Validation of Profile Classification Algorithms

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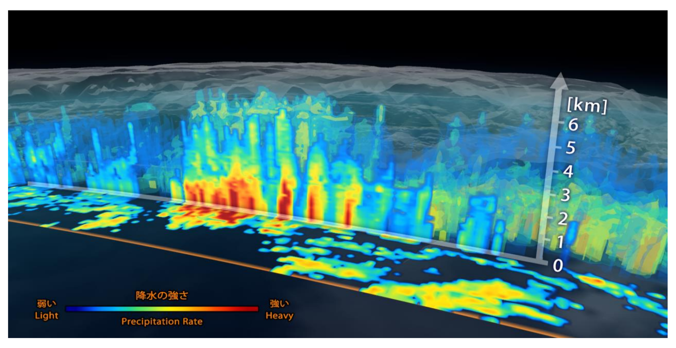
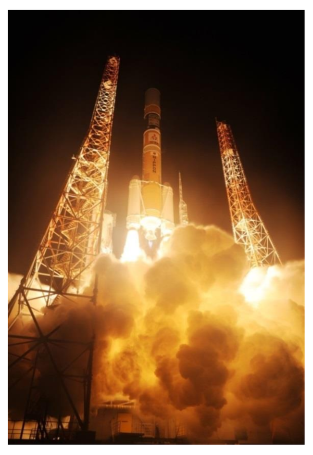
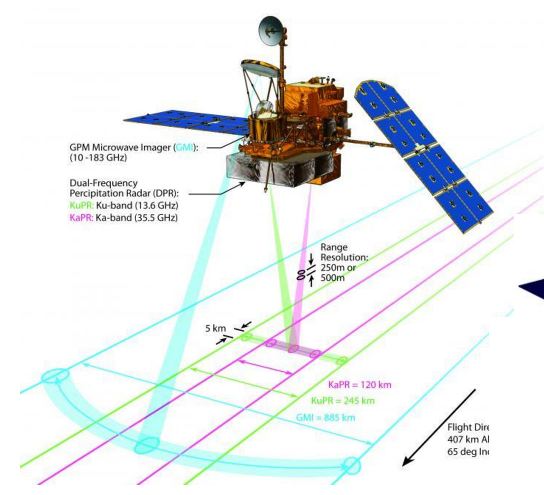
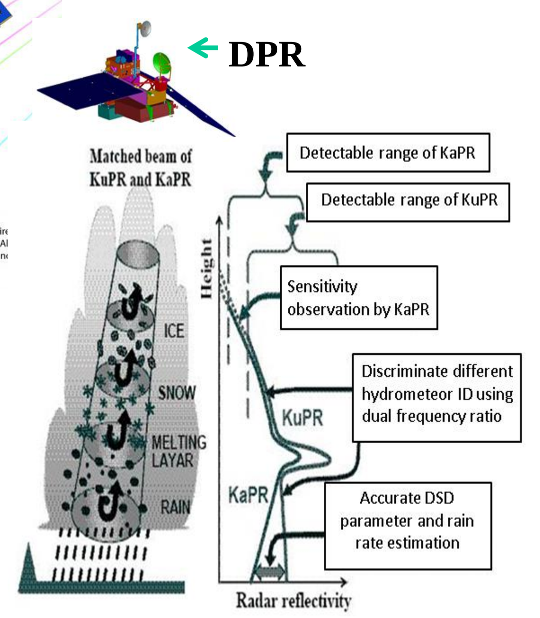




3D view inside an extra-tropical cyclone observed off the coast of Japan, March 10, 2014, by GPM's Dual-frequency Precipitation Radar. The vertical cross-section approx. 4.4 mi (7 km) high show rain rates: red areas indicate heavy rainfall while yellow and blue indicate less intense rainfall. Image Credit: JAXA/NASA

http://www.jaxa.jp/press/2014/03/20140325_gpm_j.html
http://www.nasa.gov/press/2014/march/first-images-available-from-nasa-jaxa-global-rain-and-snowfall-satellite/





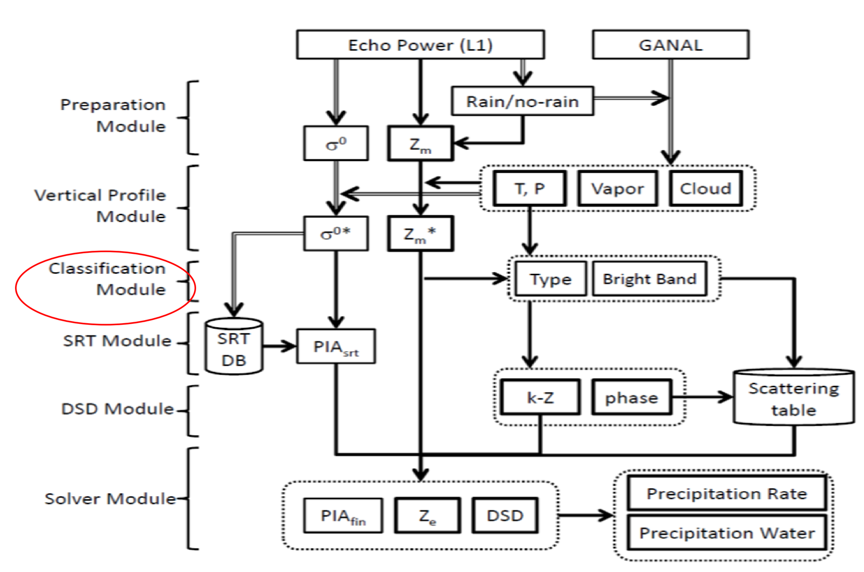
Dual-frequency Precipitation Radar (DPR)

- Ku-band (13.6 GHz) similar to TRMM-PR
- Ka-band (35.5 GHz) –0.87 cm. wavelength
- Coverage area 65°S – 65° N
- 3D precipitation observations around the globe every 3 hours.

Key benefits of GPM-DPR

- Retrieve more accurate DSD and thus improve accuracy of rainfall rate estimate.
- Be able to discriminate between rain and frozen precipitation .

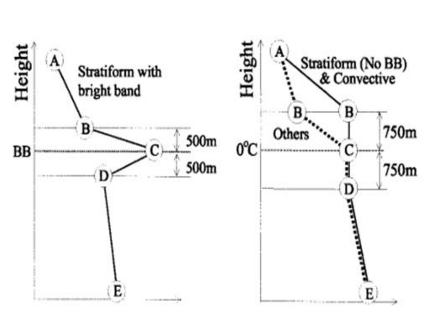
GPM-DPR level-2 flowchart



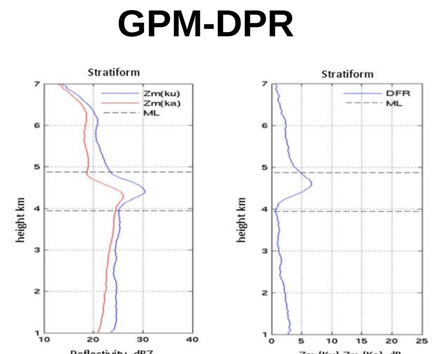
Module Objective

- detects melting layer.
- classifies rain into three major categories, which are stratiform, convective, and other. (Here category “other” means that there exists only cloud or possibly noise when the radar echo is examined along the radar beam)

TRMM-PR

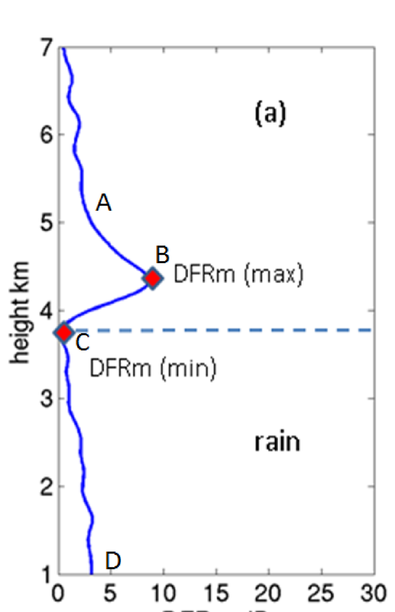


GPM-DPR



Measured dual-frequency ratio (*DFRm*)

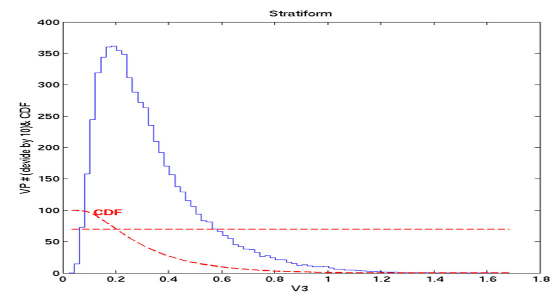
$$DFR_m = 10\log_{10}(Z_m(K_u)) - 10\log_{10}(Z_m(K_a))$$

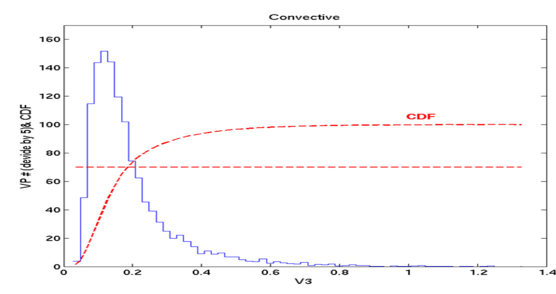


$$V1 = \frac{DFR_{ml}(\max) - DFR_{ml}(\min)}{DFR_{ml}(\max) + DFR_{ml}(\min)}$$

$$V2 = abs(mean(DFR_m\ slope))$$

$$V3 = \frac{V1}{V2}$$



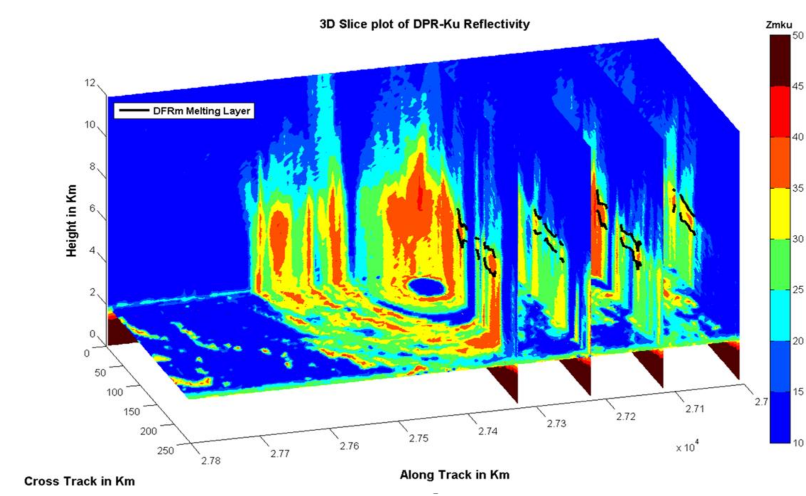


Statistics of threshold C1 and C2 for V3 value is calculated based on 121859 vertical profiles of GPM data.

Convective rain: V3< C1

Stratiform rain: V3>C2

Transition: C1<=V3<=C2



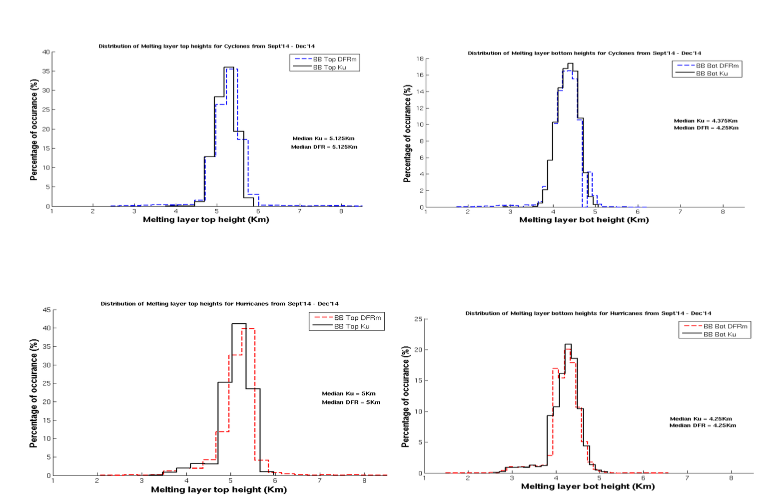
- Melting layer top is defined as the height at which *DFRm* gradient has maximum value.
- Melting layer bottom is defined as the height at which *DFRm* has a local minimum value.

Algorithm details can be found at Minda and Chandrasekar (2013) [1] [2].

Large scale analysis of storms

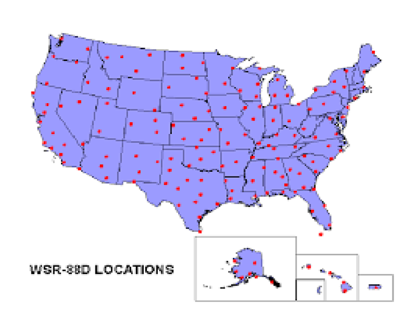
(A) Rain type count

(B) Melting layer heights

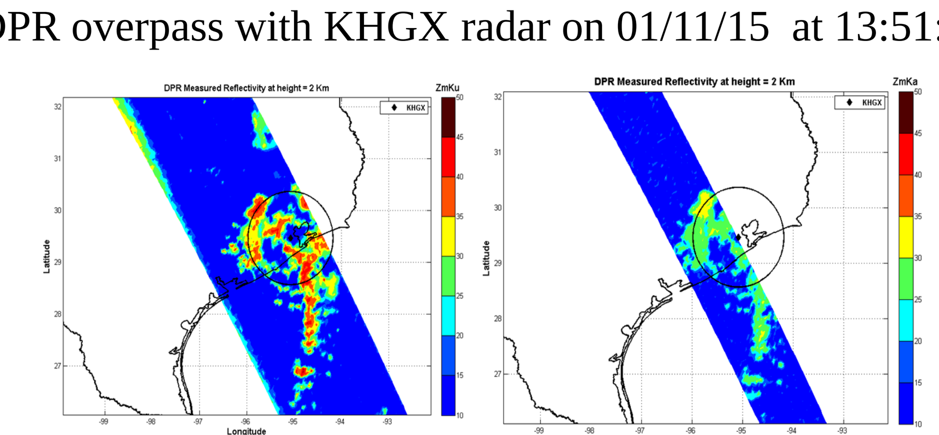


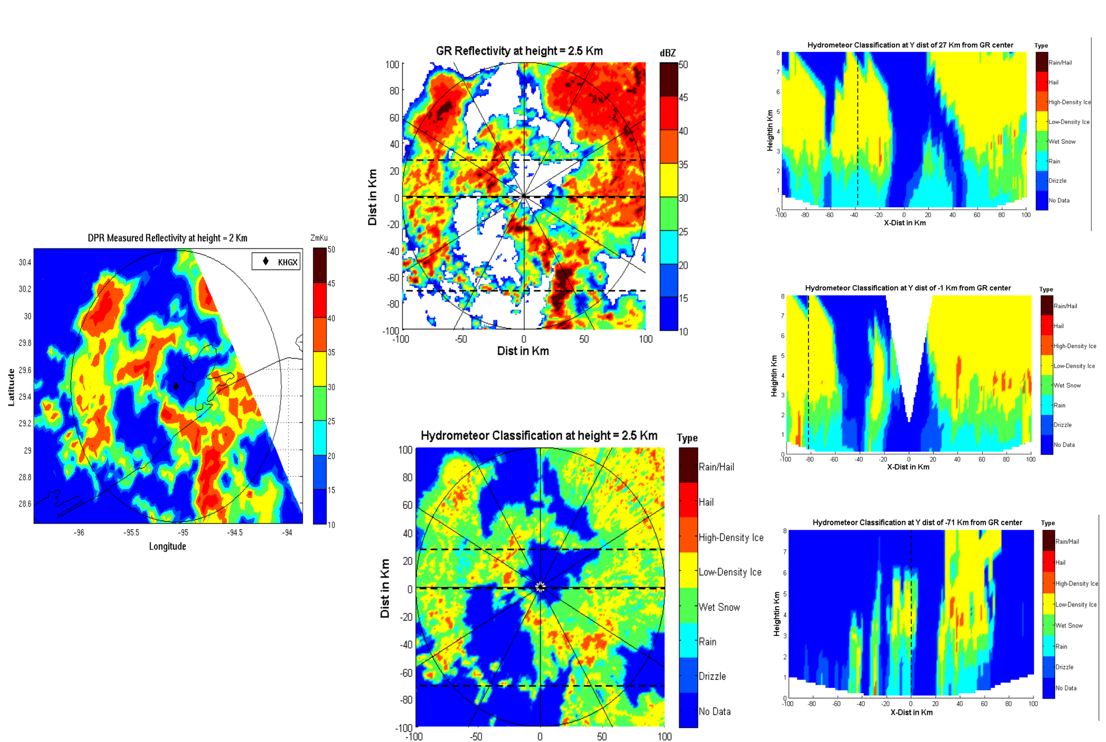
Case Study

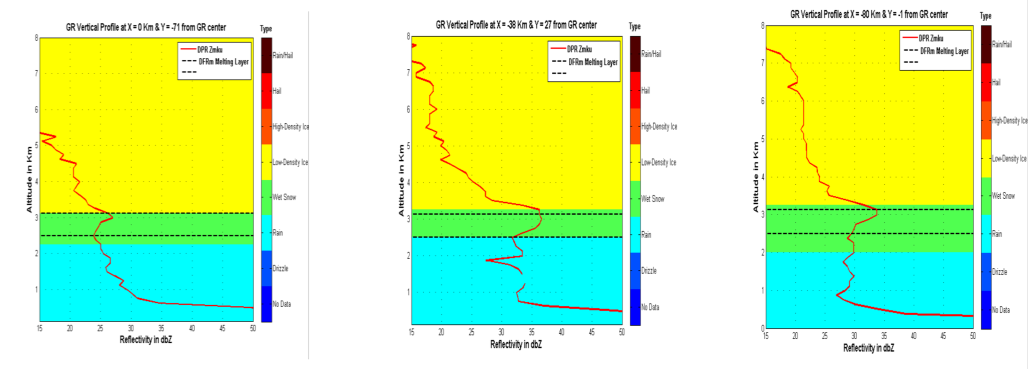
NEXRAD (Next-Generation Radar) is a network of 160 high-resolution S-band Doppler weather operated by the National Weather Service (NWS).



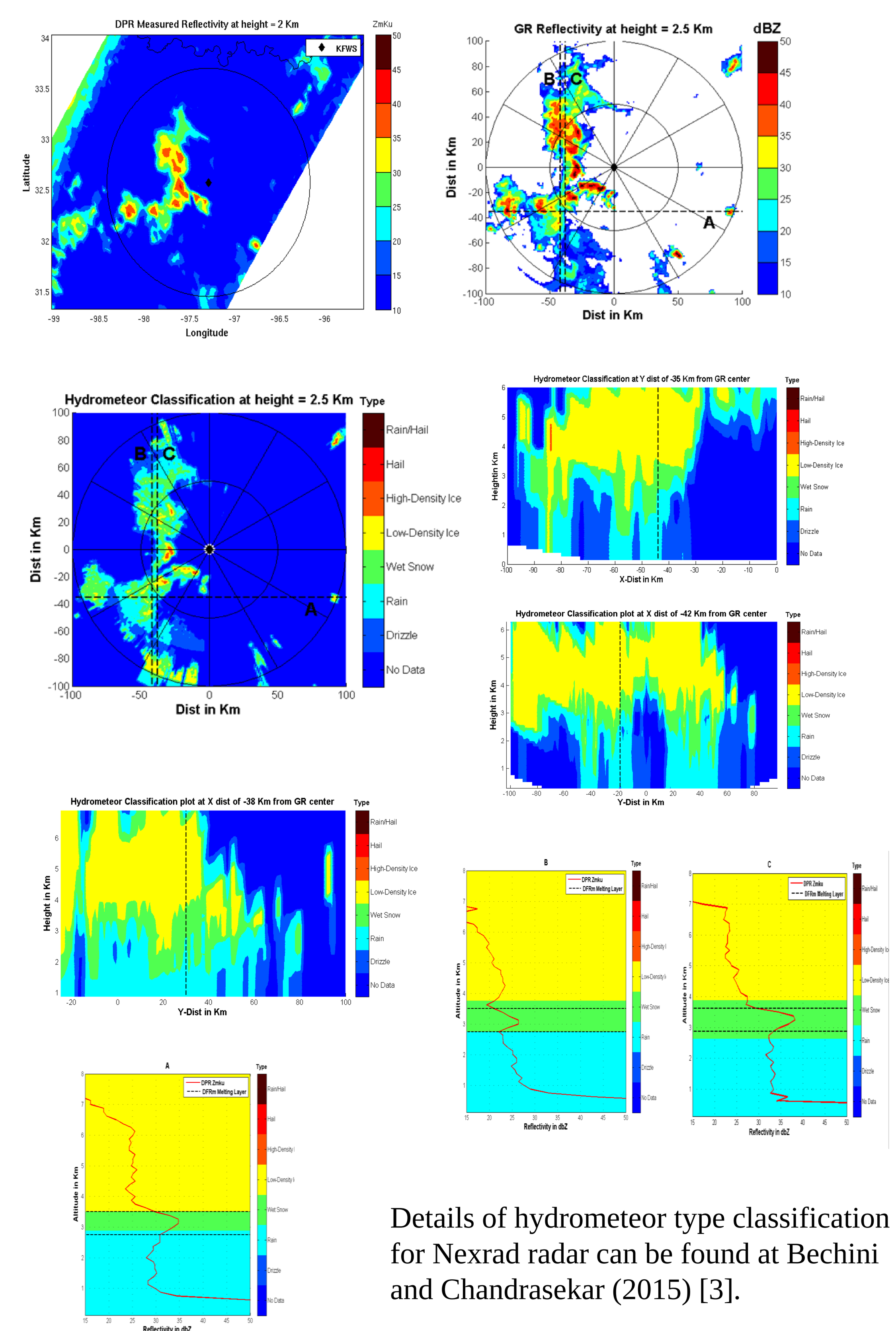
- DPR overpass with KHGX radar on 01/11/15 at 13:51:52 UTC







- DPR Overpass with KFWS Radar on 03/18/15 at 08:56:09 UTC



Details of hydrometeor type classification for Nexrad radar can be found at Bechini and Chandrasekar (2015) [3].

SUMMARY

- Dual-frequency profile classification algorithm is successfully implemented in GPM DPR level 2 algorithm.
- The algorithm includes rain type classification and melting region detection for vertical profile using parameter of measured dual-frequency ratio.
- Large scale analysis is performed for different storm types.
- Overpasses between DPR radar and Nexrad KFWS radar are selected. Melting layer detected from DPR and KFWS/ KHGX are compared.
- This study shows very good comparisons of melting layer regions between DPR radar and Nexrad radar.

REFERENCE

[1] M. Le and V. Chandrasekar, Precipitation Type Classification Method for Dual-Frequency Precipitation Radar (DPR) Onboard the GPM, Geoscience and Remote Sensing, IEEE Transactions, Volume:51 , Issue 3, March, 2013.

[2] M. Le and V. Chandrasekar, “Hydrometeor Profile Characterization Method for Dual-Frequency Precipitation Radar Onboard the GPM”, Geoscience and Remote Sensing, IEEE Transactions Volume:51 , Issue 6, Jun, 2013.

[3] Bechini, R., and V. Chandrasekar, 2015: A Semisupervised Robust Hydrometeor Classification Method for Dual-Polarization Radar Applications. J. Atmos. Oceanic Technol., 32, 22–47

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