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COLUMBIA RIVER SIMULATED TSUNAMI SCENARIOS

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File geodatabases are Esri® version 10.2 format.

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CR_maritime_model_Run01.gdb
CR_maritime_model_Run02.gdb
CR_maritime_model_Run03.gdb
CR_maritime_model_Run04.gdb
CR_maritime_model_Run05.gdb
CR_maritime_model_Run06.gdb
CR_maritime_model_Run07.gdb
CR_maritime_model_Run08.gdb
CR_maritime_model_Run09.gdb
CR_maritime_model_Run10.gdb
CR_maritime_model_Run11.gdb
CR_maritime_model_Run12.gdb
CR_miscellaneous.gdb

Metadata note:
Geodatabases have embedded metadata. Each feature class, table, and raster also has an associated, standalone xml-formatted file containing metadata in the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata format.

1.0 STUDY BACKGROUND

This study evaluated new tsunami modeling results completed for both distant and local tsunamis in the Columbia River system. The overall goal was to examine the interaction of tsunamis with dynamic tides (as opposed to modeling using a fixed tidal elevation such as mean higher high water), different riverine flow regimes, and friction to provide an improved understanding of tsunami effects on maritime traffic operating offshore the mouth of the Columbia River and within the estuary, as well as upriver toward the ports of Longview, Vancouver, and Portland. This modeling effort was accomplished by evaluating a suite of tsunami simulations (32 in total) for the Columbia River focused on two distant earthquake scenarios: the 1964 Anchorage, Alaska (AK64) earthquake and a maximum considered eastern Aleutian Island (AKMax) earthquake, and two local Cascadia subduction zone (CSZ) scenarios: Large1 (L1) and Extra-extra-large1 (XXL1). See Allan and others (2018) for more detailed information on the methodologies used to create these data.

The purpose of this publication is to release the tsunami model output files produced as part of the Allan and others (2018) study. The files have been consolidated into specific tsunami model runs, as shown in **Table 1-1**.

This project was funded under award #NA16NWS4670037 by the National Oceanic and Atmospheric Administration (NOAA) through the National Tsunami Hazard Mitigation Program. Production of the tsunami model geodatabases was funded under award # NA17NWS4670013.

Table 1-1. Columbia River simulated tsunami scenarios included in this release. Run numbers correspond to geodatabase run names. See Allan and others (2018) and geodatabase metadata for more detailed information on scenario definitions.

Run Name	Scenario	Tidal Phase	Spring/ Neap	River Flow (m^3/sec) (Q)*	Bottom Friction**
Run01m	Tide+flow	dynamic, flood	—	average	landscape
Run01j	Tide+flow	dynamic, flood	—	low	landscape
Run01k	Tide+flow	dynamic, flood	—	high	landscape
Run02e	AK64	event	event	estimated	landscape
Run03d (coarse grid)	XXL1	static (MHHW)	—	7,000	0
Run04a (fine grid)	XXL1	static (MHHW)	—	7,000	0
Run05a_XXL1 Run05a_L1 Run05a_AKMax	XXL1 L1 AKMax	static (MHHW)	—	0	0
Run05b_L1 Run05c_L1	L1	MHHW (static) MHW (static)	—	0	0.025 0.030
Run06a_XXL1 Run06a_L1 Run06d_AKMax	XXL1 L1 AKMax	dynamic, flood	spring	average	landscape
Run07a_XXL1 Run07a_L1 Run07d_AKMax	XXL1 L1 AKMax	dynamic, ebb	spring	average	landscape
Run08a_XXL1 Run08a_L1 Run08d_AKMax	XXL1 L1 AKMax	dynamic, flood slack	spring	average	landscape
Run09a_XXL1 Run09a_L1 Run09d_AKMax	XXL1 L1 AKMax	dynamic, ebb slack	spring	average	landscape
Run10a_XXL1 Run10a_L1 Run10d_AKMax	XXL1 L1 AKMax	dynamic, flood	spring	low	landscape
Run11a_XXL1 Run11a_L1 Run11d_AKMax	XXL1 L1 AKMax	dynamic, flood	spring	high	landscape
Run12a_XXL1 Run12a_L1 Run12d_AKMax	XXL1 L1 AKMax	dynamic, flood	neap	average	landscape

Notes:

Static means a fixed tidal elevation, and dynamic means the tide varies over time.

*Average spring "freshet" (spring thaw resulting from snowmelt) flows = June 2002 conditions (~9,000 m^3/sec). High flow = June 1997 event (~15,000 m^3/sec). Low flow = September 15, 2001, event (~2,400 m^3/sec).

Unless otherwise specified, nodal Manning-*n* coefficients are spatially assigned using land-cover definitions from the USGS National Land Cover Data (NLCD) for Oregon and Washington (see **Table 2-1). For the ocean bottom we used Manning-*n* = 0.02.

2.0 RUN SUMMARY

The geodatabases include the model output point data as well as derivative rasters of the model outputs (maximum tsunami water levels, maximum flow depths, maximum tsunami current velocities, maximum momentum flux, minimum tsunami water levels, maximum vorticity, pre- and post-earthquake digital elevation models), and polygons of the various inundation zones. The latter includes a final suite of tsunami inundation polygons that reflect a consolidation of multiple tsunami inundation runs in order to produce an ensemble inundation zone product. Also see Appendix **Table 4-1**.

All model simulations were originally undertaken using the Run03d grid (nominal resolution of ~30–40 m (98–131 ft) in the navigation channel, and ~5–10 m (15–33 ft) in areas adjacent to the estuary and river channel), with the exception of the Washington State simulations (Run05b-L1 and Run05c-L1), which used the Run04a grid (nominal resolution of ~15–20 m (45–66 ft) resolution in the navigational channel of the lower estuary, and ~5–10 m (15–33 ft) in areas adjacent to the estuary and river channel).

CR_maritime_model_Run01 = tide and river flow simulations without tsunami;

CR_maritime_model_Run02 = Alaska 1964 (AK64) tsunami simulation;

CR_maritime_model_Run03 = Test simulations undertaken using a coarse grid;

CR_maritime_model_Run04 = Test simulations undertaken using a fine grid;

CR_maritime_model_Run05 = XXL1, L1, and AKMax simulations undertaken using a static tide level;

CR_maritime_model_Run06 = XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows and landscape friction. Tsunami arrives at flood (spring) tide;

CR_maritime_model_Run07 = XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows and landscape friction. Tsunami arrives at ebb (spring) tide;

CR_maritime_model_Run08 = XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows and landscape friction. Tsunami arrives at flood slack (spring) tide;

CR_maritime_model_Run09 = XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows and landscape friction. Tsunami arrives at ebb slack (spring) tide;

CR_maritime_model_Run10 = XXL1, L1, and AKMax simulations carried out using dynamic tides, low river flows and landscape friction. Tsunami arrives at flood (spring) tide;

CR_maritime_model_Run11 = XXL1, L1, and AKMax simulations carried out using dynamic tides, high river flows and landscape friction. Tsunami arrives at flood (spring) tide; and

CR_maritime_model_Run12 = XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows and landscape friction. Tsunami arrives at flood (neap) tide.

A suite of model attributes included in this data release are summarized in **Table 2-1**. Additional geospatial outputs include a collection of ensemble model products, where the output from multiple tsunami runs have been assimilated into a single raster product.

Table 2-1. Tsunami model attributes included in this release.

Model Attribute	Computational Grid Node ID Number
Easting	Easting (Oregon State Plane (NAD83) North, meters).
Elev_MHHW	Maximum wave elevation over the course of the entire simulation, in meters, relative to the Mean Higher High Water (MHHW) tidal datum. Note that this layer includes pockets of negative values in some areas of shallow inundation depth. These negative values are legitimate — they are a result of the conversion from the Mean Sea Level (MSL) datum.
Elev_NAVD	Maximum wave elevation over the course of the entire simulation, in meters, relative to the NAVD88 vertical datum.
Elev_NGVD	Maximum wave elevation over the course of the entire simulation, in meters, relative to the NGVD29 vertical datum.
Flow_Depth	Maximum tsunami flow depth over the course of the entire simulation, in meters.
initD_MHHW	Pre-earthquake digital elevation model (DEM). Ground elevation and bathymetry, in meters, relative to the Mean Higher High Water (MHHW) vertical datum. Positive values indicate depth in meters below MHHW, and negative values represent points on dry land.
Max_vel	Maximum tsunami flow speed over the course of the entire simulation, in meters per second.
Max_vel_Kn	Maximum tsunami flow speed over the course of the entire simulation, in knots.
maxMF	Maximum momentum flux, in cubic meters per second per second.
maxVort	Maximum tsunami vorticity, expressed as the number of rotations per second.
minH	Minimum depth below the tsunami waves, in meters.
Northing	Northing (Oregon State Plane (NAD83) North, meters).
postD_MHHW	Post-earthquake digital elevation model (DEM). Ground elevation and bathymetry, in meters, relative to the Mean Higher High Water (MHHW) vertical datum. Positive values indicate depth in meters below MHHW, and negative values represent points on dry land.
u	U-velocity reflects the east (positive) - west (negative) component of maximum tsunami flow velocity in meters per second.
v	V-velocity reflects the north (positive) - south (negative) component of maximum tsunami flow velocity in meters per second.
Wet_Dry	Simulations of tsunami inundation predict, for each grid node in the model, whether the point is wet (value = 1) or dry (value =2).
Change	The vertical change of the landscape caused by the earthquake (in meters). This vertical change is calculated from initD_MHHW - postD_MHHW.
DEM_Elev	This layer shows the digital elevation model used as the terrain/bathymetry input by the numerical model SCHISM to model the tsunami. Ground elevation and bathymetry, in meters, relative to the Mean Higher High Water (MHHW) vertical datum.
StationName	Unique number ID for simulated gage station.
Instructions	Instructions for accessing PDF attachments.

For more information on the approach and methods used to develop these data, please contact the authors.

3.0 REFERENCE

Allan, J. C., Zhang, J., O'Brien, F. E., and Gabel, L. L., 2018, Columbia River tsunami modeling: toward improved maritime planning response: Oregon Department of Geology and Mineral Industries Special Paper 51, 77 p. https://www.oregongeology.org/pubs/sp/p-SP-51.htm

4.0 APPENDIX: SUMMARY OF GIS DATA

Table 4-1. Summary of GIS Data.

Geo-database	Geodatabase-Specific Information	Run ID	Run-Specific Information	Scenario	Type (Feature Classes or Rasters)	Dataset (See Table 2-1 for Model Attributes)
Run01.gdb	Tide and river flow simulations carried out using dynamic tides, variable river flows, and landscape friction. No tsunami.	Run01j	River flow (Q) = Low flow	None	FC	inundation, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxVelKnt
		Run01k	River flow (Q) = High flow	None	FC	inundation, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxVelKnt
		Run01m	River flow (Q) = Average	None	FC	inundation, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxVelKnt
Run02.gdb	Alaska 1964 tsunami simulation with landscape friction.	Runs02e	—	AK64	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
Run03.gdb	XXL1 simulation carried out using a static tide level, a frictionless bottom, and river flow of 7,000 m^3/sec. Test simulations undertaken using a coarse grid.	Run03d	—	XXL1	FC	inundation, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxVelKnt
Run04.gdb	XXL1 simulation carried out using a static tide level, a frictionless bottom, and river flow of 7,000 m^3/sec. Test simulations undertaken using a fine grid.	Run04a	—	XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH

Geo-database	Geodatabase-Specific Information	Run ID	Run-Specific Information	Scenario	Type (Feature Classes or Rasters)	Dataset (See Table 2-1 for Model Attributes)
Run05.gdb	XXL1, L1, and AKMax simulations carried out using a static tide level, variable friction coefficients, and do not include river flow.	Run05a	Bottom friction = 0	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run05b	Bottom friction = 0.03	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run05c	Bottom friction = 0.025	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
Run06.gdb	XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows, and landscape friction. Tsunami arrives at flood (spring) tide.	Run06a	—	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run06d	—	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH

Geo-database	Geodatabase-Specific Information	Run ID	Run-Specific Information	Scenario	Type (Feature Classes or Rasters)	Dataset (See Table 2-1 for Model Attributes)
Run07.gdb	XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows, and landscape friction. Tsunami arrives at ebb (spring) tide.	Run07a	—	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run07d	—	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
Run08.gdb	XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows, and landscape friction. Tsunami arrives at flood slack (spring) tide.	Run08a	—	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run08d	—	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
Run09.gdb	XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows, and landscape friction. Tsunami arrives at ebb slack (spring) tide.	Run09a	—	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run09d	—	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH

Geo-database	Geodatabase-Specific Information	Run ID	Run-Specific Information	Scenario	Type (Feature Classes or Rasters)	Dataset (See Table 2-1 for Model Attributes)
Run10.gdb	XXL1, L1, and AKMax simulations carried out using dynamic tides, low river flows, and landscape friction. Tsunami arrives at flood (spring) tide.	Run10a	—	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run10d	—	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
Run11.gdb	XXL1, L1, and AKMax simulations carried out using dynamic tides, high river flows, and landscape friction. Tsunami arrives at flood (spring) tide.	Run11a	—	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run11d	—	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
Run12.gdb	XXL1, L1, and AKMax simulations carried out using dynamic tides, average river flows, and landscape friction. Tsunami arrives at flood (neap) tide.	Run12a	—	L1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
				XXL1	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH
		Run12d	—	AKMax	FC	inundation, maxMF_minH_pt, maxVorticity_pt, pt
					R	ElevMHHW, ElevNAVD, FlowD, maxMF, maxVelKnt, maxVorticity, minH