PR V6 1B21 B-side calibration coefficients and retrieved level 1, 2, 3 statistical results

PR B-side Task Force
Domestic PR Team in Japan

1. Purpose of this document

This document is prepared to summarize the TRMM PR B-side calibration procedure and the retrieved results by using the new calibration coefficients.

2. History

May 29, 2009
The PR experienced a major anomaly, resulting in a loss of data. JAXA and NASA inferred that the FCIF/SCDP(Frequency Converter and IF/System Control Data Processor) units were not working normally.

June 17, 2009
JAXA and NASA successfully switched the FCIF/SCDP units from the original A-side (FCIF/SCDP-A) to the backup B-side (FCIF/SCDP-B) and restarted the PR to resume observation.

June 19, 2009
The first granule of the B-side standard products was acquired just after the PR panel temperatures were stabilized. PR real-time data has continued to be processed and made available to real-time users. JAXA started the B-side internal and external calibration efforts utilizing the ground-based Active Radar Calibrator.

September 7, 2009
A domestic PR team meeting in Japan was held. JAXA reported the provisional internal and external calibration coefficients and some results of retrieved rain rates by using the provisional V6 B-side calibration coefficients. However, the PR team found that there was some discontinuity of rain rates observed by the PR A-side and B-side units. A task force was organized to solve this issue by the PR team members and JAXA.

October 23, 2009
The task force decided the most appropriate V6 B-side calibration coefficients based on the continuity of sea surface received power between the PR A-side and B-side at all incidence angles. These calibration coefficients significantly reduce the discontinuity of rain rates observed by the PR A-side and B-side.

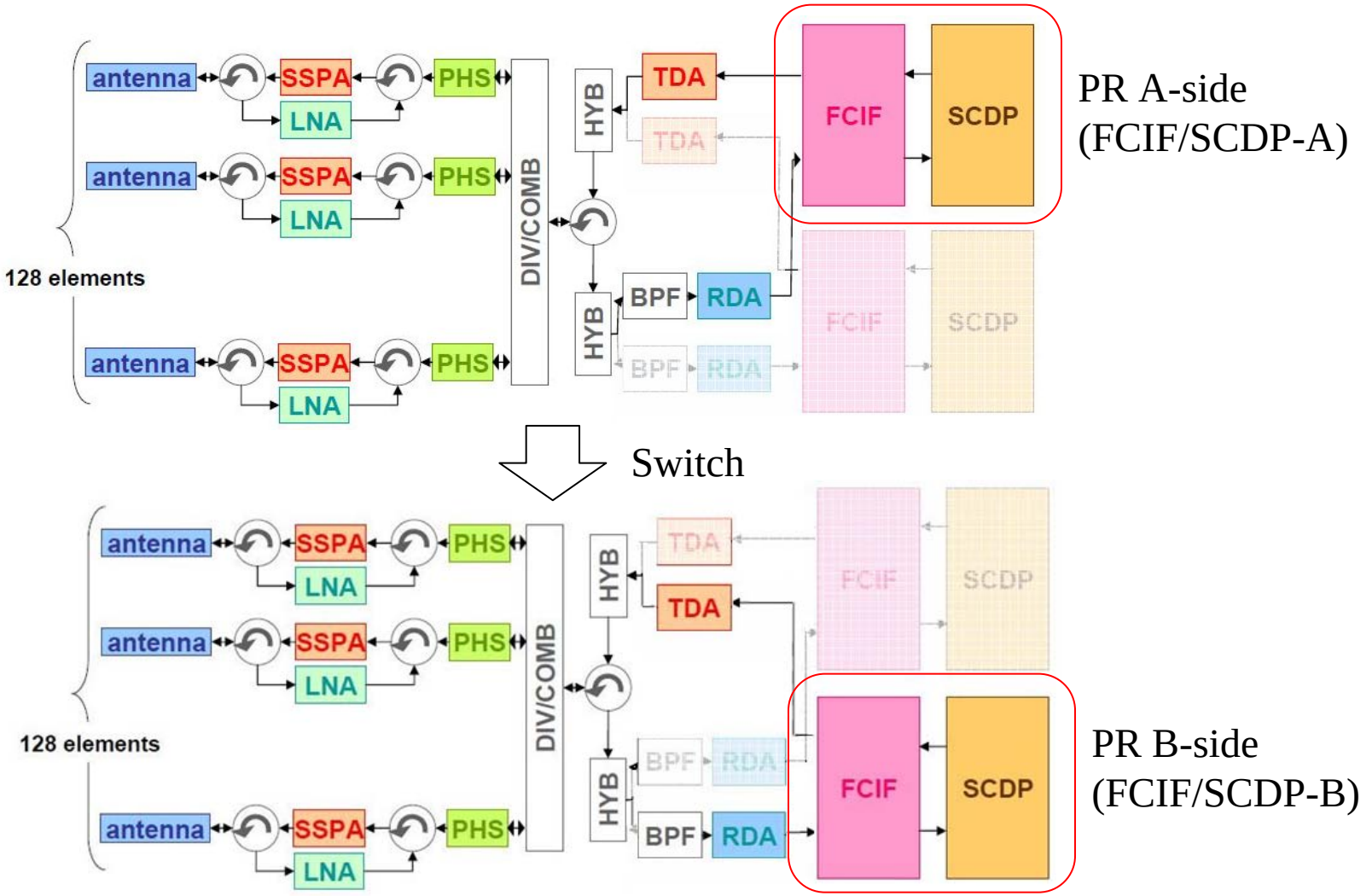
October 30, 2009
At the JPST meeting at Salt Lake City, UT, the V6 B-side calibration coefficients were proposed by the PR team. It was decided that the evaluation of the proposed calibration coefficients would be continued by statistical analyses and that the final calibration coefficients for the V6 B-side would be determined by the end of November 2009 in order to be implemented in the V6 1B21 B-side algorithm as soon as possible for the V6 data release.

November 30, 2009
A domestic PR team meeting in Japan was held. The task force reported the new final calibration coefficients for the V6 B-side which were based on the internal calibration and the continuity of surface cross sections between the PR A-side and B-side at the incidence angle of 10 degrees. These calibration coefficients minimize the discontinuity of rain rates observed by the PR A-side and B-side. The domestic PR team in Japan judged that these new final calibration coefficients are acceptable for the V6 1B21 B-side algorithm.

December 11, 2009
The TRMM project scientists of both the USA and Japan approved adoption of the new final calibration coefficients proposed by the domestic PR team in Japan for the V6 1B21 B-side algorithm.

December 18, 2009
All PR V6 B-side standard products from June 19, 2009 were released by both JAXA and NASA.

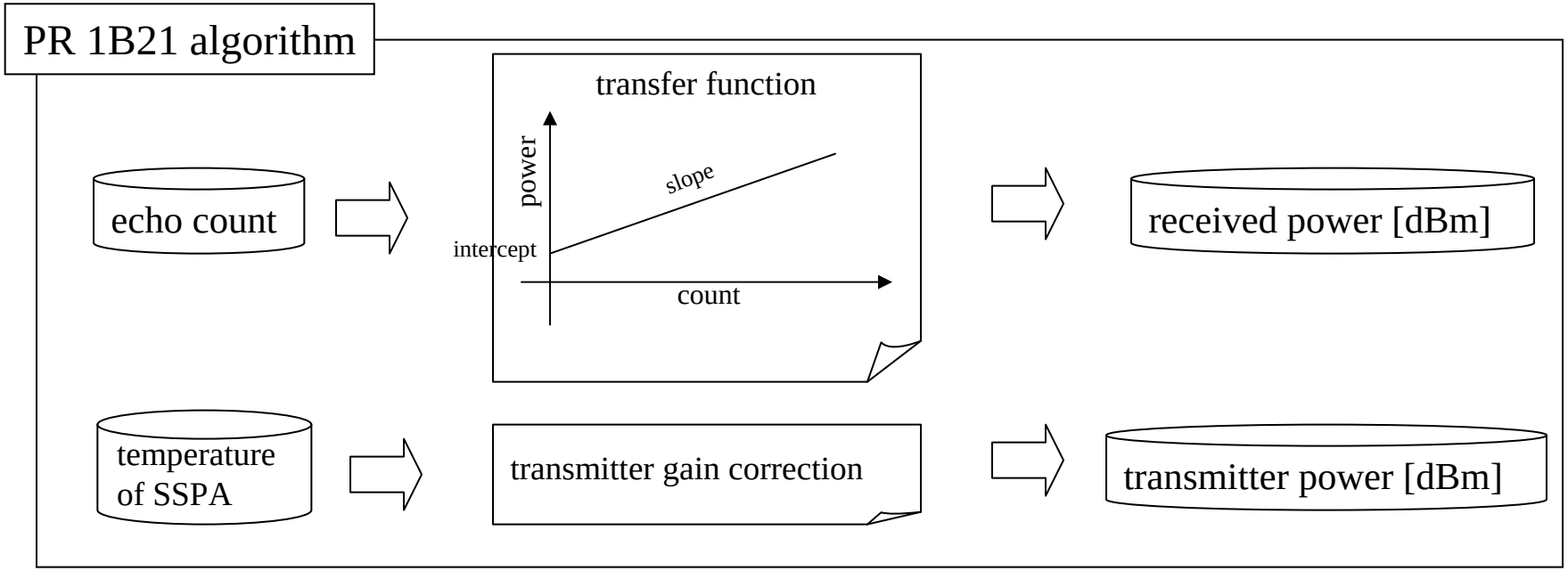
3. Switching from PR A-side to B-side



SSPA(Solid State Power Amplifier): 固体化増幅器
LNA(Low Noise Amplifier): 低雑音増幅器
PHS(Phase Shifter): 移相器
DIV/COMB(Divider/Combiner): 分波・合波器
HYB(Hybrid): 導波管分波・合波器
TDA(Transmitter Drive Amplifier): 送信部駆動増幅器
RDA(Receiver Drive Amplifier): 受信部駆動増幅器
FCIF(Frequency Converter and IF): 周波数変換・IF信号部
SCDP(System Control Data Processor): システム制御・信号処理部

Note: Not only switching FCIF/SCDP from A-side to B-side, but also switching TDA and RDA to the redundant units were made.

4. Calibration coefficients



The above schematic figure shows the flow of the PR 1B21 algorithm. A digital echo count is converted into a received power with a transfer function which is composed of a slope and an intercept (receiver gain correction). The SSPA temperature is used for calculation of the transmitter power with the transmitter gain correction.

These parameters, such as the slope, the intercept (receiver gain correction) and the transmitter gain correction, are called calibration coefficients.

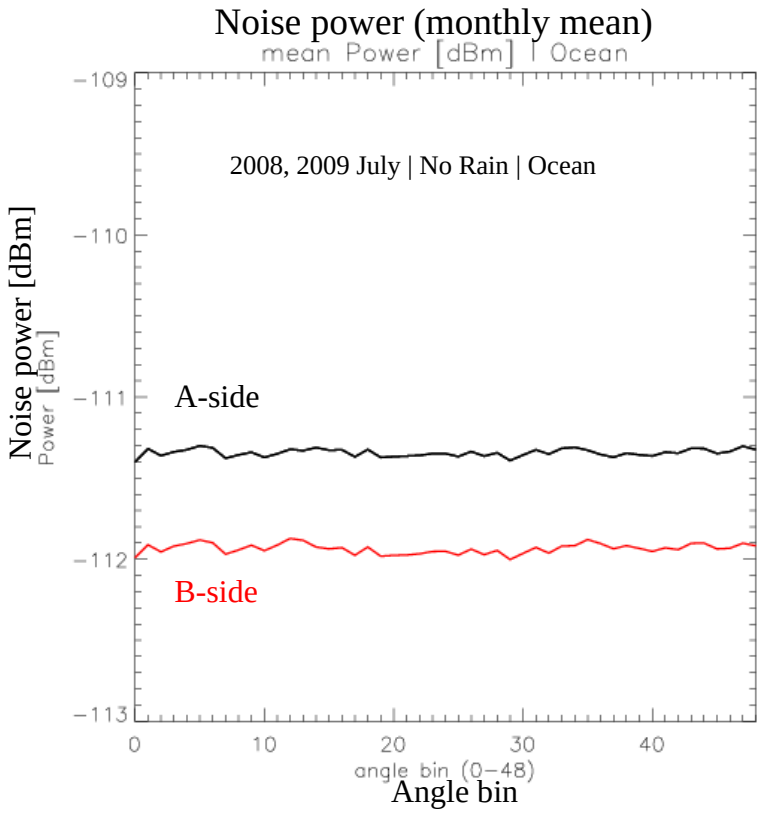
The slope of the transfer function is calculated by PR internal calibration data.

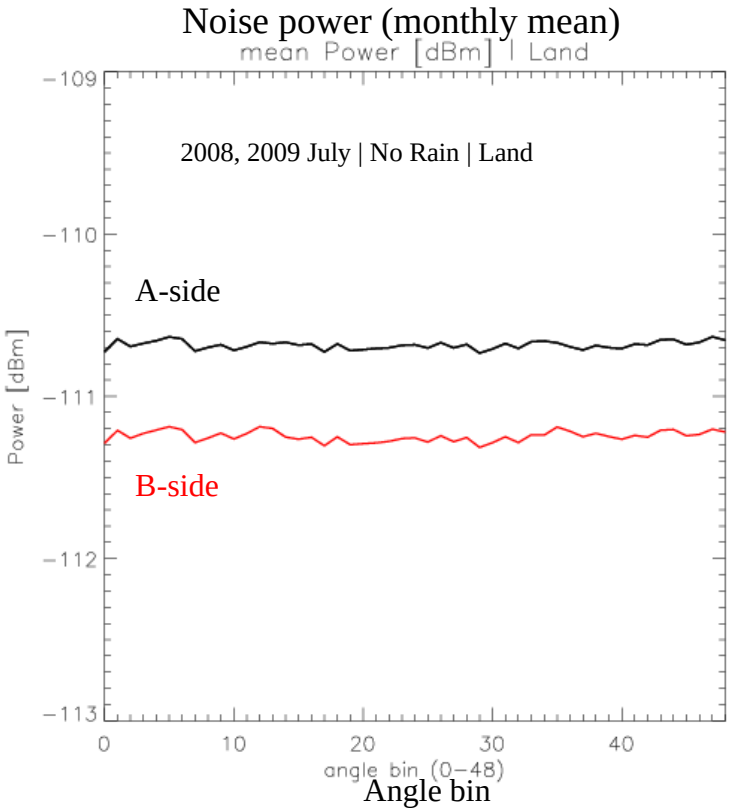
The intercept (receiver gain correction) of the transfer function is calculated by continuity of the surface cross section between the PR A-side and B-side at the incidence angle of 10 degrees.

The transmitter gain correction is calculated by ARC external calibration data.

5. Statistical results

5.1 Level 1 noise power

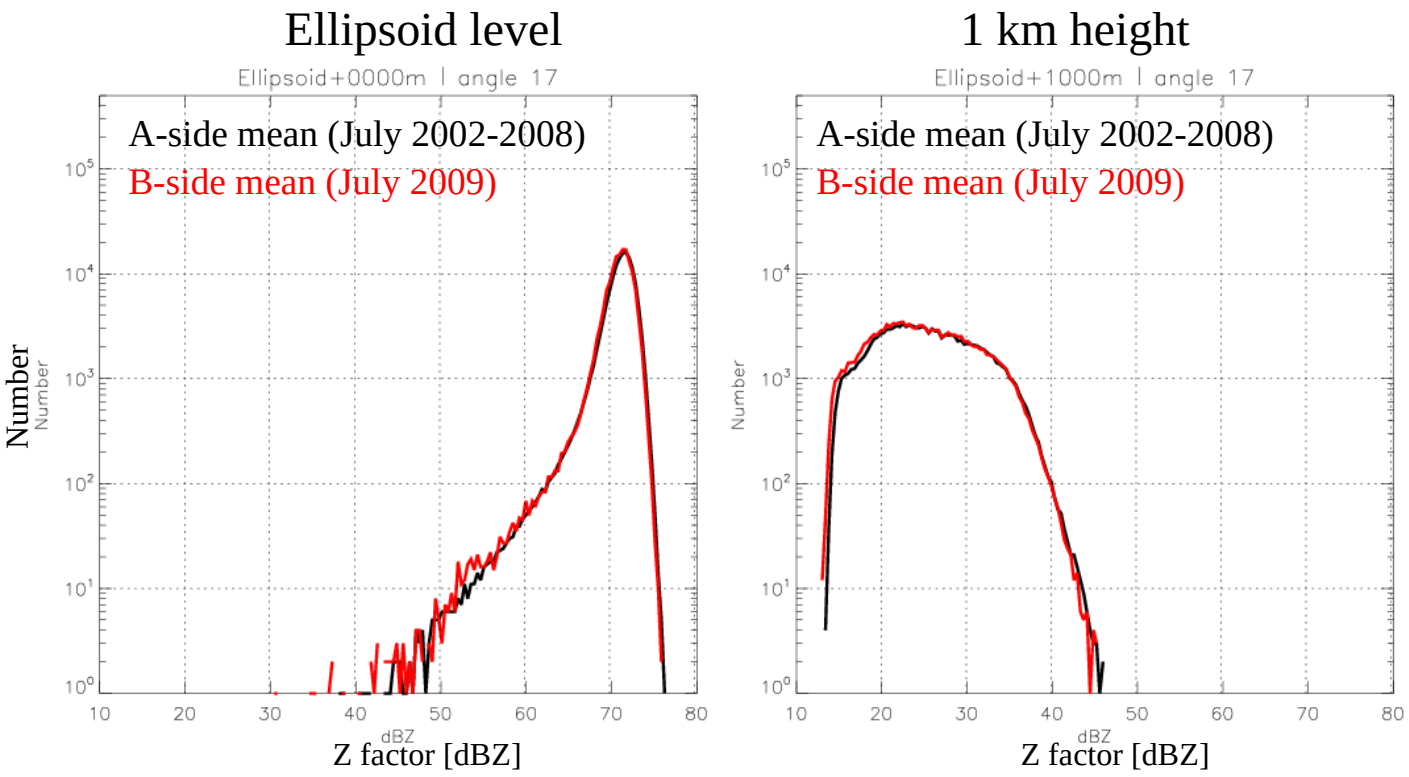




The PR B-side noise powers over both ocean and land are smaller than the A-side by about 0.6 dB for all angle bins. This may be the effects of switching to the new RDA and B-side FCIF/SCDP. It is expected that the difference of noise power affects rain / no rain classification. On this issue, however, the plot of the trend in L3 rain ratio on page 11 suggests that the effect is very small.

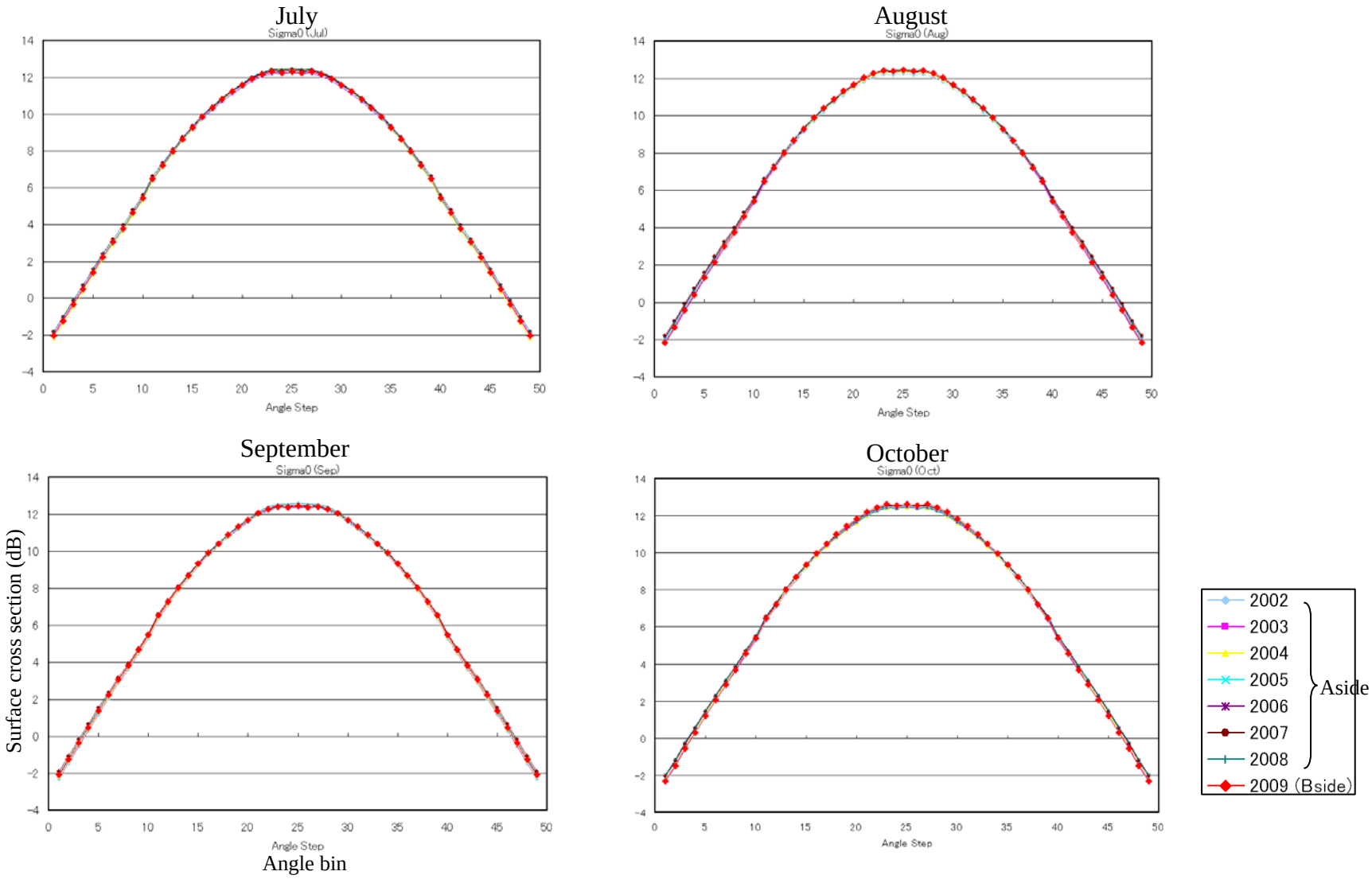
5.2 level 1 Z factor histogram

Ocean : Rain Certain: Angle bin 17



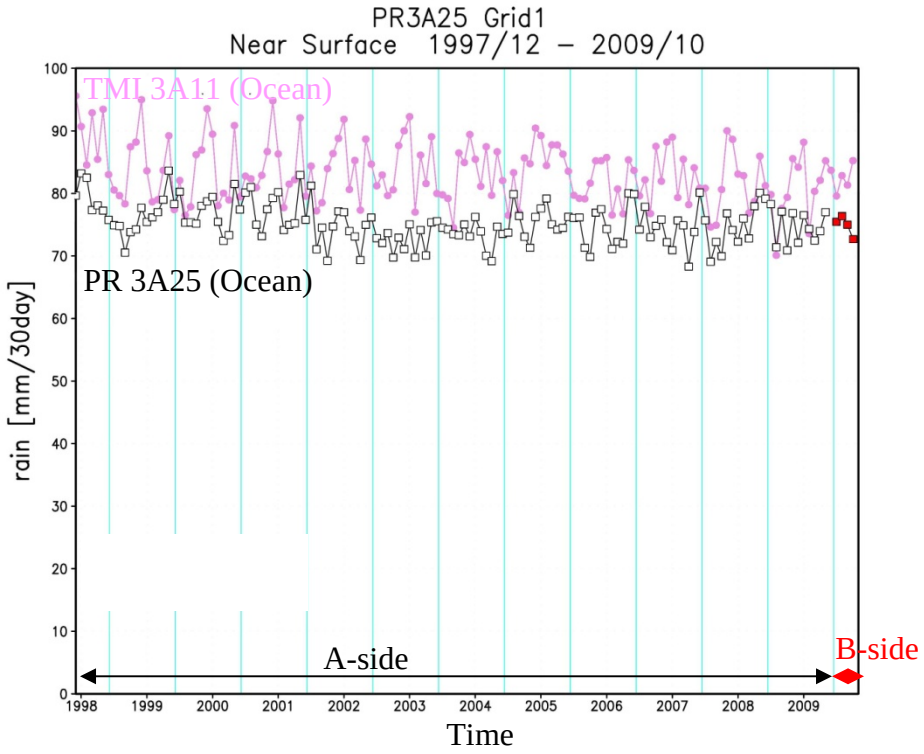
The Z factor histograms on the Ellipsoid level and 1km height show good agreements between A-side and B-side, except for signals less than 20dBZ which are affected by noise.

5.3 Level 2 surface cross section

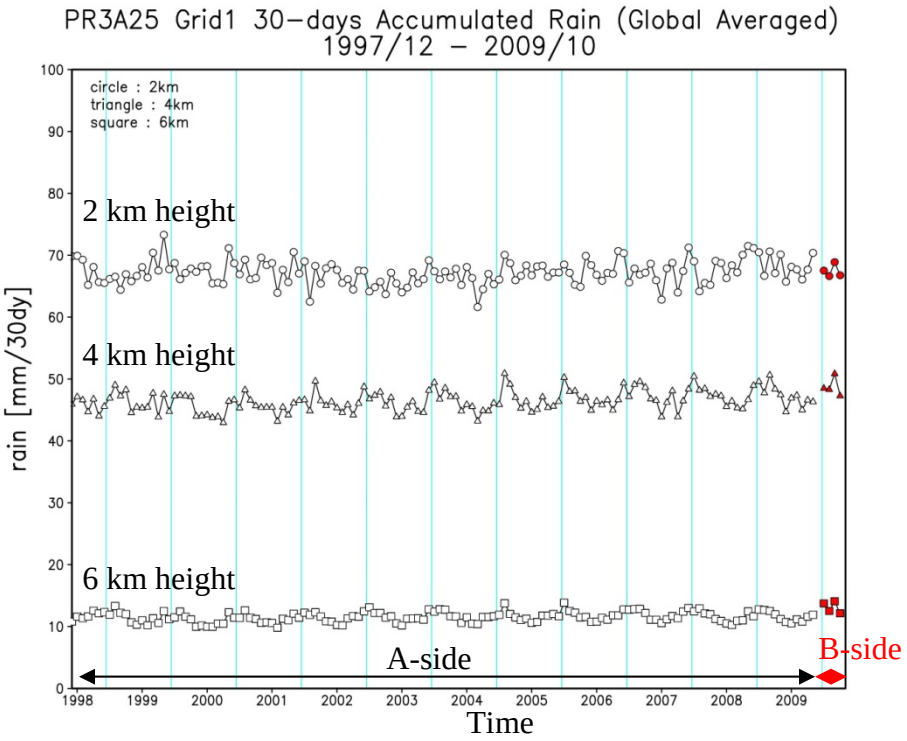


The above figures show monthly means of surface cross sections under no-rain condition. PR A-side (2002-2008) and B-side (2009) data show consistent distributions for July, August, September and October.

5.4 Level 3 trend plot (1/2)



Accumulated rain
(ocean) (near surface)

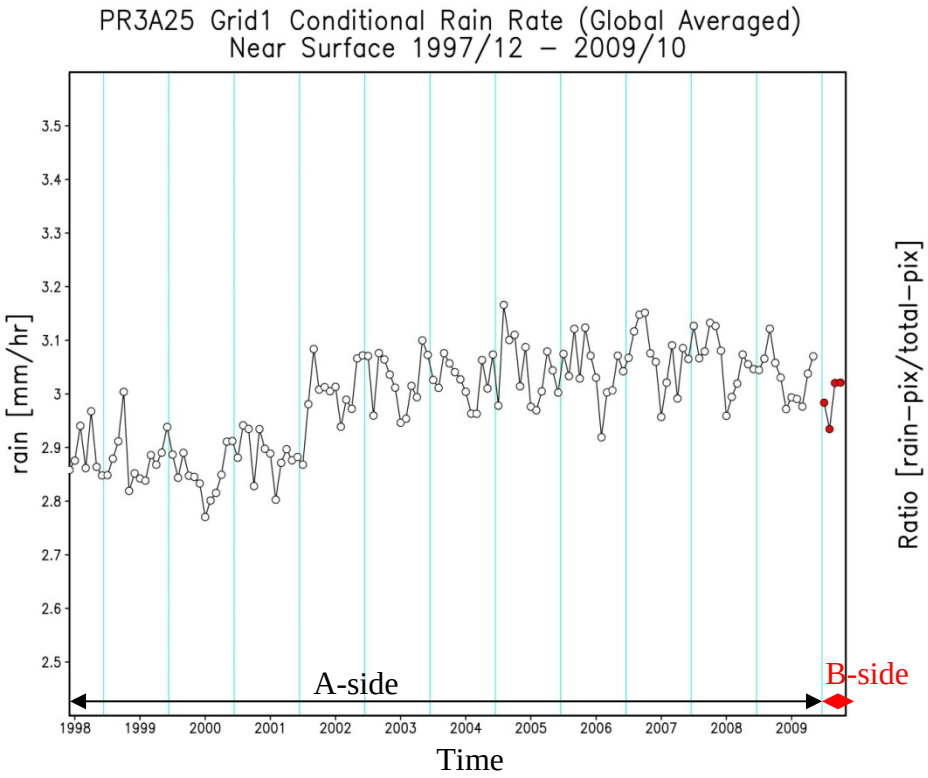


Accumulated rain
(global) (2, 4, 6km height)

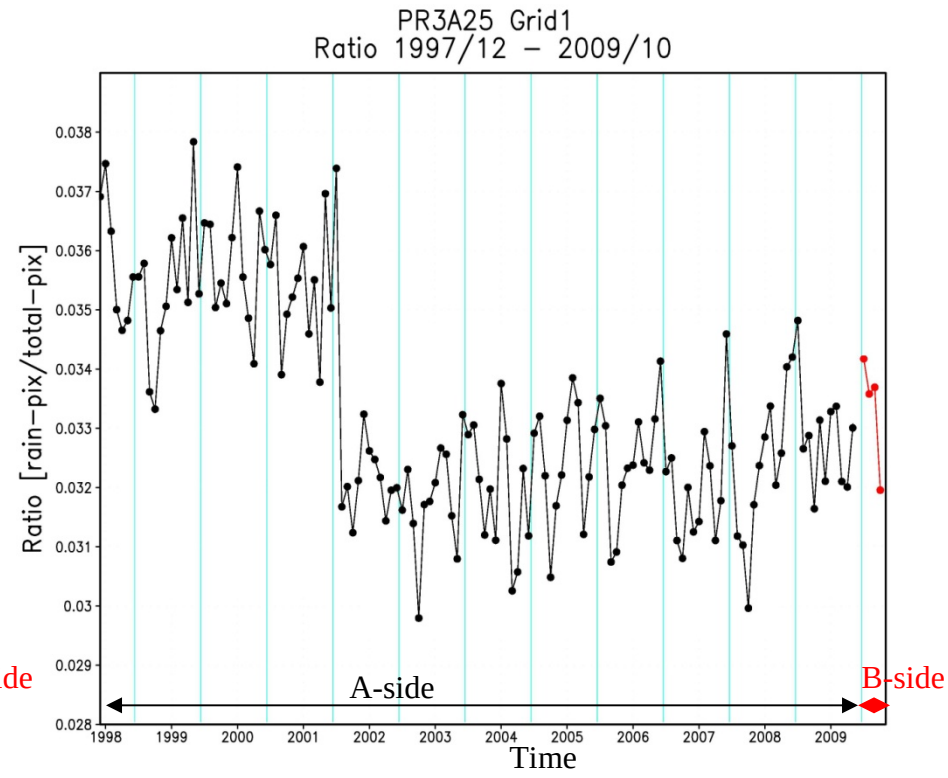
The trend of monthly rain rate shows natural continuity from the PR A-side to B-side. Compared with the variations of TMI 3A11 in the switching period from PR A-side to B-side, PR 3A25 variations show consistent variations.

3A25 values at various heights also show natural continuity from the PR A-side to B-side.

5.4 Level 3 trend plot (2/2)



Conditional rain rate
(global) (near surface)



Rain ratio [rain-pixel / total-pixel]

Both figures show natural continuity between PR A-side and B-side.

6. Summary

The PR B-side Task Force including JAXA carried out internal / external calibrations and carefully investigated the best way to calibrate the PR so as to maintain continuity of PR products between the A-side and B-side.

As a result, PR V6 B-side standard products with the new calibration coefficients show generally good continuity between A-side and B-side for L1 (noise power, Z-factor), L2 (surface cross section), and L3 (accumulated rain, conditional rain rate, and rain ratio) standard products.

Please be aware of the following issue for TRMM PR Level 3 products after the TRMM PR switched to the B-side:

The PR anomaly has caused the loss of PR data from 29 May 2009 to 19 June 2009. As a result, the June 2009 Level 3 PR products contain only 12 days of data. This makes the June 2009 products less reliable due to the lack of sufficient data upon which to base the statistics. Please take care when using June 2009 products for quantitative analysis.