United Nations/Indonesia International Conference on

Integrated Space Technology Applications to Climate Change

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Remote Sensing Application to Detect and Idetify the Cimate Change over Indonesia

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Absract

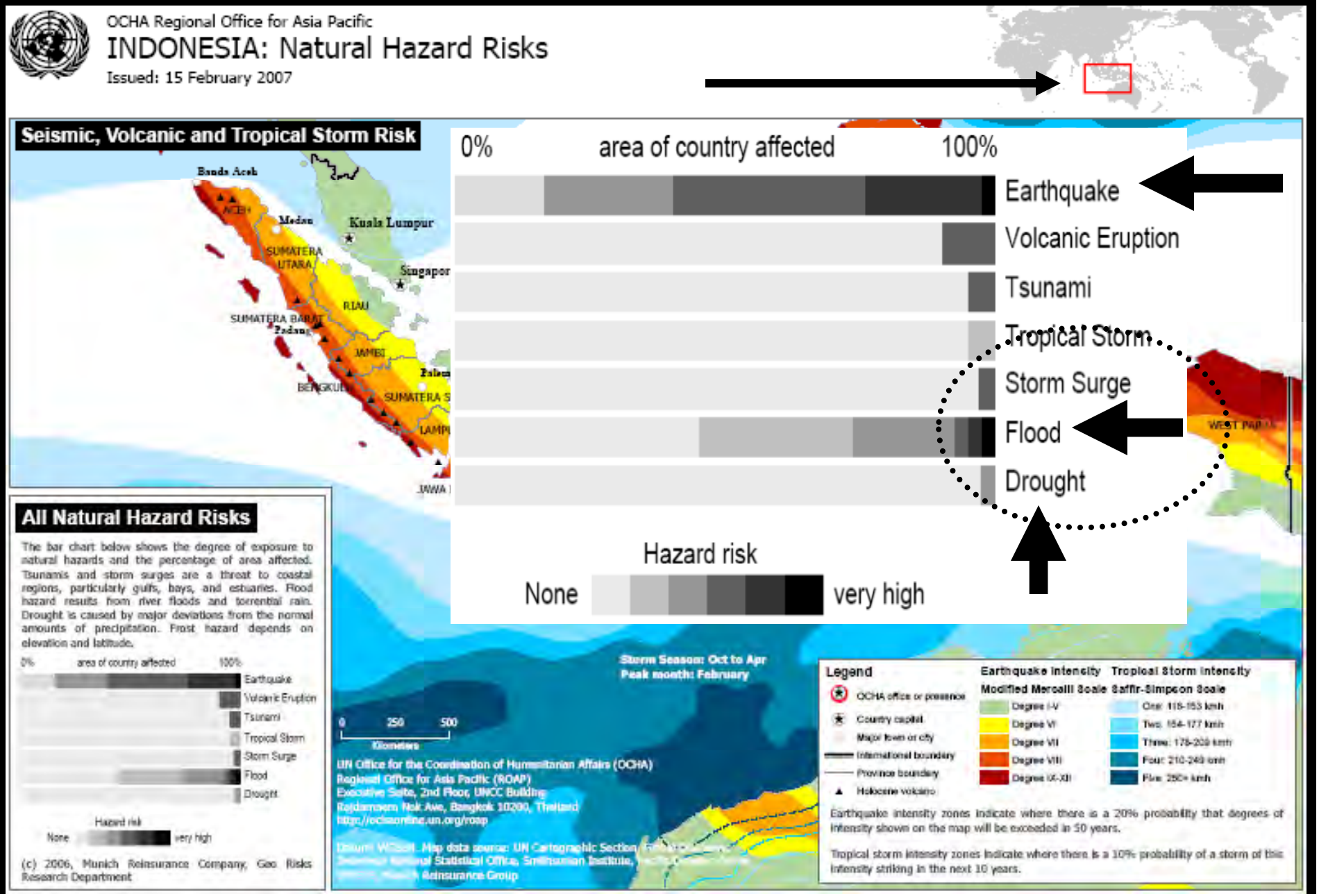
This study is mainly concerned to detect and identify the climate change over Indonesia, especially on the hydrometeorological phenomena using space technology applications. Firstly, we reviewed the basic concept of global climate change based on the trend of surface temperature and precipitation over several regions over Indonesia. Since the *Indonesia Maritime Continent* (IMC) is mostly effected by the dynamical of Monsoon system, we mainly focussed on the flood and drought hazard.

Cont ...

Then, we applied the space technology applications to detect and identify the trend or tendency of surface temperature and precipitation, mainly in the Java Island. Since, both phenomena is related well to agriculture sector, we need to consider to save the elevent provinces that has already stated as the rice production center from the extreme weather or climate condition. Here, we promote the SADEWA (*Satellite Disaster Early Warning System*) and the equatorial atmospheric model that still developing by LAPAN Bandung.

"Regarding to the statement from the IPCC experts who stated that as a result of climate change, more frequent and more intense **hydrometeorological** events can be expected, **we mainly concerned to investigate the surface temperature and precipitation (rainfall) behavior over Java Island, including their trend or tendency taken from satellite and *in-situ* observation, respectively**"

Climate Hazards in Indonesia



From this figure, we can see, at least we have seven climate hazards over Indonesia. They are :

1. Earthquake
2. Vulcano
3. Tsunami
4. Tropical Storm
5. Storm Surge
6. **Flood** --- > much water
7. **Drought** --- > less water

We know that both phenomena (flood and drought) is related well with the anomaly of Monsoon system, but we need to consider the other phenomena that also have severe impact that we call as the MJO (*Madden Julian Oscillation*) as one of the most mode oscillation along the equatorial region. We can see Jakarta flood's in 1996, 2002, 2006, 2007, and 2013 recently as the samples the severe impacts of MJO event in the Western part of Indonesia region.

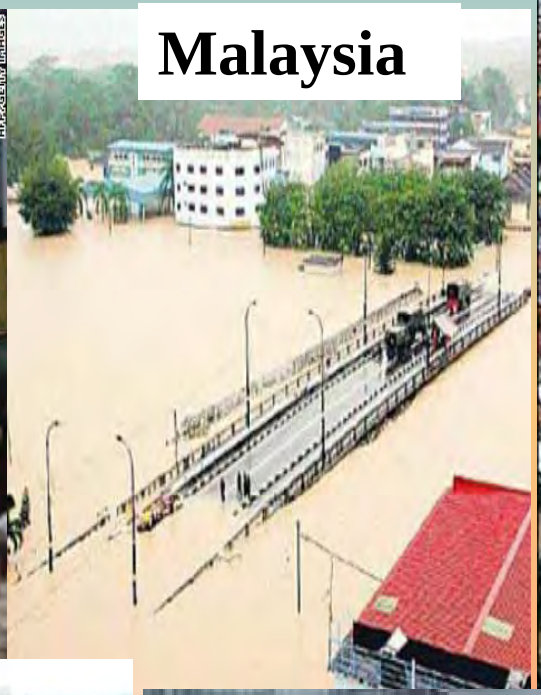
Review

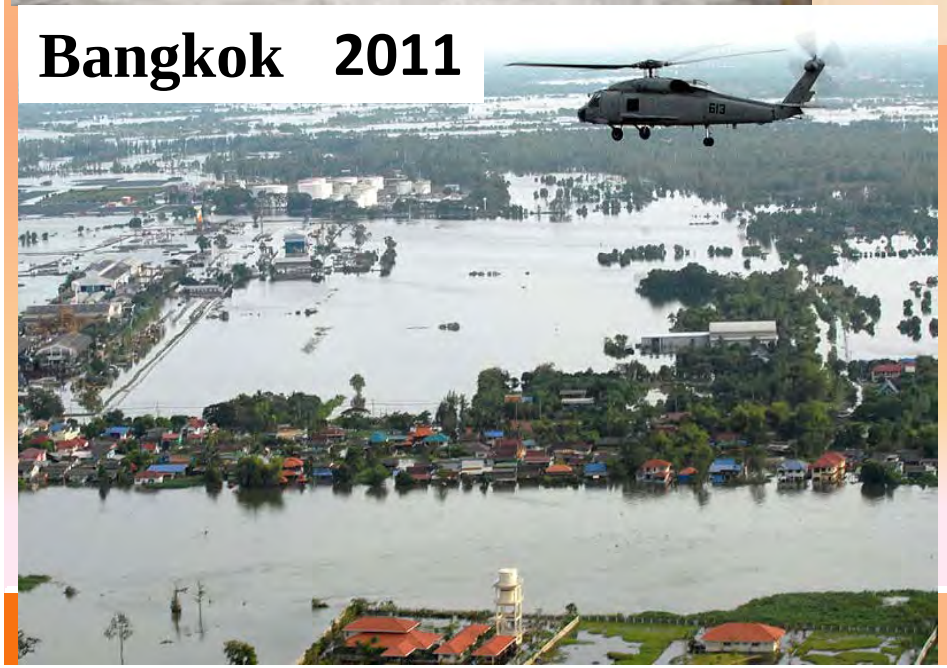
"Floods and Drought"

Jakarta Floods

In Early February 2007

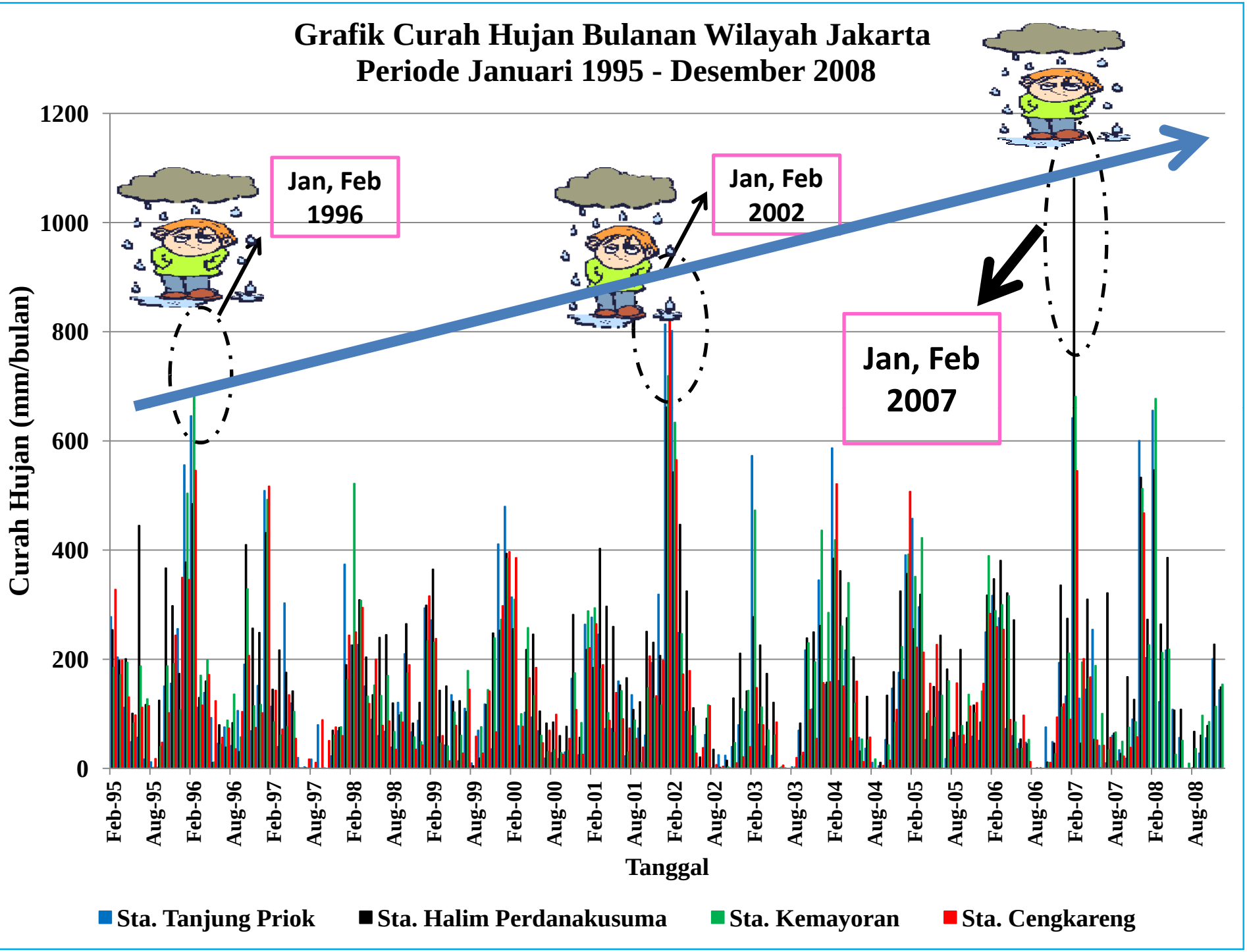
Flooding in Sprawling Mega Cities in Southeast Asia



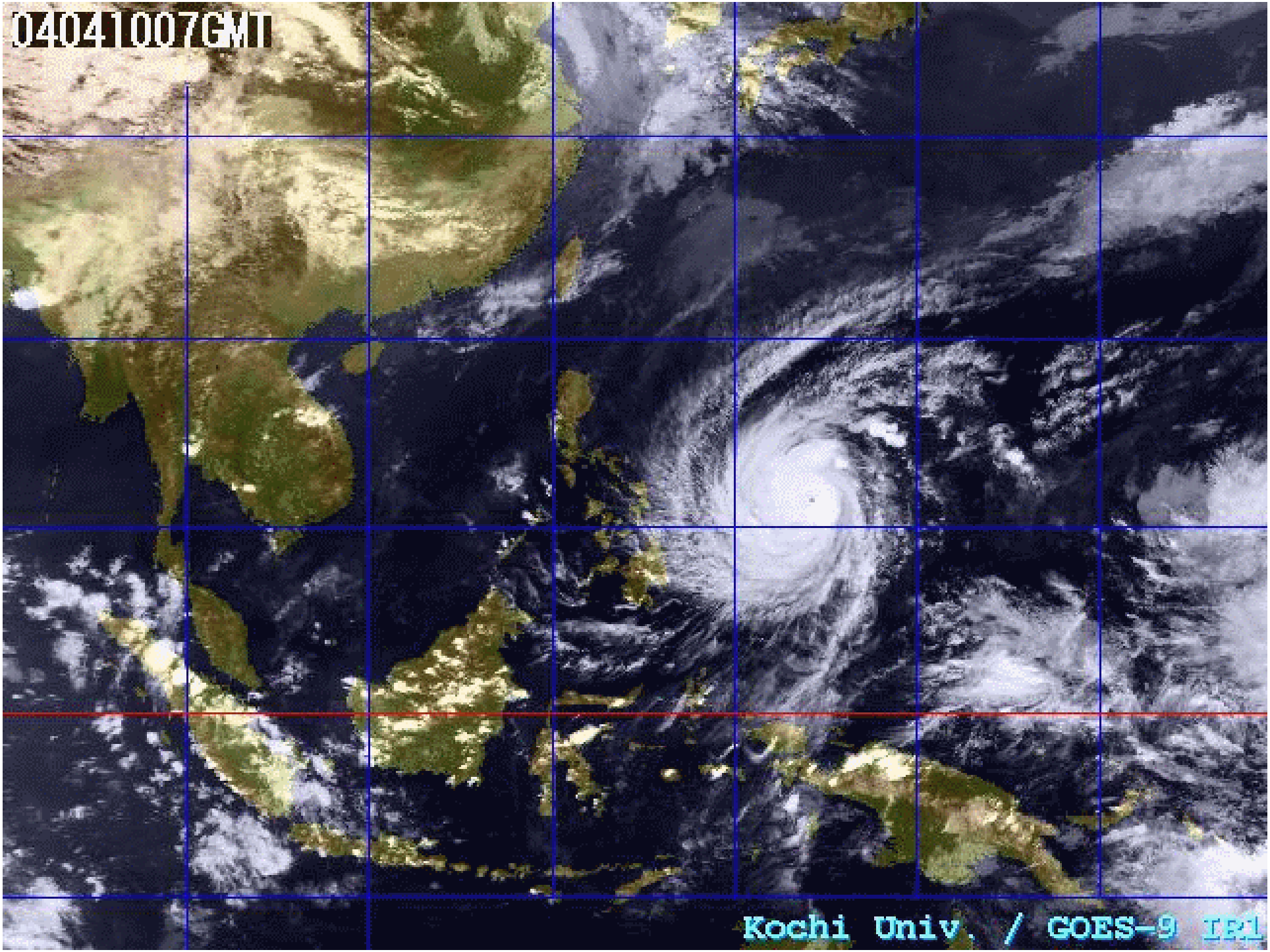


Jakarta Floods February 2007

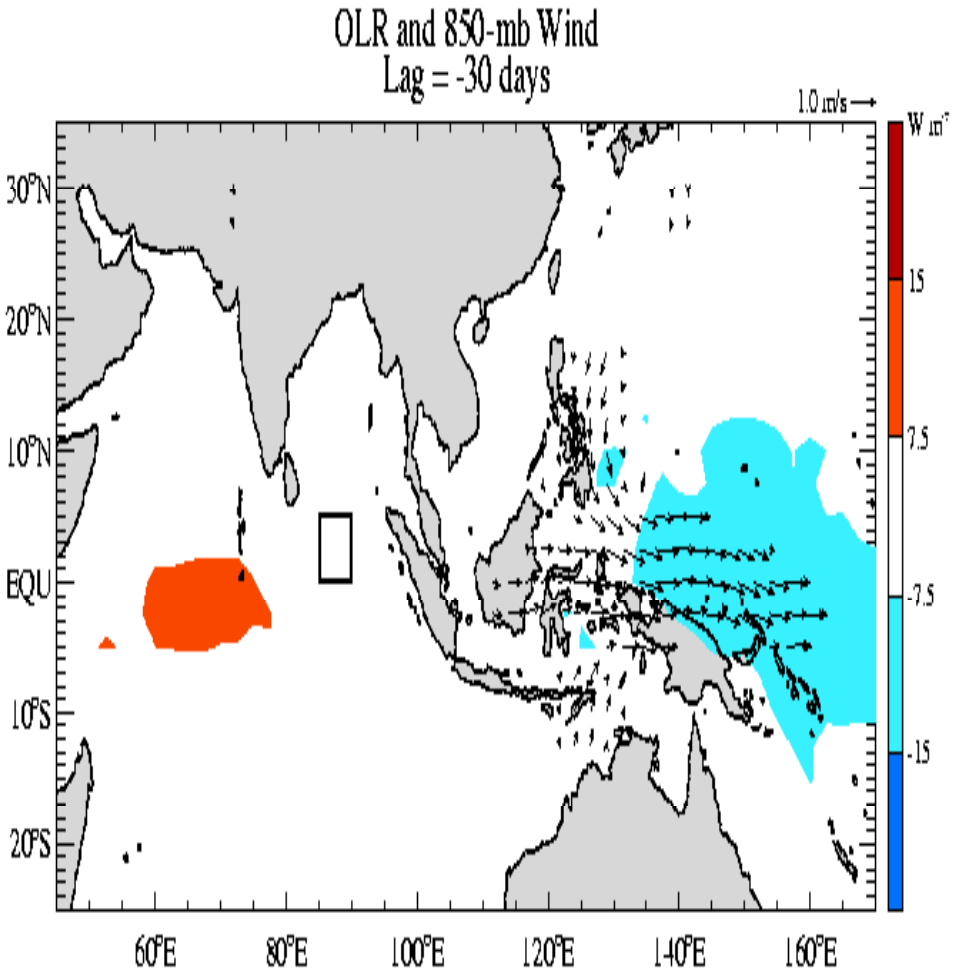
Grafik Curah Hujan Bulanan Wilayah Jakarta
Periode Januari 1995 - Desember 2008



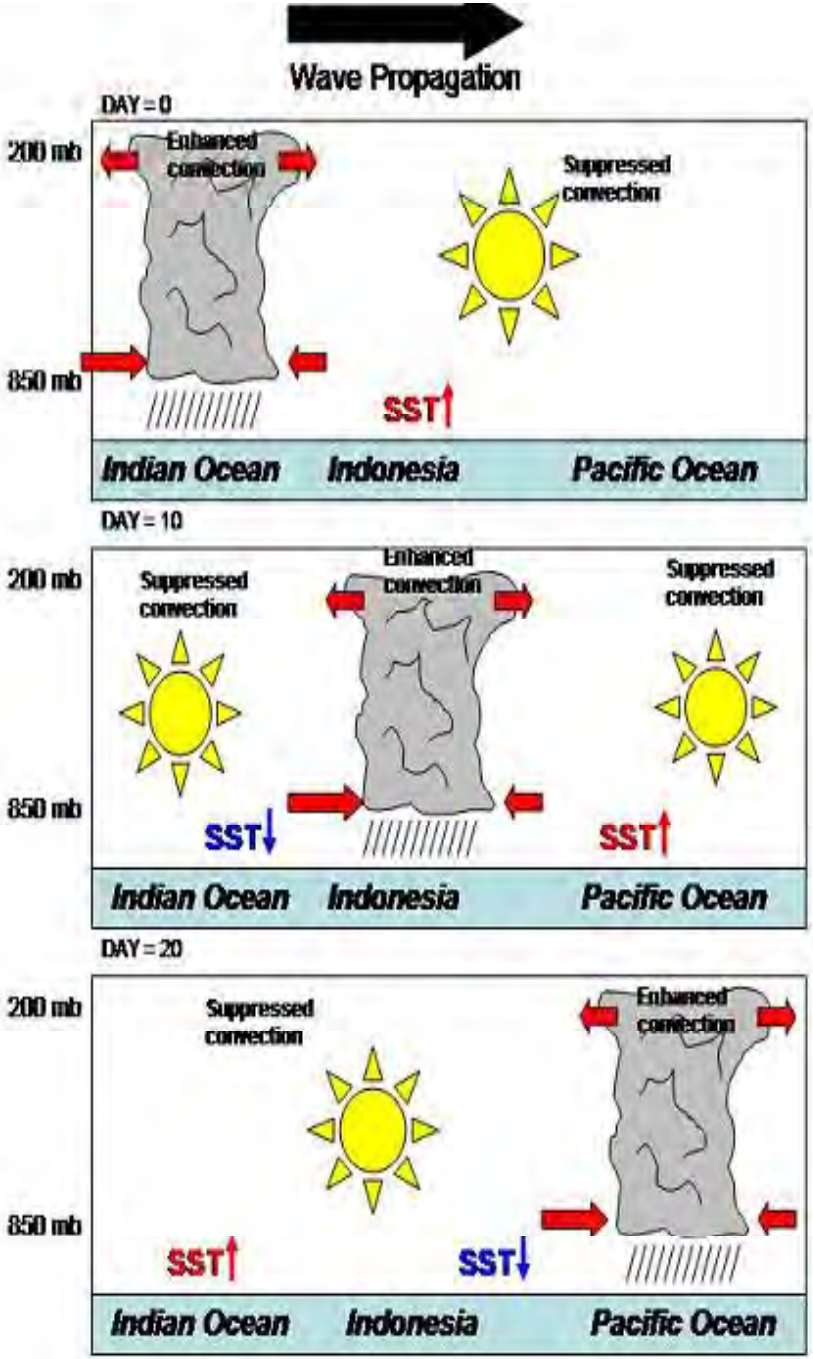
Please note here almost every 5-6 years, Jakarta is attacked by the big flooding, and the intense is still increased


04041007GMT
Kochi Univ. / GOES-9 IR1

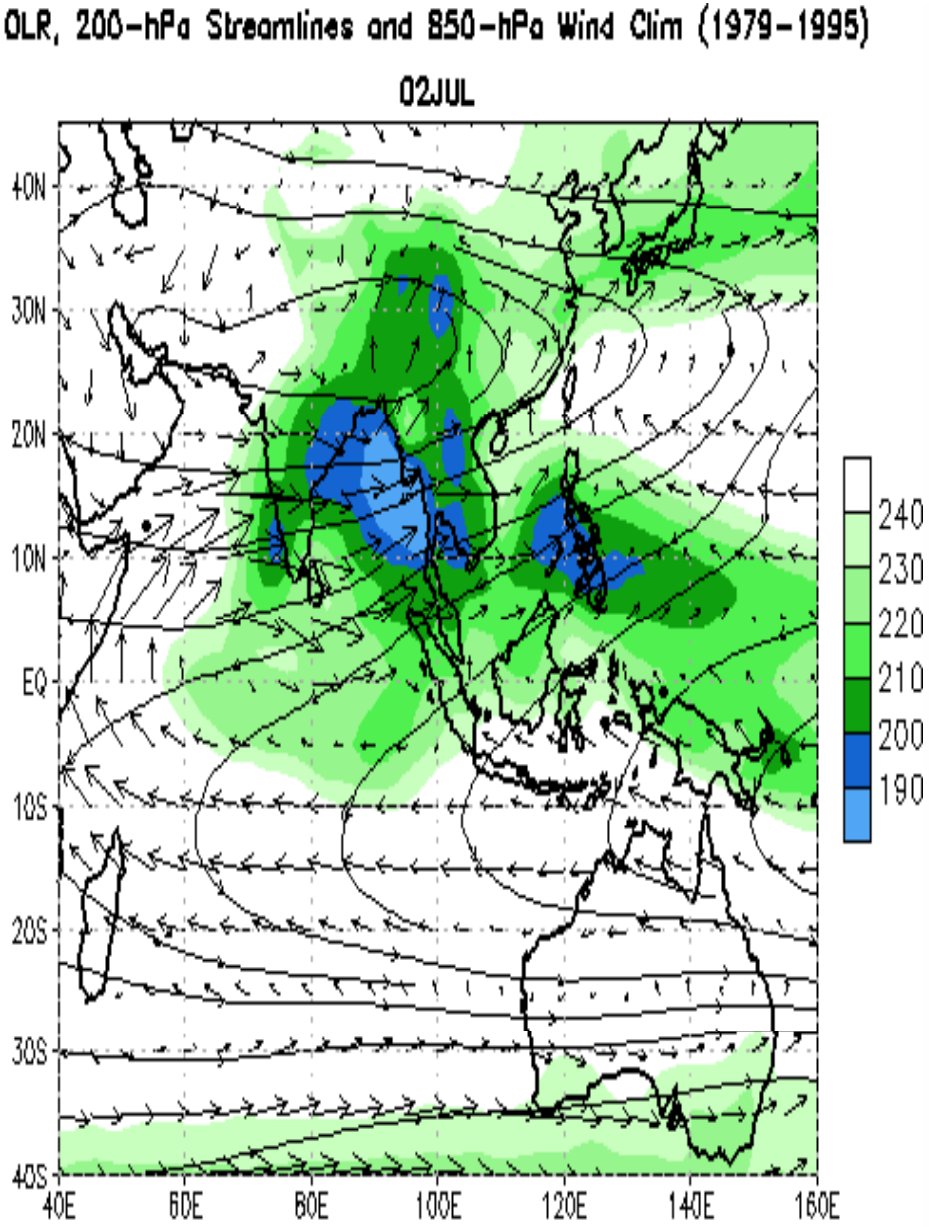
MJO animation

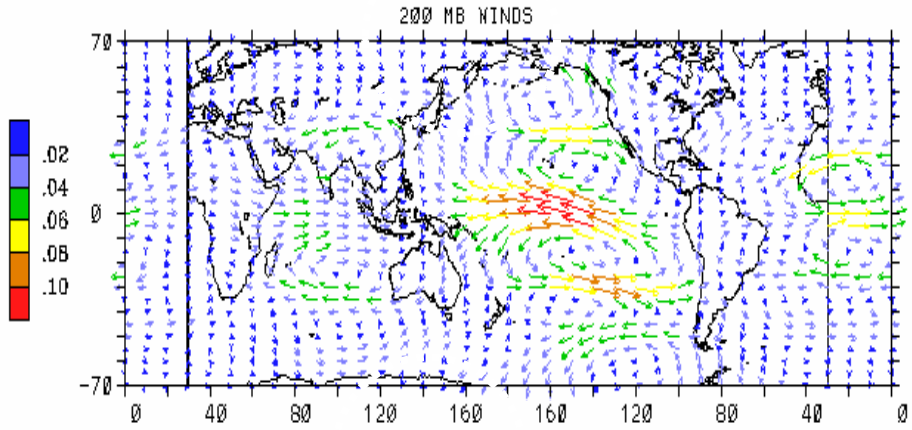


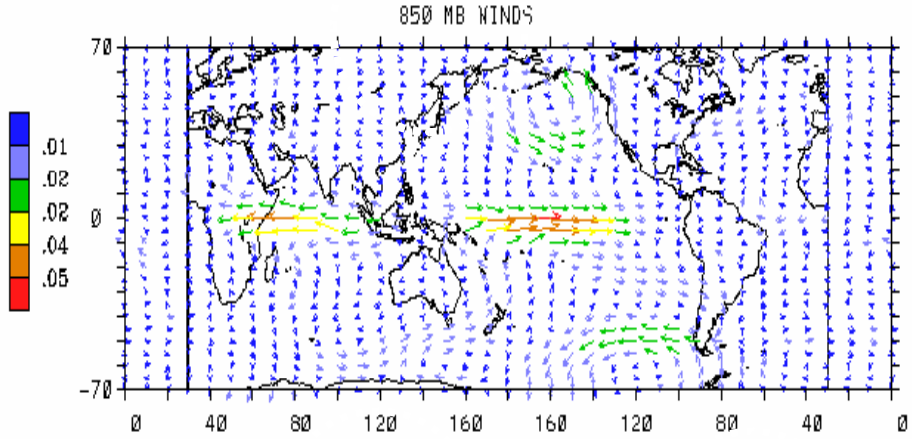
Please look at the moving of center convection over Indonesia both in 850 & 200 mb

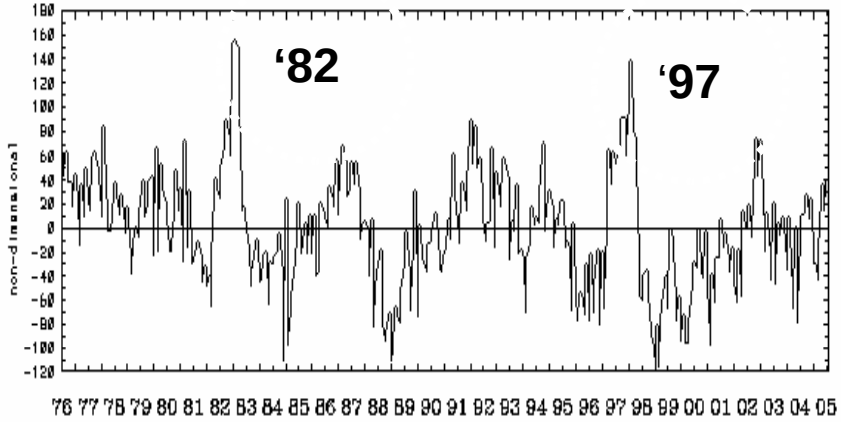


Drought
in 1997/98







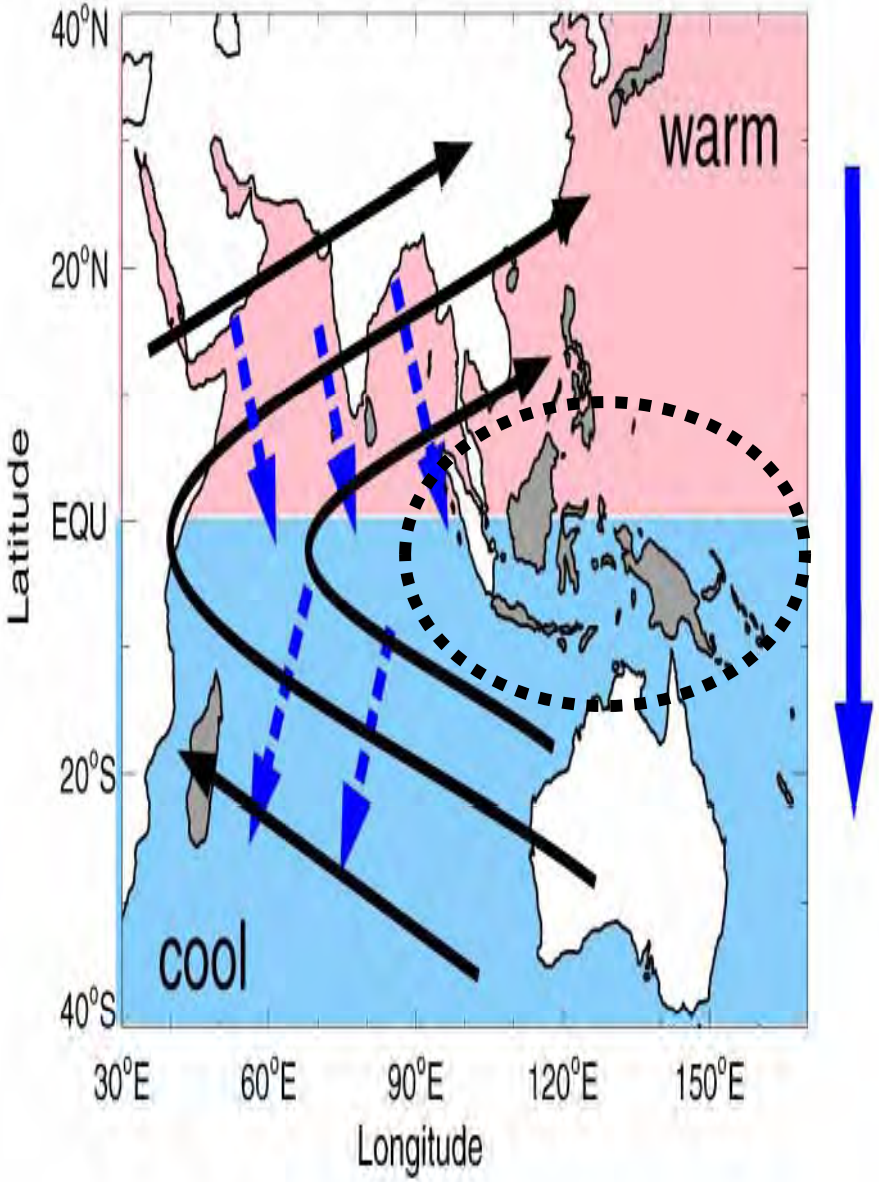


Data Sources: OLR – NESDIS/ORA, Winds – NCEP CDAS/ Reanalysis

(http://www.cpc.ncep.noaa.gov/products/Global_Monsoons/Asian_Monsoons/wind_polrc_anim_asia.gif)

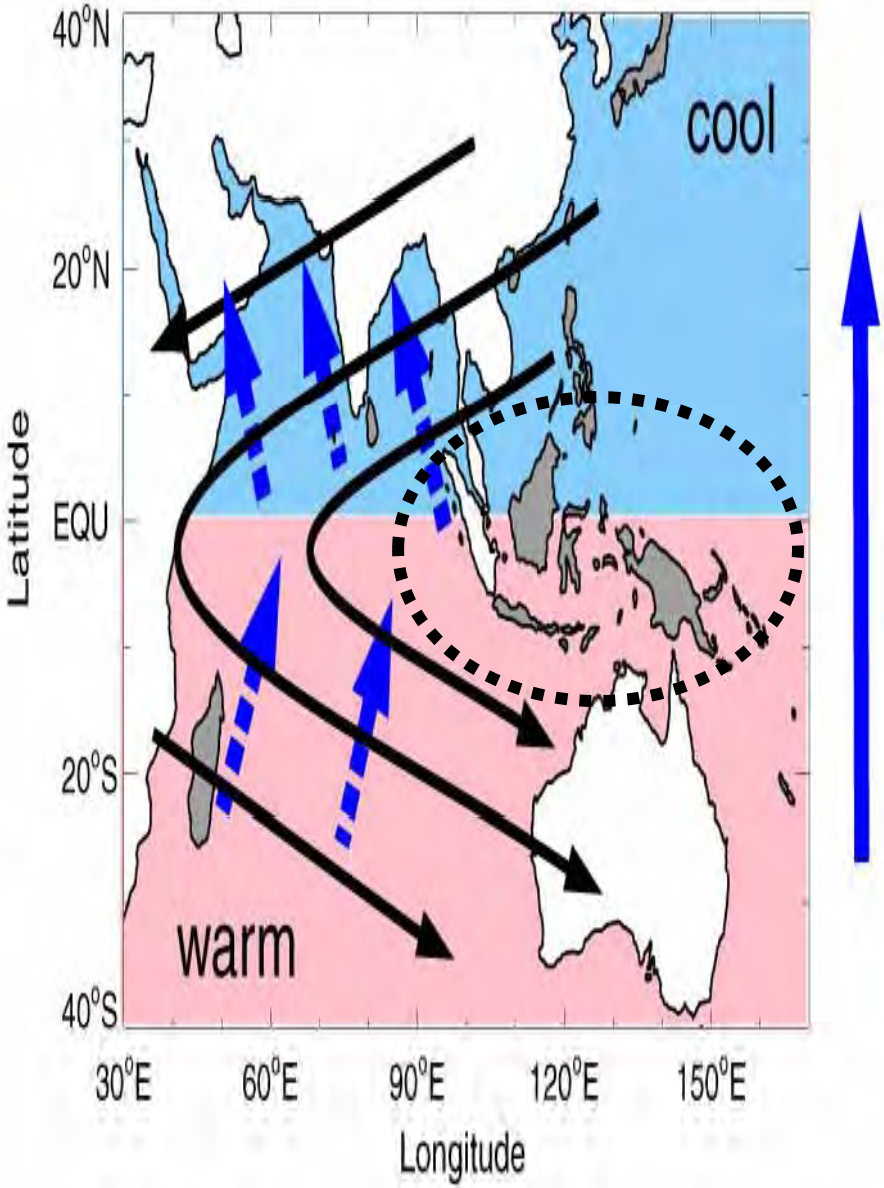
Boreal Summer

(MK = Musim Kering)

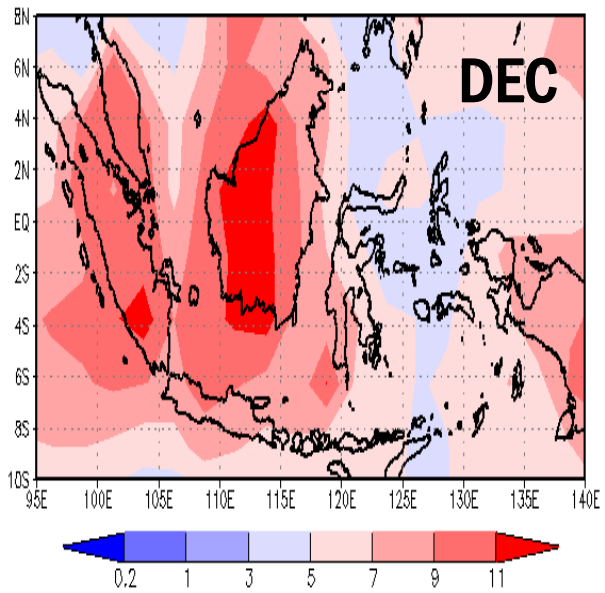


Boreal Winter

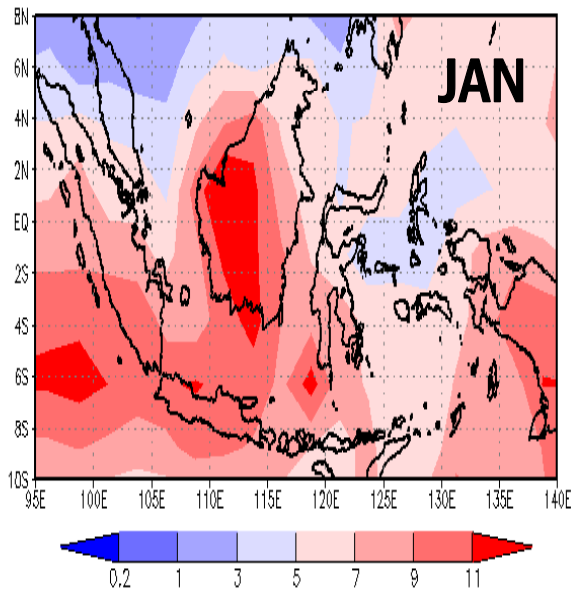
(MB = Musim Basah)



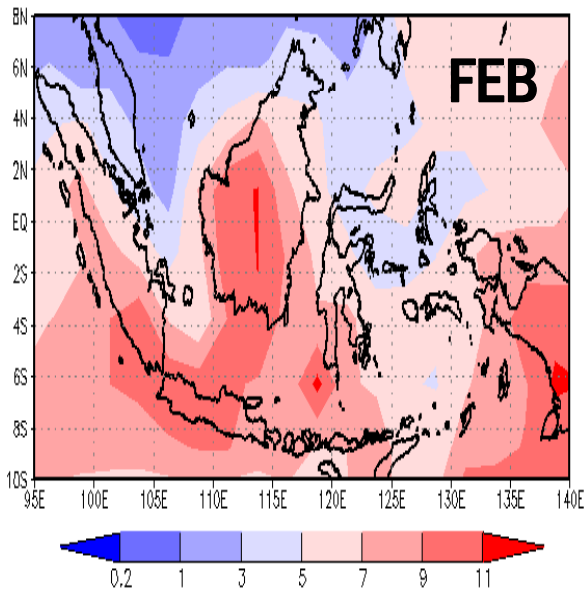
GPCP Monthly Mean Precipitation Rate (mm/day)
Calendar month DEC Average of 1979--2008



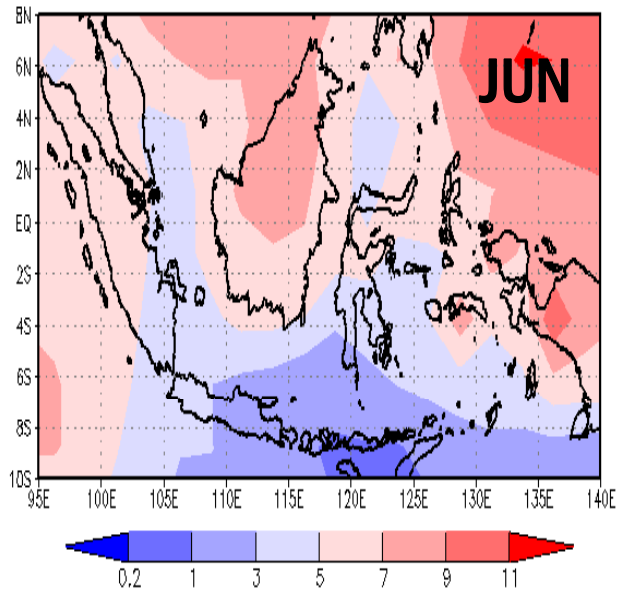
GPCP Monthly Mean Precipitation Rate (mm/day)
Calendar month JAN Average of 1979--2008



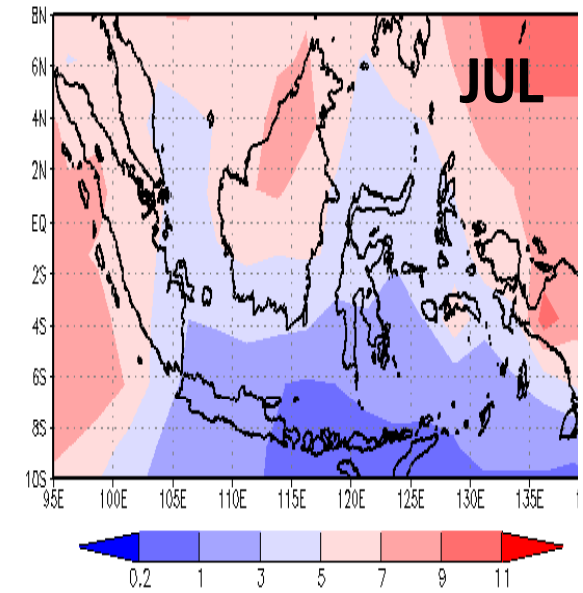
GPCP Monthly Mean Precipitation Rate (mm/day)
Calendar month FEB Average of 1979--2008



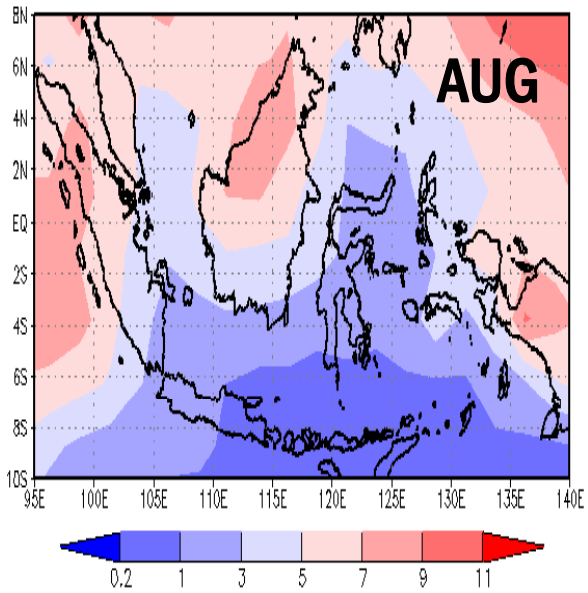
GPCP Monthly Mean Precipitation Rate (mm/day)
Calendar month JUN Average of 1979--2008

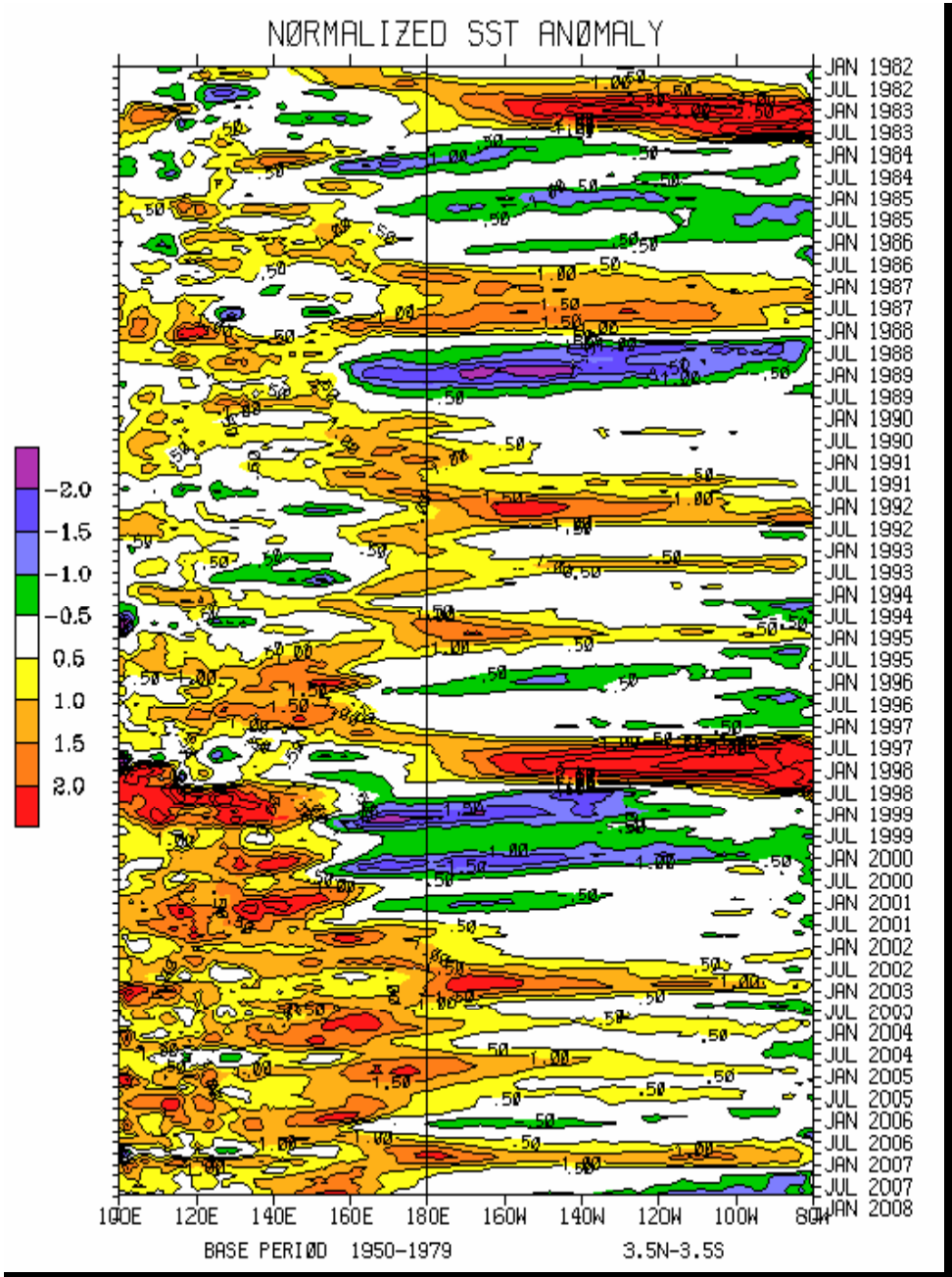


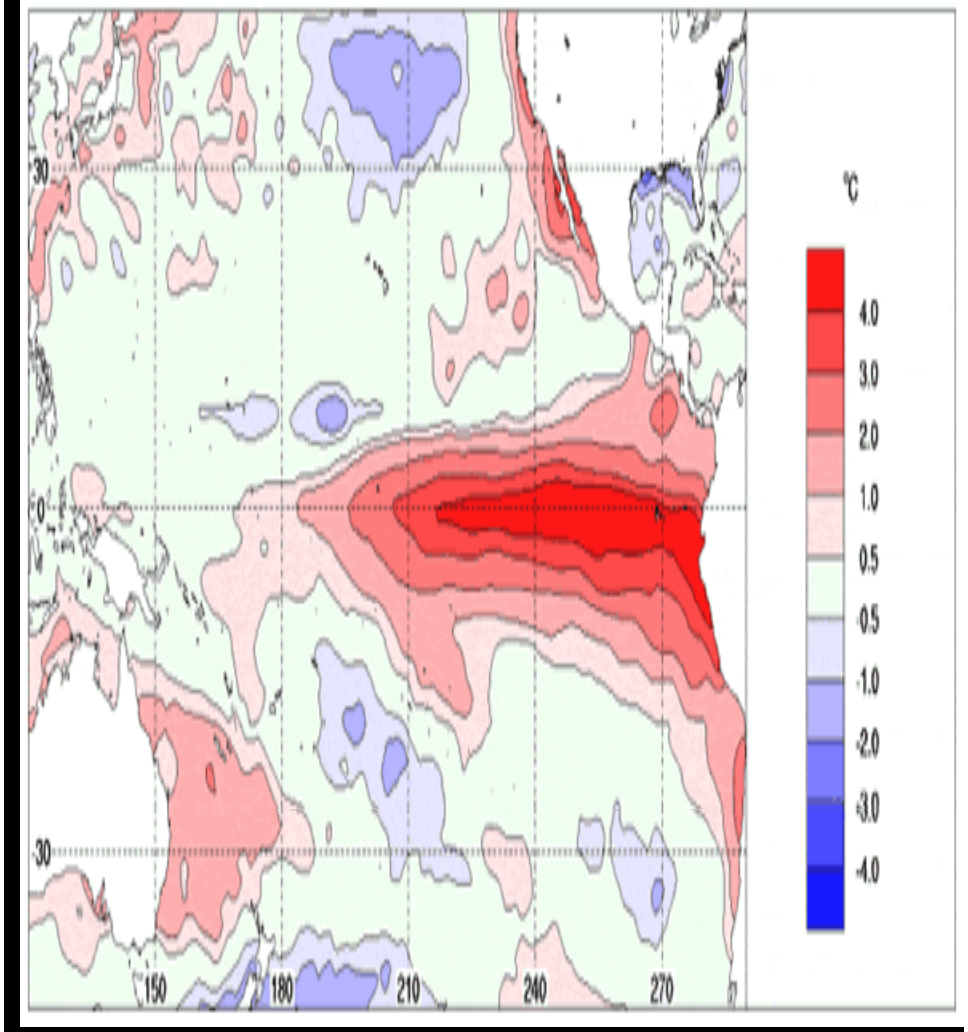
GPCP Monthly Mean Precipitation Rate (mm/day)
Calendar month JUL Average of 1979--2008



GPCP Monthly Mean Precipitation Rate (mm/day)
Calendar month AUG Average of 1979--2008

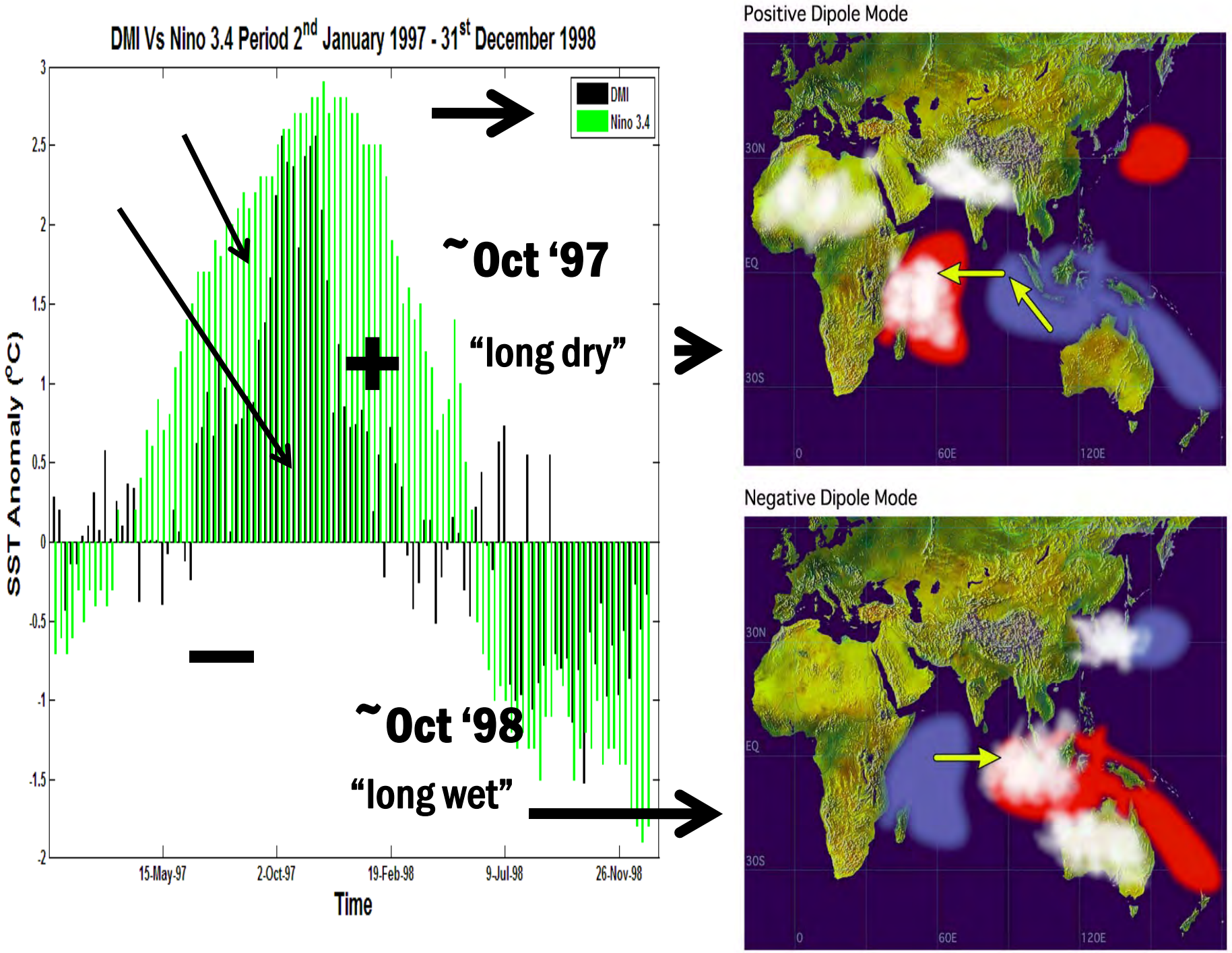


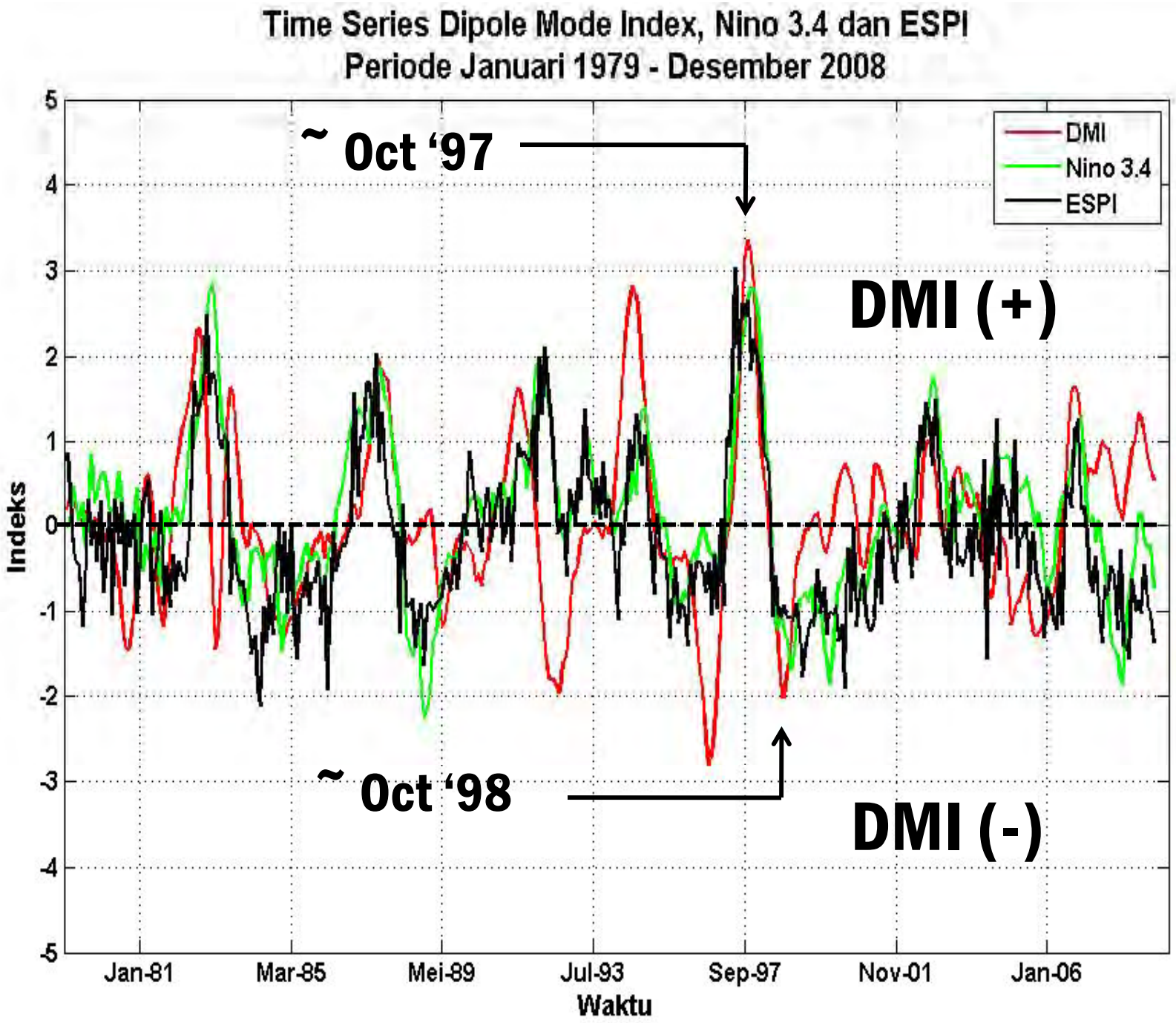


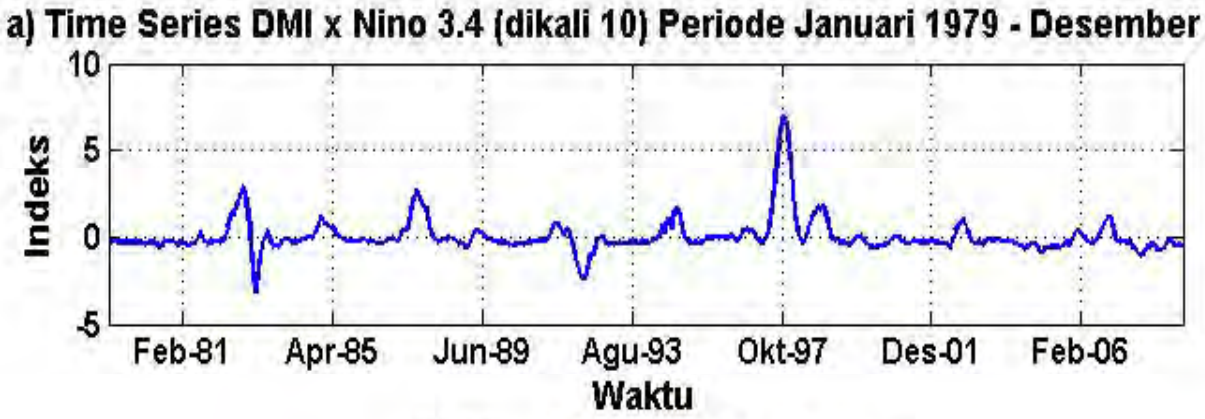


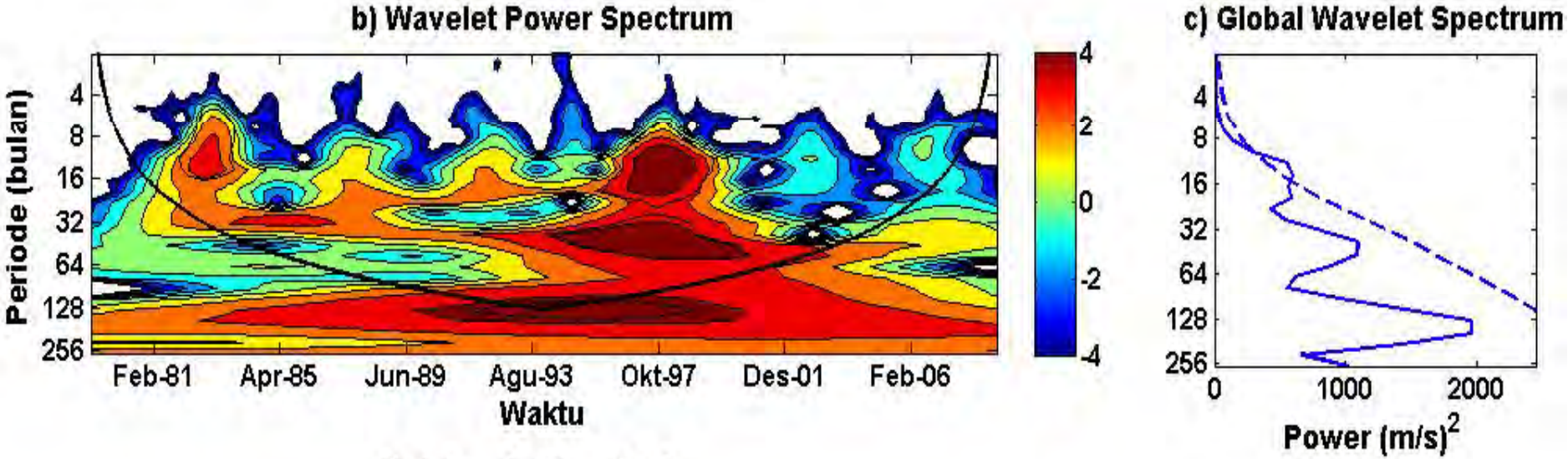
Contoh dari kondisi yang tidak neutral, yakni ekstrim anomali SST yang menyebabkan El-Nino kuat di tahun 1982 dan 1997

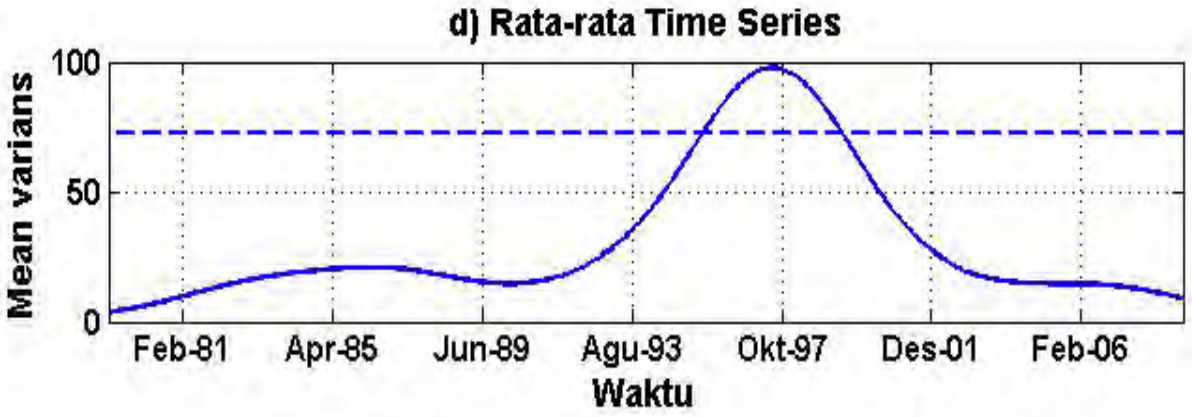
(http://www.bom.gov.au/climate/enso/nov97_ssta-small.png) di download 05.06.2010


DMI Vs Nino 3.4 Period 2nd January 1997 - 31st December 1998
DMI
Nino 3.4
SST Anomaly (°C)
Time
15-May-97
2-Oct-97
19-Feb-98
9-Jul-98
26-Nov-98
~Oct '97
"long dry"
~Oct '98
"long wet"
Positive Dipole Mode
Negative Dipole Mode
30N
EQ
30S
0
60E
120E


Time Series Dipole Mode Index, Nino 3.4 dan ESPI
Periode Januari 1979 - Desember 2008
~ Oct '97
~ Oct '98
DMI (+)
DMI (-)
DMI
Nino 3.4
ESPI
Indeks
Waktu
5
4
3
2
1
0
-1
-2
-3
-4
-5
Jan-81
Mar-85
Mei-89
Jul-93
Sep-97
Nov-01
Jan-06

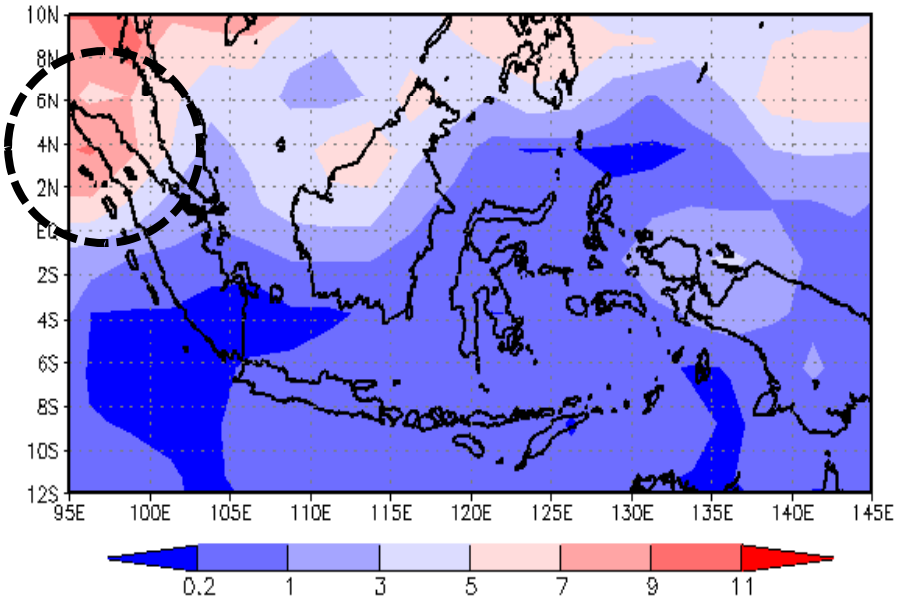




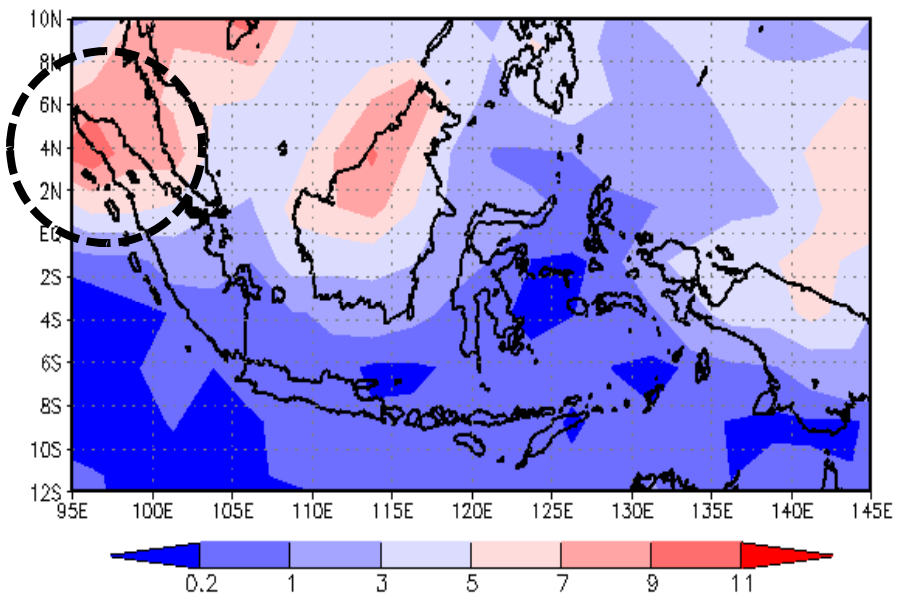


Cross correlation between DMI vs Nino 3.4

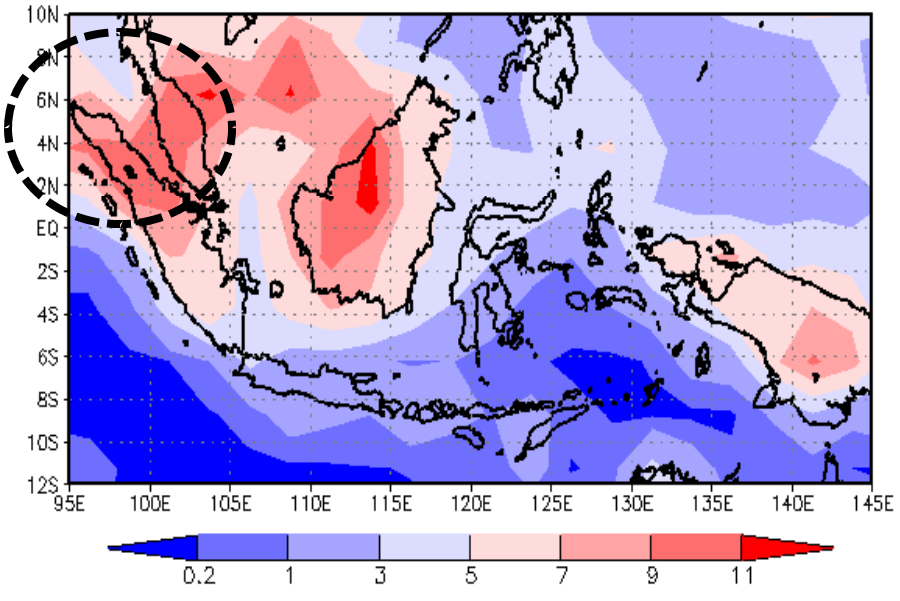
GPCP Monthly Mean Precipitation Rate (mm/day)
Time: 9/1997



GPCP Monthly Mean Precipitation Rate (mm/day)
Time: 10/1997

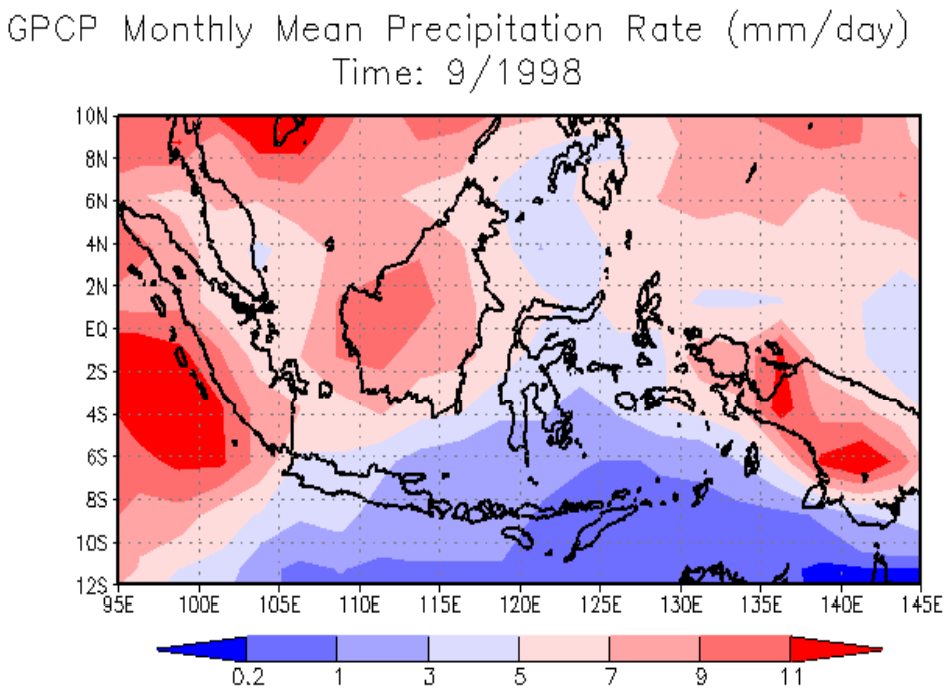


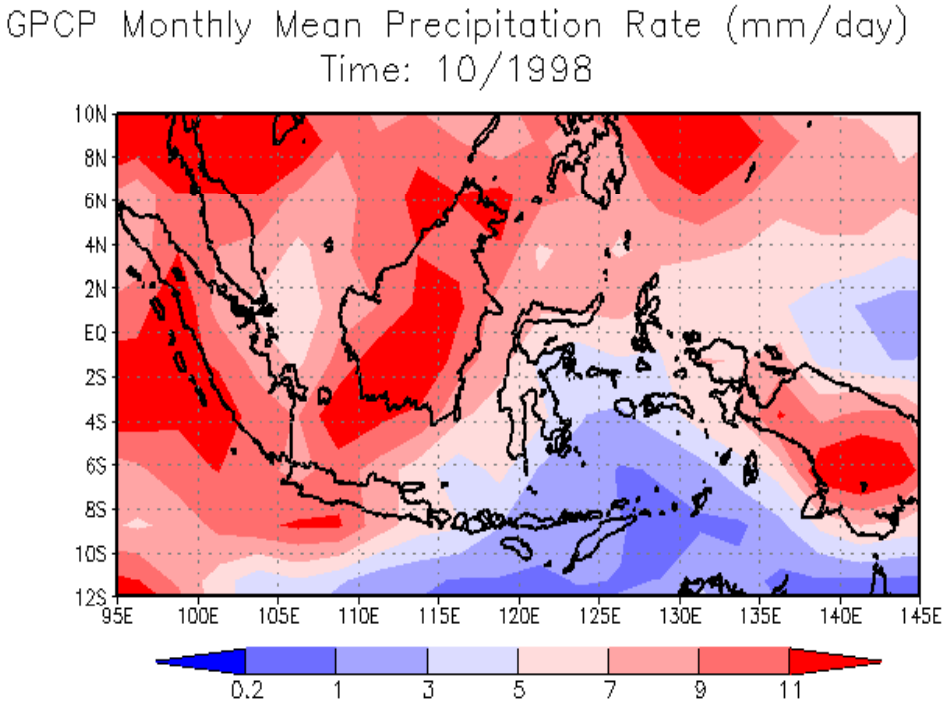
GPCP Monthly Mean Precipitation Rate (mm/day)
Time: 11/1997

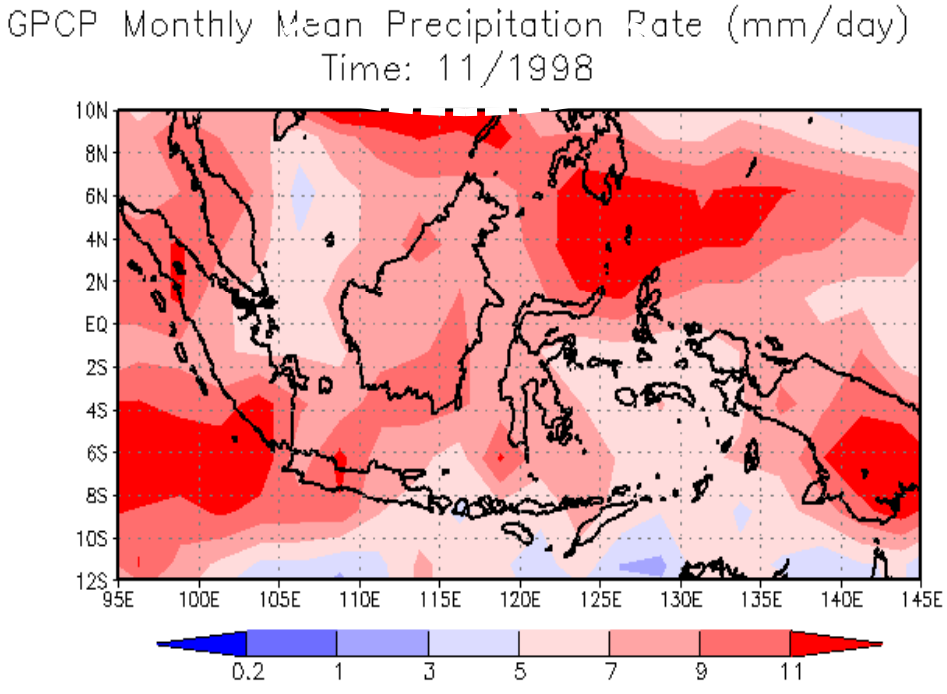


Long dry season along 1997/98

September, October, and November 1997





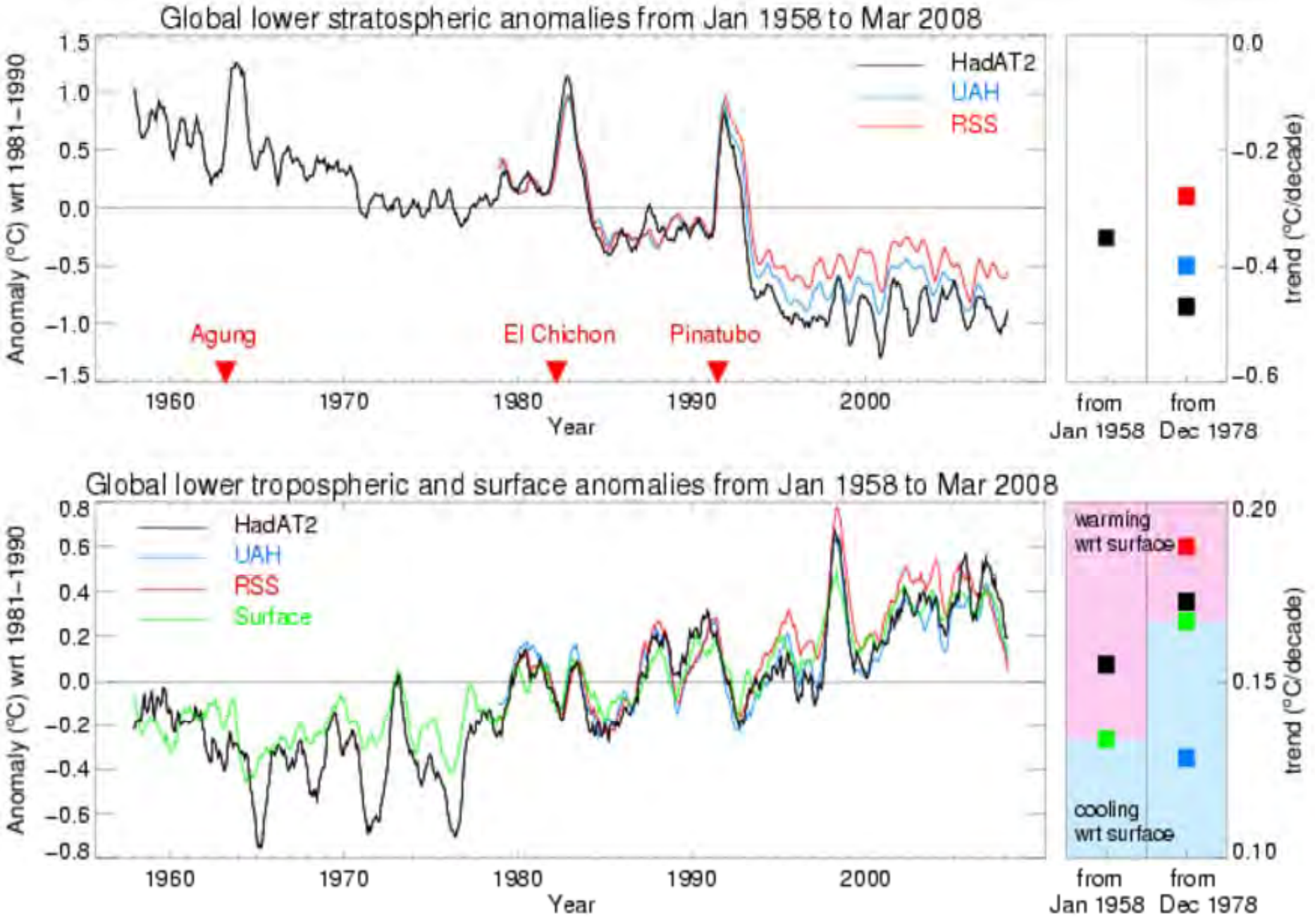


Long wet season along 1998/99

September, October, and November 1998

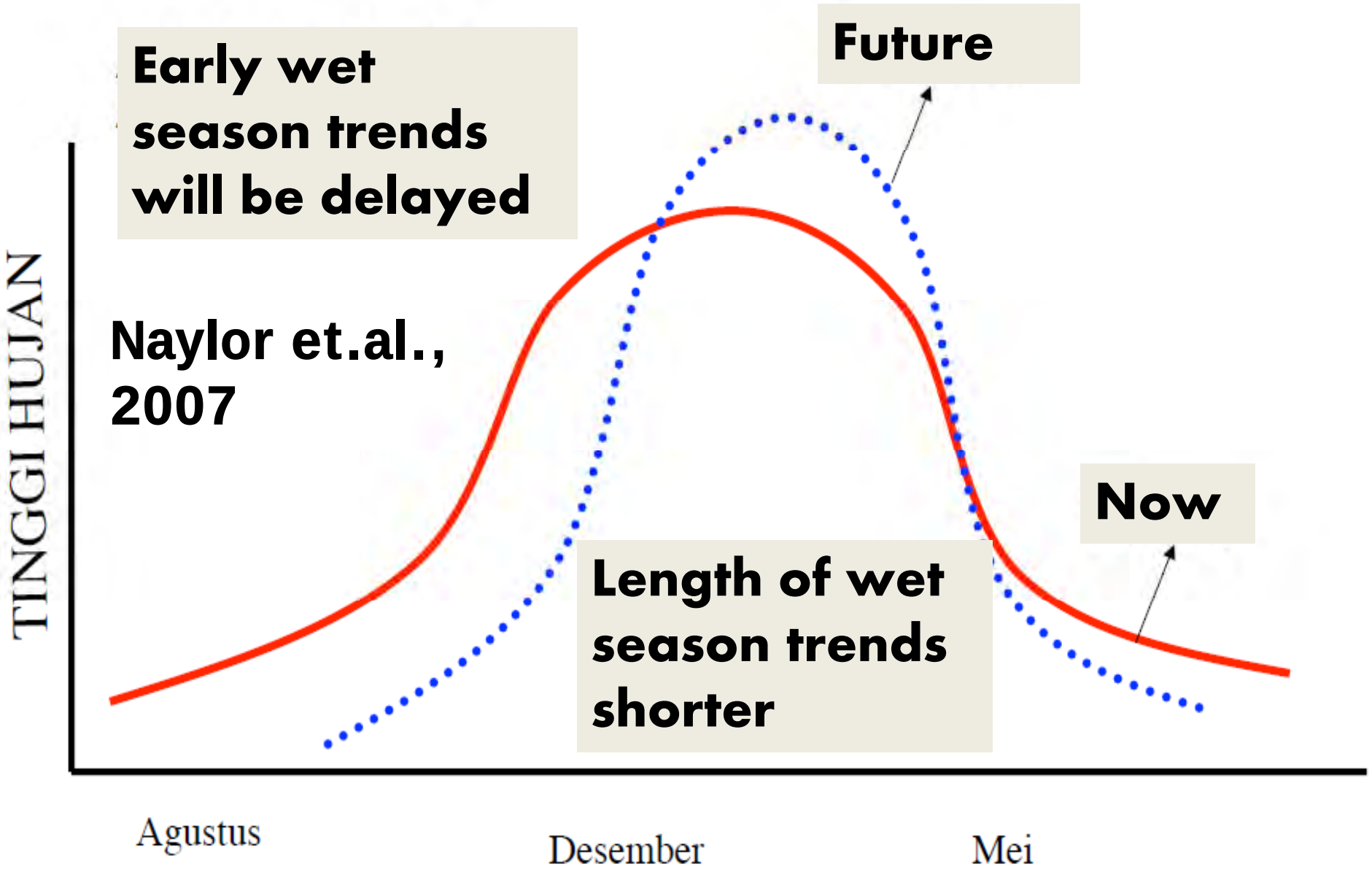
Climate Projection

Temperature & Precipitation



HadAT2 radiosonde data and HadCRUT3 surface data are produced by the Hadley Centre and are available at www.hadobs.org
UAH MSU satellite data are produced by the University of Alabama in Huntsville and are available at www.nsstc.uah.edu/public/msu courtesy of John Christy and Roy Spencer
RSS MSU satellite data are produced by Remote Sensing Systems and are available at www.remss.com courtesy of Carl Mears

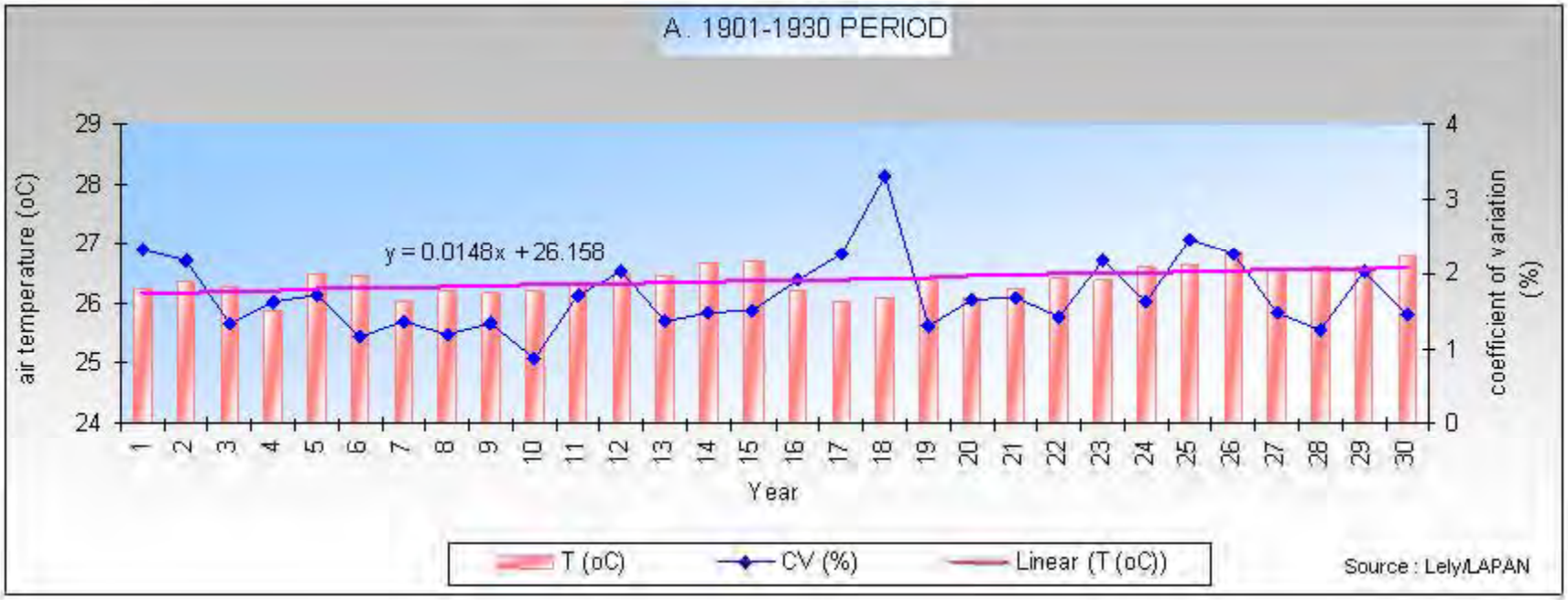
The possibility of precipitation change over Java & Bali Island



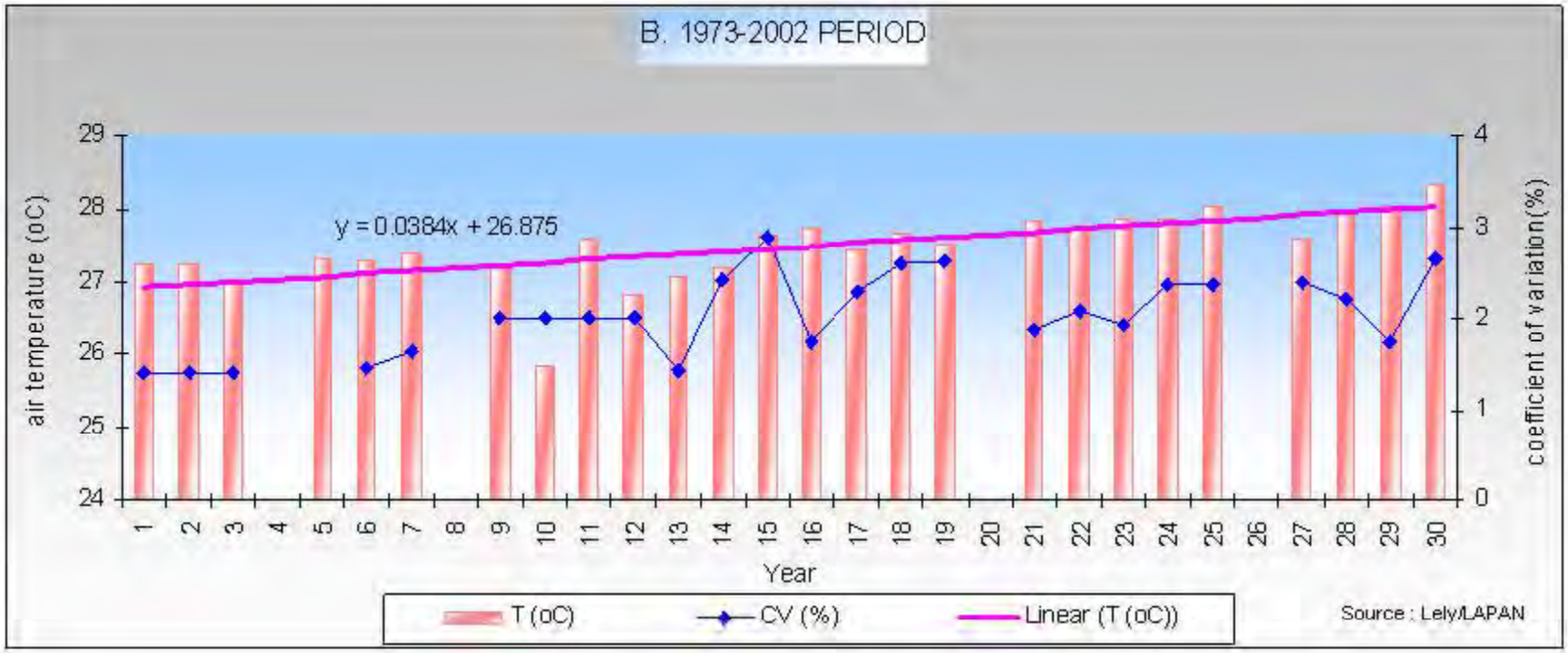
Detecting Climate Change

Temperature

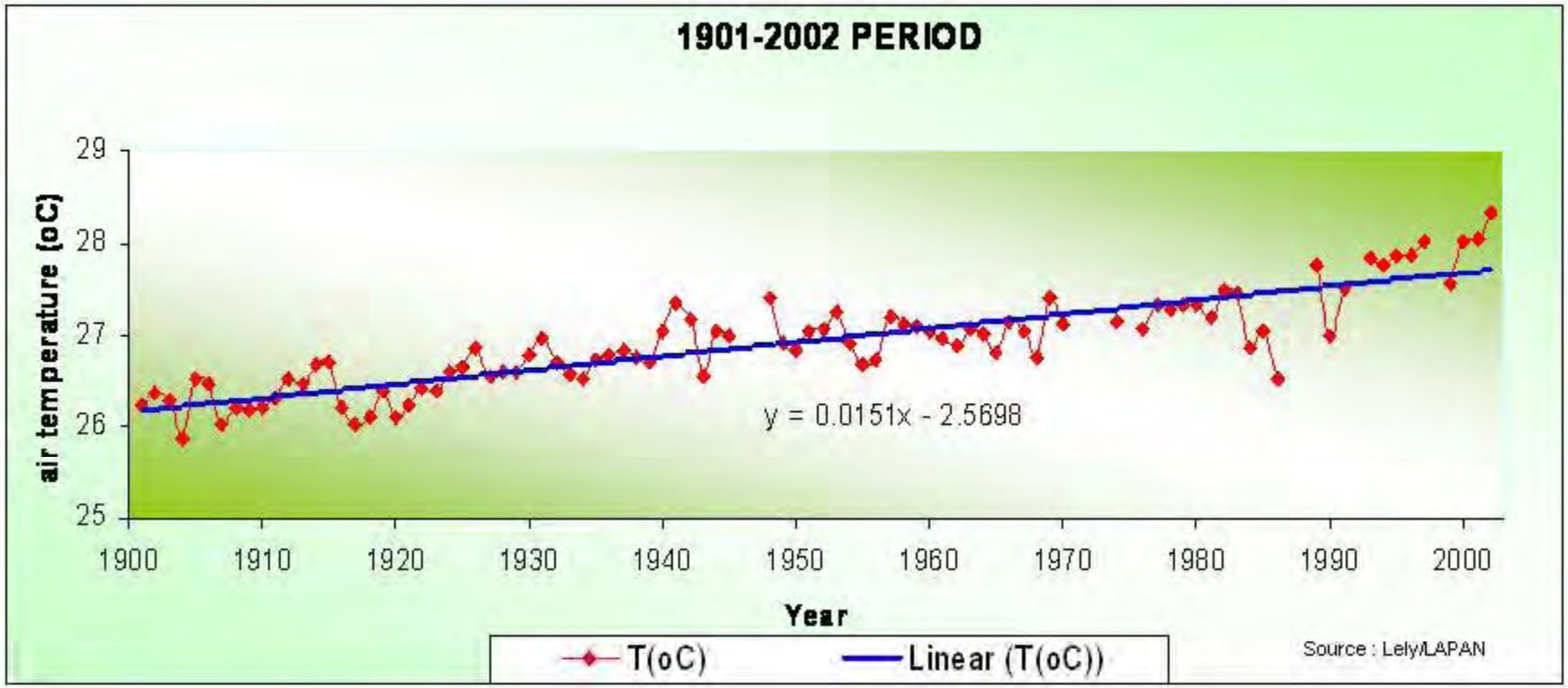
Trend, Coefficient of variation and Annual Air Temperature Variation in Jakarta, 1901-1930 PERIOD



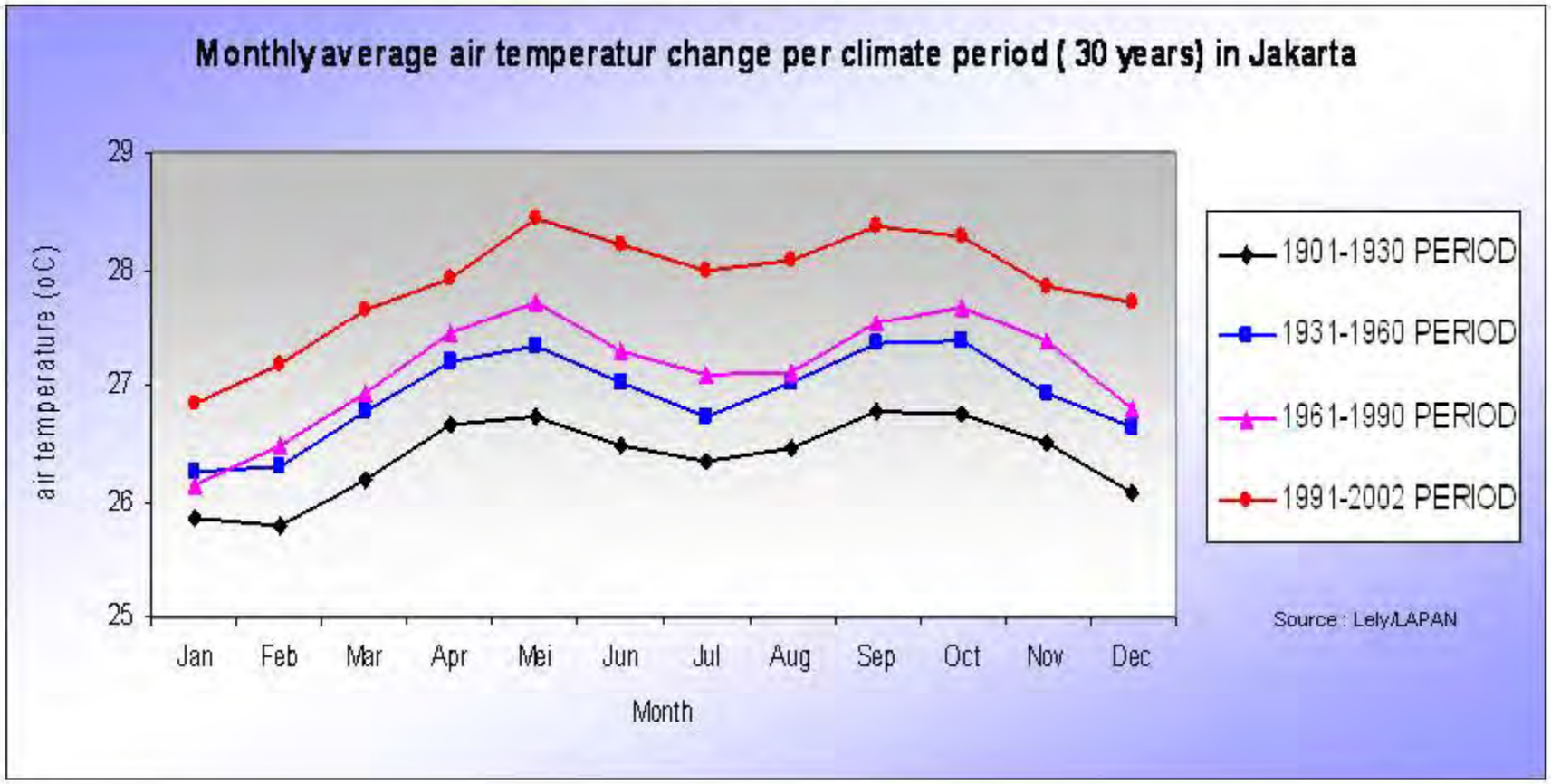
Trend, Coefficient of variation and Annual Air Temperature Variation in Jakarta, 1973-2002 PERIOD



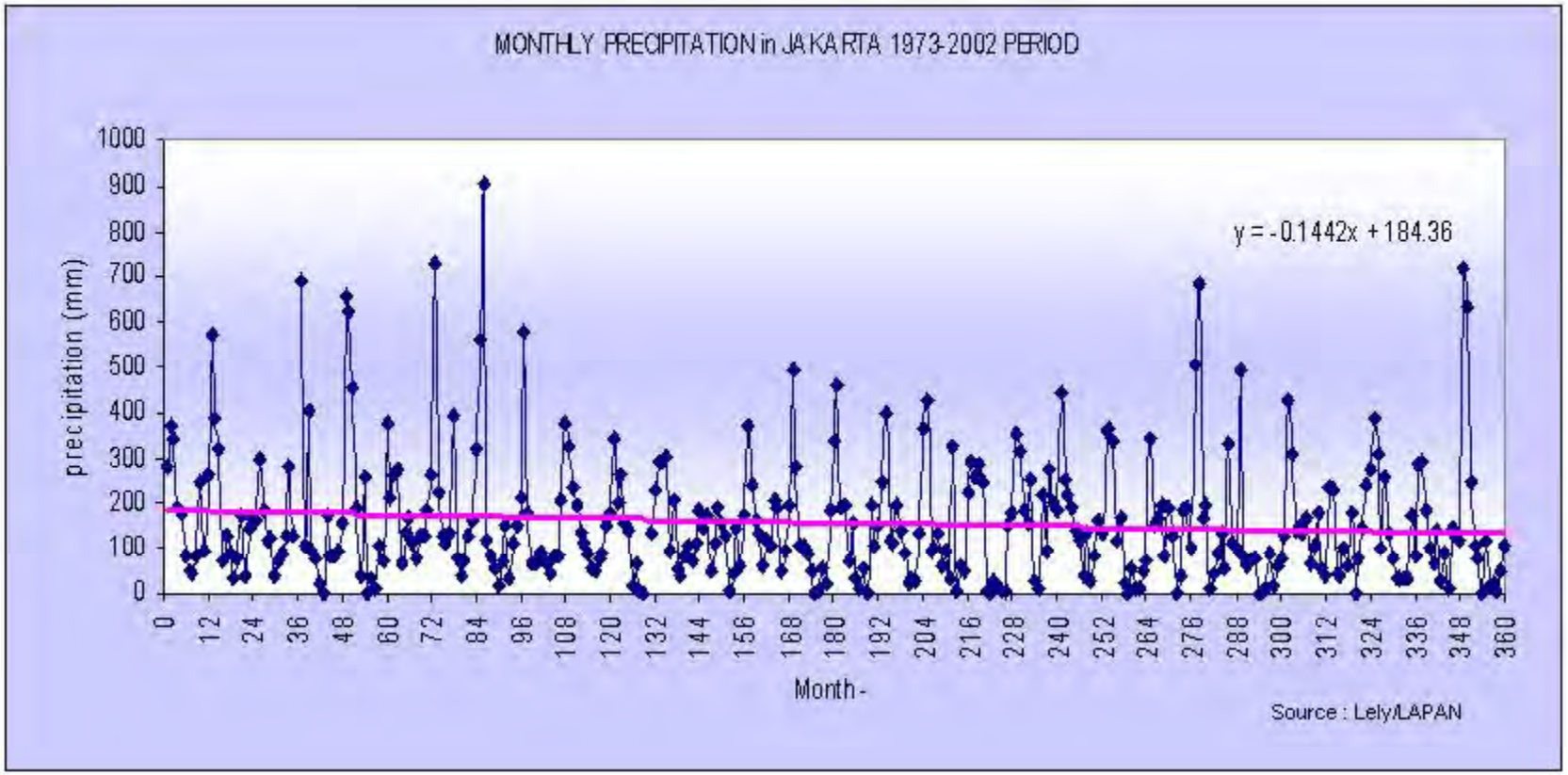
Time Series of Annual Air Temperature and Trend in Jakarta for 100 Years (1901-2002 PERIOD)

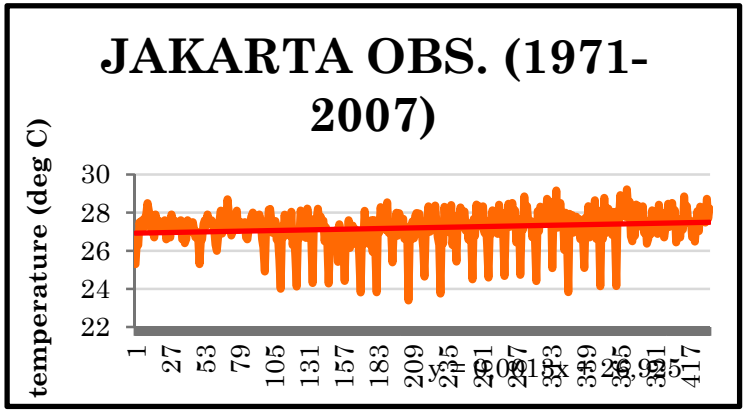


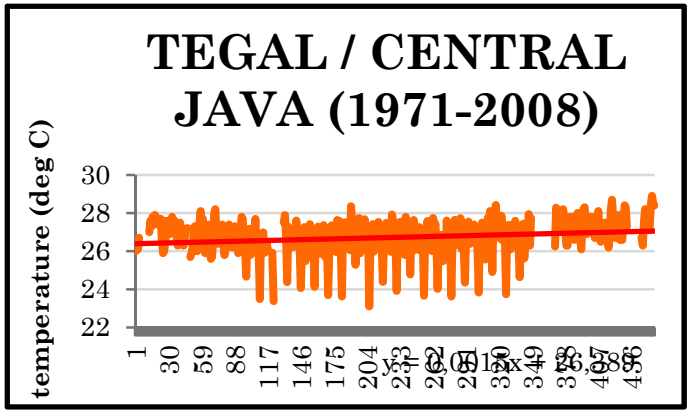
Monthly Average Air Temperature Change per Climate Period (30 years) in Jakarta

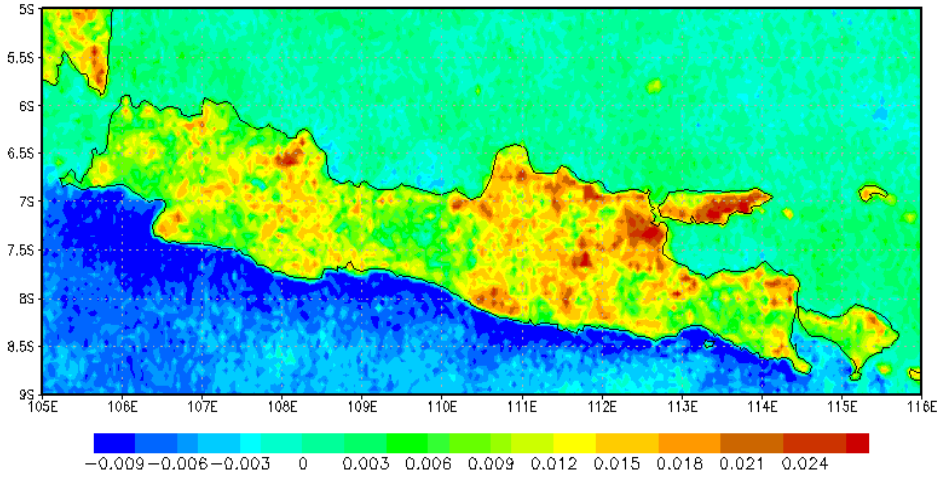


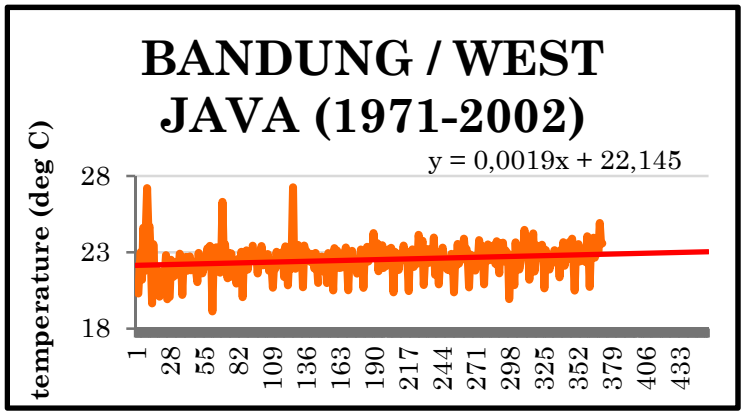
Trend and Monthly Precipitation Variation in Jakarta 1973-2002 Period

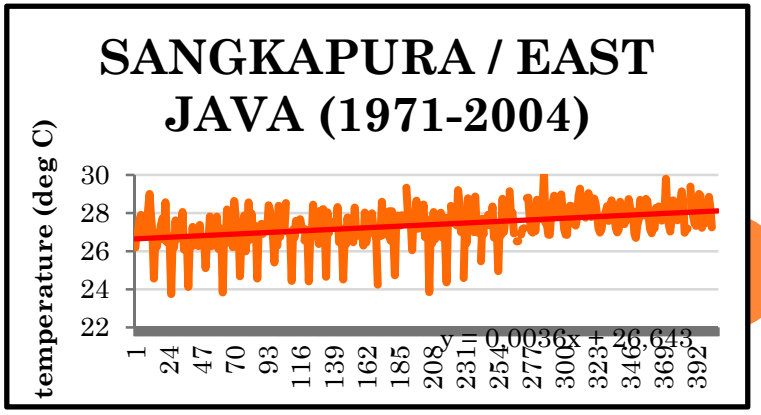



JAKARTA OBS. (1971-2007)
temperature (deg C)
30
28
26
24
22
1
27
53
79
105
131
157
183
209
417

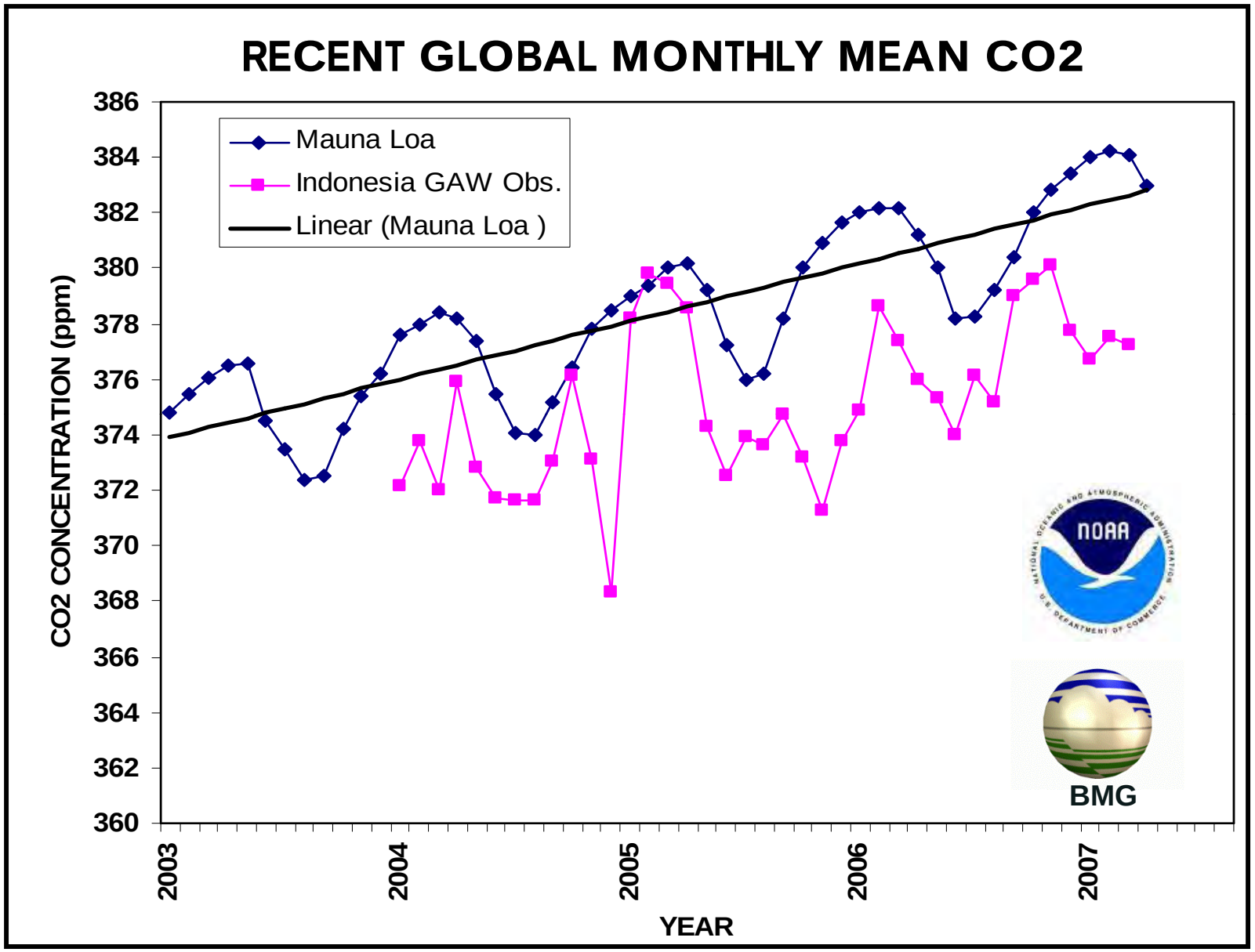

TEGAL / CENTRAL JAVA (1971-2008)
temperature (deg C)
30
28
26
24
22
1
30
59
88
117
146
175
204
349
436


5S
5.5S
6S
6.5S
7S
7.5S
8S
8.5S
9S
105E
106E
107E
108E
109E
110E
111E
112E
113E
114E
115E
116E
−0.009 −0.006 −0.003 0 0.003 0.006 0.009 0.012 0.015 0.018 0.021 0.024


BANDUNG / WEST JAVA (1971-2002)
y = 0,0019x + 22,145
temperature (deg C)
28
23
18
1
28
55
82
109
136
163
190
217
244
271
298
325
352
379
406
433


SANGKAPURA / EAST JAVA (1971-2004)
temperature (deg C)
30
28
26
24
22
1
24
47
70
93
116
139
162
185
208
231
254
277
300
323
346
369
392

BMG

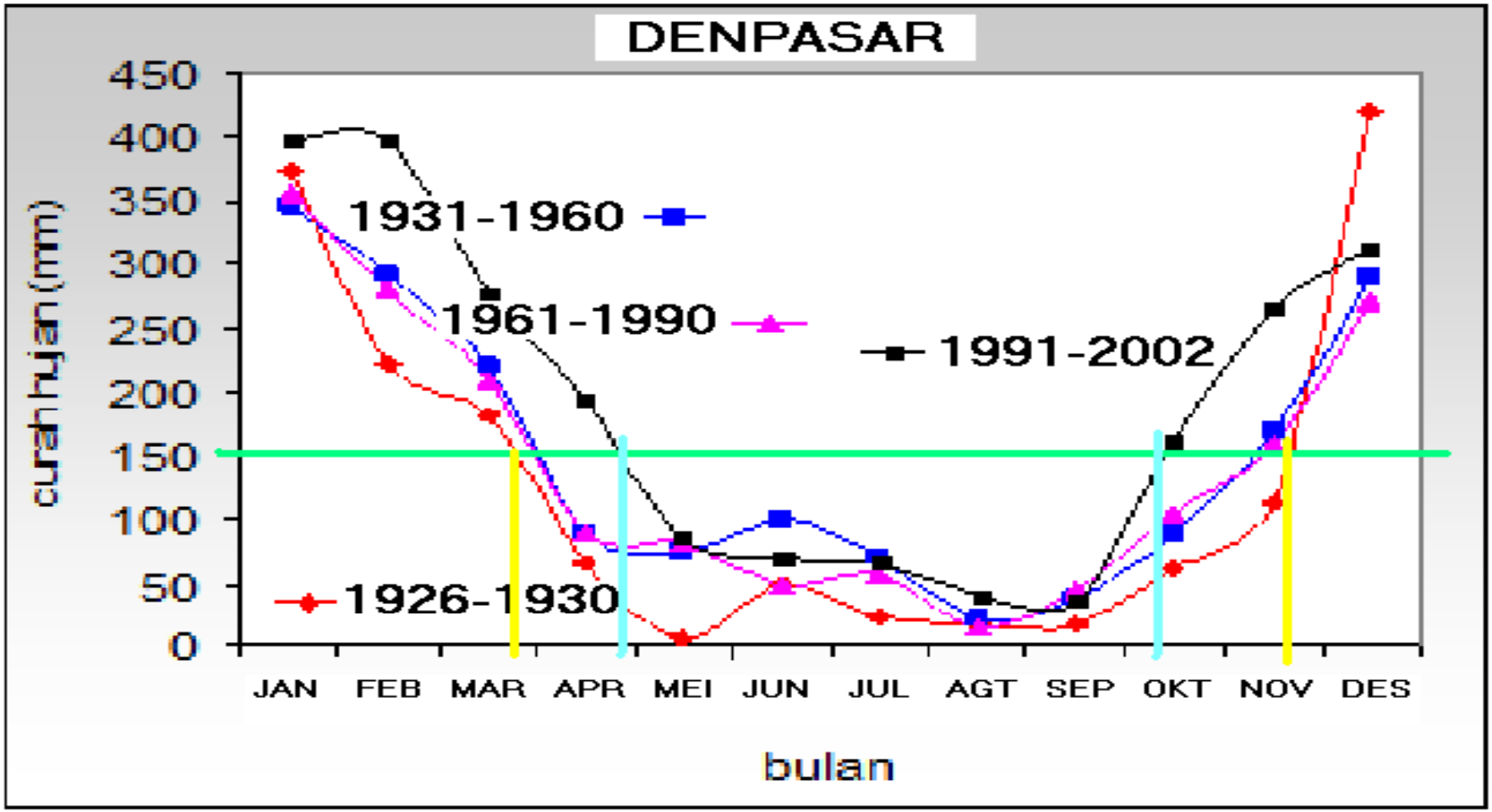


Source : NOAA – BMG, September 2007

Detecting Climate Change

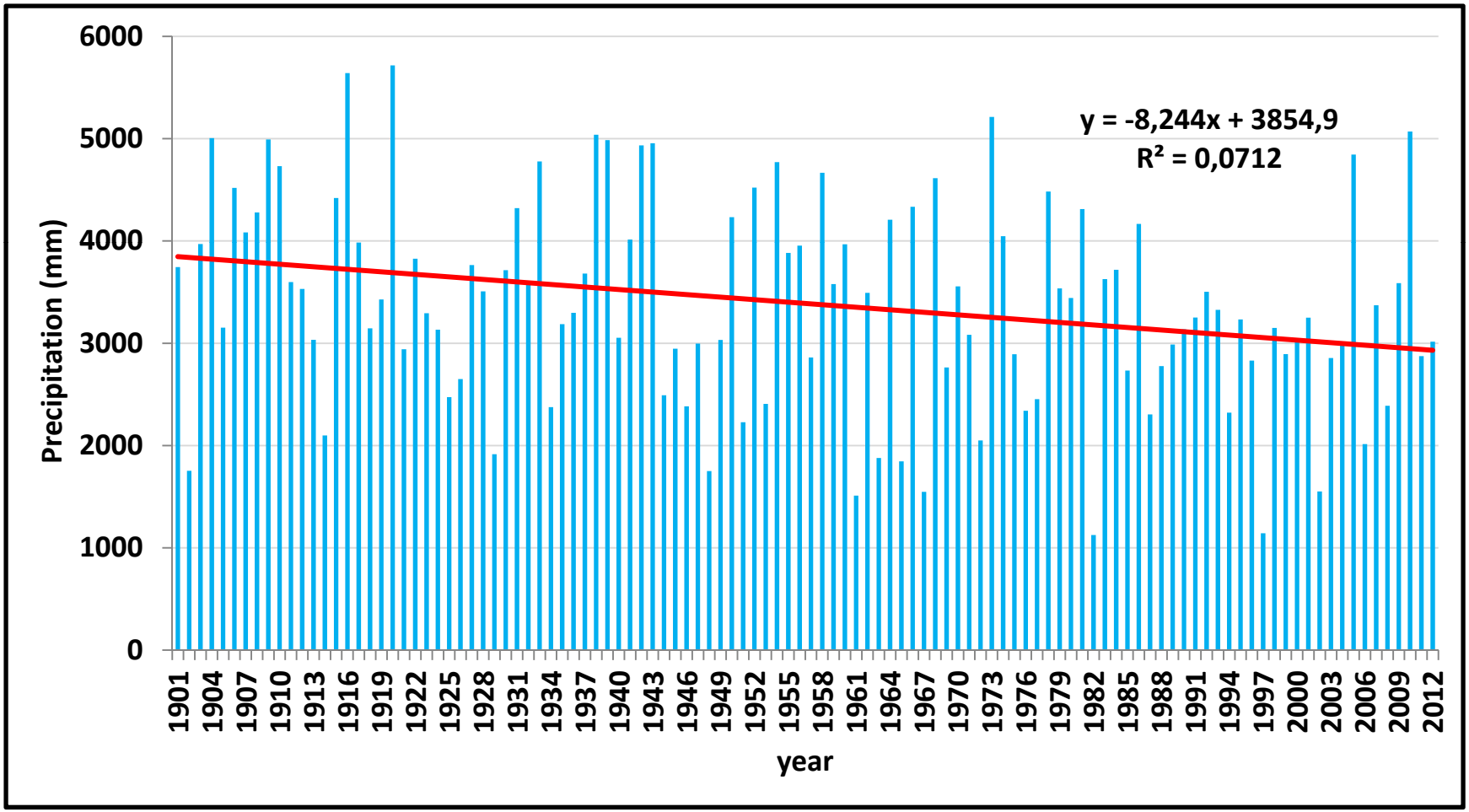
Rainfall/Precipitation

PRECIPITATION CHANGE PER- CLIMATE PERIOD (30 YEARS) IN DENPASAR, BALI



Avia, 2007b

VARIABILITY AND TREND OF PRECIPITATION 1901-2012 IN CILACAP, CENTRAL JAVA

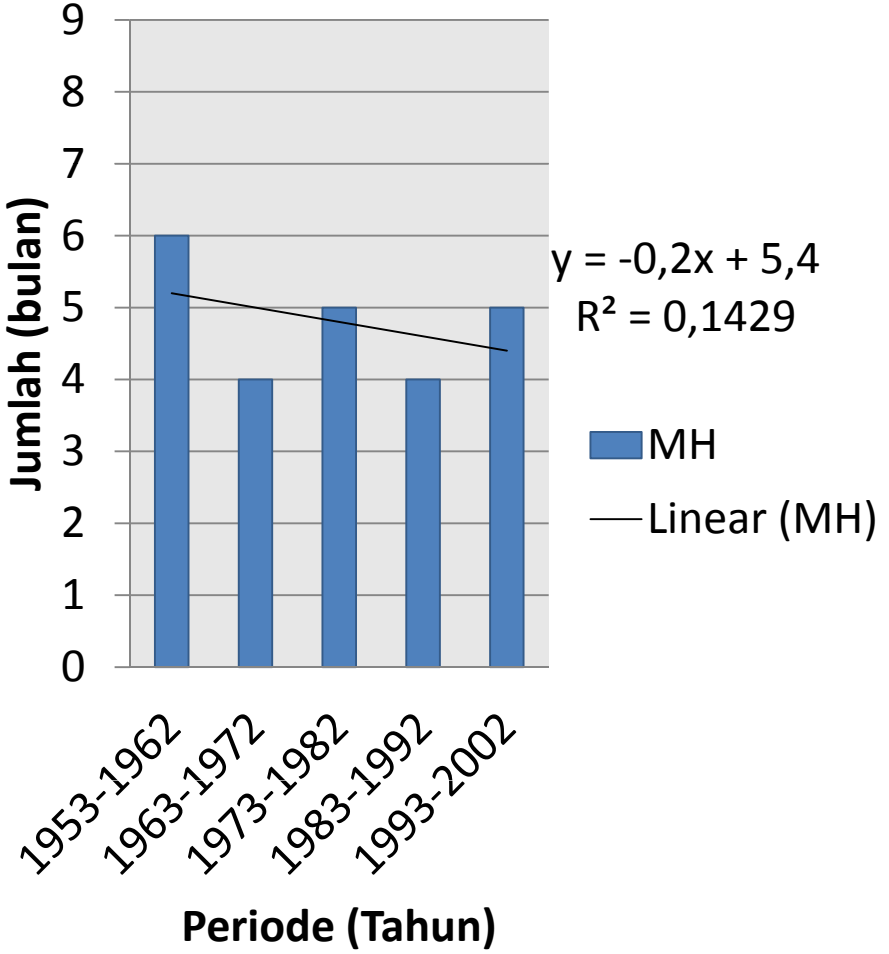


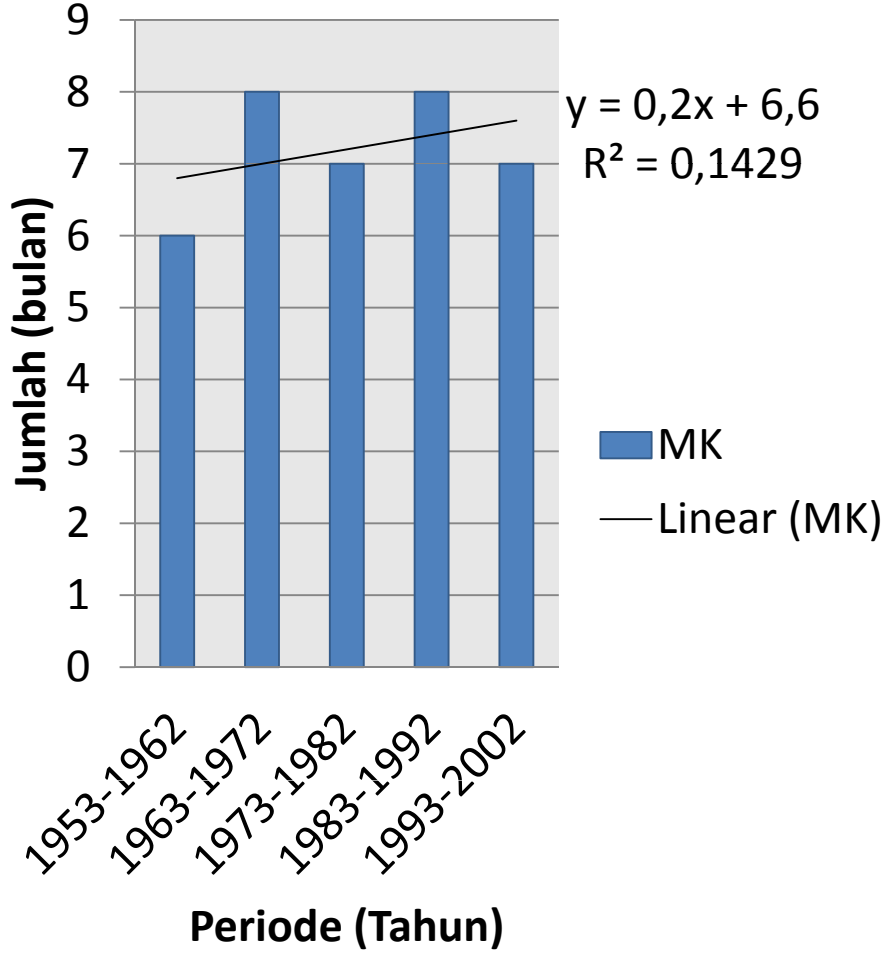
Definitions of climate change (IPCC, AR-4, 2007)

Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.

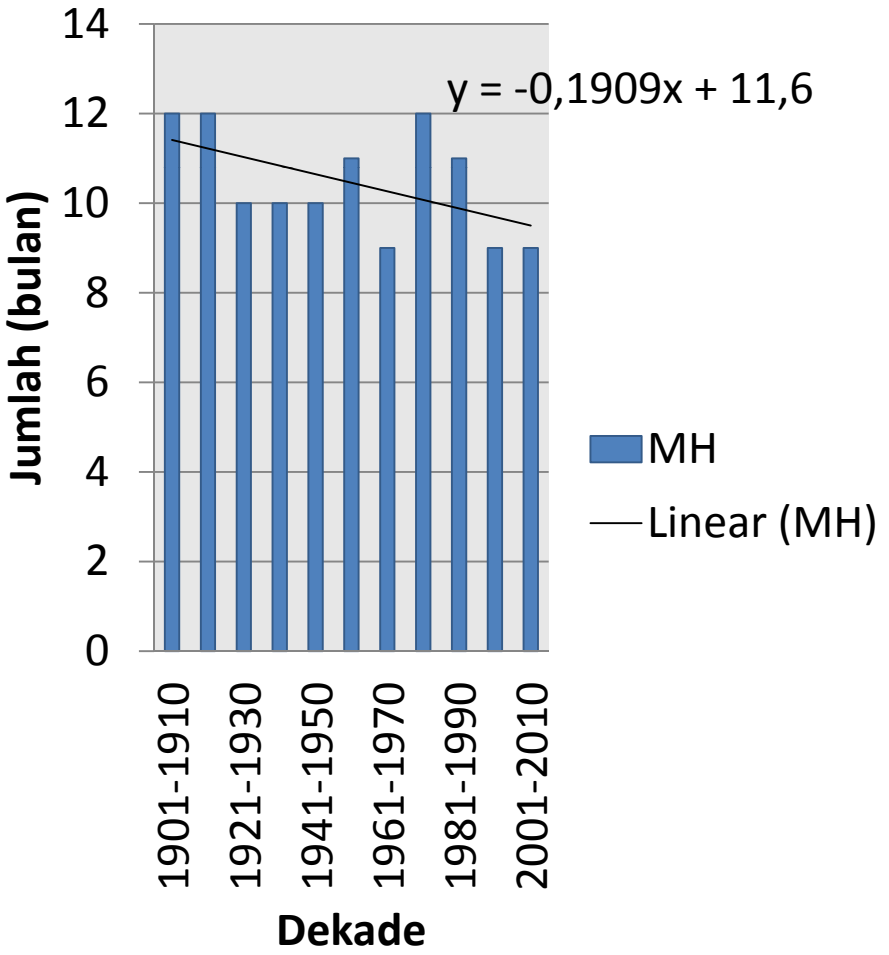

Java Sea
Jakarta
DKI Jakarta
Surabaya
Yogyakarta
Jawa (Java)
East Java
Cilacap
A
B
C
D
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2013 Google
Image Landsat
© 2013 AfriGIS (Pty) Ltd.

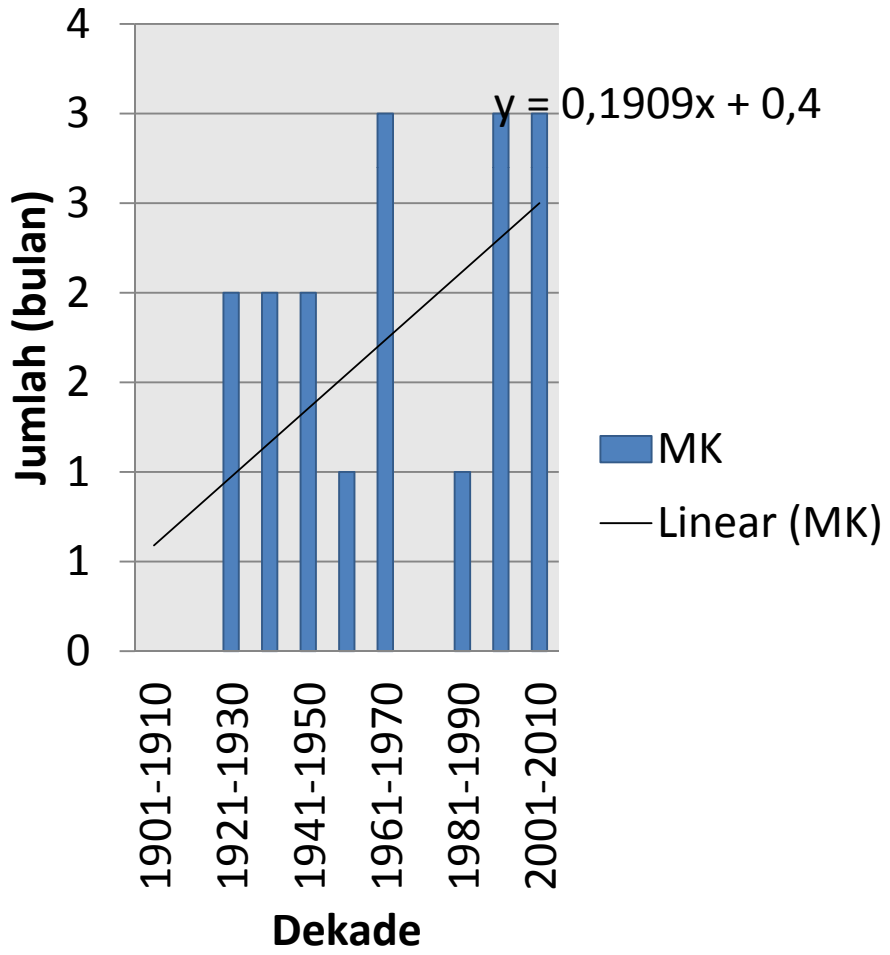
Tren the amount of wet and dry season per decade (every 10 years) for period of 1953-2002 (~53 years) at Surabaya



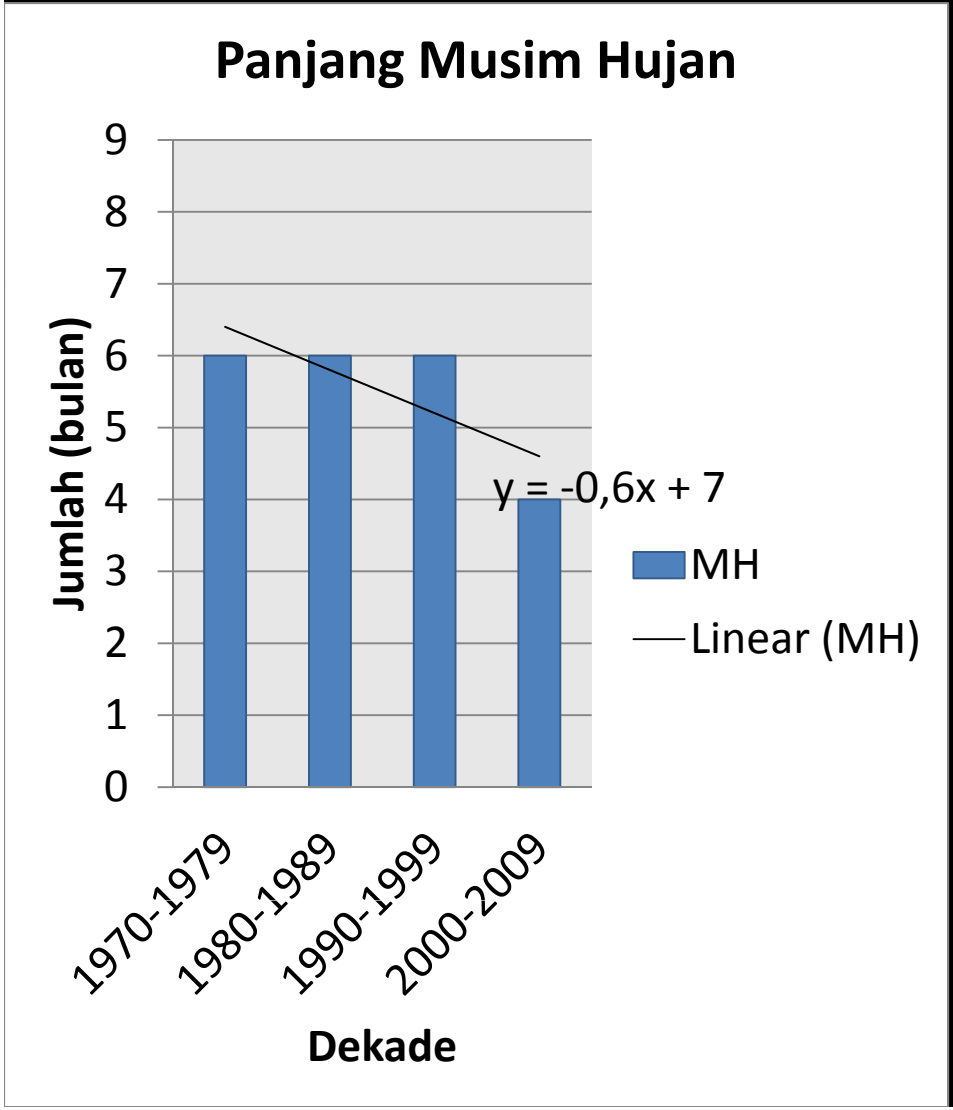


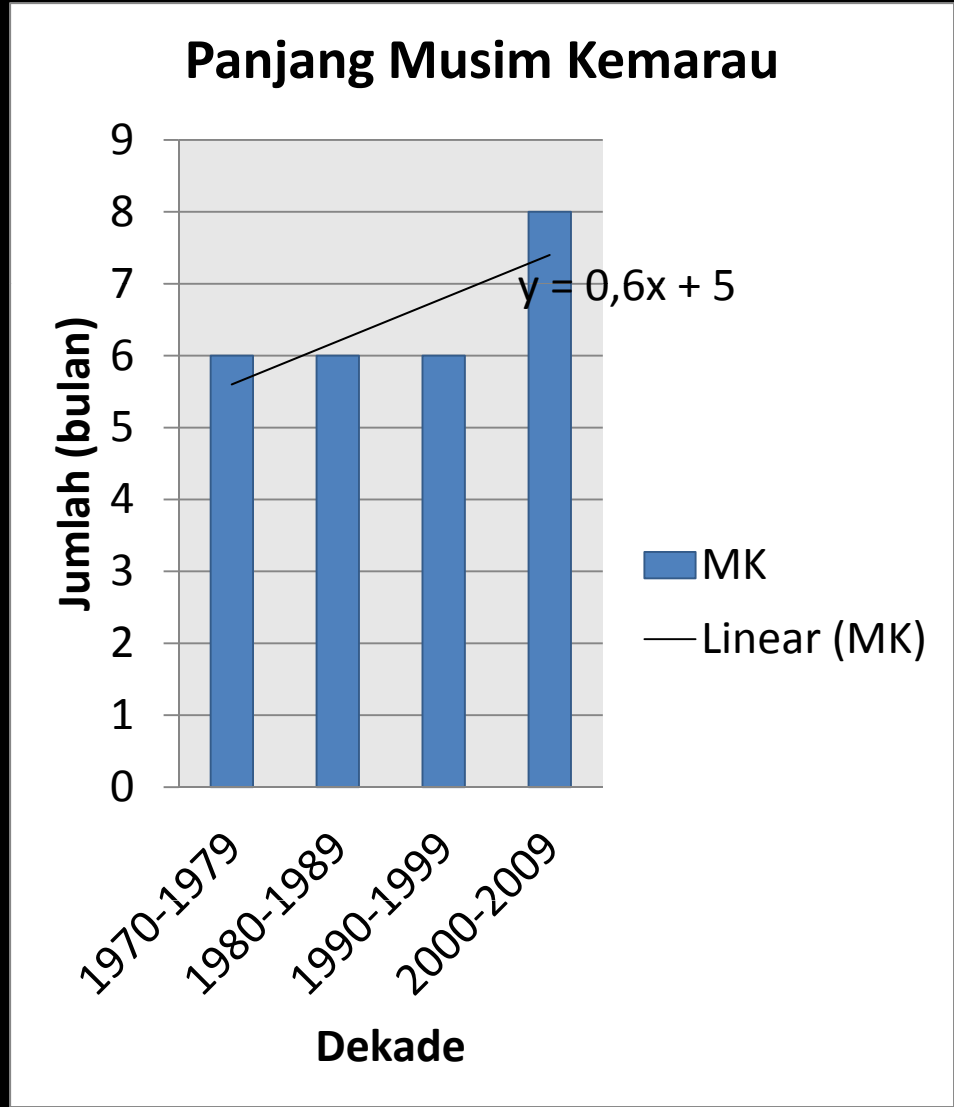
Tren the amount of wet and dry season per decade (every 10 years) for period of 1901-2012 (~112 years) at Cilacap



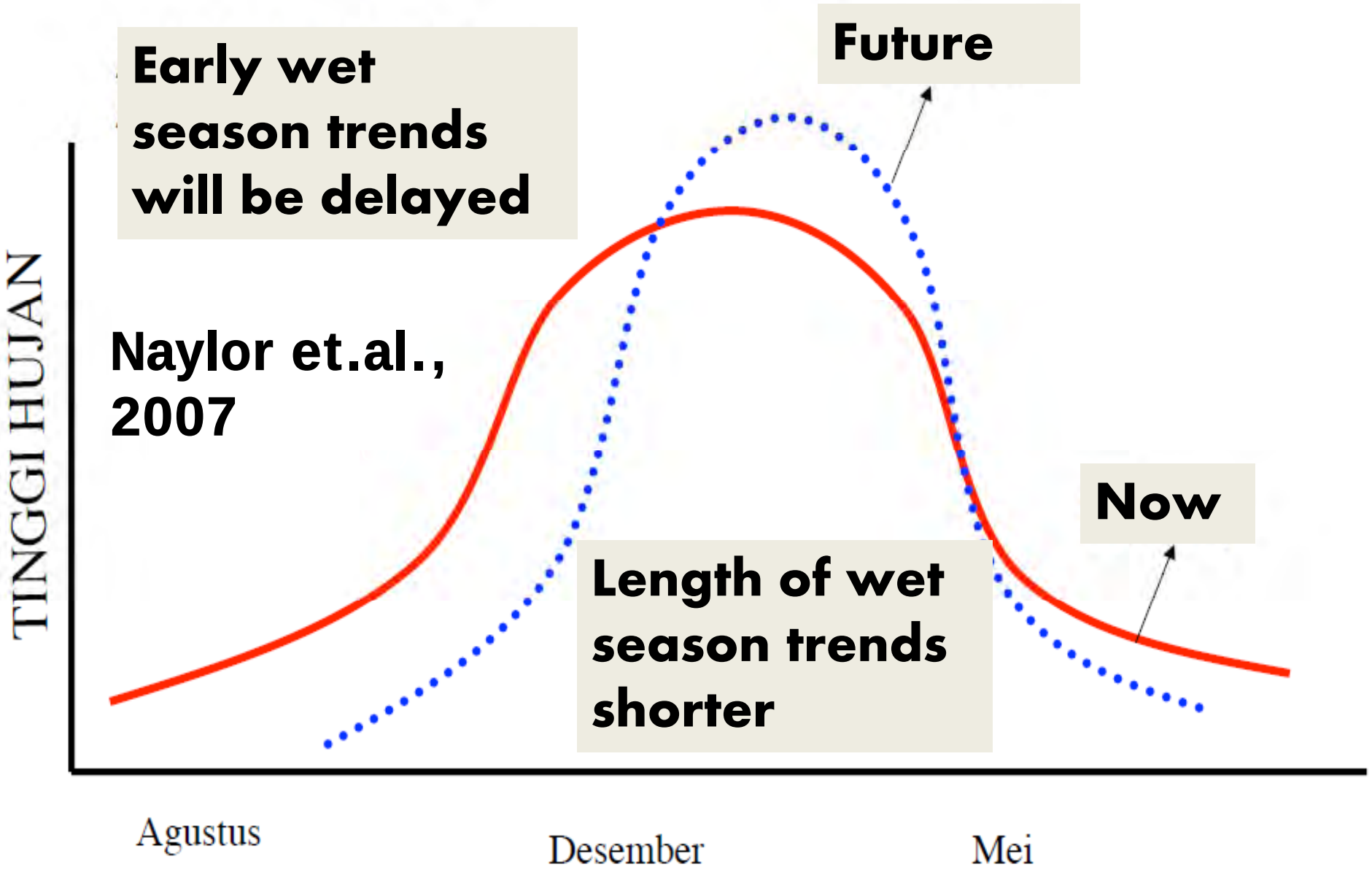


Tren the amount of wet and dry season per decade (every 10 years) for period of 1970-2012 (~43 years) at Yogyakarta





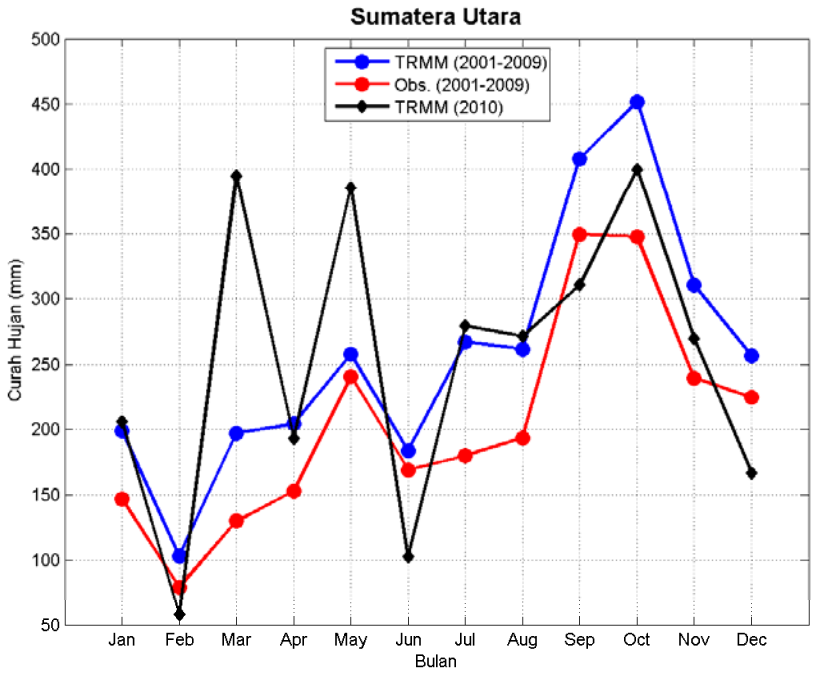
The tren/tendecy of precipitation change over Java & Bali Island



What should we do?

We need to save the 11 provinces of our rice production center from the extreme climate condition, such as already happened in 1982/83 and 1997/98 using TRMM data.

How ?


Sumatera Utara
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
Jan
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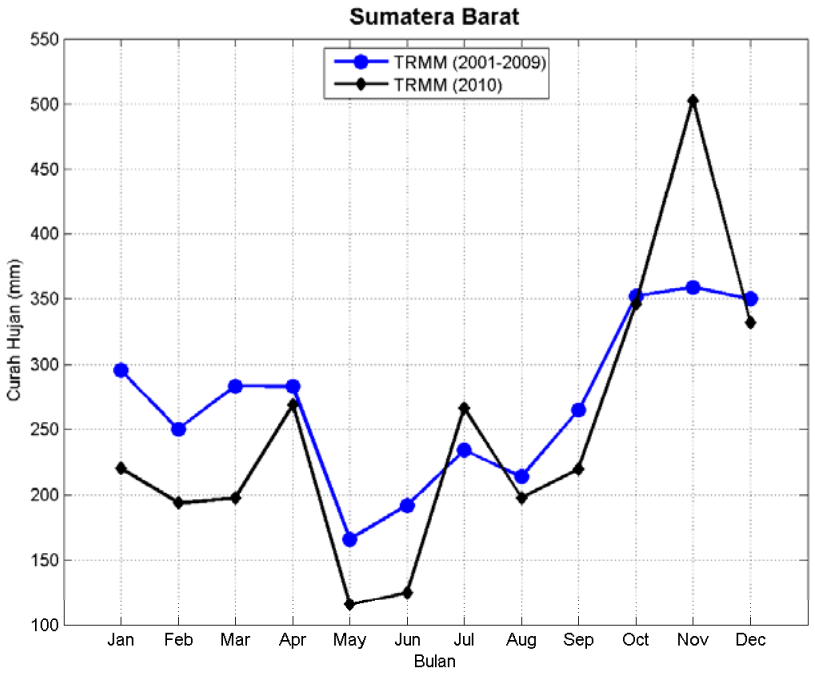
Nov
Dec


Sumatera Barat
TRMM (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
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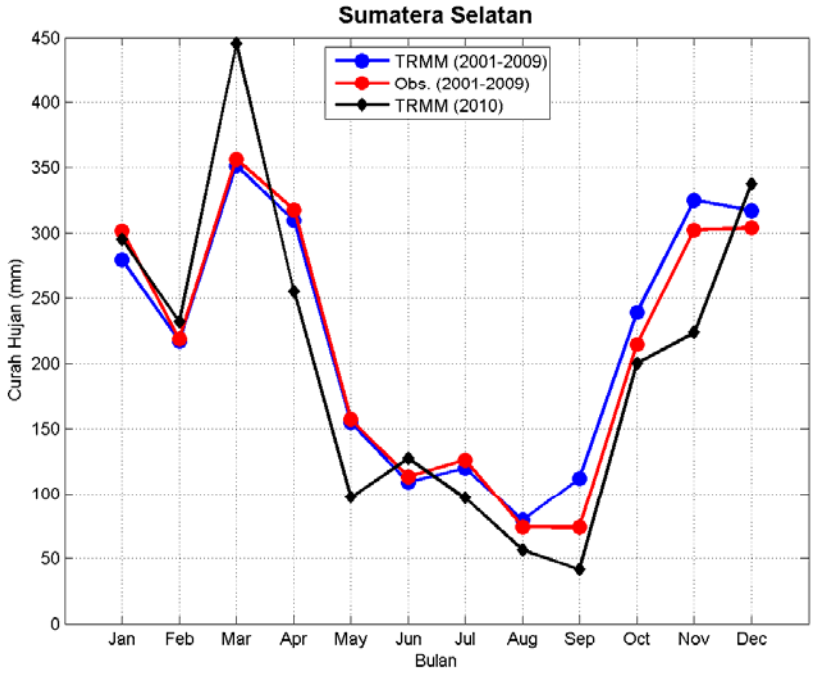
Sumatera Selatan
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
Jan
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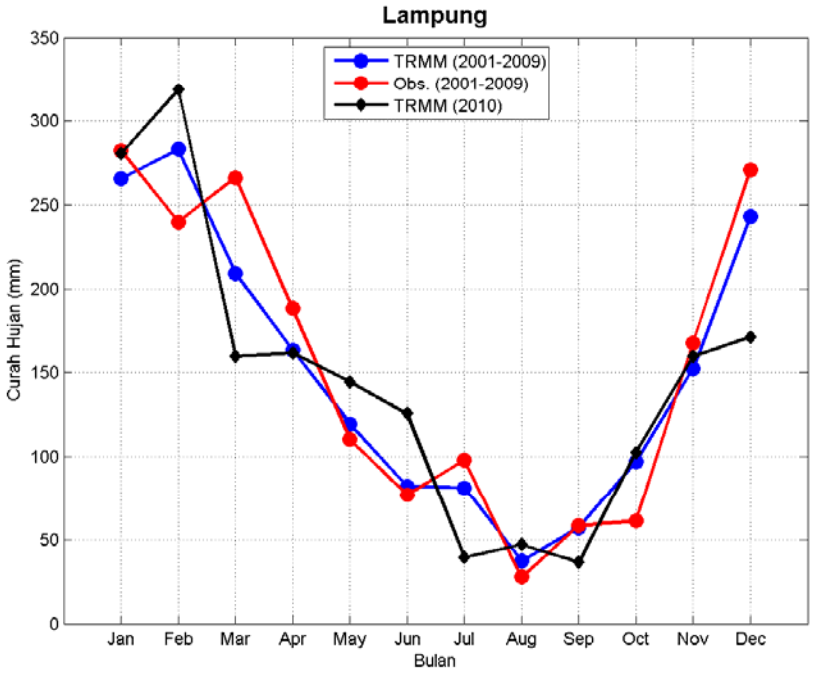
Lampung
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
Jan
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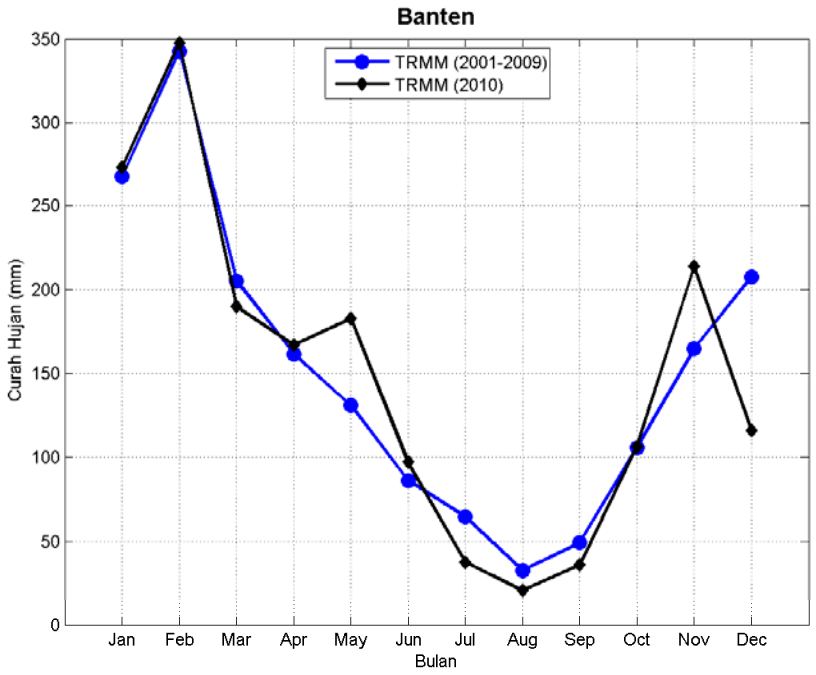
Banten
TRMM (2001-2009)
TRMM (2010)
Curah Hujan (mm)
0
50
100
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250
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350
Jan
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Nov
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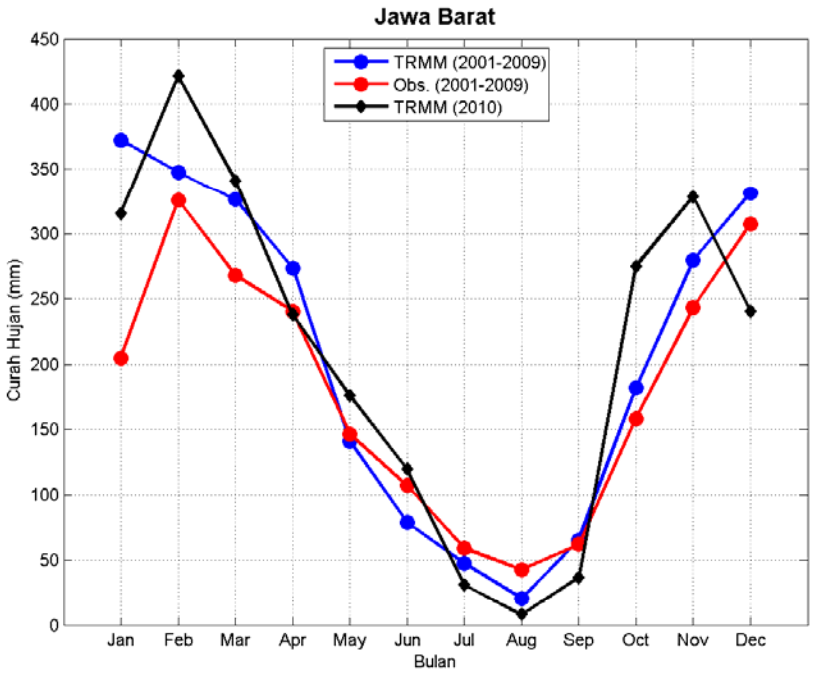
Bulan


Jawa Barat
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
0
50
100
150
200
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450
Jan
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Nov
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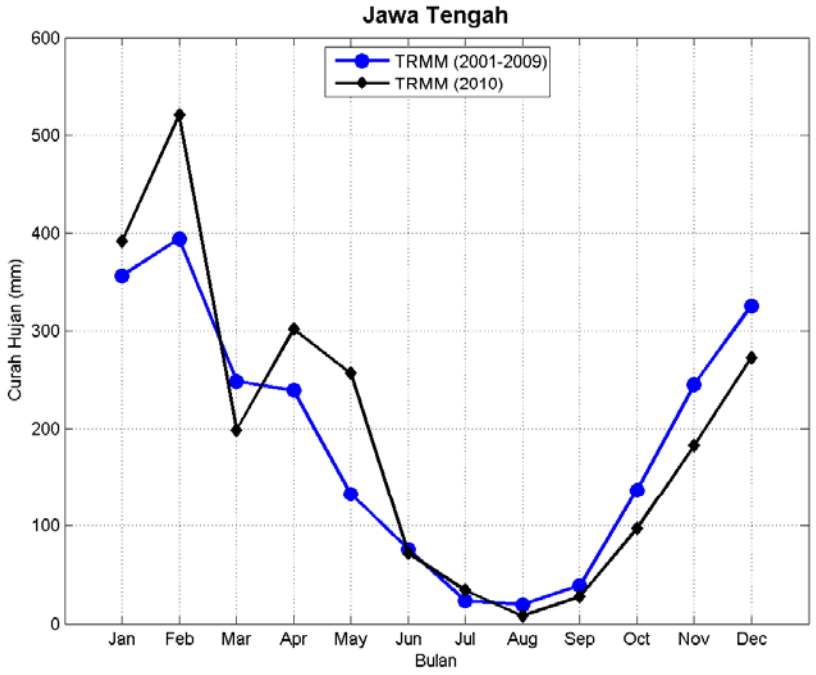
Bulan


Jawa Tengah
TRMM (2001-2009)
TRMM (2010)
Curah Hujan (mm)
0
100
200
300
400
500
600
Jan
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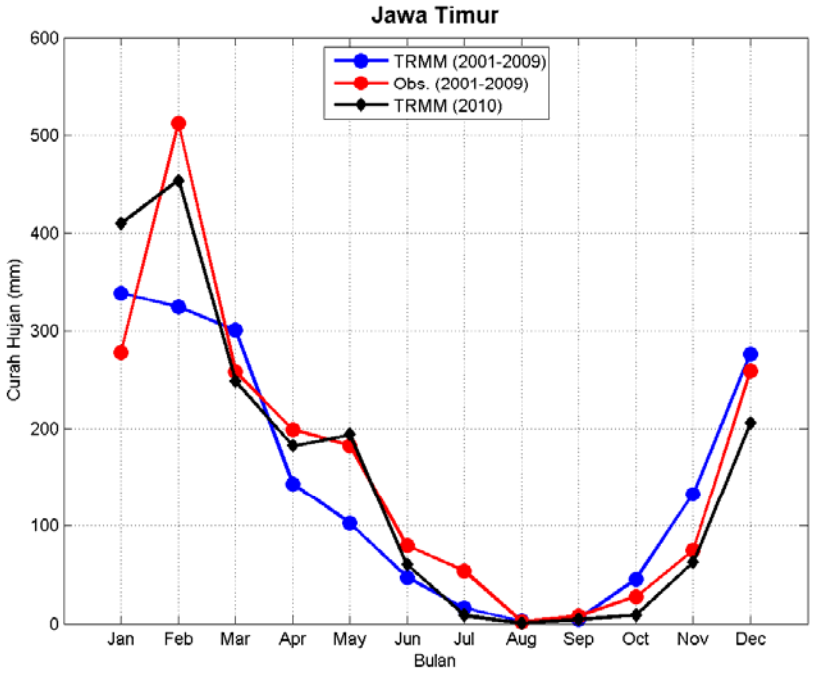
Nov
Dec
Bulan


Jawa Timur
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
0
100
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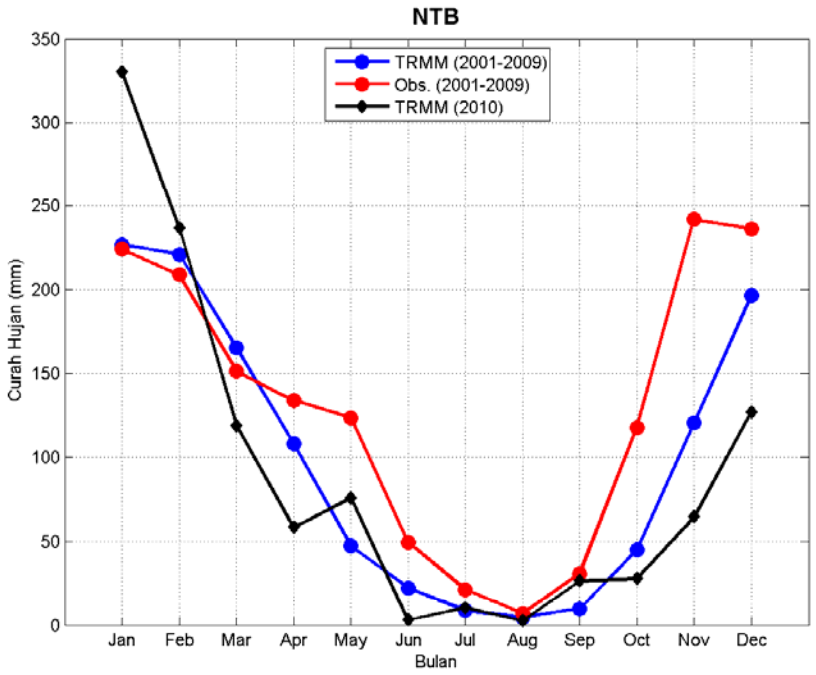
Nov
Dec
Bulan


NTB
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
Jan
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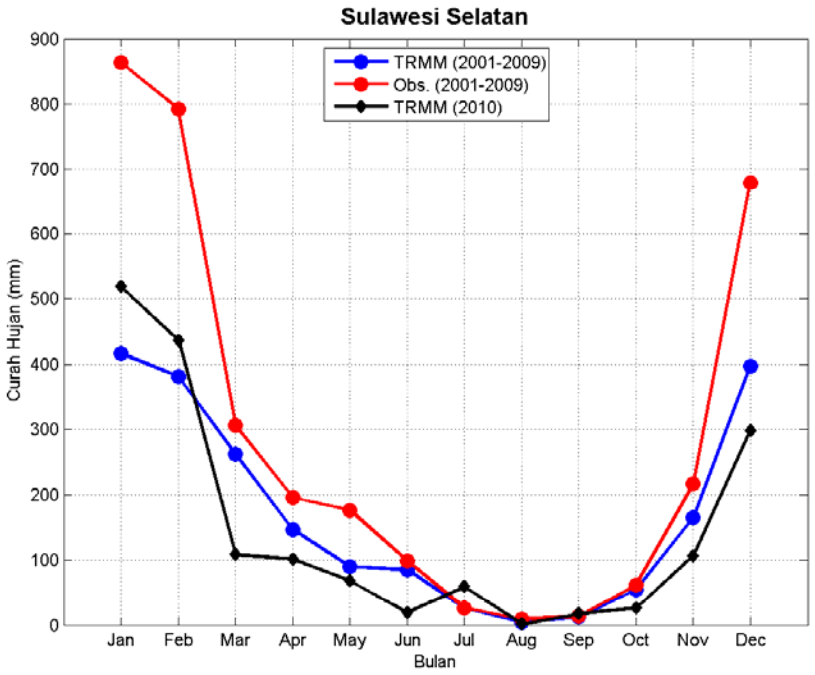
Sulawesi Selatan
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
Jan
Feb
Mar
Apr
May
Jun
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Aug
Sep
Oct
Nov
Dec
0
100
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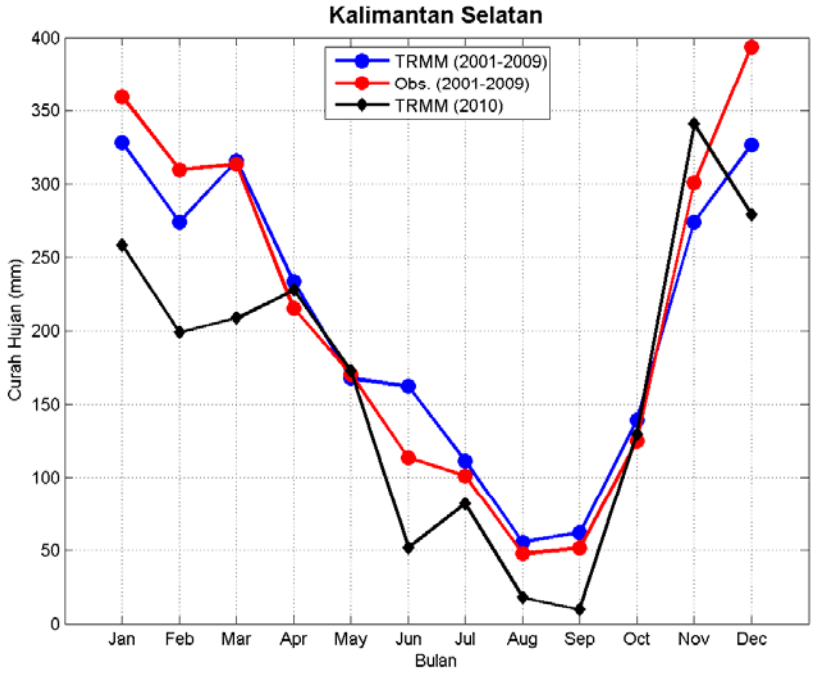
700
800
900


Kalimantan Selatan
TRMM (2001-2009)
Obs. (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
Jan
Feb
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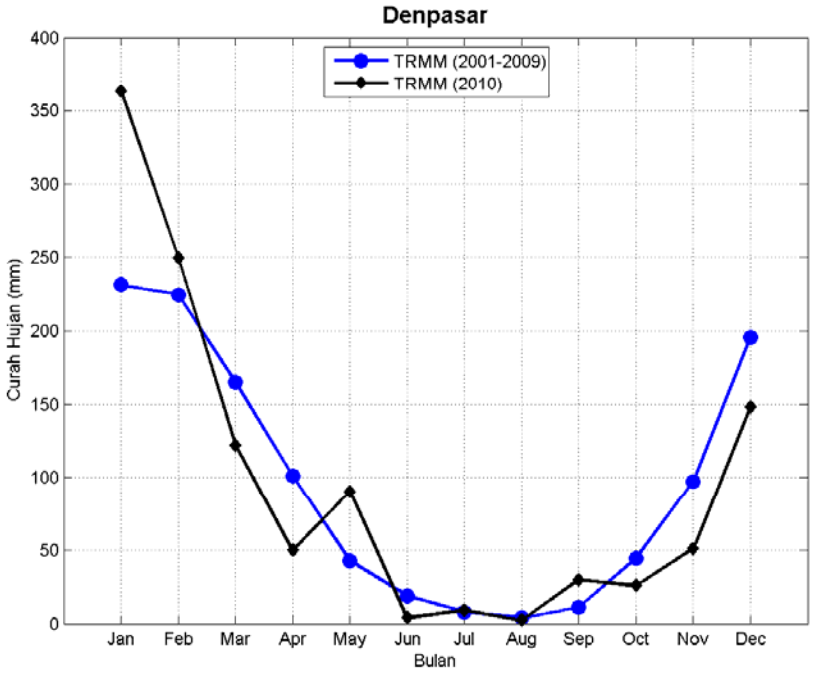
Denpasar
TRMM (2001-2009)
TRMM (2010)
Curah Hujan (mm)
Bulan
Jan
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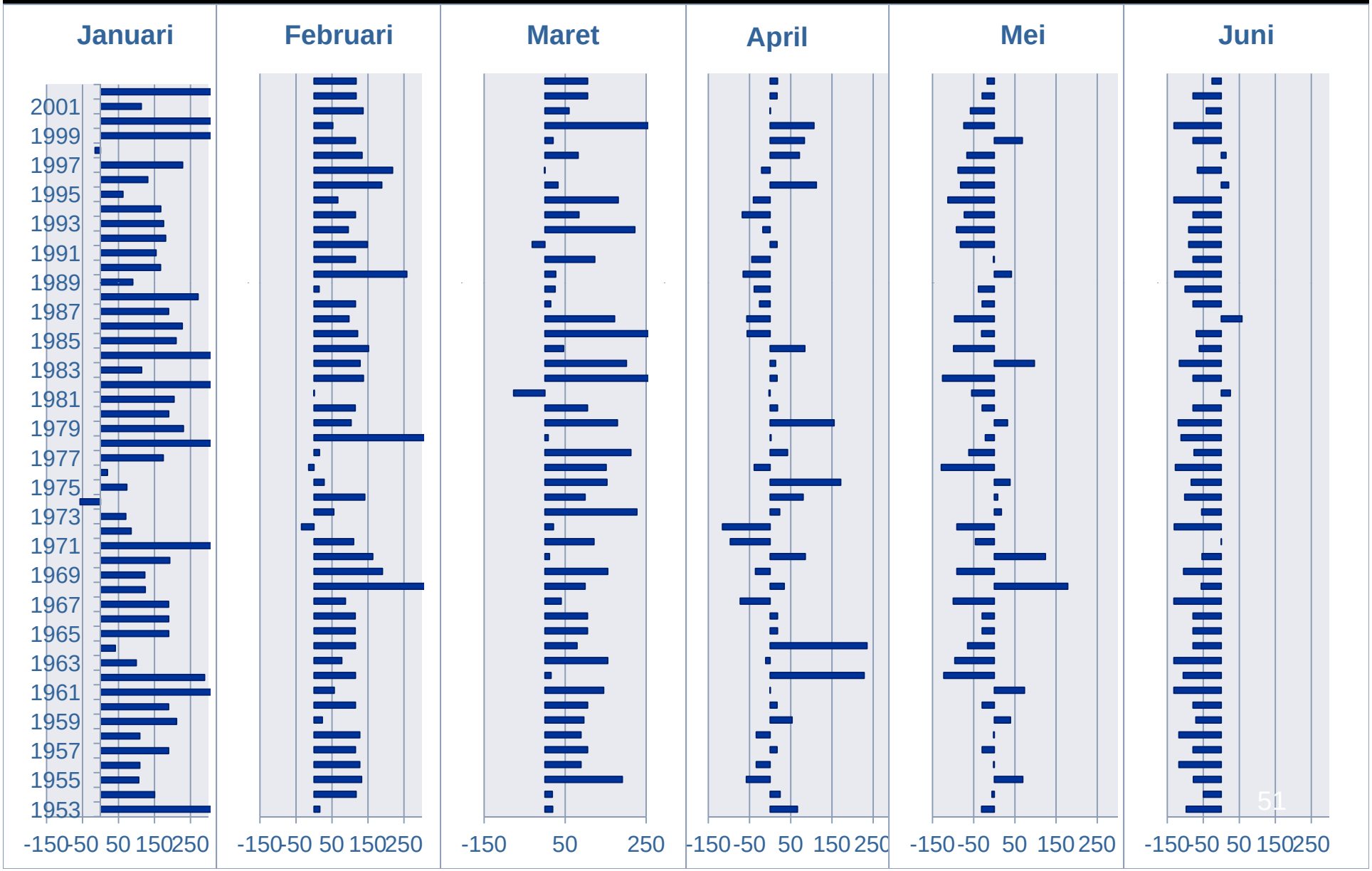
400

Rainfall at Surabaya

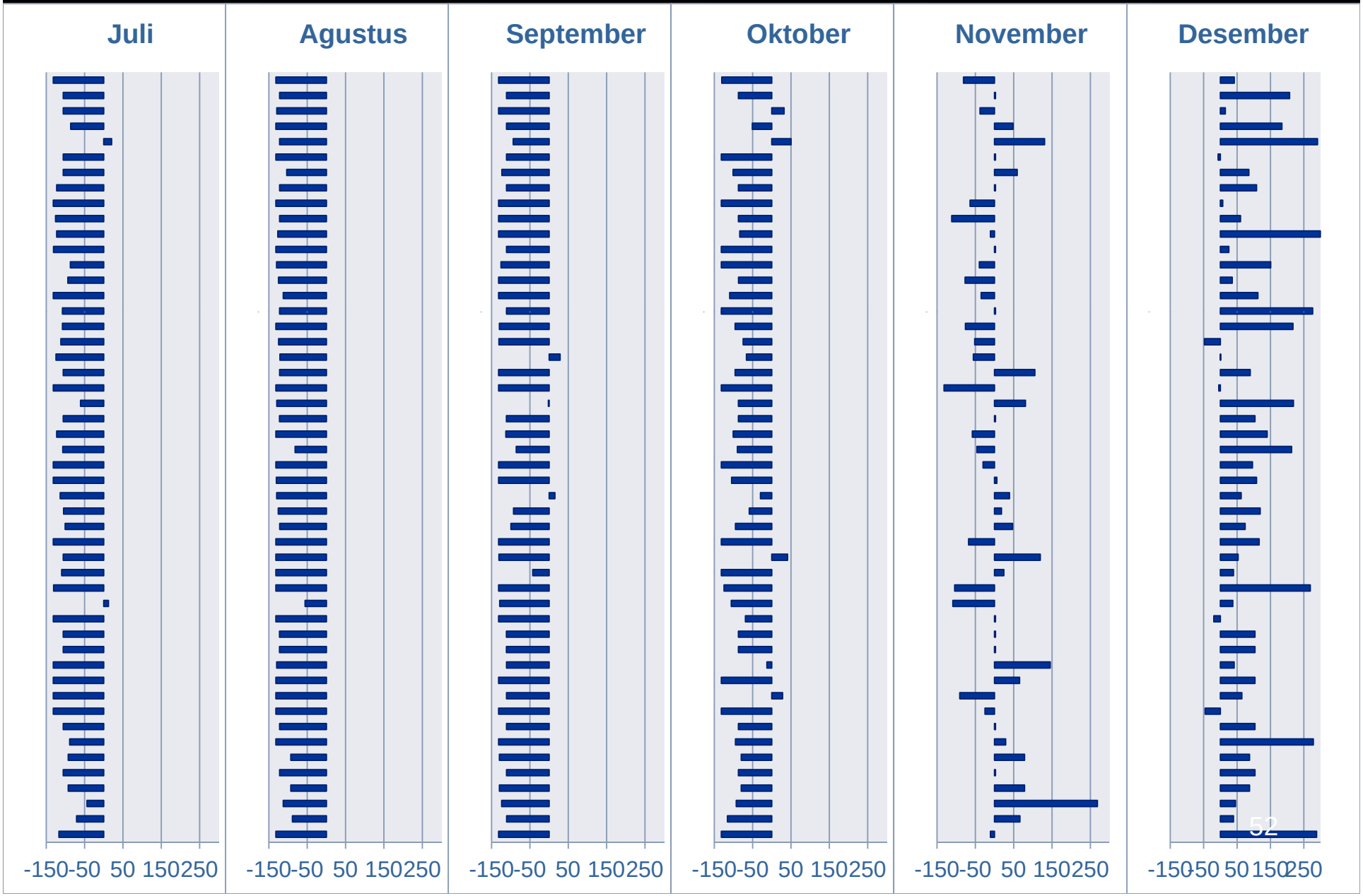
Period of 1953-2002

(50 Years Observation)

Composite Technique Analysis for Rainfall at Surabaya for Period of 1953-2002

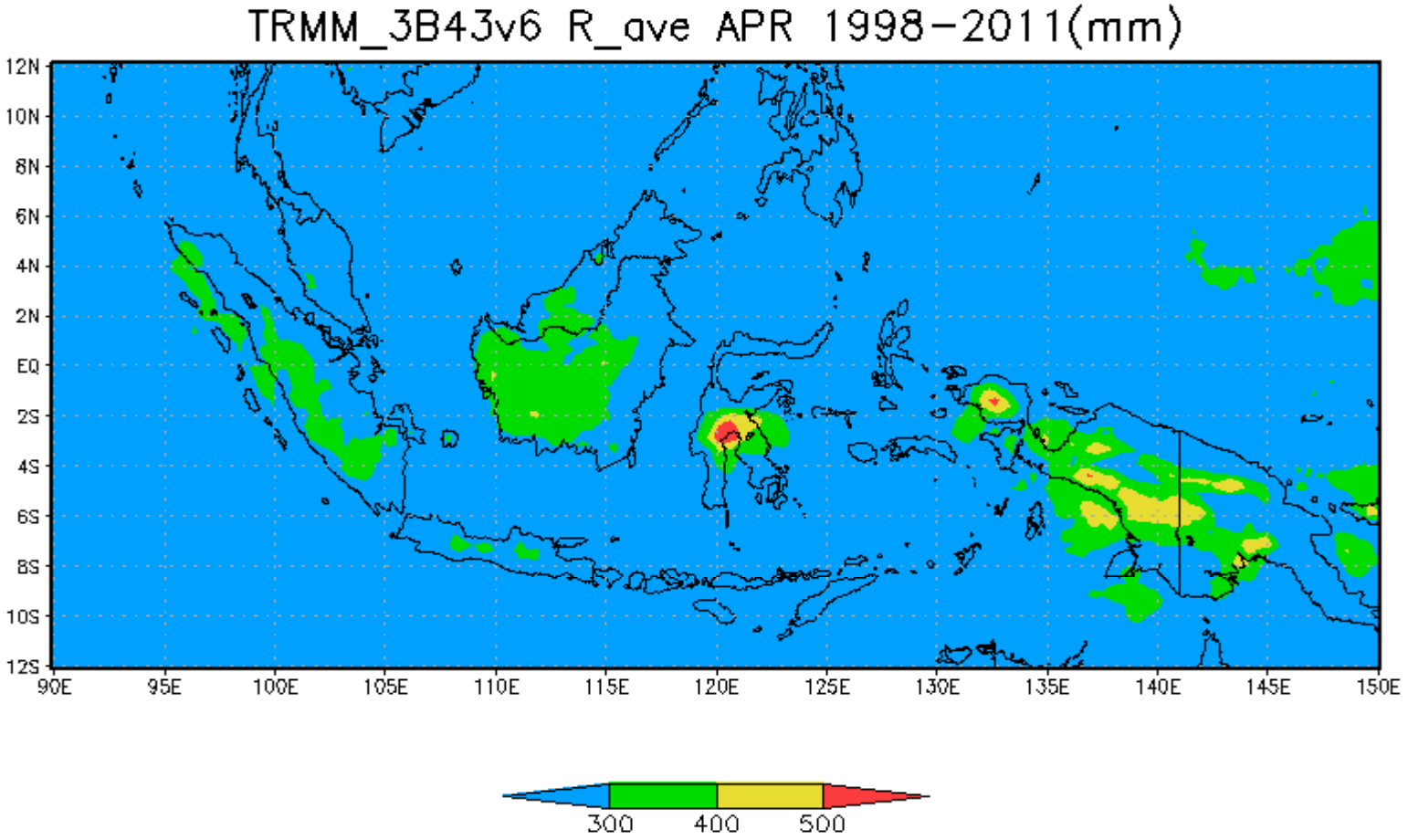


Cont ...

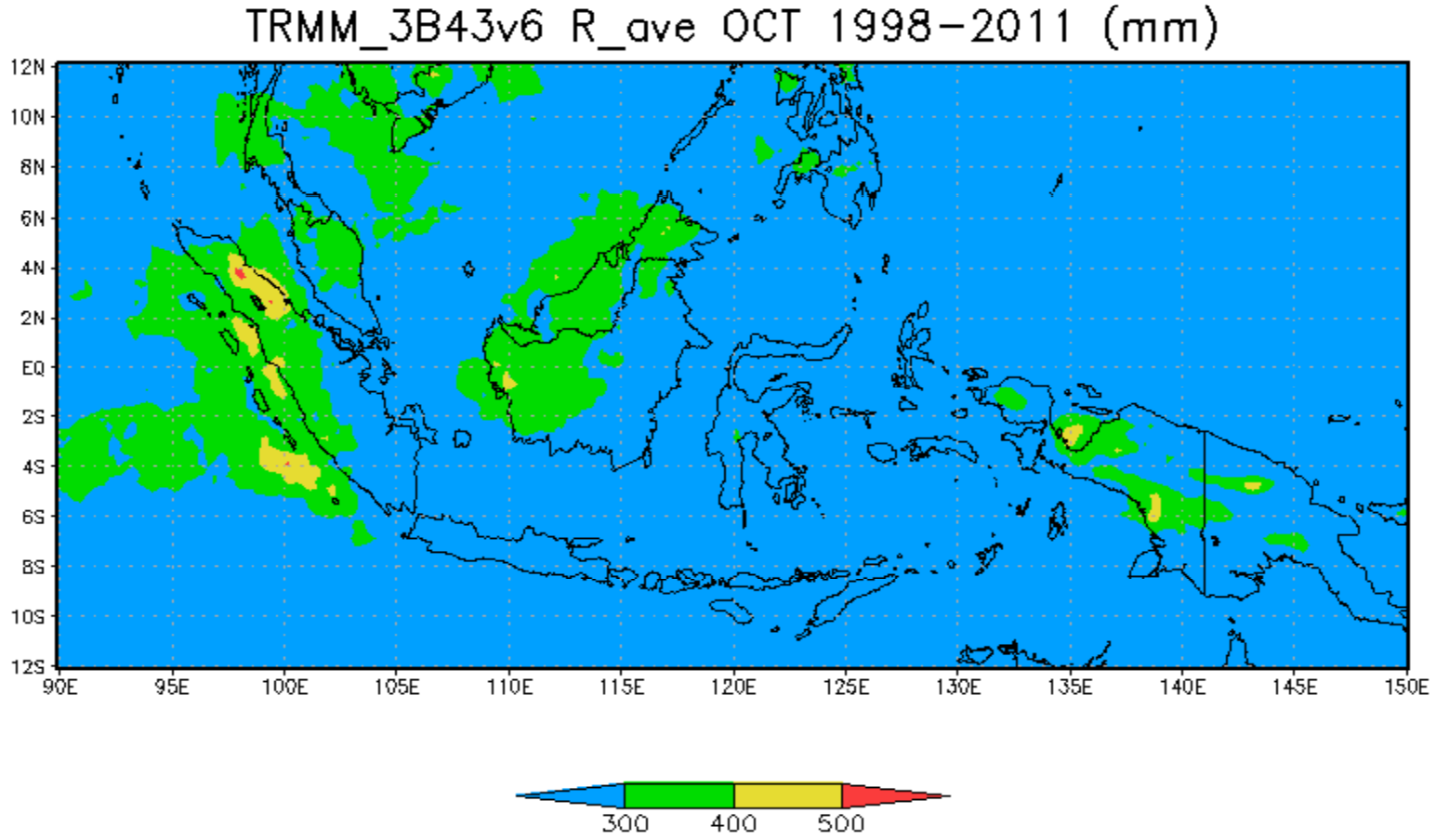

Juli
Agustus
September
Oktober
November
Desember
-150 -50 50 150 250

The Application of TRMM Data Analysis to Investigate the Heavy Rainfall Potentially over Indonesia

The Heavy Rainfall Distribution over Indonesia Based on the TRMM Data Analysis for Period of 1998-2011 averaged in April



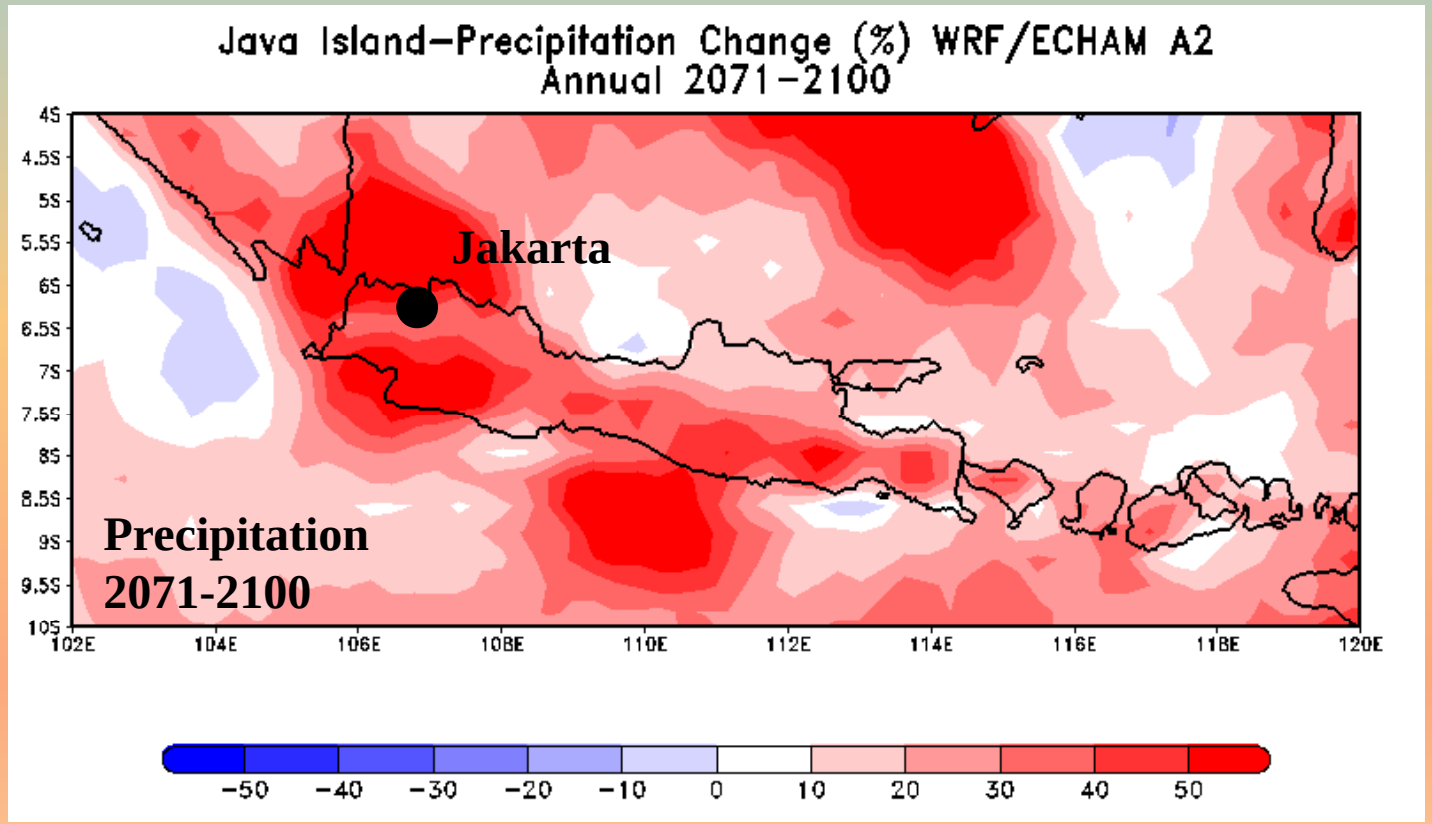
The Heavy Rainfall Distribution over Indonesia Based on the TRMM Data Analysis for Period of 1998-2011 averaged in October



Finally …

We need to develop an equatorial atmospheric model with good time and spatial high resolution

Jakarta
Future Climate Response – Precipitation (%), 2071-2100



WRF/ECHAM A2 Climate Response for Precipitation (Relative Anomaly in %) relative to 1961-1990, **JAKARTA**

Climate Signal/Climate Change factor:

▲ **= (2071-2100) – (1961-1990)**

SADEWA

(*Satellite Disaster Early Warning System*
atau
Sistem Informasi Peringatan Dini Bencana)

http://60.253.114.151/sadewa30

Thank you

Contact:
eddy_lapan@yahoo.com

Discussion ...