



The NCEP's Climatology-Calibrated Precipitation Analysis (CCPA) Version 4



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Introduction

Inspired by a need for a best analysis at high temporal and spatial resolutions for precipitation verification, calibration and downscaling, NCEP Environmental Modeling Center has developed Climatology-Calibrated Precipitation Analysis (CCPA). CCPA is a precipitation analysis at about 5km resolution with 6 hour accumulation over the Contiguous United States (CONUS). Utilizing linear regression and spatial and 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 was first implemented into operations in July 2010 and experienced twice upgrades afterwards. The product is available to users at six basic grids with 3 hour and 6 hour accumulations from 2002 to present. 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. In recent years, CCPA application is also expanded to the National Blender Models (NBM) projects led by MDL, which applies CCPA as the best analysis for precipitation calibration.

An upgrade to version 4 of CCPA (CCPAv4) is undergoing and scheduled for operational implementation at NCEP in early 2018. 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.

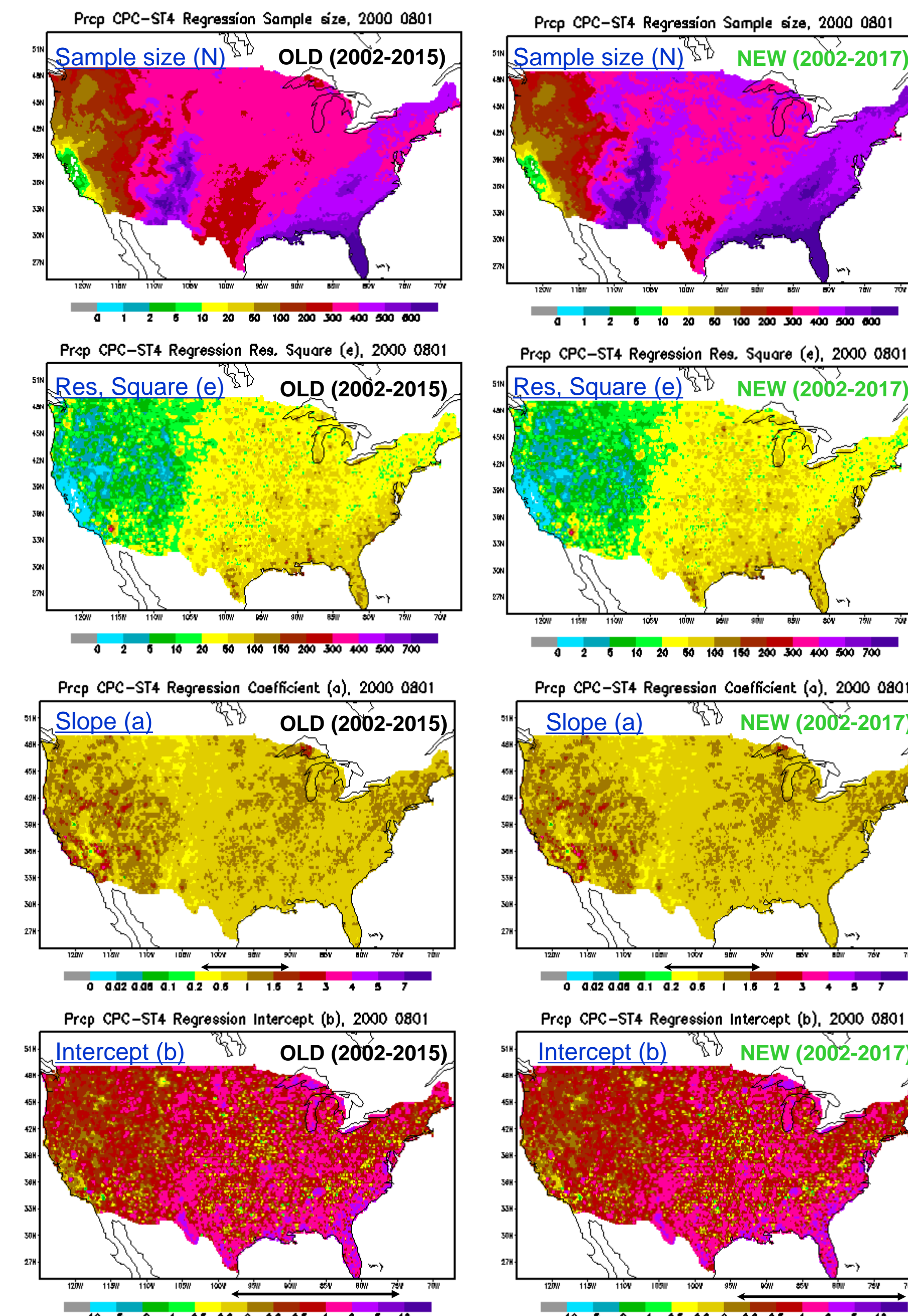
Highlights of CCPAv4 Upgrade

- Update regression coefficients by extending training data sets of CPC gauge based analysis and Stage IV multi-sensor estimation
 - Current: 13 years (2002-2015)
 - Upgrade: 15 years (2002-2017)
 - Expectation: Improved analysis with expanded training data sets
- Make a change to 3-hr CCPA by using 1-hr Stage IV data in the NWRFC and CNRFC areas
 - 3-hr CCPA is based on 1-hr Stage IV analysis
 - Current: no 1-hr Stage IV data available in both NWRFC and CNRFC areas; use 1-hr Stage II in these areas instead
 - Upgrade: 1-hr Stage IV data is available in both NWRFC and CNRFC areas in the RTMA/URMA 2.6 Upgrade which was implemented on 12/13/2017; will use 1-hr Stage IV only over CONUS
 - Expectation: Improve 3-hr CCPA with more accurate weights
- Introduce 1-hr CCPA
 - Requirement from MDL/NBM
 - Method: similar to 3-hr CCPA
 - Expectation: improved 1-hr analysis to support NBM projects

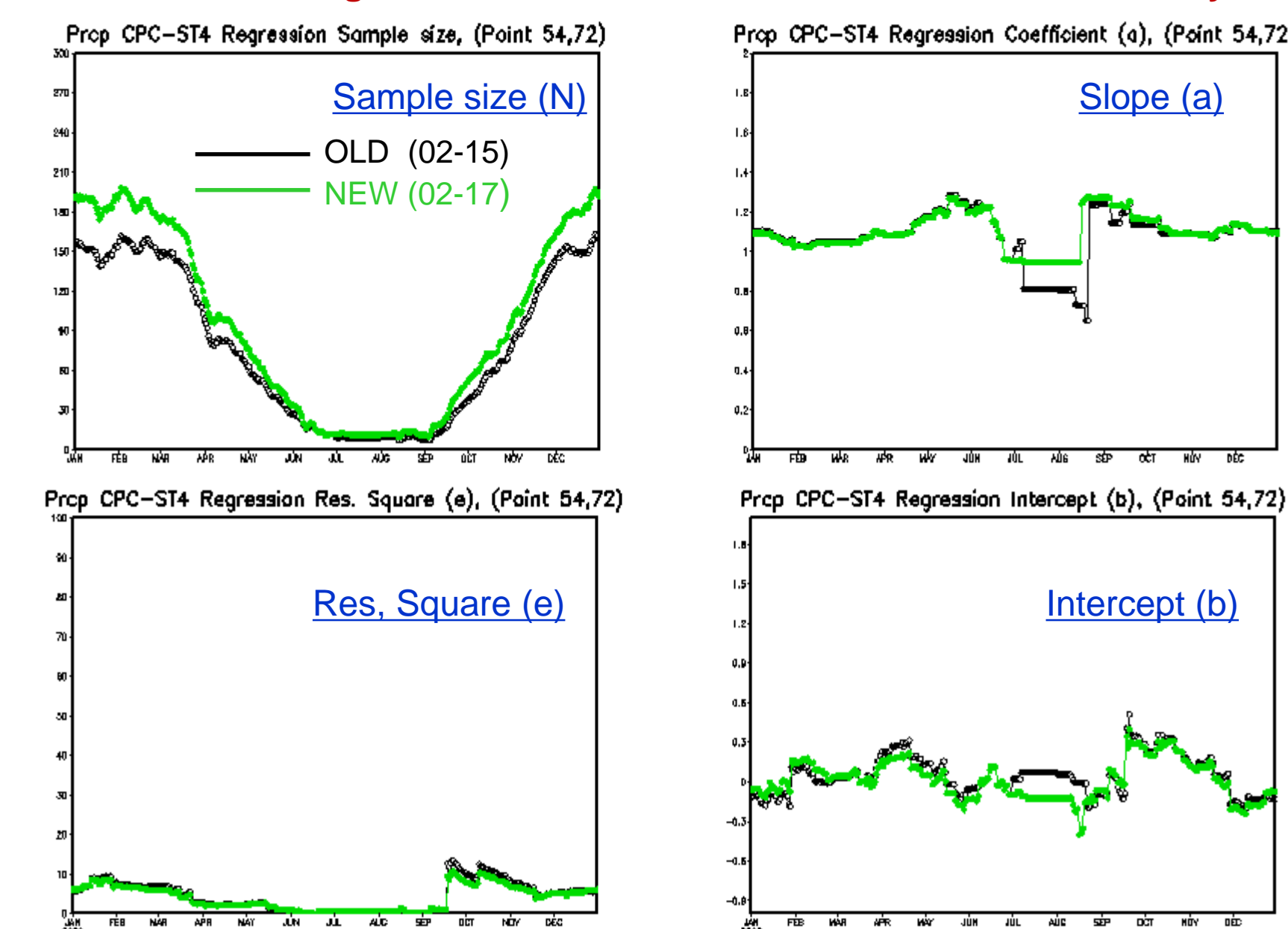
Updates on Regression Coefficients

- Historical data sets
 - Operational: June 1 2002 to July 31 2015 for CPC and Stage IV
 - Updated: June 1 2002 to July 31 2017 (two more years of data)
- Match resolutions
 - Accumulate Stage IV (hereafter ST4) over 24 hours
 - Interpolate to 1/8° (copygb w/ volume preservation)
- 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 15 years (max ~915 data points)
 - Use only data points with ST4 > 0
- Linear regression
 - CPC = a·ST4 + b
- End Result
 - Linear relationship (a & b) on 1/8° grid for each day of the year

Example of Regression for August 1st

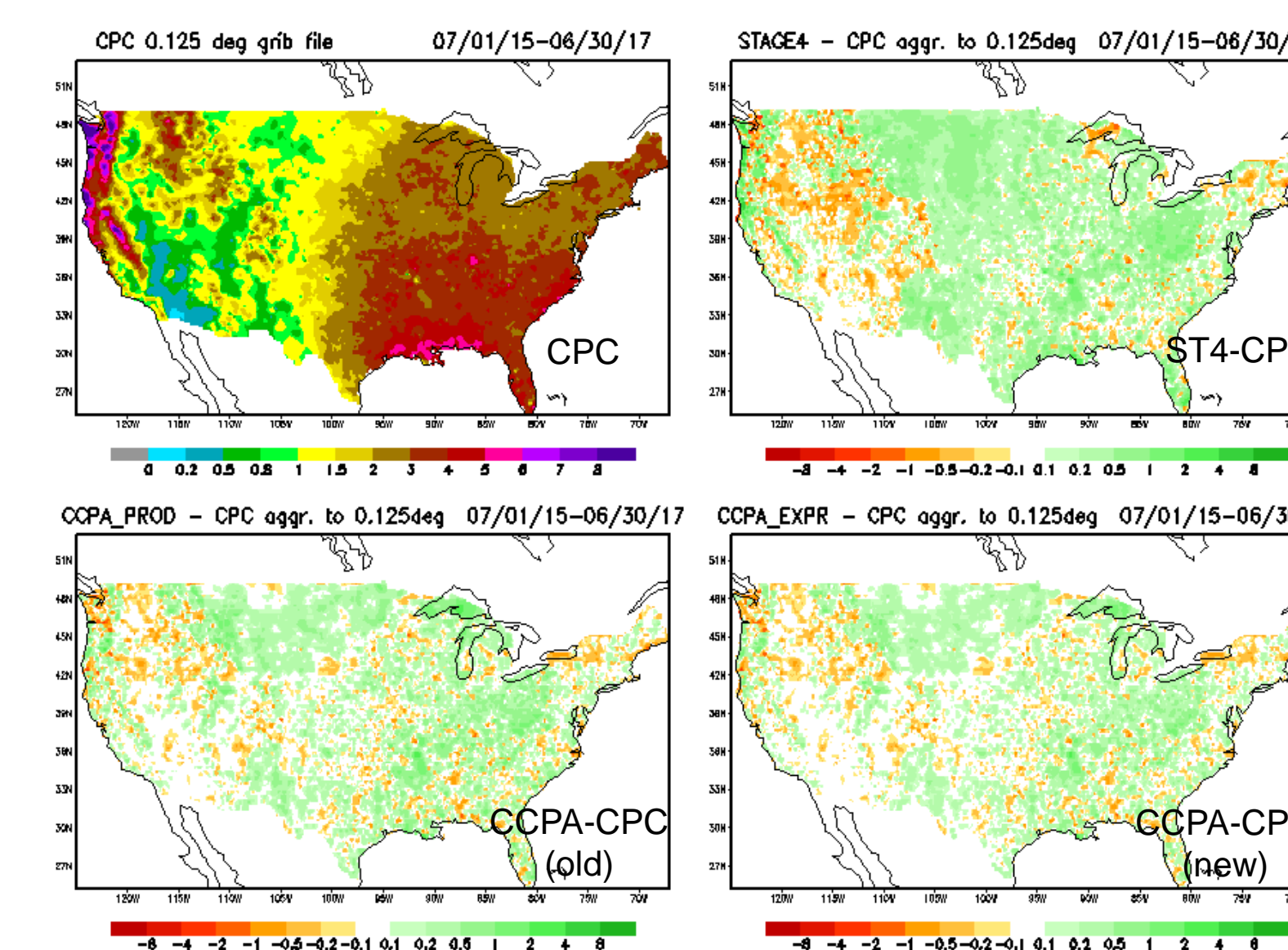


Time Series of Regression at a Grid Point in the Southwestern US Dry Area

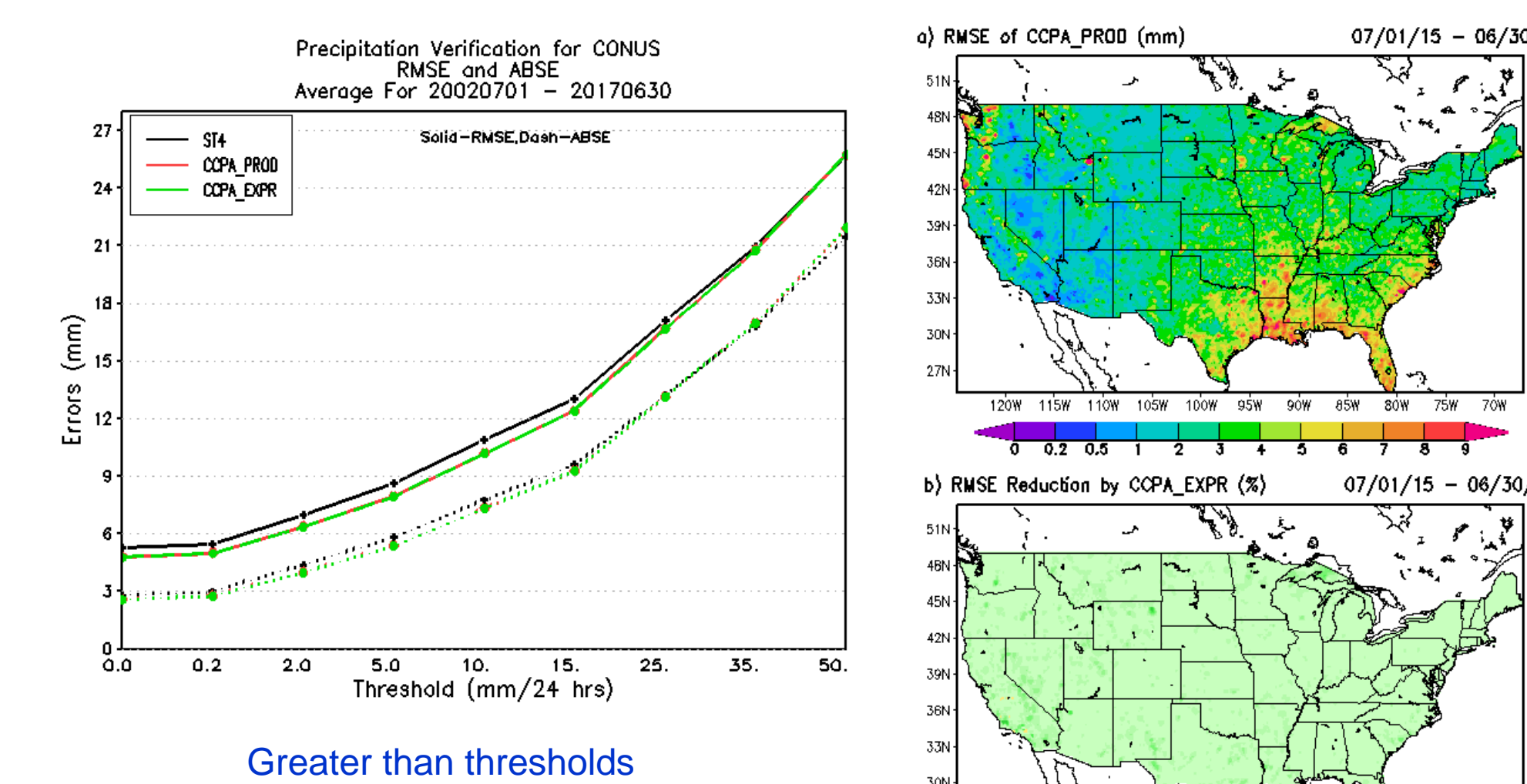


Evaluation against CPC Analysis

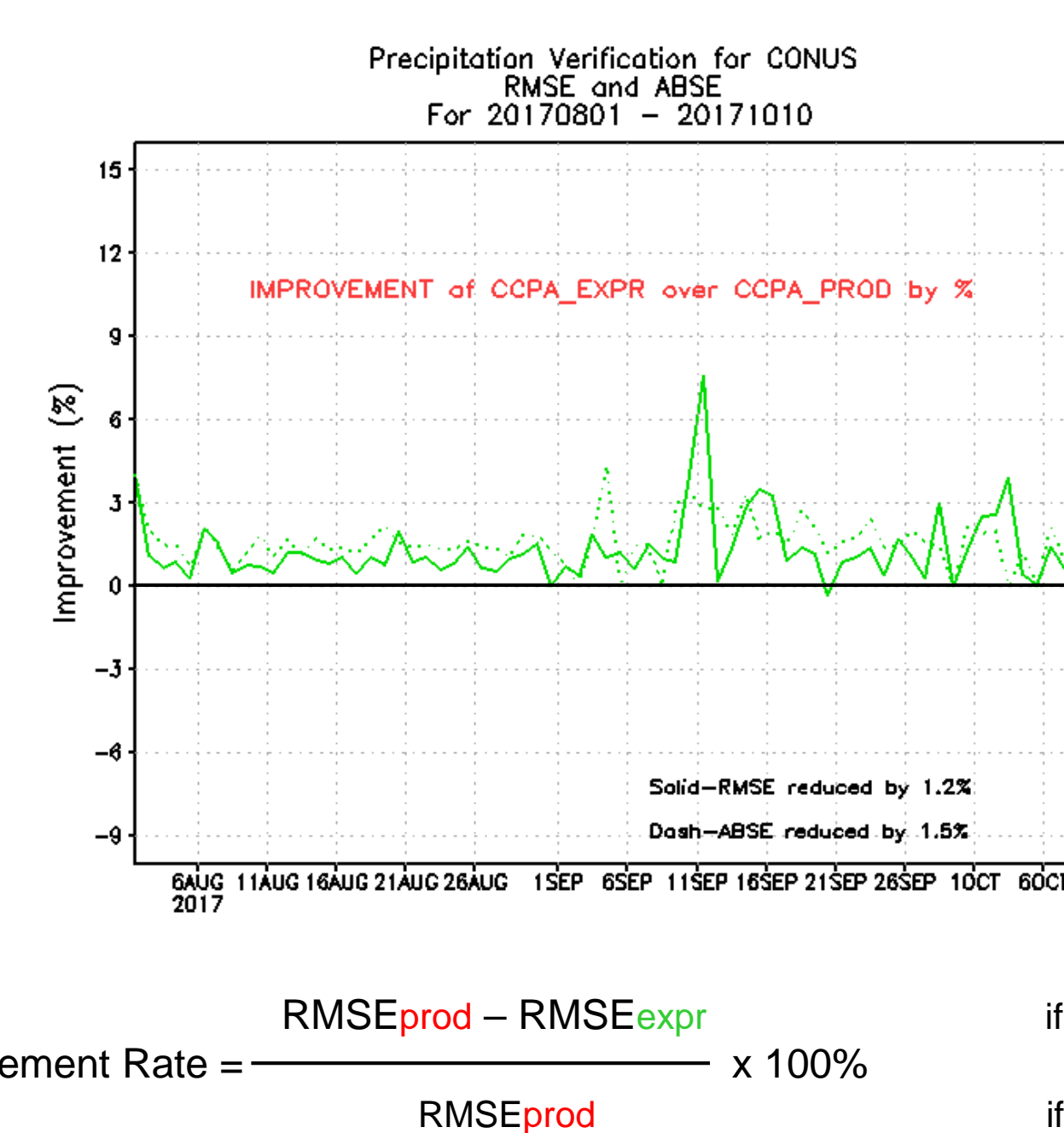
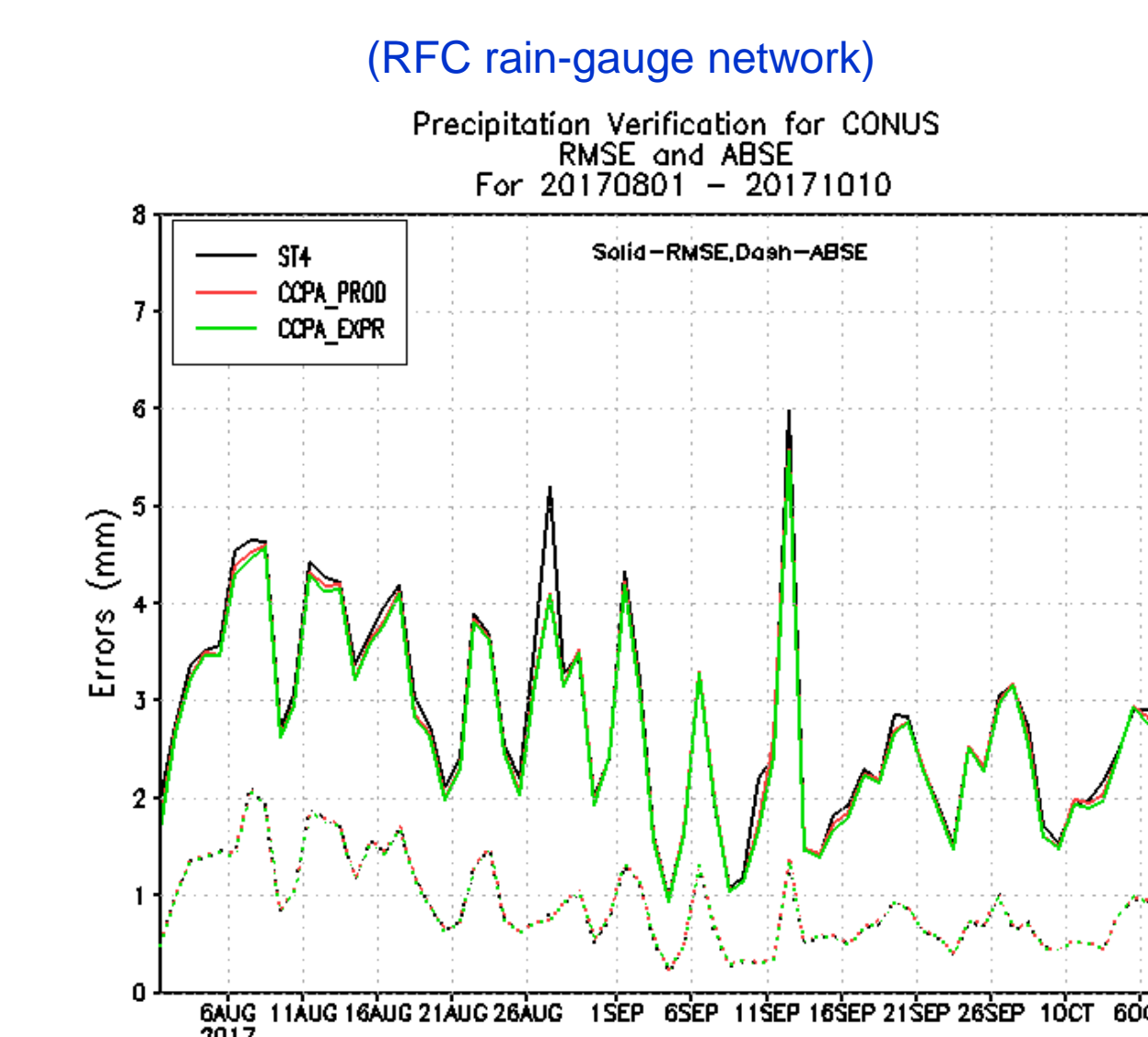
1) Mean Error (MERR)



2) Root Mean Square Error (RMSE)



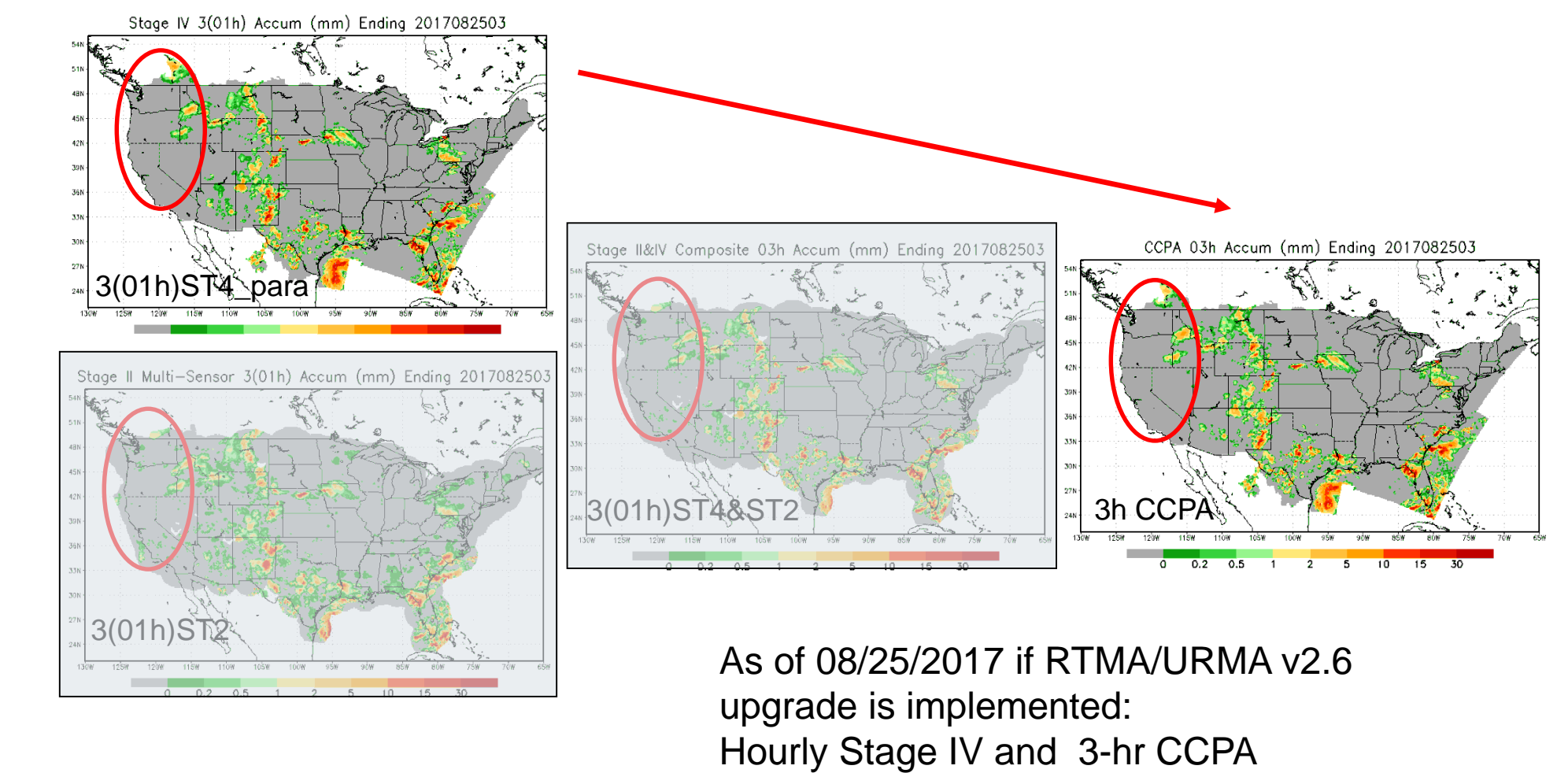
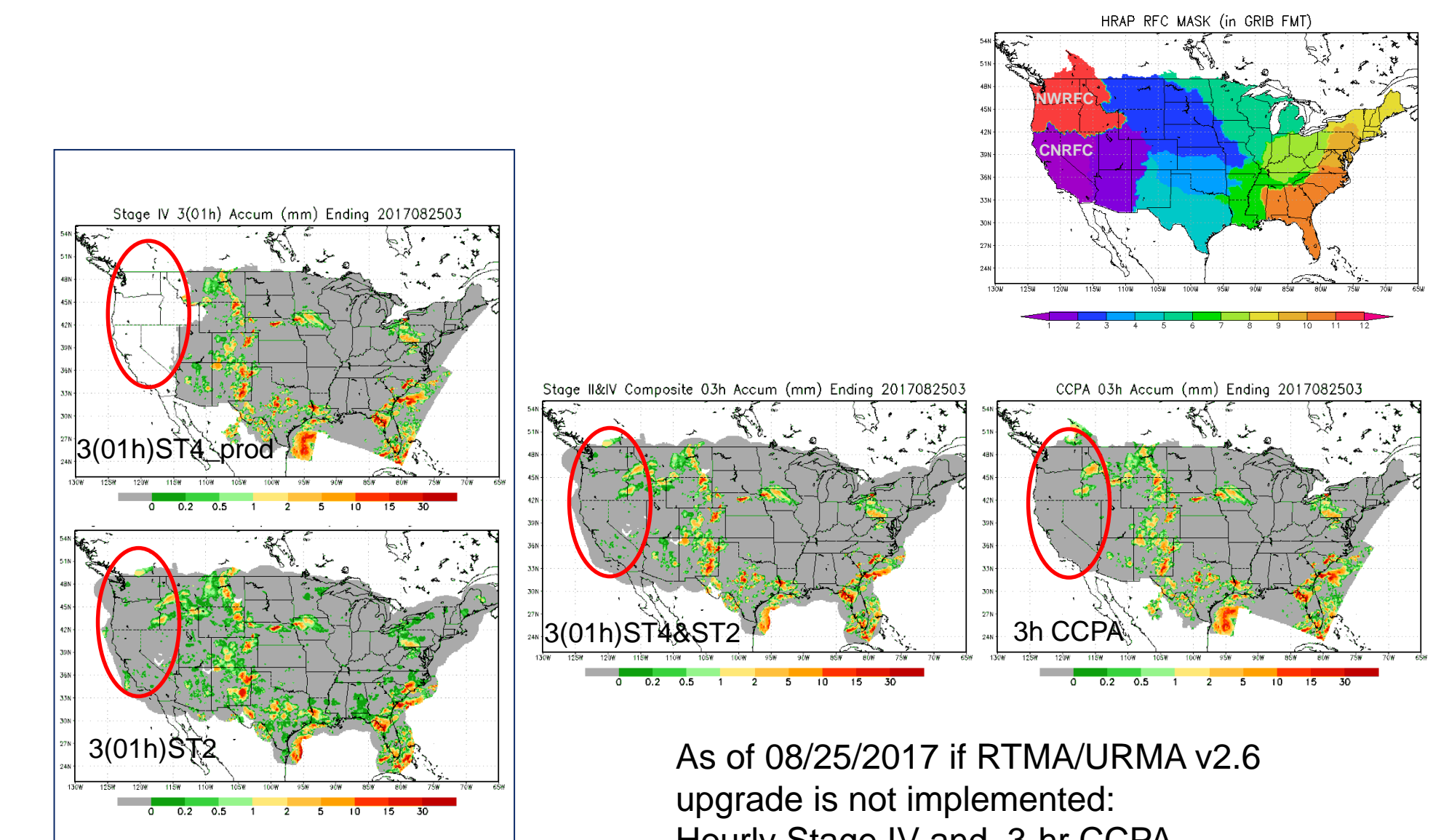
Evaluation against Observation



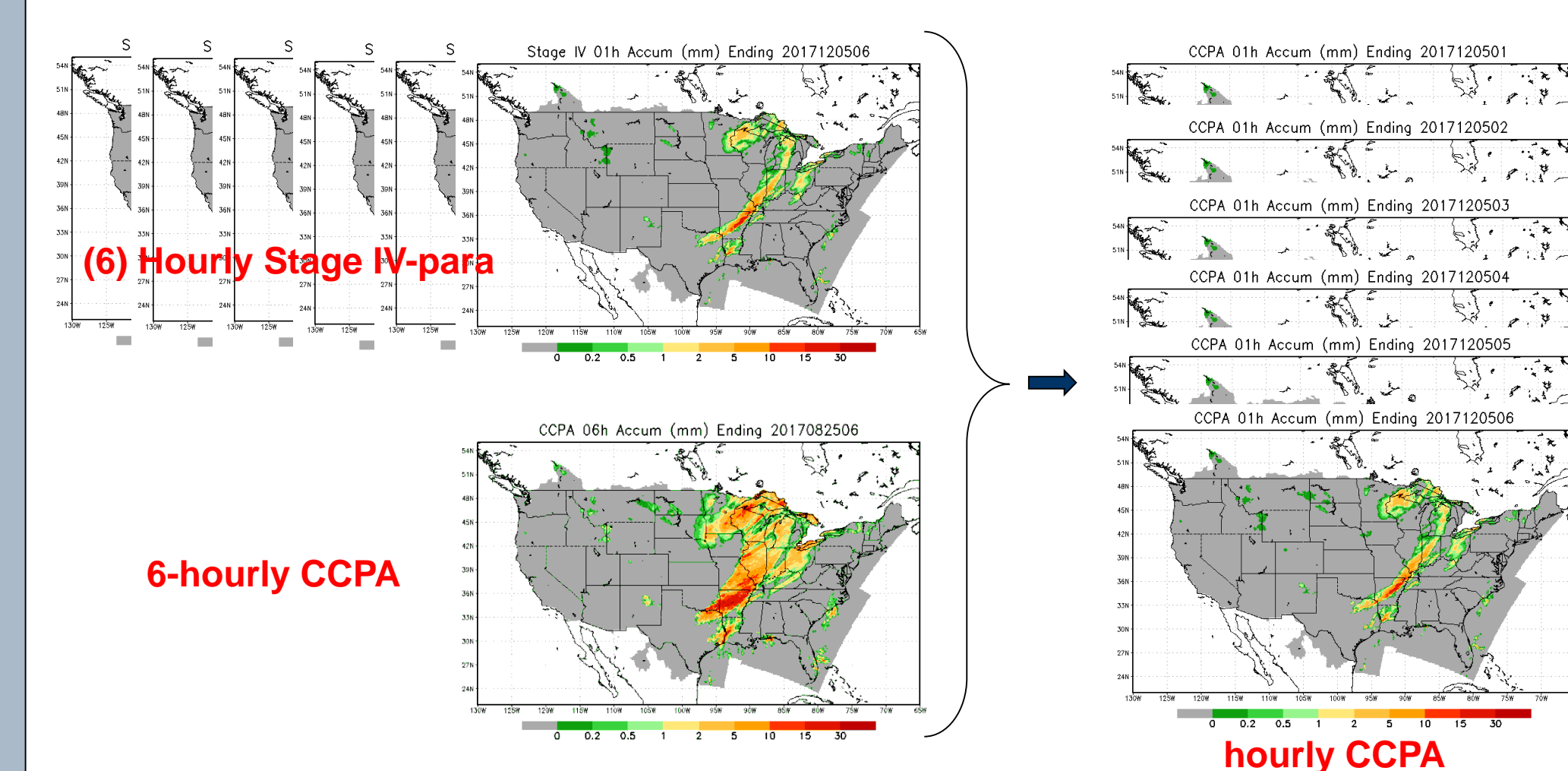
$$\text{Improvement Rate} = \frac{\text{RMSE}_{\text{prod}} - \text{RMSE}_{\text{expr}}}{\text{RMSE}_{\text{prod}}} \times 100\%$$

if >0 improvement
if <0 degradation

Why Change to 3-hr CCPA?



Introduction to 1-hr CCPA



Summary

- Updating regression coefficients:
 - Some slight improvements can be seen in term of RMSE and MERR
 - No negative impact and degradation
- Periodically (annually) upgrading regression coefficients with increasing sample size makes CCPA methodology robust
- 1 hourly analysis data is generated

References and Contact Information

- Product
 - Real-time data: <http://ftpprd.ncep.noaa.gov/pub/data/nccf/com/gens/prod>
 - Real-time image: <http://www.emc.ncep.noaa.gov/gmb/y/luo/ccpa/ccpa.php>
 - Historical data: http://ftp.emc.ncep.noaa.gov/gc_wmb/y/luo/CCPA_v2/
- Reference: <http://journals.ametsoc.org/doi/abs/10.1175/JHM-D-11-0140.1>
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