



Verifying FY-3B Level 2 Rain Rate Retrievals

Using Gauge Measurements of Minute-Rainfall over Eastern China

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Motivation

- Quantification of L2 PMW precipitation retrievals is important to both the improvements of L2 retrieval algorithms and the development of L2 integration systems
- Verification of L2 products is restricted by the availability of 'ground truth' matching the time/space scale of the satellite FOV
- Recent availability of station reports of minute-rainfall from a very dense AWS network over the eastern China provides a unique opportunity to examine the performance of L2 PMW precipitation retrievals

Objective

- To verify the L2 PMW precipitation retrievals from the Chinese FengYun(FY)-3B satellite over Eastern China

Time Period

- May – September, 2012-2013

FY-3B, MWRI and MWRI rain rate introduction



Launch date	Nov. 5, 2010
Orbit	sun-synchronous near-polar
Orbit height	836 km
Orbit period	101.6min.
Revisit period	about 6 days
Equator-crossing time	13:40
Inclination	98.75°

Microwave Radiation Imager(MWRI) Design Index

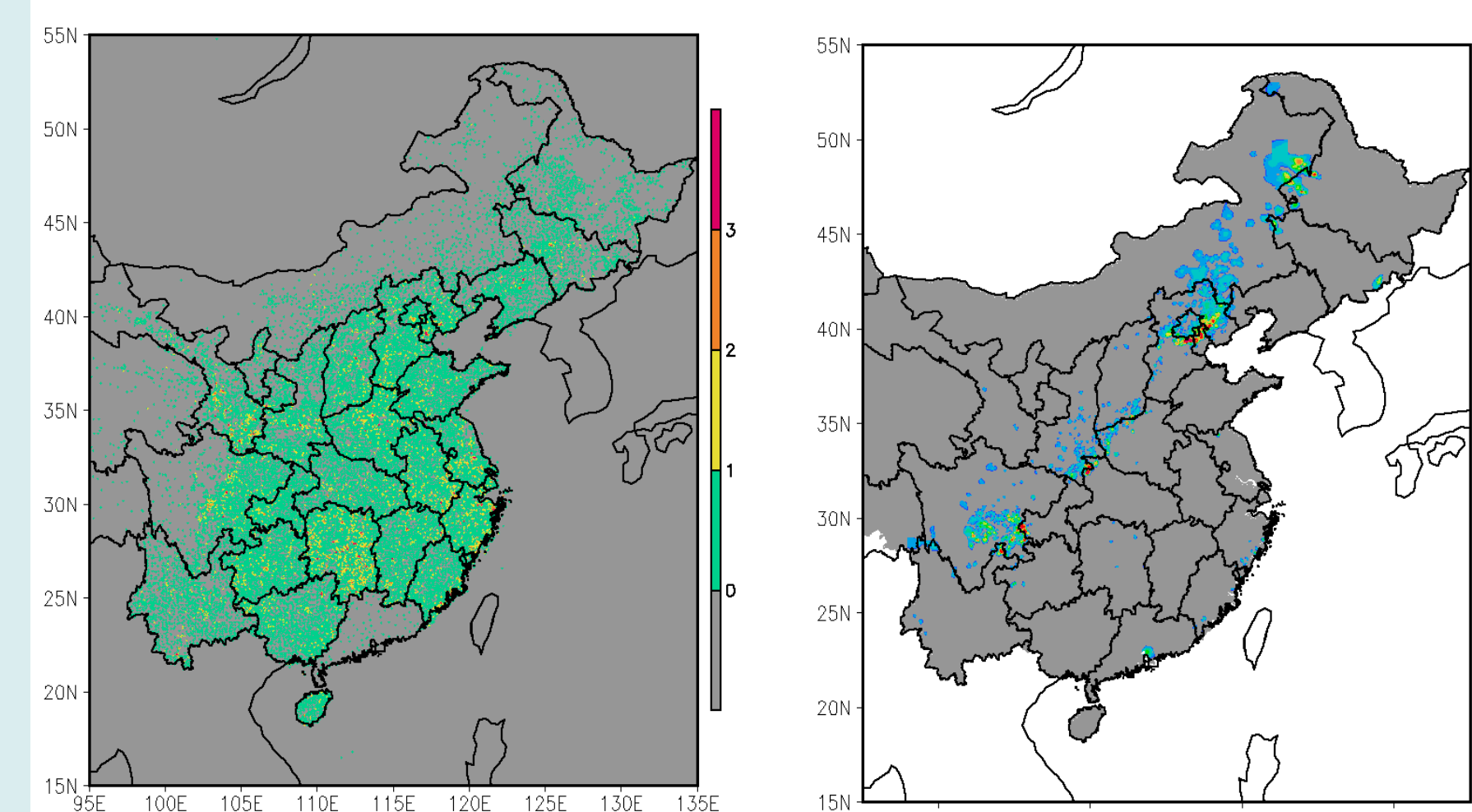
Frequency(GHz)	10.65	18.7	23.8	36.5	89
Polarisation	V/H	V/H	V/H	V/H	V/H
Resolution(km)	51x85	30x50	27x45	18x30	9x15

- Effective FOV for MWRI precipitation retrievals is considered ~ 25km
- L2 precipitation retrievals are derived from brightness temperatures from multiple PMW channels with a set of statistical relationship derived through calibration against precipitation retrievals from TRMM/PR, TMI, as well as surface observed HOURLY precipitation

Rainfall Analysis from the Chinese AWS Network

- The Chinese AWS network is currently composed of ~30K stations
- Analysis of 1-min rainfall is defined on a 0.05°lat/lon over eastern China through the algorithm of Shepard
- The 0.05°lat/lon analysis is assembled to define mean rain rate over each FOV and compared against the FY3B L2 Retrievals

20th minute of 15 GMT, July 21, 2012



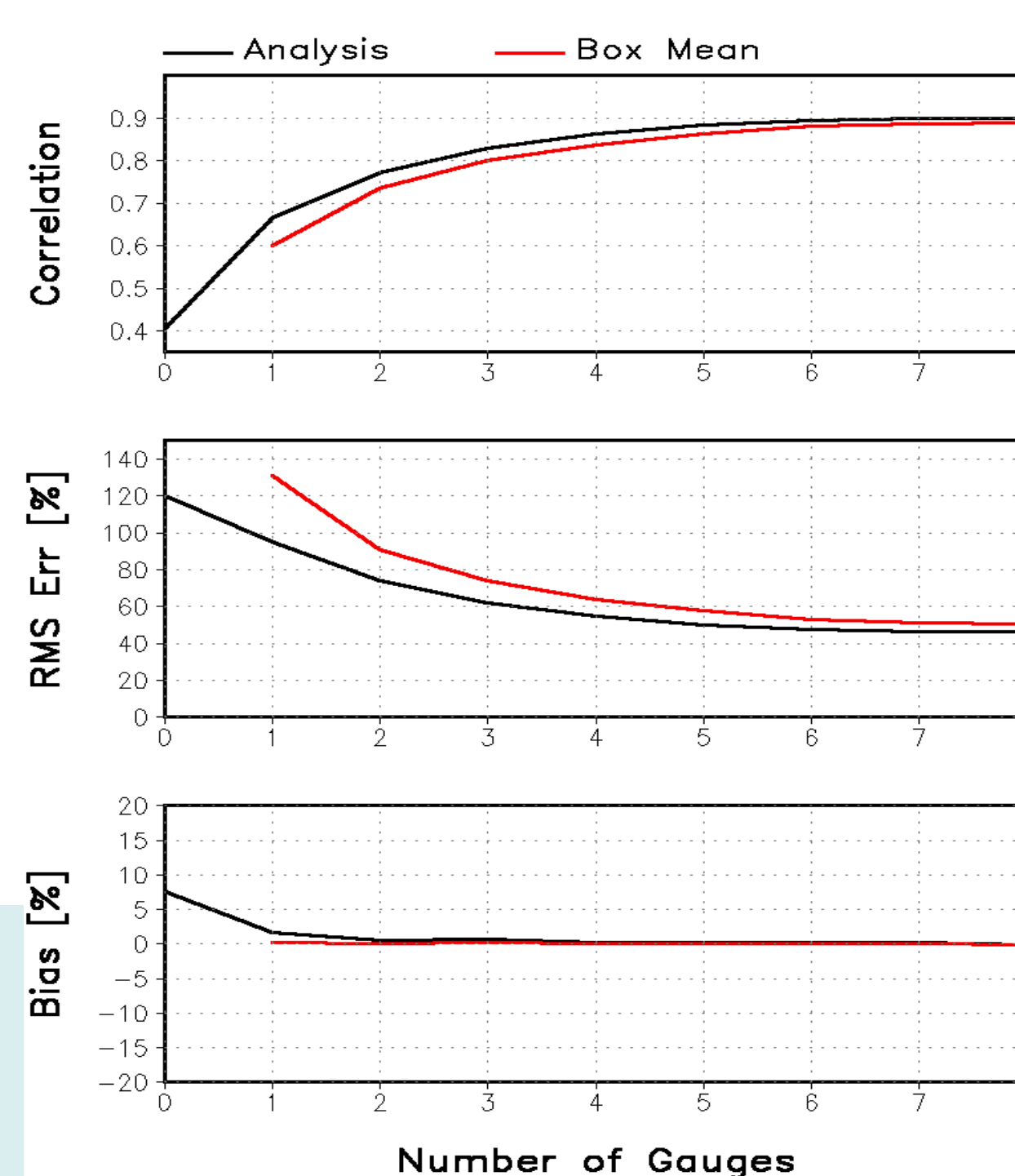
Number of gauges in a 0.05° grid box and Analyzed field of one-minute rain rate for the

Performance of the gauge analysis in representing mean rain rate over an FOV

Selected seven regions of dense gauge network

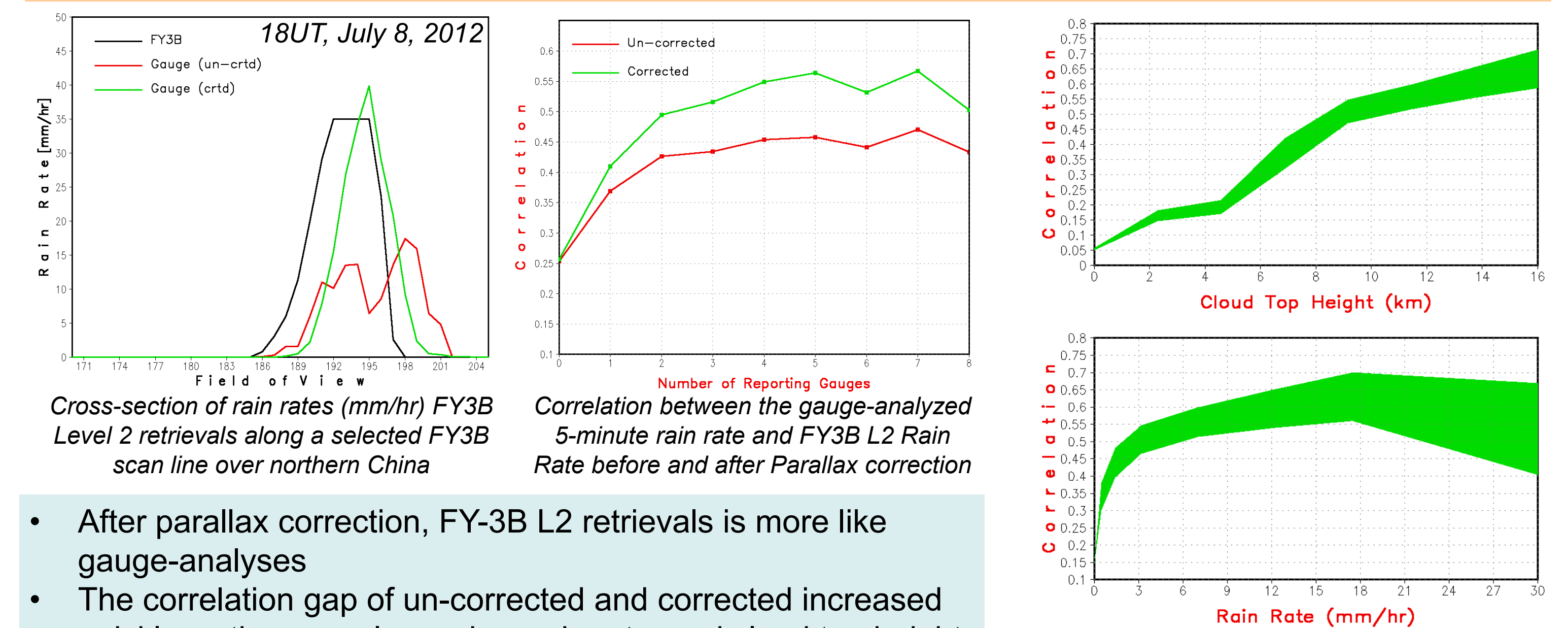
Region	Location	# of Gauges
Shengyang	41.575°N; 123.325°E	18
Beijing	39.925°N; 116.325°E	23
Tianjian	39.125°N; 117.225°E	30
Shanghai	29.775°N; 121.675°E	34
Chengdu	30.675°N; 104.075°E	22
Fuzhou	25.425°N; 119.075°E	21
Guilin	25.275°N; 110.325°E	22

- Simulation tests are conducted to examine the accuracy of the gauge-based analysis using data over 7 metropolitan regions with very dense network
- 5 or more gauges are required to ensure reasonable quality of the gauge analysis in representing mean rainfall over an FY3B FOV



Accuracy of grid box mean and interpolated 5-minute rain rate averaged over a satellite FOV

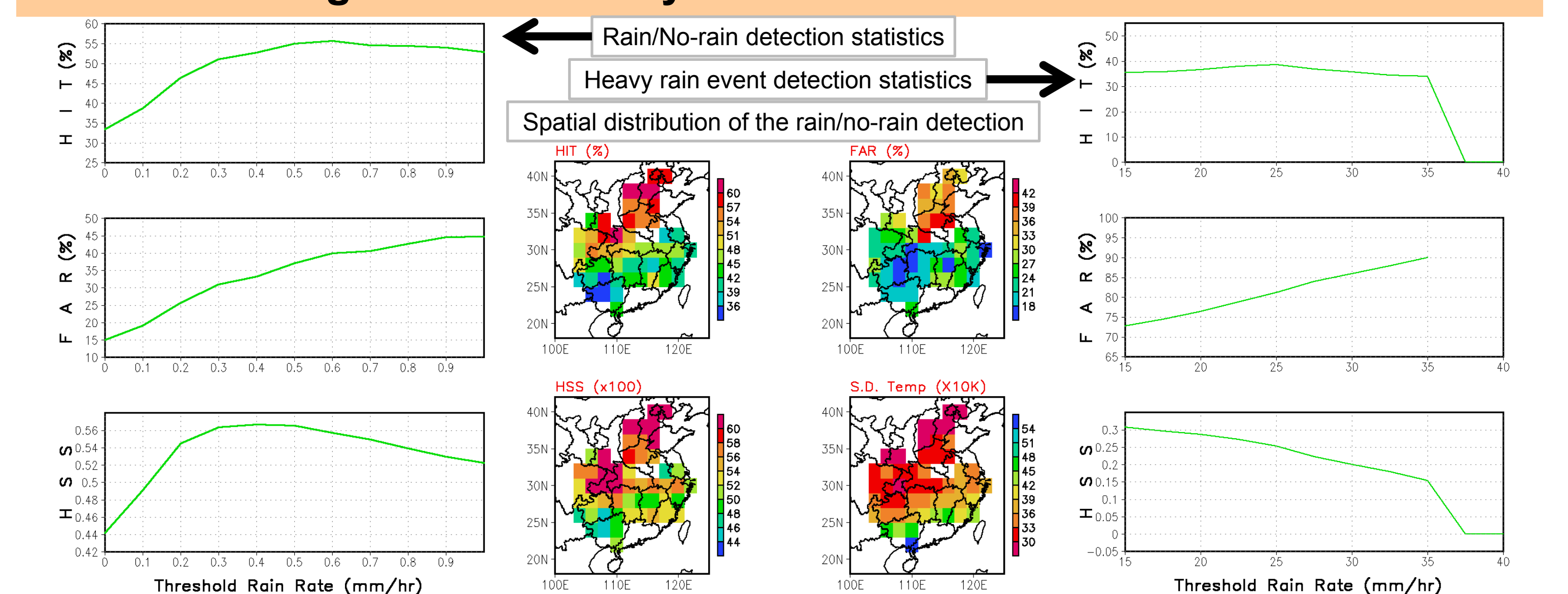
Parallax Correction for the FY3B L2 rain Rate Retrievals



Cross-section of rain rates (mm/hr) FY3B Level 2 retrievals along a selected FY3B scan line over northern China

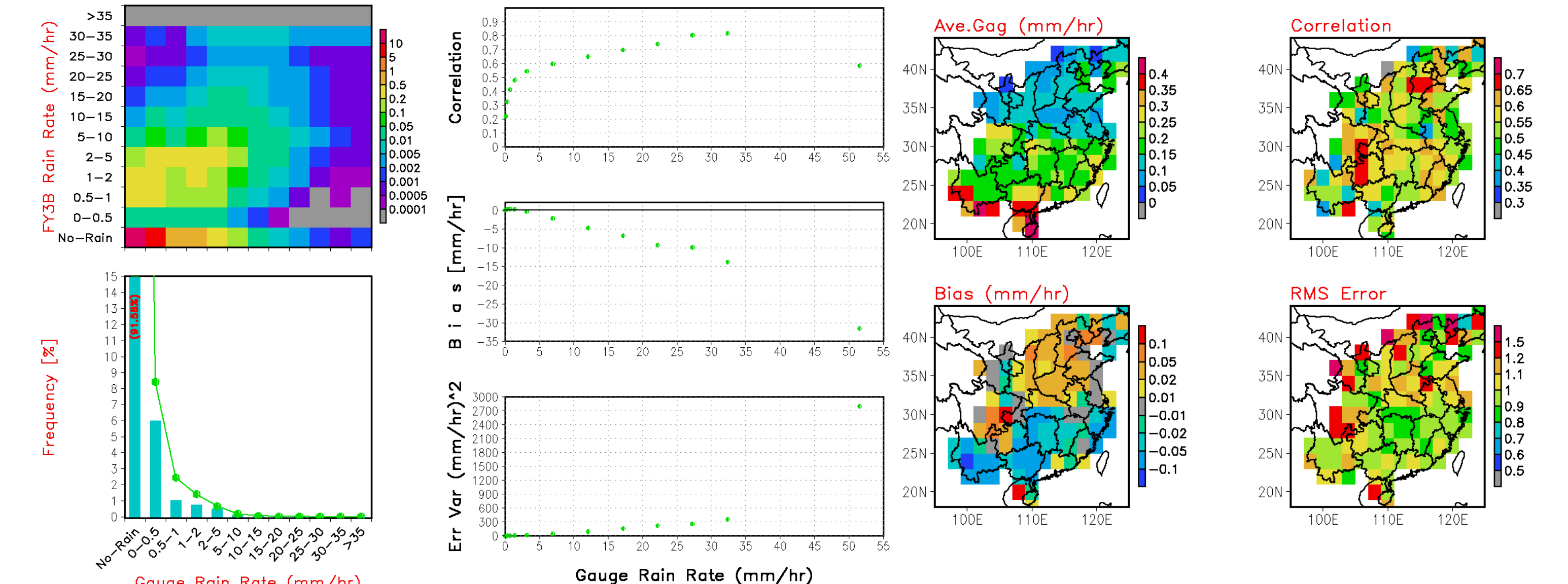
- After parallax correction, FY-3B L2 retrievals is more like gauge-analyses
- The correlation gap of un-corrected and corrected increased quickly as the gauge's number, rain rate, and cloud top height increasing
- Parallax is critical to ensure accurate verification of L2 products against the 'ground truth'

Detecting Rain and Heavy Rain Events of FY3B L 2 Rain Rate



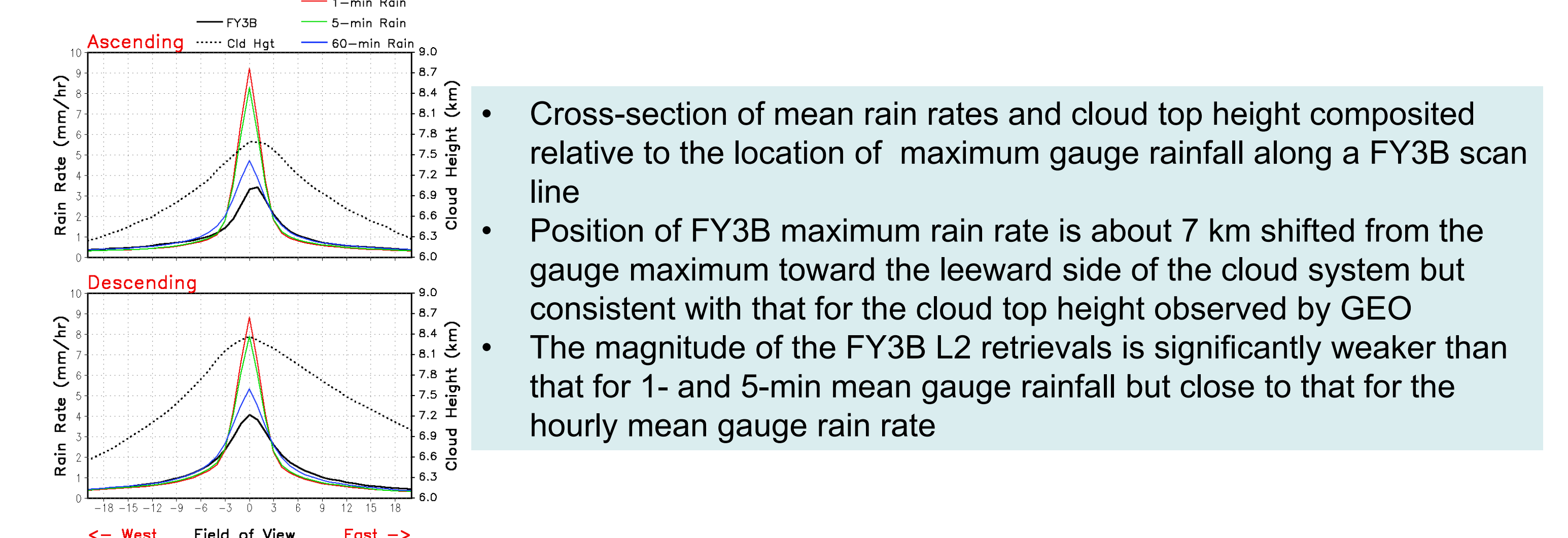
- FY3B L2 retrievals are capable of detecting rain event of 0.2mm/hr or higher
- Rain/No-rain detection statistics is better for northern China of relatively large cloud scale than over Southern China with more small-scale clouds
- FY3B L2 retrievals have a maximum rain rate of 35mm/hr

Quantifying Rain Rate of FY3B L 2 Rain Rate



- FY3B L2 retrievals tend to miss some raining events of various intensity
- For raining cases, the retrievals tend to over-/under-estimate weak / strong precipitation
- Retrieval performance (correlation) is quite poor for weak rainfall
- Overall, the F3B L2 under-/over-estimate rainfall over southern / northern China

Performance over different positions of a cloud system



- Cross-section of mean rain rates and cloud top height composited relative to the location of maximum gauge rainfall along a FY3B scan line
- Position of FY3B maximum rain rate is about 7 km shifted from the gauge maximum toward the leeward side of the cloud system but consistent with that for the cloud top height observed by GEO
- The magnitude of the FY3B L2 retrievals is significantly weaker than that for 1- and 5-min mean gauge rainfall but close to that for the hourly mean gauge rain rate

Summary and conclusions

- A gauge-based analysis of 1-min rain rate is constructed on a 0.05°lat/lon grid over the eastern China for may – September, 2012-2013, through interpolation of gauge reports from over 30K stations of CMA/AWS network
- Reports from 5 or more stations are needed inside an FOV of ~25km to produce gauge analysis of reasonable quality
- Parallax correction is desirable to ensure accurate match of the satellite L2 retrievals and ground truth rain rate analysis
- The current operational version FY3B L2 retrievals present good skill in detecting and quantifying precipitation as reflected in the 5-min gauge rate
 - FY3B L2 is capable of detecting rain rate of 0.2mm/hr or higher but misses some raining events
 - Rain detection skill is higher over northern China than over Southern China
 - FY3B L2 is a maximum retrieved rain rate of 35mm/hr
 - FY3B L2 tends to over-/under-estimate rainfall for weak / strong precipitation events
 - The retrieved rain rate maximum is ~7km shifted towards the east side of the cloud system