Great Lakes Sensitivity to Paleo-Climatic Change

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Impact of Climate Change on the Great Lakes Ecosystem

A NOAA Science Needs Assessment Workshop to Meet Emerging Challenges

Great Lakes Environmental Research Laboratory
Cooperative Institute for Limnology and Ecosystems Research
Great Lakes Sea Grant Network
NOAA Great Lakes Regional Team

July 29—31, 2008
School of Natural Resources and Environment
1040 Dana Building
University of Michigan
Ann Arbor, Michigan 48105-2945

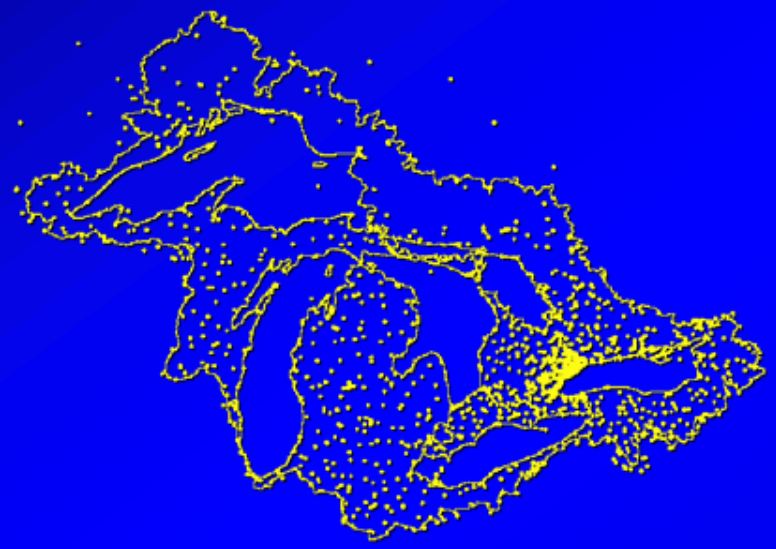
Background

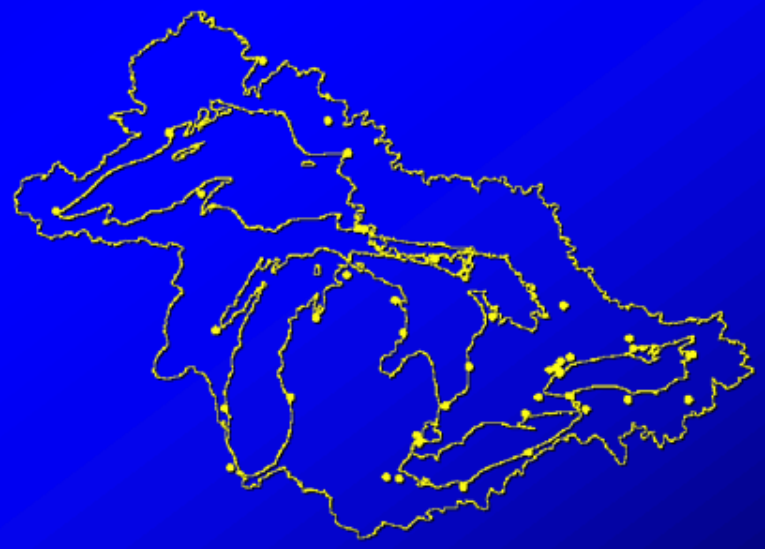
Great Lakes in terminal state about 9000 years ago
Hypothesize climate caused this
Understand extremes of climate closing Great Lakes

Data Preparation

Climate Data

- models use daily data 1948-1999
  - ~1800 stations for overland
  - ~40 stations for overlake
- Thiessen-averaged (121 subbasins & 7 lakes)

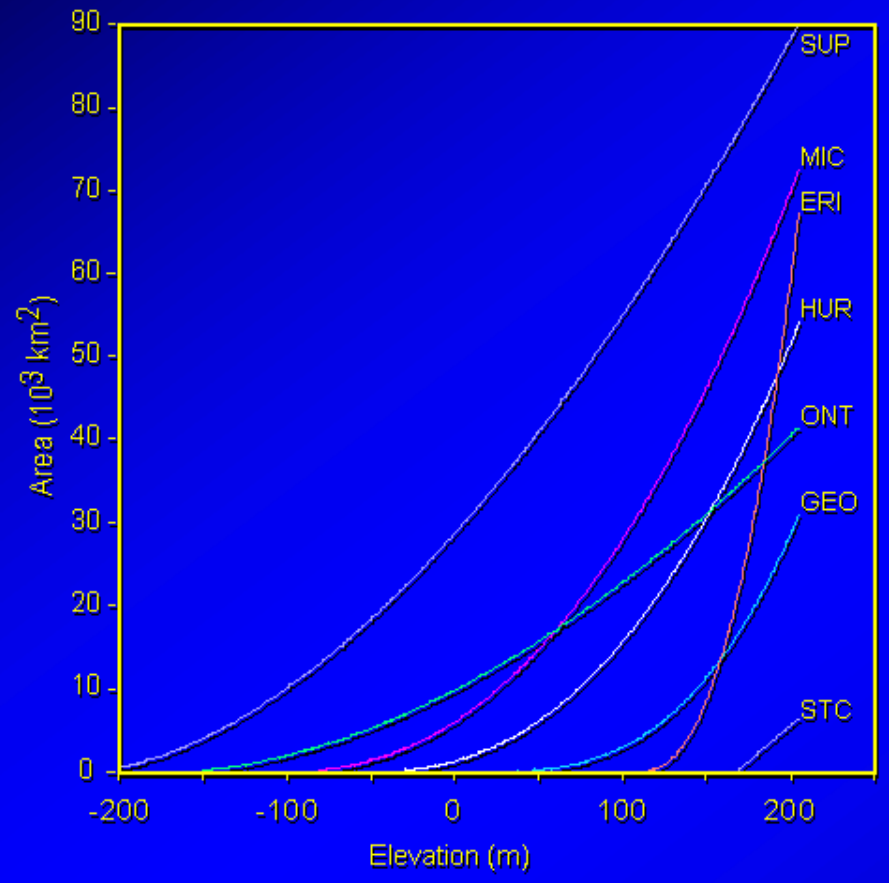


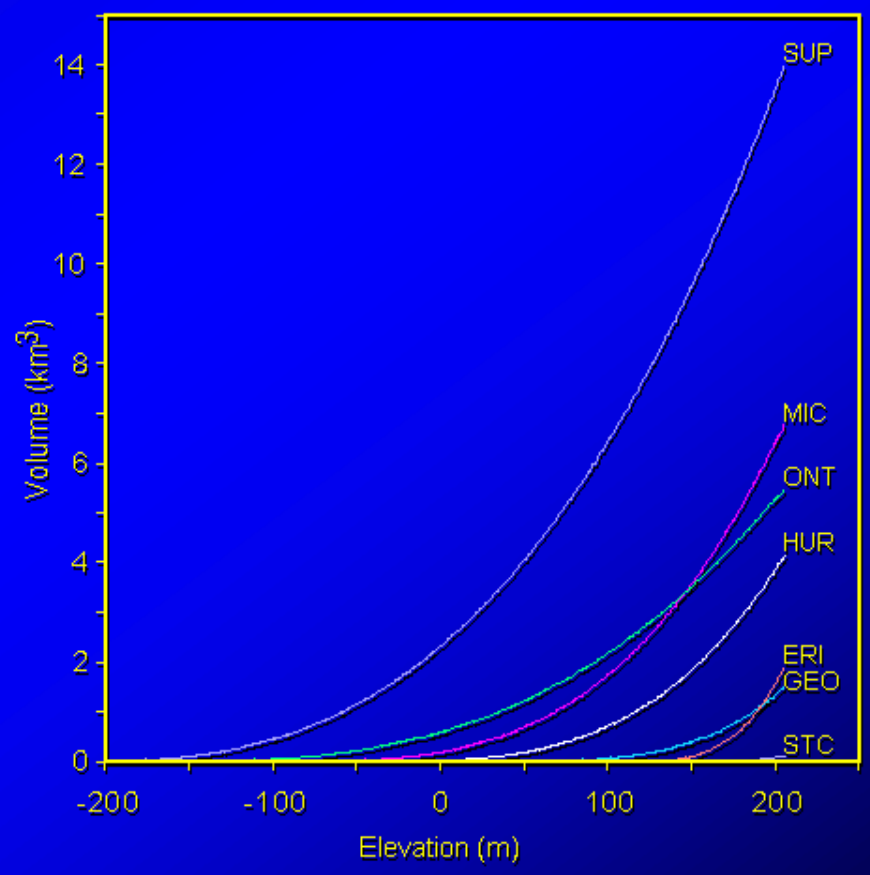


Changed Climate

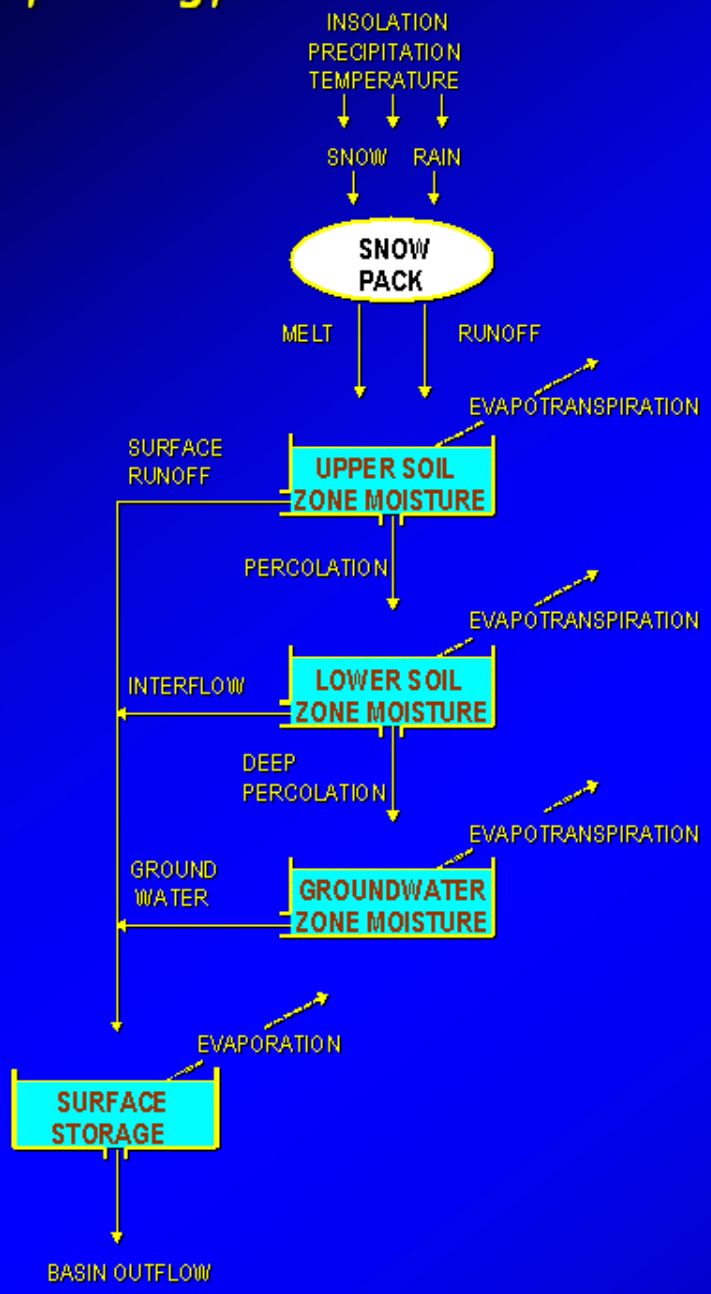
- "base case" scenario
- apply ratios & differences to historical data
- use with models to calculate climate change scenario

Hypsometric Relations





Hydrology Model



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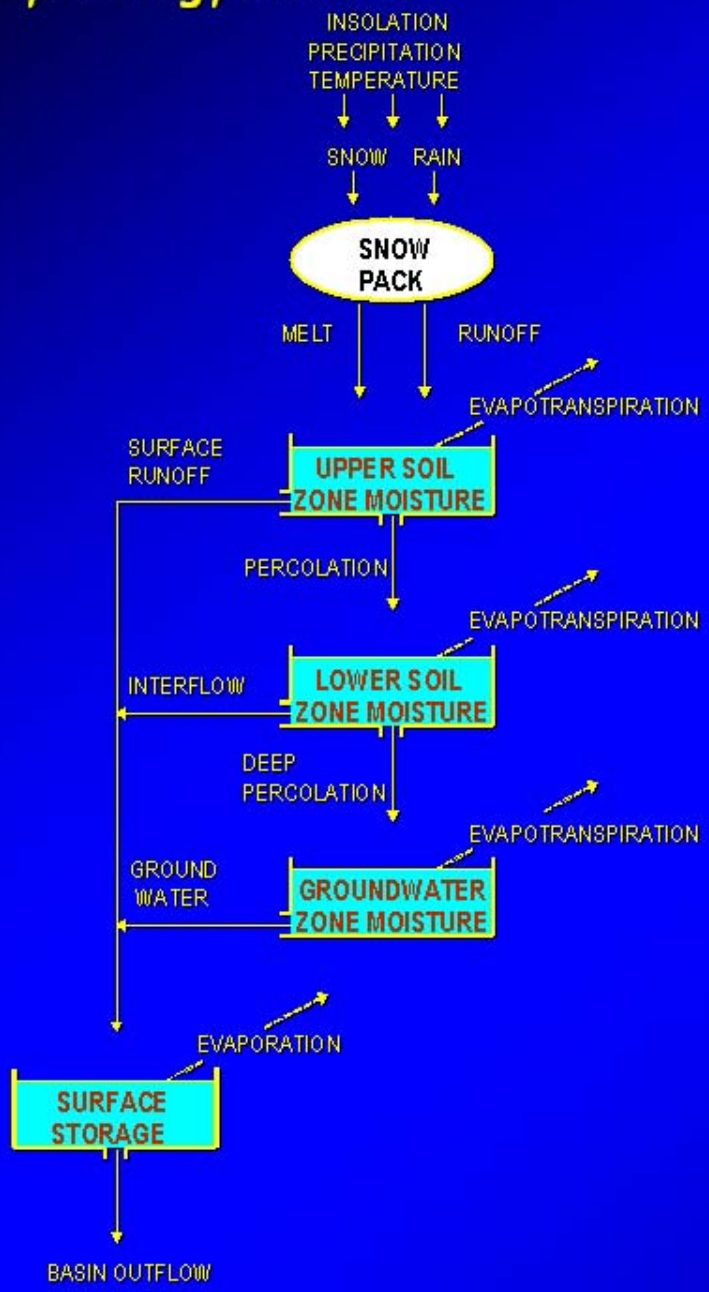

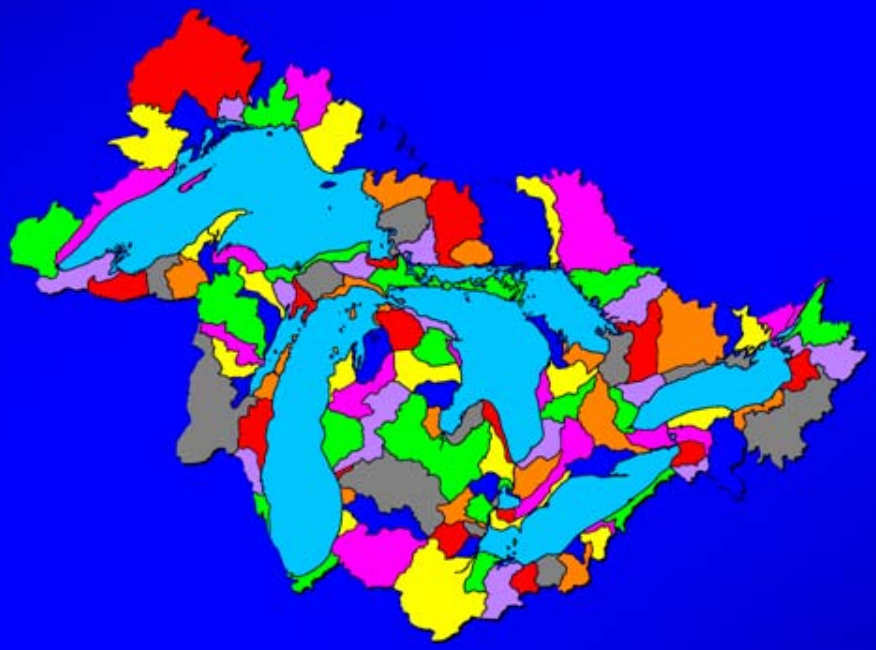

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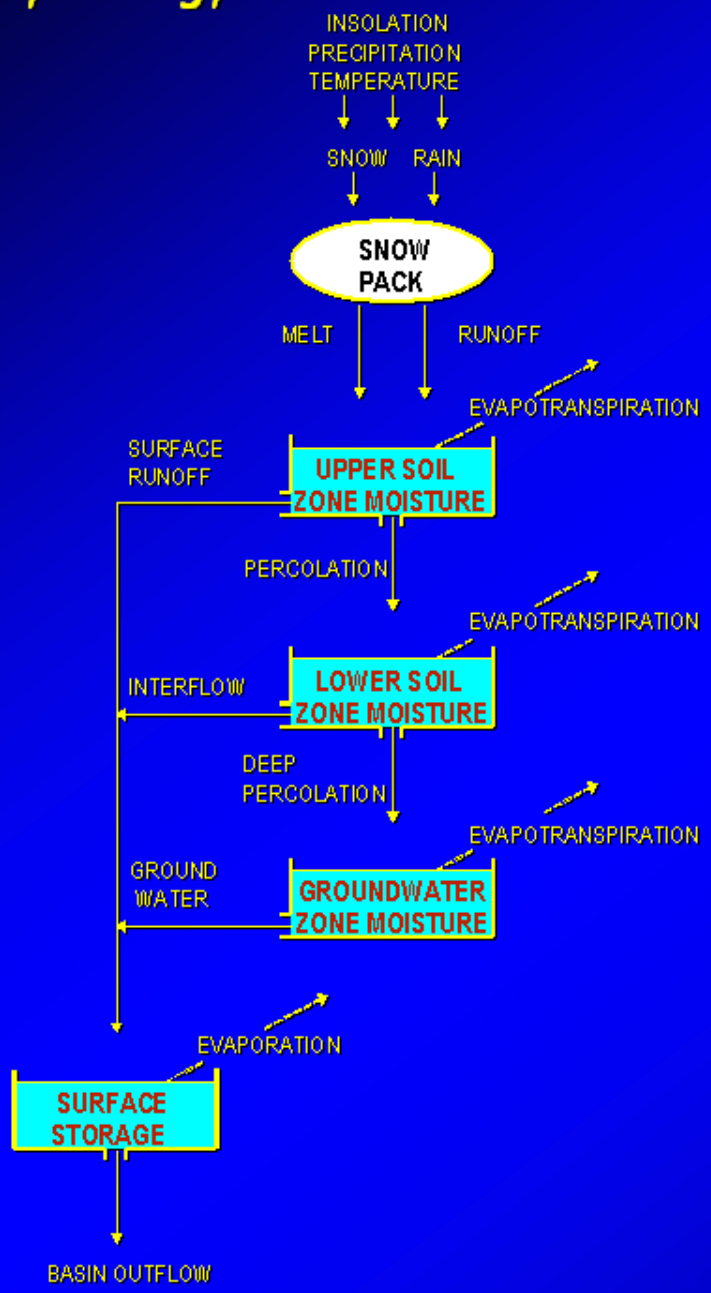

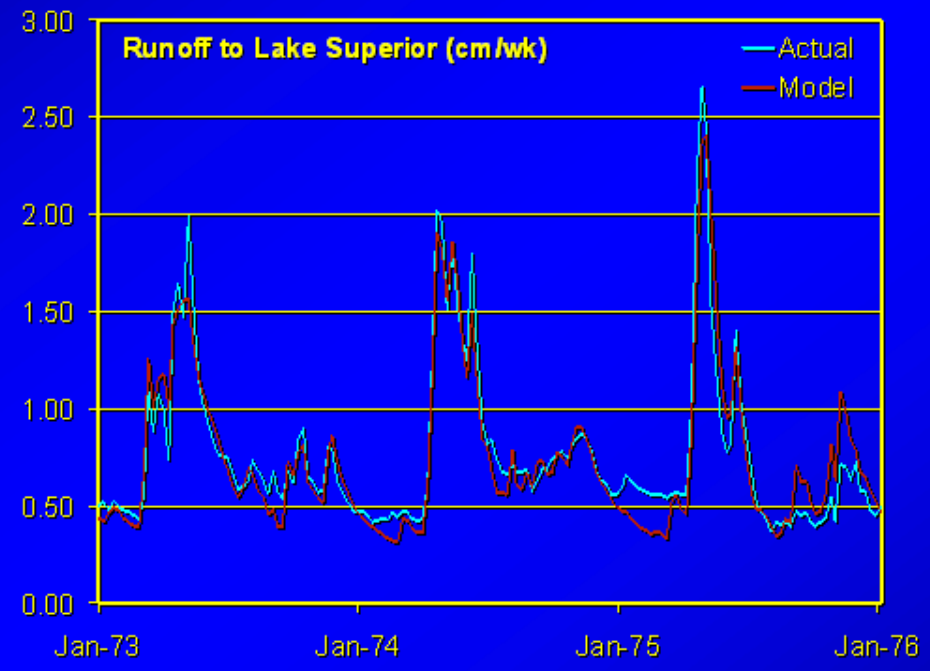

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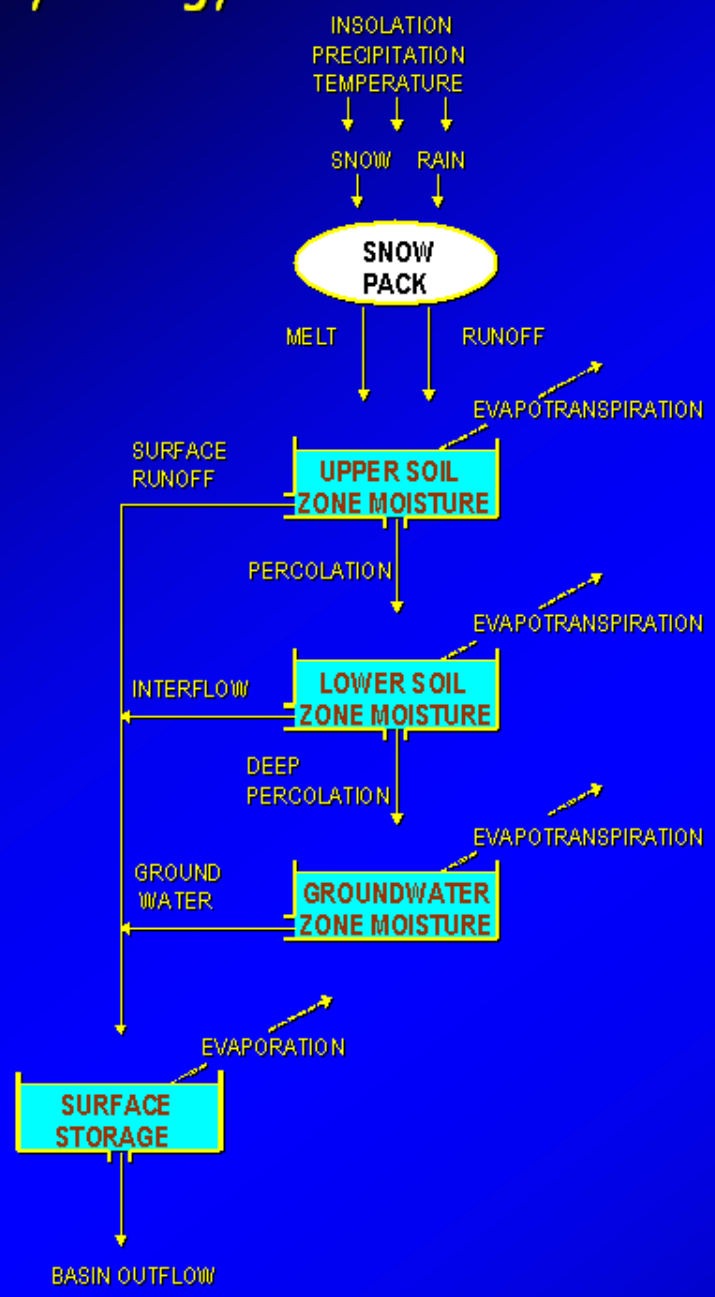
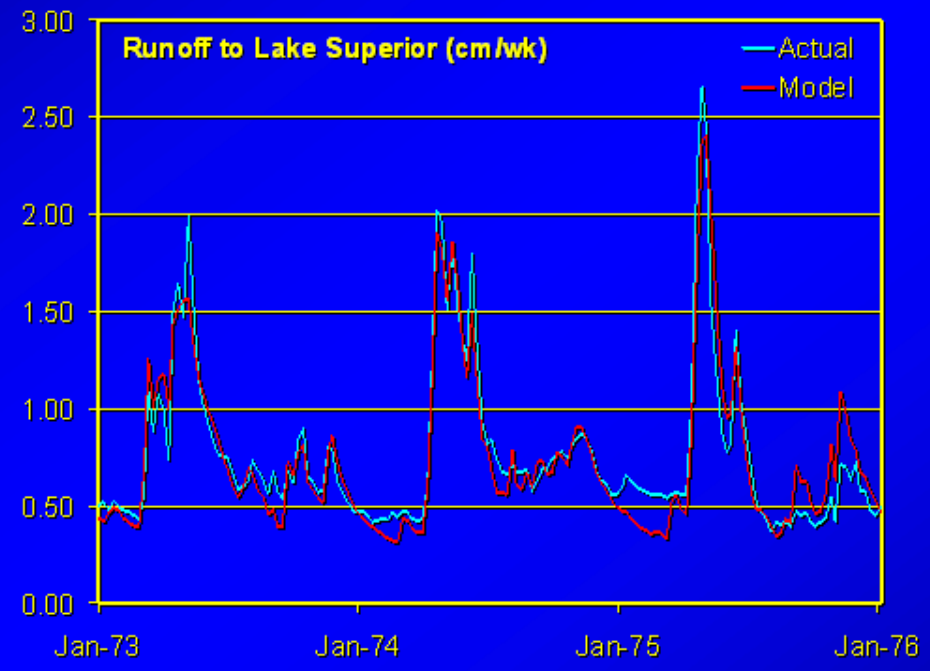
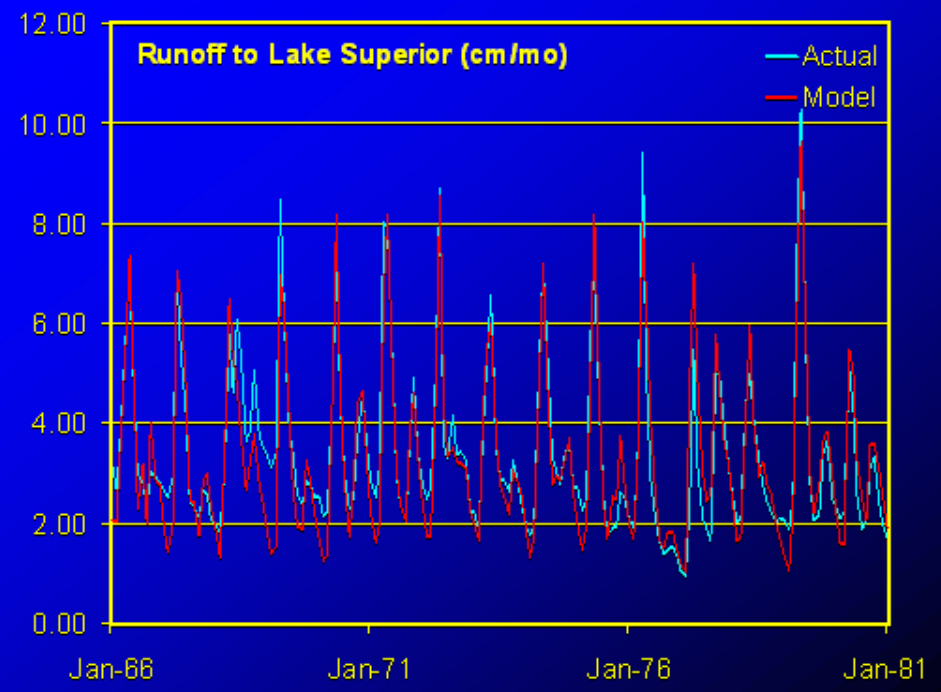
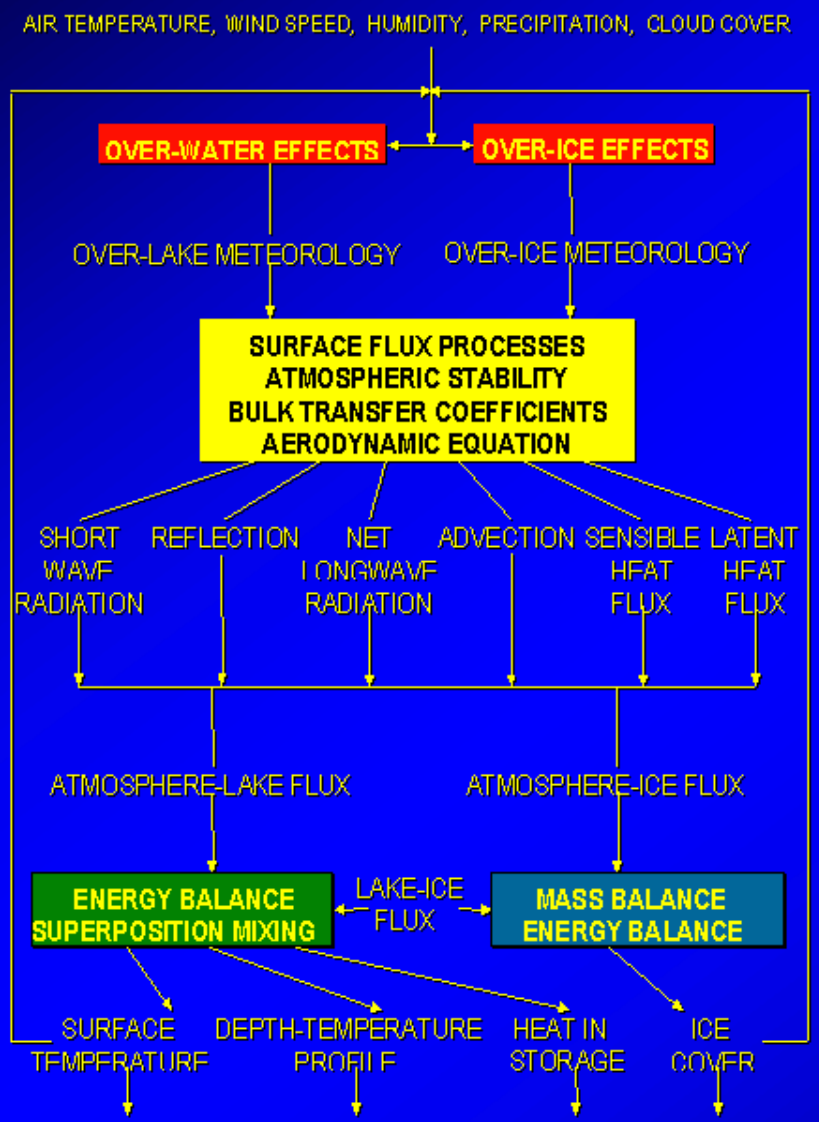






Lake Thermodynamics Model



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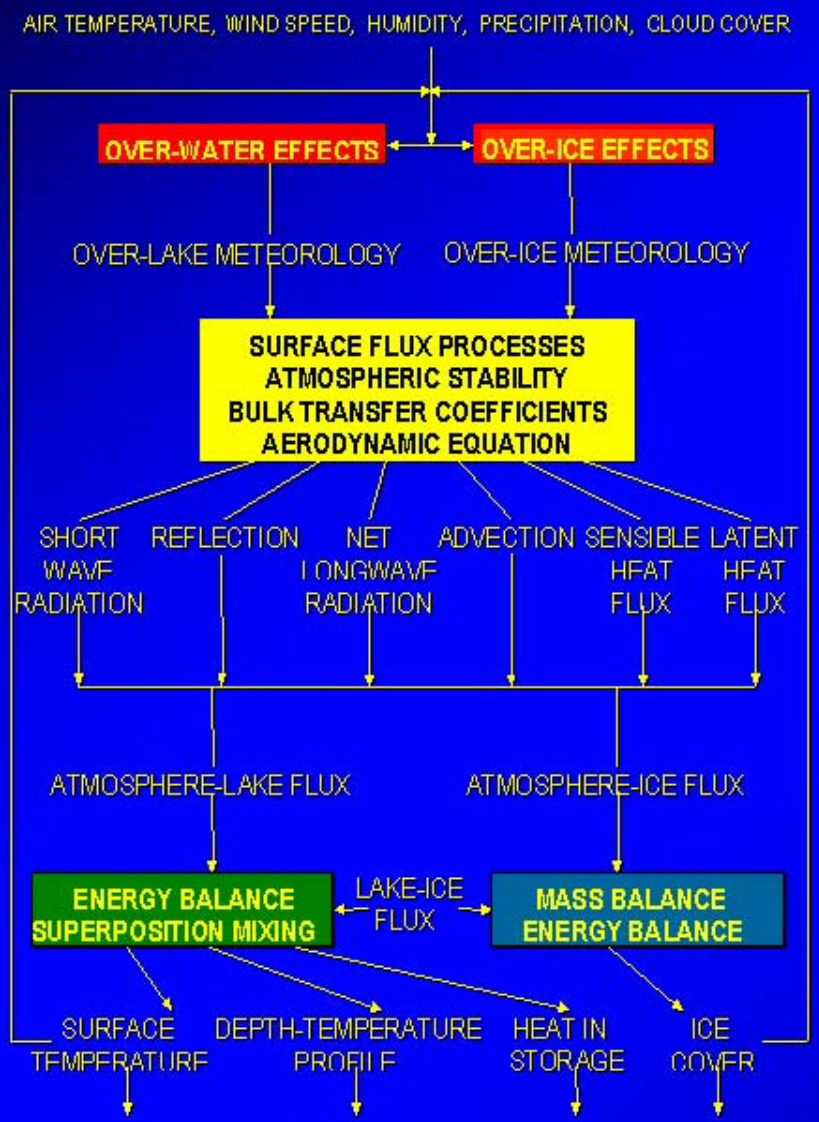

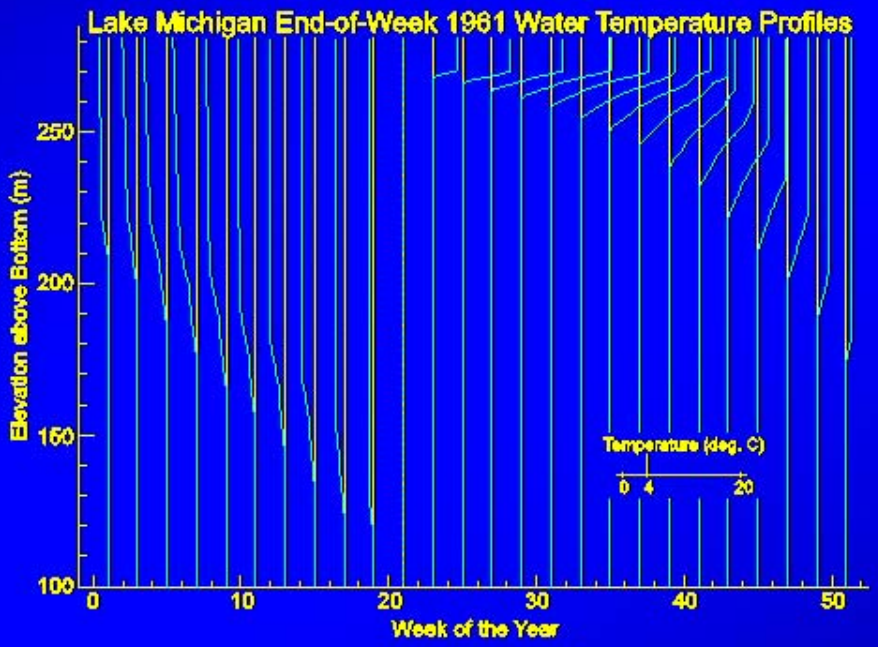

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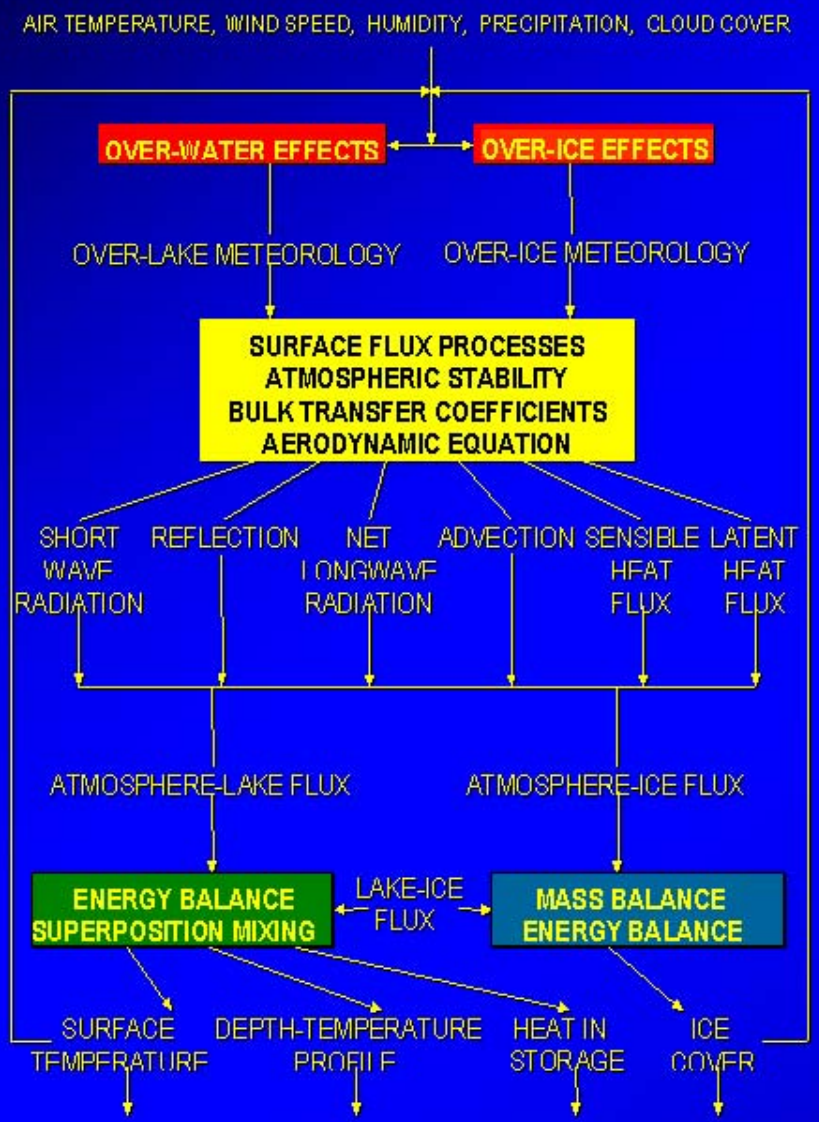
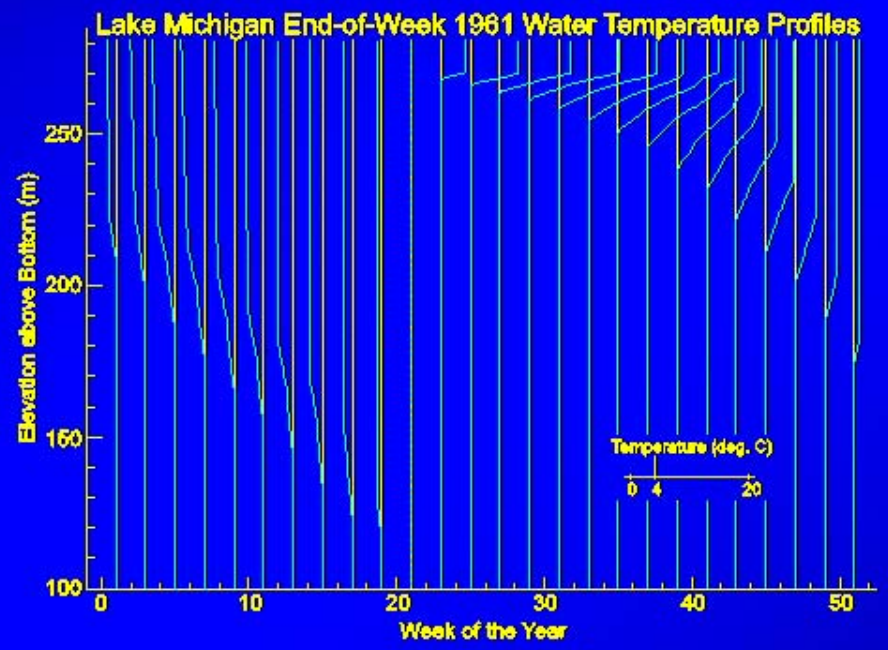
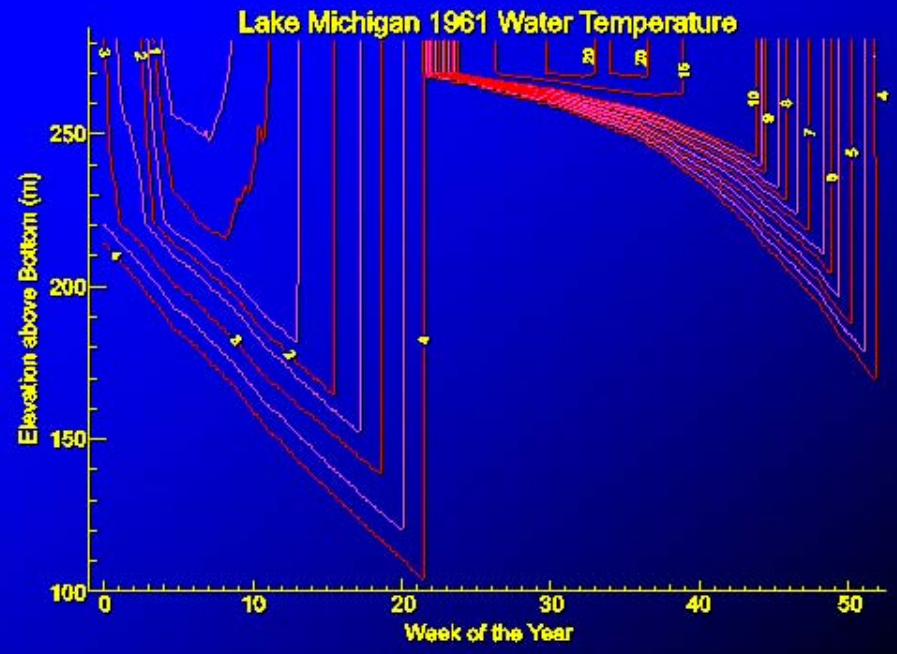






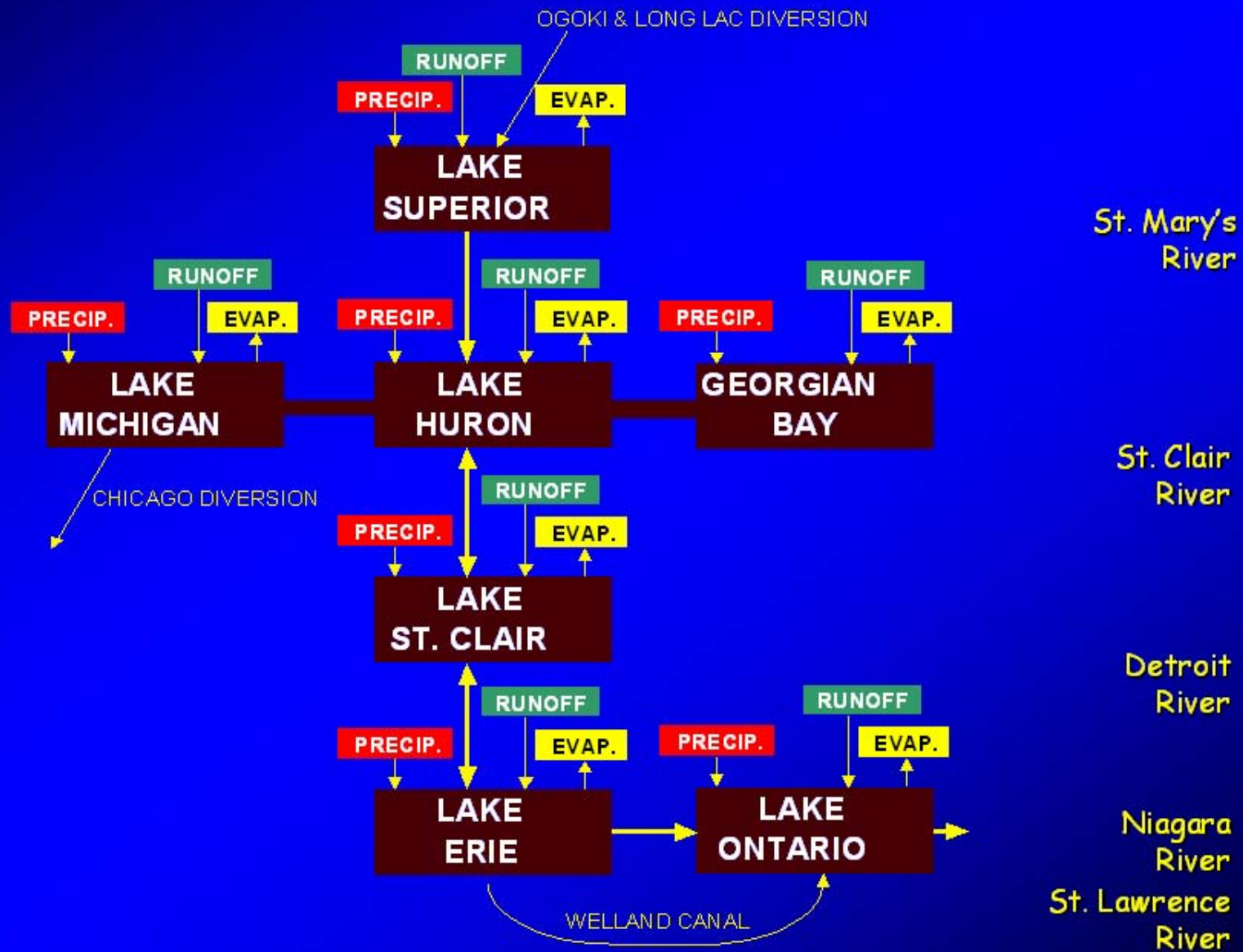
NBS Adjustment

$$P = pA$$

$$R = r\frac{A_L}{A_B - A_L}\left(A_B - A\right)$$

$$E = eA$$

Integrated System



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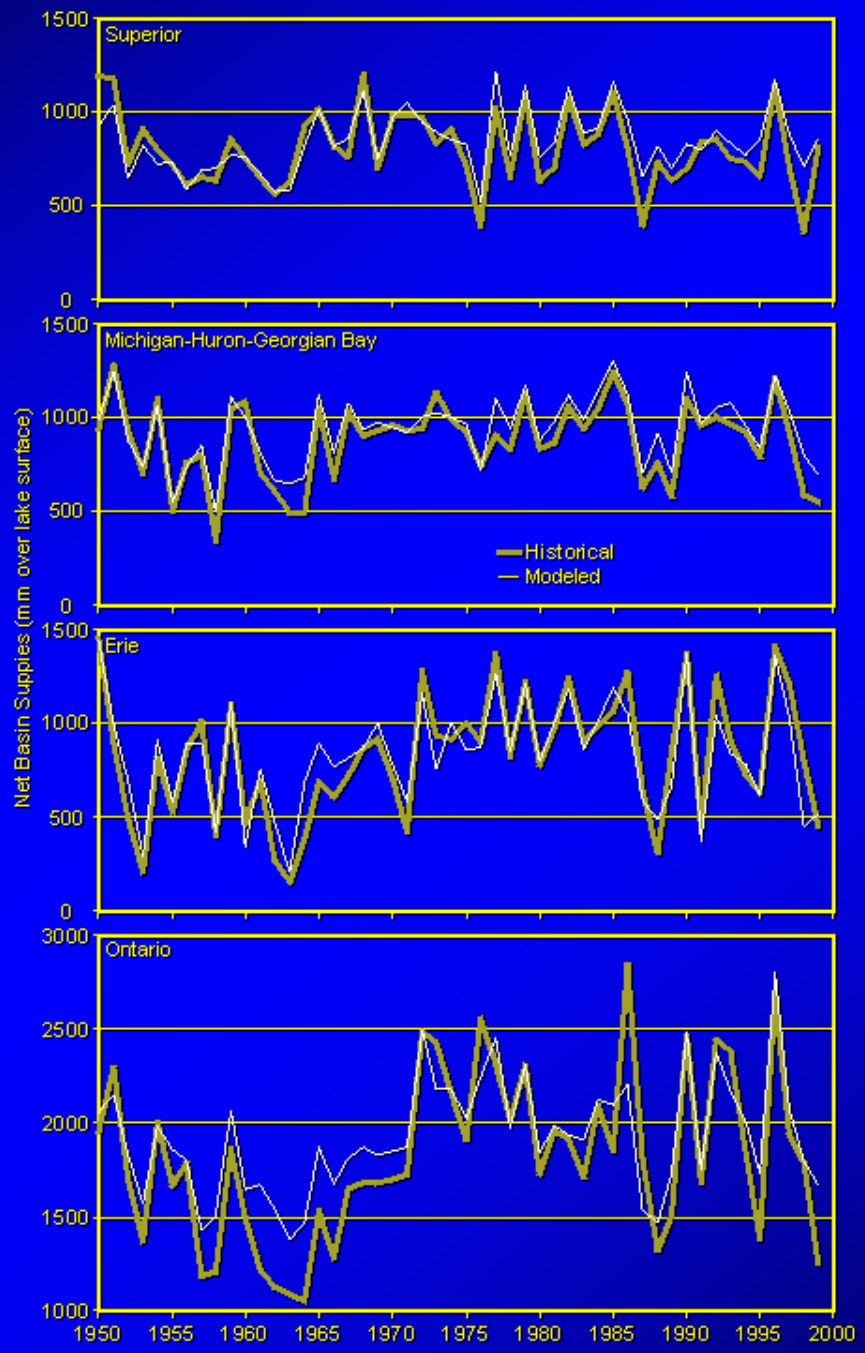
NBS



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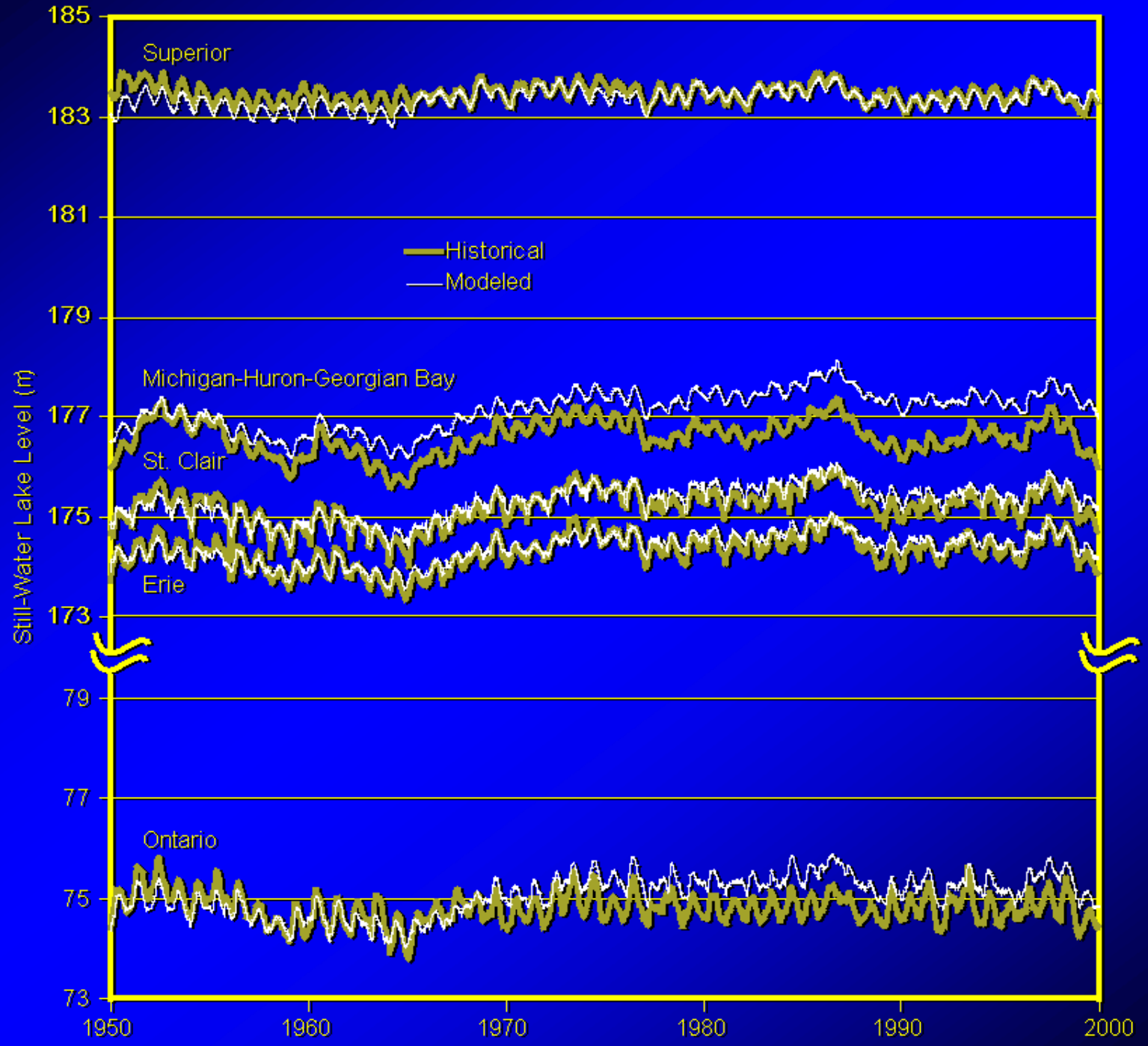
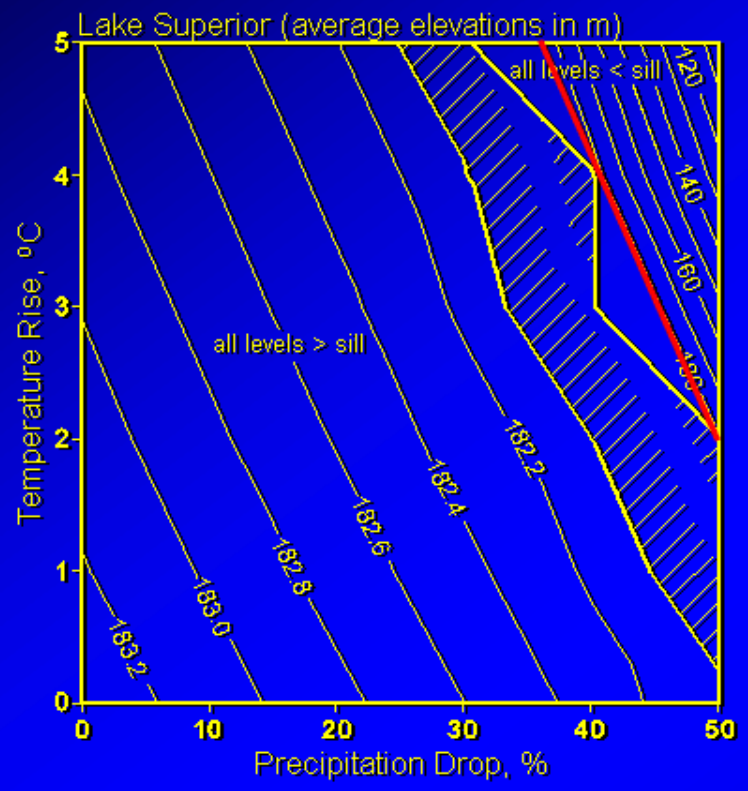
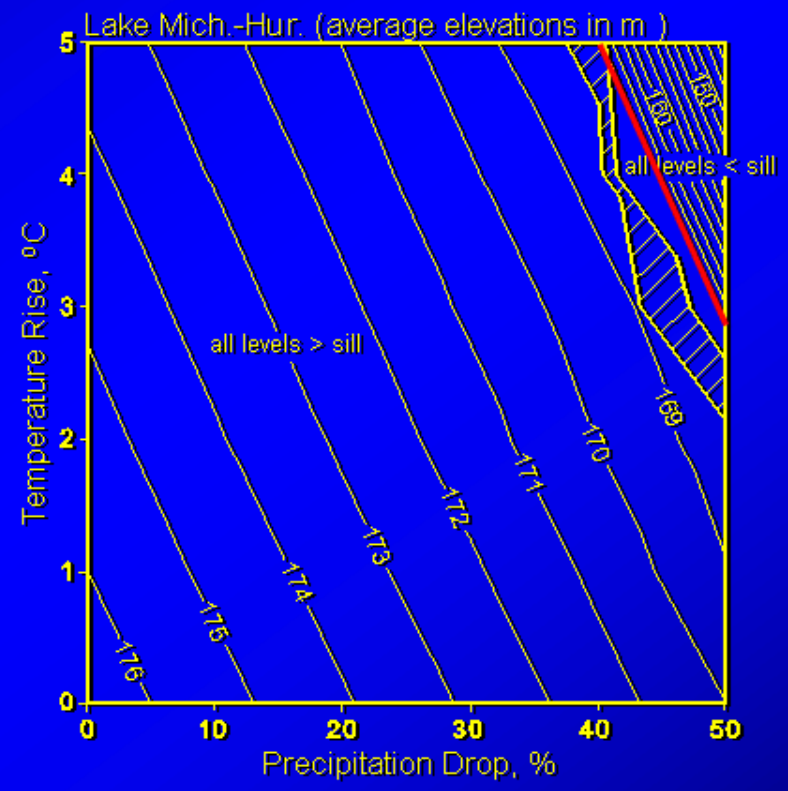


Steady-State Water Levels As a Function of Climate





Terminal Lake Climates:

Superior, 4.7 T + P > 60; **Michigan-Huron, 4.5 T + P > 63**