

# Evaluation of Precipitation Amount Products in Mid-Atlantic and Southern New England



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## Motivation and Objective

Precipitation is a driving force for the water cycle and is one of the key sources of weather extremes. The changing global climate and consequent increase in extreme weather causes life to become more reliant on precipitation. The drought in Maryland is evident, as only 48 mm (1.9”) of rainfall fell during the first 50 days of Summer 2024. This information is based on a gauge report at Baltimore Washington International airport. Unfortunately, most of the global land is not equipped with precipitation measuring devices. This is due to topography, land use coverage, cost, and remoteness. With the addition of global ocean coverage (>70%), precipitation climatology relies on spaceborne precipitation retrievals and model outputs. NASA's Global Precipitation Measurement (GPM) ground validation program has been deploying Platforms for In situ Estimation Rainfall Systems (PIERS) at granted institutes across the US. This study uses seven PIERS+ sites which include a PARSIVEL disdrometer and two tipping bucket gauges. The sites are in the Mid-Atlantic region with an additional site in Connecticut. The study focuses on event rainfall totals for January to May 2024.

## Introduction

### Total Site Locations

NASA GSFC  
PIERS 0041  
38.992, -76.840

UMES  
PIERS 0026  
38.211, -75.677

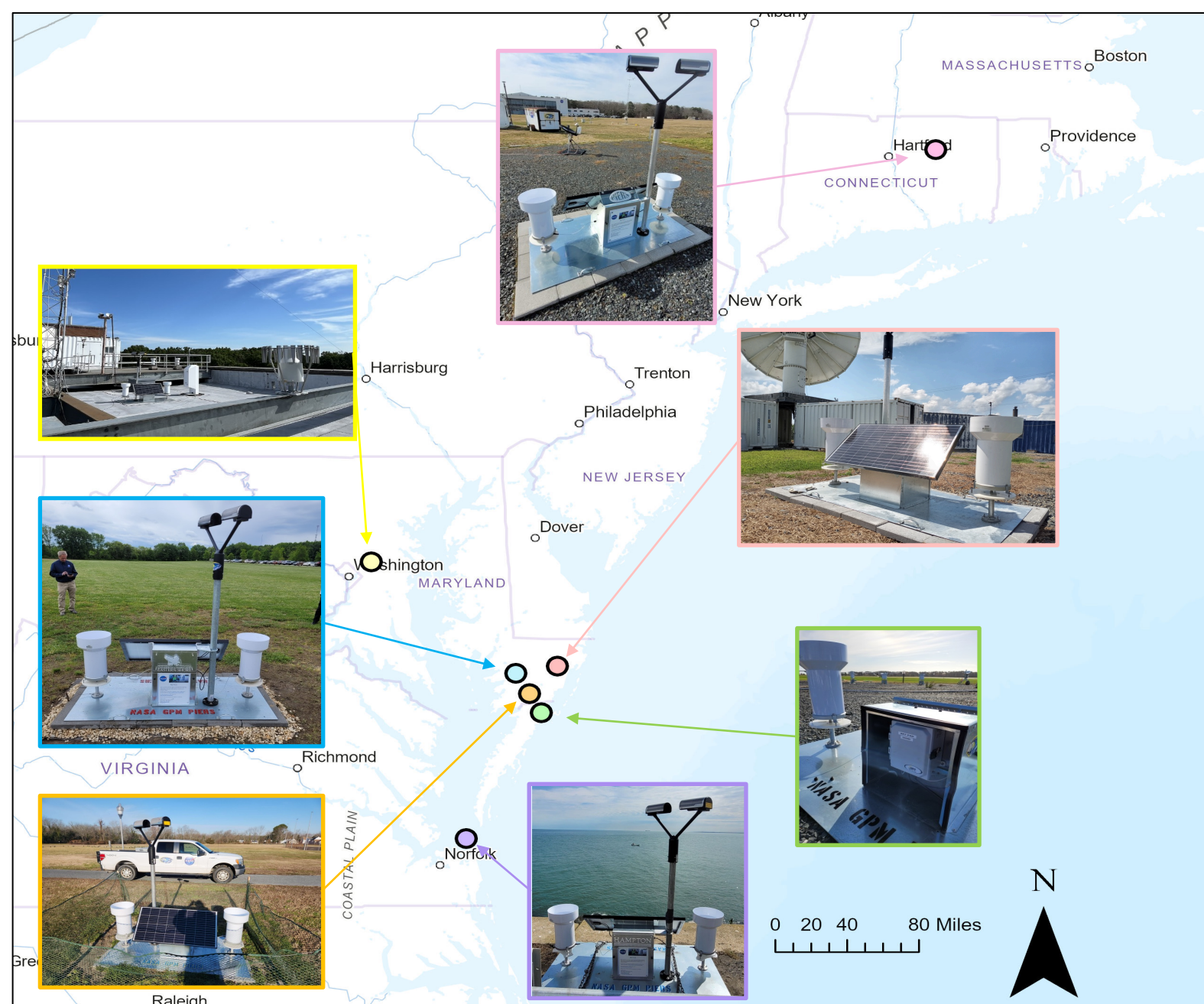
Pocomoke  
PIERS 0011  
38.067, -75.566

UConn  
APU27, APU28  
41.809 -72.295

Newark  
PIERS0039  
38.262, -75.341

Wallops  
PIERS0042  
37.9344, -75.470

Hampton  
PIERS0038  
37.036, -76.076



### UConn Site



PIERS+ site including a PARSIVEL disdrometer and two tipping bucket gauges on the same platform



### Ground Instrumentation



PARSIVEL (Partial Size Velocity) Disdromter

- Laser optical disdrometer (650nm)
- Measures particle size, fall velocity, and concentration



Tipping Bucket (TB)

- Excellent at measuring total rainfall



Pluvio Weighing Bucket

- Excellent at measuring non-rain precipitation due to having antifreeze

## Acknowledgements

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## Methodology

### Determining Rain Events

There must be at least 3 hours of no rain in between rain events, at least 2 mm of rain recorded by the PARSIVEL and other ground instruments detect rainfall, and there must only be rain precipitation (no snow or mixed precipitation).

### Statistics

$$\text{Correlation Coefficient (CC)} = \frac{\Sigma(\text{RT ref} - \text{avg}(\text{RT ref}))(\text{RT est} - \text{avg}(\text{RT est}))}{\sqrt{(\Sigma(\text{RT ref} - \text{avg}(\text{RT ref}))^2)(\text{RT est} - \text{avg}(\text{RT est}))^2}}$$

$$\text{Bias} = \frac{\Sigma(\text{RT ref} - \text{RT est})}{\Sigma \text{RT est}}$$

$$\text{Bias} = \frac{\Sigma(\text{RT ref} - \text{RT est})}{\frac{\Sigma \text{RT ref} + \text{RT est}}{2}}$$

$$\text{Mean Absolute Error (MAE)} = \frac{\Sigma |(\text{RT ref} - \text{RT est})|}{\Sigma \text{RT est}}$$

$$\text{Mean Absolute Error (MAE)} = \frac{\Sigma |(\text{RT ref} - \text{RT est})|}{\frac{\Sigma \text{RT ref} + \text{RT est}}{2}}$$

### Mean Absolute Error Interpretation

Ground Instrumentation MAE (%):

0-5: Excellent; 6-10: Very Good; 11-15: Good; 16-20: Reasonable; >20: Poor

Product MAE (%):

0-10: Excellent; 11-20: Very Good; 21-30: Good; 31-40: Reasonable; >40: Poor

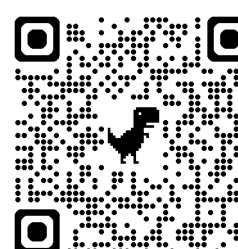
## Summary & Future Research

This project analyzes rain total data collected by ground instrumentation, consisting of the PARSIVEL disdrometer, tipping bucket and pluvio weighing bucket gauges. The ground instrumentation rain total data is then compared to the product data to show the accuracy of the products. The products analyzed in this product consist of MRMS, HRRR, ERA5, and MERRA2. There are six sites in the mid-Atlantic region and one site in Connecticut. To show a more in-depth view of the research, this poster only focuses on the Connecticut site. Currently, overall conclusions cannot be made of the products estimations because data is still being analyzed at the other six sites. Looking exclusively at the Connecticut site, HRRR, ERA5 and MERRA2 are underestimating total rainfall and MRMS is slightly overestimating total rainfall. Future research for this project consists of analyzing IMERG data compared to the ground instrumentation once this data becomes available.

## Contact Information

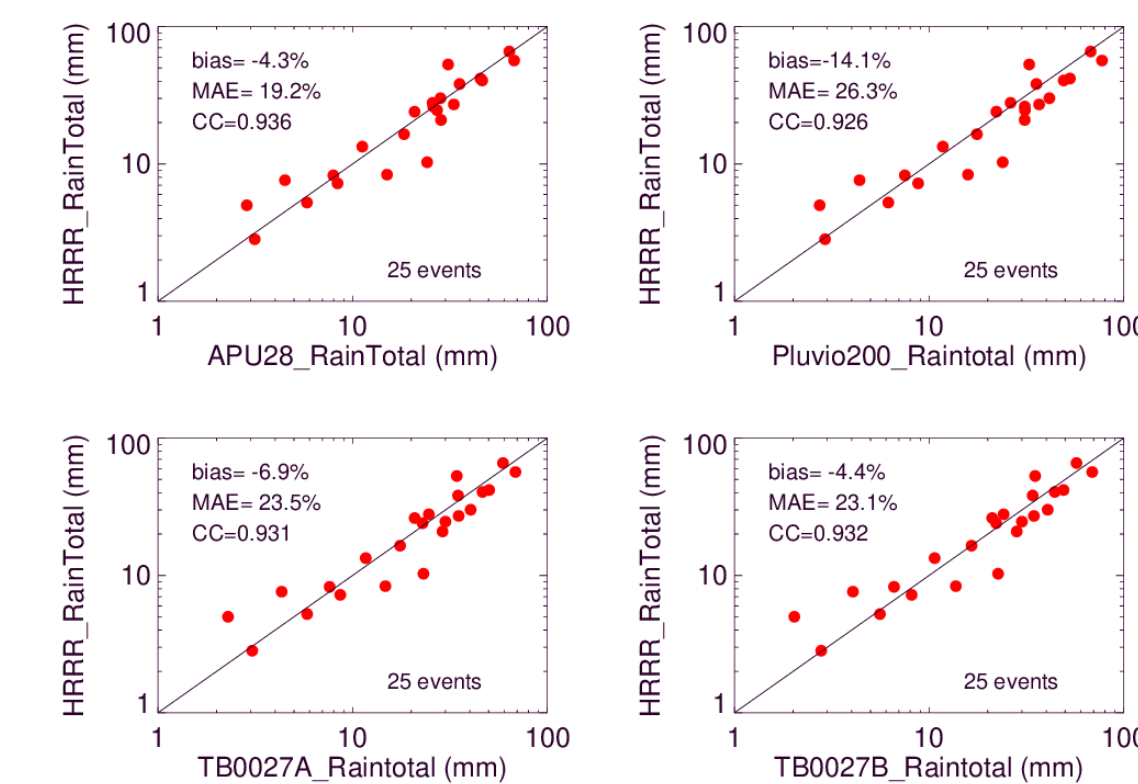


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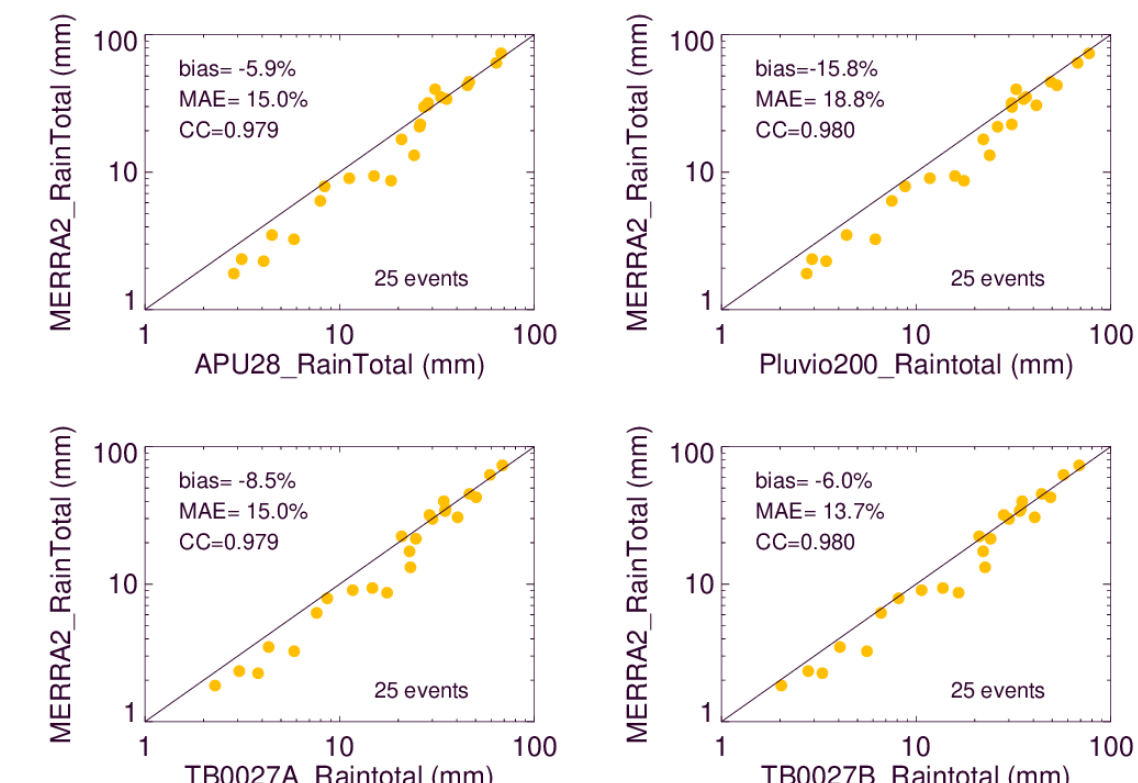


## Charts

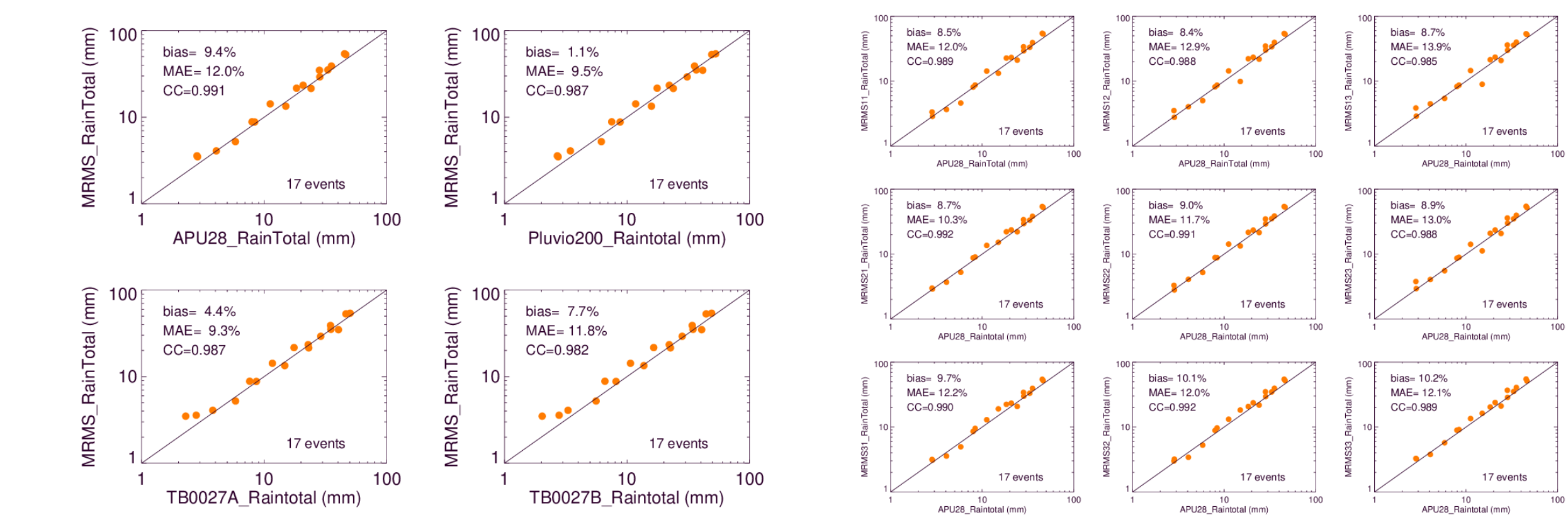
**Ground Instrumentation:** Comparison of ground instrumentation at the University of Connecticut, Connecticut site. Ground instrumentation included in this comparison consist of PARSIVEL (APU28), Pluvio (Pluvio200), and two tipping buckets (TB27A, TB27B).



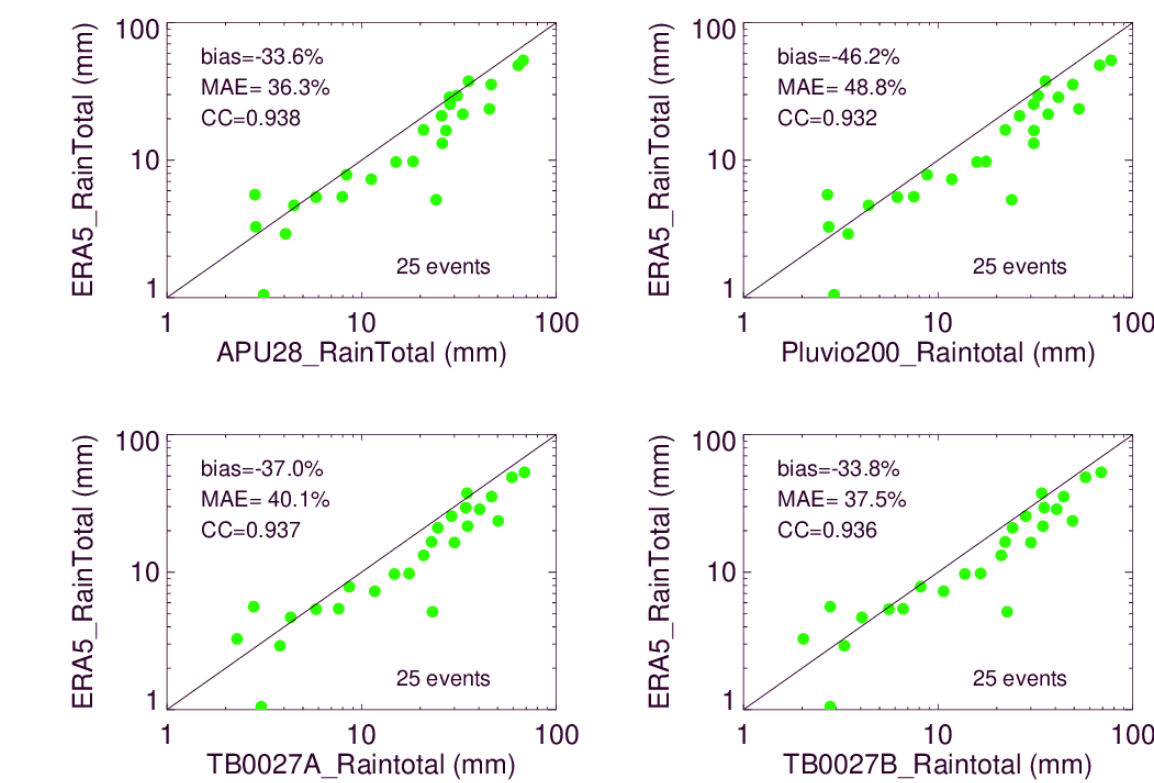
**European Centre for Medium-Range Weather Forecasts (ECMWF) Reanalysis v5 (ERA5):** ERA5 is produced by the Copernicus Climate Change Service (C3S) at ECMWF. ERA5 has a spatial resolution of 25 km and temporal resolution of 1 hr.



**Multi-Radar Multi-Sensor (MRMS):** The NOAA's Multi-Radar Multi-Sensor (MRMS) product has been widely employed to validate satellite and model precipitation estimates among many other applications. MRMS has a spatial resolution of 0.1 degree (~1 km) and temporal resolution of 2 min, although a 30 min resolution was used for this project.



**High Resolution Rapid Refresh (HRRR):** HRRR is a model that covers the continental United States and Alaska. HRRR was created by the National Oceanic and Atmospheric Association (NOAA)/National Centers for Environmental Prediction (NCEP). HRRR has a spatial resolution of 3 km and temporal resolution of 1 hr.



**Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA2):** MERRA2 is produced by NASA's Global Modeling and Assimilation Office (GMAO) at NASA Goddard Space Flight Center. MERRA2 has a spatial resolution of 0.5 degree x 0.625 degree (~50 km) and a temporal resolution of 1 hr.