Regional Technical Workshop on Application of Modelling Tools for Climate Change Impact and Vulnerability Assessment
8-9 September 2009, MRCS, Bangkok, Thailand

Climate Change Studies: Modelling for Scenarios in Vietnam

Tran Dinh Trong

Vietnam Institute of Meteorology, Hydrology and Environment

Outline

1. Introduction

2. Overview on Climate Change Studies in Vietnam

2.1 Climate change status

2.2 Climate change studies

3. Climate Change Modelling

3.1 Methods for generating the climate change scenarios

3.2 MRI/AGCM

3.3 PRECIS

3.4 MAGICC/SCENGEN 5.3, Statistical Downscaling

4. Climate Change Scenario

4.1 Criteria for Choosing Vietnam climate change scenario

4.2 Official scenario for Vietnam

1. Introduction

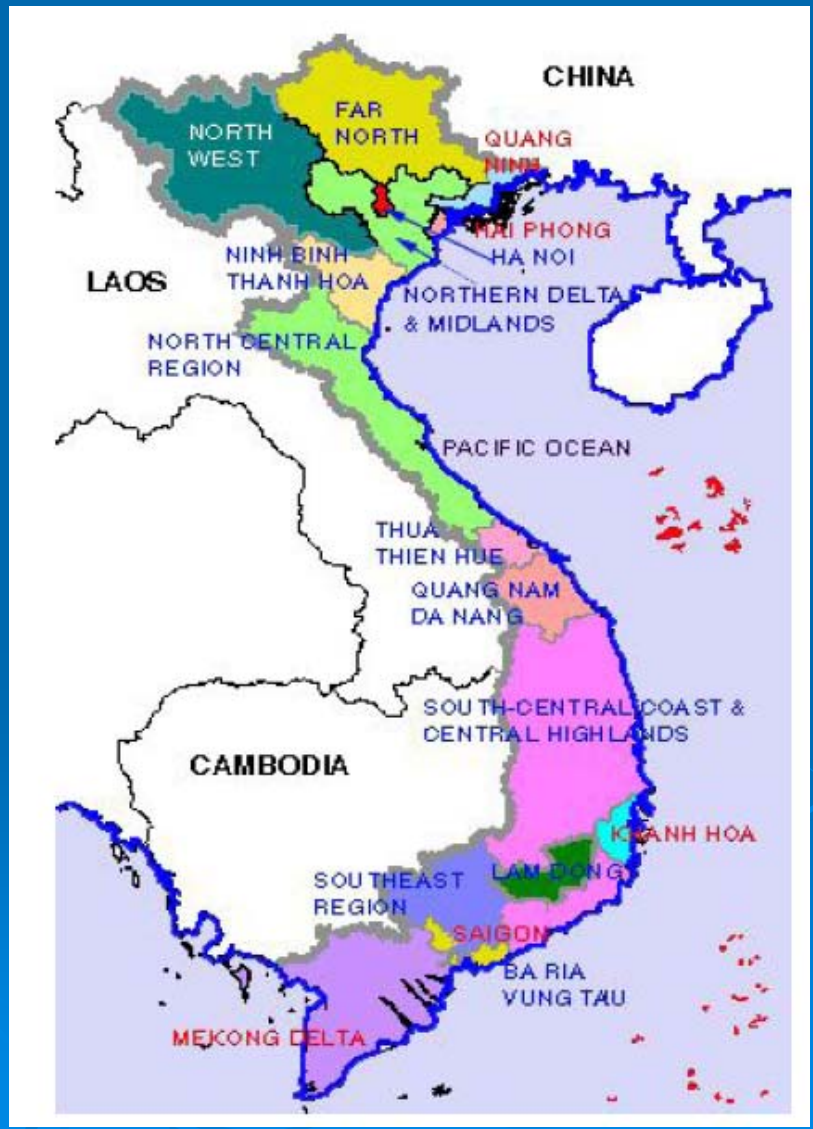
- Country position: Southeastern Asia, 8º27 to 23º23N and 102º08 to 109º30E

-Area: 330,990 km^2

-The coastline length: 3,260 km

- Climate: Tropical monsoon suffering from natural disasters such as typhoons, floods, drought,… which affected regularly to socio-economic development

- Climatic Regions: 7



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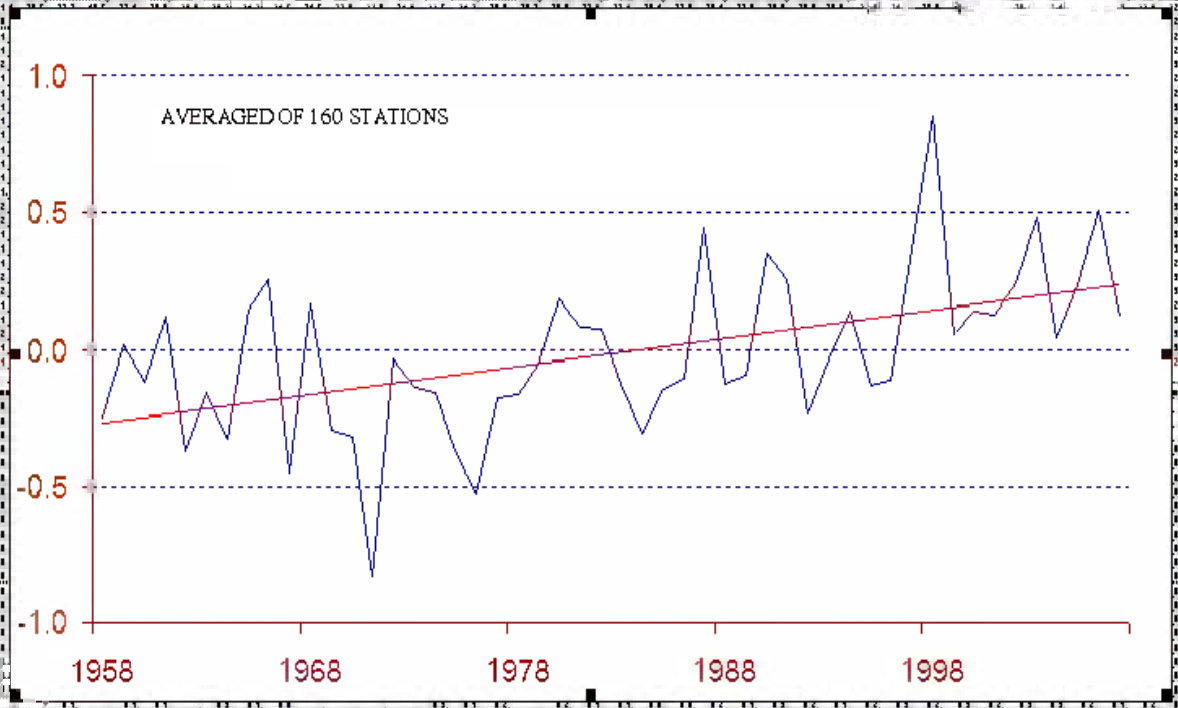
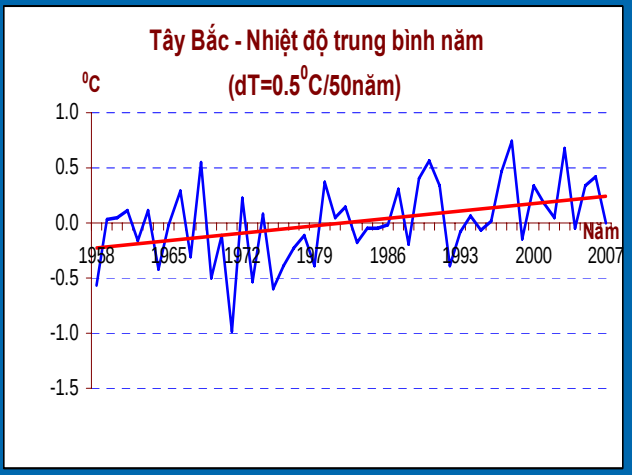
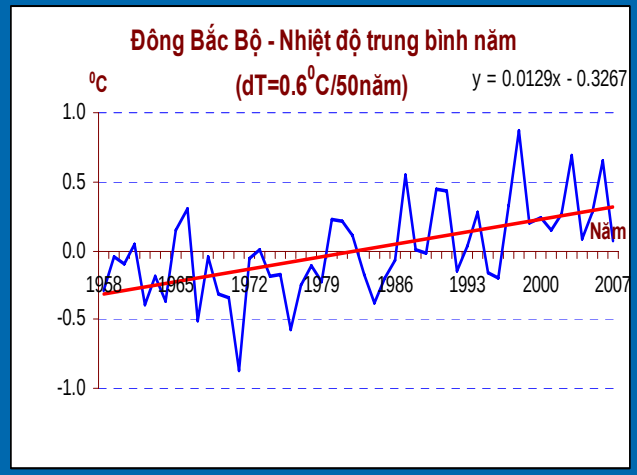
2.1 Climate change Status:

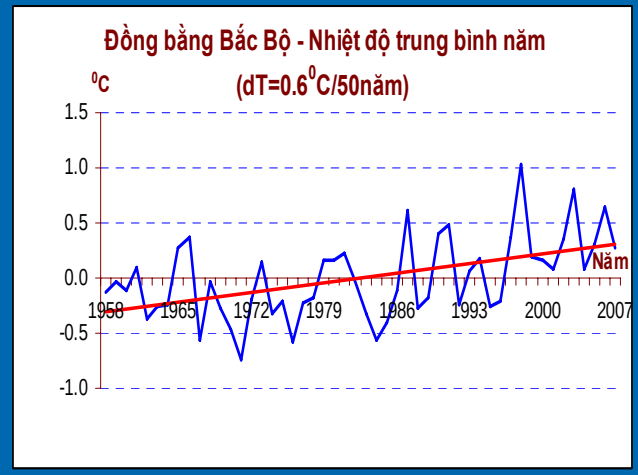
Annual average temperature increased by 0.1^0C per decade from 1900 to 2000

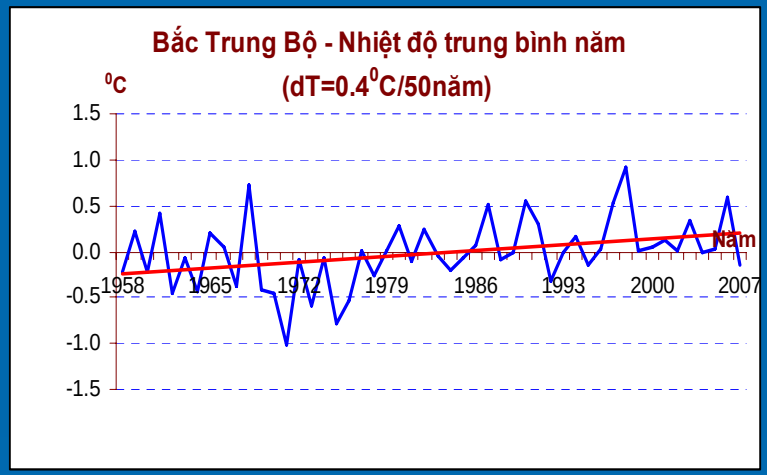


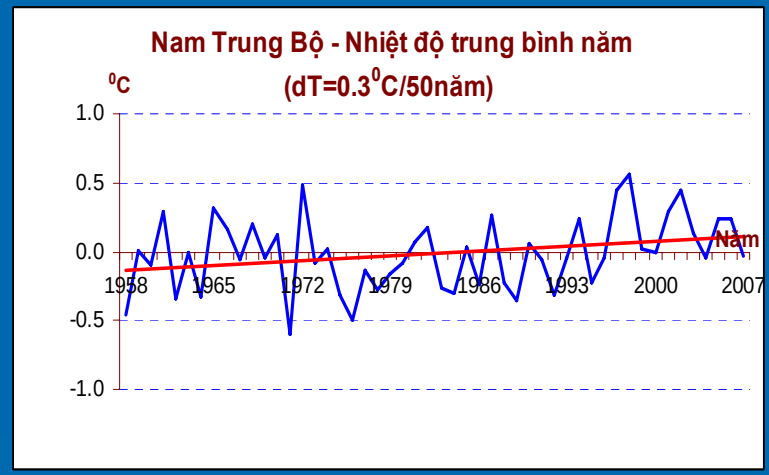
T trends in 7 climatic regions

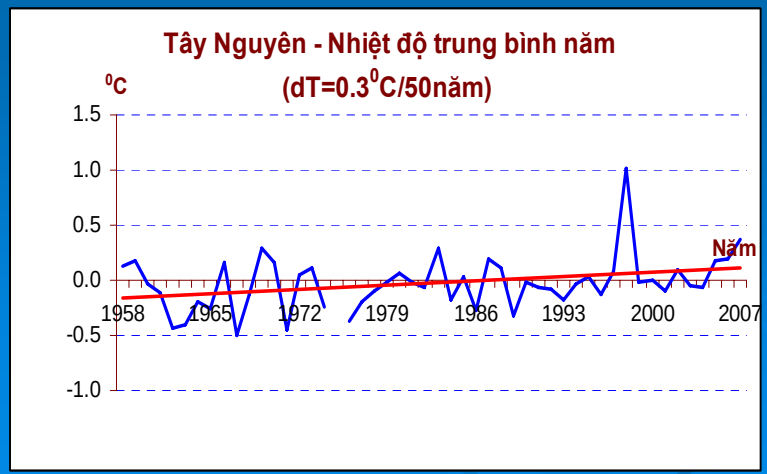


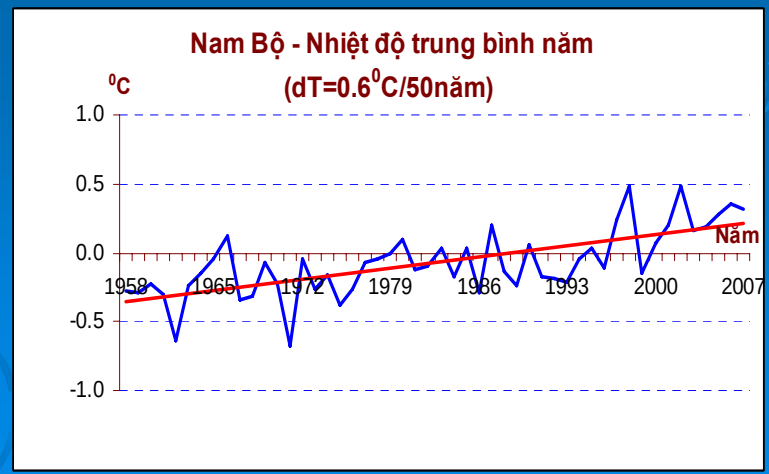




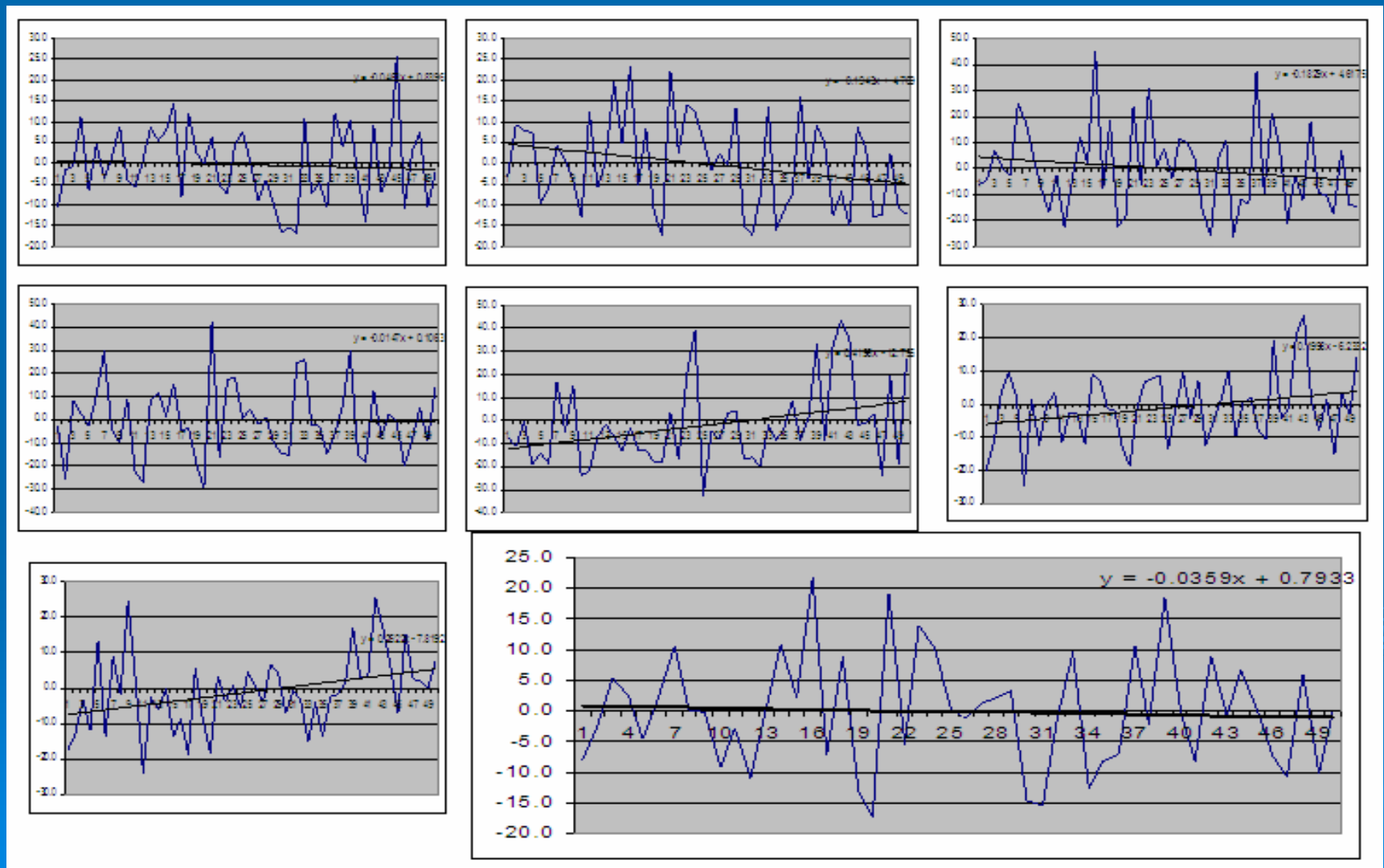








Variation tendencies of precipitation are complex and region and season specific



Increase in quantity and intensity of extreme-weather events (typhoon, flood, flash flood, drought, heavy rainfall);

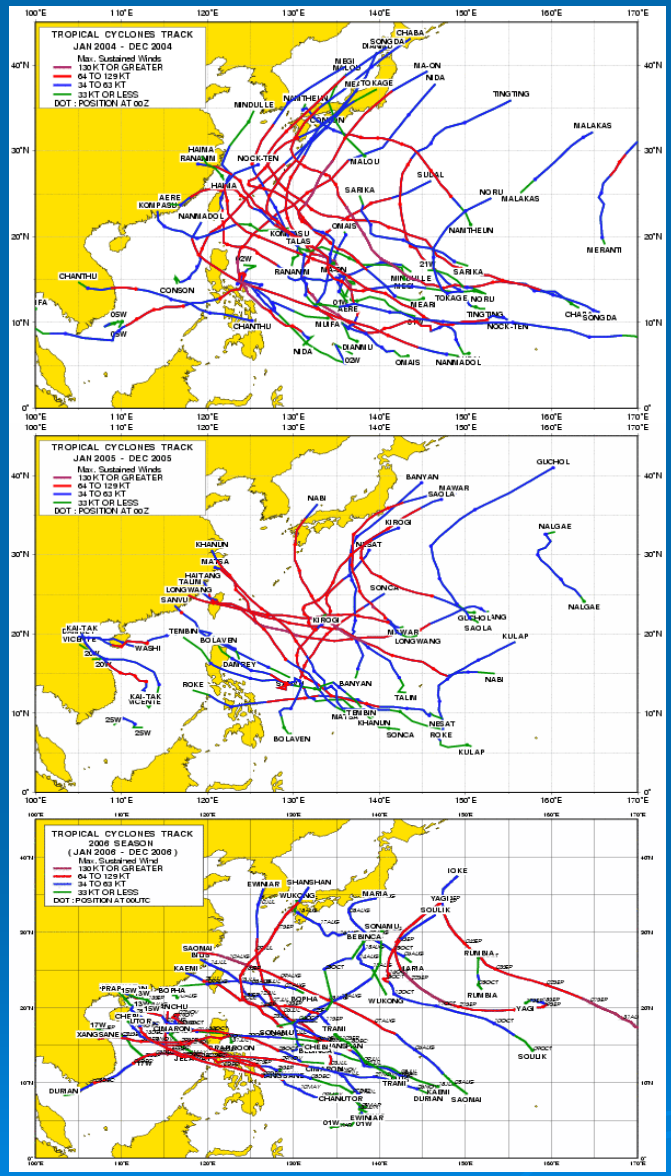
Hanoi City living with floods ! (November 2008)

Flooding in An Giang province

Source: http://www.sggp.org.vn/moitruongdothi/2008/3/144808/

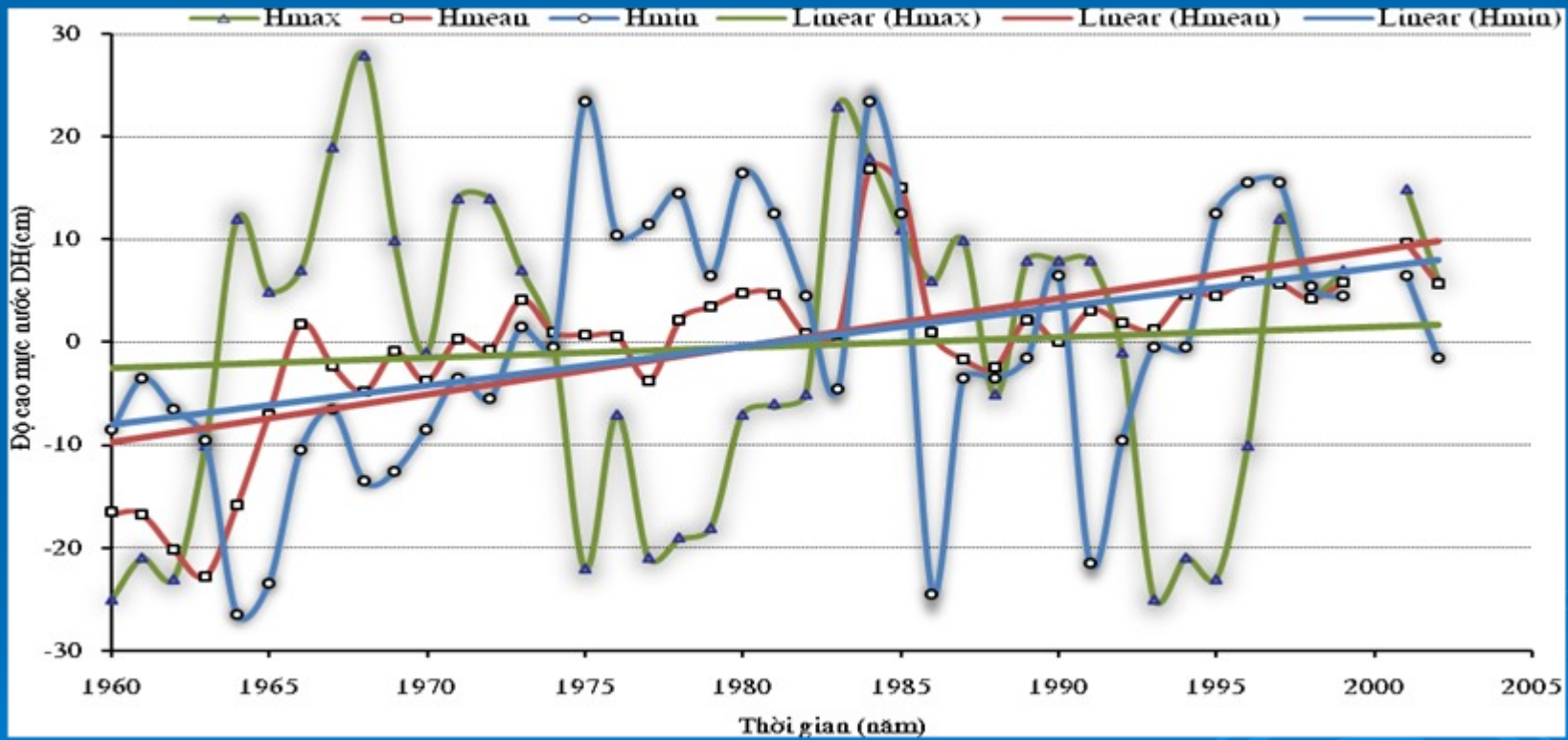
More droughts

Han.mpg



- More abnormal: patterns and directions of storm;
- Storms are moving toward southern;
- Storm season: moving to the late of years

Sea level increased about 0.2m in the last 50 years



Changes in sea level at Hon Dau oceanographical station

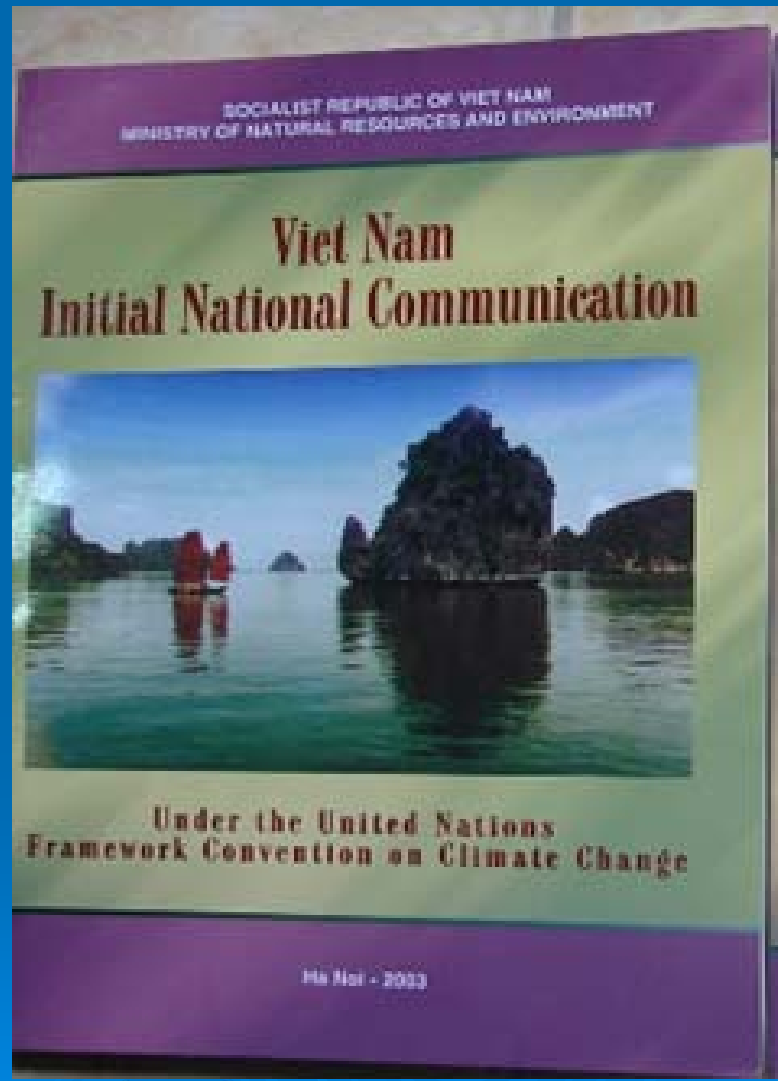
2.2 Climate change studies

Vietnam Initial National Communication (INC) to the UNFCCC in 2003:

identified water resources, coastal areas, agriculture, aquaculture, forestry, energy, transport and public health as the most vulnerable to climate change

Vietnam Second National Communication (SNC):

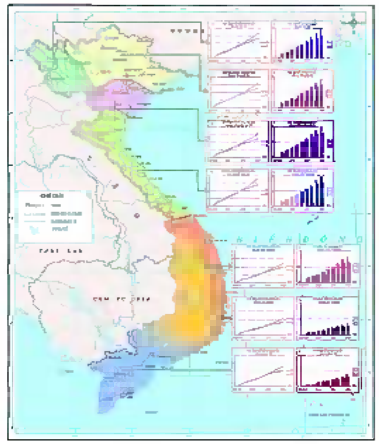
emphasizes adaptation and provides guidance to promote Climate Change Adaptation (CCA) measures in Viet Nam

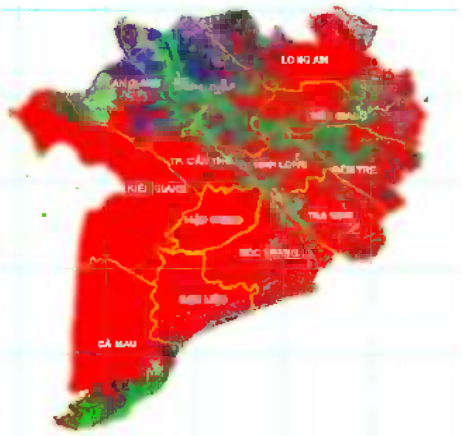


- **Climate change, sea level rise scenarios for Vietnam** is developed basing on different emission scenarios: low (B1), medium (B2) and high (A2, A1FI).

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

CLIMATE CHANGE SCENARIOS, SEA LEVEL RISE FOR VIETNAM



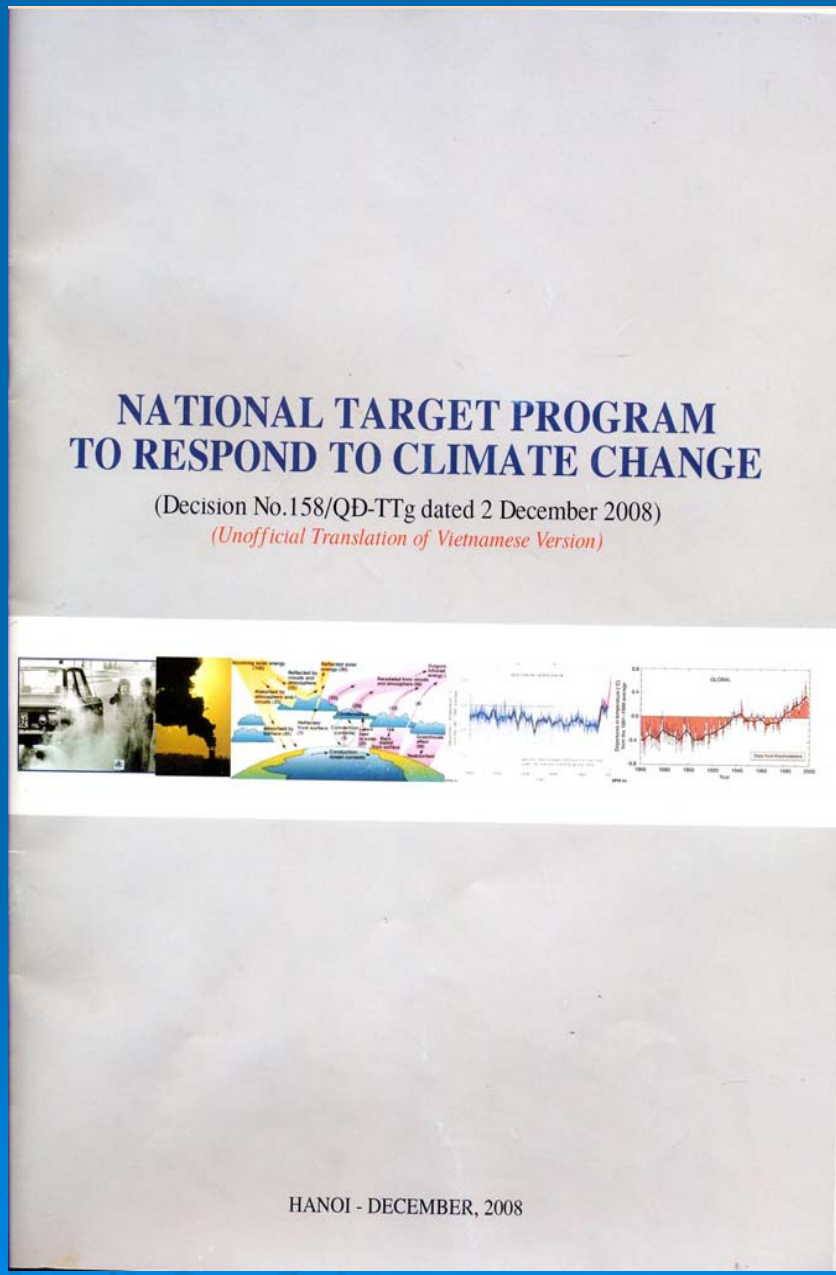


Hanoi, 4 April 2009

- The Prime Minister approved the National Target Program to respond to Climate change (NTP) on 2 December 2008 (Decision No. 158/QD-TTg dated 2 December 2008);
- **Strategic objectives of the NTP**

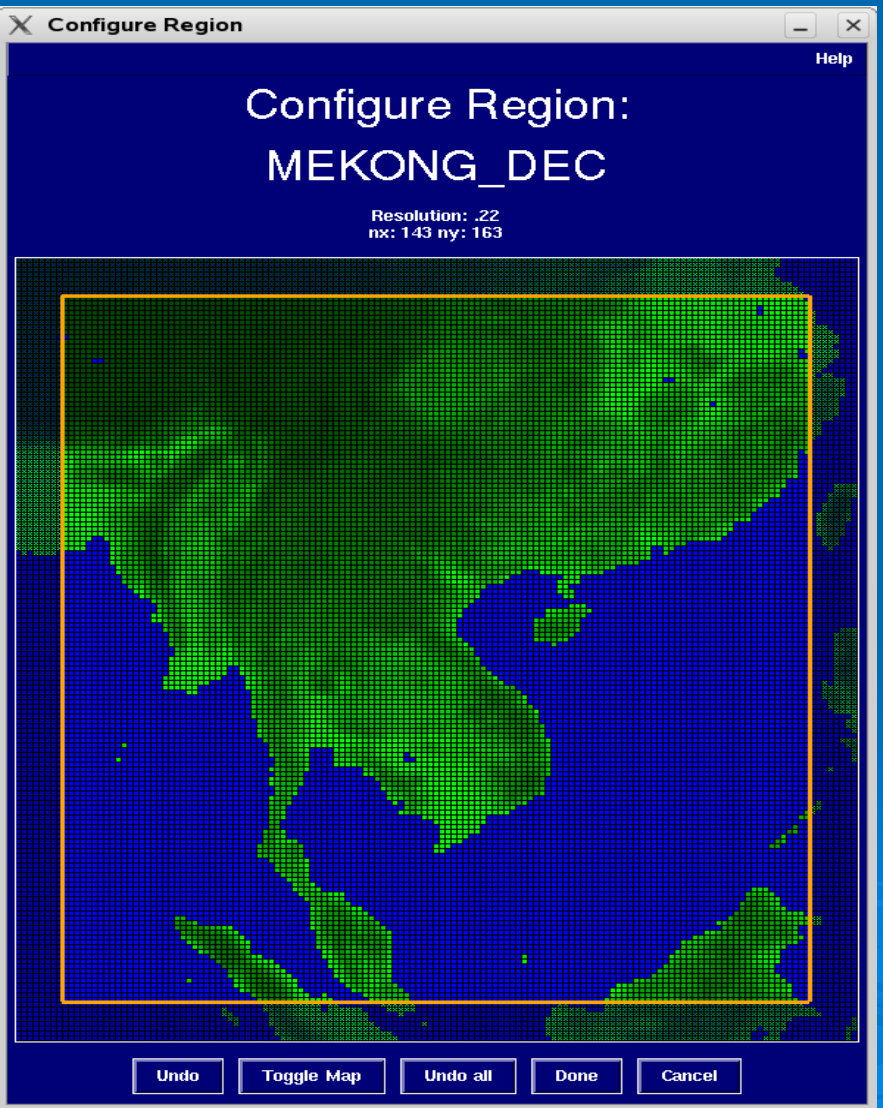
-To assess climate change's impacts on sectors and regions in specific periods; and

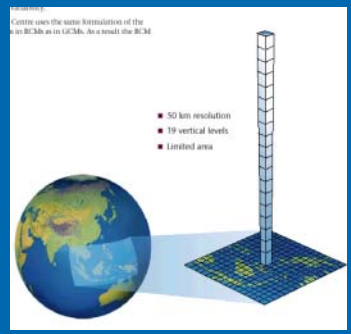
-To develop feasible action plans to effectively respond to climate change in ensuring sustainable development of Viet Nam, taking opportunities to develop towards a low-carbon economy, and jointing international community's effort of protecting climatic system;

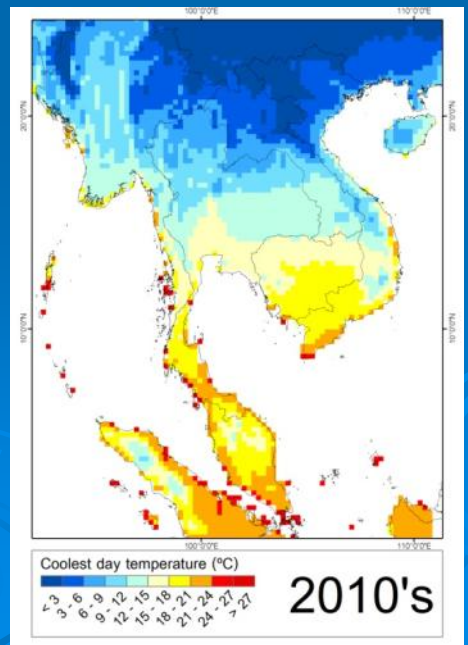


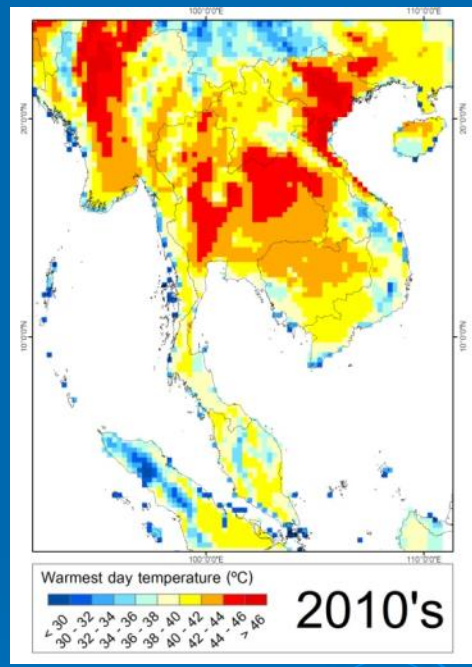
Development of Climate Change Scenario for Vietnam and the Region

Funding: SEA START *Implementing: IMHEN*







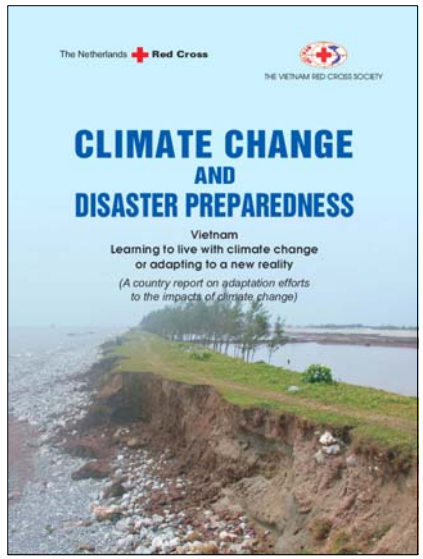


Preparedness for Disasters Related to Climate Change

Funding: Netherlands Red Cross, Implementing: Vietnam Red Cross
Participating: IMHEN

- Objective is to strengthen the most vulnerable people communities in the disaster-prone areas to climate change and disasters to response and adapt to these disasters.

The Vietnam Red Cross Society
Supported by The Netherlands Red Cross

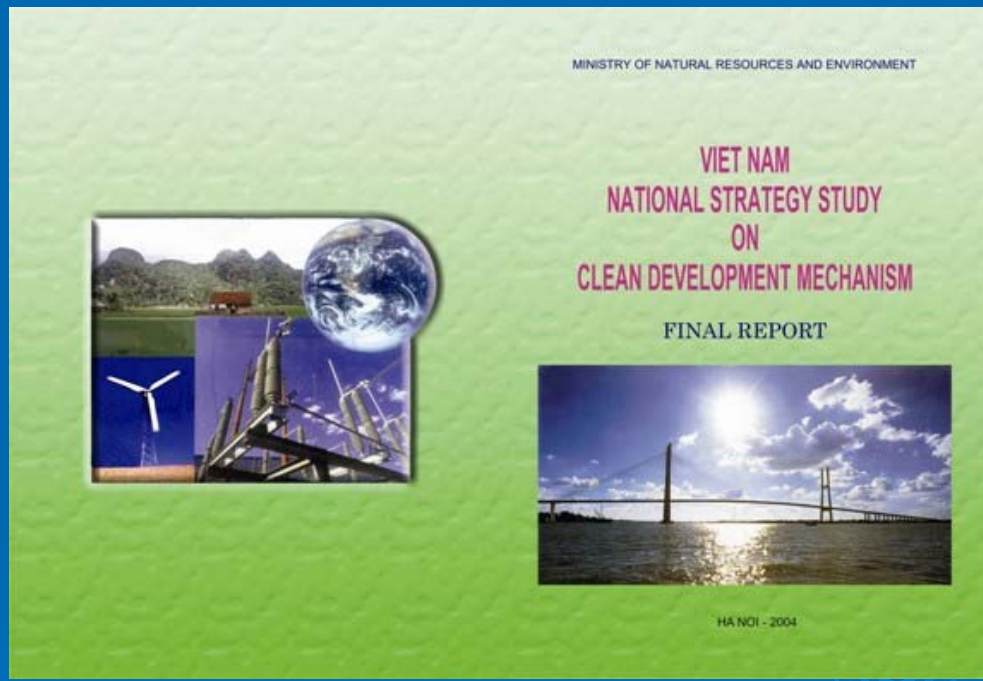


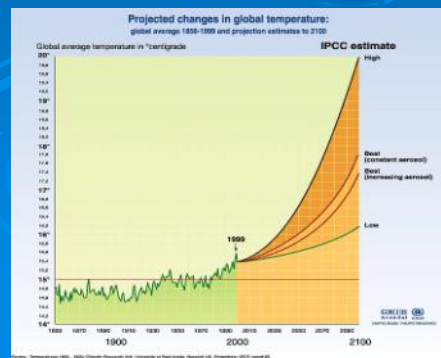
Preparedness for Disasters related to Climate Change

Vietnam National Strategy Study on Clean Development Mechanism

Funding: WB *Implementing: IMHEN*

- Current CDM policy status;
- GHG abatement potential in Vietnam;
- CDM market opportunities for Vietnam;
- Analysis of institutional set-up and institutional requirements;
- Implementing CDM: criteria and approval processes;
- Realisation of CDM opportunities in Vietnam;
- Summary of Vietnam's National CDM Strategy.



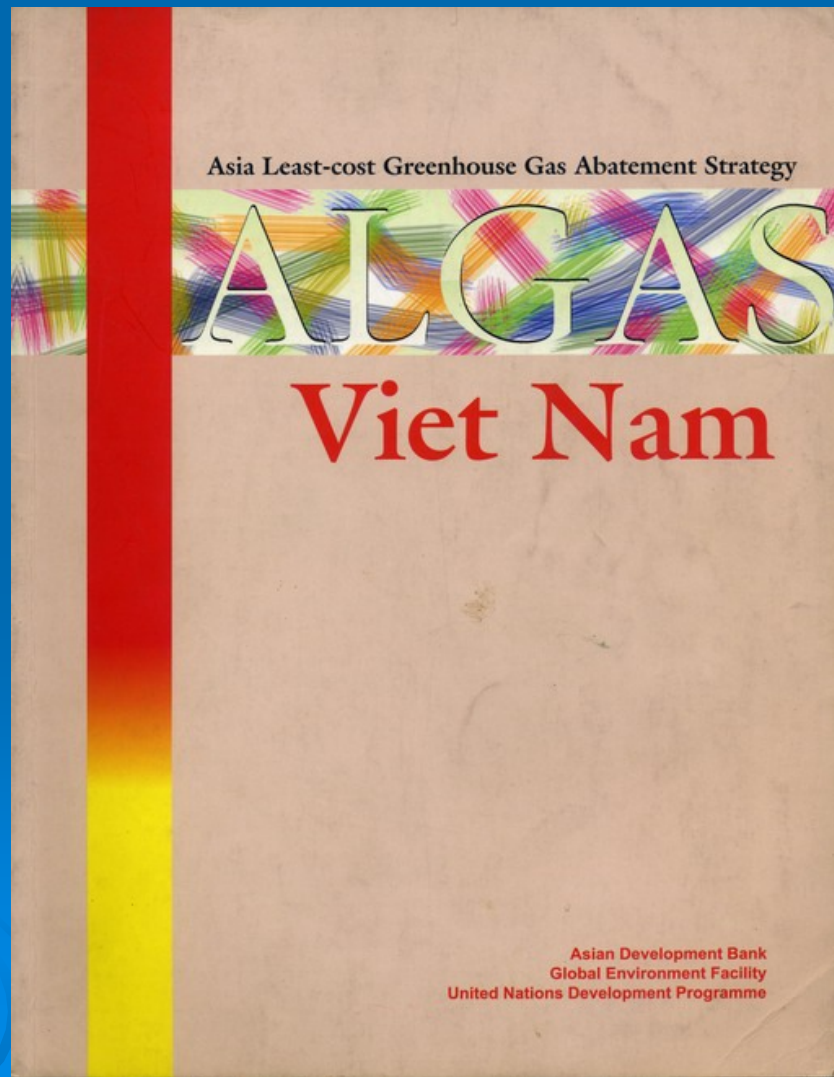


Asia Least - Cost Greenhouse Gas Abatement Strategy (ALGAS) Project

Funding: UNDP/GEF/ADB

Implementing: IMHEN

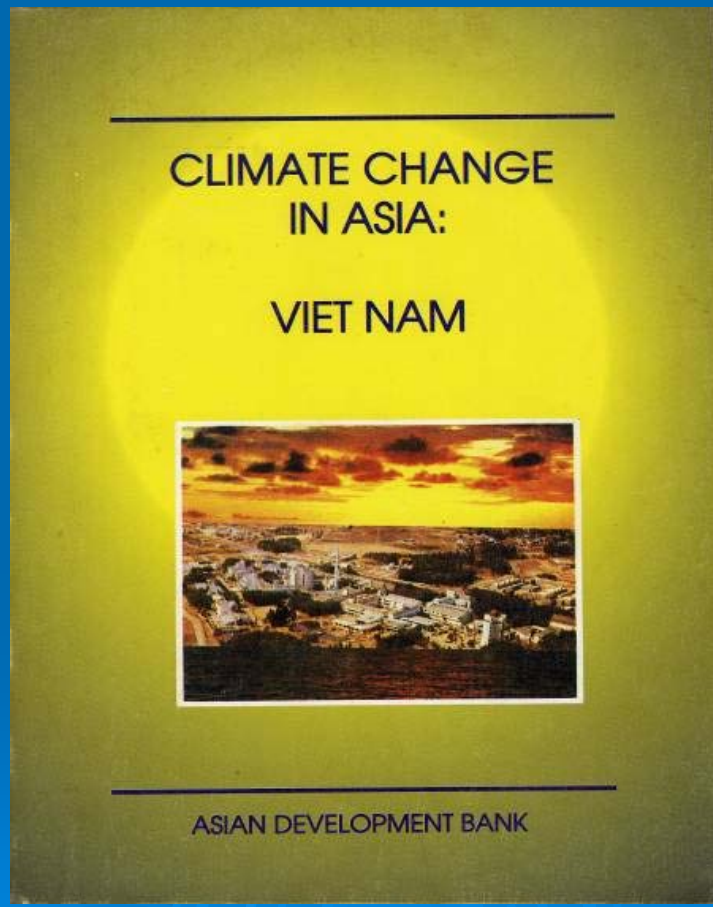
- Vietnam is one of the 12 Asian Countries participating in this UNDP/GEF/ADB project.
- Started in 1995 and completed in 1997.
- Aims to enhance and improve the national capacity of the participating countries.
- Conducting GHG Inventory based on the IPCC Guidelines for the year 1993.
- Assessing mitigation options.
- Developing the least-cost GHG abatement strategy and action plan.



Climate Change in Asia: Vietnam.

Funding: ADB *Implementing: IMHEN*

- A regional study on Global Environment Issue funded by ADB.
- Project started in 1992, Report was published by ADB in 1994.
- Scope includes GHG emission inventory based on 1990 data.
- Provided mitigation options for energy and industrial, building, transportation, agricultural, forestry and land use sectors.
- Assessment of the impacts on agriculture, monsoon and water resources, coastal zone, forestry, human health, energy system, transport and infrastructure.
- Policy options to cope with climate change for agriculture, water resources, coastal protection, forestry, human health and natural disasters were discussed.



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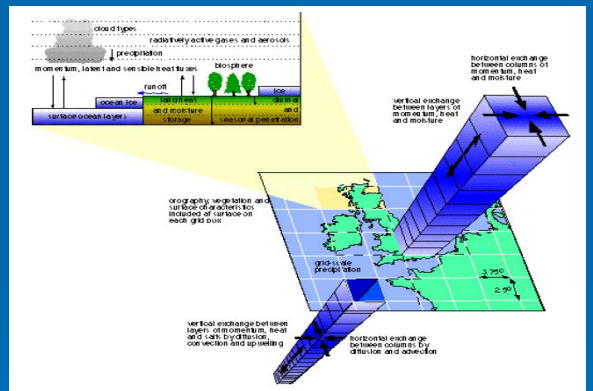
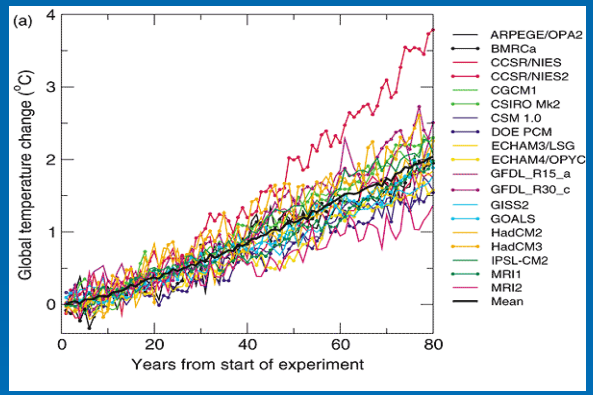
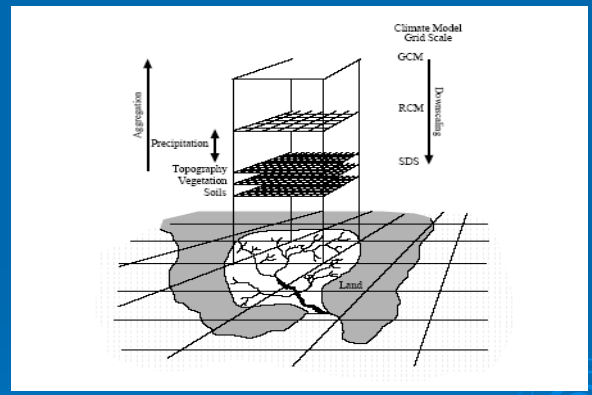
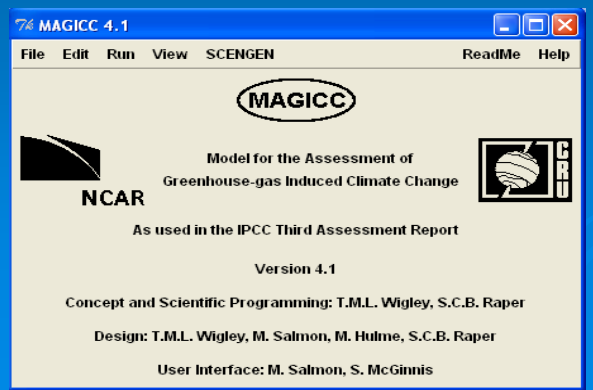
3.1 How to generate the regional climate change scenarios

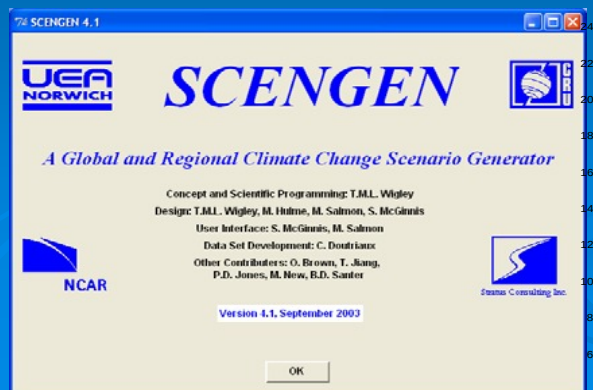
- Global Climate Models
- Assemble
- Dynamic Models
- Statistical Dowscaling
- MAGICC/SCENGEN
- Graphics
- inter- extrapolations

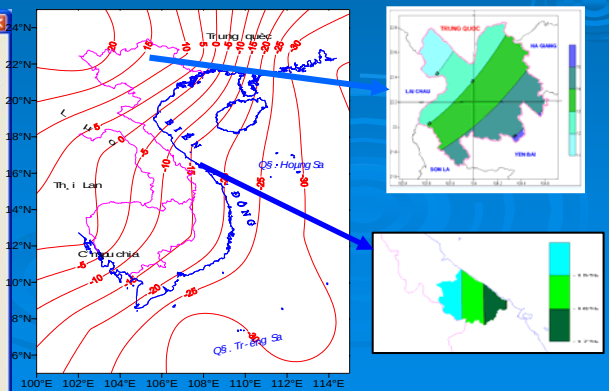




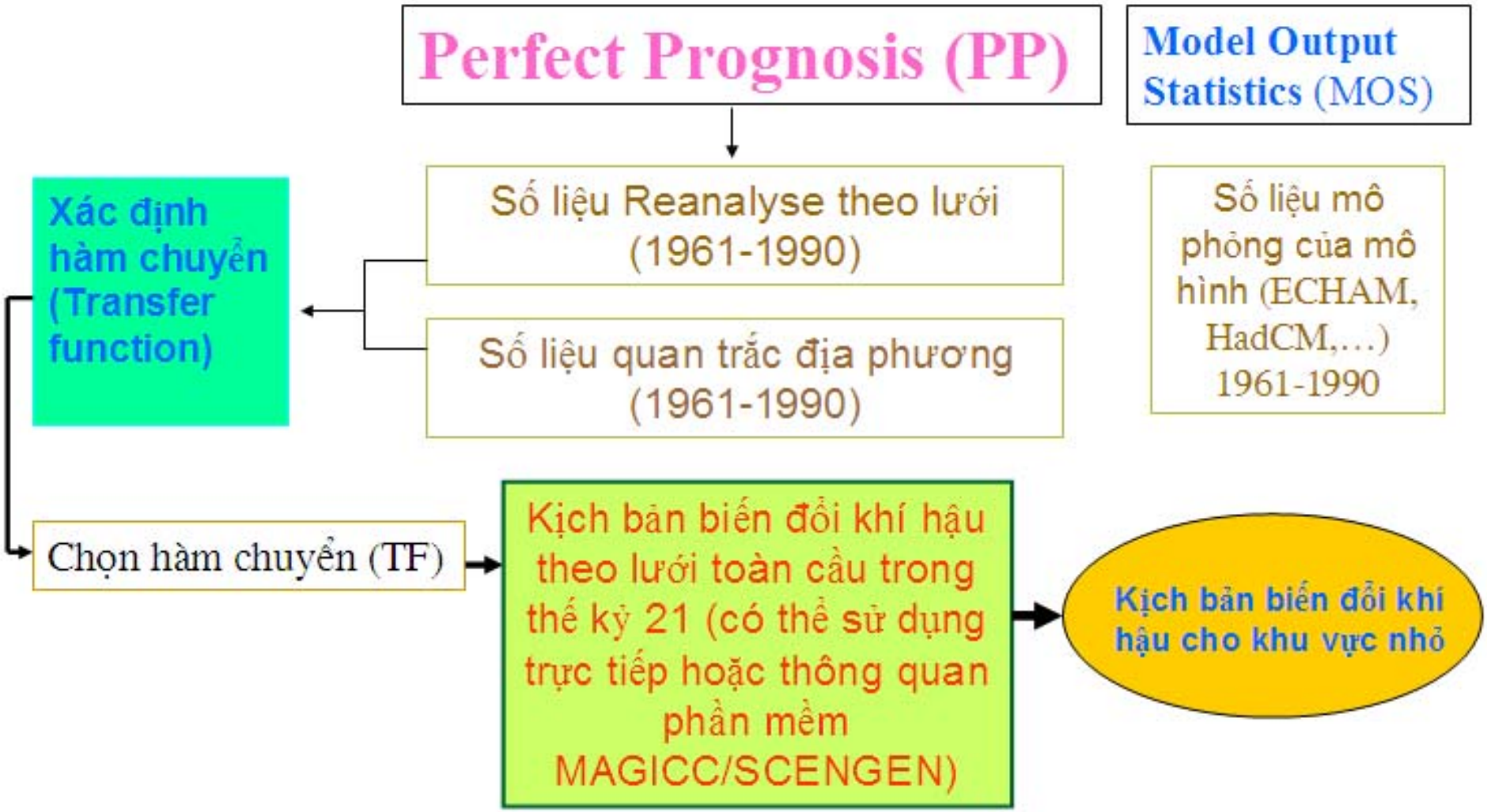








Statistical Downscaling: **Perfect Prognosis** (PP), **Model Output Statistics** (MOS)



3.2 MRI/AGCM

- MRI/AGCM →Japan Meteorology Research Institute-Atmospheric Global Circulation Model:
  - Resolutions: 20 km, 60 km, 120 km, 180km
  - Scenario: A1B
  - Computer: - Earth Simulator –ES
  - MRI-AGCM →IPCC AR4 (2007)
  - MRI-AGCM →IPCC AR5 (2014)

Earth Simulator (ES)

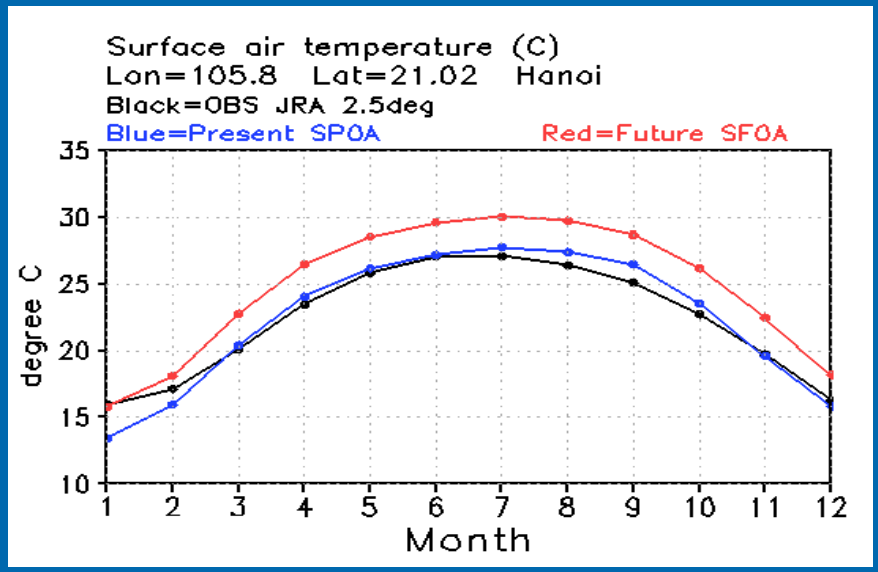
The Earth Simulator (ES), a super-computer, began operation in March 2002. The ES is one of the three essential elements for projecting or predicting global change according to recommendations made in 1996 by an expert committee of the Science and Technology Agency (now merged into MEXT), the other two being process studies by modeling and observation systems.

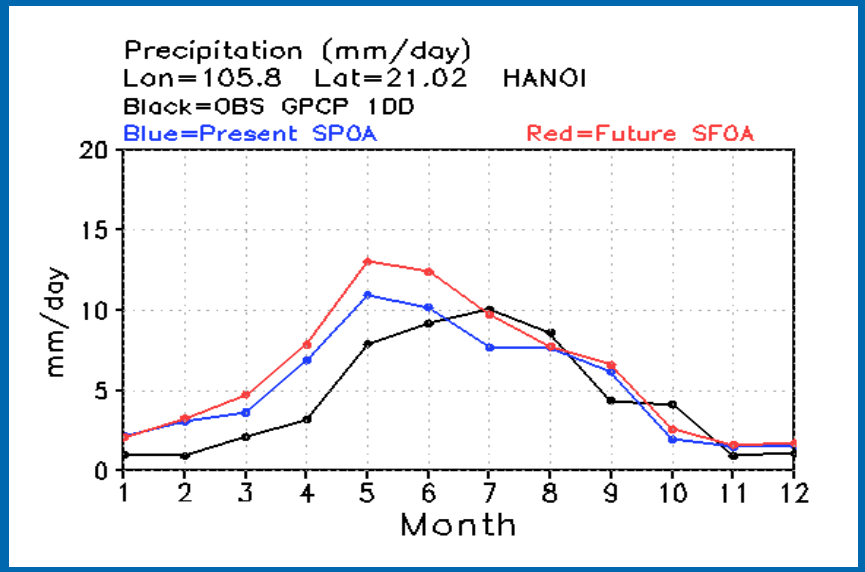
The ES was ranked first in the world among the "Top 500" supercomputers from 2002 to 2004, during which time substantial experiments on climate change projection were conducted. The research results contributed to the IPCC's AR4. The fastest computation made by the ES was 35.86 Teraflops (10^{12} calculations per second). Even today, the ES might be the fastest supercomputer among those mainly available for Earth sciences.

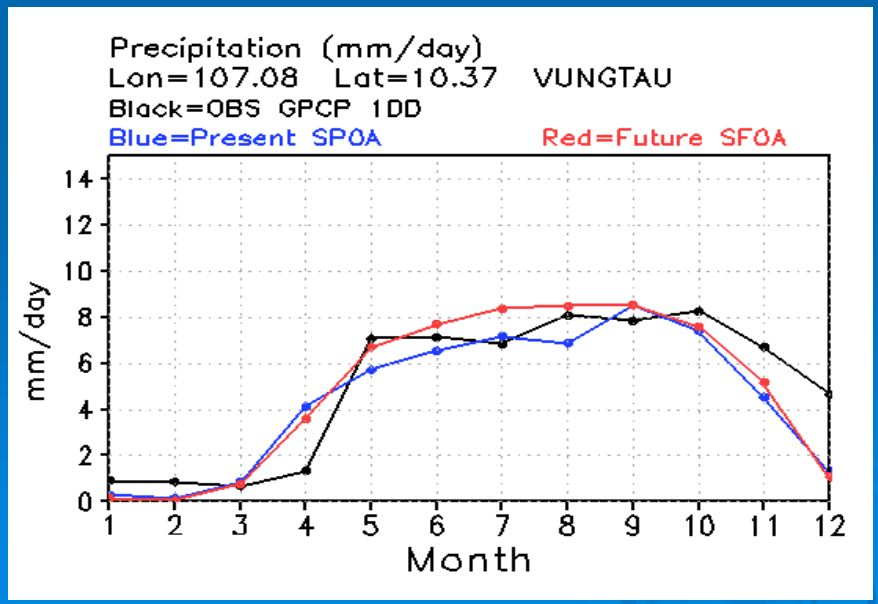
The ES allowed the Kyosei Project to make substantial contributions to the IPCC's AR4. Using this supercomputer system, the KAKUSHIN Program is expected to make important contributions to the IPCC's Fifth Assessment Report (AR5).

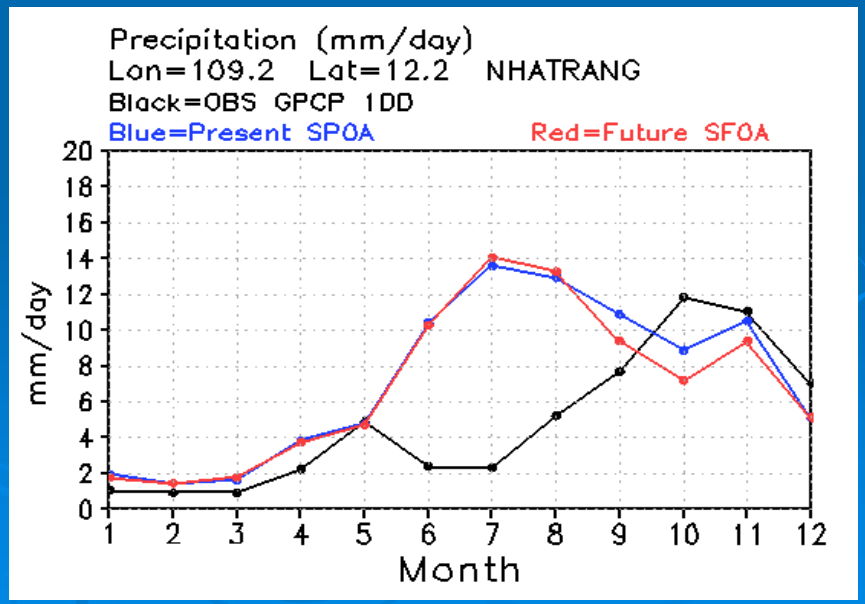
Photo credit: ESC / JAMSTEC

Temperature and precipitation simulated by MRI/AGCM

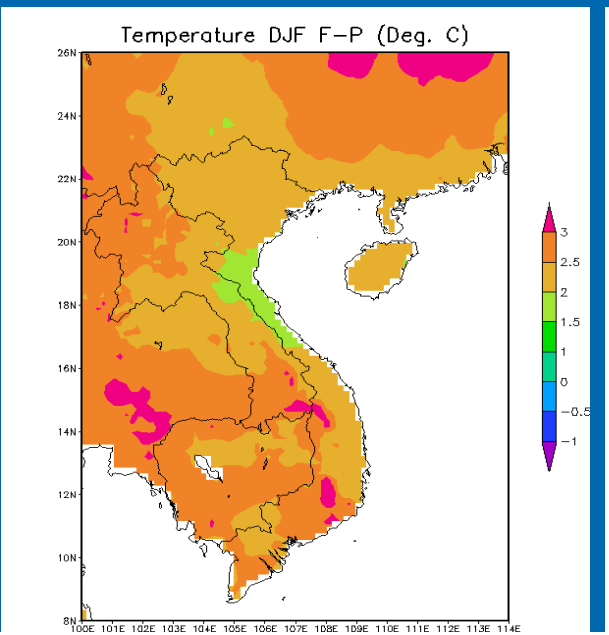


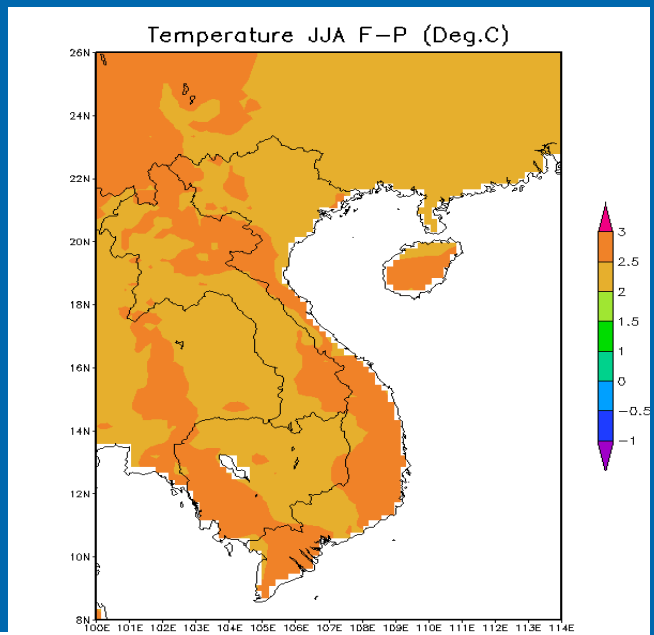


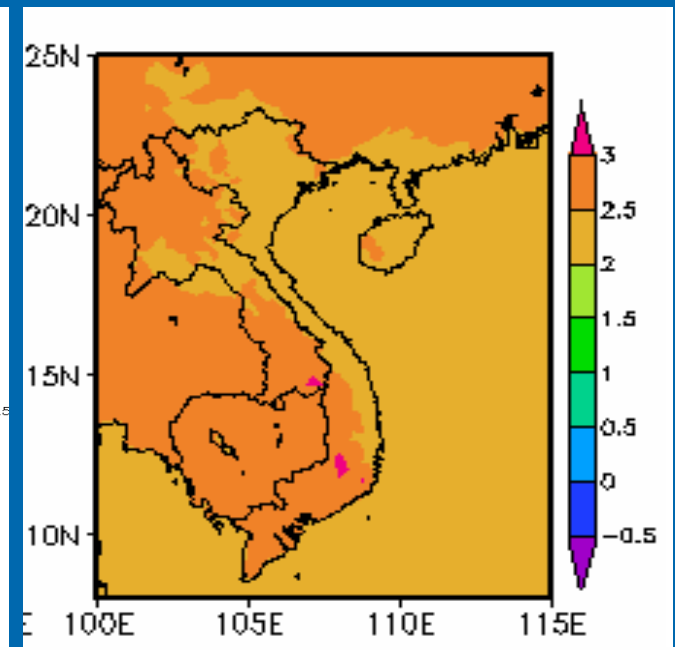


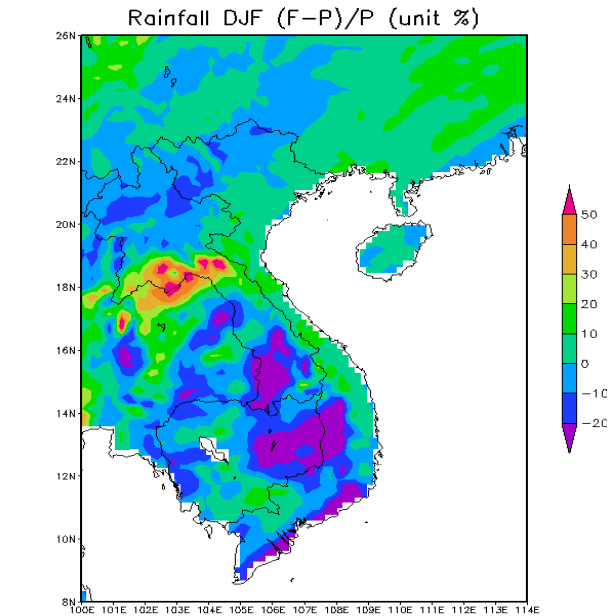


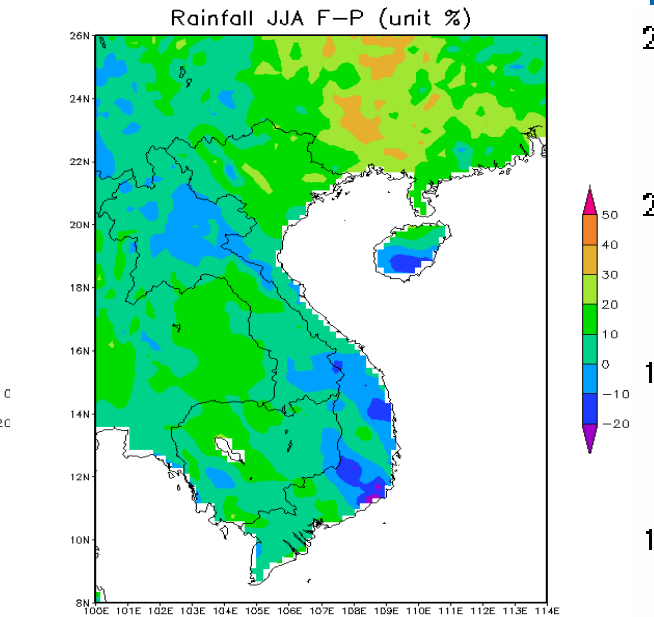
Differences between present and the end of 21st century

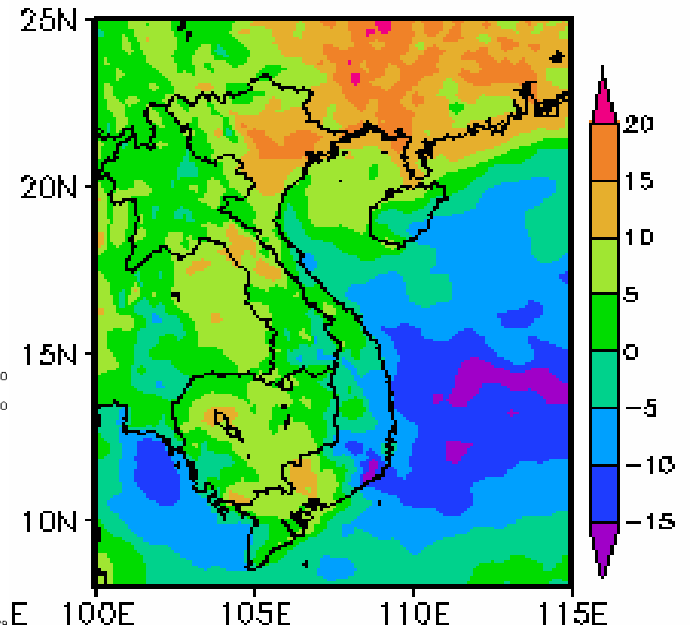






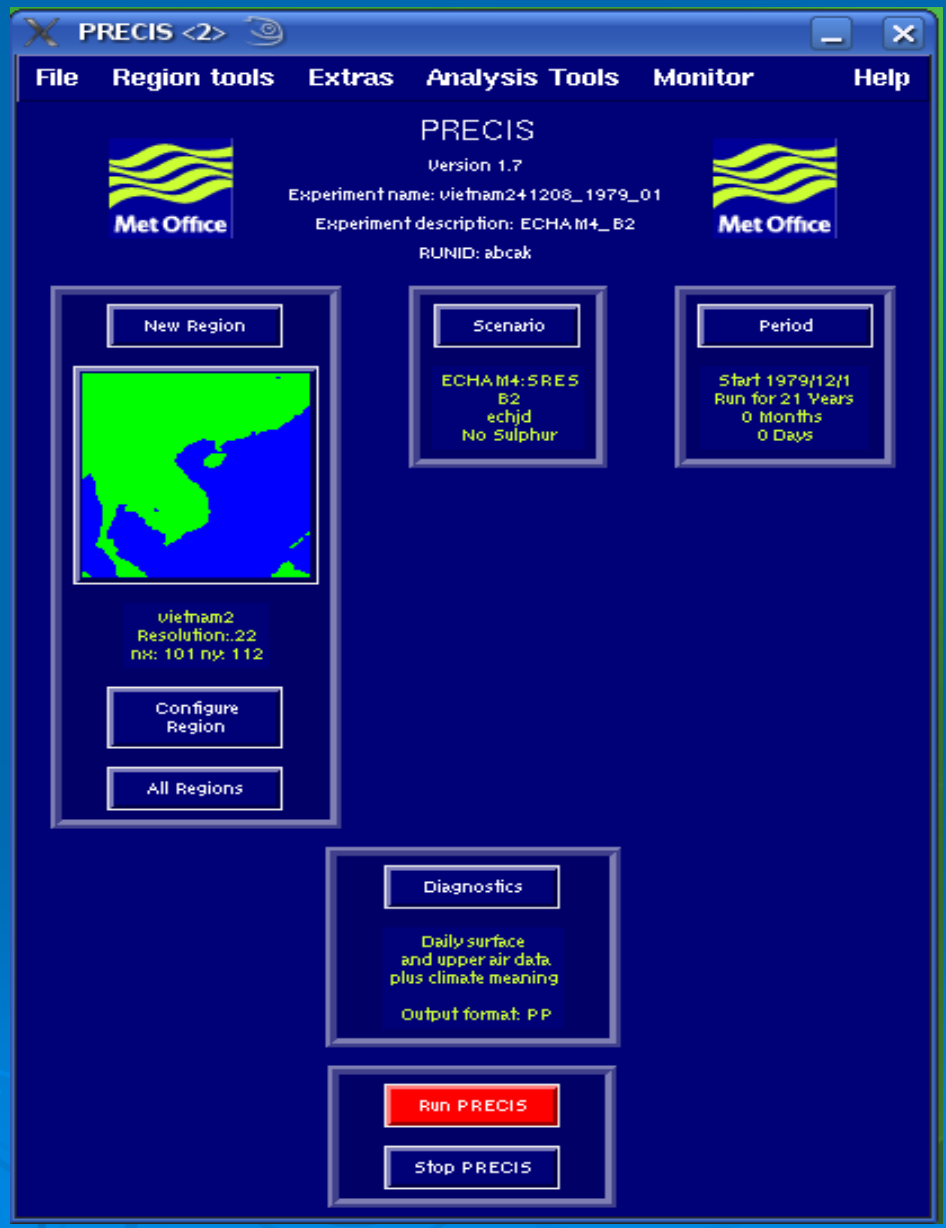




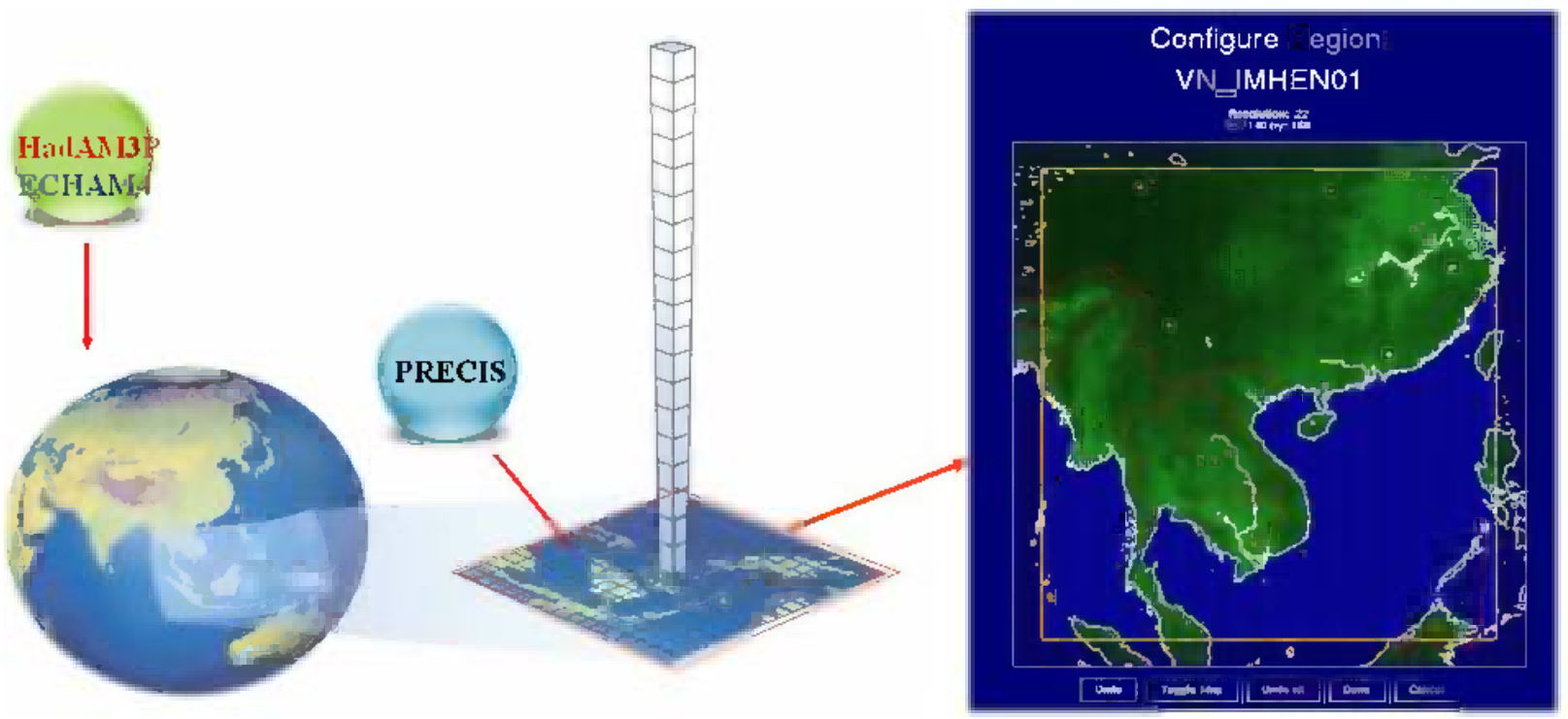


3.3 PRECIS

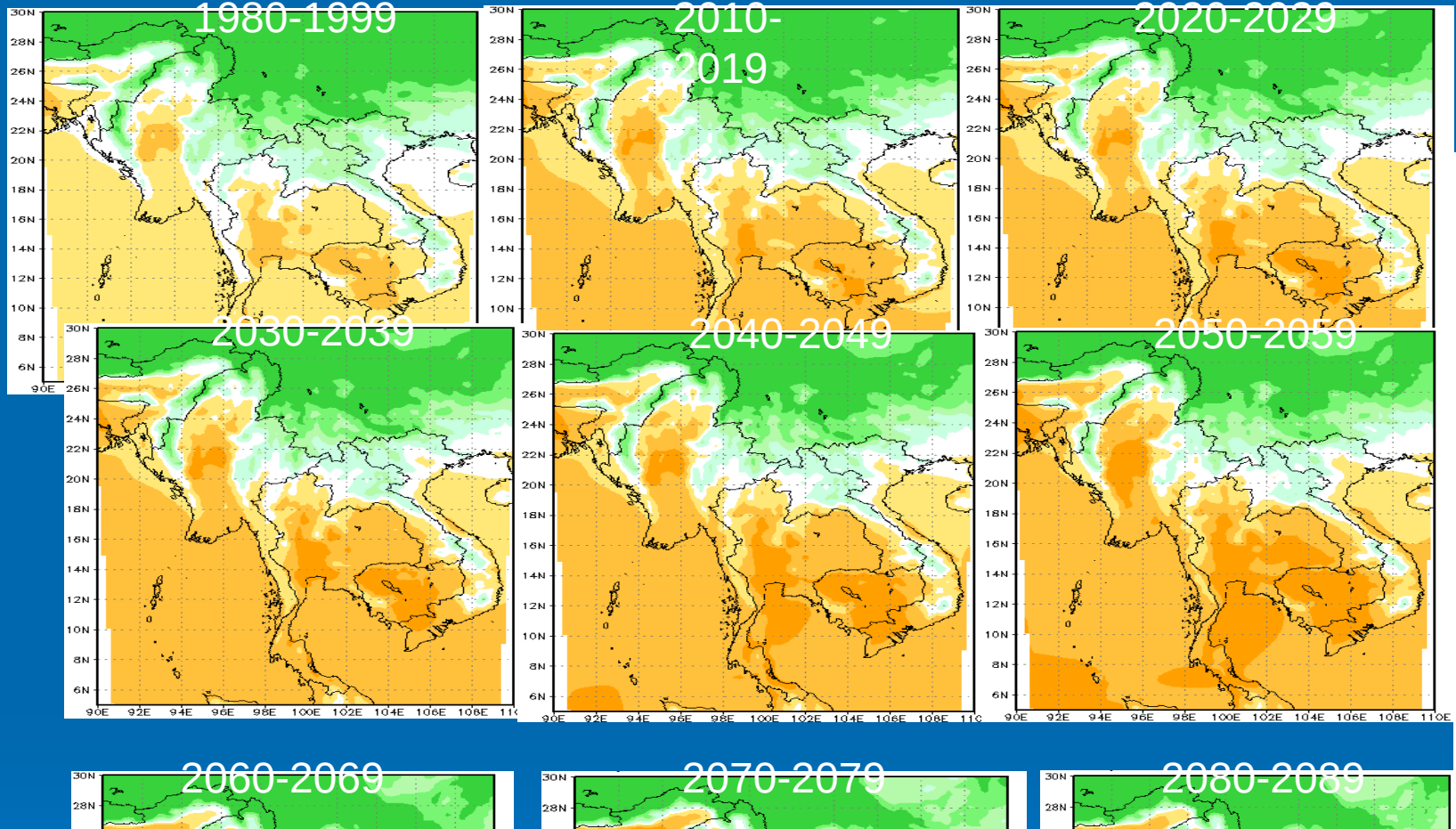
- PRECIS (Providing Regional Climates for Impacts Studies): developed by Hadley center, UK;
- PRECIS: Dynamical Downscaling For generating regional climate change scenario;
- Simple interface with detail manual.
- Present and future simulation under: A2, B2, A1B.



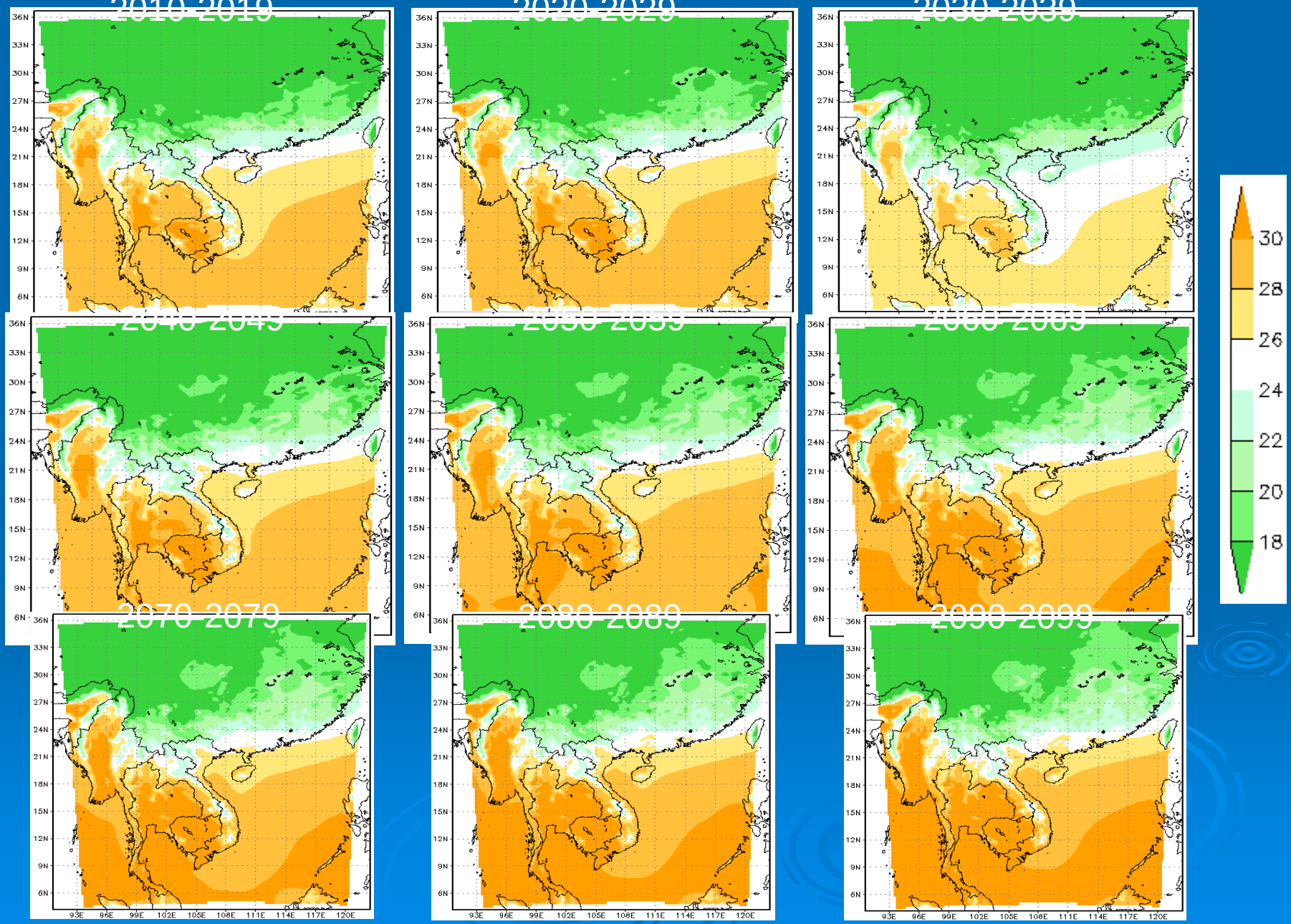
PRECIS POSITION IN THE PROGRESS OF CLIMATE CHANGE MODELLING



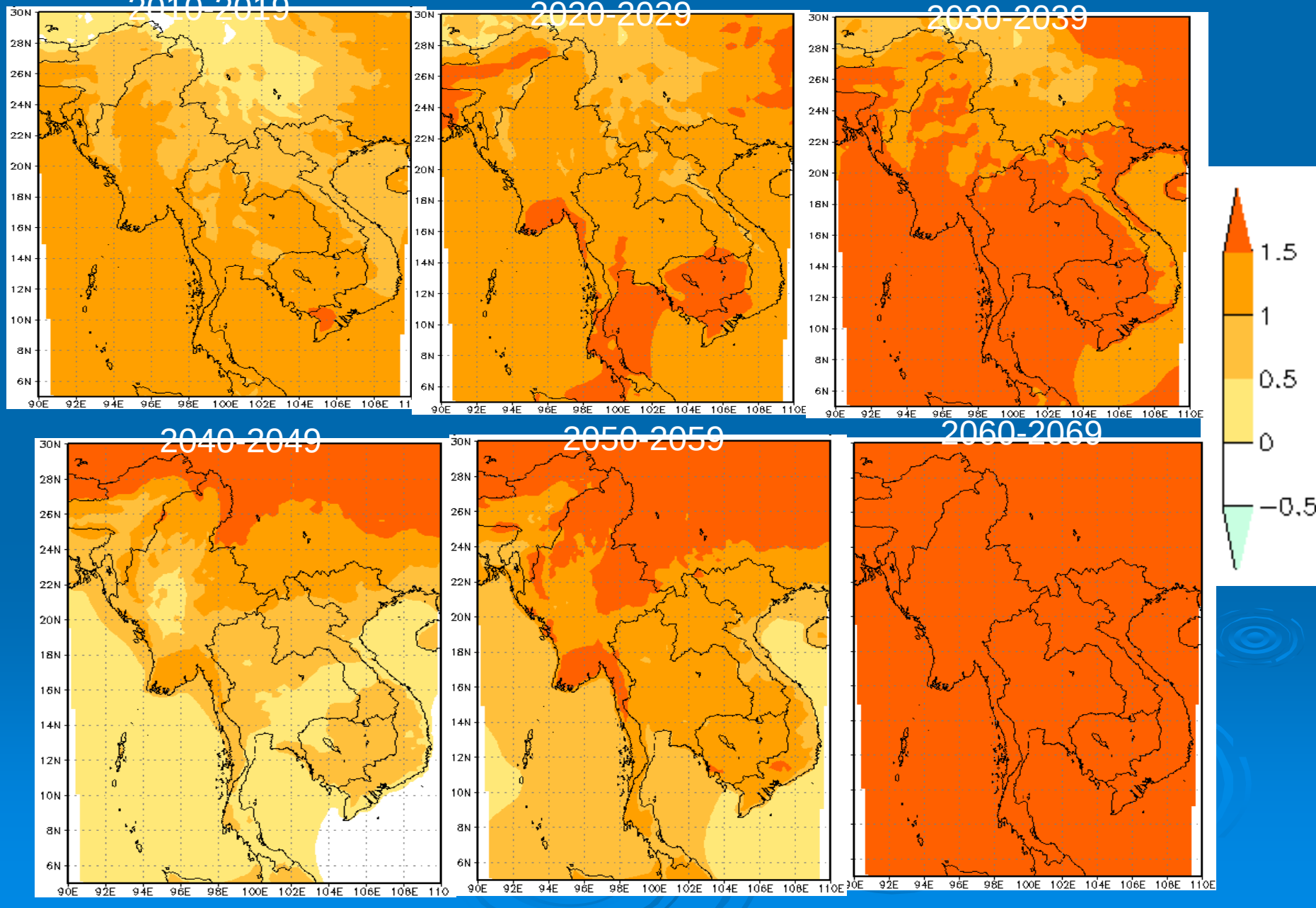
Temperature Simulated by Precis (A2)



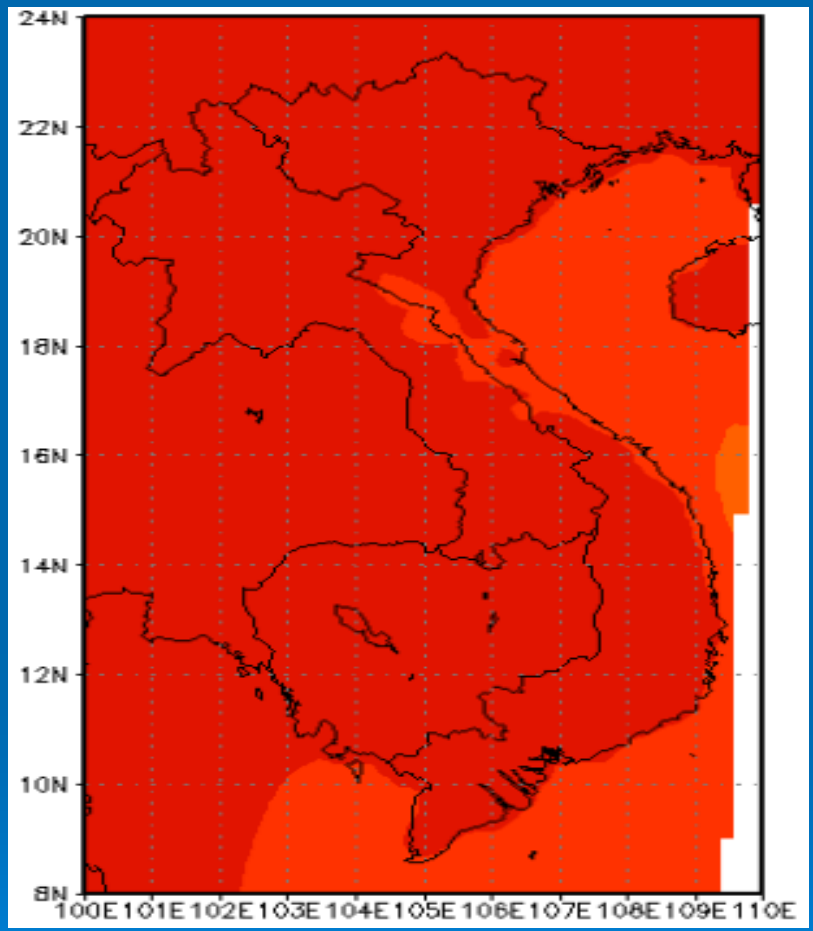
Temperature Simulated by Precis (B2)

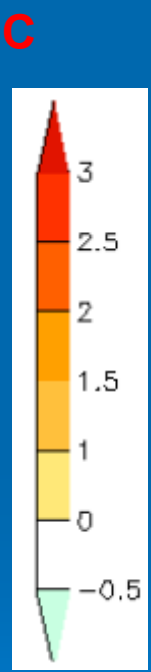


Temperature differences between simulation and baseline (1980-1999) (A2)



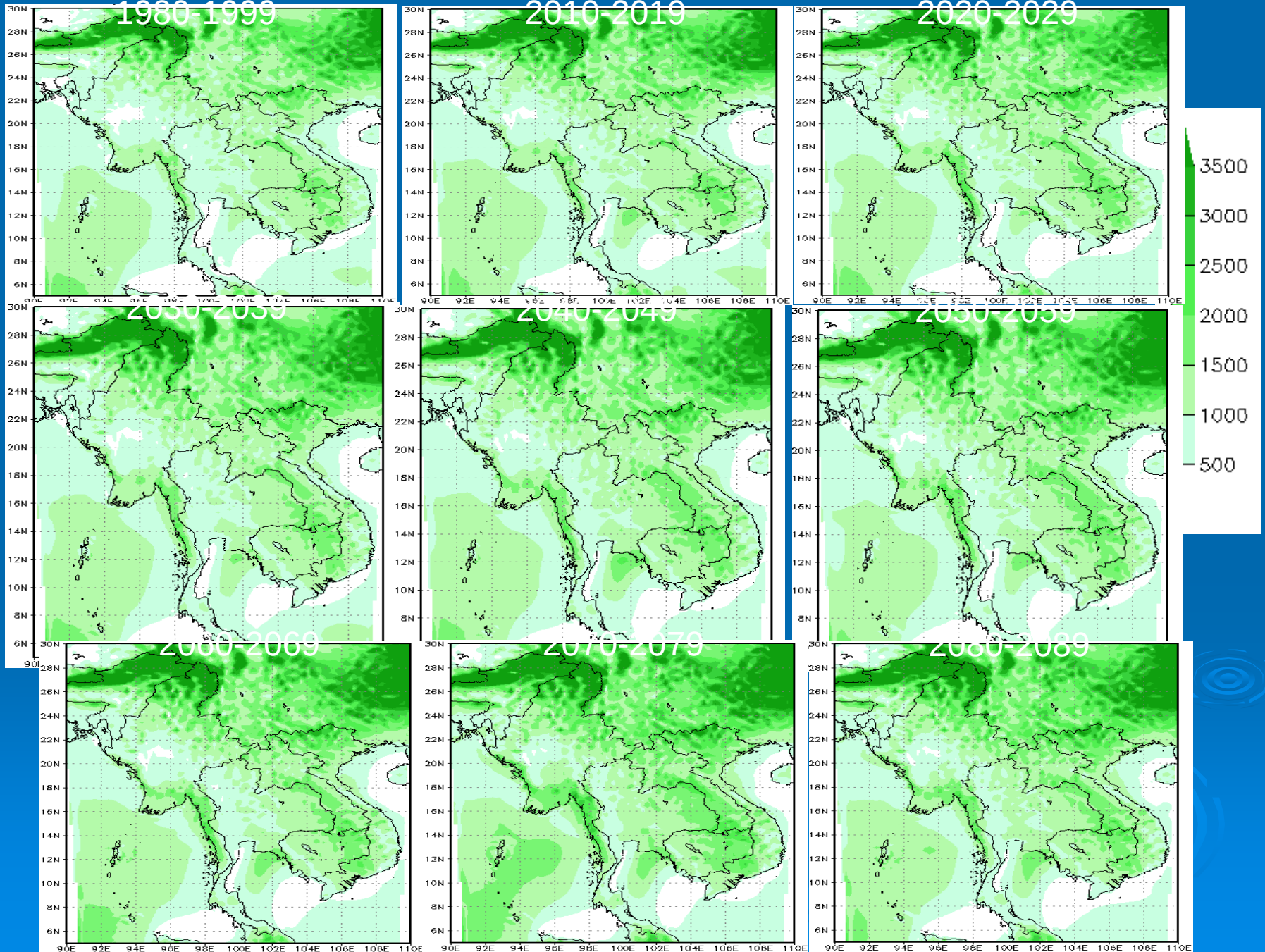
Temperature differences between simulation and baseline (1980-1999) (A2)



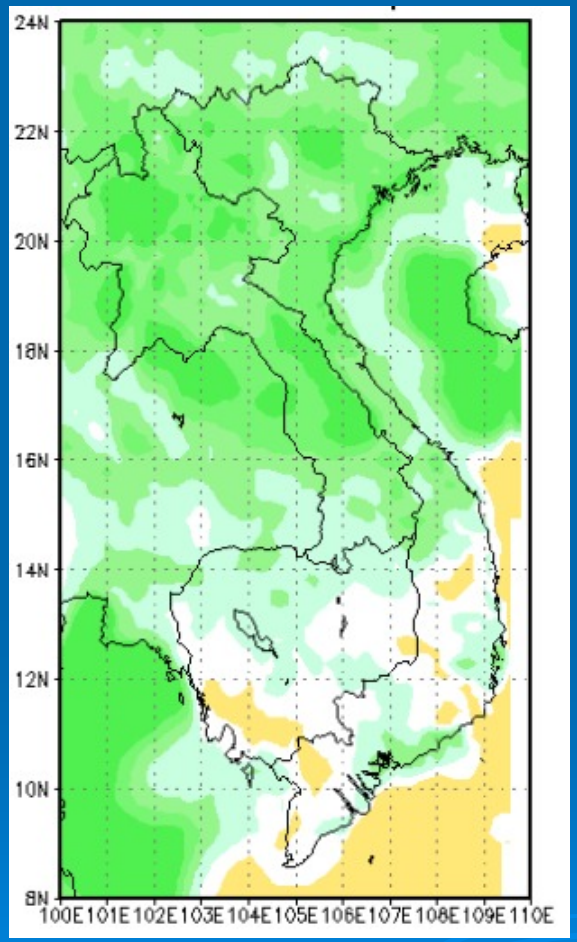


2090-2099

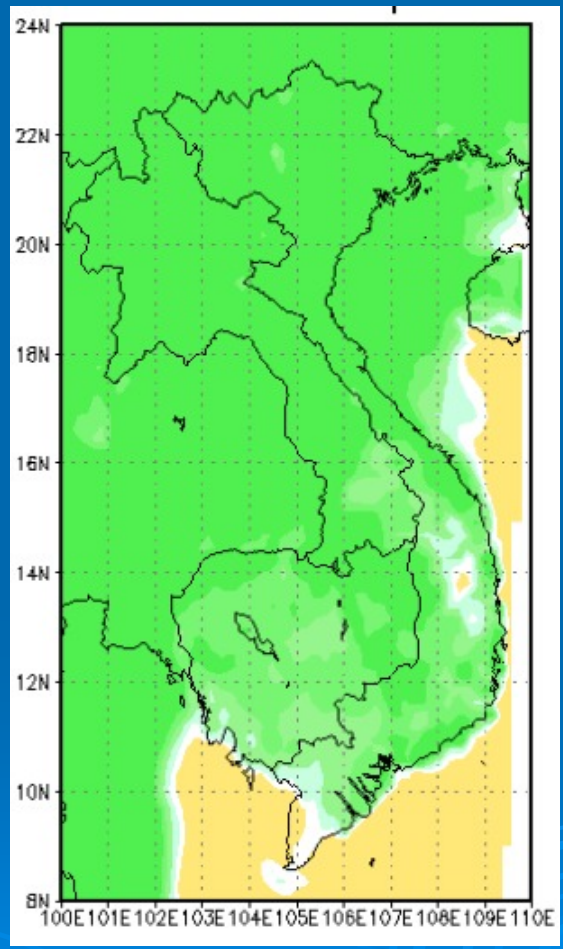
Annual rainfall amount simulated under A2 scenario



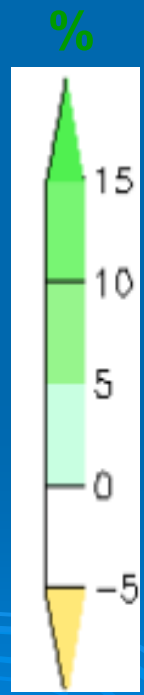
Annual rainfall differences between simulation and baseline (A2)



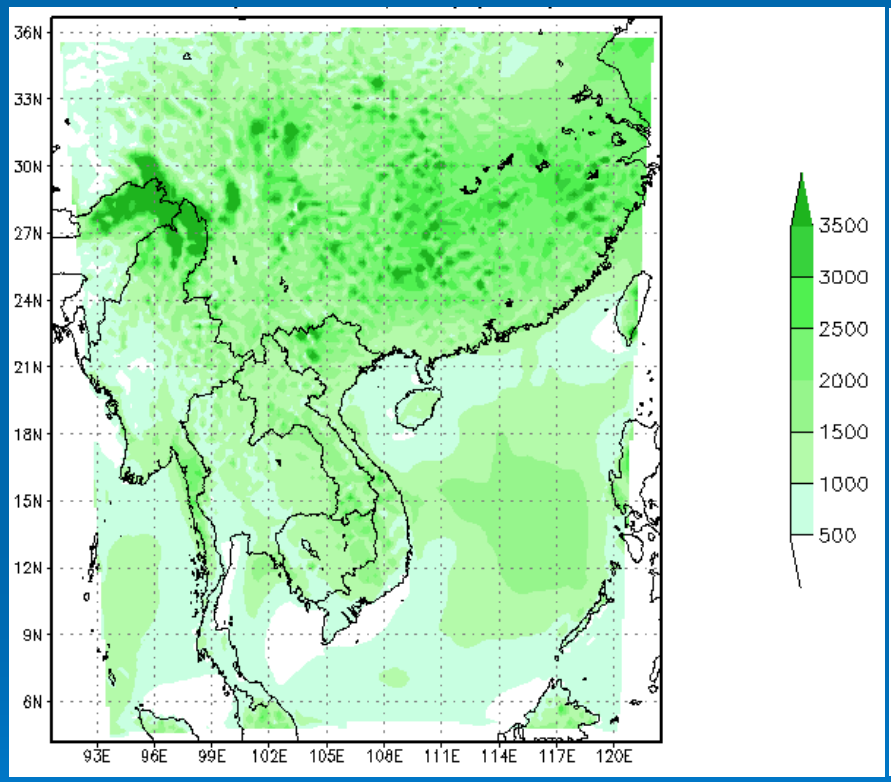
2050-2059



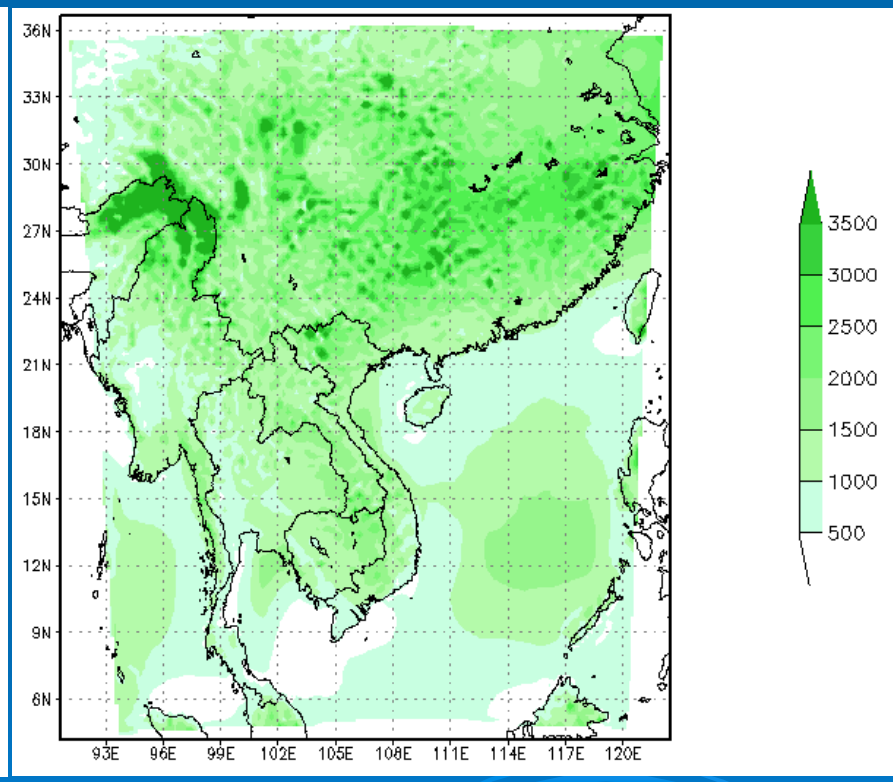
2090-2099



Rainfall simulation (B2)



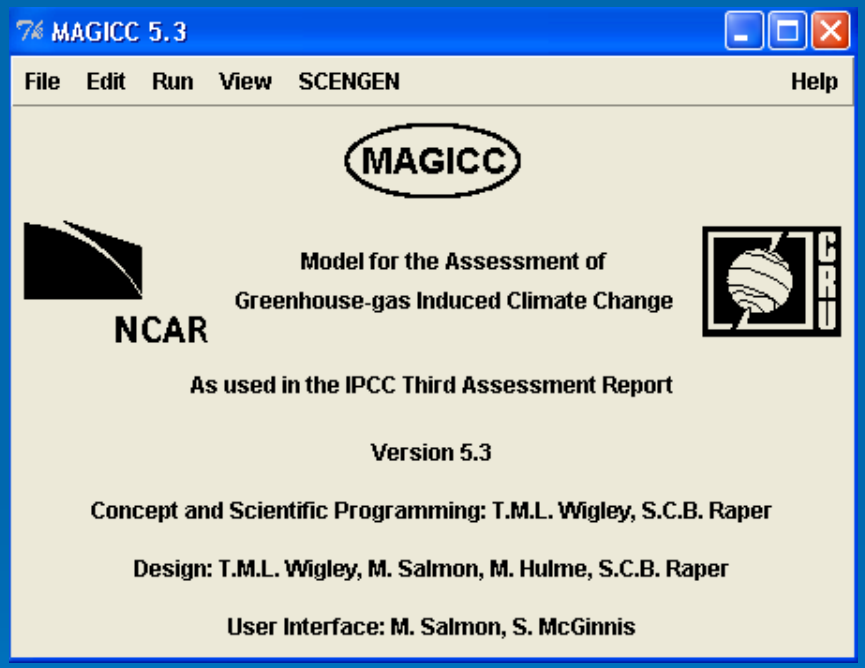
2050's

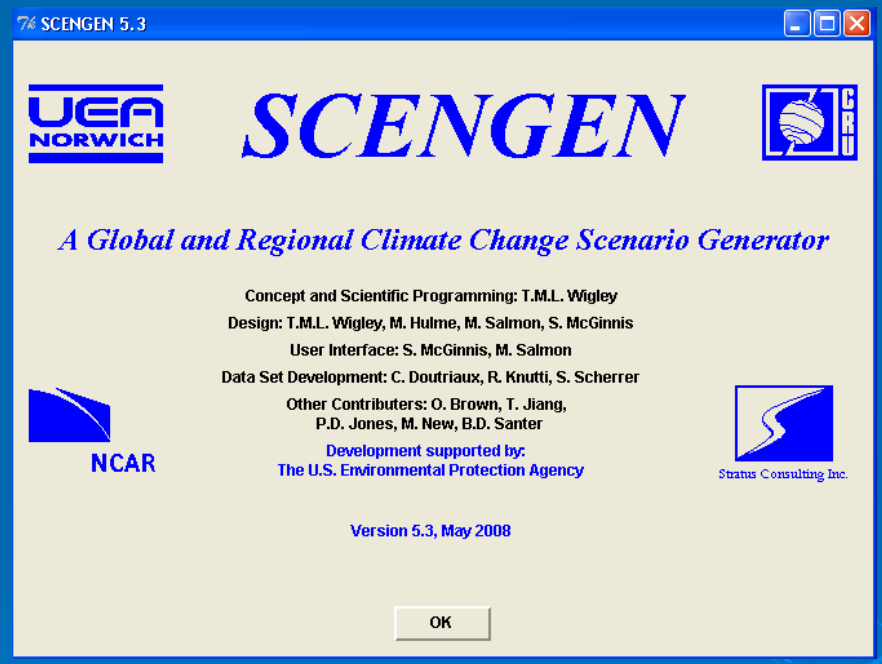


2090's

3.4 MAGICC/SCENGEN 5.3, Statistical Downscaling

MAGICC/SCENGEN 5.3/2007: already be updated AR4





- Advantages than Magicc/Scengen 4.1:
  - Resolution 2,5ºx2,5º
  - AOGCMs database: more and flexible for Scengen

Outline

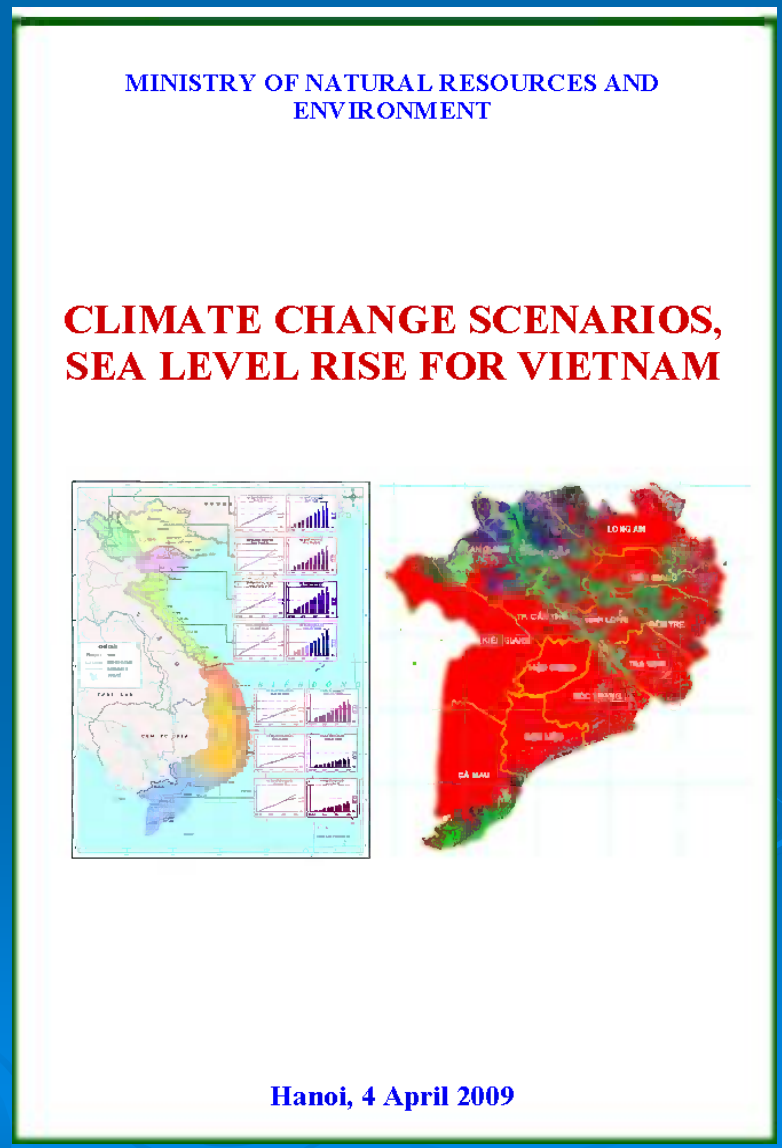
4.1 Criteria for Choosing Vietnam climate change scenario

1) Plausibility of global climate change scenarios
2) Level of details of climate change scenarios: climatic regions
3) Inheritability: Vietnam INC, SNC
4) Up-to-date: AR4-2007
5) Local appropriateness: agreement with the local evolutions
6) Completeness of scenarios: can include high, medium, low scenarios
7) Possibility of self updating.

4.2 Official scenario for Vietnam

a) Temperature:

- T_{winter} increase > T_{summer} Increase
- $T_{Northern}$ increase > $T_{Southern}$ Increase



Annual Mean Temperature Changes (°C) relative to period from 1980-1999 for Scenarios: B1, B2, A2

A2

Climatic Region	Decades in the 21 Century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
North West	0.5	0.8	1.0	1.3	1.7	2.0	2.4	2.8	3.3
North East	0.5	0.7	1.0	1.3	1.6	1.9	2.3	2.7	3.2
North Delta	0.5	0.7	1.0	1.3	1.6	1.8	2.3	2.6	3.1
North Central	0.6	0.9	1.2	1.5	1.8	2.2	2.6	3.1	3.6
South Central	0.4	0.5	0.8	1.0	1.2	1.5	1.8	2.1	2.4
							.5	1.8	2.1
							.9	2.3	2.6

B2

Climatic Region	Decades in the 21 Century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
North West	0.5	0.7	1.0	1.3	1.6	1.9	2.1	2.4	2.6
North East	0.5	0.7	1.0	1.2	1.6	1.8	2.1	2.3	2.5
North Delta	0.5	0.7	0.9	1.2	1.5	1.8	2.0	2.2	2.4
North Central	0.5	0.8	1.1	1.5	1.8	2.1	2.4	2.6	2.8
South Central	0.4	0.5	0.7	0.9	1.2	1.4	1.6	1.8	1.9
Central Highlands	0.3	0.5	0.6	0.8	1.0	1.2	1.4	1.5	1.6
South	0.4	0.6	0.8	1.0	1.3	1.6	1.8	1.9	2.0

B1

Climatic Region									
North West	0.5	0.7	1.0	1.2	1.4	1.6	1.6	1.7	1.7
North East	0.5	0.7	1.0	1.2	1.4	1.5	1.6	1.7	1.7
North Delta	0.5	0.7	0.9	1.2	1.4	1.5	1.5	1.6	1.6
North Central	0.6	0.8	1.1	1.4	1.6	1.8	1.8	1.9	1.9
South Central	0.4	0.6	0.7	0.9	1.0	1.2	1.2	1.2	1.2
Central Highlands	0.3	0.5	0.6	0.8	0.9	1.0	1.0	1.1	1.1
South	0.4	0.6	0.8	1.0	1.1	1.3	1.3	1.4	1.4

- b) Rainfall:

Rainfall in dry season can decrease in most climate zones, especially in Southern climate zones. Rainfall in the rainy season and the total annual rainfall can increase in all climate zones.

Seasonal Rainfall changes (%) in Vietnam climate zones relative to the period of 1980-1999, for scenarios: B1, B2, A2

B1

Climate zones	Month periods
North West	D
	M
	Ju
	Se
North East	D
	M
	Ju
	Se
North Delta	D
	M
	Ju
	Se
North Central	D
	M
	Ju
	Se

B2

Climate zones	Month periods
North West	Dec-Feb
	Mar-May
	Jun-Aug
	Sep-Nov
North East	Dec-Feb
	Mar-May
	Jun-Aug
	Sep-Nov
North Delta	Dec-Feb
	Mar-May
	Jun-Aug
	Sep-Nov
North Central	Dec-Feb
	Mar-May
	Jun-Aug
	Sep-Nov
South	Dec-Feb
	Mar-May

A2

Climate zones	Month periods	Decades in the 21 Century								
		2020	2030	2040	2050	2060	2070	2080	2090	2100
North West	Dec-Feb	1.2	1.7	2.2	2.9	3.6	4.4	5.3	6.2	7.2
	Mar-May	-1.2	-1.6	-2.1	-2.8	-3.5	-4.3	-5.2	-6.1	-7.1
	Jun-Aug	2.5	3.5	4.6	5.9	7.5	9.3	11.0	12.2	15.1
	Sep-Nov	0.5	0.6	0.8	1.1	1.4	1.7	2.1	2.4	2.8
North East	Dec-Feb	0.8	1.1	1.5	1.9	2.4	3.0	3.5	4.2	4.9
	Mar-May	-0.9	-1.3	-1.7	-2.2	-2.8	-3.4	-4.1	-4.9	-5.6
	Jun-Aug	2.7	3.7	4.9	6.3	7.9	9.8	11.8	13.7	16.1
	Sep-Nov	0.5	0.9	1.2	1.5	1.9	2.4	2.8	3.3	3.8
North Delta	Dec-Feb	0.9	1.3	1.6	2.0	2.7	3.4	4.0	4.7	5.5
	Mar-May	-1.4	-2.0	-2.6	-3.4	-4.3	-5.3	-6.3	-7.4	-8.6
	Jun-Aug	3.1	4.5	5.8	7.5	9.4	11.7	14.0	16.3	19.1
	Sep-Nov	1.0	1.4	1.9	2.4	3.0	3.6	4.5	5.3	6.1
North Central	Dec-Feb	0.6	0.9	1.1	1.5	1.9	2.4	2.8	3.4	3.8
	Mar-May	-2.1	-2.9	-3.5	-4.9	-6.2	-7.7	-9.2	-10.9	-12.6
	Jun-Aug	3.0	4.6	5.6	7.3	9.1	11.3	13.6	15.9	18.5
	Sep-Nov	1.5	2.5	3.3	4.3	5.4	6.5	7.9	9.4	10.8
South Central	Dec-Feb	-2.2	-3.0	-4.0	-5.3	-6.3	-8.0	-9.6	-10.5	-13.0
	Mar-May	-3.0	-4.2	-5.5	-7.1	-8.9	-11.0	-13.2	-15.6	-18.1
	Jun-Aug	0.8	1.2	1.5	1.9	2.5	3.1	3.7	4.3	5.0
	Sep-Nov	2.5	3.5	4.6	6.1	7.6	9.3	11.3	13.3	15.3
	Dec-Feb	-3.1	-4.4	-5.7	-7.4	-9.2	-11.5	-13.8	-15.7	-18.5

Annual Rainfall Changes (%) relative to period of 1980-1999 for scenarios: B1, B2, A2

A2

Climatic Region	Decades in the 21 Century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
North West	1.6	2.1	2.8	3.7	4.5	5.6	6.8	8.0	9.3
North East	1.7	2.2	2.8	2.8	4.6	5.7	6.8	8.0	9.3
North Delta	1.6	2.3	3.0	3.8	5.0	6.1	7.4	8.7	10.1
North Central	1.8	2.3	3.0	3.7	4.8	5.9	7.1	8.4	9.7
South Central	0.7	1.0	1.2	1.7	2.1	2.5	3.0	3.6	4.1
Central Highlands	0.3	0.4	0.5	0.7	0.9	1.1	1.3	1.5	1.8
South	0.3	0.4	0.6	0.7	1.0	1.2	1.4	1.6	1.9

B2

Climatic R									
North West									
North East									
North Delta									
North Central									
South Central									
Central Highlands	0.3	0.4	0.5	0.7	0.9	1.0	1.2	1.3	1.4
South	0.3	0.4	0.6	0.8	1.0	1.1	1.2	1.4	1.5

B1

Climatic R									
North We									
North Eas									
North Del									
North Central	1.5	2.2	3.1	3.8	4.3	4.7	4.9	5.0	5.0
South Central	0.7	1.0	1.3	1.6	1.8	2.0	2.1	2.2	2.2
Central Highlands	0.3	0.4	0.5	0.7	0.7	0.9	0.9	1.0	1.0
South	0.3	0.4	0.6	0.7	0.8	0.9	1.0	1.0	1.0

C) ***Sea Level Rise***:

- Sea Level Rise (cm) relative to period of 1980 – 1999

Scenarios	Decades in the 21 Century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Low emission Scenario (B1)	11	17	23	28	35	42	50	57	65
Medium emission scenario (B2)	12	17	23	30	37	46	54	64	75
High emission scenario (A1FI)	12	17	24	33	44	57	71	86	100

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Contact: trongkh@vkttv.edu.vn