Updating CPC T2M Observational Verification Dataset and Impact on the Seasonal T2M GPRA

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NOAA National Weather Service

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Outline

- Background
- CPC's Seasonal T2M GPRA Time Series from FY2003 to present
- Descriptions of current and new verification data sets
- Verification examples and comparison of GPRA time series using current and new observed data for verification
- Summary

Background on CPC Seasonal T2M GPRA Metric

- The CPC T2M GPRA Metric is for the 48 month running mean Heidke Skill Score (HSS) of the favored category for the first lead seasonal temperature forecast. The forecasts are given as probability of tercile categories: below, near, and above normal.
- The monthly evolution of the CPC T2M GPRA Metric is influenced by two factors:
  - -The skill of the latest seasonal prediction, which is added.
  - -The skill of the seasonal prediction 48 months ago, which is removed.
- The CPC GPRA will go up (down) if the score from 48 months ago was lower (higher) than the current month score that replaces it in the running mean. Idealized examples can be constructed to highlight this behavior.

Calculation of the Heidke Skill Score

Modified Heidke Skill Score:
% Improvement over Random Forecasts

$$s = \frac{c - e}{t - e} * 100$$

c = # correct forecasts

t = # total forecasts

e = # correct randomly (expected outcome)

For our system, correct randomly (expected outcome) is 1/3

Sample Verification for DJF 2019-2020

- Verification of temperature/precipitation outlooks done on 2x2 grid for CONUS.
- This sample verification encompasses 232 valid grid squares. Forecast breakdown for this case: Total forecast grids= 153, climo grids = 51, correct grids = 124, incorrect grids = 29.
- HSS in this case is (124-51) / (153-51) = 73/102 = 71.6
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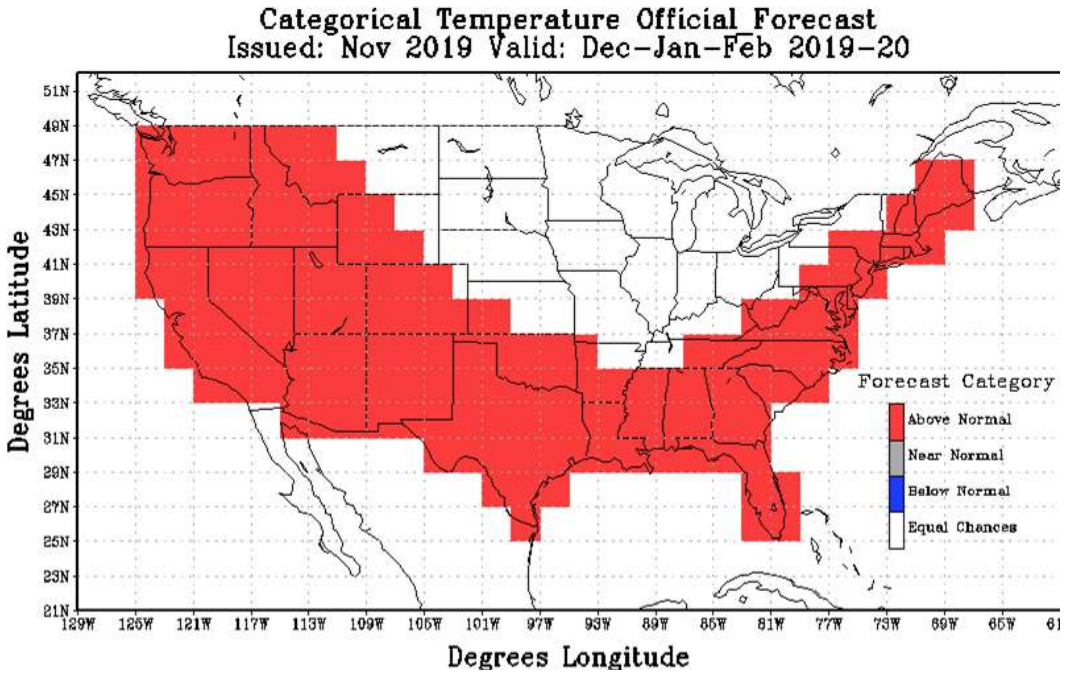
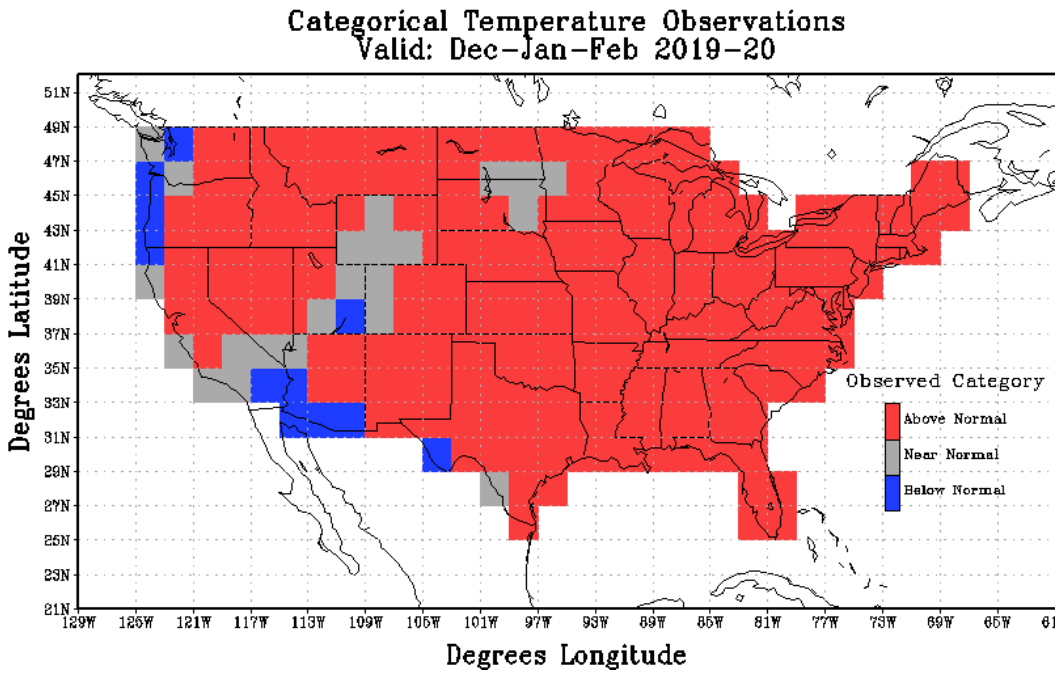
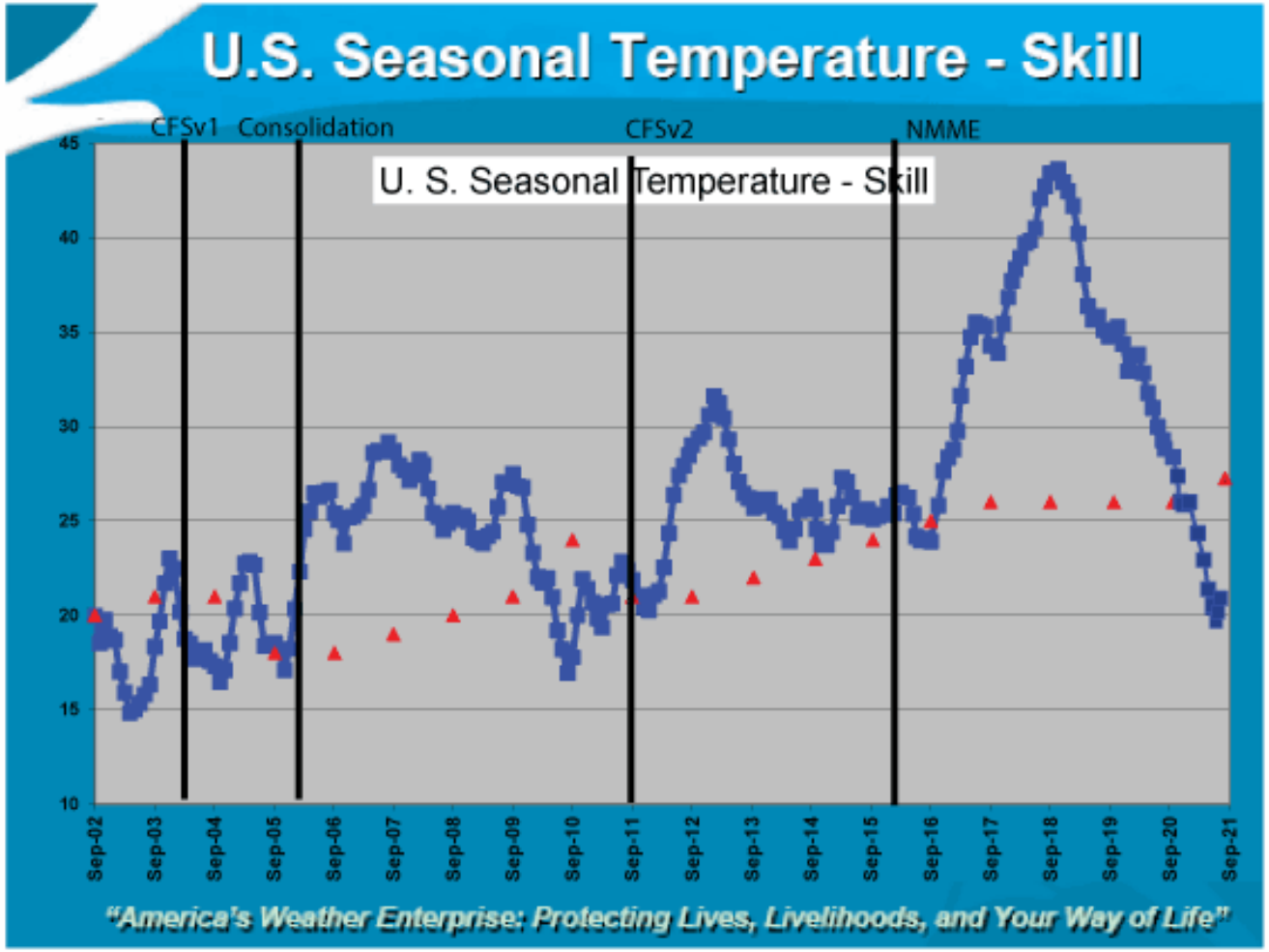


CPC Forecast



CPC Operational Observed Verification Data

Current GPRA

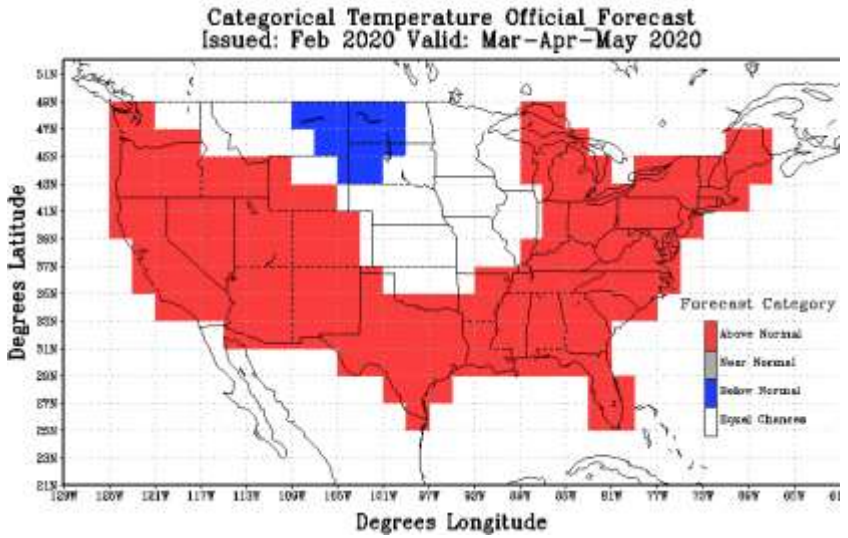


Individual forecasts are verified using the Heidke Skill score, calculation listed on next slide.

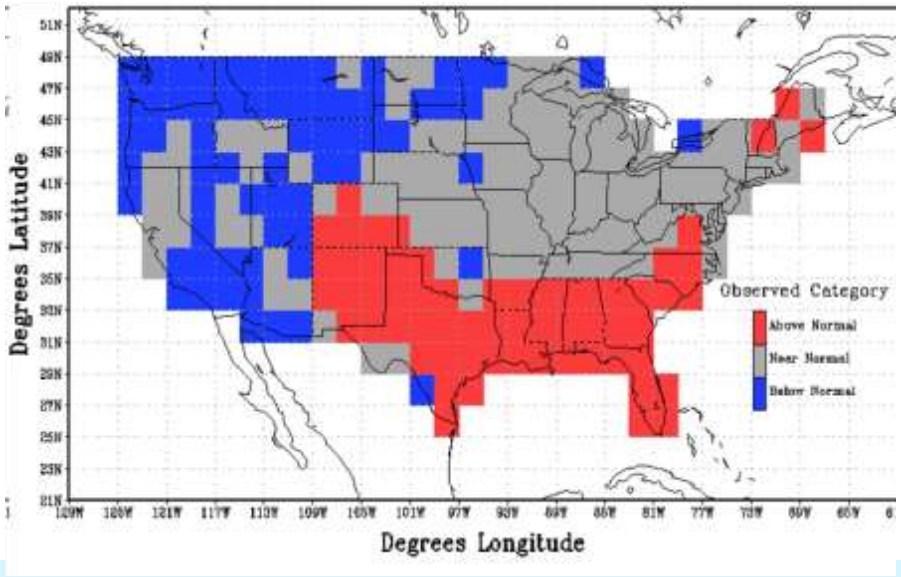
This score can be volatile. To minimize the volatility, the GPRA metric is the running mean of the last 48 seasonal scores. A single seasonal score is generated after the end of each month, and it includes data from the past three full months. The oldest of the last 48 seasons ended 48 months prior to the last day of last month is replaced each month.

Verification for March – May 2020

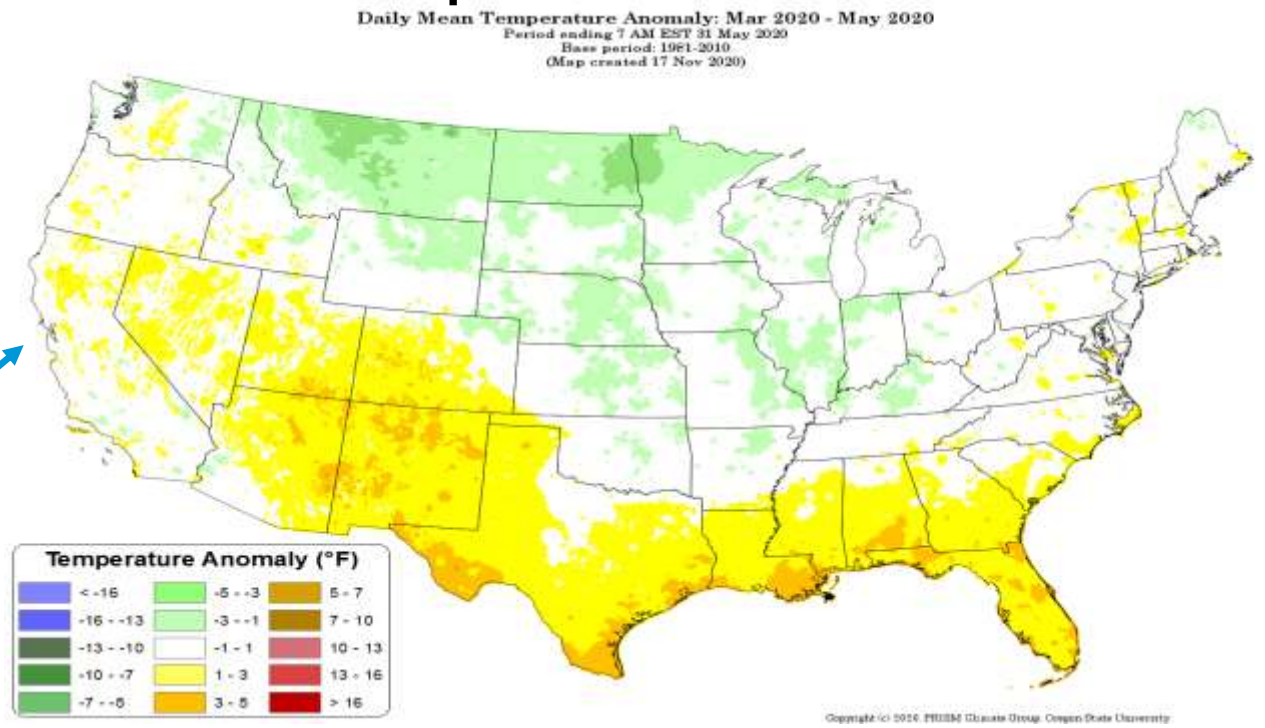
CPC Forecast



CPC Operational Verification



Prism Temperature Anomalies



Comparison of current CPC observational verification data with PRISM data shows that the CPC data is too cold over much of the western US.

Heidke Skill Score in this case is 6.6.

Overview of Current Verification Data Set

Historical (Climatological) Data:

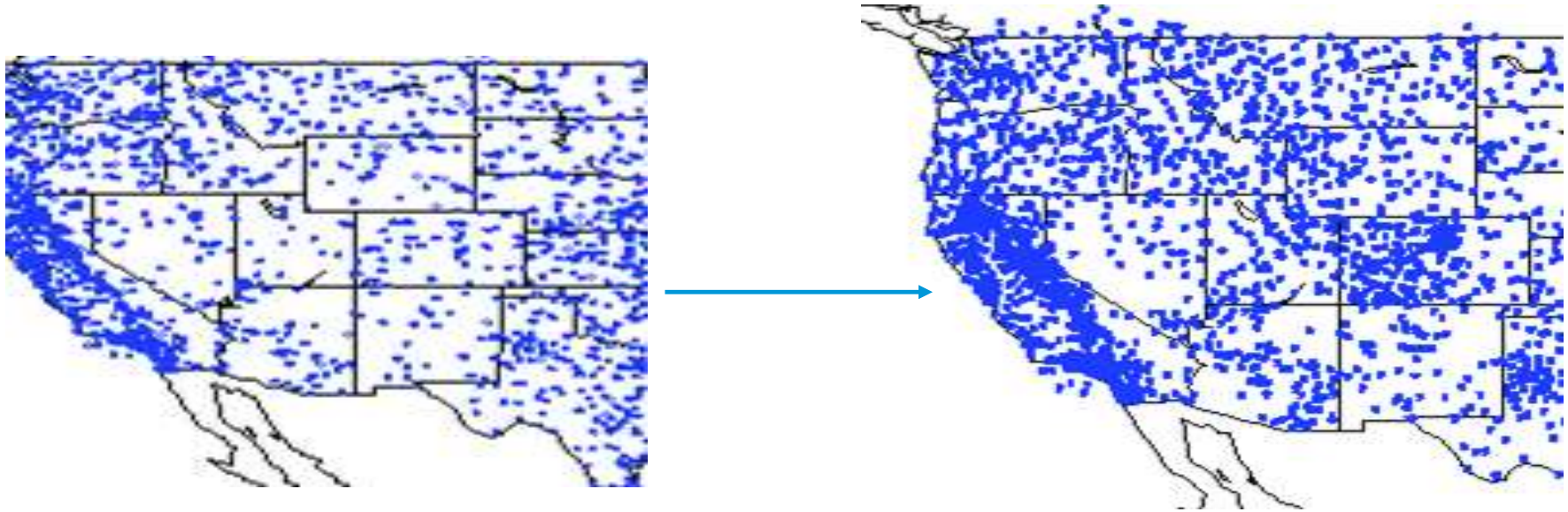
- NCDC COOP - 1981-2003

Real time Data:

- RFC (including HADS <5K Meters) - 2004-present
- Roughly 5000 stations in mid-late 2000s
- Expansion of HADS from 10K in 2003 to ~18K currently
- Includes ~2700 RAWS (remote automated weather Stations) many at higher elevation.

Comparison of Station Density Over Time for CPC Operational Observed T2M Verification Dataset

Between 2014 and 2021 the Density of the Observational Network Increased Substantially in the Western US



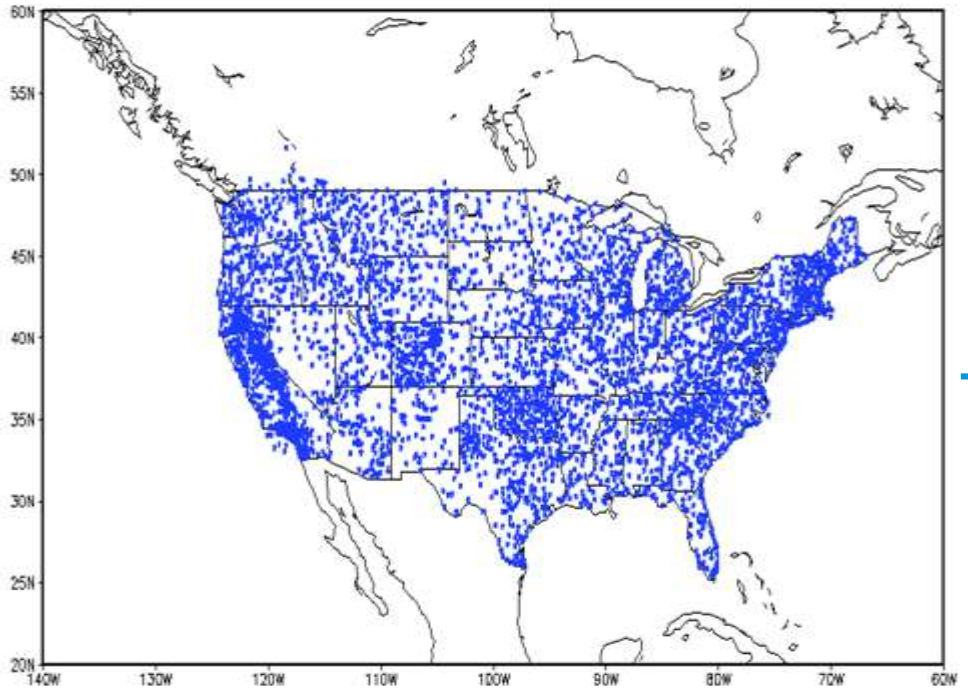
January 6, 2014

January 6, 2021

New T2M Verification Data Set and Station Density Comparison with Current Data Set

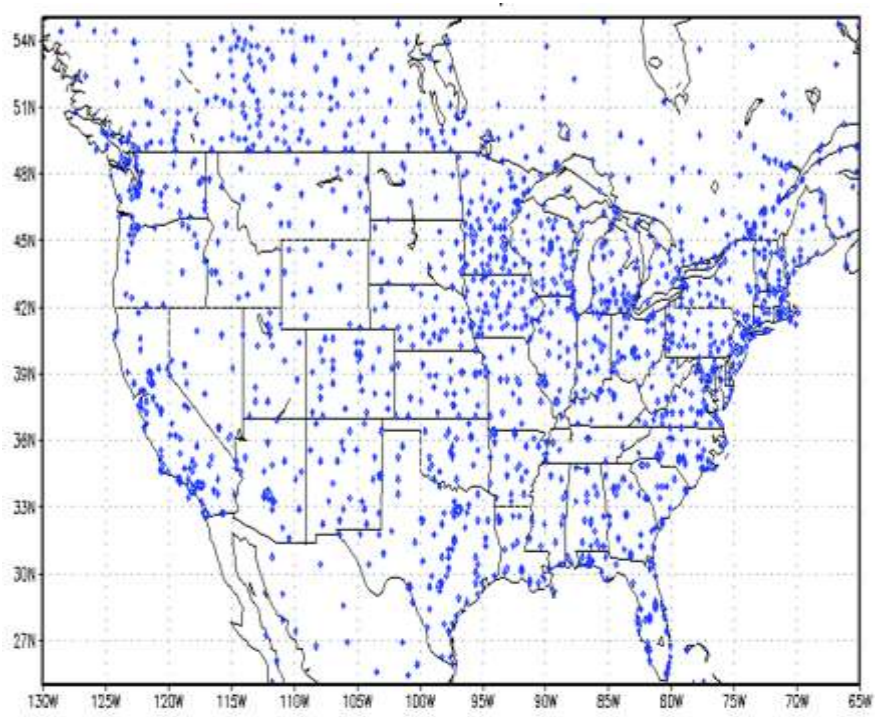
Background on New T2M Verification Dataset:

Historical and real-time (same density, i.e. constant throughout record): ~1500 stations acquired daily via the GTS; includes Synoptic and Metar.



Station Density of Current Operational Data (2021)

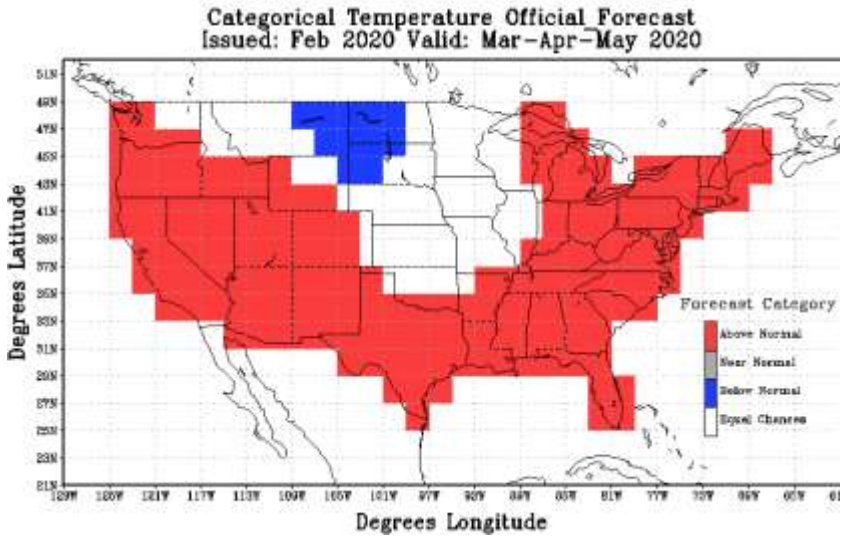
Reduced station density for new dataset



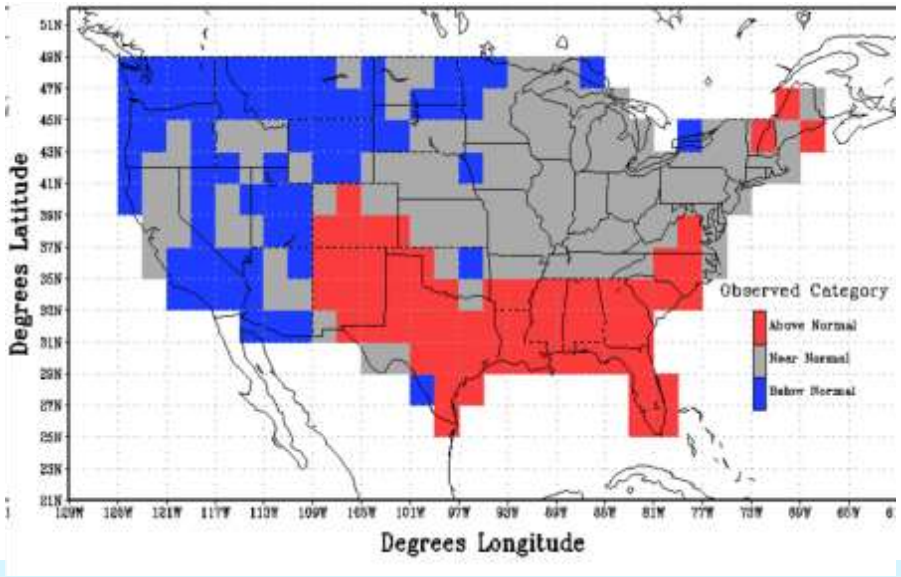
Station Density of New Data (constant over time)

Verification for March – May 2020

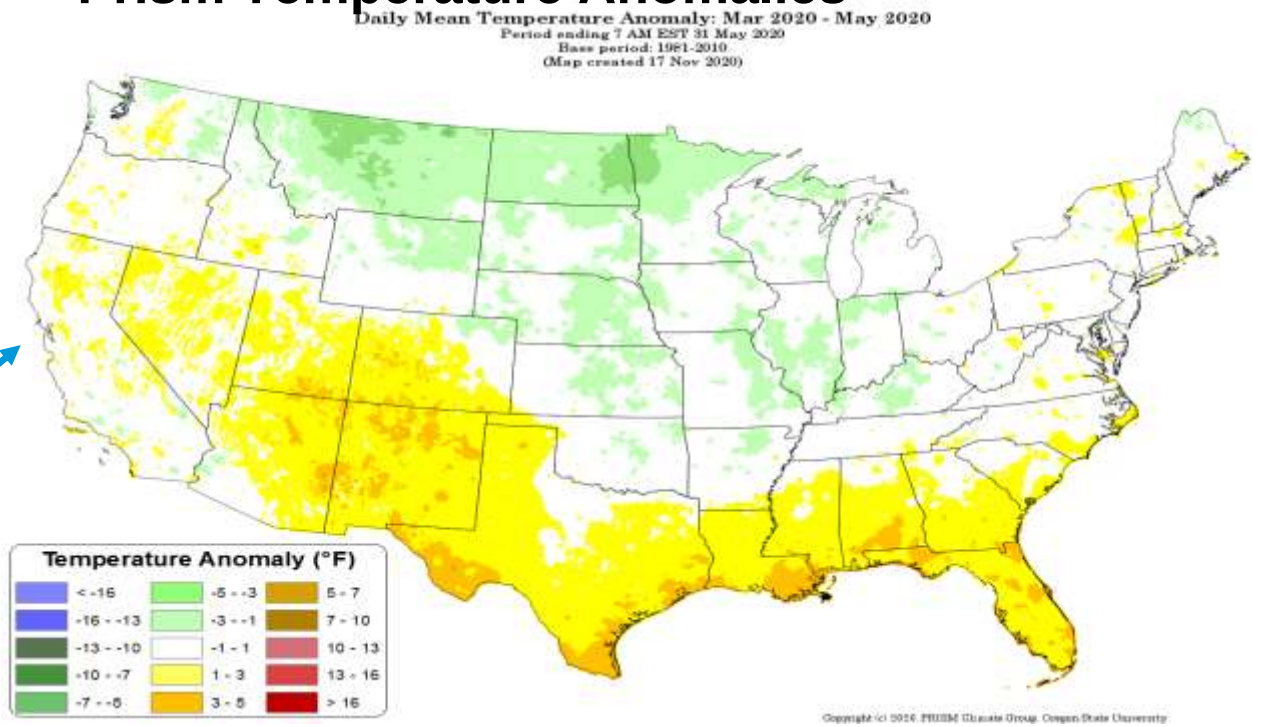
CPC Forecast



CPC Operational Verification



Prism Temperature Anomalies

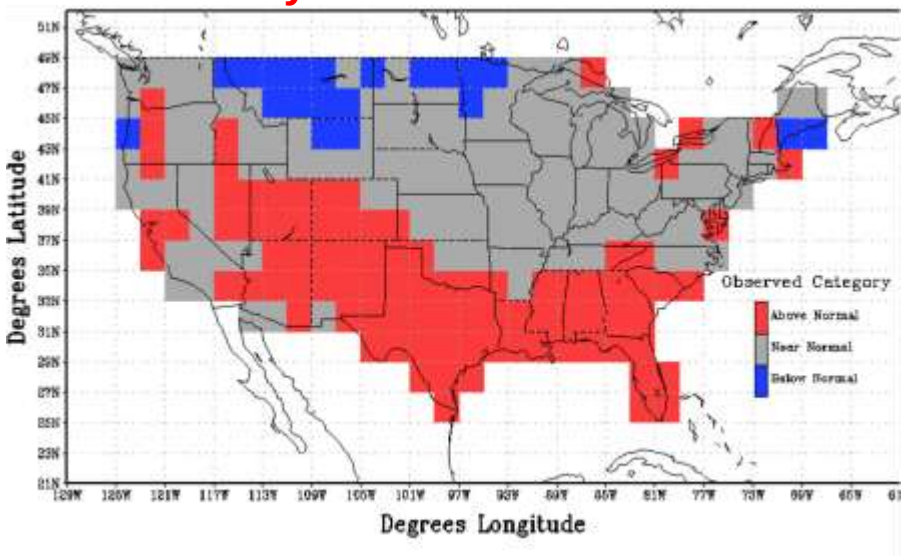


Comparison of current CPC observational verification data with PRISM data shows that the CPC data is too cold over much of the western US.

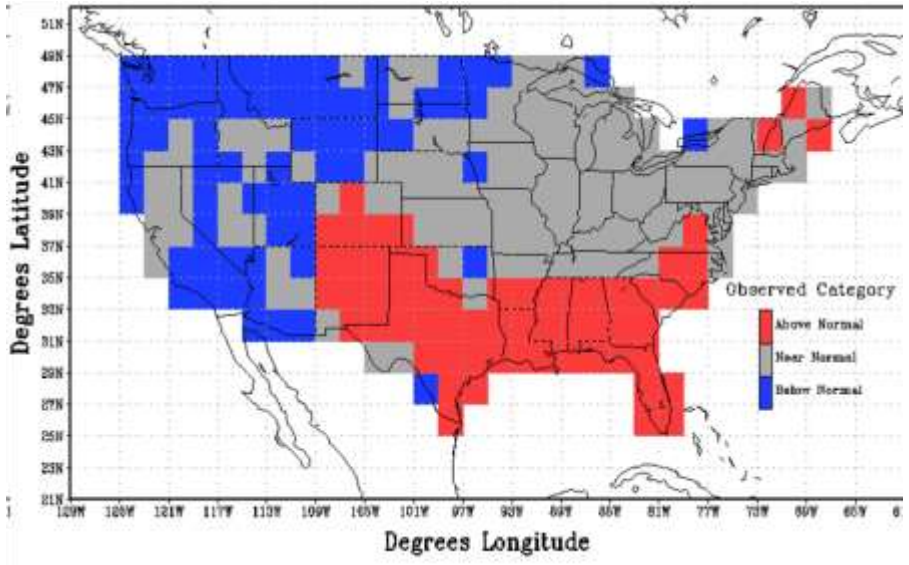
Heidke Skill Score in this case is 6.6.

Comparison of March – May 2020 Observed Datasets with PRISM And Verification Score for CPC Outlooks Using These Datasets

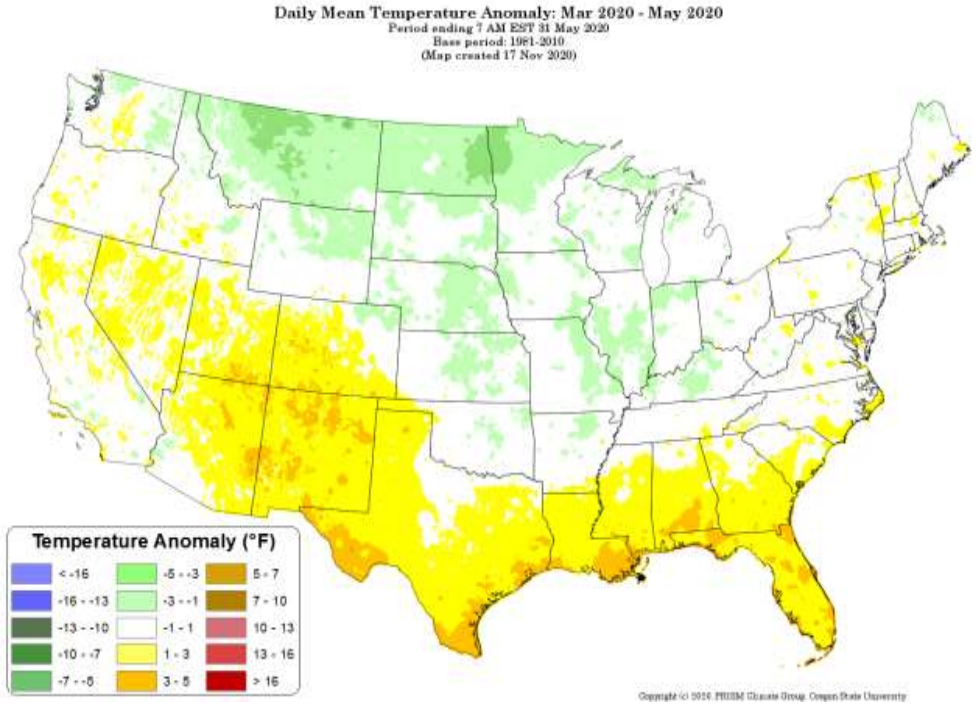
New Analysis



Operational (Current) Analysis

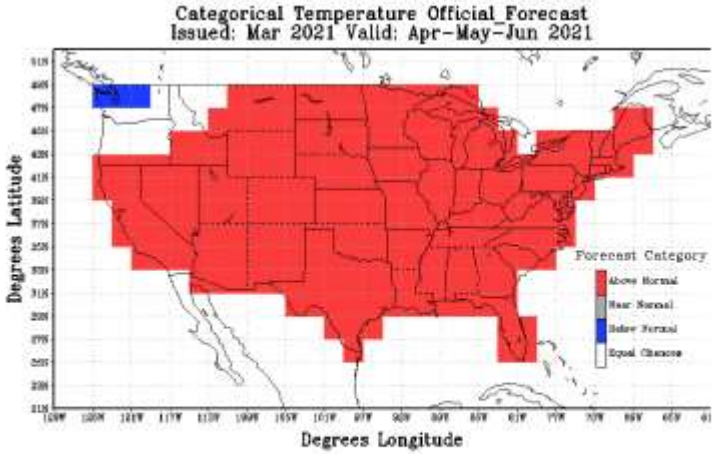


Prism Temperature Anomalies



Heidke Skill Score for CPC Official Outlook is 6.6 for current analysis, while for new analysis is 28.9 Improvement is largely the result of a warmer verification in the West, which is consistent with the PRISM analysis.

Recent Example

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Non-EC (new-old): 21.56 - -8.03 = 29.59
All-FC (new-old): 20.26 - -7.54 = 27.80
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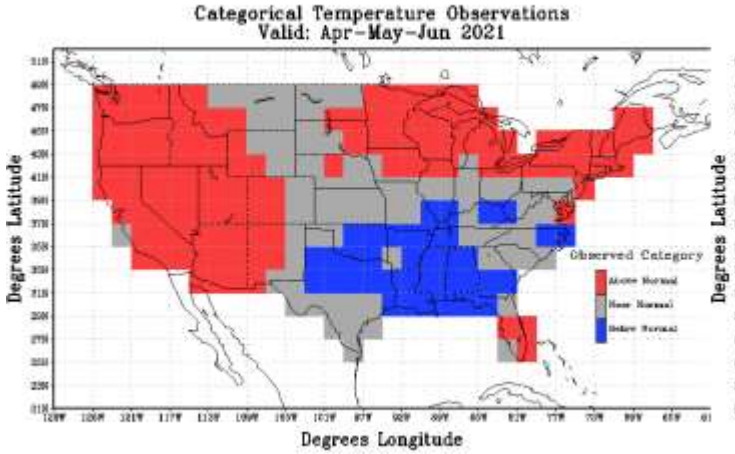
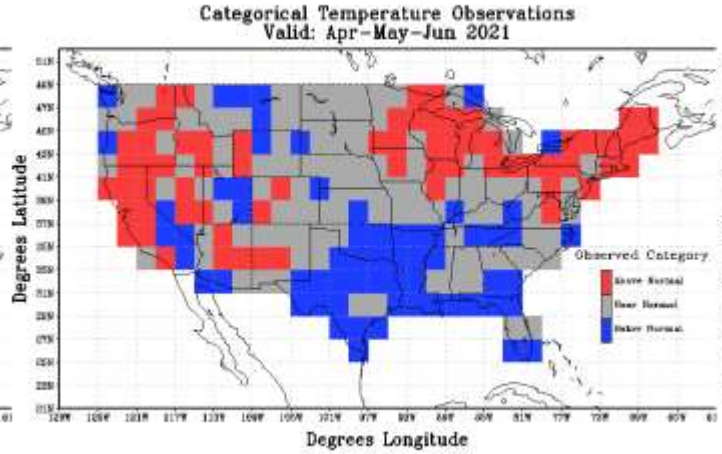
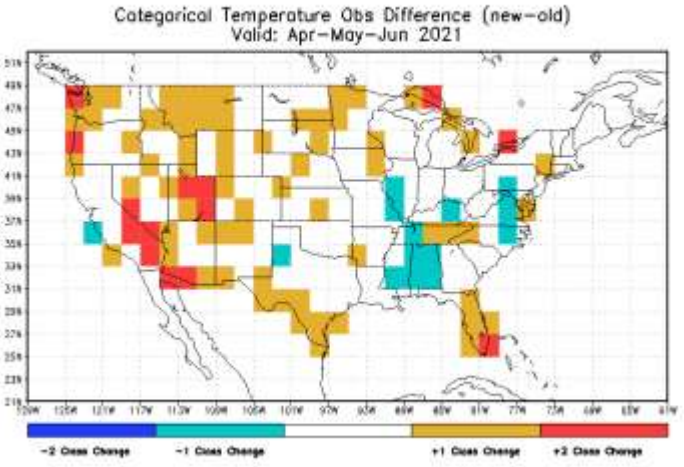
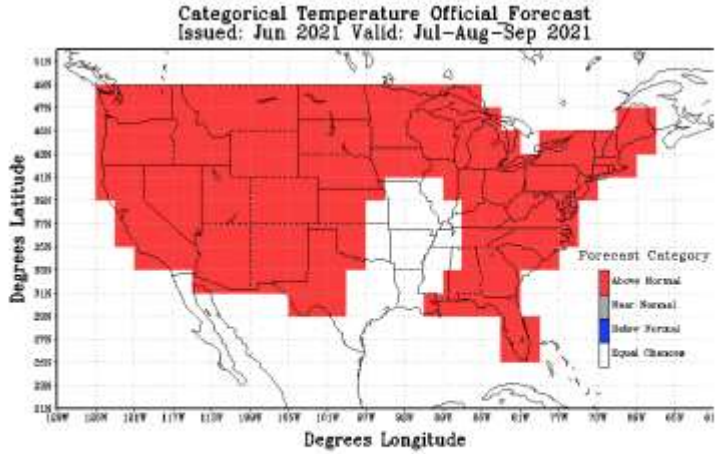


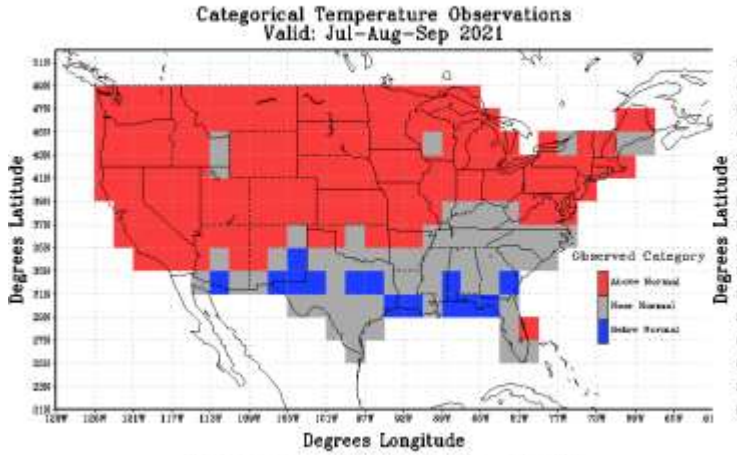




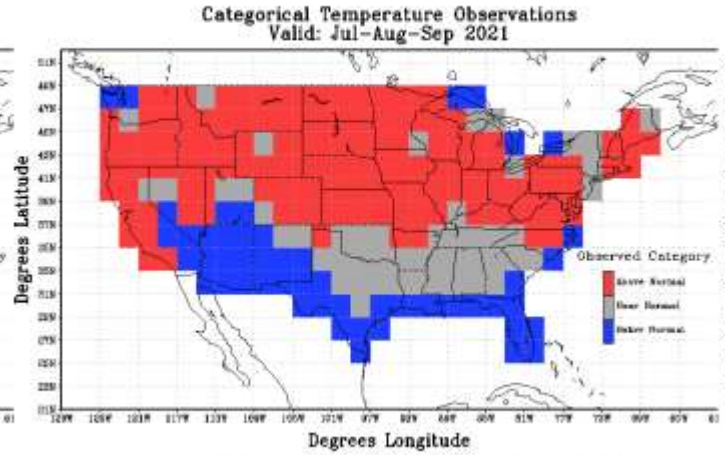
Recent Example



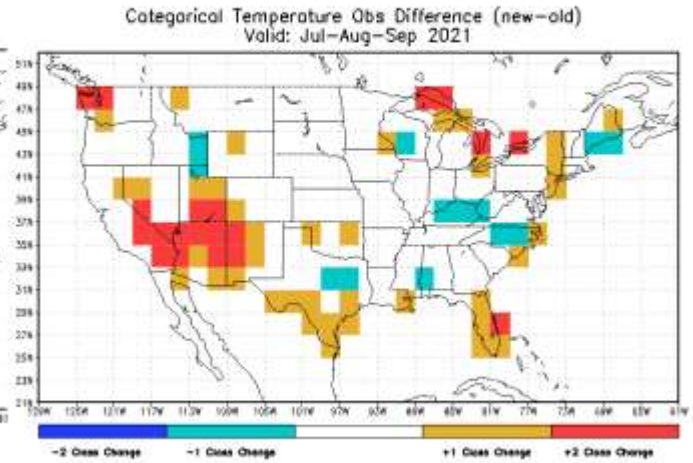
Non-EC (new-old): 61.94 - 41.04 = 20.90
All-FC (new-old): 53.66 - 35.56 = 18.10



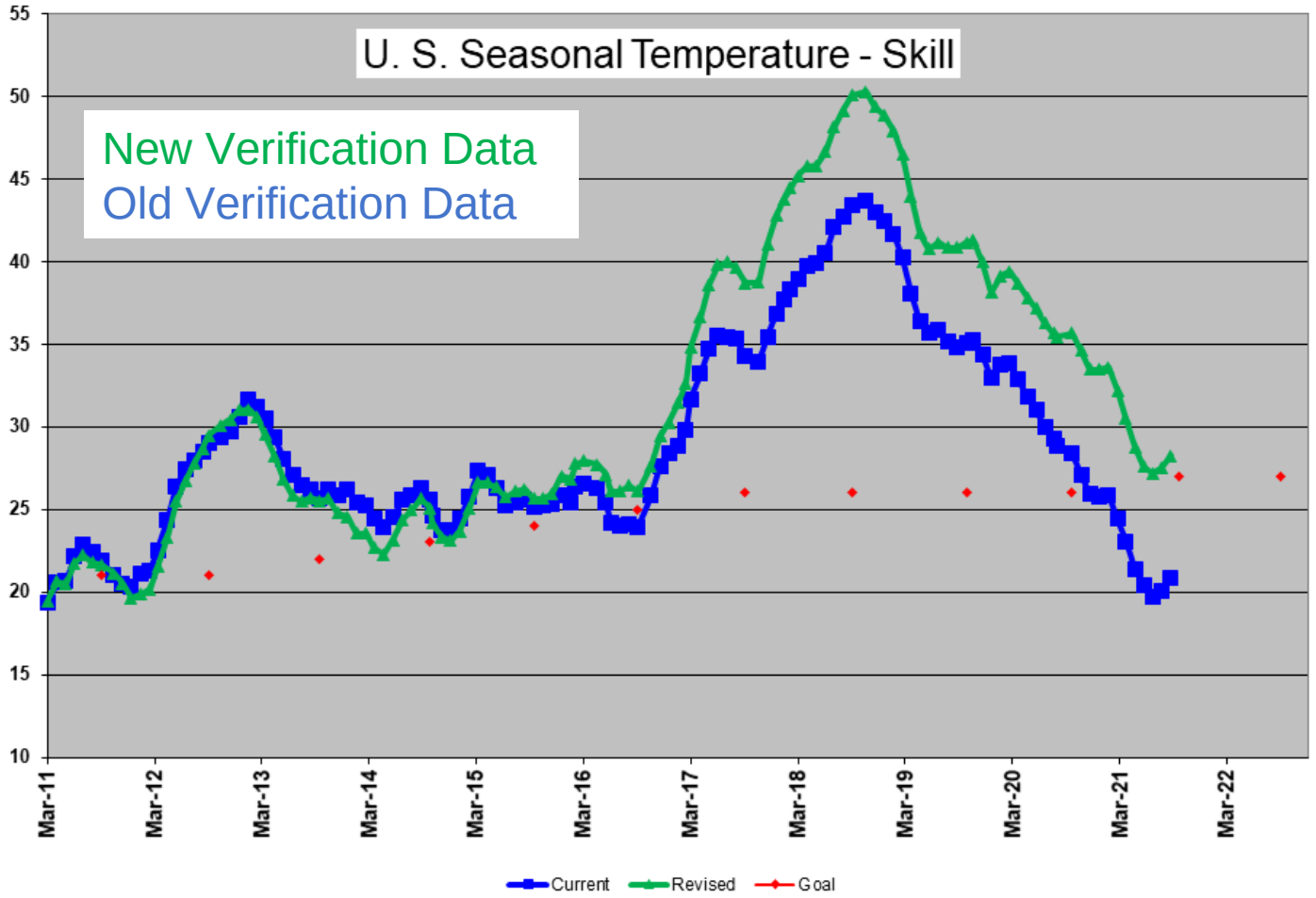
New = GLBT (91-20)



old = NOHADS (91-20)



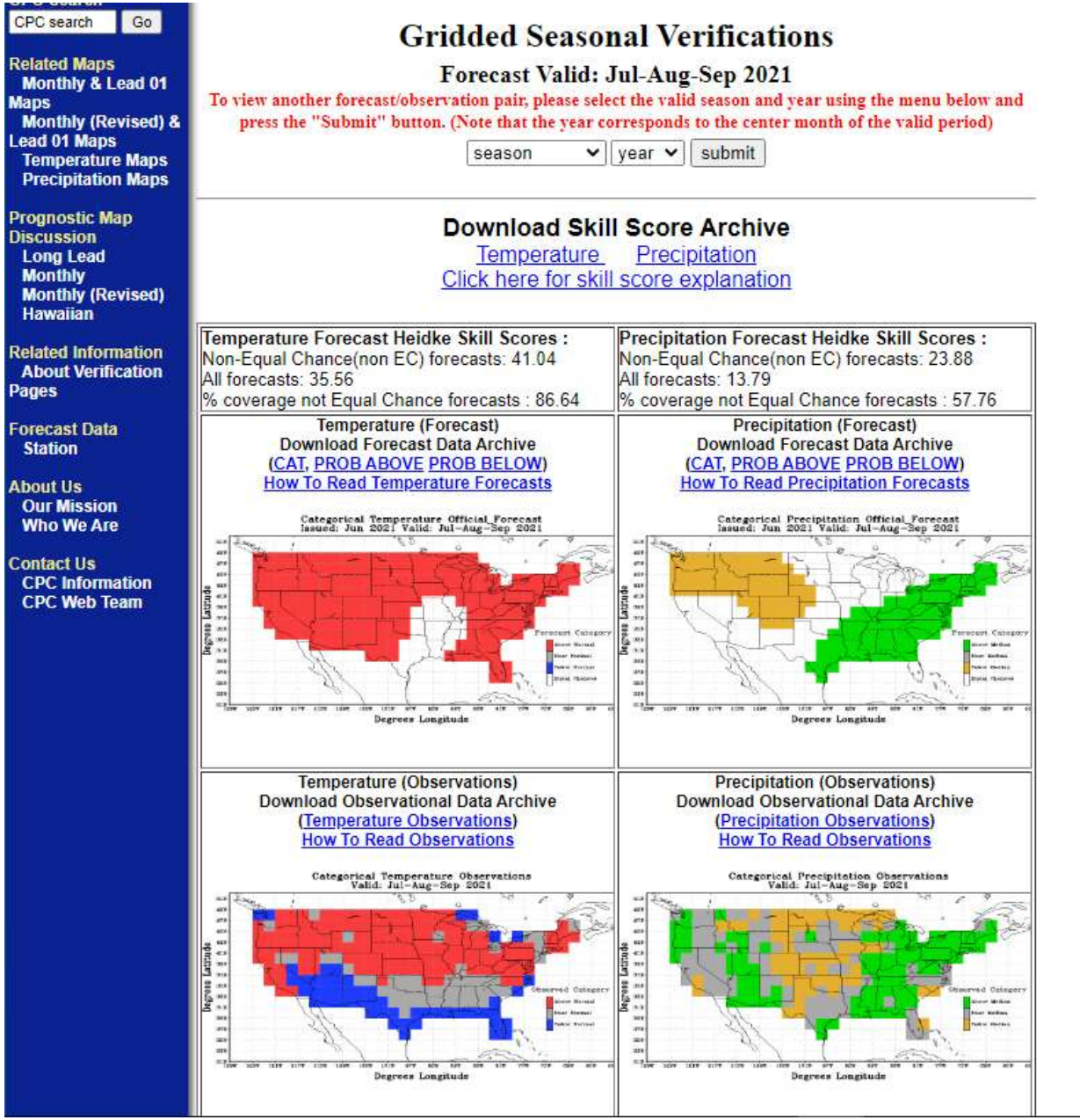
Comparison of Verification of CPC Official Outlooks Using Old and New Verification Data



This figure shows the Heidke Skill Score for CPC Official Outlook using the old and new observed verification data since 2011. The green curve is the verification score using the new data, while the blue curve is the verification score using the old verification dataset. Note that the shape and tendency of the verification curve stays the same but the magnitude of the skill increases when using the new observed data.

Impacts to users:

- Figures on CPC verification webpage will change
- More accurate verification



Summary

- CPC seasonal temperature outlooks form the basis for the CPC GPRA metric
- Real time verification from 2004 is based on data from COOP and HADS networks, using climatology from the NCEI COOP network
- Large increase in HADS data, particularly in last ~5-7 years has introduced a cold bias into the verification data set.
- Proposal is to convert CPC GPRA verification to a new gridded data set developed at CPC, which uses fewer stations, but which are consistent in both the historical and real time periods.
- CPC will generate a short document regarding the justification for the change in the observational database and link it to our verification page.
- Change will be implemented at the beginning of FY23.