Abstract: The underlying chemistry and biology of Green Bay, Lake Michigan is strongly affected by exchange of water between Green Bay and Lake Michigan proper. Thermistors moored throughout the bay during the stratified season in 2012 allowed the behavior of cold water intrusions, hypothesized to originate from hypolimnetic Lake Michigan waters, to be tracked. To better understand the dynamics that drive the size and extent of these cold water intrusions, highly resolved wind speed and direction data for 2013 were coupled with thermistor data to analyze the meteorological conditions that accompany cold water intrusions of different volumes. The relevance of these findings to current research on hypoxia in Green Bay is considered.

Discussion
Analysis of 2013 wind data coupled with thermistor data at Station 17 suggests that the dynamics driving cold water intrusions in Green Bay are complex. Past studies have suggested that winds from the southwest enhance water mass exchange with Lake Michigan, with significant implications for bottom water hypoxia and sediment methane production (Waples & Klump 2002). The findings from this analysis suggest that: 1) Regional summer winds are predominantly westerly, with a secondary, easterly component; 2) Westerly winds perpendicular to the axis of the bay enhance persistence and size of cold water intrusions, while easterly winds shut down this exchange, agreeing with model output (Hamidi et al., in review). High variability in wind velocity requires a longer time series for clearer trends and consideration of other dynamics that affect bottom water intrusions in Green Bay. While wind velocity appears to drive the intrusion presence and persistence, it is also the primary mode of water column mixing above 8 m/s (Grunert 2013). This complicates the analysis when using thermocline presence as the indicator for intrusion variability. Future studies should consider hysteresis and connections with Lake Michigan.

Significance
Green Bay is notoriously hyper-eutrophic with high organic matter settling rates (Klump et al. 2009) resulting in high sediment oxygen demand (SOD) and sediments that quickly become anoxic. The result is rapid depletion of hypolimnetic oxygen under stratified conditions and hypoxic/anoxic conditions in much of southern Green Bay (Valenta et al. 2012).

References