1N line field measurements: CCKW propagation across the Maritime Continent

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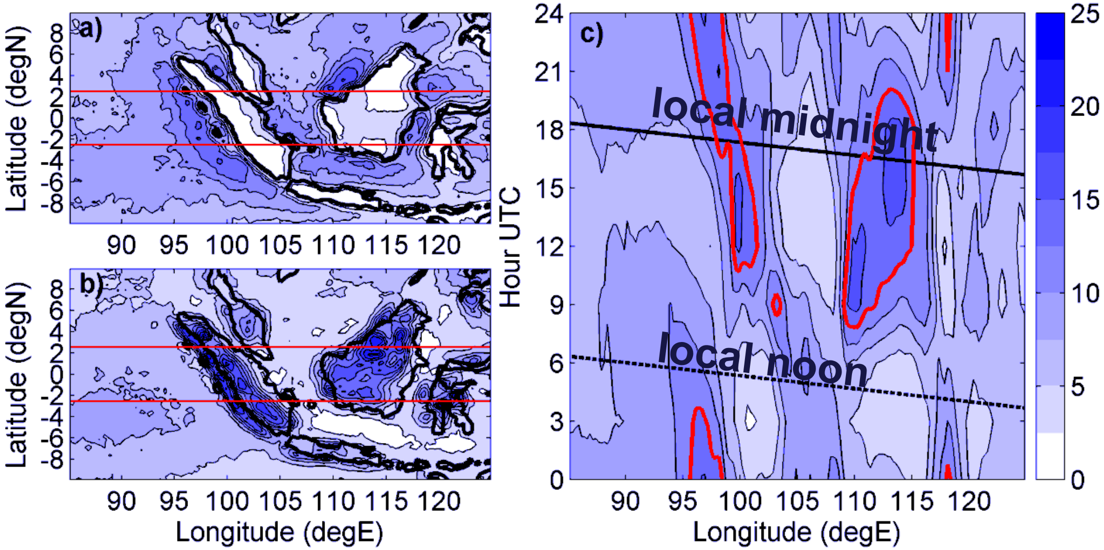
Outline

- Motivation
  - Termination of the propagating convective events (MJO, CCKWs) over the Maritime Continent
  - Multi-scale interactions across the regions
  - Air-sea interactions over surrounding seas
  - Numerical model biases
- Deployment plans
  - Land based instrumentation
  - Oceanographic instrumentation

Mean Diurnal Cycle of precipitation over Maritime Continent

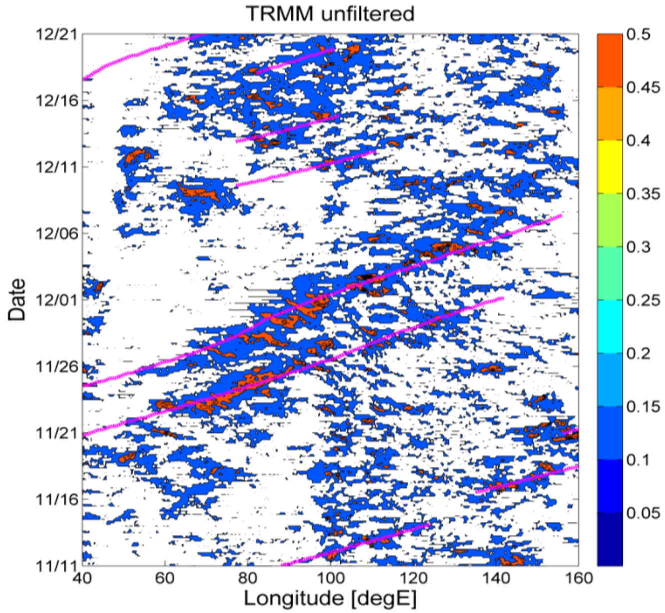
- Maritime Continent is characterized by strong diurnal cycle of precipitation
- Daytime maxima over Sumatra and Borneo
- Nighttime maxima between the islands and west of Sumatra

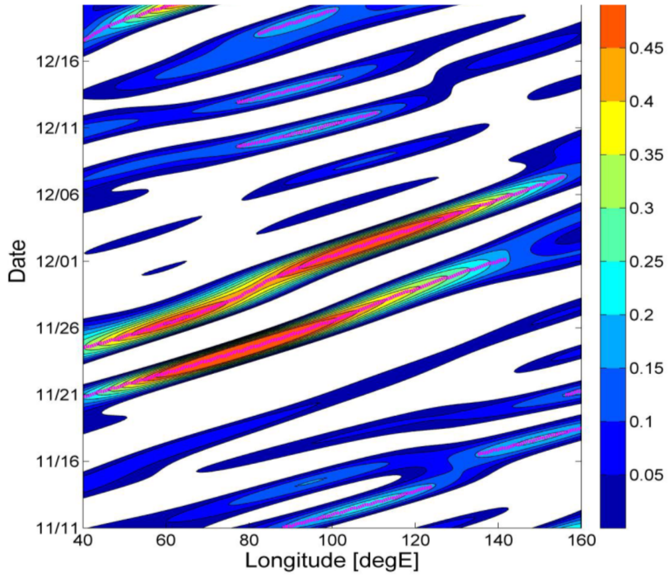


If/How local diurnal cycle of precipitation interacts with the eastward propagating organized convection

Convectively Coupled Kelvin Waves (CCKW) data base

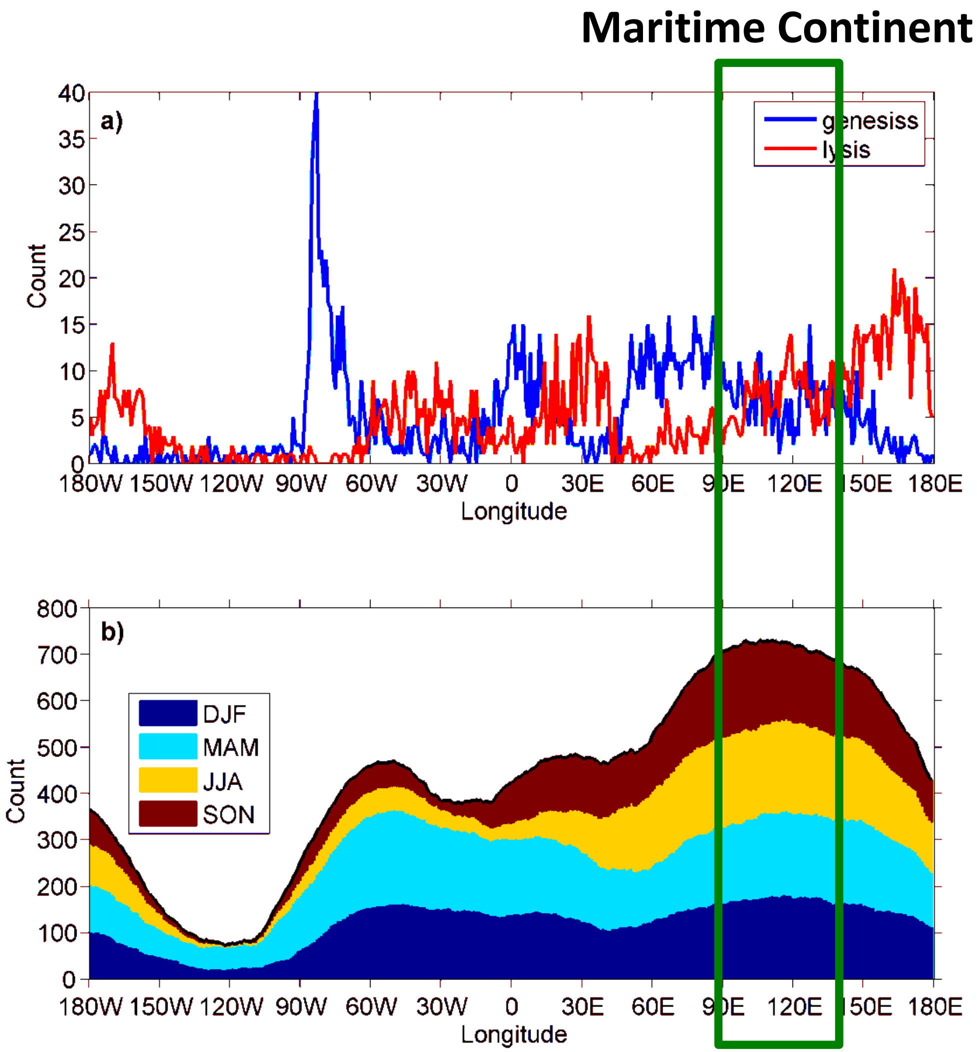
- CCKW trajectories calculated using FFT filtering
- Globally 1840 CCKW trajectories during 1998-2012 period
- Nearly 800 CCKW trajectories over Indian Ocean
- Globally highest CCKW activity over MC
- Eastward increasing number of CCKW ends of trajectories over Indian Ocean and Maritime Continent





Convectively Coupled Kelvin Waves example

- Globally 1840 CCKW trajectories during 1998-2012 period
- Nearly 800 CCKW trajectories over Indian Ocean
- Globally highest CCKW activity over MC
- The Maritime Continent region is sink of the CCKWs propagating along the equator – more trajectories end than begin

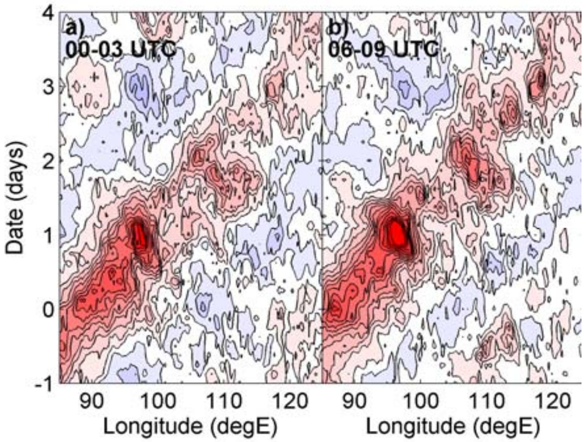


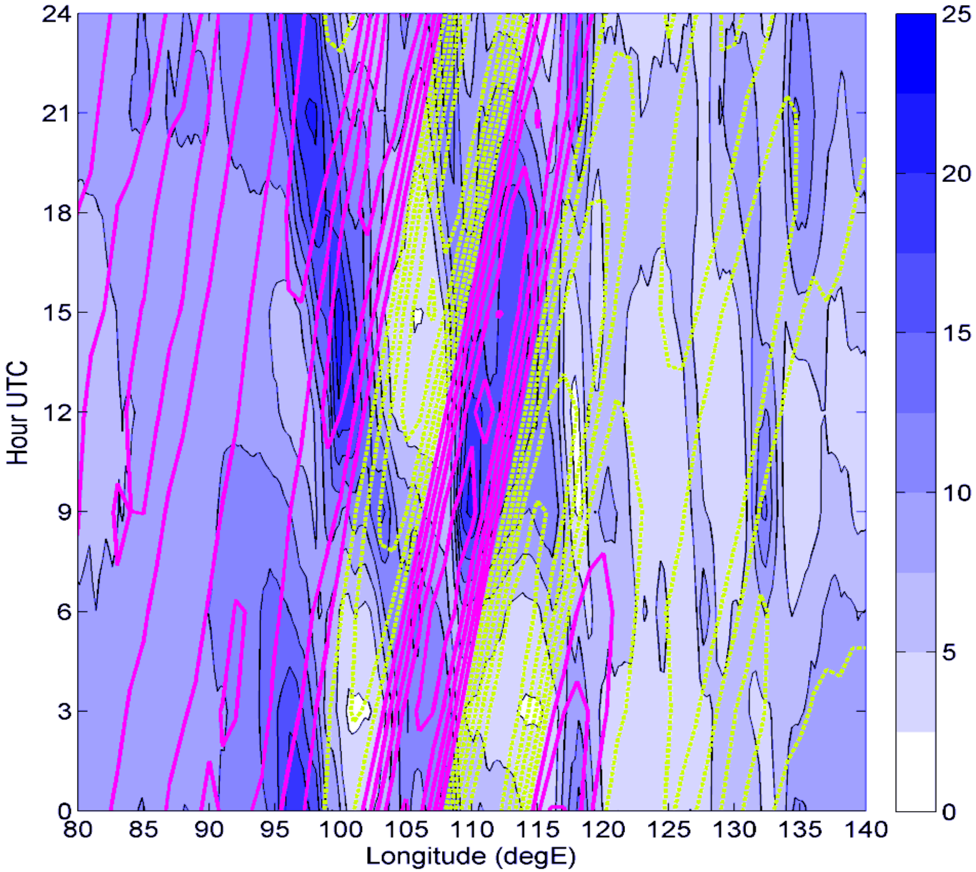
Mean diurnal cycle of precipitation over MC: full vs. CCKW filtered

- The phase diurnal phase locking in Kelvin waves

- Maxima in CCKW filtered precipitation (convective part) match maxima of the local diurnal cycle of precipitation over Maritime Continent

- Question: are some waves better “synchronized ” with MC convection then the others?



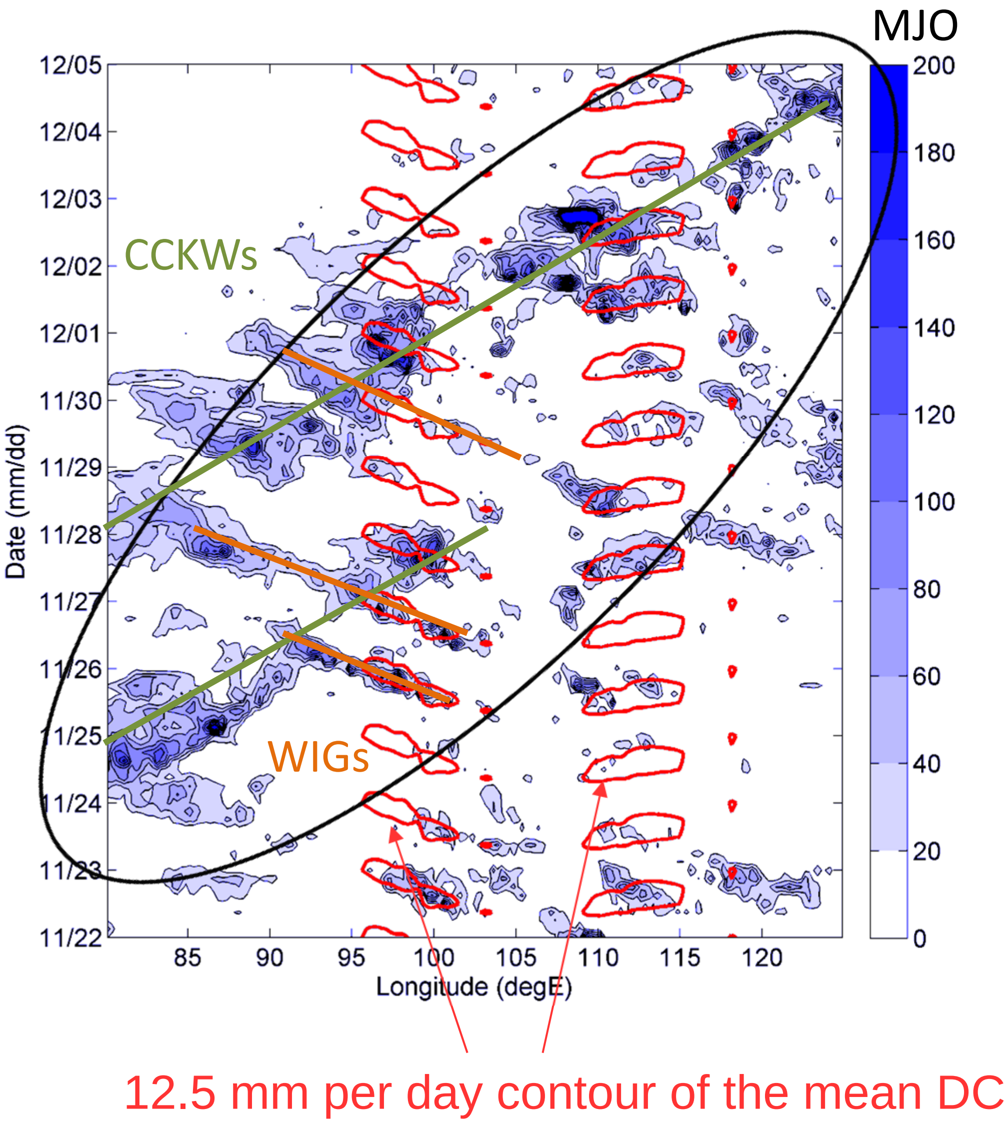


Background (color shadings): mean diurnal cycle of full precipitation
Foreground (contours): mean diurnal cycle of filtered precipitation in the vicinity (±12h) to the CCKW trajectory
Solid magenta: 8.5-13.5 mm/day
Dashed yellow: 3.5-7.5 mm/day

Multi-scale interactions framework

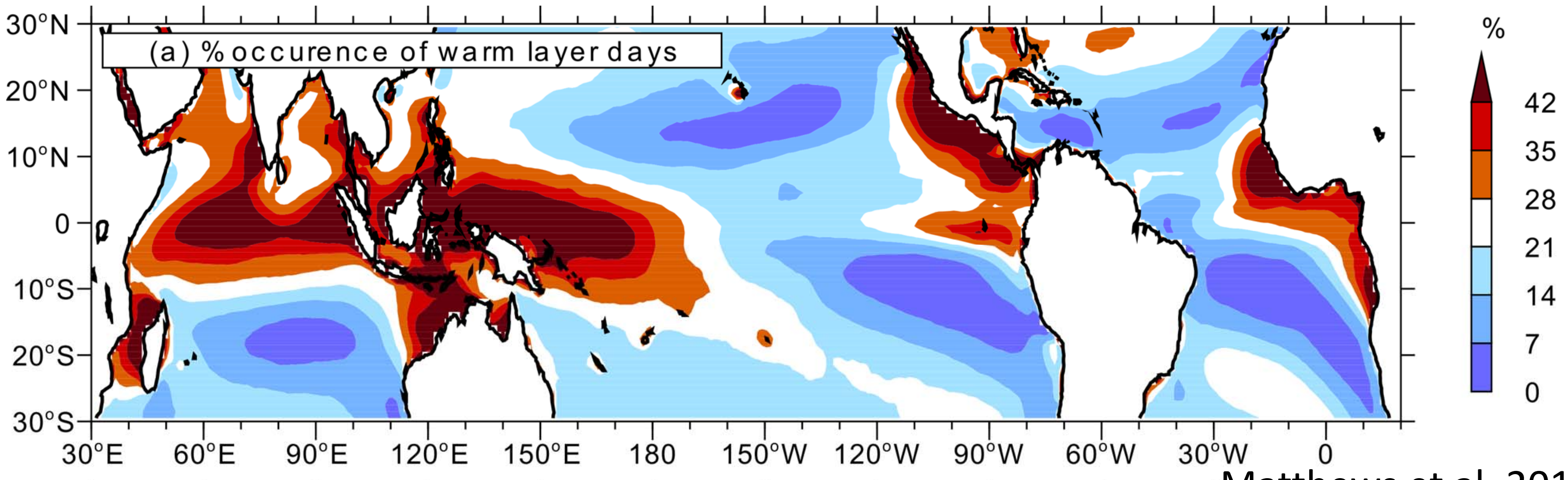
- MJO
- 2 sequential CCKWs embedded in MJO envelop
- Westerly Inertia Gravity waves propagating of the coast of Sumatra
- Diurnal cycle of precipitation

All involved in non-linear interactions with each other.



Air-sea interactions

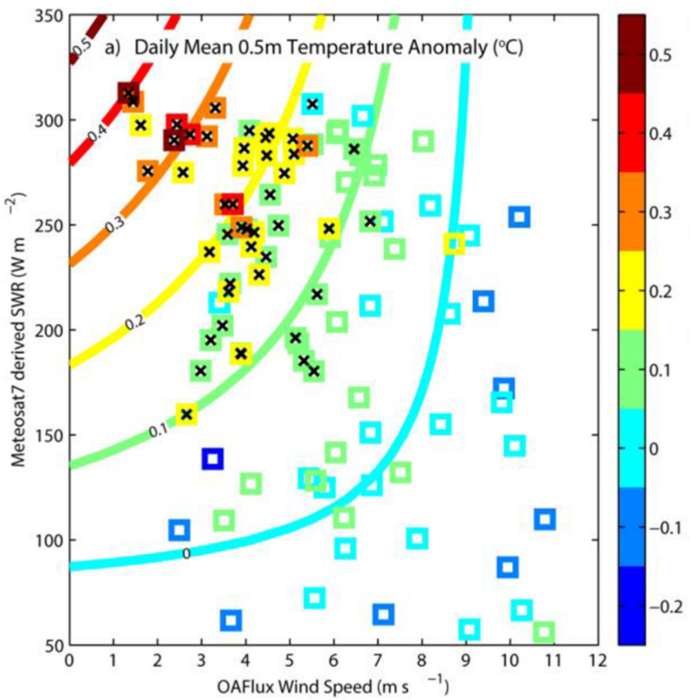
- Ocean regions around the Maritime Continent exhibit very high potential for oceanic warm layer development
- Underwater Seagliders has recently (DYNAMO) been successfully used in long term (4months) warm layer measurements

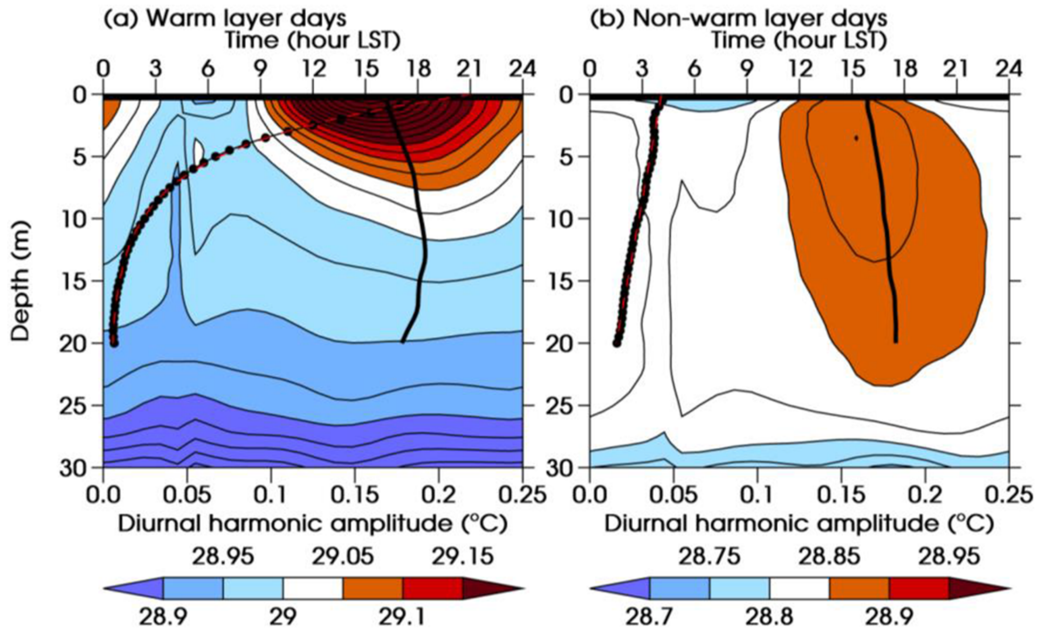


Matthews et al. 2014

Air-sea interactions

- Warm layer develops on calm, clear sky days on the ocean surface
- Maximum diurnal SST amplitude at 16UTC
- Warm layer dissipation due to vertical mixing
- Warm layer amplitude is dependent on the mean surface wind speed and insolation.





Matthews et al. 2014

MJO-MC Interaction Model Evaluation Study

with

YOTC/MJOTF-GEWEX/GASS Multi-Model Physical Processes Experiment

A Work in Progress on behalf of the S2S Project's MJO-MC Interaction Subproject

Darek Baranowski, Duane Waliser and Xianan Jiang

JPL/UCLA

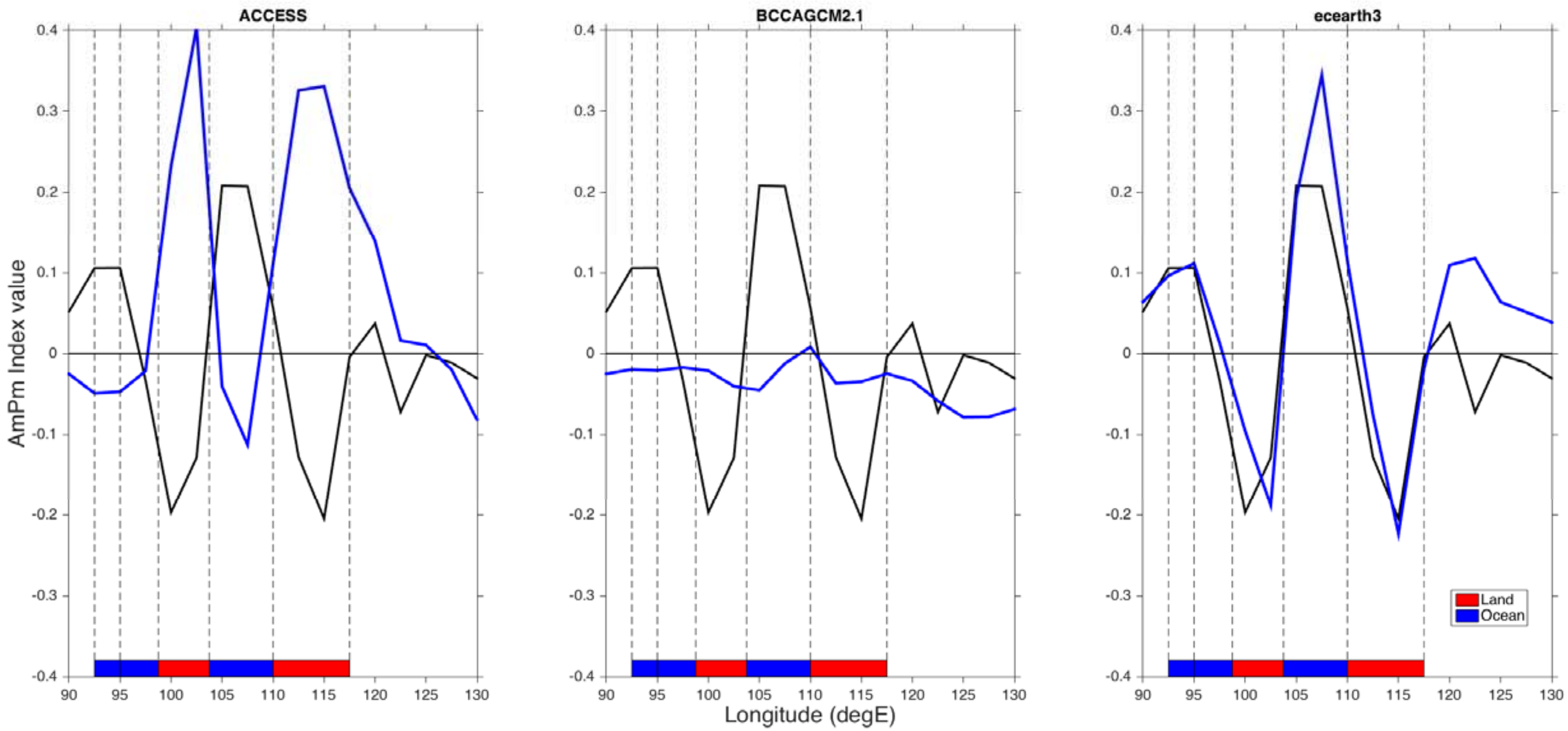
S2S Project Meeting; Nov, 2015 - ECMWF

Zonal variability of the daytime/nighttime precipitation

AmPm index from LO TRMM(black) and GASS models (blue)

AmPm Index = (AMpr –PMpr)/(AMpr +PMpr); AM and PM in LST

Reversed diurnal cycle | Weak diurnal cycle | Good diurnal cycle

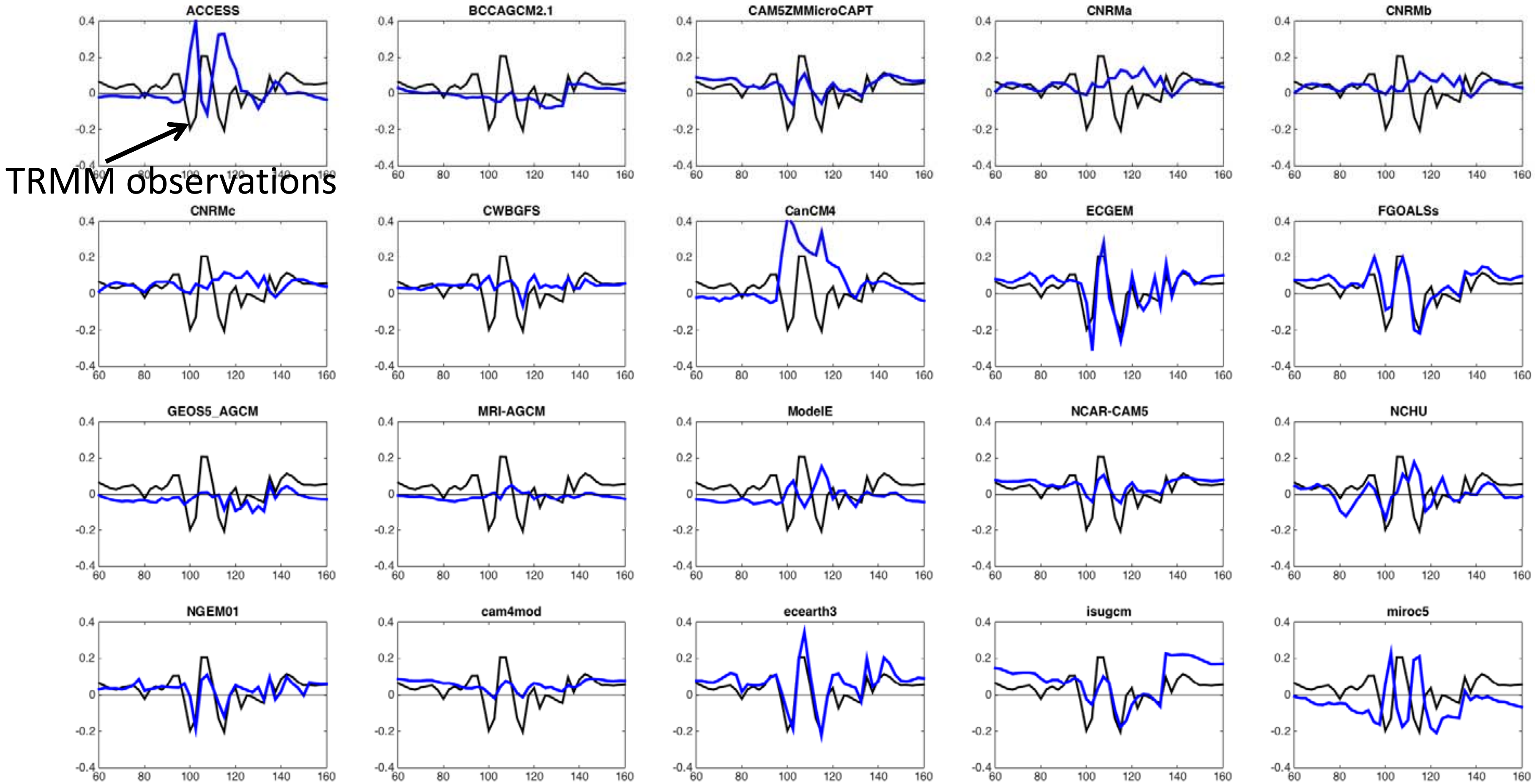


AmPm index indicates zonal variability in excess nighttime (positive values) or daytime (negative values) precipitation. It qualitatively shows skill of the model to reproduce the land-ocean contrast in phase and relative amplitude of the diurnal cycle

Model bias – diurnal cycle

AmPm index from LO TRMM(black) and GASS models (blue)

AmPm Index = (AMpr –PMpr)/(AMpr +PMpr); AM and PM in LST



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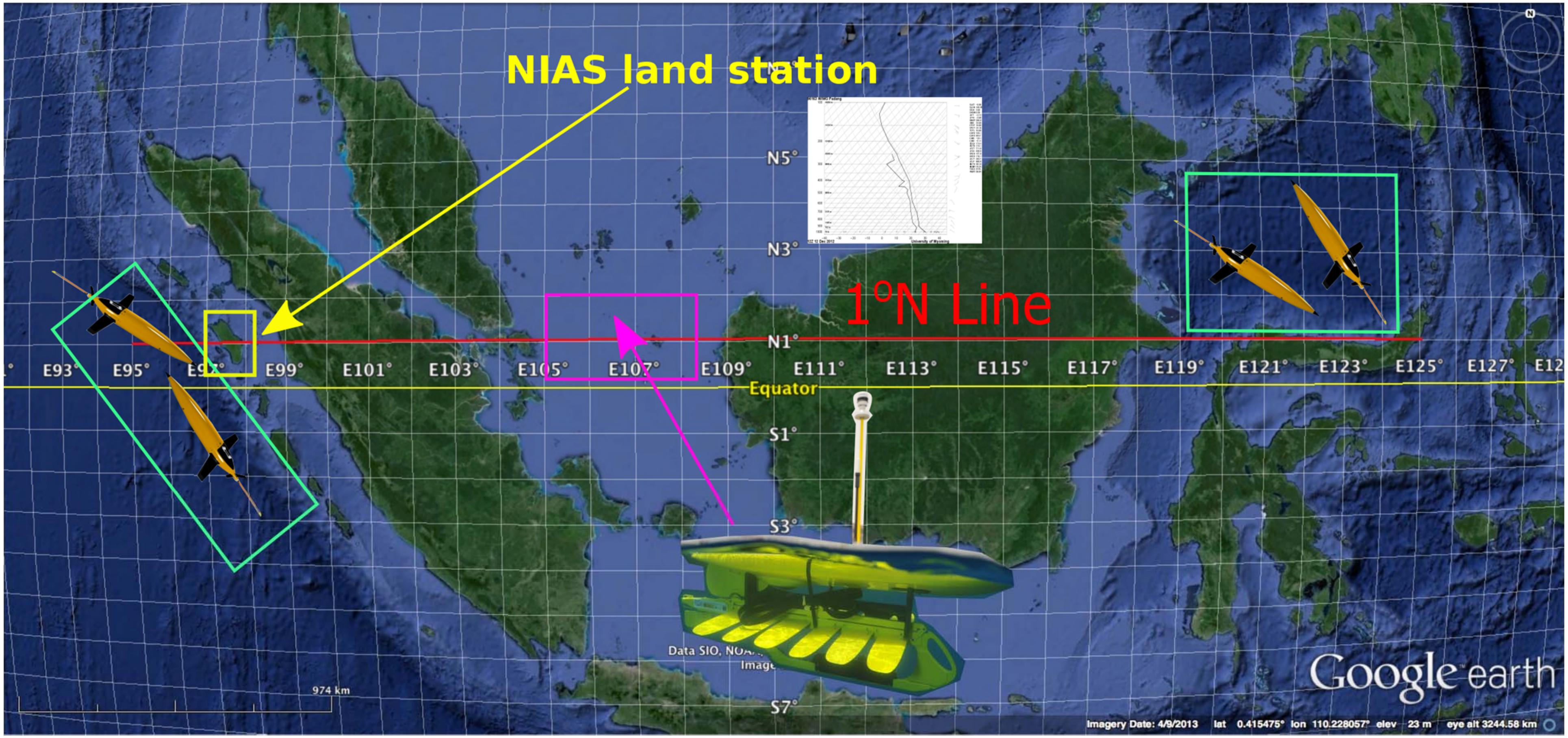
1N line field experiment
YMC component
Research question

If/How interaction with local diurnal cycle of precipitation over Maritime Continent affects CCKW and MJO ability to successfully propagate into Western Pacific?

1N line field experiment components

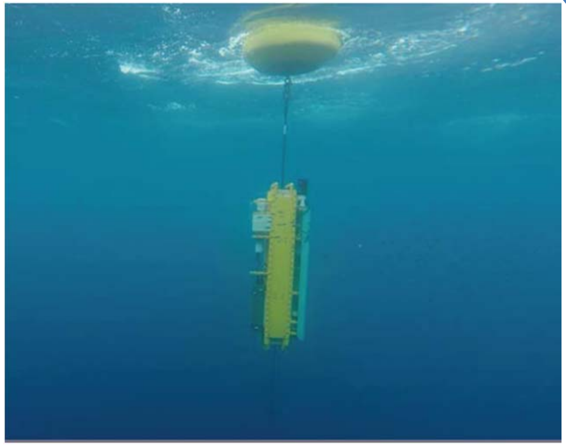
- Assessment of the diurnal cycle variability west of the coast of Sumatra during life cycle of MJO/CCKWs
  - Impact of phase and amplitude of the diurnal cycle on the convection propagation
  - Interactions between eastward propagating modes and WIGs initiated over Sumatra
  - Land based observations from Nias island
- Observations upper ocean variability – impact of upper ocean warm layer development
  - west of the coast of Sumatra (eastern Indian Ocean)
  - between Sumatra and Borneo
  - east of Borneo

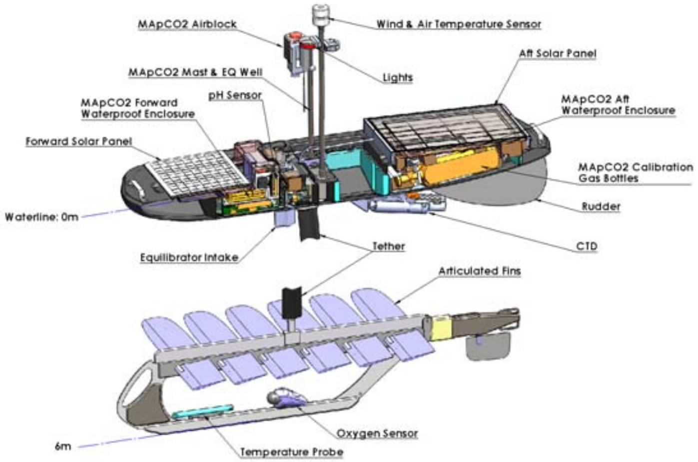
1N line field experiment outline

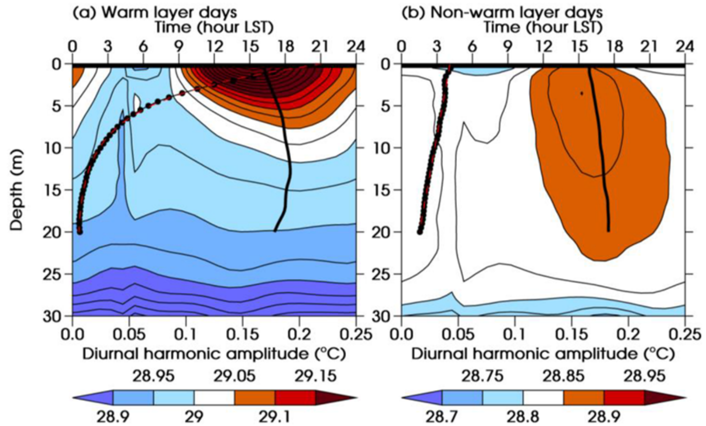


Oceanic

Seaglider University of East Anglia, Wave Glider (Adrian Matthews)
Wire walker (Matthew Alford, Scripps Institution of Oceanography)







Ship: Fluxes, stabilized platform (ship deployment)

Latent Heat Flux, Solar and IR

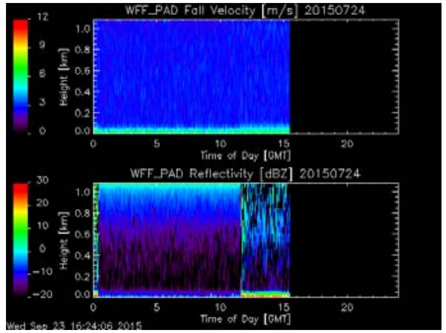
SPS-P230 Stabilized Platform. The stable platform is intended to stabilize the payload all the time while it is moved.

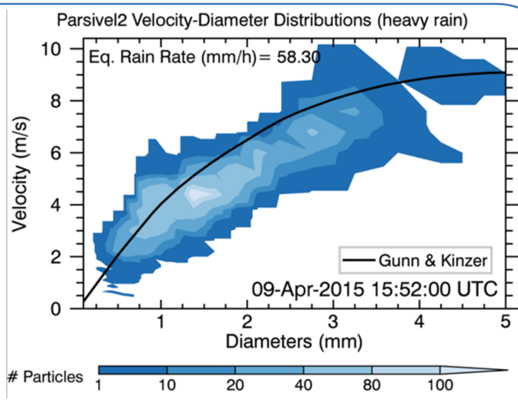
Surface

Latent Heat Flux, Solar and IR

Preciptation: Persivel2 disdrometer, MRR radar

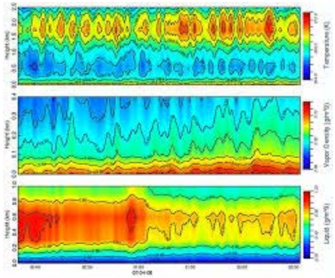
Sky imaging

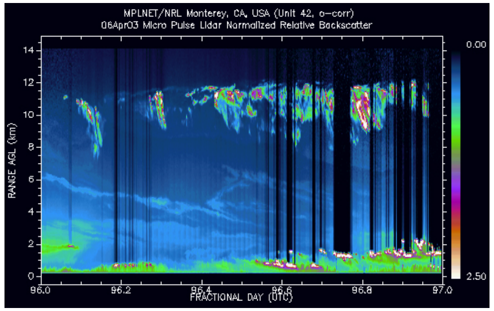




Surface

T, RH profiles Radiometrics MP3000
Cloud structure: Ceilometer CL51, MPL Lidar





1N line field experiment instrumentation

- Land based instruments
  - Soundings
  - Radar
  - Radiometers, T, RH
- Oceanographic instruments
  - 4 Seagliders, 2 west of Sumatra and 2 east of Borneo
  - Wave glider – between Sumatra and Borneo