The Severe Weather component reading

# Diurnal Land–Sea Rainfall Peak Migration over Sumatera Island, Indonesian Maritime Continent, Observed by TRMM Satellite and Intensive Rawinsonde Soundings – Mori et al., 2004

## Abstract

* Using intensive rawinsonde sounding data was also useful in discovering remarkable diurnal variations of wind, humidity, and stability in lower troposphere corresponding to migrating rainfall peaks over both inland and coastal sea regions.
* Mechanism of diurnal land-sea rainfall peak discussed using TRMM PR, intensive rawinsonde soundings, GMS data, objective reanalysis, and ground-based observation data. Finally, a crucial difference in rainfall peak migrating mechanisms is suggested between those towards inland region in the day and offshore region in the nighttime.

## Introduction

* Important to understand diurnal rainfall cycle in tropics because of significant LH release.
* Important apps - large-scale energy and water cycles such as Asian monsoon system
* Diurnal convective variations also found in MC (and other regions)
* Phase propagation away from coastlines can be explained in several ways:
* Interaction between orography and local land-sea-breeze circulation
* Gravity waves generated by developed convections
* Cold gravity currents generated under developed convection
* Advection conveyed by background wind flow
* These were documented as candidates for driving source.
* But no study done on this phenomenon in Indonesian Island regions!
* Stratiform and convective rainfall have different LH profiles so must be quantified separately.
* Since the Indonesian MC is composed of many islands and surrounding sea, both regional and temporal variations of rainfall may be quite complicated because of strong interactions between land and adjacent sea through heterogeneous radiation properties and local circulations.
* Study presents characteristics of diurnal rainfall cycle and regional differences over Indonesian MC - esp Sumatra island using TRMM.

## Some results

* Indonesian MC is one of the regions with largest rainfall on globe - most in Sumatra Island (agreed with other readings).

## Discussion

* High stratiform rainfall ratio over inland region through night till early morning, and over both coastal sea and offshore regions in the day.
* Renggono et al. (2001) examined diurnal rainfall variations over Serpong by classifying them into convective and stratiform rainfalls - variation of convective rainfall over inland region consistent, but amplitude of stratiform rainfall of paper results in weaker. Peak time delay between rainfall types is up to 3h.
* Remarkable increase of convective rainfall compared with stratiform in afternoon over inland region but both convective and stratiform rainfalls show similar variations at night over coastal sea regions.
* Hence most precipitating clouds over inland region in afternoon are isolated convective clouds accompanied by smaller component of stratiform clouds.
* Total rainfall peak at 1700-1800LT in evening, but after that convective rainfall fraction decreases with time (less heating). But convective rainfall fraction over coastal sea region remains 50-60% throughout the day.
* Total rainfall over SW coastal sea region greater than over land region
* Takayabu (2002) distinguished convective and stratiform rainfalls in diurnal variations using TRMM on both land and ocean and over globe.
* Characteristics of rainfall over regions thought to differ between land and offshore regions. So globe classified into 3 regions:

1. Land
2. Coastal region within 500-1000km from coast
3. Isolated ocean far from coastline

* 4 main possible driving mechanisms propsoed for the diurnal migration of convective systems:

1. Advection process due to large-scale background circulation
2. Interaction between gravity current produced by cold downdrafts from developed convective cloud and an ambient wind near surface, making new convergence ahead of old cloud system
3. Upward current caused by gravity waves originating from adjacent developed convective cloud system
4. Thermal instability of lower troposphere propagated by gravity waves originating in diurnally oscillating heat sources of daytime mixed layer over adjacent coastal land region.

## Conclusions

* Around 70% rainfall over inland region of Sumatra island during evening is convective. Sharp peak in convective rainfall in evening followed few hours later by a weak peak of stratiform rainfall. But in the surrounding coastal sea region both convective and stratiform rain are in almost equal measure. Amplitude of diurnal variation decreases with distance from coastline.
* Regional variability of rainfall caused by migration of peak from coastline toward inland region in the day and toward offshore region at night. Convective rainfall ratio over land in daytime reaches max just before time of rainfall peak and migrates inland with time. This ratio is unchanged with time in the ocean during the night and has no relation to distance from coastline.
* Most convective clouds develop along SW coastline of Sumatra island between 1300-1600LT.
* Initial convections in late morning and late evening are generated along SW foot of mountains by local convergence of sea breeze against mountains and land breeze against background W wind.

