Multi-regional evaluation and error modeling of satellite precipitation products over complex terrain

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Improving Satellite Precipitation Estimates Using NWP Simulations

- Apply a technique to adjust high-resolution satellite-retrieved rainfall fields using NWP precipitation datasets.

❑WRF ❑CMORPH → WRF CDF array (5%, 10%, ……, 95%) / CMORPH CDF array → CMORPH is fitted to WRF by a *power-law function*

$$WRF = a \times CMORPH^b$$

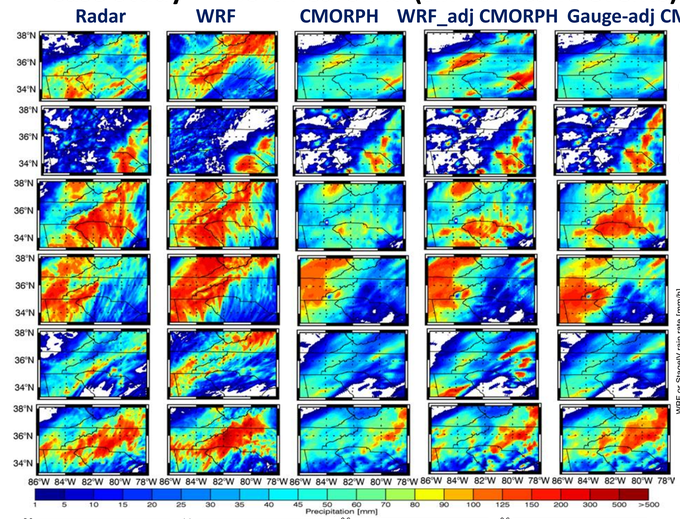
❑Find parameter a and b values by least squares methods

❑Apply a and b on each CMORPH rain rates [mm/h]

$$WRF\ adjusted\ CMORPH = a \times CMORPH^b$$

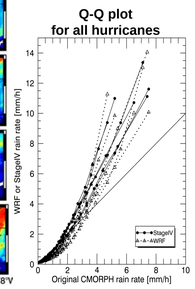
❑Now we have a new precipitation dataset: WRF-adjusted CMORPH rain rates

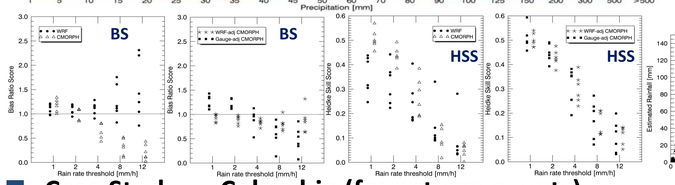
Case Study --- North Carolina (six hurricane events)

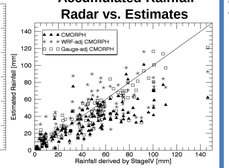


Hurricanes

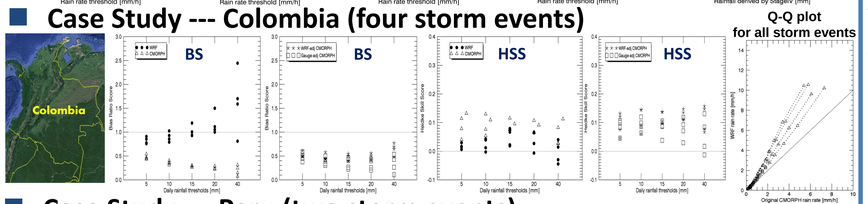
Bill:	2003-07-01
Gaston:	2004-08-29
Frances:	2004-09-07
Ivan:	2004-09-16
Cindy:	2005-07-06
Fay:	2008-08-26



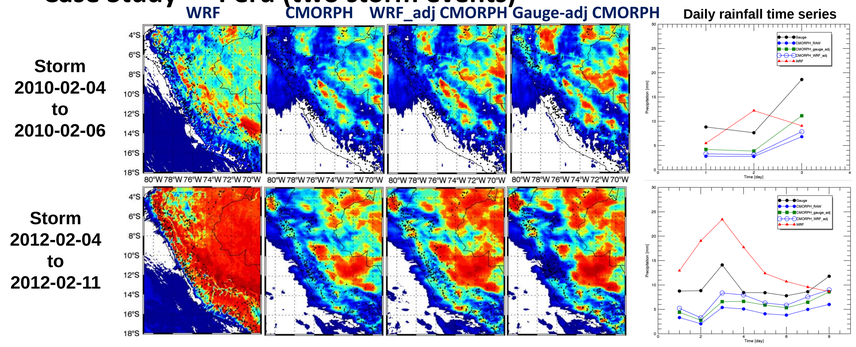




Case Study --- Colombia (four storm events)



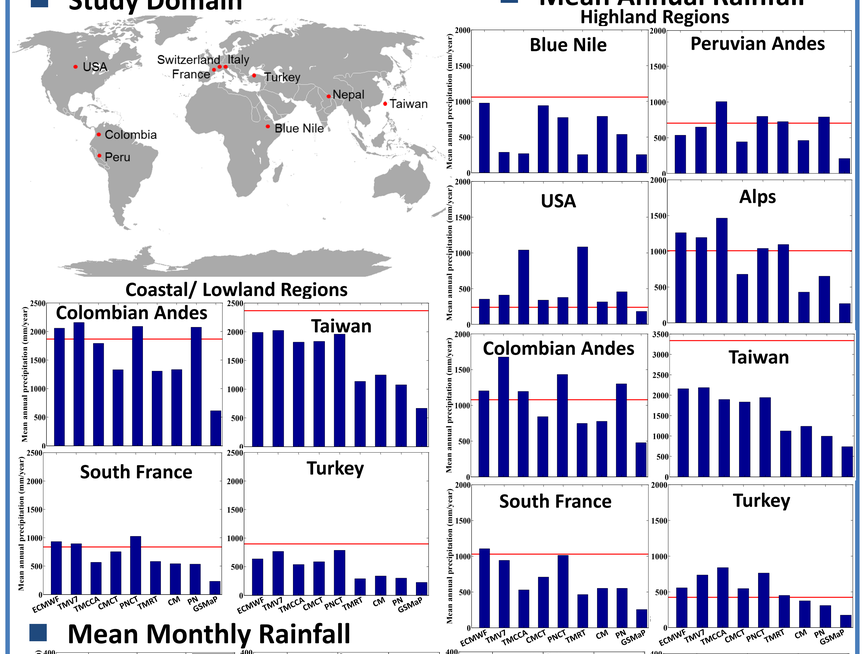
Case Study --- Peru (two storm events)



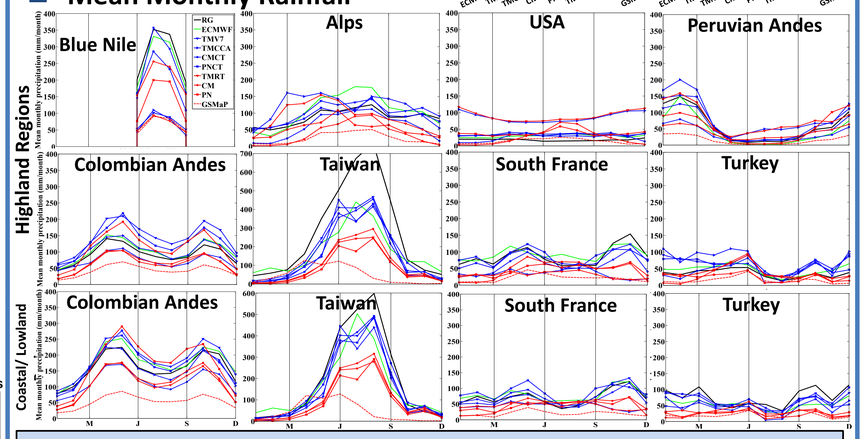
Multi-regional Evaluation of Satellite Products using Daily Gauge Networks

Study Domain

Mean Annual Rainfall

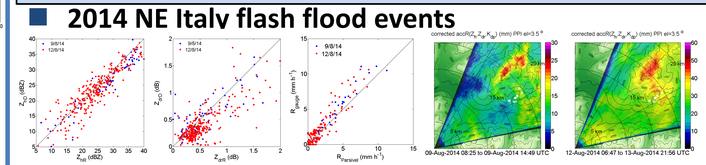


Mean Monthly Rainfall

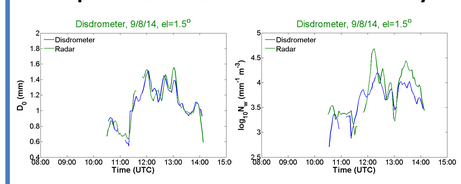


X-band Dual Polarization Radar Rainfall Estimation for GV

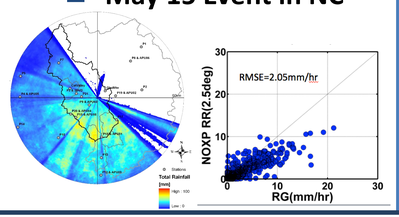
2014 NE Italy flash flood events



DSD parameter verification over NE Italy



May 15 Event in NC



Error Propagation of Satellite Precipitation in Streamflow Simulation

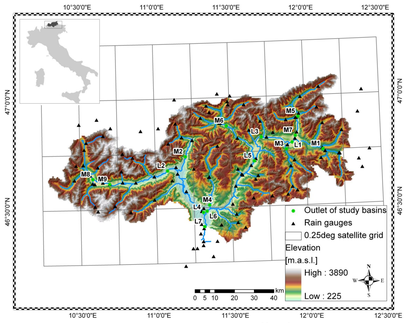
Study Domain

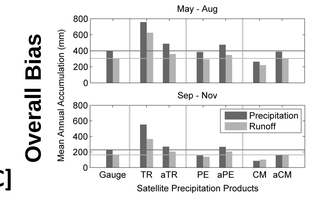
- HyMex: Upper Adige river basin in the Northeastern Italian Alps (6967 km²).

Data (2002-2010)

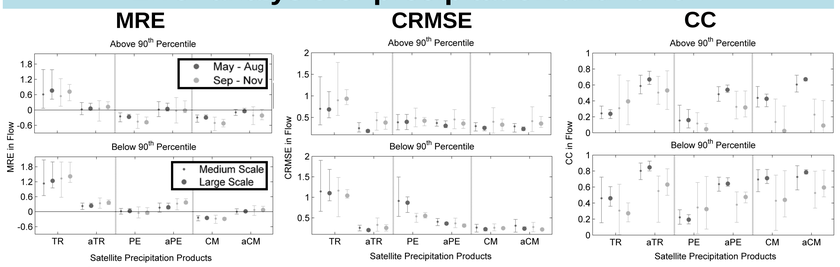
- Dense rain gauge network (65km²/gauge)
- Simulated hydrograph (13 sub-basins).
- Satellite products:

1. 3B42-RT-CCA [TR] & 3B42-V7 [aTR]
2. PERSIANN [PE] & adjusted PERSIANN [aPE]
3. CMORPH [CM] & adjusted CMORPH [aCM]
4. Kalman Filter-based CMORPH [hC] & adjusted Kalman Filter-based CMORPH [ahC]

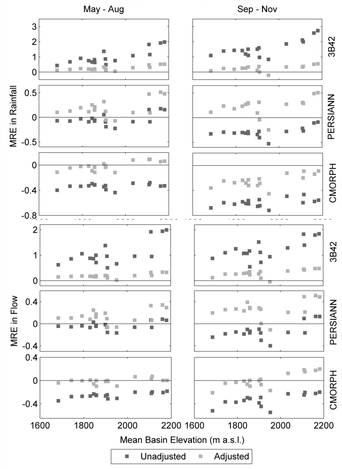




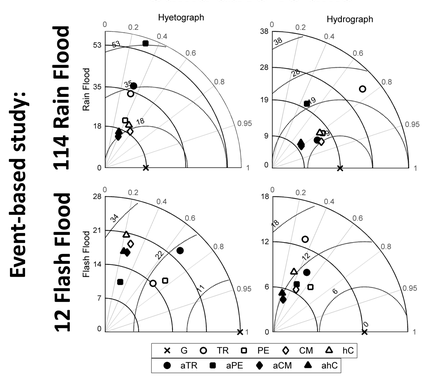
Error analysis of precipitation and runoff



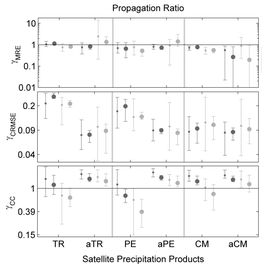
Elevation vs MRE



Cumulative Volume



Error Propagation



Summary

- Bias increase from underestimation to overestimation with elevation.
- The low to moderate flow rate have lower degree of systematic and random error and higher temporal similarity.
- Dampening effect is shown for the random error and most of the systematic error metrics.