

# Australian proposal for the Years of the Maritime Continent (YMC): Observing convection with the RV Investigator

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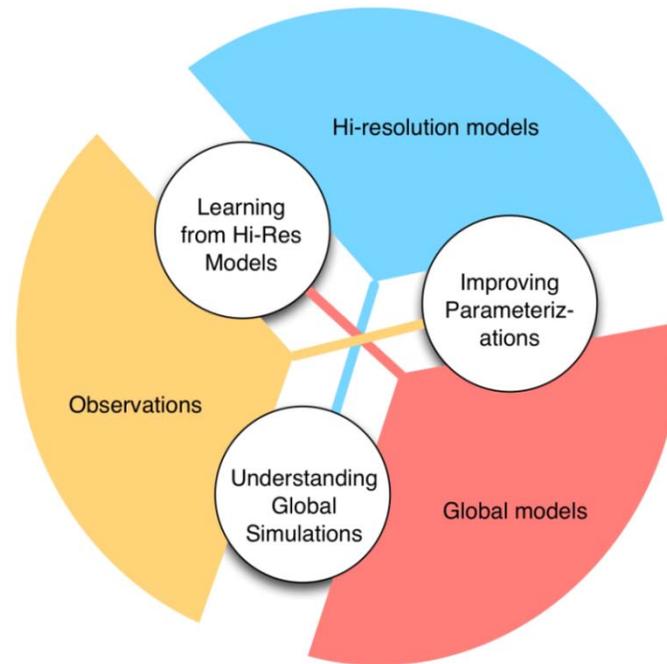
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**MONASH** University

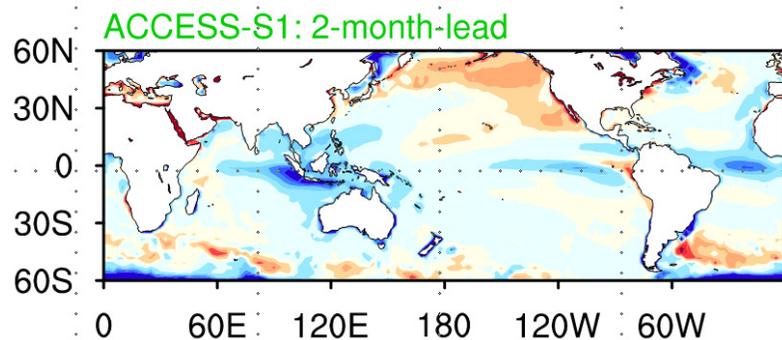
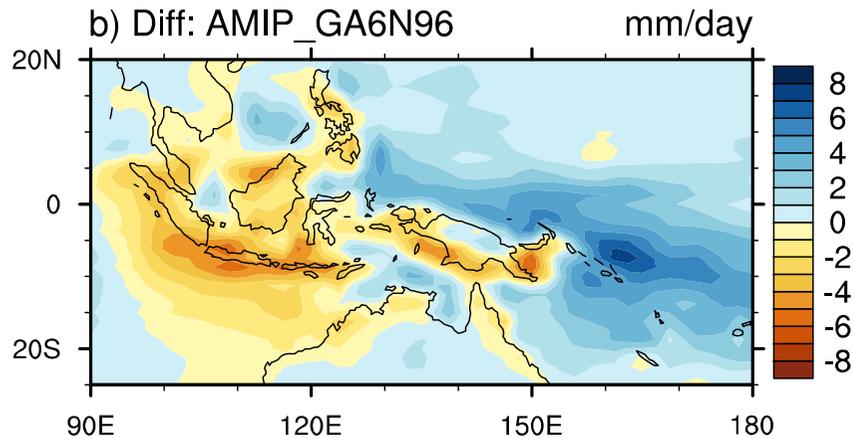
# Background of Australian interest

Motivated by large precipitation and other **biases** in our global numerical models in the MC region, Australian institutes (BoM, CSIRO, Universities) began a joint "Maritime Continent Initiative" in 2013. We framed a three component approach comprising global models, hi-resolution models, and observations.



Our interest in the **YMC** nicely fits within this framework.

Australia's modelling collaboration with the UK Met Office has also led to the formation of a **Process Evaluation Group** (PEG) on Maritime Continent biases (focussed solely on the Unified Model/ACCESS).



- Large negative **SST bias** in MC region  
SST bias (in °C) in hindcasts from the ACCESS-S1 coupled seasonal prediction system, initialized on 1st May 1990-2009, and verifying in June-July-August

Other phenomena are also difficult in the MC region: Madden-Julian oscillation (MJO), Indian Ocean Dipole (IOD), "cold surges" from the South China Sea, El Niño-Southern Oscillation (ENSO).....

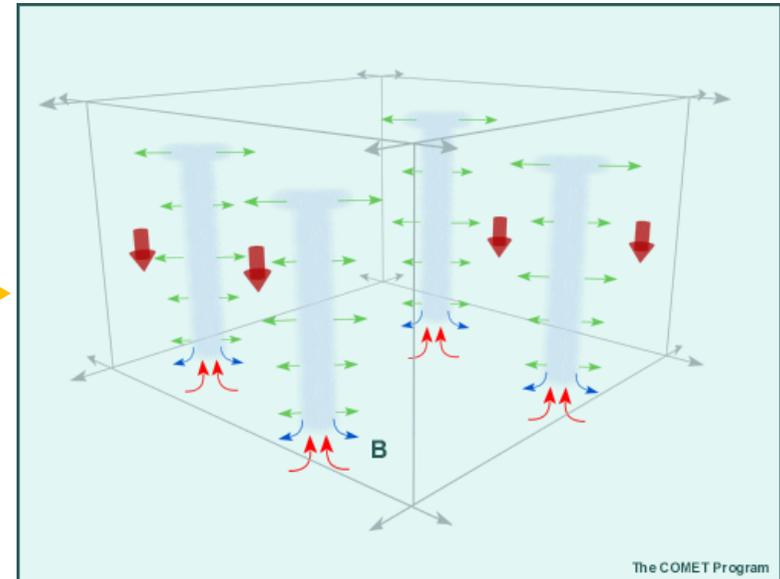
The complex topography and land/sea mix are a likely cause of many of the difficulties.

# Why are new measurements needed?

The main issue with our numerical models is the **parameterization of physical processes** related to the formation of clouds, moist convection, and precipitation.



parameterization



These parameterizations often critically depend on quantities that are difficult to measure, e.g. the **vertical distribution of convective mass flux** within **sub-grid scale plumes**.

We also need integrated measurements of the entire physical system (ocean and land surface states, fluxes into and out of the ocean and land, radiation, atmospheric waves) to understand the sensitivities and improve the model parameterizations.

The uniqueness of the MC's mix of ocean, land, topography and surface types, reduces the relevancy of the detailed observations that have been taken elsewhere (e.g. over the Pacific and Indian oceans). Satellite measurements also have problems.

# *RV Investigator sea-time proposal*

New research vessel: Operated by CSIRO as the "Marine National Facility" (MNF)

## Statistics:

93.9 m long, up to 300 days at sea per year (60 days max per voyage, 180 days funded) – 35 scientists

## Proposal status :

Reviews were excellent (maybe thanks to some of you !)

Proposal ranked 1<sup>st</sup> on scientific merit and team quality – national benefit review unknown

Sea time offer will be announced by end of March 2017

## Atmospheric instruments relevant to YMC:

Dual-pol C-band Doppler radar (MNF/BOM)

OceanRAIN ODM disdrometer (U. Hamburg)

Vertically-pointing Micro Rain Radar (TBC)

Cloud radar and cloud-aerosol lidar (BOM)

Microwave radiometer / profiler (BOM, TBC)

Radiative and air-sea fluxes (BOM/Uni Melb)

Atmospheric composition (CSIRO/Uni Melb)

Radiosonde ground station

Very detailed description of aerosols, CN, CCNs



## Oceanic measurements relevant to YMC:

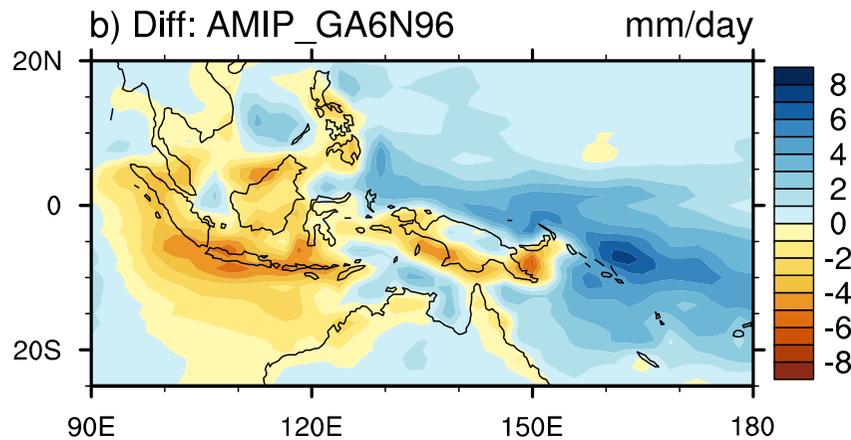
48-hour Triaxus; CTDs; LADCP; microstructure vertical profiler.

We are very open to hosting other scientists and their instruments on board. **Need to know soon !**

# What location for the RV Investigator?

From a **scientific perspective**, we would like to concentrate on a region that has both a strong diurnal cycle of precipitation, and with a large mean bias in models:

Model precipitation bias during DJF: GA6 – GPCP observations

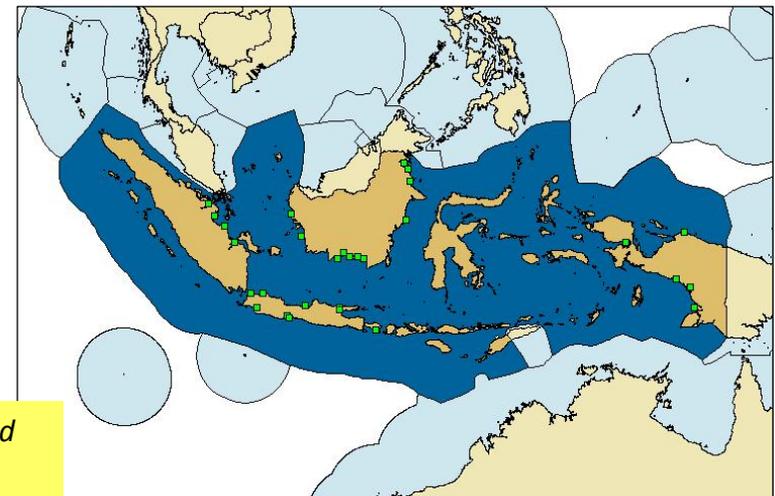


Amplitude of the diurnal harmonic of precipitation from TRMM



Ideally, the ship radar should be located about 50-70km offshore from a land-based radar and instrumentation, allowing for dual-Doppler analysis for 3D winds.

Logistics of taking observations in the Exclusive Economic Zone (EEZ) of other countries. BPPT in charge !



The EEZ of Indonesia (dark blue) and surrounding countries (light blue)

# Proposal for Australia's Research Vessel Contribution to YMC

(as submitted to the Marine National Facility in September 2016)

## Principal Investigators

Matthew Wheeler: Bureau of Met; Lead PI & atmospheric dynamics

Alain Protat: Bureau of Met; Alternate Lead PI & Radar science

Todd Lane: University of Melbourne; High-resolution atmospheric modelling

Robyn Schofield: University of Melbourne; Atmospheric chemistry

Susan Wijffels: CSIRO; Physical oceanography and Indonesian Throughflow

Christian Jakob: Monash University; Cumulus & related parameterizations

Robin Robertson: UNSW; Internal tides and ocean mixing parameterizations

Adrian Matthews: University of East Anglia; Sea-gliders in upper ocean

Toshiyuki Hibiya: University of Tokyo; Ocean mixing observations & modelling

Fadli Syamsudin: BPPT; Oceanography and Indonesian permit coordination

Ming-Jen Yang: National Taiwan University; Radiosondes & dynamics

Jason Monty: University of Melbourne; Eddy-covariance air-sea fluxes

Alex Johnson: University of Melbourne; Biogeochemical cycling observations

Damien Callahan: Deakin University; Halocarbon and elemental analysis

Lakshmi Kantha: University of Colorado; Atmospheric turbulence observations

Eric Schulz: Bureau of Meteorology; Surface meteorology & bulk fluxes

Charmaine Franklin: Bureau of Meteorology; Cloud physics and NWP

Zoran Ristovski: Queensland University of Technology; Aerosol microphysics

## Voyage Plan

Targeting November-December 2018

58 days total voyage time (Darwin to Darwin)

### **Bengkulu station (15+15 days)**

*Concentrating on radar observations of convection in collaboration with BMKG operational radar. 3-hourly radiosondes; cloud radar-lidar; ocean observations with Triaxus tows and CTD two-yos in small region; sea-gliders.*

### **Ombai and Lombok Straits (8 days)**

*Concentrating on observations of ocean internal waves, vertical mixing, and water mass transformations near sills. 48-hour Triaxus; CTDs; LADCP; microstructure vertical profiler.*

*Atmospheric chemistry, surface meteorology, and air-sea flux components to operate for entire voyage.*



RV Investigator – Australia's Marine National Facility

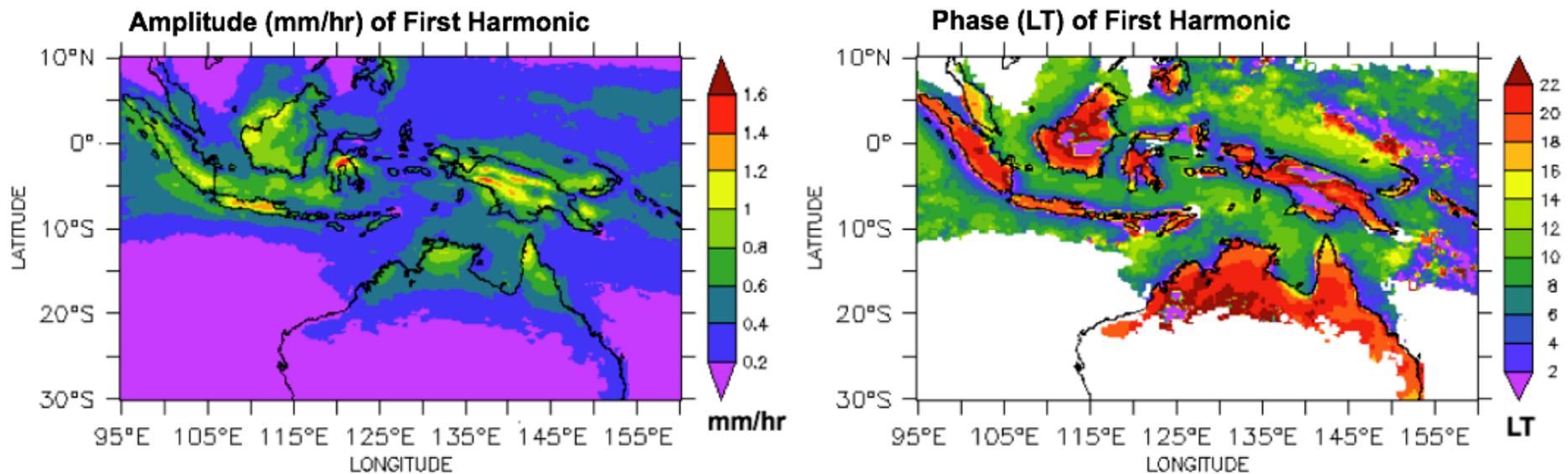


# Plan B: North coast of Australia

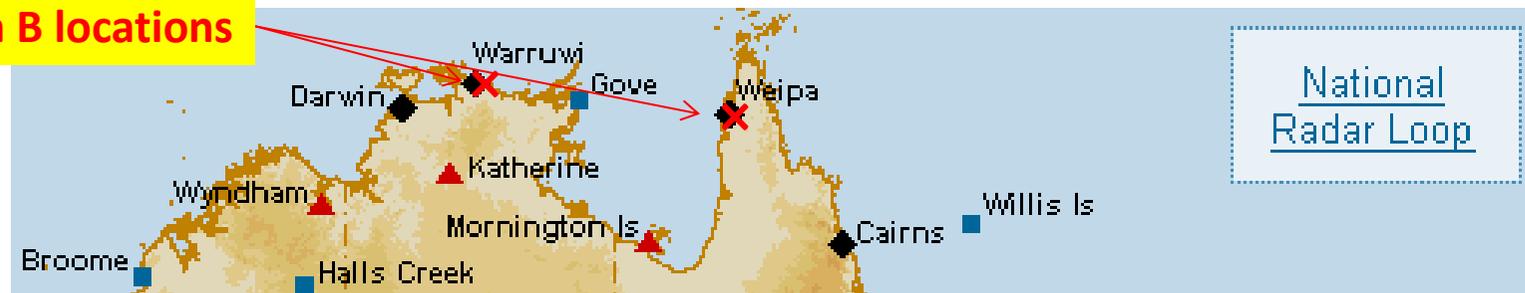
If we are denied entry to the Indonesian EEZ we plan to instead propose to go to a location about 50-70km off-shore from an existing operational radars in northern Australia (e.g. Warruwi or Weipa).

The offshore amplitude of the diurnal cycle is still large in these locations.  
We would still be welcoming scientists from other countries on board.

*Diurnal cycle analysis of 10 DJF seasons (1989-2010) of TRMM3B42 by Surendra Rauniyar*



## Plan B locations



## ***RV Investigator : Items for discussion***

Proposal heavily relies on **BMKG Bengkulu operational radar** for dual-Doppler analysis. Should we try to get a third radar (e.g., X-band polarimetric) to do triple-Doppler?

Radiosondes at Bengkulu : operational 2/day. Ship would have 4/day or 8/day. Is it possible to increase frequency at Bengkulu through YMC collaboration ?

### **Modelling component of Australian proposal presented by Todd Lane**

We can host additional instruments on the ship, potentially. Anyone interested ?  
Gaps : wind profiler, scanning wind lidar

**Thanks !**

**Alain Protat**

Australian Bureau of Meteorology

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