Thermal Bar formation
- The thermal bar is a hydrodynamic structure that forms in spring in the Great Lakes due to rapid warming of shallow, nearshore waters.
- The thermal bar (4 °C) separates warm (>4 °C) nearshore waters and cold (<4 °C) offshore waters, reducing mixing.

Spring runoff
- Snowmelt and spring rains represent the largest hydrologic event of the year, delivering 70% of the annual solids load to the lake.

Juxtaposition of the spring runoff event and the thermal bar
- Spring runoff and the thermal bar may co-occur (e.g. 1979) or be offset by several weeks (e.g. 1990).

Hypothesis
- Co-occurrence leads to nutrient trapping and stimulation of a nearshore phytoplankton bloom, while an offset in time leads to offshore transport of nutrients reducing the potential for a nearshore phytoplankton bloom.

1) Testing the hypothesis
- The hypothesis is tested by examining temperature and chlorophyll-a profiles (as an analog for phytoplankton biomass) at a location traversed by the thermal bar (3 km off shore) by deploying a BAT/CTD25 towbody.
- This location (indicated in red at right) is traversed by the thermal bar and represents an area where the spring phytoplankton bloom is observed when it develops.
- In 1999, for example, a striking spring phytoplankton bloom was observed at this site (Bub 2001). Here, we compare results from 2011.

2) Spring runoff and thermal bar establishment (1999 vs. 2011)
- In 1999 the thermal bar was established in time to entrain the discharge from the spring runoff event.
- In 2011 the thermal bar was not established until much later and the potential for entrainment was much less.

3) Spring phytoplankton
- In 1999 a spring phytoplankton bloom was observed.
- In 2011 a spring phytoplankton bloom was absent.

4) Conclusion
- A spring phytoplankton bloom occurred when thermal bar establishment was in time to entrain spring runoff and did not occur when formation missed the spring runoff event, supporting our hypothesis.
- The effects of thermal bar formation should be incorporated in ecosystem models developed for predicting the response of the Lake Superior ecosystem to expected changes in the thermal regime (climate change).