

CCPA V4.0 Upgrade

Yan Luo

**Environmental Modeling Center
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Climatology Calibrated Precipitation Analysis

- Motivation and background - (QPF and PQPF calibration in NCEP)
 - Implemented on 2004 (HPC, CPC endorsed)
 - Bias corrected GFS/GEFS forecasts
 - At 2.5 degree resolution, every 24 hours, using Gauge (12UTC-12UTC)
 - Using decay average (or Kalman Filter) method for sampling
 - Using frequency match algorithm for CDF of OBS/FCST
- Climatological Calibrated Precipitation Analysis (CCPA)
 - Use CPC unified analysis at 1/8 degree, daily, global land - reliability
 - Use RFC/QPE (stage IV) 5km resolution, 6-h(CONUS) – resolution
 - Use regression method to generate a and b from above two datasets
 - Produce CCPA analysis ($CCPA = a * QPE_{rfc} + b$)
 - Resolution is 5km (NDGD) grid (and subsets) for CONUS for current production
 - Update frequently by apply longer stage IV to produce better regression coefficients
- Important Applications
 - Improving QPF/PQPF bias correction – GEFS, NAEFS, SREF and etc...
 - Statistical downscaling QPF/PQPF forecast for GEFS, NAEFS, SREF and etc...
 - WPC daily precipitation analysis products – CCPA web products (2012)
 - Daily precipitation verifications (WPC and EMC meg briefing)
 - NAM's precipitation analysis
 - NBM and Hydrological application – MDL, NWC and RFC
 - Research Communities
- Reference
 - Publication: <http://journals.ametsoc.org/doi/abs/10.1175/JHM-D-11-0140.1>
 - Web display (EMC): <http://www.emc.ncep.noaa.gov/gmb/ylo/ccpa/ccpa.php>

Highlights of CCPA 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
- Introduce hourly CCPA
 - Requirement from MDL/NBM
 - Method: similar to 3 hourly CCPA
 - Expectation: improved hourly analysis to support NBM projects
- Make change to 3-hourly CCPA due to improved data quality of Stage IV hourly data in NWRFC and CNRFC areas
 - Current: using Stage II hourly in both NWRFC and CNRFC
 - Upgrade: will use Stage IV hourly only over CONUS
 - Expectation: improve 3-hourly CCPA with more accurate weights

Updating Regression Coefficients

1. 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)

2. Match resolutions

- a. Accumulate RFC over 24 hours
- b. Interpolate to $\frac{1}{8}^\circ$ (copygb w/ volume preservation)

3. Collect precip samples

- a. For each day of the year and at each grid point, collect all precip within 60 day window centered around that day, over all 15 years (max ~915 data points)
- b. Use only data points with ST4 > 0

4. Linear regression

- $\text{CPC} = a \cdot \text{ST4} + b$

5. End Result

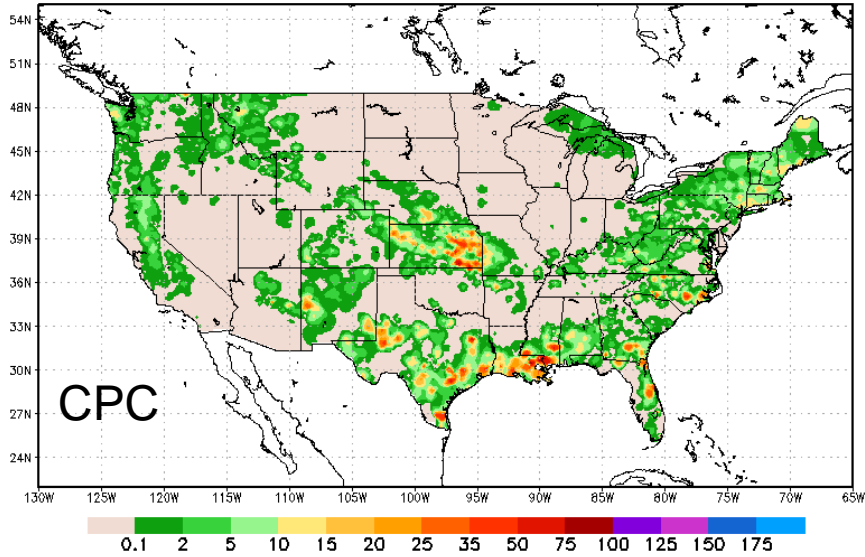
- Linear relationship (a & b) on $\frac{1}{8}^\circ$ grid for each day of the year

Change Specific to 3-hr CCPA

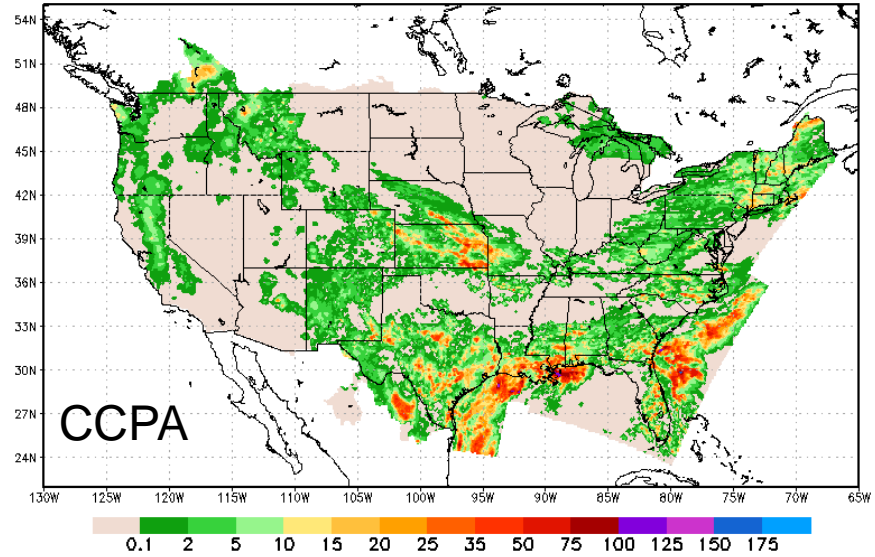
- Current CCPA production is using Stage II hourly in both NWRFC and CNRFC while use Stage IV hourly in remaining areas as weights to produce 3-hr CCPA
- Reason for change: Stage IV hourly in both NWRFC and CNRFC will be improve by using hourly gauge-corrected MRMS as weights to dis-aggregate the 6-hourly QPE from NWRFC and CNRFC into hourly amounts in the upcoming RTMA/URMA upgrade v2.6 (pcpanl.v3.0.0, to be implemented around Oct 2017).
- CCPA upgrade will use Stage IV hourly only over the entire CONUS domain as weights to produce 3-hr CCPA

24h totals ending 12Z 01 Jun 2017

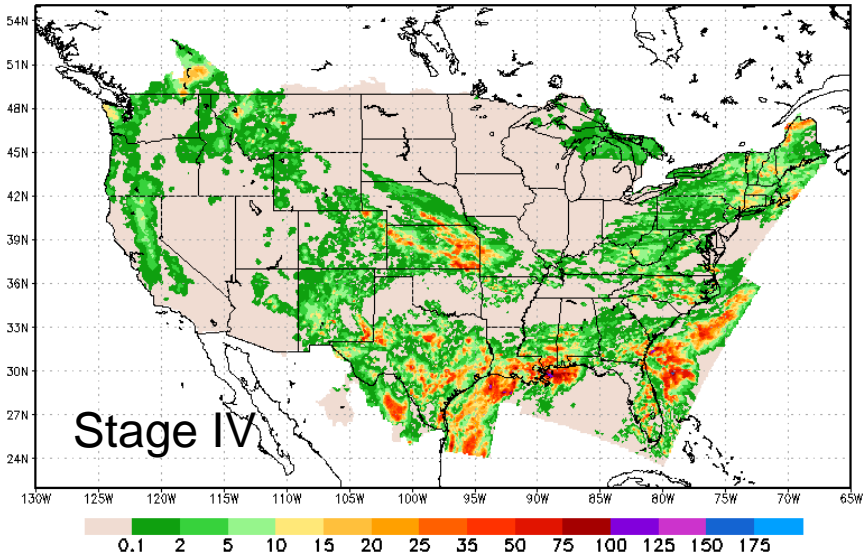
CPC 24h Accum (mm) Ending 2017060112



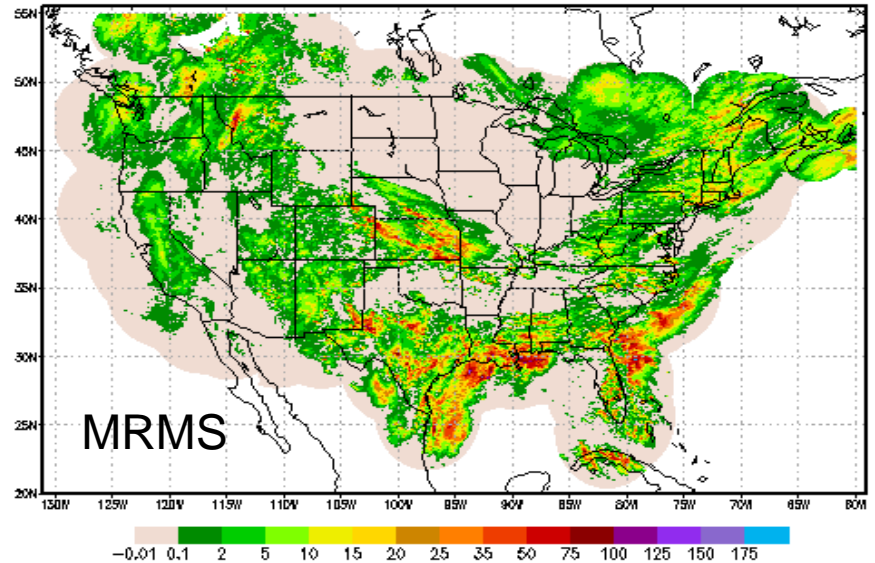
CCPA 24h Accum (mm) Ending 2017060112



Stage IV 24h Accum (mm) Ending 2017060112

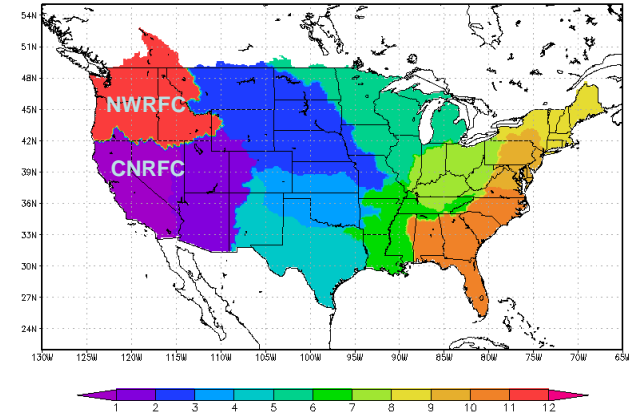


MRMS 24h pcp ending 12Z 20170601

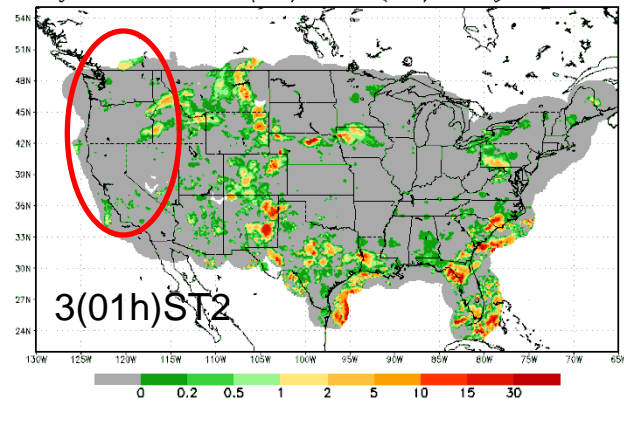
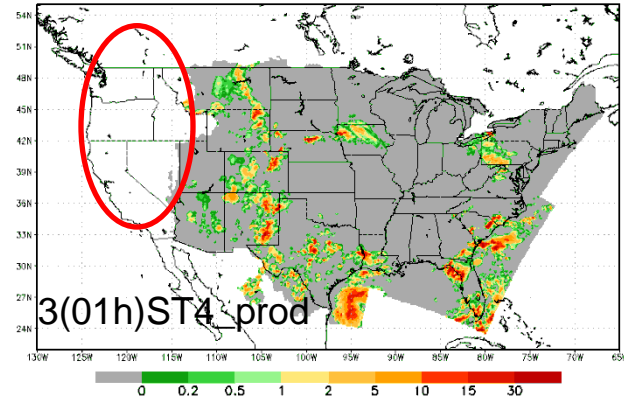


Why Change to 3-hr CCPA?

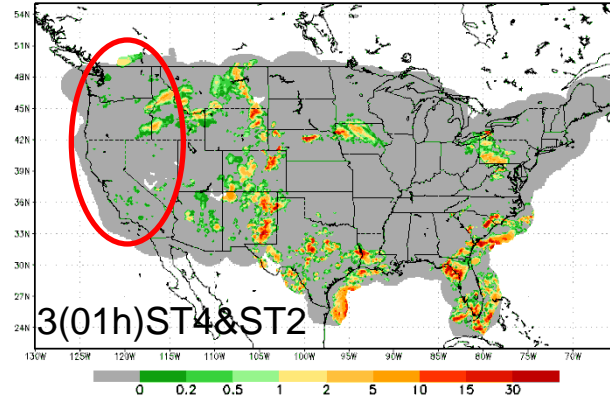
HRAP RFC MASK (in GRIB FMT)



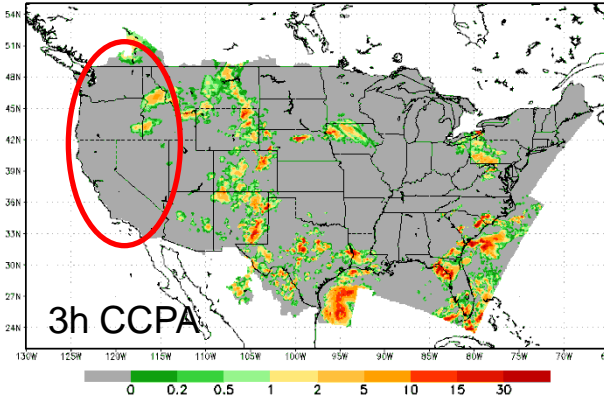
Stage IV 3(01h) Accum (mm) Ending 2017082503



Stage II&IV Composite 03h Accum (mm) Ending 2017082503



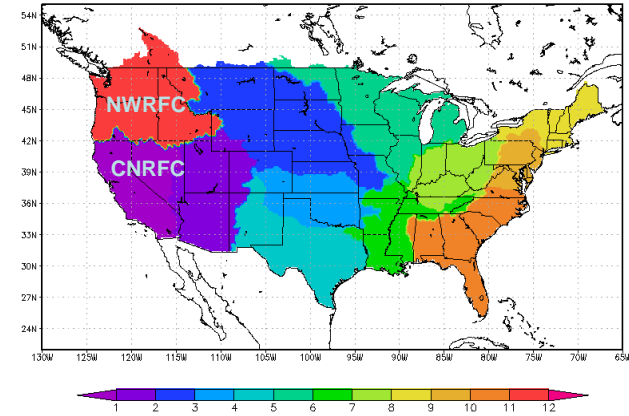
CCPA 03h Accum (mm) Ending 2017082503



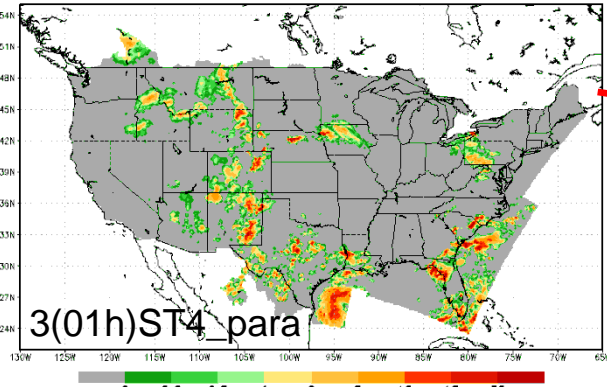
Current hourly Stage IV and 3-hr CCPA

Why Change to 3-hr CCPA?

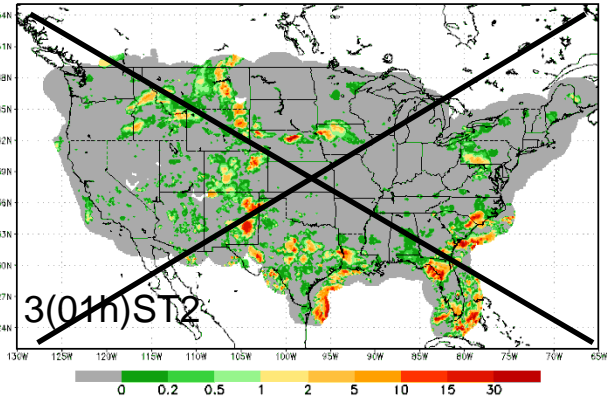
HRAP RFC MASK (in GRIB FMT)



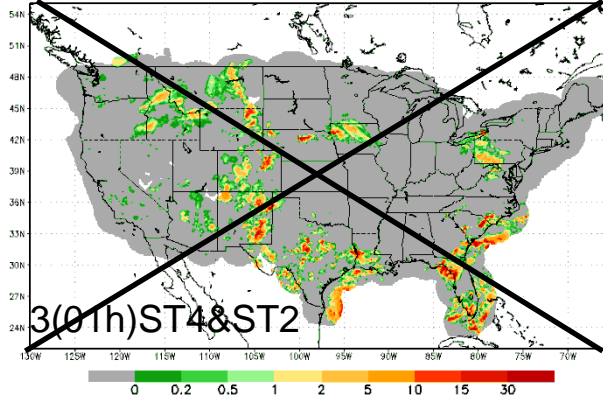
Stage IV 3(01h) Accum (mm) Ending 2017082503



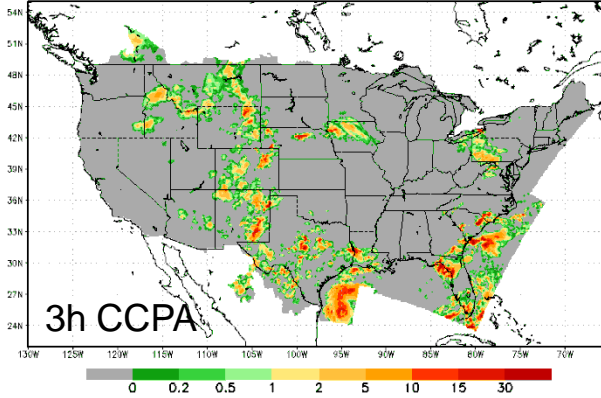
Stage II Multi-Sensor 3(01h) Accum (mm) Ending 2017082503



Stage II&IV Composite 03h Accum (mm) Ending 2017082503



CCPA 03h Accum (mm) Ending 2017082503



Future hourly Stage IV and 3-hr CCPA

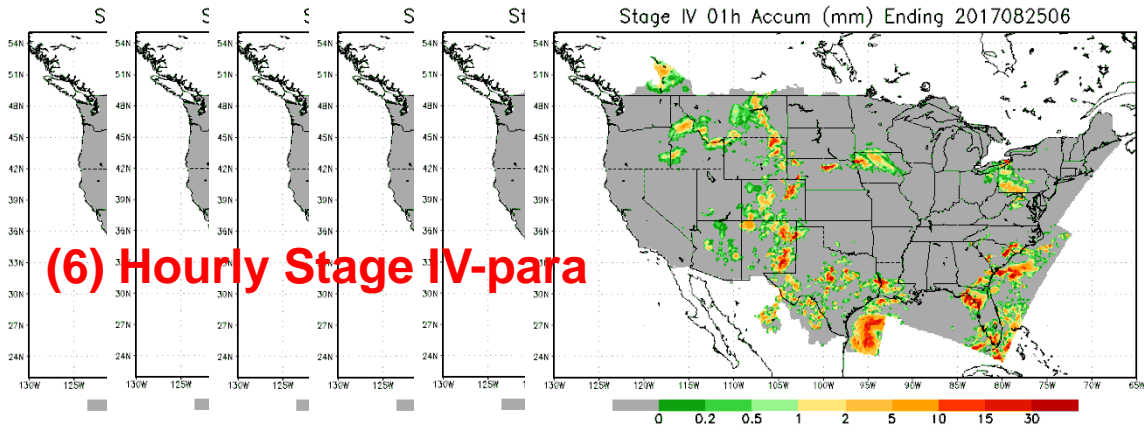
Introduction to 1-hourly CCPA

- NBM requirement for 1-hourly CCPA
- Similar approach as the one to produce 3-hourly CCPA

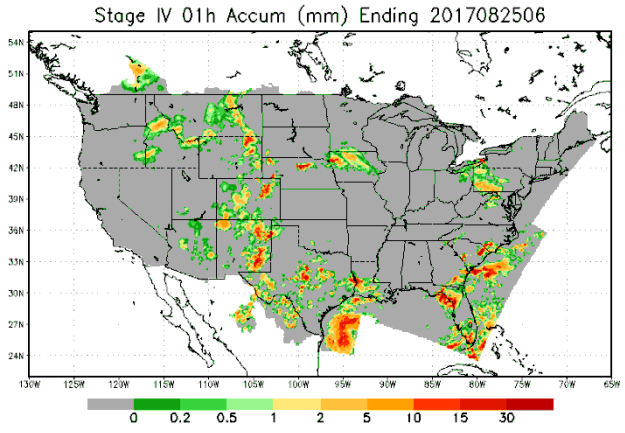
Reference: [2012 AMS poster](#)

Approach

(6) Hourly Stage IV-para



6-hourly CCPA



hourly CCPA

Method:

Use hourly Stage IV as weights to disaggregate 6-hourly CCPA



CCPA (V4.0) Upgrade for CONUS

Project Status as of 09/06/17



Project Information and Highlights



Scheduling

Lead: Yuejian Zhu/Yan Luo (EMC), Steven Earle (NCO)

Scope:

- Model – Climatology-Calibrated Precipitation Analysis (CCPA) system version 4.0
- Introduce hourly precipitation analysis for extended CONUS with improving methodology to support NBM projects
- Sciences:
 - Update regression coefficients based on 15-year (vs. 13-year) of training data sets of CPC gauge based analysis and STAGE IV multi-sensor estimation
 - Statistically adjust STAGE IV towards CPC analysis
 - Linear regression is applied at 0.125 degree resolution and 24h accumulation
- Output
 - Converted back to HRAP grid and 6 hour accumulation
 - Interpolated to 1.0, 0.5, 0.125 degree and NDGD grids (5km, 2.5km); hourly, 3hourly and 6hourly analysis

Expected Benefits:

- Improved analysis quality with extended training data

Implemented with: N/A

Dependencies: Stage II (?) and IV



Issues/Risks

Issues/Risks: None

Resource estimation:
5 nodes for 15 minutes

Milestones & Deliverables	Date	Status
Freeze system code and deliver to NCO	10/15/2017	On track
Complete full retrospective/real time runs and evaluation	11/15/2017	On track
Conduct CCB and deliver final system code to NCO	12/01/2017	On track
Deliver Technical Information Notice to NCO	12/01/2017	On track
Complete 30-day evaluation and IT testing	1/15/2018	On track
Operational Implementation	1/15/2018	On track

EMC	NCO	Red text indicates change from previous quarter
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Resources

Staff: 0.5 contractor FTEs (Yan Luo);

Funding Source: STI

Compute:

- **EMC Dev:** 5 nodes (Delta: 5 nodes);
- **Parallels:** 5 nodes (Delta: 5 nodes);
- **Ops:** 5 node5 (Delta: 5 nodes)

Archive:

- **Parallels:** 600mb/day (Delta: 300mb/day);
- **Ops:** 600mb/day (Delta:300mb/day)



Management Attention Required



Potential Management Attention Needed



On Target

Implementation Details

- Rules
 - Only Non-Zero Stage IV is adjusted
 - Zero values remains zero
 - Adjustment is applied over CONUS LAND only
- Leap Year
 - 366 day convention is adapted in regression calculations
 - Feb 29 has its own regression coefficients a and b
- Spatial Continuity
 - US Boundaries
 - Land/Ocean Boundary
 - Zero/Non-Zero Boundary
- Rare cases of abnormal regression coefficients
 - Temporal smoothing of a and b reduces abnormal values
 - Discard the regression coefficients a and b, if too large
 - Set an upper limit to the adjusted St4 value