Local Extreme Weather Events:

Mesoscale Convective Complexes and Their Evolutions Over Peninsular Malaysia

APCC WG Member Meeting
19 Septmeber 2007
Busan, Korea

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CONTENT

1. Motivation and purpose
2. Methodology
3. Data sources
4. Case study
5. Conclusions

MOTIVATION AND PURPOSE

- Mesoscale convective complexes (MCCs) cause a lot of flash floods especially in the inland area of Peninsular Malaysia

- Analyze the atmospheric conditions and general patterns of the MCC features so as to further understand the dynamics of the MCCs and the spatial and temporal distributions of such events

METHODOLOGY

Three cases that generated extreme weather events are studied

Areas of interest:

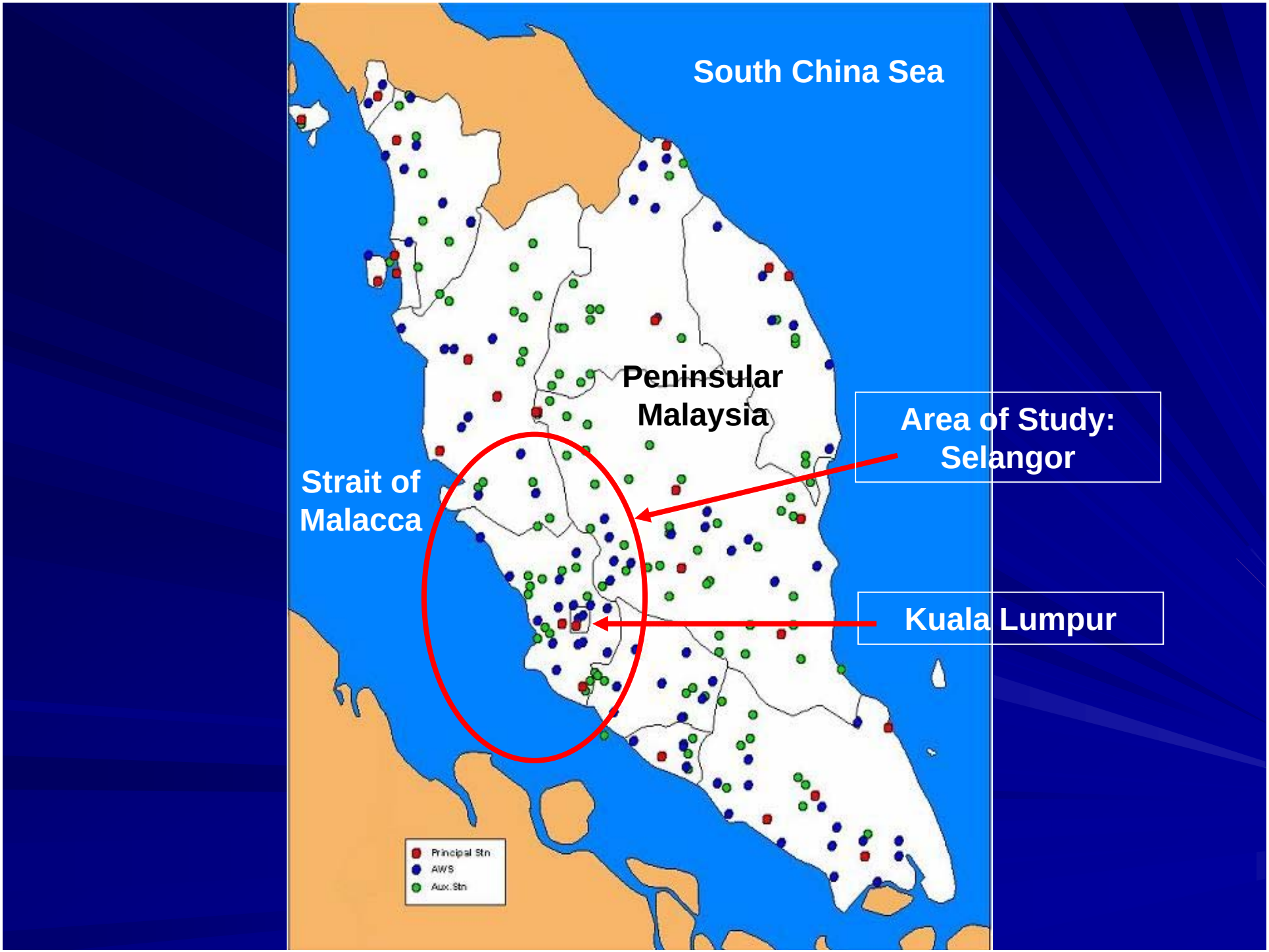
1. Pre-storm environment, storm environment and post-storm environment
2. Trajectory of the MCCs

DATA SOURCES

1. ECMWF ANALYSIS DATA
2. ECMWF REANALYSIS DATA (ERA 40)
3. JRA-25 REANALYSIS DATA
4. JMA ANALYSIS DATA
5. BOM OLR INDEX
6. RADAR IMAGE
7. SATELLITE IMAGE
8. SURFACE OBSERVATION DATA

CASE STUDY

1. 10 JUNE 2007
2. 21 MARCH 2007
3. 14-15 APRIL 2006

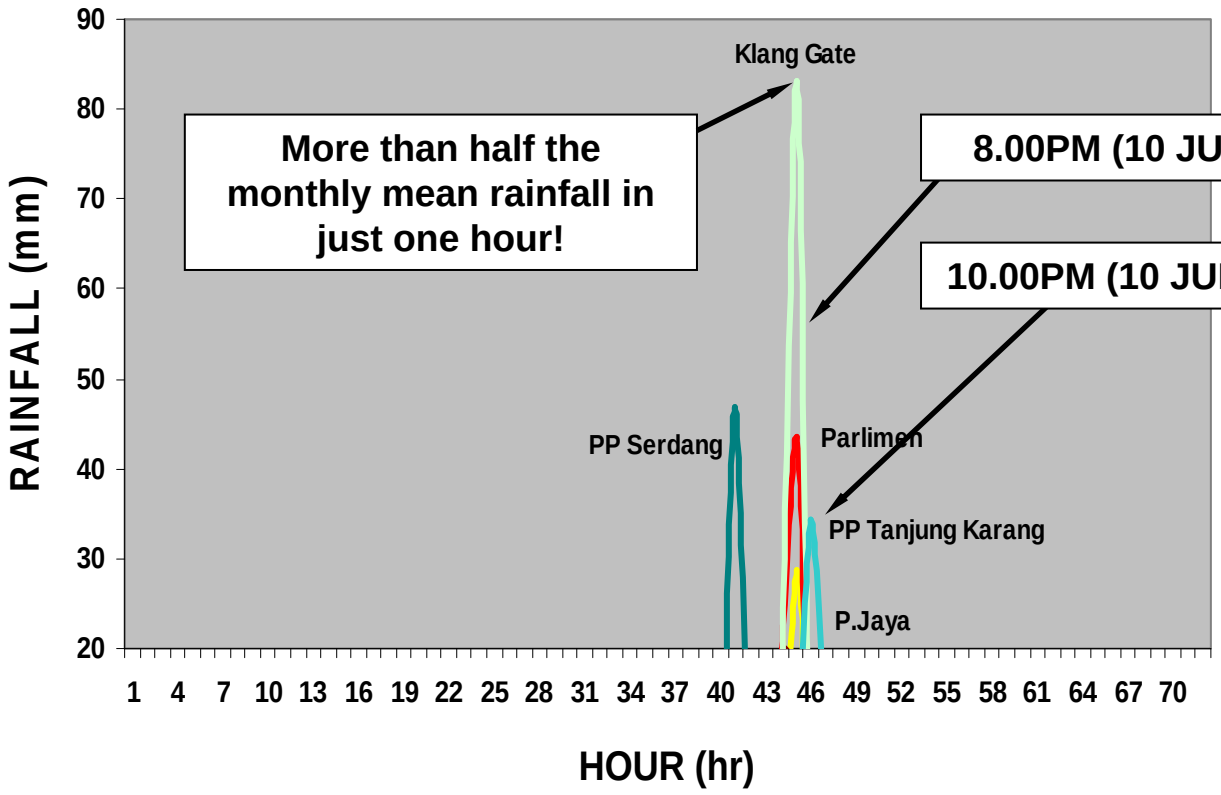

South China Sea
Peninsular Malaysia
Strait of Malacca
Area of Study: Selangor
Kuala Lumpur
Principal Stn
AWS
Aux.Stn

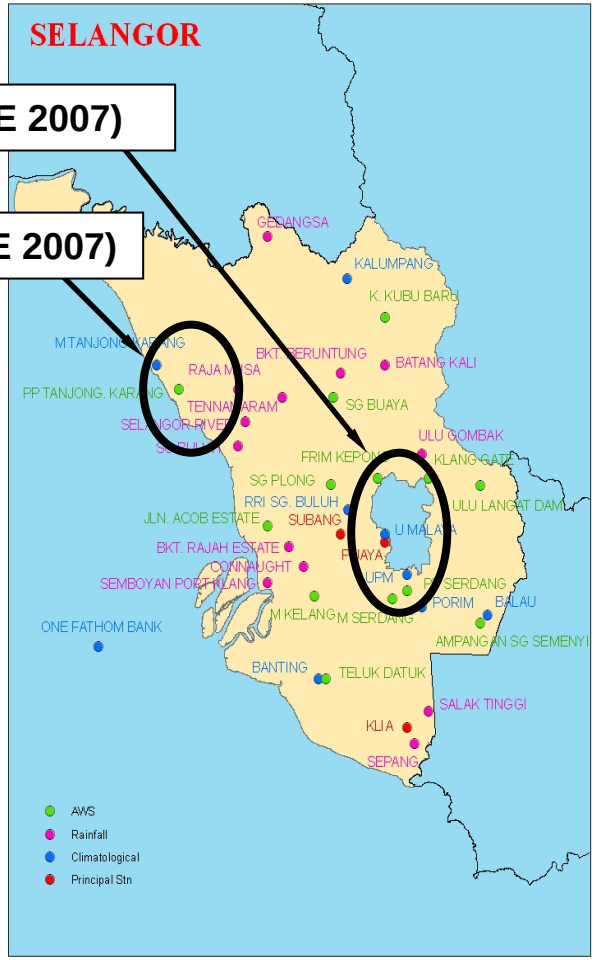

PERAK
PAHANG
SELANGOR
KUALA LUMPUR
NEGERI SEMBILAN
STRAIT OF MALACCA
GEDANGSA
SG. BESAR
KALUMPANG
K. KUBU BARU
M TANJONG KARANG
BKT. BERUNTUNG
BATANG KALI
RAJA MUSA
PP TANJONG KARANG
TENNAMARAM
SG BUAYA
SELANGOR RIVER
SG BULUH
FRIM KEPONG
SG PLONG
RRI SG. BULUH
JLN. ACOB ESTATE
SUBANG
U MALAYA
BKT. RAJAH ESTATE
P JAYA
CONNAUGHT
UPM
PP SERDANG
PORIM
BALAU
M KELANG
M SERDANG
ONE FATHOM BANK
AMPANGAN SG SEMENYI
BANTING
TELUK DATUK
SALAK TINGGI
KLIA
SEPANG
AWS
Rainfall
Climatological
Principal Stn

10 JUNE 2007

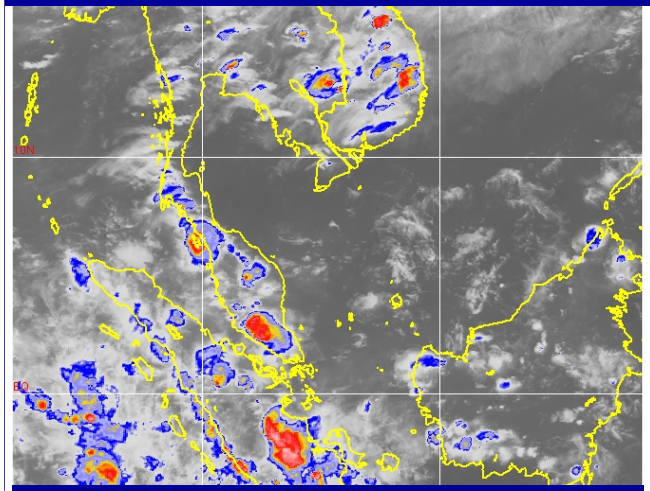
RAINFALL DISTRIBUTION

RAINFALL OVER SELECTED STATIONS FROM 9-11 JUNE 2007





SATELLITE PICTURES (10 JUNE 2007)



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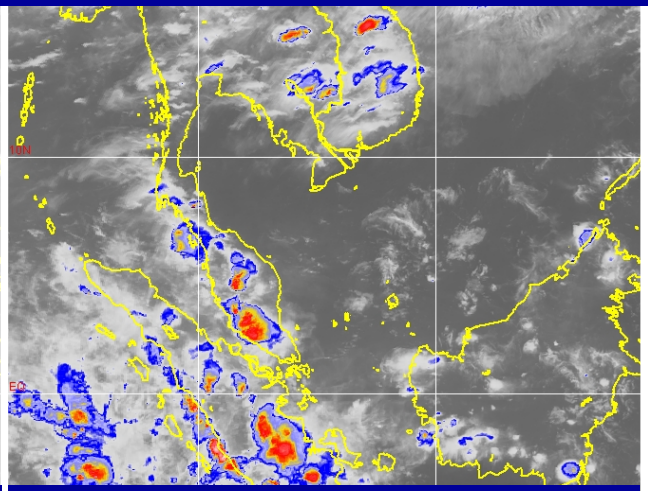
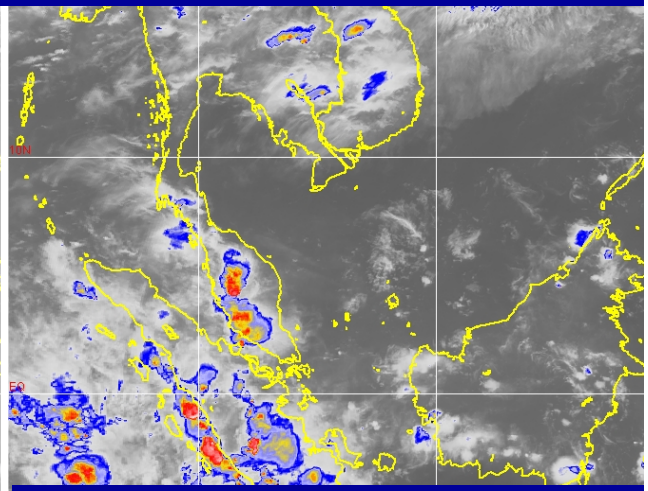
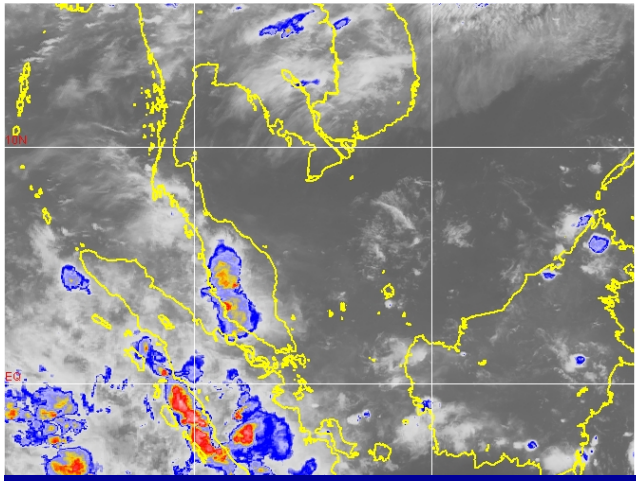


7.30PM (1130 UTC)



8.30PM (1230 UTC)



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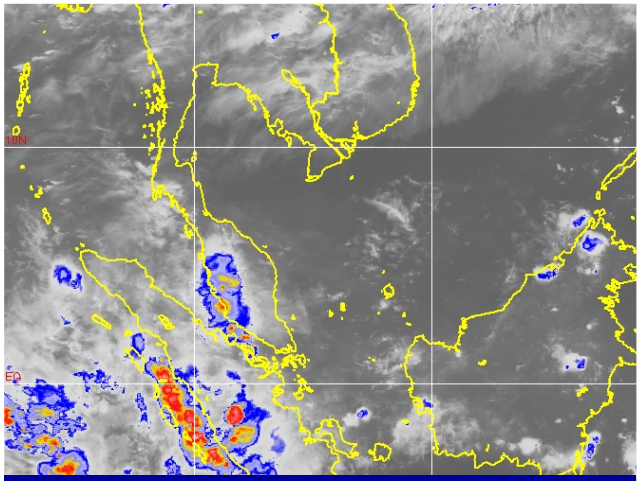

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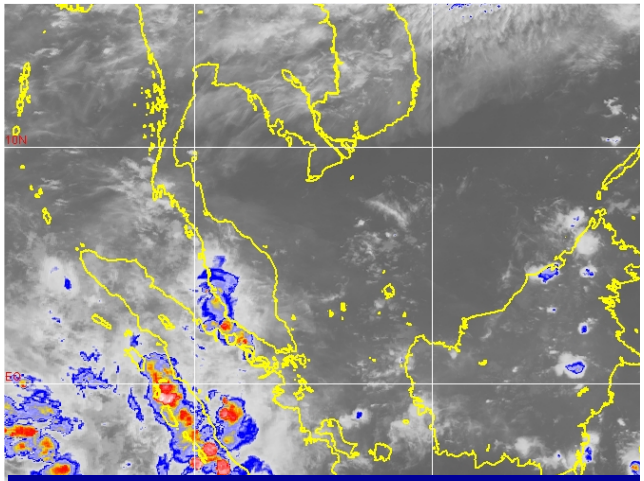
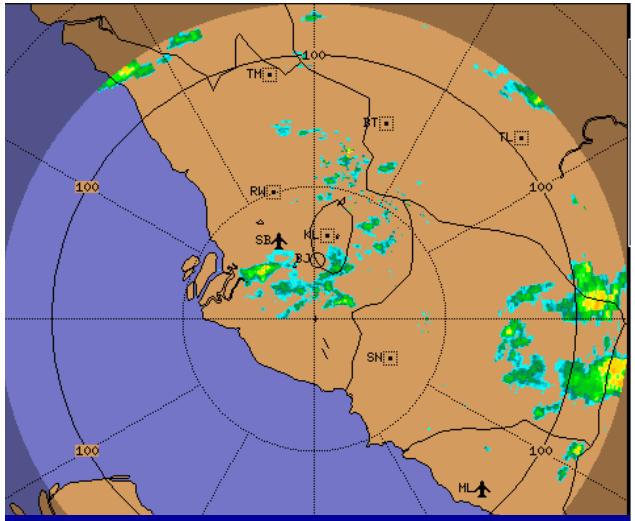


11.30PM (1530 UTC)

RADAR ECHOES (10 JUNE 2007)



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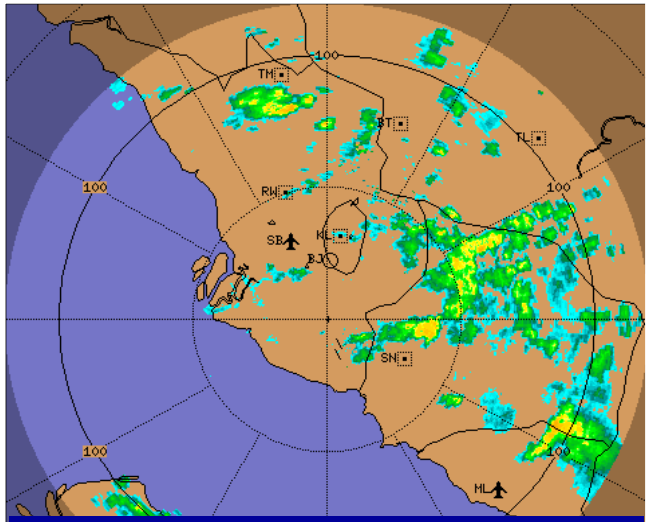

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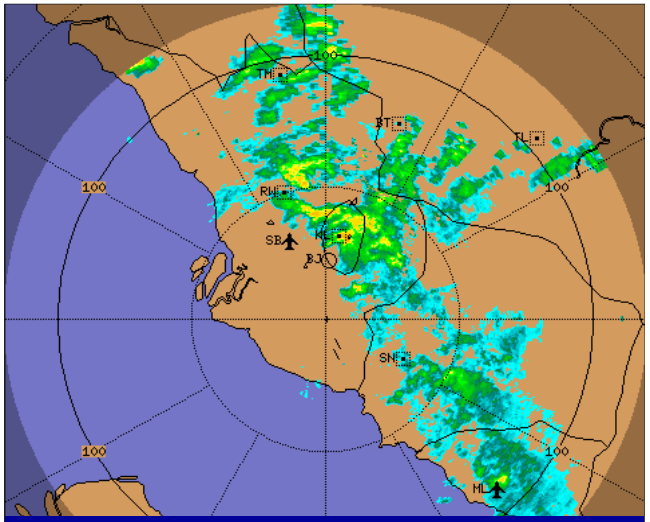

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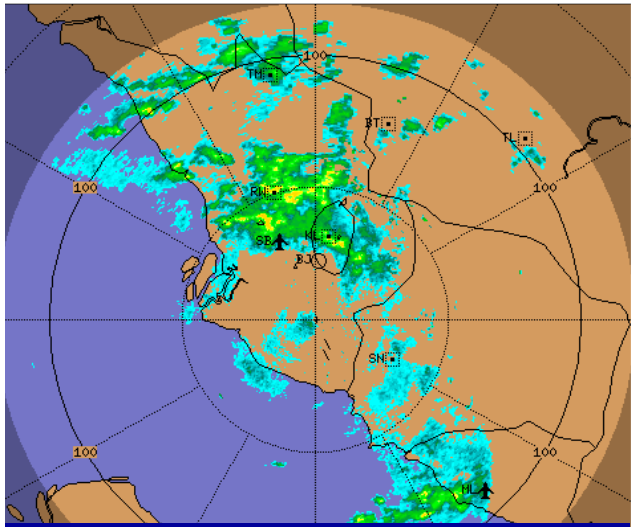

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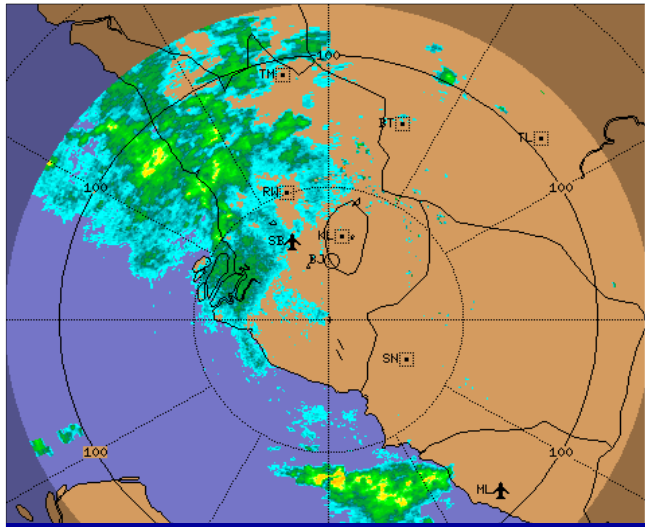

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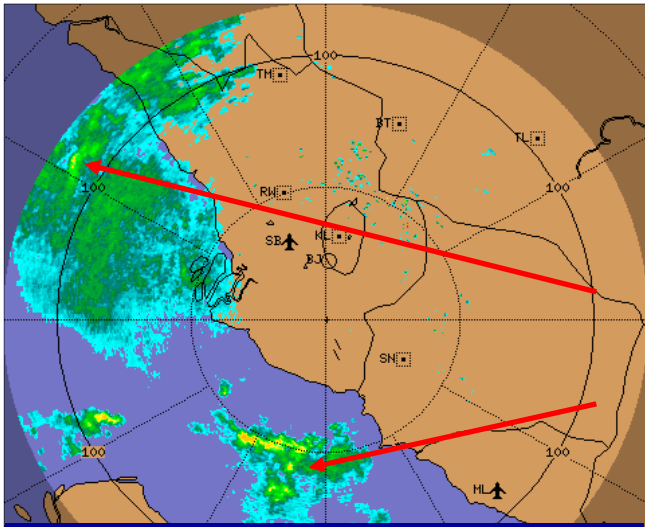

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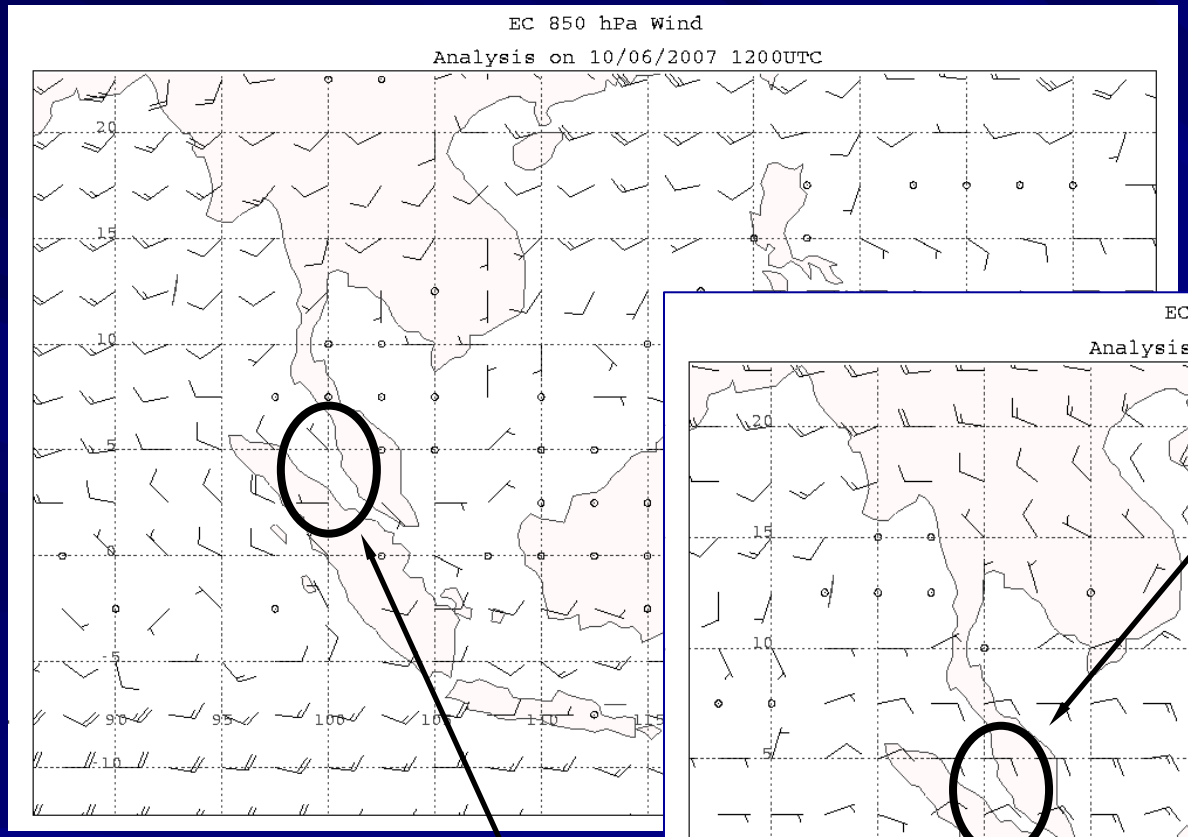
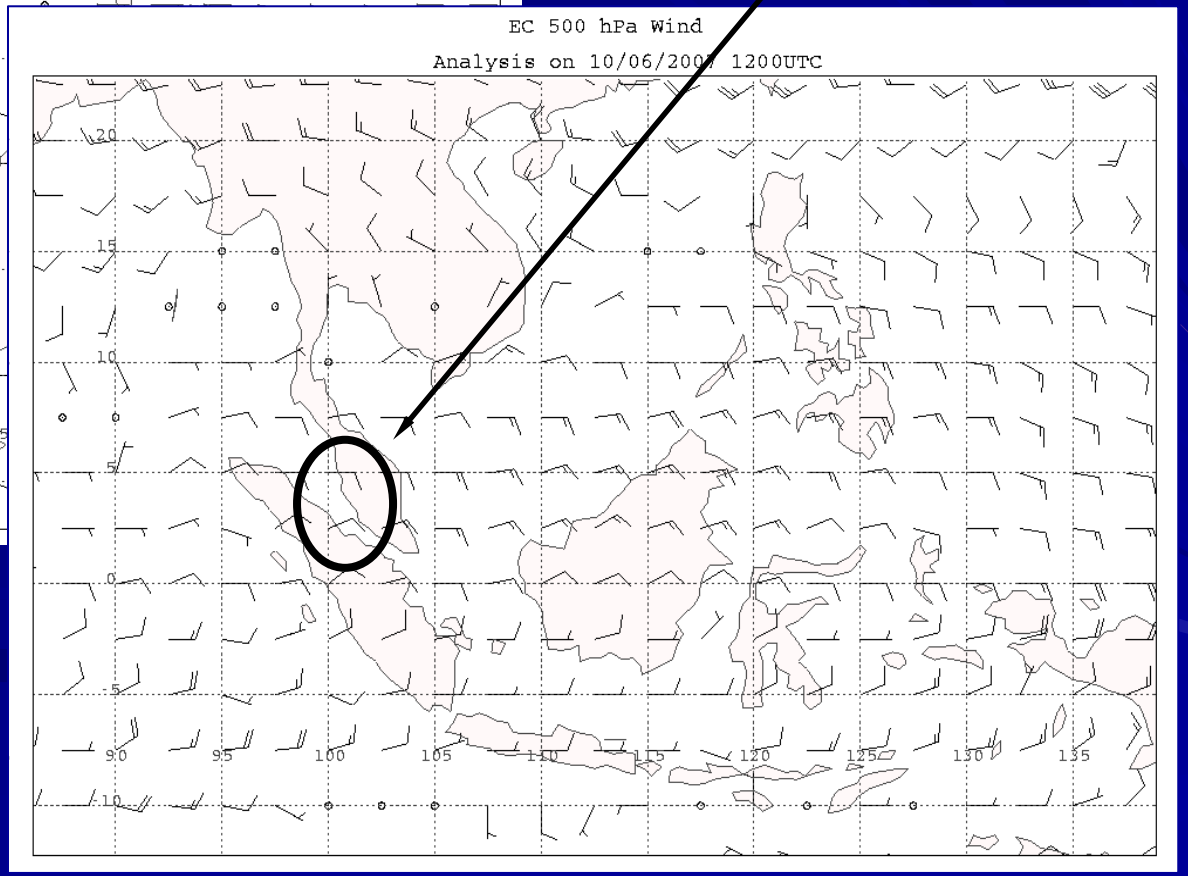
WIND ANALYSIS



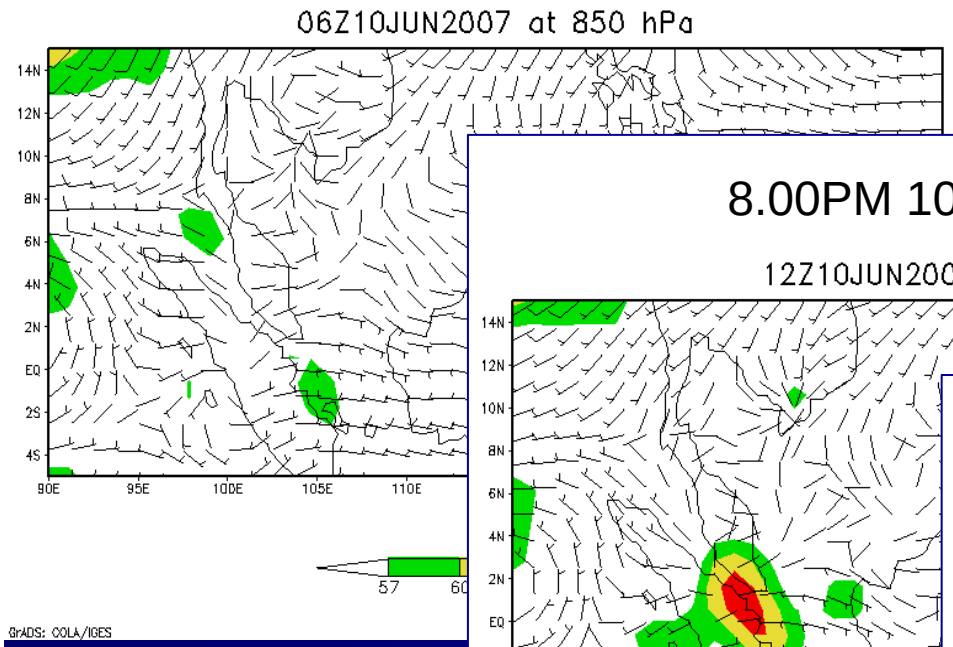
Diverging mid level winds driving the convective systems towards Strait of Malacca



No active monsoon trough but converging low level winds feeding into the convective systems

PRECIPITABLE WATER

2.00PM 10 JUNE 2007



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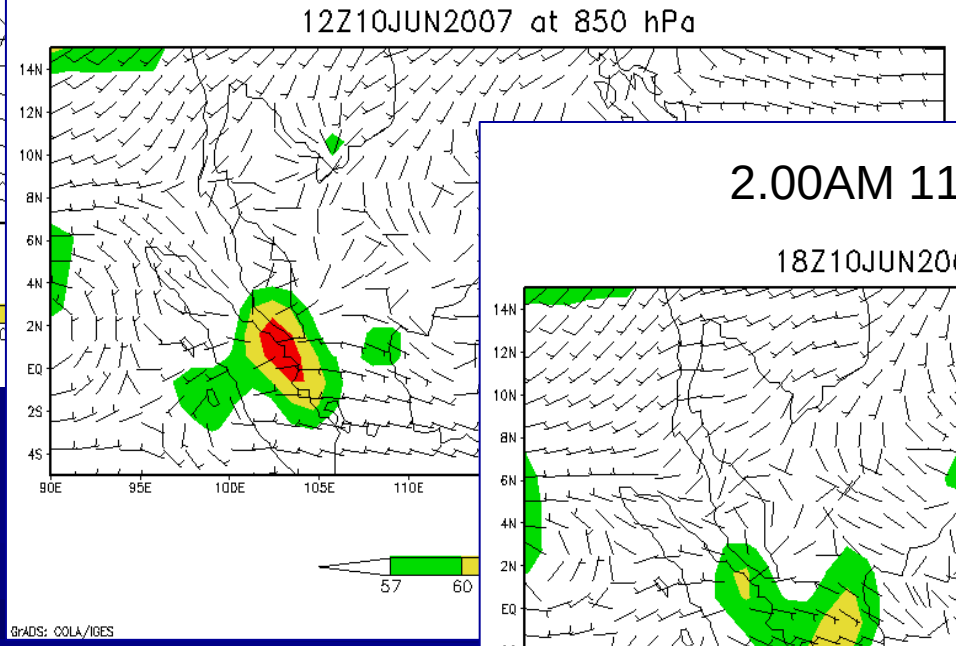

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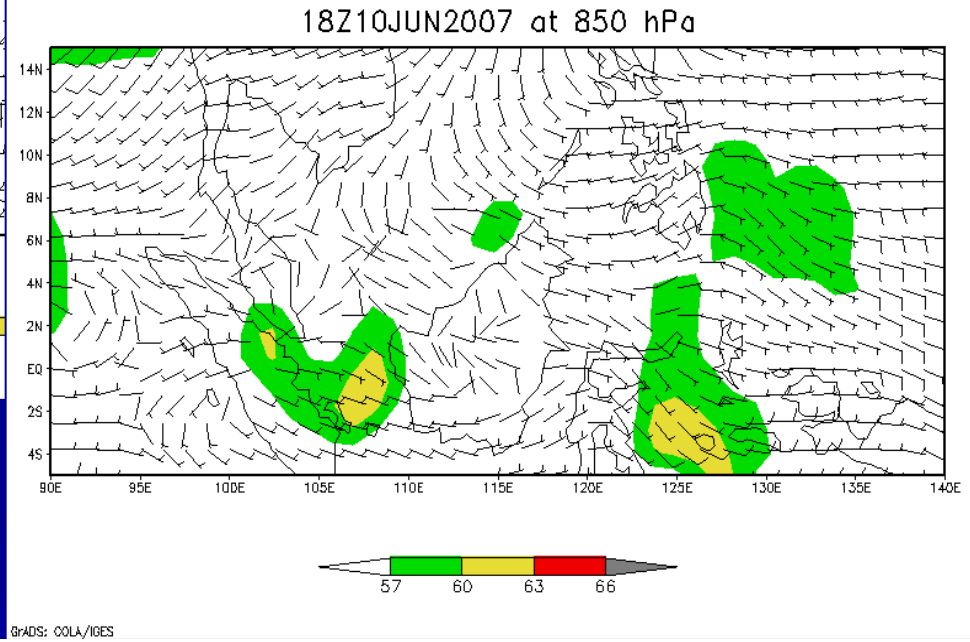
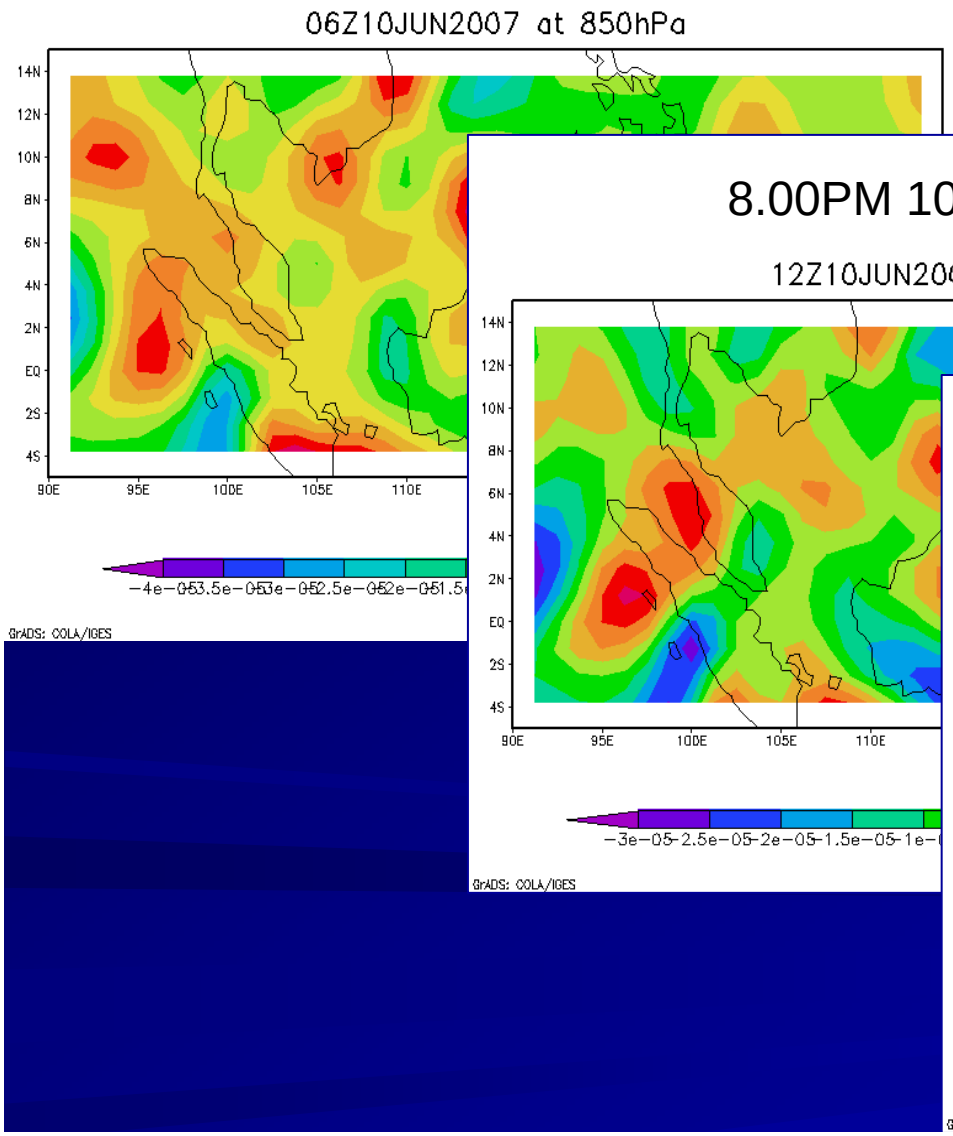


850 hPa VORTICITY

2.00PM 10 JUNE 2007



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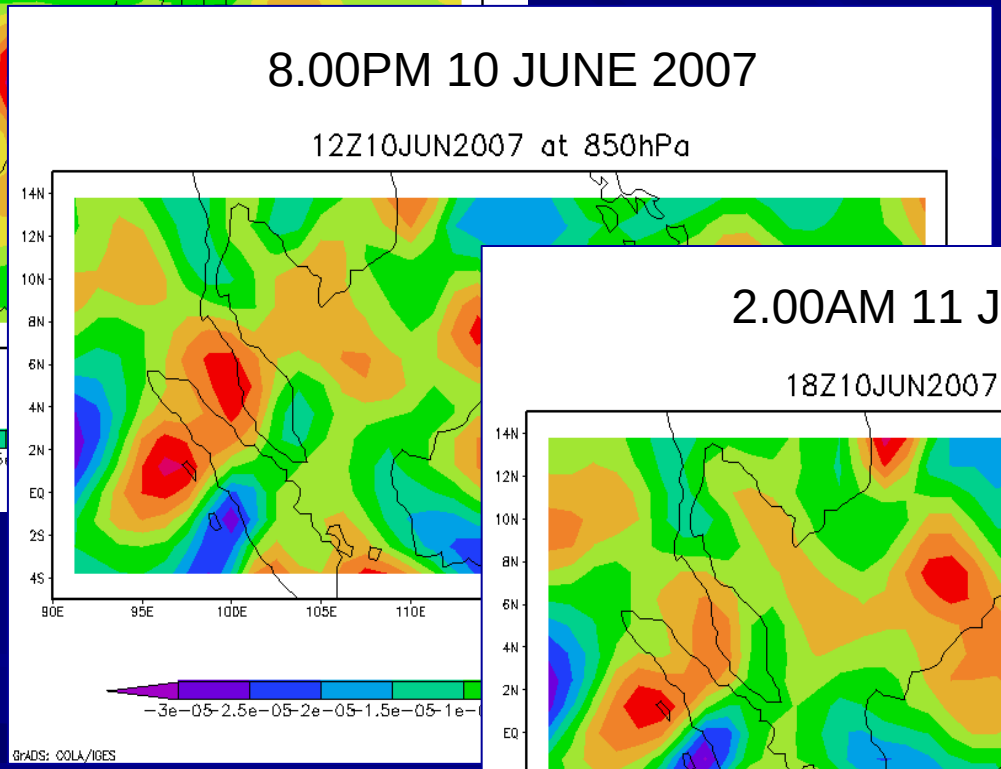

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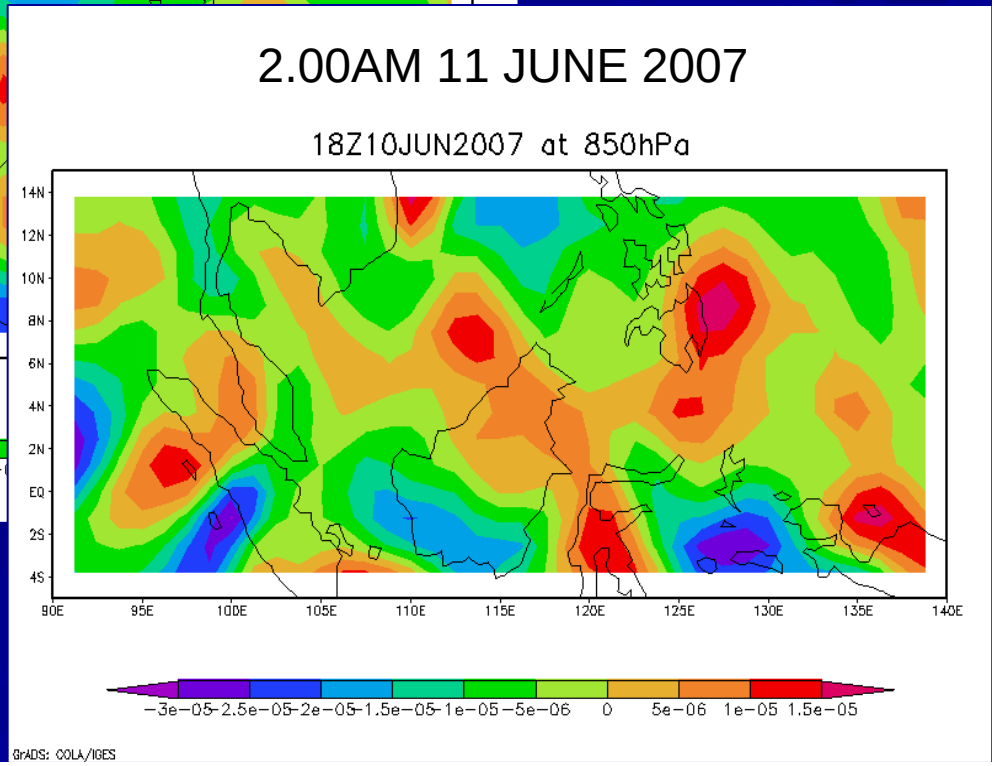
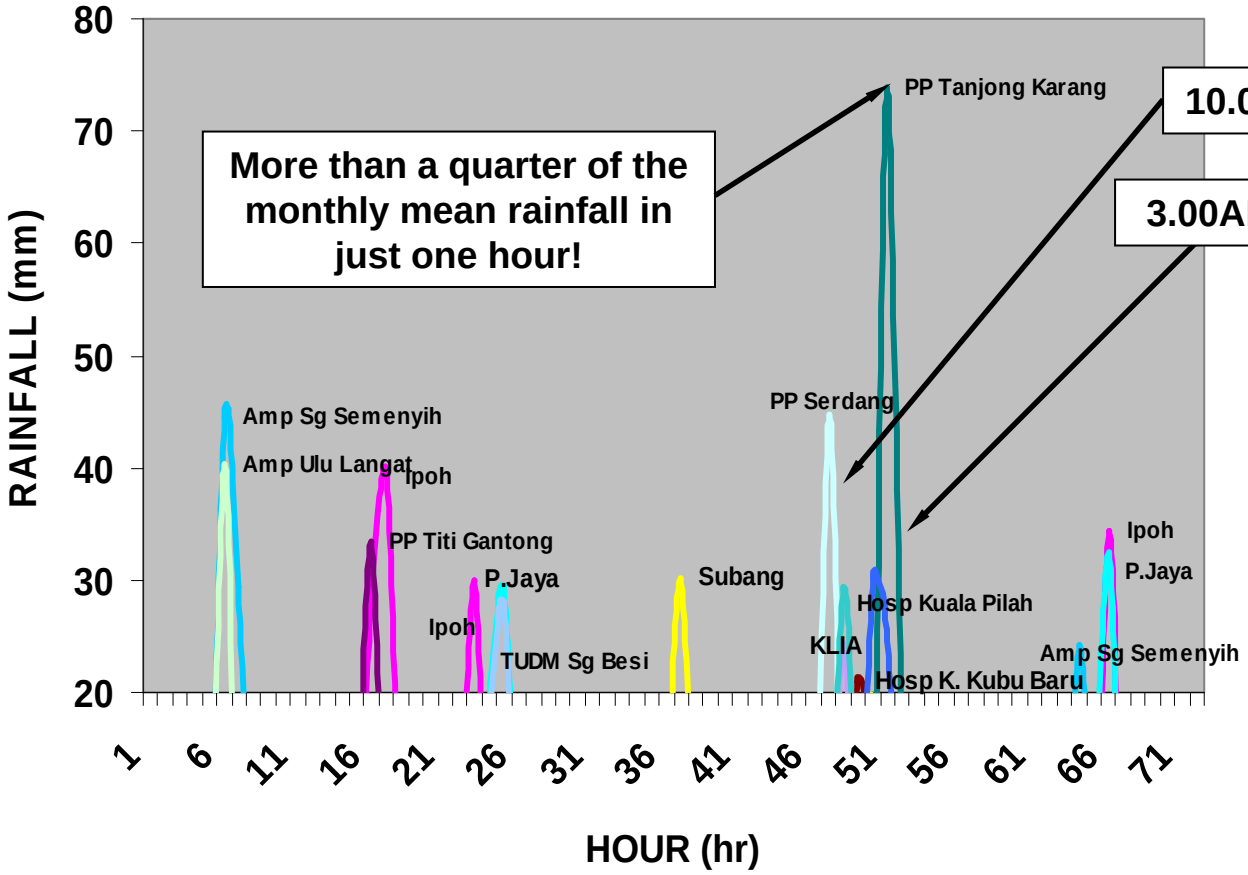
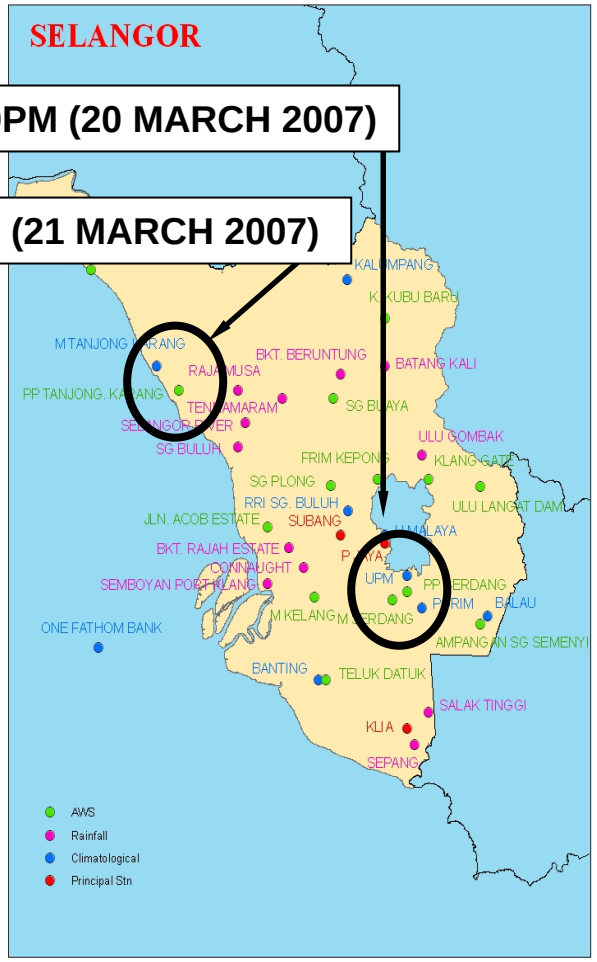


21 MARCH 2007

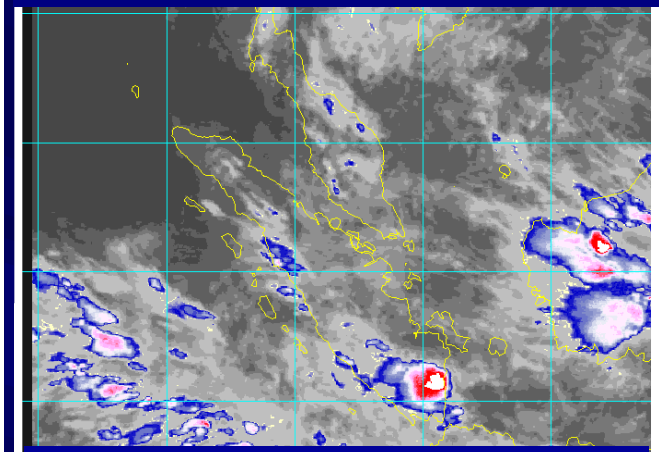
RAINFALL DISTRIBUTION

RAINFALL OVER SELECTED STATIONS FROM 19-21 MARCH 2007





SATELLITE PICYURES (20-21 MARCH 2007)



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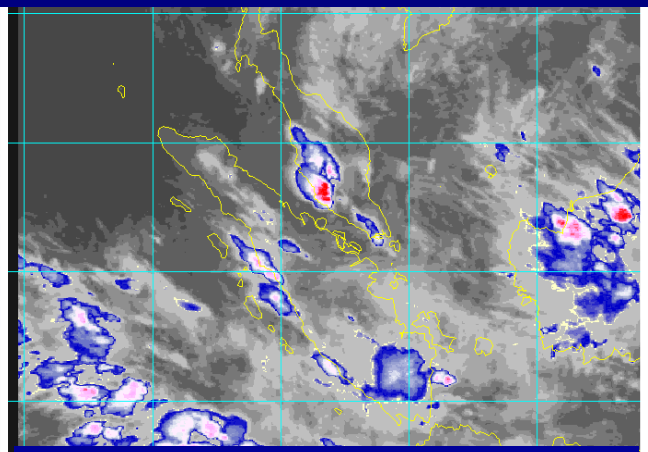
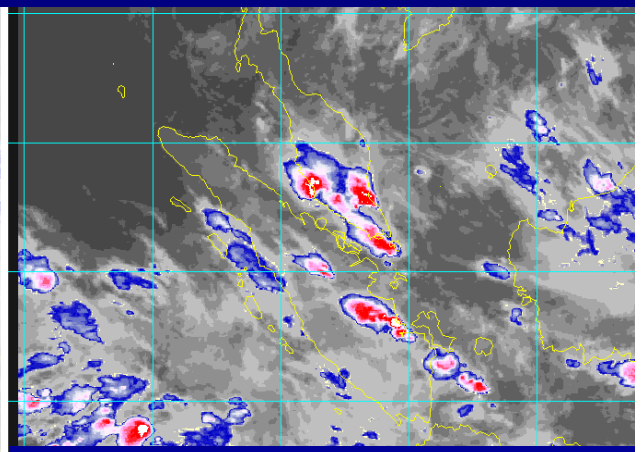
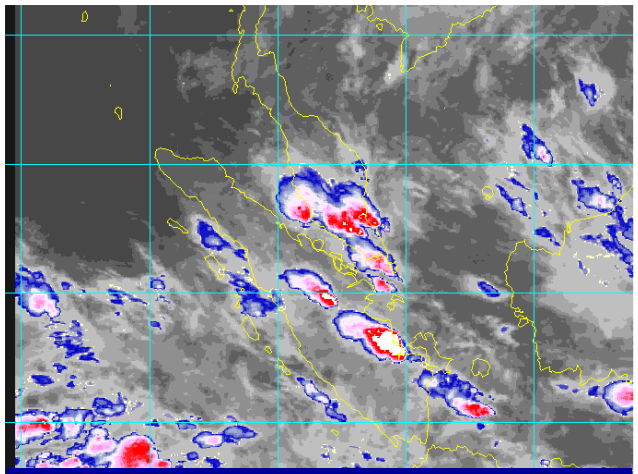


12.10AM (21/3/07)



3.10AM (21/3/07)



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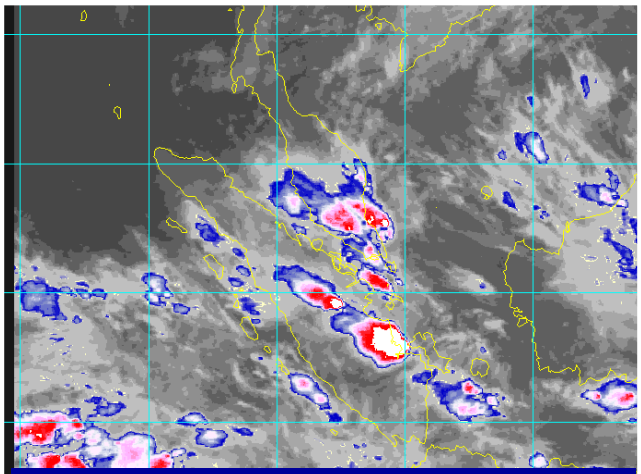
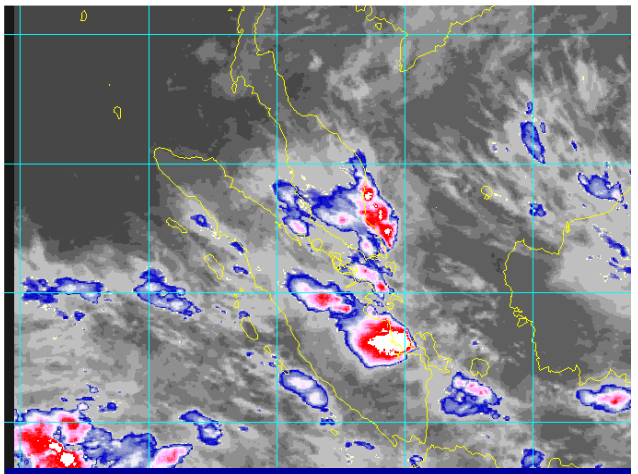
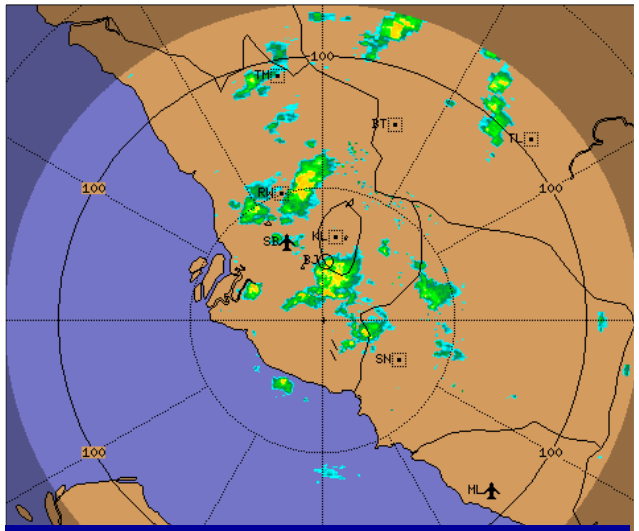


5.10AM (21/3/07)



6.10AM (21/3/07)

RADAR ECHOES (20-21 MARCH 2007)



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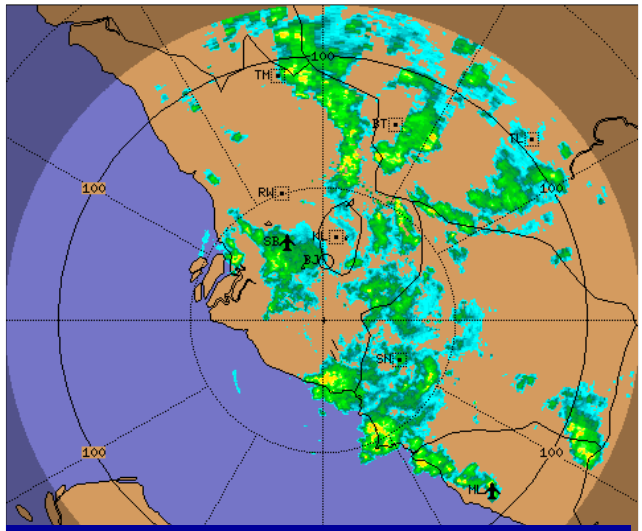

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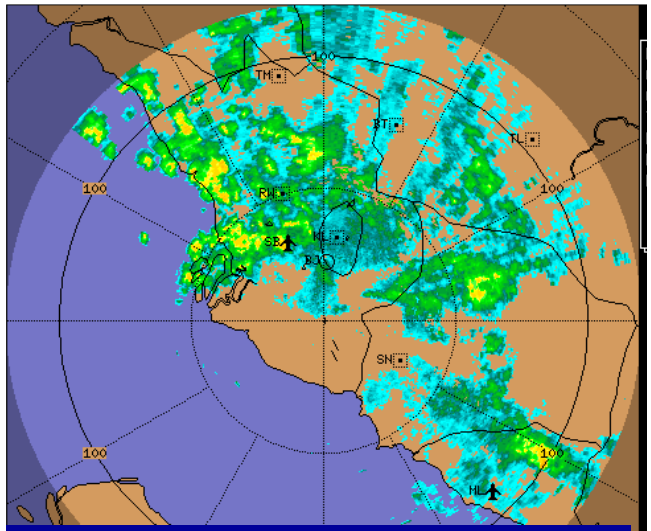

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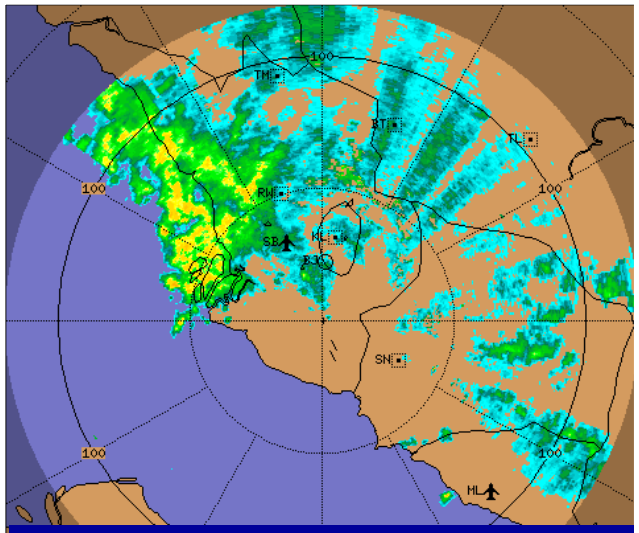

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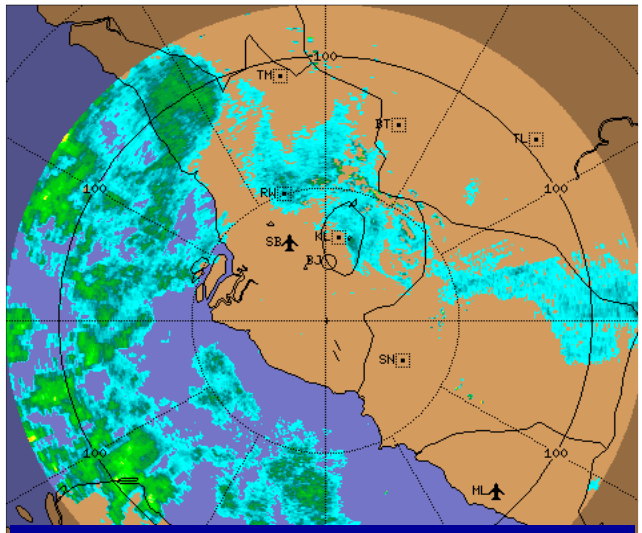

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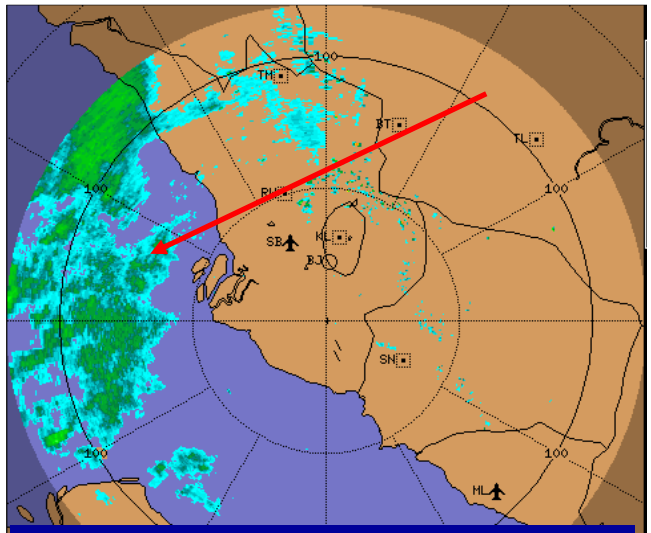
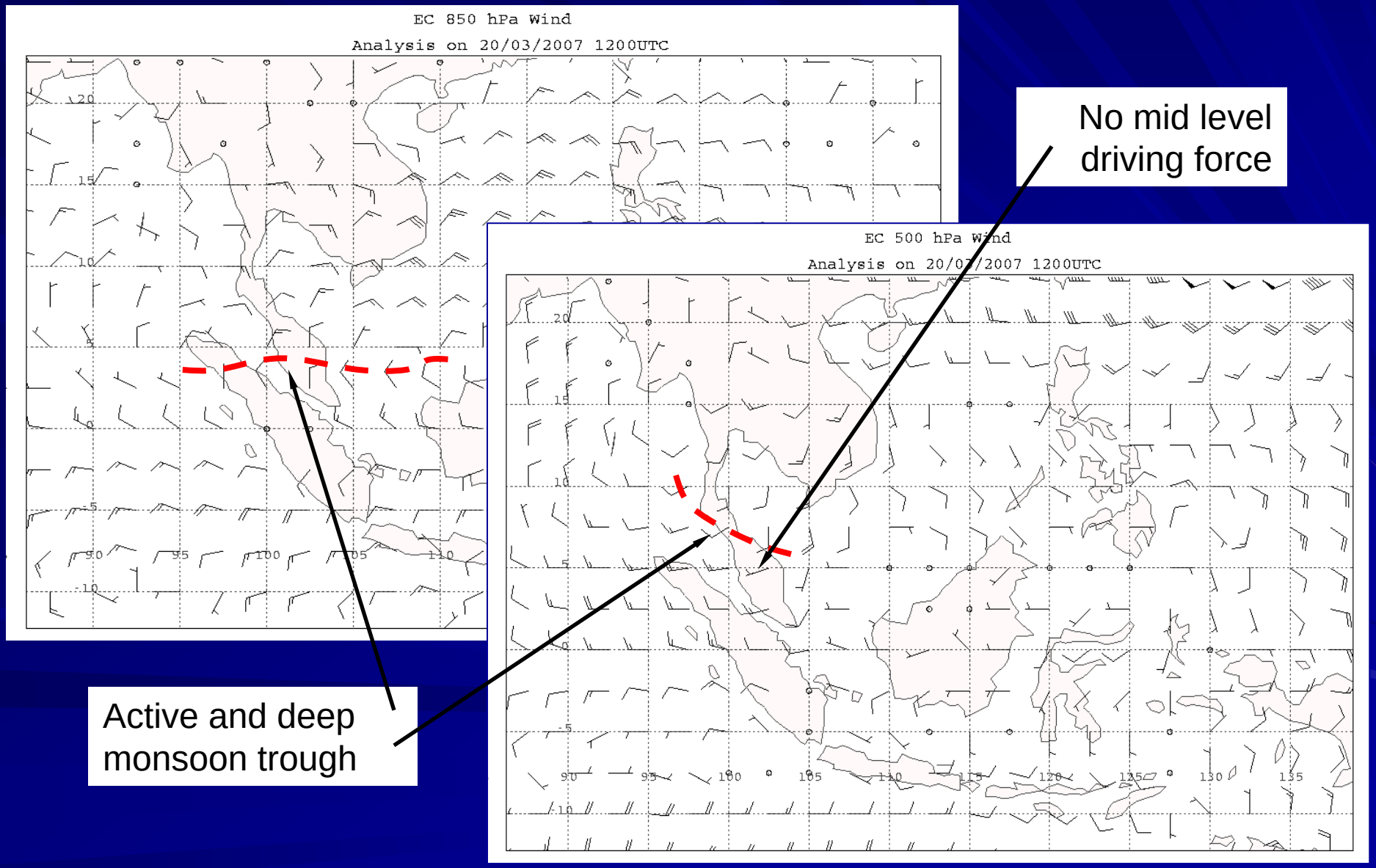


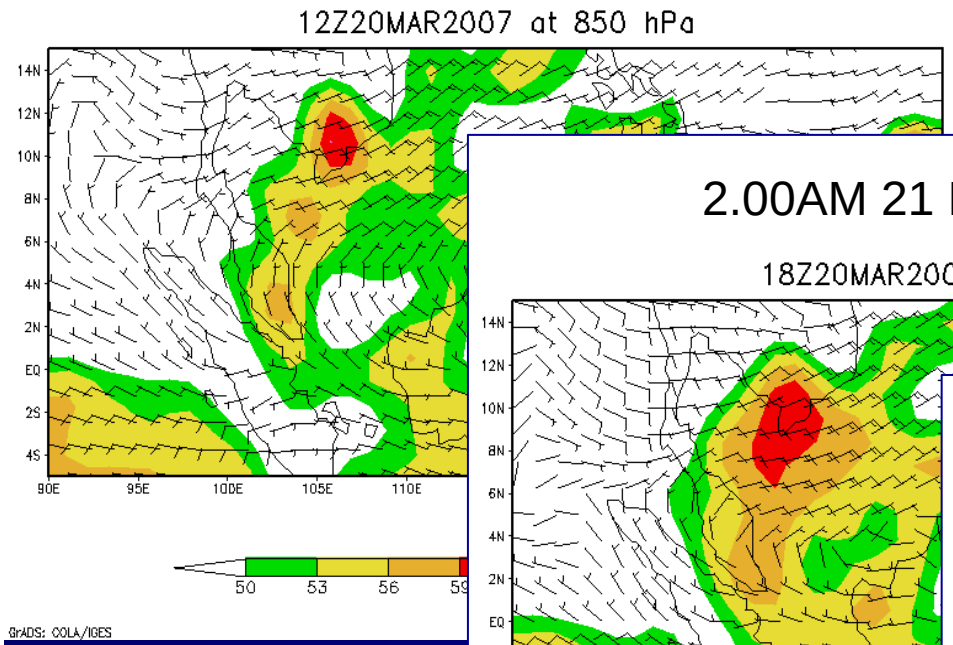
8.45AM (21/3/07)

WIND ANALYSIS

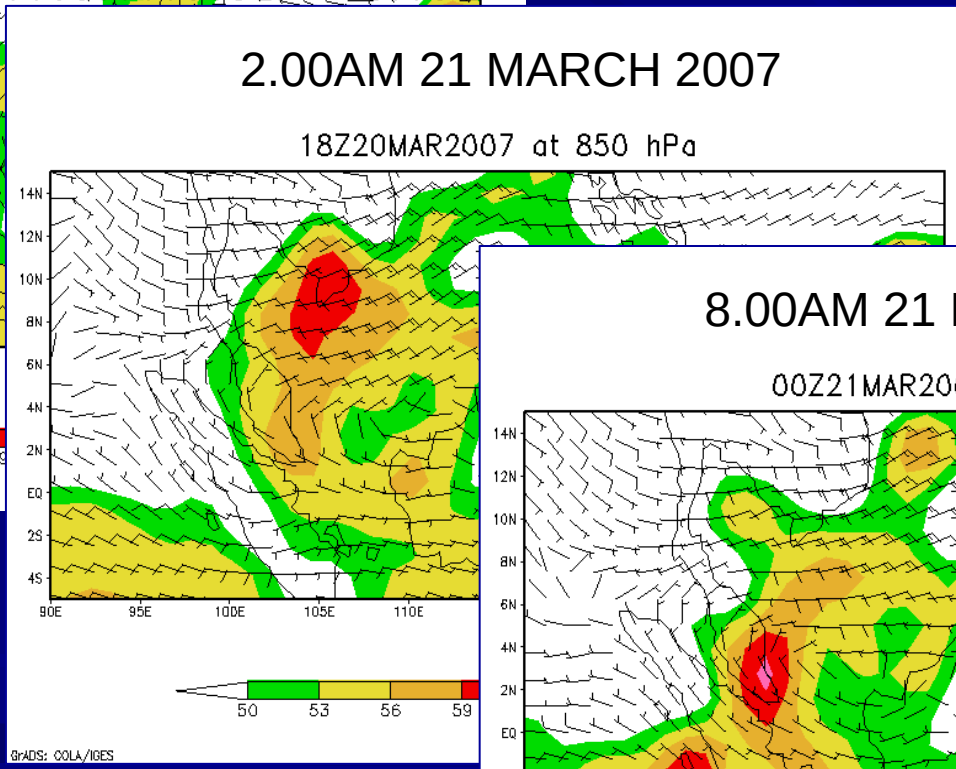


PRECIPITABLE WATER

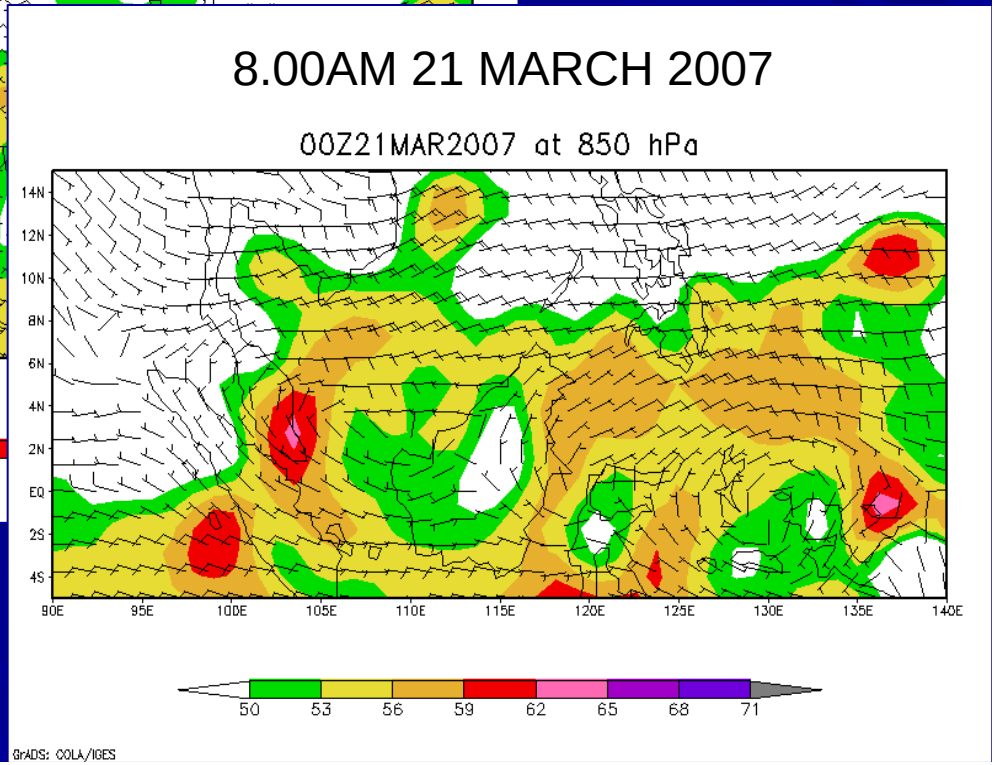
8.00PM 20 MARCH 2007



2.00AM 21 MARCH 2007

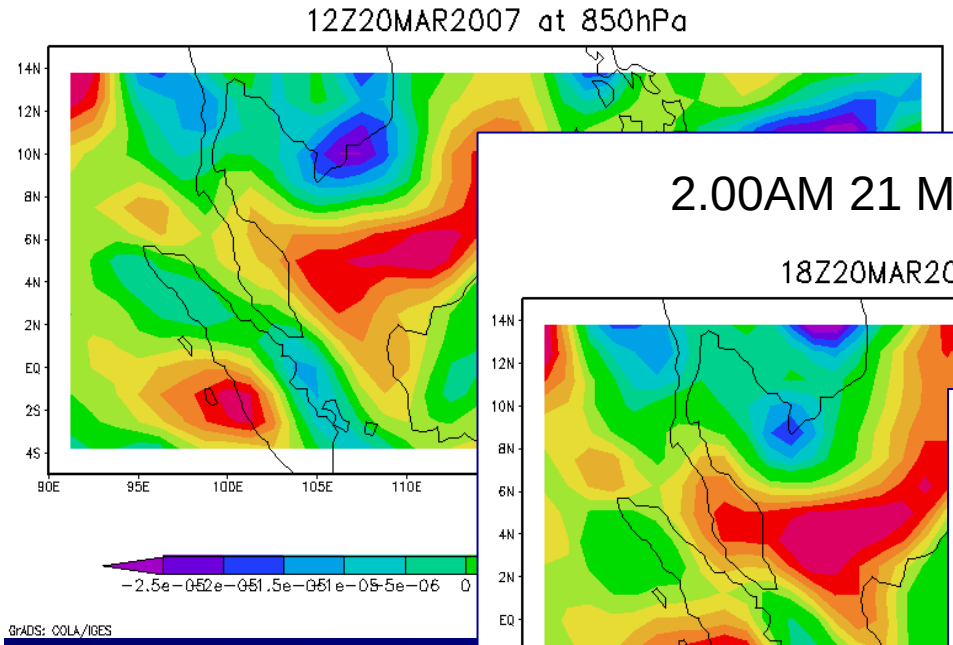


8.00AM 21 MARCH 2007



850 HPA VORTICITY

8.00PM 20 MARCH 2007



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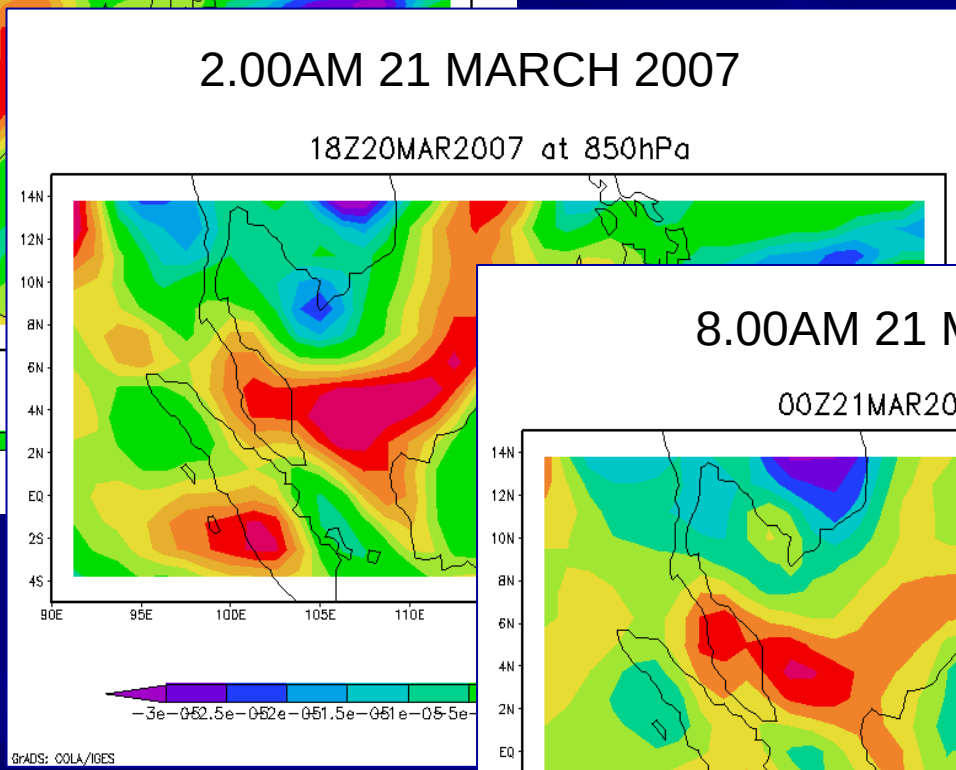

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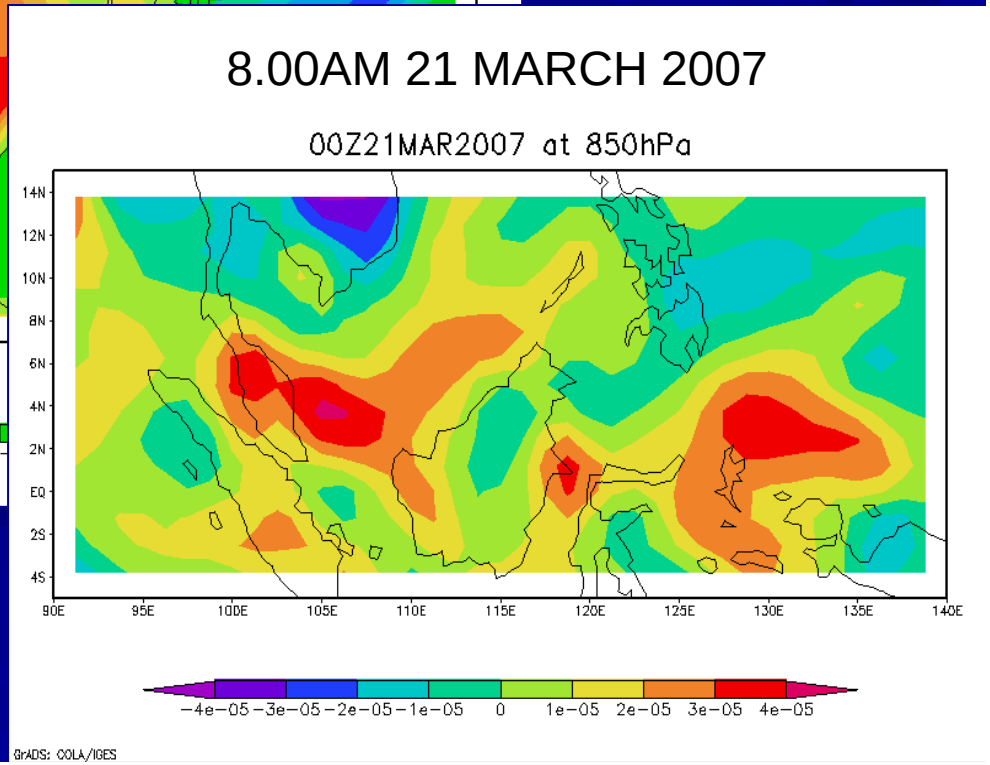

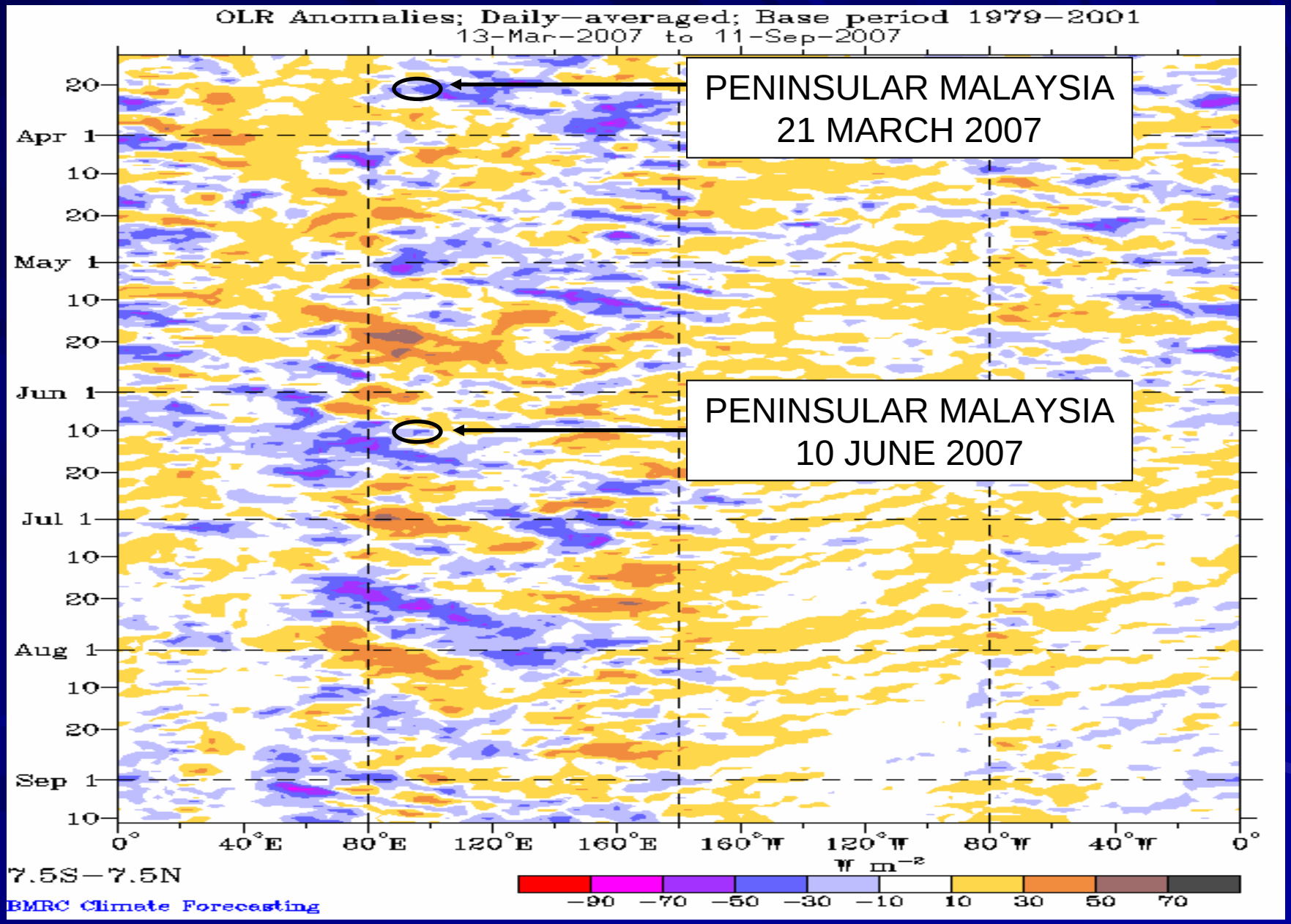
OLR Anomalies; Daily-averaged; Base period 1979-2001
13-Mar-2007 to 11-Sep-2007
PENINSULAR MALAYSIA
21 MARCH 2007
PENINSULAR MALAYSIA
10 JUNE 2007
20
Apr 1
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May 1
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Jun 1
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Jul 1
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Aug 1
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Sep 1
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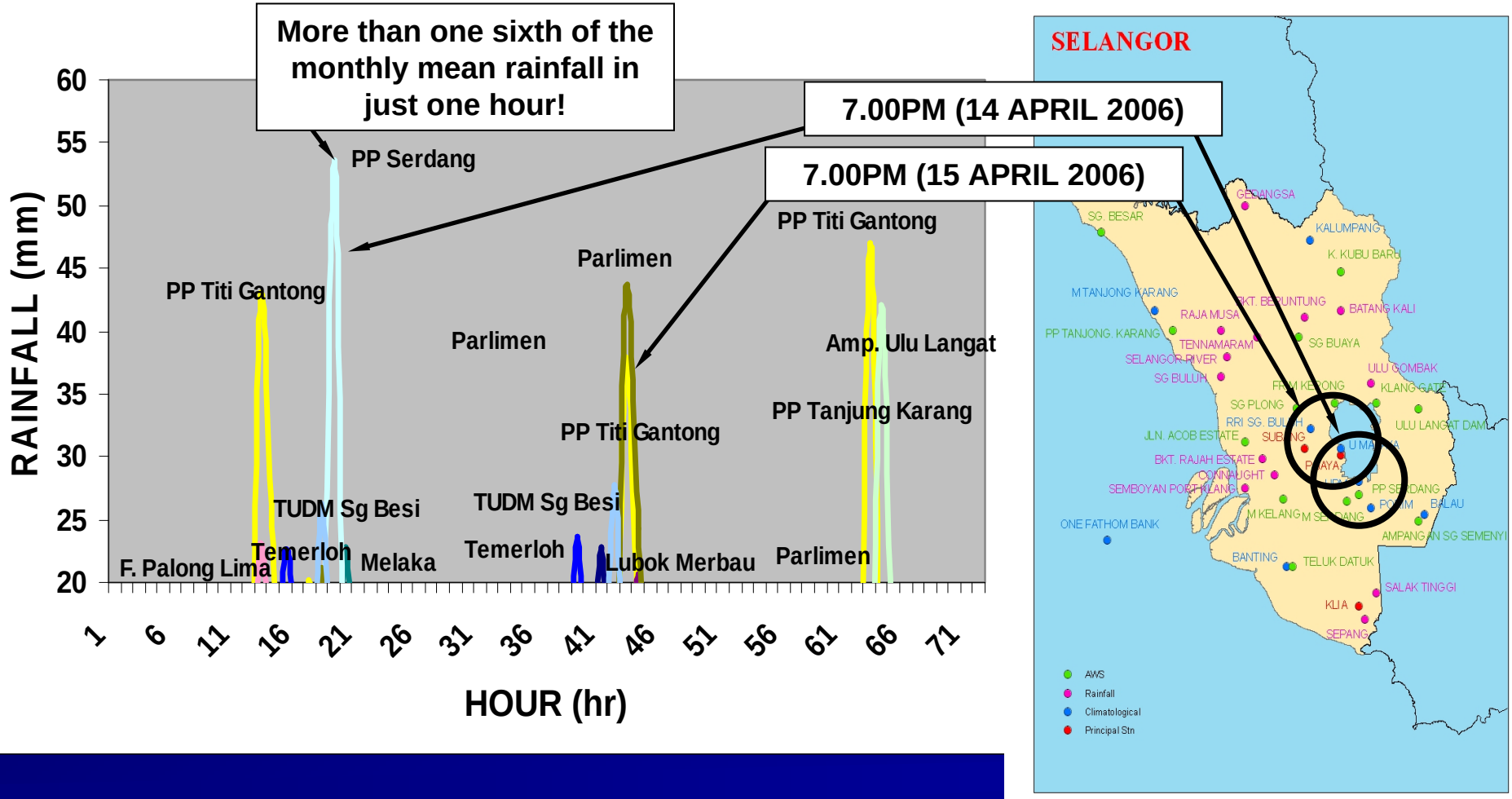
40°E
80°E
120°E
160°E
160°W
120°W
80°W
40°W
0°
7.5S-7.5N
W m⁻²
-90 -70 -50 -30 -10 10 30 50 70
BMRC Climate Forecasting

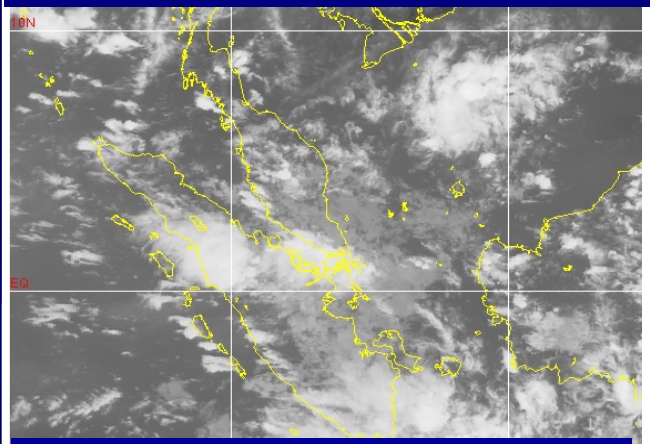
14-15 APRIL 2006

RAINFALL DISTRIBUTION

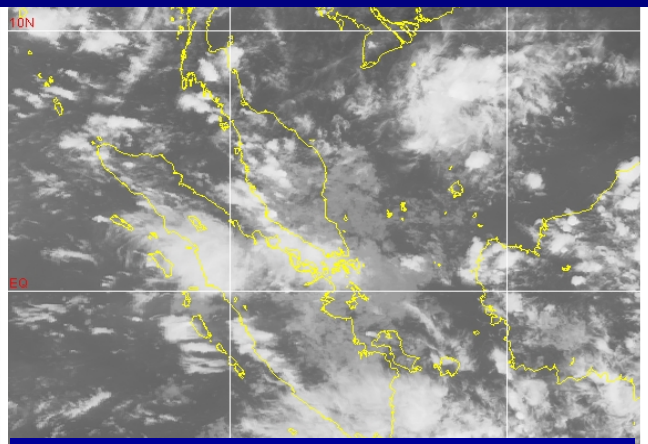
RAINFALL OVER SELECTED STATIONS FROM 14-16 APRIL 2006



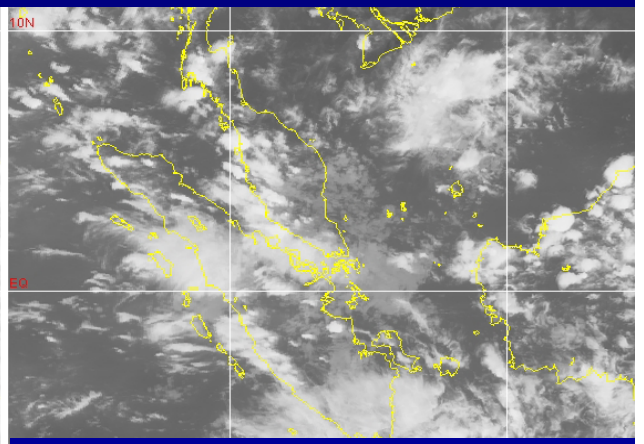
SATELLITE PICYURES (14 APRIL 2006)



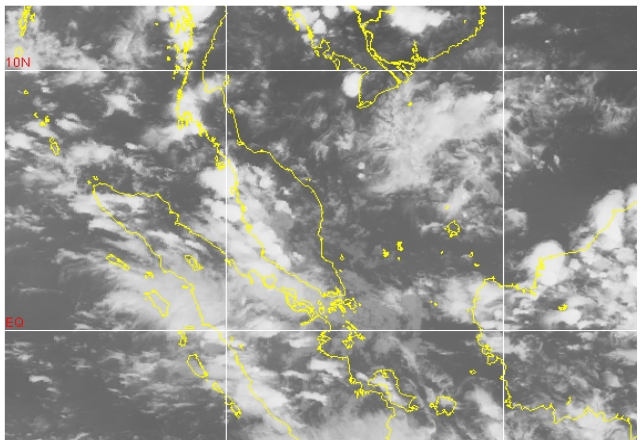
2.30PM



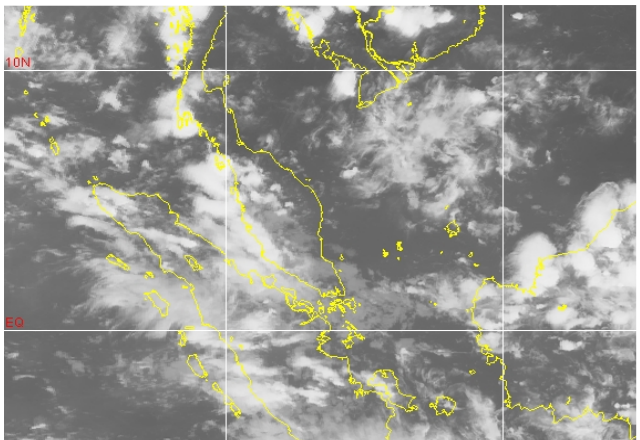
3.30PM



4.30PM



5.30PM



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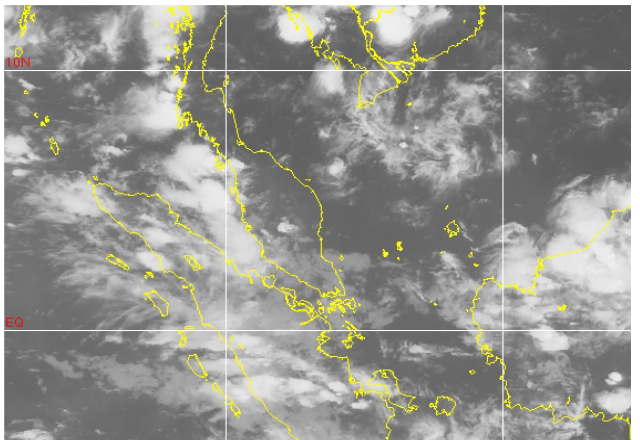
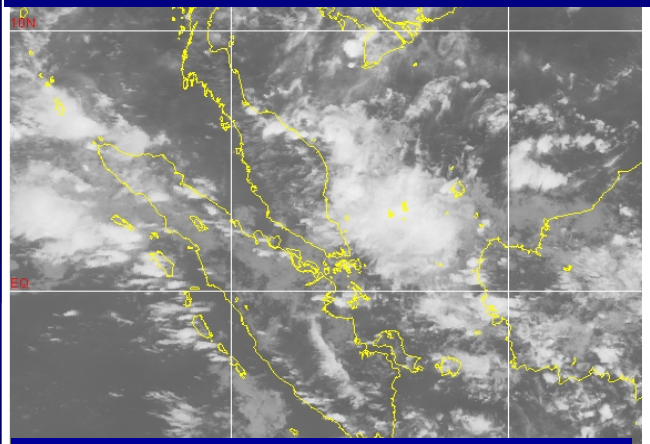


8.30PM

SATELLITE PICYURES (15 APRIL 2006)



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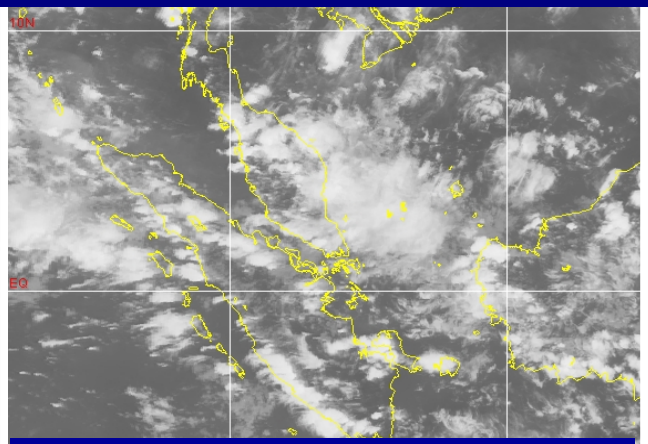

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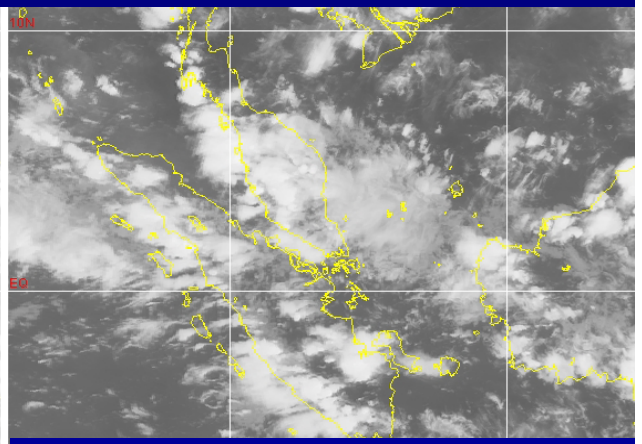

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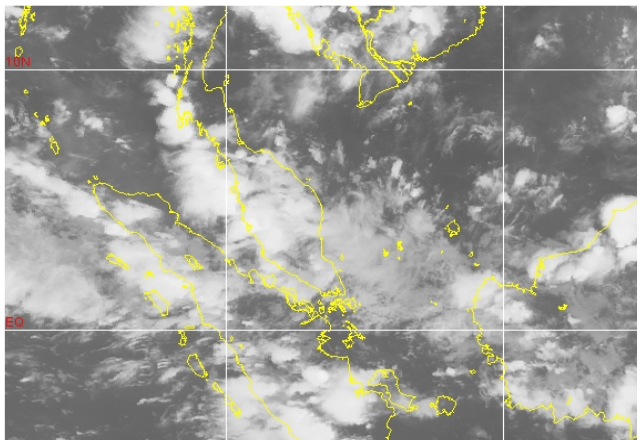

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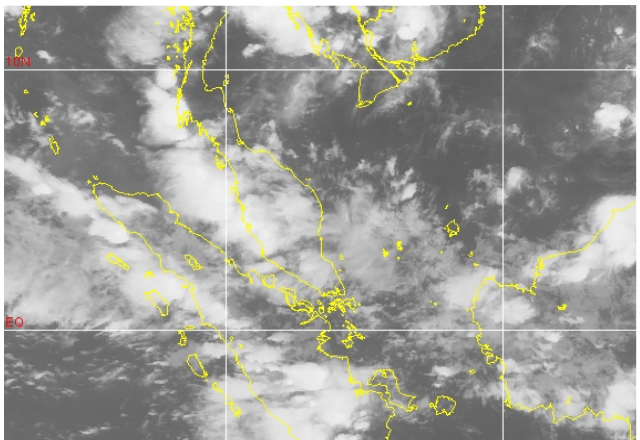
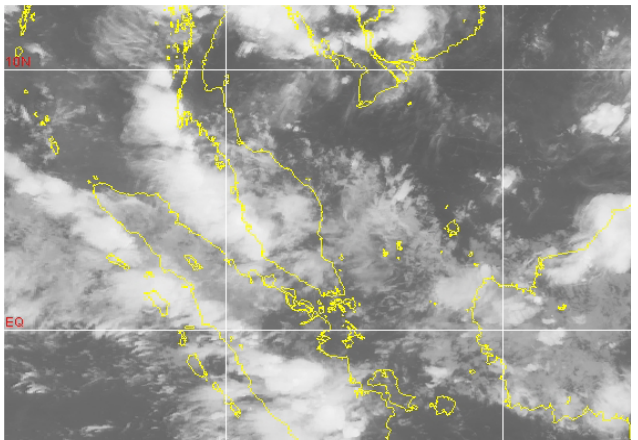
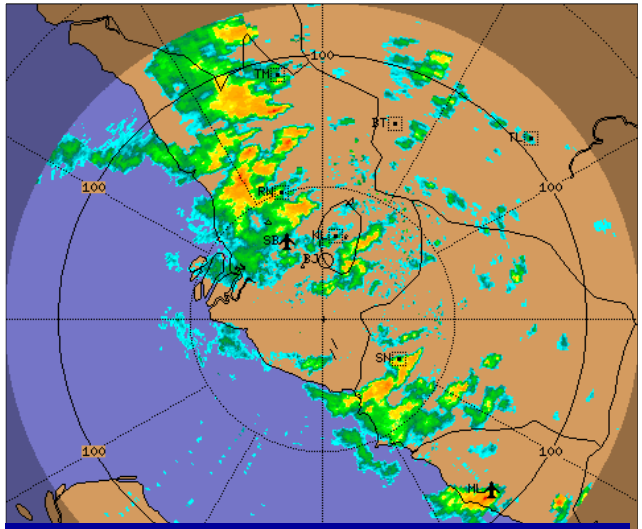


7.30PM



8.30PM

RADAR ECHOES (14 APRIL 2006)



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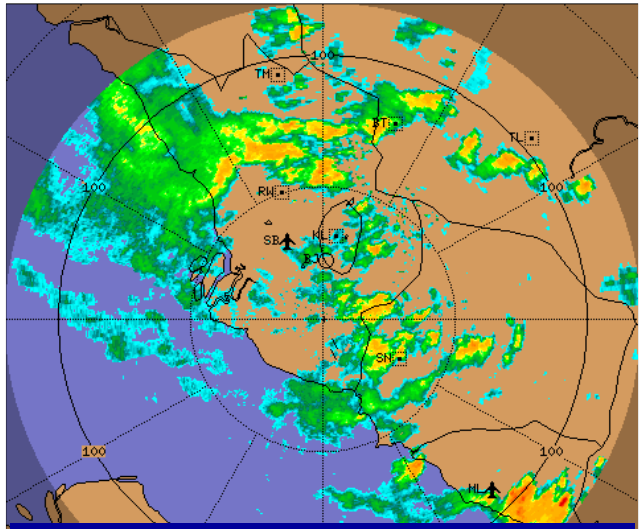

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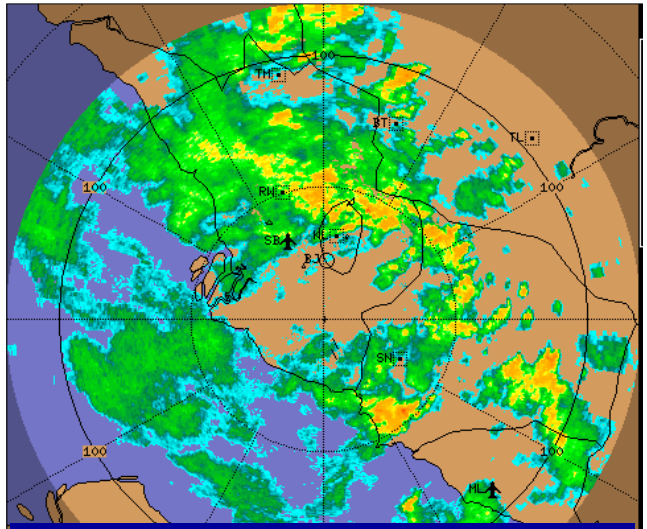

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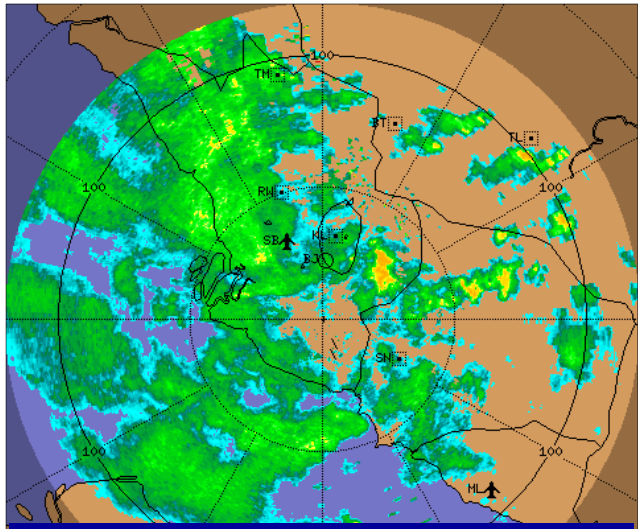

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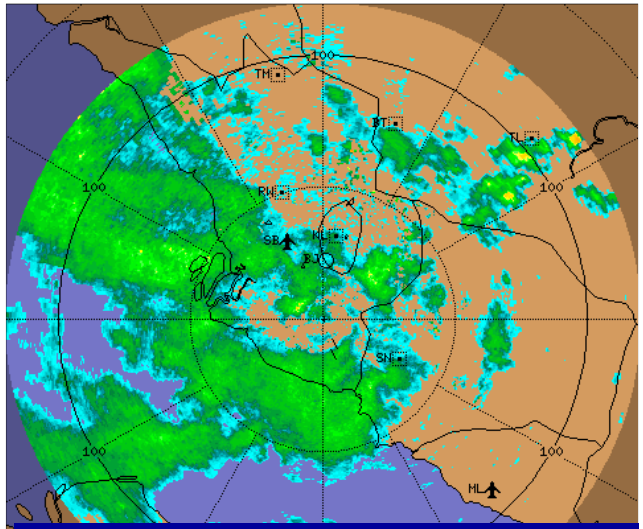

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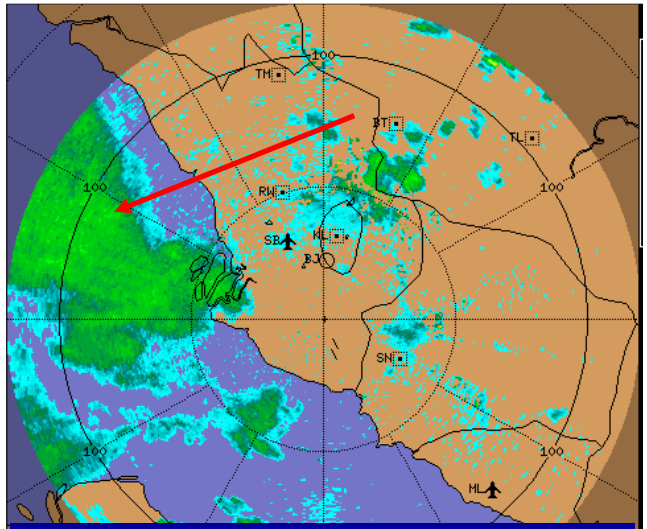
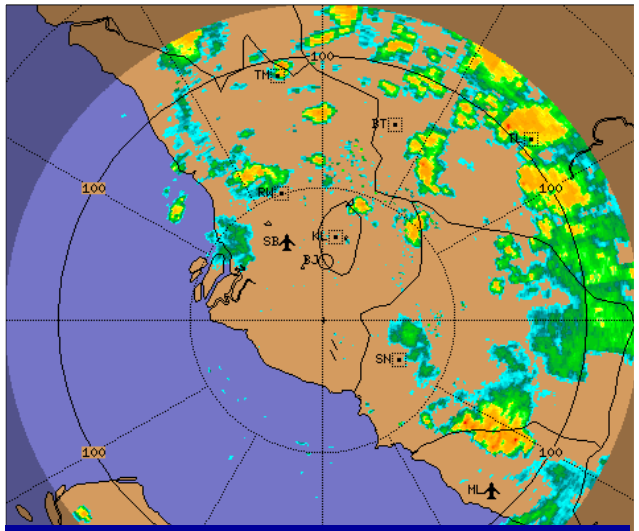


8.46PM

RADAR ECHOES (15 APRIL 2006)



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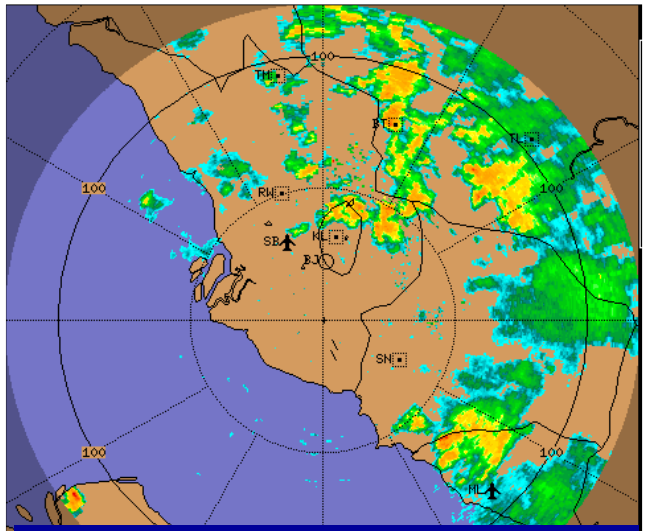

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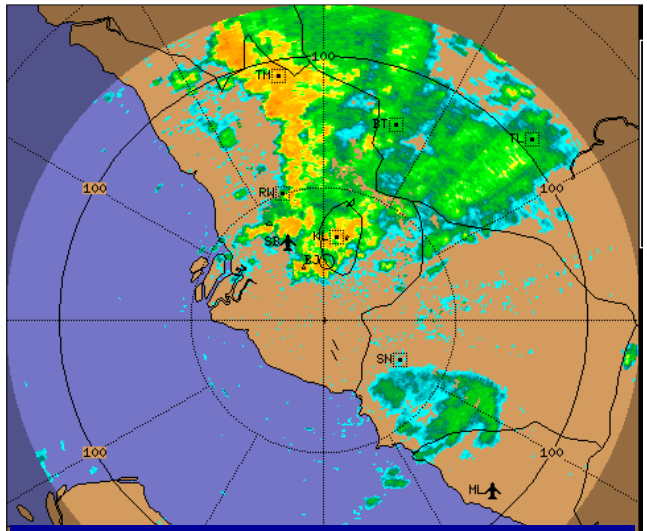

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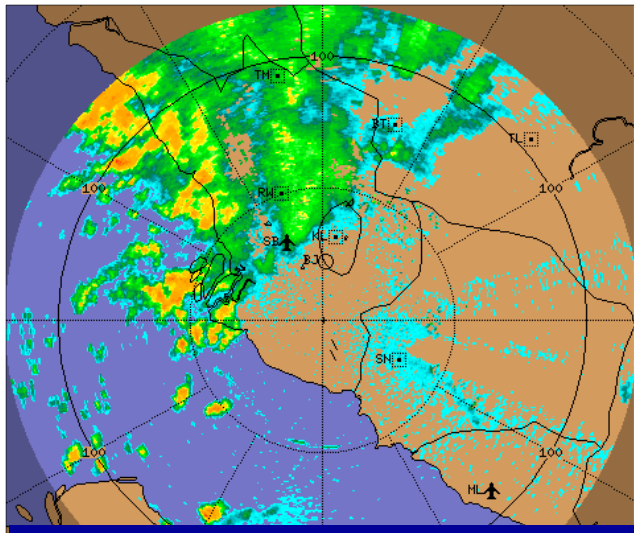

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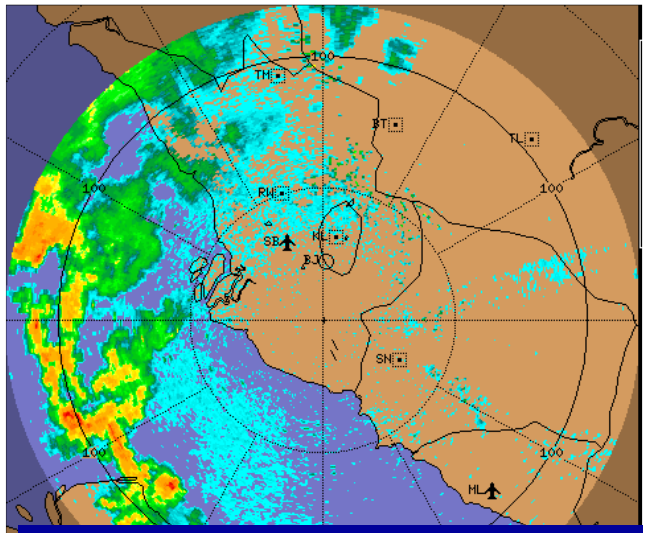

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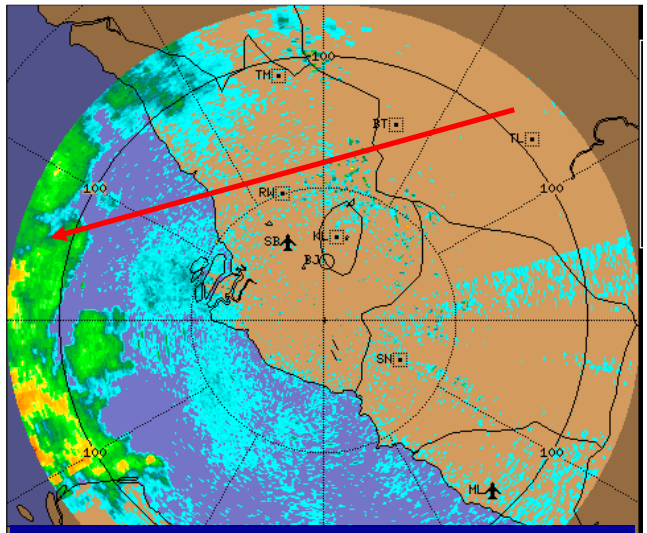
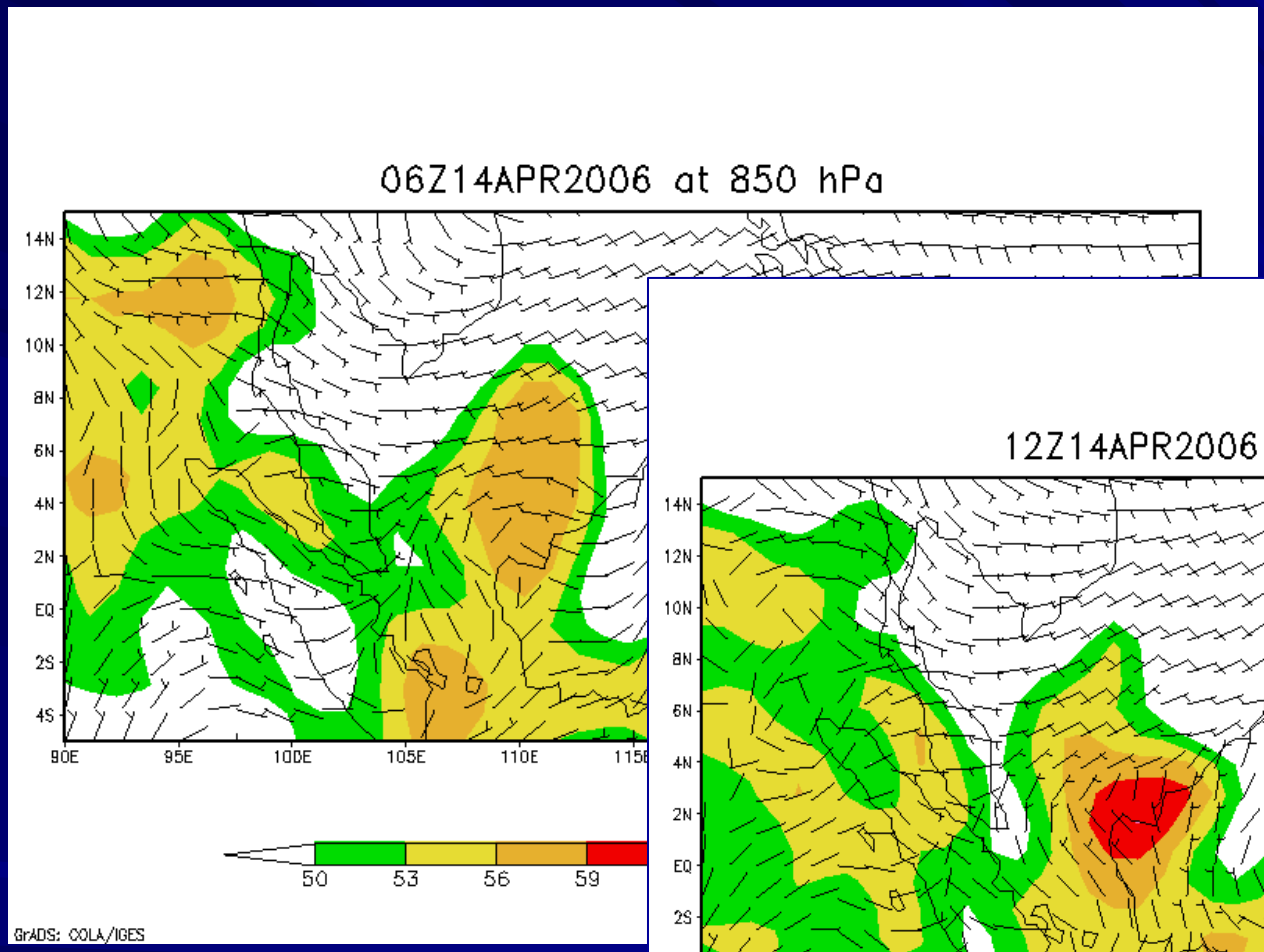
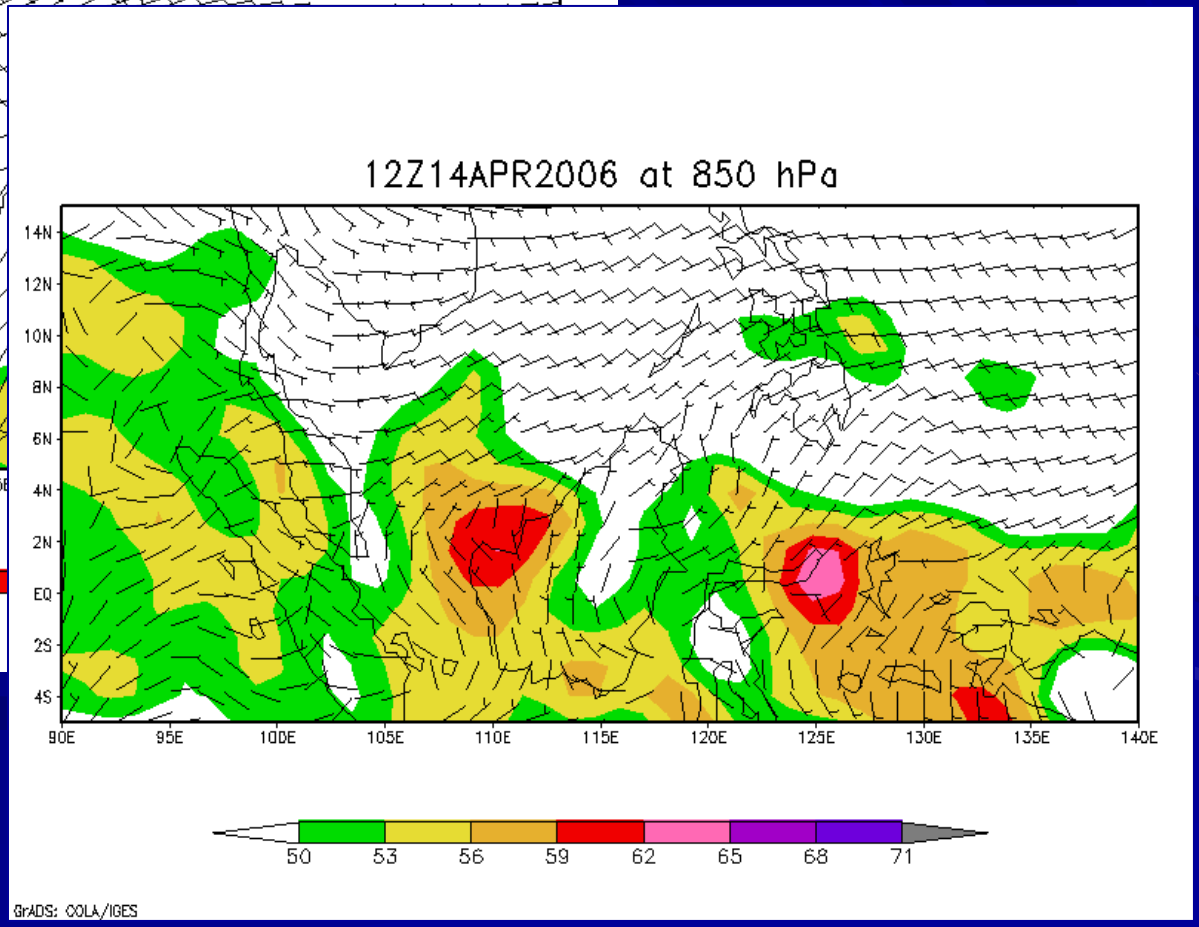


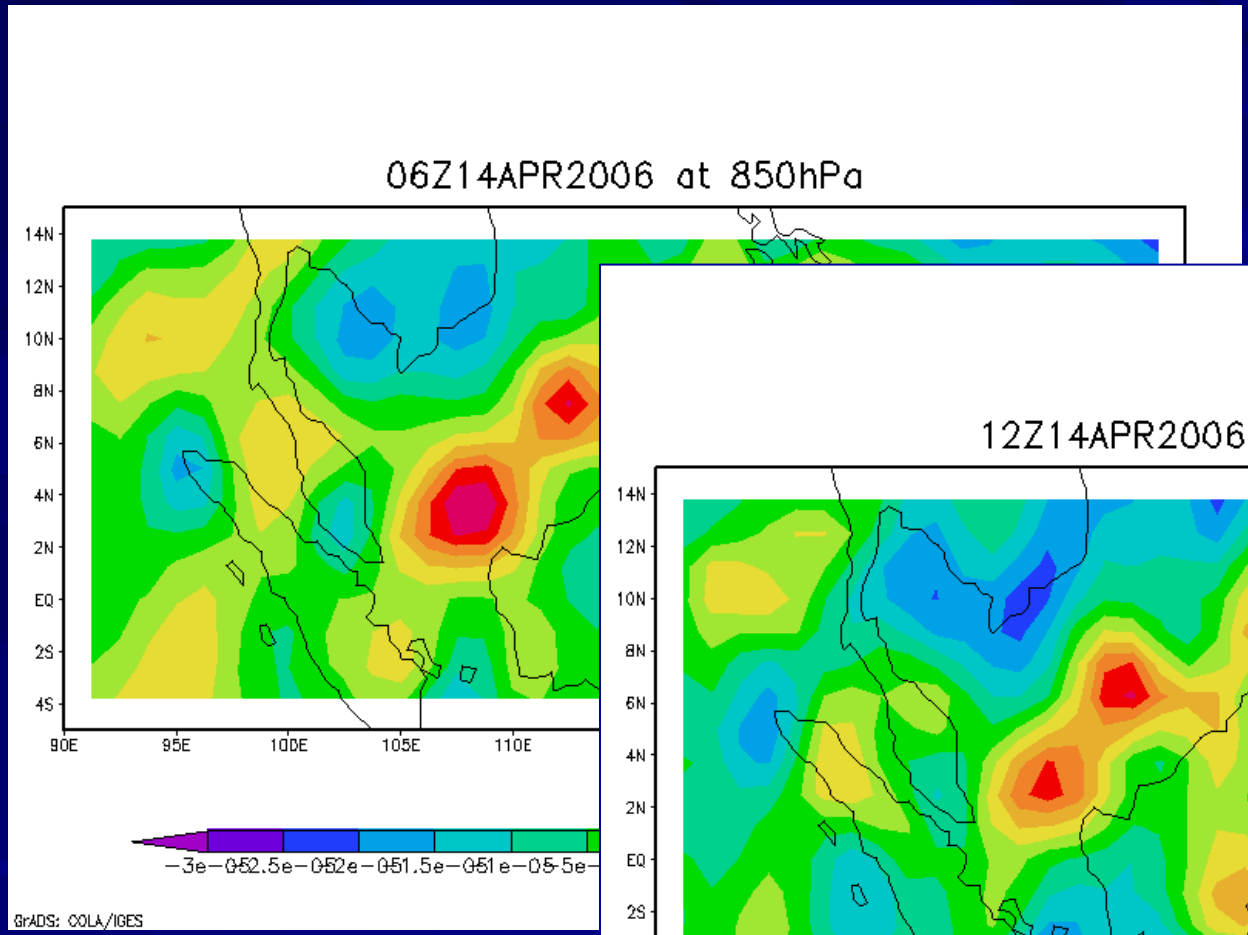
11.47PM

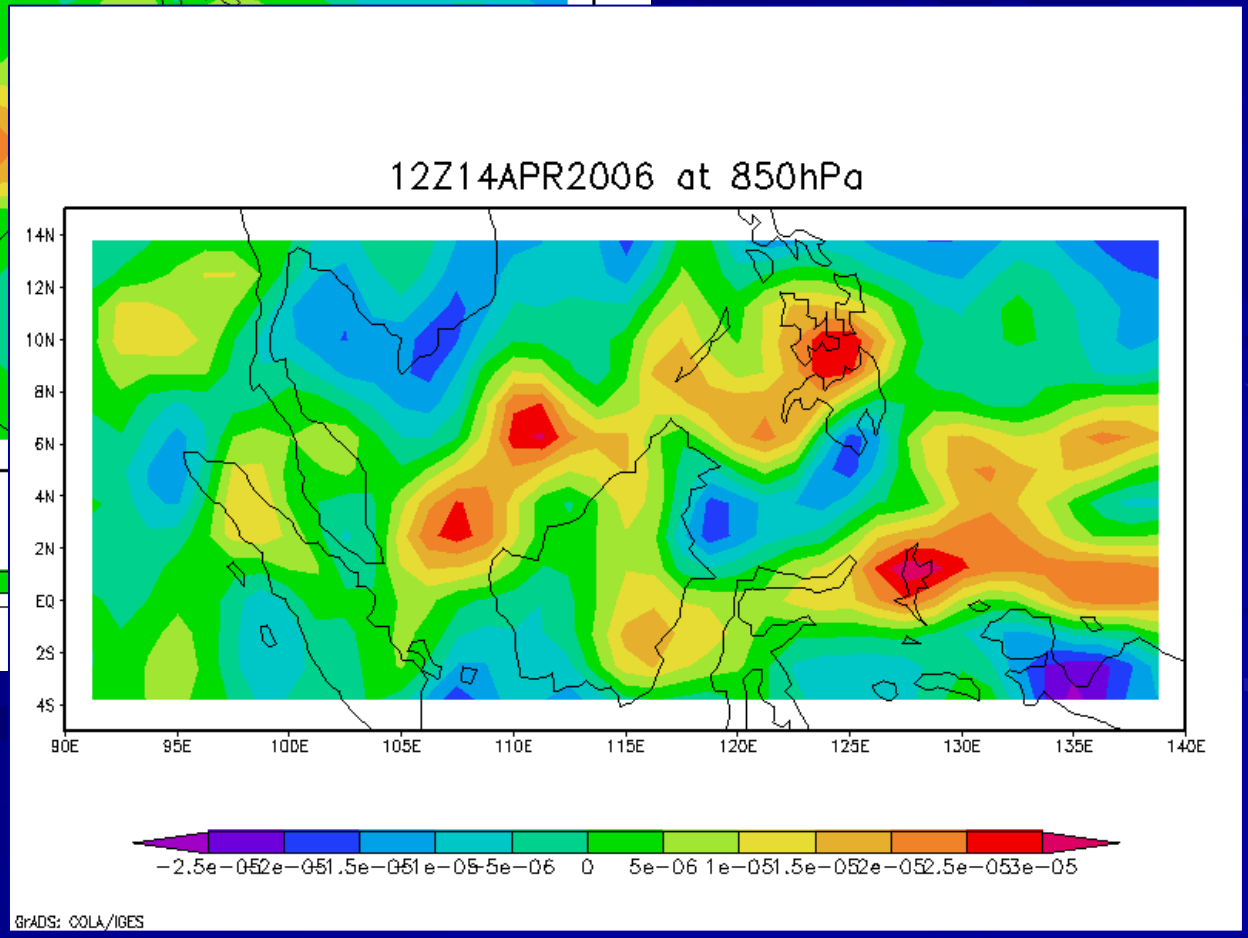
PRECIPITABLE WATER

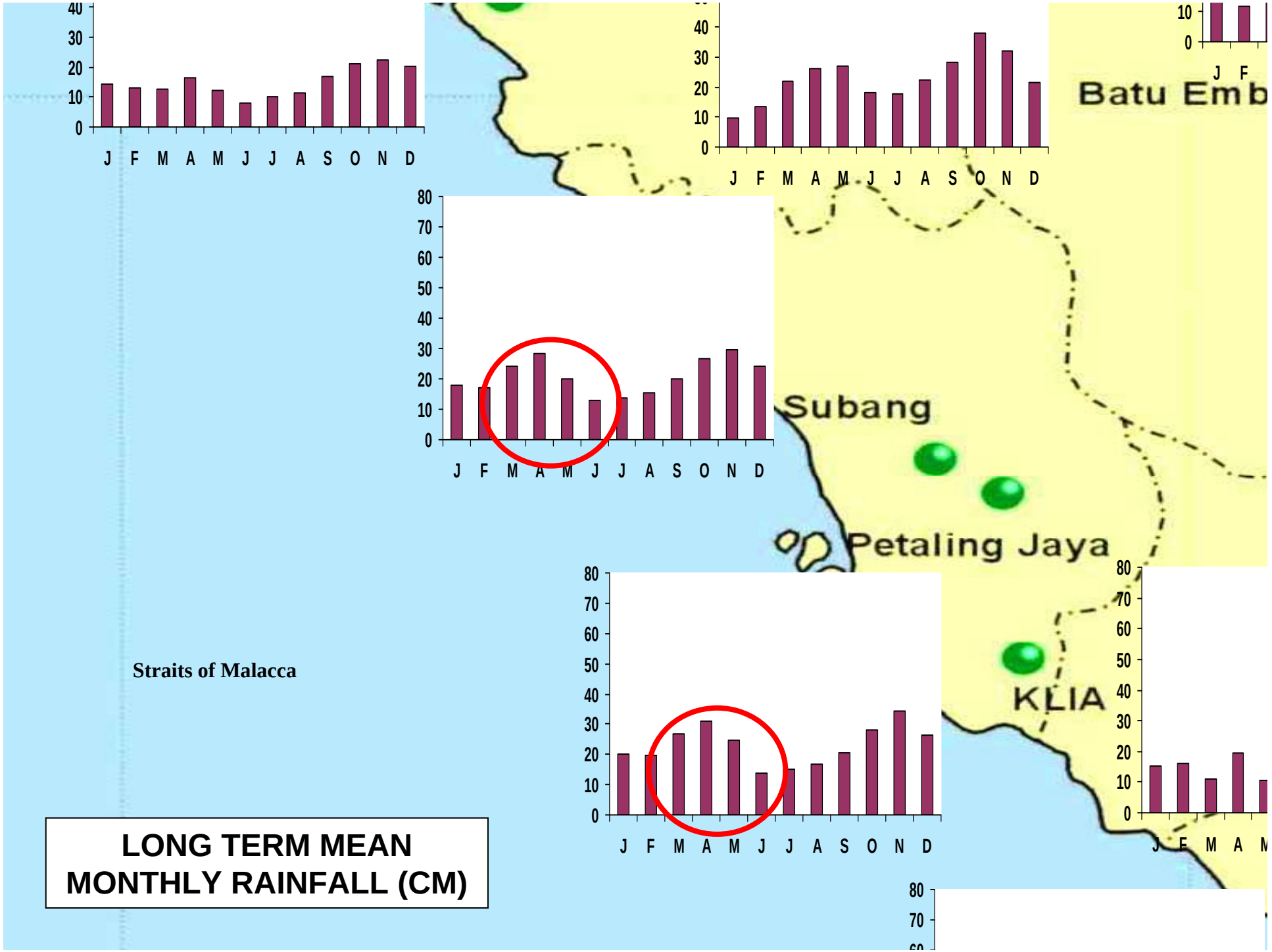




850 HPA VORTICITY






40
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J F M A M J J A S O N D
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J F M A M J J A S O N D
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J F M A M J J A S O N D
Subang
Petaling Jaya
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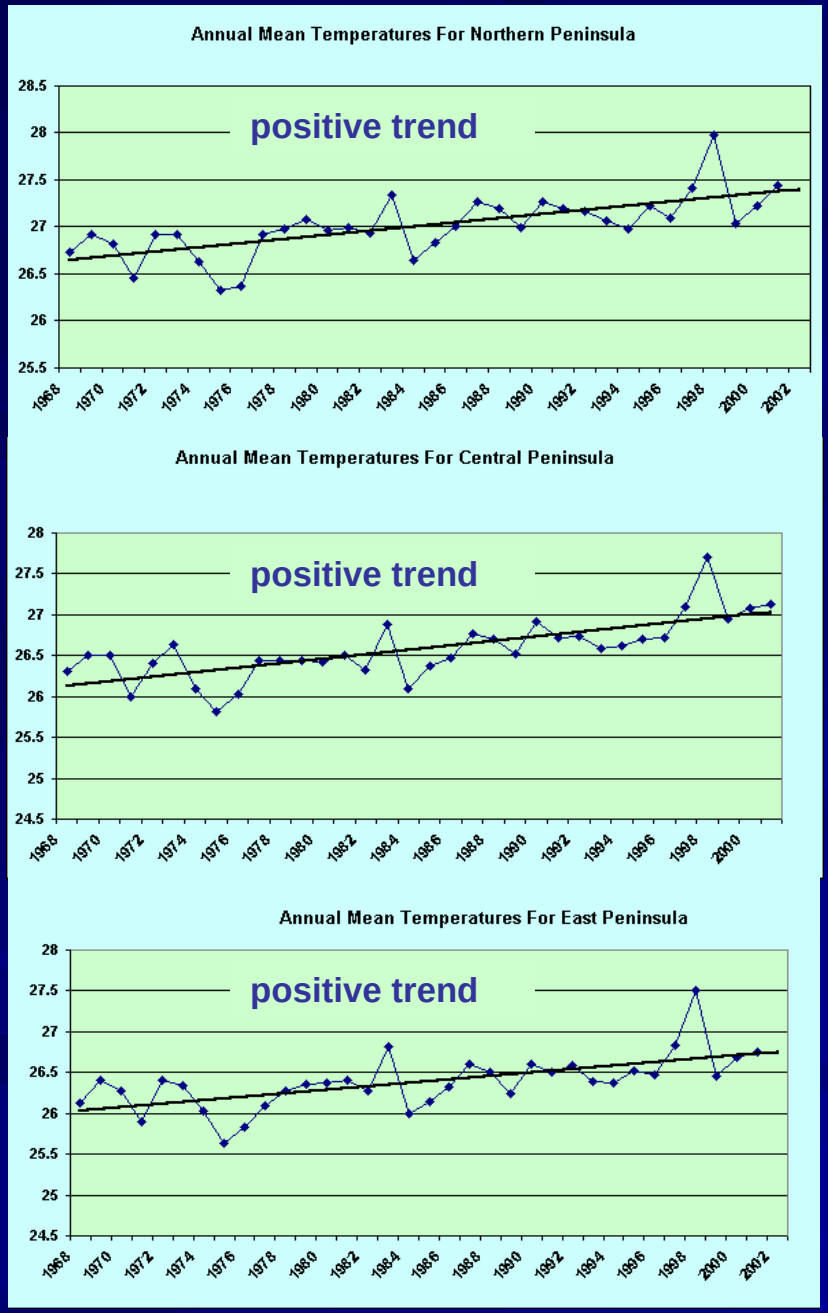
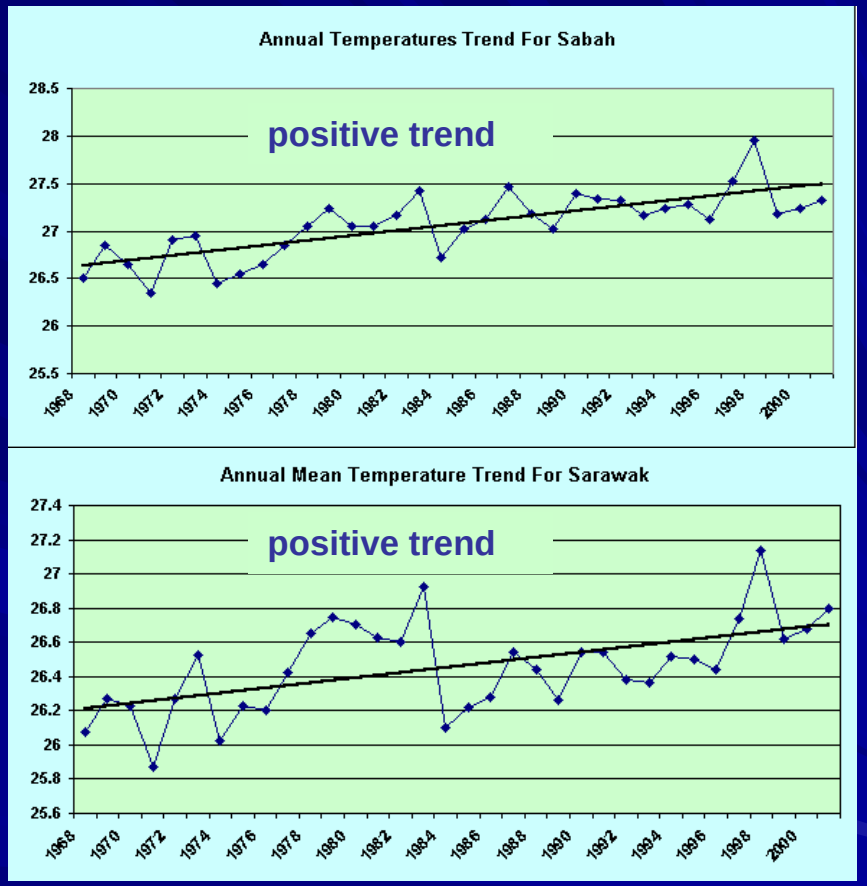
Straits of Malacca
LONG TERM MEAN
MONTHLY RAINFALL (CM)

Monitoring Climate Change

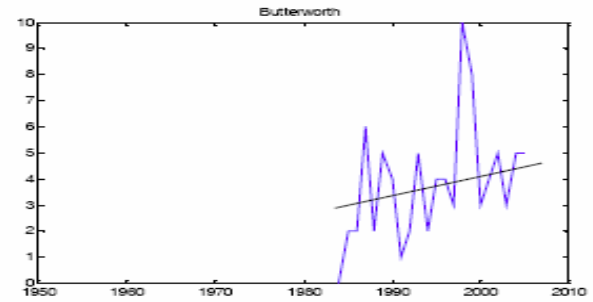


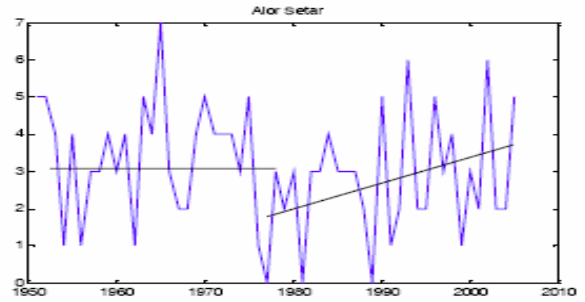
Temperature trends?

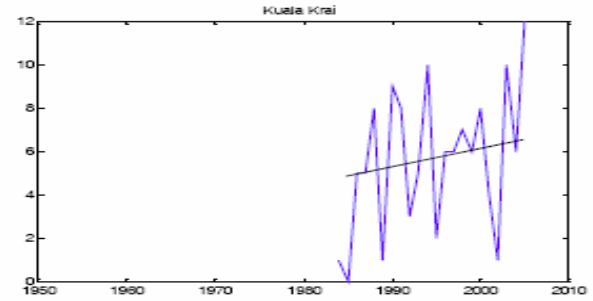


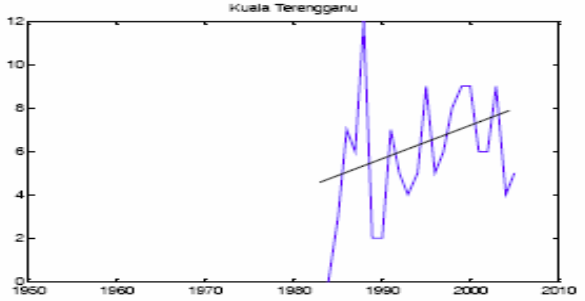
Increased **0.7°C to 1.3°C** per half century

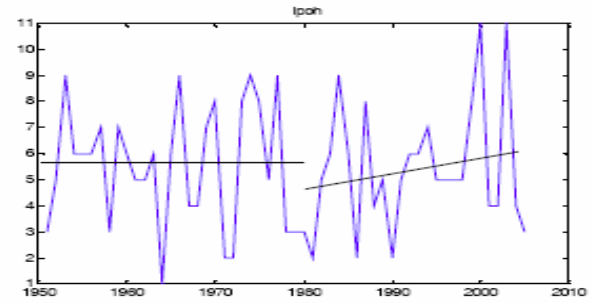
Historical Data From MMD Stations

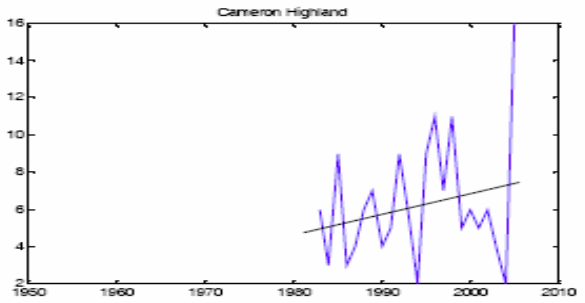


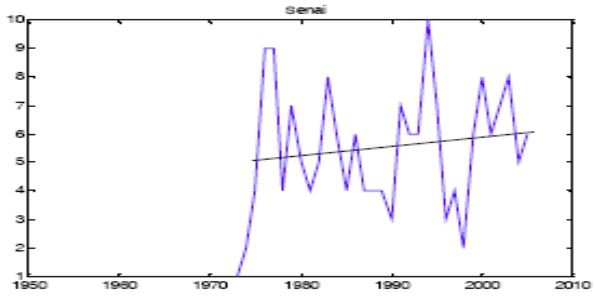


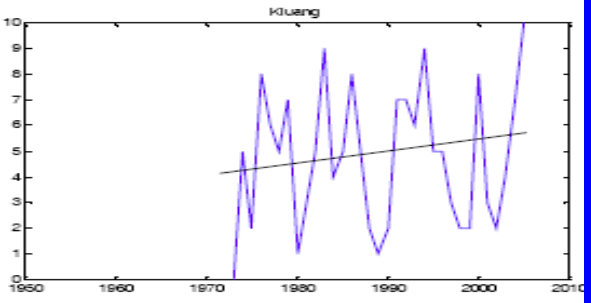












Since ~1980s: Increasing number of days of extreme rainfall event (exceeding 90th percentile of total rainfall) for several stations over the Peninsular Malaysia

Conclusions

- MCCs that cause flash floods are triggered by low level wind convergence and active monsoon trough
- Could be enhanced by other environmental phenomena such as MJO
- Most often build up over inland area and move towards the Strait of Malacca and dissipated
- Move fast (15-30km/h) when steered by mid level winds, move slow (10-12km/h) otherwise
- Could be re-intensified over Strait of Malacca and move across if synoptic situations are favourable

Thank You