



EarthCARE 2026 Science and Validation workshop

8–12 June 2026 | Rhodes House | Oxford, UK

Cross-Validation between EarthCARE Cloud Profiling Radar (CPR), GPM DPR and Ground Dual-polarization Observations

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- ❑ This study is focused on cross validations between:
 - ❑ EarthCARE CPR level 2 products and GPM DPR Hydrometeor identification products.
 - ❑ EarthCARE CPR level 2 products and S band dual-pol weather radar hydrometeor types.
- ❑ CPR level 2 algorithm (incorporating BC version) is used in the validation. Six cases from November 2025 to January 2026 are cross validated between CPR and DPR.
- ❑ One validation case is chosen between CPR and WSR-88DP KFTG and KCYS on 04-27-2026.
- ❑ The validations illustrate promising results.

Background

Main products for CPR level-2:

CPR_FMR_2A
CPR_CD_2A
CPR_CLD_2A

CPR_TC_2A (target classification products)

- 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)).

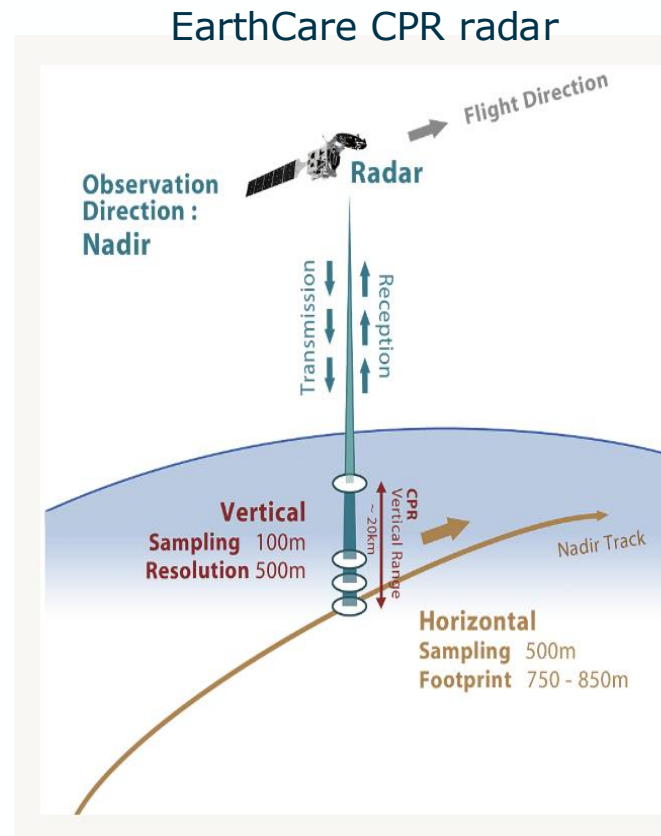
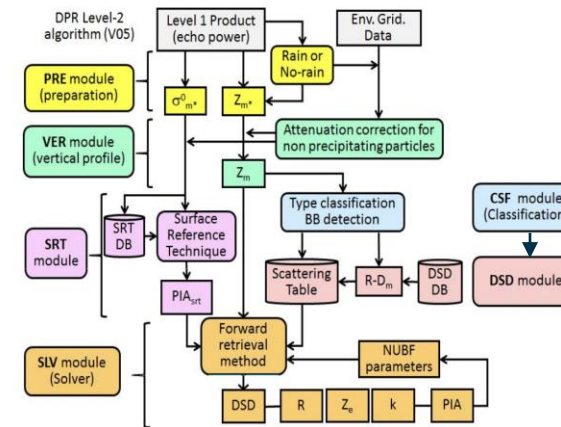


Image: https://www.eorc.jaxa.jp/EARTHCARE/about/inst_cpr_e.html



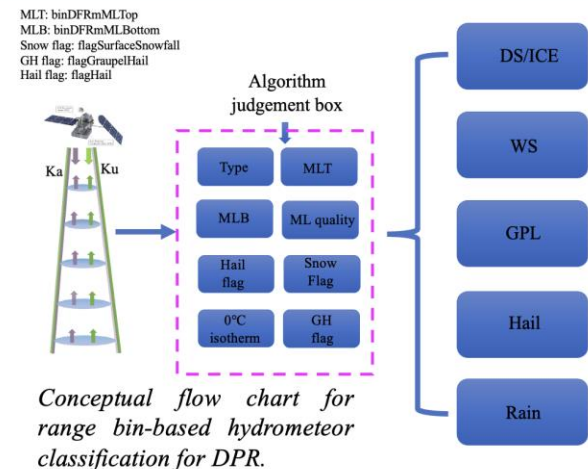
Flowchart of GPM DPR level 2 algorithm (from GPM DPR ATBD, 2021)

Hydrometeor Profiling algorithm is a new feature in **Version 8** for GPM-DPR level-2 algorithm.

The V8 of GPM DPR algorithm is available for public since April 2026.

Algorithm is developed using products (Le and Chandrasekar 2017, 2020, 2021, 2022, 2023) our team have developed.

GPM DPR hydrometeor products



- In current version, five hydrometeor types will be introduced. They are dry snow/ice crystal (DS/ICE), wet snow (WS), graupel (GPL), hail (Hail) and rain (Rain). DS/ICE, GPL and Hail represent low-density, medium-density, high-density particles, respectively. Ground Clutter is also considered as a category.

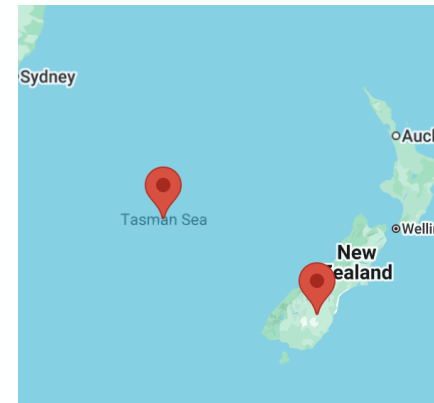
Validation between EarthCARE CPR VS GPM DPR



- 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.



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

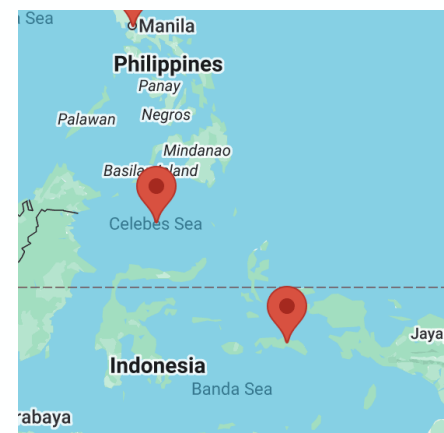
4) 2025-11-26-DPR-orbit-66647-CPR-8497DE

5) 2025-11-26-DPR-orbit-66656-CPR-8506H-8507A

6) 2026-01-05-DPR-orbit-67267-CPR-9122E

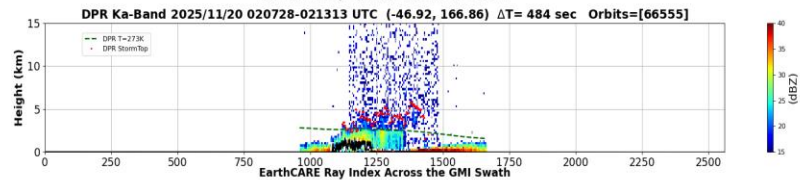
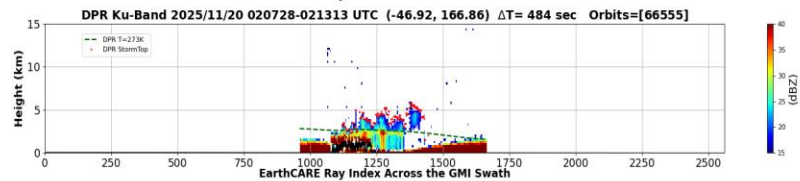
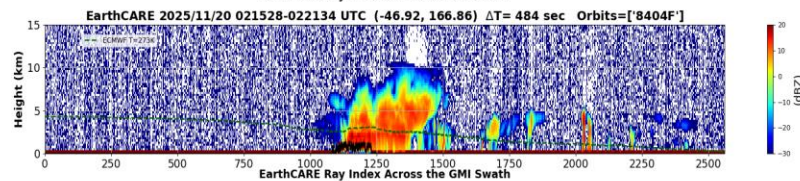
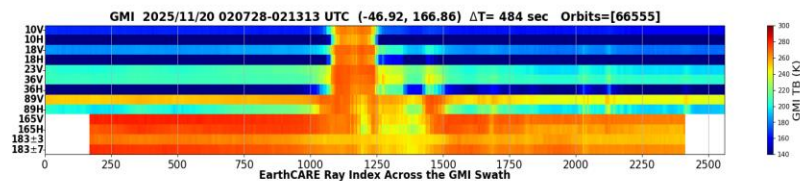
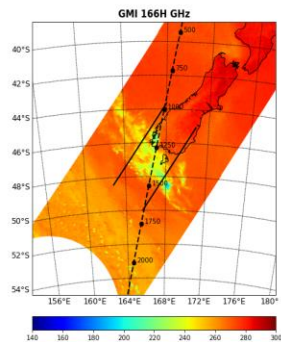
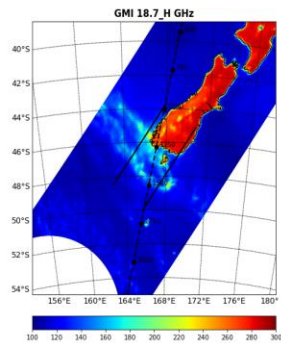
Sample six:

- 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

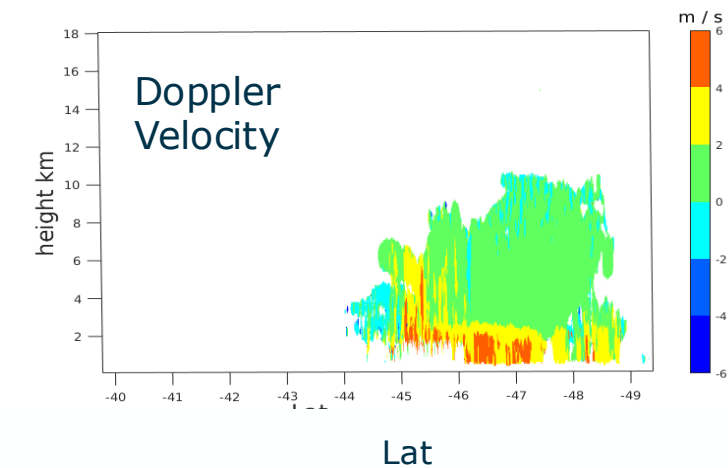
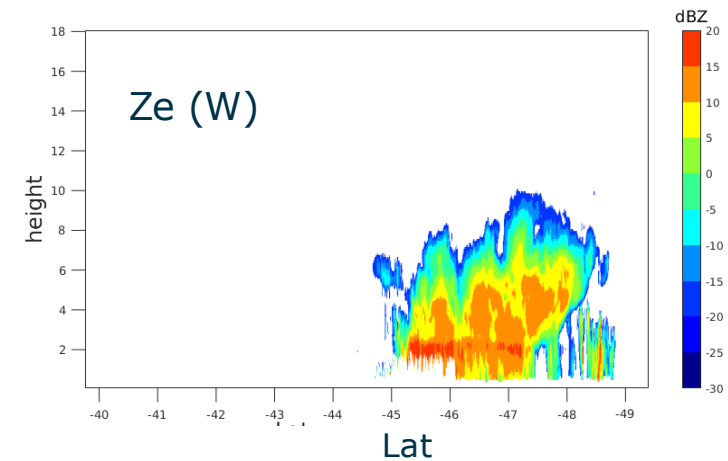
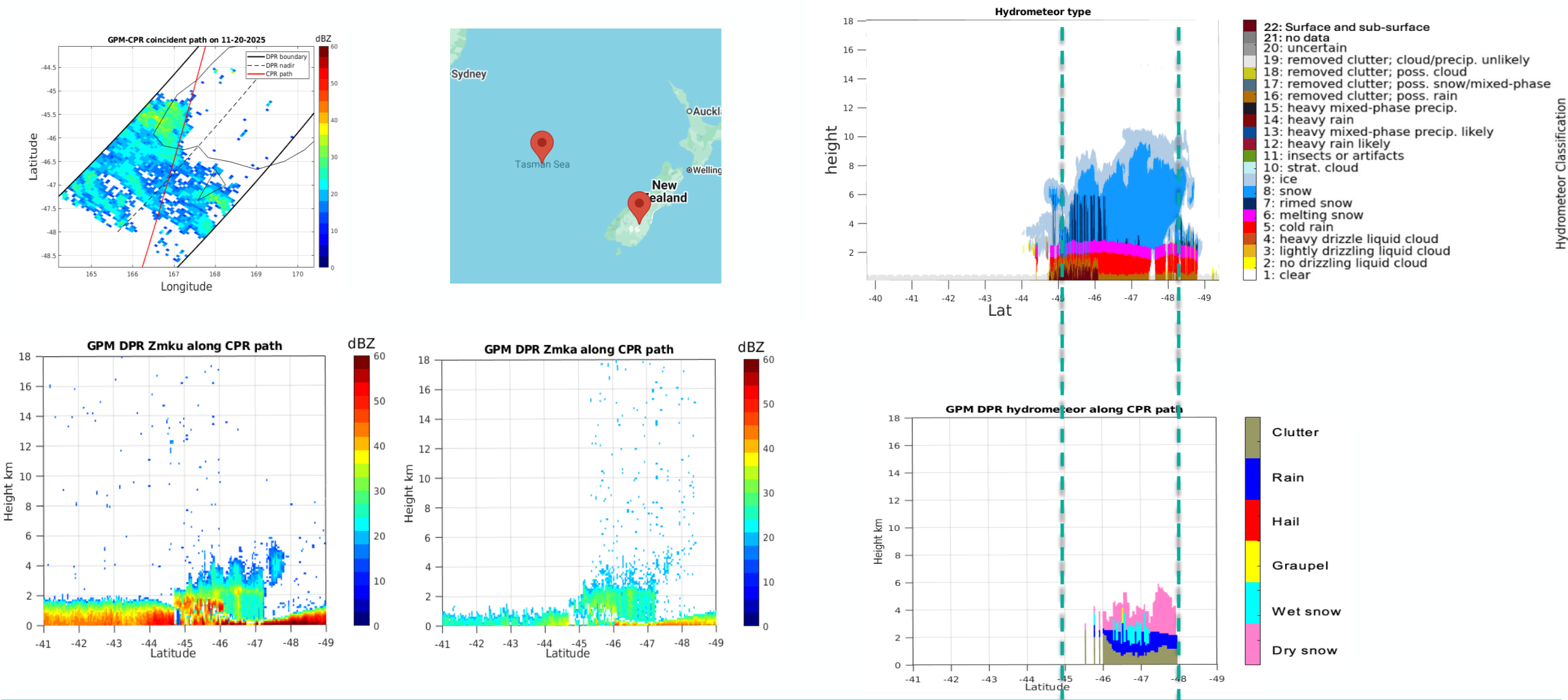
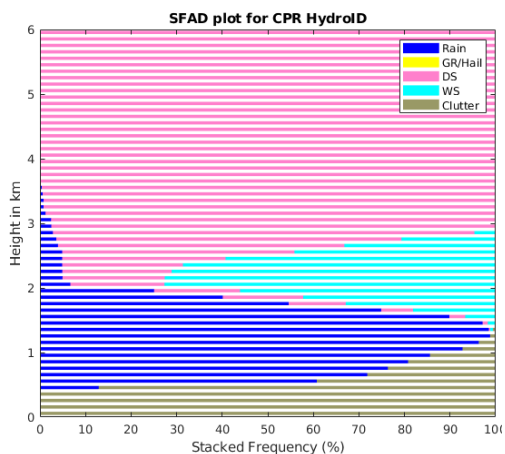
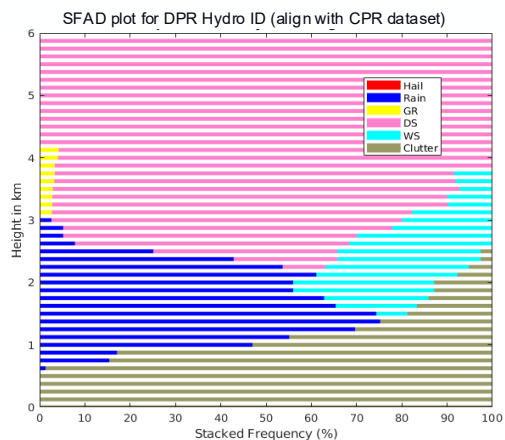


Image from CPR DPR coincident database, JAXA

DPR along path images



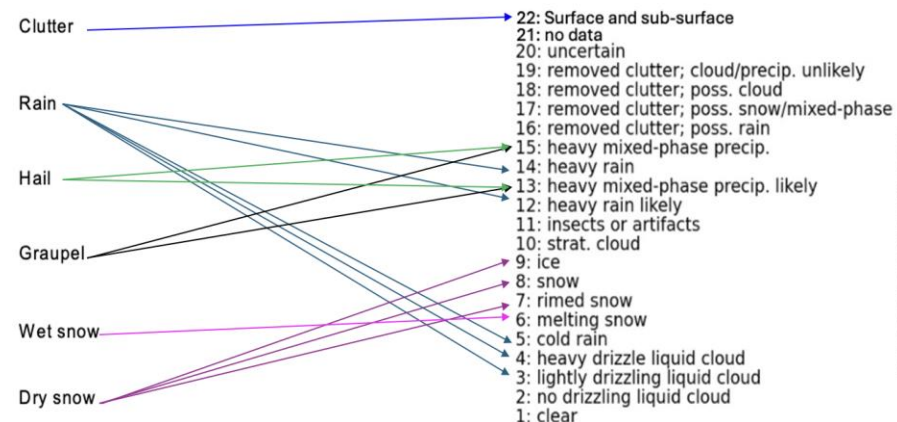
Statistics study



Corresponding hydrometeor classes between DPR and CPR

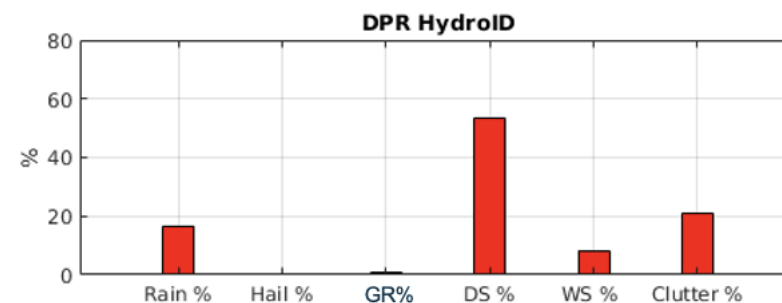
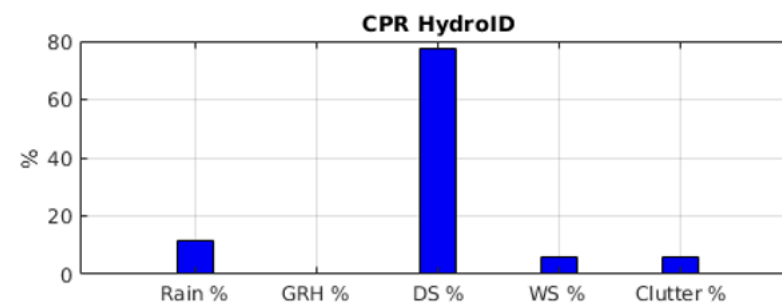
DPR Hydrometeor classes in level2 Classification module (V8)

Hydrometeor classes in CPR level2 TC files



- GRH in CPR includes Graupel and Hail.

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



Percentage is calculated based on each category versus whole event.

Sample six:

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

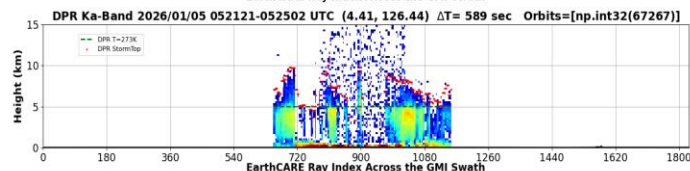
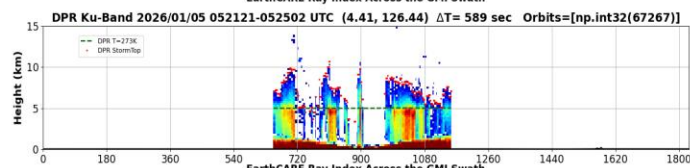
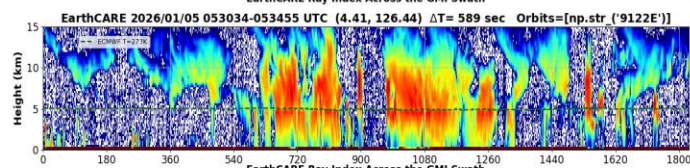
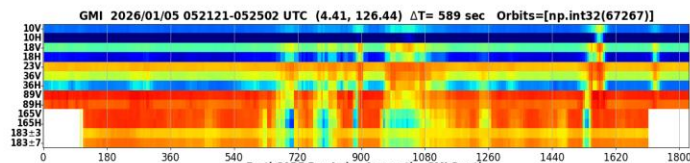
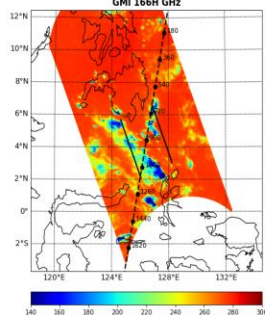
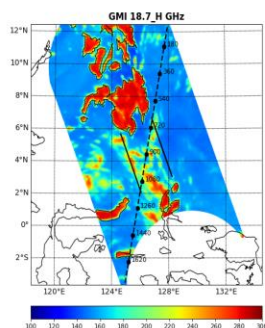
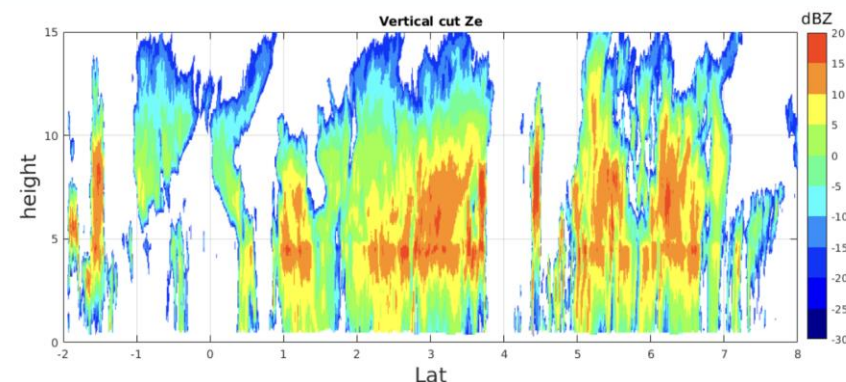


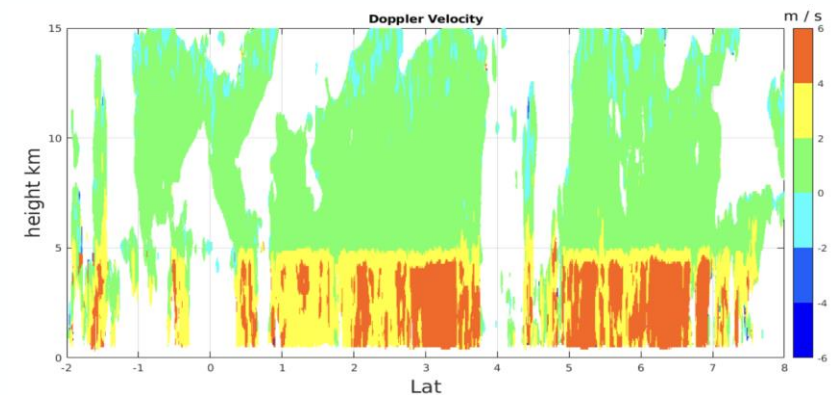
Image from CPR DPR coincident database, JAXA

CPR image

Ze at W band

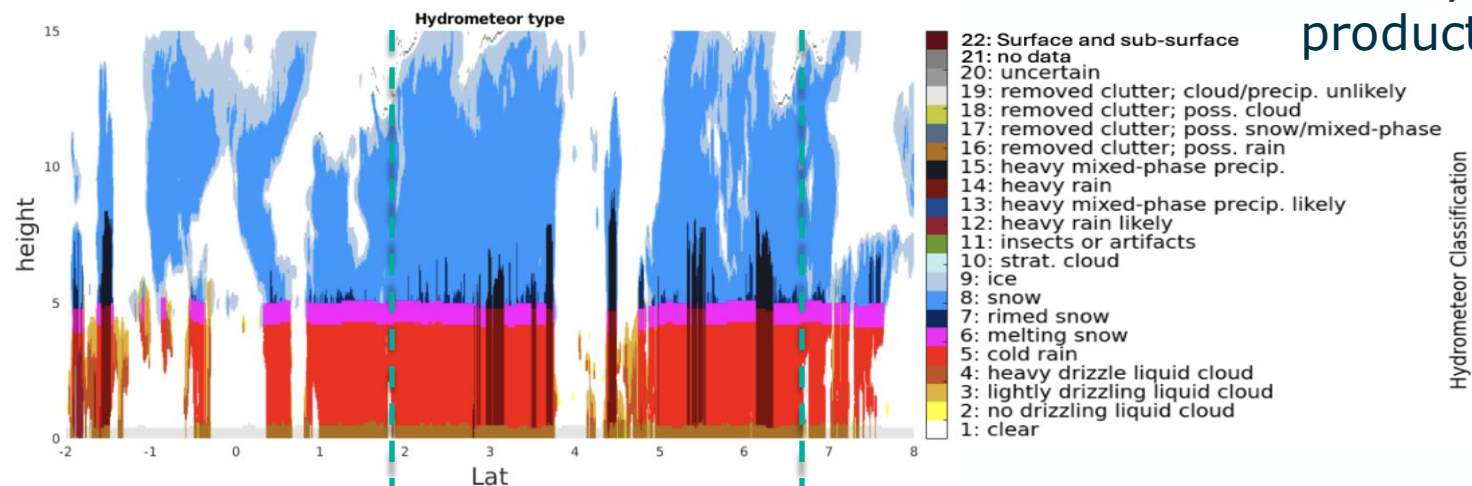
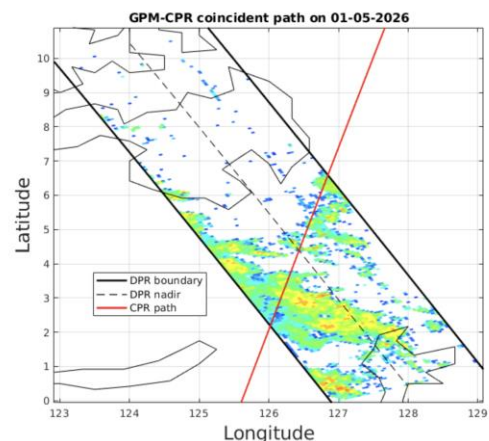


Doppler velocity

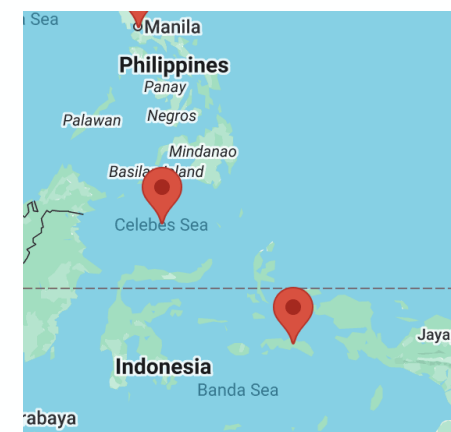
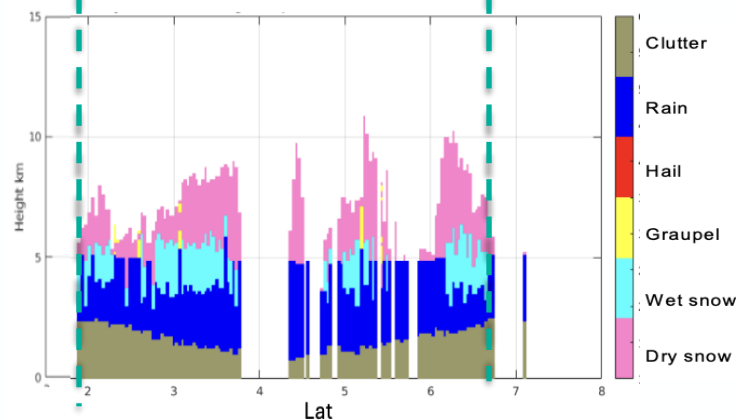
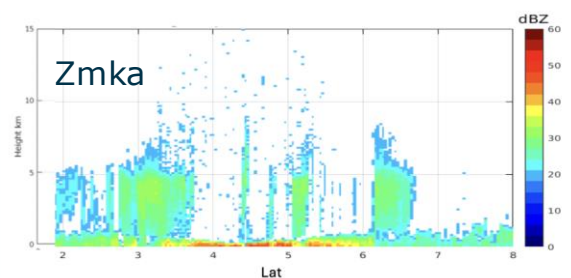
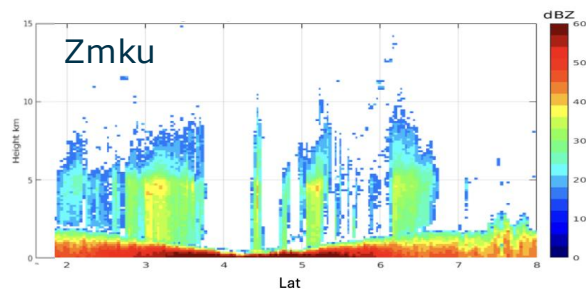


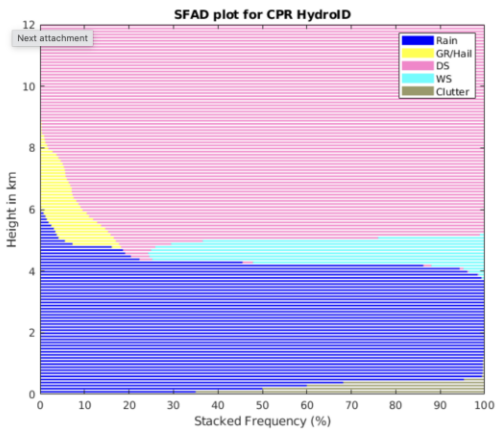
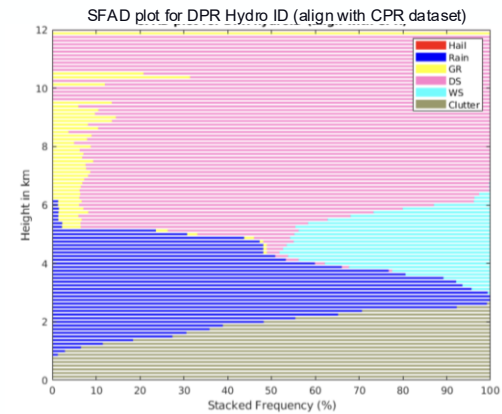
DPR along path images

CPR hydrometeor products



DPR hydrometeor products

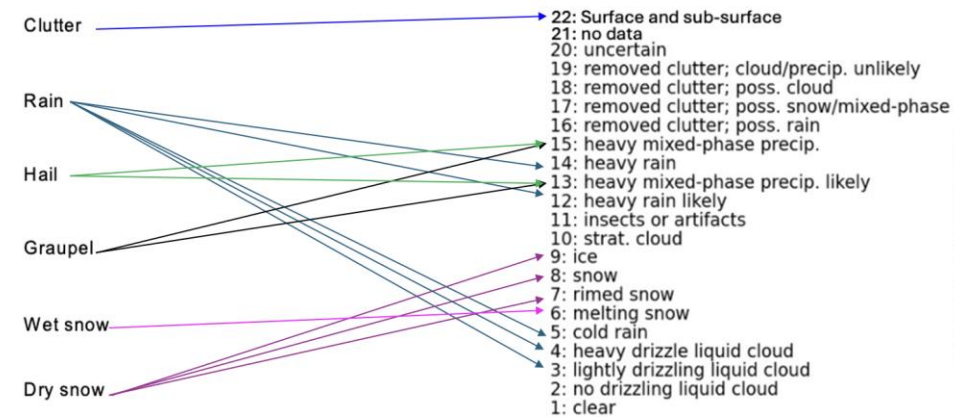




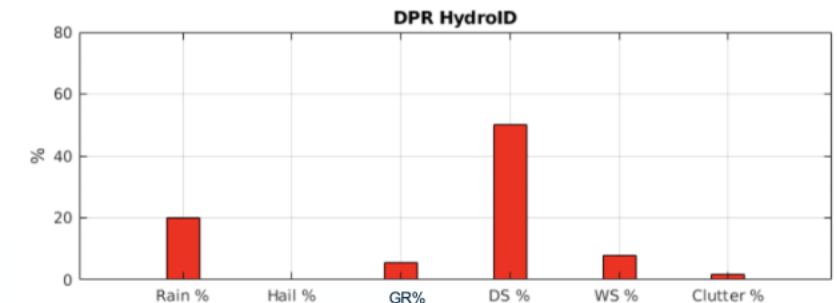
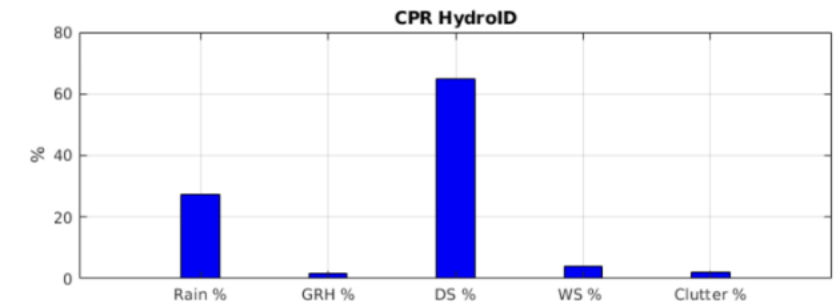
Corresponding hydrometeor classes between DPR and CPR

DPR Hydrometeor classes in level2 Classification module (V8)

Hydrometeor classes in CPR level2 TC files



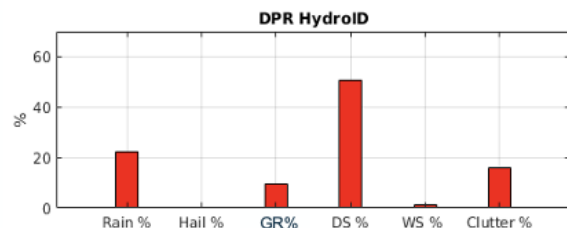
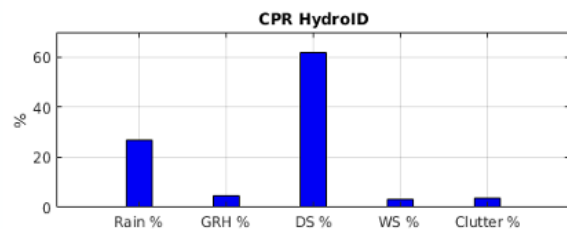
- GRH in CPR includes Graupel and Hail.



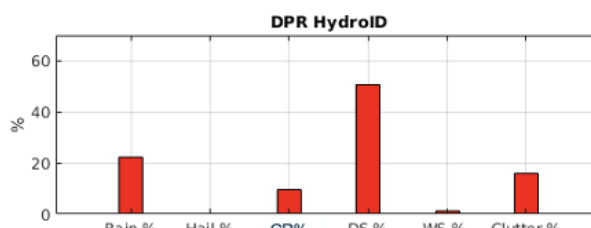
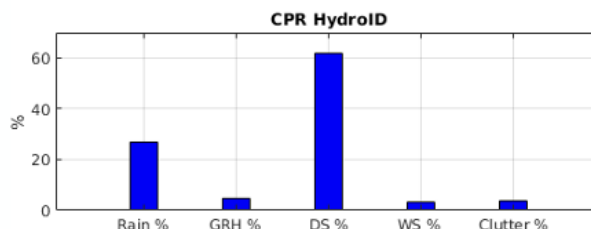
The Stacked Frequency by Altitude Diagrams (SFADs) represent the relative frequency of each identified hydrometeor type at each height.

Statistics plots for 4 other cases not illustrated

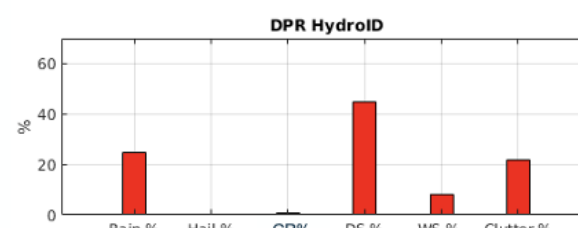
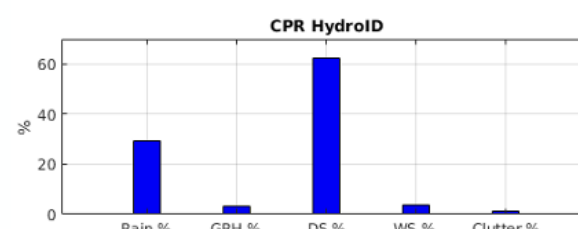
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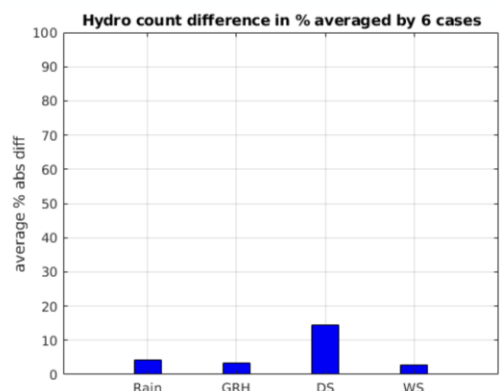
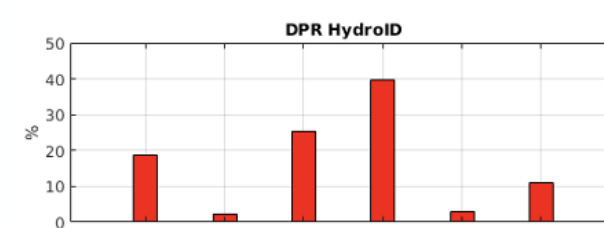
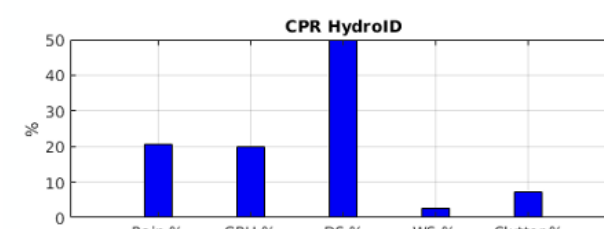
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2025-11-26-DPR-orbit-66647-CPR-8497DE



2025-11-26-DPR-orbit-66656-CPR-8506H-8507A

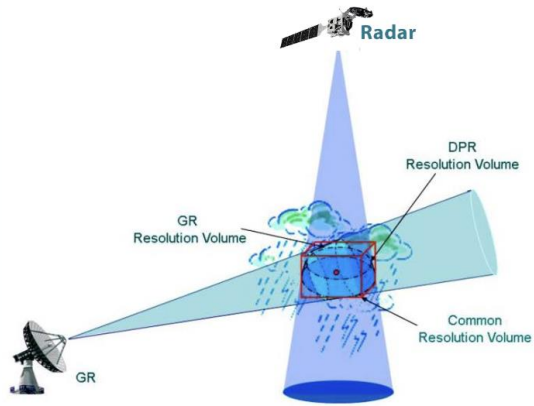


- The difference in % of 4 major types (rain, Graupel/hail, dry snow and wet snow) between CPR and DPR on 6 validation cases are around 5%, 4%, 15% and 3% respectively.
- GRH is CPR corresponds to Hail and graupel in DPR category.
- Major difference comes from dry snow category.
- In general, the comparison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

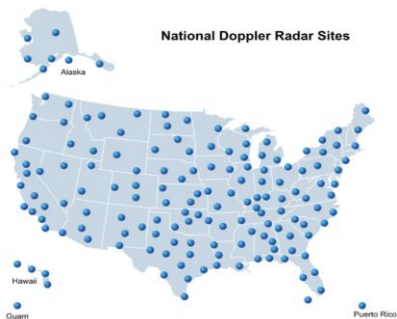
Validation between CPR VS NEXRAD



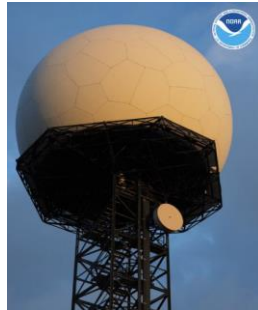
- KFTG (Denver area) and KCYS (Cheyenne area)



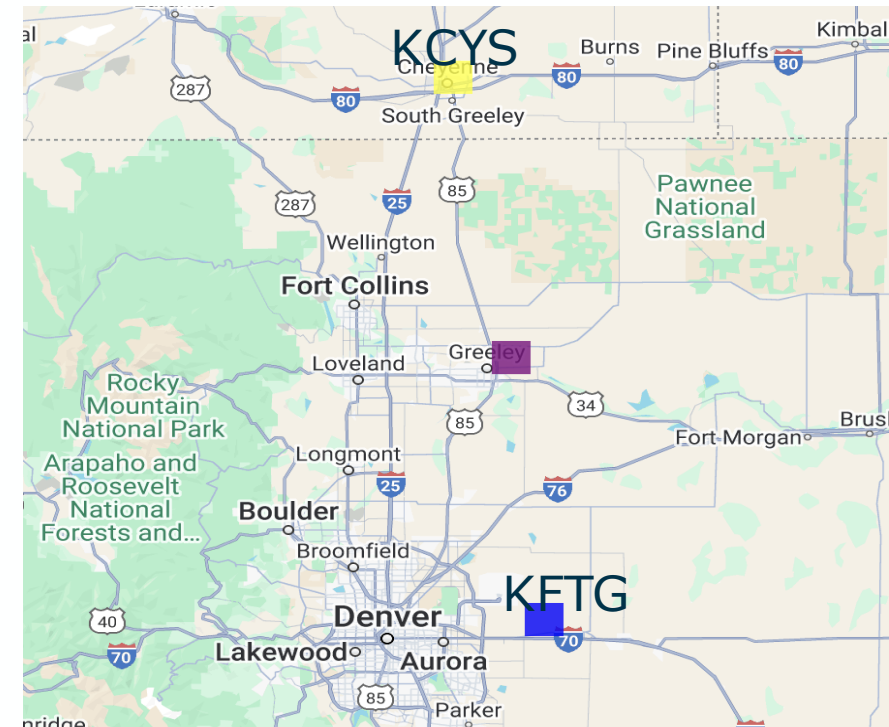
Validation cases with
Nexrad radar network
of KFTG and KCYS in
April 2026



NEXRAD radar network. KFTG.



KCYS



NEXRAD or Nexrad (Next-Generation Radar) is a network of 159 high-resolution S-band Doppler weather radar operated by the National Weather Service, and agency of the National Oceanic and Atmospheric Administration (NOAA) within the United States.

Sample validation

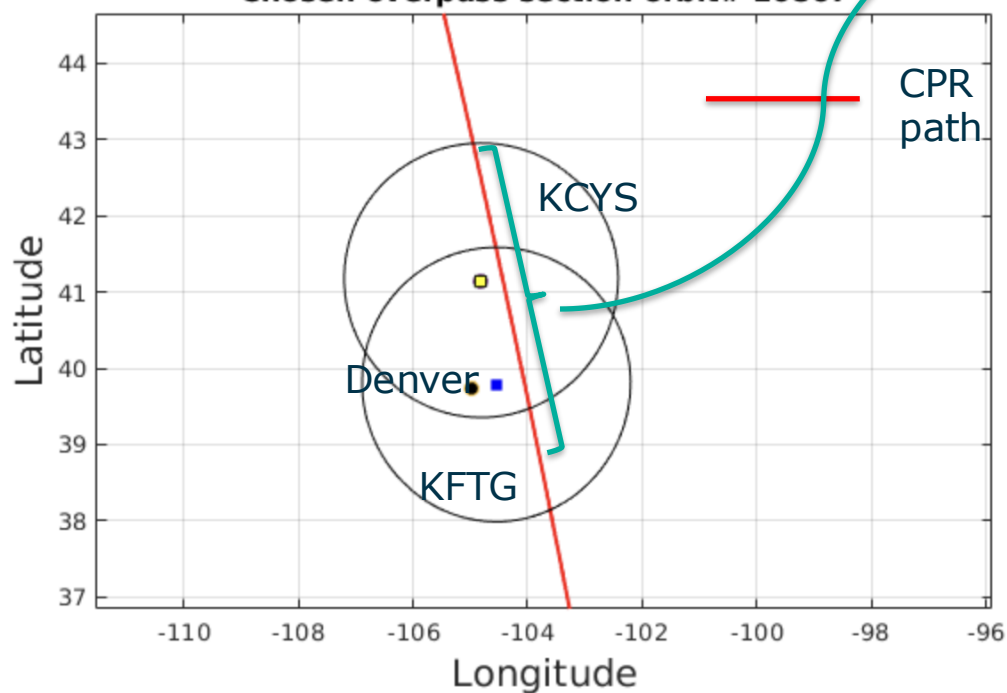


CPR orbit: 10867B(baseline BC)

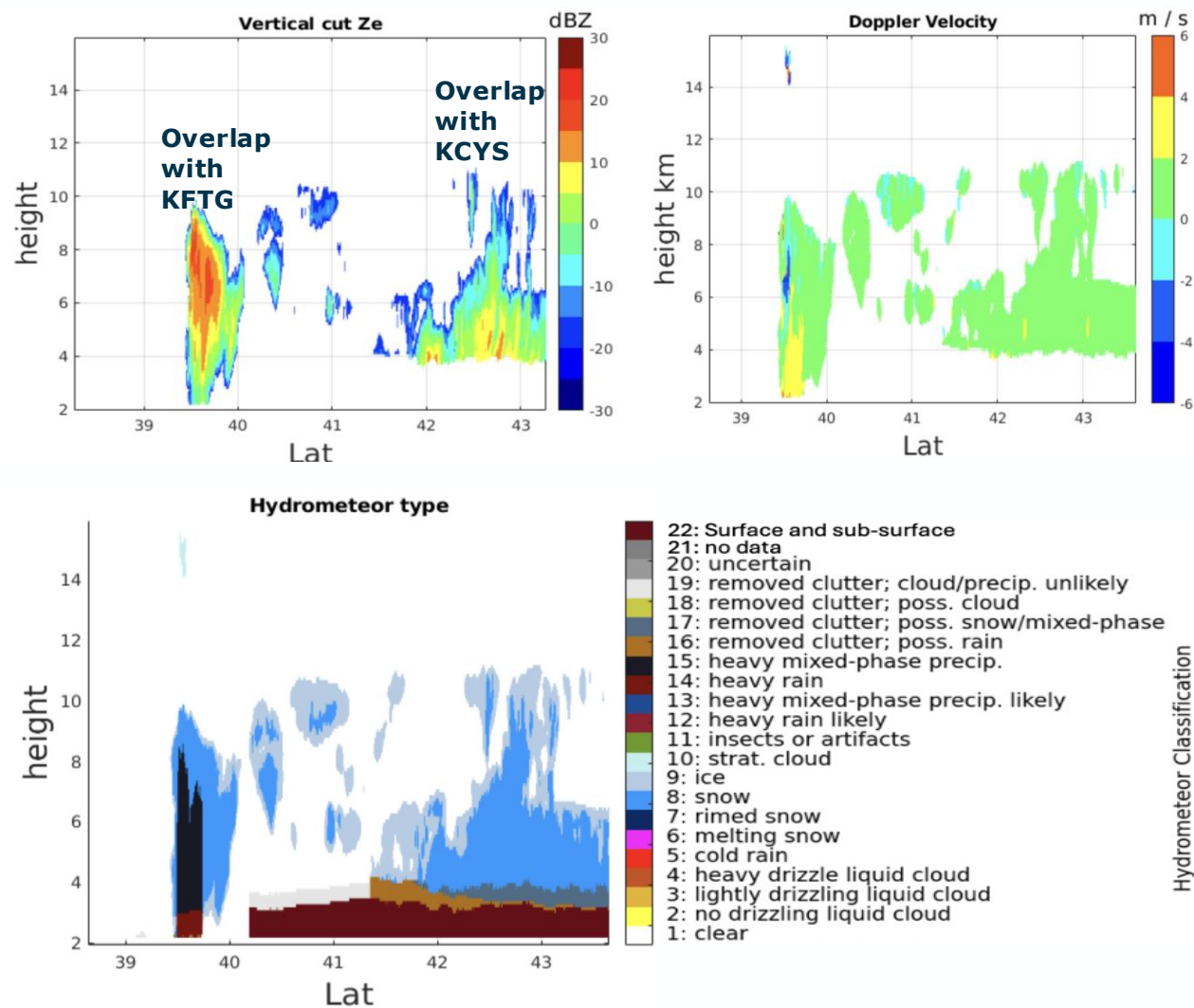
NEXRAD radar: **KCYS**

Time: 2026-04-27 T08:29

Chosen overpass section orbit# 10867



CPR data:



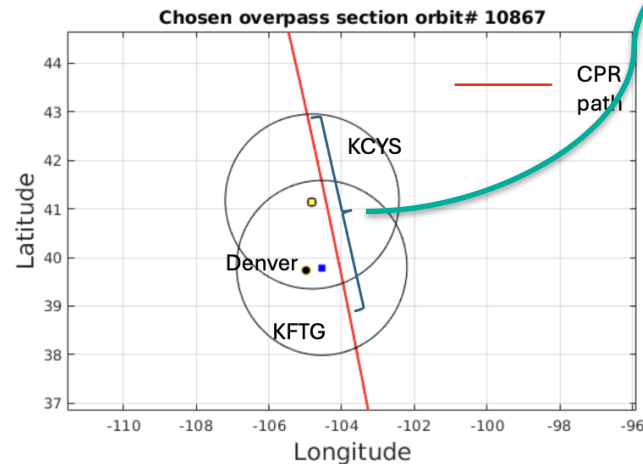
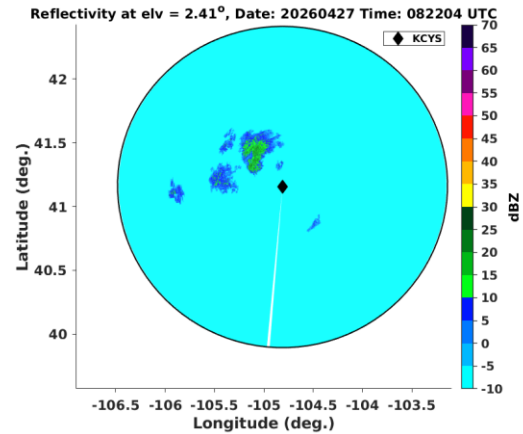
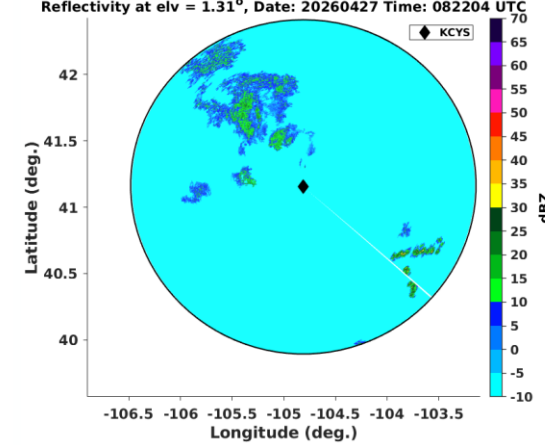
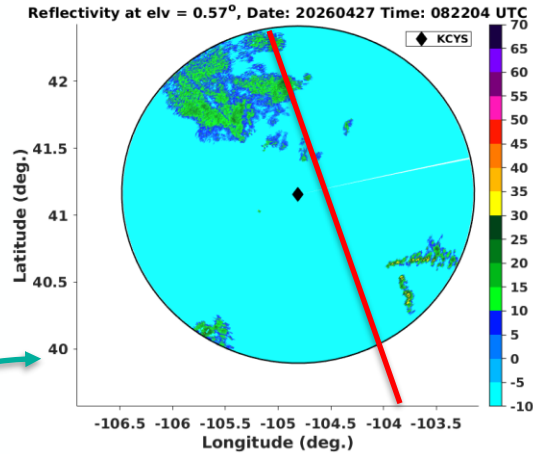
- KCYS data UTC: 20260427_082900, within time frame of CPR orbit.
- Altitude of KCYS: 1.87 km
- Covered height from 2.3km ~ 8.4 km.
- Peak of Ze is around 20 DBZ at lat of 42 deg, CPR peak Ze is about 10-15 dBZ.
- Hydrotpe is classified as "DS (dry snow)" and "CR(crystal)" (algorithm by Bechini and Chandrasekar, 2015). This agrees with CPR hydro type.

Ze

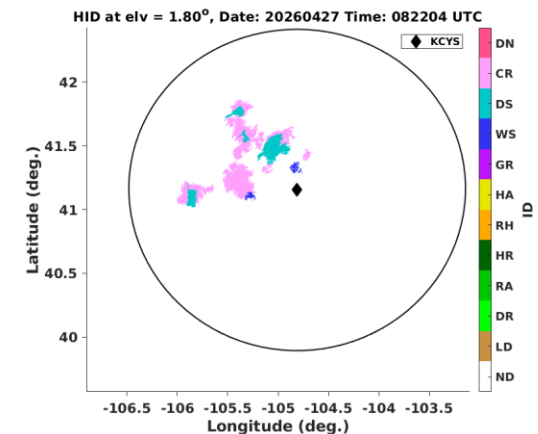
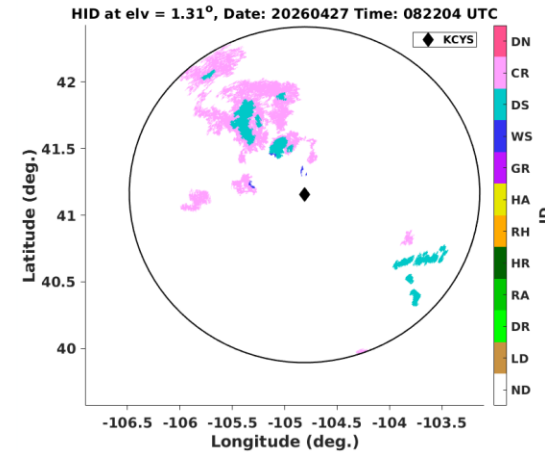
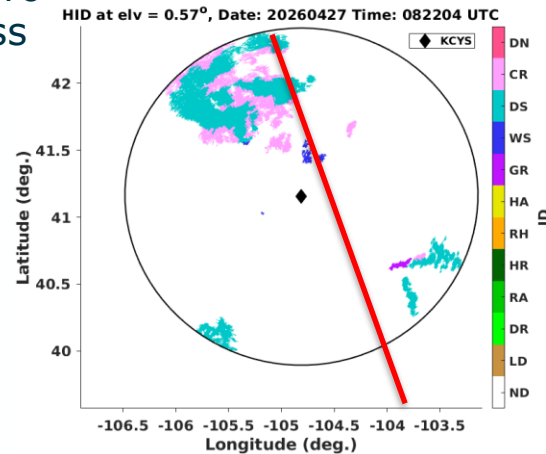
elevation: 0.57°

elevation: 1.31°

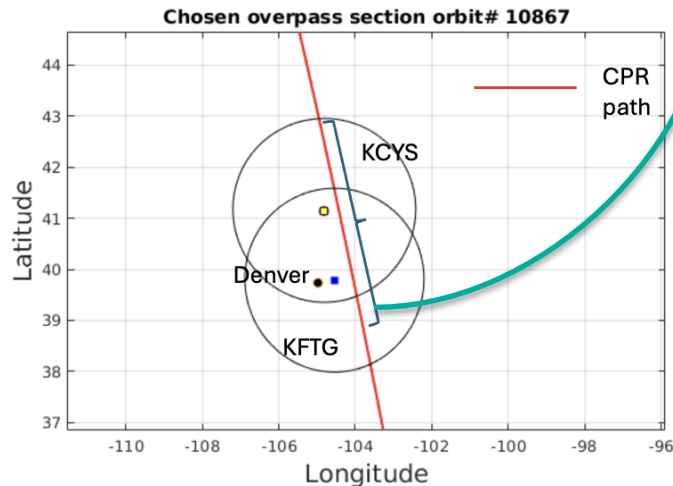
elevation: 1.8°



Hydro Class



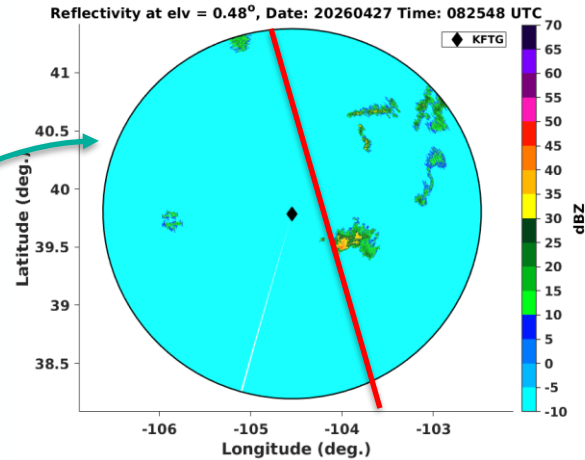
- KFTG data UTC: 20260427_082900, within time frame of CPR orbit.
- Altitude of KFTG: 1.77 km
- Covered height from 2.3km ~ 8.4 km.
- Peak of Ze is around 45 dBZ at lat of 39.5 deg, but CPR peak Ze is about 20-25 dBZ.
- Hydrotpe is classified as "Rain" and "Graupel"(algorithm by Bechini and Chandrasekar, 2015).
- CPR classifies this region as "Heavy mix-phase precip".



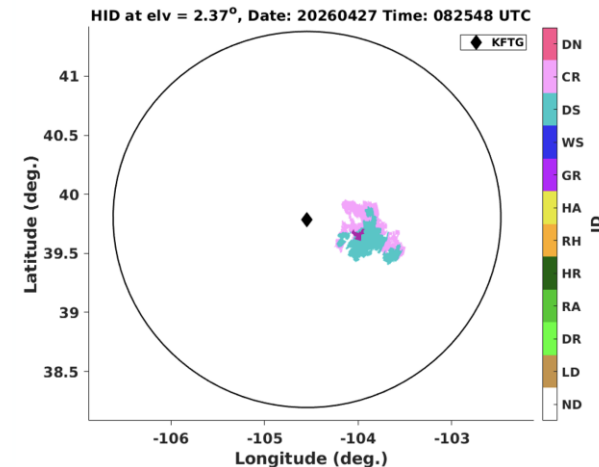
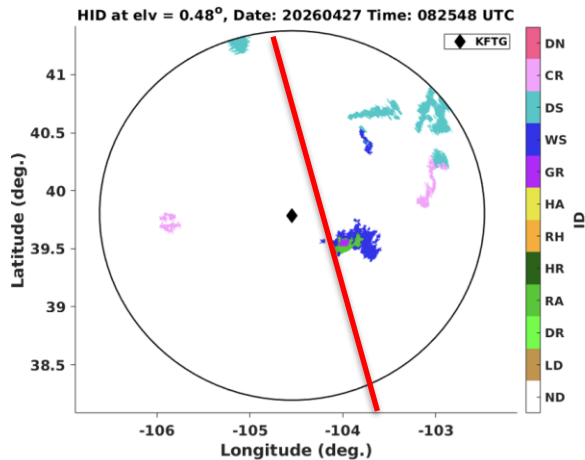
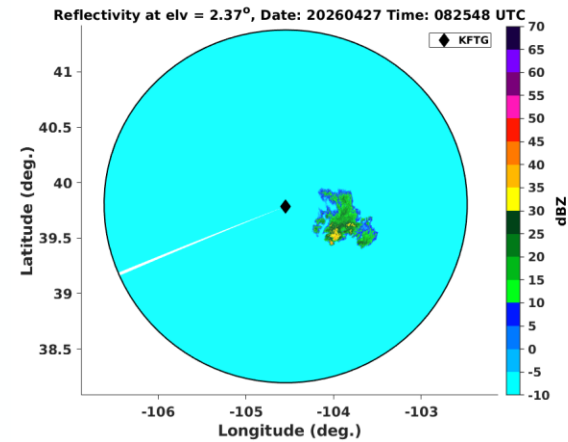
Ze

Hydro
Class

elevation: 0.57°



elevation: 2.37°



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.
- ❖ Cross validation for CPR and NEXRAD (KFTG and KCYS) are performed and a sample case on 04-27-2026 is illustrated. Both both KFTG and KCYS comparison, same hydrometeor types are cross validated.
- ❖ More detailed validations will be performed in the near future.

Acknowledgement: Supported by NASA and JAXA. Special thanks to Dr. Nobuhiro Takahashi and Dr. Takuji Kubota for their insight and support.