Comparison of GPCP 1DD Precipitation Product Using NEXRAD Q2 Precipitation Estimates over the CONUS

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Introduction/Motivation

- Improvements in satellite retrievals make it possible for researchers to develop global precipitation products with finer resolution. These precipitation estimates are critical for studying climate change and hydrologic cycle, and verifying numerical model simulations. However, satellite-based estimates are associated with errors from sampling, merging algorithms and satellite instruments.
- Ground-based radar retrievals can provide instantaneous precipitation estimates at high temporal and spatial resolution, but these estimates have problems with variations of Z-R relationship, beam attenuations, ground clutter issues.
- The comparison of satellite-based Global Precipitation Climatology Project One Degree Daily (GPCP 1DD) estimates with radar-based National Mosaic and Multi-Sensor Next Generation Quantitative Precipitation Estimation System (NMQ Q2) estimates will provide insight into the limitations, advantages and seasonal tendencies of each dataset over a large climatologically diverse region.

Data and Methodology

GPCP

Native Resolution: $1^{\circ}\times1^{\circ}$, daily

40°N-40°S: rainfall estimates are computed by the Threshold-Matched Precipitation Index (TMPI) using infrared (IR) data from geostationary satellites and calibrated by Special Sensor Microwave Imager (SSM/I) retrievals.

Outside 40° latitudes: rainfall estimates are computed by the rescaled Television and Infrared Observation Satellite (TIROS) Operational Vertical Sounder TOVS from polar-orbiting satellites.

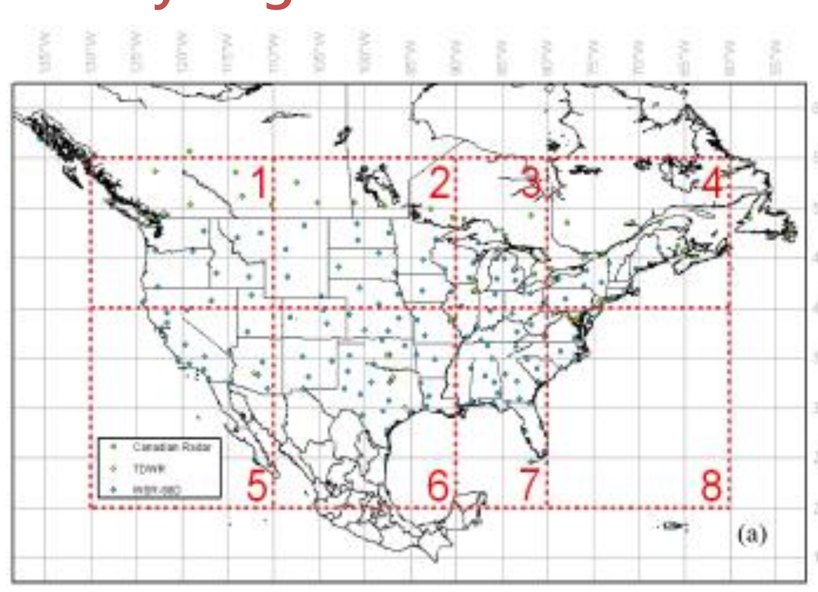
Q2

Native Resolution: 1km$\times$1km, 1hr accumulated.

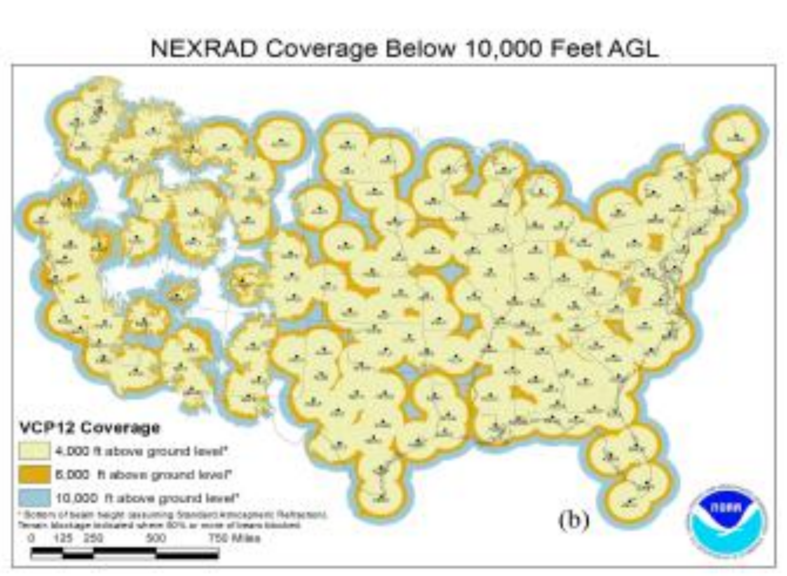
Sum the hourly data to daily and rescaled to $1^{\circ}\times1^{\circ}$ to match the GPCP 1DD.

Radar reflectivity→Precipitation type (i.e., convective, straitform, warm rain, snow) →Z-R relationship corresponds to the classification→Precipitation estimates

Study Region



(a) NMQ Domain divided into 8 tiles



(b)NEXRAD Coverage Map

Tiles 1 and 5 were excluded because of significant beam blockages over the mountainous regions.

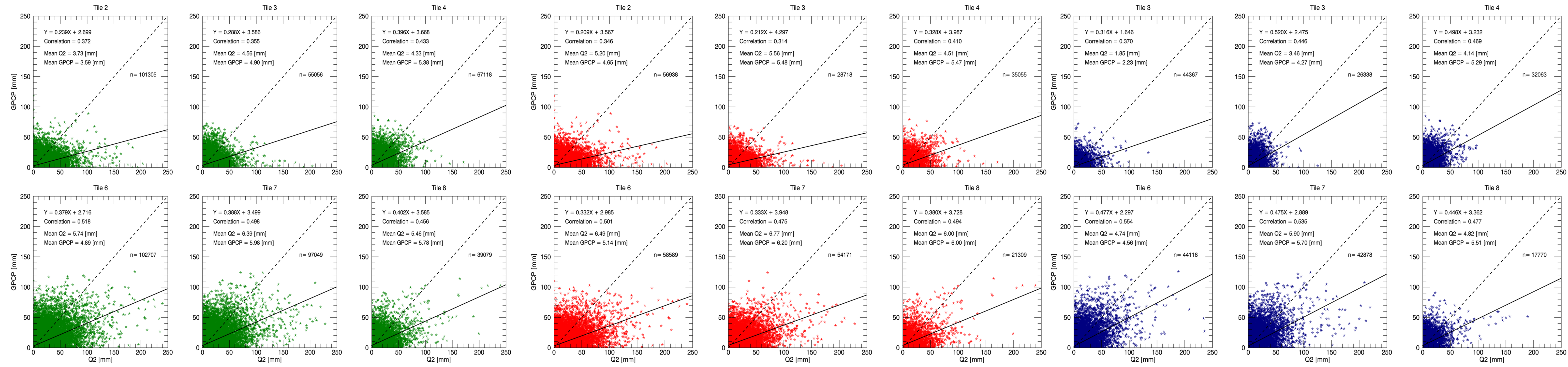
Tile 2: 40° N-60° N, 105° W-90° W Tile 3: 40° N-60° N, 90° W-80° W
Tile 4: 40° N-60° N, 80° W-60° W Tile 6: 20° N-40° N, 105° W-90° W
Tile 7: 20° N-40° N, 90° W-80° W Tile 8: 20° N-40° N, 80° W-60° W

- Concurring grid cells with zero accumulated precipitation are eliminated.
- Monthly and annual accumulated precipitation are calculated by simply summing the daily estimates.
- Spatial average precipitation were computed for daily and monthly estimates by adding up precipitation values of grid boxes within the tile and divided by the total number of grid boxes.
- Comparisons were conducted for both warm season (April – September) and cold season (October – March).

Results and Discussions

Daily estimates

All Seasons | Warm Season | Cold Season



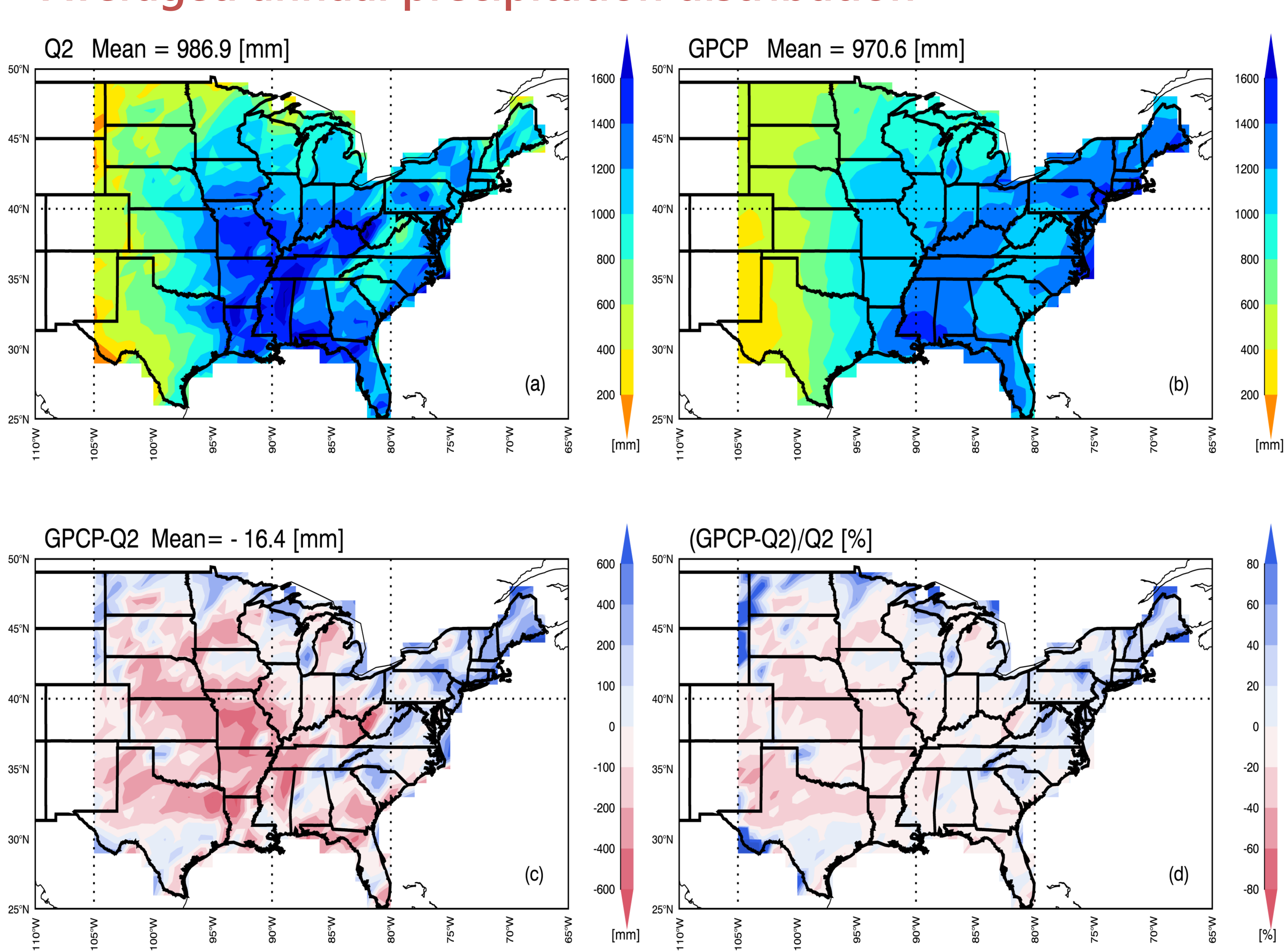
Monthly and annual estimates

Correlations for Monthly and annual analysis

		Tile 2	Tile 3	Tile 4	Tile 6	Tile 7	Tile 8
Monthly	All	0.784	0.680	0.603	0.781	0.744	0.683
	Warm	0.696	0.649	0.614	0.747	0.708	0.665
	Cold	0.678	0.634	0.577	0.808	0.752	0.626
Annual	All	0.790	0.686	0.418	0.887	0.553	0.511
	Warm	0.765	0.693	0.621	0.819	0.570	0.625
	Cold	0.763	0.626	0.277	0.895	0.646	0.440

- GPCP > Q2: Tiles 2, 6, 7, 8 GPCP < Q2: Tiles 3, 4.
- Compared to Q2, GPCP 1DD estimates capture fewer intense precipitation events, especially during warm season.
- Cold season correlations were higher than those of warm season for daily analysis.
- Correlations increased from daily to monthly analysis, but in some tiles decreased from monthly to annual analysis.
- Highest correlations were found in tile 6 for both warm and cold seasons comparing to other tiles.

Averaged annual precipitation distribution



- GPCP estimates are 1.7% less than Q2 estimates for the CONUS with large regional differences.
- Q2 estimates are much larger than GPCP over central US, and for some regions up to 400 mm.
- Q2 estimates are lower than GPCP in northern and northeastern US.

Summary

- For daily estimates, the differences between Q2 and GPCP vary from -0.85 mm to 1.05 mm. The differences are reduced and correlations are increased for monthly and annual means.
- Compared to Q2, GPCP captures fewer intense precipitation events, especially during warm season. In other words, Q2 may have a wet bias for these intense precipitation events due to its Z-R relationship.
- GPCP and Q2 show similar spatial distribution pattern but GPCP is too smooth near the complex terrain.
- Q2 estimates are much larger than GPCP over central US, but lower than GPCP in northern and northeastern US.

Spatial Averages

- Q2 and GPCP are well correlated due to the large scale averaging.

Correlations	Tile 2	Tile 3	Tile 4	Tile 6	Tile 7	Tile 8
Daily	0.710	0.657	0.746	0.757	0.782	0.789
Monthly	0.959	0.909	0.918	0.913	0.926	0.916