

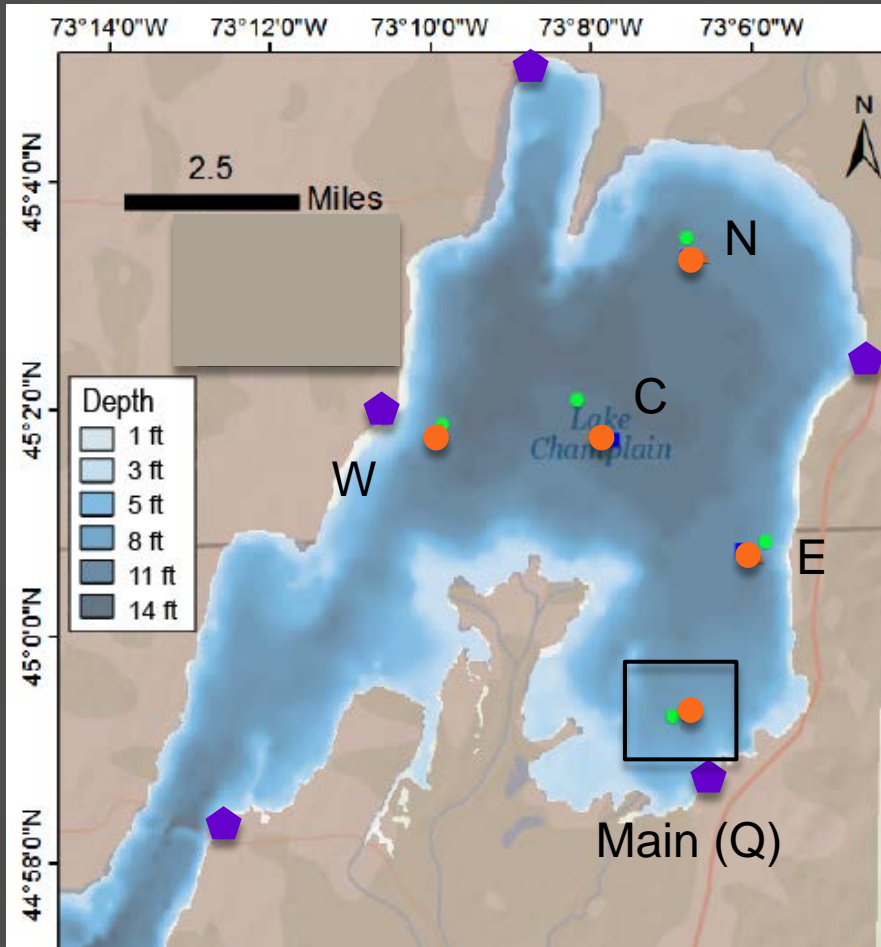


# Summertime Hydrodynamics and Sediment Dynamics in Missisquoi Bay, Lake Champlain



Emily Wei  
RACC Conference  
Middlebury College  
Advisors: Tom and  
Pat Manley  
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# Methods: Approach



## ● Internal Sites

- Currents
- Suspended sediment

## ◆ Perimeter sites

- Water level and temperature
- Standing waves

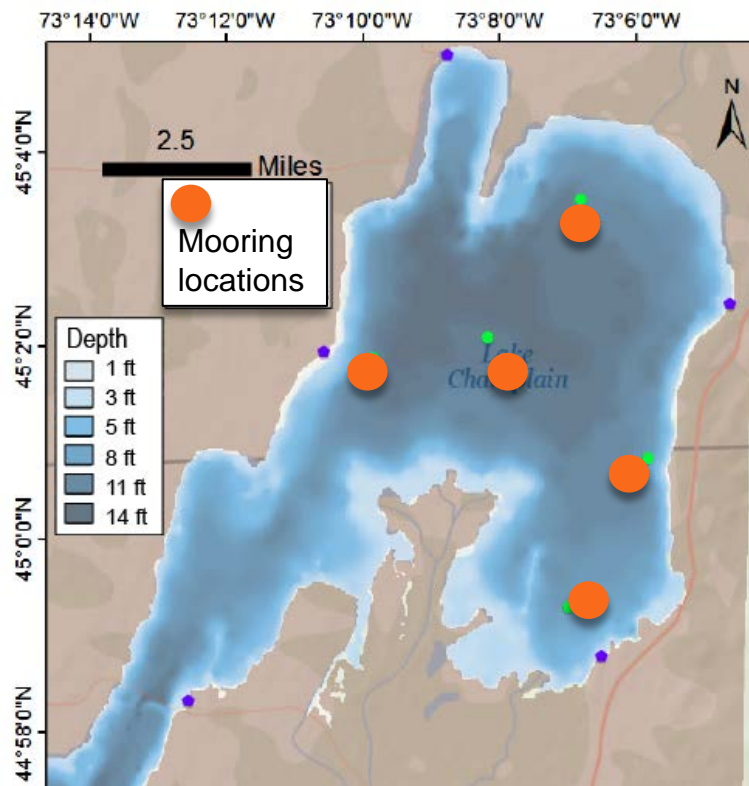
## ● Cores

- Sediment Dynamics
- Main monitoring site
- Focus on sediment transport
- Meteorological buoy



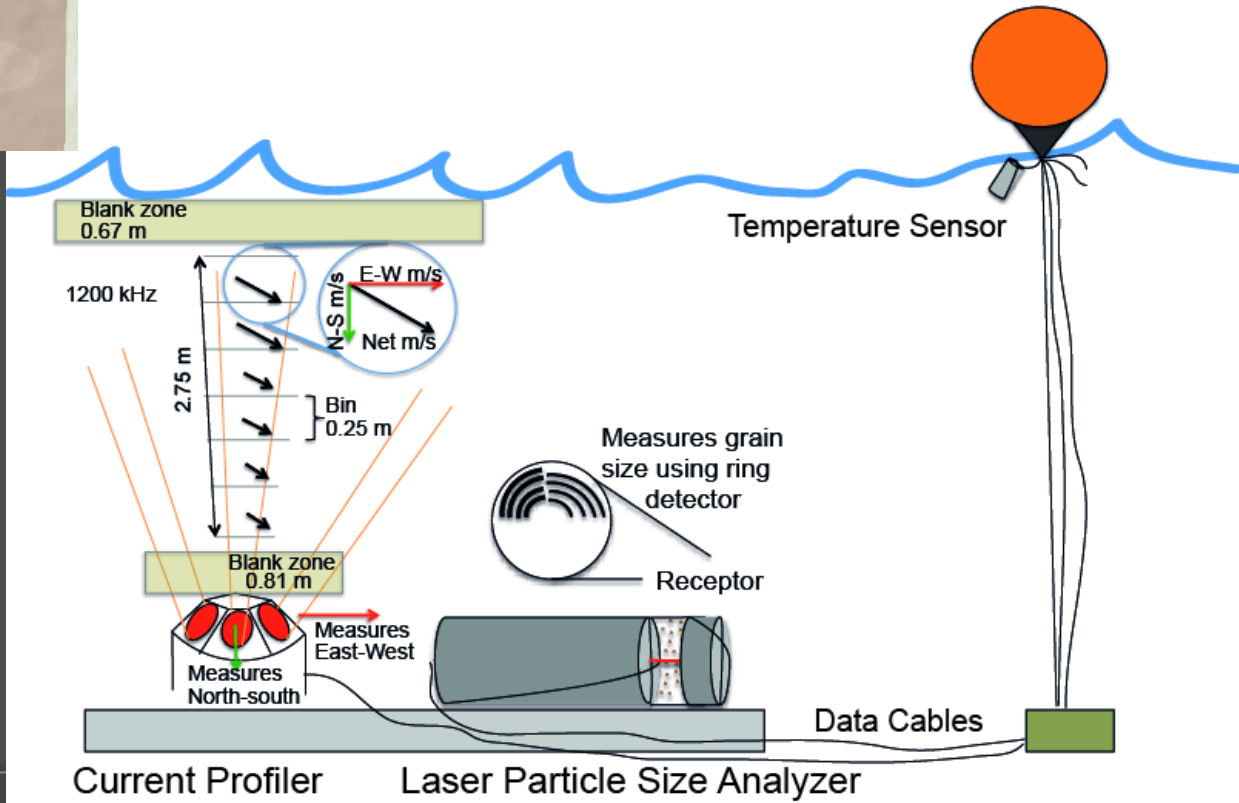
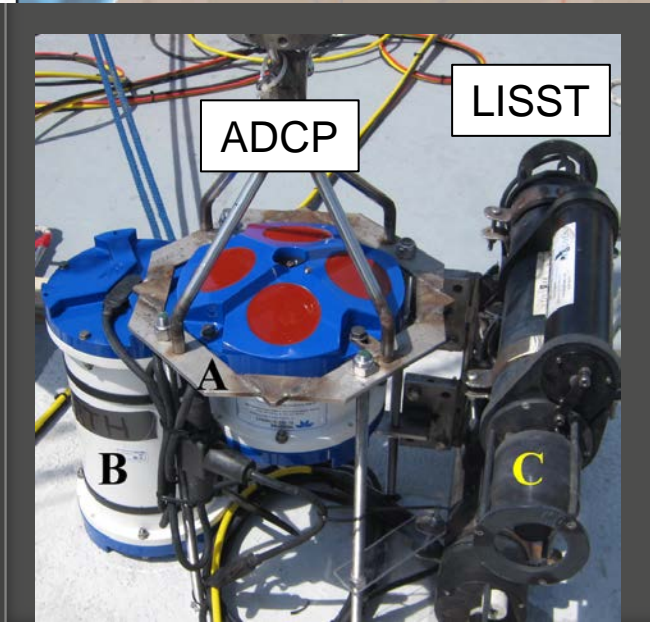


# Methods and Instrumentation: Mooring

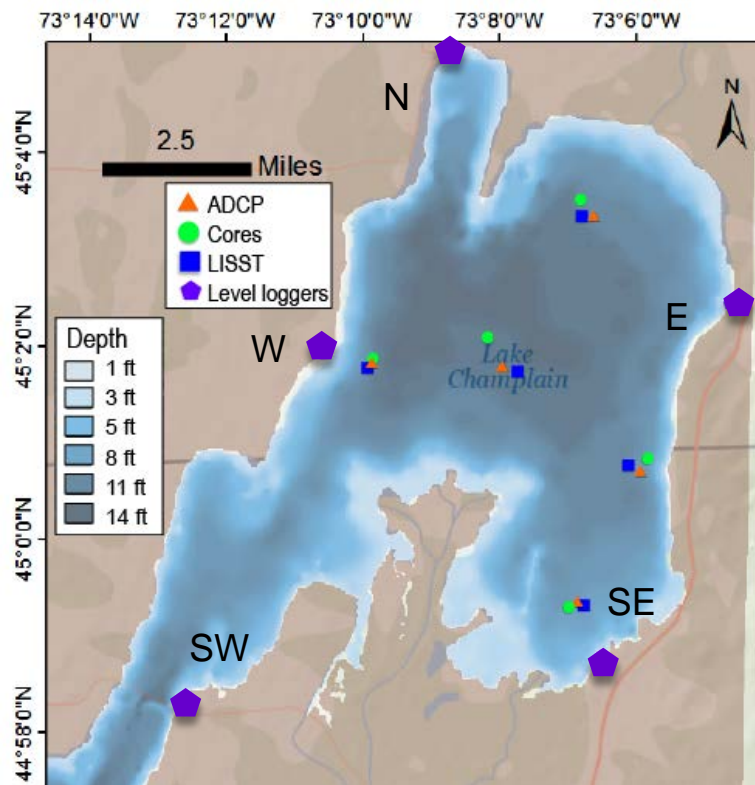


Current Profilers = ADCP  
magnitude and direction

Suspended Sediment = LISST  
Concentration and size

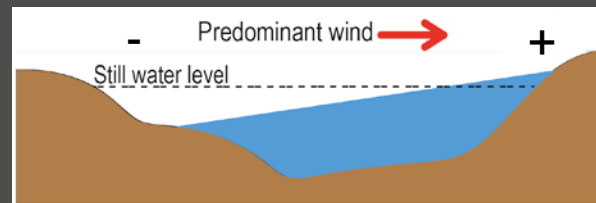


# Methods and Instrumentation: Level

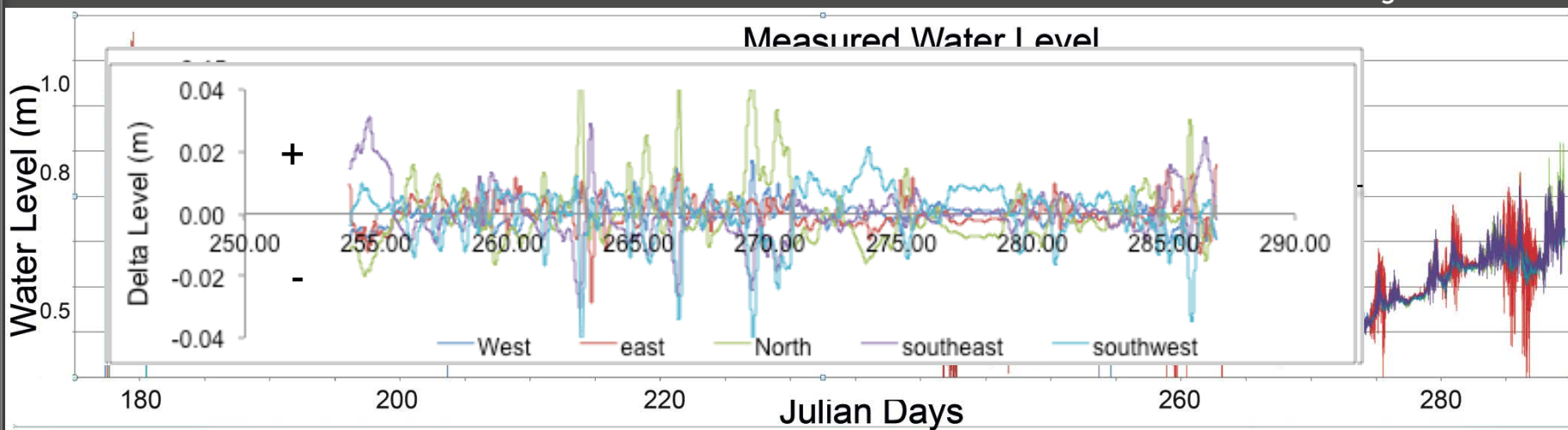


## Water Level Loggers

- Corrected for atmospheric pressure
- Relative water level
  - But high-amplitude level changes
  - Surface waves
- 6-hr filters (forward and backward)
- Detrended
- Average water level subtracted
  - Delta level
  - + and -

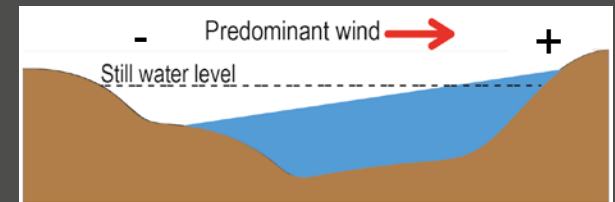
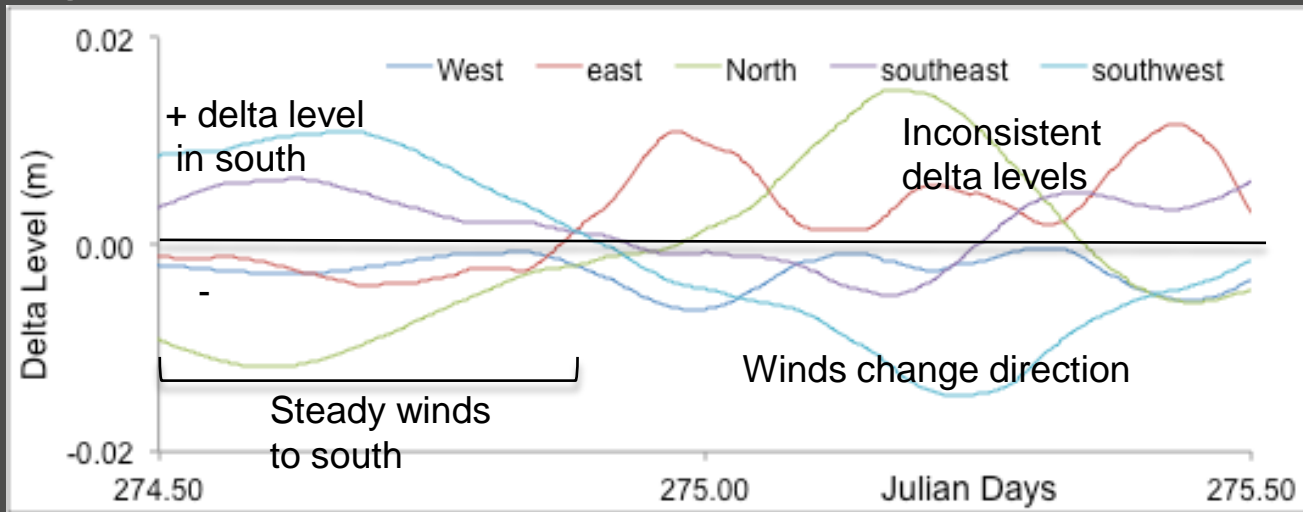


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# Standing waves and oscillations



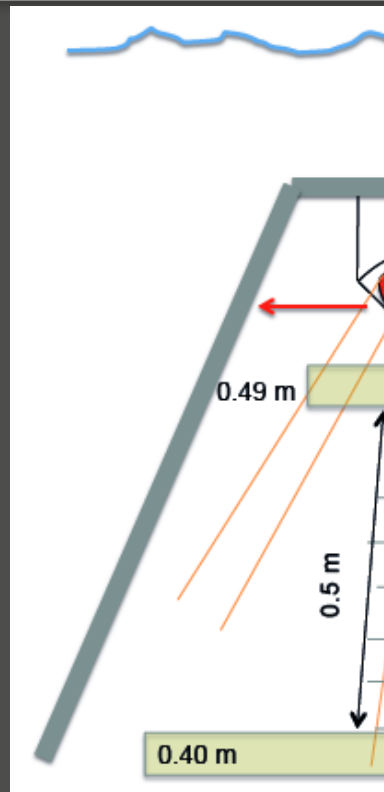
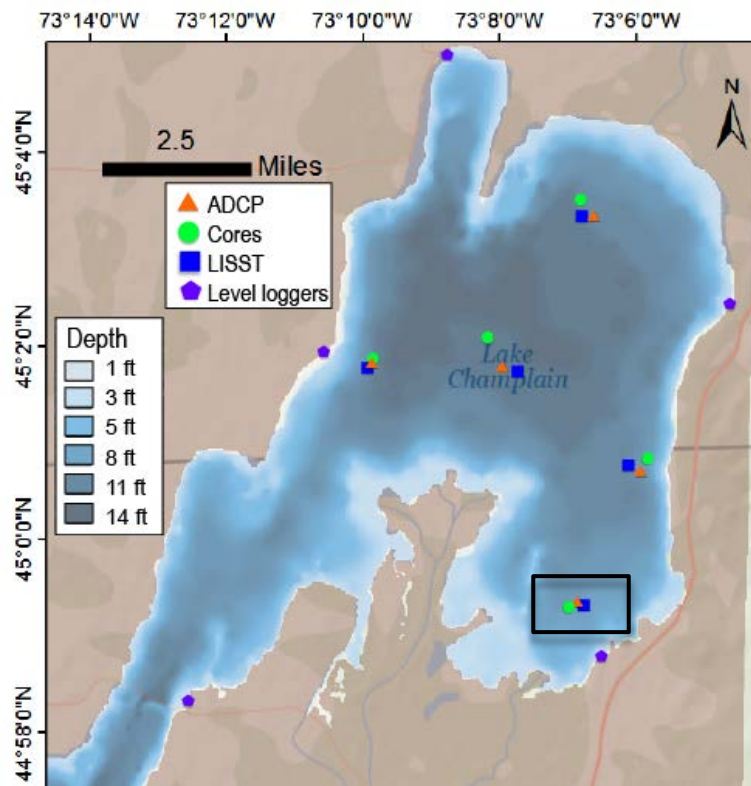
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Period of steady southerly winds

Followed by

Change in wind directions





### Downward-facing ADCP

- Velocities: 1/8 m intervals
- Measurements closer to bottom

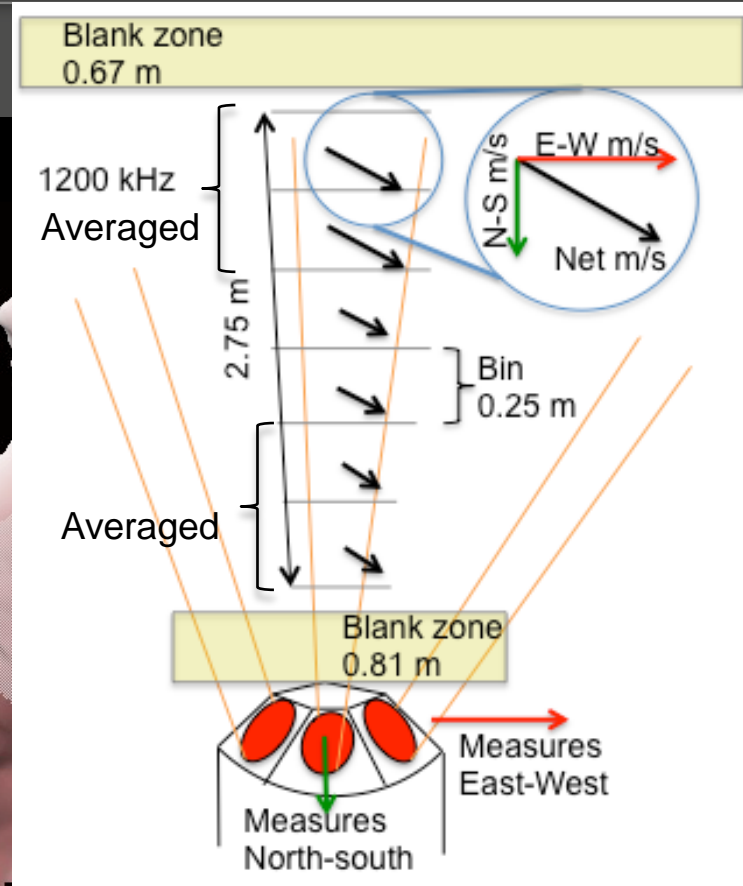
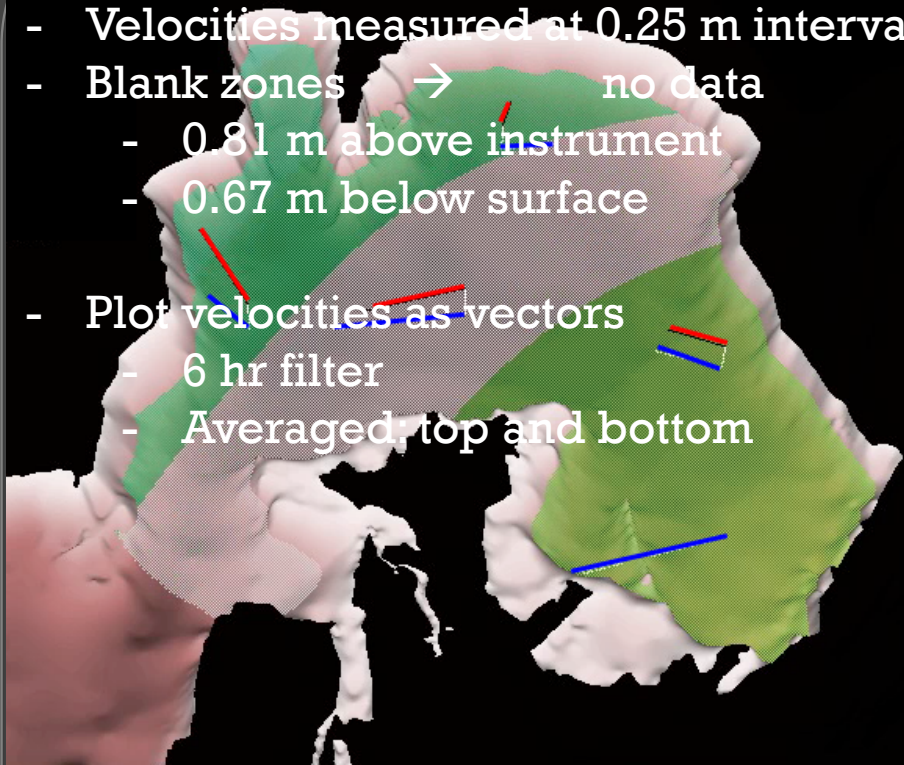
### Meteorological buoy

- Wind speed, direction
- Temperature sensor chain

## Methods and Instrumentation: Special site (Quad)

# Results: Currents

- Velocities measured at 0.25 m intervals
- Blank zones → no data
  - 0.81 m above instrument
  - 0.67 m below surface
- Plot velocities as vectors
  - 6 hr filter
  - Averaged top and bottom



## 2 Dominant Trends

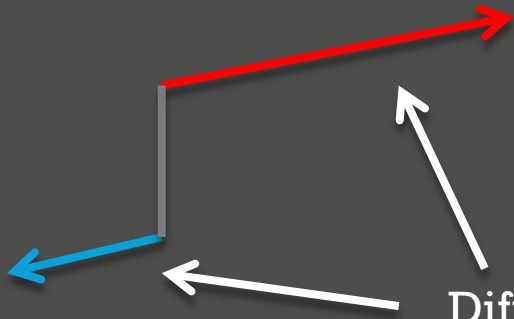
- Uniform: Surface and Bottom currents
- Moderate velocity
- Predicted by models
- Separation up to 180°
- High velocity
- Unpredicted

➡ Shear

How do we explain shear?



# What is Shear?



$$\frac{\delta v}{\delta z}$$

or

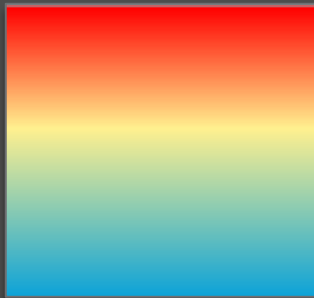
$$\frac{\text{Change of velocity}}{\text{Change in depth}}$$

Difference between directional components

## Is shear related to stratification?



Difference: surface and bottom Temp

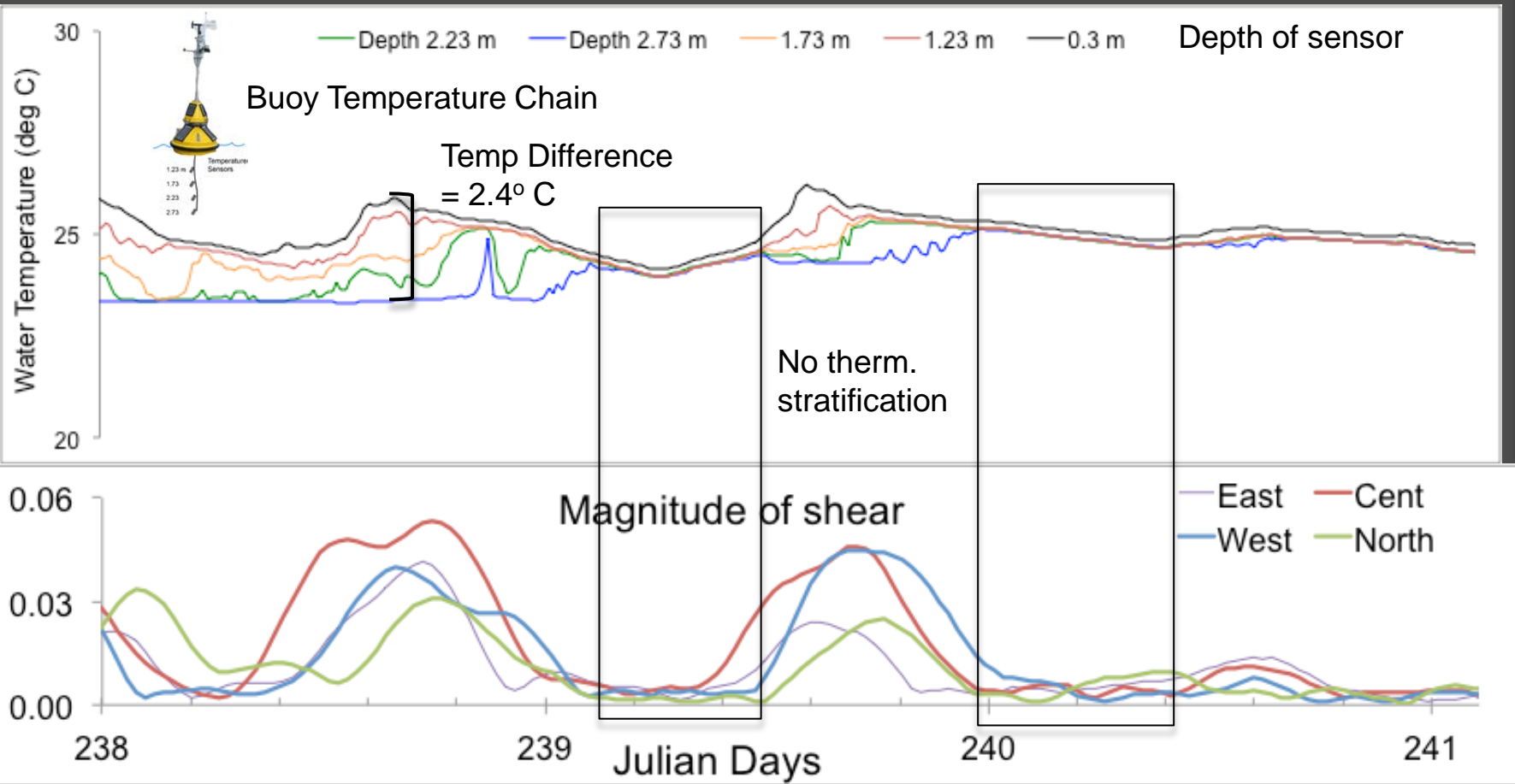


warm

cool

Water column

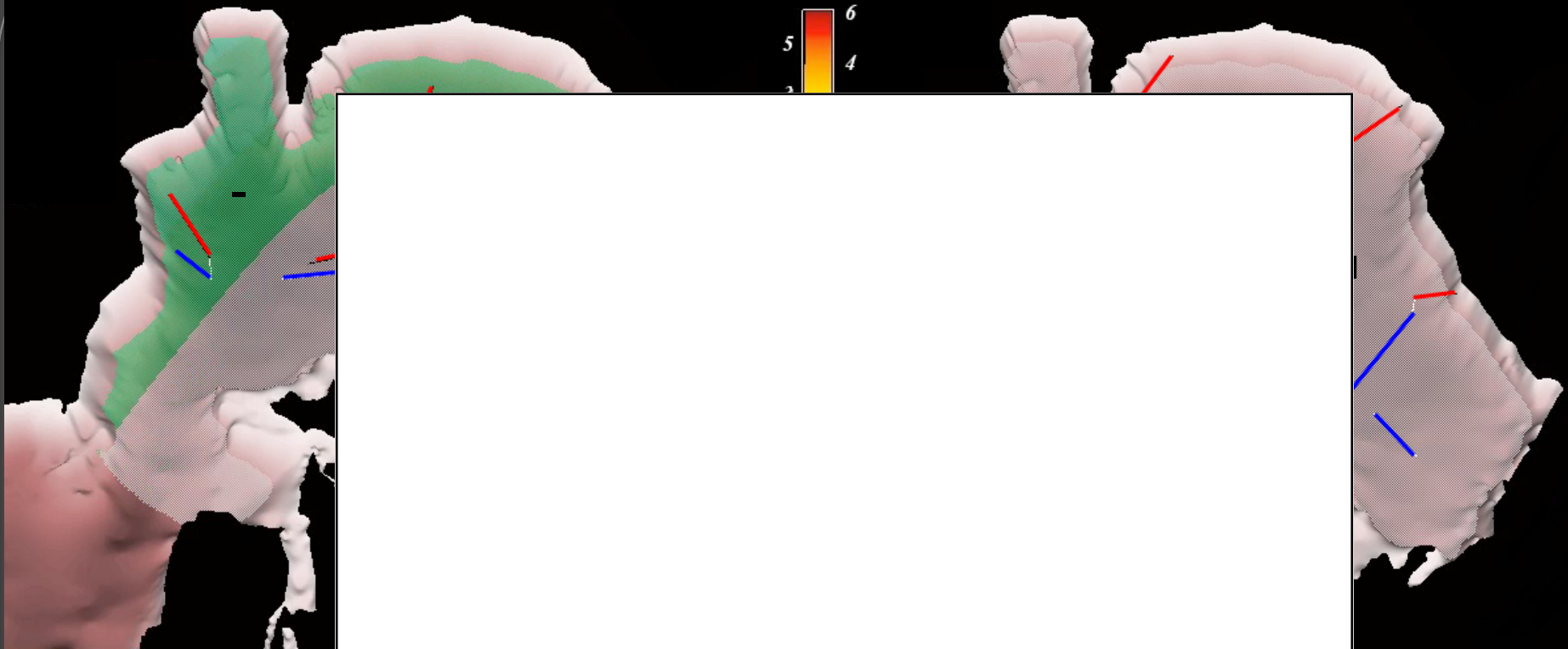
# Is shear related to stratification?



No therm. Strat → little shear

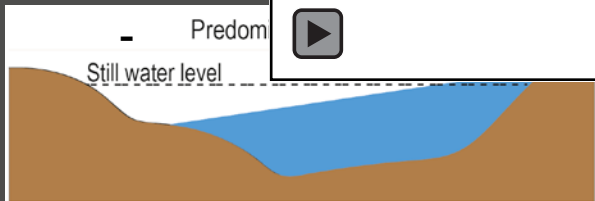
Stratification → Shear

# Results: Explain shear with water level?



Positive and neg  
setup

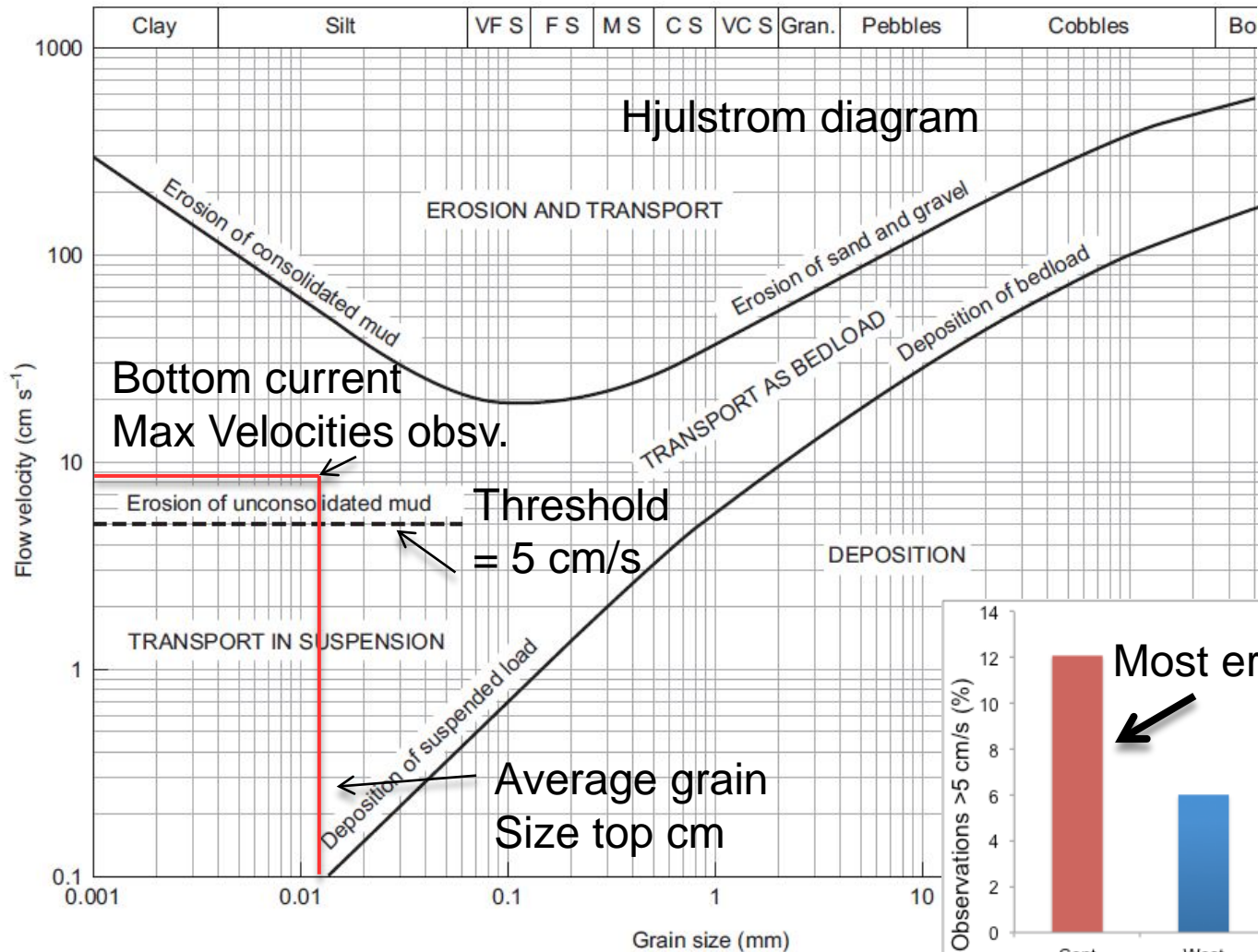
face



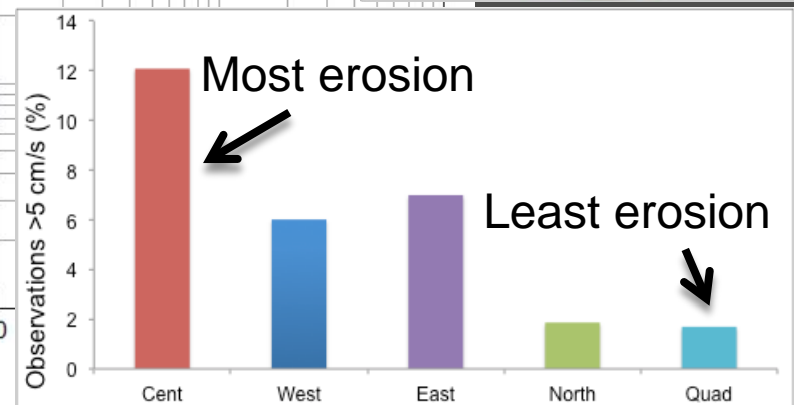
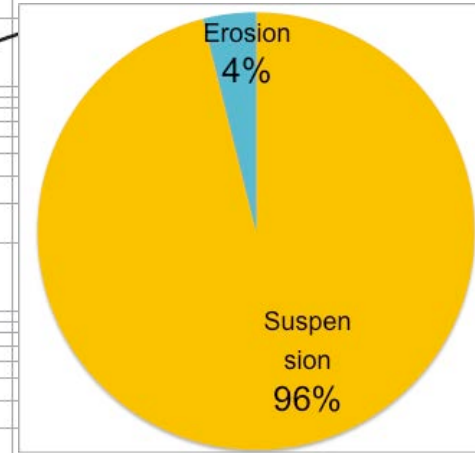
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# Transportation of sediment in Missisquoi

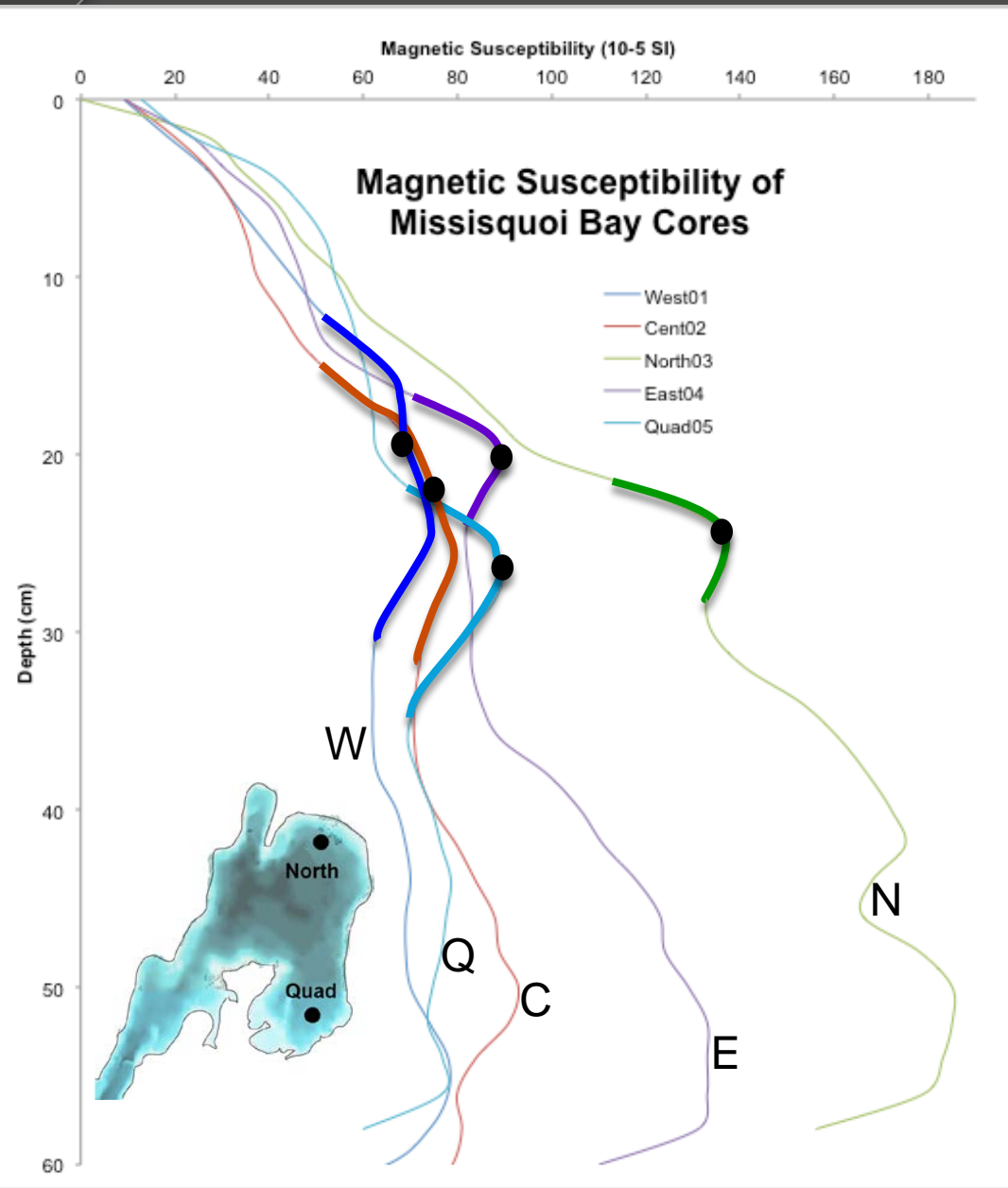


Occurrence  
Bottom velocities  
> 5 cm/s



Surficial sediment can be eroded  
Assume: top cm is unconsolidated

96% of time,  
Sediment is transported in suspension



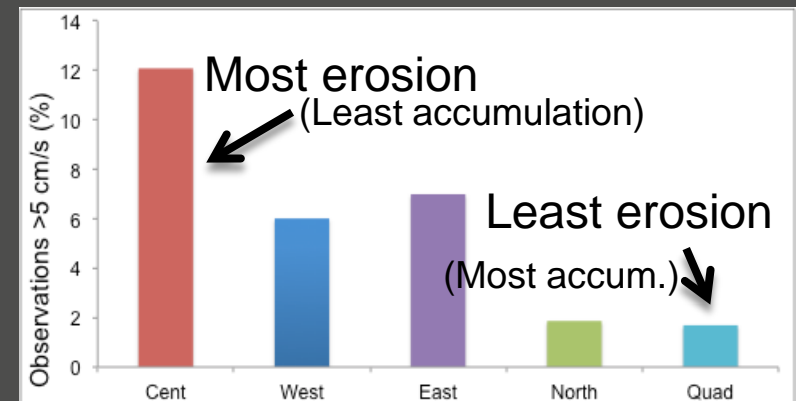
## Sedimentation Rates

Core **West**, **Cent**, **East**

Net accumulation ~ 0.2-0.5 cm/yr

Core **North**, **Quad (Main)**

Net accumulation > 0.5 cm/yr



# Conclusions

- 2 dominant circulation patterns
  - Uniform flow
  - shear
- Shear related to periods of stratification
  - Neutral water levels
- 4% of observed currents can erode sediment
  - Remainder: in suspension or deposition
- High deposition in **N, SE**

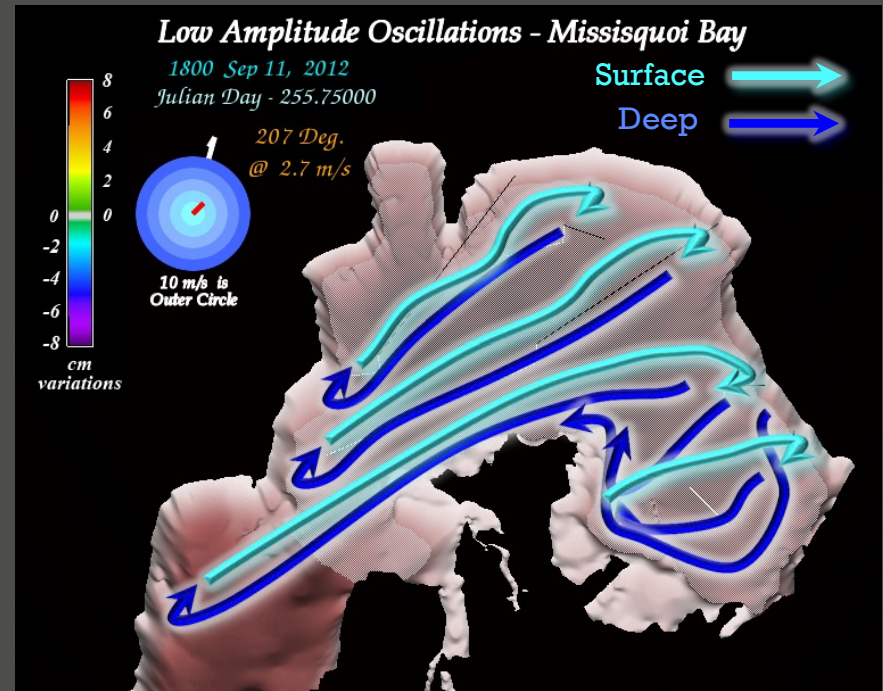




# Future Investigation



Variable Gyres



Bay Wide Upwelling / Downwelling