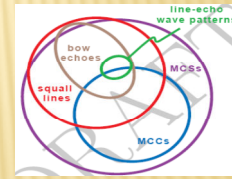
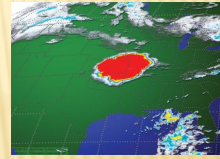






## WHY MCC IS VERY IMPORTANT?

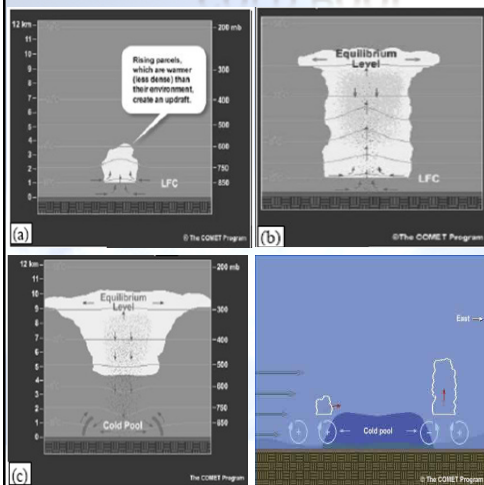
- ✧ Mesoscale convective systems (MCSs) refer to all organized convective systems larger than ~50 km (long axis)
- ✧ Mesoscale convective complexes (MCCs) represent a larger form of mesoscale convective system (MCS) organization.
- ✧ MCCs can produce severe weather (severe weather) and continuous rains (copious rainfall) even trigger extreme rainfall (Fritsch and Maddox 1981; Maddox and Heckman 1982; Wetzel et al 1983, and Laing and Fritsch 1993)
- ✧ MCCs are major precipitating cloud systems of the tropics
- ✧ MCCs strongly affect heating patterns in the tropics
- ✧ MCCs also produce a broad range of severe convective weather events: strong winds, hail, tornadoes, lightning, and flooding.
- ✧ Some classic convective system types include:
  - + squall lines
  - + bow echoes
  - + line echo wave patterns
  - + MCC



Nomenclature	Dimensions	Typical WX Feature
Mesoscale-alpha (a)	200 - 2000 km 6 hrs - 2 days	Jet stream, small hurricanes, weak anticyclones
Mesoscale-beta (b)	20 - 200 km 30 min - 6 hrs	Local wind fields, mountains winds, landsea breeze, mesoscale convective complexes (MCCs), large thunderstorms
Mesoscale-gamma (c)	2 - 20 km 3 - 30 min	Most thunderstorms, large cumulus, extremely large tornadoes




## COLD POOL



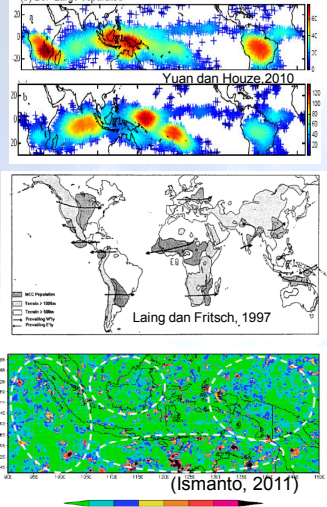
Cold pools are evaporatively cooled areas of downdraft air that spread out horizontally underneath a precipitating cloud. (Byers and Braham 1949; Purdom 1976;) Wilson and Schreiber 1986. Engereer (2008))

Cold Pool can be an important focus for the development of new convective cells, since some of the environmental air that approaches a cold pool is lifted up and over it


The cold pools from a number of precipitating thunderstorms can combine into a coherent mesoscale-sized cold pool (100–400 km in horizontal extent) as is commonly observed in association with mesoscale convective systems (MCSs; Fujita 1959; Johnson and Hamilton 1988).



## Motivation




- ✗ Maritime Continent (BM) is a large area of the emergence of MCSs fragmented (individual) or connected to each other (which includes MCC). (Yuan and Houze, 2010)
- ✗ Inconsistencies regarding the presence of MCC in the Indian Ocean under study Laing and Fritsch (1997) is not a point of MCC, while the results of the study Yuan and Houze (2010) show different things.
- ✗ Still very limited study of the characteristics of MCC and its contribution to extreme rainfall in Indonesia
- ✗ The main problem that arises is the appearance of many areas with extreme rainfall in the besides MCC area, whether phenomenon of MCC affects the atmospheric environment around them?.. Is there a role in this cold pool?



## Objective

1. To analyze the contribution of MCCs against extreme rainfall in Indian Ocean
2. To mapping the geographical distribution (spatial) of MCCs in Indian Ocean
3. To understand the characteristics and propagation of MCCs in IMC, especially Indian Ocean.
4. To analyze the influence of MCCs in the Indian Ocean against convective activity in the surrounding area.
5. To Analyze the processes and mechanisms of propagation of cold pool.







## Data

Instrument	Variable	Range
GMS/GOES/MTSAT IR	IR1 (3 hourly)	2000 – 2009
TRMM 3B42 v6	Rainfall estimation (3 hourly)	2000 – 2009
Cross-Calibrated Multi-Platform (CCMP)	Wind surface (6 hourly)	2000 - 2009
Synoptic Data from Ogimet	Rainfall data and temperature (3 hourly)	2000 - 2009
Equatorial Atmosphere Radar	Zonal and meridional wind, Spectral Width, Echo Power	2001 – 2009
Automatic Weather Station	Rainfall data (hourly)	2001 - 2009

Using software: linux, Matlab, Grads.




## EQUATORIAL ATMOSPHERE RADAR (EAR)



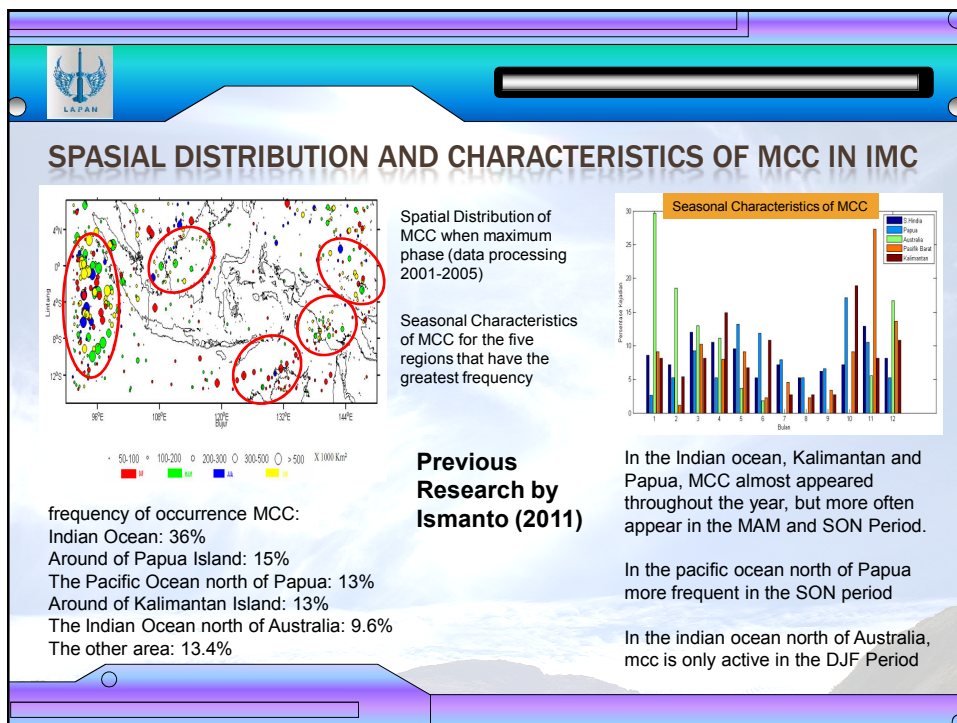
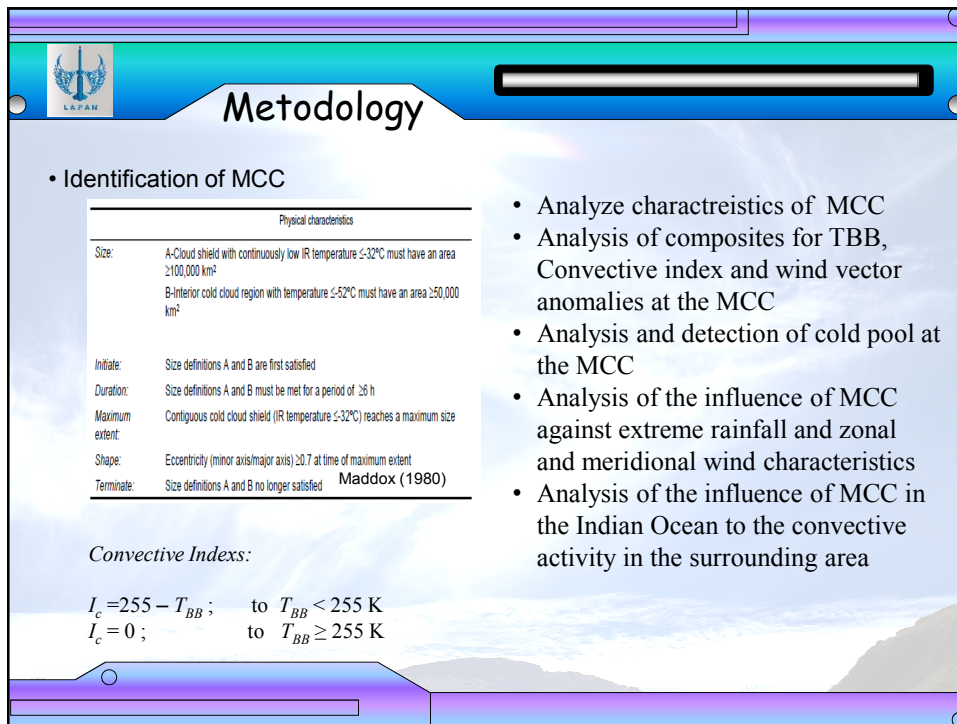
**Location :**  
**Koto Tabang, Palupuh District,**  
**Agam, West Sumatra, Indonesia**  
**(0.2°S, 100.32°E)**

**Joint Research between LAPAN,**  
**Indonesia and Research Institute**  
**for Sustainable Humanosphere**  
**(RISH) Kyoto University, Japan**

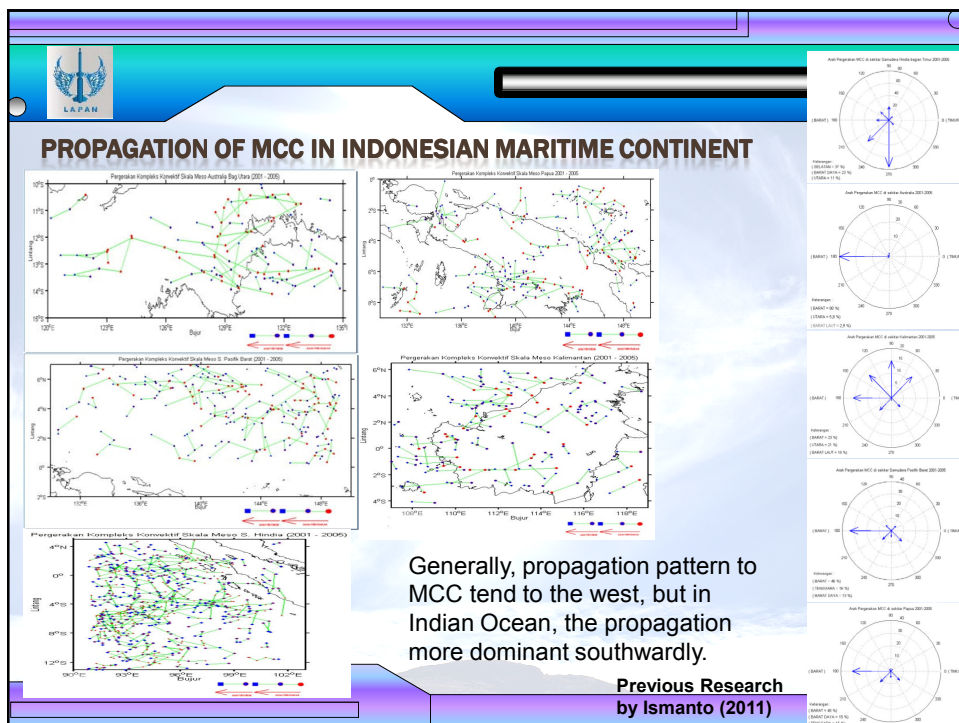
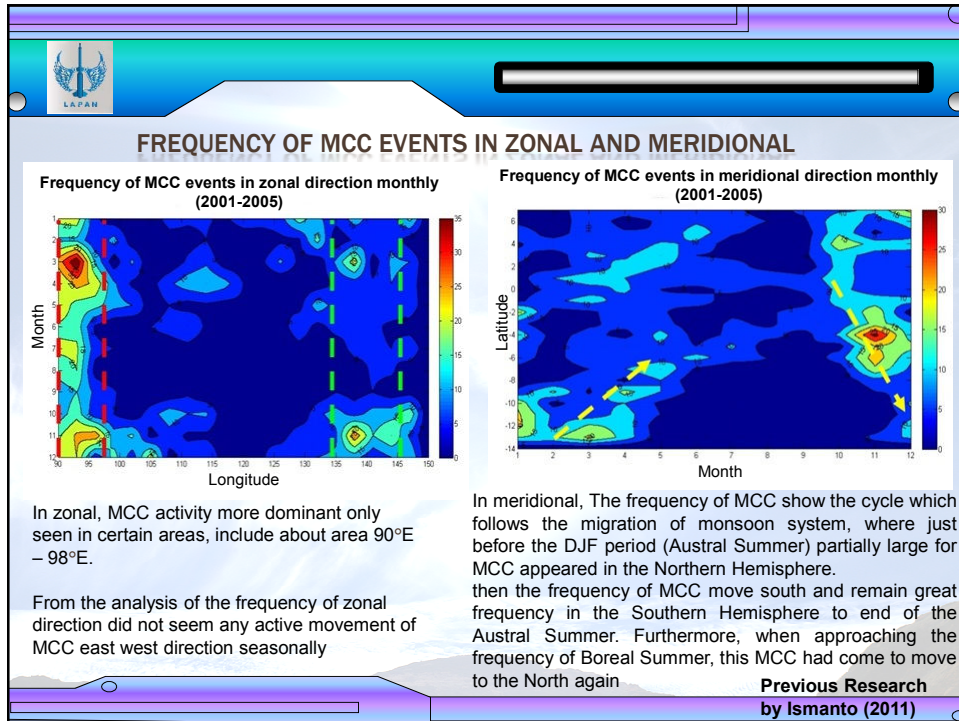
**Antenna (diameter 110 m)**



**560 Yagi-arrays**









## CONCLUSION OF CHARACTERISTICS OF MCC IN IMC

There are five area often occurrence of MCC in IMC ; Indian Ocean, Around of Papua Island, The Pacific Ocean north of Papua, Around of Kalimantan Island and the Indian Ocean north of Australia.

The Indian ocean is the largest area of the MCC in IMC

Propagation pattern to MCC tend to the west, but in Indian Ocean, the propagation more dominant southwardly

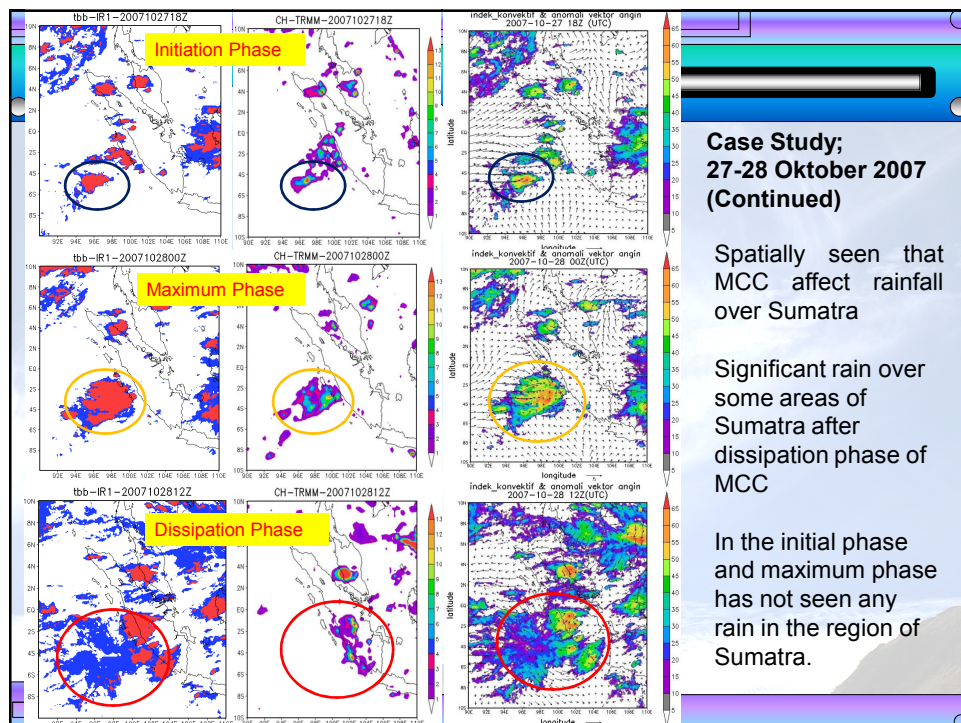
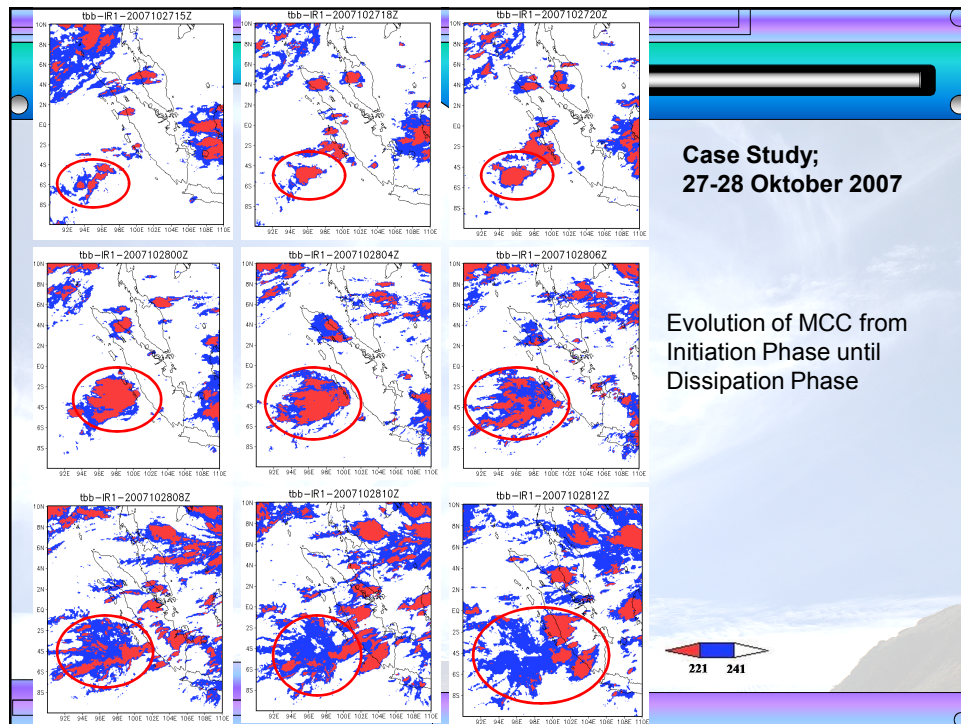
**Previous  
Research by  
Ismanto (2011)**

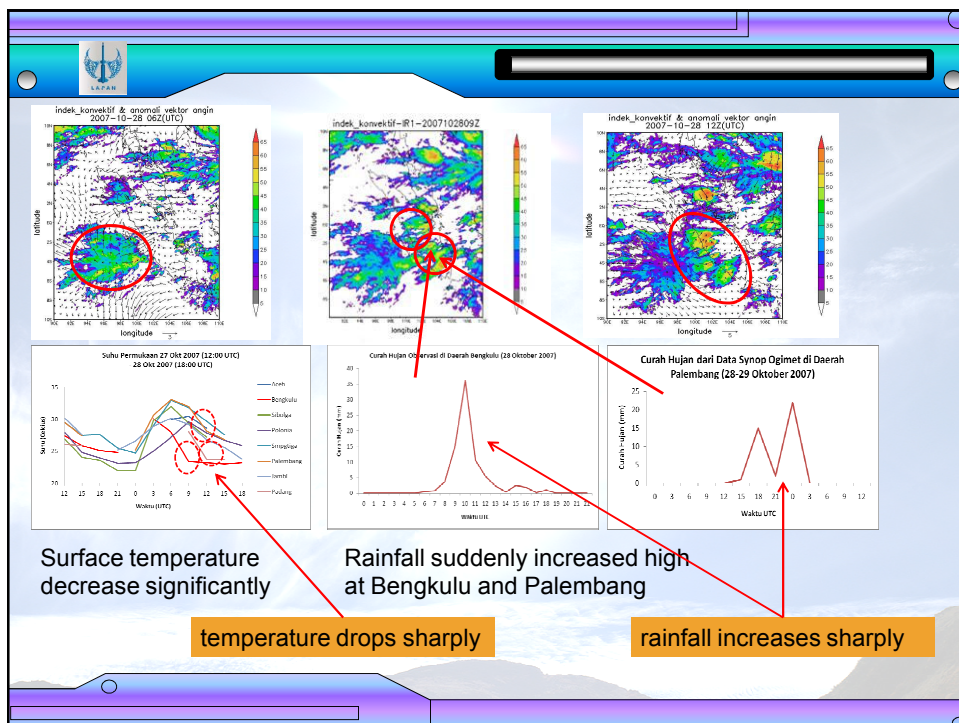
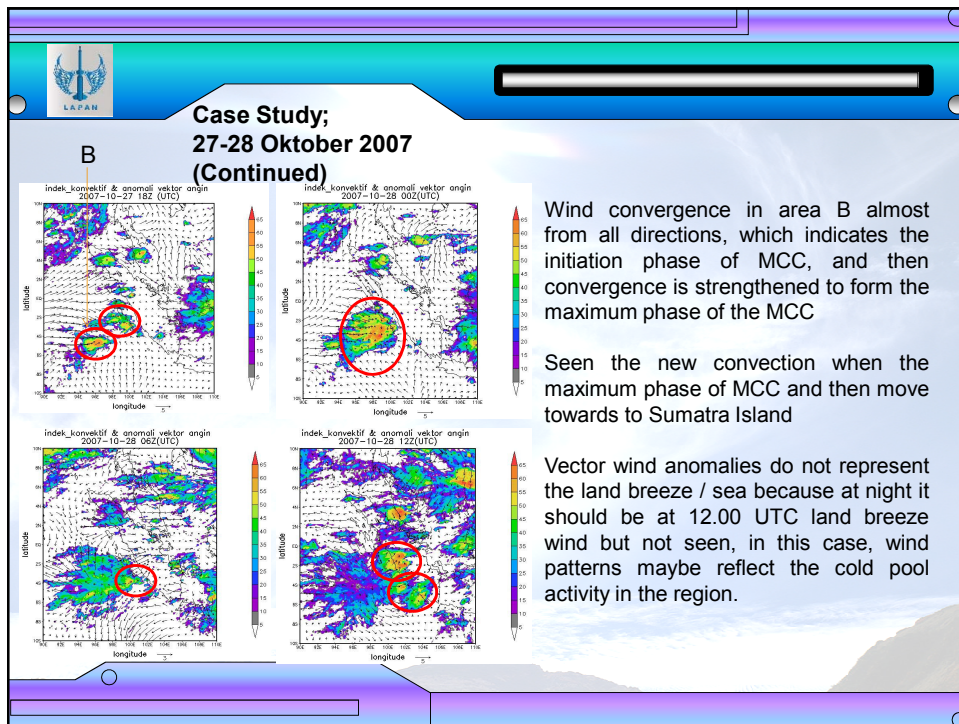


## CASE STUDY

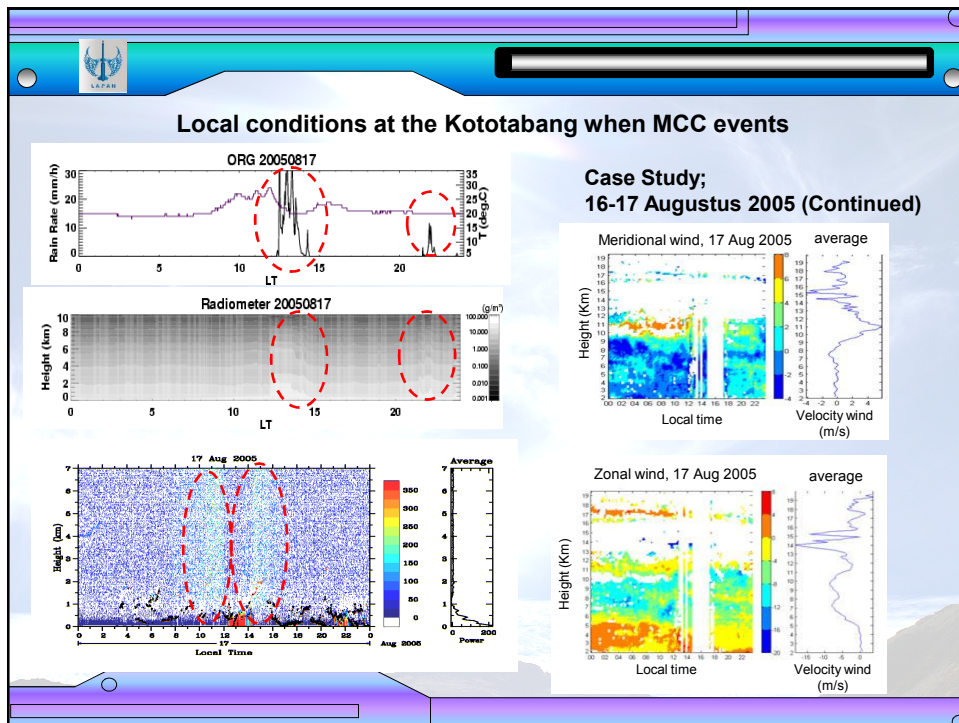
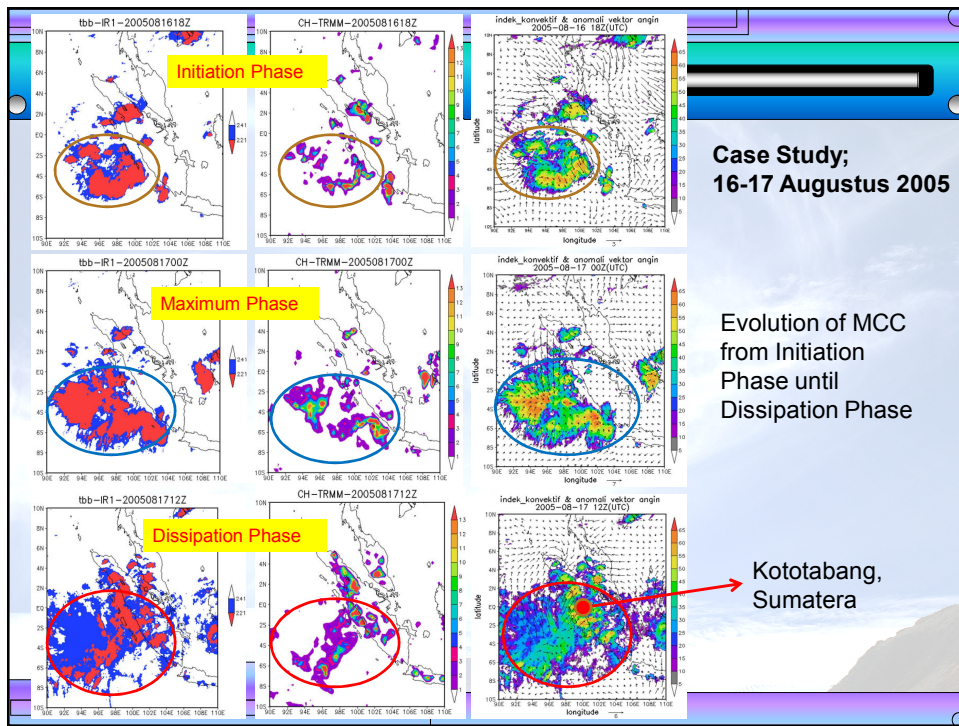










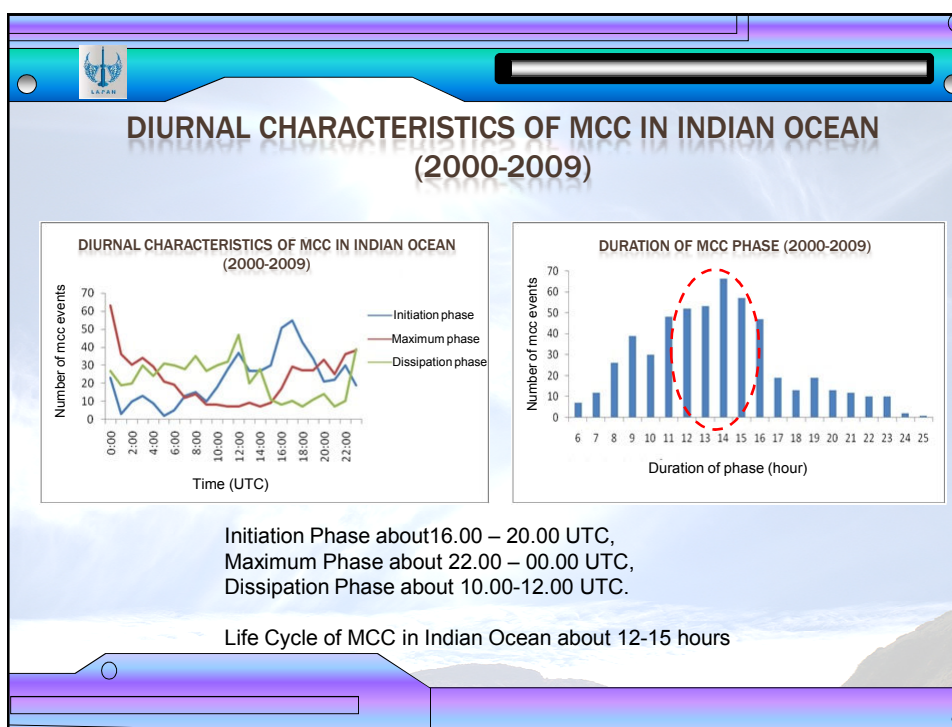
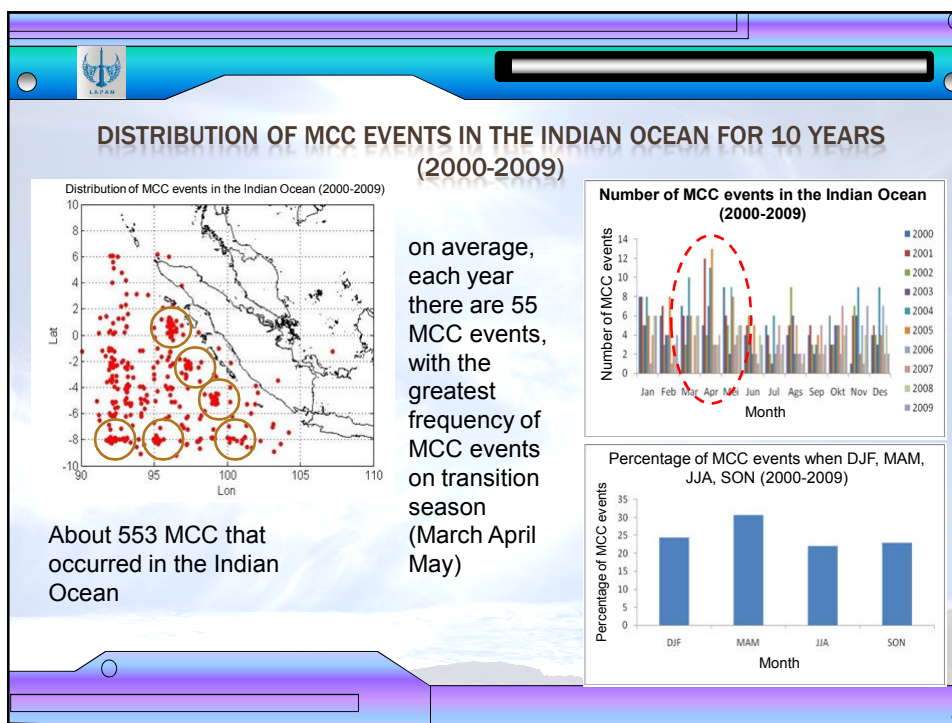


**CONCLUSION FROM THE CASE STUDIES**

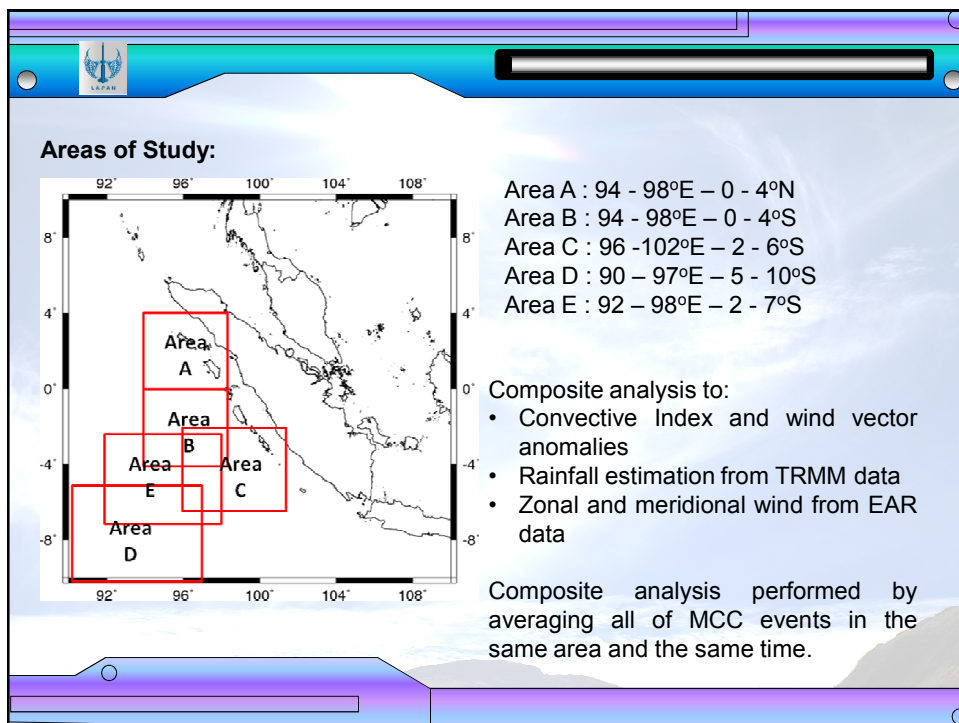
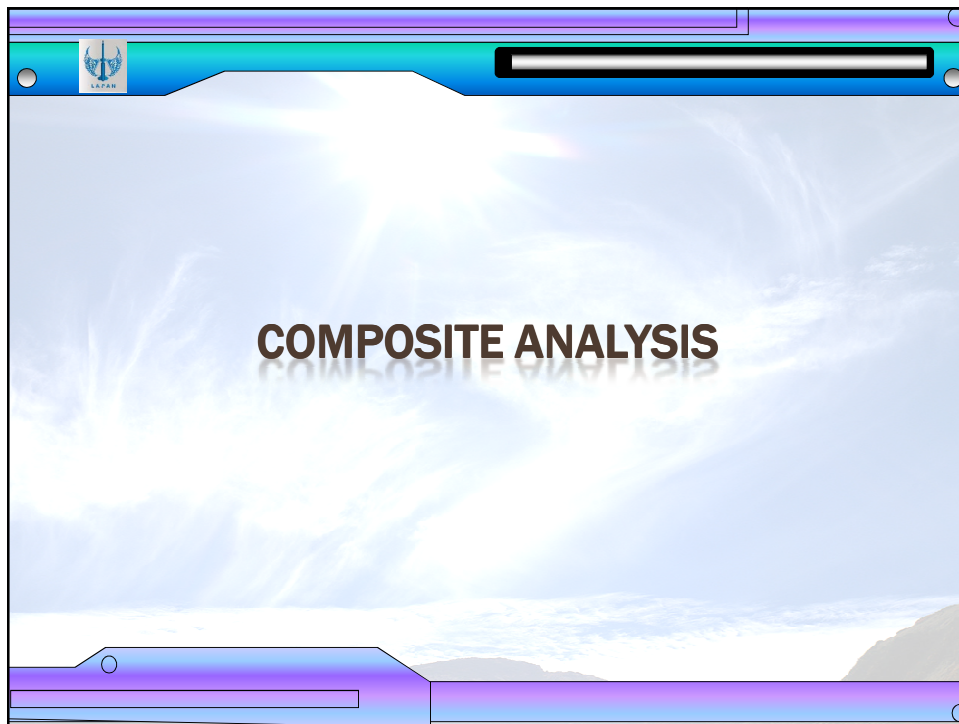
Indicate that the MCC affect rainfall in the surrounding area with induces the convection activity around mcc, this is possible because of the cold pool mechanism forming new convection around MCC.

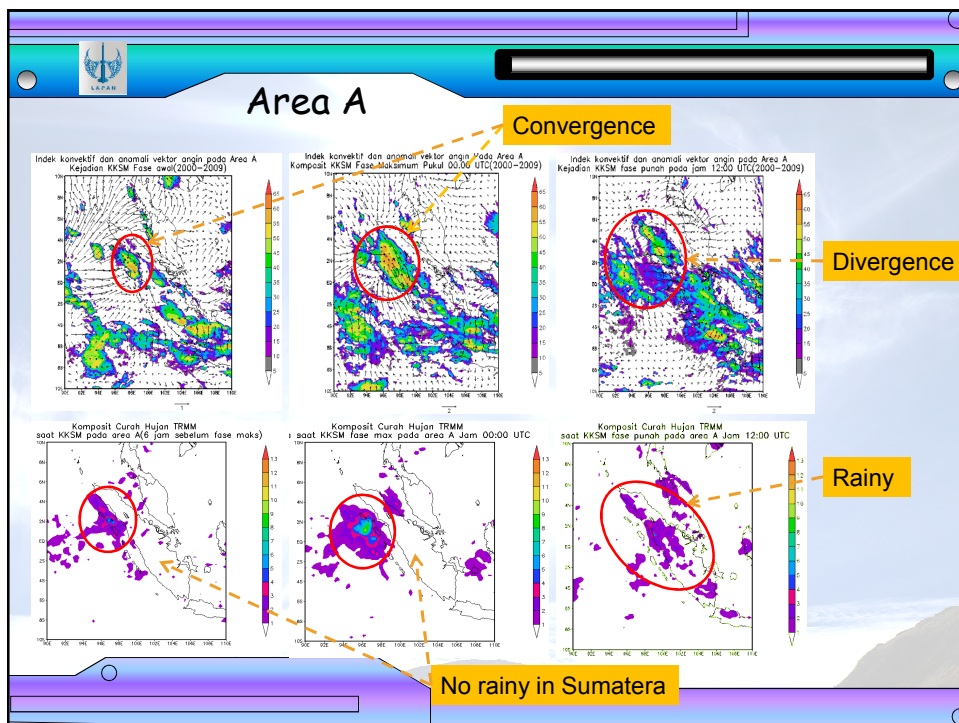
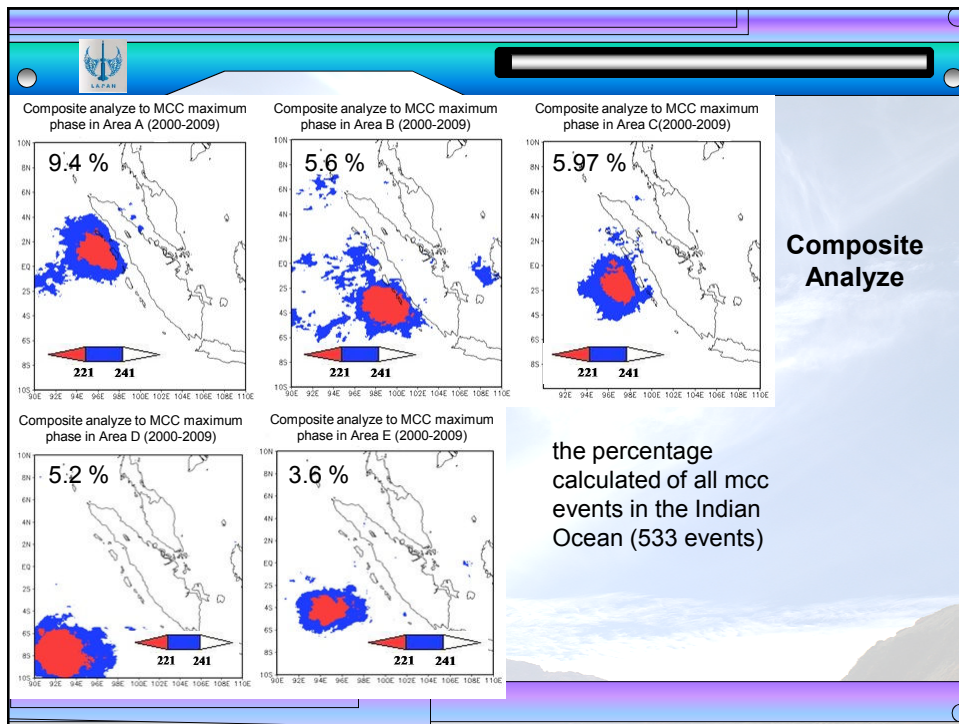
This raises the further question, whether all MCC events consistent as case studies?

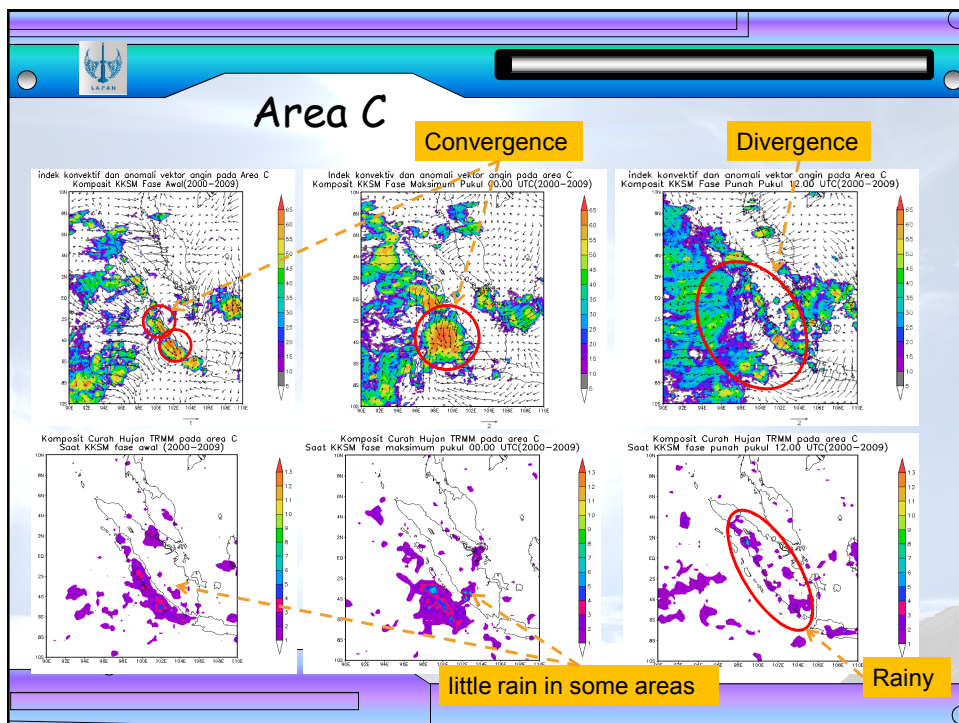
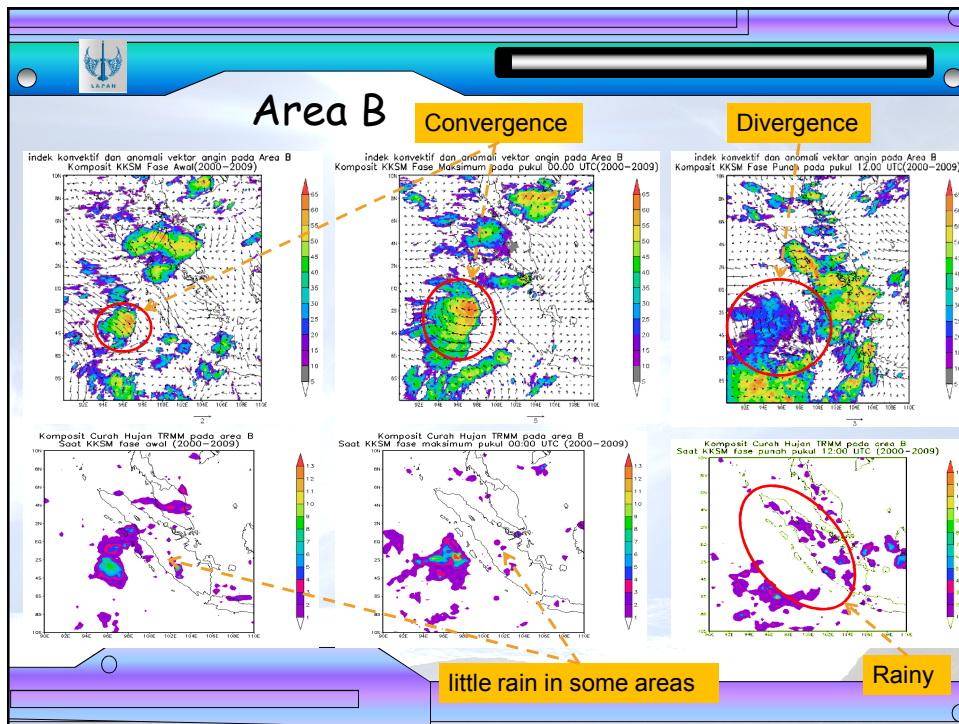
**GENERAL CHARACTERISTICS OF MCC  
AT INDIAN OCEAN**



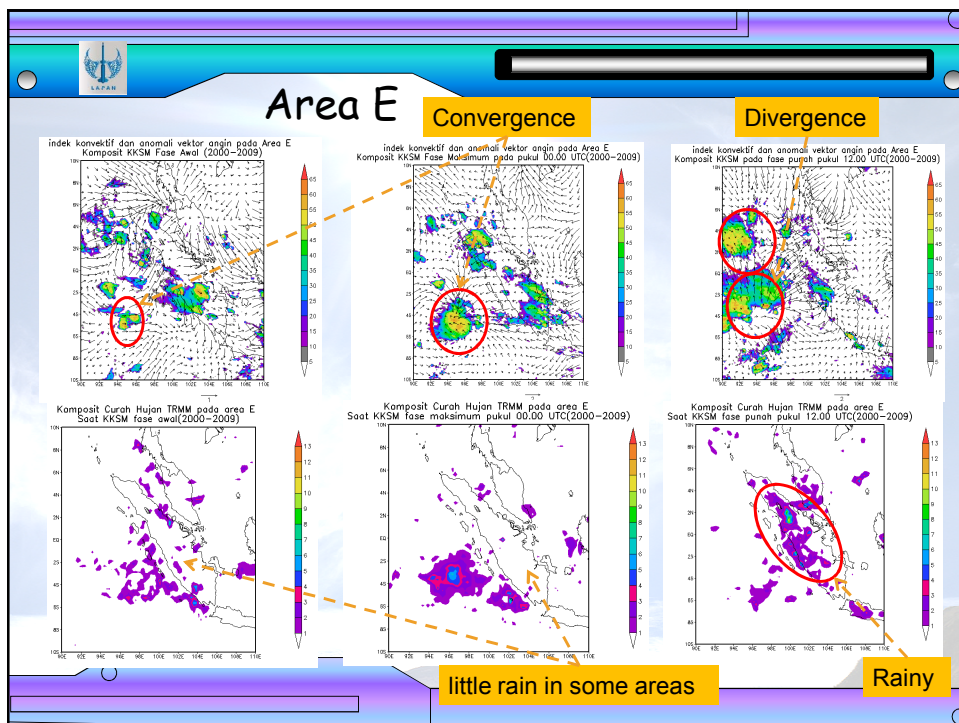
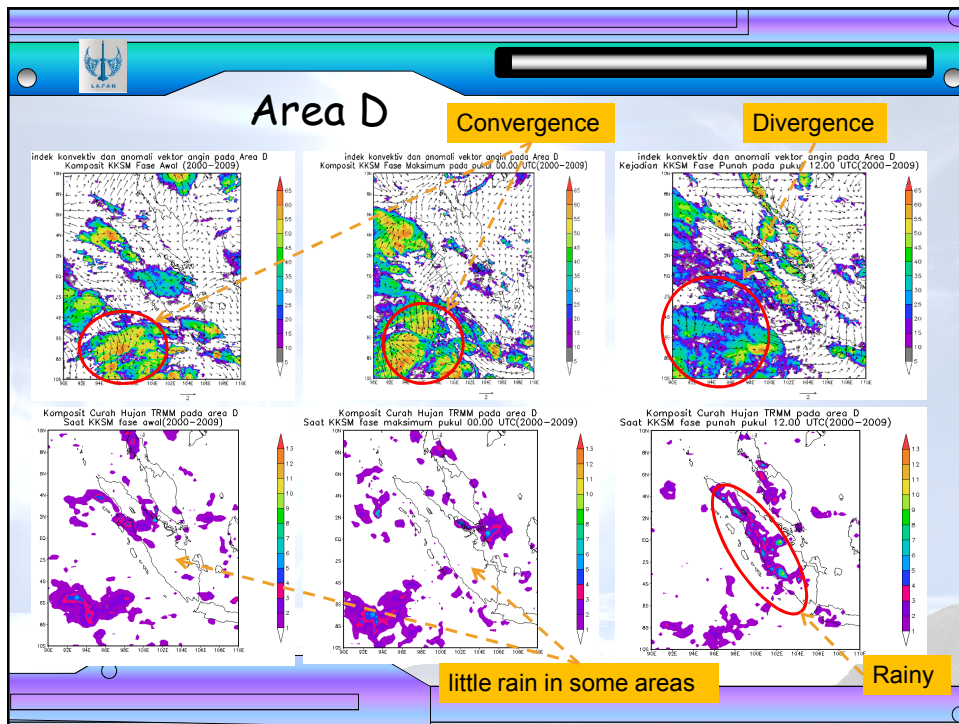


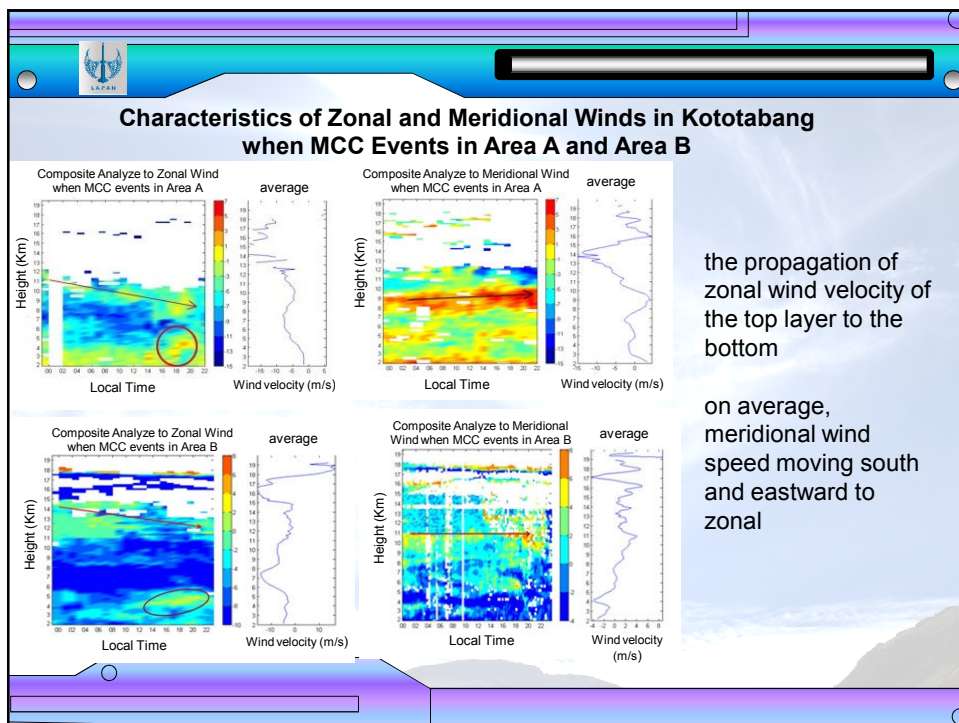
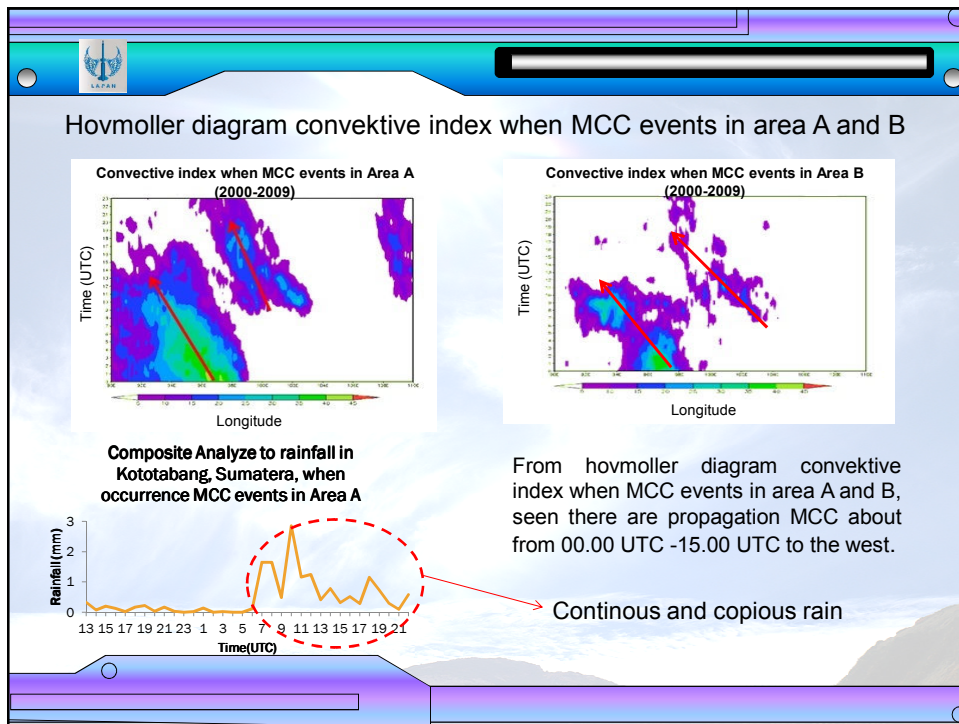


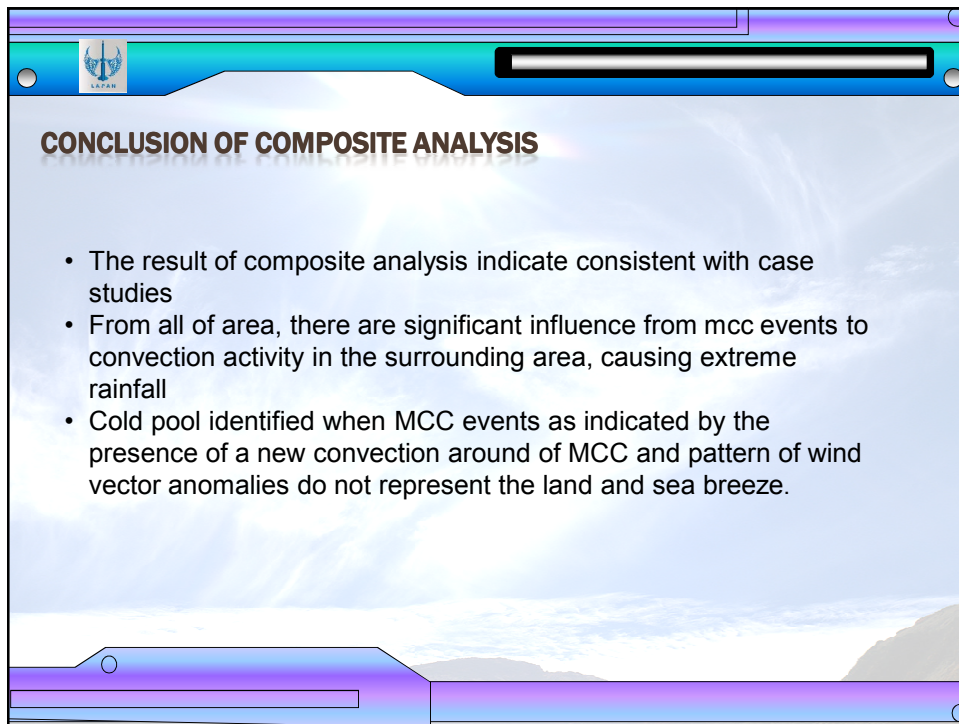






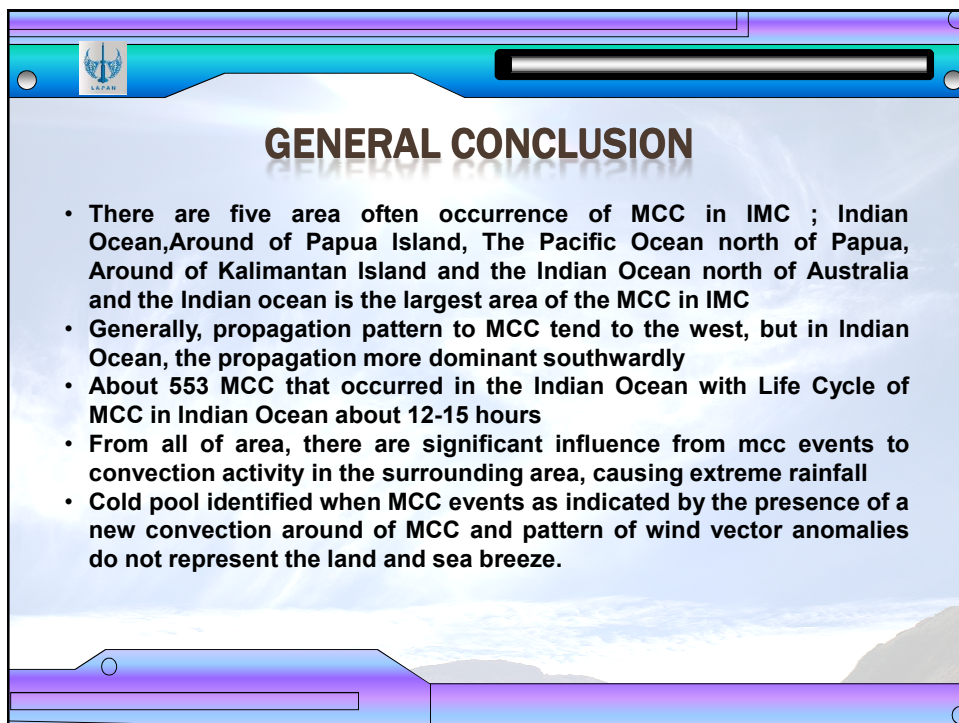






**CONCLUSION OF COMPOSITE ANALYSIS**

- The result of composite analysis indicate consistent with case studies
- From all of area, there are significant influence from mcc events to convection activity in the surrounding area, causing extreme rainfall
- Cold pool identified when MCC events as indicated by the presence of a new convection around of MCC and pattern of wind vector anomalies do not represent the land and sea breeze.



**GENERAL CONCLUSION**

- There are five area often occurrence of MCC in IMC ; Indian Ocean, Around of Papua Island, The Pacific Ocean north of Papua, Around of Kalimantan Island and the Indian Ocean north of Australia and the Indian ocean is the largest area of the MCC in IMC
- Generally, propagation pattern to MCC tend to the west, but in Indian Ocean, the propagation more dominant southwardly
- About 553 MCC that occurred in the Indian Ocean with Life Cycle of MCC in Indian Ocean about 12-15 hours
- From all of area, there are significant influence from mcc events to convection activity in the surrounding area, causing extreme rainfall
- Cold pool identified when MCC events as indicated by the presence of a new convection around of MCC and pattern of wind vector anomalies do not represent the land and sea breeze.



