Long-term Trends in Mean Annual Streamflow in the United States for the Period 1960-2012

Modified from the authors' American Geophysical Union presentation, Fall 2013

Presented by Robert B. Swanson
USGS Nebraska Water Science Center
February 26, 2014

Long-term Trends in Mean Annual Streamflow in the United States for the Period 1960-2012 (H52B-02)

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USGS-South Dakota Water Science Center

American Geophysical Union,
Fall 2013 Conference

Session “H52B. Hydroclimatic Extremes: Estimation and Forecasting IV”

San Francisco, CA
Dec. 13, 2013

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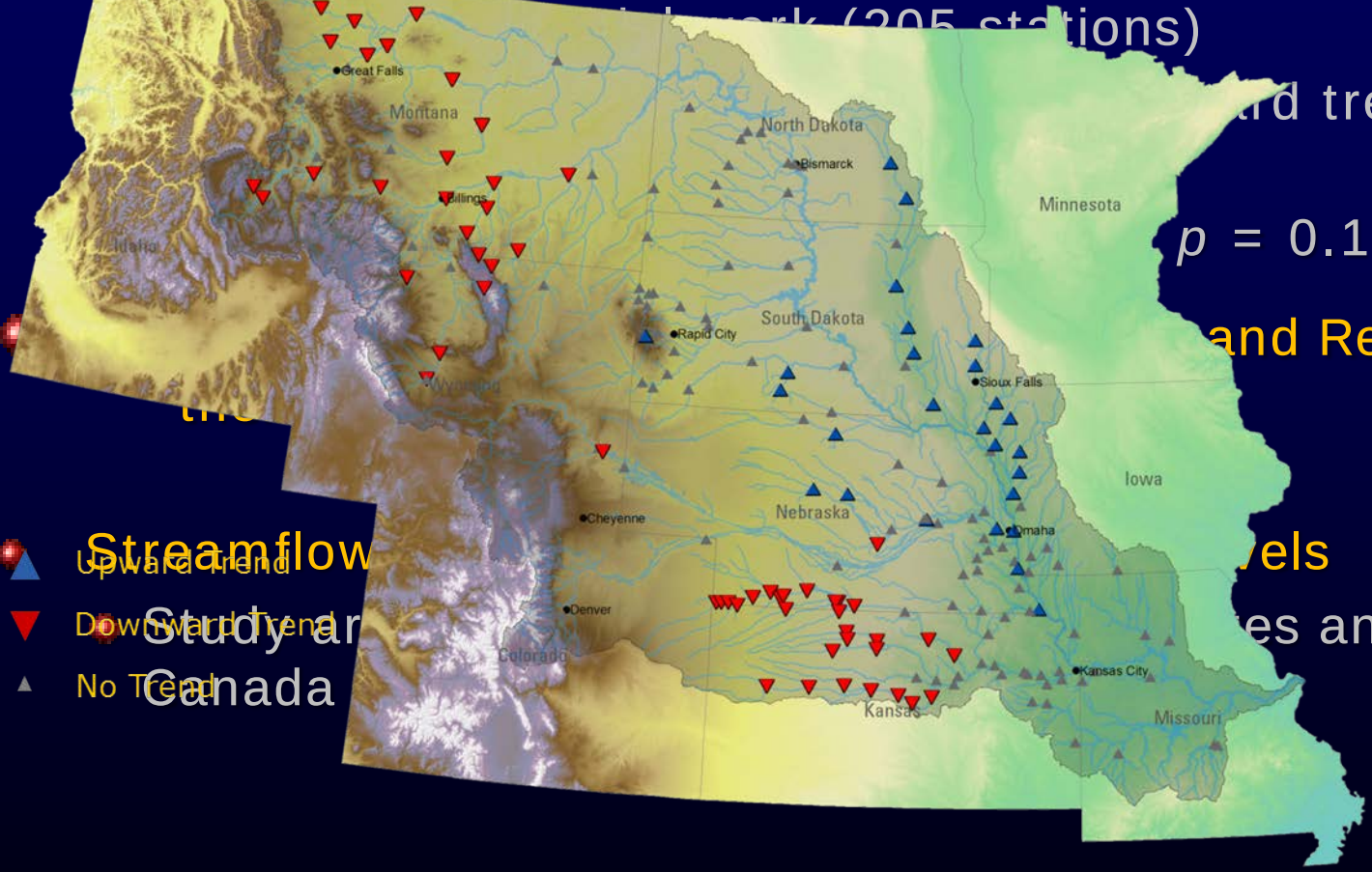
Topics

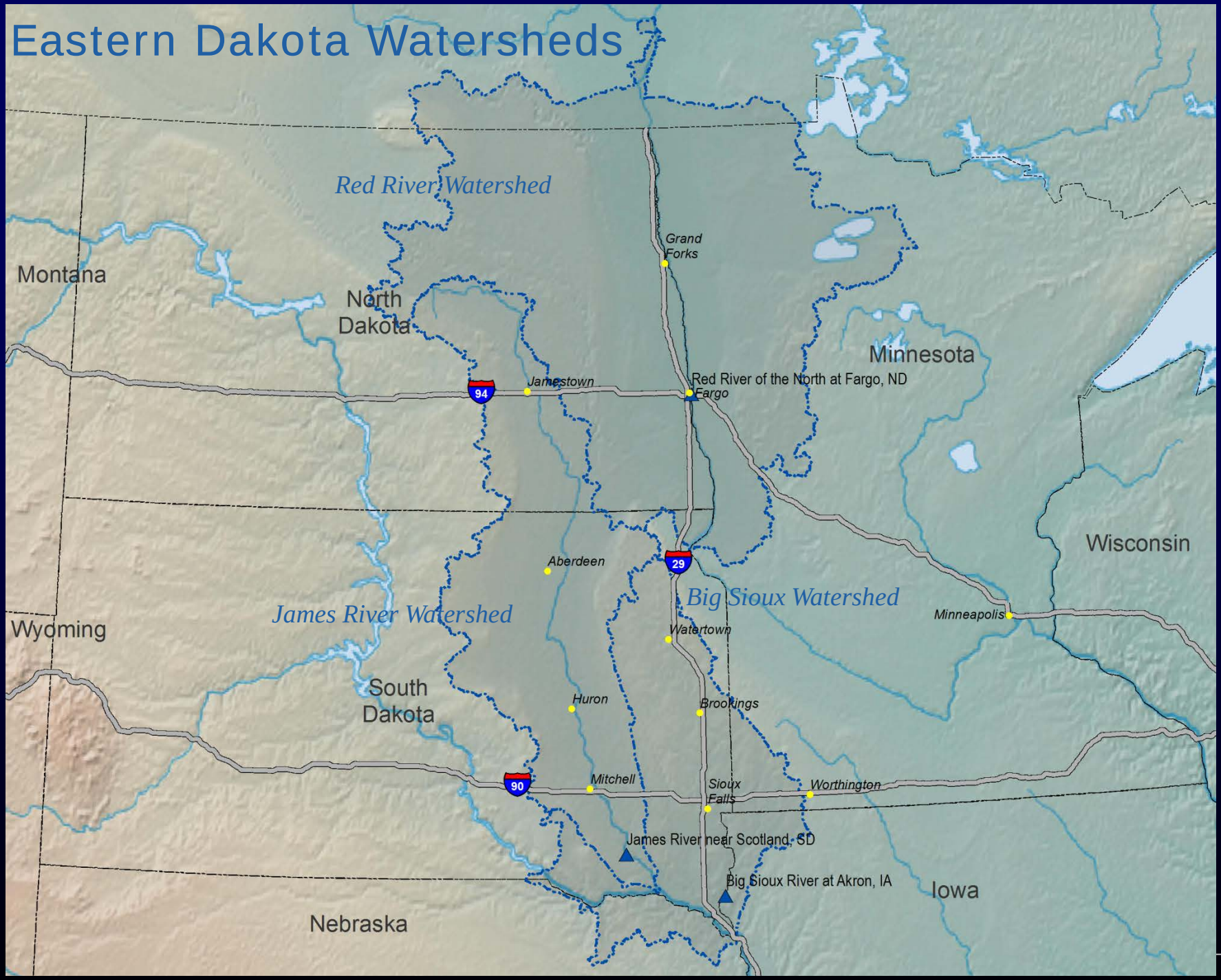
- Streamflow trends
  - Previous Work in SDWSC
  - Network
- Annual Trends
  - Mean Annual Streamflow
  - Geographic Distribution
- Forcing factors
  - Precipitation
  - Climate and Land Use Change?
- Conclusions

Research on Streamflow trends as a Climate Signal

- Streamflow trends for Missouri River Basin
  - ...work (205 stations)
  - ...rd trends in
  - p = 0.10
- ...and Red River
  - ...the
- Streamflow ...vels
  - Study ar... ...es and Canada

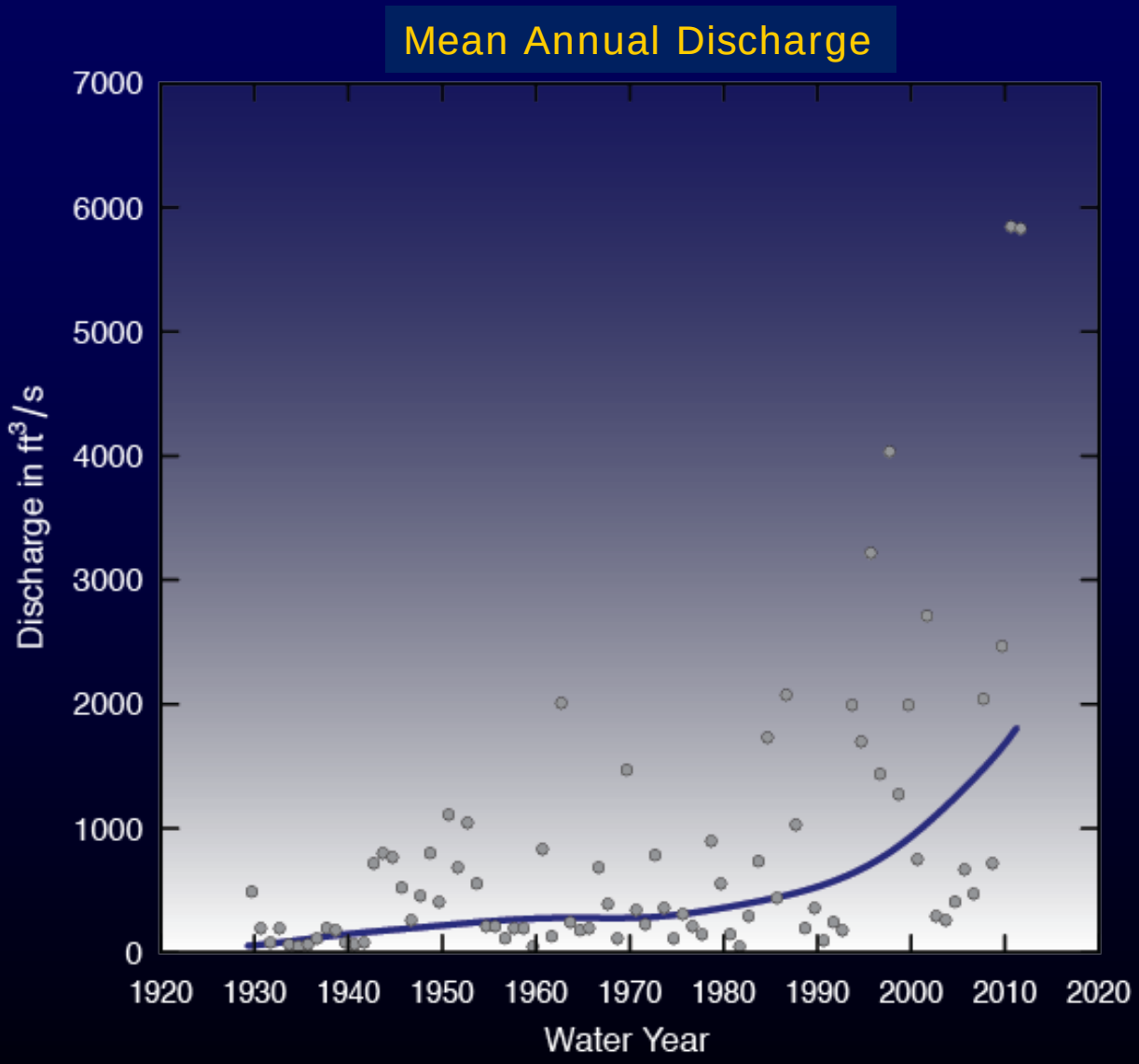


Eastern Dakota Watersheds



James River near Scotland, SD 1929-2011

View of James River
at Scotland Gage Site



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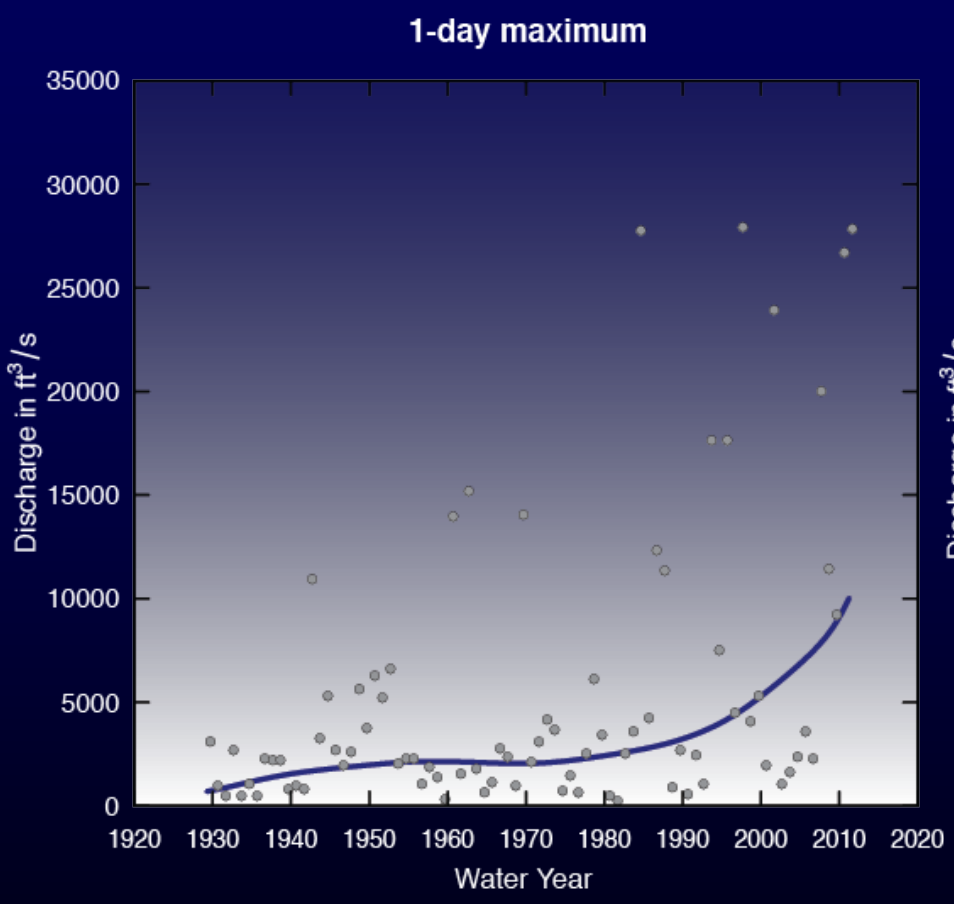
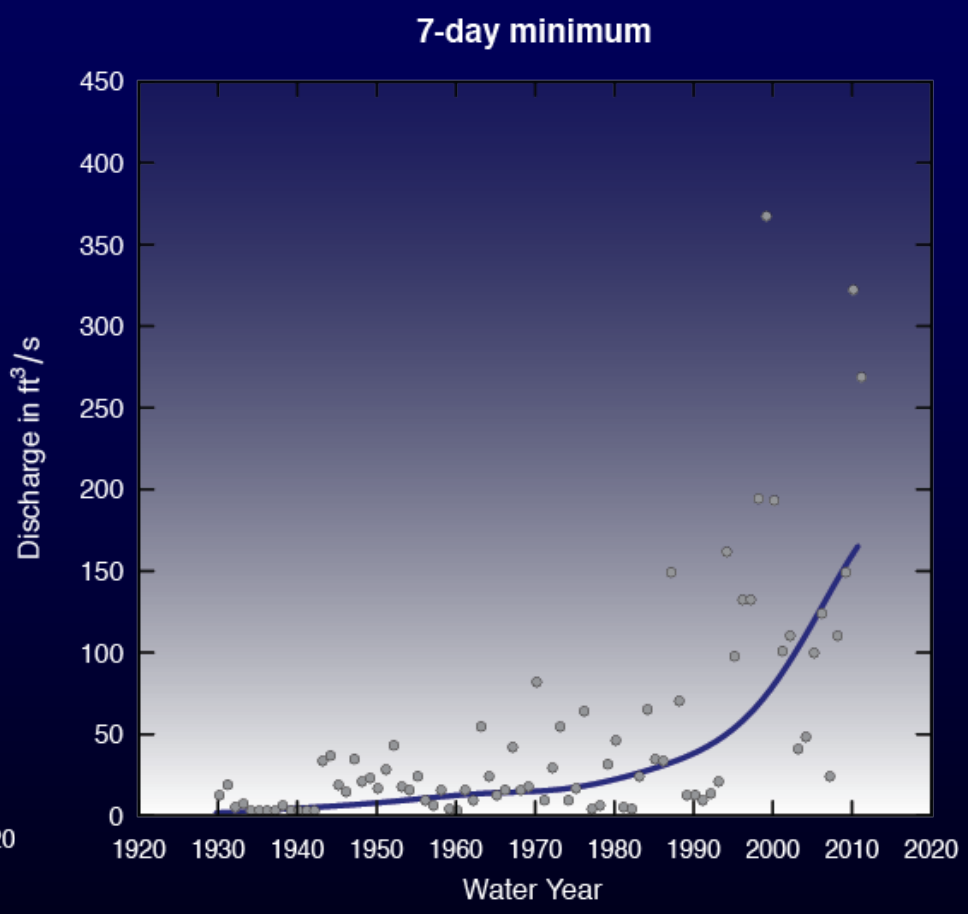
James River near Scotland 1929-2011





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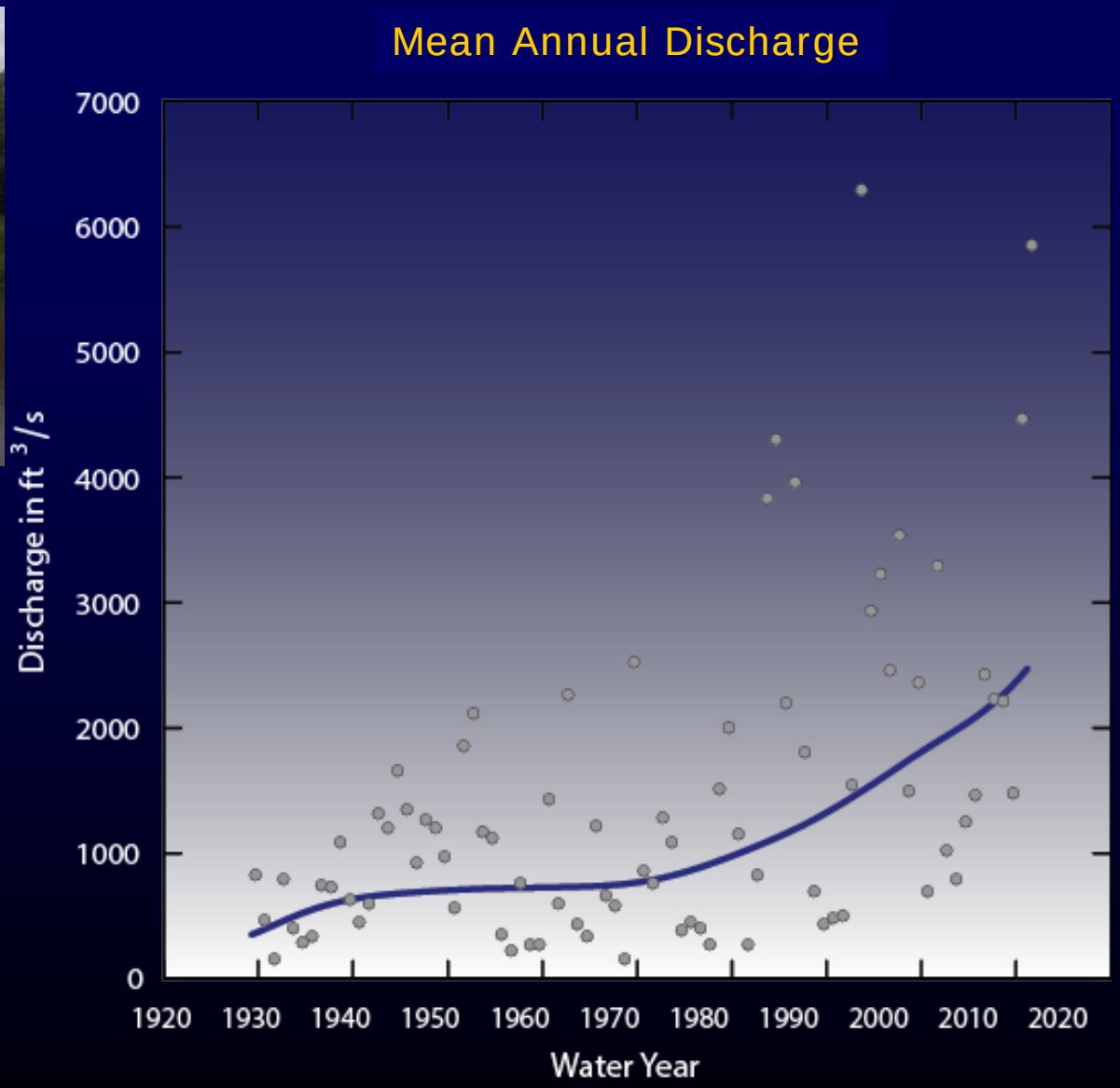
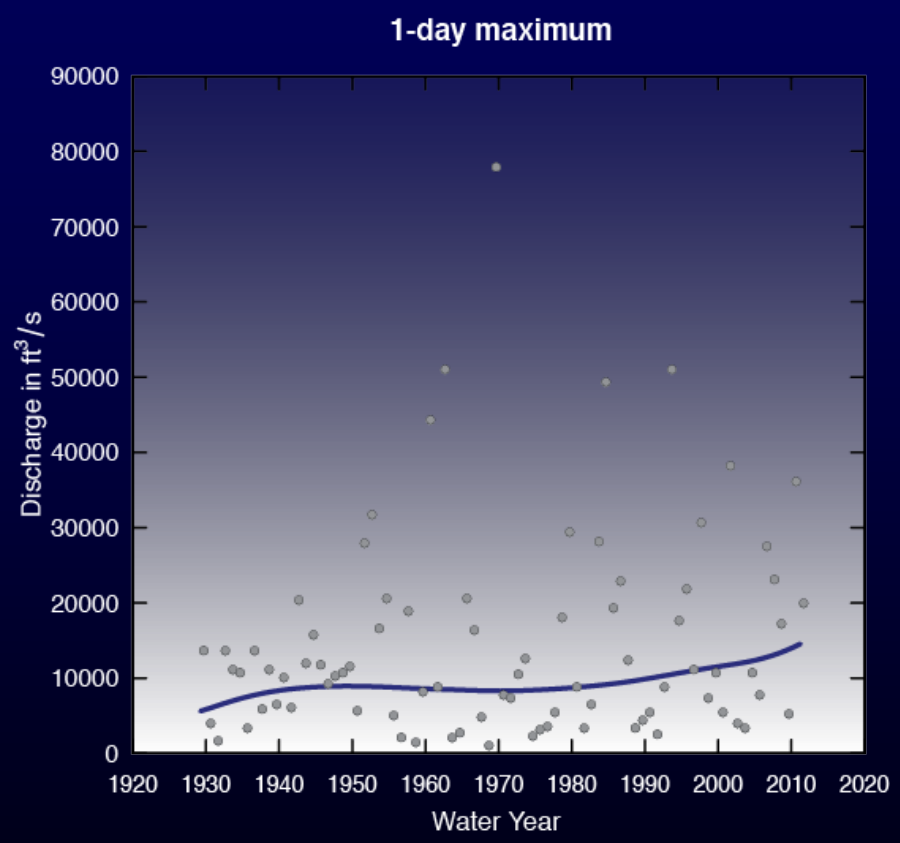
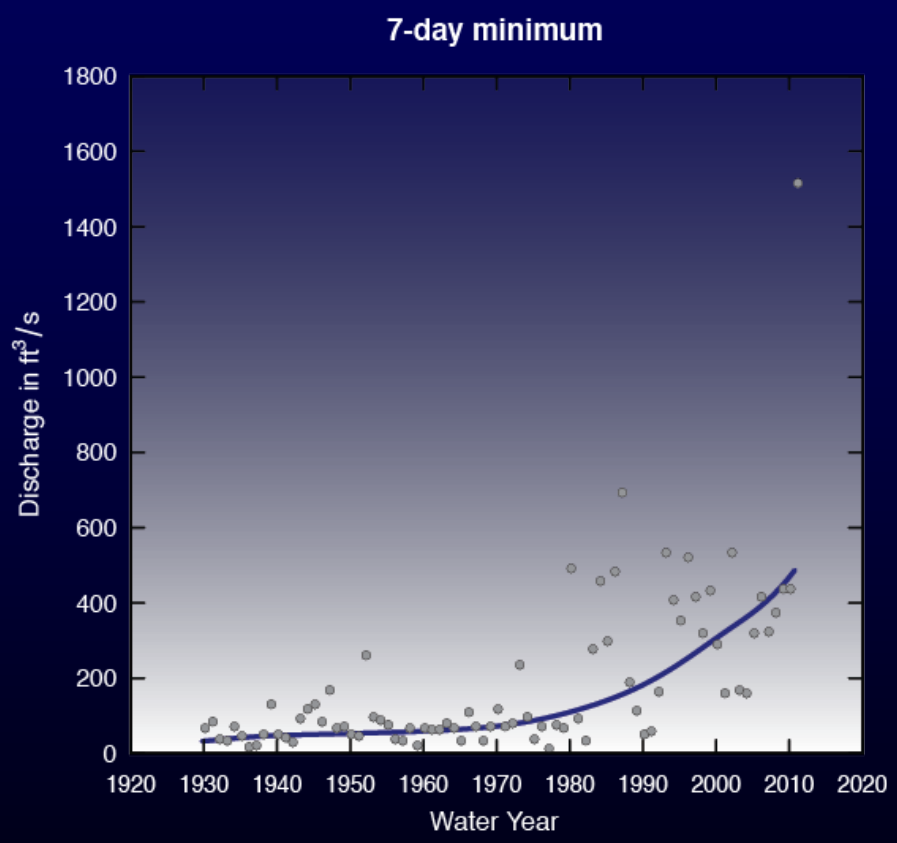
Big Sioux River at Akron, 1929-2011

View of Big Sioux River at Akron Gage Site



Big Sioux River at Akron, IA 1929-2011





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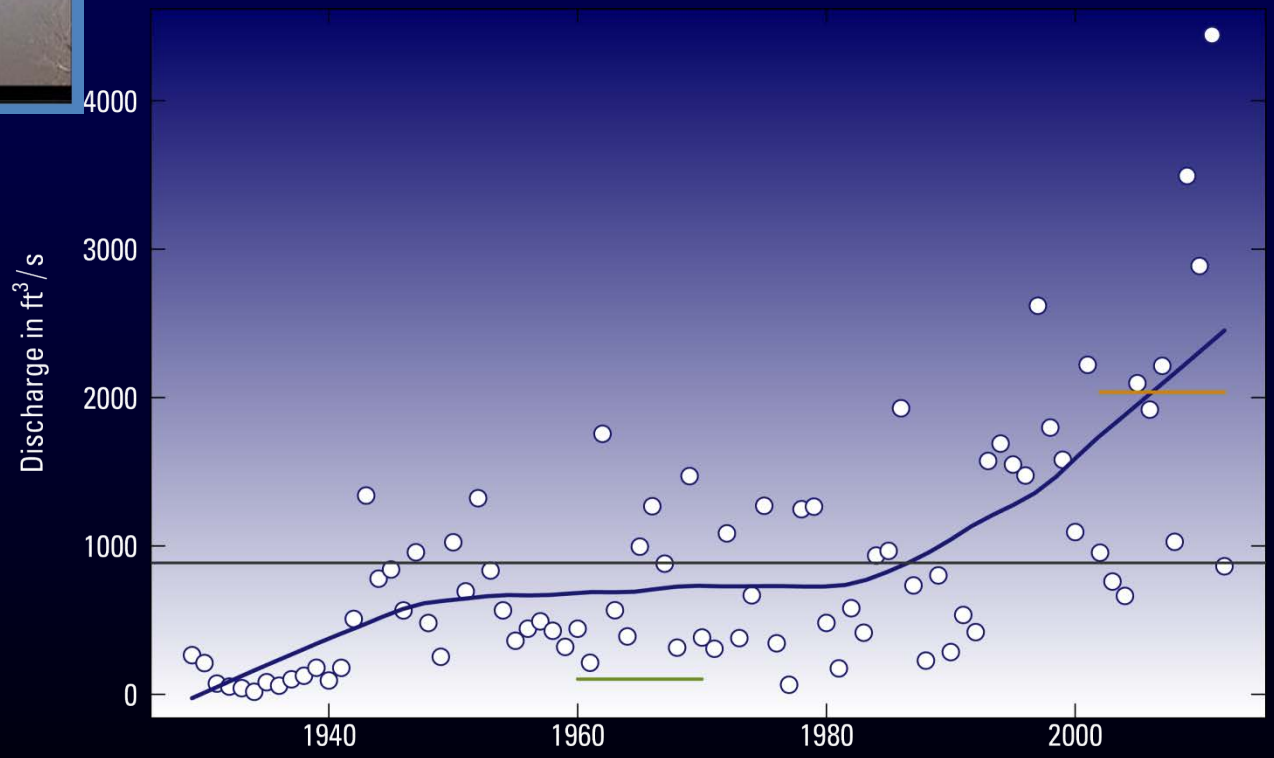
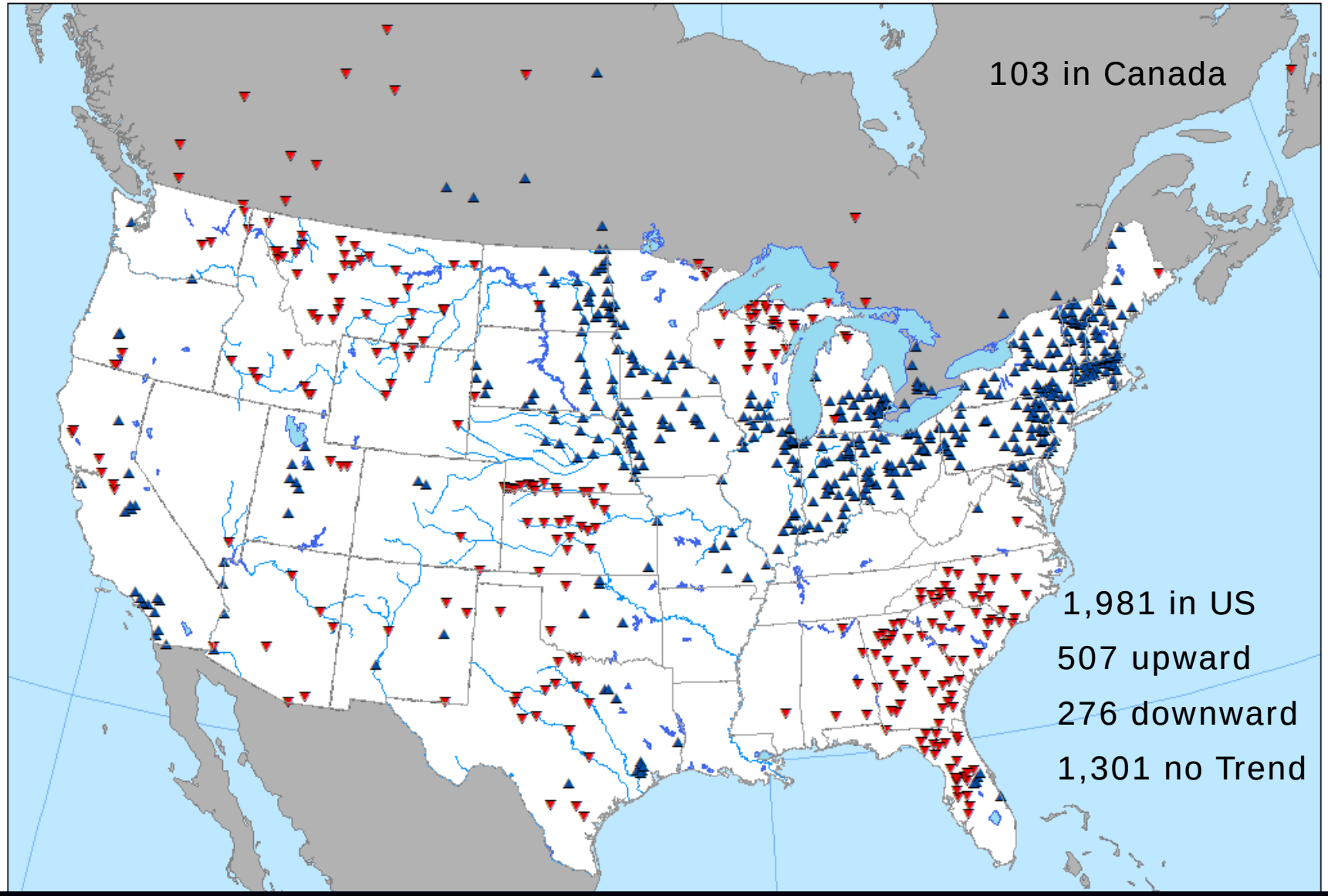
Red River at Fargo, ND, 1929-2012

View of Red River at Fargo Gage Site

Mean Annual Discharge

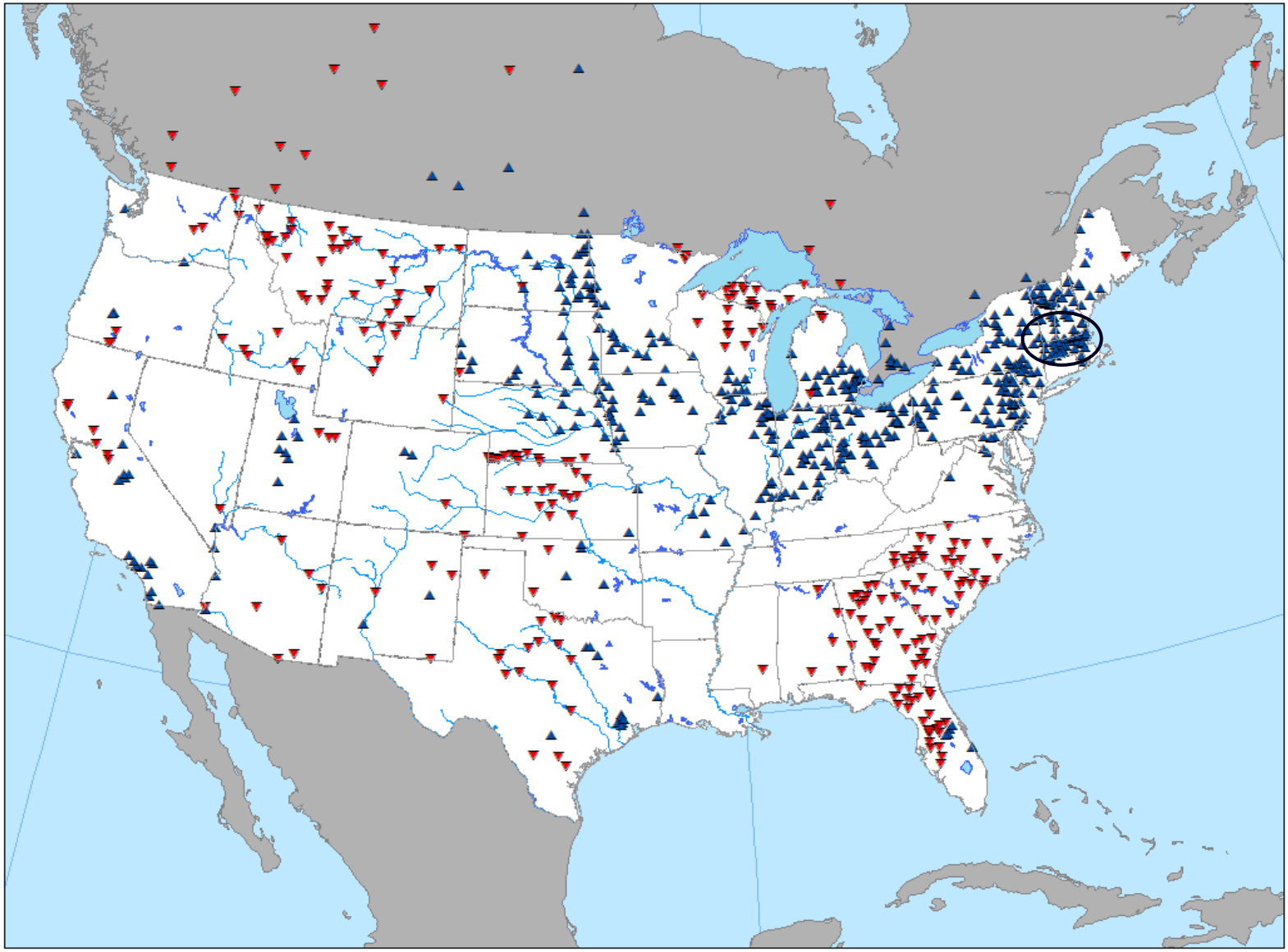


Streamflow trends (p=0.10) for stations with continuous records 1960-2012



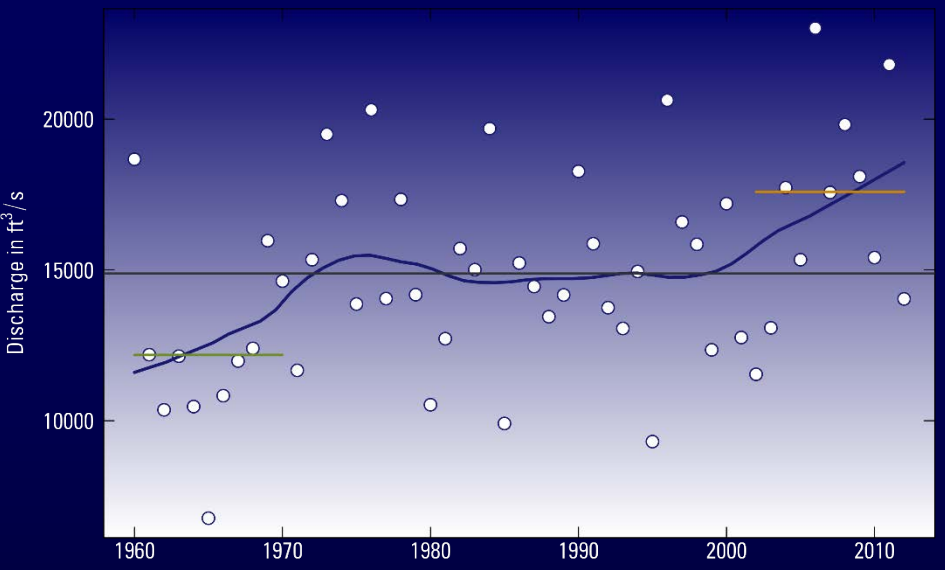
Example of a Significant upward trend-smaller basin

Nashua River at E. Pepperell, MA

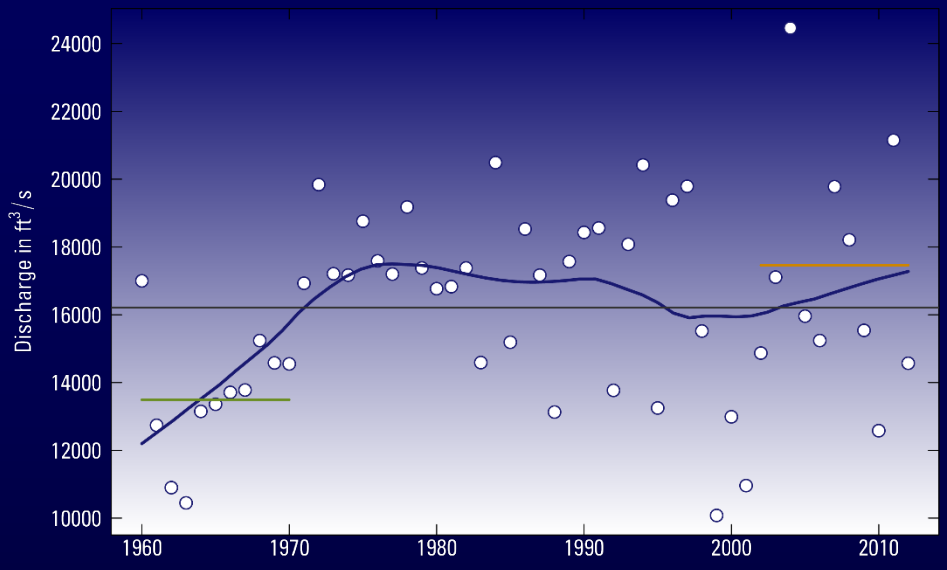


Discharge in ft^3/s

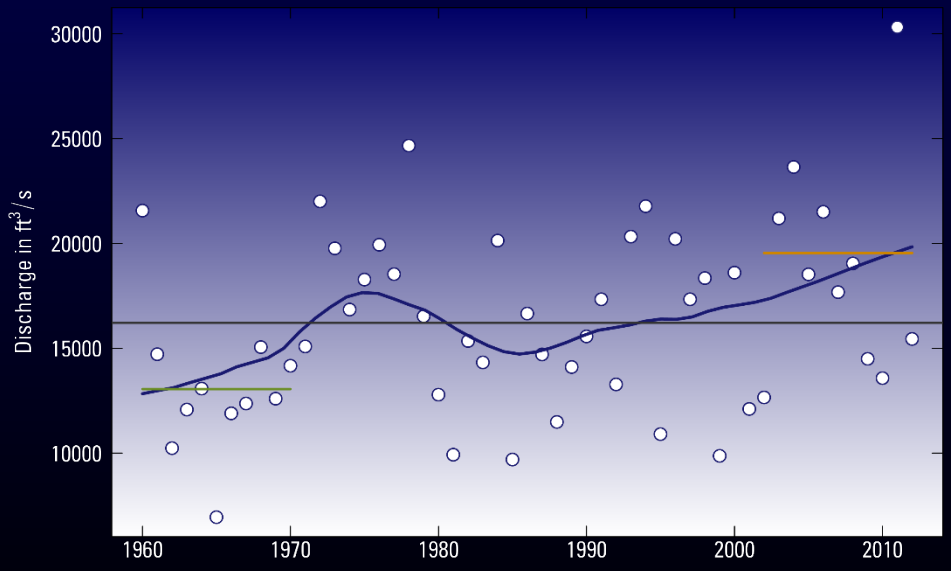
Connecticut River at Montague City, MA



Allegheny River at Kittaning, PA



Susquehana River at Danville, PA

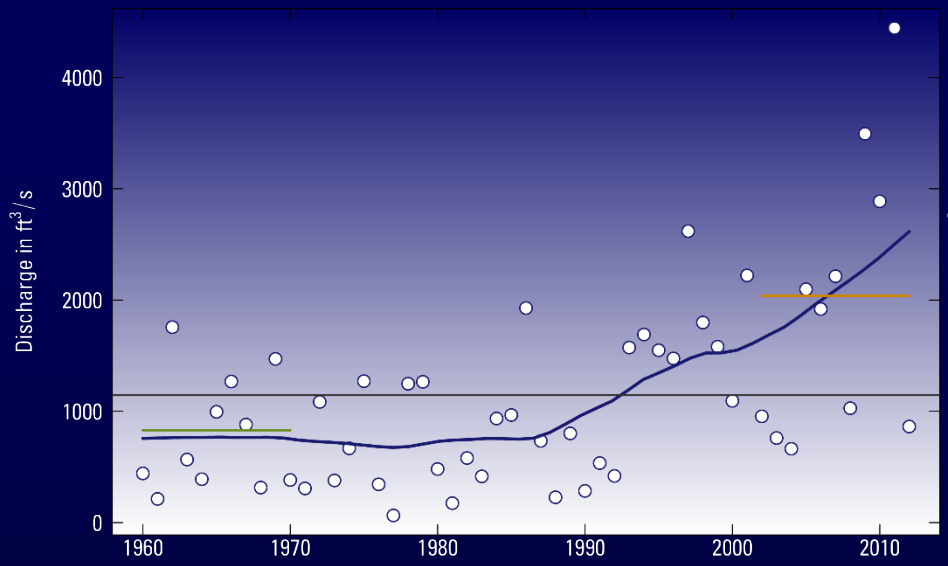


2003-2012 average

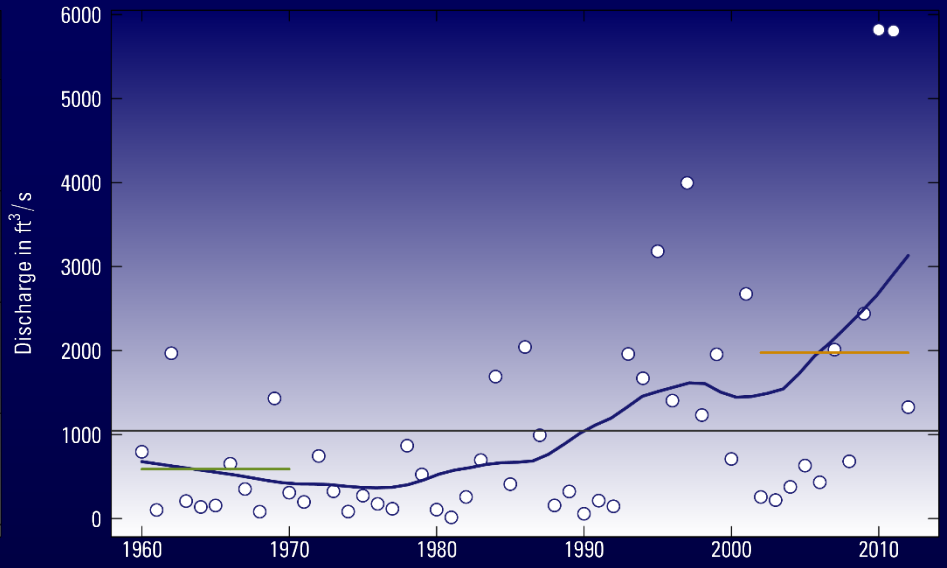
1960-1969 average

1960-2012 average

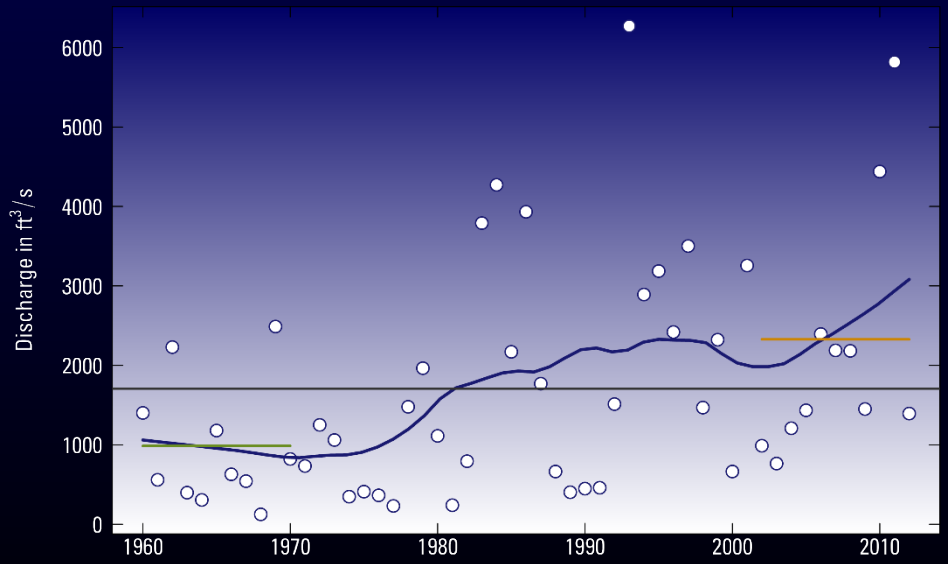
Red River of the North at Fargo, ND



James River at Scotland, SD



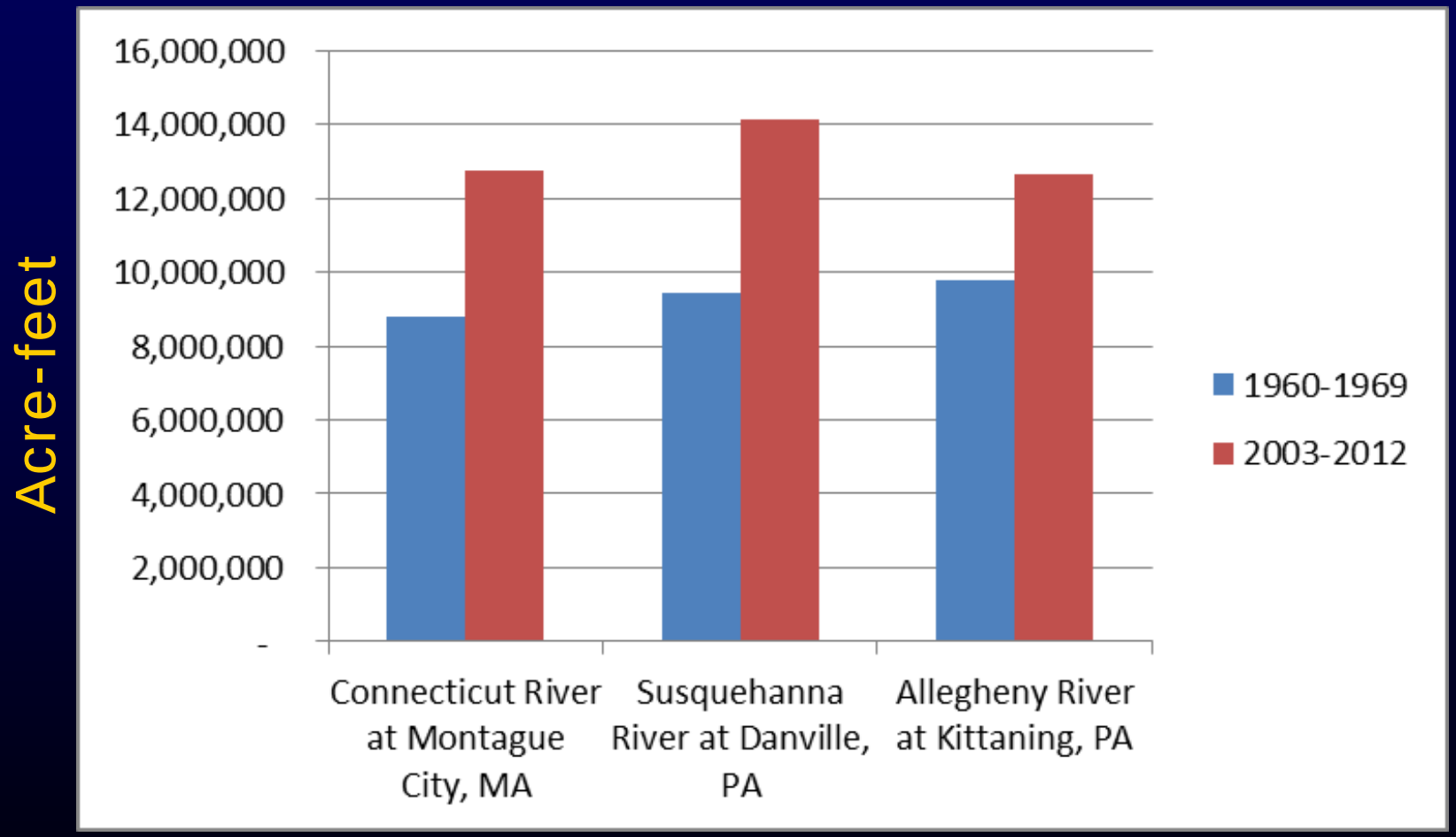
Big Sioux River at Akron, IA



- 2003-2012 average
- 1960-1969 average
- 1960-2012 average

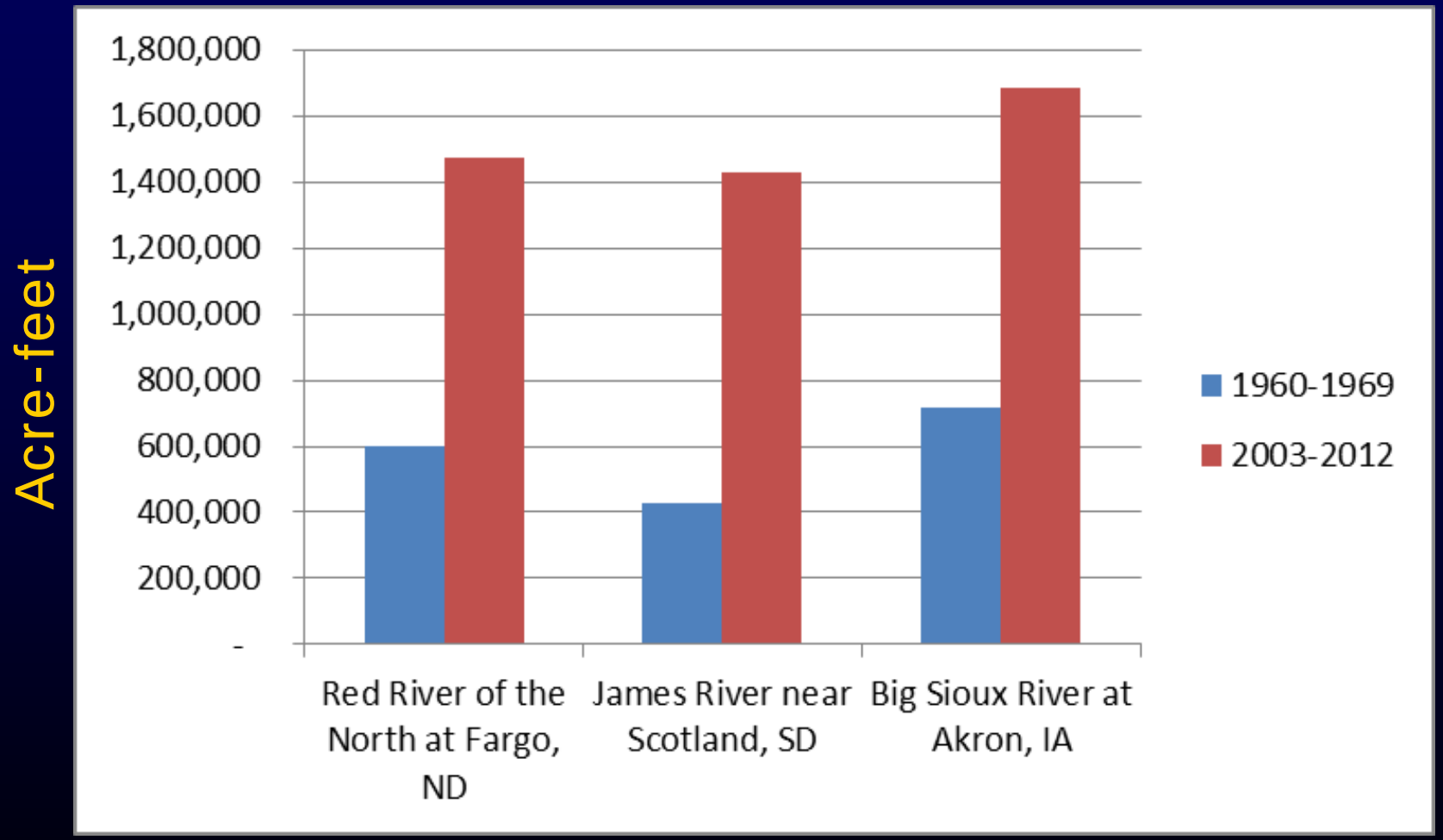
Increase in Annual Volume of Runoff from 1960-69 to 2003-2012

Select New England Stations

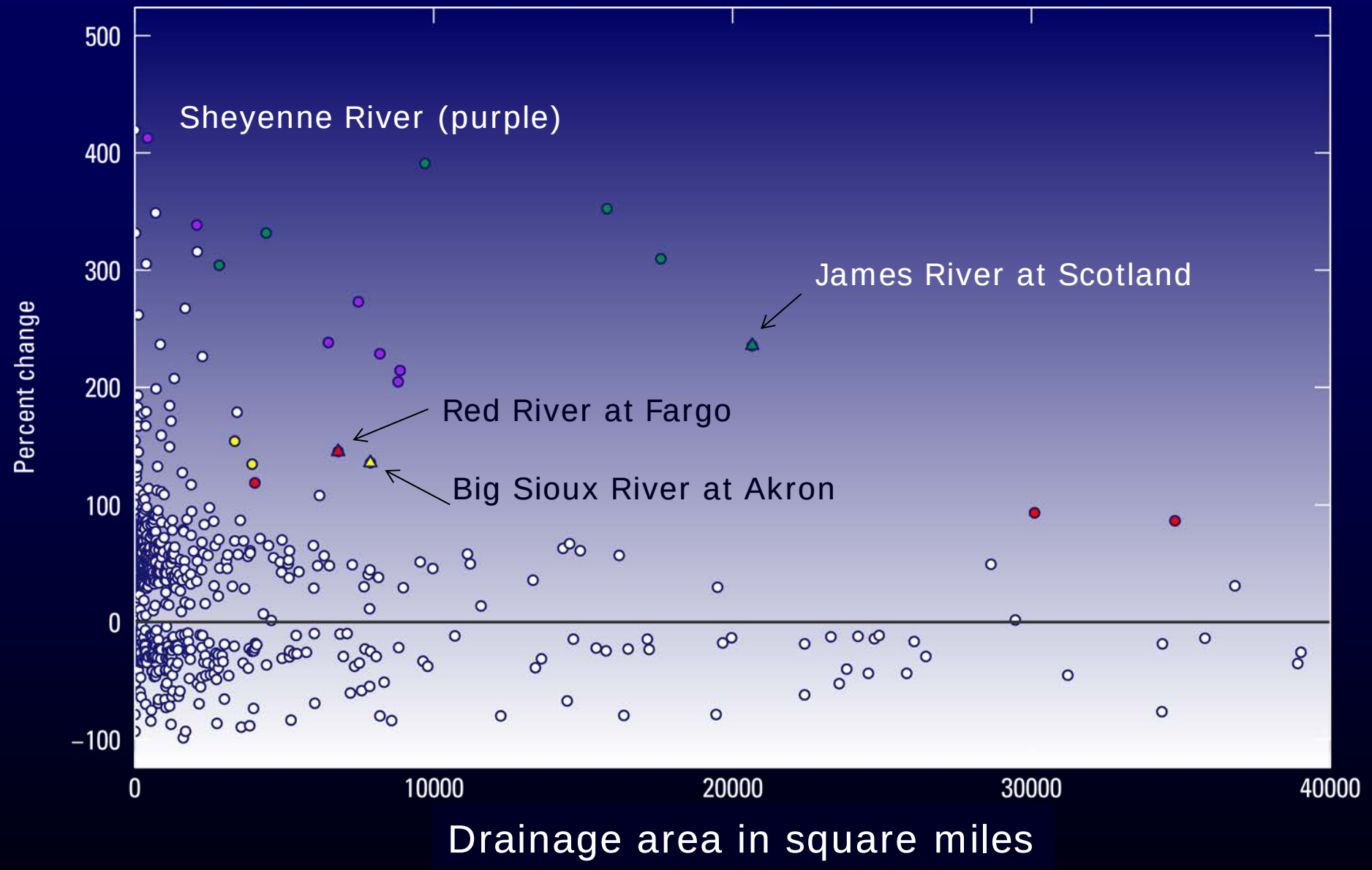


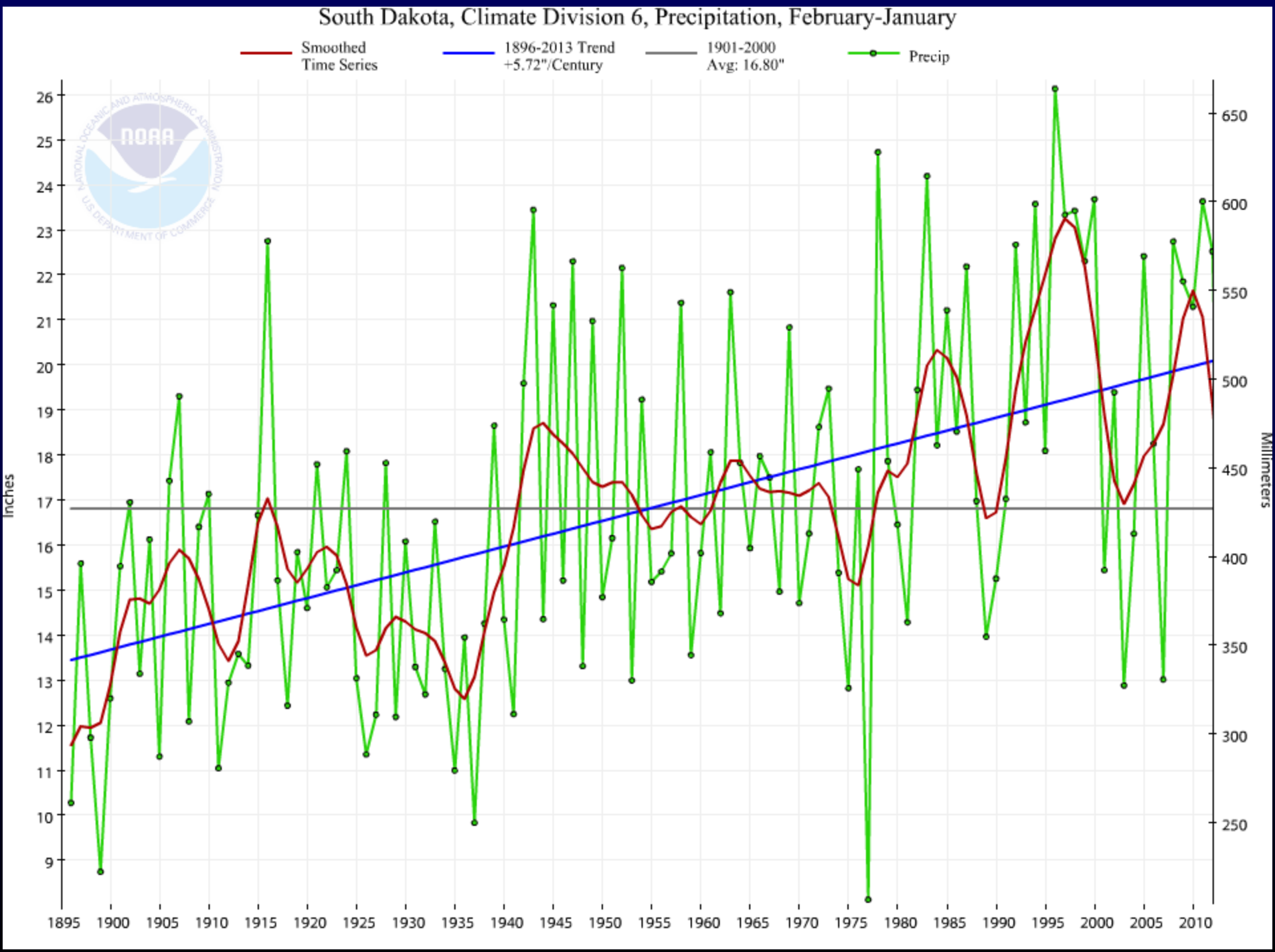
Increase in Annual Volume of Runoff from 1960-69 to 2003-2012

Select Dakota Stations



Percent Change in Discharge by Drainage Area




South Dakota, Climate Division 6, Precipitation, February-January
Smoothed Time Series
1896-2013 Trend +5.72"/Century
1901-2000 Avg: 16.80"
Precip
Inches
Millimeters
26
25
24
23
22
21
20
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300
250
1895
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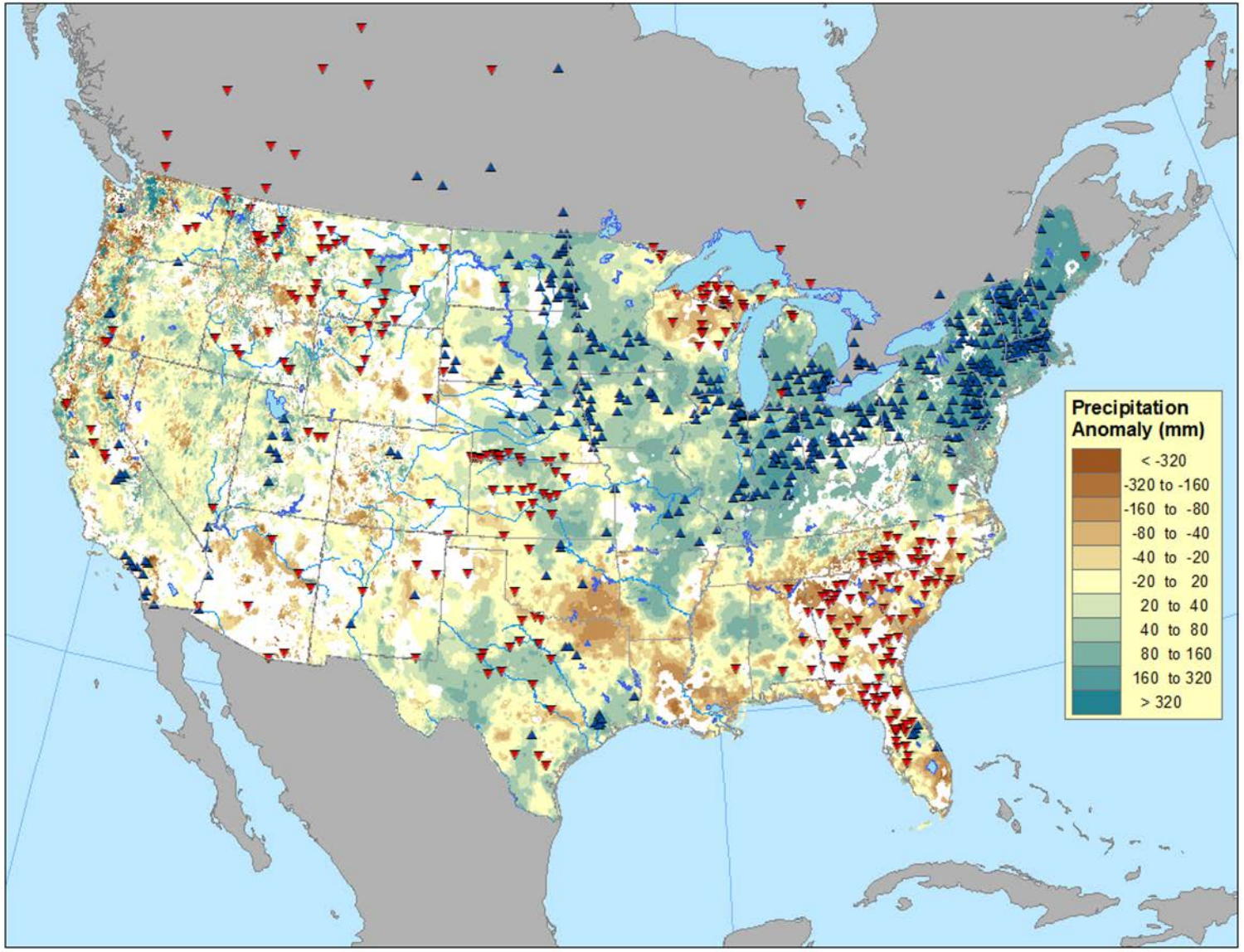
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

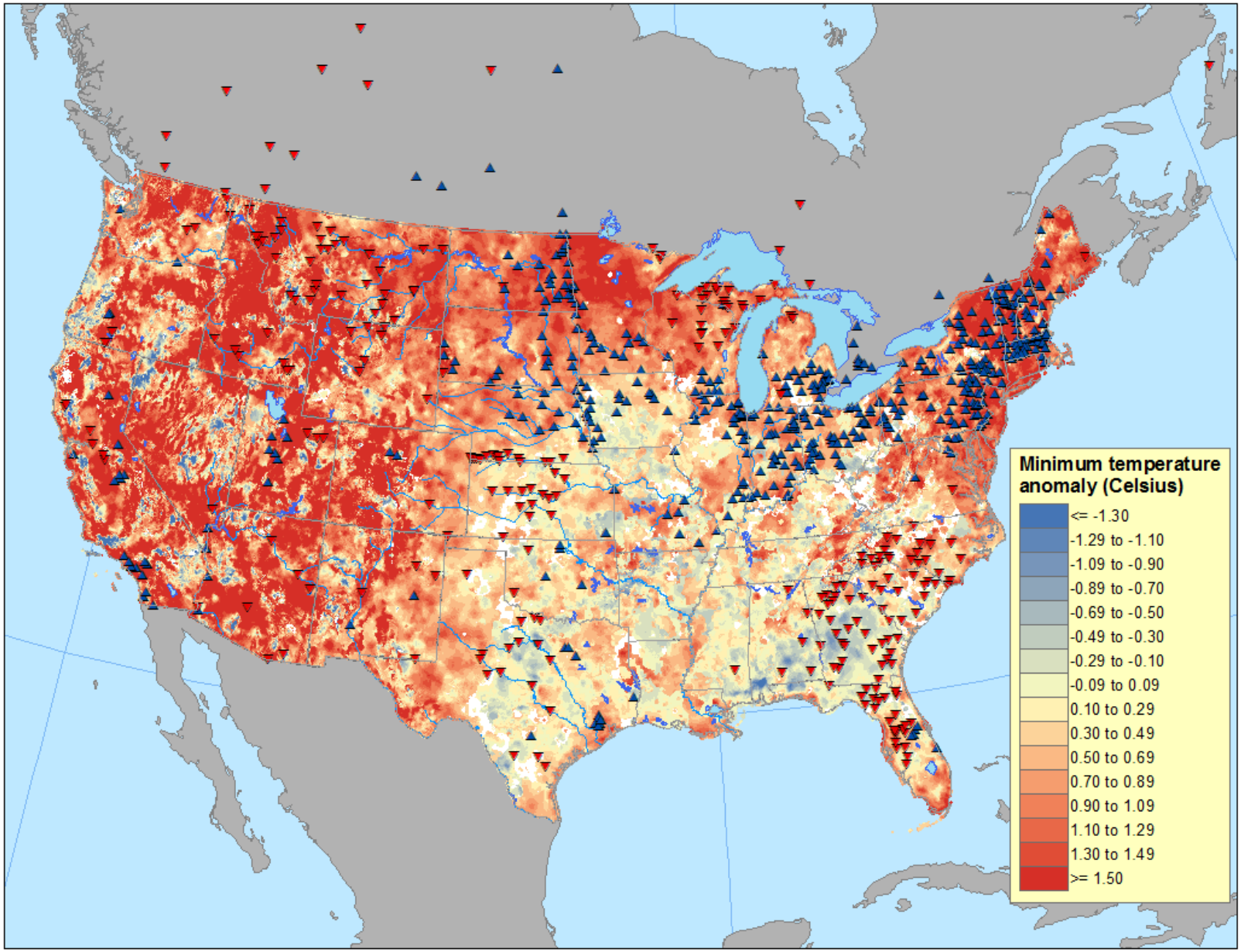
Trends in annual temperature and precipitation

- Based on Parameter-elevation Regression on Independent Slopes Model (PRISM)
  - interpolates monthly weather station data to grid points
  - annual and moving 10-year averages computed for analyses
- Trend based on Kendall tau nonparametric test applied to applied to moving 10-year averages for each grid point

Streamflow trends (1960-2012) with annual precipitation anomalies 2003-2012 compared to long-term average—a forcing factor

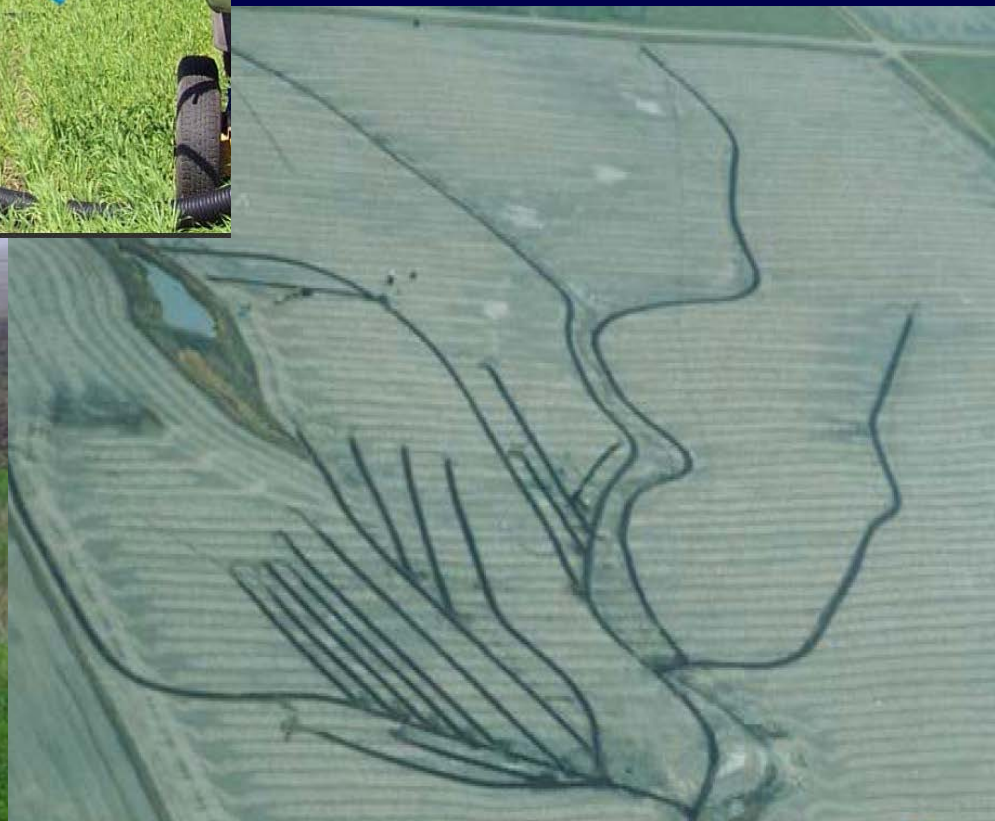


Minimum air temperature trends along with streamflow trends



Further research—Land use change, More row crops, retirement of CRP, drainage tile

Installation with a Tile Plow



Conclusions

- Streamflow increases in James, Big Sioux, Red River are proportionally the largest in USA
- Part of a larger pattern of increases around Midwest and New England.
- Land use change can't be discounted for Dakota's watersheds
- Forcing factors
  - Precipitation—a contributing factor
  - More research needed on:
    - Hydrologic Role of change in minimum temperatures
    - Changes in atmospheric moisture delivery to the continent
    - Land Use Change, pattern tiling and more cultivated crops

Questions

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