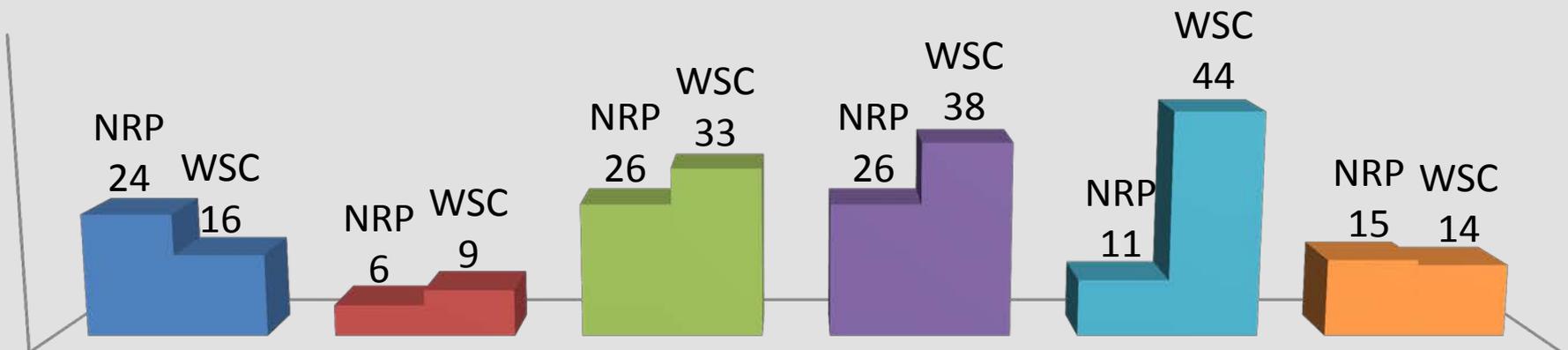
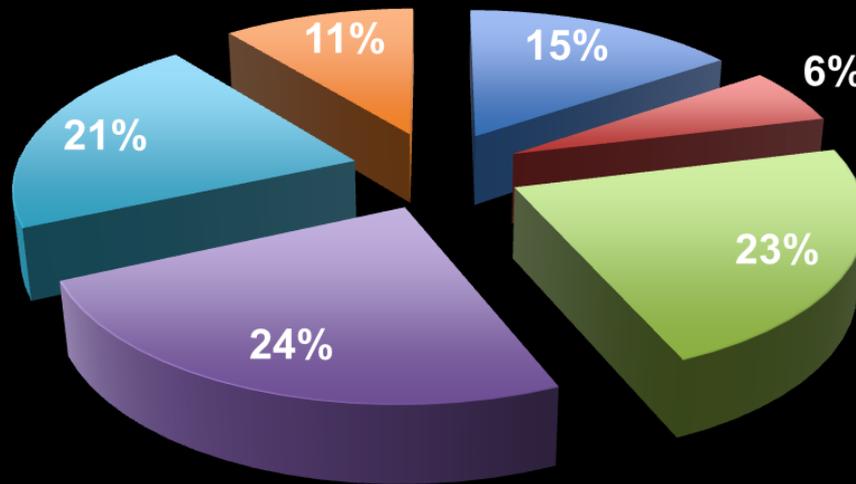


# Research in the Water MA of USGS

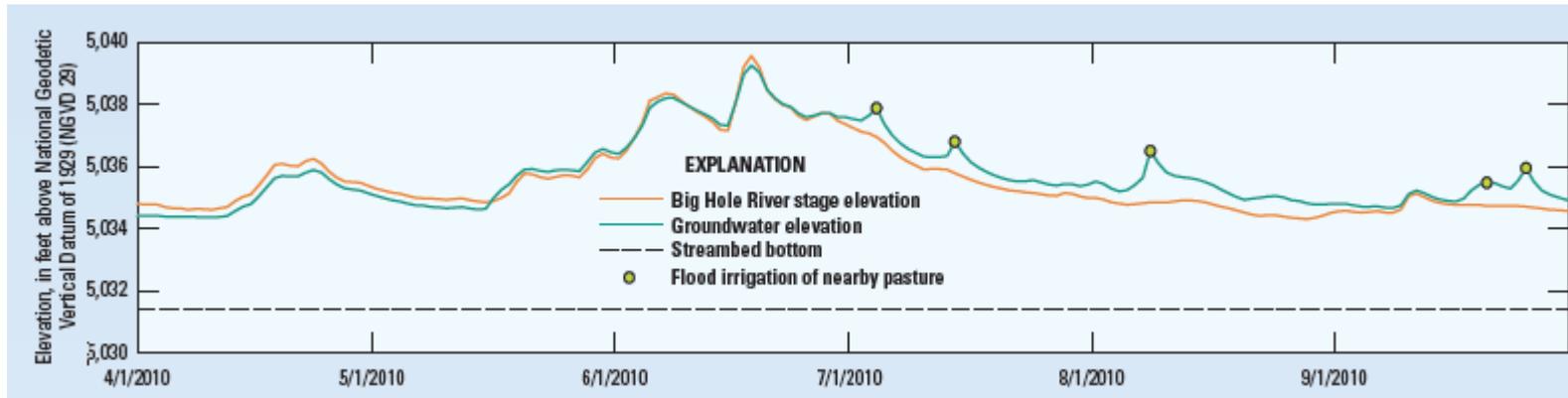
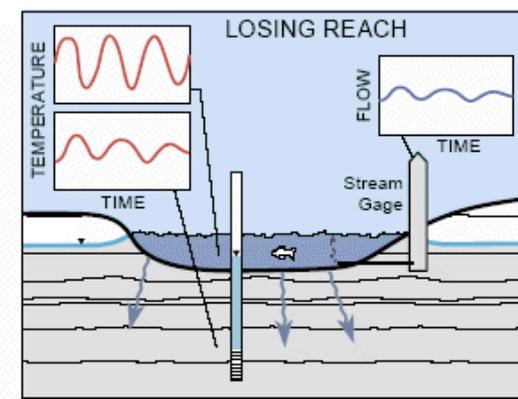
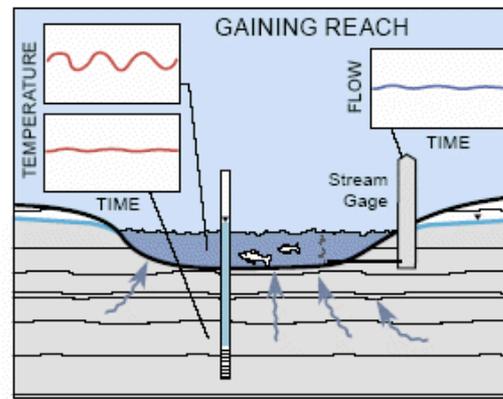
- Research—A process of steps used to collect and analyze information to increase our understanding of an issue.
  - Basic research—increase understanding of fundamental principals.
  - Applied research—practical application of science.
  - Mission-drive research—provides knowledge, fundamental and applied, to address societal problems.

# Water MA Research Scientists (2010)

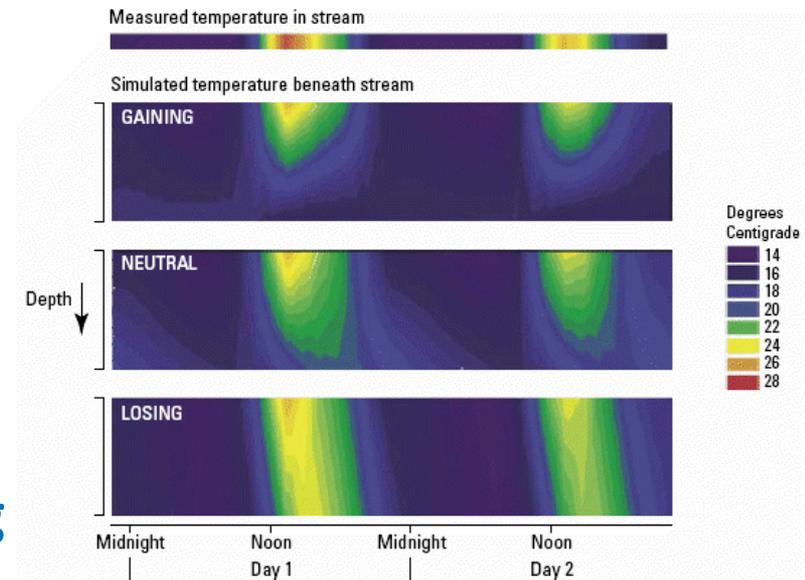
- Ecology
- Geomorph. and Sediment Transport
- Groundwater Chemistry
- Groundwater Hydrology
- Surface Water Chemistry
- Surface Water Hydrology



# Research to Enhance Value of Streamgaging

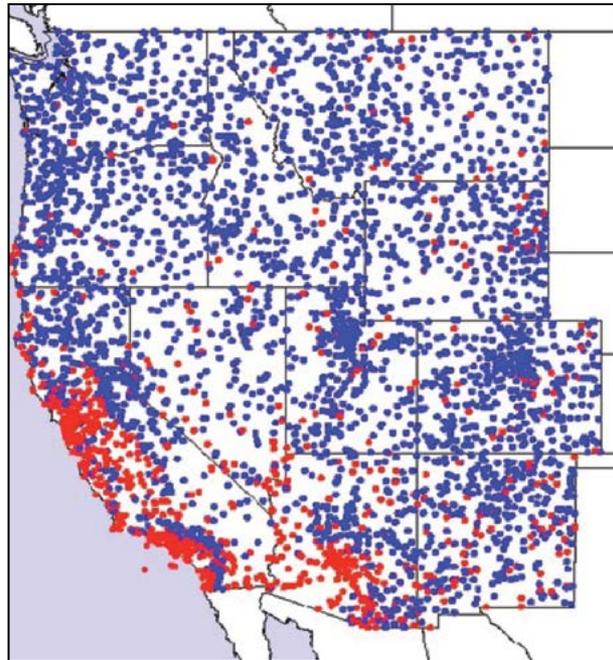


## Measurements



## Modeling

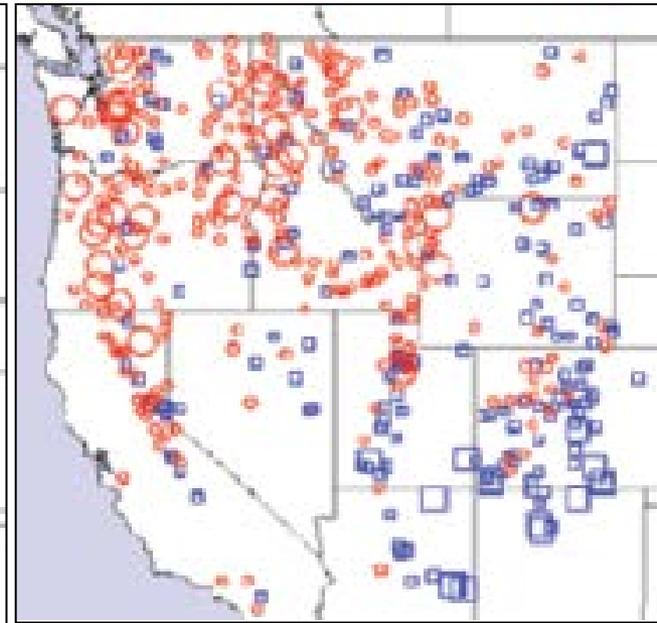
# Research to Understand Floods



**4318 sites for period 1949-2003 analyzed for rain-on-snow (ROS) events. Blue sites had at least one event.**

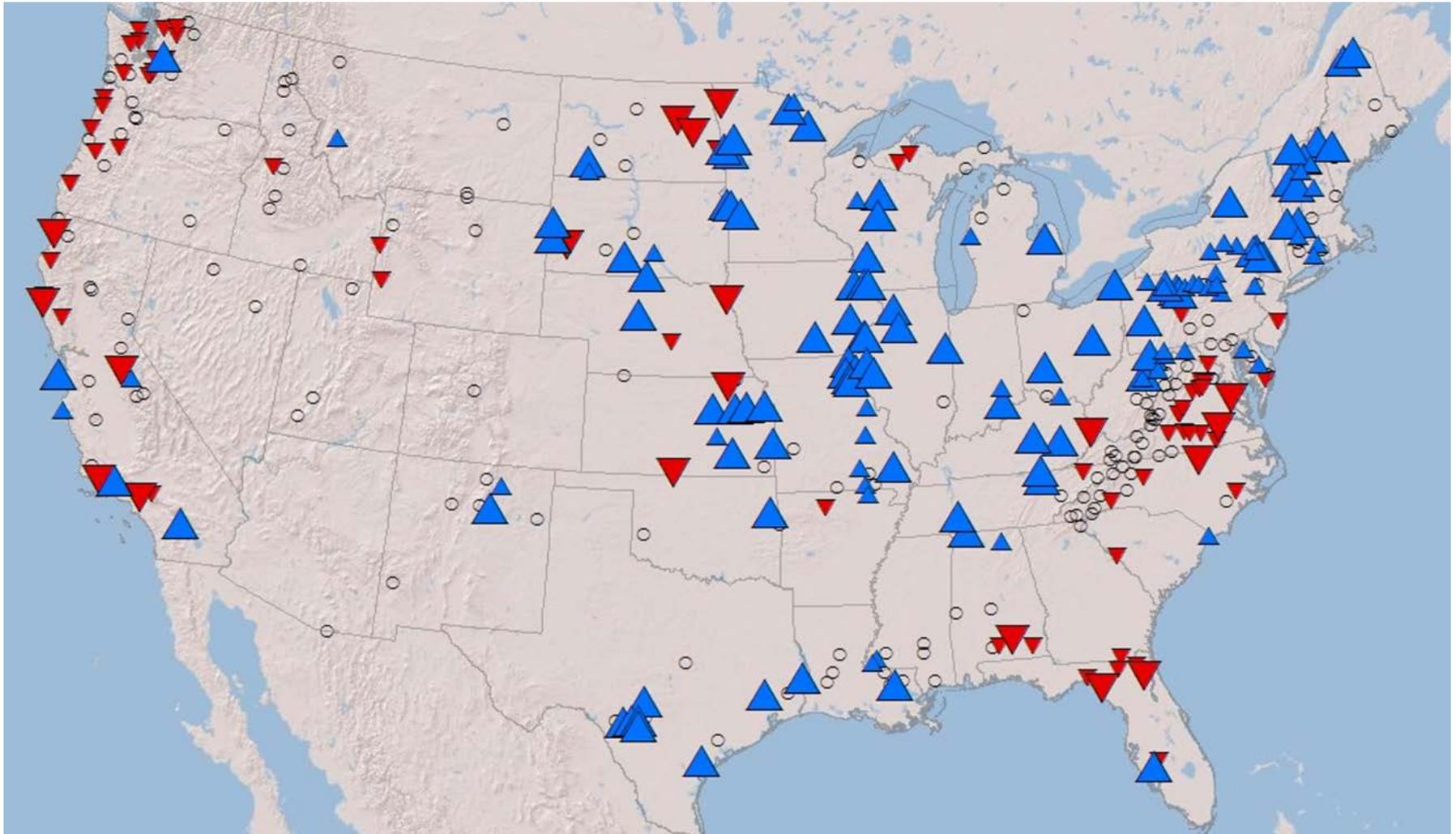


**Linear trends of number of ROS events; Red = increasing trend; correlation; blue = decreasing trend; large symbols = 95% significant**



**Correlation of number of ROS events with ENSO index. Red = positive correlation; blue = negative correlation; large symbols = 95% significant**

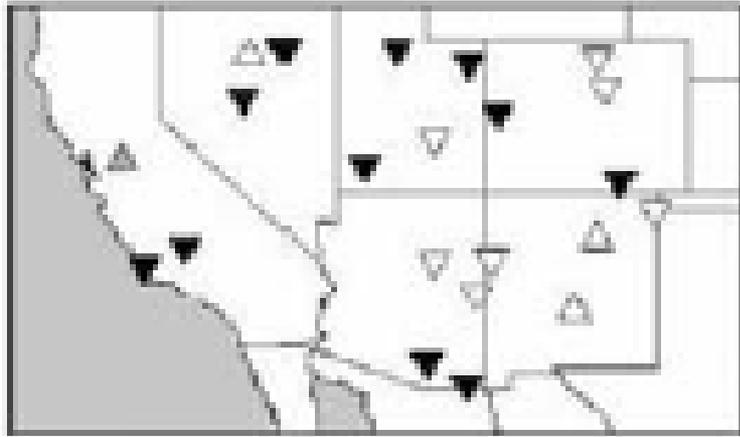
# Research to Understand Droughts



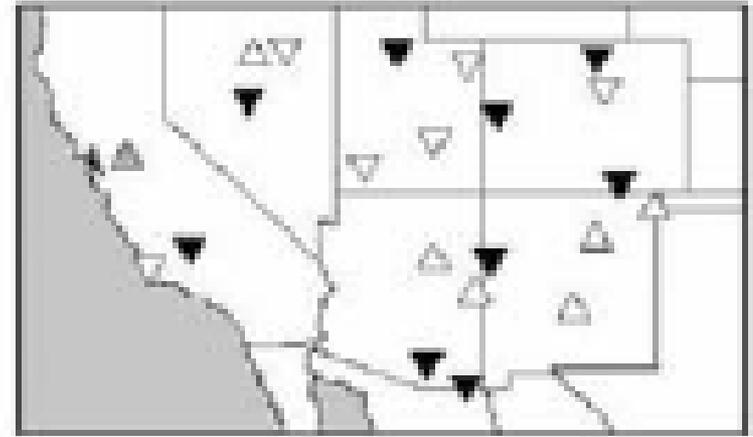
7-day low annual flow trends

1940-2009

# Research to Understand Droughts



Minimum 10-day dry event



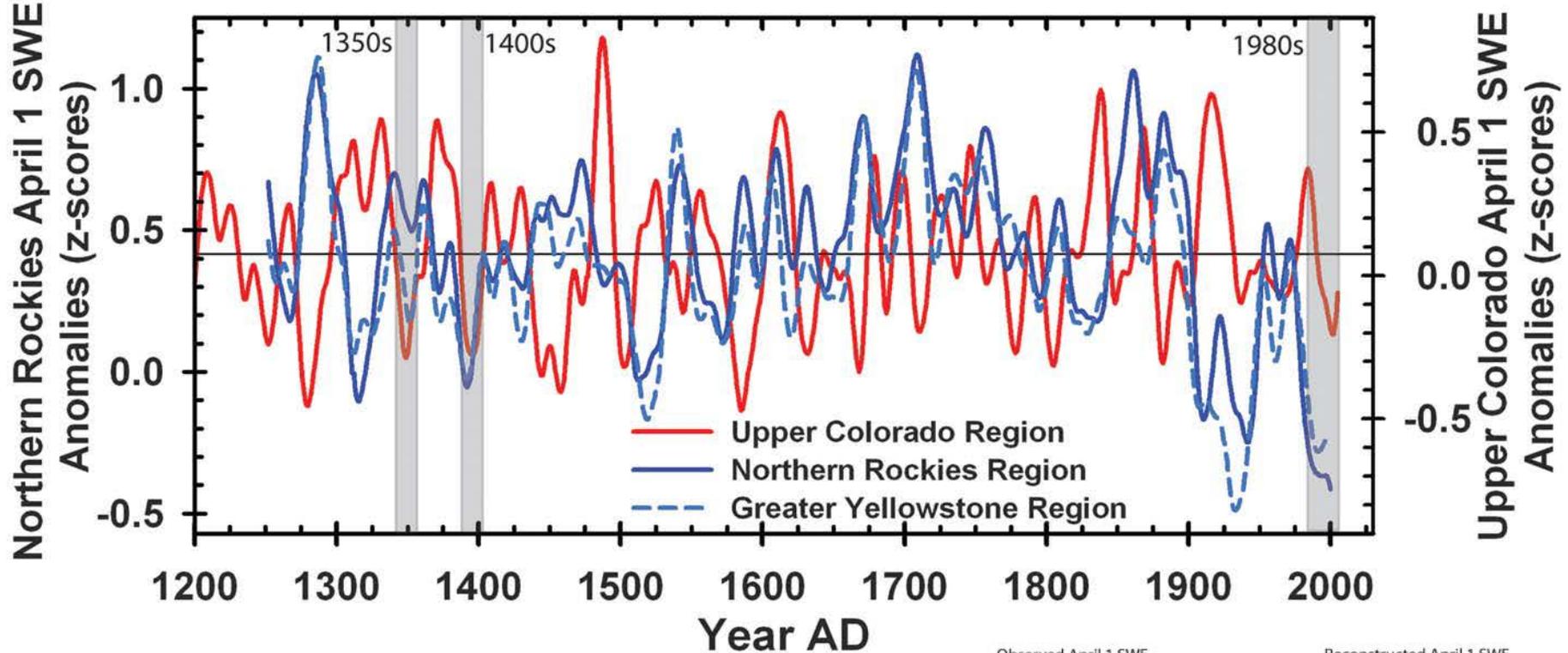
Minimum 20-day dry event

Annual trends in 5-year moving average length of dry events; or  
Is the time between precipitation events increasing or decreasing?

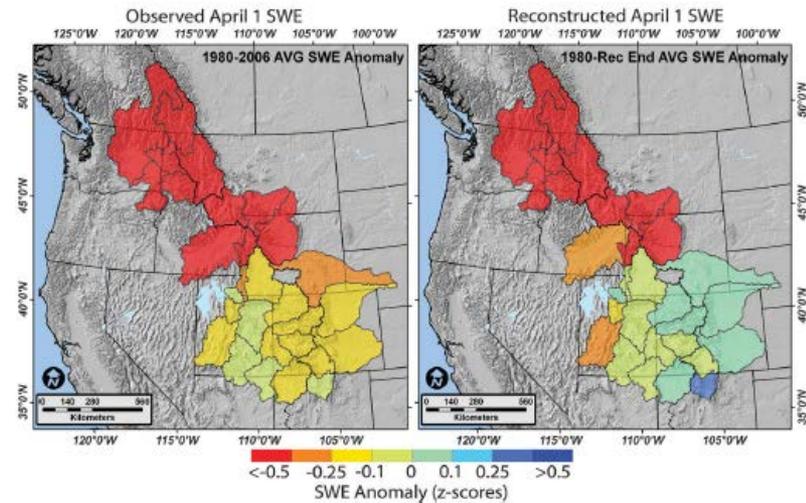
Data from 22 NWS 1<sup>st</sup> order weather stations for 1951 – 2006.  
Precipitation threshold = 0.1 inches

Most sites indicated negative trends (black -= significant); For warm season  
(April – September), more sites were positive than for cool season.

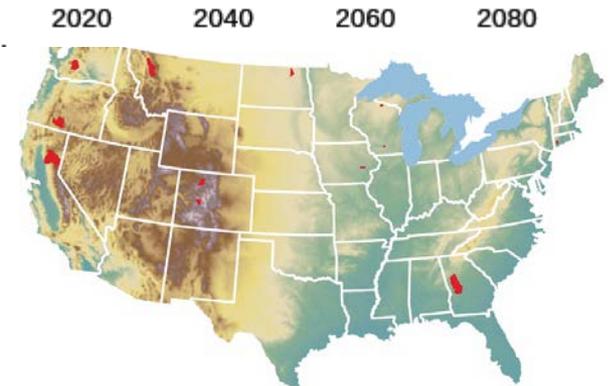
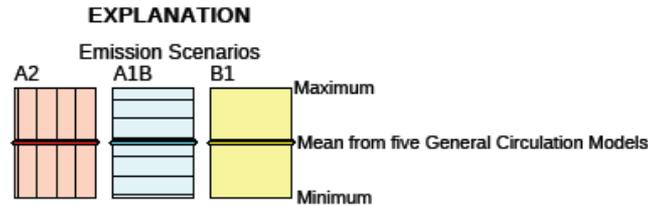
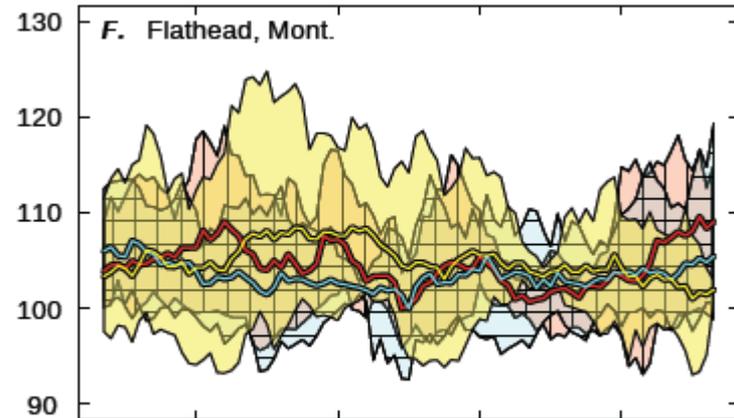
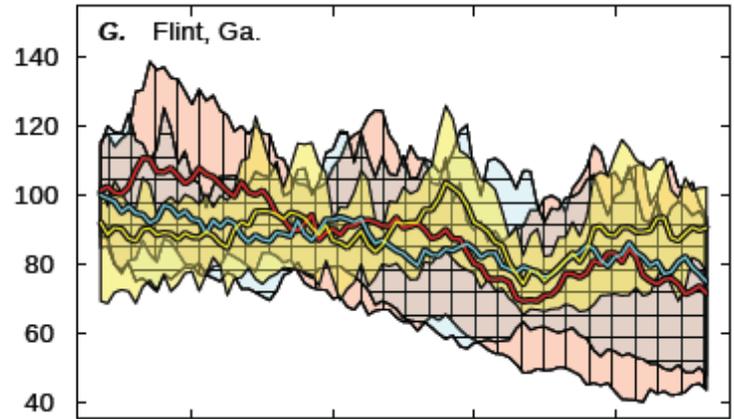
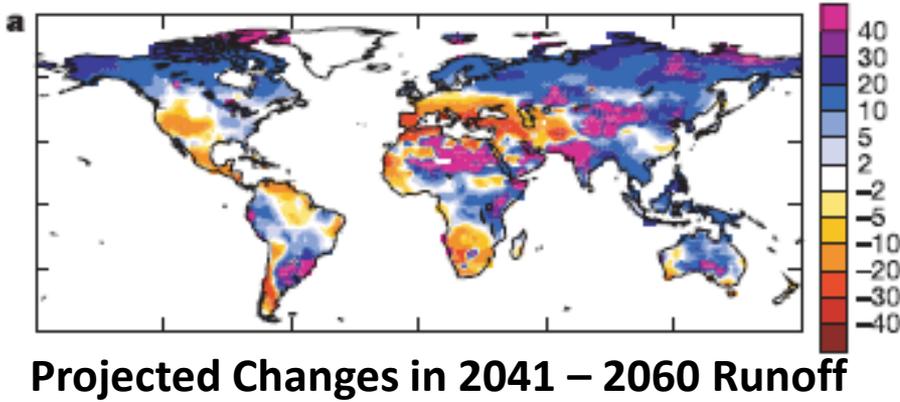
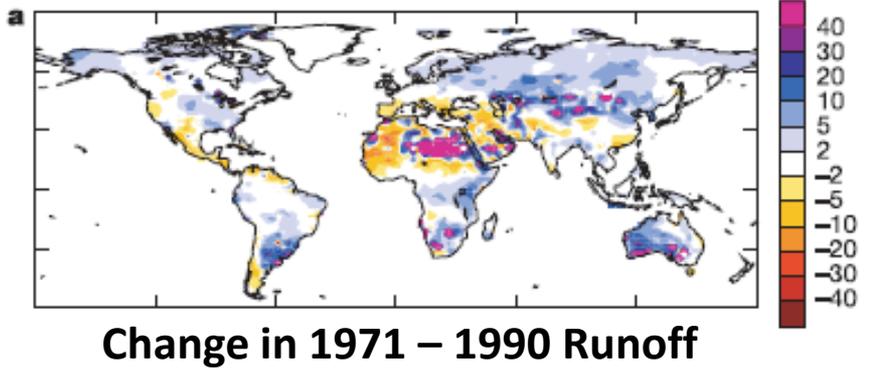
# Research to Understand Water Availability



800-year tree-ring reconstruction of April 1 snow-water equivalent



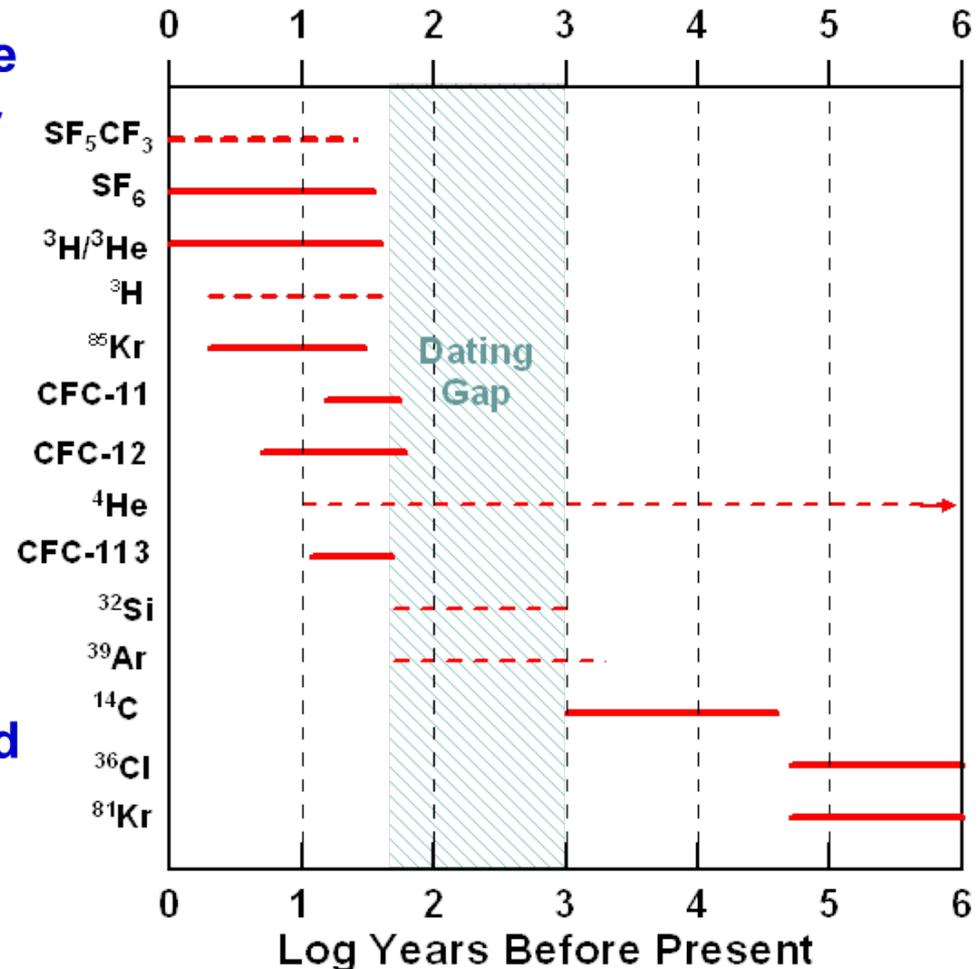
# Research to Forecast Future Water Availability



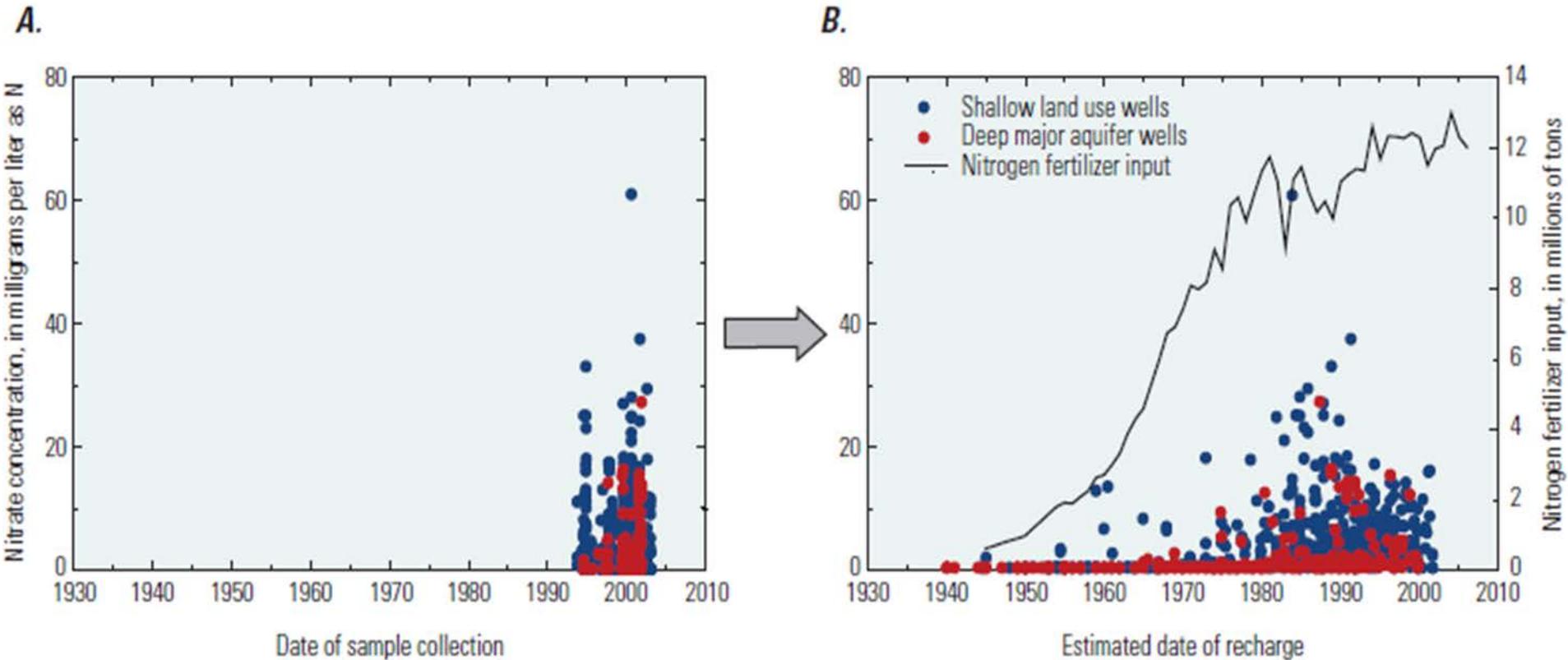
# Research to Understand Hydrologic Processes

## Environmental Tracers

- Date the tracer and infer water age
- Estimate fractions of young water and the mean age of the young fraction in mixtures.
- Evaluate vulnerability to contamination.
- Estimate recharge rates.
- Improve conceptualization of groundwater flow in aquifers
- Calibrate models of groundwater flow.
- Estimate rates of geochemical and microbiological processes.
- Date historical records of contaminant loading to aquifers.
- Estimate remediation times.



# Research to Understand Hydrologic Processes



**Measured nitrate concentration in shallow groundwater and deep aquifers by (A) date of sample collection and (B) estimated date when the groundwater was recharged**