

Hydrometeor Type Validation between EarthCARE Cloud Profiling Radar (CPR) and GPM DPR Observations

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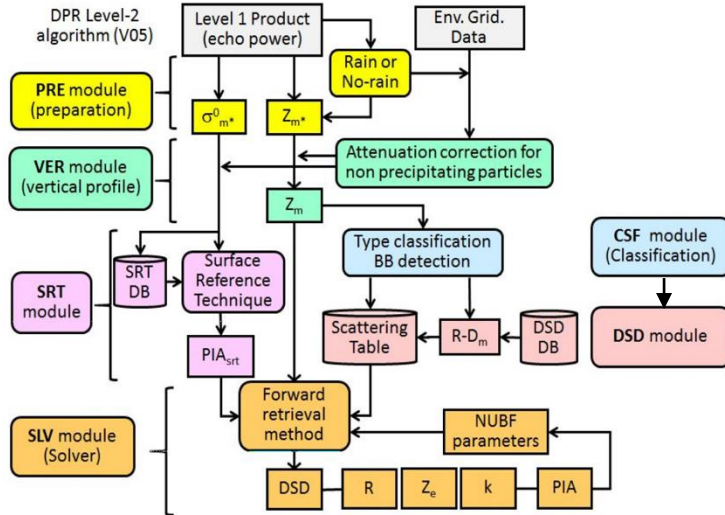
IPWG-12 Workshop
Kraków, Poland
7-10 July 2026

Outline

- New hydrometeor identification product is now available in Version 8 of GPM DPR level-2 algorithm since April 2026.
- EarthCARE CPR level 2 algorithm (incorporating BC version) is used in the validation with DPR.
- Six cases from November 2025 to January 2026 are cross validated between CPR and DPR for hydrometeor products. Three of them are illustrated in this presentation.

Background

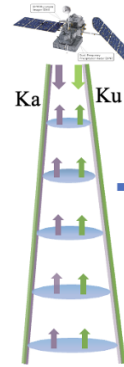
GPM DPR hydrometeor products



Flowchart of GPM DPR level 2 algorithm
(from GPM DPR ATBD, 2021)

- Hydrometeor profiling algorithm is a new featured in the classification module in Version 8 of GPM-DPR level-2 algorithm now available to public.
- Algorithm is developed using products (Le and Chandrasekar 2017, 2020, 2021, 2023) our team have developed.

MLT: binDFRmMLTop
MLB: binDFRmMLBottom
Snow flag: flagSurfaceSnowfall
GH flag: flagGraupelHail
Hail flag: flagHail



Algorithm judgement box

Type	MLT
MLB	ML quality
Hail flag	Snow Flag
0°C isotherm	GH flag

Conceptual flow chart for range bin-based hydrometeor classification for DPR.

In level 2 product of CPR, the algorithm performed hydrometeor classification inherited from CloudSat and is extended to CPR. Information of doppler velocity is included for the hydrometeor type classification for CPR (EarthCARE JAXA level 2 Algorithm Theoretical Basis Document (ATBD) and Irbah et al. (2023)).

EarthCare CPR radar

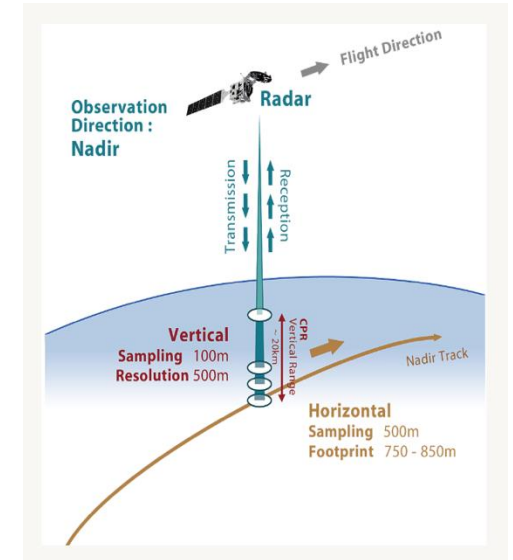


Image:
https://www.eorc.jaxa.jp/EARTHCARE/about/inst_cpr_e.html

Main products for CPR level-2:

CPR_FMR_2A
CPR_CD_2A
CPR_CLD_2A
CPR_TC_2A (target classification products)

Validation between EarthCARE CPR VS GPM DPR

- Six validation cases incorporating BC version from November 2025 to January 2026 are performed. Two sample cases are illustrated here.

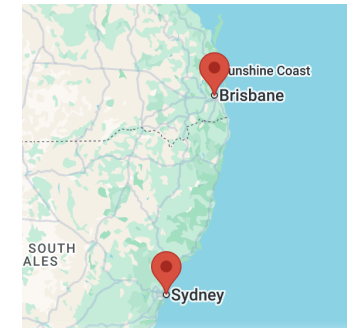
Sample one:

- Date: 2025-11-20
- DPR orbit: 66555
- CPR orbit: 8404F
- Location: This region spans the southwestern Pacific Ocean, separating Australia and New Zealand.



Sample five:

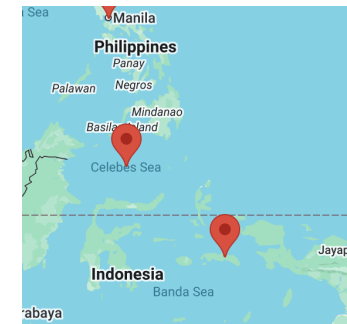
- Date: 2025-11-26
- DPR orbit: 66656
- CPR-8506H-8507A
- Location: Eastern Australia, including parts of the Coral Sea and the Tasman Sea.



- 1) 2025-11-20-DPR-orbit-66555-CPR-8404F
- 2) 2025-11-25-DPR-orbit-66643-CPR-8493DE
- 3) 2025-11-25-DPR-orbit-66645-CPR-8495DE
- 4) 2025-11-26-DPR-orbit-66647-CPR-8497DE
- 5) 2025-11-26-DPR-orbit-66656-CPR-8506H-8507A
- 6) 2026-01-05-DPR-orbit-67267-CPR-9122E

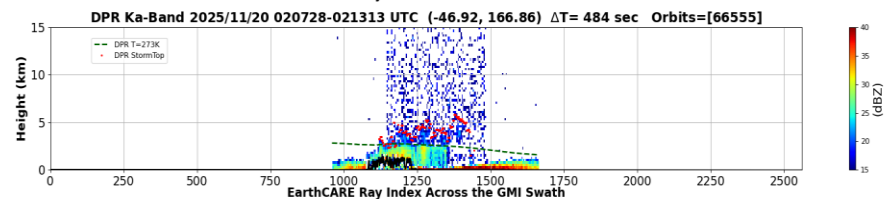
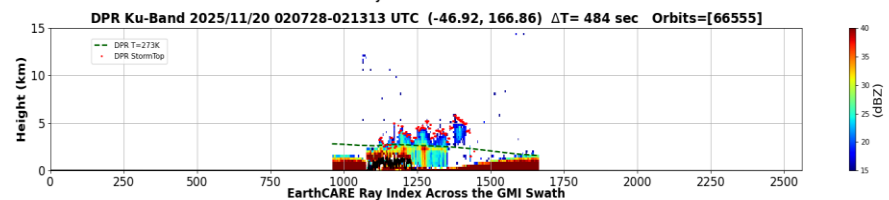
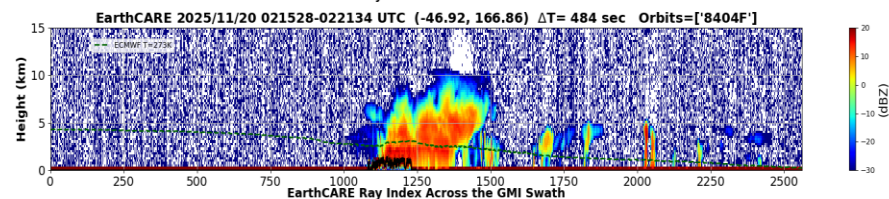
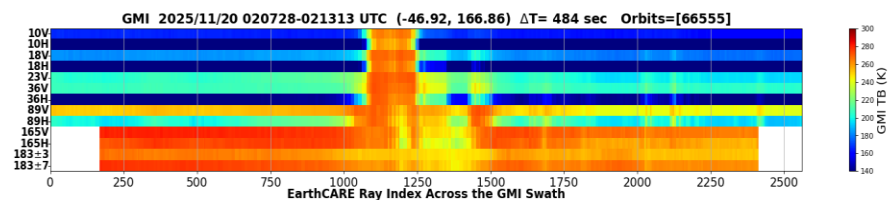
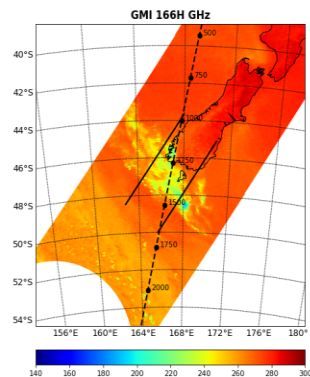
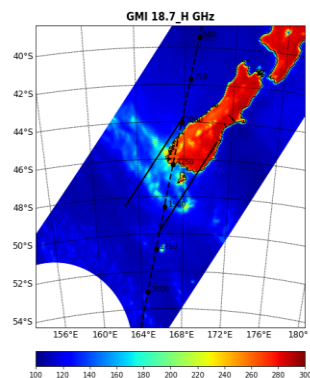
Sample six:

- Date: 2026-01-05
- DPR orbit: 67267
- CPR orbit : 9122E
- Location: It captures the southern half of the Philippines and the northeastern islands of Indonesia, surrounding a series of highly active tropical seas.



Sample one:

- Date: 2025-11-20
- DPR orbit: 66555
- CPR orbit: 8404F
- Location: Near New Zealand



CPR image

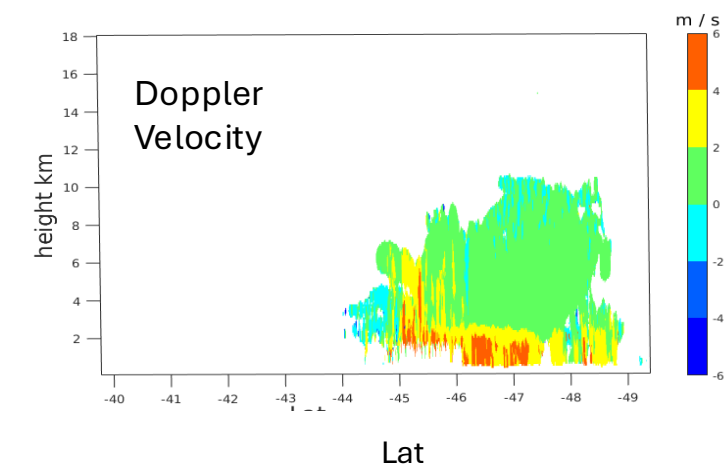
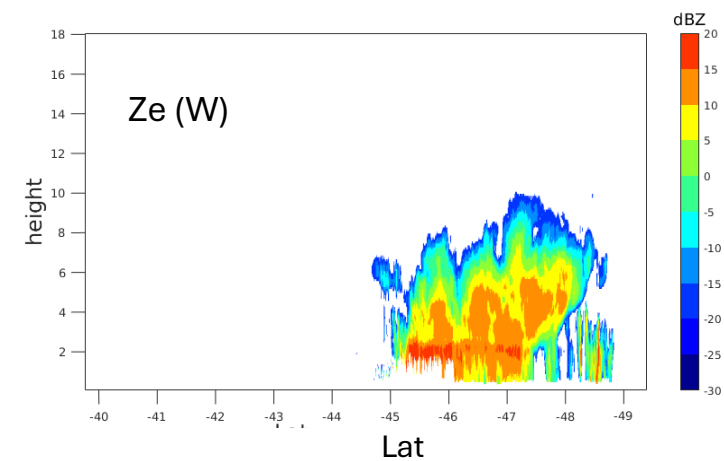
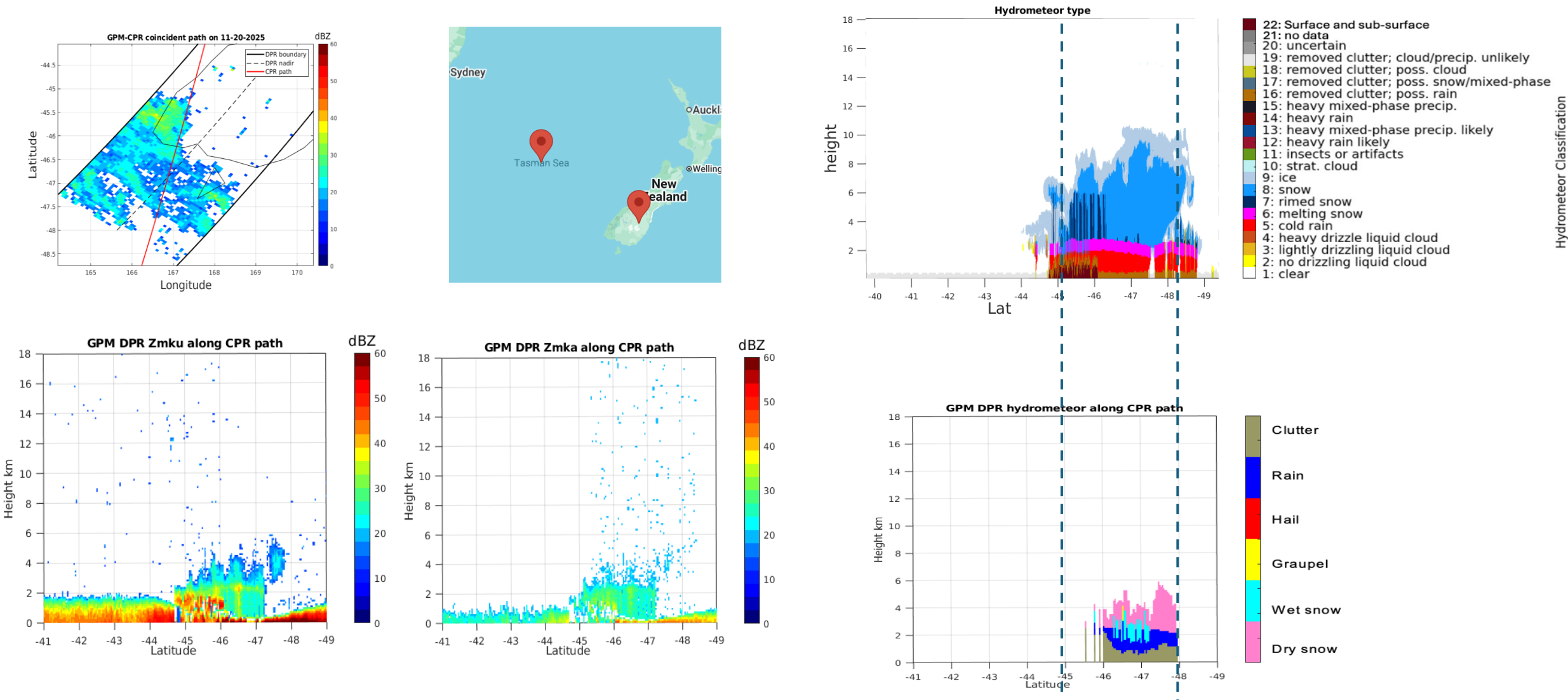


Image from CPR DPR coincident database, JAXA

DPR along path images

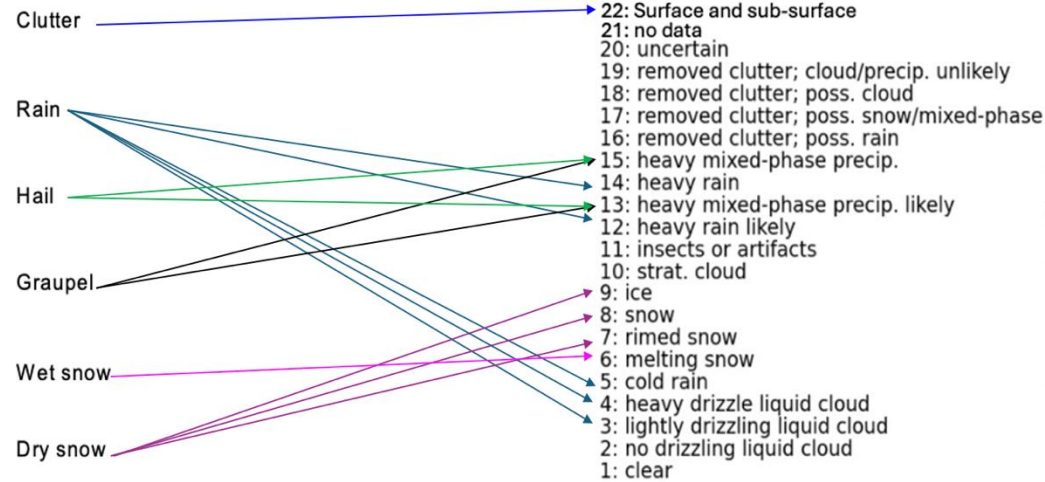


Statistics study

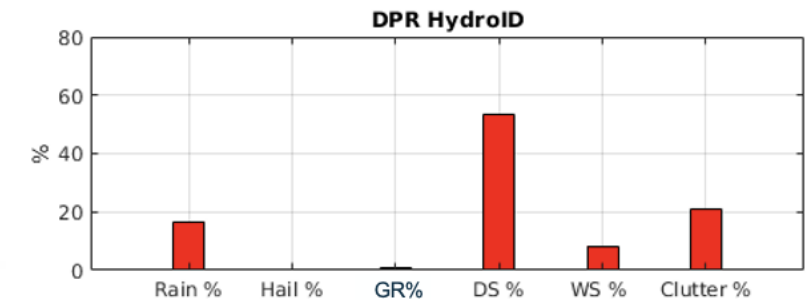
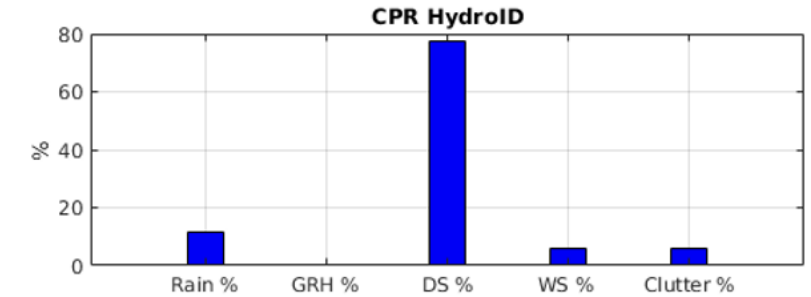
Corresponding hydrometeor classes between DPR and CPR

DPR Hydrometeor classes in level2 Classification module (V8)

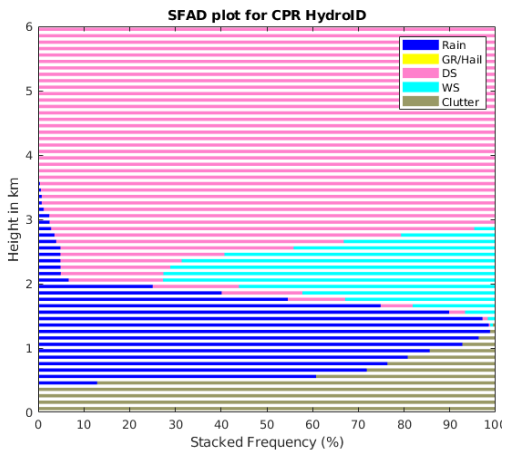
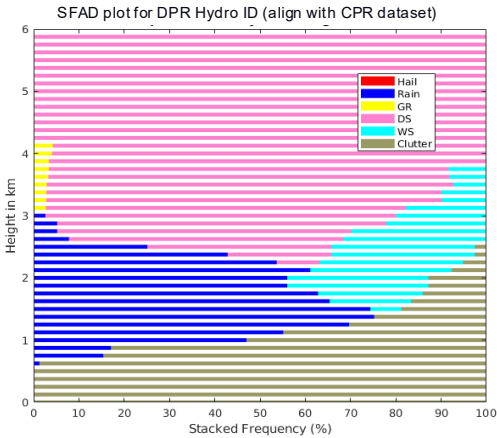
Hydrometeor classes in CPR level2 TC files



- GRH in CPR includes Graupel and Hail.



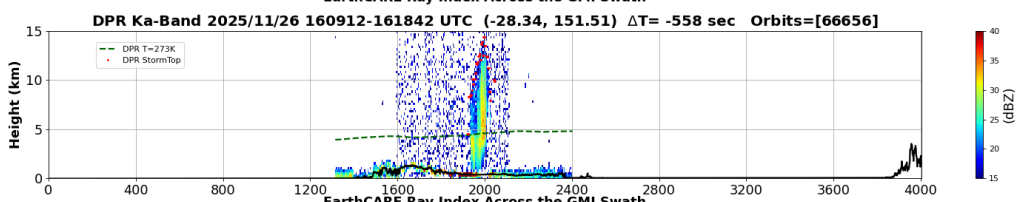
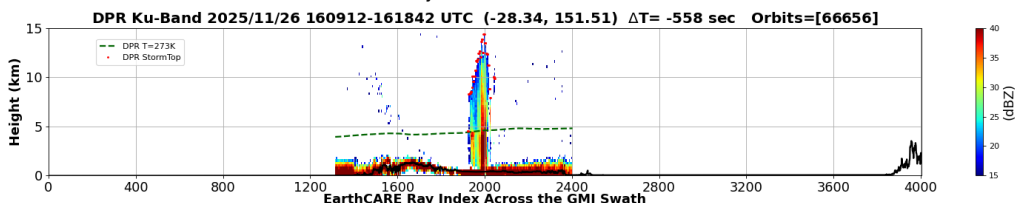
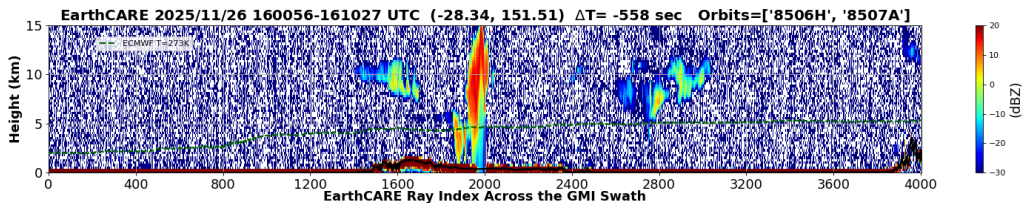
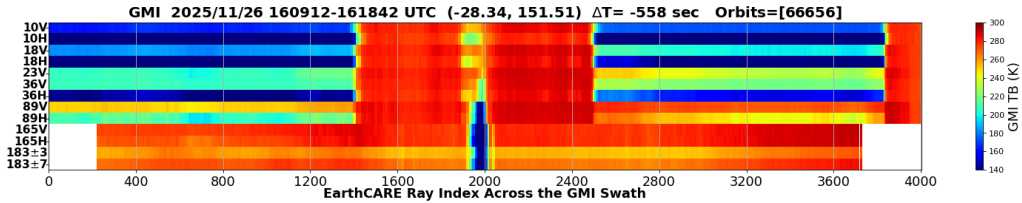
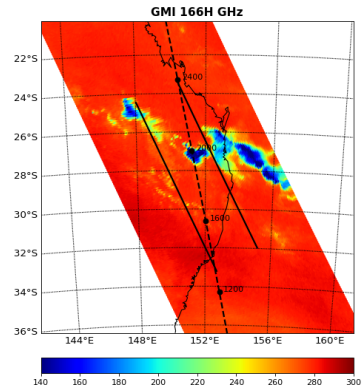
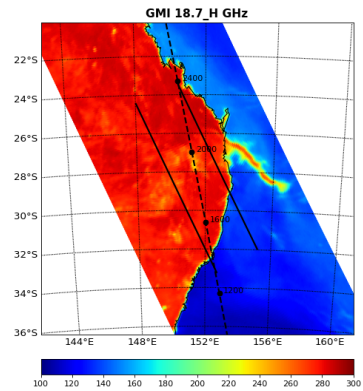
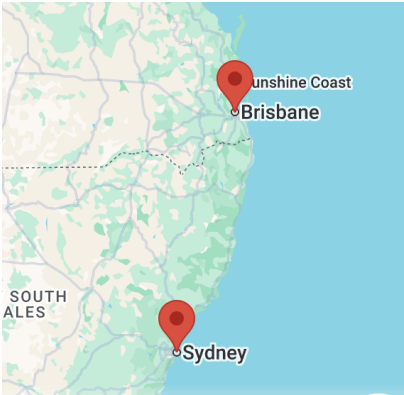
Percentage is calculated based on each category versus whole event.



The Stacked Frequency by Altitude Diagrams (SFADs) represent the relative frequency of each identified hydrometeor type at each height.

Sample five:

- Date: 2025-11-26
- DPR orbit: 66656
- CPR-8506H-8507A
- Location: Eastern Australia, including parts of the Coral Sea and the Tasman Sea.



CPR images

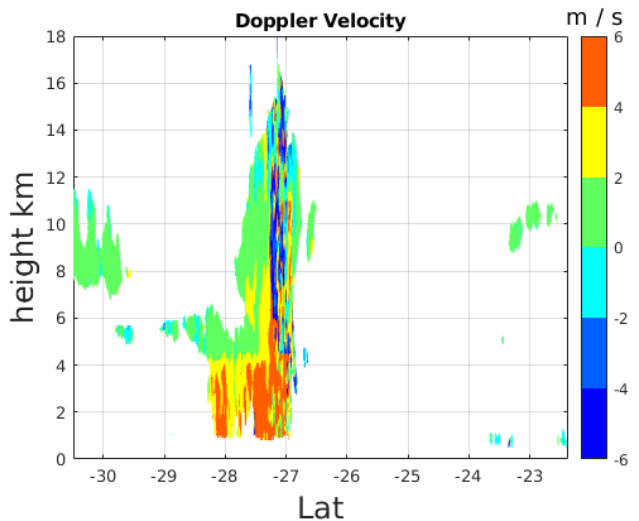
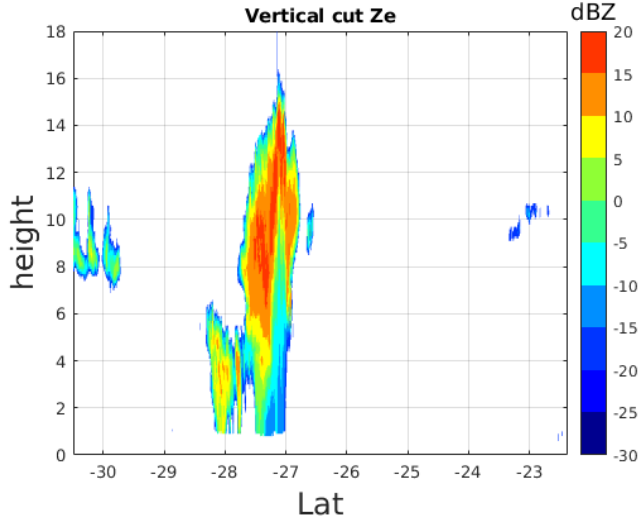
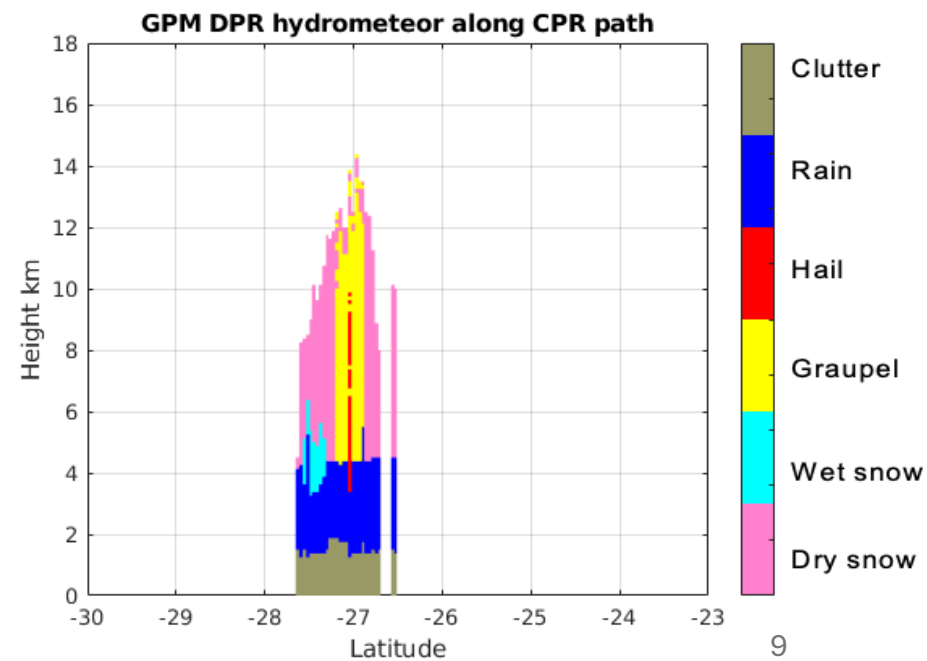
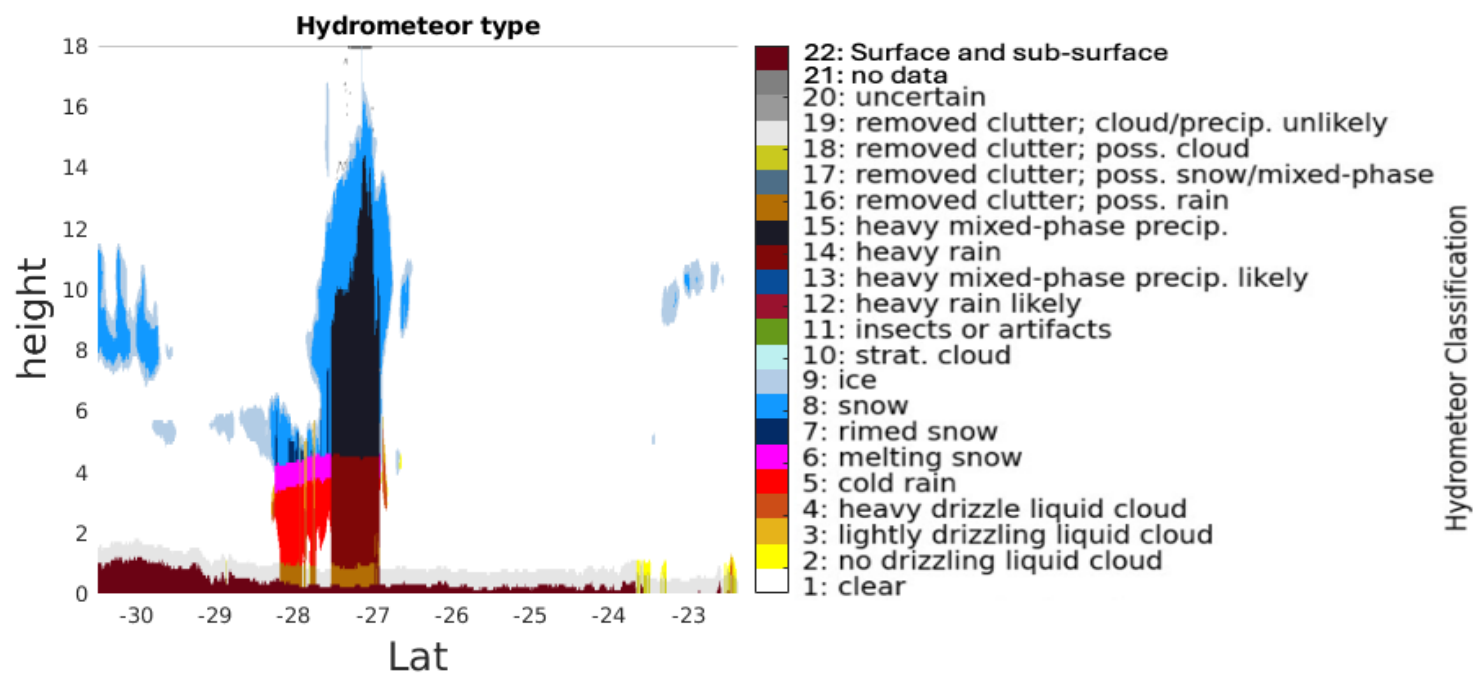
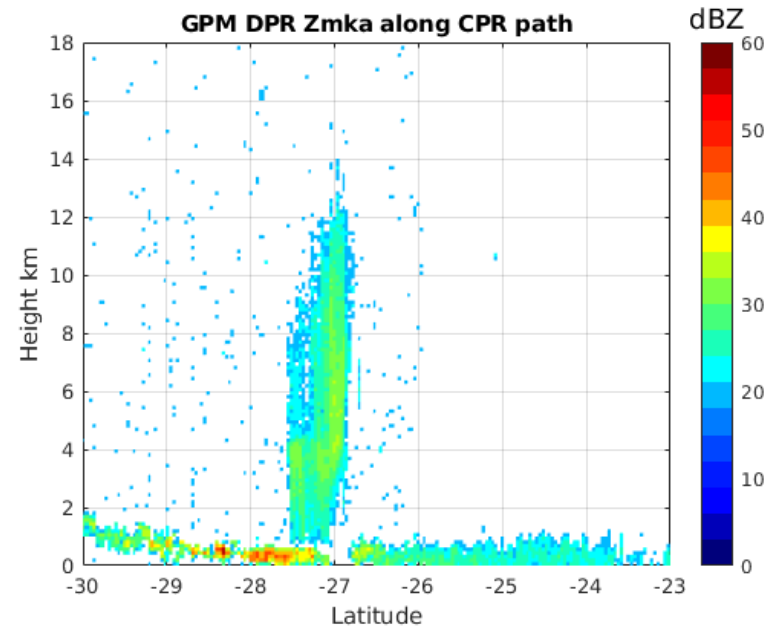
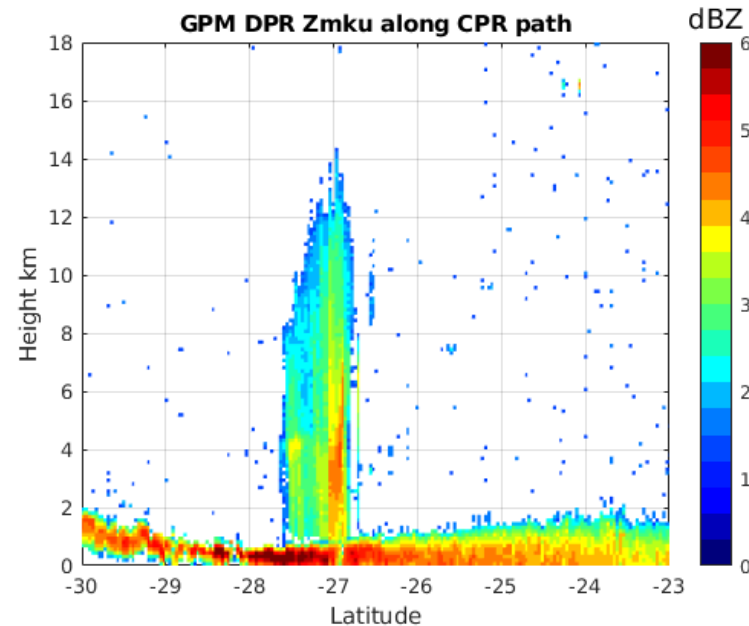
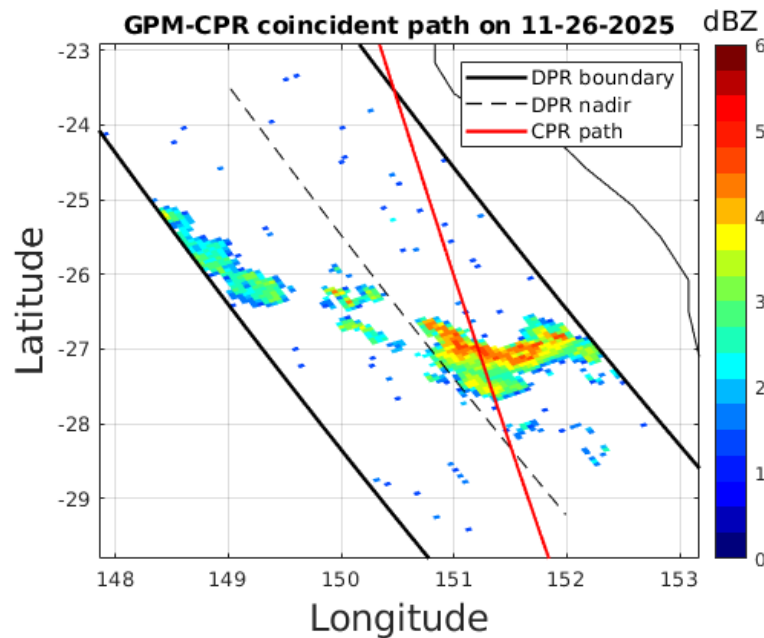
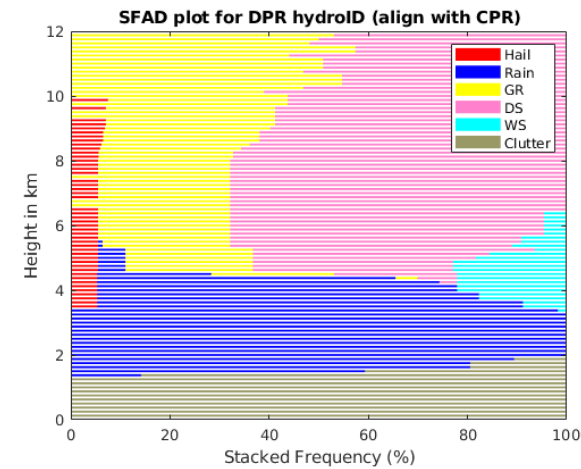
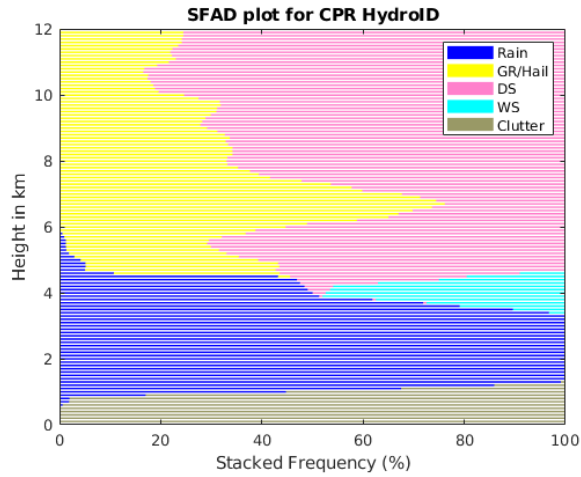


Image from CPR DPR coincident database, JAXA



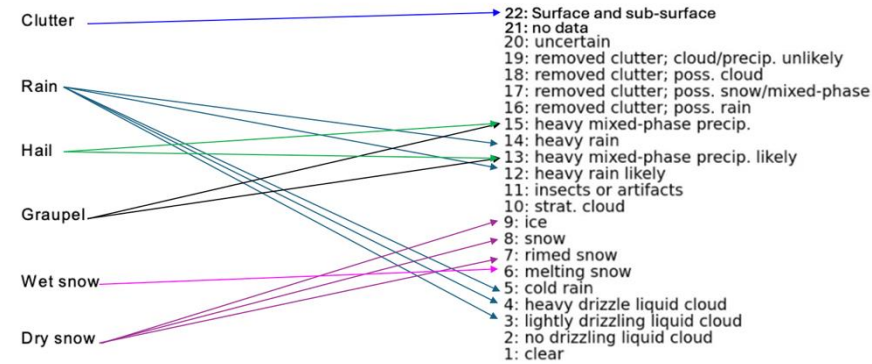
Statistics study



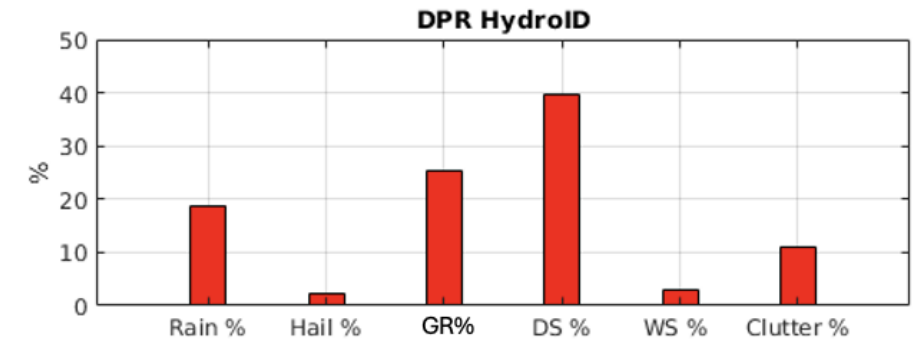
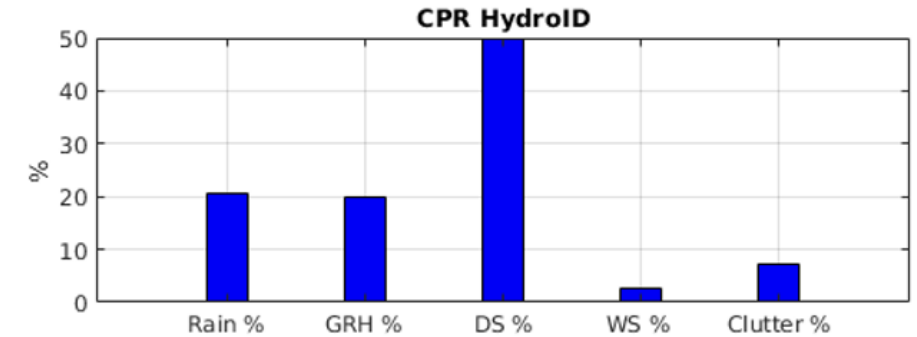
Corresponding hydrometeor classes between DPR and CPR

DPR Hydrometeor classes in level2 Classification module (V8)

Hydrometeor classes in CPR level2 TC files



- GRH in CPR includes Graupel and Hail.



The Stacked Frequency by Altitude Diagrams (SFADs) represent the relative frequency of each identified hydrometeor type at each height.

Sample six:

- Date: 2026-01-05
- DPR orbit: 67267
- CPR orbit : 9122E
- Location: southern half of the Philippines and the northeastern islands of Indonesia.

CPR image

Ze at W band

Doppler velocity

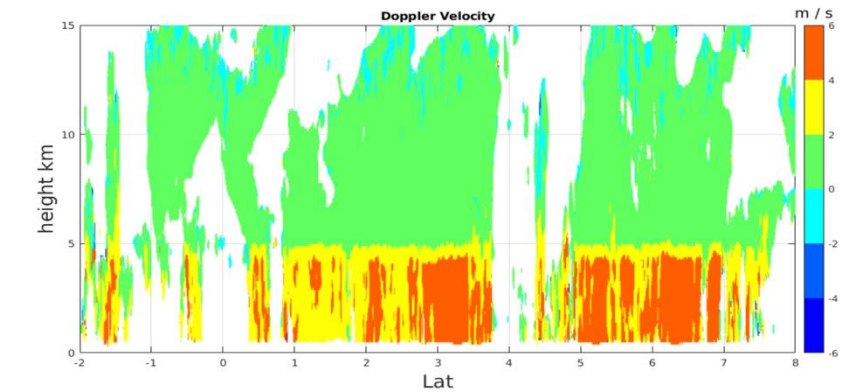
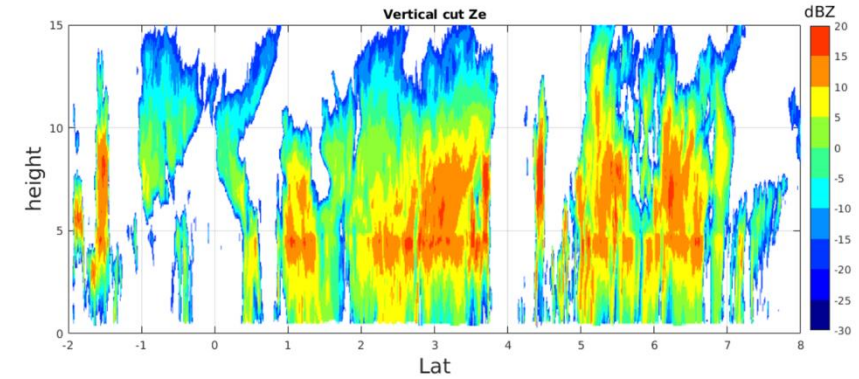
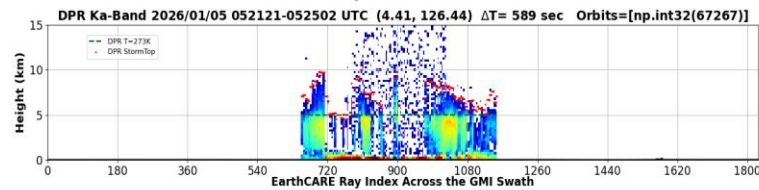
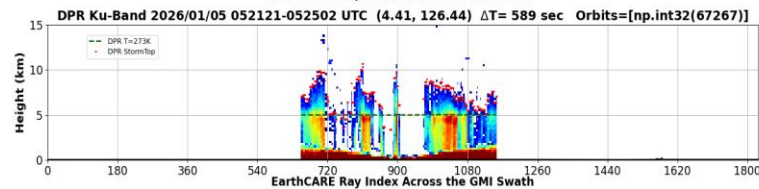
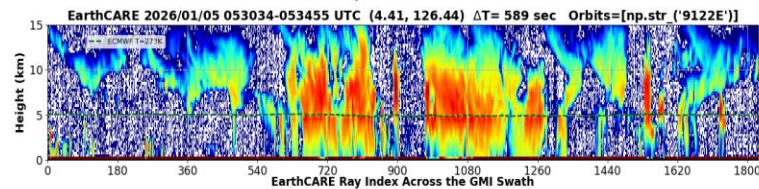
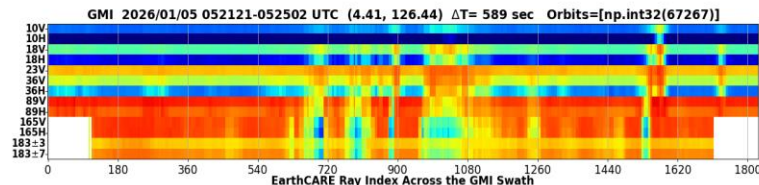
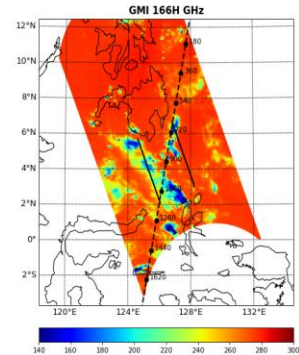
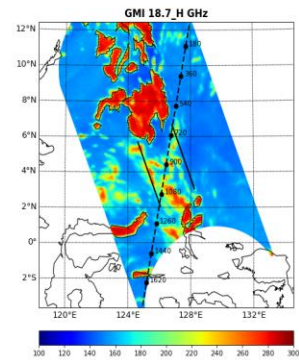
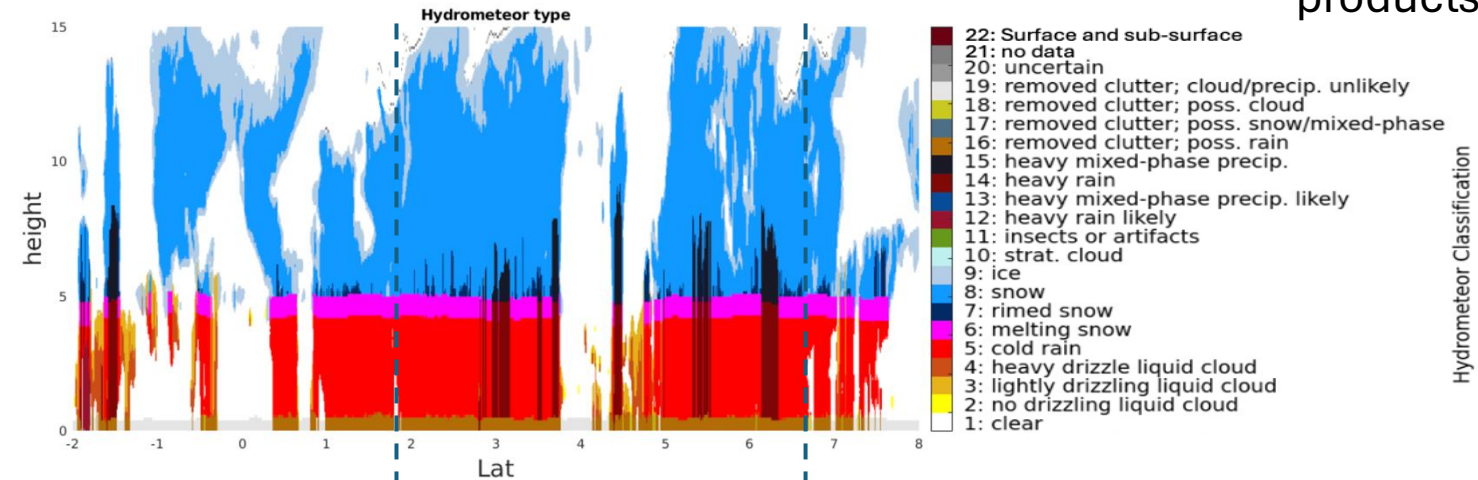
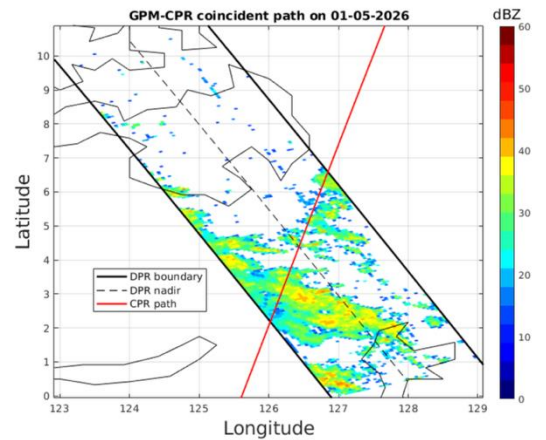
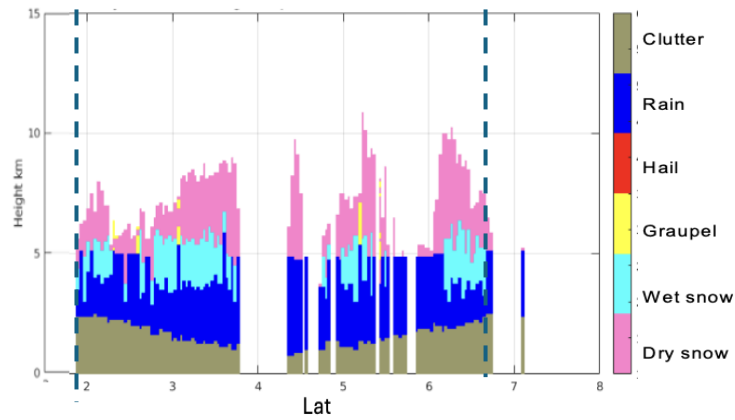
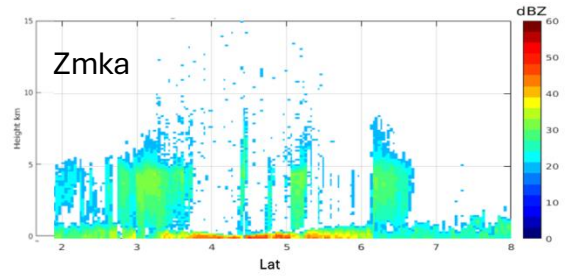
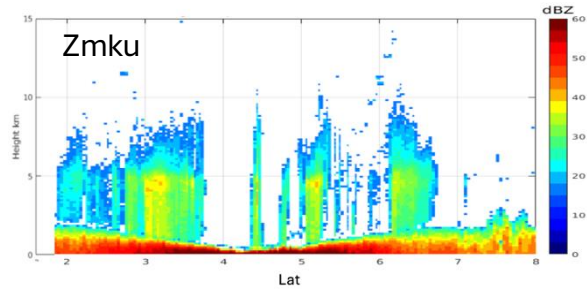


Image from CPR DPR coincident database, JAXA

DPR along path images



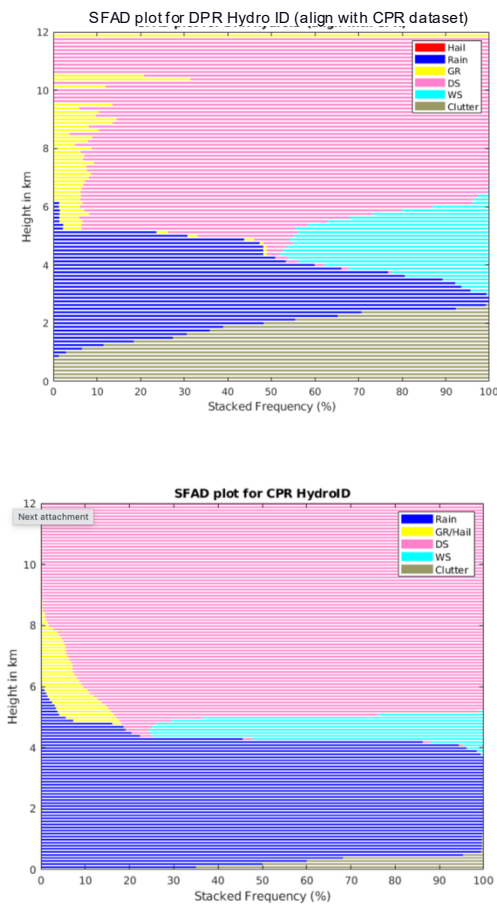
DPR hydrometeor products



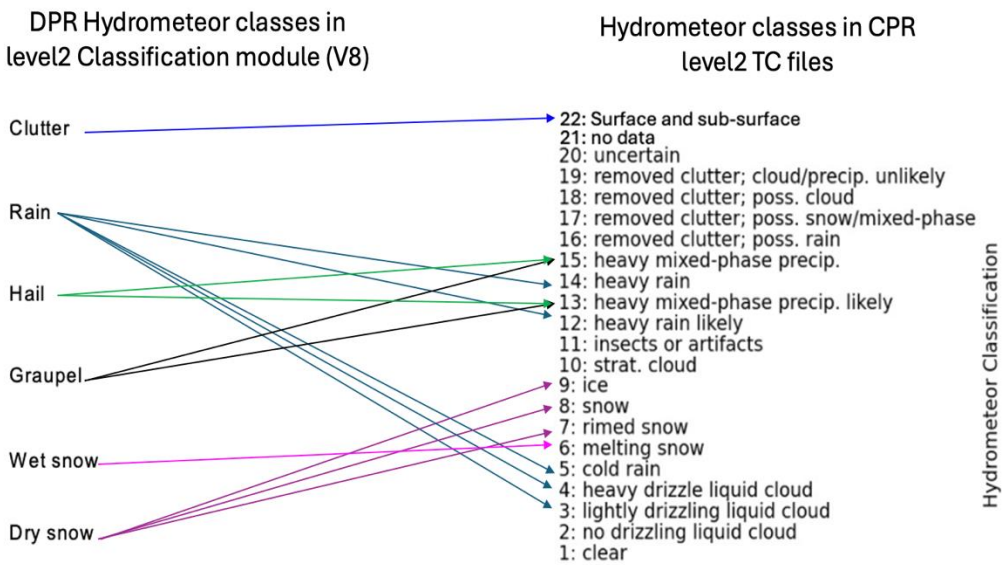
CPR hydrometeor products



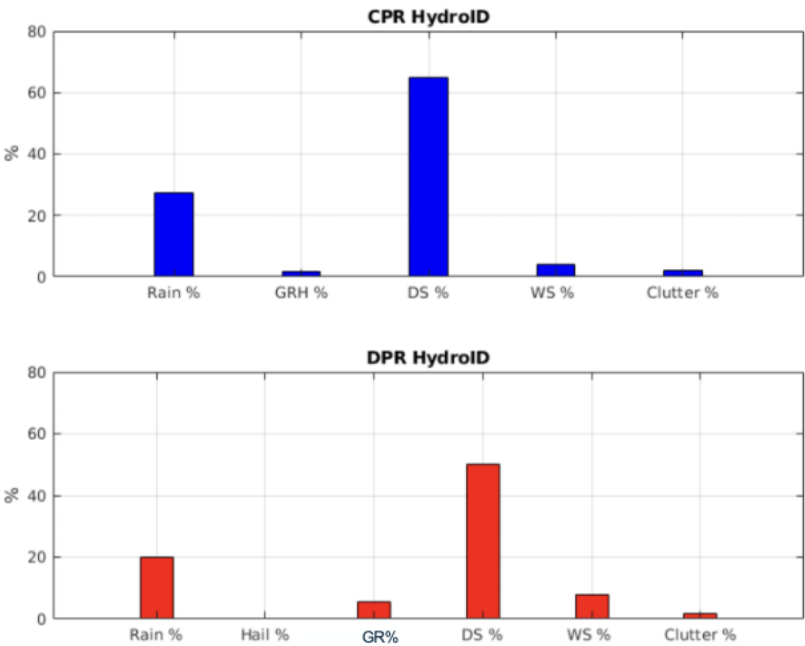
Statistics study



Corresponding hydrometeor classes between DPR and CPR



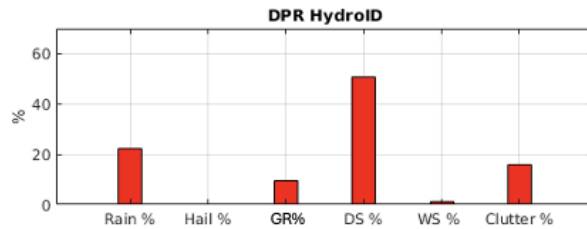
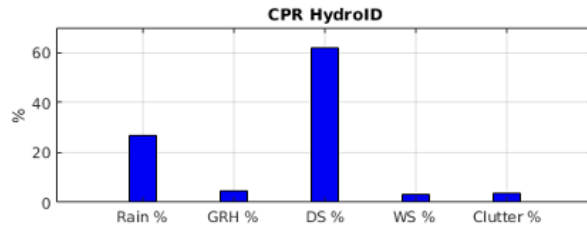
- GRH in CPR includes Graupel and Hail.



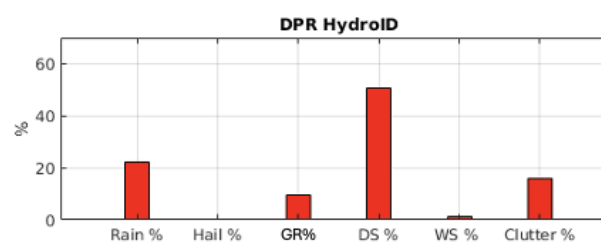
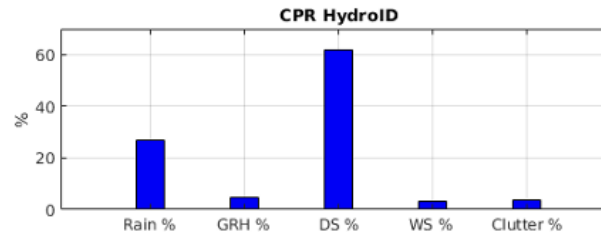
The Stacked Frequency by Altitude Diagrams (SFADs) represent the relative frequency of each identified hydrometeor type at each height.

Statistics plots for 3 other cases not illustrated

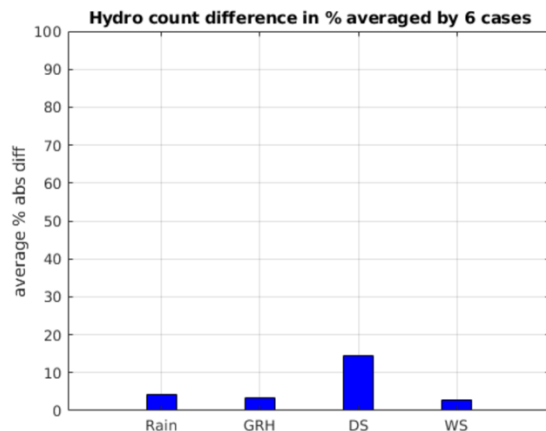
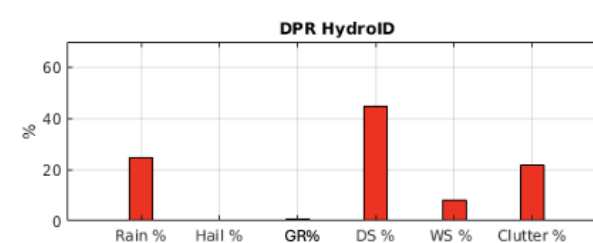
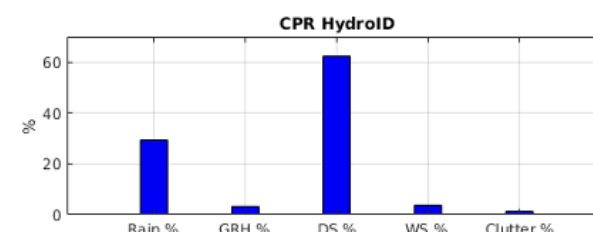
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8493DE



2025-11-25-DPR-orbit-66645-CPR-
8495DE



2025-11-26-DPR-orbit-66647-CPR-
8497DE



- The difference in % of 4 major types (rain, Graupel/hail, dry snow and wet snow) between CPR and DPR on 6 validation cases are around 5%, 4%, 15% and 3% respectively.
- GRH in CPR corresponds to Hail and graupel in DPR category.
- Major difference comes from dry snow category.
- In general, the comparison is promising.



Summary

- Cross validations for CPR level 2 products and GPM DPR hydrometeor products are illustrated. Six cases are chosen from November 2025 to January 2026. Statistics show promising results.
- More detailed validations will be performed in the near future.