

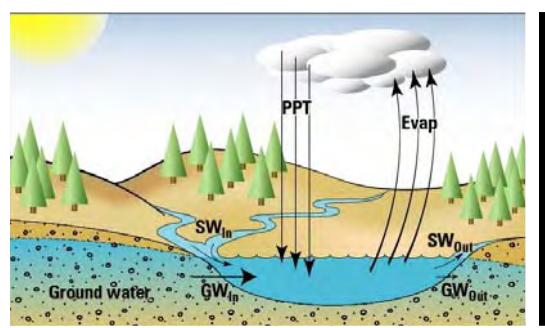
Adapting to Low Lake Levels and the Implications of a Changing Climate



Bass Patterson Lake, Washburn County (E. Cook)

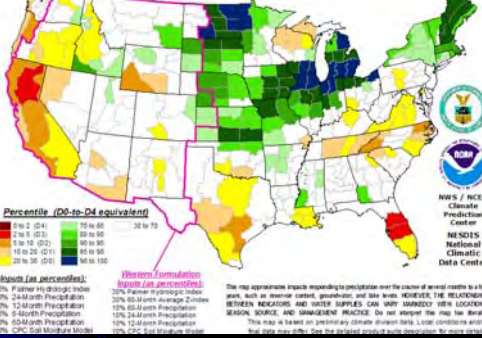
Many factors affect water levels

- Lake morphology and hydrology
- Landscape position
- Natural variability (weather)
- Short term drought (and wet) cycles
- Climate change
- Human water use (i.e. water withdrawals)



Objective Long-Term Drought Indicator Blend Percentiles

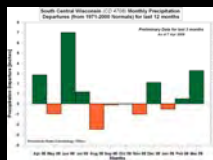
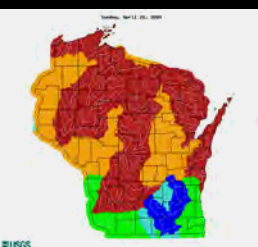
April 25, 2009



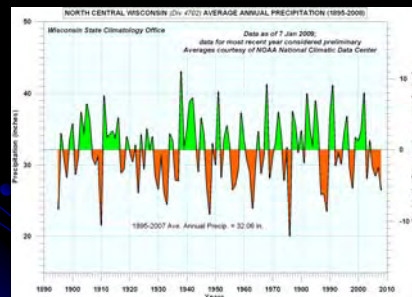
Statewide trends and contrasts

28-day streamflow compared to long term average (April)

Precip departures from normal



How does this compare long-term?

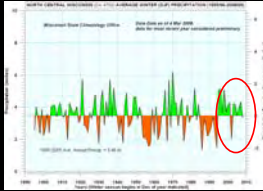


Seasonal differences

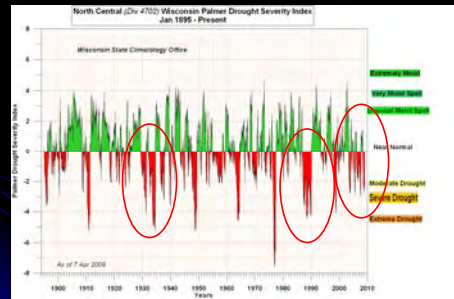
Summer (JJA)



Winter (DJF)



Long term perspective



Response of Lakes to Drought

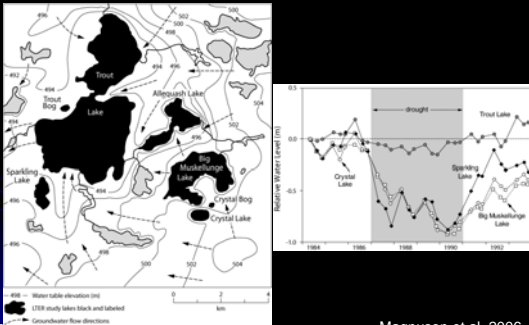
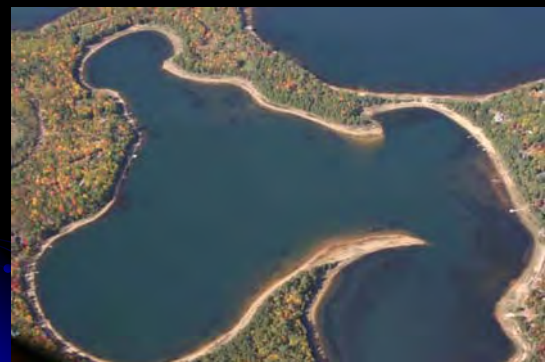


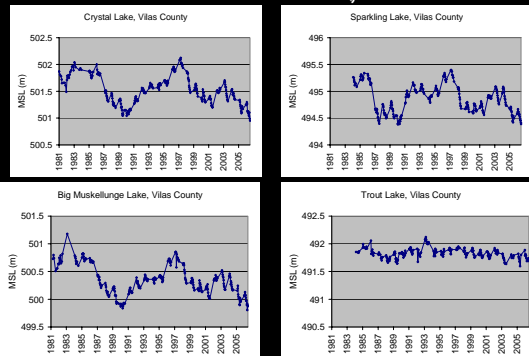
Fig 3.2

Magnuson et al. 2006



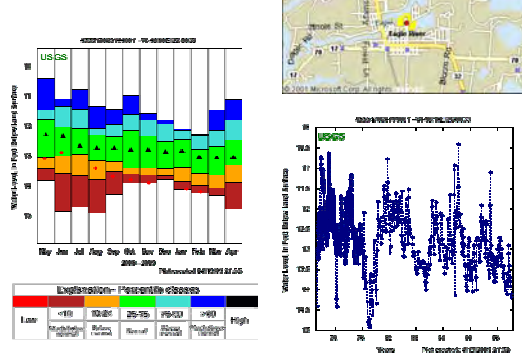
Tomahawk Lake, Bayfield County

LTERR Lake Levels, Vilas Co

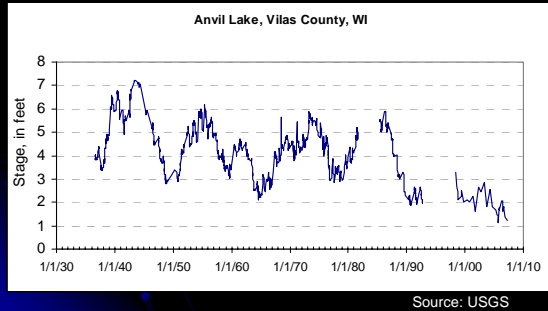


Source: NTL LTER, Center for Limnology

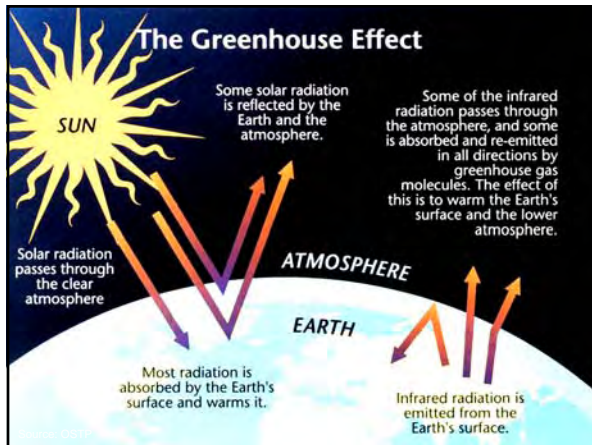
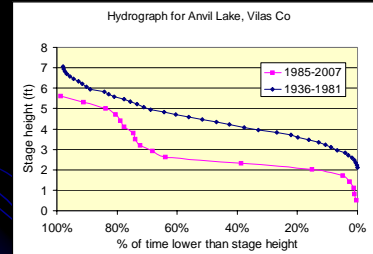
Eagle River well record



Anvil Lake Stage Record (1936 – 2006)



Anvil Lake – Regime shift?



Climate Change in the Great Lakes Region: Starting a Public Discussion

Global Warming Is Unequivocal:

- The recent IPCC report has clearly stated that “warming of the climate system is unequivocal” and it is “very likely” caused by human activities.
- Moreover, most of the observed changes are now simulated by models over the past 50 years, adding confidence to future projections.

Evidence of Climate Change in the Great Lakes Region

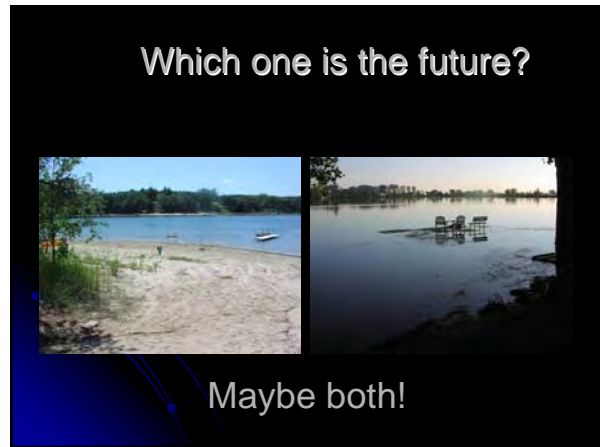
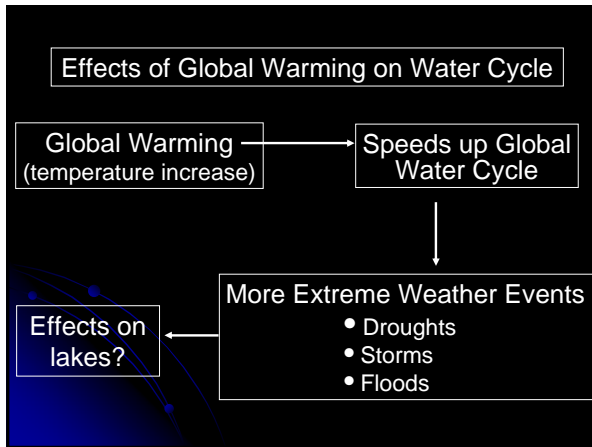
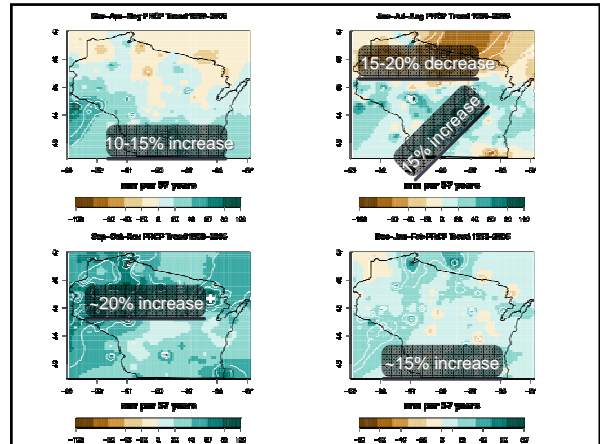
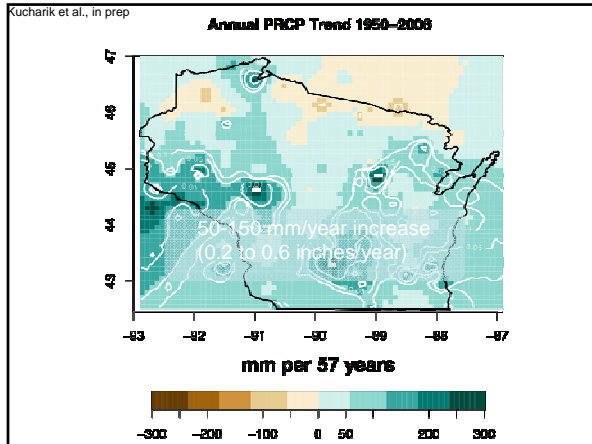
- Temperatures are rising, especially in winter.
- Extreme rainfall events (24-hr and 7-day) are becoming more frequent.
- Winters have become shorter.
- Spring is coming earlier.
- Duration of ice cover is shorter, especially on smaller lakes.



SOURCE: UCS/ESA, 2003

Climate change in Wisconsin: 1950-2006

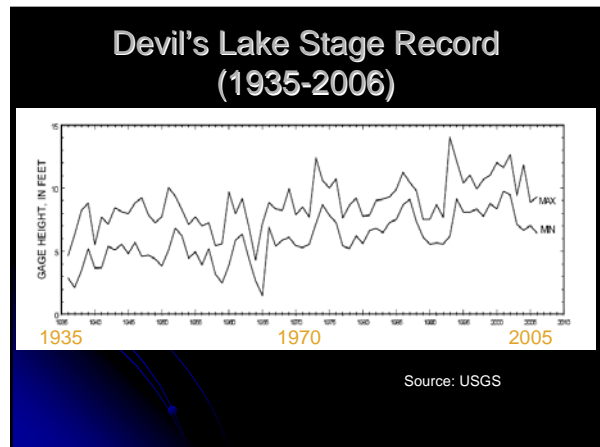
Long term precipitation trends



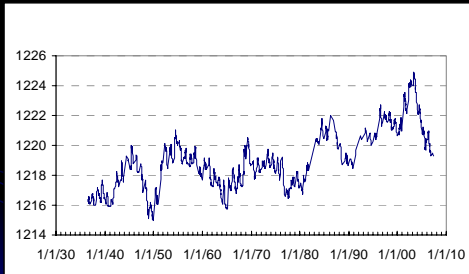
Water Levels – Scenario #1

- Warmer, wetter winters
- More CO₂ in atmosphere makes plants more water efficient
- More storms increases runoff
- More recharge increases baseflow and groundwater levels
- Lakes may go up

Source: John Magnuson, 2007



Shell Lake Stage Record (1936 – 2006)



Source: USGS

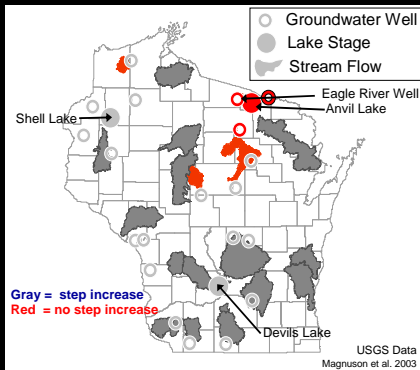
Water Levels – Scenario #2

- Shorter duration of ice cover will increase evaporation in winter
- Warmer air temperatures will increase evapotranspiration
- Lower precipitation in summer will decrease soil moisture
- Lakes may go down

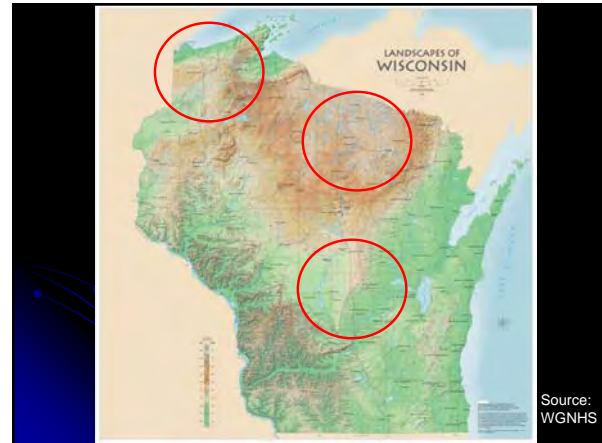
SOURCE: UCS/ESA 2003



Step Increase in Lake Stage, Stream Flow, and Groundwater Levels after 1970



USGS Data
Magnuson et al. 2003



Source: WGNHS

Role/implications of climate change for lake levels in the north

- Short term or long term?
- Factors at play
 - Changing timing of precipitation
 - Changes in snowfall and recharge
 - Increased summer evaporation
 - Decreased summer rainfall
 - High in the landscape regionally
 - Groundwater Divides

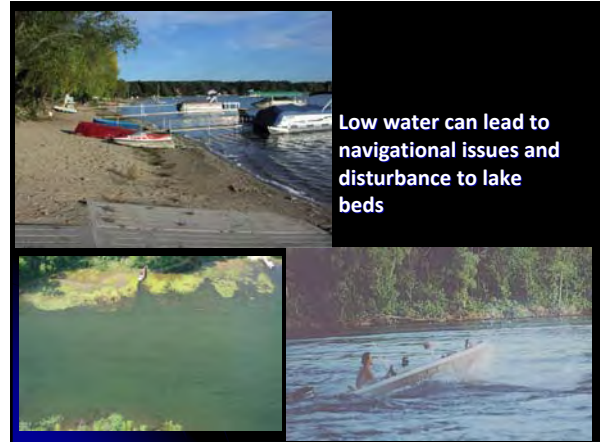
OK, SO NOW WHAT?

- Wait it out!
- Natural variations are part of lake ecosystem
- But, larger forces at work (climate change, water use, land use)
- Solutions may be local, regional, and global
- Mitigation vs Adaptation



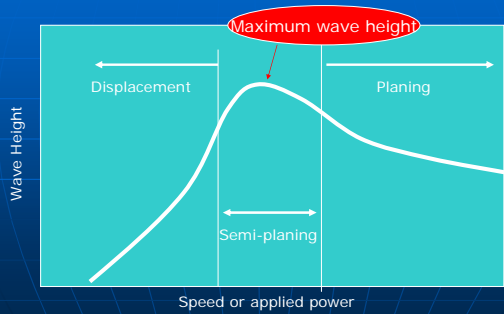
Adapting to low lake levels

- Understand your lake
- Careful use of lakes and lakeshores
- Protect habitat – fragile ecosystems
- Reduce nutrient inputs
- Shift boating behavior – go deep!

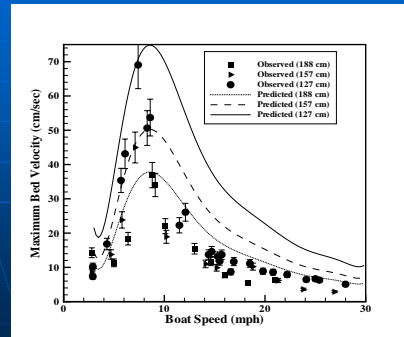


Boat wave characteristics

(adapted from Maynard, 2005)



Boat speed and water depth affect sediment disturbance



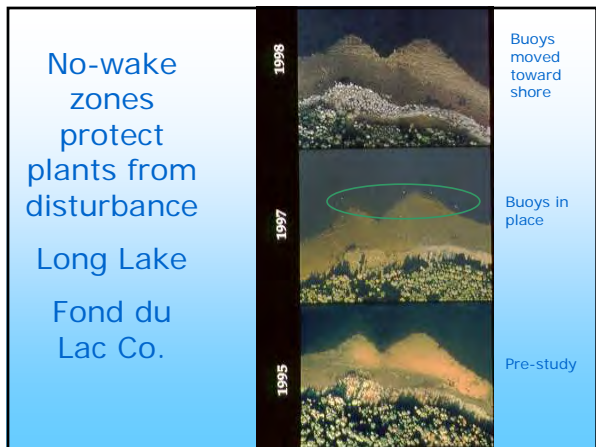
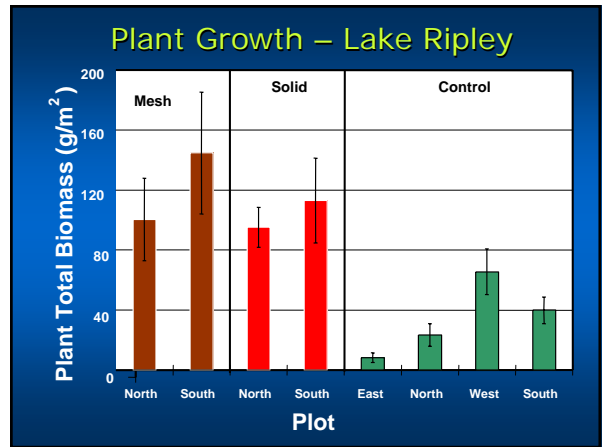
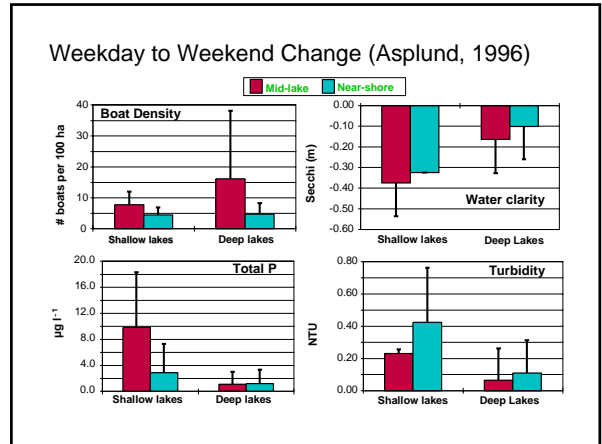
(From Beachler and Hill, 2003)

Sediment disturbance



Sediment disturbance





Adaptation strategies during times of low water

Does your lake experience natural water level fluctuations? Such lakes:

may have these problems	and may benefit from
aquatic invasive plant species that are adaptable to water level increases or decreases	<ul style="list-style-type: none"> looking for and removing exotic aquatic invasive plants during low water periods
damage to unique habitats by human use during low water periods	<ul style="list-style-type: none"> establishing barriers to prevent vehicle access to the dry lake bed during low water periods
sensitivity to changes in groundwater recharge	<ul style="list-style-type: none"> use of swales and rain gardens to encourage infiltration of rainwater and snowmelt
a large area less than 8 feet deep during some parts of the year	<ul style="list-style-type: none"> no-wake speeds or electric-motor-only zoning
winter fish kills	<ul style="list-style-type: none"> adding oxygen when necessary by mechanical aeration or by plowing snow off the lake surface to encourage plant growth
removal of woody material, leading to loss of potential habitat for fish during periods of high water	<ul style="list-style-type: none"> leaving fallen trees, logs, or branches in place or adding them to the exposed lake bed during low water periods

Mechenich and Turyk
UWSP