

NOAA Climate Prediction Center

Experimental

Water Year Outlook

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Western States Water Council S2S
Workshop

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Why a Water Year Outlook?

- Filling the need for precipitation forecasts at time scales beyond seasonal, in a format/time-frame that is informative and relevant to water managers.
- Collaborate with water managers to explore different sources of information and useful methods for correction.
 - Could be updated multiple times throughout the water year (monthly).
 - Combine with other forecast methods to optimize skill.
- First step is to assess the viability of such an outlook using the North American Multi-Model Ensemble (NMME) which delivers up to 6-month leads of realtime precipitation and temperature forecasts each month (common period).
 - NMME also has a robust hindcast for sensitivity testing.

Making the Water Year Outlook

- Defining the Water Year: Water supply forecast information for the Western U.S. is often conveyed on a “water year” basis, with the water year starting on Oct 1. CPC is working on three WYOs:
 - 6-month outlook initializing in October and running thru March → ONDJFM
 - 5-month outlook initializing in the following month, November, and running thru March → NDJFM
 - 4-month outlook initializing in December and running thru March → DJFM
- Skill assessment of the NMME’s performance for these outlooks in a hindcast setting: OND 1982 – DJF 2020
 - NMME:

• CFSv2	24 members
• GEM_NEMO	10 members
• CanCM4i	10 members
• GFDL_FLOR	24 members
• NASA_GEOS5v2	4 members
• NCAR_CCSM4	10 members
- Verification dataset: CPC’s official precipitation dataset, but expanded, not publicly available
 - Hybrid Sat interpolation over the ocean + Gauge over land, to increase coverage off the coast

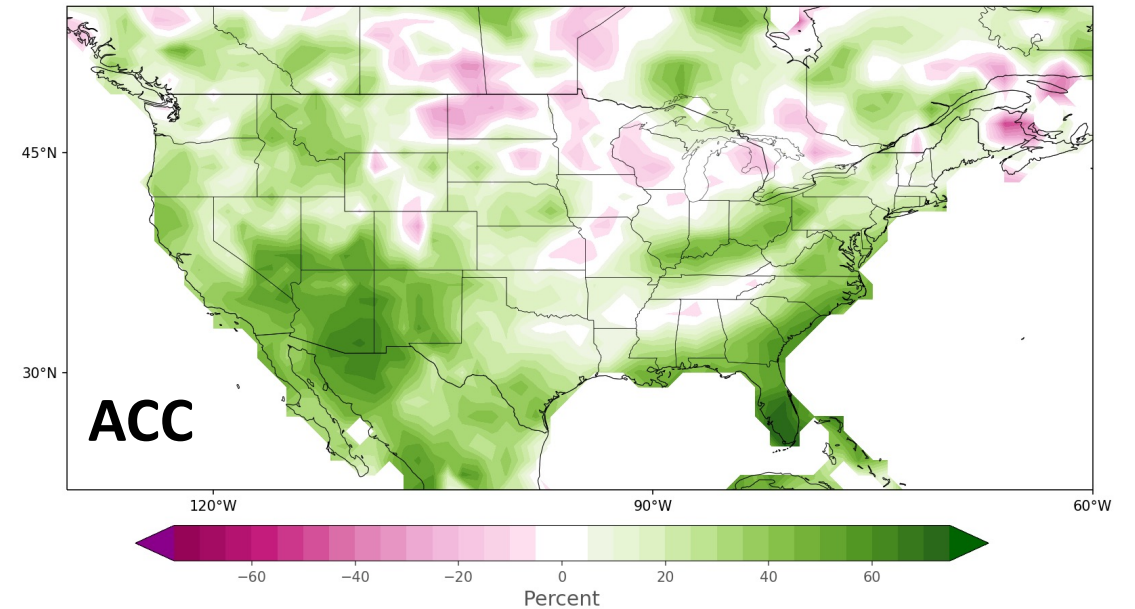
Making the Water Year Outlook

- Skill assessment of the ONDJFM NMME's WYO in the common hindcast period 1982-2020
 - All Years
 - Conditioned on ENSO years as defined by an ongoing measure of Tropical SSTs → Ocean Nino Index (ONI) (threshold is + or – 0.5 degrees)
 - For example, for **DJF** in 1992, ONI value of **+1.7** → El Nino year so that year is selected for the ON**DJF**M outlook initializing in 1992. Repeat.
 - La Nina years (negative ONI years)
 - ACC: Anomaly Correlation Coefficient
 - percent the observed standard deviation of the anomalies is captured by the models
 - HSS: Heidke Skill Score – 2-category probabilistic skill score
 - the percent improvement/degradation over using climatology of using the NMME
 - RPSS: Rank Probability Skill Score – 3-category probabilistic skill score
 - how skillfully the models capture the observed climatological distribution

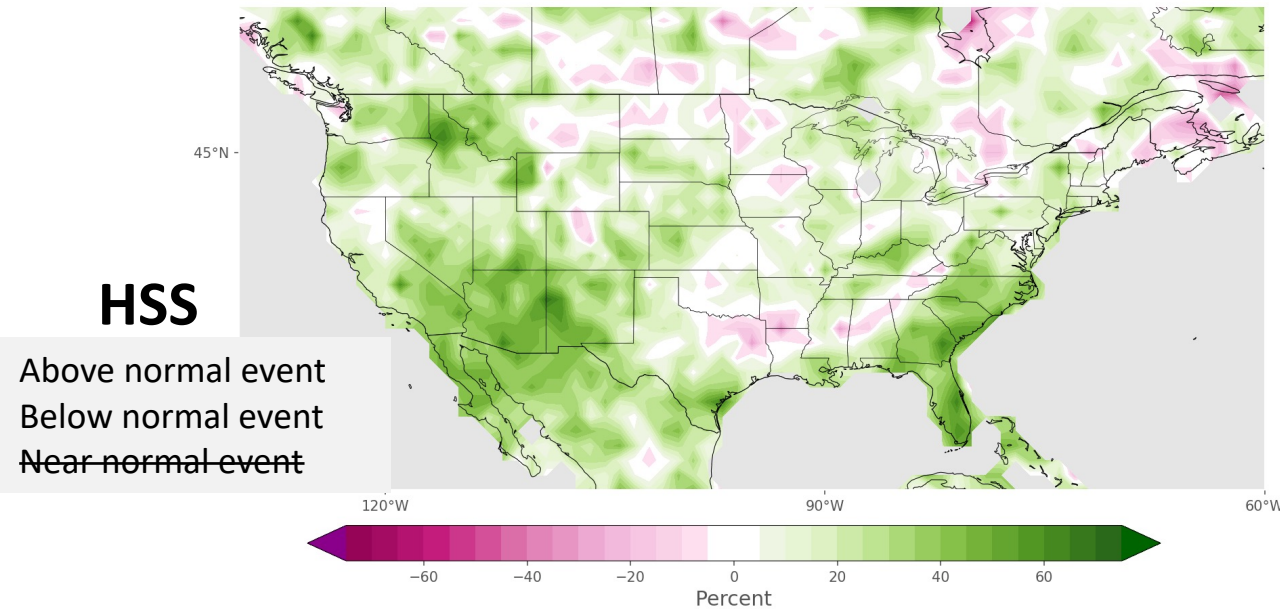
WYO ONDJFM Skill Assessment (Precipitation)

- **All Years** from 1982-2020
 - **ACC:** percent the observed standard deviation of the anomalies is captured by the NMME
 - **HSS:** 2-category probabilistic – the percent improvement/degradation of using the NMME vs climatology
 - **RPSS:** 3-category probabilistic outlook – how skillfully the NMME captures the observed climatological distribution

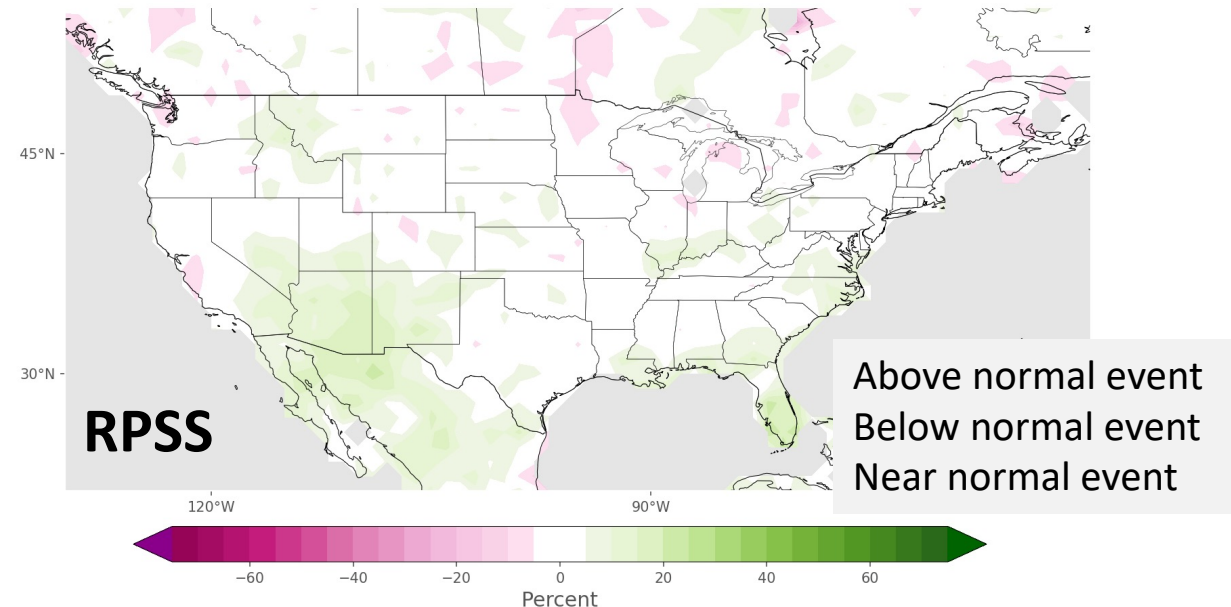
NMME Water Year Outlook Skill: ACC All Years 1982-2020



NMME Water Year Outlook Skill: HSS All Years 1982-2020



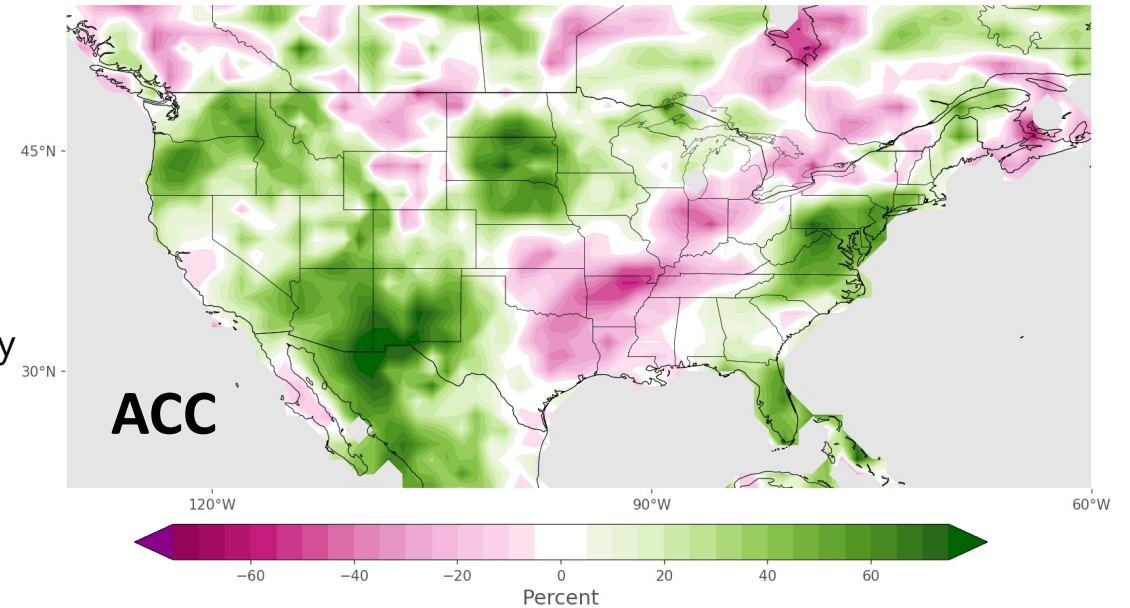
NMME Water Year Outlook Skill: RPSS All Years 1982-2020



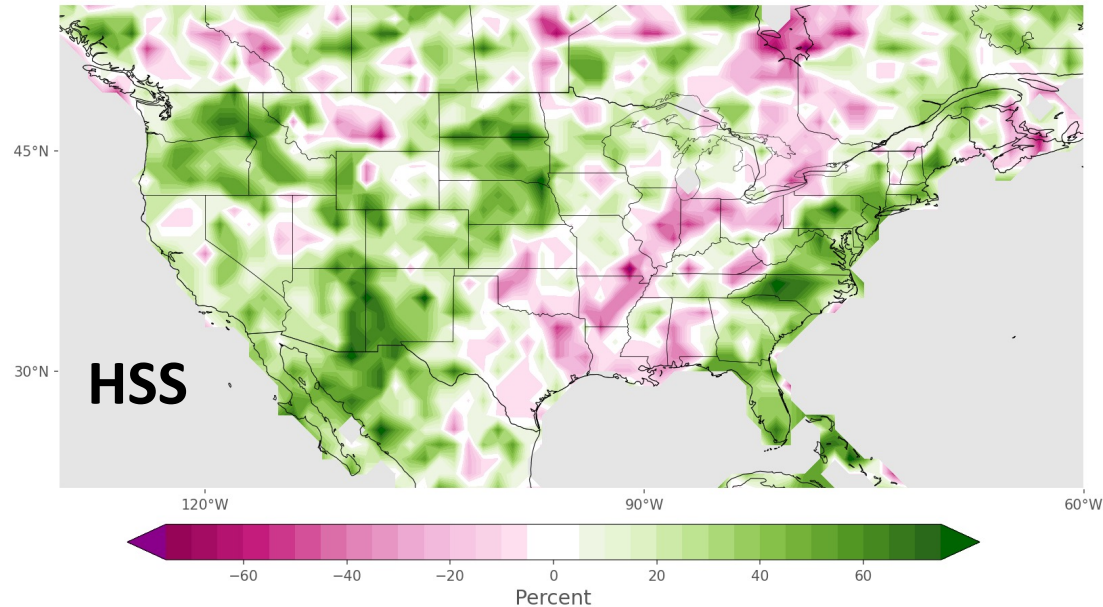
WYO ONDJFM Skill Assessment (Precipitation)

- **La Nina years** within 1982-2020 -- about 12
 - **ACC:** percent the observed standard deviation of the anomalies is captured by the NMME
 - **HSS:** 2-category probabilistic – the percent improvement/degradation of using the NMME vs climatology
 - **RPSS:** 3-category probabilistic outlook – how skillfully the NMME captures the observed climatological distribution

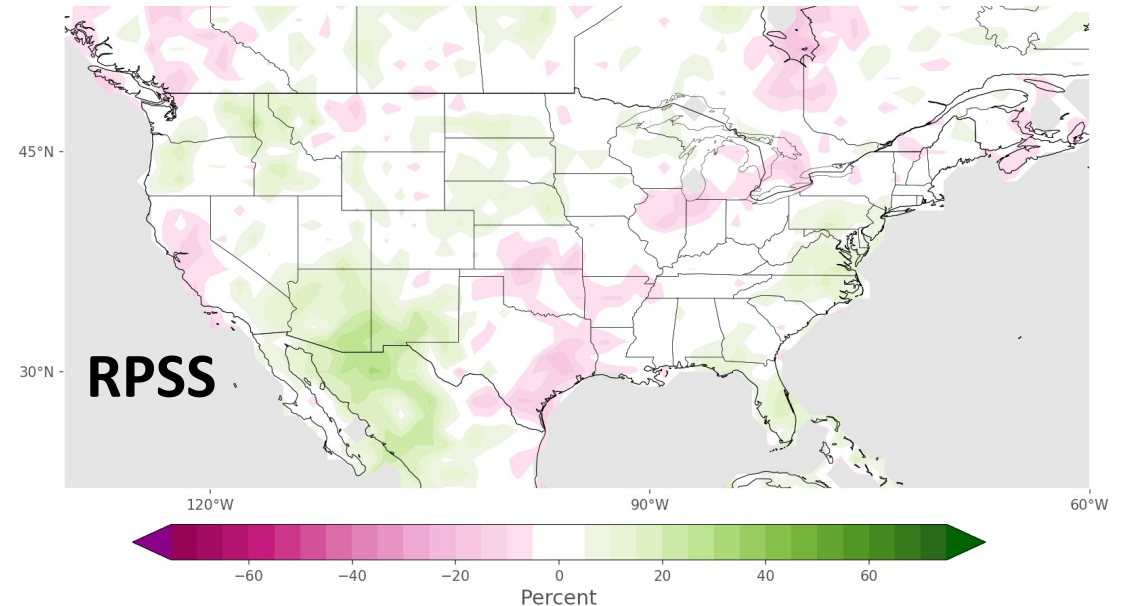
NMME Water Year Outlook Skill: ACC La Nina Years 1982-2020



NMME Water Year Outlook Skill: HSS La Nina Years 1982-2020



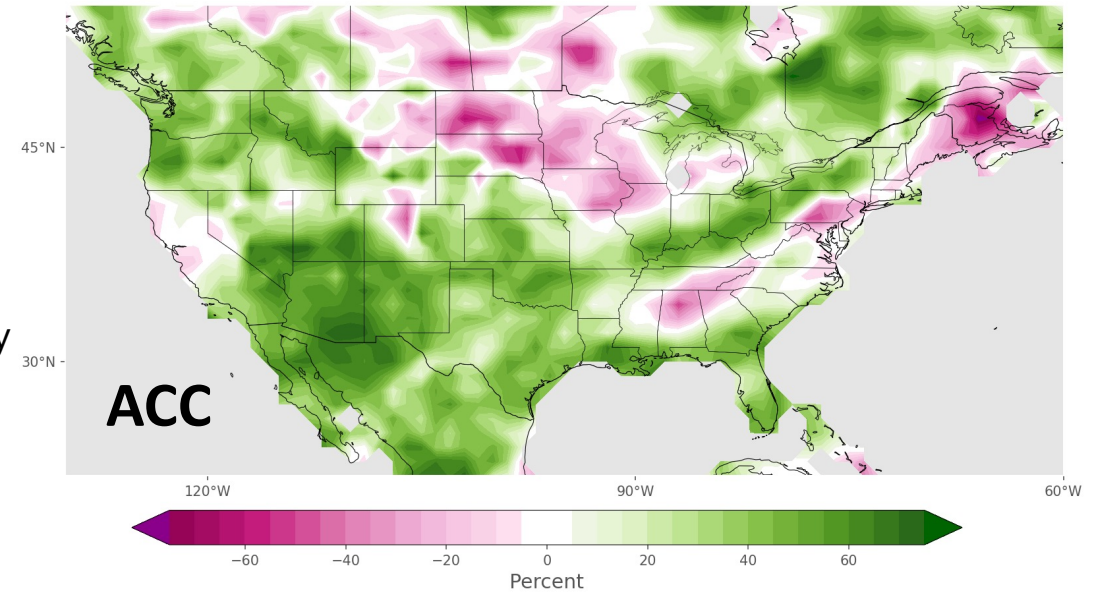
NMME Water Year Outlook Skill: RPSS La Nina Years 1982-2020



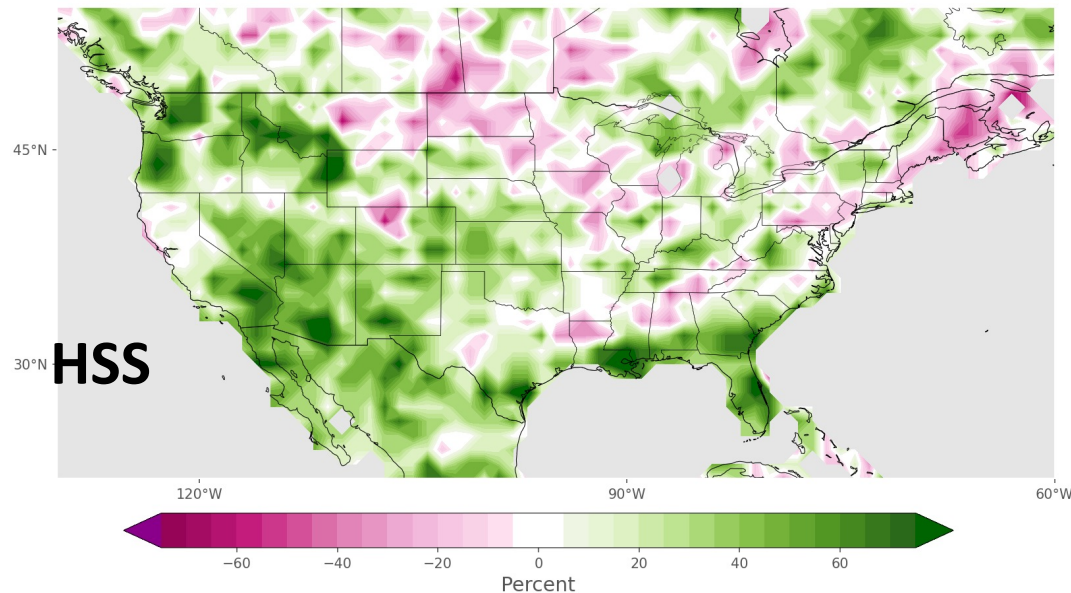
WYO ONDJFM Skill Assessment (Precipitation)

- **El Nino years** within 1982-2020 -- about 12
 - **ACC:** percent the observed standard deviation of the anomalies is captured by the NMME
 - **HSS:** 2-category probabilistic – the percent improvement/degradation of using the NMME vs climatology
 - **RPSS:** 3-category probabilistic outlook – how skillfully the NMME captures the observed climatological distribution

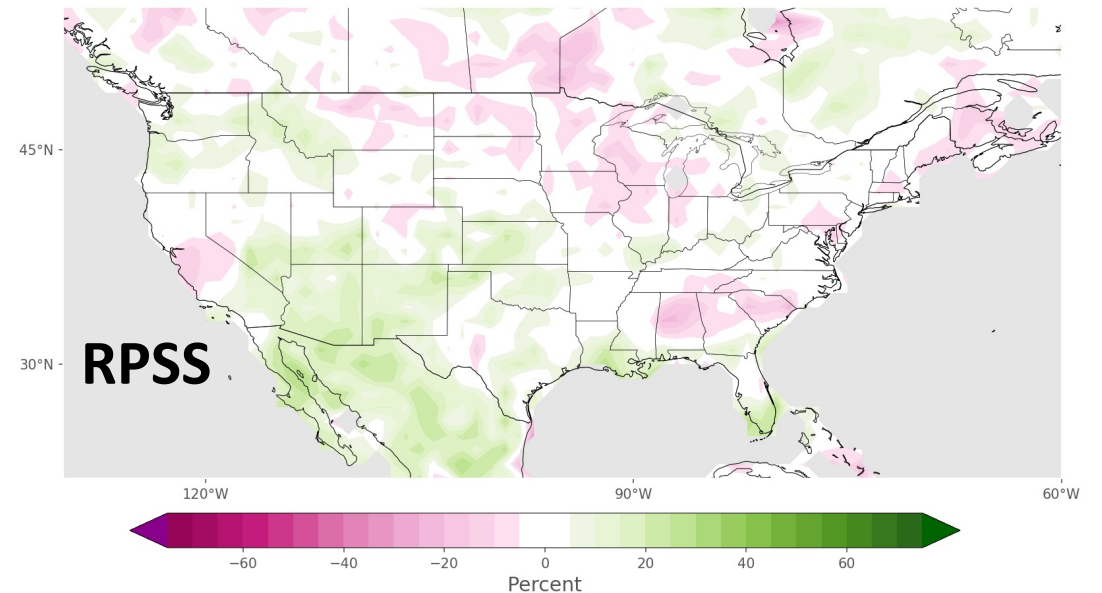
NMME Water Year Outlook Skill: ACC El Nino Years 1982-2020



NMME Water Year Outlook Skill: HSS El Nino Years 1982-2020

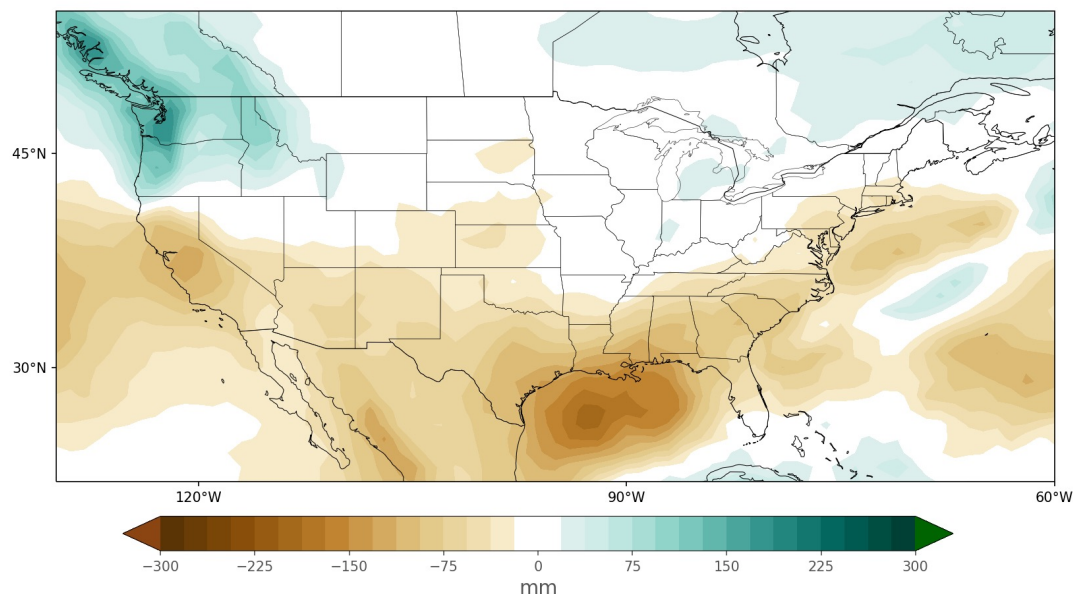


NMME Water Year Outlook Skill: RPSS El Nino Years 1982-2020



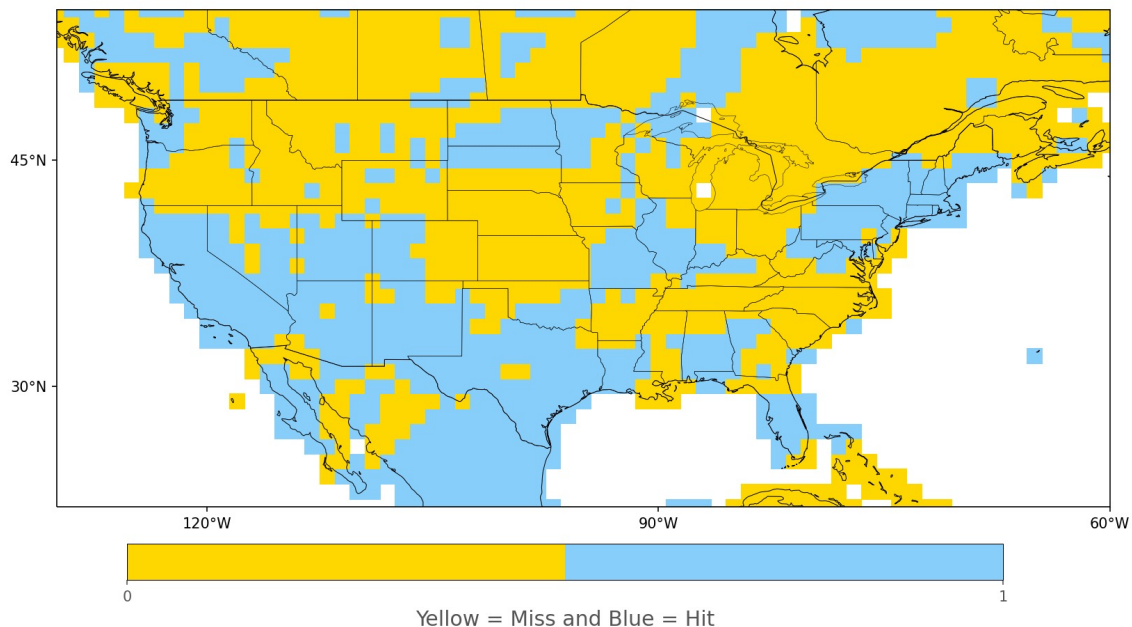
Reviewing the 6-mth WYO October 2020 – March 2021

NMME Experimental Water Year Outlook: Anomaly Precipitation Forecast
Initialized 2020 ONDJFM



WYO → ONDJFM

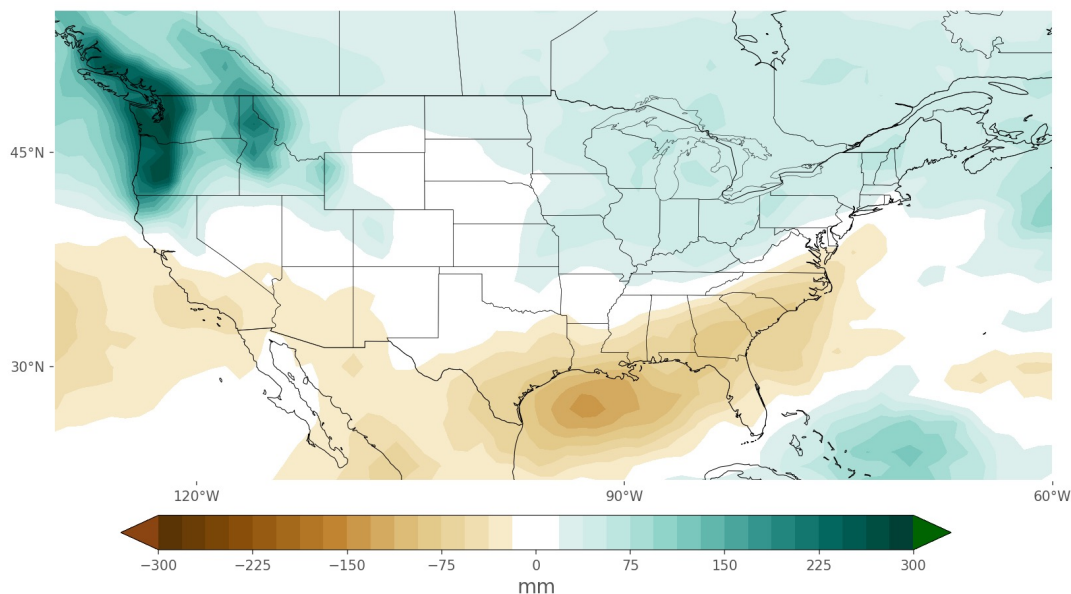
NMME Experimental Water Year 2020 ONDJFM Outlook
Precipitation Forecast Verification: Hit Miss



"Hit Miss" verification: Captures the skill of the direction of the forecast anomalies relative to the observed anomaly. *Hit* → NMME forecasted a positive (negative) anomaly and a positive (negative) anomaly was observed.

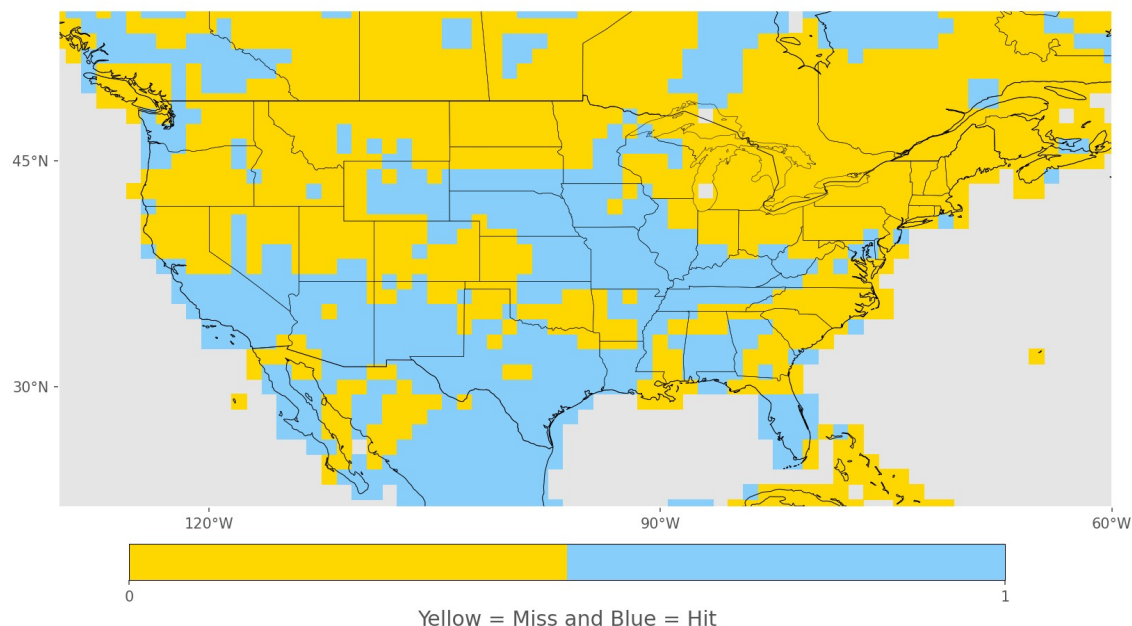
Reviewing the 5-mth WYO November 2020 – March 2021

NMME Experimental Water Year Outlook: Anomaly Precipitation Forecast
Initialized 2020 NDJFM



WYO → NDJFM

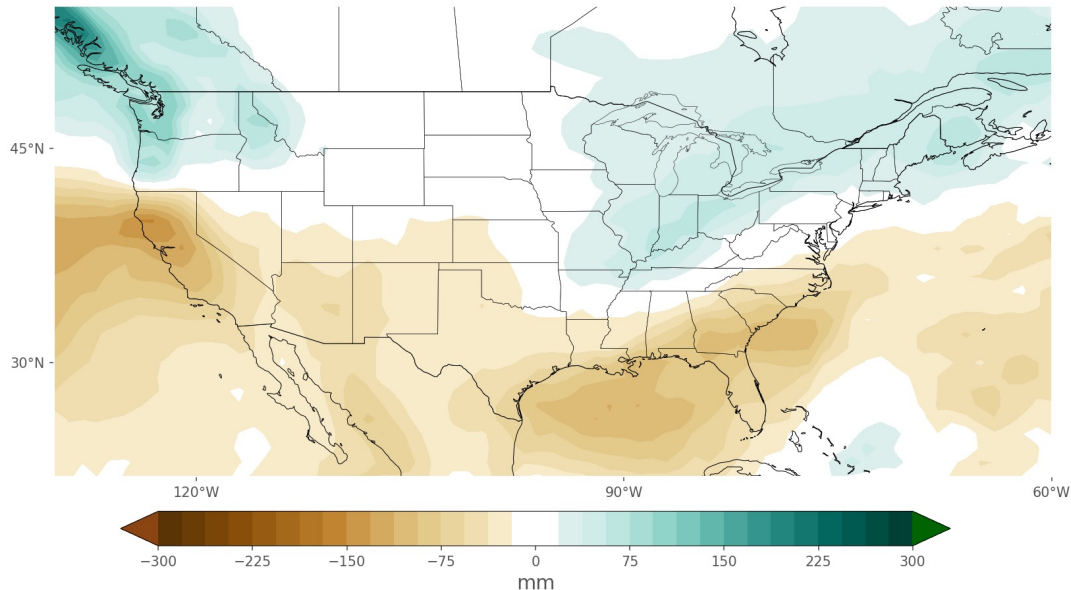
NMME Experimental Water Year 2020 NDJFM Outlook
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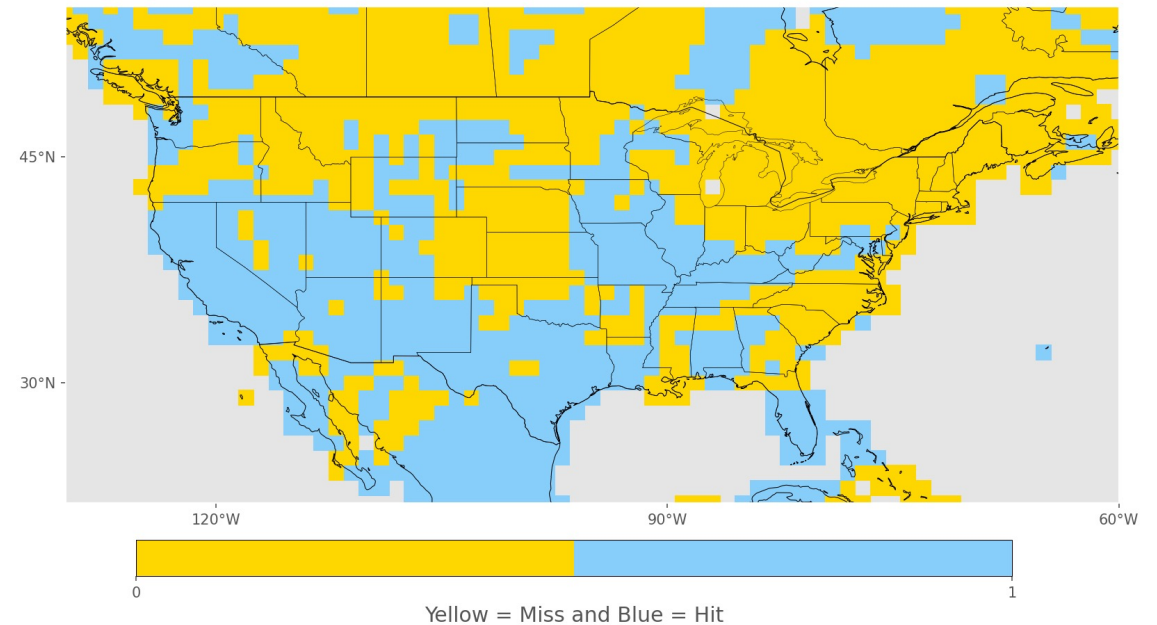
Reviewing the 4-mth WYO December 2020 – March 2021

NMME Experimental Water Year Outlook: Anomaly Precipitation Forecast
Initialized 2020 DJFM



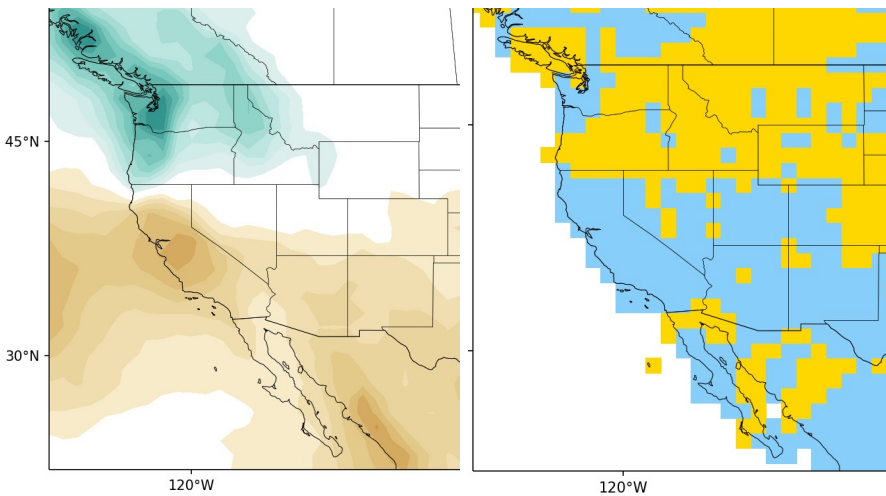
WYO → DJFM

NMME Experimental Water Year 2020 DJFM Outlook
Precipitation Forecast Verification: Hit Miss

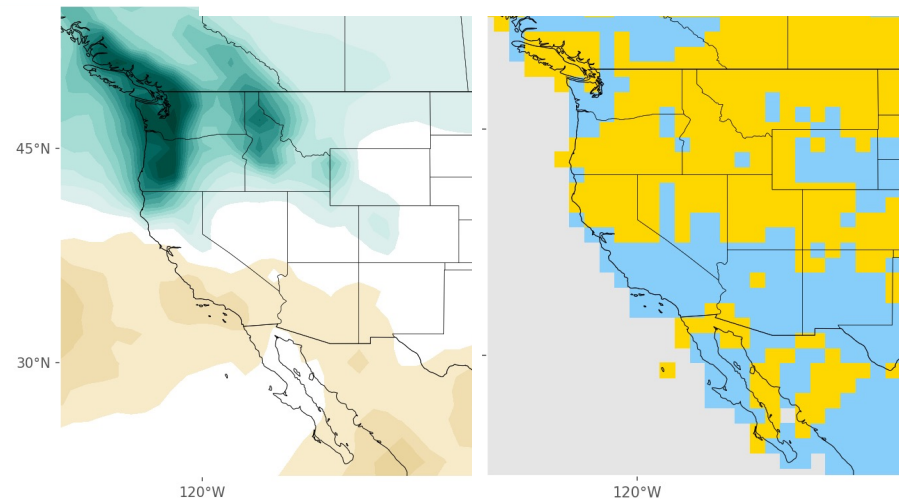


“Hit Miss” verification: Captures the skill of the direction of the forecast anomalies relative to the observed anomaly. **Hit** → NMME forecasted a positive (negative) anomaly and a positive (negative) anomaly was observed.

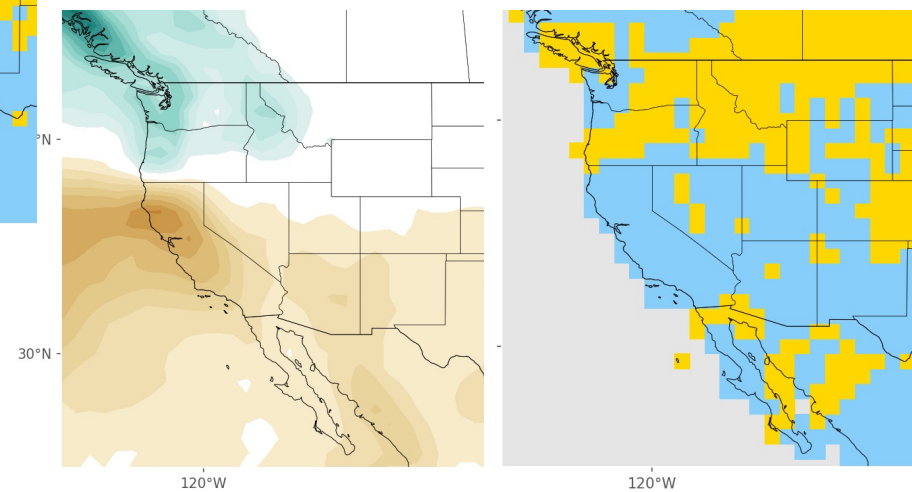
6-mth WYO Oct Start and Hit-Miss



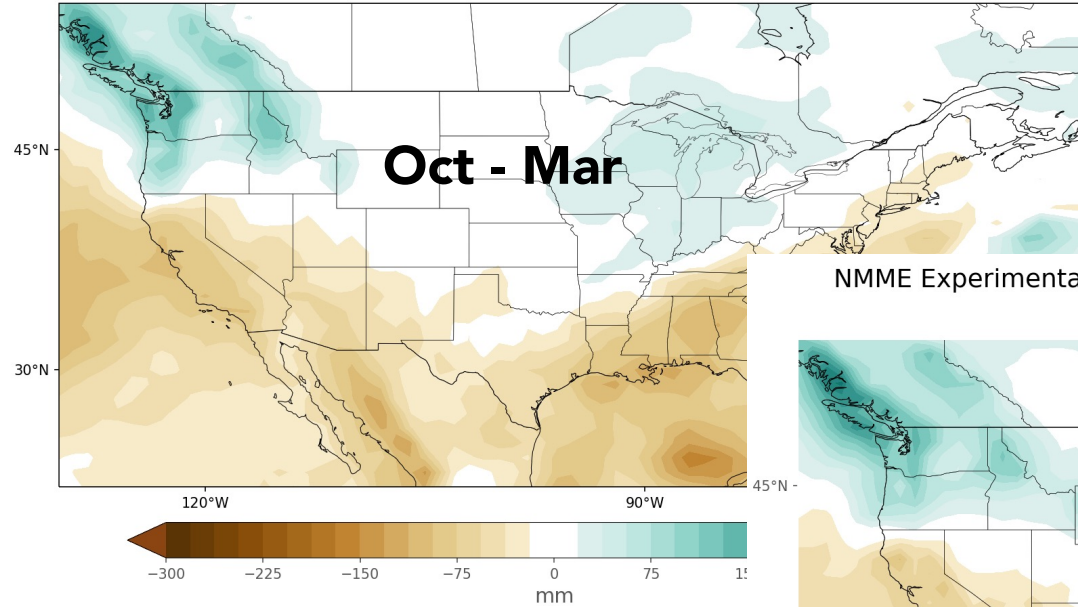
5-mth WYO Nov Start and Hit-Miss



4-mth WYO Dec Start and Hit-Miss

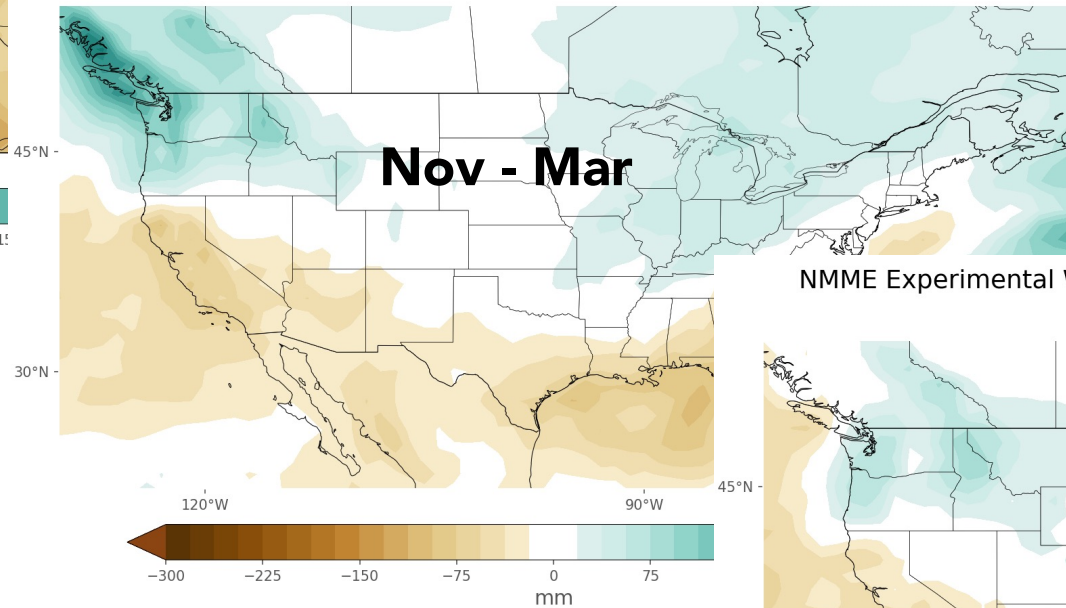


NMME Experimental Water Year Outlook: Anomaly Precipitation Forecast
Initialized 2021 ONDJFM

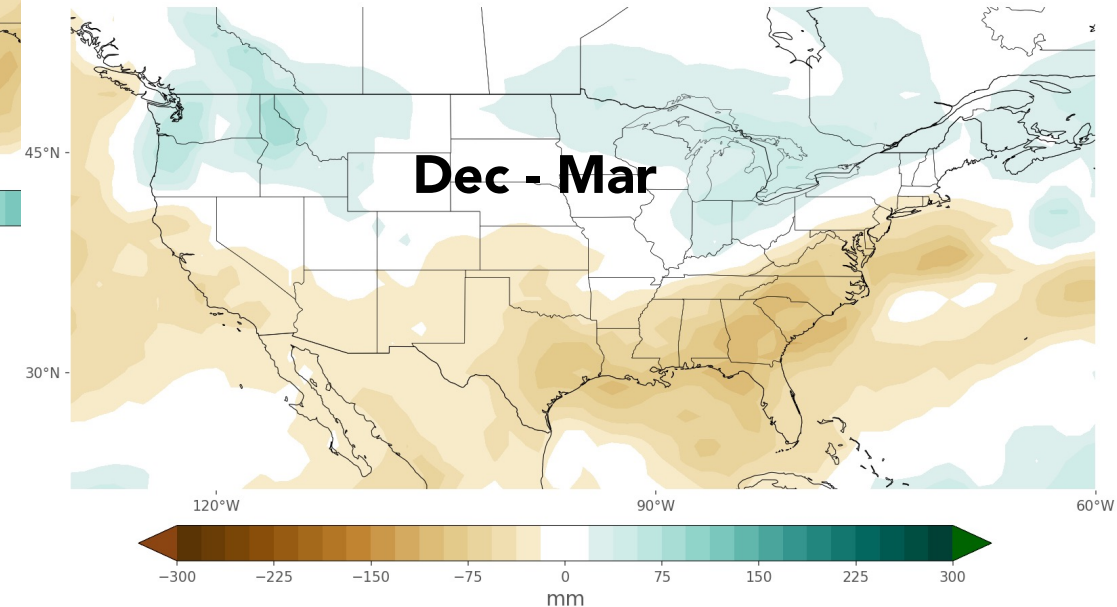


Experimental Water Year Outlooks: 2021 - 2022

NMME Experimental Water Year Outlook: Anomaly Precipitation Forecast
Initialized 2021 NDJFM



NMME Experimental Water Year Outlook: Anomaly Precipitation Forecast
Initialized 2021 DJFM



Next steps...

- Skill of the 5- and 4-mth outlooks
- NMME Bias-correction/calibration
 - Exploring up/down scaling
 - Calibration typically brings the model inline with climatology – if climatology is not as useful in the face of anthropogenic forcing/other trends, what other signals or model parameters can be developed to better capture what's happening in localized areas?
- Explore sensitivity in criteria of ONI years – add lags, choose different months, other measures of ENSO, etc.
- Explore hybrid methods – statistical + dynamical tools
- Engagement with the hydrology and water resources community to fine tune product(s)
 - Long lead temperature outlooks
 - Peak Melt
 - Dry Season Outlook



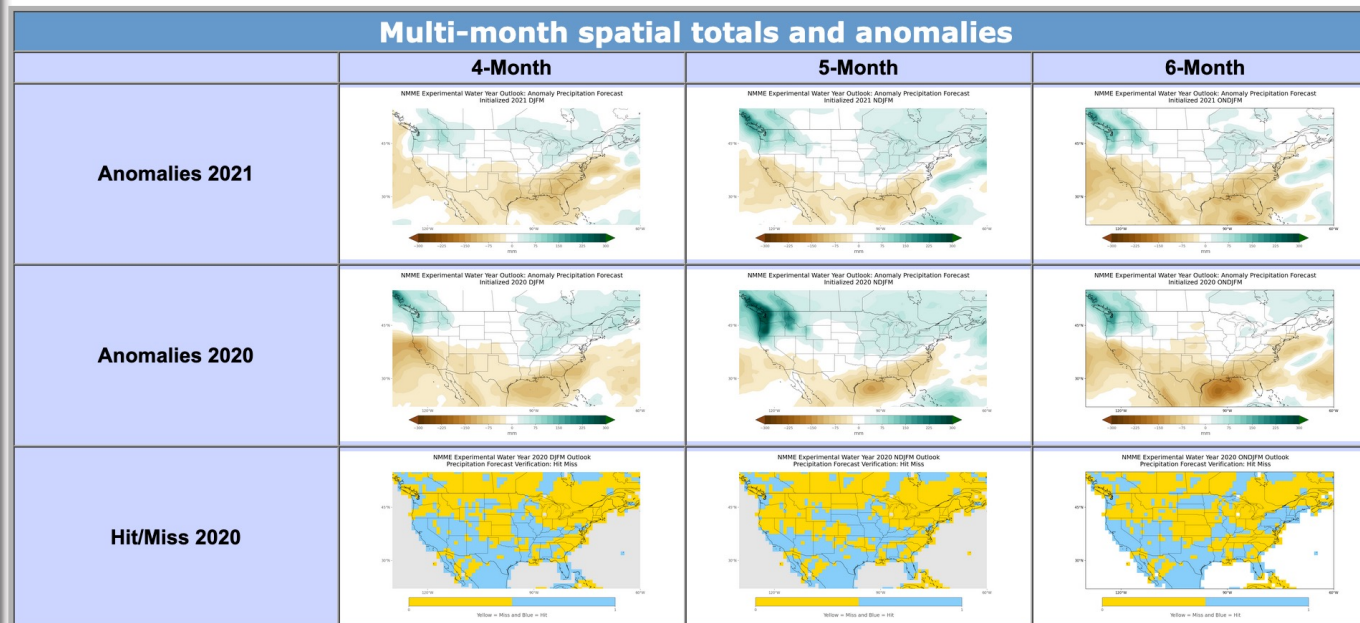
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NMME Forecasts of Precipitation

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Multi-month spatial totals and anomalies



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