

AMIE/DYNAMO/CYNDY (ADC) Field Campaign: Achievement and Beyond

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CINDY2011 Participating Countries: Australia, France, Korea, India, Indonesia, Japan, Kenya, Maldives, Seychelles, Sri Lanka, Taiwan, UK, US

DYNAMO Participating Institutes:

19 universities (80 students)

11 national centers and laboratories

Funding Agencies: NSF, ONR, DOE, NOAA, NASA

Websites:

DYNAMO Home <http://www.eol.ucar.edu/projects/dynamo/>

Field Catalog <http://catalog1.eol.ucar.edu/dynamo/>

Trilogy of International Tropical Field Experiments in Weather and Climate:

GATE (Atlantic Ocean): 1974

TOGA COARE (western Pacific Ocean): 1992-1993

DYNAMO (central Indian Ocean): 2011-2012

AMIE/DYNAMO/CINDY2011 Field Experiment (October 2011 – March 2012)



Falcon



S-PolKa



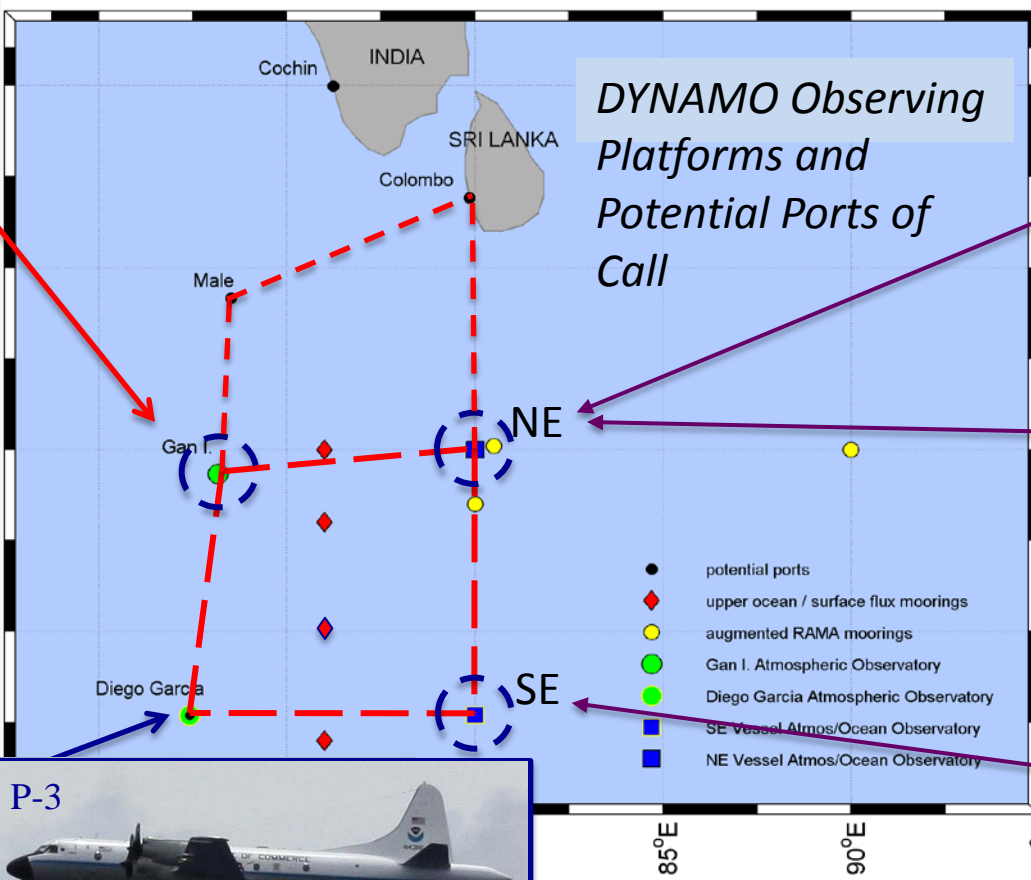
SMART-R



AME2



ISS



R/V R. Revelle



R/V S. Kanya

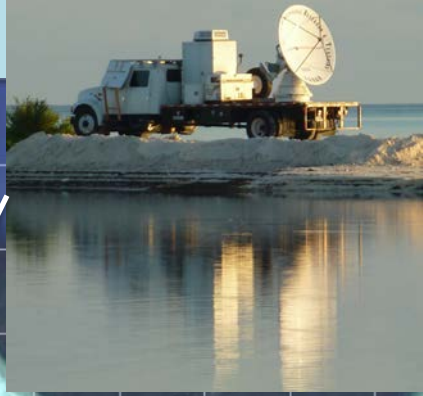
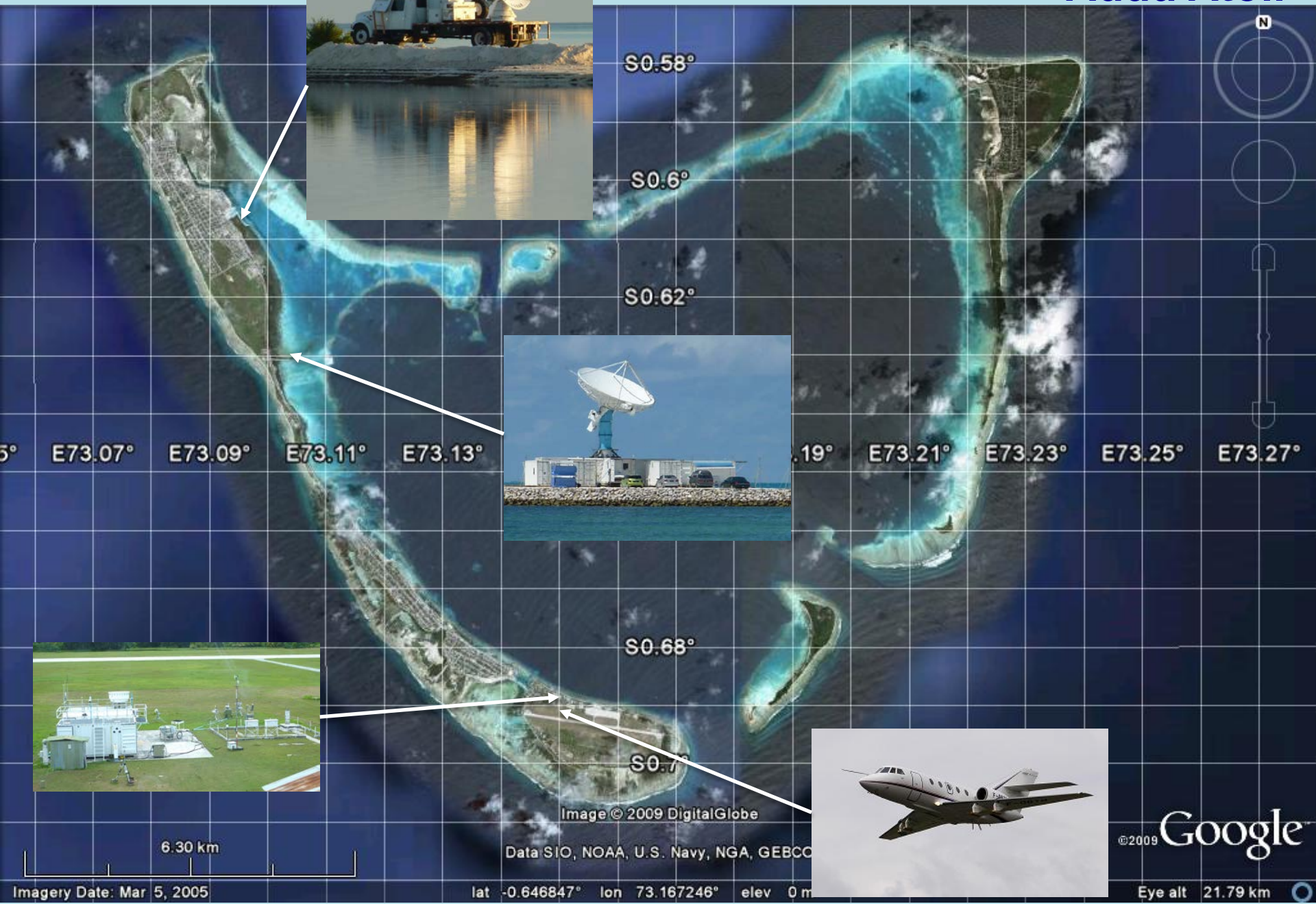


R/V Mirai



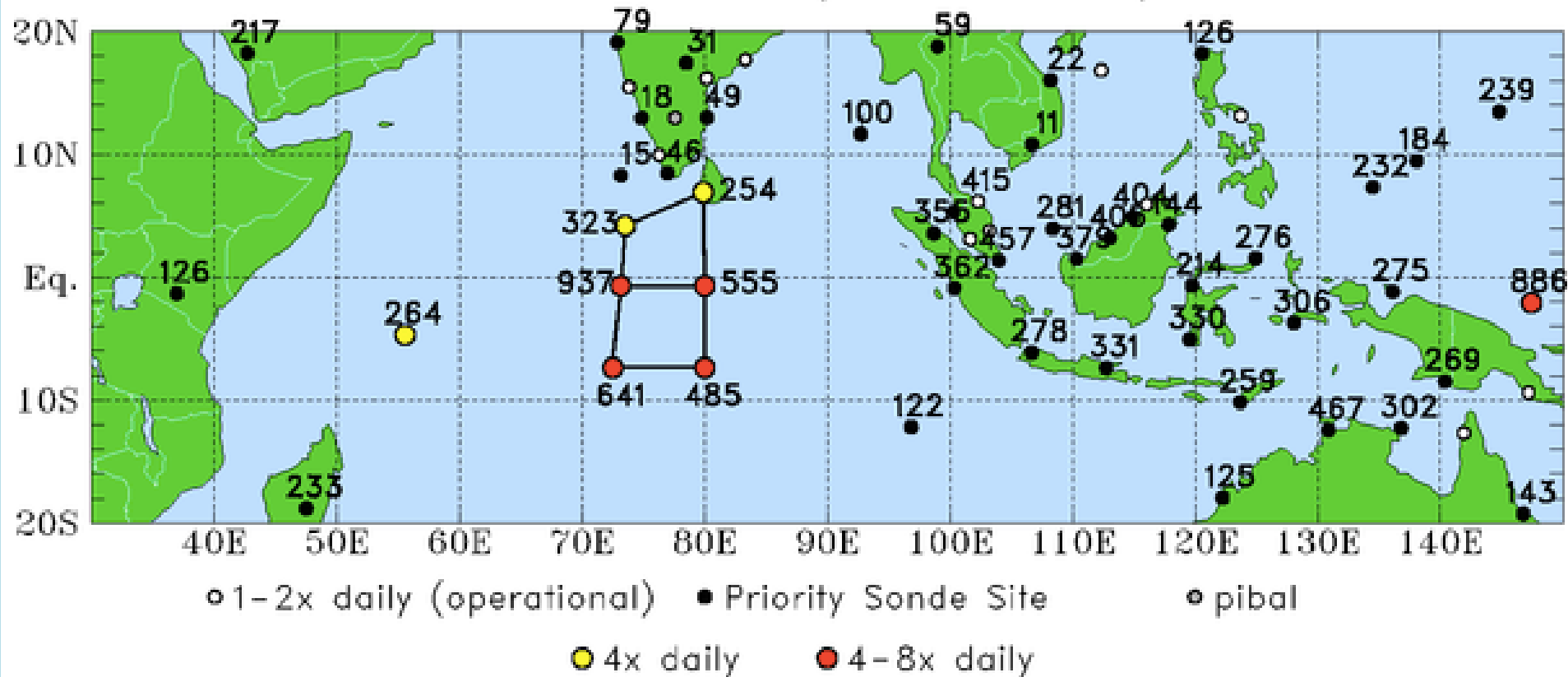
P-3

Addu Atoll



AMIE/DYNAMO/CINDY2011 Upper-Air Sounding Network

Sonde network inventory as of 31 January 2012



Enhanced sounding network extends over 120 degrees of longitude, with 11 research sounding sites, 3 enhanced operational sites, 18 other operational sites, and one research airplane.

Data (>95%) were sent to GTS and received by NWP centers

Over 13,000 soundings were collected, more than 9,000 of them are of high resolutions⁵

ADC Timeline

SEP OCT NOV DEC JAN FEB MAR APR

EOP

AMF2 (AMIE-Gan), SMART-R, AMIE-Manus
8/day soundings at Gan and Manus

IOP

S-PolKa, R/V Revelle, P3, Falcon

Revelle

P3

Falcon

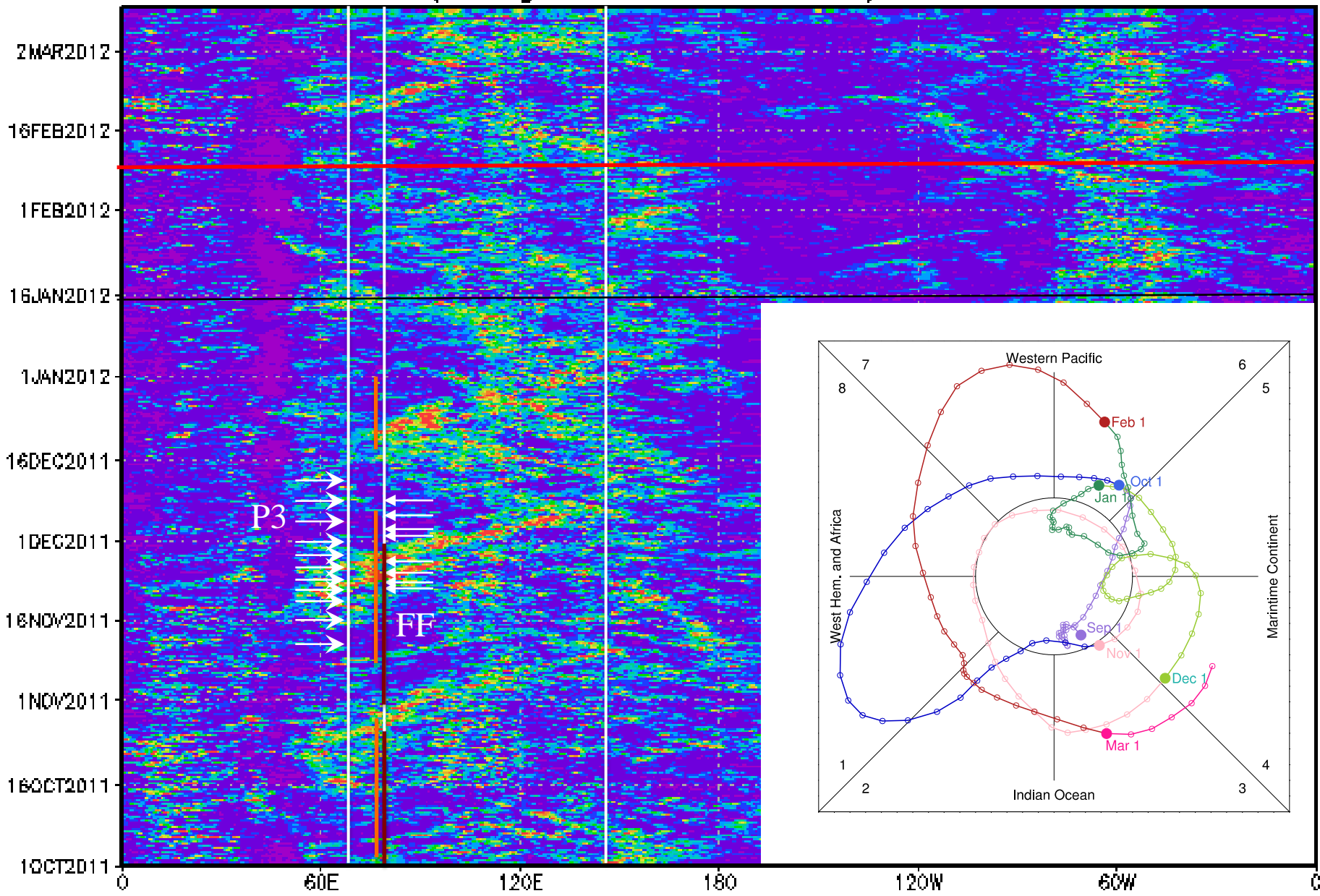
SOP

8/day soundings at Diego Garcia, Revelle, Mirai

Mirai

Moorings

TRMM_3B42RT.006 precipitation [mm/hr]
(Average Lat: 10.0S - 10.0N)



Post-Field Activities

- Data QC, release, and share (CINDY, French Falcon)
- Data comparisons
 - radars: calibration, cloud population statistics
 - humidity: MWR, S-Polka, soundings, GPS
 - ships and moorings: Wyrcki jets, Seychelles-Chagos thermocline ridge, etc.
 - ships and aircraft: surface fluxes
etc.
- Data Workshop (March 2013?)
- Assessment of NWP MJO forecast skill
NCEP, ECMWF, BOM, EC, JMA, TCWB, CPTEC, UKMO
- Assessment of field observation impact (ECMWF denial experiments)
- Continuous collaboration with MMS: Atoll rainfall data (QC, climatology of the Maldives), Gan sounding archive

Post-Field Plans and Challenges

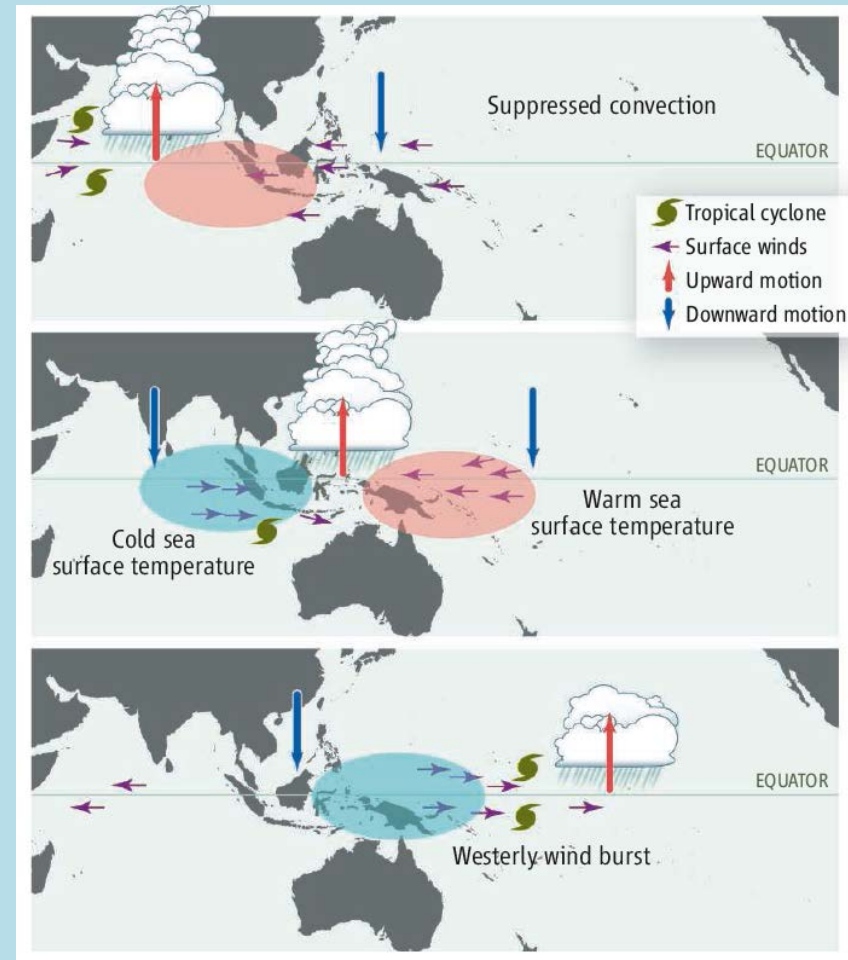
- Conceptually assimilate all field observations
- Integration of the field observations and modeling efforts
 - model validation and improvement
 - model interpretation of the field observations
- New ideas on the MJO:
 - Effect of vertical wind shear
 - The Maritime Continent: A source of MJO convection?
 - Role of planetary-scale perturbations
 - Asymmetry in cloud population evolution
 - The energy recharge-discharge hypothesis disapproved?
 - Super Kelvin waves?

MJO (Madden-Julian Oscillation)

- Period: 30 – 80 days (intraseasonal)
- Zonal wavenumber 1 – 3 (planetary)
- Eastward propagation speed: ~5m/s
- Main initiation region: Indian Ocean

Global Impact:

- Tropical cyclones (Hurricanes)
- Extreme rainfall
- Diurnal cycle
- Cold surges
- Storm tracks
- Monsoons
- ENSO, NAO, AO, AnO, IOD
- Indonesian Throughflow
- Wyrтки Jets
- Antarctic circumpolar circulation
- Ozone, Tropospheric CO, Aerosol, Ocean chlorophyll
- Length of the day
- Schumann resonance



Hartmann and Hendon (2007)

Main Problems

Prediction skill of the MJO, especially its initiation, remains poor.

Dynamical forecast does not outperform statistical forecast;

Human experience beats model forecast.

Most climate models fail to reproduce the MJO.

Missing physics post a liability issue in our confidence in the climate models

DYNAMO Goal:

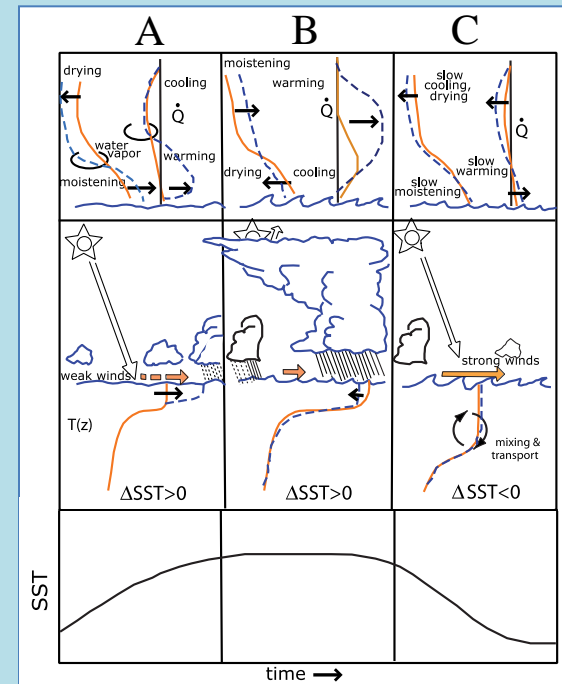
To expedite our understanding of MJO initiation processes and efforts to improve simulation and prediction of the MJO

Conceptual Model for MJO initiation:

Pre-onset stage (A): Convectively suppressed; recharging with deepening moist layer, aided by shallow clouds

Onset stage (B): Convectively active, with both shallow and deep (including stratiform) convective clouds; deep moist layer, maintained by low-level moisture supply

Post-onset stage (C): strong surface wind and entrainment cooling; deep convection declining due to low SST



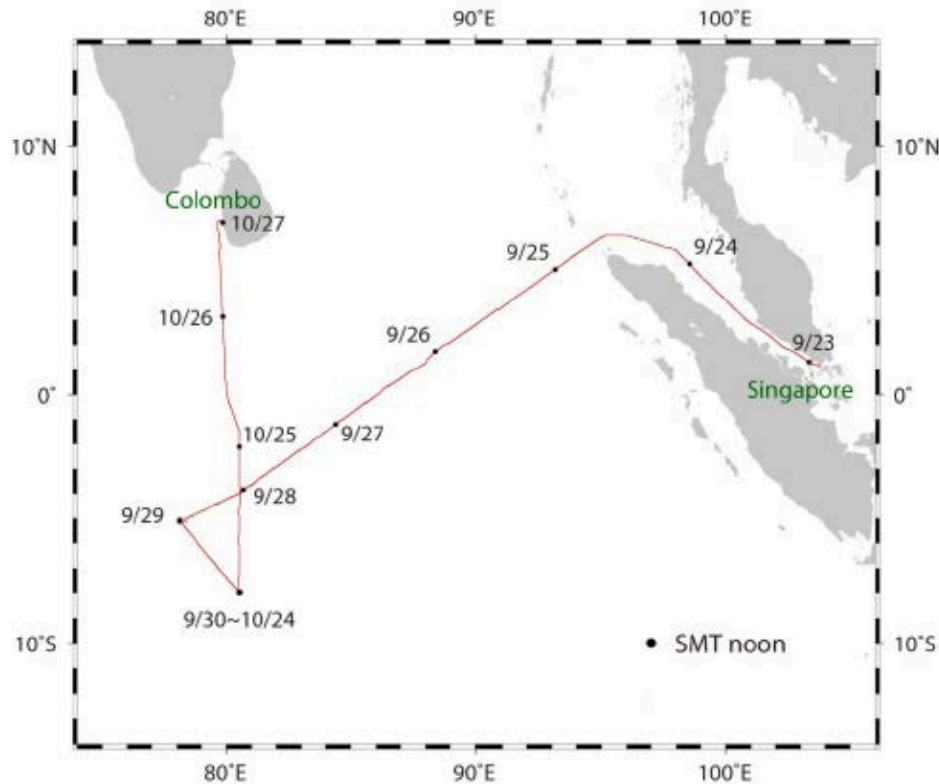
Hypotheses: Three essential factors for MJO initiation

- I. Interaction between convection and its environmental moisture
- II. Distinct roles of different types of convective clouds at each MJO initiation stage
- III. Upper ocean processes and air-sea interaction

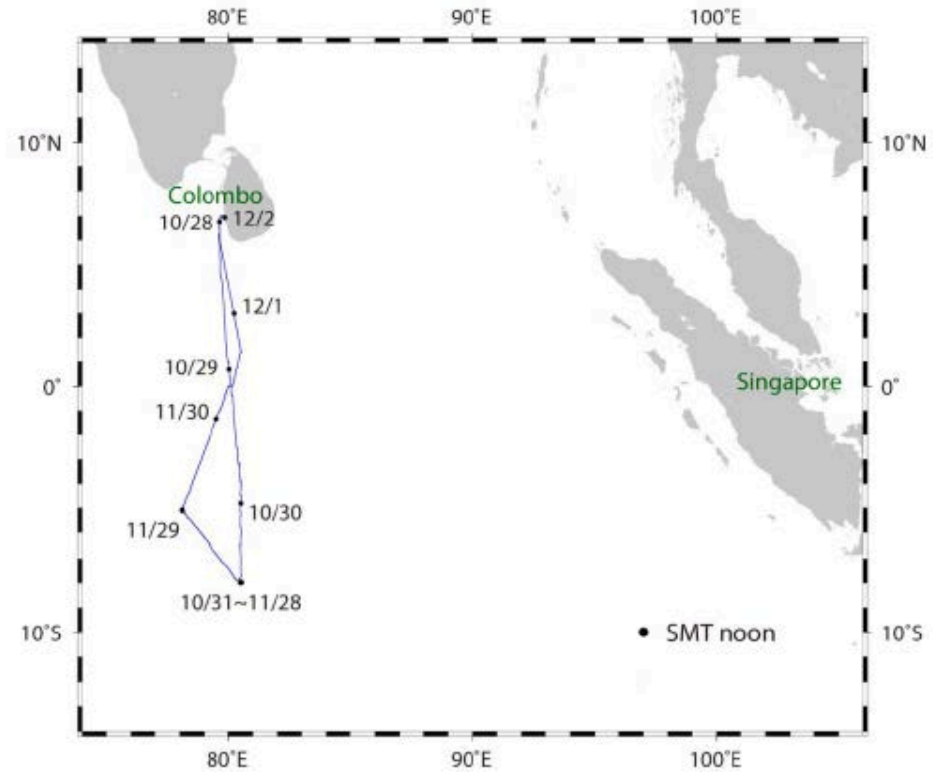
R/V Mirai



MR11-07 Leg-1 Cruise track



MR11-07 Leg-2 Cruise track

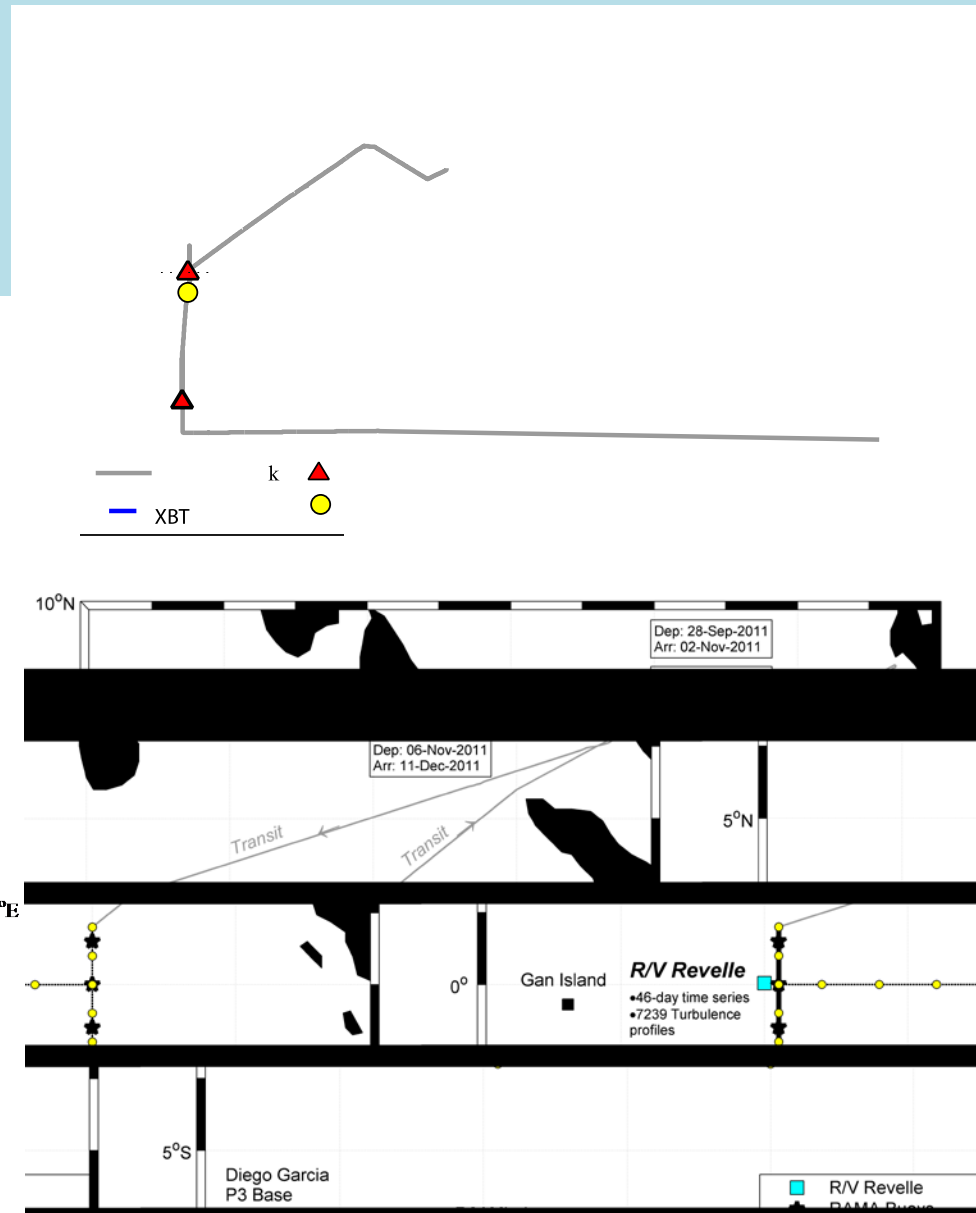
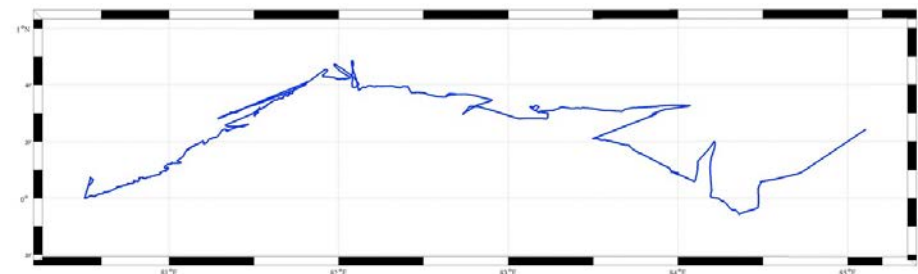
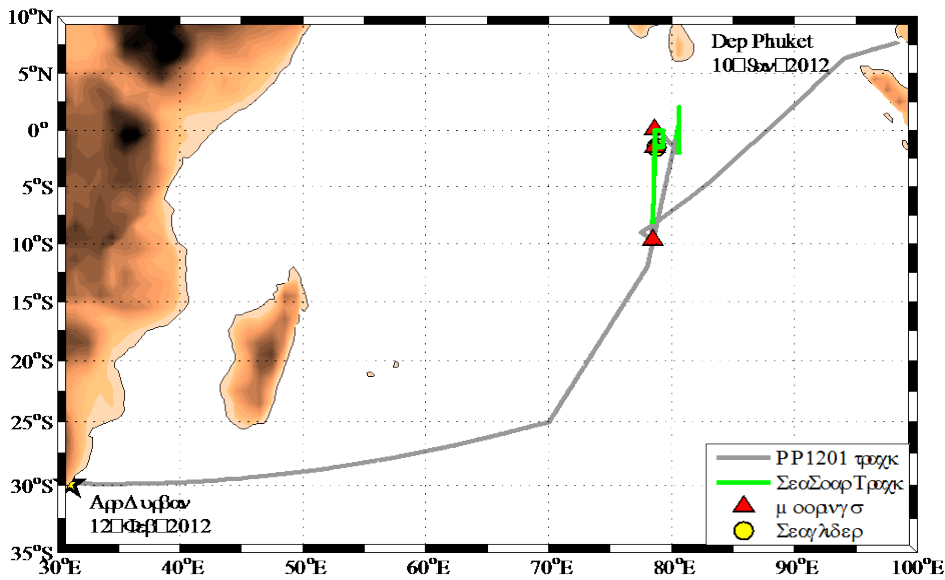


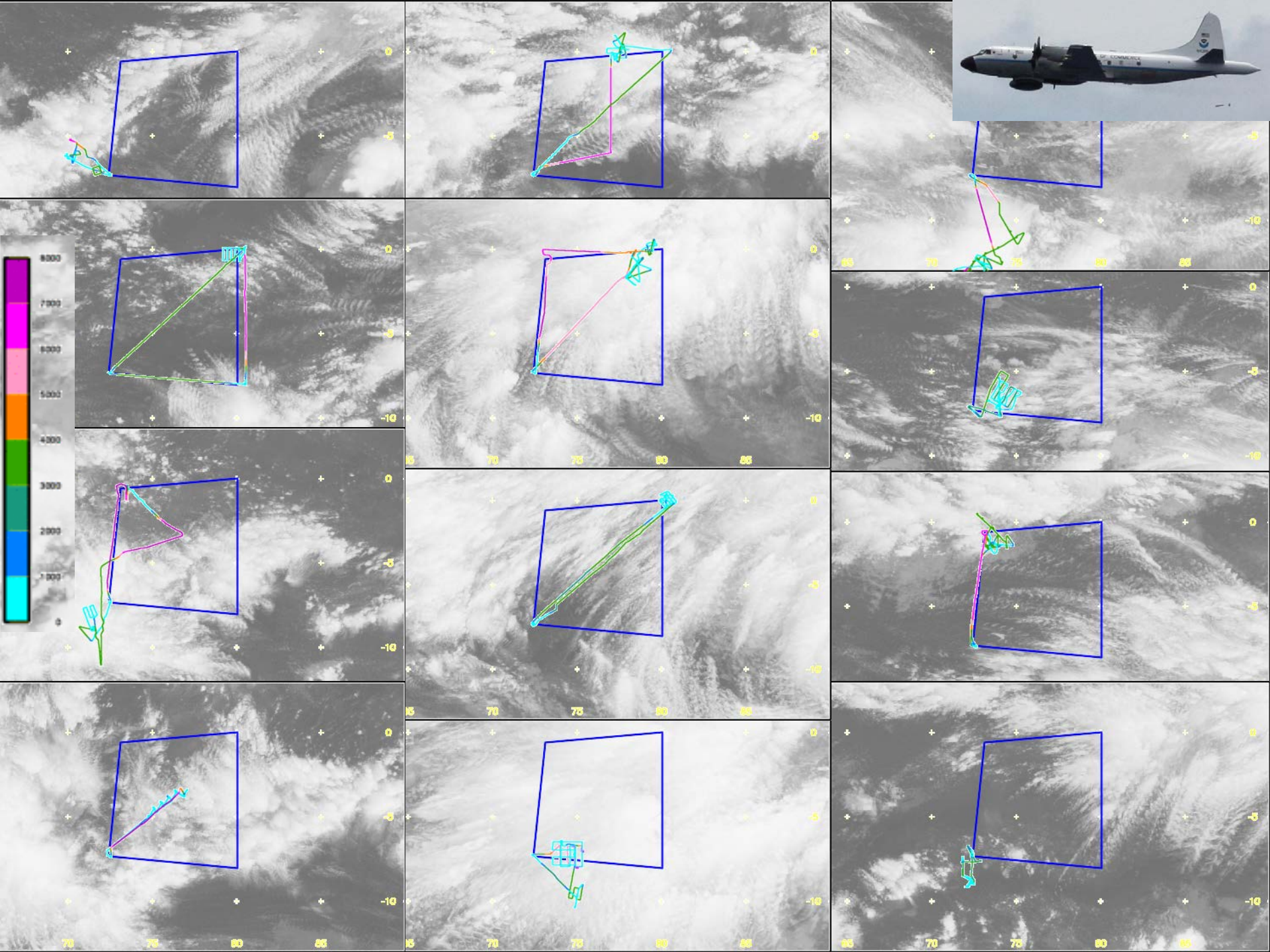
500 Radiosondes, 423 CTDs, 14 XCTDs

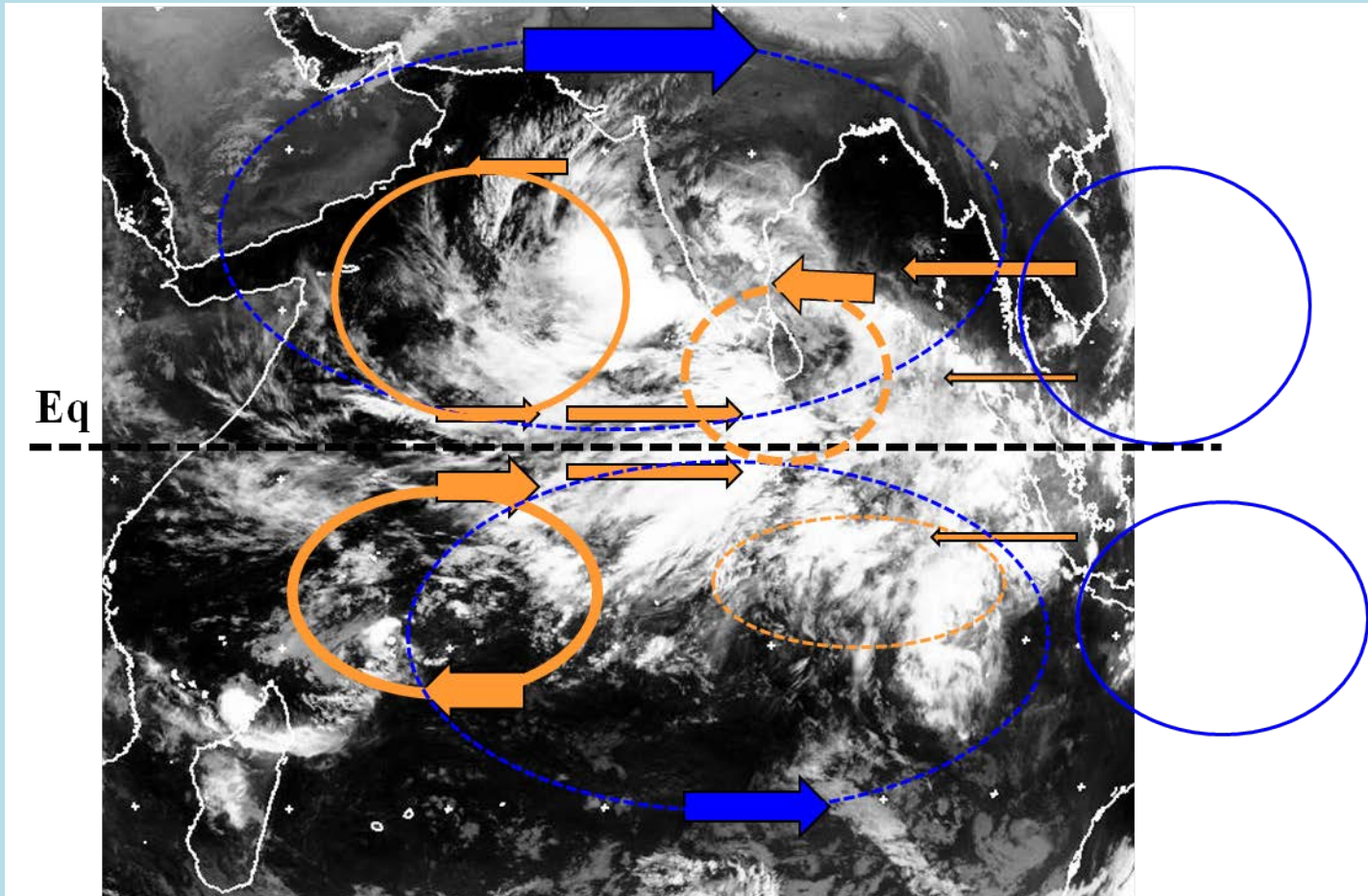


R/V Roger Revelle

ΔΥΝΑΜΟ Λεγ 5: 9-10, 2012 – 12, 2012







Courtesy of Peter Bechtold