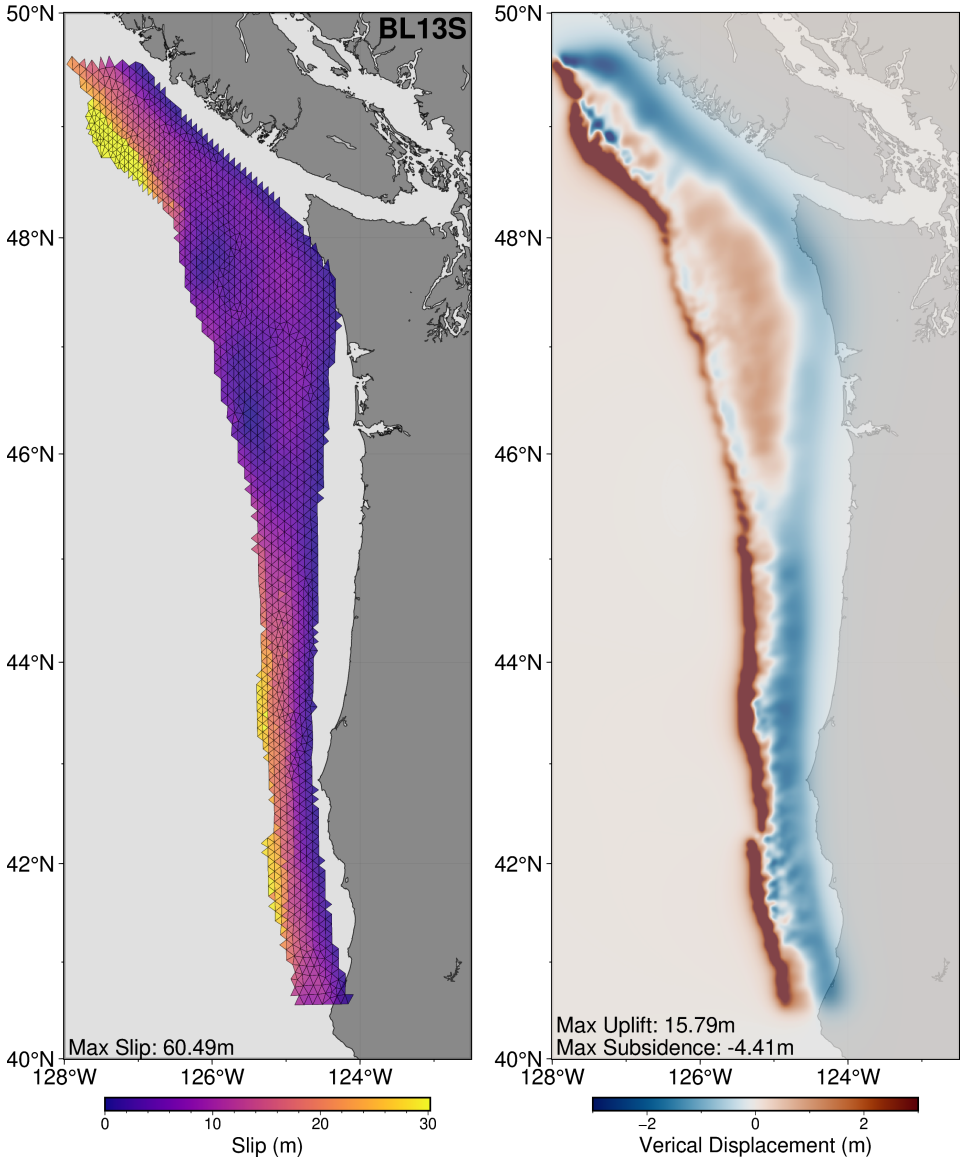
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Middle

Magnitude: 8.93



EVID: BL13S

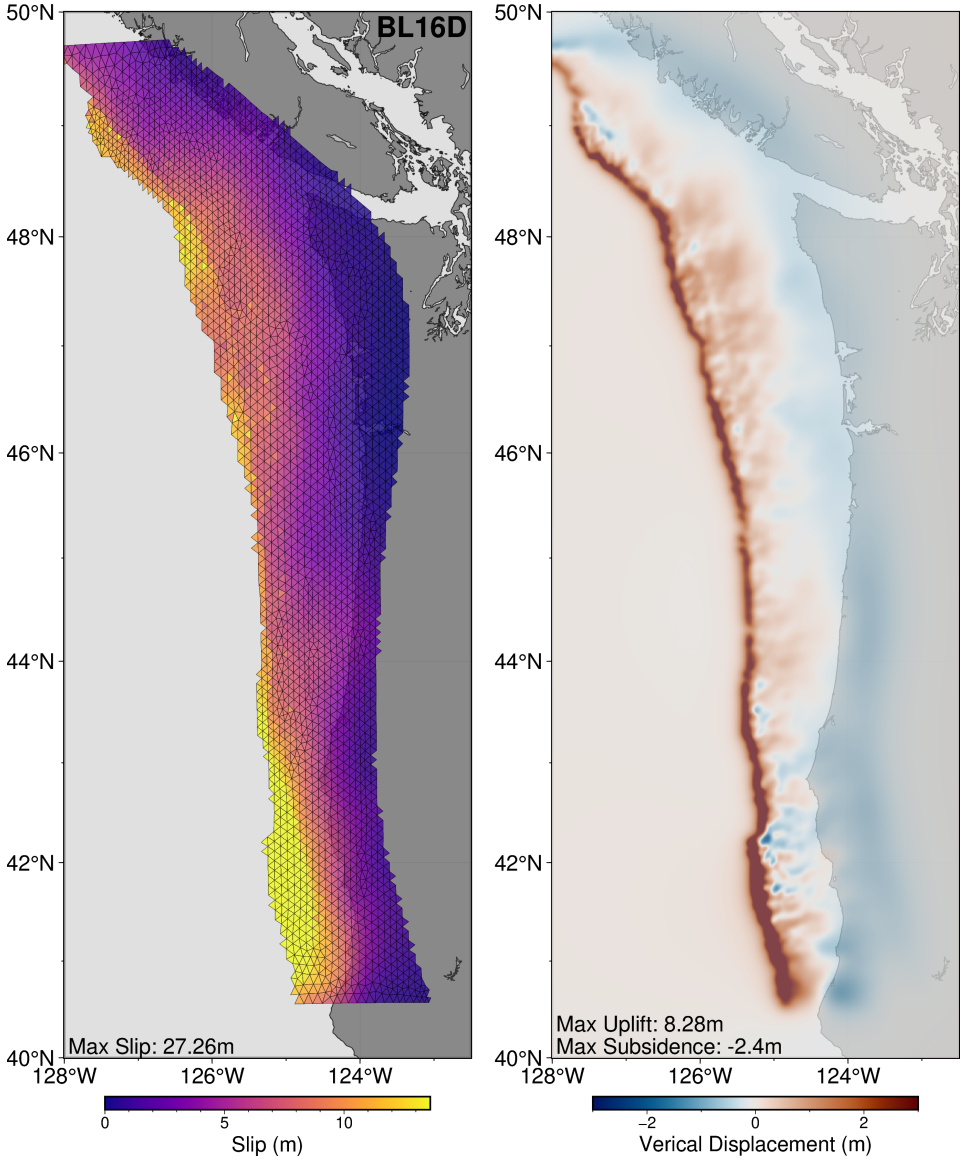
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Shallow

Magnitude: 8.85



EVID: BL16D

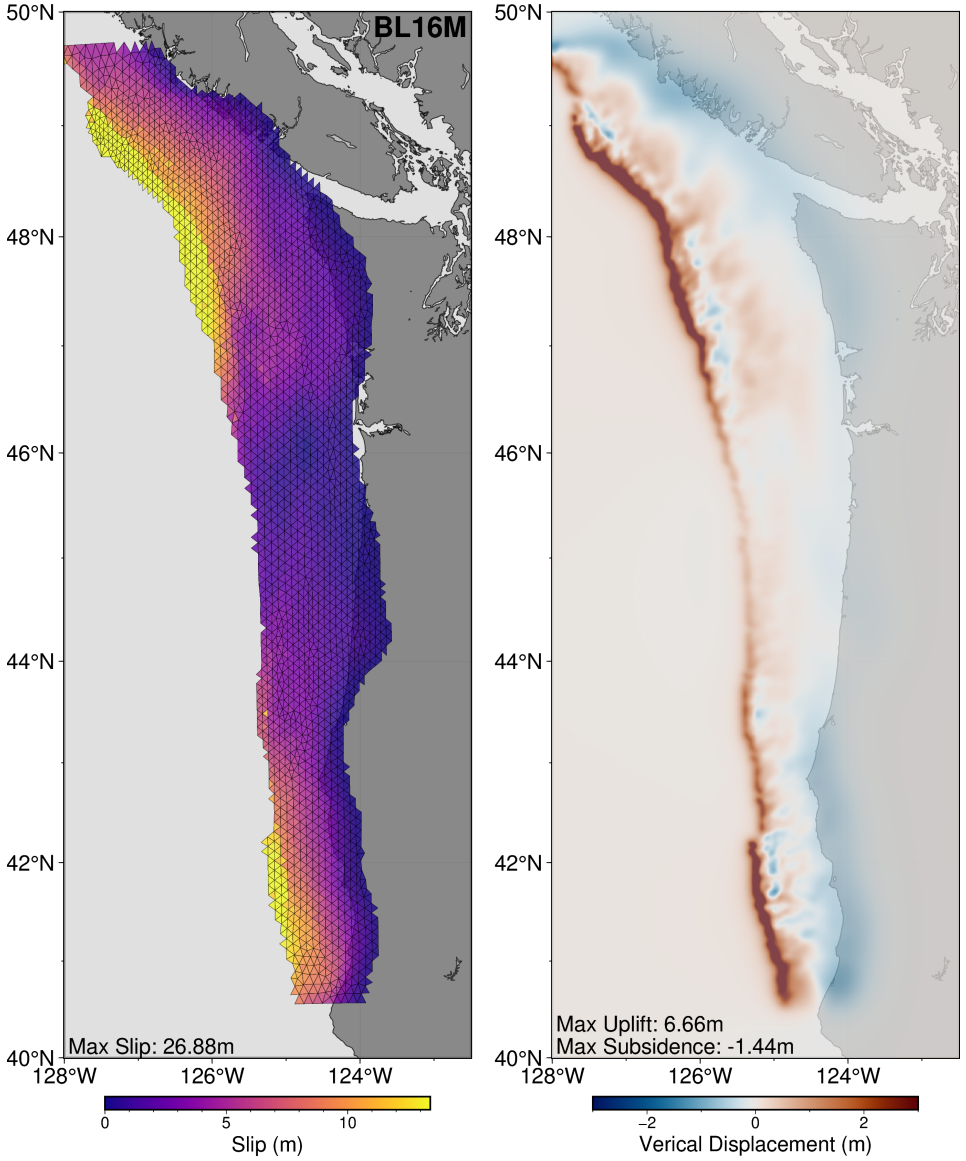
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Deep

Magnitude: 8.93



EVID: BL16M

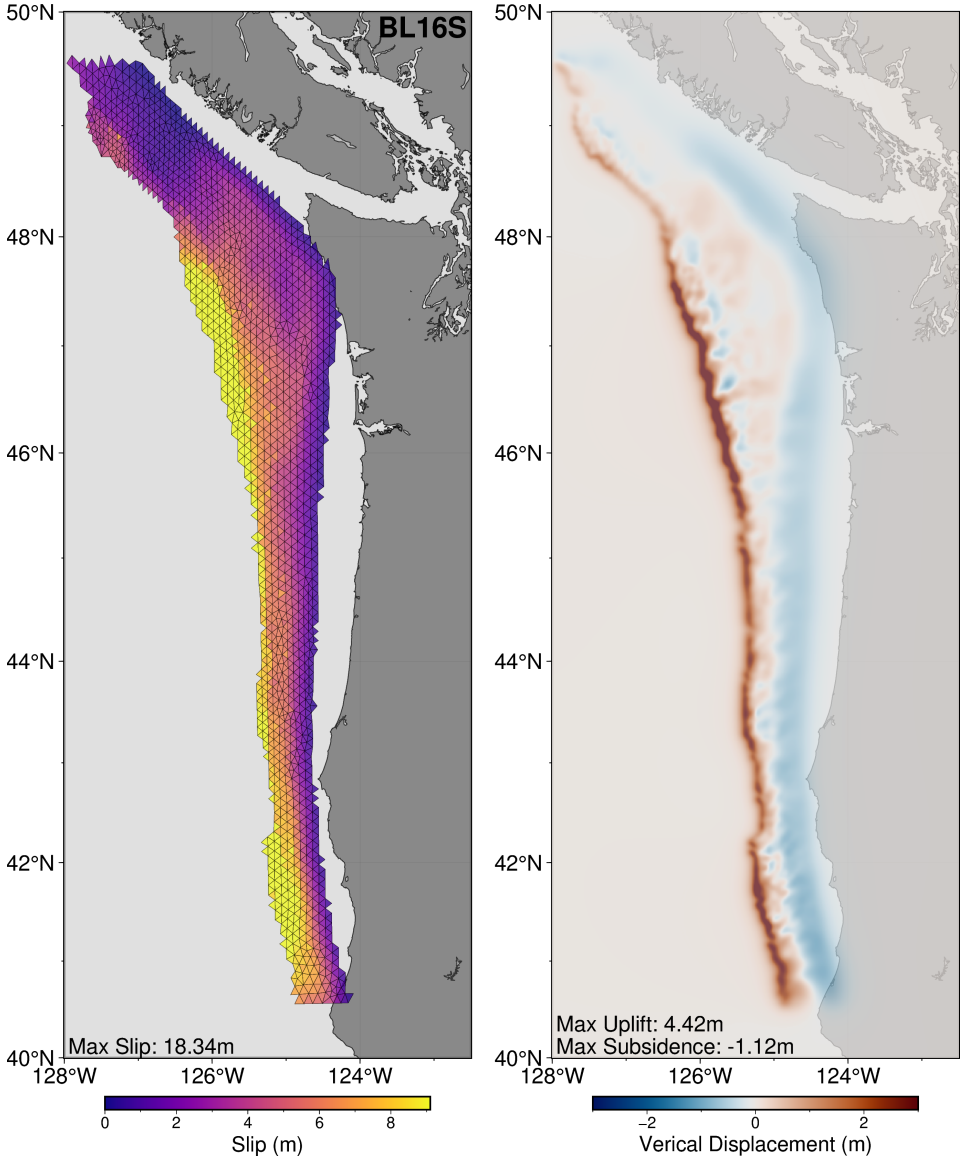
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Skarladoudis et al., (2016), Skl16

Downdip limit: Middle

Magnitude: 8.79



EVID: BL16S

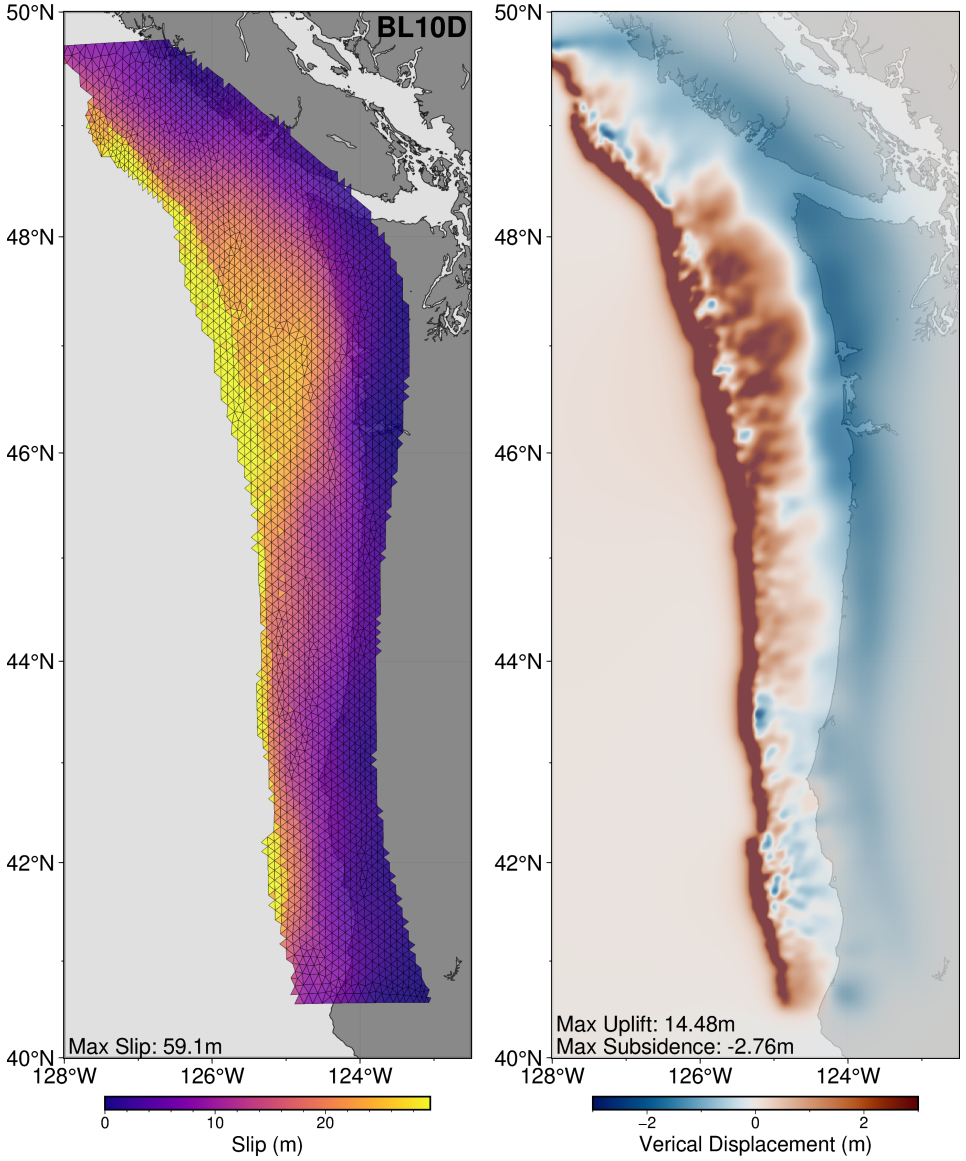
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Shallow

Magnitude: 8.66



EVID: BL10D

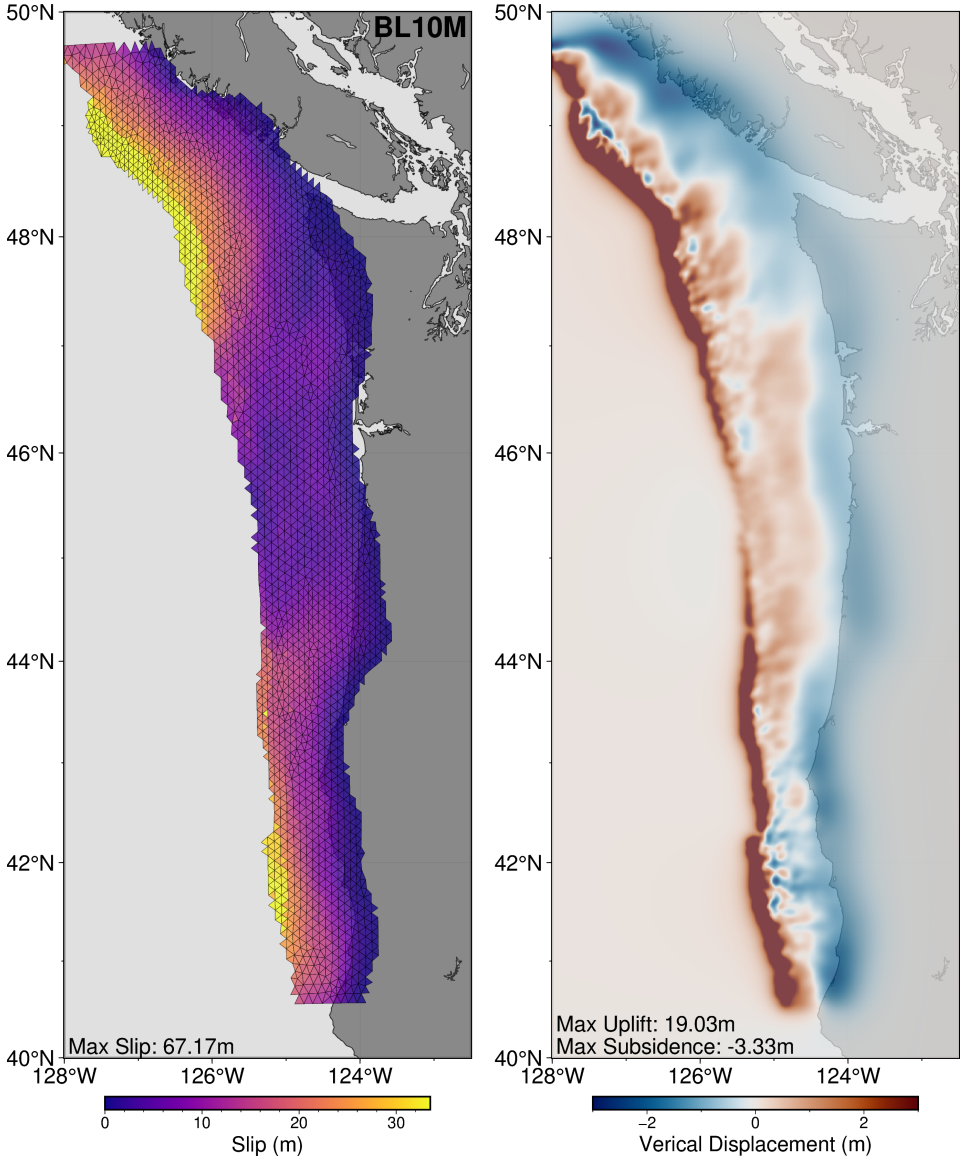
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Deep

Magnitude: 9.18



EVID:BL10M

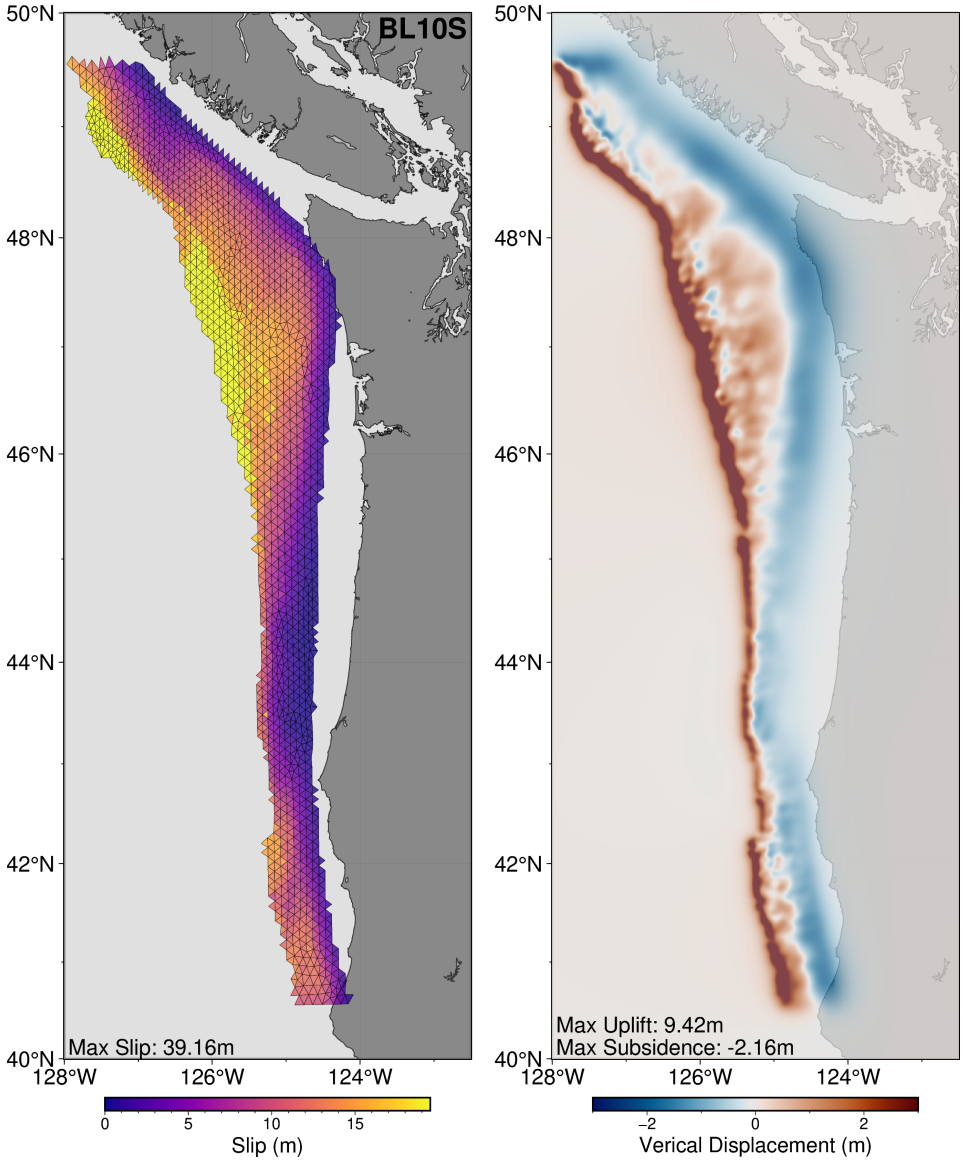
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Middle

Magnitude: 9.05



EVID: BL10S

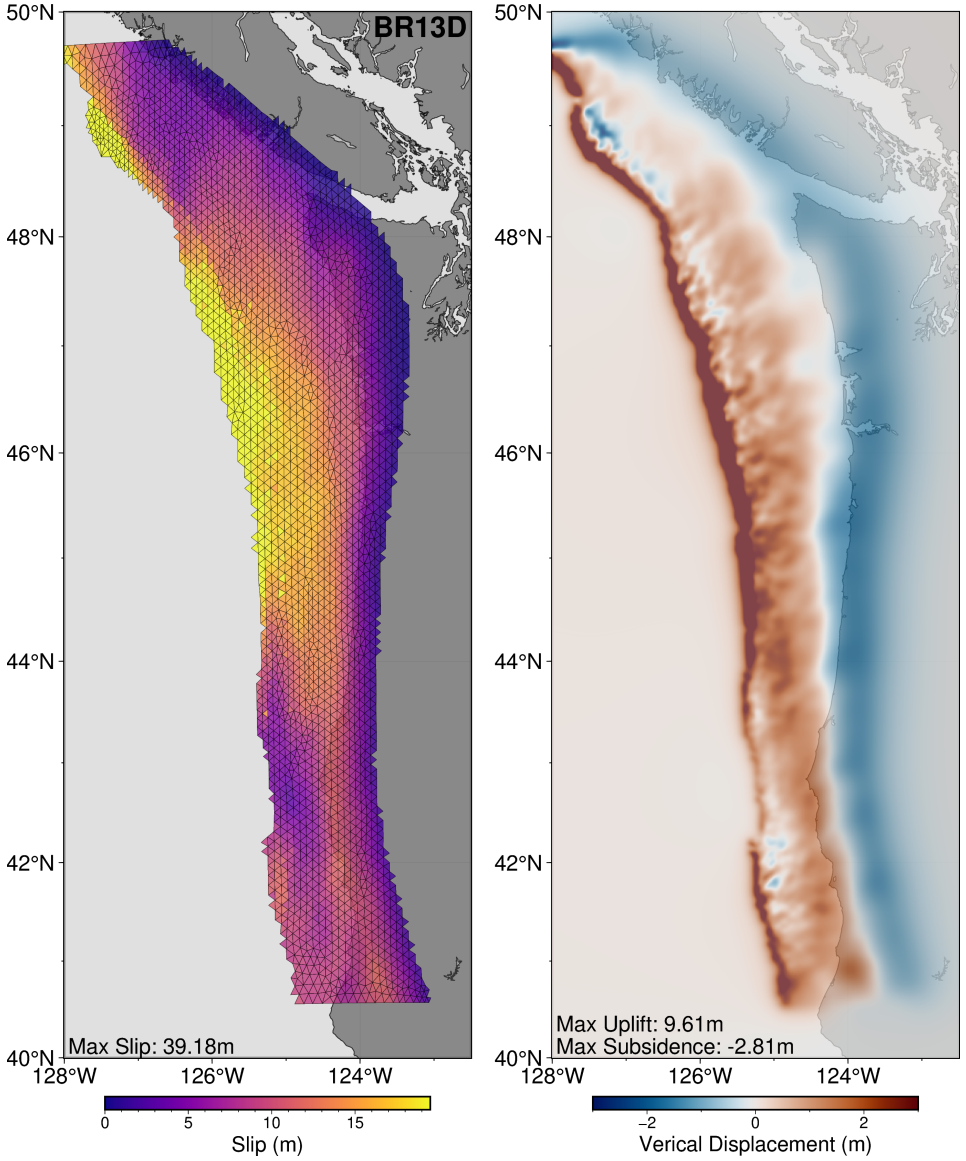
Updip limit: Buried

Slip distribution: Locking

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Shallow

Magnitude: 8.88



EVID: BR13D

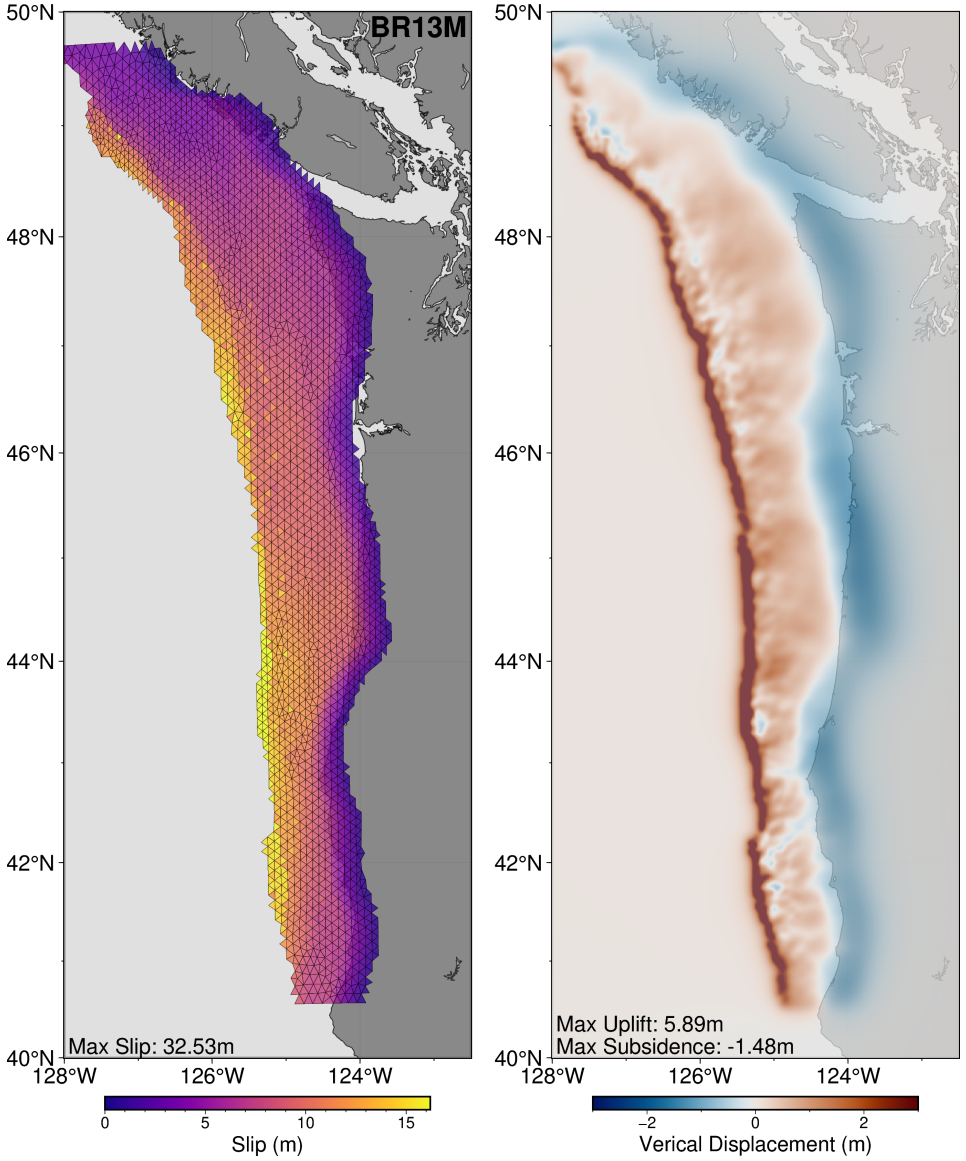
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Deep

Magnitude: 9.1



EVID: BR13M

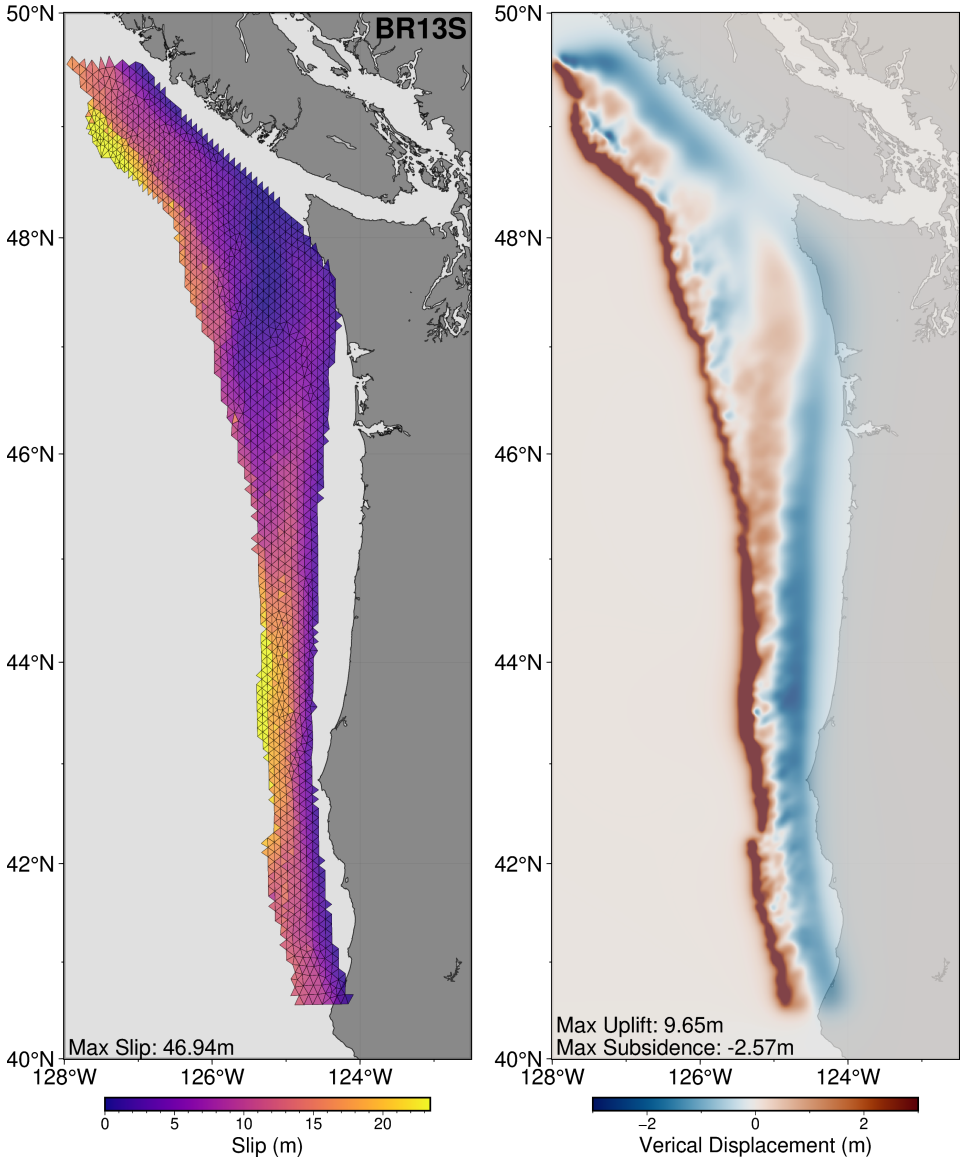
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Middle

Magnitude: 8.89



EVID: BR13S

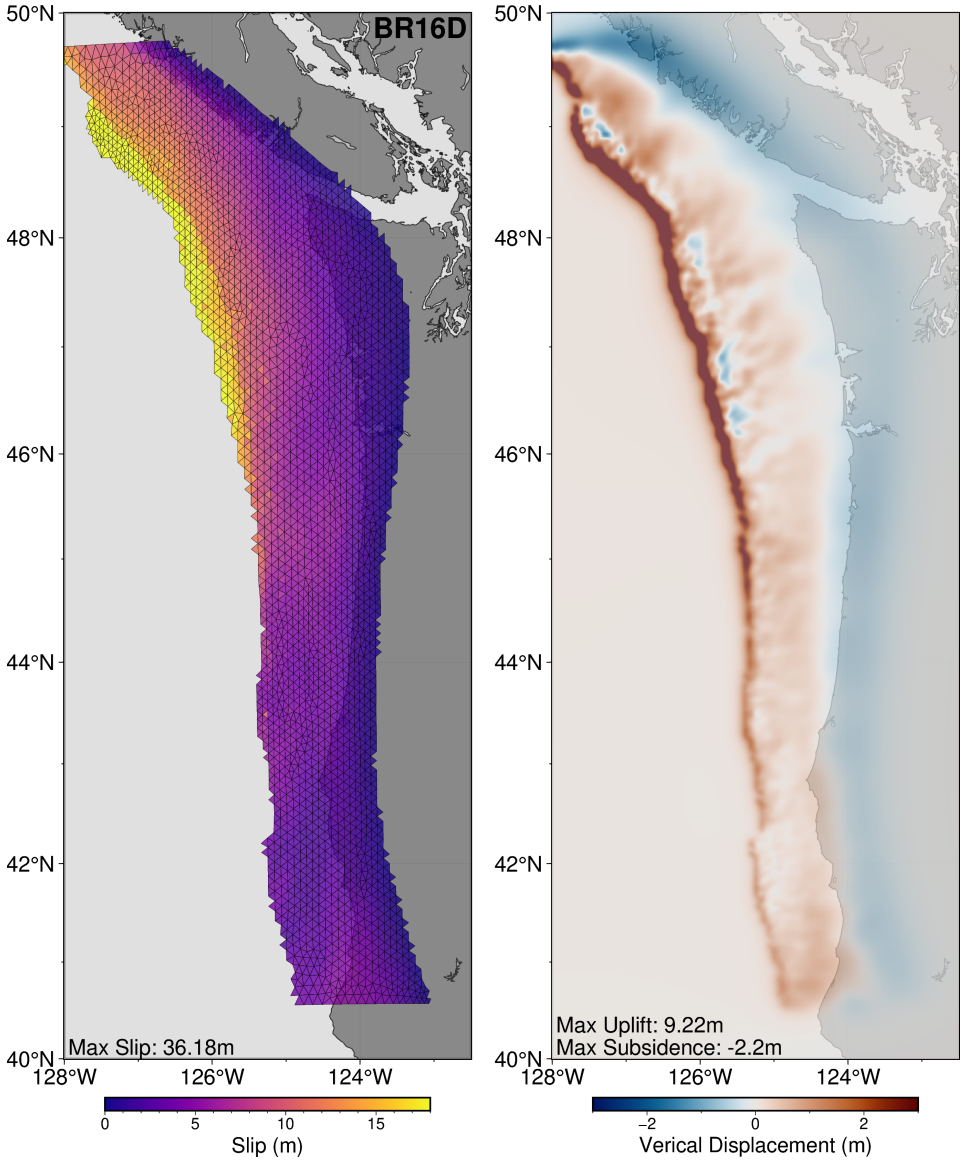
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Shallow

Magnitude: 8.85



EVID: BR16D

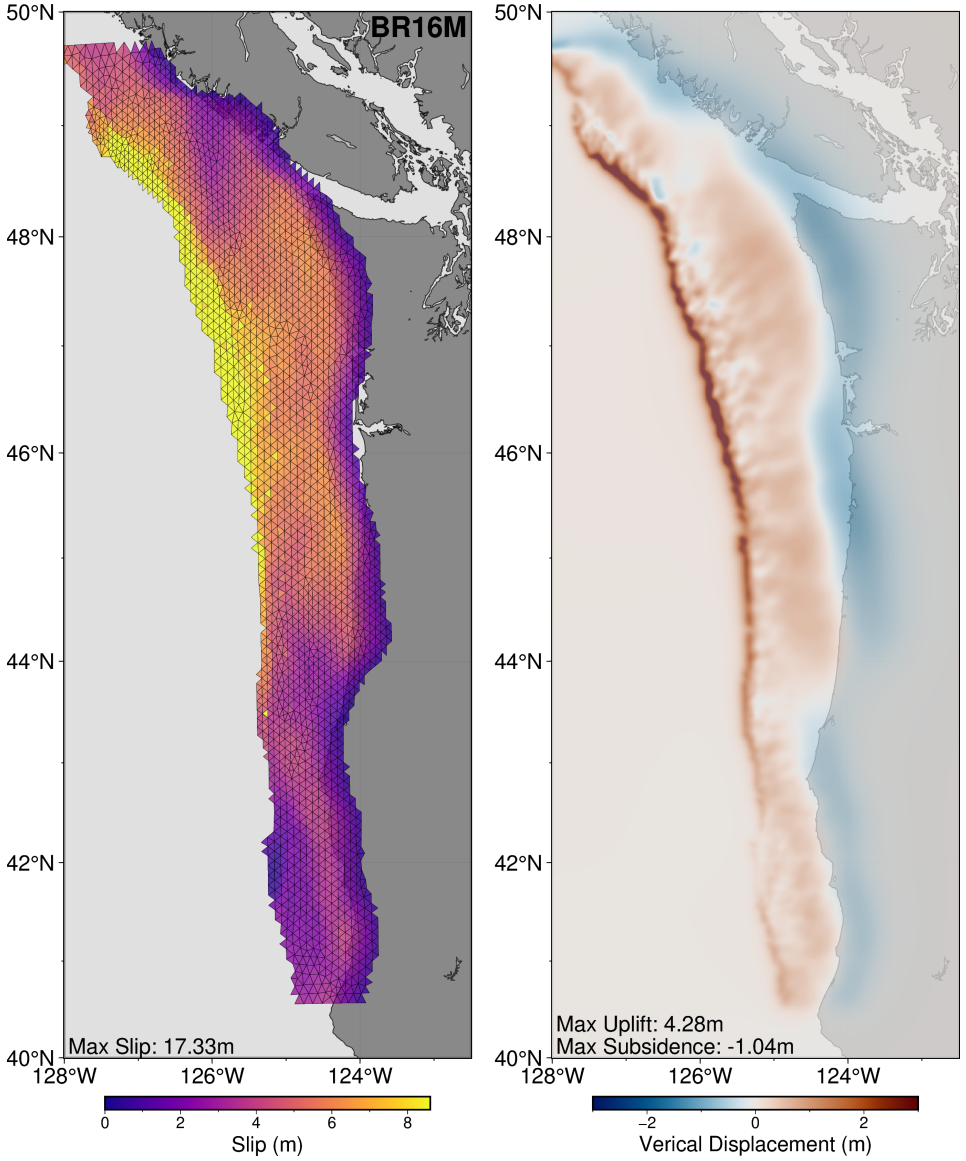
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Deep

Magnitude: 8.94



EVID: BR16M

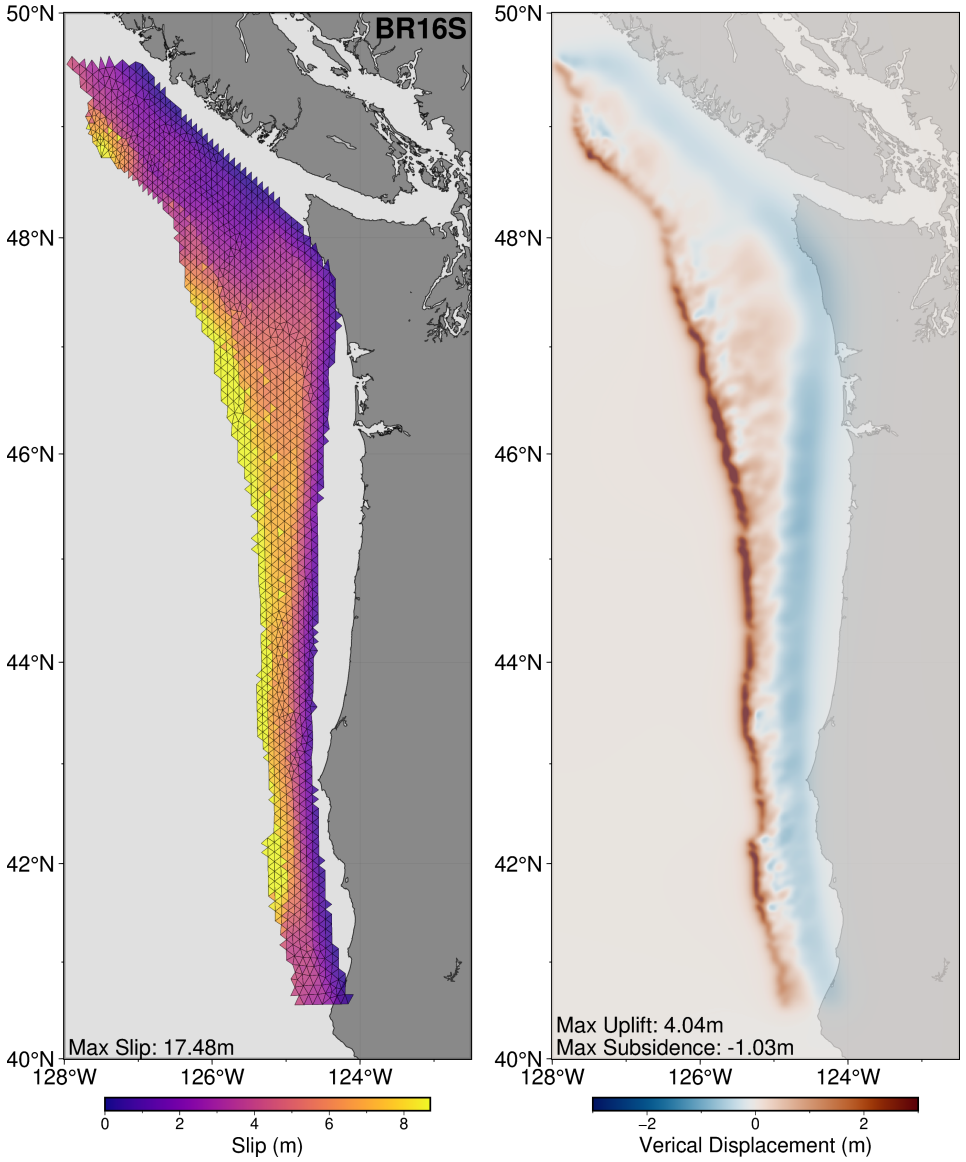
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Middle

Magnitude: 8.83



EVID: BR16S

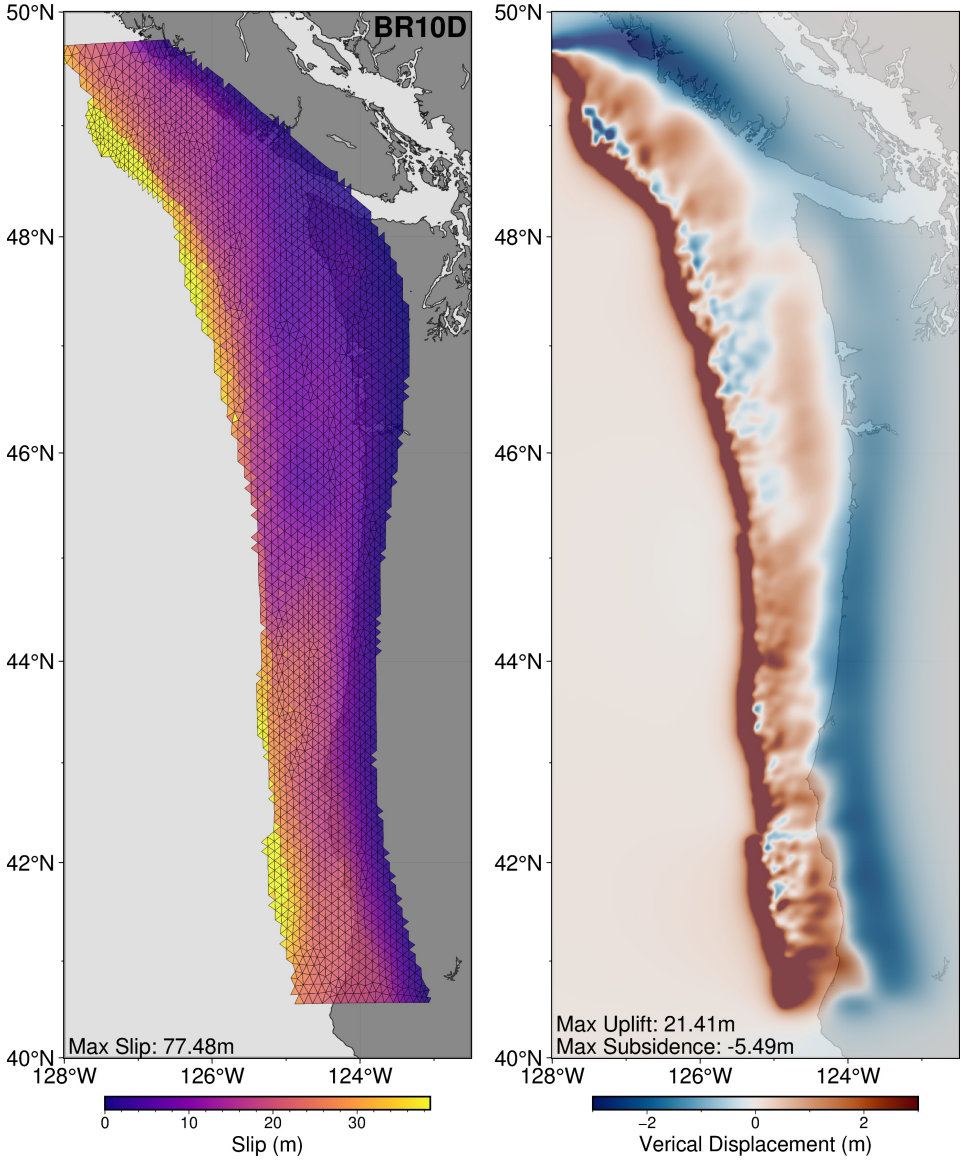
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Shallow

Magnitude: 8.67



EVID: BR10D

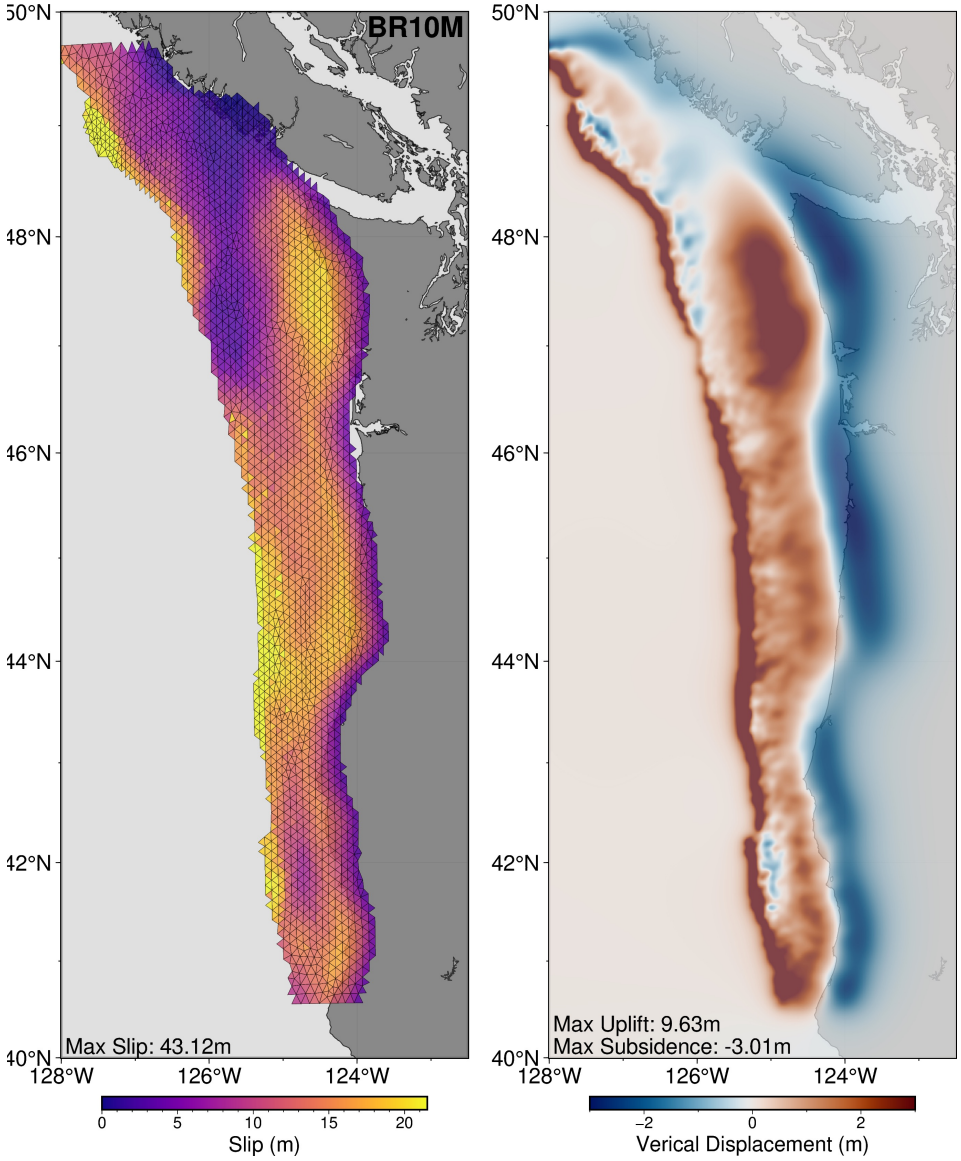
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Deep

Magnitude: 9.22



EVID: BR10M

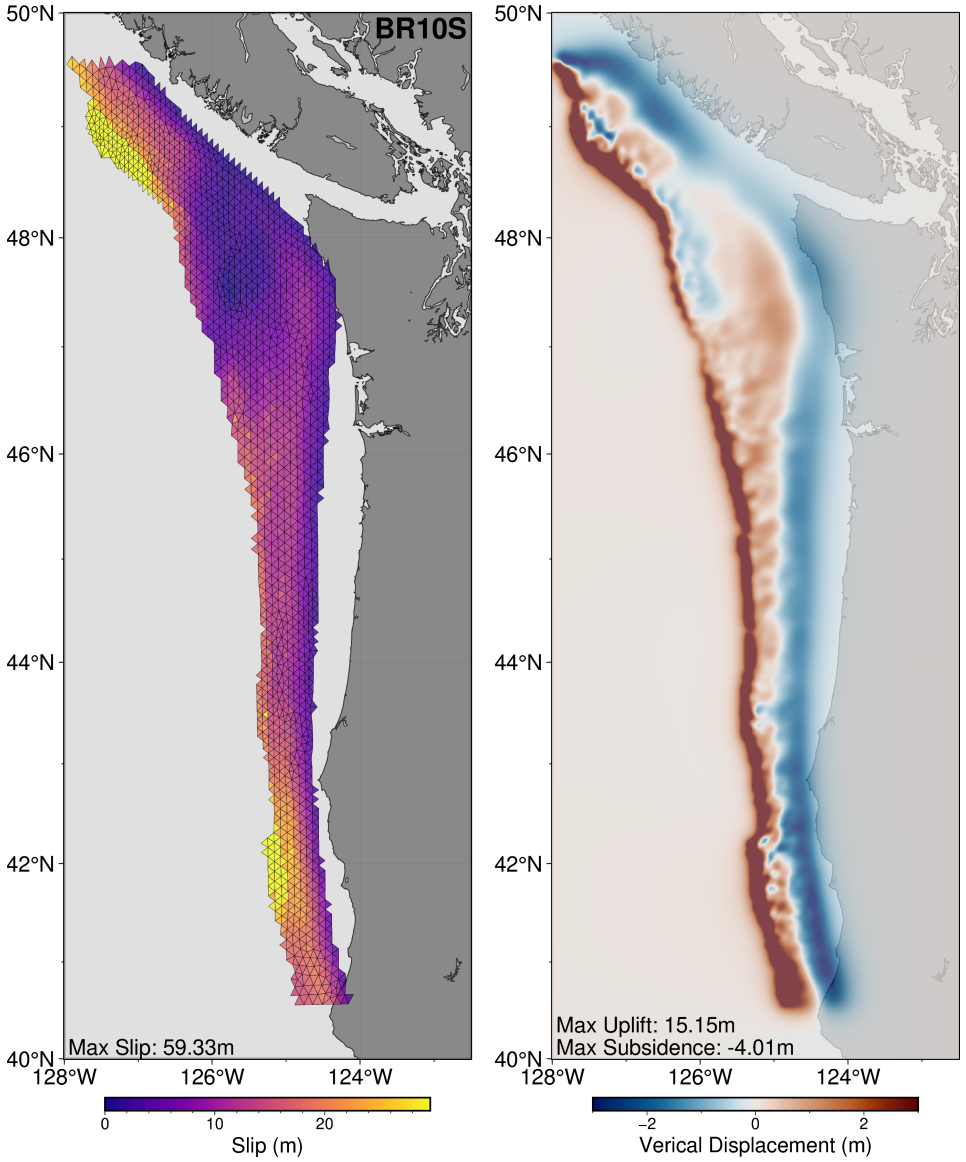
Updip limit: Buried

Slip distribution: Random

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Middle

Magnitude: 9.12



EVID: BR10S

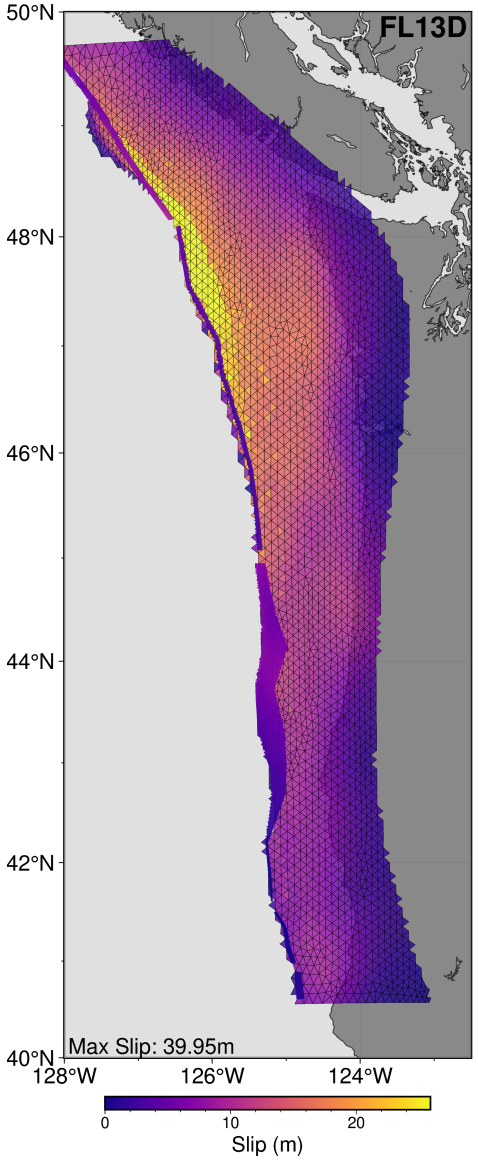
Updip limit: Buried

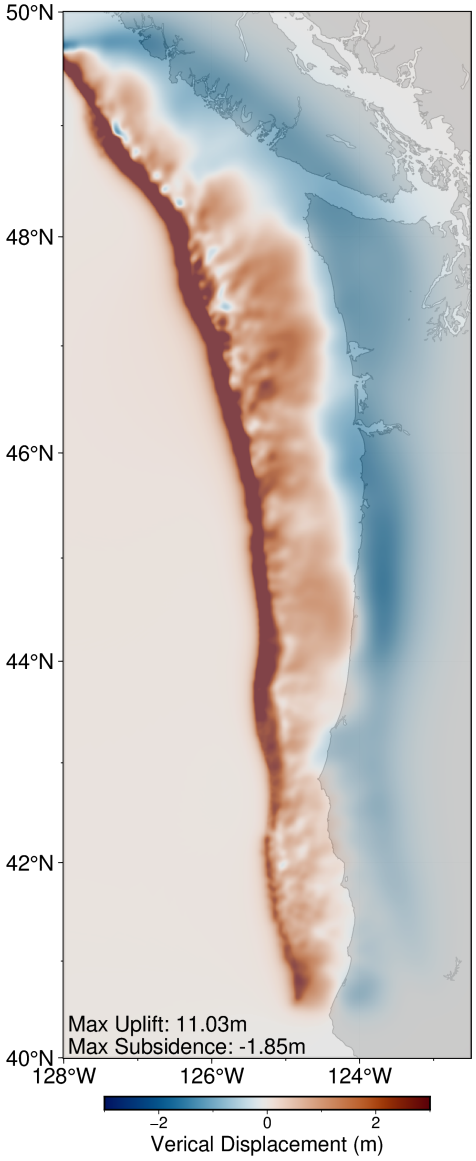
Slip distribution: Random

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Shallow

Magnitude: 8.93





EVID: FL13D

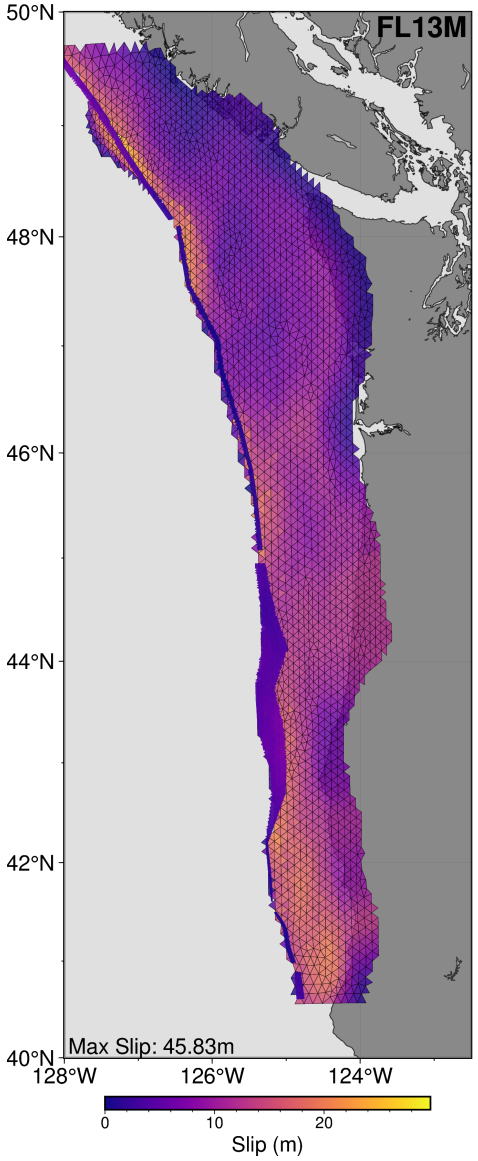
Updip limit: FrontalThrust

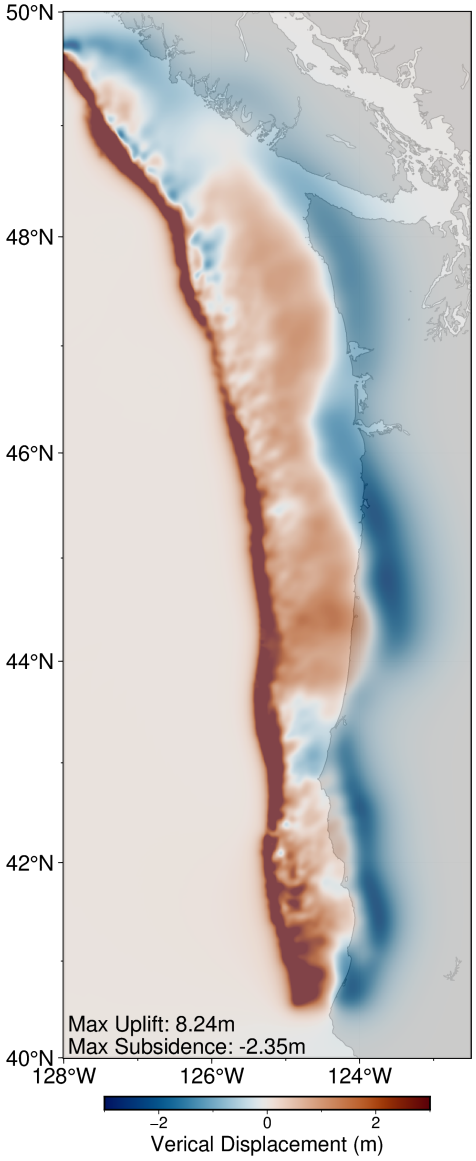
Slip distribution: Locking

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Deep

Magnitude: 9.11





EVID: FL13M

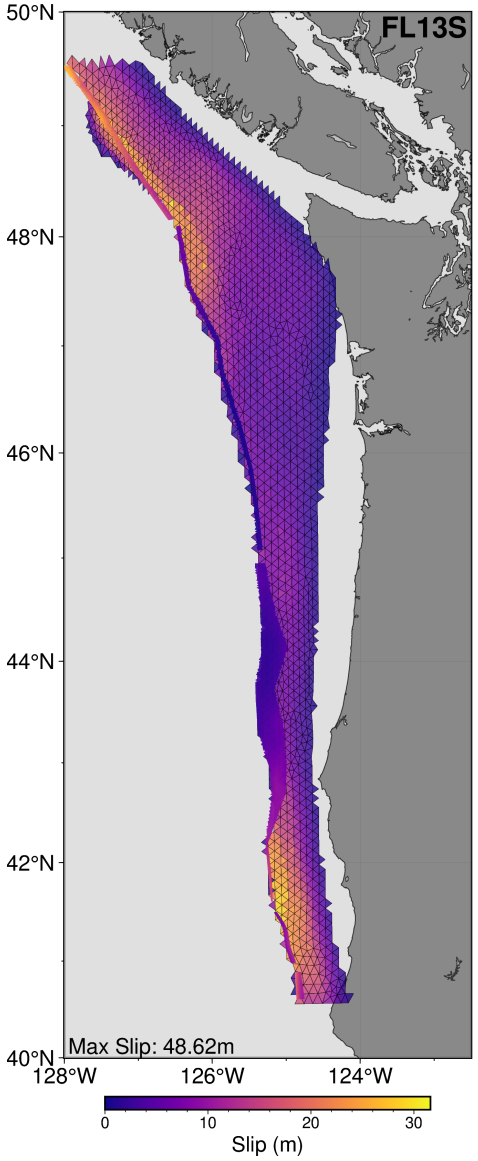
Updip limit: FrontalThrust

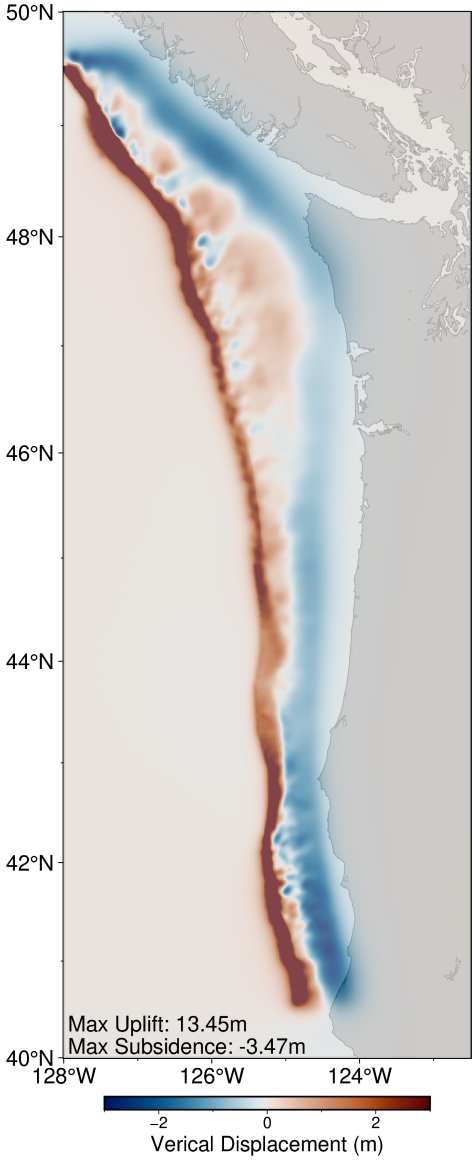
Slip distribution: Locking

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Middle

Magnitude: 8.99





EVID: FL13S

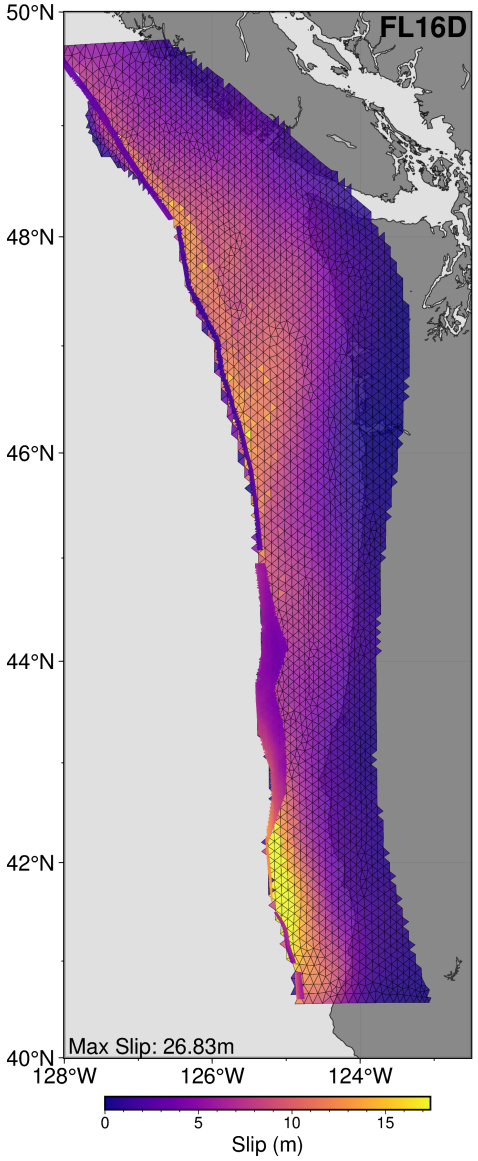
Updip limit: FrontalThrust

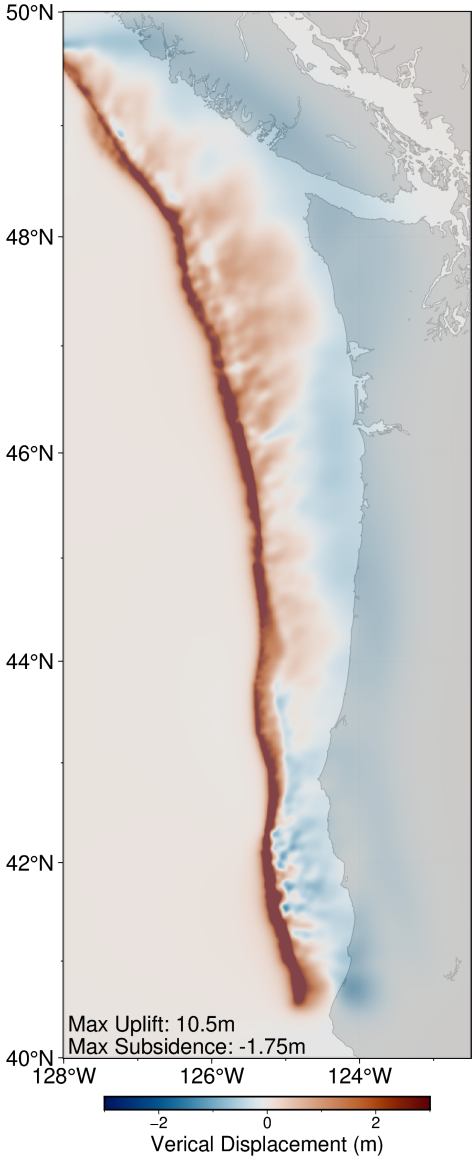
Slip distribution: Locking

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Shallow

Magnitude: 8.86





EVID: FL16D

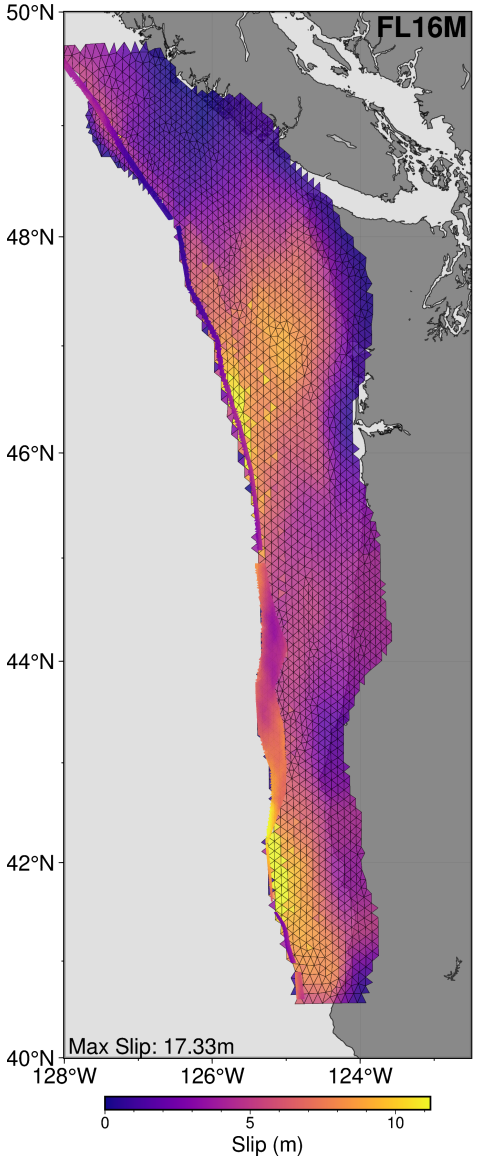
Updip limit: FrontalThrust

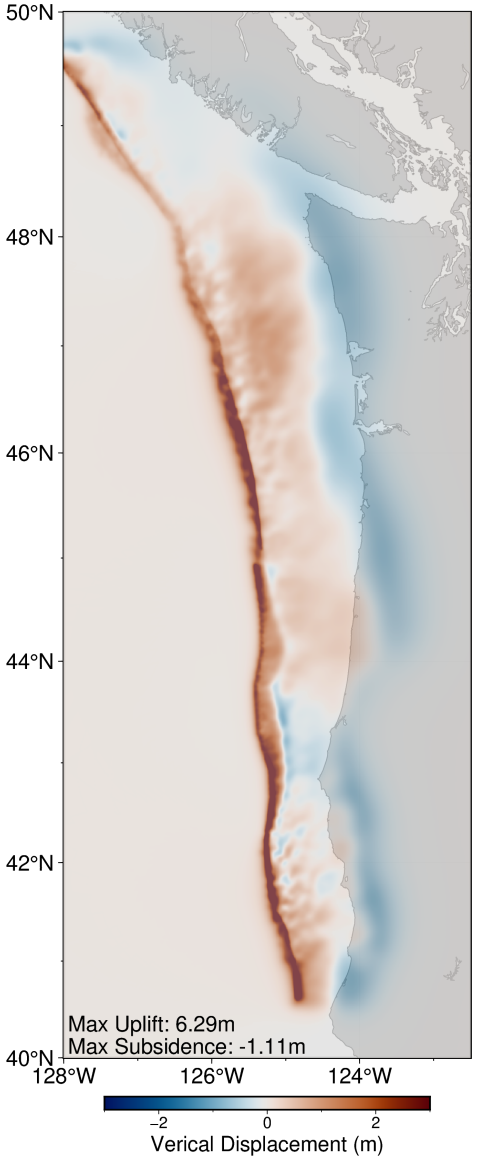
Slip distribution: Locking

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Deep

Magnitude: 8.94





EVID: FL16M

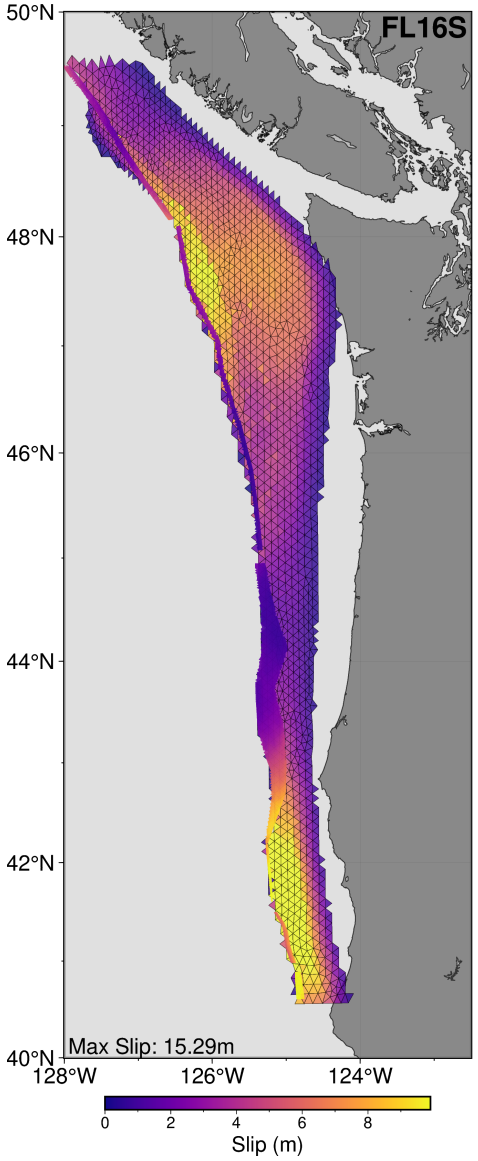
Updip limit: FrontalThrust

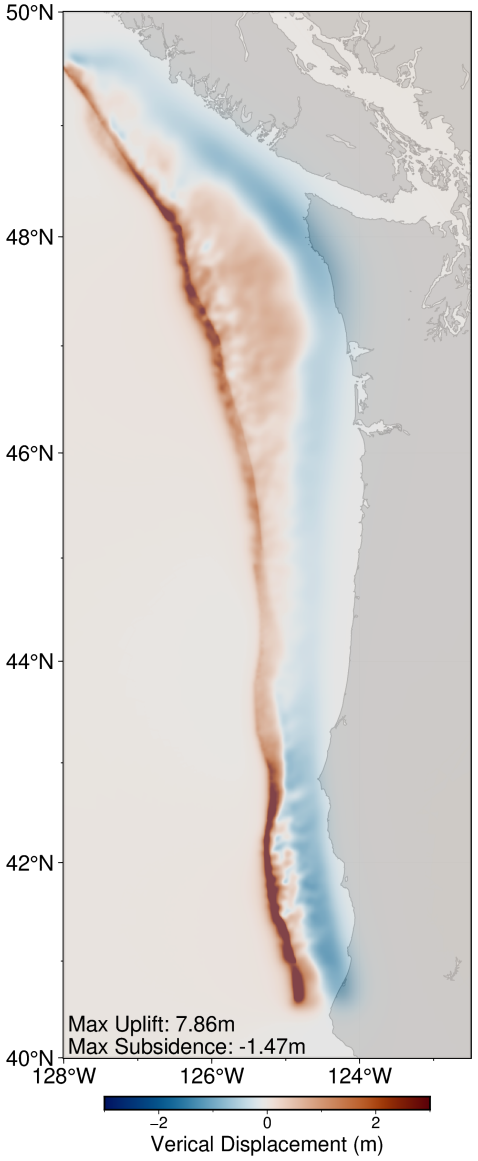
Slip distribution: Locking

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Middle

Magnitude: 8.8





EVID: FL16S

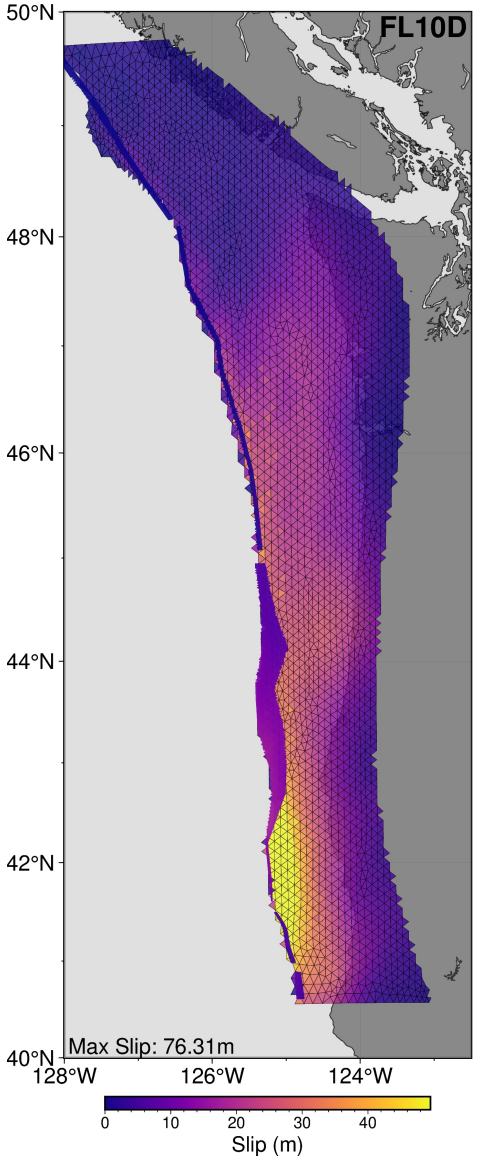
Updip limit: FrontalThrust

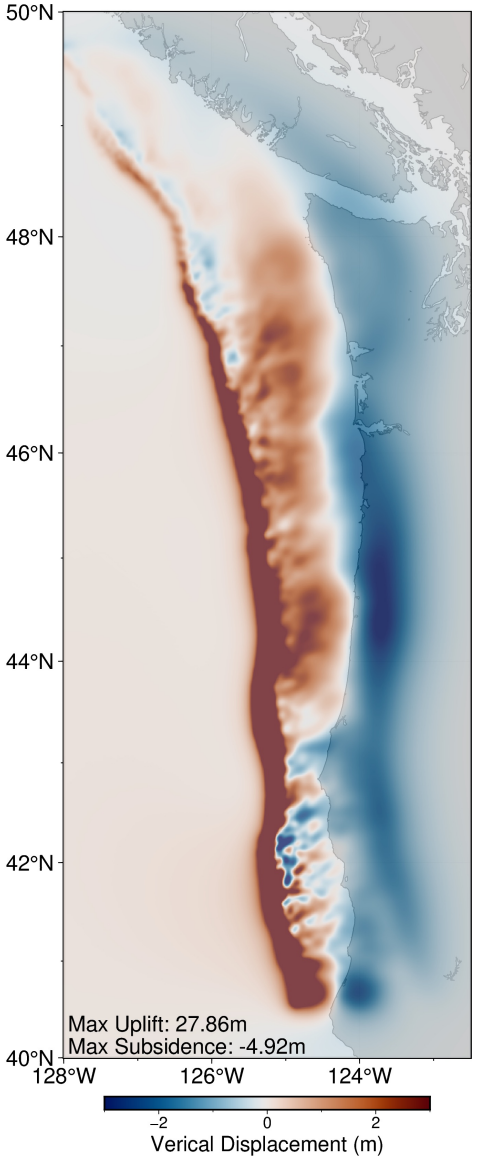
Slip distribution: Locking

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Shallow

Magnitude: 8.67





EVID: FL10D

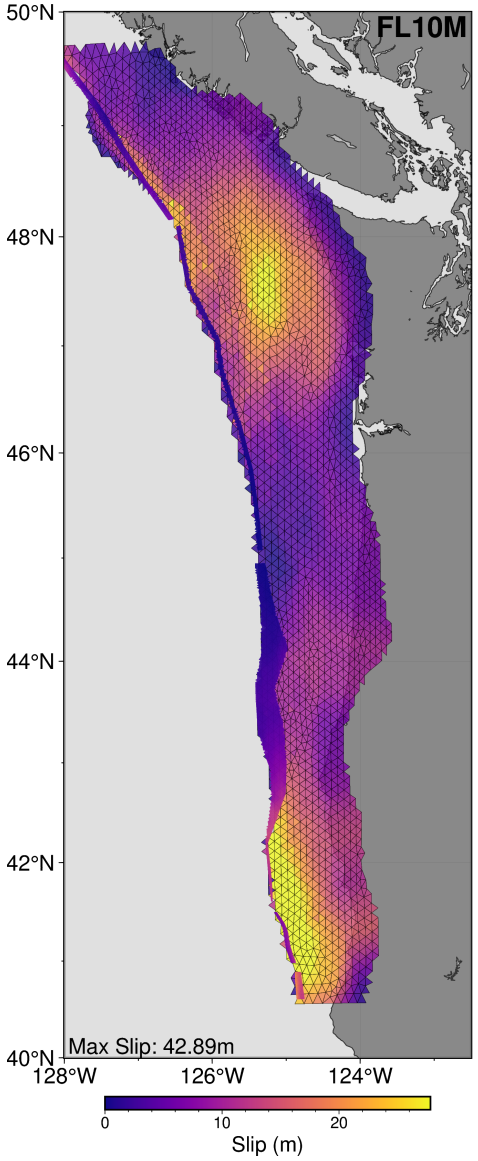
Updip limit: FrontalThrust

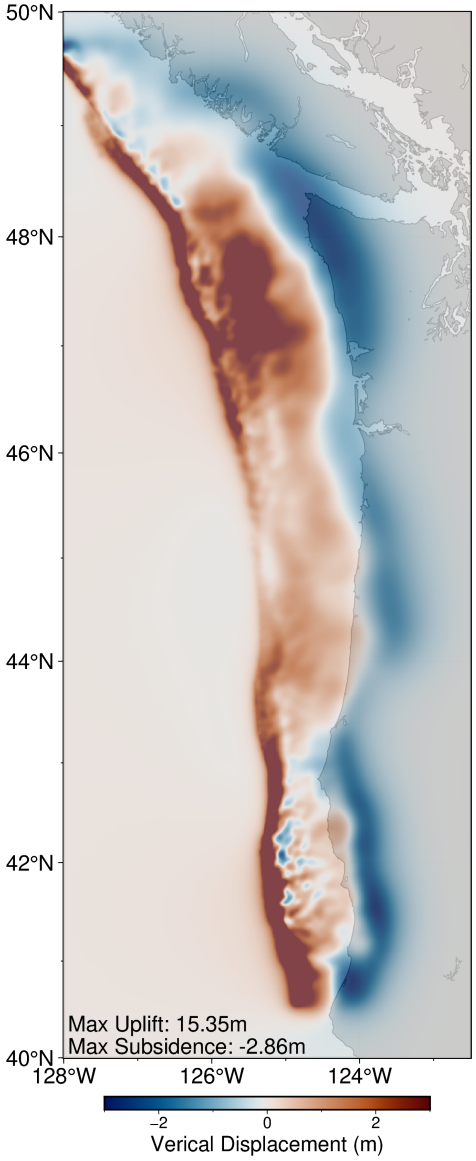
Slip distribution: Locking

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Deep

Magnitude: 9.23





EVID: FL10M

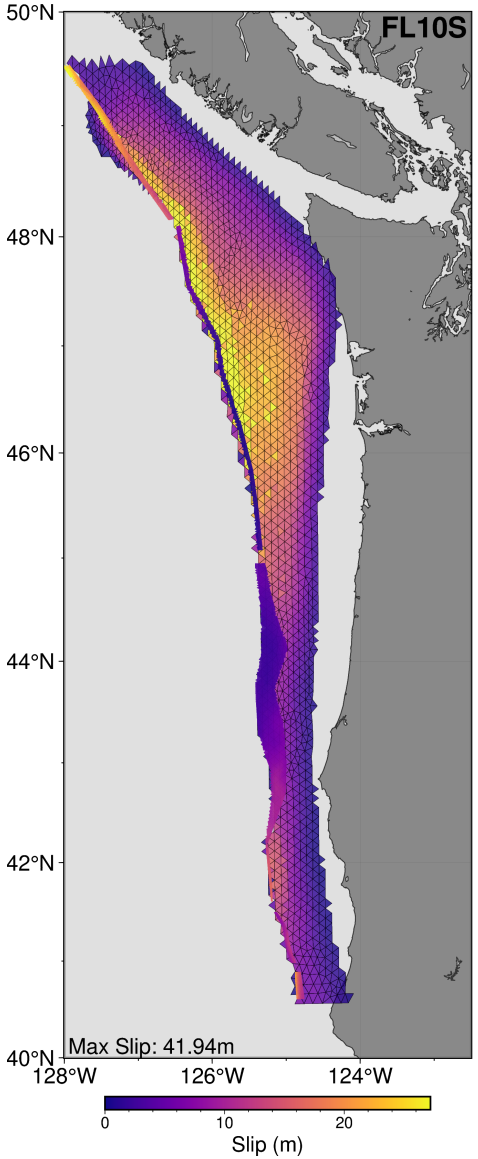
Updip limit: FrontalThrust

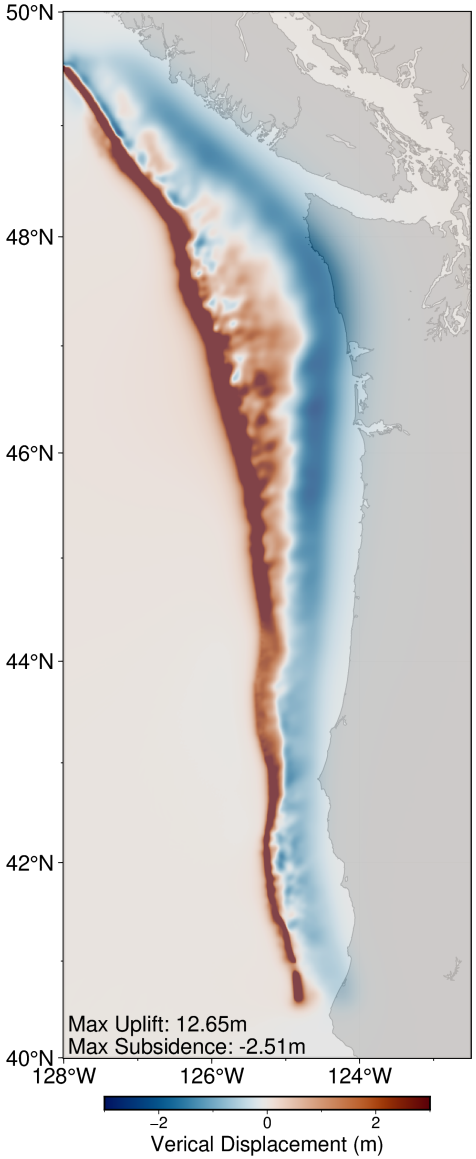
Slip distribution: Locking

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Middle

Magnitude: 9.05





EVID: FL10S

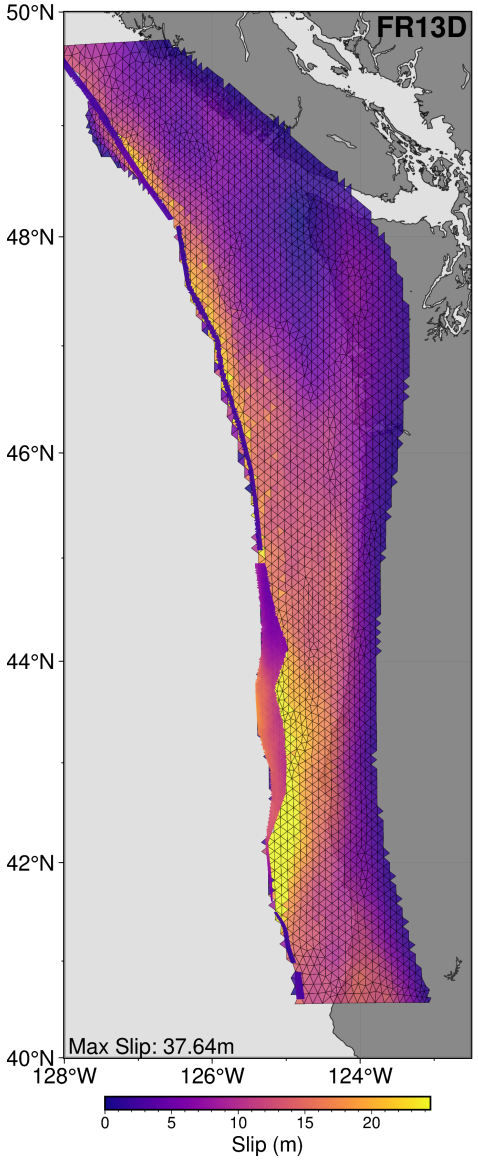
Updip limit: FrontalThrust

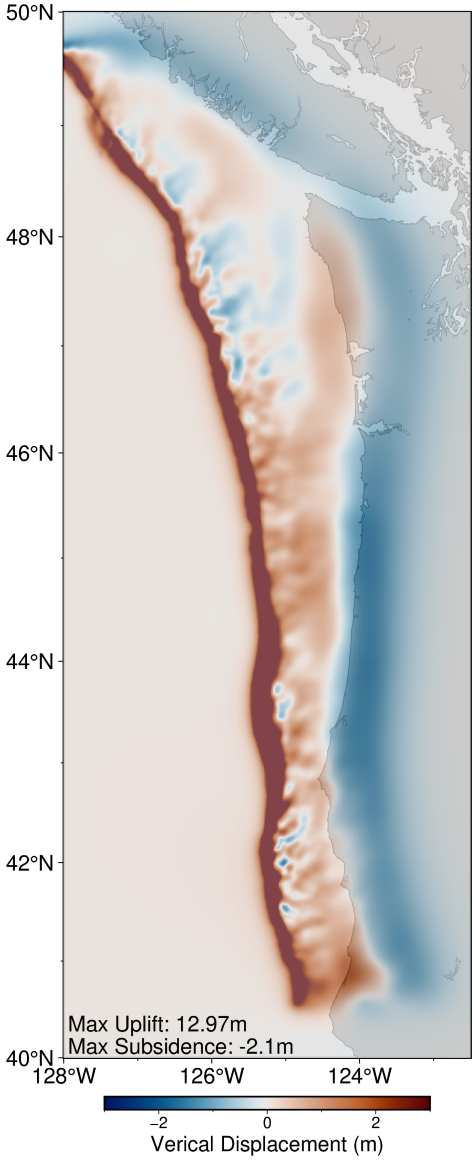
Slip distribution: Locking

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Shallow

Magnitude: 8.94





EVID: FR13D

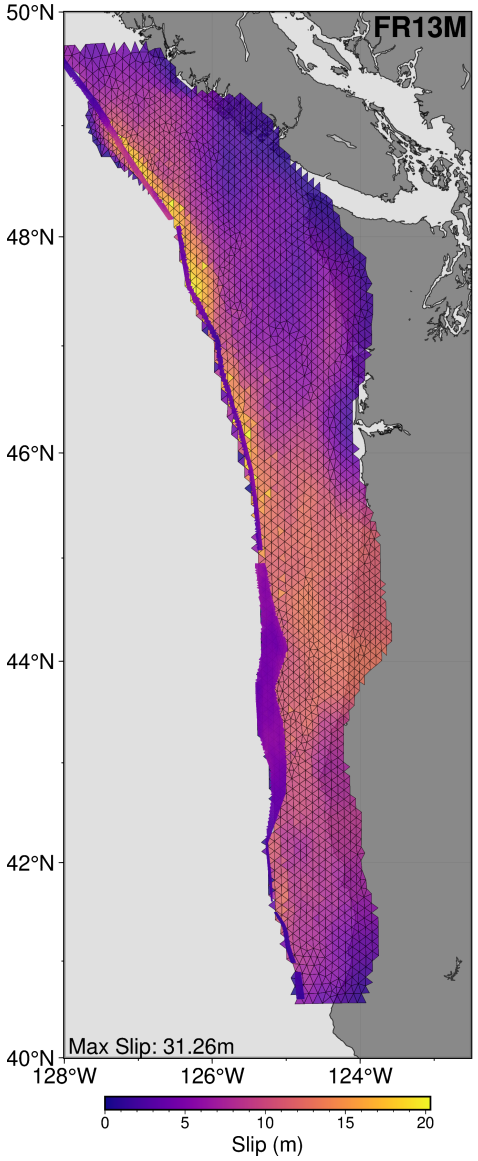
Updip limit: FrontalThrust

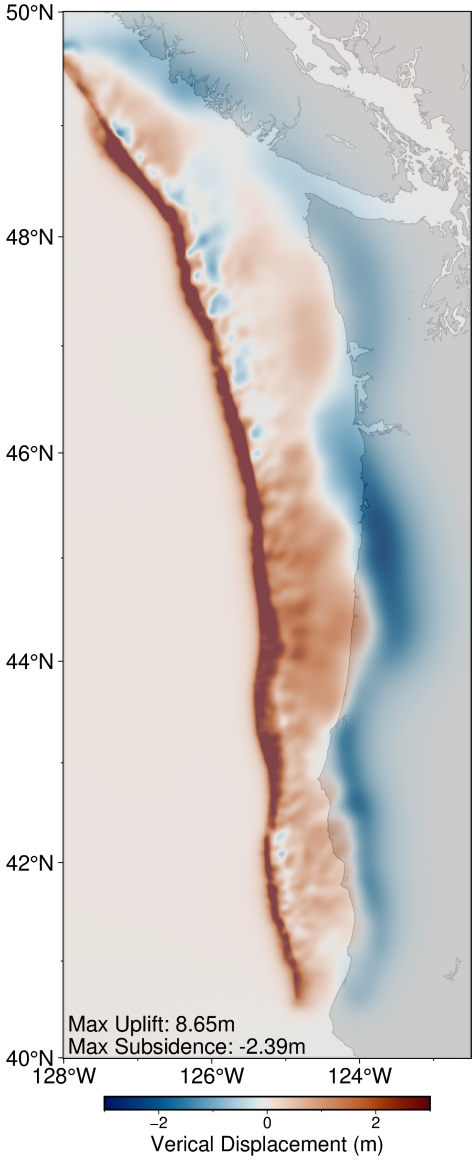
Slip distribution: Random

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Deep

Magnitude: 9.12





EVID: FR13M

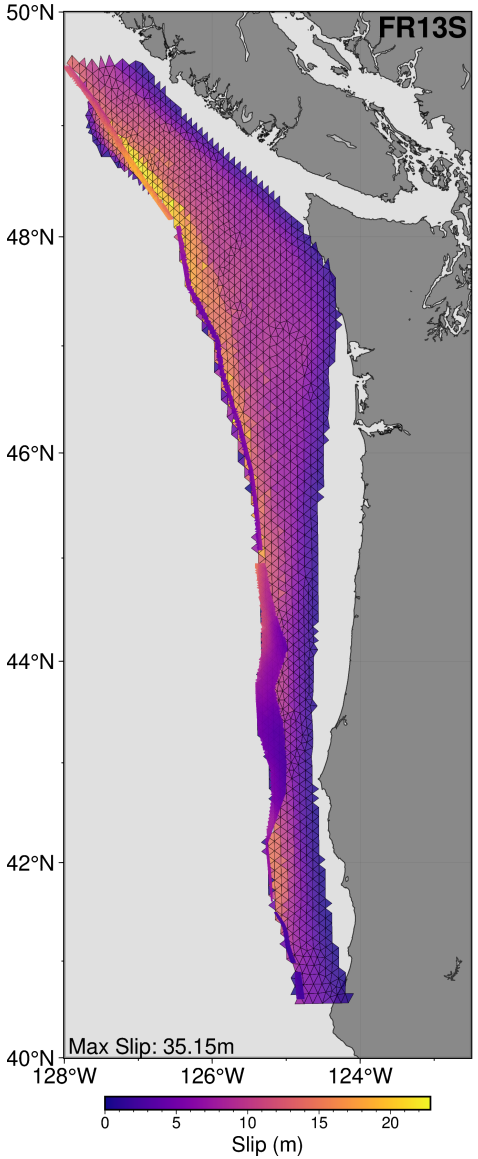
Updip limit: FrontalThrust

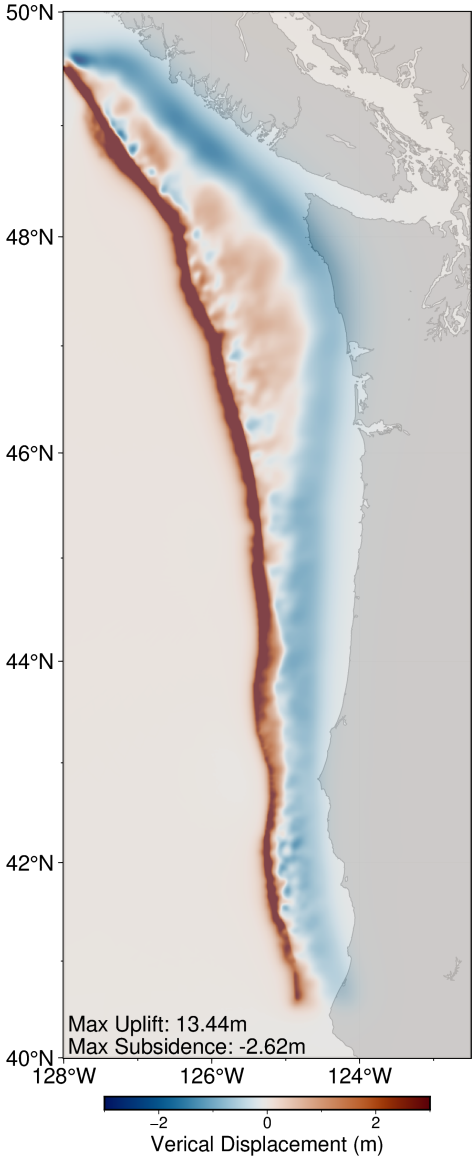
Slip distribution: Random

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Middle

Magnitude: 8.94





EVID: FR13S

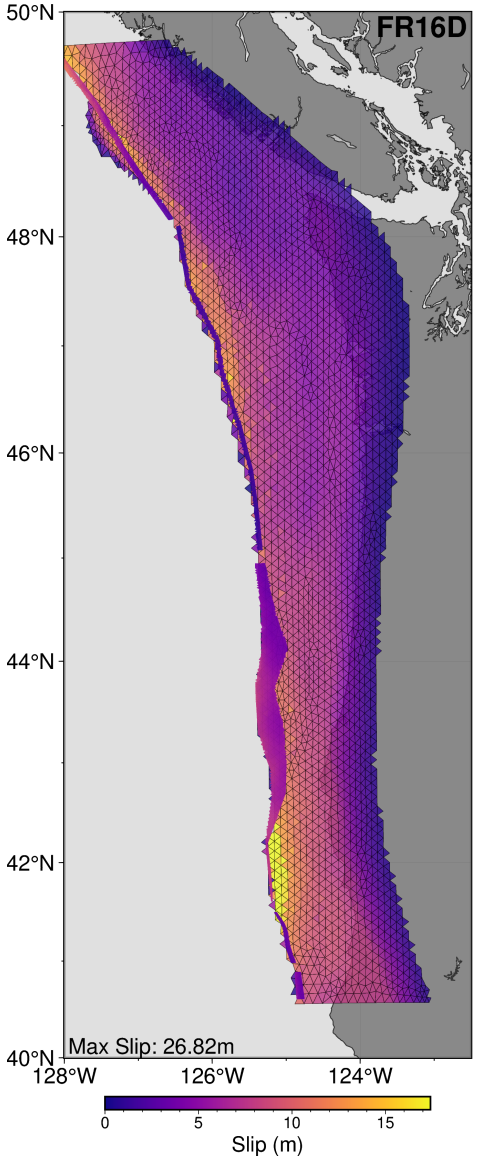
Updip limit: FrontalThrust

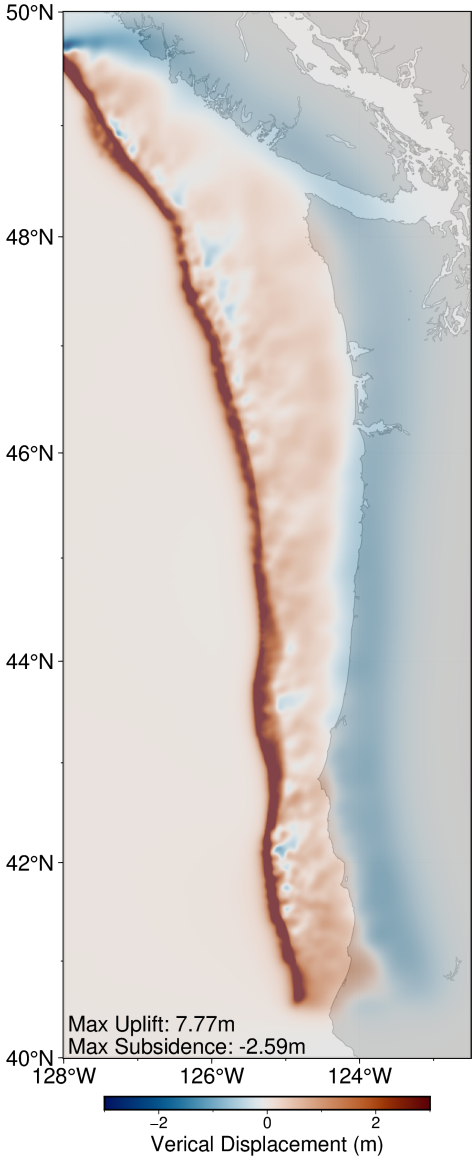
Slip distribution: Random

Magnitude area relationship: Murotani et al., (2013), Mur13

Downdip limit: Shallow

Magnitude: 8.83





EVID: FR16D

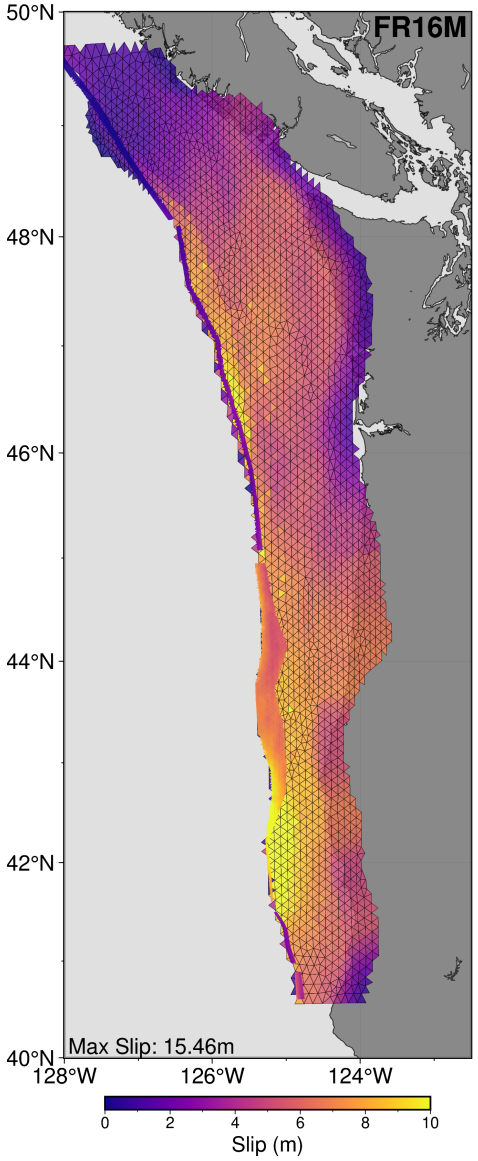
Updip limit: FrontalThrust

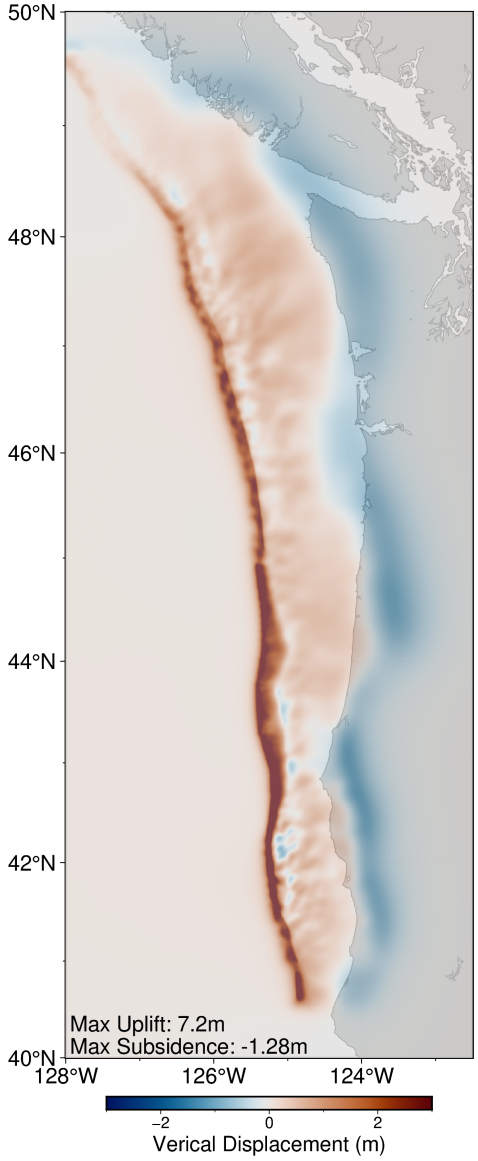
Slip distribution: Random

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Deep

Magnitude: 8.97





EVID: FR16M

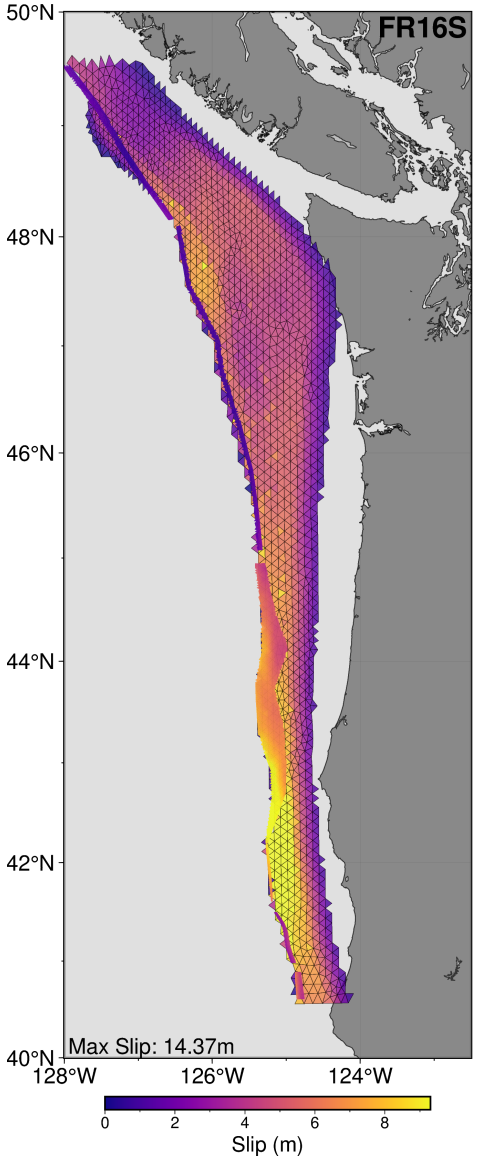
Updip limit: FrontalThrust

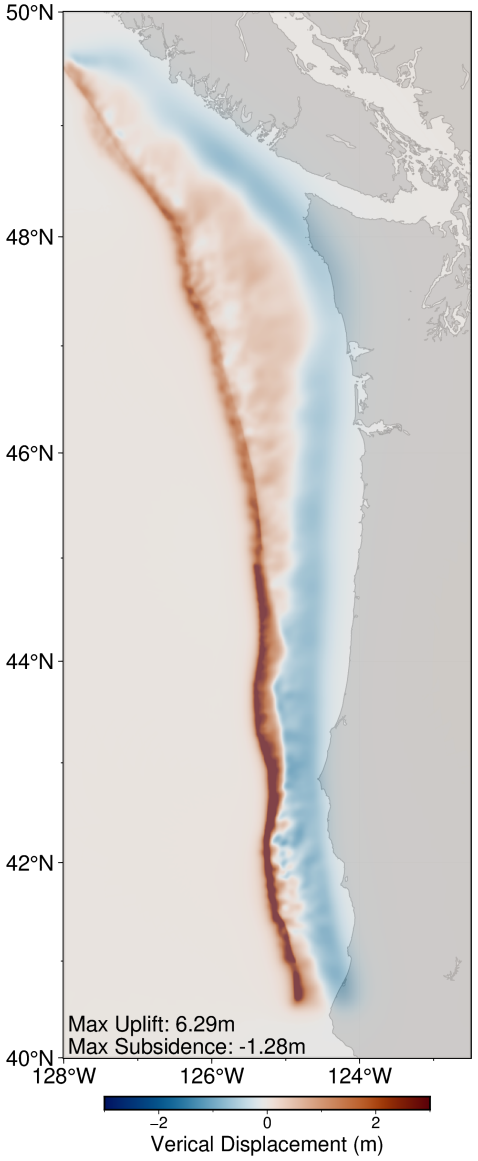
Slip distribution: Random

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Middle

Magnitude: 8.83





EVID: FR16S

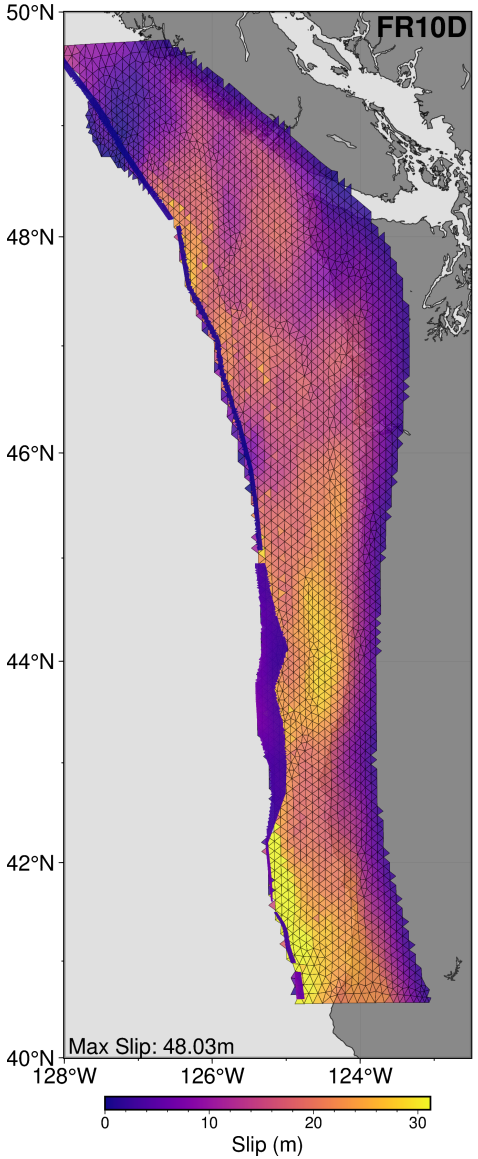
Updip limit: FrontalThrust

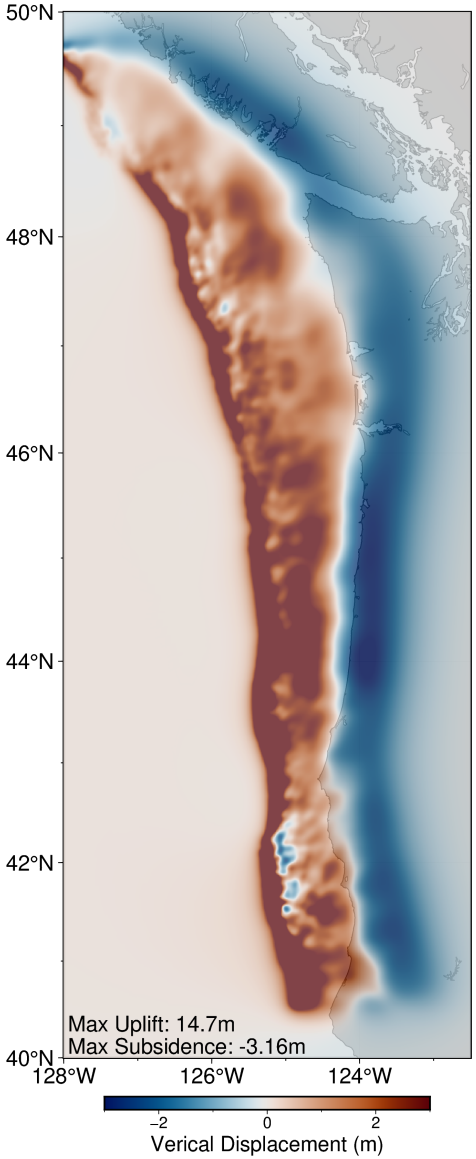
Slip distribution: Random

Magnitude area relationship: Skarlatoudis et al., (2016), Skl16

Downdip limit: Shallow

Magnitude: 8.7





EVID: FR10D

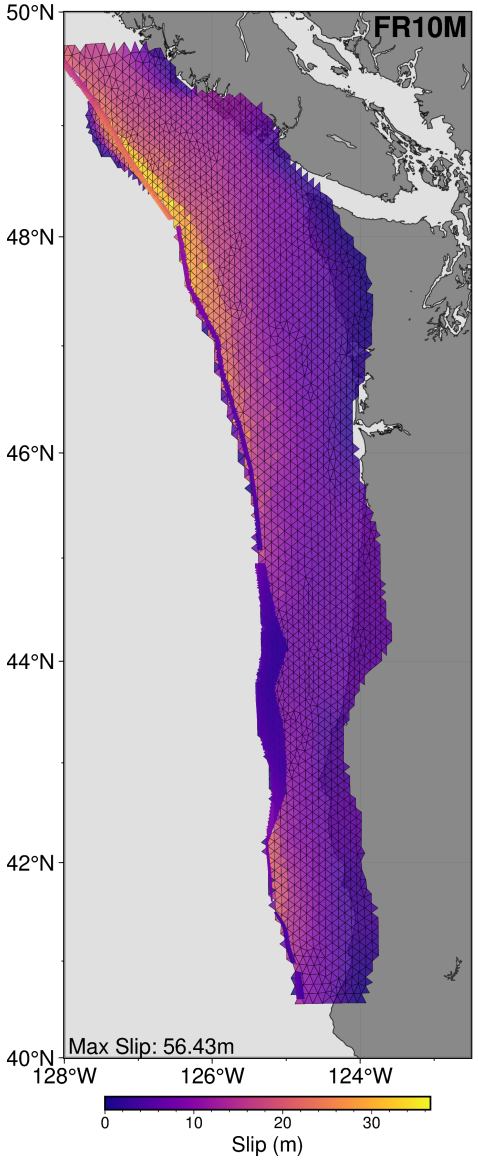
Updip limit: FrontalThrust

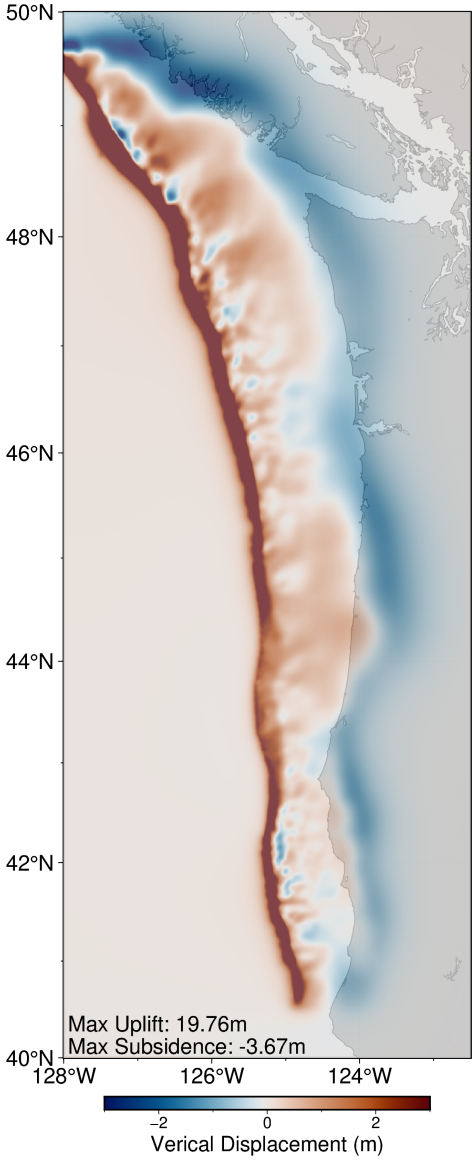
Slip distribution: Random

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Deep

Magnitude: 9.26





EVID: FR10M

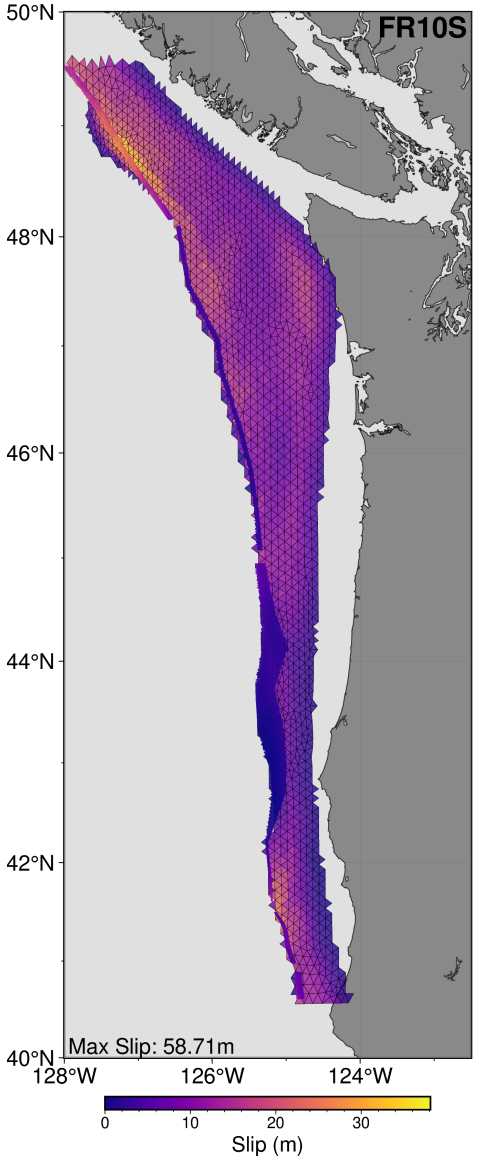
Updip limit: FrontalThrust

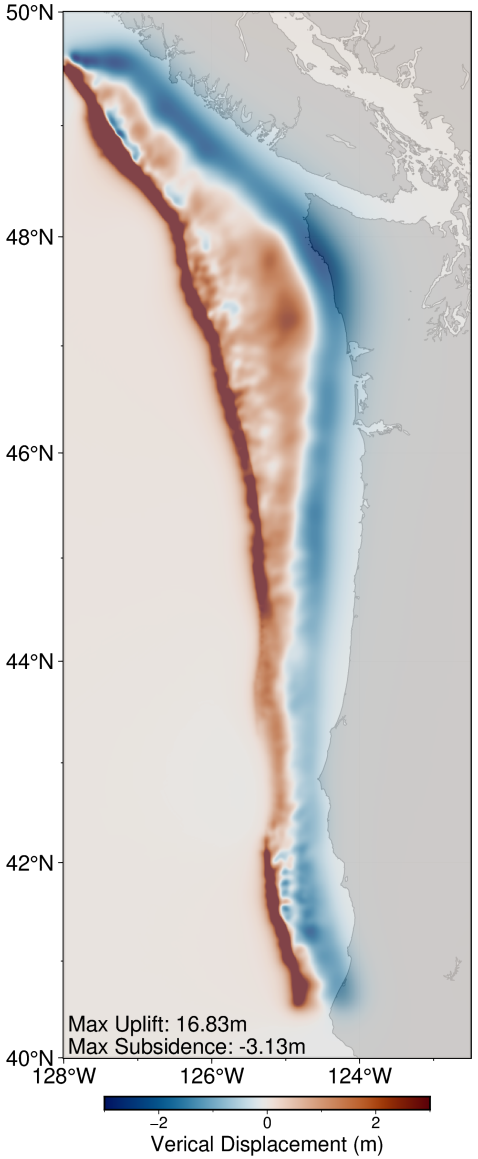
Slip distribution: Random

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Middle

Magnitude: 9.02





EVID: FR10S

Updip limit: FrontalThrust

Slip distribution: Random

Magnitude area relationship: Strasser et al., (2010) Str10

Downdip limit: Shallow

Magnitude: 8.91