Welcome:

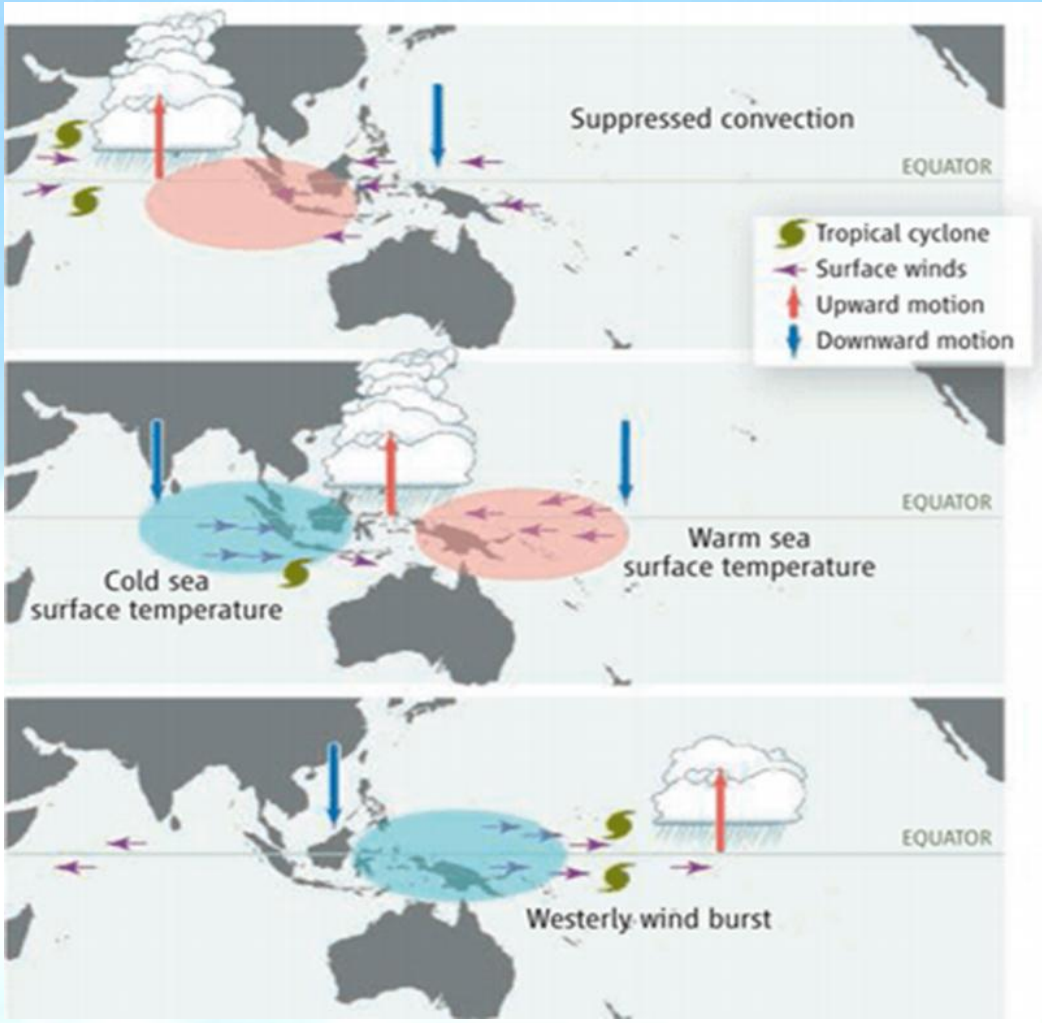
MJO Discussions and AMIE/DYNAMO Breakout

Study of the Madden-Julian Oscillation (MJO)

Wednesday March 17, 1-3 pm

MJO: A Schematic

- Occurs during boreal winter
- Area of increased convection & rainfall
- First develops in the Indian Ocean
- moves eastward at about 5 m/s
- Through maritime continent and on into TWP
- Period of ~30-60 days



Panels separated by ~15 Days (Hartmann and Hendon, Science, 318, 1731)

Agenda

- Welcome & AMIE/DYNAMO/CINDY2011 overview (Chuck Long)
- AMIE/DYNAMO Radar plan (Bob Houze)
- Forcing data sets for AMIE (Shaocheng Xie)
- AMIE/DYNAMO/CINDY2011 Q&A

- Use of observations and cloud resolving models for cumulous parameterizations (Samson Hagos)
- MJO representation in models: improvements, issues, and use of observations (Tony DelGenio)
- Discussion: Formation of an “MJO Focus Group” under CLWG

AMIE:
A Two-Pronged Campaign in association with DYNAMO and CINDY2011

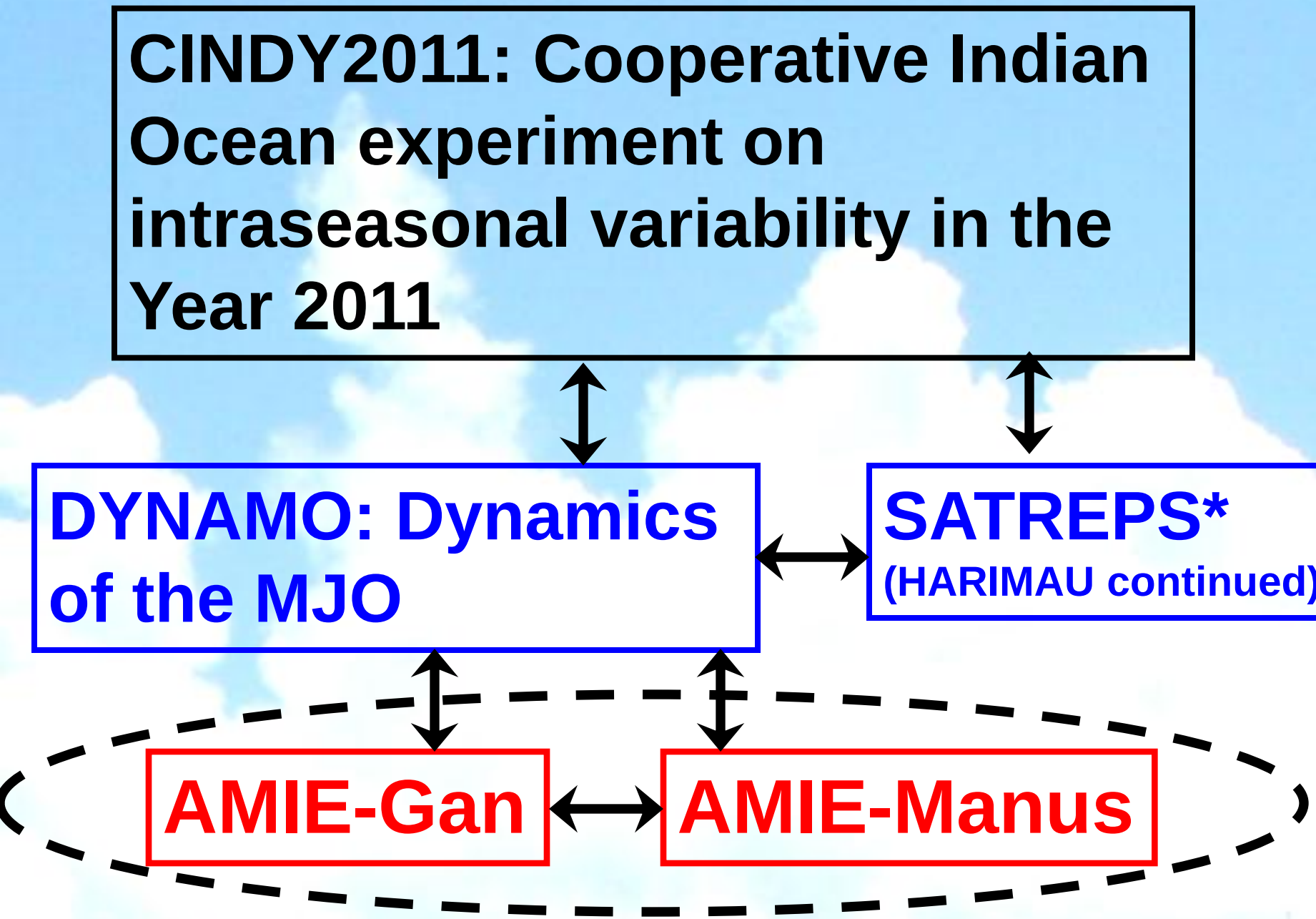
Chuck Long and Sally McFarlane

http://campaign.arm.gov/amie/

ARM MJO Investigation Experiment

AMIE Science Steering Committee

Chuck Long (PI), Tony DelGenio, Bill Gustafson, Bob Houze, Christian Jacob, Mike Jensen, Richard Johnson, Steve Klein, Ruby Leung, Xaihong Liu, Ed Luke, Peter May, Sally McFarlane, Pat Minnis, Courtney Schumacher, Andy Vogelmann, Yi Wang, Peter Webster, Xiaoqing Wu, Shaohong Xie, Chidong Zhang



*Japan Science and Technology Research Partnership for Sustainable Development

Project Timeline

EOP

AMIE-Gan (AMF2), SMART-R, AMIE-Manus, Darwin

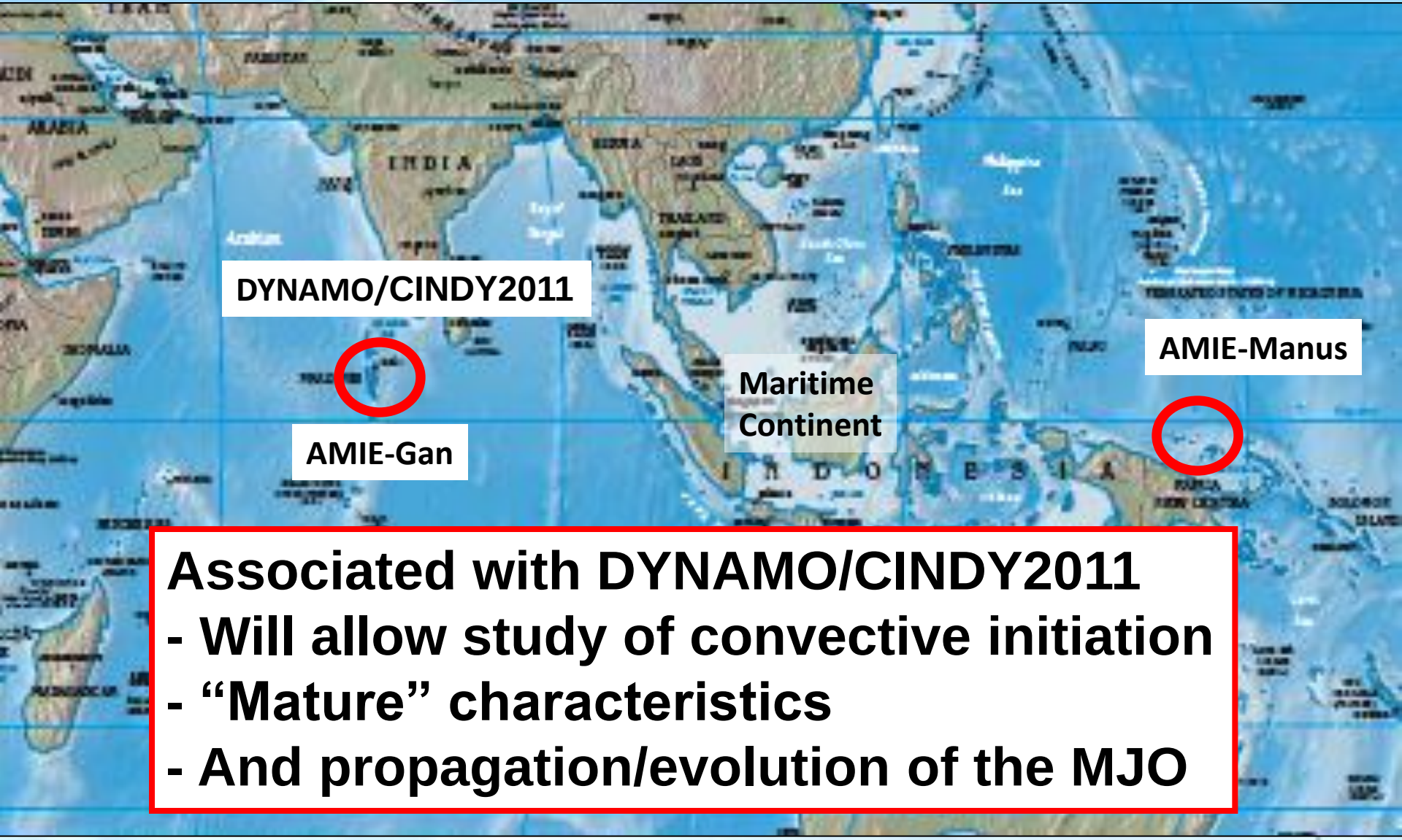
IOP

S-PolKa, RV Revelle, RV Sagar-Kenya (plus EOP observations)

SOP

RV Mirai, RV Revelle, (plus IOP and EOP observations)

AMIE: A 2-prong Campaign

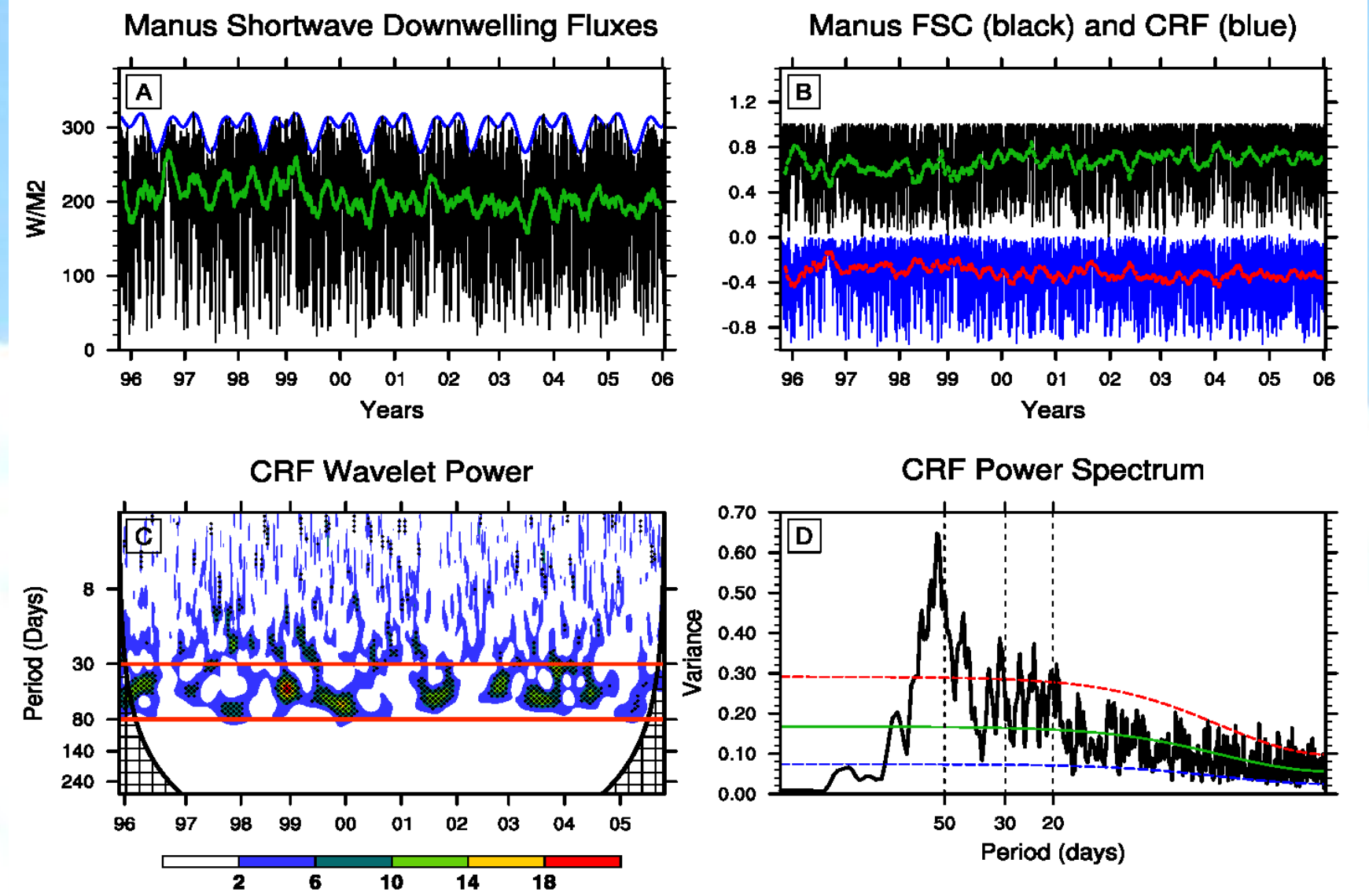


Associated with DYNAMO/CINDY2011
- **Will allow study of convective initiation**
- **“Mature” characteristics**
- **And propagation/evolution of the MJO**

Observations/Modeling Synergy

- **AMIE runs from Oct. 1, 2011 through Mar. 31, 2012**
- **AMIE/DYNAMO a hypothesis testing driven effort**
  - **Hypotheses significantly formed using models due to lack of in-situ data**
- **Gives inherent synergy between observational and modeling efforts**
- **Thus we have proposed the formation of an MJO Focus Group**
  - **Coordinate efforts both within ASR, and with larger DYNAMO/CINDY2011 participants**

Manus MJO Signal



Wang et al., 2010, “Convective signals from surface measurements at ARM Tropical Western Pacific site: Manus.” Climate Dynamics

ARM Modeling Paradigm

- Single Column and Cloud Resolving models need context
- ARM has developed Variational Analysis forcing data product for this
- Typically required surrounding the domain with sonde launches
- Not practical/possible for ARM TWP equatorial sites
- TWP-ICE showed the powerful constraint afforded by C-POL precipitation information

AMIE-Manus, AMIE-Gan

- Oct. 2011 – March 2012 (coincides with CINDY2011/DYNAMO)
- Take advantage of C-band/ X, Ka band radars to be installed on Manus
- Deploy AMF2 and SMART-R on Gan Island
- Increased sonde launches
  - 8/day for entire period for Manus and Gan
- Use in conjunction with reanalysis product
- Produce Variational Analysis forcing data products for the entire 6-month period at both sites

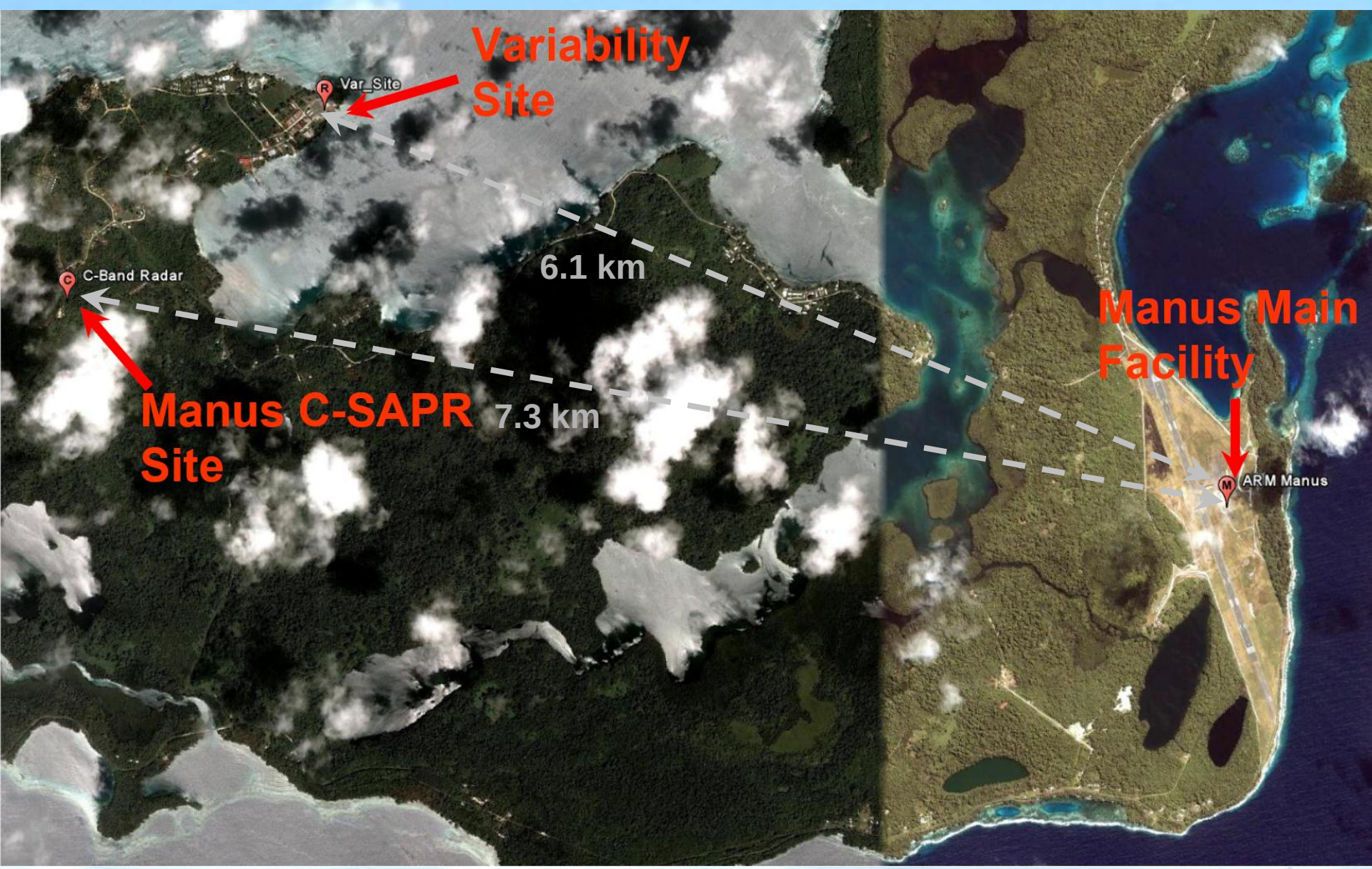
AMIE Hypotheses

- **AMIE-Gan:**
  - **Deep convection can be organized into an MJO convective envelope only when the moist layer has become sufficiently deep over a region of the MJO scale**
  - **Specific convective population at different stages are essential to MJO initiation**
  - **Upper ocean processes play essential roles in MJO initiation in the Indian Ocean**

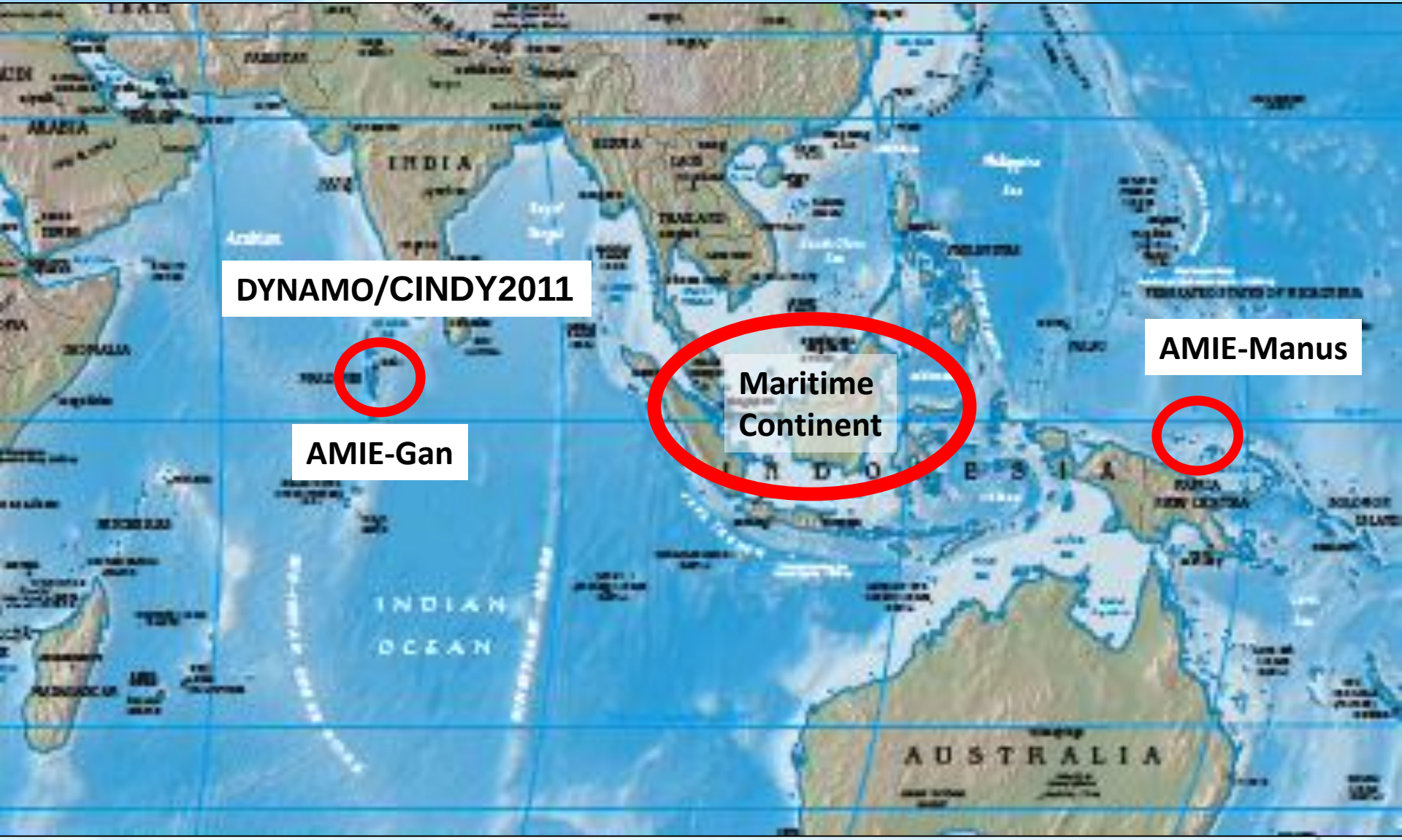
- **AMIE-Manus**
  - **Surface energy fluxes drive the MJO (thus the weakening over the maritime Continent)**
  - **Heating and drying by convection stabilize the atmosphere and dampen longer-term variability; the trailing stratiform anvil region cools and moistens the lower troposphere via rain evaporation**
  - **"Recharge-discharge" mechanism; the dry free atmosphere is moistened by shallow convection, allowing transitioning to the disturbed phase of the MJO**

AMIE-Gan Sites

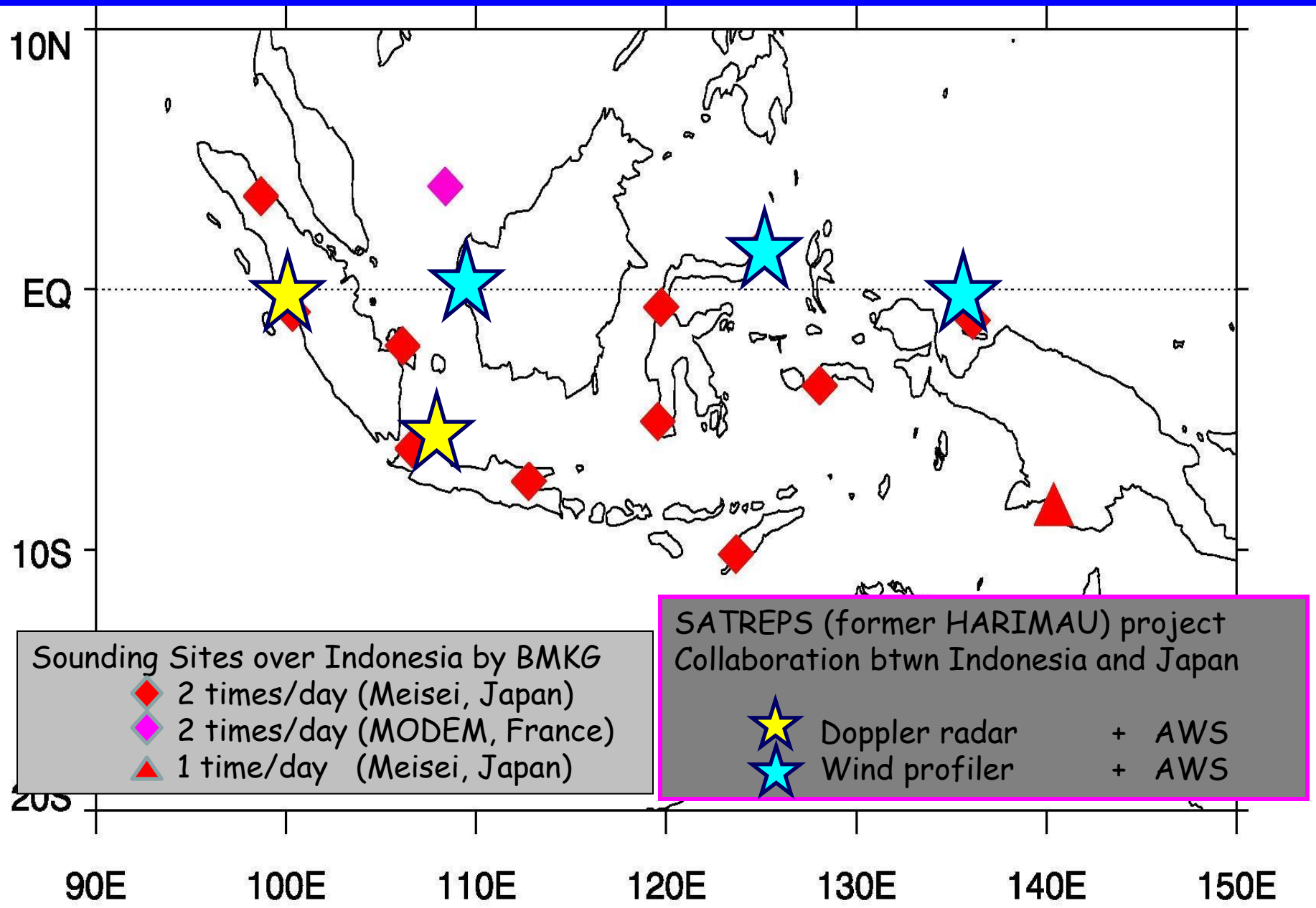
AMIE-Manus Sites



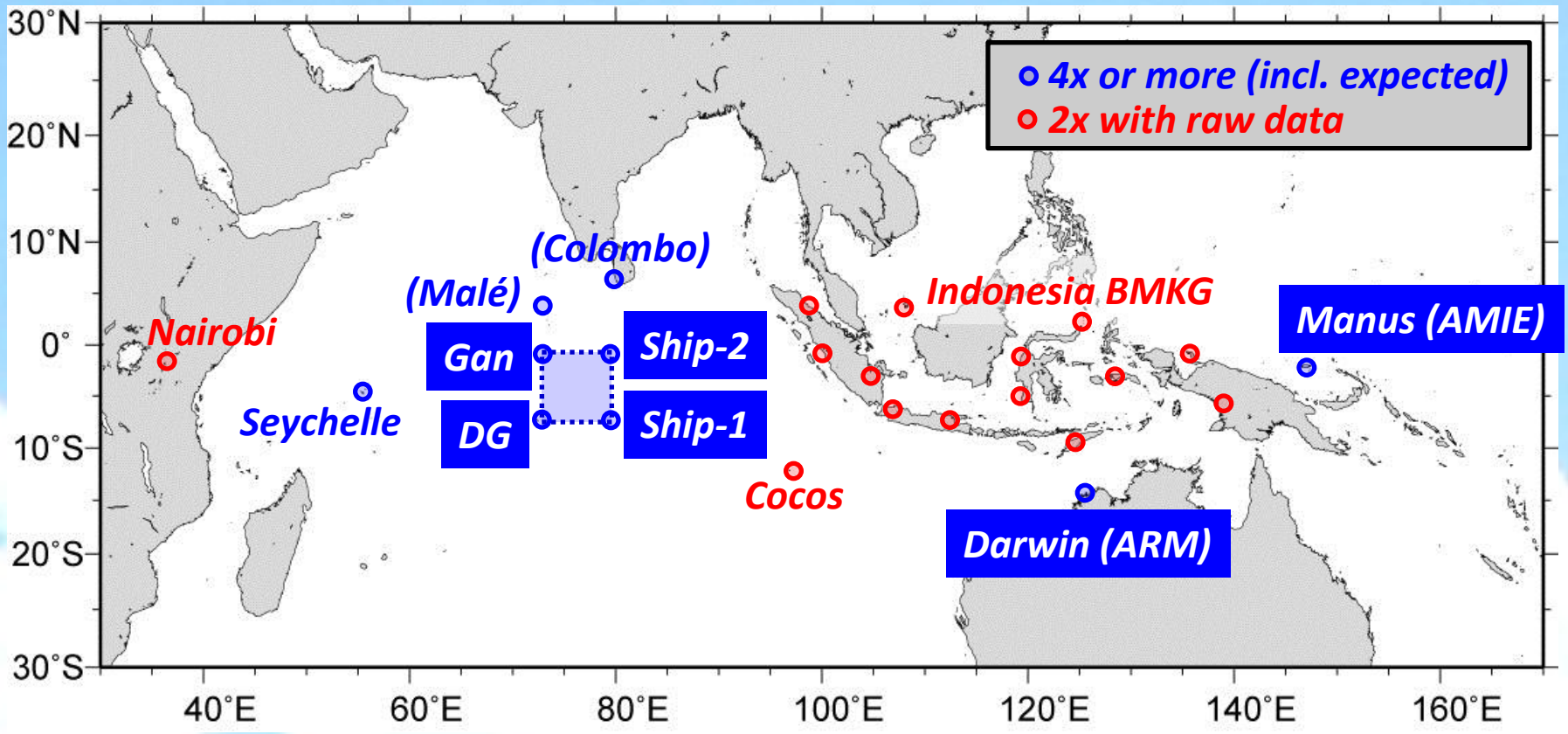
AMIE: A 2-prong Campaign



SATREPS Indonesia/Japan (Maritime Continent)



Sounding sites with (something) special on CINDY/DYNAMO



Enhanced sounding network extends over 120 degrees of longitude – SOP, IOP, EOP

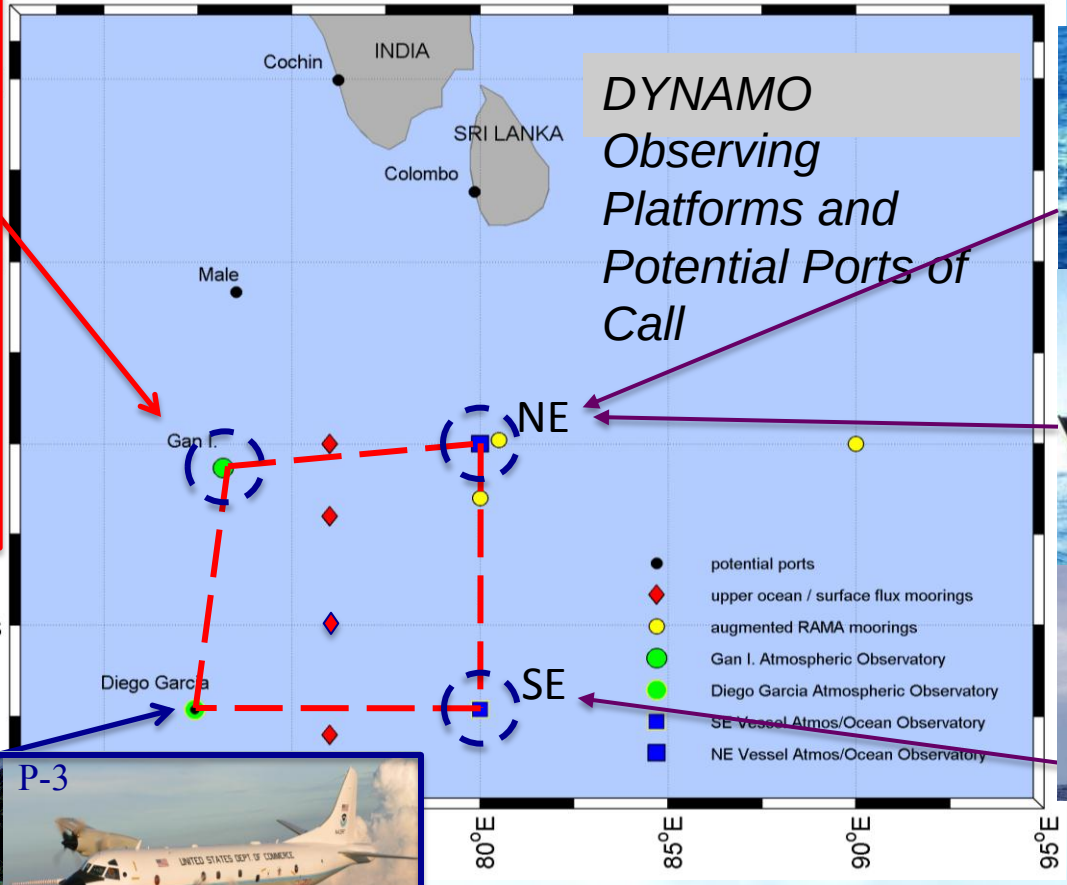
DYNAMO/CINDY Experimental Design (2011)


Falcon


S-PolKa


SMART-R


AMF2



DYNAMO Observing Platforms and Potential Ports of Call


R/V R. Revelle


R/V S. Kanya


R/V MIRAI


ISS

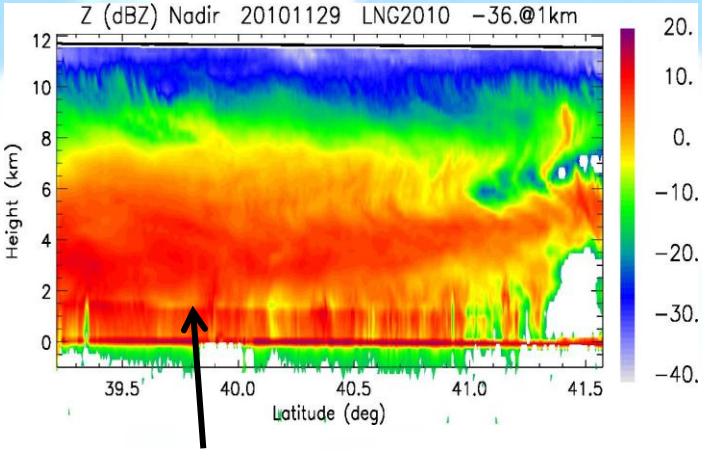
P-3

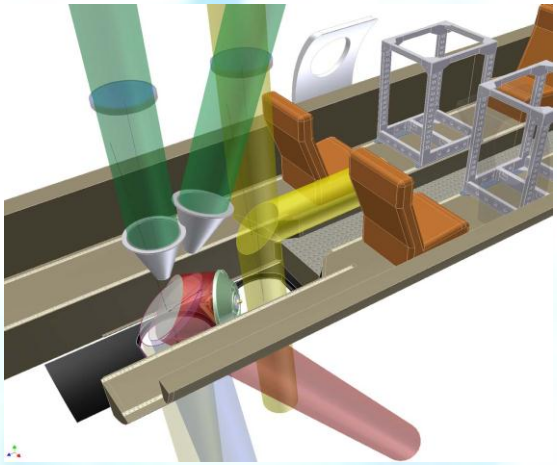
NOAA P-3 Key Aircraft Instruments

Flight Level *in situ* Sensors:	Navigational parameters
	Pressure and thermodynamic parameters
	Mean winds and turbulence
	High-rate T, q, CO_2 perturbations
	Cloud physics
	Radiation
Radars:	Lower fuselage C-band Doppler radar
	Tail X-band Doppler radar
Expendables:	GPS dropwindsonde atmospheric profiling system
	Airborne eXpendable Bathythermographs (AXBT's)
	Airborne eXpendable Conductivity Temperature and Depth probes (AXCTD)
Others:	Riegl LMS Q240i scanning lidar
	Stepped Frequency Microwave Radiometer
	Radiometric SST

Falcon 20 deployment during CINDY-DYNAMO (Alain Protat, Alfons Schwarzenboeck)

Aircraft : Falcon 20 (200 ms^{-1}, 3.5 hours endurance, 12 km ceiling)
Instrumentation : 95 GHz Doppler cloud radar + in-situ $\mu\Phi$: 2D-S +CIP + PIP (+ ?)
Deployment : 1-31 October 2011, 40 flight hours (~ 12 flights)





RASTA 95 GHz Doppler cloud radar :
3 radar beams looking down
3 radar beams looking up
-37 dBZ @ 1 km

3D wind retrieval – Terminal Fall speed retrieval

Doppler radar and Radar-Lidar microphysics

(IWC, extinction, effective radius, N_T)

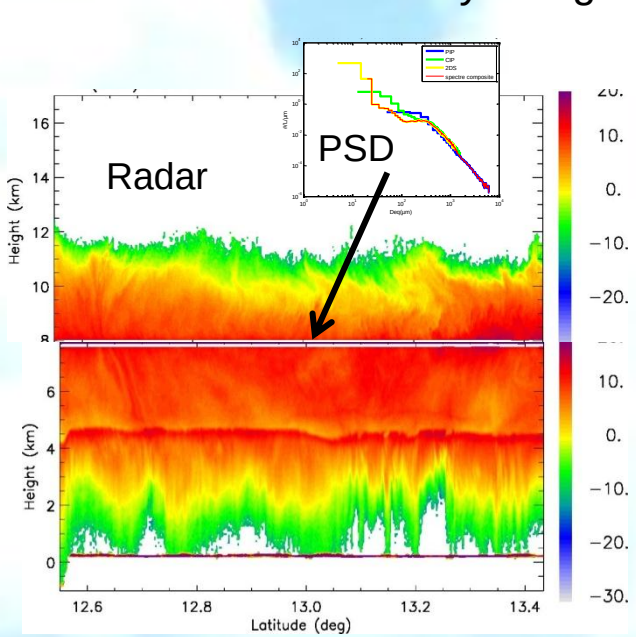
Scientific Objectives

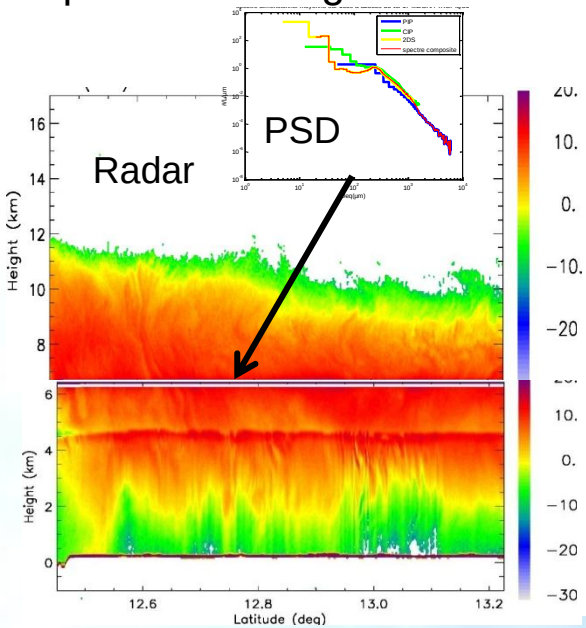
Provide information about tropical ice anvil cloud microphysics to Megha-Tropiques passive retrievals of rainfall rate over land and ocean (CNES pays the bill !)

→ Characterize the statistical properties of the particle size distribution (PSD) in tropical ice anvils produced by MJO deep convection

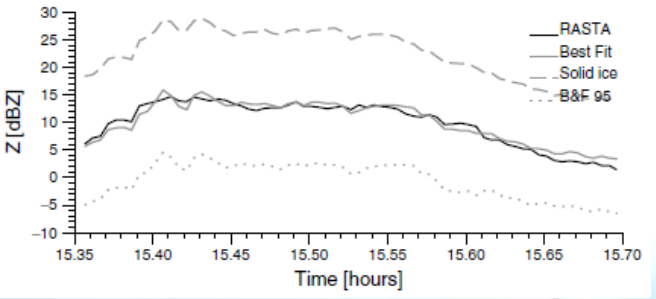
→ Characterize the vertical profile of mass-maximum dimension using closure analysis between radar and in-situ observations

→ Characterize the dynamical and microphysical properties of tropical ice anvils and the variability along the tropical belt using other field experiments





Mass-dimension relationship from radar Z and in-situ PSD



DYNAMO/CINDY2011 Process-oriented modeling summary

Lead: Eric D. Maloney

Global Models At least 15

Regional Models At least 3

Small Domain Models At least 5

Global Modeling

Superparameterized (Flow-following finite-volume icosahedral model) FIM

- ***PI:*** **Todd Jones/Dave Randall**

IPSL Forced and Coupled model

- ***PI:*** **JP Duvel, JY Grandpeix**

NICAM (Nonhydrostatic ICosahedral Atmospheric Model) [funding pending]

- ***PI:*** **Nasuno, Satoh**

HYbrid Coordinate Ocean Model (HYCOM) [funding pending]

- **PI: Shinoda, Wang, Han**

Community Climate System Model 4 (CCSM4)

- ***PI:*** **Art Miller**

Seoul National University GCM [funding pending]

- **PI: Daehyun Kim, Adam Sobel**

GFDL CM2.1 [funding pending]

- ***PI:*** **Daehyun Kim, Adam Sobel**

Superparameterized Community Atmosphere Model (SP-CAM)

- ***PI:*** **Kuang, Sobel, Maloney**

Global WRF

- ***PI:*** **Kuang, Sobel, Maloney**

NCAR CAM with Relaxed Arakawa-Schubert Convection

- ***PI:*** **Maloney, Sobel, Kuang**

NCAR Community Atmosphere Model (CAM) with Revised Zhang Convective Closure [funding pending]

- ***PI:*** **Guang Zhang and Xiaoliang Song**

Iowa State University General Circulation Model

- ***PI:*** **Xioaqing Wu, Mitch Moncrieff**

NCAR Community Atmosphere Model Versions 3 to 5

- ***PI:*** **Rich Neale**

CFS and MOM4

Regional & Small Domain Modeling

Coupled Ocean Atmosphere Mesoscale Prediction System(COAMPS)/NCOM/SWAN

- ***PI:*** **Chen, Flatau, Shinoda, Jensen**

RSM (Regional Spectral Models) /ROMS (Regional Ocean Modeling System) and WRF (Weather Research and Forecasting Model) /ROMS

- ***PI*****: Art Miller**

WRF

- ***PI*****: Takemi**

General Ocean Turbulence Model (GOTM) [funding pending]

- ***PI:*** **Shinoda, Wang, Han**

LES (Skyllingstad) with WRF radiation and microphysics

- ***PI:*** **Eric Skyllingstad and Simon de Szoeke**

Limited Domain WRF

- ***PI:*** **Kuang, Sobel, Maloney**

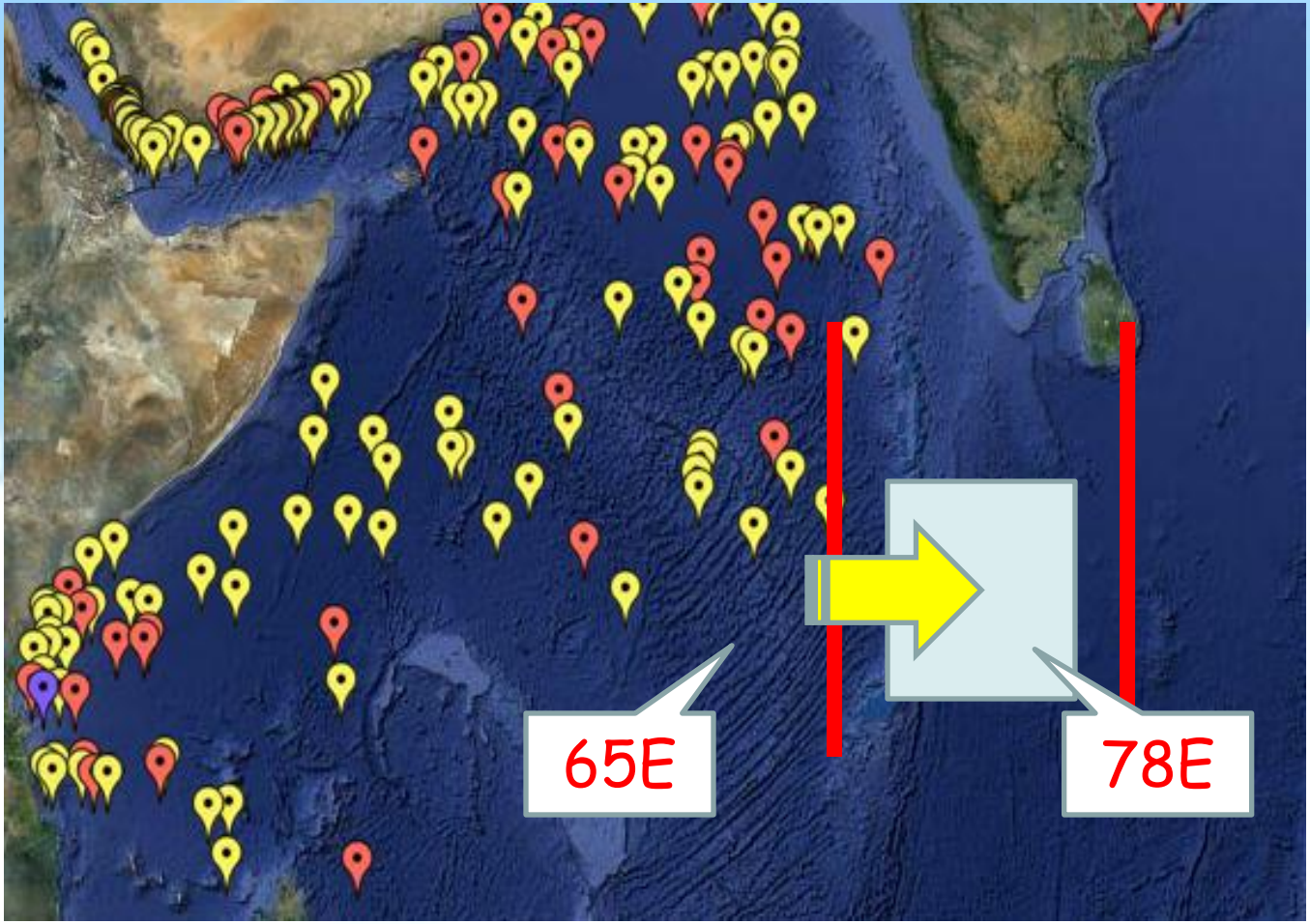
Limited Domain System for Atmospheric Modeling (SAM)

- ***PI:*** **Sobel, Kuang, Maloney**

Iowa State University Cloud Resolving Model

- ***PI:*** **Xioaqing Wu, Mitch Moncrieff**

Piracy Problem ???



War Risks Zone to be expanded from 65E to 78E as attack area grows.
If decided, JAMSTEC ship may need to pay much for insurance …
It may affect the deployment of ADCP sub-surface mooring at 5S, 77E.

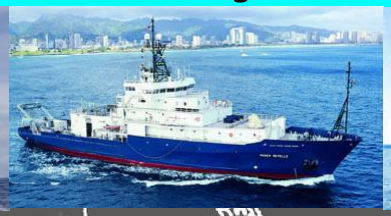
Observation Network of CINDY2011 / DYNAMO + Collaborative Projects

Ship-1 & 2 sites will be occupied by 3 ships (and more, if possible)

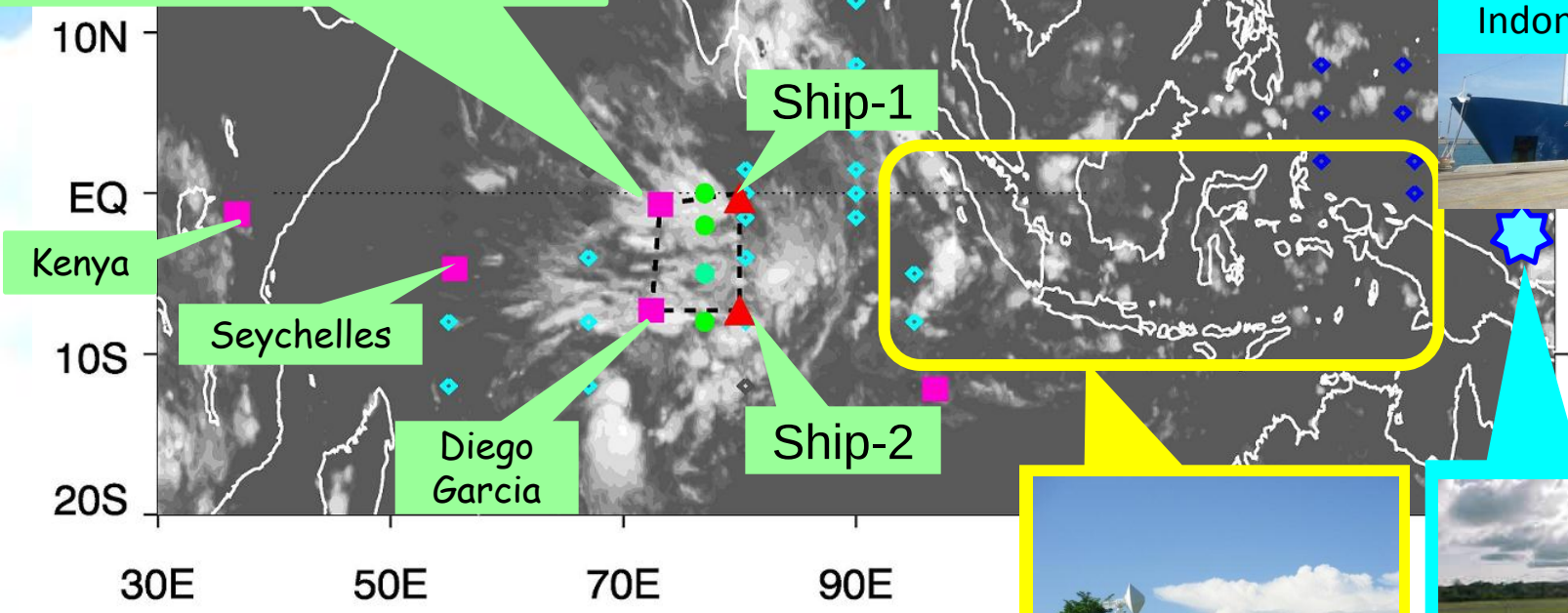
Gan ; Super site

Japan / Mirai

US / Roger Revelle



India / Sagar



Indonesia / BJ-III

SATREPS Indonesia/Japan

AMIE-Manus by US DOE

Observation network will be formed over the central equatorial Indian Ocean with Islands, ships, and moorings. By combining relevant projects, it is possible to monitor the entire life cycle of MJO convection from IO to Pacific.