Mapping and Modeling Sub-Committee Meeting

Monday 18 July 2022
https://meet.goto.com/303912653
United States: +1 (872) 240-3212
Access Code: 303-912-653

09:30 - 10:30 Annual Work Plan updates

1. Powell Center tsunami sources update (Lead: Ross) (10)
2. NCEI DEM Development (Lead: Carignan) (10)
3. Maritime Guidance (Lead: Wilson) (10)
4. Sediment transport modeling benchmark workshop (Lead: Kirby) (10)
5. Landslide PTHA (Lead: Grilli/Horrillo) (10)
6. Tsunami debris modeling (Lead: Wilson/Lynett) (10)

10:30 - 11:15 National Plan to Coordinate Post-Tsunami Investigations (Lead: Jaffe/Ross USGS) (45); includes California/Washington clearinghouse efforts (5 mins each).

11:15 - 11:45 Wave arrival times discussion (Lead: Dolcimascolo) (30)

11:45 – 13:15 Lunch

13:15 - 13:30 Evacuation modeling discussion (Lead: Wood) (15)

13:30 - 14:50 MMS lightning talks (10 mins each)

- Puerto Rico
- U.S. Virgin Islands
- Gulf Coast
- East Coast
- Guam/Northern Mariana Islands
- American Samoa
- Hawaii
- Alaska

14:50 – 15:20 Working break (Q/A discussion)

15:20 - 16:30 MMS lightning talks continued (10 mins each)

- Washington
- California
- NOAA Great Lakes
- NOAA NCEI
- NOAA TWC
- NOAA Sea Grant, Washington
- Oregon

16:30 – 17:00 Q/A discussion

Annual Work Plan updates

1. Powell Center tsunami sources update (Lead: Ross) (10)

- Goal: Increase coordination on common tsunamigenic sources that transcend state and territory boundaries to increase consistency in planning.
- Meeting 1, April 2018: Develop an approach.
- Meeting 2, October 2018: Alaska-Aleutian Subduction Zone (AASZ) tsunami sources.
- Meeting 3, May 2019: US East Coast, Gulf Coast & Caribbean.
- Meeting 4, May 2022: Cascadia Subduction Zone (CSZ) tsunami sources (May 2022). Jay Patton (CGS) is leading meeting report. There is also an additional Powell Center working group focusing on Cascadia recurrence, though their meeting was postponed to November 2022.
- Meeting 5, Postponed to Spring 2023: Pacific Tsunami Sources other than AASZ and CSZ. Will include a half-day discussion on volcanic tsunami sources.
- Meeting 6, August, 2023: Crustal faults and potentially other non-standard tsunami sources. Liz Vanacore mentioned that she can send a preprint of a UNESCO/IOC white paper on this topic to anyone interested.

2. NCEI DEM Development (Lead: Carignan) (10)

- New staff member: Mike MacFerrin.
- Finished NTHMP DEMs: San Francisco Bay.
- NTHMP DEMs in progress: Prince of Wales, select areas in Puget Sound, Santa Cruz, southwest Washington (once topobathy update is completed).
- Finished non-NTHMP DEMs: Hawaii, East and Gulf Coasts, Puerto Rico, USVI.
- Non-NTHMP DEMs in progress: CNMI, Florida Keys, southwest Florida…
- Now photon-counting capabilities to filter out non-land photons.
- Public DEM Access available via Digital Coast, and discoverable via NCEI Bathymetric Data Viewer.
- *How to retain and archive modified DEMs done by NTHMP partners?* Not currently discussed, though will need to develop these procedures in the future.
- Start thinking about DEM plans for next year.

3. Maritime Guidance (Lead: Wilson) (10)

- Website developed (also embedded on NTHMP website): Contains different hazard tools and guidance information for specific states and territories.
- Maritime guidance depths: harbors were happy to hear that different, more modest guidance levels are being considered beyond catchall guidance for distant vs. local tsunami events. In some smaller events, even 30 fathoms may be too strict. Plan is to design specific guidance to match specific tsunami and alert level and develop more response-oriented guidance moving forward. It is necessary to also understand the needs of specific harbors.
- *Is there a conditional statement in maintaining a safe depth, but also staying farther away from topographic points that increase local currents?* Currently, this approach is very simplistic and this idea requires a more detailed look for a specific area. Model-based guidance needs to be included, still early in this discussion.
- All NTHMP partners seem to be involved in some sort of maritime modeling and thus, generic depth guidance should be revisited. Incorporating model results will allow for more specific guidance to be implemented.
- Currently drafting language for TsunamiReady community tab.
- Reexamining FASTER approach.

- Playbooks are being simplified. Ongoing task.

4. Sediment transport modeling benchmark workshop (Lead: Kirby) (10)

- Workshop funded by FY21, but deferred to FY22.
- Background: Progression of East Coast's inundation maps went from static DEMs ➔ Dynamic morphology adjustment in response to event conditions. Even weak models (Lisbon source) show that changes in morphology causes significant changes in modeled inundation lines. Thus, it is clear Tsunamis can cause large morphology changes and erosion. *Though, how do these different changes/patterns of deposition and erosion affect the hazard level?*
- Scope of benchmark problems for this workshop should cover both broad and narrow areas. Lean on Japan examples and there is a growing body of laboratory tests examining profile changes and local processes around structures. Field datasets are also strengthening and becoming more available due to improved post-event surveying and site inspection.
- -Tsunami models have shown to be qualitatively accurate in a range of settings and they are ready for benchmark testing.
- Workshop planning is ongoing: Looking at August 2023. Currently recruiting members for an organizing committee that will assist with identifying potential benchmarks and persons responsible for organizing data/documentation needed for each, in addition to identifying the pool of potential workshop participants (and guest speakers). Message Jim Kirby if interested.
- This workshop may also be concurrent with upcoming tsunami debris workshop. Advertisement to communities is coming once previous two topics are more settled (ITIC, etc.).
- Goal to develop a website to mimic 2017 landslide workshop website that includes overview of workshop goals and distribution of benchmark data.
- NSF has funded sediment transport workshops in the past. Have not explored NSF funding for this one, but it's still a possibility. Contact: Jody Bourgeois.

5. Landslide PTHA (Lead: Grilli/Horrillo) (10)

- Started looking at probabilistic landslide modeling back in 2019 (Objective defined based on the 2019 USGS Powell Center meeting).
- Methodology: Monte Carlo approach (order of 10,000s), based on Grilli and others (2009). Models probabilistically address slope stability, and different, randomized sediment properties (cohesion, soil types, thickness, etc.) at specific sites. Example: Cohesive vs less cohesive sediment leads to different types of slides (e.g. rotational vs translational).
- Validation through new Monte Carlo Matlab code and incorporates a factor of safety.
- Next step is to incorporate seismic scenarios with simplified coastlines. Goal to compute return periods for SMF (Bellotti and others, 2021 covers SMF tsunami model adoption, development, structure, and assembling).
- Cluster computer put together at Texas A&M for SMF tsunami model parallelization for faster processing. The testing stage is ongoing. Next is execution, and then reporting.

6. Tsunami debris modeling (Lead: Wilson/Lynett) (10)

- PIs have reached out to participants.
- Interest in combining with sediment transport modeling benchmark workshop.
- Date and location TBT: 2023.

10:30 - 11:15 National Plan to Coordinate Post-Tsunami Investigations (Lead: Jaffe/Ross, USGS) (45); includes California/Washington clearinghouse efforts (5 mins each).

- Bruce Jaffe presented on developing the national plan for coordinating post-tsunami investigations.
- March 11, 2011 tsunami: California response was a success. Set objections for before, during, and after event.
- US national plan for disaster impact contains a tsunami data protocol. Following DIAP general protocol.
- MMS provided feedback to include the following data: bottom roughness for modeling, flow direction indicators, detailed nearshore bathymetry, drone/satellite data.
- Tsunami plan is based on NEHRP plan for earthquake response.
- Shared outline for tsunami plan: Phase 1 plan implementation (minutes to days), phase 2 perishable data recon (days to months), phase 3 research and knowledge transfer (months to years).
- Important topic: triggering criteria for deciding to implement the plan.
- There is FEMA support.
- Next steps: Share, consult, coordinate with NOAA, USGS, FEMA, states and territories. States want to make sure national plan includes how it will interact with state plans.
- Summary: Learned from American Samoa tsunami (2009), developed and published state protocols (2011-2015), develop national protocol (2017 to present).
- *Questions: How can NTHMP support the national plan?* Funds to help with an exercise.
- *What role can national satellites play and pick up?* Useful in areas that are impossible to travel to immediately. *How quickly do you have to get there?* As quickly as possible, though there is a flexible timescale in some cases.
- Regional effort lead by Idaho and EERI. Partnering states for Cascadia.

<u>CGS clearinghouse:</u>

- Post-earthquake information clearinghouse established in 1972 to provide state and federal disaster response for seismic events.
- Mission statement: To facilitate the gathering and dissemination of post-earthquake information …
- Paraphrased language for earthquake activation: following a significant, damaging earthquake in California, a clearinghouse operation will be established (activation checklist: magnitude 6+, upon recommendation by State Geologist, or damage).
- Tsunami component now included in clearinghouse and is activated based on tsunami unit/team consultation once event happens (tide gauge data are helpful to make this decision).
- Arc Collector schema (Survey123 field form to collect data). Can be activated at a moment's notice and handles both earthquake and tsunami. Field collection forms contain information about runup, flow depth, wave velocity, samples, damage, and general observations. Also there are 3 types of simplified surveys (maritime, emergency managers, and general public) based on person who is being surveyed.

<u>WGS clearinghouse:</u>

- Multi-hazard clearinghouse plan (draft form): landslide, earthquake, tsunami, volcano
- Completed a practice earthquake event and learned that templates are useful since they simplify duties in real-time.
- Tsunami activation criteria: For damaging or inundation tsunamis or seiches… There is a coordination call to decide if activation is necessary.
- Plan to exercise with regional and local scientists. Goal to train others in specific locations outside of Olympia to help with data collection in hard to access communities.

11:15 - 11:45 Wave arrival times discussion (Lead: Dolcimascolo) (30)

- Open discussion prior to lunch to think about during the week. Complex topic.
- Onshore vs offshore needs and differences.
- Hazard arrival (currents, land level change, etc.) vs tsunami arrival (crest, trough, maximum).
- When do I need to run?
- Numerical vs actual.
- Goal to develop definition/glossary to be used between NTHMP partners. Will be addressed in further standalone meetings.

11:45 – 13:15 Lunch

13:15 - 13:30 Evacuation modeling discussion (Lead: Wood) (15)

- Upgrades to USGS PEAT Pedestrian walk analysis: Evacuation watersheds, cluster analysis to compare areas, comparative Vertical Evacuation Structure (VES) analysis tool, and easier ways to compare input scenarios. For example, comparative metrics of different sites to determine best location for VES construction.
- Migrating to ArcPro and having ArcPro tasks instead of ArcPy code under the hood. Single interface window with multiple modules instead of walking through screens.
- Current tool creates maps of pedestrian travel time to evacuate hazard zones regardless of wave arrival time. There are additional 'beat the wave' maps that incorporate pedestrian travel speed based on an assumed wave arrival time.
- Interest in Vehicular Evacuation Analyst Tool as it has applications for lahar evacuations and other distant tsunami scenarios with long arrival times, though guidelines do not yet exist.
- *Would vehicular evacuation take traffic density into account?* Yes, there are a lot of variable knobs and users can simulate 100s of runs with different inputs to account for traffic density, road capacity, light lengths, etc.
- Training on the evacuation tools is available: contact Nate

13:30 - 14:50 MMS lightning talks (10 mins each)

Puerto Rico

- New tsunami evacuation pedestrian models and created bilingual online module for how to use this information (intended for emergency managers, community leaders, and community members). Quiz at end that includes questions and other feedback. Currently available online in beta mode.
- Updating inundation maps with high resolution (1/9") in addition to earthquake hazard maps (USGS and UPRM) to set up next generation of probabilistic modeling.
- Continuing FEMA HAZUS implementation
- Community level: Created a tsunami evacuation mural and ran a nighttime tsunami evacuation event.

U.S. Virgin Islands

- Completed a scientific review of certain VITEMA proposals and of certain public education materials (public service announcements).
- Renewing TsunamiReady status: includes assisting with the improvement of tsunami evacuation maps.
- Outreach contribution focused on informing the USVI population about specific incidents that created alarm (e.g. 2018 tsunami alert, 2020 SW Puerto Rico quakes, 2022 Hunga-Tonga eruption).

- Promoting resumption of VITEMAs development of a tsunami maritime response playbook in addition to other tsunami-related research (e.g. tsunami deposit studies, expanding awareness of source areas, regional hazards) and seeking funding to restart tsunami deposit research as needed to summarize findings of earlier studies. Goal is to make results more available and useful to emergency managers.
- Promoting workforce development and resident expertise relevant to coastal and geological hazards within higher education, emergency management, planning and natural resource agencies.
- Tsunami water level analyses: Part of response to the barometric air pressure wave impulses following the Hunga-Tonga eruption. Goal is to link meteorological observations with geologic observations. Combination of data is crucial for future playbook strategies.
- Challenges: Periodic government administration changes (~4 years) affects the continuity of USVI representation on the NTHMP Coordinating Council.
- NTHMP partners to offer help for funding with maritime-related response and general awareness (currents, etc.).

Gulf Coast

- New modeling executed and planned within Gulf of Mexico (Juan has map of these locations).
- Meteotsunamis are ubiquitous in the north-eastern-western Gulf of Mexico and can be triggered by winter and summer extra-tropical storms and by tropical cyclones. A total of 15 to 25 events.
- Computed numerical models to determine meteotsunami characterization and generation regions (rose diagrams and distributions).
- Artificial Neural Network (ANN) Approach for meteotsunami prediction.
- Cluster computer with ~10,000 cores: very fast modeling—17,280 30 hour runs in 18 days.
- Global Tsunami Model, Tsunami Decade program strategy: Can run multiple resolutions for the entire globe at the same time. 1’ resolution in 2 hours 30 minutes; 2’ resolution in 33 minutes; 4’ minute resolution in 5.2 minutes.

East Coast

- New complete, enhanced regional hazard maps (done using new Tsunami Intensity Index metric; Grilli and others, 2022).
- Identified and modeled a collection of sources (4) and determined return periods for each (based on Powell Center meetings; published (Grilli and others, 2022).
- Goal is to continue to produce high-resolution (5-10 m) 2nd generation maps with enhanced dynamic products for 2 areas/year (including inundation, current speeds, elevation, flow depth, momentum flux, etc.)
- Mapping is GIS online based and is interactive. Also includes regional maps with coarse resolution.
- Meteotsunami collaboration within Gulf of Mexico. Grid configuration with coordinate rotations. Reproduction and validation compared to Geist and others (2014). Monte Carlo simulations taking into account storm translation speed, size, maximum pressure anomaly, etc.
- Landslide PTHA mentioned in earlier agenda topic.
- *Can we forecast meteotsunamis?* Potentially, modeling done in matter of minutes, but need data still in real-time.

Guam

- Working on NeoWave modeling projects, outreach, and updates to users' manuals. Completed Apra Harbor, Agana Bay, Tumon Bay, Agat Marina.
- Reevaluated/changed Pago Bay to Merizo. New updated DEMS (NCEI) did not improve Pago Bay bathymetry, however identified larger at-risk population at Morizo (piers, barrier reef). Also there is now better alignment with Inarajan Bay Sector.
- Prepared position paper on impact of sea level rise.
- Evaluated Nate Wood's evacuation proposal.
- Experienced many Covid-19 travel and grant execution challenges.
- Guam is TsunamiReady since 2006.

Northern Mariana Islands

- Identified 4 critical tsunami sources from subduction zones: Marianas Trench, Nankai, Philippine, New Guinea. Travel time from Marianas only 6-8 min.!
- Tsunami inundation maps computed at MHHW and MSL to see ranges of surges and drawdowns.
- CNMI Challenges: Category 5 typhoon in 2018. Other category 2 typhoons in 2015 and 2018. Destroyed many tsunami signs, knocked out NOAA radio tower. Delayed some grants. Funds reprogrammed to complete coastal siren program. Voluntarily omitted grant cycles of 2019 and 2022. Looking into mobile sirens for flexibility and ease of permitting.
- Solutions: NeoWave modeling for Saipan Harbor delayed several years, using playbook and FASTER approach as interim solution. Many funds reprogrammed to mobile coastal sirens. Delays in implementing proposal for producing evacuation maps. Goal is to get back on track by 2023.

American Samoa

- Project status (completed in 2018): Advisory-level tsunami hazard maps (9 m resolution) for critical sources to American Samoa.
- New maritime hazard mapping: Au'asi and Aunu'u Harbors.
- Maritime hazard mapping: Pago Pago Harbor (Local Partnership: USCG Sector Honolulu with NWS Pago Pago, American Samoa DHS, and Port of Pago Pago).
- Tsunami advisory: evacuation not mandatory.
- Tsunami warning: evacuation mandatory. Offshore hazard maps based on a M9 Tonga Trench earthquake are included in the Tsunami Plan for evacuation of ships.
- New tsunami component in USCG's Heavy Weather Plan to determine waterway closure, along with conditions of tides, winds, wind waves.
- Data available at https://www.pacioos.hawaii.edu/data/search-results/?text=tsunami

Hawaii

- Maritime hazard mapping for advisory-level and extreme tsunami events. Included in USCG's Heavy Weather, Hurricane & Tsunami Plan (2021) - 100% completion.
- Tsunami advisory: Heavy Weather Plan determines waterway closure based on tides, winds, wind waves, and newly included tsunami waves.
- Tsunami Warning: Tsunami Plan to evacuate ships and shore personnel.
- New maritime hazard mapping in support of HDOT's 2050 Master Plans for state harbors.
- 200 and 500-year tsunami scenarios from Eastern Aleutian Alaska Subduction Zone (AASZ): nearest and most impactful to Hawaii.
- Used Paleotsunami deposit data from USGS as reference for development of design scenarios that considered recurrence intervals of 100-300 years (inferred from sand layers in the Aleutians and Hawaii).

- Pattern of alternating mid-depth and near trench slip from preliminary results. There is a recurring ~32 m slip on the locked zone of the AASZ—1300s mid-depth long rupture (~7-14 m slip); 1400s near-trench shore rupture (~32 m slip); 1700s mid depth shore rupture (~32 m slip); 1957 near trench long rupture (~16-32 m slip).
- Analyzed the 500-year tsunami: 22 m average slip along a 700 km fault that is comparable to the 1300s and 1400s Aleutian events combined.
- Project status: completed 200- and 500-year scenarios for 3 of the 10 HDOT harbors. Wrapping up paleotsunami study with colleagues from USGS and UC Santa Cruz for publication. Inundation modeling consists of different sea level datums—MSL, MHHW, MHHW +1m, MHHW +2m.

Alaska

- Shared snapshot of current (2021-2022) mapping and modeling activities, in addition to warning coordination, education and outreach.
- Created tsunami brochures for coastal Alaska. Will finish 6 brochures for 6 communities.
- Updated Seward inundation map: slip close to trench changed the inundation map and now shows significantly more inundation. This means that runup is dependent on the spatial distribution of slip.
- Anchorage Project: Learned that tsunami hazard in Anchorage is not negligible, despite what is currently believed by many. There is a misconception that Anchorage is immune to tsunami impacts, which largely arose when the 1964 rupture and other recent historic events did not have substantial slip in the Kenai Peninsula segment. Also, these events did not produce tsunami impacts with much effect in Upper Cook Inlet (The only 1964 tsunami effects in upper Cook Inlet include a localized wave in Turnagain Arm that flooded Hope). It is lost to the general population and stakeholders that two earthquakes in the past were larger than the 1964 earthquake in both rupture area and magnitude (many not ready for bad news and need extra 'lead time'). This has led to a quest for determining the worst-case credible scenario.
- Produced ruptures to find a potential deterministic worst-case scenario: Very fine subfaults in fault model. Used USGS Slab data for subfault geometry. Result—In Anchorage, sources with deeper slip are worse than sources with slip near trench (i.e. earthquakes with M8+ can generate a sizeable wave in Anchorage/upper Cook Inlet when slip is deeper).
- Sensitivity studies show that coseismic slip in the Kennedy Entrance at deeper parts of the interfaces generates substantial waves even for events of M8.7. Public and stakeholders' education and outreach in Upper Cook Inlet, especially in Anchorage, is essential.
- Sources south of Kodiak: Shelikof Strait. Tsunami arrives in Anchorage 5 hours after the earthquake.

14:50 – 15:20 Working break (Q/A discussion)

15:20 - 16:30 MMS lightning talks continued (10 mins each)

Washington

- New Seattle fault tsunami publication for Puget Sound and other parts of the Salish Sea. Includes both current speed and inundation depth maps. Earthquake rupture model was based on the last Seattle Fault earthquake ~1,100 years ago. This is the largest Seattle fault earthquake preserved in the geologic record within the last 16,000 years. 5 tsunami deposits sites from this last Seattle fault earthquake-generated tsunami. Fault scarp also exposed in the geologic record.

- New simulation videos for Seattle fault tsunami scenario. Extensive inundation in downtown Seattle with fast wave arrival (3-5 minutes).
- New evacuation walk time maps in Ocean Shores and Tokeland Peninsula for Cascadia Subduction Zone tsunami. Slow speed walk paces to reach high ground from within hazard zone. There is FEMA funding + local state funding to build VES structure in southern Ocean Shores. Will remake the Ocean Shores evacuation map once VES is completed with agent-based modeling.
- VES completed on Tokeland Peninsula (grand opening, August 5th, 2022) and walk map shows updated walk times.
- Maritime response and mitigation strategies. Completed for Bellingham, near-complete for Port of Grays Harbor, upcoming for Guemes Channel (Port of Anacortes).
- Upcoming probabilistic modeling for outer coast of state and then whole state once Powell Center meetings conclude.

California

- The 2013 USGS SAFRR study found that improving tsunami planning could reduce casualties and damage by 80-90%.
- New PTHA products: represents multiple hazard levels (average return periods [100 to 3000y]). Data covers all low-lying populated communities along the coast. Improves tsunami hazard maps for evacuation, land-use, and construction.
- PTHA looked at tsunami sources, disaggregation of sources, and inundation models. It is now easy for statewide comparisons of the hazard level for specific return periods—SoCal has low hazard level overall, NorCal has high hazard level (Crescent City).
- Working on subzone maps (Seismic Hazard Mapping Act, similar to what Japan is doing). This consists of looking at the same tsunami hazard map areas, but with three different purposes/uses related to evacuation (preparedness, response, and mitigation). For example, engineering zone has to look at both evacuation and engineering facets to mitigate tsunami impacts.
- Mitigation focuses: Harbor Improvement Reports, Seismic Hazard Zones, HAZUS and CA Building Code
- Tsunami sediment movement and debris guidance for mitigation and recovery planning covers 2/3 of state (intended for evacuation mapping). The final third to be completed August 2022.
- Building code uses updated ASCE hazard tool. Now has 10m coastline resolution as opposed to 60 m.
- Working with CalOES and NWS to put out real time forecasting (FASTER), which is used in the Maritime Response playbooks.
- Tonga volcanic eruption simulation from Patrick Lynett and others at USC. This event had complicated tsunami generation and activity and put CA in advisory level for ~19 hours. The wave in front of pressure wave showed up on marigrams ~4 hours before tsunami wave arrival. Damage in Santa Cruz harbors and others.
- Input for PLTHA for next tsunami map updates.
- Using 975-year for evacuation mapping. Voted and driven by locals as appropriate risk level. May go higher in the future.

NOAA Great Lakes

- *n/a*

NOAA NCEI

- The hazards team maintains the historical event and image database. Responsible for archiving and processing DART and coastal tide gauge data.
- Historical hazards data: authoritative source for historical tsunami event data. The database is continuously updated based on new sources. Includes economic and human impacts. New interface (since 2020).
- Marigrams- Sifted through over 3000 historic paper records and converted from analog to digital media. Database now includes several digitized records for select events.
- NCEI Water Level Report (biannual release): Describes what is new in water level world. Tsunami water level data is available where available.
- Image database (continuously add new images): not much has changed since last update.
- Produced some tsunami online event summaries after large/impactful events.
- ETOPO and other global regional grids set to be updated later this year (September).

NOAA TWC

- LANTEX22 exercise: scenario—NW Caribbean to simulate what a tsunami event may look like on the Atlantic coast. There were modest GOM impacts. Actions—pre-exercise consists of revising workbooks; Exercise day— Comms test as kickoff. 4 conference calls. Email bulletin released over 7.5 hrs. Google chat support in Atlantic Collaboration Room; Extensive Survey Post exercise—Goal to make these exercises more useful in future years, increase engagement.
- NTWC messaging: planning for common system. Testing completed for new version of current software.
- Specific inner coast messaging (Salish Sea, WA) for Cascadia, and the Barry Arm landslide tsunami will hit operational systems within the next few weeks.
- Barry Arm sensitivity studies for initial conditions: Tsunami detection- detiding on the fly, internal alarming mechanism for when something unusual is happening. For example, there is a high probability a Barry Arm tsunami won't start with earthquake. Need to detect tsunami wave in real time based on just sea-level data.
- Forecasting: updates to tsunami travel times. Better bathymetry and inclusion of more locations. Travel times are based on bathymetry and increased resolution helps with this. More observations helps with forecasting.
- RIFT model (the tsunami model that PTWC uses as its primary real time tsunami model) is going to be integrated within the NTWC. This will allow for better NTWC backup support to PTWC, also will provide better initial guidance on tsunamis from non-subduction zone sources.

NOAA Sea Grant, Washington

- n/a

Oregon

- New maritime modeling – Coos Bay. Goal to understand tsunamis with dynamic tides. Started process with Columbia River. Non-linear responses there. Looking at both distant events (Alaska Max and L & XXL Cascadia).
- Modeled variety of different tidal stages (flood stack, ebb stack, etc.) with focus on how different interactions affect the tsunami current speeds.
- Guidance for maritime evacuation maps offshore: incorporates a 3 knot boundary, 4 knot boundary, etc. Need to go far offshore based on modeling and may not have enough time in local Cascadia event.

- Oregon coast evacuation modeling: incorporated wave arrivals with ‘Beat the Wave’ investigations. XXL Cascadia scenario only.
- NVS Tsunami evacuation zones: recommended speed to travel, other useful information on site and in app.
- Earthquake-tsunami risk assessments for M, L, XL, XXL Cascadia events. Goals: determine casualties, assess building losses and debris volumes, and assess economic impact. Completed ~70% of Oregon coast.