Years of the Maritime Continent (YMC)

Science Plan Overview

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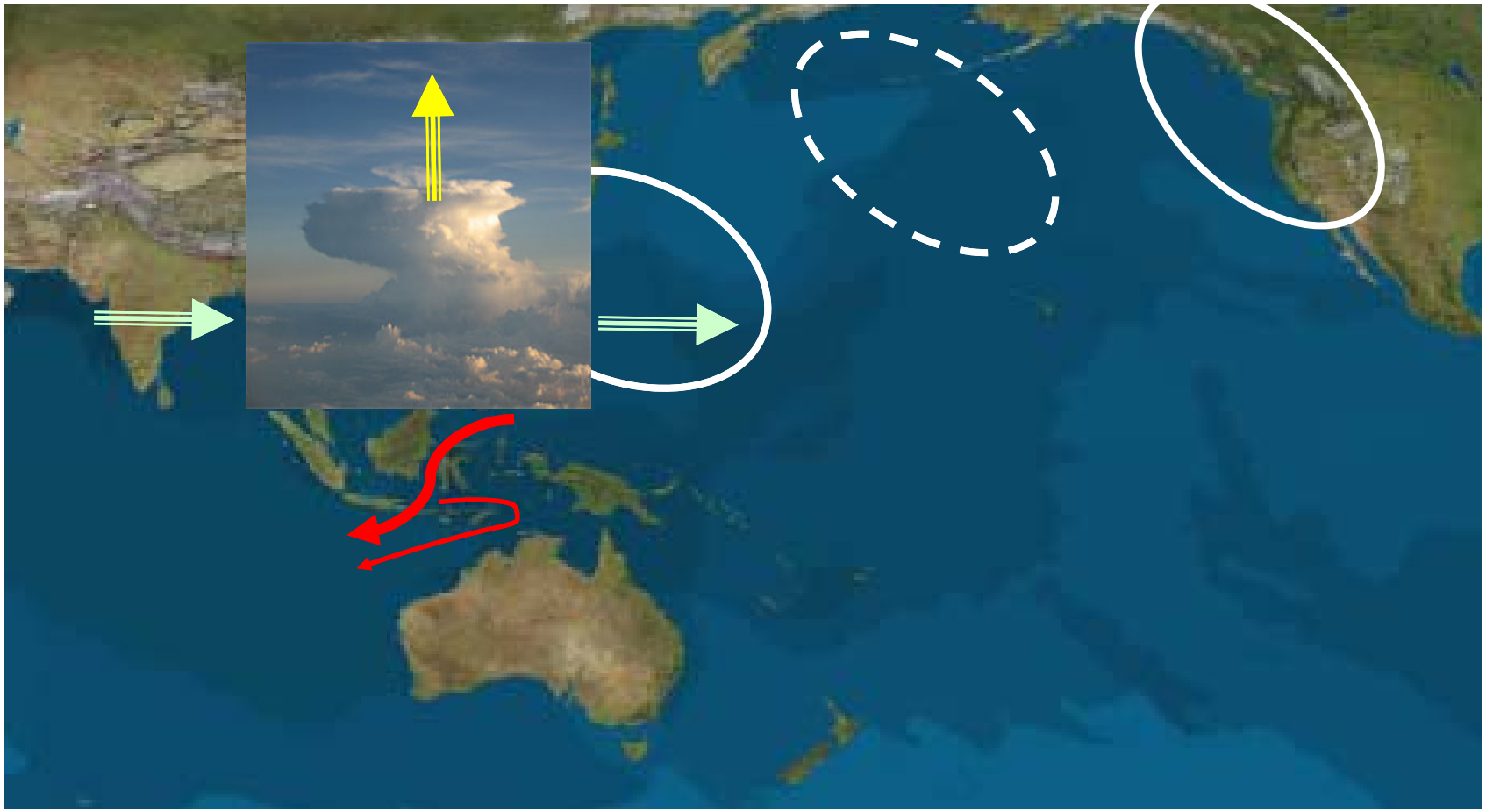
YMC Motivations

- **Global Importance**: Connections between the Indian and Pacific Oceans, between the tropics and higher latitudes, and between the troposphere and stratosphere



YMC Motivations

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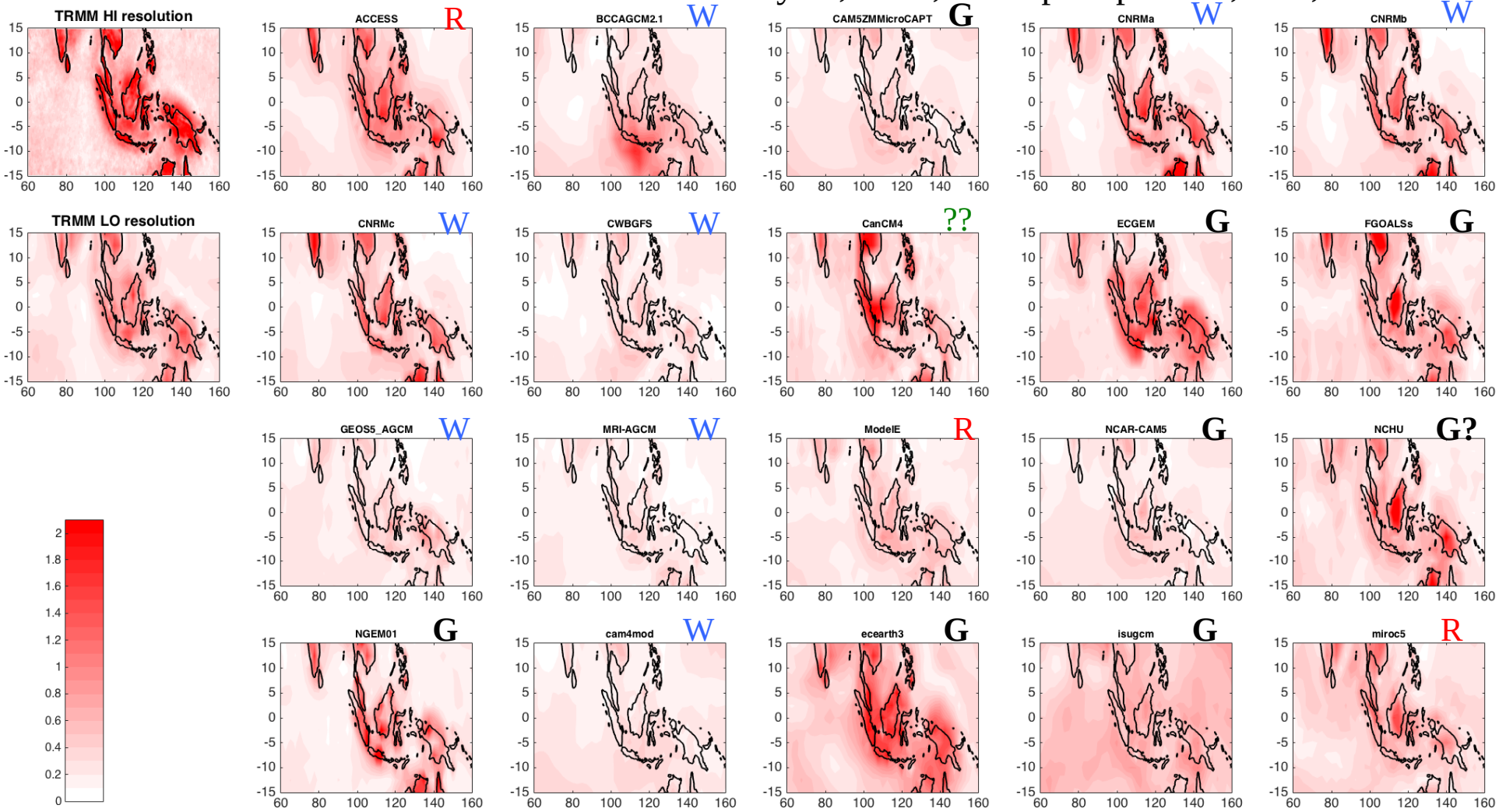
- **Persistent Biases in Global Models**: Diurnal cycle, MJO, mean precipitation, SST, TTL



Courtesy of Darek Baranowski, Duane Waliser and Xianan Jiang

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- **Persistent Biases in Global Models**: Diurnal cycle, MJO, mean precipitation, SST, TTL
- **Unique Geographic Setting**: Complex air-sea-land geometry
- **Forecast Challenges**: High-impact weather, the MJO, and climate variability

YMC Science Plan

Websites: http://www.bmkg.go.id/ymc/; http://www.jamstec.go.jp/ymc/

Goal: Observing the weather-climate system of the Earth's largest archipelago to improve understanding and prediction of its local variability and global impact

Science Themes: Atmospheric Convection, Stratosphere-Troposphere Interaction, Upper-Ocean Processes and Air-Sea Interaction, Aerosol, Prediction Improvement

Main Activities: Two-Year Data Sharing, Field Campaigns, Modeling, Prediction and Application, Outreach and Capacity Building

Objectives:

- Build a comprehensive database of the MC weather-climate system
- Advance modeling and prediction capability
- Educate the next generation of scientists who are dedicated to solving the MC problems

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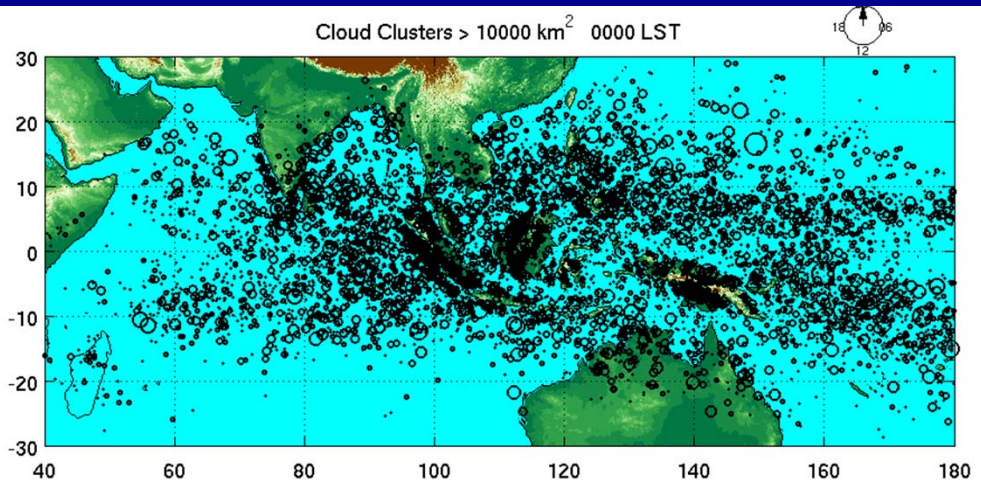
YMC Science Plan

Science Themes:

1. Atmospheric Convection



Courtesy of Shuyi Chen and Brandon Kerns

(a) Diurnal cycle

Hypothesis 1.1: Three steps: triggering, propagation, growth (TPG)

Hypothesis 1.2: TPG -> contrasts in convection (land/water, islands)

(b) Diurnal cycle – Large-scale (MJO, monsoons) interaction

Hypothesis 1.3: Large-scale modulation of timing, location, and vigor of TPG

Hypothesis 1.4: TPG -> Different diurnal responses to large-scale modulation

(c) MJO barrier

Hypothesis 1.5: MCS over water -> MJO propagation through the MC

Hypothesis 1.6: TPG and MCS over water <-> MJO barrier

(d) Interaction between the MC and E/SE Asia

Hypothesis 1.6: Role of cold surges in multi-scale interaction

YMC Science Plan

Science Themes:

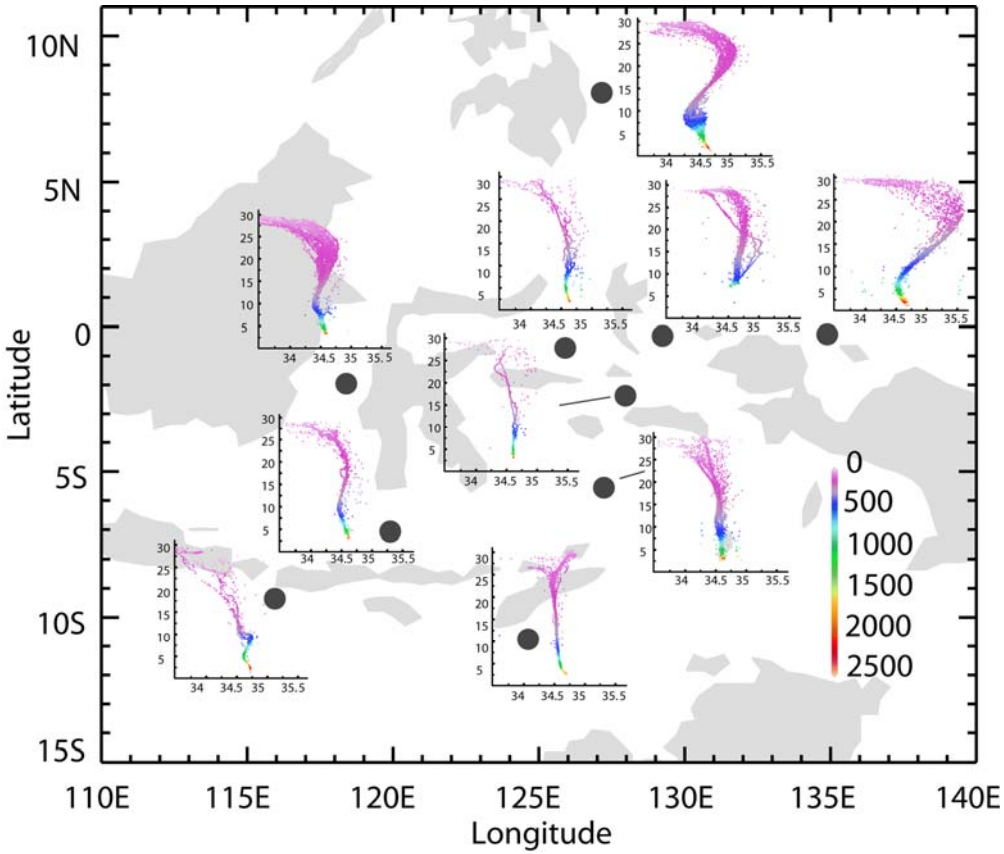
2. Ocean and Air-Sea Interaction

(a) Upper-ocean processes: mixing, advection, upwelling, wave propagation

(b) Air-sea interaction: forcing to the ocean, effects on MCSs over water, diurnal vs. other timescales

General issues:

- Relative roles of competing processes: near inertial waves, tide, atmospheric forcing, advection, upwelling, wave propagation, etc.
- Spatial differences: bathymetry,
- depth, internal vs. external forcing
- MC seas compared to open oceans

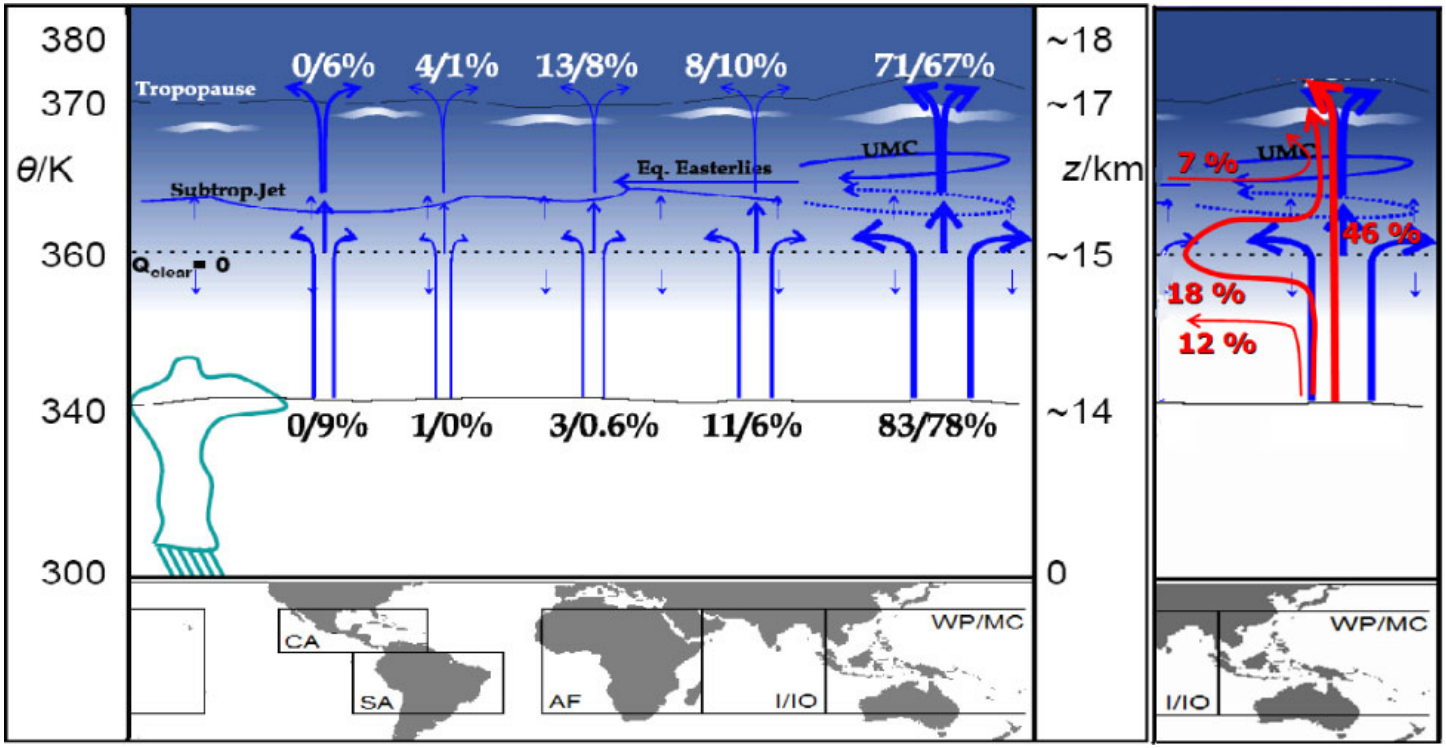


Koch-Larrouy et al. (2007)
Sprintall et al., (Nature Geosci. 2014)

YMC Science Plan

Science Themes:

3. Stratosphere-Troposphere Interaction
(a) TTL: dehydration and cirrus-cloud formation
(b) Convection: Penetration vs. wave generation
(c) Large-scale processes: Quasi-horizontal transports, Asian monsoon, Diurnal atmospheric tide



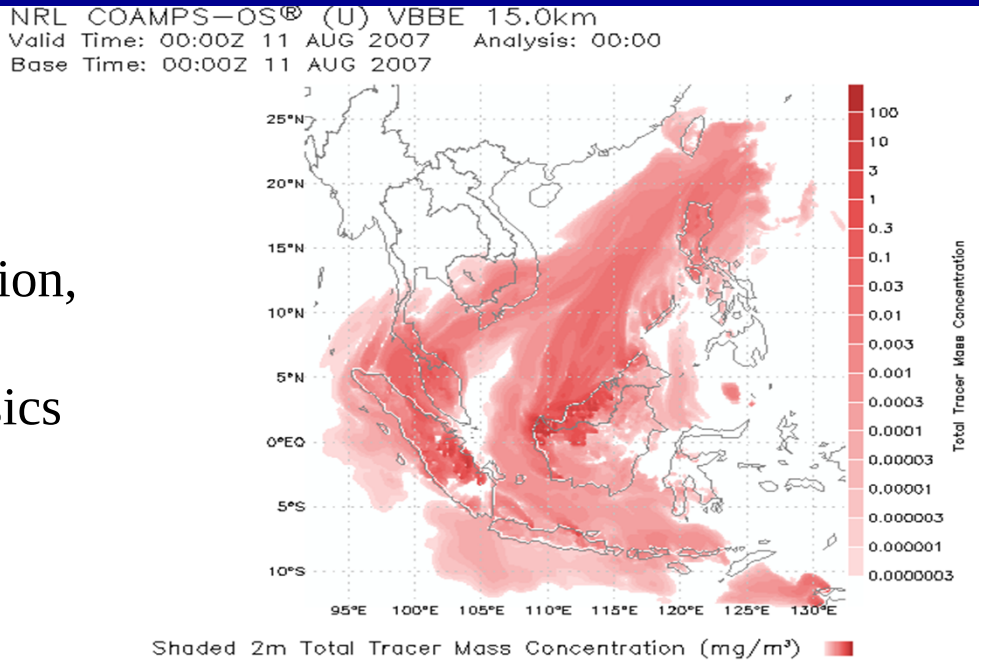
http://www.ozone-sec.ch.cam.ac.uk/scout_o3/field_campaigns/Darwin/science/science_rational.htm

YMC Science Plan

Science Themes:

4. Aerosol

- Effects of rainfall and wind on production, transport, mixing, deposition, distribution, and sizes of aerosol
- Effects of aerosol on cloud microphysics and dynamics, and rainfall



Courtesy of Jeffery Reid

Hypothesis 4.1: Concentrations and the vertical distributions of aerosols are modulated by the monsoon, MJO, and land-sea breezes. MCS-driven precipitation is an essential scavenging mechanism that limits regional transport and the depth of aerosol layer presence. Aerosol-modified cloud microphysics within the convective core influences storm strength, precipitation, vertical depth, and cloud lifetimes.

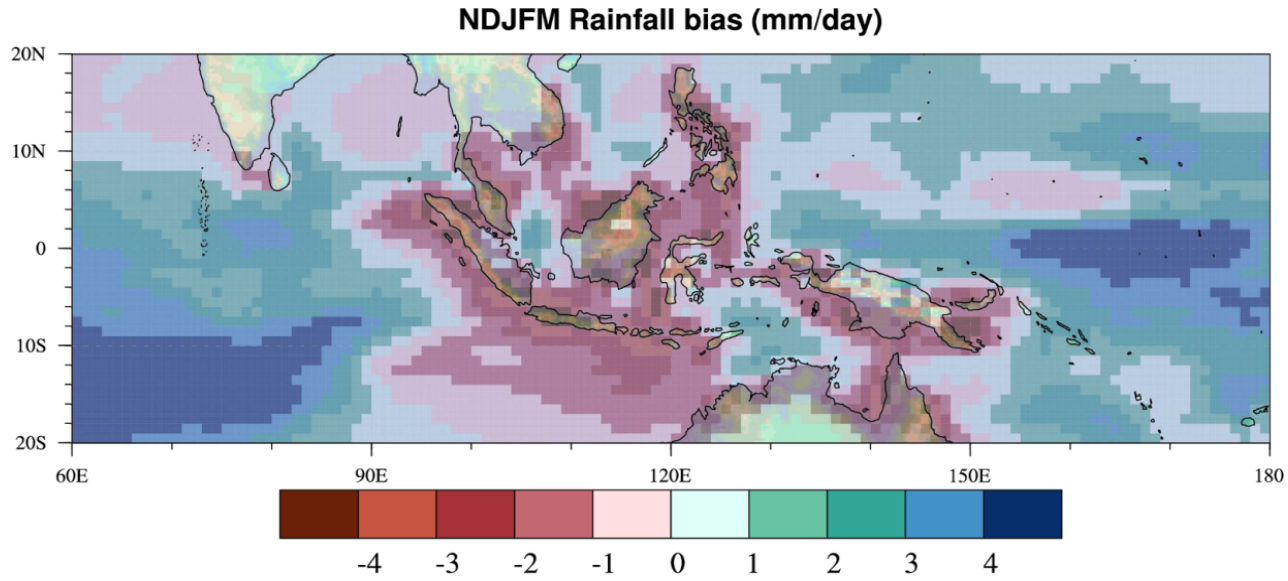
YMC Science Plan

Science Themes:

5. Prediction Improvement

(a) Prediction of the MC region; (b) Global prediction related to the MC; (c) Prediction model improvement through YMC

- Model reproduction of land/ocean breeze circulation, and TPG
- Effects of equatorial waves, monsoon surges, ENSO and MJO on MC rainfall
- Effects of soil moisture
- MC effects on remote areas
- Initialization, data assimilation, and evaluation
- Applications of YMC field observation



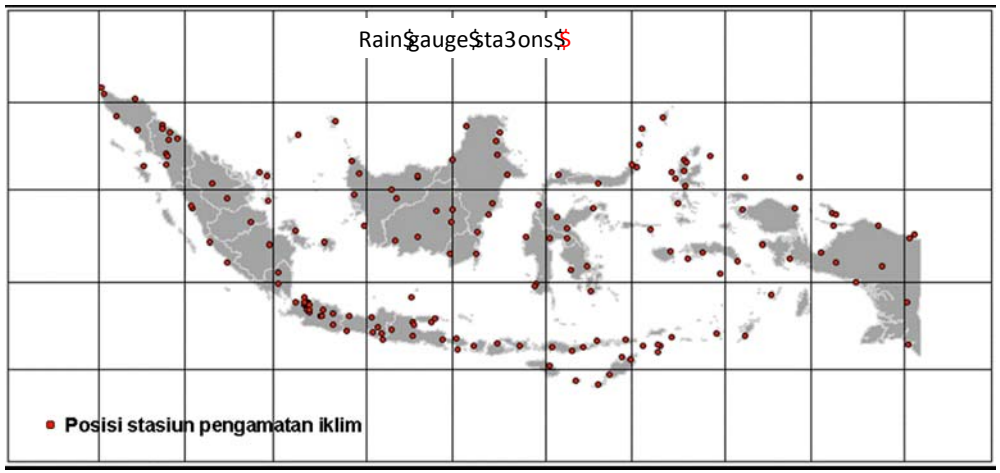
Bias of November-March mean rainfall in atmosphere-only Met Office Unified Model GA6.0 (AMIP-type simulation)

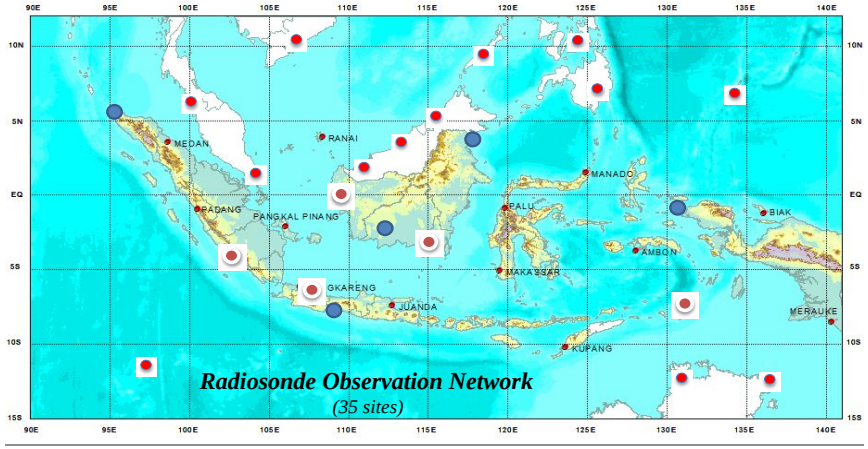
Courtesy of Cathryn Birch

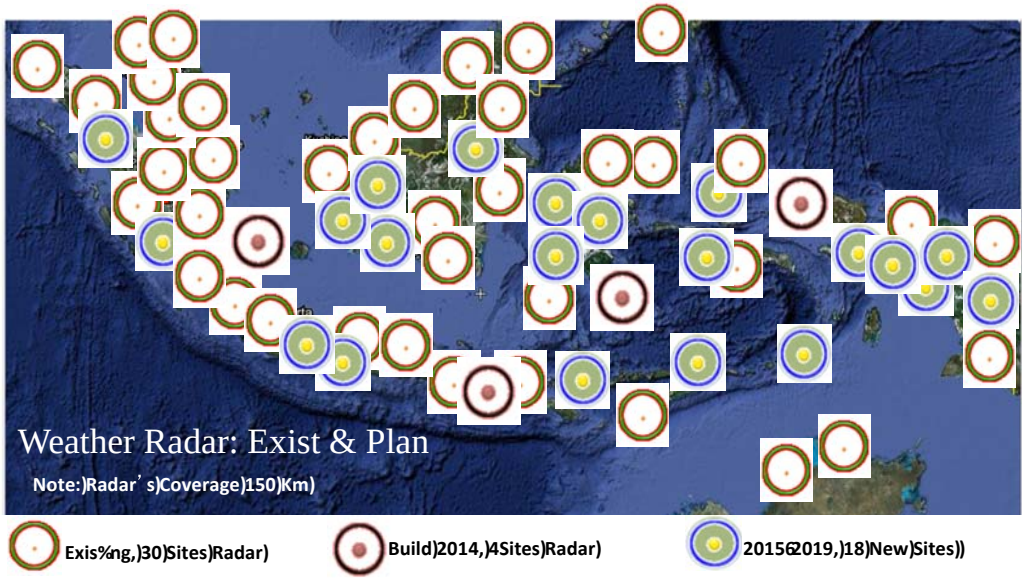
YMC Science Plan

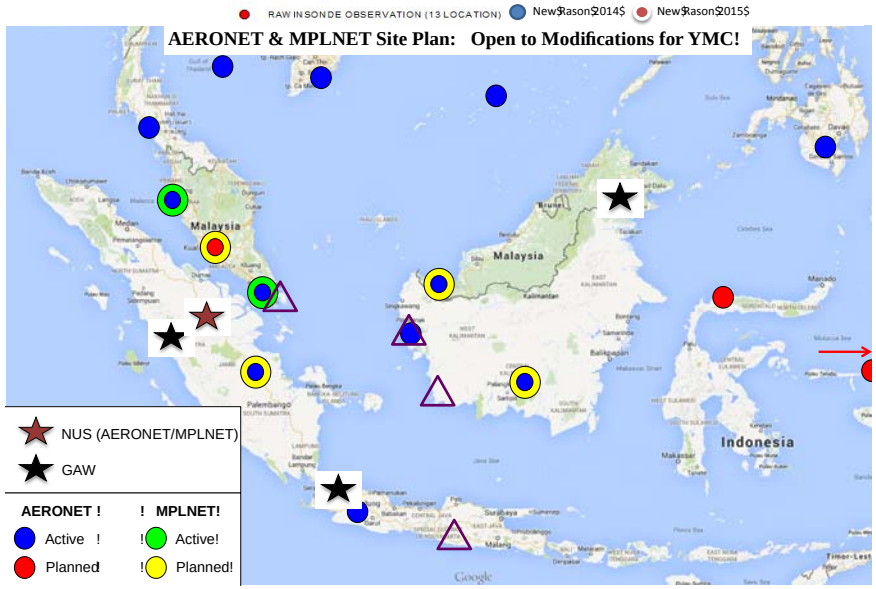
YMC Main Activities:

1. Data Sharing









YMC Science Plan

YMC Main Activities:

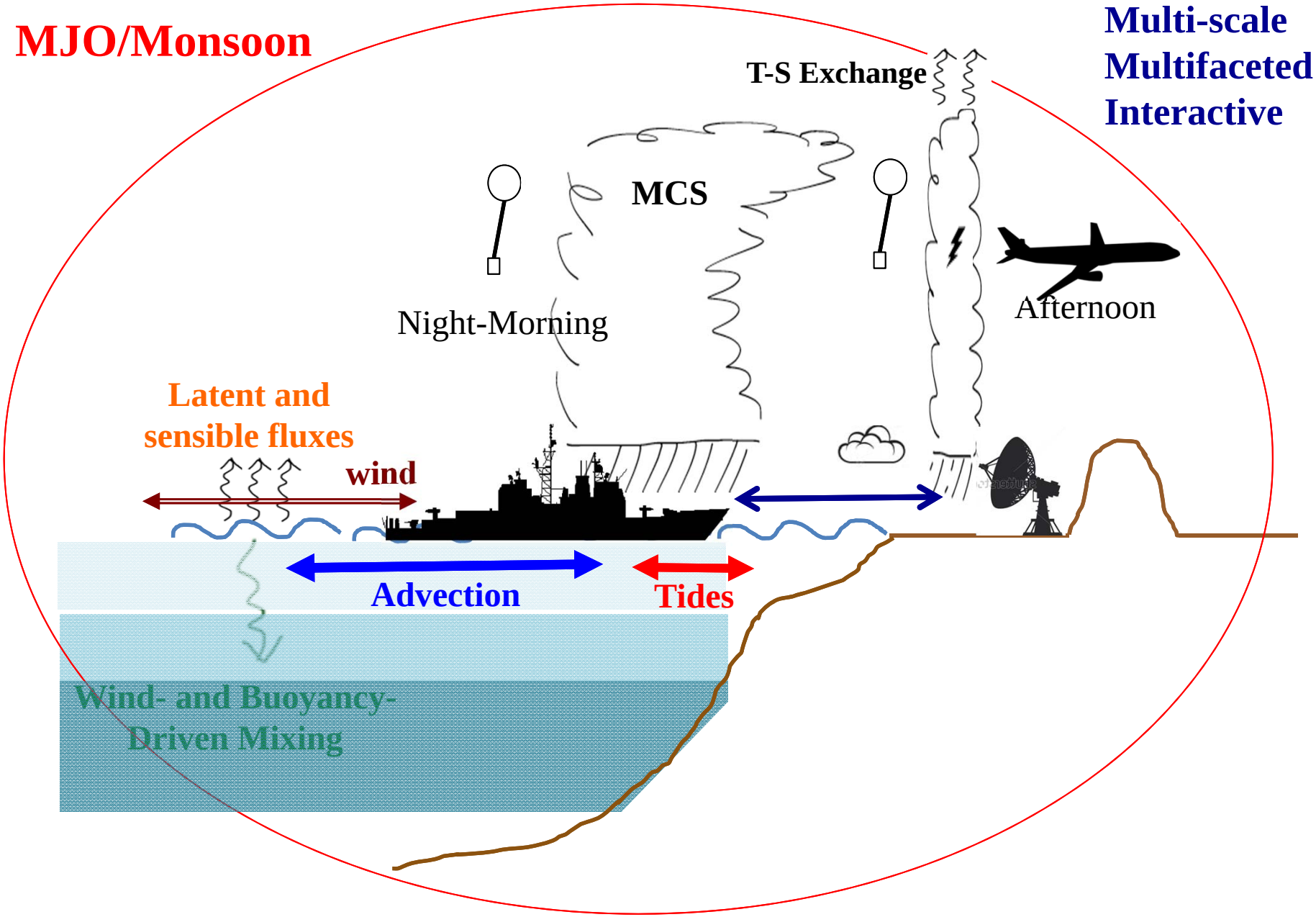
1. Data Sharing
2. Field Campaign
3. Modeling
4. Prediction and Applications
5. Outreach and Capacity Building

YMC Science Plan

Synergy with other projects:

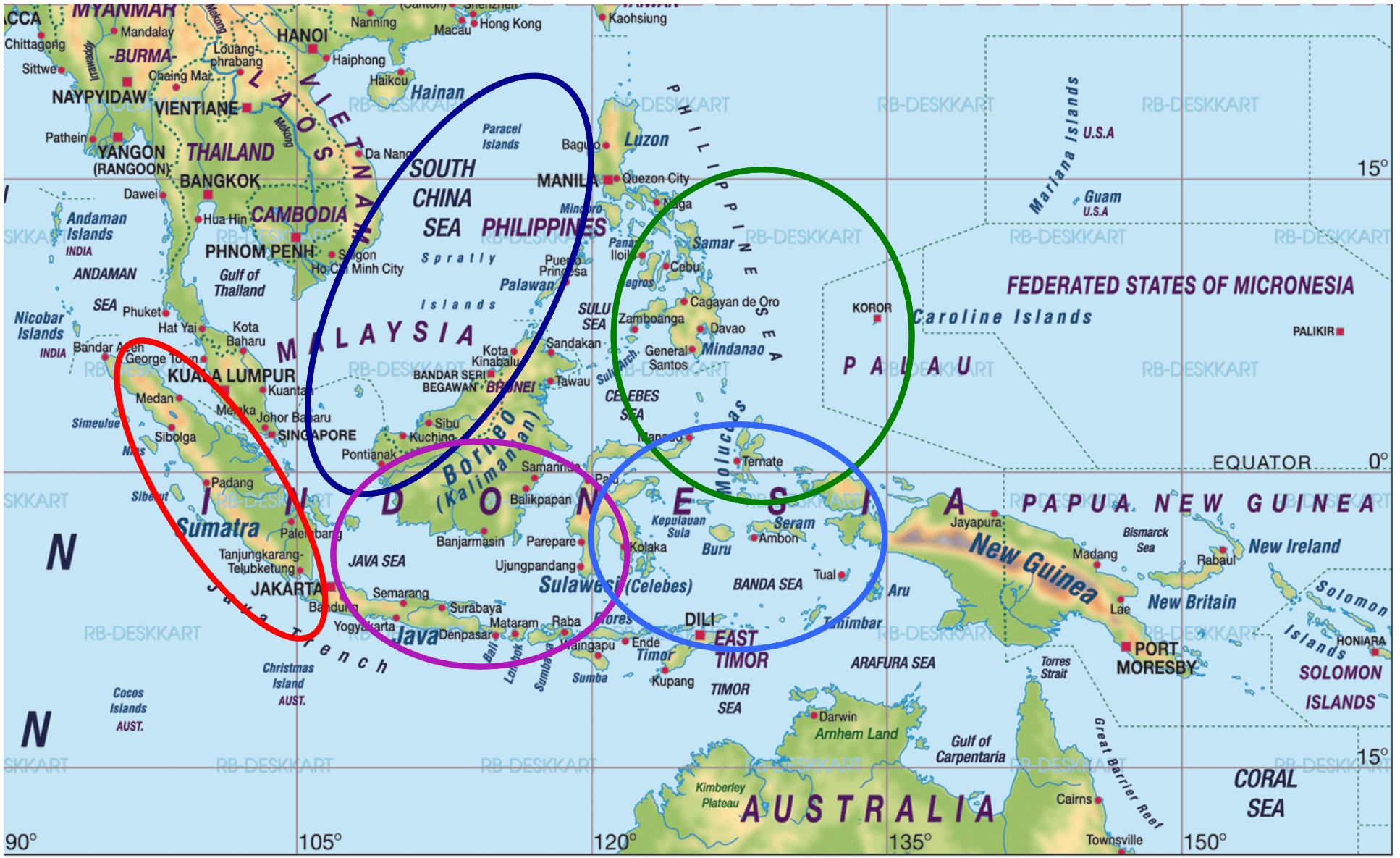
1. Propagation of Intra-Seasonal Tropical Oscillations (PISTON)
   - integrated in YMC
2. Cloud-Aerosol-Monsoon Philippines Experiment (CAMPEx)
   – integrated in YMC
3. International Indian Ocean Expedition 2 (IIOE-2)
   – partially integrated in YMC
4. Subseasonal-to-Seasonal Prediction Project (S2S)/MJO Task Force (MJOTF) Joint Maritime Continent Initiative
   – *Joint effort with YMC?*
5. CORDEX-Southeast Asia (CORDEX SA)
   - *partially integrated into YMC?*
6. Year of Polar Prediction (YOPP) - share ECMWF data support
7. Southeast Asian Studies (7SEAS) - joint effort with YMC
8. Stratosphere-troposphere Processes and their Role in Climate (SPARC) - *??*
9. Strateole-2 - partially integrated in YMC

YMC Field Campaign: Ideal Setting



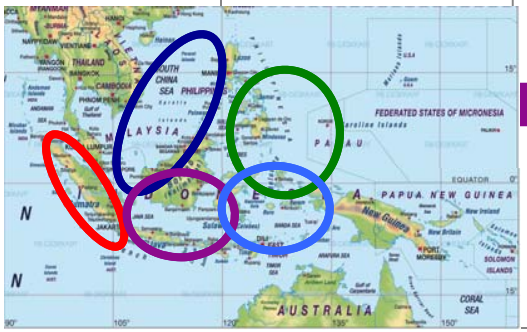
YMC Implementation Plan

Focused Observing Areas



YMC Implementation Plan

Tentative Deployment Timeline



R/V Mirai
JAMSTEC ground facilities
R/V Dayang #1

NCAR facilities (Plan A)

R/V XiangYangHong 18

UND facilities (flux tower, radiometers, ceilometers)

UND facilities (radiosondes, lidars)

Taiwan Consortium facilities

NASA P-3B (CAMPEx)

NCAR facilities (Plan B)

UK Consortium facilities

KITCube or KITCube

X-band Doppler radar

Aeroclippers

NCAR C-130 (Plan B)

R/V Sally Ride (PISTON)

R/V B. Jaya III and Geomarine III

Oceanic autonomous devices and moorings

NCAR C-130 (Plan A)

Oceanic autonomous devices and moorings

ETH cloud chamber

CNR Raman lidar

NCAR C-130 (Plan A)

R/V Investigator

AMF-1

July 2017 Jan 2018 July 2018 Jan 2019 July 2019