A Mismatch Between Rainfall and Summer Streamflow Patterns in the Kettle River Watershed

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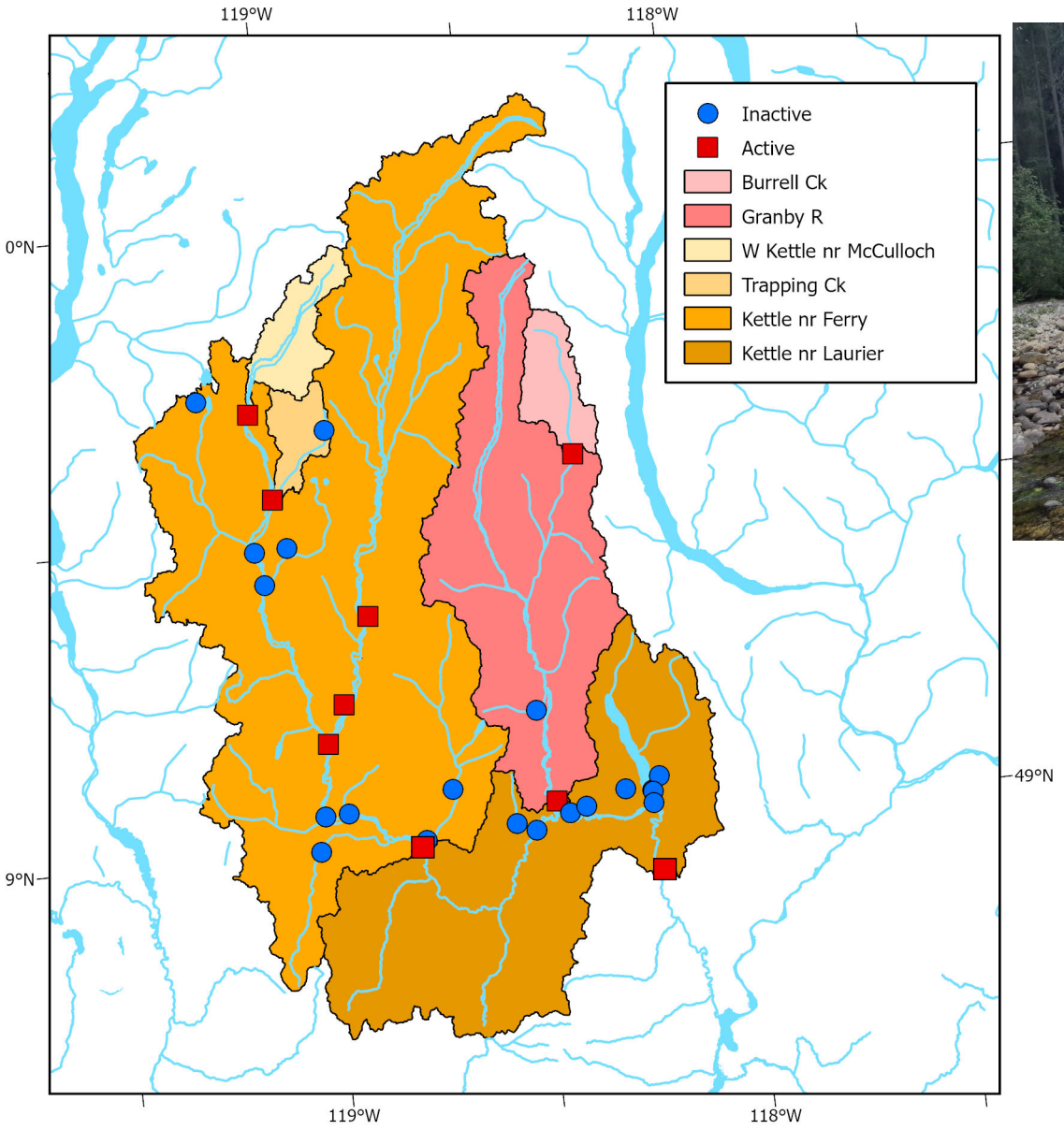
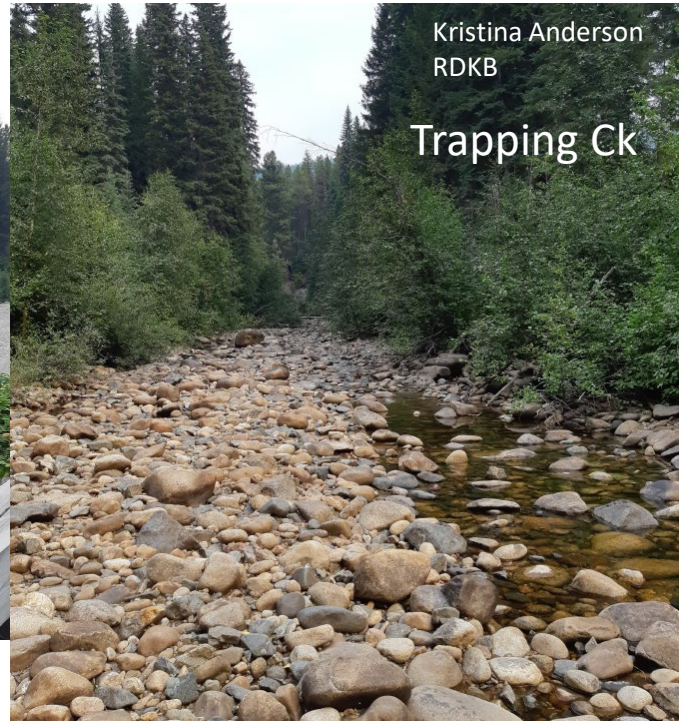




- Summer low flows increasingly a concern
- Provincial water use restrictions imposed in 2021
  - Discussed 4 years out of last 5

Types of Drought

Meteorological Drought
Dryness or rainfall deficit and length of the dry period

Agricultural Drought
Impacts of rainfall deficits, soil water deficits, and reduced groundwater or reservoir levels used for irrigation

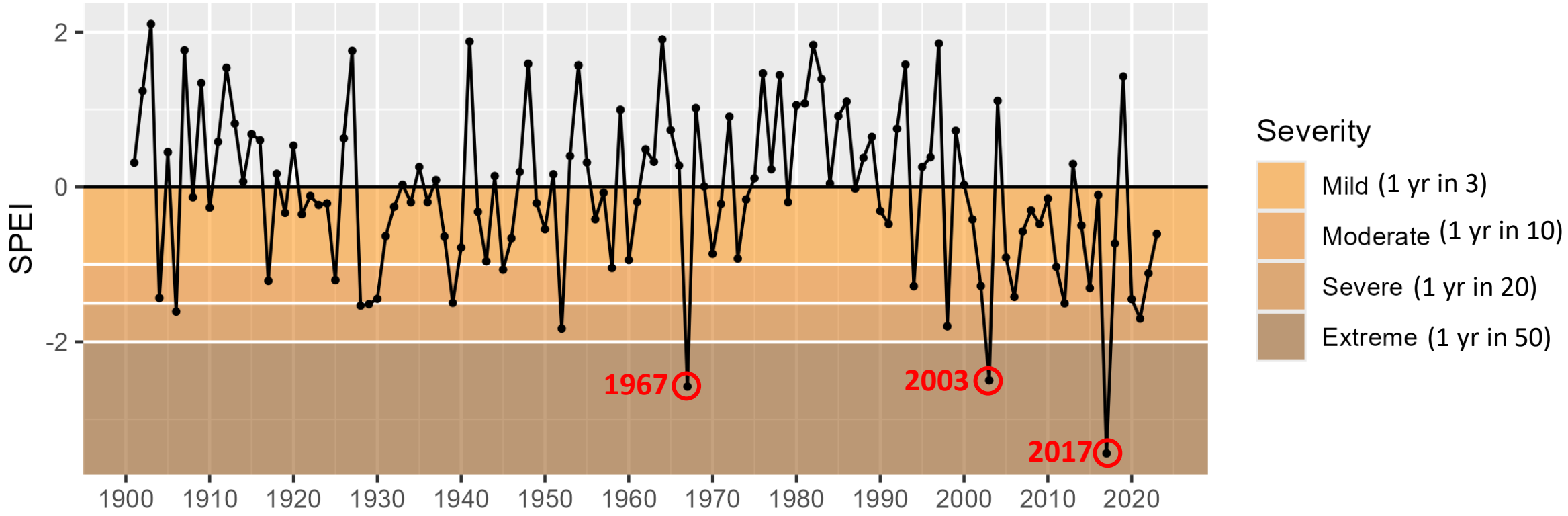
Hydrological Drought
Impacts of rainfall deficit on streamflow, reservoir and lake levels, and groundwater table

Socioeconomic Drought
Effects of other droughts on supply and demand of economic goods (e.g. produce, meat)

Meteorological Drought

Standardized Precipitation Evapotranspiration Index (SPEI)

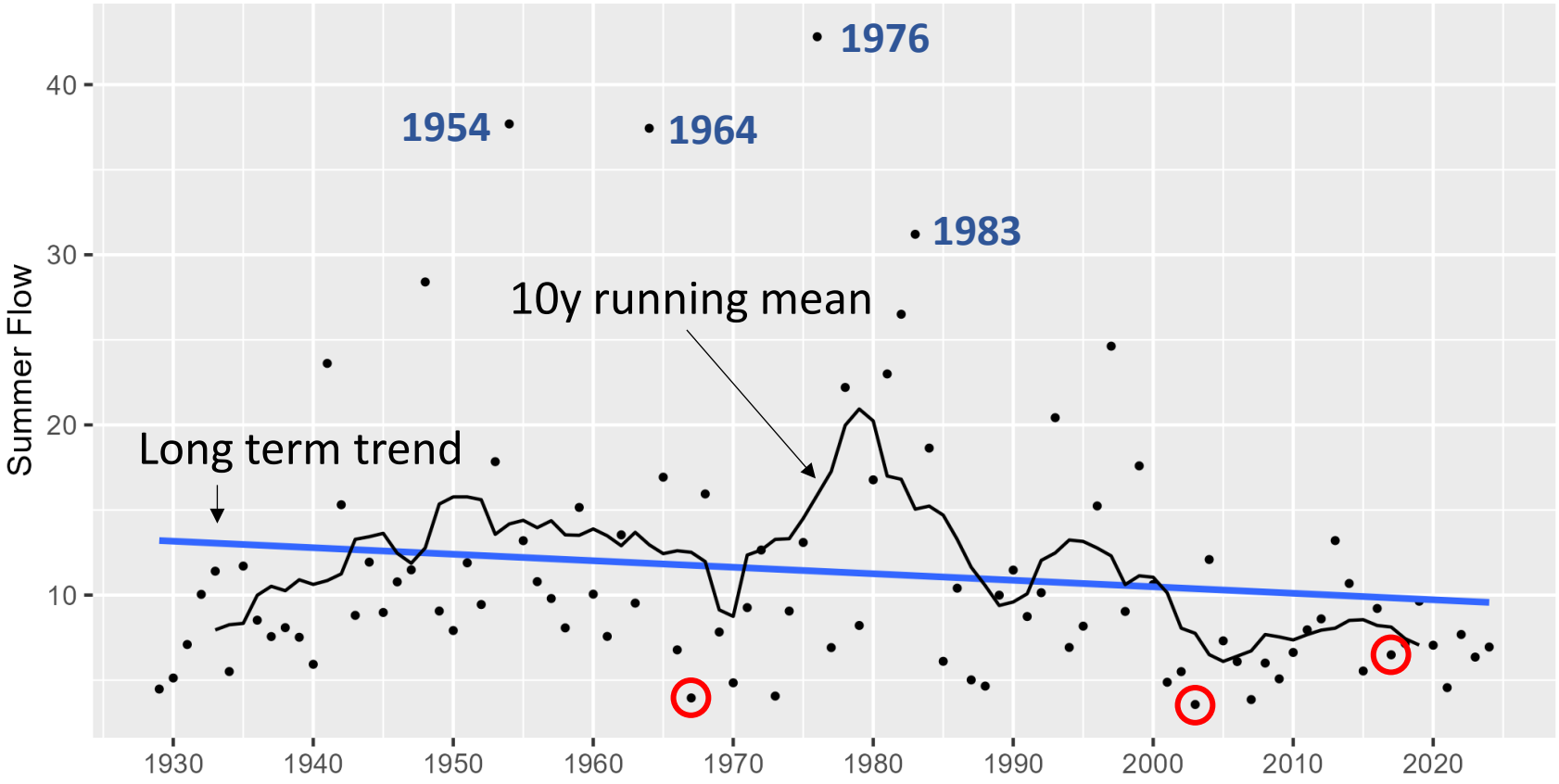
- Precipitation minus potential evapotranspiration (considers temperature)
- Summers over 1900-1915 and 1975-1995 were wetter/cooler than normal
- Current period of dry summers



Hydrologic Drought

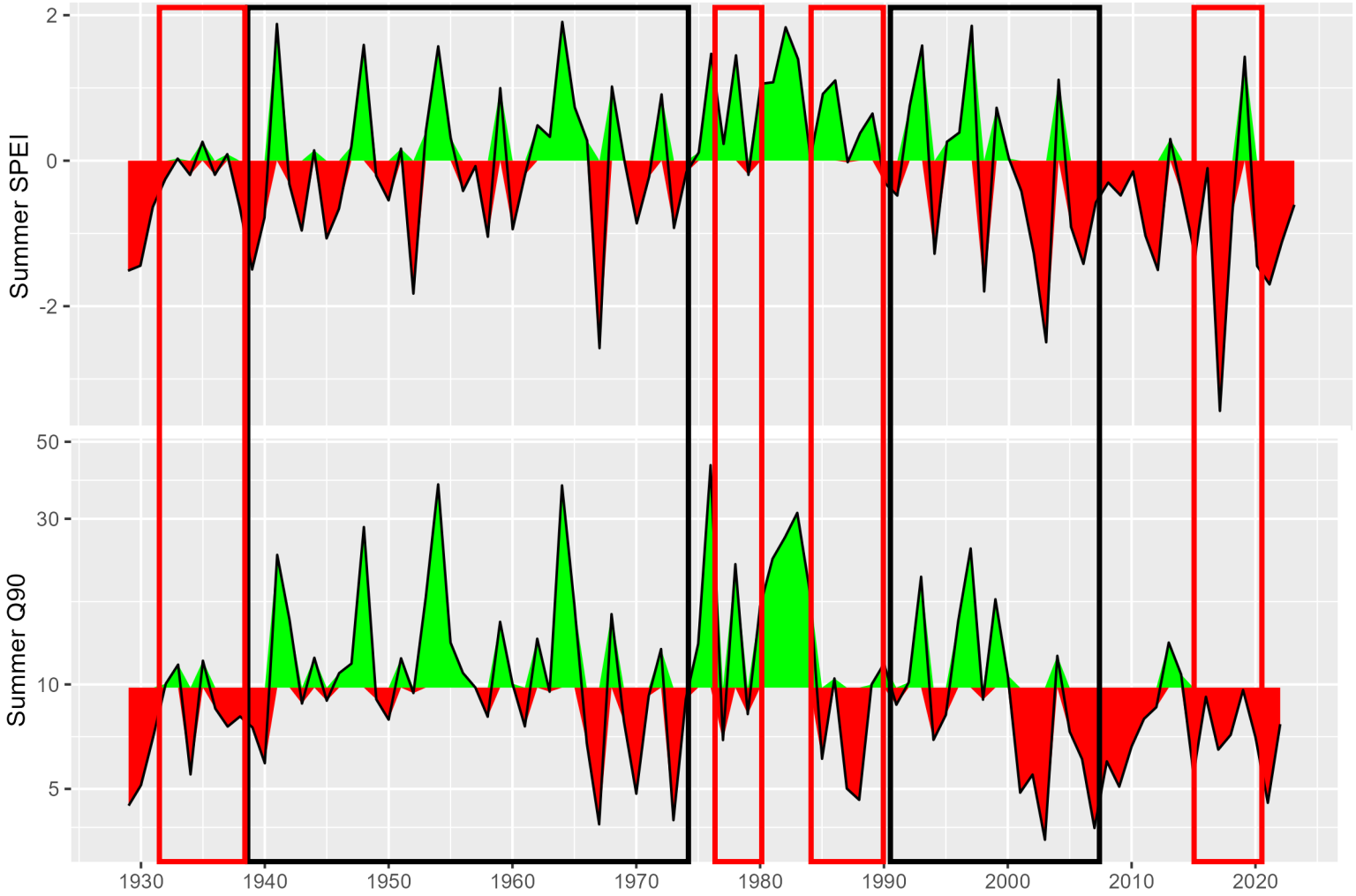
Summer Q90

- Flow rate that is exceeded 90% of the time over the summer (July-Sept) season



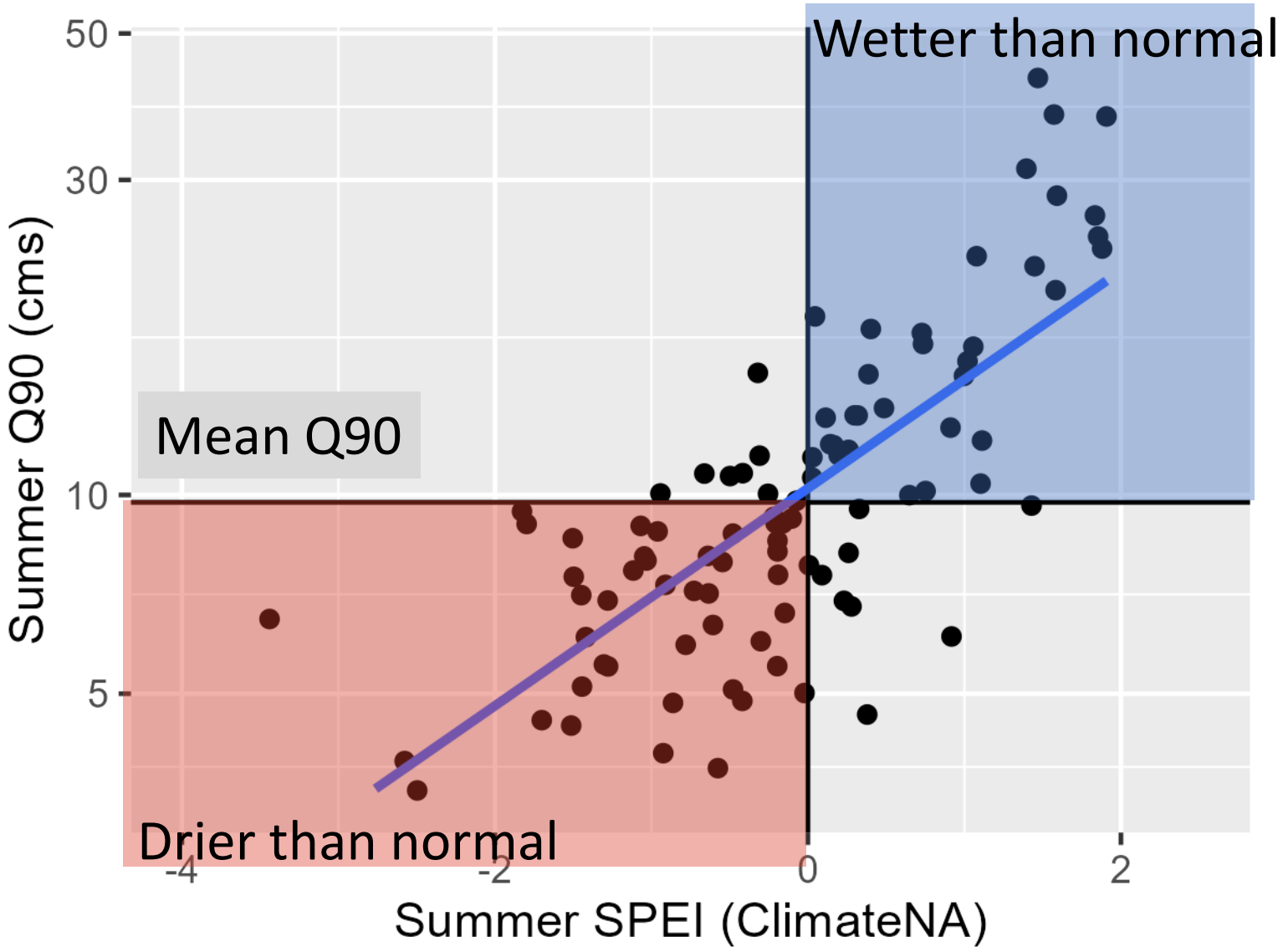
- Higher river levels in 1970s-80s
- Range of values has decreased since 2000
- Summer Q90 decreasing since 1930s

Meteorological and Hydrologic Drought



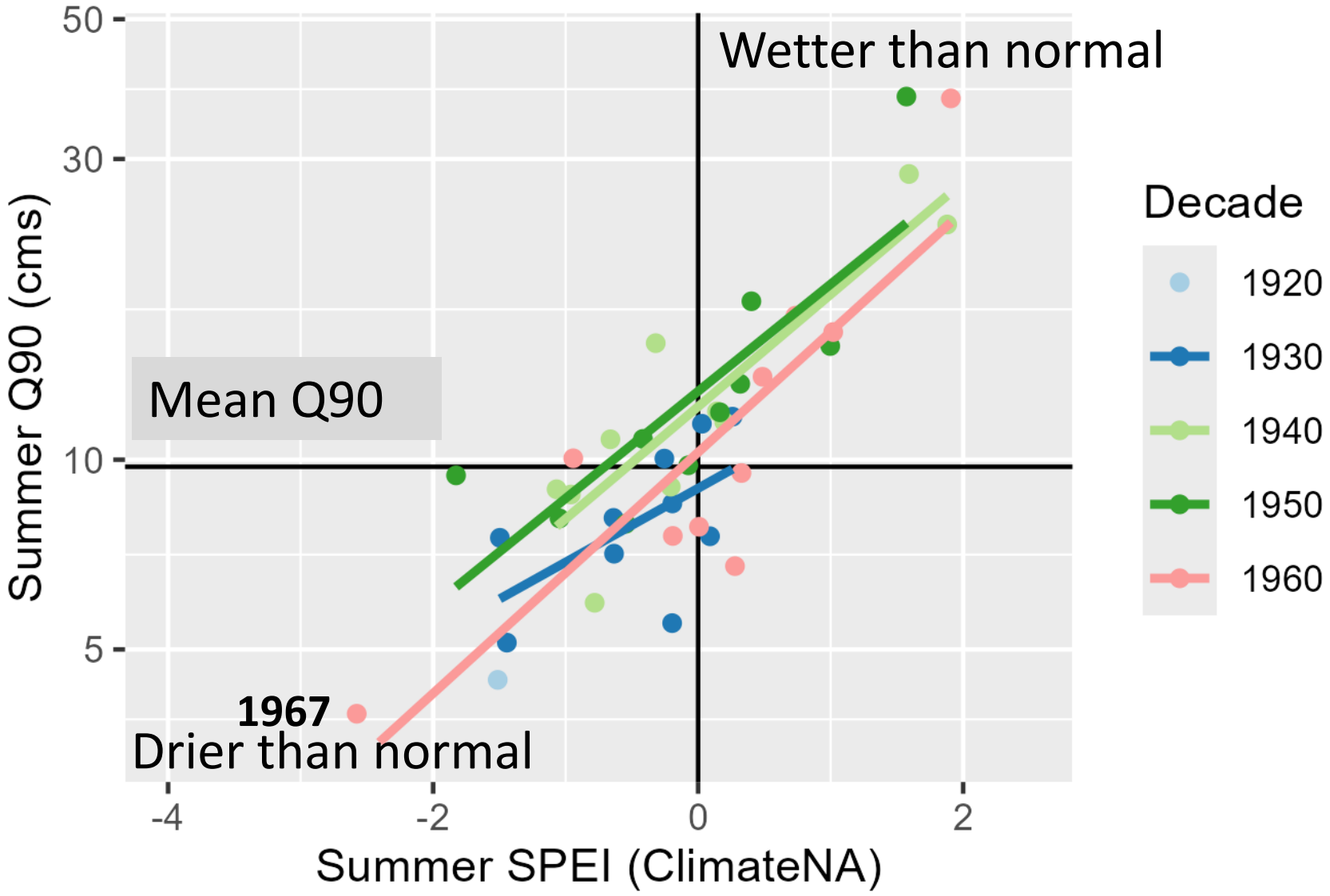
- SPEI should indicate the availability of surface water
  - Expect low streamflow during dry summers
- There are periods when streamflow is lower than would be expected based on meteorological drought indicator

Meteorological and Hydrologic Drought



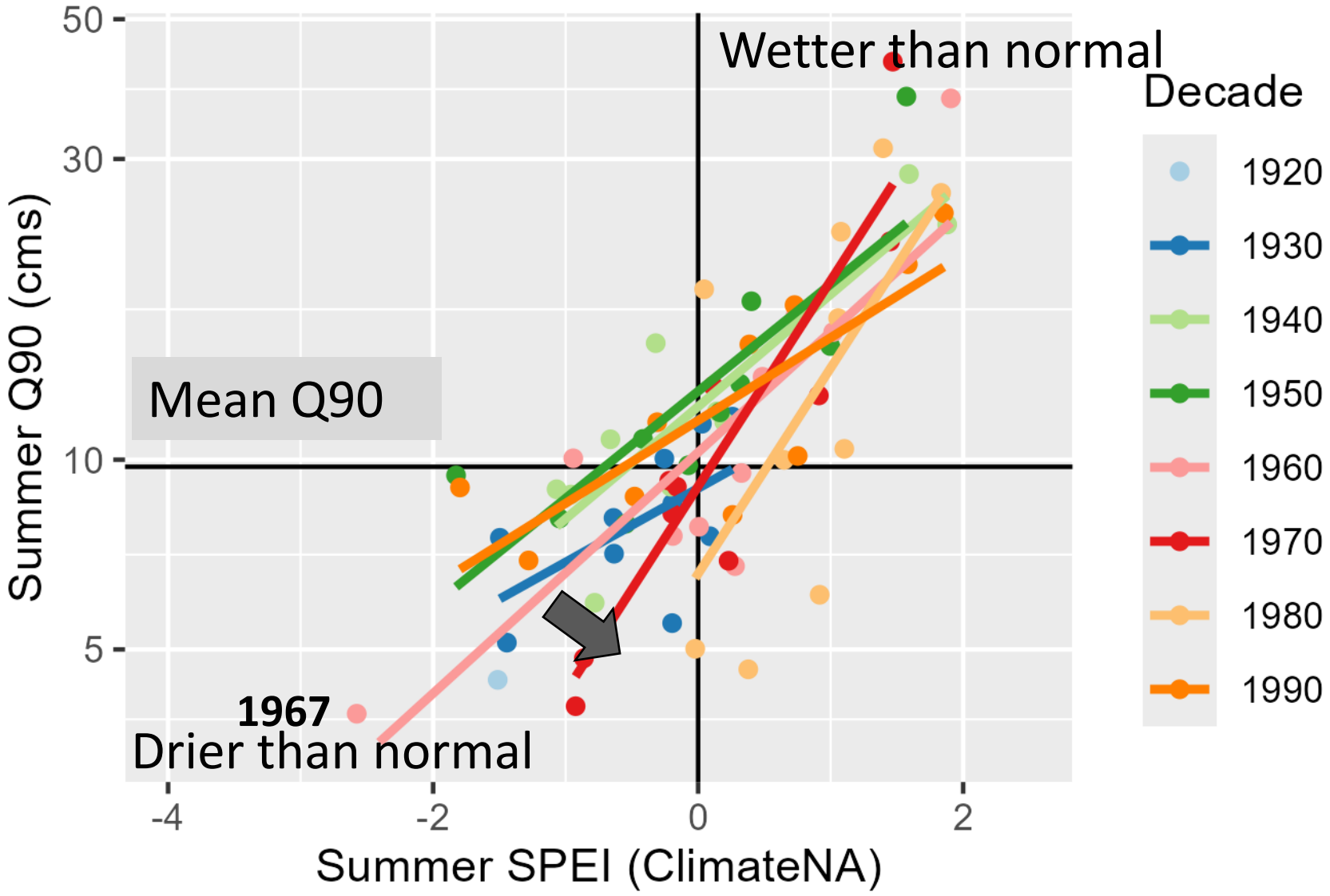
- Negative SPEI <u>should</u> result in Q90 values below the mean
  - Lower streamflow in dry years
- Why don't all points fall on the line?
  - Human removal or storage of water
  - Watershed "memory" of wet and dry conditions

Meteorological and Hydrologic Drought



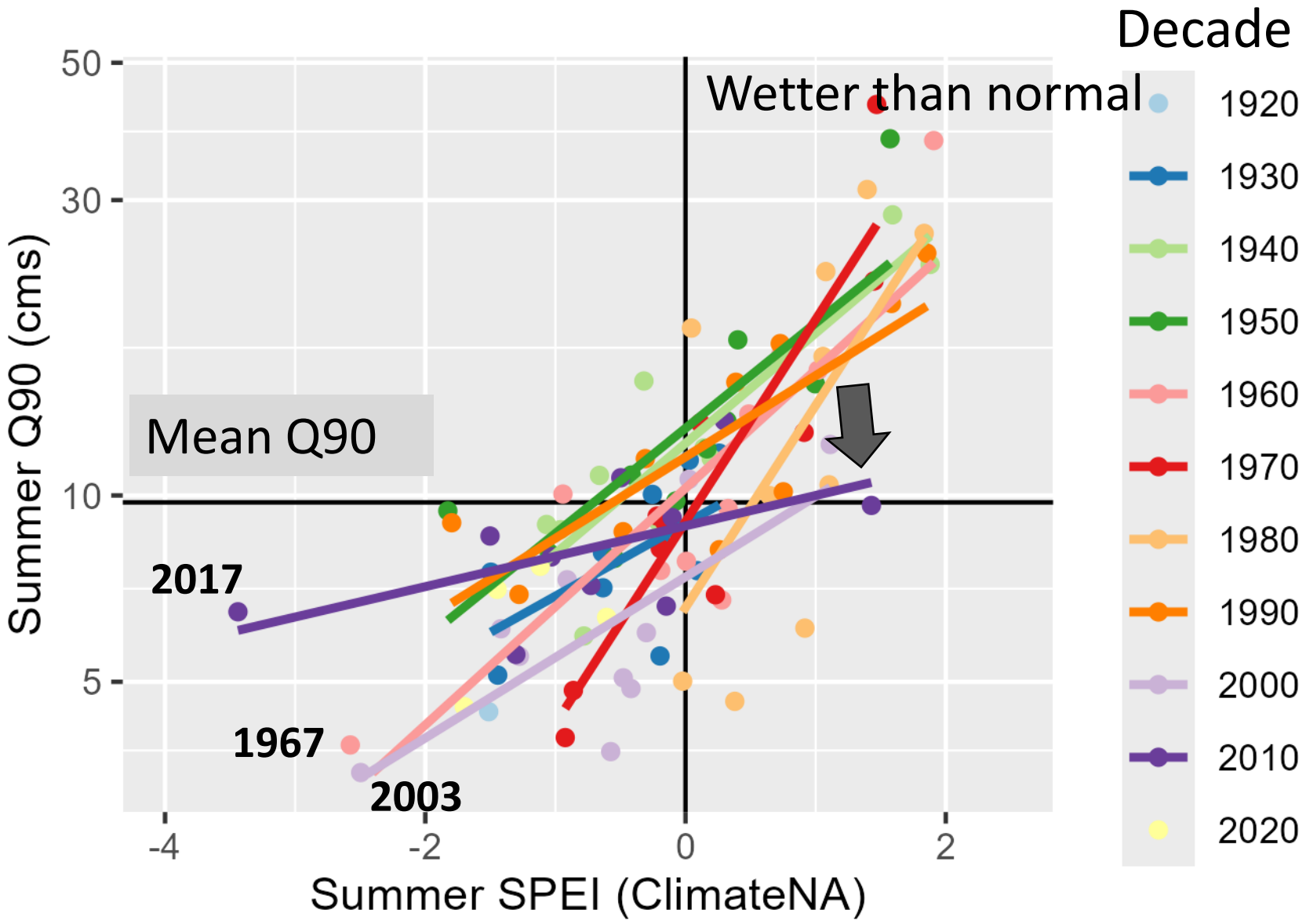
- Points are colour coded by decade
- Negative SPEI should result in Q90 values below the mean
  - Largely true before the 1970's

Meteorological and Hydrologic Drought



- Points are colour coded by decade
- Negative SPEI should result in Q90 values below the mean
  - Largely true before the 1970's
  - In 1970's-1980's see lower Q90 values at moderate SPEI values

Meteorological and Hydrologic Drought



- Points are colour coded by decade
- Negative SPEI <u>should</u> result in Q90 values below the mean
  - Largely true before the 1960's
  - In 1970's-1980's see lower Q90 values at moderate SPEI values
  - Since 2000, all but a few summer Q90 values below the mean

WHY??

- Rivers respond quickly to **rain** but effect can be short-lived and localized
- **Groundwater** inflows are more consistent over the summer but depend on weather in previous years

- How long does a meteorological drought impact river levels?
- What are the impacts of low rainfall vs. low snow years?
- What does it take to “recover” after a multi-year drought?
- How does forest change in the headwaters affect aquifers in the main valleys?