Raster-based Streamflow Analysis

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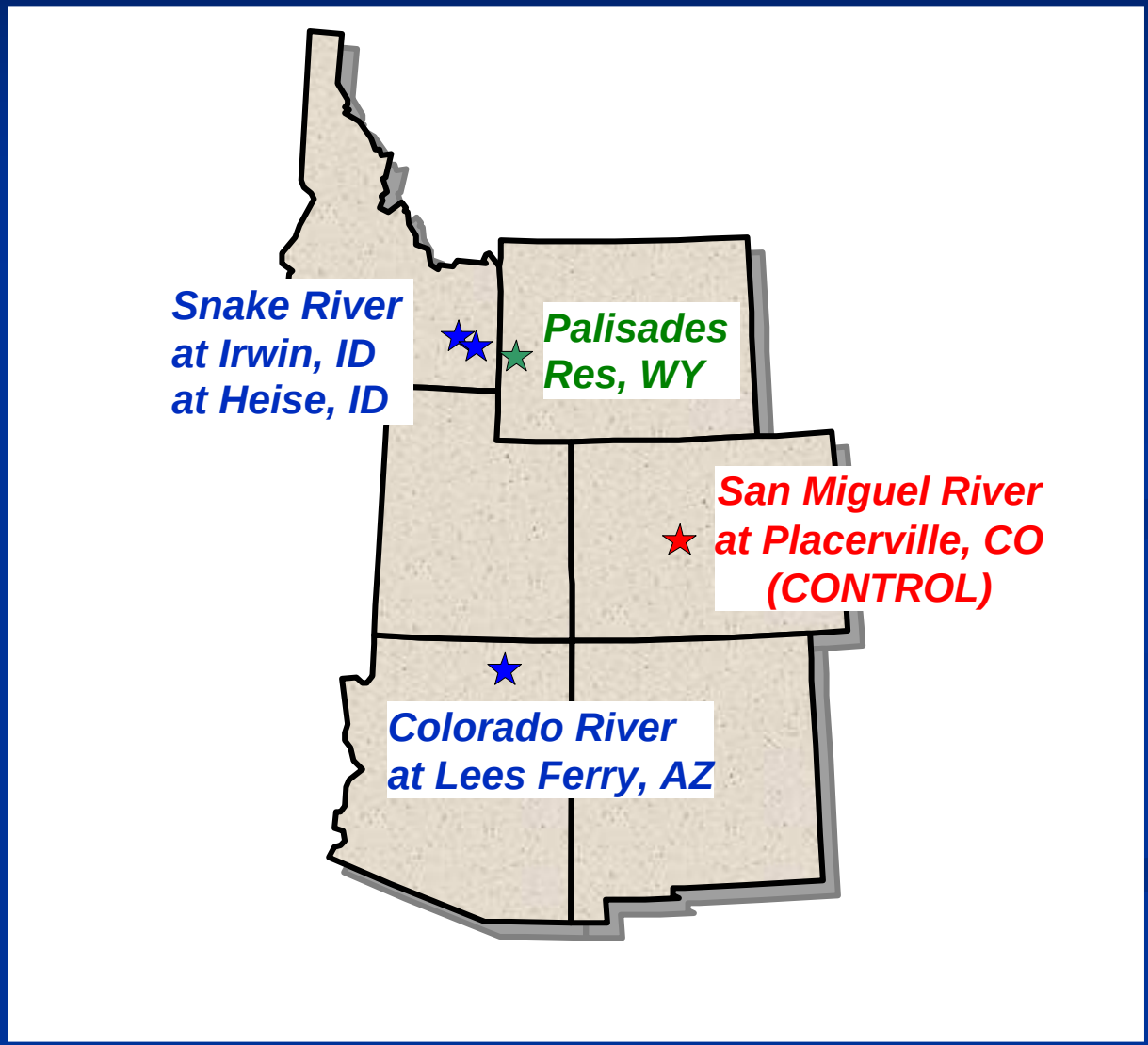
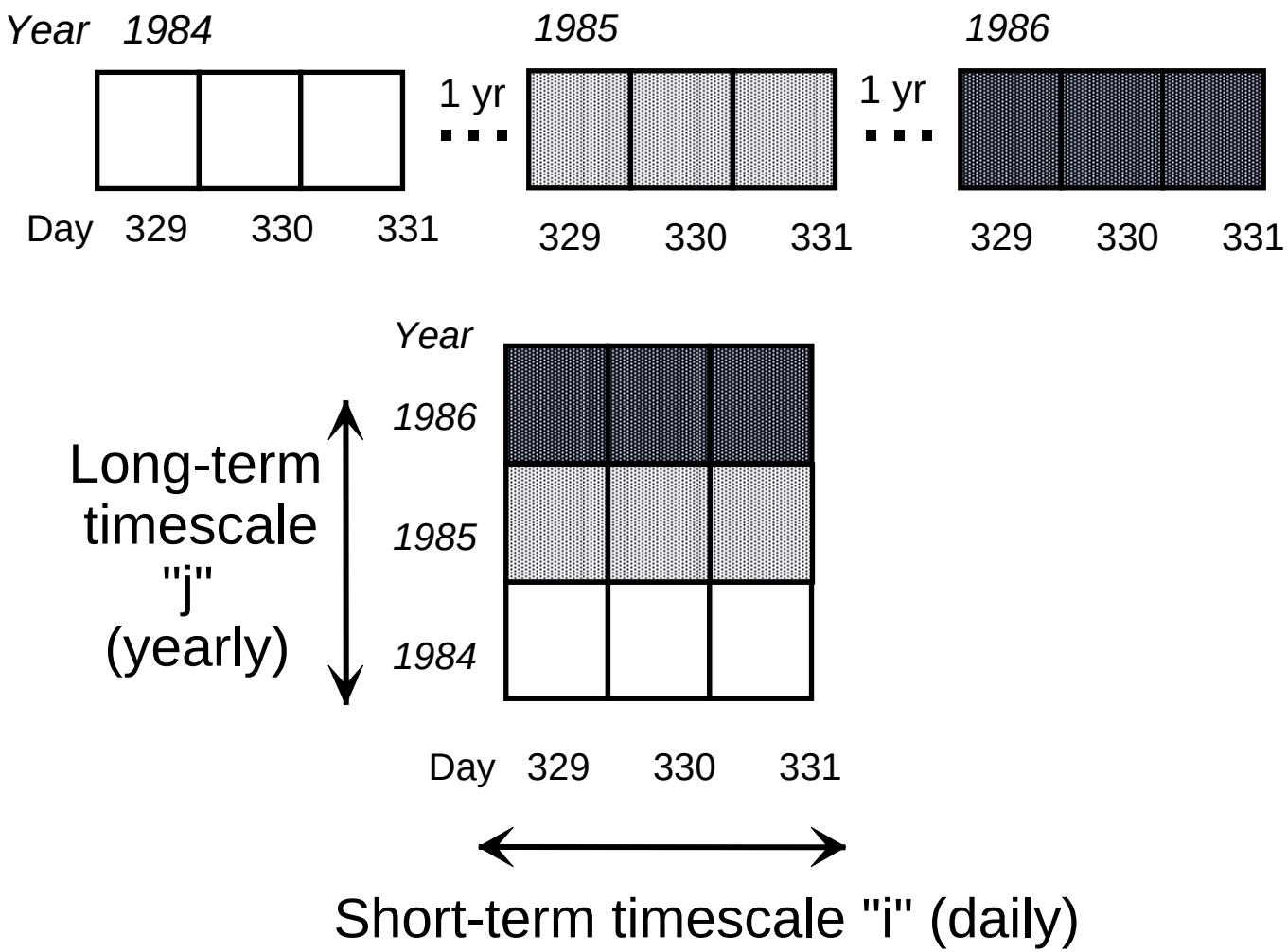
Background

- Streamflow patterns
  - Occur on different timescales
  - Include flow volume and timing
  - Show cumulative effect of disturbances
- Multiple existing methods (170+ indices)
  - Many correlated or redundant
  - Adequate for volume (composition)
  - Weak for timing (configuration)
- Large daily datasets exist

Study sites

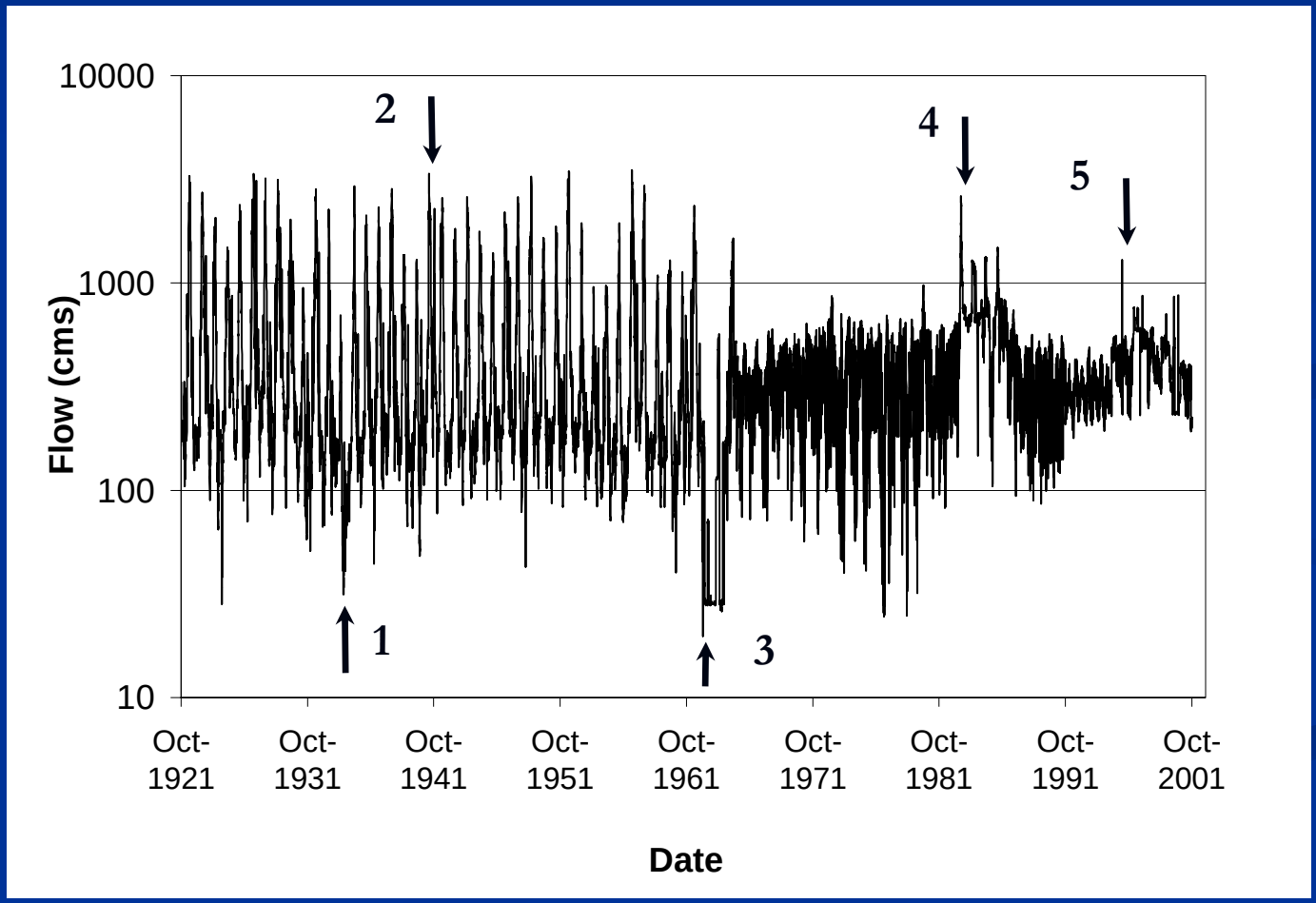

Snake River
at Irwin, ID
at Heise, ID
Palisades
Res, WY
San Miguel River
at Placerville, CO
(CONTROL)
Colorado River
at Lees Ferry, AZ

Raster ⟹ gridded time series



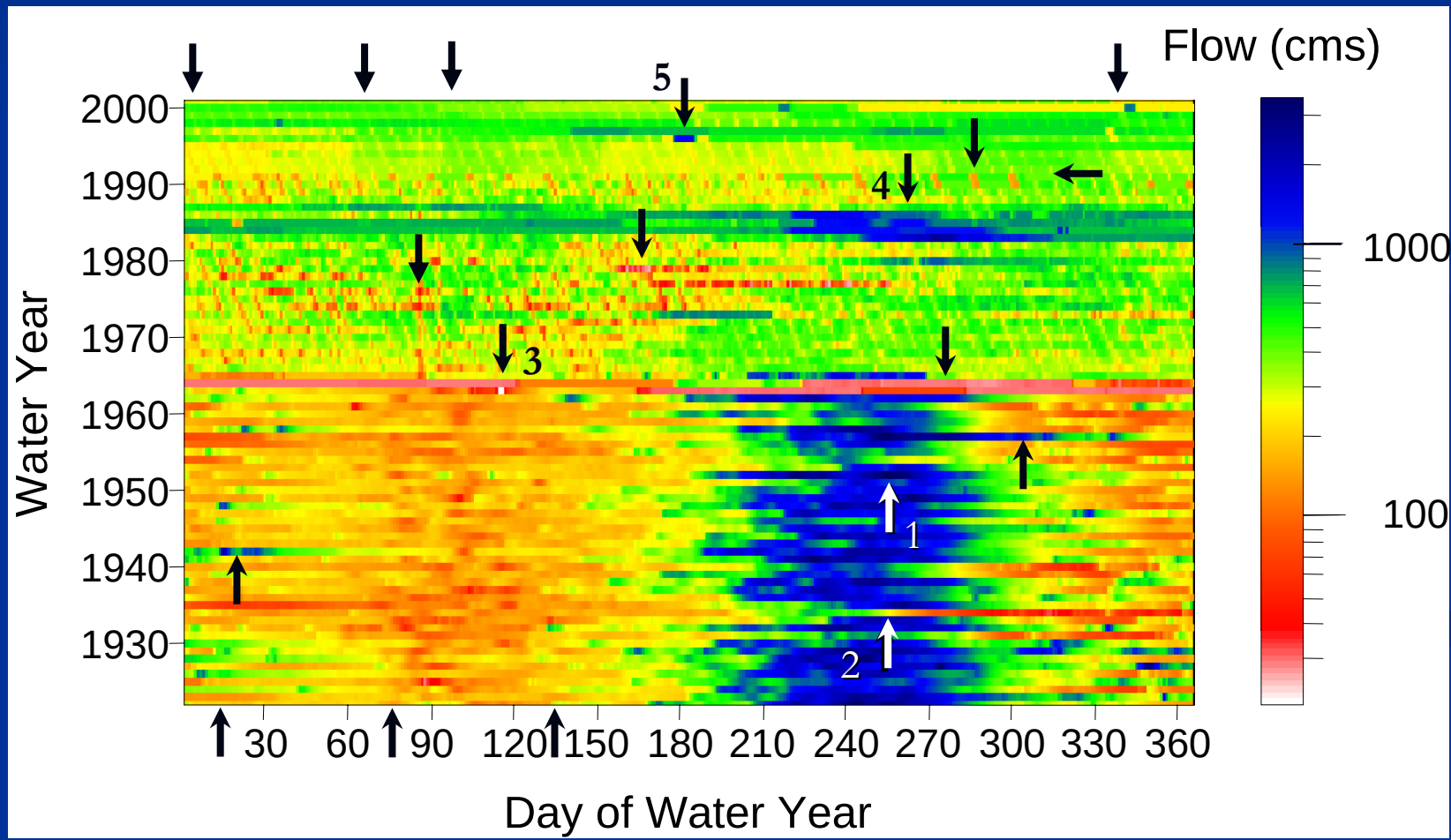
Colorado River example

- Colorado River at Lees Ferry, AZ linear hydrograph



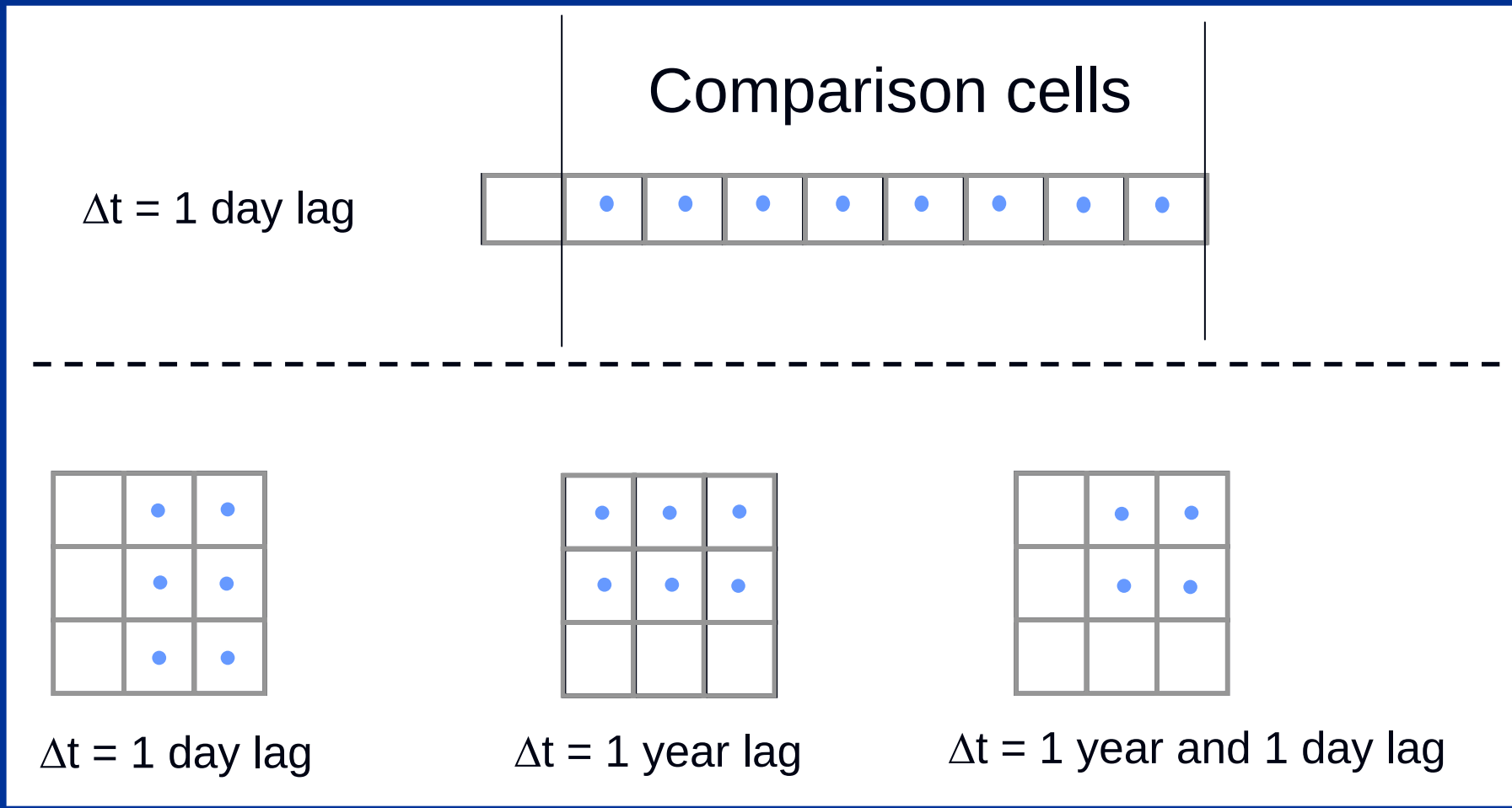
Colorado River example

- Colorado River at Lees Ferry, AZ raster hydrograph



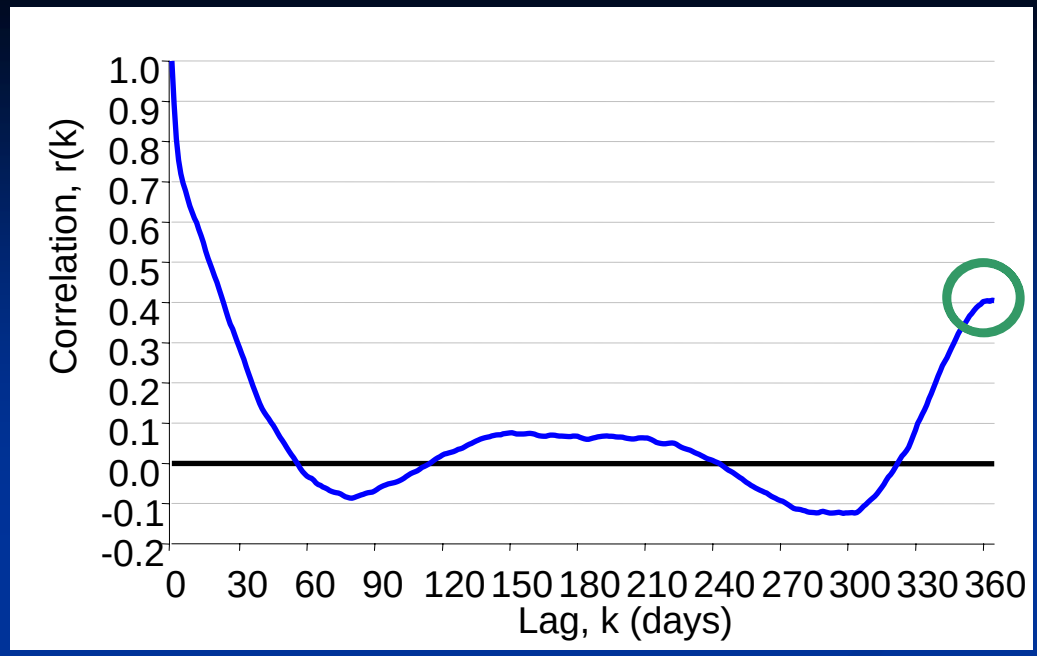
Autocorrelation

- Linear vs. grid-based lag scheme



Correlograms

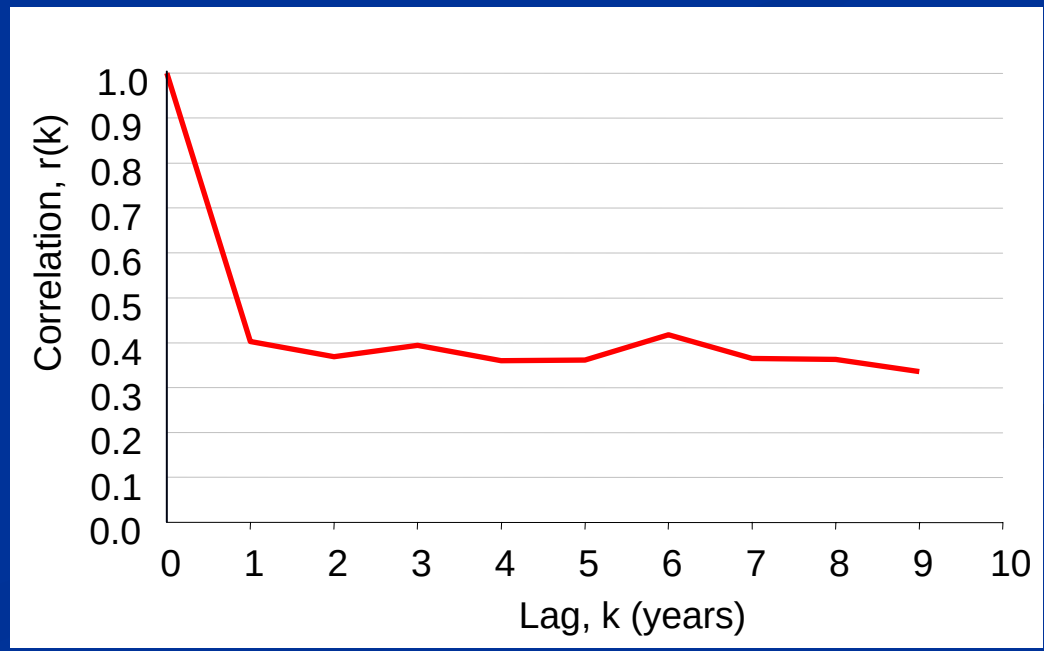
Daily



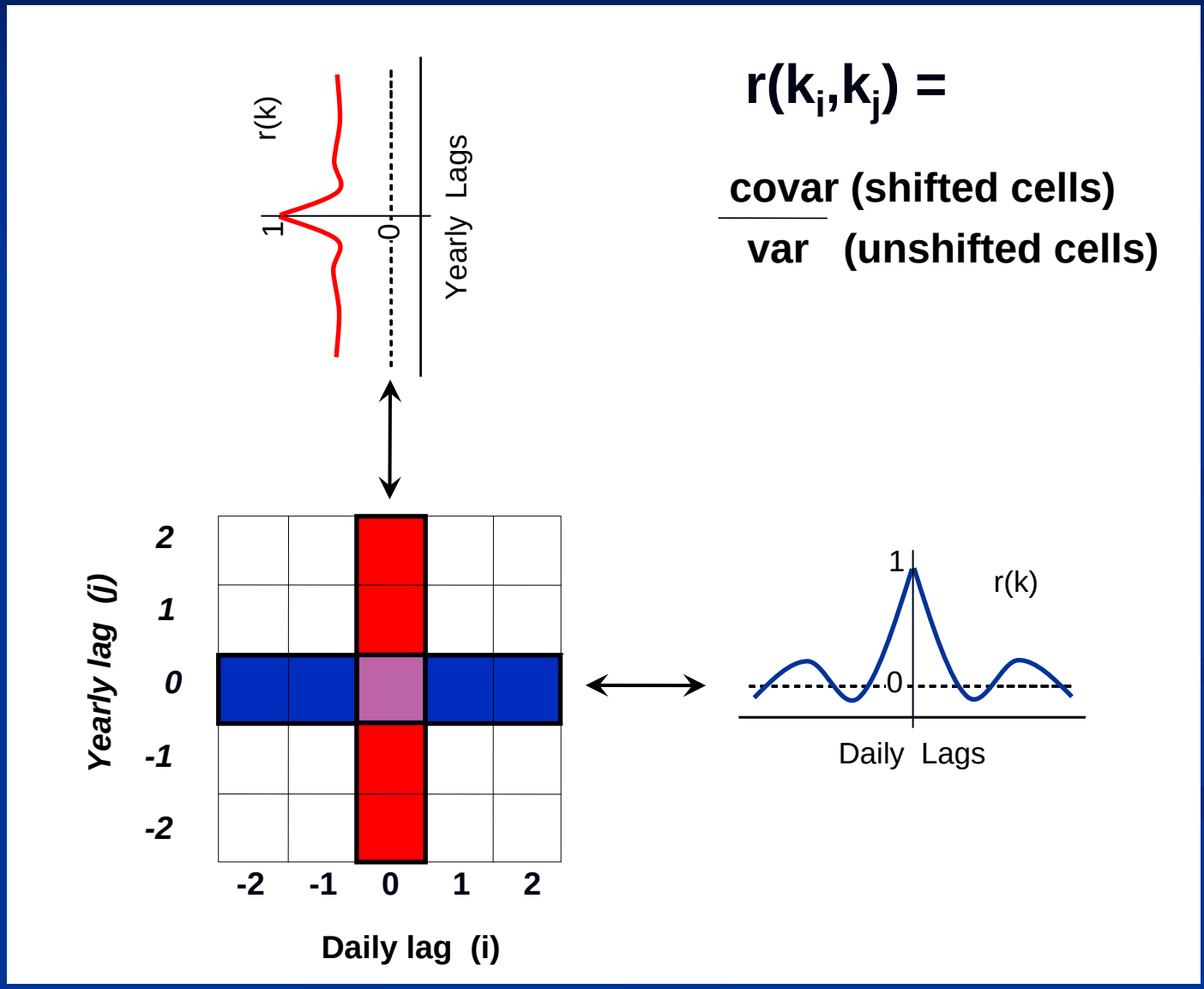
San Pedro River at Charleston, AZ

1936 - 2001

Yearly

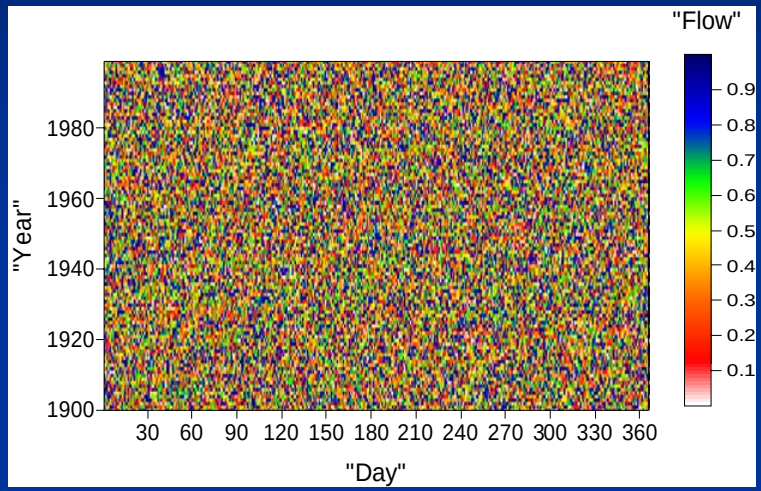


Correlograms

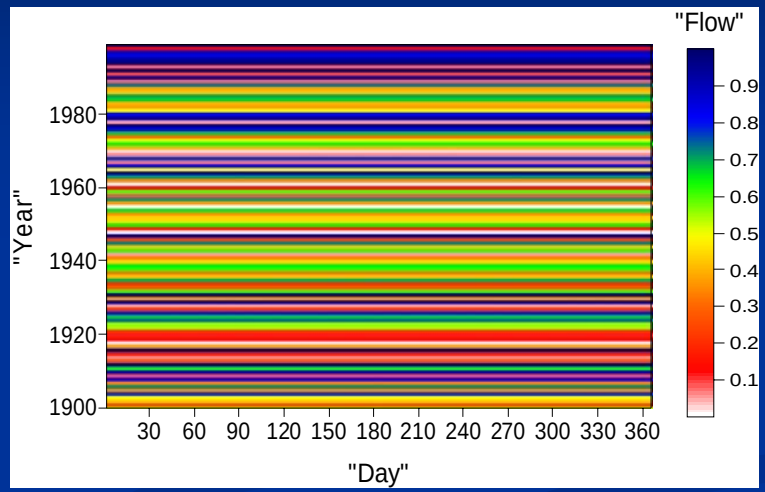


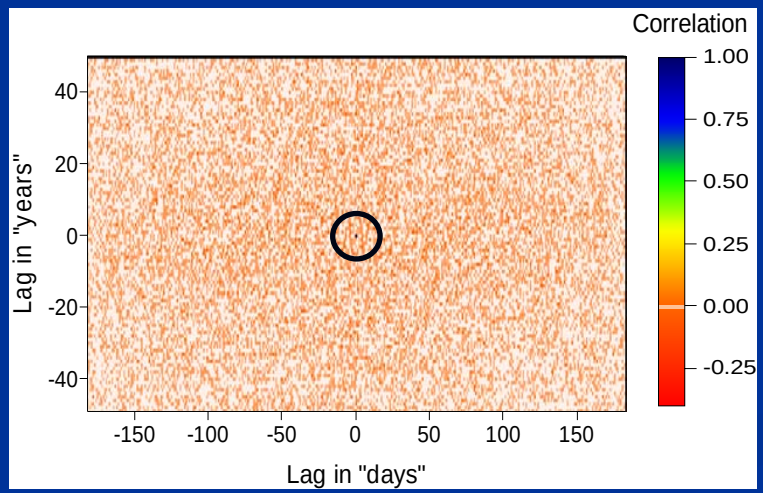
Artificial flow examples

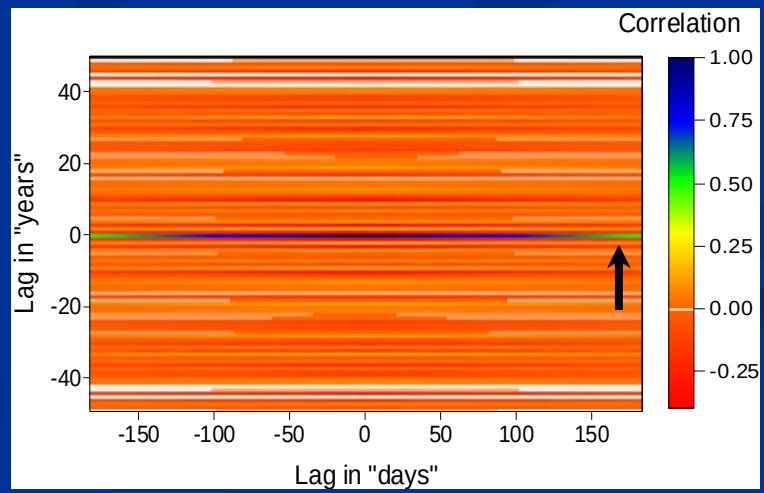
Random daily flow



Random yearly flow

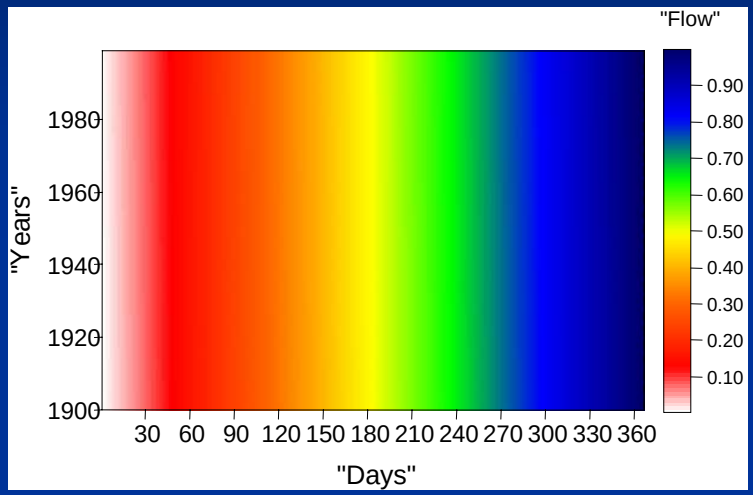




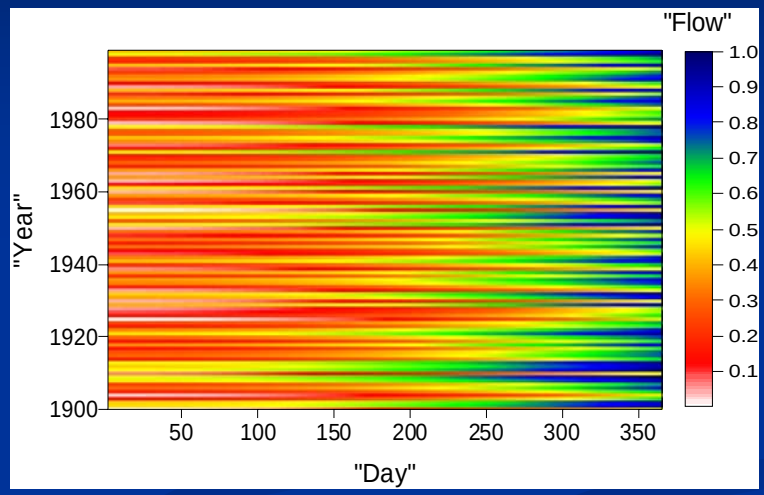


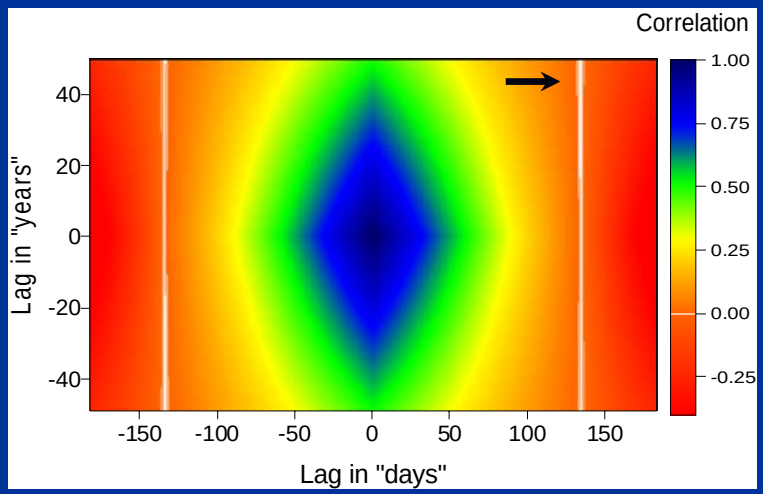
Artificial flow examples, part 2

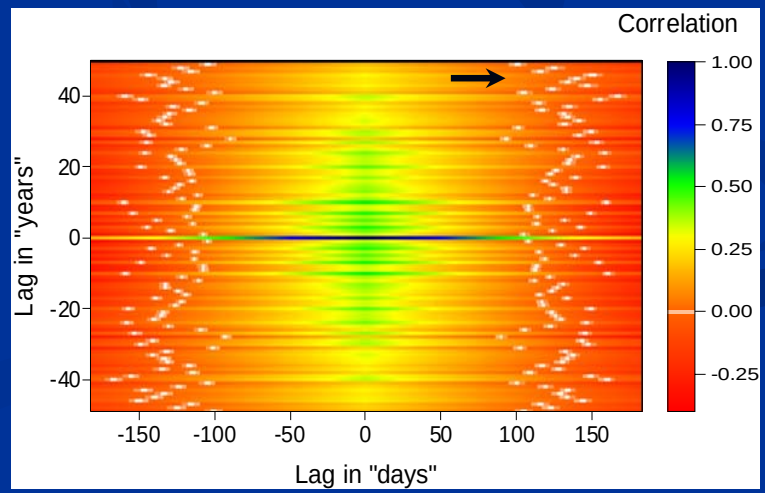
Exactly identical increasing yearly flow



Random fluctuating daily flow



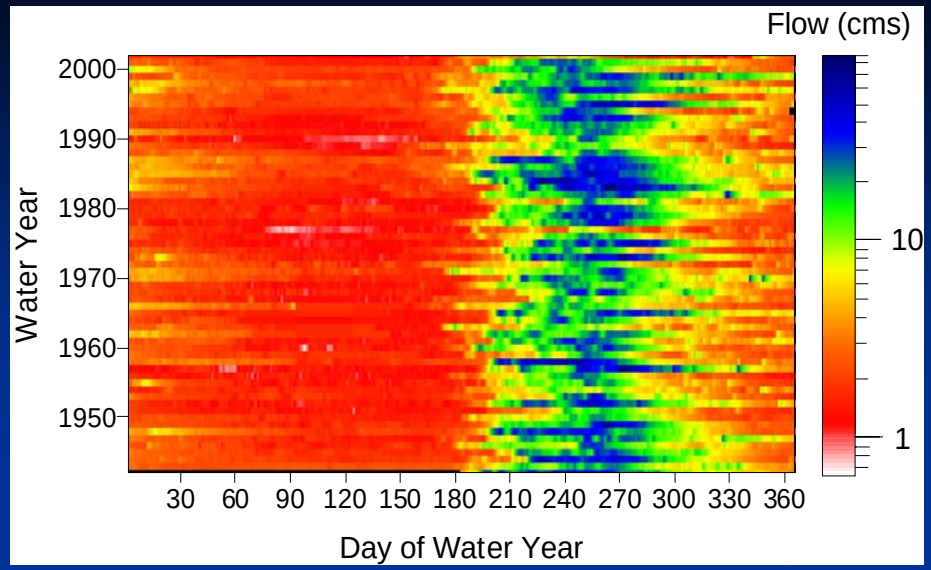




Results

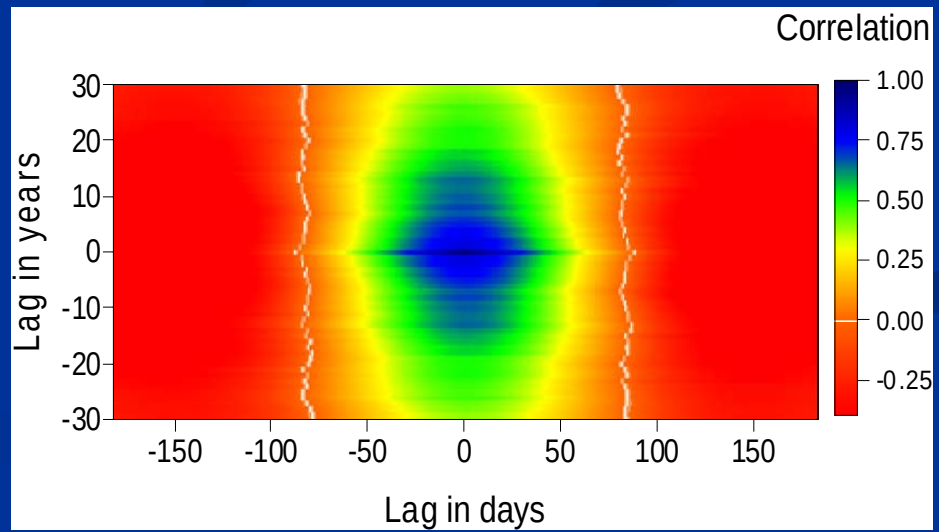
San Miguel River at Placerville, CO

Control site for Upper Colorado River Basin



Raster hydrograph

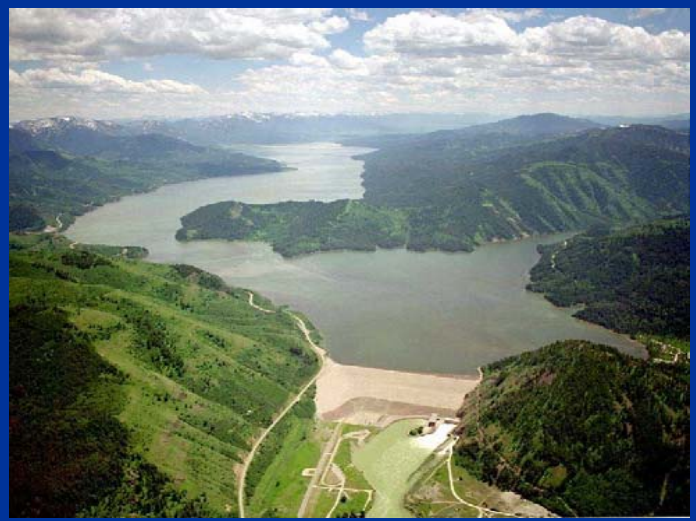
Grid correlogram

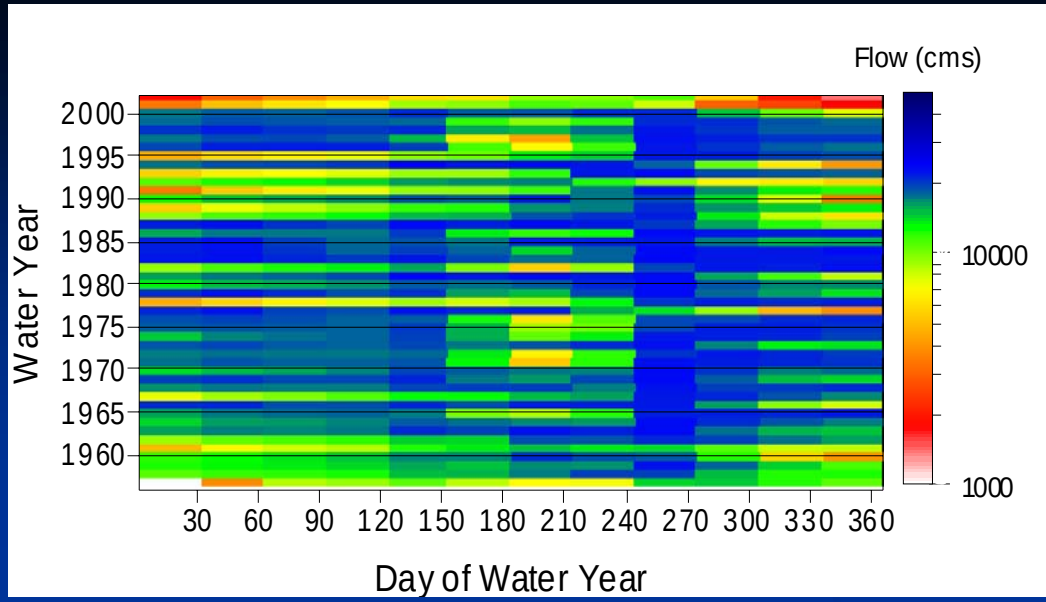


Results

Palisades Reservoir

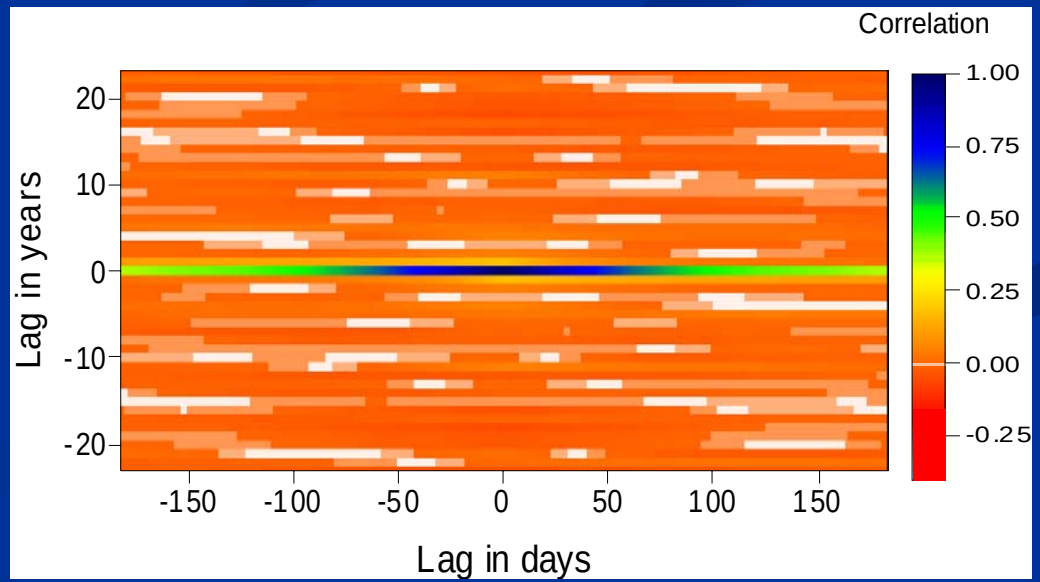
End of month storage converted to streamflow





Raster hydrograph

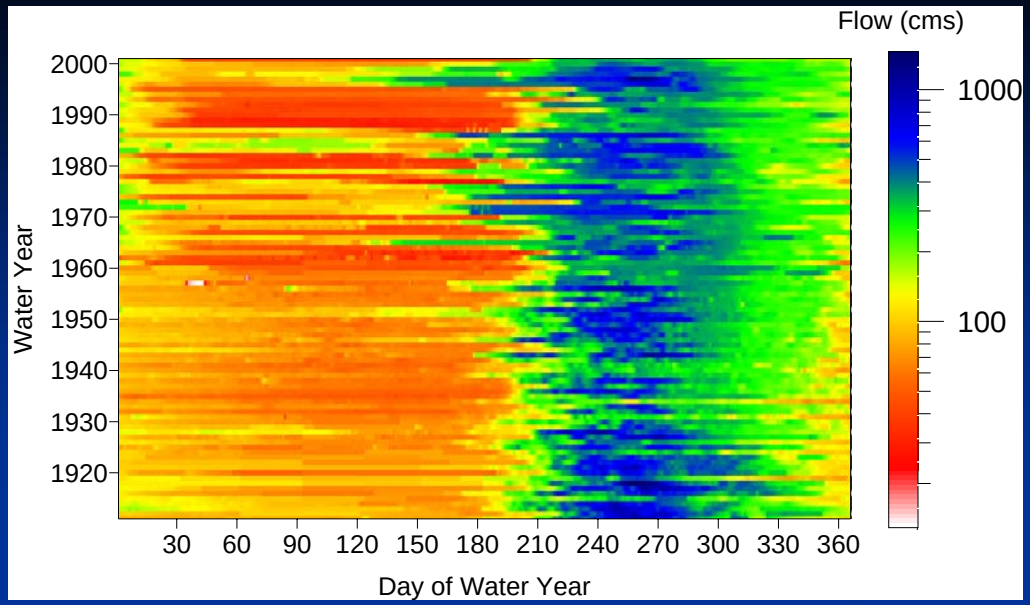
Grid correlogram



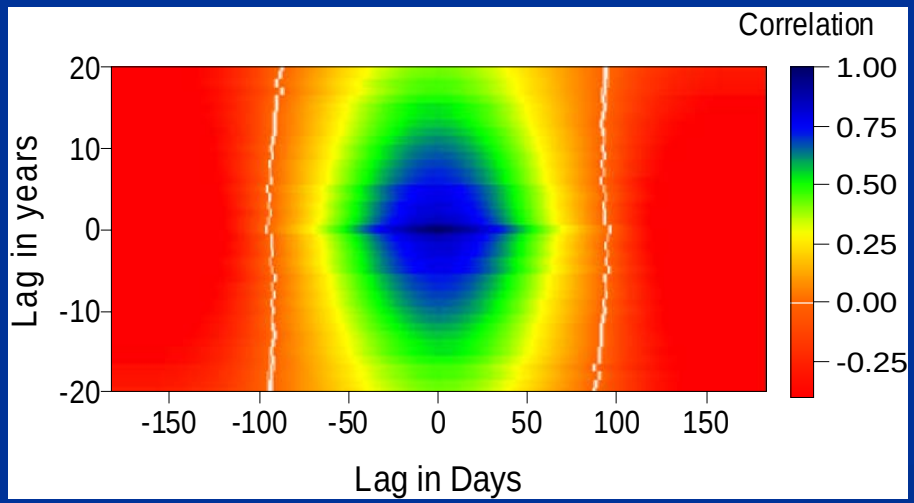
Results

Snake River at Heise, ID

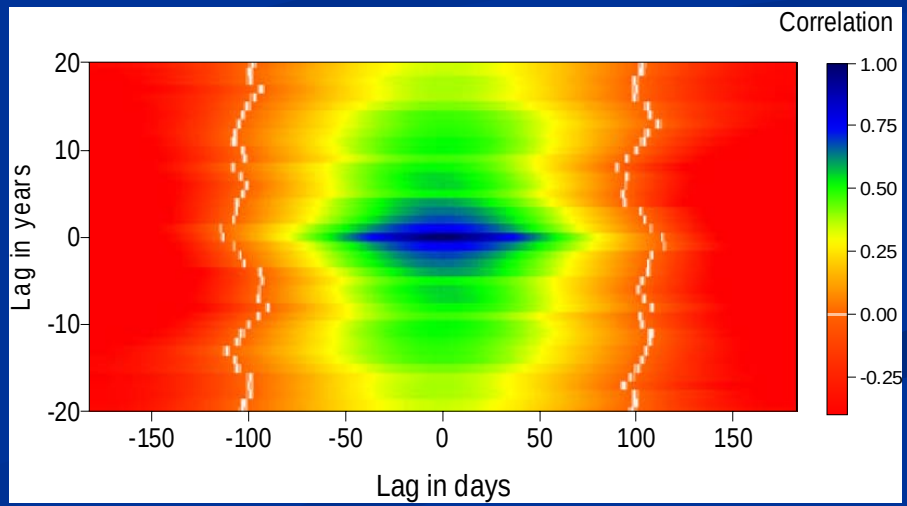
Downstream from Palisades Reservoir



Raster hydrograph



(1911 through 1951)



(1960 through 2000)

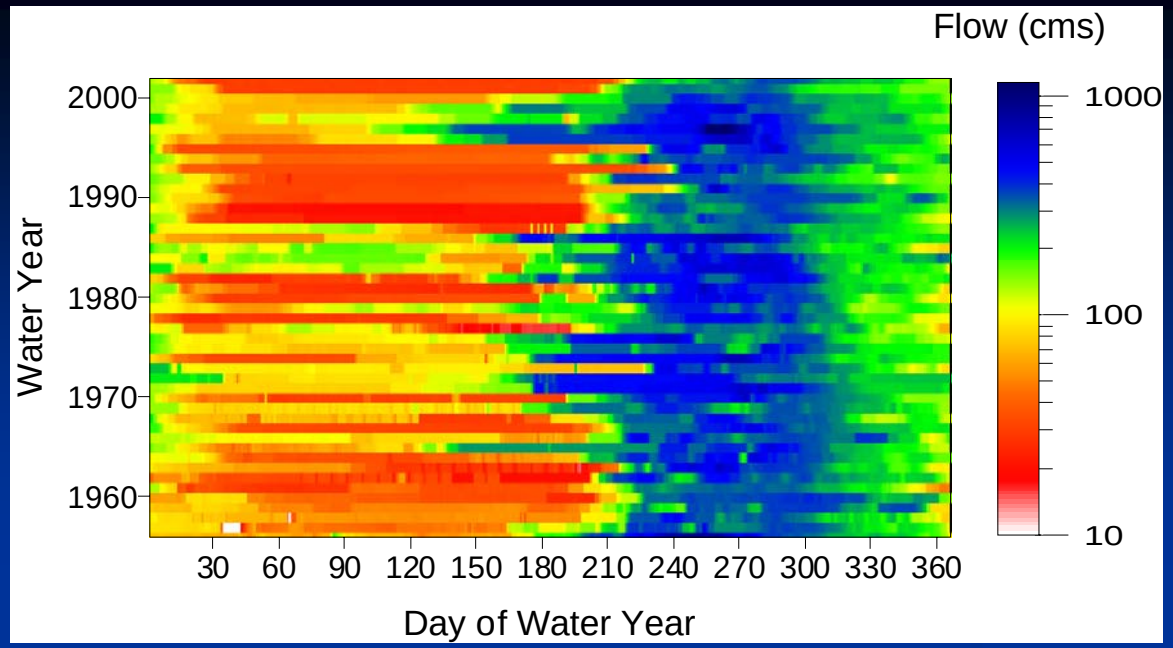
Grid correlograms

Results

Snake River at Irwin, ID

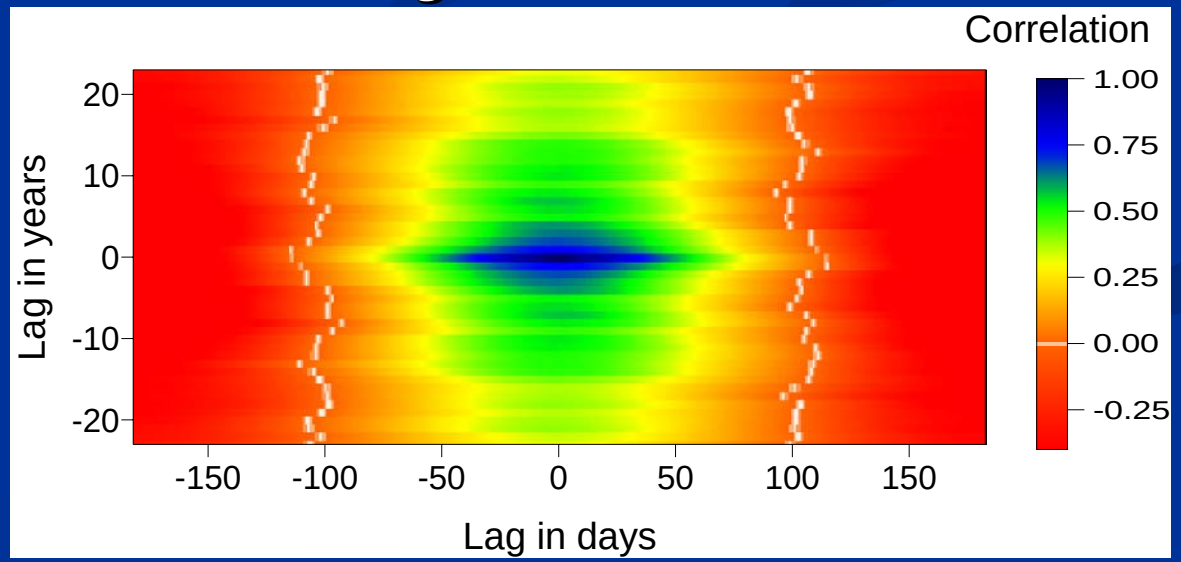
1956 - 2002

Observed hydrograph and gird correlogram



Raster hydrograph

Grid correlogram

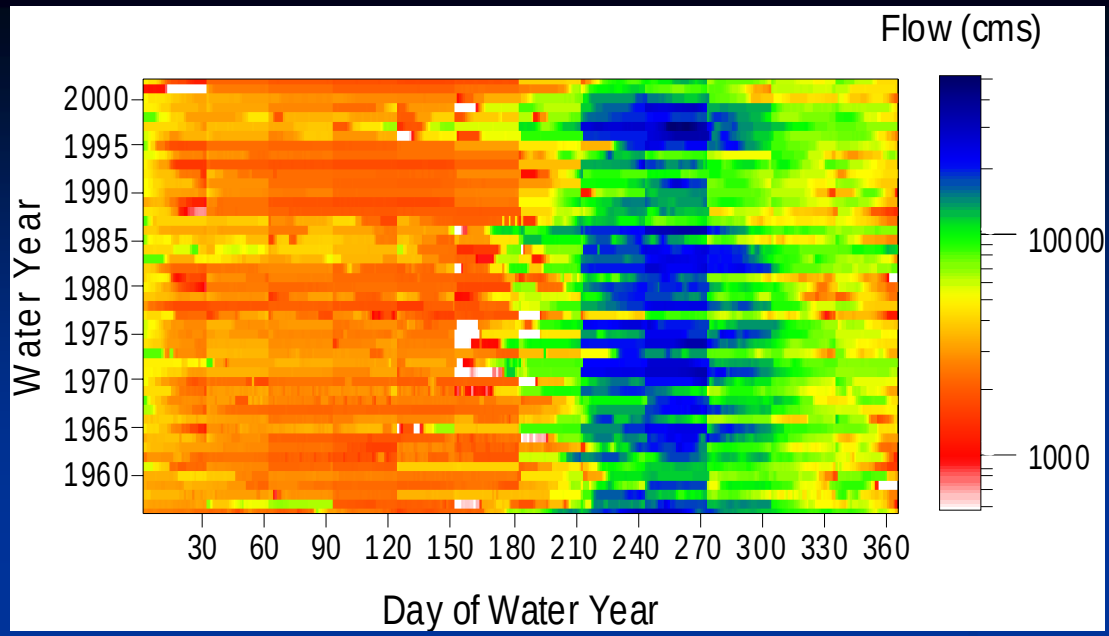


Results

Snake River at Irwin, ID

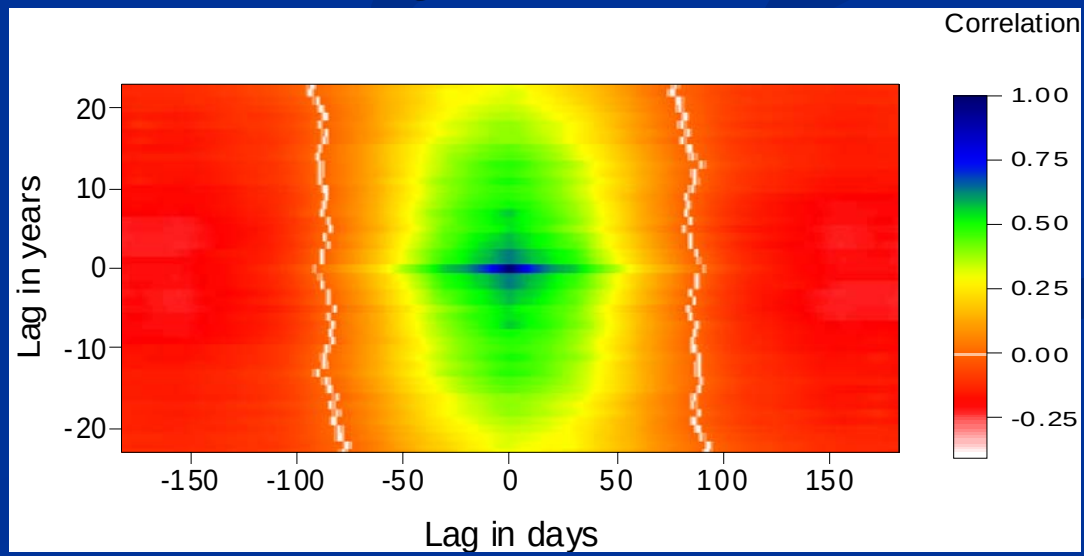
1956 - 2002

Adjusted hydrograph and gird correlogram



Raster hydrograph

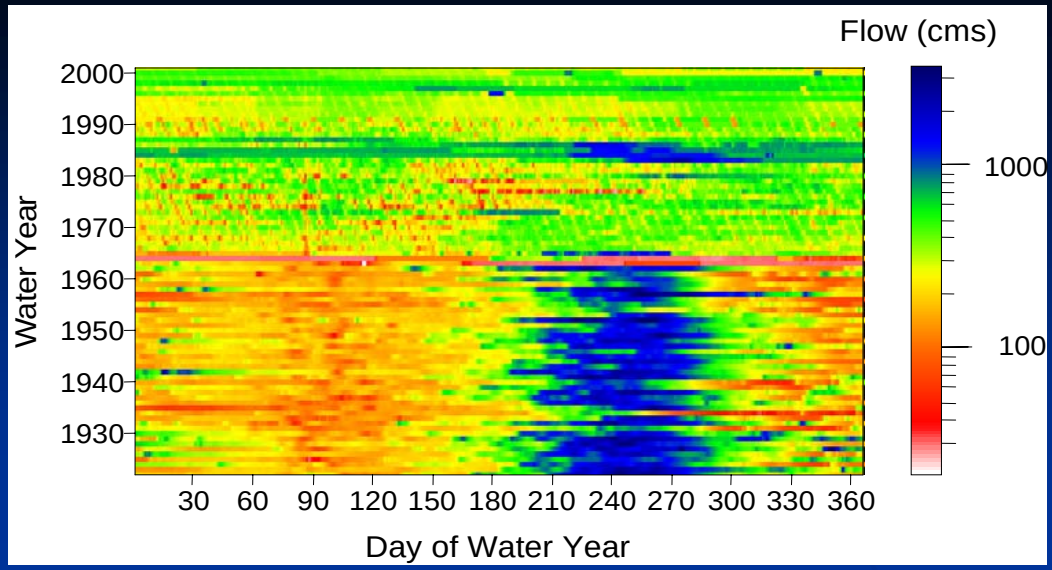
Grid correlogram



Results

Colorado River at Lees Ferry, AZ

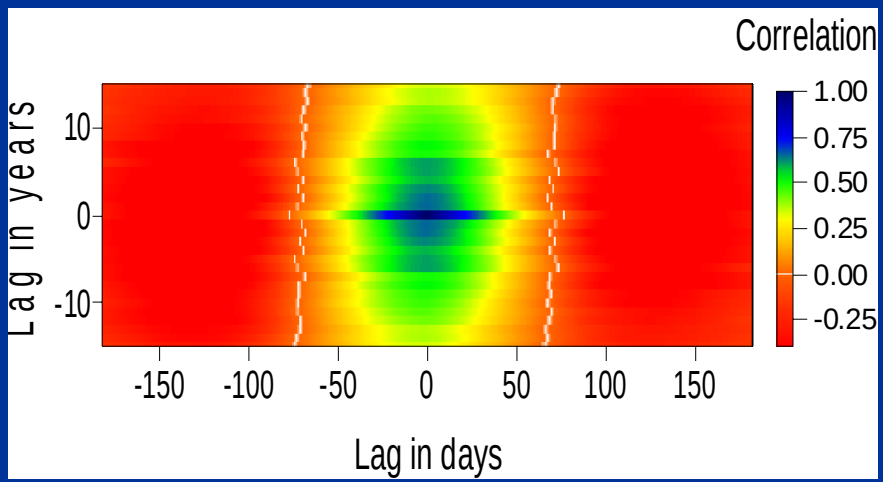
Downstream from Glen Canyon Dam



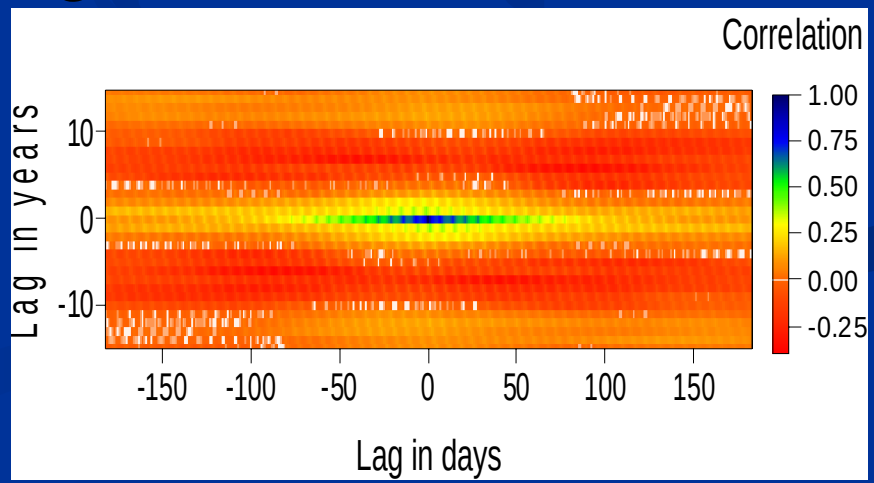
Raster hydrograph

Grid correlograms

(1930 - 1960)

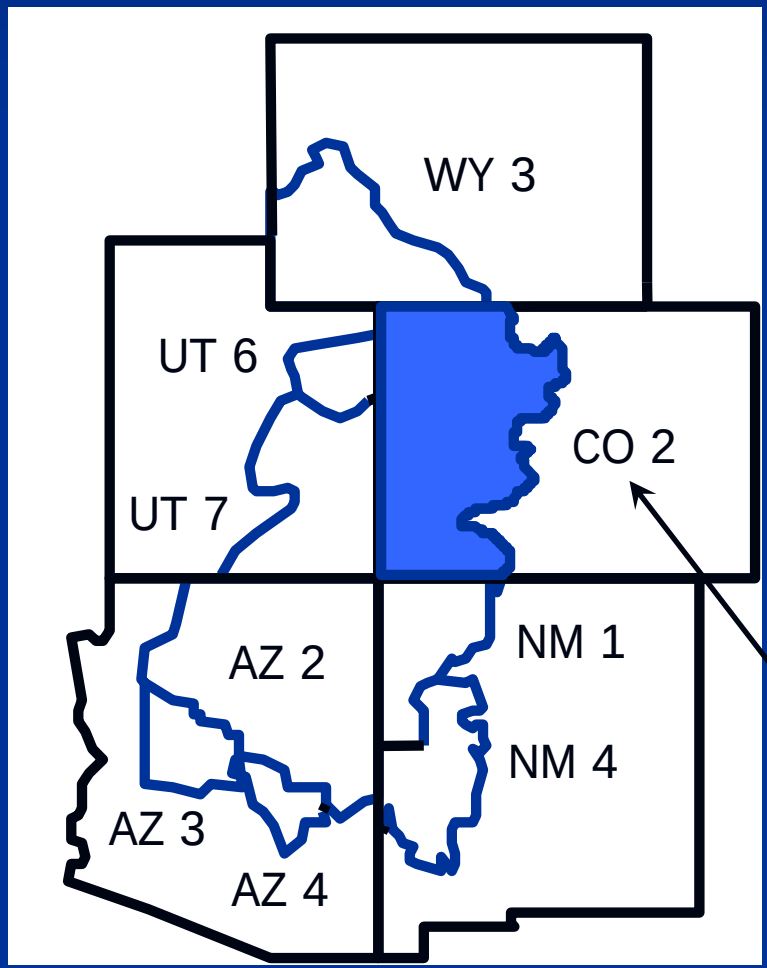


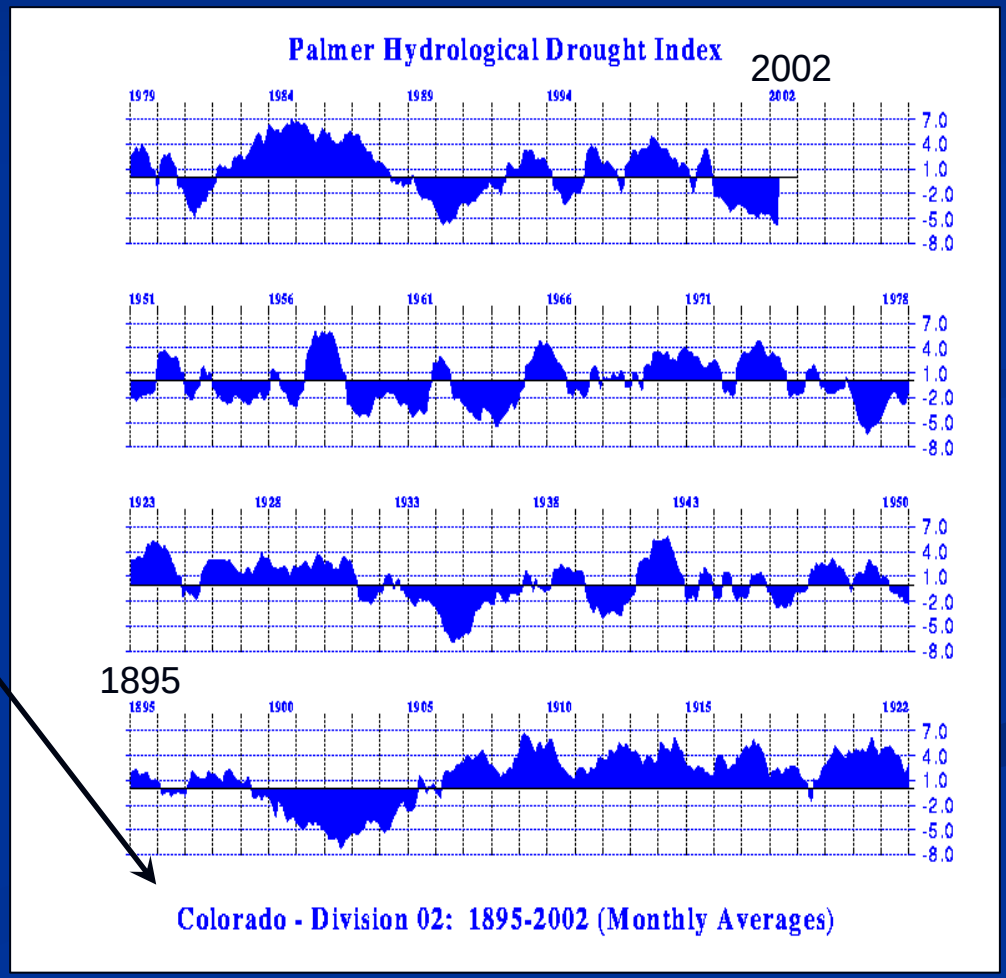
(1970 - 2000)



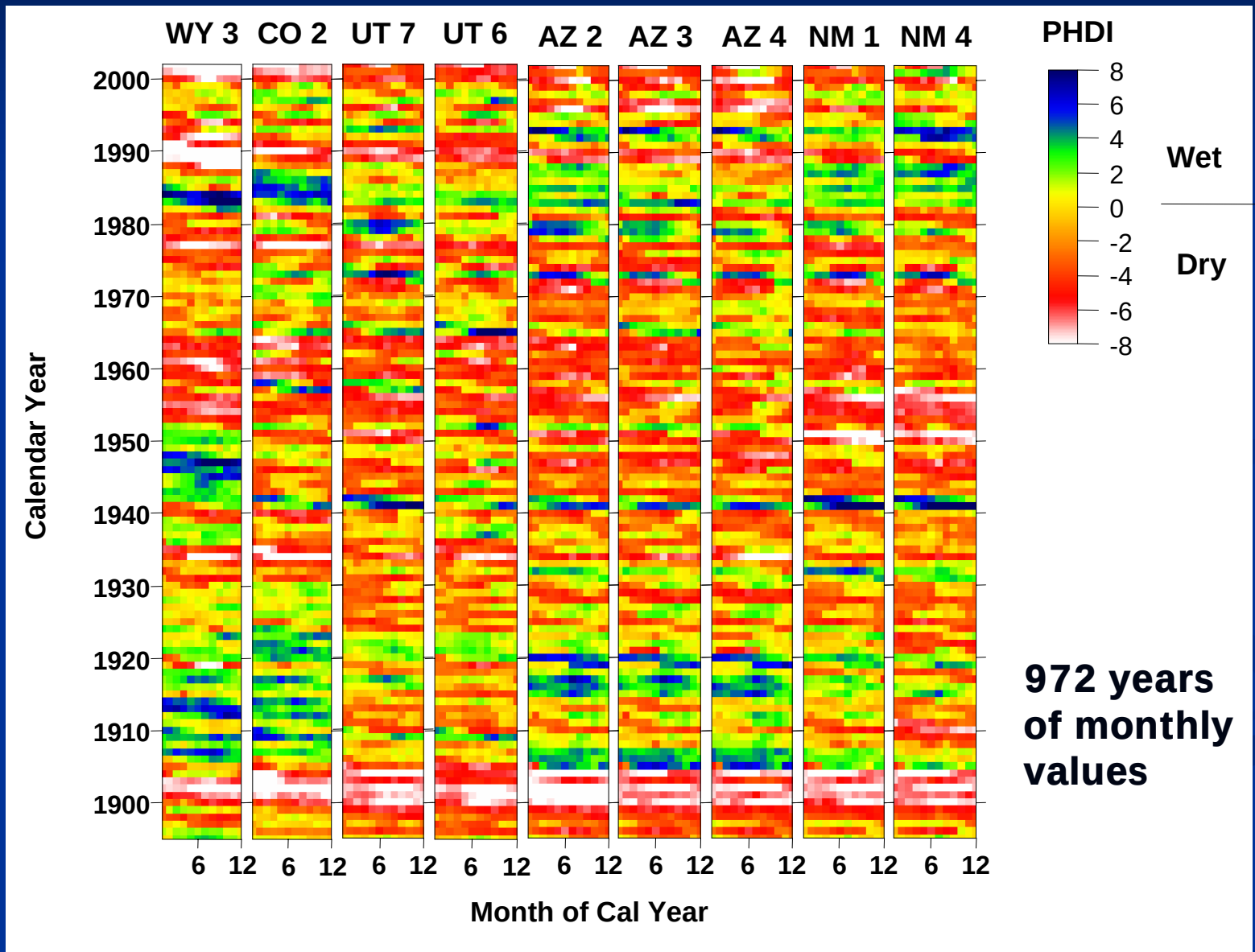
Climate applications

Temporal and spatial analysis

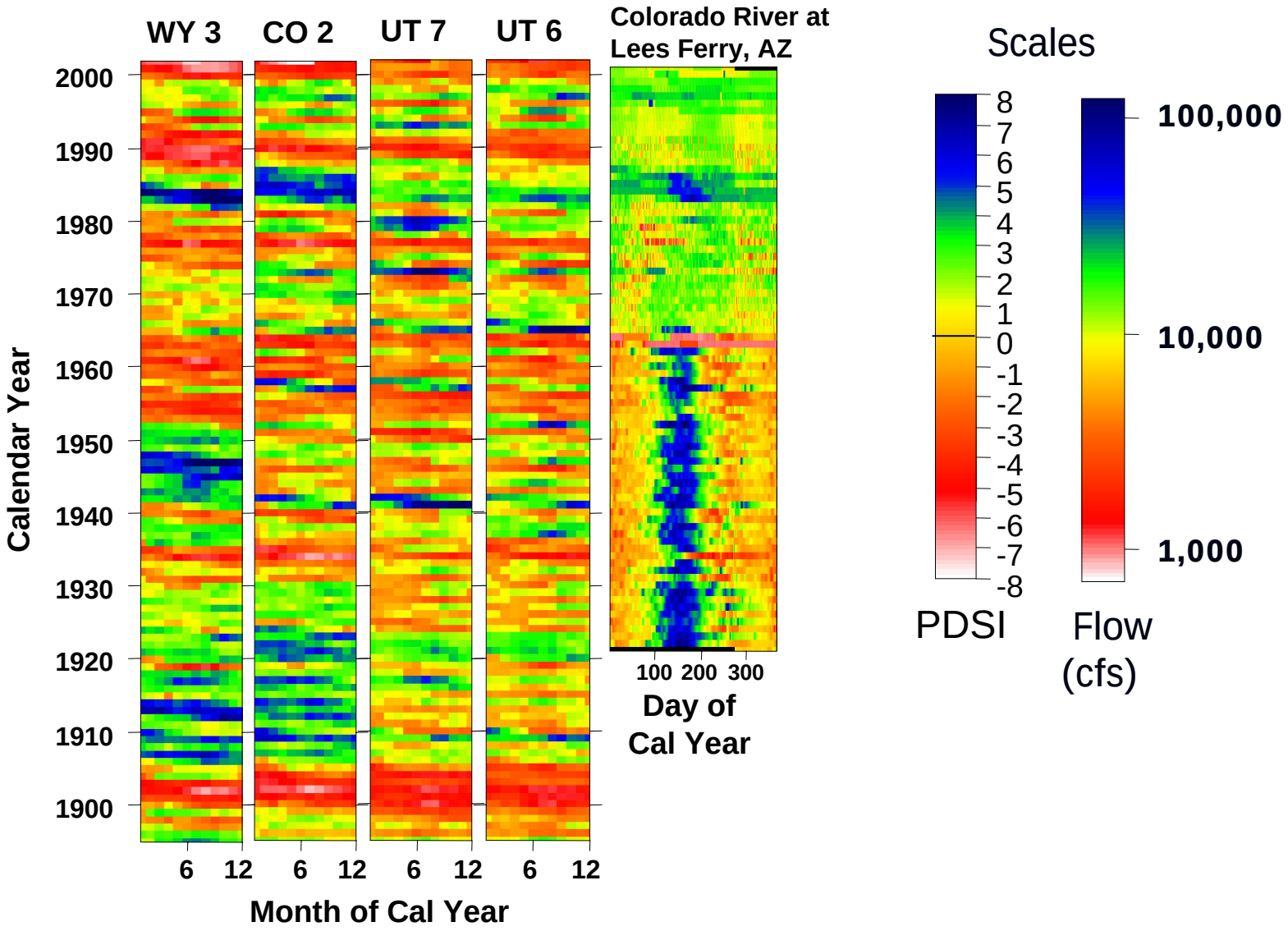




Climate applications



Other applications



Summary

- Raster-based approach
  - Greater visualization
    - Raster hydrograph
  - Analyze temporal streamflow change
    - Grid correlogram
- Verify if calibration dataset is more “natural”
  - New approach to identify temporal variability
  - Enhance and replicate streamflow conditions