Improving seasonal precipitation mapping using GPCC data over the western US

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GeoMla Conference, Belgrade, June 24, 2016
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
1. Introduction

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 Isha, 1980]. For a stationary point process, the number of events (e.g., the events are occurring at a rate of 4 days) a(T) occurring in a duration T is a random variable with a Poisson distribution with mean λT,

\[ p(n(T) = k) = \frac{(\lambda T)^k}{k!} e^{-\lambda T}, \quad k = 0, 1, \ldots \]

where λ is called the rate or intensity parameter. Changing intensity over the year can be dealt with using a nonhomogeneous Poisson process (same as...
Trends in winter (Nov-March) precipitation

(a) Timing of the spring warm spell

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?
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
  - Lat, Long & Alt

Method: Regression Kriging (RK)

$R^2 = 0.91$
3. Results

Mean Annual 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

Pattern3 Onset 11/9 Frequency = 0.395
Patterns, 1978-2006
Comparative Patterns

Days Since August 5th

Pattern

1978-2006
1948-2006
1948-1976
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?
2. 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?
Thank you very much!

References:

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