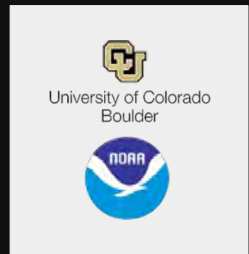


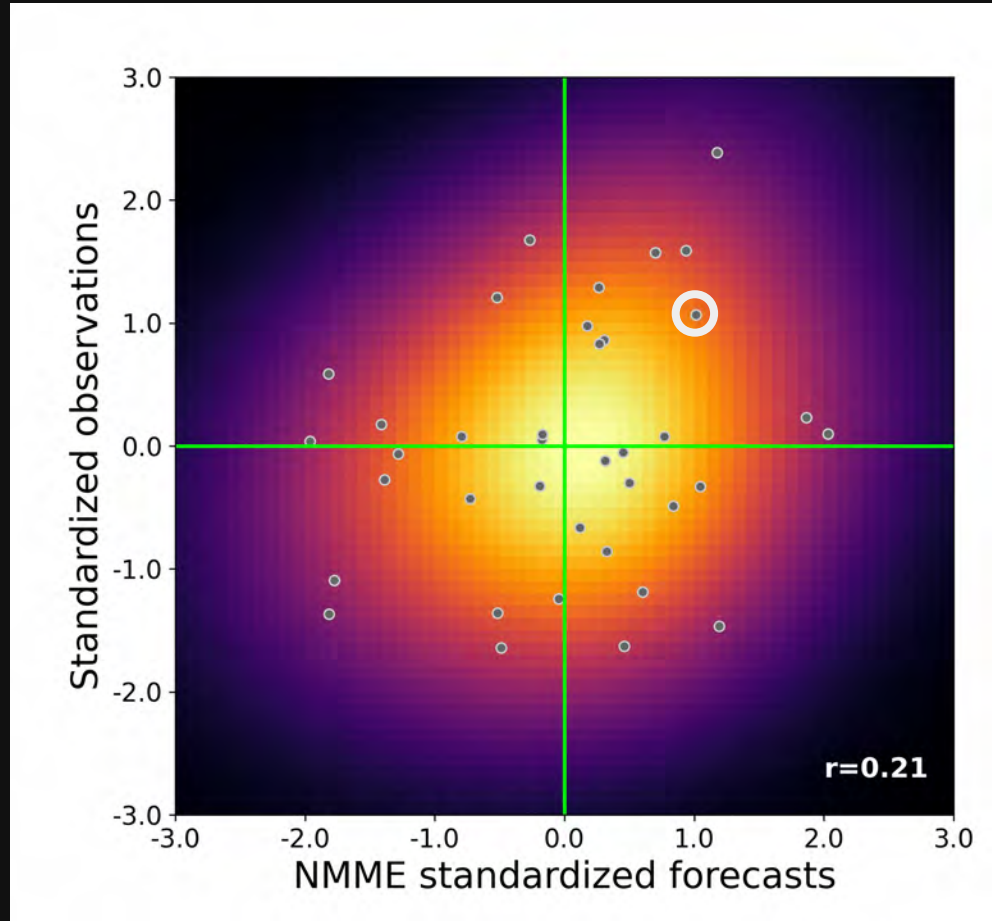
Cool-Season (Nov-Mar) Precipitation Forecasts Across CONUS and the West

CRWUA - December 14, 2021

Matt Switanek



Benchmark: What is NMME's forecast skill in the Upper Colorado?



What do I aim to accomplish?

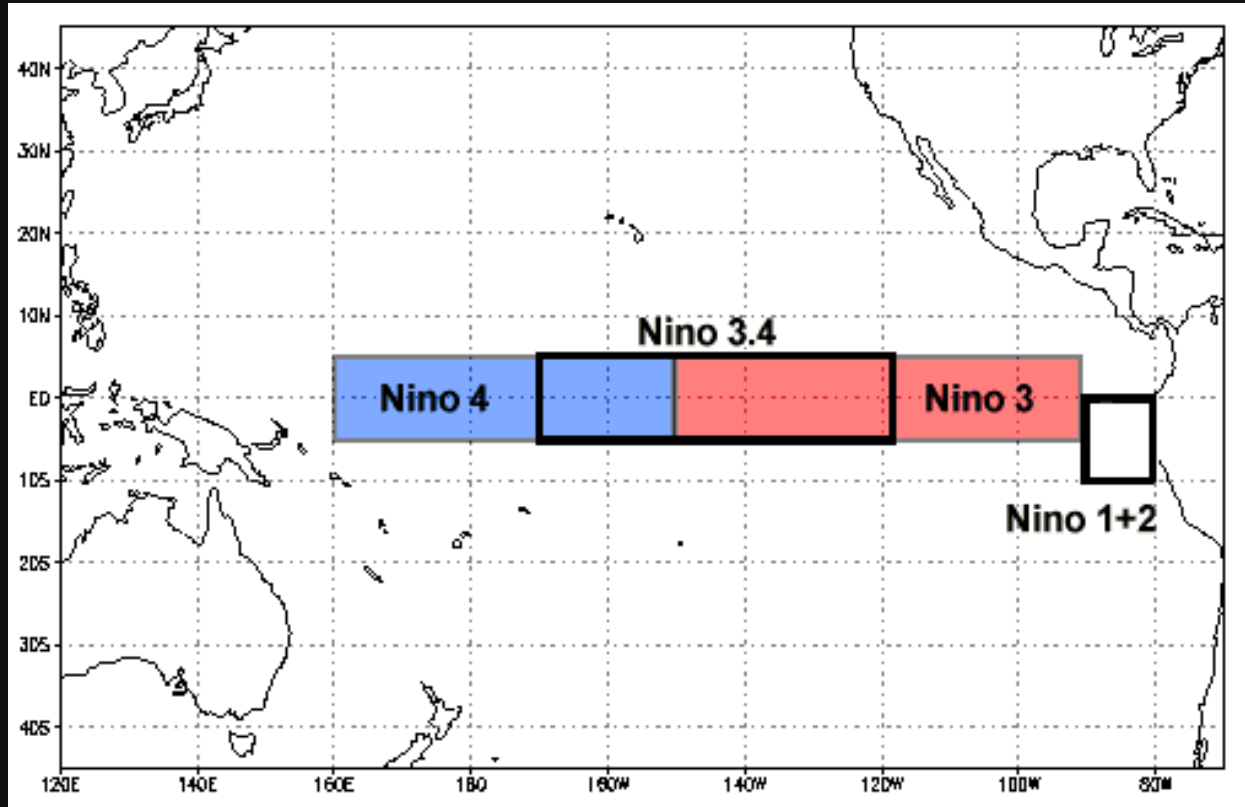
- Produce skillful cool-season (November-March) forecasts that are statistically significant across much of CONUS and the Western US.
- Additionally, show that the forecast skill is an improvement with respect to the NMME ensemble mean.

Outline of Today's Talk

1. Simplest model, but still skillful.
2. Added complexity, what does that give us?
3. A reason for optimism.
4. Where are we headed next?

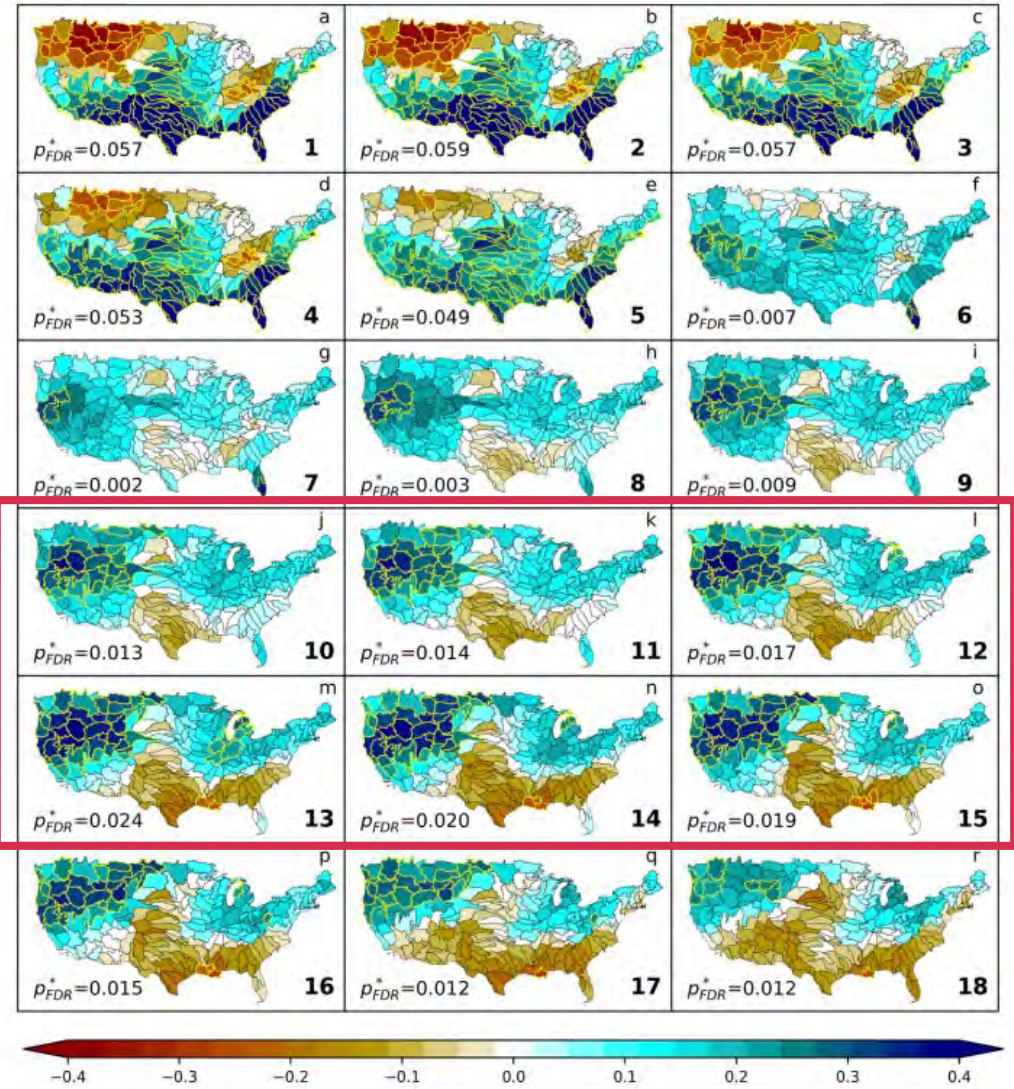
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Using only the NINO3.4 index



source: <https://www.ncdc.noaa.gov/teleconnections/enso/indicators/sst/>

Anomaly Correlation 1901/02-2017/18



This is robust and useful

Switanek, M. B., Barsugli, J. J., Scheuerer, M., & Hamill, T. M. (2020). Present and past sea surface temperatures: a recipe for better seasonal climate forecasts. *Wea. Forecasting*, **54**, 6739-6756. doi: 10.1029/2018WR023153.

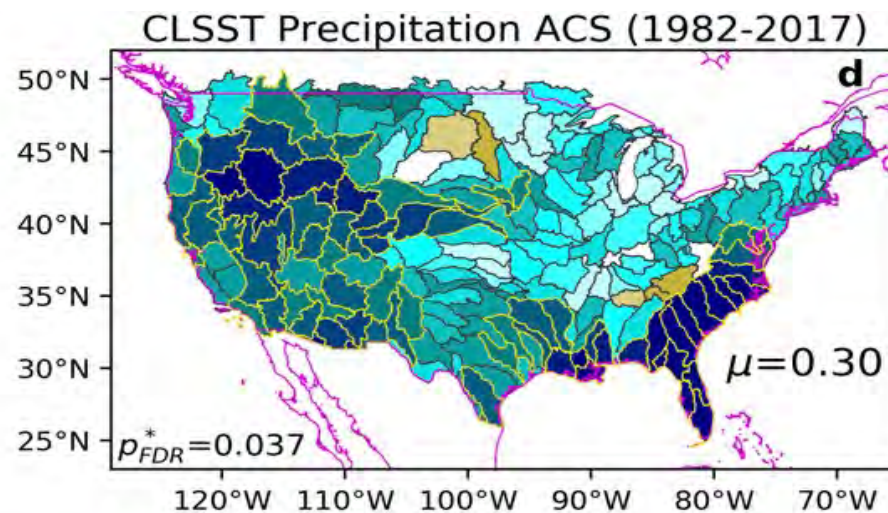
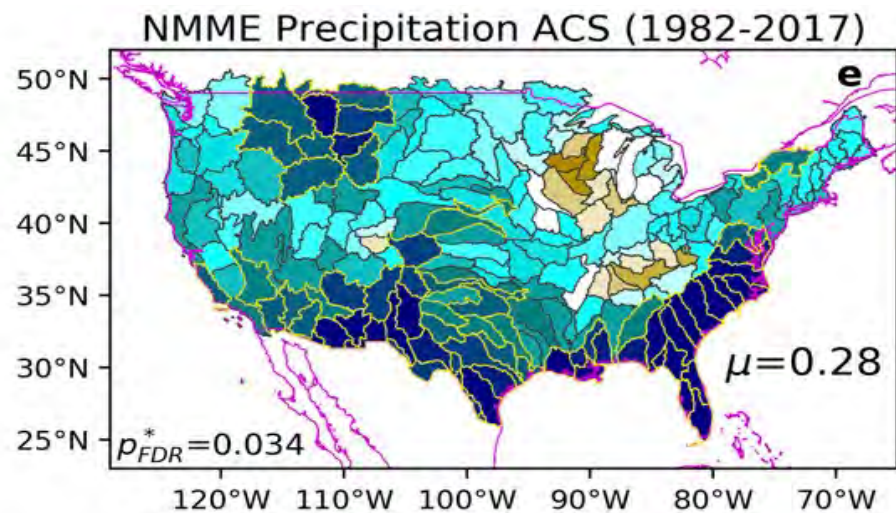
The CLSST model

Combined-Lead Sea Surface Temperature (CLSST) model relies solely on the NINO3.4 SST time series as a predictor.

1. Use dimensionality reduction. Here, we are only predicting the leading five principal components of CONUS cool-season precipitation.

2. The forecasts are a weighted ensemble mean where the forecasts in the validation period vary as a function of how well the hindcasts performed. For example, if NINO3.4 better predicted Northern California or Upper Colorado precipitation in our historical period at a lead time of 10 months, those forecasts would be weighted more than those with a lead time of 1 month.

The forecast skill of this simple model



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The SCEF model

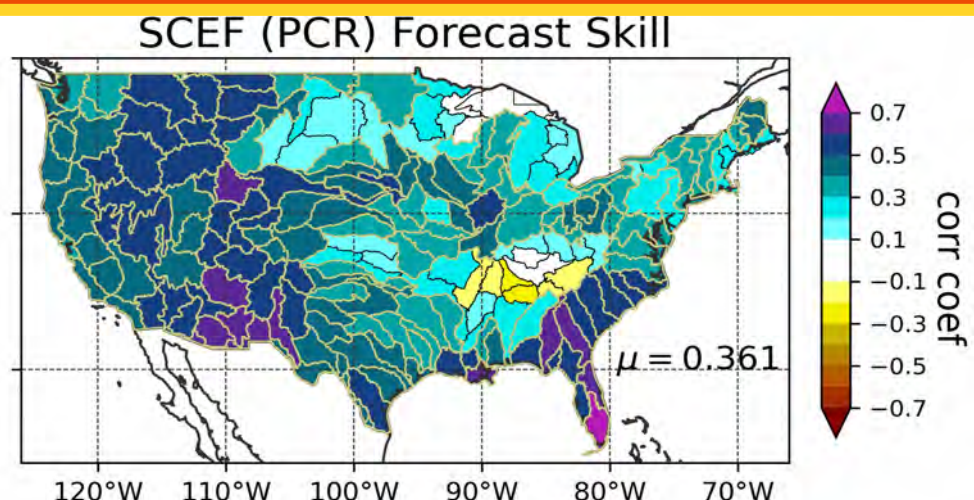
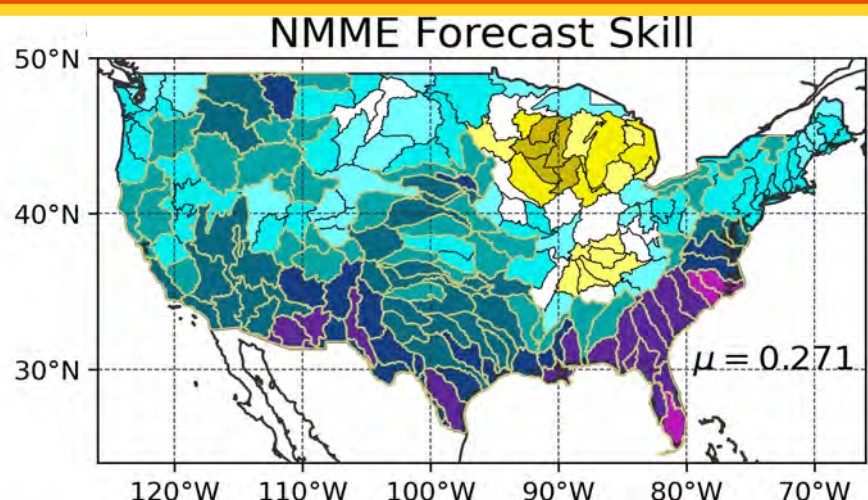
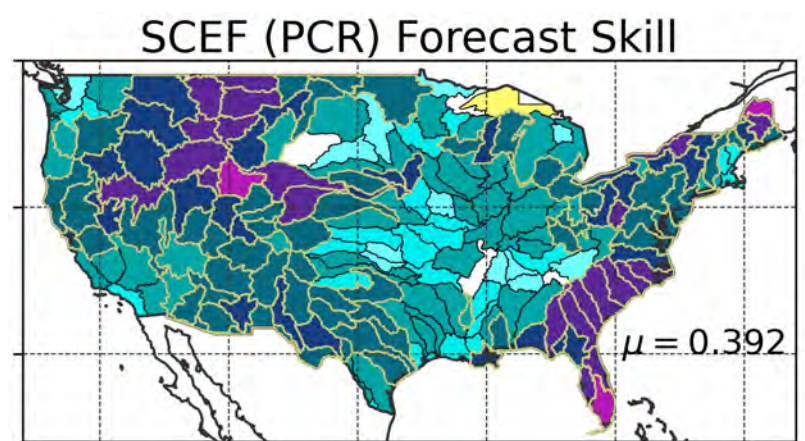
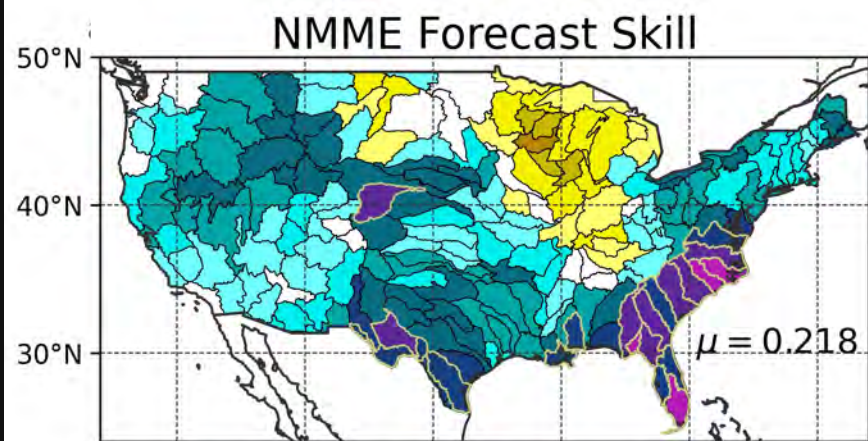
Statistical Climate Ensemble Forecast (SCEF) model relies on CLSST and other large-scale predictors (e.g., SLP, UWND, VWND).

- 1. Use dimensionality reduction** on our predictors and our predictands. In contrast to CLSST, we now use fields of predictors.
- 2. It is a principal component regression model**, or a multiple linear regression model that uses the leading predictor and predictand principal components.

Publication is forthcoming...

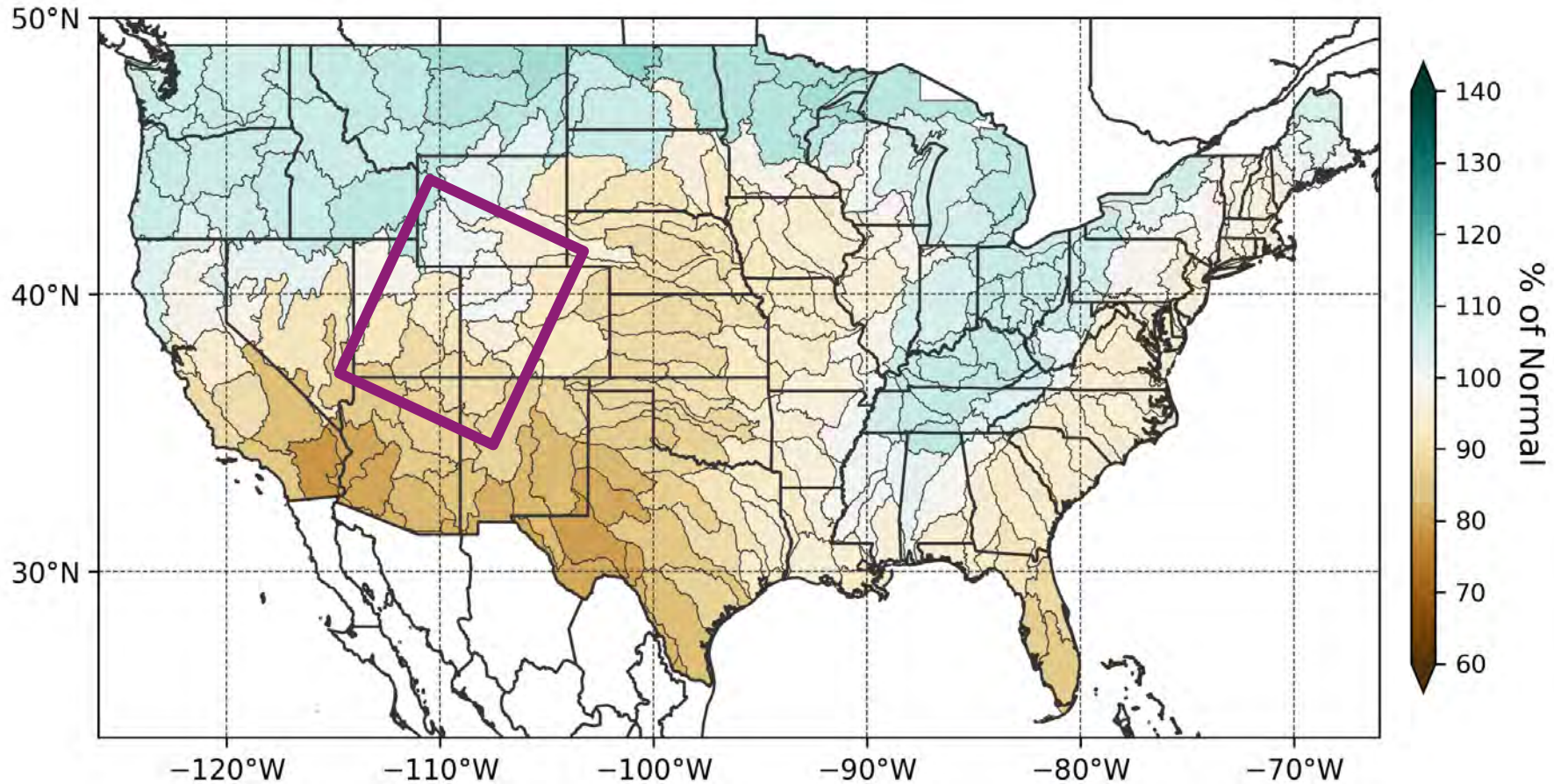
The SCEF model

Last 20 years (split validation)



Last ~40 years (10-fold cross-validation)

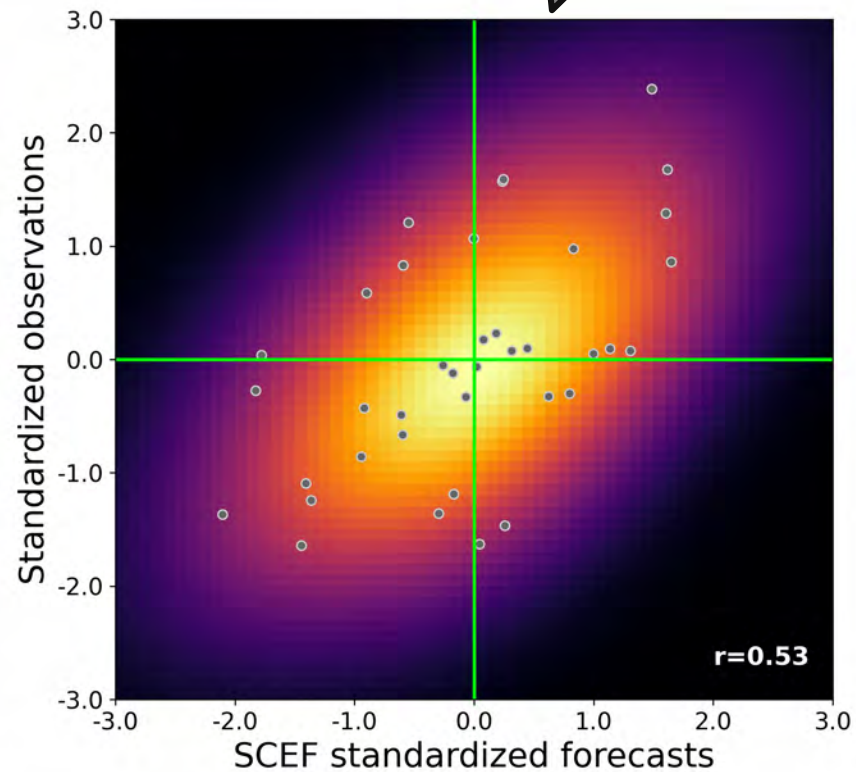
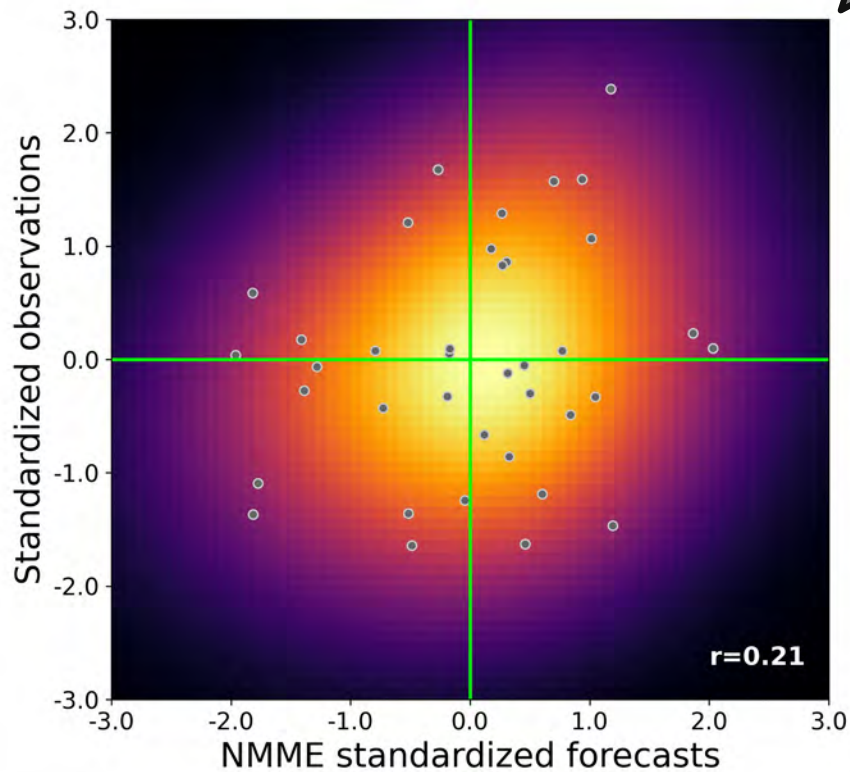
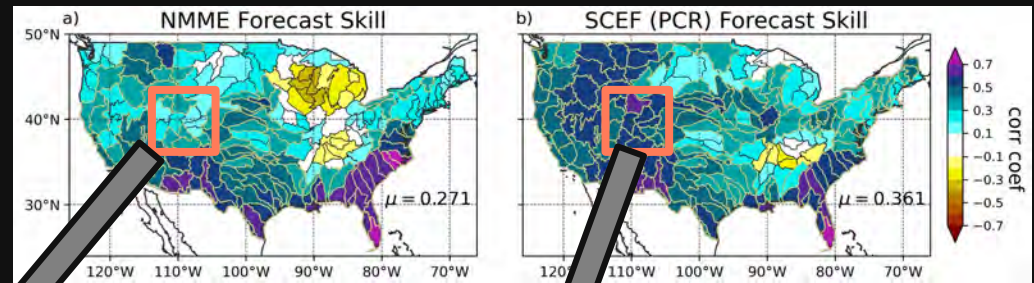
Our forecast for this cool-season (Nov-Mar 2021/2022)



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HUC4 Basin Number	HUC4 Basin Name	SCEF Anomaly Corr	NMME Anomaly Corr	HUC4 Basin Number	HUC4 Basin Name	SCEF Anomaly Corr	NMME Anomaly Corr
1801	Klamath - N. Cal. Coastal	0.44	0.29	1401	Colorado Headwaters	0.35	0.09
1802	Sacramento	0.44	0.29	1402	Gunnison	0.41	0.11
1803	Tulare - Buena Vista Lakes	0.41	0.35	1403	Upper Colo - Dolores	0.52	0.27
1804	San Joaquin	0.43	0.26	1404	Great Divide - Upper Green	0.58	0.28
1805	San Francisco Bay	0.38	0.37	1405	White - Yampa	0.41	0.09
1806	Central Cal. Coast	0.41	0.45	1406	Lower Green	0.53	0.19
1807	Southern Cal. Coast	0.43	0.39	1407	Upper Colo - Dirty Devil	0.52	0.37
1808	North Lahontan	0.51	0.19	1408	San Juan	0.54	0.37
1809	N. Mojave - Mono Lake	0.47	0.43				
1810	S. Mojave - Salton Sea	0.51	0.43				

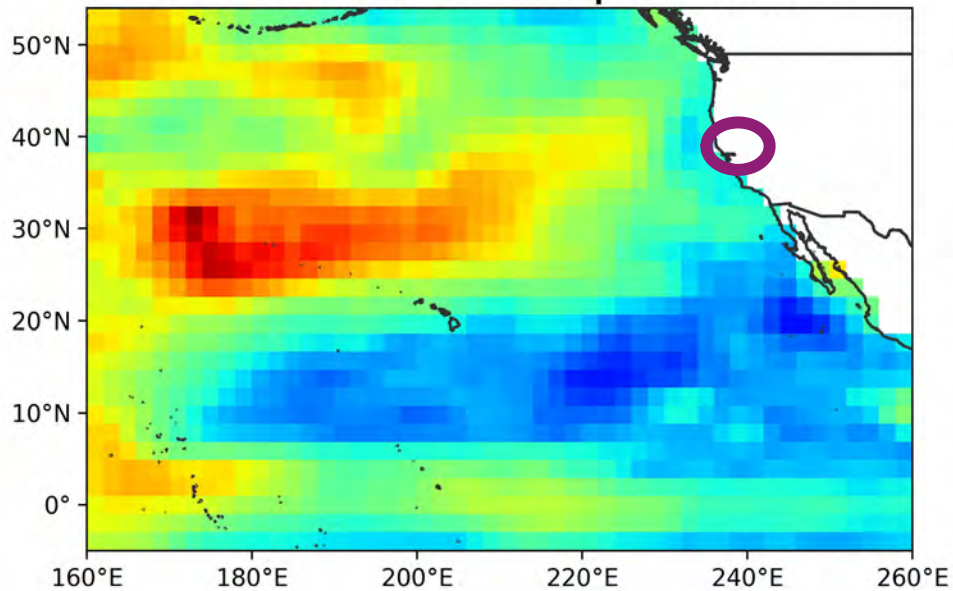
Upper Colorado



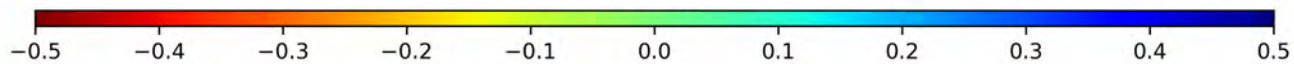
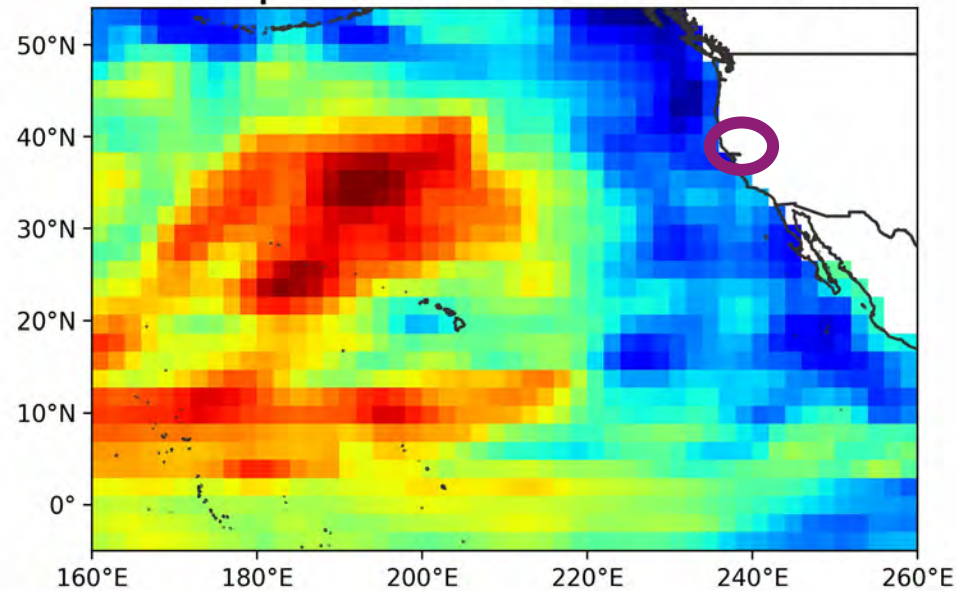
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Subsurface ocean temperatures

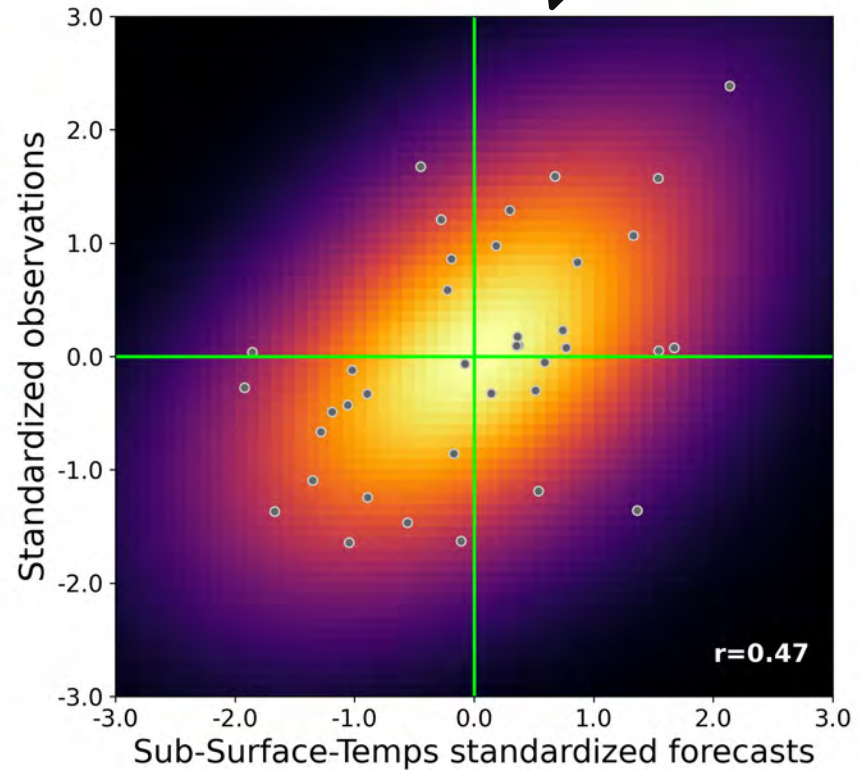
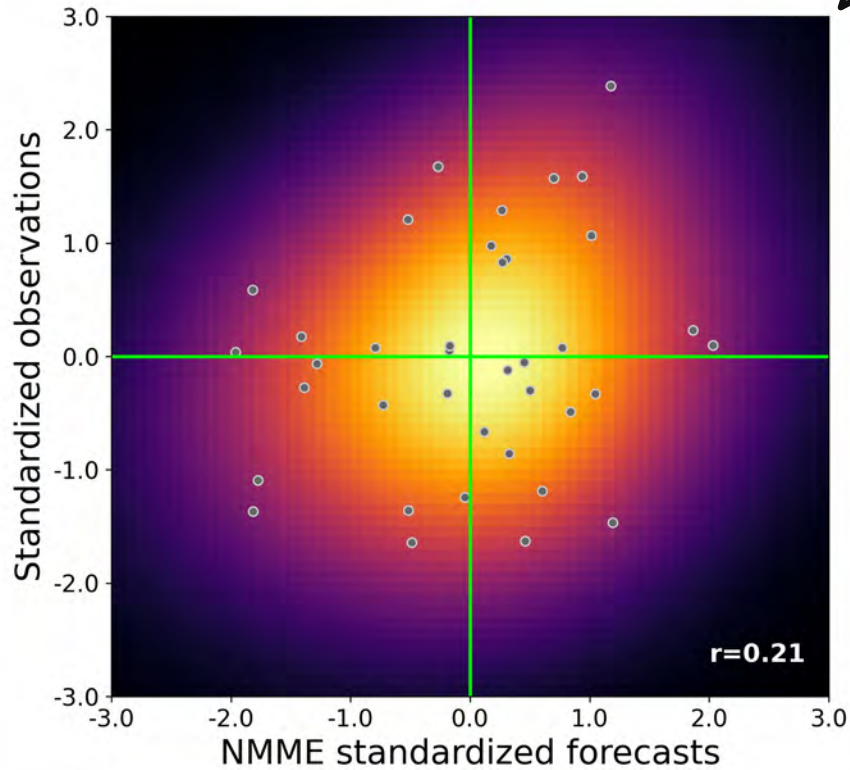
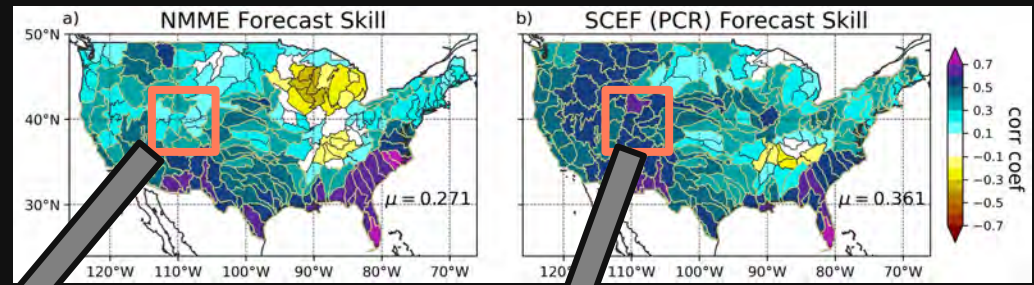
Sea Surface Temperatures



Temperatures at 85 Meters

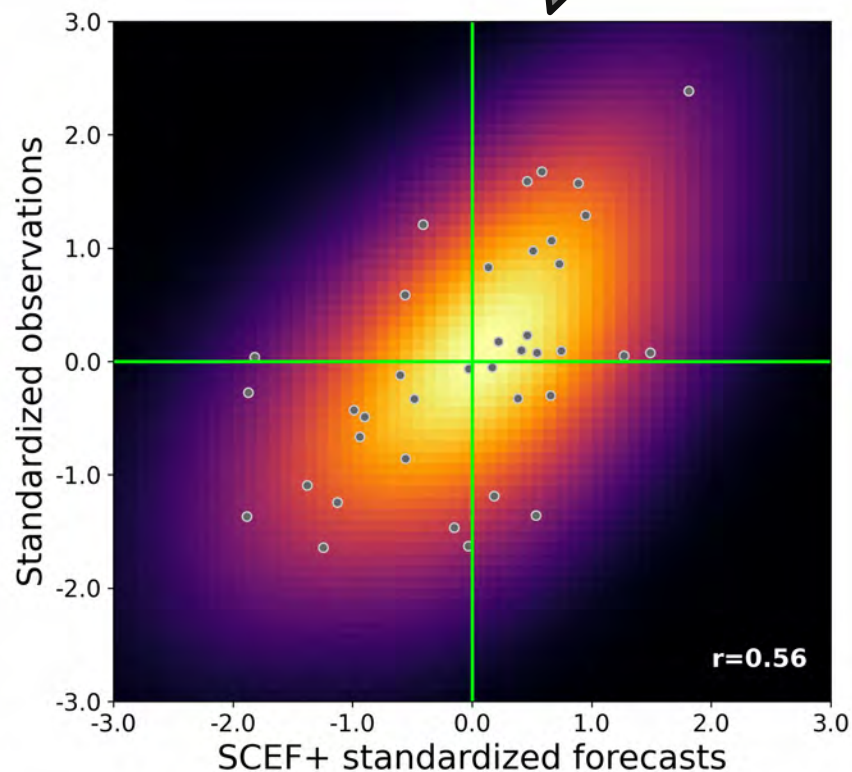
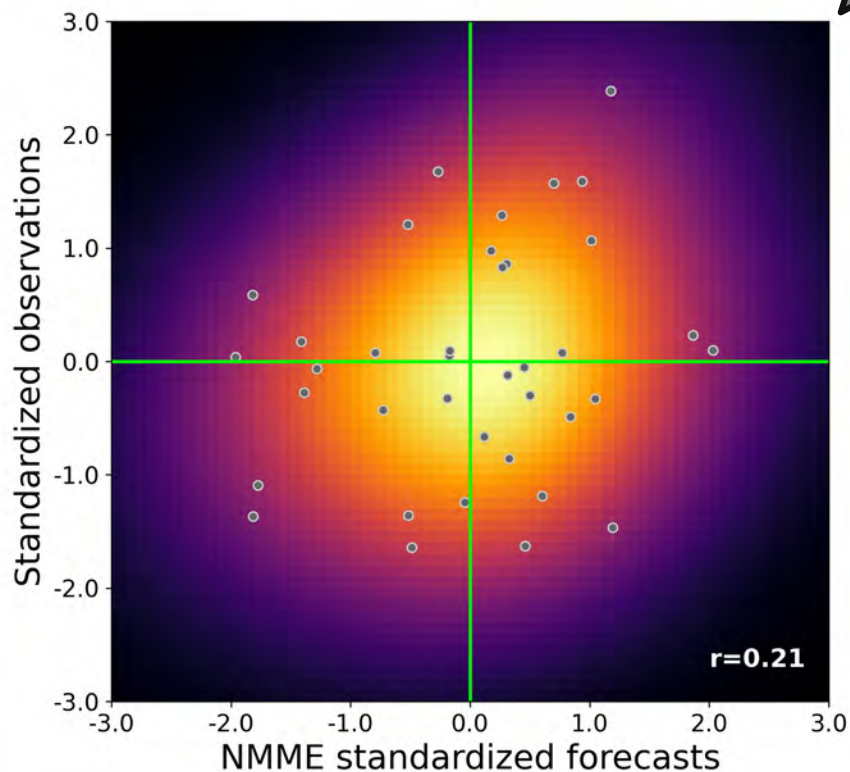
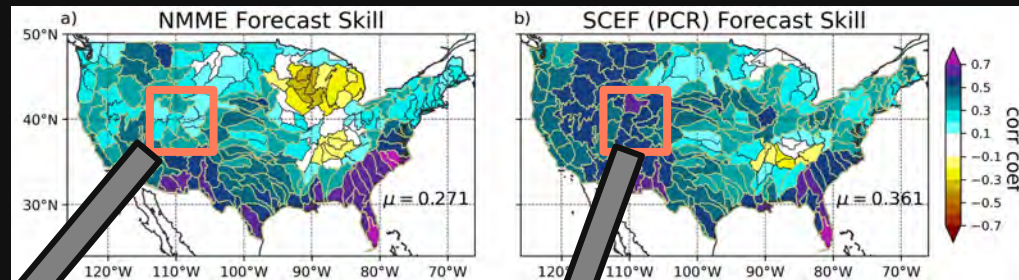


Upper Colorado



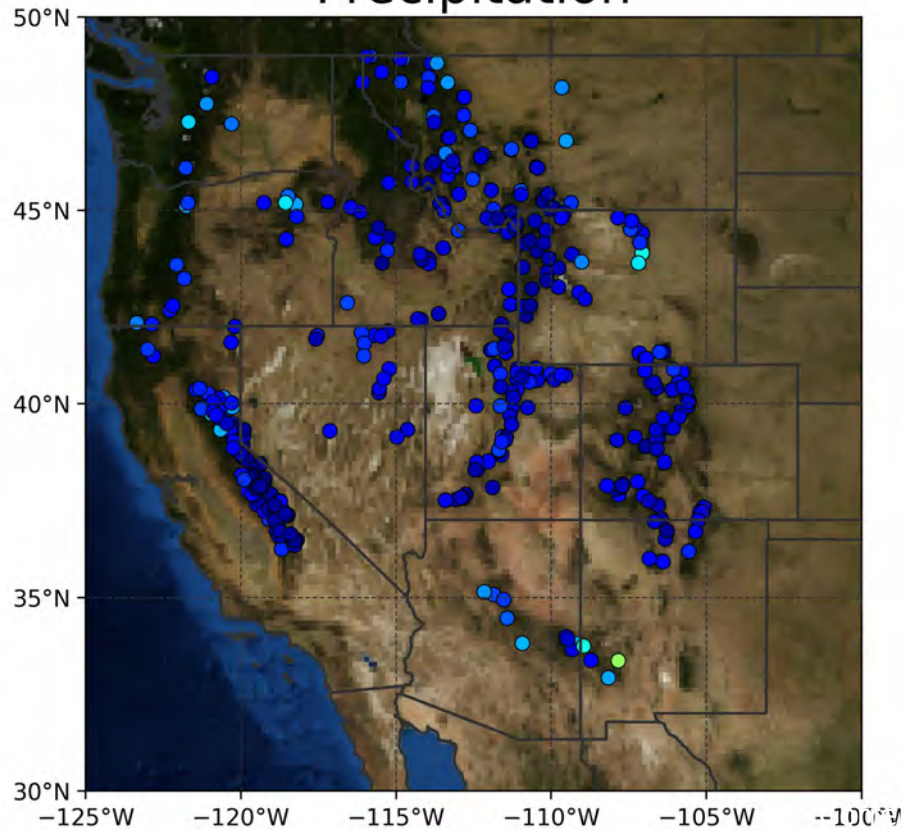
Upper Colorado

7x the variance explained

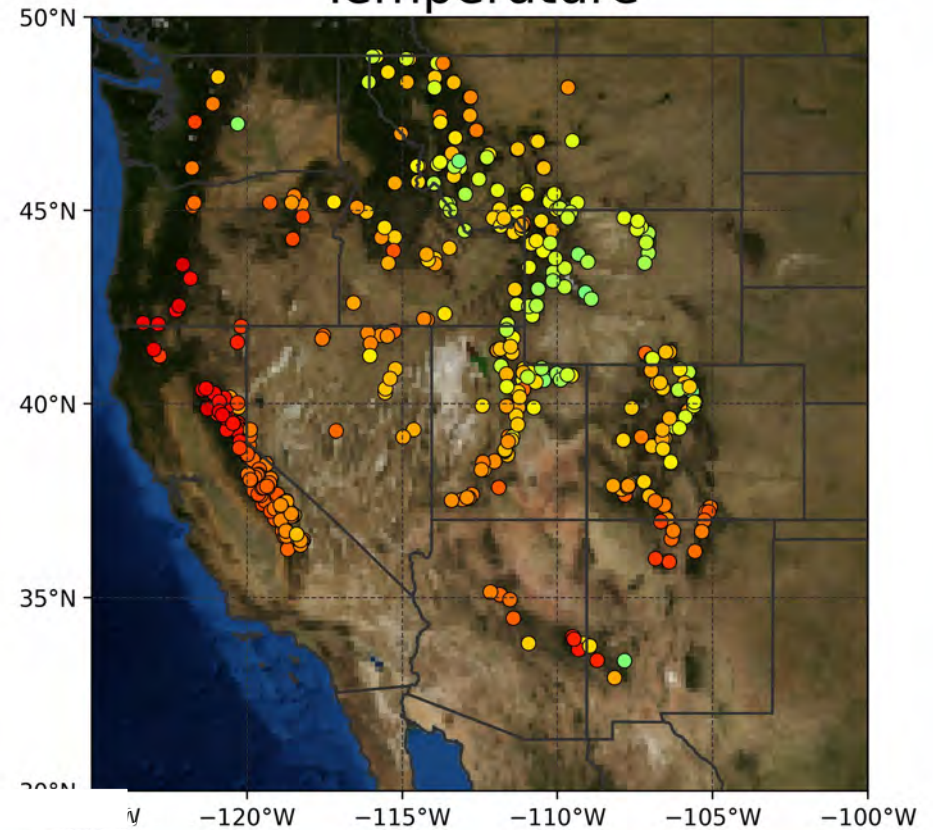


Directly forecast snow water equivalent

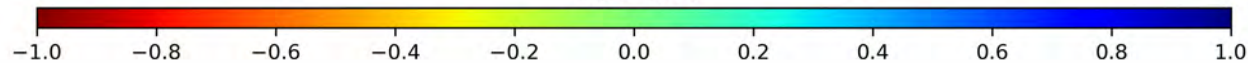
Precipitation



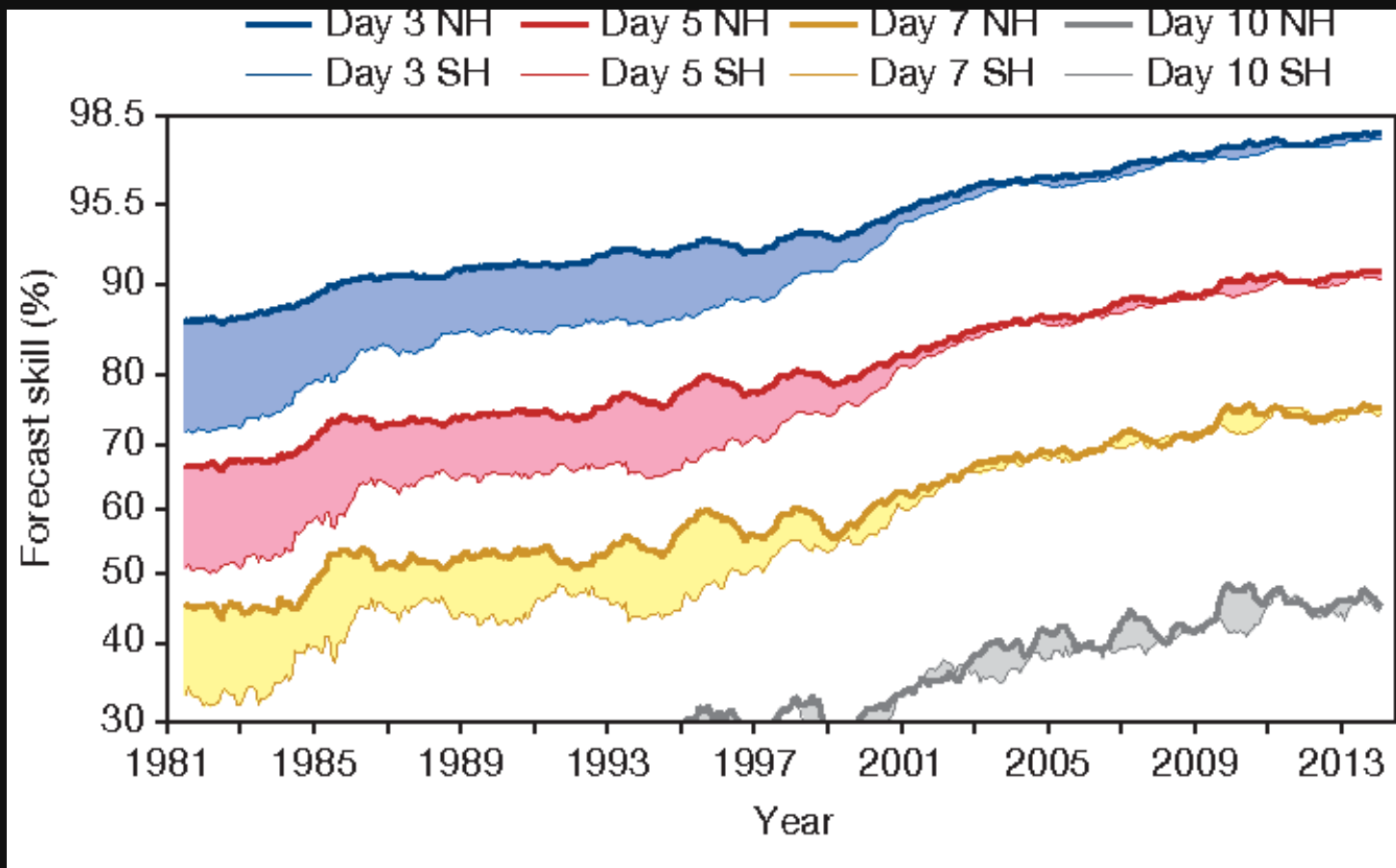
Temperature



Corr Coef



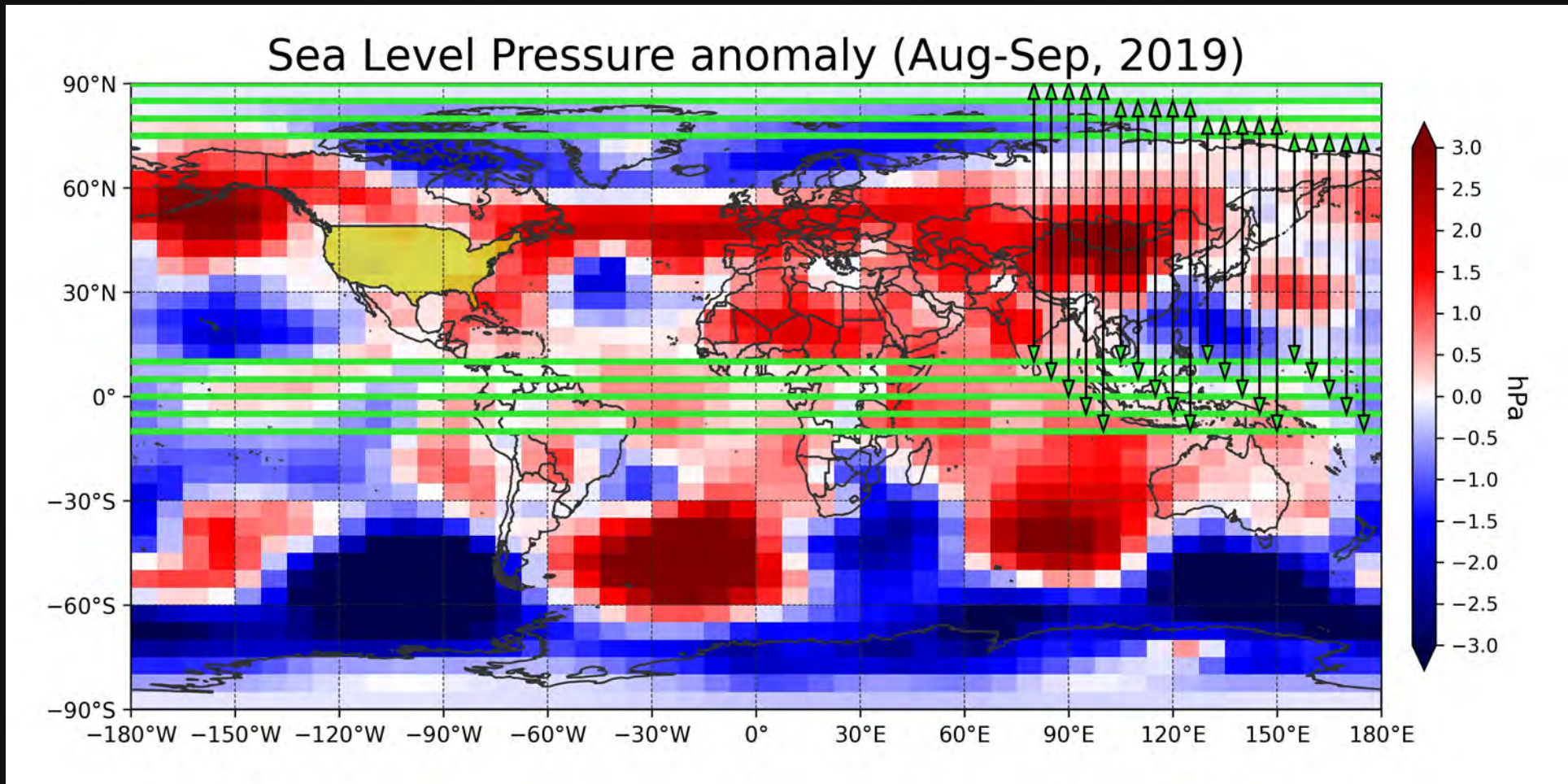
Thank you!



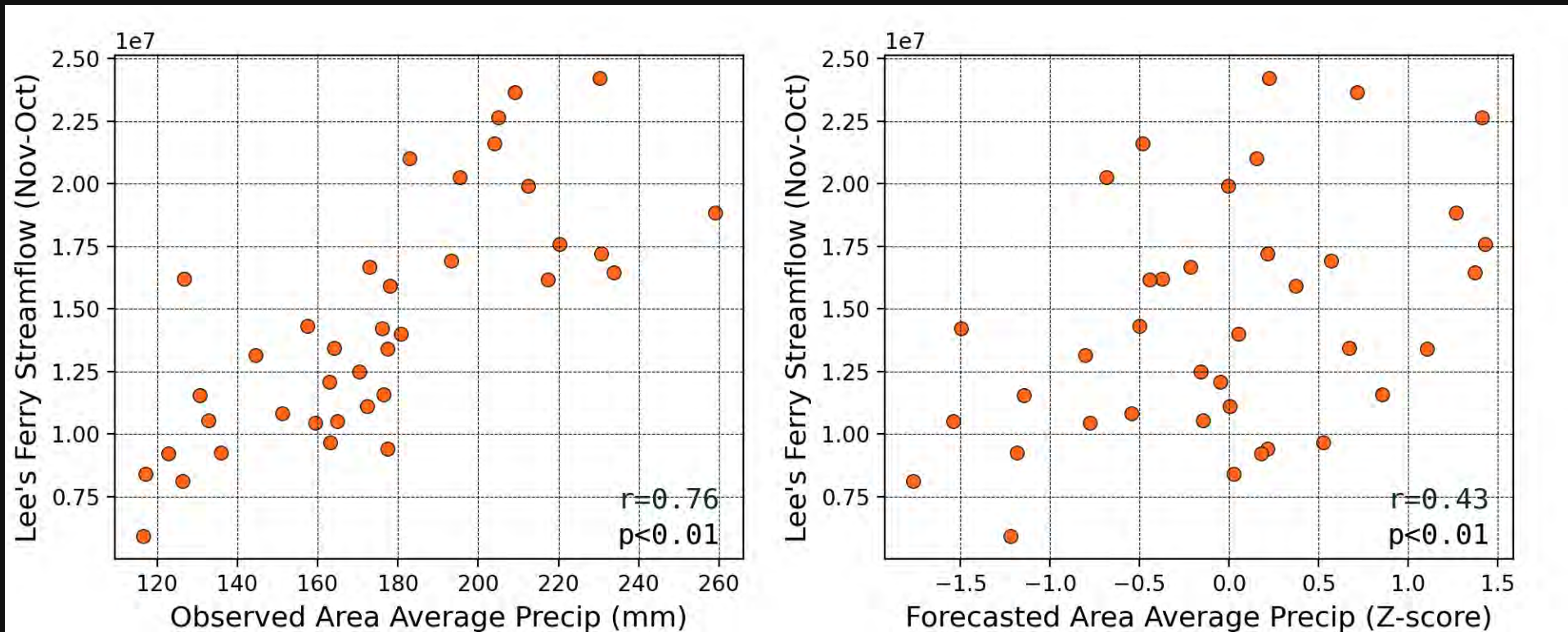
Source: Bauer et al., 2015, The quiet revolution of numerical weather prediction.

Extra slides

Extend the CLSST Model with Other Predictors (e.g., SLP, UWND, VWND)



Streamflow in the Upper Colorado River Basin



Period: 1981/82 - 2018/19