Interaction of convection over the SCS-MC with large-scale motion

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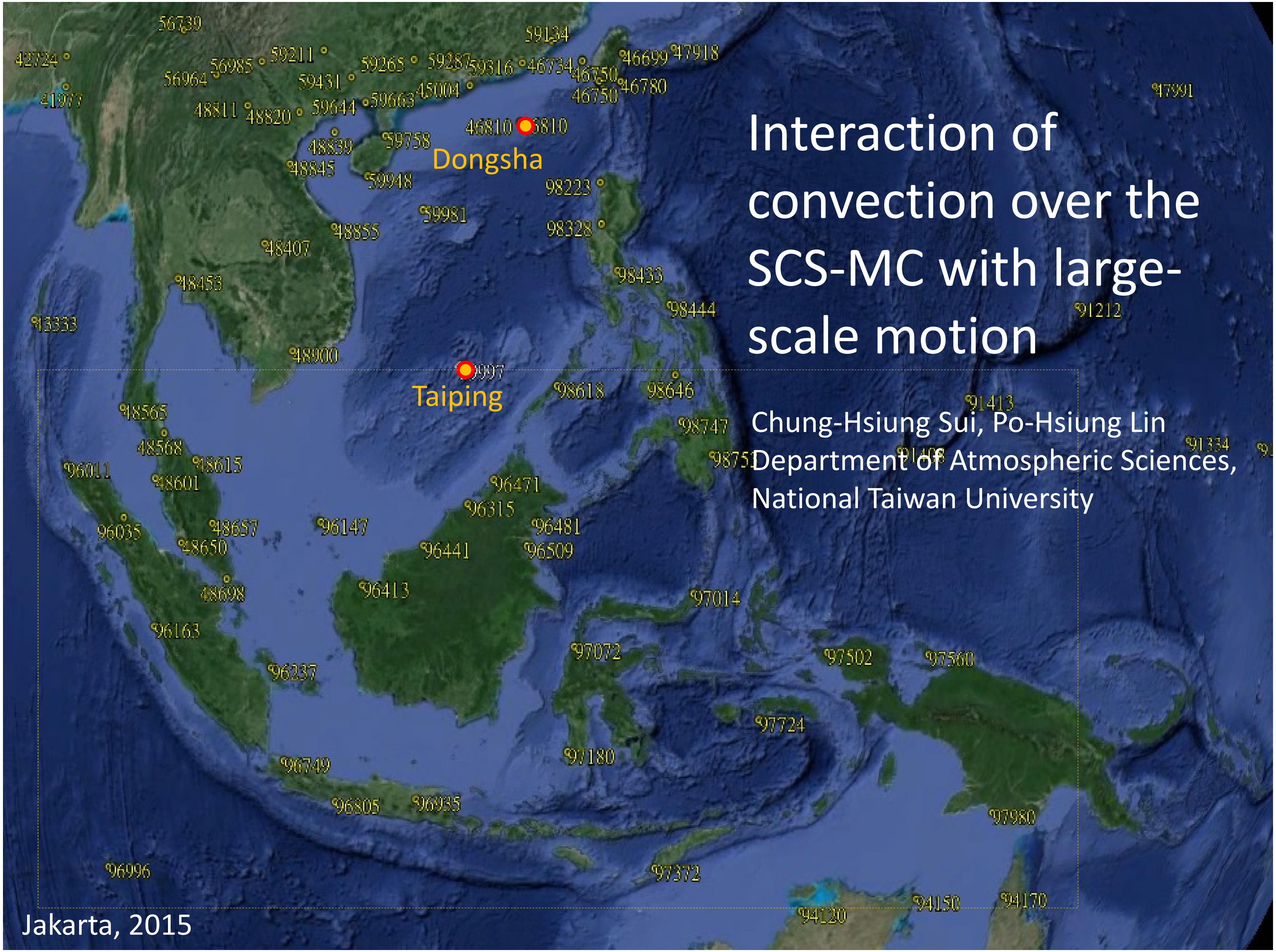
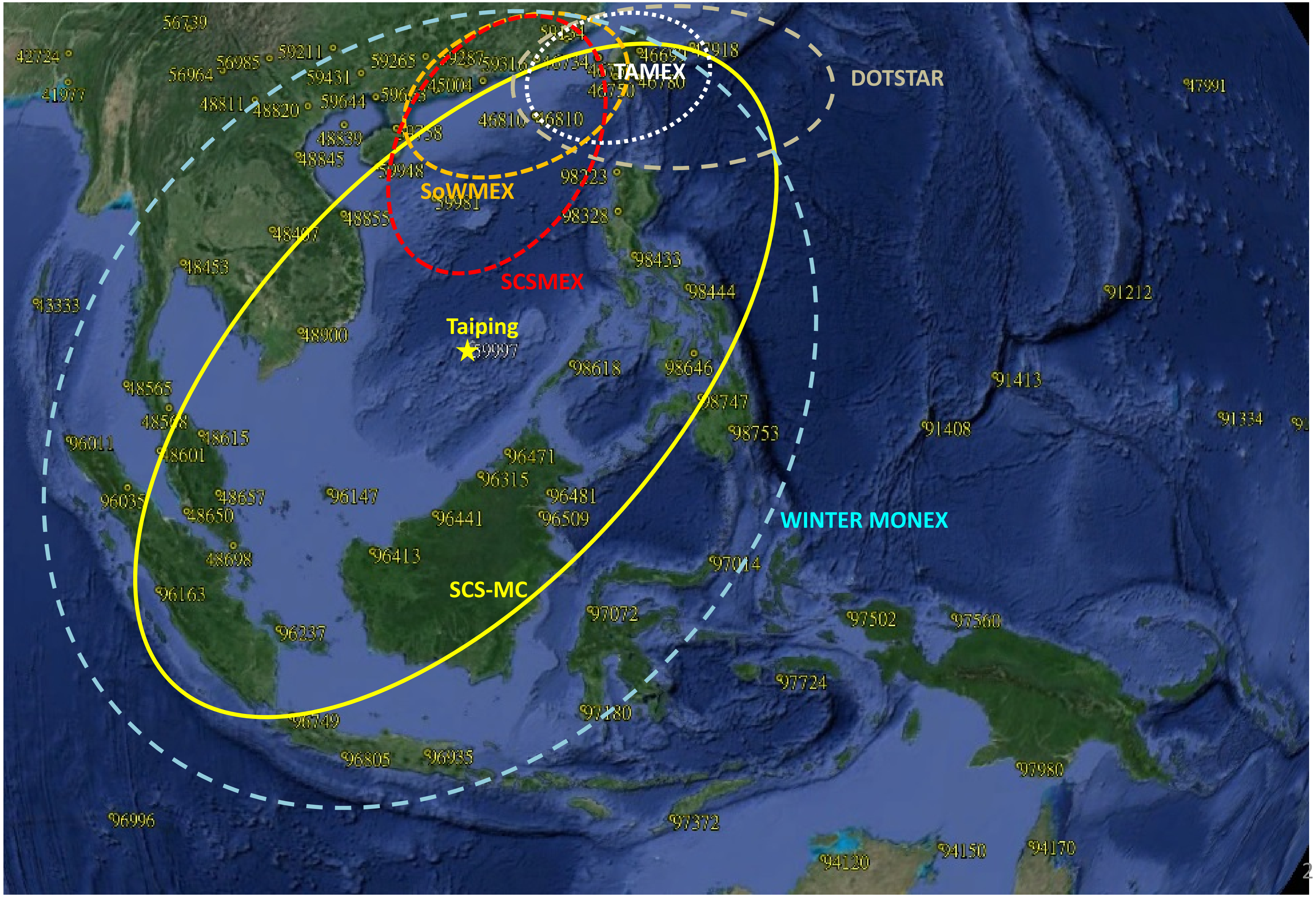


Jakarta, 2015

The field experiments related to South China Sea western Pacific region (fund by MOST)

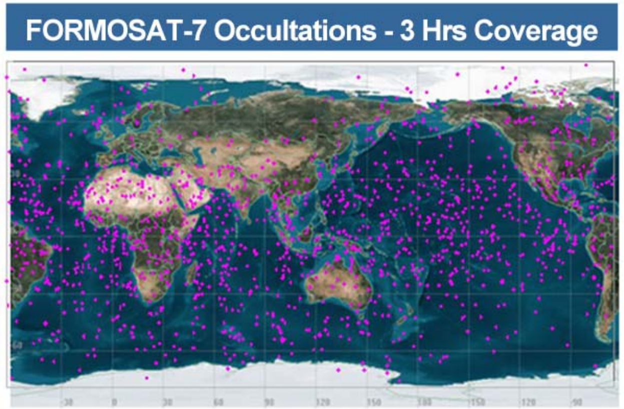
1978-1979 WINTER MONEX; 1987 TAMEX;   1998 SCSMEX; 2003-2009 DOTSTAR; 2008 SoWMEX

Proposed **2016-2019 SCS-MC**



Goal

- To carry out long-term regular and intensive observations at Taiping and Dongsha
- To participate YMC observations and to share the SCS observations for collaborative studies
- Integrate in-situ, satellite (including Formosat-7) measurements, and numerical modeling, to enhance monitoring and forecasting capacity of weather and climate over MC-SCS-Taiwan and neighboring region

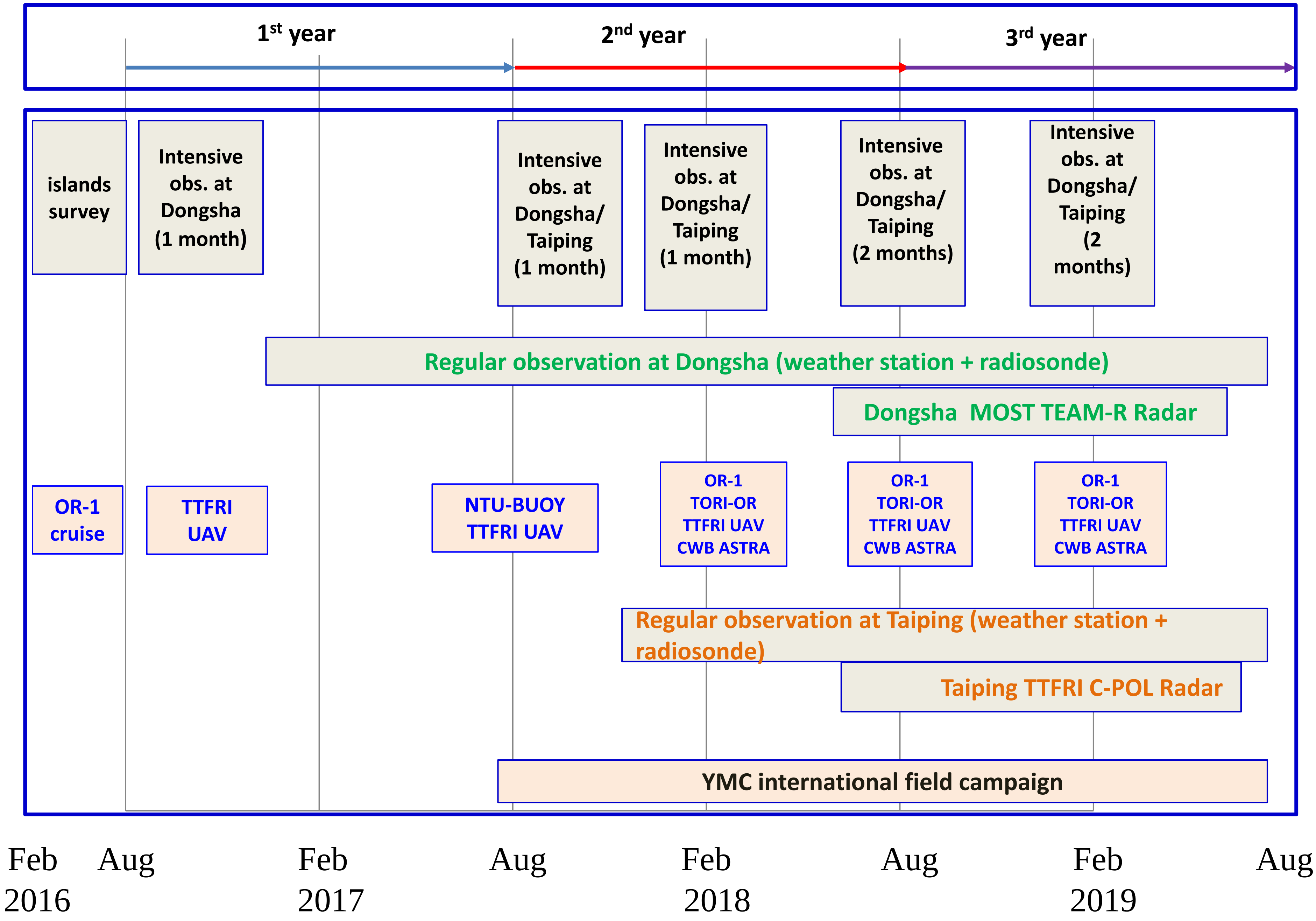


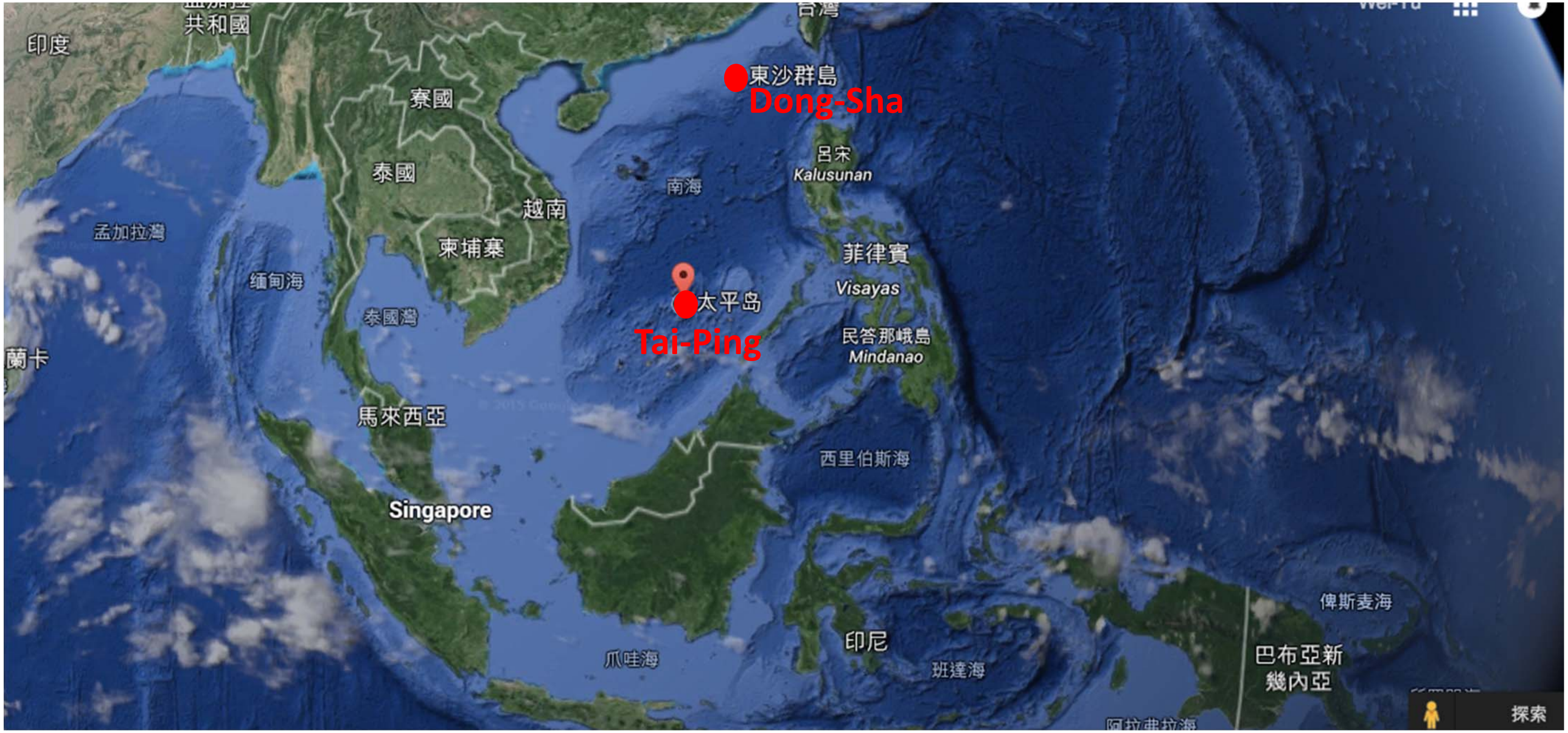
12-satellites are planned to be launched and deployed in two clusters of 6-satellites into the designated low and high inclination orbits in 2016 and 2018, respectively. (NSPO)

TORI new RV (2017)

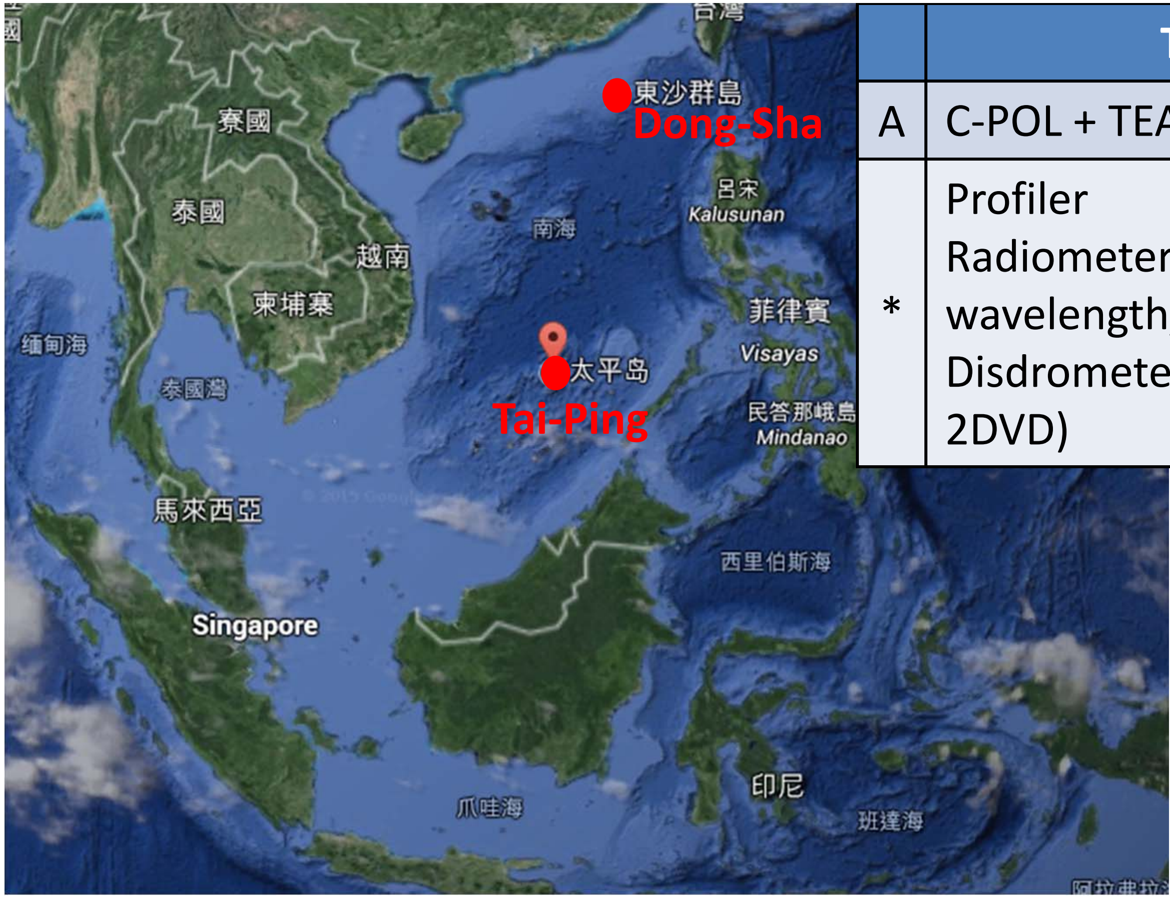
NTU BUOY

Proposed time schedule of SCS-MC observation activities





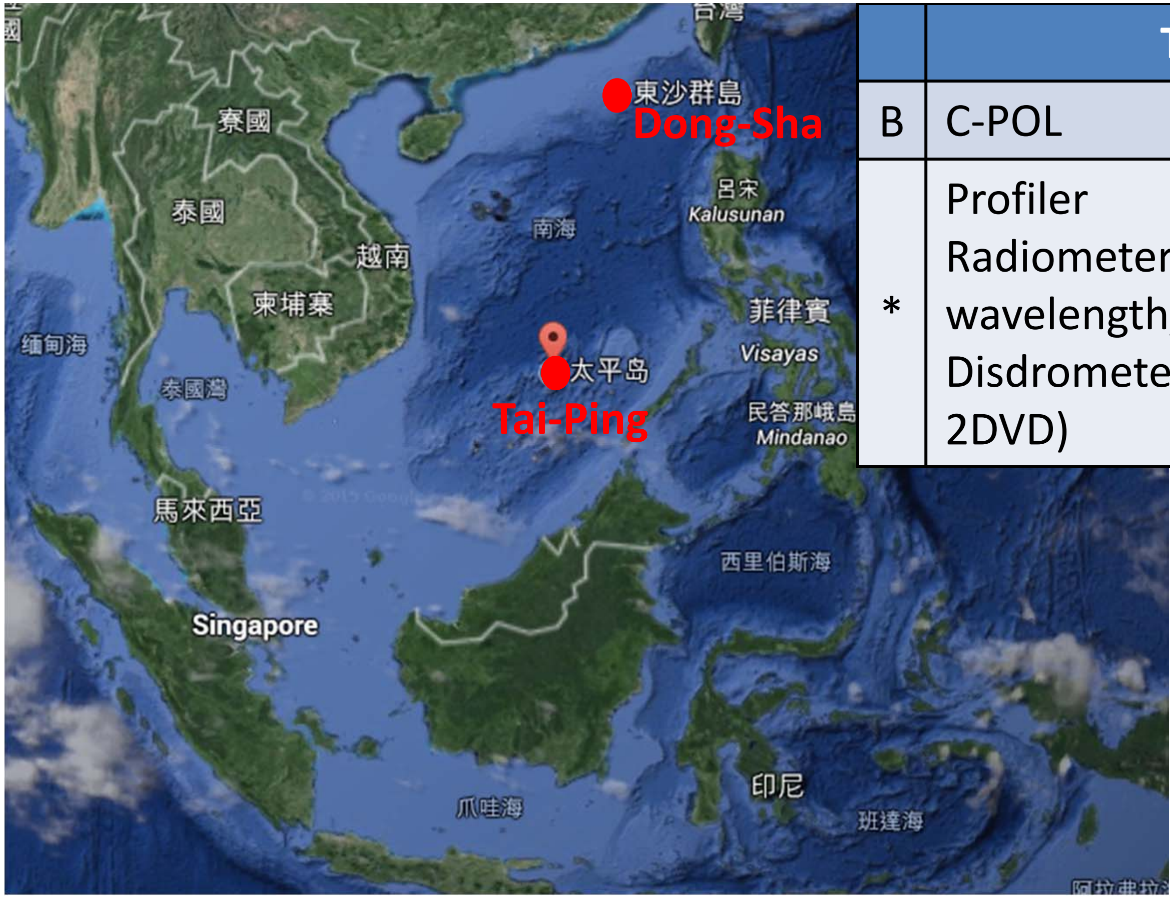
	Tai-Ping	Dong-Sha
A	C-POL + TEAM-R	
B	C-POL	TEAM-R
C	TEAM-R	
*	Profiler Radiometer (daul-wavelength/pol) Disdrometer(PARSIVAL, 2DVD)	Profiler Disdrometer (JWD)



	Tai-Ping	Dong-Sha
A	C-POL + TEAM-R	
*	Profiler Radiometer (daul-wavelength/pol) Disdrometer(PARSIVAL, 2DVD)	Profiler Disdrometer (JWD)

Plan A

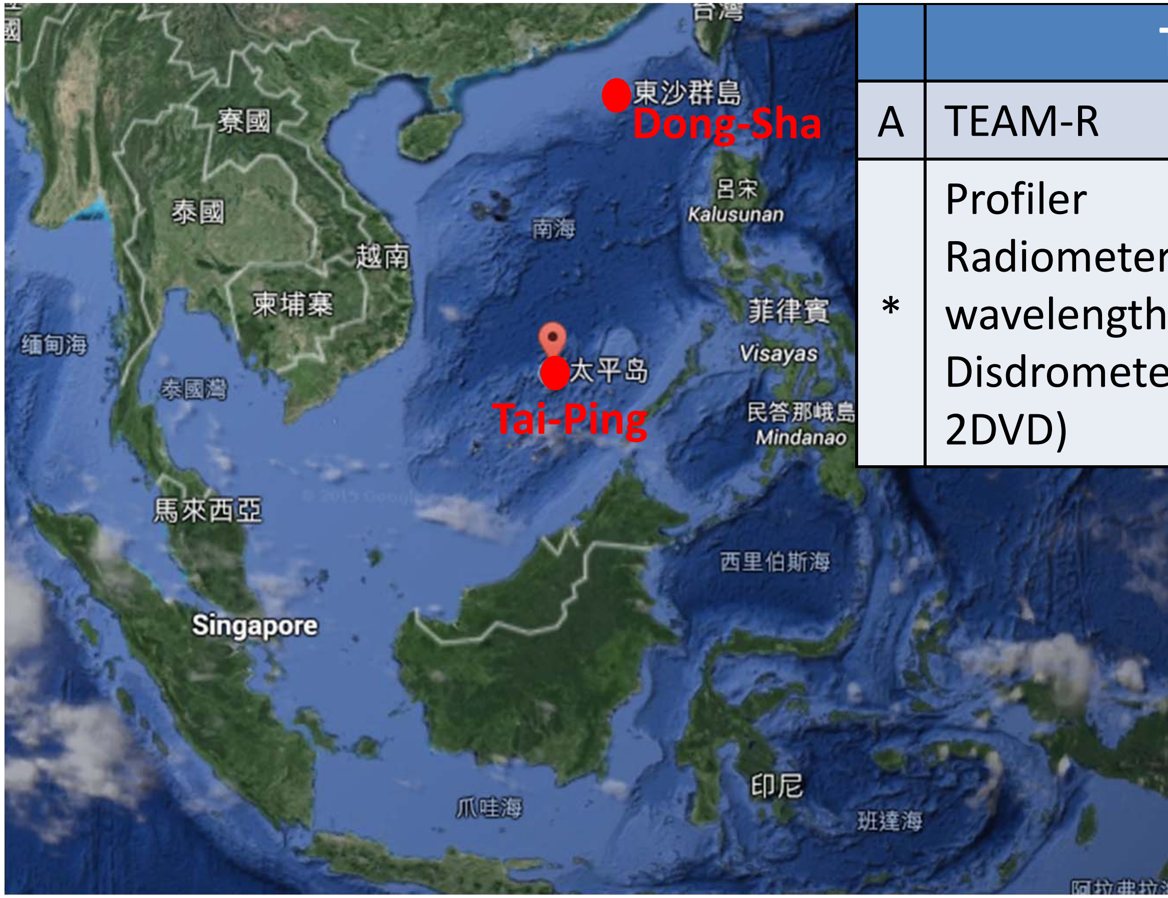
1. **The spatiotemporal structure of precipitation systems over SCS-MC**
2. **The microphysical characteristics and precipitation efficiency of convection systems over SCS-MC**
3. **Improve the accuracy of the radar-based quantitative precipitation estimation**
4. **Obtaining the kinematic, thermodynamic, water vapor fields using advanced retrieval technique.**
5. **Provide ground validation data for radar (dual-pol) and satellite (GPM) retrievals.**
6. **Provide validation data for cloud-resolving numerical model simulation**



	Tai-Ping	Dong-Sha
B	C-POL	TEAM-R
*	Profiler Radiometer (daul-wavelength/pol) Disdrometer(PARSIVAL, 2DVD)	Profiler Disdrometer (JWD)

Plan B

1. **The spatiotemporal structure of precipitation systems over SCS-MC**
2. **The microphysical characteristics and precipitation efficiency of convection systems over SCS-MC**
3. **Improve the accuracy of the radar-based quantitative precipitation estimation**
4. **Obtaining the kinematic, thermodynamic, water vapor fields using advanced retrieval technique.**
5. **Provide ground validation data for radar (dual-pol) and satellite (GPM) retrievals.**
6. **Provide validation data for cloud-resolving numerical model simulation**



	Tai-Ping	Dong-Sha
A	TEAM-R	
*	Profiler Radiometer (daul-wavelength/pol) Disdrometer(PARSIVAL, 2DVD)	Profiler Disdrometer (JWD)

Plan C

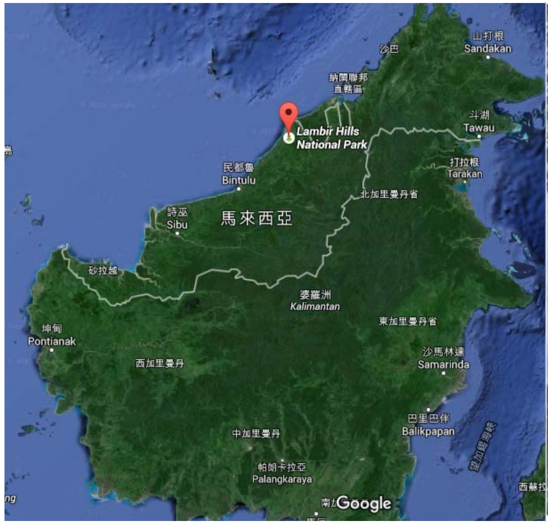
1. **The spatiotemporal structure of precipitation systems over SCS-MC**
2. **The microphysical characteristics and precipitation efficiency of convection systems over SCS-MC**
3. **Improve the accuracy of the radar-based quantitative precipitation estimation**
4. **Obtaining the kinematic, thermodynamic, water vapor fields using advanced retrieval technique.**
5. **Provide ground validation data for radar (dual-pol) and satellite (GPM) retrievals.**
6. **Provide validation data for cloud-resolving numerical model simulation**

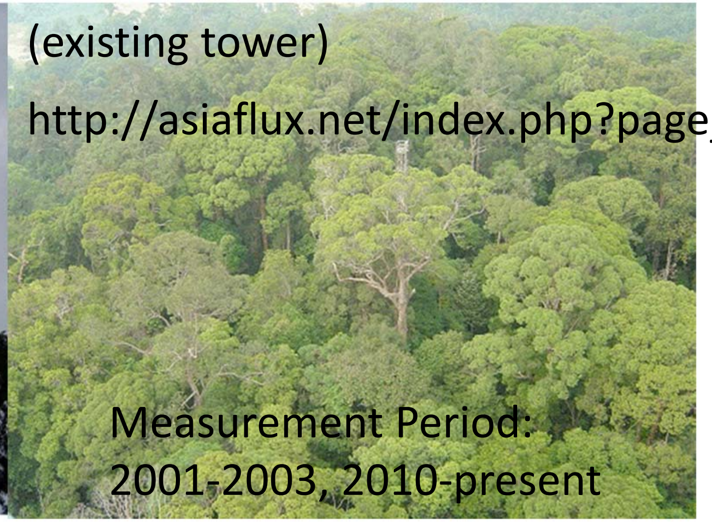
	Tai-Ping	Dong-Sha
A	C-POL + TEAM-R	
B	C-POL	TEAM-R
C	TEAM-R	

	A	B	C
The spatiotemporal structure of precipitation systems over SCS-MC	5	5	2
The microphysical characteristics and precipitation efficiency of convection systems over SCS-MC	5	3	1
Improve the accuracy of the radar-based quantitative precipitation estimation	5	3	2
Obtaining the kinematic, thermodynamic, water vapor fields using advanced retrieval technique.	5	5	2
Provide ground validation data for radar (dual-pol) and satellite (GPM) retrievals.	5	3	3
Provide validation data for cloud-resolving numerical model simulation	5	5	3

A proposed Joint YMC field project-1

To study the influence of the natural forest conversion to oil palm on surface water and energy fluxes over Borneo **(Min-Hui Lo & Tomonori Kume)**

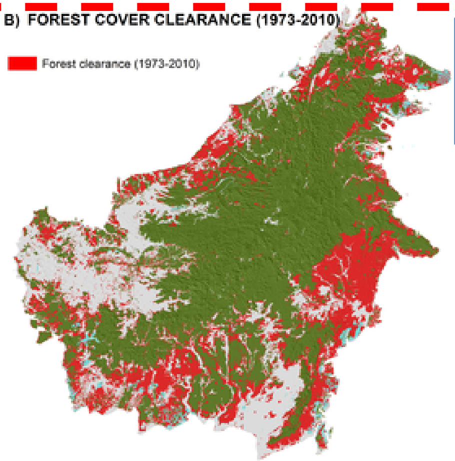




(existing tower)

http://asiaflux.net/index.php?page_id=76

Measurement Period:
2001-2003, 2010-present

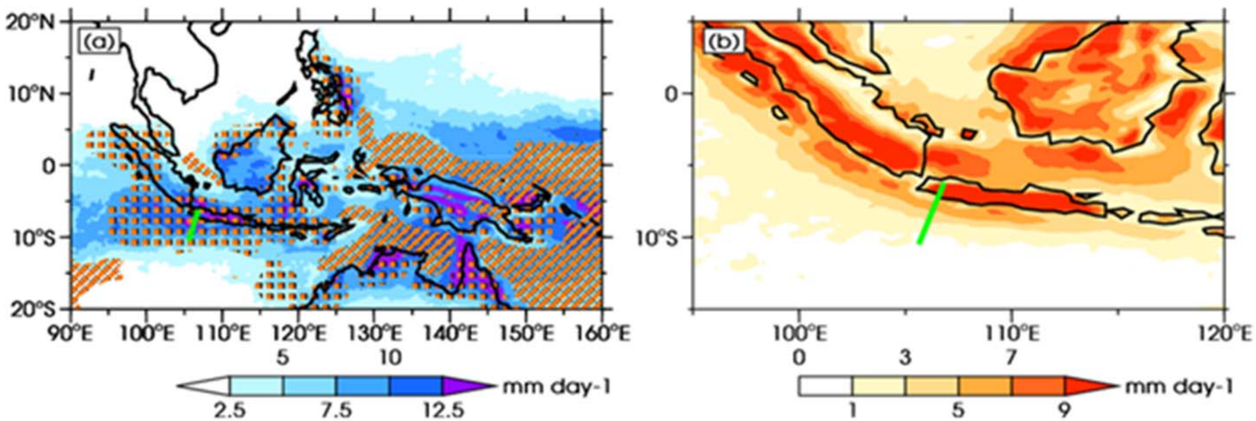


deforestation

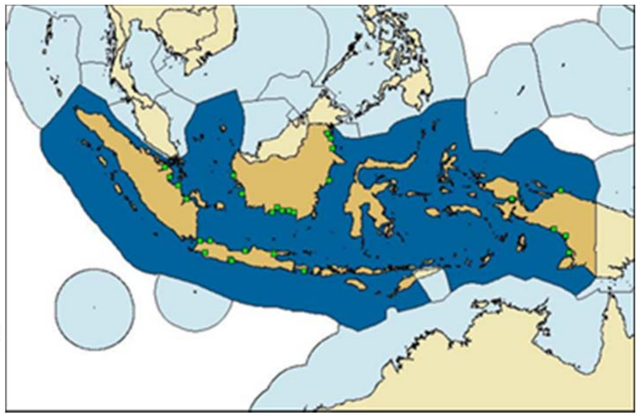
1. An existing cite is maintained by Prof. Tomo Kume from School of Forestry and Resource Conservation, NTU, and we propose to measure more variables (soil water fluxes and radiation) over this site.
2. Since Prof. Kume's site is over the natural forest region, we also propose to install another one over oil palm regions if possible.
3. To compare the differences between the sites, we should be able to explore how such deforestation affects the local energy and water cycle, and thus the atmospheric boundary layer development changes .

A proposed joint YMC field project-2 onboard R/V Investigator

we plan to have the Investigator located on the line between Christmas Island (Australian territory) and Java (green line in figures below) during the same period that the UK partnership (Met Office and University of East Anglia) plan to have their aircraft and seagliders/wavegliders in the region, sometime in the period of late 2018 to early 2019. The exact time depends on both the UK proposal (to NERC) as well as our own proposal to the Australian Maritime National Facility (MNF). The UK side wish to deploy a portable radiosonde launcher on Christmas Island (BoM only has surface met there), but we are still lacking a source for radiosondes from the ship. Besides the lack of radiosondes on the Investigator, the other instrumentation on the ship is very extensive, including an advance dual-POL radar. See here: http://mnf.csiro.au/Vessel/Investigator-2014/Equipment.aspx



(a) Observed mean precipitation for Feb (shading), and Met Office climate model error (squares below -2 mm day^{-1}. diagonal shading above +2 mm day^{-1}) over the MC. (b) Amplitude of diurnal harmonic of observed precipitation over Java region. Green lines shows the proposed 400 km flight transect from Jakarta to Christmas Island



EEZ zones of Indonesia and surrounding countries – Australian zone around Christmas Island.

Interaction of convection over the SCS-MC with large-scale circulation

Large scale Processes

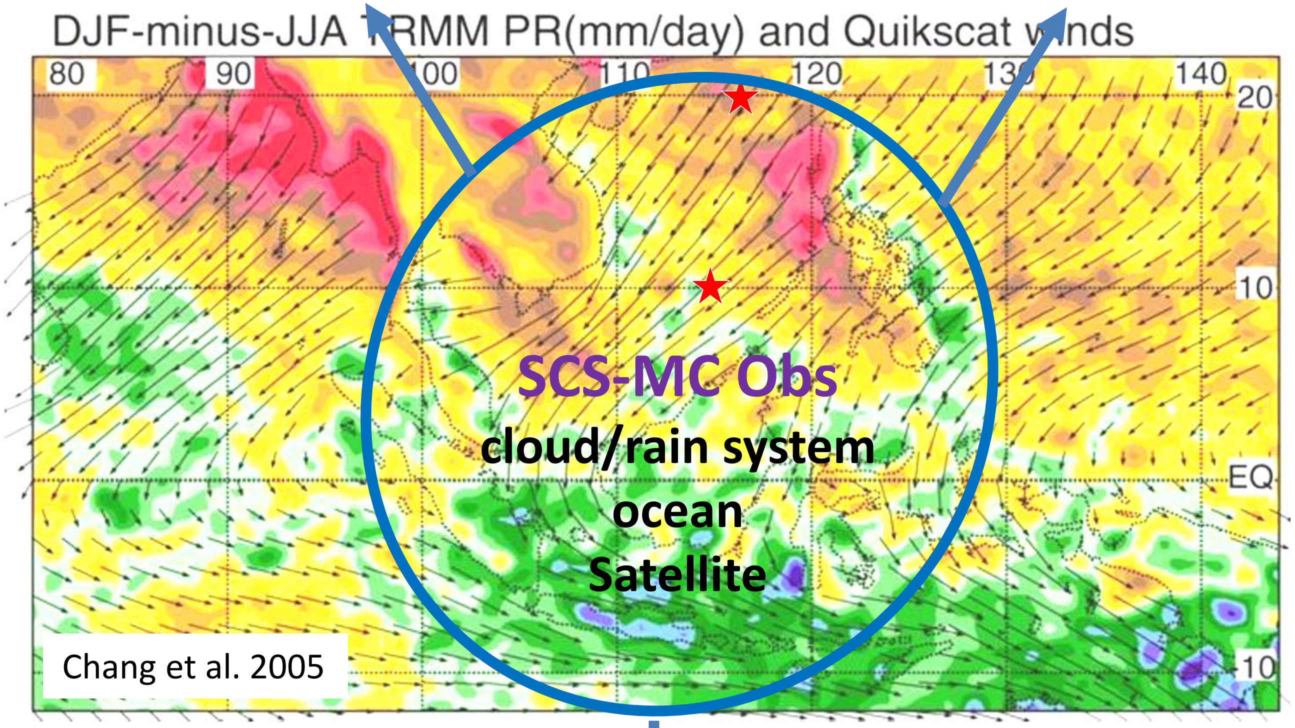
Siberia-H & tropical interaction
Development of SW monsoon and tropical disturbances

Interaction

Extreme weather in Taiwan & neighboring areas

A-S/conv processes

GCM vs. diurnal conv
Convective system modeling



YMC: 1. Land-air observation over Borneo
2. RV Investigator radio sounding

Proposed Research Tasks (PIs)

1. Winter midlatitude-tropical interactions (張智北、游政谷、 劉清煌) *To study boreal winter midlatitude-tropical interactions associated with the MC convection at the synoptic and intraseasonal scales, and their possible relationships with longer time scales.*

2. Intraseasonal variability in water and energy cycle (隋中興) *To study the initiation and evolution of intraseasonal oscillations over the Indian Ocean and Maritime Continent and their downstream influences*

3. ISO-TC Interactions in the SCS-MC (陳昭銘） *To study the interactions between intraseasonal oscillation and tropical cyclone activities in the SCS-MC and associated rainfall regional variability*

4. Convection interactions in the SCS-MC (楊明仁) *To study the cloud dynamics processes for convective system interacting with the East Asian monsoon flow over the SCS-MC region.*

5. Diurnal Variability over SCS and its representation in global models (陳維婷、吳健銘) *To study the climate characteristics of diurnal variability of cloud and convection over SCS and their representation in global climate models.*

6. Radar-satellite observations and Convection Processes (廖宇慶、陳台琦、林沛練、鳳雷、鍾高陞、張偉裕) *To observe and analyze statistical and dynamic characteristics of precipitating clouds by X-band and C-Band polarimetric radars in SCS, and to study cloud microphysical and dynamical processes*

7. Characterization of water vapor and clouds over SCS using passive microwave radiometer (侯昭平) *To observe water vapor, rain and cloud LWPs of precipitating clouds by passive radiometer at Nansha*

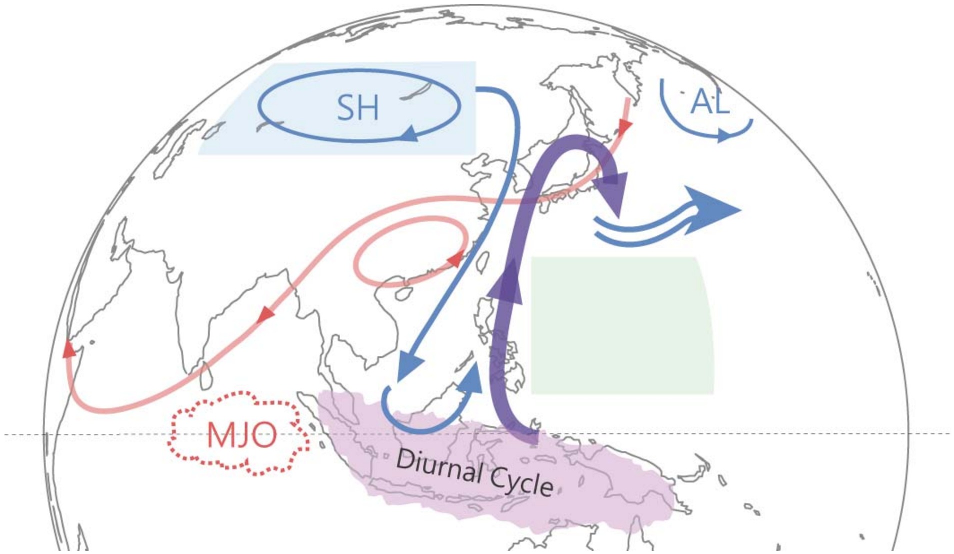
8. Next generation satellite observations of SCS Convection Processes（劉千義） *To study cloud properties from Himawari-8/9 measurements (16 visible-IR channels, 500 m to 2 km & 10-min resolution)*

9. Air-Sea Interaction in the South China Sea and its connectivity with MC (詹森、楊穎堅、張明輝) *To study the influence of air-sea interaction on typhoons and monsoon in the SCS using in situ measurements at Nansha, Dongsha, SEATS (1998-2007), R/V OR1 (1985-2012) & existing ocean-atm reanalysis, and to monitor global warming and ocean acidification in the SCS*

S1: Siberia High and SCS-MC convection

To study boreal winter midlatitude-tropical interactions associated with the MC convection at the synoptic and intraseasonal scales, and their possible relationships with longer time scales

(張智北, 游政谷, 劉清煌)



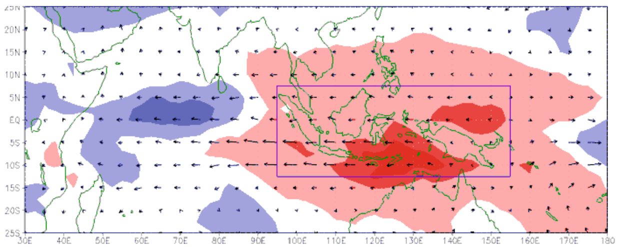
Specific questions:

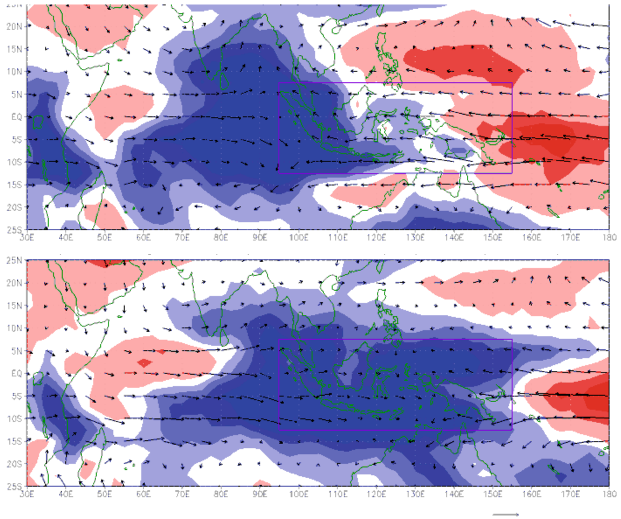
- While the influence of Siberian High (SH) on MC convection through the synoptic scale cold surges in the SCS is known, is there also a longer time scale relationship beyond the synoptic scale, i.e., intraseasonal, seasonal, and longer, between SH and tropical weather in the SCS and the Maritime Continent?
- How does the different convective forcing – initiated or associated with cold surges, Borneo vortex, and MJO – feedback to the East Asian Jet (EAJ)? how does the feedback influence the East Asian Major Trough (EAMJ)?

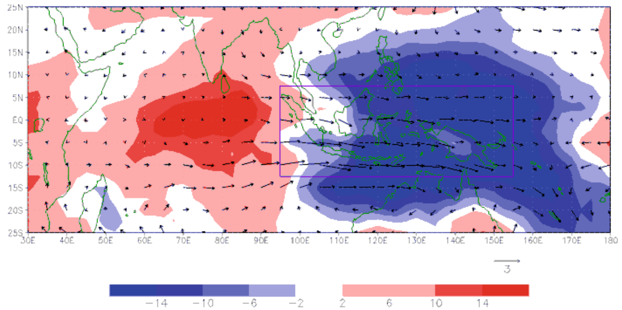
S2: Intraseasonal variability in water and energy cycle

To study the initiation and evolution of intraseasonal oscillations over the Indian Ocean and the MC and their influences on extreme weather over SCS, Taiwan and neighboring areas

（隋中興 ）





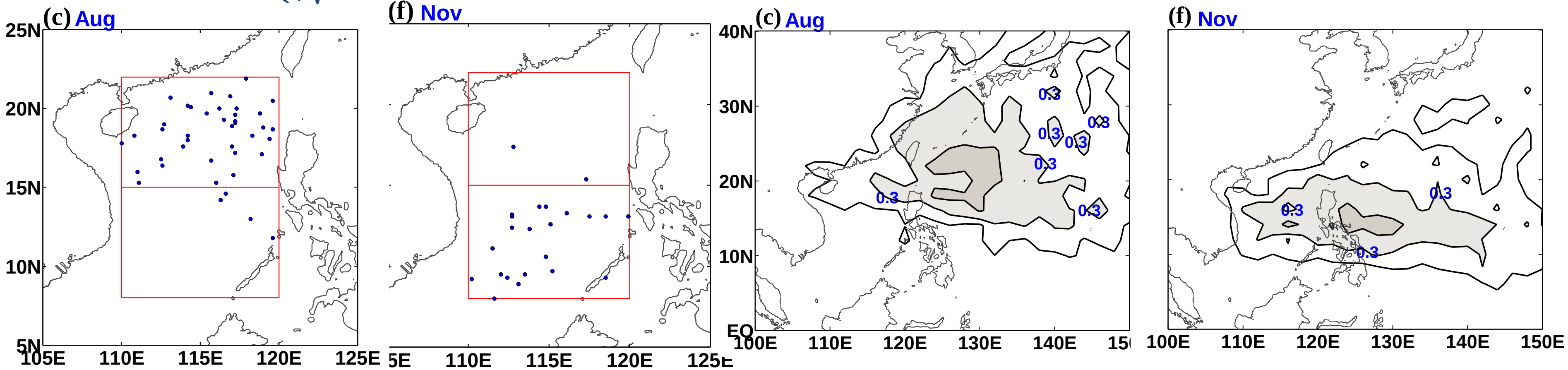


Specific questions:

- *What is the relative importance of horizontal advection of moisture by different large-scale (monsoon, ISO, and higher-frequency) flow to the air-sea fluxes in the evolution of the MC convection?*
- *Why are the past studies about northward propagation of BSISO over SCS-MC different? Two major factors are hypothesized: one is due to the different monsoon flow, i.e. the SCS monsoon from late May to Mid-July and the NWP monsoon that the BSISO moves into; the other is due to different scales of intraseasonal signals, i.e. 30-60 day vs 10-20 days*

S3: ISO-TC Interactions in the SCS-MC

To study the interactions between Intraseasonal oscillation propagations and tropical cyclone activities in the SCS-MC and associated rainfall variability in Taiwan （陳昭銘）

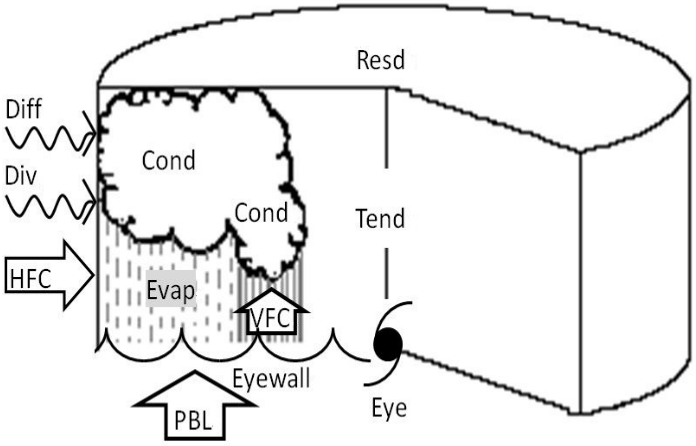


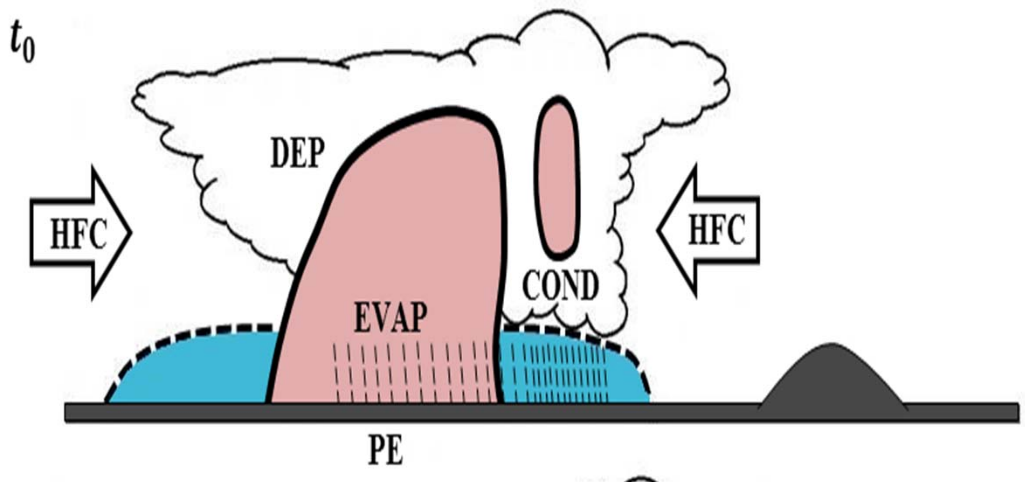
Specific questions:

- *What are the propagation features of intraseasonal oscillation (30-60-day, 10-20-day) associated with different tropical cyclone activities (in situ formation vs. passage from the western Pacific) in the SCS-MC regions?*
- *Why are the seasonal variability of ISO-TC interactions among difference monsoon seasons ? Specifically, SCS monsoon during May-June, East Asian monsoon during July-September, Northeast monsoon during October-December.*
- *What are rainfall variability features in Taiwan associated with different ISO-TC interactions in terms of variability of TC passage frequency from the western Pacific toward the SCS or Taiwan? What are the associated large-scale regulating processes?*

S4: Convection interactions in the SCS-MC

To study the dominant cloud dynamics processes for convective system interacting with the East Asian monsoon flow over the SCS-MC and surrounding topography **(楊明仁)**





Specific questions:

- 1) What are the differences of water cycle and precipitation efficiency in different weather systems (typhoons, MCSs, and MJO convective systems) over the SCS-MC and surrounding topography?
- 2) How does the convective regime shift from the oceanic convective system over the southwesterly flow in the SCS-MC to southern Taiwan?
- 3) How does the dominant cloud dynamical processes change along the “atmospheric river” within the southwesterly flow from the SCS-MC to southern Taiwan?

How the special observational data can help address the scientific questions in S3?

S3. ***To study the dominant cloud dynamics processes for convective system interacting with the East Asian monsoon flow over the SCS-MC and surrounding topography***

Observational data to address the specific questions:

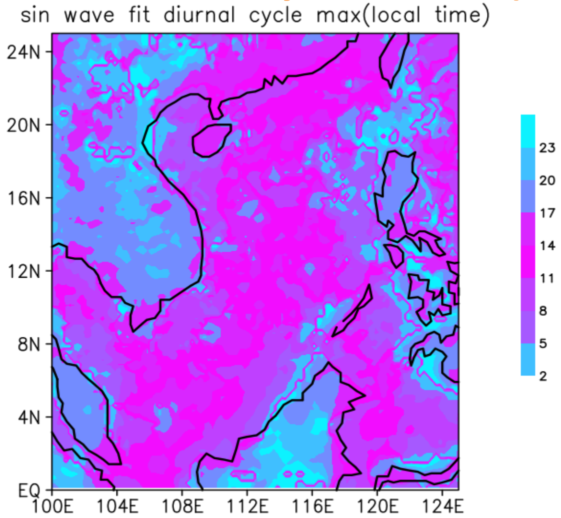
- 1) What are the differences of water cycle and precipitation efficiency in different weather systems (typhoons, MCSs, and MJO convective systems) over the SCS-MC and surrounding topography?
- => The **moisture profile from sounding and wind and precipitation data from radar** can be used to calculate the water budget and precipitation efficiency in different weather systems over the SCS-MC.
- 2) How does the convective regime shift from the oceanic convective system over the southwesterly flow in the SCS-MC to southern Taiwan?
- => The **radar and satellite (GPM) data** over the SCS-MC and southern Taiwan can be used to distinguish the convective regime and stratiform regime, thus to understand the convection regime shift along the southwesterly flow from the SCS to southern Taiwan.
- 3) How does the dominant cloud dynamical processes change along the “atmospheric river” within the southwesterly flow from the SCS-MC to southern Taiwan?
- => The **sounding and satellite (OLR) data** over the SCS-MC can be used to determine the convection propagation in different MJO phases (Wheeler and Hendon; 2004)

S5: Diurnal Variations of Moist Processes over the SCS and Their Representation in Global Models

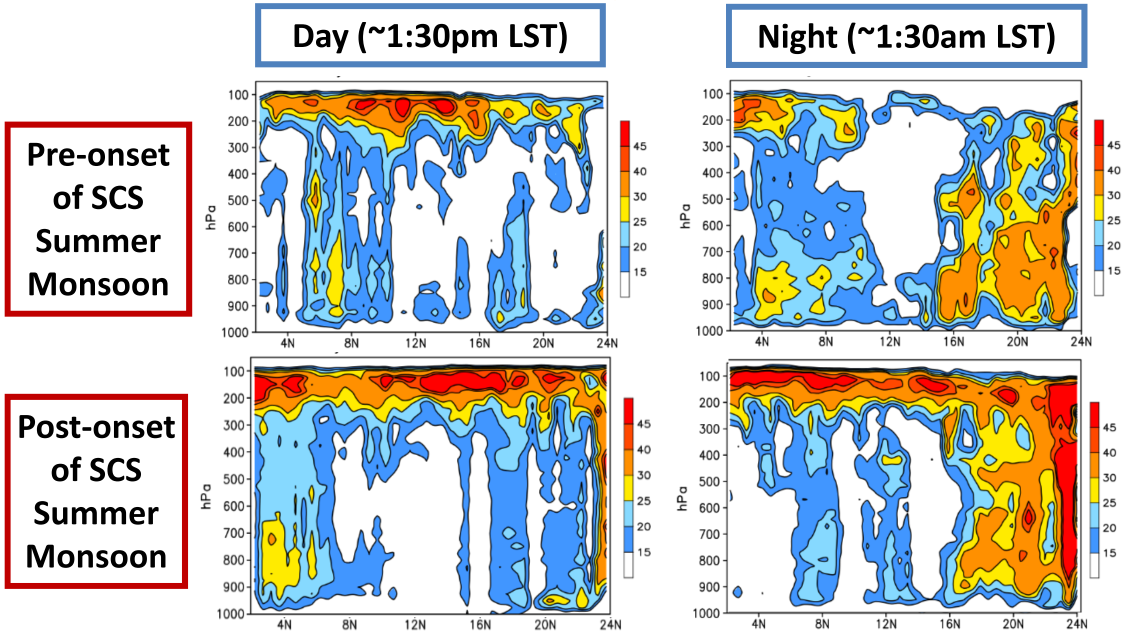
To study the climate characteristics of diurnal variability of cloud and convection over SCS and their representation in global climate models.

(陳維婷, 吳健銘)

TRMM Diurnal Cycle Rainfall (2007)



Vertical Cloud Fraction (CloudSat+CALIPSO, 2007)

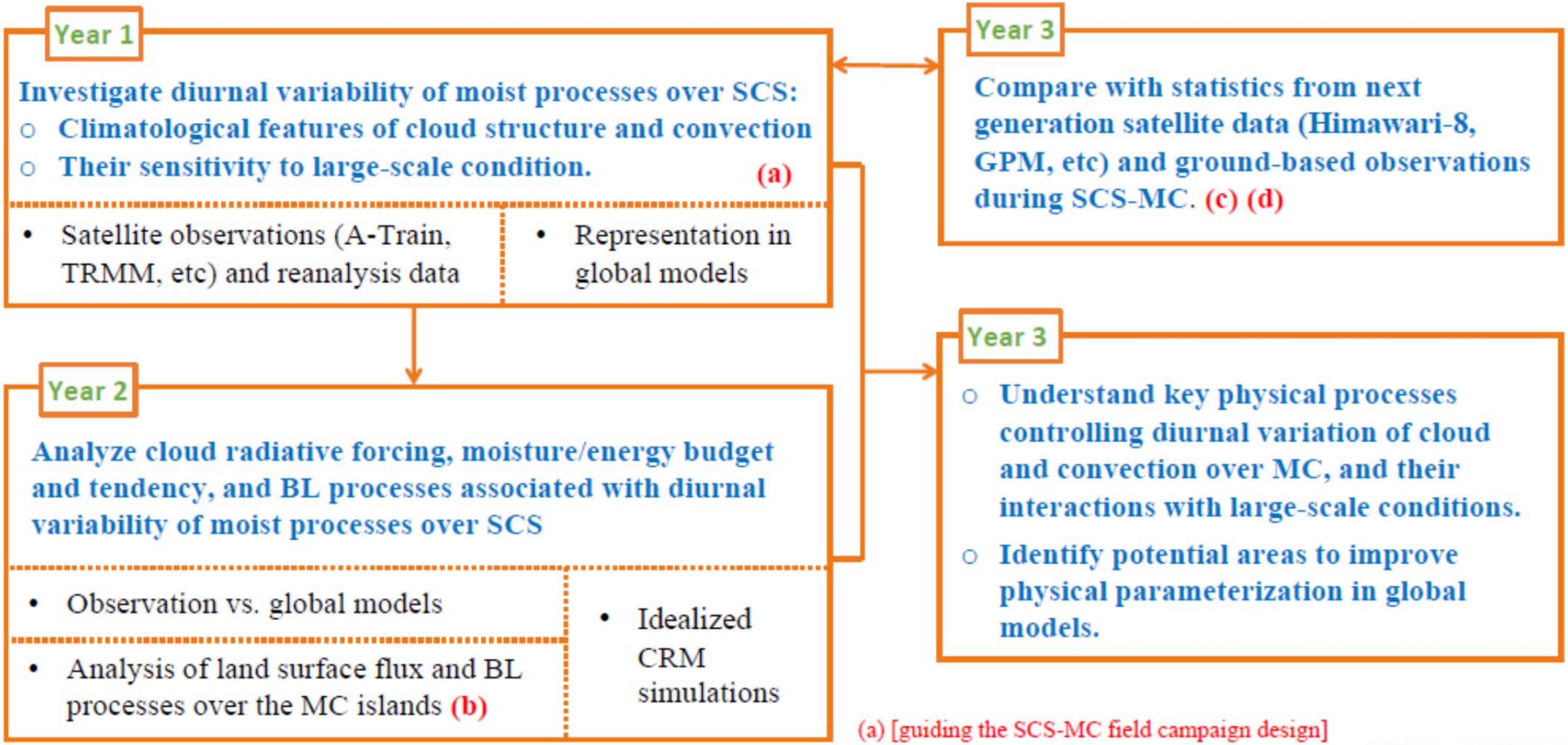


Goals:

Goal #1: Study the climatological features of diurnal variations of cloud and convection over SCS based on observational data sets, including their sensitivity to large-scale conditions, and their impacts on energy and moisture budgets.

Goal #2. Evaluate the representation of diurnal variations of moist processes in global atmospheric models, and its potential influences on the simulated large-scale climate.

Methodology



(a) [guiding the SCS-MC field campaign design]
(b) [connection with field campaign measurements of YMC and SCS-MC]
(c) [connection with 子計畫 by Dr. C.-Y. Liu]
(d) [connection with SCS-MC field campaign measurements]

S6: Radar-satellite observations and Convection Processes study

To carry out precipitation measurements by X-band and C-Band polarimetric radars in SCS, and to study cloud microphysical and dynamical processes

(廖宇慶、陳台琦、林沛練、鳳雷、鍾高陞、張偉裕)

1. 南海地區冬季風與夏季風海洋性對流時空結構與與變化特性

2. 南海地區降水系統的雲微物理特徵、降水型態與降水效率的關聯。

C.南海地區定量降水估計與預報的精確度。

D.以資料反演/同化方法探討對流系統內風場、熱力場、水氣場的時空變化，了解對流初生、成熟、運動、與衰退的機制。

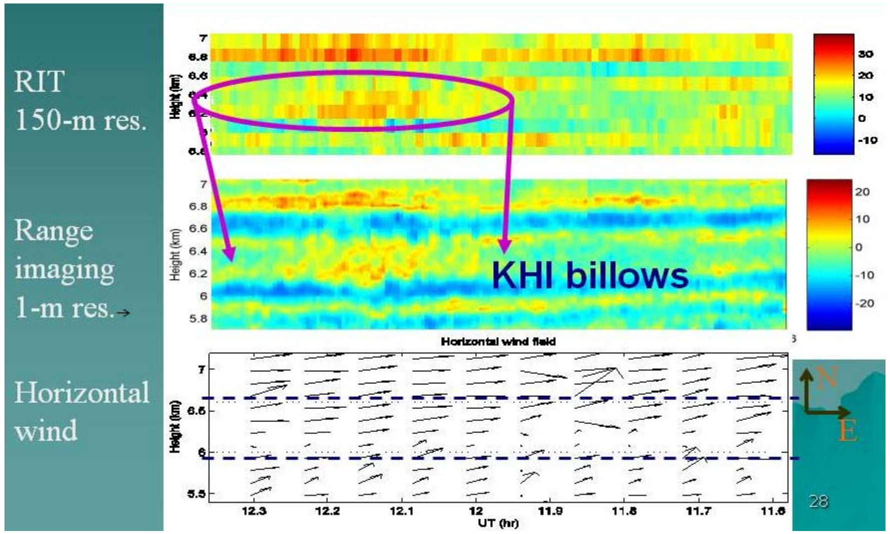
E.雷達觀測及反演結果與數值模式及衛星資料進行比對。

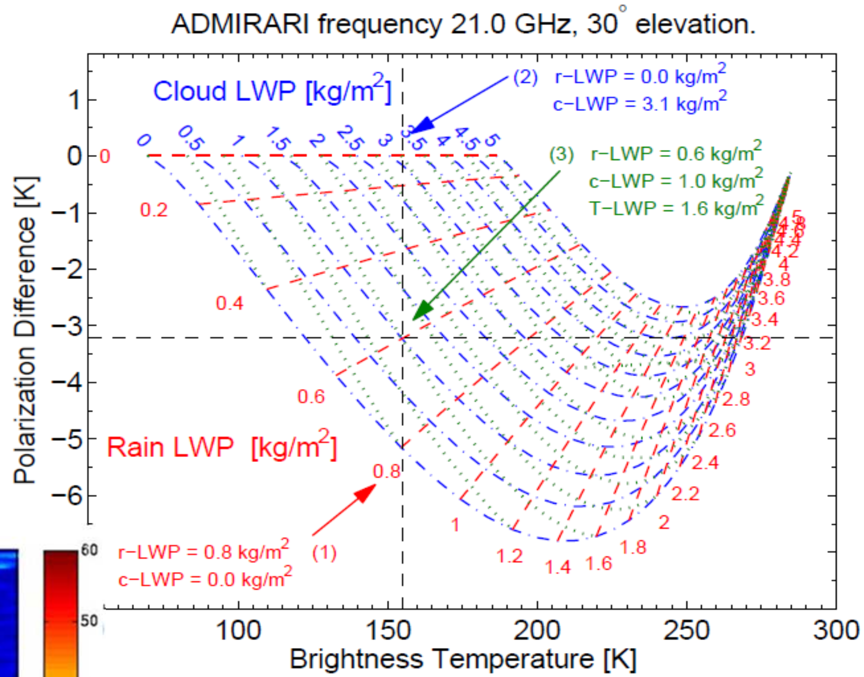
F.提供雲模式中微物理方案評估所需之資訊。 。

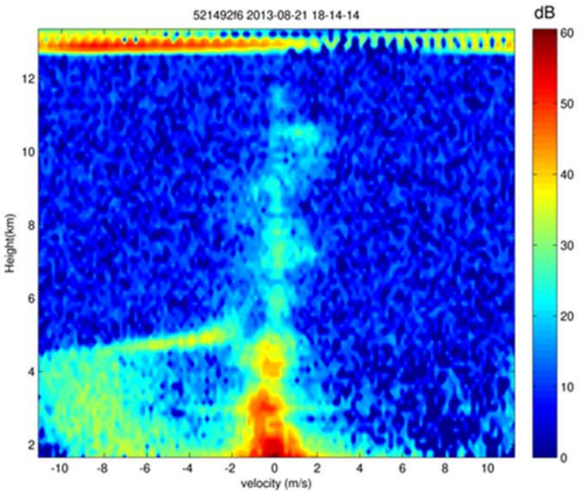
1. Statistical and dynamic characteristics of precipitating clouds, especially the polarimetric variables
2. Validation of satellite rain produced by GPM with a dual frequency (Ka and Ku bands) radar and new rainfall retrieval algorithm

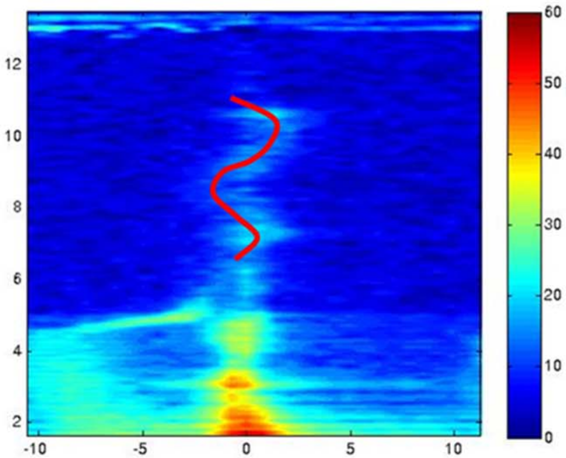
S7: Characterization of water vapor and clouds over SCS using passive microwave radiometer (侯昭平 Jou-Ping Hou)

To observe water vapor, rain and cloud LWPs of precipitating clouds by passive radiometer at Taiping Island, and winds, clear sky turbulence, and precipitation near Dongsha Island.



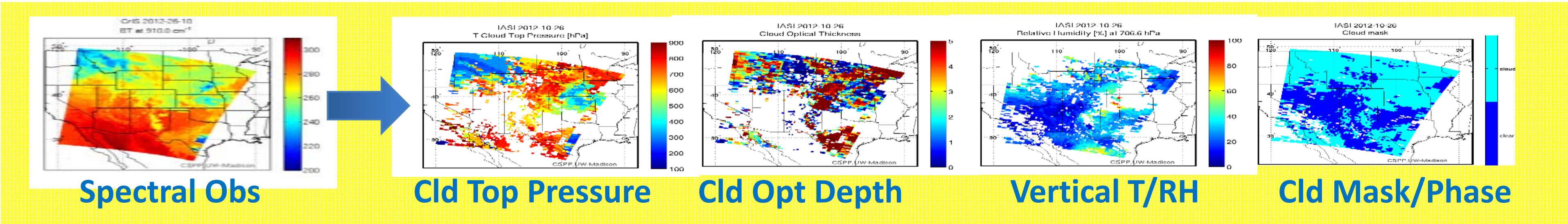






S8: Remote sensing of cloud properties over SCS by next-generation satellite （劉千義）

To study cloud properties from Himawari-8/9 (since 2014) 16-channel (visible to IR) fine resolution (500 m to 2 km, 10-minute) measurements.



- To provide observations for studying diurnal and longer variability
- To compare with GPM/ground-based radar/EOS A-Train constellations
- To provide a reference for model initialization and verification
- To provide a reference for GOES-R (US) and MTG (Europe) (to be launched).

S9: Air-Sea Interaction in the South China Sea and its connectivity with MC

(詹森、楊穎堅、張明輝 Institute of Oceanography, NTU)

To study the influence of air-sea interaction on typhoons and monsoon in the South China Sea based on existing air-sea flux data and in situ measurements at SEATS (1998-2007) and by R/V OR1 (1985-2012)

To maintain long term measurements in SCS (Dongsha, Nansha, SEATS) as ground truth for satellite remote sensing and in-situ data for model validation, and for monitoring global warming and ocean acidification in the South China Sea