



Evaluating Satellite Precipitation Products over Complex Terrain: Preliminary Results from IPHEX and HyMeX Observations



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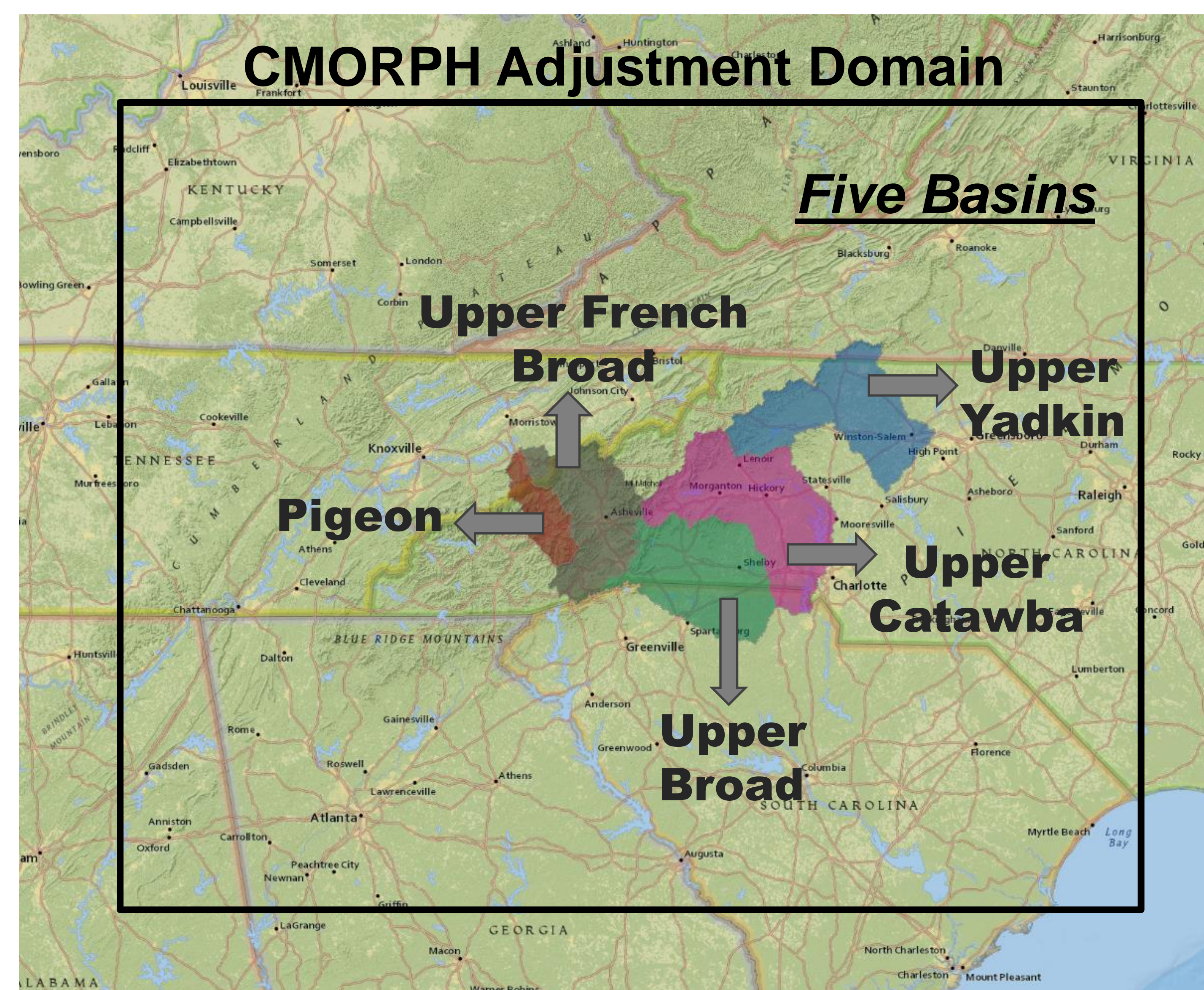
Improving Satellite Precipitation Estimates over Mountainous Terrain

Objectives

- Apply a technique to adjust high-resolution satellite-retrieved rainfall fields (CMORPH) over complex terrain using NWP predicted precipitation datasets (Zhang et al. 2013).
- Evaluate the satellite adjustment technique using independent rainfall fields from gauge-adjusted (Stage IV) WSR-88D estimates focusing on heavy-precipitation storm events over the IPHEX domain.

Study Domain

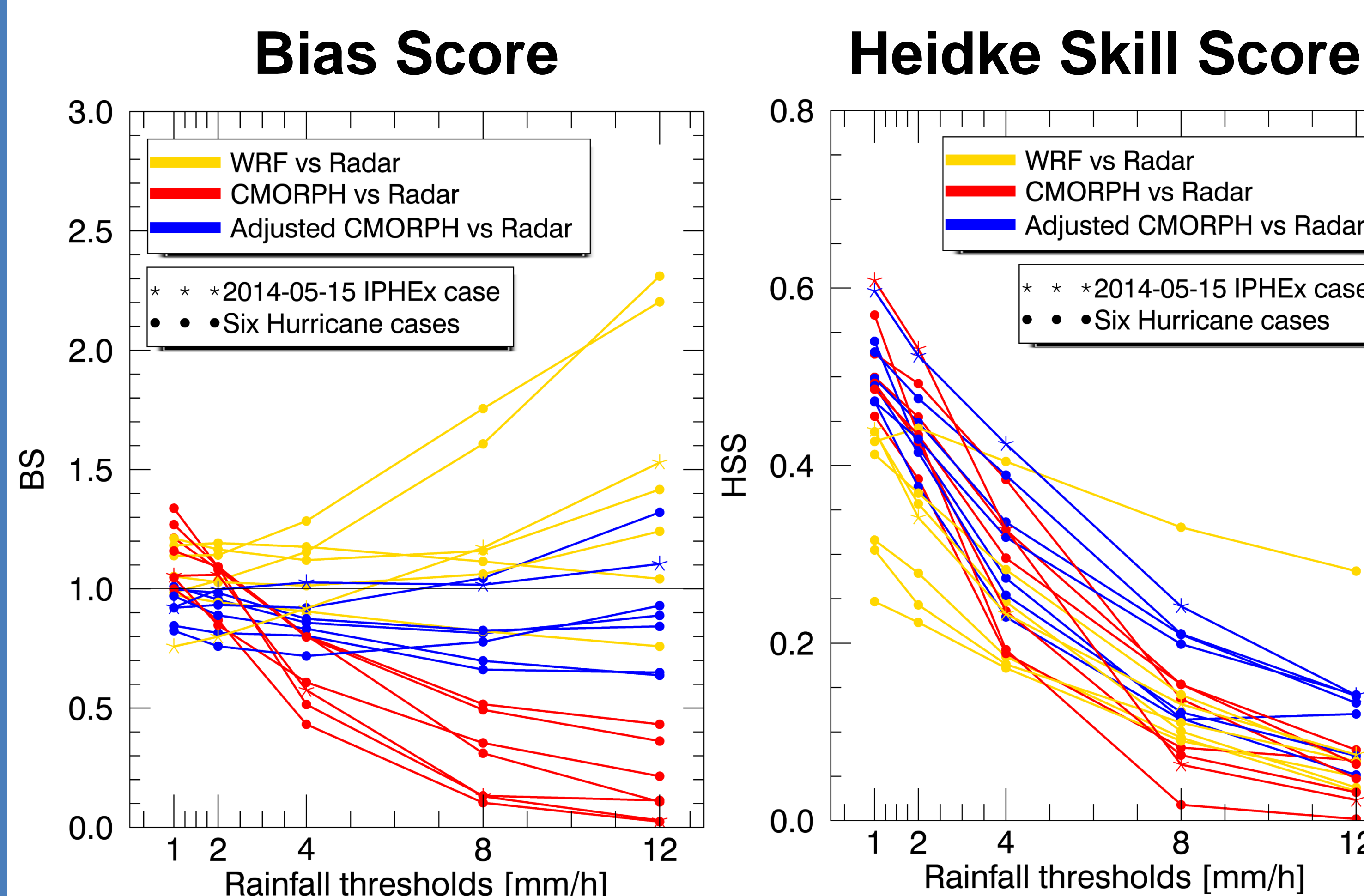
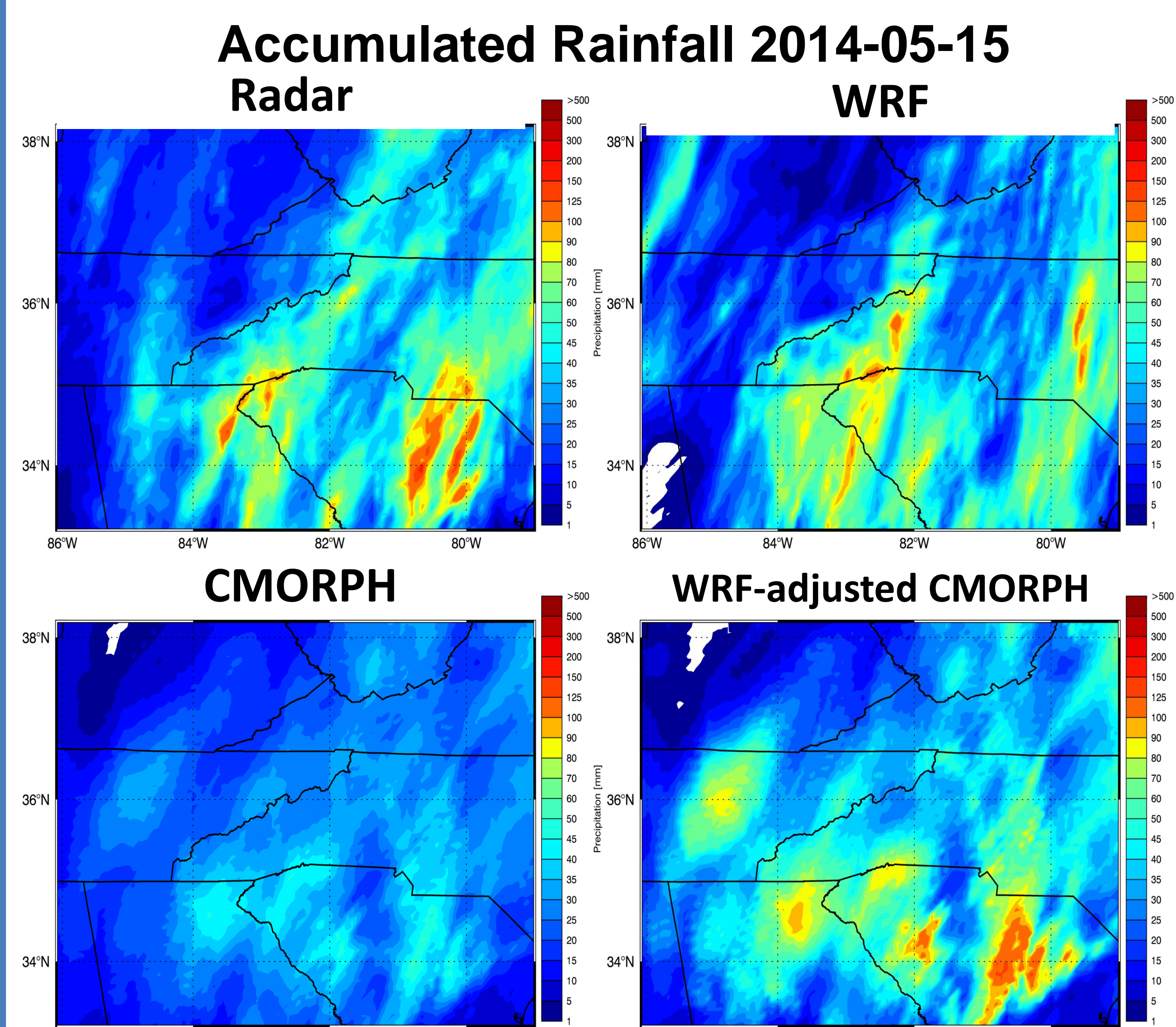
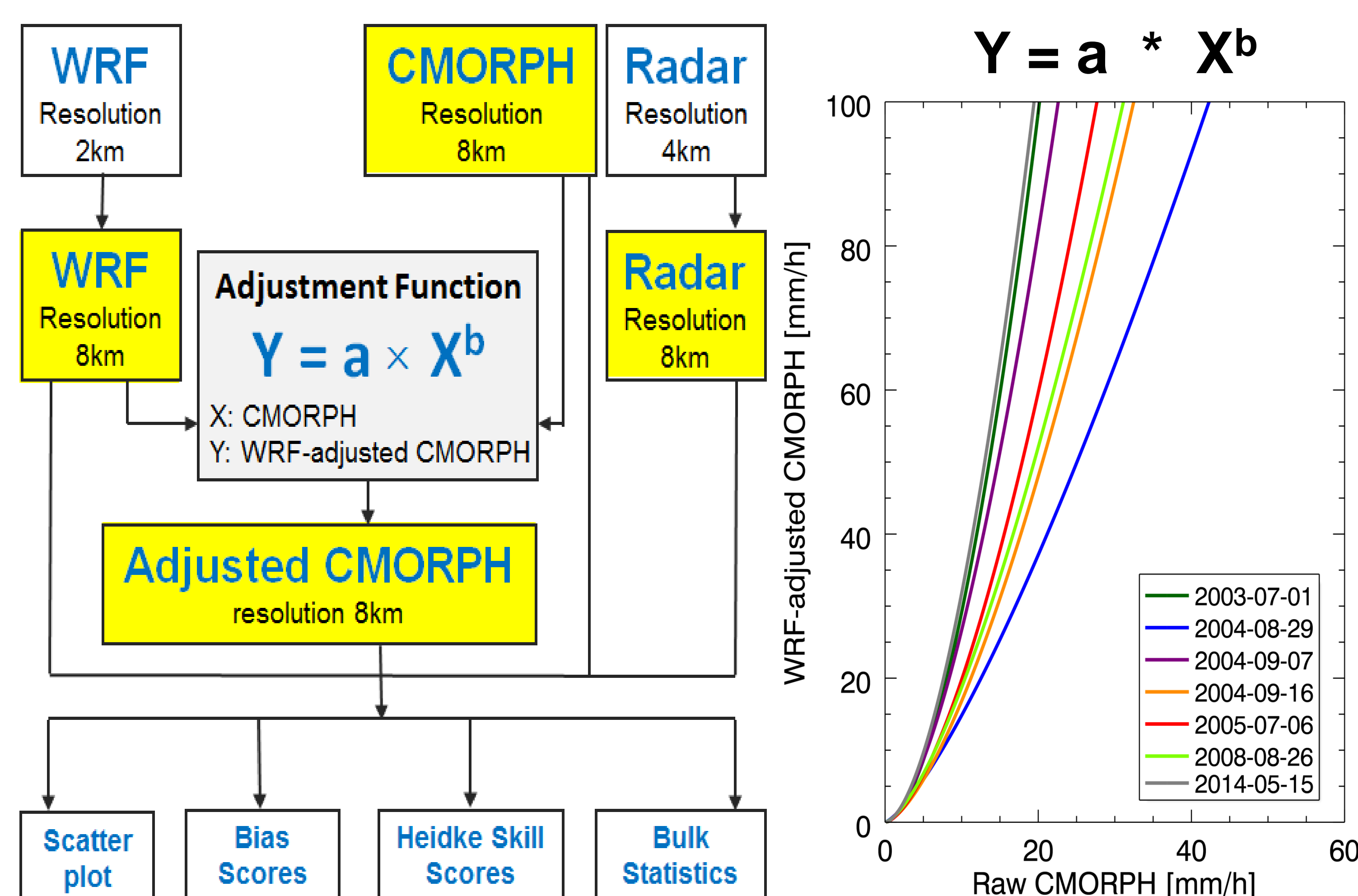
- IPHEX GV field campaign domain: Centered in the Southern Appalachians and spanning into the Piedmont and Coastal Plain regions of North Carolina.



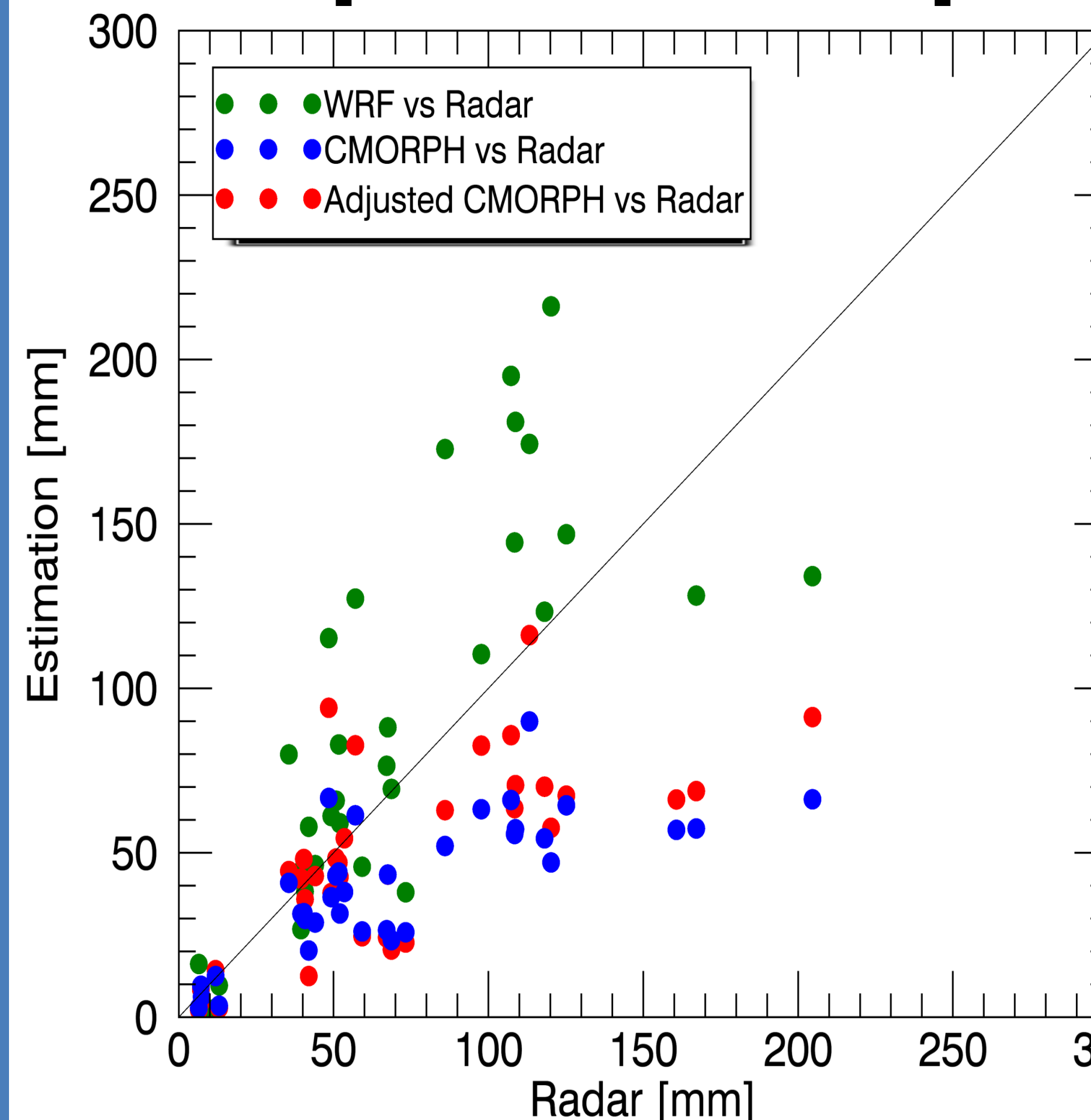
Data: Seven Storm Events

- A storm event in IPHEX experiment: 2014-05-15
- Six historical hurricane events:
 Bill: 2003-07-01 Gaston: 2004-08-29 Frances: 2004-09-07
 Ivan: 2004-09-16 Cindy: 2005-07-06 Fay: 2008-08-26

Methodology



Scatter plot of acc. rain [7 Events * 5 basins]



Event	Estimator vs Radar	BIAS	
		Over Entire Domain	Over Five Basins
2003-07-01	WRF	1.334	1.897
	CMORPH	0.808	0.985
	Adjusted CMORPH	0.985	1.198
2004-08-29	WRF	0.895	0.657
	CMORPH	0.832	0.753
	Adjusted CMORPH	0.977	0.704
2004-09-07	WRF	1.177	1.080
	CMORPH	0.597	0.420
	Adjusted CMORPH	0.788	0.531
2004-09-16	WRF	1.315	1.261
	CMORPH	0.770	0.539
	Adjusted CMORPH	0.838	0.579
2005-07-06	WRF	1.436	0.927
	CMORPH	0.833	0.593
	Adjusted CMORPH	1.116	0.656
2008-08-26	WRF	1.120	1.557
	CMORPH	0.679	0.486
	Adjusted CMORPH	0.819	0.598
2014-05-15	WRF	0.971	0.997
	CMORPH	0.682	0.707
	Adjusted CMORPH	1.024	0.977

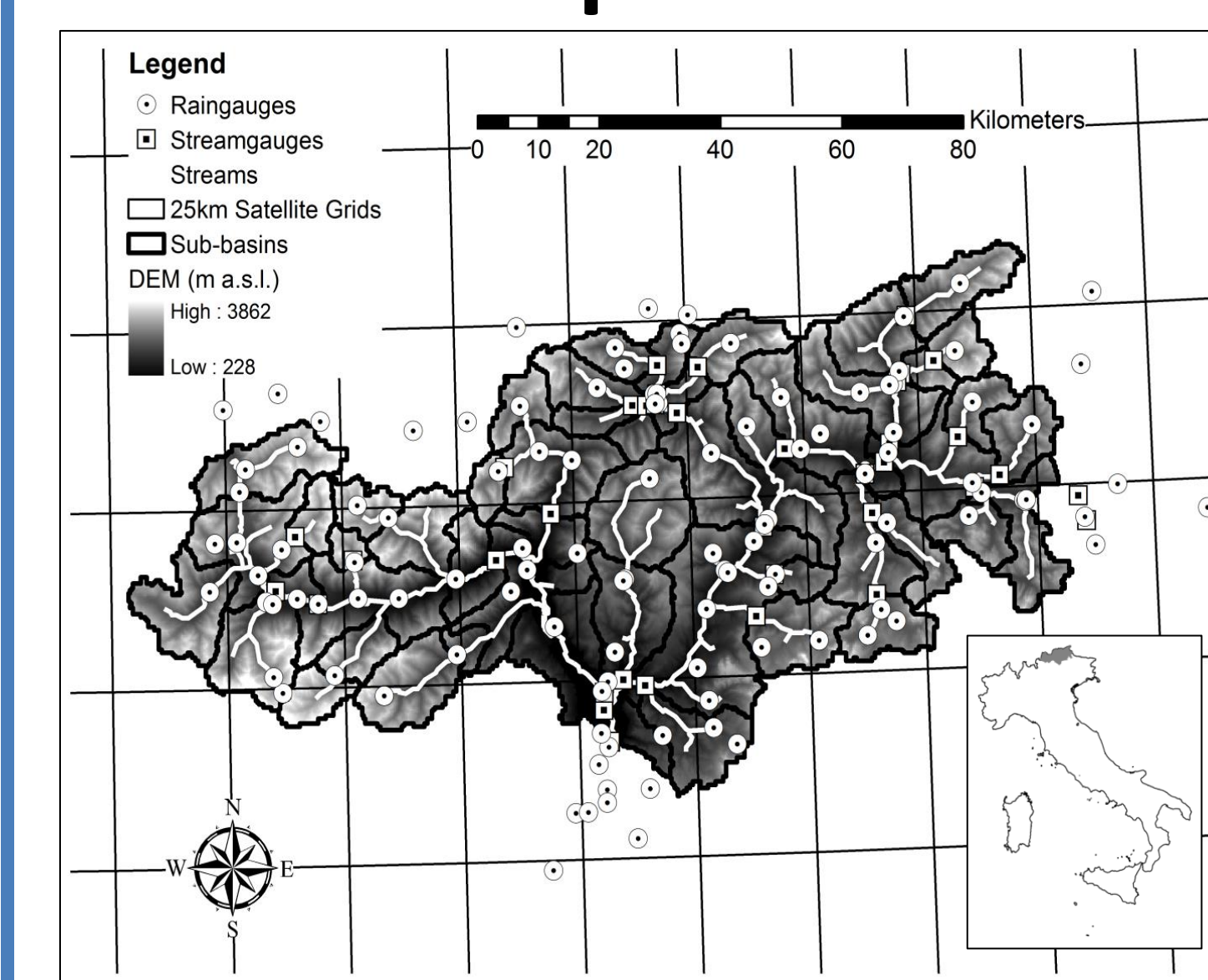
Summary

- CMORPH provides similar rainfall pattern to the radar data, while WRF is good at rainfall magnitude prediction.
- WRF-adjusted CMORPH rain rates exhibits improved error statistics against independent radar-rainfall estimates. The adjustment reduced the underestimation of high rain rates thus moderating the strong rainfall magnitude dependence of CMORPH rainfall bias.

Error Propagation of Satellite Precipitation in Streamflow Simulation

Study Domain

- HyMEX: Upper Adige river basin in the Eastern Italian Alps.



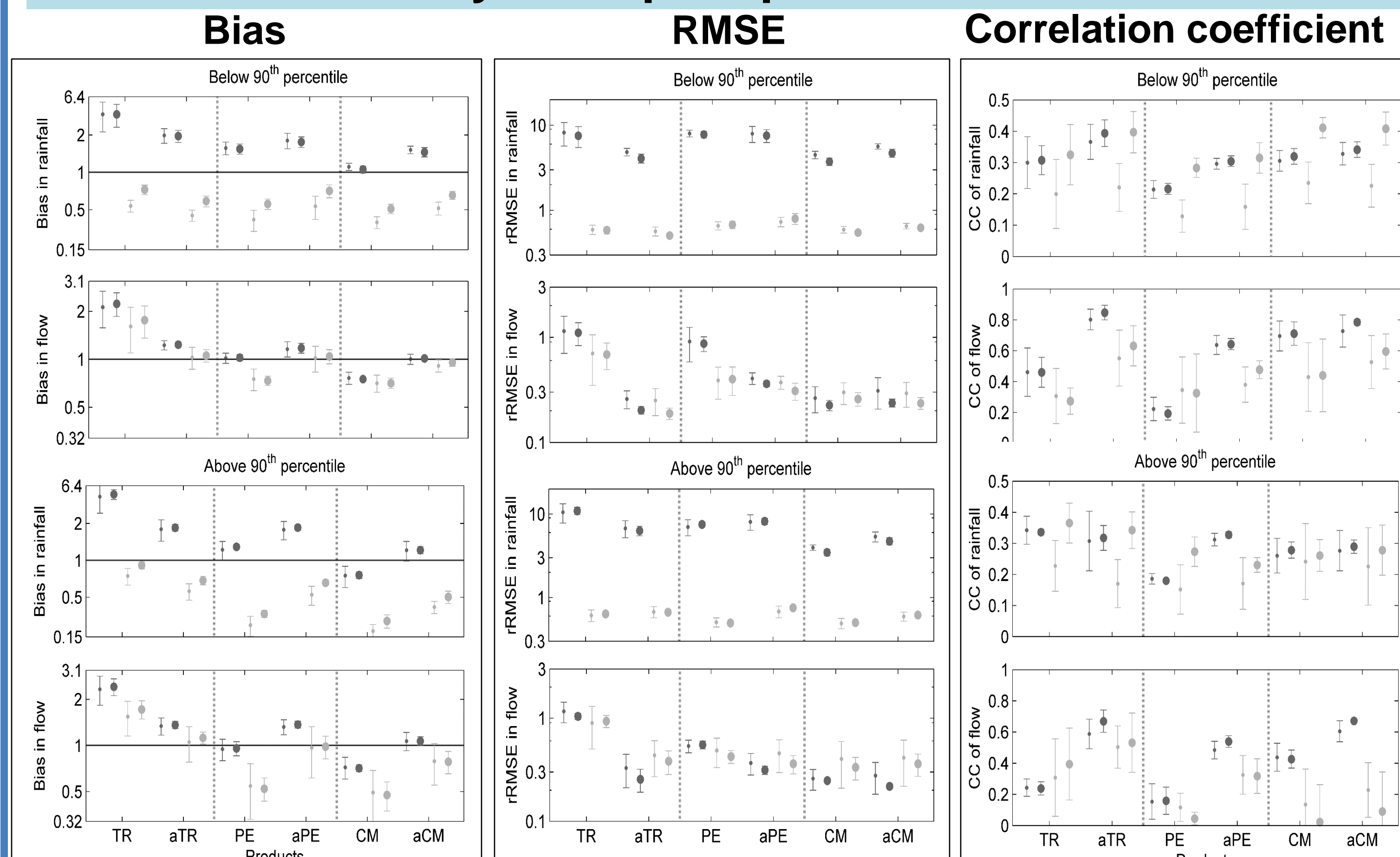
Data

- 9-year (2002-2010) precipitation
- Satellite products:
 - TRMM 3B42-RT [TR]
 - TRMM 3B42-V7 [aTR]
 - CMORPH [CM]
 - gauge-adjusted CMORPH [aCM]
 - PERSIANN [PE]
 - bias-adjusted PERSIANN [aPE]
- Rain-gauge network
- Simulated hydrograph

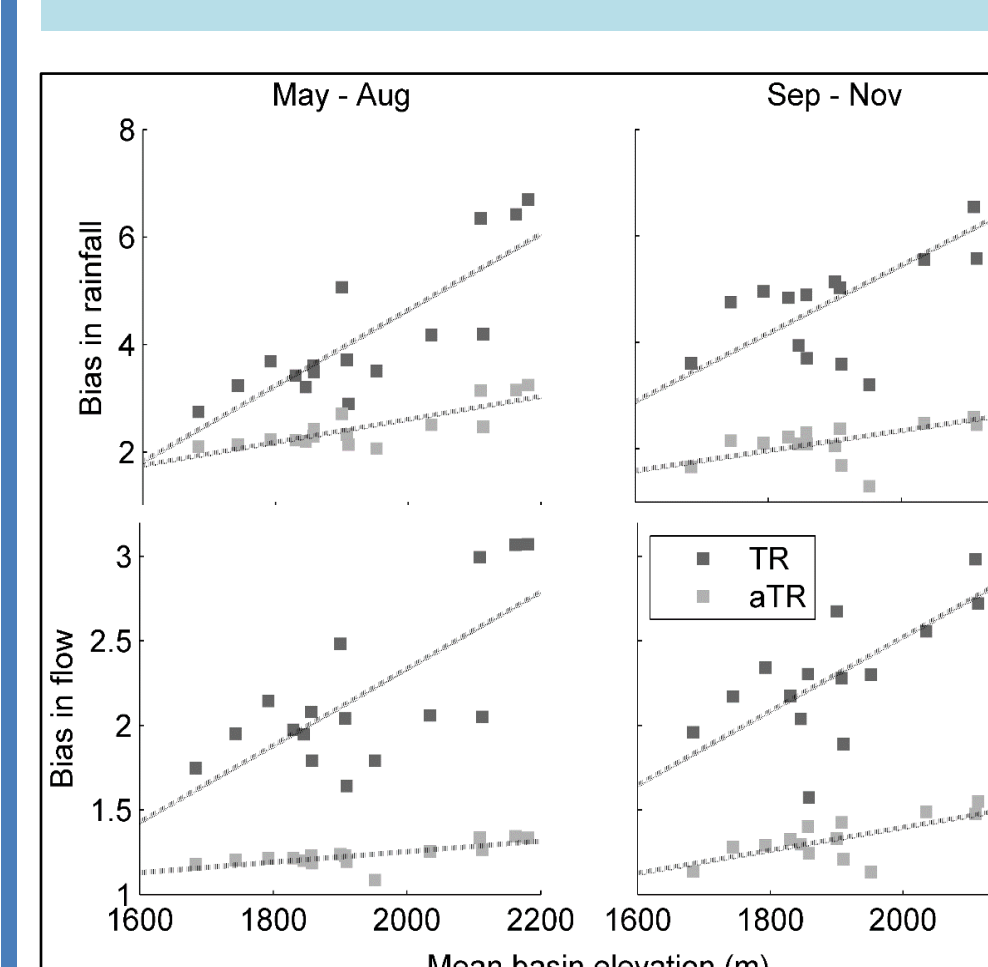
Results

- Basin scales: Medium Scale, Large Scale
- Seasons: May - Aug, Sep - Nov

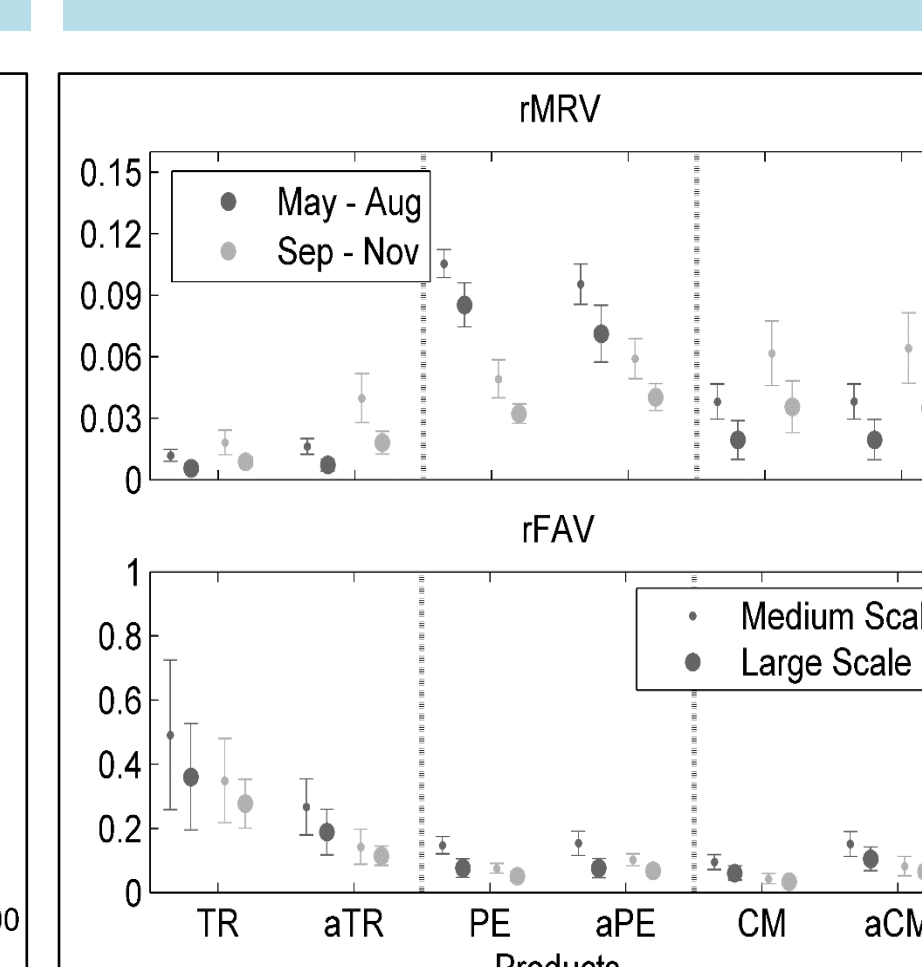
Error analysis of precipitation and runoff



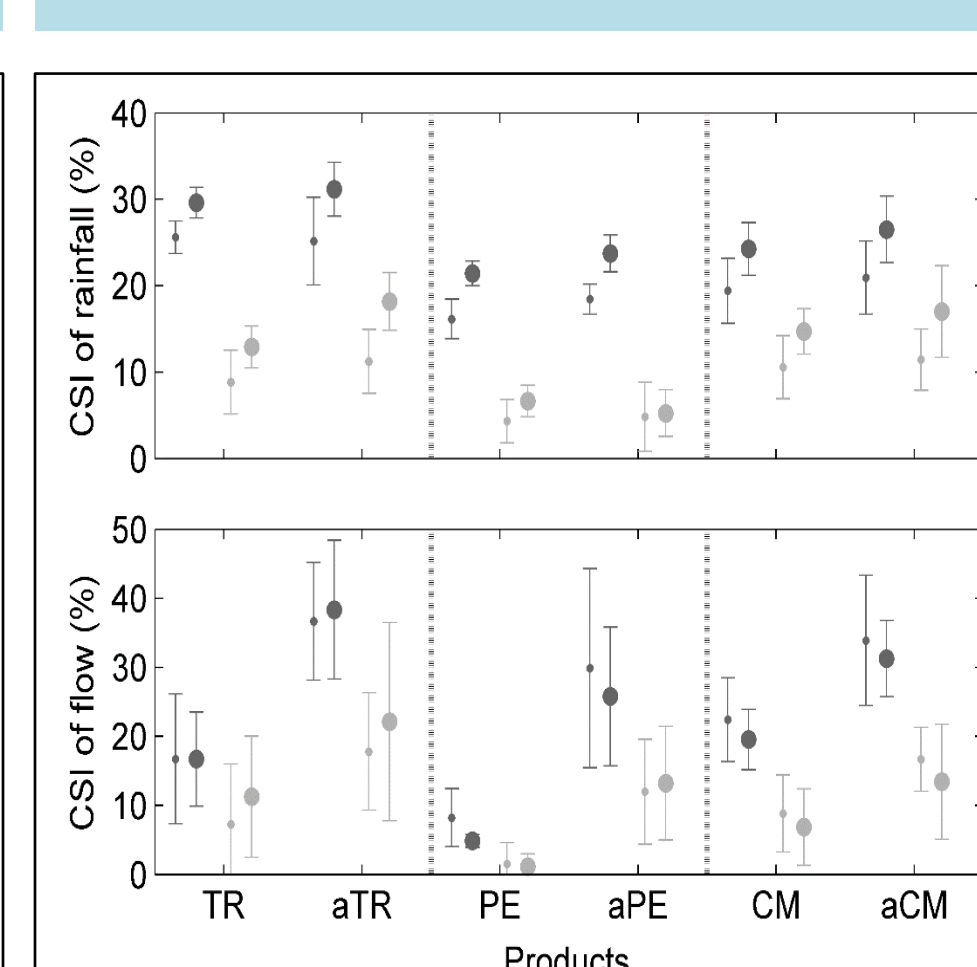
Elevation vs Bias



Relative MRV & FAV



Critical Succeed Index



Summary

- Detection of precipitation is not an important issue (except for 3B42RT).
- Bias in basin-average precip. depends on a) product, b) basin area, c) basin elevation and d) season.
- Satellite-based simulations, estimated total runoff within ~ 25% bias (except for 3B42RT).
- Correlation and CSI of high flow values is low.
- Which scales? Results show >10% improvement from smallest to highest scales examined.
- Which products? Performance varied among products but overall.....adjusted CMORPH is the authors choice!