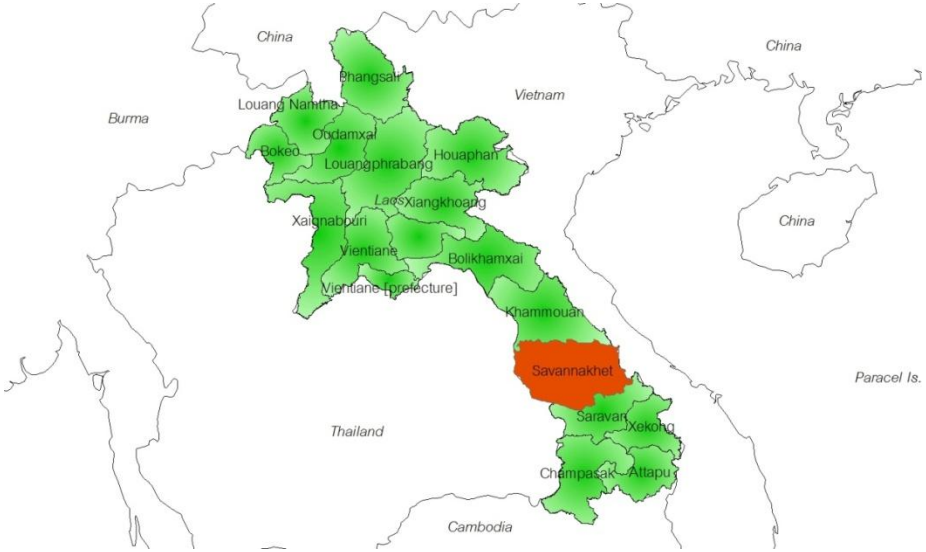
Rapid Assessment on Climate Change Risk
CCAI pilot site: Champhone, Savannakhet, Lao PDR



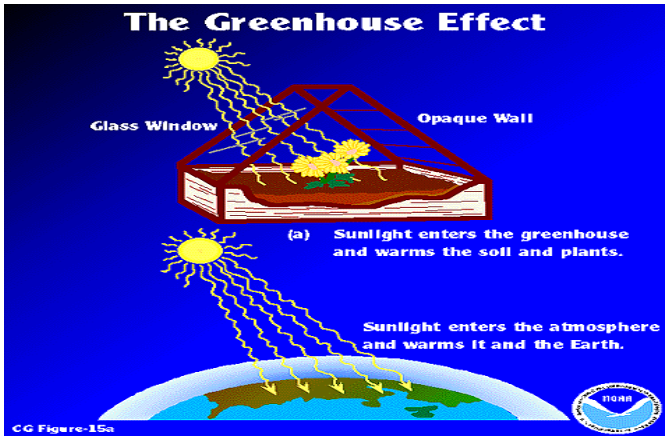
Session 2: Understanding future climate change

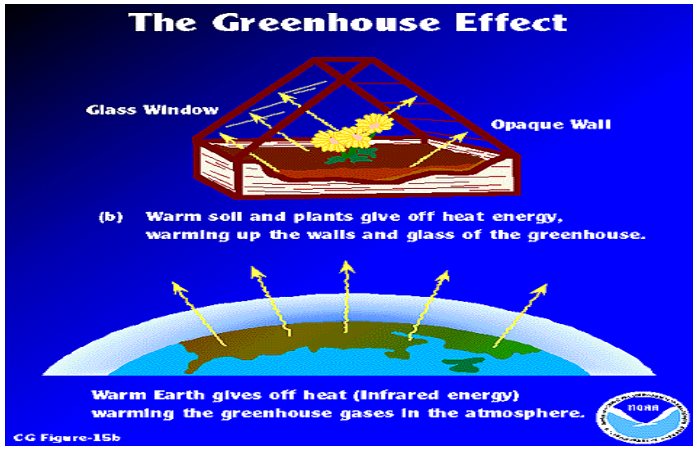
Southeast Asia START Regional Center

Overview on Climate Change

Global warming and climate change - Increasing of greenhouse effect from increasing atmospheric greenhouse gases

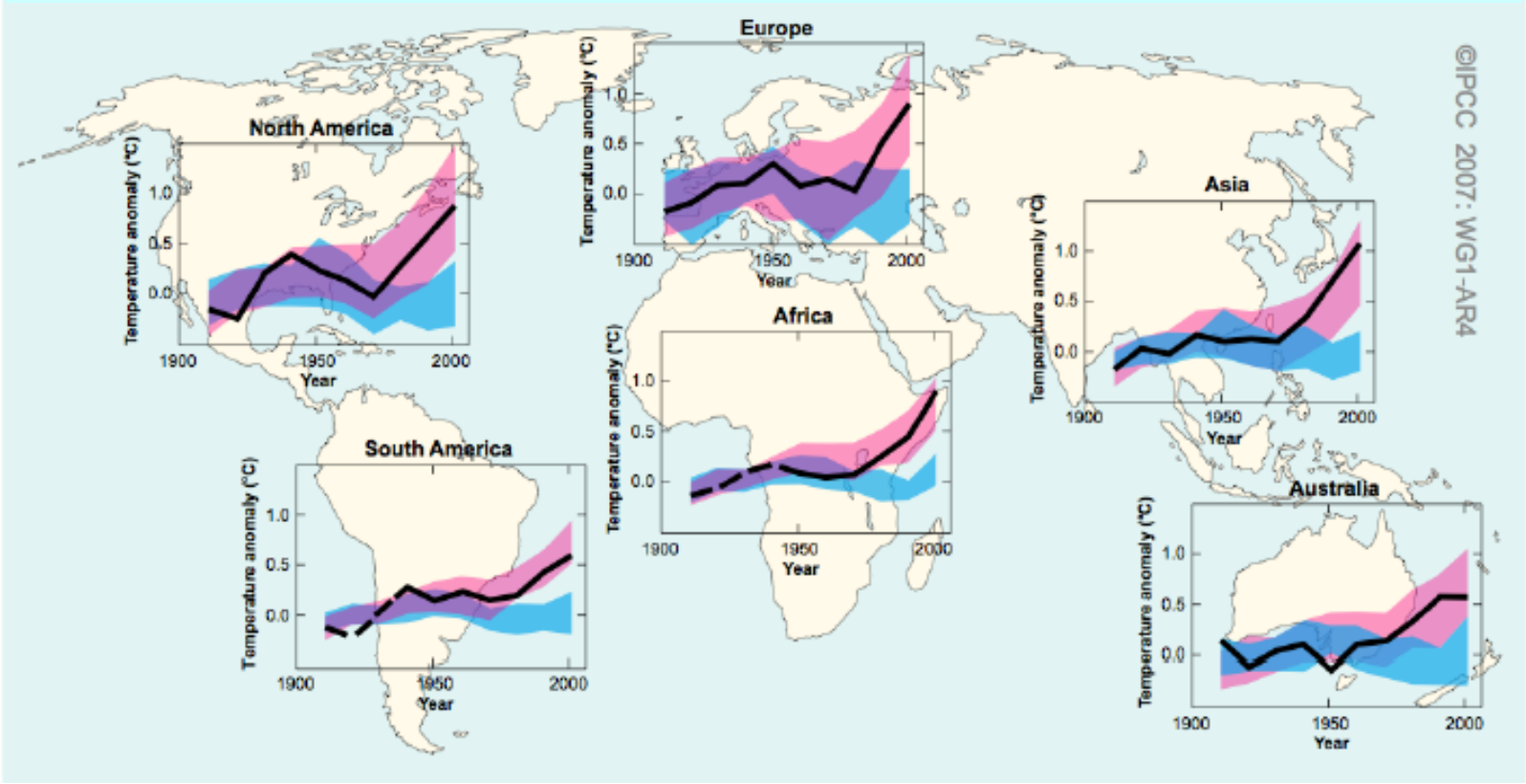
- Carbon dioxide – major portion from burning of fossil fuel (coal, oil, etc.)
- Methane – from organic decomposing
- Others





Overview on Climate Change

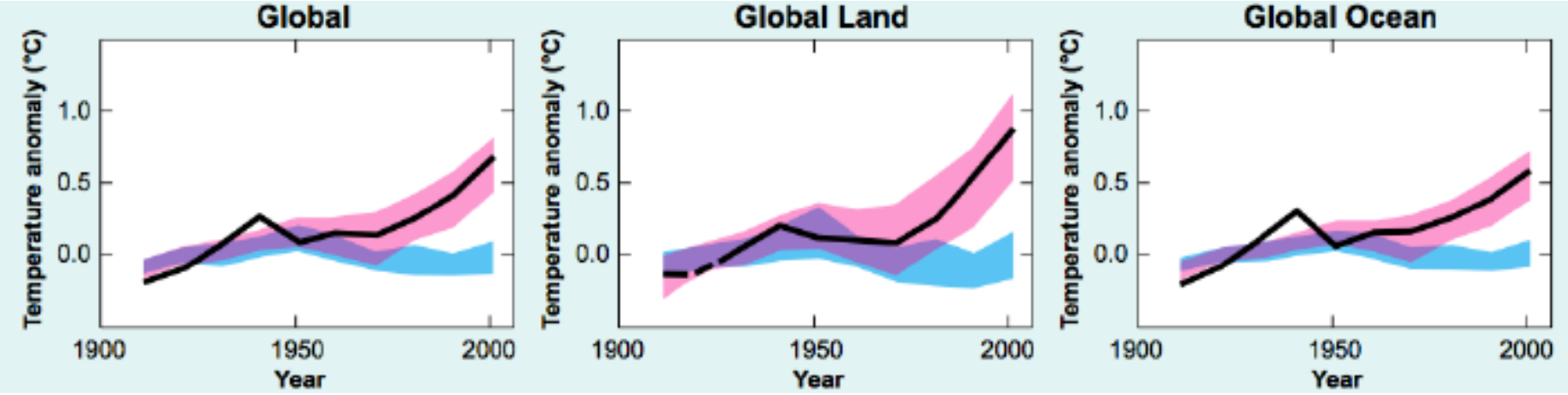
Warming up temperature over the past century
Not equally warmed up from region to region



Source: WMO INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE UNEP

Overview on Climate Change

Global average increasing in temperature in 2oth century



Global average | Land surface average | Ocean surface average

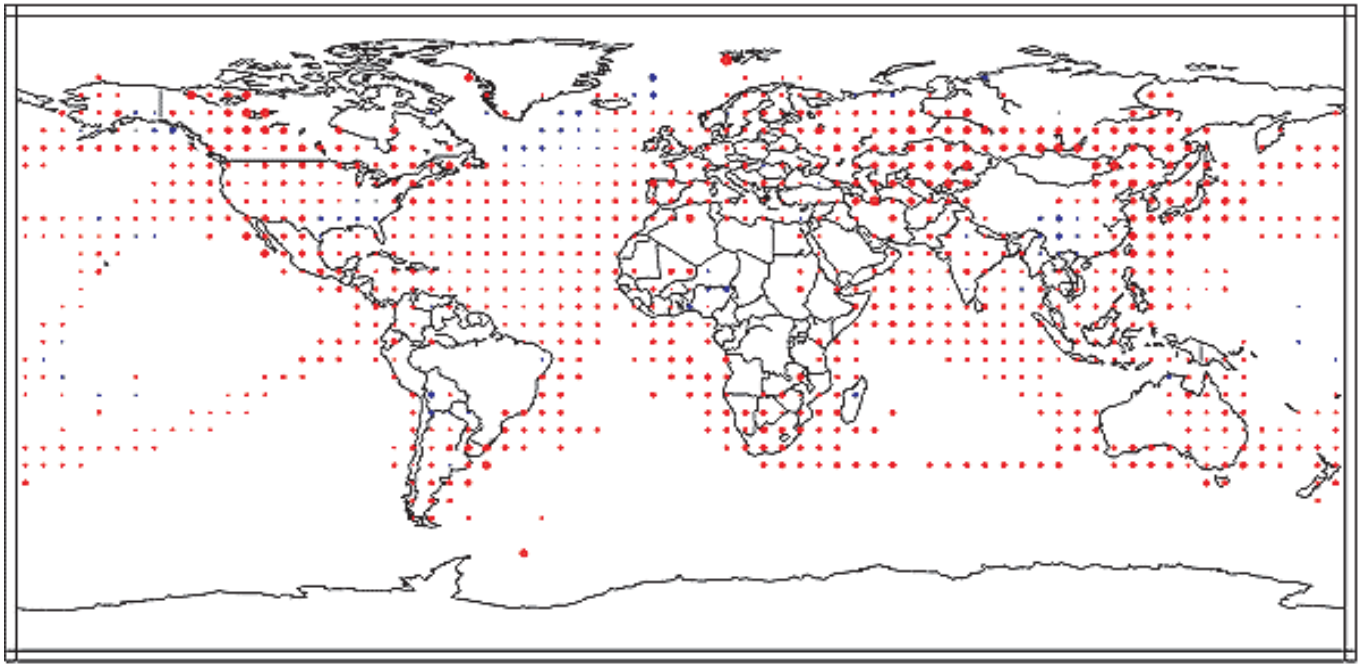
Source: WMO | INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE | UNEP

Overview on Climate Change

Why global warming influence climate change?

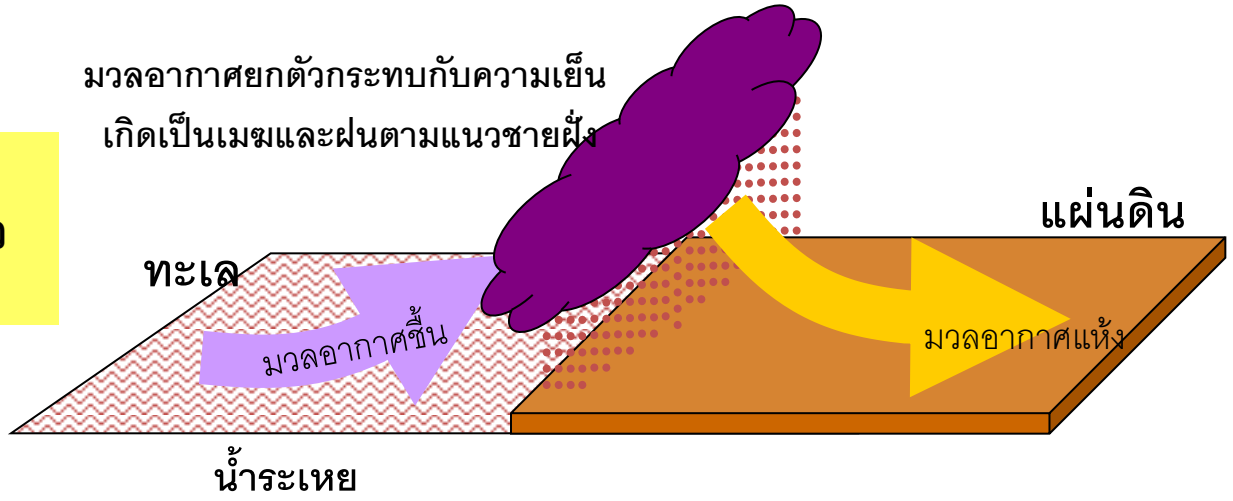
1. **More evaporation in ocean – more cloud**
2. **Different temperature at different regions cause would affect atmospheric dynamic – wind.**

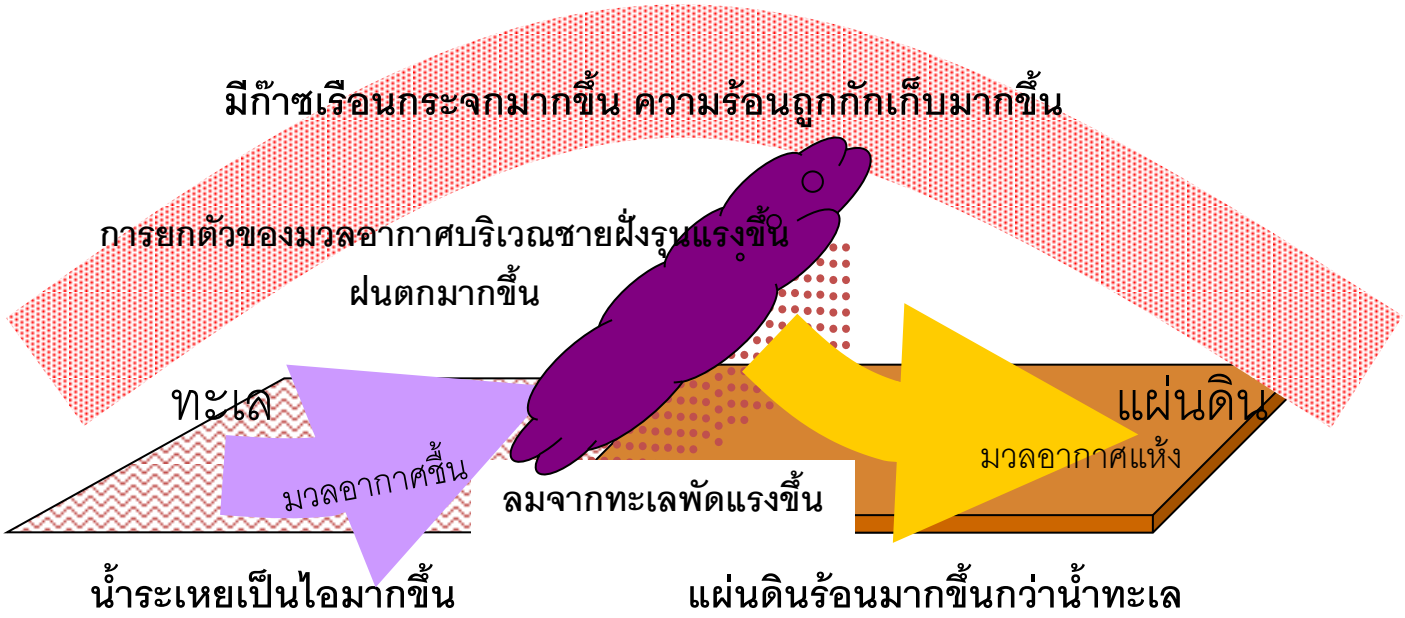
(a) Annual temperature trends, 1901 to 2000



Overview on Climate Change

กระบวนการเกิดลม เมฆและฝนตามแนวชายฝั่งทะเล





Concerns on Climate Change for Southeast Asia and Climate Projection over 21st Century

Putting climate change into right context of Southeast Asia region

Issues

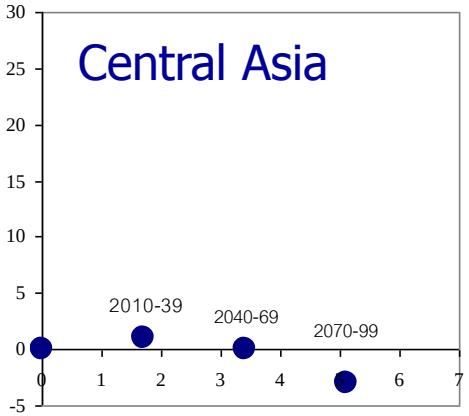
- Confusion on "Climate" and "Change" - mixed up between climate VS weather / change VS variability
- Over emphasize on the temperature increasing – global mean temperature
- Unaware of the fact that change is not uniform across space and time - overlook multiple aspects of climate change
  - Seasonality – season shifting
  - Distribution pattern – rainfall pattern
  - Fluctuation from year to year
  - Extreme weather event – hot year / wet year – change frequency / magnitude

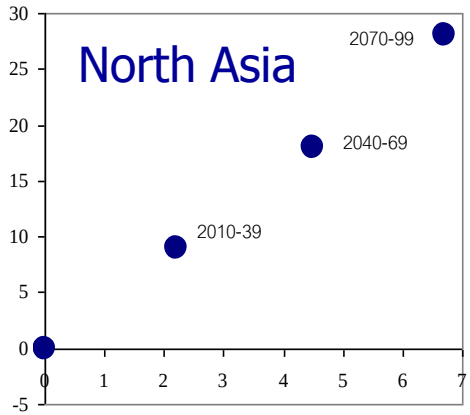
Concerns on Climate Change for Southeast Asia and Climate Projection over 21st Century

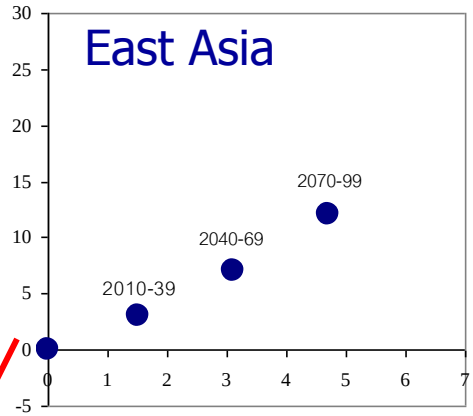
Key concern on the message that need to communicate across public sectors

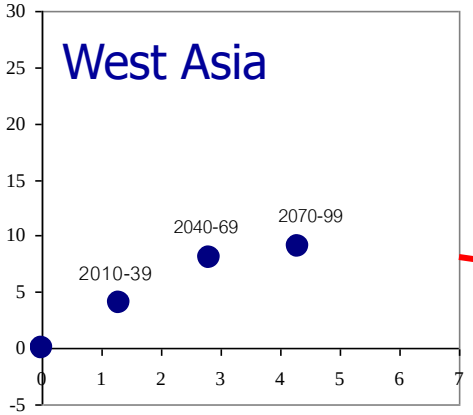
Concern on climate change **NOT** the change in climate means, but change in year-to-year fluctuation of weather pattern in the long term

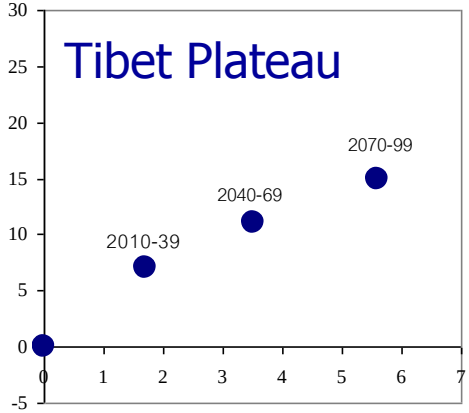
On "average", Southeast Asia climate will change less than other regions

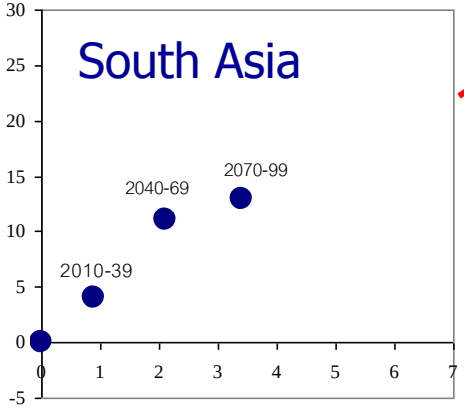


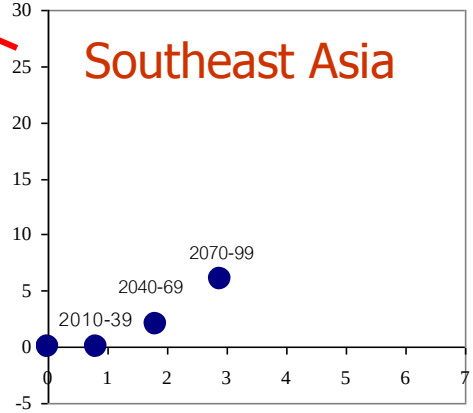












Changes in mean temperature and precipitation are relative less than other regions in Asia

Annual Precipitation Change (%)

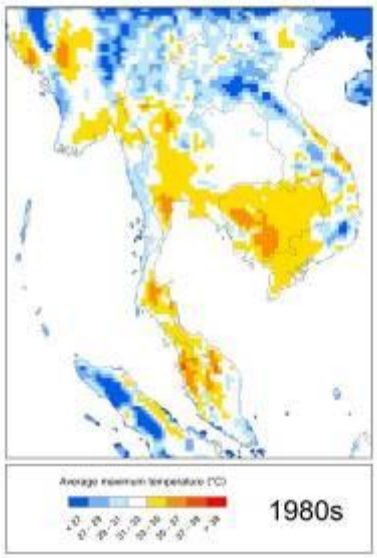
Average Temperature Change (°C)

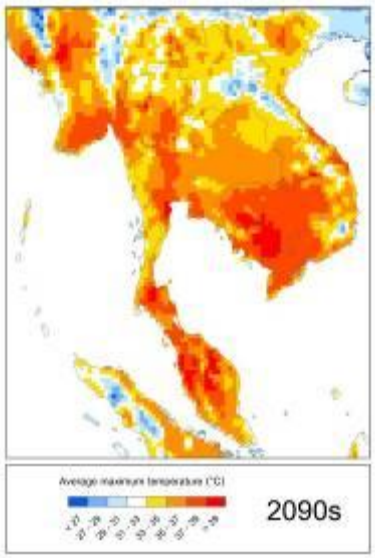
Southeast Asia START Regional Center
IHDP · IGBP · WCRP

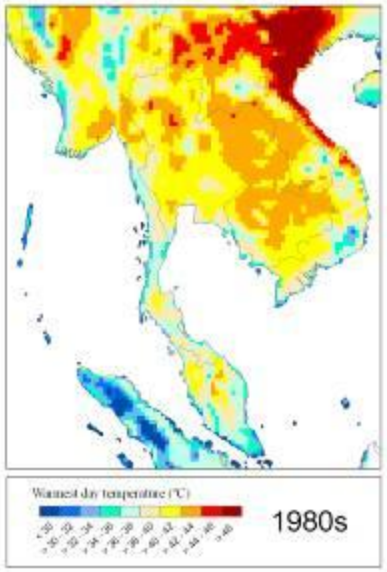
Concerns on Climate Change for Southeast Asia and Climate Projection over 21st Century

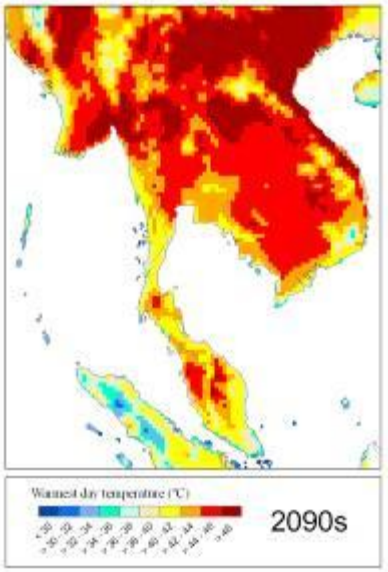
Example: Multiple aspects of climate change - average VS extreme

Average maximum temperature VS Annual highest temperature





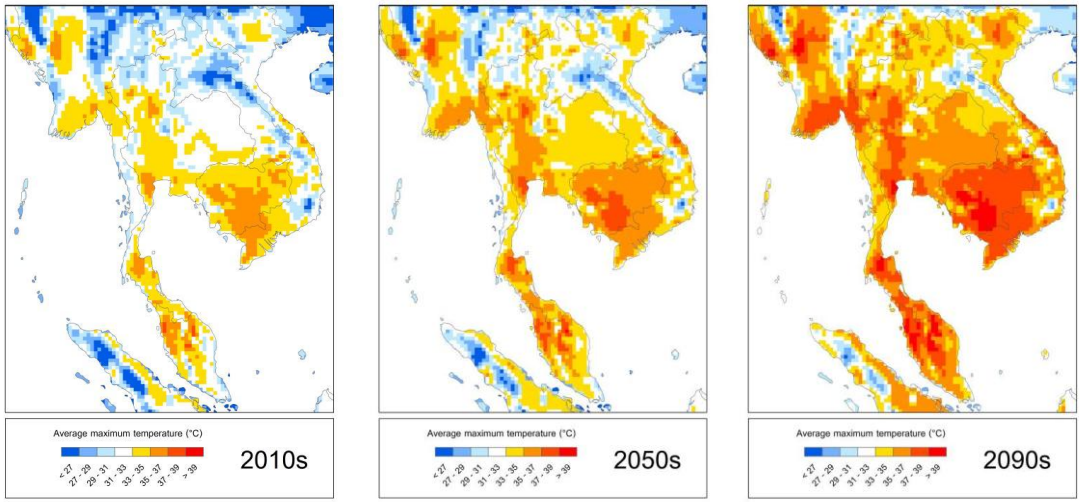




Different aspects of change bring different risks

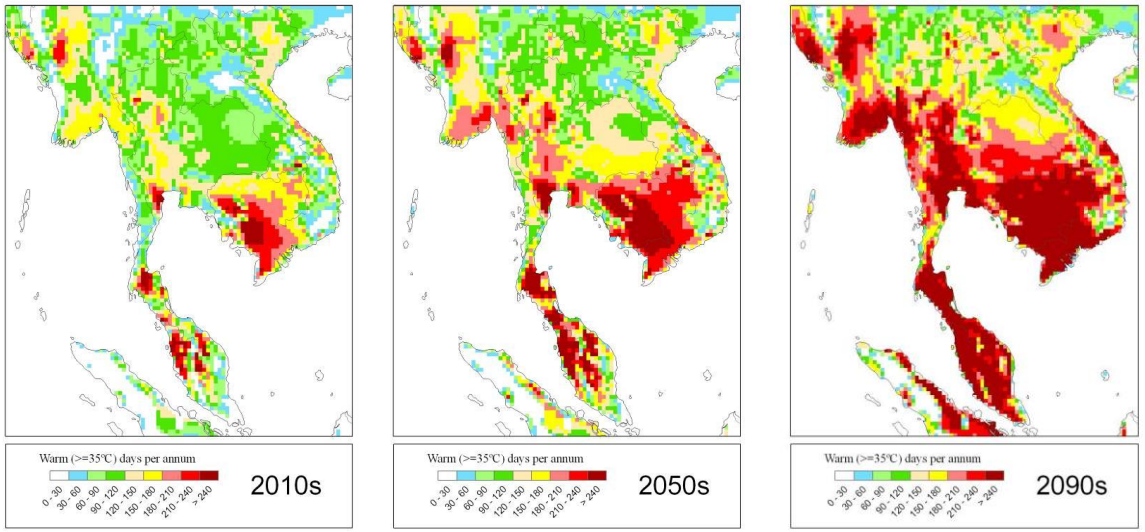
Concerns on Climate Change for Southeast Asia and Climate Projection over 21st Century

Example: Multiple aspects of climate change - time & place



Change in average maximum temperature

Change in hot period over the year



Concerns on Climate Change for Southeast Asia and Climate Projection over 21st Century

Concern of the Southeast Asia region:

Change in climate pattern – year-to year fluctuation in long term

Different between land and ocean warming will induce change in the monsoon system

Higher fluctuation and change in seasonal should be major key concerns: season shifting / distribution of rainfall / storm track / etc.

Concerns on Climate Change for Southeast Asia and Climate Projection over 21st Century

Key concern:

Propagate effect of multiple events

Higher chance that many extreme events may occur at the same time and result in more severe catastrophe

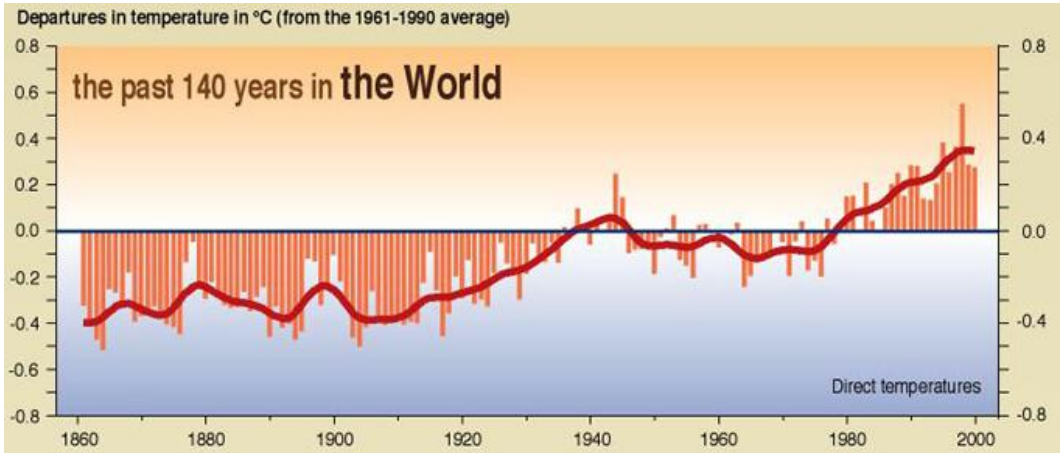
Impacts of climate change should not be dealt with discreetly – to be considered in area-based context

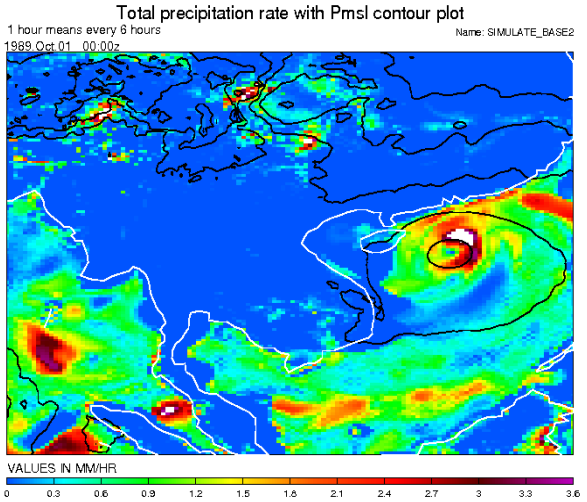
Background on Climate Scenario

We can observe that climate change has occurred in the 20th century.

How can we know what the future holds

Climate change is slow and complex process
Study on climate change is based on scenarios





Background on Climate Scenario

Scenario as a way to describe the 'Future'

- Descriptions of future condition that are based on a number of factors that are internally consistent and put together according to some scientifically acceptable logics
- Something to compromise between **projection** and **prediction**
- May or may not use mathematical models, but mathematical technique usually has more advantage for generating scenarios since it can put together large number of factors and processes in quantitative way
- Use climate change scenario to assess impact – risk – vulnerability of various systems and sectors

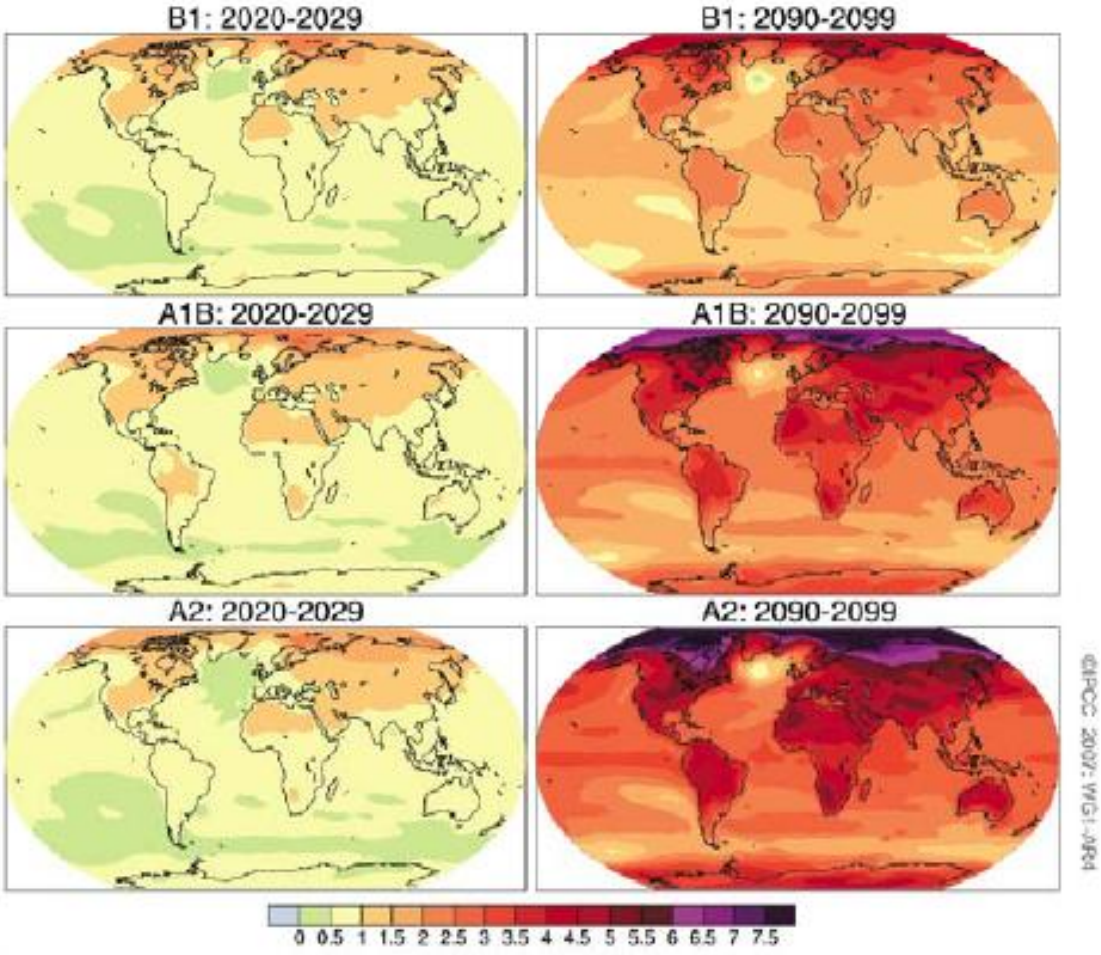
Background on Climate Scenario

Forewords about climate scenario:

- Climate scenario is only a plausible future – not forecast
- Data from climate scenario is not "truth" – need to be interpreted with care – it indicates direction and magnitude of future change in a broad sense
- Good and less good information, never perfect information
- Uncertainty – need for multiple scenarios
- New and/or improved method and technique for generating climate scenario is yet to come

Background on Climate Scenario

Example of climate scenario - Trend of increasing temperature



Source: WMO INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE UNEP

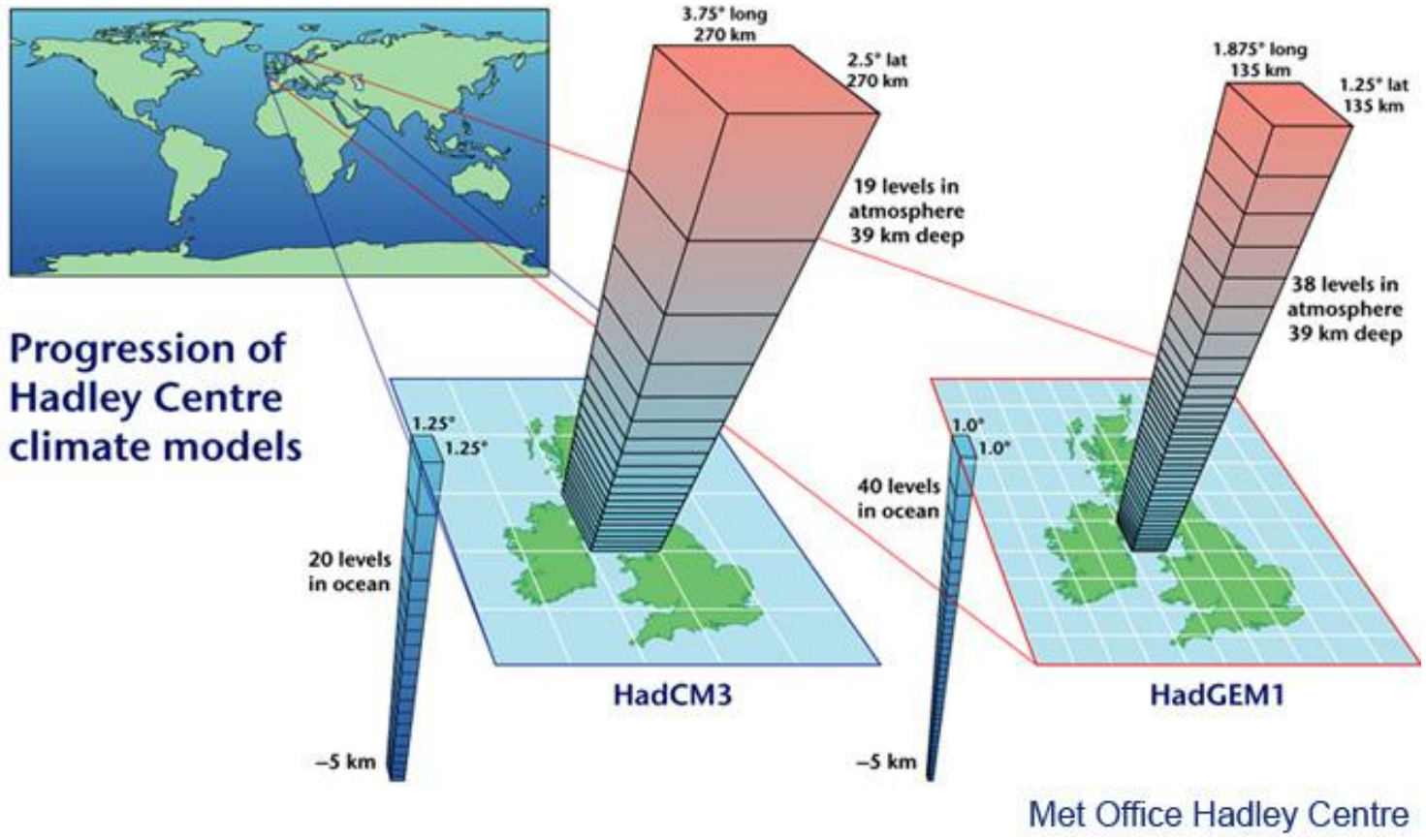
How Climate Scenario is Developed?

How climate change scenario is developed?

Climate Models simulate climates of the past, present and future

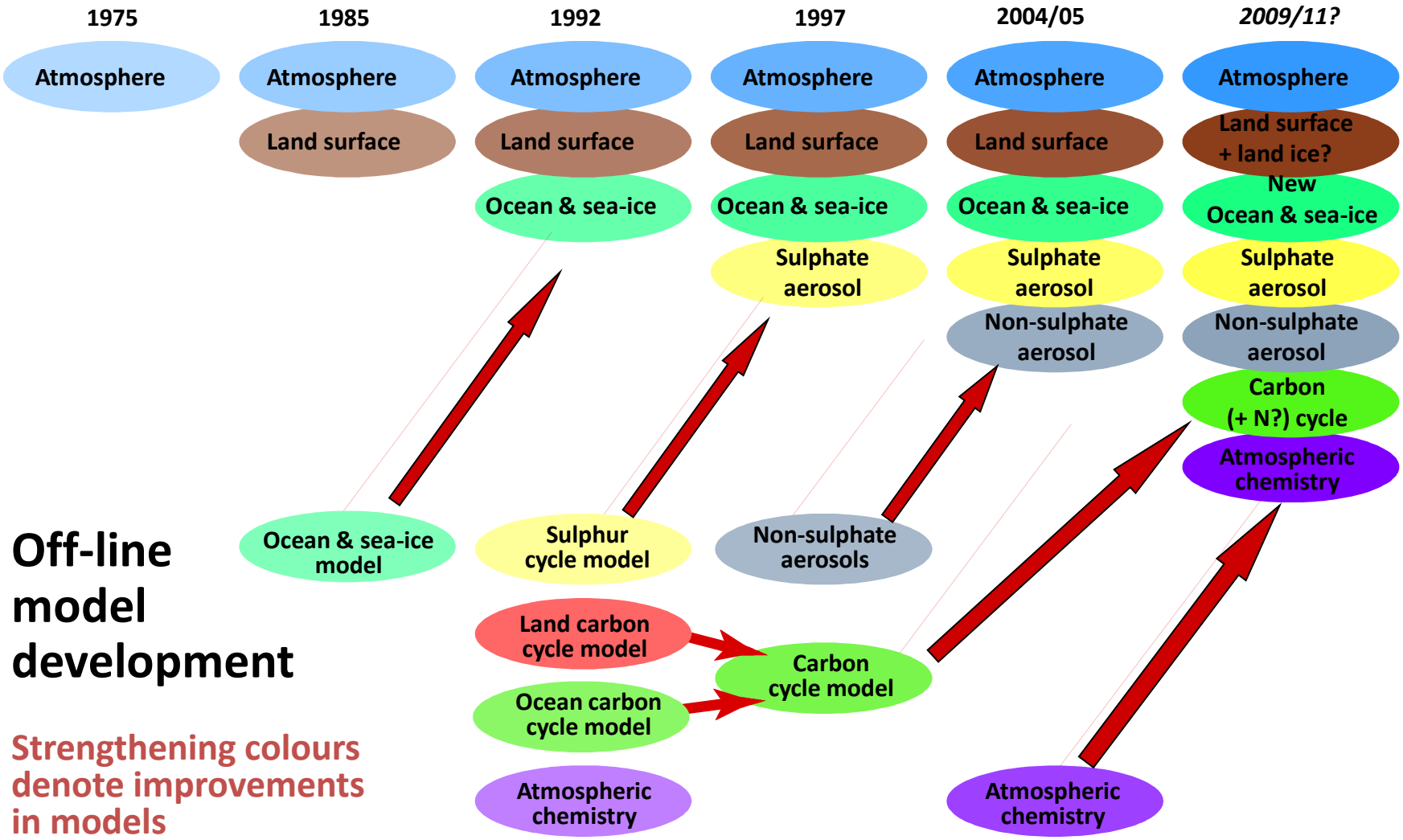
How Climate Scenario is Developed?

Climate models



How Climate Scenario is Developed?

Climate model improvements



Strengthening colours denote improvements in models

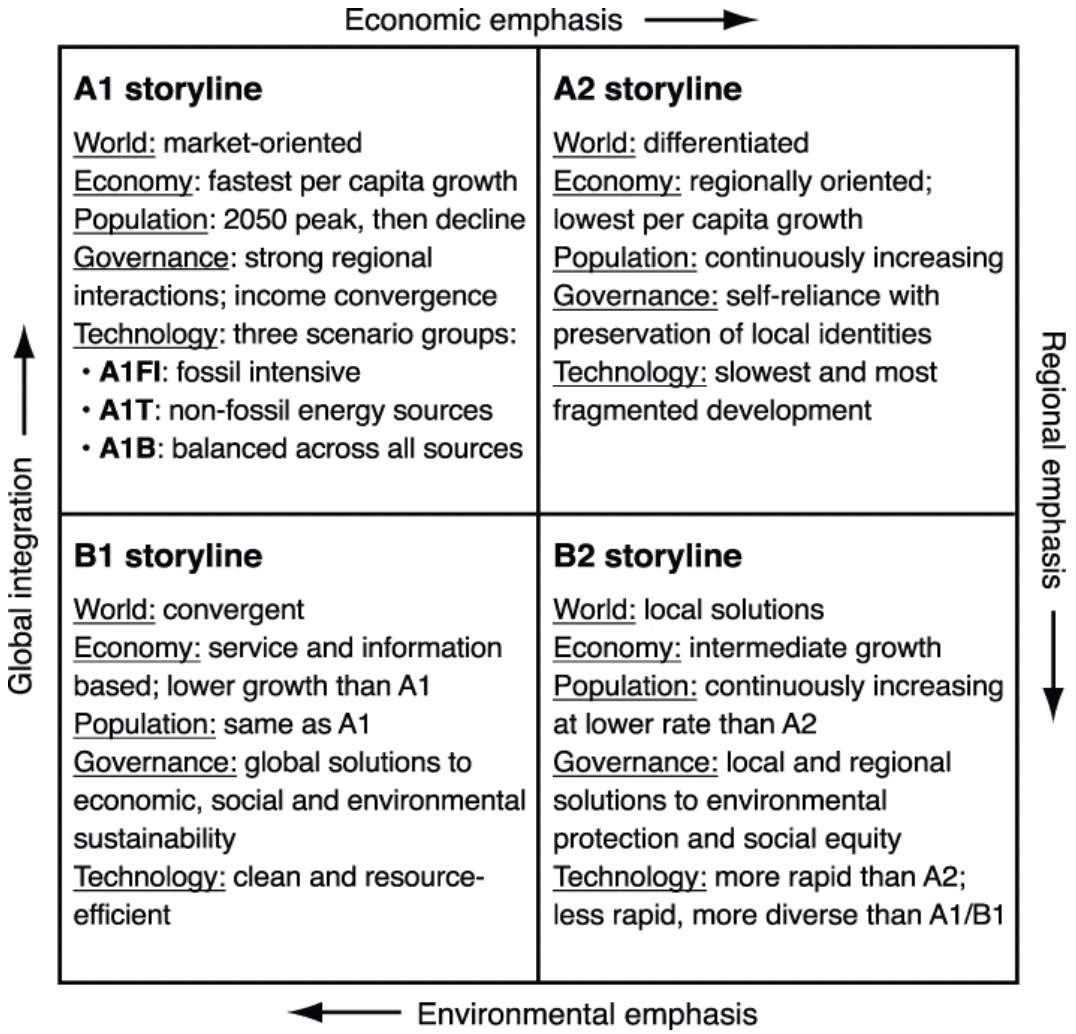
How Climate Scenario is Developed?

The main driver of climate change in the models is increasing levels of greenhouse gases.

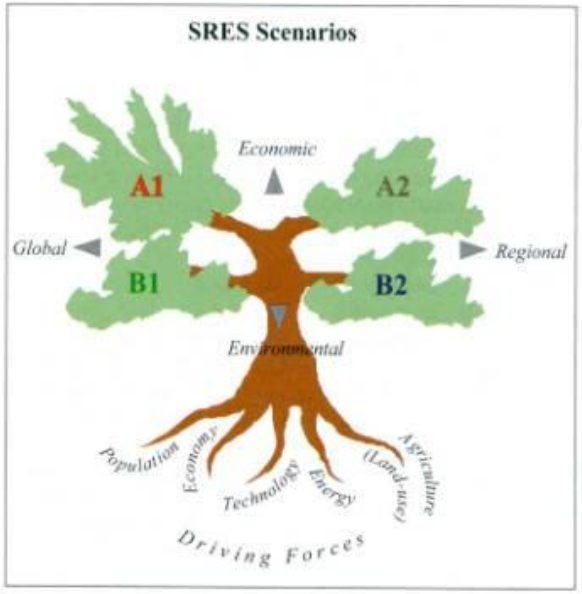
Many plausible futures of future GHG emission too

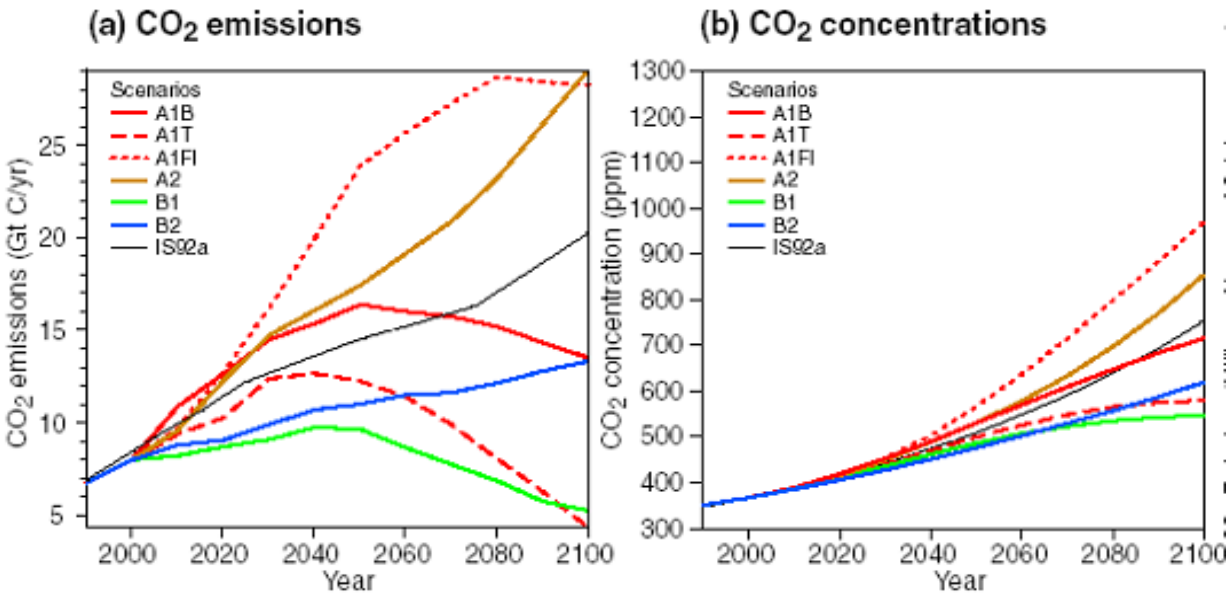
How Climate Scenario is Developed?

Summary characteristics of the four IPCC SRES storylines



How Climate Scenario is Developed?



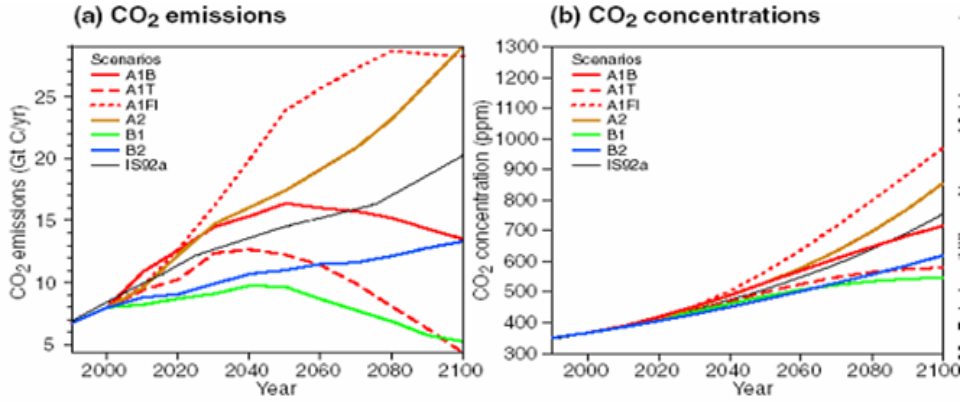


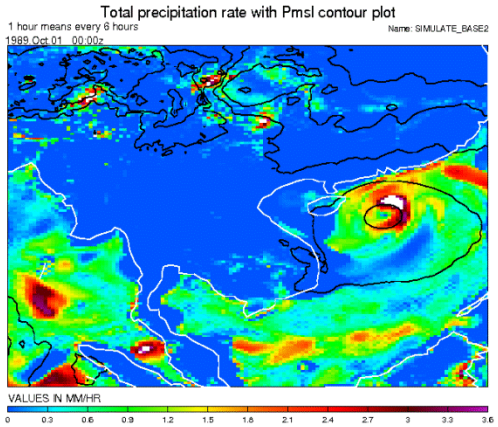
How Climate Scenario is Developed?

Climate model - simulation

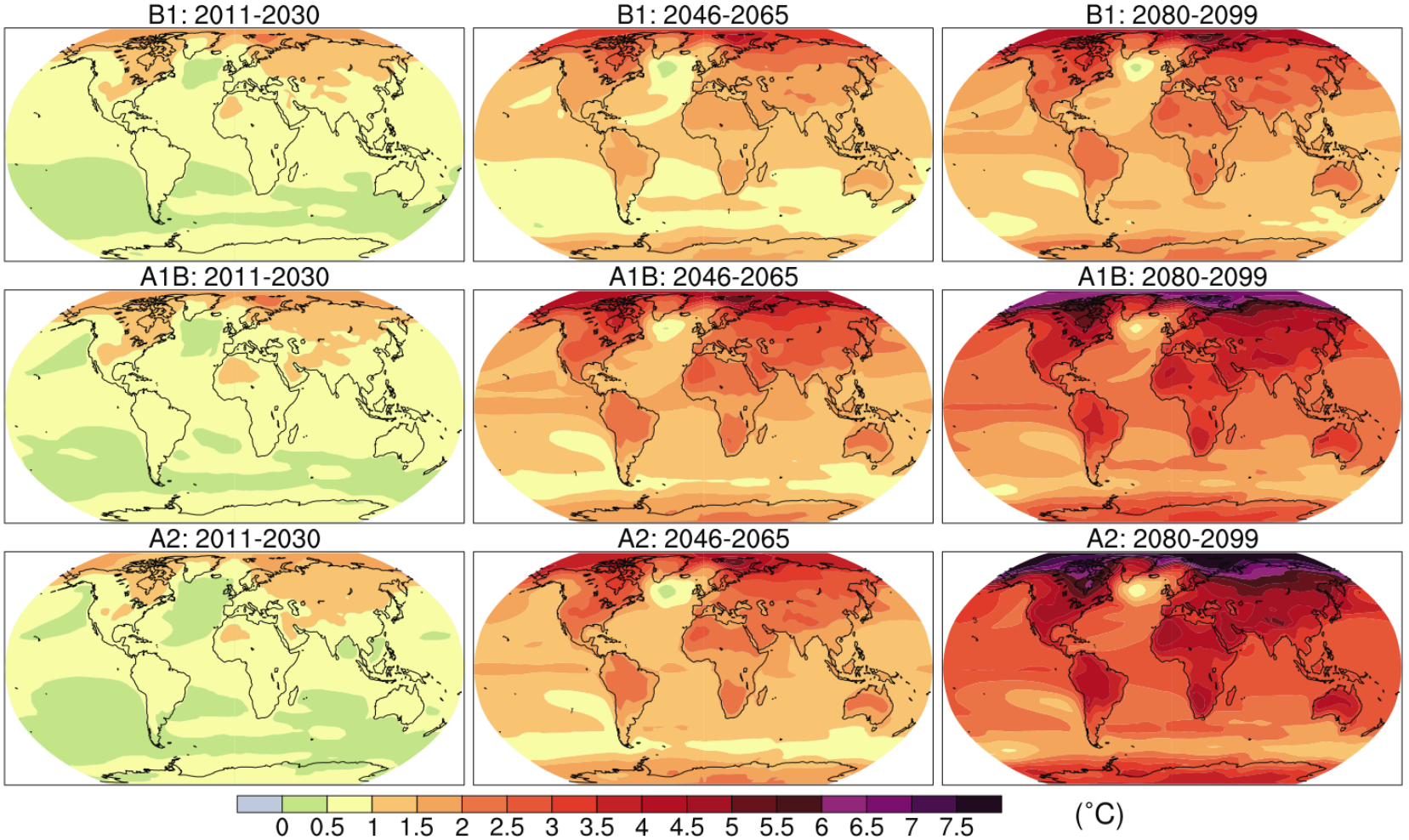
Future GHG Scenario

Future climate Scenario



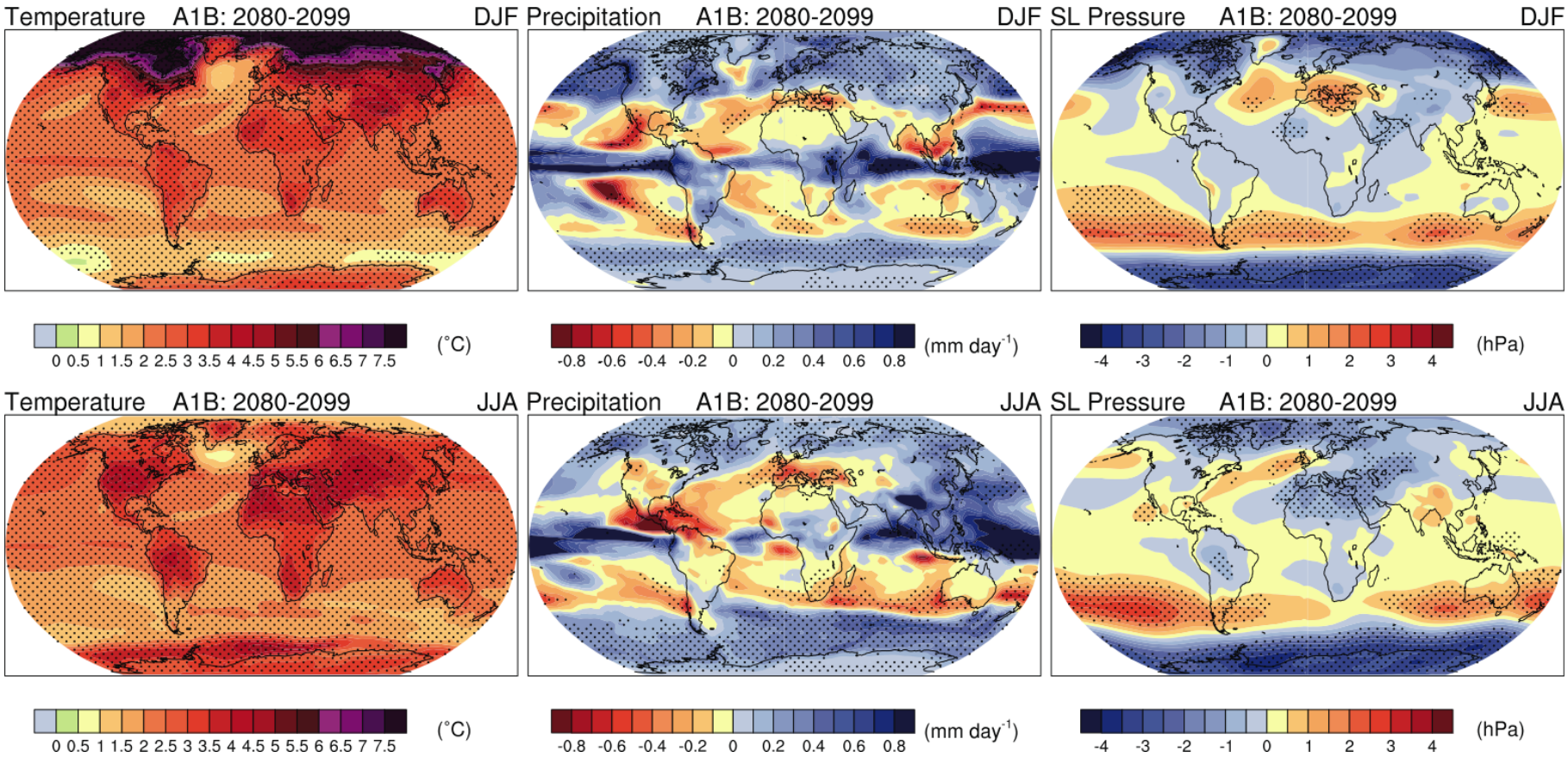


How Climate Scenario is Developed?



Source: INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

How Climate Scenario is Developed?

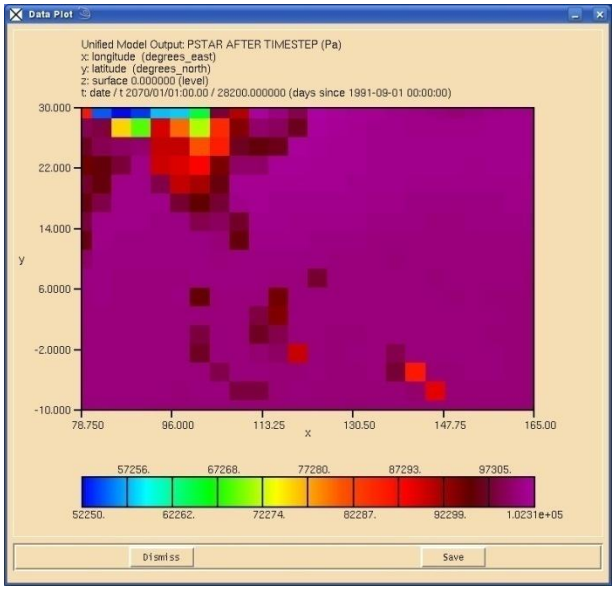


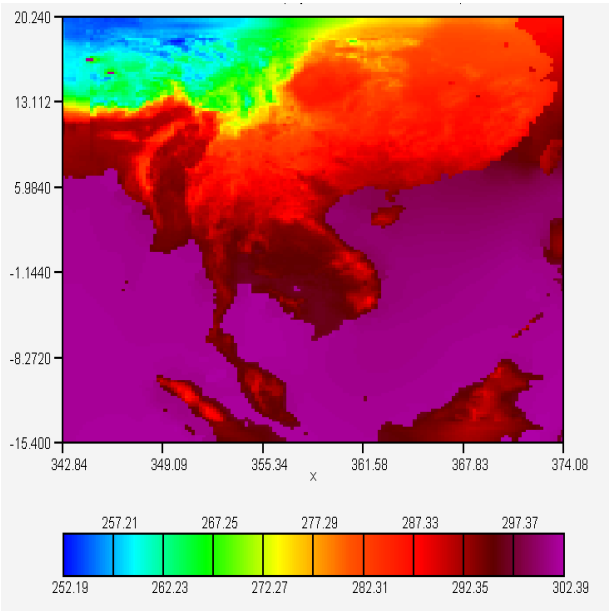
Source: WMO INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE UNEP

Global VS Regional Climate Scenario

Global Climate Model VS Regional Climate Model: concern on scale resolution

- Projecting future climate scenario needs to simulate the whole globe – single system at the global scale
- Very time and resource consuming process
- Compromise with details loss – to recalculate to regain more details later

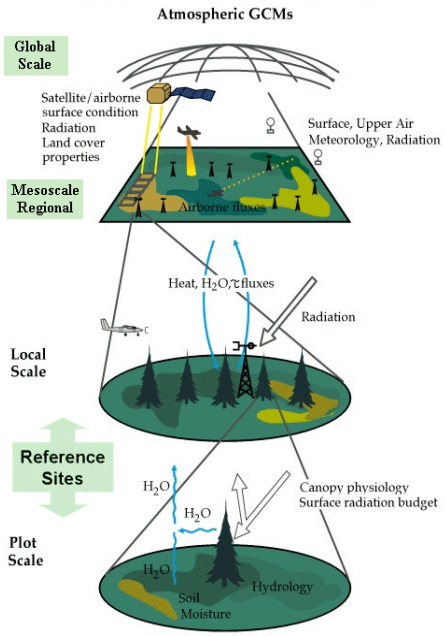


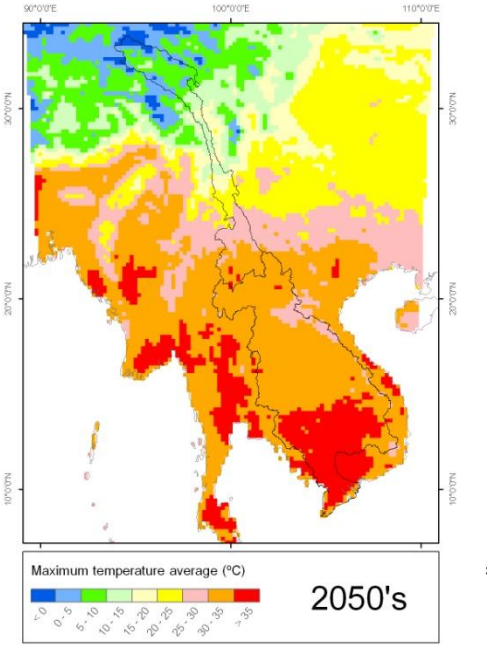


Global VS Regional Climate Scenario

Downscaling

The challenge of bring confident large scale projections to scales of adaptation and policy

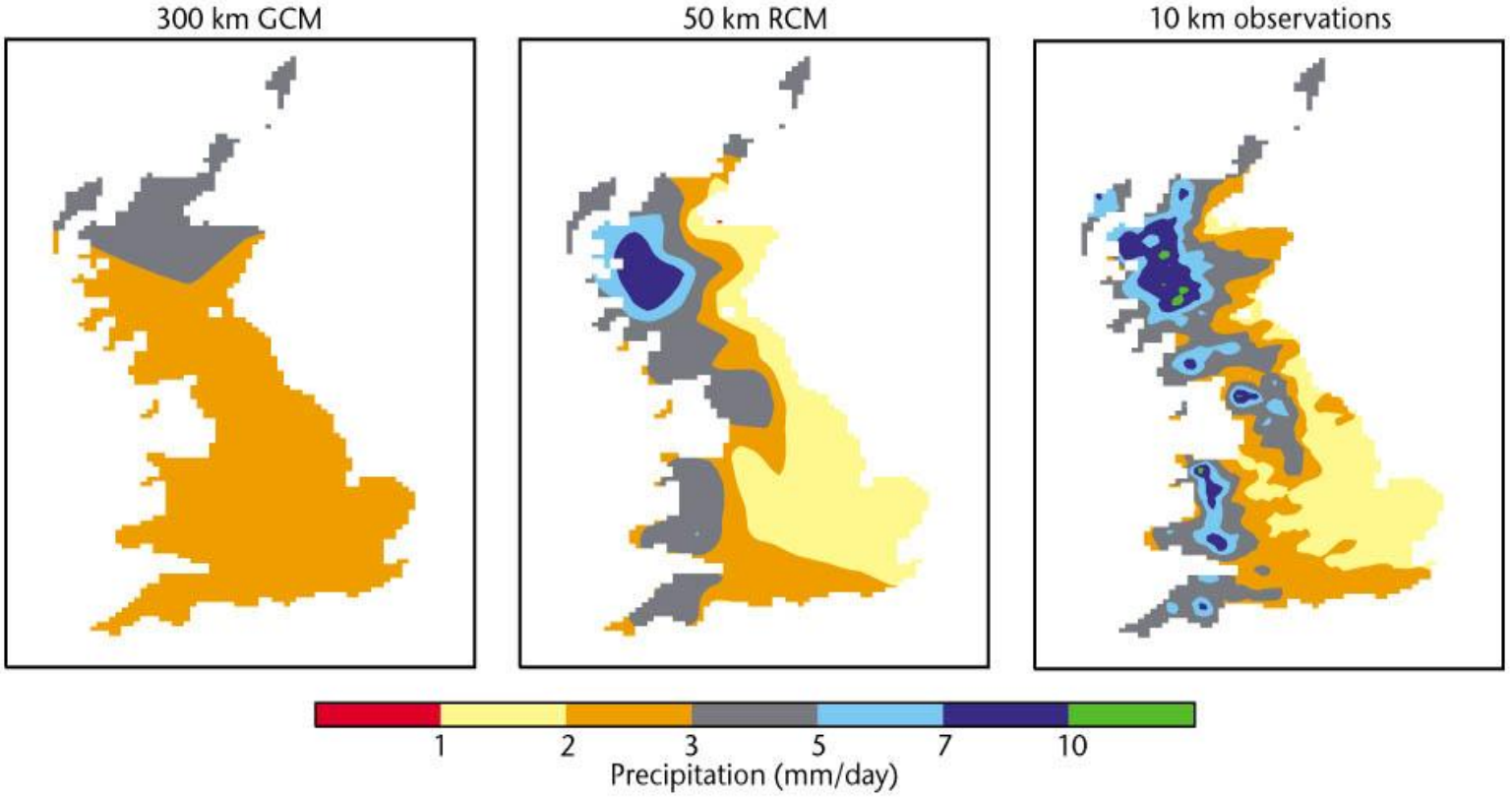




Ideal condition – to have high resolution climate scenario without downscaling process - but limited with today's technology

Global VS Regional Climate Scenario

Improvements seen at higher resolution



Improvements through "downscale process"

Global VS Regional Climate Scenario

There are 2 common techniques used in downscaling process

Statistical VS Dynamic downscaling

Global VS Regional Climate Scenario

Downscaling: Statistic/Empirical

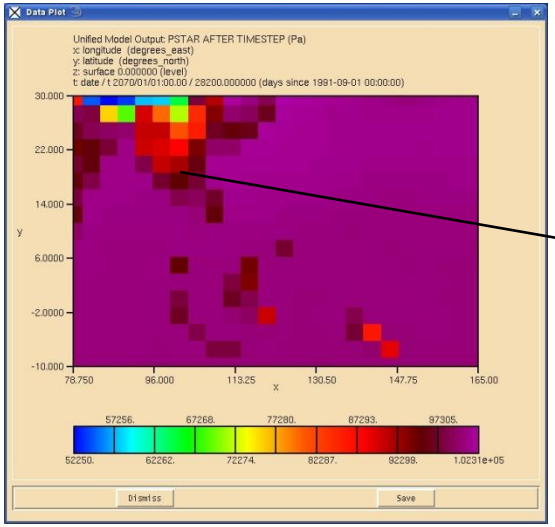
Uses the fact that local scale climate is largely a response to large scale forcing. As GCMs are arguably skillful at the large scale processes, allows derivation of local scales from predictor variables of the GCM

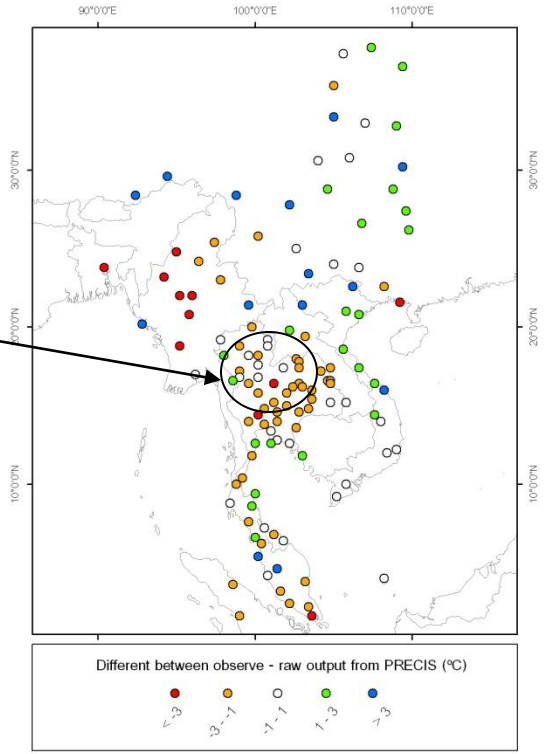
Assumption: the statistical relationships calculated from observed data will remain valid under future climate conditions.

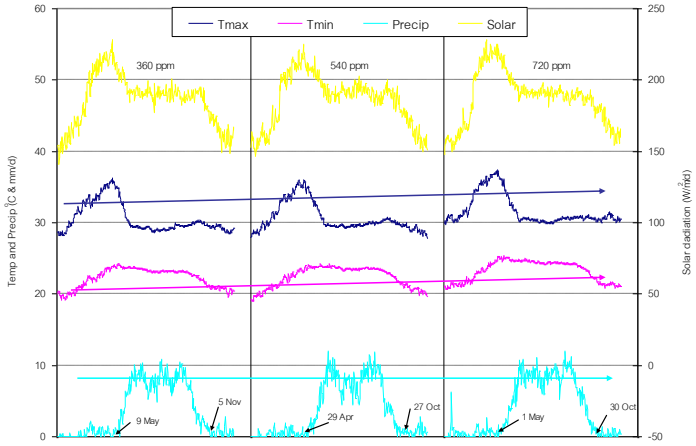
- Less method-dependant
- dependence on long observation data from weather stations
- good at station scale
- More reliable when producing
  - Extremes weather
  - Range of potential climate change

Global VS Regional Climate Scenario

Downscaling: Statistic/Empirical







Global VS Regional Climate Scenario

Downscaling: Dynamic

A high resolution limited area dynamical model forced by GCM at lateral boundary; is reduced complexity physical system; can not produce reality; generates basic descriptions of dynamics regional of climate system

Advantages

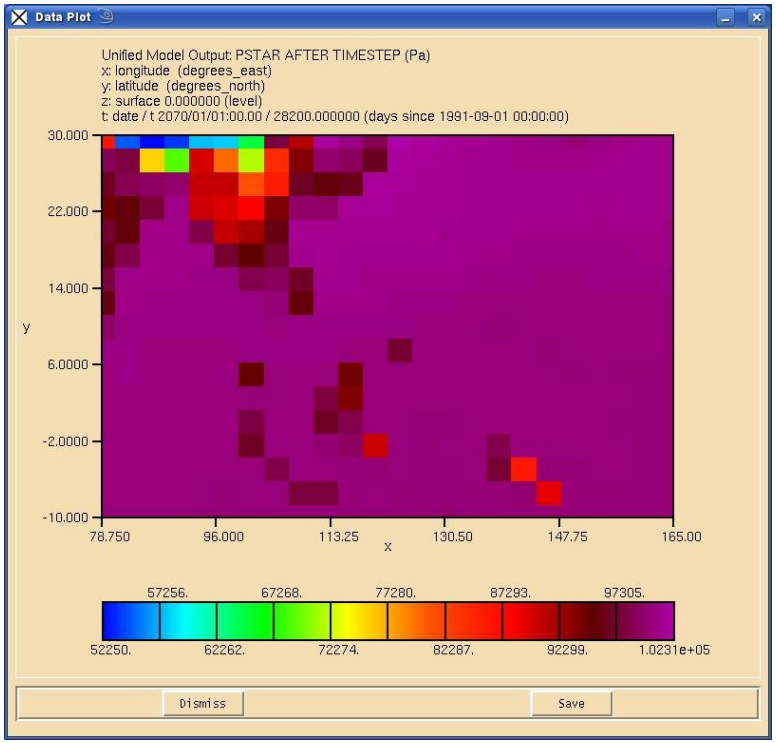
- It is physics-based
- It has moderate to high resolution (25km – 60km)
- It can reproduce local feedbacks

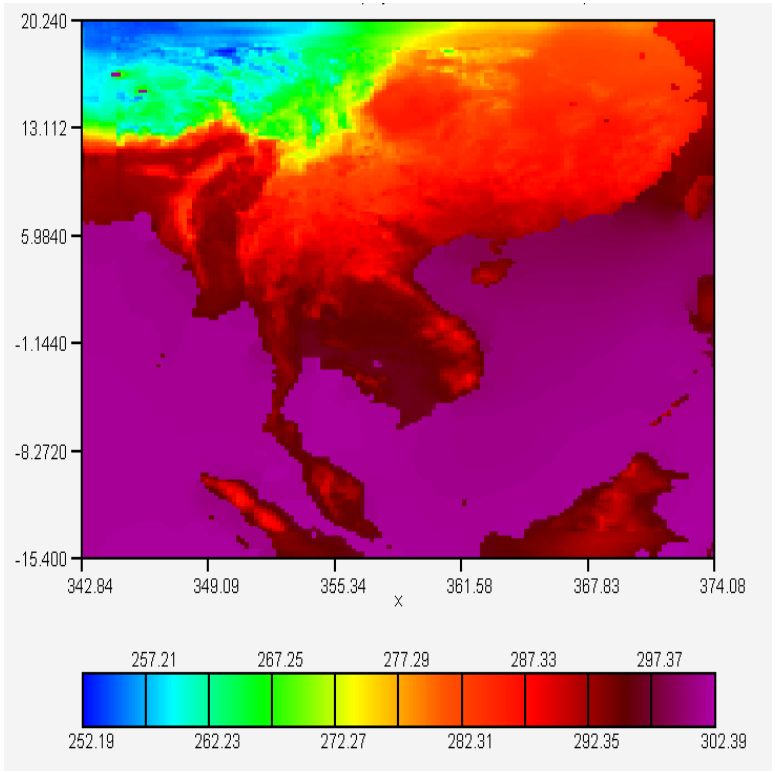
Disadvantages

- Vulnerable to incorrect representation of local processes (e.g. diurnal cycle)
- Single grid cell value is of low robustness
- Is a spatially smoothed product compared to station scale
- Usually require management of large data files

Global VS Regional Climate Scenario

Downscaling: Dynamic





Global VS Regional Climate Scenario

Example of climate scenario:

Multiple dimensions / aspects of climate change

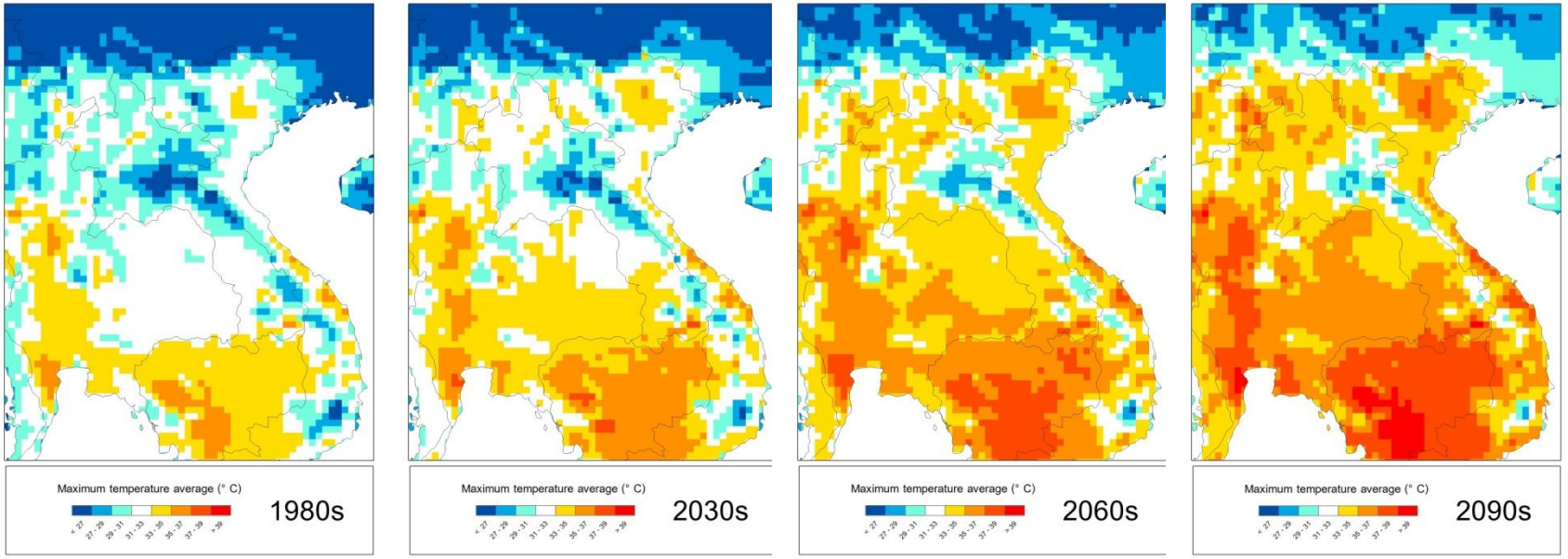
- Magnitude – change in range of weather pattern
- Frequency – change in return cycle of extreme weather event
- Distribution
  - Temporal – e.g. length of season, onset – end of season, distribution of weather parameters over time
  - Geographical – e.g. area of hot area / distribution of weather parameters over geographical area

Note: Single scenario only – one plausible future

Background on climate change scenario

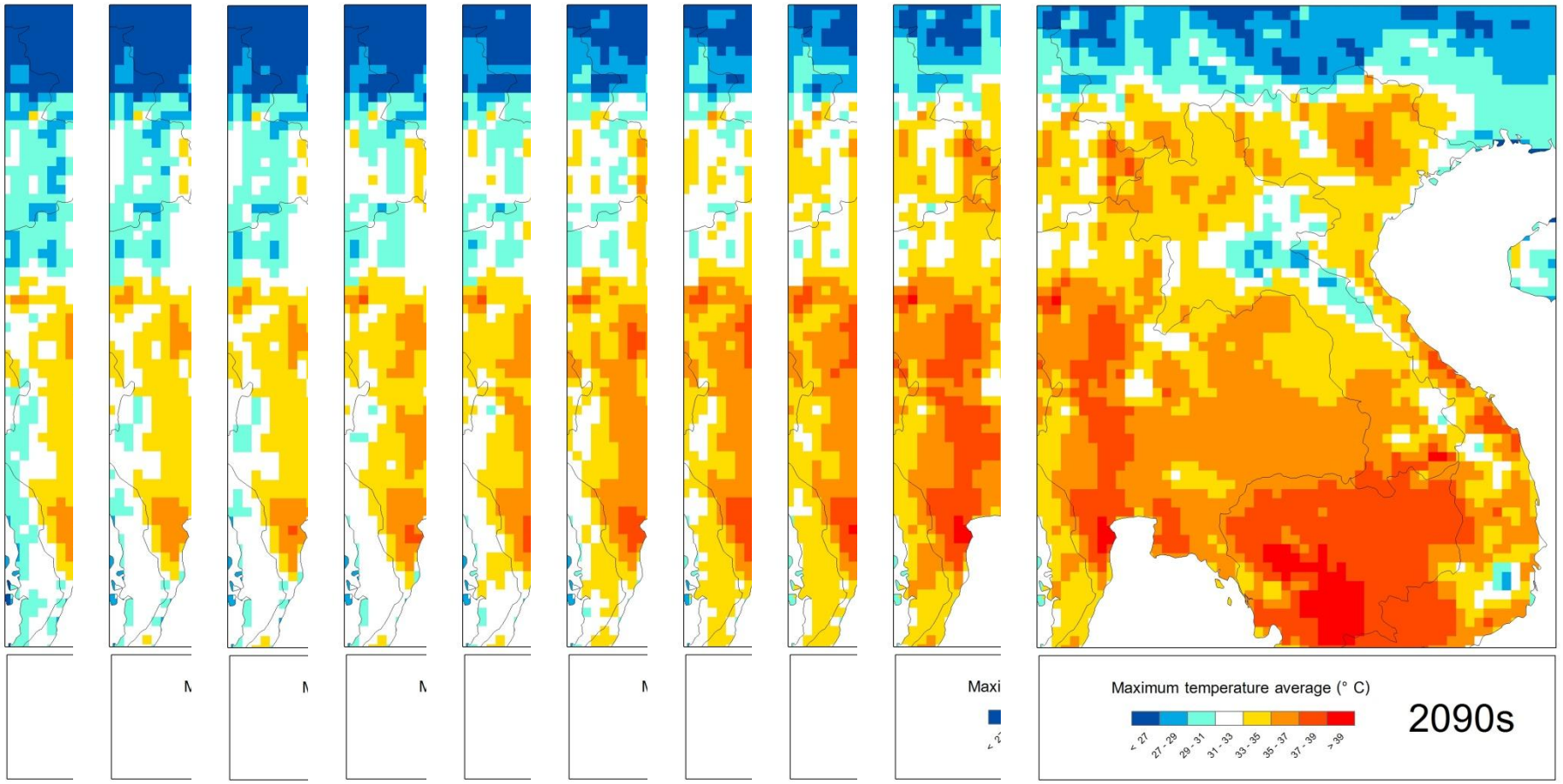
Average maximum temperature (decadal average)

Example of change in magnitude /geographical distribution



Background on climate change scenario

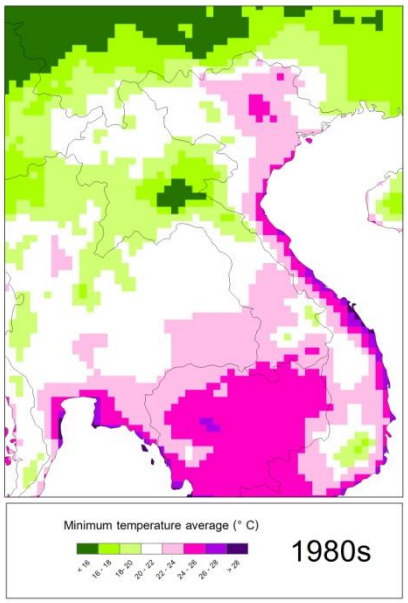
Average maximum temperature (decadal average)

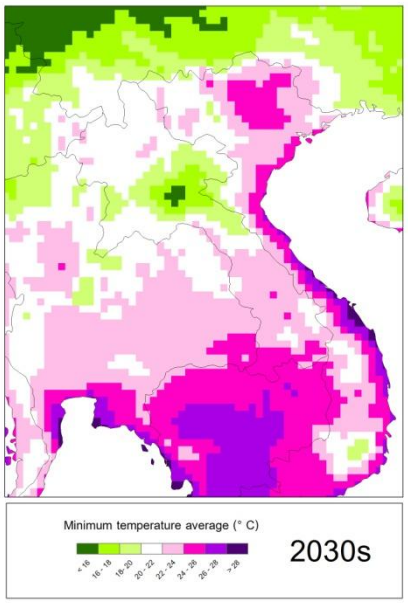


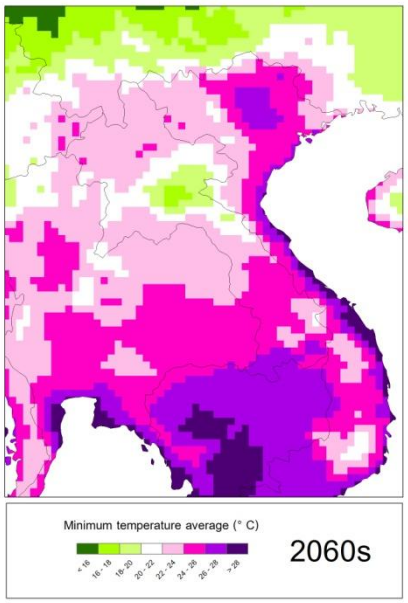
Background on climate change scenario

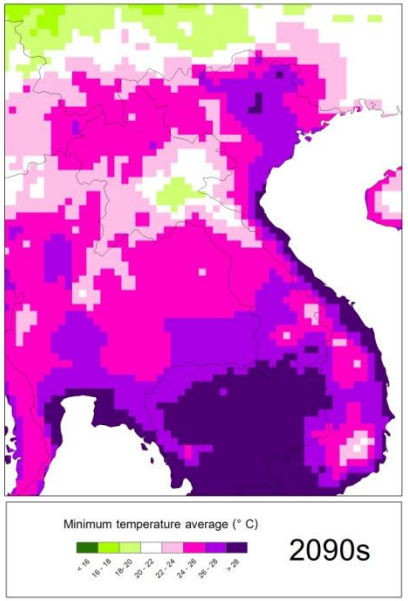
Average minimum temperature (decadal average)

Example of change in magnitude /geographical distribution



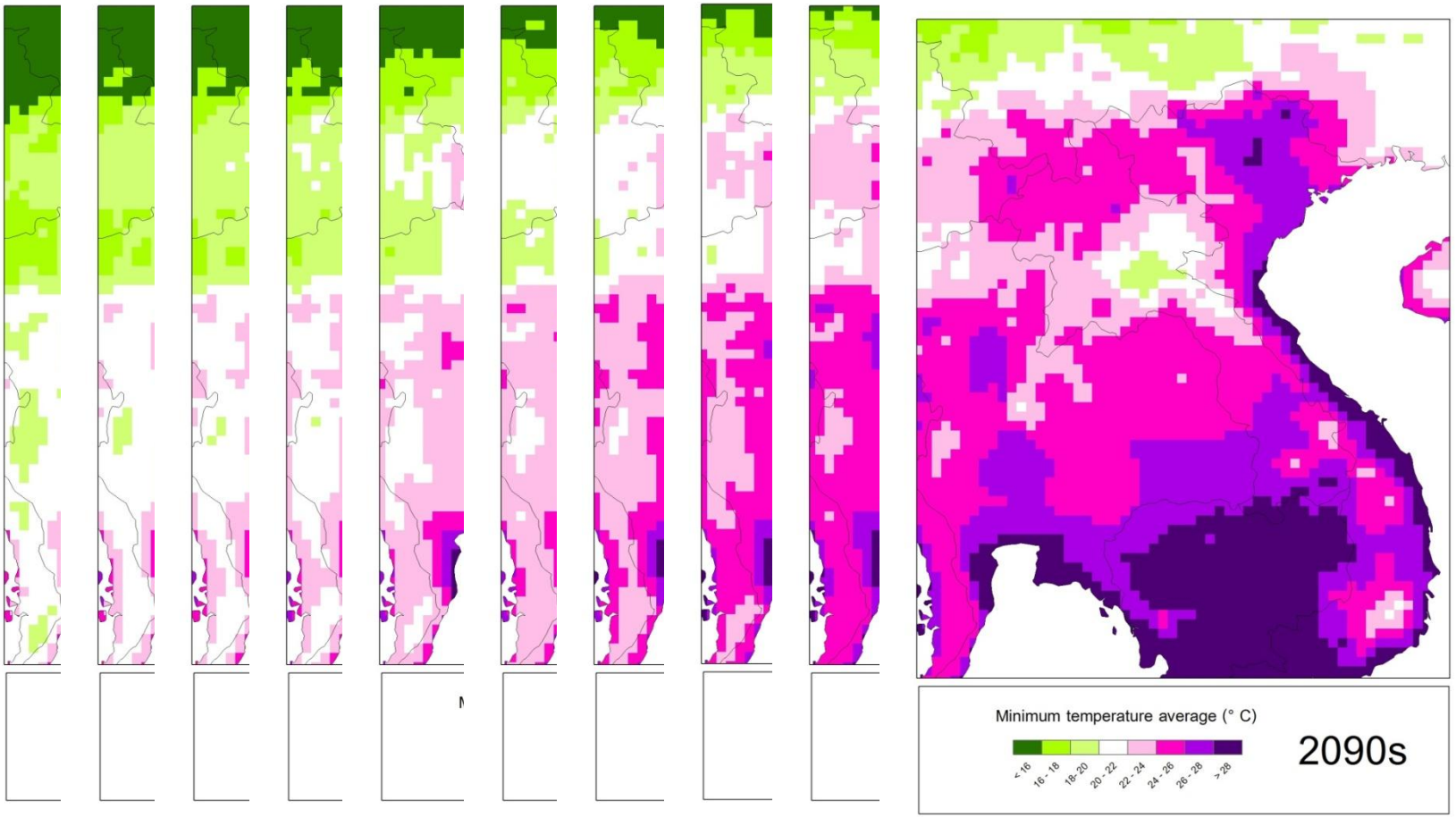






Background on climate change scenario

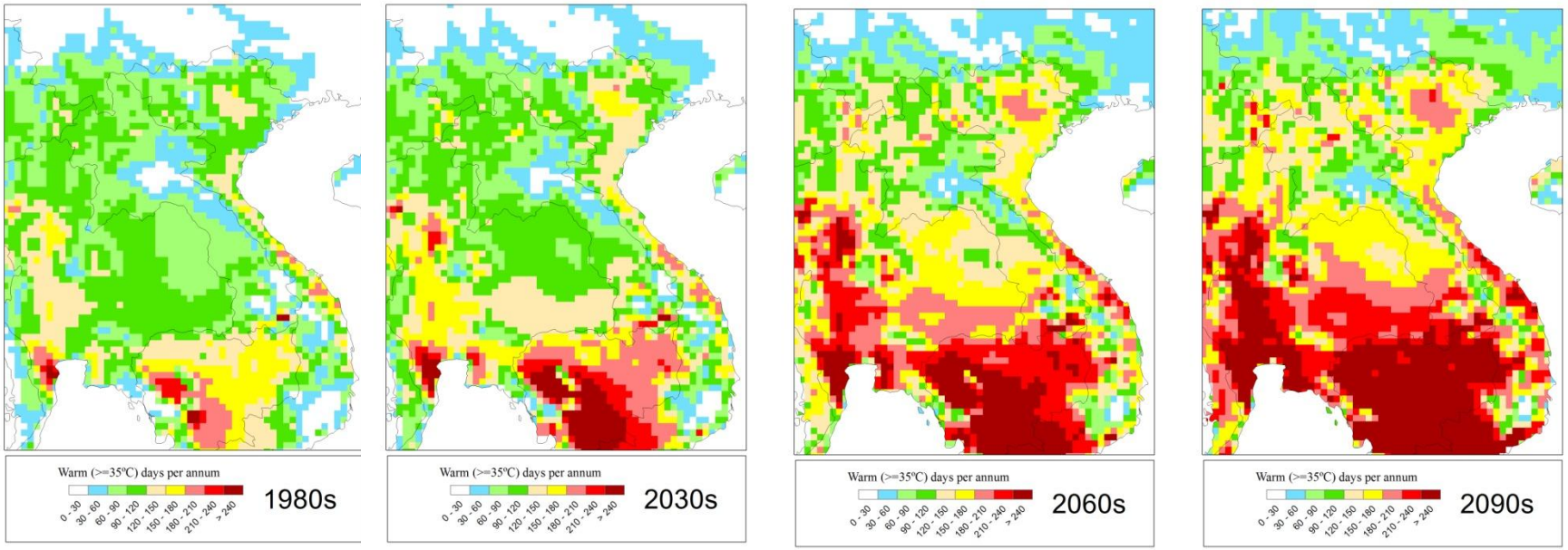
Average minimum temperature (decadal average)



Background on climate change scenario

Number of hot days per annum (>=35 °C)

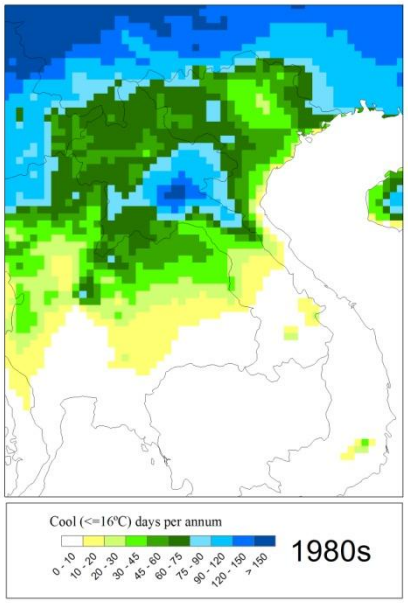
Example of change in temporal & geographic distribution

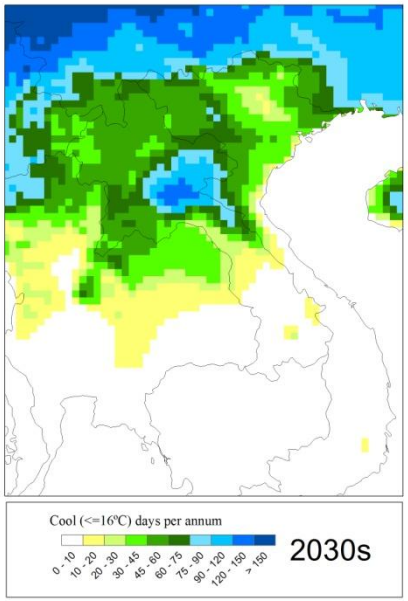


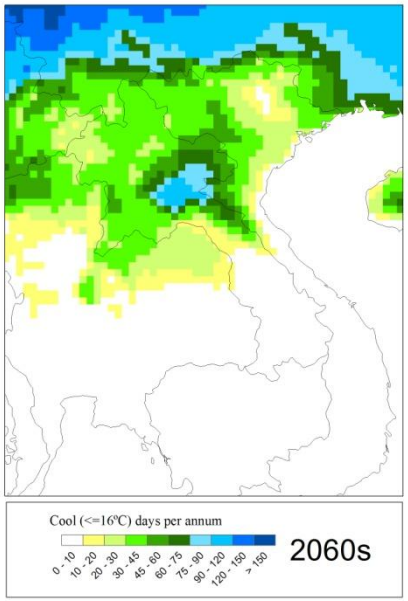
Background on climate change scenario

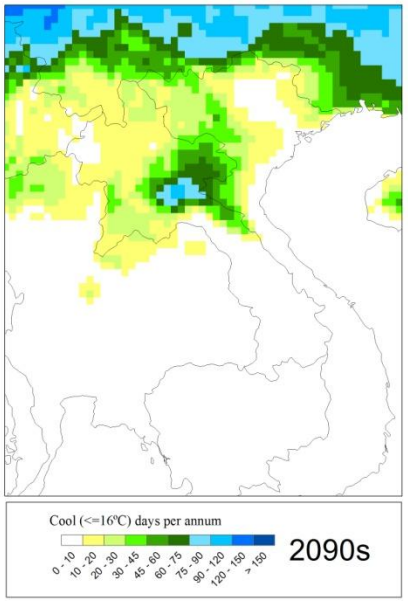
Number of cool days per annum (<=16 °C)

Example of change in temporal & geographic distribution



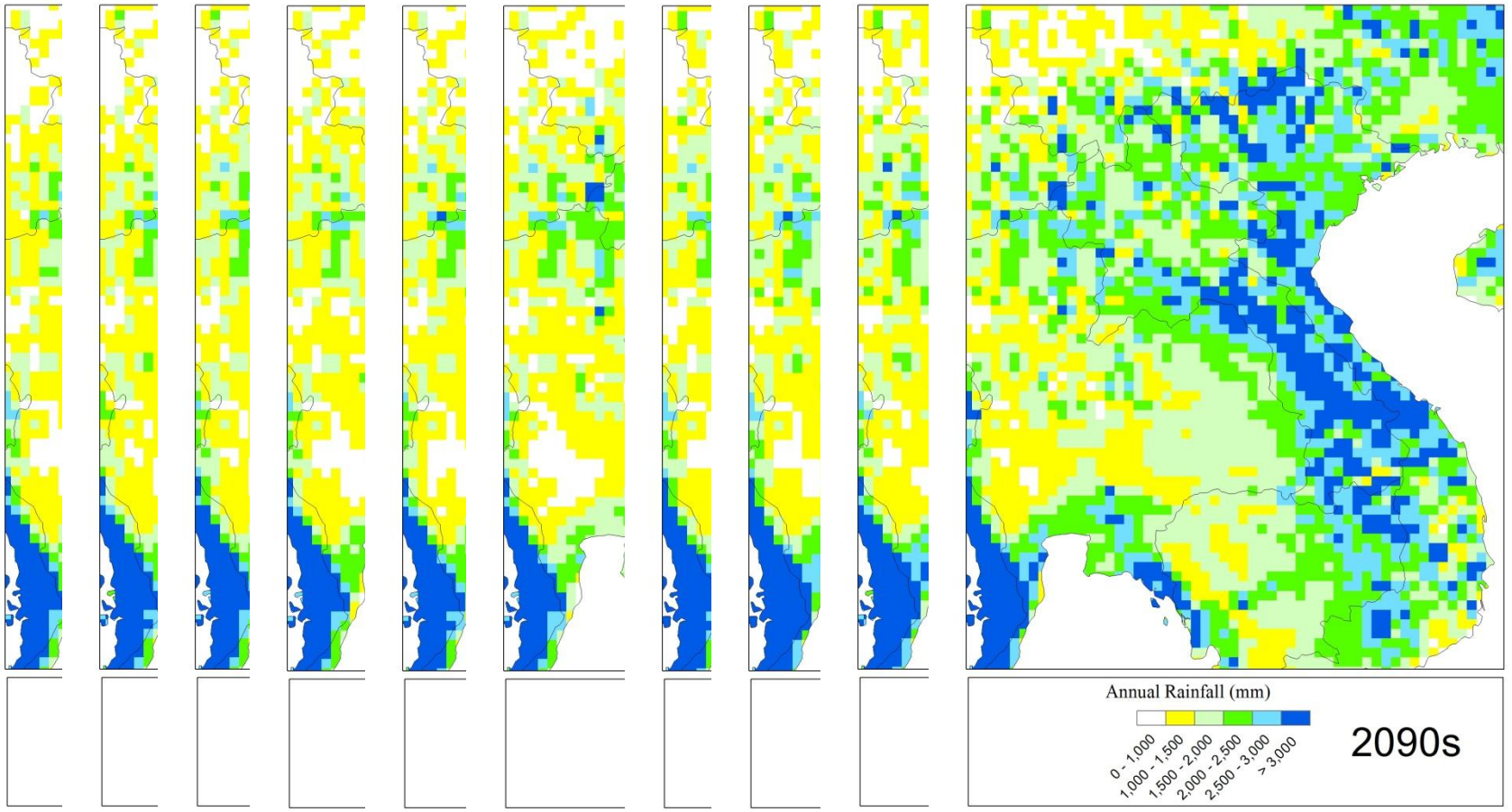






Background on climate change scenario

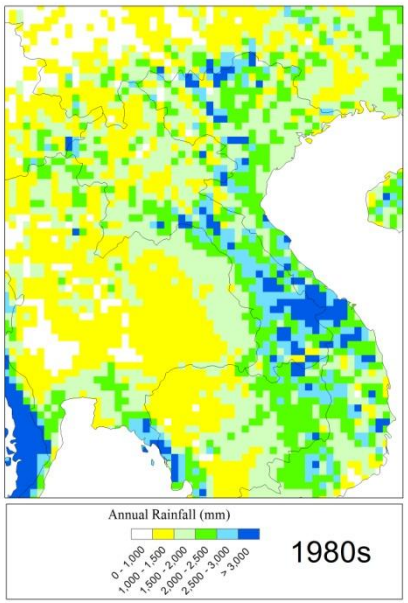
Rainfall distribution

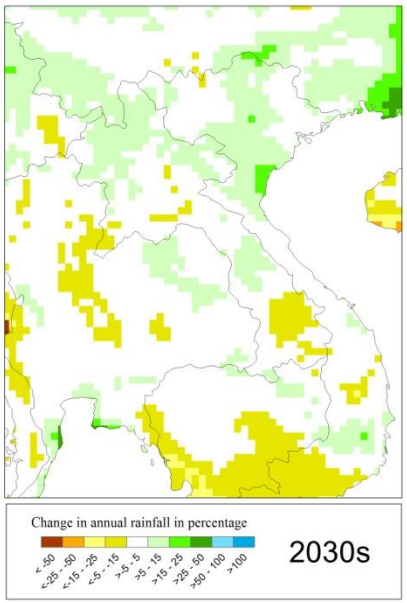


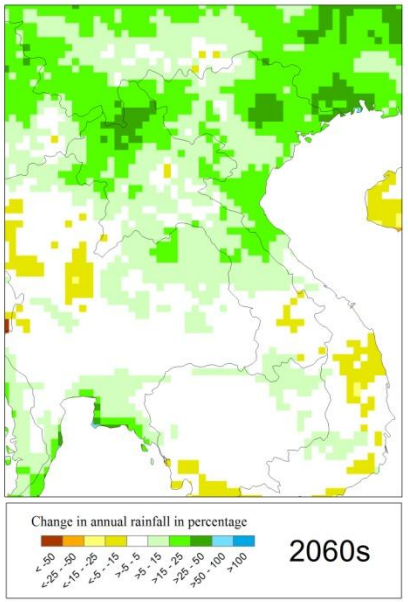
Background on climate change scenario

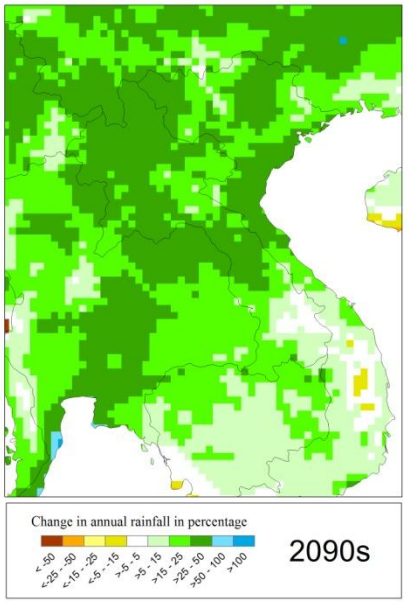
Change in rainfall distribution (compare to 1980's - %)

Example of change in geographical distribution









Thank you