October 17, 2018

Release Notes for the DPR Level 2 and Level 3 products

＜Major changes in the DPR Level2 from Version 05B to Version 06A＞

1. A new SRT code has been modified to include calculations of Hitschfeld-Bordan PIA as well as a hybrid PIA that combines HB and SRT results. As a result of applying the new PIA in SLV module, erroneously large estimates of high precipitation over ocean (near coast) are mitigated and both DPR(MS) and Ku rain estimates in V06A agree better with Gound Validation data over USA.

2. A new classification algorithm is introduced by the University of Washington (Stacy Brodzik & Robert Houze) to reclassify the stratiform rain type. The new algorithm improved an angle-bin dependence of rain classification and SLH profiles.

Minor changes in DPR L2 algorithm:

- Mitigated KaHS's sidelobe clutter and re-calculated the data base for KuPR's sidelobe clutter.
- New variables are introduced. They are `flagScanPattern` in PRE module, `PIAhb`, `PIAhybrid`, `reliabFactorHY`, `reliabFlagHY`, `stddevEff`, `stddevHY` and `zeta` in SRT module. The meanings of these variables should be referred to the user's manual.
- Modification of surface snow Index for the winter temperature inversions.
- Applied the latest SRT data base.
- Bug fix of flagEcho in dual frequency data processing.

There are cases of instantaneous retrieved precipitation rate classified as stratiform rain that exceed 40mm/hr. These cases are rare, and the frequency is latitude dependent with more cases near the equator than in the extra-tropics.

＜Major changes in the DPR Level3 products from Version 05B to Version 06A＞

1. New variables are introduced. They are `zFactorMeasuredNearSurface`, `DFRNearSurface`, `DFRmNearSurface`, `piaHybrid`, `piaHybridDPR`, `piaHB`, `zeta`, and `flagHeavyIcePrecip`. The meanings of these variables should be referred to the user's manual.

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＜Major changes in the DPR Level2 products from Version 05A to Version 05B＞

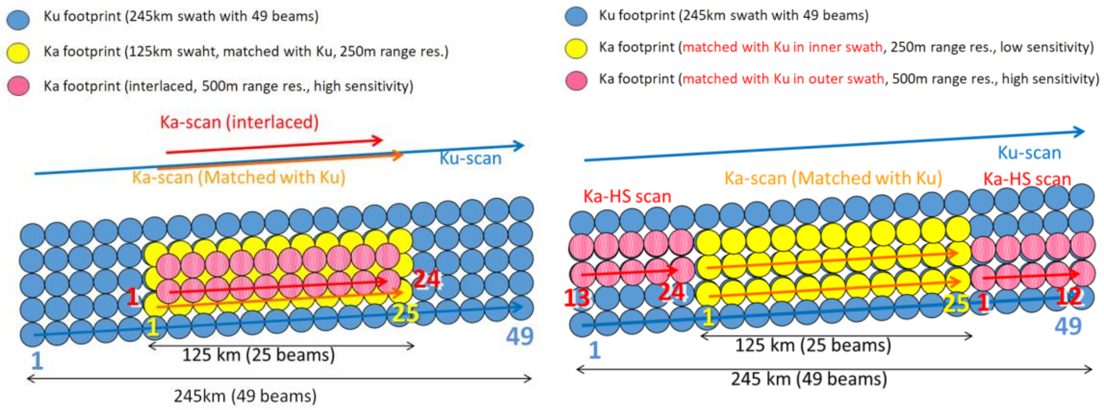

Figure 1. DPR's scan pattern before May 21 2018 (left) and after May 21 2018 (right). KaHS beams scan in the inner swath before May 21 2018, but now they scan in the outer swath and match with KuPR's beams. Numbers in color indicate angle bin numbers for KuPR (blue), KaMS (yellow), and KaHS (red).

1. As of May 21, 2018, the scan pattern of KaHS beams was changed as shown in Fig. 1. The KaHS beams scanned in the inner swath before May 21 2018, but now they scan in the outer swath and match with KuPR's beams. Please note that the range resolution of KaHS is 500m and differs from that of the KuPR or KaMS. One scan of KuPR over the full swath consists of 49 beams which are numbered from 1 to 49 in Fig. 1 below. The array for one scan of KaMS data consists of 25 beams which correspond to KuPR's central beams from 13 to 37, whereas one scan of KaHS data array for 24 beams consists of two parts. The first 12 elements in the array correspond to KuPR's beams from 38 to 49, and the last 12 elements correspond to KuPR's beams from 1 to 12 of the following scan. All KaMS beams and the first 12 KaHS beams match well with KuPR's beams from 13 to 49. The magnitude of misalignment between these KuPR and KaPR beams is estimated to be less than 50 m after May 21. However, KaHS's beams from 13 to 24 are slightly shifted from the corresponding KuPR beams from 1 to 12 in the along-track direction. The magnitude of misalignment in these beams is about 400 m.
   The dual-frequency algorithm can be applied to the full swath of data after the change of scan pattern. However, because it takes time to develop a new algorithm applicable to the full swath and to adjust the necessary parameters to ensure the quality of the products, KaHS data are not processed in V05B L2 algorithm. Missing values are stored in the output variables that use KaHS data. KaHS's received power data are available only in L1 products in V05B.

2. All beam directions of KuPR and KaPR were adjusted to match better with the nominal footprint locations. The difference between KuPR and KaPR’s footprint centers is now about 30 m at nadir. It was about 300 m before May 21, 2018. This improvement of beam matching is not considered to make a big difference in the L2 output products except for very heavy rain cases because the mismatch was small (300 m) from the beginning.

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＜Major changes in the DPR Level2 products from Version 04A to Version 05A＞

All users of DPR L2 data should keep in mind the following changes in V5 products.

This document describes only the major changes in the level 2 products. There are some changes in level 1 that affect the level 2 products. Please refer to “Release Notes for the DPR Level 1 products” for the details of the changes in level 1 products.

Among several changes in level 1 products, the important changes that affect level 2 products substantially are the following points.

The DPR’s system parameters were re-examined. Based on the new calibration results, the offset parameters for the transmitting powers, receiver’s gains, the beam widths, and the pulse width of both KuPR and KaPR are redefined. As a result, Zm of KuPR has increased by about +1.3 dB, and Zm of KaPR by about +1.2 dB. The radar surface cross section (sigma0) of KuPR has increased by about +1.2 dB and that of KaPR by about +1.1 dB, although the changes in sigma0 depend slightly on the incidence angle due to the changes in the beam widths. Because of the introduction of the adjustment factors in L2 (see below) whose magnitudes vary with time, the numbers mentioned above are not fixed numbers but change with time, especially near the beginning of the GPM mission. In fact, for example, statistics show that an average (over angle) increase in sigma0 at Ku-band is about +1.0 dB, that at KaMS is about +0.6 dB and that at KaHS is about +0.9 dB on the first 5 days in June 2014.

- The FCIF-LUT for the KuPR near the saturation was improved so that the effect of saturation near the saturation level was mitigated.

Changes in level 2 algorithm

- In addition to the changes in the DPR L1 calibration, adjustment factors are introduced to remove small trends in the overall system gains in KuPR and KaPR. The adjustment factors change the measured received powers only by a small fraction of dB.
- Since the FCIF-LUT for the KuPR near the saturation level was modified to mitigate the effect of saturation, the statistics of sigma0 near the saturation level in the KuPR has changed. This change affects the SRT performance as well. The side-lobe echo cancellation parameters are adjusted to cope with this change as well
- Measured radar reflectivity factor Zm and surface radar cross section sigma0 are calculated based on the new values of the pulse widths of both KuPR and KaPR. Accordingly, the angle bin dependence of sigma0 has changed slightly.
- A DSD database that depends on the month, region, surface type and rain type was created

from the statistics of DSD parameters estimated with the dual-frequency algorithm. The R-Dm relationship in the DSD database is used as the default R-Dm relationship in the single frequency (Ku-only and Ka-only) data processing before it is modified by other constraints such as the path-integrated attenuation. The introduction of the DSD database has modified the precipitation estimates substantially when they are light (less than about 3mm/h) in many cases. Rain estimates from the Ku-only and dual-frequency algorithms now agree very well.

- New flags are introduced. They are `snowIceCover` in the preparation module, `flagHeavyIcePrecip` and `flagAnvil` in the classification module, and `flagSurfaceSnowfall` and `surfaceSnowfallIndex` in the experimental module. The meanings of these flags should be referred to the user's manual.
- Winter convective storms that give large DFRm (measured Dual-Frequency Ratio) at the storm top are flagged and the corresponding pixels are classified as convective in V5. This category only appears in the inner swath since DFRm is available only there.