Fusing GPM and Ground Observations for Hydrologic and Climate Applications

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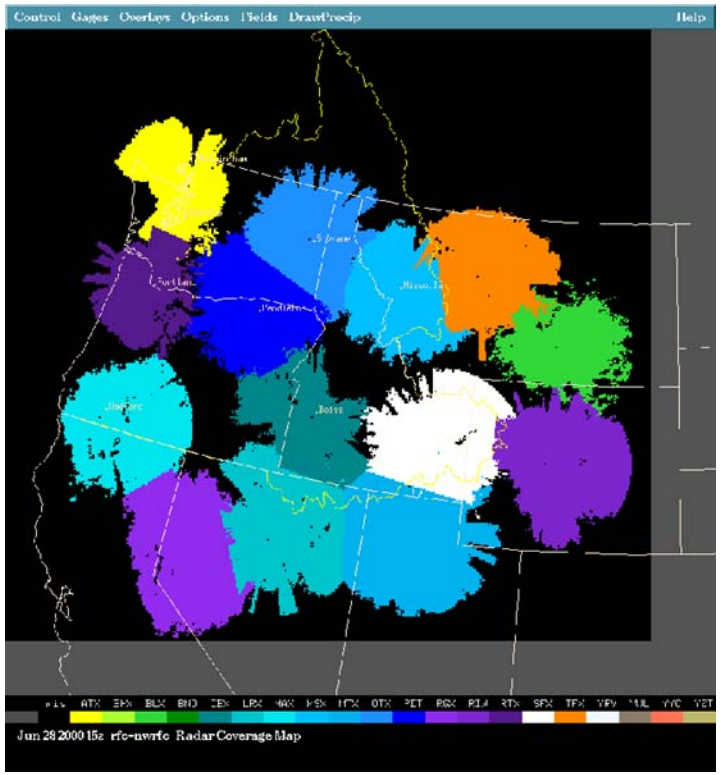
PingPing Xie

NWS Climate Prediction Center

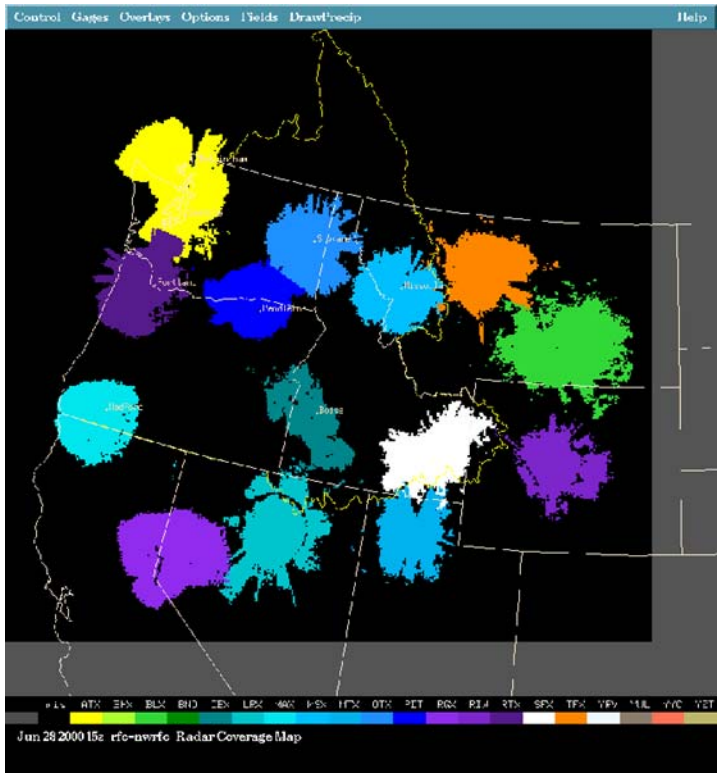
Operational Fusion Frameworks

- OHD
  - Multisensor Precipitation Estimator (MPE)
  - Blending of gauge, ground radar and IR
- CPC
  - CPC-Morphing (CMORPH)
    - Uses IR for advecting microwave rain rate estimates
  - Augmentation to incorporate ground observations

Need for Data Fusion – NEXRAD coverage

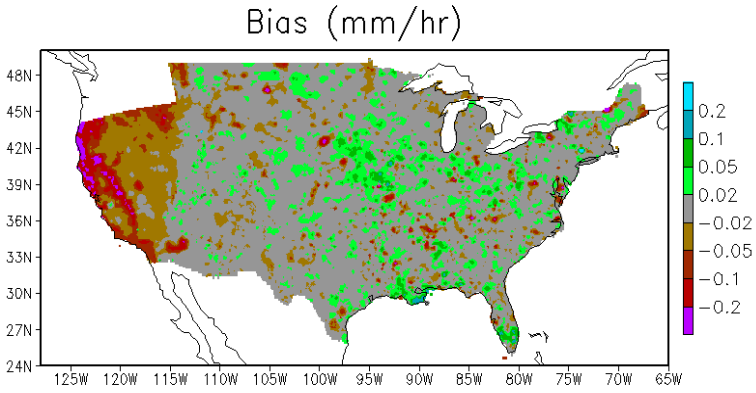


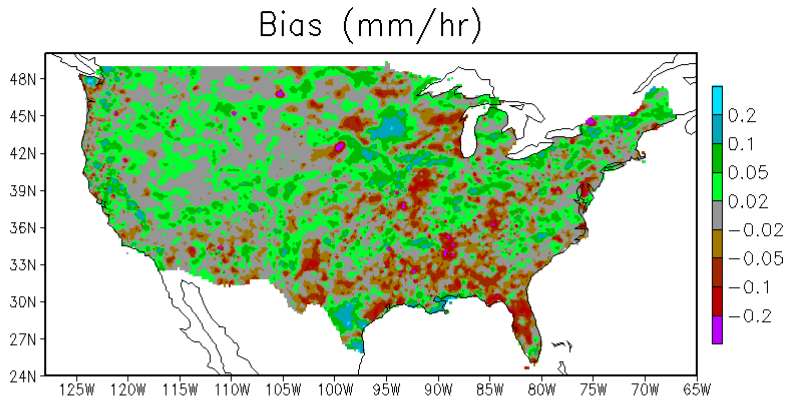
NEXRAD Coverage - summer

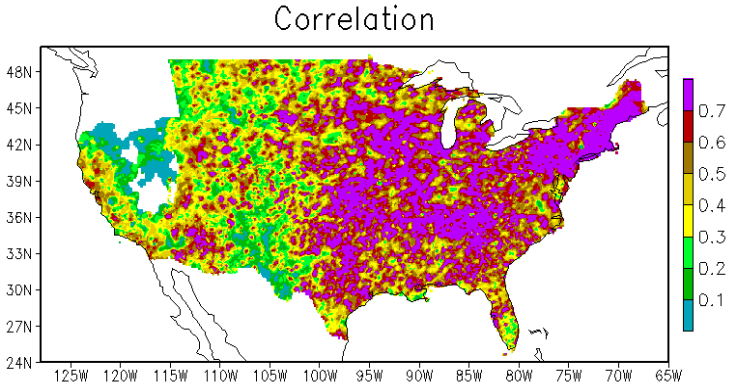


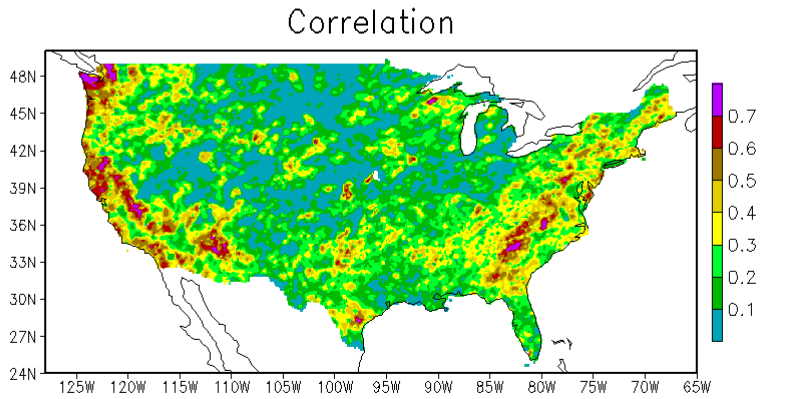
NEXRAD Coverage - winter

Comparison of Radar and Model with Gauge - Regional Performance





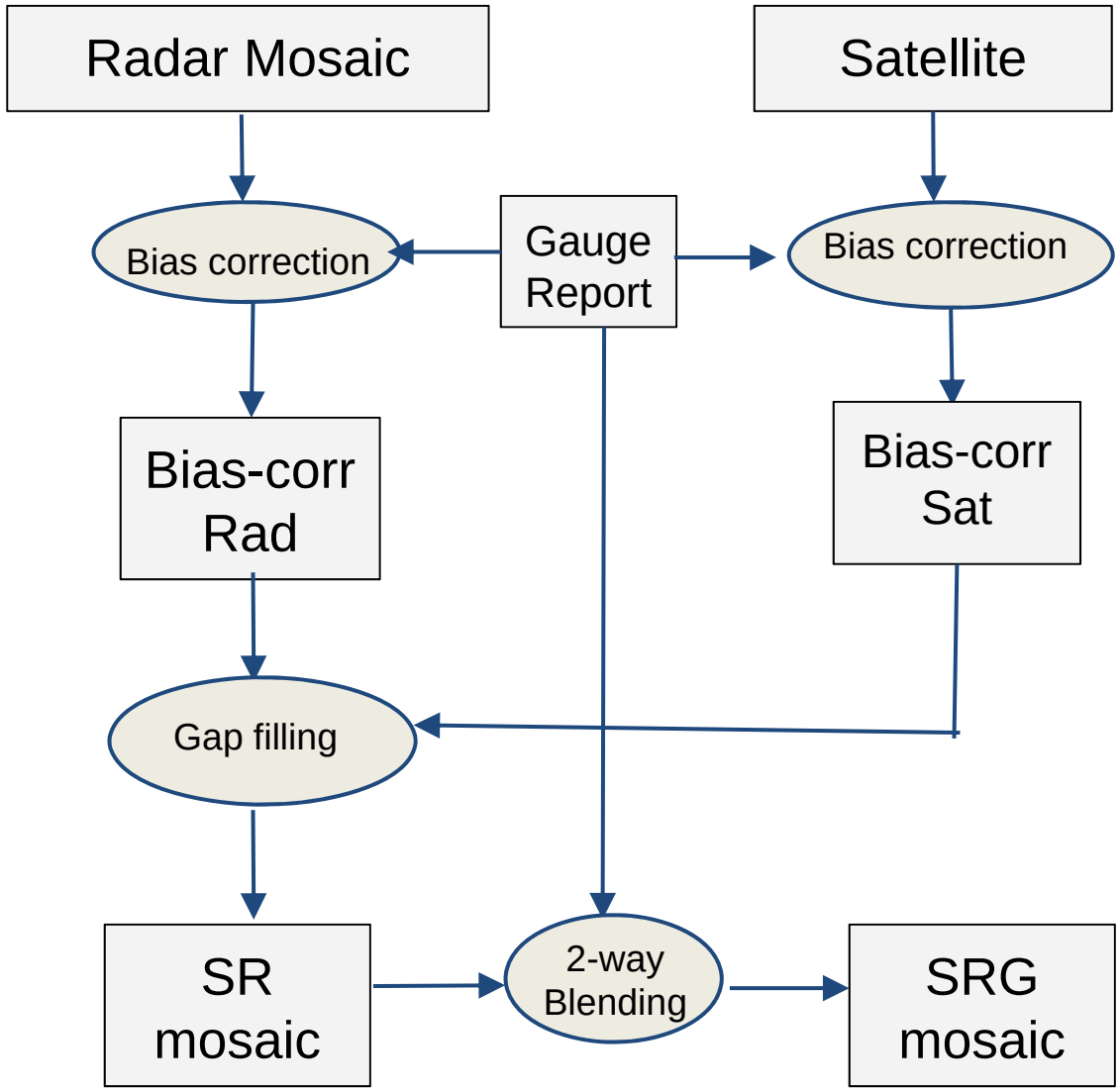




Multisensor Precipitation Estimator

- Mechanisms
  - Mean-field and local bias correction
    - Based on time and distance-weighted precip/ amounts
    - Local bias correction used for satellite QPEs
  - Multisensor blending
    - Variations of co-kriging
- Products
    - Gauge-only (interpolated gauge data)
    - Bias corrected radar and satellite
    - Blended radar-satellite, and radar-satellite-gauge products

Existing MPE Satellite-Radar-Gauge mechanism



Highlights:

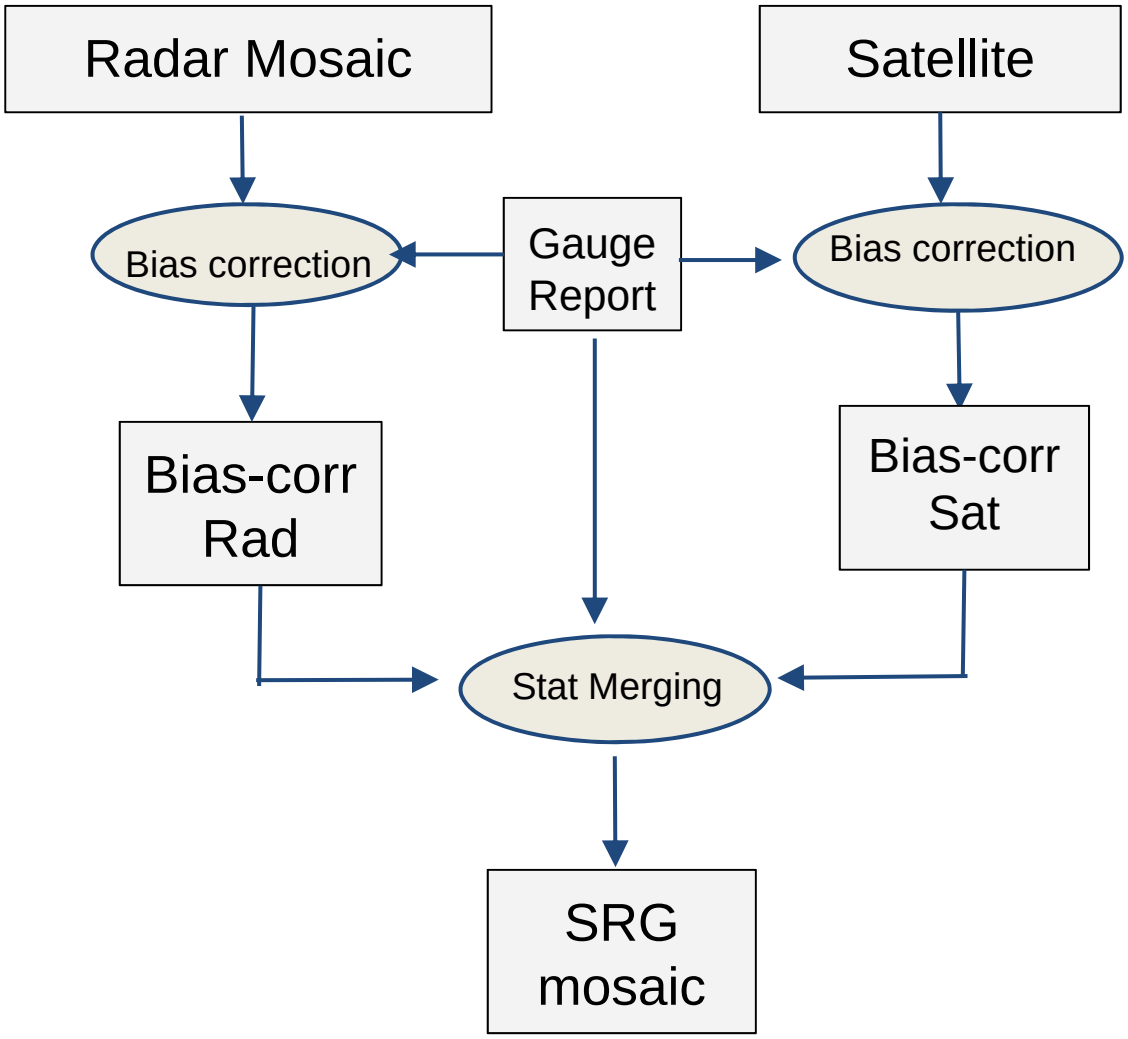
1. Sat. data at present are from IR-based Hydro-Estimator

2. Sat. data fills the gaps only

2. SR merged product is blended with gauge data

3. This operation is performed for hourly S, R and G data

Revised Algorithm for SRG mosaic



Highlights:

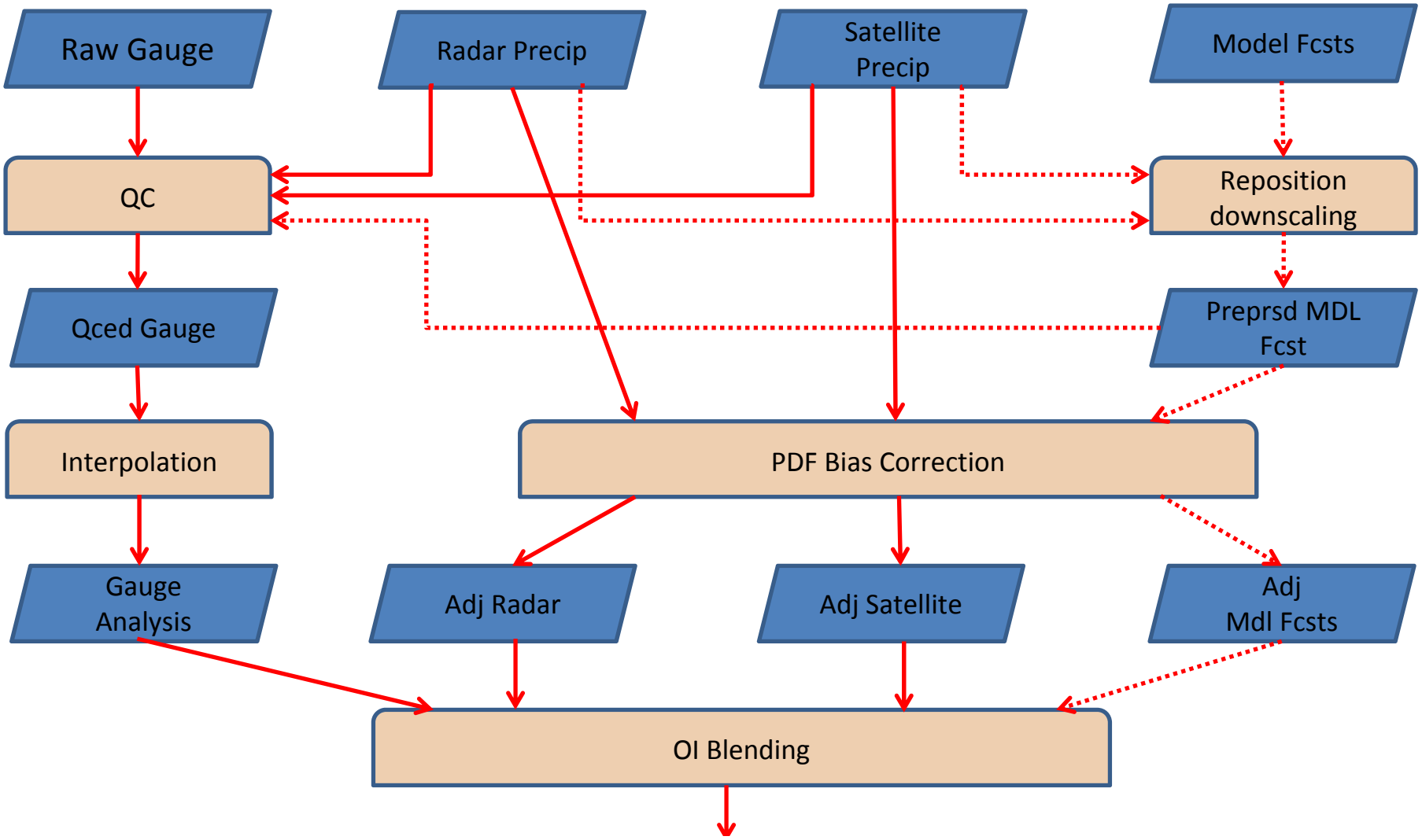
1. Sat/Gauge/Radar merged in 2 steps via MPE-DOE

2. Beam height and quality index will be used in formulating the covariance matrix

CMORPH Fusion Approach

- Objective:
  - To construct high-resolution regional precipitation analyses over CONUS and its adjacent oceans through blending information from gauge measurements, radar observations, satellite estimates and numerical model forecasts
- Resolution:
  - Starting with Hourly / 4km (HRAP)
- Inputs being tested:
  - Hourly gauge reports from NCDC (will include MESONETS data)
  - NCEP Stage IV radar (will be replaced by Q2 in the future)
  - CMORPH (will be using regional CMORPH)
  - NAM (will check other possibilities)

CPC Strategy and Flow Chart



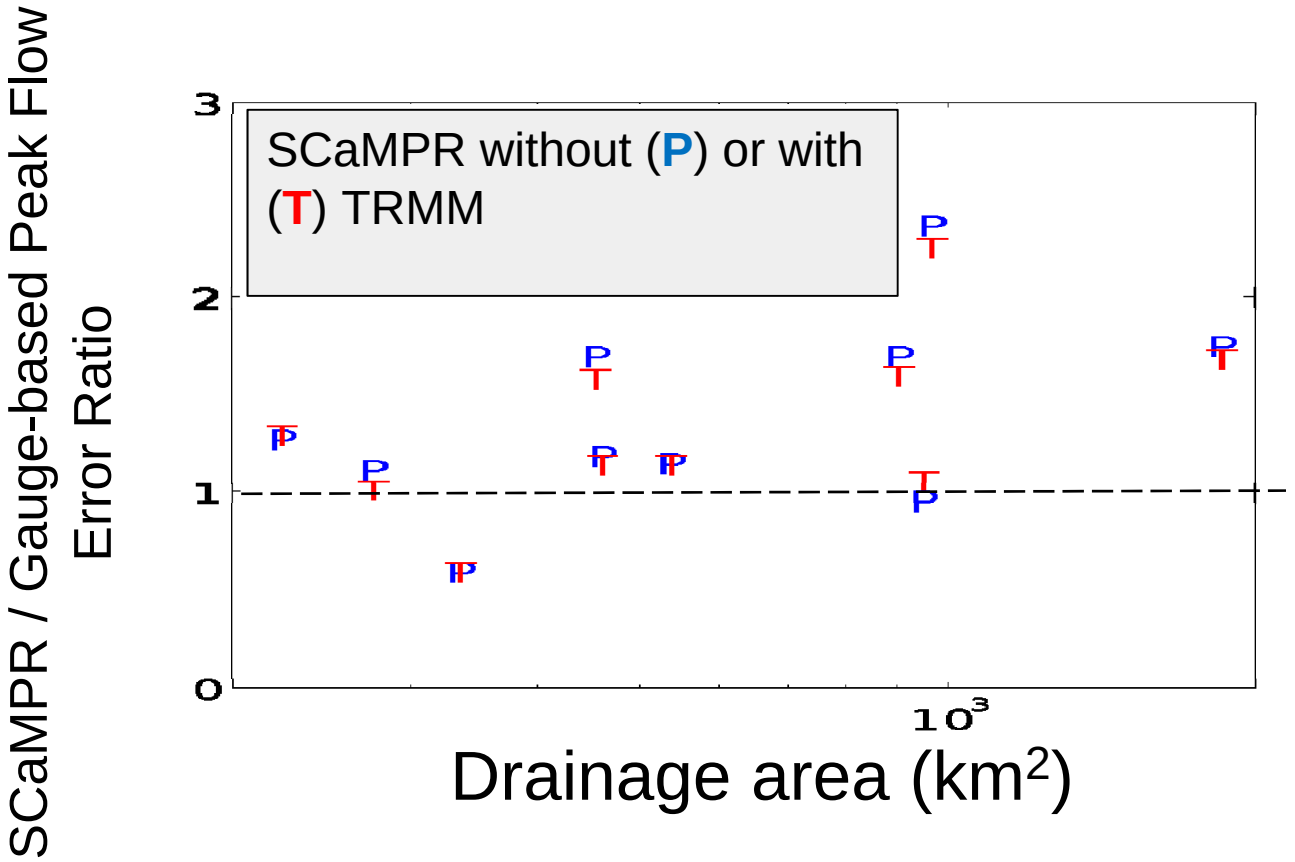
Individual Processes and Current Status

- QC for gauge reports
  - Based on CPC QC system for daily precip
  - A very preliminary system tested
  - Need extensive work for complete development
- Gauge interpolation
  - Developed based on Xie et al. (2007)
- Bias correction for radar, satellite and model precip
  - Developed based on Xie and Xiong (2011)
- OI blending
  - Developed based on Xie and Xiong (2011)
- Model precip repositioning and downscaling
  - In preliminary tests

Science Infusion and Assessments

- Synergy needed to test methodologies
  - Identify the best approaches from MPE and CMORPH for bias correction and multisensor fusion
  - Incremental benefit of fusing model predicted precip
- Determine the impacts on hydrologic predictions
  - Effectiveness in capturing heavy/extreme floods at different scales
  - Stability of the bias across spatial and temporal settings

Science Infusion and Assessments



Challenge: How to move the points below the dotted line? For what regions/watersheds can superior performance from fused QPE be achieved?