



The 2015 Upgrade of NCEP's Climatology-Calibrated Precipitation Analysis (CCPA)



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Introduction

Through a closely collaborative effort with OHD and ESRL, the NCEP Environmental Modeling Center has developed Climatology-Calibrated Precipitation Analysis (CCPA), a precipitation analysis at about 5km resolution with 6 hour accumulation over the Contiguous United States (CONUS). Utilizing linear regression and spatial temporal downscaling techniques, this 6-hourly analysis product is generated by combining two widely used datasets by taking advantage of the higher reliability of the NCEP CPC Unified Global Daily Gauge Analysis and the higher temporal and spatial resolution of the NCEP EMC Stage IV multi-sensor quantitative precipitation estimations (QPEs). CCPA has been running operationally in real-time since July 2010. The product is available to users at five basic grids from 2002 to present. In 2011, at the request of users, the 3-hourly analysis was developed and successfully implemented within the CCPA production suite. The CCPA product is being widely used in research and applications for precipitation verification, bias correction and downscaling. At EMC, CCPA provides a proxy of truth for the bias correction and statistical downscaling of precipitation forecasts from the NCEP GFS Ensemble Forecast System (GEFS) and Short Range Ensemble Forecast System (SREF) products, and precipitation verifications in evaluating the performance of various forecast systems.

An upgrade to version 3 of CCPA (CCPAv3) is undergoing and scheduled for operational implementation at NCEP in early 2016. In this presentation, all enhancements will be described, evaluated and validated. Especially comparison of both the original and new products against rain gauge observations will be performed and a summary of the presentation and results will be shown.

Highlights of CCPA Upgrade

- Update regression coefficients by extending training data sets of CPC gauge based analysis and Stage IV multi-sensor estimation
 - Current: 7 years (2002-2009)
 - Upgrade: 13 years (2002-2015)
 - Expectation: Improved analysis with expanded training data sets
- Make a change to 3-hr CCPA to avoid poor data quality of Stage IV hourly data in CNRFC area
 - 3-hr CCPA is based on Stage IV hourly analysis, that is unavailable or has poor quality over some RFCs
 - Current: using Stage II hourly in NWRFC only
 - Upgrade: will use Stage II hourly in both NWRFC and CNRFC
 - Expectation: Improve 3-hr CCPA with more accurate weights
- Make a change to CCPA rerun schedule
 - Current: rerun at 1 day only after the end of the accumulation time
 - Upgrade: rerun at 1/3/5/7days
 - Expectation: Improved final analysis with more accurate Stage IV inputs

Updates on Regression Coefficients

1. Historical data sets

Operational : June 1 2002 to July 31 2009 for CPC and Stage IV
Updated: June 1 2002 to July 31 2015 (six more years of data)

2. Match resolutions

- Accumulate Stage IV (hereafter ST4) over 24 hours
- Interpolate to $\frac{1}{8}^\circ$ (copygb w/ volume preservation)

3. Collect precipitation samples

- For each day of the year and at each grid point, collect all precipitation within 60 day window centered around that day, over all 13 years (max ~793 data points)
- Use only data points with ST4 > 0

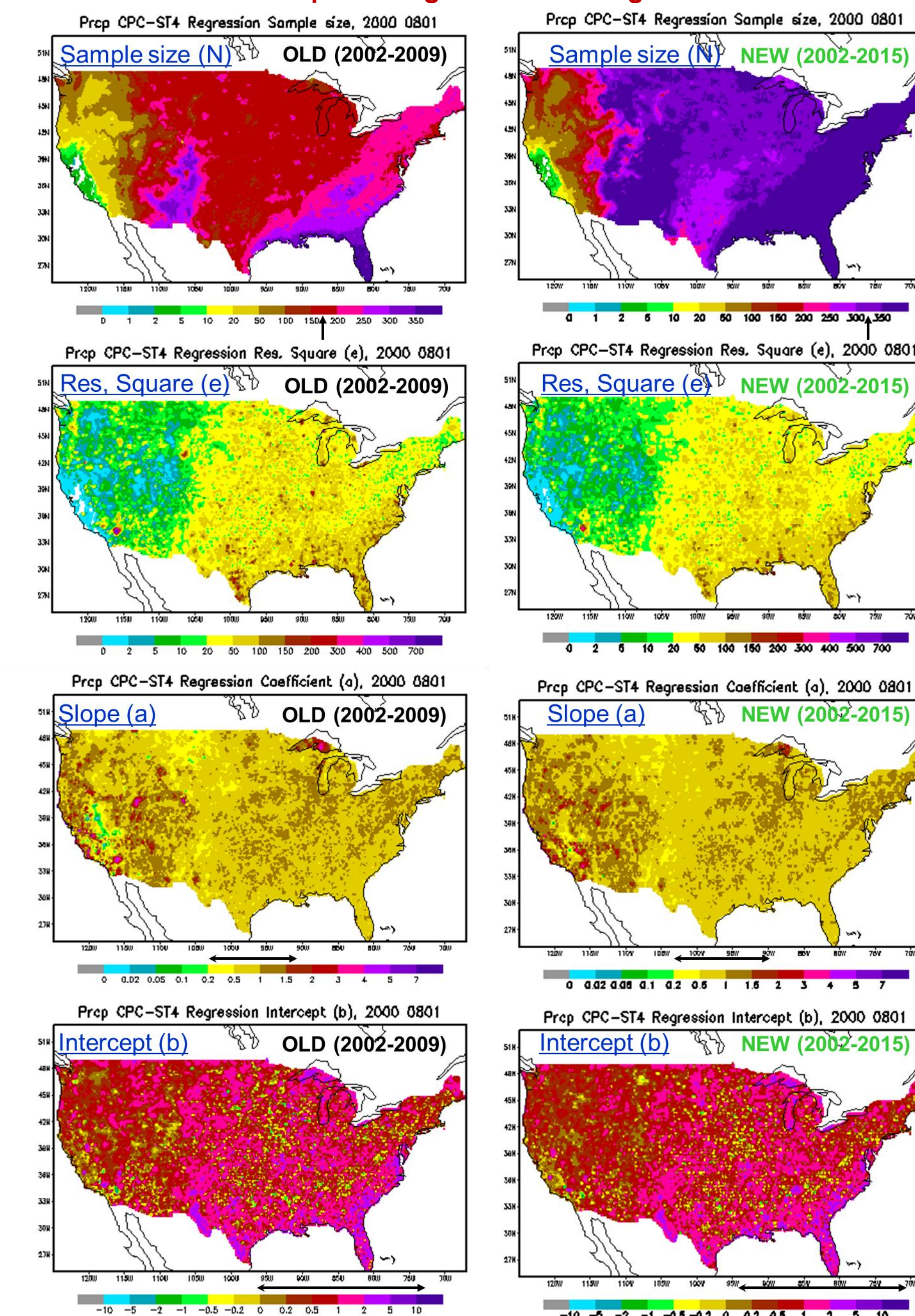
4. Linear regression

- CPC = a·ST4 + b

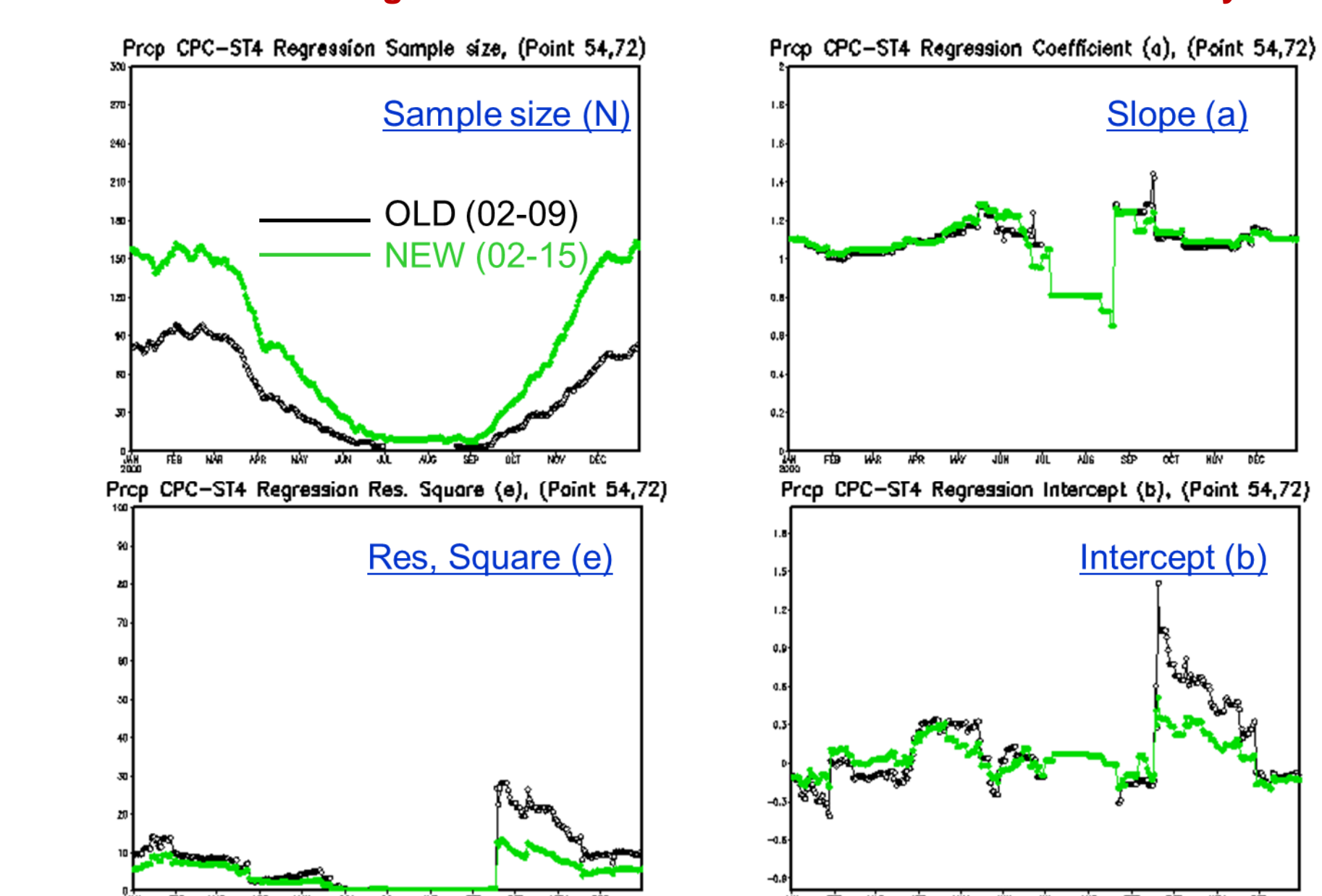
5. End Result

- Linear relationship (a & b) on $\frac{1}{8}^\circ$ grid for each day of the year

Example of Regression for August 1st

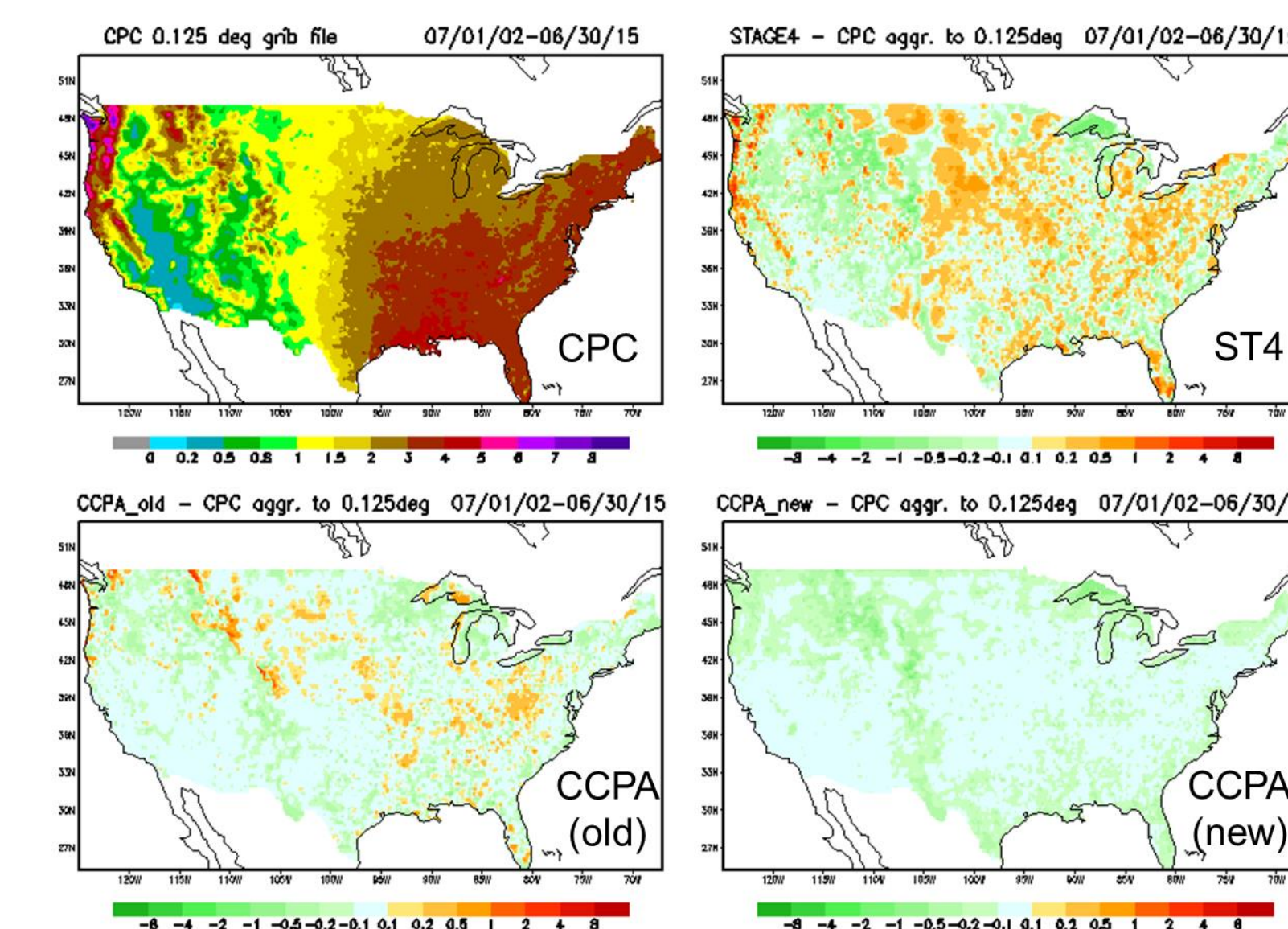


Time Series of Regression at a Grid Point in the Southwestern US Dry Area

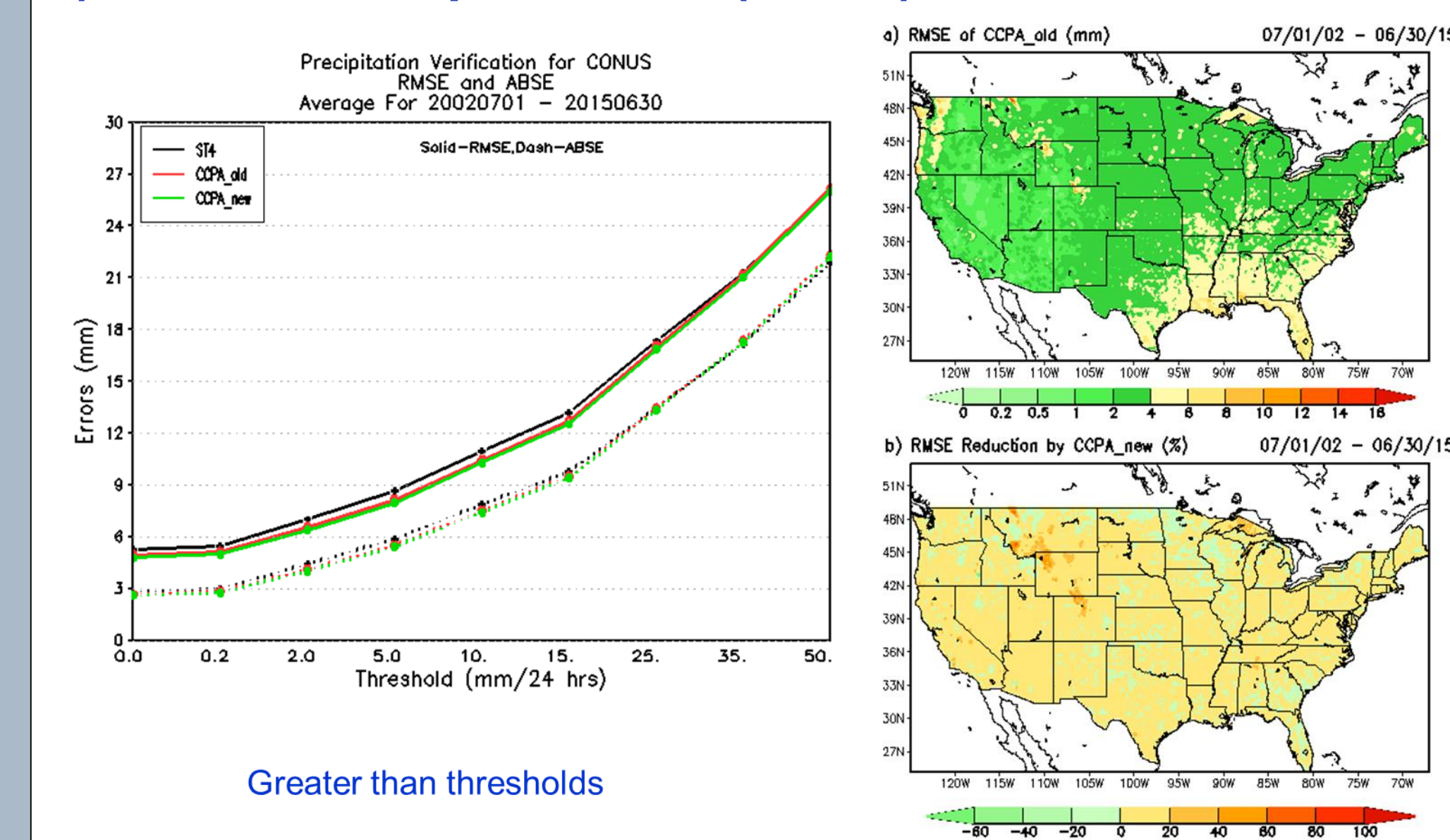


Evaluation against CPC Analysis

1) Mean Error (MERR)

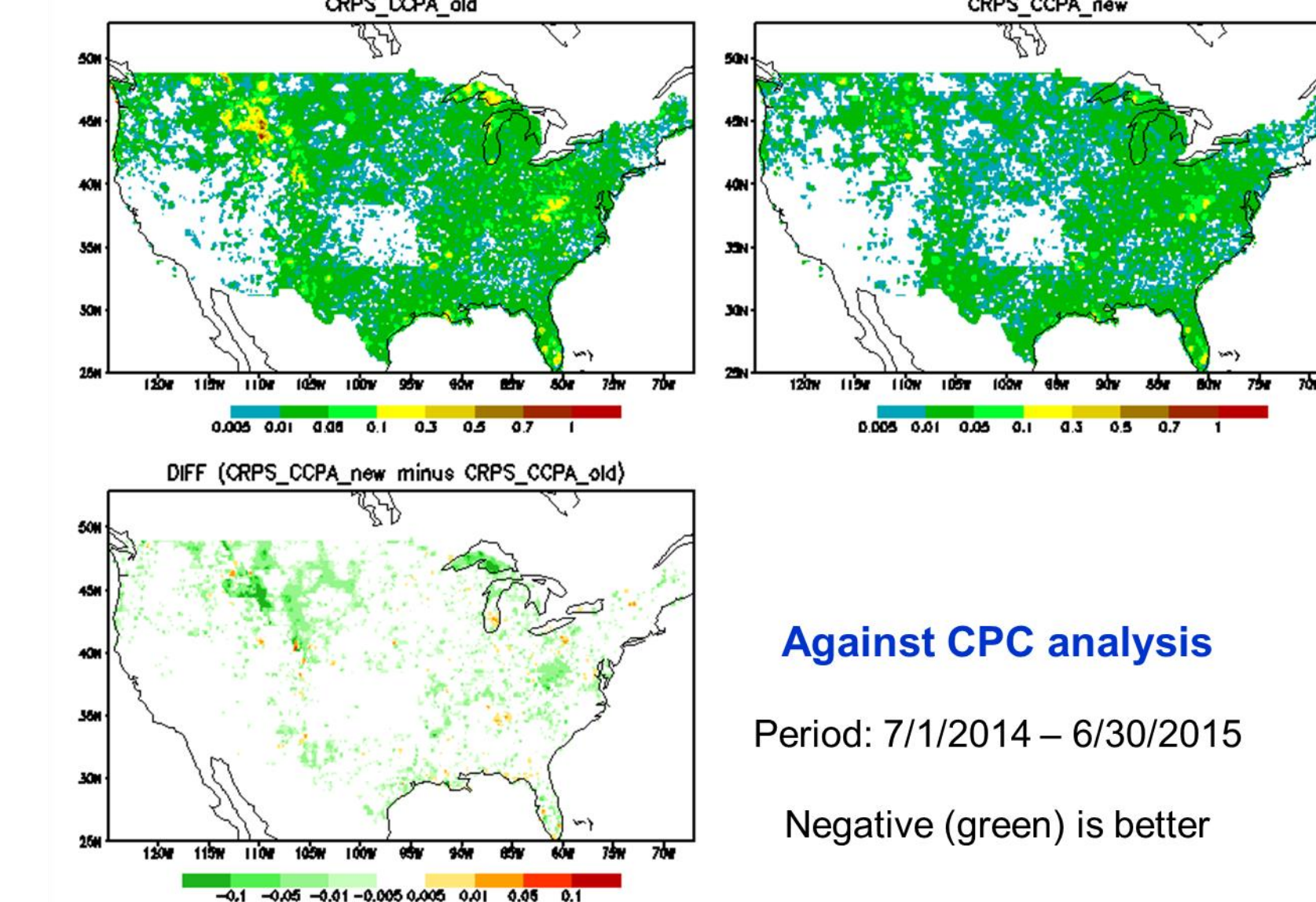


2) Root Mean Square Error (RMSE)



3) CRPS

$$CRPS = \sum_{i=1}^n \sum_{j=1}^{nthres} \left[\frac{1}{nday} \sum_{k=1}^{nday} Count_{cpa}(i, j, k) - \frac{1}{nday} \sum_{k=1}^{nday} Count_{pc}(i, j, k) \right]^2$$



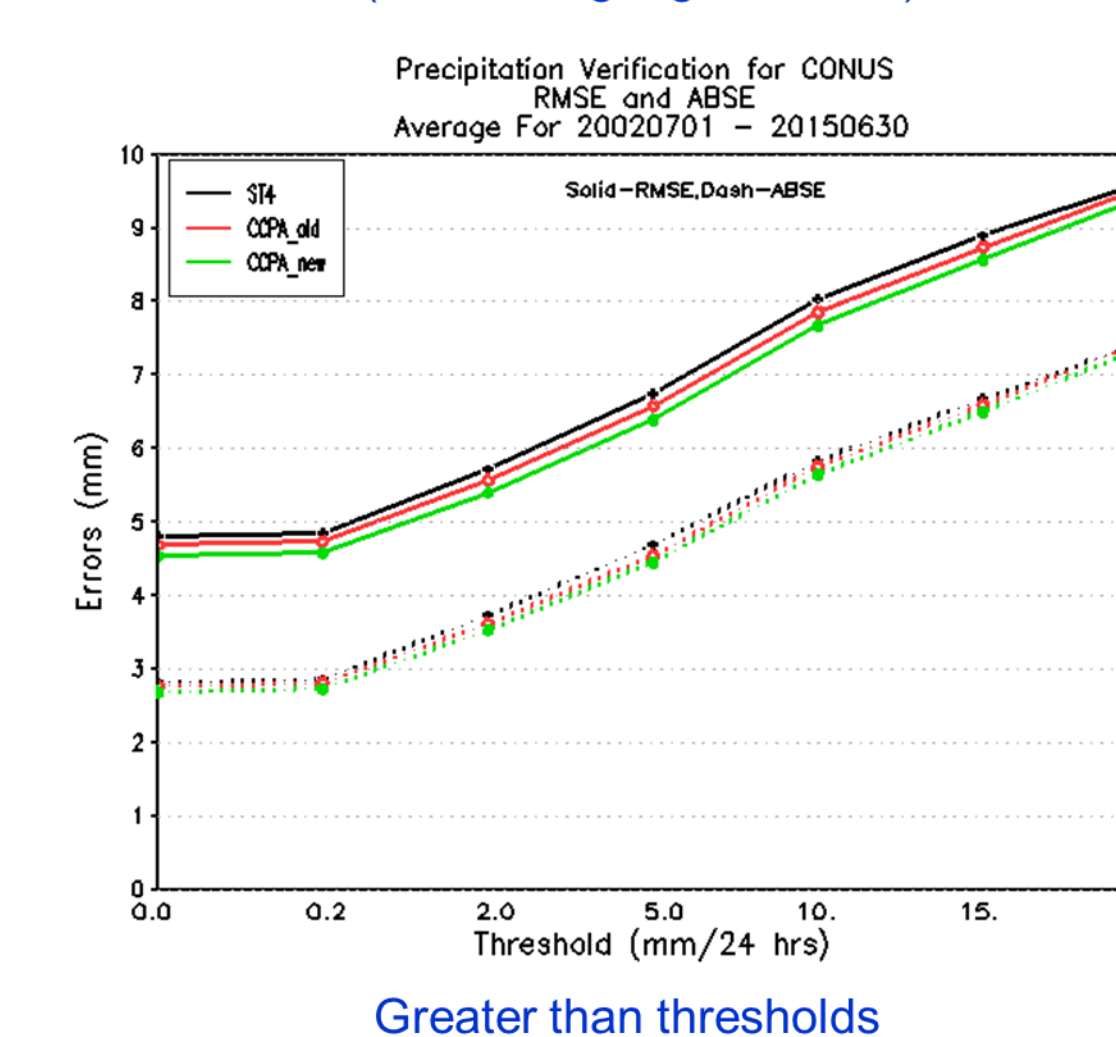
Against CPC analysis

Period: 7/1/2014 - 6/30/2015

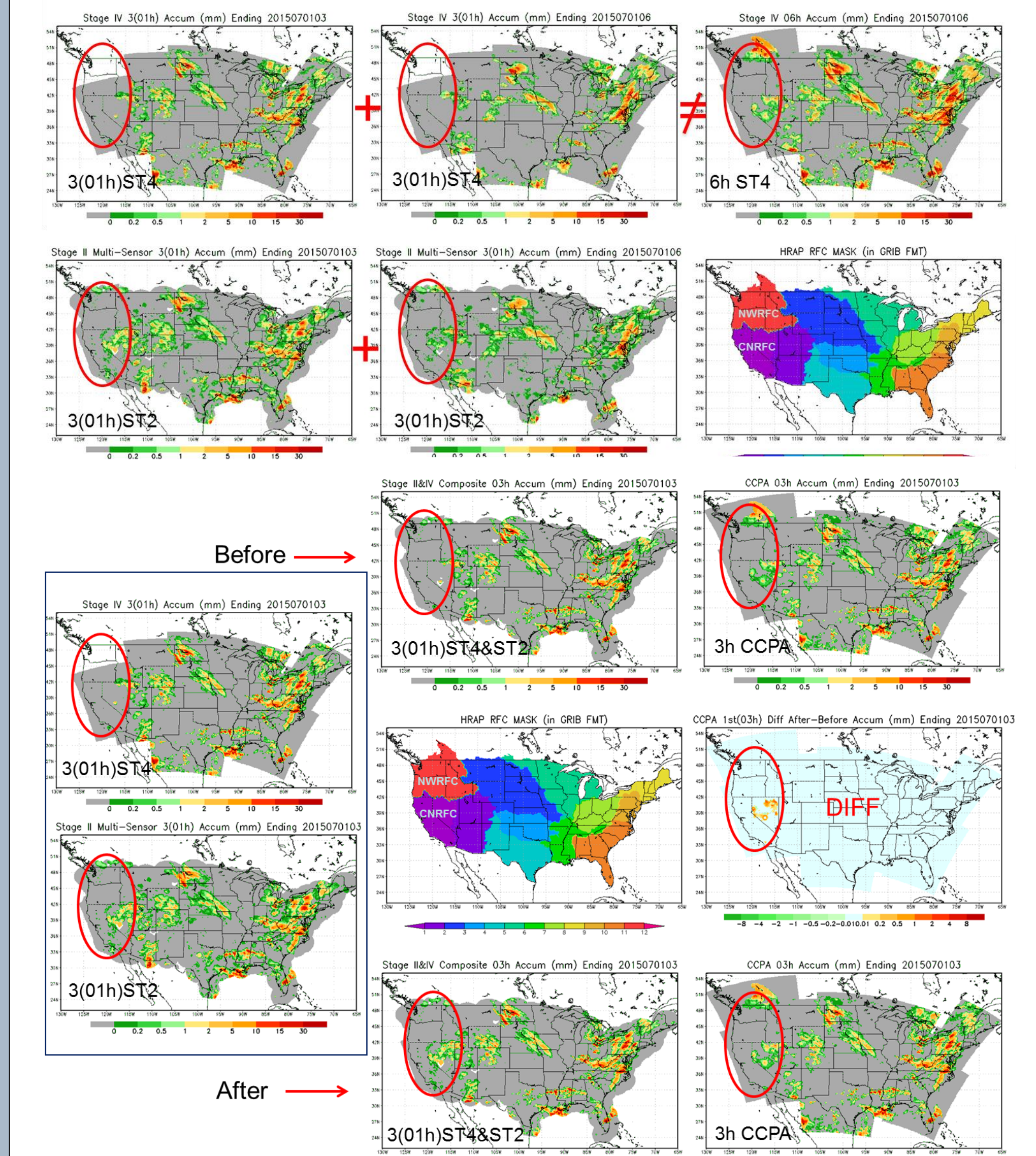
Negative (green) is better

Evaluation against Observation

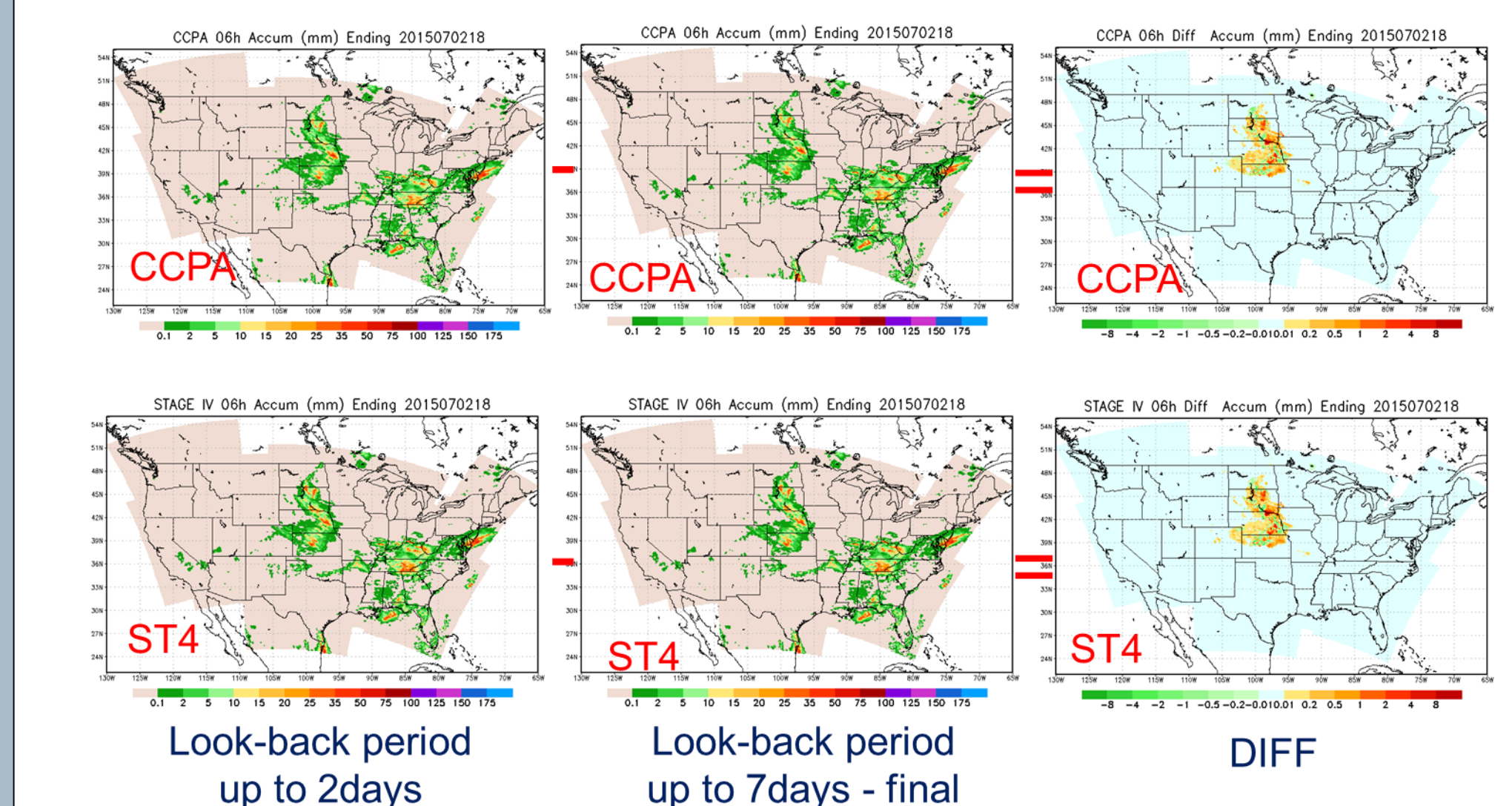
(RFC rain-gauge network)



Why Change to 3-hr CCPA?



Impact of Change in Rerun Schedule (example)



Summary

- Updating regression coefficients:
 - Some slight improvements can be seen in term of RMSE, MERR, and CRPS.
 - No negative impact and degradation were found when regression coefficients were updated and applied to generate new version of CCPA.
- Periodically (annually) upgrading regression coefficients with increasing sample size makes CCPA methodology robust.

References and Contact Information

- Product
 - Real-time data
<http://ftp.prdd.ncep.noaa.gov/pub/data/nccf/com/gens/prod>
 - Real-time image
<http://www.emc.ncep.noaa.gov/gmb/yluo/ccpa/ccpa.php>
 - Historical data
http://ftp.emc.ncep.noaa.gov/gc_wmb/yluo/CCPA_v1/
- Reference
 - Manuscript
http://www.emc.ncep.noaa.gov/gmb/yluo/CCPA_Manuscript.pdf
- Contact information: Yan.Luo@noaa.gov