# A statistical method for reducing sidelobe clutter for the Dual-frequency Precipitation Radar onboard the GPM Core Observatory

*Takuji Kubota[1], Toshio Iguchi[2], Takeshi Masaki[3], Riko Oki[1]

1. Japan Aerospace Exploration Agency, 2. National Institute of Information and Communications Technology, 3. Remote Sensing Technology Center of Japan

The Global Precipitation Measurement (GPM) mission is an international collaboration to achieve highly accurate and highly frequent global precipitation observations. The GPM mission consists of the GPM Core Observatory jointly developed by U.S. and Japan and Constellation Satellites that carry microwave radiometers and provided by the GPM partner agencies. The GPM Core Observatory, launched on February 2014, carries the Dual-frequency Precipitation Radar (DPR) by the Japan Aerospace Exploration Agency (JAXA) and the National Institute of Information and Communications Technology (NICT). The DPR consists of the Ku-band (13.6 GHz) precipitation radar (KuPR) and the Ka-band (35.5 GHz) precipitation radar (KaPR).

After the launch of the GPM Core Observatory, it was found the KuPR sidelobe clutter was much more severe than that of the precipitation radar onboard the Tropical Rainfall Measuring Mission (TRMM), and has caused misidentification of precipitation in an early stage of the product developments.

Therefore, a statistical method for reducing sidelobe clutter in the KuPR was examined and installed in the KuPR level-2 algorithm (Kubota et al. 2016). The statistical method to reduce sidelobe clutter was constructed by subtraction of the estimated sidelobe power, based upon a multiple regression model with explanatory variables of the Normalized Radar Cross Section (NRCS) of surface, from the received power of the echo. The saturation of the NRCS at near-nadir angles, resulting from strong surface scattering, was considered in the calculation of the regression coefficients.

By the implementation of the method, it was found that the received power from sidelobe clutter over the ocean was largely reduced by using the developed method, although some of the received power from the sidelobe clutter still remained. From the statistical results of the evaluations, it was shown that the number of KuPR precipitation events in the clutter region, after the method was applied, was comparable to that in the clutter-free region. This confirms the reasonable performance of the method in removing sidelobe clutter. For further improving the effectiveness of the method, it is necessary to improve the consideration of the NRCS saturation, which will be a future work.

On the other hand, the sidelobe clutter in the KaPR was not so striking, and there was no routine related to the sidelobe clutter reduction in previous KaPR-Level 2 algorithms. However, recently, contaminations related to the sidelobe clutter were found in the high sensitivity mode of the KaPR (KaHS). Thus, the statistical method of the KaHS was constructed with a concept like that of the KuPR (Kubota et al. 2018, 2019). This method was installed in the V06A version of KaPR-level 2 algorithm. By applied the method, contaminations in the KaHS were largely removed. One-month analyses during April 2017 shows the method was very effective in precipitation estimates over subtropical calm oceans and polar sea-ice regions.

On May 2018, the JAXA and the NASA implemented the change of the KaPR scan pattern, and beams of the KaHS were changed from the original near-nadir swath to match with the Ku-band beams in the outer swaths. With this mode of operation, the dual-frequency method between the Ka and Ku band can be obtained over the entire swath. This will be beneficial also for reducing contaminations of the sidelobe clutter. The sidelobe clutter will be less influential in the dual-frequency product by prioritizing information from the KaHS with more decreased contaminations of the sidelobe clutter in the outer swath.

Keywords: Global Precipitation Measurement, Dual-frequency Precipitation Radar, sidelobe clutter