Profile Classification Module: Status and Update

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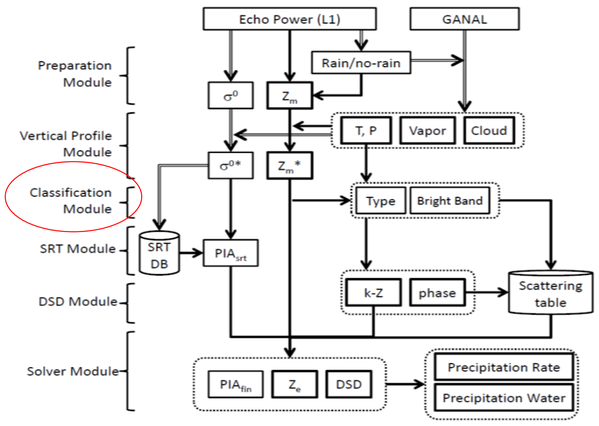


GPM-DPR level-2 flowchart

CSF module

Objectives:

- **Detection of BB**
- **Classification of rain type**

There are three CSF modules:

Ku-only CSF module
Ka-only CSF module
DPR CSF module.

Each CSF module (Ku, Ka, and dpr) outputs three major rain types :

- Stratiform,
- Convective,
- Other.

CSF single frequency modules

- Ku and Ka modules: V-method + H-method

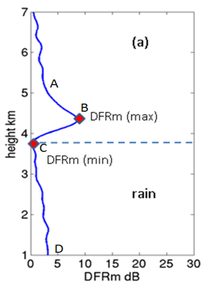
In single frequency CSF modules, i.e., Ku and Ka modules, rain type classification and BB detection are made by two method; one is a vertical profile method (V-method) and the other a horizontal pattern method (H-method). The Ku-alone CSF module is close to TRMM 2A23 algorithm.

CSF dual frequency module (DPR module)

- DPR module: a kind of V-method

In the DPR CSF module, a DFRm method is used instead of V-method. The DFRm method is developed by CSU.

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

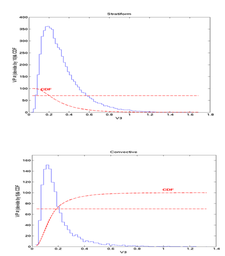


$$V1 = \frac{DFR_{ml}(\max) - DFR_{ml}(\min)}{DFR_{ml}(\max) + DFR_{ml}(\min)}$$

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

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

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

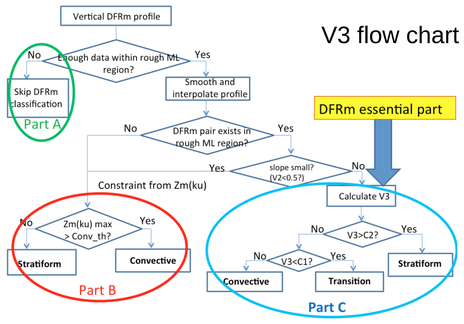


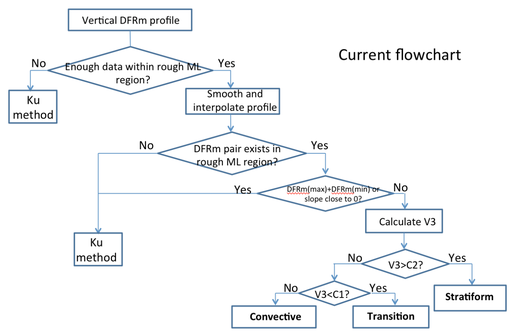
Convective rain: V3< C1

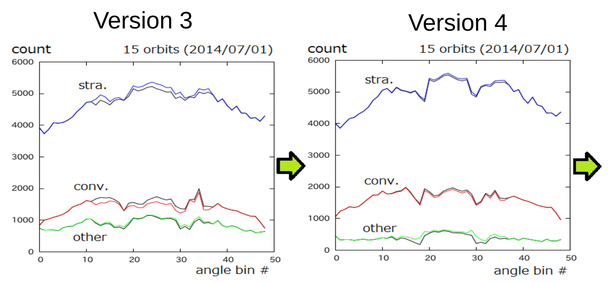
Stratiform rain: V3>C2

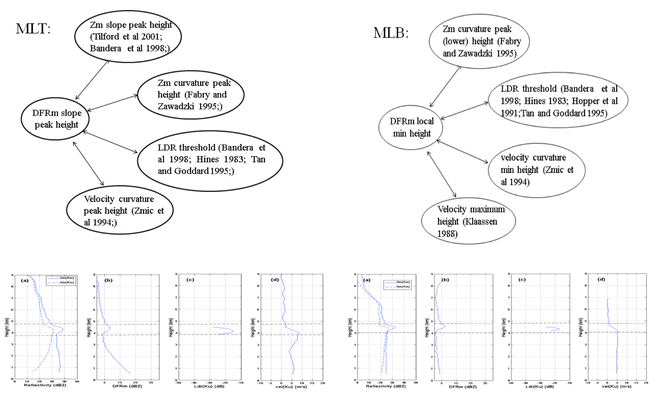
Transition: C1<=V3<=C2

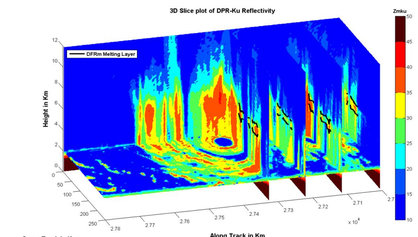
Change from version 3 to version 4











- 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.

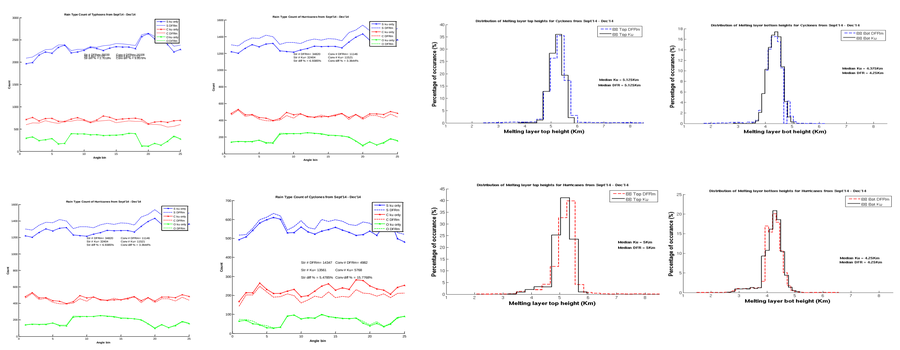
Algorithm details can be found at Minda and Chandrasekar (2013) [1] [2].

Large scale analysis of storms

Storms are chosen from Sept, 2014 to Dec 2014 in tropical area. Total of 85 storms are included. Comparison below are made based on version 3 public data.

(A) Rain type count

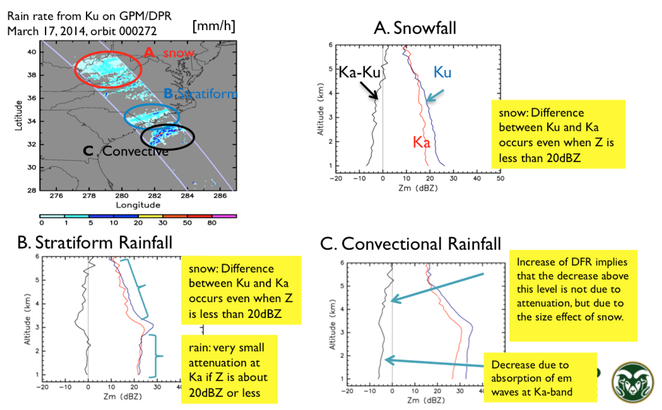
(B) Melting layer heights



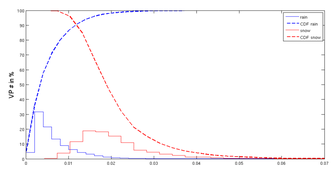
Enhancement of the dual-frequency profile classification module

➢ snow/ rain separation

Plot curtsey Toshio Iguchi



Potential parameter “snow classification index (SI)” to perform snow/rain separation

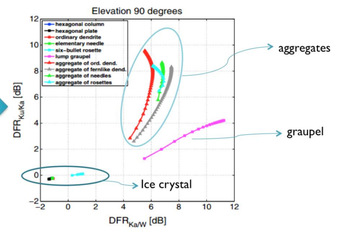


SI= mean(abs(DFRm)) / Zmku(max) / Storm_Depth

Parameter SI can perform separation of snow and rain profiles on around 90% of CDF

Statistics of parameter “SI”, based on 5828 snow profiles (naturally selected) and 354024 rain profiles

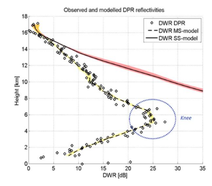
➢ Stretch Goal: snow type identification



DFRm is a very useful parameter to distinguish different snow types.

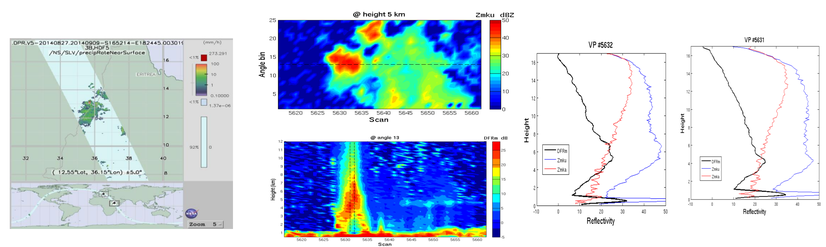
Figure from Tyynela and Chandrasekar, Characterizing falling snow using multi-frequency dual-polarization measurements, Journal of geophysical research: Atmospheres. Vol 119, issue 13, 2014.

➢ Multiple scattering effect



Existence of DFRm knee is a potential feature for multiple scattering effect

Plot from
A. Battaglia , S. Tanelli , K. Mroz , and F. Tridon, Multiple scattering in observations of the GPM dual-frequency precipitation radar: Evidence and impact on retrievals, Journal of geophysical research: Atmospheres. Vol 120, issue 9, 2015



SUMMARY

- Most current of profile classification module is version 4 (not public V3).
- Revision from version 3 to version 4 shows improvements on rain type classification.
- Large scale analysis is performed for different storm types. Good agreements are illustrated between DPR and Ku results for both rain type classification and melting region detection.
- Enhancement of the classification module includes adding ability to perform snow/ rain separation, as well as to identify different snow types using dual-frequency parameters.
- Other enhancement of the module includes adding the ability to tag multiple scattering effect.

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.

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