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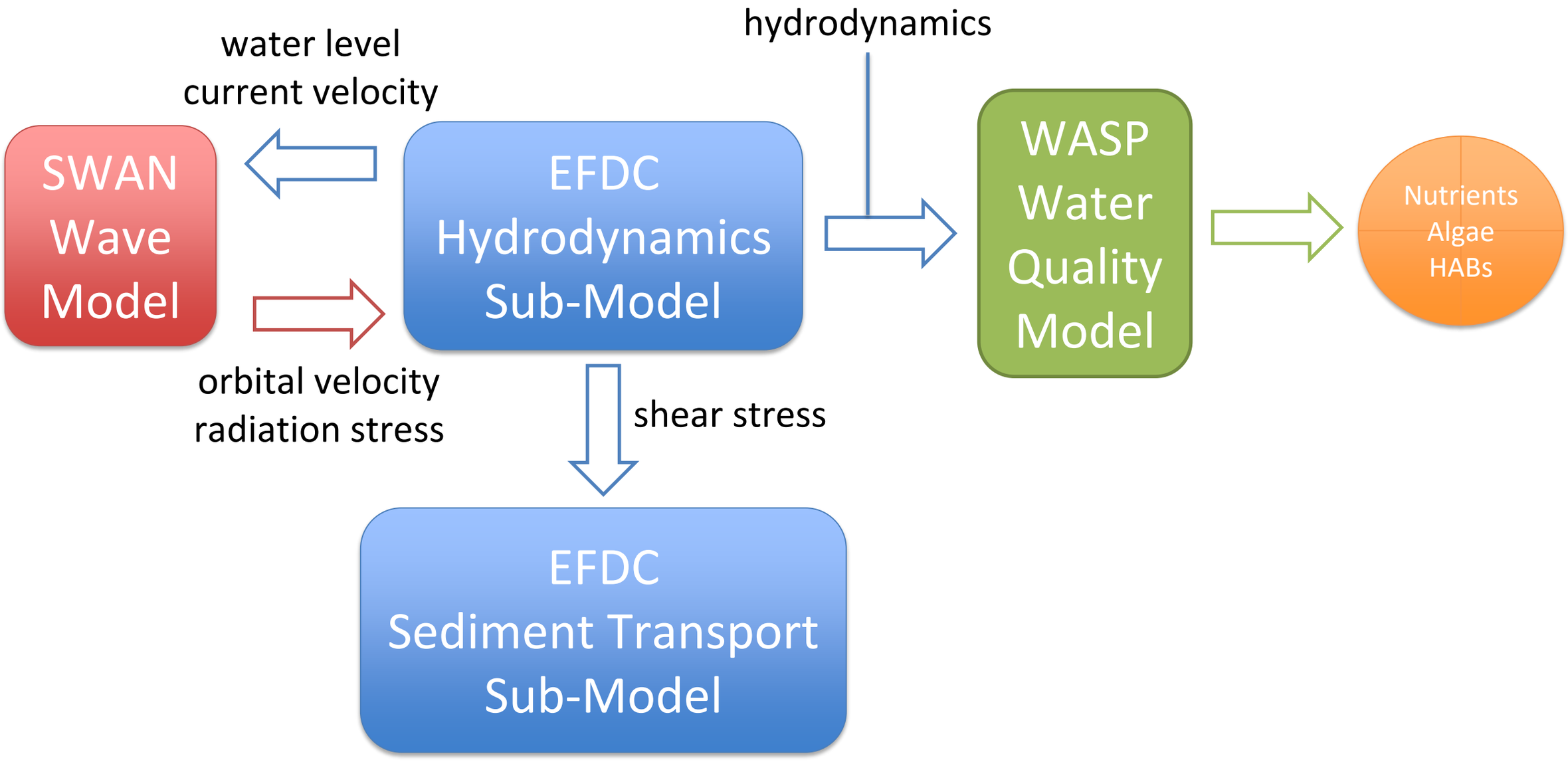
Utah Lake Modeling Update

Nicholas von Stackelberg
Science Panel Meeting 12/10/2019

Topics

1) Lake and watershed modeling update
2) Hydrodynamics and sediment transport data collection update

Lake Model Framework



Lake Model Status

EFDC

- WY2006-2018 model built
- Water depth and temperature calibrated
- Need to build SWAN wind wave model and couple to EFDC
- Need to calibrate sediment transport to observed data

WASP

- WY2006-2015 model built
- Coupled to EFDC through hydrodynamic linkage
- Need to correct run time issues with sediment diagenesis routine in WASP8 linkage to EFDC
- Prescribed fluxes for SOD and sediment nutrients per Hogsett et al. 2019
- Annual average atmospheric deposition per Brahney 2019

Model Calibration Report

- Under development - estimated delivery February 2020

Watershed Model Status

- University of Utah watershed models
  1) DHSVM - Headwaters
  2) SWMM – Urban catchments
  3) GoldSim – Water demand systems model
- Model framework limitations
  - Upper Provo River watershed above Deer Creek Reservoir not simulated
  - Headwater nutrient loading not simulated
  - Nutrient transformations within tributaries not simulated
  - Limited calibration of SWMM loading due to lack of observed data
- Likely will not meet the needs of the Utah Lake Water Quality Study

Watershed Model Need

➢ Numeric Nutrient Criteria Development

1) Backcast pre-European settlement nutrient loading
   - *Can statistical methods (i.e. Olson and Hawkins 2013, SPARROW) be employed, rather than mechanistic model?*
2) Stressor-response loading analysis
   - *Can boundary loadings be adjusted without identifying the source of the reduction?*

➢ Implementation

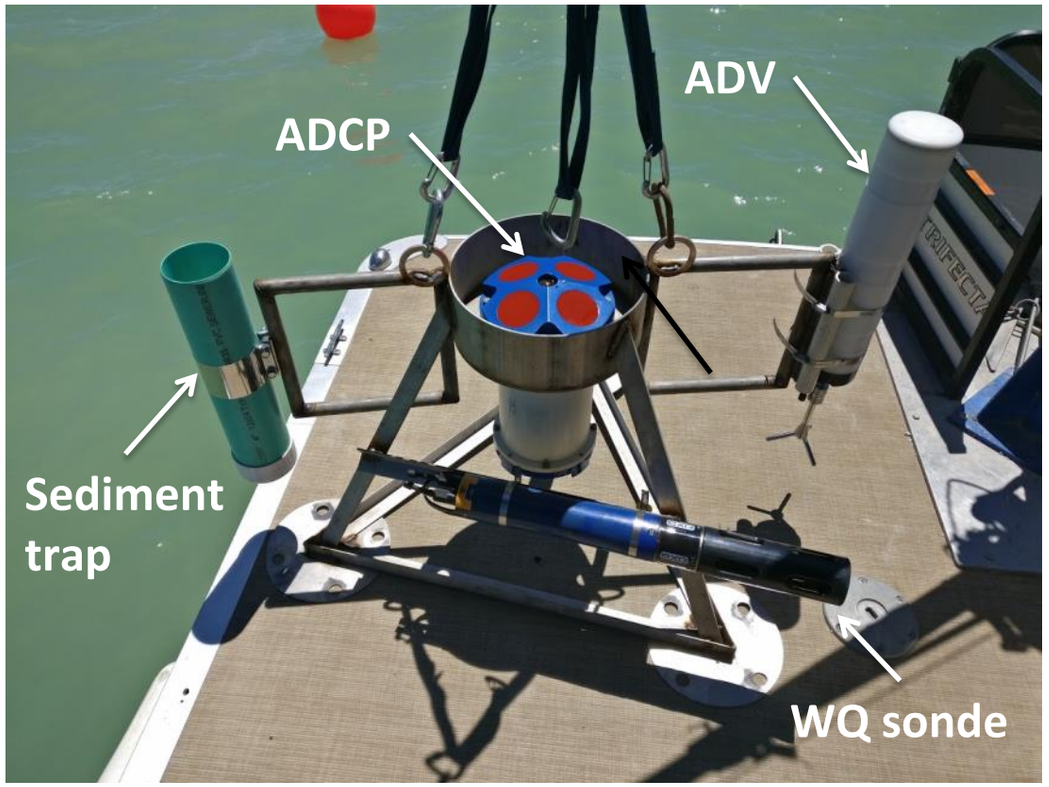
1) Load allocation scenarios including treated wastewater, stormwater and agricultural nonpoint source
2) Stressor-response loading analysis

Modeling Proposed Next Steps

- Lake Model
  - Receive model from University of Utah – estimated January 2020
  - Identify gaps and needs (i.e. bioturbation, calcite scavenging)
  - Procure consultant support
- Watershed Model
  - Model selection process - summer 2020 after adoption of nutrient criteria technical framework
  - Model development – initiate after model selection

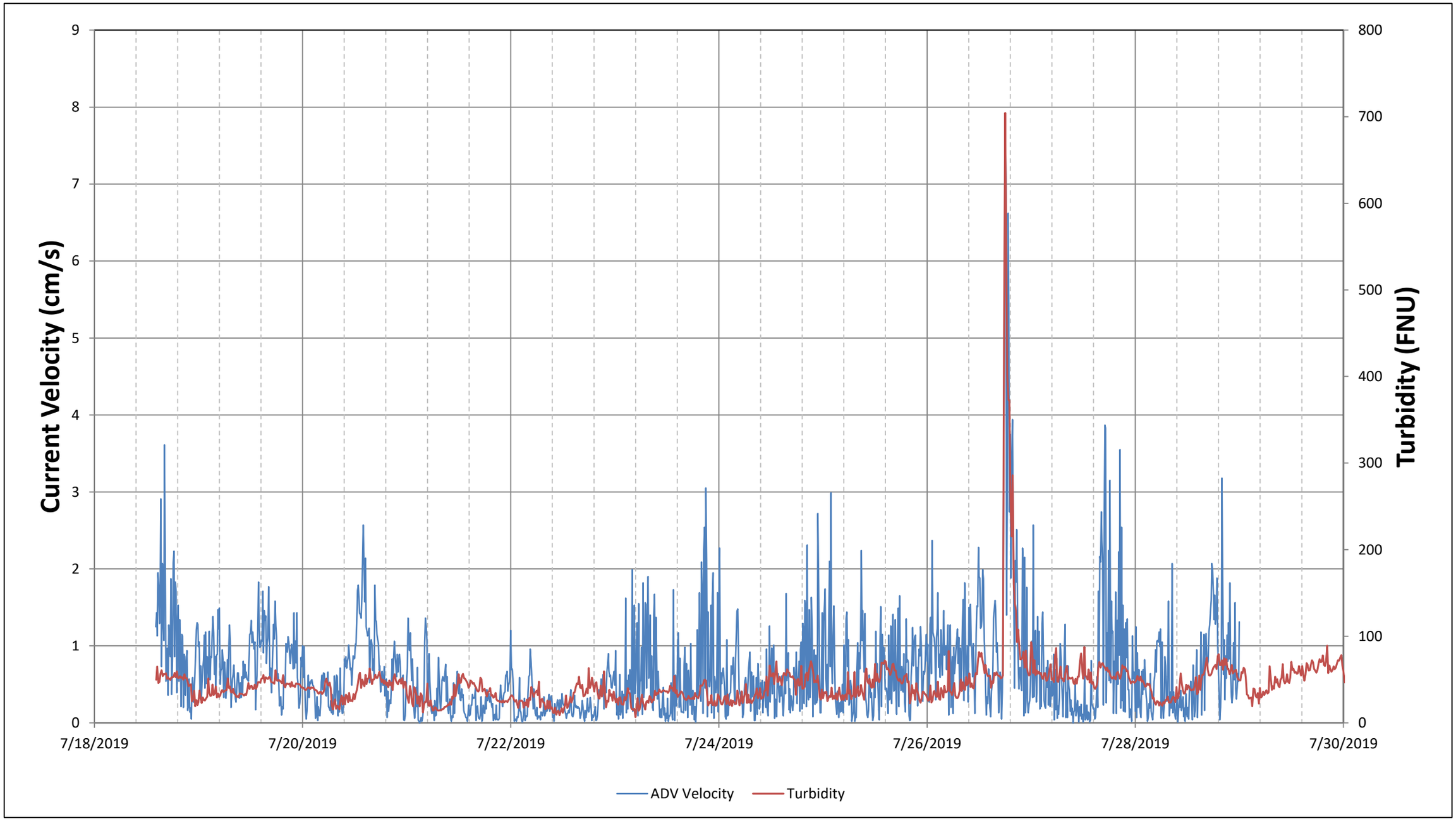
Data Collection for Hydrodynamic and Sediment Transport Modeling Update

- Instrument deployment at 2 sites – continue in spring
  1) North Lake Site – near American Fork Marina
  2) Provo Buoy Site – near Utah Lake State Park Marina
- Sediment cores from 5 sites analyzed by Dr. Goel's lab
  1) Bulk density
  2) Organic content
  3) Grain size distribution
  4) Mineralogy – to be completed



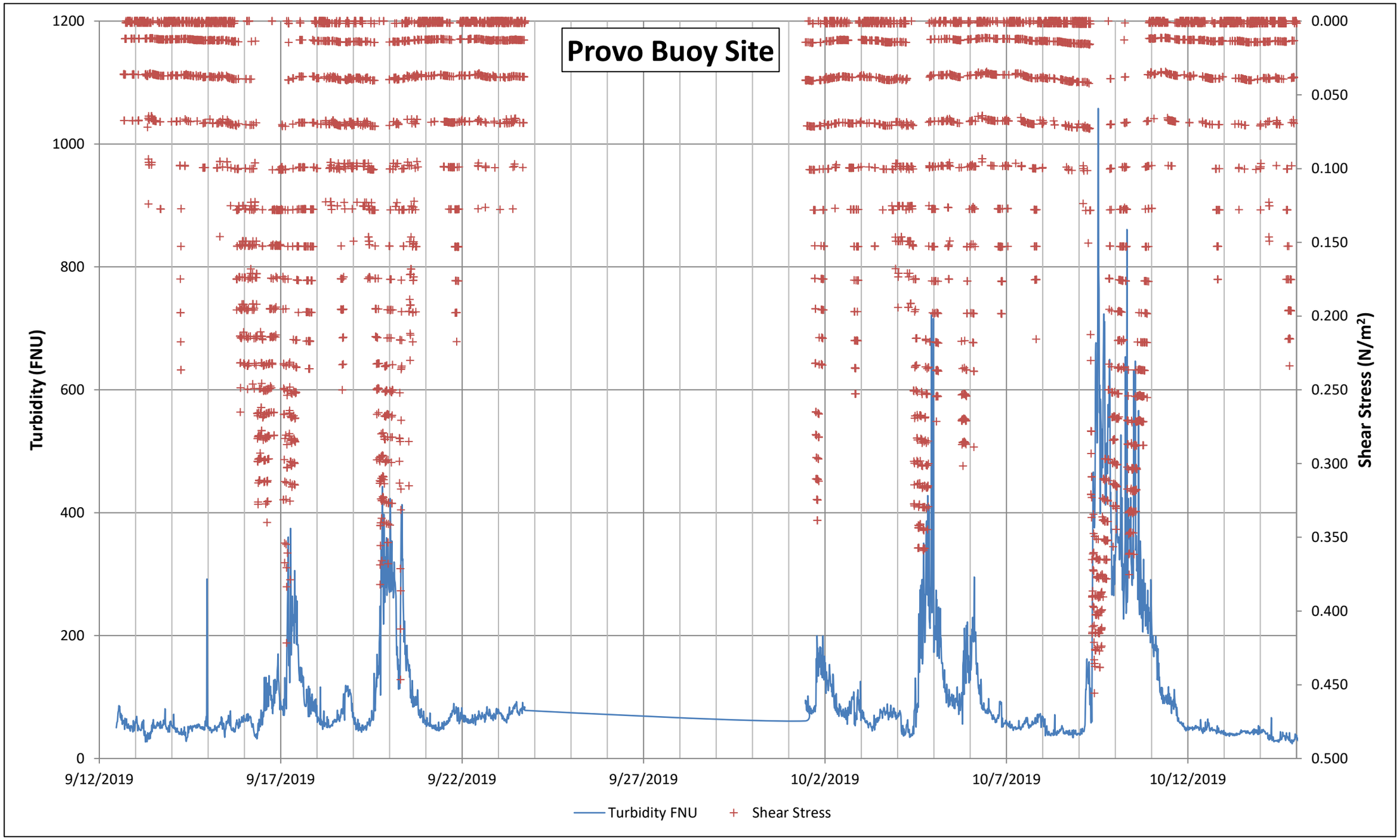
Lake Bottom Lander

Turbidity vs. ADV Current Velocity



Evidence of dependence of turbidity on near bottom water velocity

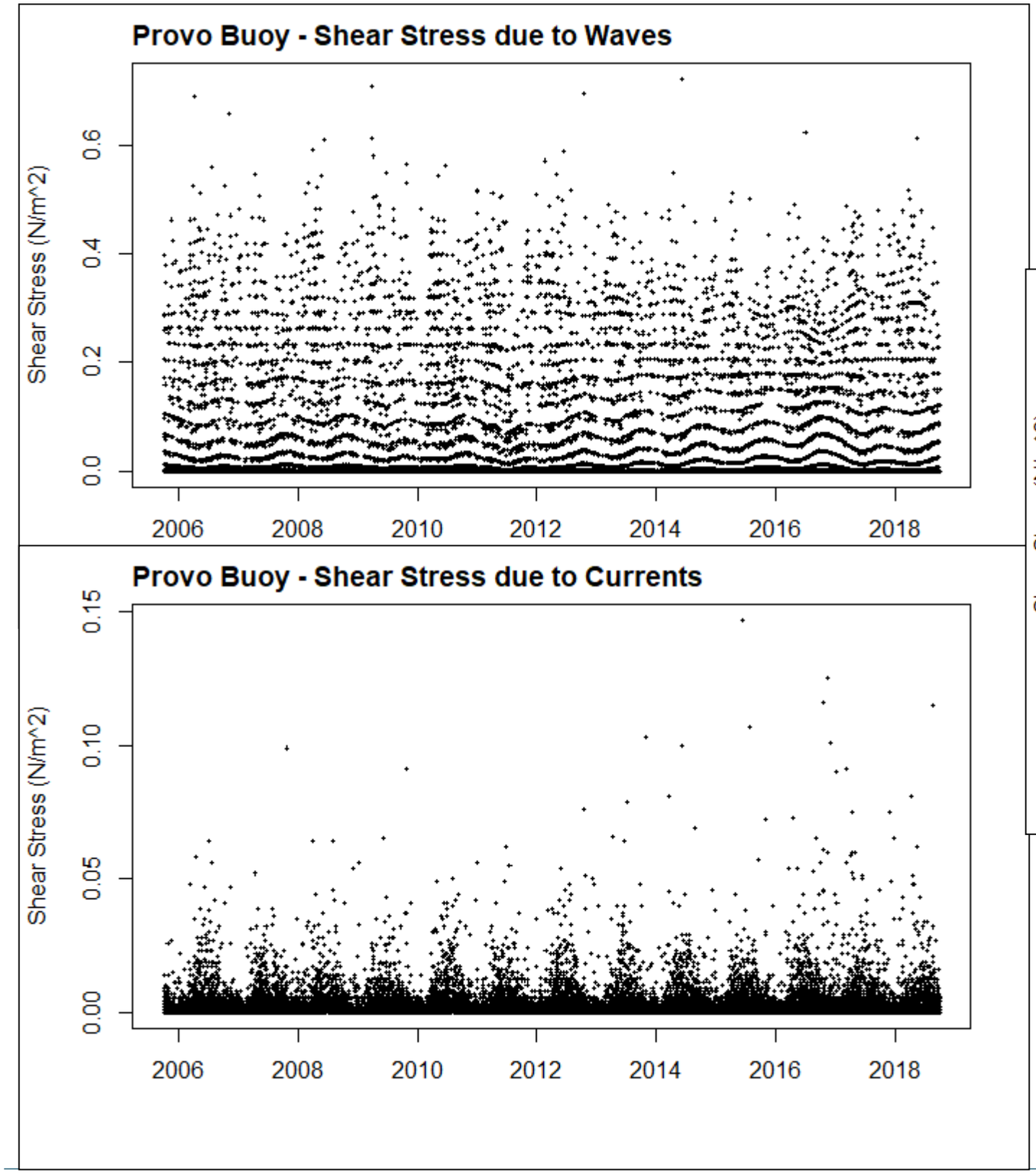
Lake Bottom Turbidity vs. Shear Stress Due to Wave Action

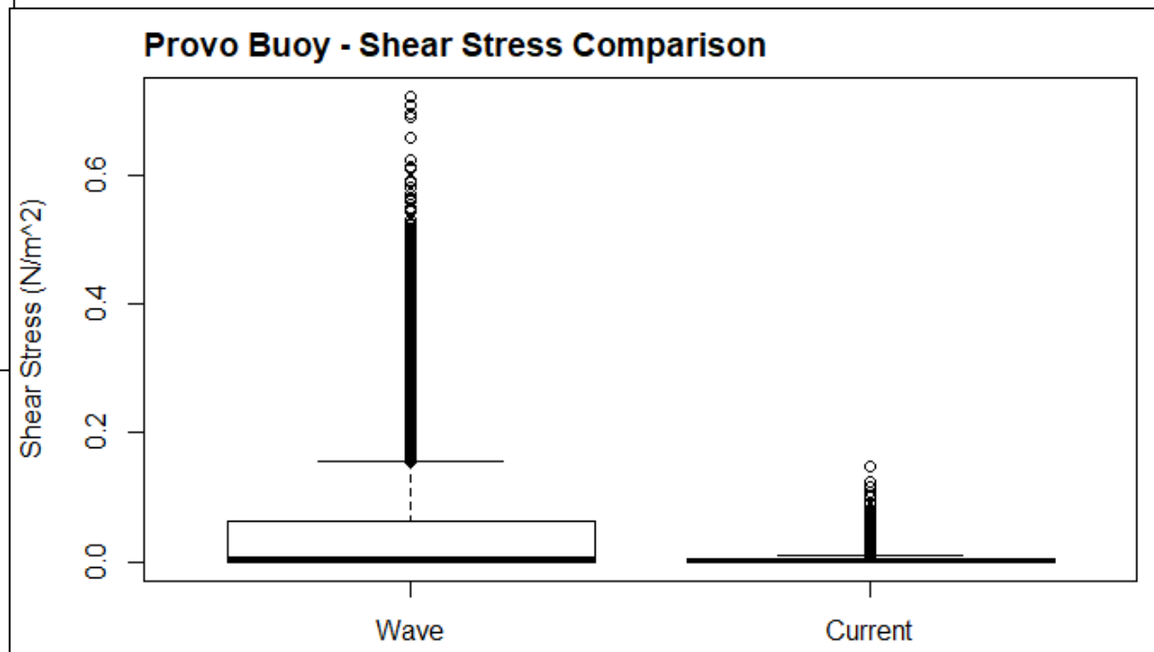


Evidence of dependence of turbidity on shear stress

Appears to be a threshold shear stress ~ 0.35 N/m^2

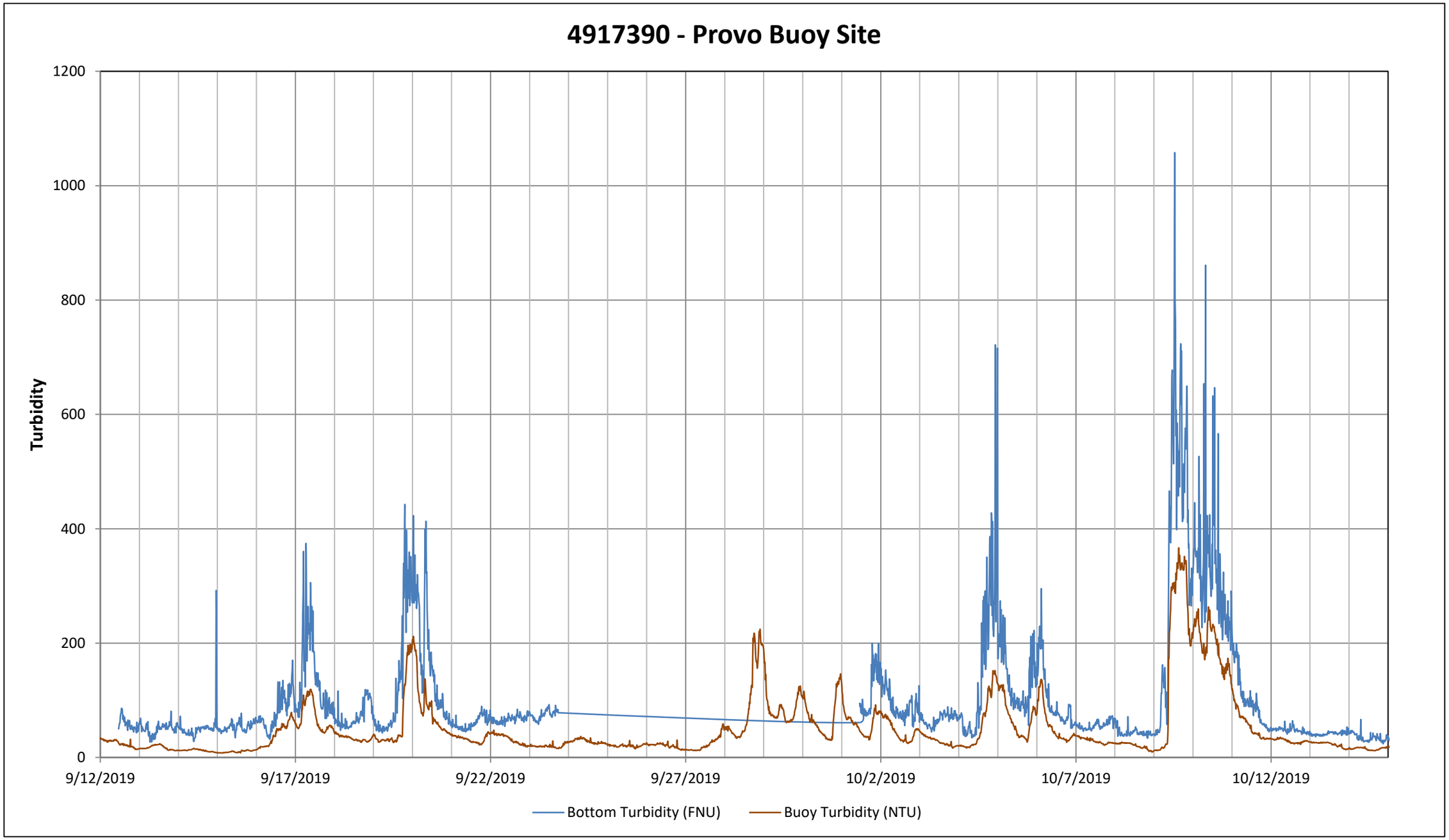
Shear Stress on Lake Bottom





Shear stress due to wave action an order of magnitude greater than due to current velocity

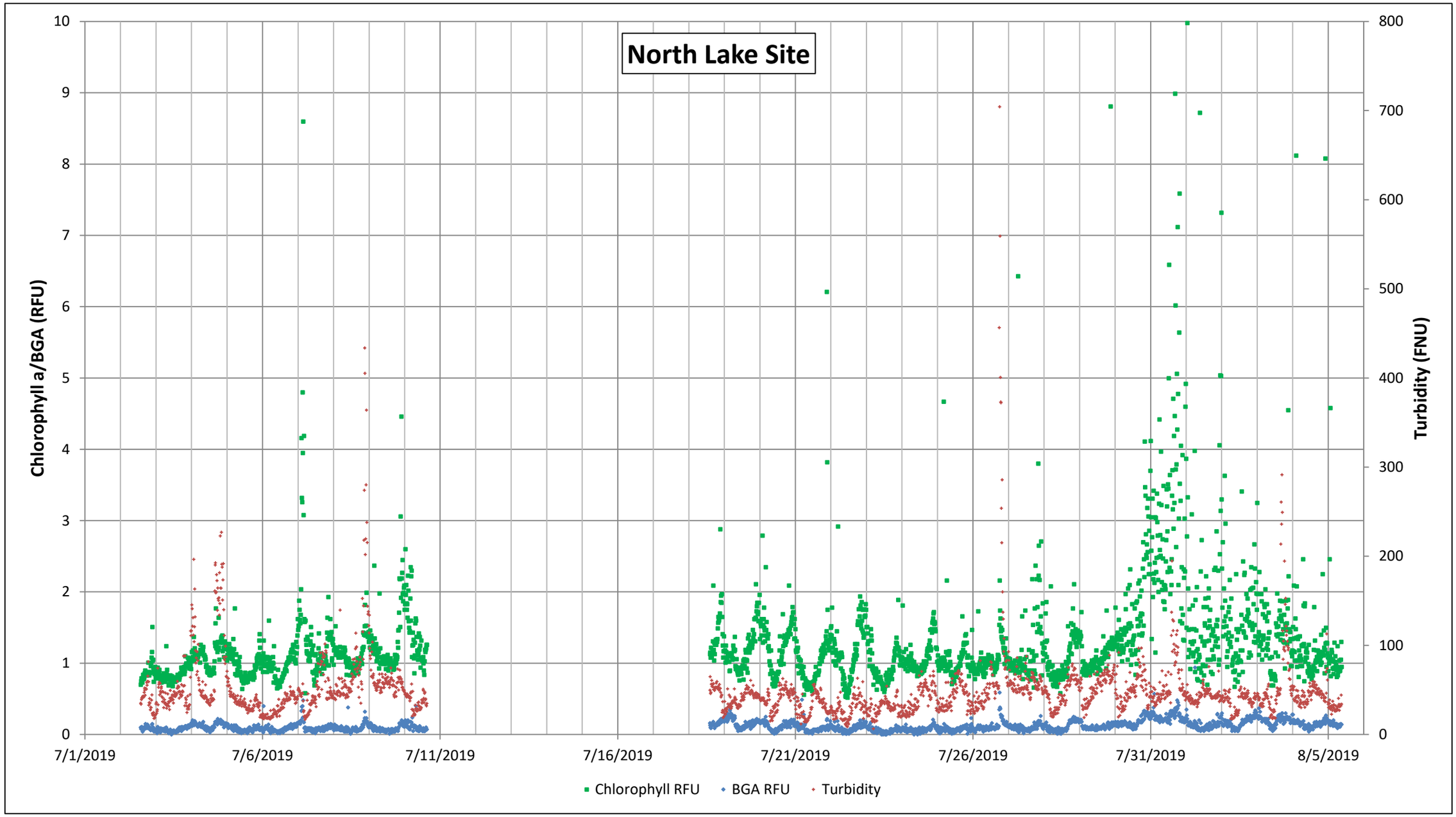
Surface vs. Bottom Turbidity



Offset in turbidity between lake surface and lake bottom

Lake is well-mixed

Turbitity, Chlorophyll a and Phycocyanin at Lake Bottom



Evidence of algal and cyanobacterial growth near lake bottom

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