

Multi-Scale Climate Processes of ENSO, Monsoon & Diurnal Cycle in Rainfall Variability over the Maritime Continent

Jian-Hua (Joshua) Qian¹, Andrew W. Robertson², Vincent Moron²

¹Department of Environmental, Earth & Atmospheric Sciences, University of Massachusetts Lowell, Massachusetts, USA ²International Research Institute for Climate and Society (IRI), Columbia University, New York, USA

Precipitation is mostly concentrated over islands in the Maritime Continent

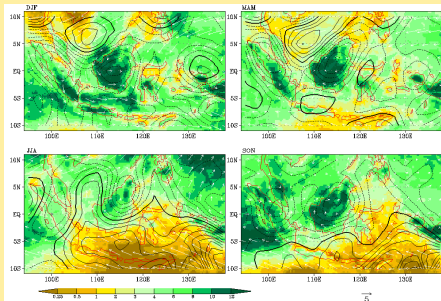


Fig.1 Averaged CMORPH seasonal precipitation (mm/day, color) and the NCEP-reanalysis winds and divergence (contour) at 925 hPa.

Because:

- Sea-breeze convergence – more rain over islands
- Valley-breeze convergence – more rain over mountains
- Cumulus-merger processes

Land-sea breezes

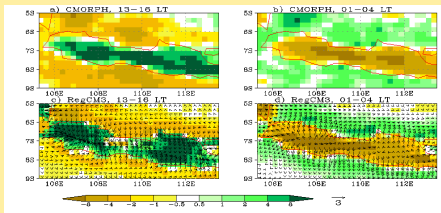


Fig.2 Diurnal cycle of rainfall over Java associated with land-sea breezes shown by the CMORPH satellite estimates in day (a) and night (b), and the regional climate model RegCM3 simulated rainfall in day (c) and night (d) in the wet season December to February (DJF).

Contrasting rainfall variability between mountains and plains over Java associated with El Niño - Southern Oscillation (ENSO)

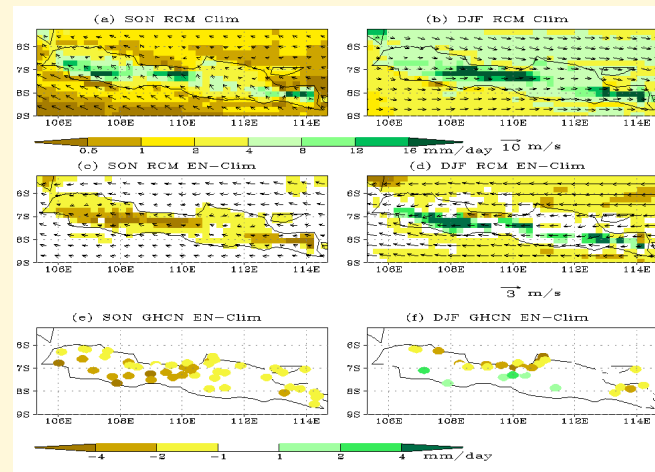
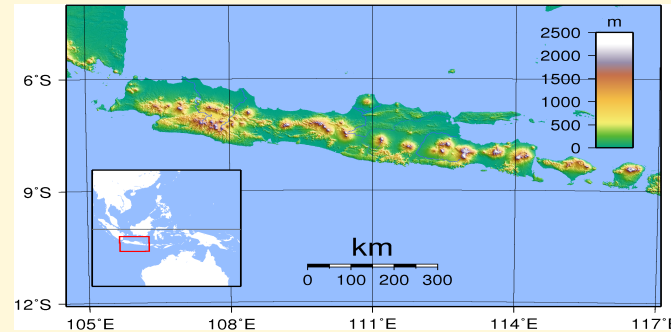


Fig.3 Climatology of NCEP-reanalysis-driving RegCM3 simulated rainfall (mm/day) and low-level winds in September to November (SON, a) and December to February (DJF, b); (El Niño – Climatology) composite of RegCM3 simulated rainfall and winds in SON (c) and DJF (d); and (El Niño – climatology) composite of the GHCN gauge rainfall in SON (e) and DJF (f). Note contrasting rainfall anomalies over mountains and plains.

Inverse relationship between the diurnal cycle of rainfall and monsoonal wind speed

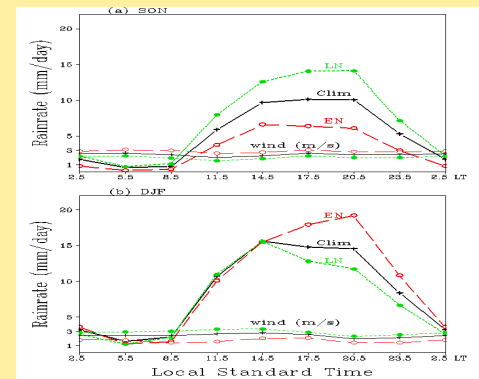


Figure 4: Diurnal cycles of RegCM3 rainfall (thick, mm/day) and wind speed (thin, m/s) over Java Island in SON(a) and DJF(b) for climatology (black), El Niño years (red) and La Niña years (green). "LT" denotes the local standard time at Jakarta, Indonesia.

MULTI-SCALE PROCESSES:

- El Niño (with southeasterly wind anomalies)
- Weaken northwesterly monsoon in DJF
- Strengthen diurnal cycle of winds
- Strengthen sea-valley-breeze convergence
- Produce more rainfall over mountains and less rainfall over plains.

References

- Qian, J.-H., 2008: Why precipitation is mostly concentrated over islands in the Maritime Continent. *J. Atmos. Sci.*, **65**, 1428-1441.
- Qian, J.-H., V. Moron, and A.W. Robertson, 2010: Interactions among ENSO, the monsoon and diurnal cycle in rainfall variability over Java Indonesia. *J. Atmos. Sci.*, **67**, 3509-3524.

JianHua_Qian@uml.edu