

Estuary Modeling for Tidal Energy in Puget Sound, WA



Kristen Thyng^α and Mitsuhiro Kawase^β

Department of Mechanical Engineering^α and School of Oceanography^β, University of Washington

thyngkm@u.washington.edu

Northwest National Marine Renewable Energy Center

The University of Washington has partnered with Oregon State University to conduct research on tidal and wave energy, respectively. This partnership, the Northwest National Marine Renewable Energy Center (NNMREC) has been funded by the Department of Energy. Our goal is to connect research of renewable marine energy at universities with device developers and public interests.

Problem Setup

Goals

- Establish calibrated 3D model of Puget Sound and surrounding area
- Simulate in-stream tidal turbines and examine far-field effects on domain

SUNTANS

Stanford Unstructured Nonhydrostatic Terrain-following Adaptive Navier-Stokes Simulator [FGS06]

- Nonhydrostatic, unstructured grid, Boussinesq approximation, parallel, z-level, 3D
- Wetting and drying in a newer Eulerian-Lagrangian version of the code

Domain

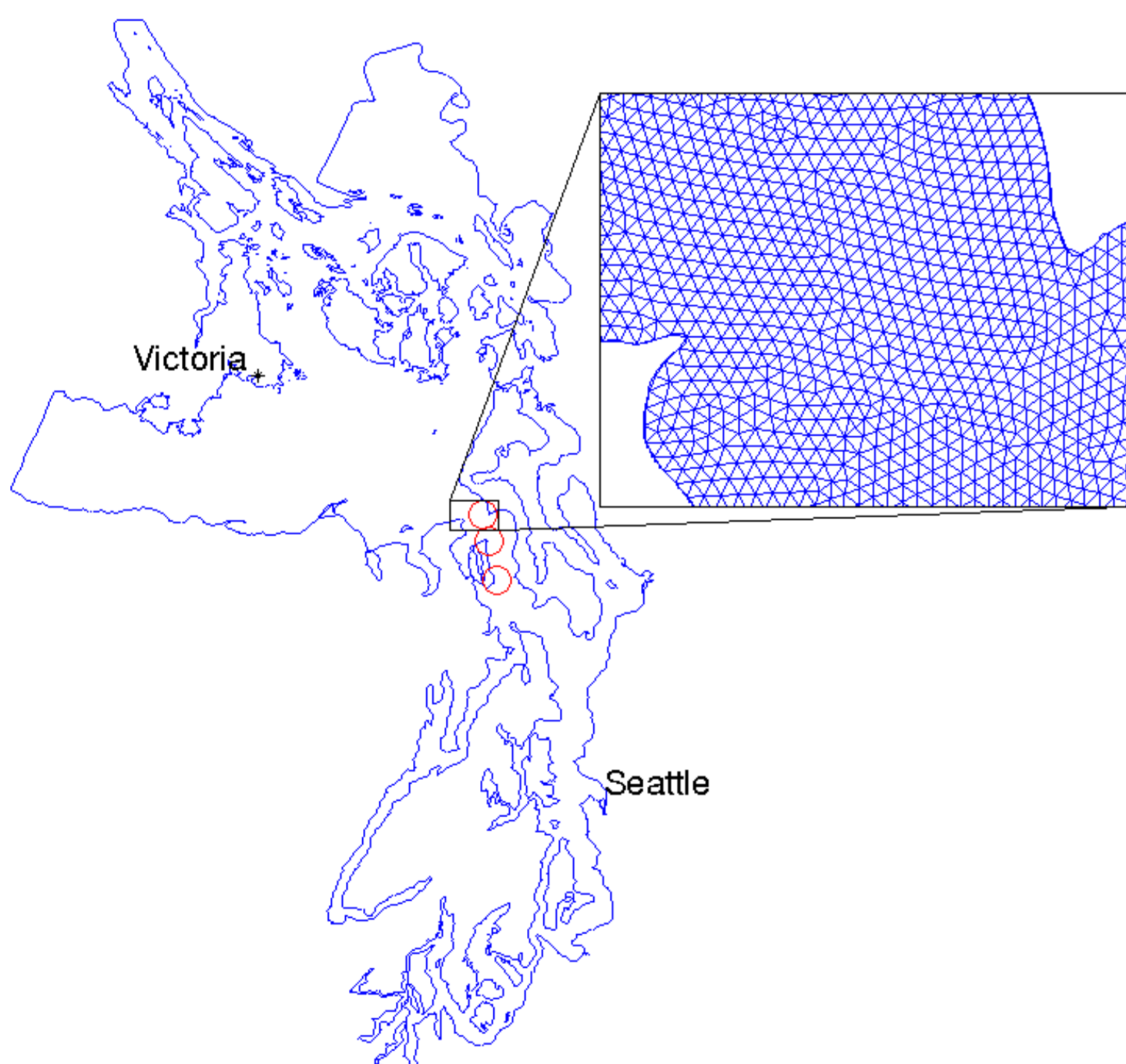


Figure 1: Numerical Domain. Red circles indicate possible pilot project locations. Subimage shows detail of Admiralty Inlet area grid.

Results

Time Series Plots

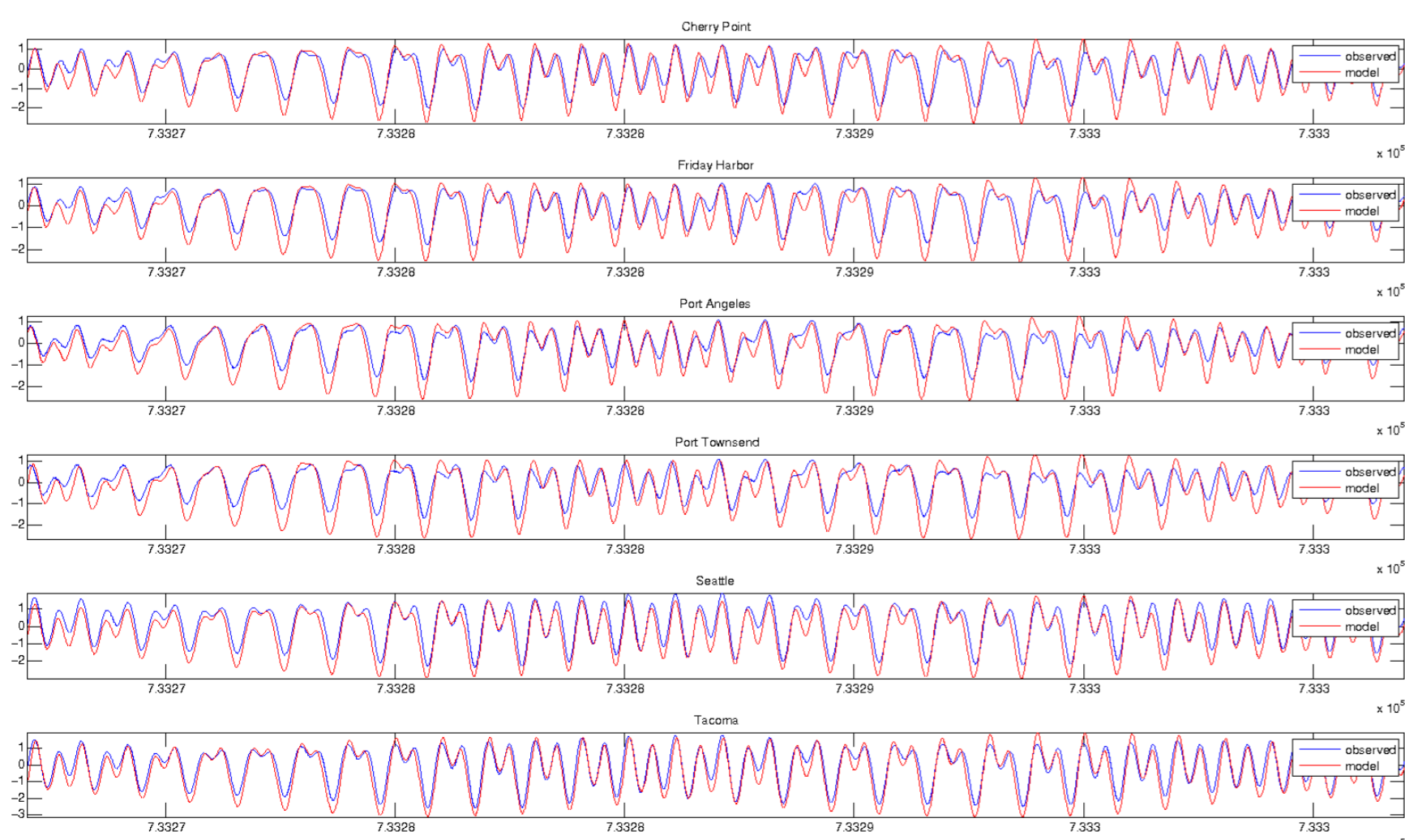


Figure 2: Comparison of free surface height between model output and observed data from NOAA [TC] throughout the domain.

Constituent Calibration

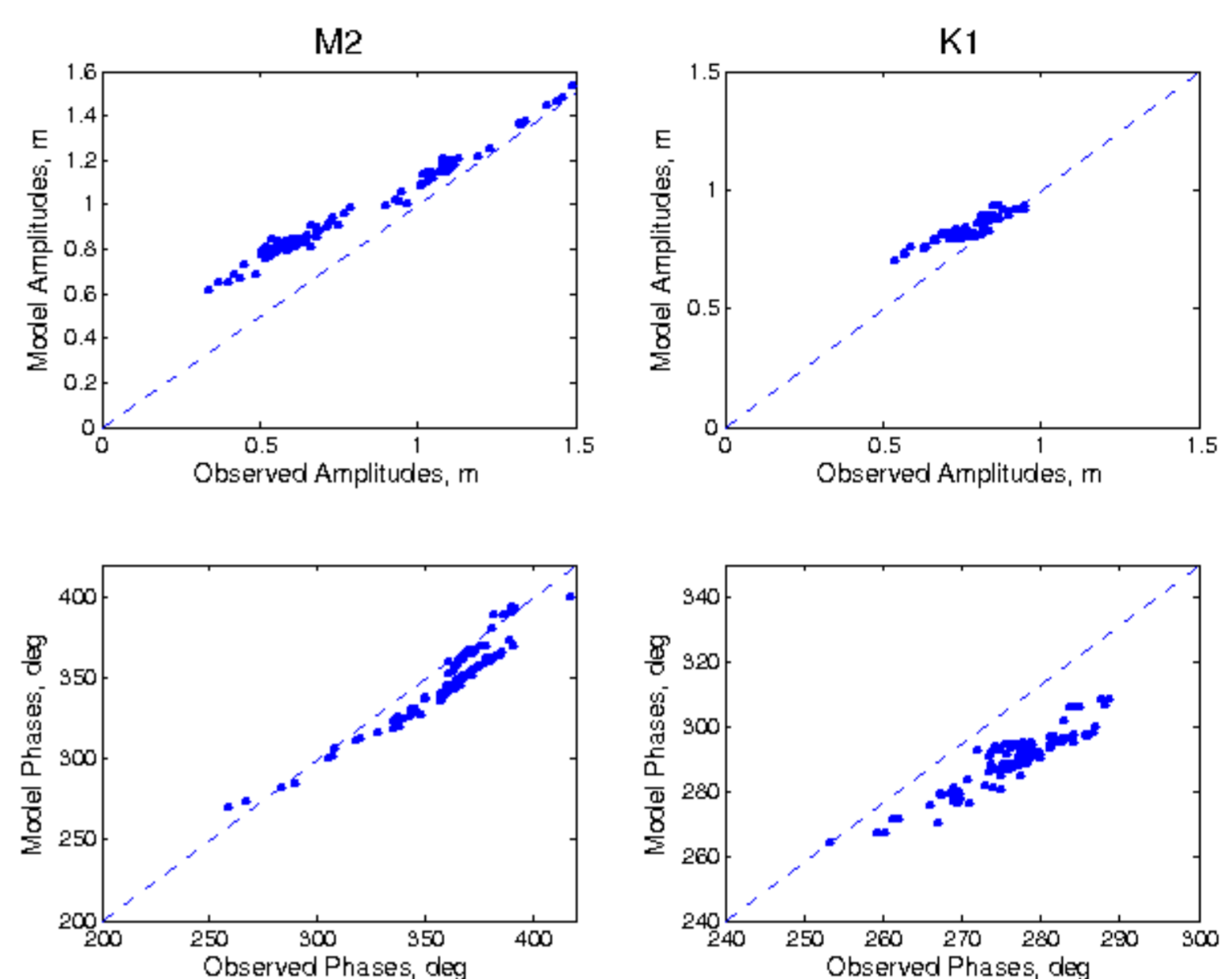


Figure 3: Comparison of amplitude and phase of tidal constituents between model output and observed data from Lavelle et al [Lea88] throughout the domain.

Speed Comparison

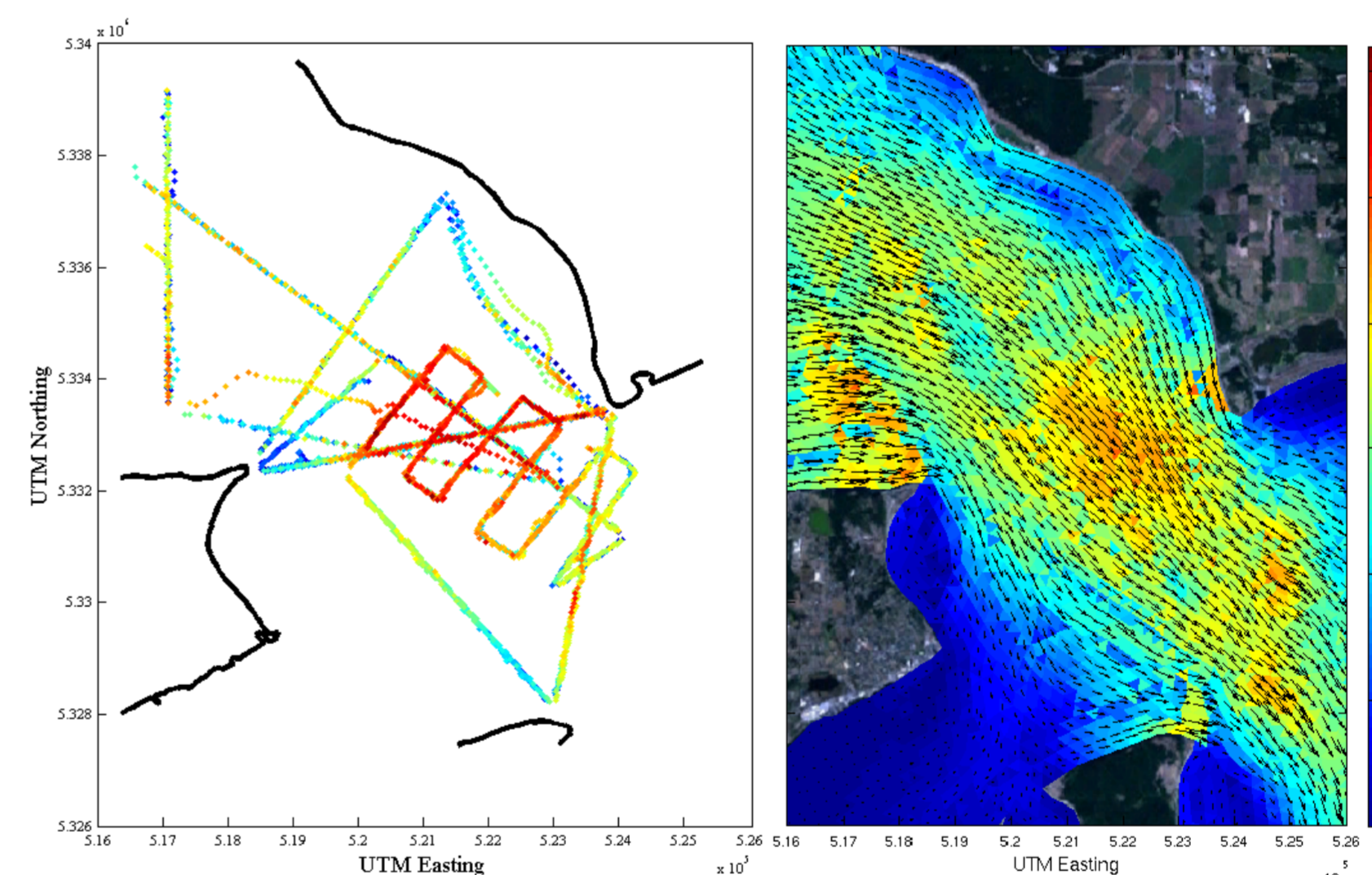


Figure 4: Comparison of depth-averaged speed between model output and over-the-side ADCP data [Inc] in Admiralty Inlet. Arrows show currents direction.

Future Work

- Shift focus to smaller domain: simulation of Admiralty Inlet, most immediate area of interest
- Determine optimal turbine placement in channel
- Compare with active data accumulation
- Examine detailed fluid movements in the area and determine significant flow structures

References

- [FGS06] O. B. Fringer, M. Gerritsen, and R. L. Street. An unstructured-grid, finite-volume, nonhydrostatic, parallel coastal ocean simulator. *Ocean Modelling*, 14(3-4):139–278, 2006.
- [Inc] Evans Hamilton Inc, 8/18/07-9/19/07. Snohomish Public Utilities District Acoustic Doppler Current Profiler.
- [Lea88] J. W. Lavelle and H. O. Mofjeld et al. A multiply-connected channel model of tides and tidal currents in Puget Sound, Washington, and a comparison with updated observations. *NOAA Technical Memorandum ERL PMEL-84*, 1988.
- [TC] NOAA Tides and Currents. <http://tidesandcurrents.noaa.gov/>.