Site Characterization of Tidal Resources: Admiralty Inlet

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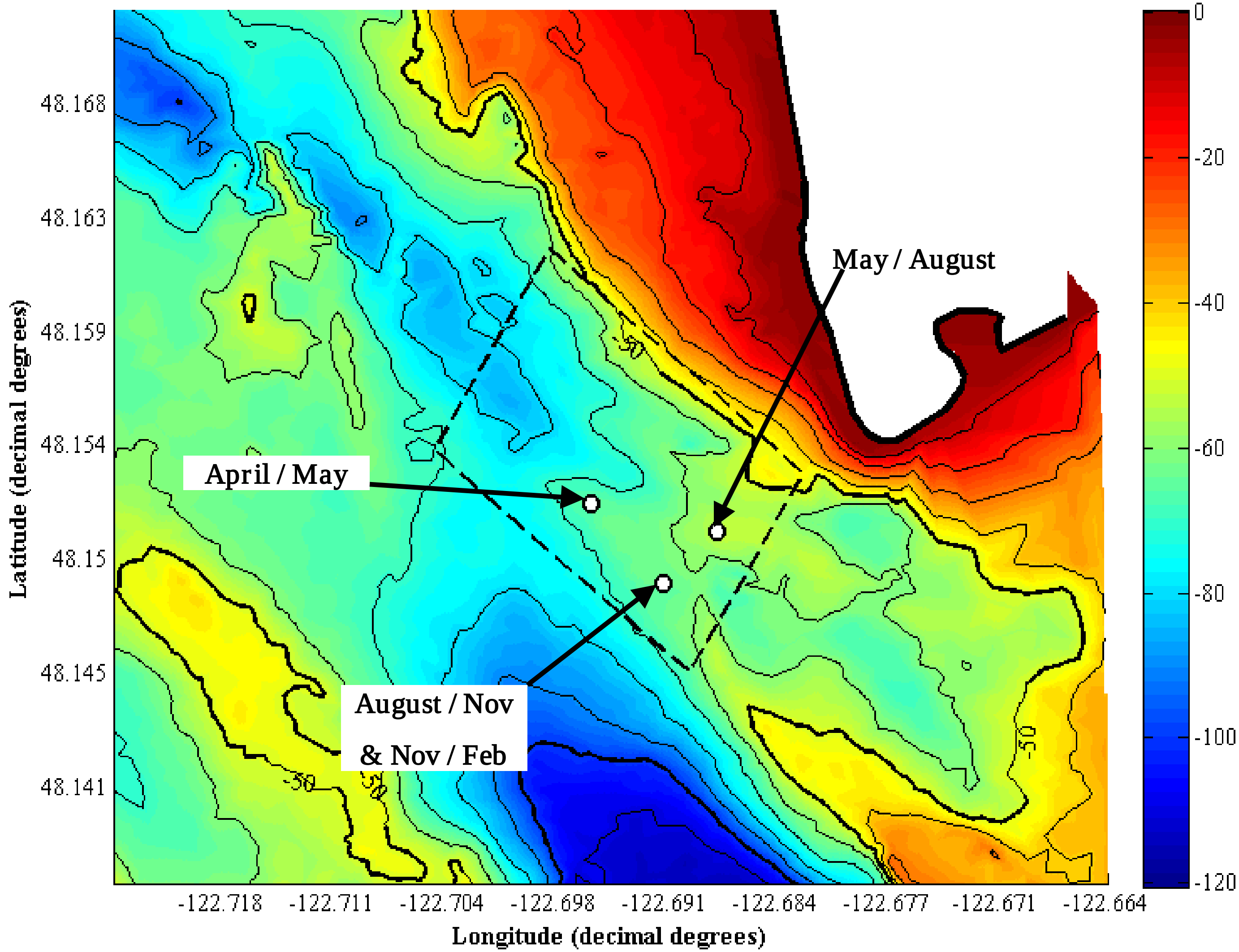
Scope of Thesis Work

- Predictability of tidal currents using stationary ADCP data
  - Develop a set of requirements for accurate long-term predictions

- Development of a quantitative application for use of shipboard ADCP data
  - Resolve uncertainty in current amplitude and phase between survey tracks
  - New survey patterns

ADCP Deployments



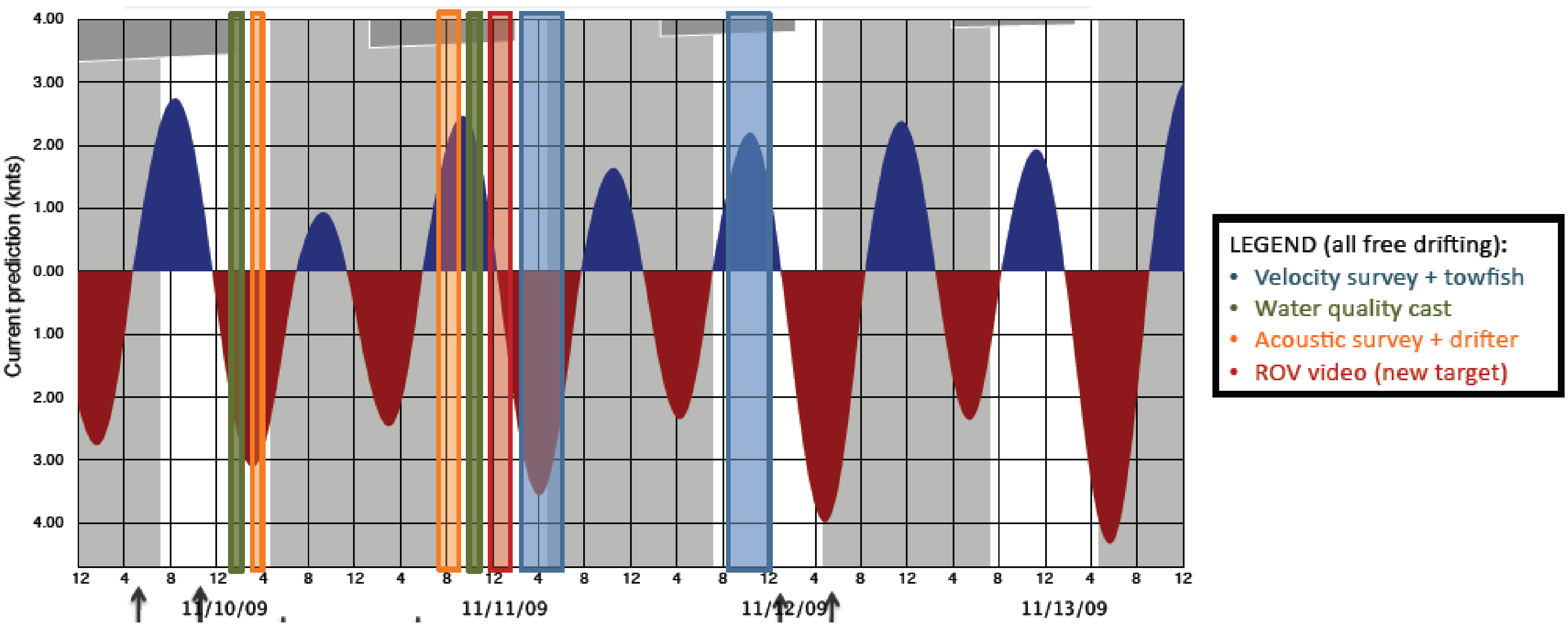
Prediction of Tidal Currents: Why?

- Estimation of tidal resource
  - Location and orientation of device
  - Long-term tidal resource prediction (feasibility)
  - Noise generation due to device operation

- NOAA predictions are given for a single point
  - Surface currents only
  - Bathymetry, Turbulence, etc. cause 3-D velocity variations

Prediction of Tidal Currents: Why?

- Recovery of sea-spider (11/10/09) during slack water
- Strong currents increase noise which could mask the acoustic release signal



T Tide- Tidal Analysis

- Performs harmonic analysis of tidal signal resolving the data as a superposition of sin waves due to tidal constituents

$$u(t) = \sum A_i \cos(\omega_i * t - \phi_i)$$

- Rayleigh criterion and signal to noise ratio (SNR) determine which constituents can be resolved
- Finds the least-squares fit to the current velocity data
- Statistical error analysis
- Principal Axis Velocity

Rayleigh Criterion

- A methodology developed by Foreman (1977) to determine which tidal constituents can be resolved with T Tide

$$\left|\omega_2 - \omega_1\right| * T > R$$

Ex. Resolving the K1 vs. P1 Tidal Constituents

K1, *Luni-solar diurnal constituent,* ω = 0.04178075 cycles / hr

P1, *Solar diurnal constituent,* ω = 0.04155259 cycles / hr

$$\left|\omega_{K1} - \omega_{P1}\right| * T > 1 \rightarrow T \approx 182 \text{ days}$$

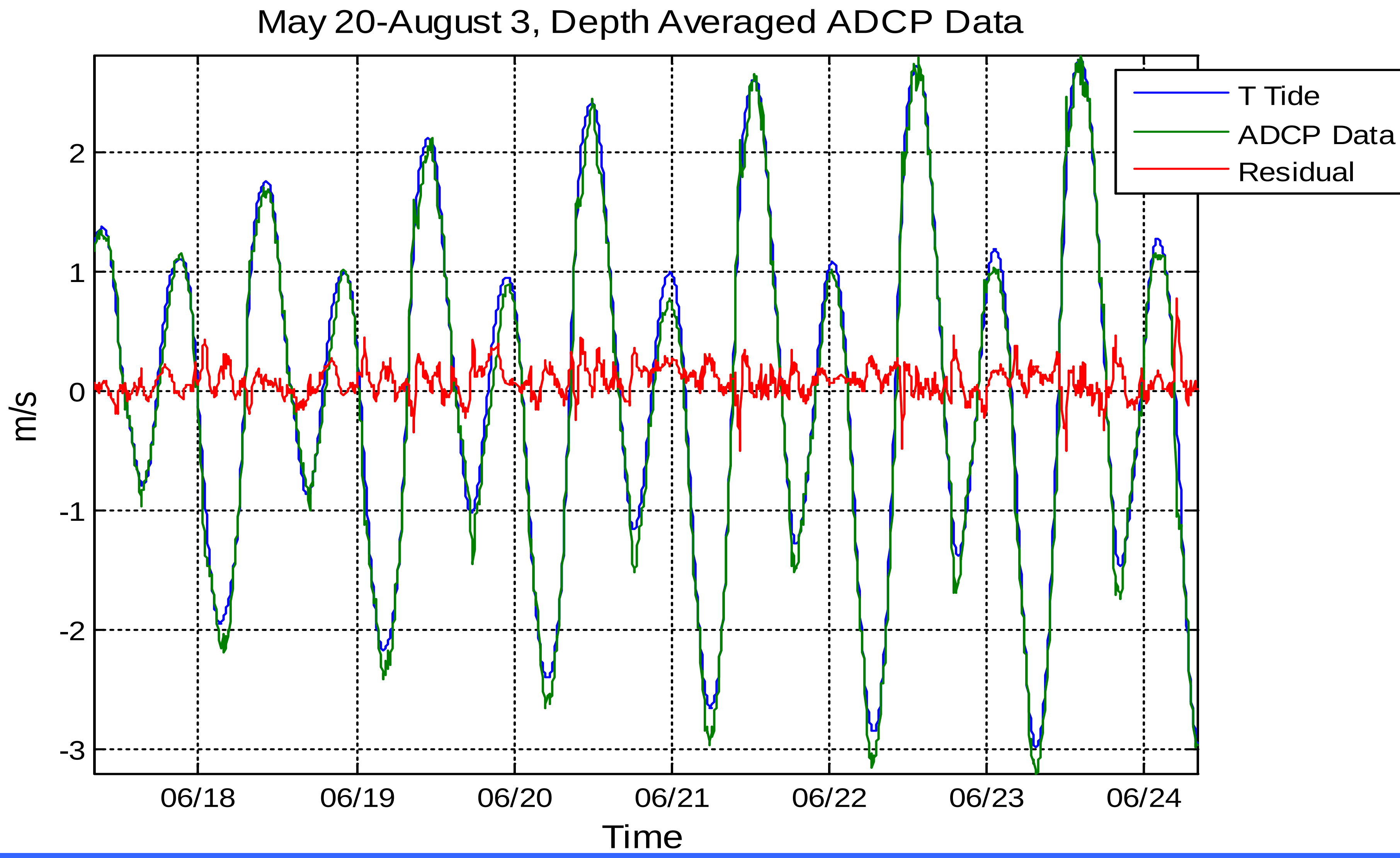
For T < 182 days, K1 contains P1 information

Rayleigh Criterion

Days (T)	# Constituents	Variance Explained
7	8 (5)	93.6 %
15	17 (15)	95.1 %
30	29 (26)	97.9 %
70	35 (32)	98.3 %

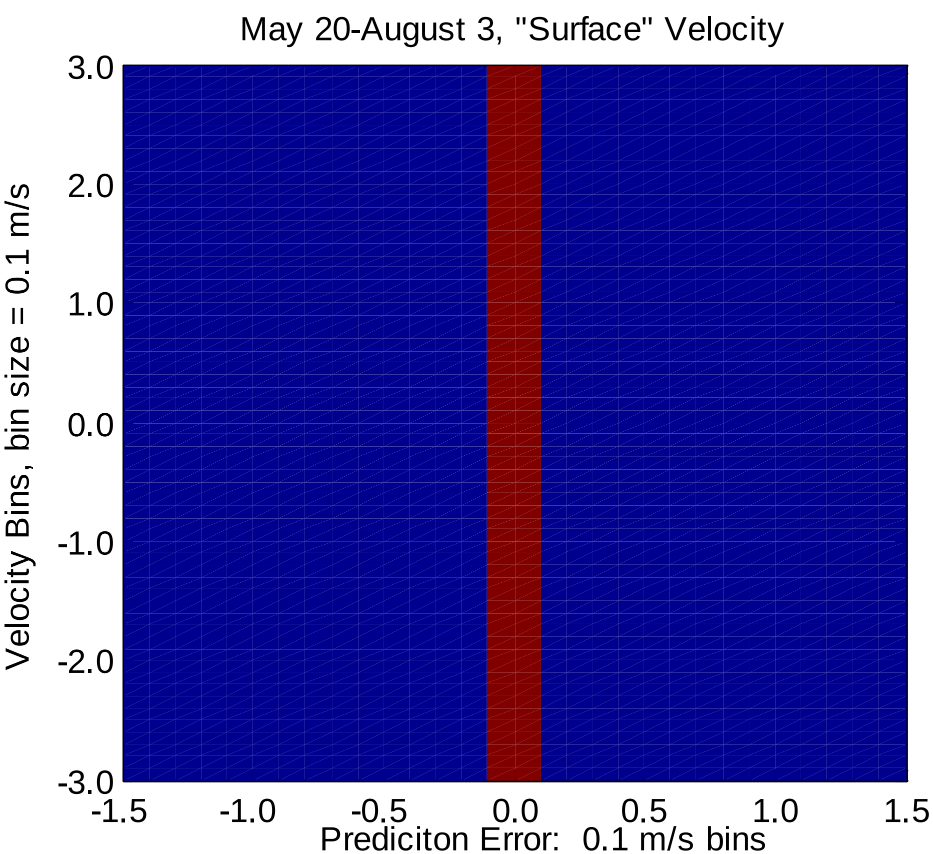
$$Var.Explained = \frac{Variance_{T\_Tide}}{Variance_{Data}}$$

T Tide vs. ADCP

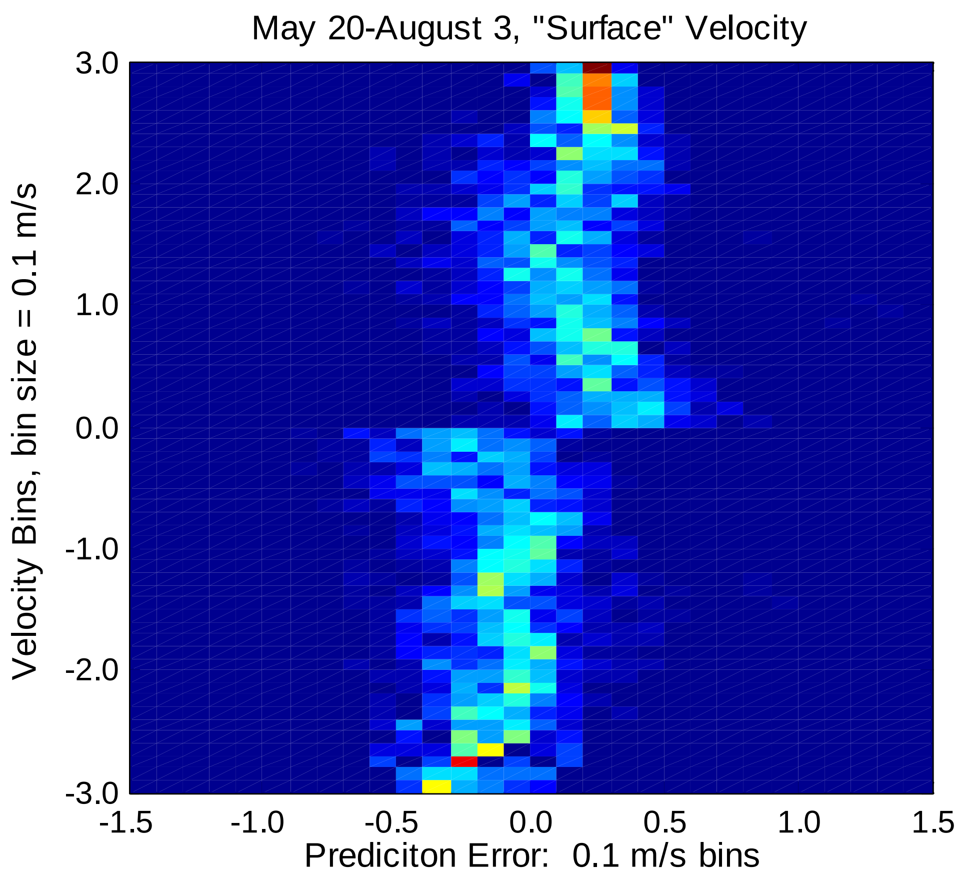


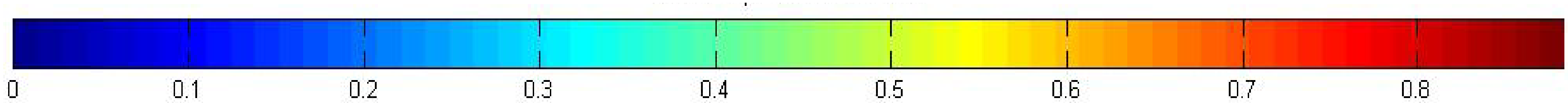
How well does T Tide work?

Ideal Case

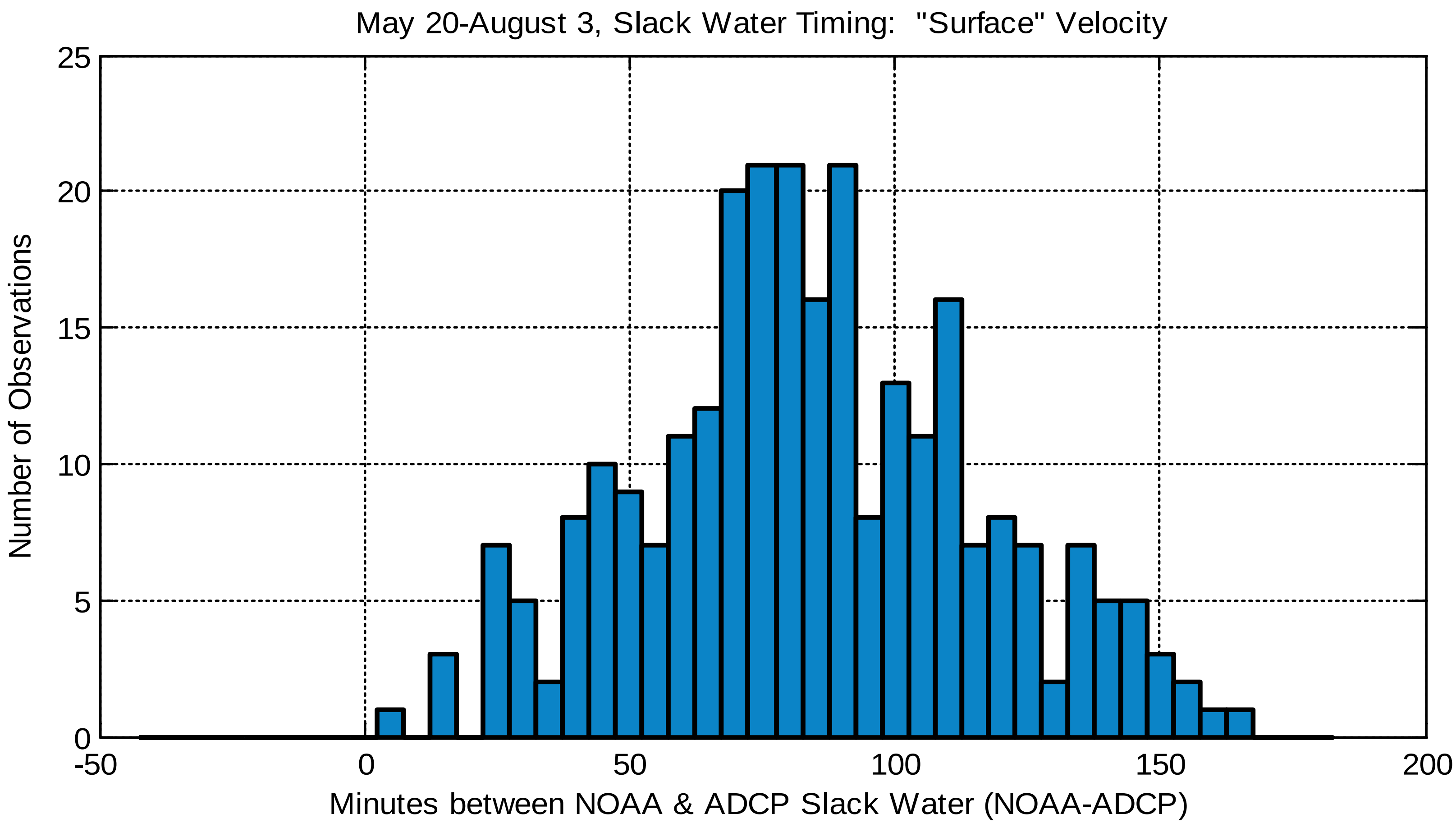


Actual Case





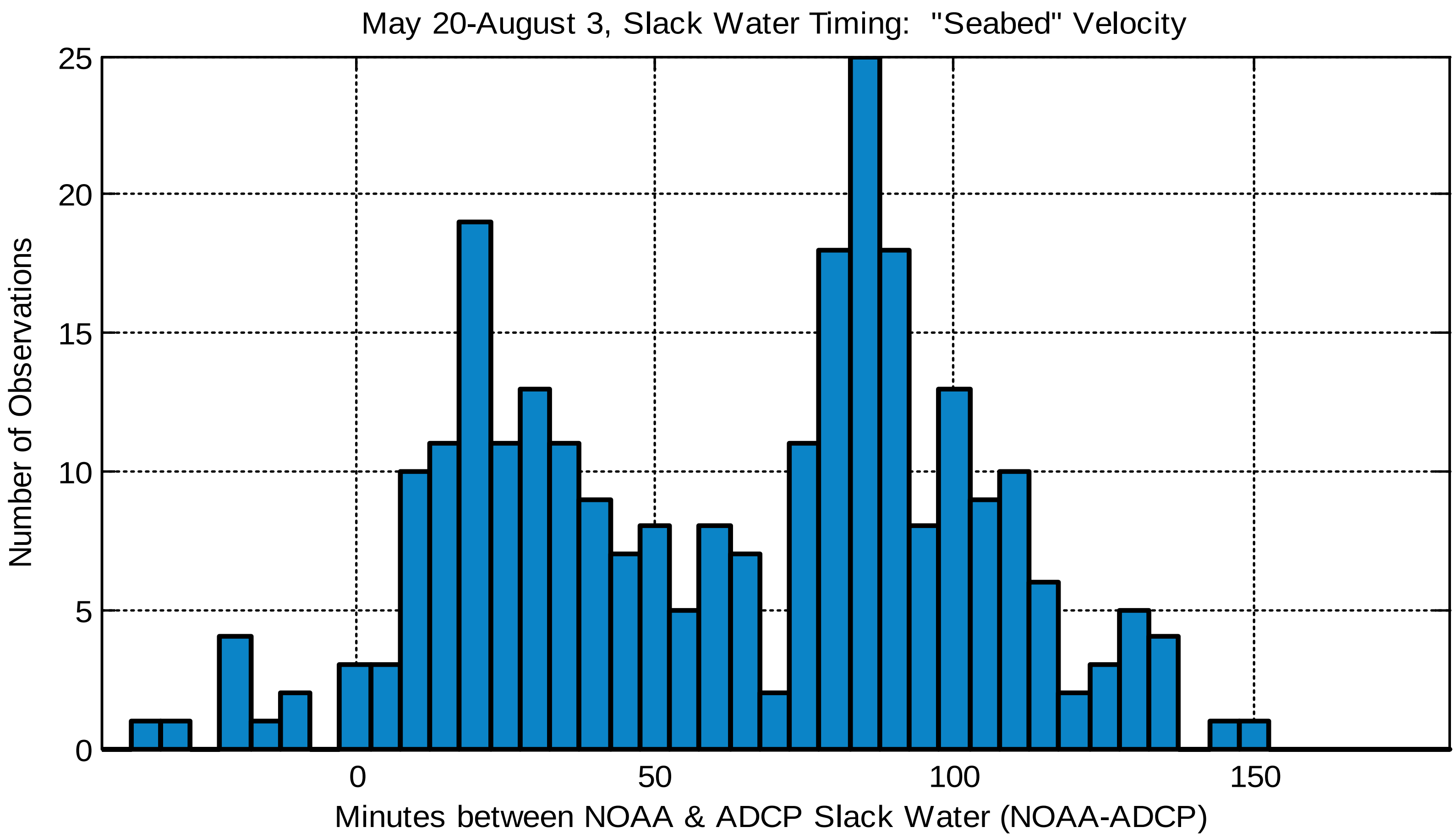
NOAA Predictions vs. ADCP



Flood to Slack: Mean = 92.9 min, Standard Deviation = 37.2 min

Ebb to Slack: Mean = 75.7 min, Standard Deviation = 21.6 min

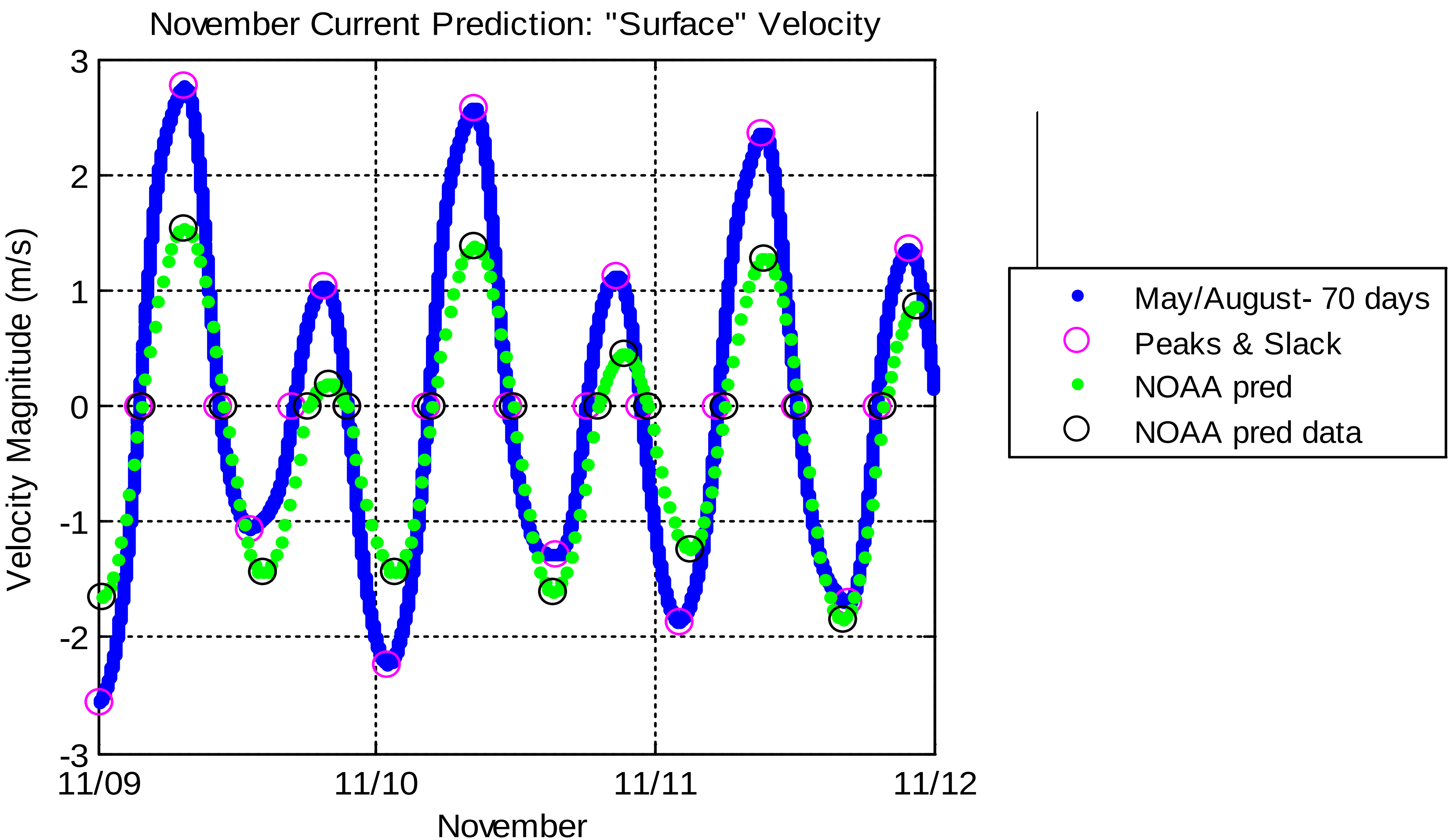
NOAA Predictions vs. ADCP



Flood to Slack: Mean = 31.6 min, Standard Deviation = 26.8 min

Ebb to Slack: Mean = 93.1 min, Standard Deviation = 20.5 min

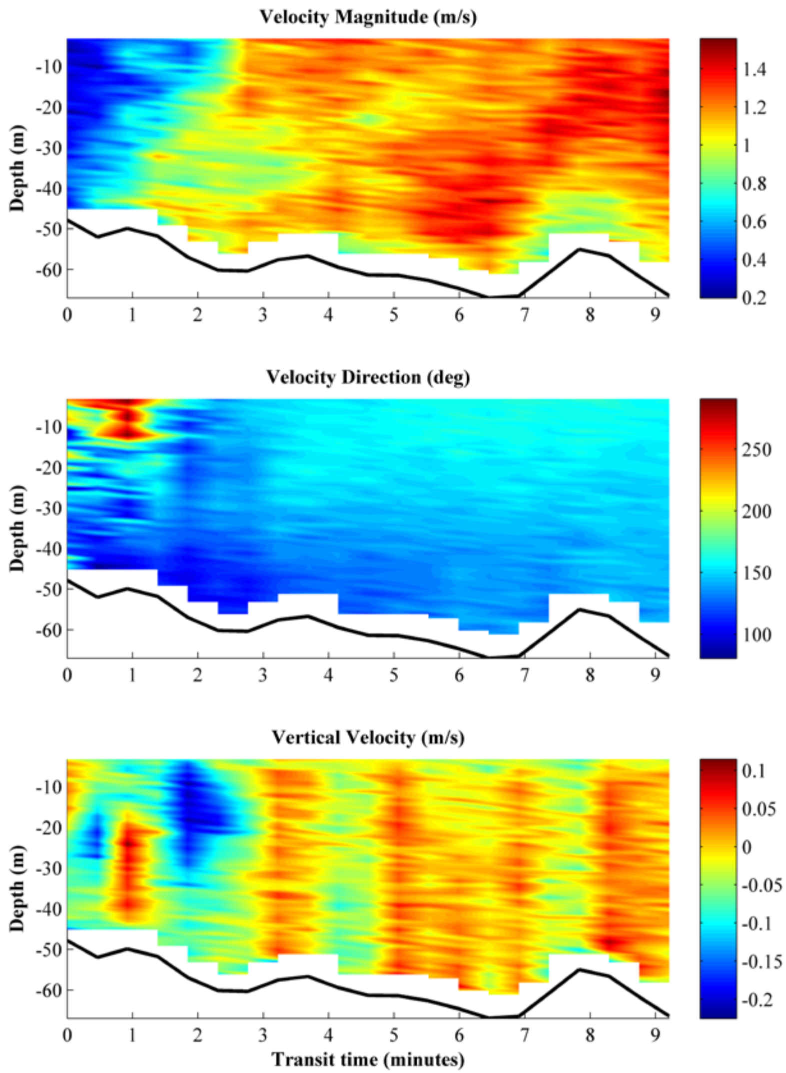
T Tide- November Prediction

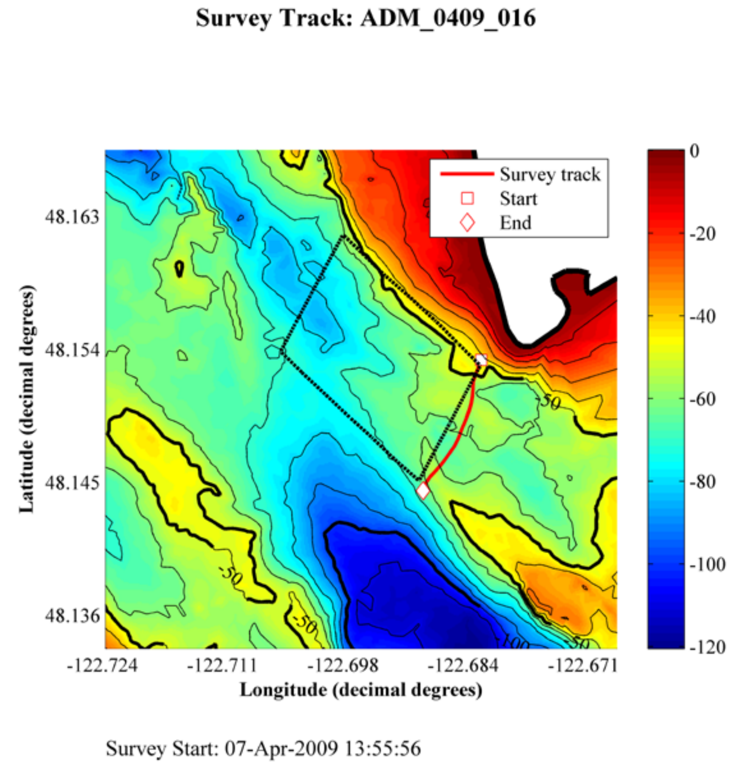


Coming Work

- Fourier analysis of residual between T Tide and ADCP data
- Estimating sea surface height from backscatter intensity

Mobile ADCP Data





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Questions?