California-Nevada Drought Early Warning System

2018 Southern California Winter Status Update

Drought and climate seasonal outlook

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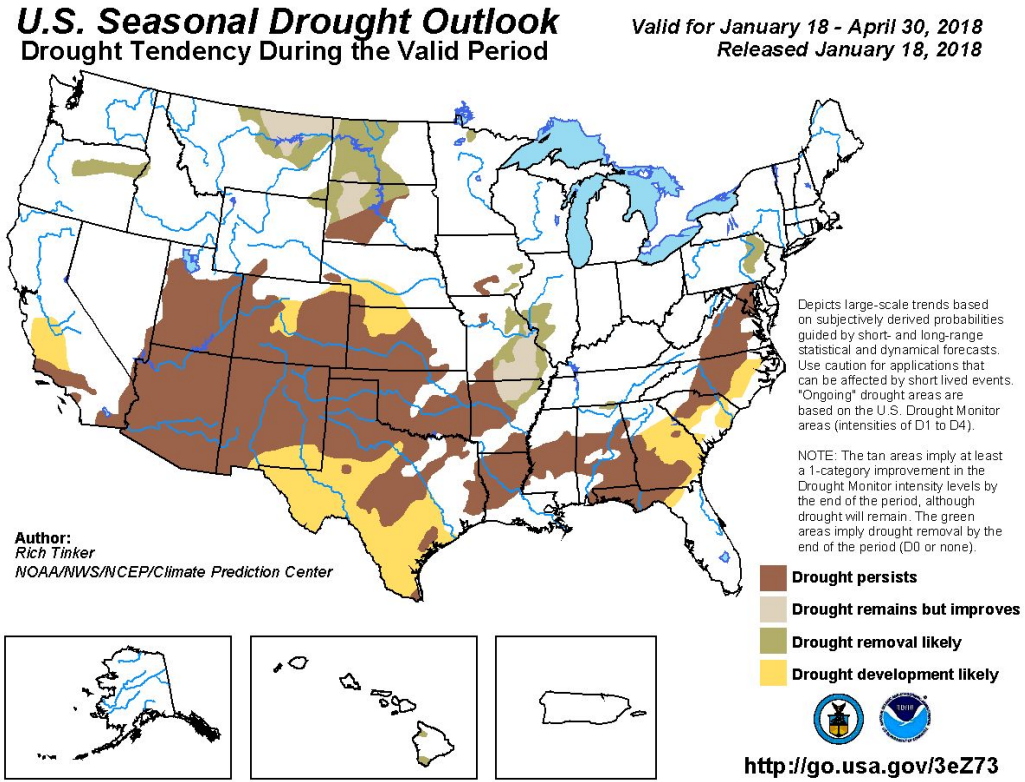
CPC's Seasonal drought outlook (January-April, 2018)

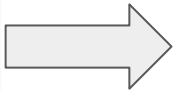


Source: http://www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.png

- Uses US Drought Monitor as initial conditions.
- Focuses over the next three month period.
- Based on short-range (e.g. 2 weeks forecasts) and long-range (~3 months) dynamical and statistical forecasts.
- Drought is likely to persist in Central coastal CA and interior areas, and parts of Southern CA, and likely to develop and expand.

Outline

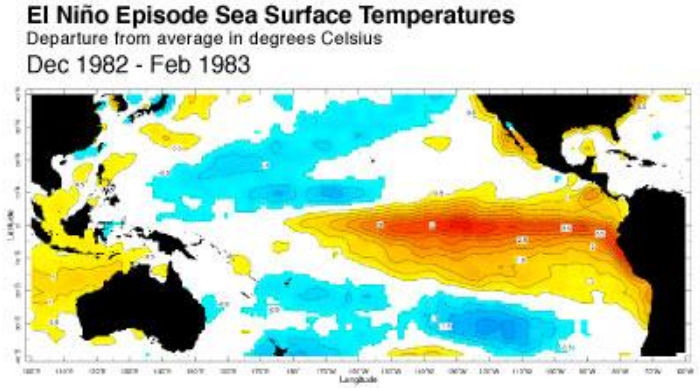
- This presentation will focus on:
  - Large scale climate outlook (ENSO)
  - Precipitation and temperature forecasts
  - Hydrologic forecasts

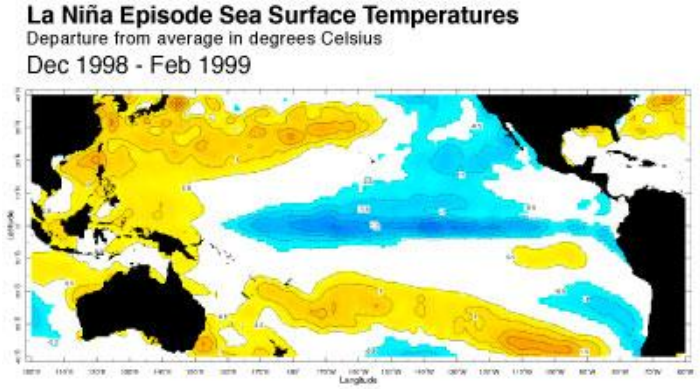


Method and skill of the above forecasts and where to find them.

ENSO forecast

What is ENSO?

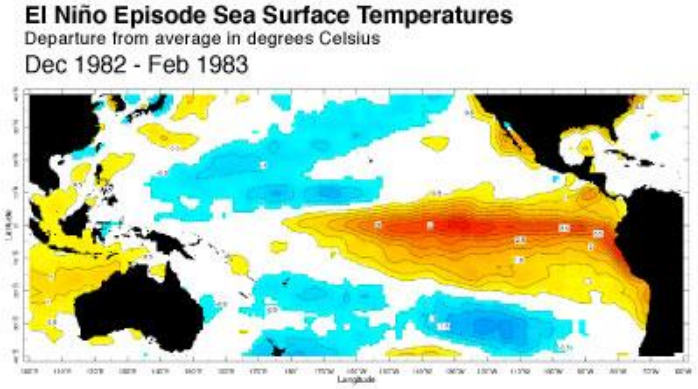




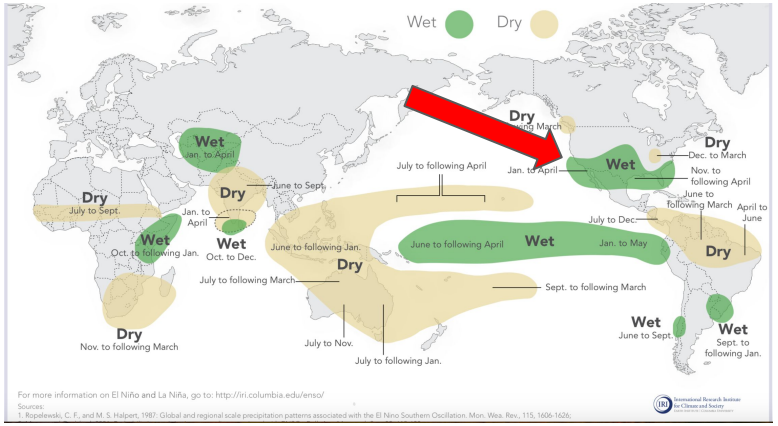
- ENSO describes the natural year-to-year variations in the ocean and atmosphere in the tropical Pacific.
- Sea-surface temperatures in the central and eastern equatorial Pacific cycle between above- and below-average.
- An El Niño state occurs when the central and eastern equatorial Pacific sea-surface temperatures are substantially warmer than usual (see the top figure).
- La Niña conditions occur when the central and eastern equatorial Pacific waters are substantially cooler than usual (see, bottom).

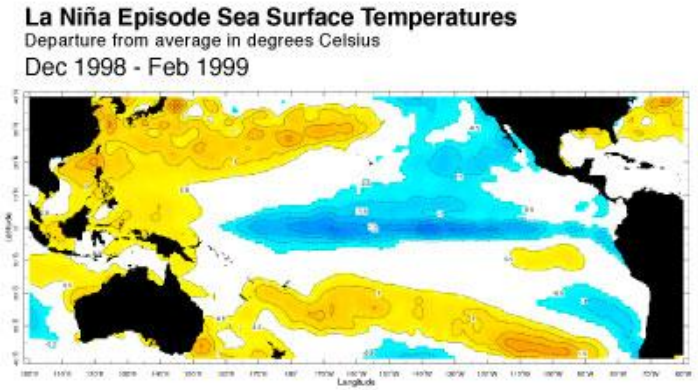
Source:
https://iri.columbia.edu/our-expertise/climate/enso/enso-essentials/

What's the typical influence of ENSO on climate?

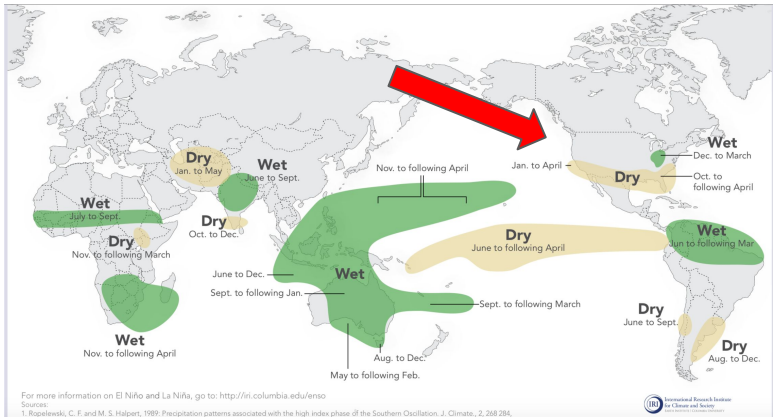


El Niño

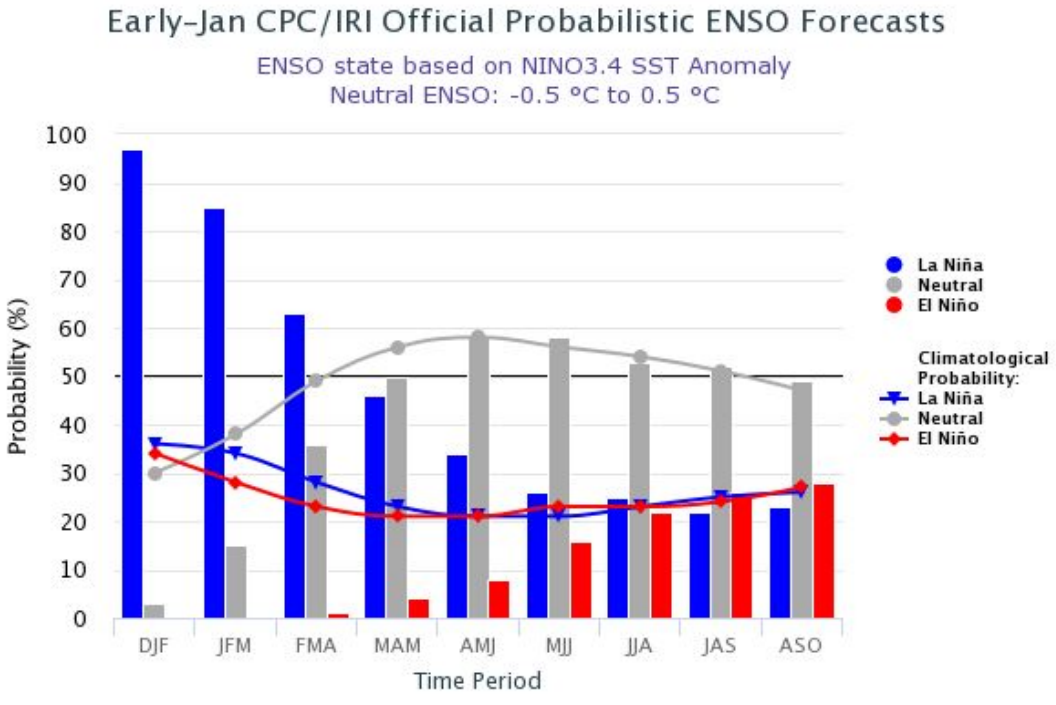




La Niña



CPC/IRI ENSO forecasts (Early Jan 2018)

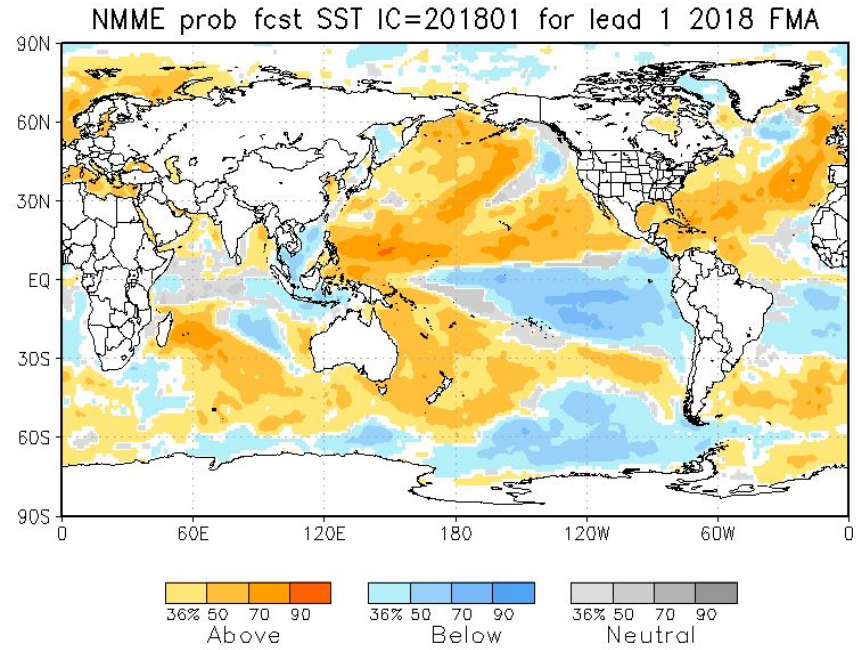


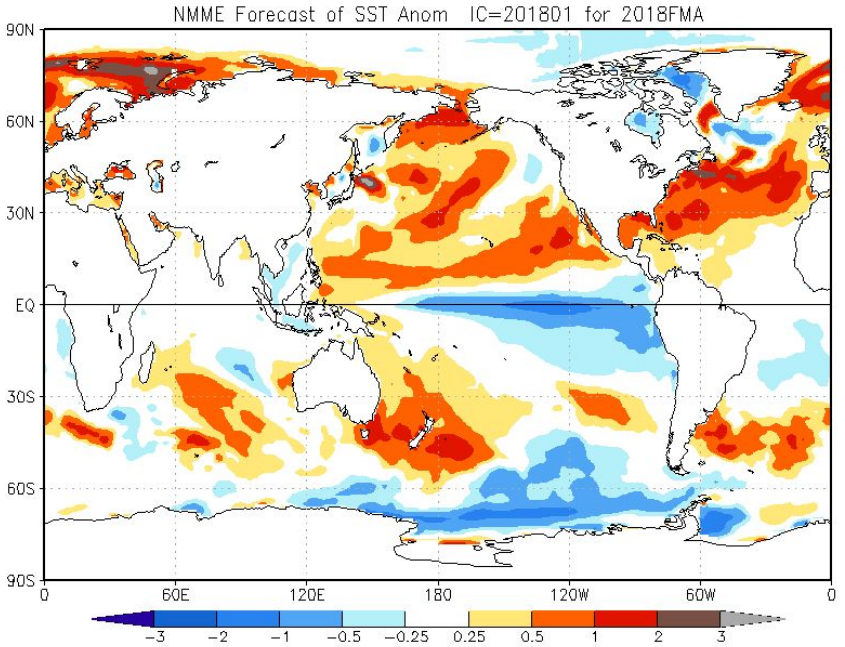
Source:http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

- Official ENSO forecasts.
- Released on January 11, 2018
- Uses dynamical and statistical models, and human judgement based on model biases.
- **La Niña is likely to persist through the next 3 months.**

Season	La Niña	Neutral	El Niño
JFM 2018	85%	15%	0%
FMA 2018	63%	36%	1%
MAM 2018	46%	50%	4%

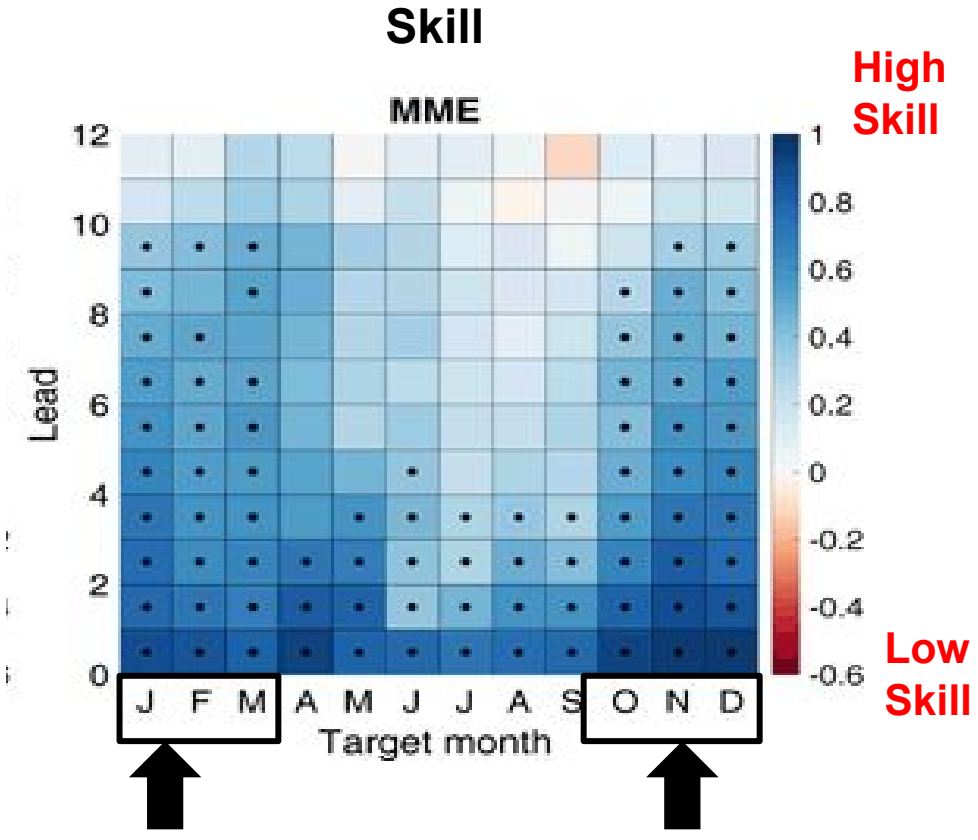
North American Multimodel Ensemble (NMME) Sea Surface Temperature (SST) forecasts





Source: http://www.cpc.ncep.noaa.gov/products/NMME/

NMME ENSO forecast skill



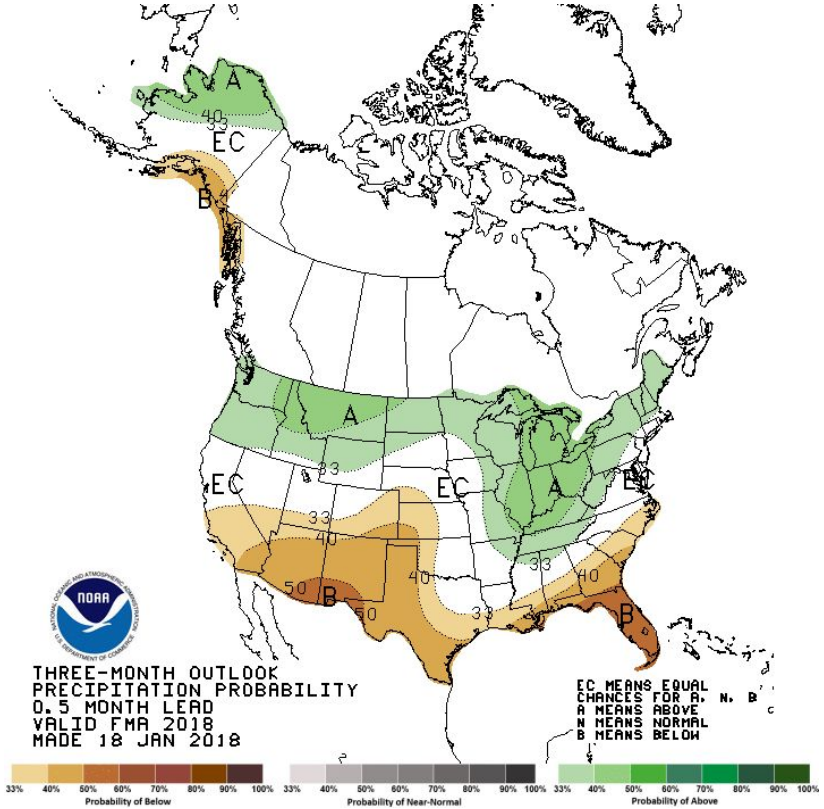
- The skill in forecasting ENSO conditions during fall/winter months is high and statistically significant for at least 6 months of so in advance.
- ENSO forecast for the upcoming water year are typically skillful starting mid-to-late summer.

Source: Tippet et al., 2017

Precipitation and Temperature forecasts

CPC’s Precipitation forecasts

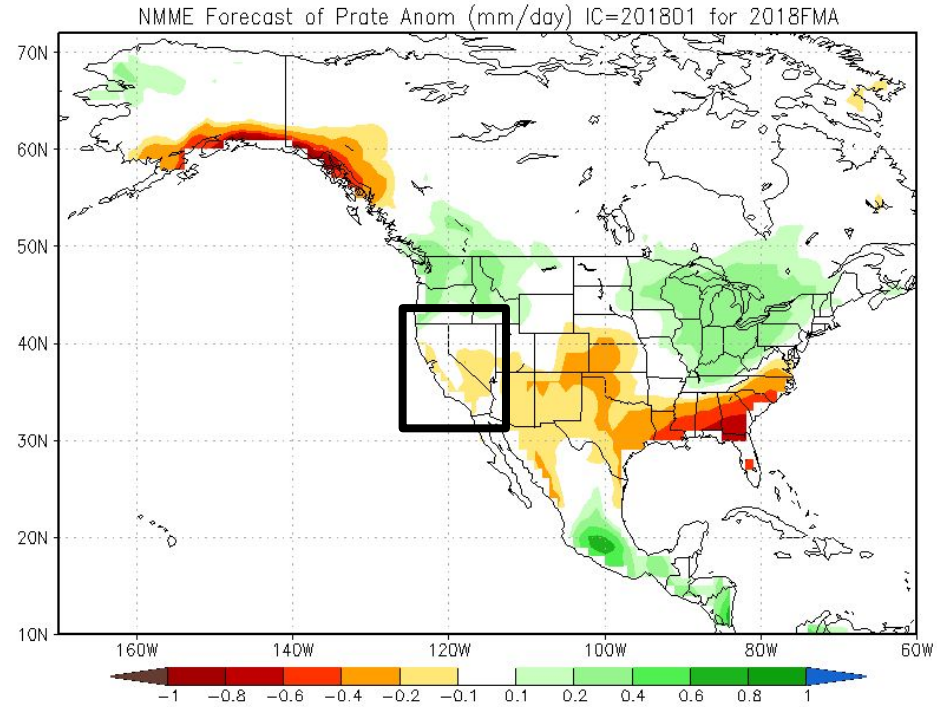
Source: http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=1

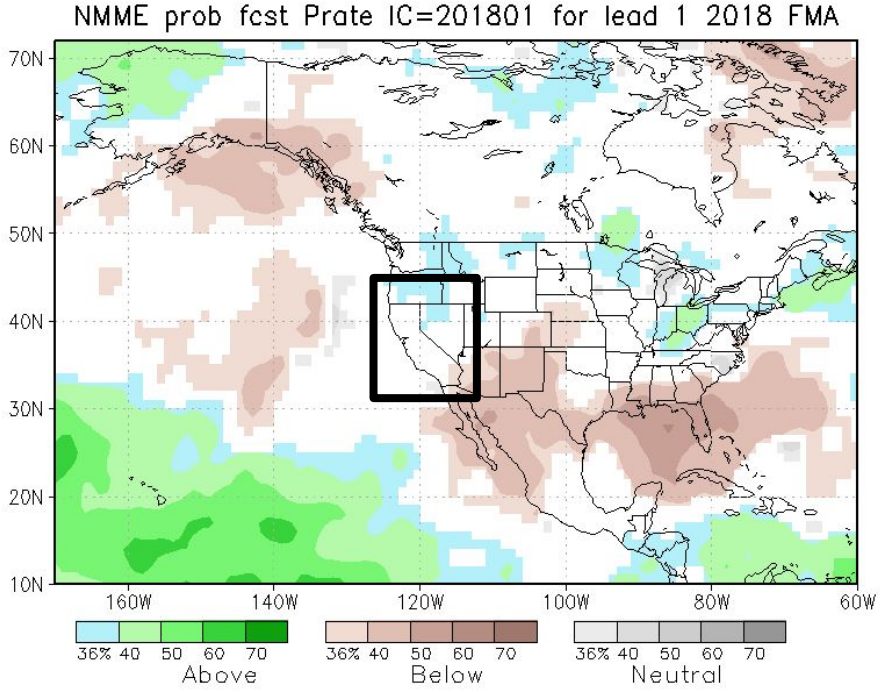


- >40% chances of below normal rainfall in FMA, over parts of Southern California.
- >33% chances of below normal precipitation in majority of Central to Southern California and Southern Nevada.
- Equal chances of rainfall over Northern California.

NMME precipitation forecast

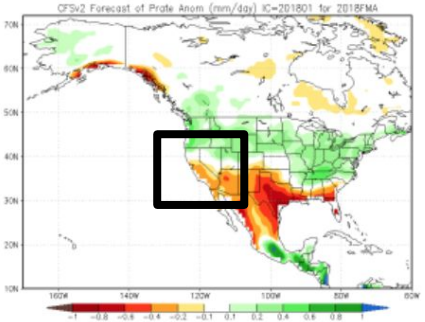
- Dynamical precipitation forecasts indicate even less probability of below normal rainfall than CPC's outlook.



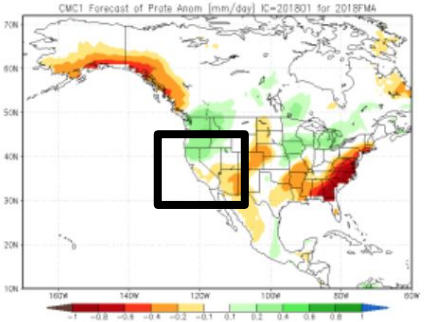


Individual model's precipitation forecast

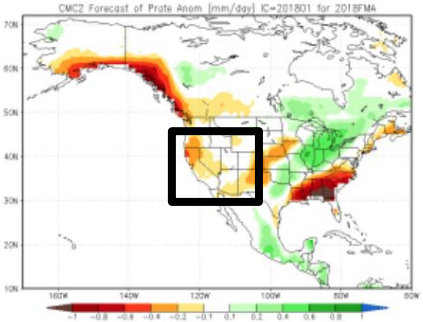
NCEP_CFSv2



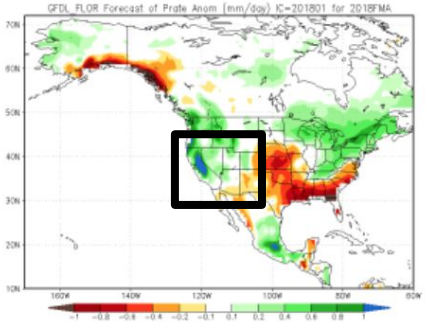
CMC1_CanCM3



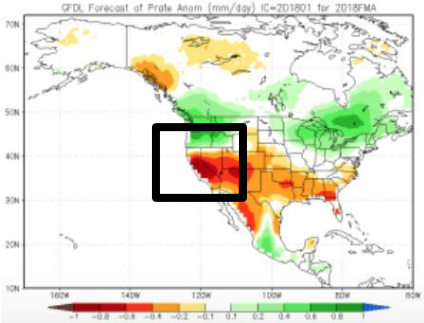
CMC2_CanCM4



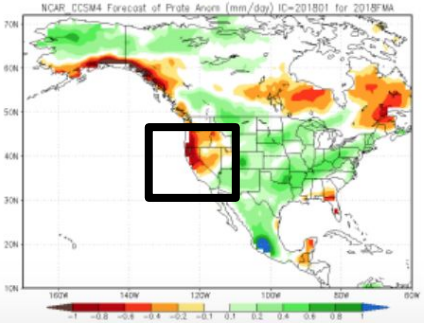
GFDL_FLOR



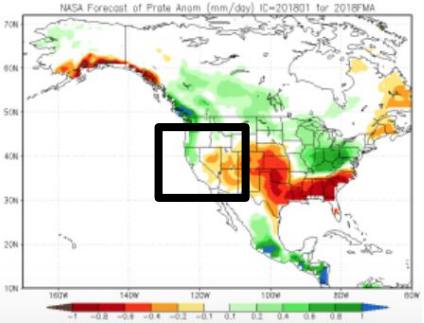
GFDL_CM2.1



NCAR_CCSM4



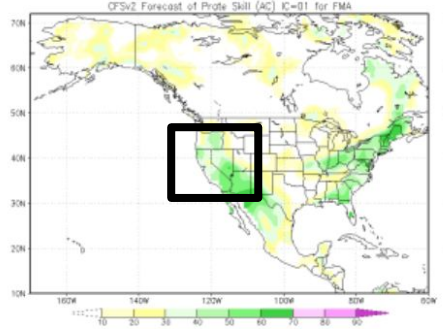
NASA_GEOS5



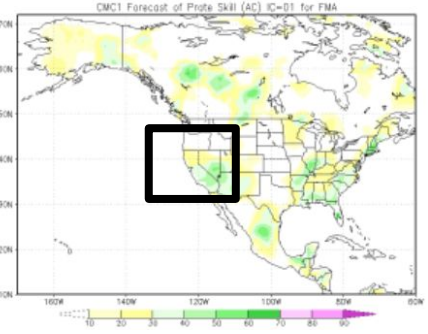
- Substantial variability in precipitation forecasts among individual NMME models.

Individual model's precipitation forecast skill

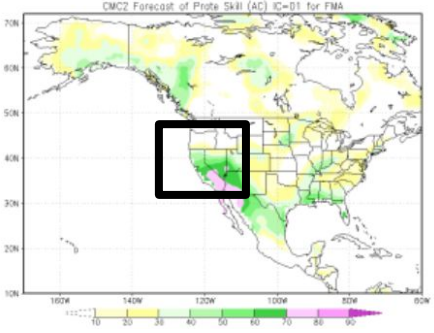
NCEP_CFSv2



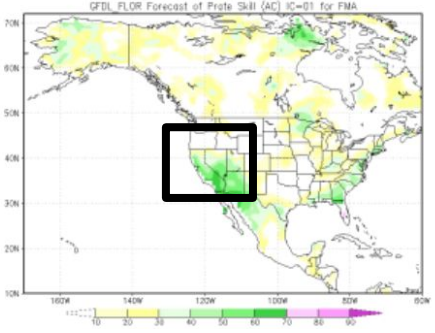
CMC1_CanCM3



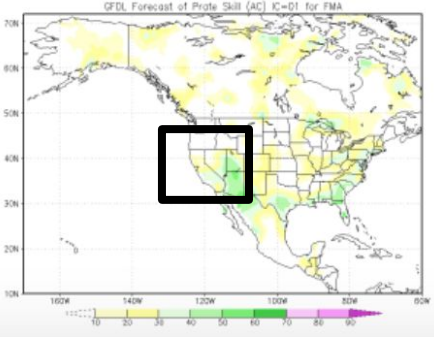
CMC2_CanCM4



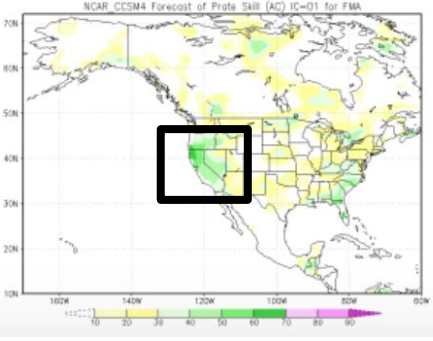
GFDL_FLOR



GFDL_CM2.1



NCAR_CCSM4



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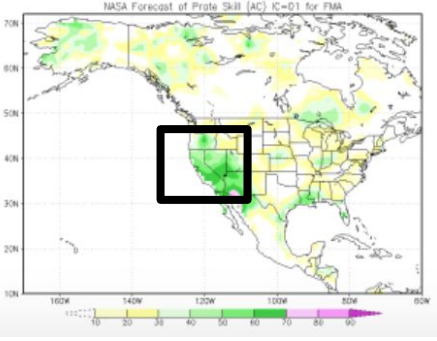
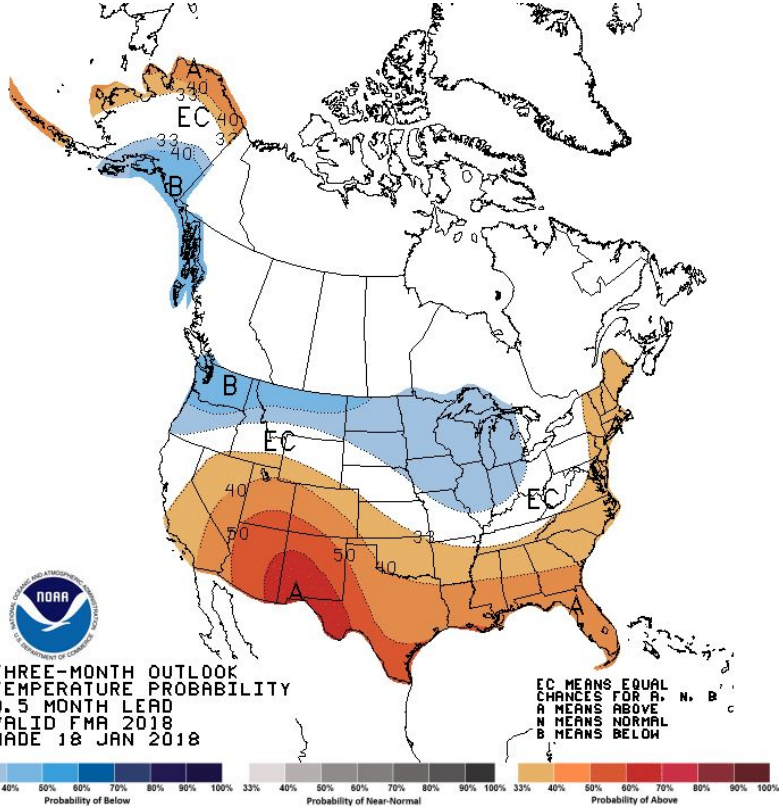


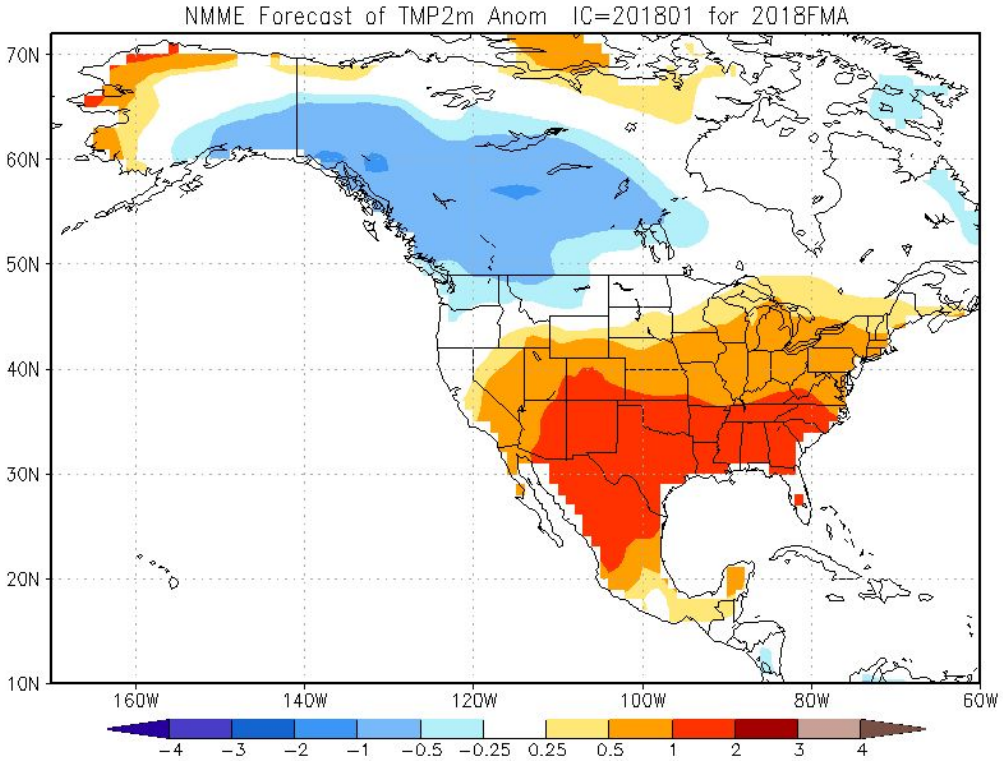
- For FMA precipitation models skill is generally limited to Southern California and Nevada.

CPC’s temperature forecasts



- >40% chances of above normal temperature in FMA, over parts of Southern California and Nevada.
- >33% chances of above normal temperature in majority of Central to Southern California and entire Nevada.
- Equal chances of temperature over Northern California.

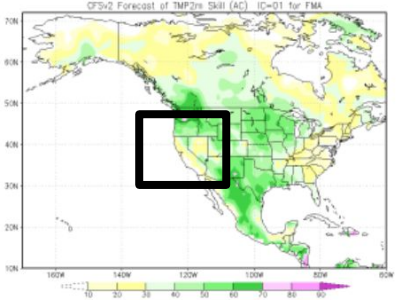
NMME's Temperature forecast



- Dynamical temperature forecasts indicate above normal temperature but their skill is negligible!

Individual model's temperature forecast skill

NCEP_CFSv2



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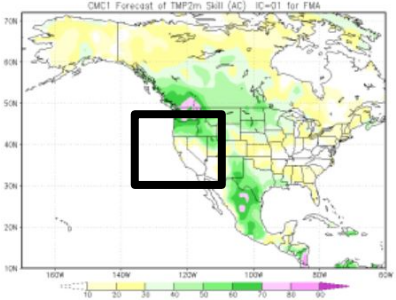
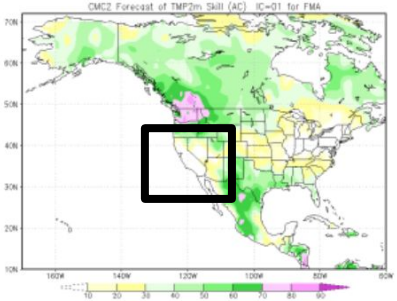
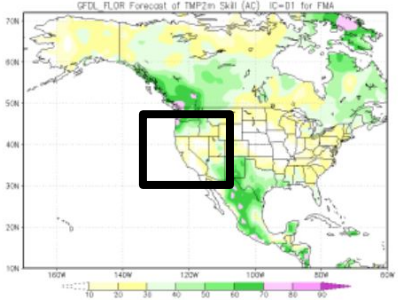


CMC2_CanCM4



GFDL_FLOR



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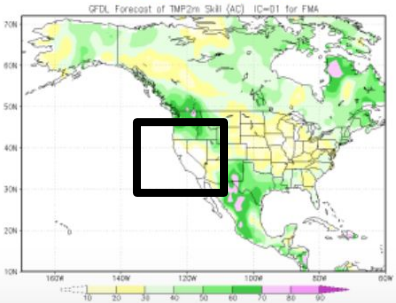
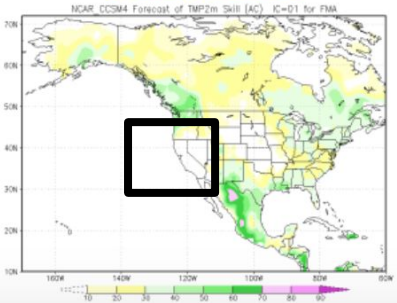


NCAR_CCSM4



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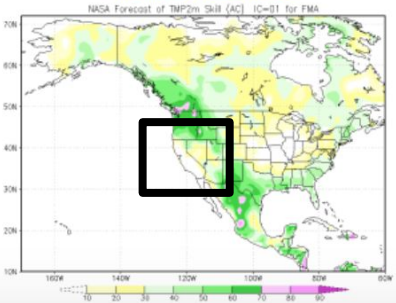
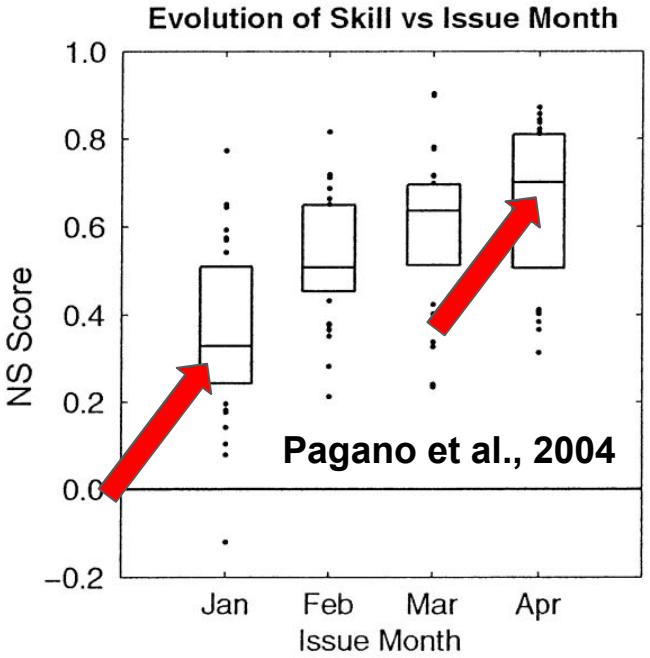


- NMME model's FMA temperature forecasts are not skillful.

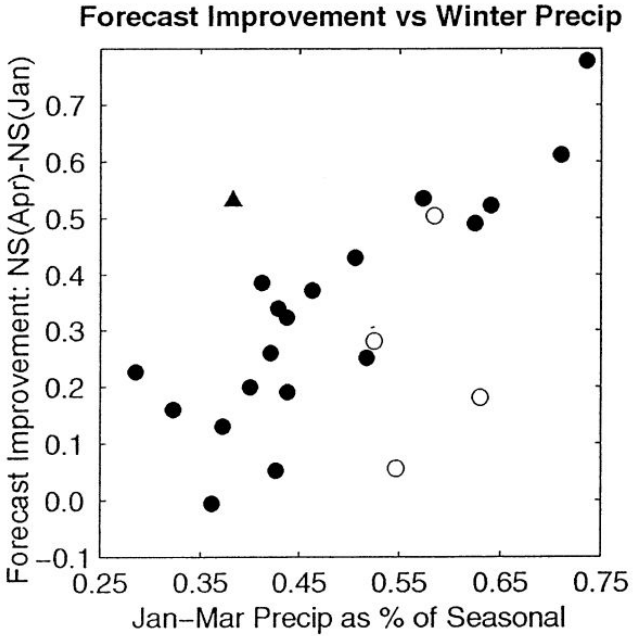
Hydrologic forecasts

How well can we forecast water supply in January?

- Skill of water supply forecasts issued in January is low. The skill improves in late spring.

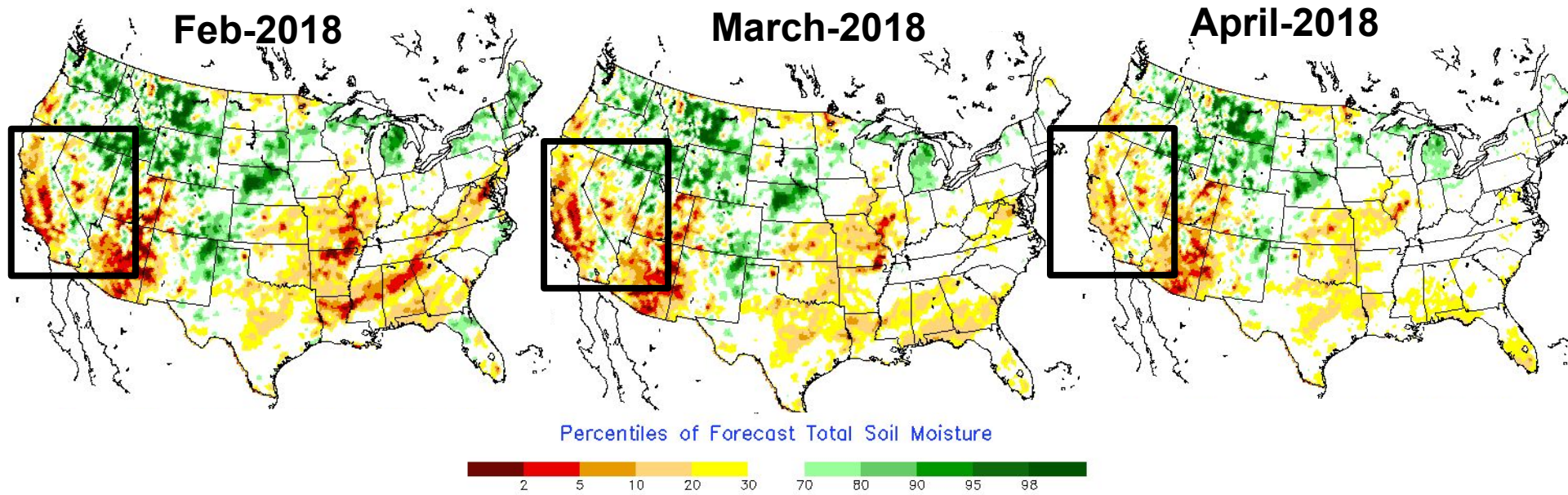


- Improvement in skill between April and January depends on how much (in %) it rains in JFM.



Soil Moisture (SM) forecasts (NCEP's EMC)

Source: http://www.emc.ncep.noaa.gov/mmb/nldas/forecast/TSM/perc/



- Forecast generated in February 2018. Generated by forcing a hydrologic model (VIC) with CFSv2 seasonal climate forecasts followed by post-processing for bias-correction.
- SM is forecasted to be below normal to normal in CA and NV, converging to normal (i.e. climatology) conditions as forecast lead time increases.

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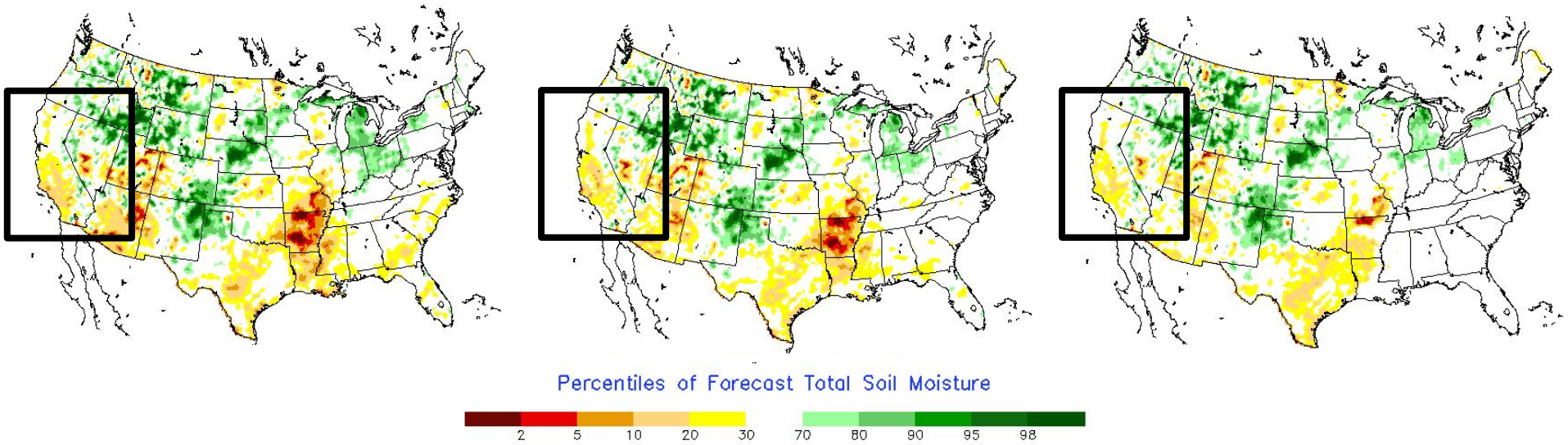
Jan-2018 | **Feb-2018** | **March-2018**



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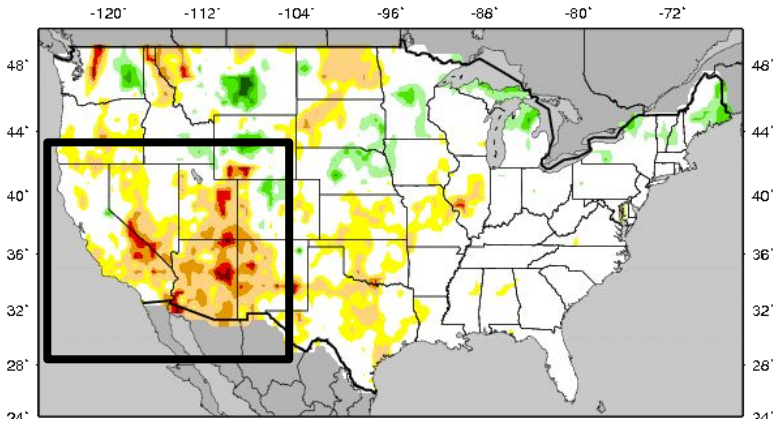
- SM is forecasted to be below normal to normal in CA and NV, converging to normal (i.e. climatology) conditions as forecast lead time increases.

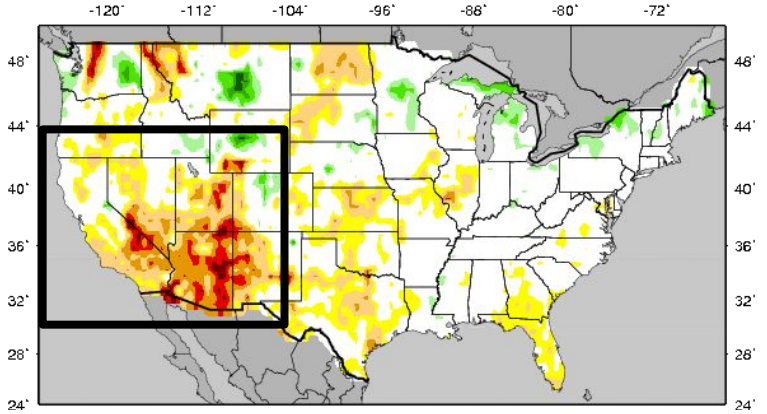
Soil Moisture (SM) forecasts (UW's Surface water monitor)

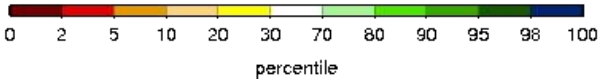
Source: http://www.hydro.washington.edu/forecast/monitor/outlook/index.shtml

SM forecasts for March 2018 generated using forcings from all past years



SM forecasts for March 2018 generated using forcings from years with similar ENSO conditions





- SM forecasts generated in **February 2018** using historical years similar in ENSO state as the current year (i.e. La Niña years) is drier than the one generated using all historical years.

Soil Moisture (SM) forecasts (UW's Surface water monitor)

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SM forecasts for March 2018 generated using forcings from all past years

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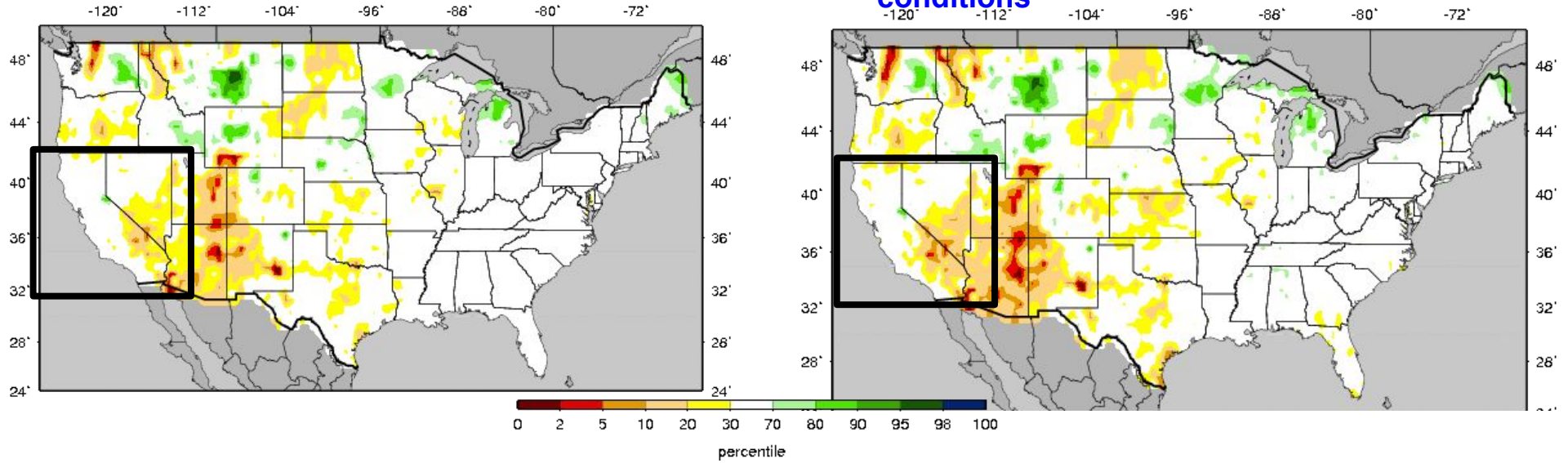

- SM forecasts generated in **January 2018** using historical years similar in ENSO state as the current year (i.e. La Niña years) is drier than the one generated using all historical years.

Summary

- Persistence in drought in parts of Southern California is **likely** with new drought development likely in parts of Central and Southern California.
    - Official ENSO forecasts is for La Niña. La Niña *typically* means below normal precipitation in Southern California.
    - **Below normal precipitation is forecasted** (>33 to 40%) for parts of Southern California and Nevada. Models precipitation forecasts are generally more skillful over this region than over Northern California.
- **Temperature is forecasted to be above normal** (>33% to 40%) but skill for FMA season is negligible.
- Hydrologic forecast that take into account of the initial state of moisture are indicating below normal soil moisture over the upcoming months.

Forecast sources:

CPC's Seasonal Drought Outlook:
http://www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.png

CPC/IRI's ENSO Forecast: http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

Short-term forecast: http://cw3e.ucsd.edu/precipitation_forecasts/

CPC's Seasonal Outlook: http://www.cpc.ncep.noaa.gov/products/predictions/90day/

NMME Forecast: http://www.cpc.ncep.noaa.gov/products/NMME/

SM forecasts (EMC): http://www.emc.ncep.noaa.gov/mmb/nldas/forecast/TSM/perc/

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