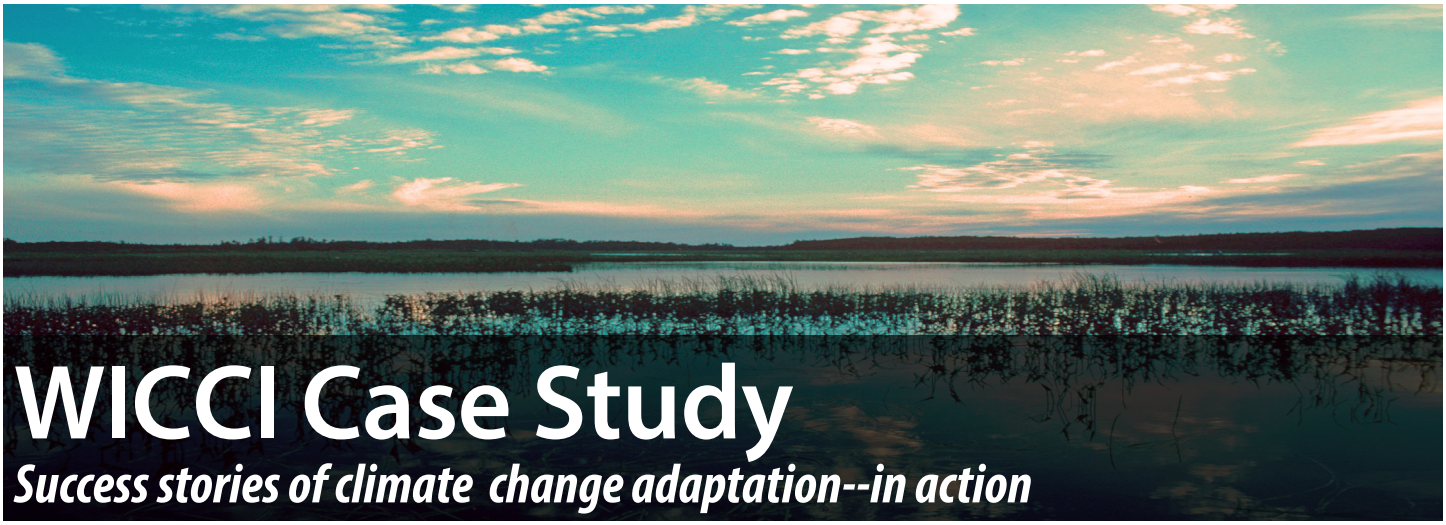
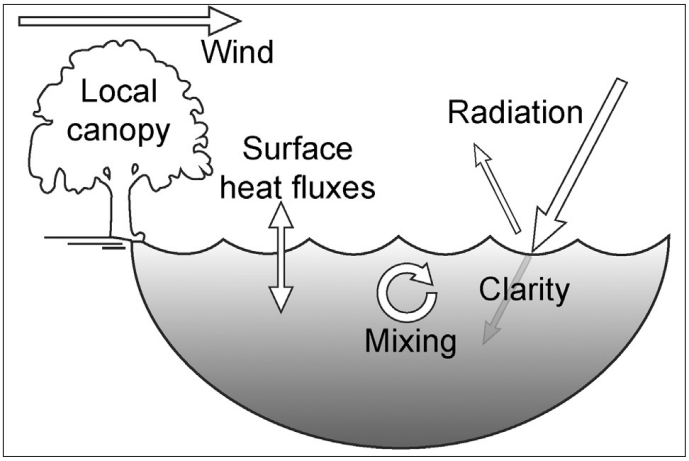


WICCI Case Study

Success stories of climate change adaptation--in action

The Temperature of Wisconsin's Lakes are Changing with the Climate

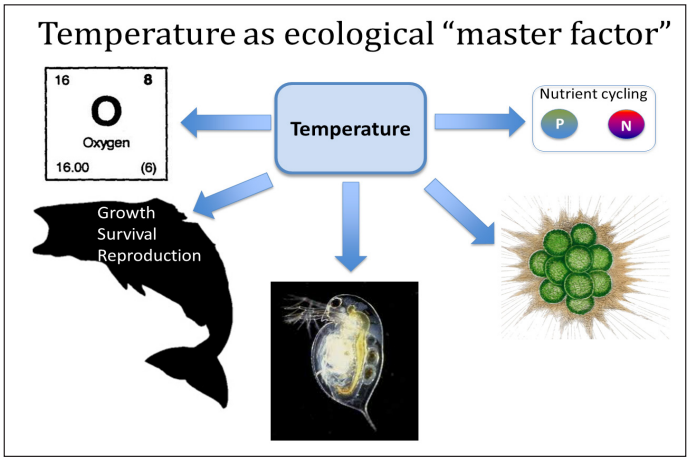
Water temperature is a major controller of many organisms living in a lake. Reproduction, metabolic rate, and survival of fish and other aquatic animals; plant and algal growth and biomass; and nutrient cycling are all driven by water temperature. For example, the timing of walleye spawning is linked to the time when surface water temperatures reach 48 degrees Fahrenheit. However, the long term data needed to understand temperature trends and their influence on aquatic organisms has only been recorded on a few of Wisconsin lakes.



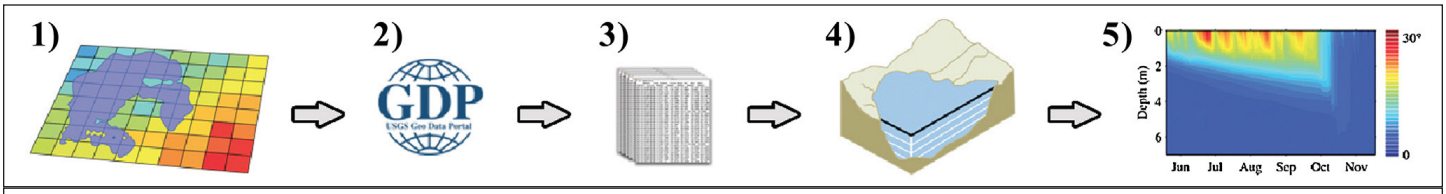
Many factors affect a lake's temperature throughout the year. The lake temperature model inputs these variables to estimate past temperatures and predict future temps based on changing climate.

In response to the need for lake temperature data for specific frequencies and durations, a multi-disciplinary team from UW Madison, Wisconsin DNR, NASA, USGS, and the University of Iowa have developed a hydrodynamic model that allows them to *hindcast* the daily thermal profiles and annual ice cover from 1979-2012 for more than 2,300 Wisconsin lakes. The model's results allow users to derive lake-specific and time-varying estimates of temperatures which influence species of interest to biologists, managers and users of Wisconsin's lakes. To date, the team has looked at lake records for more than 2,400 lakes around the state and have included these observations into the model.

The model uses information on air temperature and lake properties like clarity, mixing and local vegetation



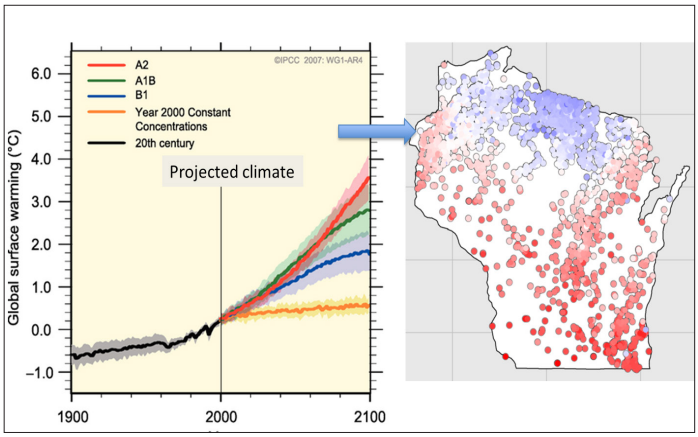
Temperature is a key driver for many organisms in a lake. Changing temperatures can effect biological processes like food and oxygen availability as well as fish reproduction.



Lake modeling framework includes (1) selecting a lake feature (e.g. the surface shape of Big Muskellunge Lake; WI, USA, shown here in blue) and gridded data, (2) extracting lake-specific data using the USGS-Geo Data Portal, (3) translating time-series and static data into model input, (4) driving the lake simulation model, (5) processing model results for each simulation.

in addition to historic records of lake temperatures statewide. The goal is to accurately predict lake temperatures at various depths during different seasons and times of the year. The research team works closely with fisheries and water resource managers to provide relevant water temperature metrics for a wide variety of management programs. One example of the utility of model is the linking of historic temperature data to the likelihood of walleye reproductive success. This information was used by fisheries managers to help prioritize lakes that were best suited for stocking walleyes under the Wisconsin Walleye Initiative.

The team is currently working to modify the model to be able to project future lake temperatures in order to *forecast* possible changes in the abundance or distribution of aquatic animals and plants, enabling effective adaptation strategies for Wisconsin lakes. Another goal involves adding predictive capabilities to the model for dissolved oxygen concentrations to better link lake conditions and coldwater fish habitat. These adaptation measures will further allow managers to identify locations where sport fish species of interest are likely to be most resilient and in turn focus management resources on these lakes. Additionally, vulnerable populations that could benefit from the restoration of lake habitat may also be identified using this model.



The lake temperature model will use different climate scenarios to predict future lake temperatures.

Funding sources for Lake Temperature Modeling project: USGS National Climate Change and Wildlife Science Center, USGS Northeast Climate Science Center, Sport Fish Restoration funds

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April 2015