Climate Change: Past, Present and Future

John E. Hay

University of Waikato, New Zealand

Ibaraki University, Japan

Lead Author,

Intergovernmental Panel on Climate Change

Take Home Message #1

Climate change is *not* new – the climate has always changed……

気候変動は新しいものではない―気候は常に変化してきた。

Take Home Message #2

But human activities are a *new and additional* cause of climate change.

しかし、人間活動は、気候変動の新しい追加的な原因である。

Take Home Message #3

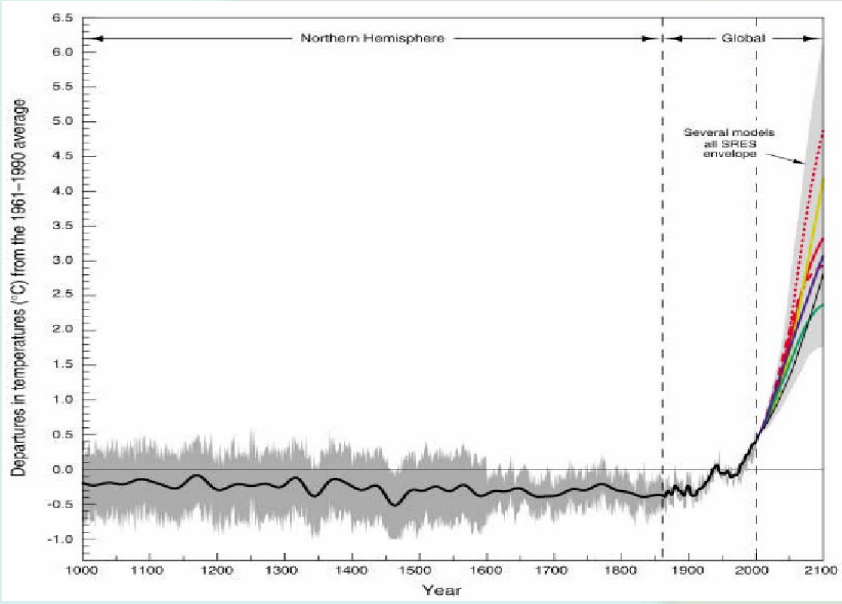
The new climatic conditions are already having major, and increasing, social and economic consequences.

現在の新しい気候状態は、既に、社会・経済に対して、大きく、かつ増加しつつある影響を及ぼしている。

Take Home Message #4

Both the rate of climate change, and the consequences, will likely escalate in the coming decades.

気候変動の速度と影響は、今後一層加速すると予想される。



Take Home Message #5

Urgent action is required, individually through to globally.

個人レベルから地球規模まで、すぐに行動を起こすことが必要である

Take Home Message #6

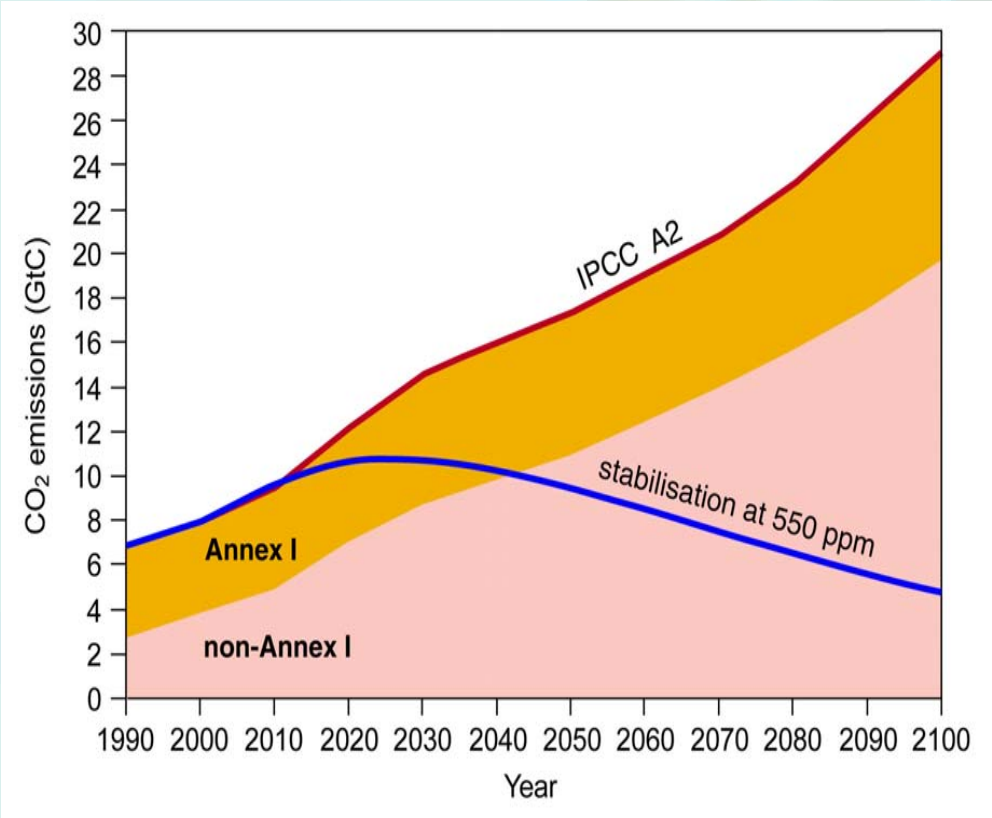
The cost of slowing climate change is minor, relative to the damages that will be avoided.

気候変動の速度を抑えるための費用は、それによって回避される被害額に比べて、少ない。

Take Home Message #7

Despite even our best efforts, the climate will continue to change for many decades at least.

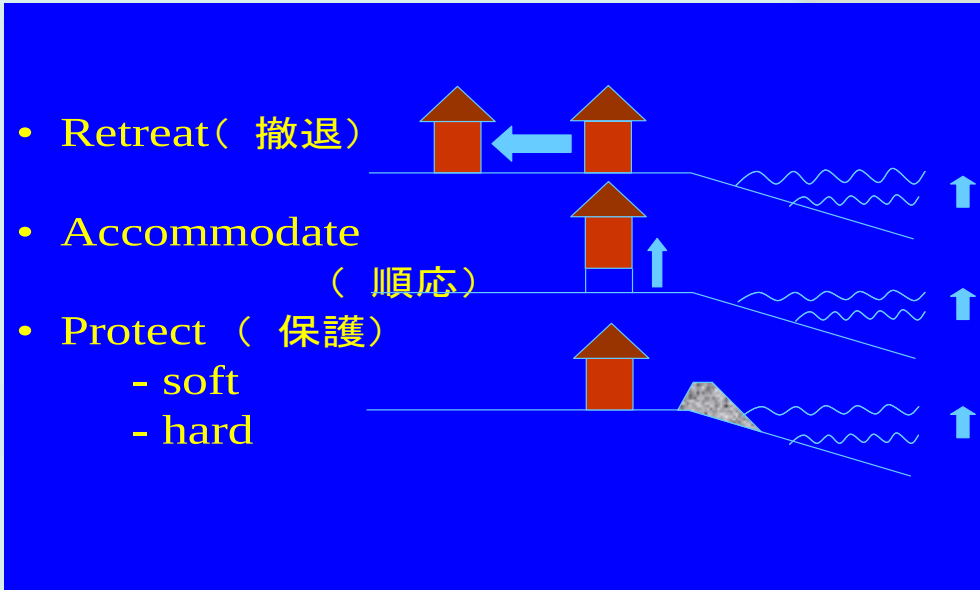
対策をとっても、気候は、少なくとも今後数十年間は変化し続ける。



Take Home Message #8

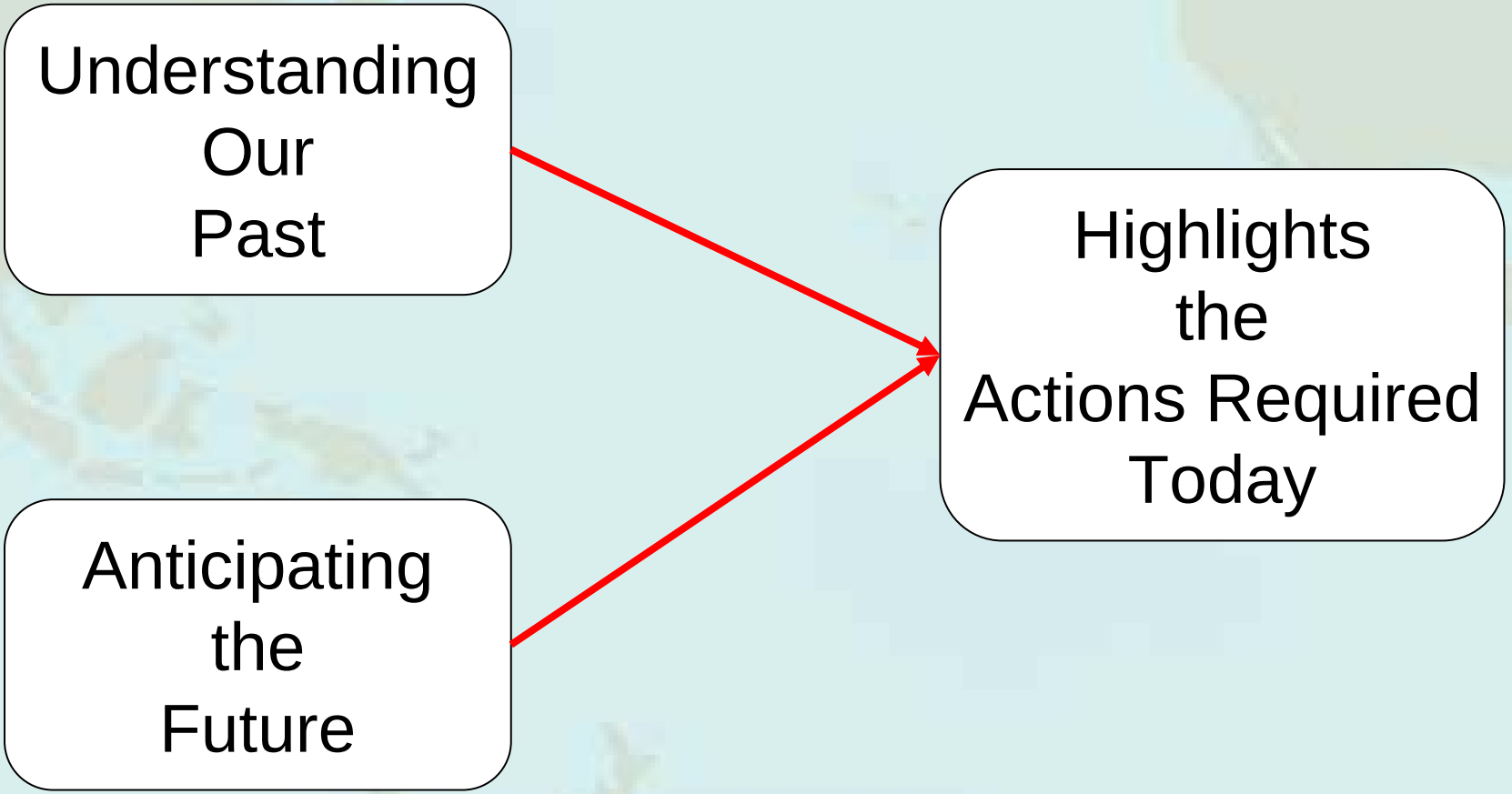
We must adapt, in order to minimise these unavoidable impacts.

その影響は避けられないが、できるだけ小さくするために、適応が必要である。



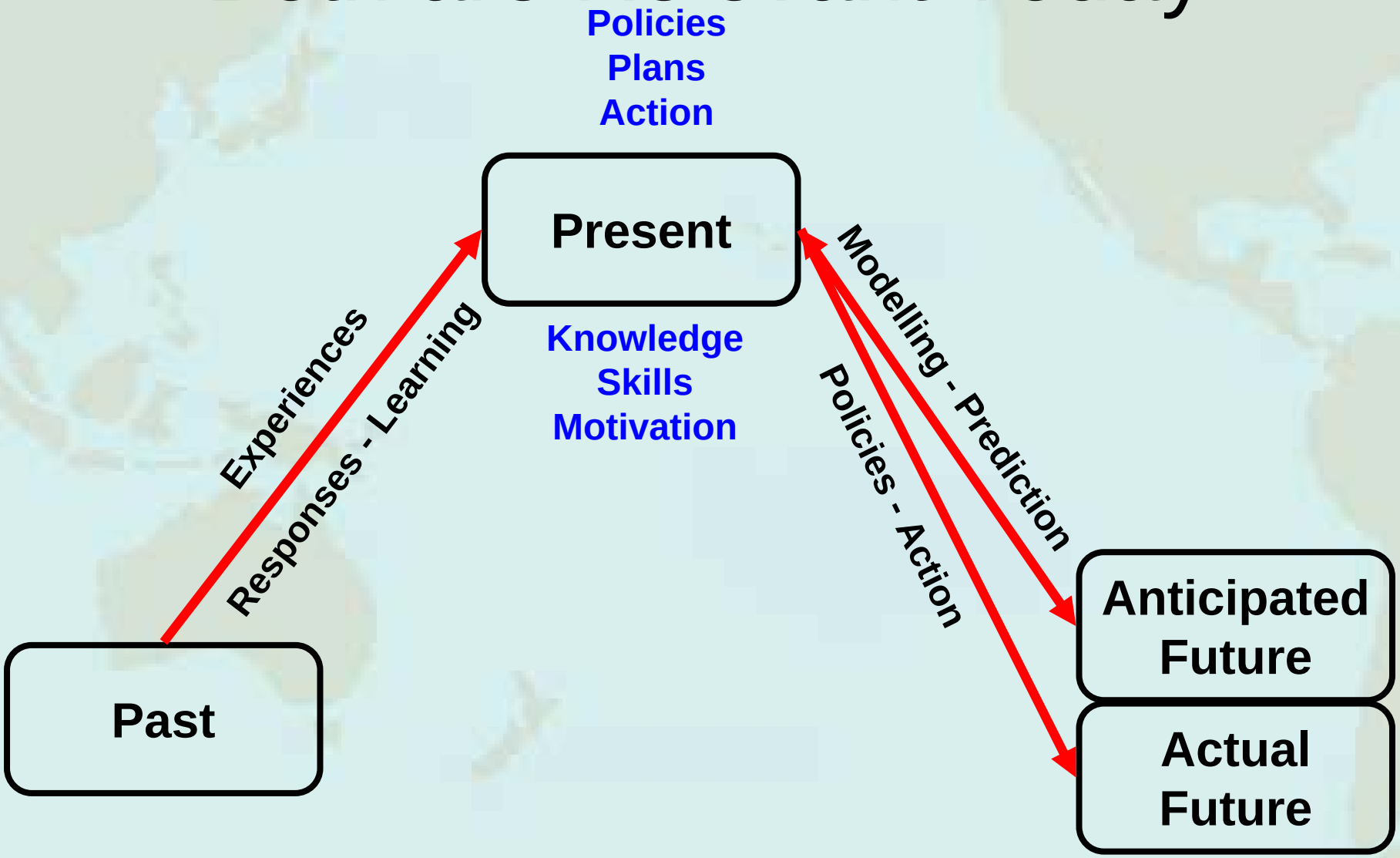
The Past and the Future:

Both are Relevant …… Today!



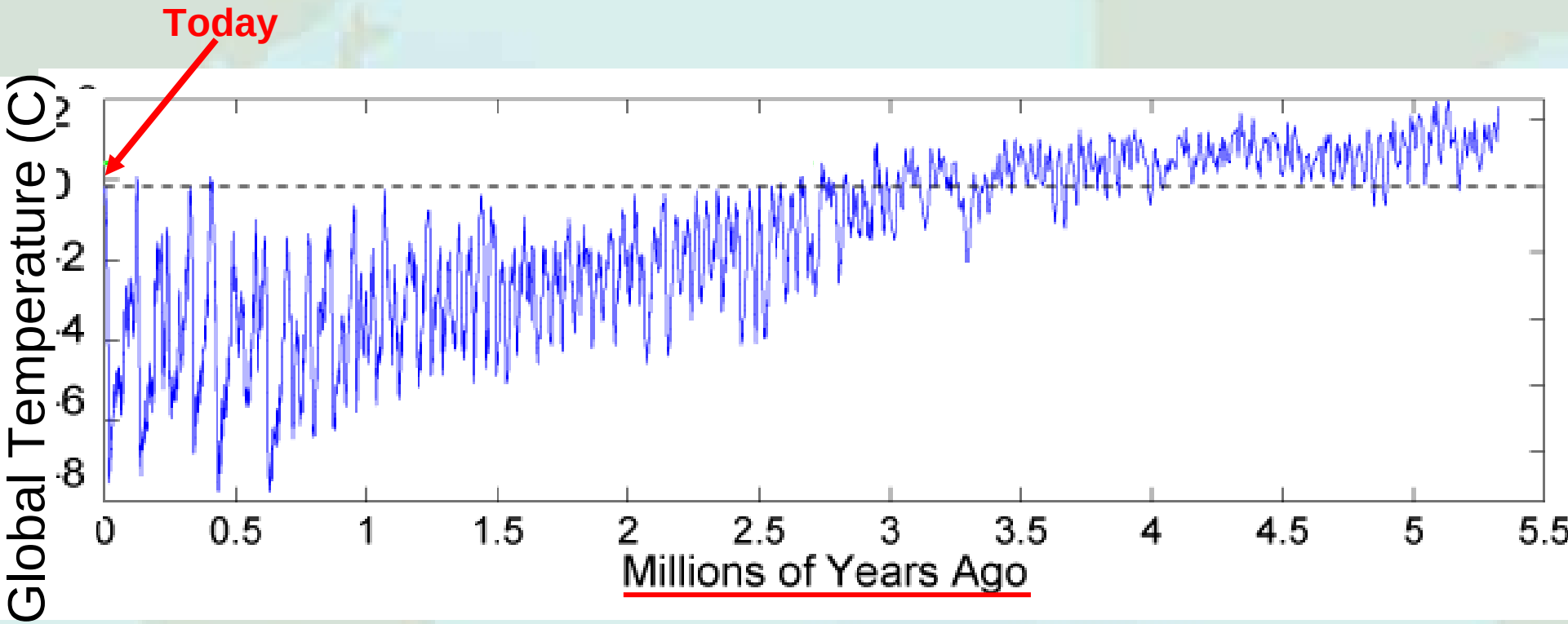
The Past and the Future:

Both are Relevant Today



The Past:

Five Million Years of Climate Change

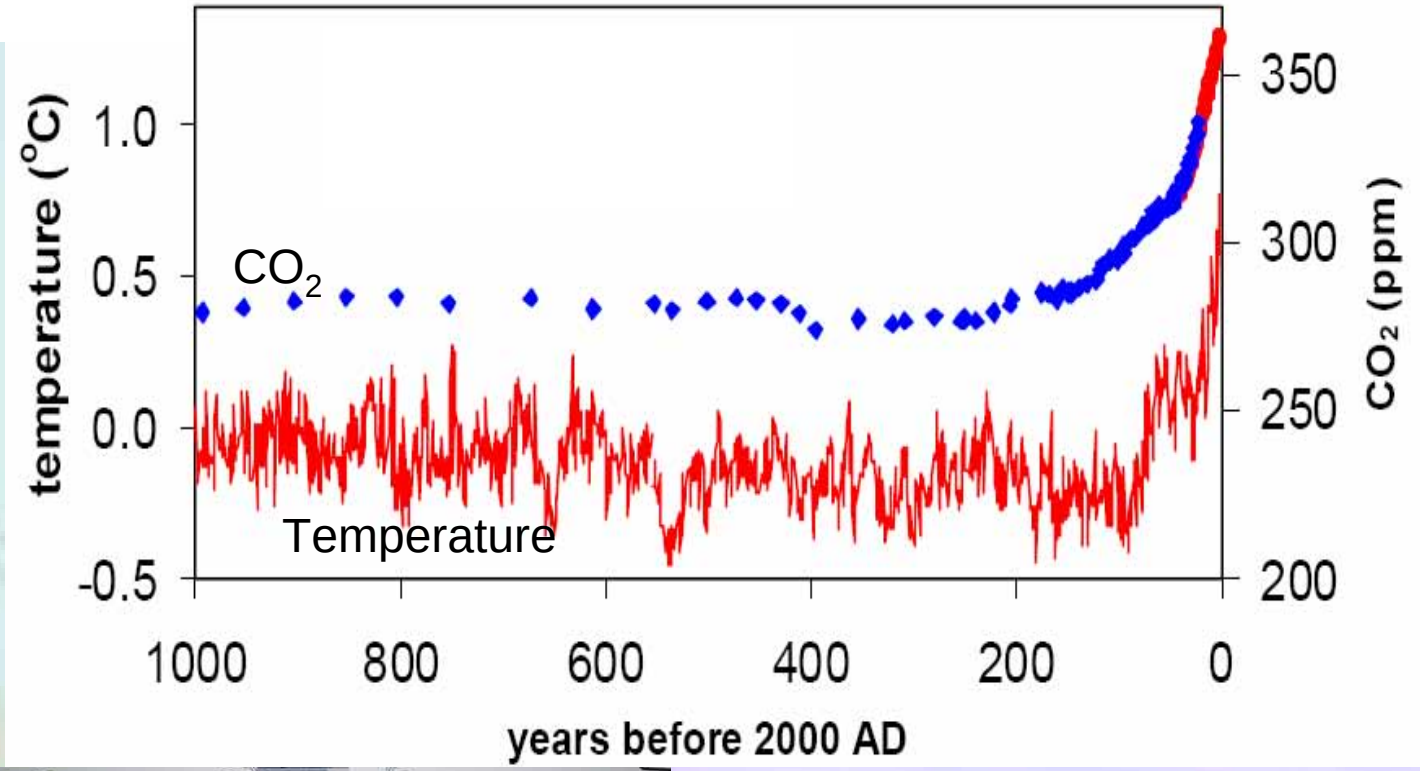


The Past:

400,000 Years of CO_2 Record

Recently:

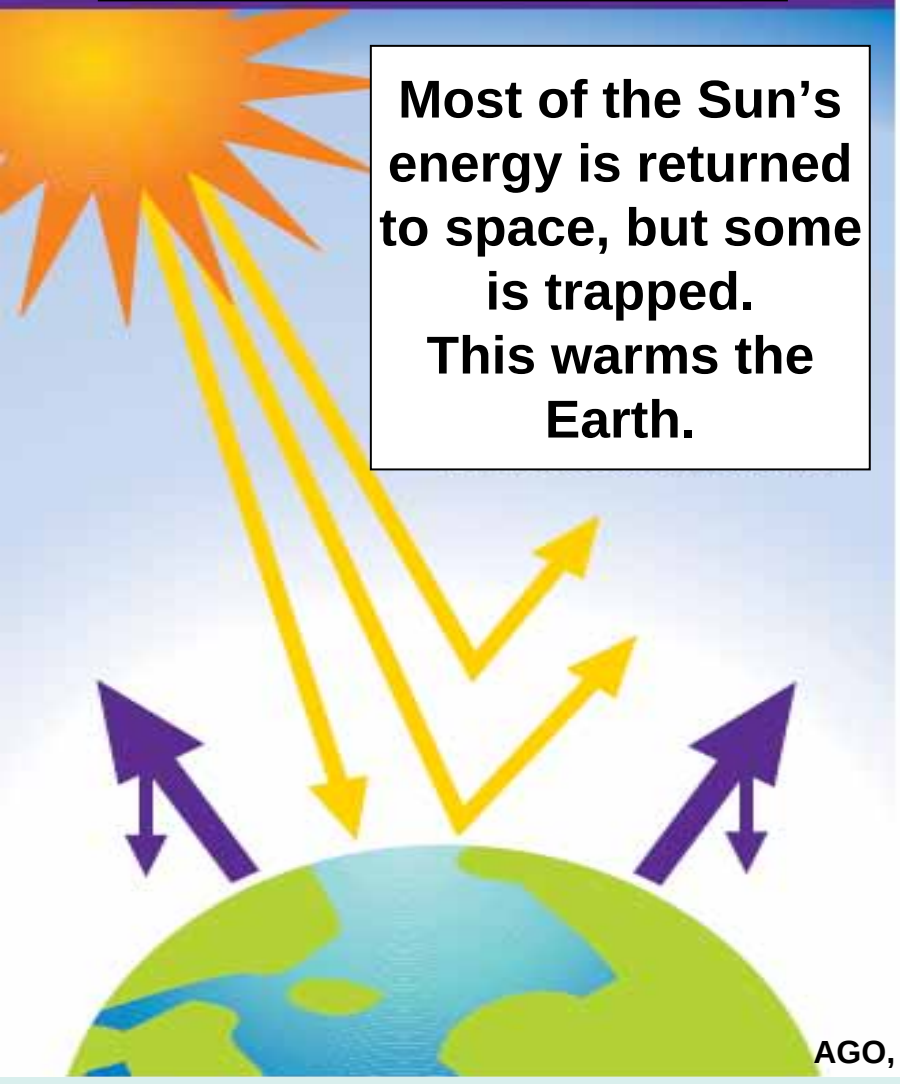
New Contributors to Climate Change



The Greenhouse Effect

Natural Greenhouse Effect

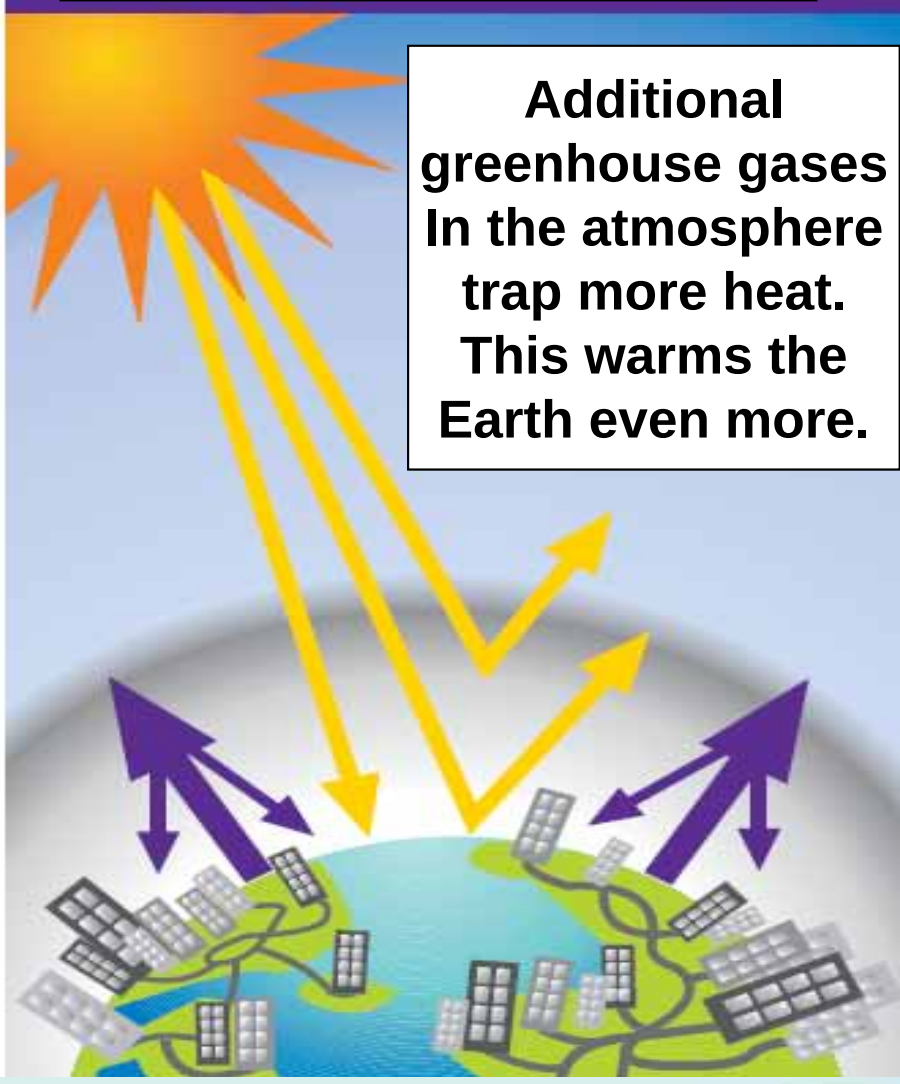
Most of the Sun's energy is returned to space, but some is trapped. This warms the Earth.



AGO, 2005

Increased Greenhouse Effect

Additional greenhouse gases In the atmosphere trap more heat. This warms the Earth even more.



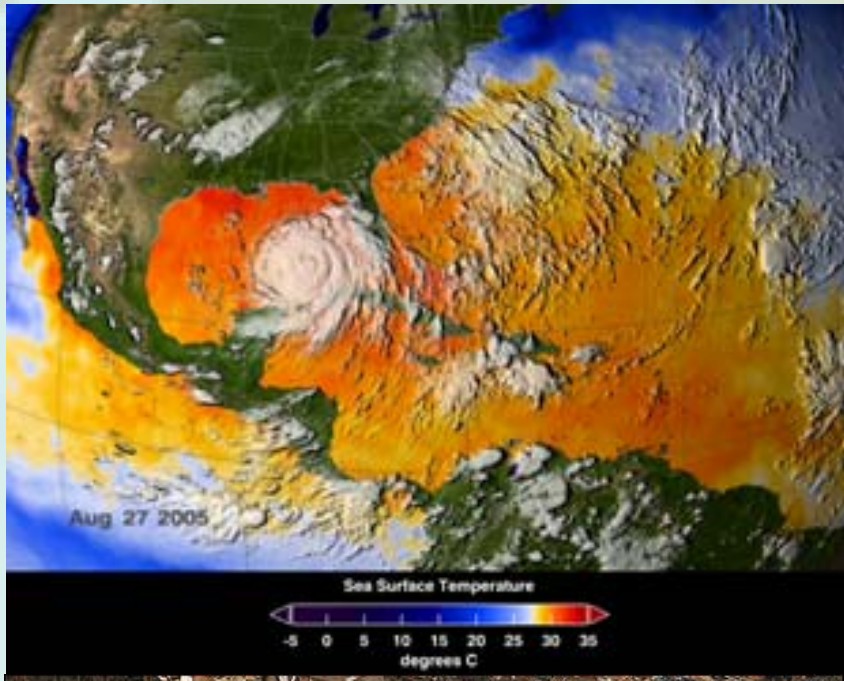
The Present: Our Climate is Changing

Increased:

- heatwaves
- droughts
- strong typhoons
- major rain storms
- sea level

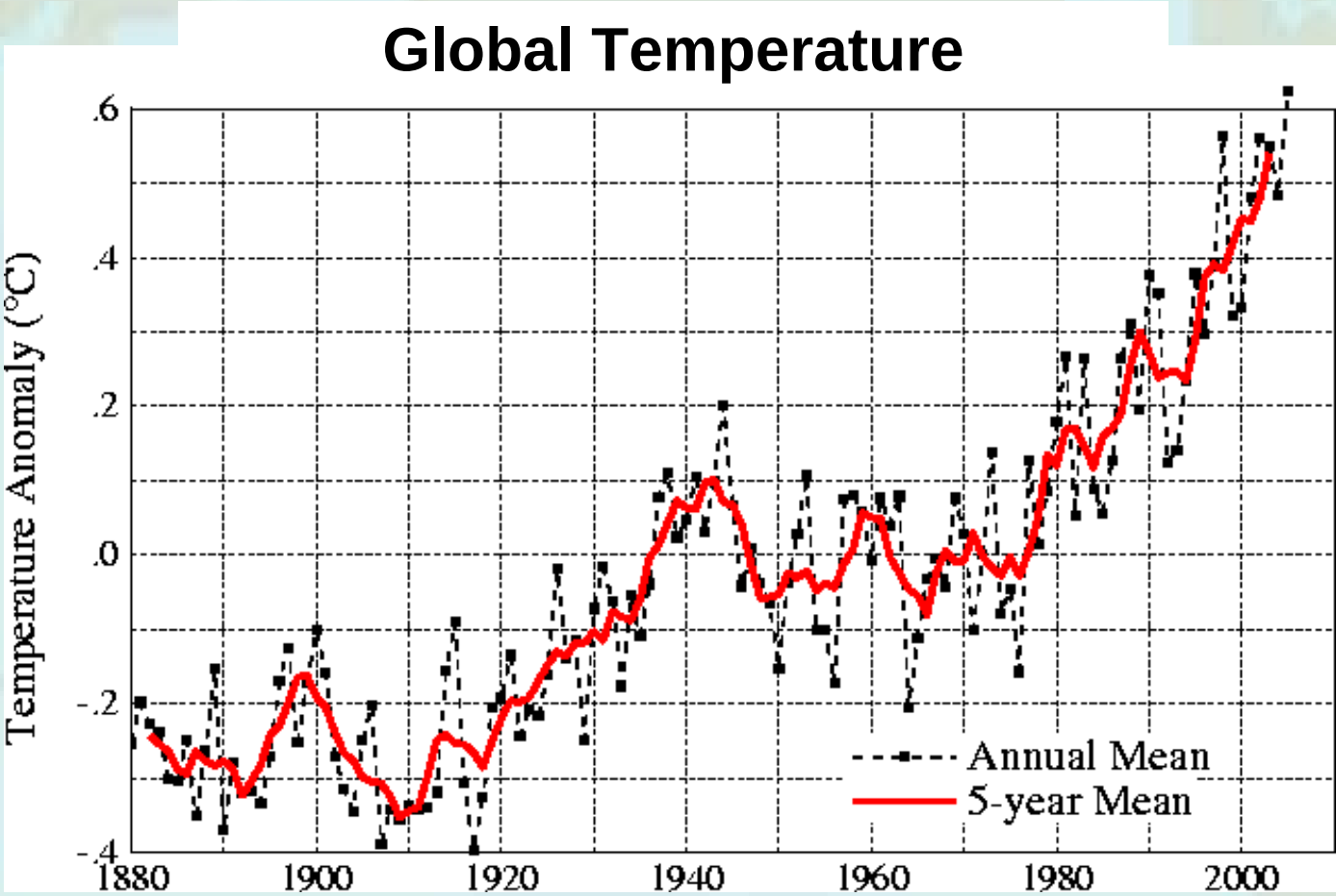
Less:

- frosts
- sea ice
- snow cover
- glacier ice



Present Changes: Rising Temperatures

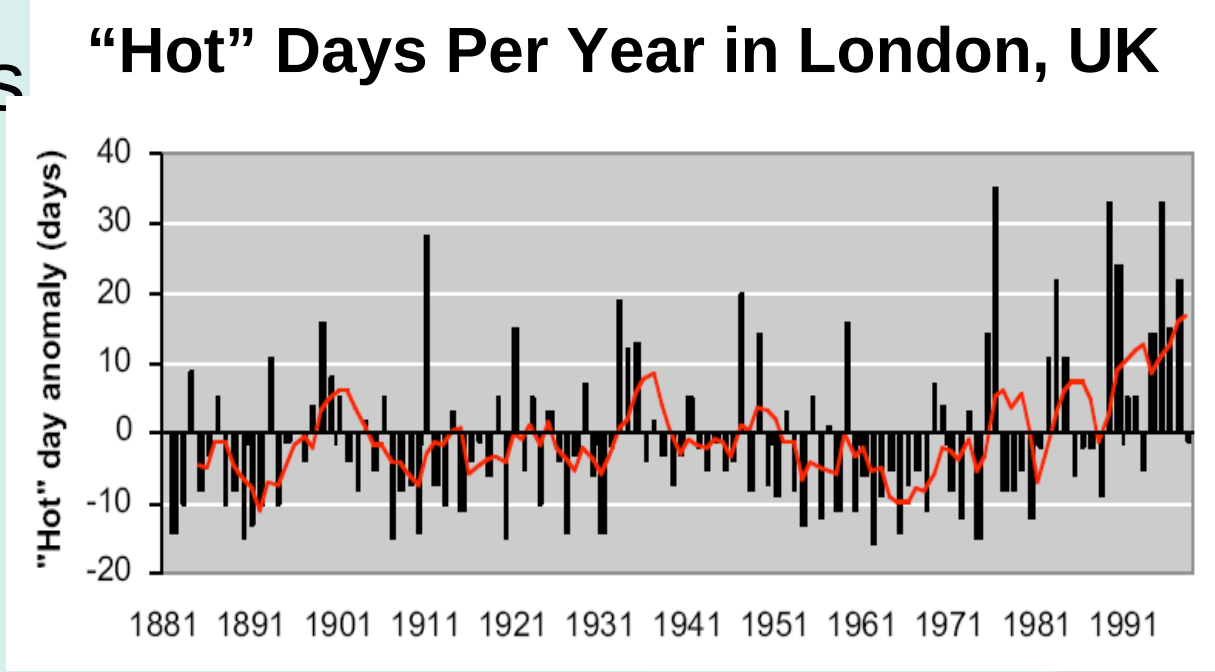
- 2005 the warmest year on record;
- 1990s the warmest decade on record;
- 10 warmest years on record have all occurred since 1990.



Hansen et al., 2006

Present Changes: More Heatwaves

- Increased frequency of days with very high temperatures;
- In Europe, human-induced climate change has already doubled the likelihood of a summer as hot as that in 2003.

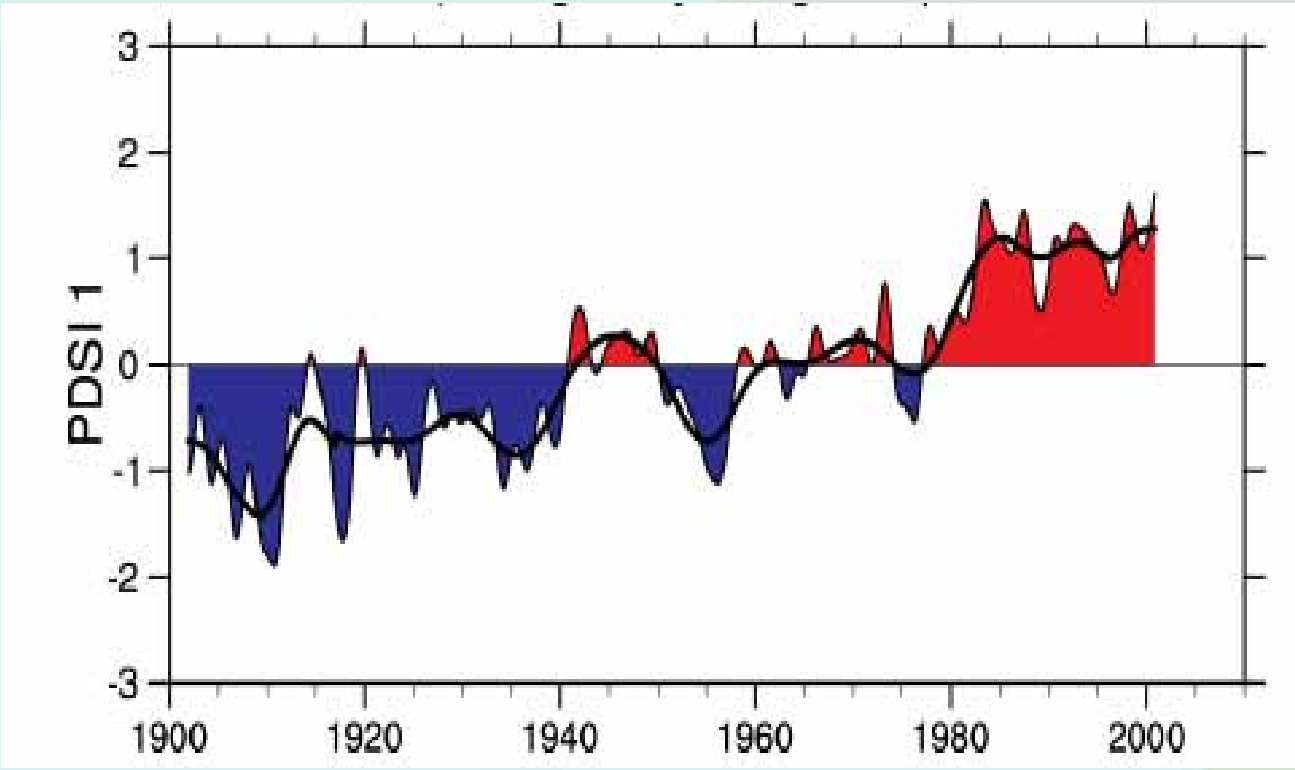


Clarke et al., 2002

Present Changes: More Droughts

Since the 1970s decreased land precipitation and increased temperatures have resulted in more intense and longer droughts over wider areas.

Global Drought Severity Index
1900 - 2002

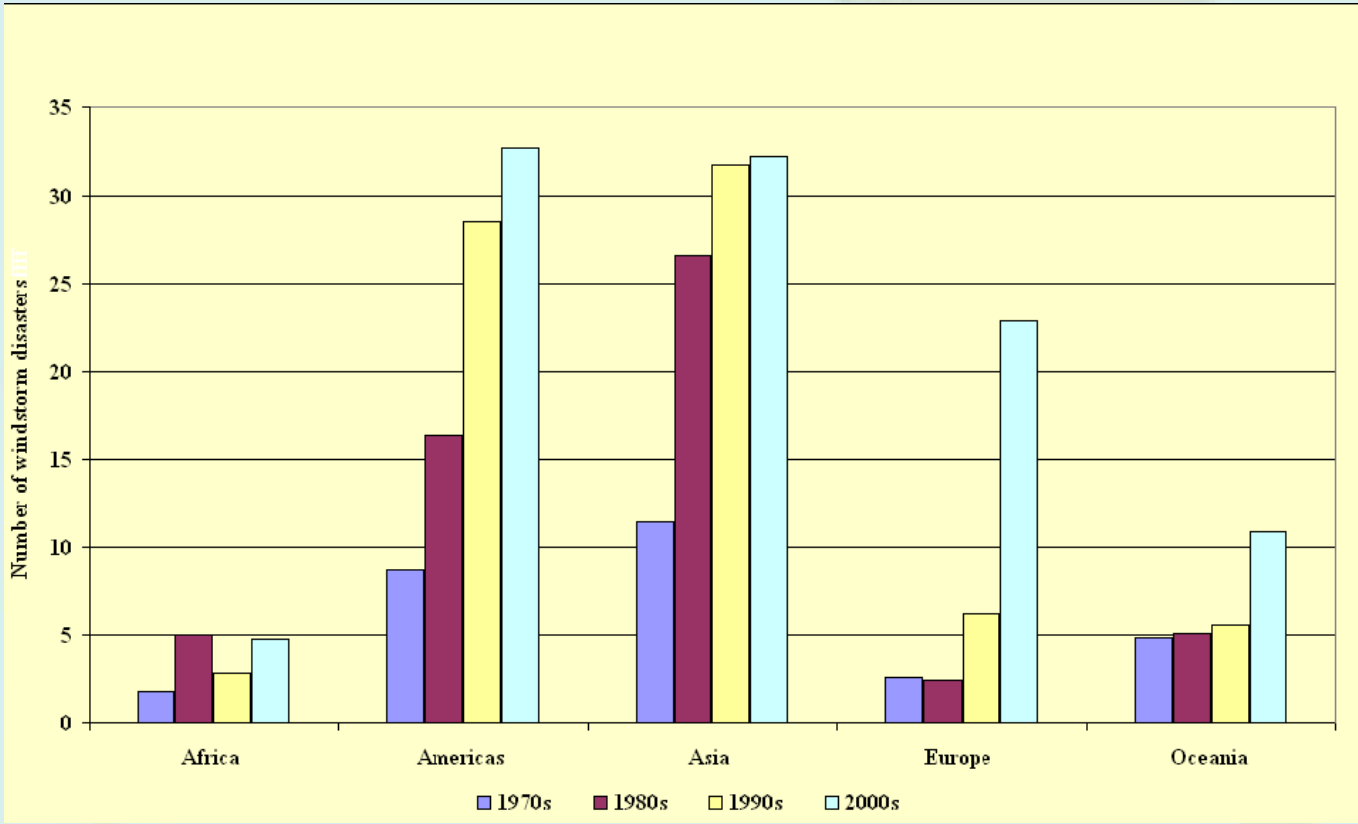


Dai et al., 2004

Present Changes: More Windstorms

Increased frequency of severe storms (e.g. typhoons), often causing extensive losses.

Trend in Windstorm Disasters, By Region: 1970 - 2005

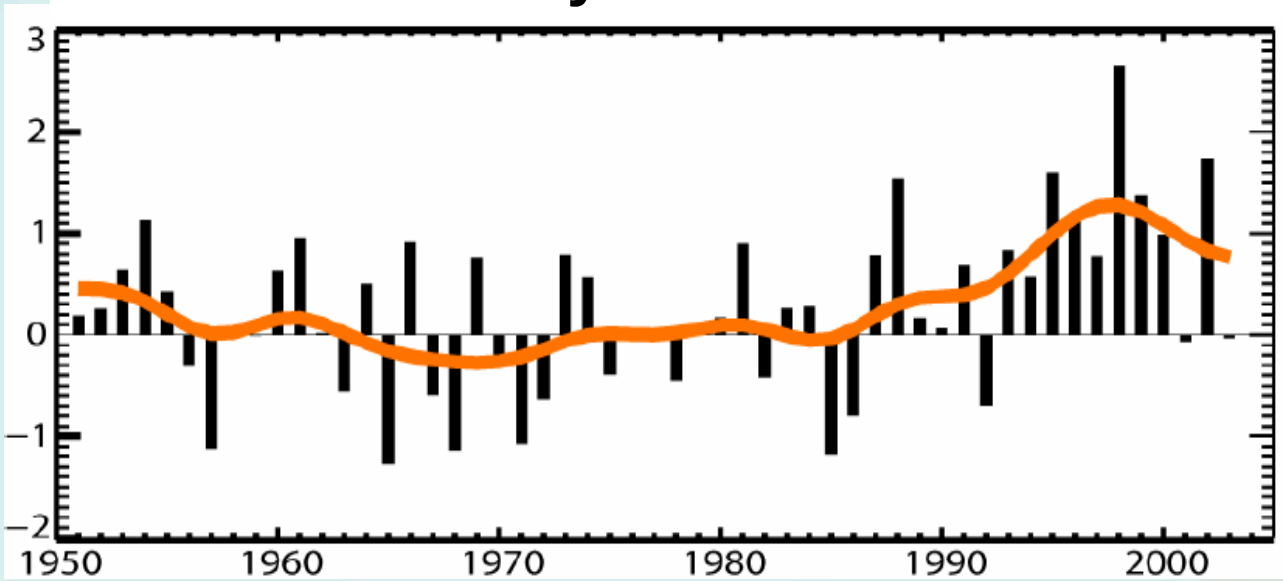


CRED, 2005

Present Changes: More Rain Storms

Increased number of heavy precipitation events over many land areas, *even where total precipitation has decreased.*

Change in Number of Very Wet Days, Globally: 1951 - 2003



Alexander et al., 2006

Present Changes: Less Arctic Sea Ice

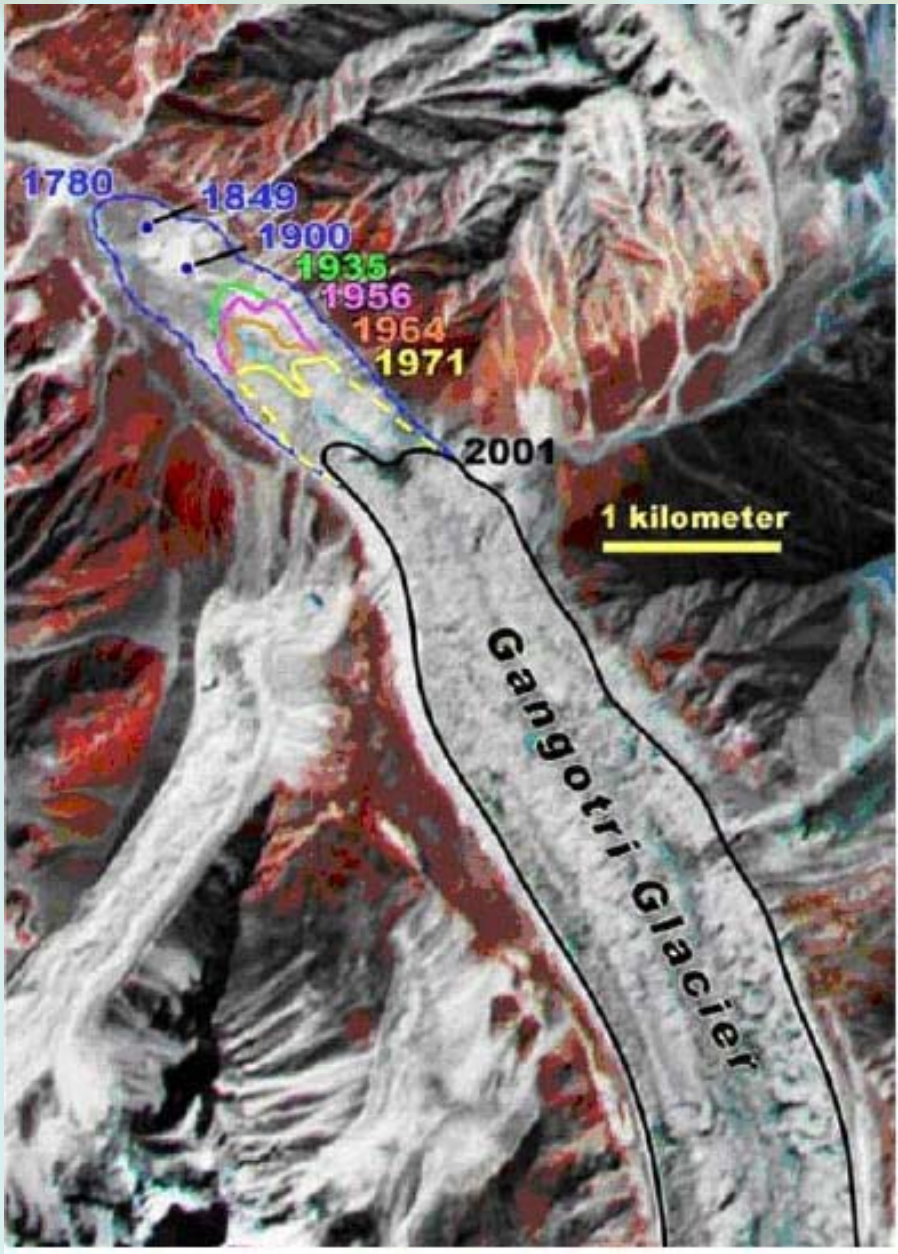
- The average extent of Arctic sea ice has declined by 15 – 20% over the past 30 years.

- No significant trends in Antarctic sea-ice extent are apparent.

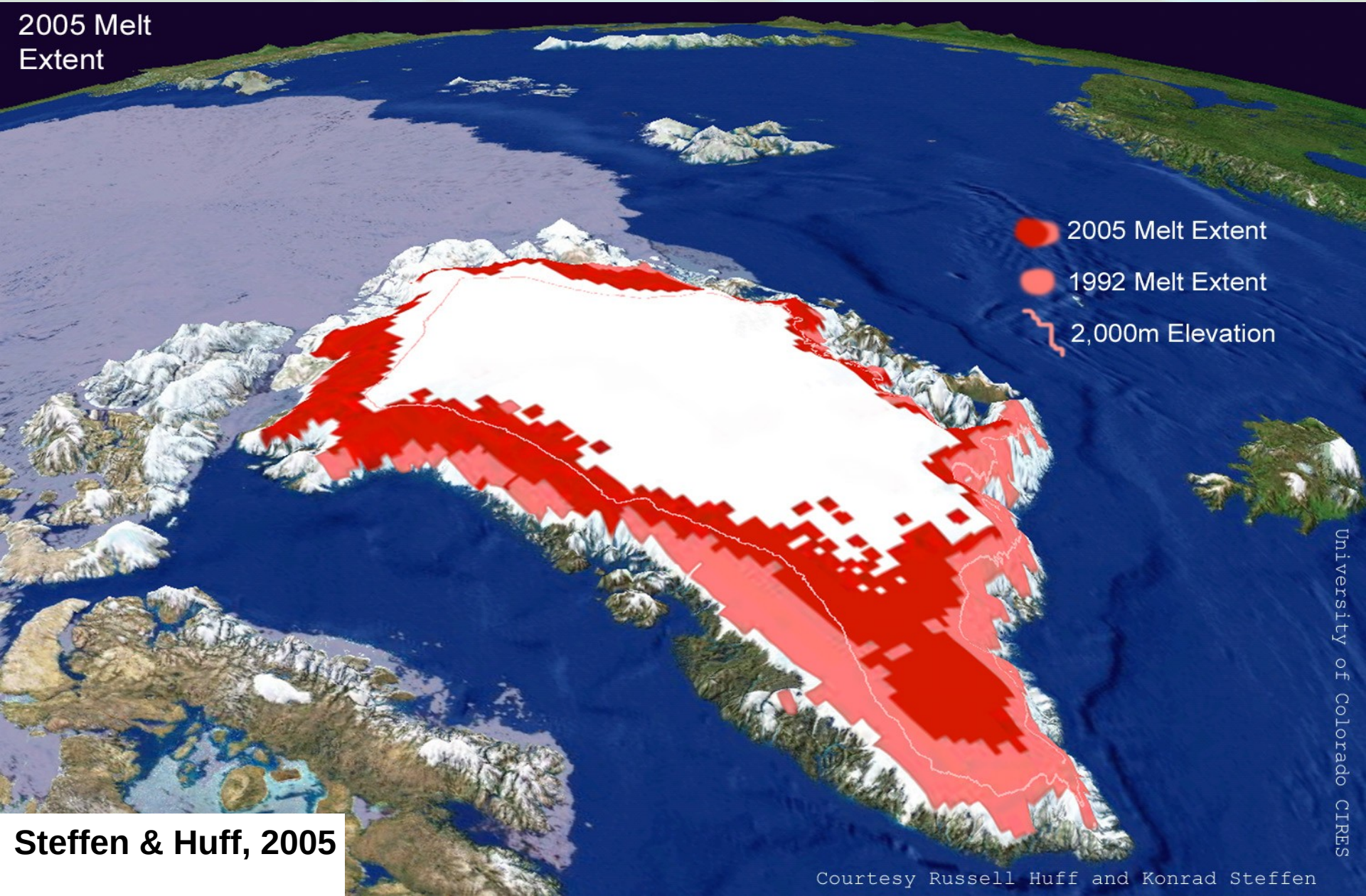
ICIA, 2004

Present Changes: Retreating Glaciers

- Gongotri Glacier, India – annual rate of retreat has increased by over 250% since 1780.



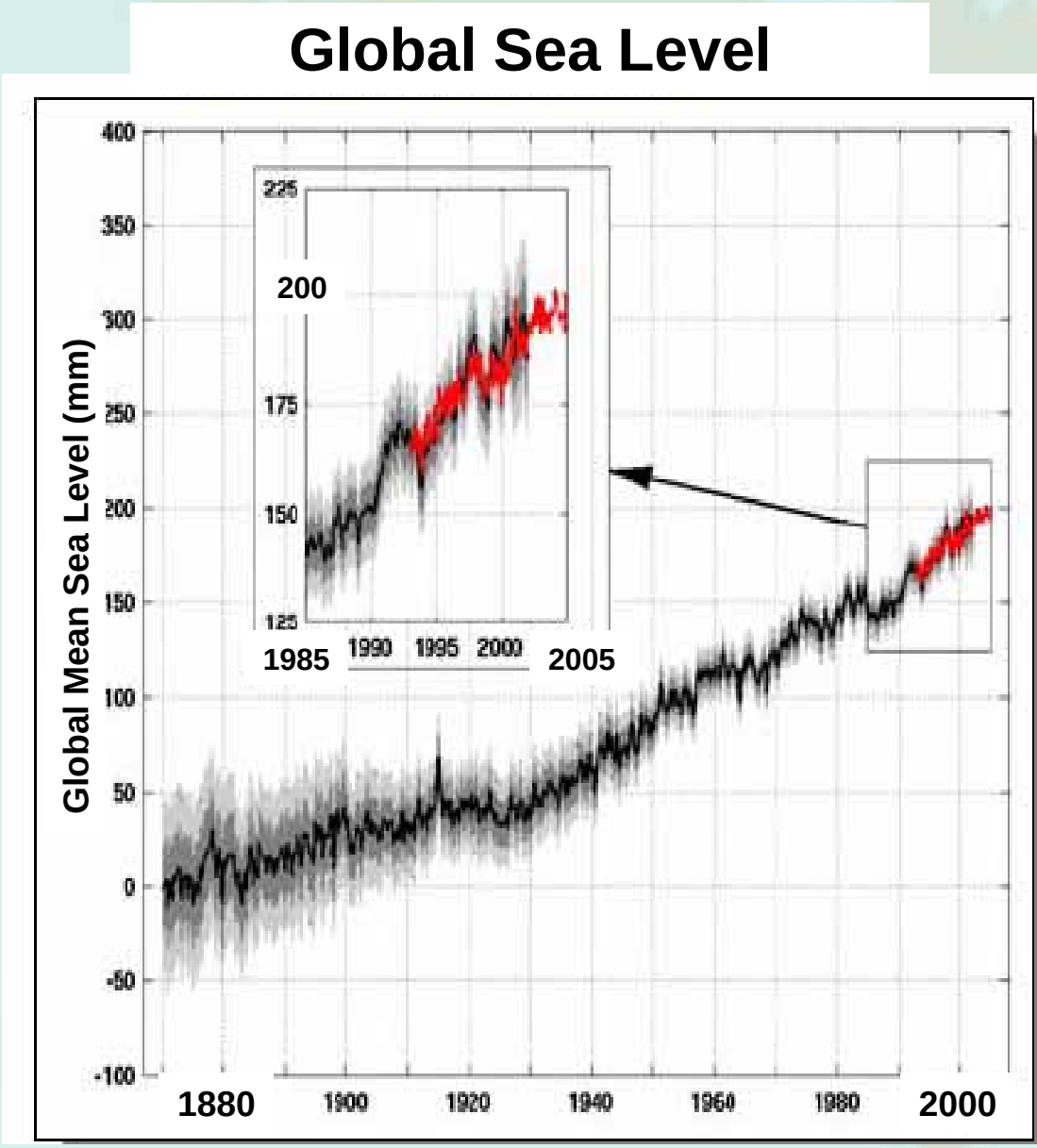
Present Changes: Melting Ice Sheets



Steffen & Huff, 2005

Present Changes: Rising Sea Levels

- Since the 1870s global sea level has risen by about 20 cm;
- Last century the rate was 1.7 mm/yr;
- Since the early 1990s the rate has been 3.2 mm/yr.



Present Impacts: Ecosystems

- The species composition of terrestrial ecosystems has changed, and plants are migrating to higher elevations and latitudes.

Example:

Apoi Mountain, Japan (811m)

High mountain pine has moved upward by 0.4～2m/year.

As the height available for further upward movement is only 30~40m, precious species of wild flower will be wiped out in 30 years.

Present Impacts:

- Globally spring events have advanced by 2 to 5 days per decade;
- Since the 1950s the growing season has lengthened by up to two weeks in mid and high latitudes of the Northern Hemisphere; and
- Globally ocean annual primary production is down more than 6% since the early 1980s.

Present Impacts: Heatwaves

- Excess deaths in 2003 European heatwave :

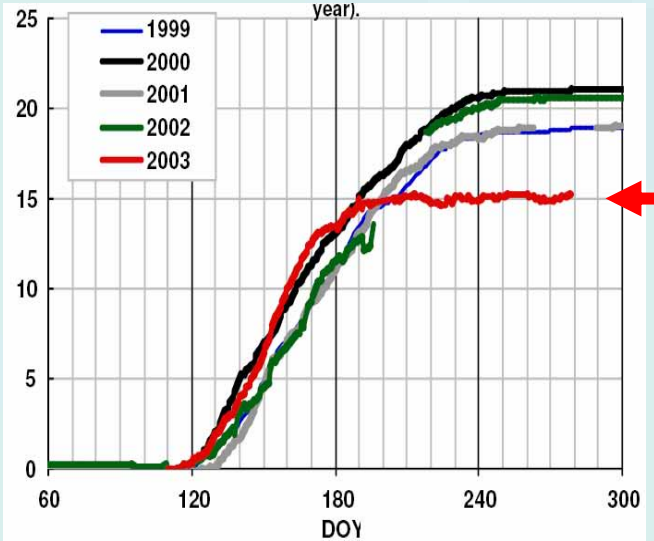
France – 14,802

U.K. – 2,045

Portugal: 2,099

Tree Growth Rates in France 1999-2003

A. Granier



International Herald Tribune | 5
Wednesday, September 10, 2003

Heat claimed 15,000 in France

Estimate by funeral director exceeds latest by government

From news reports

PARIS: The number of people who died in France because of the August heat wave is 15,000, the country's largest undertaker estimated Tuesday, placing the death toll about 3,500 higher than the official government figure.

Isabelle Dubois-Costes, a spokeswoman for General Funeral Services, said the revised total includes deaths from the second half of August, after record-breaking temperatures had abated.

Late last month, the government issued its official estimate of 11,435, but the Health Surveillance Institute, died. At the time, the government put the figure at a maximum of 3,000.

The heat wave brought suffocating temperatures of up to 40 degrees Celsius (104 degrees Fahrenheit) in the first two weeks of August in a country where air conditioning is rare. The heat baked many parts of Europe, but nowhere was

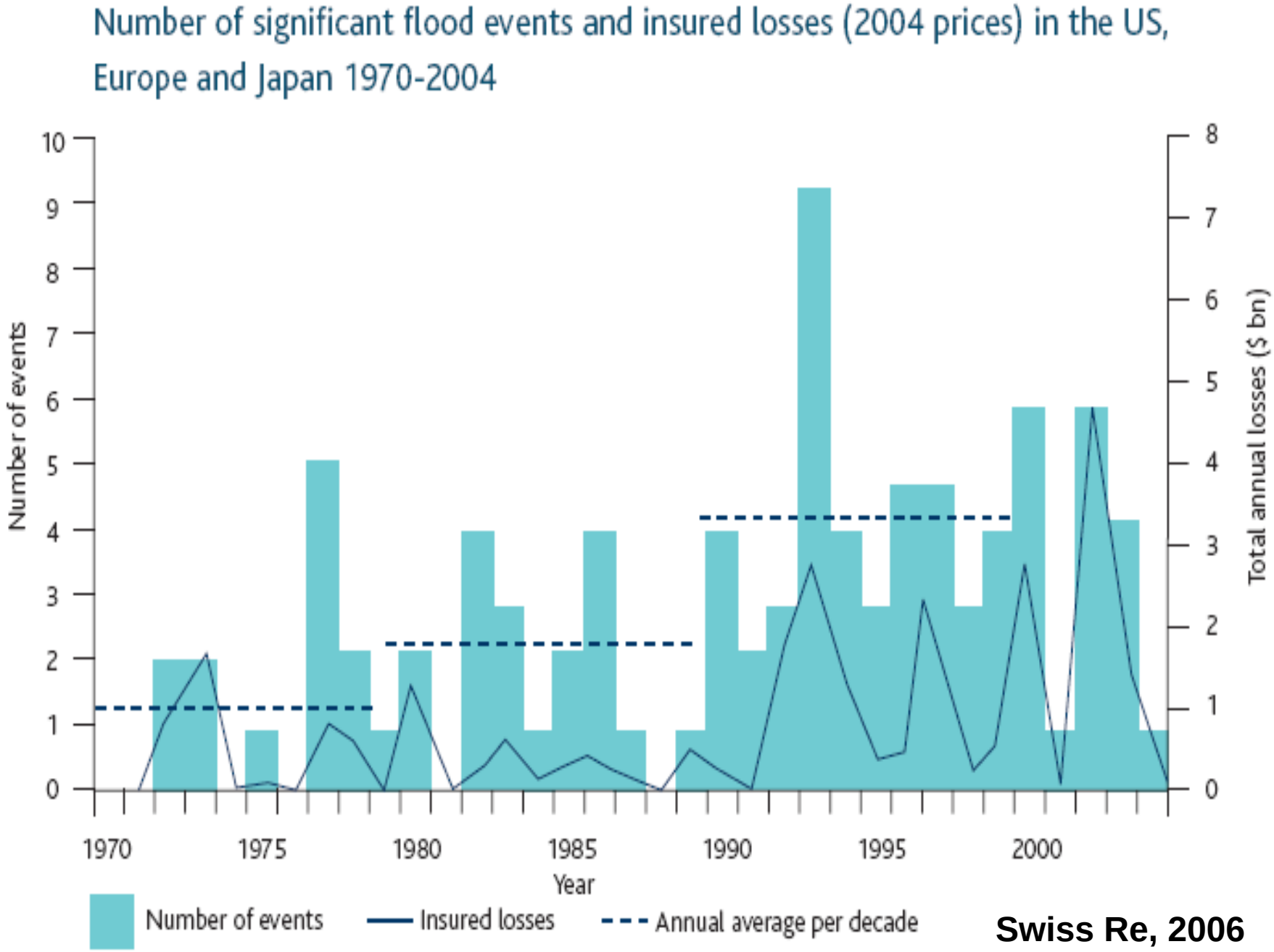
The revised total includes deaths from the second half of August.

families were away on lengthy August vacations. Authorities reportedly had difficulty making contact with survivors who were away on vacation.

A team of medial experts named by the Health Ministry to conduct the first official inquiry into the crisis issued a scathing report Monday that found "an error in anticipation, organization and coordination," and said "the response was not suited" to the situation.

The experts said the "compartmentalization" of services between the health and other ministries and workers in the field prevented a pooling of available information about the scope of the crisis.

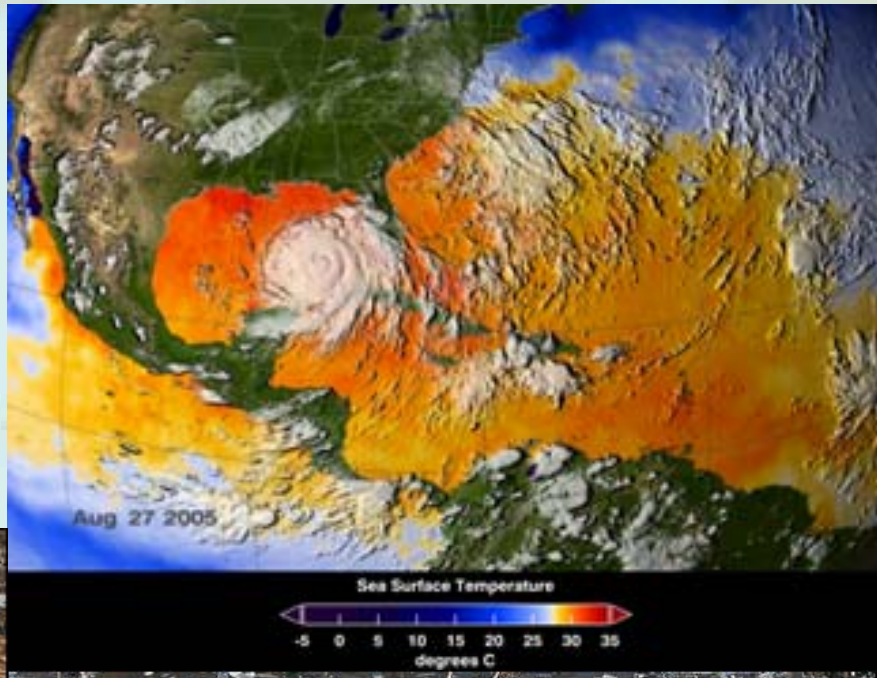
Present Impacts: More Major Floods



Swiss Re, 2006

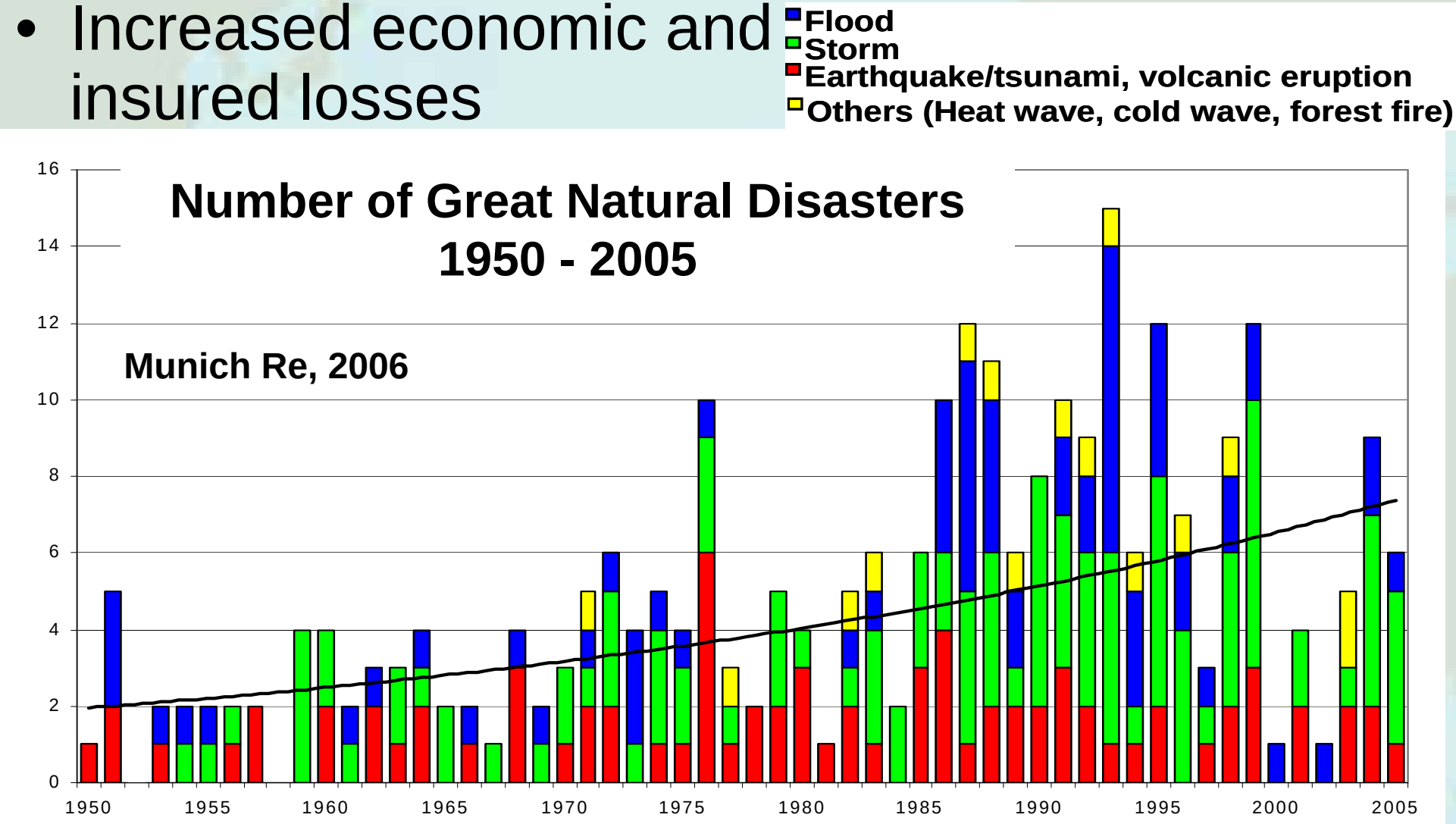
Present Impacts: Intense Windstorms

Example: Losses due to Hurricane Katrina were US$96 billion, plus large social costs.



Present Impacts: Increasing Disasters

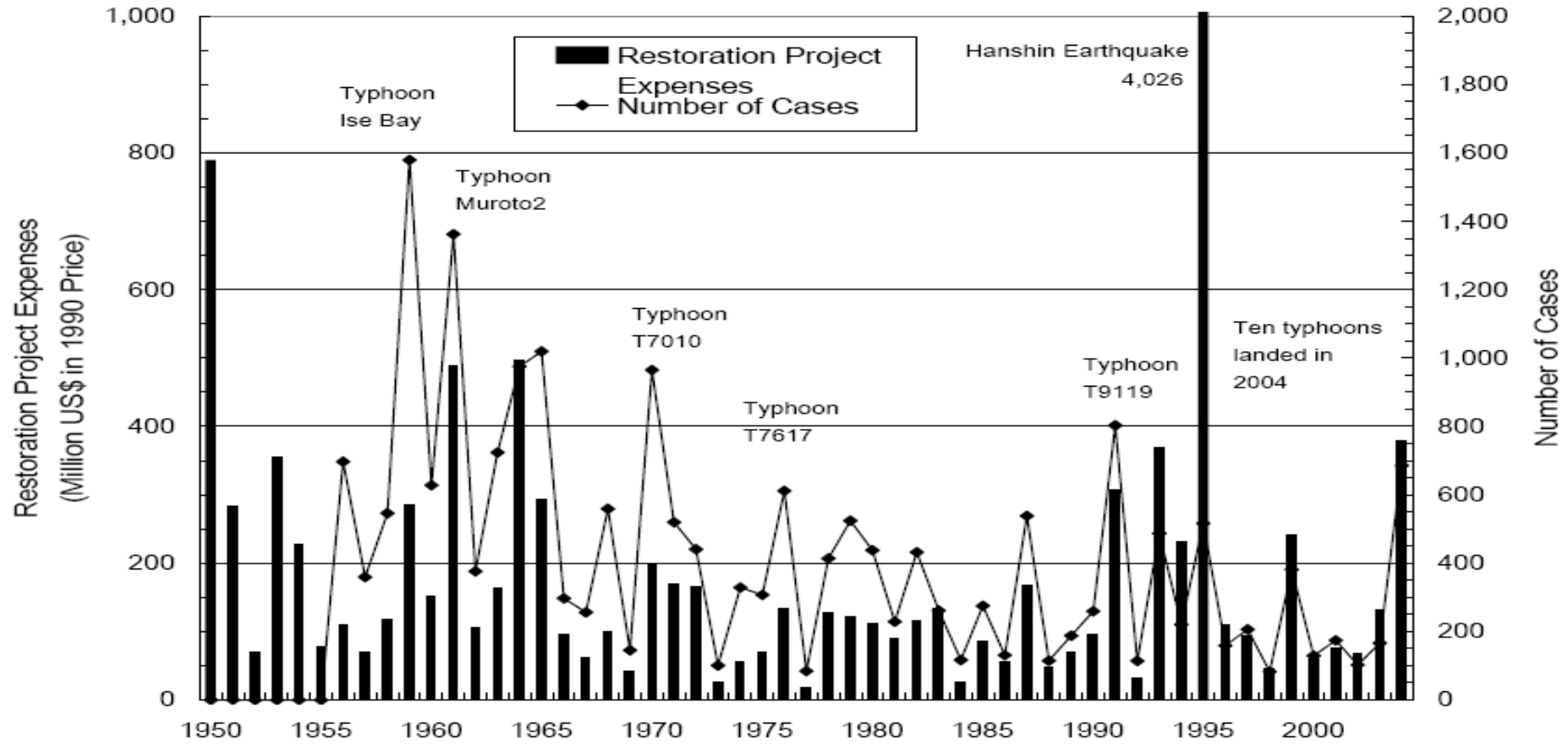
- Increased number of weather-related disasters
- Increased economic and insured losses
- No change in non-weather disasters



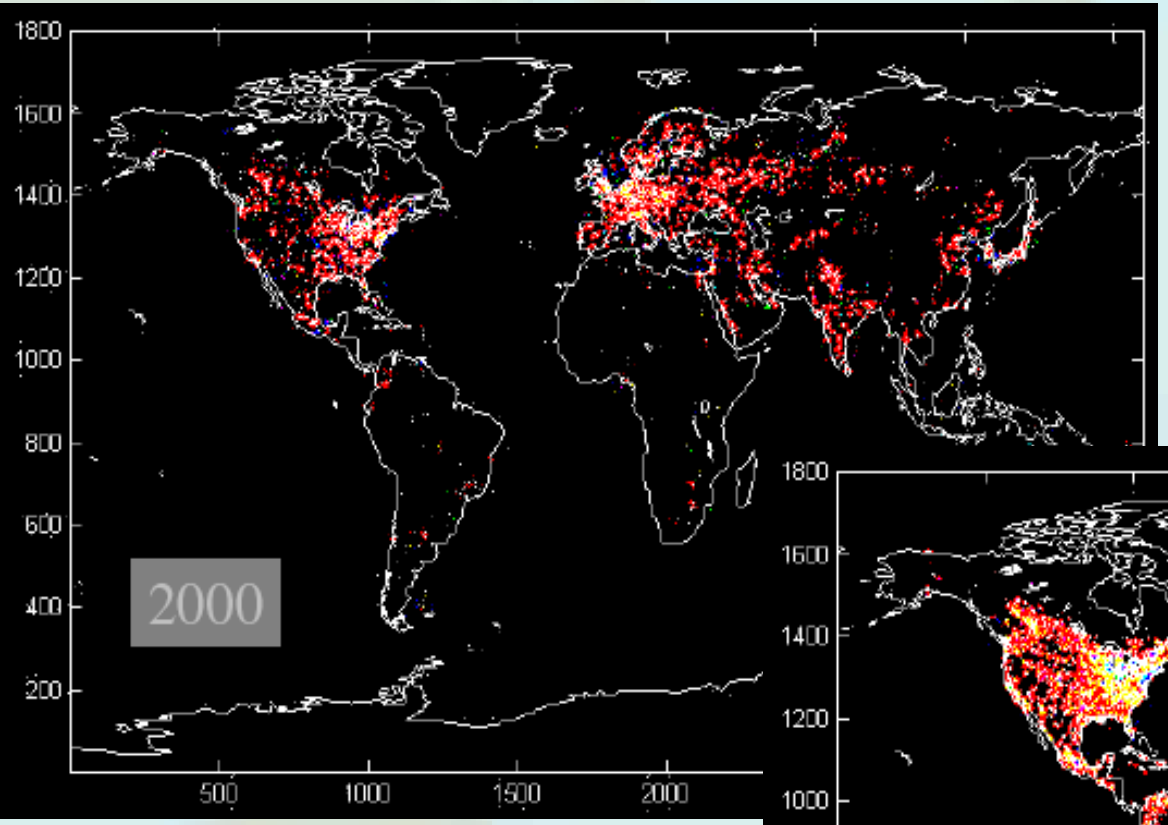
The Present:
Benefits of Planning & Preparedness

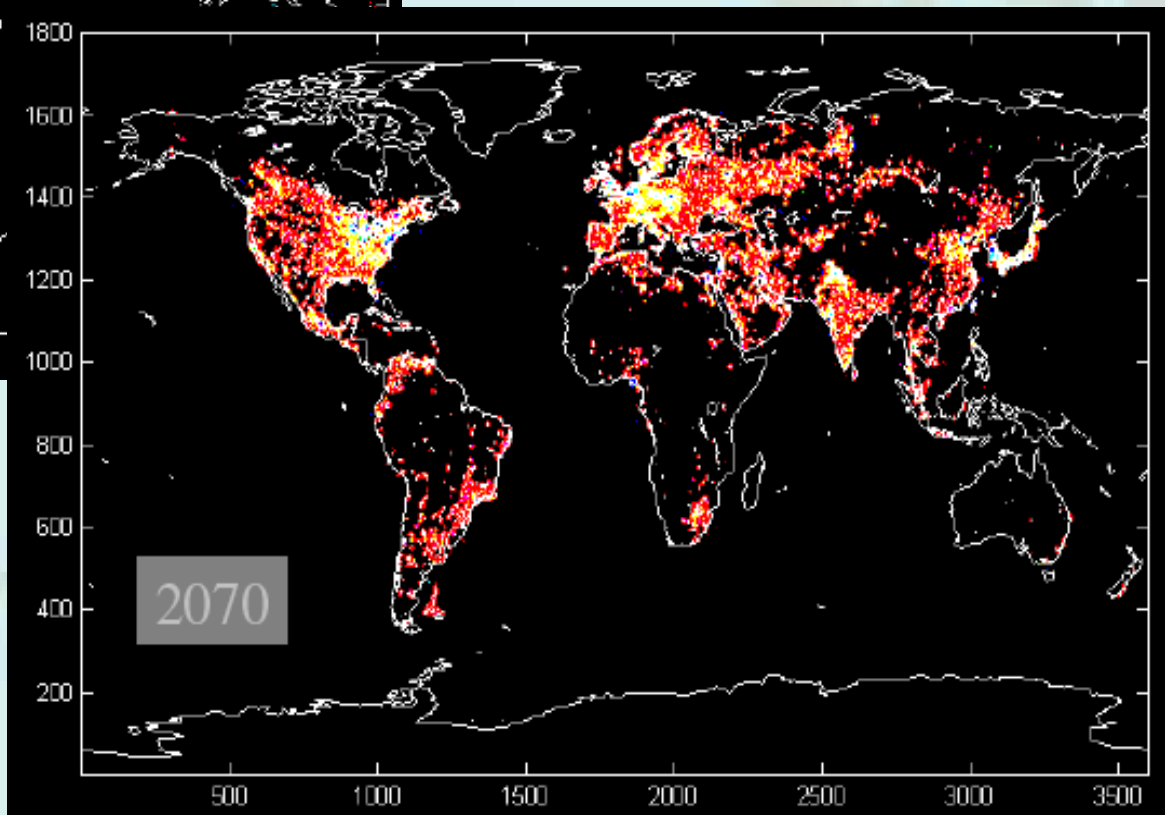
For Japan, the number of port-related disasters, and damage costs, have both declined.

Hay & Mimura, 2006



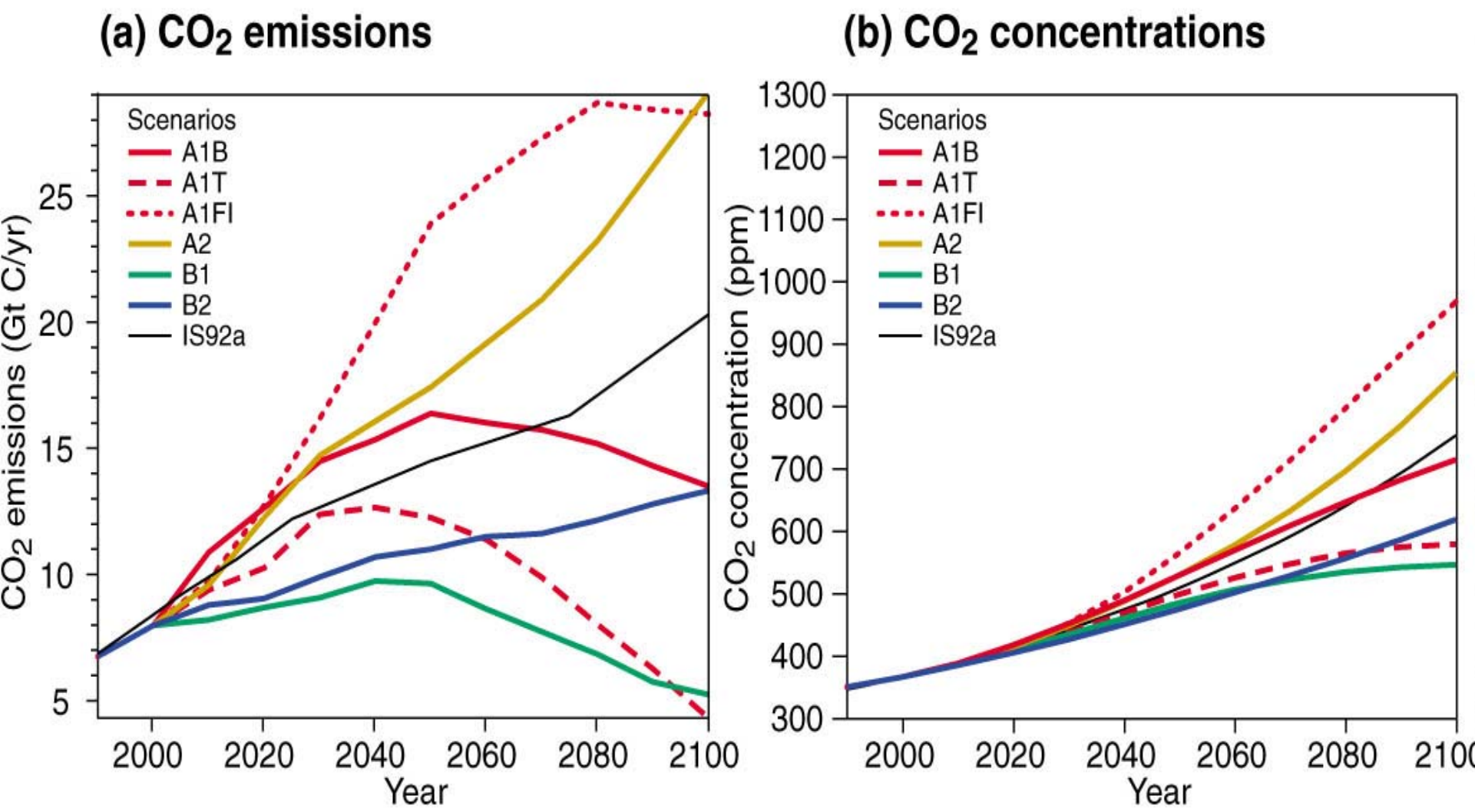
Anticipating the Future:





Nakicenovic, 2002

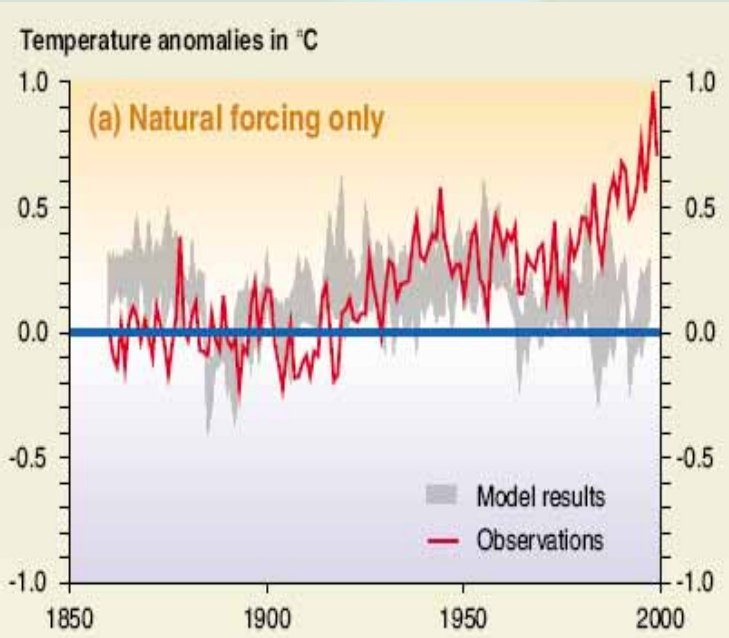
Anticipating the Future:

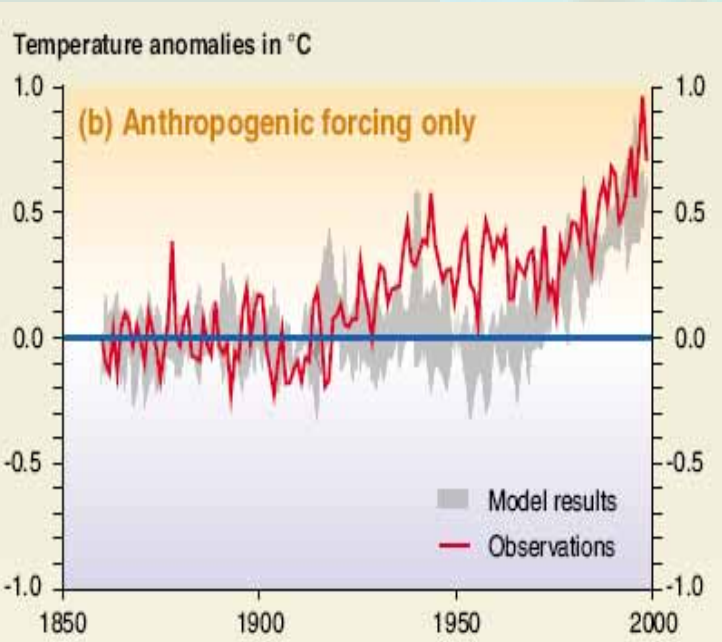


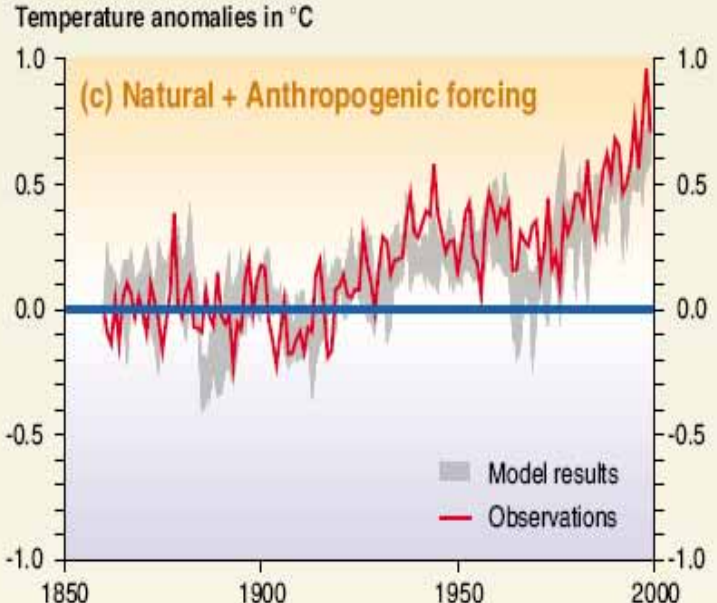
IPCC, 2001

Anticipating the Future:

Climate Modelling

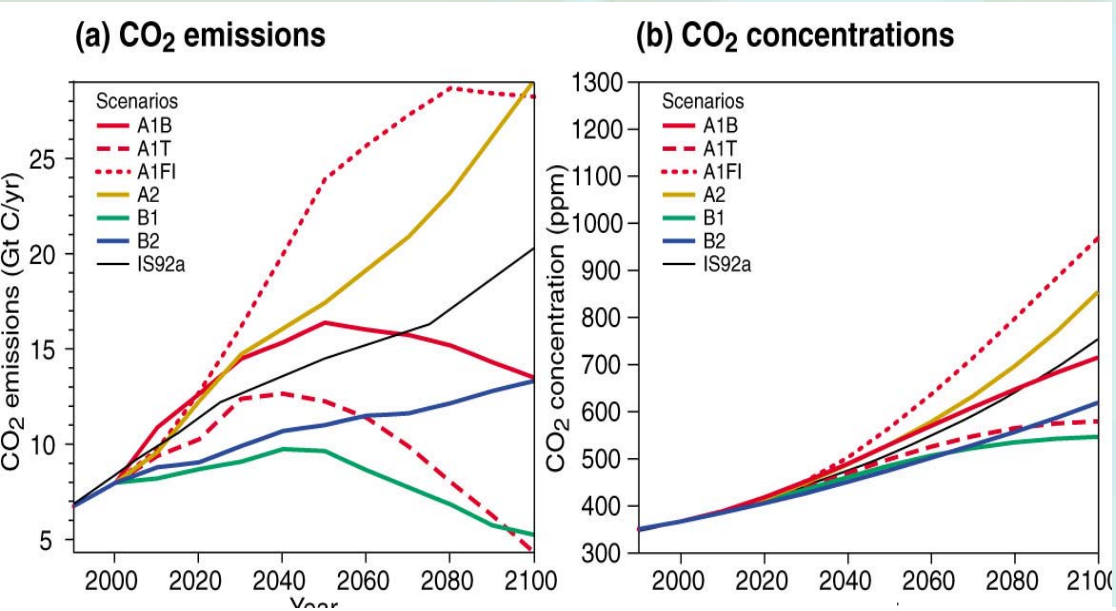






IPCC, 2001

Anticipating the Future:



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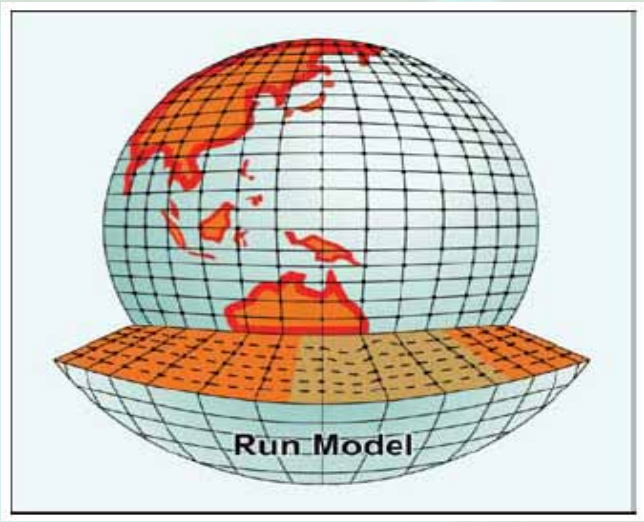

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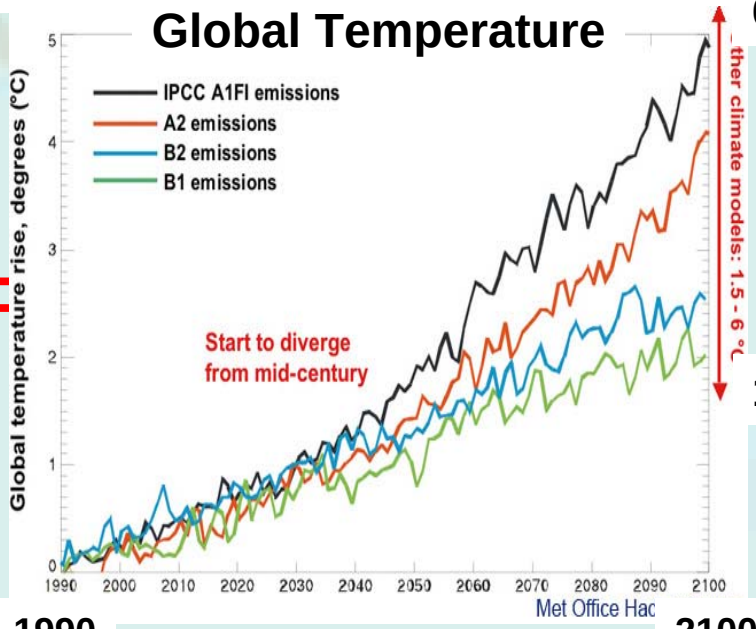
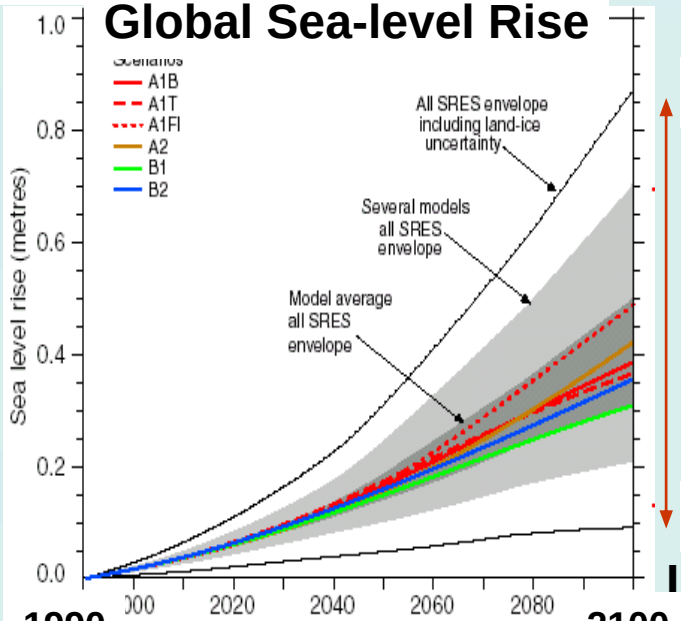


6 C

and

1.5 C



88 cm

etc

9 cm

IPCC, 2001

1990

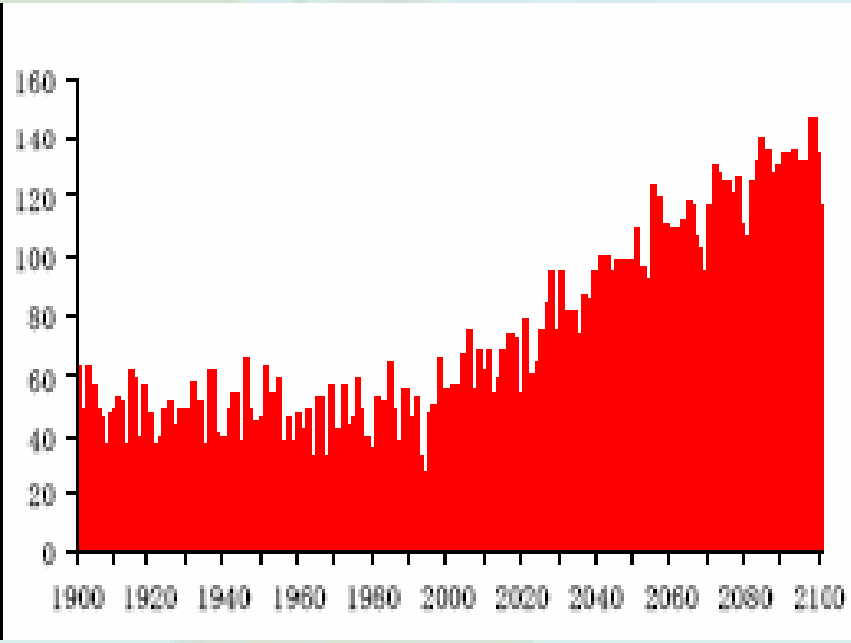
2100

1990

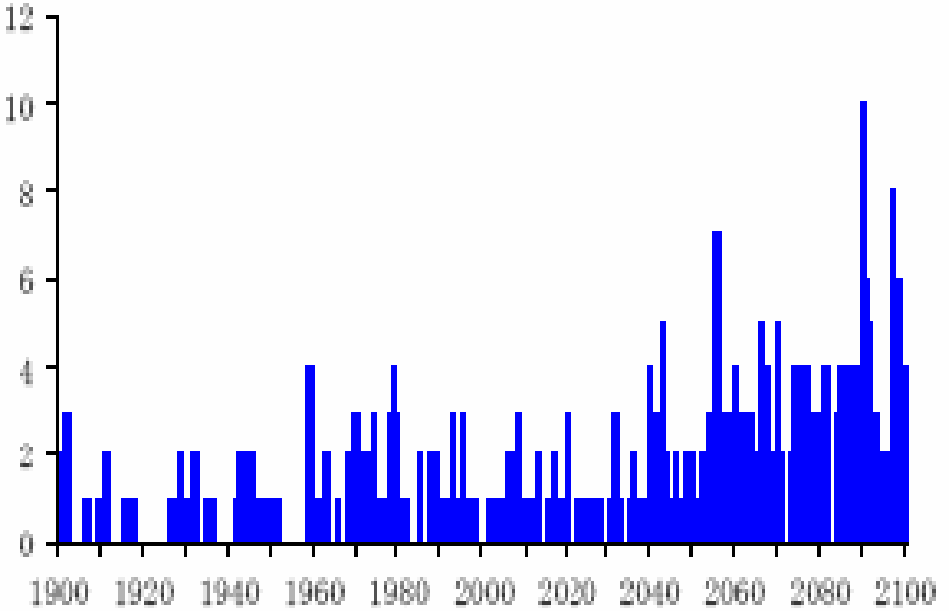
2100

Anticipating the Future: Japan

Predicted number of days >30 C

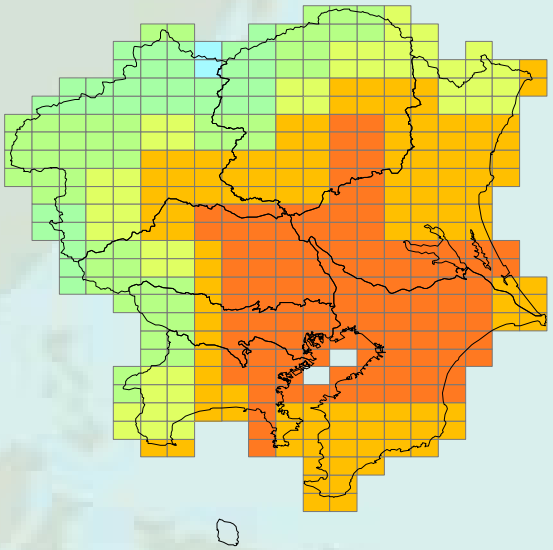


Predicted number of days rainfall >100 mm/day

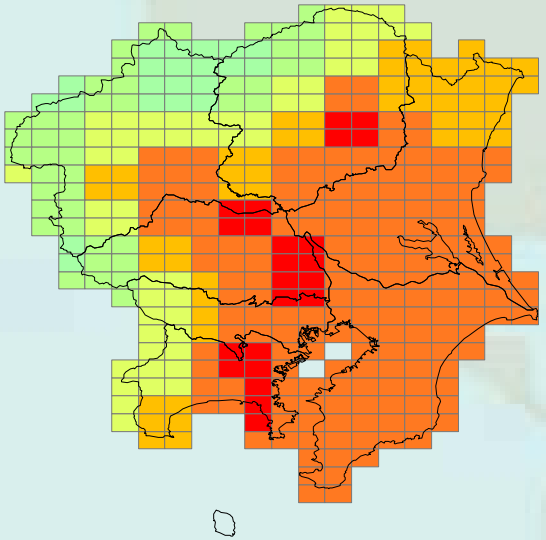


Hasumi and Emori, 2004

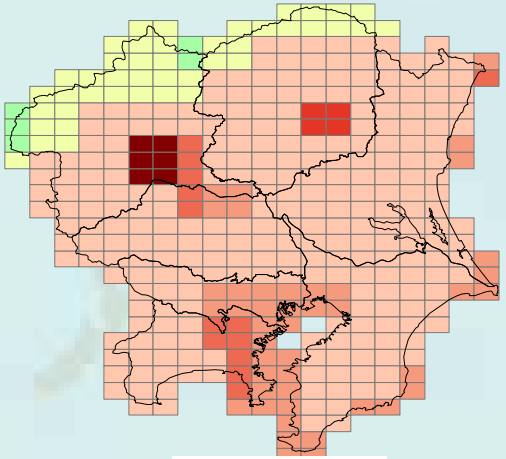
Anticipating the Future: Maximum Temperature in August for Tokyo



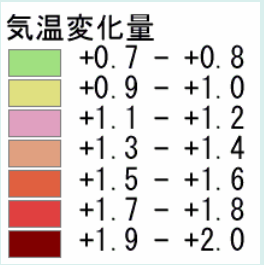
1981- 2000



2081 - 2100

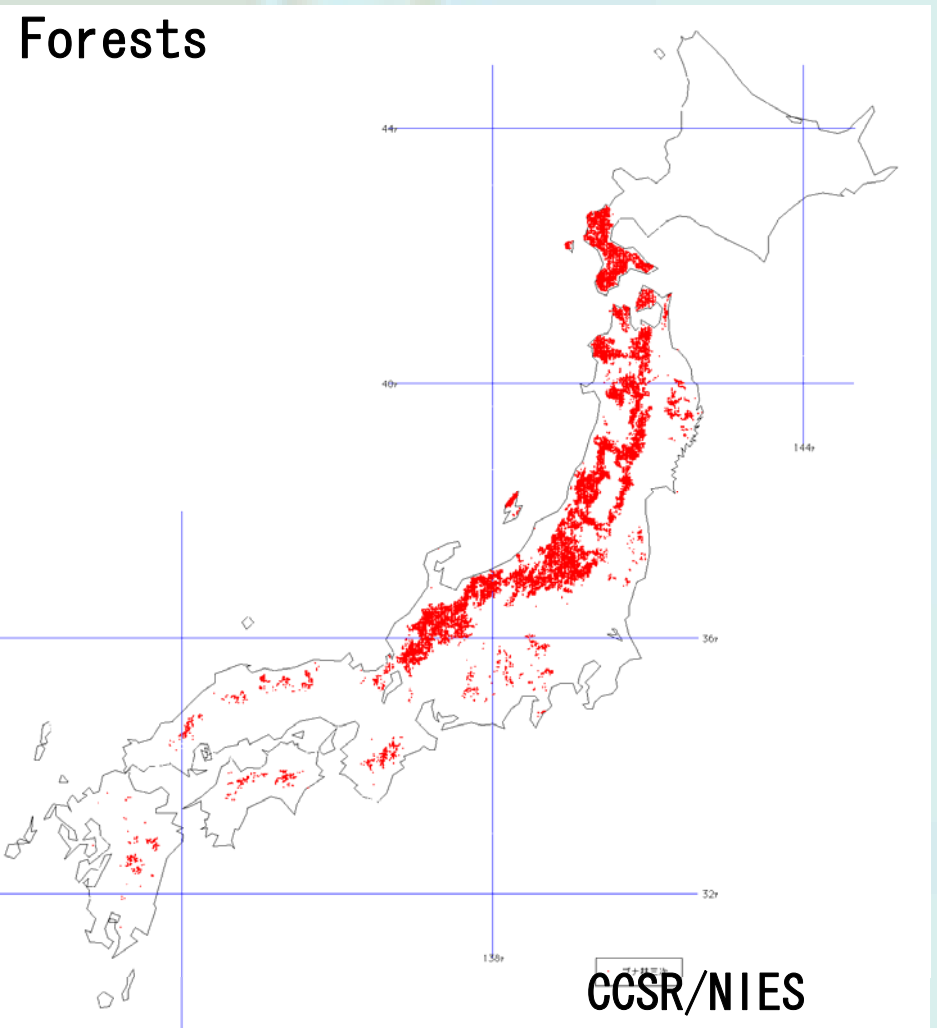


Change

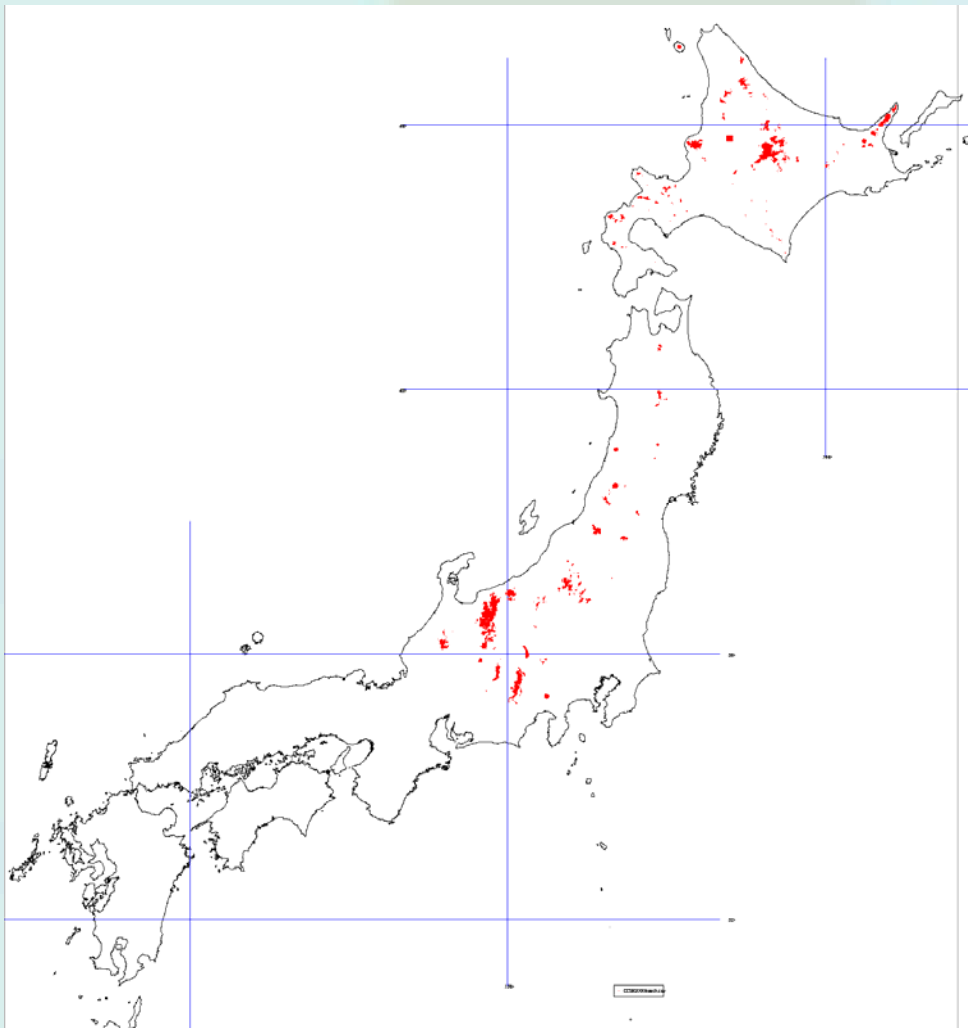


Anticipating the Future: Impact on Beech Forests

Present Distribution of Beech Forests

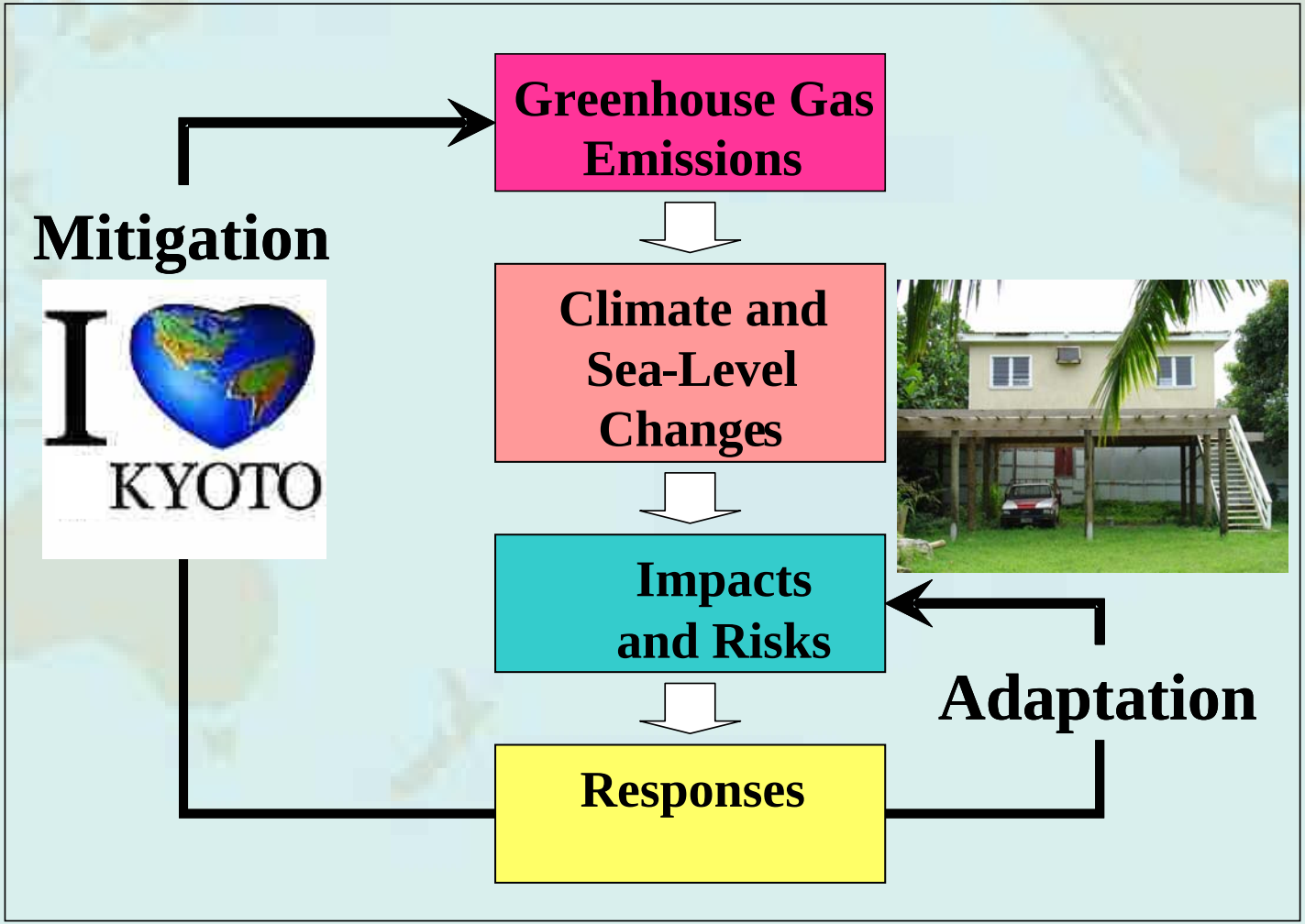


Distribution in 2090



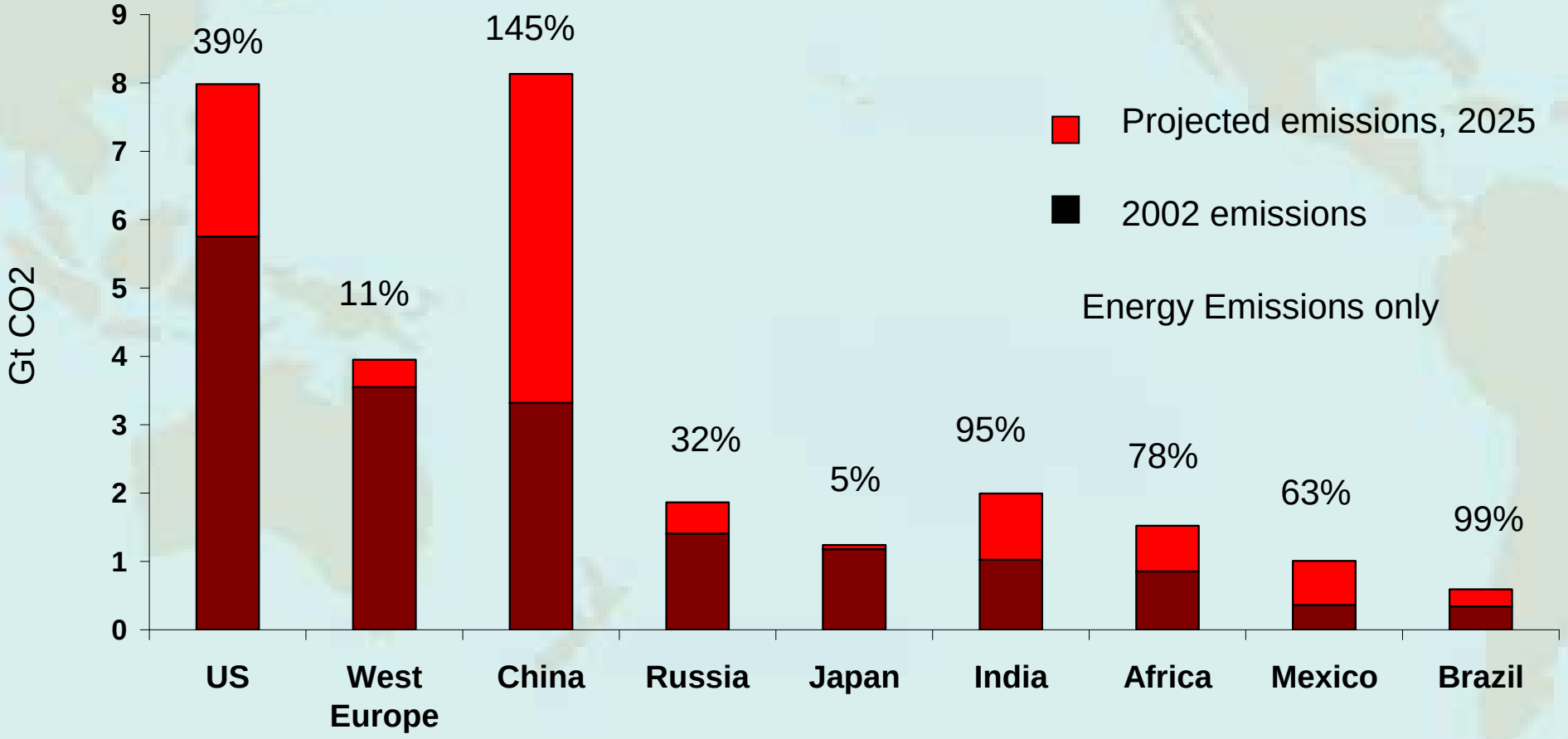
CCSR/NIES

Influencing the Future: Policy Options to Address Climate Change



Future Emissions

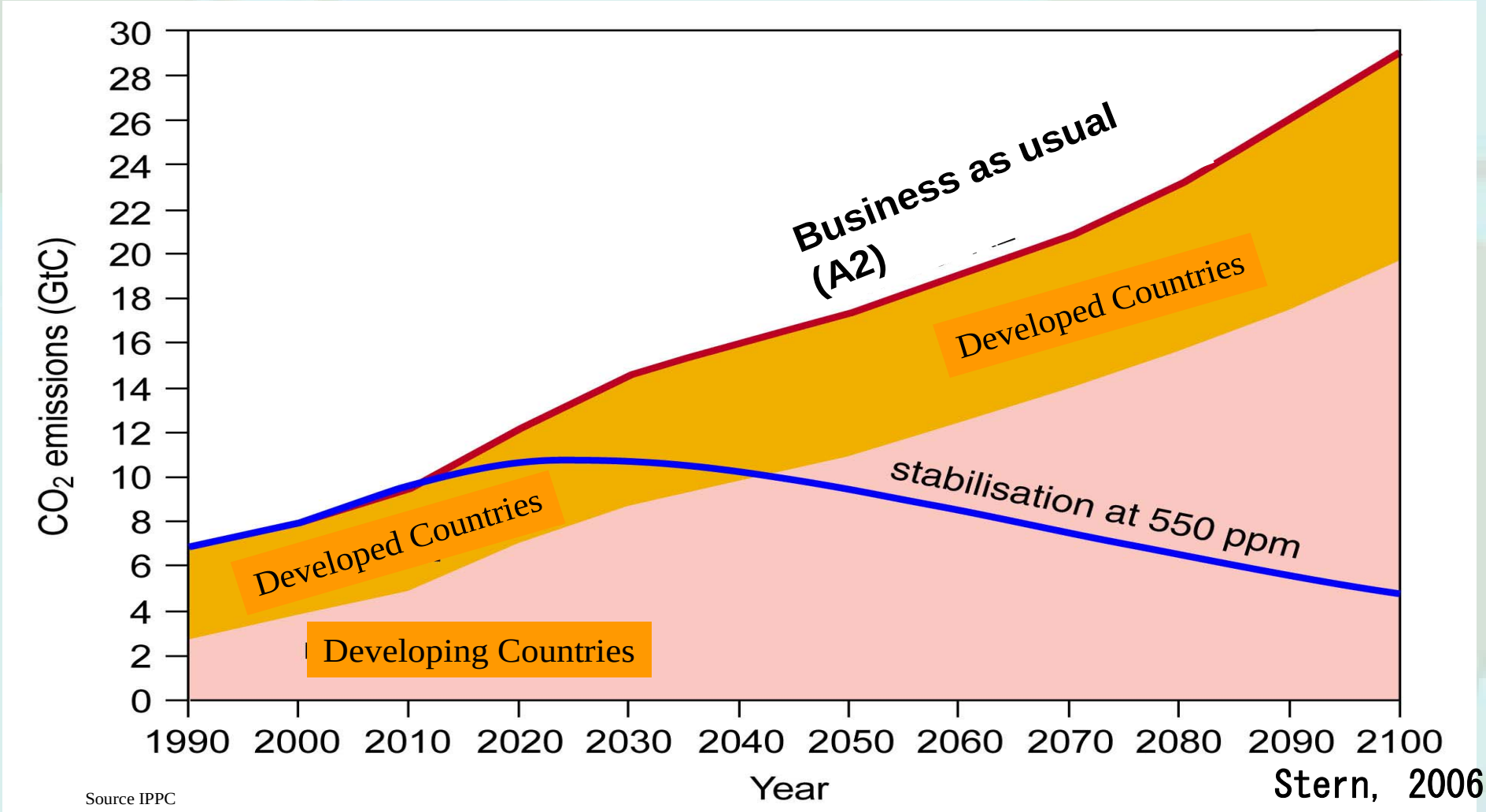
Larger developing countries account for much of the forecast rise in emissions



Stern, 2006

Future Emissions

To stabilise atmospheric CO_2 concentrations at below 550 ppm, emissions must start to fall soon & developing countries must be part of the solution



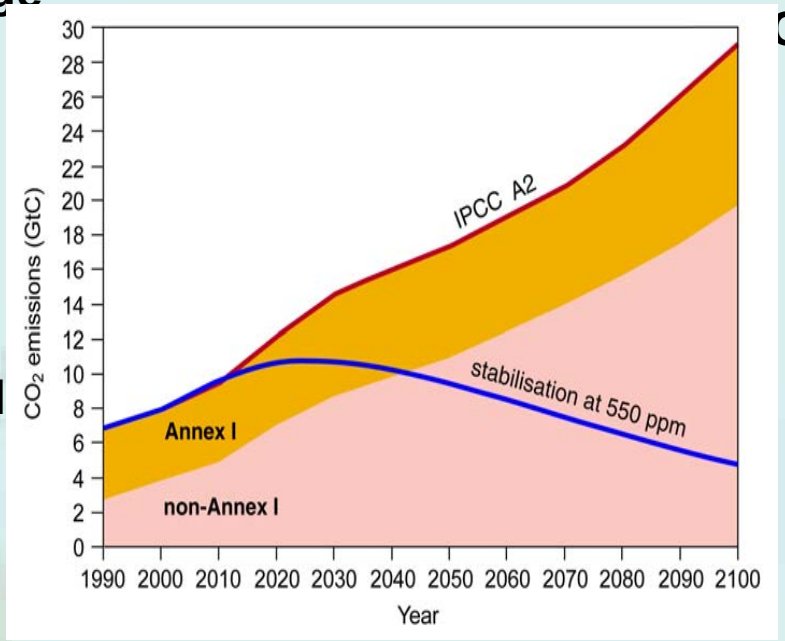
Source IPPC

Mitigation Futures

Renewable Electricity and Fuels

CO_2 Capture and Storage

Energy Efficiency & Conservation



Forests & Soil

Fuel Switching

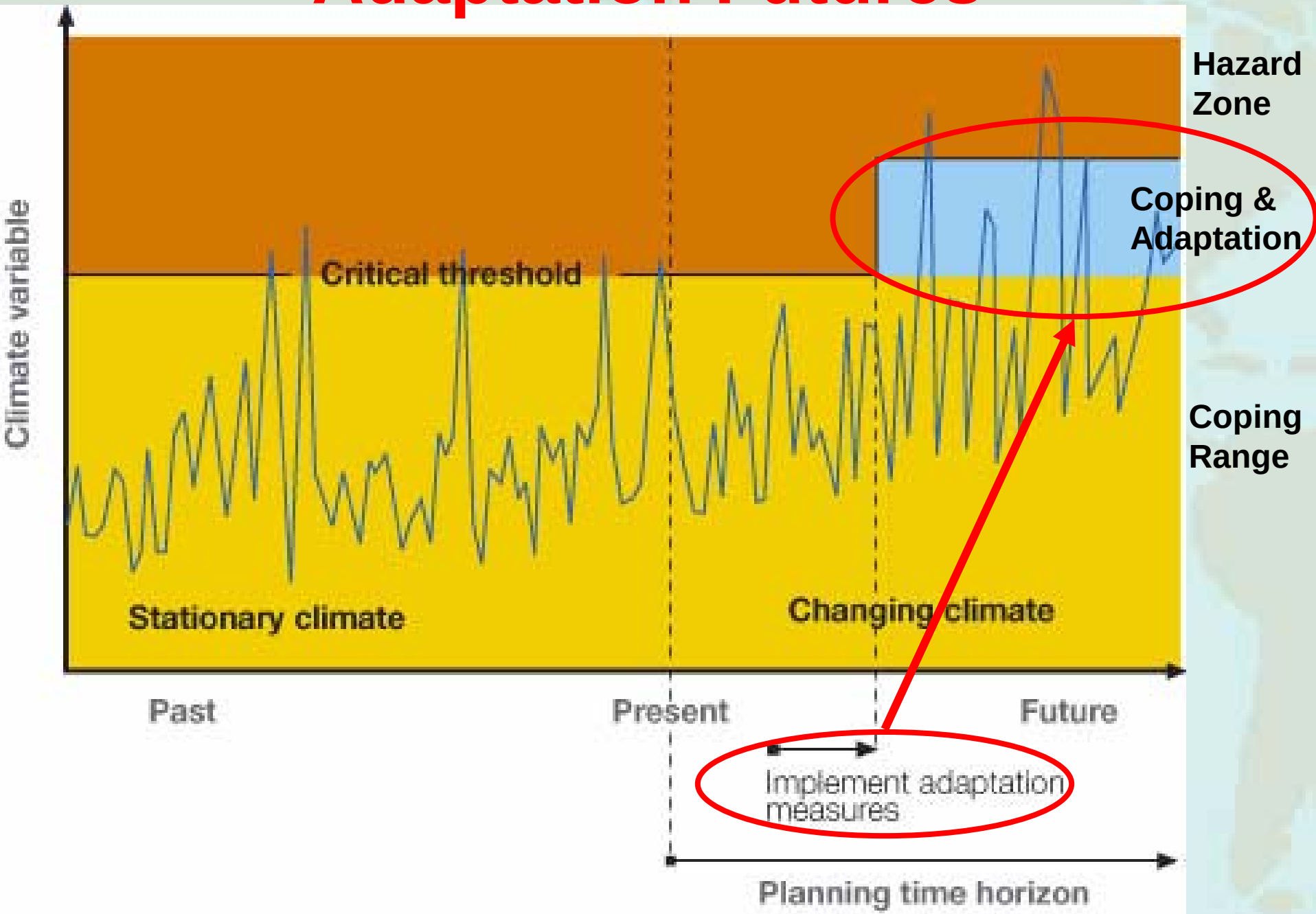
Nuclear Fission

Wild, 2005

Adaptation Futures

- Even with strong mitigation, a substantial change in climate is inevitable, necessitating adaptation;
- Adaptation is not addressed adequately by the current international legal regime;
- The costs of adaptation are uncertain, but are thought to be considerable;
  - Developing countries will likely require the largest investment - $10 billion to $40 billion per year incremental annual costs of adaptation; **WB, 2006**
  - 50 Least Developed Countries: $1.3 billion just for ‘urgent and immediate’ adaptation **Stern, 2006**

Adaptation Futures



ADAPTATION（適応策）

Eight Generic Types: （8つの一般的なタイプ）

- Preventing loss（損失･被害の防護）
  - e.g. coastal protection
- Tolerating loss（損失･被害の許容）
  - e.g. disaster recovery planning
- Spreading or sharing loss（損失･被害の分散･共有）
  - e.g. crop, building and business insurance
- Capturing positive consequences（良い結果の利用）
  - e.g. switch to crops requiring longer growing season
- Changing use or activity（利用･活動の変更）
  - e.g. snow-based resorts offer summer attractions
- Changing location（場所の変更）
  - e.g. relocate away from coastal areas that are at risk
- Restoration（回復，再生）
  - e.g. beach nourishment
- Do nothing（何もしない）
  - e.g. hope for the best

Key Conclusions

- The climate has always changed; but human activities are a *new and additional* cause of climate change;
- New climatic conditions are already having major, and increasing, social and economic consequences;
- Both the rate of climate change, and the consequences, will likely escalate in the coming decades;
- The cost of slowing climate change is minor relative to the damages avoided; and
- We must adapt, in order to minimise the unavoidable consequences of climate change.


Thank you
ご静聴、有り難うございました。