

**Assessment of High-Latitude  
Global Precipitation Climatology Project (GPCP)  
Daily and Monthly Precipitation Estimates  
using Ground-Based Observations**

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## OBJECTIVE

Assess the quality of the Global Precipitation Climatology Project (GPCP) satellite-based high-latitude land precipitation estimates using dense rain gauge observations

## MOTIVATION

- To date, most ground validation analyses of satellite-based precipitation estimates have covered primarily the tropics and mid-latitudes
- Challenging to estimate precipitation from satellites at high latitudes as microwave and infrared sensors have difficulty distinguishing precipitation from cold land - how well are we (GPCP) really doing?
- Challenging to obtain dense, high-quality precipitation gauge observations at high latitudes
- Provide a framework for assessment and validation of the future Global Precipitation Mission (GPM) precipitation estimates

# DATASETS

Compare **GPCP One-Degree Daily (1DD)** satellite-based estimates with **Finnish Meteorological Institute (FMI)** gauge observations

- **GPCP 1DD Satellite Estimates**

- Satellite-based precipitation estimates ( $1^{\circ} \times 1^{\circ}$ , UTC day resolution)
- Tropics: Geo-IR calibrated by coincident DMSP SSM/I microwave estimates
- High Latitudes: TOVS/AIRS estimates calibrated by SSM/I occurrence and GPCP V2 SG monthly amount
- 1DD estimates scaled to sum to the  $2.5^{\circ} \times 2.5^{\circ}$  GPCP V2 Satellite-Gauge (SG) monthly product (using bilinear interpolation) for product suite consistency

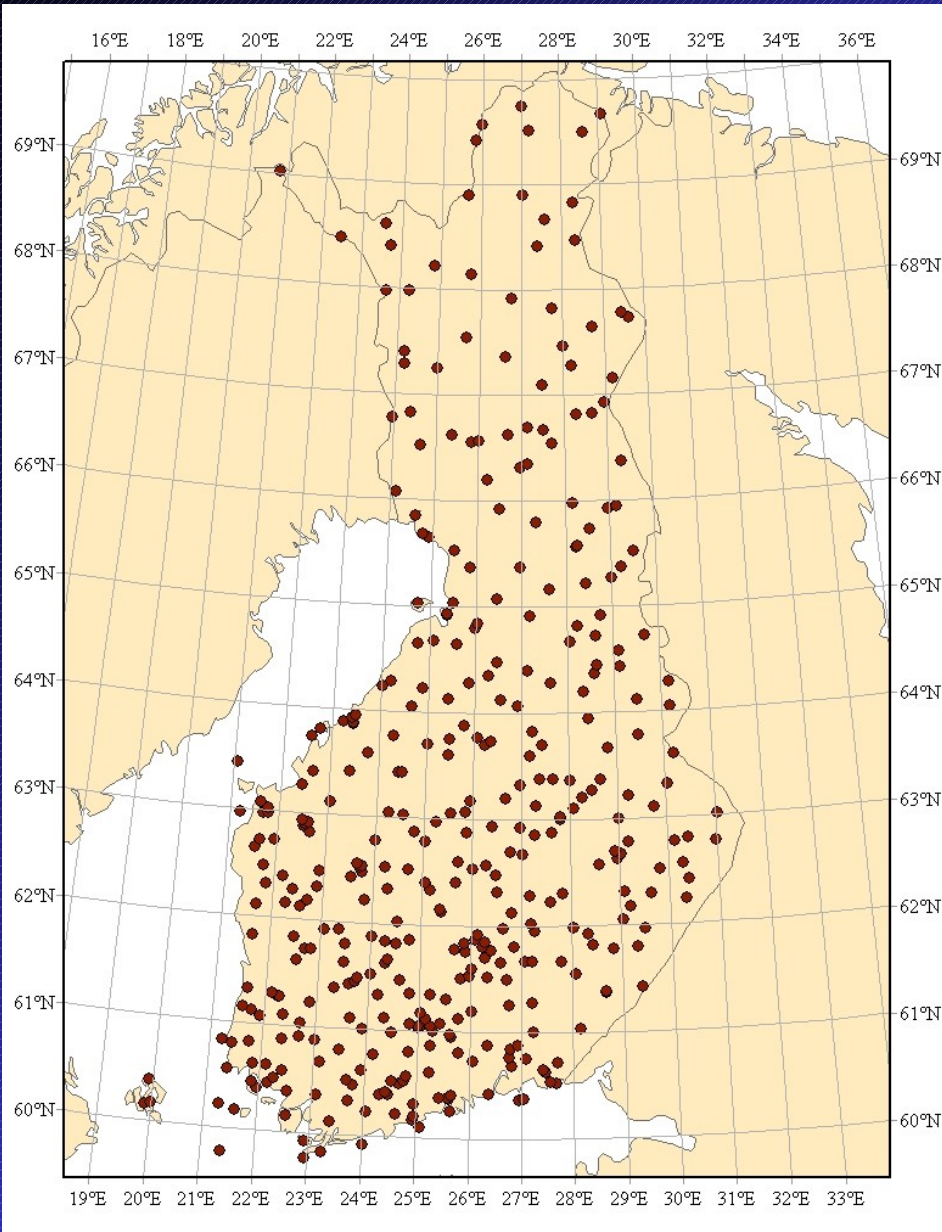
# DATASETS

Compare **GPCP One-Degree Daily (1DD)** satellite-based estimates with **Finnish Meteorological Institute (FMI)** gauge observations

- **FMI Gauge Observations**
  - Official Finnish government gauge network observations
  - Excellent quality control
  - Daily observations ending 00 UTC
  - Measures liquid and solid (liquid equivalent) precipitation
  - No wind-loss correction applied
  - Data courtesy of the Finnish Meteorological Institute

**Analysis span:** August 2005 - September 2006

# FMI GAUGE STATIONS



FMI gauge coverage for the period  
August 2005 - October 2007

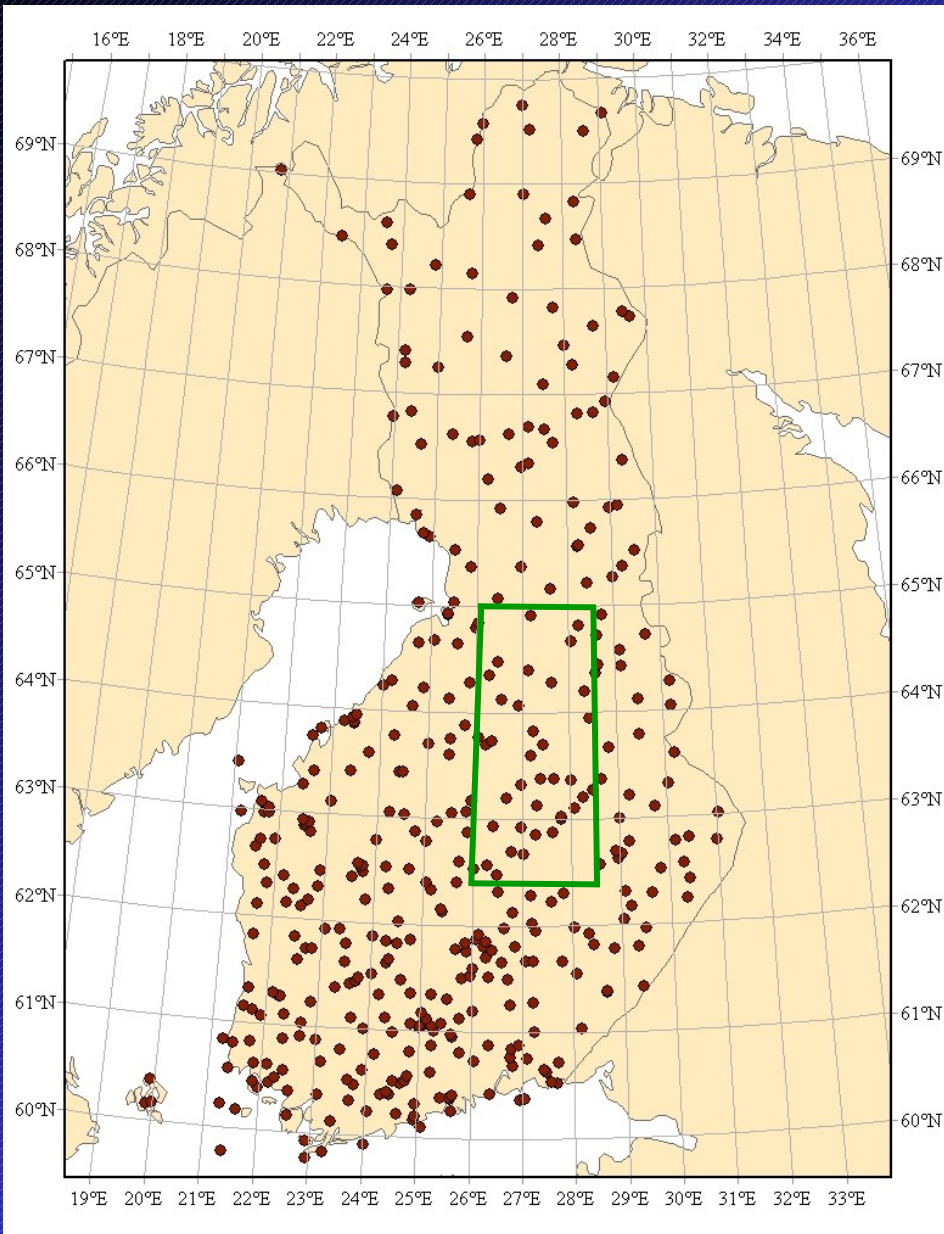
# RESULTS

Establish a “best you can do” baseline by comparing monthly FMI average precipitation with monthly GPCP V2 SG precipitation

Why is this a “best you can do” comparison?

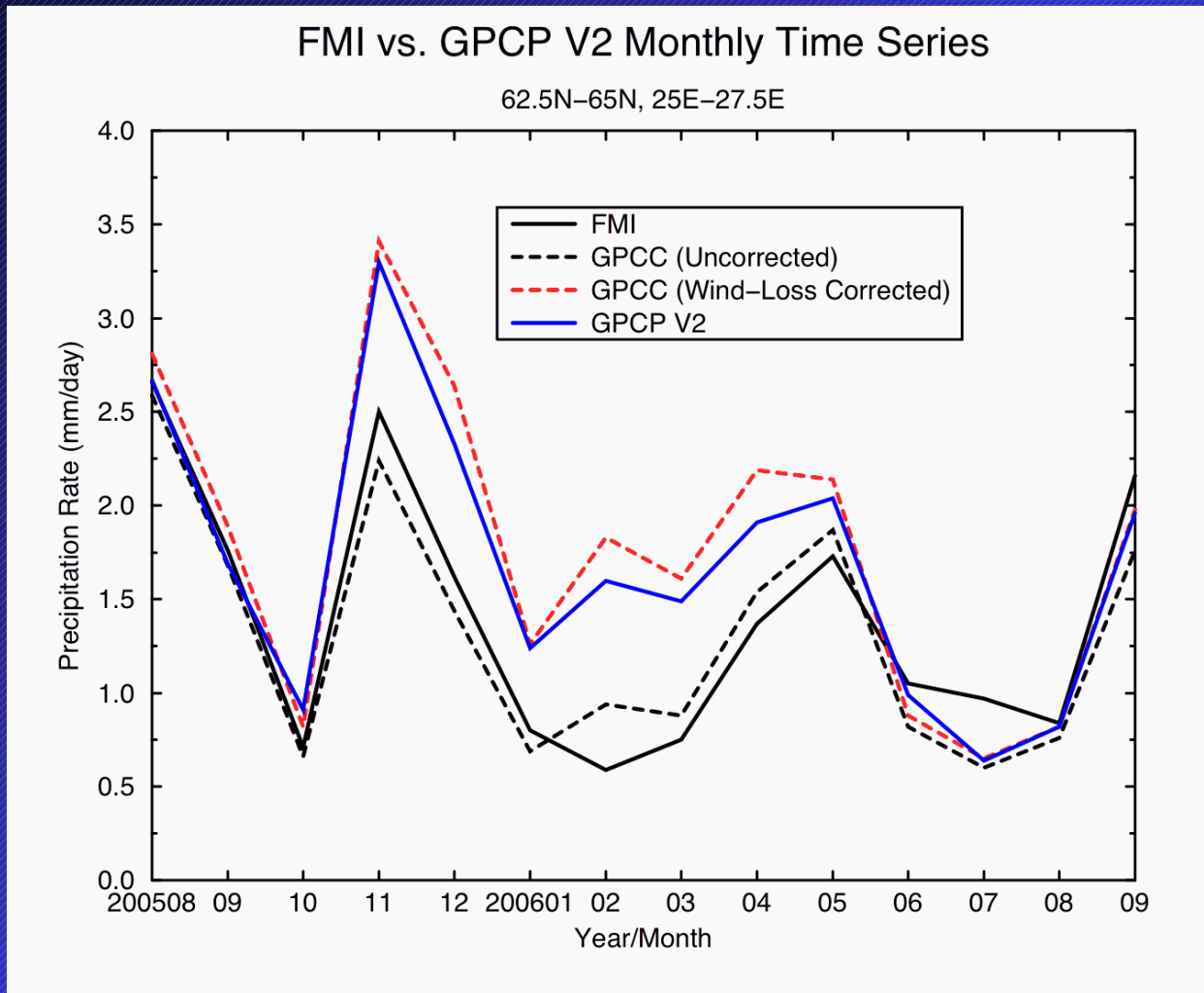
- 1DD estimates scaled to sum to the  $2.5^{\circ} \times 2.5^{\circ}$  GPCP V2 SG monthly product
- $2.5^{\circ} \times 2.5^{\circ}$  GPCP V2 SG monthly estimates heavily weighted by GPCC gauge analysis where available
- GPCC gauge analysis is provided and used at the  $2.5^{\circ} \times 2.5^{\circ}$  monthly resolution (likely to include a small subset of FMI observations)
- Use wind-loss correction (Legates & Willmott) as GPCC recommends
- In the current context, a “clean” comparison of  $2.5^{\circ} \times 2.5^{\circ}$  GPCC gauge analysis and 1DD estimates not possible due to difference in scale

# RESULTS



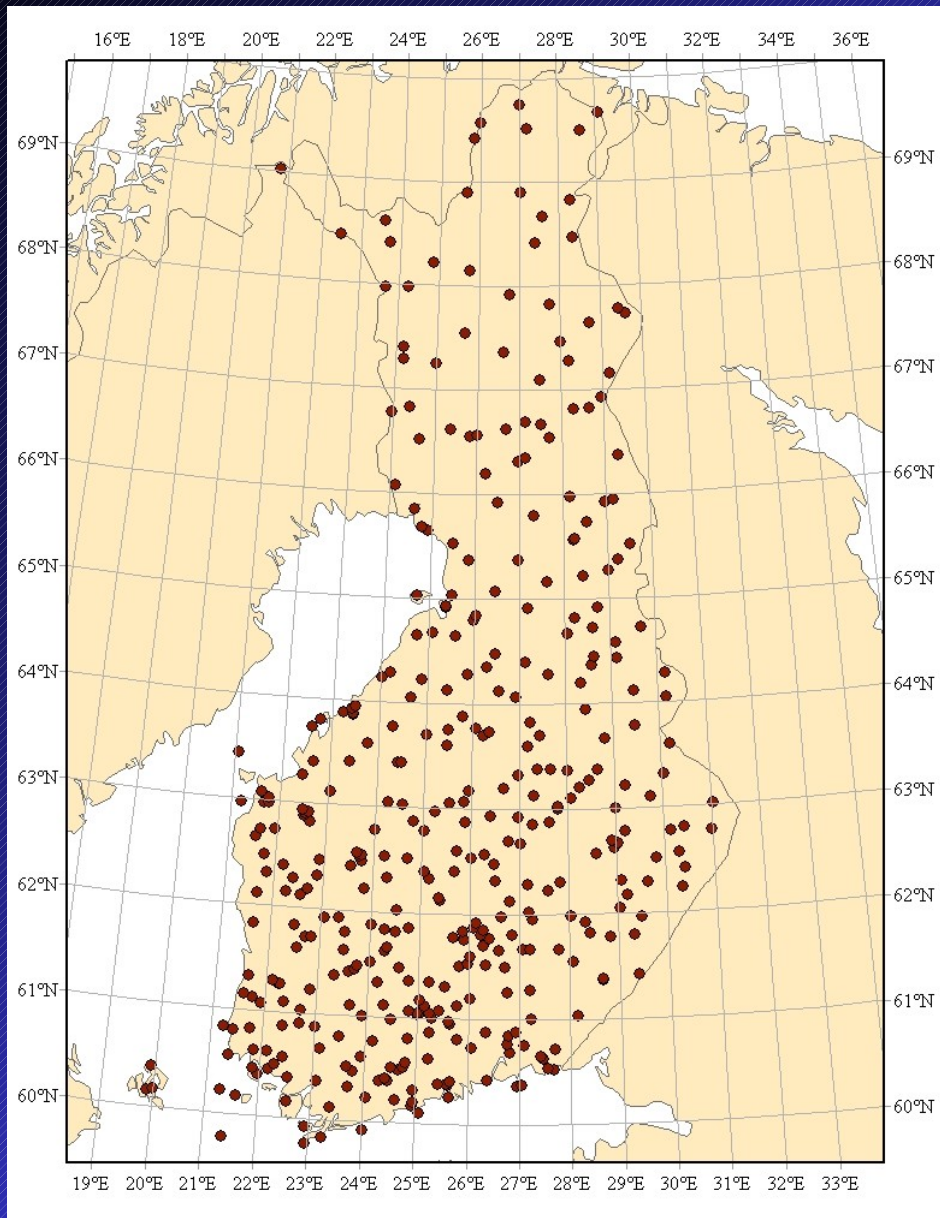
Generate GPCP vs. FMI Monthly  
Time Series Plot for a Single  
2.5°x2.5° Gridbox

# RESULTS



GPCP 1DD bias compared to FMI should closely follow the GPCP V2 SG bias, but day-to-day variations will exist

# RESULTS

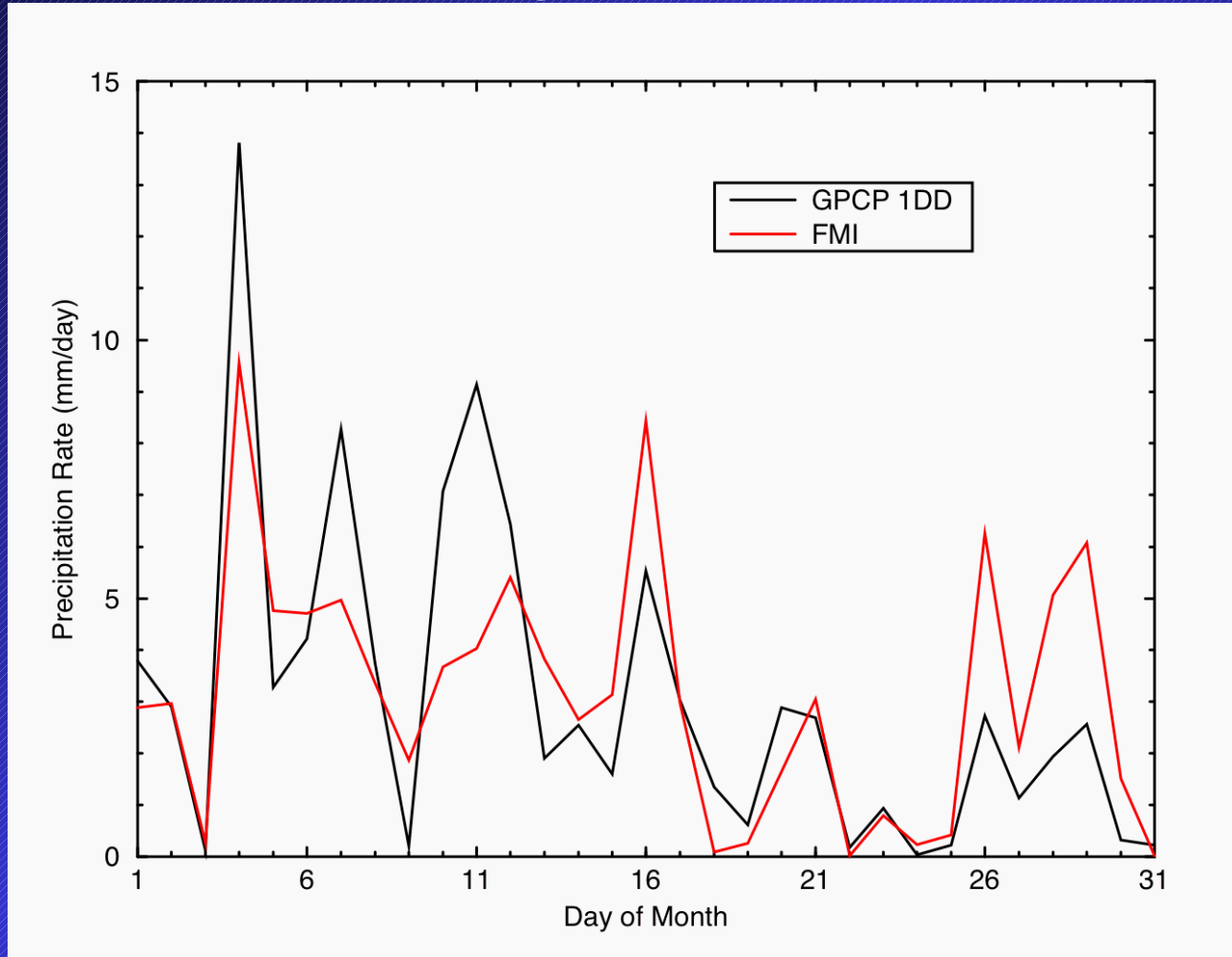


Generate GPCP 1DD vs. FMI Daily Time Series Plots for Selected Months Averaged Over the Entire FMI Domain (Finland)

# RESULTS

## GPCP 1DD vs. FMI Daily Time Series (Entire FMI Domain)

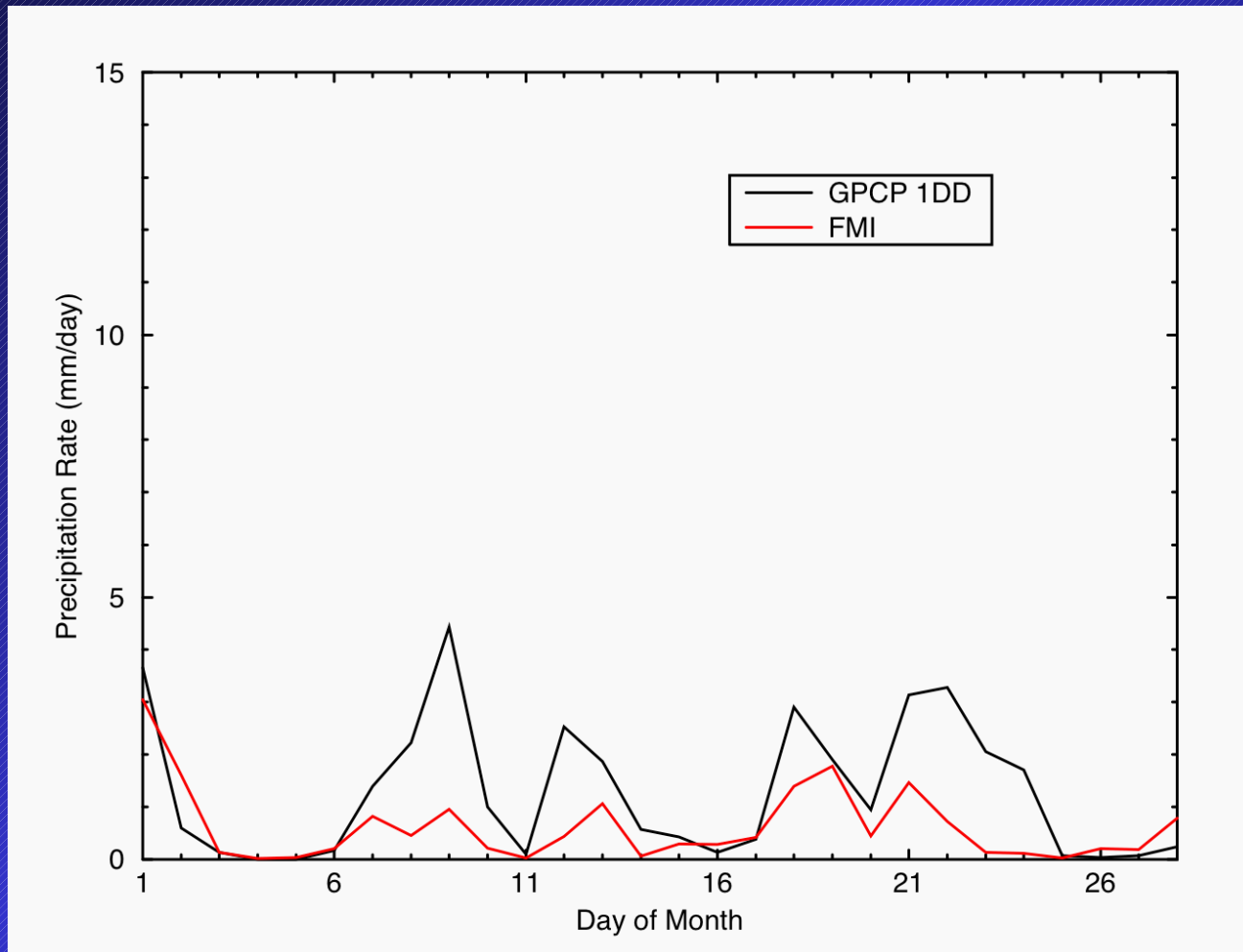
August 2005



# RESULTS

## GPCP 1DD vs. FMI Daily Time Series (Entire FMI Domain)

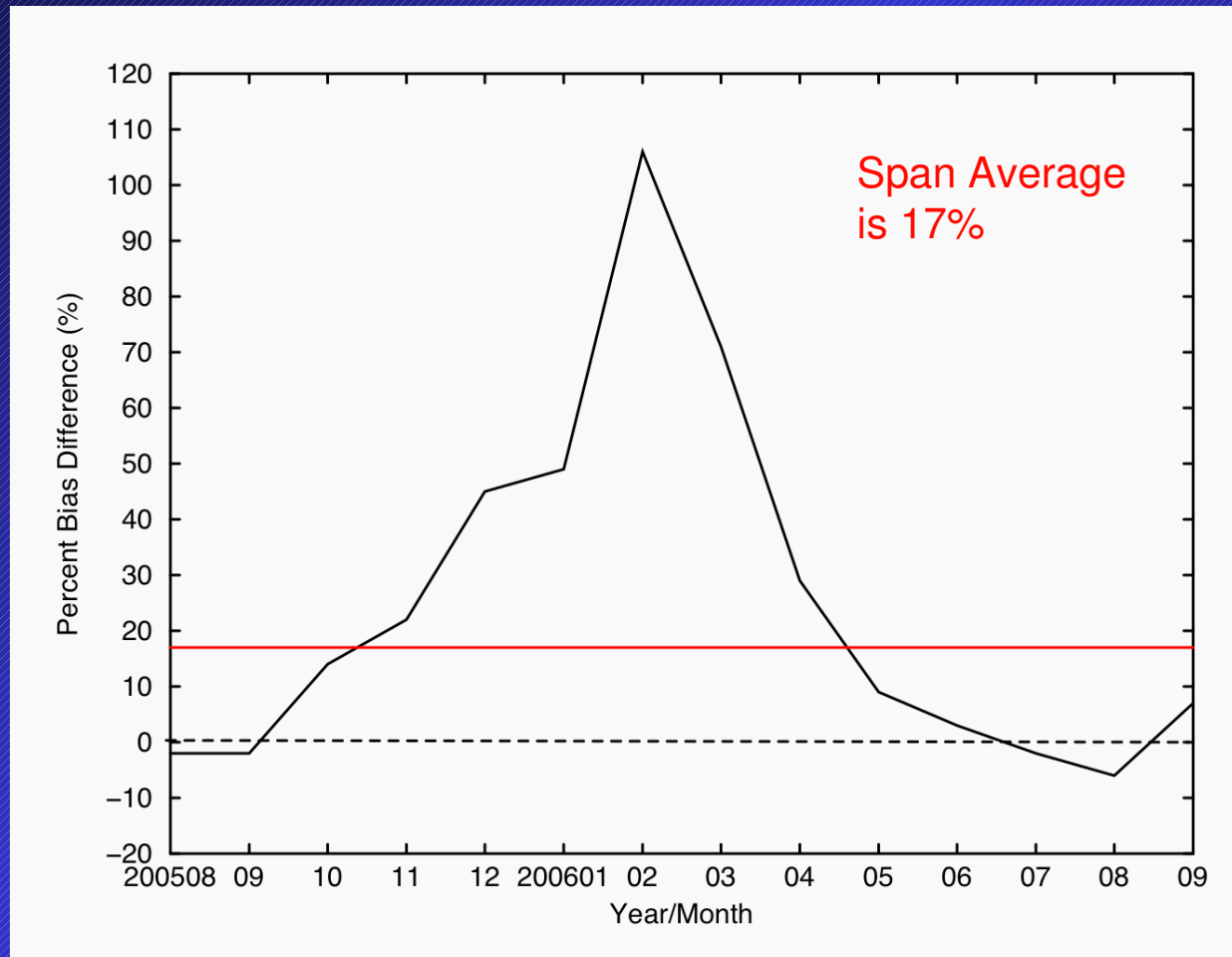
February 2006



# RESULTS

## Monthly Time-Series of Percent Bias Difference Between Monthly Average GPCP 1DD and FMI (over the entire FMI area)

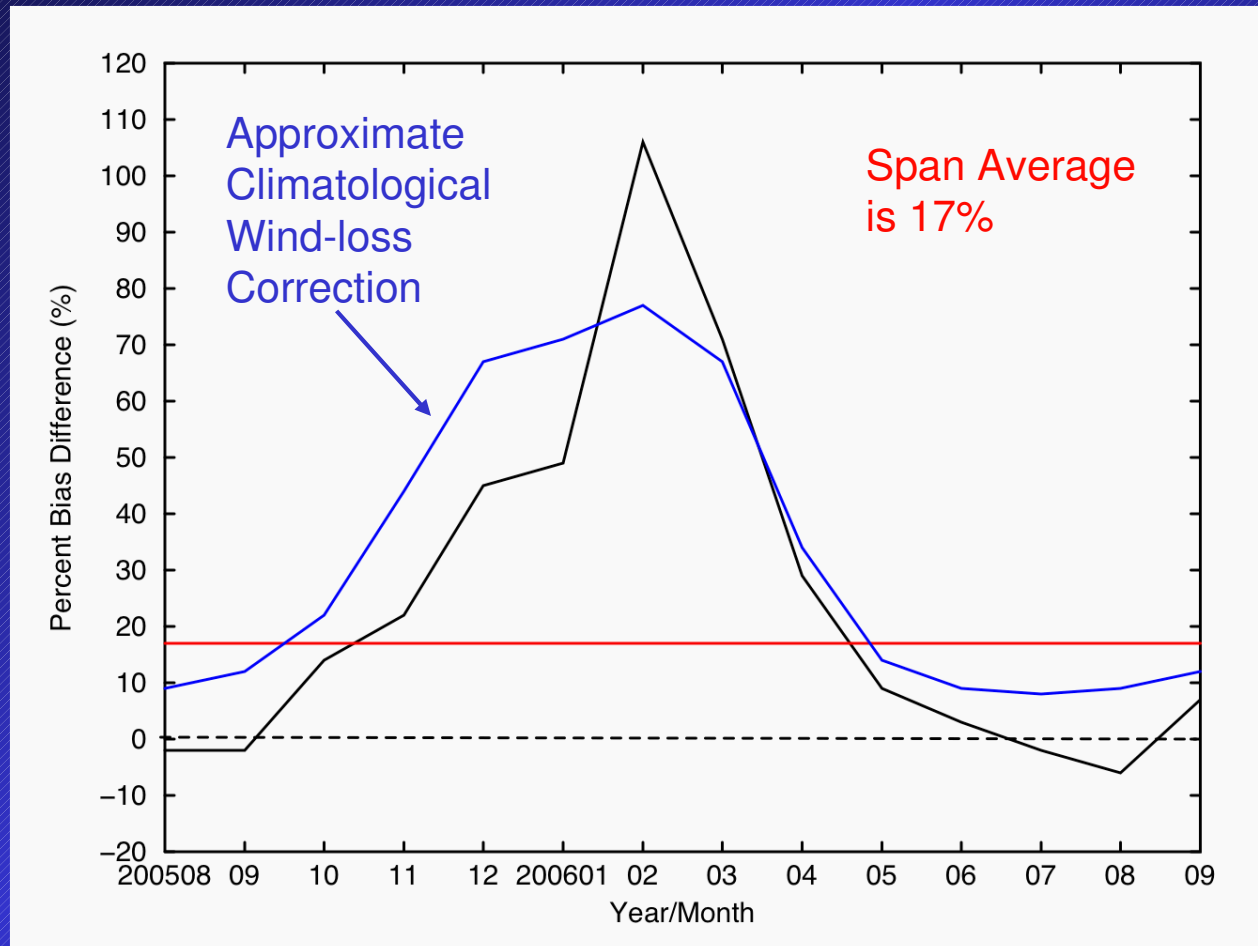
$$\text{Percent Bias Difference} = ((\text{GPCP 1DD} - \text{FMI}) / \text{FMI}) * 100$$



# RESULTS

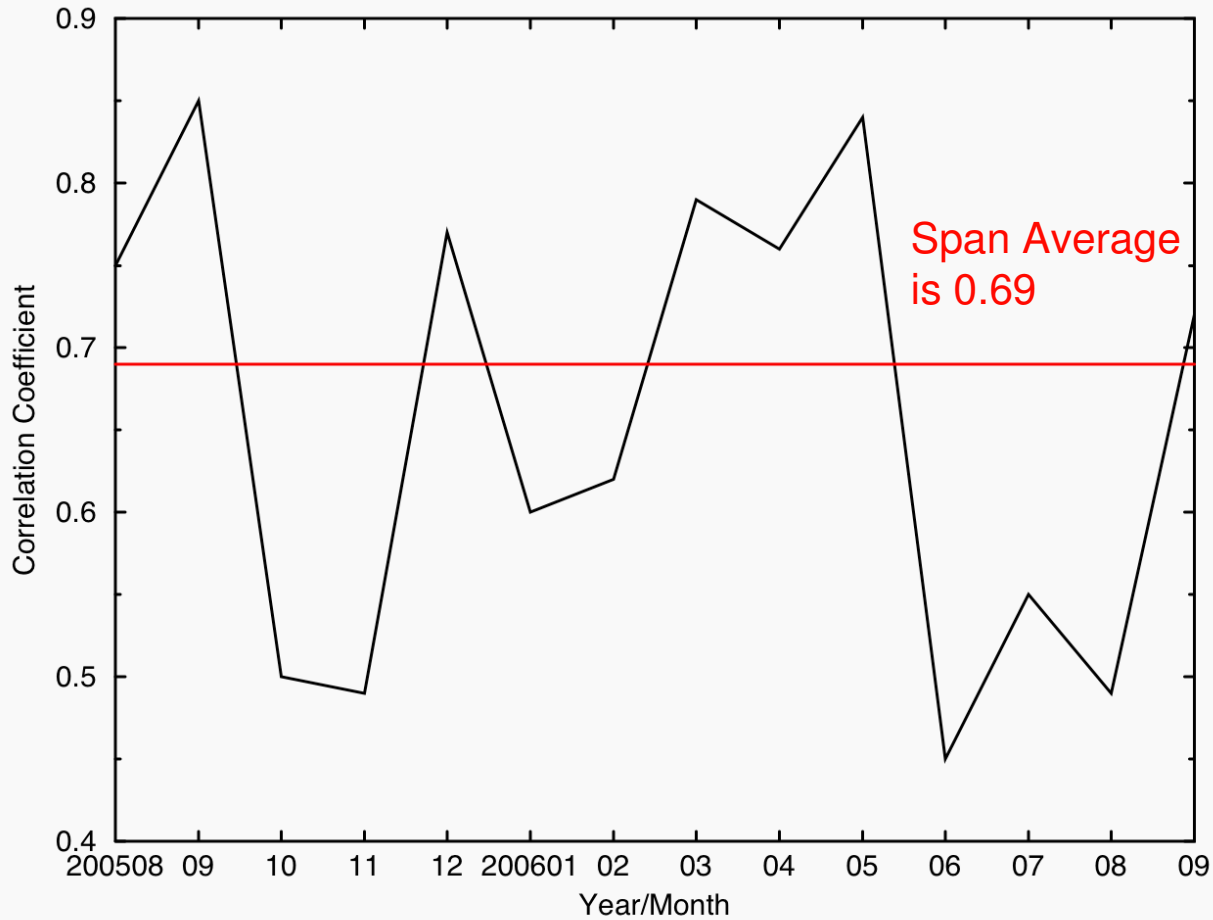
## Time-Series of Percent Bias Difference Between Monthly Average GPCP 1DD and FMI (over the entire FMI area)

$$\text{Percent Bias Difference} = ((\text{GPCP 1DD} - \text{FMI}) / \text{FMI}) * 100$$

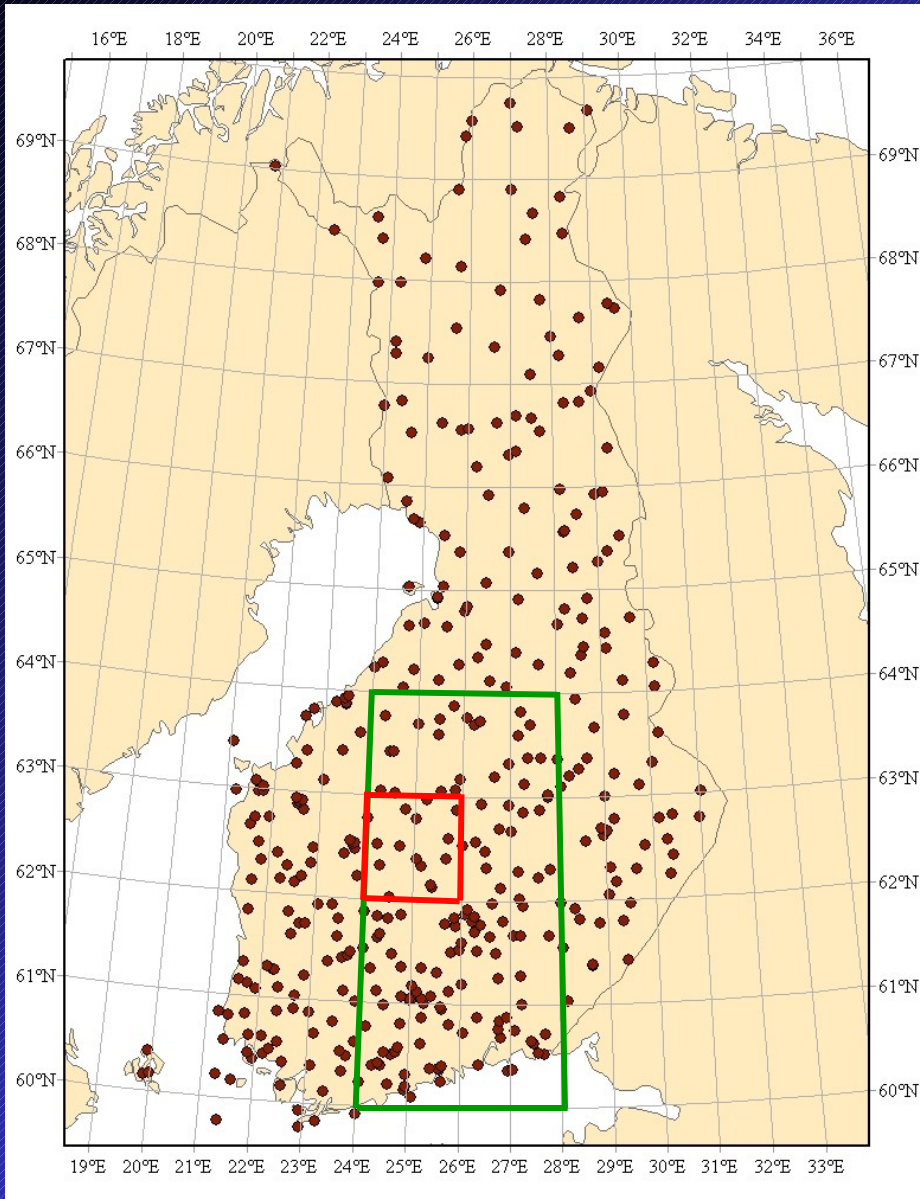


# RESULTS

## Time-Series of Monthly Correlation Coefficient Between Daily GPCP 1DD and FMI (over the entire FMI area)



# RESULTS

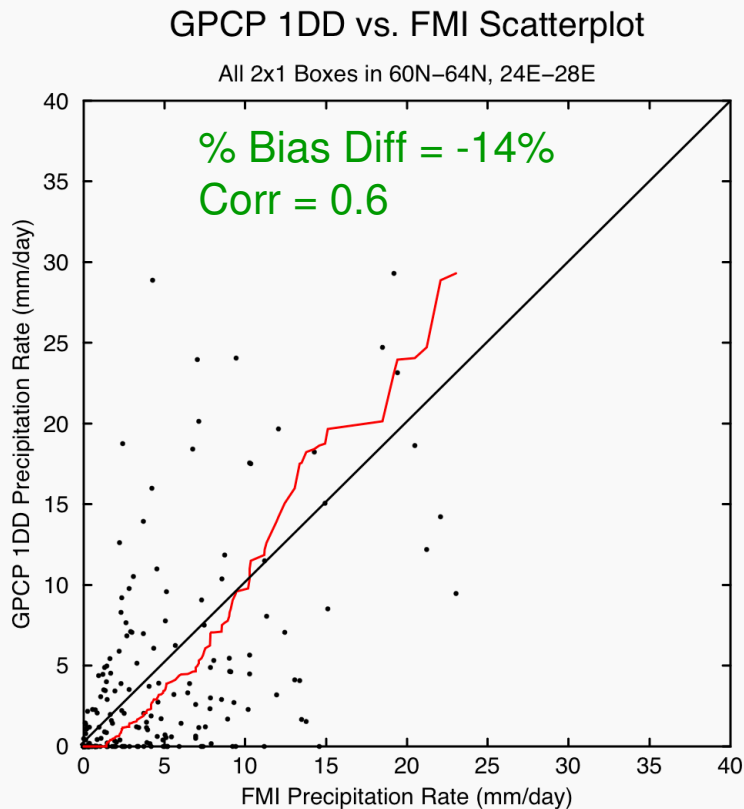


Compare GPCP 1DD vs. FMI at  
Smaller Spatial Scales

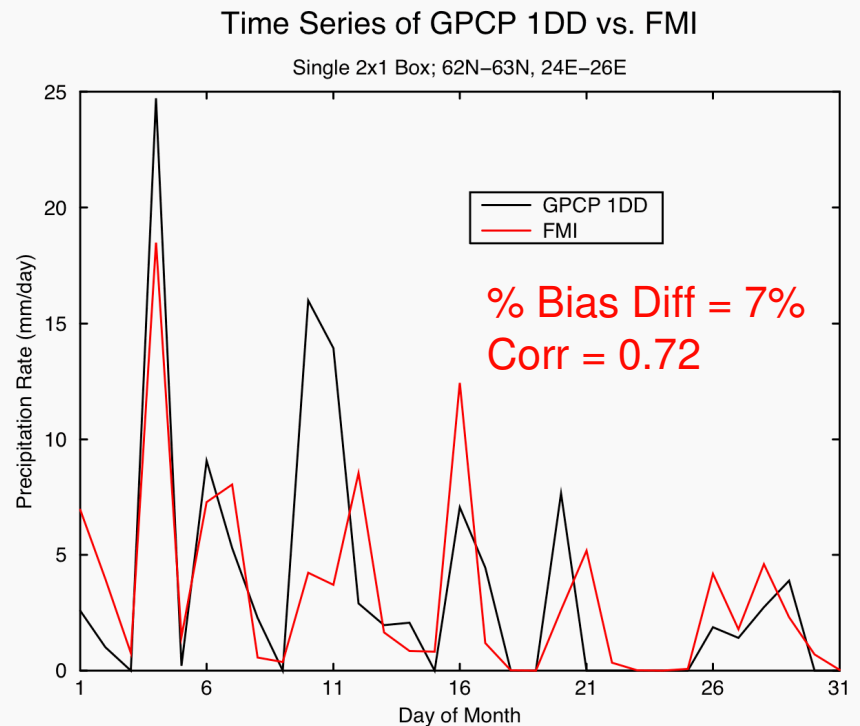
# RESULTS

August 2005

Scatterplot of all 8 Daily  $2^\circ \times 1^\circ$  Precipitation Values for the month within the  $4^\circ \times 4^\circ$  Green Box



Time Series of Daily Precipitation for the  $2^\circ \times 1^\circ$  Red Box



# CONCLUSIONS

- 2.5°x2.5° monthly average uncorrected GPCP gauge observations agree well (qualitatively) with FMI gauge observations
- Differences between 2.5°x2.5° monthly GPCP V2 SG estimates (which incorporate corrected GPCP analysis) and FMI observations are mostly due to wind-loss correction
- Because GPCP 1DD is scaled to sum to the 2.5°x2.5° monthly GPCP V2 SG estimates, see similar differences between 1DD and FMI
- Large-Scale Comparison
  - Percent bias difference follows a predictable annual cycle directly related to the wind-loss correction; GPCP 1DD exceeds FMI by 17%
  - Daily correlation coefficient does not exhibit a predictable annual cycle; average is relatively high at 0.69
- Preliminary small-scale comparisons show GPCP 1DD and FMI fairly well correlated, indicating that GPCP 1DD shows skill at smaller scales

## FUTURE WORK

- This is really just the beginning of a longer term effort
- Continue investigating the quality of the GPCP 1DD at small spatial scales
- Analyze GPCP 1DD versus FMI observation correlations as a function of time and space averaging
- Investigate secondary sources of differences between the GPCP 1DD and FMI
- Obtain and use other high-latitude gauge data sets for comparison in other regions (Canada, for example)
- Investigate new GPCC event-by-event wind-loss corrections
- Develop techniques to refine the GPCP V2 SG and 1DD high-latitude estimates