"Take-Home" Message

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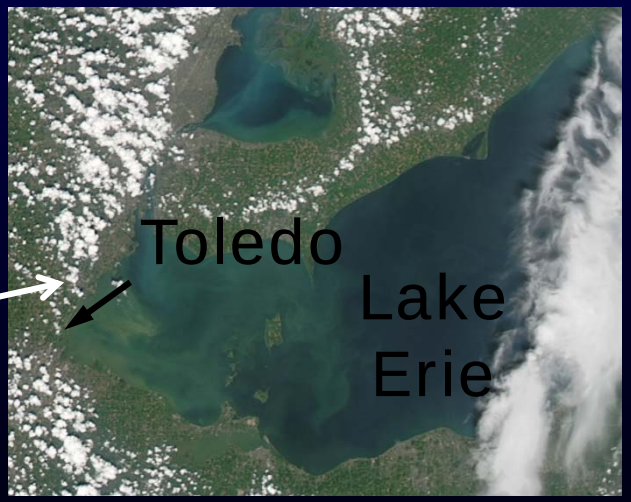
  - *In other watersheds, high flows have been associated with increases in nutrient and sediment loading: Mississippi River, Maumee River*

Do not drink advisory due to microcystin – Summer, 2014



http://eoimages.gsfc.nasa.gov

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Comparison of trends in a National context

- 2,084 streamgages with continuous observational records during 1960-2011 were evaluated
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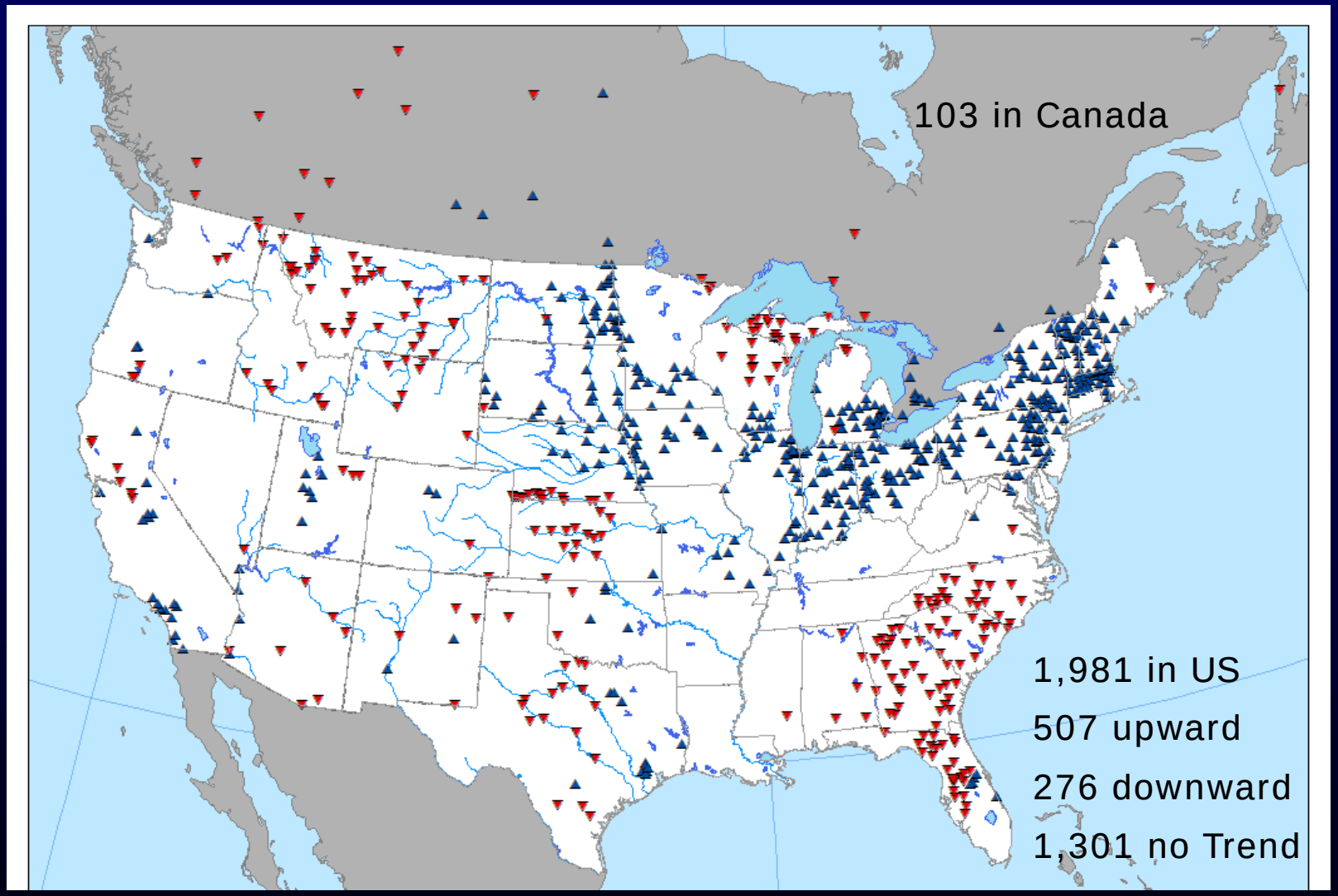
National context (cont.)



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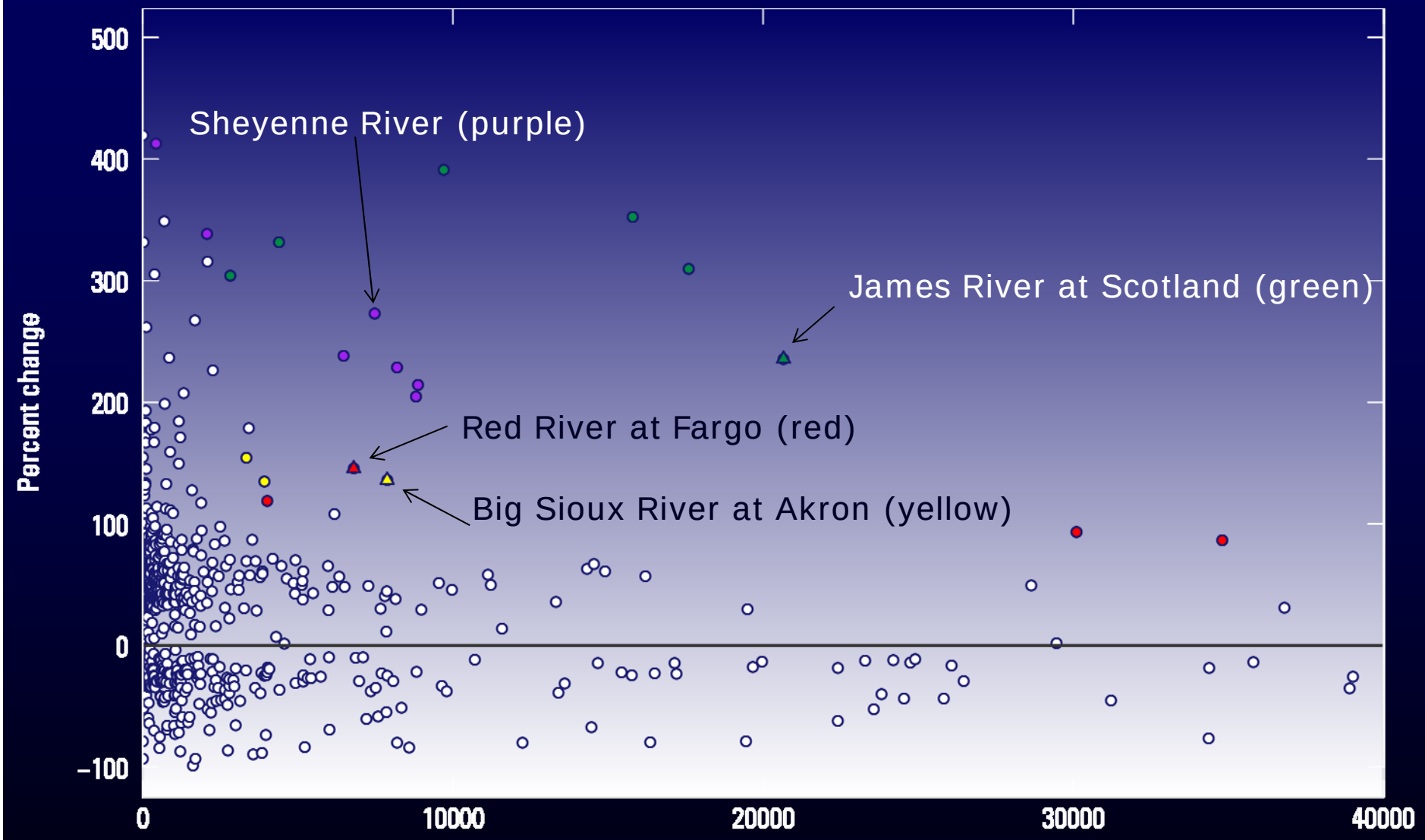
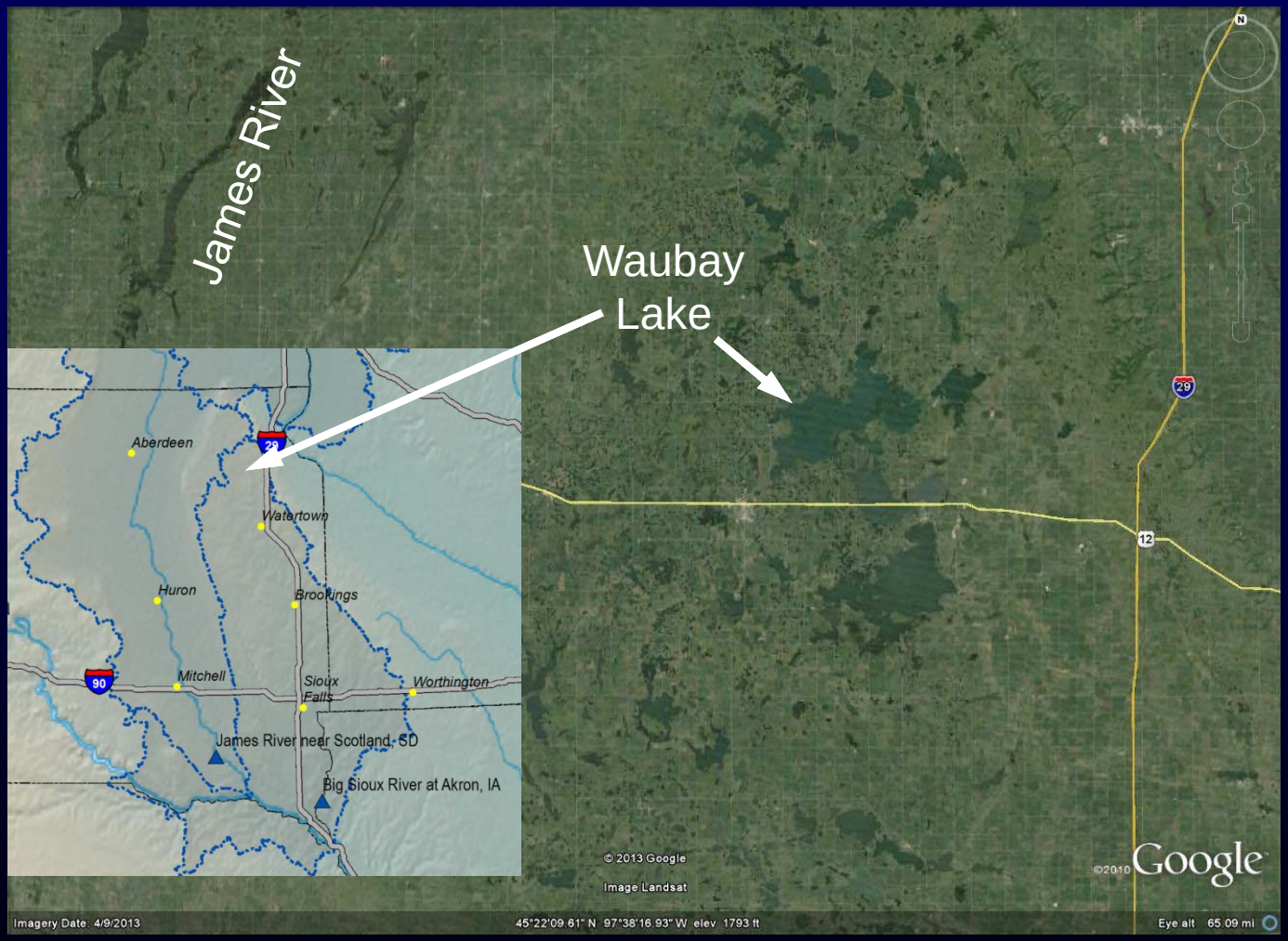
Percent Change in Discharge by Drainage Area



Potential factors



Higher groundwater levels in glacial aquifers may account for increased streamflow

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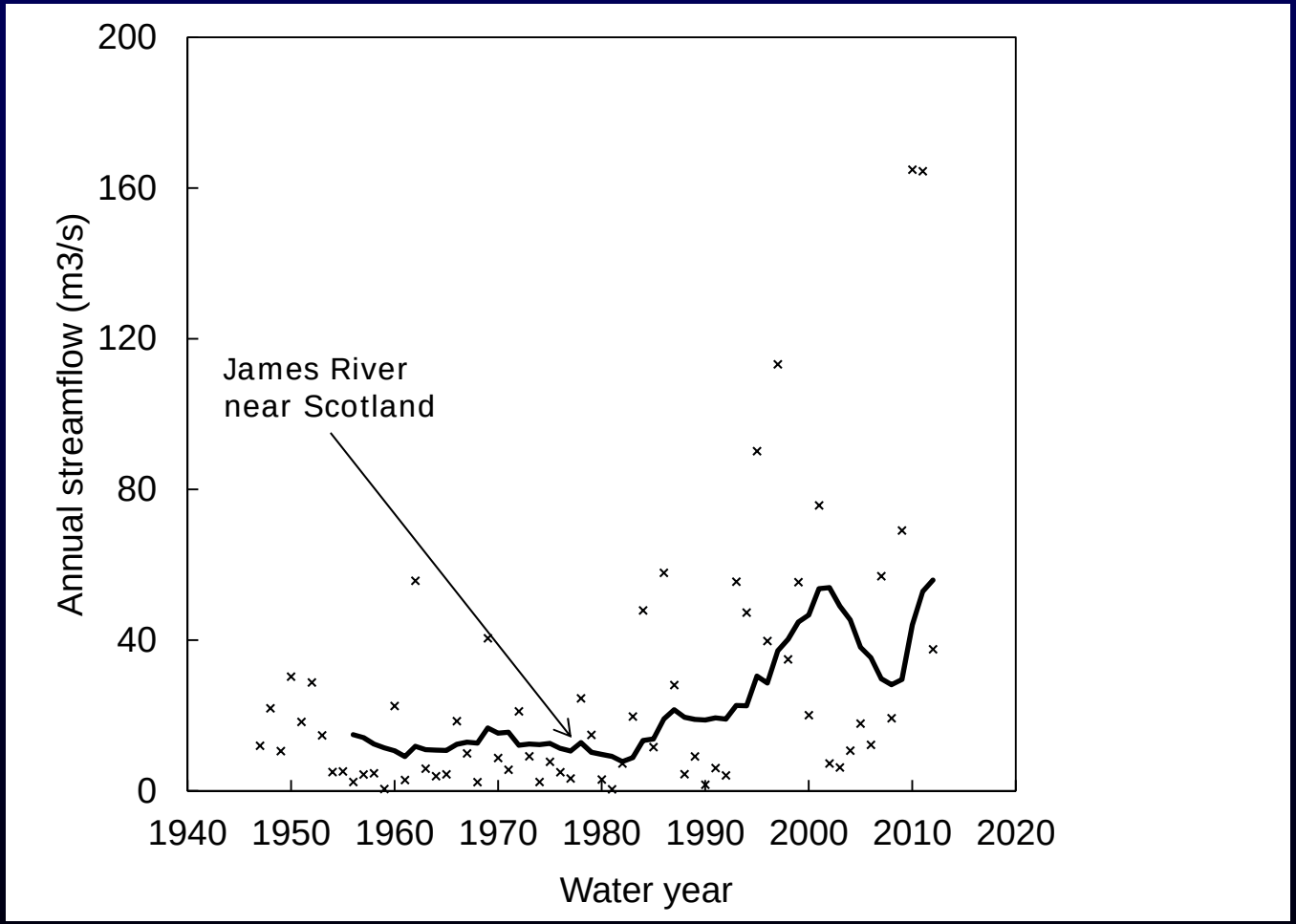
Potential factors (cont.)



10-year moving average for Q and precipitation

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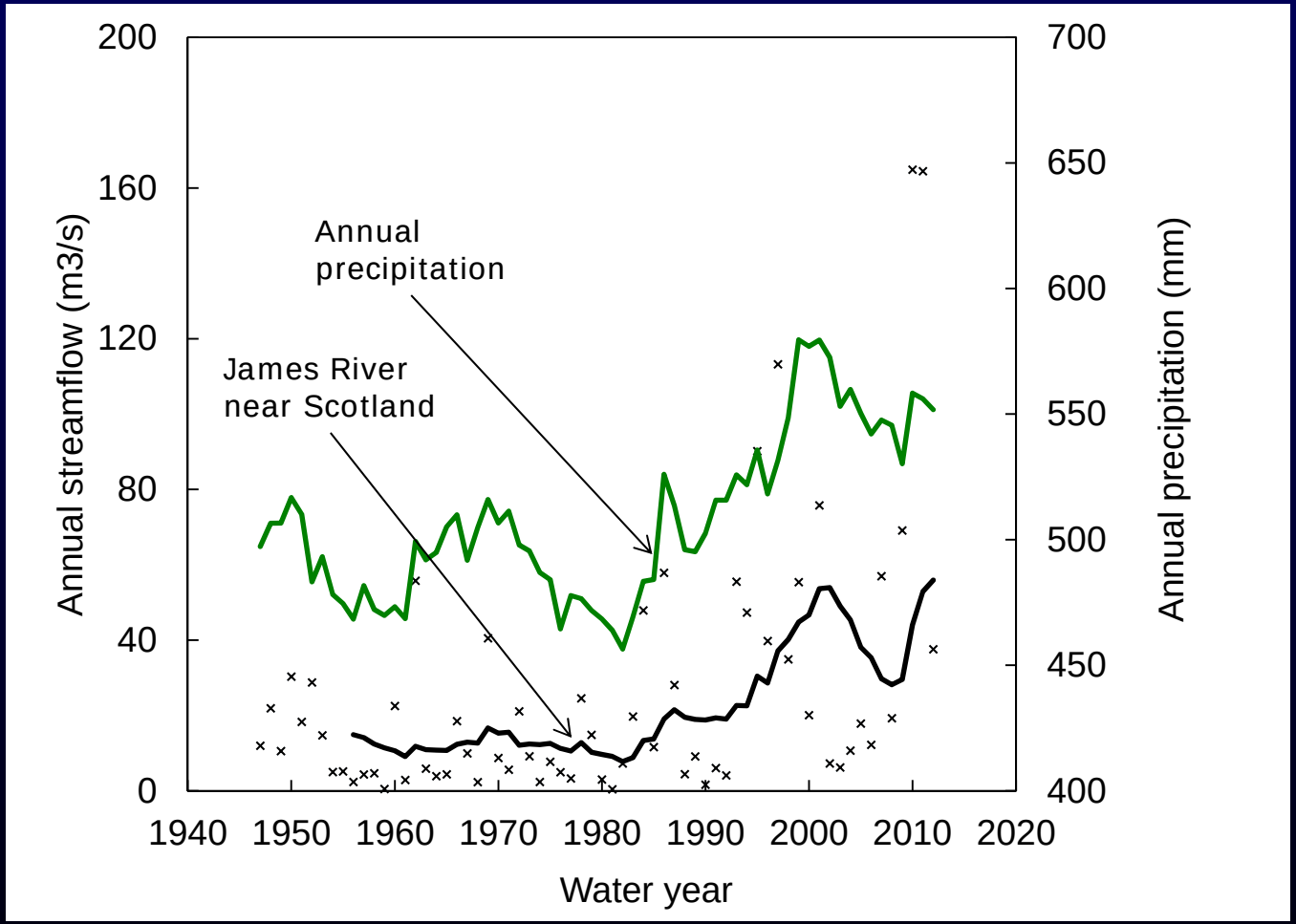
Potential factors (cont.)



10-year moving average for Q and precipitation

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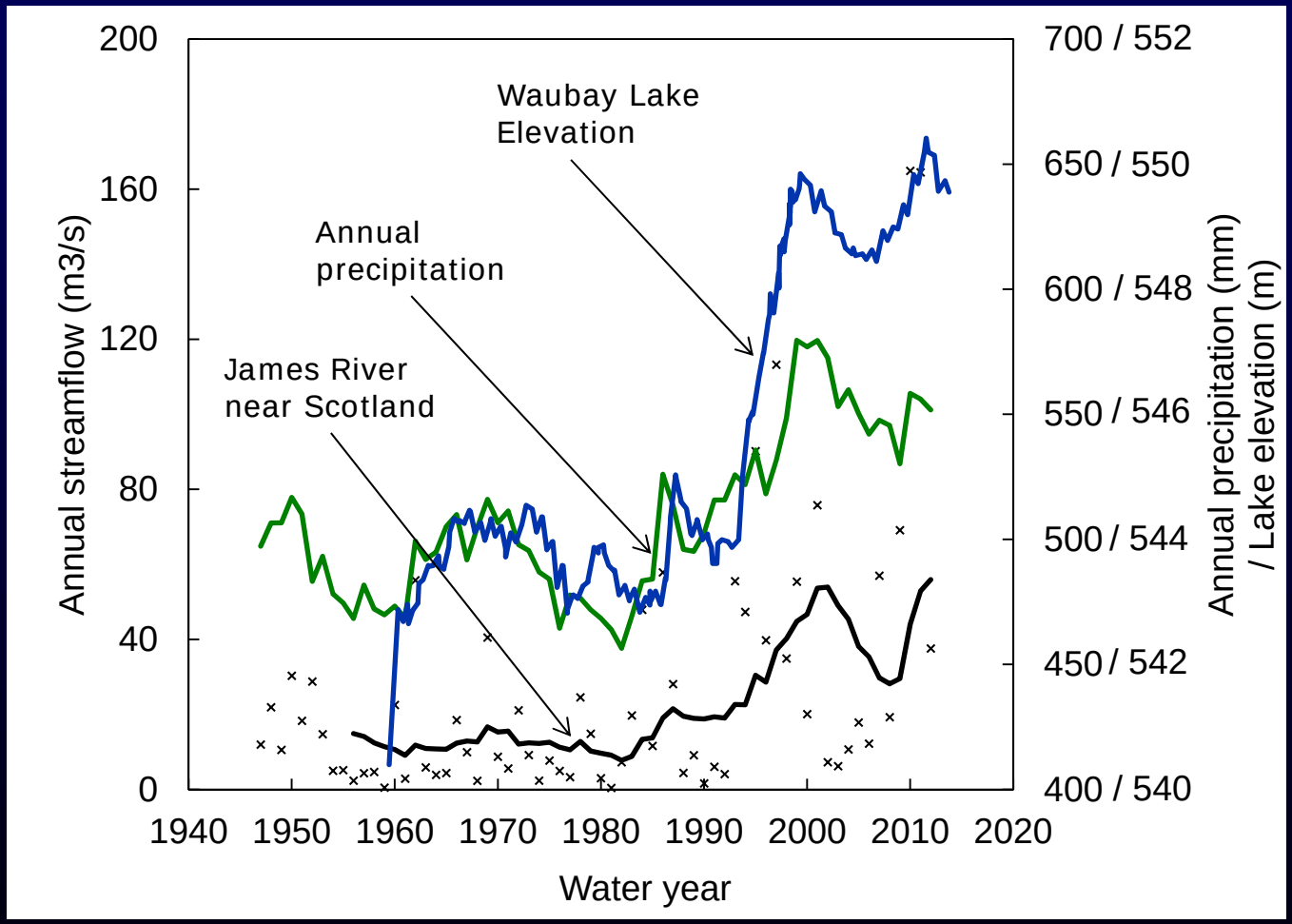
Potential factors (cont.)

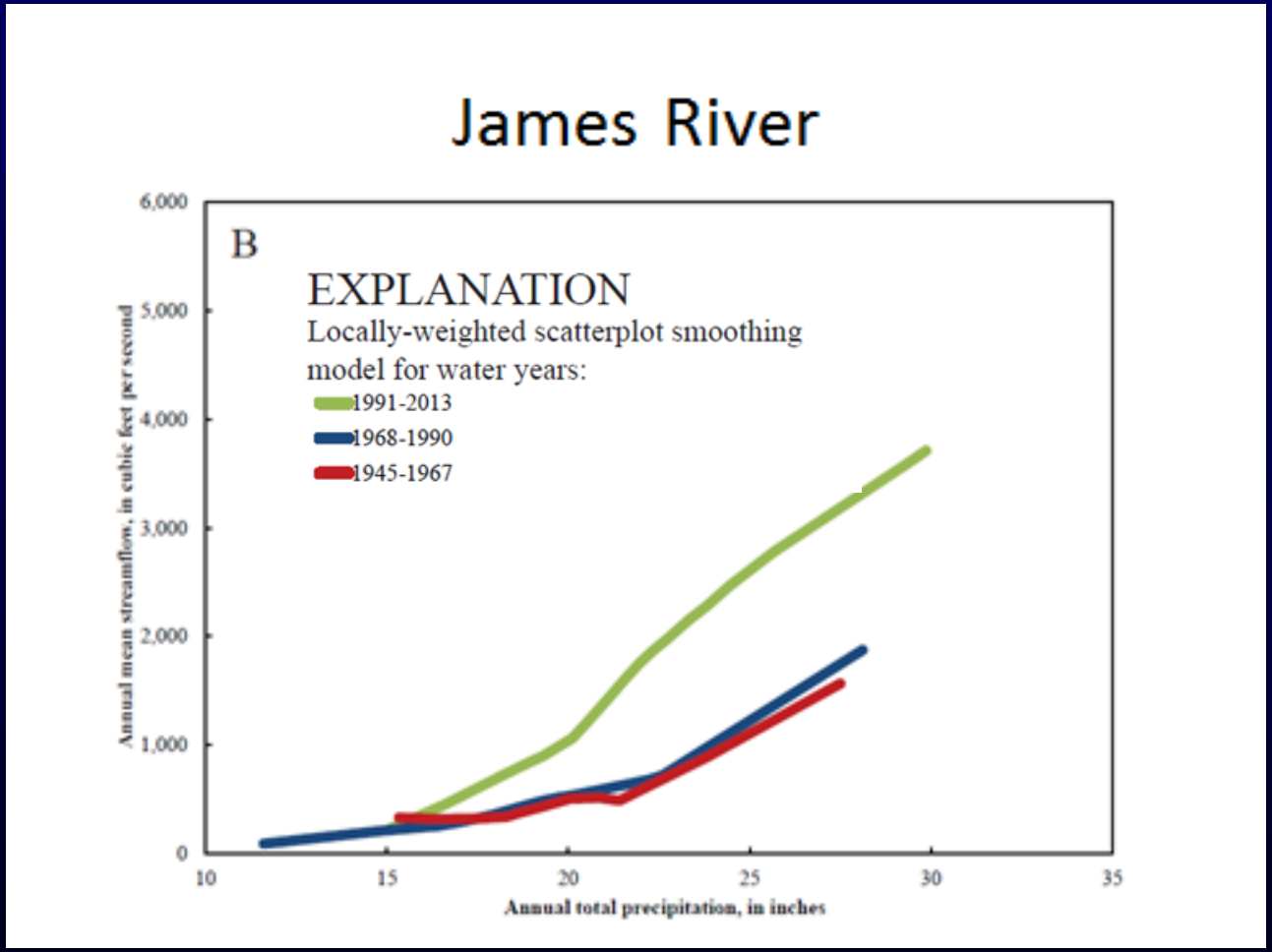


10-year moving average for Q and precipitation

Potential factors (cont.)

Hoogestaat and Stamm, 2015, in press

Climate and Streamflow Characteristics for Selected Streamgages in Eastern South Dakota, Water Years 1945– 2013



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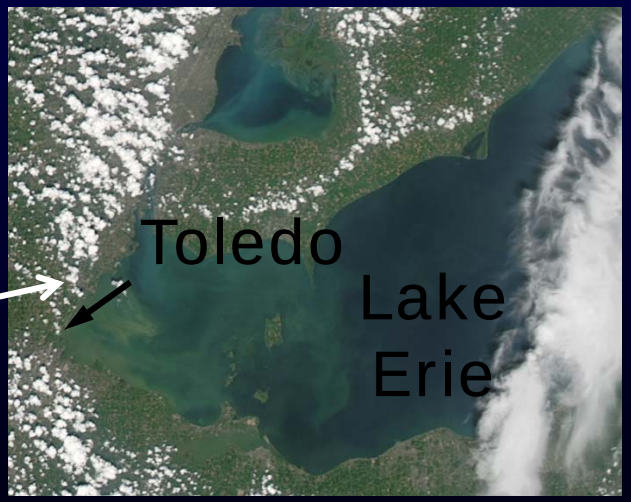

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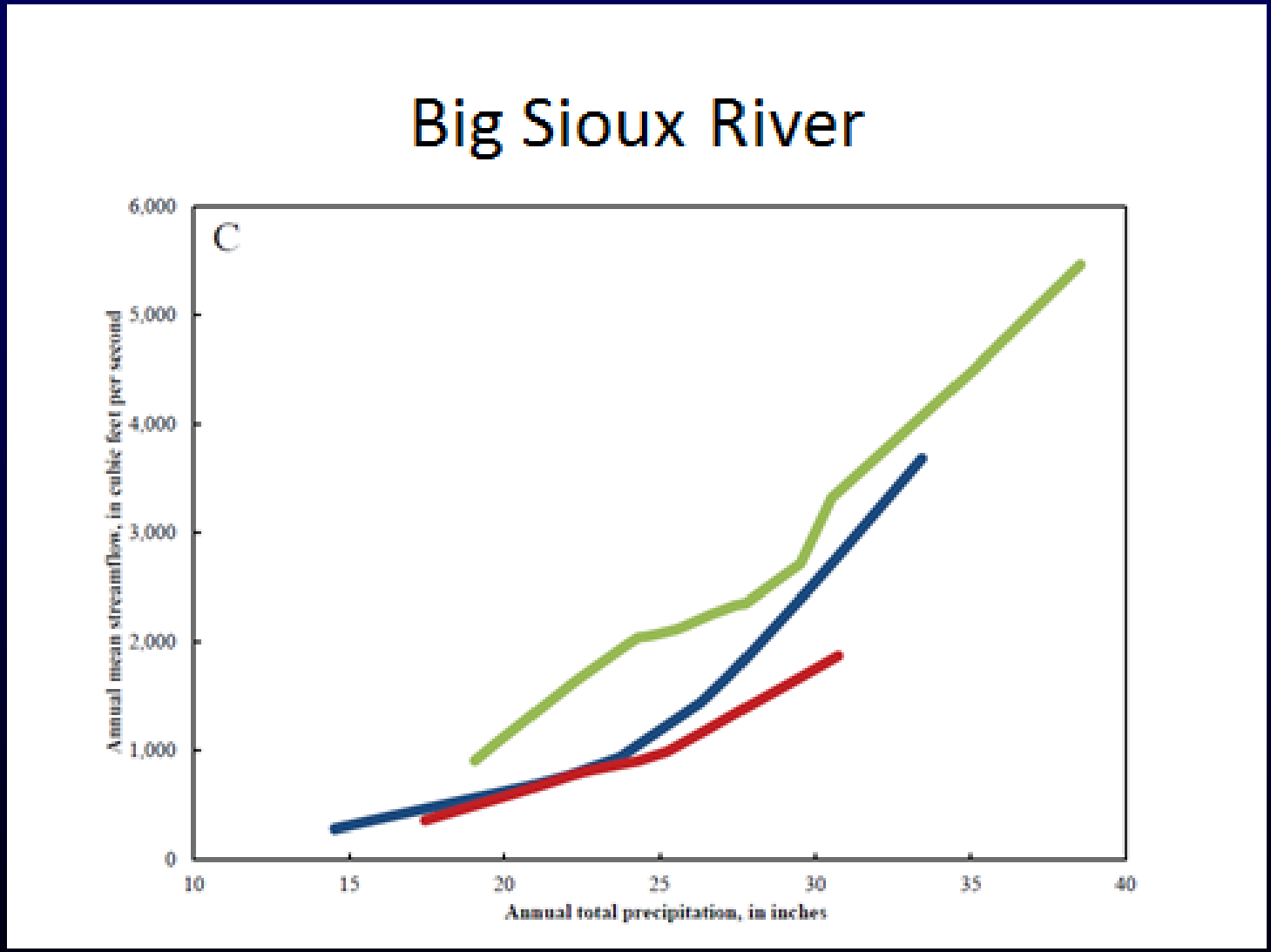
Potential factors (cont.)



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Long-term Trends in Mean Annual Streamflow in the James and Big Sioux Rivers

Presented by:
Greg Delzer
USGS SD Water Science Center

Parker Norton

Mark Anderson

John Stamm

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Potential factors (cont.)

Hoogestaat and Stamm, 2015, in press

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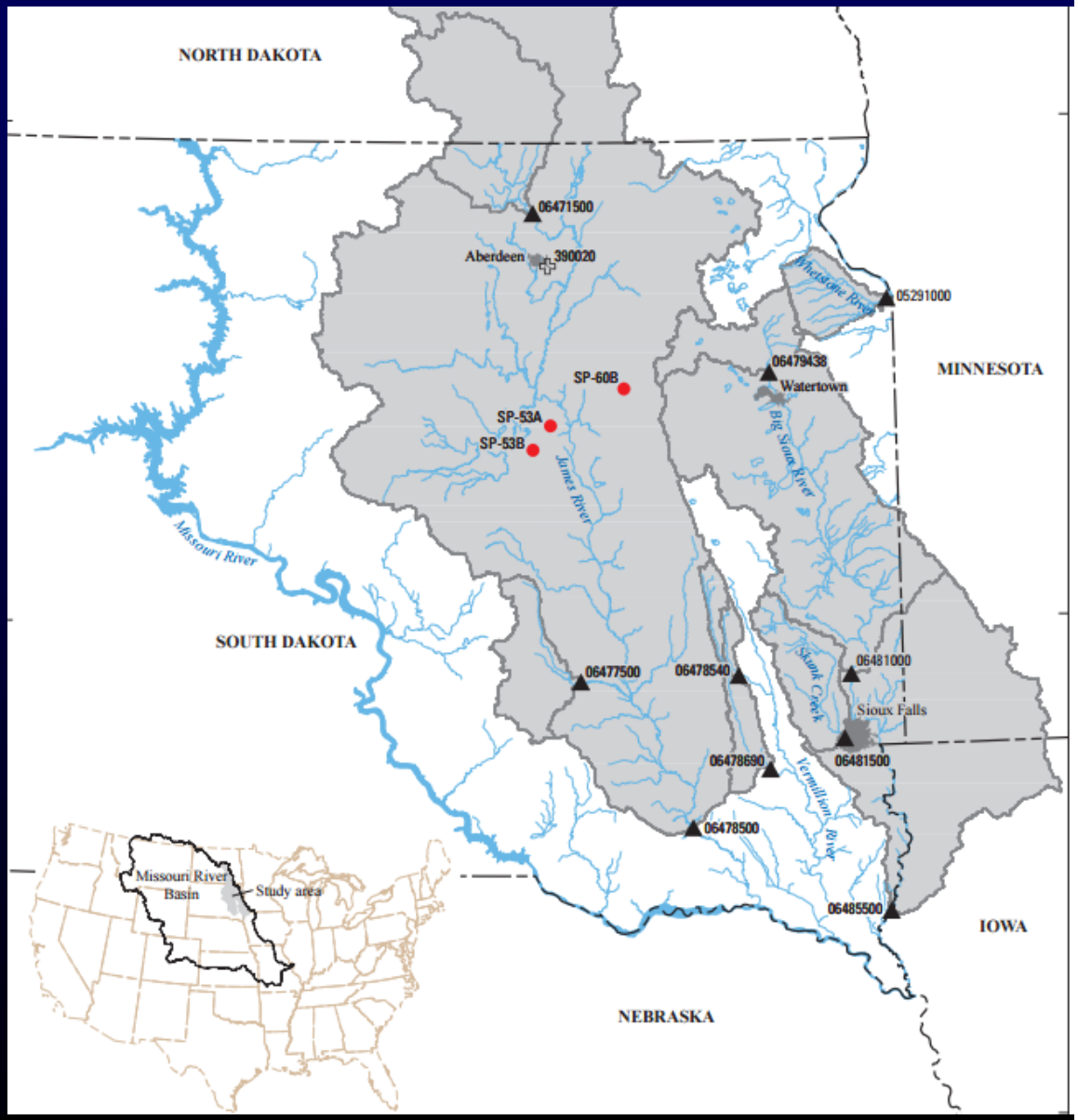

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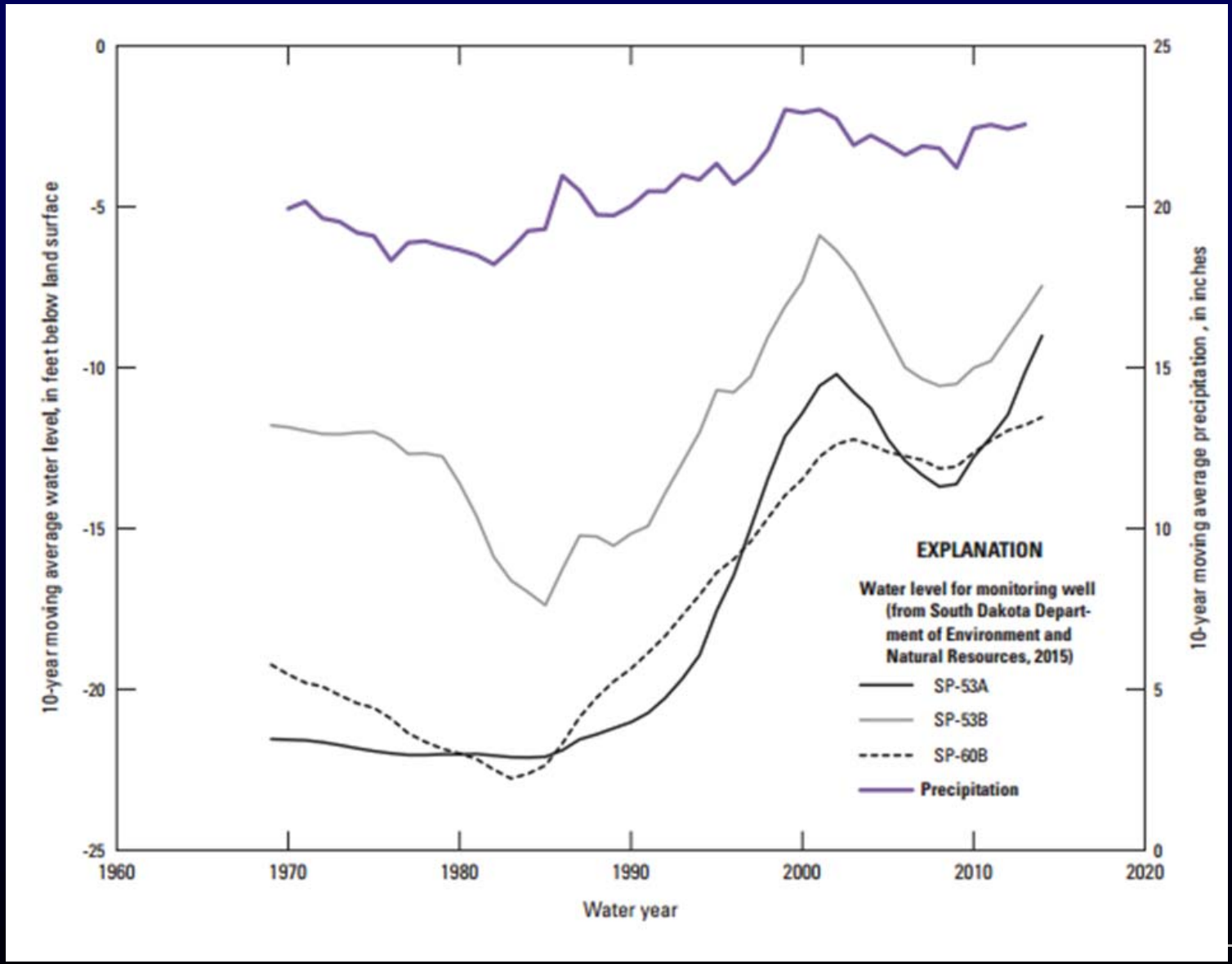
Potential factors (cont.)



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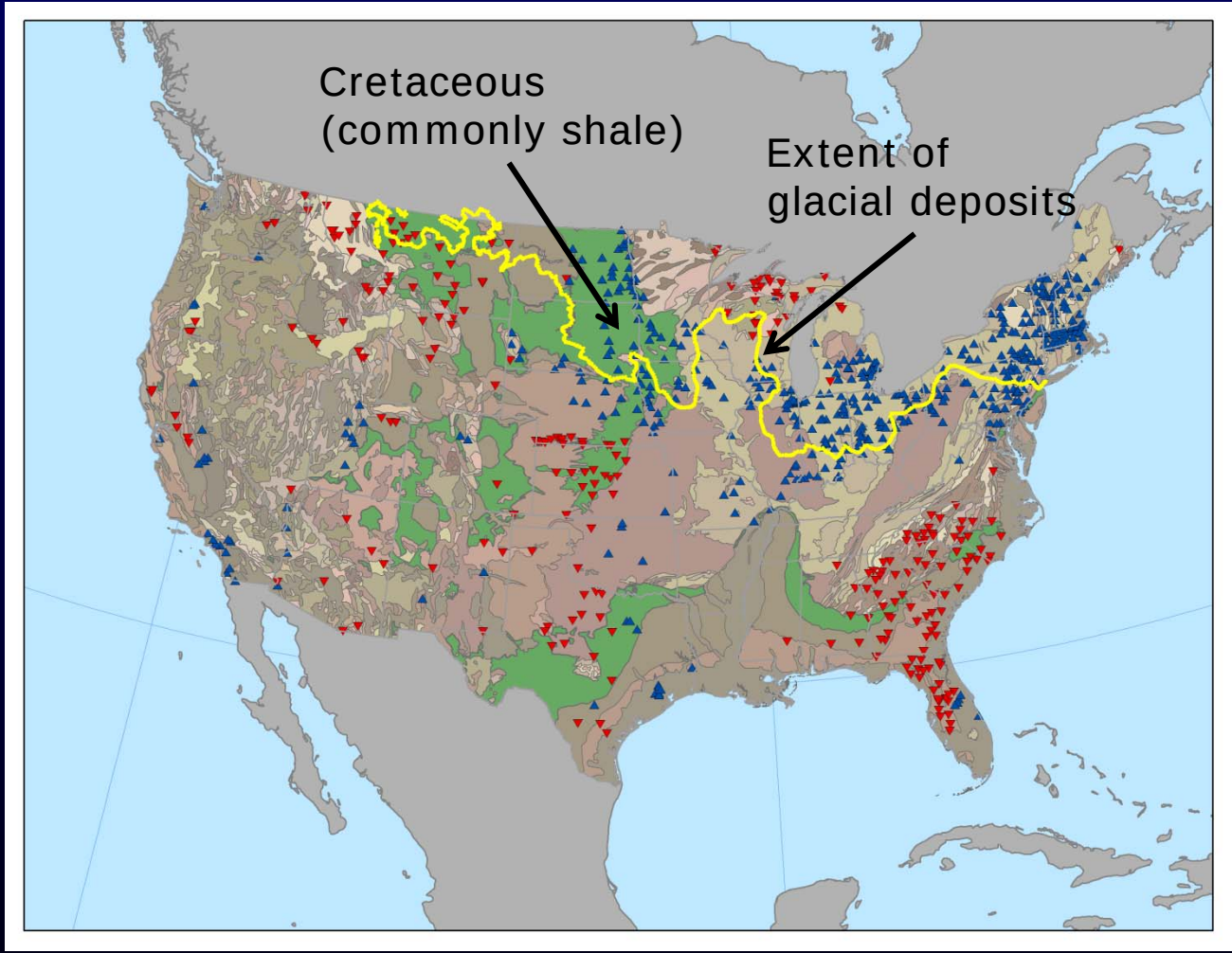
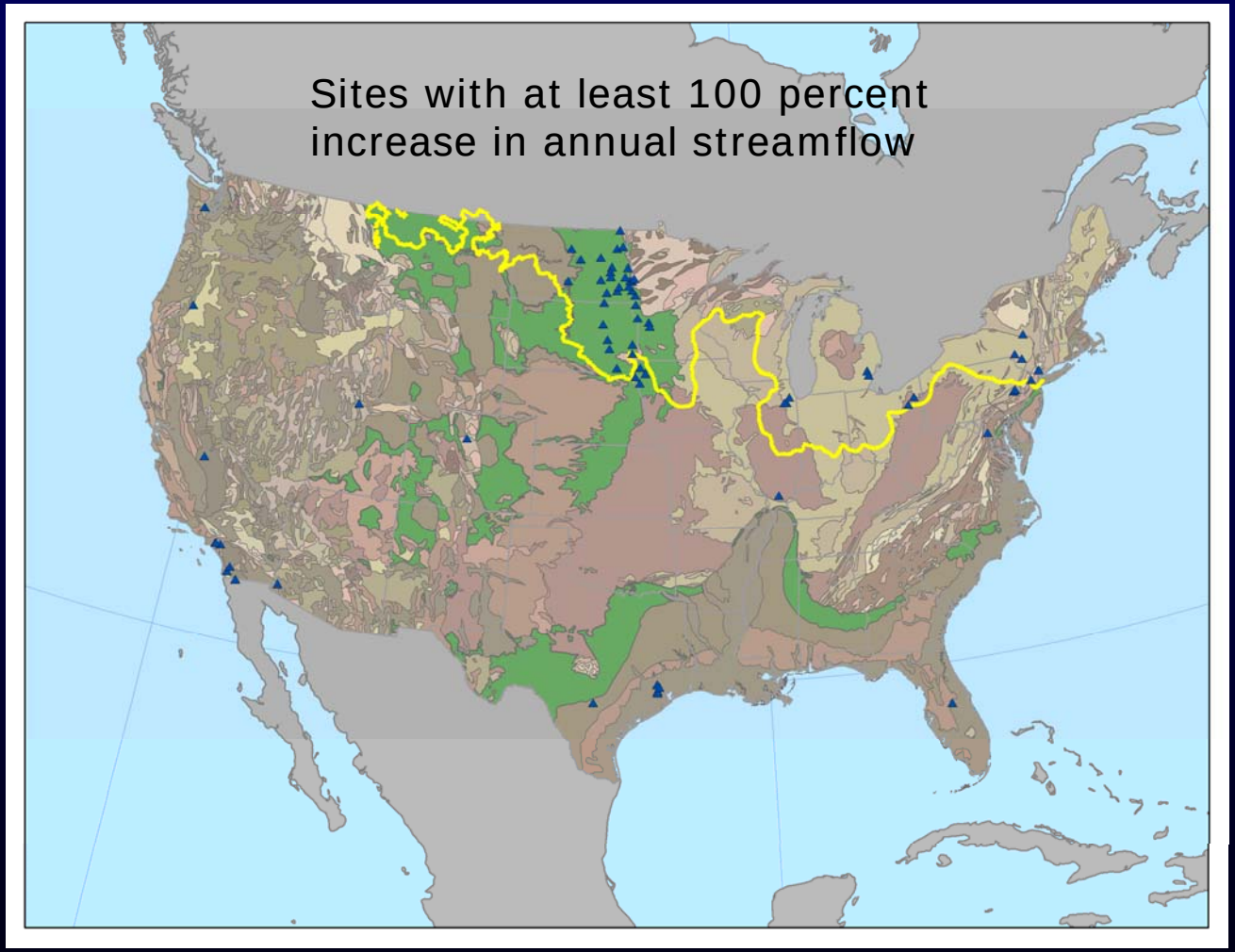
Potential factors (cont.)



Potential factors (cont.)



Higher groundwater levels in glacial aquifers underlain by confining layer may play a role in increased flow in the Eastern Dakotas

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Topics for Today's Discussion

- Streamflow trends in the Missouri River Basin
- Comparison of trends in a National context
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Trends in Annual, Seasonal, and Monthly Streamflow Characteristics at 227 Streamgages in the Missouri River Watershed, Water Years 1960–2011

Scientific Investigations Report 2014–5053

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

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Streamflow trends in the Missouri River Basin

- 227 streamgages with continuous observational records during 1960-2011 were evaluated
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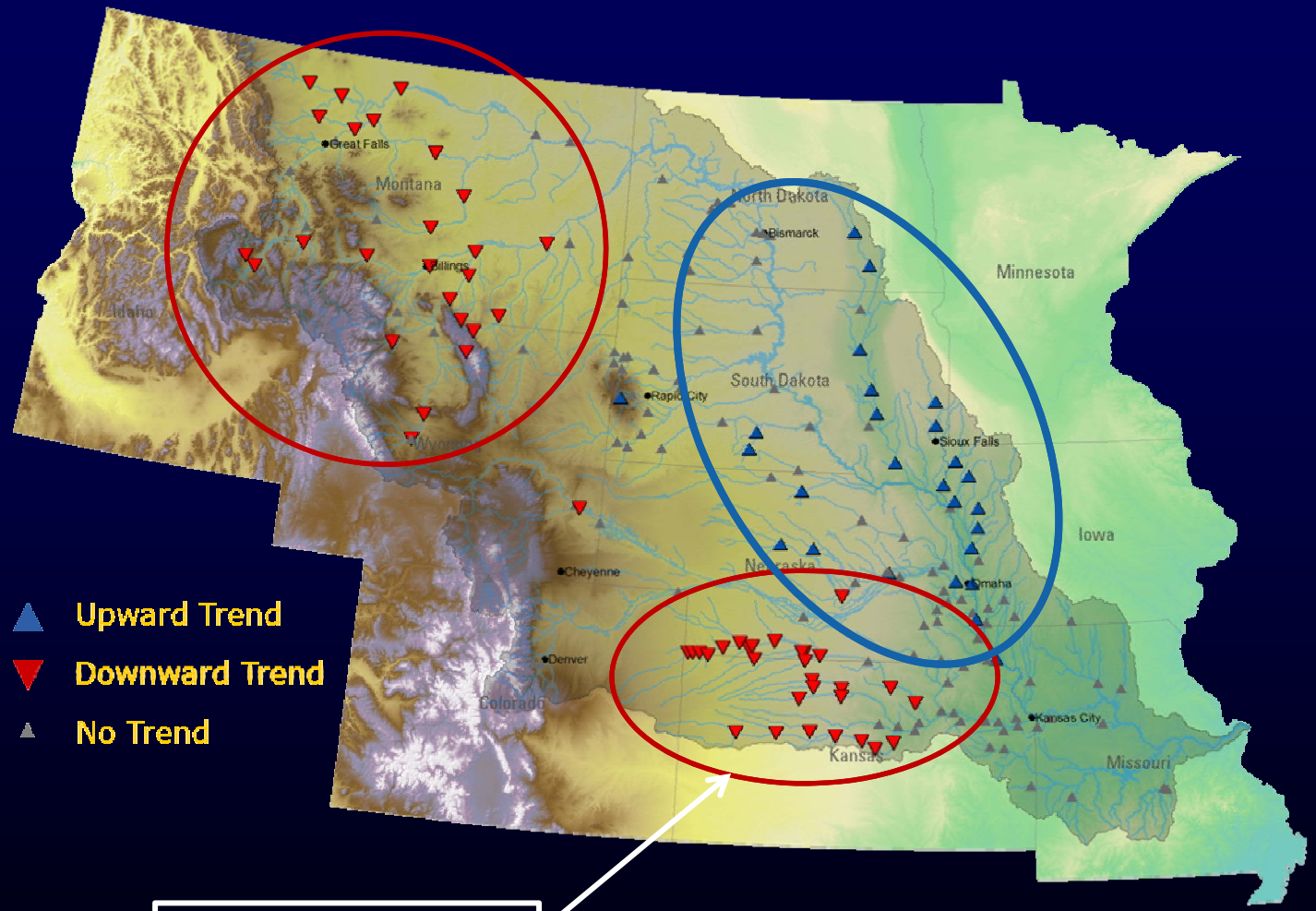
Streamflow trends in the Missouri River Basin (cont.)



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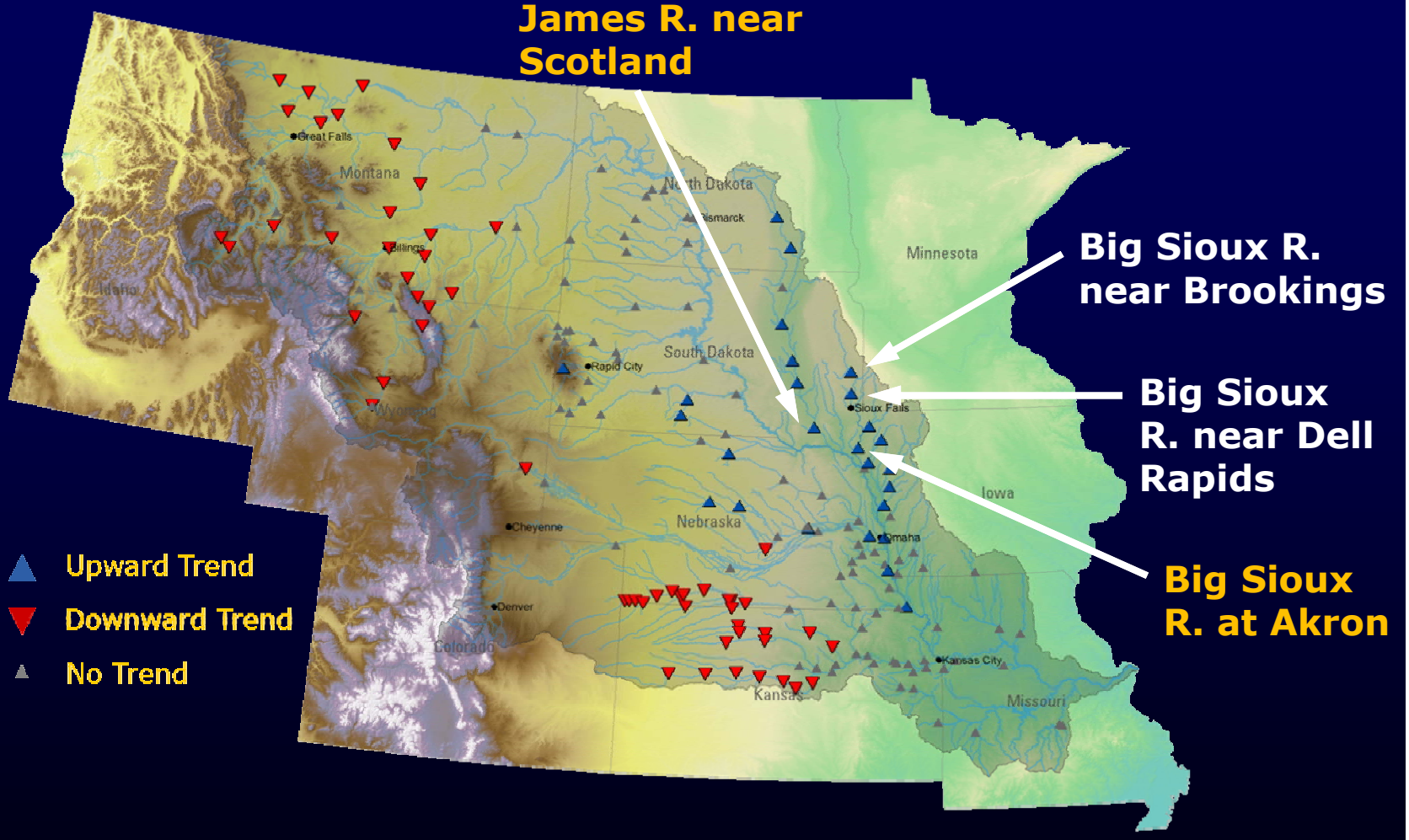
Streamflow trends in the Missouri River Basin (cont.)



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Streamflow trends in the Missouri River Basin (cont.)

James River near Scotland, 1960-2012

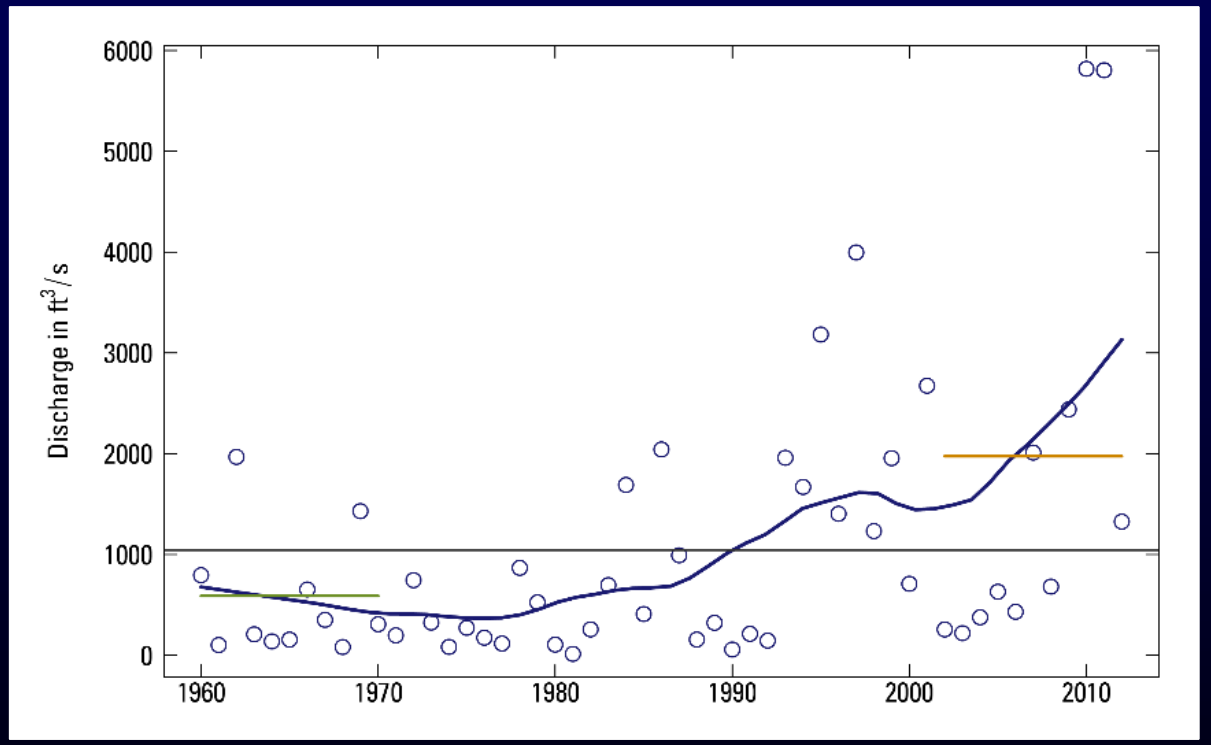
James River near Scotland streamgage site

2003-2012 average

1960-1969 average

1960-2012 average

Mean Annual Discharge



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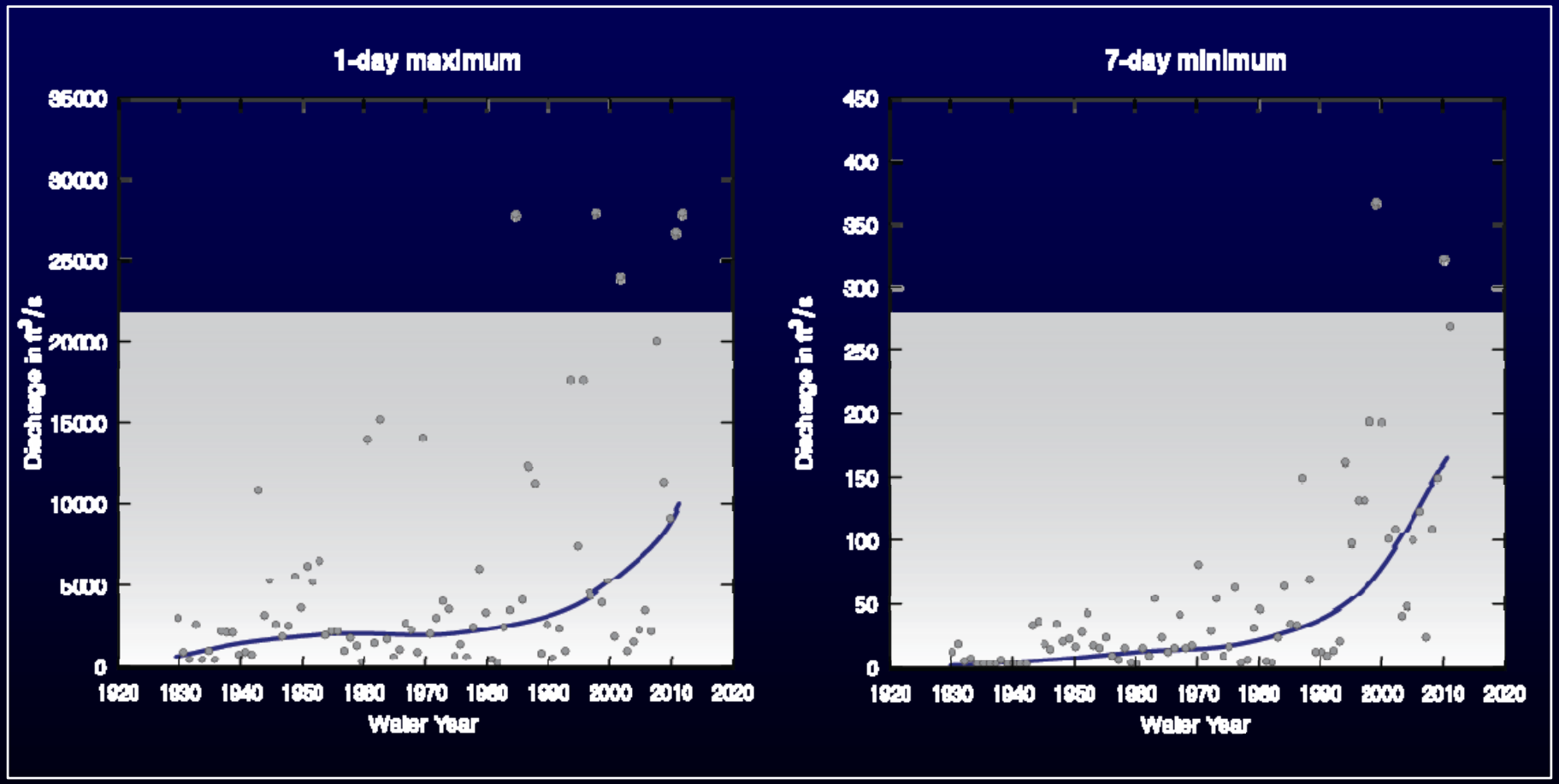
Streamflow trends in the Missouri River Basin (cont.)

James River near Scotland, 1929-2011



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Streamflow trends in the Missouri River Basin (cont.)

Big Sioux River at Akron, 1960-2012

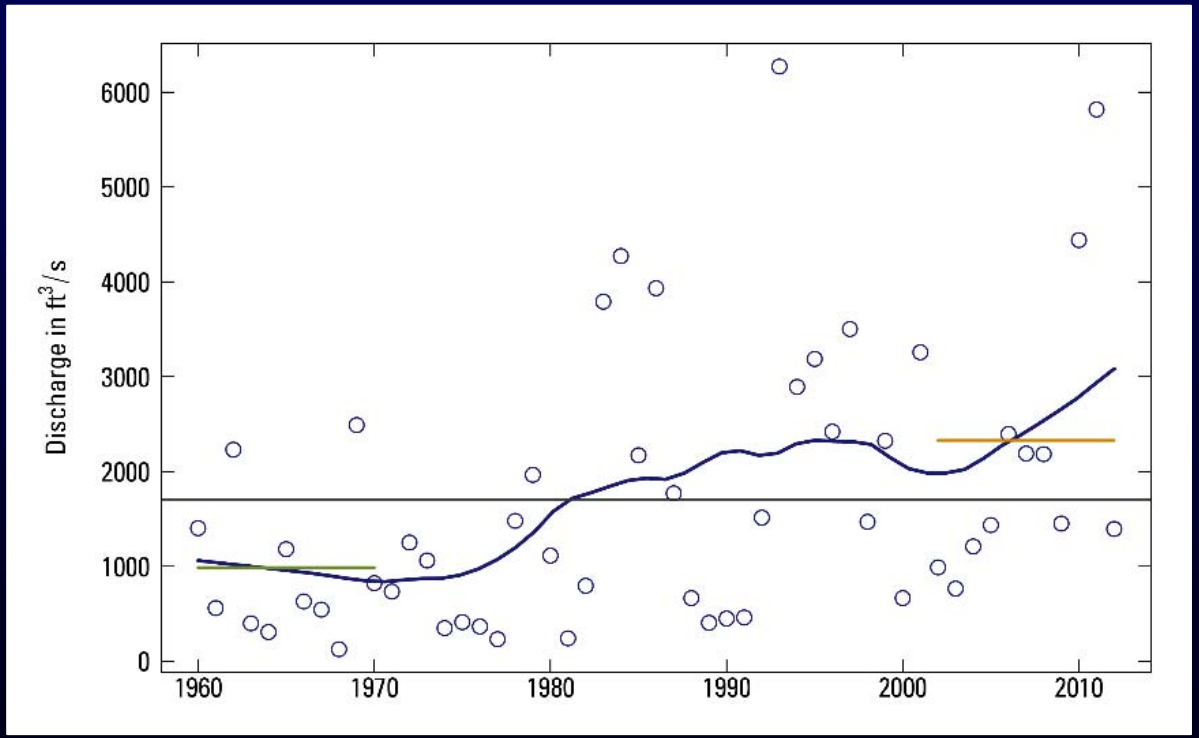
Big Sioux River at Akron streamgage site

2003-2012 average

1960-1969 average

1960-2012 average

Mean Annual Discharge



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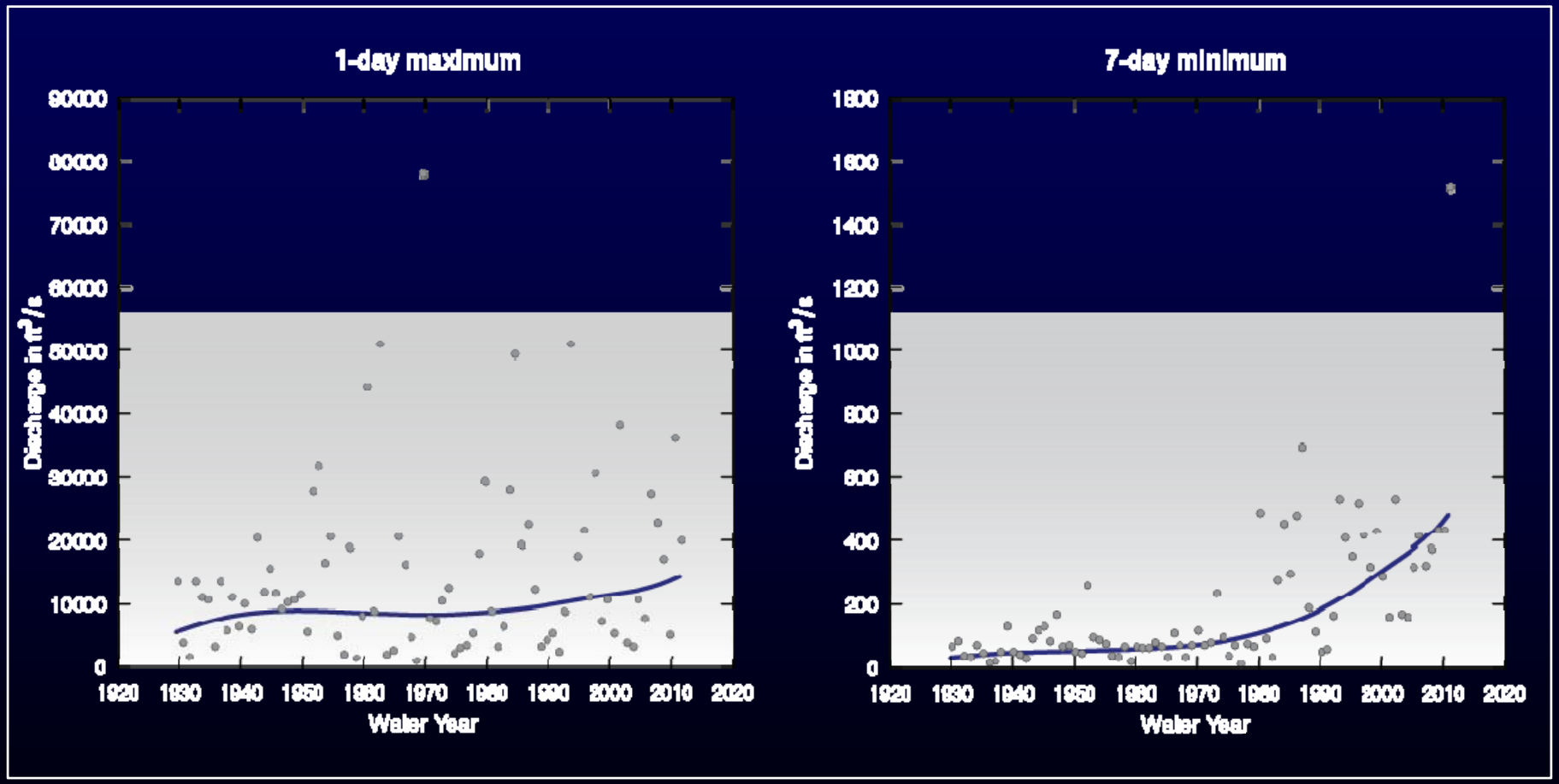
Streamflow trends in the Missouri River Basin (cont.)

Big Sioux River at Akron, 1929-2011



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Streamflow trends in the Missouri River Basin (cont.)

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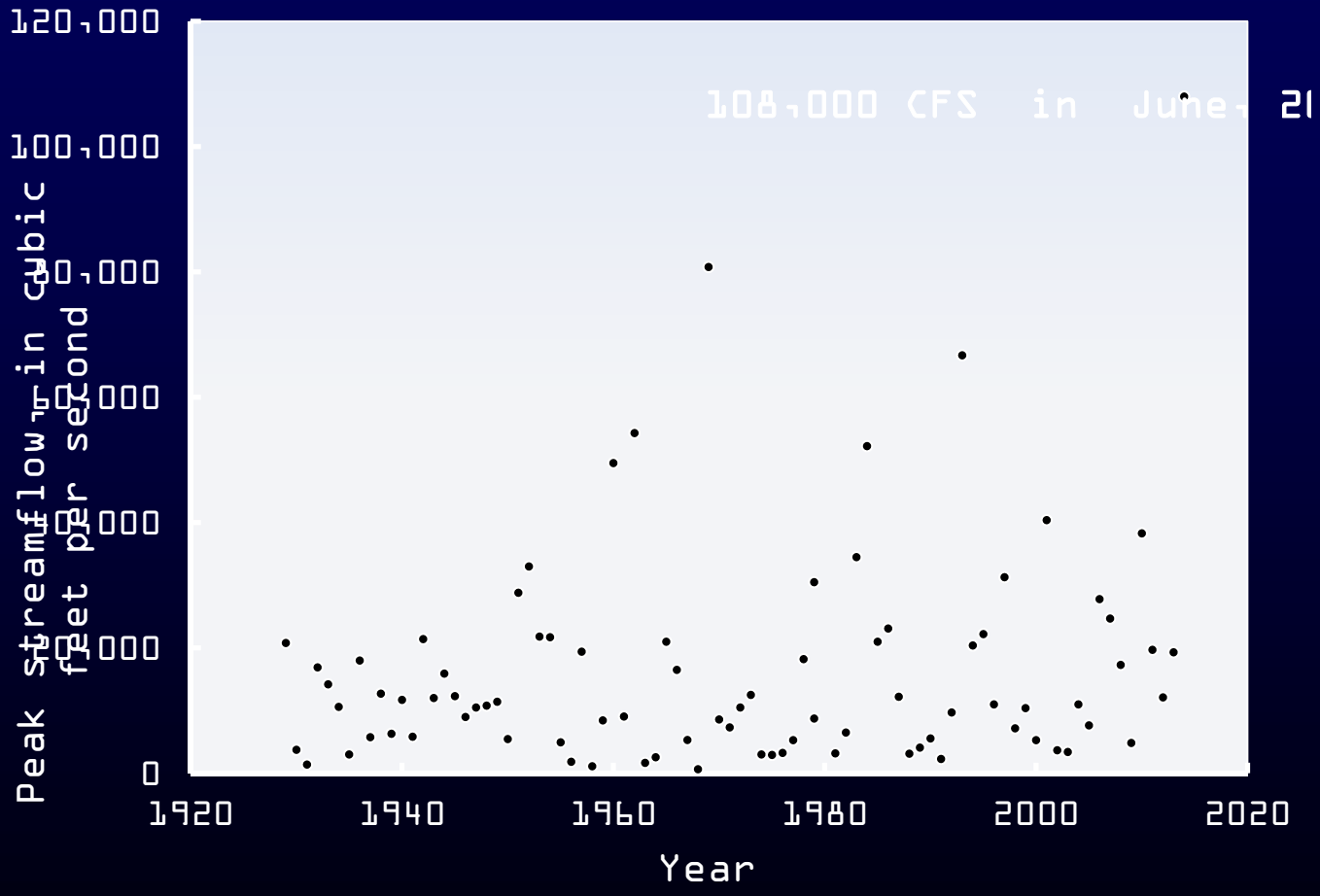

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Topics (cont.)

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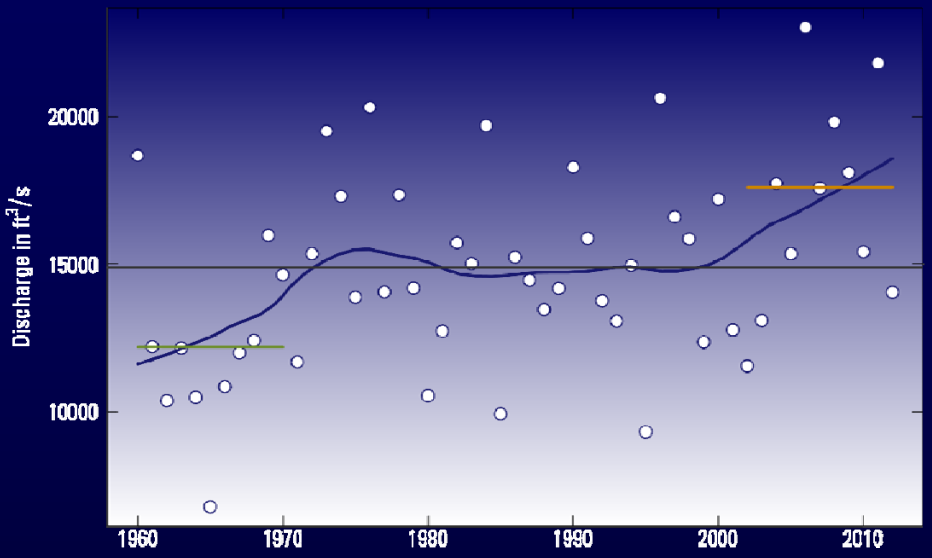
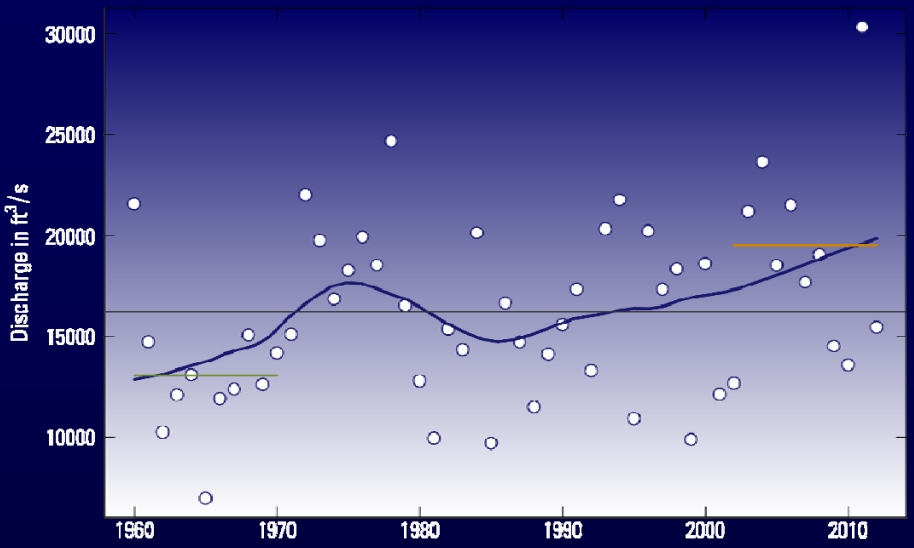
National context (cont.)

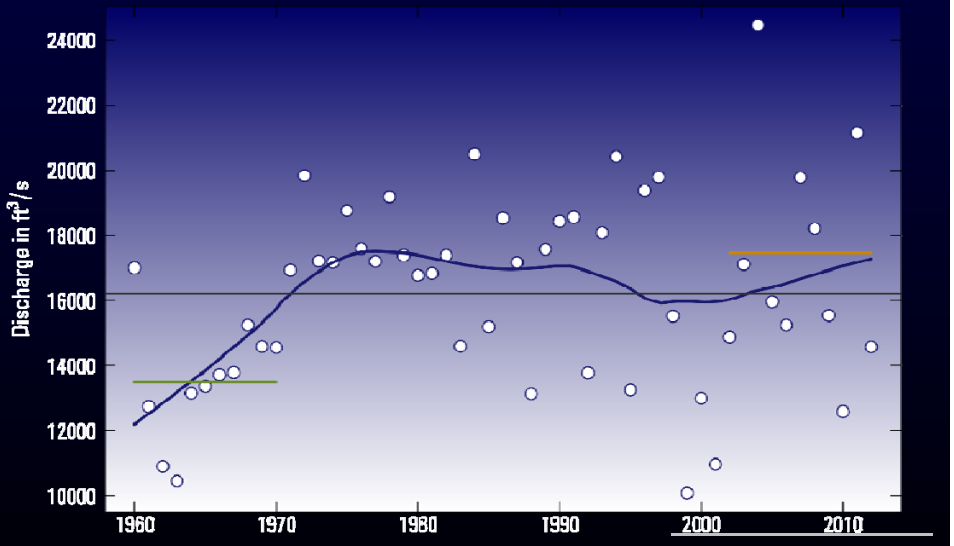
Connecticut River at Montague City, MA



Allegheny River at Kittaning, PA



Susquehana River at Danville, PA



2003-2012 average

1960-1969 average

1960-2012 average

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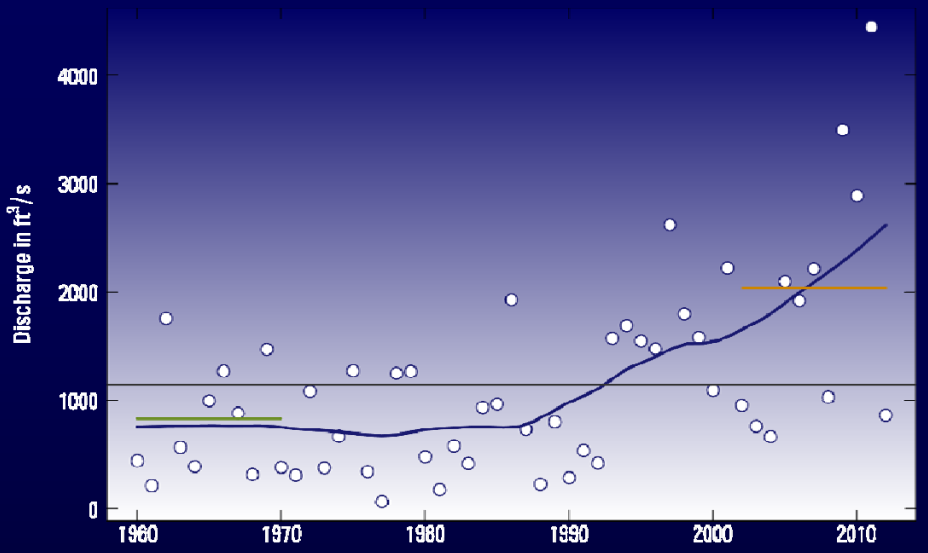
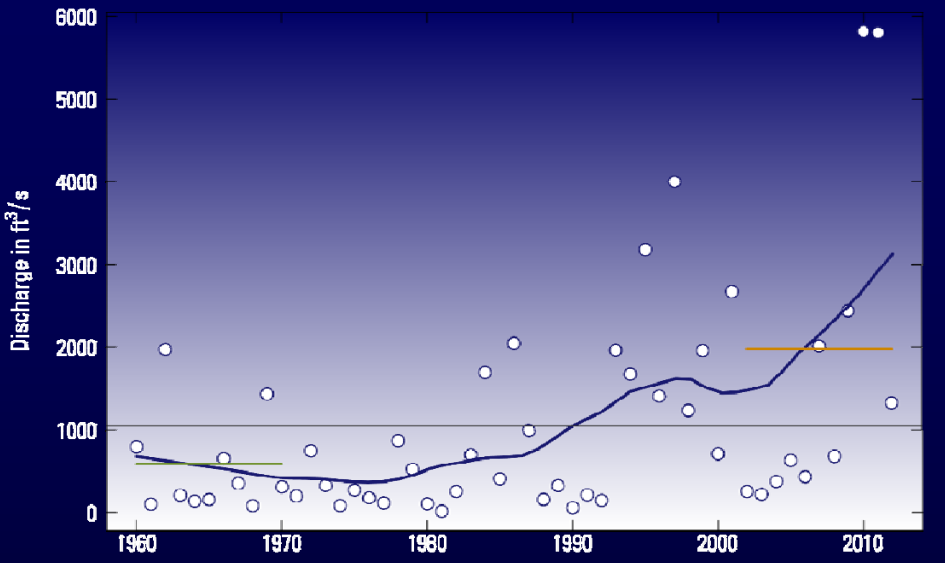
National context (cont.)

Red River of the North at Fargo, ND



James River at Scotland, SD



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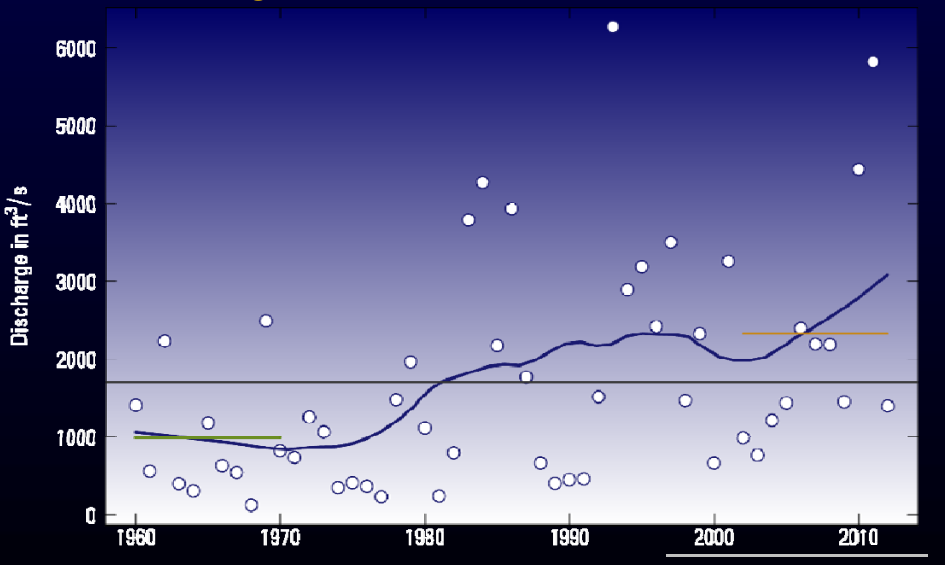
Big Sioux River at Akron, IA



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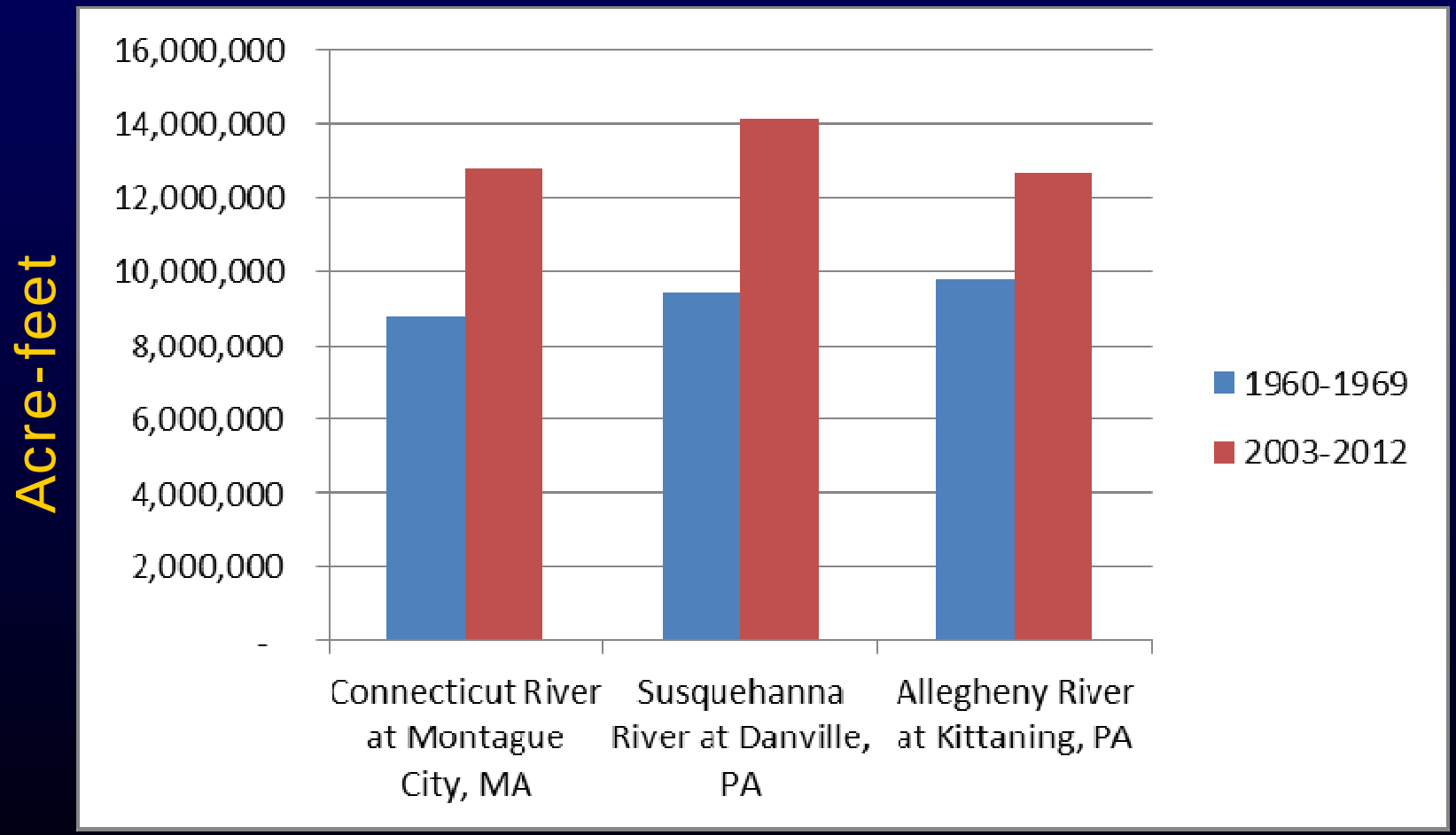
Increase in Annual Volume of Runoff from 1960-69 to 2003-2012



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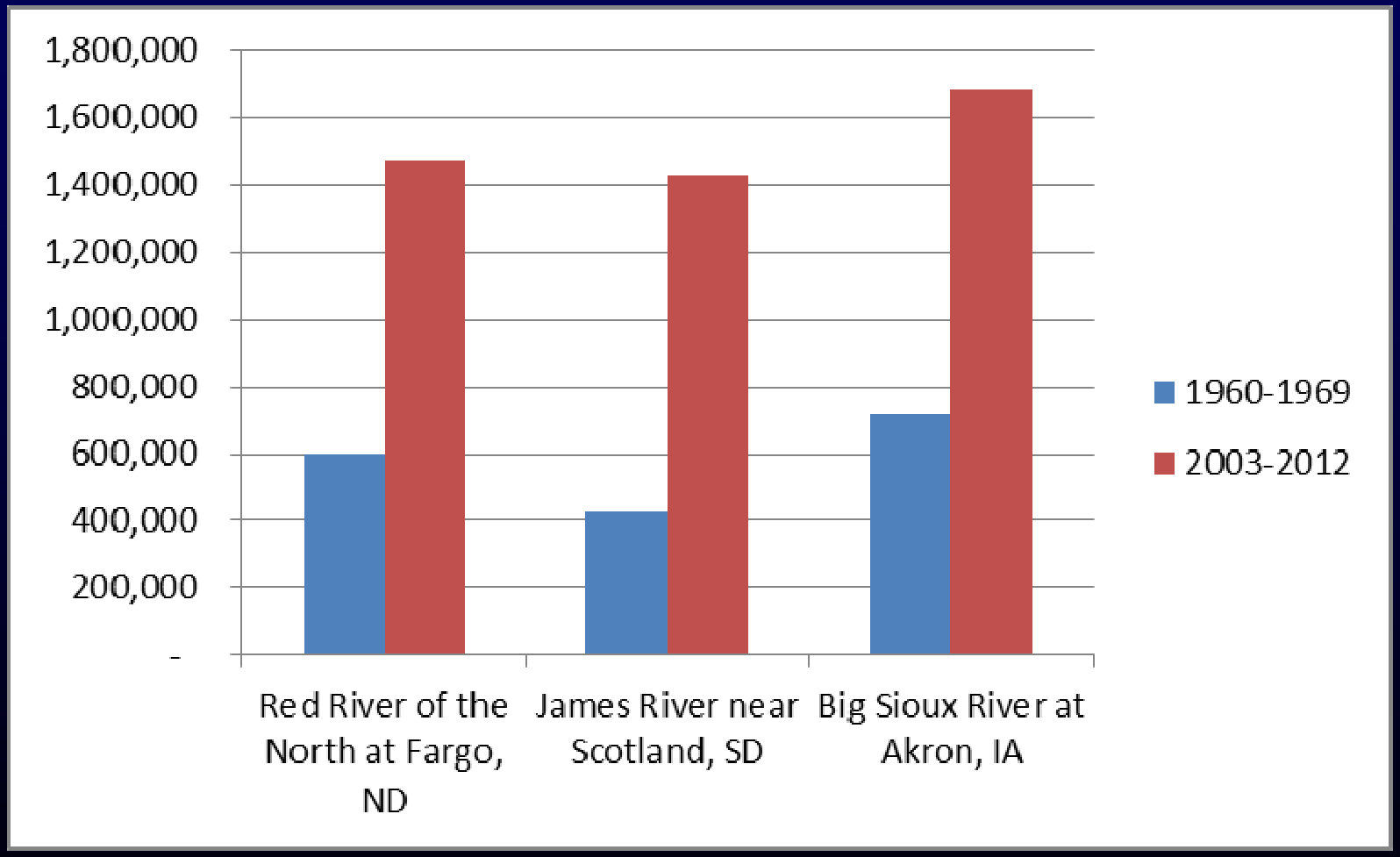
Increase in Annual Volume of Runoff from 1960-69 to 2003-2012

Selected Local Stations



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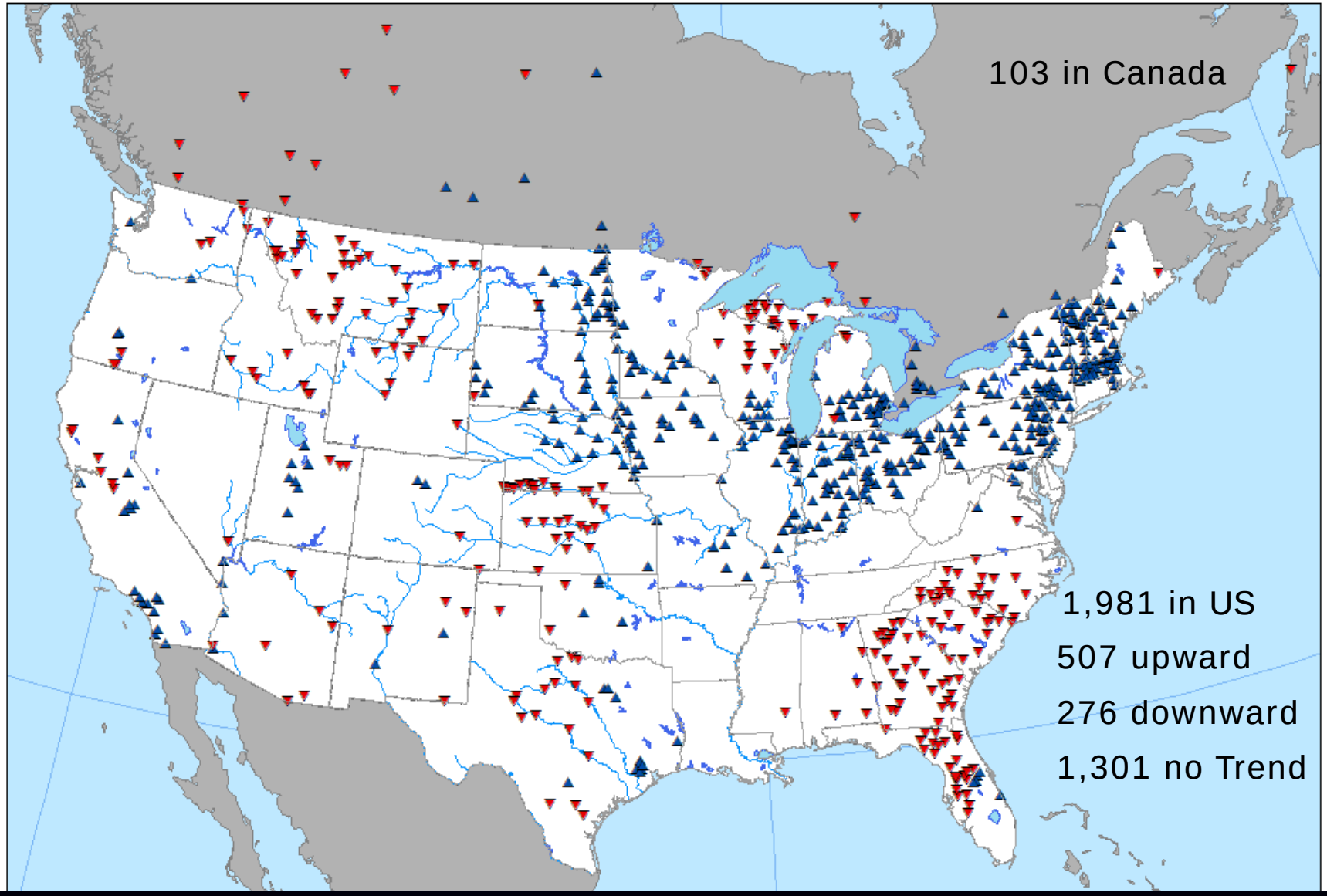
National context (cont.)



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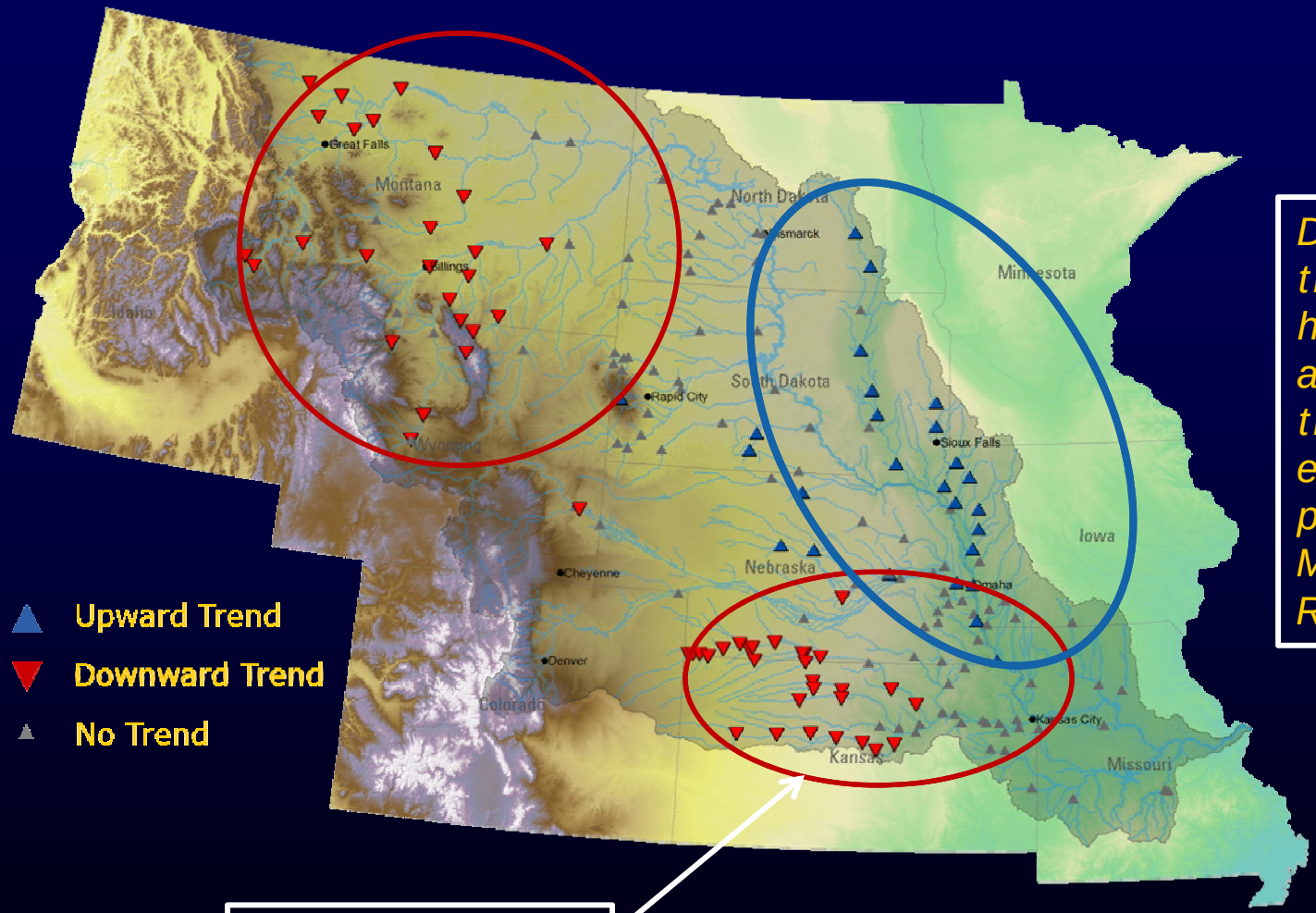

Downward trends in headwaters and upward trends in eastern parts of Missouri River Basin

Coming back to this

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Potential factors (cont.)

Journal of Hydrology (2006) 327, 603–617

available at www.sciencedirect.com

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journal homepage: www.elsevier.com/locate/jhydrol

Evaluation of the impact of groundwater irrigation on streamflow in Nebraska

Fujiang Wen, Xunhong Chen *

Groundwater withdrawal can be primary factor in streamflow depletion

Republican River basin. This decrease plausibly matches a pattern of an increasing number of irrigation wells and the declines of the groundwater level. Because there was no decreasing trend in precipitation, it is most likely that groundwater withdrawal in this basin was a primary factor in streamflow depletion. Besides Nebraska, where a significant amount of groundwater was withdrawn from the High Plains regional aquifer, irrigators in Kansas and Colorado were the other likely contributors to streamflow depletion in the Republican River.

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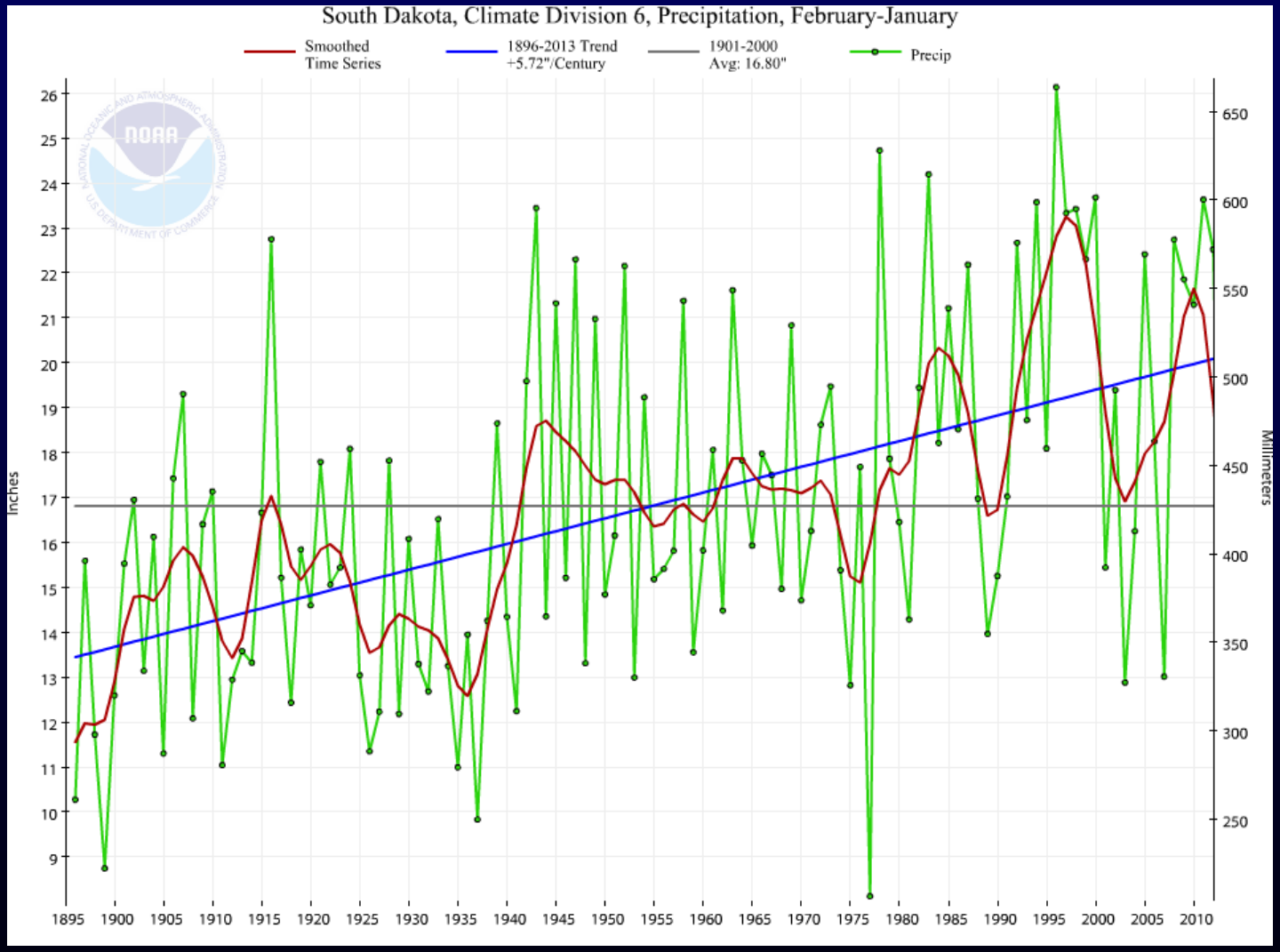
Potential factors (cont.)



Precipitation is a contributing factor in ESD – especially in the fall

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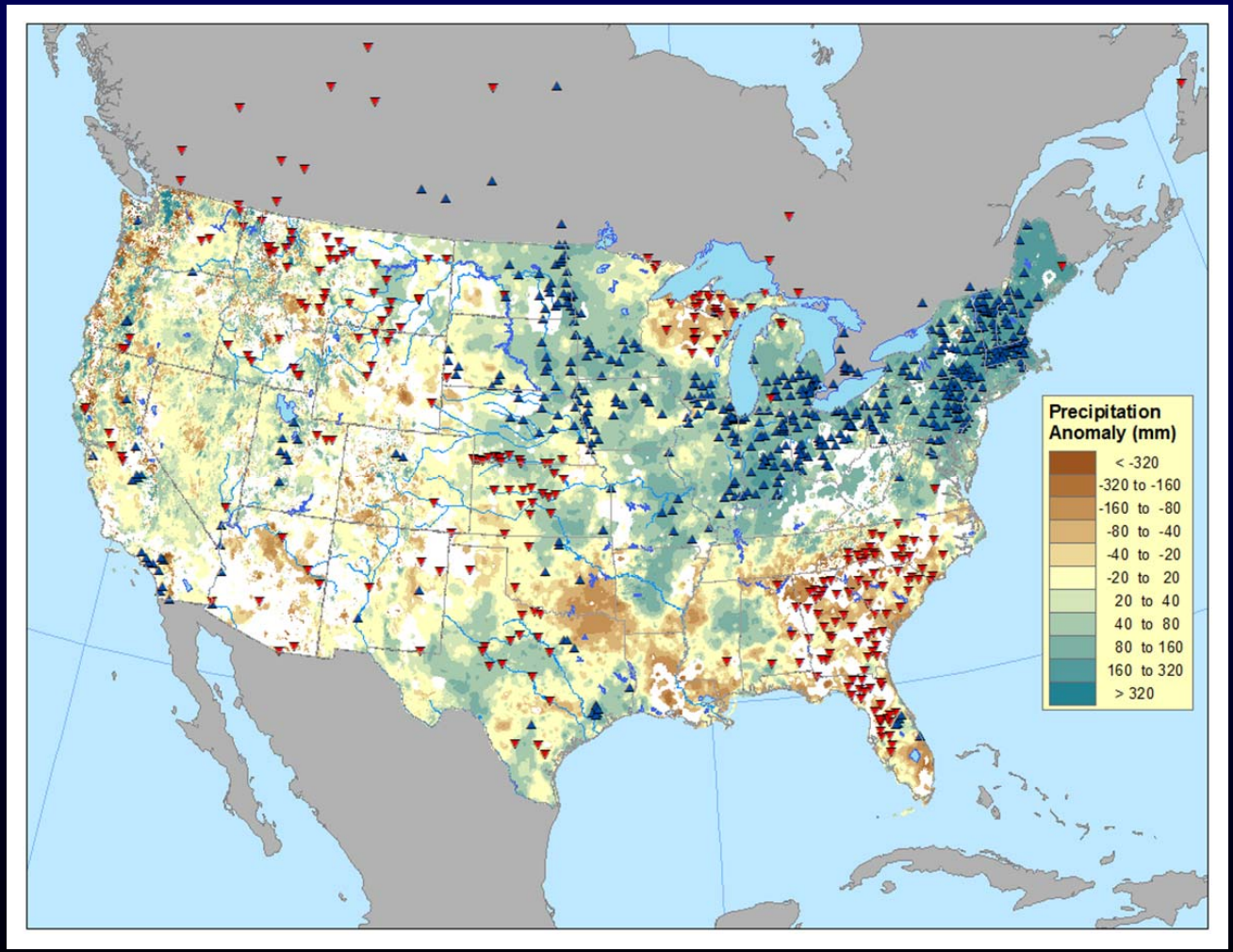
Potential factors (cont.)

Annual precipitation anomalies 2003-2012 compared to long-term average—a forcing factor



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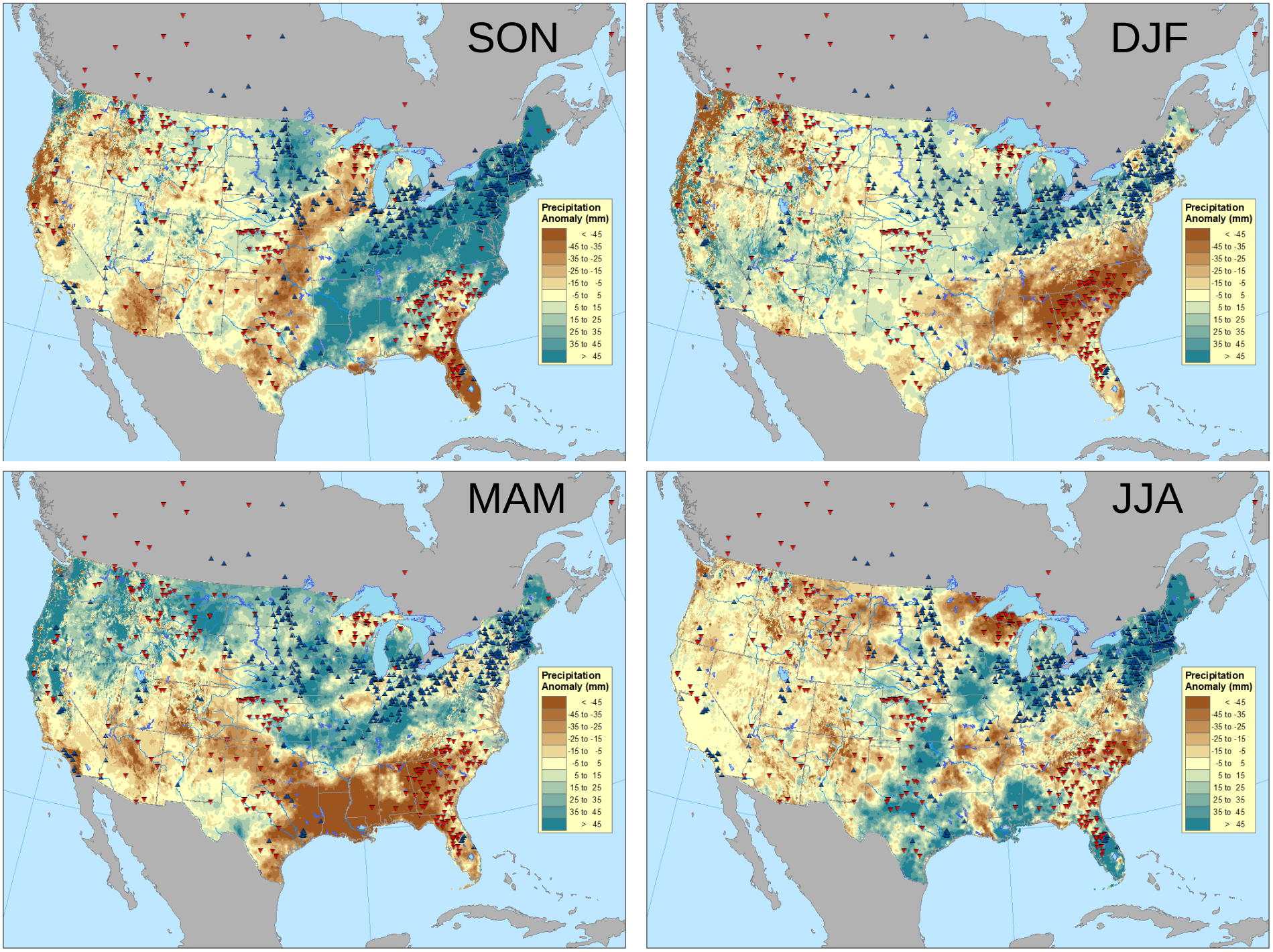
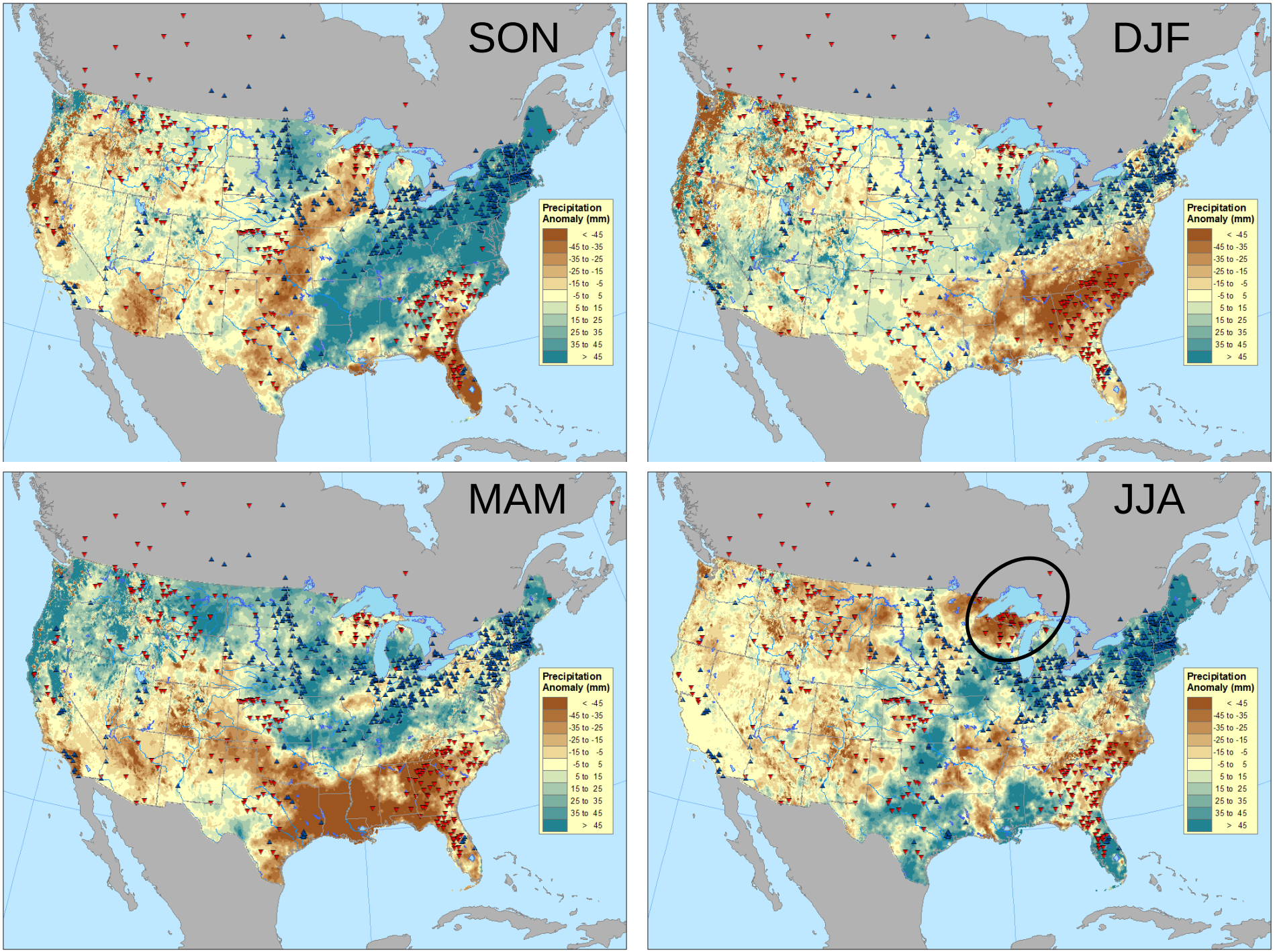

SON
DJF
MAM
JJA
Precipitation Anomaly (mm)
< -45
-45 to -35
-35 to -25
-25 to -15
-15 to -5
-5 to 5
5 to 15
15 to 25
25 to 35
35 to 45
> 45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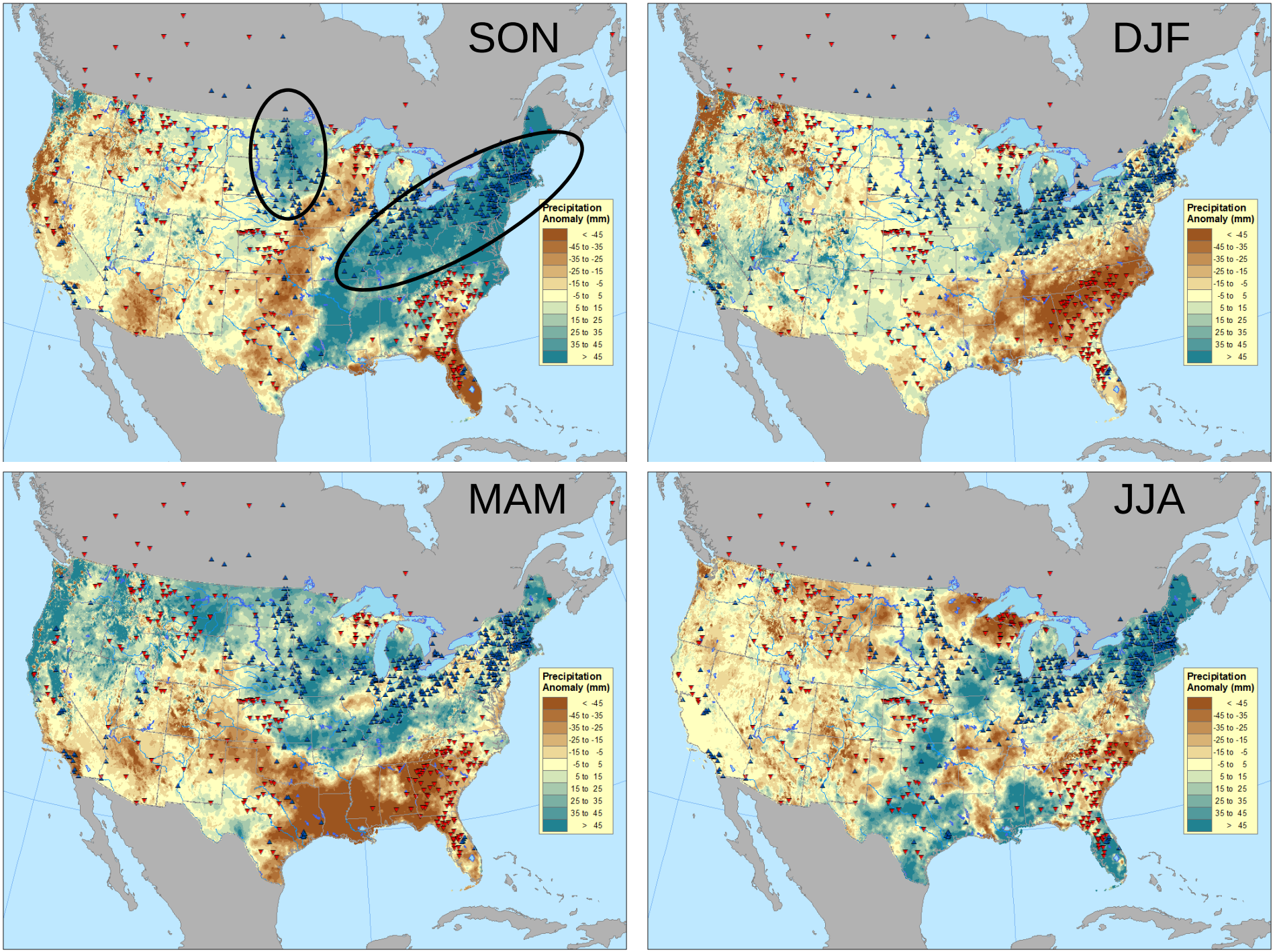
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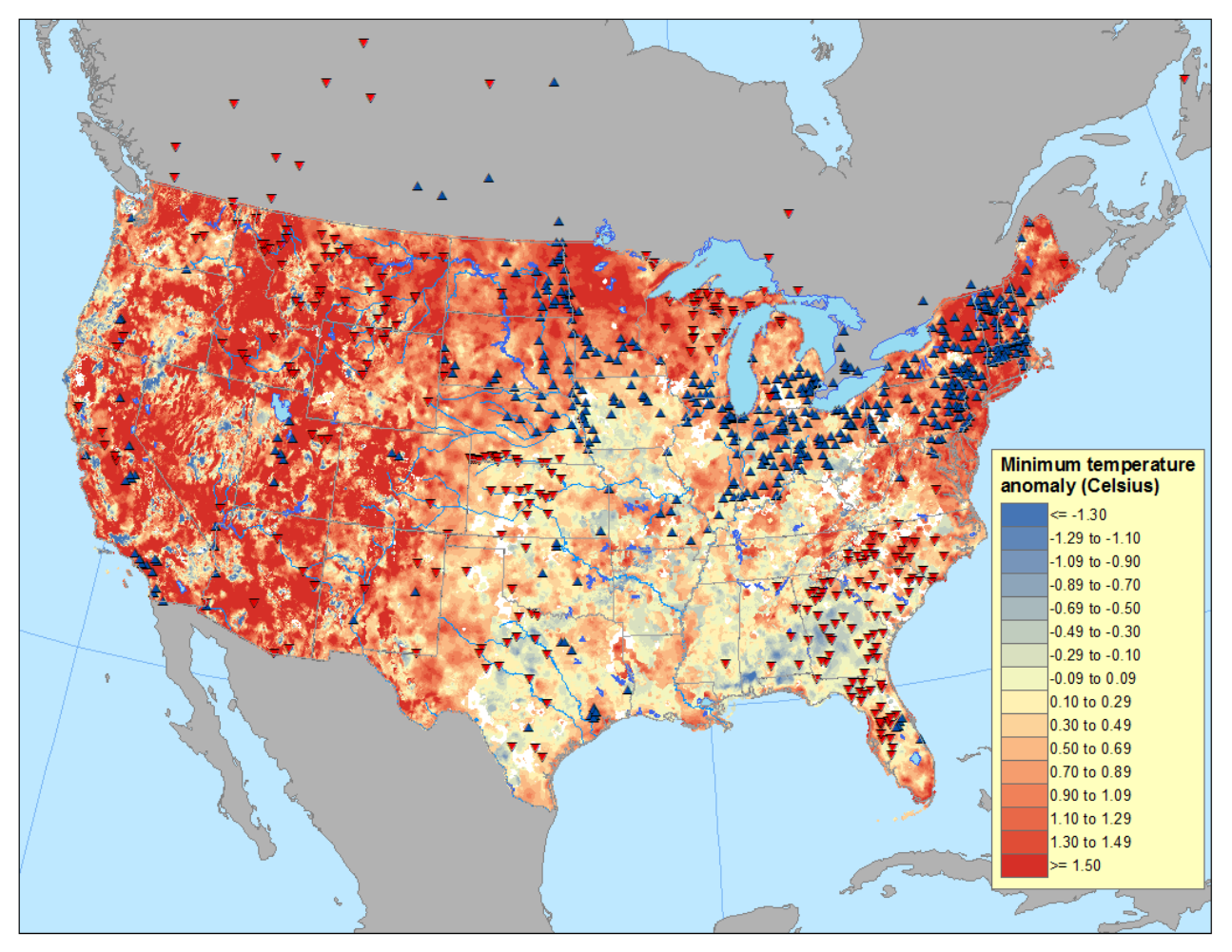
Potential factors (cont.)

Mean annual minimum temperature trends



Minimum temperature increases have been observed in ESD and much of the West. Thus, T may affect snowpack and runoff, particularly in the western MRB.

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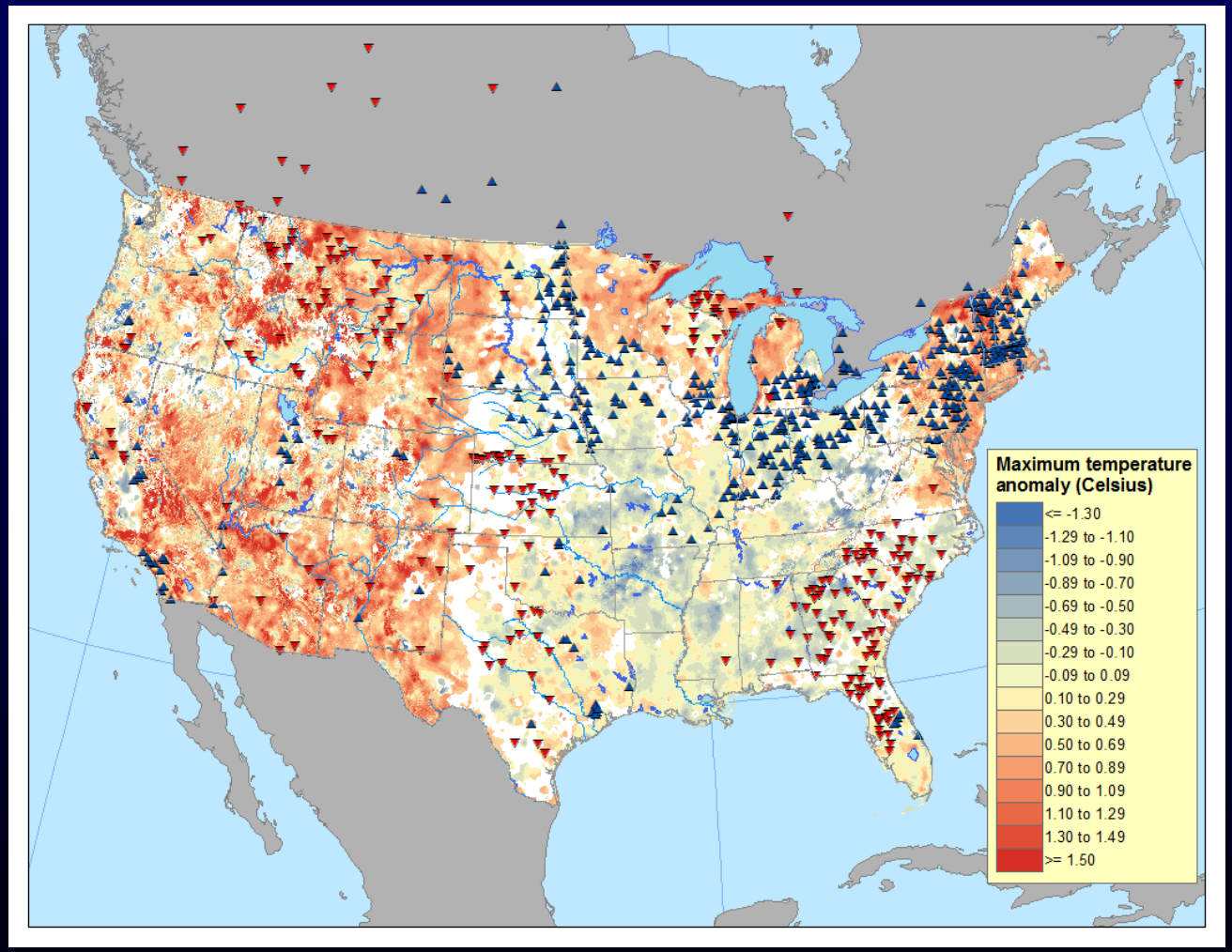
Potential factors (cont.)

Mean annual maximum temperature trends



Maximum temperature hasn't changed much in ESD. Some potential indication of increased moisture from the Gulf of Mexico.

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Conclusions

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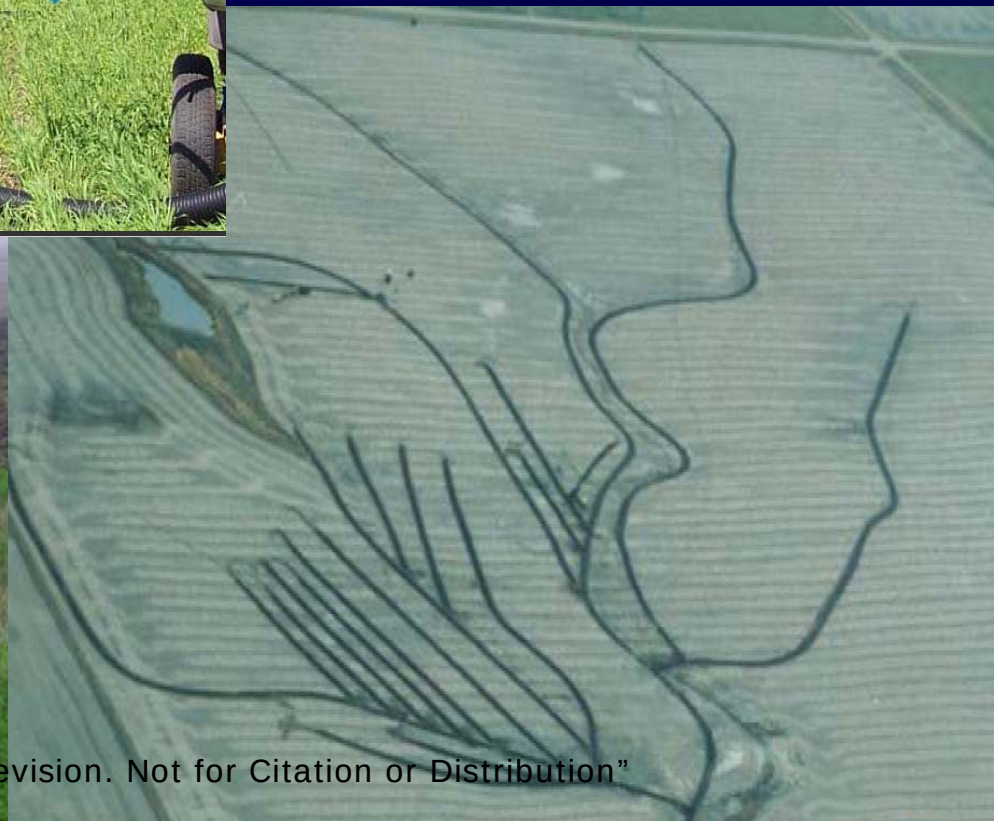
- Downward trends in headwaters and upward trends in eastern parts of Missouri River Basin
- Groundwater withdrawal can be primary factor in streamflow depletion
- Precipitation is a contributing factor in ESD – especially in the fall
- Higher groundwater levels in glacial aquifers underlain by confining layer may play a role in increased flow in the Eastern Dakotas

Installation with a Tile Plow

Further research

- Land use change
- More row crops
- Retirement of CRP
- Drainage tile,
- More cultivated crops,
- Changes in atmospheric moisture delivery to the continent



Questions

Contact: gcdelzer@usgs.gov; (605) 394-3230