Adjusting Historical Data for Climate Changes

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Historical Data Provide Key Input for Planning and Operations

Analysis Types:

- System operations planning runs (time series)
- System operational forecasting (position analysis)
- Hydrologic forecasts
- Design

Parameters of interest:

- Water supply availability
- water quality
- water temperature
- fish survival
- energy planning

Do we need Climate Adjusted Historical Conditions?

- Have changes in climate over the past 50-years rendered our historical observed record inadequate for expressing statistical distributions of current conditions?
- What are the critical signals/trends in the historical data that we would need to adjust?
- What are the best methods and approaches for imposing climate adjustments?

*Broad agreement that historical data should not be “cut”, we should use as much information as possible from historical observed data.

DWR Historical Data Workgroup

- Lead by SWP Climate Action Coordinator
- Participations from:
  - Modeling Service Office (Central Valley Modeling- hydrology, integrated modeling; Delta Modeling)
  - SWP Operations
  - Climate Change Program
  - State Climatologist
  - USBR

Weekly meetings, highly collaborative, and loosely structured to facilitate creative thinking and open communication.

Steps in the Process

1. Analyze and consider a wide range of climate and hydrologic data to identify trends and changes
2. Consider how those trends and changes translate through planning and forecasting models and decision processes
3. Identify specific trends and changes that are “unambiguous enough” that the historical conditions should be adjusted to resemble recent conditions
4. Develop methodologies for applying selected shifts to historical datasets to create a “Climate Adjusted Historical Conditions Scenario”
5. Use Climate Adjusted scenario for descriptions of current conditions (baseline current conditions for CEQA, DCR, position analysis forecasts, etc.)

Selection of watersheds to evaluate

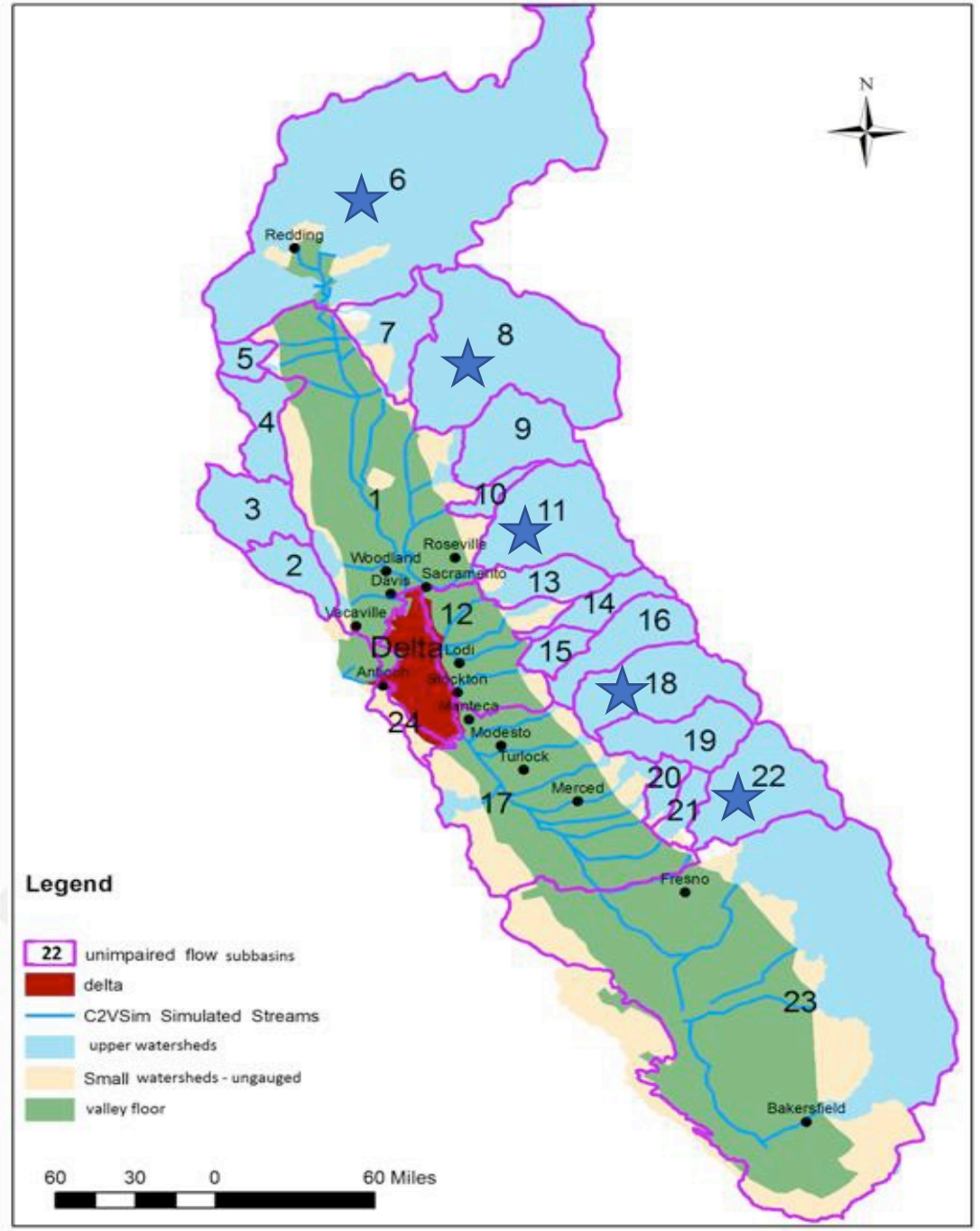
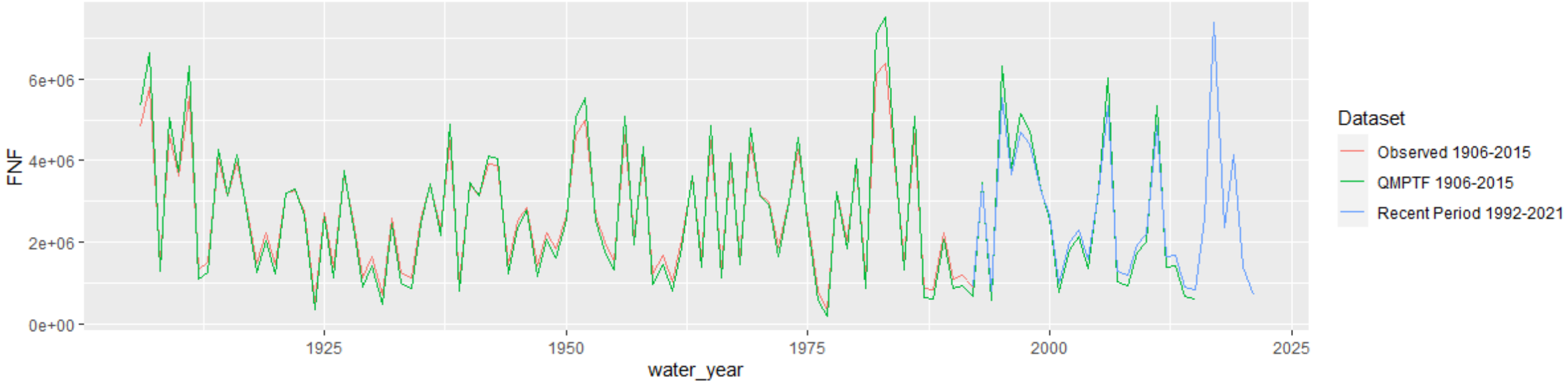


Figure A-1. Unimpaired flow subbasins in the Central Valley of California

Objective: Create a climate adjusted historical time series

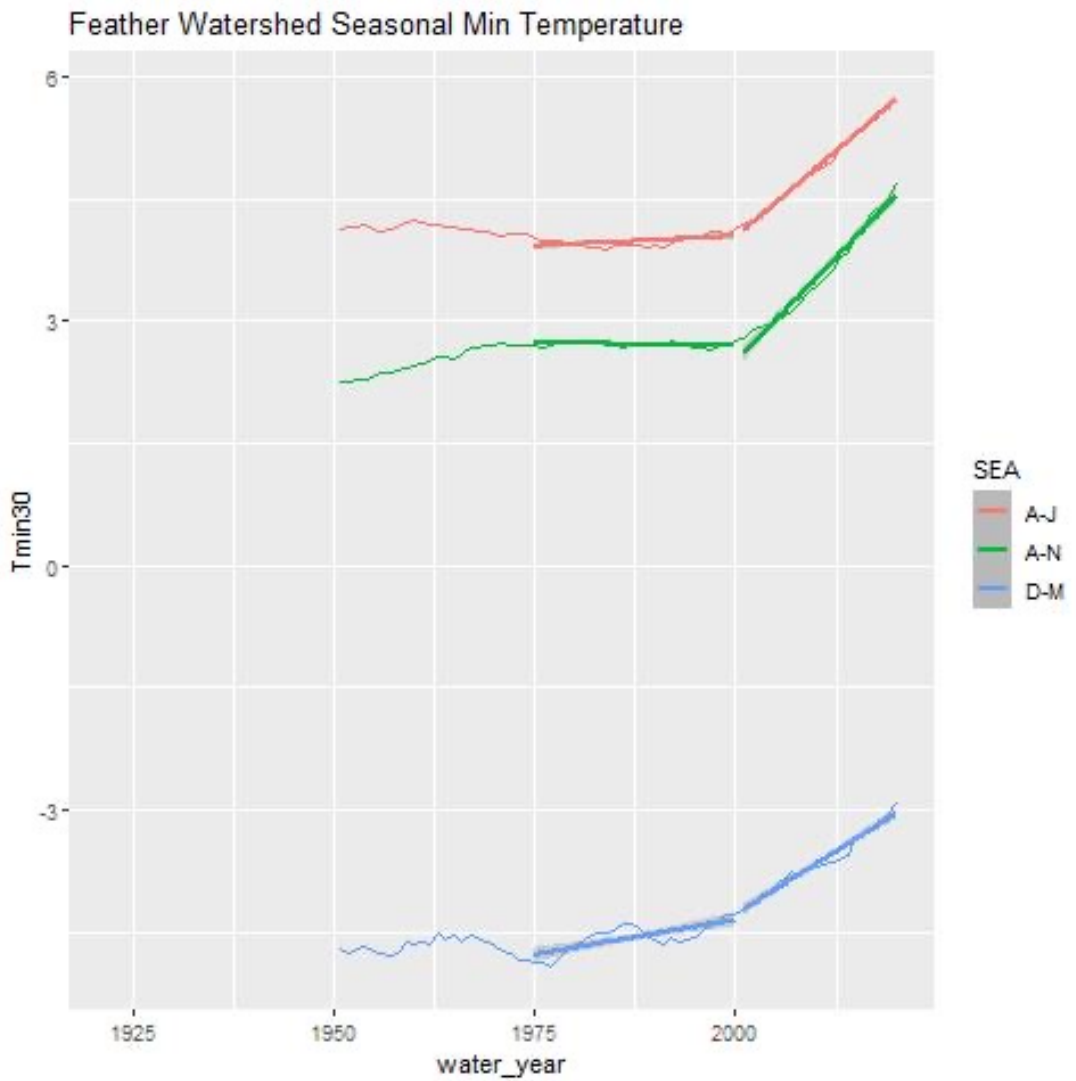
- Maintains the underlying characteristics of the long observational record (transitions from wet to dry, droughts, variability in long-term means—i.e., the underlying climatology of California)
- In cases where conditions are evolving, the adjusted record reflects recent conditions over the entire record

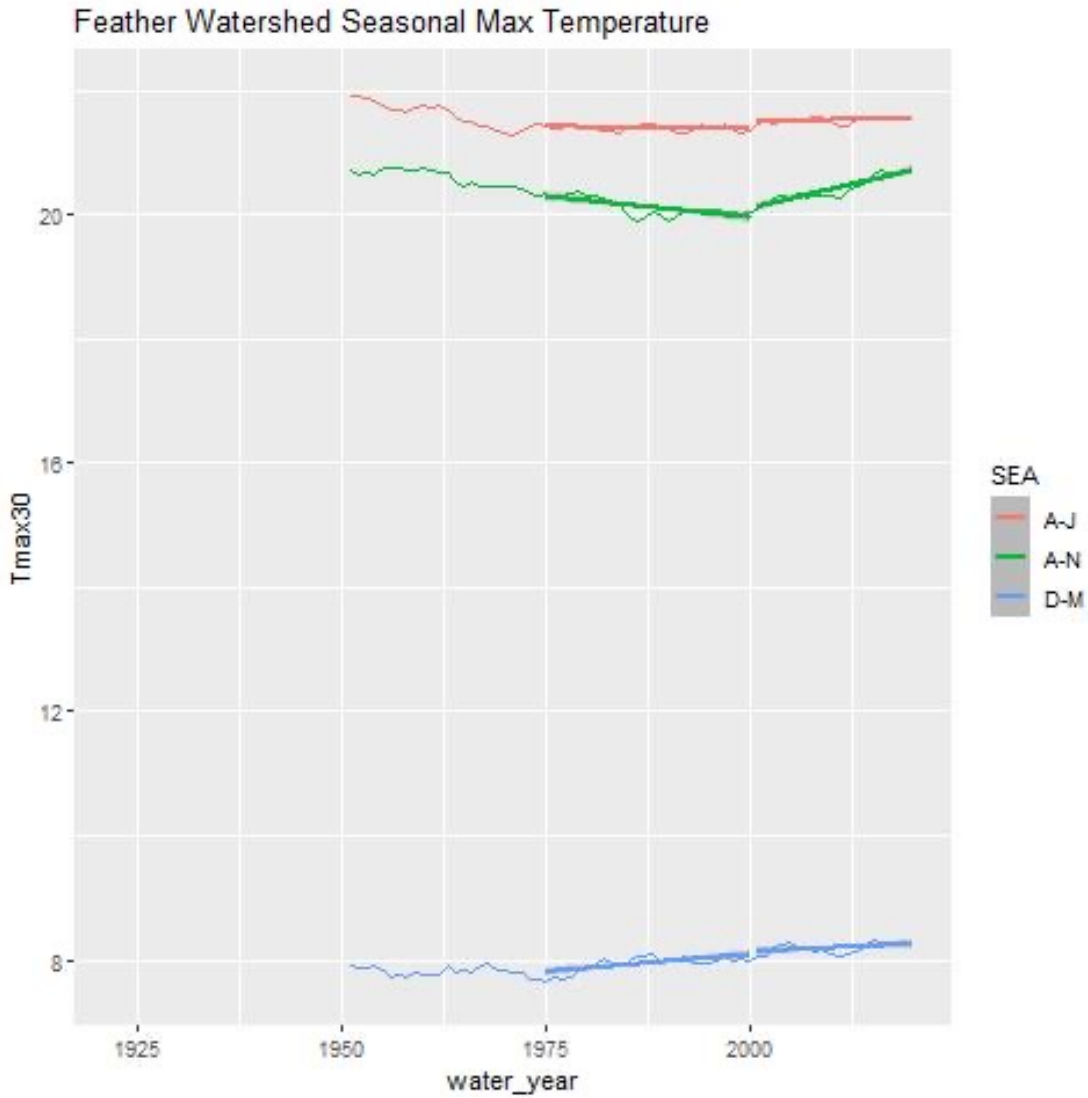


Step 1: Analyze Climate and Hydrologic Data

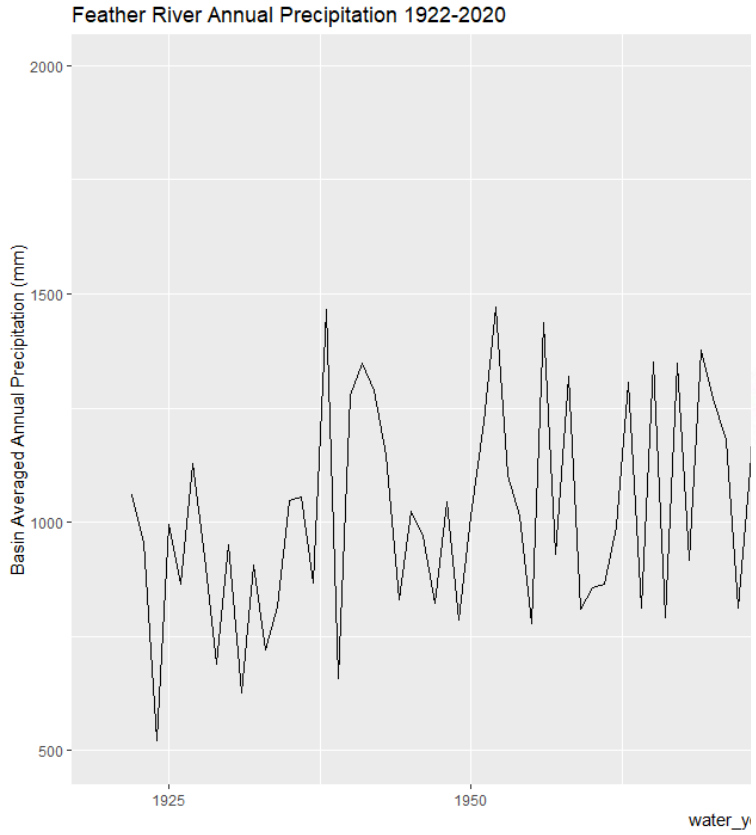
- Temperature (PRISM)
  - Annual and seasonal changes in Tmin, Tmax, Tave
- Precipitation (PRISM)
  - Annual and seasonal changes in mean and variability
- Annual Runoff Amount (FNF)
  - Annual and seasonal changes in mean, variability; 2,3,5,10,20-year averages/drought persistence
- Runoff Timing (FNF)
  - Amount and percent of annual volume arriving by season and month
- Runoff Efficiency (FNF/PRISM)
  - Annual mean, variability, cumulative change, correlation with prior year/temp/seasonal precip

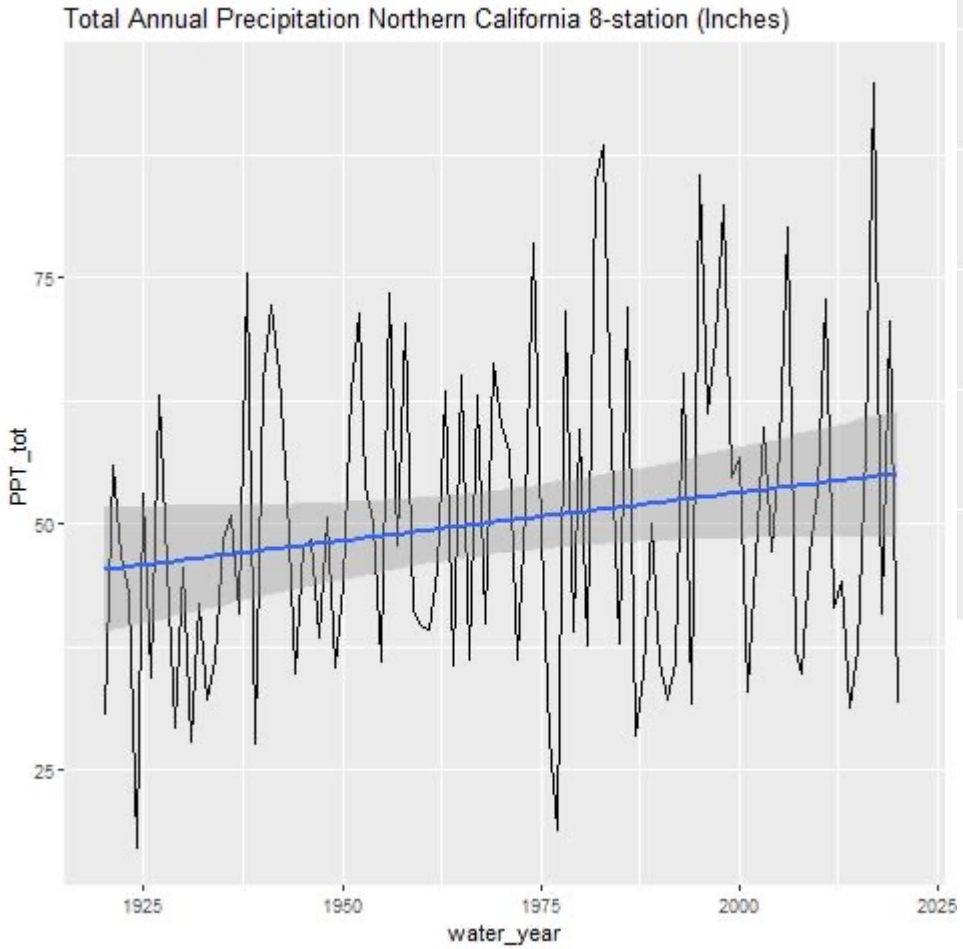
Temperature Changes

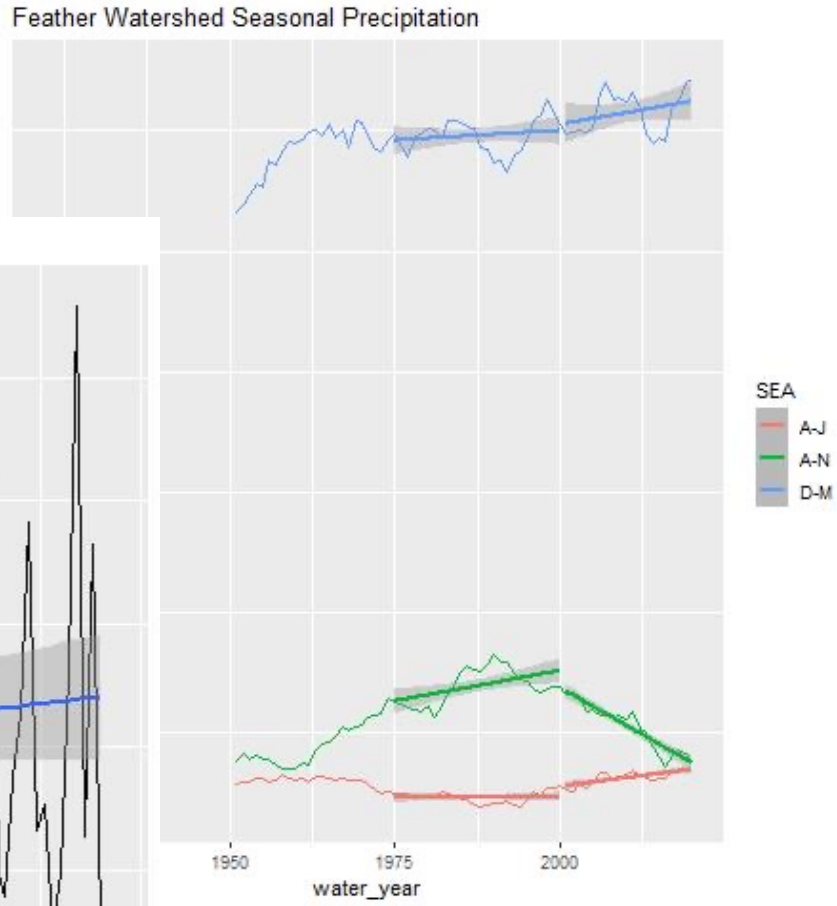




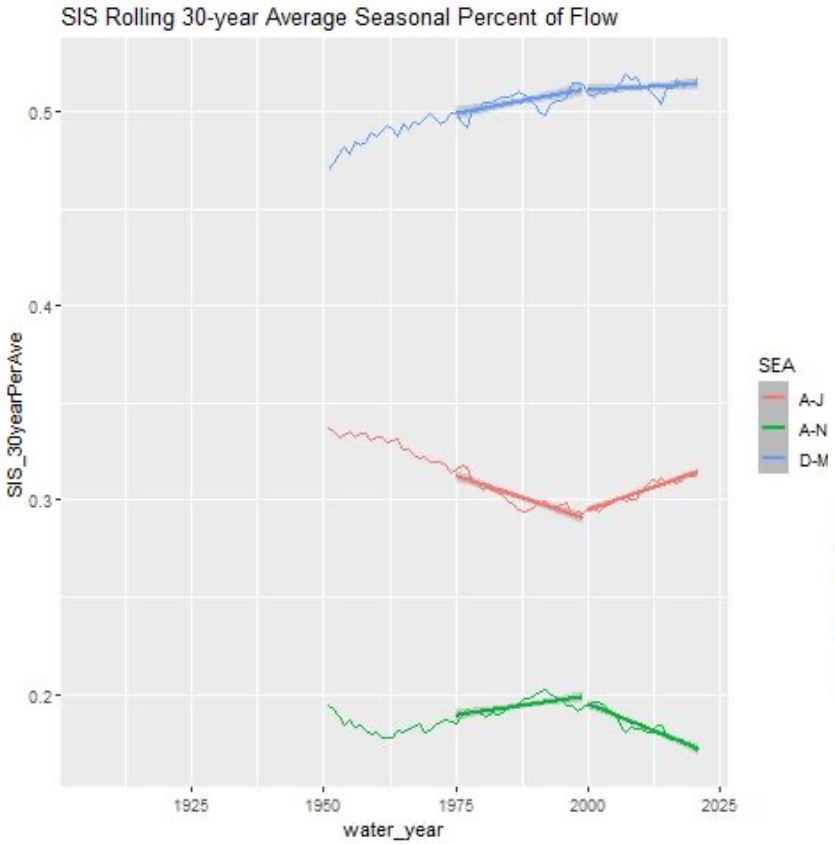
Precipitation



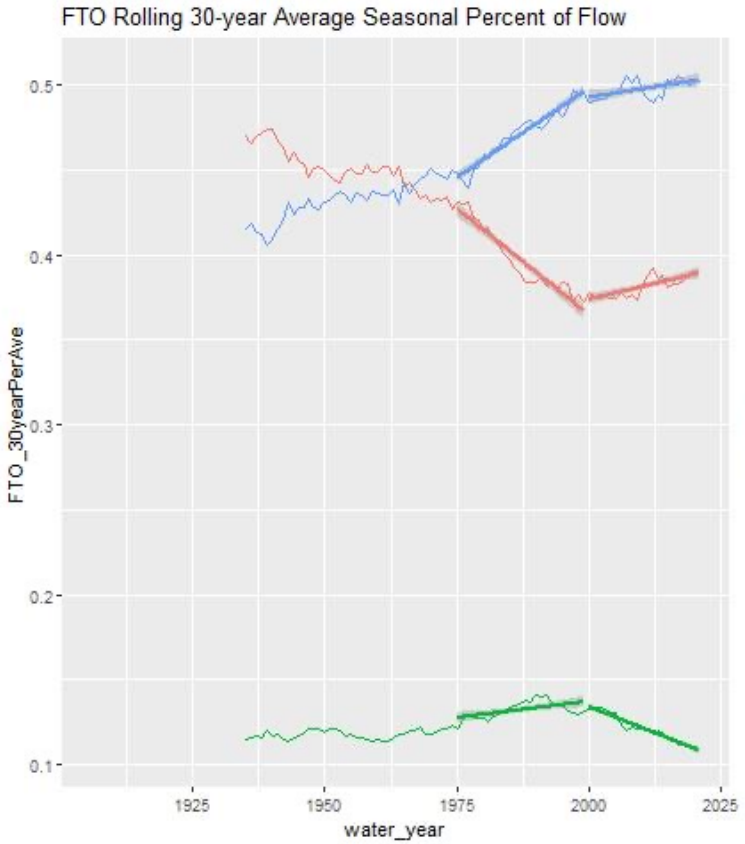




Shasta



Feather

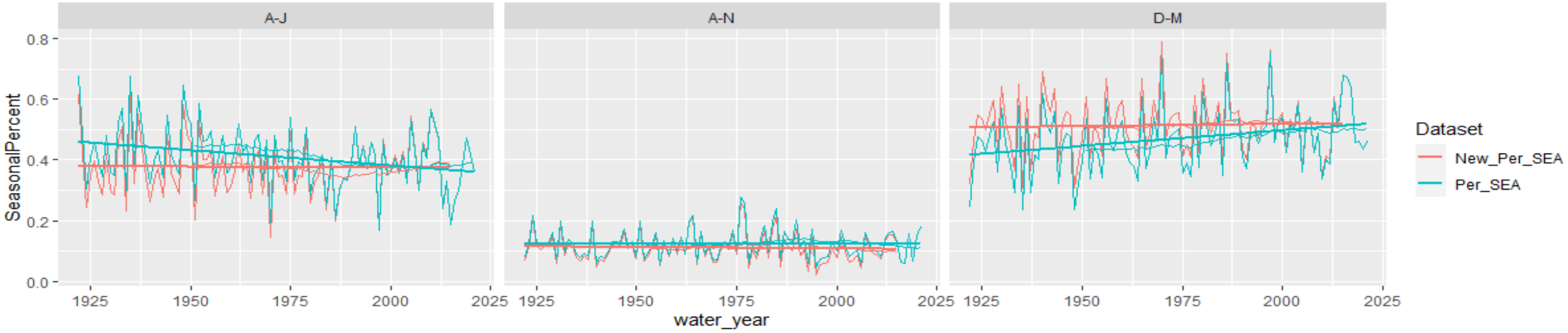


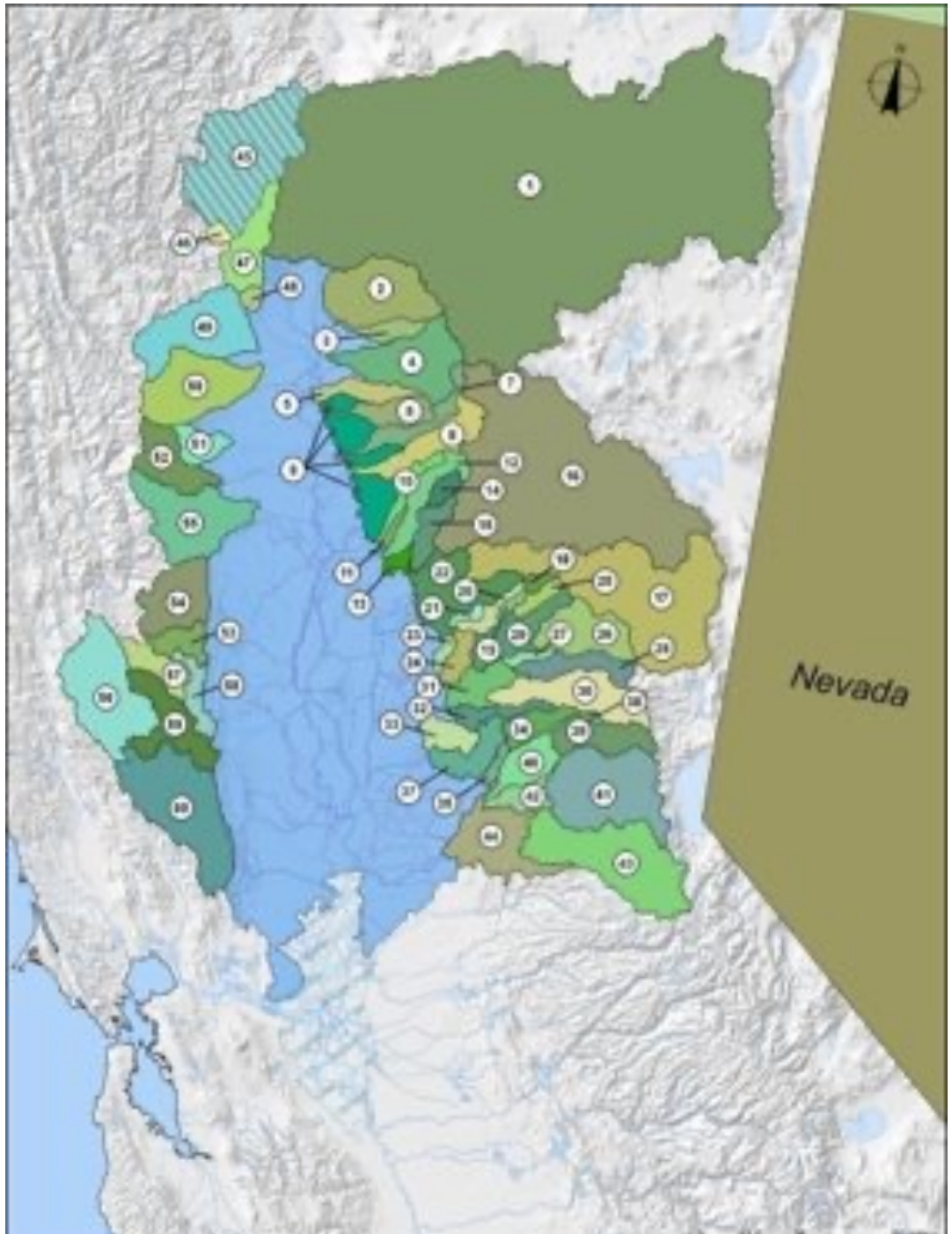
	1975-2000	2001-2020
D-M	Strong Increasing	Flat/Weak Increasing
A-J	Strong Decreasing	Weak Increasing
A-N	Flat	Strong Decreasing

American

Step 2 and 3 Outcomes

- We **will** work directly on runoff data to avoid hydrologic model uncertainty
- We **will** adjust annual runoff volumes to reflect recent increases in variability (wetter wets, drier dries) **[SD 11-22% larger]**
- We **will** adjust seasonal runoff volumes to reflect recent shifts toward earlier runoff **[1.5-4% shifting from A-J to D-M]**
- We **will not** adjust runoff efficiency **[Trend, if any, is still ambiguous]**





Final Product will be FNF timeseries 1922-2021 for 63 Rim basins (but similar methodology could be applied else where).

Thank You!

Questions?

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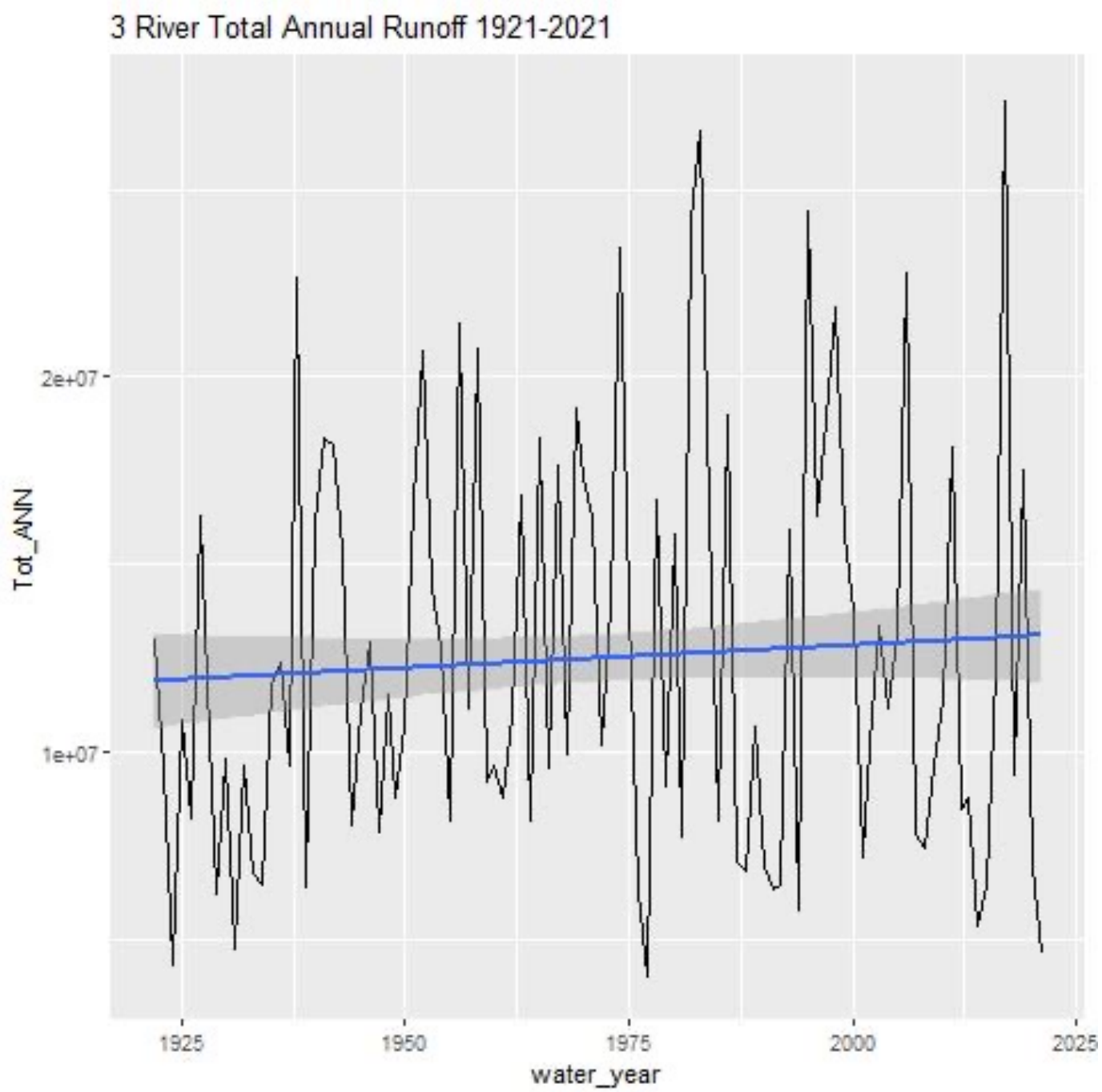
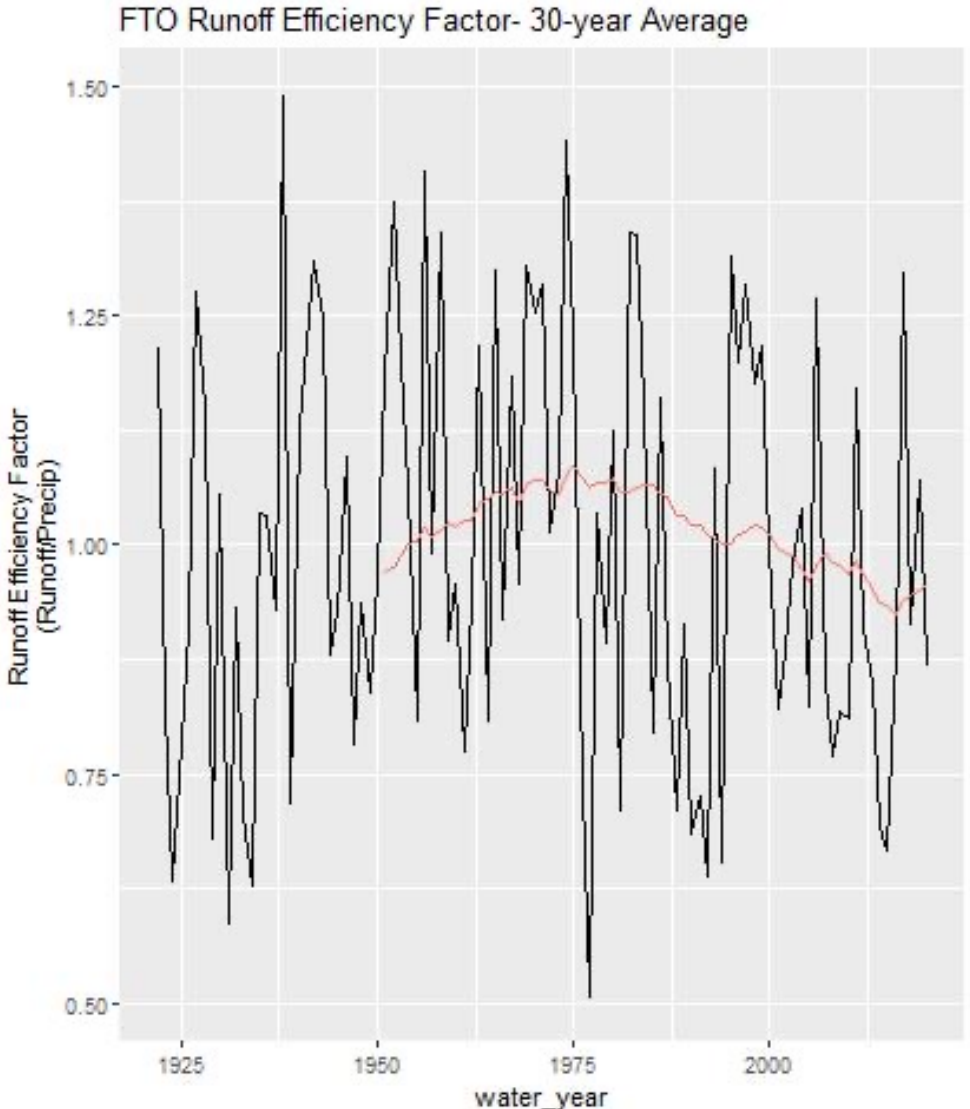
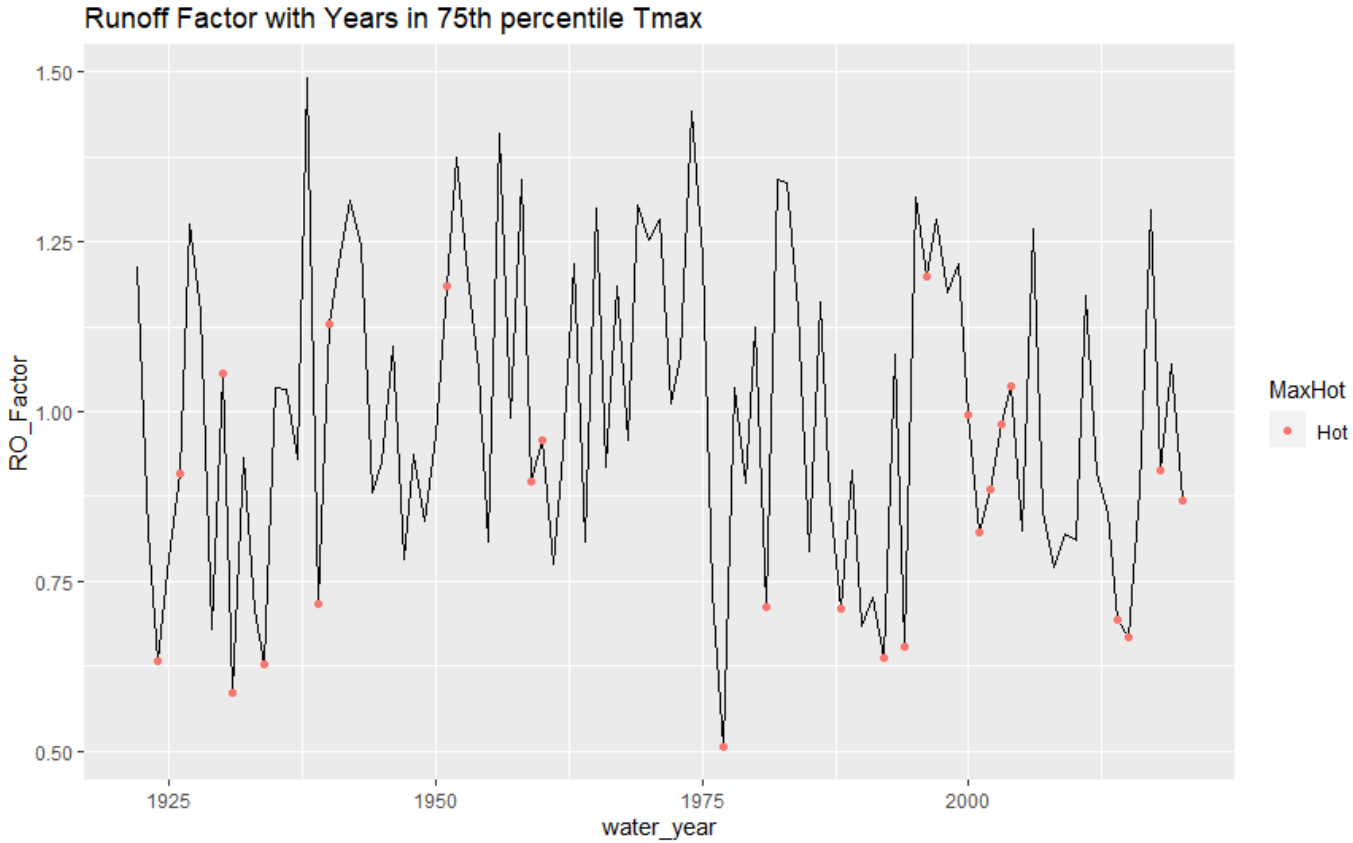
Runoff Amount

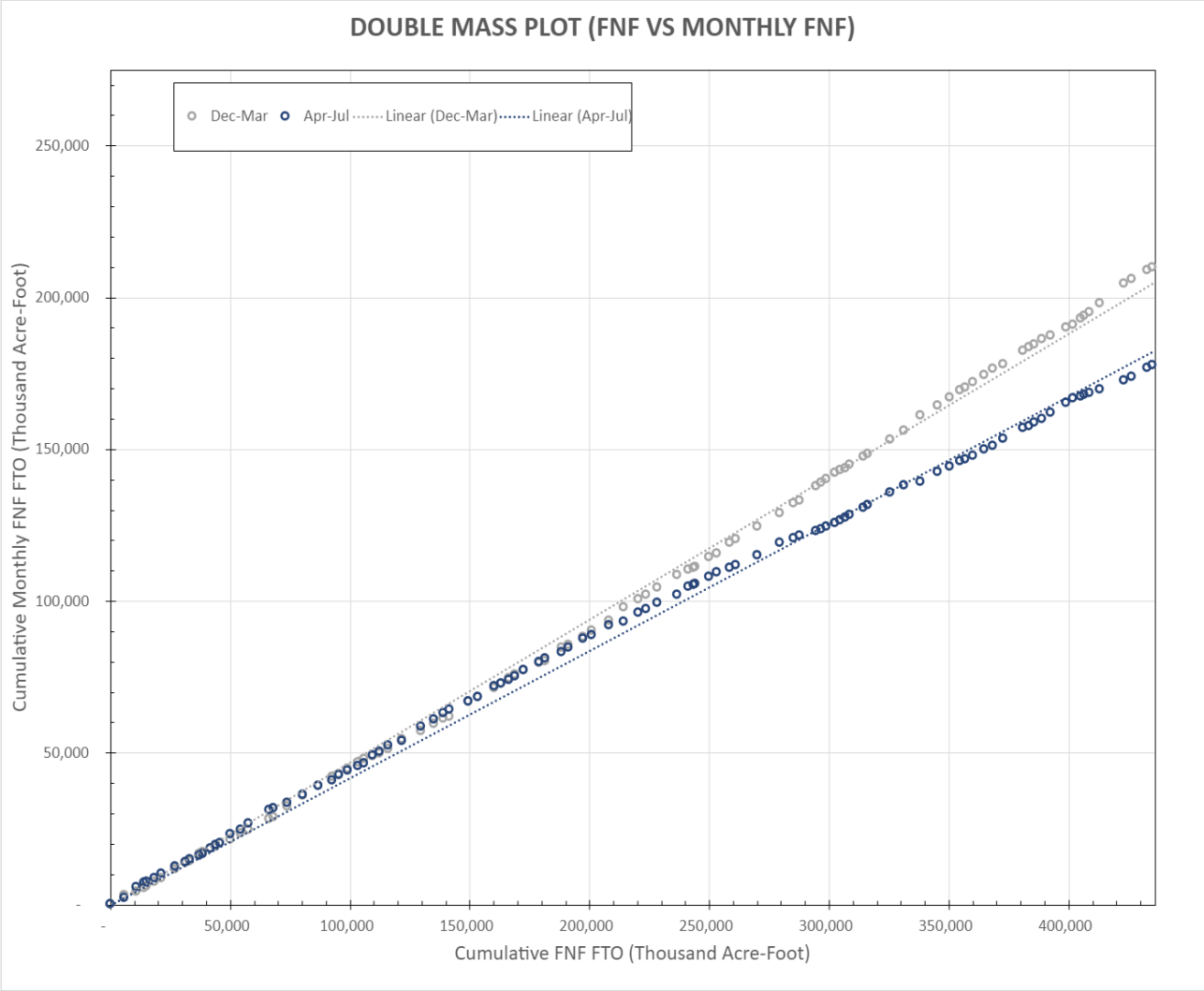


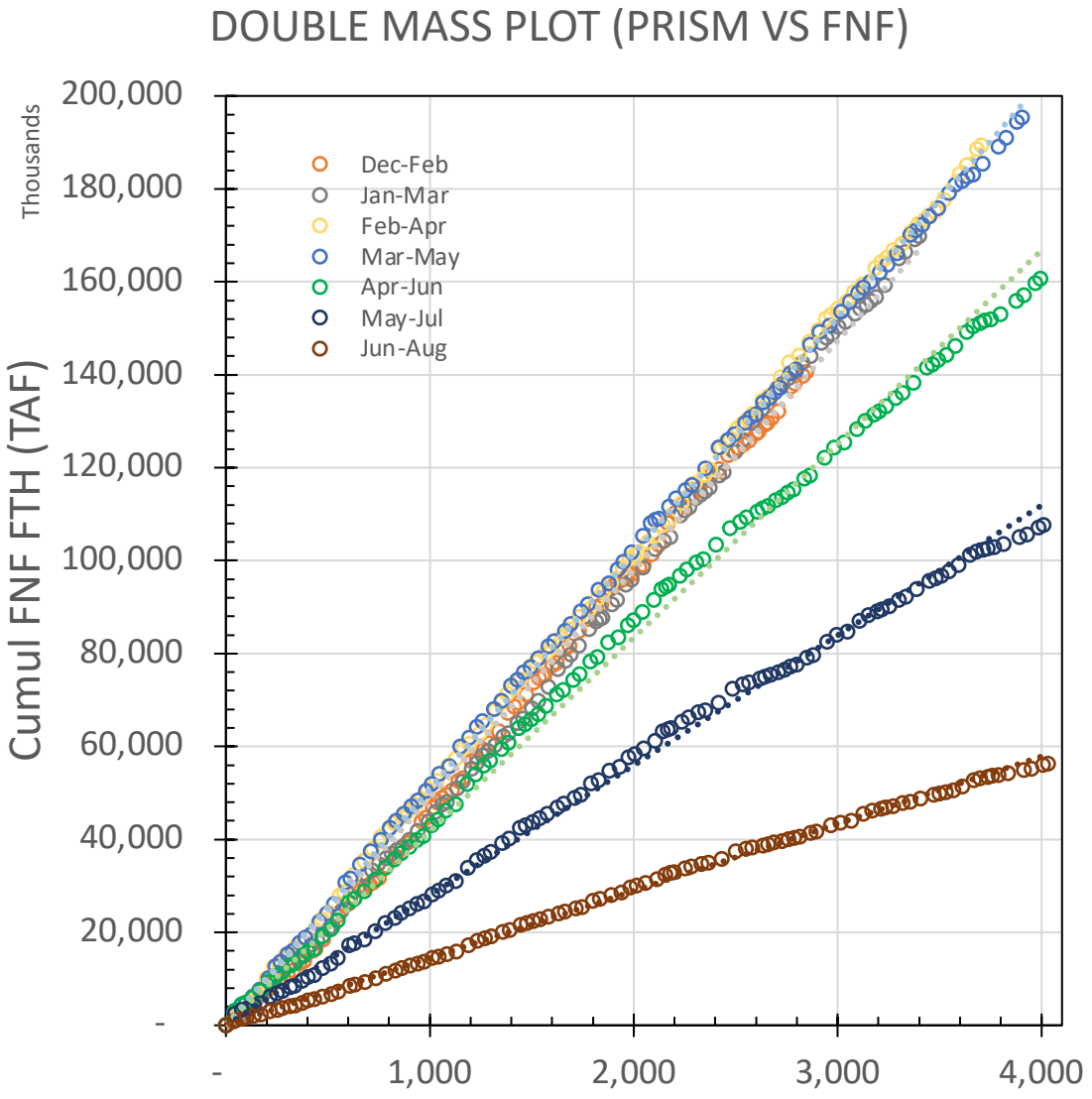
Runoff Efficiency

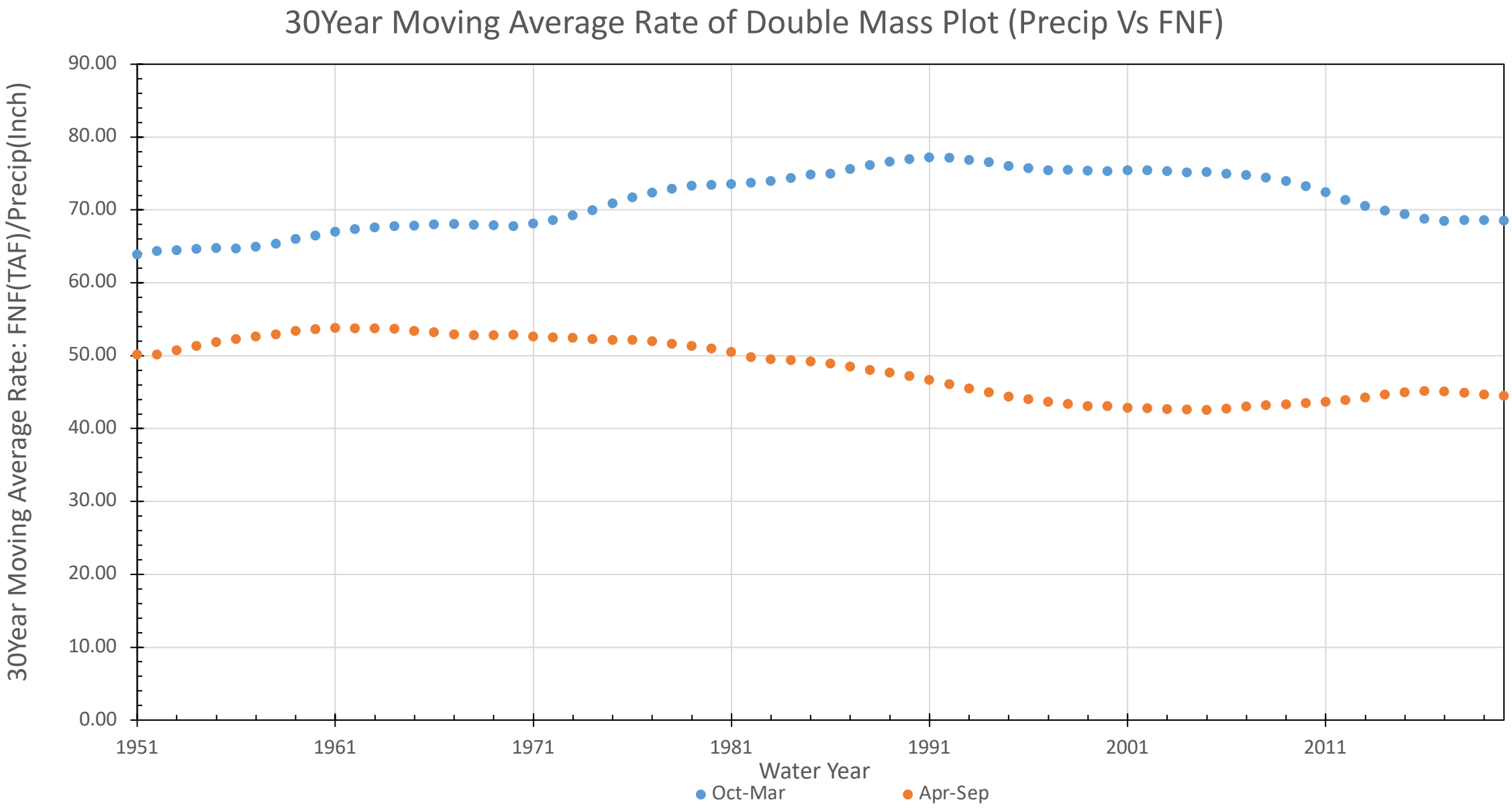




Seasonal Runoff



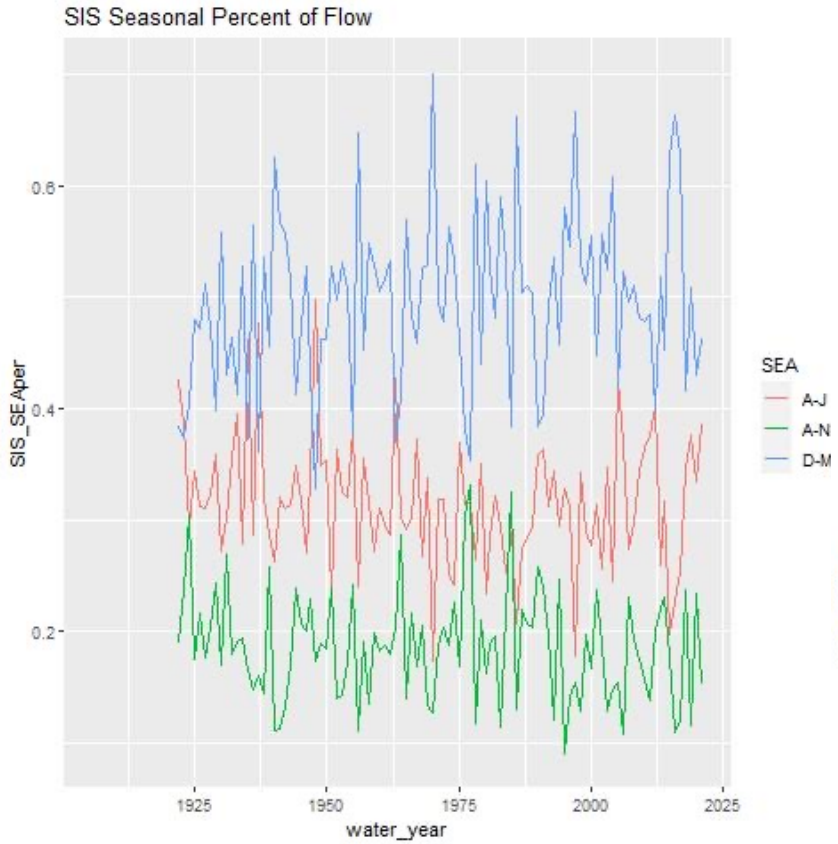



30Year Moving Average Rate of Double Mass Plot (Precip Vs FNF)
30Year Moving Average Rate: FNF(TAF)/Precip(Inch)
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1951
1961
1971
1981
1991
2001
2011
Water Year
Oct-Mar
Apr-Sep

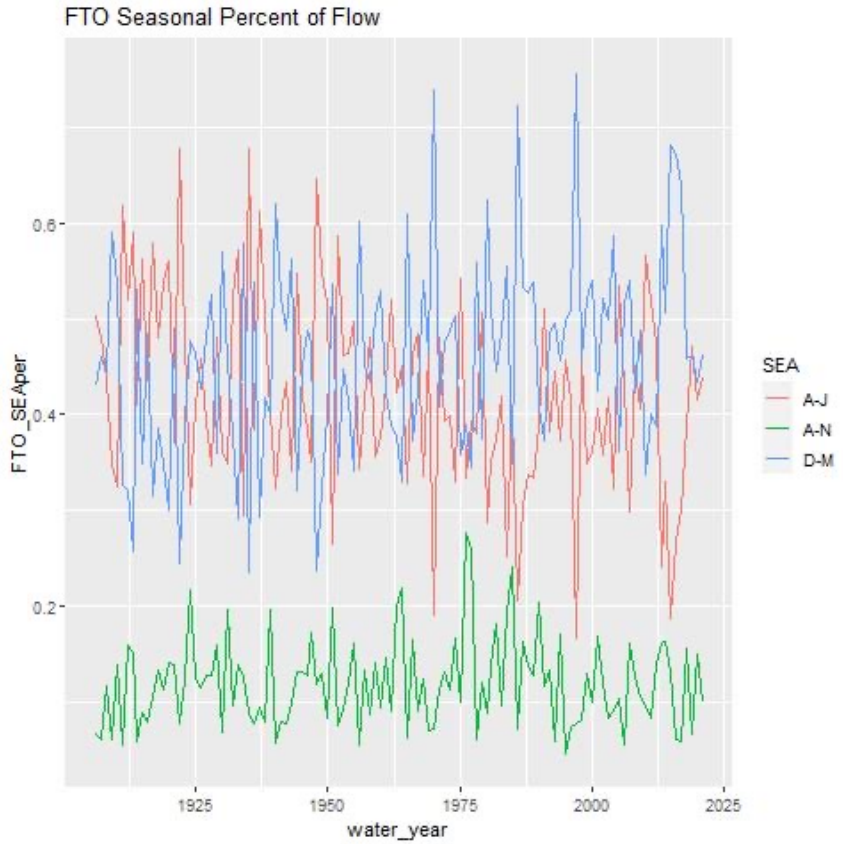
Seasonal Percent of Annual Flow

Noisy, no obvious trends

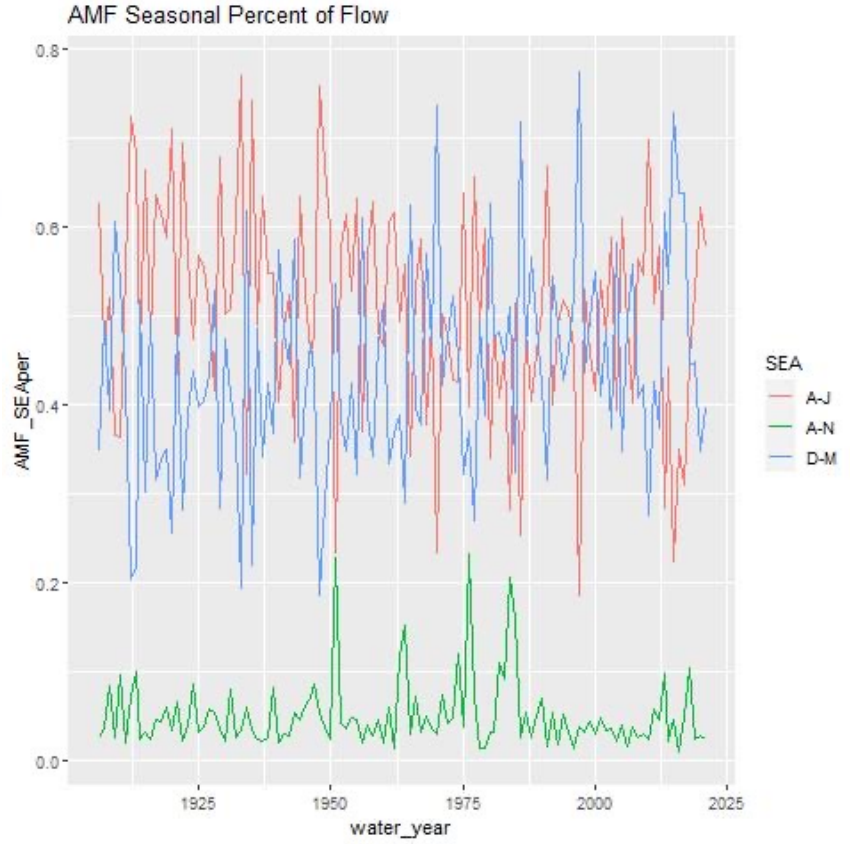
Shasta



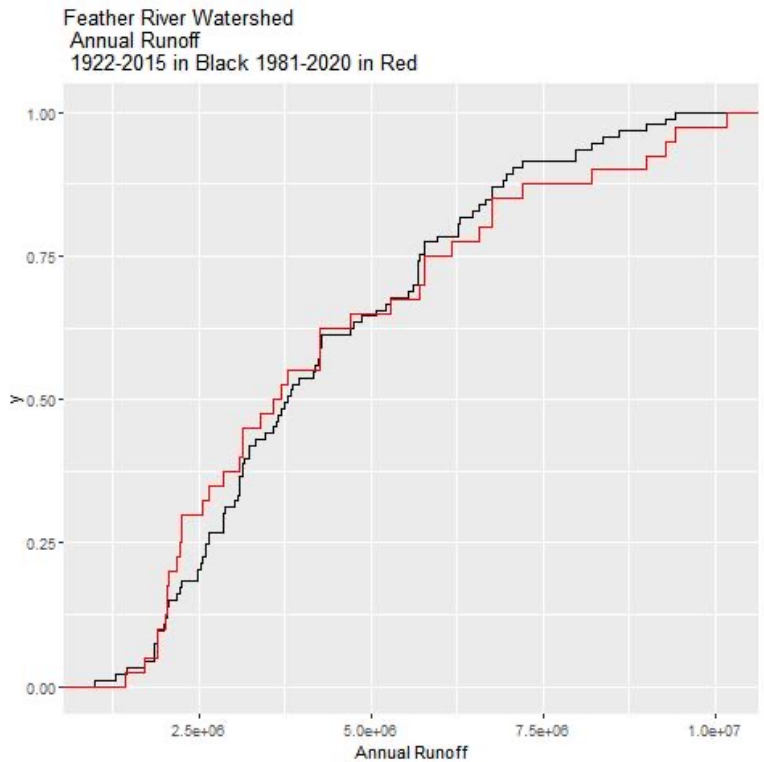
Feather

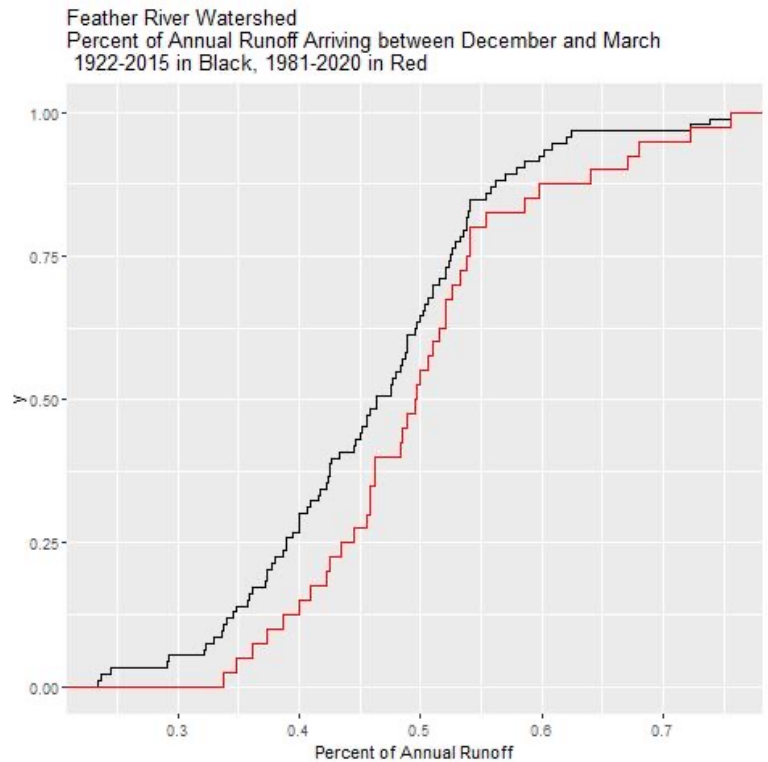


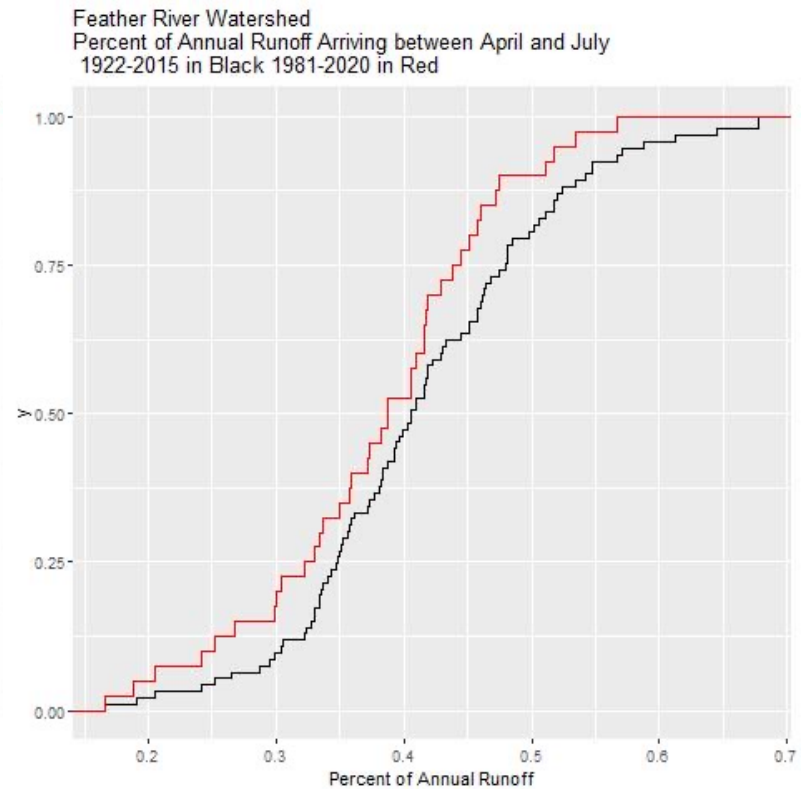
American



Seasonal Percent = amount of FNF during season/total FNF for Water-year *100


Feather River Watershed
Annual Runoff
1922-2015 in Black 1981-2020 in Red
1.00
0.75
0.50
0.25
0.00
y
2.5e+06
5.0e+06
7.5e+06
1.0e+07
Annual Runoff


Feather River Watershed
Percent of Annual Runoff Arriving between December and March
1922-2015 in Black, 1981-2020 in Red
1.00
0.75
0.50
0.25
0.00
y
0.3
0.4
0.5
0.6
0.7
Percent of Annual Runoff

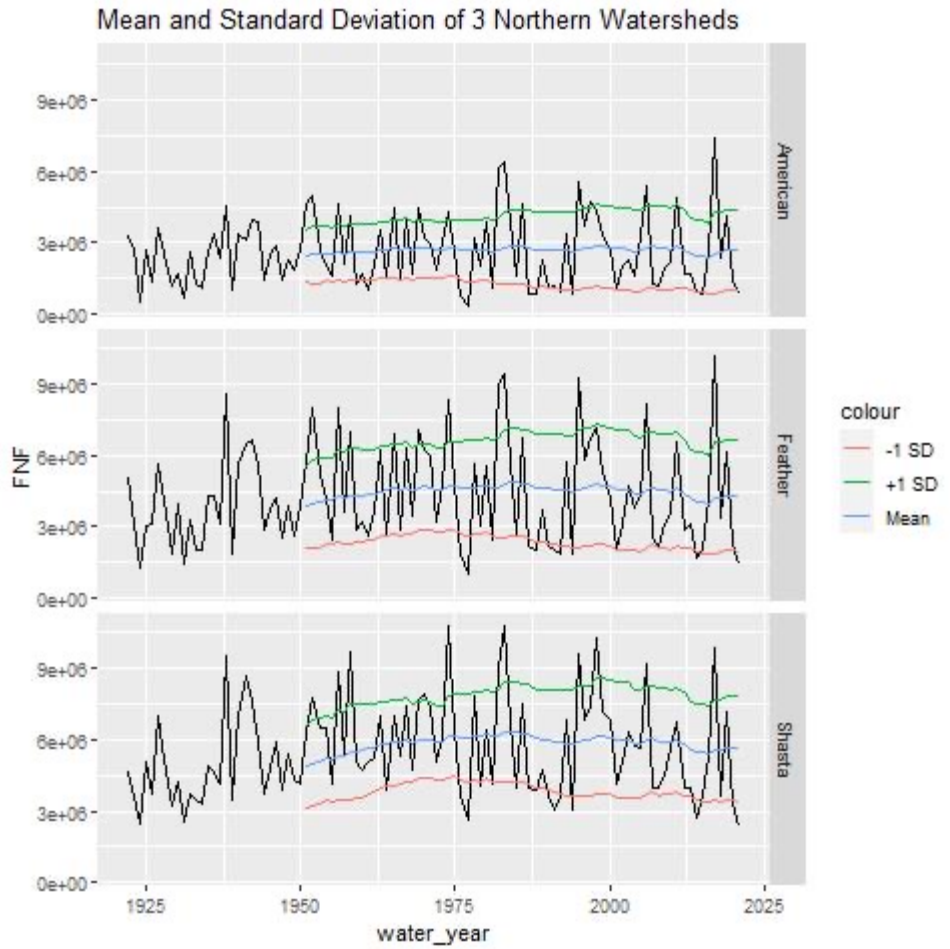

Feather River Watershed
Percent of Annual Runoff Arriving between April and July
1922-2015 in Black 1981-2020 in Red
1.00
0.75
0.50
0.25
0.00
y
0.2
0.3
0.4
0.5
0.6
0.7
Percent of Annual Runoff

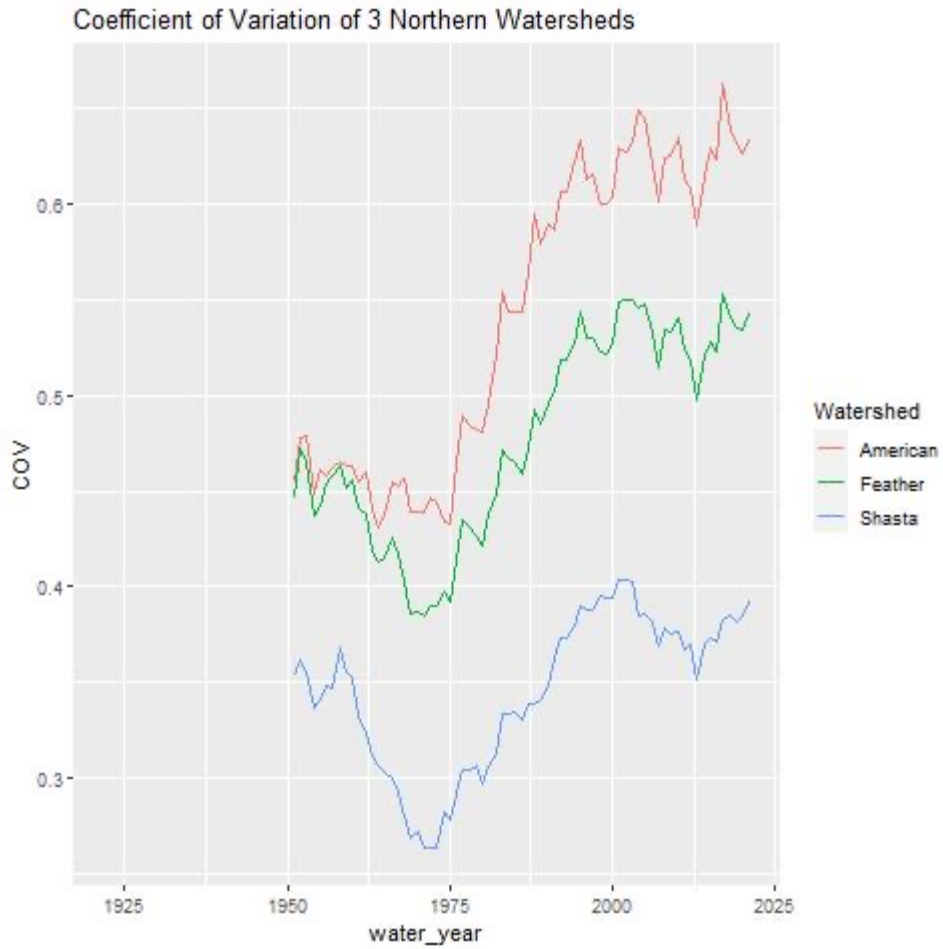
Approved Motion:

- Based on the data and trends we've looked at, the shift in the seasonal timing of runoff is significant *enough* to *move on to the step of deciding how to adjust it.*

On going Discussions:

- Should increase in inter-annual variability of runoff also be adjusted?





Next steps, USBR involvement/Coordination

- Participation in workgroup?
- Technical assistance with development of methodologies?
- Analysis of impacts when run through CalSim?
- ….