AQPI: Coastal and Fluvial Integrated Flood Forecast Modeling: Case Study Development in South San Francisco Bay

Liv Herdman[1], Rosanne Martyr-Koller[1], Li Erikson and Patrick Barnard[1]
[1]Pacific Coastal and Marine Science Center, Santa Cruz, CA

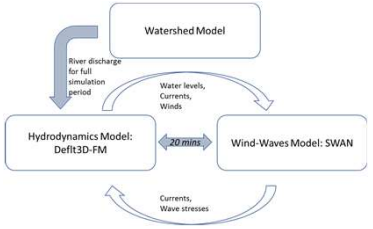
Introduction

Can we build an operational model that predicts both fluvial and coastal flooding?

In order to do this some development of the existing CoSMoS framework is necessary. Improvements for CoSMoS-Hydro include transition to a flexible mesh to allow for the resolution of small channels, improvements in computational efficiency, as well as seamless integration with the other operational models in AQPI.

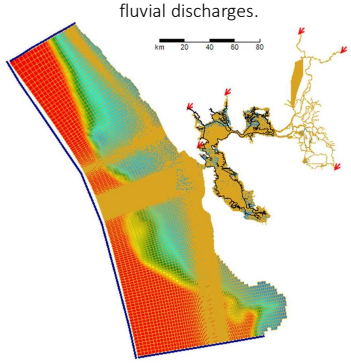
A case study that demonstrates the feasibility of this approach has already been done for the Napa River (Herdman et al in review). Here we present the necessary model development for a case study in Coyote Creek, South San Francisco Bay that will demonstrate the feasibility and usefulness of this approach.

Processes Included in CoSMoS-Hydro



CoSMoS-Hydro fully resolves coastal interactions with discharges of the major tributaries in San Francisco Bay. It achieves this result by closely coupling the discharge from the watershed model with a coupled waves and coastal model. The water levels include the effect of tides, stormsurge, waves, and fluvial discharges.

We used the hydrodynamic modeling software DFlow FlexibleMesh from Deltares. There are 202,842 grid cells in the domain with the size of the grid cells ranging from 4 km at the ocean side to as small as 5 meters in the coastal region near the major tributaries. The bathymetry in the model is determined by averaging depth points from a 2-m digital elevation model contained in each grid cell (Foxgrover et al., 2011 and 2014).

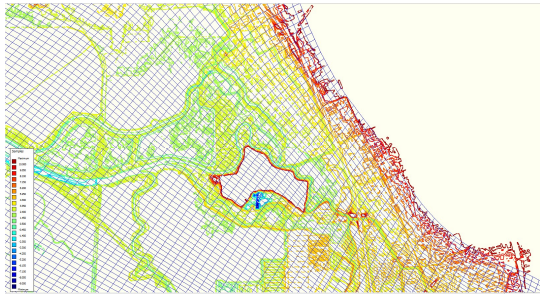


Computational Efficiency

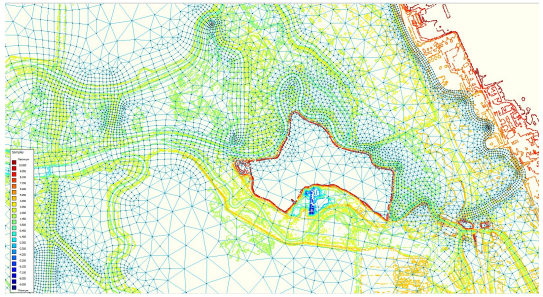
	Runtime for 72hr forecast
Weather and Water Model	20 minutes
Coastal	40 minutes

To provide the desired 72 hour forecast window, we must have the input latency below 30 minutes as it takes 40 minutes to run the coastal model in its current architecture.

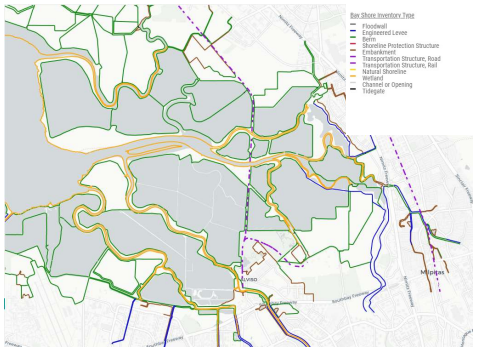
Case Study Model Development



While appropriate for purely coastal flooding, previous CoSMoS versions relied on a structured grid which does not have the flexibility to resolve the small channels that drain into the bay.

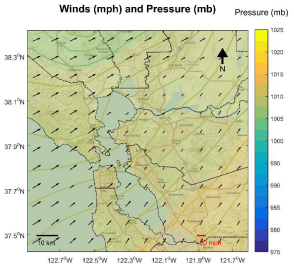


CoSMoS-Hydro utilizes a flexible mesh hydrodynamic code to create very high resolution results in the channels to accurately predict the coastal water level interactions with the discharge.



A numerical representation of the regional levees is now also directly implemented (SFEI, 2016). Locations are defined at the velocity points to block flow between the two adjacent computational cells when water levels are below a specified height without reducing the total wet surface and the volume of the model. This allows us to represent levees which have sub-grid dimensions, but are large enough to change flow patterns and flood extents.

AQPI Points of Integration



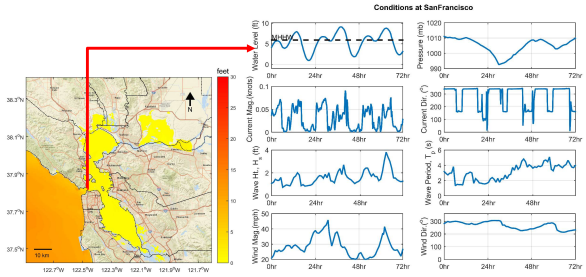
HRRR-WEATHER MODEL

The entire domain of CoSMoS-Hydro is forced with wind and pressure fields from the AQPI weather model. As a future development task we intend to include the rain inputs to allow for very fine-scale water routing in the coastally influenced zone.

NWM-HYDROLOGY MODEL

For each tributary the appropriate segment from the National Water Model must be identified for coupling with CoSMoS-Hydro. There is a tradeoff between maximizing the catchment area included in the coupling and going far enough upstream that coastal influence has diminished.

Products



Water level, currents, wave height, period and direction are available as time series forecast within the bay. Also available are 2 meter resolution forecasts of maximum flood depth, wave runup potential, and flooding uncertainty. (See laptop demo to see resolution of flood layers)

Acknowledgements and References

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Further questions can be directed to Liv Herdman: lherdman@usgs.gov

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