Years of the Maritime Continent (YMC)
(2017-2019)
- Observing the weather-climate system of Earth's largest archipelago to improve understanding and prediction of its local variability and global impact **-**

Executive Summary

The Maritime Continent (MC), a unique mixture of land and ocean straddling the equator between the Indian and Pacific Oceans, is the largest archipelago on Earth. It is known for its complex geophysical setting, its marine and land biodiversity, and its rich human history and cultures. Sitting in the middle of the warmest body of water known as the Indian and West Pacific warm pool, the MC plays a pivotal role in the global weather-climate continuum. The complex land-sea distribution and topography make prediction of high-impact events in this region extremely challenging.

The intricacy of land, sea and terrain of the MC cultivates intriguing multi-scale variability in rainfall and in the circulation, which breeds high-impact events such as flood and drought. Predicting extreme events associated with the diurnal cycle, synoptic weather systems, the Madden-Julian Oscillation (MJO), and the monsoons is of paramount socioeconomic benefit to the region.

The MC hosts one of the major equatorial atmospheric convection centers resides. The tremendous energy released by convective condensation over the MC fuels the global atmospheric circulation. Rossby wavetrains excited by MC convection emanate toward higher latitudes. The atmospheric large-scale upward motion associated with the MC convection constitutes the ascending branch of the Walker Circulation, the interannual zonal migration of which is a key ingredient of the El Niño **-** Southern Oscillation (ENSO) variability. Teleconnections related to the MJO are strongest when its convection is centered over the MC. But the MC is a known barrier for the eastward propagation of the MJO. Atmospheric deep convection penetrating the tropopause over the MC makes it a primary spot for vigorous stratosphere-troposphere interaction. The Indonesian Throughflow (ITF), the artery connecting the tropical Pacific and Indian Oceans, is a crucial link of the ocean general circulation that affects not only properties of these two oceans but also global climate. Coastal upwelling near Sumatra is a key ingredient of the Indian Ocean Dipole (IOD), an essential feature of the regional climate.

Unfortunately, current state-of-the-art global climate models (GCMs) and numerical weather prediction (NWP) models suffer from persistent systematic errors and limited prediction skills in the MC region. They cannot reproduce the observed diurnal cycle of precipitation over the MC. They exaggerate the MJO barrier effect of the MC. They suffer from systematic dry and wet biases in precipitation in the MC region. Even models with the highest resolutions cannot reproduce observed rainfall variability and associated dynamical features in the MC region. Prediction skill of rainfall, especially its extreme events, in the MC is very limited.

"Years of the Maritime Continent (YMC)" is a two-year (July 2017 **-** July 2019) project. Its overarching goal is to expedite the progress of improving understanding and prediction of local multi-scale variability of the MC weather-climate systems and its global impact through observations and modeling exercises.

YMC includes five science themes:

Theme 1: Atmospheric Convection. To advance understanding of physical processes governing diurnal, synoptic, intraseasonal and seasonal variability of atmospheric convection and their interaction under the influence of the complex land-sea distribution and topography.

Theme 2: Upper-Ocean Processes and Air-Sea Interaction. To advance understanding of controlling processes for the multi-scale diurnal, intraseasonal and seasonal variability of the ocean and air-sea interaction in the MC region under the influence of extremely complex bathymetry and islands.

Theme 3: Stratosphere-Troposphere Interaction. To advance understanding of processes governing the dynamical coupling of the stratosphere and troposphere and their mass exchanges over the MC.

Theme 4: Aerosol. To advance understanding of key processes by which the multi-scale variability and interaction of convection and circulation affect the production, transport, and disposition of aerosol and their interaction with clouds in the MC.

Theme 5: Prediction improvement. To improve representations of key processes in weather and climate models through use of field observations and improved understanding.

YMC will engage five main activities:

1. Data Sharing: Through collecting, archiving, and sharing data from observing networks in the MC region, satellites and NWP products, build a two-year comprehensive database for detailed documentation of multi-scale variability and interaction of the MC weather-climate system.
2. Field Campaign: Collect special observation through a two-year field campaign to advance our understanding of physical processes key to the multi-scale variability and interaction of the MC weather-climate system.
3. Modeling: Quantify biases/errors of numerical models and the potential for improvement of prediction and simulation skill, and improve physical understanding through coordinated numerical experiments.
4. Prediction and Applications: Demonstrate prediction improvement through model improvement and assimilating supplementary data from activities 1 and 2; Study optimizations of targeted prediction products for users, information disassembling through modern media, and support to emergence management.
5. Outreach and Capacity Building: Educate the general public about the MC weather-climate system, its local variability and global impacts; Train the next generation of scientists, forecasters, and technicians for future research, operations, and applications of prediction and simulation tools.

In summary, through international collaboration and coordination, integrating observations and modeling, bridging research and operations, and outreach and capacity building, YMC strives to advance at an unprecedented pace our understanding and prediction of the MC weather-climate systems for socioeconomic benefit both locally and globally.