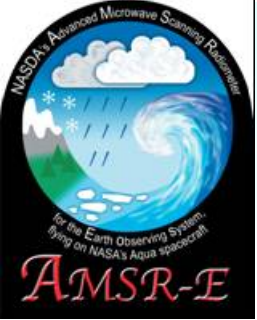


“Wakasa Bay”

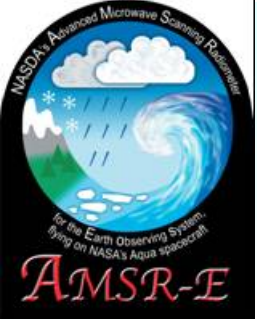
An AMSR Precipitation Validation Campaign

E. Lobl, K. Aonashi, B. Griffith, C. Kummerow, G. Liu, M. Murakami, and T. Wilheit



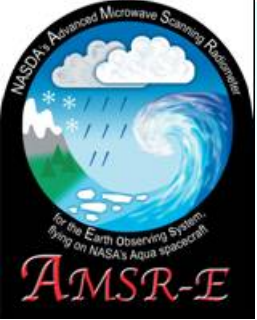
Outline

- General objective
- Experiment set up
 - Instrumentation
 - Flight lines
- Preliminary assessment
- 27 & 29 January NASA P3 data
- Data availability
- Summary



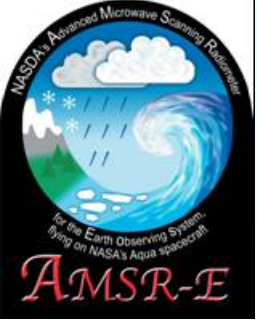
General Objective

- Physical validation of the AMSR precipitation retrievals:
 - Beam filling (BF)
 - Freezing level (FL)
 - Bright band (BB)
 - Snow measurement over the ocean (SO)
 - Forward modeling (FM)
 - Rain/Snowfall over land (RSL)
 - Cloud water (CW)
 - Surface emissivity/backscatter (SCF)
 - Drop size distribution (DSD)
 - Case studies/time evolution (CS)



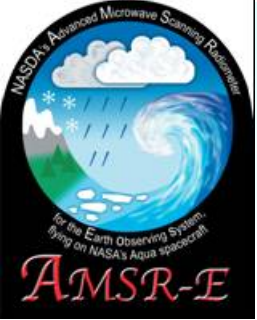
Experiment Set Up

- There were two bases for the airborne operations:
 - The NASA P3 was based at Yokota Air Base, near Tokyo
 - The Gulfstream II was based at Nagoya airport
- There were two Doppler radars: at Mikuni and Unami
- Ground based data were taken at Fukui airport



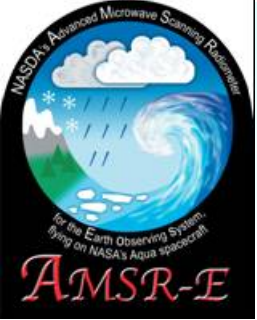
NASA P3 Instrumentation

- **Airborne Multi-channel Microwave Radiometer (AMMR):** 21 & 37 GHz, valid data at: low altitudes, ascent, descent
- **Millimeter-wave Imaging Radiometer (MIR):** 89, 150, 183+/-1, 3, 7, 220 & 340 GHz, swath: +/- 50 deg off nadir, ext. calibration,
- **Airborne Precipitation Radar 2 (APR2):** 13.4 & 35.6 GHz, HH&HV pol., 60 m vertical res., 10 km swath
- **Polarimetric Scanning Radiometer (PSR):** 10.7, 18.7, 21.5, 37, 89 GHz, 9.6-11.5 μm , conical scanner, V&H pol.
- **Airborne Cloud Radar (ACR):** 94 GHz, HH&HV pol., 120 m vertical res.; off below 2.6 km msl.



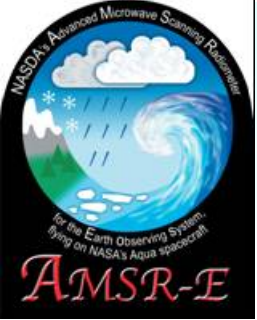
Gulfstream II Instrumentation

- **Forward scattering spectrometer probe (FSSP), two-dimensional cloud optical array probe (OAP- 2DC), two-dimensional precipitation optical array probe (OAP-2DP), CSIRO King liquid water probe (KLWC-5):** made by Particle Measuring Systems (PMS)
- **Cloud aerosol precipitation spectrometer (CAPS):** made by Droplet Measurement Technologies, Inc. (DMT)
- **Particulate volume monitor (PVM-100A):** made by Gerber Scientific, Inc.
- **Nevzorov total water content/liquid water content (TWC/LWC) probe:** made by Skytech Research, Inc.
- **Total Air Temperature (TAT) sensor:** Rosemount
- **Dew Point Hygrometer (Model-137):** Edgetech
- **Lyman-alpha hygrometer (AIR-LA-1):** Atmospheric Instrumentation Research, Inc.
- **Gust probe**
- **Global Positioning System (GPS) receiver:** Trimble(TNL 2100T)
- **Inertial Reference System (IRS):** Honeywell (HG1050AD09)
- **Cloud radar (SPIDER*) 95.04 GHz Reflectivity, Doppler velocity, LDR:** NIICT(CRL) airborne cloud profiling radar, Nadir or side looking mode
- **Microwave radiometer (WVR-1100) 23.8 and 31.4 GHz:** Radiometrics Corporation
- **GPS dropsonde (RD93):** Vaisala
- **Video cameras (forward and downward):** Hi8



Instrumentation at Fukui

- **3 Ground microwave radiometers** (23.8&31.4 GHz; 23.8&36.5 GHz; 9 ch. 50.8-58 & 90 GHz): all with a 55 deg. zenith angle
- **MicroRain radar** (24GHz) :FM-CW radar, vertical profile and velocity
- **Precipitation gauges** (every minute): electric balance
- **Optical sensors**: concentration, DSD and vertical velocity of snow flakes
- **Automated weather station** (every 10 minutes): air temp., wind speed, RH, precipitation gauge
- **Radiosondes** (4 times daily): also at Akita, Wajima and Yonago stations and on the 3 research vessels in the Sea of Japan

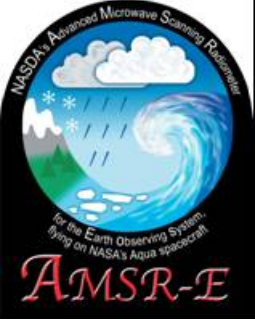


Doppler Radars

- Doppler radars were located at Mikuni and Goishigamine (C Band): dual polarization, Doppler, 1 deg beamwidth, 2 msec pulse; 3D (CAPPI) and 2D RHI data



March 11 2008



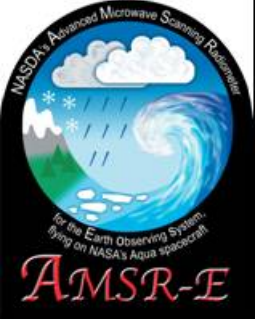
Flight lines

Date	Region Observed	Flight Altitude km MSL	Instrument Status /Problems	Comments
1/14/03	NW coast of Honshu	7, 0.15 (3 circuits ¹)	No PSR data for the entire flight	Rain, then snow over ocean; BB visible
1/15/03	Honshu	7	PSR/89 GHz channel not operational	Snow showers over land
1/19/03	Western Pacific	6.3, 0.15	All instruments operating well	Rain cells over ocean, snow, freezing level 1.7 km
1/21/03	Western Pacific	7, 3 (2 circuits)	All instruments operating well	Significant rainfall over ocean, freezing level 1.6 km
1/23/03	Western Pacific	7, 3 (2 circuits)	No MIR data	Rain over ocean; BB near 2.5 km
1/26/03	Honshu	7	No MIR & PR2 data	Baseline around Fukui
1/27/03*	Sea of Japan	7 (4 lines ²)	PR2/Ka band portion had occasional interruptions	Stratiform rain over land; BB near 1.8 km
1/28/03*	Sea of Japan	7 (4 lines)	No AMMR data	Snow showers over land and water
1/29/03*	Sea of Japan	7 (6 lines)	No AMMR data	Widespread snow
1/30/03*	Sea of Japan	7 (4 lines)	No AMMR data	Light snow showers
2/01/03	Honshu	7	No ACR data at the beginning of the flight	No precipitation, snow on the ground
2/03/03	Western Pacific	7, 0.15 (1 circuit)	No APR data for the first 2 hr of flight	Rainfall over ocean; spiral up through rain

¹ a circuit is a flight that can be considered a vertical rectangle with the long sides being at 7 and at 0.15-km altitude and the short sides being the descent and ascent between the two levels.

² a line is a flight between two points at the same altitude. More than one line means that the lines were flown at the same altitude, shifted horizontally from one another

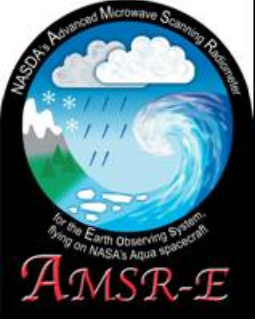
March 11, 2008
* Coincident NASA P3 and Gulfstream II flights



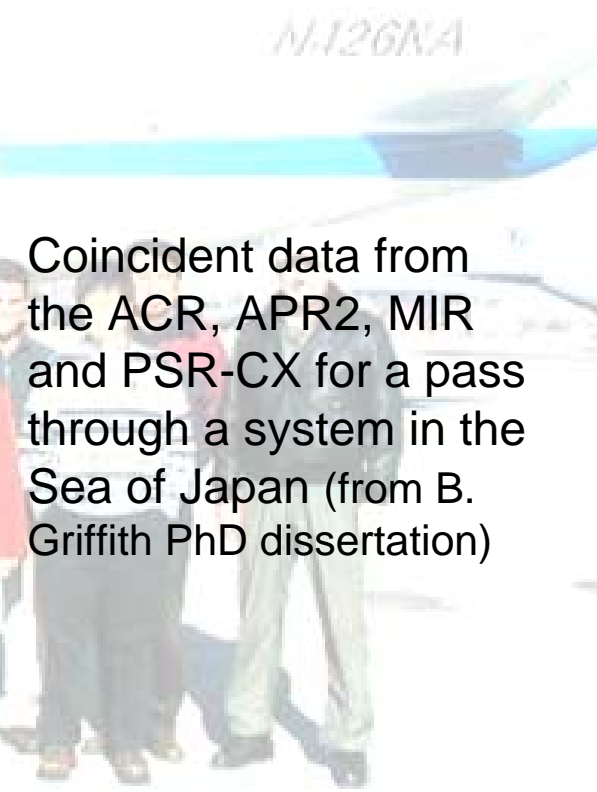
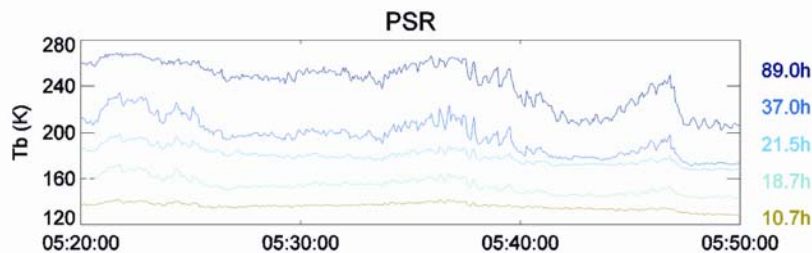
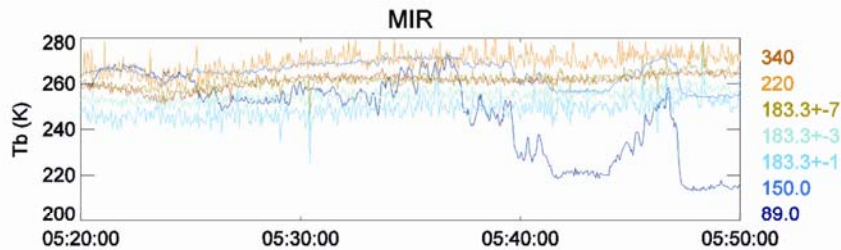
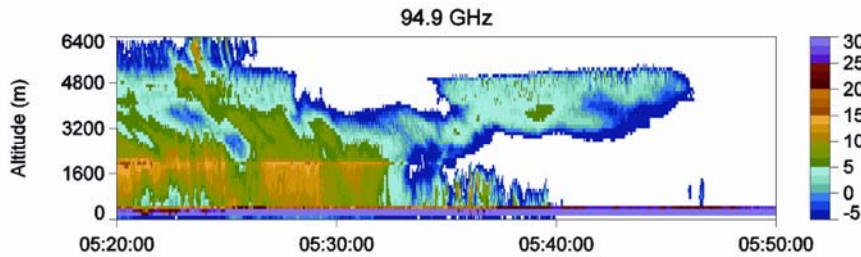
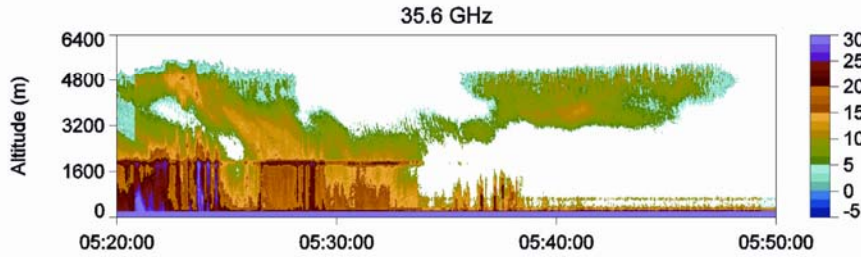
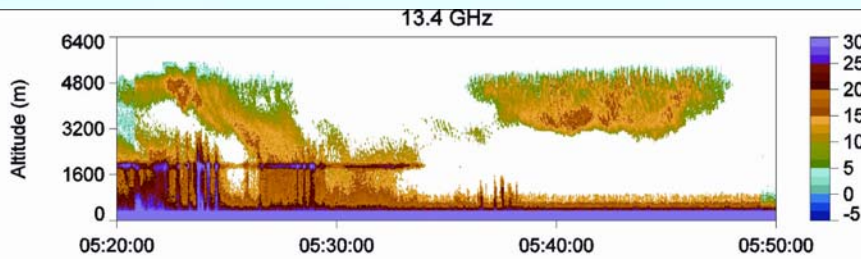
Preliminary assessment

Wakasa Bay campaign objectives with a preliminary assessment of corresponding flight days

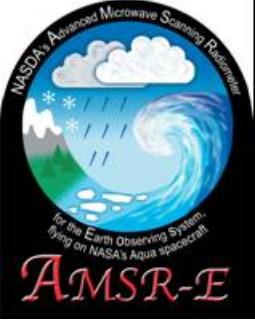
Objective	Flight dates
Length scale of precipitation (beam filling)	19, 21, 23, 28, 29 January, 3 February
Cloud water retrieval	
Drop size distribution	
Freezing level retrieval	14, 19, 21, 23, 27 January, 3 February
Radiative transfer in bright-band	14, 19, 21, 27 January, 3 February
Forward modeling	
Surface emissivity/backscatter	
Snow measurement over ocean	14, 21, 28, 29, 30 January
Rain/snowfall over land	15, 27, 28 January, 1 February
Case studies/time evolution	ALL except 26 January & 1 February



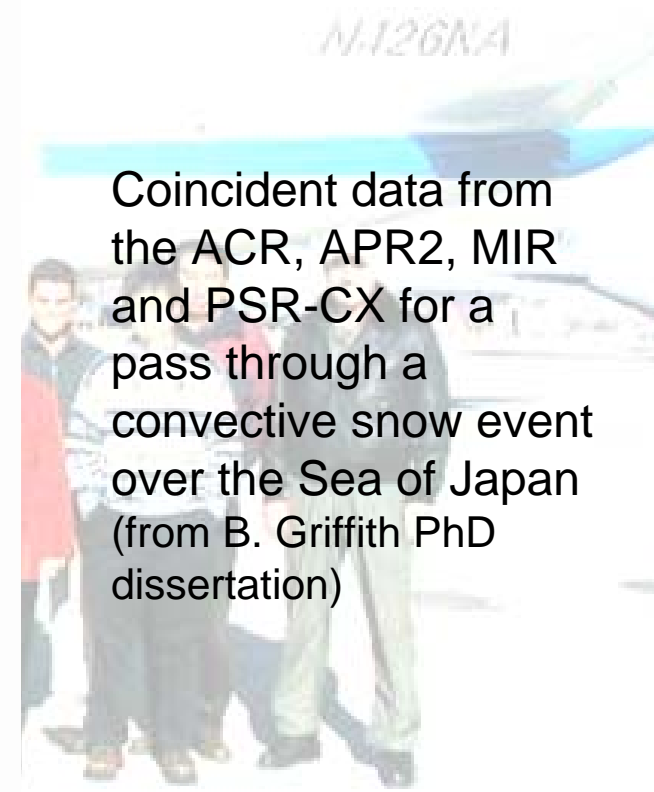
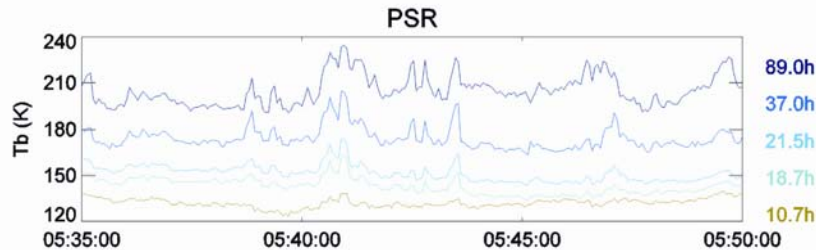
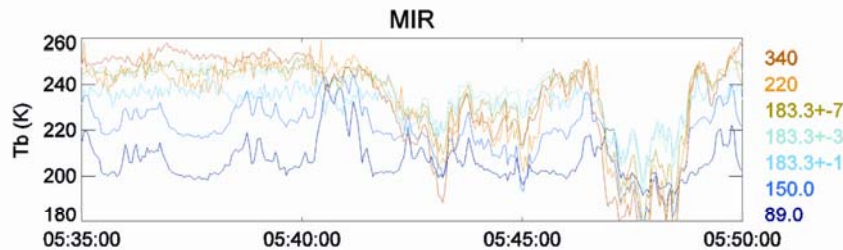
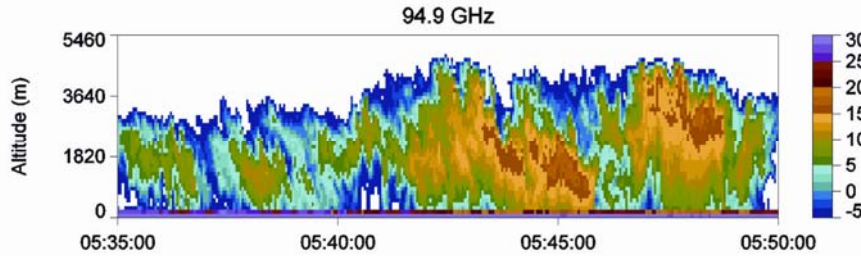
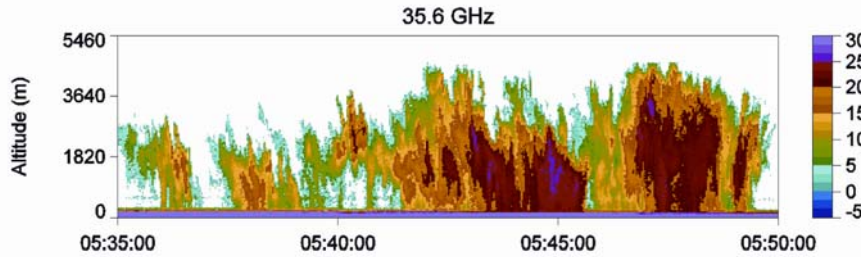
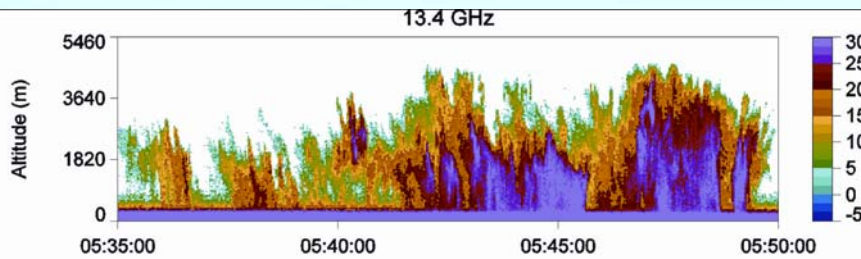
27 January 2003



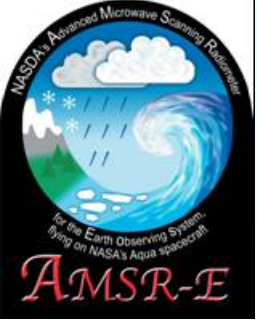
Coincident data from the ACR, APR2, MIR and PSR-CX for a pass through a system in the Sea of Japan (from B. Griffith PhD dissertation)



29 January 2003

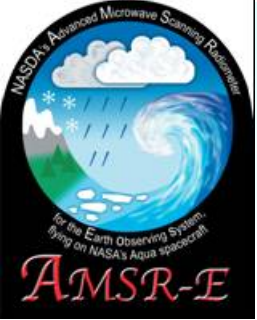


Coincident data from the ACR, APR2, MIR and PSR-CX for a pass through a convective snow event over the Sea of Japan (from B. Griffith PhD dissertation)



Data Availability

- The data taken by the instruments on the NASA P3 can be obtained from NSIDC
 - http://nsidc.org/data/amsr_validation
- Data taken at the Fukui ground station, the Doppler radars and the Gulfstream II instruments can be obtained from
 - http://sharaku.eorc.jaxa.jp/AMSR/data_val



Summary

- This joint (Japan and US) campaign was designed to answer specific rainfall validation questions
- The meteorological conditions were varied: good for meeting the proposed goals
- The goals were met: more research analysis needed with these data