Climate Change ~~and Biodiversity:~~ Gaps in Science and Research Information in Malaysia

Fredolin Tangang [A.K.A Tajudin Mahmud]

Research Centre for Tropical Climate Change System (IKLIM),
Faculty of Science & Technology,
Universiti Kebangsaan Malaysia (UKM)

IPCC Working Group I Vice-Chair

Workshop on Climate Change & Biodiversity: Mobilizing the Research Agenda, 13-14 December, 2010

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Malaysia is a Megabiodiversity Country







Sensitive to temperature change and water related stresses

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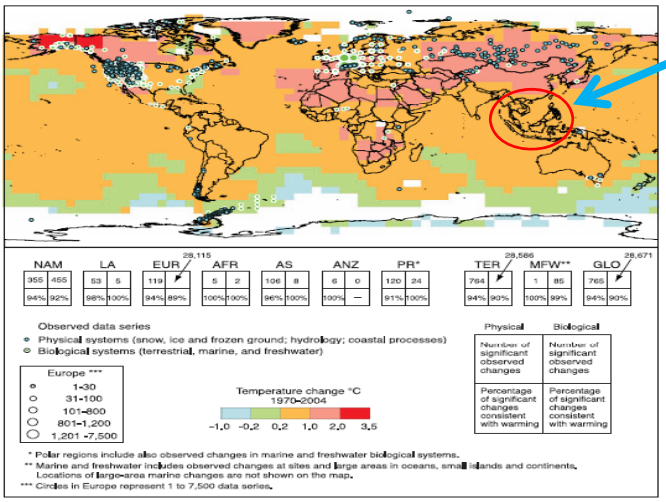
Climate Change Impacts on the Pysical and Biological Systems



Major gap in SEA region

29,000 observational data series, ~ 90% show changes consistent with warming

(IPCC WGII, 2007)

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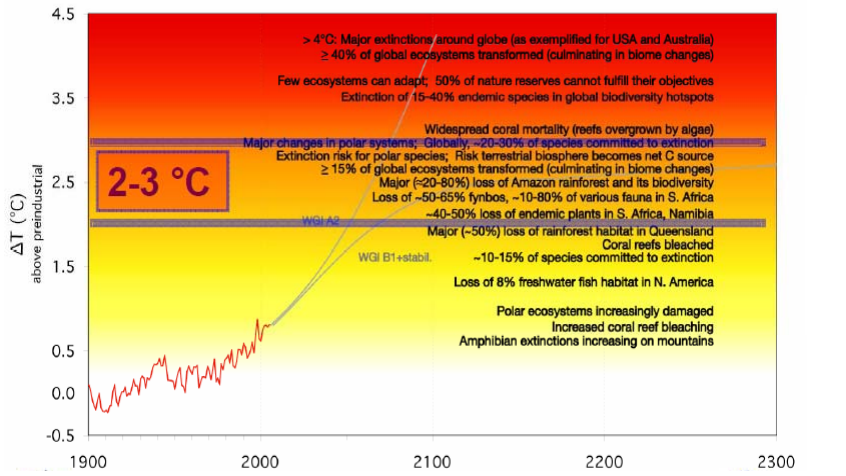
Reasons for gaps / imbalance

- lack of access by IPCC authors,
- lack of data, research and published studies
- lack of knowledge of system sensitivity, differing system responses to climate variables,
- Lag effects in responses, resilience in systems and the presence of adaptation.

(IPCC WGII, 2007)

Projected Climate Change Impacts on Ecosystems



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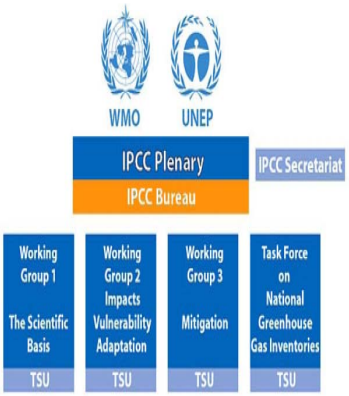
Outline

- IPCC and IPCC Assessment
- Gaps in understanding of monsoon system in Malaysia
- Gaps in understanding of regional climate phenomena – ENSO, IOD, MJO
- Gaps in understanding of extreme events
- Gaps in understanding of oceanographic aspects of regional seas e.g. South China Sea
- Gaps in climate modeling
- Summary and way forward

Inter-governmental Panel on Climate Change (IPCC)

UNGA 42 proposed the establishment of IPCC and in 1988 IPCC was established under WMO and UNEP



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Why IPCC?

- Prior to the establishment of IPCC, growing number of literatures indicate the Earth's climate system is warming due to increasing GHG concentration in atmosphere
- Independent, objective, fair and transparent assessment of the state of global climate system is required
- The establishment of IPCC was for this purpose
- The IPCC provides such assessment and this becomes the source of information to policy makers and UNFCCC on 1. causes of climate change, 2. potential impacts on built and natural systems and socio-economic, 3. possible response options.
- IPCC Reports are **policy-relevant** NOT **policy-prescriptive**
- Four assessment reports so far & AR5 will be out by 2013.

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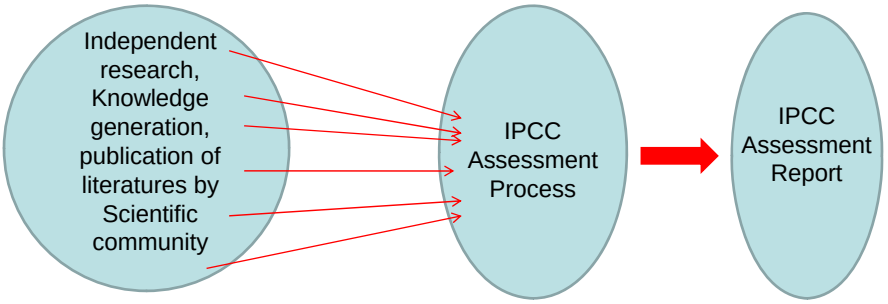
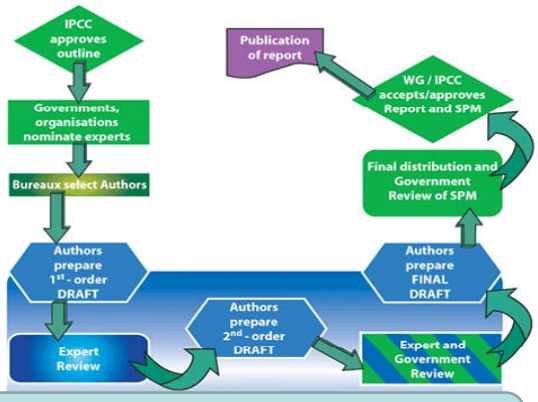
Research vs. IPCC Process

IPCC Doesn't Conduct Research



IPCC doesn't involve at this stage

IPCC Assessment Process

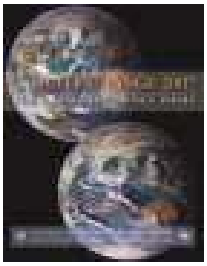


IPCC assessment is based on available peer-reviewed publications

Key « Rules » for IPCC Work

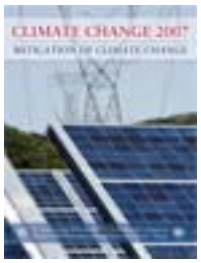
- COMPREHENSIVE – all the latest relevant scientific, technical and socio-economic literature published wordwide is assessed
- BALANCED – differring views are reflected in the reports
- OPEN – selection of authors from all countries and relevant discipline, wide review process by experts and governments
- TRANSPARENT – strict clear procedures

The IPCC Fourth Assessment Report (2007)



(WG I)

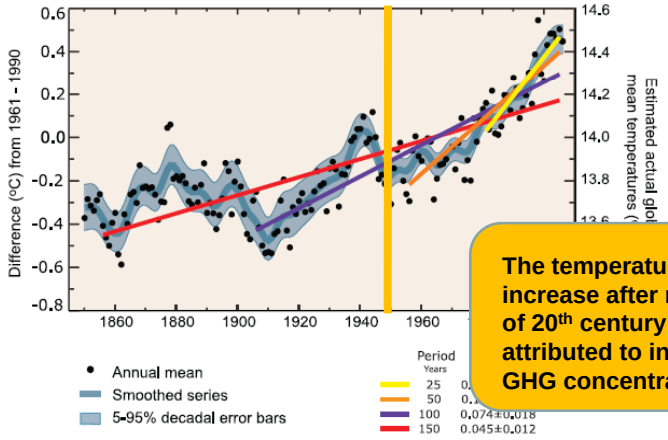
(WG II)



(WG III)

"Warming of the Earth's Climate System is unequivocal" --- WGI

Global temperature increase & attribution to GHG

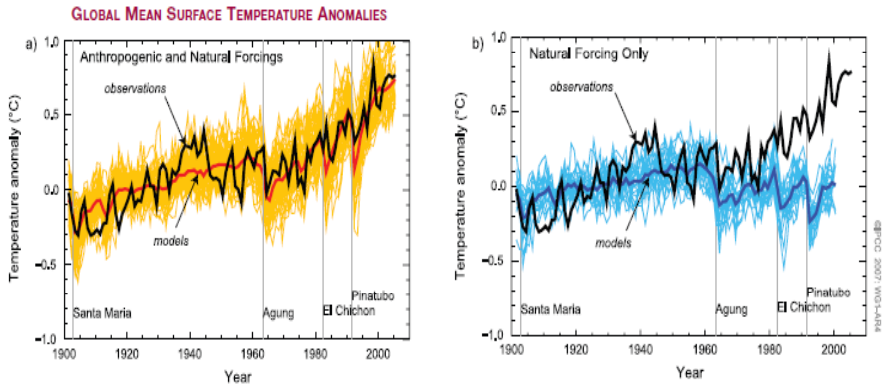


The temperature increase after middle of 20th century was attributed to increased GHG concentration

(IPCC 2007)

Attribution to Anthropogenic Forcing

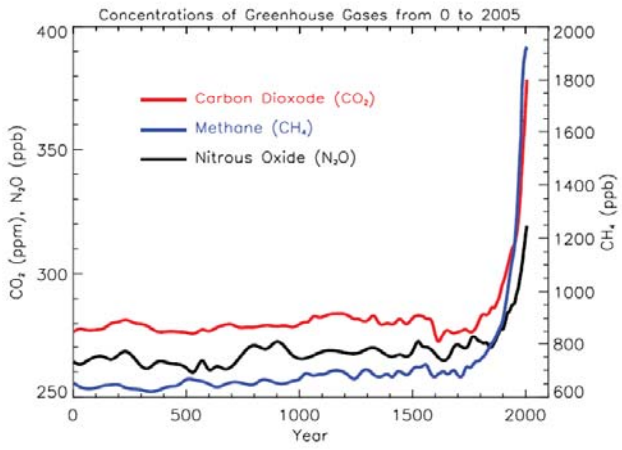
Modeling Results



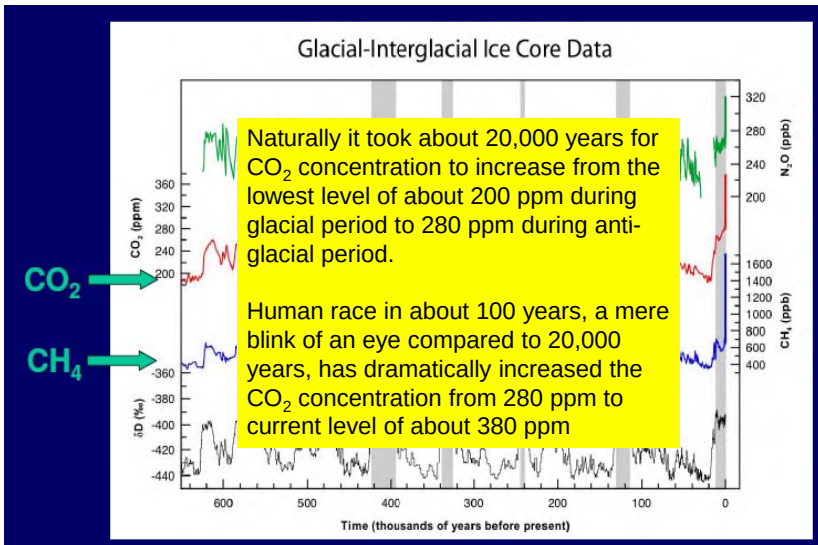
(Natural + Anthropogenic) (Natural)

(IPCC 2007)

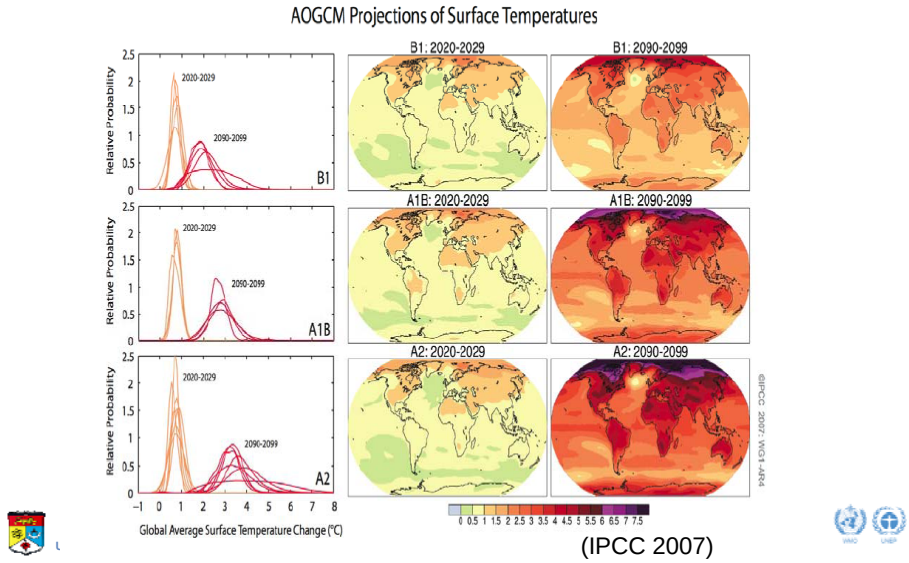
What causes these changes? Increasing concentration of GHG in the atmosphere



(Source: IPCC 2007)

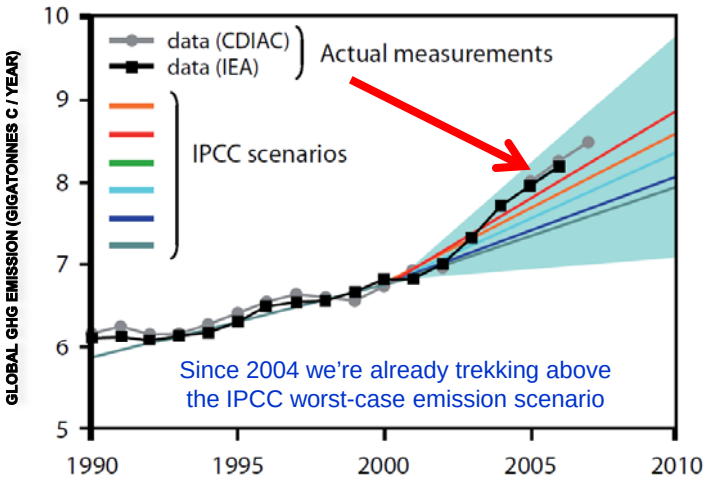


Global Mean Temperature Projection



(IPCC 2007)

Current Global GHG Emission



(UNEP 2009)

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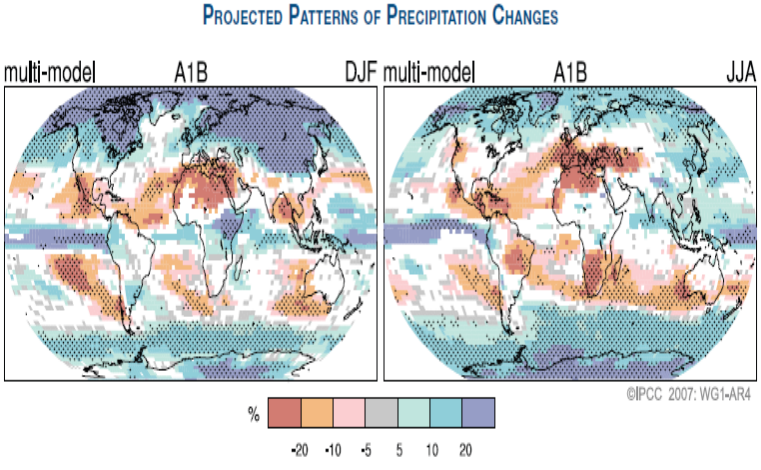
Projected Pattern of Precipitation Changes by 2100



(IPCC 2007)

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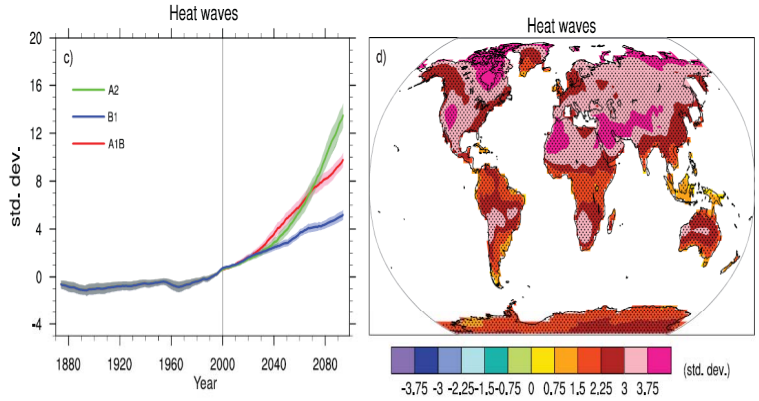
Projection of Heat Waves

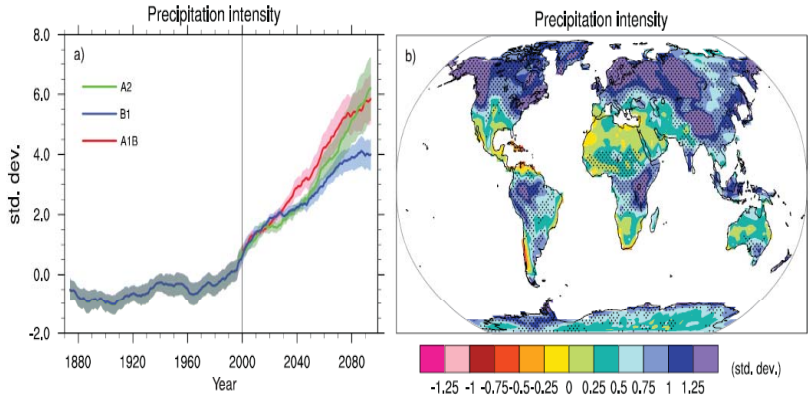
AIB: (2080-2099) – (1980-1999)



(IPCC 2007)

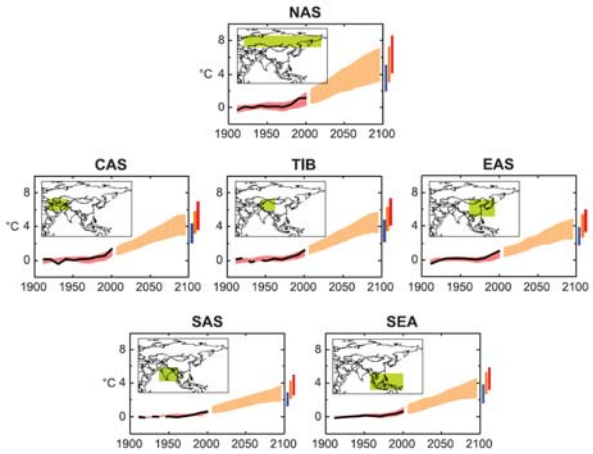
Projection of Precipitation Extremes

A1B: (2080-2099) – (1980-1999)



(IPCC 2007)

Regional Mean Temperature Projection



(IPCC 2007)

- AR4 did not provide detailed projection at a particular region
- In AR5 the focus will be for regional climate phenomena although Atlas of global and regional projection will be provided.
- For local / regional impact study, IPCC assessment won't be adequate. Downscaling of GCM to local / regional scales is still needed

New features in WGI AR5

Chapter 14: Climate Phenomena and their Relevance for Future Regional Climate Change
Executive Summary
- Patterns of variability: observations, understanding and projections
- Monsoon systems: observations, understanding and projections
- Extremes: observations, understanding and projections
- Interconnections among phenomena

Frequently Asked Questions

Annex I: Atlas of Global and Regional Climate Projections:
Editorial Team, Review Editor Team, Advisory Board

The full Outline of WGI is available on www.ipcc.unibe.ch

Structure of AR5 in perspective


	FAR 1990 **11 Chapters**	SAR 1995 **11 Chapters**	TAR 2001 **14 Chapters**	AR4 2007 **11 Chapters**	AR5 2013 **14 Chapters**
observations	✓	✓	✓	✓✓✓	✓✓✓
paleoclimate				✓	✓
sea level	✓	✓	✓		✓
clouds					
carbon cycle			✓		✓
regional change			✓	✓	✓✓✓

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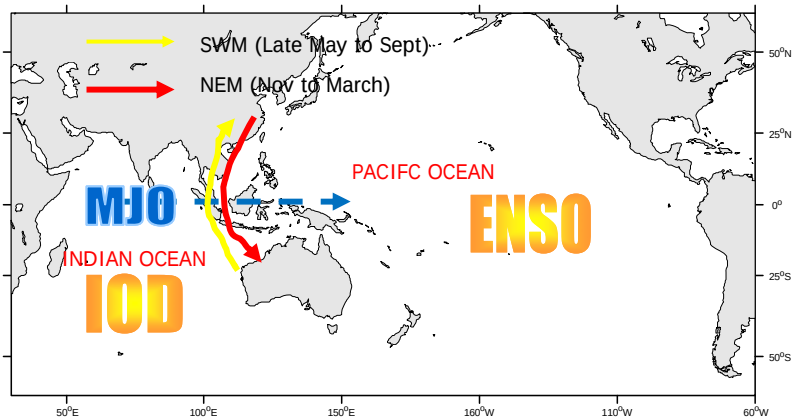
Monsoon & Dominant Modes of Climate Variability



Indian Ocean Dipole (IOD), El Nino-Southern Oscillation (ENSO) ---- Interannual oscillation (2-7 years)

Madden-Julian Oscillation (MJO) – intra-seasonal oscillation (20-60 days)

Understanding of future climate change requires complete knowledge of the climate system itself

[Patterns of variability, monsoon, extreme events, interconnections]

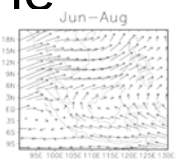
Level of understanding of our climate system and how it changes and responds to anthropogenic warming is still

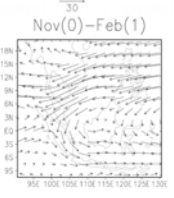
LOW & PATCHY

Why lack of knowledge?

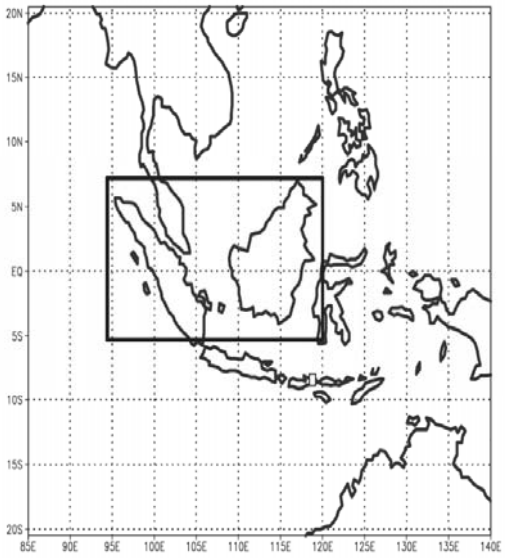
- Lack of research, published materials
- In the past, research related to climate not given priority
- Lack of expertise, capacity and capability
  - We have limited or no relevant academic program (e.g. Atmospheric Science) in our universities in Malaysia
  - We have limited number of climatologists, physical oceanographer, climate modeler in Malaysia
  - We have limited group conducting and focusing in climate research

Level of understanding of the monsoon system



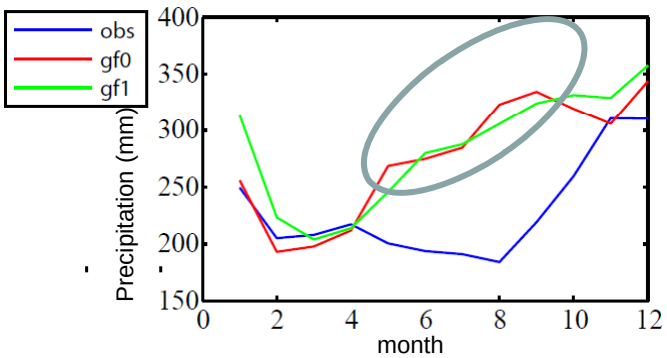


- Good for basic monsoon climatology
- Poor for monsoon variability
- Poor for monsoon teleconnection with tropical climate phenomena – ENSO, IOD, MJO
- Poor for monsoon changes associated with climate change

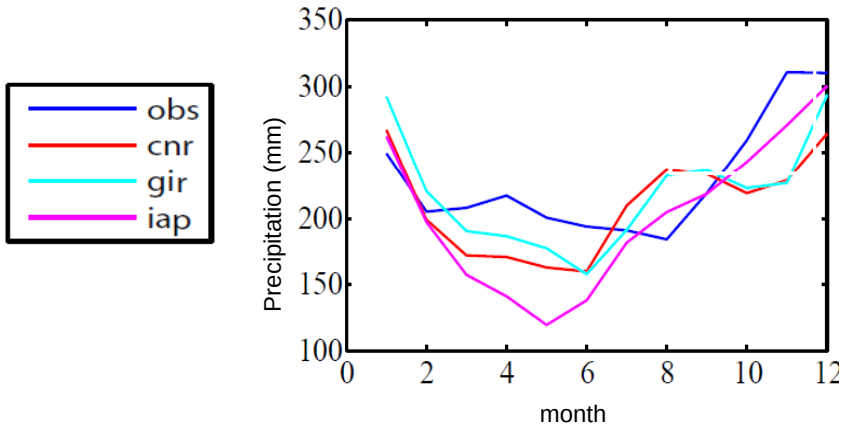


We evaluated the performance of 19 (15 for wind) IPCC-PCMDI GCMs in simulating precipitation and wind (U and V) annual cycles for the 20th experiment (20c3m) by averaging the precipitation and wind (U and V) for the indicated box and the spatial pattern.

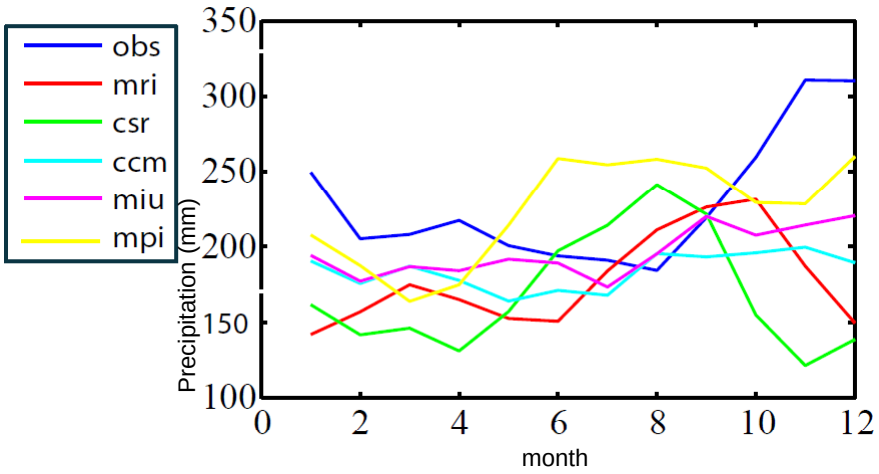
Over estimated during summer



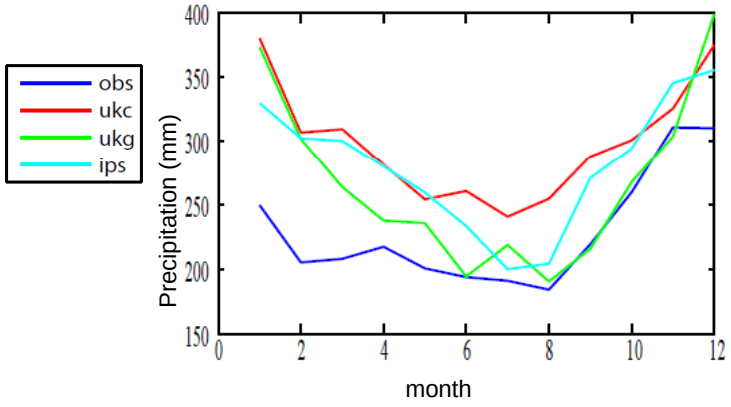
OBS= CMAP
gfo=GFDL-CM2.0 (USA)
gf1=GFDL-CM2.1 (USA)



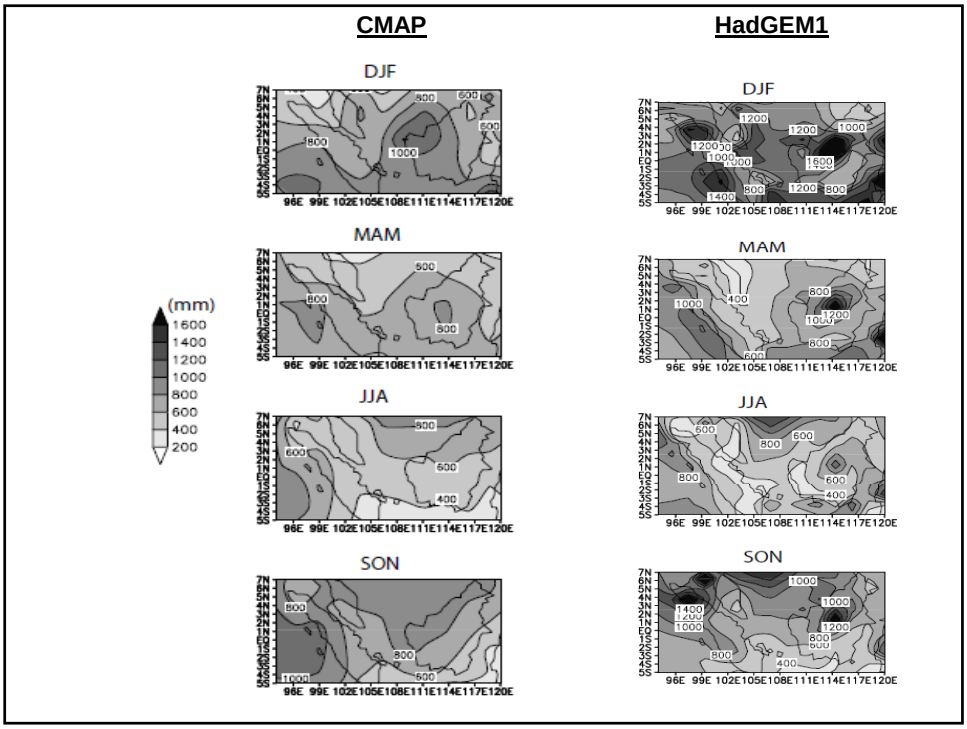
CNR=CNRM-CM3 (France)
GIR=GISS-ER(USA)
IAP=FGOALS-g1.0 (CHINA)

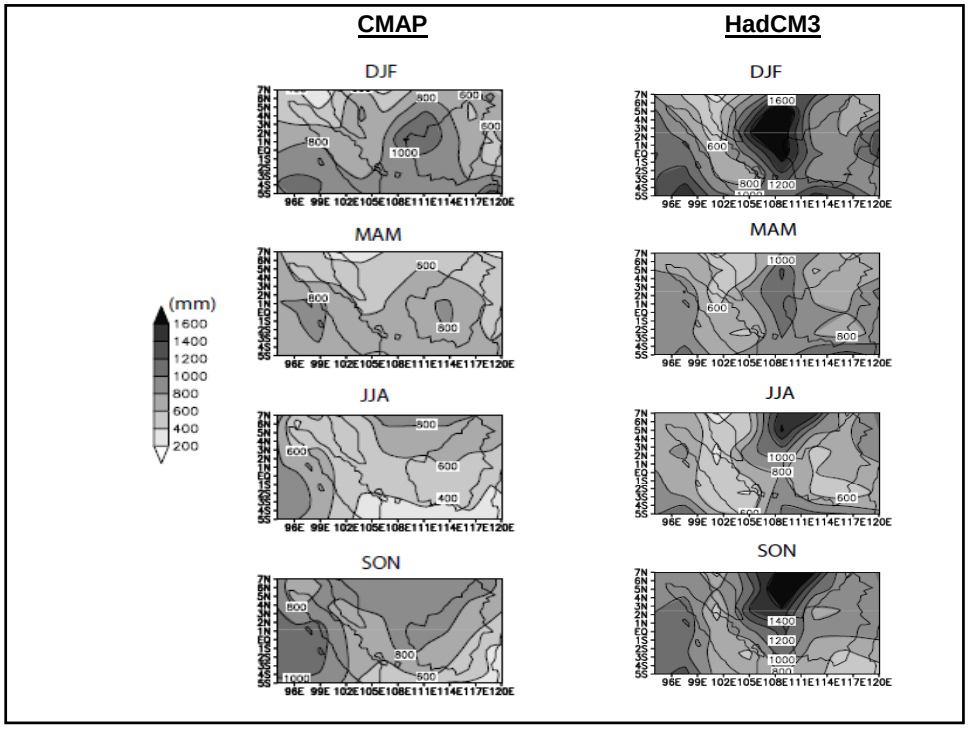


MRI=MRI-CGCM2.3.2 (JAPAN)
CSR=CSIRO-MK3.0 (AUSTRALIA)
CCM=CGCM3.1 (CANADA)
MIU=ECHO-G (GERMANY / KOREA)
MPI=ECHAM5/MPI-OM (GERMANY)



UKC=UKMO-HadCM3(UK)
UKG=UKMO-HadGEM1(UK)
IPS=IPSL-CM4 (FRANCE)




CMAP
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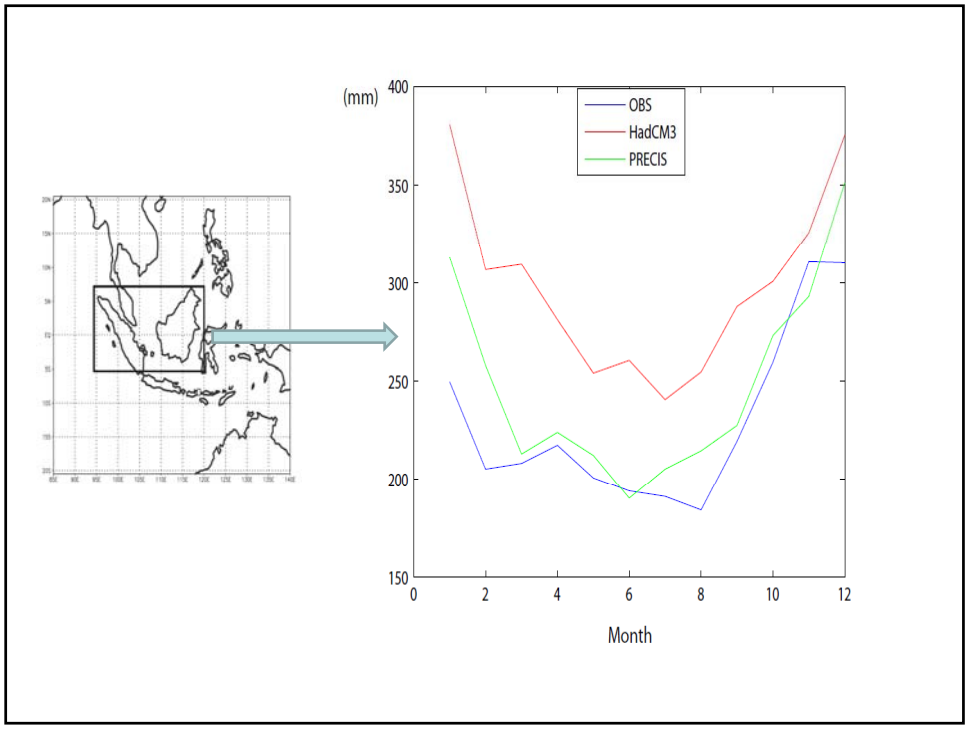
(mm)
OBS
HadCM3
PRECIS
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300
250
200
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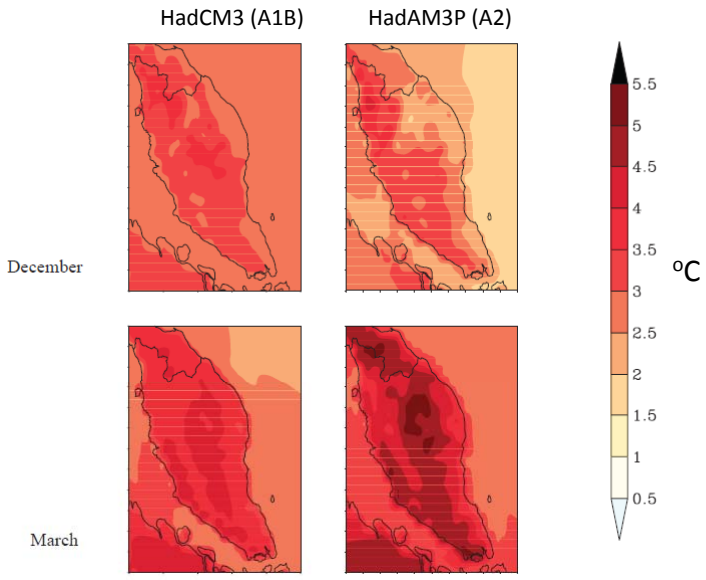
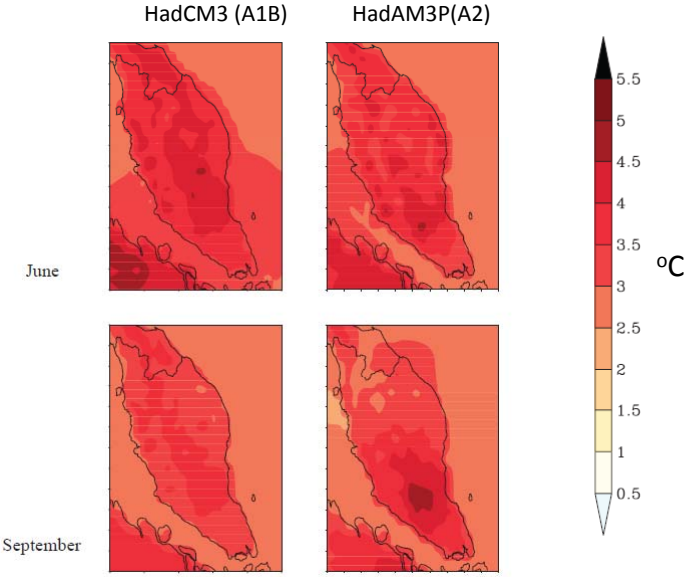
12
Month

Projected Mean Surface Temperature Change by the end of 21st century



Research Centre for Tropical Climate Change System (IKLIM) / NAHRIM

Projected Mean Surface Temperature Change by the end of 21st century



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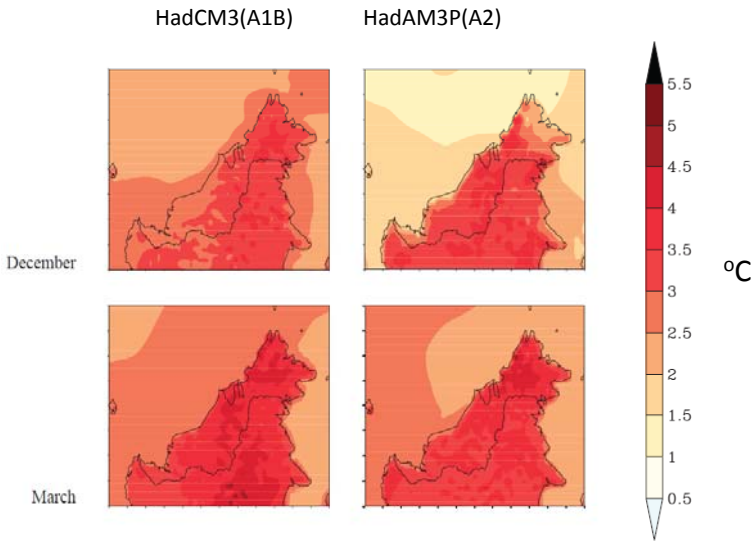

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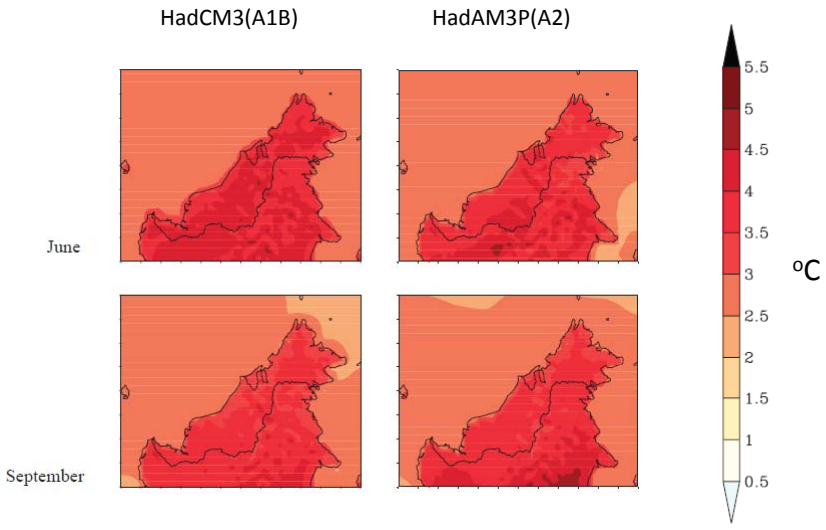

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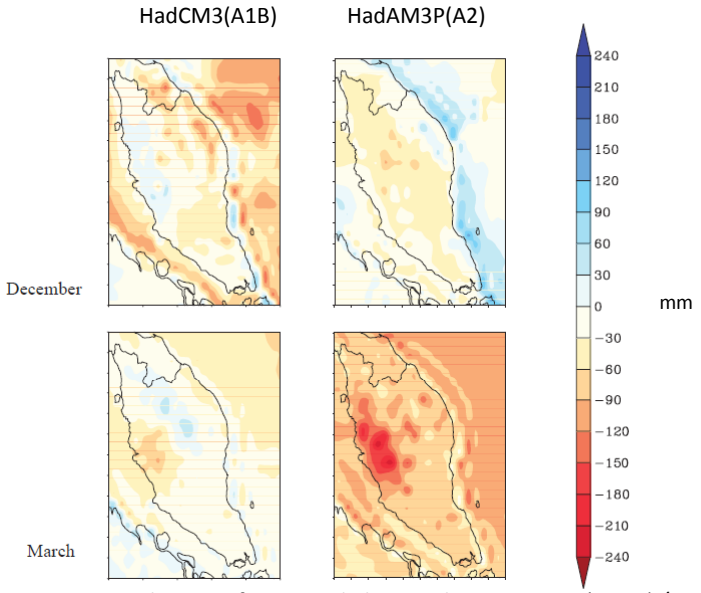
Projected Mean Precipitation Change by the end of 21st century



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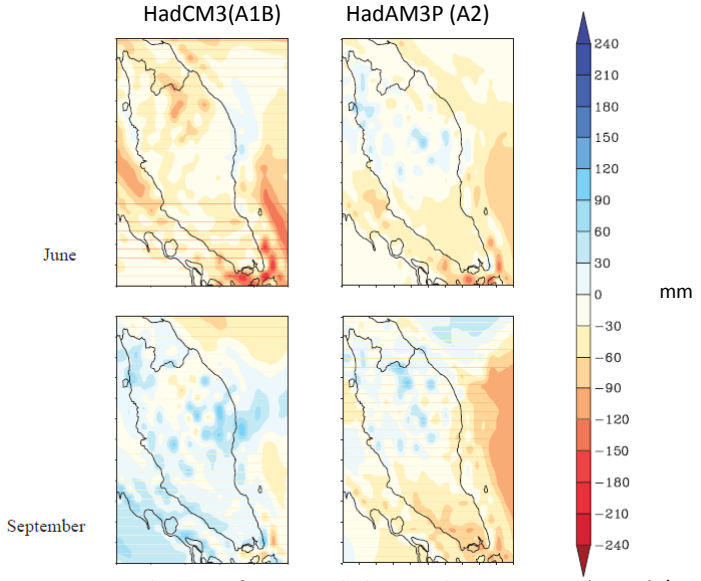
Projected Mean Precipitation Change by the end of 21st century



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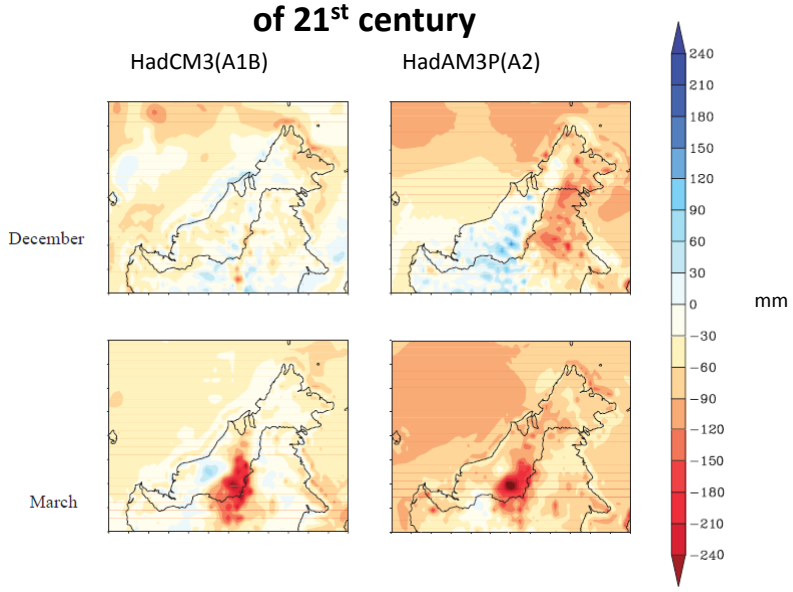
Projected Mean Precipitation Change by the end of 21st century



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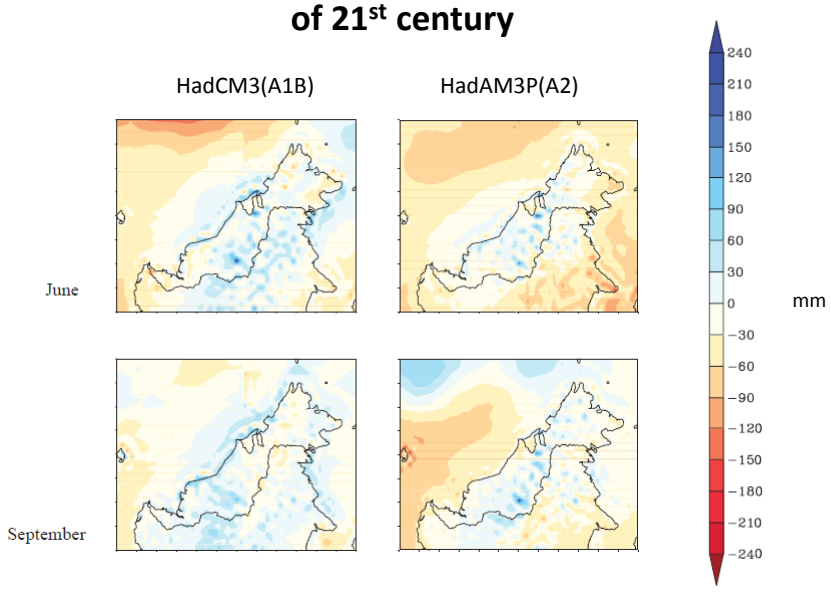

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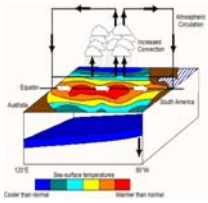
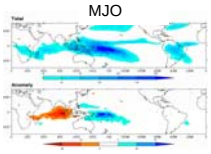
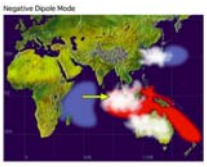
Level of understanding of ENSO, IOD and MJO

- Moderate for how these phenomena modulate anomalous rainfall over Malaysia
- Poor for how these phenomena interact with monsoon system
- Poor for how anthropogenic warming affects these phenomena (frequency and intensity)
- Poor for present climate models to simulate these phenomena







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Mechanisms of Malaysian Rainfall Anomalies

FREDOLIN T. TANGANG AND LIEW JUNENG

Marine Science Program, School of Environmental Sciences and Natural Resource Sciences, Faculty of Science and Technology, National University of Malaysia, Bangi, Selangor, Malaysia

(Manuscript received 24 June 2003, in final form 21 January 2004)

Climate Dynamics (2005) 25: 337–350
DOI 10.1007/s00382-005-0031-6

Liew Juneng · Fredolin T. Tangang

Evolution of ENSO-related rainfall anomalies in Southeast Asia region and its relationship with atmosphere–ocean variations in Indo-Pacific sector

Theor. Appl. Climatol. 89, 127–141 (2007)
DOI 10.1007/s00704-006-0263-3
Printed in The Netherlands

Theoretical and Applied Climatology

[1] Marine Science Program, Faculty of Science and Technology, School of Environmental and Natural Resource Sciences, National University of Malaysia, Bangi, Selangor, Malaysia
[2] School of Social, Development and Environmental Studies, Faculty of Social Sciences and Humanities, National University of Malaysia, Bangi, Selangor, Malaysia

Trend and interannual variability of temperature in Malaysia: 1961–2002

F. T. Tangang[1], L. Juneng[1], and S. Ahmad[2]

INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. (2007)
Published online in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/joc.1617

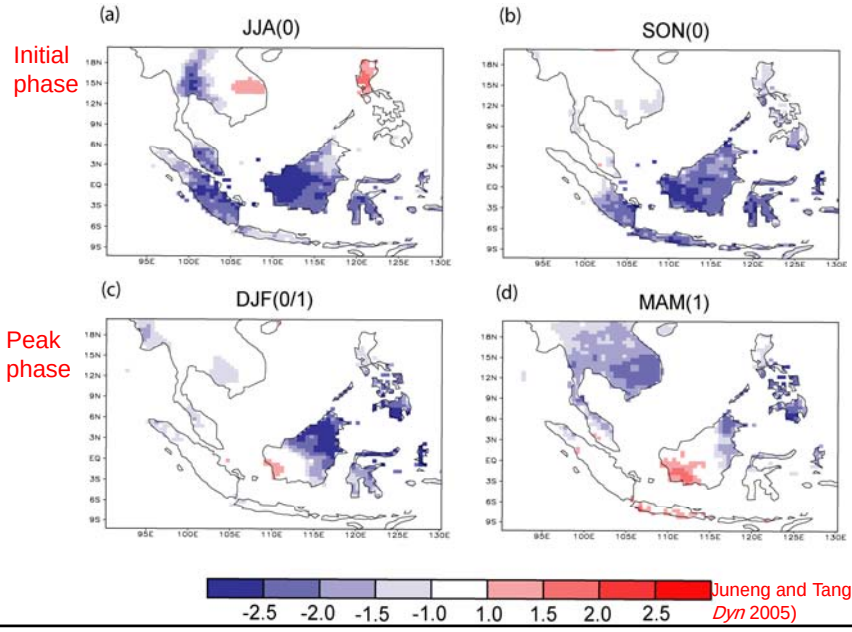
RMetS

Level and source of predictability of seasonal rainfall anomalies in Malaysia using canonical correlation analysis

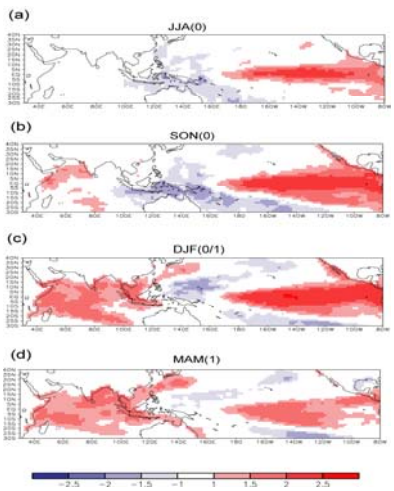
Liew Juneng and Fredolin T. Tangang*

Marine Science Program, School of Environmental and Natural Resource Sciences, Faculty of Science and Technology, National University of Malaysia, Malaysia

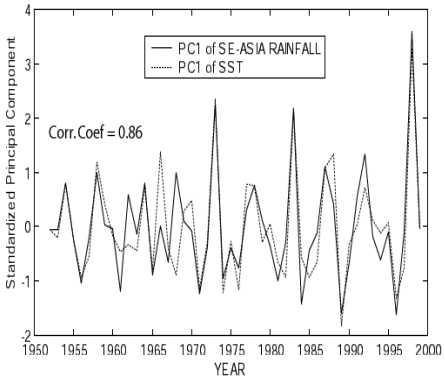
Dominant mode of Seasonal evolution of ENSO related signal in anomalous precipitation (~ 20% total variance)



Juneng and Tangang (*Clim Dyn* 2005)



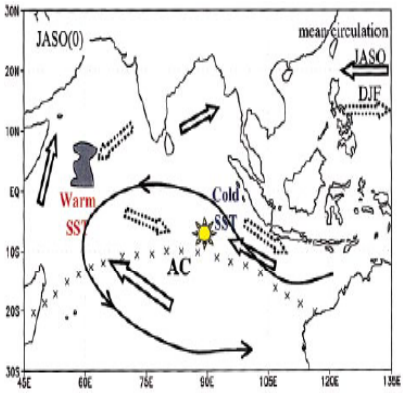
Typical evolution anomalous SST associated with an El Nino (La Nina)



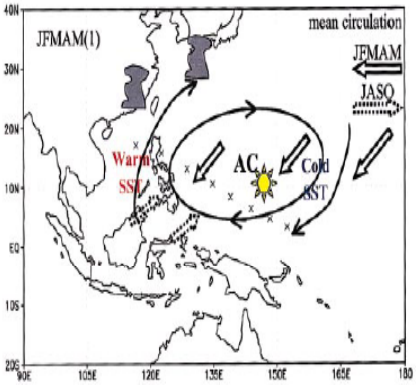
Juneng and Tangang (*Clim Dyn* . 2005)

Evolution of ENSO Signal over SEA is due to Ocean-Atmosphere Interaction

SIO Region

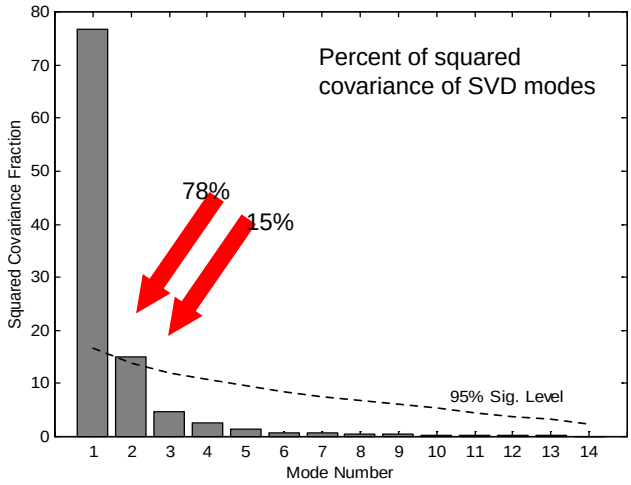


NWP Region



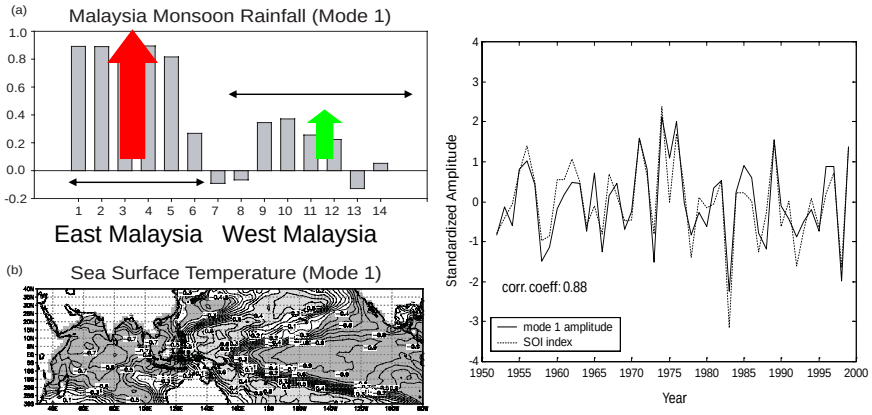
(Wang et al. 2003)

Singular Value Decomposition (SVD) between Station Northeast Monsoon rainfall and SST



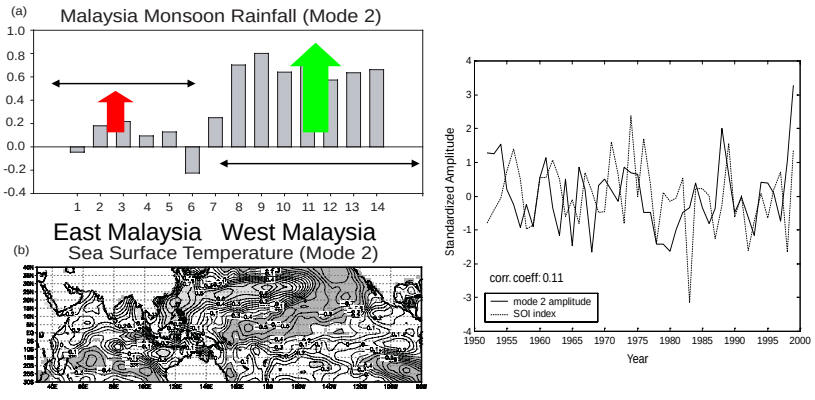
(Juneng and Tangang, 2006)

Spatial and temporal patterns for Mode 1 (~78%)



(Juneng and Tangang, 2006)

Spatial and temporal patterns for Mode 2 (~15%)

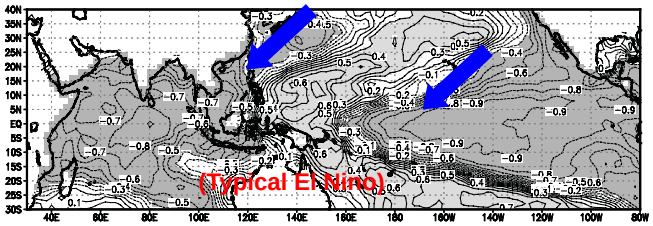


(Juneng and Tangang, 2006)

Comparison of SST patterns between Mode 1 and Mode 2

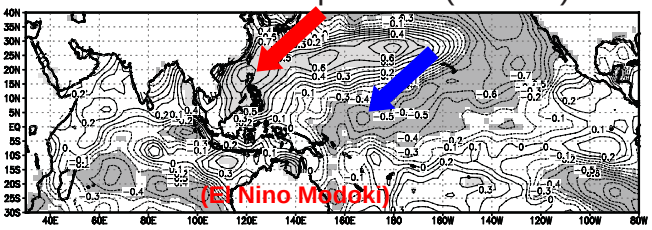
Sea Surface Temperature (Mode 1)

Significant Impacts over Sabah & Sarawak

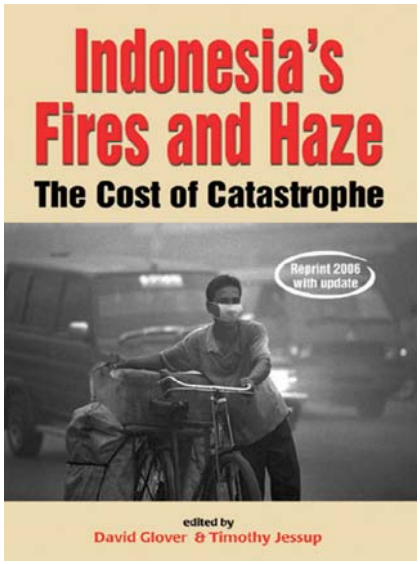


Sea Surface Temperature (Mode 2)

Significant Impacts over Peninsular Malaysia



1997 Haze Episode



Economic Impacts to Malaysia

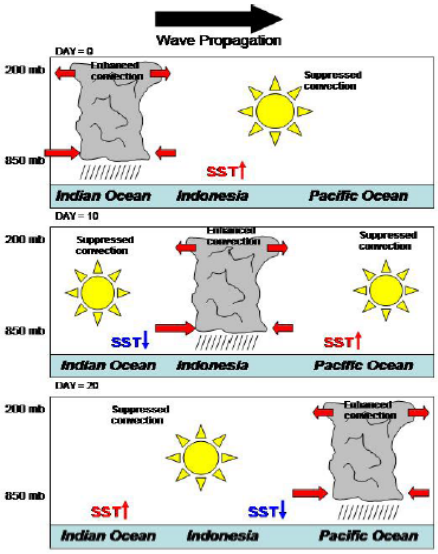
TABLE 3.17
Aggregate Value of Haze Damage

Type of Damage[1]	RM Million	US$ Million	Percentage
Adjusted cost of illness	21.02	8.41	2.62
Productivity loss during the state of emergency	393.51	157.40	49.07
Decline in tourist arrivals	318.55	127.42	39.72
Flight cancellations	0.45	0.18	0.06
Decline in fish landings	40.58	16.23	5.00
Cost of fire-fighting	25.00	10.00	3.12
Cloud seeding	2.08	0.83	0.26
Expenditure on masks	0.71	0.28	0.09
Total damage cost	801.90	321.00	100.00

Source: Shahwahid & Othman (1999)

Institute of Southeast Asian Studies, Singapore / International Development Research Centre, Canada

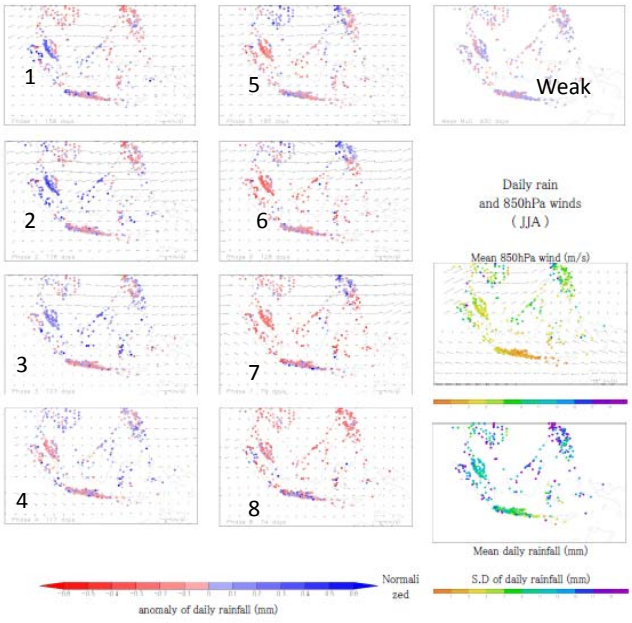
Schematic Representation of MJO eastward propagation from Indian Ocean to western Pacific Ocean



Science gaps – how MJO would be affected by warming?

How the changes would affect the region?

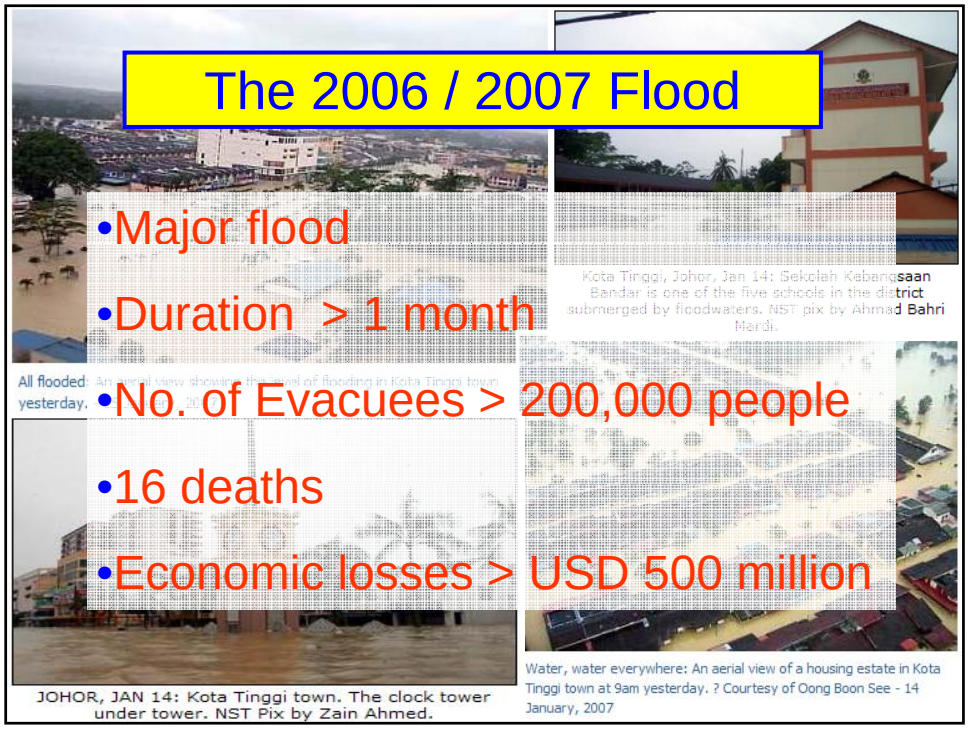
MJO Composites of Daily Rainfall Anomaly (JJA)

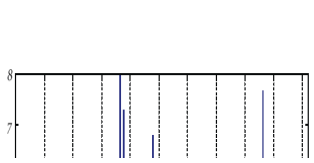


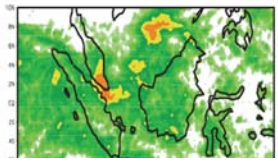
Jamaludin, Tangang, Juneng, Wheeler, Yu (2010, in prep)

Level of understanding of extreme events (e.g. drought, floods, storm)

- Moderate understanding of the mechanism of these extreme events
- Poor understanding how the frequency and intensity of these events would be affected by climate change







(1st)

GEOPHYSICAL RESEARCH LETTERS, VOL. 35, L14S07, doi:10.1029/2008GL033429, 2008

Click Here for Full Article

On the roles of the northeast cold surge, the Borneo vortex, the Madden-Julian Oscillation, and the Indian Ocean Dipole during the extreme 2006/2007 flood in southern Peninsular Malaysia

Fredolin T. Tangang,[1] Liew Juneng,[1] Ester Salimun,[1] P. N. Vinayachandran,[2] Yap Kok Seng,[3] C. J. C. Reason,[4] S. K. Behera,[5] and T. Yasunari[6]

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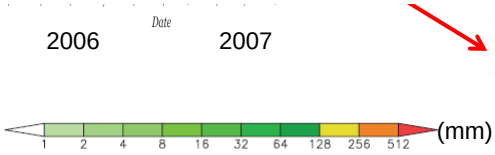
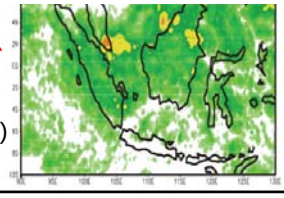
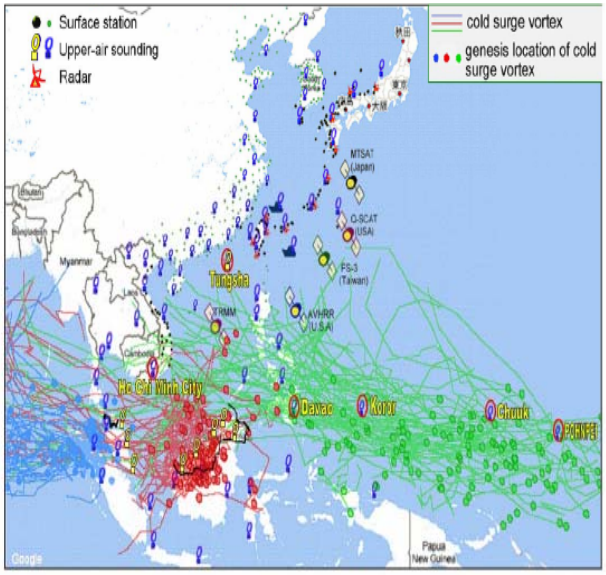




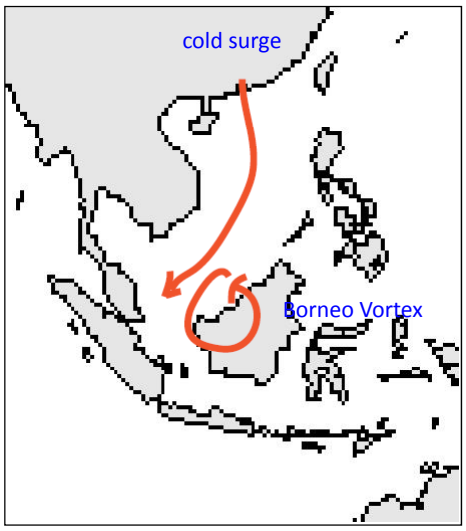
(3rd)

(Tangang et al. 2008, GRL)



Courtesy: Prof. Mike Chen, Iowa State University

Synoptic circulation during winter monsoon



Cold surges --- pluses of strong northeasterly winds

Borneo vortex – low level cyclonic circulation system

ATMOSPHERIC SCIENCE LETTERS
Atmos. Sci. Let. **11**: 199–203 (2010)
Published online 6 April 2010 in Wiley Online Library (wileyonlinelibrary.com) **DOI**: 10.1002/asl.272

RMetS
Royal Meteorological Society

Long-term trends of winter monsoon synoptic circulations over the maritime continent: 1962–2007†

Liew Juneng* and Fredolin T. Tangang
Research Centre for Tropical Climate Change System, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi Selangor DE, Malaysia

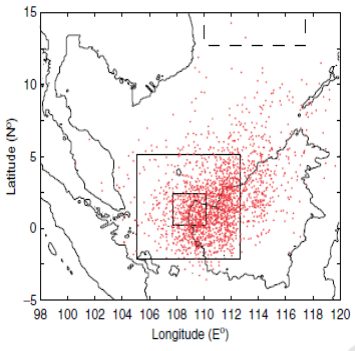
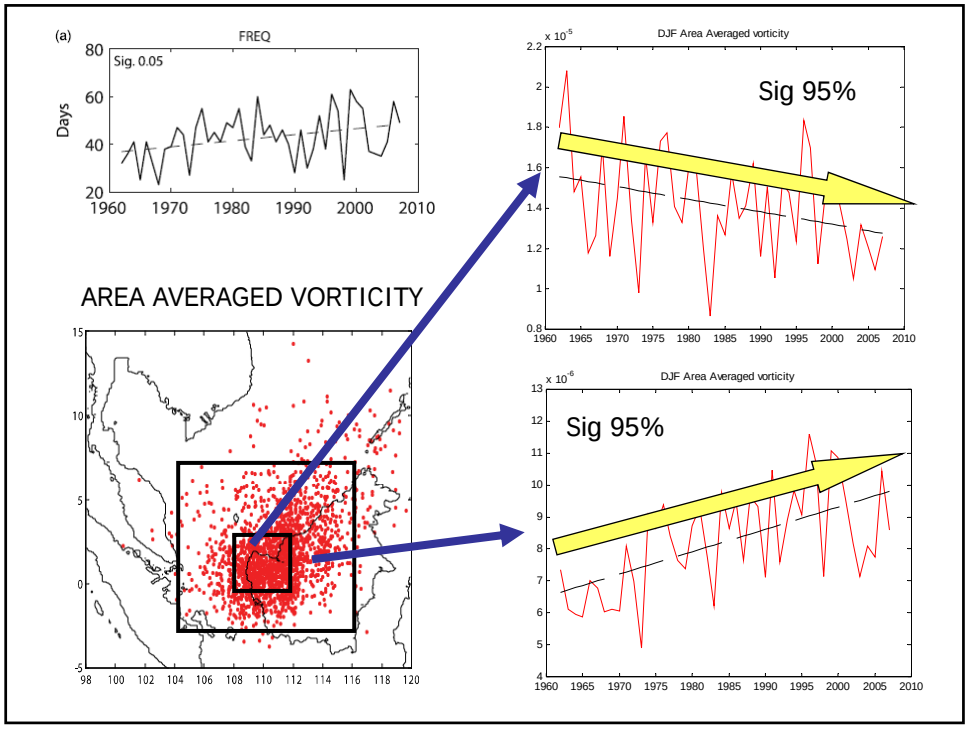


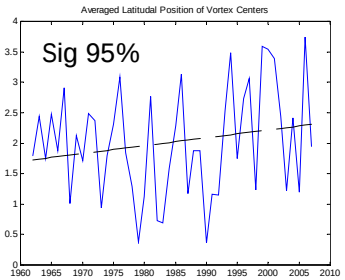
Table I. The definition of indices characterizing the Borneo vortex and the cold surge winds during the winter monsoon.

Index	Definitions
FREQ	The frequency of vortex days in the 3-month period of December–February. Through streamline analysis of the 925 hPa winds, any particular day with an identified closed circulation within the domain (Figure 1) and with a wind speed of 2 ms^{-1} was identified as a vortex day.
VORT/S	Spatially averaged seasonal vorticity within a small box (Figure 1).
VORT/L	Spatially averaged seasonal vorticity within 105 °E–112.5 °E and 2.5 °S–5°N.
VLAT	Seasonal mean of the latitudinal positions of the identified vortices.
VLON	Seasonal mean of the longitudinal positions of the identified vortices.
USURGE	Spatially averaged of the mean seasonal 950 hPa u-wind component within 110 °E–117.5 °E and 12.5 °N–15°N.
VSURGE	Spatially averaged of the mean seasonal 950 hPa v-wind component within 110 °E–117.5 °E and 12.5 °N–15°N.

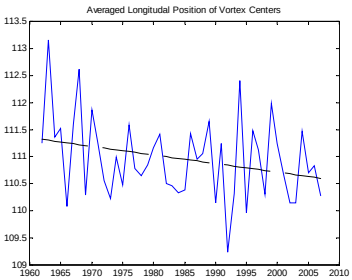


The positional shift of the vortex centers

LATITUDAL



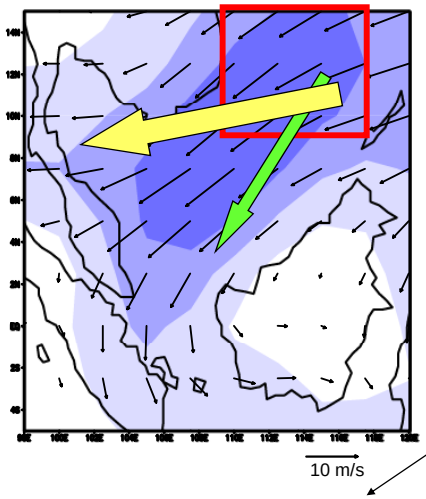
LONGITUDAL

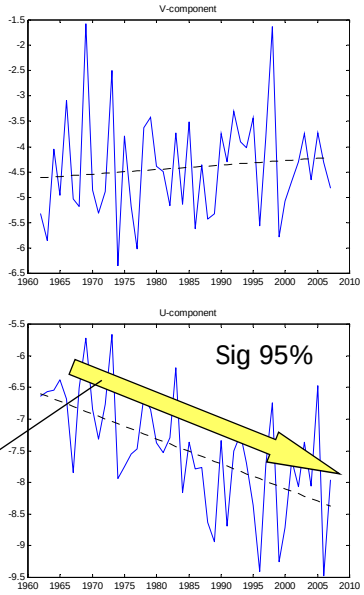


There is a slight northwestward shift (off shore) of the vortex centers

The vortex tended to be more over water than land

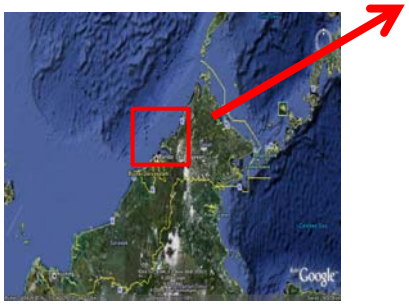
Trend of the Cold Surge Wind

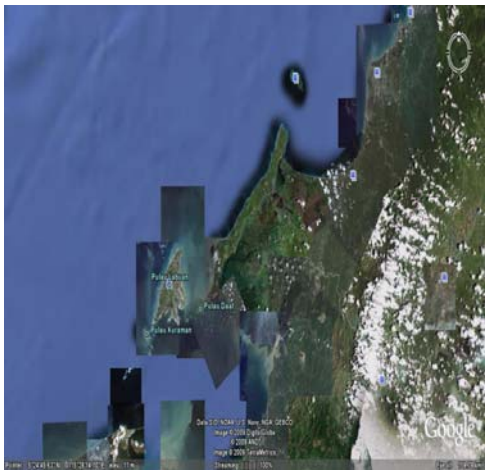




Increased Easterly component

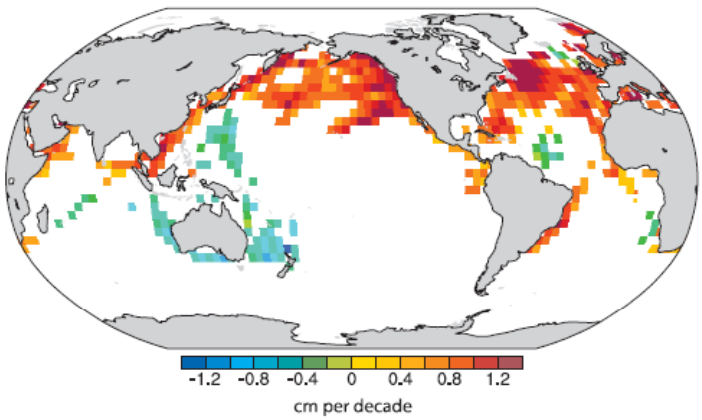
Coastal Erosion in west coast of Sabah





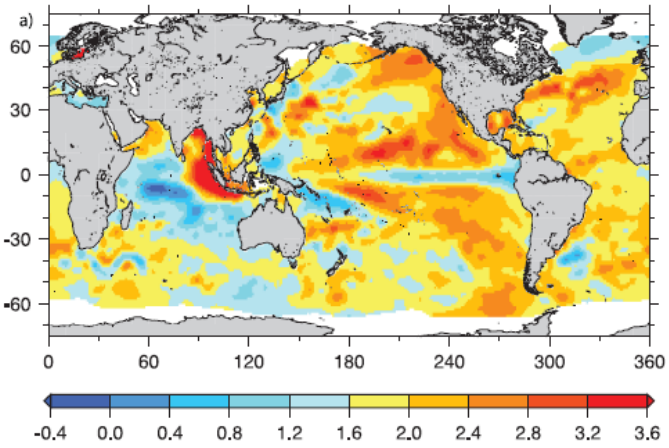
Malaysia coastline=4809 km
~30% (1380 km) facing serious erosion (DID)

Changes in the Wave Characteristics (SWH)



(IPCC WGI, 2007)

Higher SLR in the Southeast Asia region



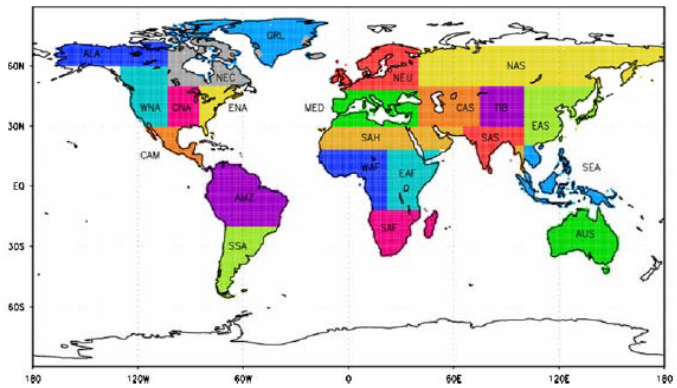
Linear trend of SLR for 1955-2005 (mm/yr)

(IPCC 2007)

UNIVERSITI KEBANGSAAN MALAYSIA

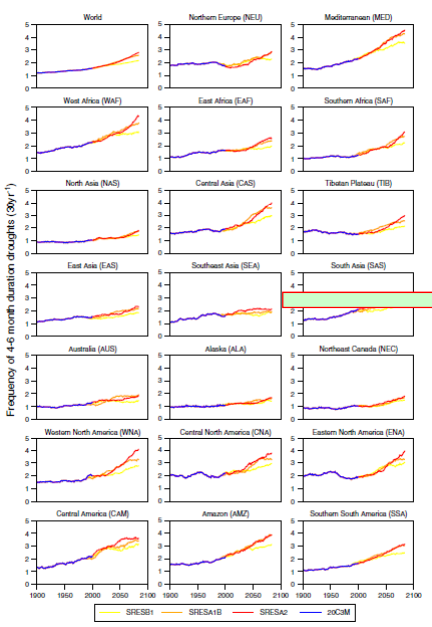
ipcc INTERGOVERNMENTAL PANEL ON Climate change

Future Droughts Projections

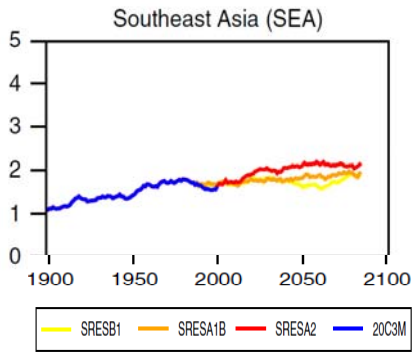


Sheffield and Wood (2008, Clim Dyn): Projected changes in drought occurrence under future global warming

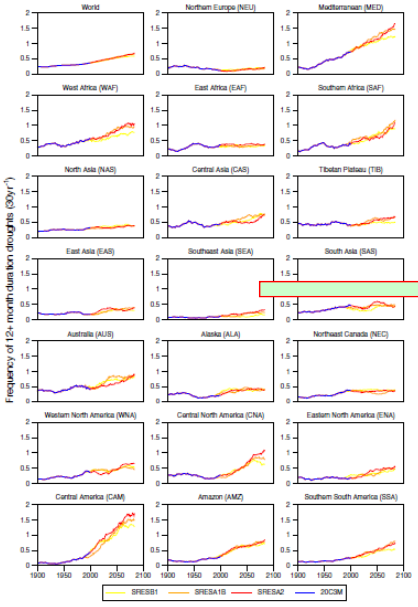
Yet to be assessed by IPCC



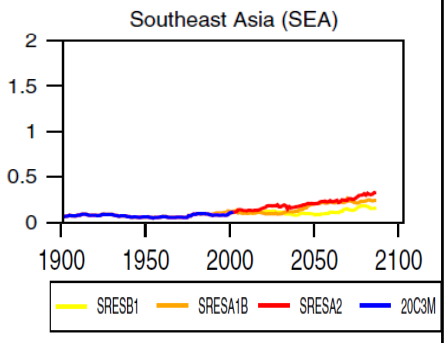
Frequency of 4-6 months drought ($30yr^{-1}$)



Sheffiled and Wood (2008)



Frequency of 12+ months drought ($30yr^{-1}$)

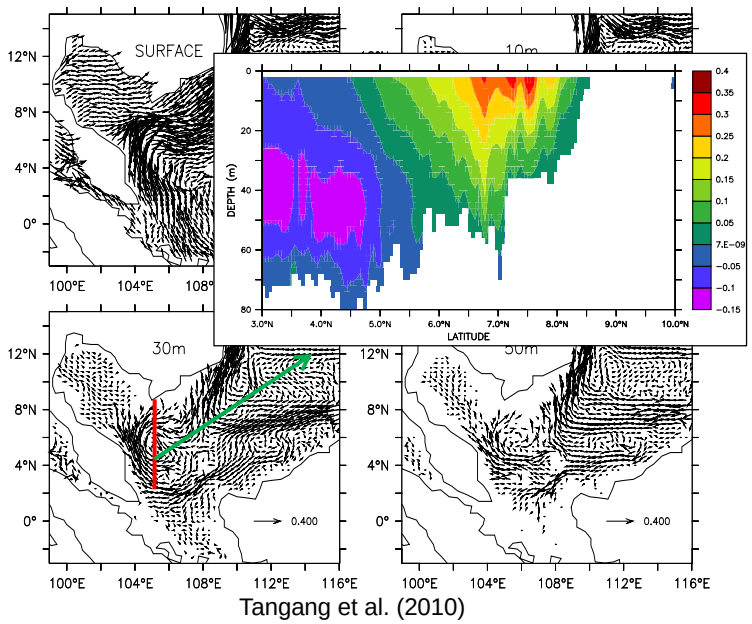


Sheffiled and Wood (2008)

Level of understanding of changes in our seas

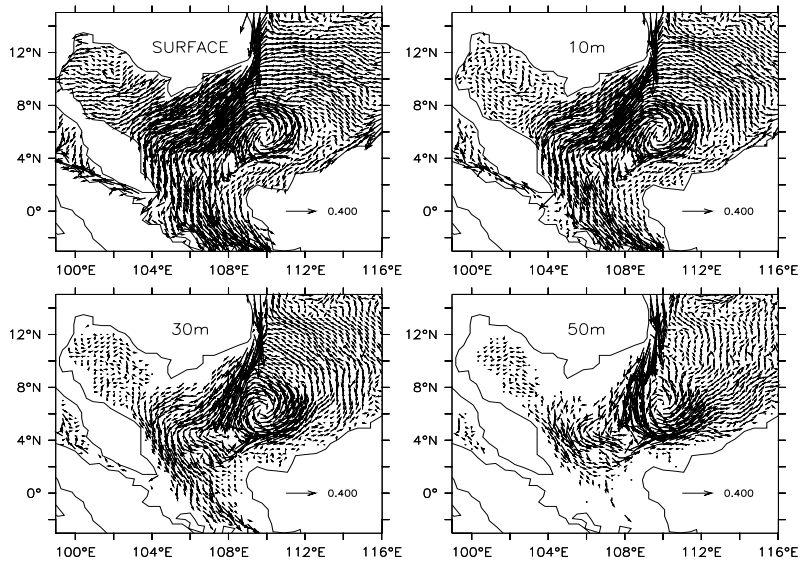
- Poor understanding of how current / circulation would be affected by climate change
- Poor understanding of how waves / storm surge would be affected by climate change
- Poor understanding on how local atmosphere-ocean interaction would be affected.
- Poor understanding of Sea Level Rise within our coastlines

Simulated currents JJA



Tangang et al. (2010)

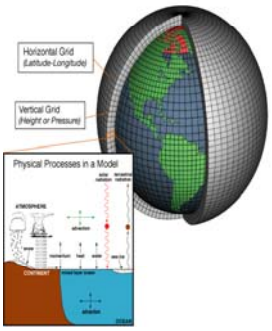
Simulated Currents DJF

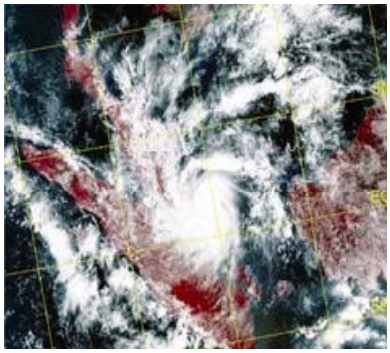


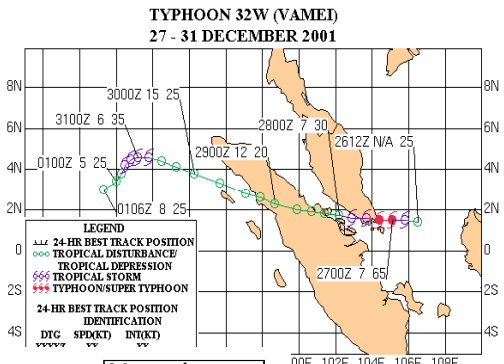
Tangang et al. (2010)

Climate and Ocean Modeling

- Lack in capability to run GCM
- Poor understanding of how various processes are represented in the models
- Moderate ability to run regional climate / atmospheric models / Ocean Model (e.g. PRECIS, MM5, WRF, POM, ROMS)







Meteorol Atmos Phys 97, 273–290 (2007)
DOI 10.1007/s00703-007-0259-2
Printed in The Netherlands

Meteorology and Atmospheric Physics

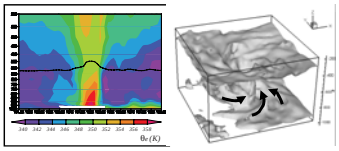
[1] Marine Science Program, School of Environmental and Natural Resource Sciences, Faculty of Science and Technology, National University of Malaysia, Bangi, Selangor, Malaysia
[2] Department of Oceanography, University of Cape Town, Rondebosch, South Africa
[3] Malaysian Meteorological Department, Petaling Jaya, Selangor, Malaysia

Simulation of tropical cyclone Vamei (2001) using the PSU/NCAR MM5 model

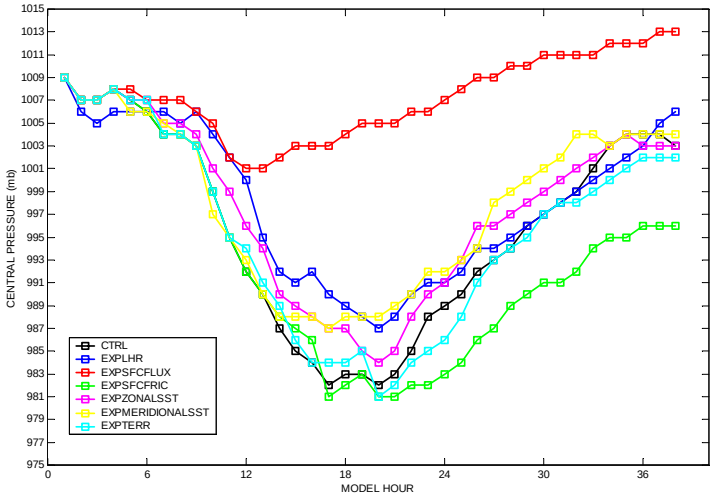
L. Juneng[1], F. T. Tangang[1], C. J. C. Reason[2], S. Moten[3], and W. A. W. Hassan[3]

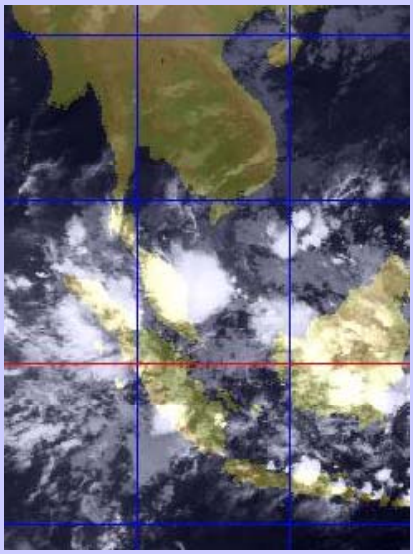
With 16 Figures

Received June 2, 2006; accepted January 6, 2007
Published online: March 14, 2007 © Springer-Verlag 2007



Sensitivity experiments





9 – 11 DEC 2004

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DOI 10.1007/s00703-006-0236-1
Printed in The Netherlands

Meteorology and Atmospheric Physics

[1] Faculty of Science and Technology, Marine Science Program, School of Environmental and Natural Resource Sciences, National University of Malaysia, Bangi Selangor, Malaysia
[2] Oceanography Department, University of Cape Town, Rondebosch, South Africa

Numerical case study of an extreme rainfall event during 9–11 December 2004 over the east coast of Peninsular Malaysia

L. Juneng[1], F. T. Tangang[1], and C. J. C. Reason[2]

Meteorol Atmos Phys (2010) 107:33–49
DOI 10.1007/s00703-010-0067-y

ORIGINAL PAPER

Simulation of heavy precipitation episode over eastern Peninsular Malaysia using MM5: sensitivity to cumulus parameterization schemes

Ester Salimun · Fredolin Tangang · Liew Juneng

Quality of simulation is very dependant on the cumulus parametrization schemes

Conclusion & Way Forward

- Level of understanding of the climate system in Malaysia and how the climate is changing are incomplete and patchy.
- We need to seriously consider and strategize to enhance our capacity and capability in research of climate system and its components.
- We need to increase and facilitate research in climate system (e.g. more funding, free access to data)

Thank You