Improving seasonal precipitation mapping using GPCC data over the western US

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Motivation

- Precipitation seasonality changes insufficiently studied over the western US
- Area of particularly interest due to predicted MEGA droughts in California
- Basic climatology study for California lacks

Outline

1. Introduction
   Western US precipitation seasonality

2. Data & Methodology
   Datasets
   Predictors
   Mapping precipitation

3. Results (including SOM)

4. Conclusion & References

Western US precipitation seasonality

Seasonal Precipitation Fluctuations in the Western United States During the Late Nineteenth Century

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(Manuscript received 14 August 1975, in revised form 12 January 1976)

U.S. (approx. longitude 112°W). Long record precipitation stations which had essentially complete records were selected from latitude 48°17' N to latitude 32°15' N . We were interested in daily precipitation because of its use for agriculture, crop management and forest management. The attributes of interest considered are precipitation magnitude and relative frequency of occurrence.

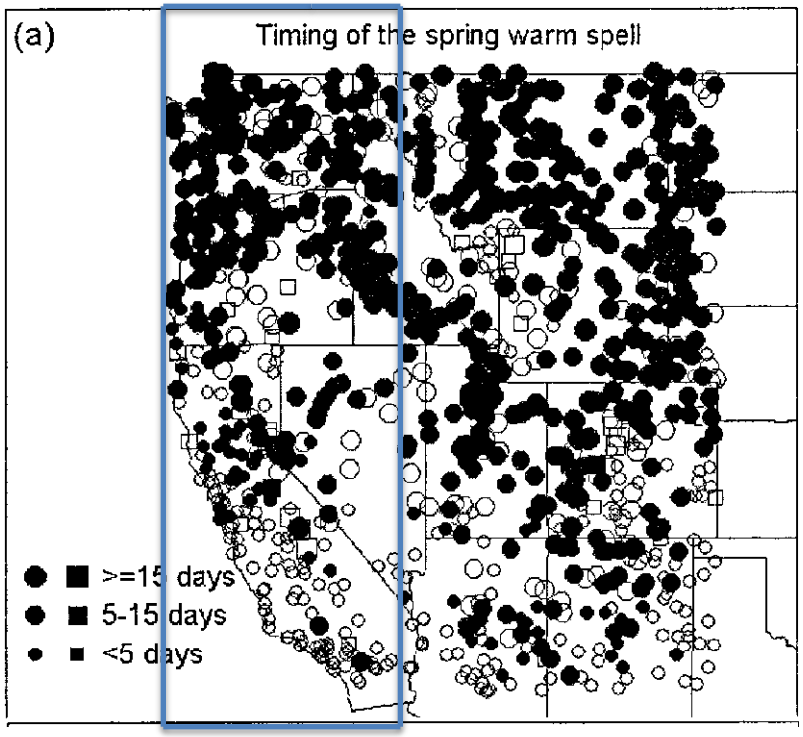
Stochastic precipitation models as well as other hydrologic models often deal with the nonstationarity in precipitation and other climatic inputs by dividing the

as a point process [*Waymire and Gupta* , *and Isham*, 1980]. For a stationary point p number of events (e.g., the events are occurre days) n(T) occurring in a duration T is a ra able with a Poisson distribution with mean

$$p(n(T) = k) = \frac{(\lambda T)^k}{k!} e^{-(\lambda T)} k = 0, 1,$$

where λ is called the rate or intensity paran changing intensity over the year can be de a nonhomogeneous Poisson process (same as

Trends in winter (Nov-March) precipitation

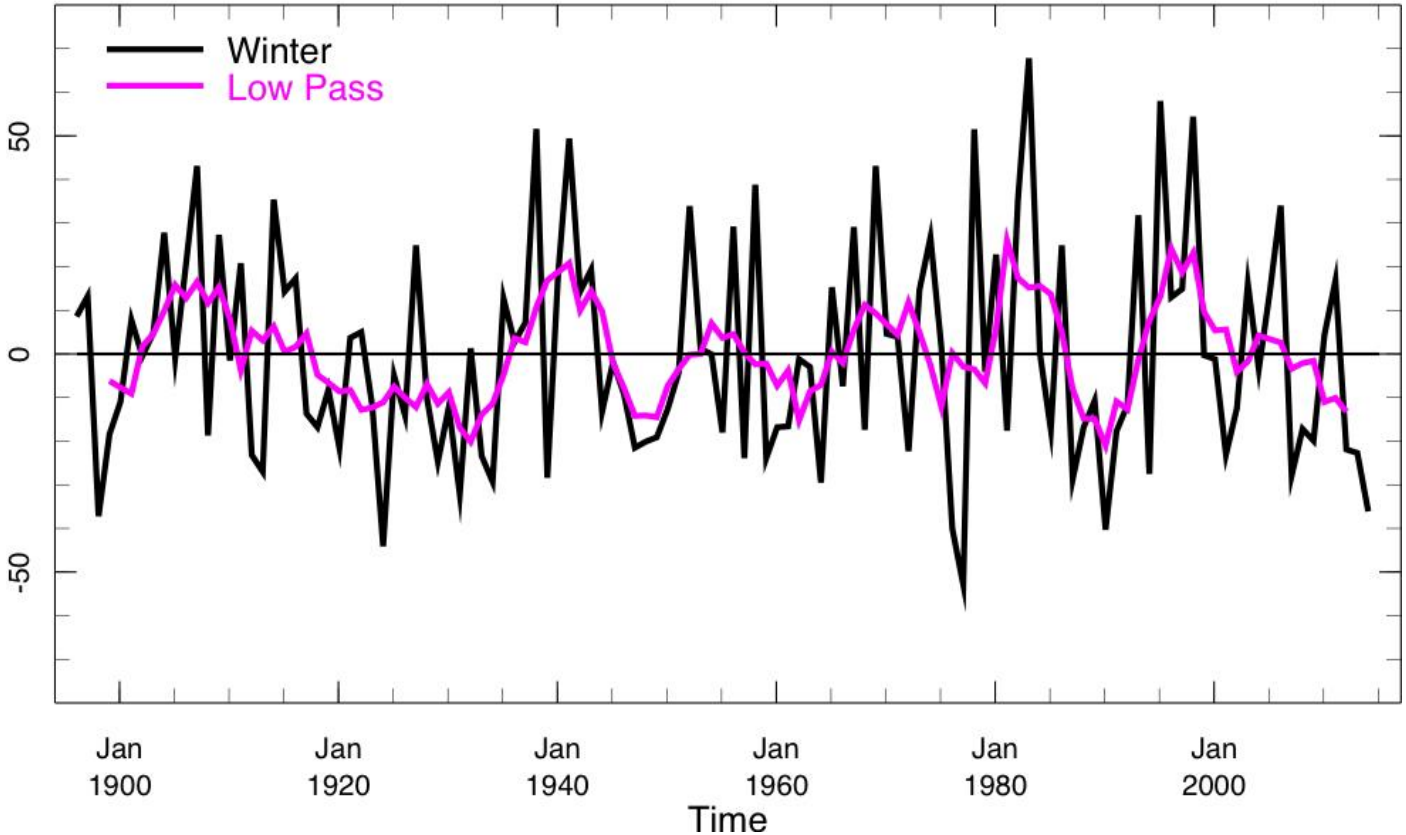


Trends in the winter rainfall (1950-1999)

decreasing values
Increasing values

Regonda et al. (2004)

Trends in winter (N-M) precipitation for California

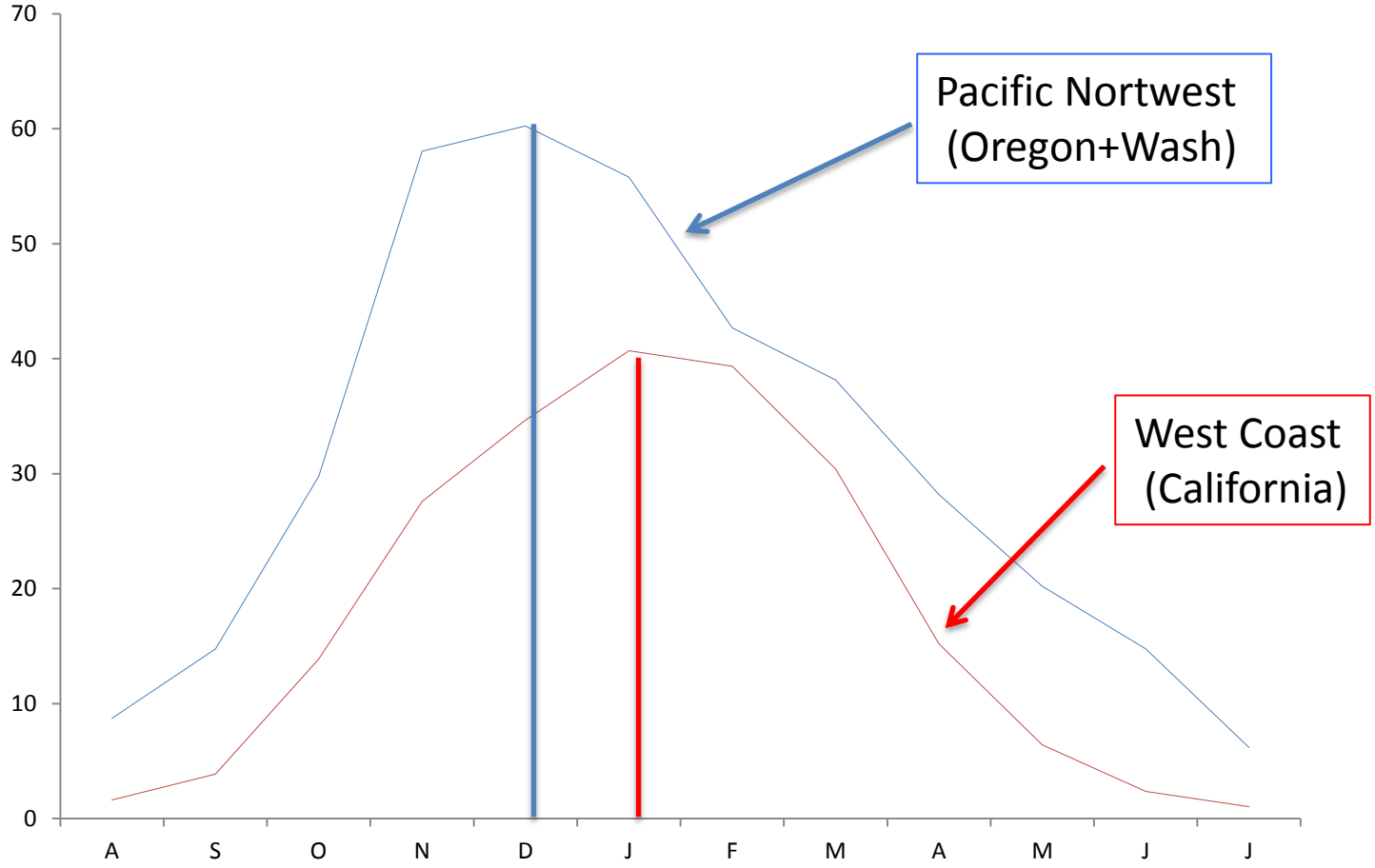


Seager al. (2014)

Questions

1. What are monthly and seasonal precipitation trends and their spatial signatures?
2. Are there changes in the onset and termination of the rainy season?
3. What is a relationship to large scale circulation patterns?

COOP climatology 1961-2010 (mm/month)



Using daily, monthly and seasonal observations from National Weather Service Cooperative Network (COOP) for the period 1961-2010 for Cal, Oregon and Washington. Seasons are defined as follows: winter (DJF), spring (MAM), summer (JJA), and autumn (SON).

Mapping seasonal precipitation in the western US using RK

Dataset:

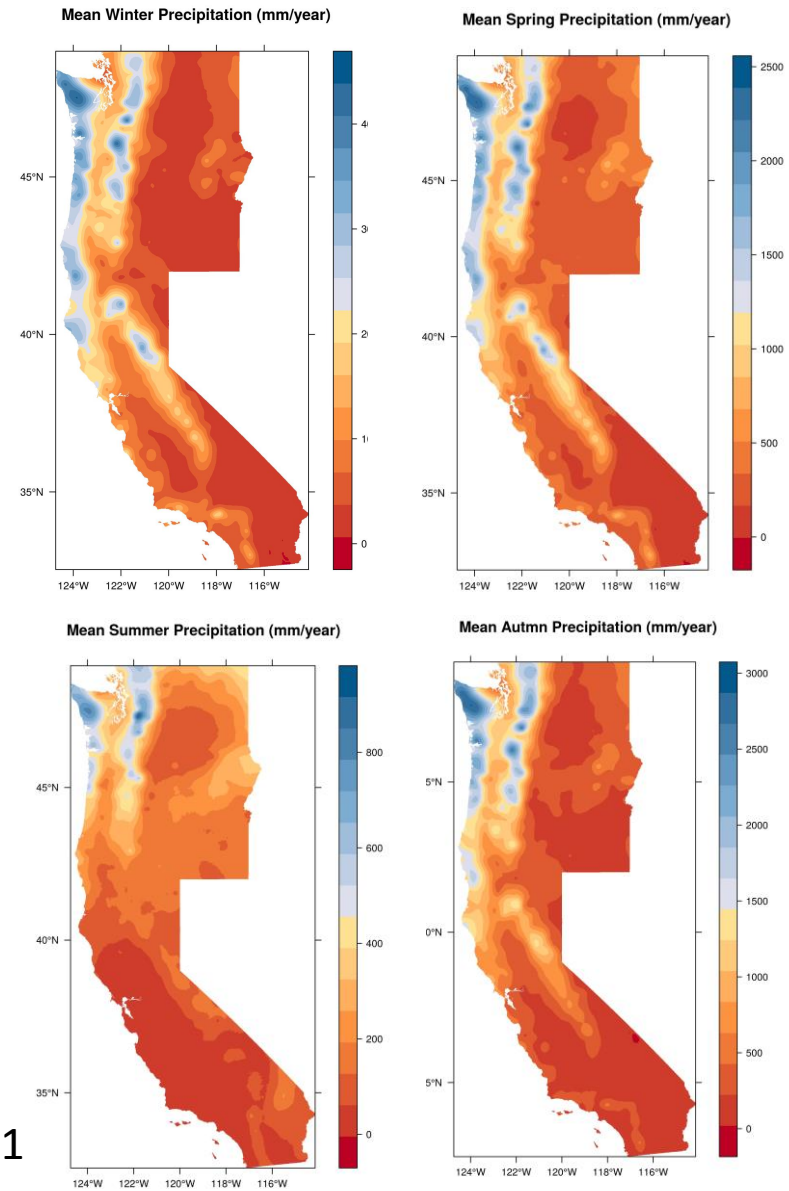
- COOP observations (1961-2010)
- ASTER GDEM global model (Version 1)

Predictors:

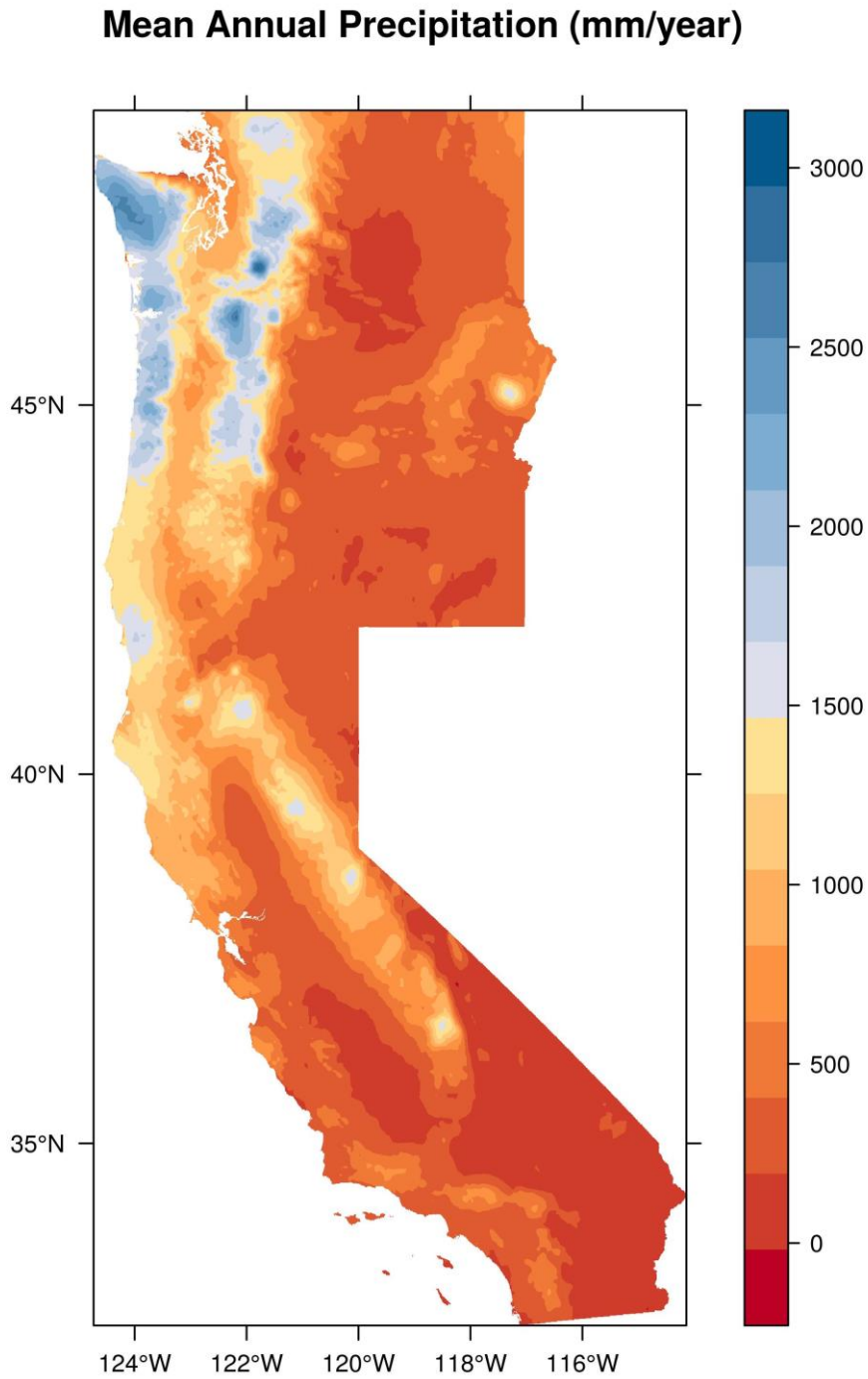
- GPCC Normals Version 2010
ftp://ftp-anon.dwd.de/pub/data/gpcc/html/gpcc_normals_download.html
-Lat, Long & Alt

Method: Regression Kriging (RK)

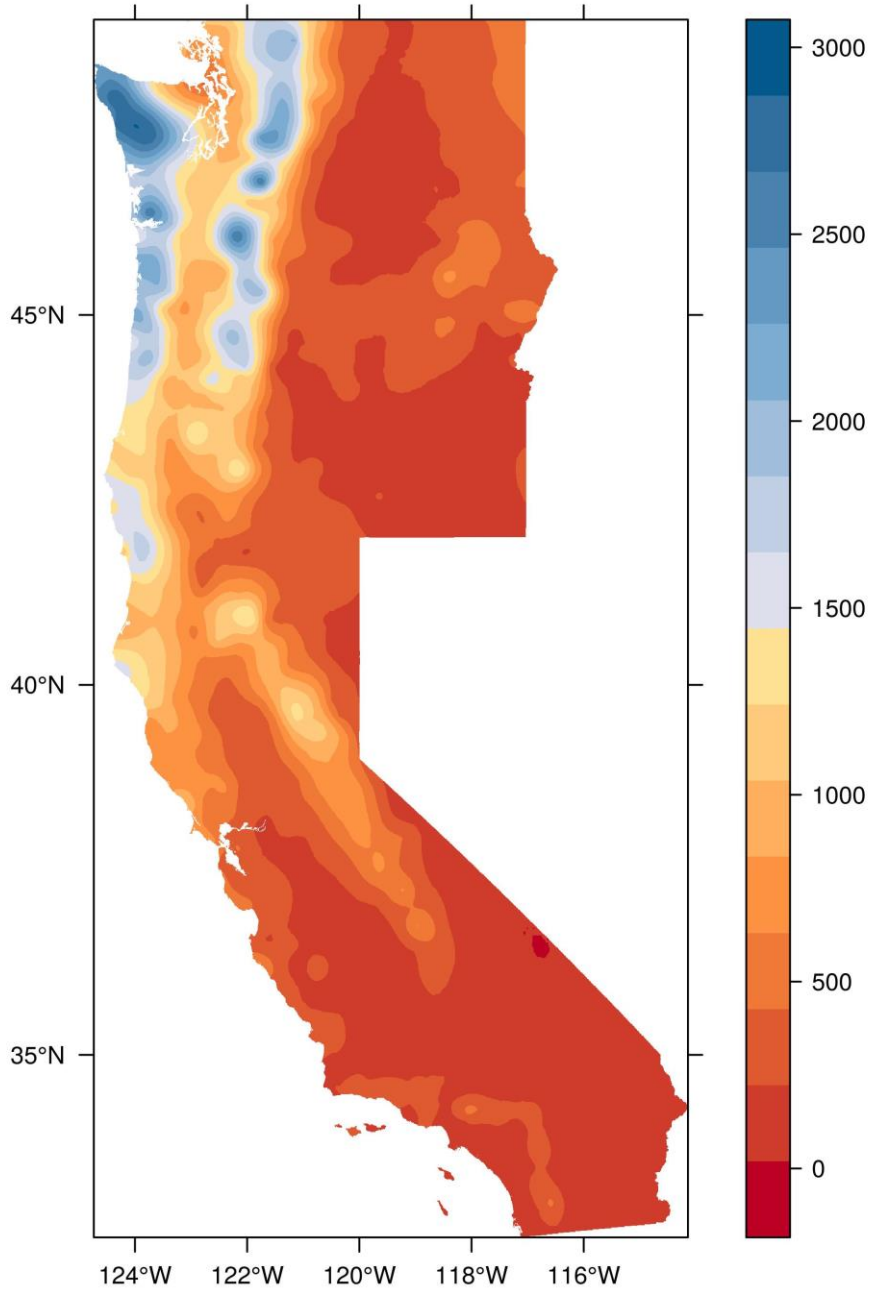
R^2=0.91



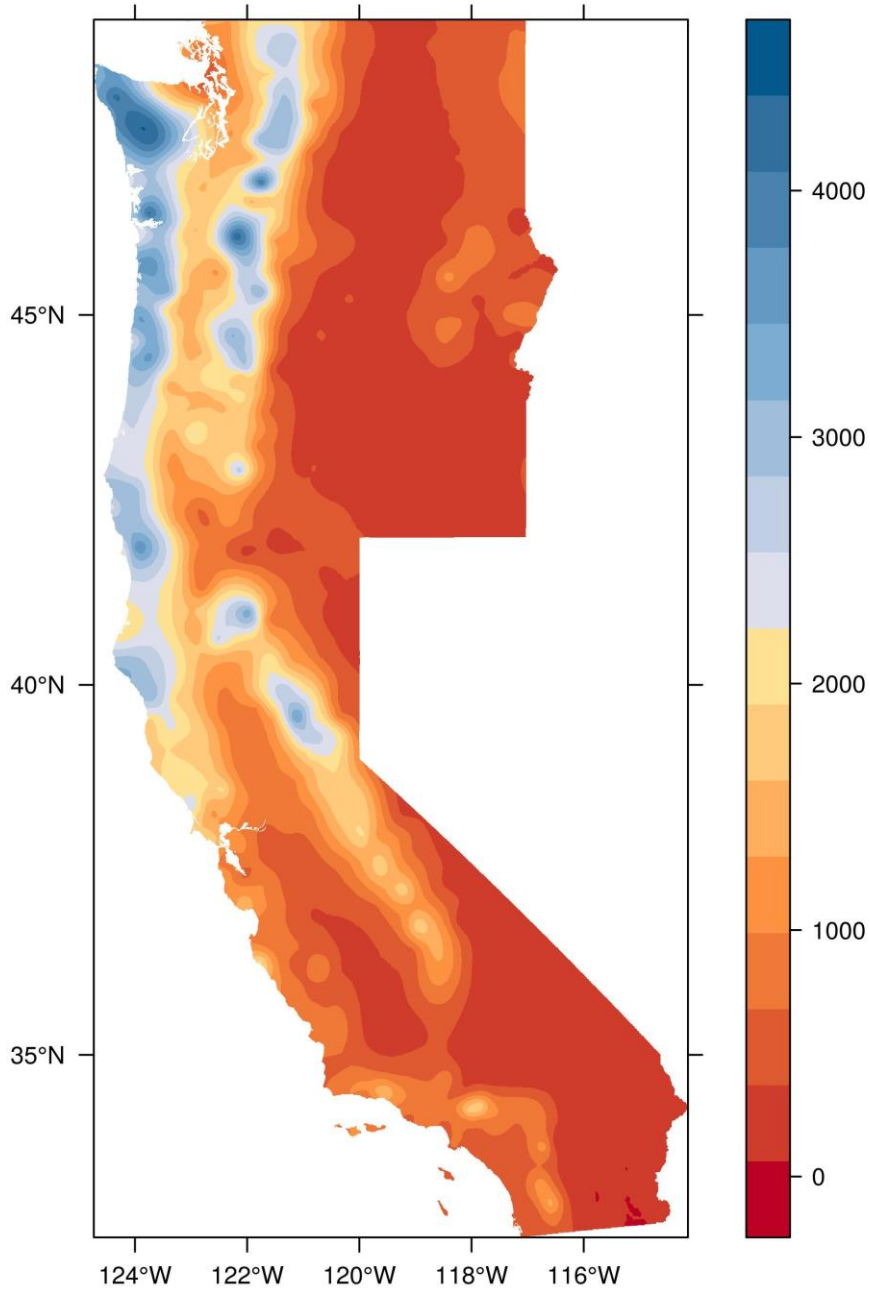
3. Results


Mean Annual Precipitation (mm/year)
45°N
40°N
35°N
124°W
122°W
120°W
118°W
116°W
3000
2500
2000
1500
1000
500
0

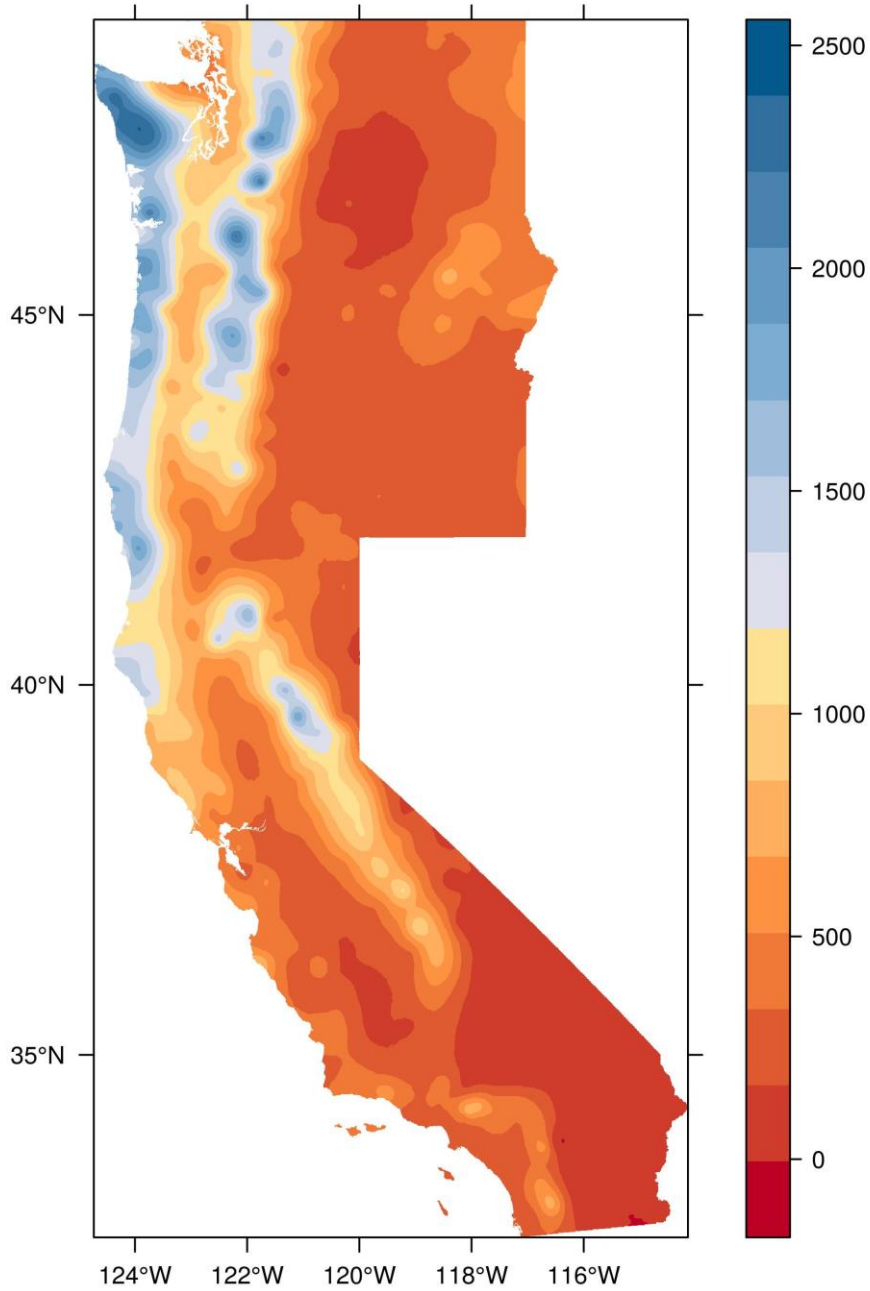
Mean Autmn Precipitation (mm/year)



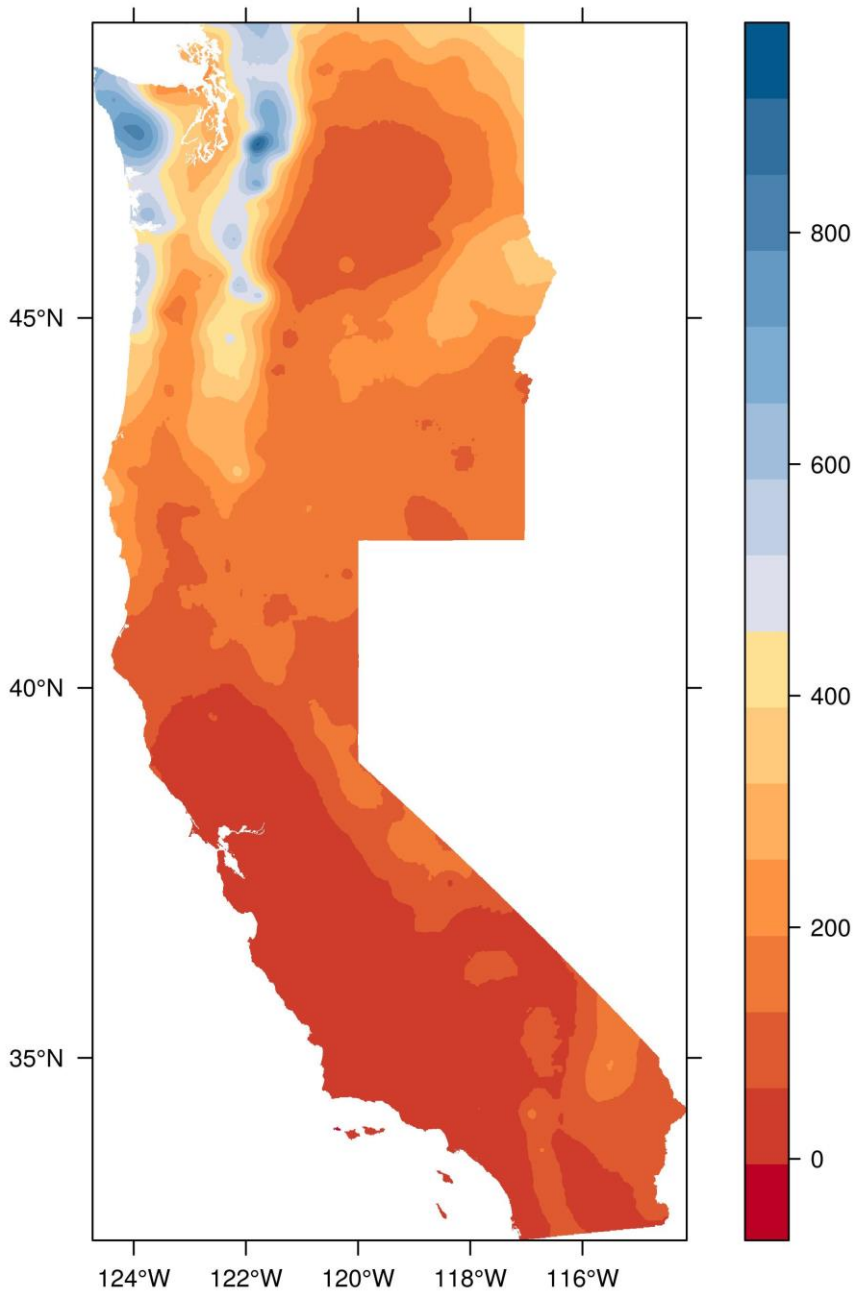
Mean Winter Precipitation (mm/year)



Mean Spring Precipitation (mm/year)



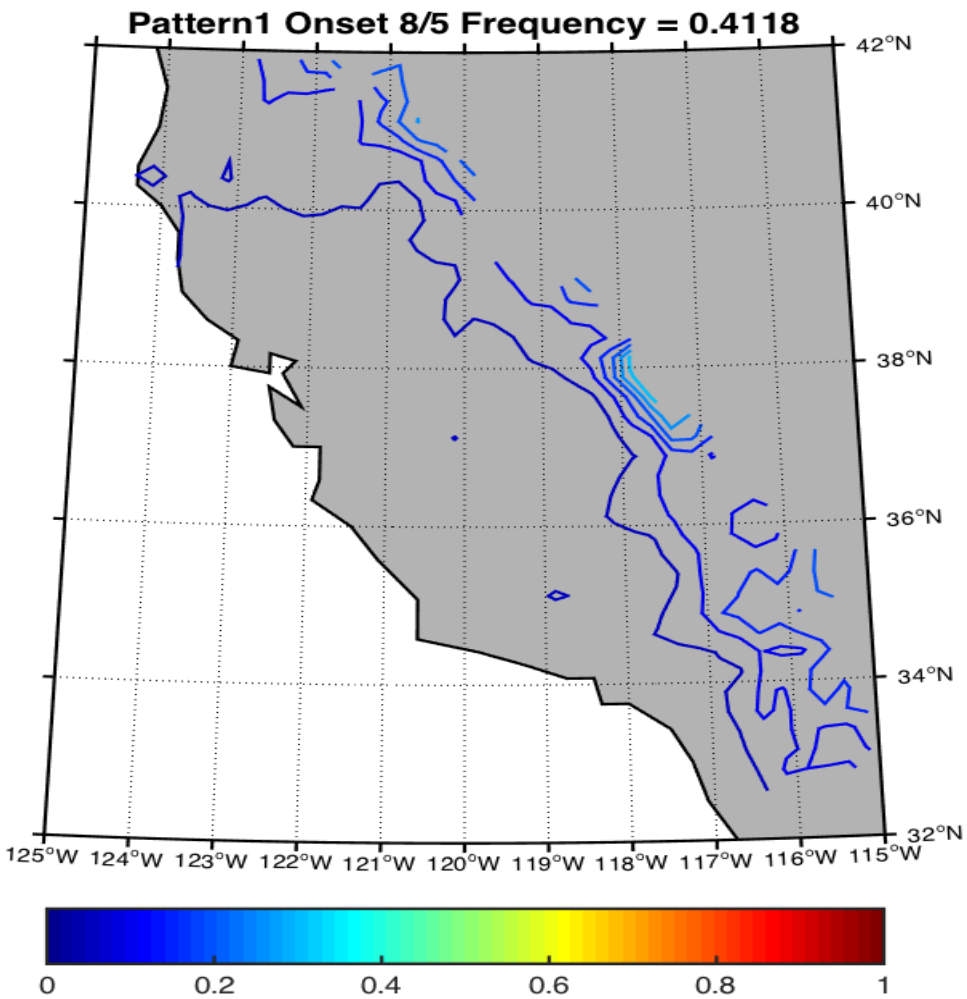
Mean Summer Precipitation (mm/year)



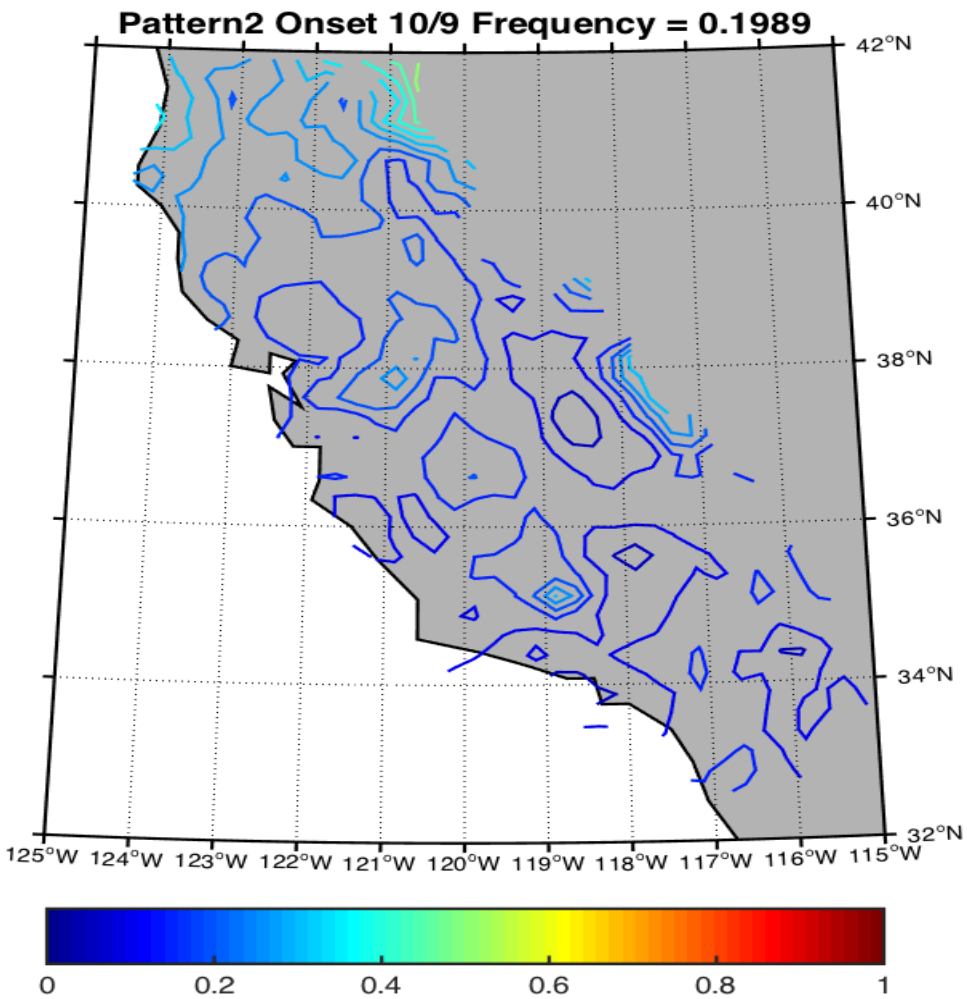
3. SOM with CAL GPCC Precipitation (1948-2006)

Done by Lief Swenson

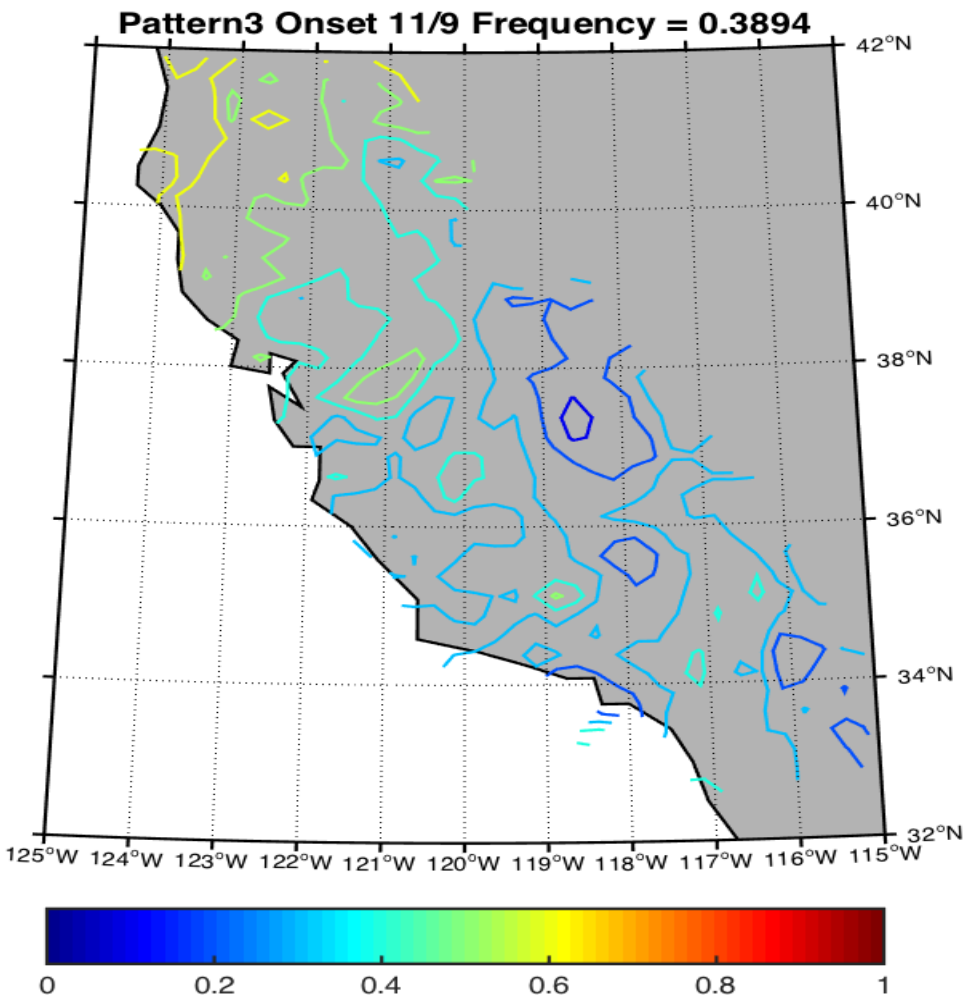
Pattern1, 1948-2006



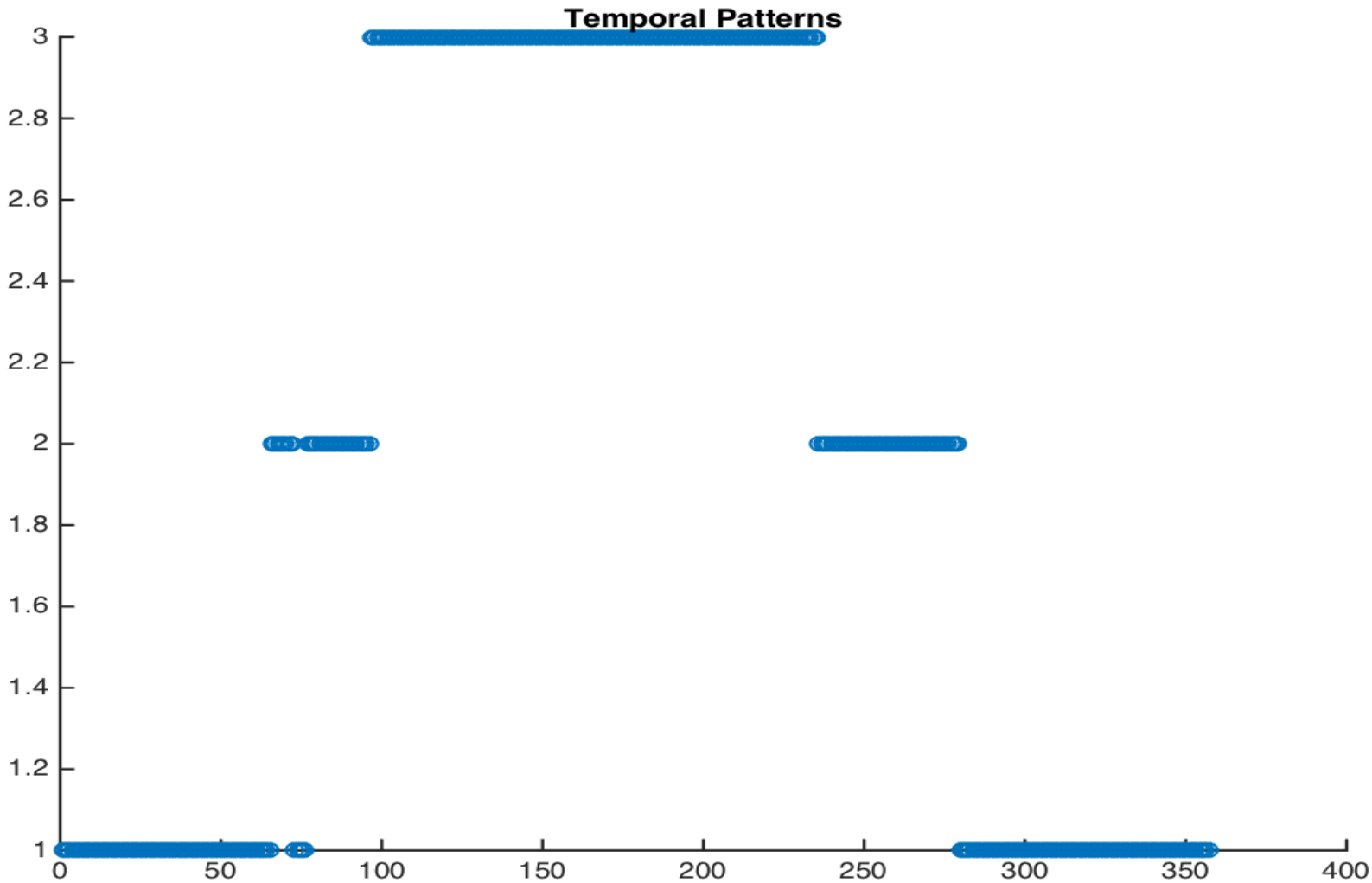
Pattern2, 1948-2006



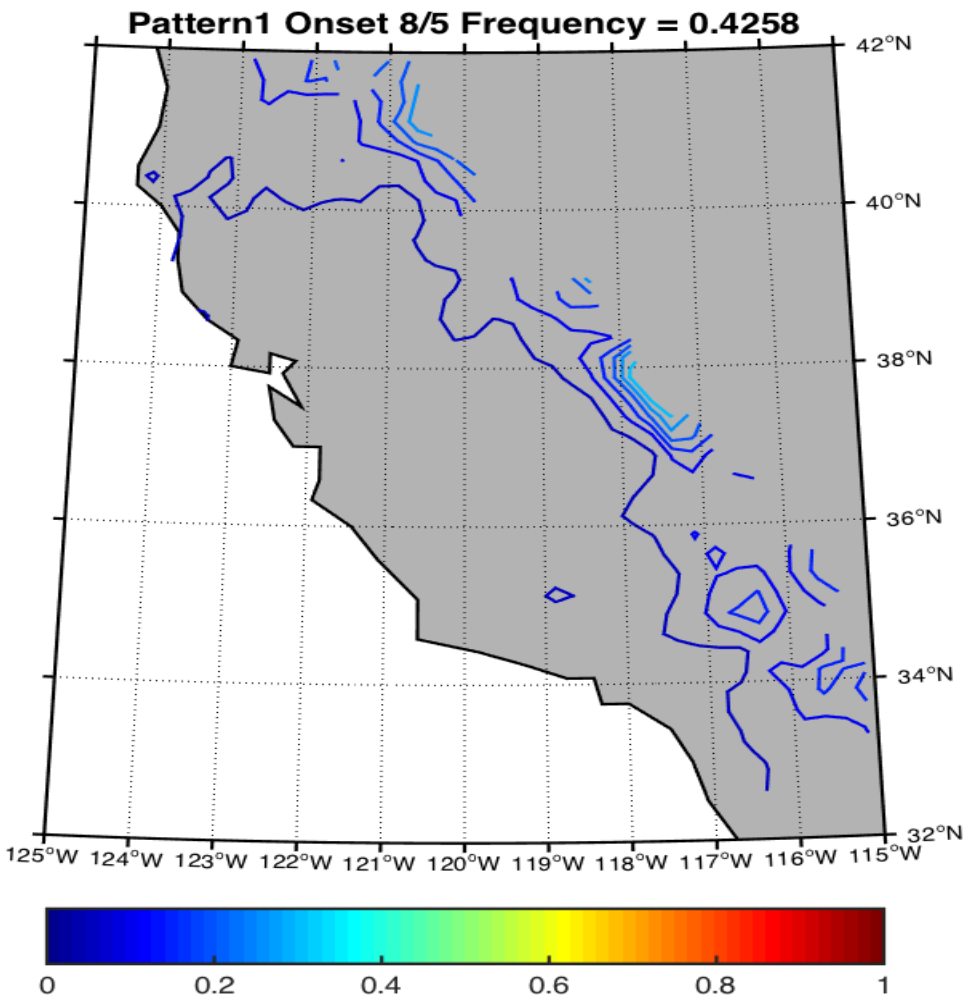
Pattern3, 1948-2006



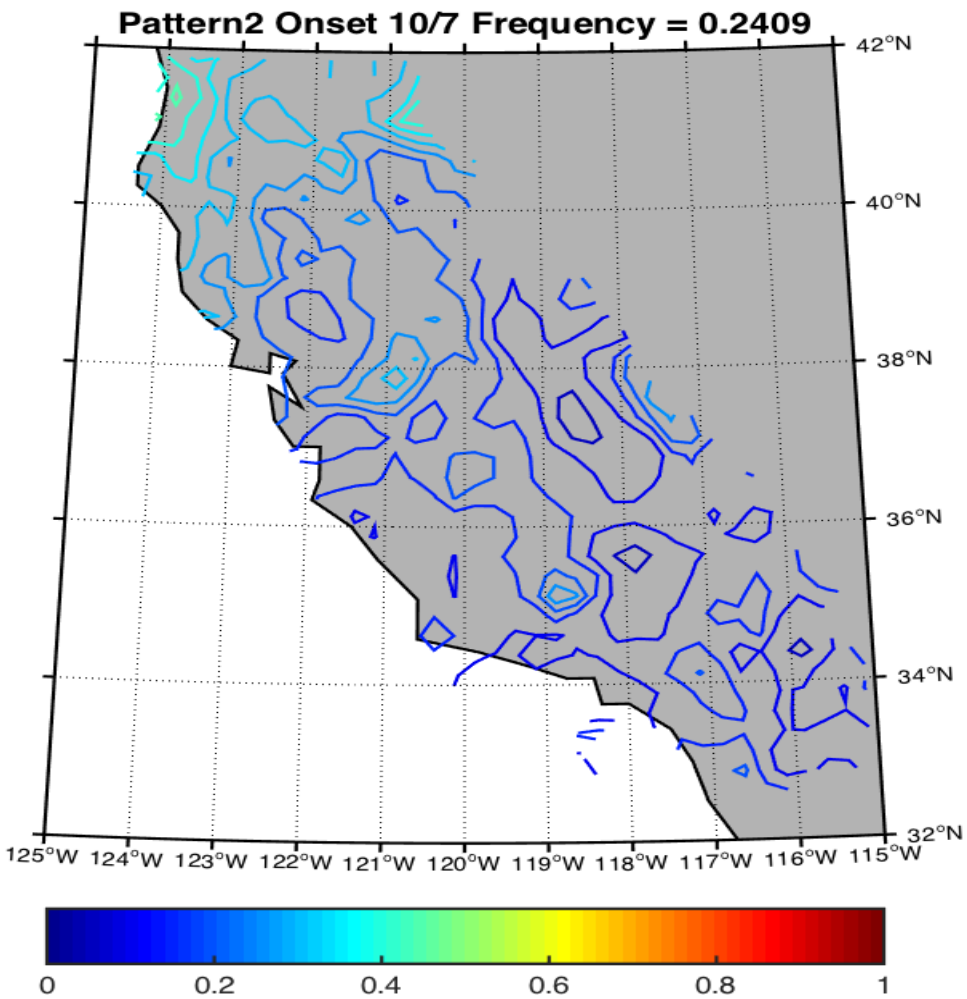
Patterns, 1948-2006



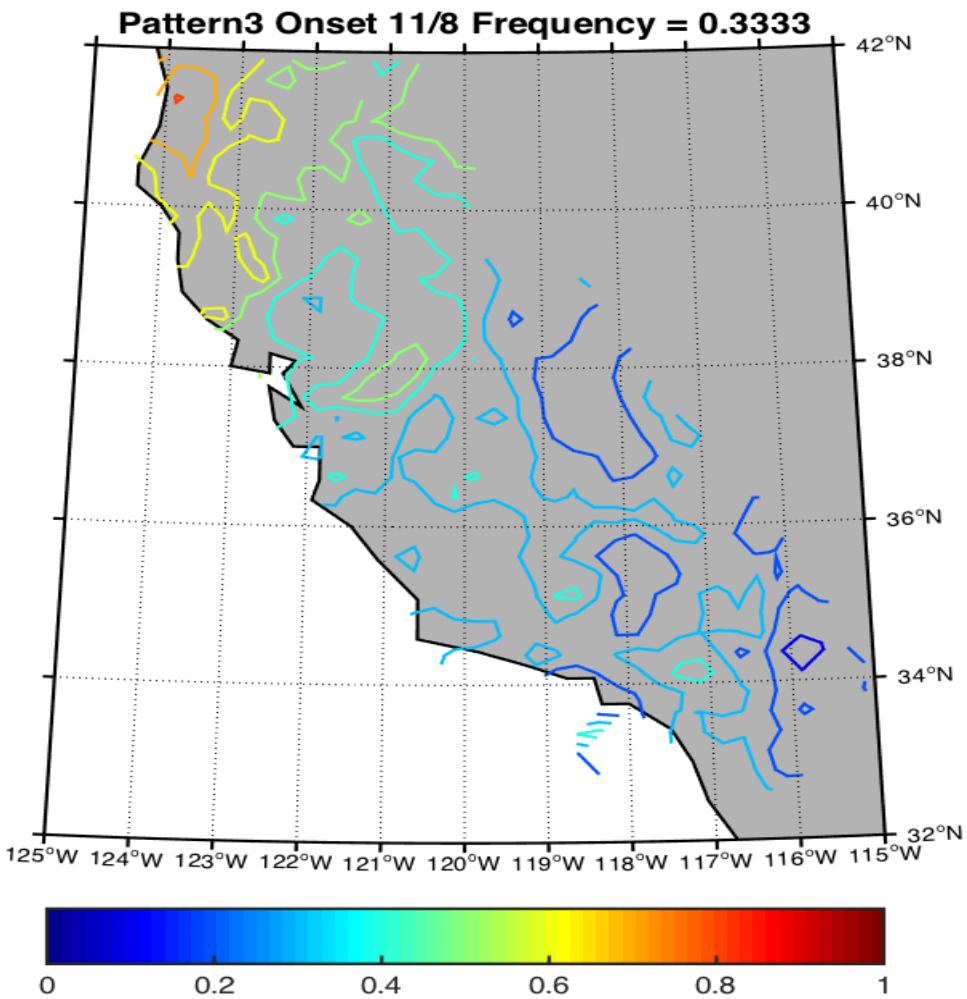
Pattern1, 1948-1976



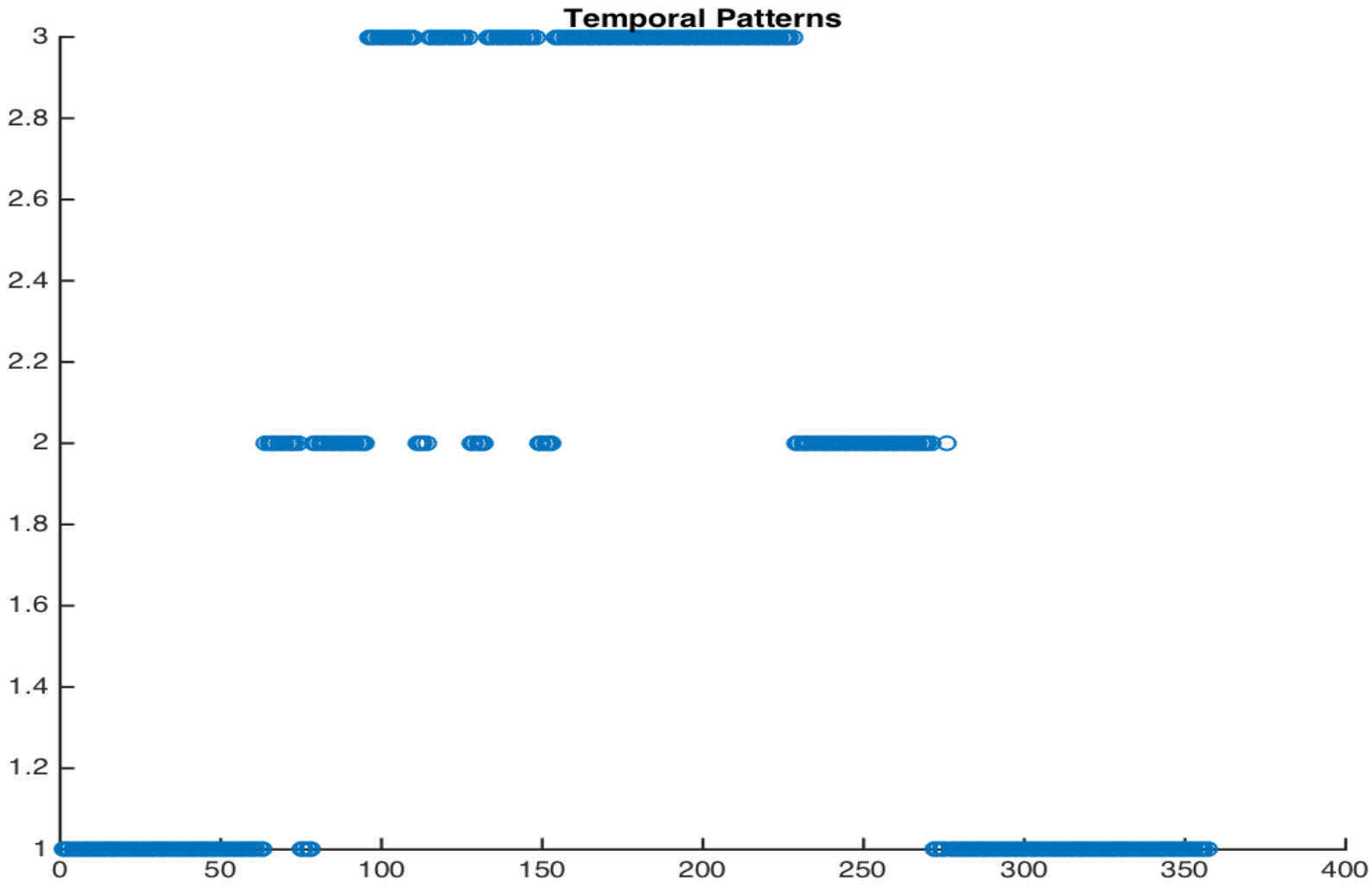
Pattern2, 1948-1976



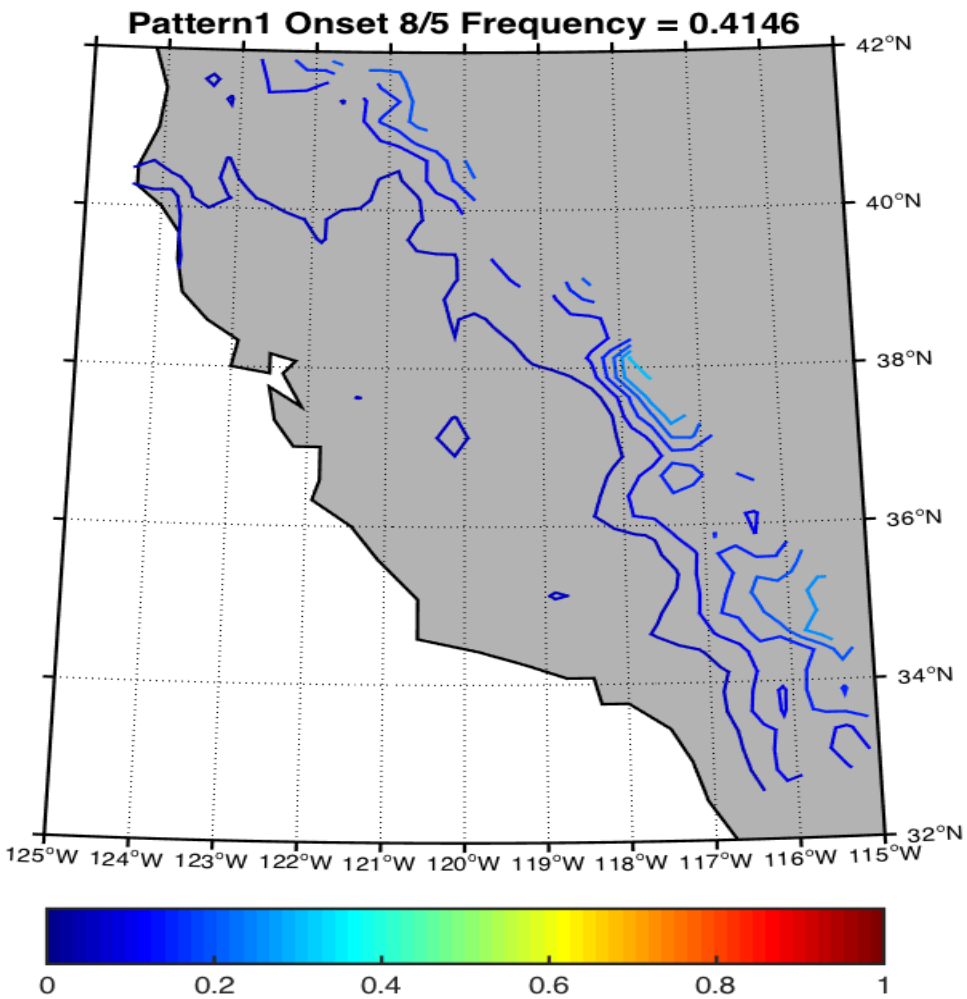
Pattern3, 1948-1976



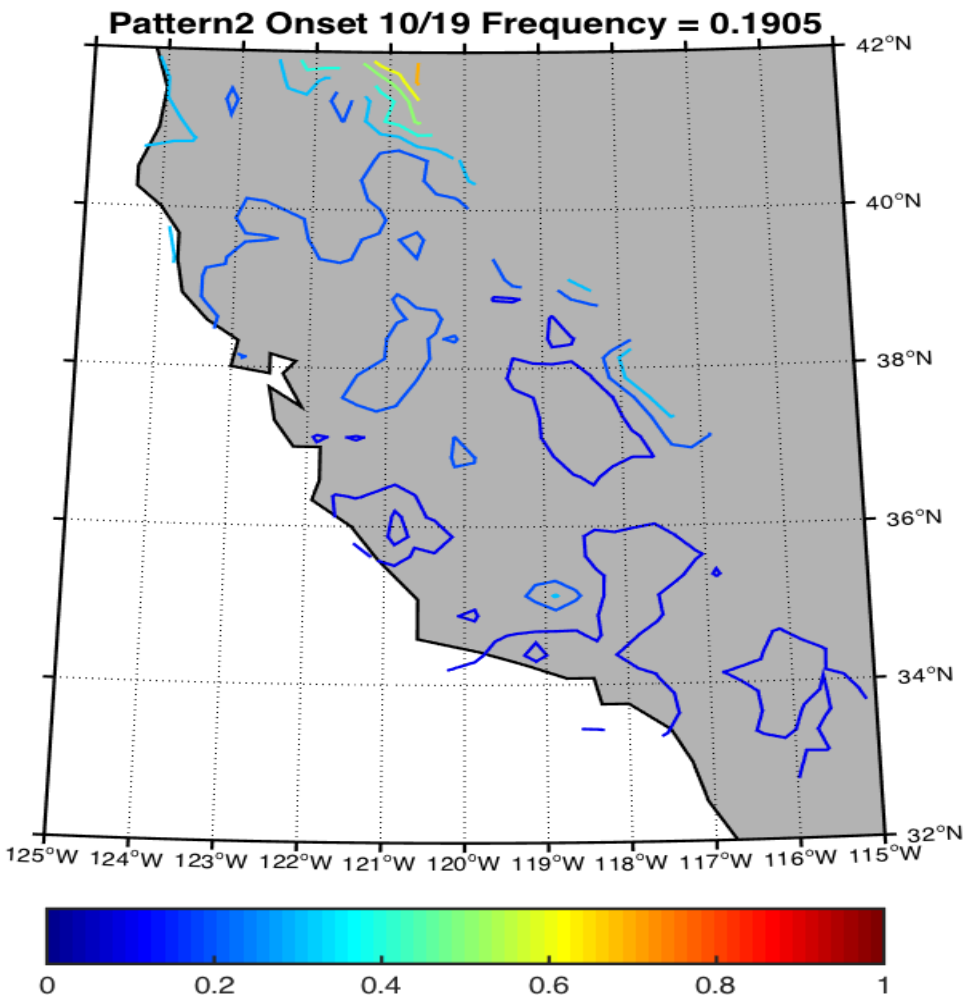
Patterns, 1948-1976



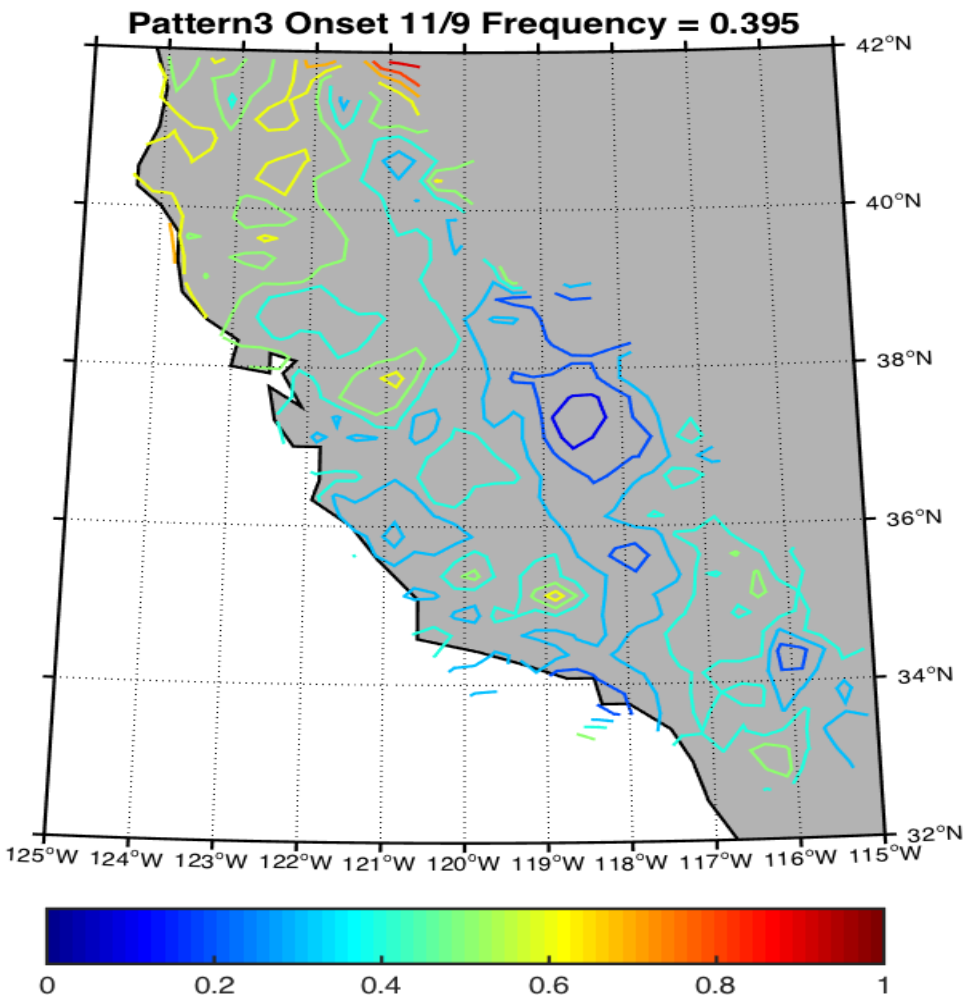
Pattern1, 1978-2006



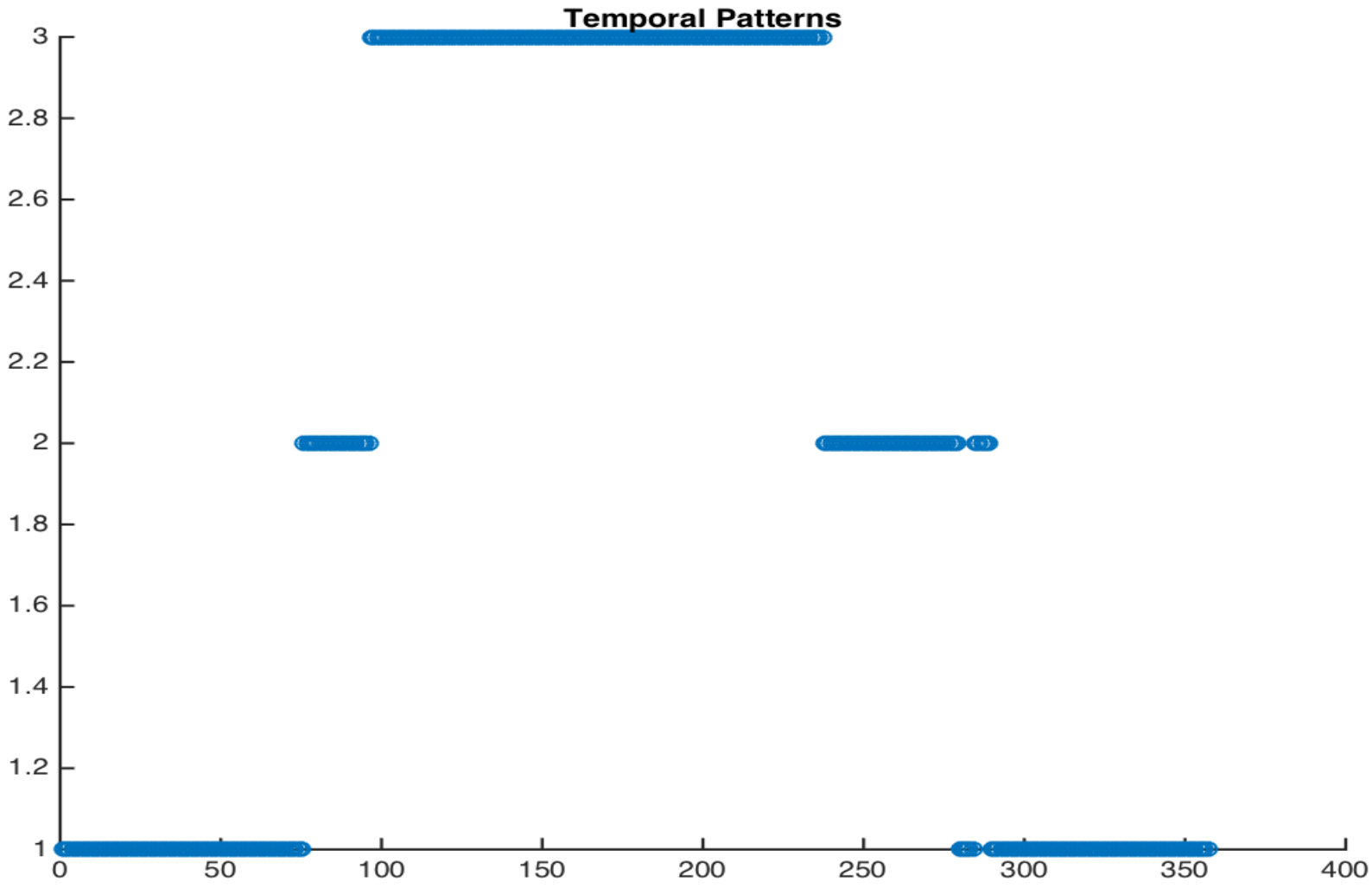
Pattern2, 1978-2006



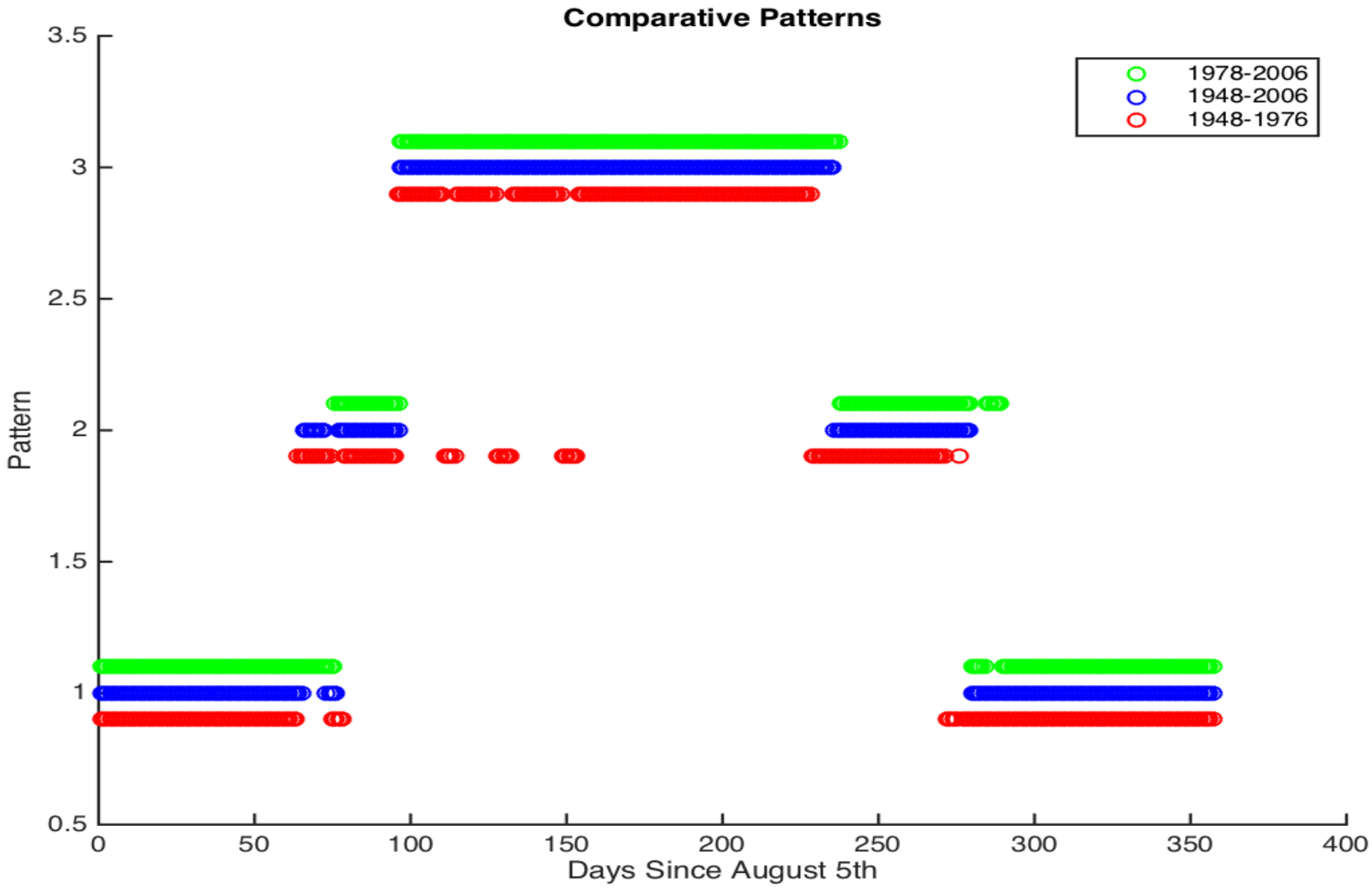
Pattern3, 1978-2006



Patterns, 1978-2006



Comparative Patterns



4. Questions instead of conclusion

1. Is there a shift in precipitation seasonal cycle over the western US, and if so, what are the dominant drivers?
1. Why max rainfall shifts from Jan to Feb in last few decades?
2. Why there is Nov decrease and Feb increase in rainfall over CA?

References:

Seager et al. 2015: Causes and Predictability of the 2011-2014 California Drought, NOAA Drought Task Force

Regonda, Satish Kumar, et al. "Seasonal cycle shifts in hydroclimatology over the western United States." Journal of Climate 18.2 (2005): 372-384.

Thank you very much!