

Modelling Climate Change in Malaysia

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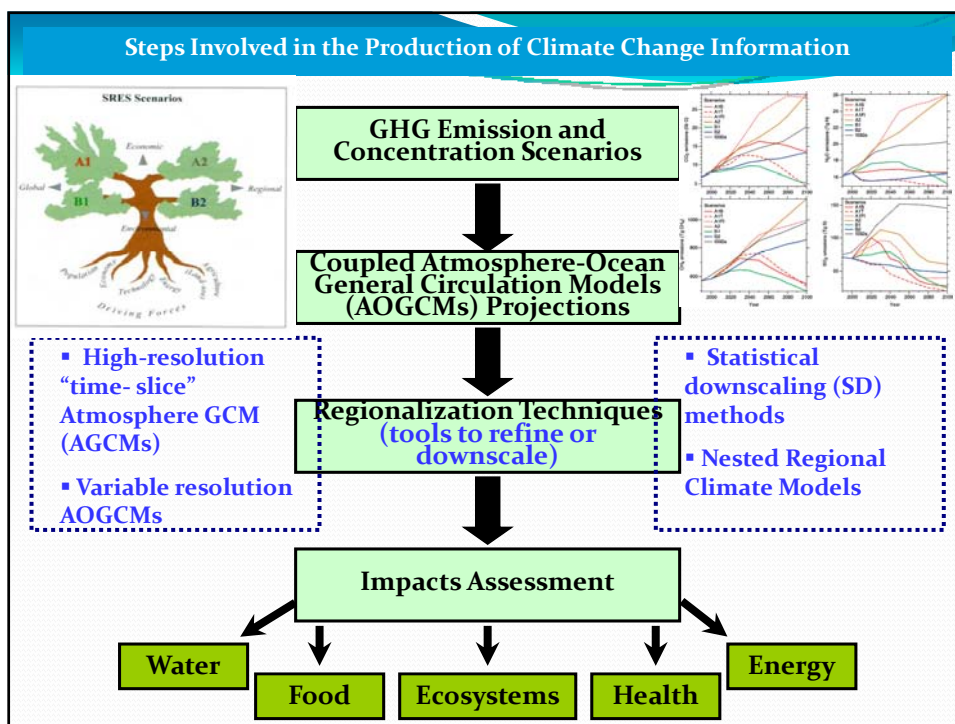
Climate Change and Biodiversity Workshop: Mobilizing the Research Agenda,
13 – 14 December 2010, UKM

Outline

- 1. Introduction**
Modelling Steps Involved in the Production of Climate Change Information
- 2. Atmosphere-Ocean General Circulation Models (AOGCMs)**
Climate Change Scenario from Ten AOGCMs
- 3. Downscaling of AOGCMs**
 - Statistical downscaling
 - Dynamical downscaling
- 4. Discussion and Conclusion**
Uncertainties & A Path Toward Credible (Robust Findings) Climate Change Scenarios

Introduction

Modelling Steps Involved in the Production of Climate Change Information



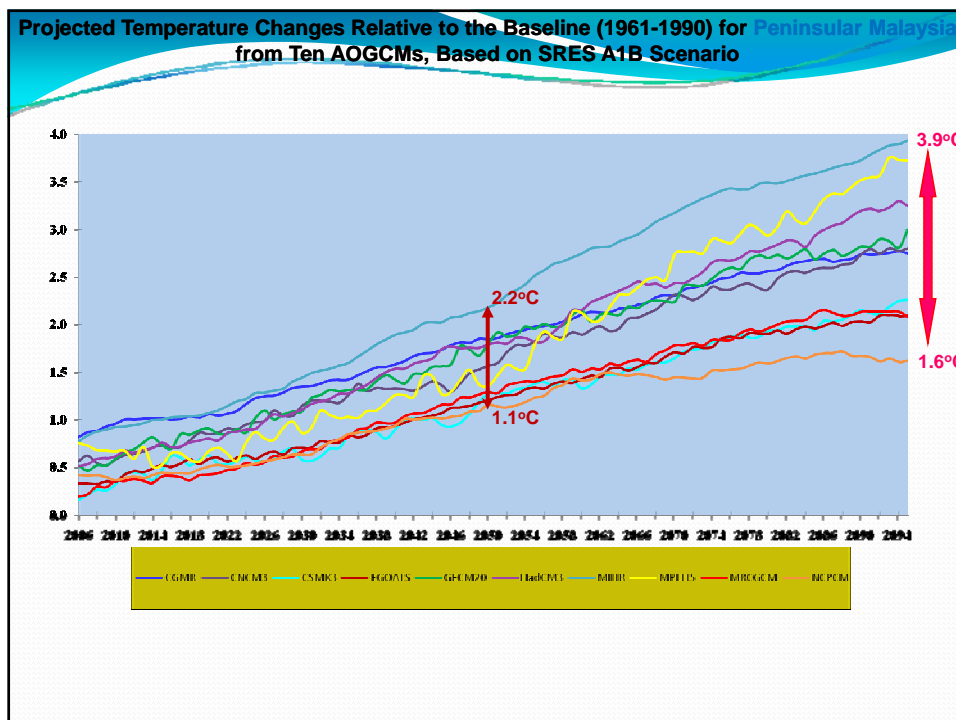
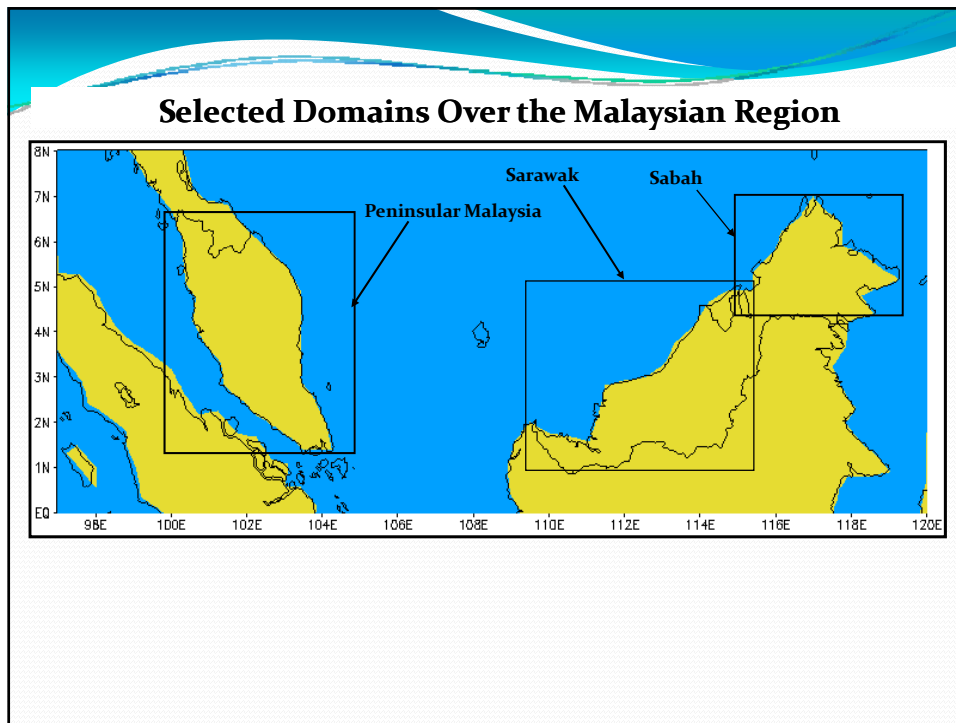
Atmosphere-Ocean General Circulation Models (AOGCMs)

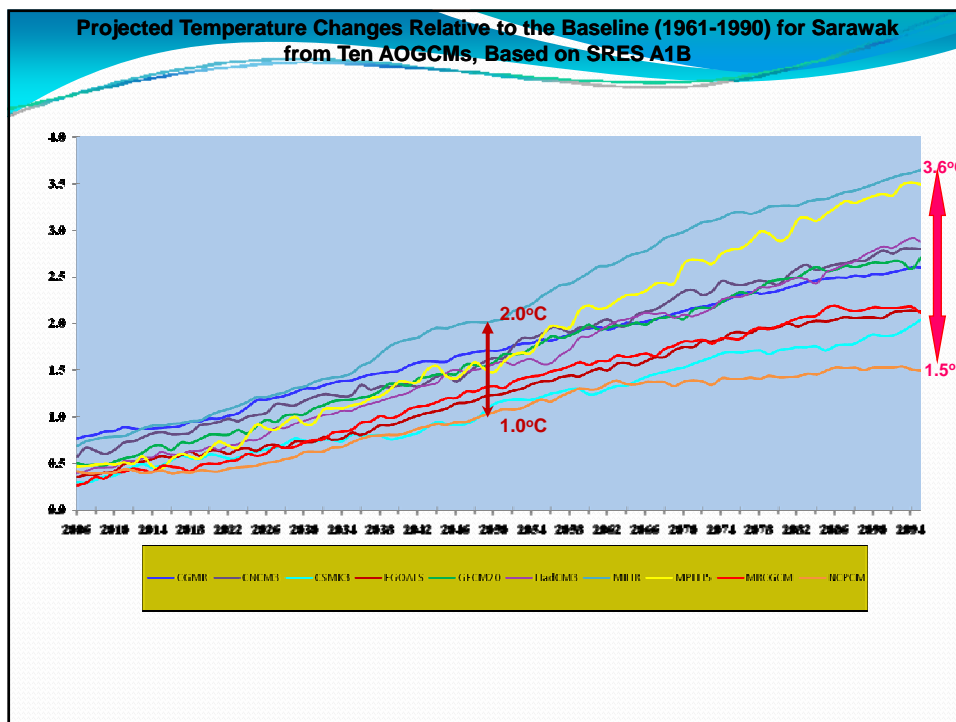
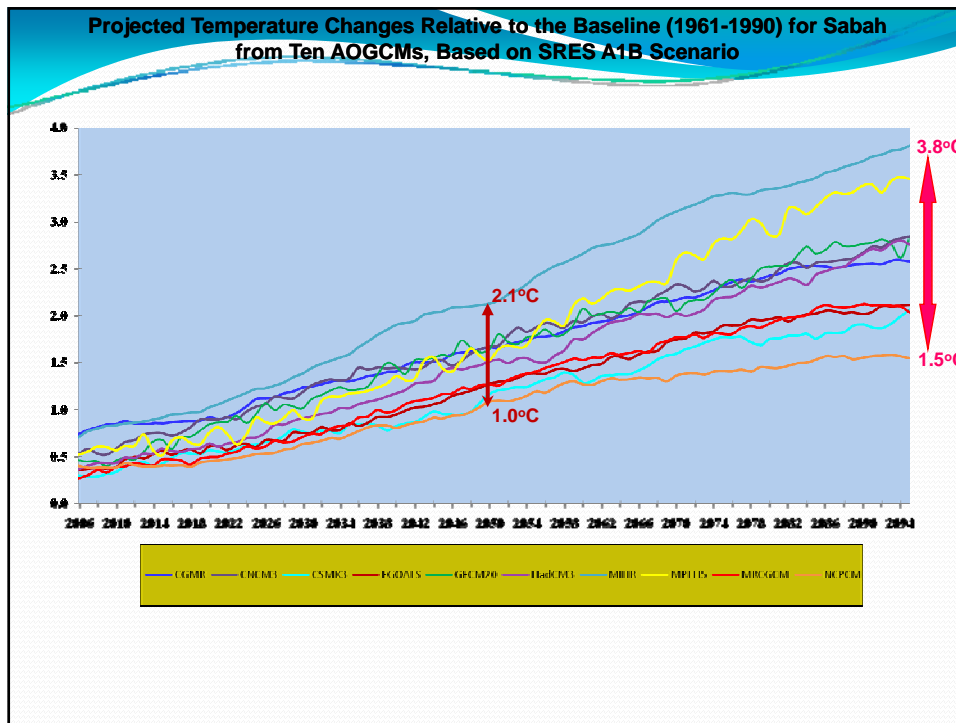
Climate Change Scenario from Ten AOGCMs:

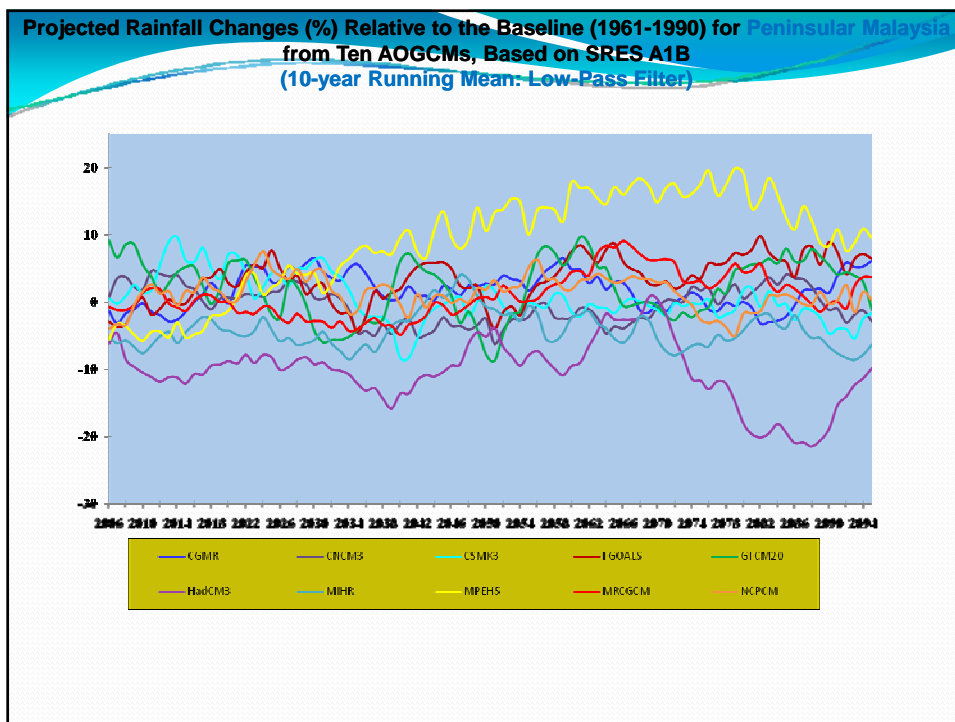
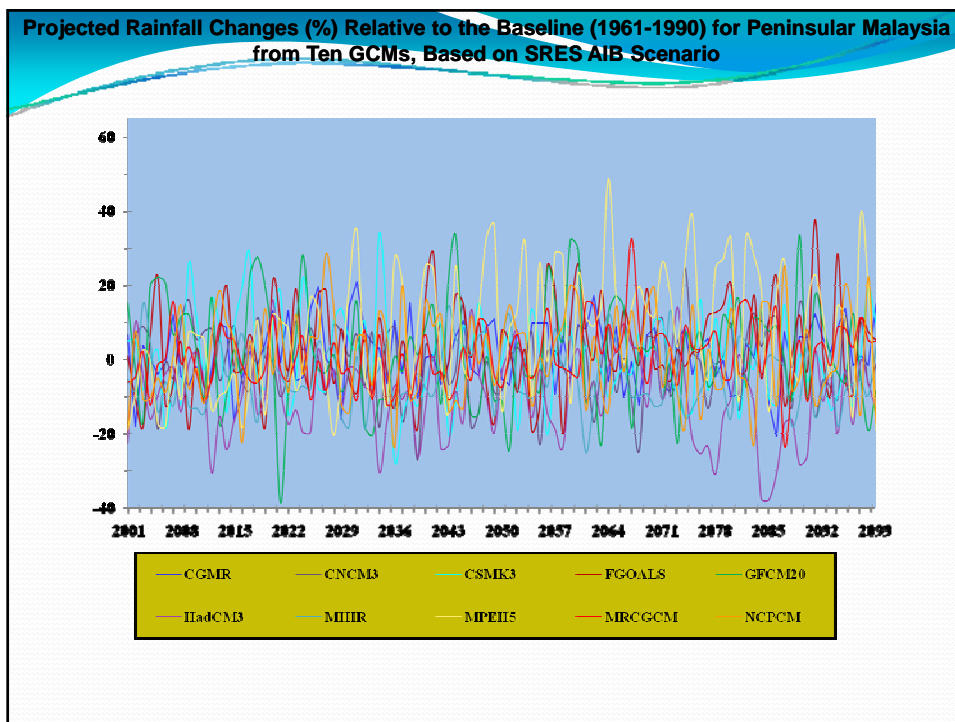
- *Temperature Trends*
- *Rainfall Trends*
- *The Winter Monsoon Intensity Projection*

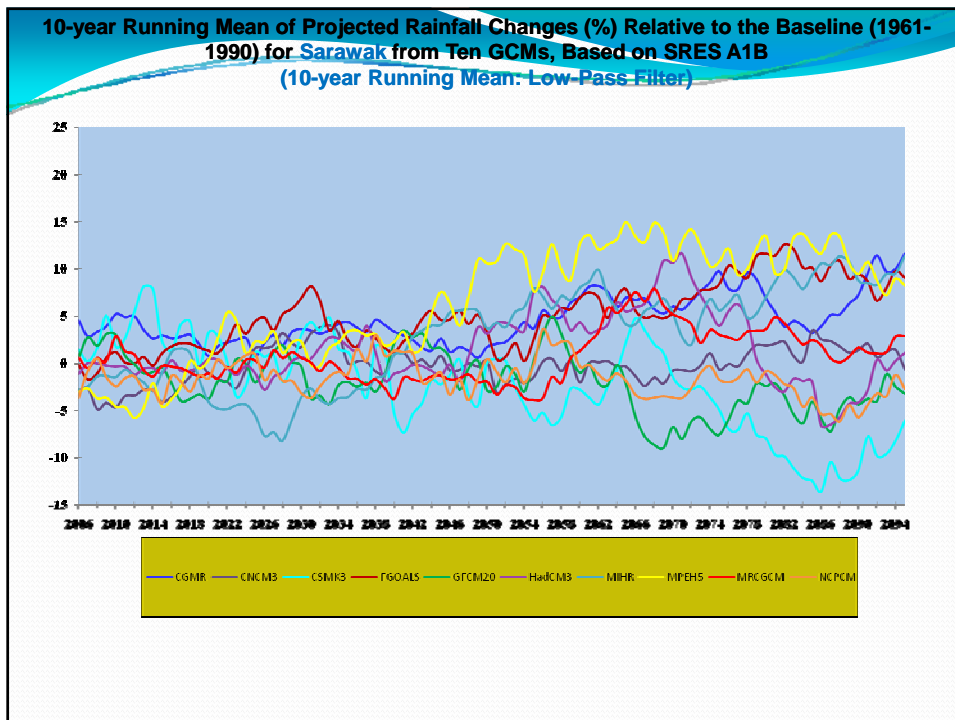
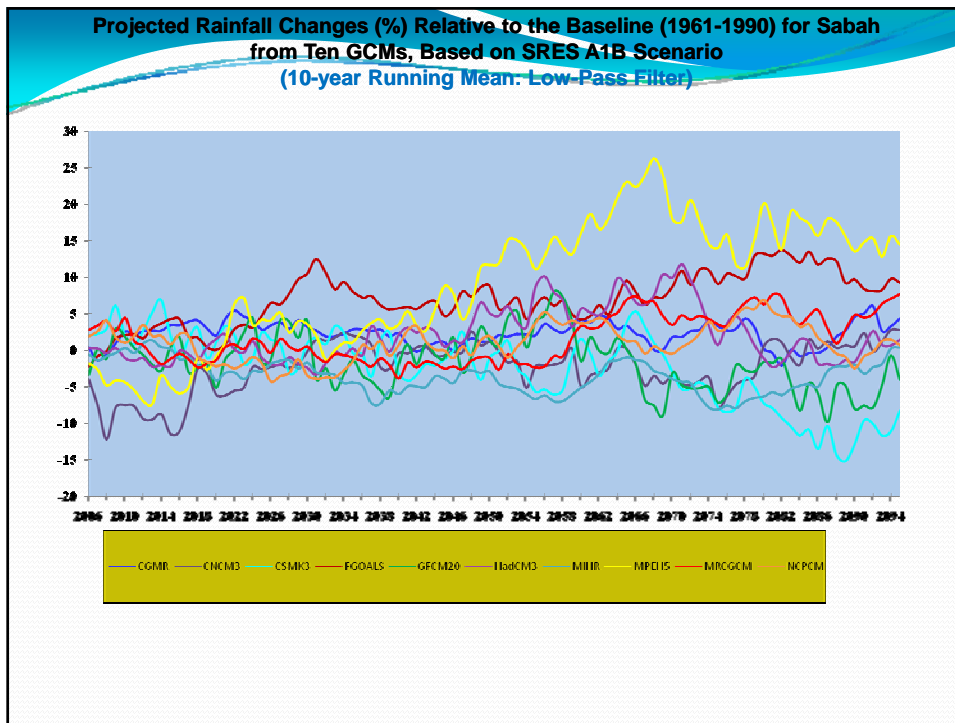
Name, Institution and Resolution of AOGCM Models

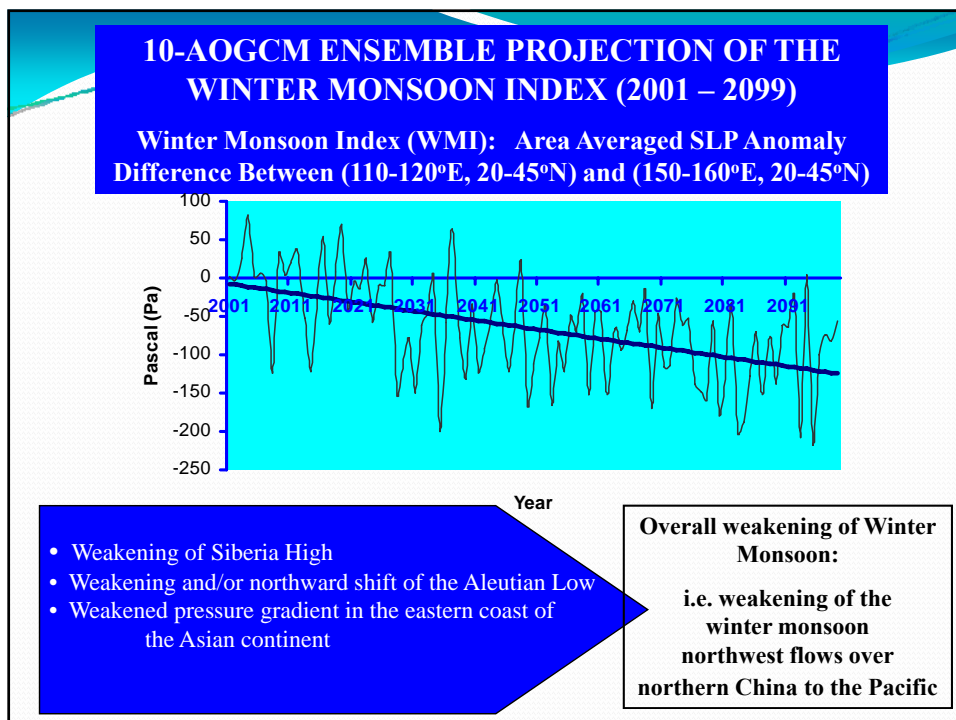
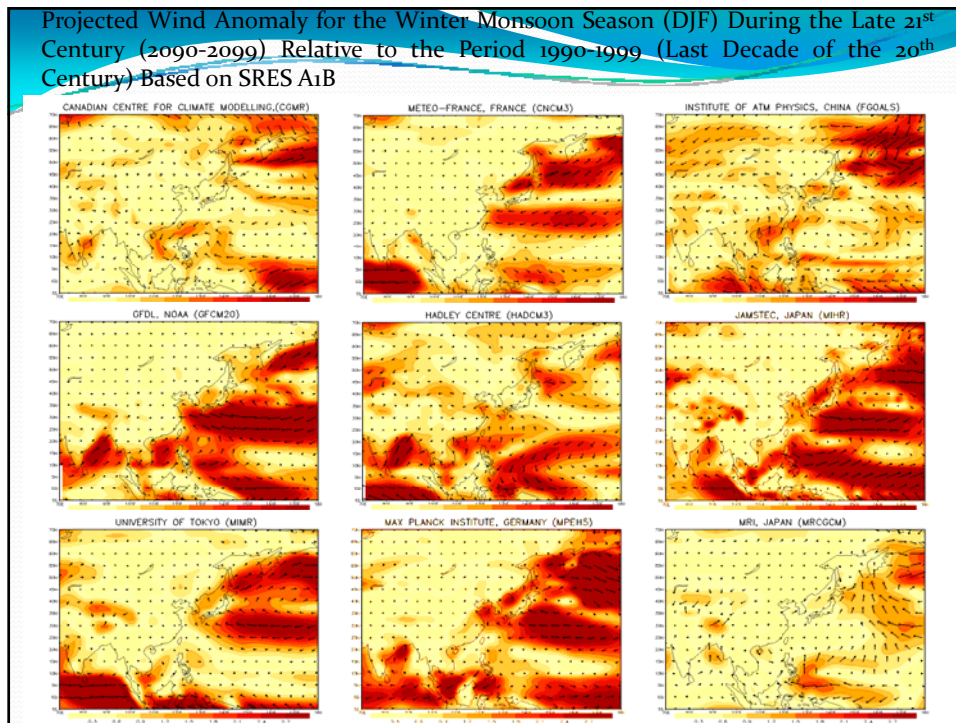
Model	Institution	Resolution
CNCM3	Meteo-France	2.8° x 2.8°
MRCGCM	Meteorological Research Institute, Japan	T42 (≈2.8° x 2.8°)
FGOALS	Institute of Atmospheric Physics, China	T42 (≈2.8° x 2.8°)
GFCM20	NOAA/GFDL, USA	2.5° x 2.0°
HADCM3	Hadley Centre, UK	3.75° x 2.5°
MIHR	JAMSTEC, Japan	T42 (≈2.8° x 2.8°)
MPEH5	Max Plank Institute, Germany	T63 (≈1.8° x 1.8°)
NCPCM	NCAR, USA	2.8° x 2.8°
CSMK3	CSIRO Atmospheric Research	2.8° x 2.8°
CGMR	Canadian Centre for Climate Modeling & Analysis	T47 (≈3.75° x 3.75°)

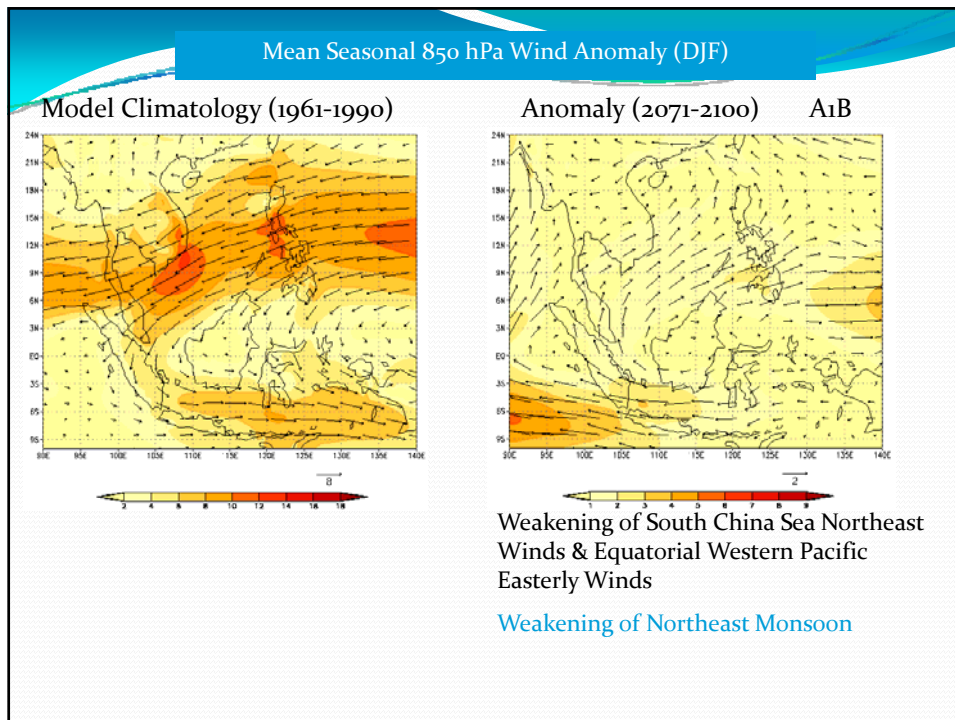










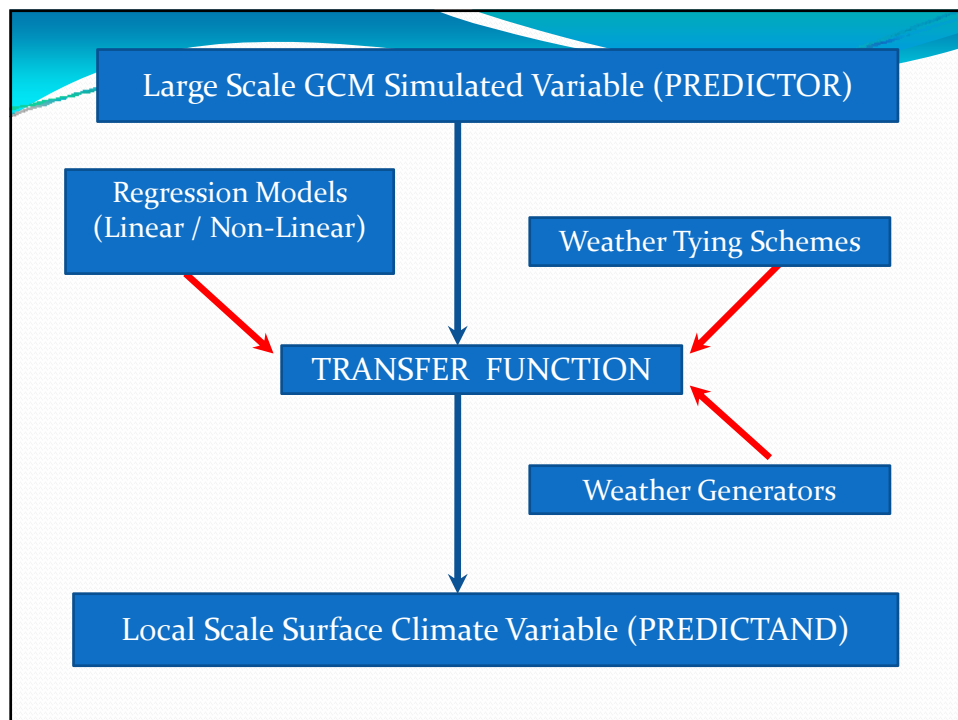


GENERAL CIRCULATION MODELS (GCM)

- Coarse resolutions.
- Reliable climate information at local scales cannot be obtained
- Extreme events (cyclone, heavy rainfall events) not captured or unrealistic low intensity at coarse resolution

FOR IMPACT STUDIES – FINE SCALE RESOLUTION IS NECESSARY

Downscaling of AOGCMs:
Statistical downscaling



ADVANTAGES

- Relatively Cheap Computational Cost
- Generation of Multiple Scenario and Multiple AOGCM Ensemble (Accounts for Wide Uncertainties)

DISADVANTAGES

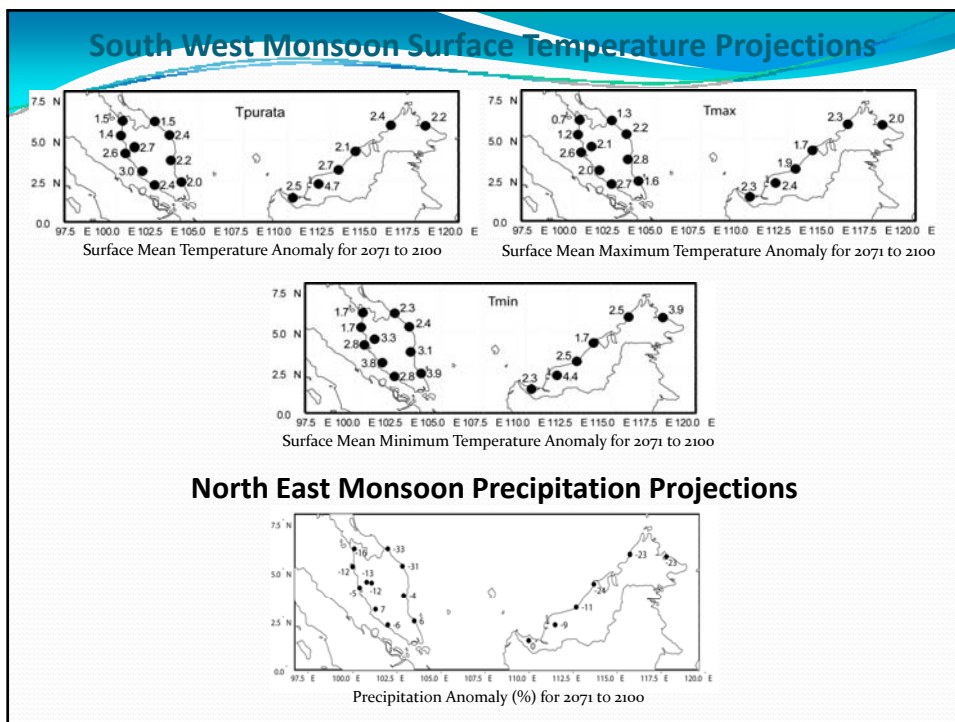
- Based upon assumption that **predictor-predictand** relationship does not change over course of climate change period considered (Non-Physically Based). This may not be true.
- Cannot be applied on spatial locations without sufficient record of observations (Data Driven Approach)

PREDICTOR - PREDICTAND

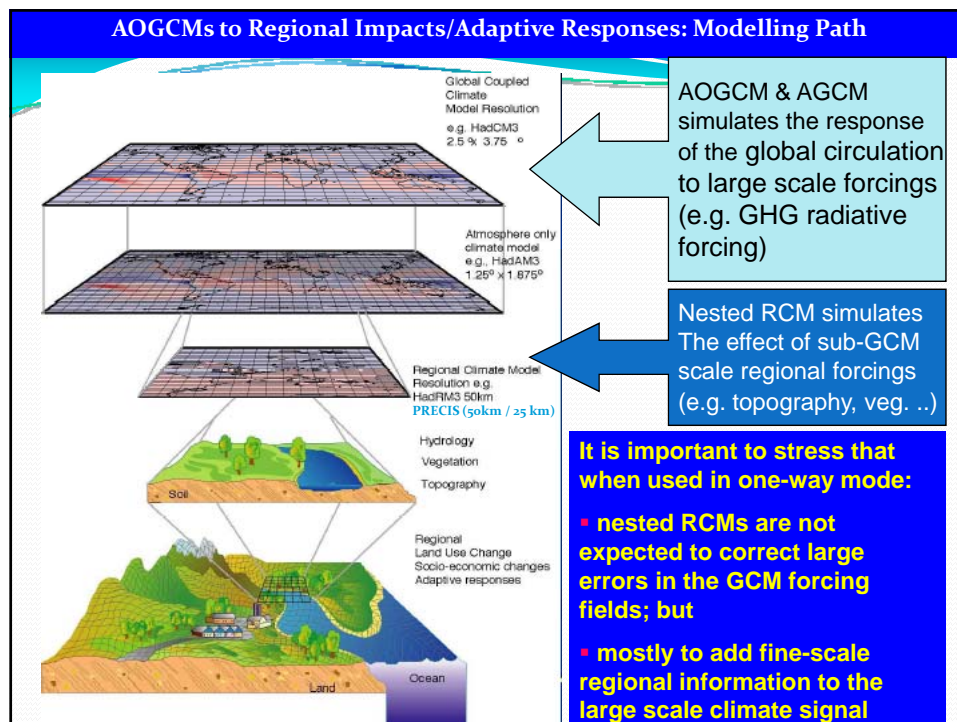
At UKM (IKLIM):

- Canonical Correlation Analysis (CCA) algorithm (non-linear regression methodology) - downscale predictors from AOGCMs to obtain predictands
- AOGCM – obtained from National Center for Environment Prediction (NCEP)
 - 14 AOGCMs
 - Baseline (1970 – 1999)
 - Future Projection (A2 Scenario – 2070 to 2100)
- Different predictor – predictand relationship for different seasons

North East Monsoon (DJF)	- sea level pressure (predictor)
	- precipitation (predictand)
 South West Monsoon (JJA)	 - 500hPa Geopotential height (predictor)
	- 850hPa Relative Humidity (predictor)
	- Surface Temperatures (predictand)



Downscaling of AOGCMs:
Dynamical downscaling



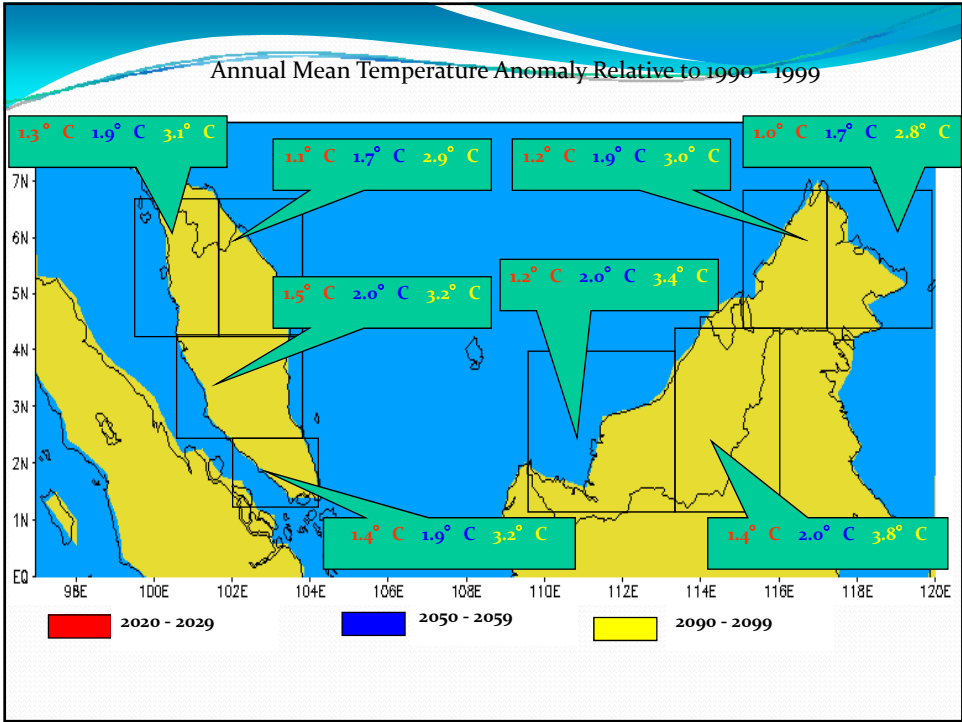
ADVANTAGES:

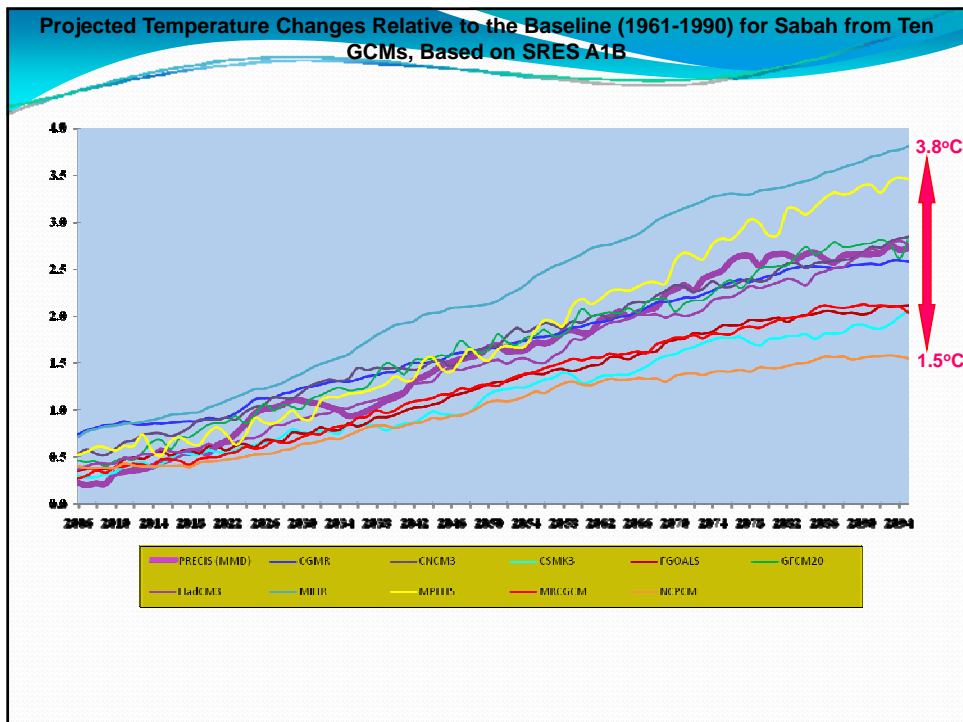
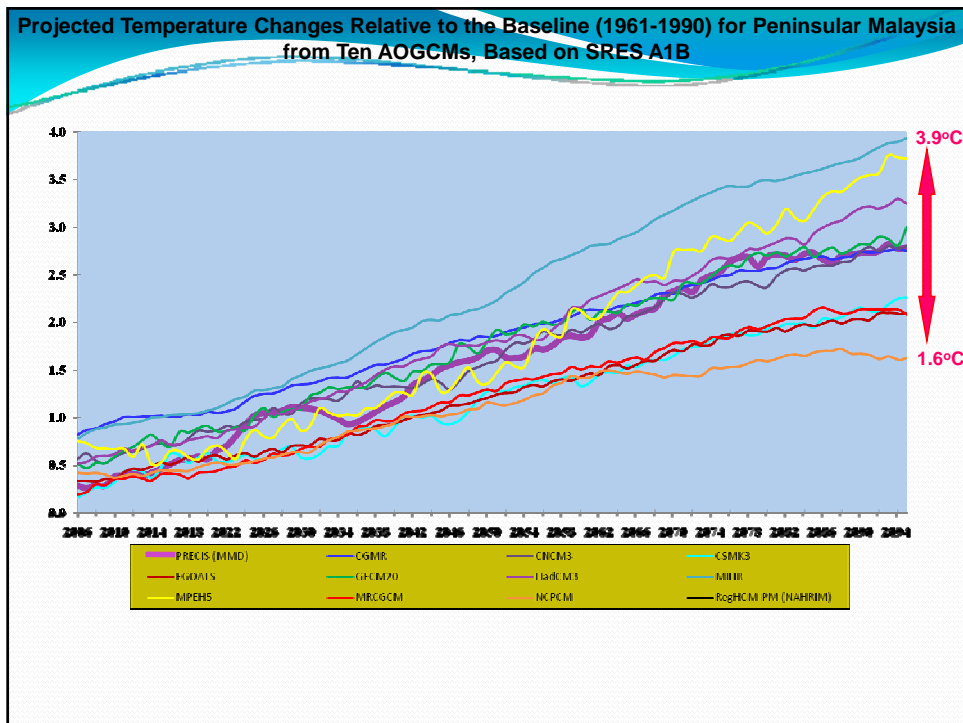
- Physically based model representing important components of Climate System.
- High Spatial and Temporal resolution compared to AOGCM (Suitable for Impact Studies).

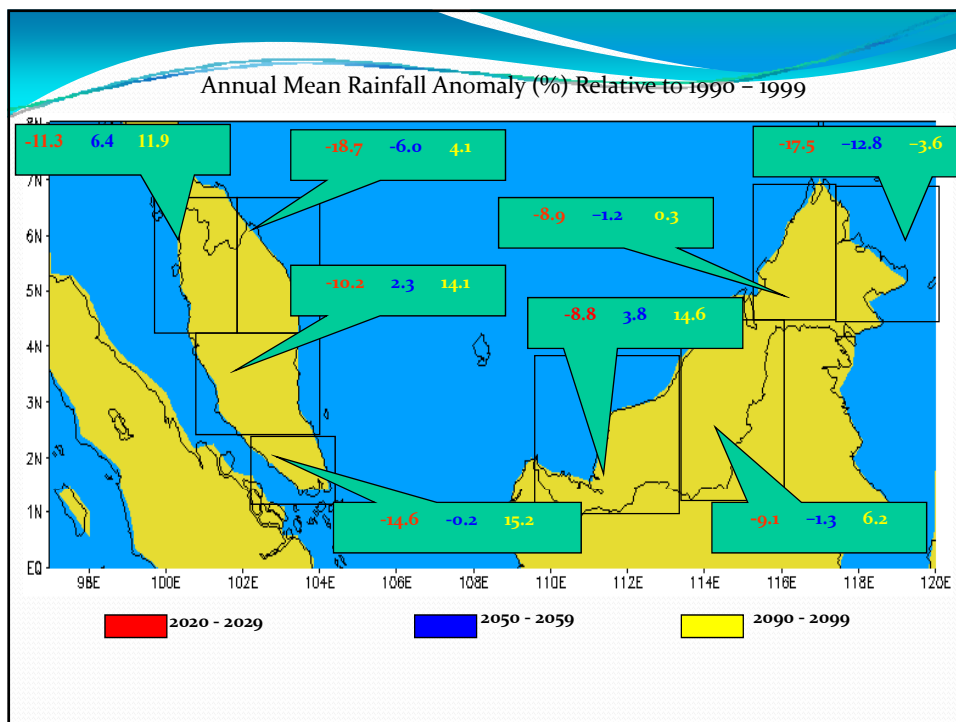
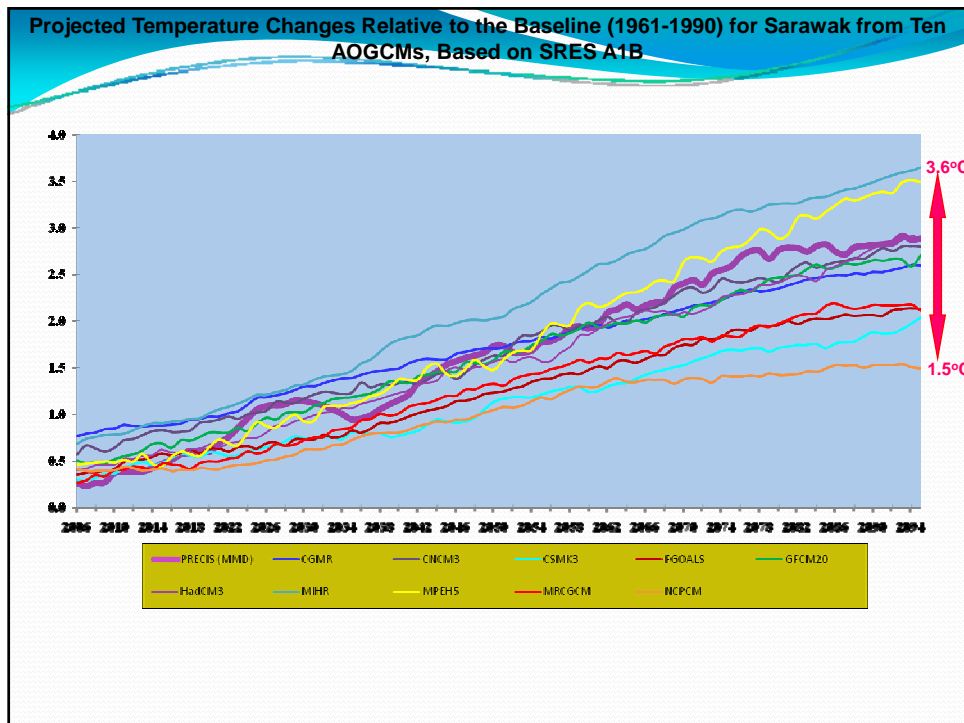
DISADVANTAGES:

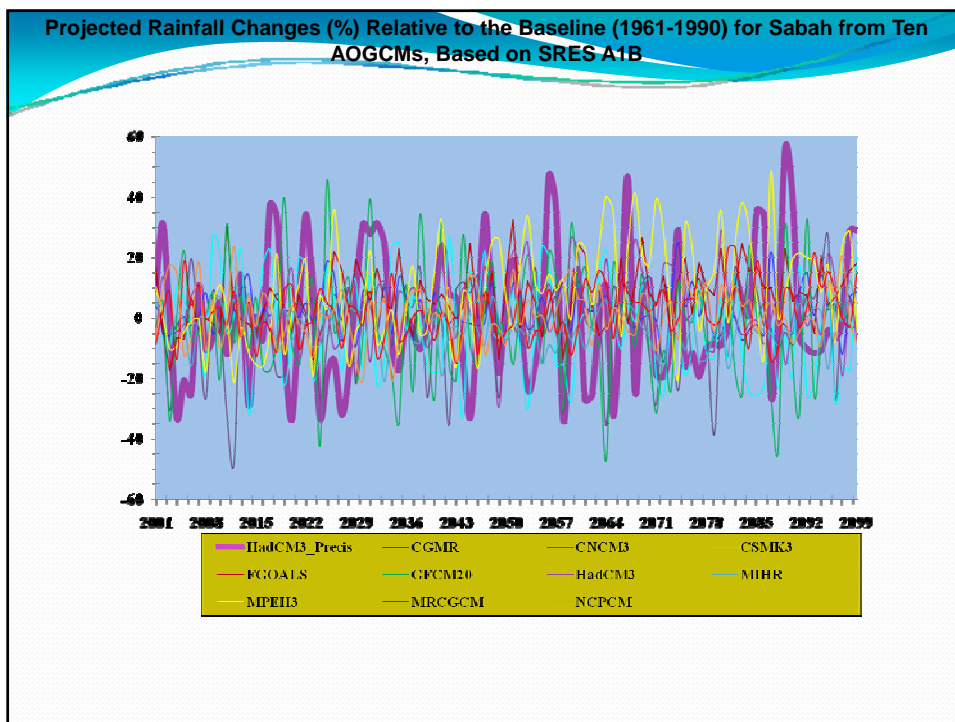
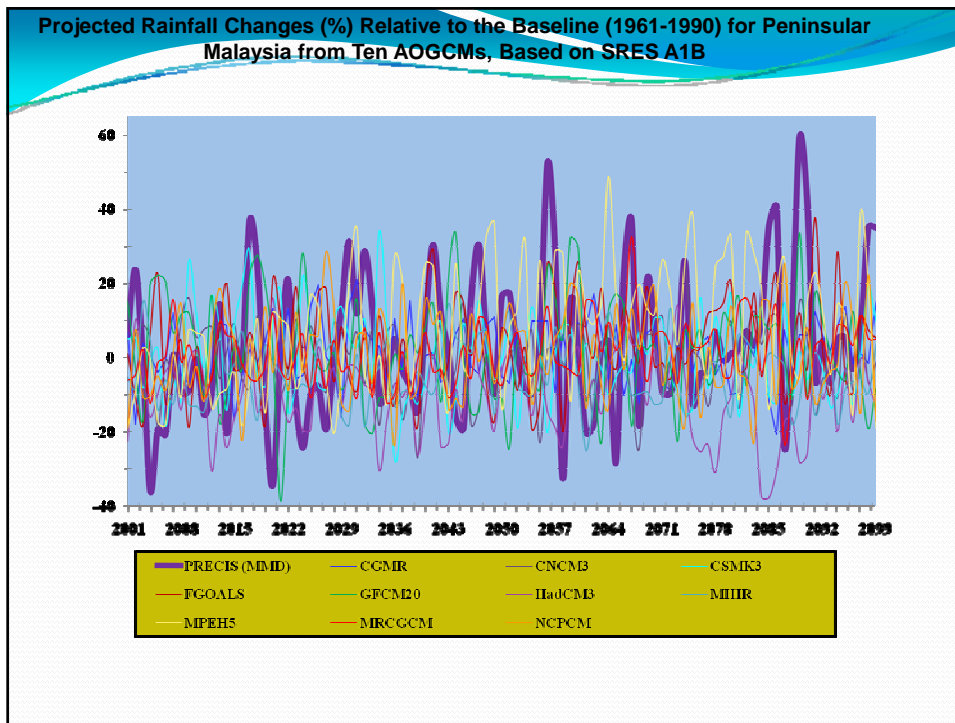
- Main response of RCM very much dependent on AOGCM simulation. Errors in AOGCM will be carried on to RCM simulation.
- New growth of errors in the dynamical downscaling process.

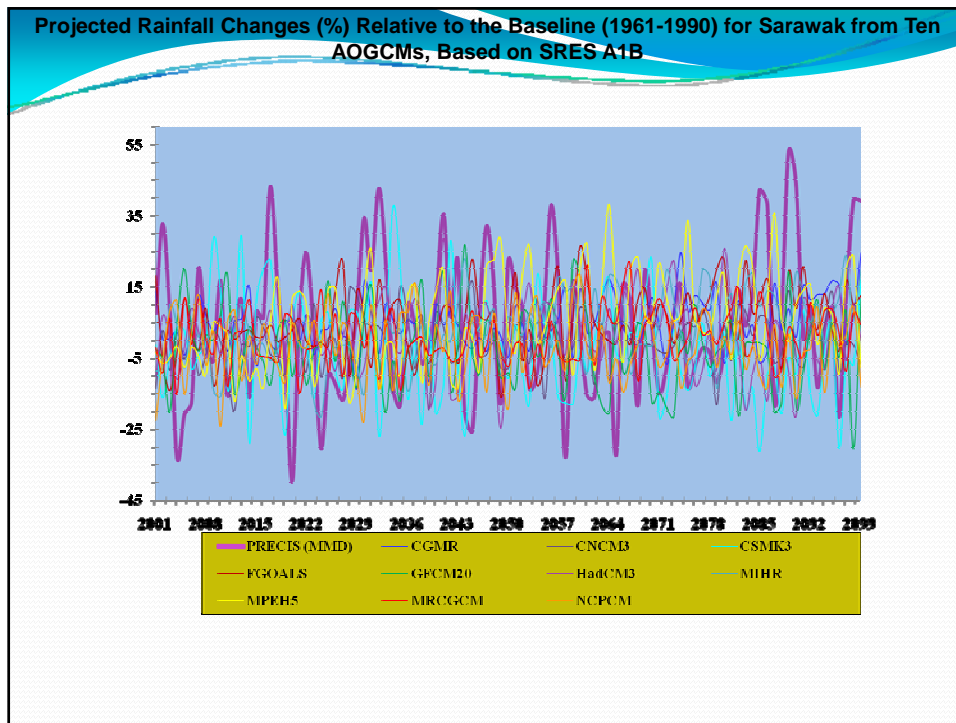
Providing Regional Climates for Impacts Studies (PRECIS)



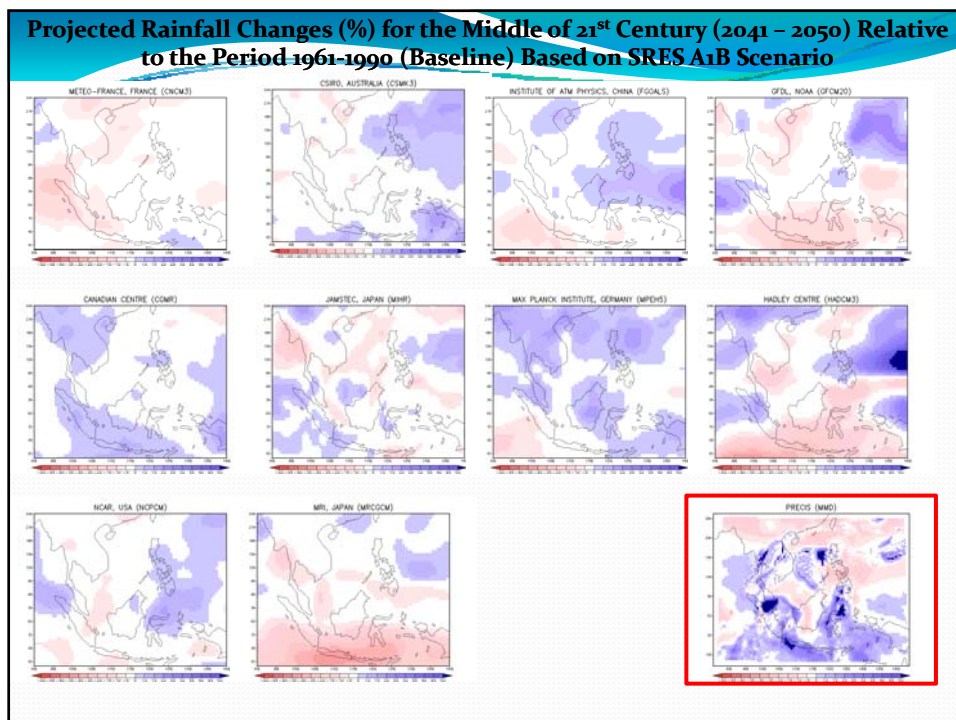
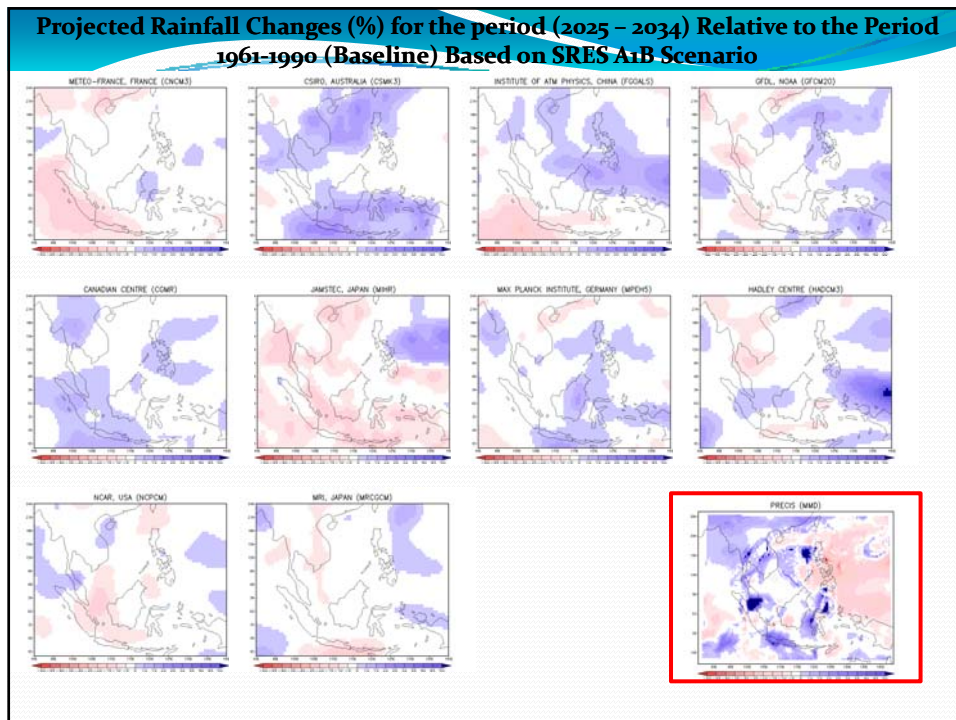


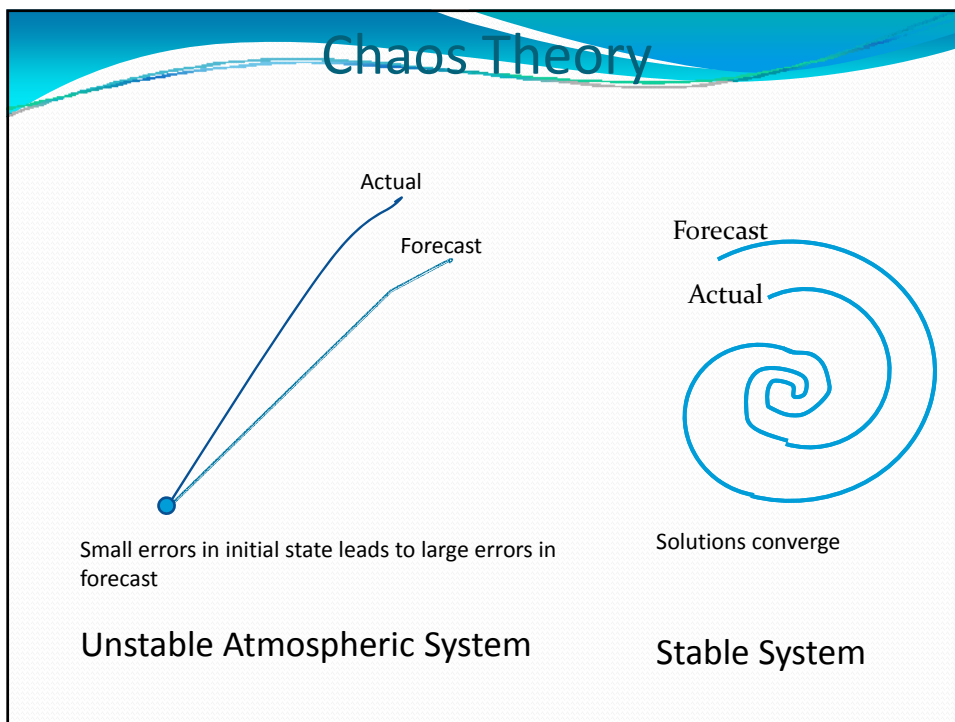
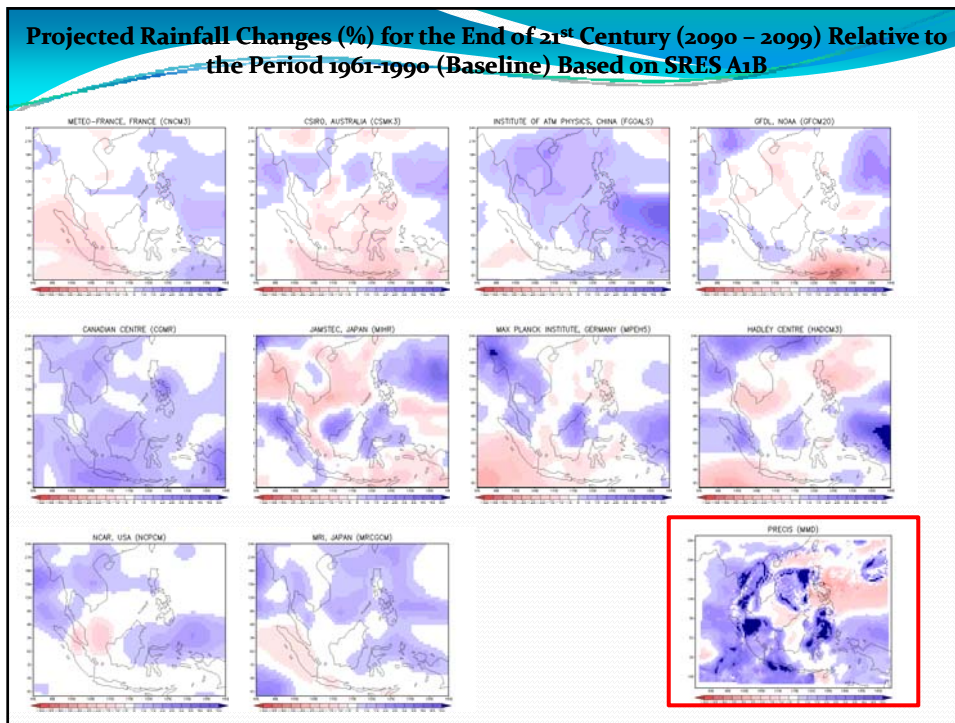


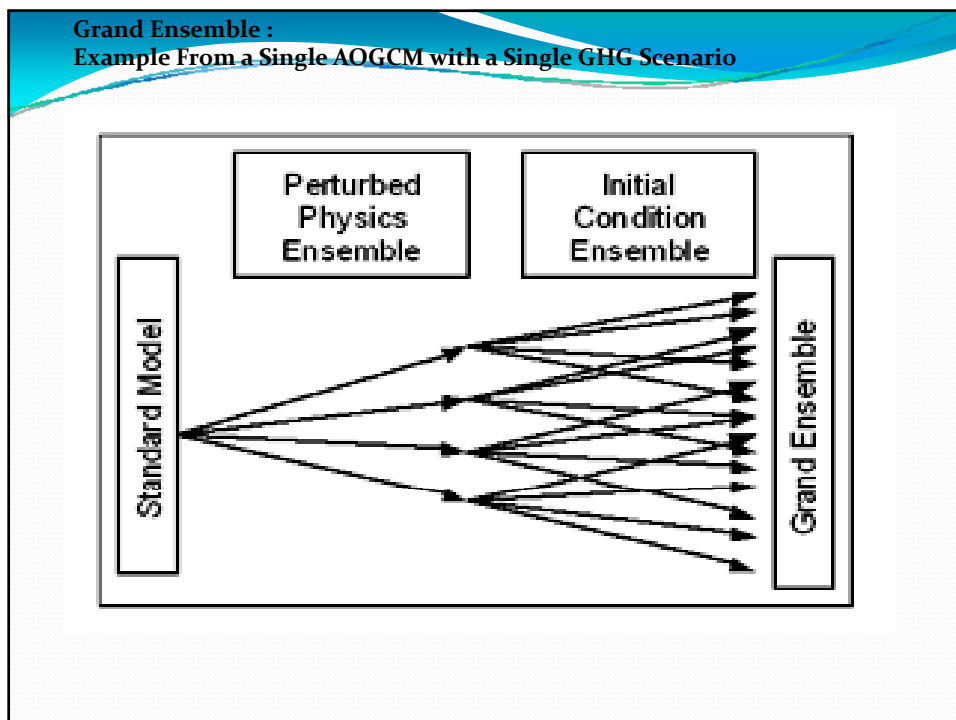
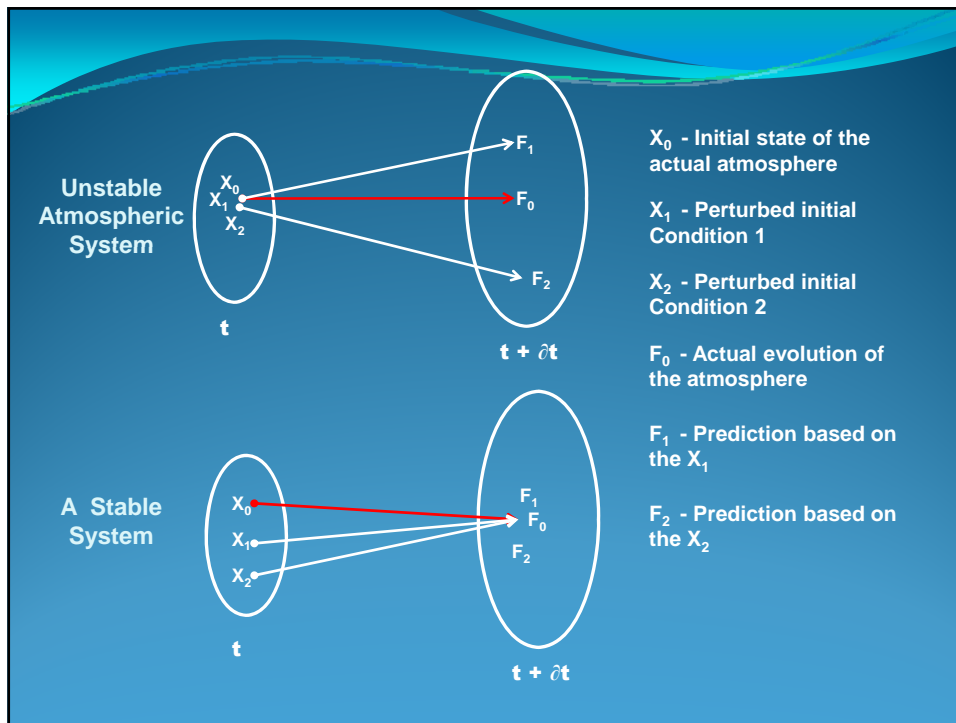




Discussion and Conclusion
 Uncertainties & A Path Toward Credible
 (Robust Findings) Climate Change Scenarios







Concluding Remarks:

Source of Uncertainty	Ways to address it
Future emission	Run RCM for a range of emission scenarios
Incomplete understanding / imperfect representation of processes in models ("science uncertainty")	Use projections from a range of GCMs
Natural variability	Use an ensemble of GCM projections with different initial conditions

THANK YOU