

## Observation System for Equatorial Convective Activities at Koto Tabang, Sumatra

Coupling Processes in the Equatorial Atmosphere: CPEA

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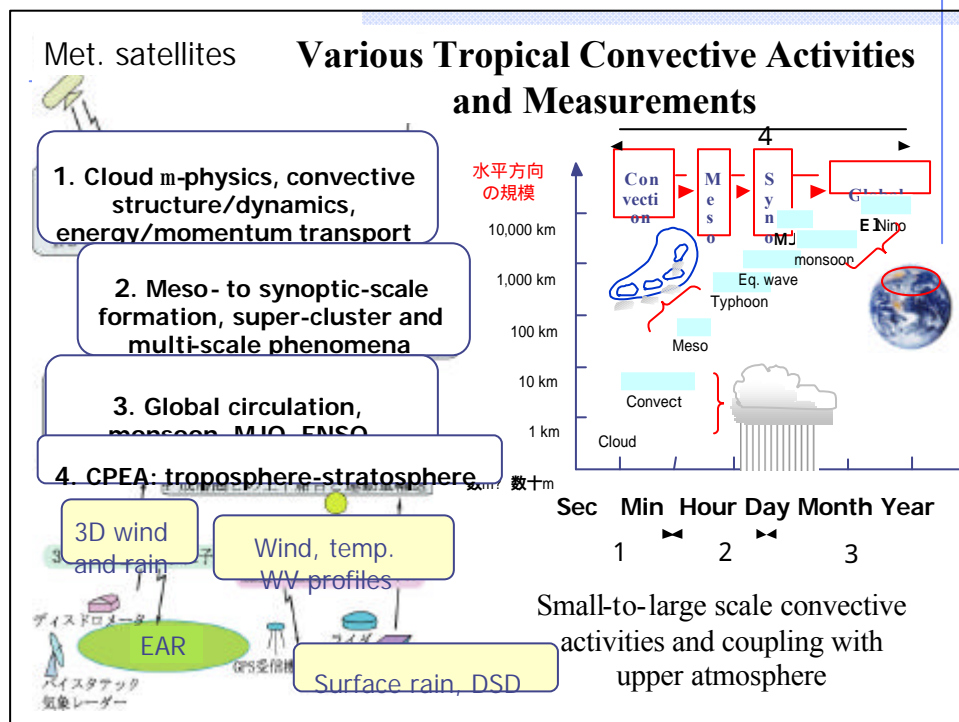


### Objectives of CPEA Project

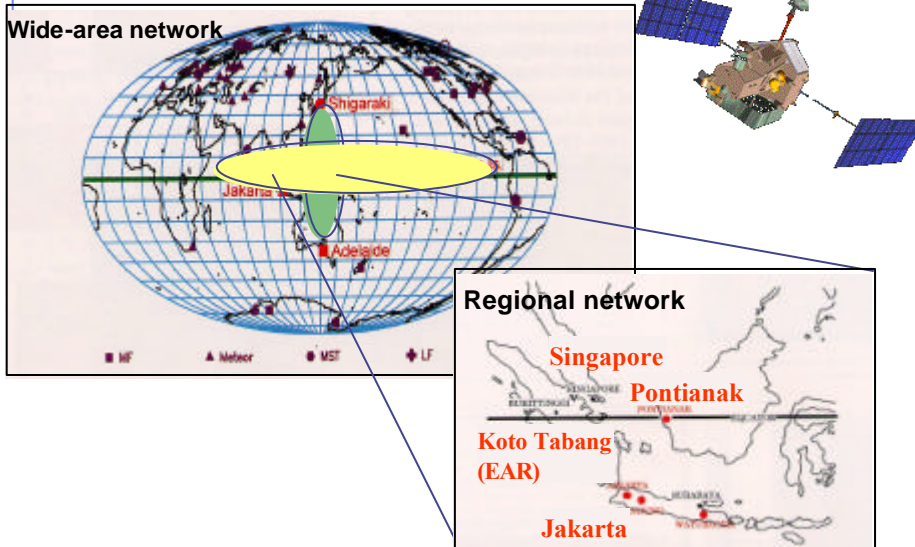
- To elucidate the coupling processes of equatorial atmosphere at the most active convective region, Indonesia.
- To study small scale atmospheric phenomena through constructing a comprehensive regional observation network.
- To study large-scale atmospheric phenomena through conducting systematic observation campaigns and constructing a wide-area network supported by international collaborations.

## Study Subjects of A03: Convection systems SG

1. Study of **each convective cloud**: Generation and evolution (cloud  $\mu$ -physics, convective structure & dynamics, energy & momentum transport).
2. Study of **meso-scale to synoptic-scale** formation, super-cluster and multi-scale phenomena.
3. Study of global circulation and **large-scale convective activities** (monsoon, MJO, ENSO).
4. Study of **CPEA** and relation to large scale phenomena in 2 and 3.
5. Study and validation of ground-based and satellite atmospheric **remote sensing techniques**.



## Wide-Area and Regional Networks, and satellite observations expected & utilized



## Instruments to be deployed at EAR site

Atmospheric parameters to be measured	Instruments	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006
		2001	2002	2003	2004	2005	2006
Wind & rain profiles	EAR	←	←	←	←	←	←
Temp. profile	RASS		←	←	←	←	←
Ground Met. Data	Met. Data (GAW)	←					
High-res. Rain rate	ORG		←	←	←	←	←
Water vapor profile	Radiometer		←	←	←	←	←
3D rain structure	X-band radar		←	←	←	←	←
Low alt. DSD	m-rain radar	←	←	←	←	←	←
Press. Gradient	m <sup>2</sup> barograph	←		↔	↔	↔	↔
Ground DSD	Disdrometer		←	←	←	←	←
3D wind and rain	Bistatic Doppler radar			←	↔	↔	
Pass-integ. Water vapor	GPS	←	←	←	←	←	←
Water vapor profile	Laman lidar				←	←	←
High-alt. Met data	Sonde			↔		↔	

## Summary of Instruments

- Wind profiles: EAR, BLR (GAW station)
- Temp. profile: EAR/RASS
- Water vapor profiles: Radiometer, (Laman lidar), w/ GPS
- Rain profile: EAR, BLR (GAW station),  $\mu$ -rain radar
- Rain rate, DSD: ORG, Disdrometers
- Press. Gradient:  $\mu$ -barographs
- 3D Rain and wind: Bistatic Doppler Radar
- Basic meteorological data on the ground

## (Equatorial Atmosphere Radar; EAR) (Completed in March 2001)



Antenna (diameter 110 m)

Location:

Koto Tabang, Palupuh District,  
Agam, West Sumatra, Indonesia  
(0.2 deg S, 100.32 deg E)

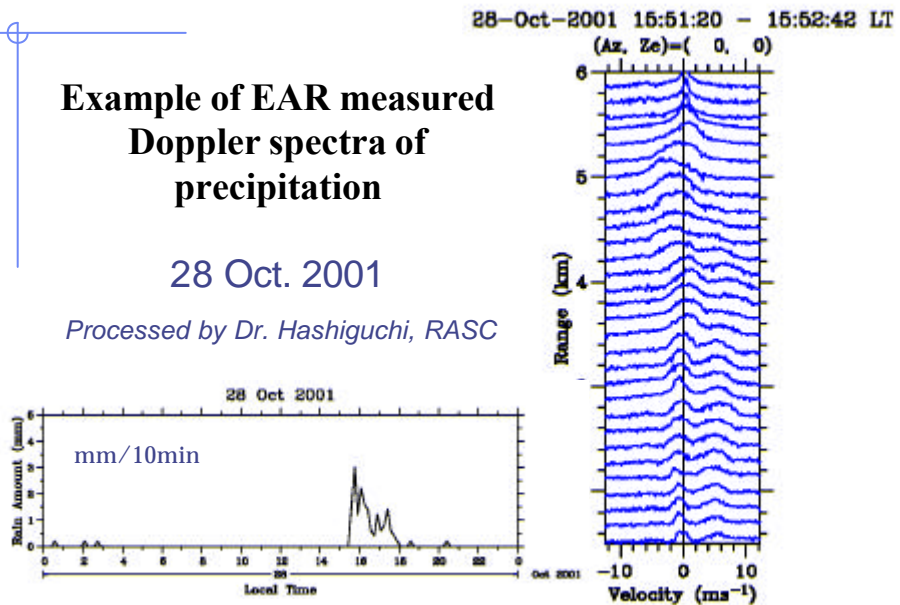


560 Yagi-arrays

## Example of EAR measured Doppler spectra of precipitation

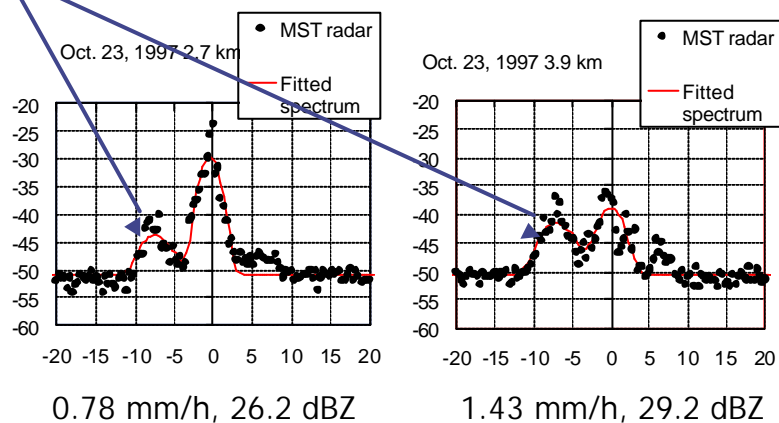
28 Oct. 2001

Processed by Dr. Hashiguchi, RASC

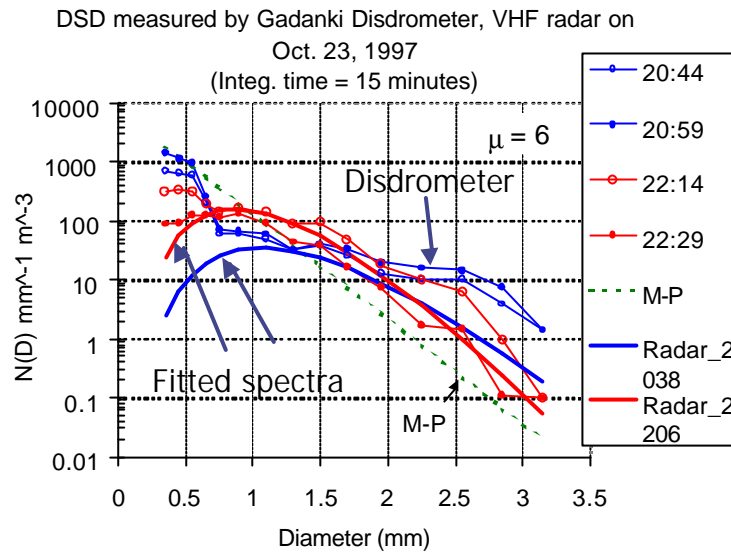


## Higher-order Moment Non-linear LSQ of Doppler Spectra for DSD Estimation

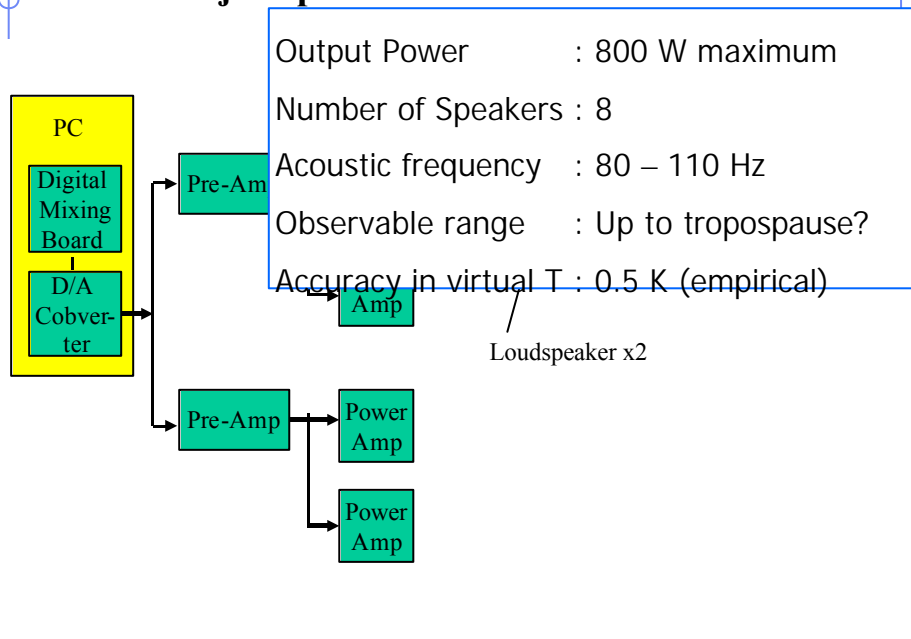
Precipitation spectra



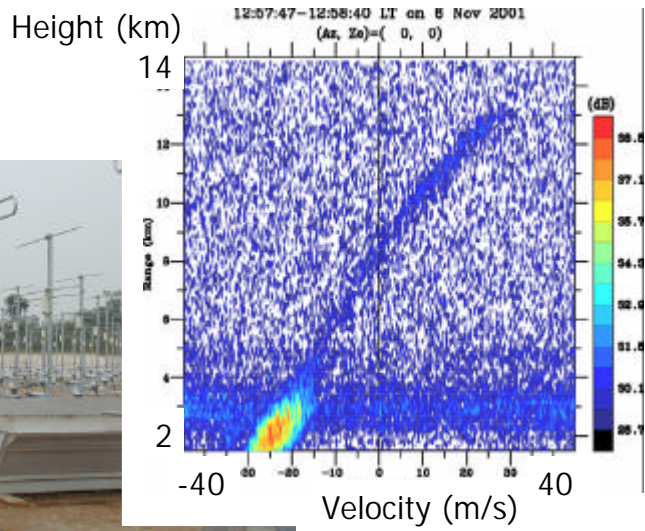
## Example of MST radar DSD Estimation



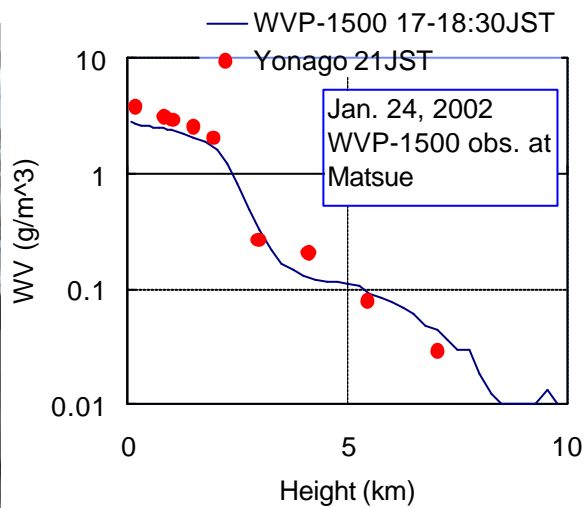
## Major Specification of EAR/RASS



## RASS Speaker Box and Example of RASS echo

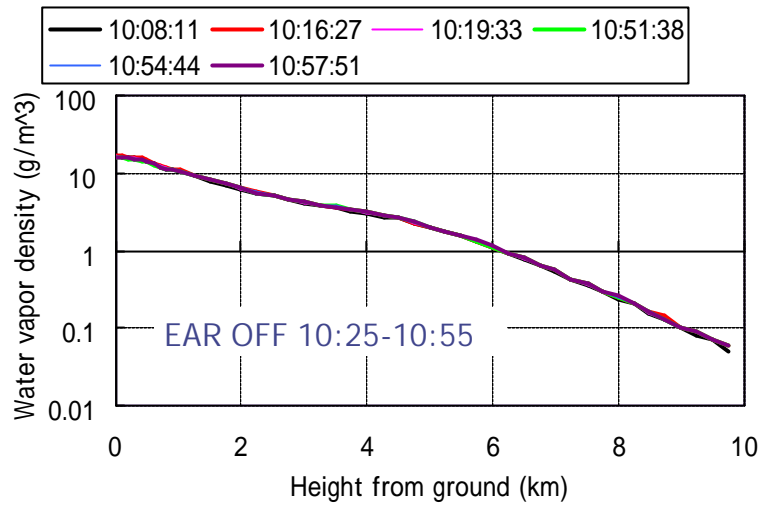


## Water Vapor Profiling Radiometer

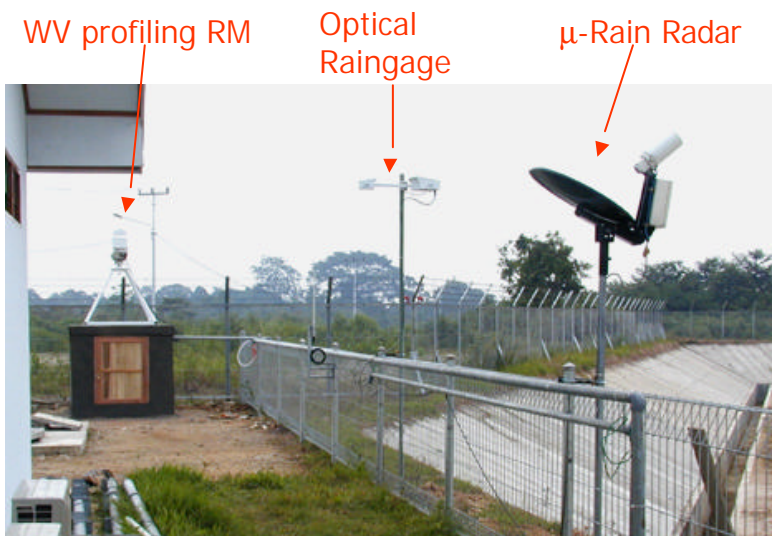


## WV Profiling Radiometer Tests at Koto Tabang

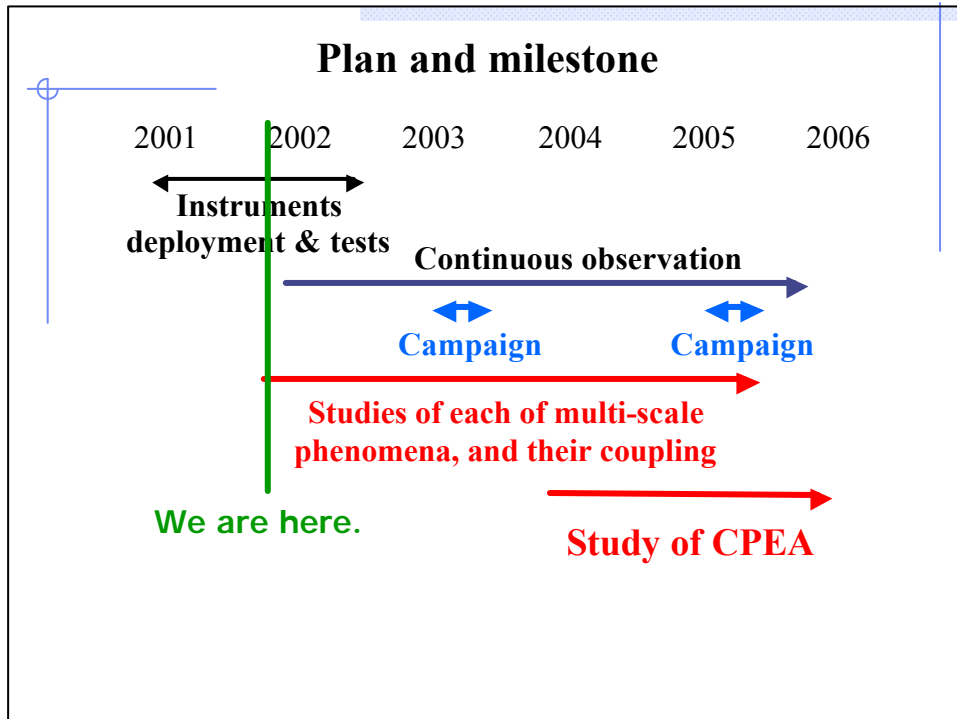
WVP-1500 test at EAR, 13 Mar. 02



## WV Profiler, ORG and m-Rain Radar at EAR Site

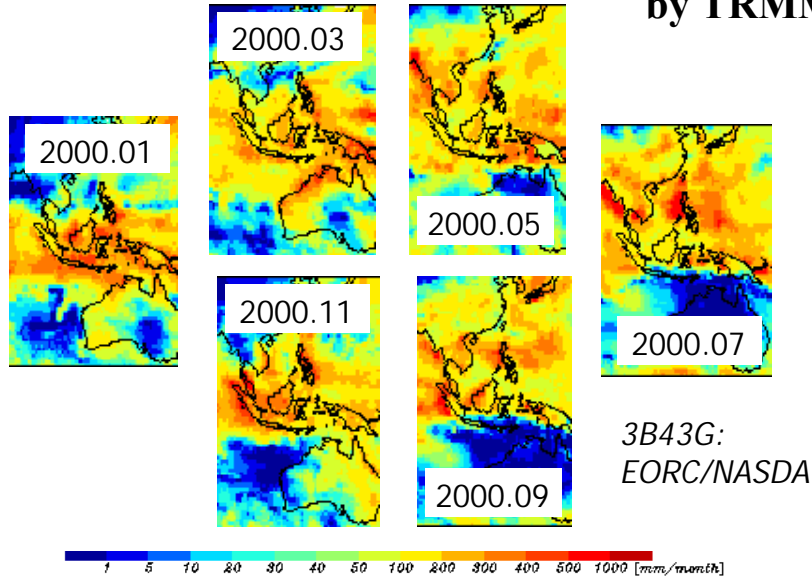




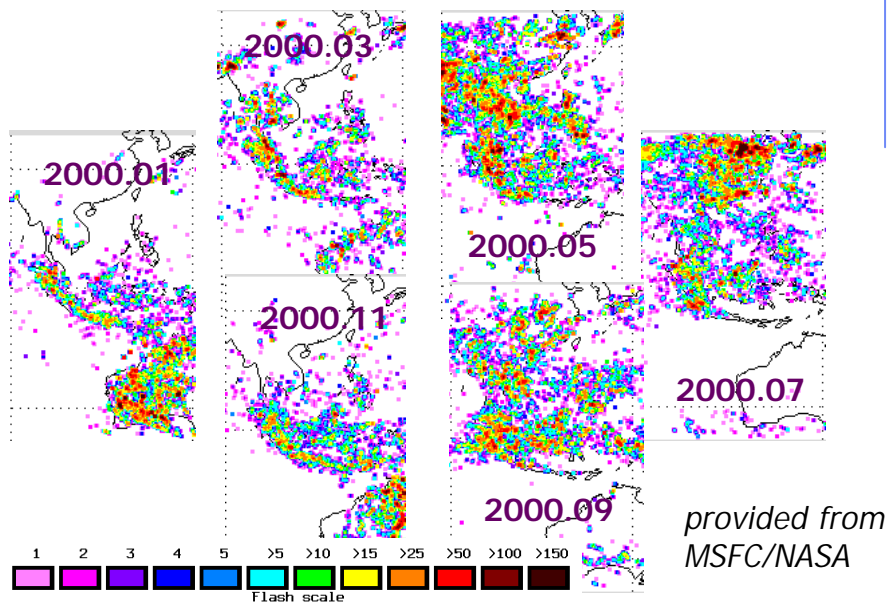


## Intensive Observation Campaign planned in 2003 and 2005

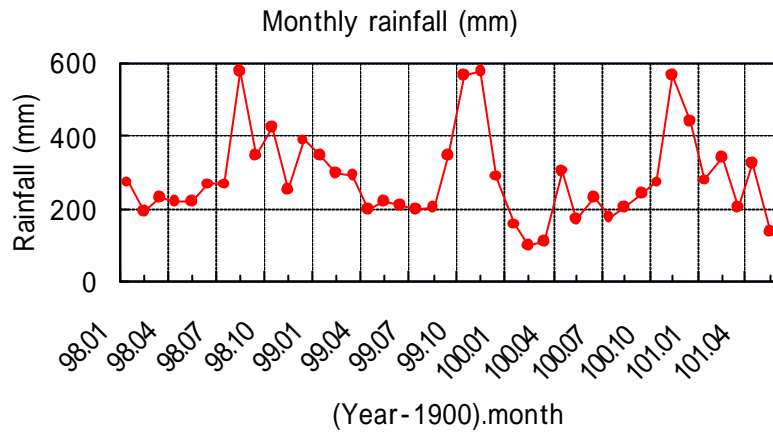
## Monthly Rainfall in East Asia and Australia by TRMM



## Monthly Lightning measured by TRMM/LIS



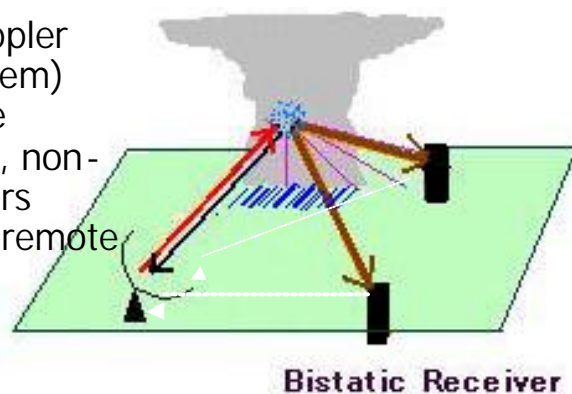
## TRMM derived Monthly Rainfall around Koto Tabang



TRMM 3B43 grid: Lon:100-101E, Lat: 0-1S

## Bistatic Doppler Radar: Concept

A bistatic multi-Doppler radar network: comprised one transmitting Doppler radar (main system) and one or more passive low-gain, non-scanning receivers (sub-system) at remote sites.



## ITLS/FORSGC Bistatic Doppler Radar



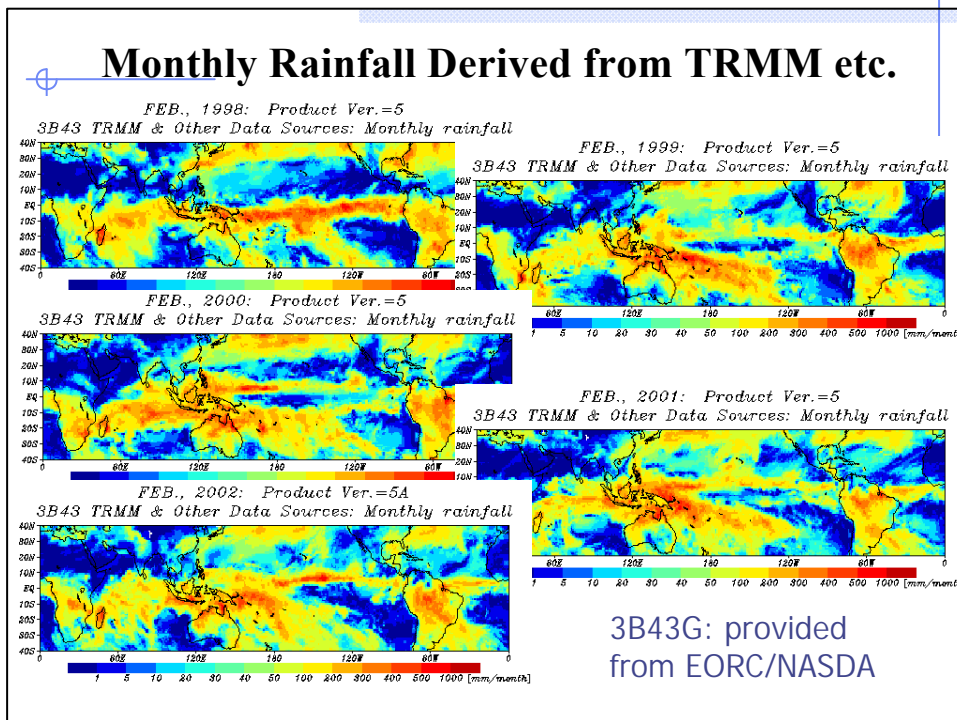
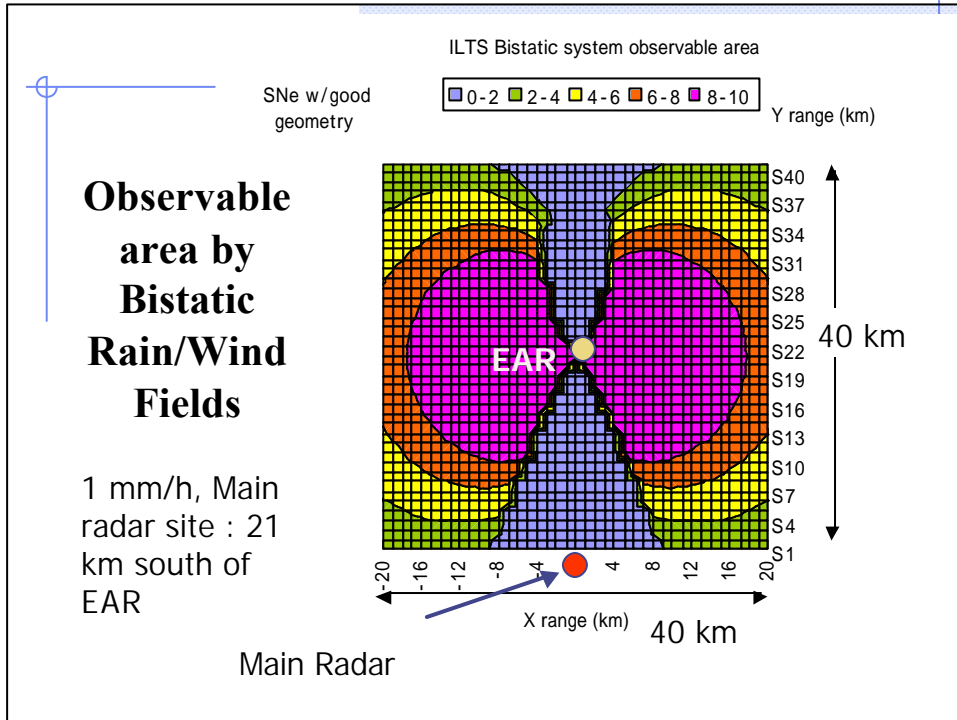
Bistatic Sub-system (antenna)



Main Doppler radar

## Characteristics of ILTS/FORSGC Bistatic Doppler Rain Radar

- Frequency: 9450 MHz ( $\lambda = 3$  cm)
- Peak power: 40 kW
- Pulse length: 0.5  $\mu$ S, 2000 PPS
- Minimum detectable power: < -110 dBm
- Antenna scan rate: 6 rpm
- Detection Range: 68 km (250 m resolution)
- Main system
  - Shelter (230x240x660cm, 5t), Antenna (200 $\phi$ , 1.5t)
  - Power supply: 2phase-220AC, 10KVA
- Sub-system:
  - PC (in side) 1set per sub-system
  - Antenna (outside, 150x30x30cm, 20Kg)
  - Power supply: 2phase 100VAC, 1kVA
  - The distance between PC and antenna < 10 m.



## Summary

- Detailed study of Coupling Processes excited from equatorial convection needs comprehensive measurements including temperature, water vapor & rain profiles, and 3-D structure of rain & wind.
- We have started development and deployment of various remote sensing and in-situ observation instruments, *i.e.* RASS, WV-profiler, ORG, micro-rain radar, micro-barographs, disdrometer, etc.
- Continuous observation with the initiation of El Nino expected. Campaigns are scheduled in fall '03 & '05.