Field Campaign for GPM/DPR Ground Validation using the Dual Ka-band Radar System

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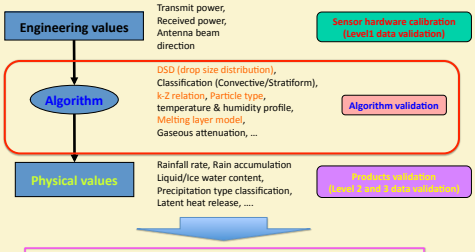
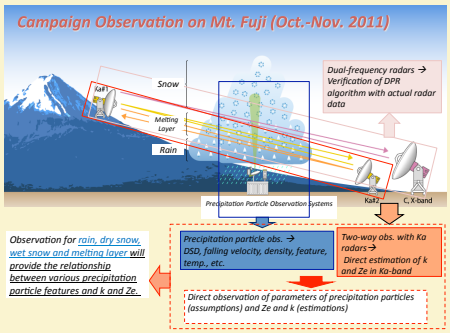
Motivation

Global Precipitation Measurement (GPM) started as an international mission and follow-on mission of the Tropical Rainfall Measuring Mission (TRMM) project to obtain more accurate and frequent observations of precipitation. Japan Aerospace Exploration Agency (JAXA) is in charge of developing GPM/Dual-frequency Precipitation Radar (DPR) algorithms as the sensor provider and producing and delivering hourly global precipitation map to make useful for various research and application areas. In order to secure the quality of precipitation estimates, ground validation (GV) of satellite data and retrieval algorithms is essential.



Dual Ka-radar system
Mobile precipitation observation system
were developed.

Overview of the campaign observation using the dual Ka-band radar system



Observation for rain, dry snow, wet snow and melting layer will provide the relationship between various precipitation particle features and k and Ze.

Ka-radar system and Mobile precipitation observation system

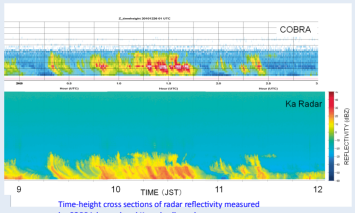
Specification	
Frequency	35.25 GHz (Ka-band)
Minimum Detect Zm	-20 dBZ at 10 km
Range Resolution	< 50m
Doppler Velocity	> ±10 m/s
Observable range	From 500 m to 30 km
Antenna beam width	0.6 deg
Antenna Sidelobe	25 dBZ >

- 2Dimensional Video distrometer (2DVD)
- Joss-type disdrometer
- Optical rain gauge
- Tipping bucket rain gauge
- Micro-rain radar
- Wind direction & speed
- Thermo-hygrometer
- Parsival (Laser Optical disdrometer)

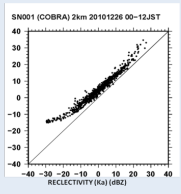
System evaluation

Comparison between Ka radar and well-calibrated radar (C-band Okinawa Bistatic Polarimetric Radar (COBRA) and Disdrometer for system evaluation.

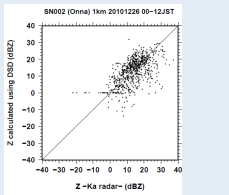
Simultaneous observation of COBRA and Ka radar



Time-height cross sections of radar reflectivity measured by COBRA (upper) and Ka radar (lower)

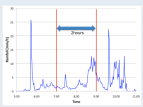


Scatter diagram of radar reflectivity by a Ka-radar and C-band radar.

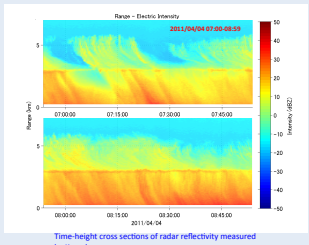


Scatter diagram of radar reflectivity by a Ka-radar and a disdrometer

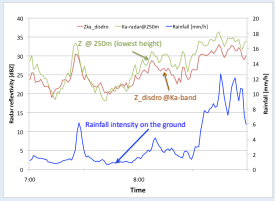
Simultaneous observation of Ka radar and Disdrometer



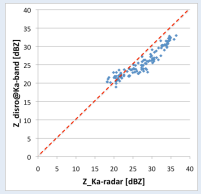
Time series rainfall intensity observed by the optical rain gauge



Time-height cross sections of radar reflectivity measured by Ka radar



Time series rainfall intensity observed by the optical rain gauge and radar reflectivity observed by Ka radar (250m heigh) and disdrometer



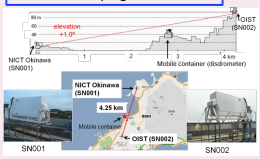
Scatter diagram of radar reflectivity by a Ka-radar @250m (lowest height) and a disdrometer

- Similar cross sections of reflectivity between Ka radar and COBRA
- Good correlation of reflectivities on scatter diagrams with COBRA and disdrometer

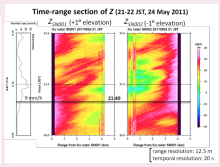
Ka radar has good performance quantitatively for GV experiments.

Results

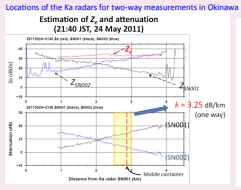
Okinawa Campaign Observation



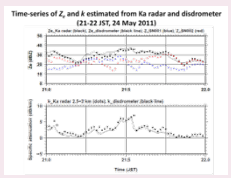
Locations of the Ka radars for two-way measurements in Okinawa



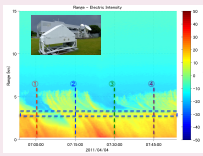
Time series of reflectivity profiles of Ka radars



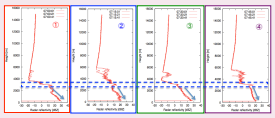
Reflectivity (Zm and Ze) profiles from two Ka radars



Time series of Ze and k estimated from Ka radar and disdrometer



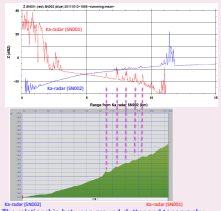
Time series of vertical reflectivity profiles of Ka radars



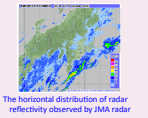
Vertical profile of reflectivity at each time, ①, ②, ③, and ④

Mt. Fuji Campaign Observation

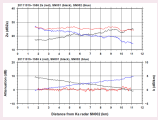
Locations of the Ka radars for two-way measurements in Mt. Fuji



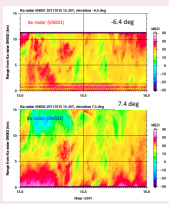
The relationship between ground clutter and topography



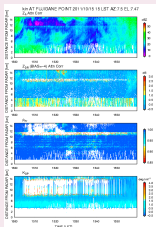
The horizontal distribution of radar reflectivity observed by JMA radar



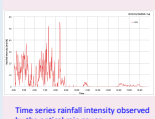
Reflectivity (Zm and Ze) profiles from two Ka radars



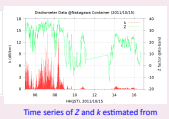
Time series of reflectivity profiles of Ka radars



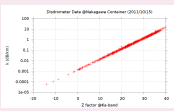
Time series of polarimetric parameter profiles of Ka MP-X (EL=7.5deg, Δx=150m)



Time series rainfall intensity observed by the optical rain gauge



Time series of Z and k estimated from disdrometer



The k - Z relationship estimated from disdrometer