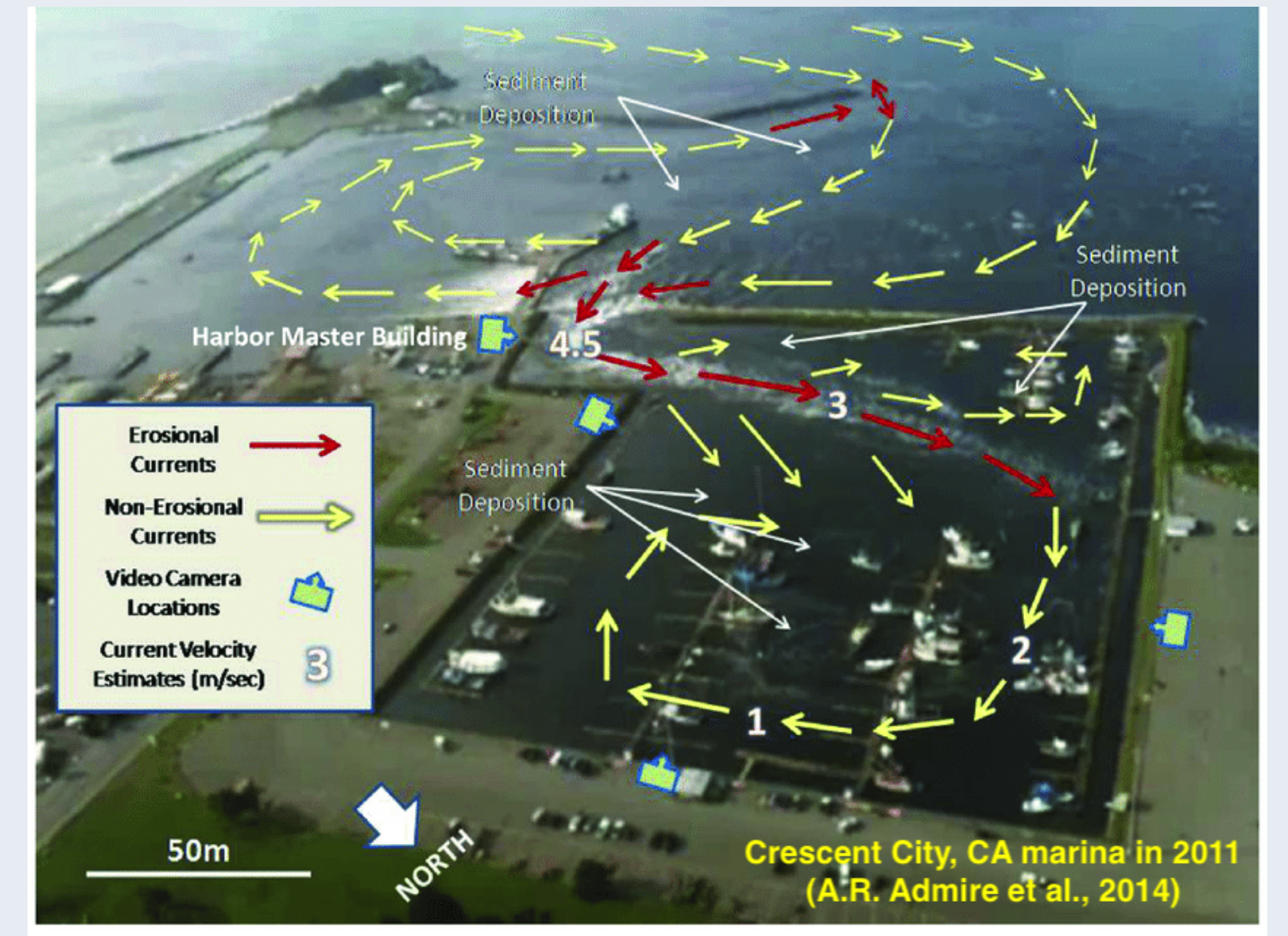


# Visualizing Ship Motion in Tsunami Currents

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## Summary of Work in Progress / On-going Research!



Tsunami currents can be very dangerous even if there is no onshore inundation, and can create whirlpools and other small-scale structures.

With inundation, ships can be carried onshore and become part of the debris field. Developing better algorithms for debris tracking and using them in probabilistic models is a very active research topic for the Cascadia CoPes Hub ([cascadiacopeshub.org](http://cascadiacopeshub.org)) and others in the tsunami modeling community.

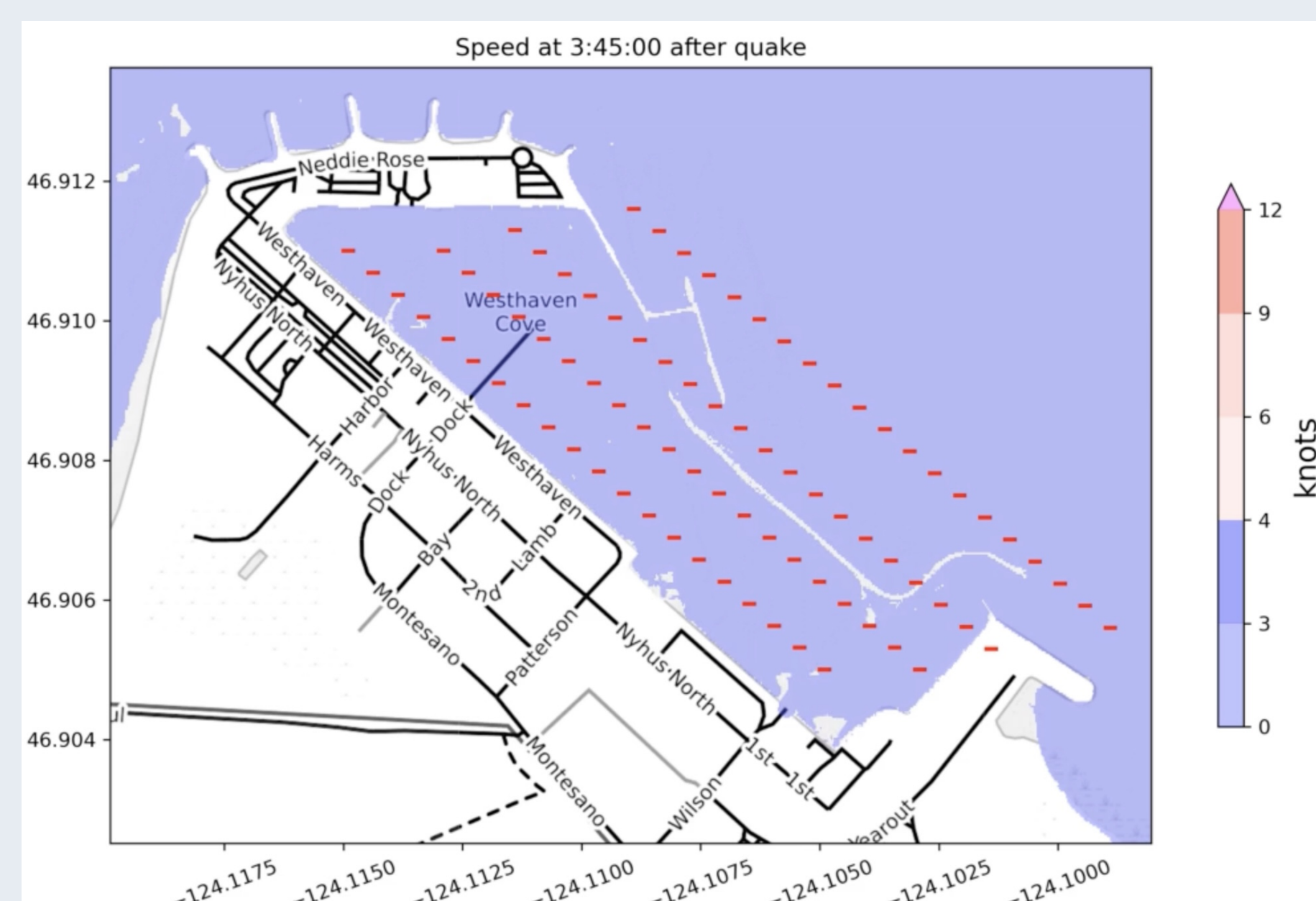
The open source GeoClaw tsunami modeling code ([geoclaw.org](http://geoclaw.org)) is used to model tsunami generation, propagation and inundation. The depth-averaged shallow water equations are used to compute the water depth and fluid velocities, which are saved on a fine grid near the region of interest every few seconds. Postprocessing scripts are then used to track the motion of particles in this flow field, making it easy to experiment with different initial particle locations, masses, grounding depths, etc. (Ship is grounded if water depth < grounding depth = draft of ship.)

### Westport Marina / Alaska Earthquake

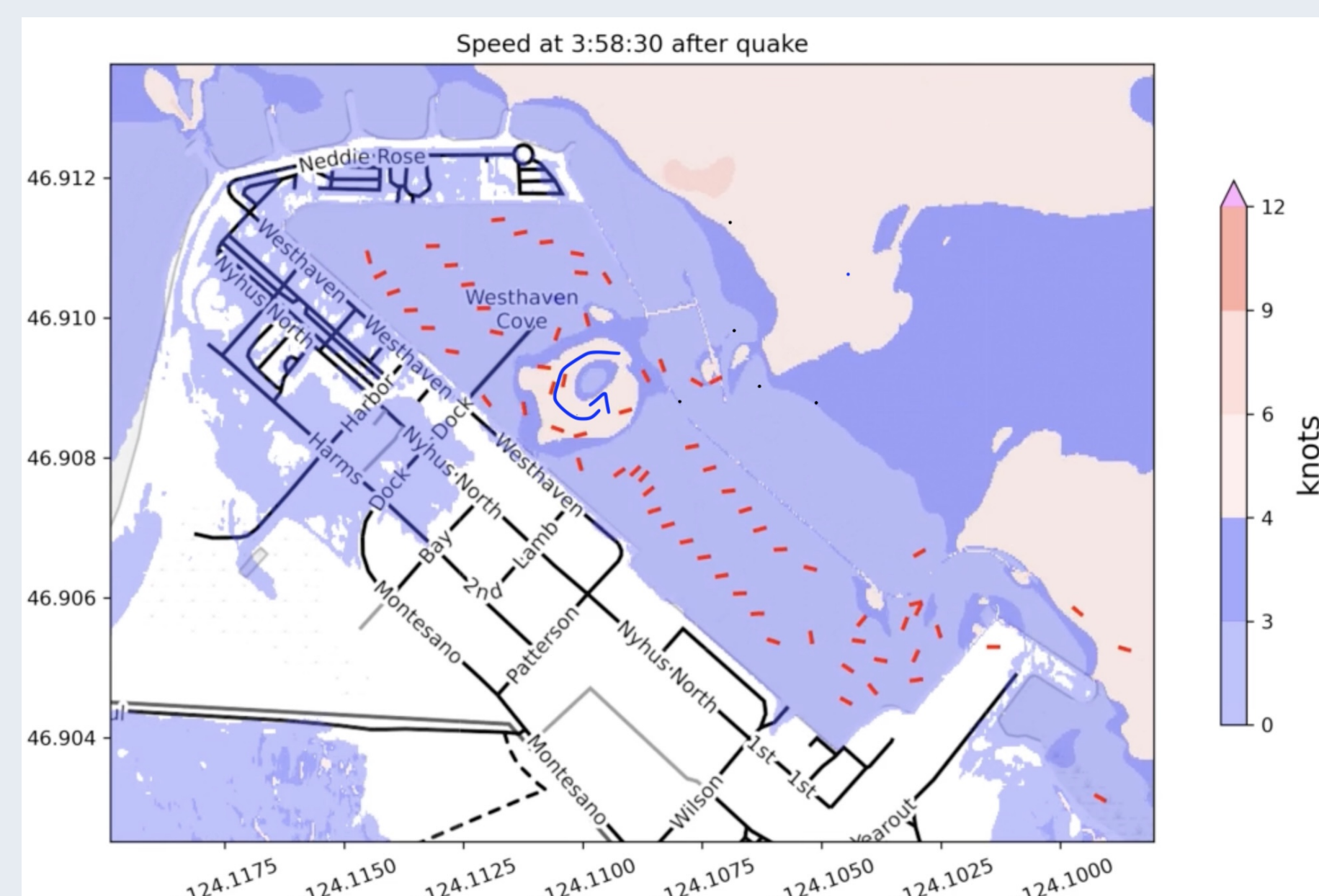
Work performed as part of preliminary study for WA State's Tsunami Maritime Response and Mitigation Strategy for the Port of Grays Harbor's Westport Marina, see

<https://mil.wa.gov/tsunami#education>

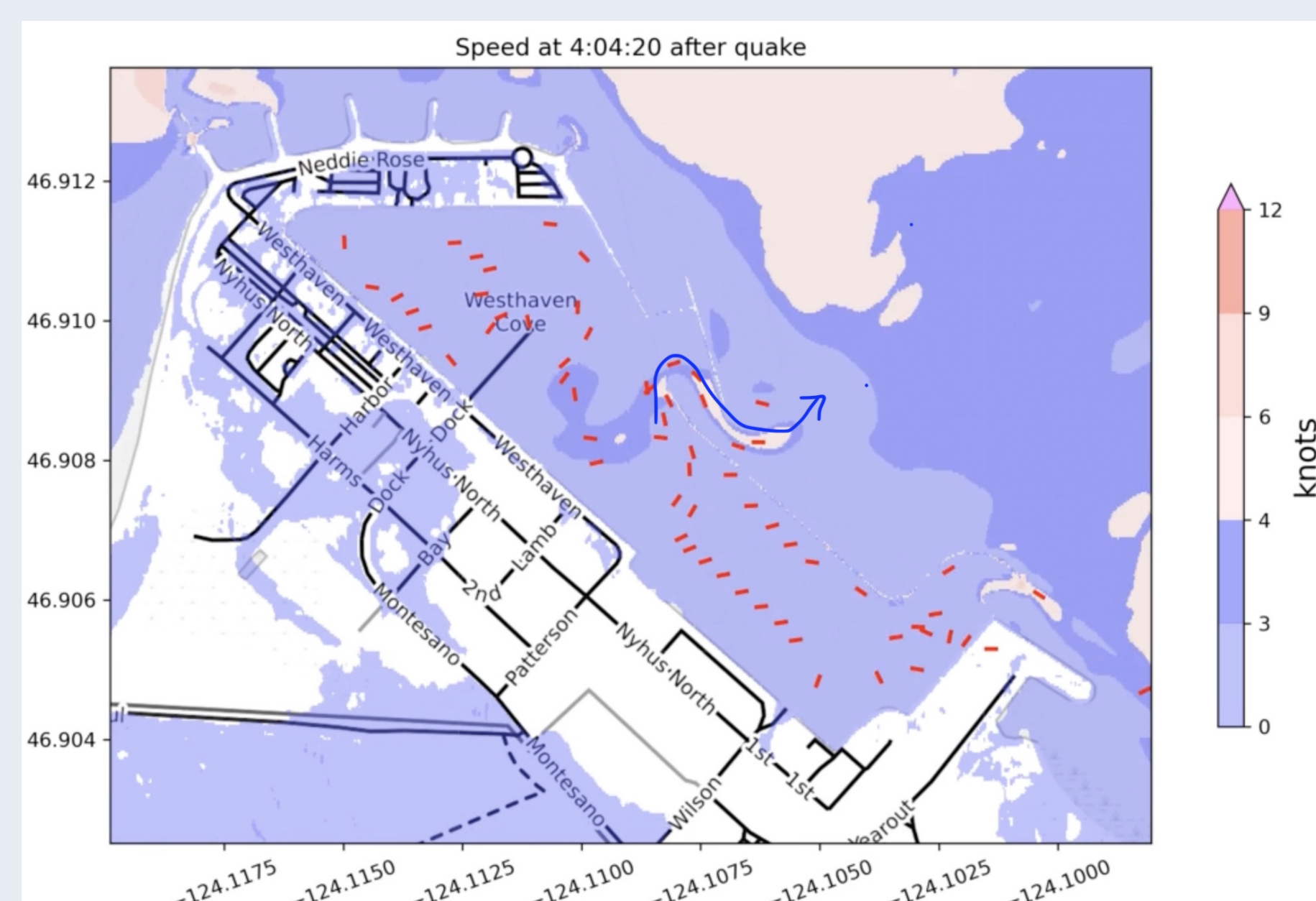
#### Initial location of particles:



#### Whirlpool in marina:



#### Strong outward current:

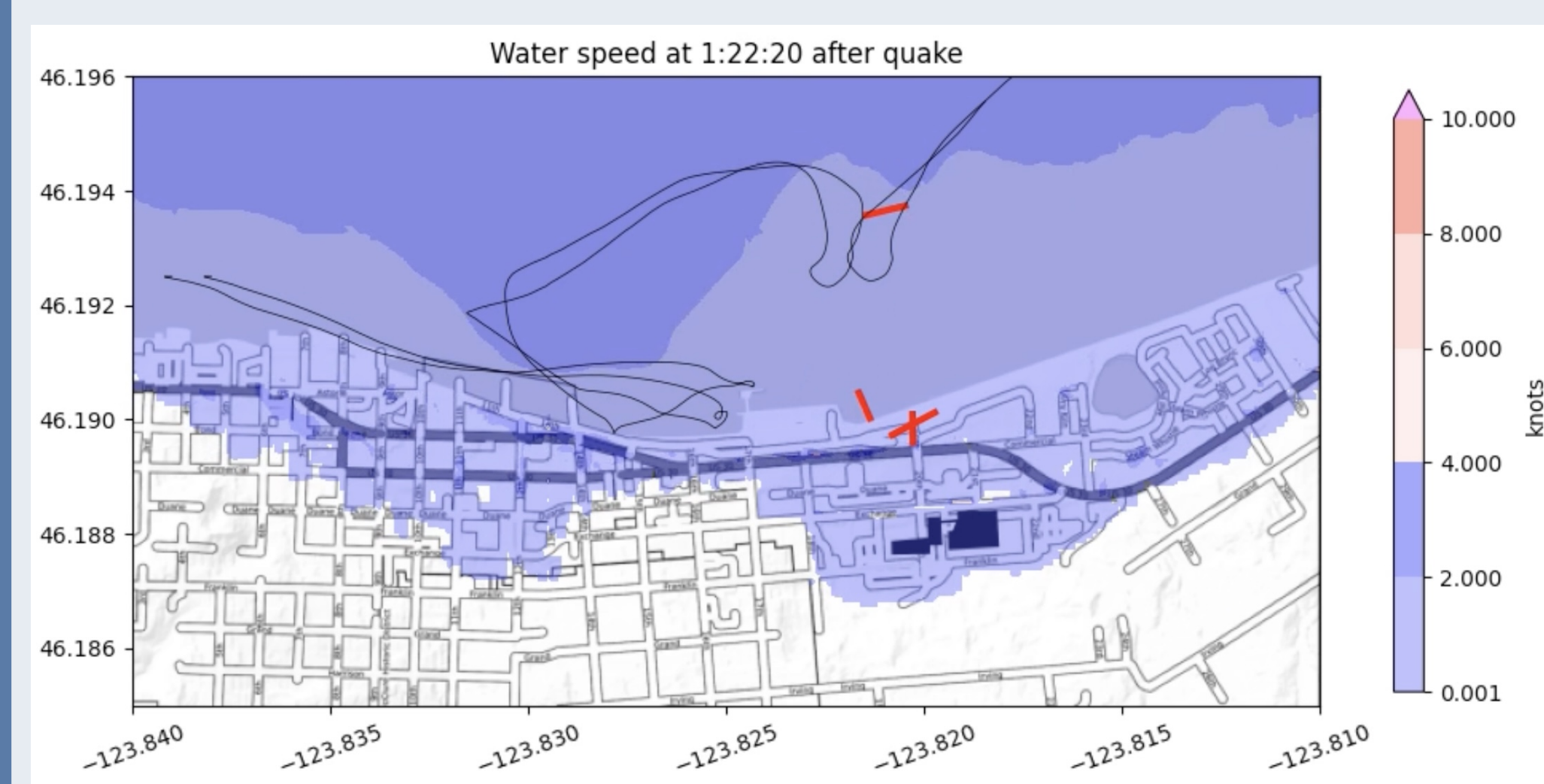
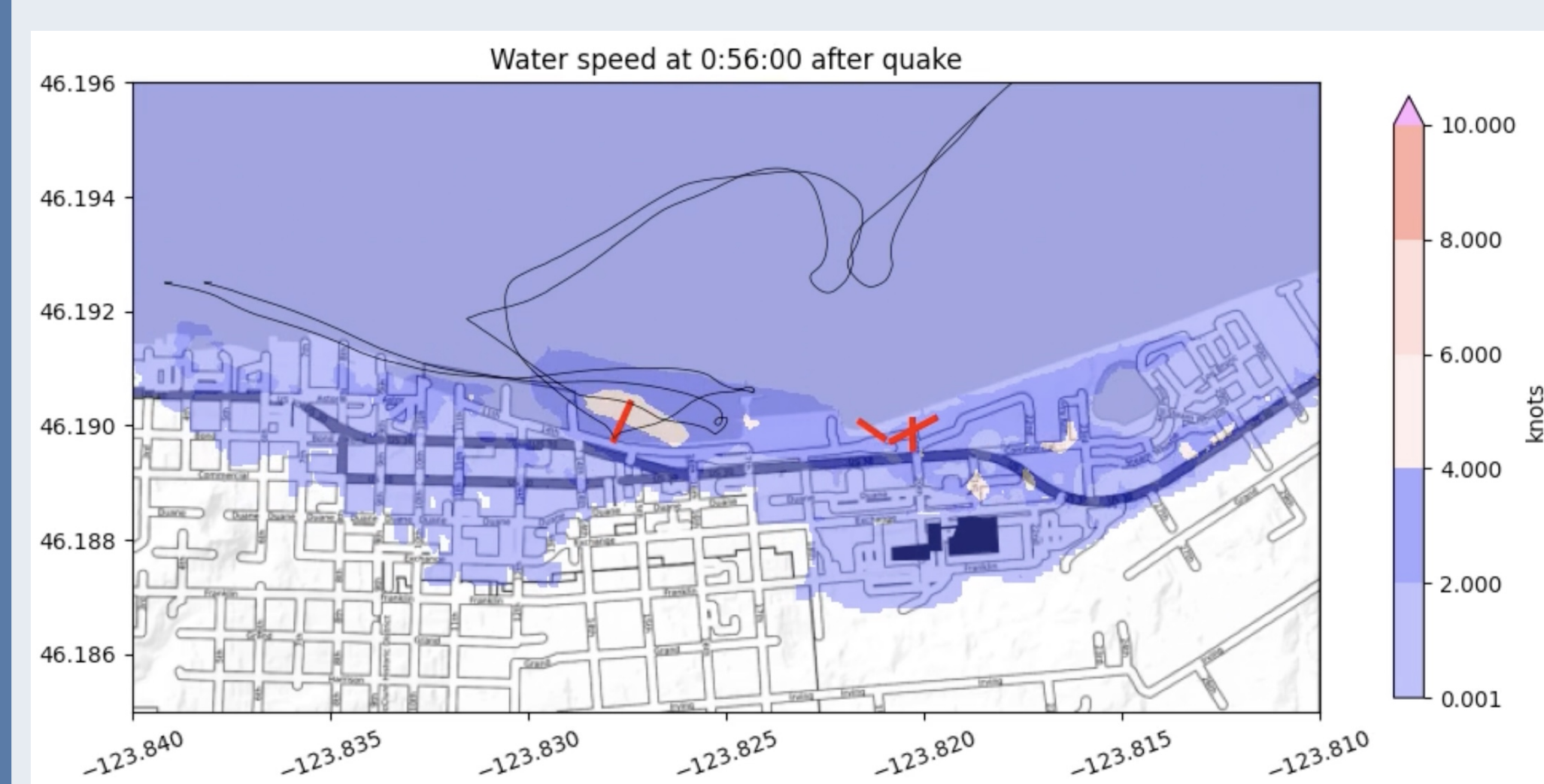
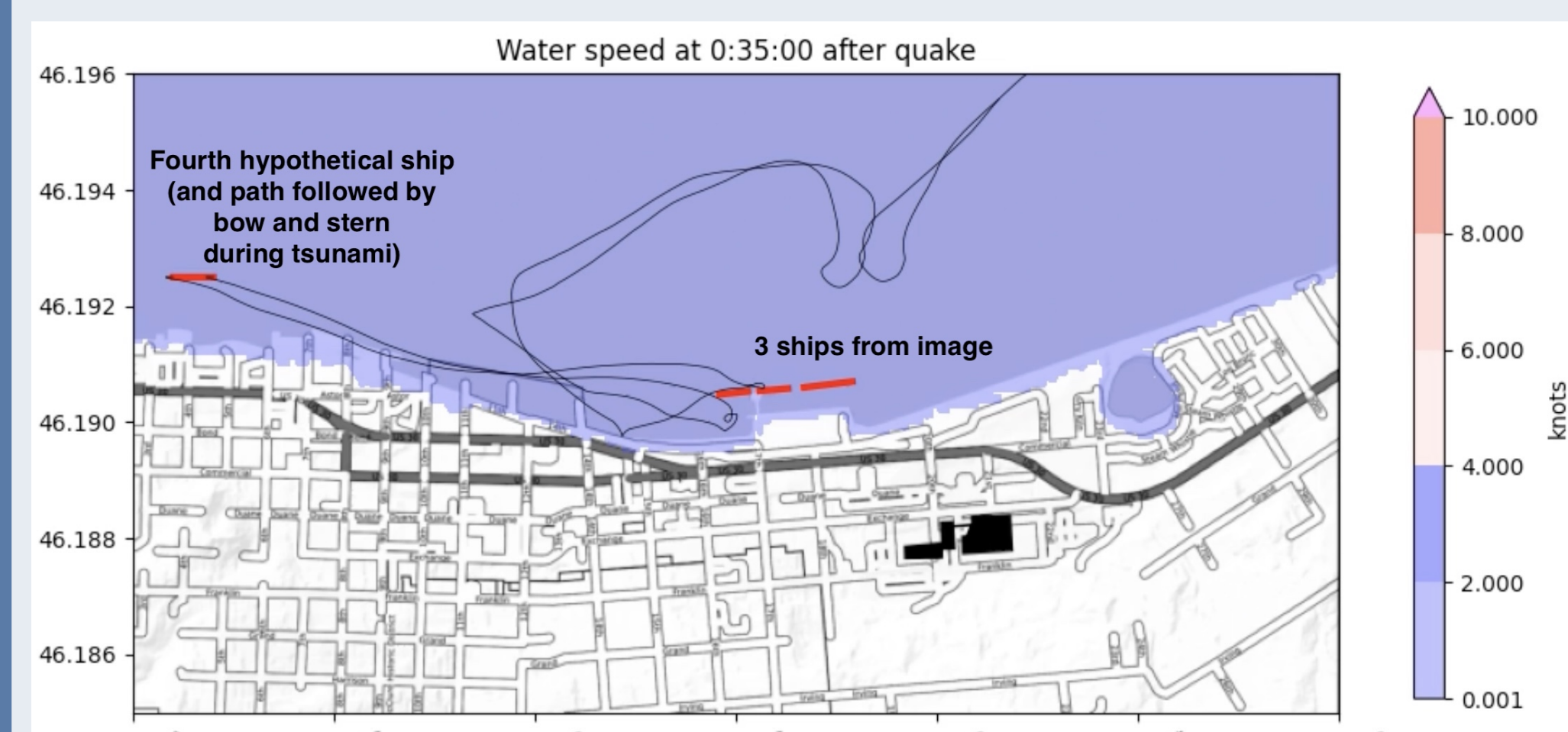


### Currents near Astoria / CSZ Earthquake

Work performed as part of a study for the Columbia Memorial Hospital expansion plan, see

<https://www.columbiamemorial.org/buildcmh/>

An amplified version of the "2500-year L1 event" was modeled at MHW on top of 1.5 m sea level rise projection.



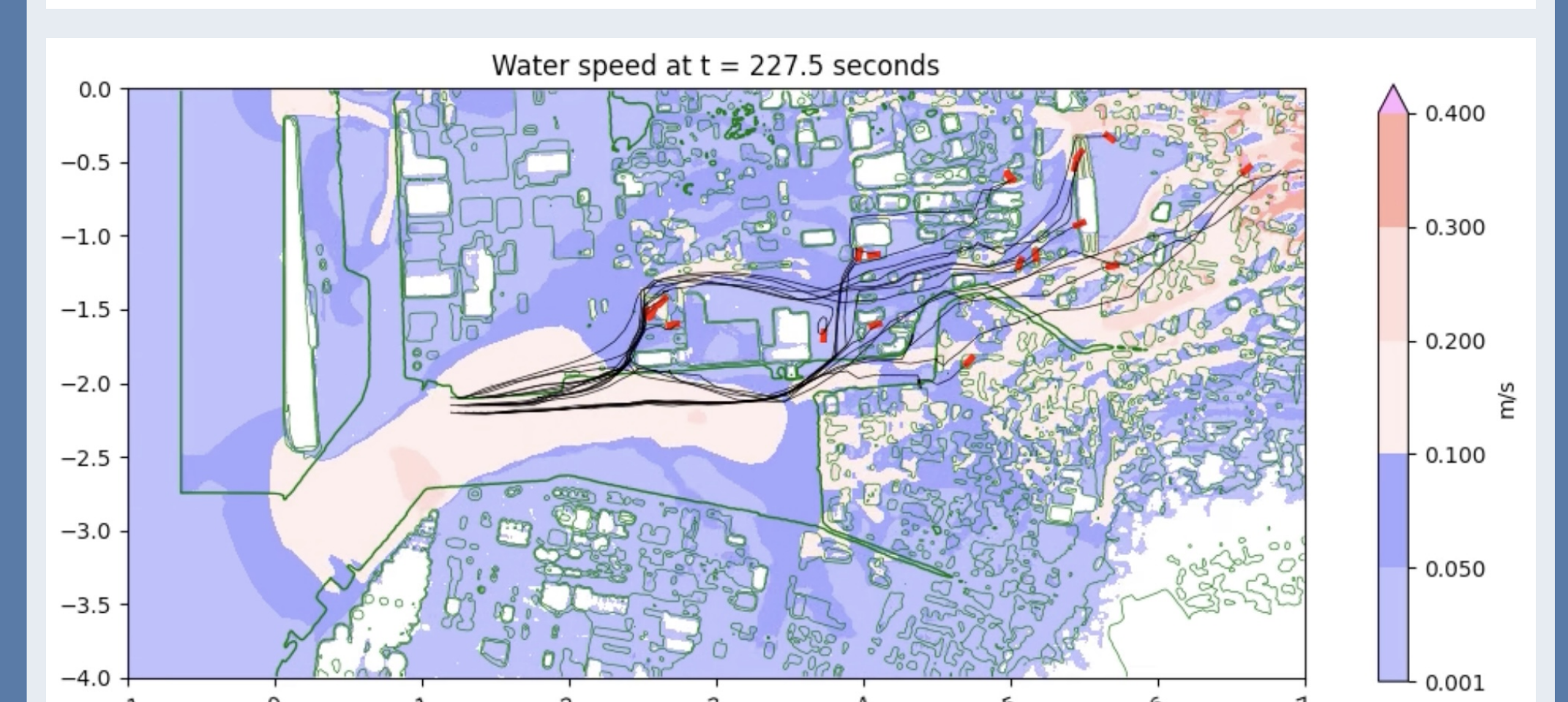
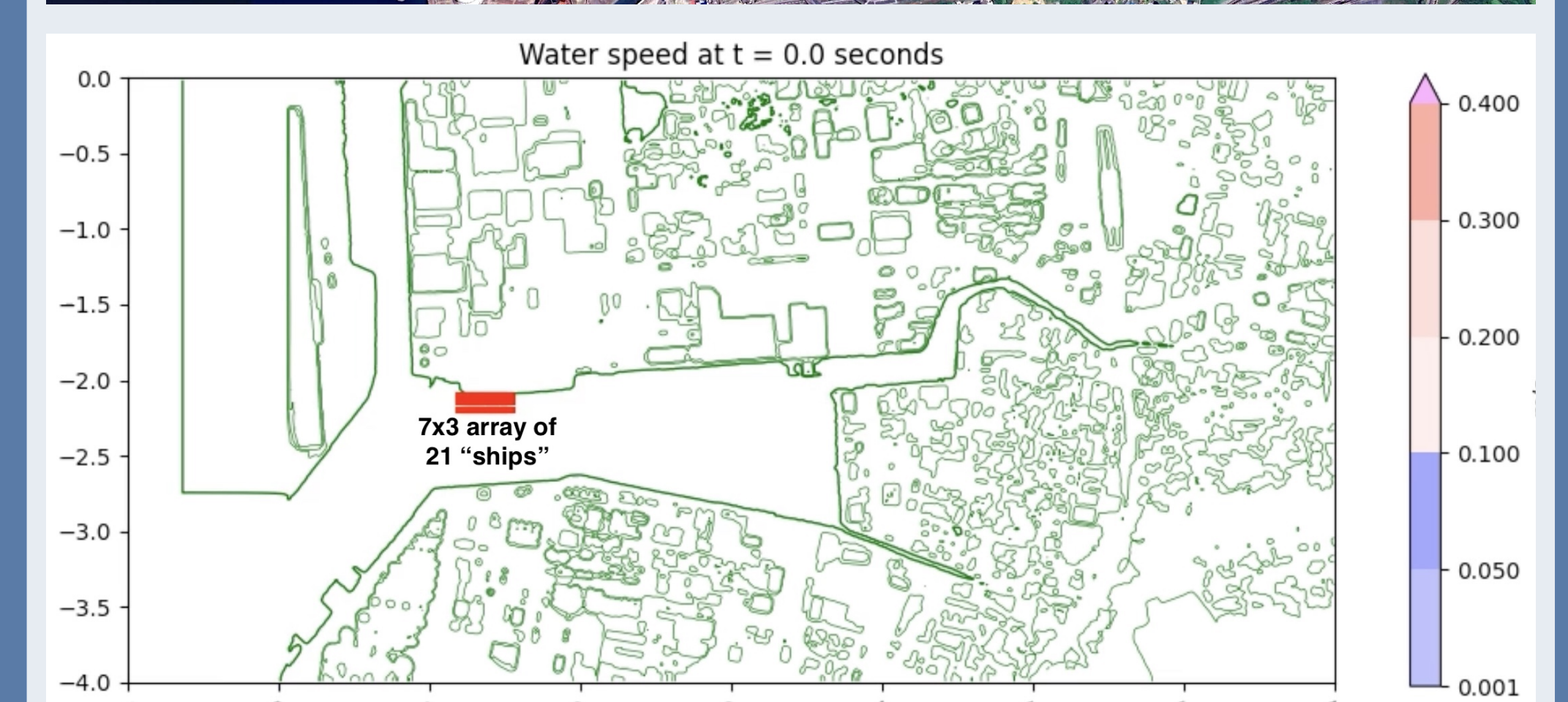
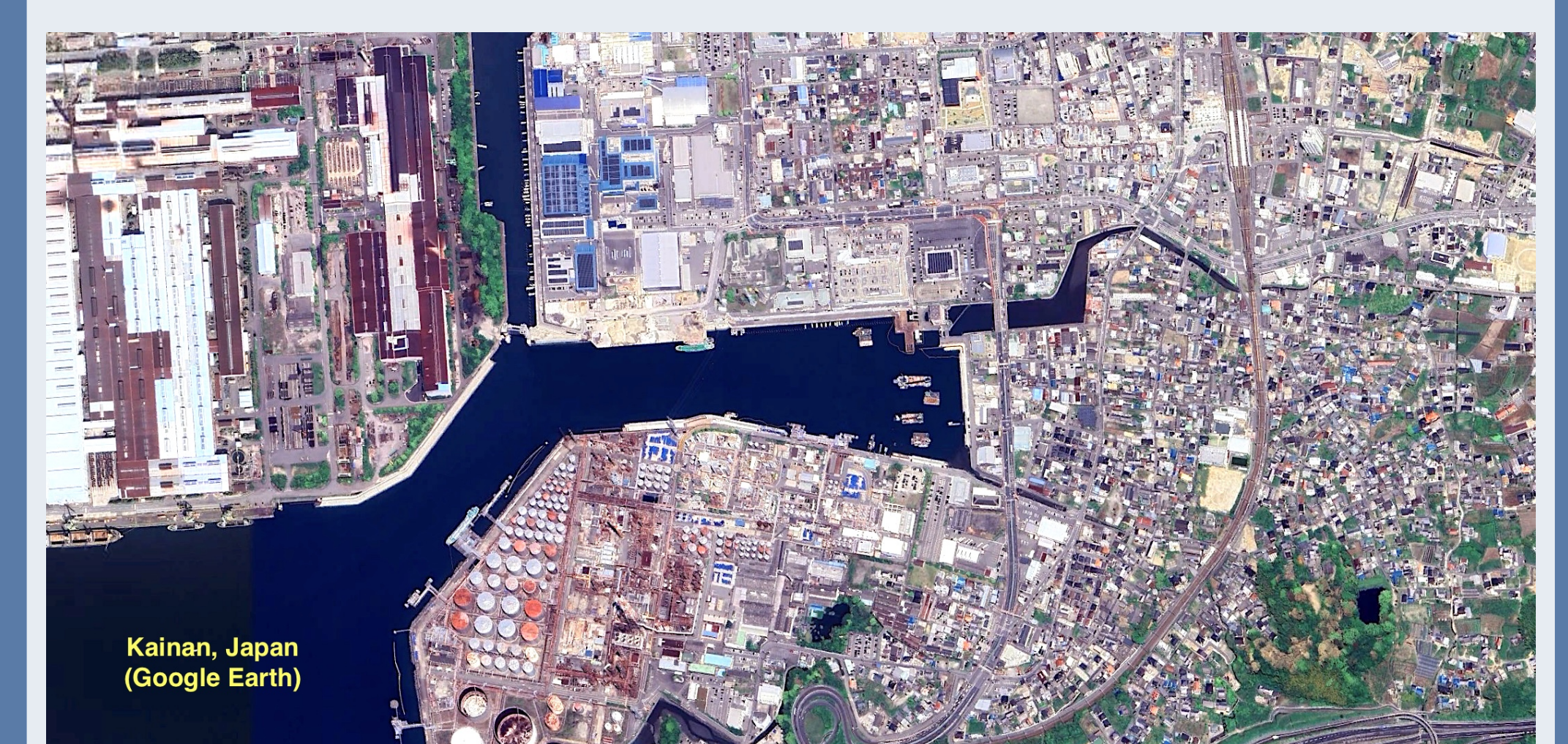
### Wavetank Experiment

Work performed as part of a benchmarking exercise for the National Tsunami Hazard Mitigation Program (NTHMP) workshop on Tsunami Debris, May, 2023 in Newport, OR. See <http://tsunamiworkshop.org>.

Benchmark Problem 3 was based on a wavetank experiment performed in Kyoto and described in:

Chida, Y. and Mori, N., Numerical modeling of debris transport due to tsunami flow in a coastal urban area. Coastal Engineering, 179 (2023) DOI 10.1016/j.coastaleng.2022.104243

Buildings in the model were included in the GeoClaw simulation, as part of the topography when solving the shallow water equations.



Scan this QR code for animations, references, and other links cited.

