

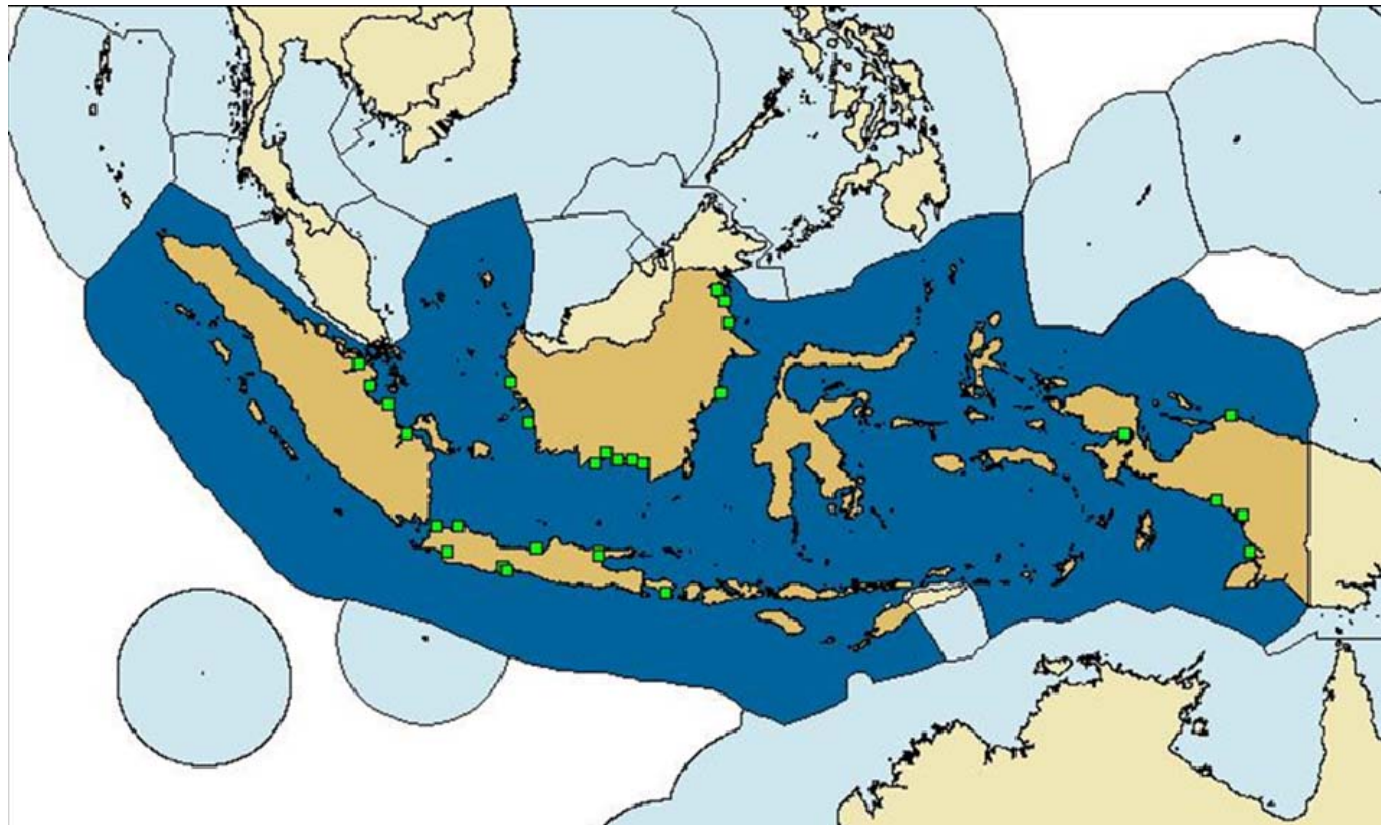
# RV Investigator cruise during Oct-Dec 2019

Matthew Wheeler<sup>1</sup>, Alain Protat<sup>1</sup>, Fadli Syamsudin<sup>2</sup>, and Urip Haryoko<sup>3</sup>

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# A "Granted Voyage" on *RV Investigator*



Project title: **Maritime Continent observations of atmospheric convection, biogenic emissions, ocean vertical mixing, and the Indonesian Throughflow**

Dates: 19 October to 18 December 2019

Project berths: 28 (1 of these for Indonesian Security Officer)

<u>Chief Scientist:</u>	<u>Leg 1 (~1 month)</u> Alain Protat	<u>Leg 2 (~1 month)</u> Susan Wijffels
<u>Deputy Chief Scientist:</u>	Susan Wijffels	Matthew Wheeler



# RV Investigator cruise – Plan A

## Principal Investigators

Matthew Wheeler: Bureau of Met; Co-lead PI & atmospheric dynamics  
Alain Protat: Bureau of Met; Co-lead PI & radar science  
Todd Lane: University of Melbourne; High-resolution atmospheric modelling  
Robyn Schofield: University of Melbourne; Atmospheric chemistry  
Susan Wijffels: CSIRO/WHOI; Oceanography and Indonesian Throughflow  
Robin Robertson: Xiamen University; Internal tides and mixing parameterization  
Fadli Syamsudin: BPPT; Oceanography and Indonesian permit coordination  
Urip Haryoko: BMKG; Bengkulu radar and land-based observations  
Christian Jakob: Monash University; Cumulus & related parameterizations  
Zhiyu Liu : Xiamen University; Ocean mixing observations & modelling  
Po-Hsiung Lin: 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  
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  
Mei Zheng: Peking University; Aerosols

## Voyage Plan

19 October – 18 December 2019

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. 4-hourly radiosondes; cloud radar-lidar; ocean observations with Triaxus tows and CTD tow-yos in small region.*

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

*Concentrating on observations of ocean internal waves, vertical mixing, and water mass transformations near sills. 25-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





# Collaboration with Indonesia (Plan A)

- Australia to support at least 5 Indonesian scientists or students on board the ship.
- Indonesia to provide staff, radiosondes, and radars at multiple ground sites, and some instrumentation on the ship.
- Opportunities for Indonesian students and early-career scientists to attend University training in Australia.
- Australia to host three Indonesian scientists for 1 month visits to work on cruise data at BoM, CSIRO, and Melbourne University.
- Ultimately the project will lead to co-authored journal papers, more highly-trained scientists, and greater knowledge for better prediction of our weather and climate.



## Updates and recent progress

- Alain Protat is currently working on the detailed voyage plan, including the names of voyage participants.
- We have funding for radiosondes from the Bureau (~110 sondes), Monash University (~110 sondes), National Taiwan University (~60-100), University of Auckland (~17), and UNSW (~17).
- Christmas island half-way stop-over changed to Jakarta due to Australian customs and immigration issues at Christmas Island.
- All seagliders, ocean floats, and ocean drifters have been removed from the cruise.
- Still working on an Implementation Agreement (IA) with BMKG. The IA is a necessary step in getting a Research Permit and then Security Clearance.
- We are fast approaching our deadline date of switching to Plan B, which is to cruise around northern Australia.
- Meanwhile, we have been assisting Adrian Matthews with contacts and access to Christmas Island for seaglider launches and a Terra Maris ground site.

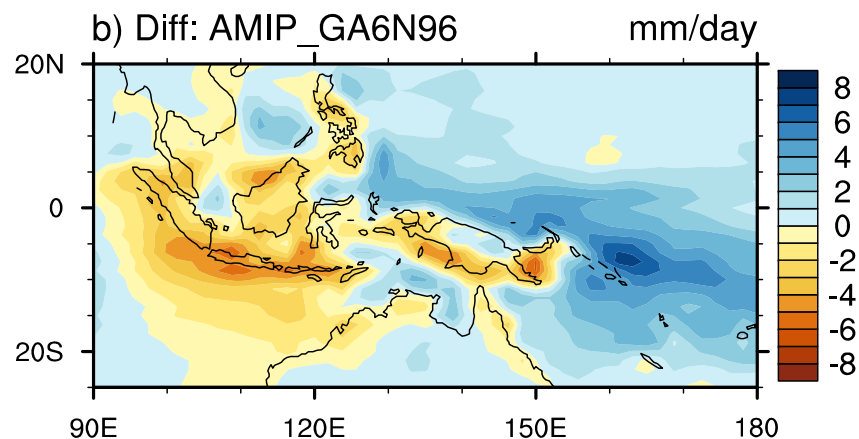
## Plan A route



## Plan B route (If we don't have permission to enter Indonesia)

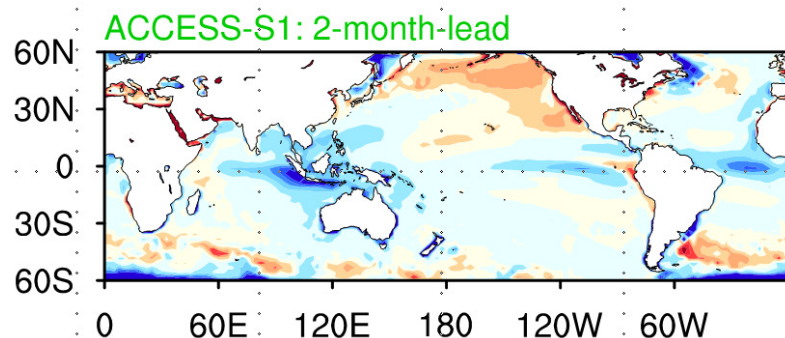
The voyage participants and instruments remain the same with the two different plans.





- Current models also have difficulty simulating the large amplitude **diurnal cycle** of precipitation.

*Climatological amplitude of the diurnal harmonic of precipitation rate from TRMM 3B42HQ during Nov-Apr (Peatman et al. 2014)*



- 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.

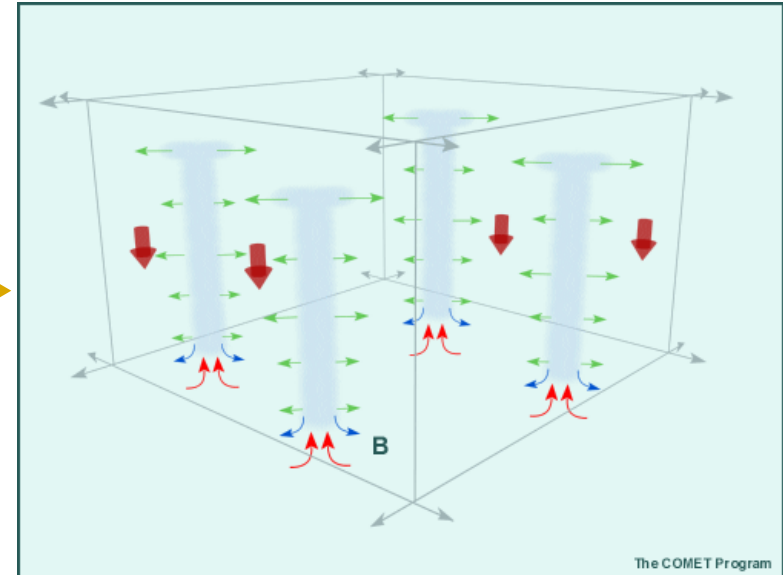


# Why are new measurements needed?

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.



For the best science we are still hoping for Plan A.

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