Product Validation for GPM/DPR

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Dual-frequency Precipitation Radar

Calibration and Validation

Engineering values — Tx/Rx power, Beam matching of KaPR and KuPR — **Sensor hardware calibration (Level1 data validation)**

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Algorithm — DSD (drop size distribution), Classification (Convective/Stratiform), *Z-R* relation, *k-Z* relation, Particle type, Melting Layer model temperature & humidity profile, … — **Algorithm validation**

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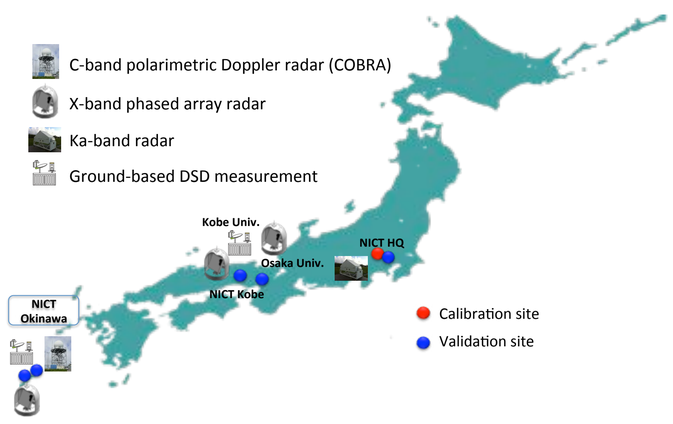
Physical values — Rainfall rate, Rain accumulation Liquid/Ice water content, Precipitation type classification, Latent heat release, …. — **Products validation (Level 2 and 3 data validation)**

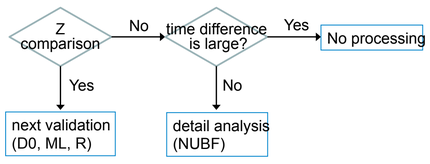
Site location for Cal. / Val.



GPM GV Target

Over-flight simultaneous volume comparison

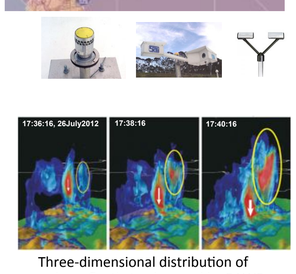
Z ⇔ Direct comparison of Z
ZDR ⇔ Do validation
pHV ⇔ melting layer flag validation
KDP ⇔ R validation (w/ Z, ZDR data)



◆ COBRA (Nago)
◆ PAWR Okinawa (Onna)
◆ Ground-based DSD measurement (Sesoko)

Z	⇔	Direct comparison of Z
ZDR	⇔	Do validation
pHV	⇔	melting layer flag validation
KDP	⇔	R validation

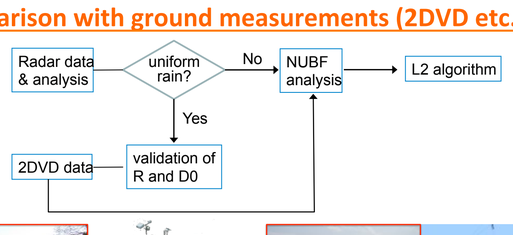
Validation of Z with very short time lag



Three-dimensional distribution of radar reflectivity observed by PAWR.

PANDA (NICT Okinawa)

Comparison with ground measurements (2DVD etc.)



- 2 Dimensional Video Distrometer (2DVD)
- Joss-type disdrometer
- Optical rain gauge (ORG)
- Tipping bucket rain gauge
- Micro-rain radar (MRR)
- Wind direction and spped
- Thermo-hydrometer
- Parsivel (Laser Optical disdrometer)
- POSS (Precipitation Occurrence Sensor System)

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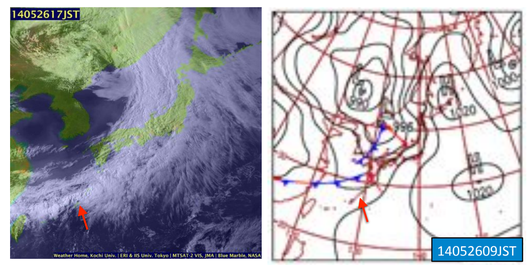
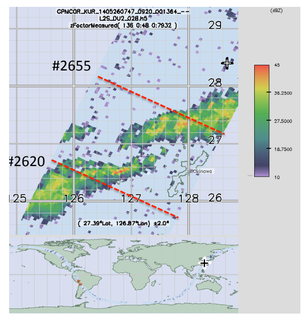
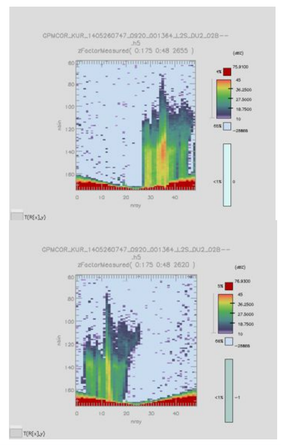
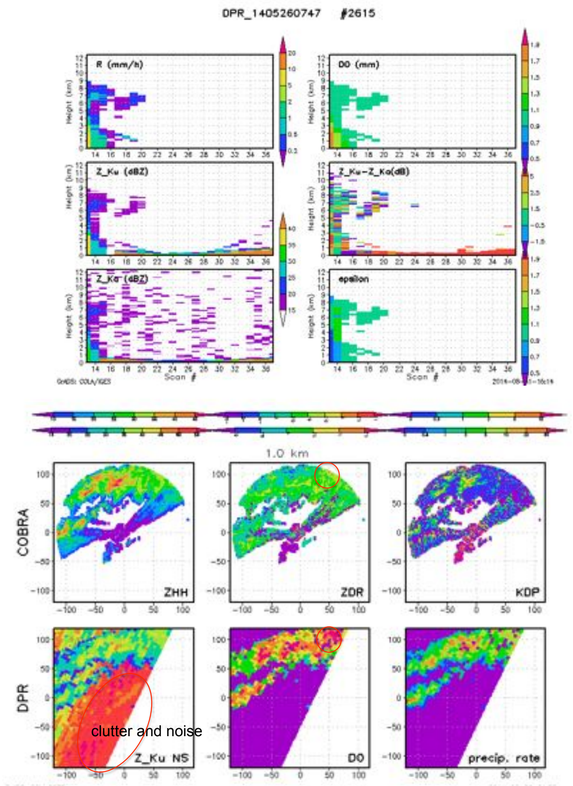
COBRA vs. DPR

Case: May 26 cold frontal rainband over Okinawa





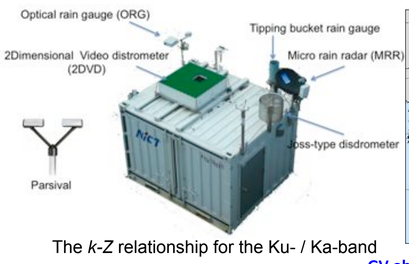


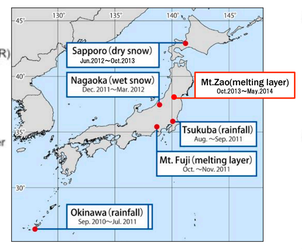


Z_C vs. Z_Ku: Similar pattern
ZDR vs. D0 : High ZDR area corresponds to high D0 with relatively low Z of DPR.
KDP vs. R : Generally similar pattern.

Dr. Takahashi (ERAD2014)

Drop size distributin and the k-Z relationship





GV observation schedule and site locations.

The *k-Z* relationship for the Ku- / Ka-band

$$k_{rain} = \alpha Z^{\beta}$$

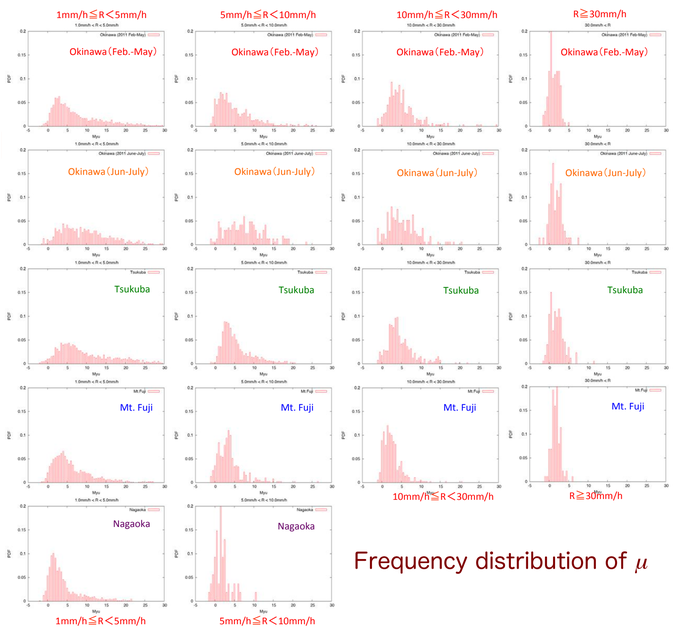
is estimated by use of the observed DSD.
The specific attenuation *k* [dB/km] is expressed as;

$$k_{rain} = 4.343\times10^{-3}\int_{D_{min}}^{D_{max}} N_{rain}(D)\cdot\sigma_{ext}(D)dD$$

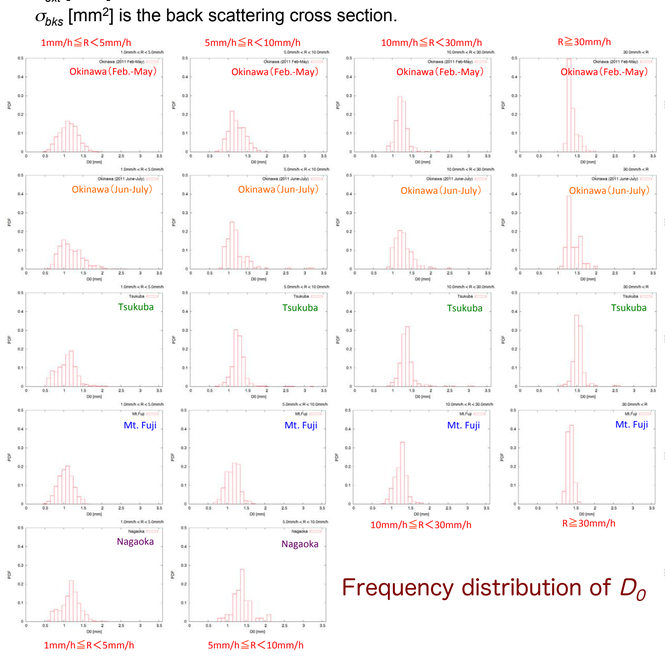
The radar reflectivity *Z* [mm^6 m^{-3}] is expressed as;

$$Z = \frac{\lambda^4}{\pi^5|K|^2}\int_{D_{min}}^{D_{max}} \sigma_{bks} N_{rain}(D)dD$$

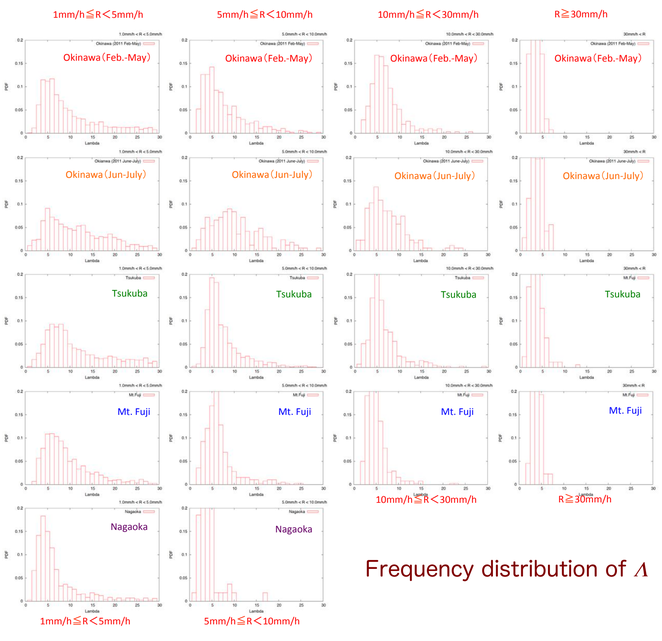
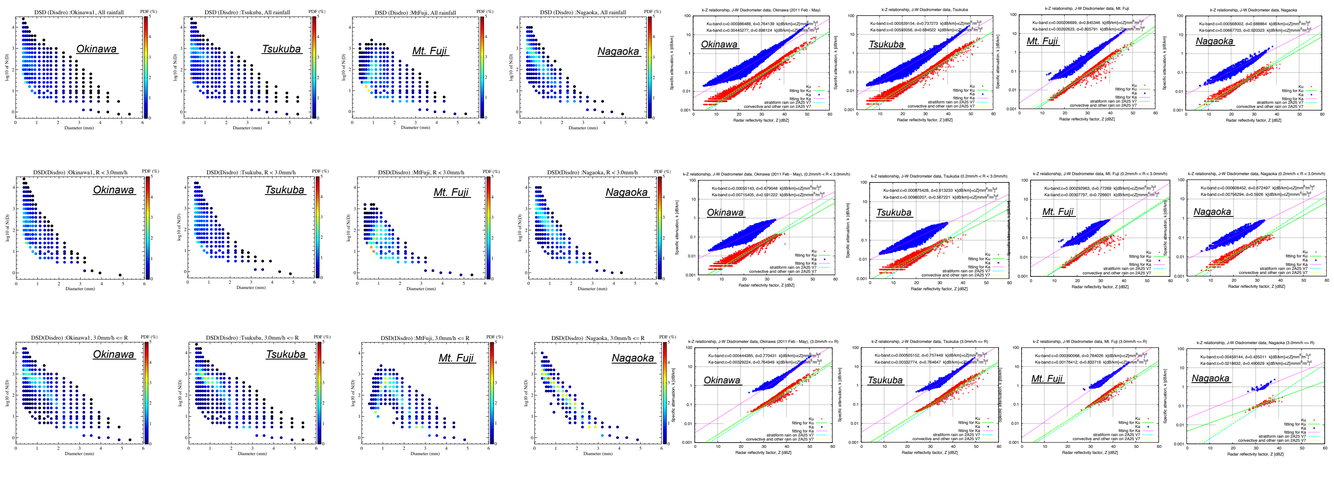
A unit of *N(D)dD* is [m^{-3}].
σ_{ext} and σ_{bks} can be processed by the Mie scattering theory.
σ_{ext} [mm^2] is the extinction cross section.
σ_{bks} [mm^2] is the back scattering cross section.



Frequency distribution of μ



Frequency distribution of D_0



Frequency distribution of Λ