Sediment flux in the southern reach of San Francisco Bay: Implications for habitat restoration

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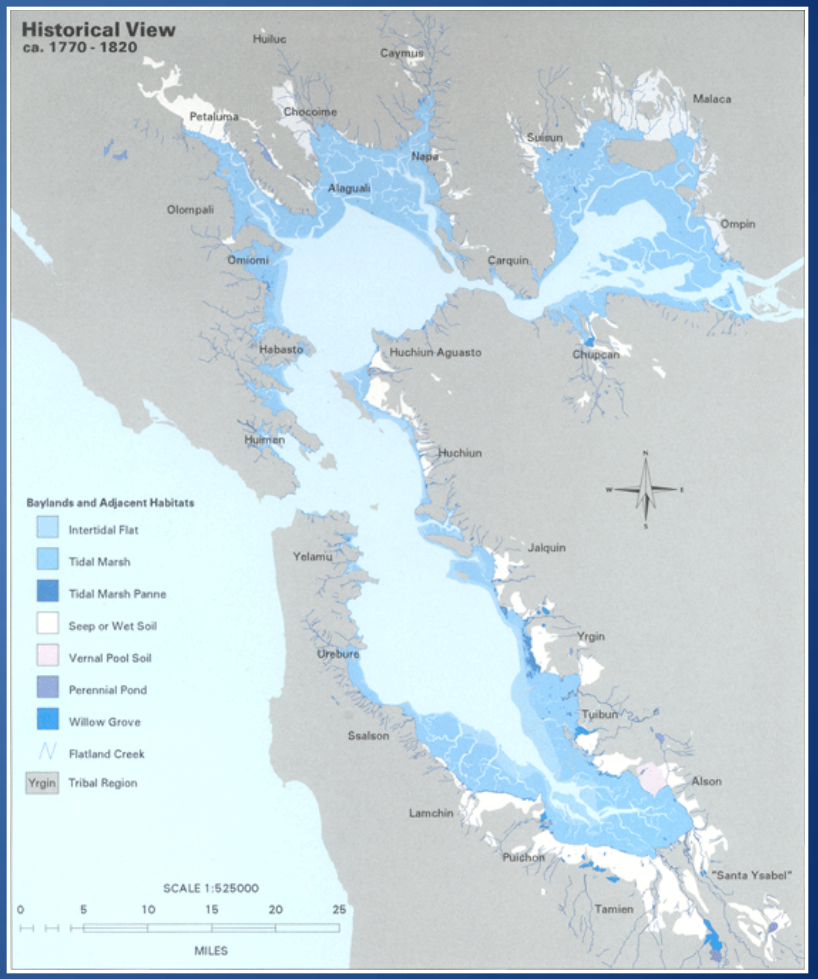
Background

- San Francisco Bay (SFB) has lost >85% of historic tidal marsh
  - Bay margins diked for agriculture and salt production
- South Bay Salt Pond Restoration Project
  - Over 6,000 hectares of former salt evaporation ponds
  - Planned for mix of tidal wetlands and managed ponds
- Several of the ponds are severely subsided



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Motivation

- South Bay Salt Pond Restoration Project
  - –32 million m^3 sediment needed to fill subsided ponds to MTL
- Direction of sediment flux unknown for far south SFB
  - –Jaffe *et al.* suggest it is generally to the south in this reach
- Sediment seasonality and sources to far south SFB
  - –Winter (wet season) input
    - Two local tributaries (important on decadal-scale)
    - Sacramento & San Joaquin Rivers (importance unknown)
  - –Summer (windy) redistribution
    - Extensive mudflats

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Study Design

- **Flux:** Dumbarton Bridge (15-min. interval)
  - ADCP for index velocity, stage, and backscatter
  - Two turbidity probes: 4’ and 25’ above bottom
  - Barometer
- **Flux:** Boat-based discharge and EDI sediment sampling for calibration (monthly)
- **Input:** Sediment measured on 2 major tributaries (daily)
- **Processes:** Adjacent mudflat (15-min. interval)
  - High-accuracy pressure transducer for waves
  - CTD + turbidity

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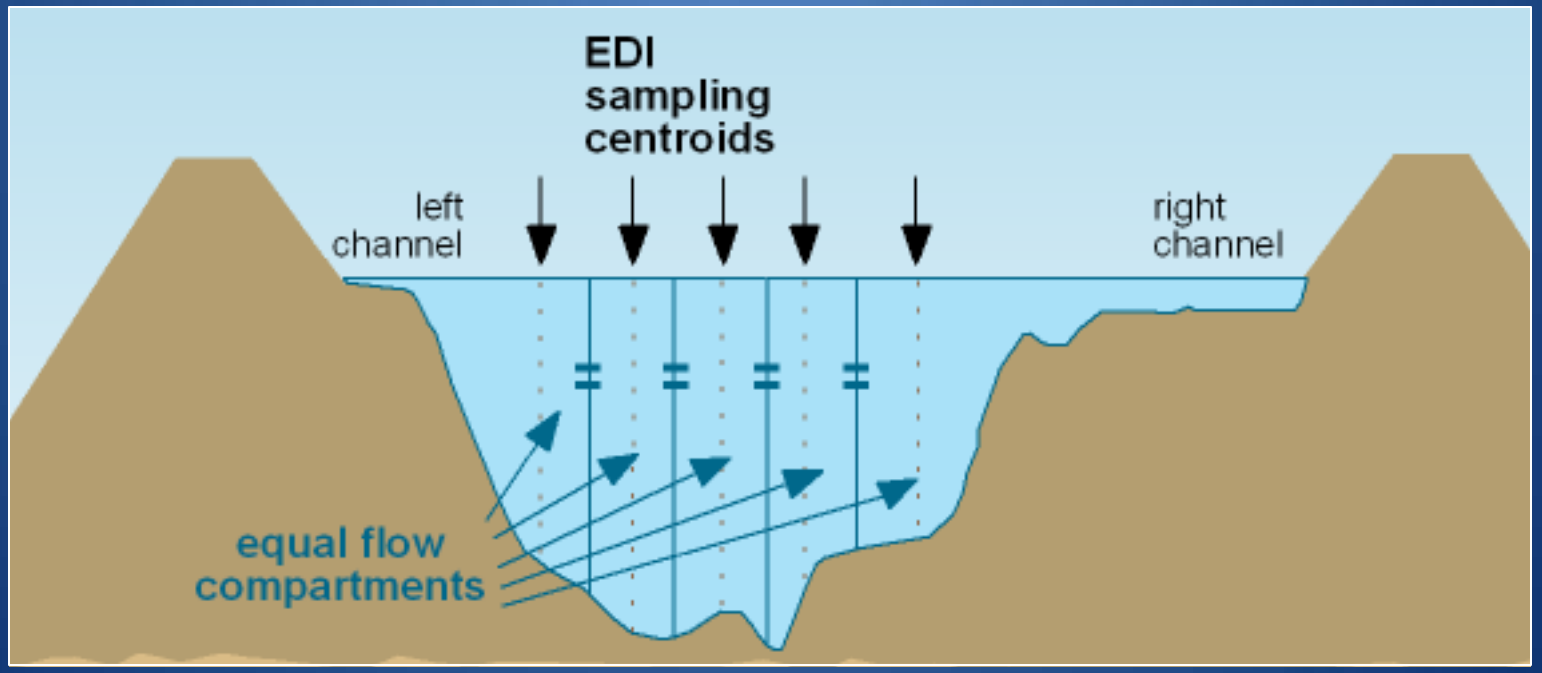
Equal Discharge Increment (EDI) Sampling

- Flow centroids determined for channel cross-section
- Depth-integrated sediment samples collected from center of each centroid



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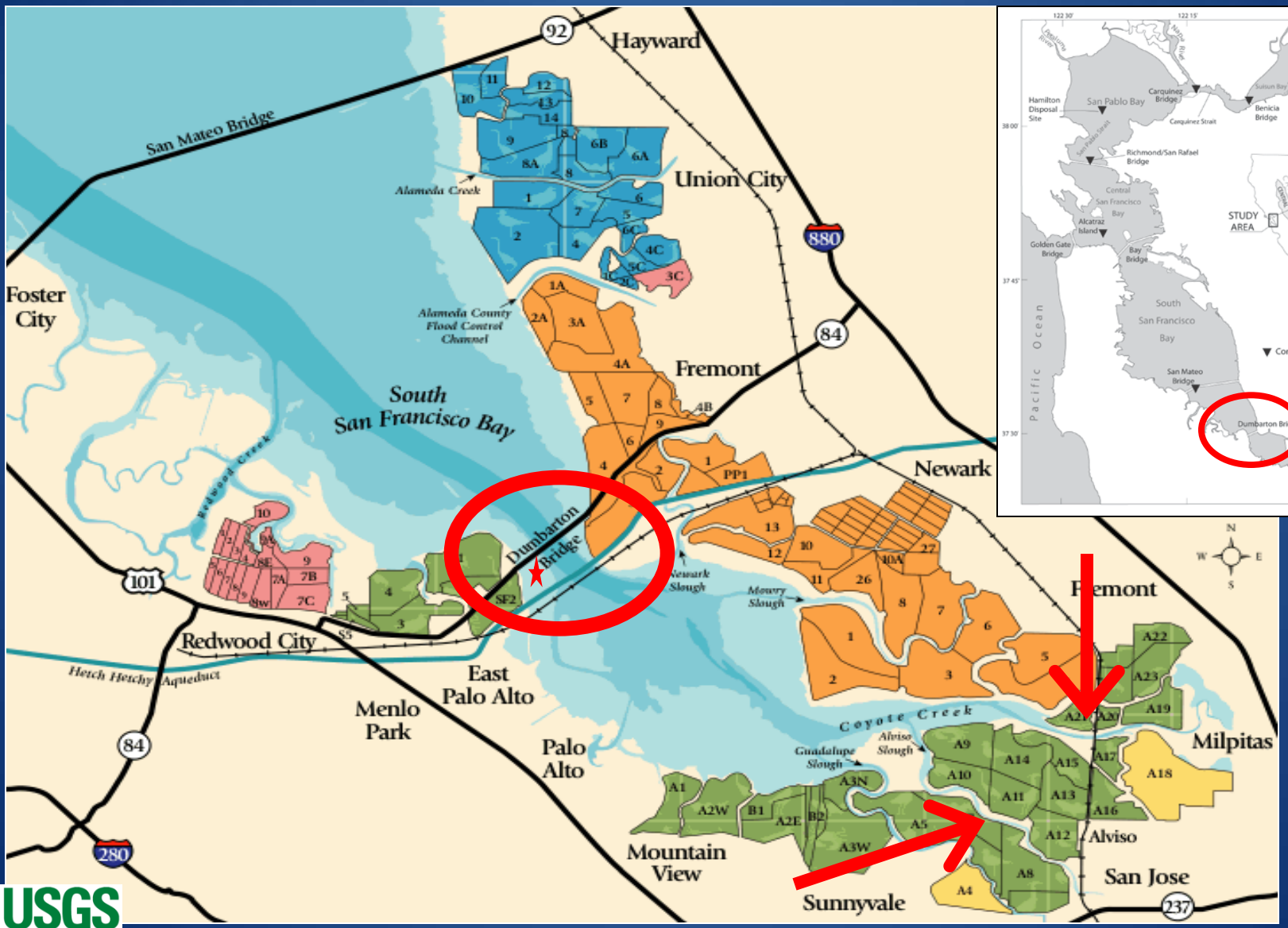
Study Area



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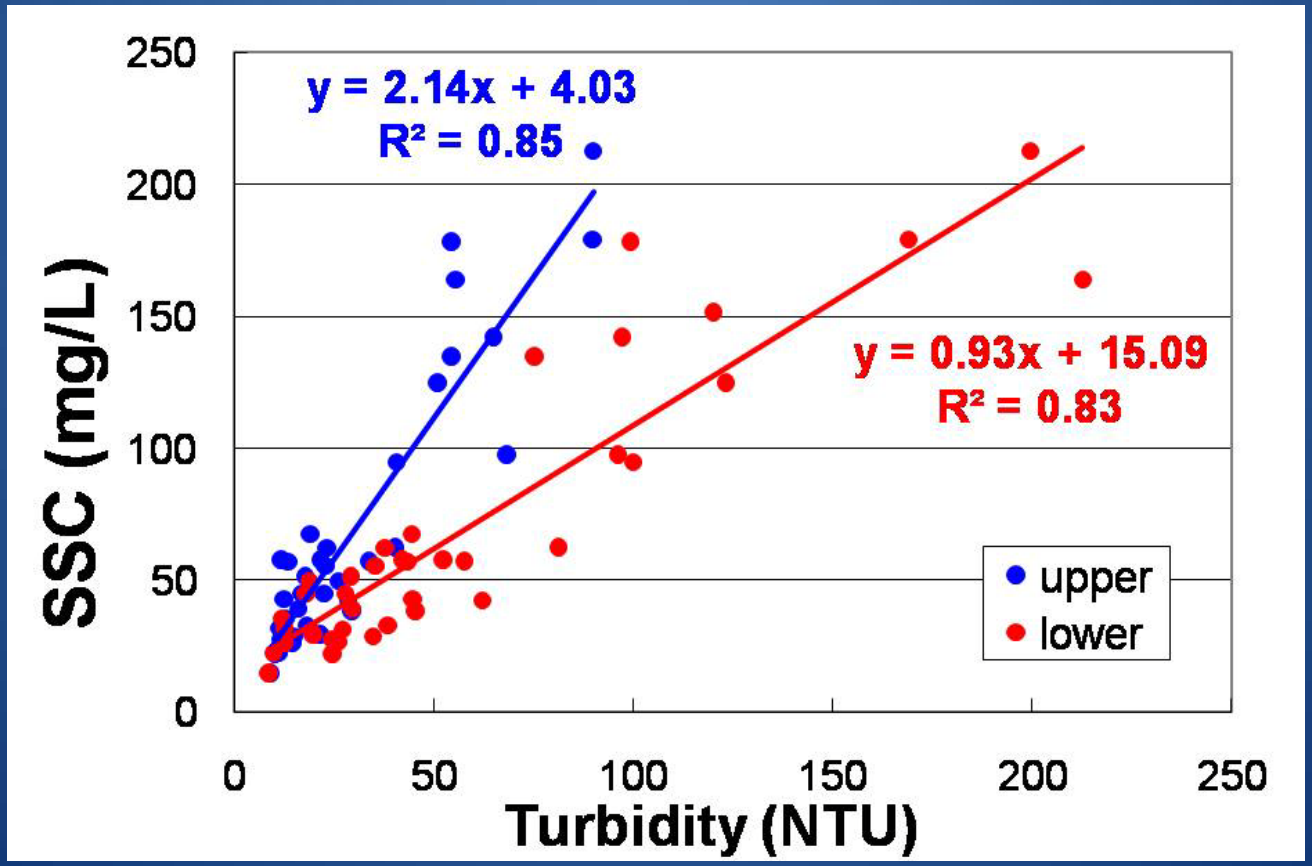
Results - Calibration

- Discharge (bridge vs. boat): y = 0.983 X - 26.7 r^2=0.984
- Suspended-sediment concentration (SSC, from EDI):



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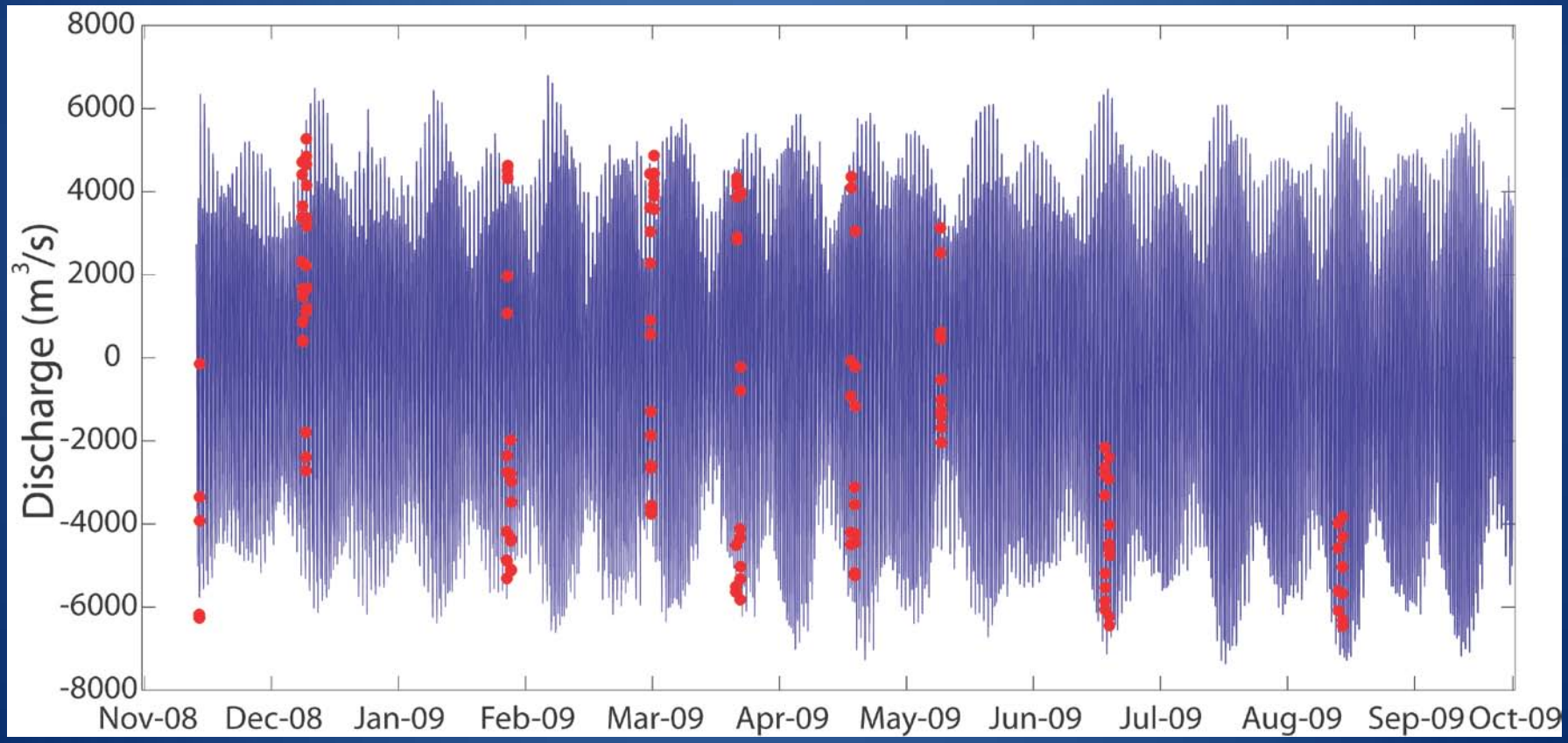
Results – Continuous Discharge

- Positive is ebb tide direction



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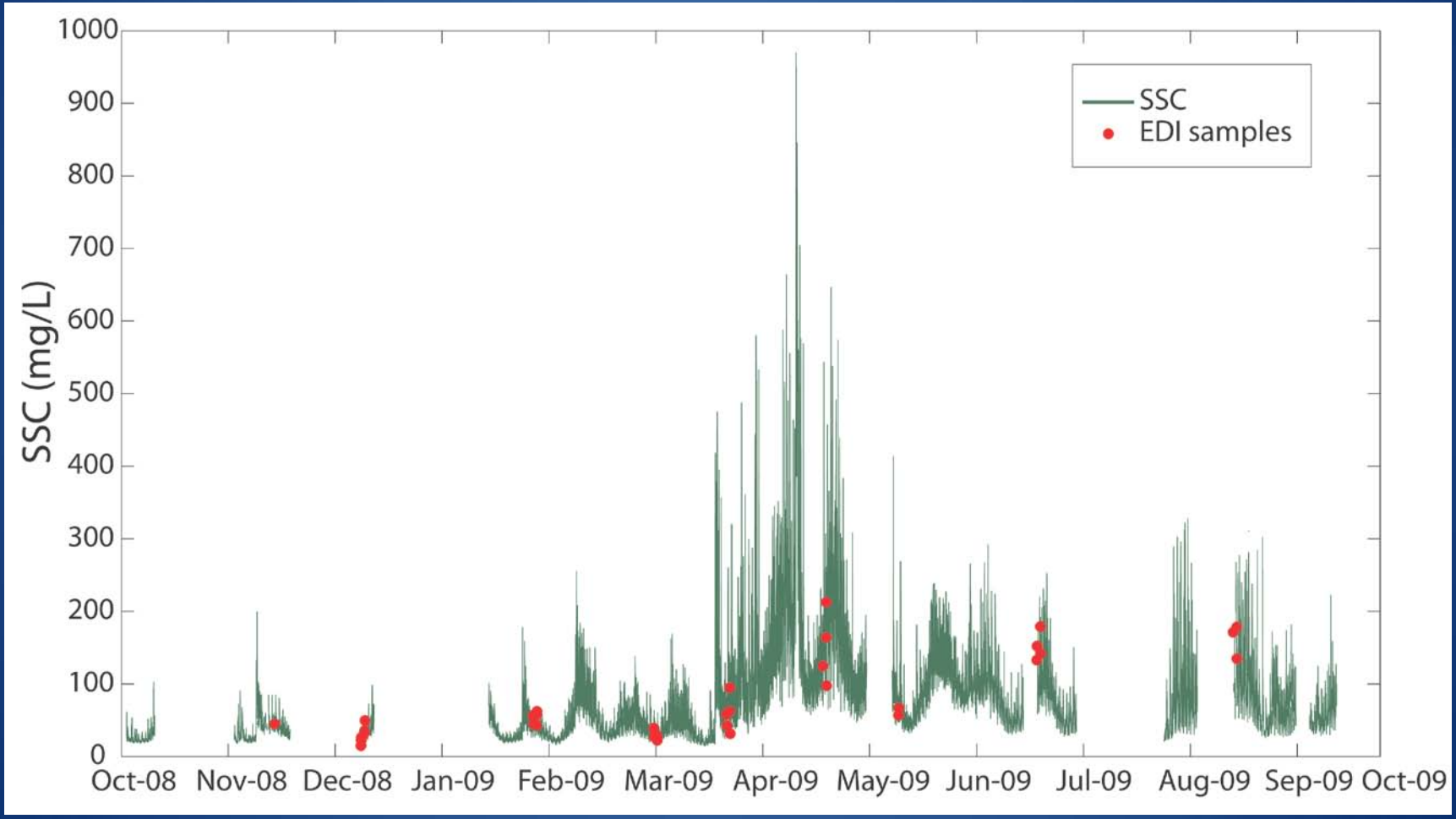
Results – Continuous SSC



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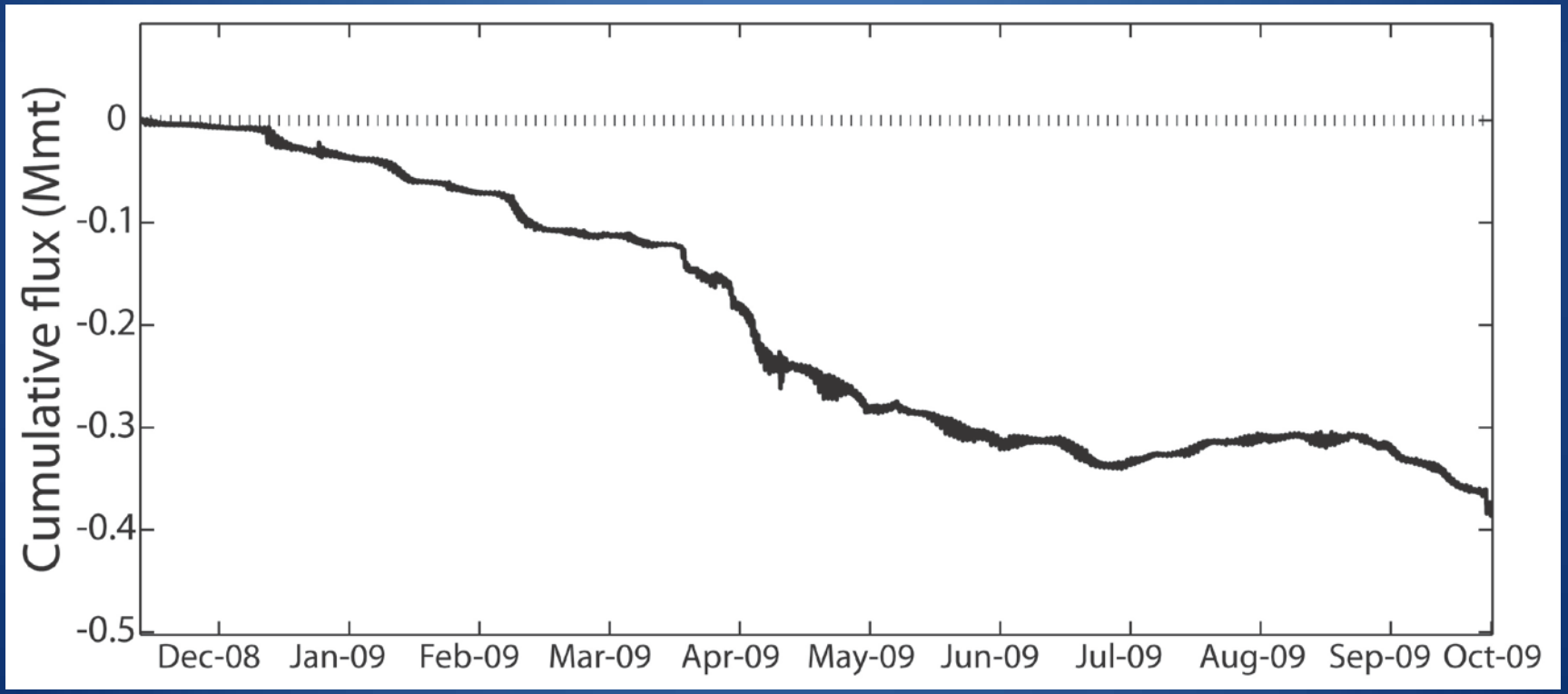
Results – Cumulative Sediment Flux

- Negative is flood direction (into far south SFB)



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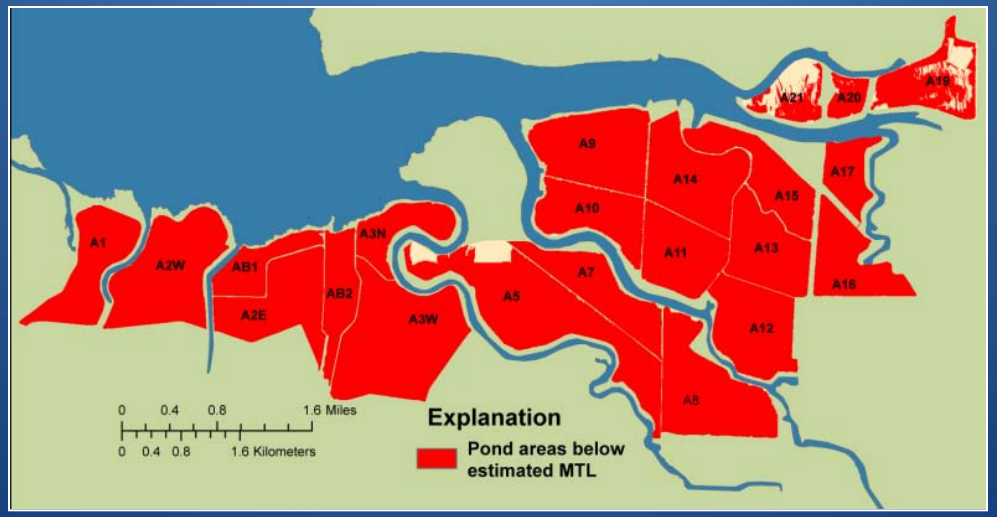
Results – Time for Restoration

- Suspended-sediment flux
  - –Tributary input: 20,000 m^3/yr
  - –Past Dumbarton: -617,000 m^3/yr
- Approximate time to fill subsided volume (32 Mm^3)
  - –Tributaries input: 1,600 yrs
  - –Past Dumbarton: 50 yrs



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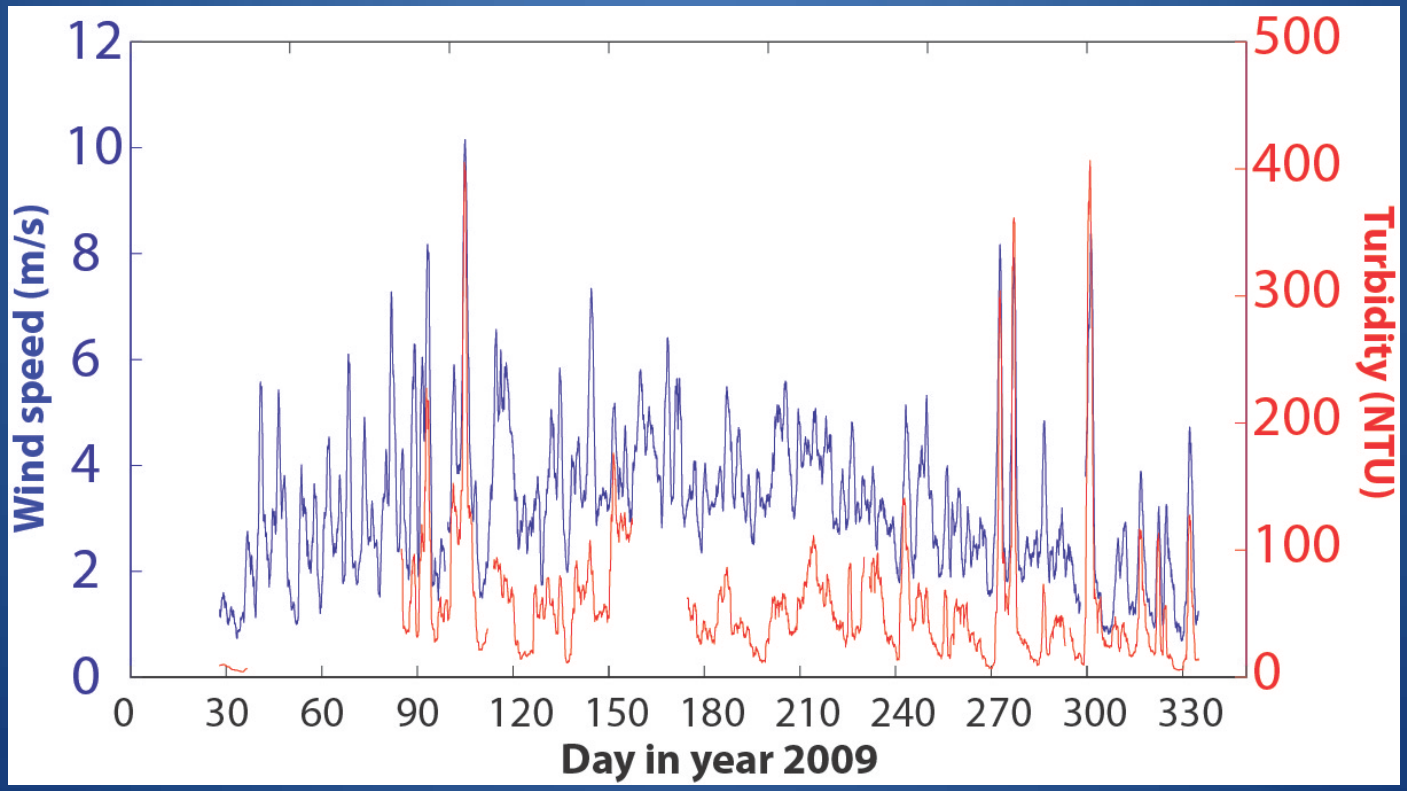
Results - Processes

- Spring-neap tidal signal (higher shear during spring tides)
- Seasonal signal (strong diurnal summer winds)



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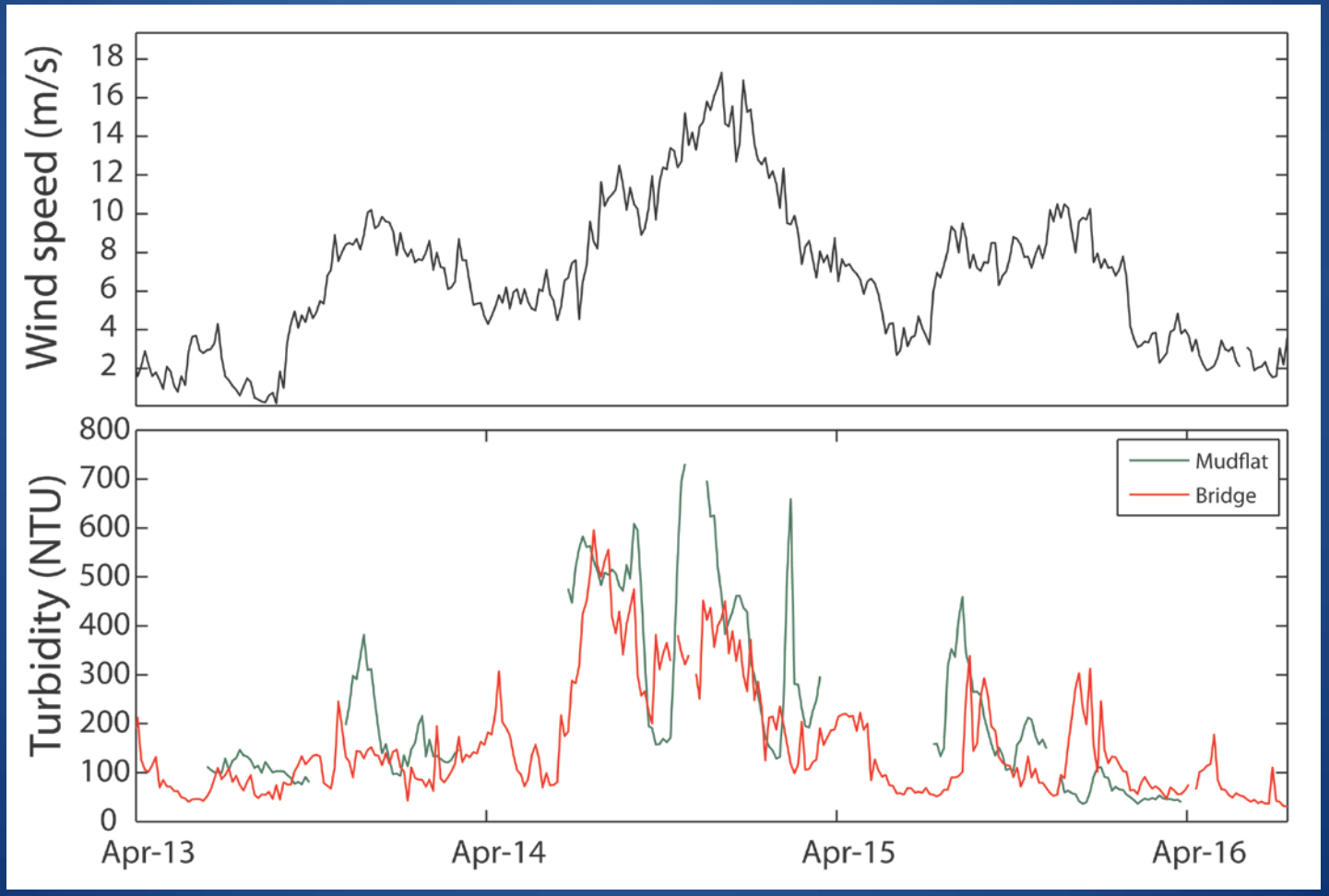
Results - Processes

- Sustained winds appear to be important for increased SSC



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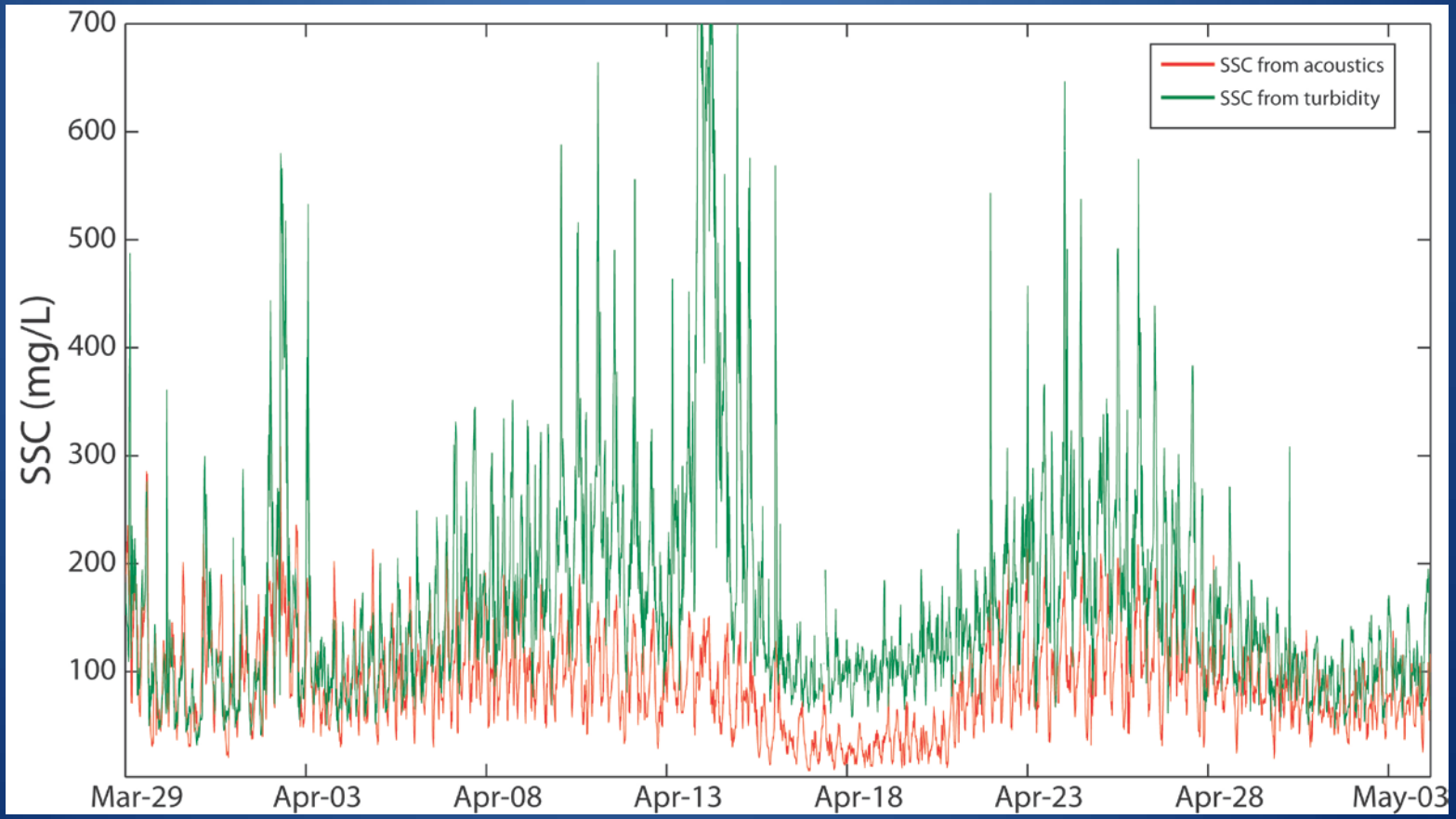
Results

- SSC derived from optical probes and acoustic backscatter diverges in the spring



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Future Work

- Further explore physical processes on suspended sediment flux using existing data (e.g., wind and waves)
- Analyze LISST data from the spring to better understand how different particles sizes change optical vs. acoustic signals
- Analyze SCUFA data to understand if the spring increase in turbidity is related to the spring phytoplankton bloom
- Maintain flux station to quantify and understand yearly differences in flux

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