Some ongoing climate-change work at the Wisconsin Science Center

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Partial list of WSC projects…

- Soil-water-balance modeling
  - better estimate of changing potential recharge
  - output is fed into stream temperature and fish occurrence model

Watershed modeling – Lake Michigan Basin

  - Build model to provide streamflow estimates for GLRI restoration efforts

- TSPROC – tool for calibrating models
  - TSPROC = time series processor (Doherty, 2008)
  - adding majority of indices evaluated in Olden and Poff (2003)

Wisconsin Stream Temperature Model

(Stewart and others, 2006)

ANN model
R-squared = 0.70

Landscape Data

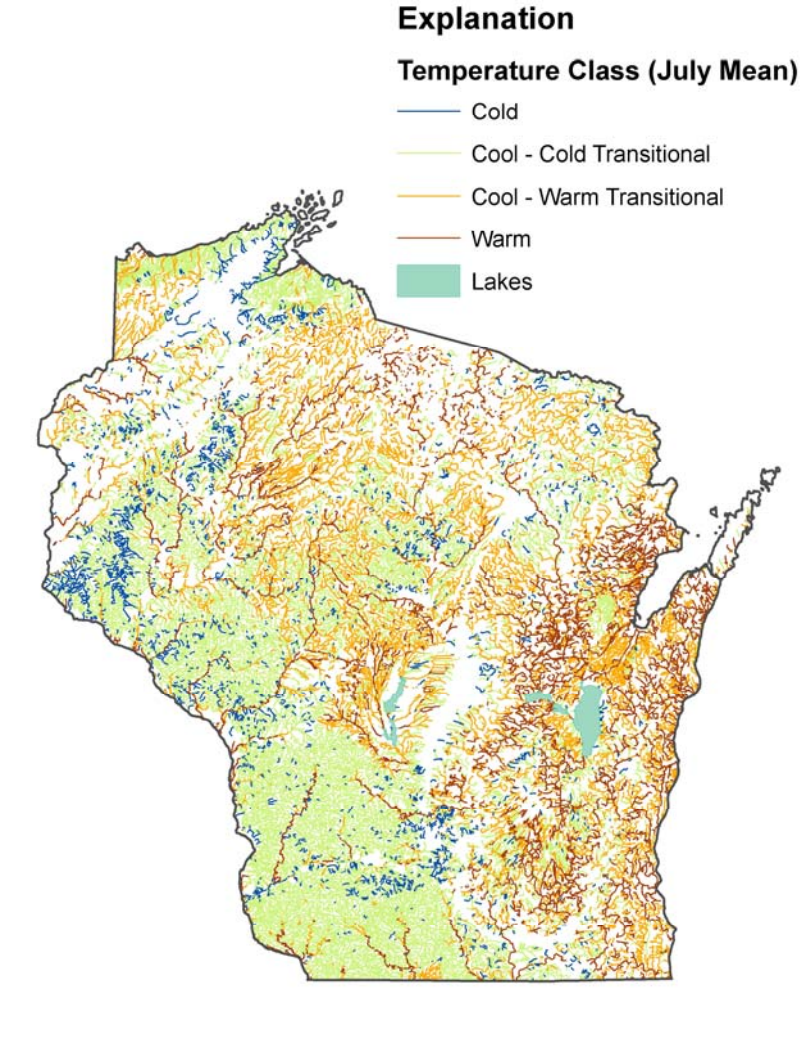
(Size, Geology, Land cover, Network position)

Climate Data

(Air temperature – daily mean - time series)

Stream Temperature

(June – August – daily mean – time series)



Temperature Classes (July mean)

(Lyons and others, 2009)

Cold (< 17.5 C)

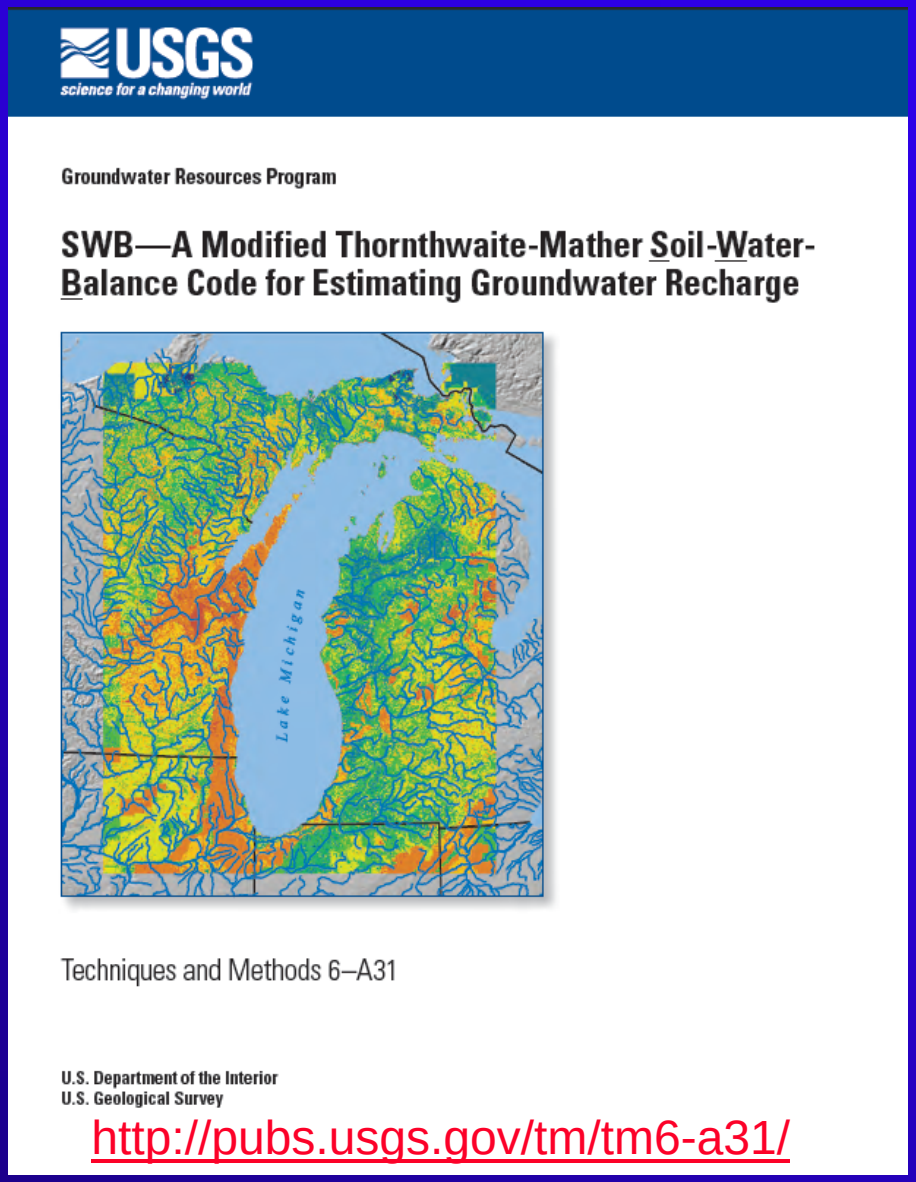
Cool – Cold transition (17 – 19.5 C)

Cool – Warm transition (19.5 – 21 C)

Warm (> 21.5 C)

Soil Water Balance (SWB)

- grid-based
- modified Thornthwaite-Mather approach
- daily timestep
- accounts for:
  - snow accumulation / melting
  - runon / runoff
  - interception
  - evapotranspiration
  - runoff from frozen ground



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Groundwater Resources Program

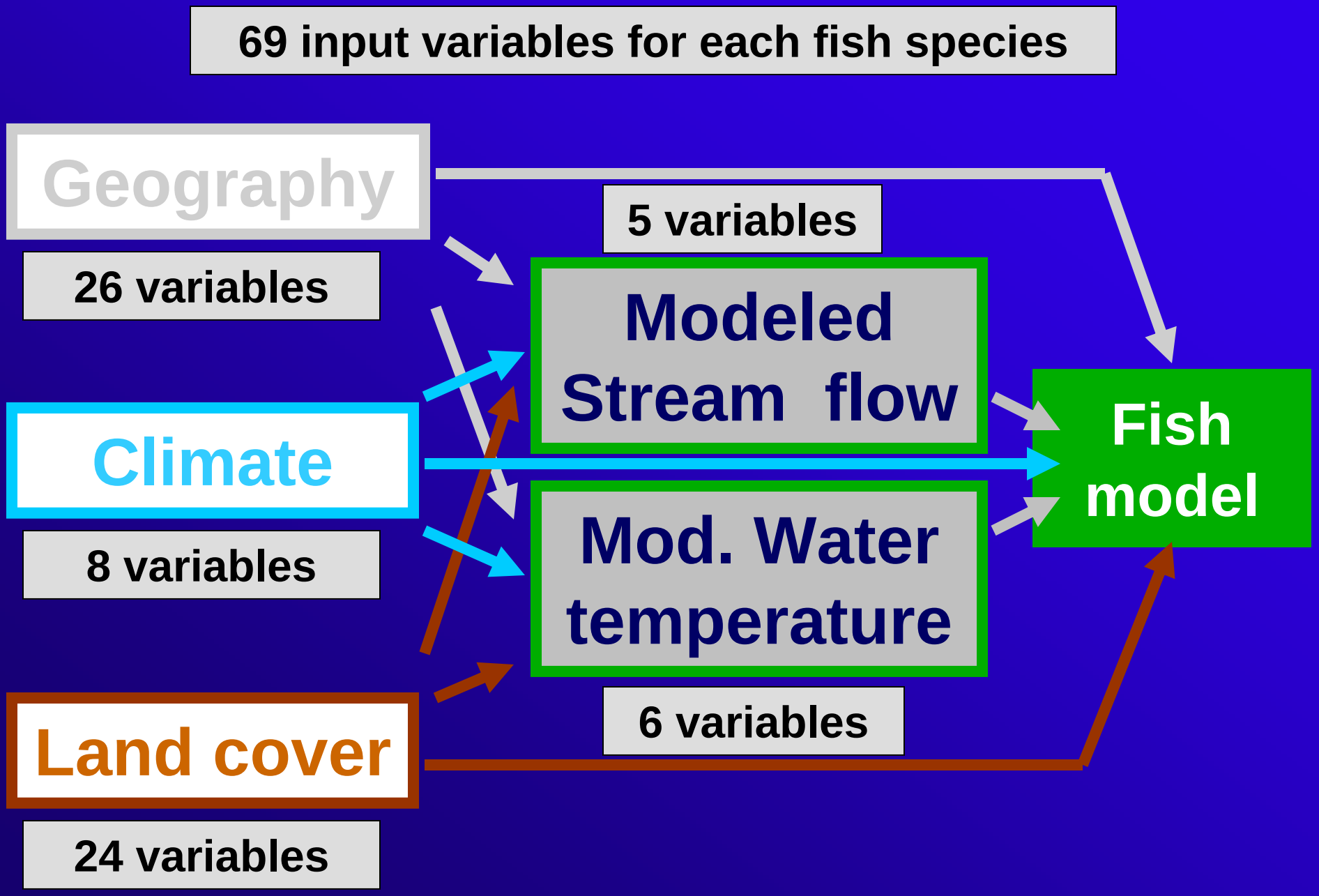
SWB—A Modified Thornthwaite-Mather Soil-Water-Balance Code for Estimating Groundwater Recharge

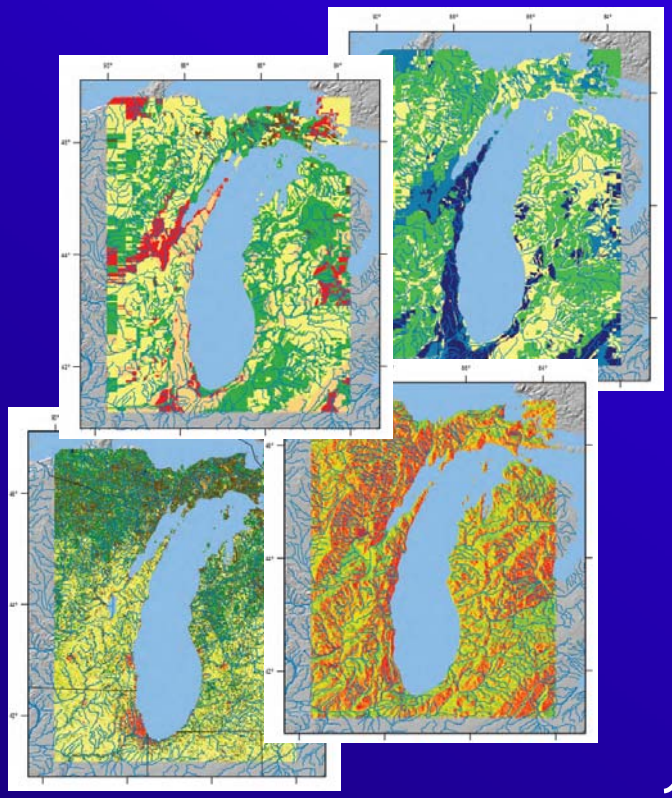
Techniques and Methods 6–A31

U.S. Department of the Interior
U.S. Geological Survey

http://pubs.usgs.gov/tm/tm6-a31/

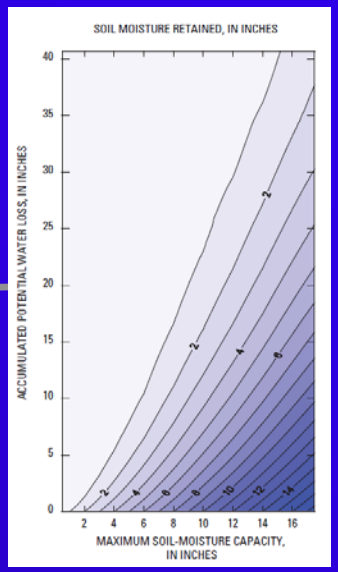
Conceptual model for predicting fish occurrence



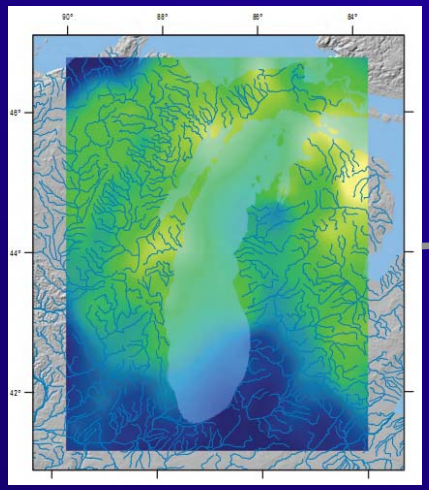


- land use / land cover
- soil hydrologic unit
- available water content
- D8 flow direction

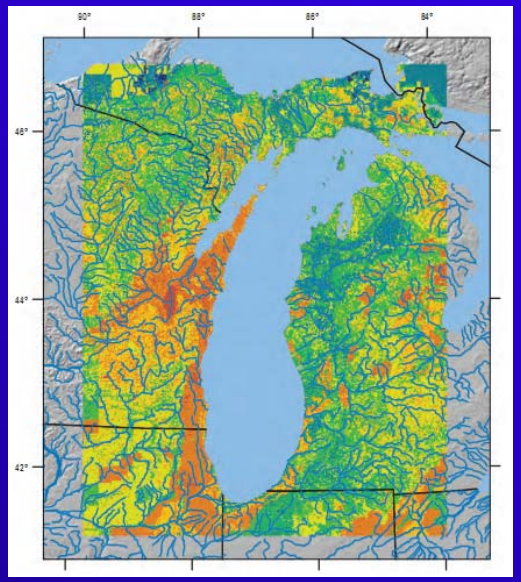
Thornthwaite-Mather soil-moisture retention tables

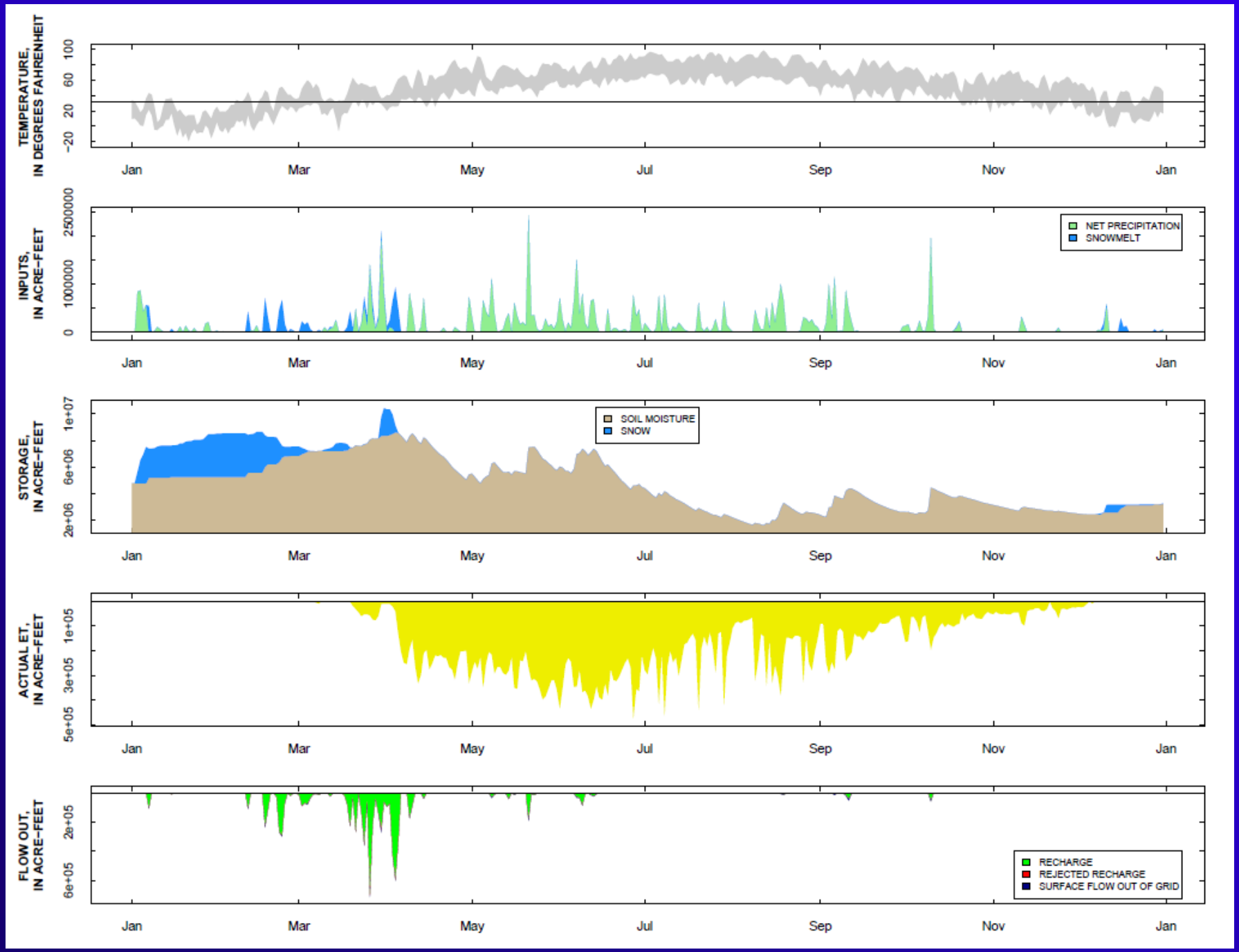


SWB

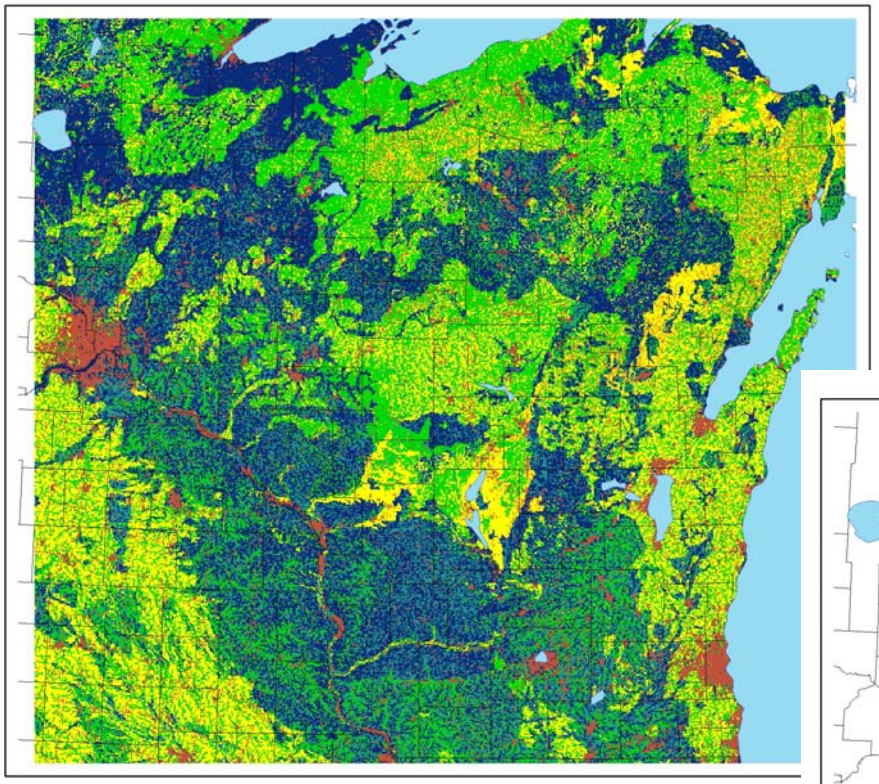


tabular or gridded meteorologic data

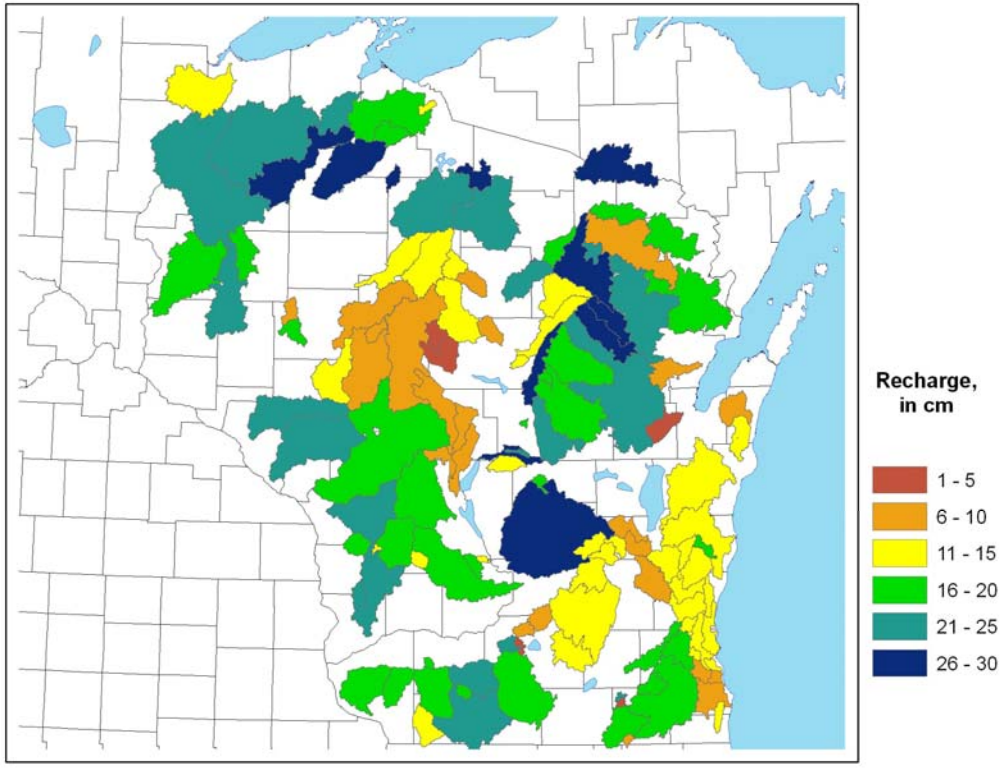



TEMPERATURE, IN DEGREES FAHRENHEIT
100
60
20
-20
Jan
Mar
May
Jul
Sep
Nov
Jan
INPUTS, IN ACRE-FEET
2500000
1000000
0
NET PRECIPITATION
SNOWMELT
STORAGE, IN ACRE-FEET
1e+07
6e+06
2e+06
SOIL MOISTURE
SNOW
ACTUAL ET, IN ACRE-FEET
1e+05
3e+05
5e+05
FLOW OUT, IN ACRE-FEET
2e+05
6e+05
RECHARGE
REJECTED RECHARGE
SURFACE FLOW OUT OF GRID

Parameter optimization with PEST



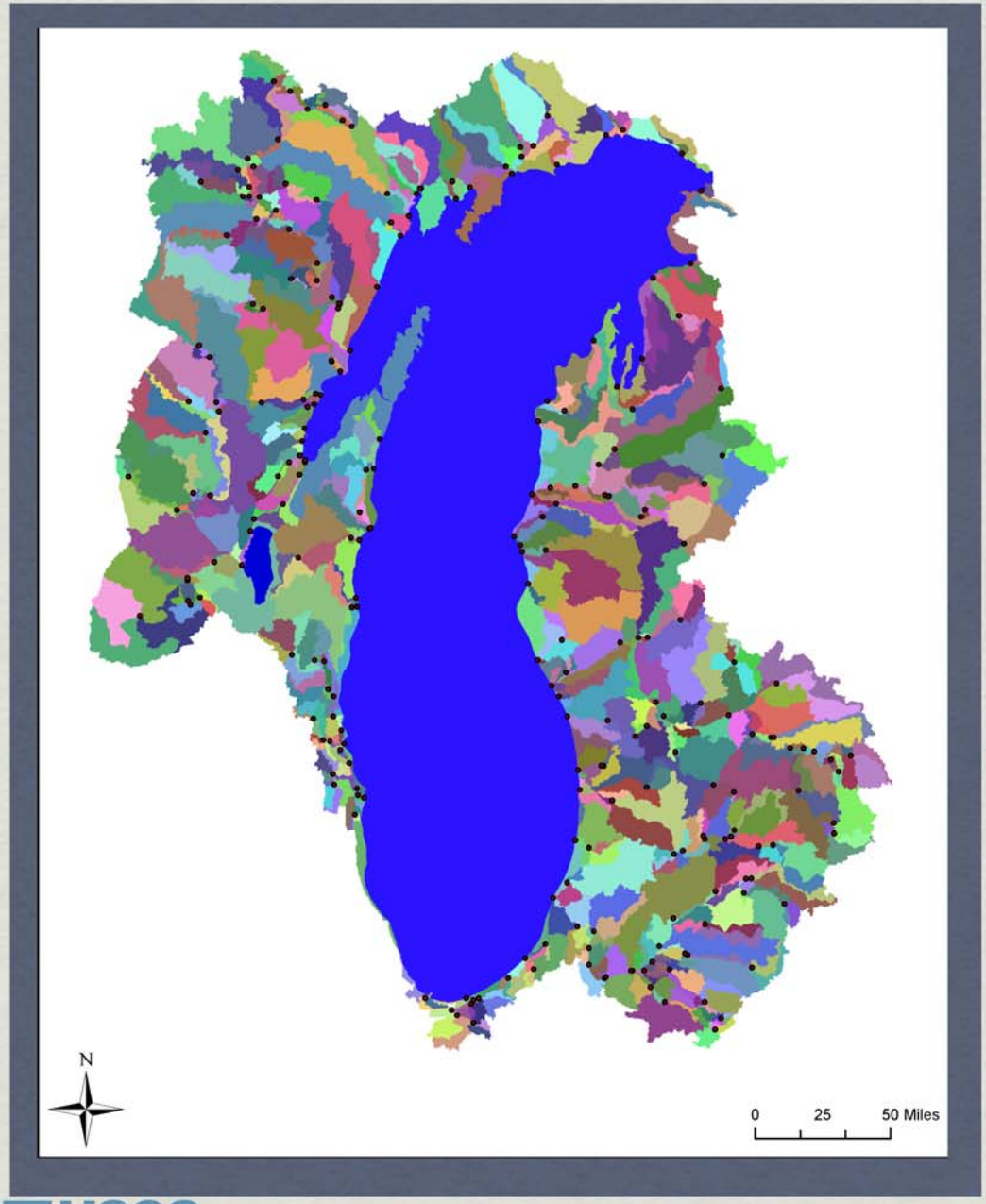
Mean annual recharge for the period 1989-2000



Mean annual recharge for various periods, usually 1970-2000

Lake Michigan Basin watershed model

- Build model capable of predicting streamflow into Lake Michigan
- Run model for current conditions and climate change scenarios
- Build two fine-scale models as insets in support of restoration efforts
- Investigate changes in hydrologic indices in response to climate change and land use scenarios



Lake Michigan Basin HRUs

Fun Facts:

- Total area: 175,000 km^2
- Nearly 300 points of interest
  - Stream gages
  - Stream outlets to the lake
  - Sparrow load basins
- 746 HRUs
- 148 stream gages
- 137 COOP climate stations
- One big HRU: Lake Michigan (58,300 km^2)

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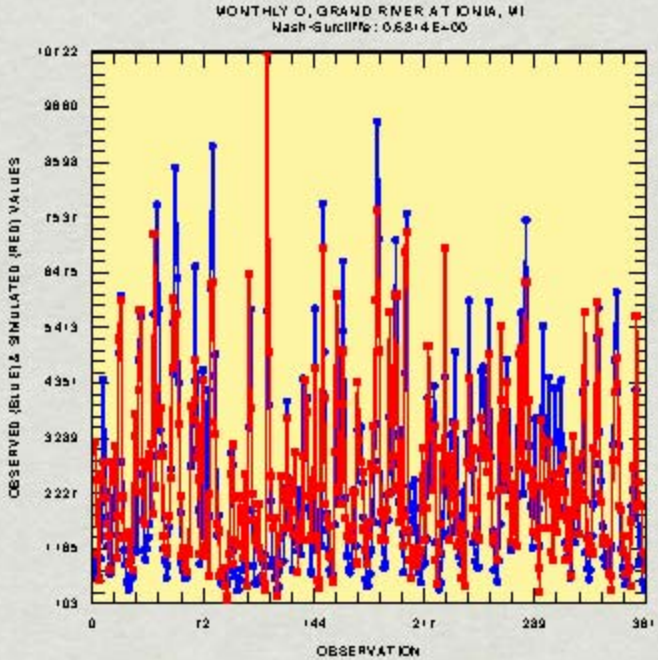

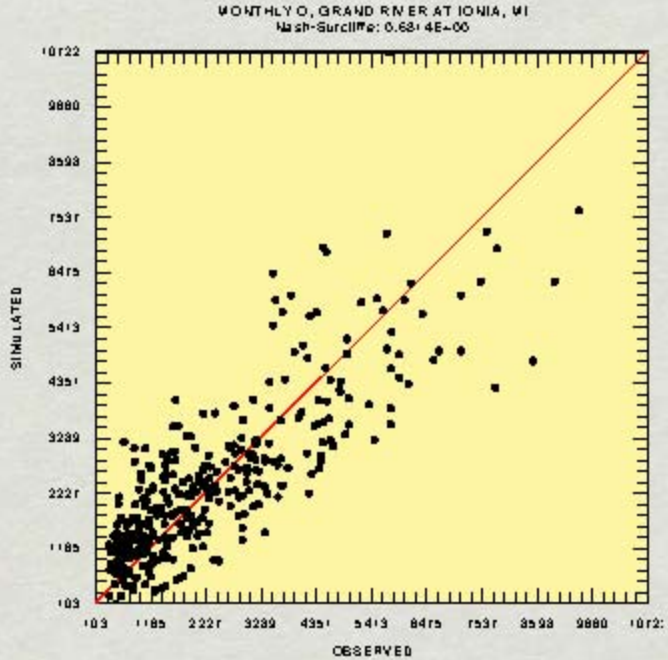

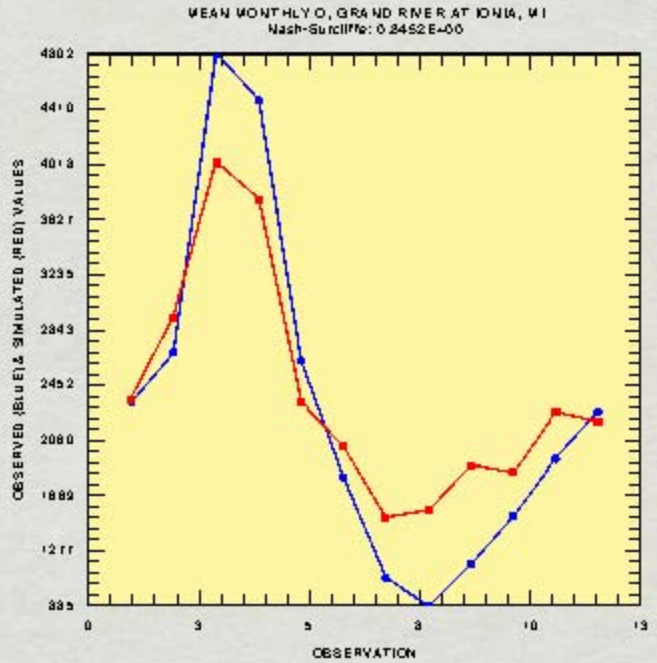

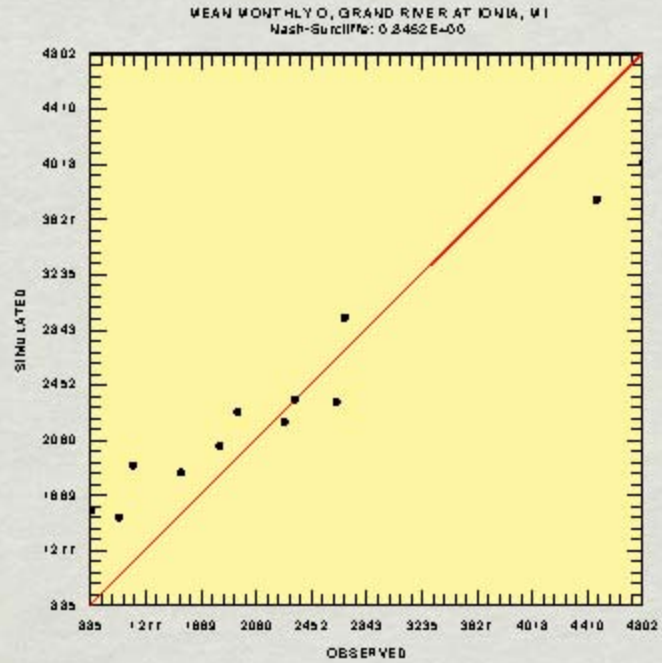

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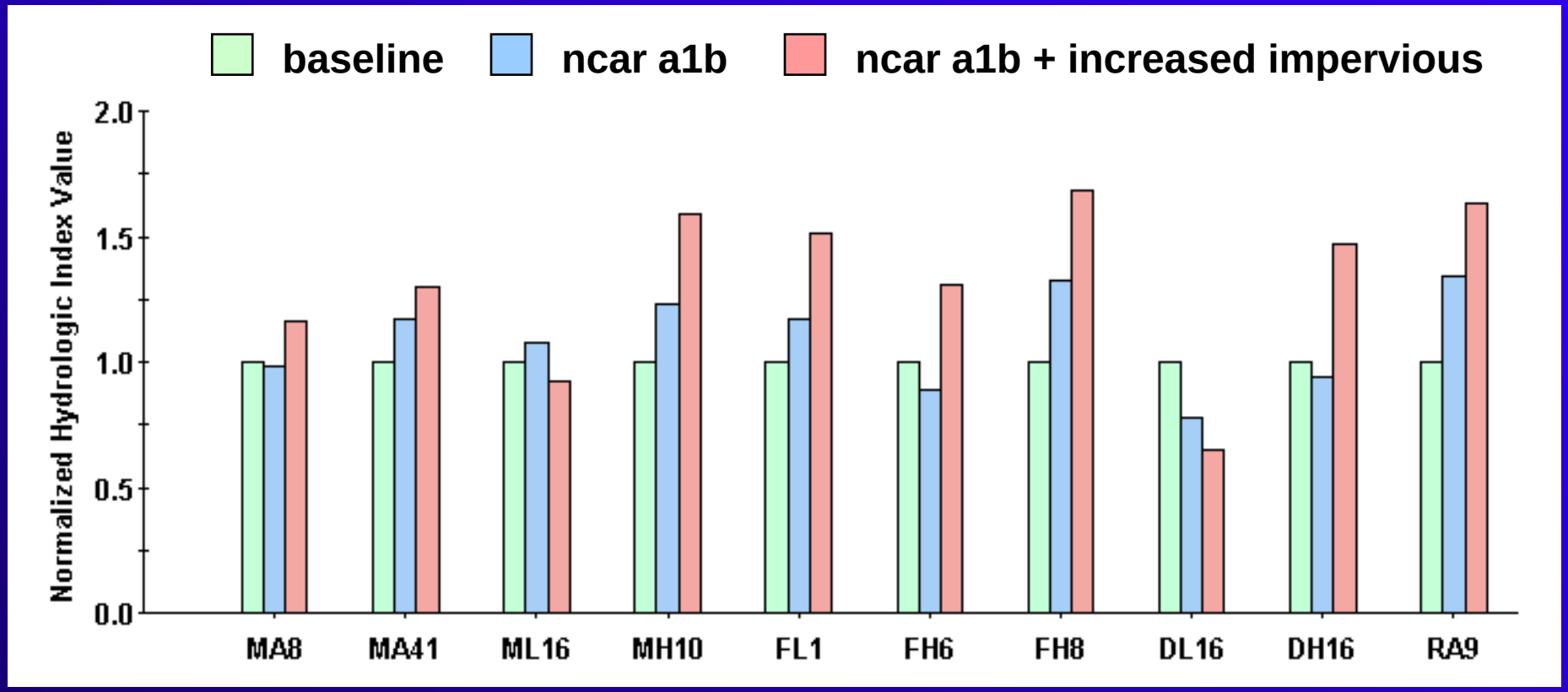
Hydrologic indices for increased impervious land cover scenario



Magnitude Average

Mag. Low, High

Freq. Low

Freq. High

Dur. Low, High

Rate of Change

Index definitions - Olden and Poff (2003)

TSPROC – time-series processor

- TSPROC has been modified to easily calculate majority of hydrologic indices considered in Olden and Poff (2003)
- designed to work with a variety of model outputs, including those from HSPF, PRMS, CE-QUAL-W2, etc.
- HOWEVER, precipitation estimates from downscaled GCMs have high uncertainty
- Need to temper our ability to calculate indices with limitations in inputs (downscaled GCMs)