Impact and Science of Climate Change on Asia-Pacific region

National Institute for Environmental Studies(NIES)

Hideo Harasawa

Impact Research in AP Region

1) **IPCC** (Asia)

2) **APN** (CAPABLE)

3) **AIACC**(Assessment of Impacts and Adaptations to Climate Change)

4) **Global Warming Research Initiative** (2002～2005FY, CSTP, Japan)

5) **Global Environmental Research Fund** (MoE, Japan)

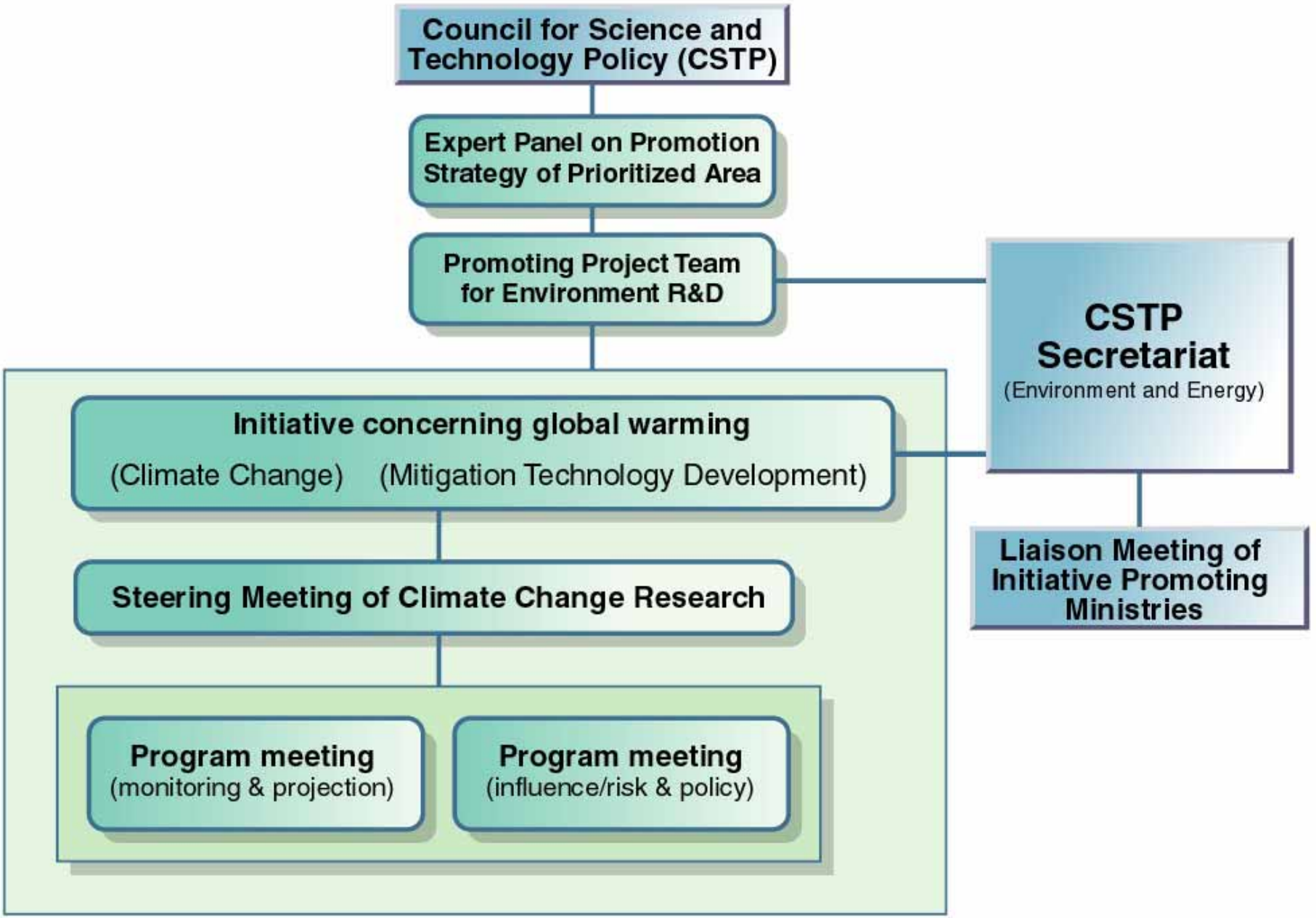
B-12 Prediction and Impacts of Extreme events

S-4 Thresholds of Impacts / Comprehensive Impacts Assessment in Japan and E-Asia, etc.

6) **Global Warming Research Project** (1st: 2001～2005FY, 2nd: 2006FY～、NIES)

- AIM (Integrated Assessment Model, 1990～)

7) Other research activities



Framework of Global Warming Research Initiative

Achievement map for impacts and risk studies in Japan

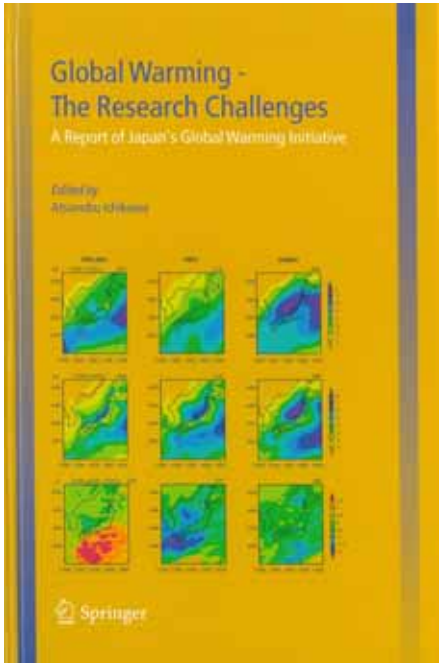
	Water resources Water environment	Terrestrial ecosystem	Agriculture, forestry and fishery	Ocean environment	Coastal zones	Land preservation, disaster prevention, and human settlement	Industry Energy	Human health
Impact detection		○○○		○○	○			○
Element studies on assessment methodology etc	○○	○○○	○○○	○	○○○	○○	○	○○○
National assessment Impact map	○	○○○	○○○		○○○	○		○
Threshold of impacts Vulnerable sectors and areas Economic assessment	○	○○	○○	○○	○○		○	○○
Adaptation	○		○○	○	○	○	○	○
Impacts on the Asia and Pacific region	○	○○	○○		○○			○

○○○ : Results obtained in most areas
○○ : Results obtained in some areas
○ : Studies in limited areas
Blank : No studies or unapparent situation

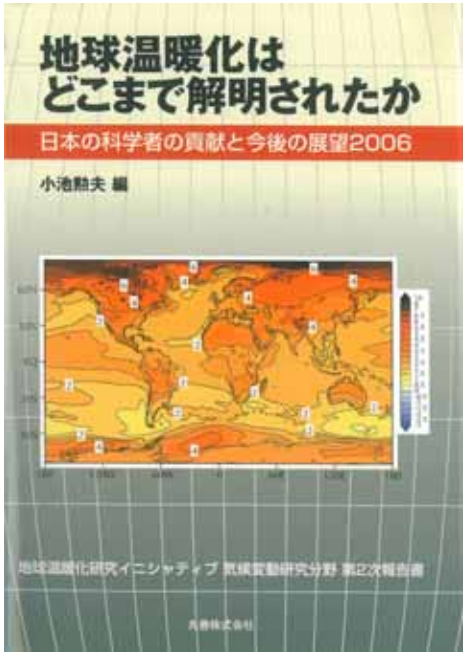
Reports of Global Warming Research Initiative

No.1, 2003 (Jp)

No.2, 2004 (Eng)



No.3, 2006 (Jp)



No.4, 2006 (Eng)

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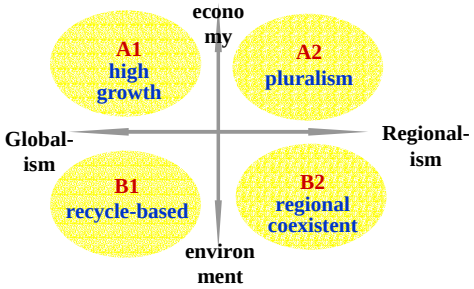
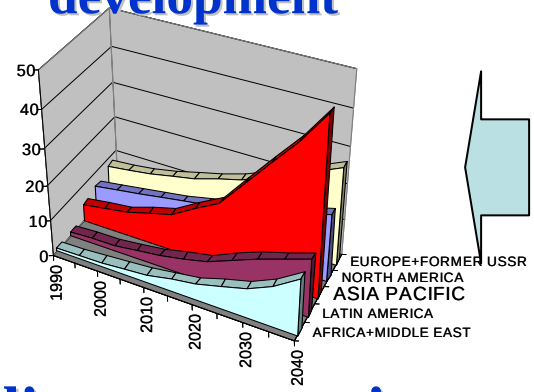
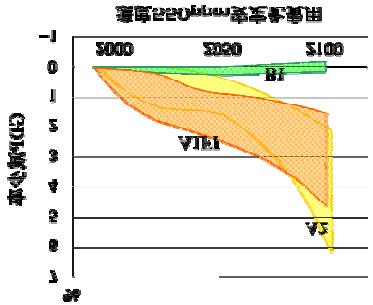
Socio-economic scenarios



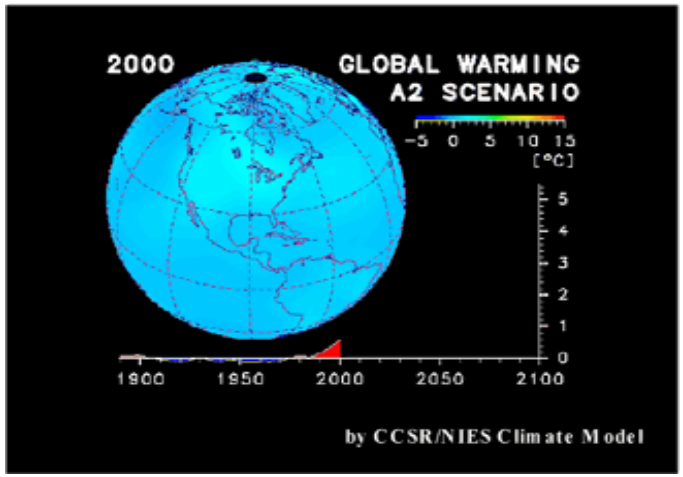
Sustainable development

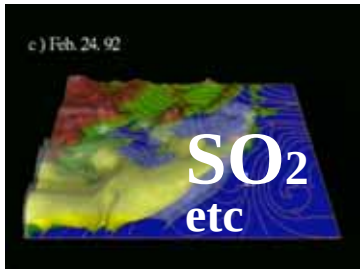


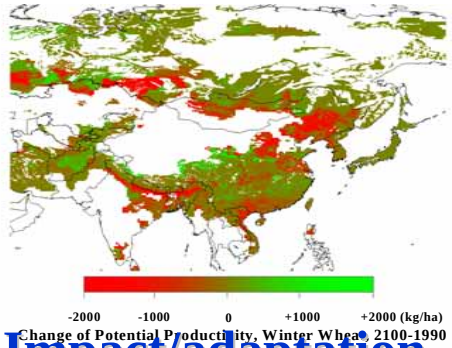
Mitigation cost



Climate scenarios

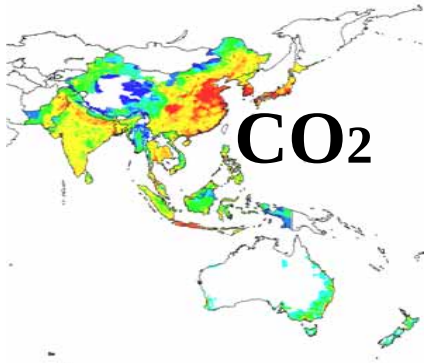


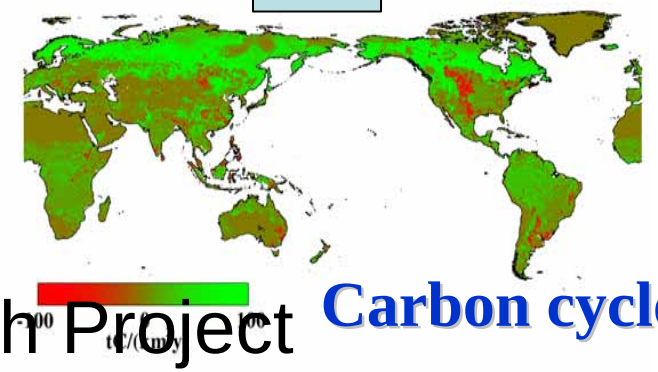




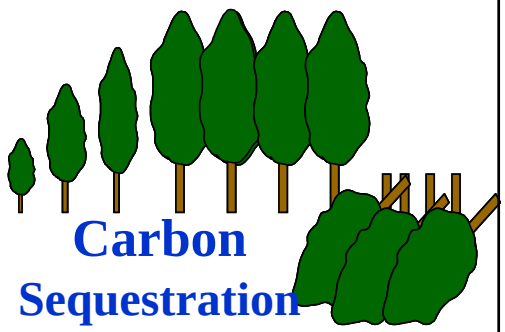
Impact/adaptation assessment

Emission Scenarios





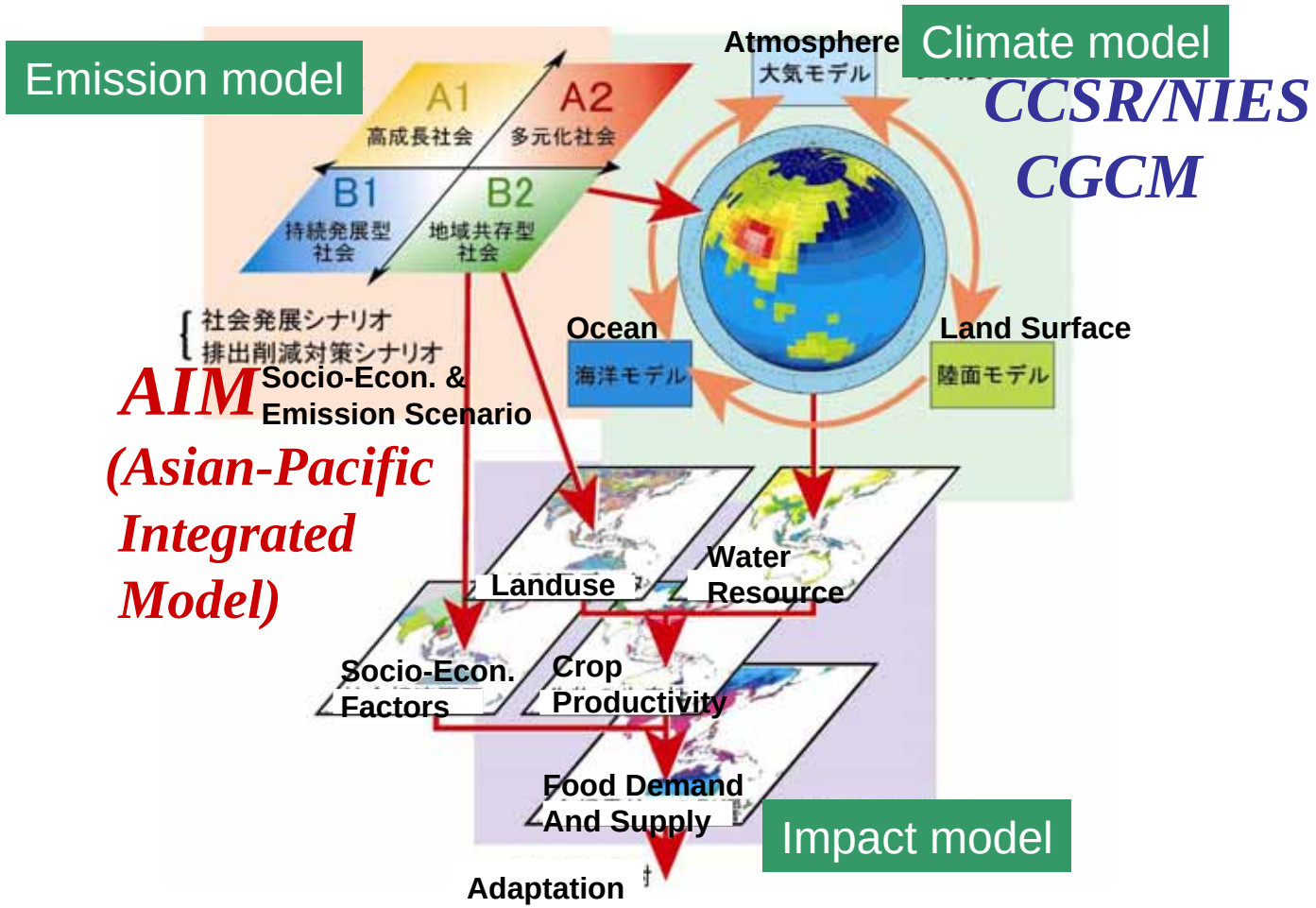
Carbon cycle



Carbon Sequestration

NIES GW Research Project

Collaboration with climate model



Observed Impacts of Global Warming

Observed Impacts of Global Warming

Retreat of Glaciers

Tianshan Glaciers (disappeared by 22% for the past 40 years)

Tibettian Glaciers (disappeared 4420km^2 (9%) for the past 30 years)

Himalayan Glaciers (500,000 km2 to 100,000 km2 by 2035)

Heat Wave

45-49^{o}C in May, 2003 in India (1600 death)

2-3 ^{o}C increase in July, 2004 in Japan (heat stroke patients more than 600 in Tokyo)

Typhoon

10 typhoon landed in 2004 in Japan (>200 death, 120 billion $ damage)

Increasing damage in Philippines (900 death, Nov. 2004, >500 , Dec. 2004)

Wind Storm

Increasing wind storm in Mongolia

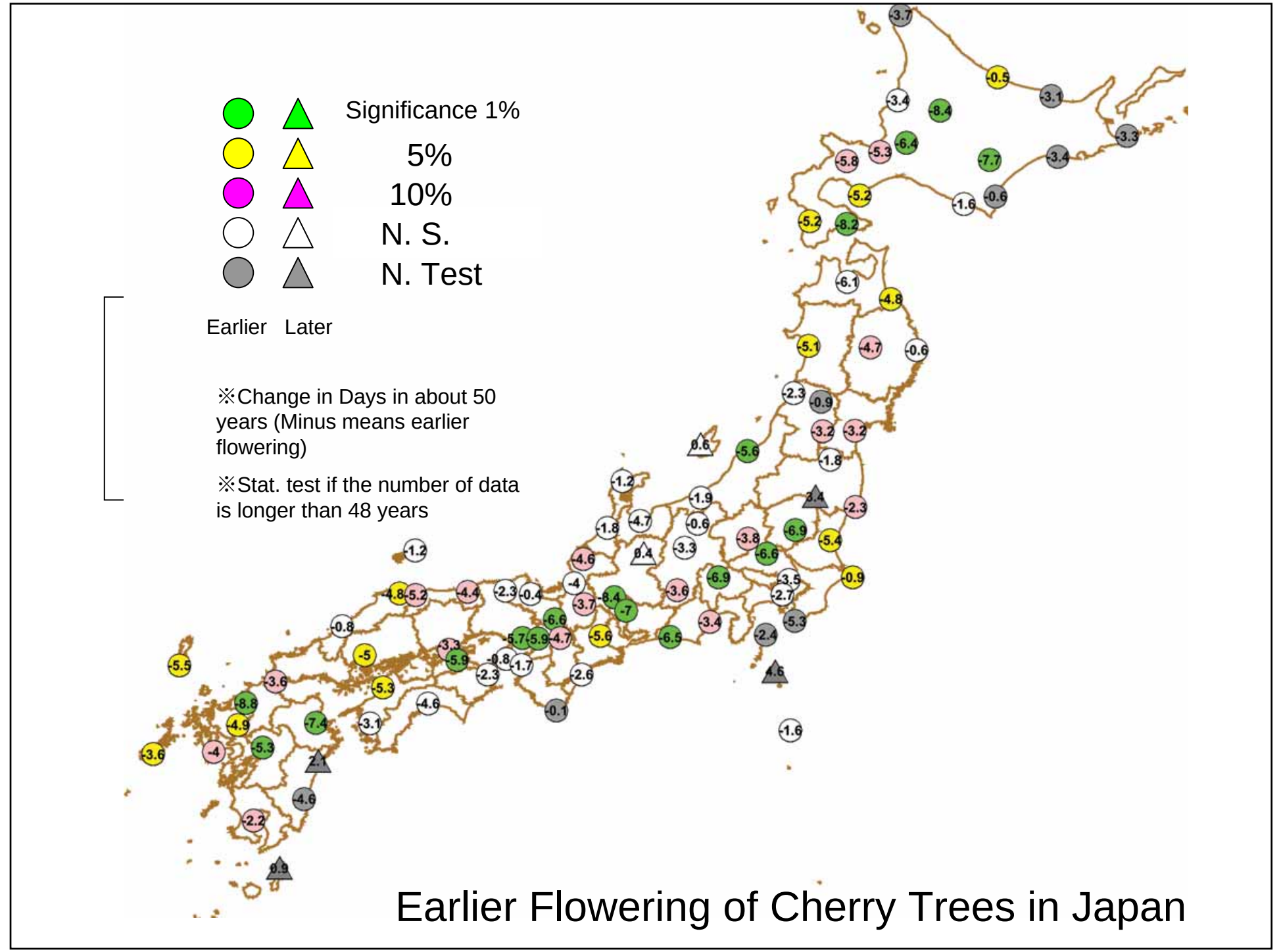
Observed Impacts in China and Japan

China

- Sea level rise: 1.4 – 2.5 mm per year
- Change in plant growing period 2-3.5 days in temperature increase 1oC
- Coral reef appearing in Gungxi and Haian Provinces

Japan

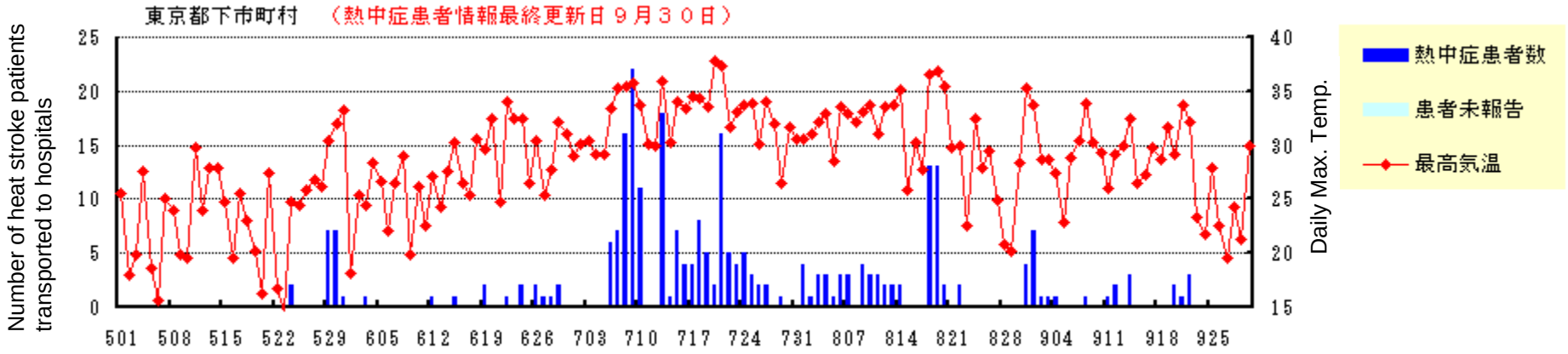
- Sea level rise 2.03mm/year (1970- 2003)
- Lake Ice: Lake Suwa in Nagano Prefecture
  Omiwatari, “the divinity’s pathway,” *Omiwatari* has not been seen very often in recent years
- Decreased alpine flora in Hokkaido, the north island in Japan and other high mountains
- Expanded distribution of southern broad-leaved evergreen trees such as the Chinese Evergreen Oak
- Nagasakiageha butterfly (*Papilio memnon thunbergii*), the northern border for which has been Kyushu and Shikoku Islands, appeared in Mie Prefecture in the 1990s, then in Tokyo area in early 2000s
- Appearance of the southern tent spider, seen only in western Japan in the 1970s, in the Kanto Region in the 1980s.
- Expansion of the wintering spot of the White-Fronted Goose to Hokkaido
- Appearance of tropical fish in Osaka Bay.
- Breaching of Coral Reef in Okinawa islands
- Shifting habitats of ermine and grouse on mountains such as Hakusan and Tateyama to higher elevations. There is some danger of complete disappearance.



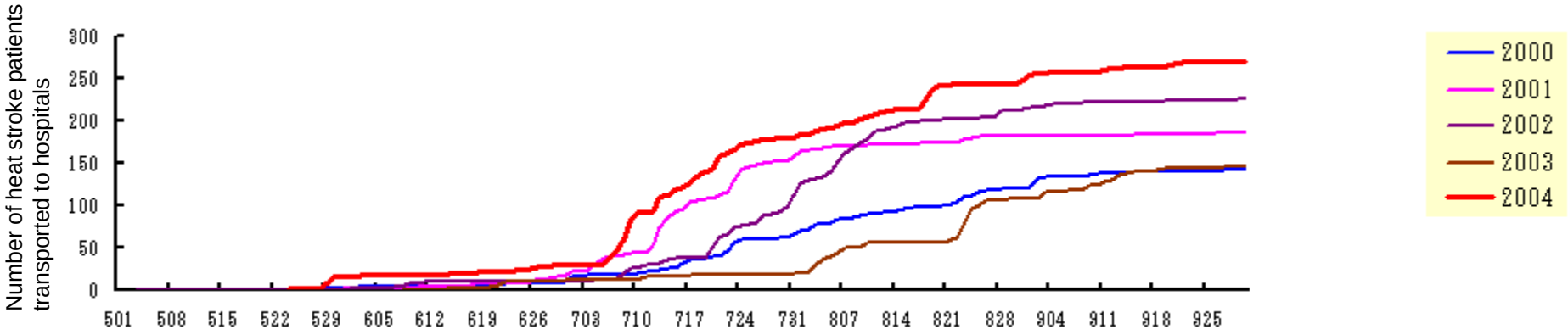
Earlier Flowering of Cherry Trees in Japan

Daily max. temperature and number of heat stroke patients

who were transported to hospitals in Tokyo suburban areas(May – Sep, 2004)



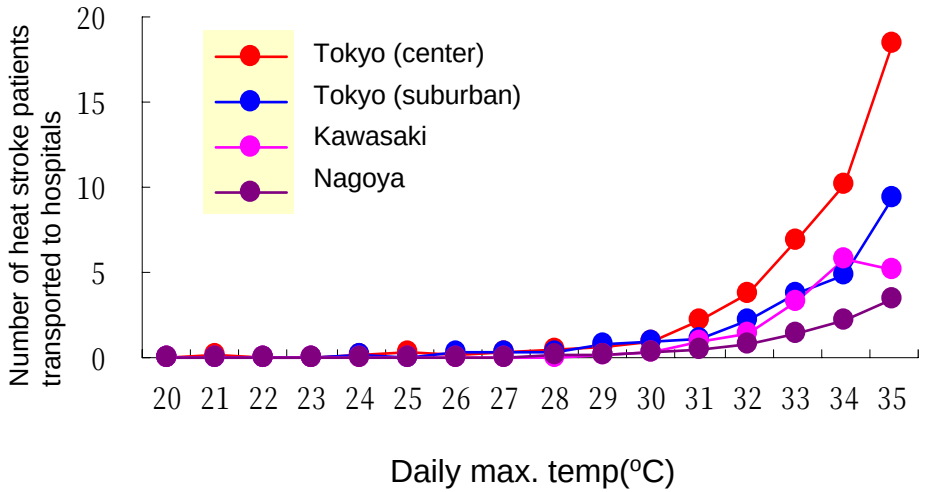
Cumulative number of Heat Stroke Patients in 2000～2003

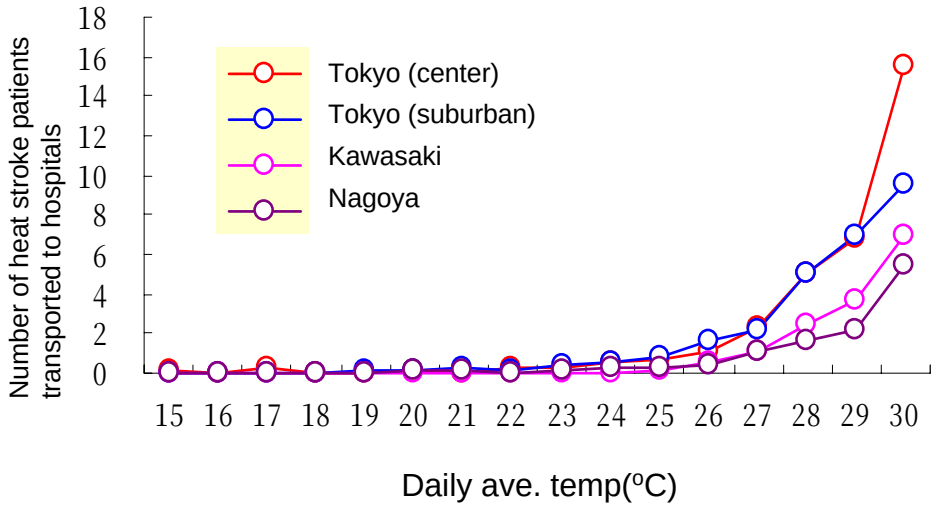


http://www.nies.go.jp/impact/index.html

Number of Heat Stroke Patients
transported to hospitals

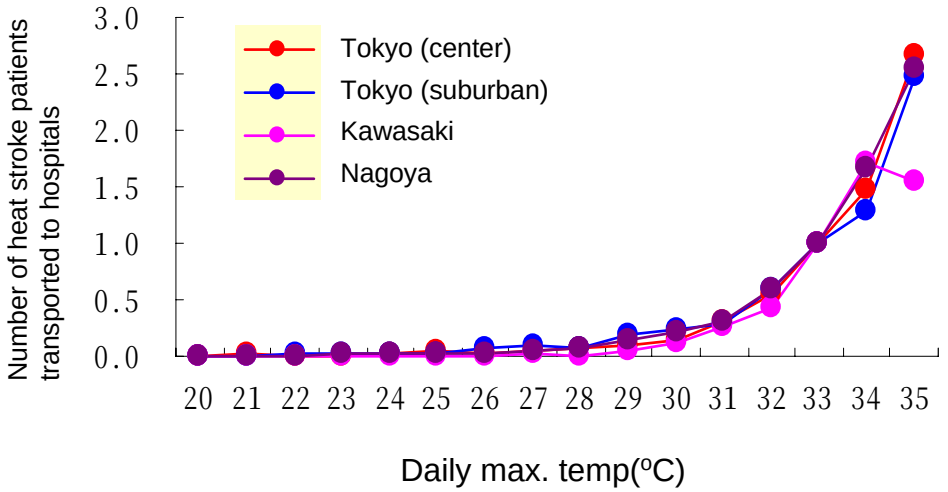
(a)

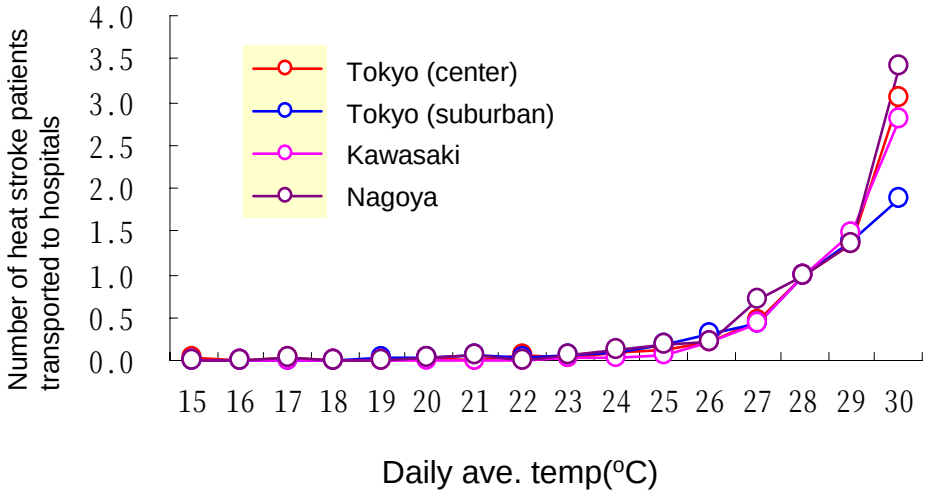




Number of Heat Stroke Patients
transported to hospitals

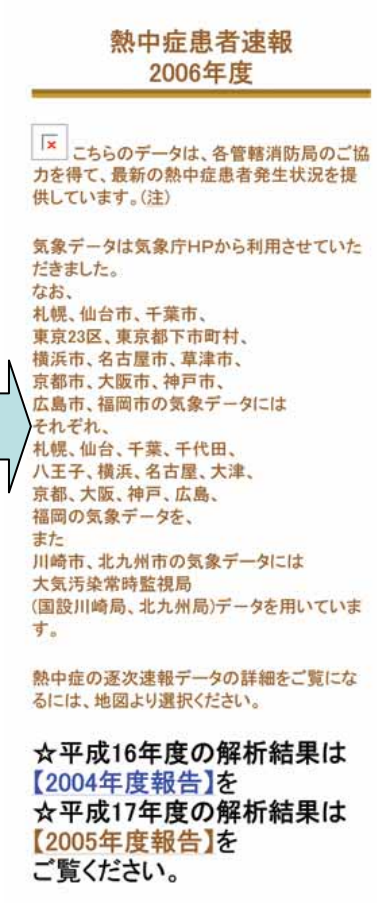
(b) Standalized





Heat Stroke Early Warning System

http://www.nies.go.jp/impact/index.html

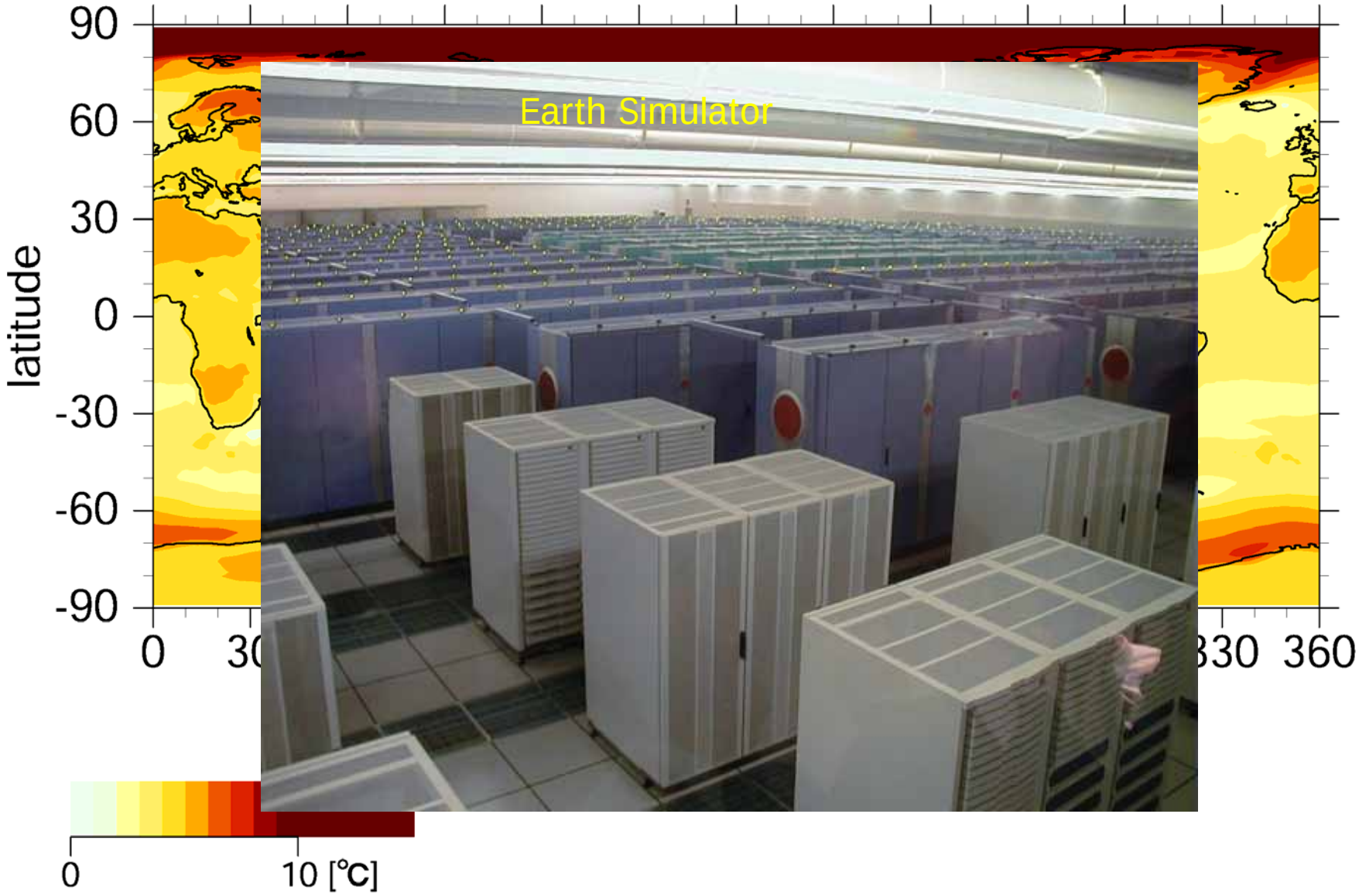


(注)ただし、ここでの熱中症患者数は、上記消防庁・消防局管内で救急車により搬送された患者数であり、救急車を使わずに直接医療機関を受診した患者、あるいは受診されなかった患者さんは含まれていません(なお、熱中症患者情報は暫定値であり、後日修正されることがあります)。

http://www.nies.go.jp/health/HeatStroke/index.html

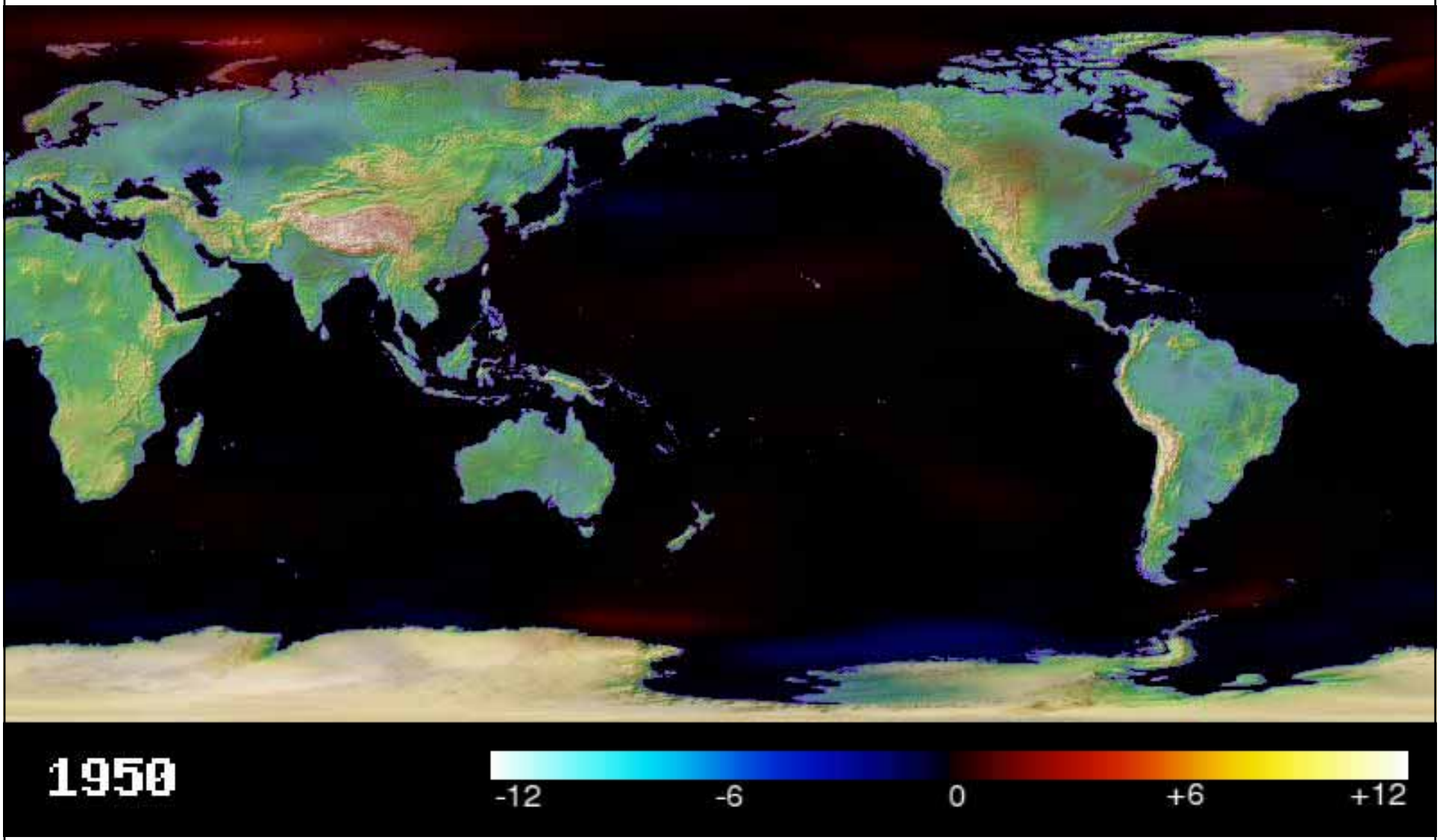
Future Climate Projection

Future Climate Projection by the Earth Simulator



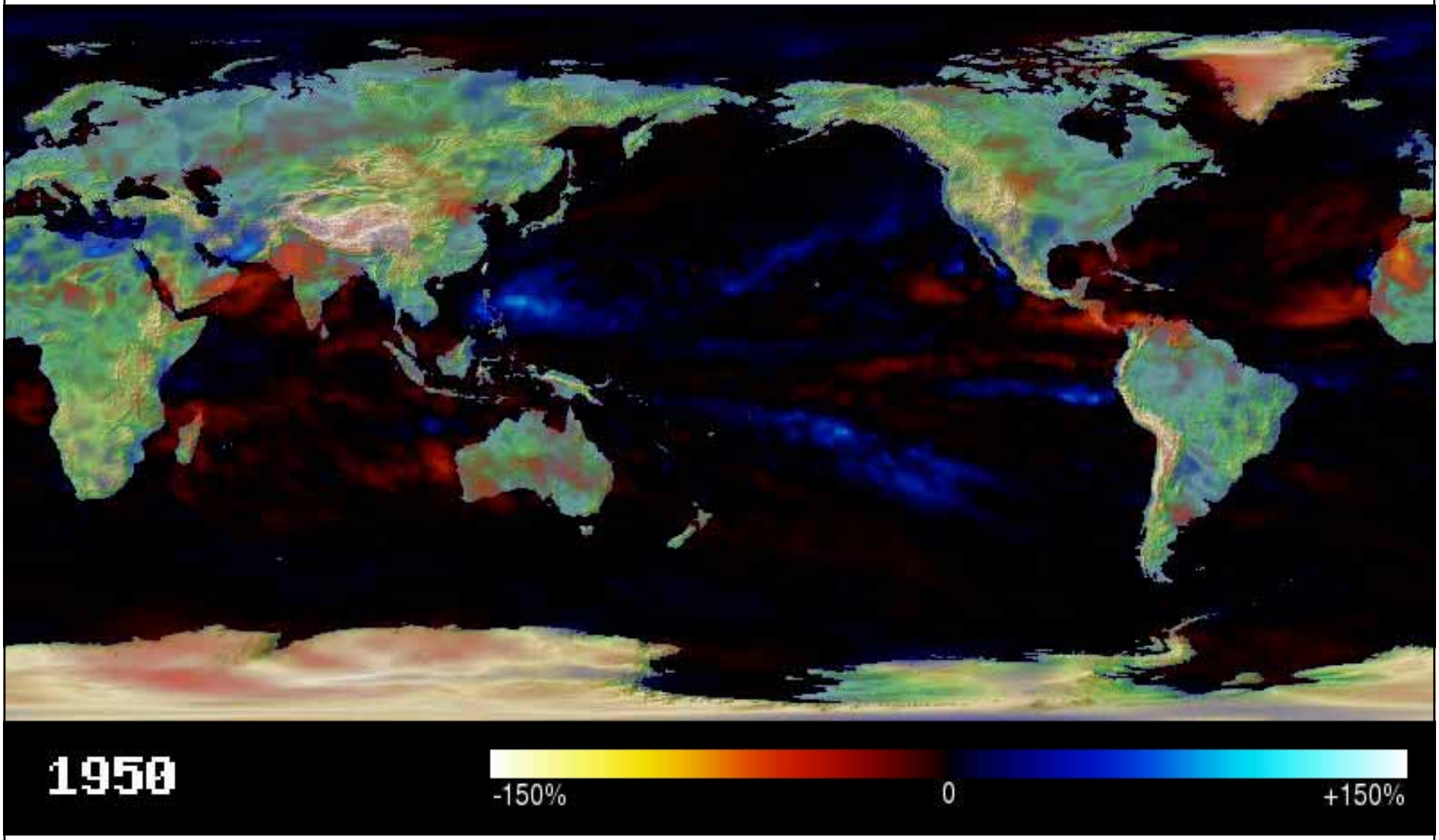
NIES/CCSR/JAMSTEC

Temperature (1950～2100)



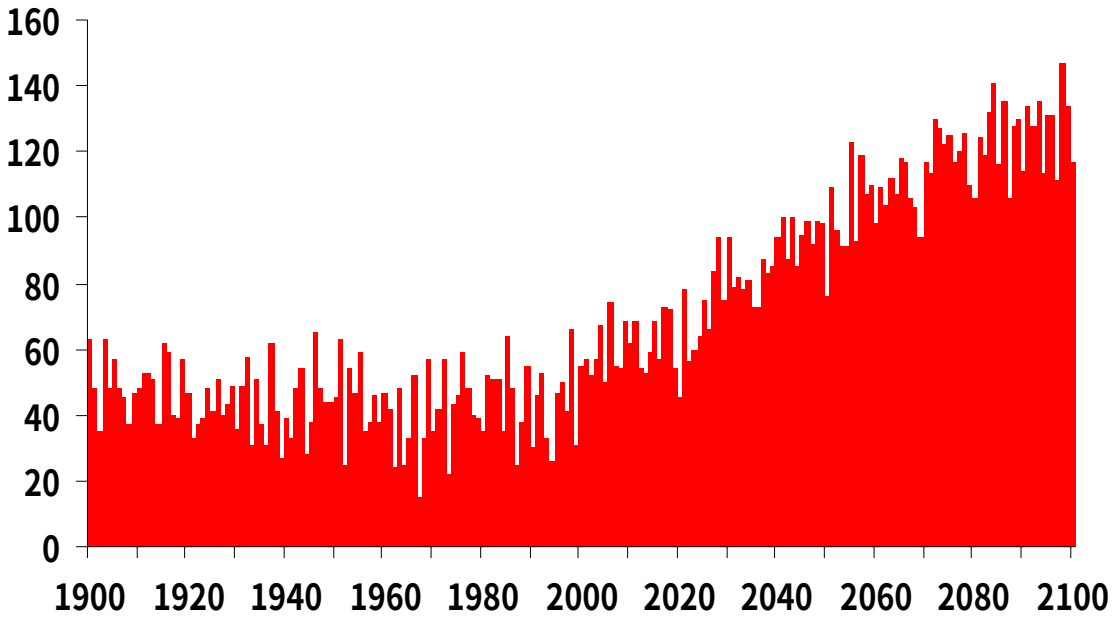
NIES/CCSR/JAMSTEC

Precipitation (1950～2100)



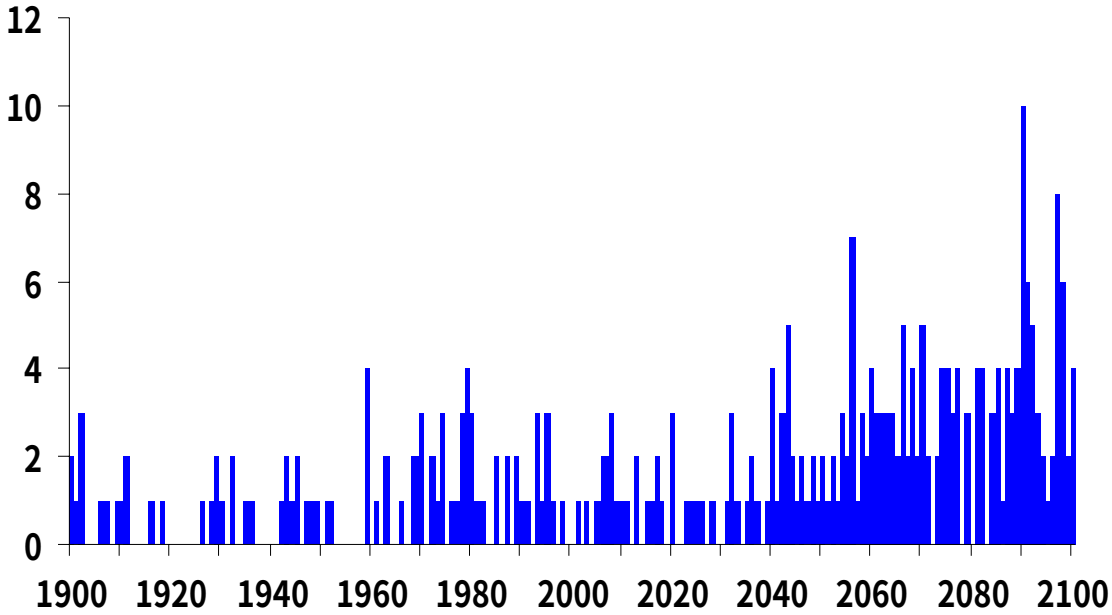
Change in Precipitation (%)

NIES/CCSR/JAMSTEC



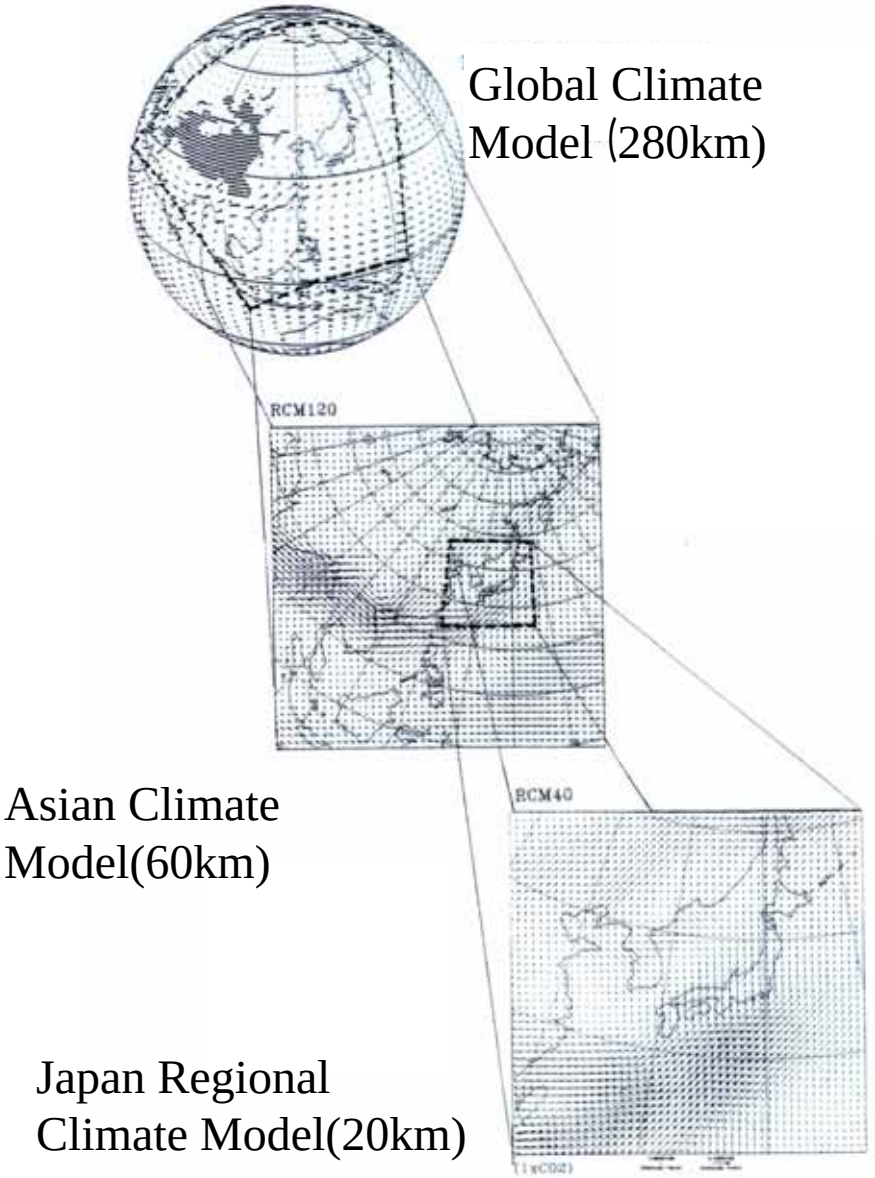
Change in higher temperature days（1900～2100）

Daily maximum temperature 30 ^{o}C without heat island effects



Change in summer heavy rain (June-August, 1990～2100）

Daily precipitation is more than 100mm



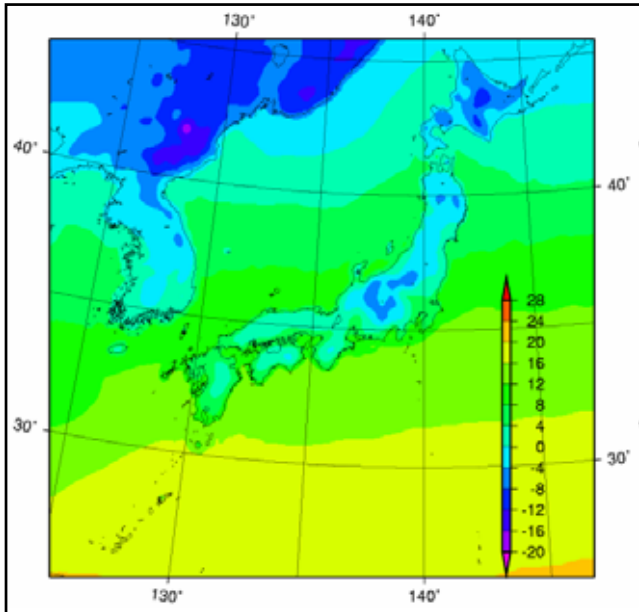
Regional Climate Model (JMA/MRI)

To predict future regional climate change in spatially high resolution (20km)

Nesting

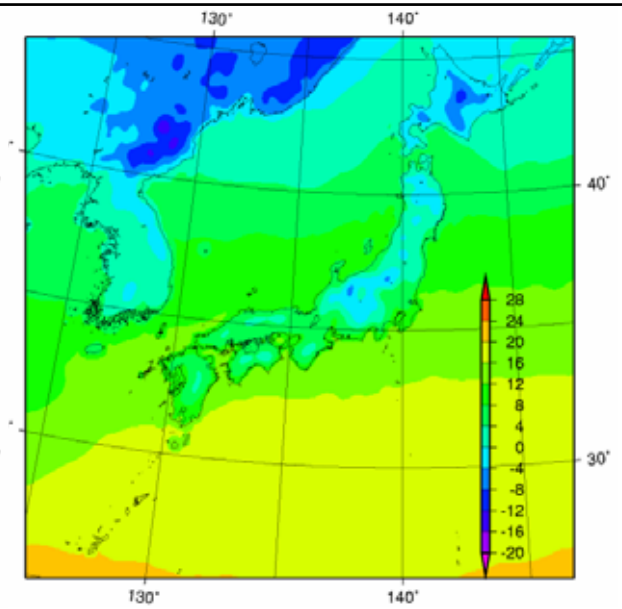
To use GCM output as boundary conditions for regional Climate Model

Japan Meteorological Agency (JMA)/ Metrological Research Institute (MRI)



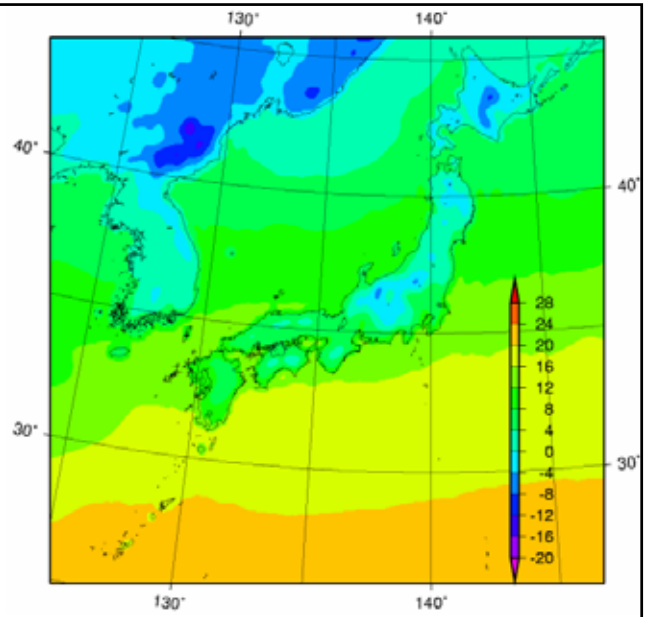
Present

(1981～2000 Ave.)



50 years

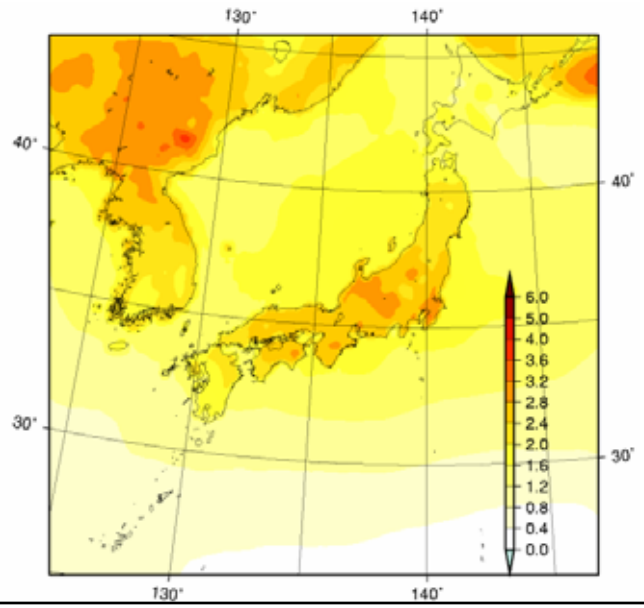
(2031～2050 Ave.)

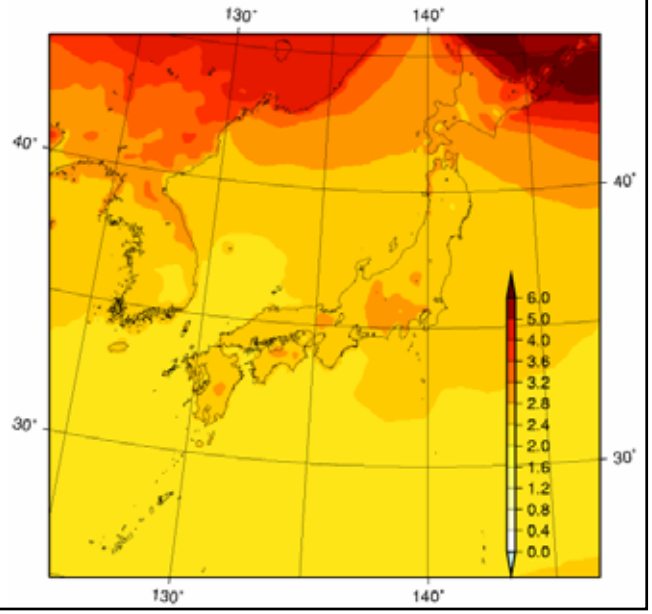


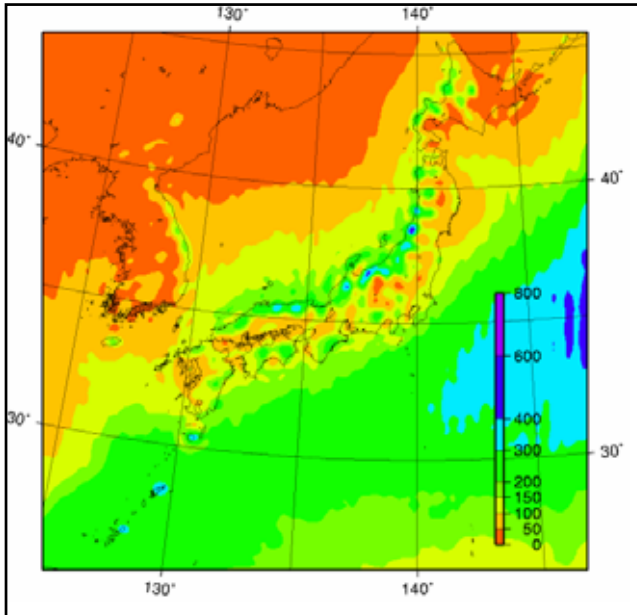
100 years

(2081～2100 Ave.)

Predicted Average Temperature in January

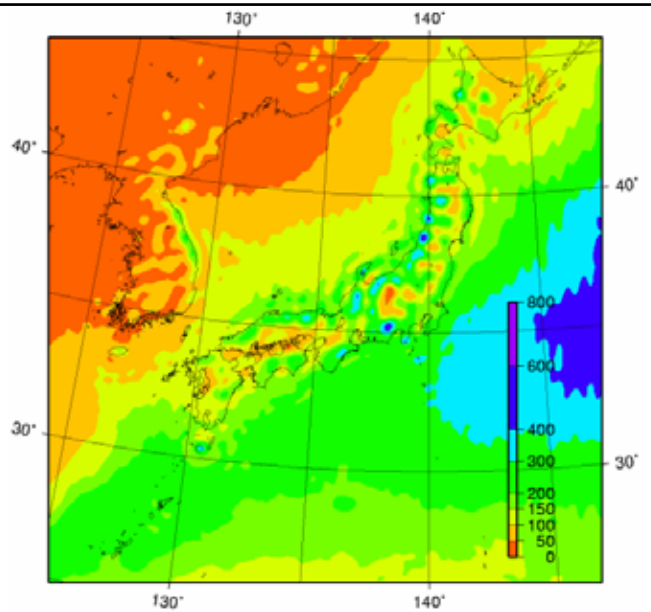






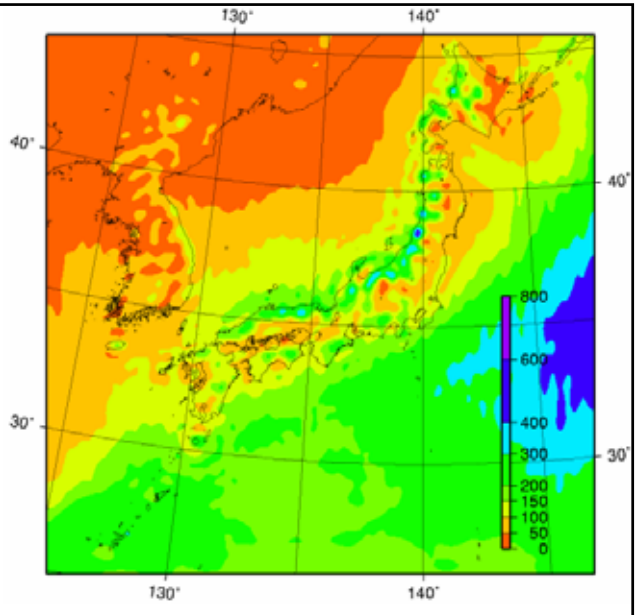
Present

(1981～2000 Ave.)



50 years

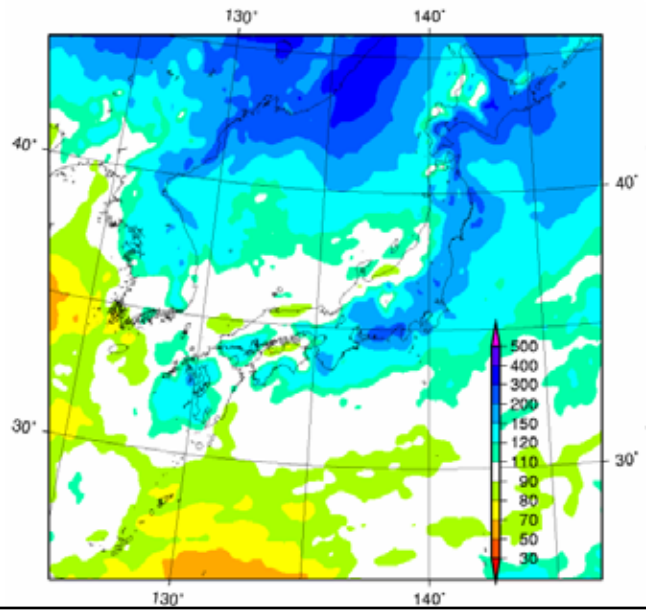
(2031～2050 Ave.)

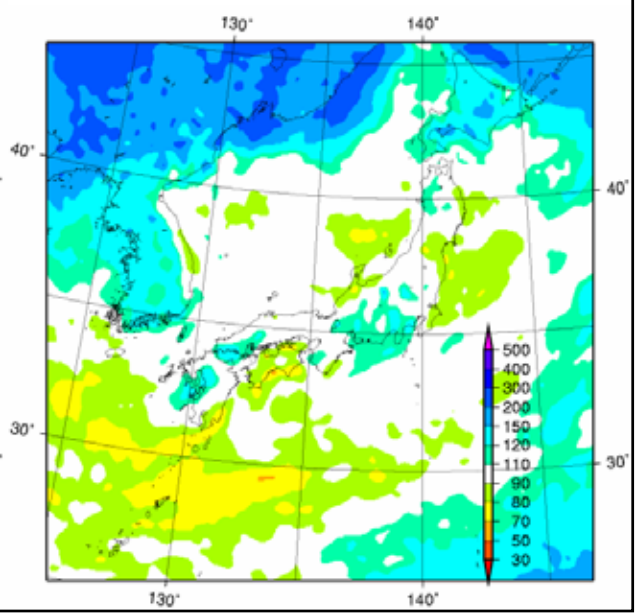


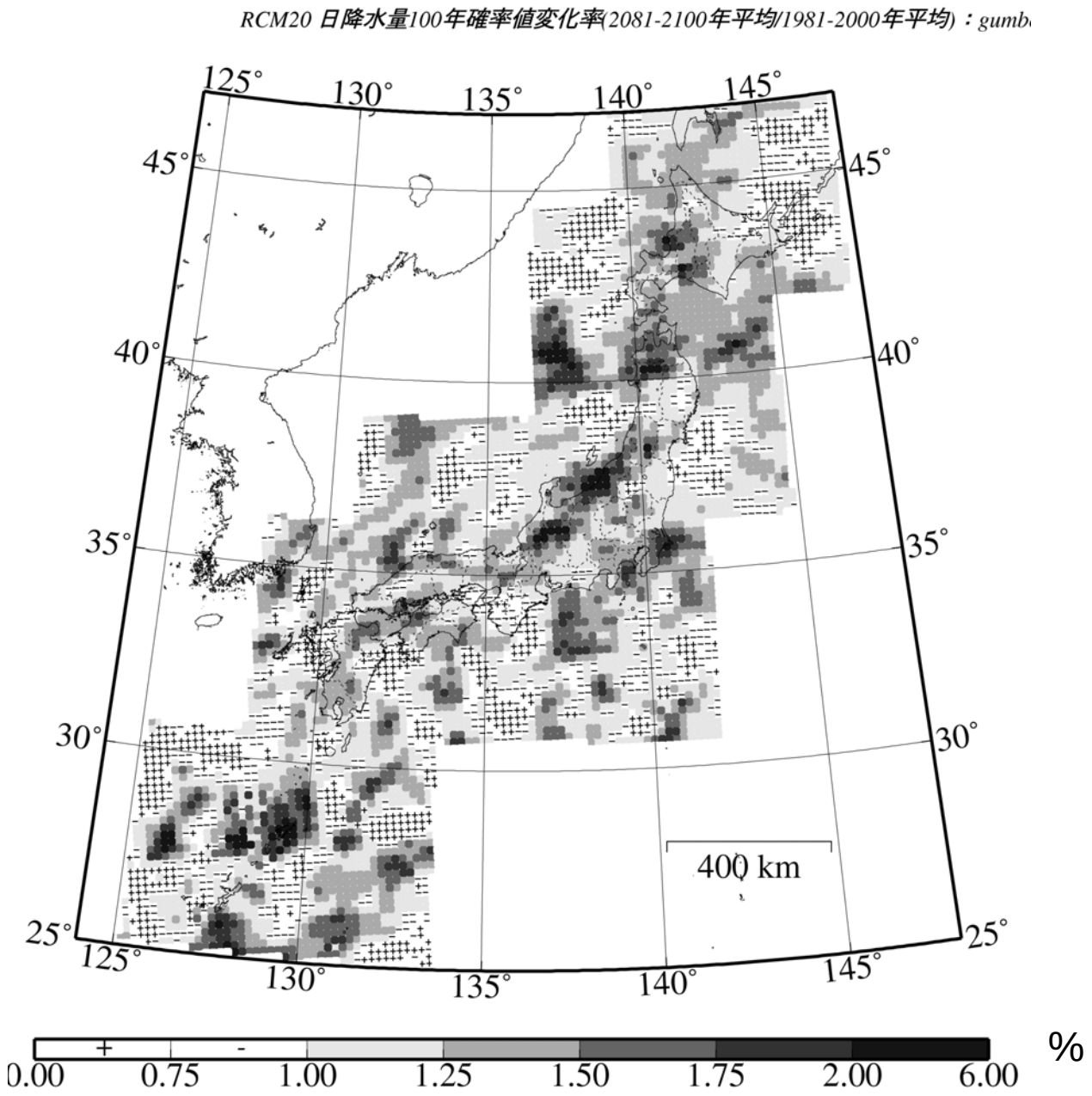
100 years

(2081～2100 Ave.)

Predicted Average Precipitation in January







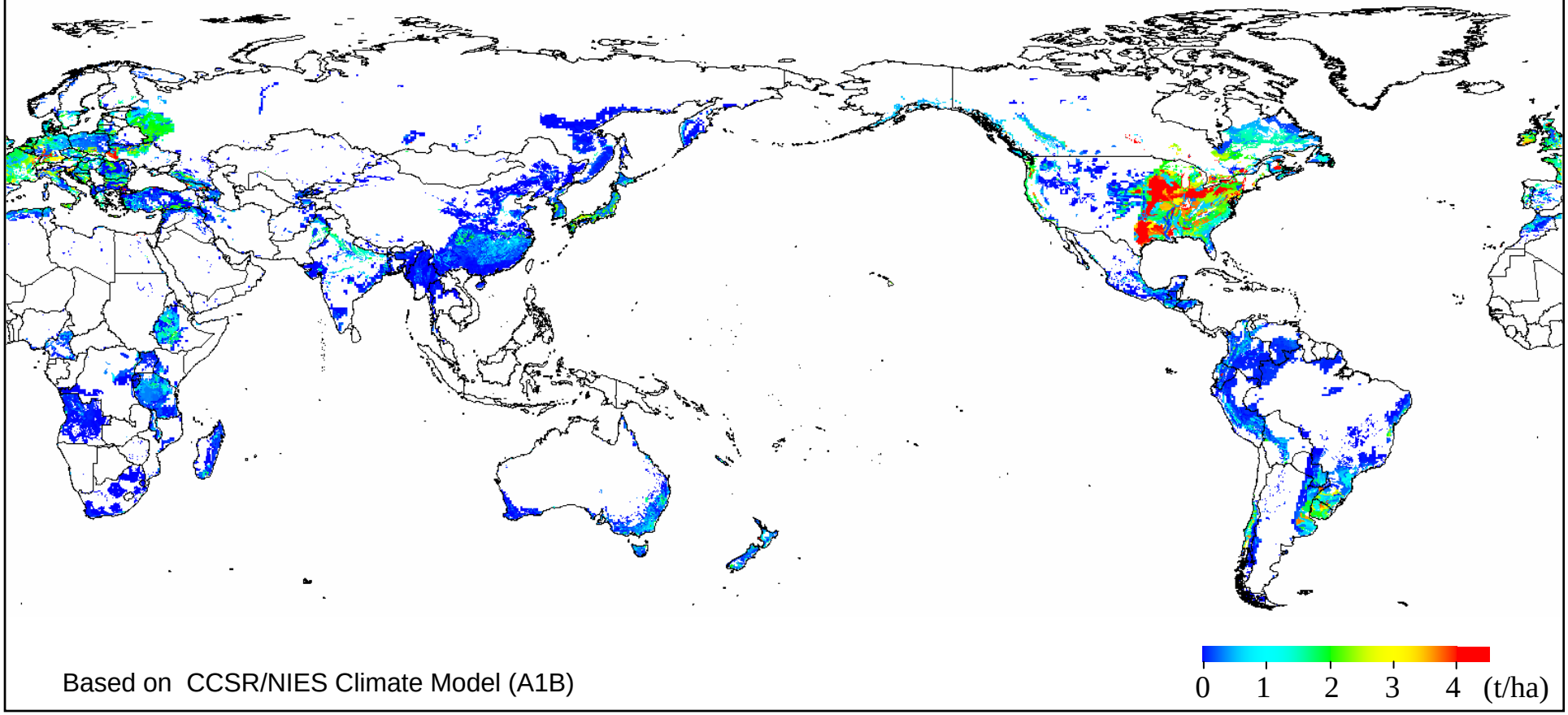
Dr. K. Wada (National Institute for Land and Infrastructure Management)

Fig Change in 100 years probability maximum daily precipitation using Gumbel Distribution (Future (100 years)/ present)

Future Impacts

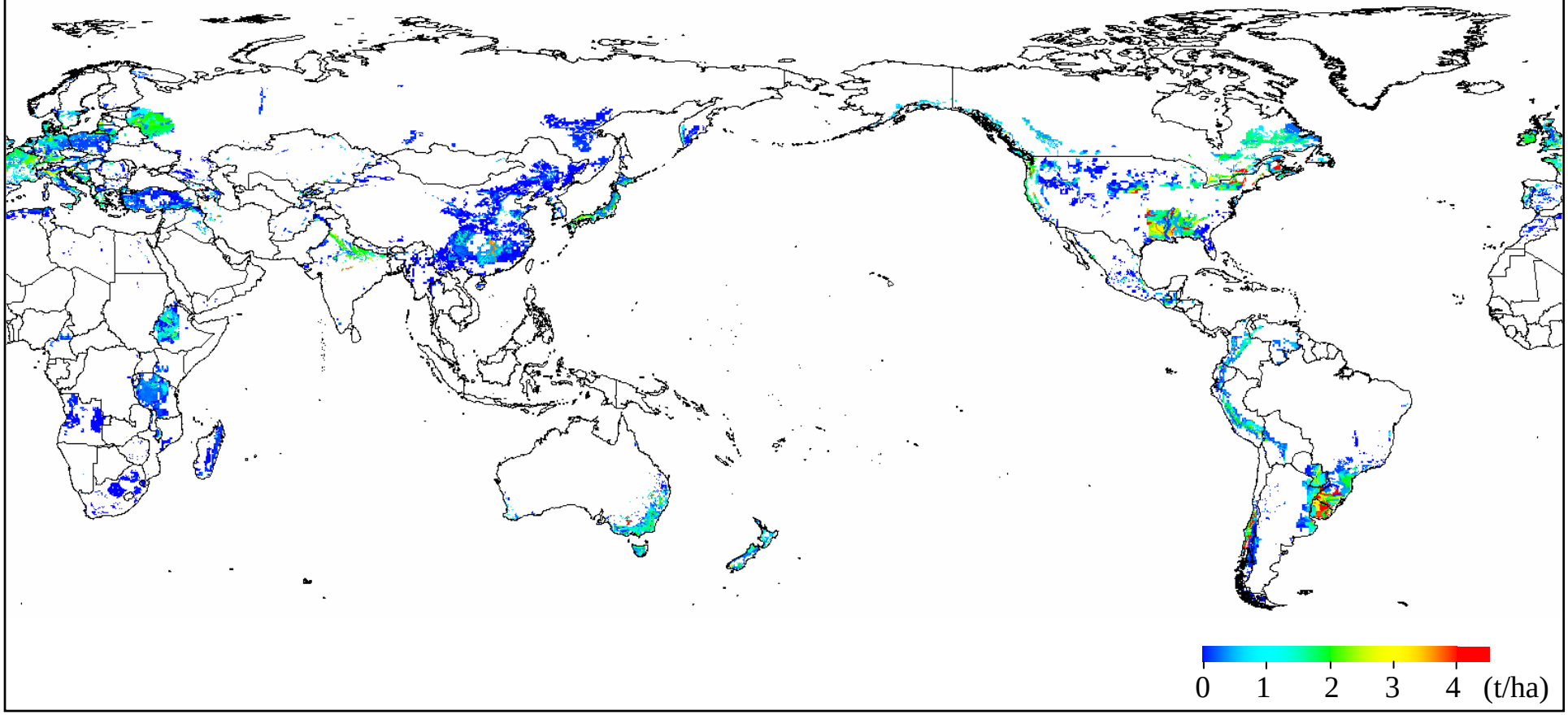
A: Potential productivity of wheat in 2000 and 2050

1) Potential Productivity of wheat in 2000

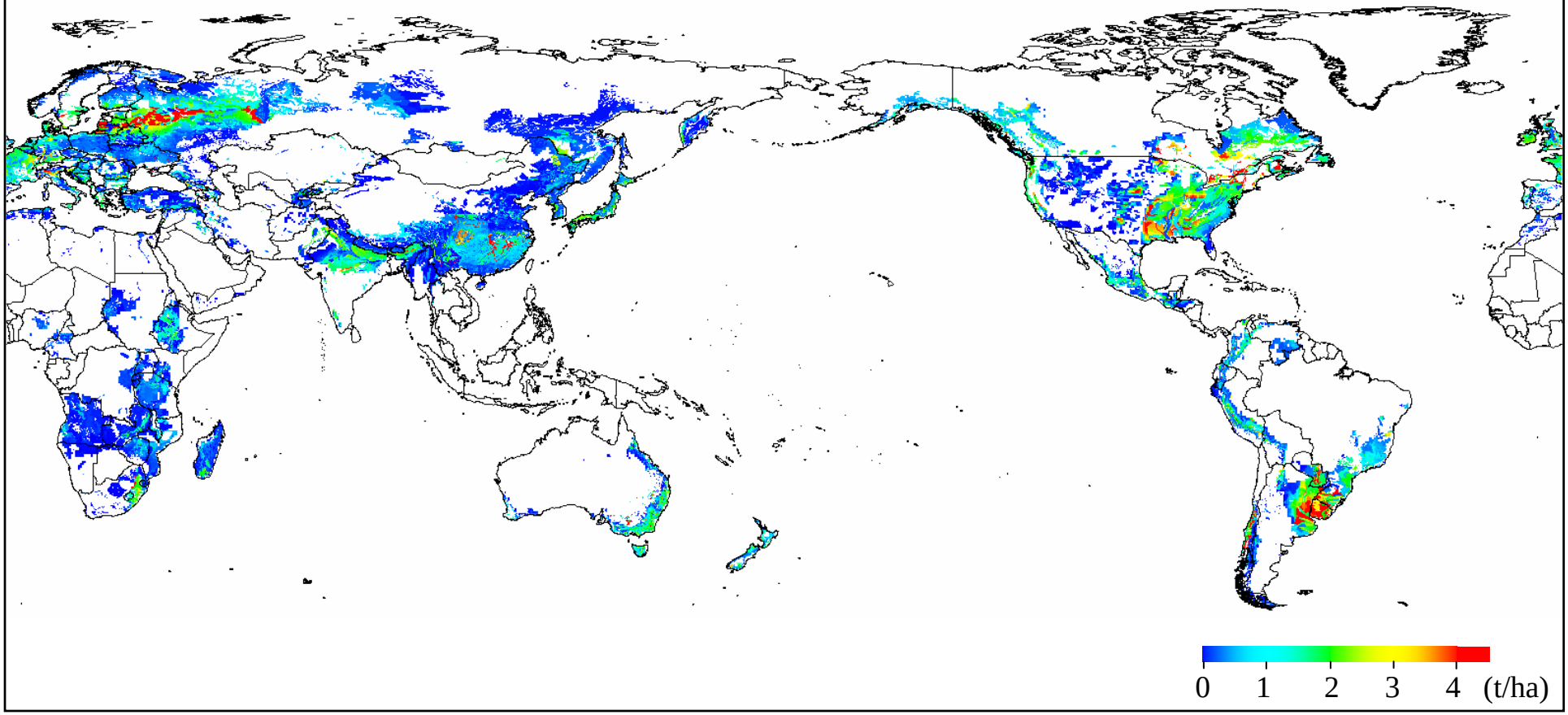


Based on CCSR/NIES Climate Model (A1B)

2) Potential Productivity of wheat in 2050 (No adaptation case)

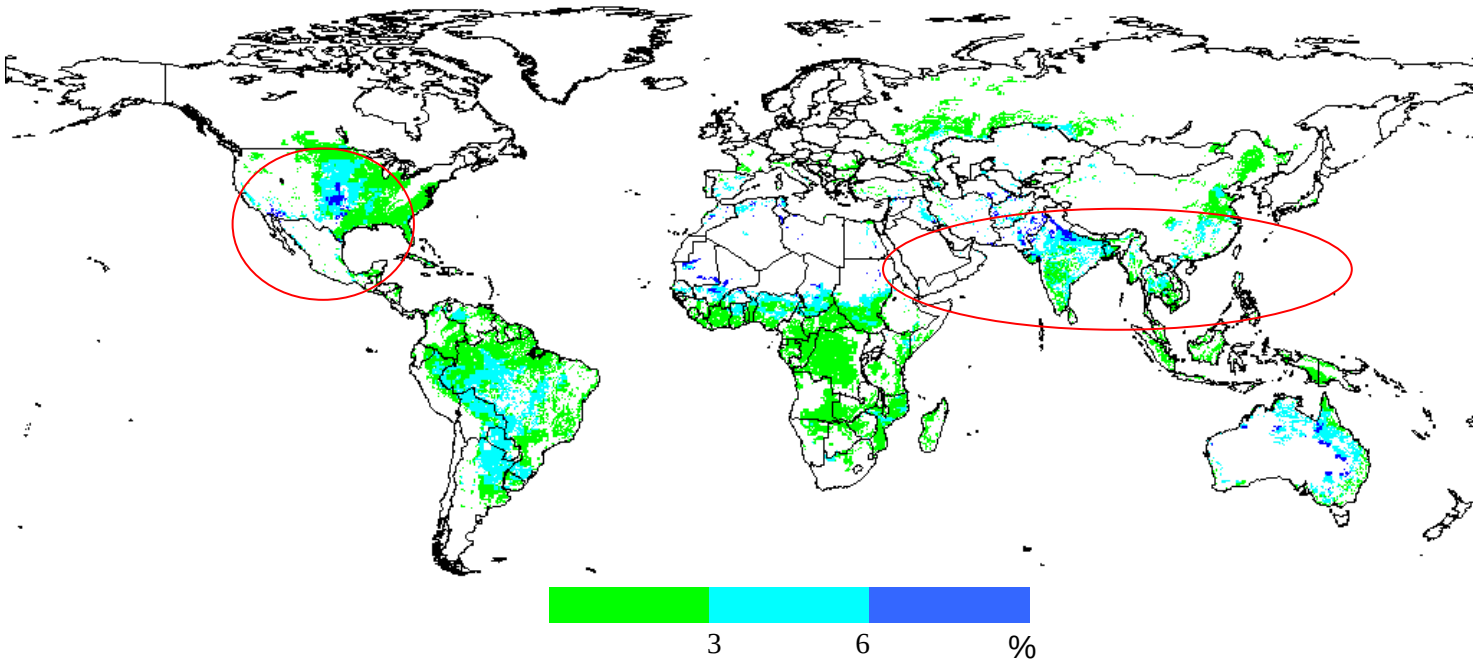


3) Potential Productivity of wheat in 2050 (Adaptation case: changing variety and planting date)



B) Heat Damage on Rice Production (Present Condition)

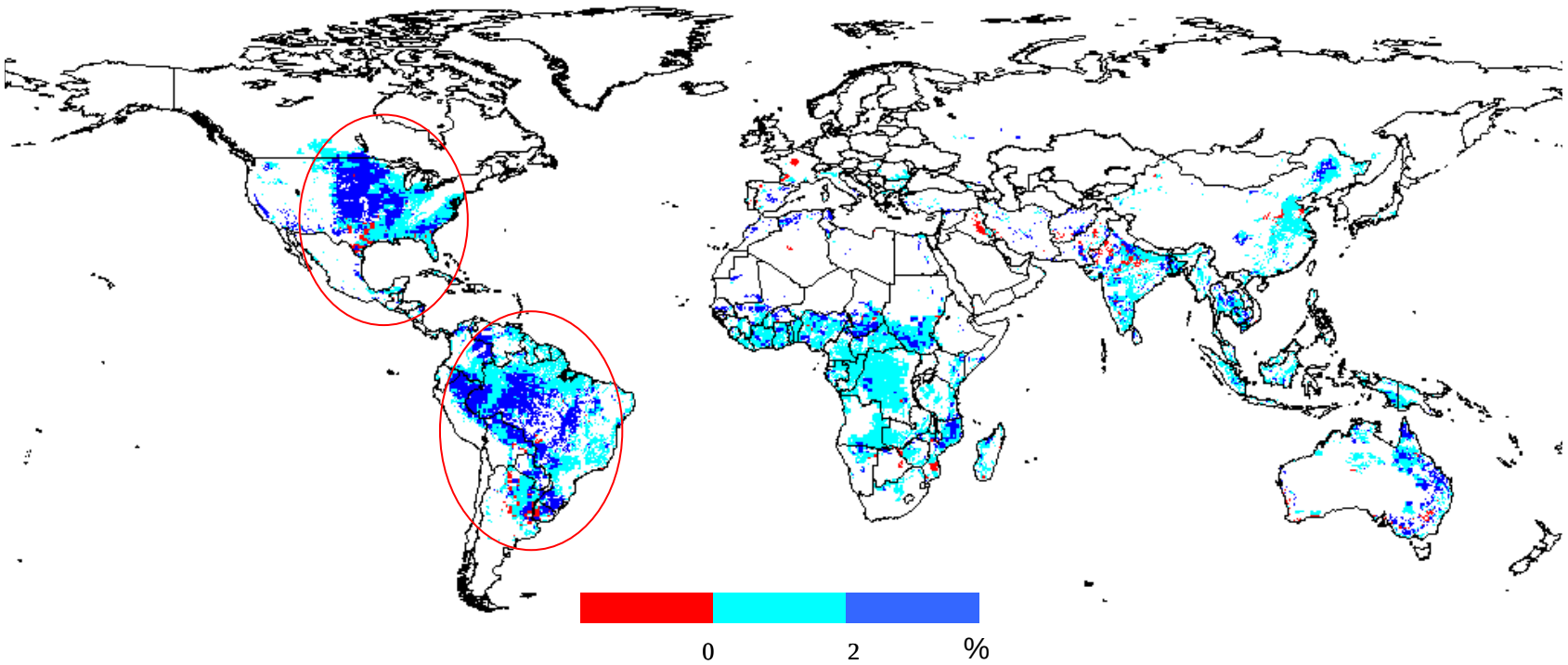
- Damage due to heat wave occurred in some regions



Damage Index = [Productivity without heat stress (A)－Productivity with heat stress (B)] / (A)

Heat Damage on Rice Production (2060)

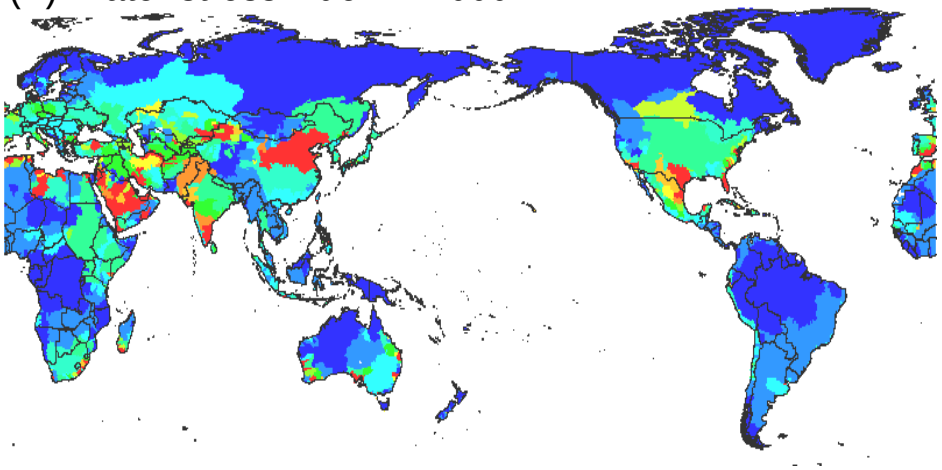
- Damage will increase in the whole world



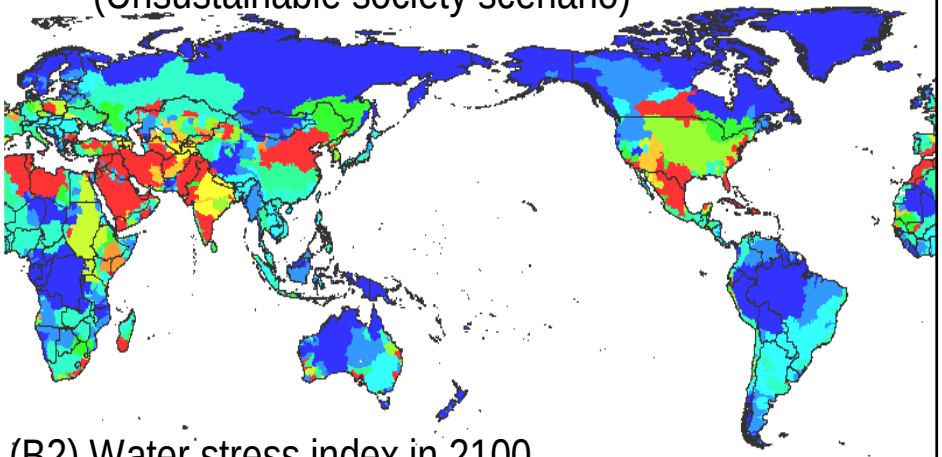
Change in Index＝ Index (2060)－Index (1990)

C) Water stress index in 2000 and 2100

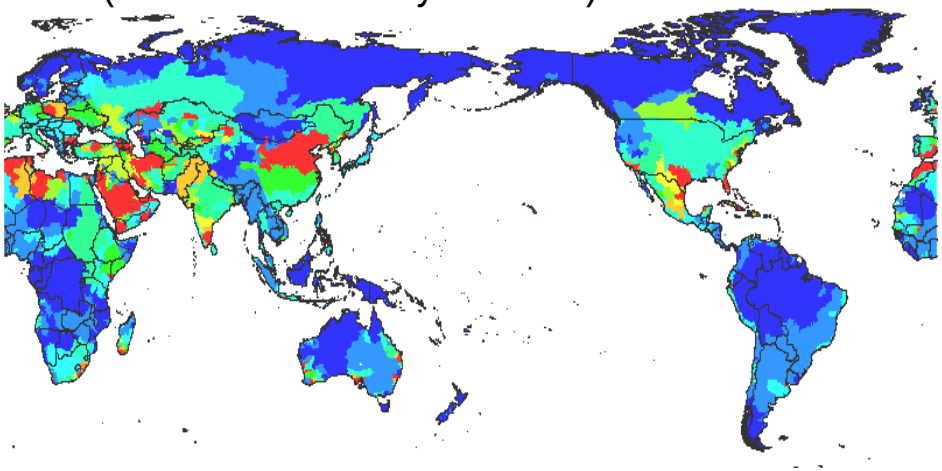
(A) Water stress index in 2000



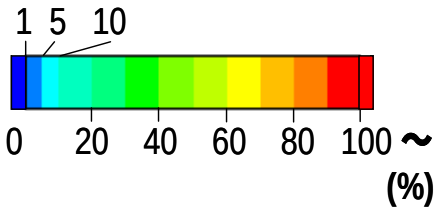
(B1) Water stress index in 2100
(Unsustainable society scenario)



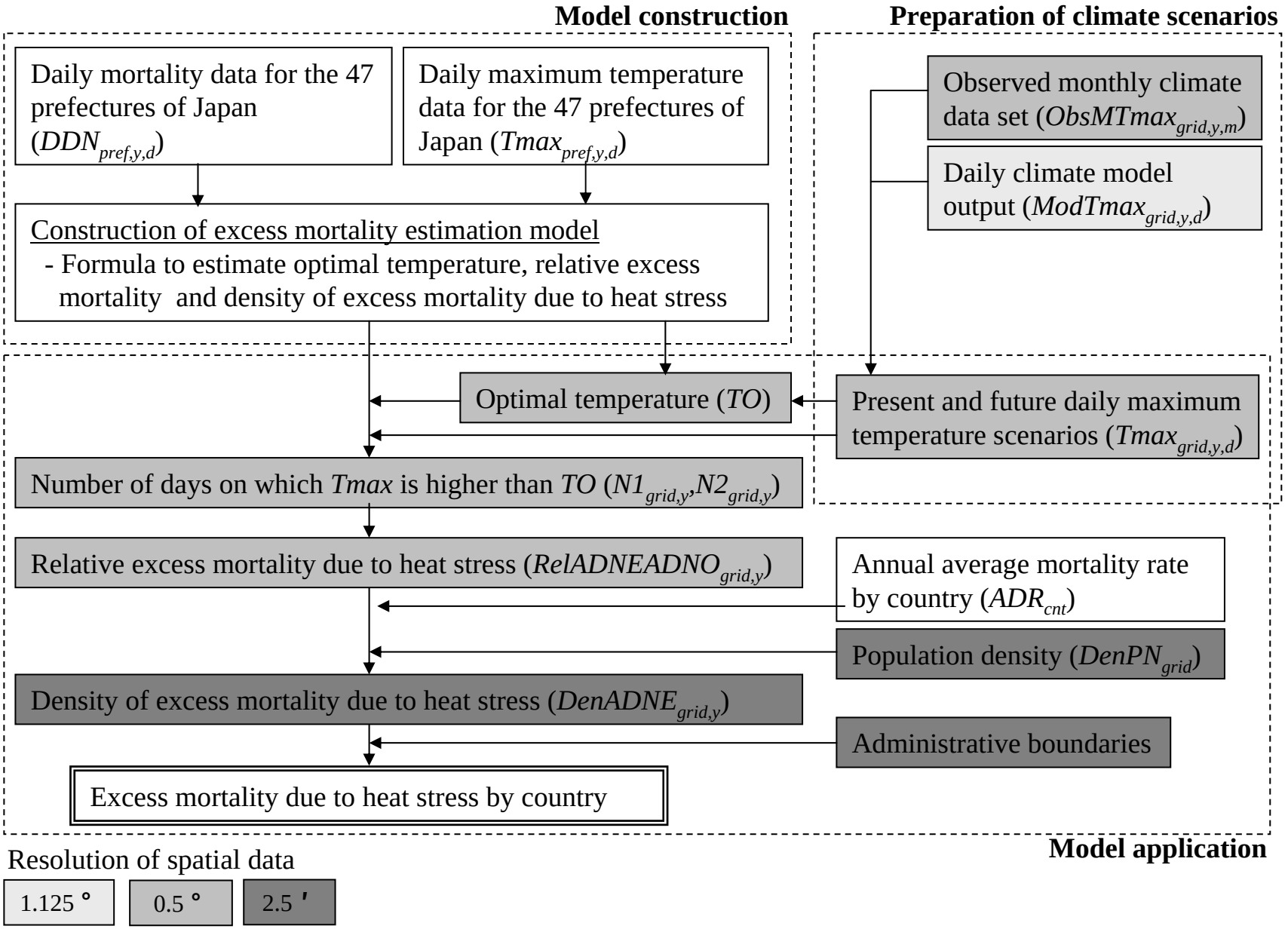
(B2) Water stress index in 2100
(Sustainable society scenario)



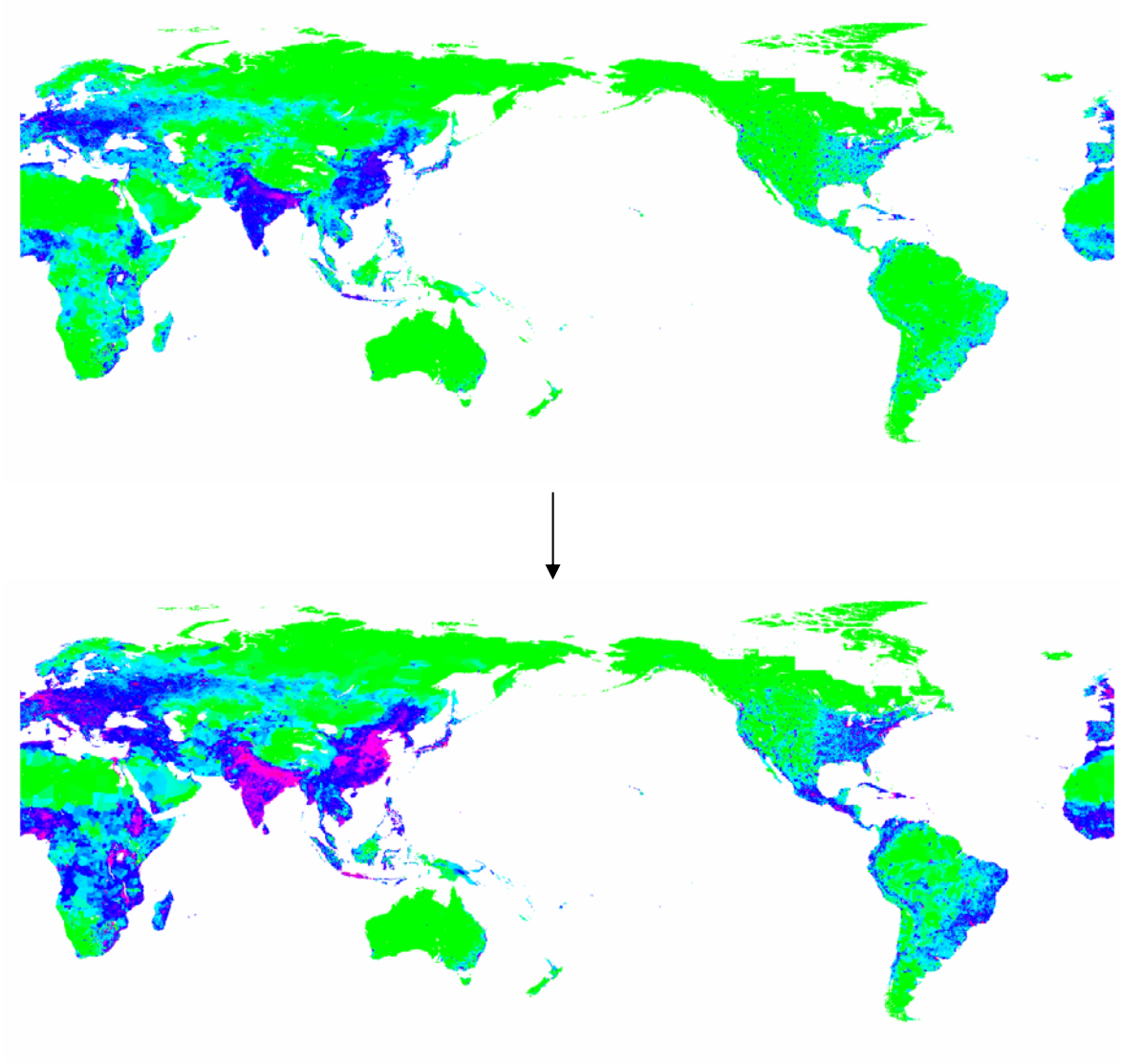
"Water stress index" is defined as the ratio between water withdrawal and renewable water resource in a river basin (figure's case), region, country or other boundaries. High value implies the higher risk of water shortage.



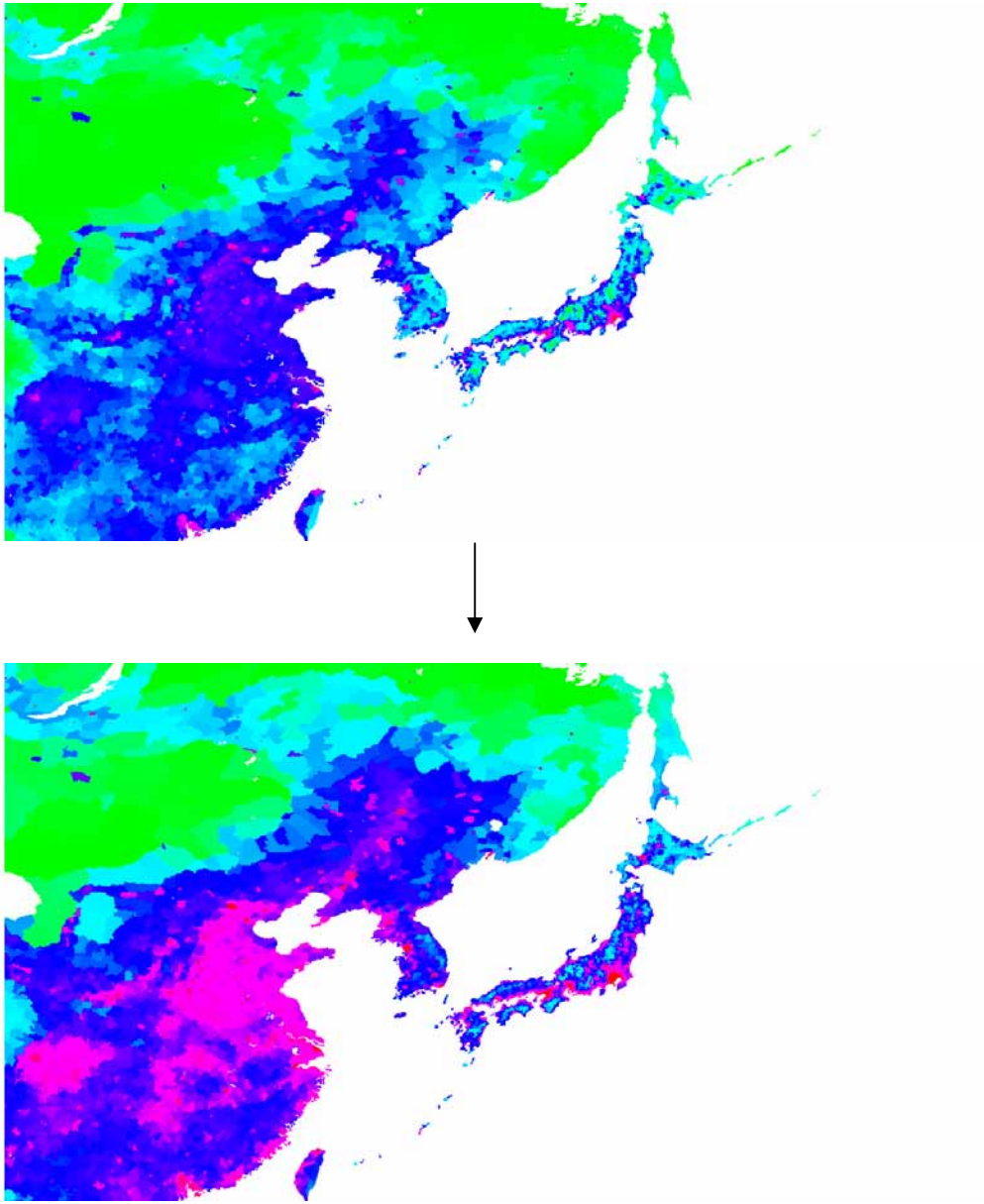
D) Heat stress Impacts



Excess mortality density due to heat stress in the existing condition and the future



Excess mortality density due to heat stress in the existing condition and the future



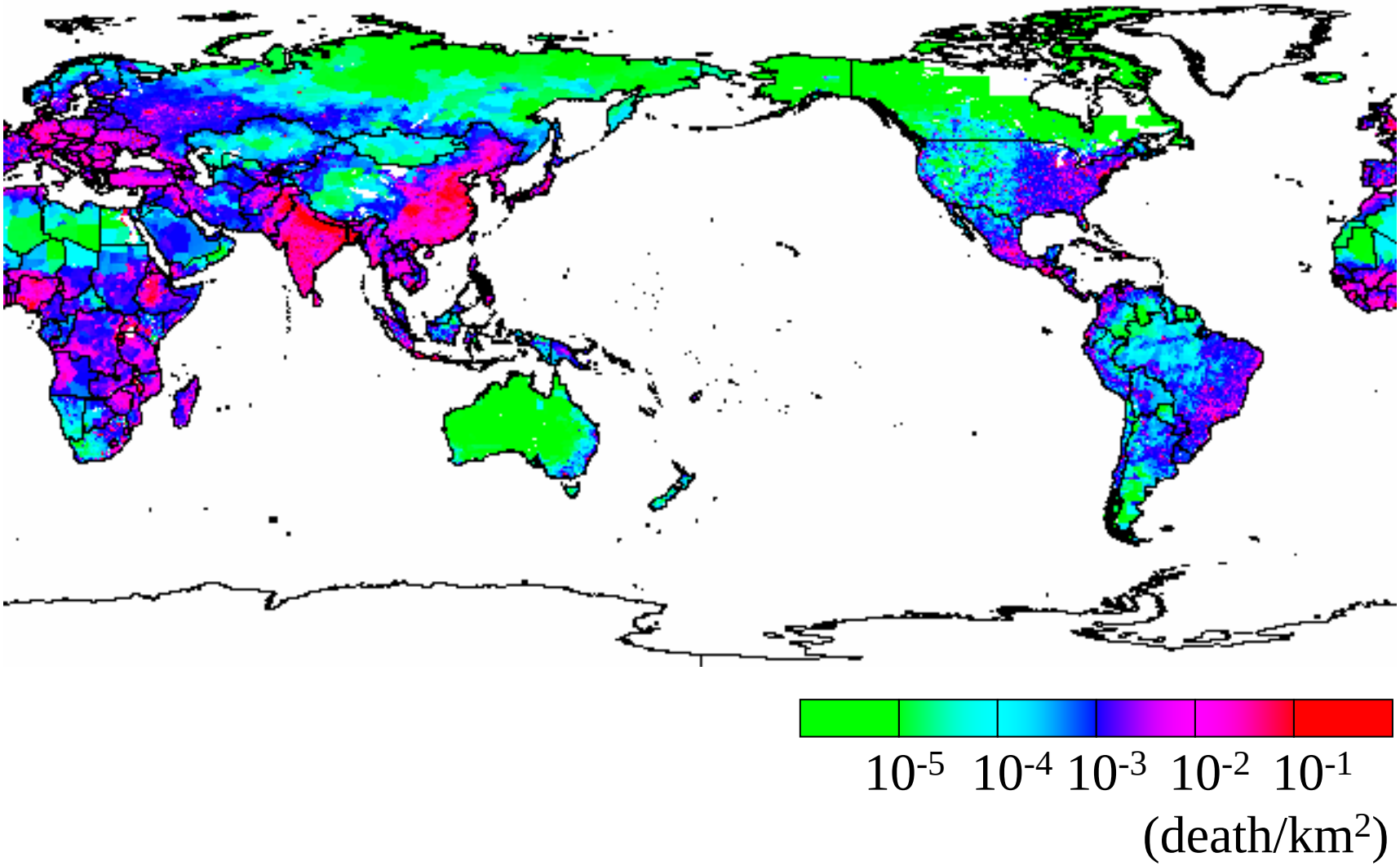
1990s

2090s

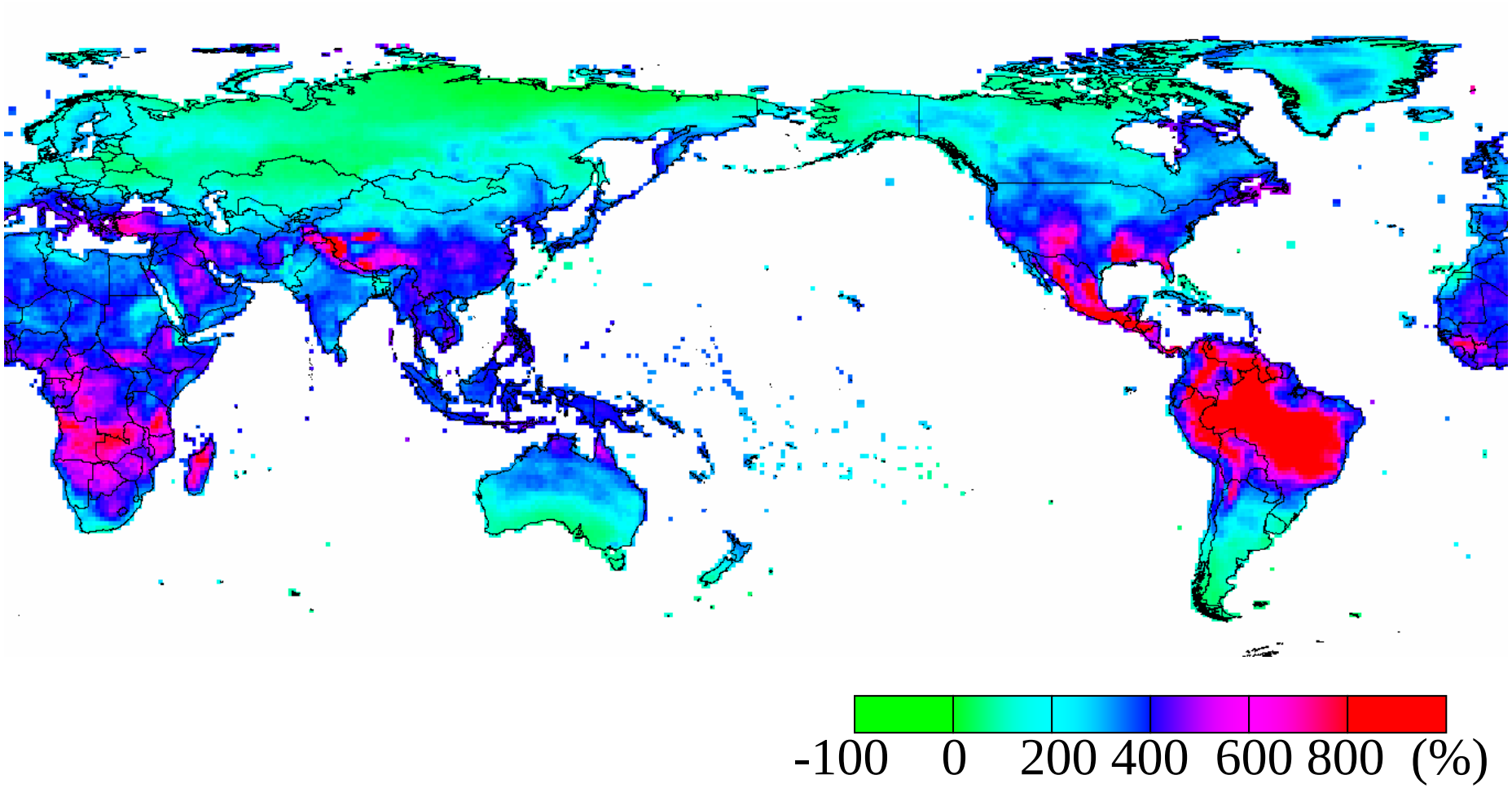
10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0}

(death/km^2)

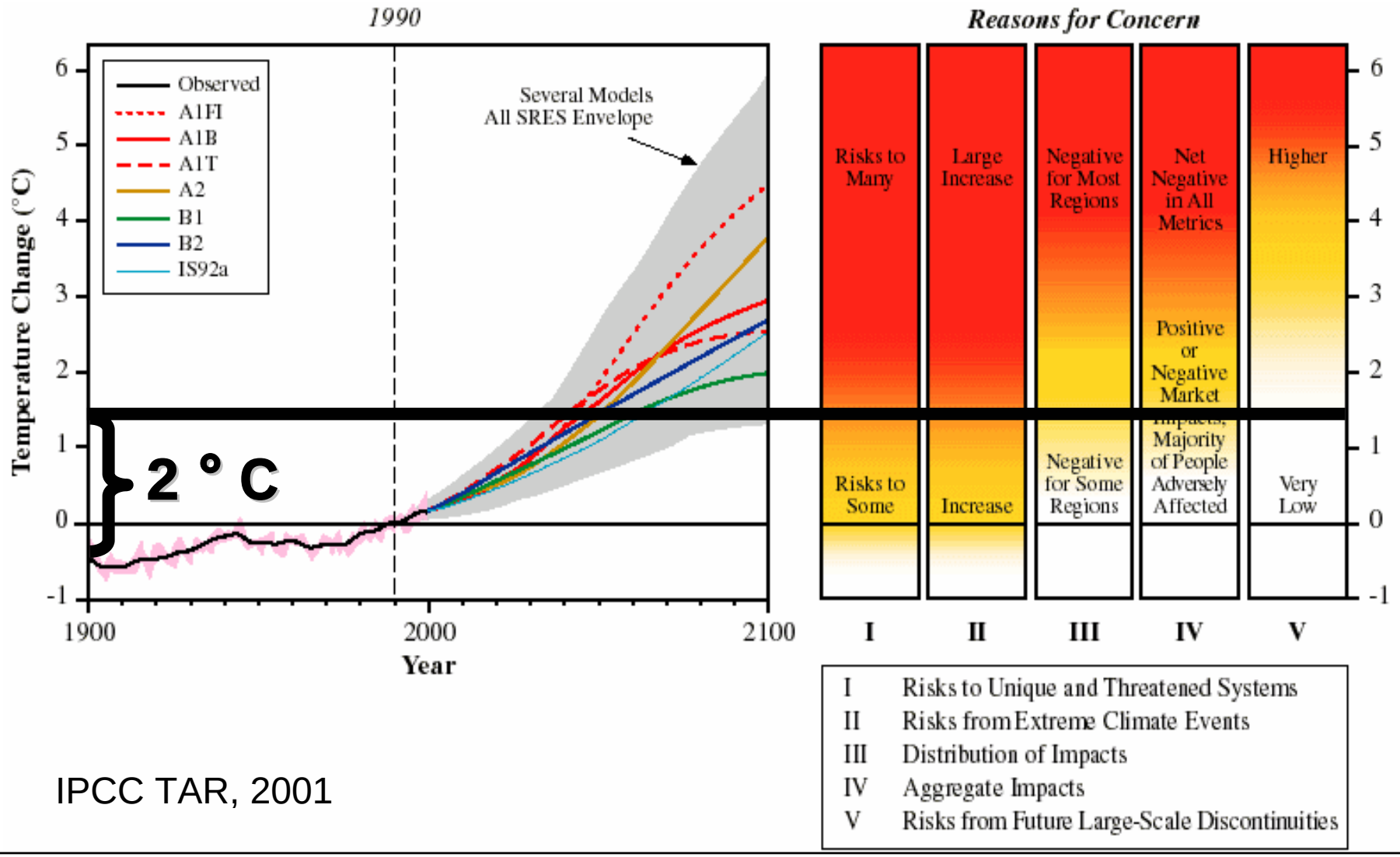
Changes in excess mortality density due to heat stress
(Future excess mortality density - Existing excess mortality density)



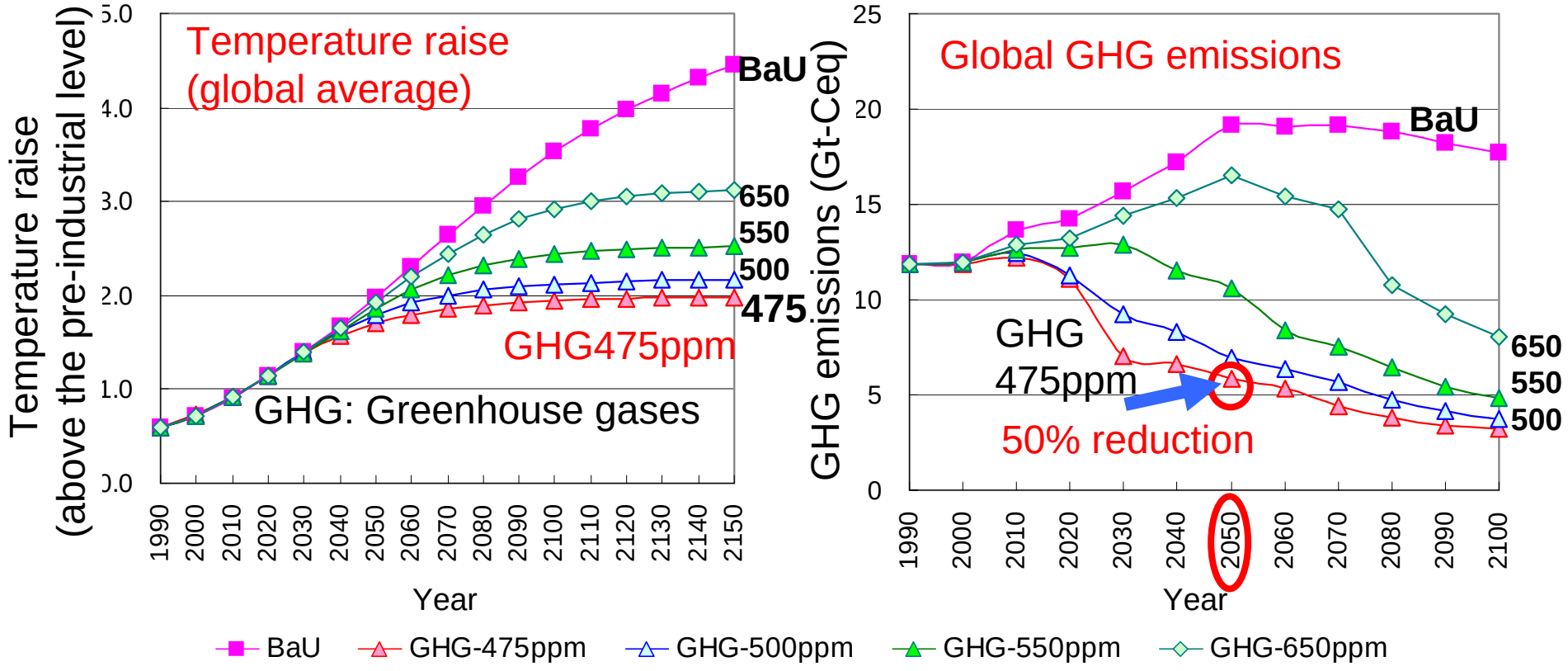
Rate of change of excess mortality density due to heat stress
(Future excess mortality density / Existing excess mortality density x 100 – 100 (%))



To avoid serious CC impacts, it is necessary to stabilize temperature rise below 2 degree compared with pre-industrialized level



IPCC TAR, 2001

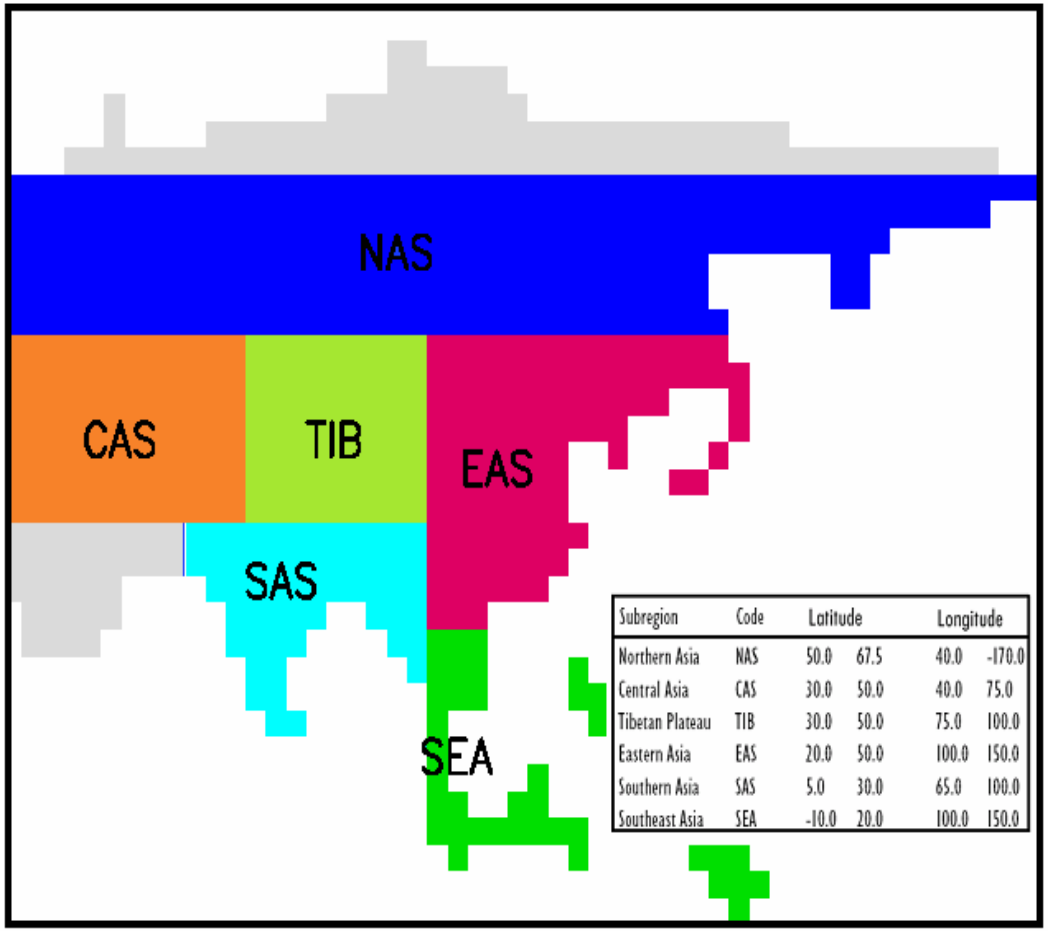


•It is estimated that around 50% GHG reductions in 2050 are required to control temperature raise below 2ºC

•Japan may be required more reduction (60-80%). Another country-level 2050 scenarios have been studied (UK 60%, Germany 80%, France 75%, and so on).

•Impacts will be occurred even in 2ºC temp control.
•Adaptation is necessary.

Calculated by AIM/Impact[policy] Model



Subregion	Code	Latitude		Longitude	
Northern Asia	NAS	50.0	67.5	40.0	-170.0
Central Asia	CAS	30.0	50.0	40.0	75.0
Tibetan Plateau	TIB	30.0	50.0	75.0	100.0
Eastern Asia	EAS	20.0	50.0	100.0	150.0
Southern Asia	SAS	5.0	30.0	65.0	100.0
Southeast Asia	SEA	-10.0	20.0	100.0	150.0

Figure Asia and its subregions as used in generating the climate change projections for SRES emission scenarios based on seven A-O GCM experiments

Table Vulnerability of key sectors to the impacts of climate change by subregions in Asia (Tentative)

Sub-regions	Food And Fiber	Biodiversity	Water Resource	Coastal Ecosystem	Human Health	Settlements	Land Degradation
North Asia	+1 / H	-2 / M	+1 / M	-1 / M	-1 / M	-1 / M	-1 / M
Central Asia	-2 / H	-1 / M	-2 / VH	-1 / L	-2 / M	-1 / M	-2 / H
Tibetan Plateau	+1/ L	-2 / M	-1 / M	NA	No Info	No Info	-1 / L
East Asia	-2 / VH	-2 / H	-2 / H	-2 / H	-1 / H	-1 / H	-2 / H
South Asia	-2 / H	-2 / H	-2 / H	-2 / H	-2 / M	-1 / M	-2 / H
Southeast Asia	-2 / H	-2 / H	-1 / H	-2 / H	-2 / H	-1 / M	-2 / H

Vulnera-bility:
-2 – Highly Vulnerable
-1 – Moderately Vulnerable
0 – Slightly or Not Vulnerable
+1 – Moderately Resilient
+2 – Most Resilient

Level of Confidence:
VH - Very High
H - High
M - Medium
L - Low
VL - Very Low

Summary

1) Impacts of Global Warming have been observed in AP region.

2) Significant impacts will be predicted in all sub-regions and sectors.

3) Precise regional climate prediction is necessary to conduct regional vulnerability assessment.

4) Adaptation is key measures to mitigate current and future impacts.

5) Research Needs

To identify Hot spots/sectors in AP region

To assess long-term and short-term (extreme events) impacts and adaptation measures

To identify thresholds of impacts

To assist capacity building of Impact researchers in AP region