

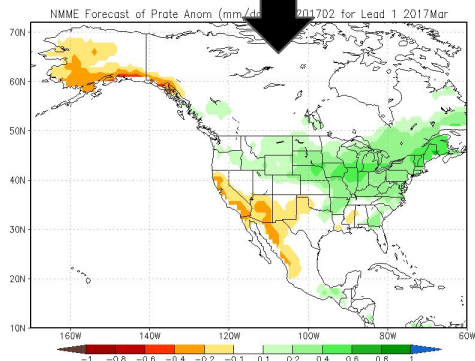
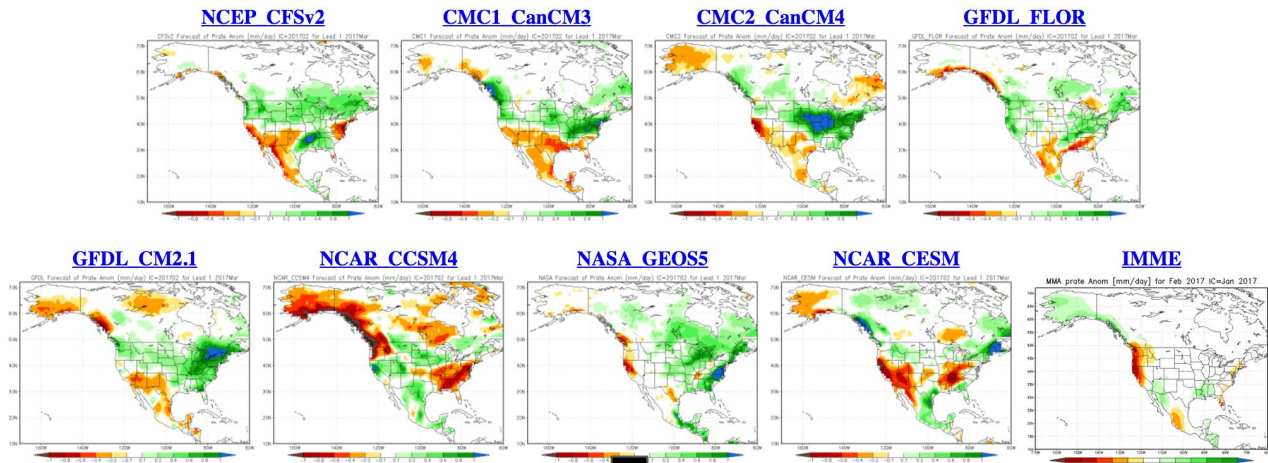
# **North American Multi-Model Ensemble (NMME) based outlook and sub-seasonal forecast products**

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# Outline

- Recap of Precipitation and Temperature forecasts and skill analysis
- Recent precipitation and temperature forecasts and skill analysis
- Initial skill analysis of S2S products based on NMME forecasts
- Summary

# North American Multimodel Ensemble (NMME) Forecasts

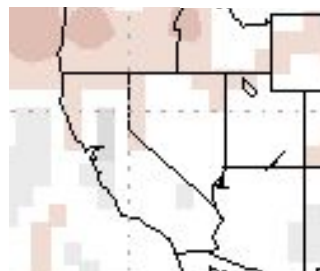
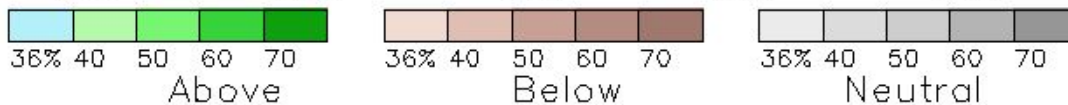


<http://www.cpc.ncep.noaa.gov/products/NMME/>

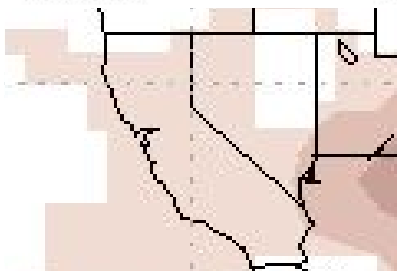
- 9 models
- About 110 scenarios
- Updates monthly

# Recap of NMME based forecasts

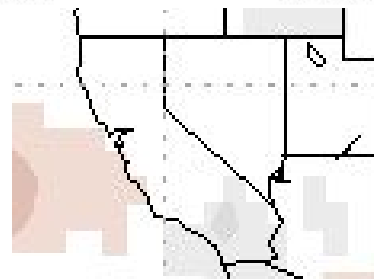
1 month ahead  
Forecast



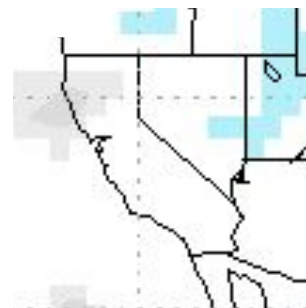
Oct, 2016



Nov, 2016

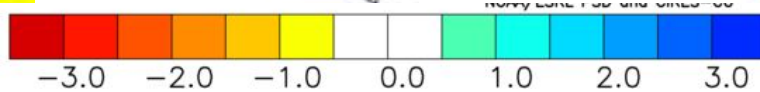
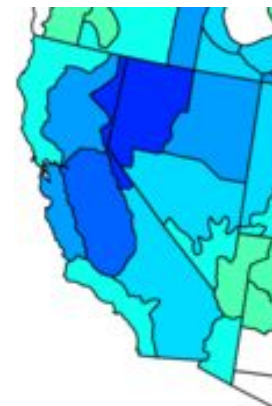


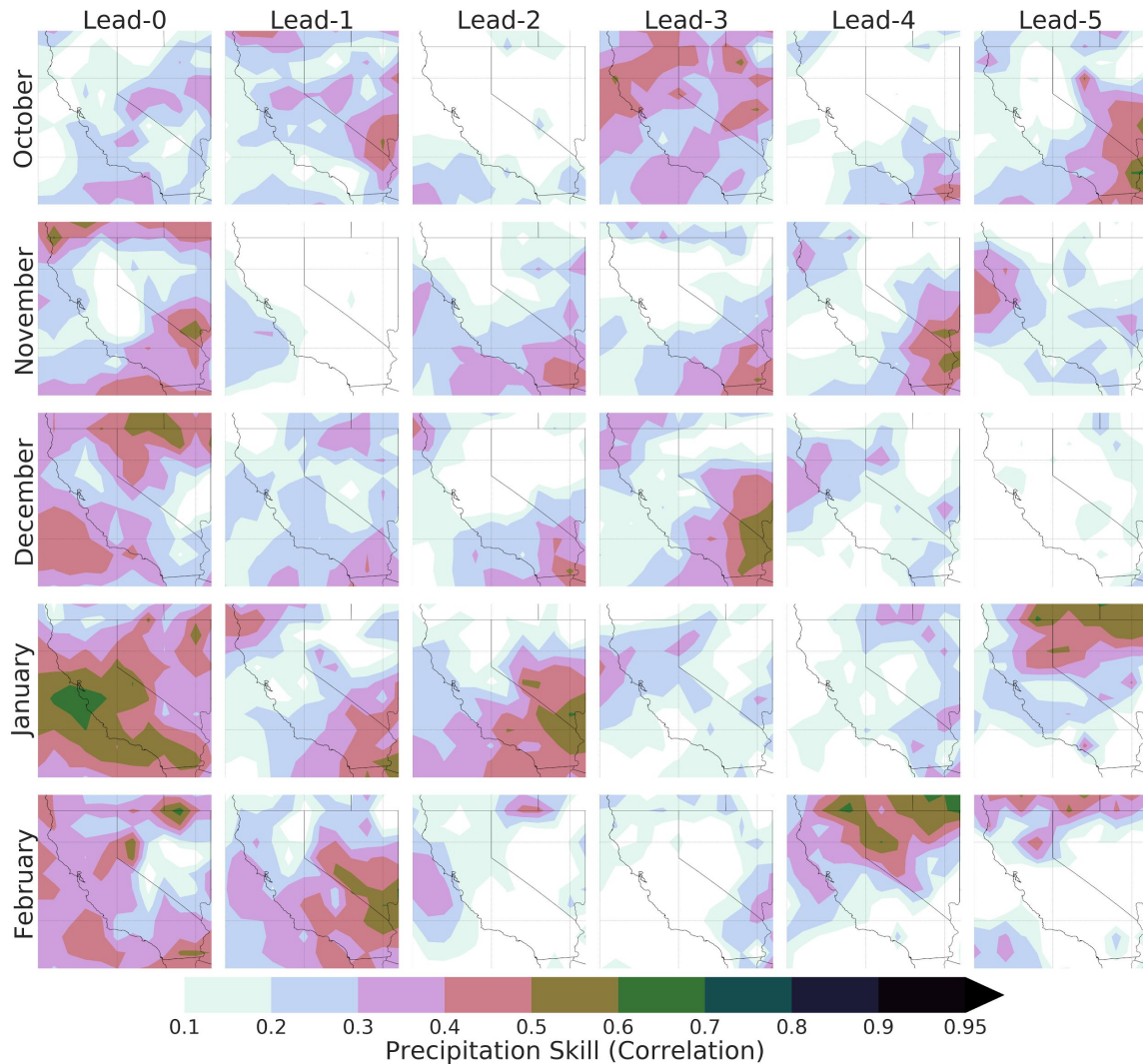
Dec, 2016



Jan, 2017

Observation

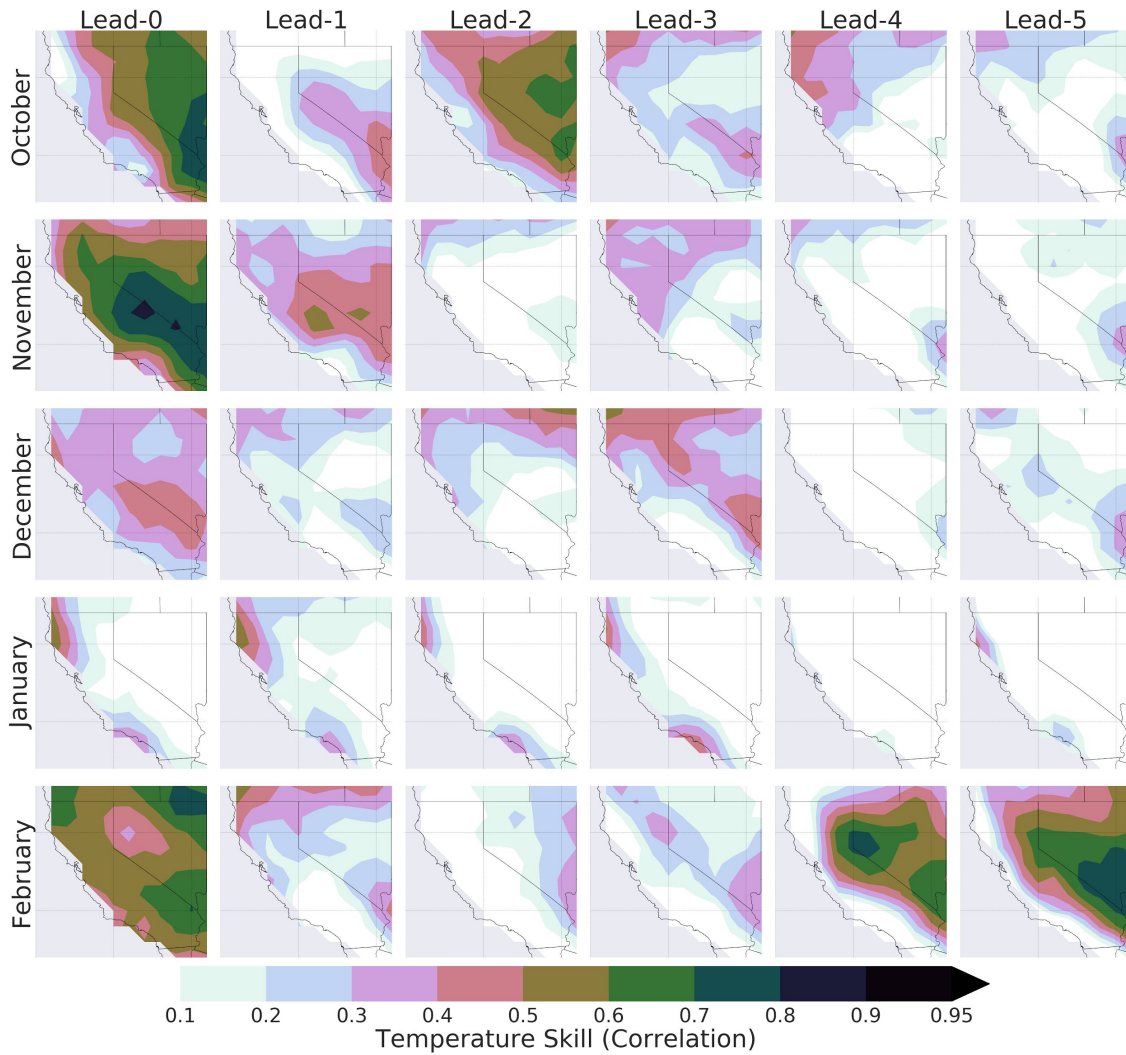




# NMME's Precipitation forecast skill

- Limited skill beyond 1 month.
- In some cases the skill is higher at longer leads than the short leads (e.g. January forecast made in October).
- March precipitation forecasts seems to be skilfull consistently going back to about 5 months in advance.

# NMME's Temperature forecast skill (Fall-Winter)

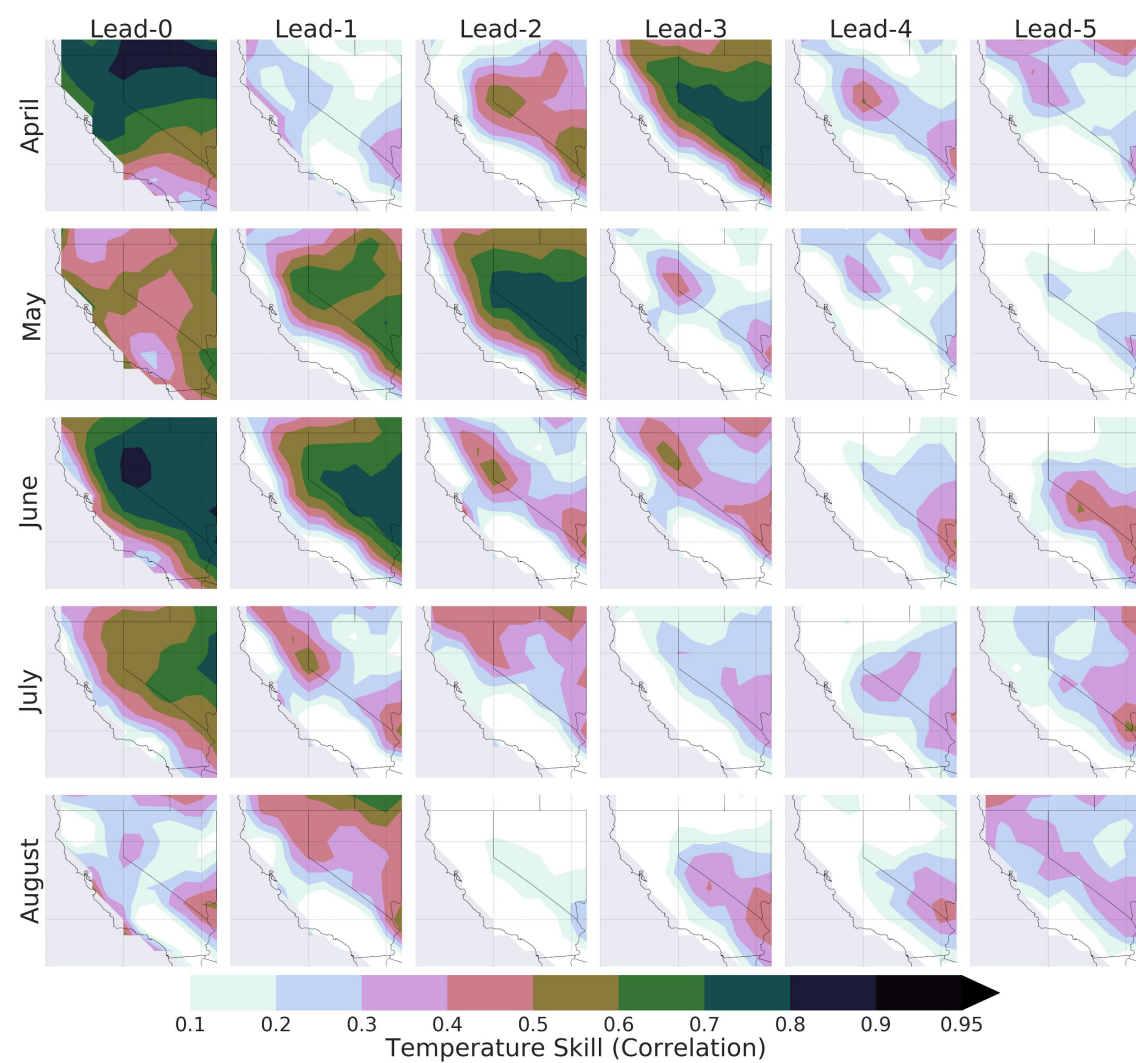


- Limited skill beyond 1 month.
- June and July temperature forecasts seem to be most skillful consistently.



# NMME's Temperature forecast skill (Spring-Summer)

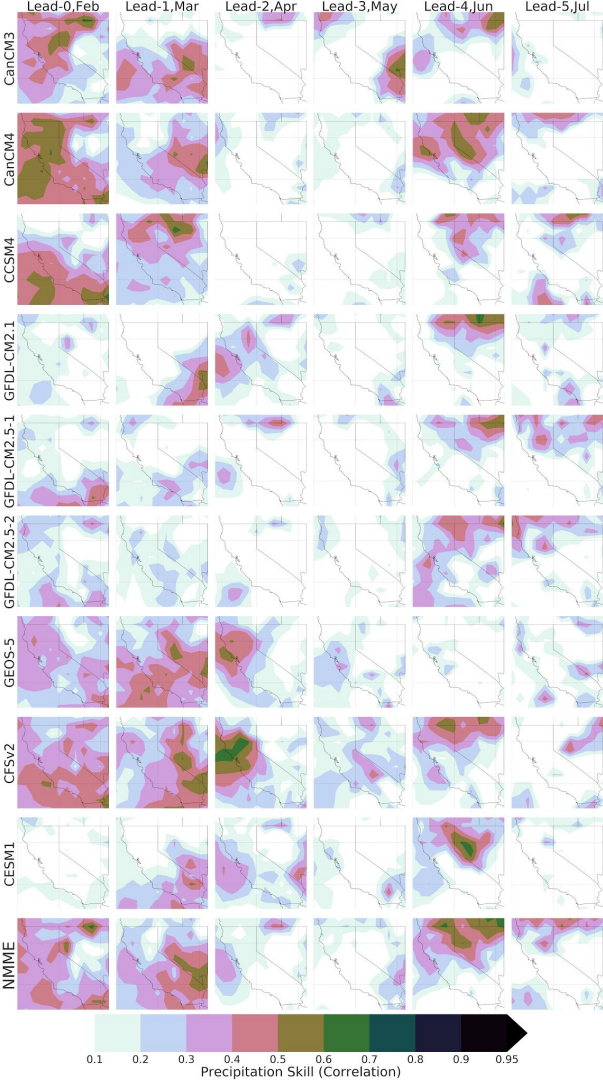
- June and July temperature forecasts seem to be most skillful consistently.



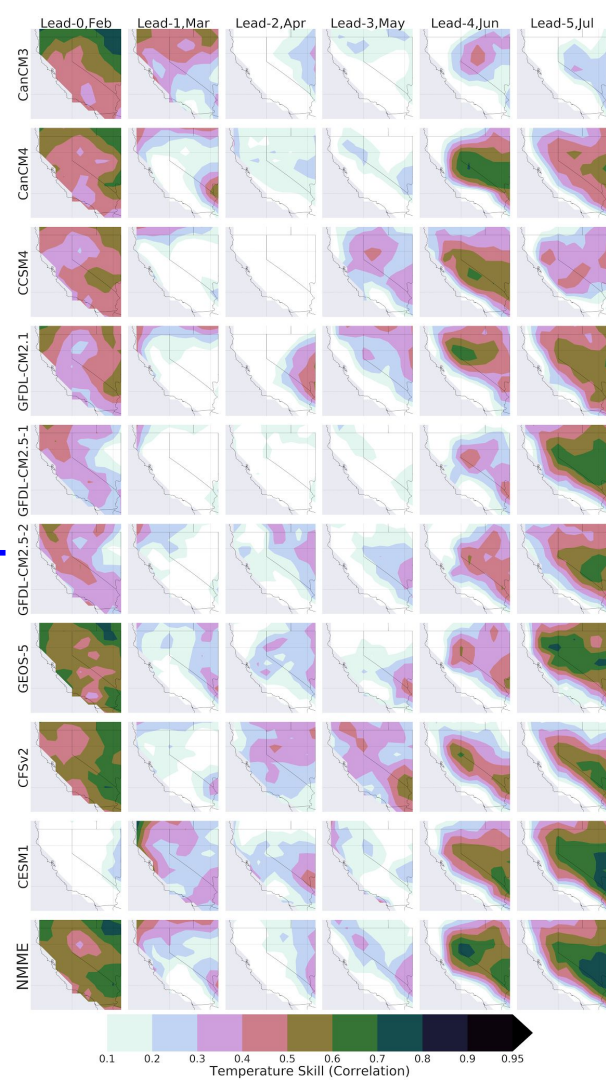
# Skill of forecasts made in February

## Precipitation

- Skill of individual models varies.
- In general the skill of NMME is equal to or more than the skill of in individual model.



## Temperature

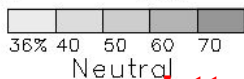
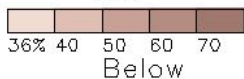
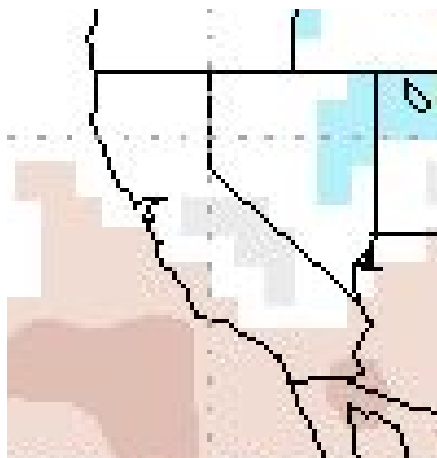




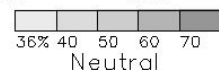
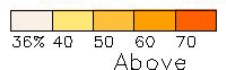
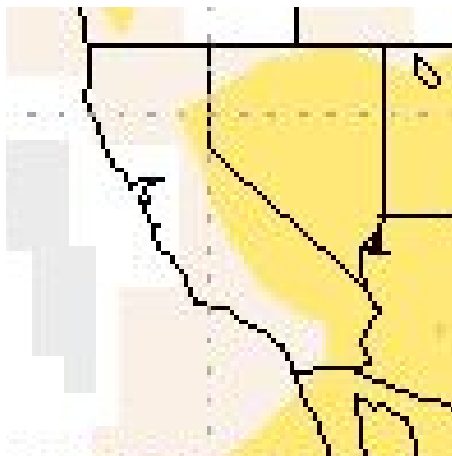
# Current Forecasts

- .Below normal March precipitation in Southern California.
- Above normal June and July temperature forecasts in much of interior CA and Nevada.

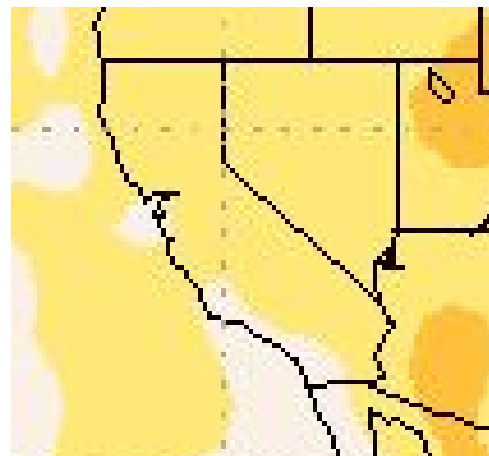
## March Precipitation




## June Temperature



## July Temperature





Sub-seasonal to  
Seasonal (S2S)  
forecast skill analysis

# Data

- Observed Precipitation and temperature:
  - Livneh et al., 2013 gridded dataset was used.
  - The dataset is spatially aggregated to 1X1 degree to match the spatial resolution of the NMME models forecasts.
- NMME forecasts:
  - 3 of the NMME models (**NASA's GEOS-5, CanCM3 and CanCM4**) are used.
  - Total 30 ensemble members.

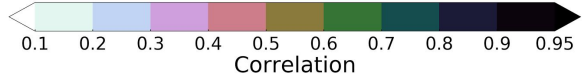
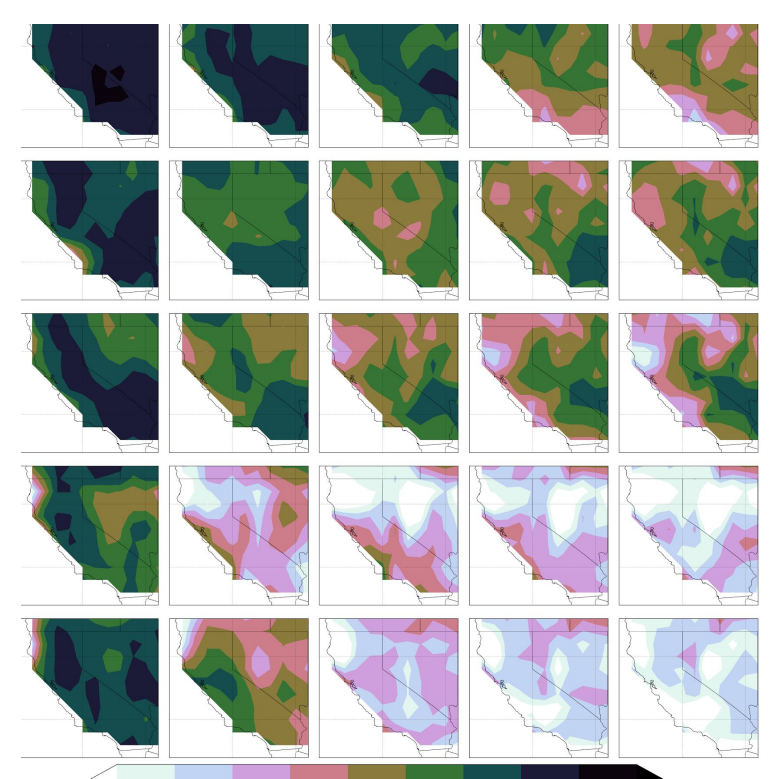
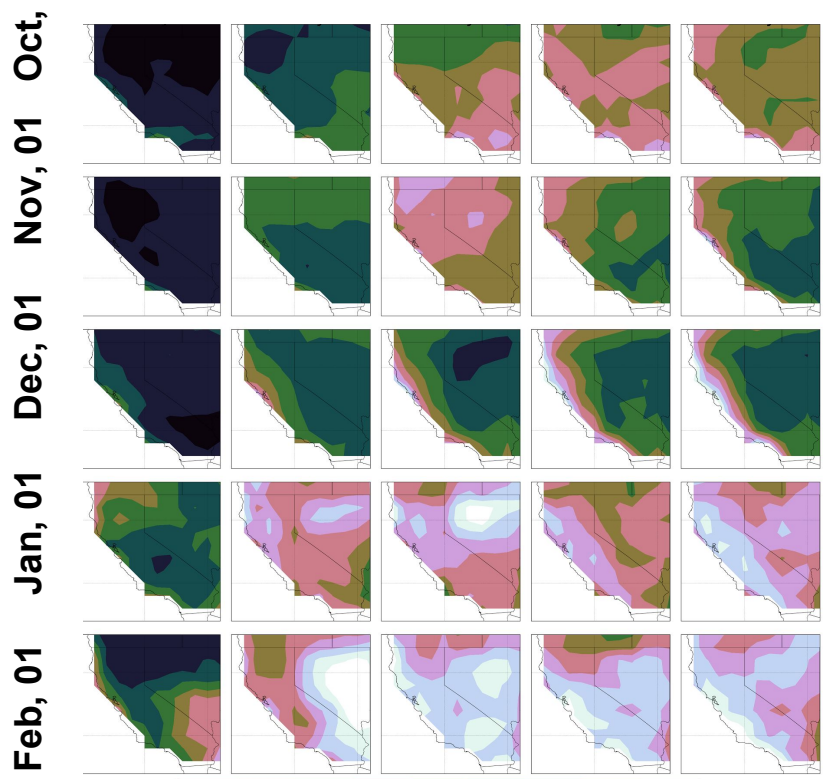
**Forecast of mean P, Tmax and Tmin  
at S2S scale**

# Temperature max

# Temperature min

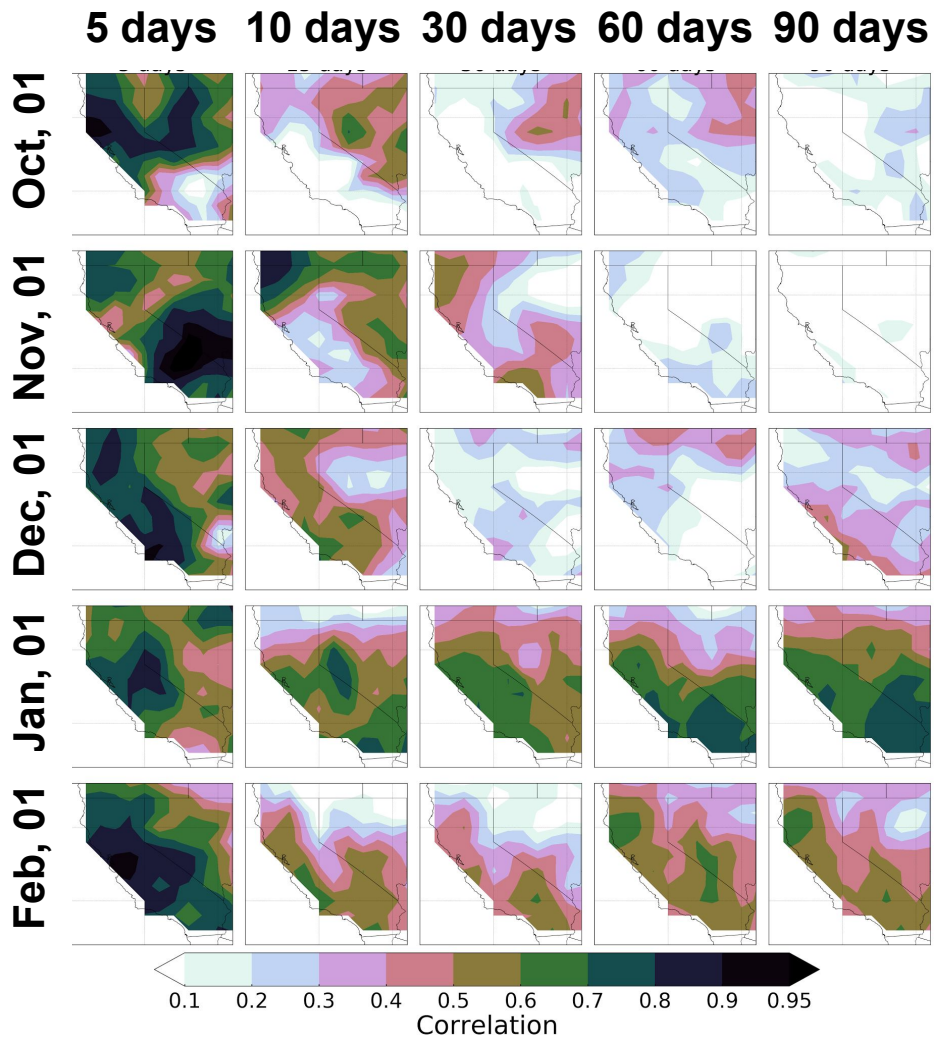
5 days 10 days 30 days 60 days 90 days

5 days 10 days 30 days 60 days 90 days





# Precipitation Forecast skill



- (1) The skill is the highest at short lead-times (<2 weeks).
- (2) The skill at seasonal scale (1 to 3 months) exists in forecasts made in early Jan and Feb.
- (3) Seasonal scale skill exists in Temperature forecasts made in April through June.

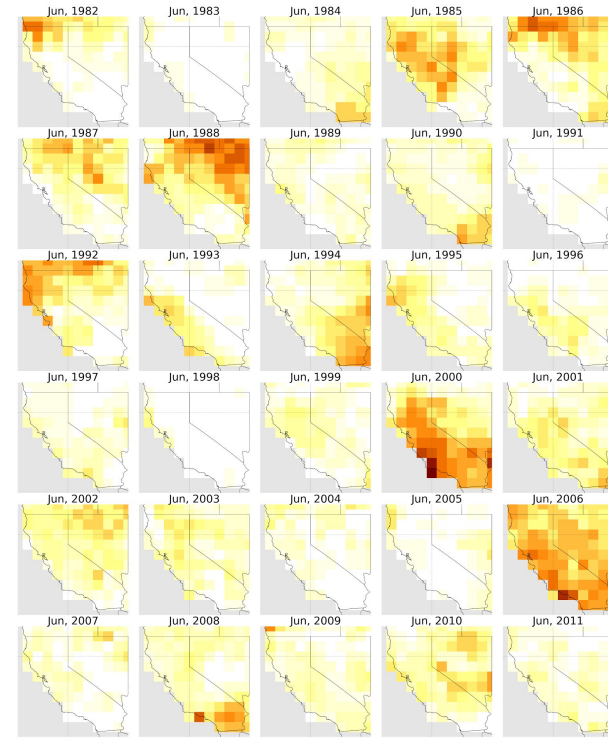
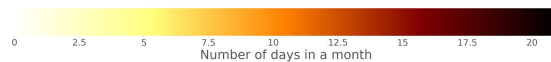
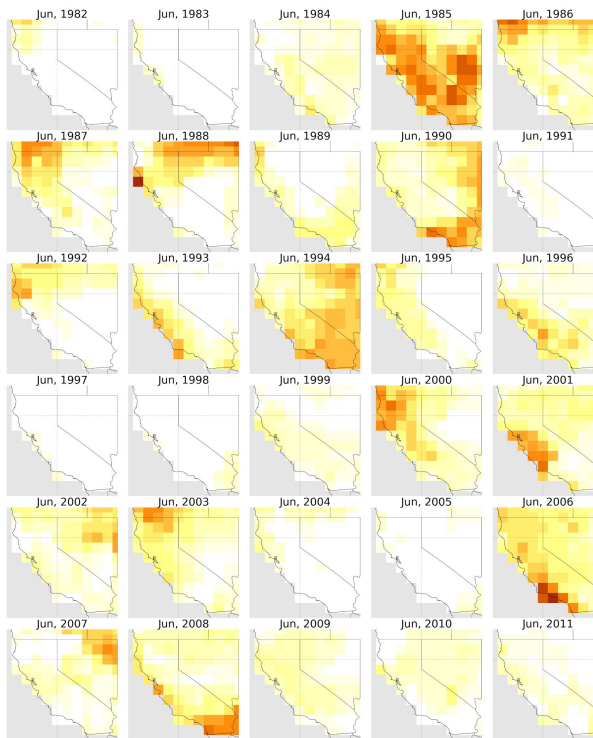
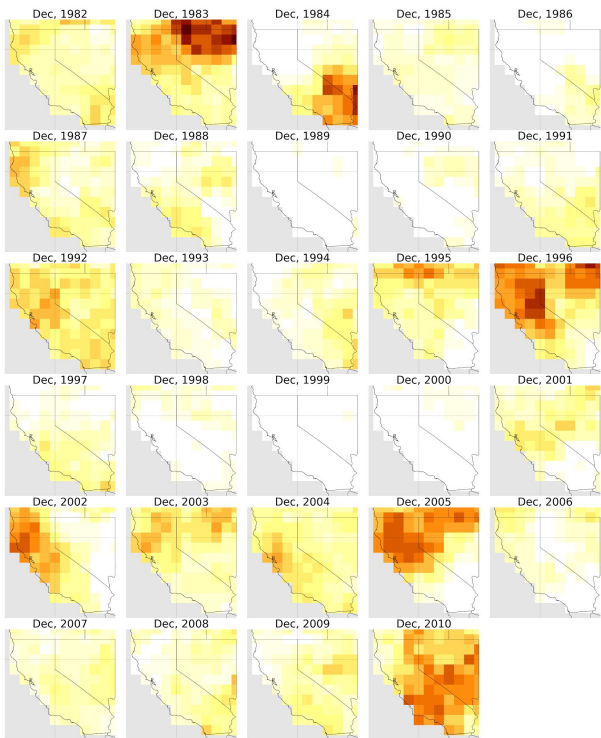
**Forecast of frequency of extreme  
events over 4 weeks**

# Observed frequency of “extreme events”

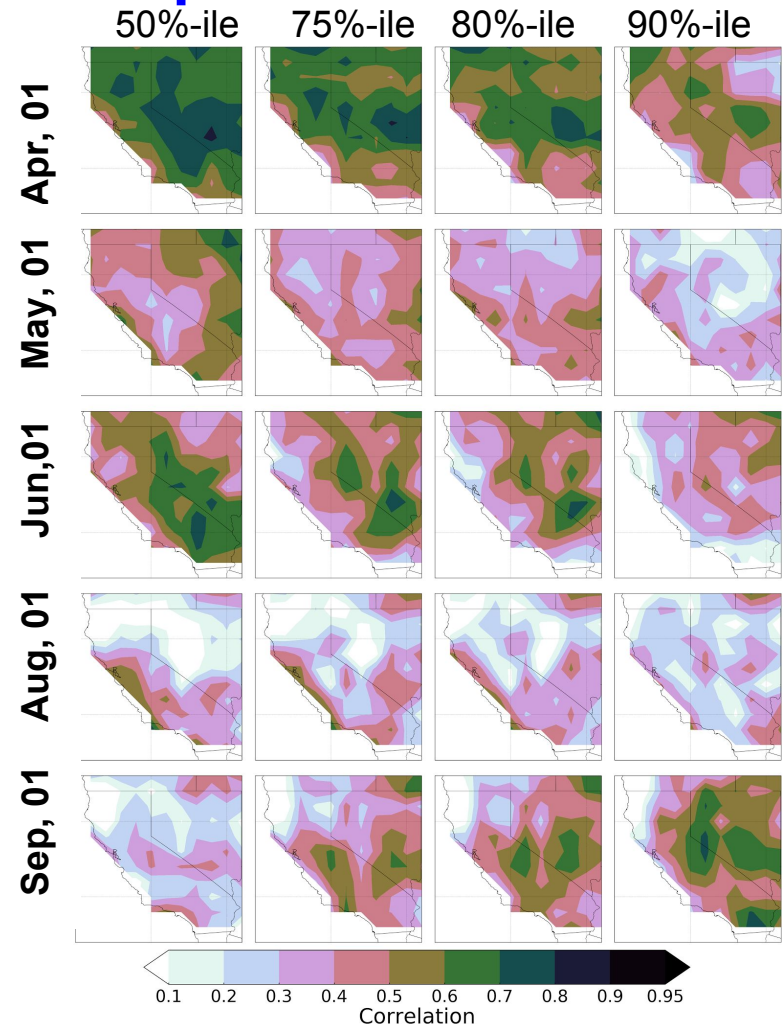
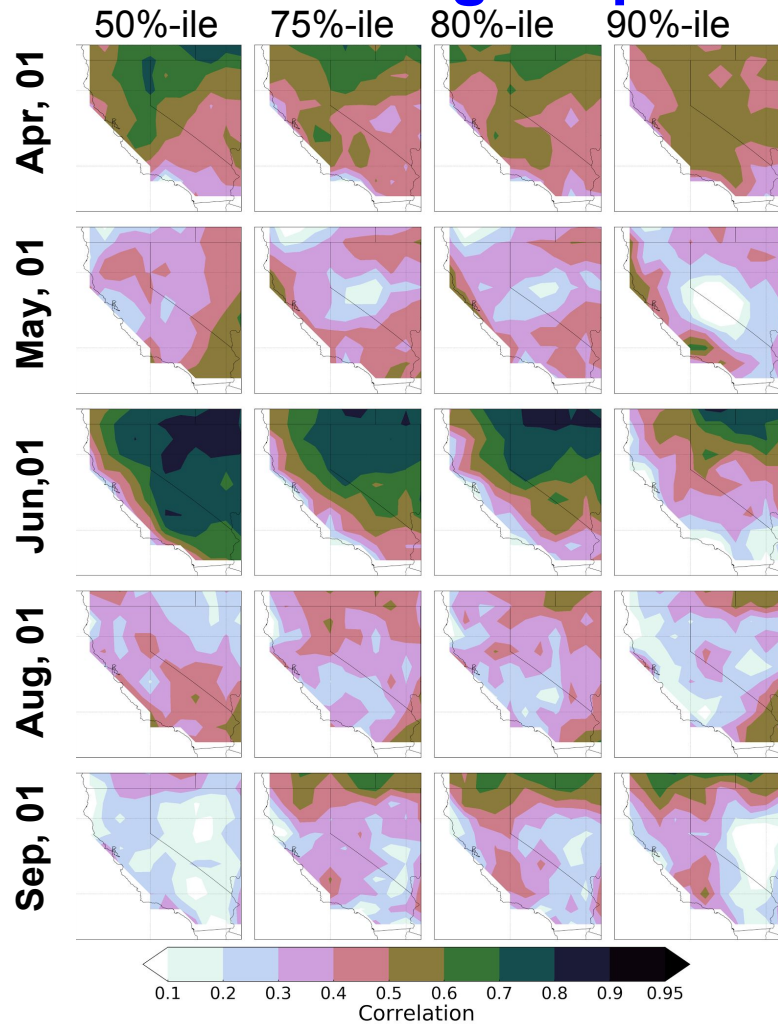
## December Precipitation

## June, Tmax

## June, Tmin

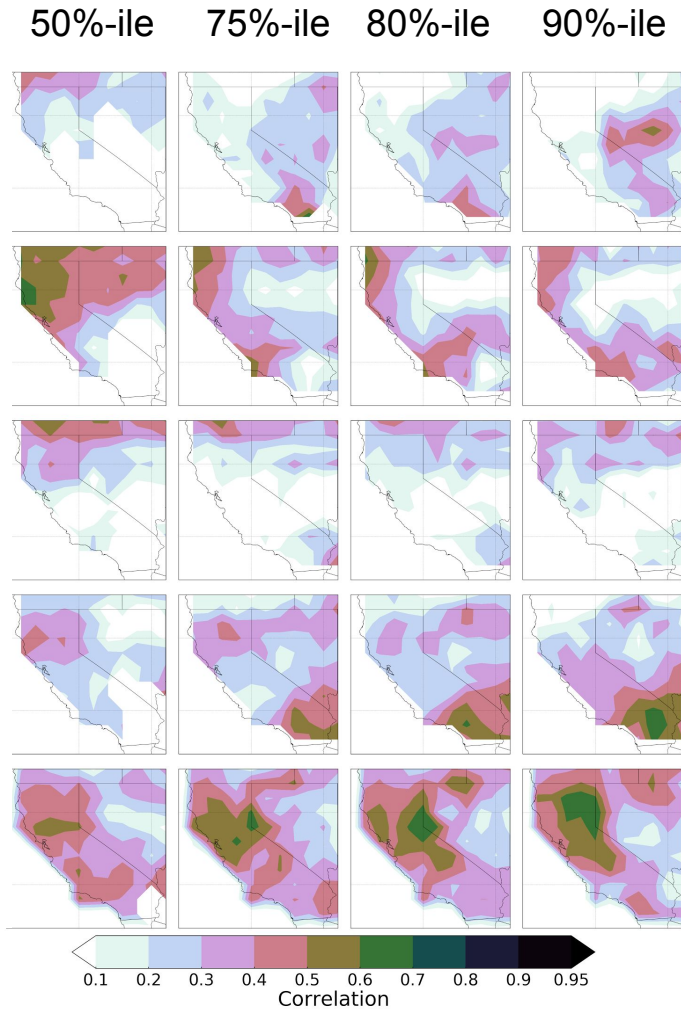


# Forecasting frequency of extreme Temperature events



# Forecasting frequency of extreme precipitation events

1. Limited skill in forecasting the frequency of extreme precipitation and heatwave level (>90%-ile P, Tmax or Tmin) events. Promising T skill exists in June forecasts, especially over non-costal areas.
2. Skill in April T forecast is promising because of its implication on snowmelt.





# Summary

- “Limited” seasonal (>1 month) precipitation and temperature forecast skill.
- It’s important to look at historical skill before utilizing operational forecasts.
- March precipitation, and June and July temperature seem to be most skillfull at seasonal scale.
- For the upcoming season, below normal March precipitation in Southern California, and above normal June, July temperature is likely.
- The NMME models (3 of them analyzed) have limited yet promising level of sub-seasonal skill (less than 1 month).
- Sub-seasonal skill analysis to be continued. Analysis to include large scale climate oscillations as well.

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