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Century-scale Trends in Peak Streamflow in the United States

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Based on ongoing work of Bob Hirsch, Karen Ryberg, and Gregg Wiche

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Gages Selected For Study

- Approximately 7,500 active gages to choose from
- Chose long-term gages
  - Period of Record 85-127 years
- Eliminated highly urbanized and regulated sites
- Other criteria
- Left with 200 sites

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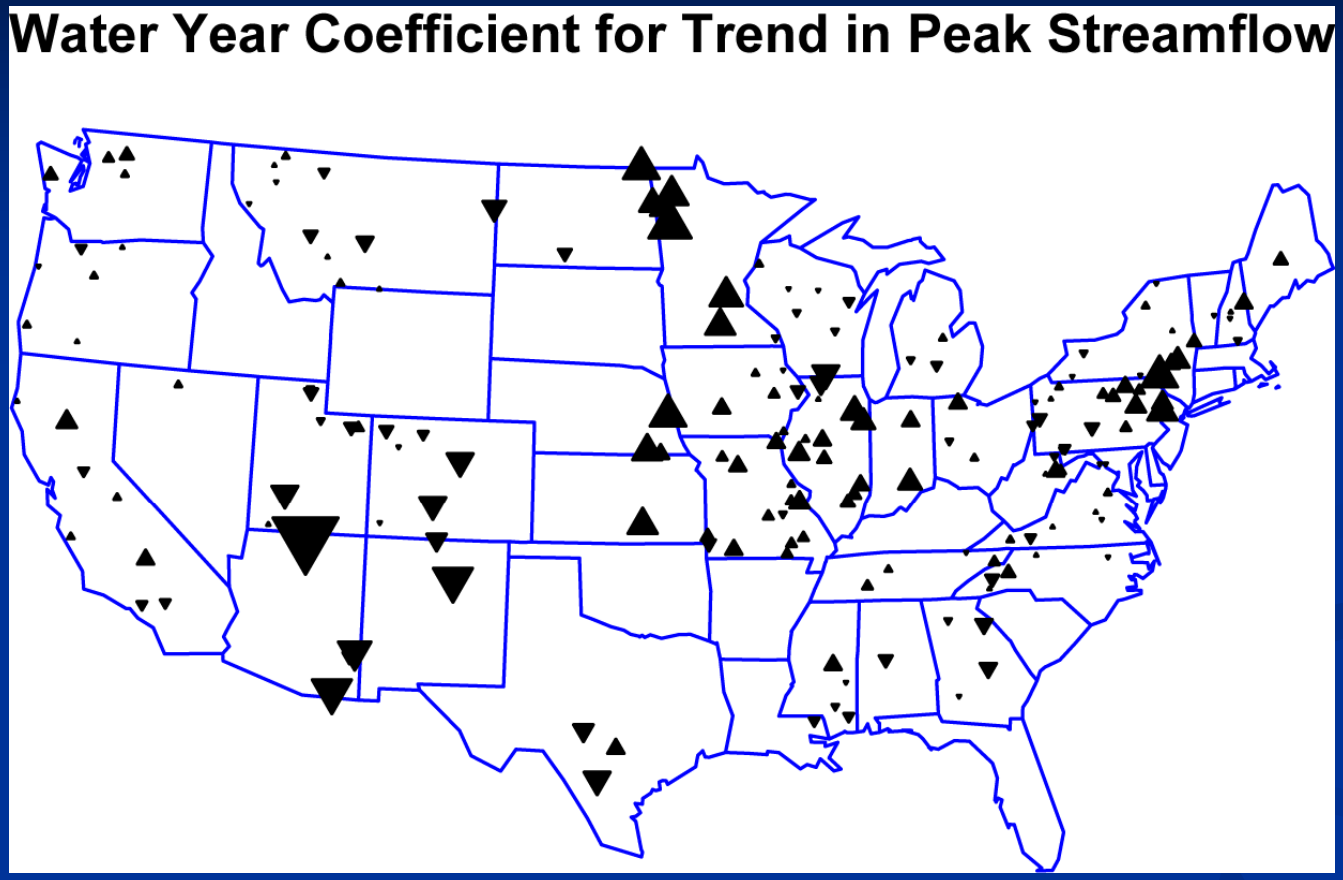
Streamflow Trends



Small increase over time

Large increase over time

Small decrease over time

Large decrease over time

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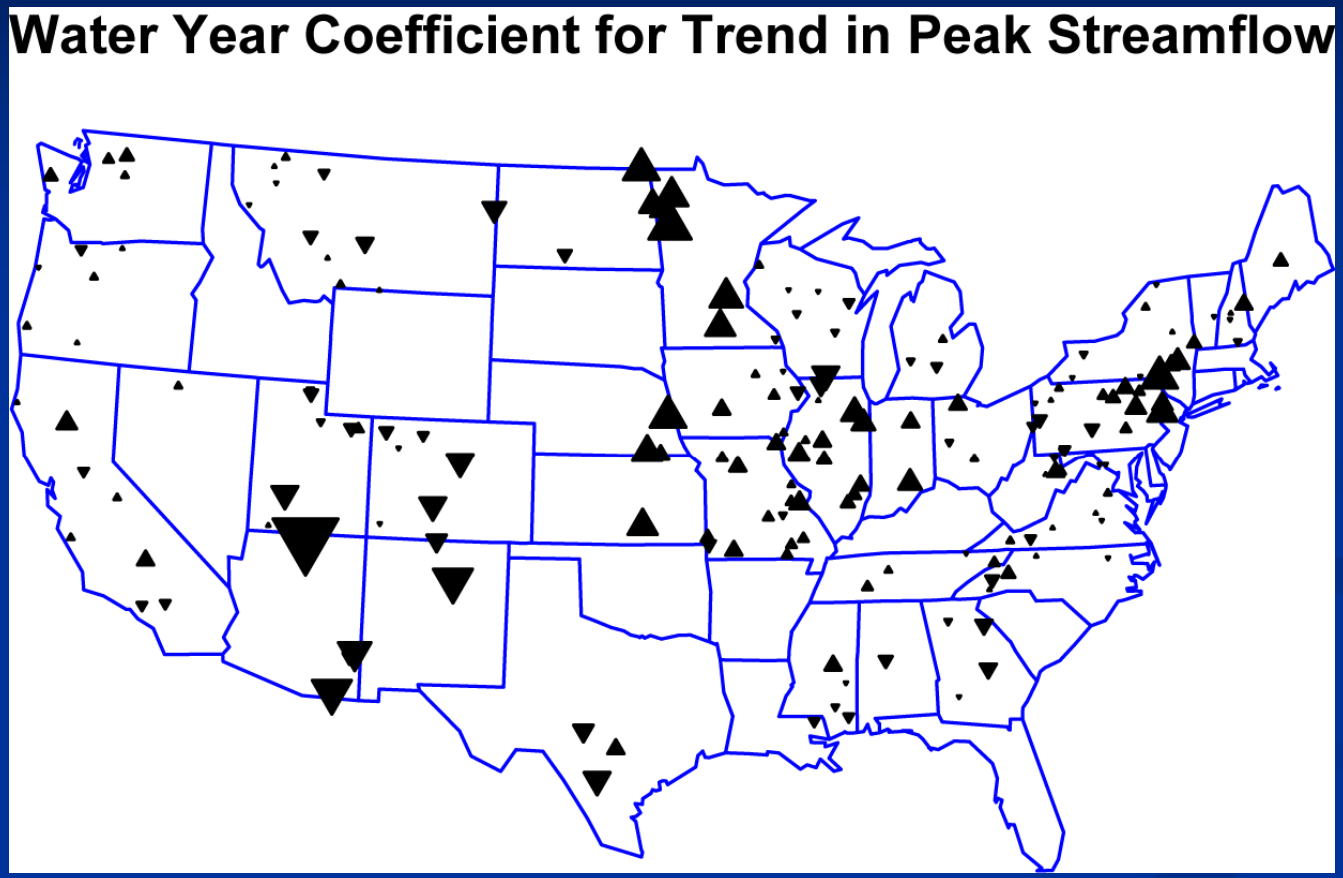
Patterns



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Long-term Monitoring Issues

- States with no long-term, unregulated sites create large gaps in map
- Clustered/correlated sites, for example, Red River of the North Basin
- Period of record makes a difference in the trend reported

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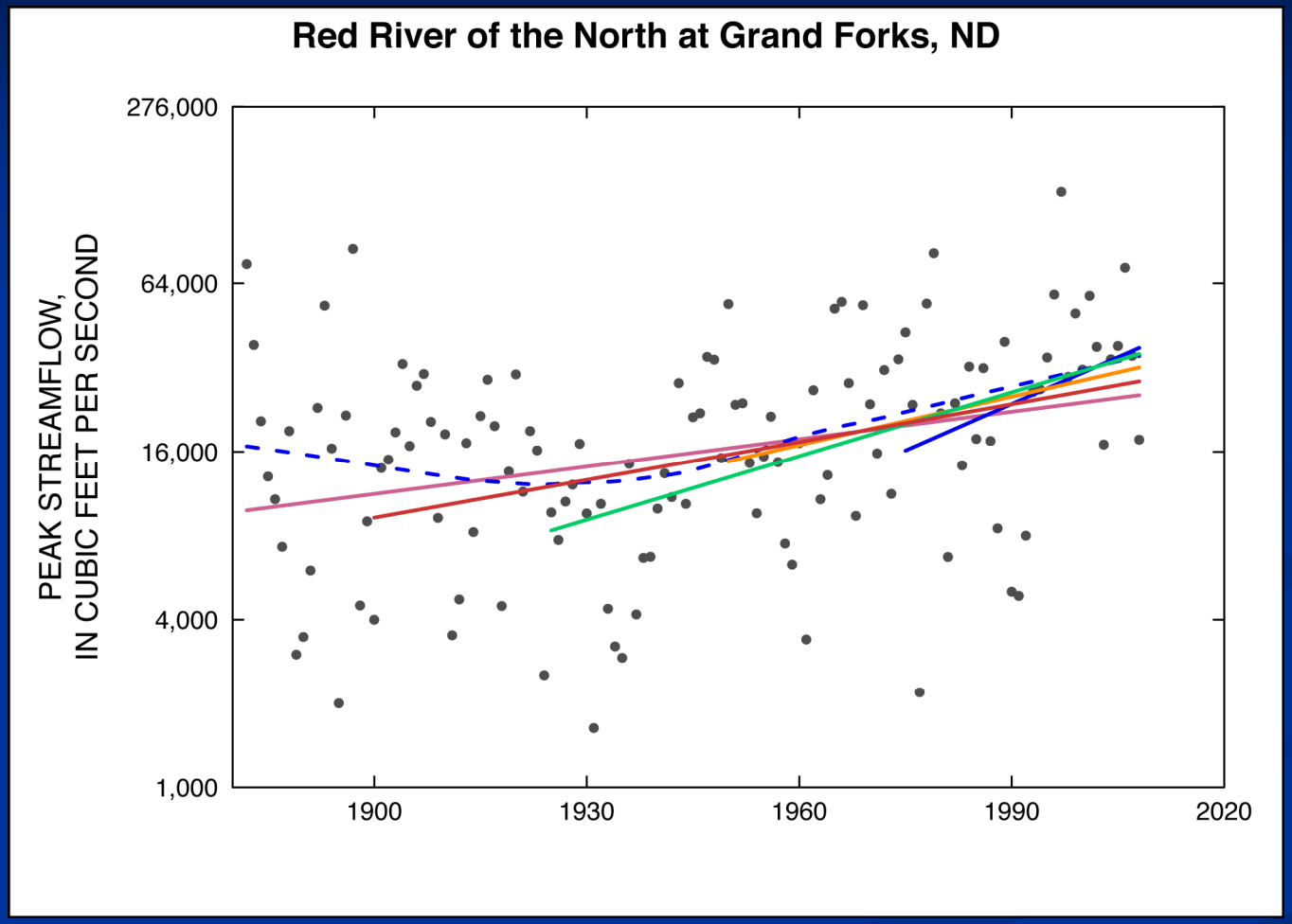
1882-2008



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What could explain the curved line?

- CO_2 – carbon dioxide in the atmosphere
- El Niño/La Niña
- PDO – Pacific Decadal Oscillation
- AMO – Atlantic Multidecadal Oscillation
- Atmospheric Temperature

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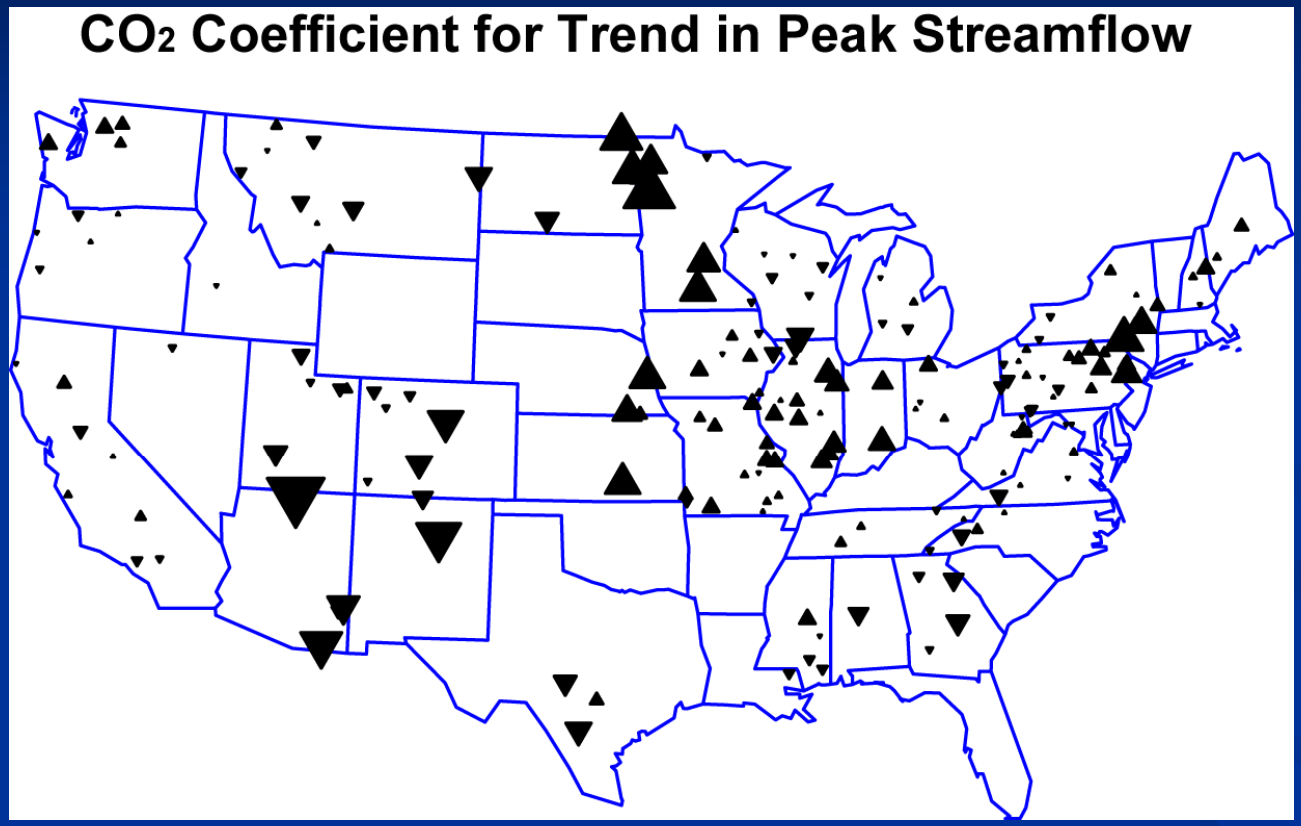
Streamflow Trends



Small increase over time

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Large decrease over time

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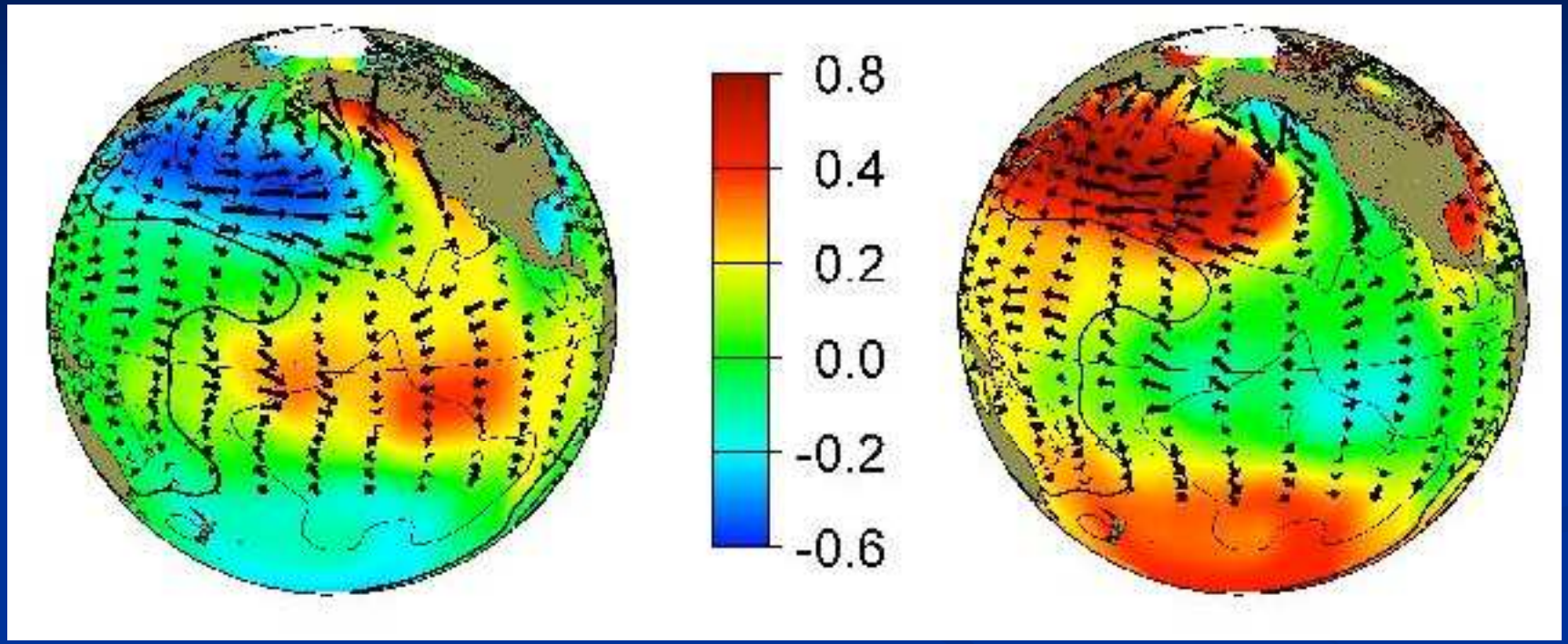
Pacific Decadal Oscillation



From Joint Institute for the Study of the Atmosphere and Ocean at the University of Washington

Typical wintertime sea surface temperature (colors), sea level pressure (contours) and surface windstress (arrows) anomaly patterns during warm and cool phases of PDO

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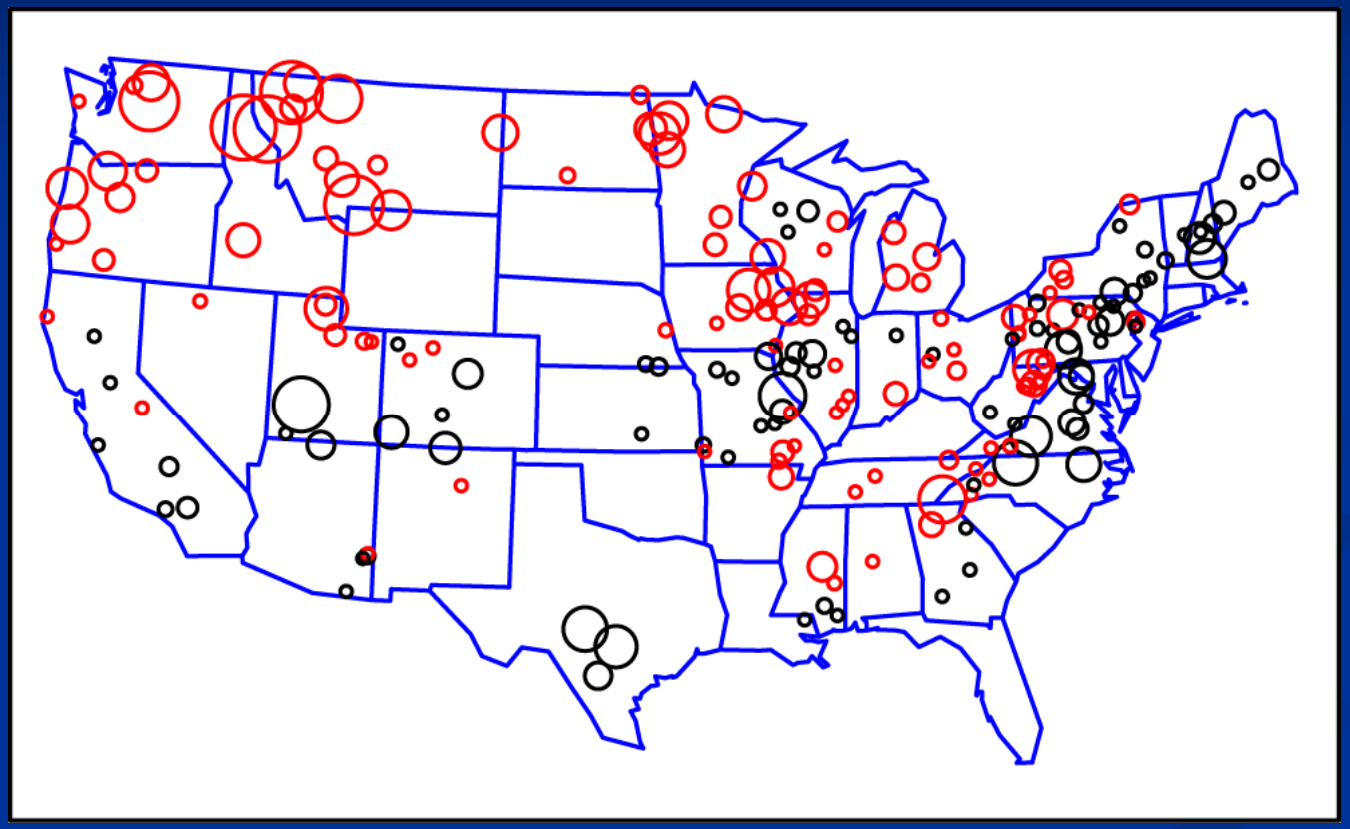
Correlation of Annual Peak Streamflow and Pacific Decadal Oscillation



Small positive correlation

Large positive correlation

Small negative correlation

Large negative correlation

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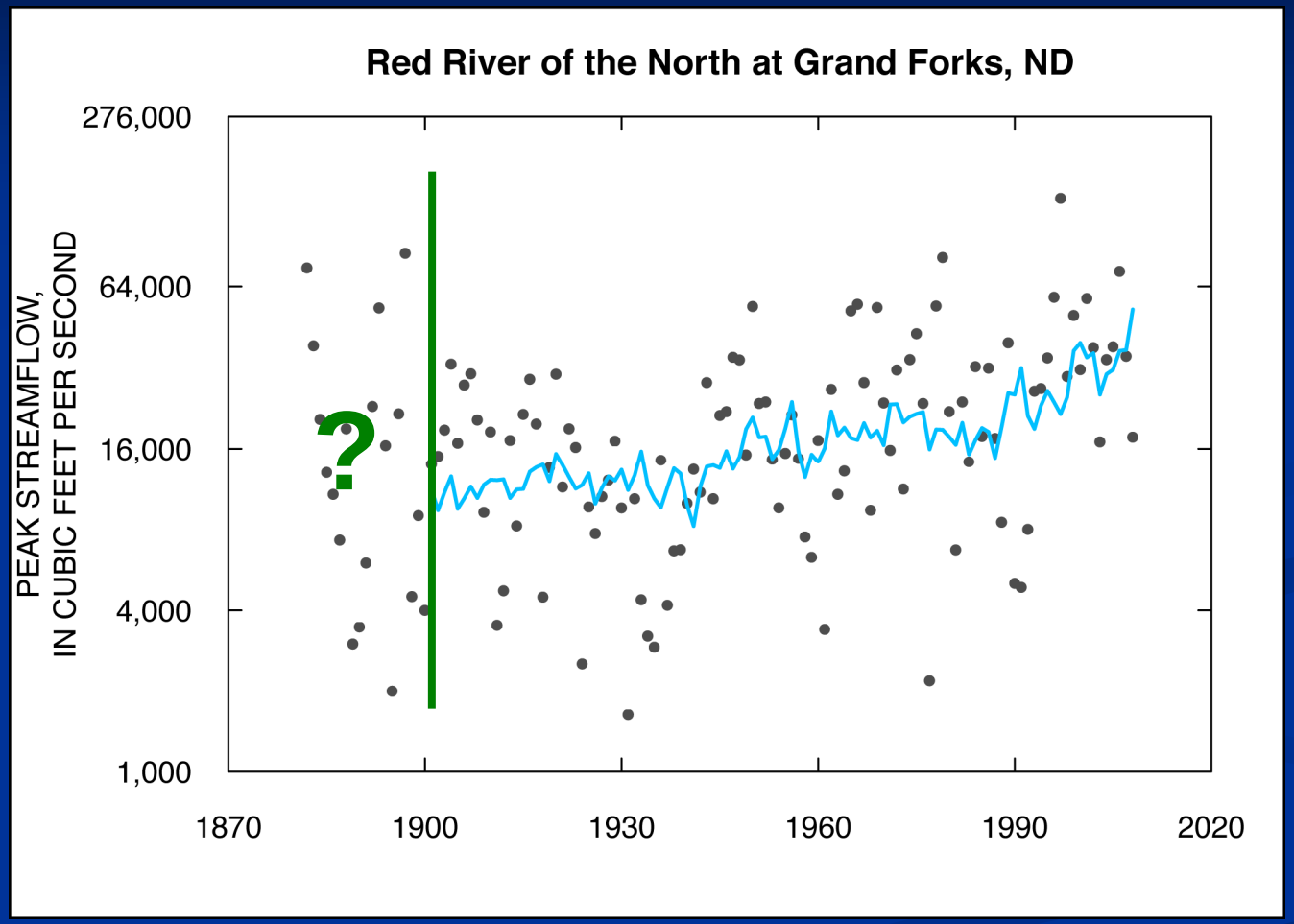
1882-2008



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What If We Go Further Back In Time

- CO_2 Was Lower
- How Do We Explain Large Floods?
- Red River of the North at Winnipeg

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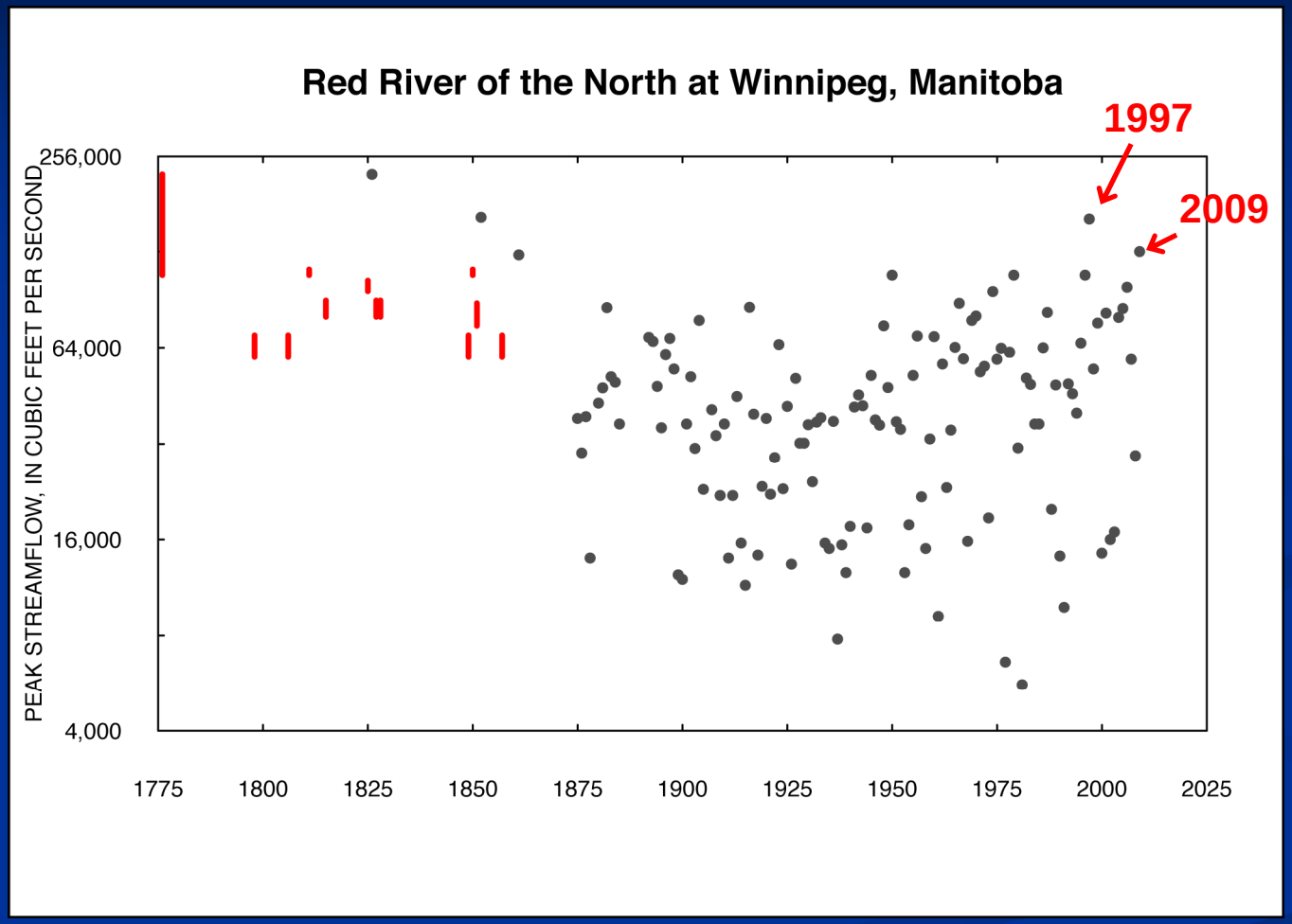
1776-2009



Data Courtesy Manitoba Water Stewardship and Geological Survey of Canada Publication by Bill Rannie

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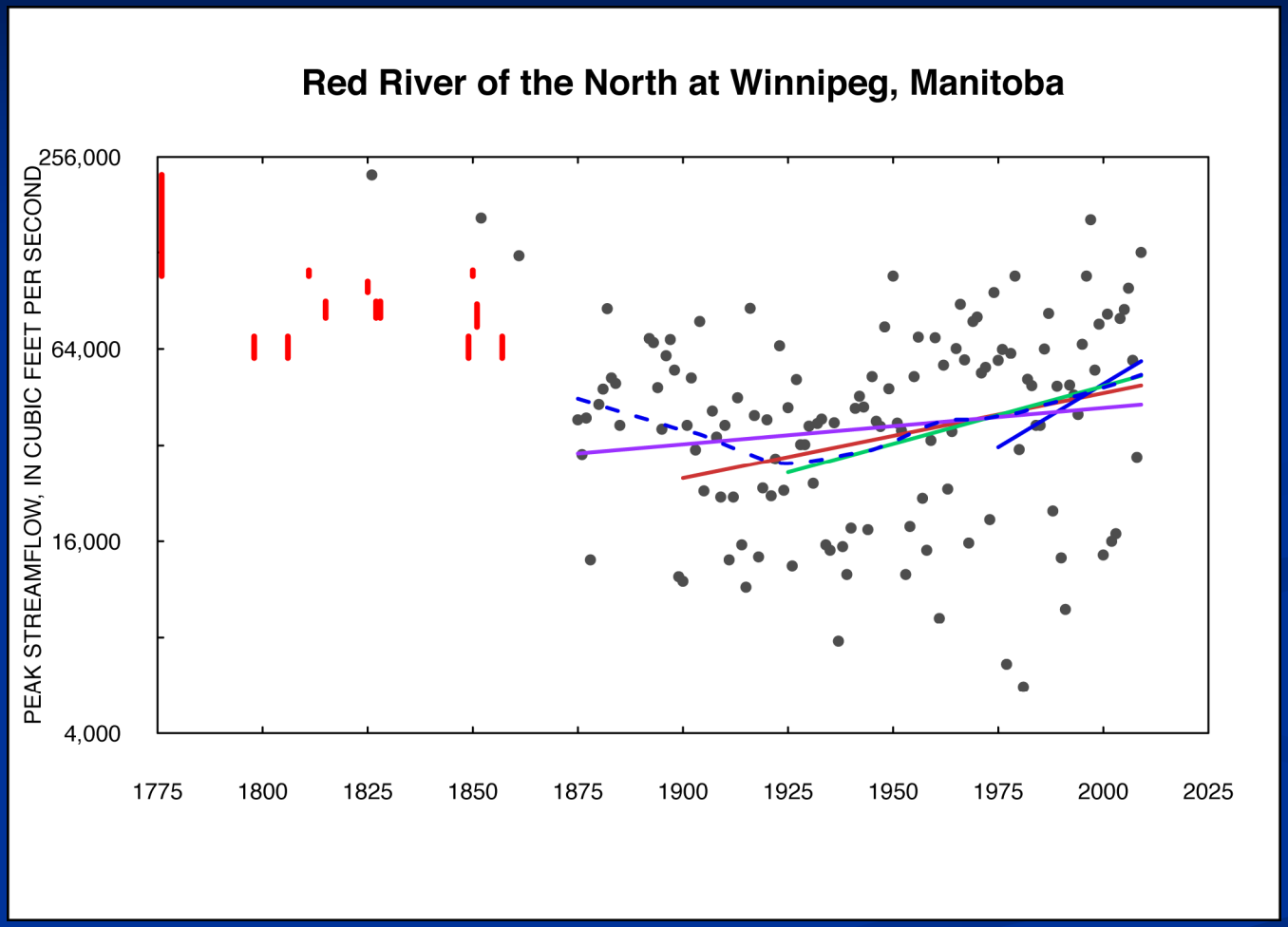
1776-2009



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Summary

- Streamflow is naturally highly variable
- Probably need 200+ years of record to get a better picture
- Long-term, geographically dispersed monitoring is needed to understand streamflow response to a diversity of climatic conditions

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