Probabilistic Extra-Tropical Storm Surge (P-ETSS v1.4)

User Evaluation Slides

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April 14, 2025

NWS/OSTI/MDL
Decision Support Division

Current P-ETSS v1.3 as of April 2025

	P-ETSS	ETSS
Model Type	Ensemble	Deterministic
Forcing	3-hourly, 0.5 degree (55-km) (0.25 degree for GEFS) 4x a day - 52 member NAEFS wind/pressure	1-hourly, 13-km 4x a day - GFS wind/pressure
Phenomena	Overland inundation based on surge + tide	
Overland bottom friction	Spatially varying bottom friction based on land cover types	
Areas: no nesting	Gulf of Alaska (Apr 2008) West Coast (Feb 2017)	
Areas: fine res nesting	East Coast (Feb 2018) Gulf of Mexico (Jun 2018) Bering Beaufort Chuckchi Seas (Nov 2015)	
Post-Processing	SHEF encoded Station based bias adjustment with Fourier-analysis post-processing mode	
Initial Water Condition	Based on the mean anomaly of all stations within a given model domain	
Restart Capability	Model Level - No	
Images	Developer account sends images to the model's real-time website	

Proposed P-ETSS v1.4 as of April 2025

	P-ETSS	ETSS
Model Type	Ensemble	Deterministic
Forcing	3-hourly, 0.5 degree (55-km) (0.25 degree for GEFS) 4x a day - 52 member NAEFS wind/pressure	1-hourly, 13-km 4x a day - GFS wind/pressure
Phenomena	Overland inundation based on surge + tide	
Overland bottom friction	Spatially varying bottom friction based on land cover types	
Areas: no nesting	Gulf of Alaska (Apr 2008)	
Areas: fine res nesting	West Coast (Feb 2017) East Coast (Feb 2018) Gulf of Mexico (Jun 2018) Bering Beaufort Chuckchi Seas (Nov 2015) Puerto Rico (Apr 2010) and Virgin Islands (Jul 2009)	
Post-Processing	SHEF encoded Station based bias adjustment with Fourier-analysis post-processing mode Correct a 1-hour shift in the tide calculation at 74 secondary tidal stations	
Initial Water Condition	Based on the mean anomaly of all stations within a given model domain	
Restart Capability	Model Level - Yes	
Images	Operational account sends images to the model's real-time website	

Proposed Upgrades P-ETSS v1.4

Science Improvements:

- S1. Nest two higher resolution basins (i.e., computational domains) for Seattle, WA and San Francisco, CA within the U.S. West Coast basin.
- S2. Nest two higher resolution basins for Puerto Rico and the U.S. Virgin Islands within the U.S. East Coast basin. This will enable the model to produce surge + tide calculations, but it will not consider wave-setup.
- S3. Upgrade Fort Myers, FL basin to match the one used within the Probabilistic tropical cyclone storm Surge model (P-Surge).
- S4.a Improve the basin used for Kotzebue, AK.
- S4.b Remove erroneous influence of a neighboring basin on the station guidance at Kotzebue.
- S5. Utilize 37 tidal constituents from Eastern North Pacific ADCIRC 2015 (ENPAC-15) data set for the West Coast instead of 13 constituents from a global tide model.
- S6. Correct a 1-hour shift in the tide calculation at the 74 secondary tidal stations.
- S7. Correct a bug which caused an observation from the wrong time to be used in the P-ETSS 6-hour projection guidance.

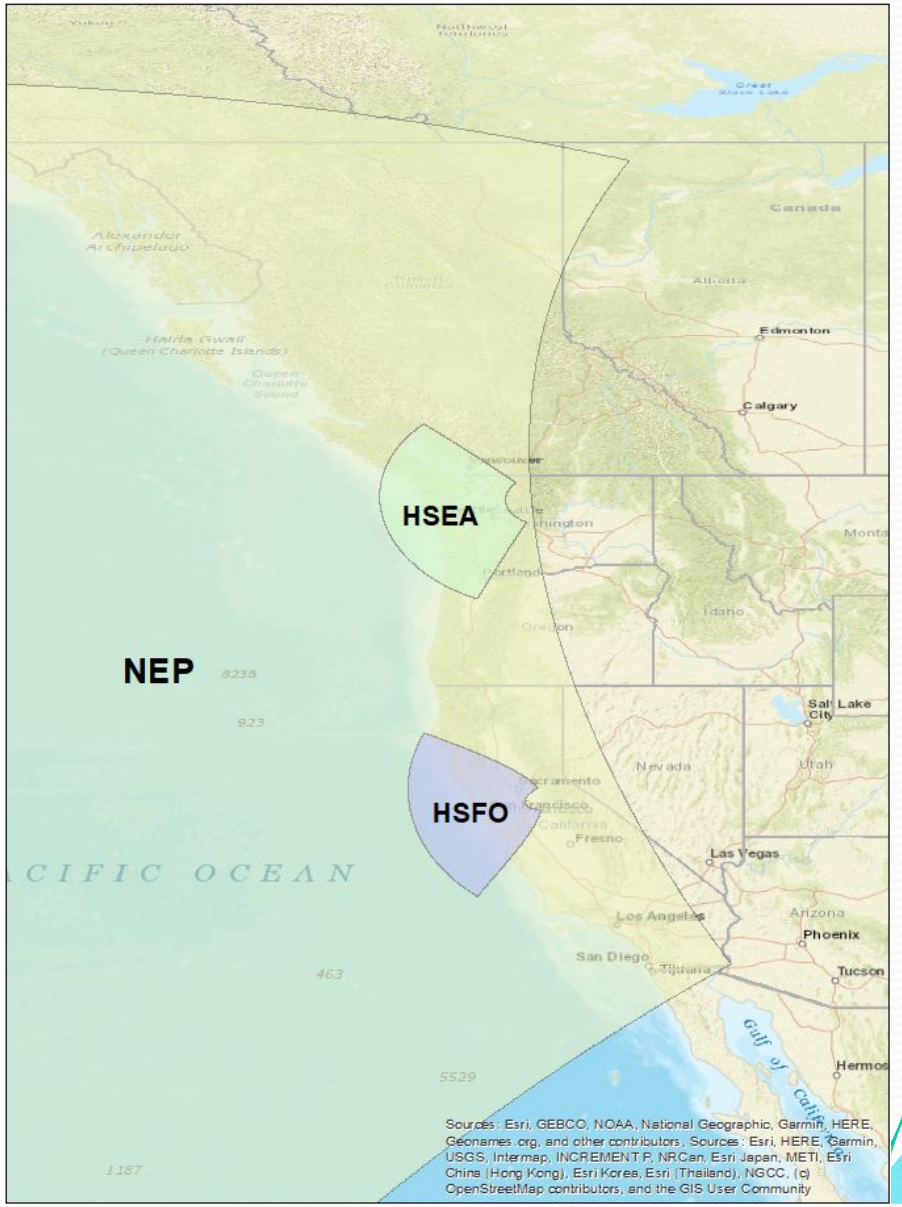
Proposed Upgrades P-ETSS v1.4

Technical Improvements:

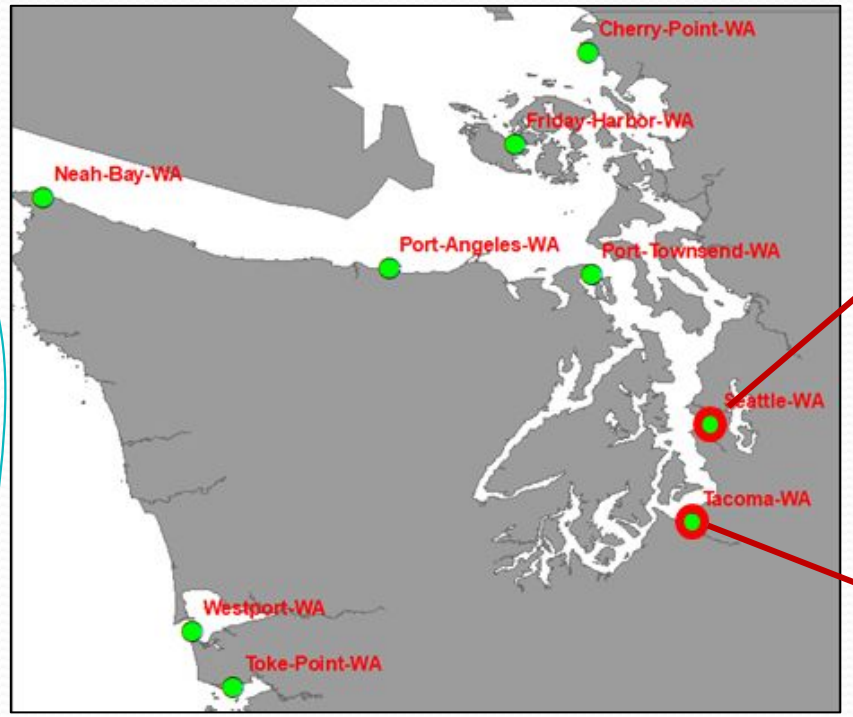
- T1. Improve the dataflow by operationally sending the model output images to the model's real-time website via an operational mechanism.
- T2. Various station changes including:
  - Correcting the National Weather Service Location Identifier for Naples, FL
  - Adding stations at: Bogue Sound on Emerald Isle, NC; Pamlico River at Washington, NC; Ponce Inlet, FL; and Ft Pierce Inlet, FL
  - Removing four temporary stations in favor of permanent stations at Kwigillingok, AK; Nelson Lagoon, AK; Seavey Island, ME; and Tangier Island, VA
  - Removing 12 National Data Buoy Center (NDBC) buoy stations off the west coast and Gulf of Alaska

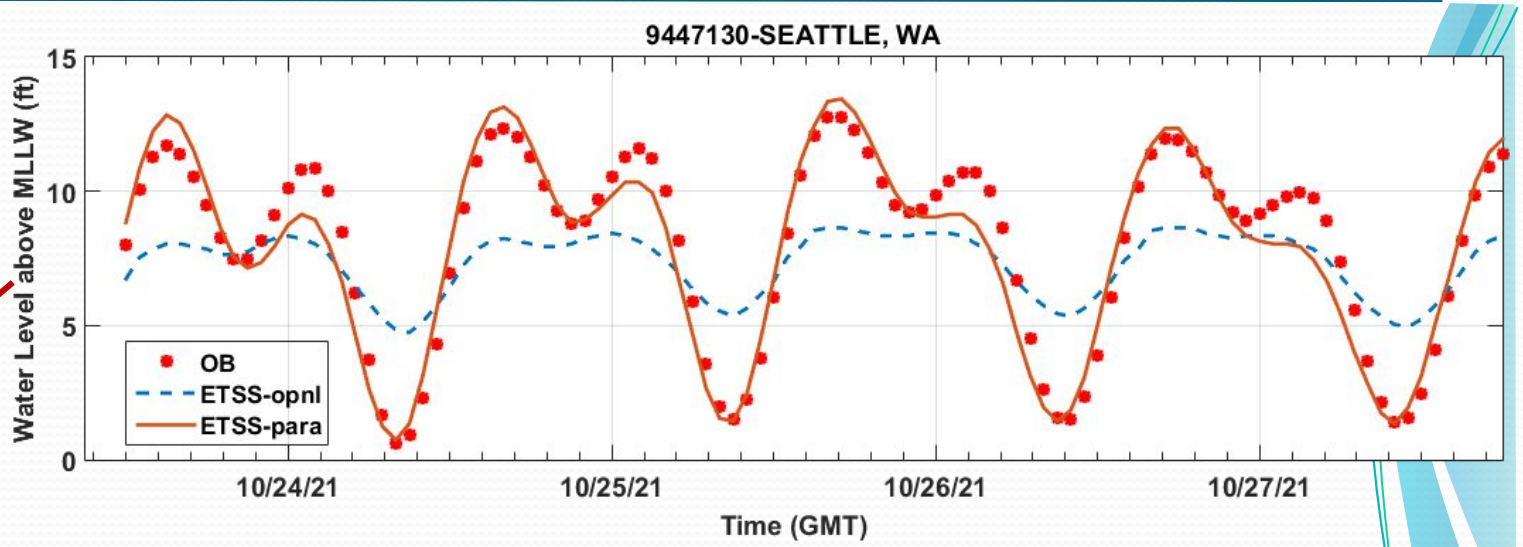
S1. West Coast Nested Basins

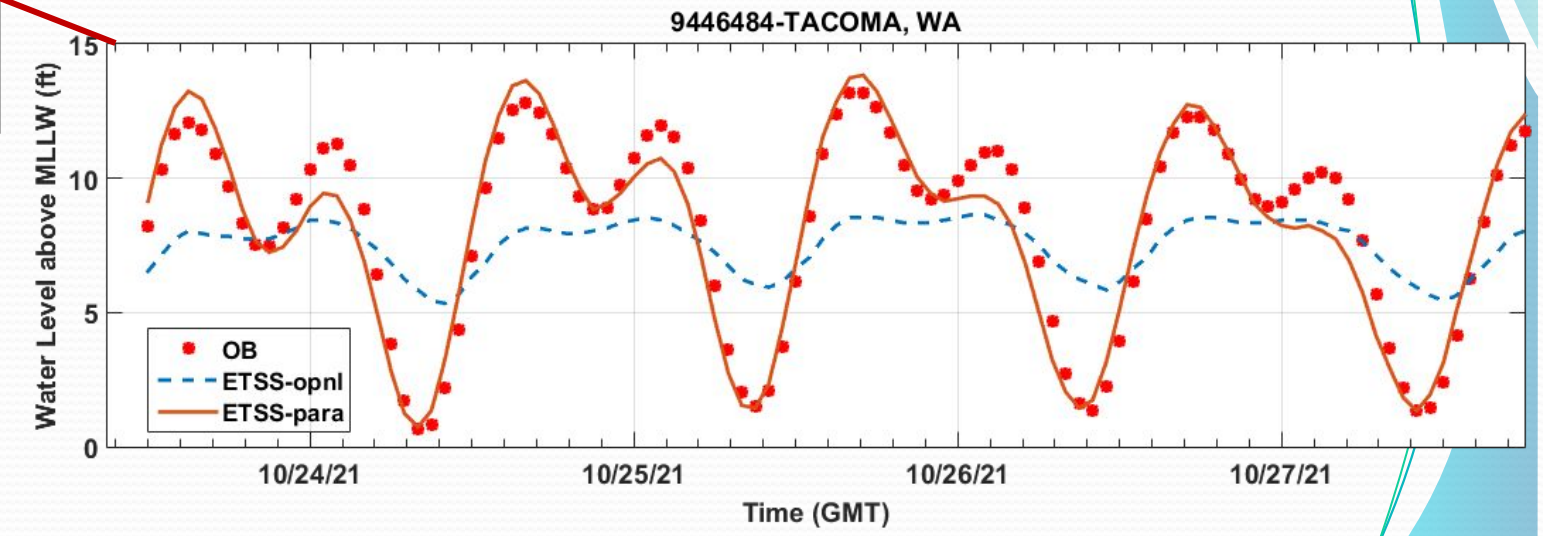
Nest two higher resolution basins (i.e., computational domains) for Seattle, WA (HSEA) and San Francisco, CA (HSFO) within the U.S. West Coast basin (NEP).



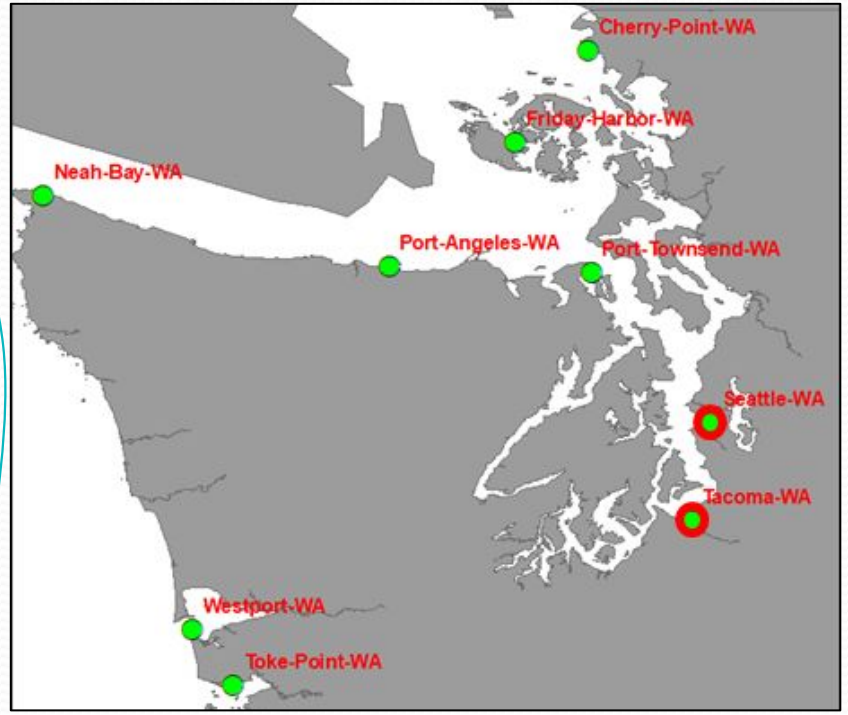
Seattle (HSEA) Oct. 24 to 27, 2021
Performance at Sample Stations

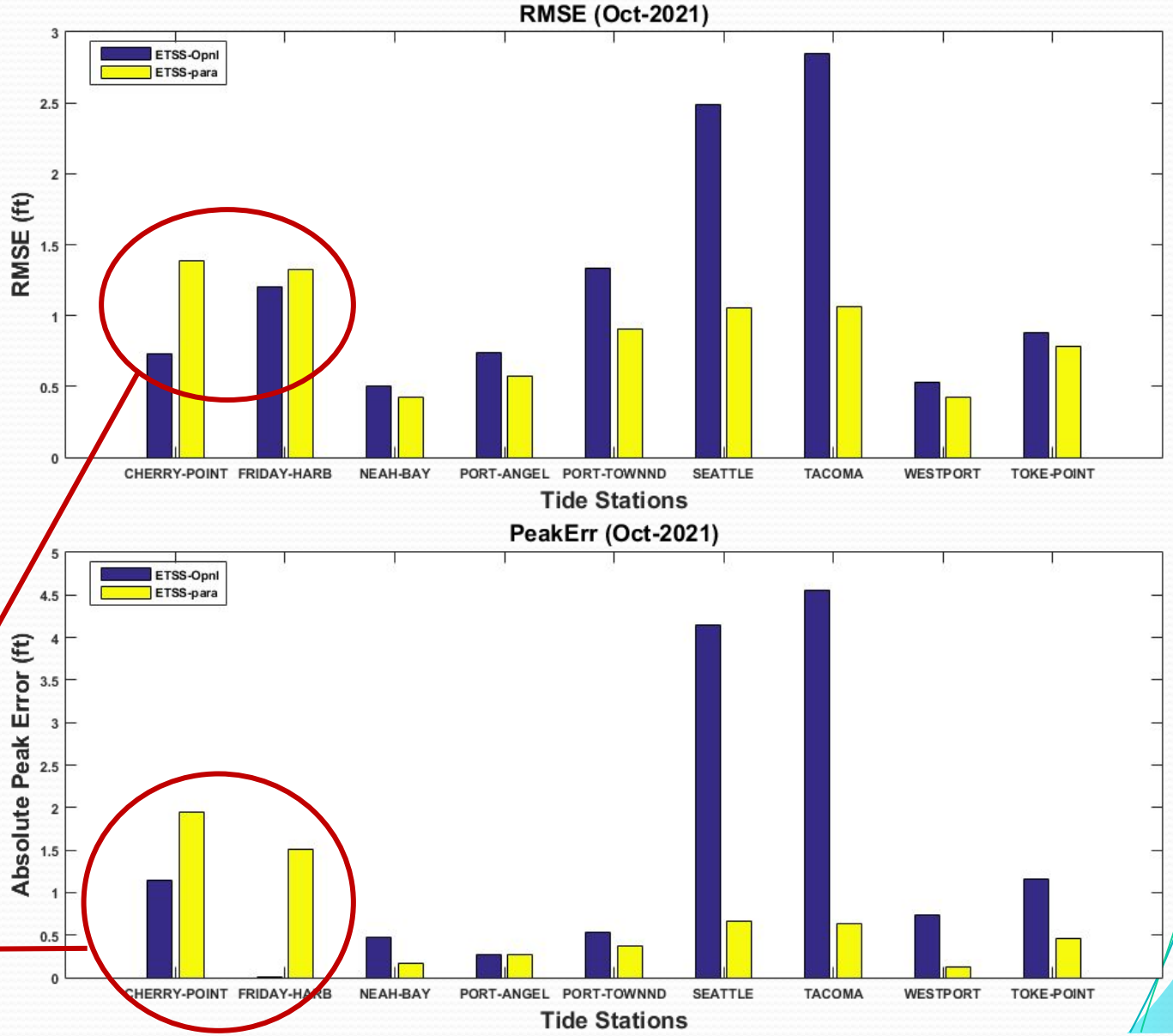






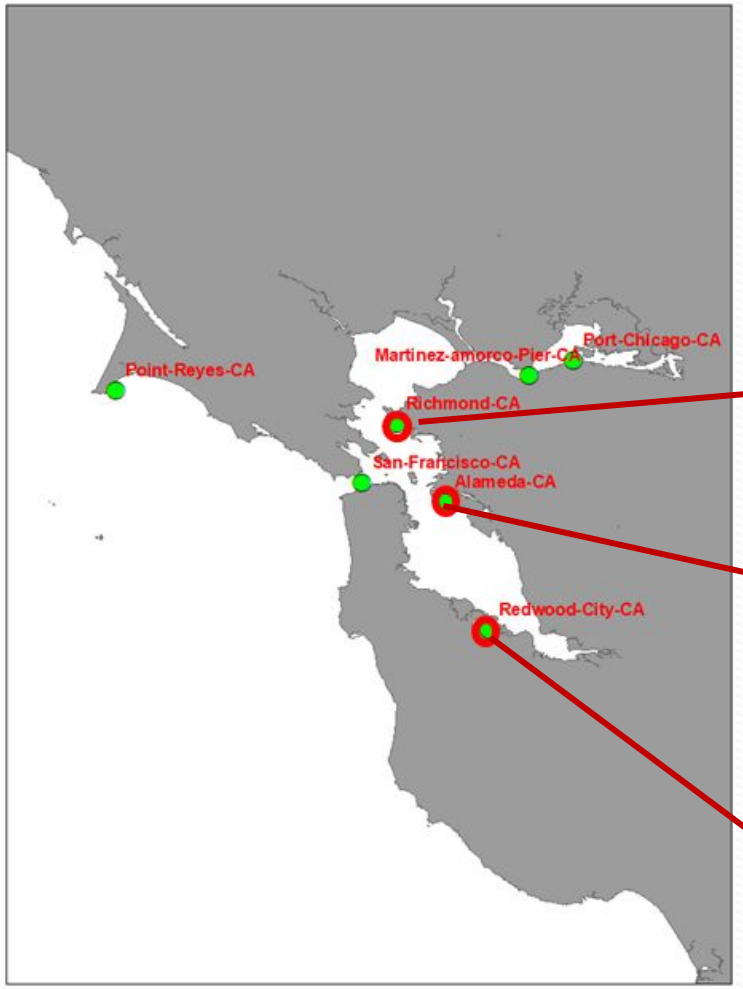
Seattle (HSEA) Oct. 24 to 27, 2021
Performance: RMSE and Absolute Peak Error

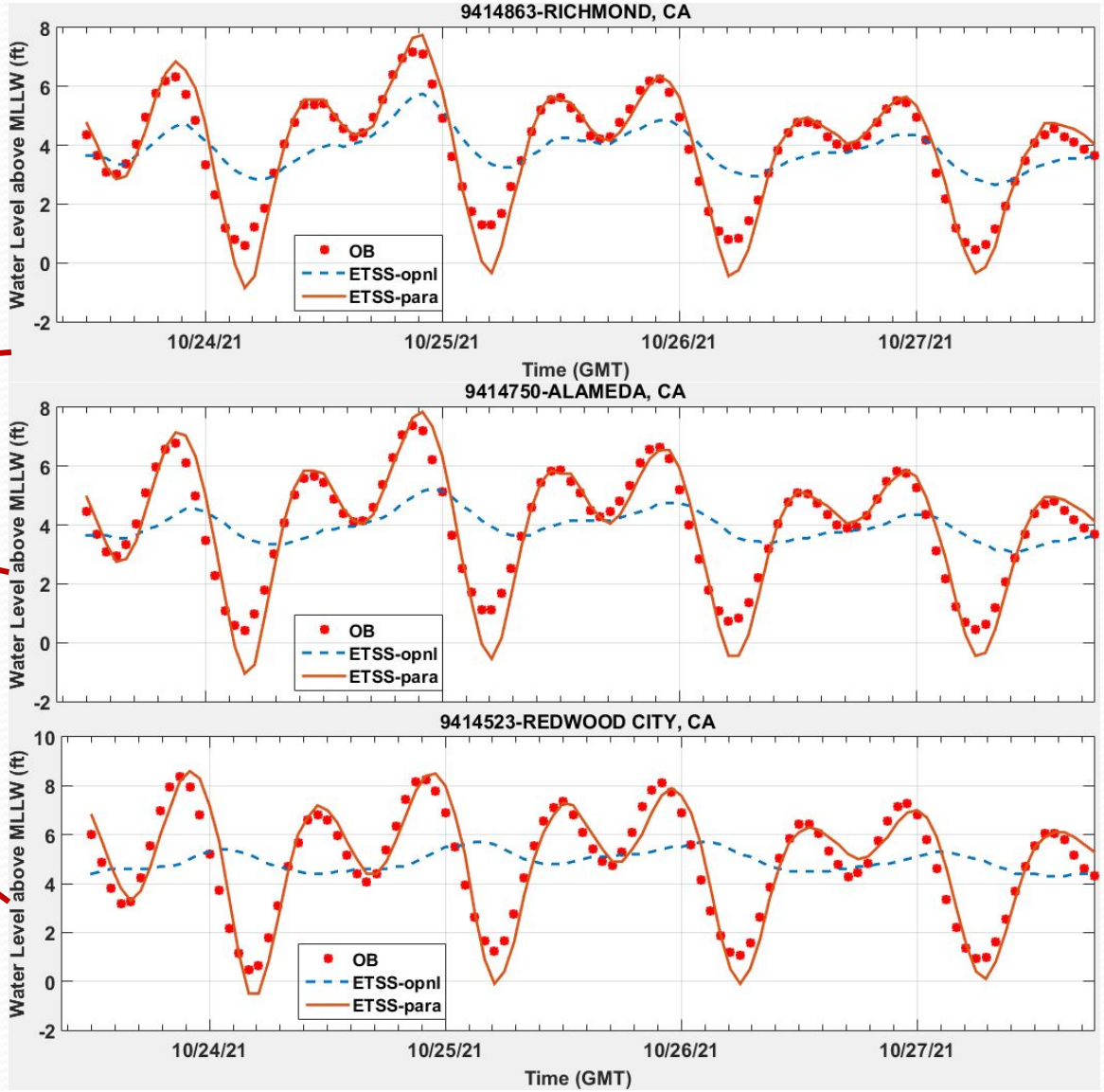




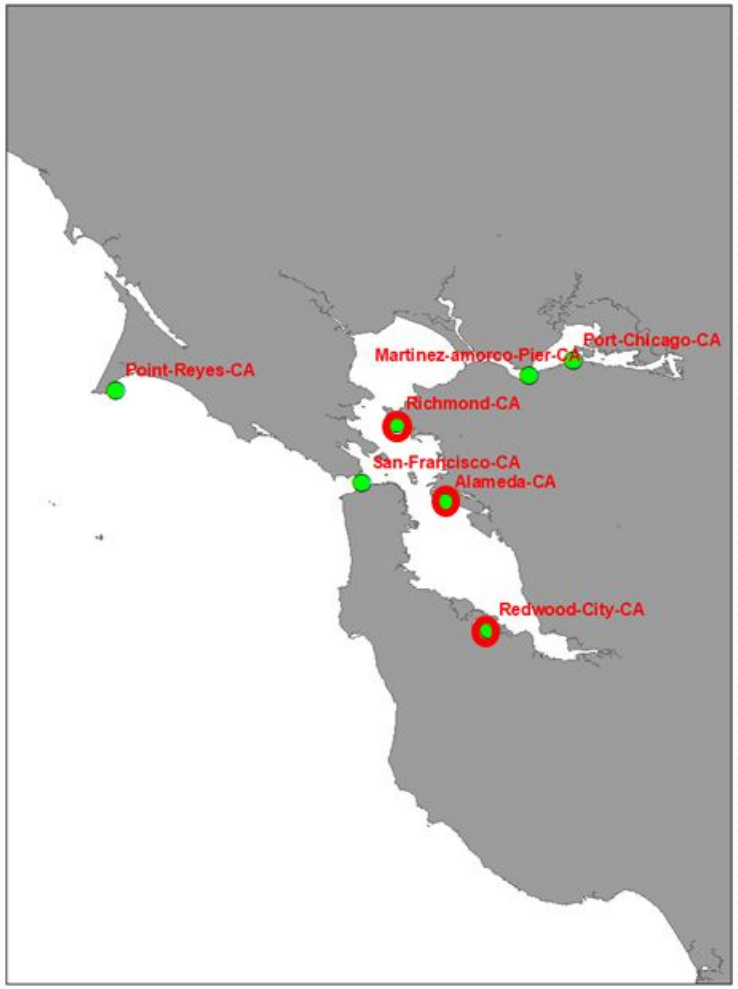
Note: The use of HSEA and the ENPAC-15 tidal constituents improve the surge surge guidance **overall**, however there is some degradation at Cherry Point and Friday Harbor. Strategies to mitigate this will be investigated for a future implementation.

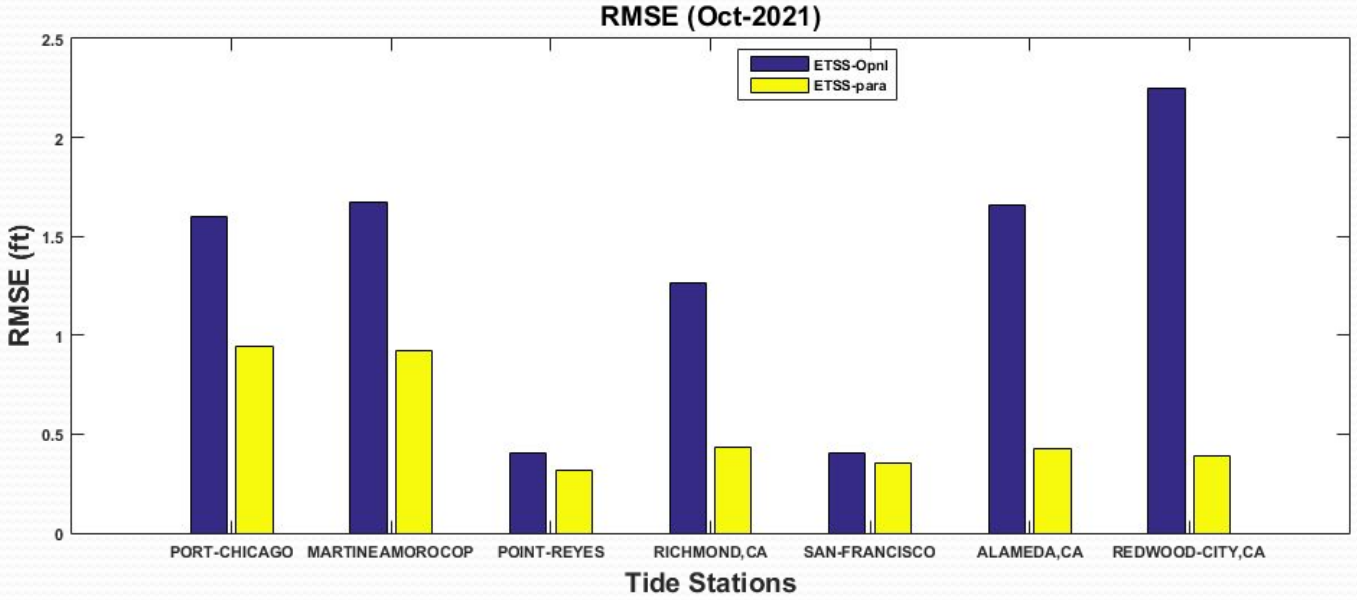
San Francisco (HSFO) Oct. 24 to 27, 2021
Performance at Sample Stations

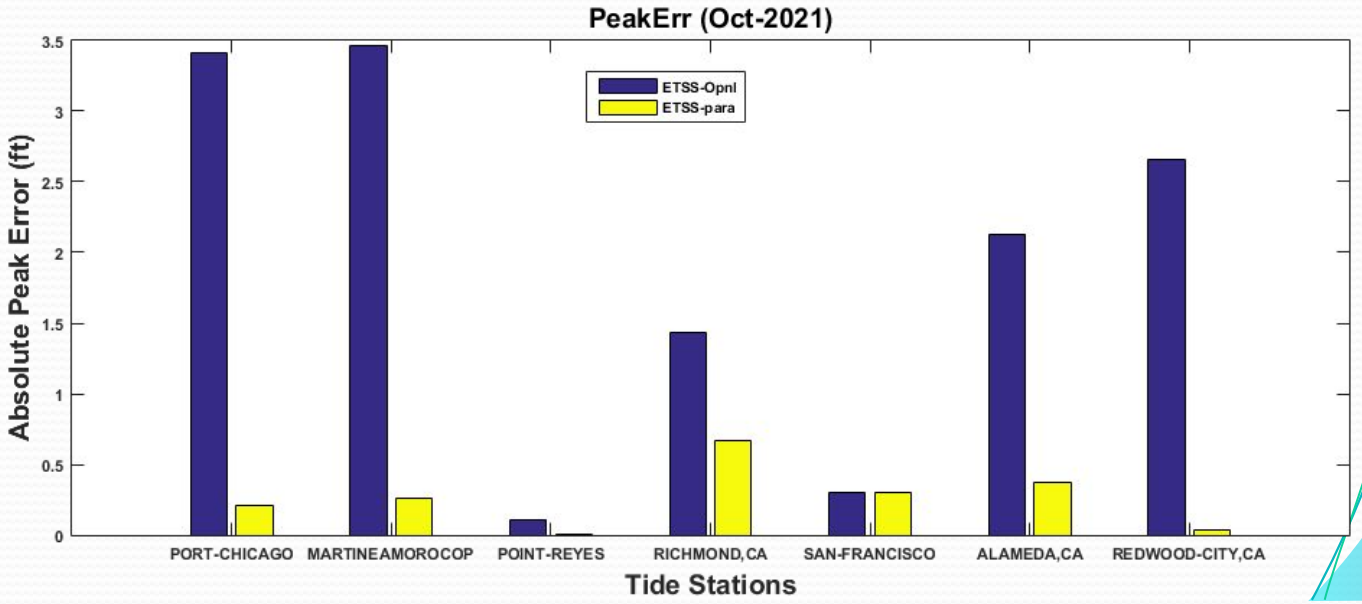




San Francisco (HSFO) Oct. 24 to 27, 2021 Performance: RMSE and Absolute Peak Error



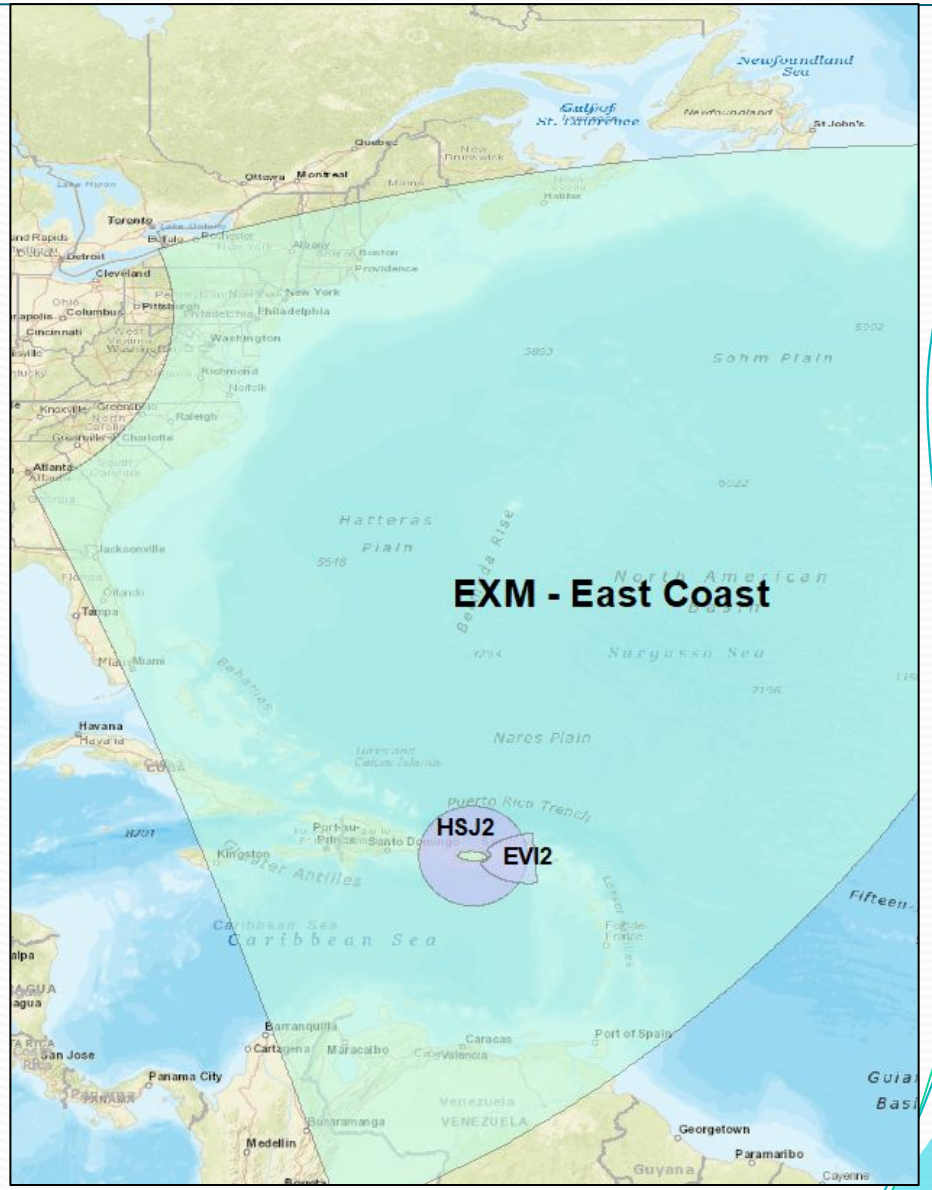




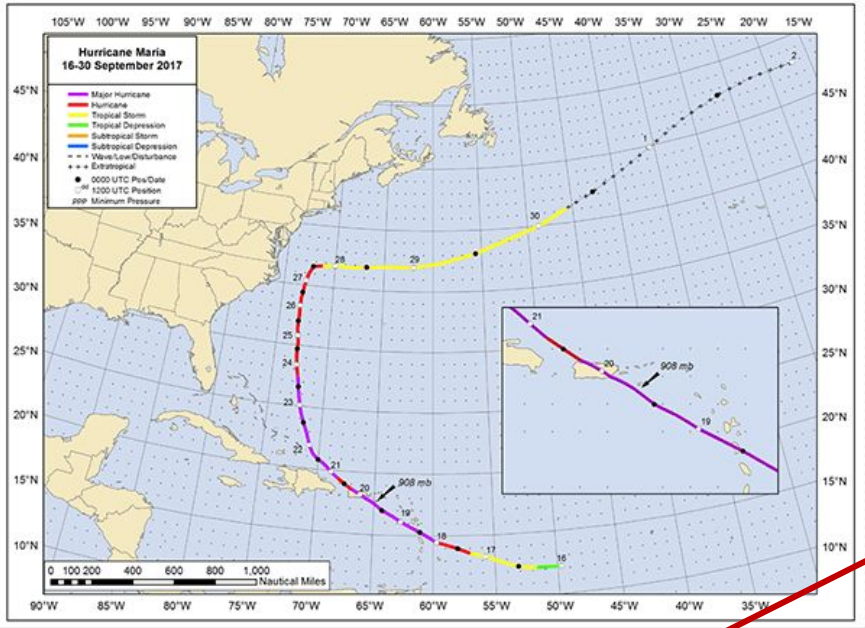
S2. Puerto Rico and U.S. Virgin Islands Basins

Nest two higher resolution basins for Puerto Rico (HSJ2) and the U.S. Virgin Islands (EVI2) within the U.S. East Coast basin (EXM)

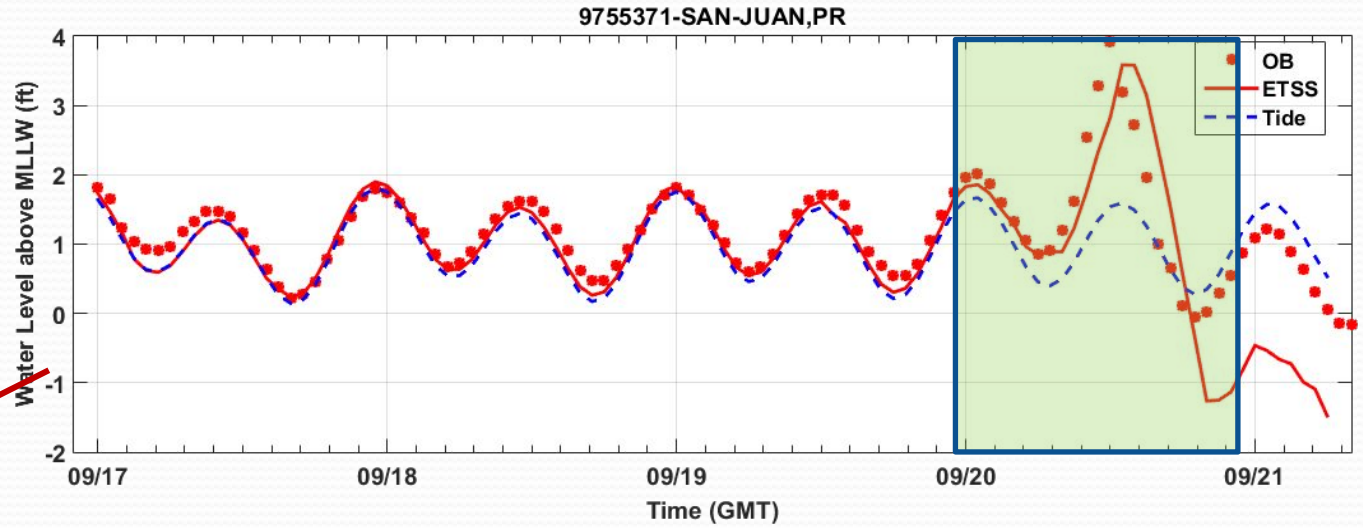
This will enable the model to produce surge + tide calculations, but it will not consider wave-setup. Therefore, in tropical cyclone storm surge situations in the Puerto Rico and the U.S. Virgin Islands domain, users will get a more accurate account of inundation by using the Probabilistic tropical cyclone storm Surge (P-Surge) model compared to P-ETSS.

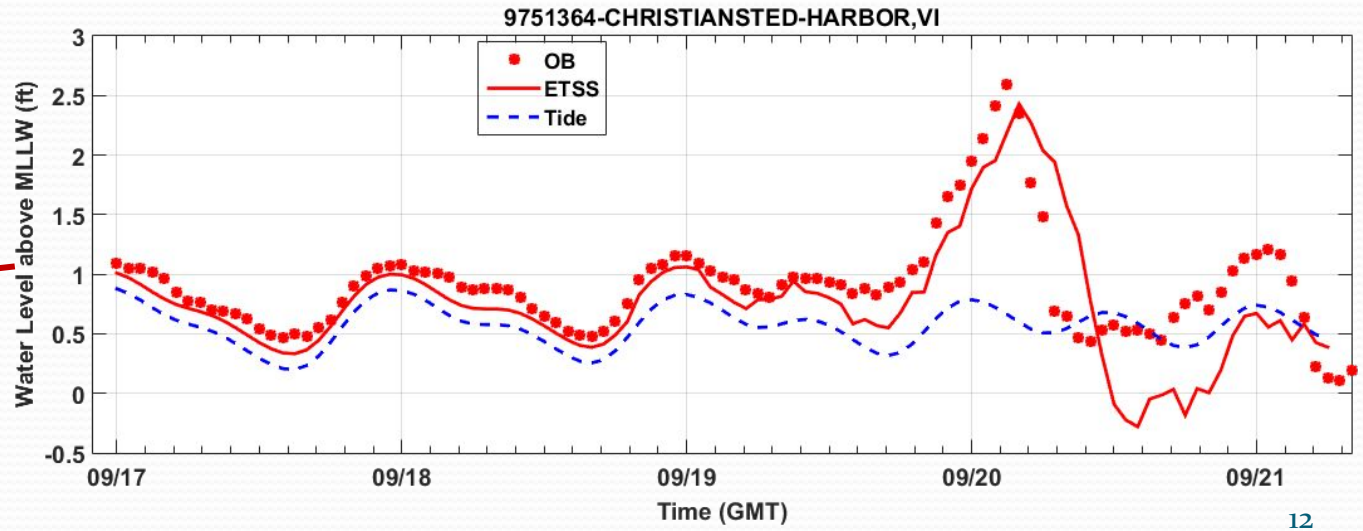


Puerto Rico (HSJ2) and U.S. Virgin Islands (EVI2) Performance: Hurricane Maria-2017 at Sample Stations

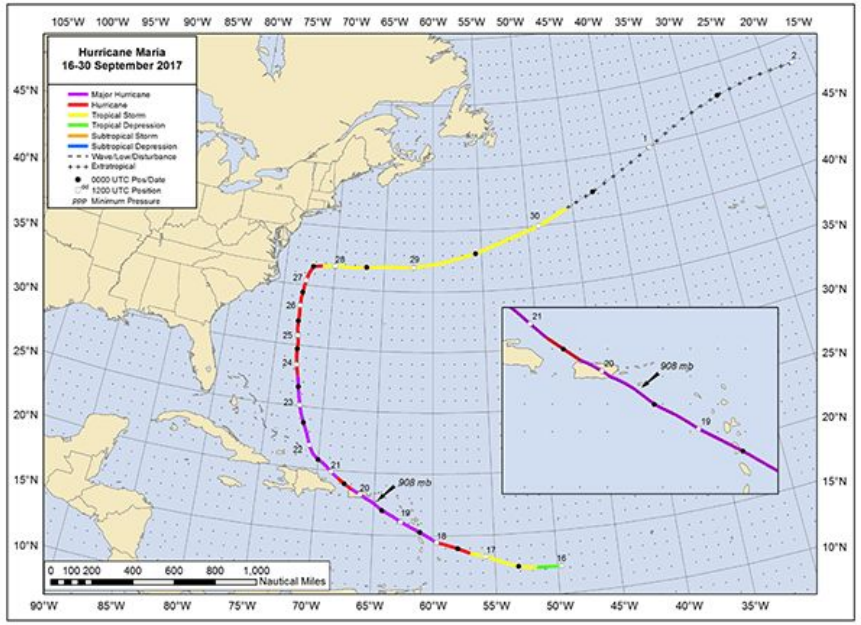


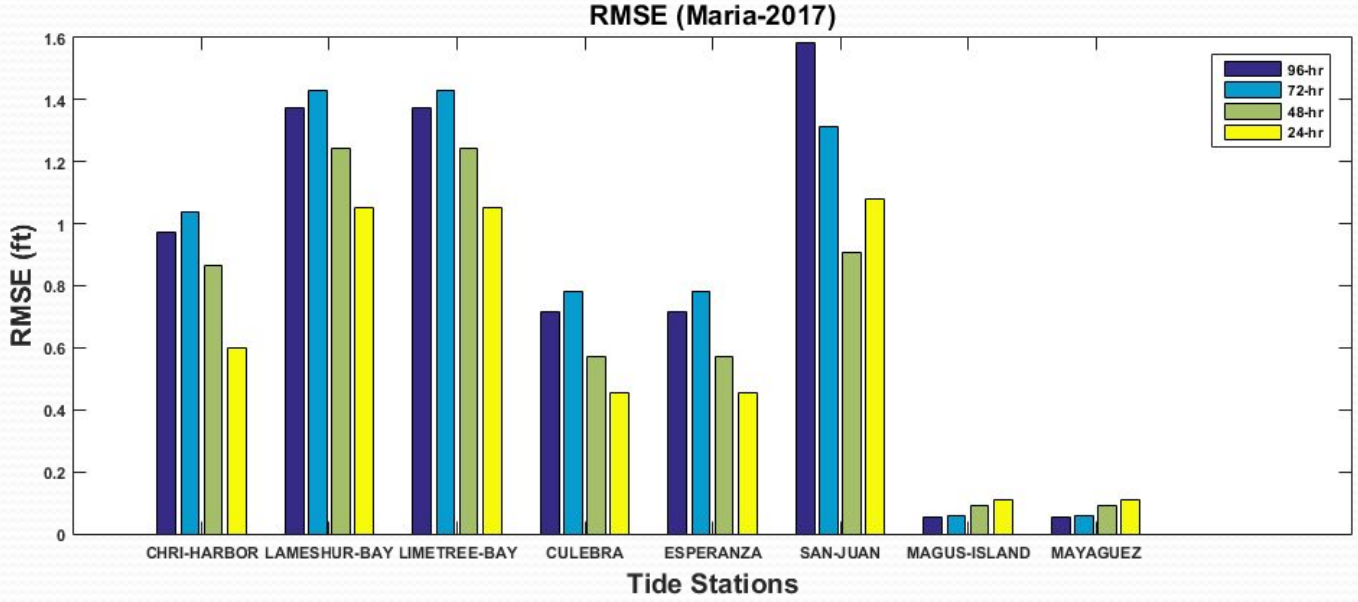
Landfall Sep 20 to Sep 21, 2017

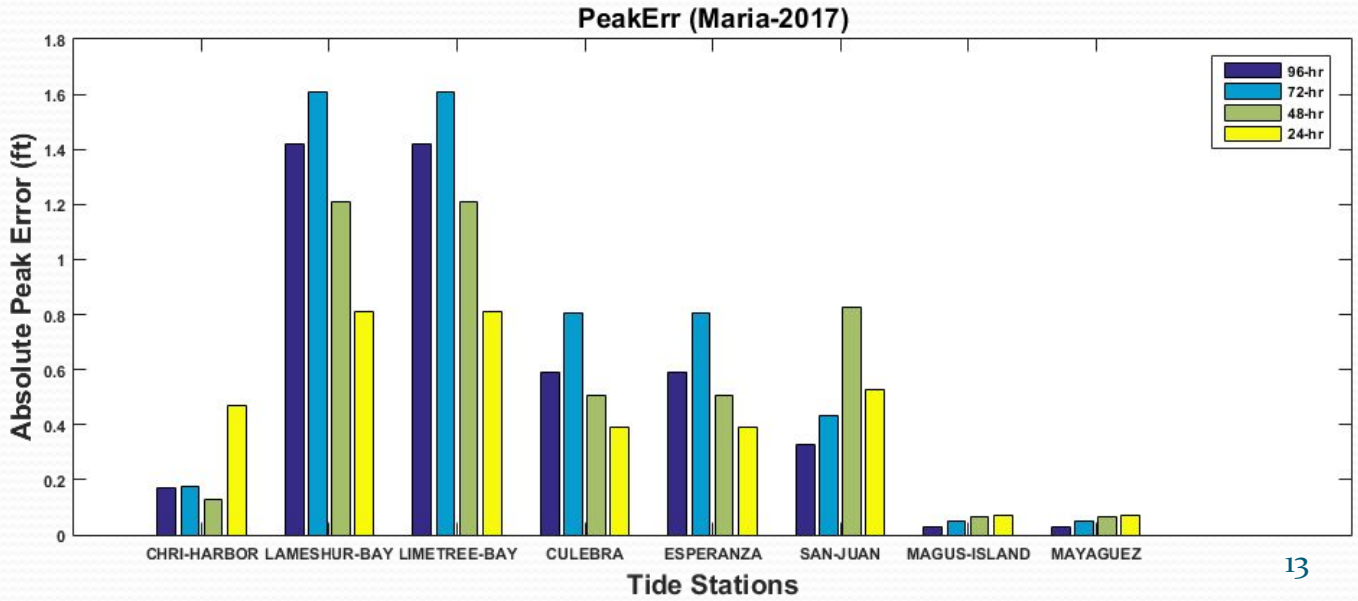




Puerto Rico (HSJ2) and U.S. Virgin Islands (EVI2) Performance: Hurricane Maria-2017 RMSE and Abs. Peak Error



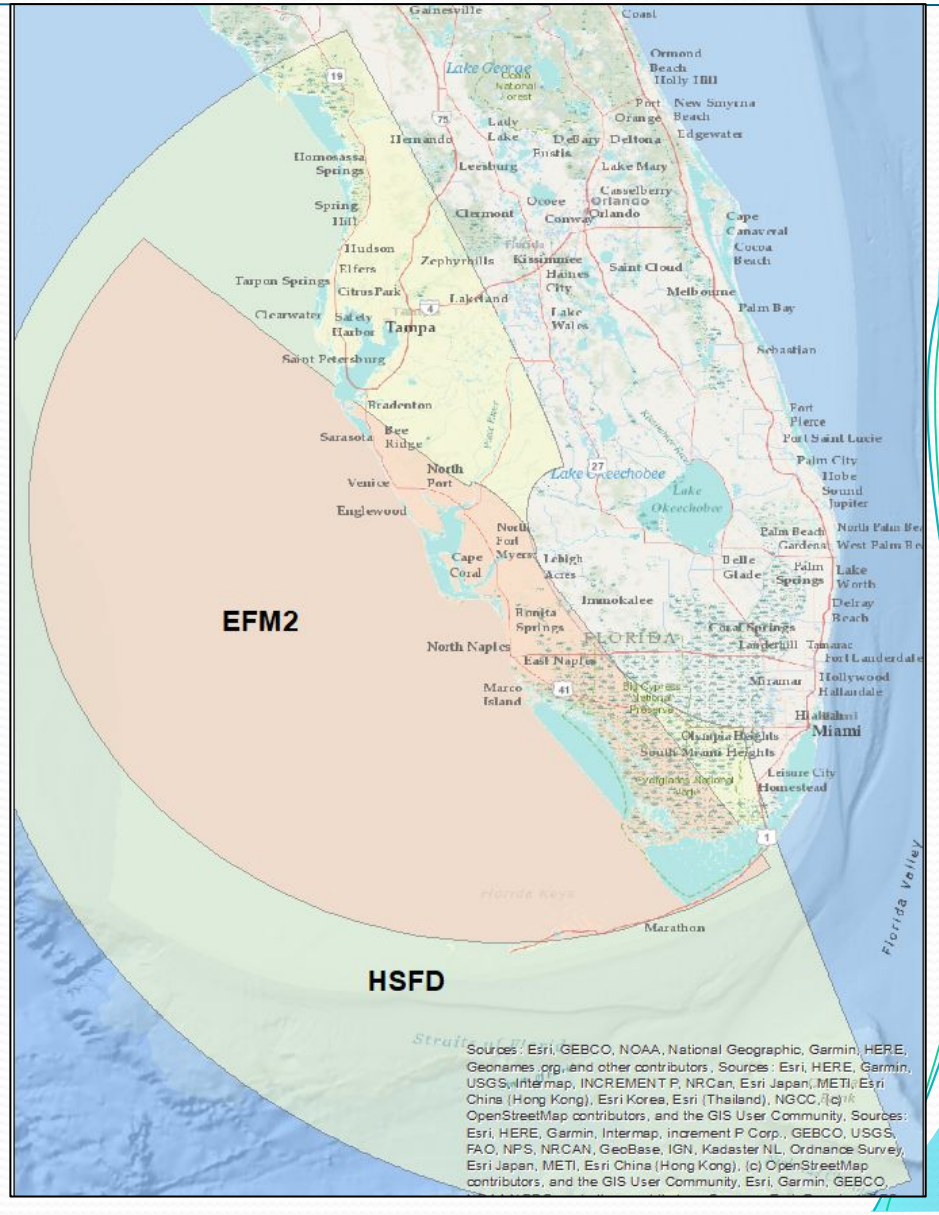




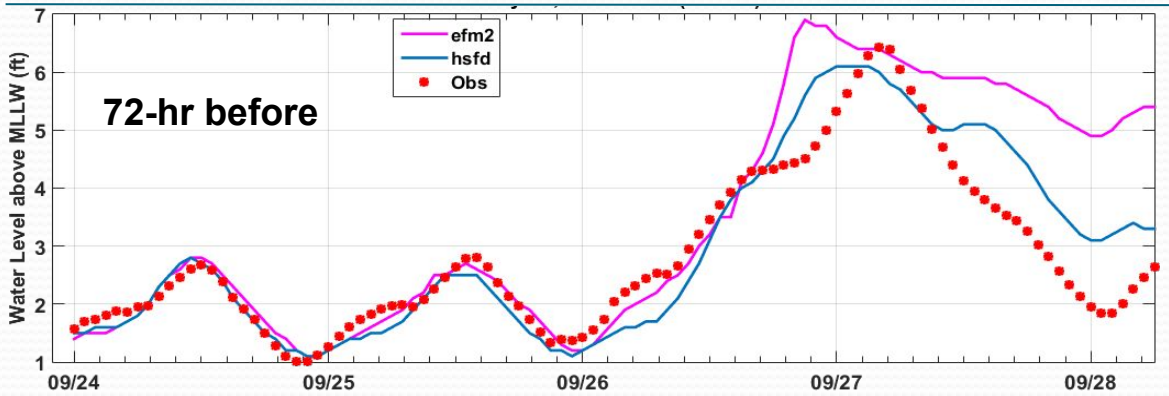
S3. Upgrade Fort Myers, FL Basin

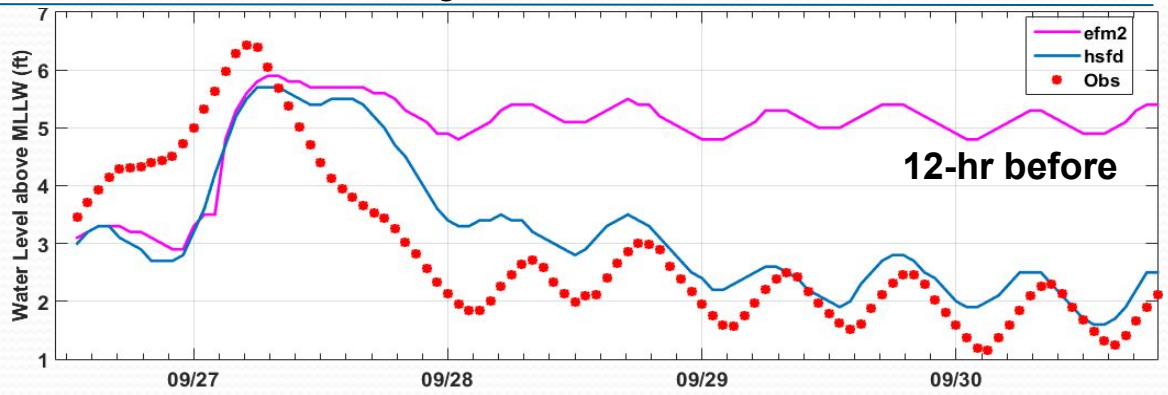
Upgrade Fort Myers, FL basin from (EFM2) to (HSFD)

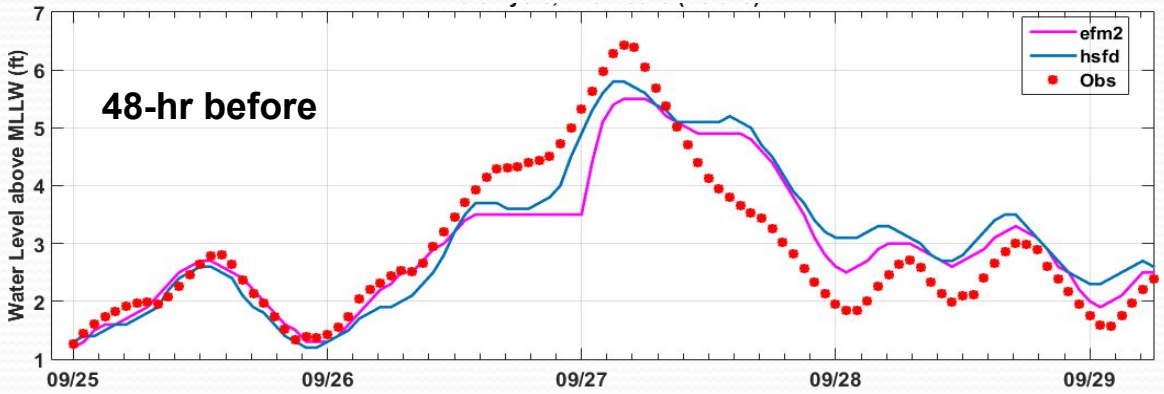
- Probabilistic tropical cyclone storm Surge model currently uses HSFD

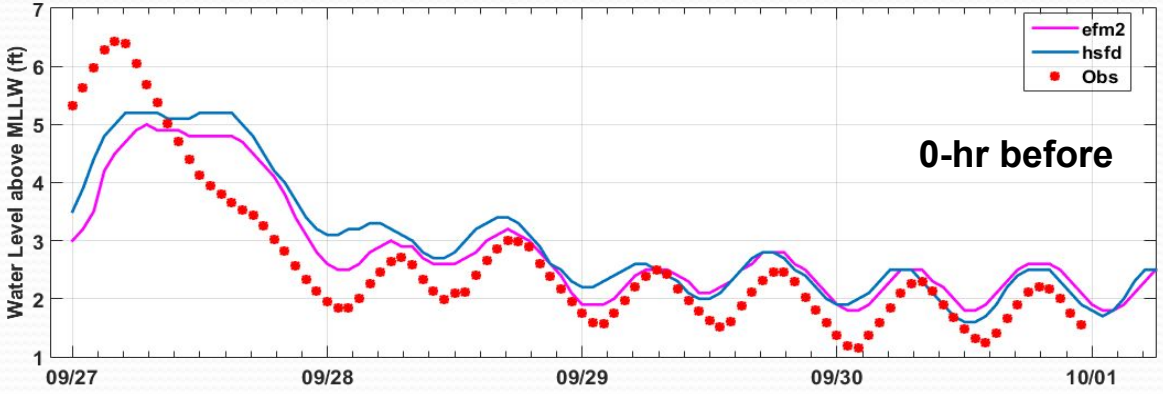


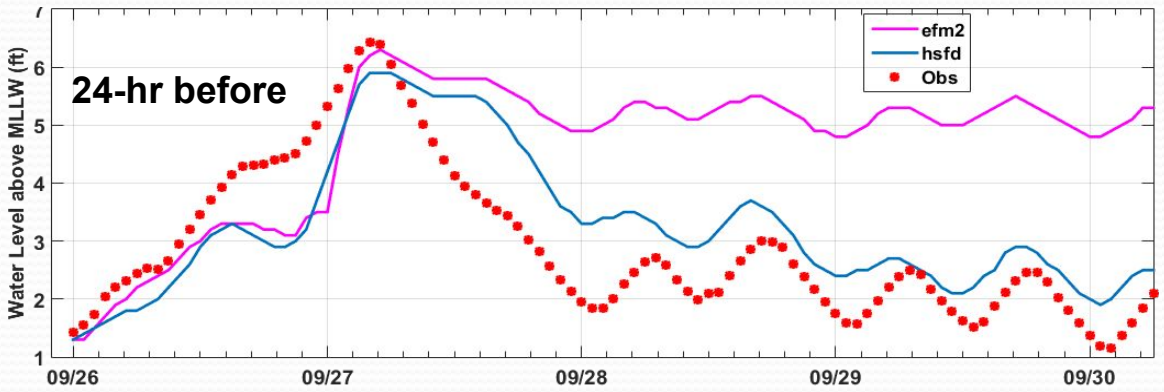
HSFD (new) vs EFM2 (original)
Hurricane Helene-2024 at Fort Myers, FL





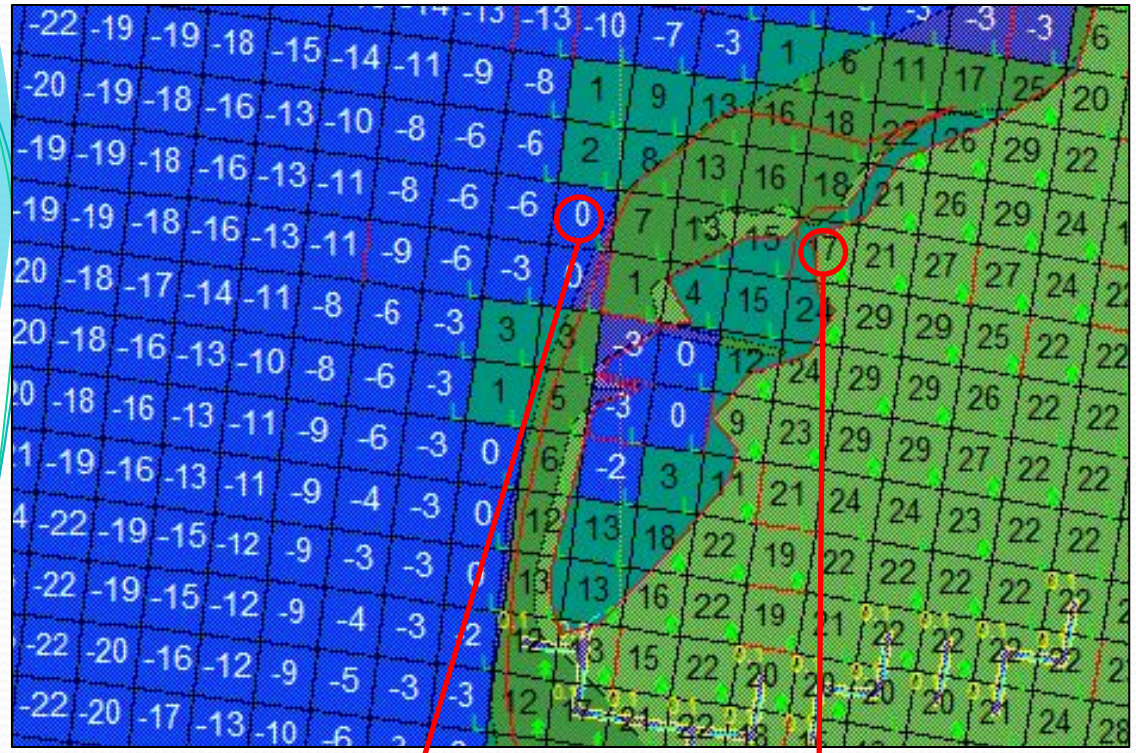


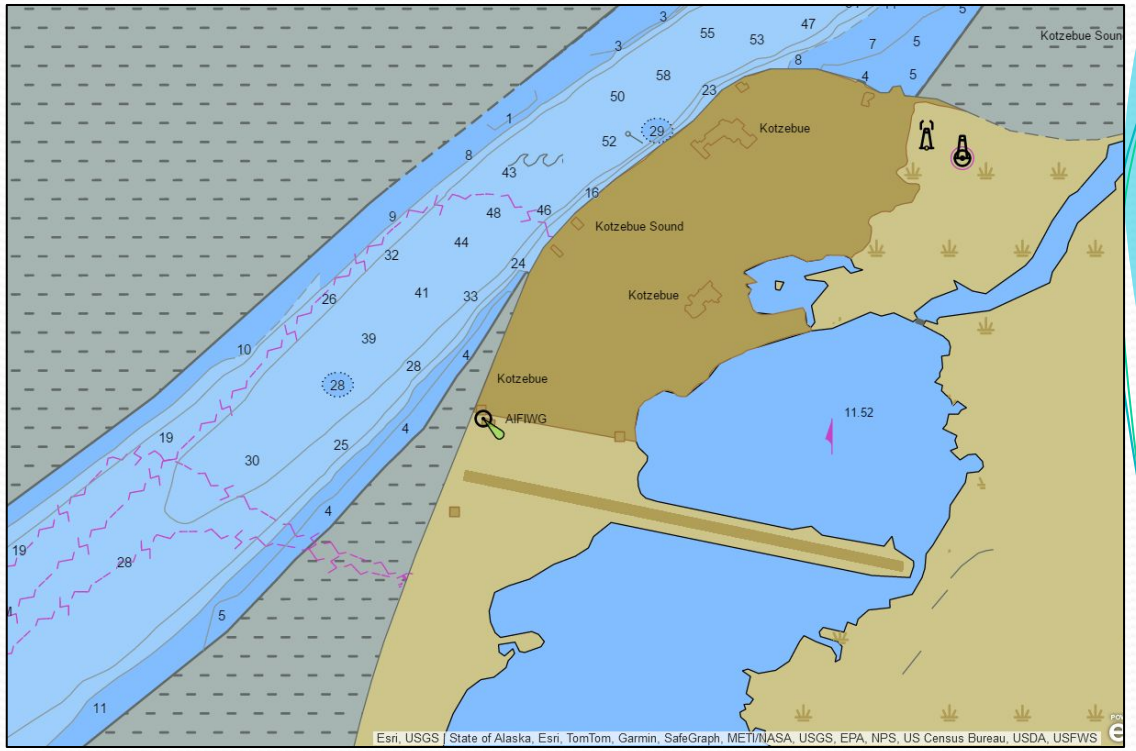




S4.a Improve the Basin Used for Kotzebue, AK

Original Kotzebue basin (left) vs CO-OPs Navigation chart (right)



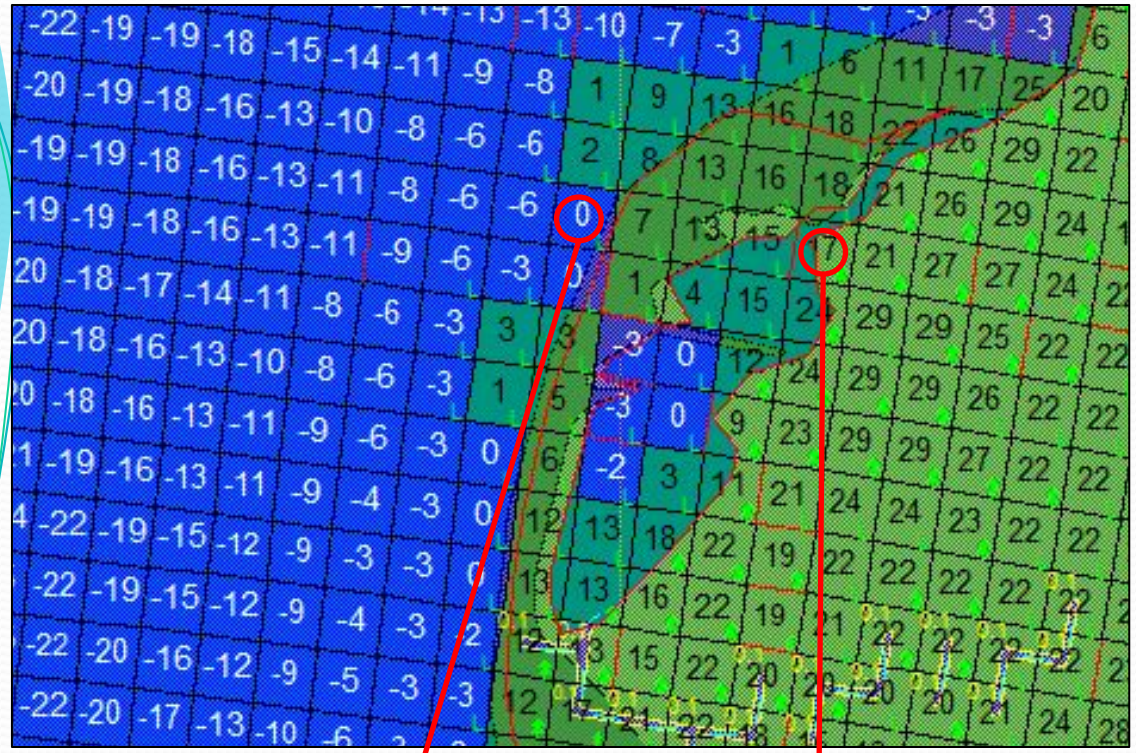


Location of model output

Actual station location

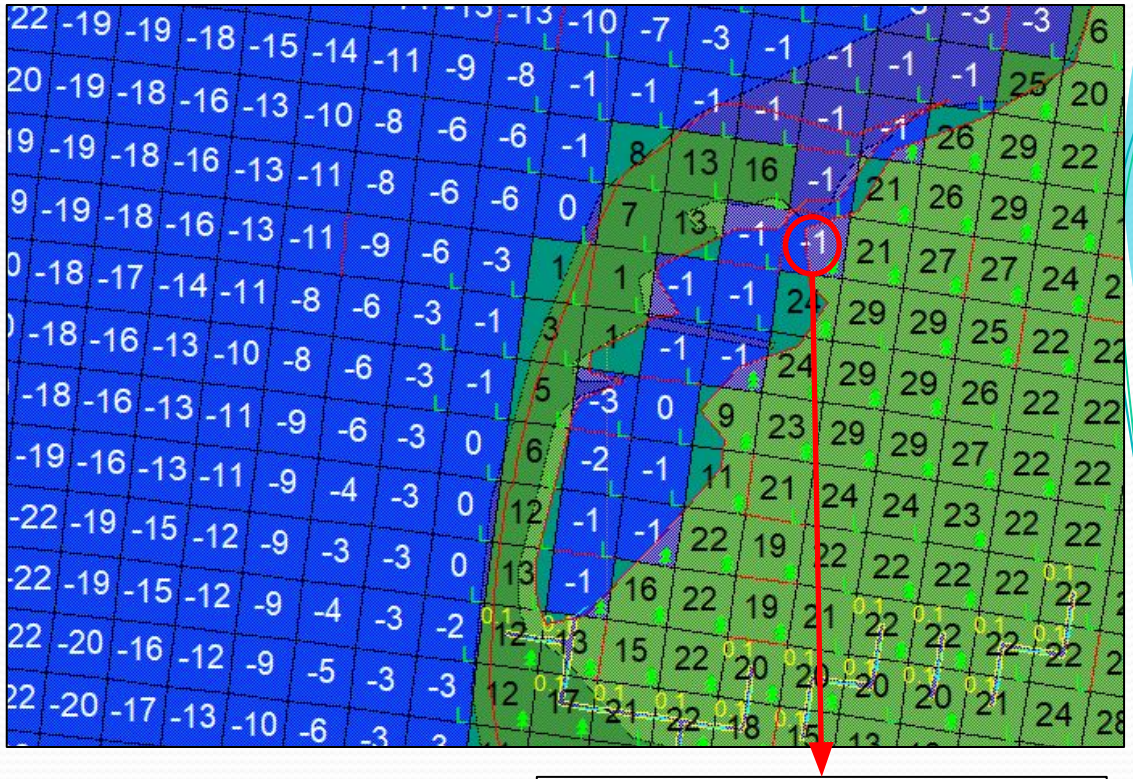
S4.a Improve the Basin Used for Kotzebue, AK

Original Kotzebue basin (left) vs Modified Kotzebue basin (right)



Location of model output

Actual station location



Location of model output and station location

S4.b Bug Fix: Remove Influence of Neighboring Basin on Kotzebue Station Guidance

- Results at stations covered by multiple basins are averaged
- Entries for Kivalina, Kotzebue, and Deering AK were accidentally copied into a neighboring basin's control file, which maps the station to a basin grid cell
- In the neighboring basin
  - Kivalina and Deering's bad grid cell forecasts were always dry so didn't impact their average
  - Kotzebue's bad grid cell was in deep water so almost always forecast a small non-zero value
  - The average of Kotezbue's good value and a small non-zero value from the neighboring basin resulted in dividing Kotzebue's guidance in half

S4.b Bug Fix: Kotzebue Station Guidance Oct 22, 2024 Storm

Obs: 6.5 feet MHHW

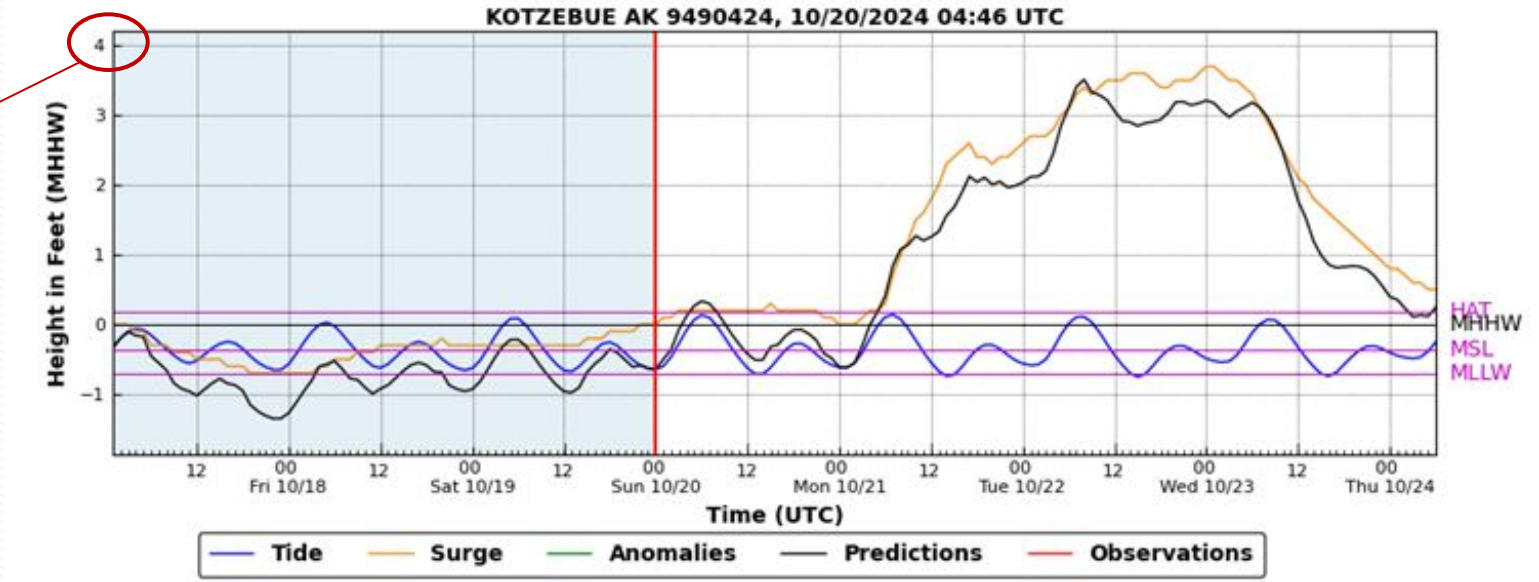
Original

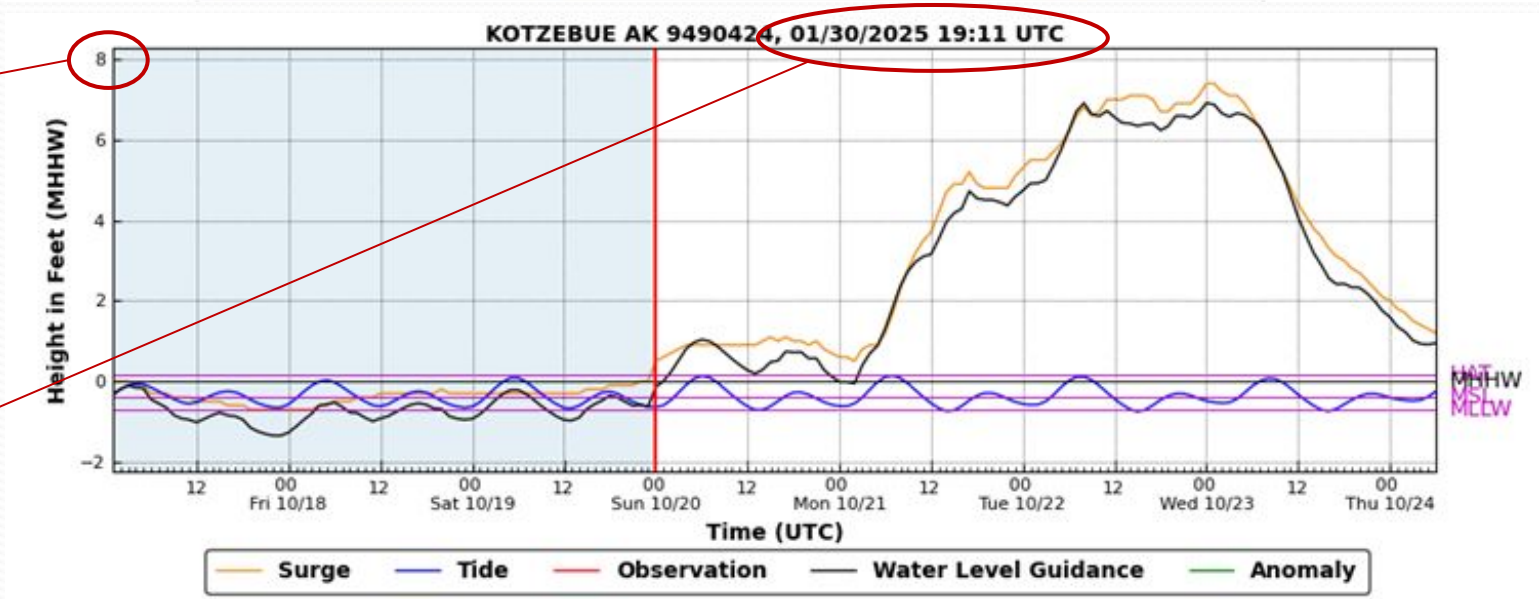
- 3 to 4 feet MHHW
- Under-Forecast

New

- 6 to 8 feet MHHW
- Fairly Good

Model was rerun on 1/30/2025



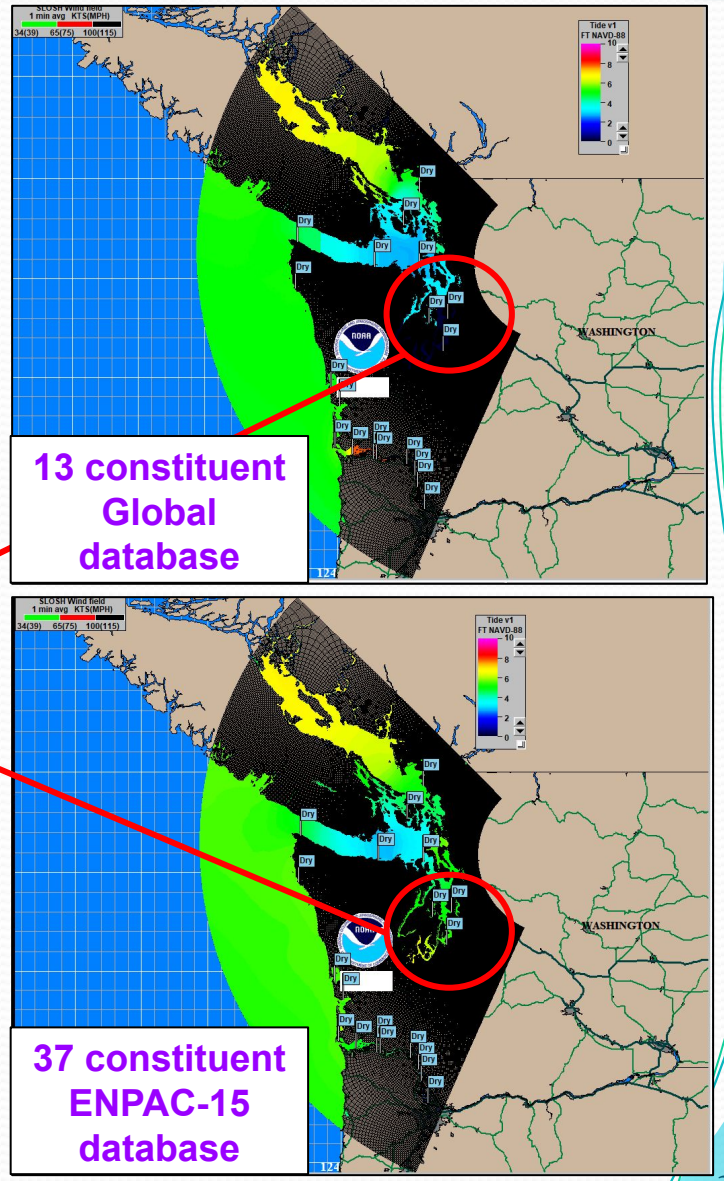


S5. Utilize 37 (vs 13) Tidal Constituents for the West Coast

For the West Coast: utilize 37 tidal constituents from the Eastern North Pacific ADCIRC (ENPAC) 2015 database vs 13 constituents from a global tide model

- Tides based on 37 tidal constituents out perform tides based on 13 tidal constituents

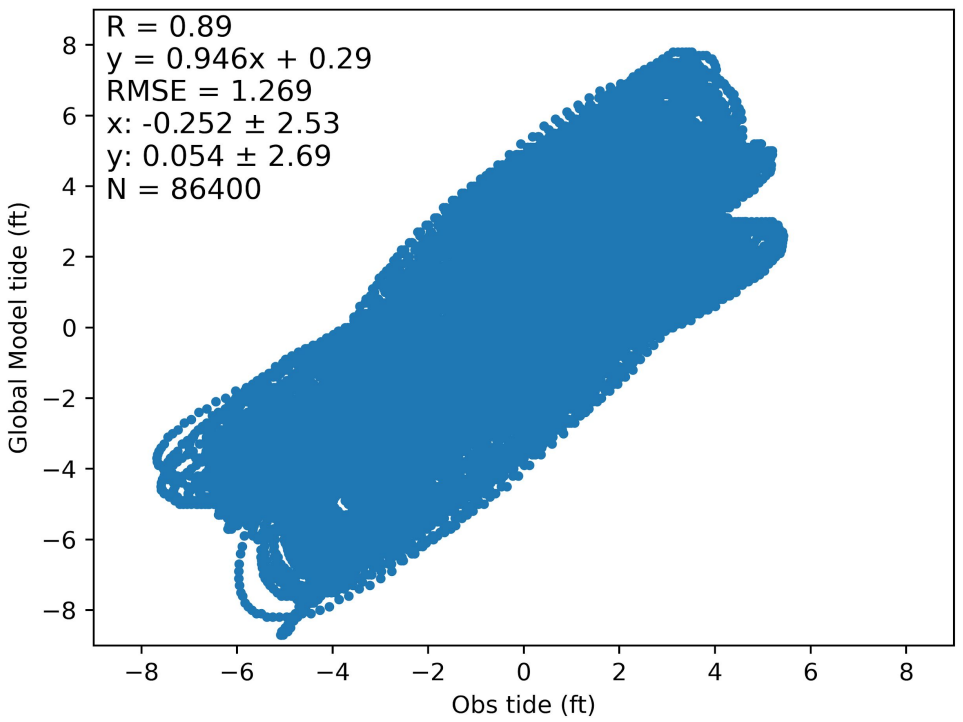
- The ENPAC-15 database produces tidal predictions further inland than the global tide model



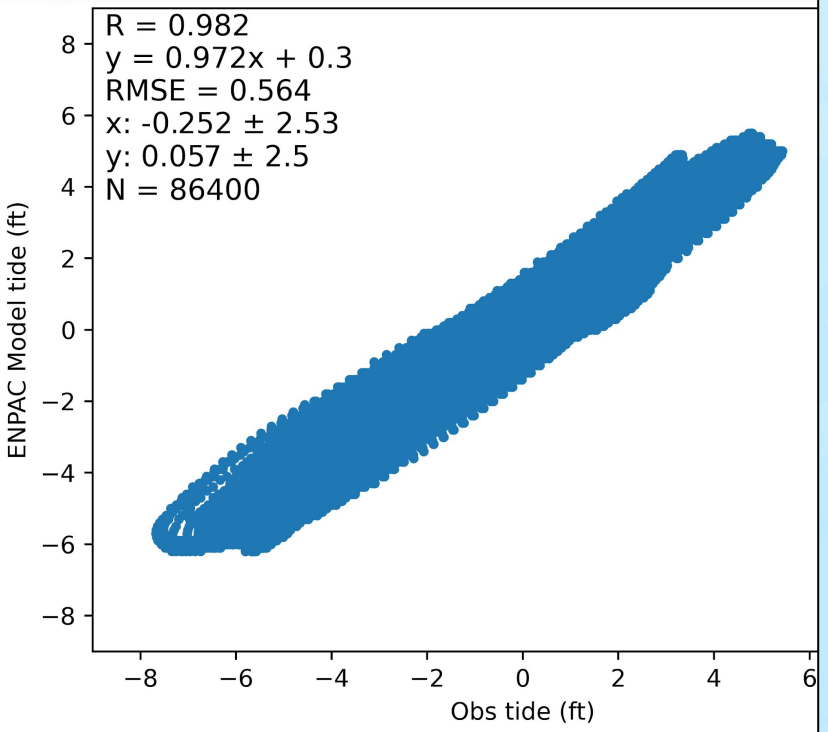
S5. Utilize 37 (vs 13) Tidal Constituents
Performance: Seattle (HSEA)

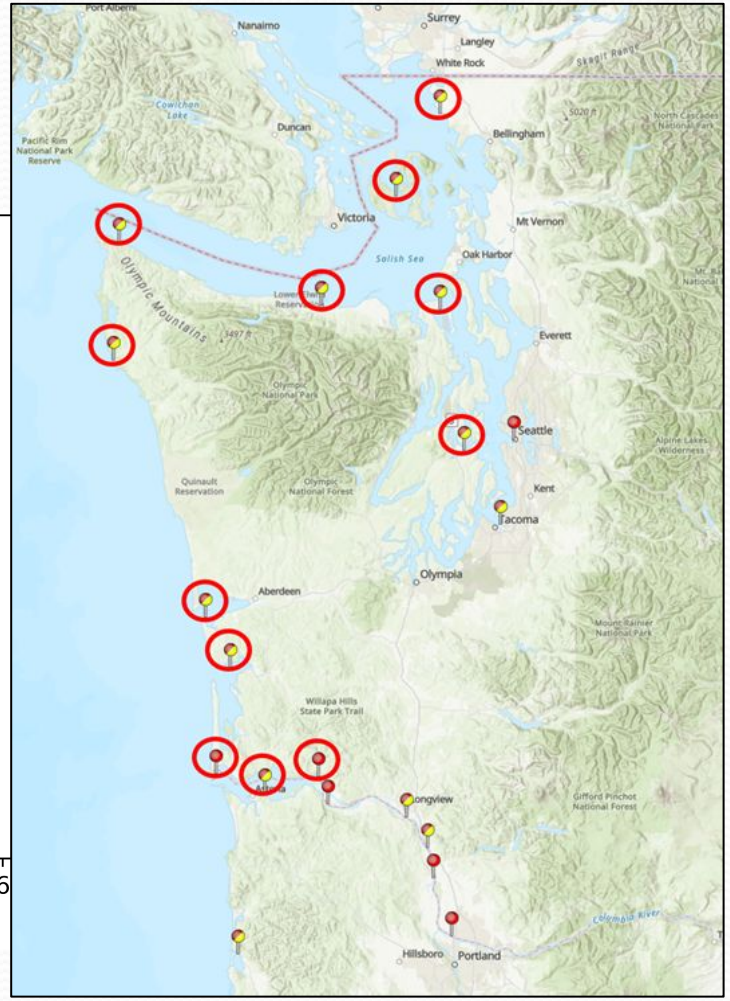
Sep 1-30, 2023: Only sites with non-dry/non-zero tides

Global: 13 constituents



ENPAC-15: 37 constituents

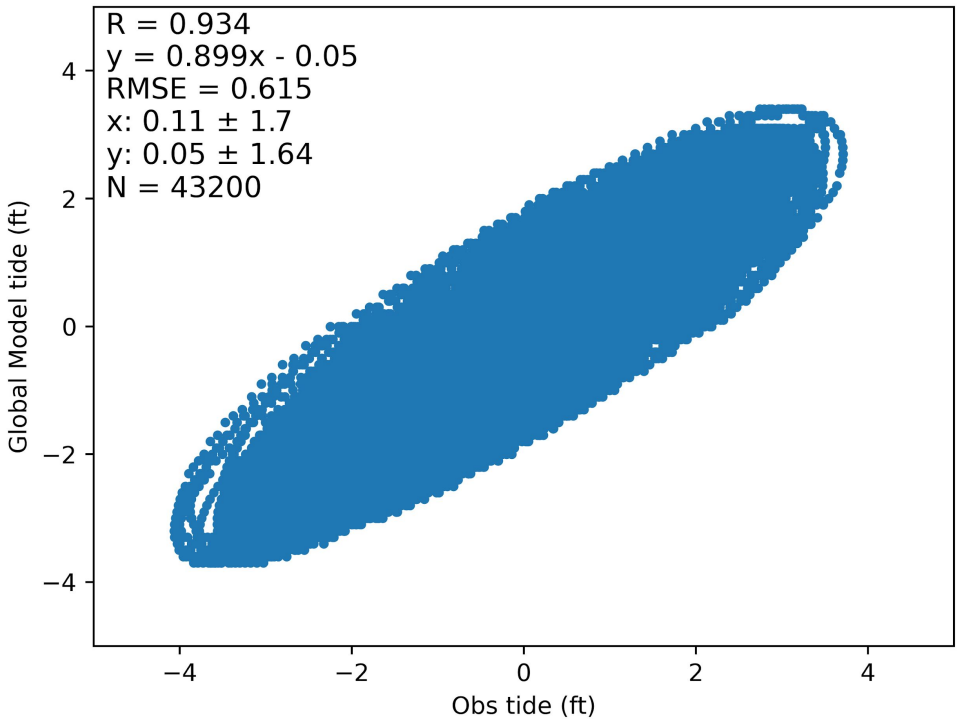




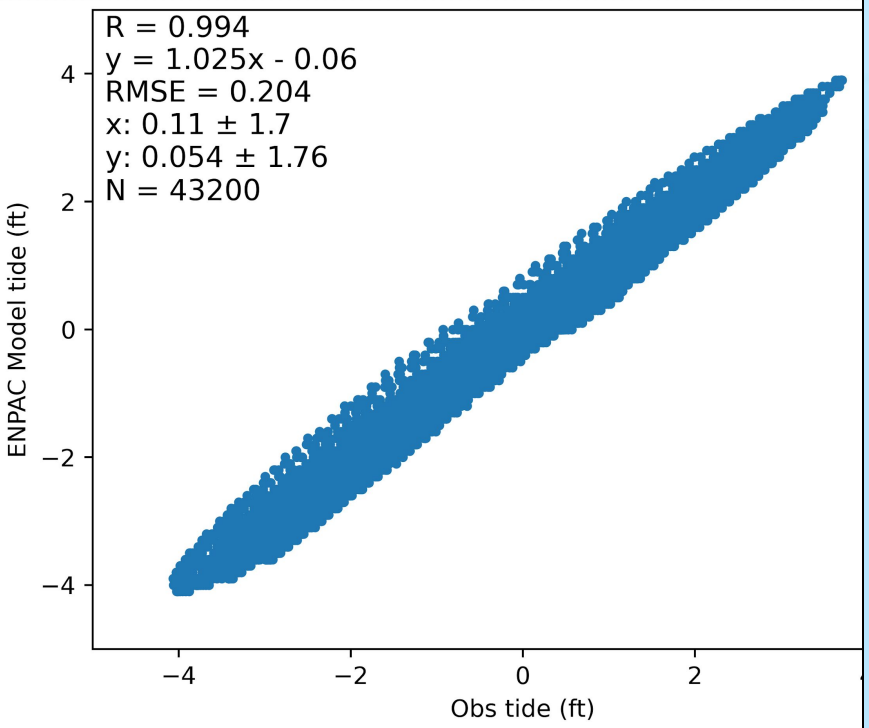
S5. Utilize 37 (vs 13) Tidal Constituents
Performance: San Francisco (HSFO)

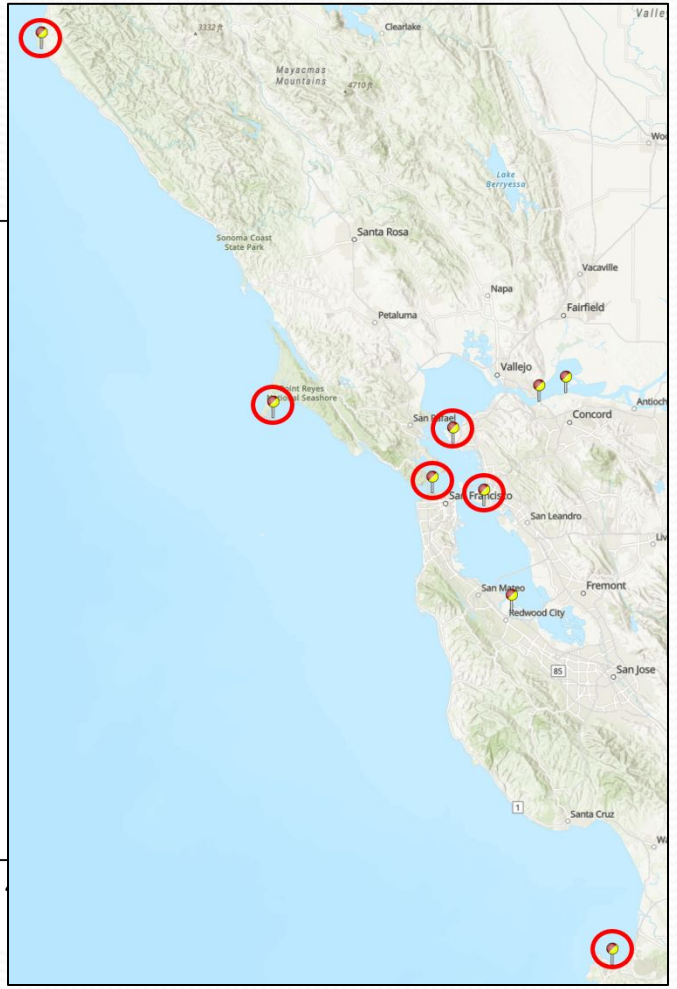
Sep 1-30, 2023: Only sites with non-dry/non-zero tides

Global: 13 constituents



ENPAC-15: 37 constituents





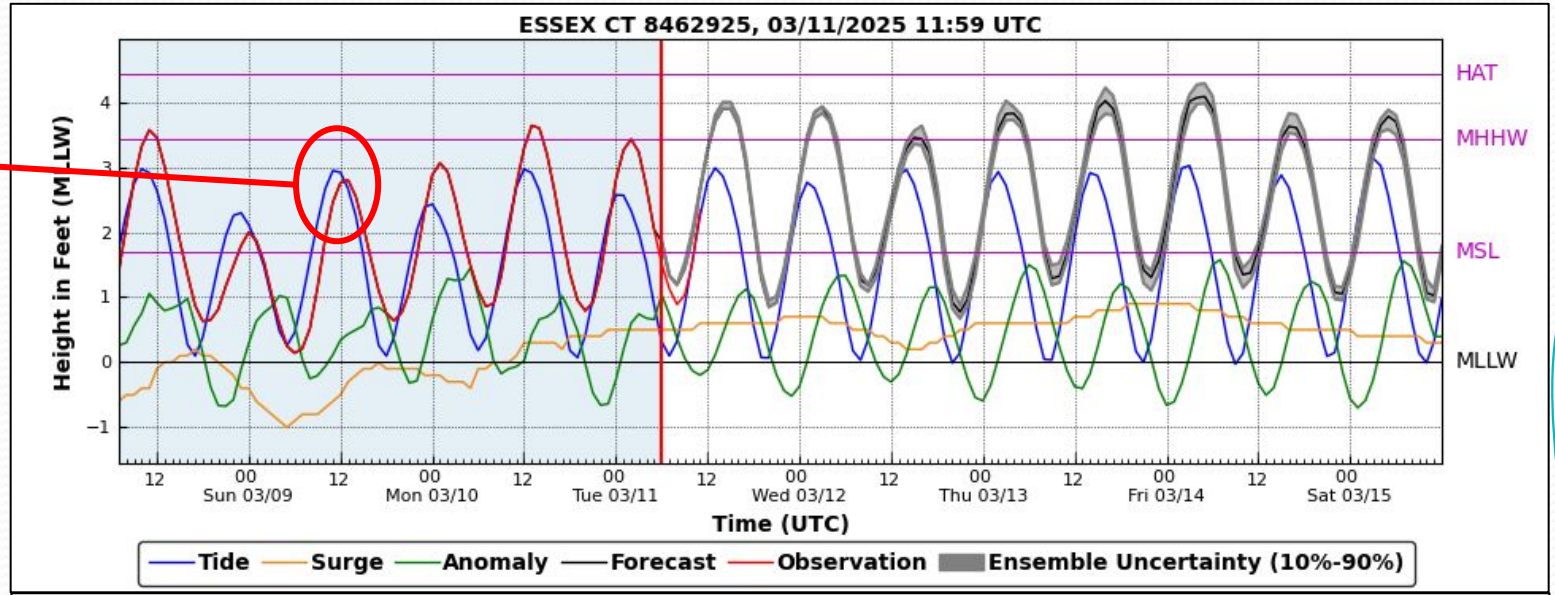
S6. Correct a 1-hour shift in the Tide Calculation at the 74 Secondary Tidal Stations

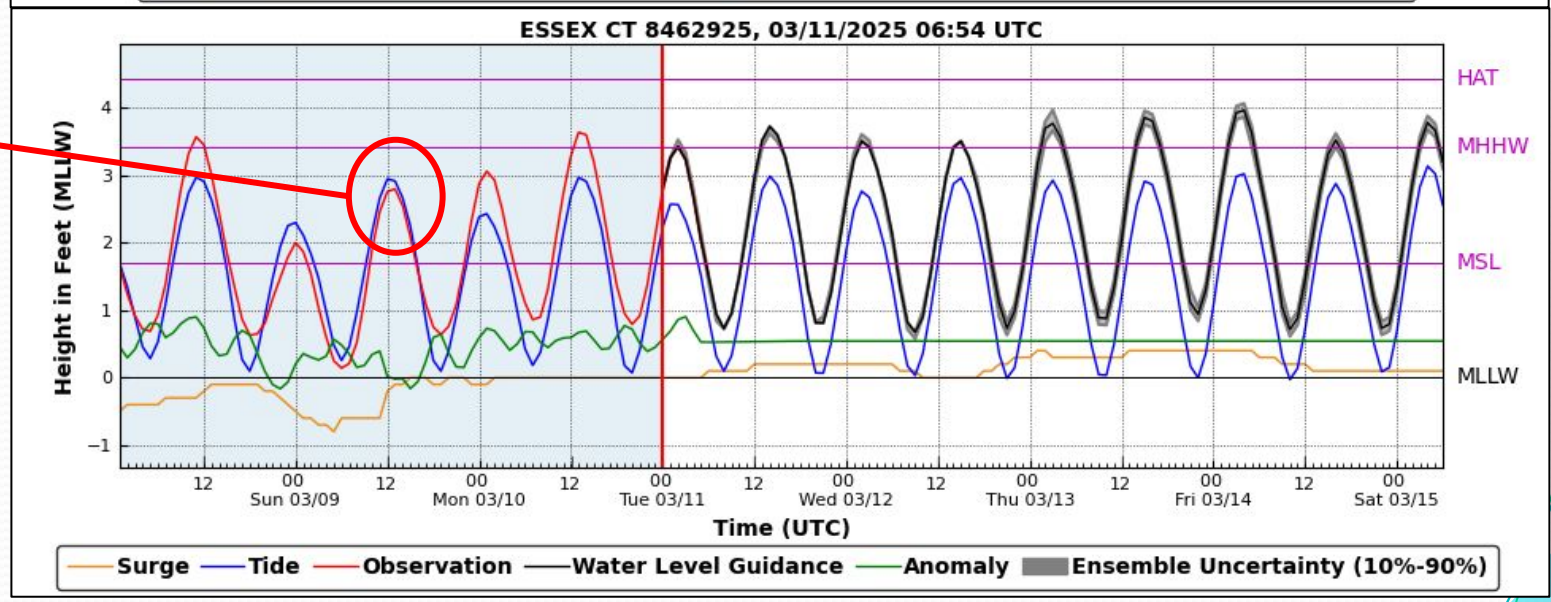
Original

- Phase Shift

New

- In Phase





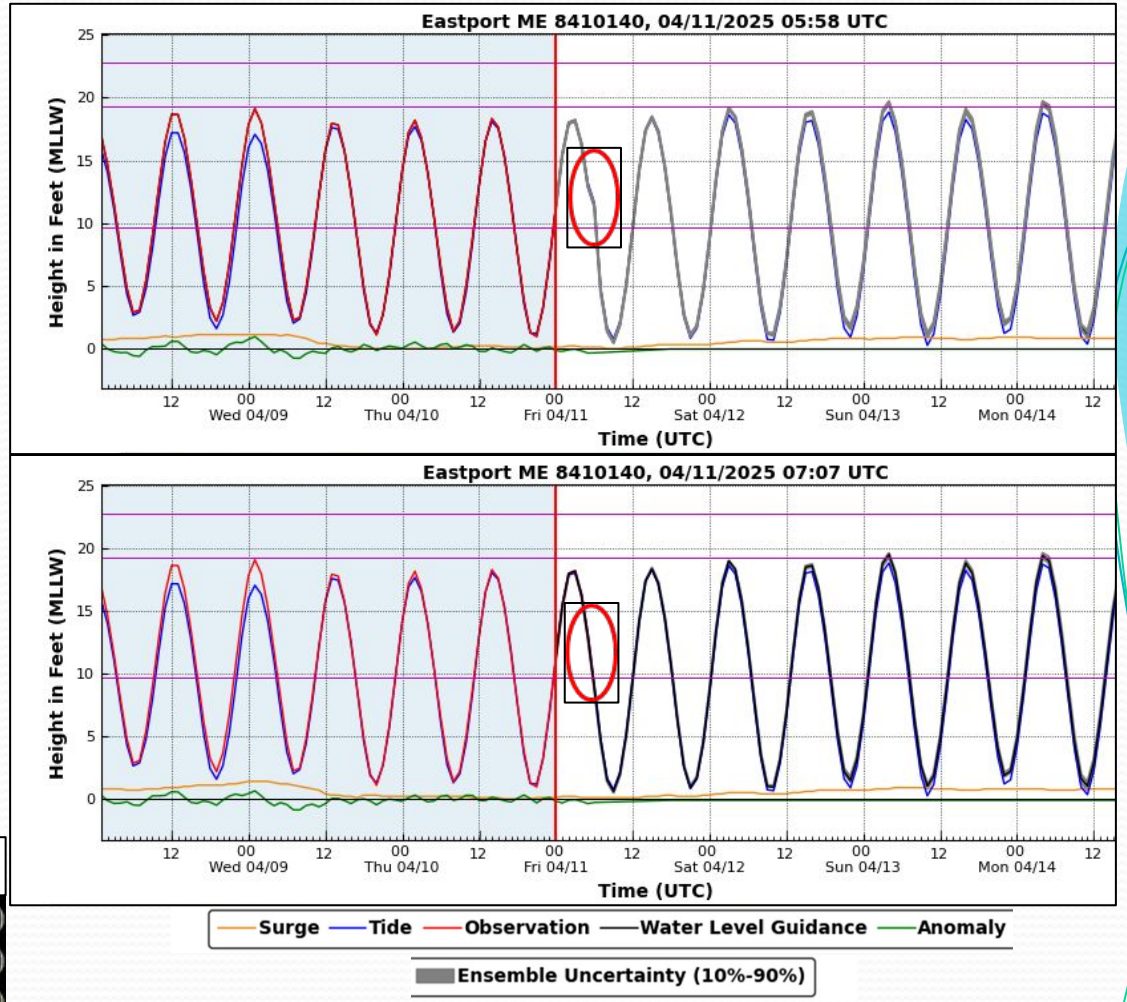
S7. Correct the P-ETSS 6-hour projection guidance to not use an observation from the wrong time

To reconcile top of the hour guidance with stations which provide hourly observations at 24 minutes past the hour, logic was added to look back 36 minutes when testing if there is an observation.

Unfortunately, depending on when the model is run, that interferes with the normal methodology for stations with 6-minute observations.

Tide and observation are same as 36-min ago

Date,	Tide,	Observation,	Surge,	Bias,	Forecast
202504110524,	11.627,	11.368,	9999.000,	9999.000,	9999.000
202504110530,	11.216,	10.978,	9999.000,	9999.000,	9999.000
202504110536,	10.797,	9999.000,	9999.000,	9999.000,	9999.000
202504110542,	10.373,	9999.000,	9999.000,	9999.000,	9999.000
202504110548,	9.943,	9999.000,	9999.000,	9999.000,	9999.000
202504110554,	9.509,	9999.000,	9999.000,	9999.000,	9999.000
202504110600,	11.627,	11.368,	0.100,	-0.359,	11.368



Current forecast is same as observation

Summary

Expected benefits of P-ETSS v1.4

- Improved model guidance in the areas of Seattle, WA; San Francisco, CA; Fort Myers, FL; Kotzebue, AK; and the west coast of the contiguous U.S.,
- Provides surge + tide guidance for Puerto Rico and the U.S. Virgin Islands
- Improved model guidance at various stations

Tentative Implementation Date: August 11, 2025

Contact Information: Arthur.Taylor@noaa.gov and Huiqing.Liu@noaa.gov

For the latest information on the Public Information Statement and Evaluation Form, please see the P-ETSS v1.4 entry on this page: https://vlab.noaa.gov/web/mdl/storm-surge-technical-notices