Group Session 1-3

Rain and Cloud Observations

Targets in Science Plans

CINDY Science Plan (Apr. 2009)

Atmospheric Research

a. Preconditioning processes
b. Rossby wave
c. Diabatic heating
d. Diurnal cycle
e. Column integrated humidity
f. Squall-line and cold pool
g. Population of clouds

Air-Sea Interaction

a. IOD / zonal SST distribution
b. Diurnal variation of SST / SSST
c. Flux (heat, moisture, momentum …)

Oceanic Research

a. Mixed layer
b. Diurnal warm layer
c. Oceanic wave (MRG, Kelvin, …)
d. Biogeochem responce

DYNAMO SPO (Jul. 2009)

Role of Moisture

a. Moist layer vs. Convections
b. Moisture above cloud base
c. Moistening vs large-scale drying

Role of Cloud Population

a. Cloud population distribution
b. Relationship to stage or moisture environment
c. Transition of stages
d. Heating profile / convergence
e. Resulting moisture transport

Role of Air-Sea Interaction

a. Flux (w/wind, humidity, SST, …)
b. Barrier layer
c. Diurnal mixing
d. Heat budget

Demands on cloud/precipitation observations

- ***Cloud population distribution***
  - *4-D reflectivity map … C-band radars*
    - *cover MJO: wide and long*
    - *resolve wide variety of clouds: height, size, life, stage transition, …*
  - *non-precipitating clouds … cloud radar, lidar*

- ***Diabatic heating***
  - *precipitation amount … radar, raingauge, disdrometer*
  - *divergence … Doppler radar*
  - *updraft … Doppler radar, …*
  - *cloud physics … dual-pol radar, cloud radar, lidar, videosonde*
  - *radiative forcing … (radiometers,) cloud radar, lidar, …*

- ***Moisture transport***
  - *updraft*
  - *non-precipitating cloud*
  - *cloud physics*

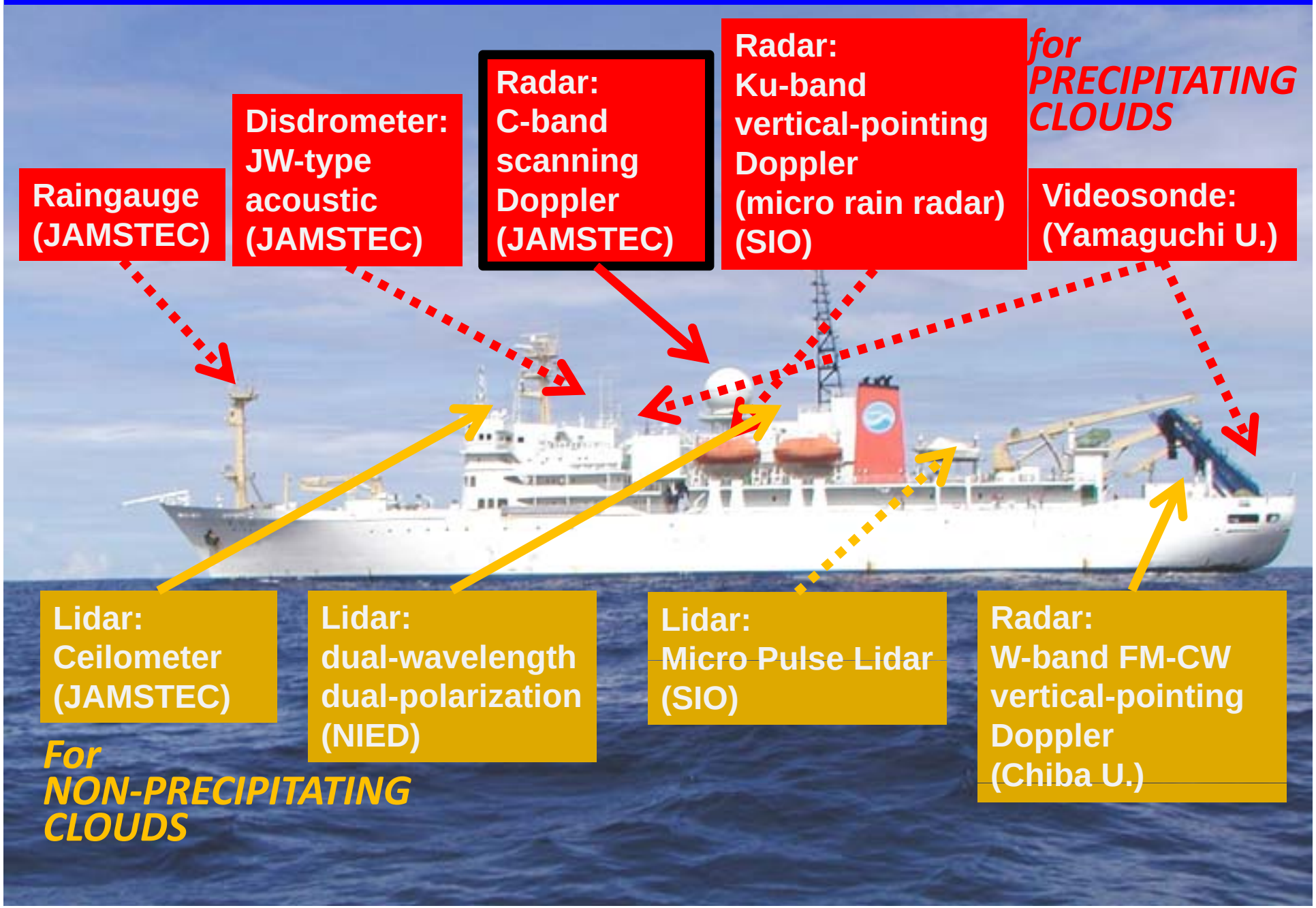
Planned Rain + Cloud Observations on R/V Mirai (+1)

Masaki KATSUMATA (JAMSTEC)

under collaboration with
Toshiaki TAKANO (Chiba Univ.)
Nobuo SUGIMOTO (NIED, Japan)
Piotr FLATAU (Scripps Institute of Oceanography)
Kenji SUZUKI (Yamaguchi Univ.)
Jeff NYSTUEN (Univ. Washington)
Kunio YONEYAMA (JAMSTEC)

CINDY workshop: Nov.8-10, 2010 @ JAMSTEC-YES

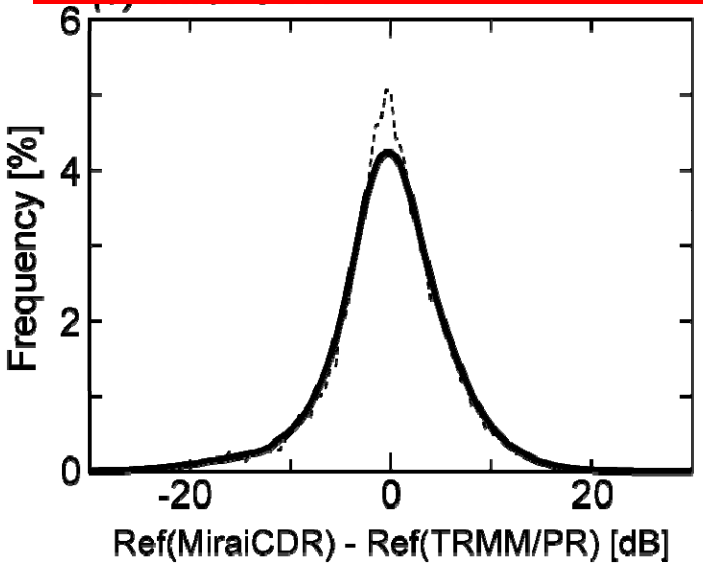
Expected rain/cloud observations on R/V Mirai



C-band Scanning Radar

- ***Basic Specs***
  - *C-band (5cm) single polarization*
  - *Stabilized by cancelling ship motion (detected by IXSEA Phins)*
  - *Recorded in Sigmet IRIS RAW format*
  - *Operated by skilled technical staff*

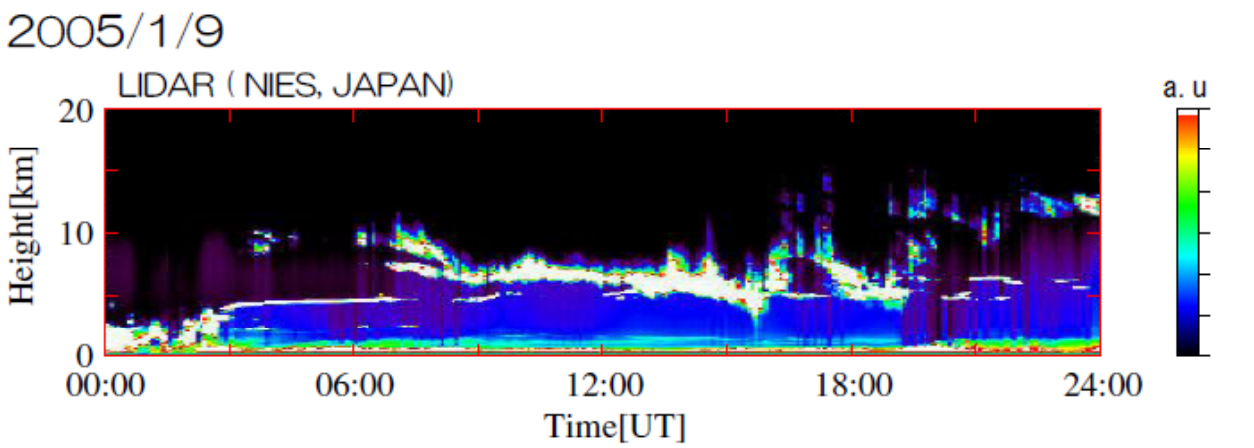
Reflectivity difference to TRMM/PR

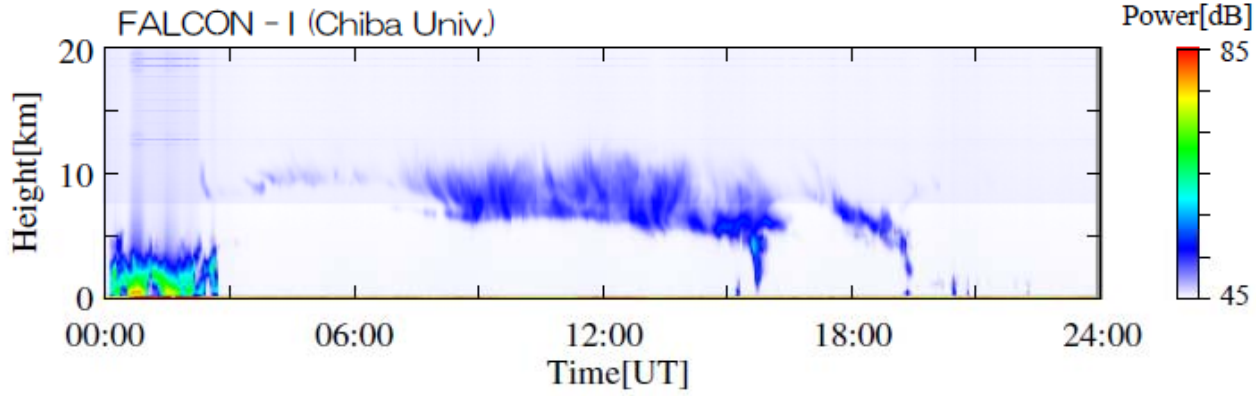


Katsumata et al. (2008)

W-band “FALCON” radar

- FM-CW: high temporal resolution
- Vertically-pointing
- non-stabilized (temporally averaged enough to cancel ship motion)



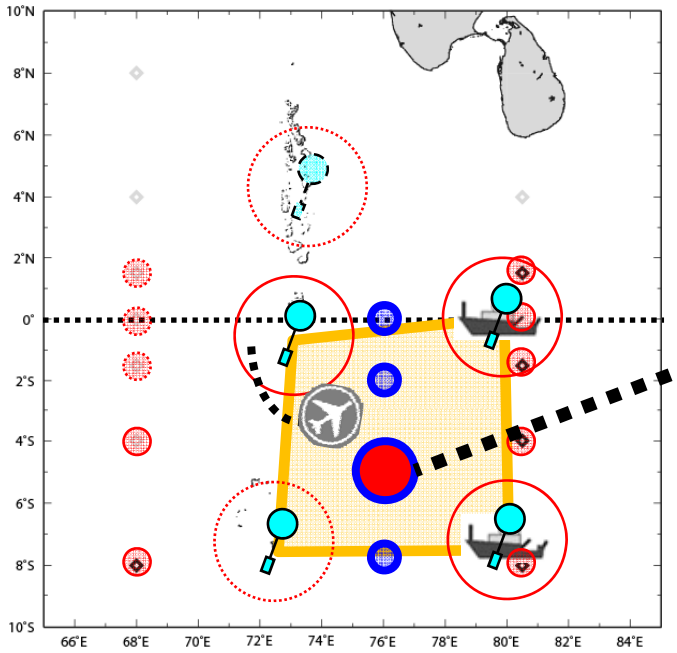


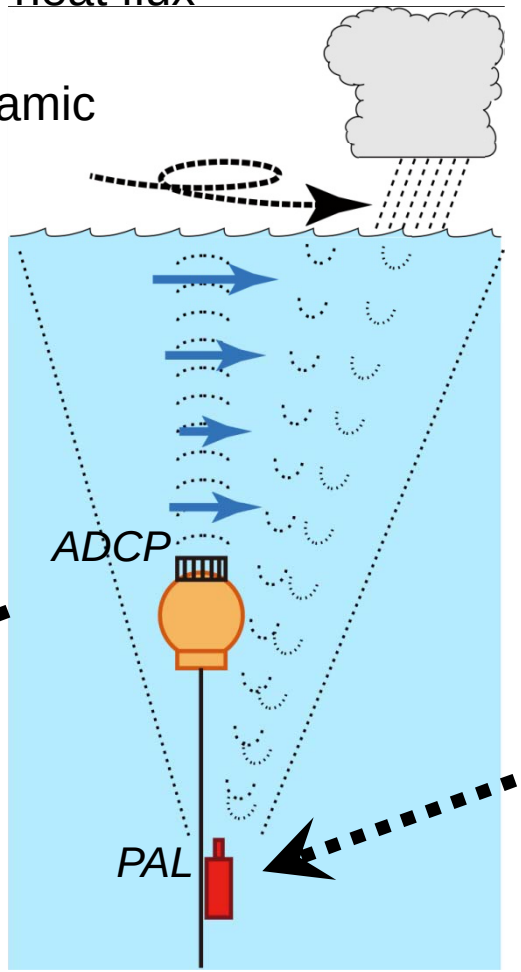
JAMSTEC subsurface mooring at (5S, 76E)

< Purposes >

to reinforce the measurements on:

- **Rain (PAL)** … for surface rain flux (to close the water-vapor budget with sounding array)
- **Surface Wind (PAL)** … for surface heat flux and surface wind stress
- **Current Profile (ADCP)** … for dynamic structure at northern edge of SCTR





Proposal to unify scan strategies for C-band scanning radars: Revelle, SMART-R(Gan) and Mirai

Masaki KATSUMATA
(JAMSTEC)

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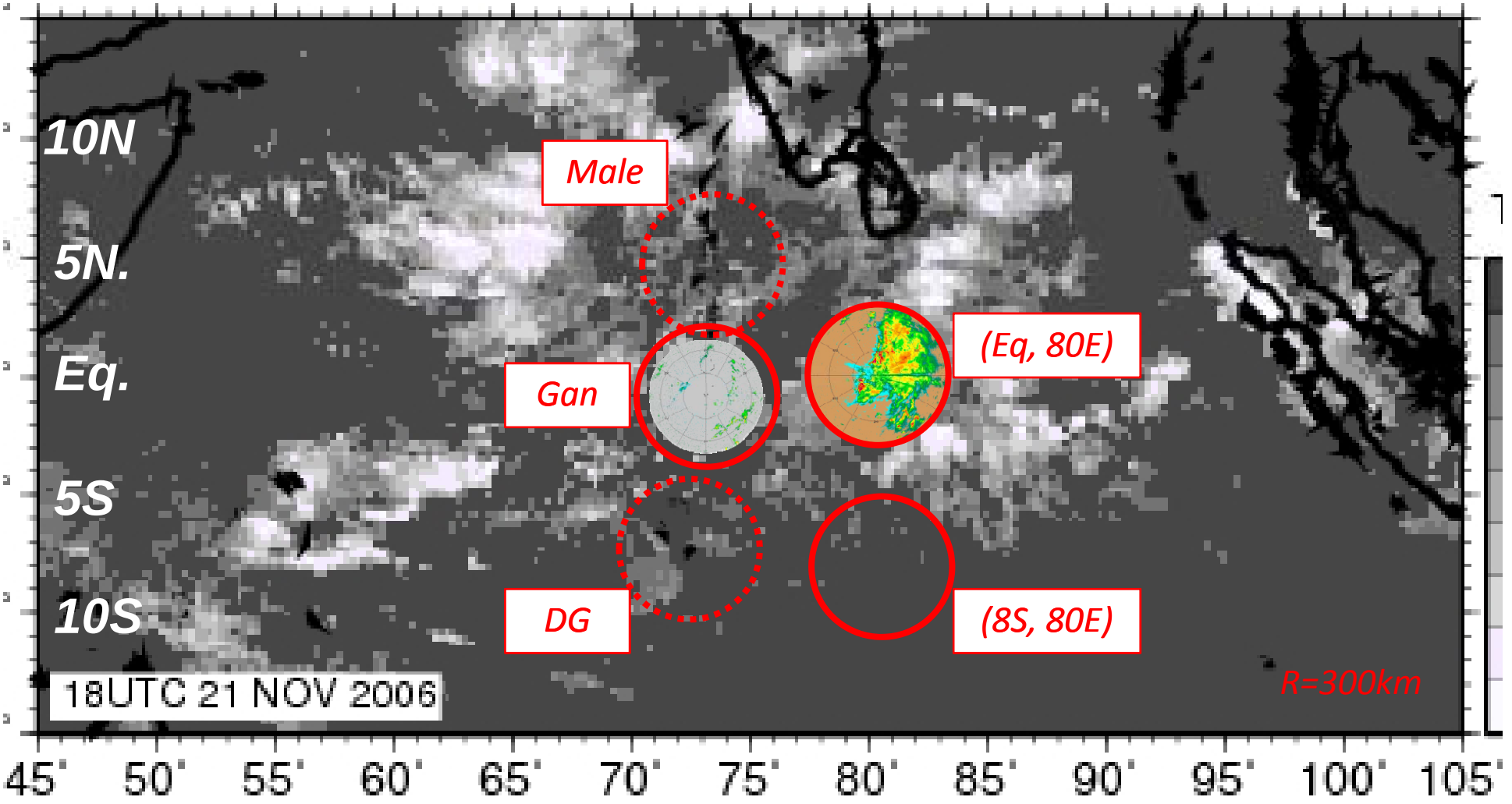
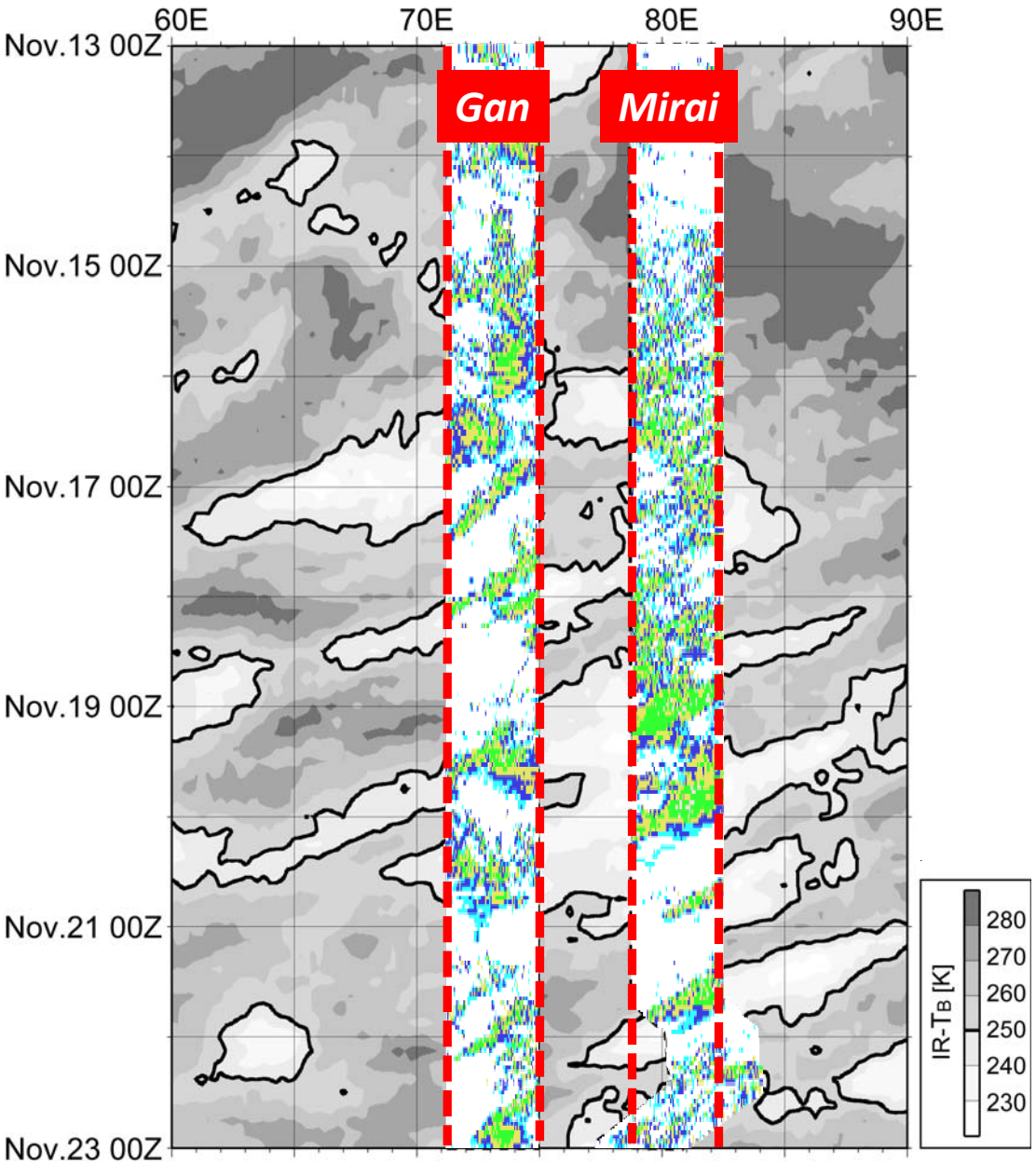
Combining C-band Radars : Example



Combining C-band Radars: Example



Katsumata et al. (2010)

Possible common products from volume scans

--- basic products ---

- reflectivity 4D map (10 min ?)
- rainmap

--- from reflectivity maps ---

- convective / stratiform mapping
- echo top height / cloud top height
- cloud population
- cell track
- cloud base height (W-, lidar, …)
- cloud amount (lidar / ceilometer / W-)
-

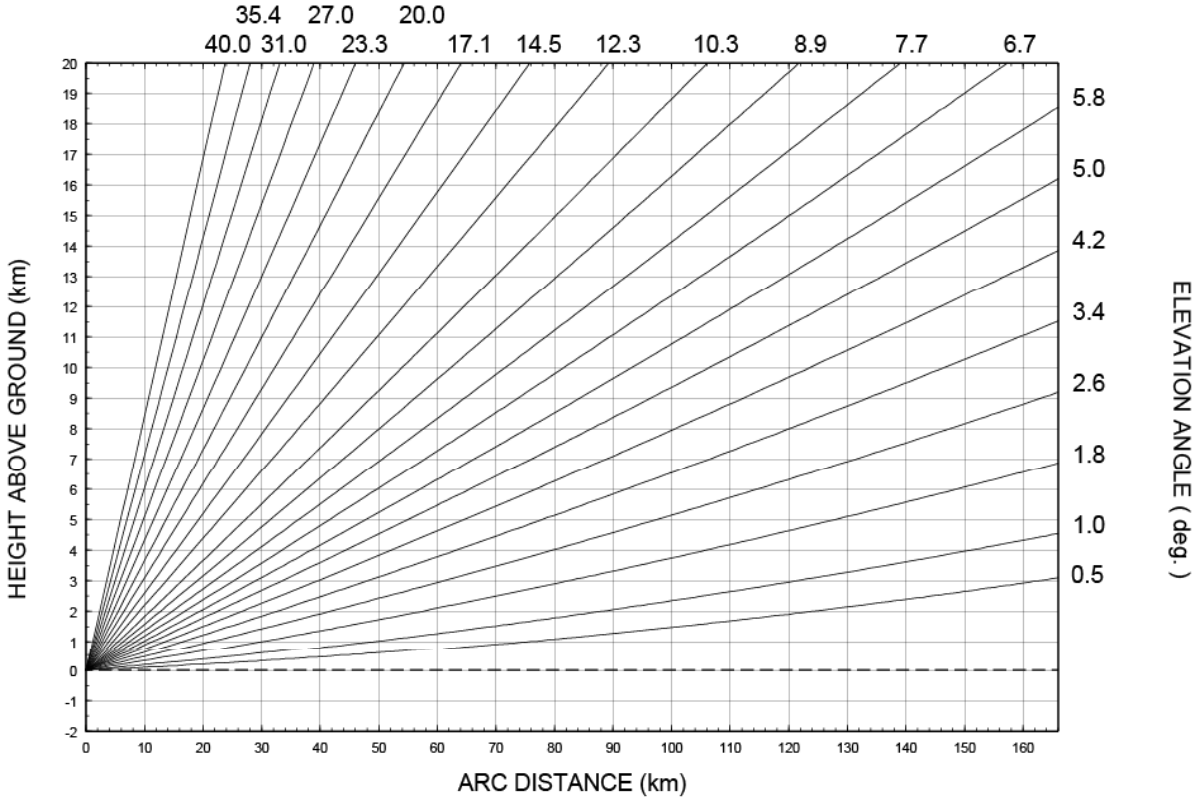
--- from Doppler velocity ---

- VAD (wind profile, divergence)
- updraft (?)

Proposed common scan strategies for C-band radars

- ***Surveillance scan***
  - *Single elevation (0.5 deg.): 30 sec. to finish*
  - *@ 30min*
  - *300km range*

- ***Volume scan***
  - *21 (or so) elevations, from bottom to top (or vice versa): 8 min. to finish*
  - *@10min*
  - *160km range*



Summary

- *Combining C-band scanning radars is useful to obtain spatial distribution of radar-derived parameters.*
- *To equalize the data quality, scan strategies of these “common” radars are better to be unified.*
- *To monitor the horizontal extent of precipitating area, long-range (R > 200km or more) surveillance scan is useful.*
- *Volume scan is essential. About 20 elevations are required to resolve 50-hPa vertical interval within 100-km range (except lower elevations where beam width is larger than 50hPa).*
- *To assume steady state in the vertical interpolation (in converting polar coodinate to cartesian), simple increase / decrease of the elevation has advantage.*