

Scientific Issues: Diurnal Cycle in Precipitation

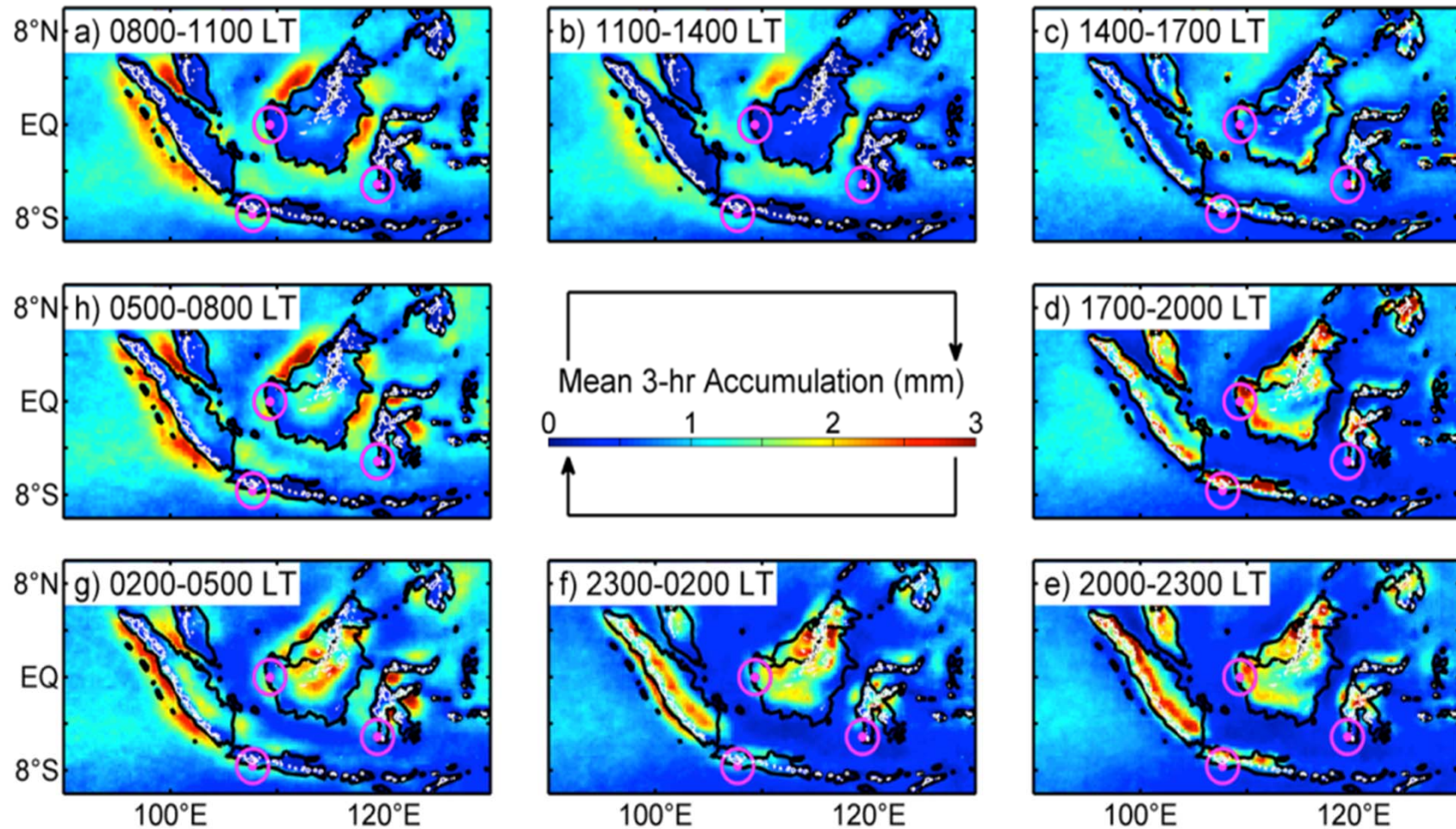
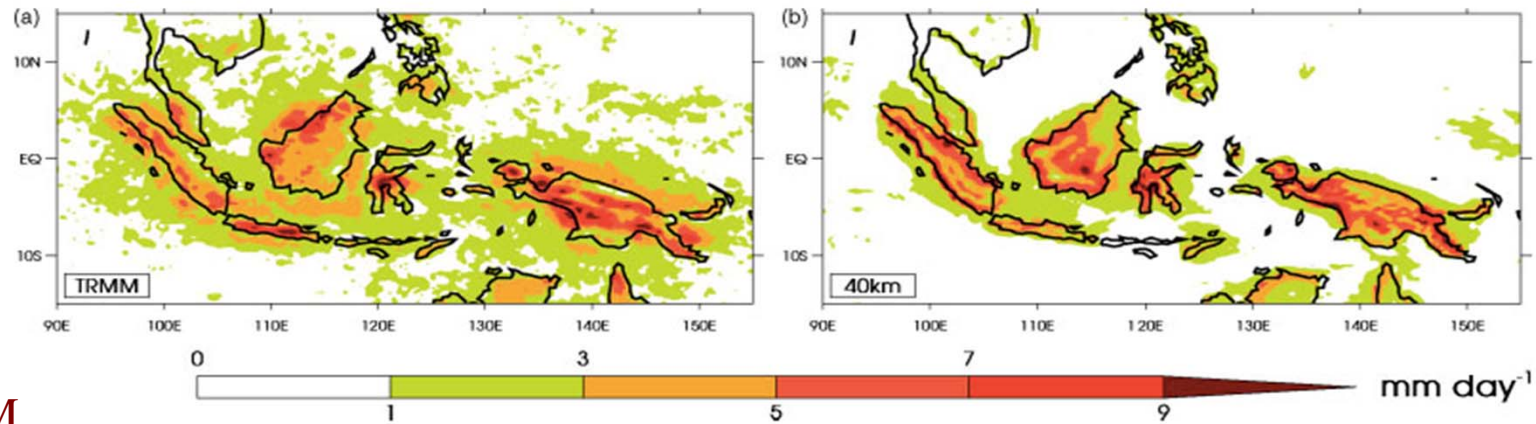


Figure 2.1.1 Climatological diurnal cycle in rainfall (TRMM 3B42) in the MC region at local time (LT) of each longitude. High terrains are highlighted by white contours, circles mark the three potential sites for YMC-ARM.

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Diurnal Amplitude



TRMM

model

Figure 5. Amplitude of the diurnal harmonic A of precipitation rate (mm day^{-1}) from (a) TRMM and (b) the 40 km model.

Diurnal Phase

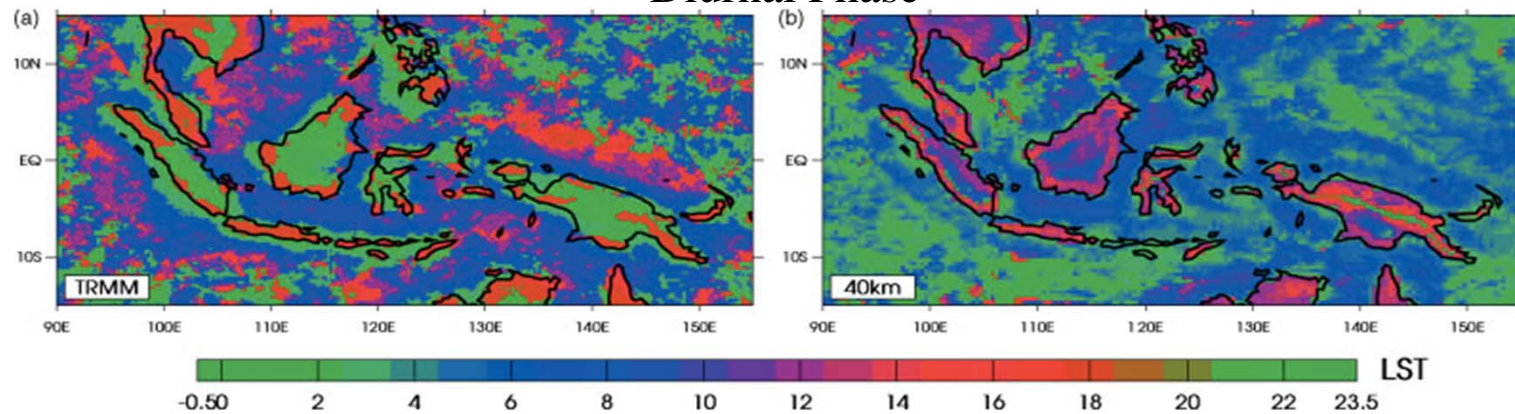


Figure 6. Time of maximum precipitation (local solar time) of the diurnal harmonic t_{ϕ} of precipitation rate from (a) TRMM and (b) the 40 km model. The shading interval is 1 h.

Love et al (2011)

YMC Hypotheses (Convection Theme)

Observations:

The known:

- “Convection is triggered by sea breeze and initiated over land near the coast, then propagates offshore via gravity waves, and grow into MCSs over water.”
- “The diurnal cycle is modulated by the MJO.”

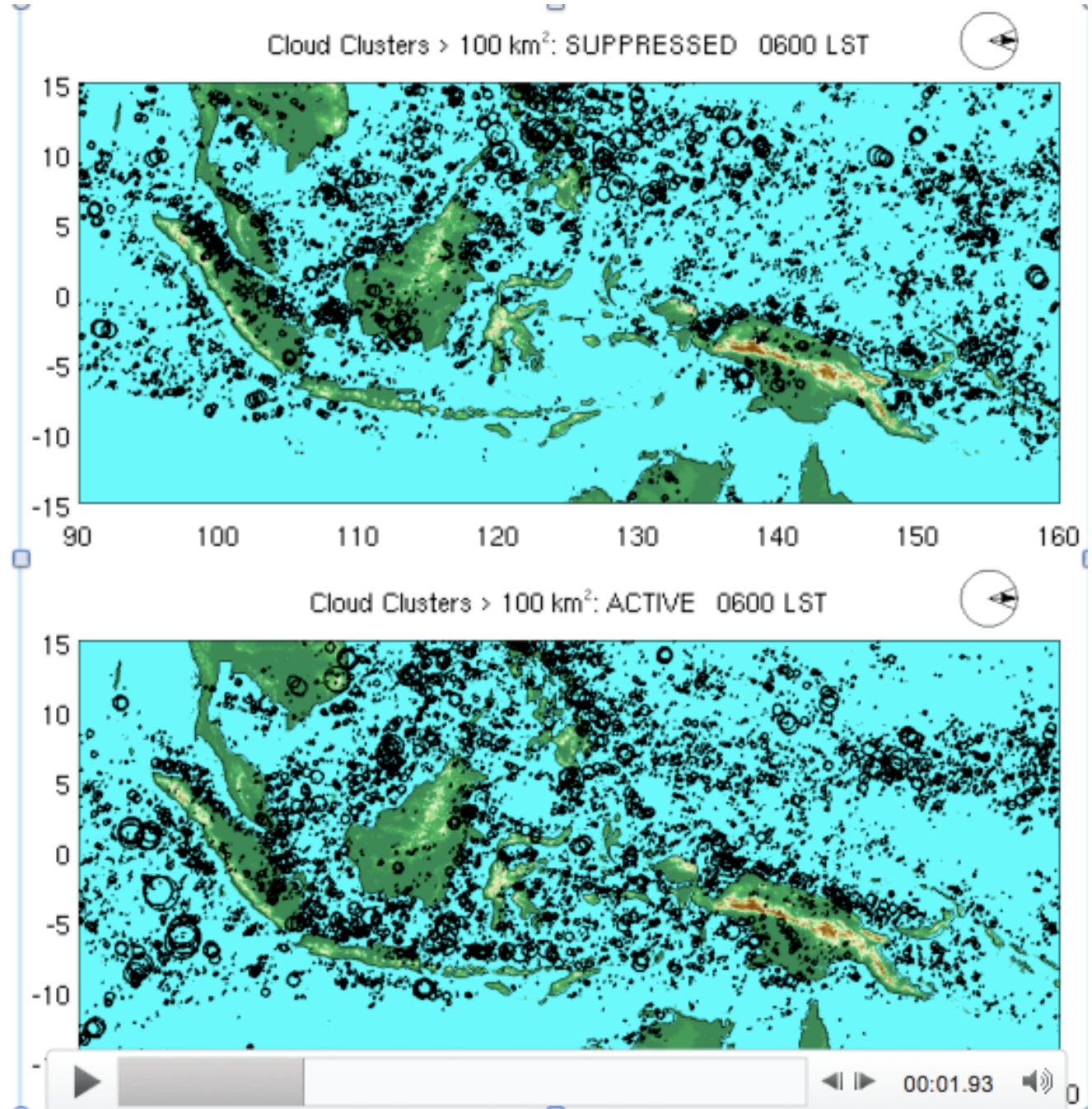
The unknowns?

- detailed cloud population evolution through the diurnal cycle over land and the oceans with simultaneous measurement of surface conditions, boundary layer and tropospheric profiles at different locations under different large-scale conditions of the MJO and monsoon.

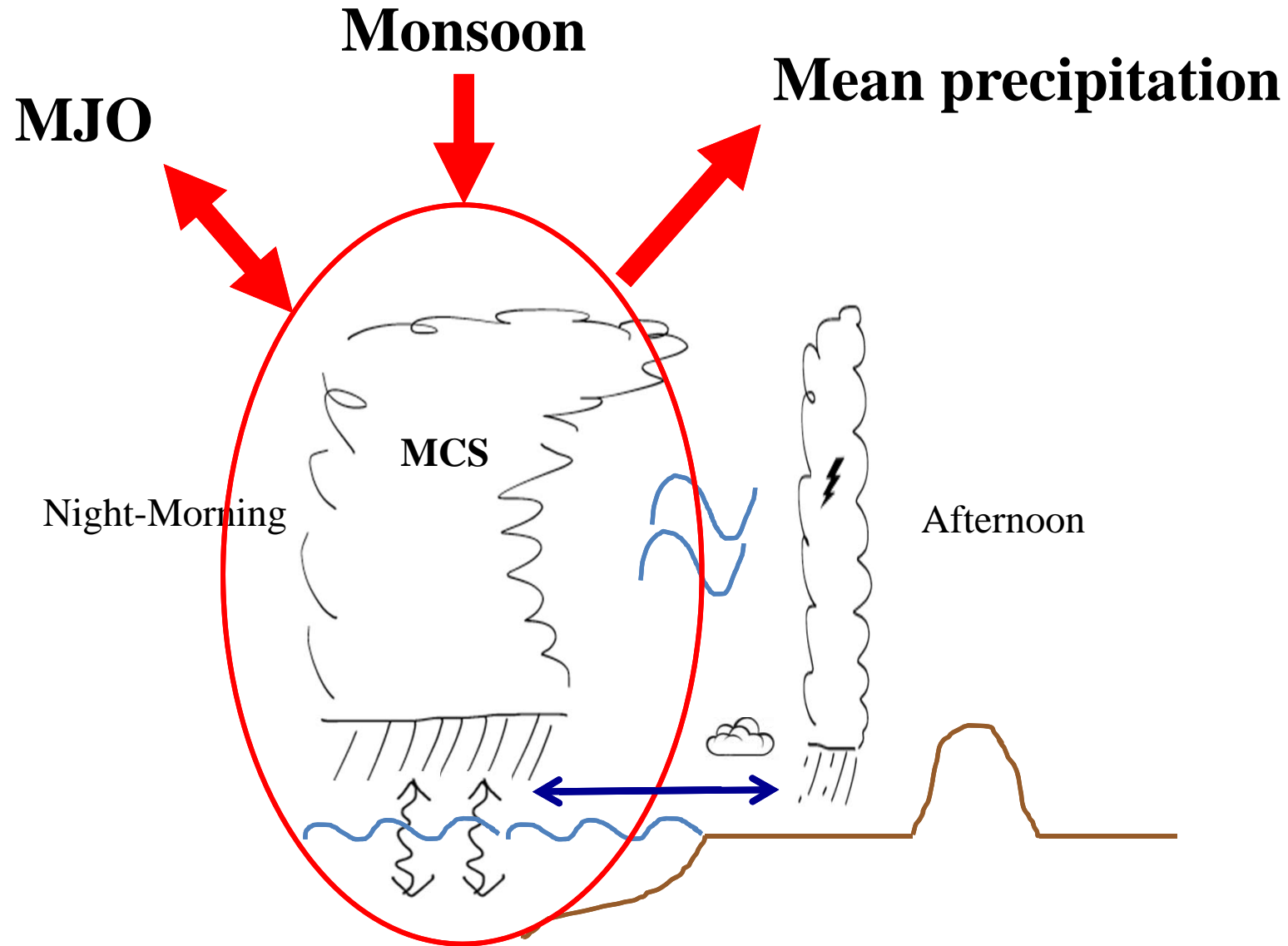
YMC Hypotheses (Convection Theme)

Upscale effects?

- MJO
- Monsoon
- Mean precipitation



YMC Convection Theme



YMC Hypotheses (Convection Theme)

Modeling:

- Cumulus parameterization problem only?
- Resolution problem (land-sea distribution, topography)?
- No problem in cloud-resolving models?
- How would observations help with model improvement (both cumulus parameterization and cloud-permitting models)?

YMC Hypotheses (Convection Theme)

1. Because of the unique geography of the MC, the diurnal cycle in rainfall is governed by *convective triggering* and *convective upscale growth* (organization). The triggering is controlled by boundary layer processes, which are different over the ocean, land, and mountains. The upscale growth is also controlled by additional large-scale conditions in the free troposphere (e.g., the MJO and monsoon).
2. The propagation of MJO precipitation over the MC is carried mainly by organized convection (e.g., MCSs) over the ocean.
1. The inability of global models to reproduce the organized convection over the ocean in the MC region related to the diurnal cycle is the main reason for their difficulty in the propagation of simulated and predicted MJO and for their dry biases over the ocean and wet biases over the land in mean precipitation in the MC region.