DPR algorithm status

Toshio Iguchi (NICT)

NASA PMM Science Team Meeting

Poenix, AZ, USA, 9 October 2018

Improvements in DPR L2 algorithm V06 from V05

Major changes

A) Mitigation of erroneously large estimates of the path-integrated attenuation (PIA) from SRT

B) New classification algorithm (slope method by Prof. Houze and Dr. Brodzik).

As a result,

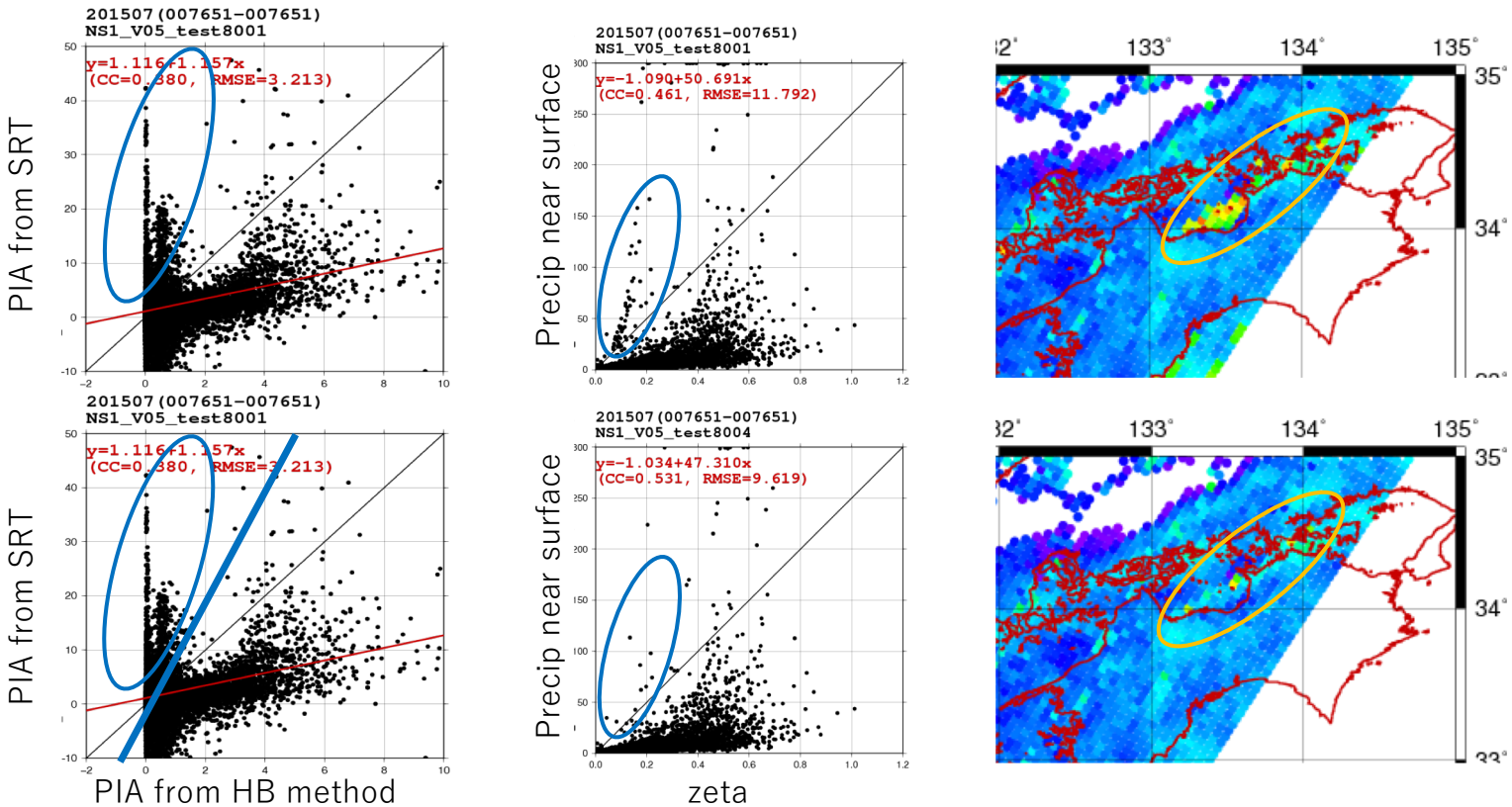
- Both DPR(MS) and Ku rain estimates in V06 agree better with GV data over USA (Petersen et al., 6 April 2018)
- Improved angle-bin dependence of rain classification
- Improved SLH profiles in DPR V06 from V05

Minor changes

- Mitigated KaHS's sidelobe clutter and re-calculated the data base for KuPR's sidelobe clutter.
- New variables are introduced: flagScanPatten in PRE module, PIAhb, PIAhybrid, reliabFactorHY, reliabFlagHY, stddevEff, stddevHY and zeta in SRT module.
- Modification of surface snow Index for the winter temperature inversions.
- Application of the latest SRT data base.
- Bug fixes in classification module and a bug fix of flagEcho in dual frequency data processing.

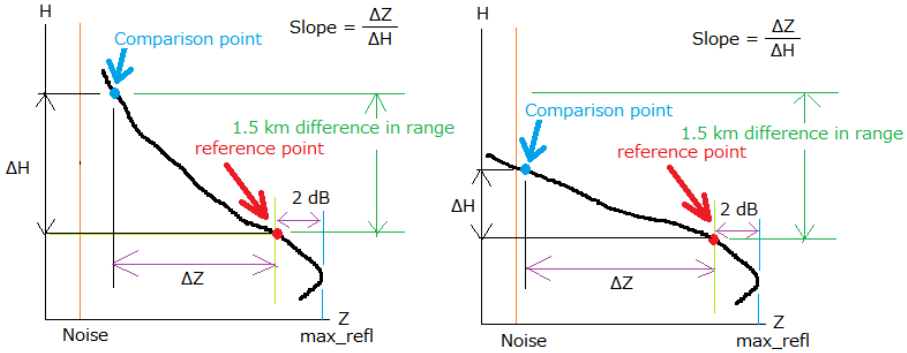
Mitigation of erroneously large PIA estimates from SRT

- If the PIA estimate from SRT is substantially larger than that from the Hitschfeld-Bordan method for light rain, the former is ignored.



Slope method to reclassify precip. type from convective to stratiform by the University of Washington (Houze and Brodzik, San Diego 2017)

The slop method examines the slope of Z profile above the 0 degrees C isotherm.
If Slope >= 7.5 dBZ/km, then change convective to stratiform



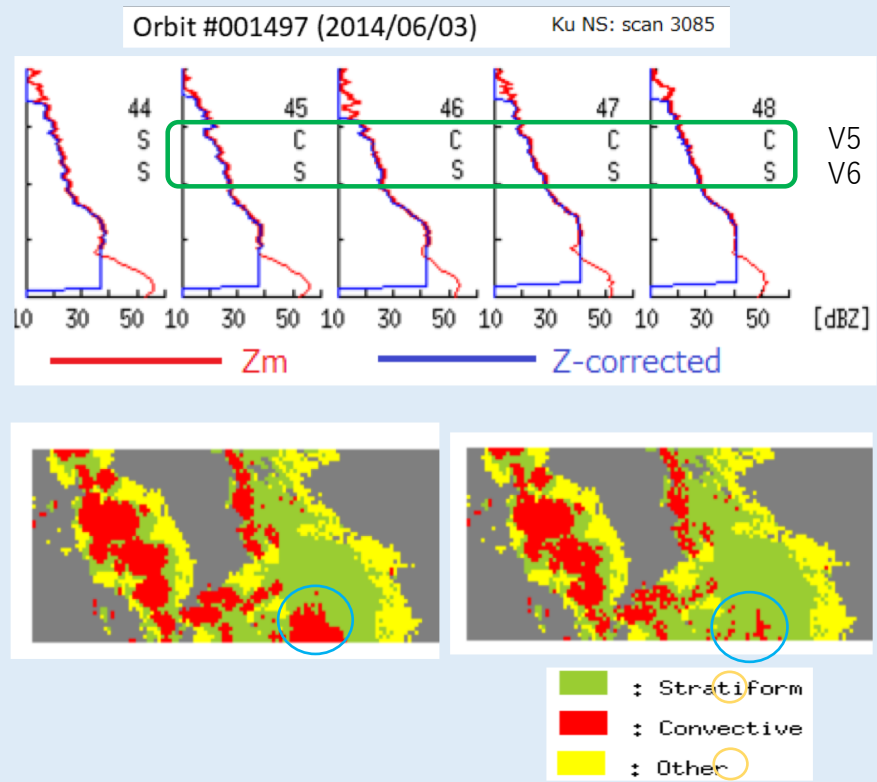
(a) Ordinary case

(b) case with no echo at comparison point

Exceptions: shallow rain, heavy ice precipitation, and some exceptional convective rain (very large Z near surface).

Applied only to the Ku-band single frequency CSF code, but influences the DPR products as well.
The slope method is applied in the second loop by using zFactorNPCorrected.

examples of reclassification



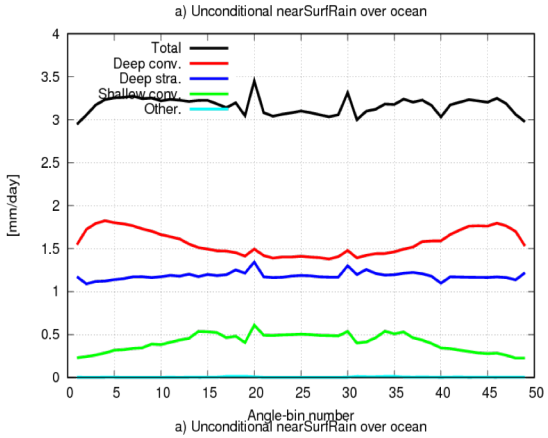
Rain Type (KuPR 35S-35N)

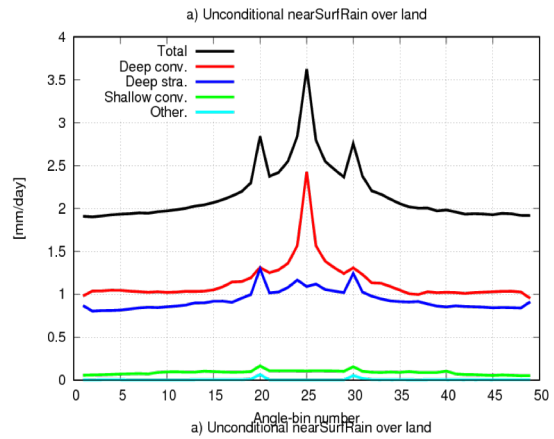
Total/**Shallow**/**Other**
Non-shallow convective
Non-shallow stratiform

Ocean

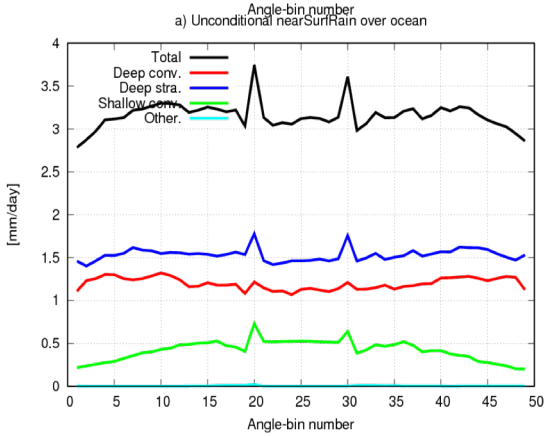
Land

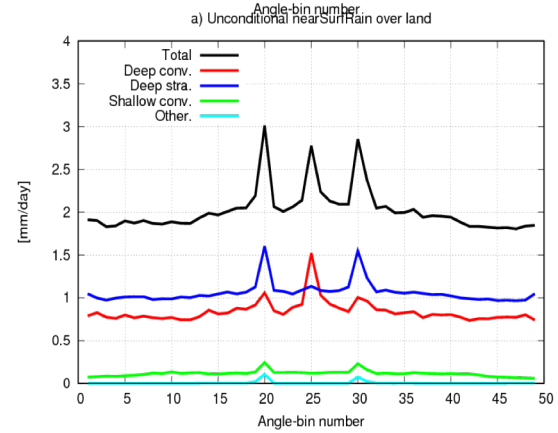
V05





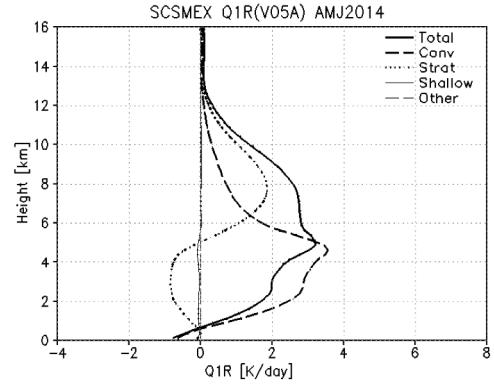
V06

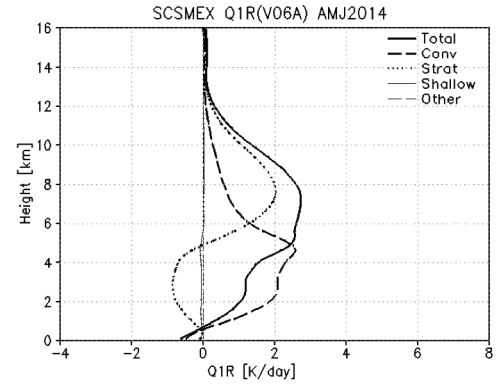




GPM SLH

SCSMEX





3-Month mean unconditional averaged heating (Q1R), AMJ 2014

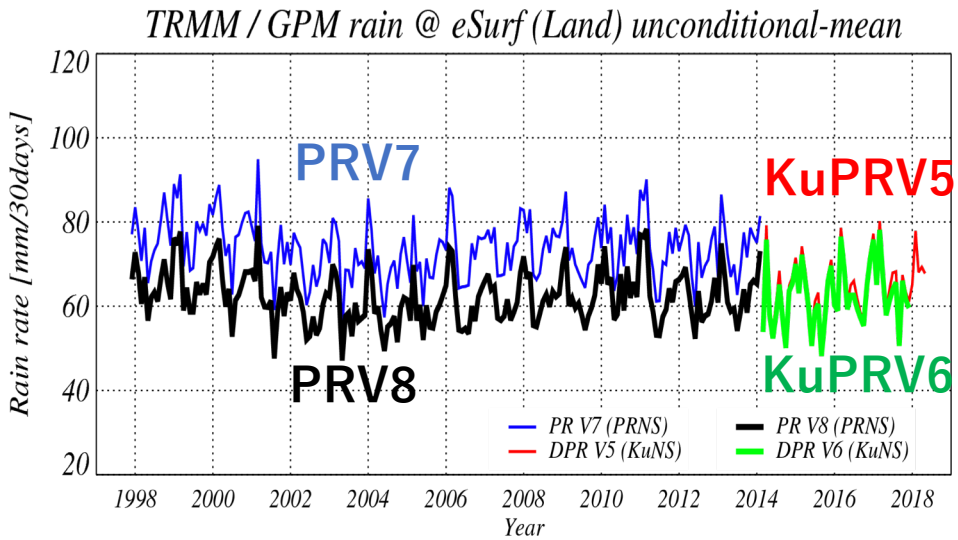
Improvements in PR V8

- A: New calibration applied.
  - More reliable Z factors
  - Continuity from PR to DPR
- B: Improved beam-mismatch correction
  - Better symmetric pattern between left and right swaths.
- C: DPR/KuPR and PR data are processed by the essentially the same algorithm.
  - Continuity from PR to DPR
  - C-1 (Improvement associated with DPR V06 from V05):
    - New classification algorithm.
    - Improved angle-bin dependence of rain classification
  - (Agreement of PR estimates with TMI and GMI estimates is about the same as before.)
- D: Improvements in vertical profiles of SLH latent heating (Top/Bottom heaviness)

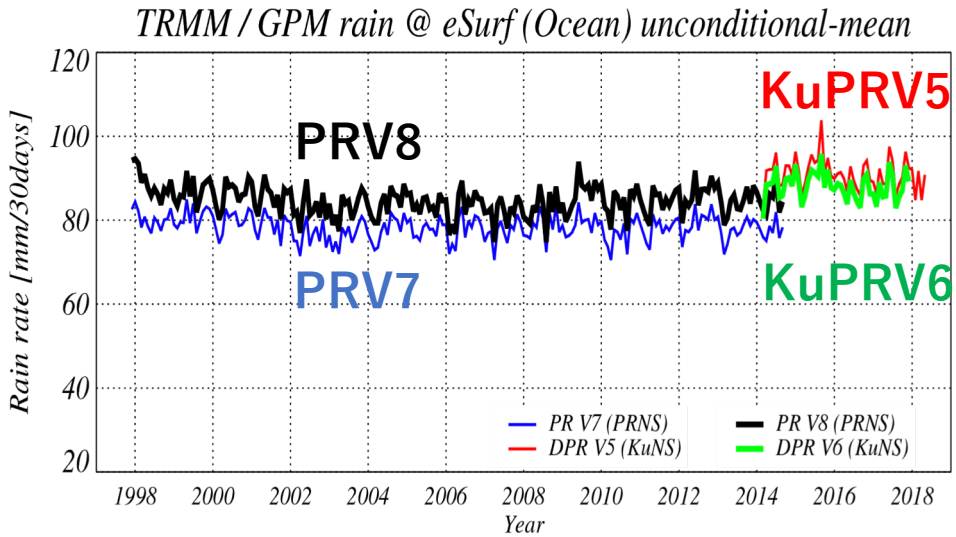
Continuity from TRMM/PR to GPM/DPR

New calibration for PR V8 that agrees with DPR calibration

Land



Ocean



- V8 time series of global mean shows increase in PR rainfall over oceans from V7, making rainfall more consistent with GPM V05 and V06.

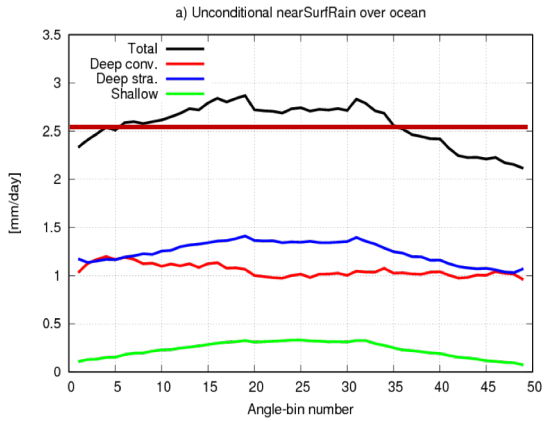
Changes in Rain Type (PR 2014/06) and improved beam-mismatch correction

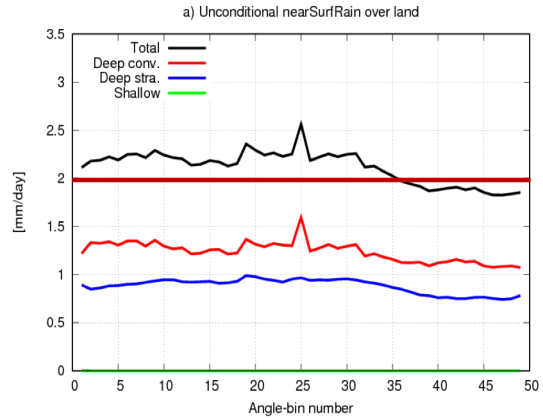
Total/Shallow/Other
Non-shallow convective
Non-shallow stratiform

Ocean

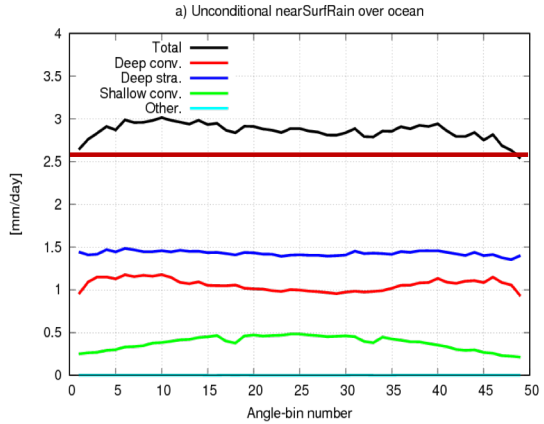
Land

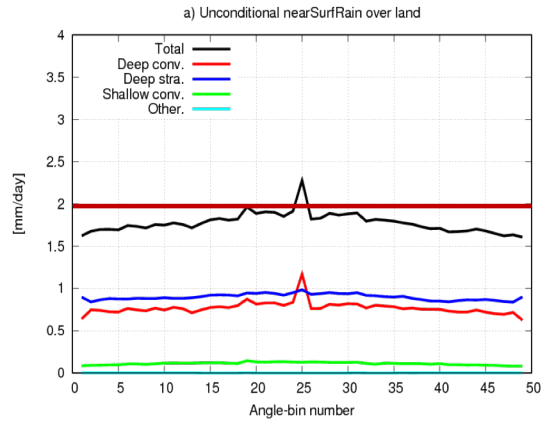
V7





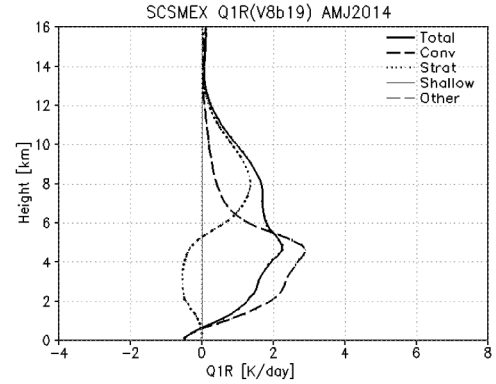
V8

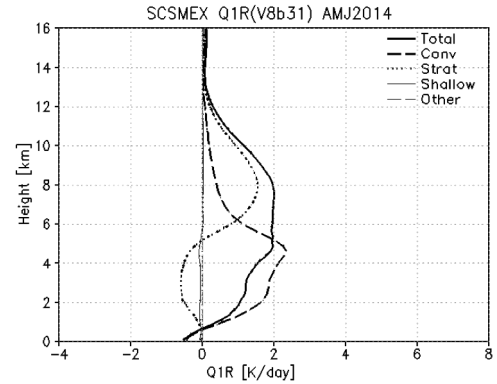




TRMM SLH

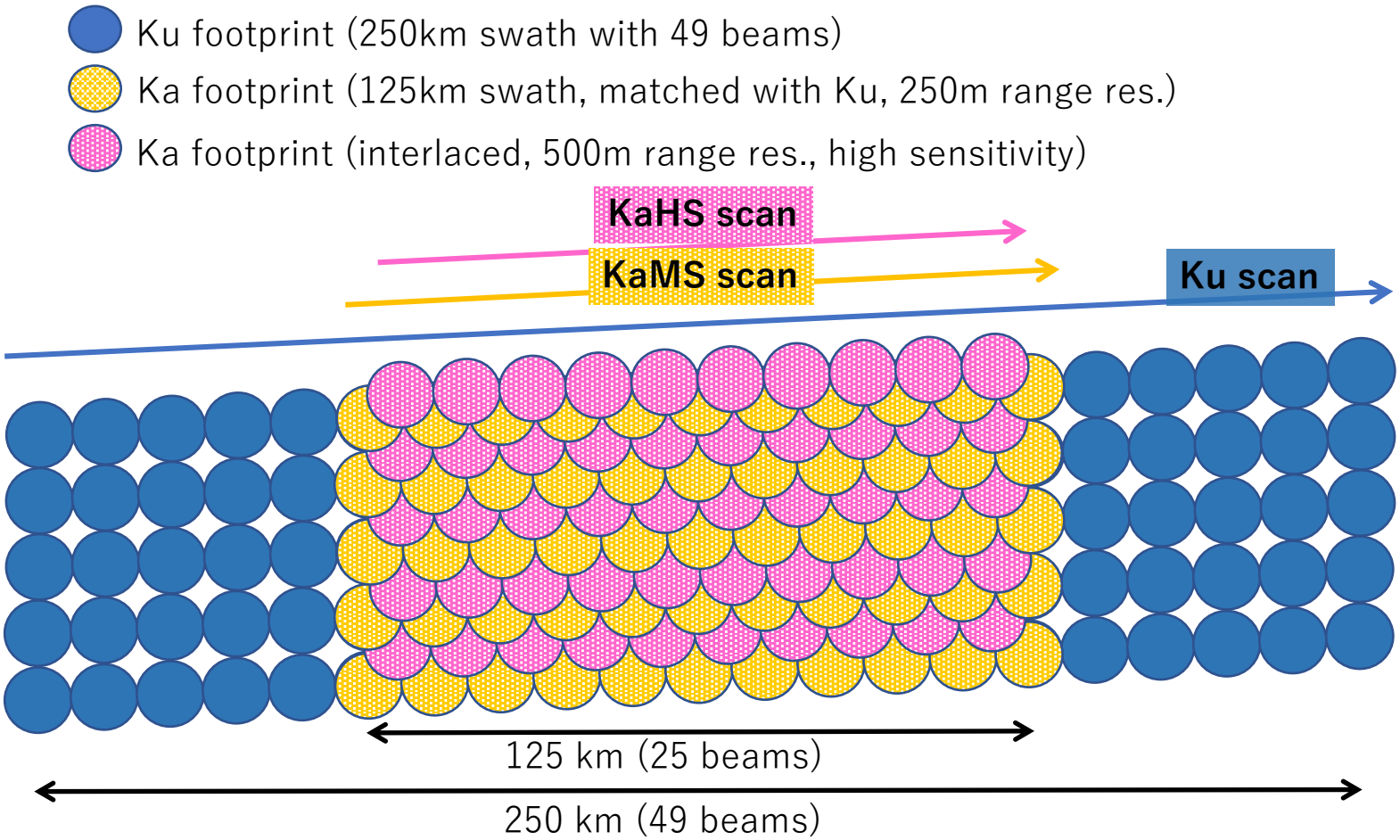
SCSMEX





3-Month mean unconditional averaged heating (Q1R), AMJ 2014

DPR scan pattern before 21 May 2018

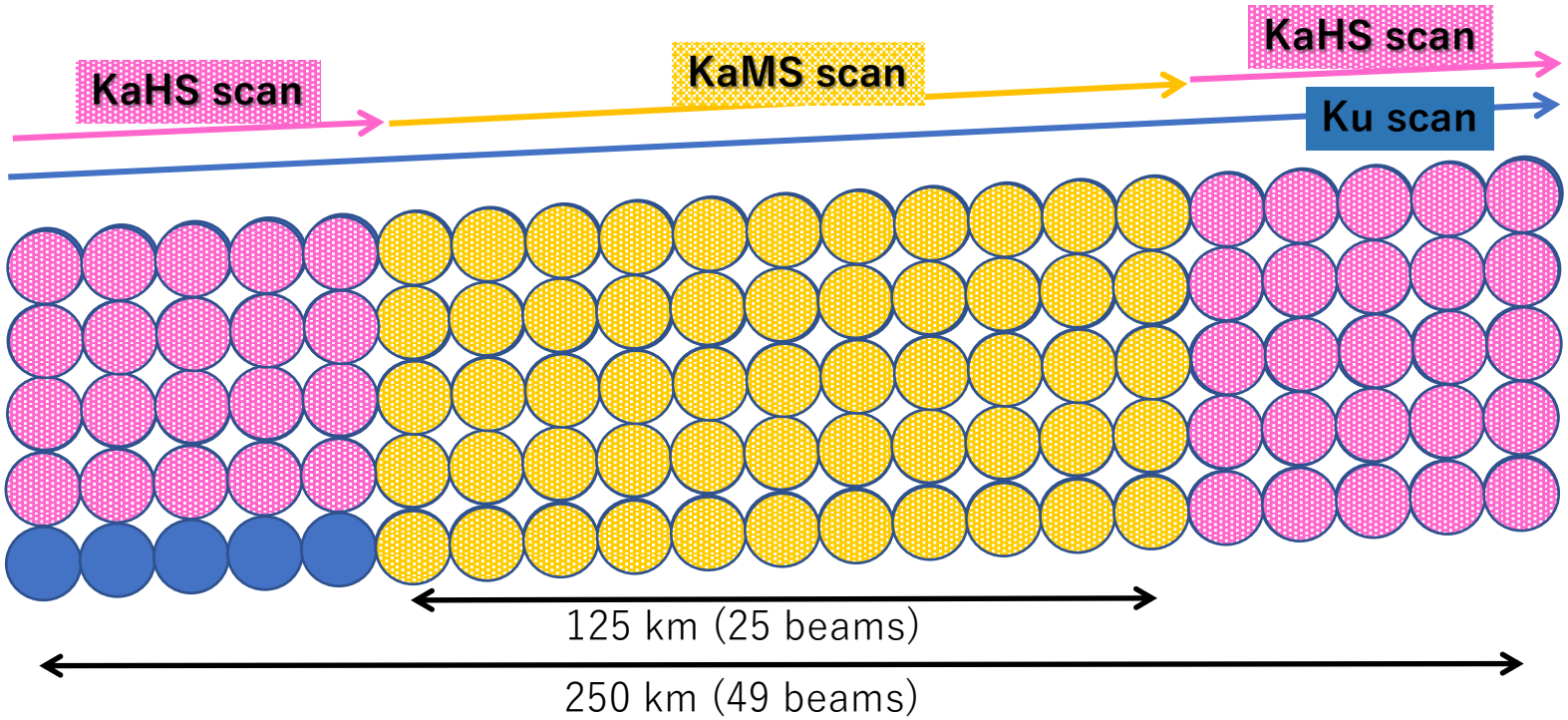


DPR scan pattern after 21 May 2018

Ku footprint (250km swath with 49 beams)

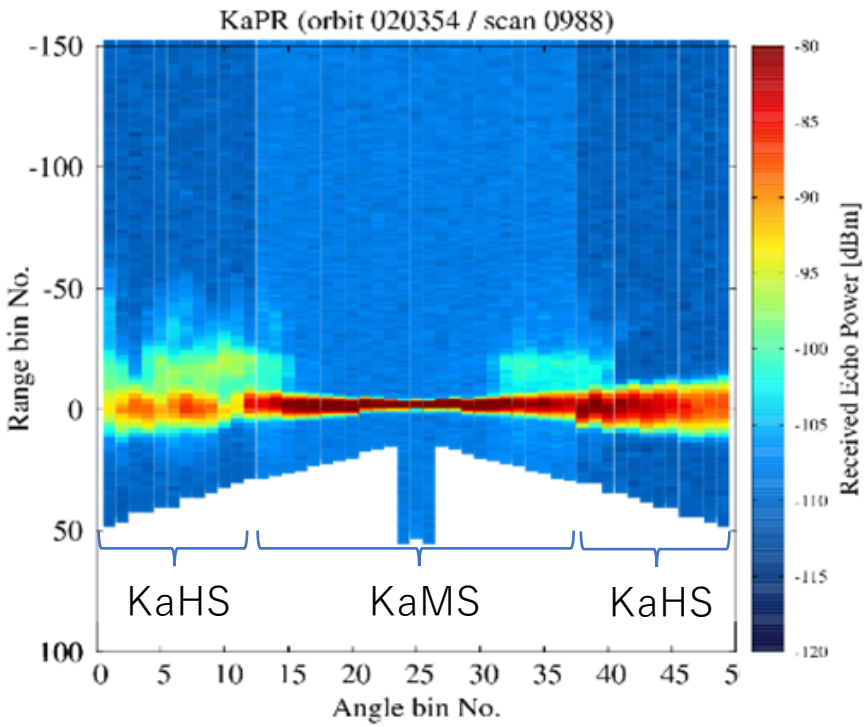
Ka footprint (matched with Ku in inner swath, 250m range res., low sensitivity)

Ka footprint (matched with Ku in outer swath, 500m range res., high sensitivity)

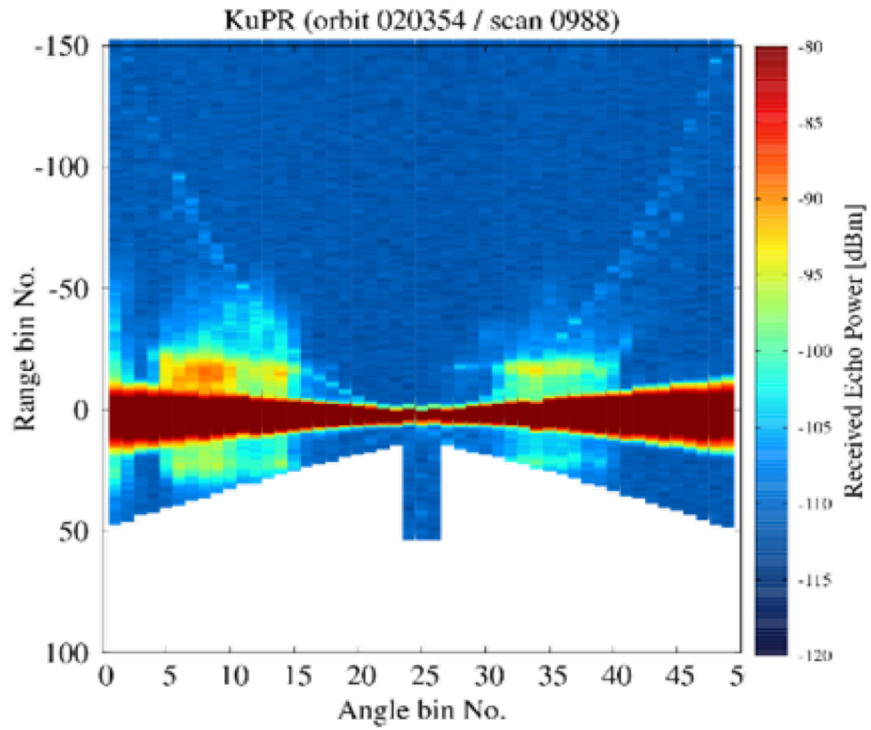


Example of KaPR scan over the full swath

KaPR



KuPR

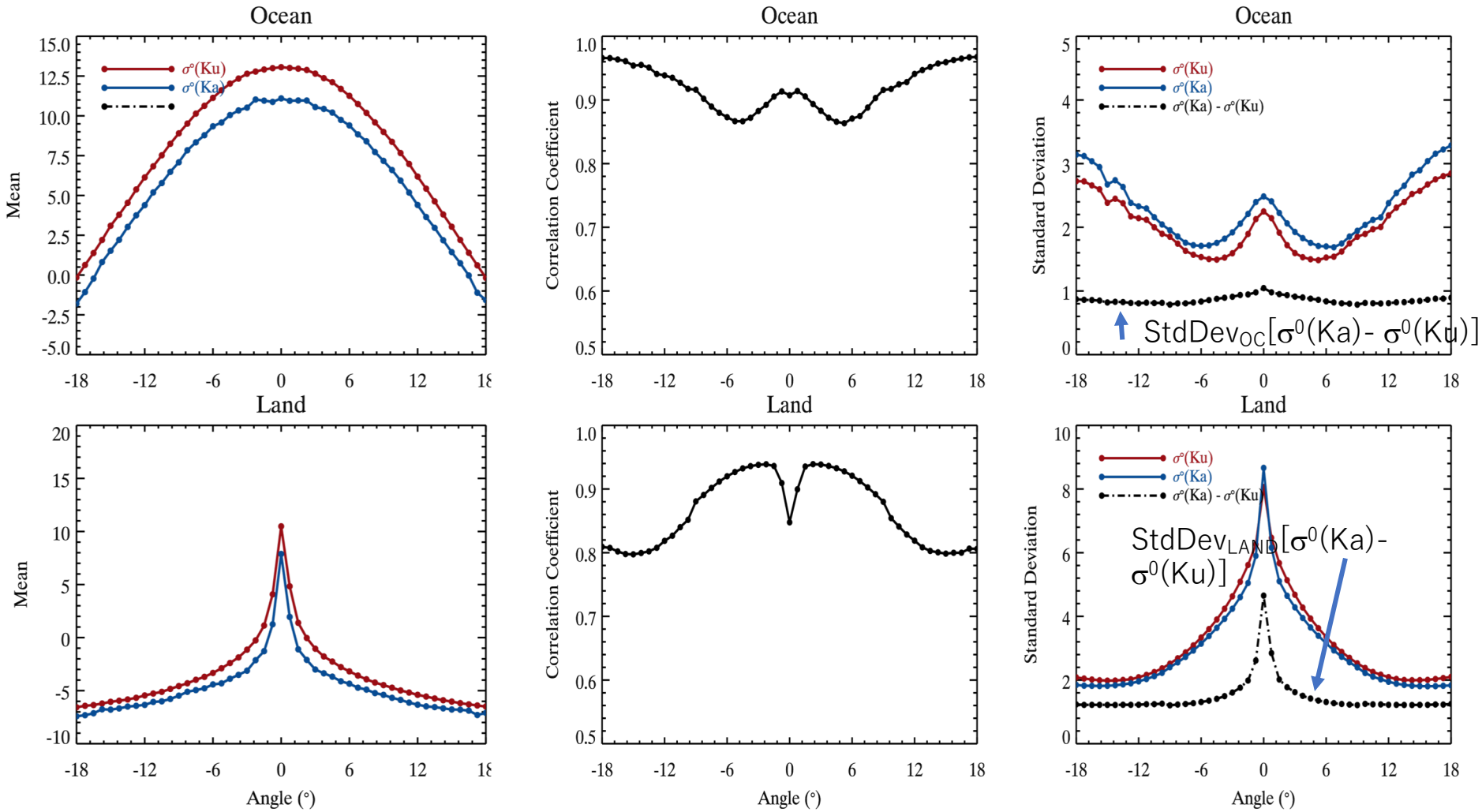


Use of KaPR data in the outer swath

- Dual-frequency information can be used to improve:
  - Accuracy of precipitation rate estimates
  - PIA estimates by Surface Reference Technique (SRT)
  - Storm classification: e.g., detection of bright band
  - Detection of Ice precipitation (snow, graupel, hail)
    - flagHeavyIcePrecip
    - flagSurfaceSnowfall
  - Mitigation of surface clutter and rain/no-rain judgment
- May extend the observable range close to the surface

New scan

New scan Pattern Ex.(06/2018)

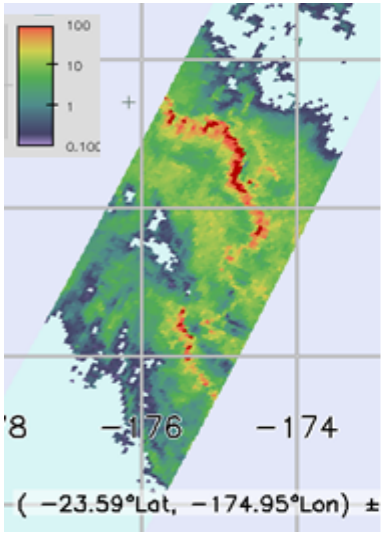


Identification of melting top by DFR in stratiform precipitation

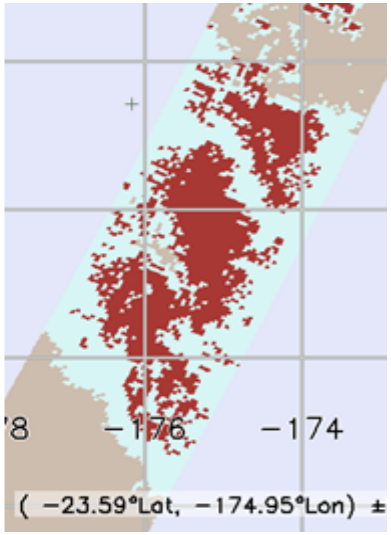
Poster 249

- Detectability of BB degrades with off-nadir angle due to the smearing effect.

Precip. Rate at E surface



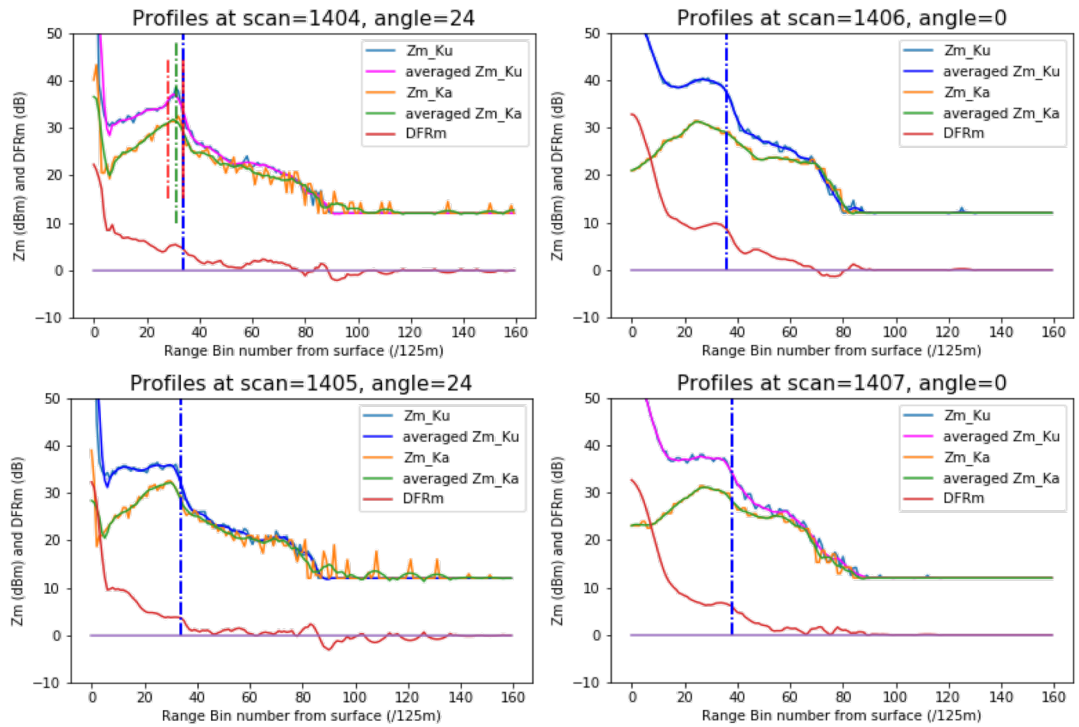
BB flag



1709280525, scan=1400-

swath center

swath edge



Melting layer top by DFR method

Bright-band center by standard method

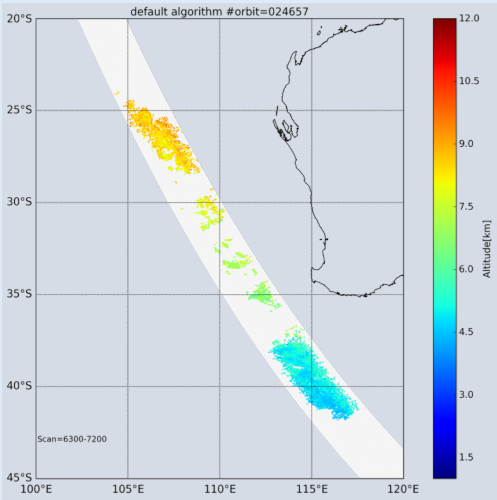
BB top and bottom by standard method

Identification of melting top in stratiform precipitation

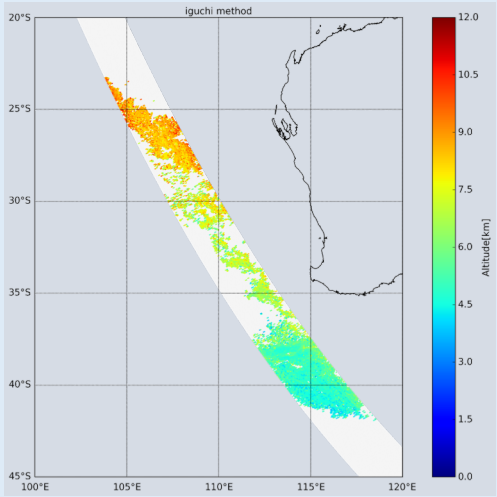
- Detectability of a bright band degrades with off-nadir angle, especially near scan edges due to the smearing effect.
- DFRm method can identify the melting top in stratiform precipitation even when there is no clear bright band.
- Will take advantage of the KaHS new scan pattern.

Detection of a melting layer and its top height

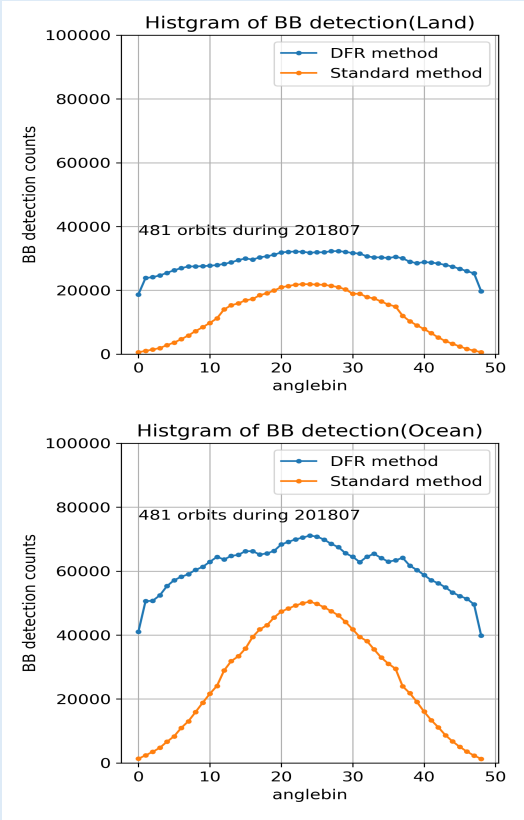
Standard product



DFRm method



Detectability of a melting layer



Land

Ocean

Future plans for V07 development

- To cope with the change of the KaHS scan pattern
  - Dual-frequency algorithm must be applied to data over the full-swath.
  - Improvements are expected in the following points:
    - PIA estimates from DSRT
    - Detection of melting layer using DFR data
    - Rain/no-rain judgment
    - Sidelobe clutter mitigation
    - Flags (FlagHeavyIcePrecip, FlagSurfaceSnow) expansion to full swath
- Improvement of V06
  - Solver module (DSD model, R-Dm relation, data base, particle shape, etc.)
  - rain/no-rain judgment
  - Use of radiometric information from DPR (over ocean)
  - SRT
- Introduction of new classes in precipitation type
  - eg. Frontal, orographic, etc.
- Addition of new flags
  - Mirror image warning

Thank you for your attention