

Support File for “Hydrodynamic and sediment transport tsunami models at the Salmon River estuary, Oregon”

SeanPaul M. La Selle

U.S. Geological Survey, Pacific Coastal and Marine Science Center, Santa Cruz, CA

Description of earthquake sources

Earthquake sources presented in this data release are from Witter et al. (2013) and Gao et al. (2018), representing 15 rupture styles and sizes. Witter et al. (2011) developed a suite of Cascadia rupture scenarios that are used in Oregon Department of Geology and Mineral Industries (DOGAMI) tsunami inundation maps. Small (SM), medium (M), large (L), to extra large (XL) models for each rupture style represent the release of interearthquake strain accumulated over 300 to 1200 year periods. The three Gao et al. (2018) sources each predict 1.0 m of subsidence at the Salmon River with peak slip of 12 m offshore, but vary in rupture style. The Gao et al. (2018) sources improve upon the fault geometries and use the same slip vectors as the preferred 1700 CE models in Wang et al. (2013).

The first set of DOGAMI sources (SM1, M1, L1, XL1) model slip onto the generalized location of a splay fault at an observed structural boundary in the upper plate between the younger and older accretionary wedge. The Gao et al. (2018) splay fault source also models rupture on a similar hypothetical splay fault, while the Gao et al. (2018) trench breaching rupture models slip to the trench on a frontal thrust, resulting in peak slip approximately 30 km farther offshore compared to the splay fault (Figure 4).

Two styles of buried rupture (non trench-breaking) scenarios are presented in the DOGAMI report, and Gao et al. (2018) use a single buried rupture scenario. All buried slip scenarios model coseismic slip as bell shaped distributions that taper in the up- and down-dip directions along the subduction zone. The DOGAMI shallow buried rupture models (SM2, M2, L2, XL2) set the updip limit of slip at the deformation front near 2 km depth, resulting in a 62 to 77 km wide region of uplift centered about 90 km offshore from the Salmon River. The deep buried rupture models (SM3, M3, L3, XL3) taper slip

to zero landward of the outer accretionary wedge, approximately 25 km landward of the deformation front. This results in a slightly narrower, 58 to 70 km wide region of uplift in shallower water, but a 5-10% higher (0.1-0.7 m) peak deformation. The Gao et al. (2018) buried rupture scenario distributes slip across a broad region that extends farther updip than the DOGAMI shallow buried source and farther downdip than the DOGAMI deep buried source. Peak uplift in the Gao et al. (2018) buried rupture (~33 m) occurs approximately 100 km offshore from the Salmon River, like the DOGAMI shallow buried rupture.

Table 1: Published Cascadia rupture models used as initial conditions to model tsunami propagation, inundation, and sediment transport in the Salmon River estuary, Oregon

Earthquake Source Name	Rupture Style	Subsidence at Salmon River (m)
Witter et al. (2011)		
SM1	Splay fault	0.4
SM2	Shallow buried	0.5
SM3	Deep buried	0.5
M1	Splay fault	0.8
M2	Shallow buried	0.8
M3	Deep buried	0.9
L1	Splay fault	1.1
L2	Shallow buried	1.2
L3	Deep buried	1.4
XL1	Splay fault	1.7
XL2	Shallow buried	1.7
XL3	Deep buried	1.7
Gao et al. (2018)		
Gao Splay A	Splay fault	1.0
Gao Trench 100	Trench Breaching	1.0
Gao Buried	Buried	1.0

Implementation of earthquake source models and tides in Delft3D-FLOW

Earthquake sources are represented in the Delft3D-FLOW models presented in this data release as initial conditions (.ini) files. For each of the 1650 m, 400 m, and 50 m resolution grids, the “earthquake_sources_XXXm” folder contains initial water level condition files for all 15 earthquake sources. These files are named with the source name

(e.g. “dogami_L3” or “gao_splay”) followed by the grid resolution (e.g. 1650, 400, or 50) in meters.

The sediment transport (10 m resolution) grid covers a small area where the predicted deformation is nearly uniform. Instead of an .ini file, the initial water level adjustment due to coseismic deformation is manually adjusted in the model definition (.mdf) file with the “Zeta0” (initial condition water level) parameter. Table 1 lists the subsidence value used as Zeta0 for each earthquake scenario.

Modeled tsunami inundation and onshore sediment transport is sensitive to tidal datums. The 10 m grid (salmonriver_delft3d_10m.zip) contains Delft3D depth (.dep) files that are adjusted for the hindcast low tide at 21:00 PST 26th, January 1700 (“1700tide”) or for modern Mean Higher High Water (“MHHW”). Subsidence is also accounted for in the depth files and the amount of subsidence, in meters, is indicated at the end of each .dep filename.

References

- Gao, D., Wang, K., Insua, T. L., Sypus, M., Riedel, M., & Sun, T. (2018). Defining megathrust tsunami source scenarios for northernmost Cascadia. *Natural Hazards*, 94 (1), 445–469. doi: 10.1007/s11069-018-3397-6
- Wang, P.-L., Engelhart, S., Wang, K., Hawkes, A., Horton, B., Nelson, A., & Witter, R. (2013). Heterogeneous rupture in the great cascadia earthquake of 1700 inferred from coastal subsidence estimates. *Journal of Geophysical Research, Solid Earth*, 118 (5), 2460–2473. doi: 10.1002/jgrb.50101
- Witter, R., Zhang, Y., Wang, K., Priest, G., Goldfinger, C., Stimely, L., & Ferro, P. (2011). Simulating Tsunami inundation at Bandon, Coos County, Oregon, using hypothetical Cascadia and Aska earthquake scenarios (Vol. 43; Tech. Rep.). Retrieved from <https://pubs.oregon.gov/dogami/sp/p-SP-43.htm>
- Witter, R., Zhang, Y., Wang, K., Priest, G., Goldfinger, C., Stimely, L., & Ferro, P. (2011). Simulated tsunami inundation for a range of Cascadia megathrust earthquake scenarios at Bandon, Oregon, USA. *Geosphere*, 9 (6), 1783-1803. doi:10.1130/GES00899.1