



# CO<sub>2</sub> and Lake Superior

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# Project Description

- Model CO<sub>2</sub> cycle within Lake Superior
  - Use measured gaseous and aqueous CO<sub>2</sub> concentrations
- Quantifying regional impact of Lake Superior on the carbon budget

# Importance of CO<sub>2</sub> Flux over Lake Superior

- Effects on terrestrial CO<sub>2</sub> concentrations
- Source or Sink?
- Seasonal and spatial variability

# Factors influencing CO<sub>2</sub> concentration over Lake Superior

- On-shore and in-lake diurnal photosynthesis and respiration patterns
- Seasonal variations in photosynthesis and respiration
- Atmospheric stability and fetch

# Methods

- Micrometeorological instruments on boat mast 10 meters about the deck
- Other Instruments on deck
- Transect out into lake
  - Stations at 3km, 10km and 20km offshore
- Land Station
  - CO<sub>2</sub> gas analyzer
  - Humidity and temperature sensor



# Lake Superior Sampling Stations

20 km offshore

10 km offshore

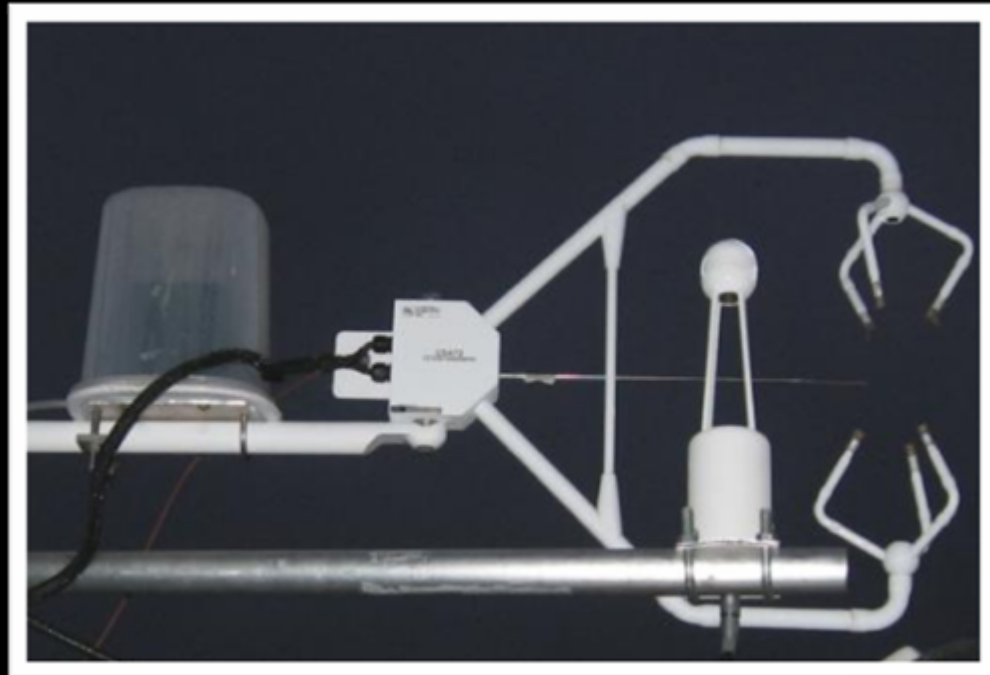
3 km offshore



USA contiguous Albers equal area conic  
GCS North American 1983  
Data Source: NOAA  
Mark Rowe 8-31-07

# Instruments on Ship

- From deck
  - GPS
  - Surface water temperature probe
- Mast 10m above ship deck
  - Sonic anemometer
  - CO<sub>2</sub> gas analyzer
  - Fine wire thermocouple
  - RM Young wind monitor
  - Humidity and temperature sensor
  - Gyroscope



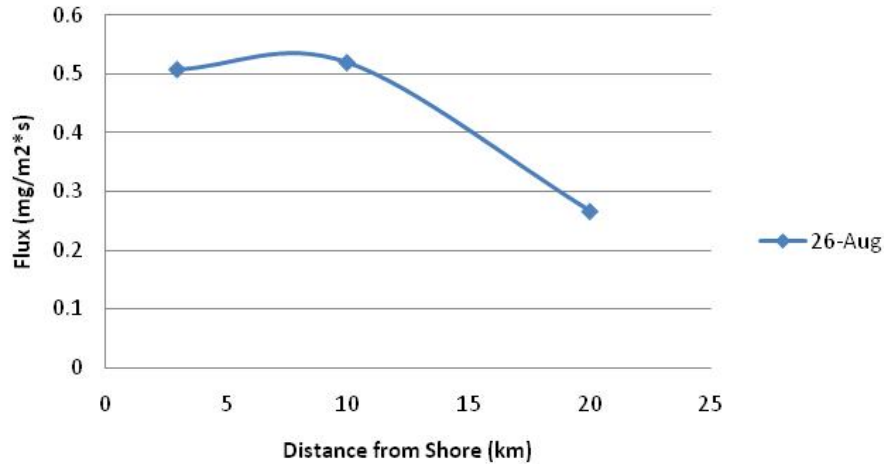
# Flux Calculations

$$Flux(mg / m^2 - s) = ([CO_2] - [CO_2]_o)(mg / m^3) \times \left[ \frac{\text{mixing height}(m)}{\text{time over lake}(s)} \right]$$

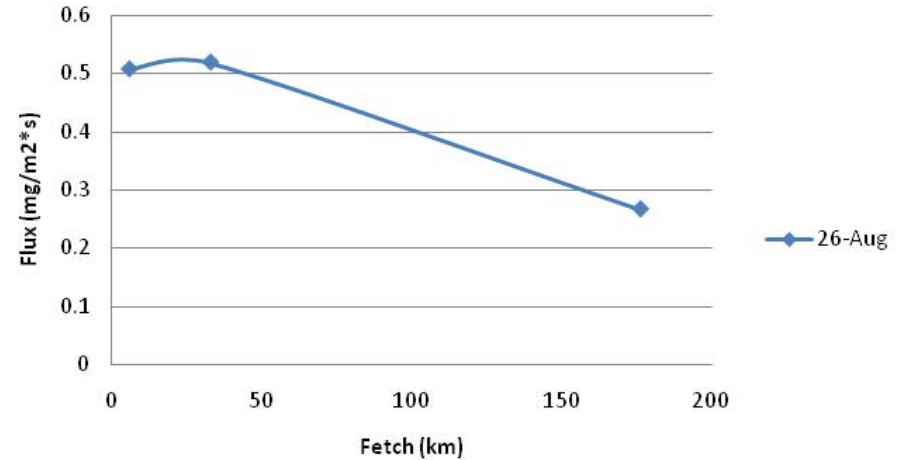
$$\text{Mixing Height} = \frac{\left[ \frac{\text{Avg Flux (mg/m}^3\text{)}}{\text{time over lake}(s)} \right]}{([CO_2] - [CO_2]_o)(mg / m^3)}$$

# Preliminary Results

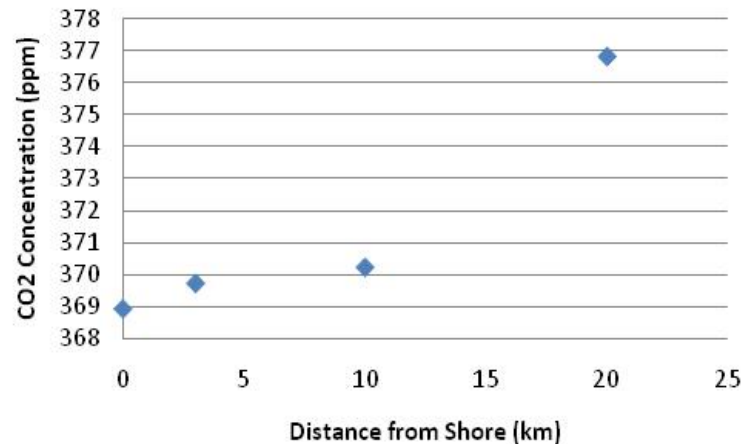
## CO2 Over Lake Superior



## CO2 Flux and Fetch



## CO2 Concentration



# What's Next?

- Motion Correct the wind speed data
  - Recalculate fluxes using vertical wind speed
  - Compare with other flux calculations
- Update Regional Model
- Paper

# Thanks To:

- Milton, Jeff, Nancy, Alicia, and ....
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