GPM activities at NICT

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- DPR Level 2 algorithm development
- Calibration and validation
  - Calibration of DPR
    - Development of active radar calibrator (ARC) (Hanado)
  - Validation of algorithms
    - Ground validation activities (Nakagawa)
      - Collecting and analyzing GV data that help algorithm development.

DPR algorithm development team

- L 2 DPR algorithm (at-launch version) consists of the main module and 6 sub-modules.
  - Main module: Seto, Iguchi
    - controls the overall flow of data processing among the other 6 modules.
  - Preparation module: Yoshida, Kubota, Hanado
  - Vertical module: Kubota, Awaka
  - Classification module: Awaka, Chandra, Le
  - SRT module: Meneghini, Seto, Liao, Tanelli, Durden
  - DSD module: Seto, Kozu, Meneghini, Liao
  - Solver module: Seto, Meneghini
- Synthetic data, Test: + Kwiatkowski, Kim

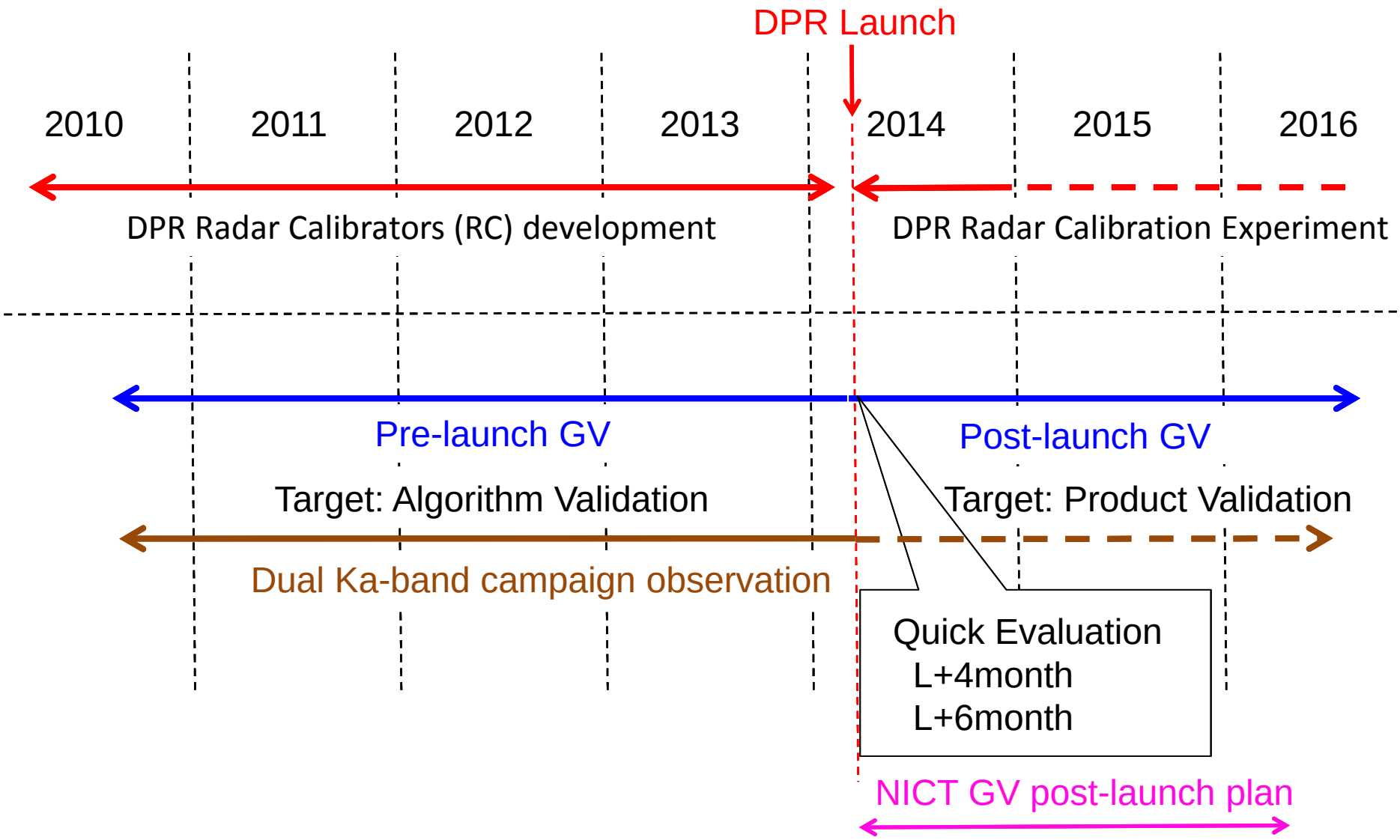
DPR L2 development activities

- International DPR L2 telecons or meetings were held once per 2 months since Apr. 2012.
  - Apr., Jun., Aug., Oct., Nov. in 2012, Jan., Mar., May, Jul., Aug., Nov. in 2013, Jan. in 2014
- Domestic DPR L2 meetings were held once a month.
  - Jan., Feb., Mar., Apr., May, Jun., Aug., Sep., Oct., Dec. in 2012, Jan., Feb., Apr., May, Jul., Aug., Oct., Nov., Dec. in 2013, Jan. in 2014
- Code submission to NASA PPS/JAXA MOSS
  - “Baseline code” (Version 2) was submitted in Jan. 2012
  - “At-launch code” (Version 3) was submitted in Dec. 2012.
  - “Updated at-launch code” (Version 4) was submitted by the end of Mar., Sep., Nov. and Dec. 2013.
  - “Final at-launch code” (Version 4) will be submitted on 15th Jan. 2014.

Summary of algorithm development

- At-launch version of the DPR algorithm was submitted to JAXA and NAXA.
- The code is currently under test with simulated data sets.
  - Early test results show that the retrieved estimates are comparable to PR estimates.
- Future activities
  - Tuning of parameters
  - Uncertainty and error analysis
  - Implementation of proposed and advanced functions
    - Wet surface SRT
    - Texture module that corrects for the effect of non-uniform beam filling.
    - Evaluation of NUBF effect and development of compensation algorithm
    - Creation of scientifically reliable models and tables:
    - scattering tables, BB model, ice particle models, etc
  - Revision of the ATBD

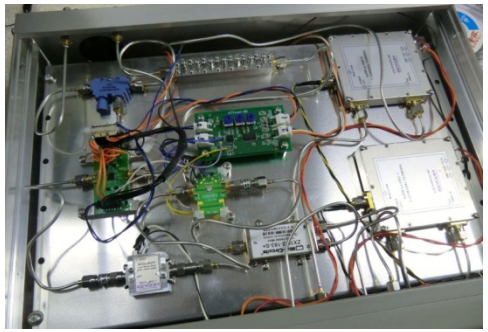
NICT activity for calibration and validation of DPR



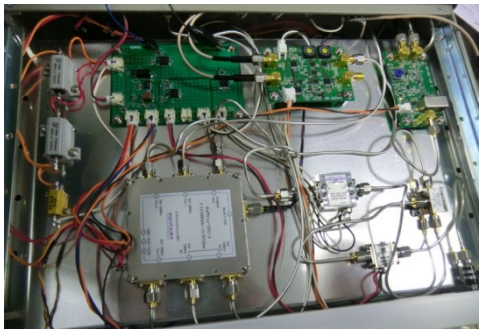
Radar Calibrator (RC) development

1	KuARC	JAXA	Tx(Pulse, CW) + Rx + Transponder	2008
2	KaARC	NICT	Tx(Pulse, CW) + Rx + Transponder	2006
3	KuARC2	JAXA	Tx(Pulse, CW with variable amplitude) + Rx + Transponder	2012-12
4	KaARC2	JAXA	Tx(Pulse, CW with variable amplitude) + Rx + Transponder	2012-13
5	KuTxRC	NICT	Tx(CW with variable amplitude)	2008-2013
6	KuRxRC	NICT	Rx (3ch)	2008-2013
7	KaTxRC	NICT	Tx(CW with variable amplitude)	2008-2013
8	KaRxRC	NICT	Rx(3ch)	2008-2013

Antenna for KuPR



Tx for KuPR



Rx for KuPR

NICT activity (FY2010-FY2012)

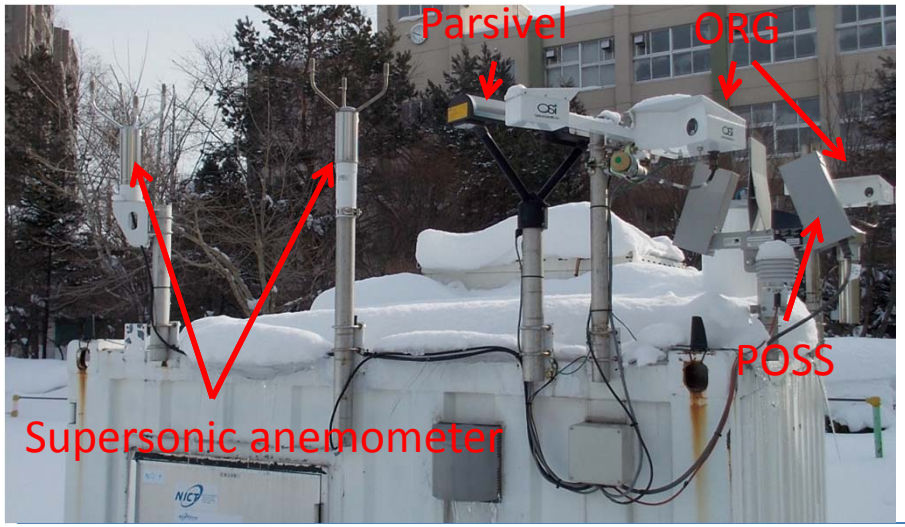
- Radar Calibrator (RC) development
  - FY2010
  - FY2011
  - FY2012

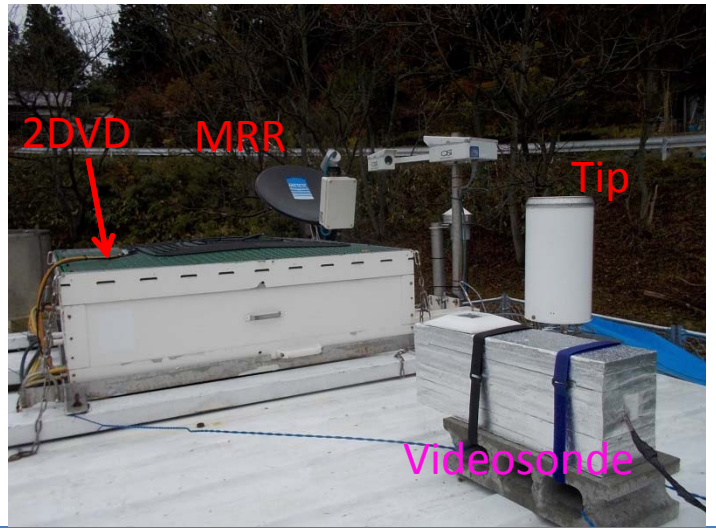
- Ground Validation
  - FY2010
    - ✓Mobile ground-based precipitation observation system development
    - ✓Surport for JAXA dual Ka-radar system development
    - ✓Dual Ka-radar system evaluation using COBRA and ground-based DSD measurement
    - ✓Dual Ka-radar observation campaign in Okinawa
  - FY2011
    - ✓Dual Ka-radar observation campaign in Tsukuba, Mt. Fuji and Nagaoka
  - 2012
    - ✓Sapporo campaign observation by the dual Ka-radar system and mobile gound-based precipitation observation system

Mobile ground-based precipitation observation system

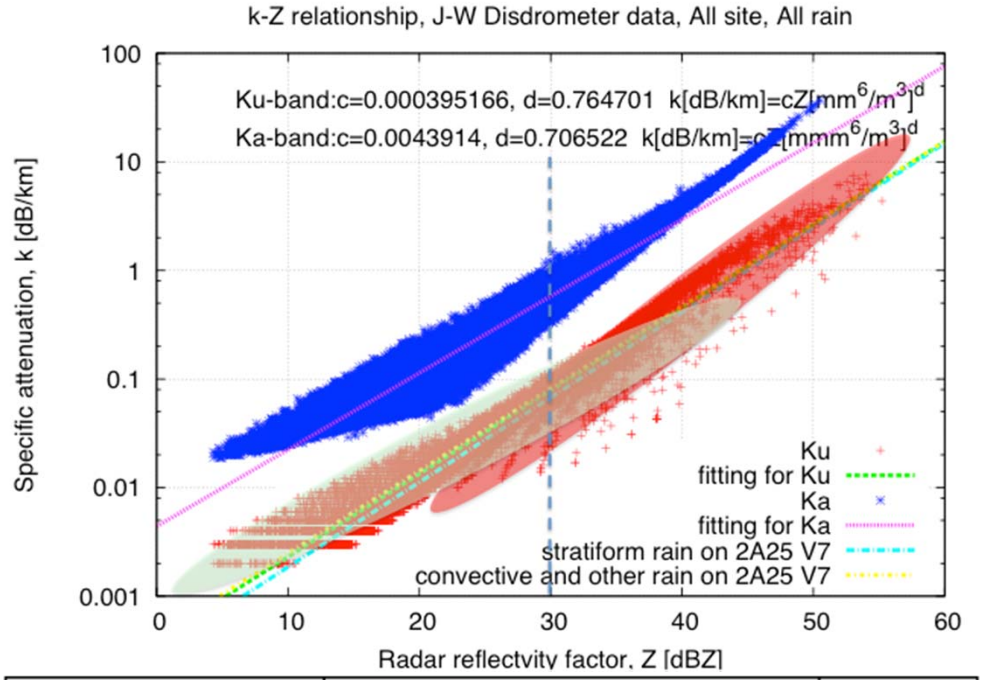
<instrument>

- ✓ 2DVD
- ✓ Impact-type disdrometer
- ✓ Optical rain gauge (ORG)
- ✓ Parsivel (laser optical) disdrometer
- ✓ POSS
- ✓ Macro rain radar (MRR)
- ✓ Tipping bucket rain gauge（Tip）
- ✓ Supersonic anemometer
- ✓ Thermo-hydrometer
- ✓ Ground-based Videosonde (with Yamaguchi Univ.)





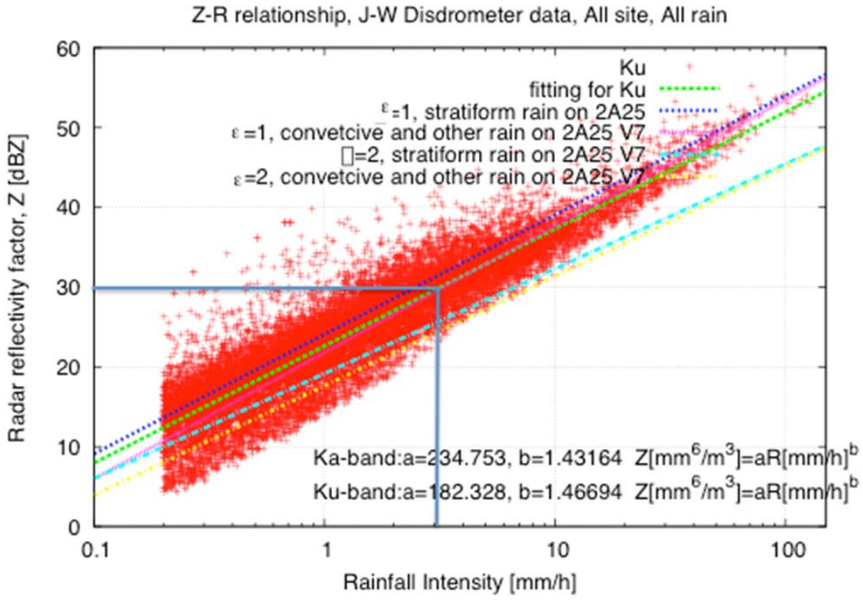
Results (*k-Z* relationship, Ground-based DSD)



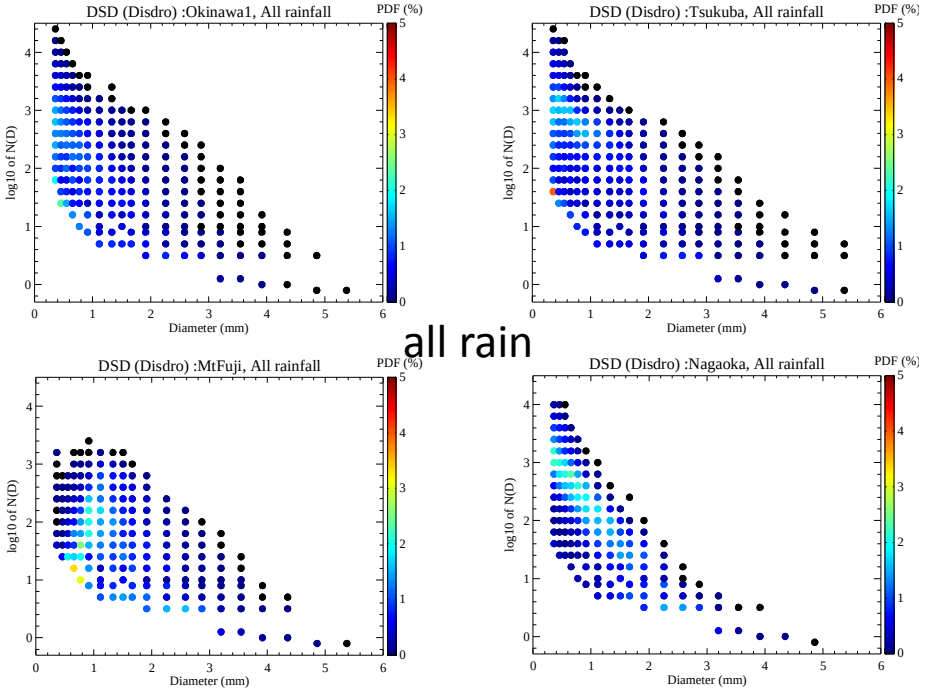
All rain (0.2mm/h < R)	k–Z reation (k=αZ^β)				
	Ku		Ka		
	α	β	α	β	α_ka/α_ku
Okinawa1	0.000386	0.764	0.00445	0.698	11.53
Okinawa2	0.000282	0.815	0.00295	0.763	10.46
Tsukuba	0.000539	0.737	0.00593	0.684	11.00
Mt. Fuji	0.000207	0.845	0.00206	0.806	9.95
Nagaoka	0.000568	0.689	0.00668	0.620	11.76
All site	0.000395	0.764	0.00439	0.707	11.11
2A25 V7 for ST	0.000307	0.781			DRP L2
2A25 V7 for Cov. & other	0.000433	0.759			α_{ka}/α_{ku} =10

Rainfall intensity category

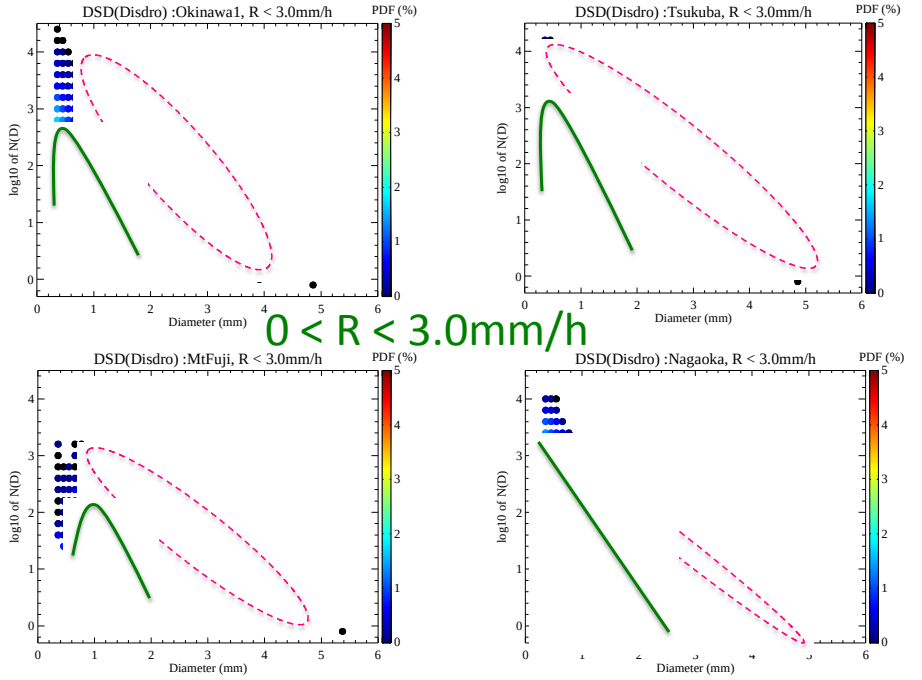
1. All rain (0.0mm/h ≦ R)
2. 0.0mm/h < R < 3.0mm/h
3. R≧3.0mm/h



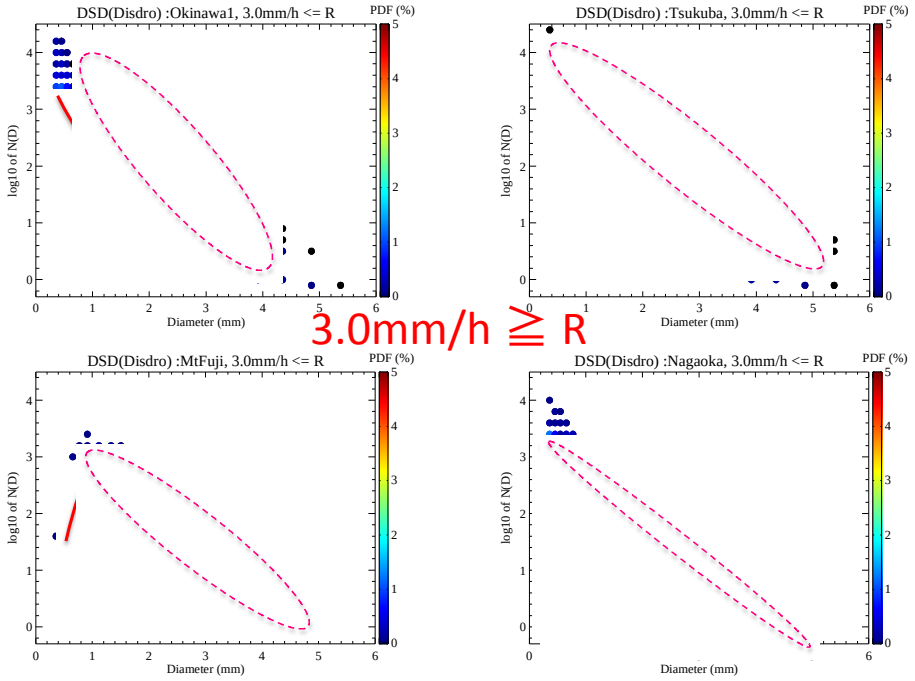
Results (*cont.*)



all rain



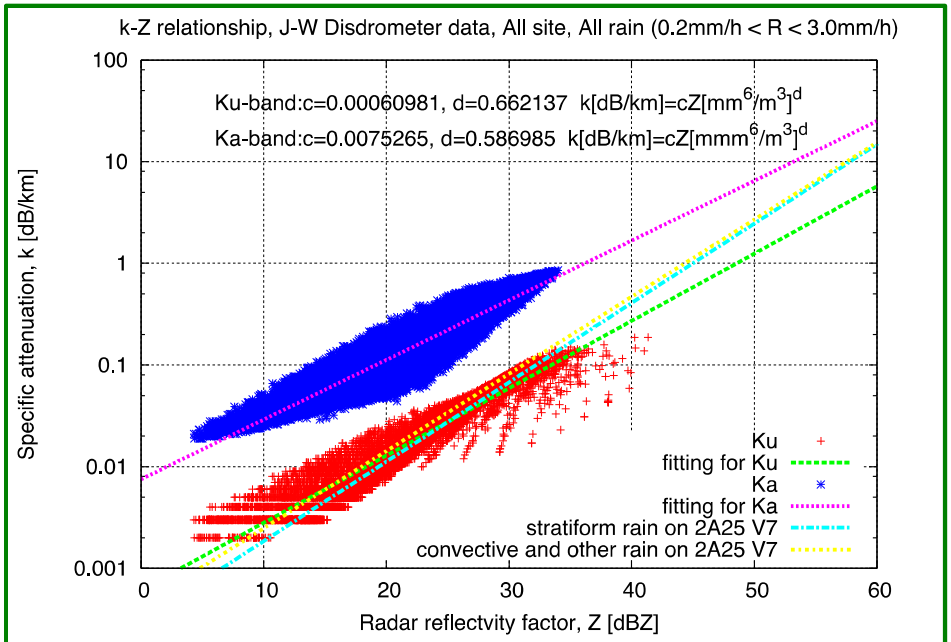
0 < R < 3.0mm/h



3.0mm/h ≦ R

Results (*cont.*)

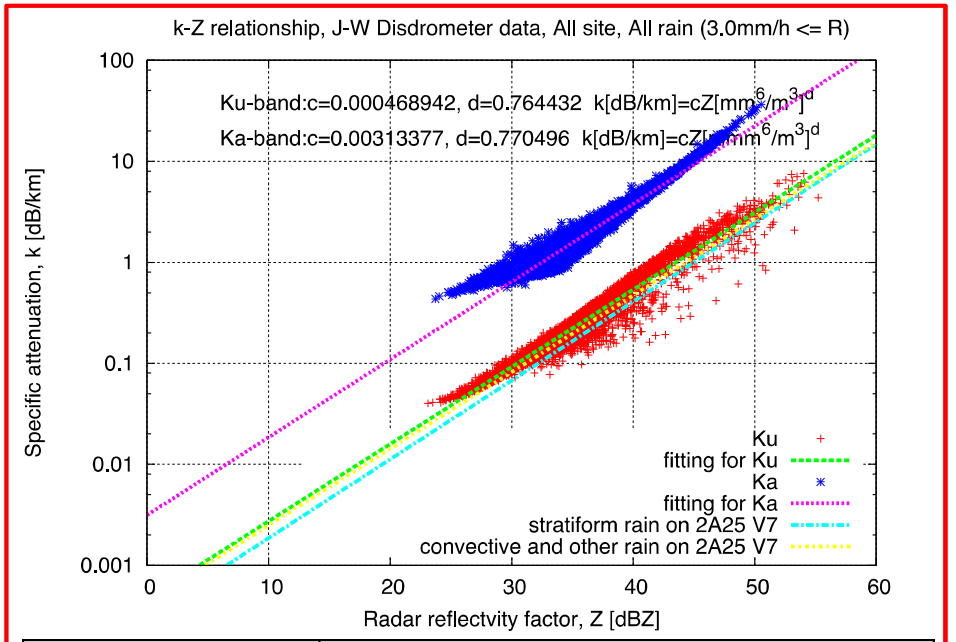
0 < R < 3.0mm/h



0.2mm/h < R < 3.0mm/h	k-Z reation (k=αZ^β)				
	Ku		Ka		
	α	β	α	β	α_ka/α_ku
Okinawa1	0.000551	0.679	0.00715	0.591	12.98
Okinawa2	0.000456	0.704	0.00595	0.613	13.05
Tsukuba	0.000875	0.613	0.0096	0.567	10.97
Mt. Fuji	0.000293	0.773	0.00308	0.727	10.51
Nagaoka	0.000606	0.672	0.00756	0.593	12.48
			0.00753	0.58	

DRP L2
α_{ka}/α_{ku} =10

3.0mm/h ≧ R

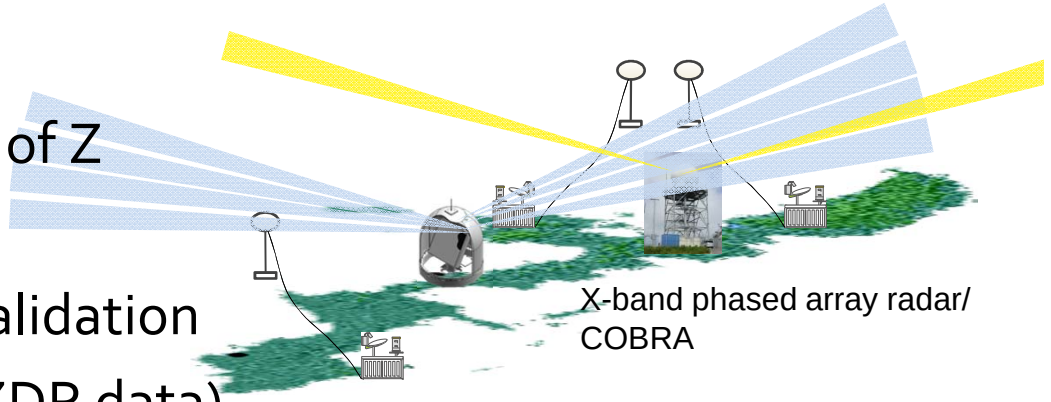


R > 3.0mm/h	k-Z reation (k=αZ^β)				
	Ku		Ka		
	α	β	α	β	α_ka/α_ku
Okinawa1	0.000444	0.770	0.00329	0.765	7.41
Okinawa2	0.000510	0.761	0.00445	0.736	8.73
Tsukuba	0.000505	0.757	0.00333	0.765	6.59
Mt. Fuji	0.000390	0.784	0.00176	0.834	4.51
Nagaoka	0.004590	0.435	0.02196	0.491	4.78
			0.00313	0.77	

DRP L2
α_{ka}/α_{ku} =10

NICT GPM GV post-launch experiment

- Location:
  - (1) Okinawa　COBRA + Phased array radar + ground measurements
  - (2) Kobe　Phased array radar (Kobe + Suita) + ground measurements
- Target (Products):
  - Z ⇔ Direct comparison of Z
  - ZDR ⇔ Do validation
  - ρHV ⇔ melting layer flag validation
  - KDP ⇔ R validation (w/ Z, ZDR data)



- Preparation:
  - software (1) GPM-Ground based radar match up
    (2) COBRA analysis tool (ZDR, ρHV, KDP)

NICT GPM GV post-launch experiment

- DSD measurement by tethered balloon
  - Video sonde type measurement
  - up to several hundred meters