

Global Focus on Knowledge #3 (2007. 12. 03)



# Global Warming and Sustainable Society

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# Summary of Previous Lectures

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- The Earth as the third planet in the Solar System
- Present age as a result of the Earth's revolution and history
- Today leads to the future.
- Looking forward resolutely (Prediction)
- What is going on now?
- What are the problems?



What was the 20<sup>th</sup> Century like ?  
What would the 21<sup>st</sup> Century be ?

20<sup>th</sup> Century was the period of explosion.

21<sup>st</sup> Century will be the period of sustainable growth.



## In the 21<sup>st</sup> Century ...

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- Society must be constructed to secure sustainability.

# Because things do not develop exponentially or infinitely.

- This is very clear notion.
- Overshoot and collapse
- When amplitude increases, adjustment starts, and transition to new phase occurs.
- However, looking back on history, this adjustment would not be amusing.
- So, can't we find a happier adjustment with intelligence and rationality.





# What is sustainability ?

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- An idea originated in fishery and forestry
- If fishers or forestry laborers collect all resources, they can't earn their living.
- They used to consider amount of bearing in a range that nature gives to them.
- Development of technology elongated time scale and space scale.
- If resources run out, move to another place.
- If resources run out, eat up savings from the past.

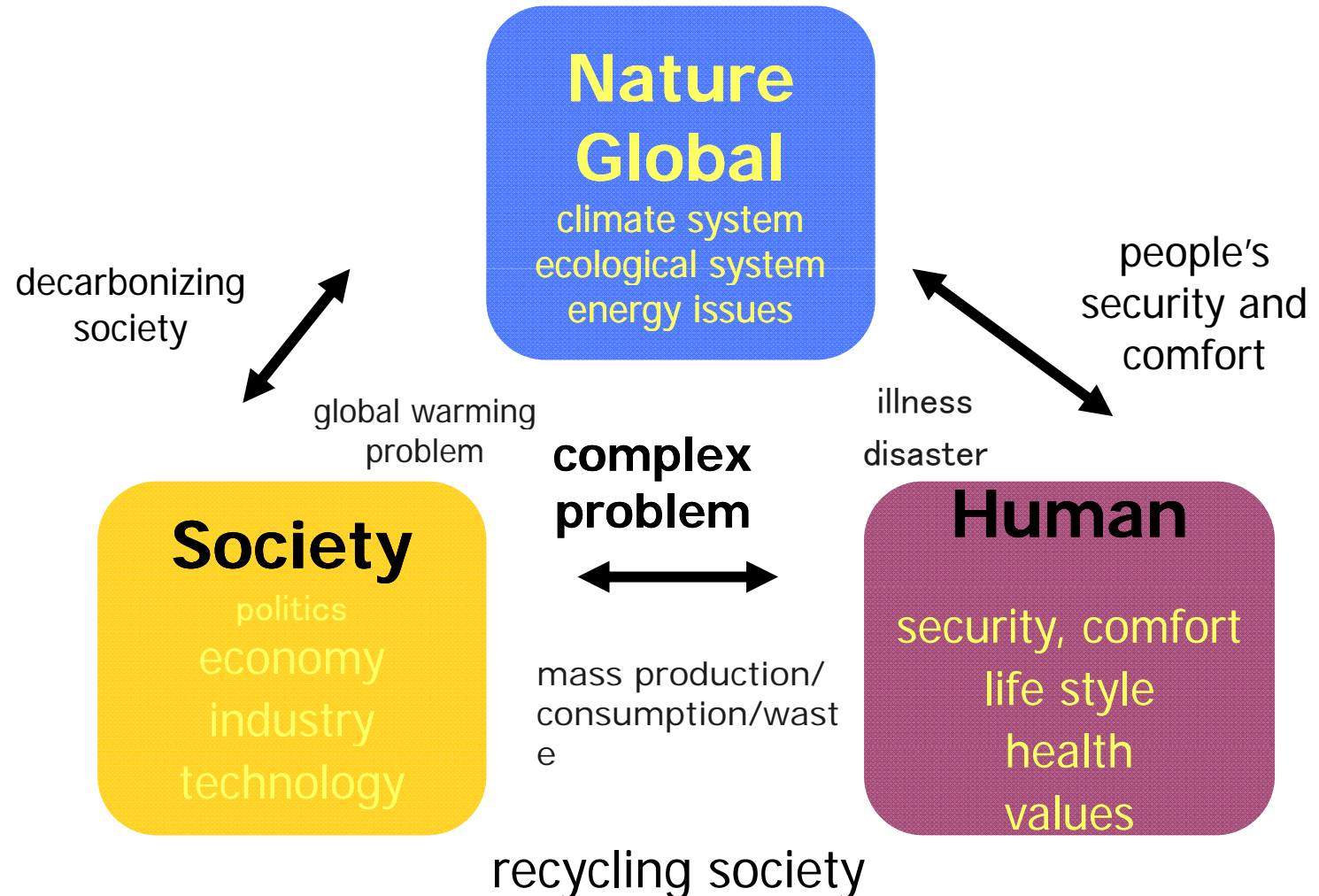


# We are not just living on the nature.

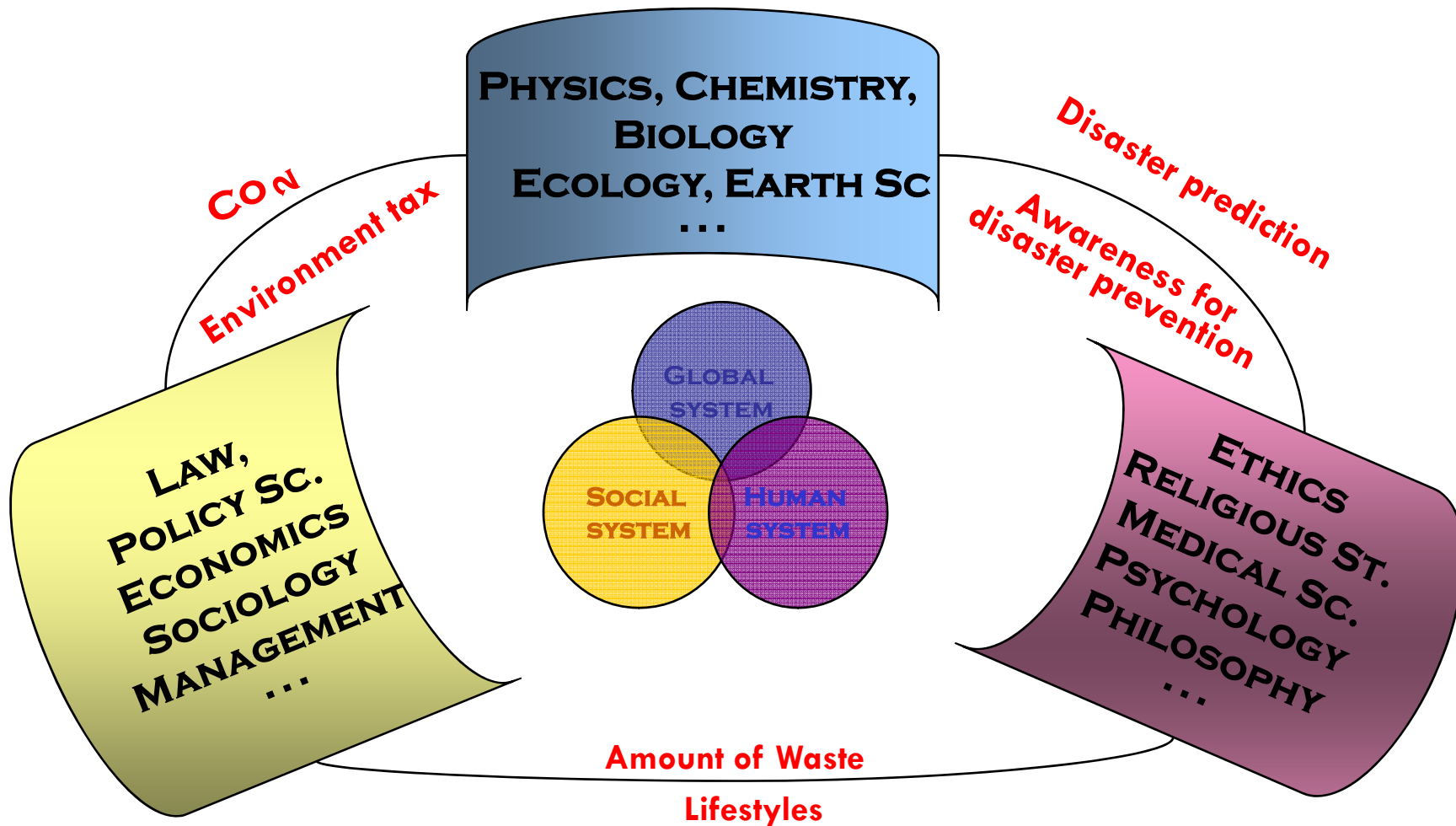
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- Natural system (Global system )
- Social system
- Human system
- We live in these systems.

These systems interact with each other.  
Problems are also related.



# Transdisciplinary approach



**Sustainability Science fuses  
Natural and Social Sciences with indicators**



# Global Warming Problem

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- Chance to consider how society should be in the 21<sup>st</sup> Century.
- Problem is not only global warming.
- Near-term problems such as poverty and future problems must be considered together.



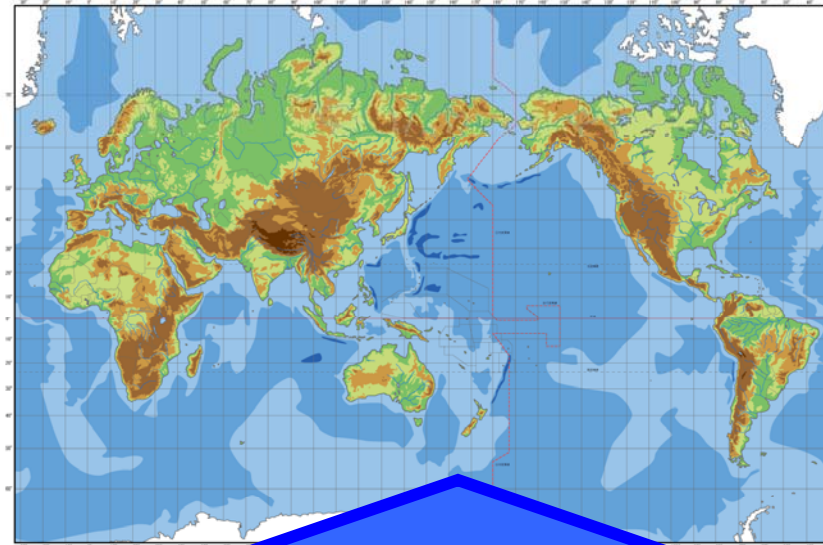
# When we think about these problems ...

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- America and Europe cannot be a model anymore.
- There is no model.
- The frontier of emerging issues (Komiyama)

# Japan could be a role model

- Scarce resources
- Increasing waste
- Environmental contamination
- Small land area (60<sup>th</sup>)
- High population (7<sup>th</sup>)
- GDP (2<sup>nd</sup>)



- Environmental technology
- Energy technology
- Know-how for pollution control
- Co-existence with nature (traditional value)





# Climate change reflects society

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- revolution (change of dynasty) decreed by Heaven when the incumbent emperor is found lacking in moral virtue
- misrule——> dry weather · famine——> farmers' revolt
- ——> revolution, change of power
  
- Climate change in the 21<sup>st</sup> Century reflects how we are in the modern society.
- Climate security

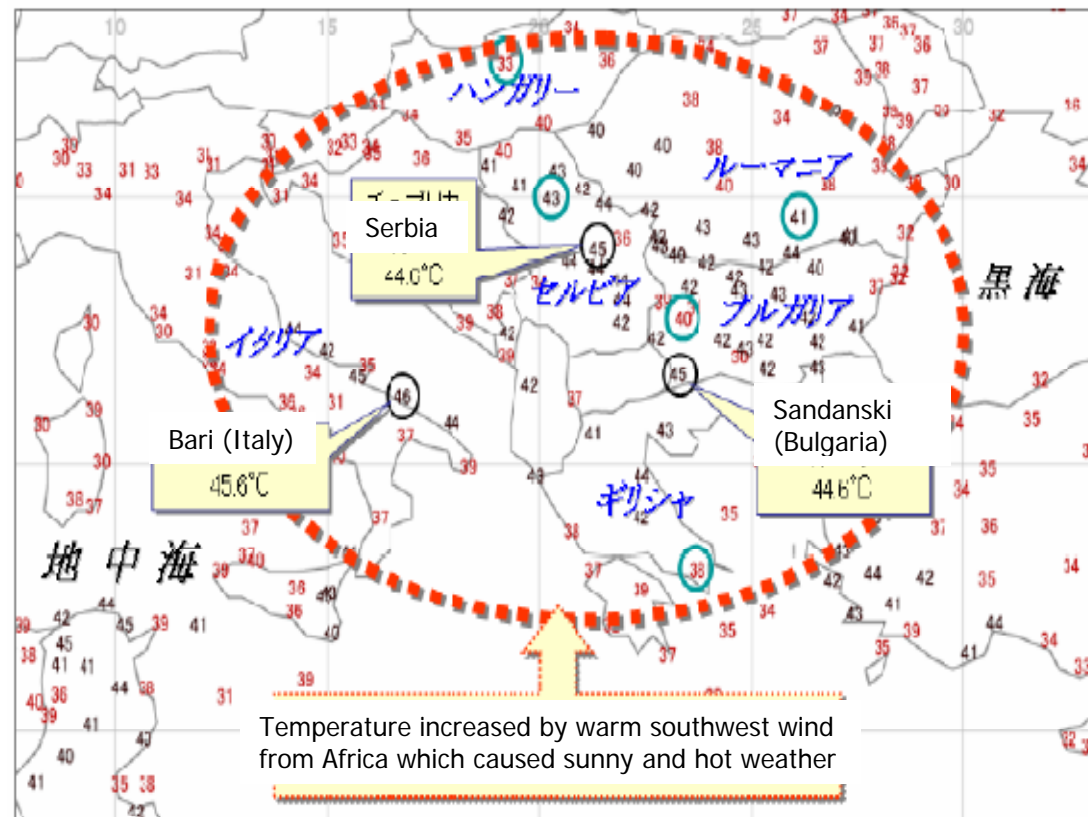


# Abnormal Climate in 2007 (1)

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- **Water disaster in China, 500 people are dead or disappeared. The government dispatched emergency team.**
- Newspaper on July 24, 2007
- 【Beijing=Yuji Hiraiwa】 Xinhua News Agency reported that “the largest rainstorm in this 100 years” attacked Chongqing, the inland area of China, and there was a rash of historical water disasters such as “the largest flood in 50 years” occurred in middle south area. More than 500 people are dead or missing in 24 districts, municipalities and cities.
- In Chongqing, there were continuous strong torrential rainfalls from June, and 54 people were dead, 22 were missing. Victims are more than 18 million and 55 thousand. Chongqing also experienced natural disaster last year, which was a severe dry weather said to be “worst in 100 years” last year. The Central government dispatched emergency team organized by Water Agency, Economy Agency, and the Ministry of Hygiene. General Secretary Hu Jintao visited Chongqing on 21<sup>st</sup> and 22<sup>nd</sup> of July, and promised to “secure food, clothing, and clear water” to victims.

# Heat wave in South Europe, which caused more than 10 dead / 46 degrees in Sicily



Highest temperature in Southeast Europe on July 24, 2007 (from Meteorological Agency's web site)



# Recent Movements (1)

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- Post-Kyoto
- **The Stern Report**
- Not “Take actions or not” but “Which costs less, taking actions or not?”
  - Cost of Action and Cost of no-Action
- **EU's strategic actions**



## Recent Movements (2)

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- America's movements — by some means, Cap and Trade
- Technological response
  - CCS, coal clean energy and nuclear power
- CO<sub>2</sub> standard
- Climate security
  - To win over the USA ?
  - In relation to national security ?



## Recent Conditions (3)

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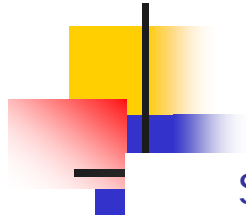
- IPCC the 4<sup>th</sup> Report (2007)
  - Human activities are more than 90% responsible in global warming
  - Inclination to accommodation measures



# What is global warming?

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- Why weather gets warm when CO<sub>2</sub> increases ?
- Isn't heat from cars stronger ?
- Answer by remembering previous lessons.



## Scientific Reasons for Humans-caused Global Warming Presented in IPCC Report

- First Assessment Report (FAR, 1990)

Observed temperature increase can largely be caused by natural climate change, but inversely, larger artificial greenhouse effect might be balanced out by natural changes and other artificial factors. Increase of greenhouse effect cannot be clearly detected from observation results in 10 or few more years.

- Second Assessment Report (SAR, 1995)

Results from comparative discussion of evidences indicate detectable artificial effects on climate.

- Third Assessment Report (TAR, 2001)

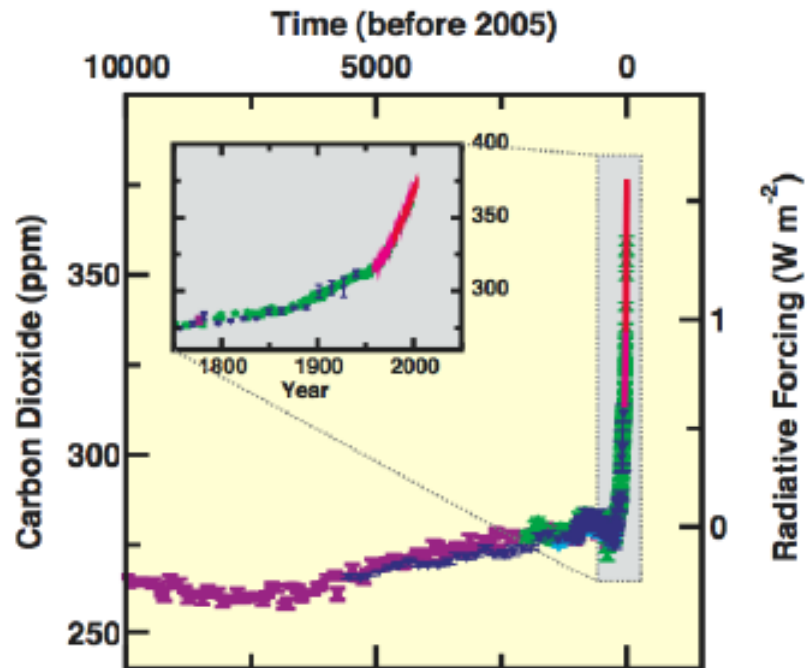
There is a new, stronger evidence to prove global warming observed in last 50 years were caused by human activities.

- Fourth Assessment Report (AR4, 2007)

Most temperature increase in last 50 years were highly possibly caused by increase of artificial greenhouse effect. (Its possibility is more than 90%)

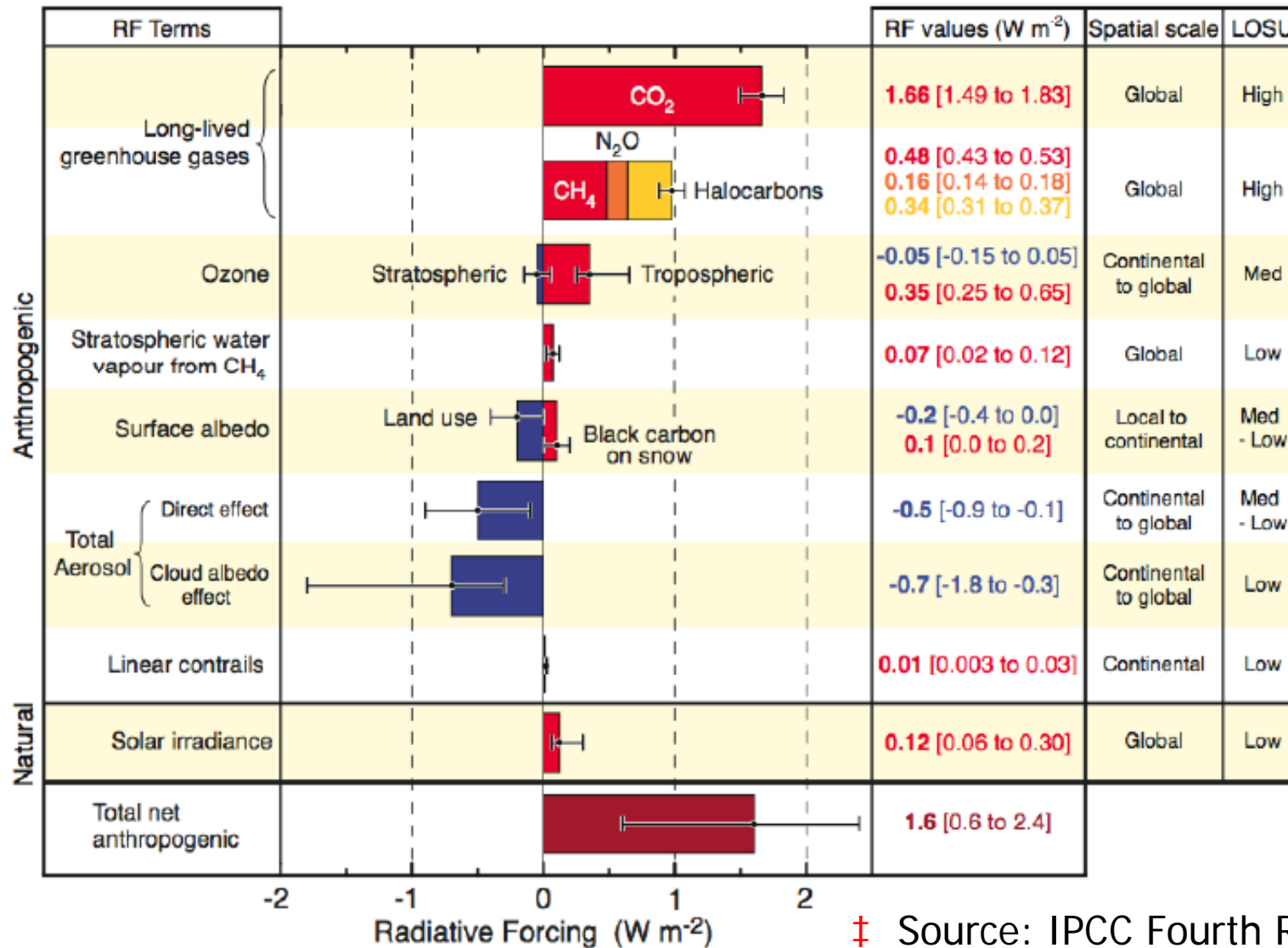
# CO2 in atmosphere is increasing.

Changes in Greenhouse Gases  
from ice-Core and Modern Data



† Source: IPCC Fourth Report

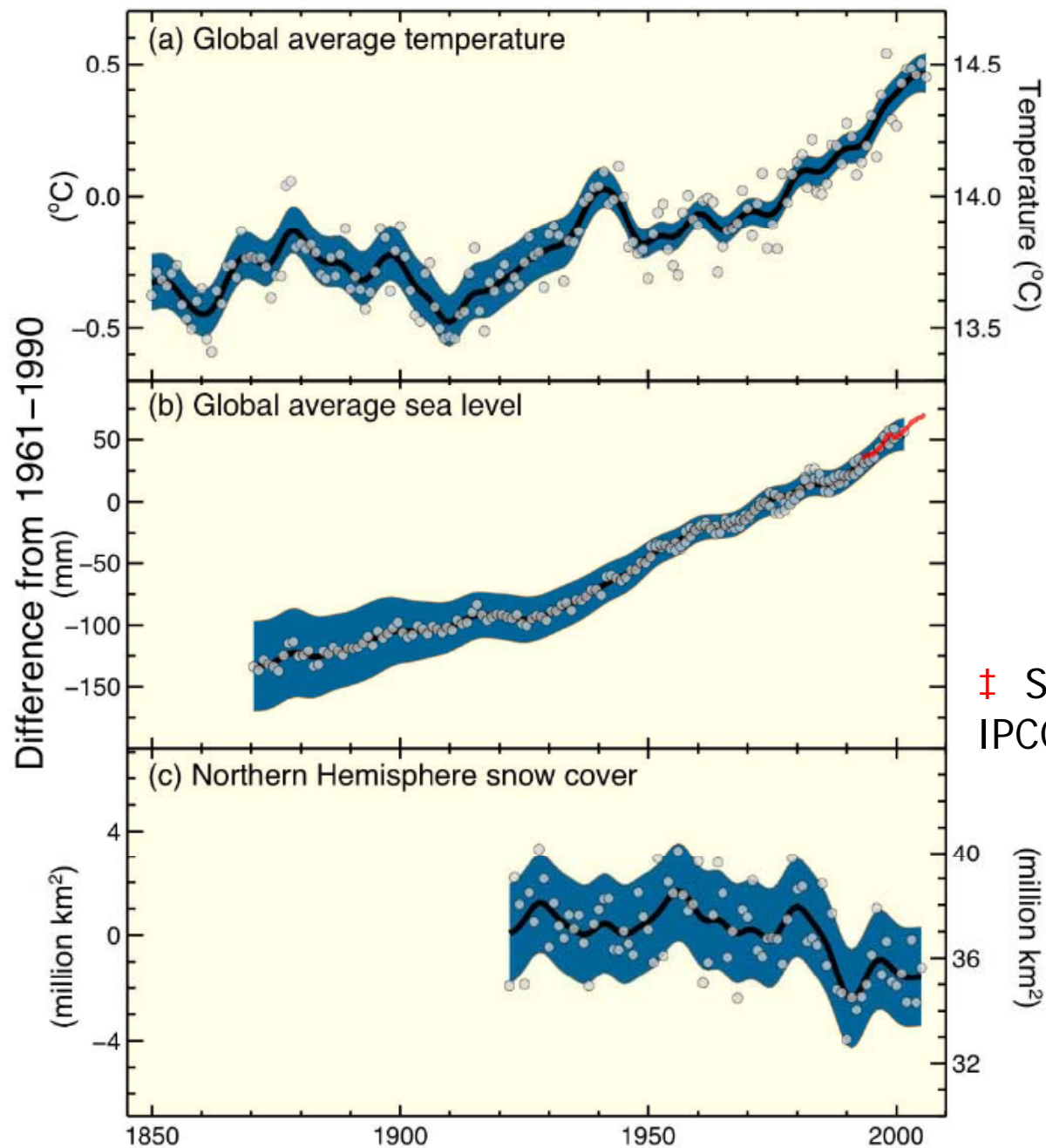
# Radiative Forcing Components



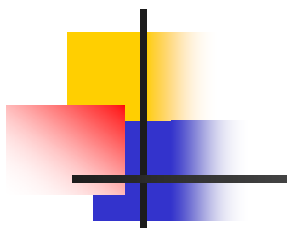
©IPCC 2007: WG1-AR4

† Source: IPCC Fourth Report

# Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover



† Source:  
IPCC Fourth Report

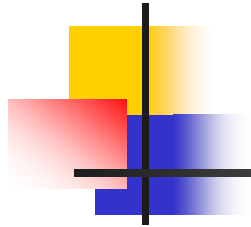




# Is global warming caused by humans ?

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- It cannot be proved perfectly.
- Inference was made by climate model.
- There are many things unsolved, but many things are understood.
- Verification is done by daily weather forecast, seasonal forecast and reproduction of climate changes in the 20<sup>th</sup> Century.



# 20th Century Simulation

## External Forcing Considered in 20<sup>th</sup> Century Simulation



➤ Climate effect caused naturally

✓ Solar constant change (Lean et al., 1995)

✓ Aerosol release into stratosphere caused by volcano eruption (Sato et al., 1993)

➤ Climate effect caused artificially

✓ Increase of greenhouse effect gas (Radiation+MATSIRO)

✓ Decrease of ozone in stratosphere

✓ Increase of ozone in troposphere

✓ SO<sub>2</sub> release by fossil fuel combustion

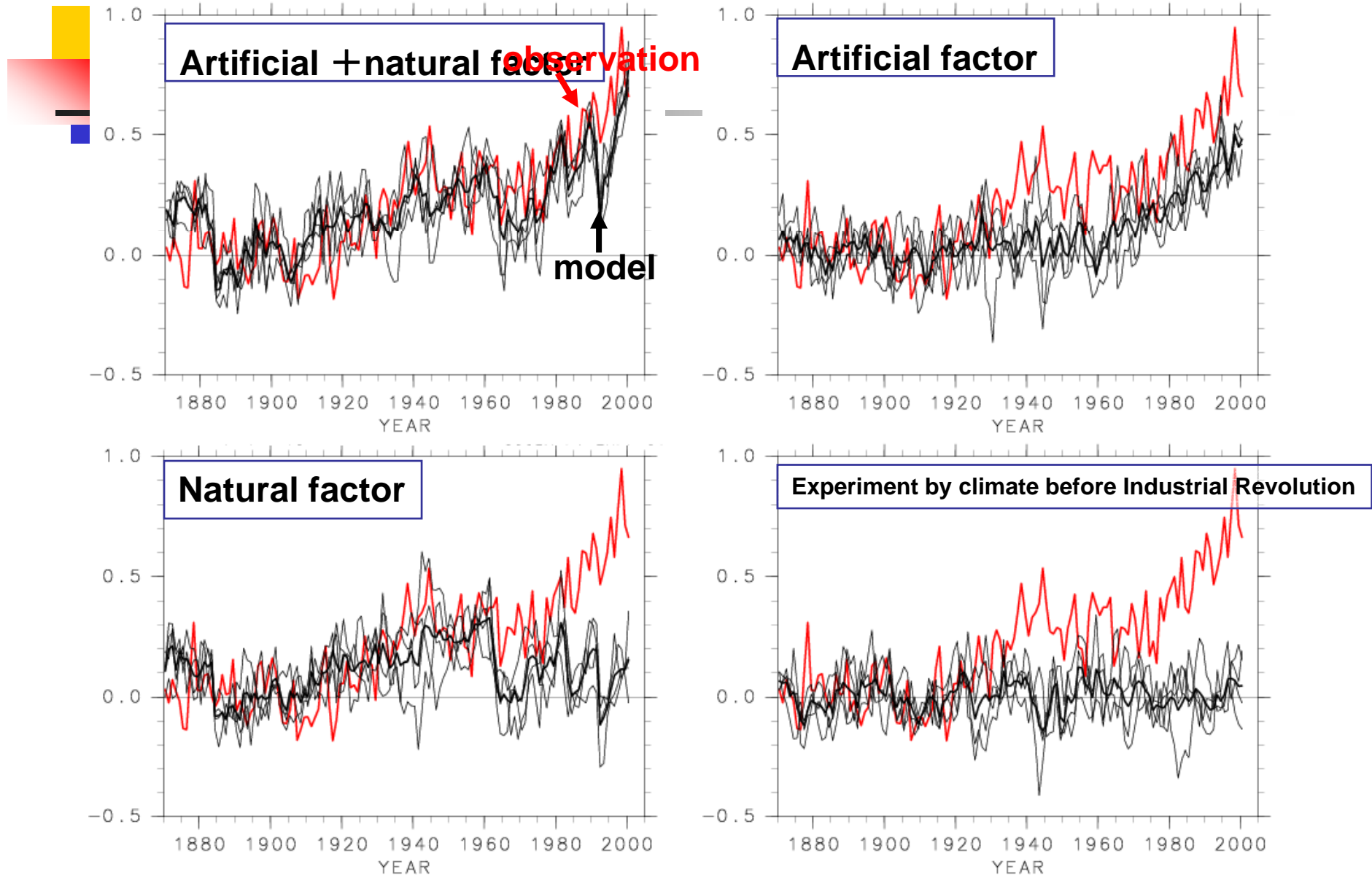
✓ Release of carbon aerosol precursors by fossil fuel combustion, use of wood fuel for living, agricultural waste combustion, forest fire

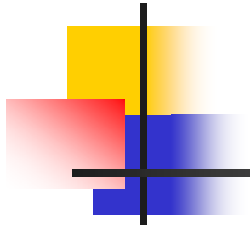
✓ Changes in use of land (change of LAI)

※ Sea salt particles and soil dust are measured by model variables (land wind speed, amount of moisture in soil, snow), so they are not considered to be external forcing.

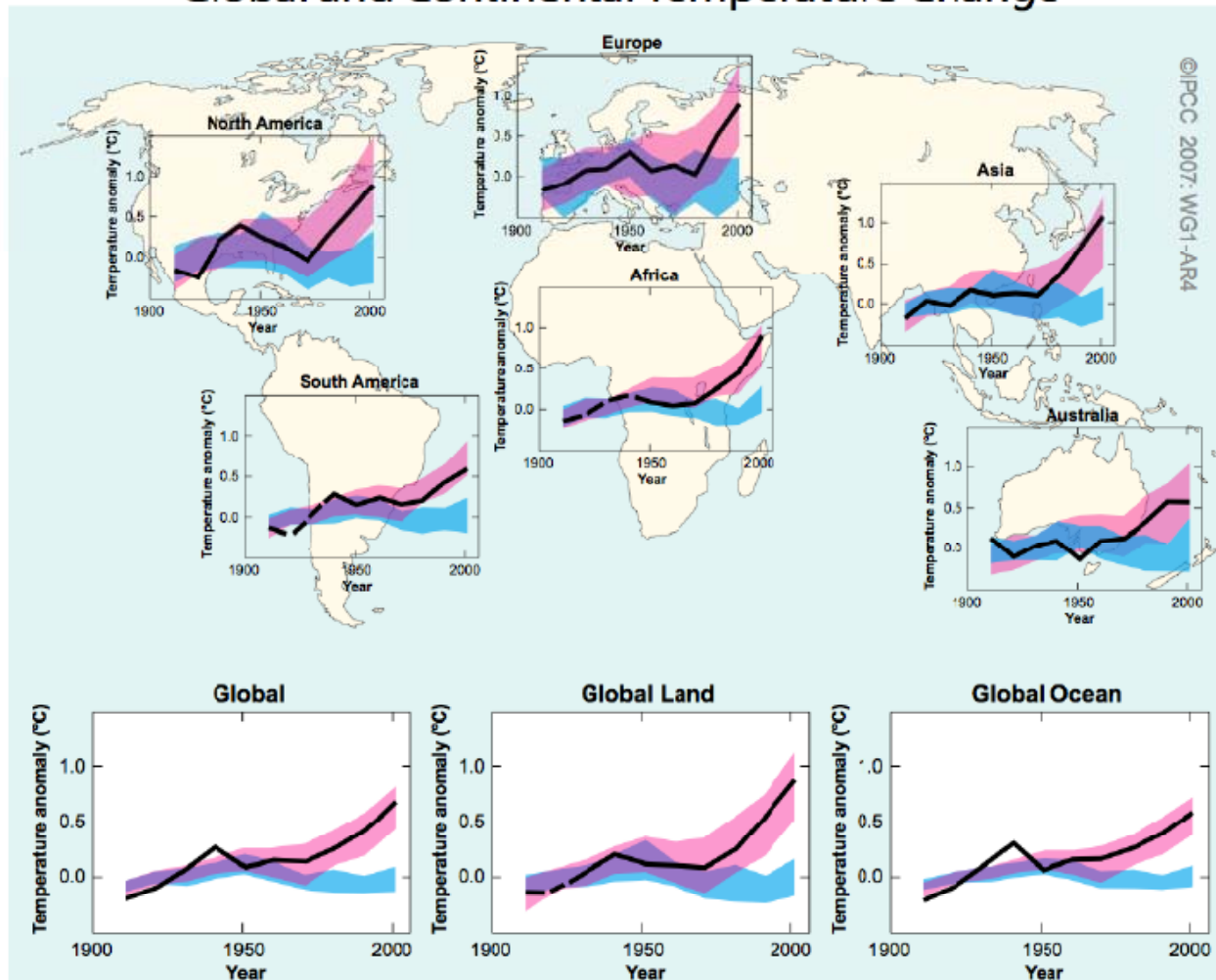
# 20th Century Simulation

Global average surface temperature—changes from the 18<sup>th</sup> Century



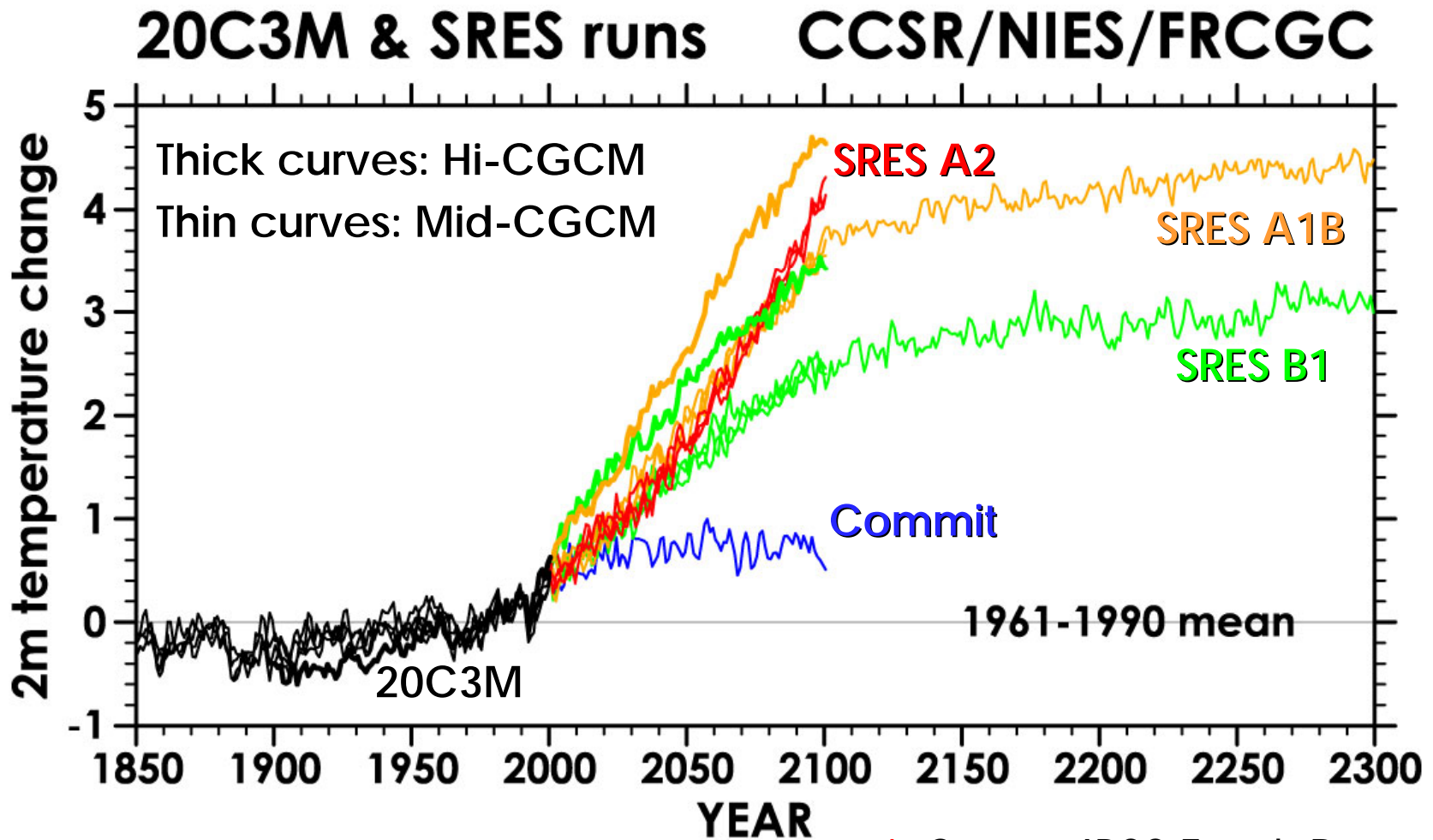


## Global and Continental Temperature Change

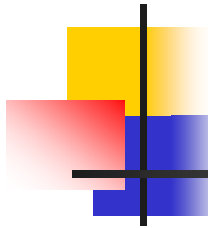


† Source: IPCC Fourth Report

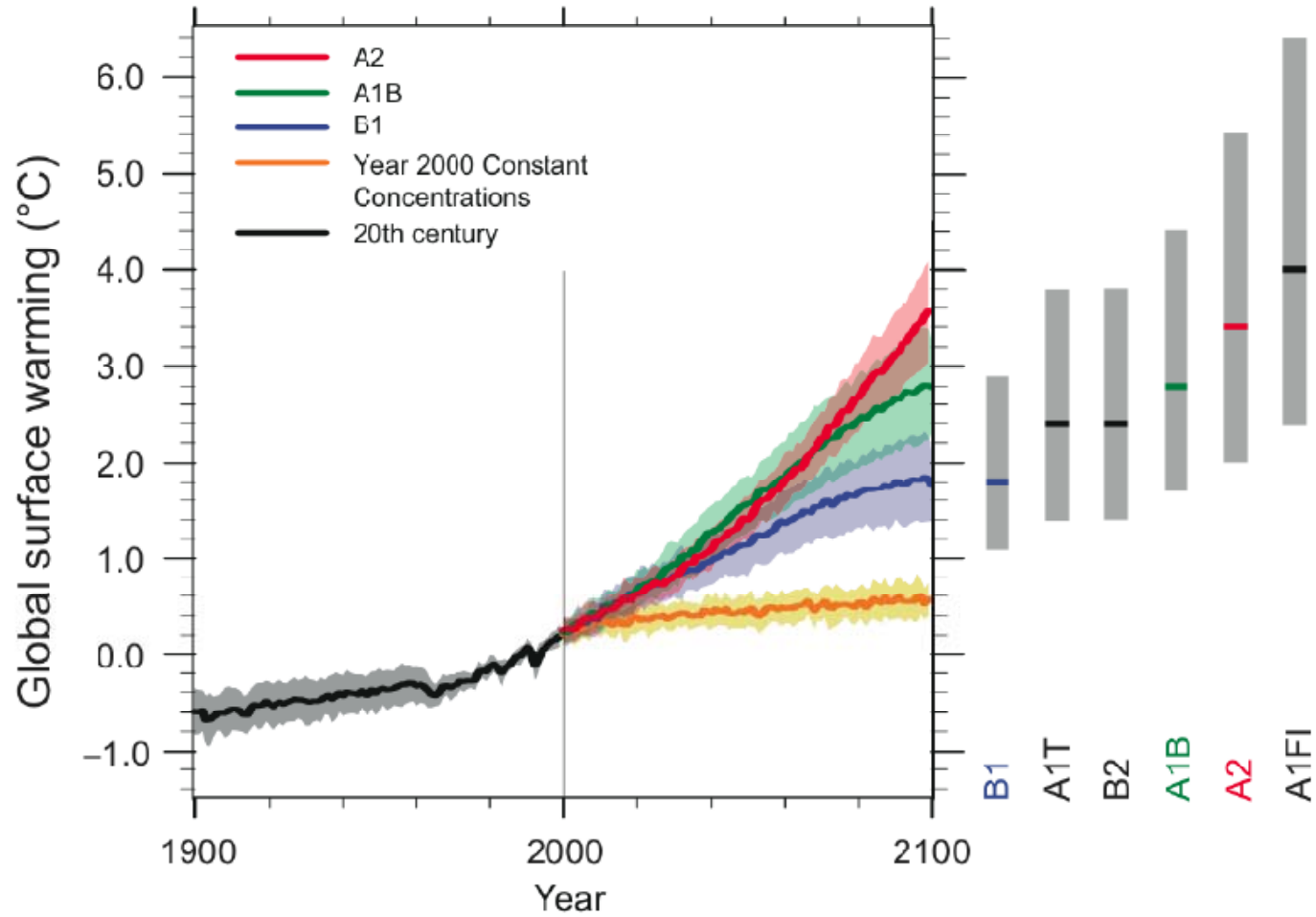
# Global Mean Surface Temperature



† Source: IPCC Fourth Report



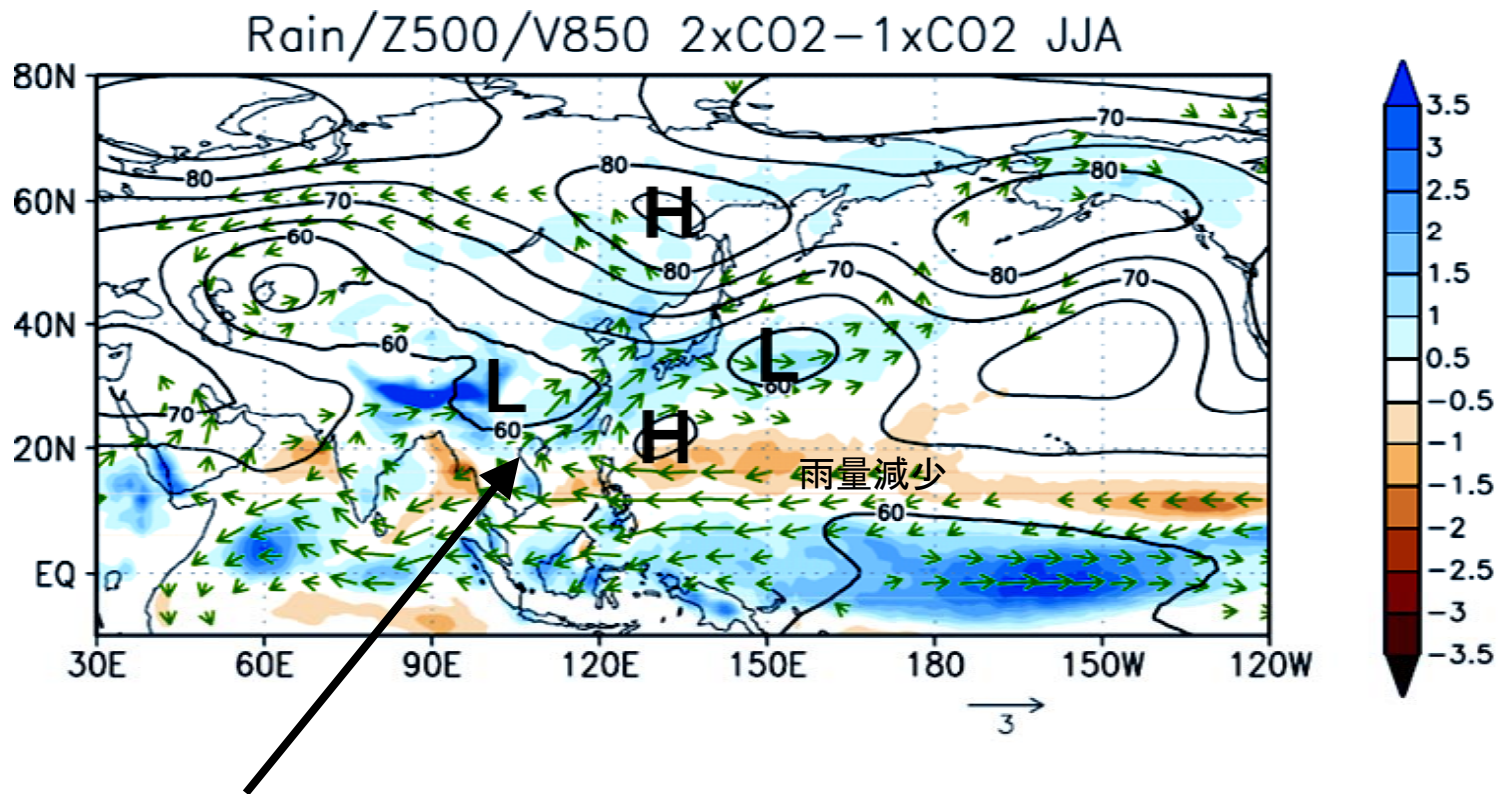
## Multi-model Averages and Assessed Ranges for Surface Warming



† Source: IPCC Fourth Report

# How about a climate in 2070(doubling CO2)?

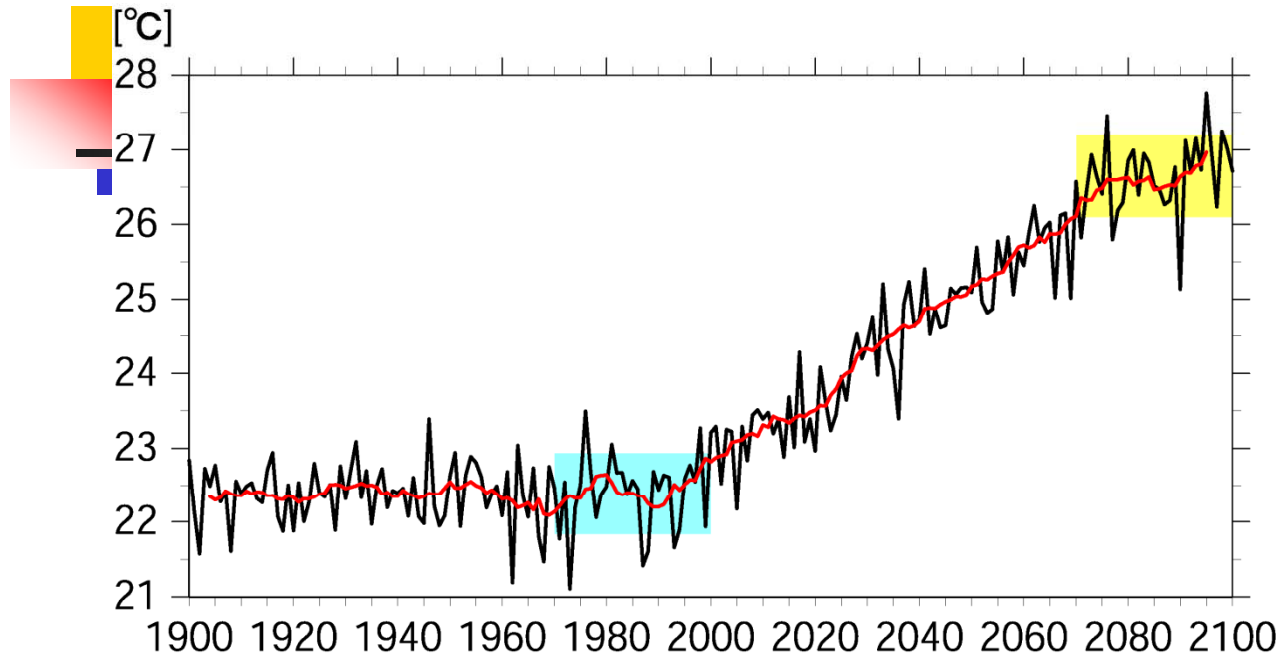
Rainfall Increase



Ranfall increases in blue region.

Average Temperature Increase is about 2.5°C.

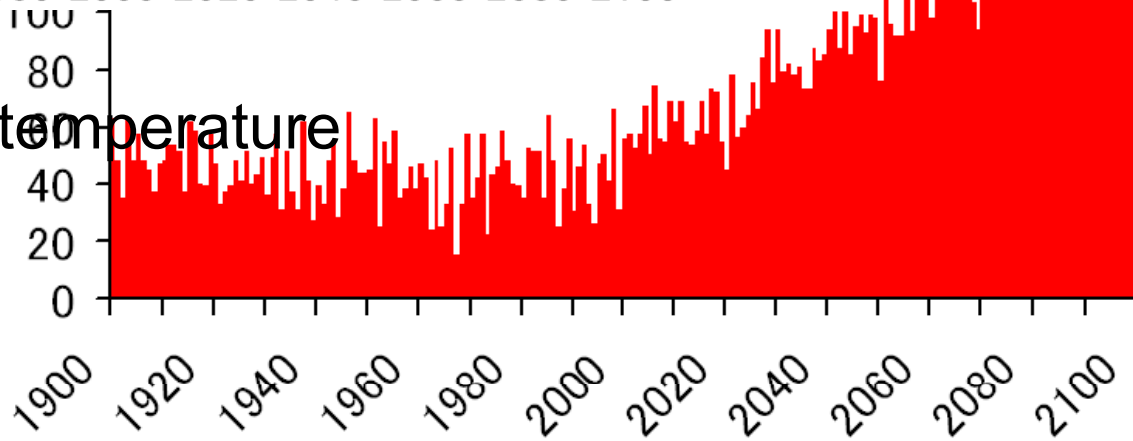
# Days of real summer heat and change of average temperature in summer in Japan



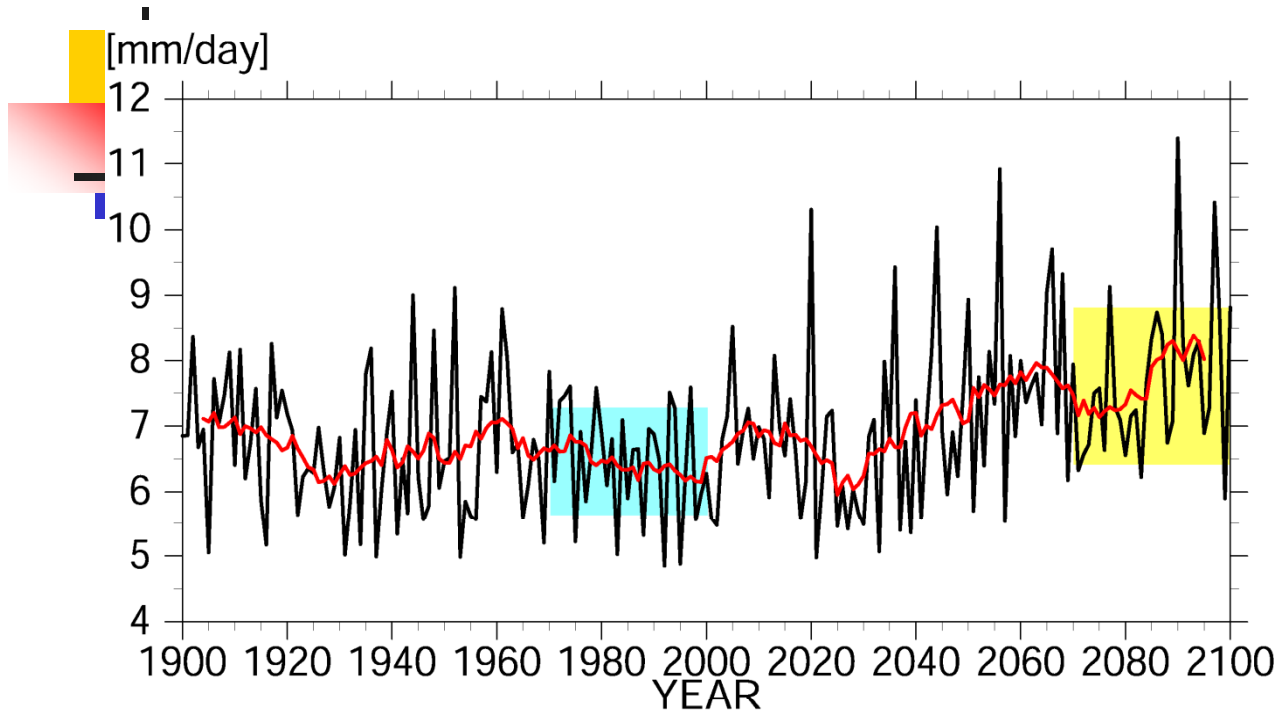
Fluctuation band of each year do not change much.

Scenario A1B

Global average temperature raised 4.0°C in 100 years.

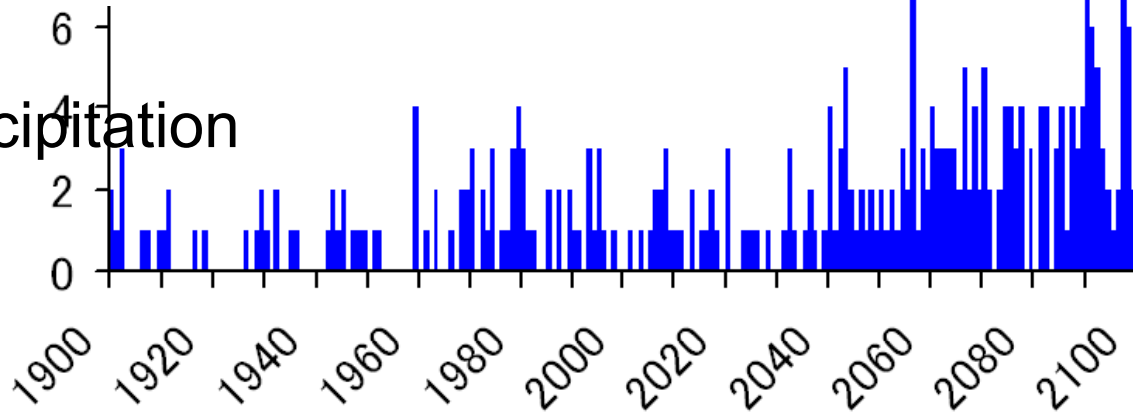


# Days of rainstorm and change of average precipitation in summer in Japan



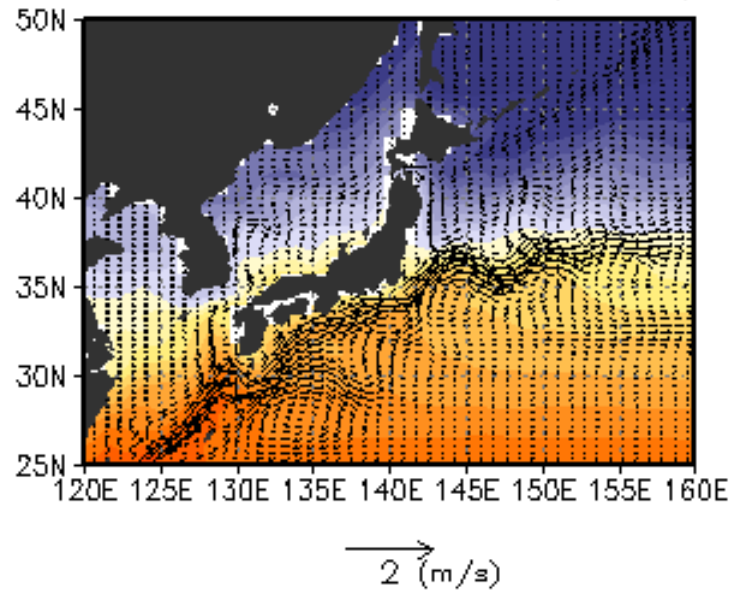
Fluctuation band of increase by year.

Scenario A1B  
Global average precipitation  
increased 6.4%  
in 100 years.

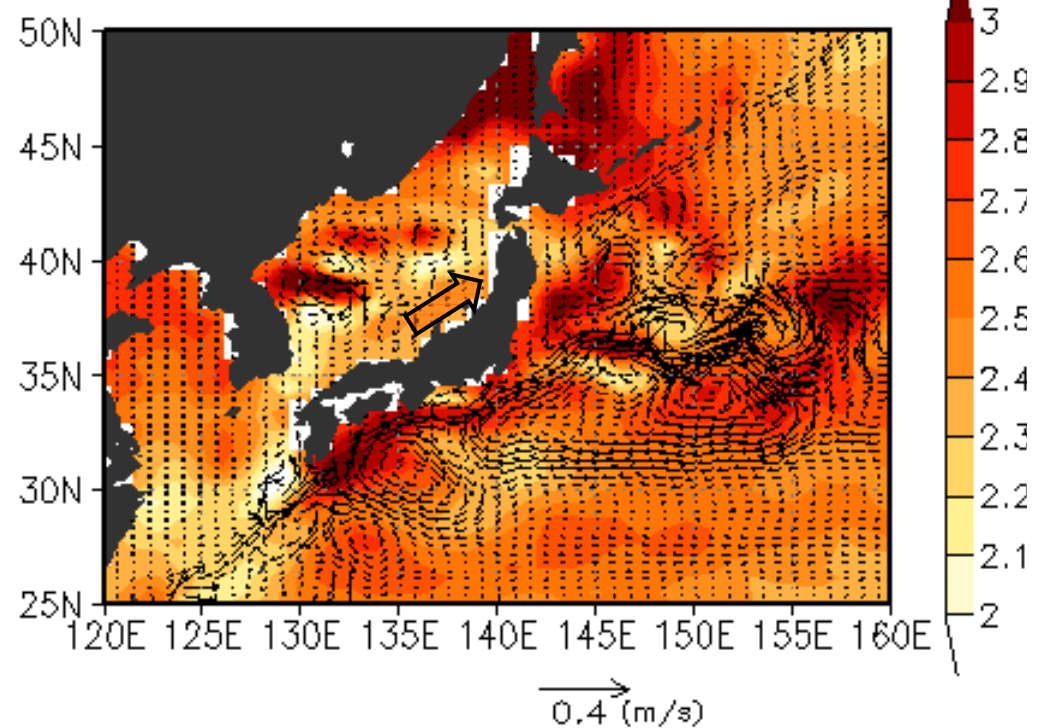


# Change of Kuroshio due to Global Warming

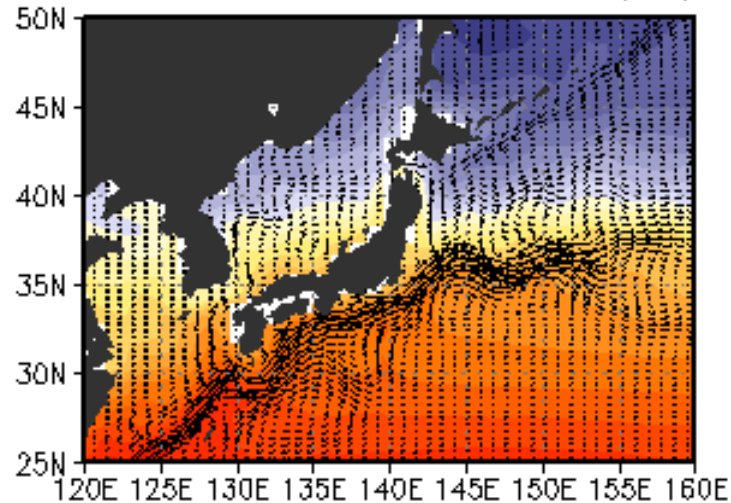
SST & ocean current at 100-m depth (CONTROL)



SST & ocean current at 100-m depth (CO2-CONTROL)



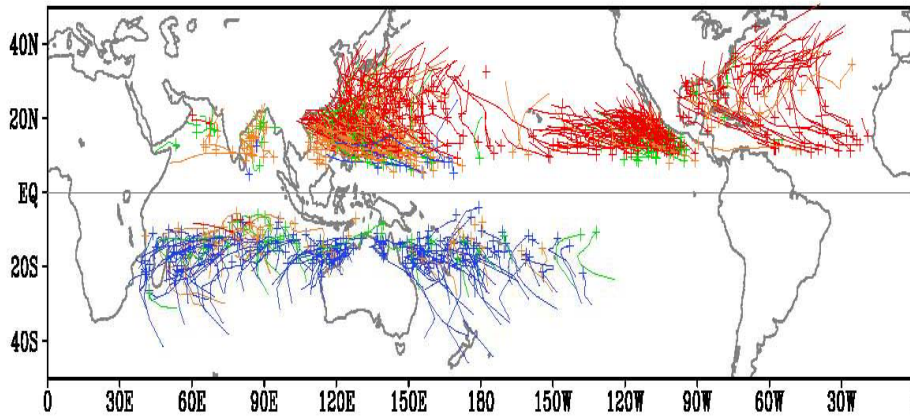
SST & ocean current at 100-m depth (CO2)



# Tropical cyclone tracks

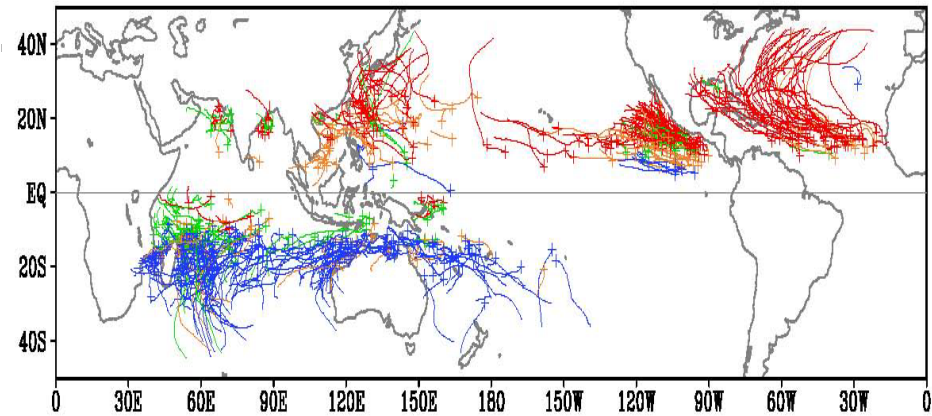
Observation 1979–1988

10 years



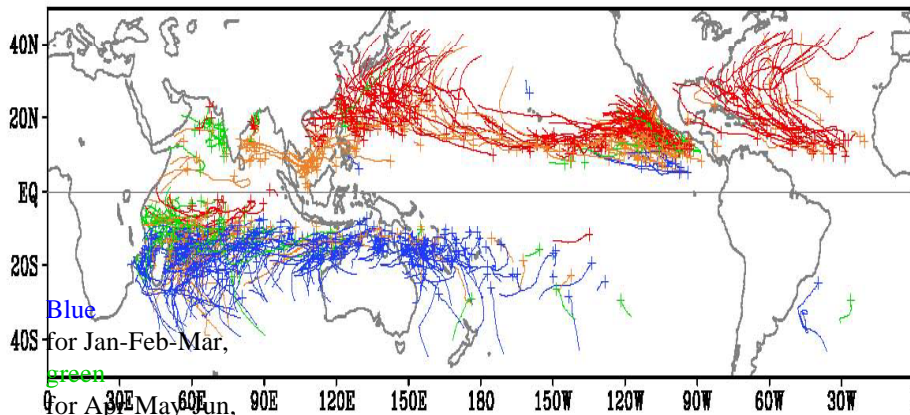
Future expt. (AK) with MRI ΔSST

10 years



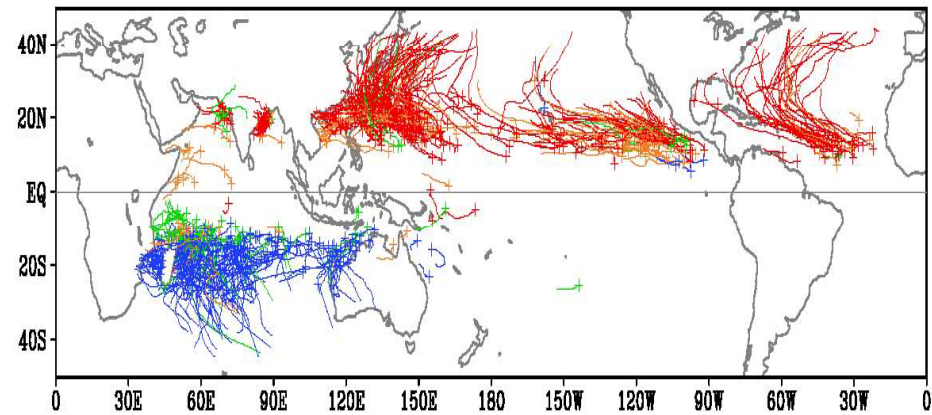
Present-day expt. (AJ)

10 years



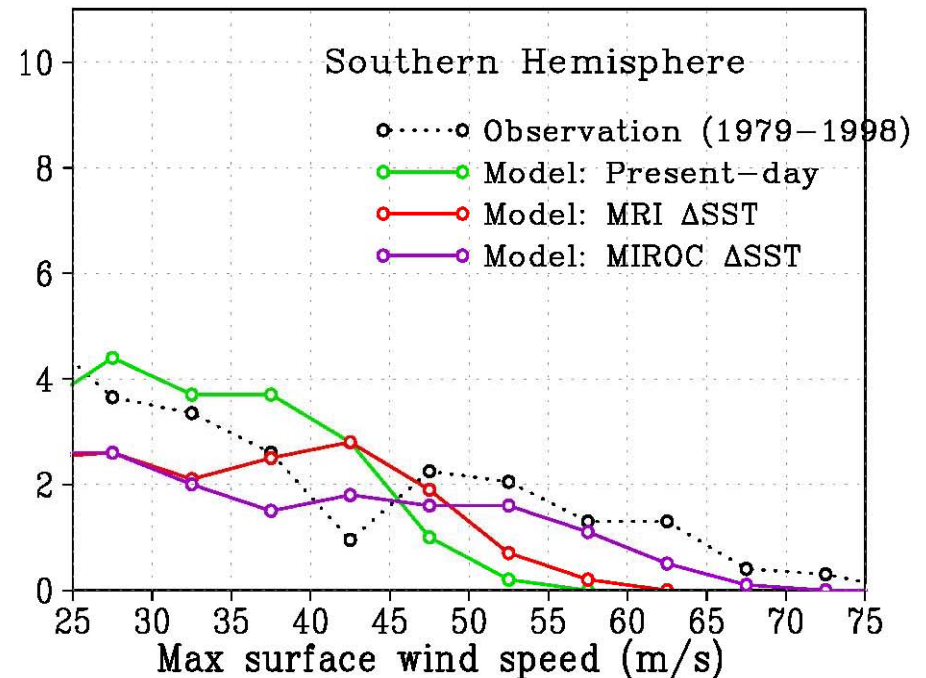
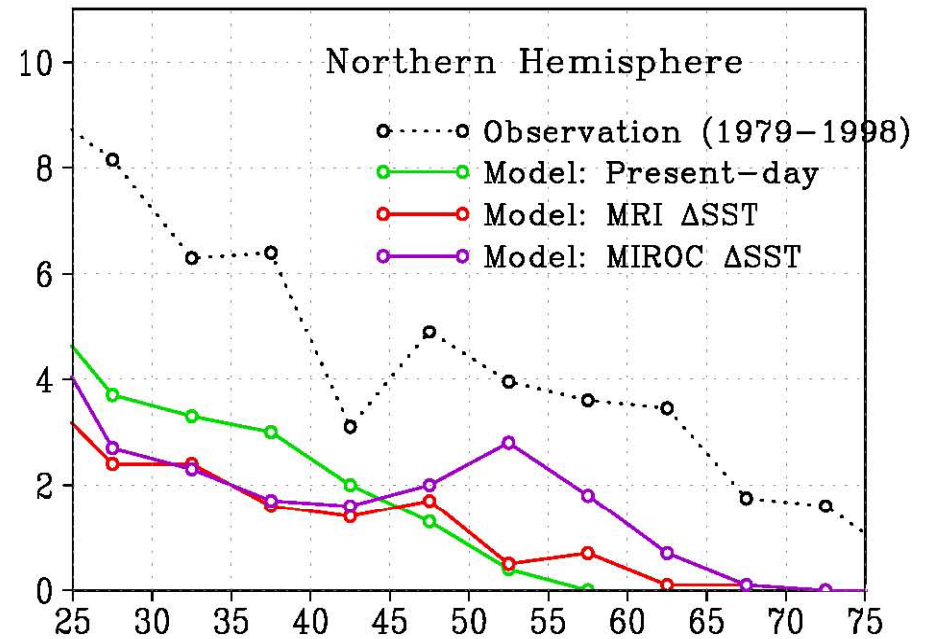
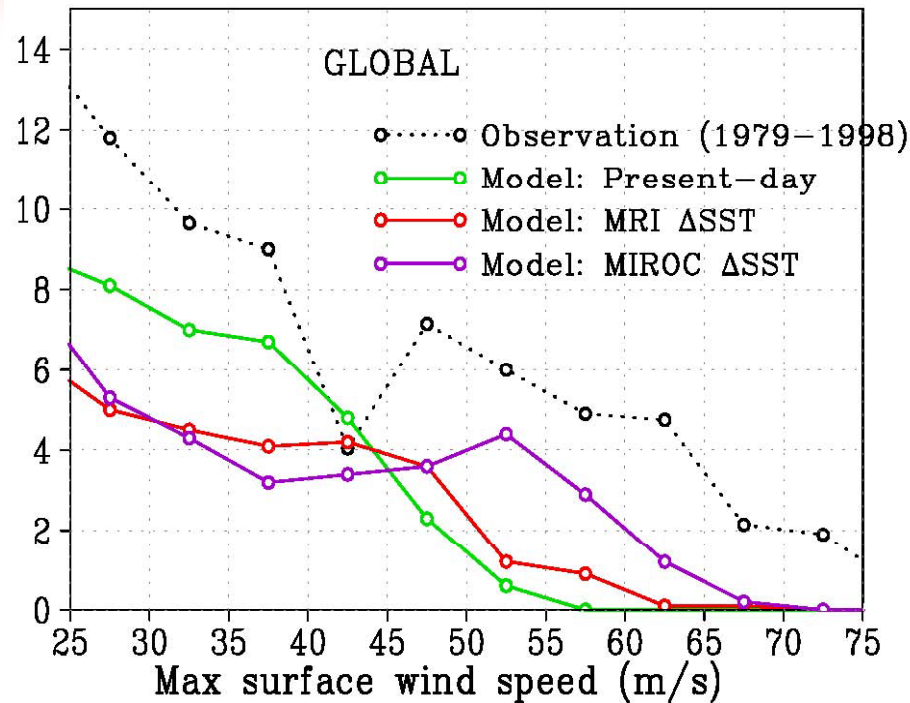
Future expt. (AS) with MIROC ΔSST

10 years

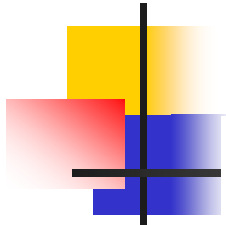


Blue  
for Jan-Feb-Mar,  
green  
for Apr-May-Jun,  
red  
for Jul-Aug-Sep,  
orange  
for Oct-Nov-Dec.

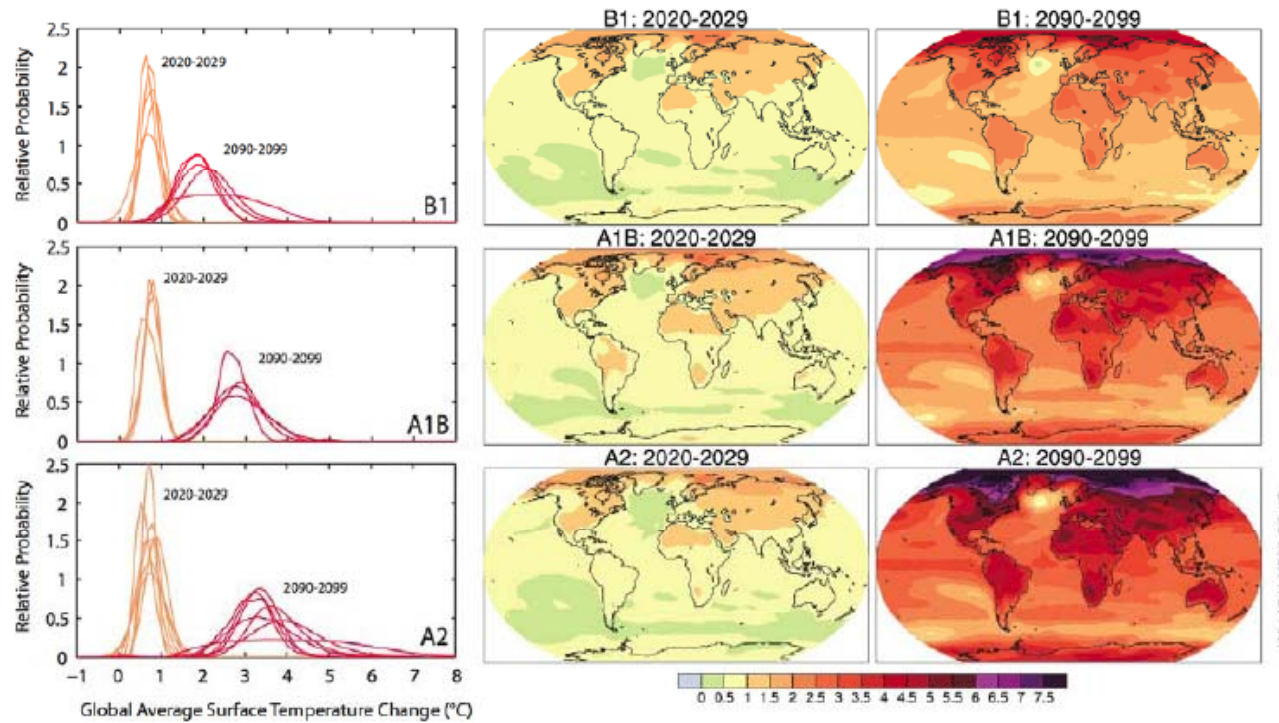
# TC frequency as a function of peak wind intensity



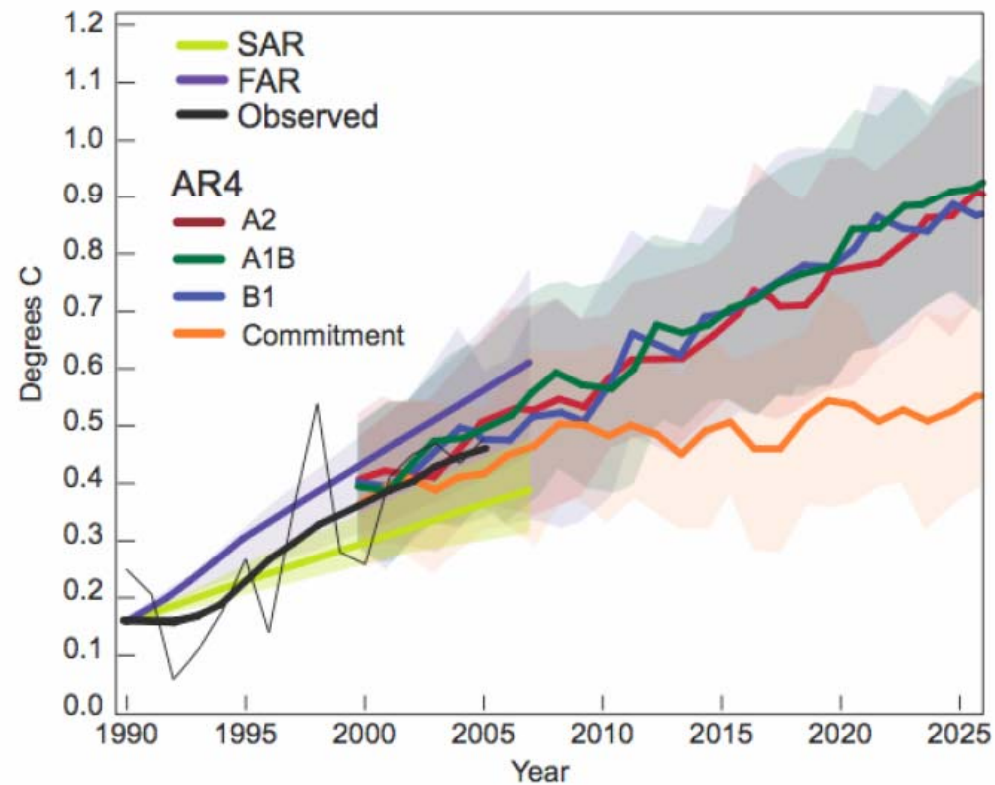
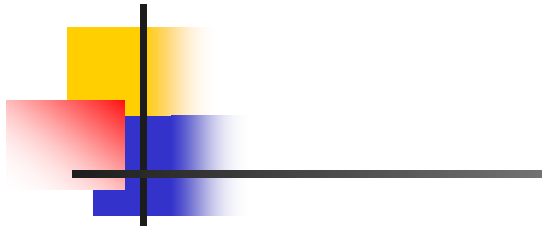
† 「Development of Super High Resolution Global and Regional Climate Models」, AESTO/JMA/MRI/JAXA



### AOGCM Projections of Surface Temperatures



† Source: IPCC WG1 AR4 Tech. Summary



**Figure TS-29.** Model projections of global mean warming compared to observed warming. Projections given in the IPCC First and Second Assessment Reports (solid lines labelled FAR and SAR) and their corresponding uncertainty ranges (shaded areas) are compared with observed annual temperature anomalies (thin black line from 1990) and smoothed temperatures (thick black line). Projections from this report for the B1, A1B and A2 SRES scenarios are shown starting in 2000 as blue, green and red curves with shaded areas representing uncertainty ranges. The orange curve from year 2000 and associated shaded area shows model projections of warming if greenhouse gas and aerosol concentrations were held constant from year 2000 – i.e., the constant forcing commitment for the period 2000–2025.

† Source: IPCC WG1 AR4 Tech. Summary

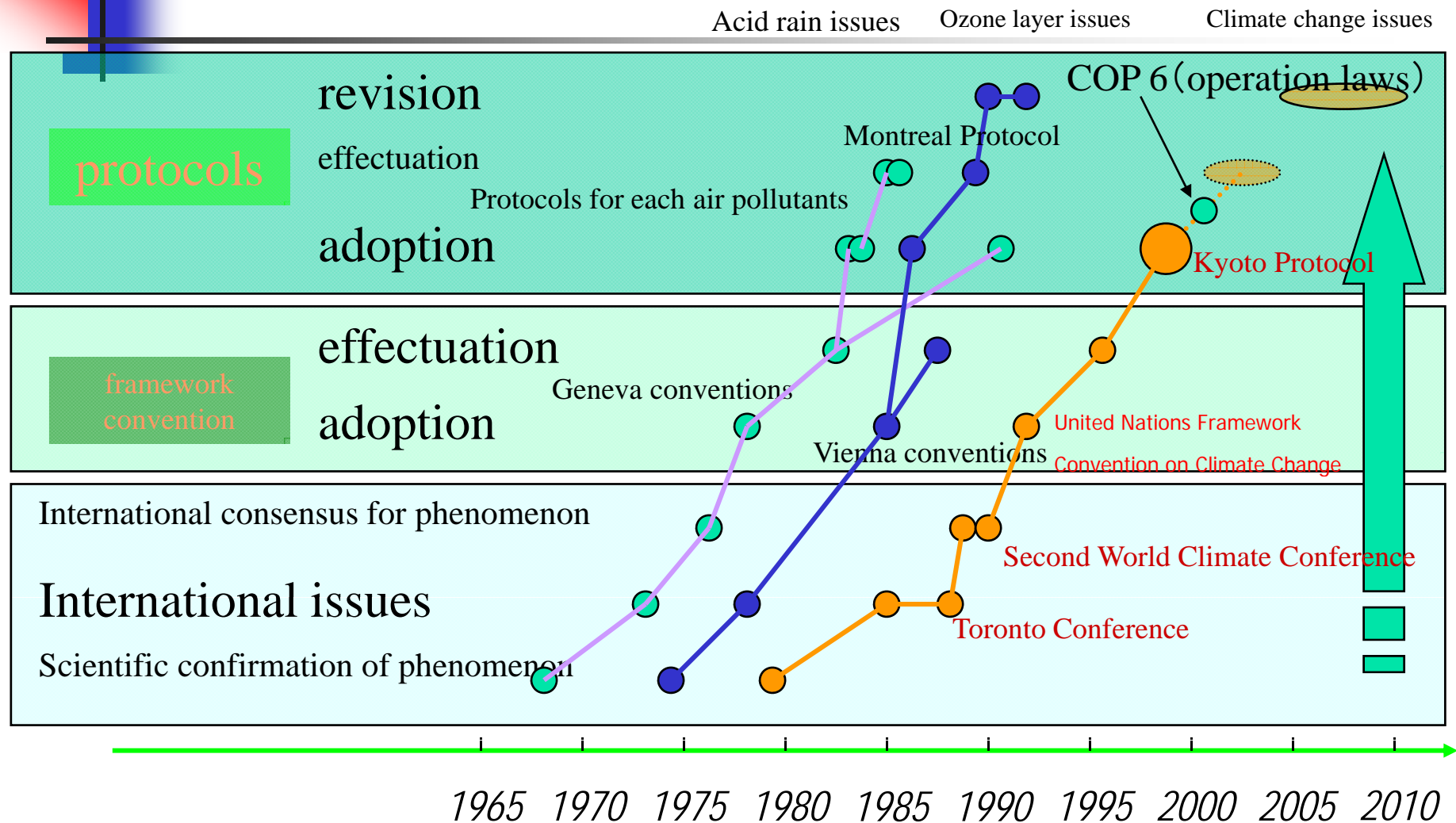


# International negotiations among global warming

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- International negotiations for each country's future on a stage of global warming
- They are using scientific knowledge as a tool, but conclusion is not made only from scientific facts.

# Changes in International Framework to Confront Global Warming





# Why are global warming issues difficult ?

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- What to do is unclear.
- Road map is unclear.
- Conclusion is that we are in the period of regime change same as Meiji Restoration or the WW II .
- Fear for “winners” and “losers”
- No one can be trusted !



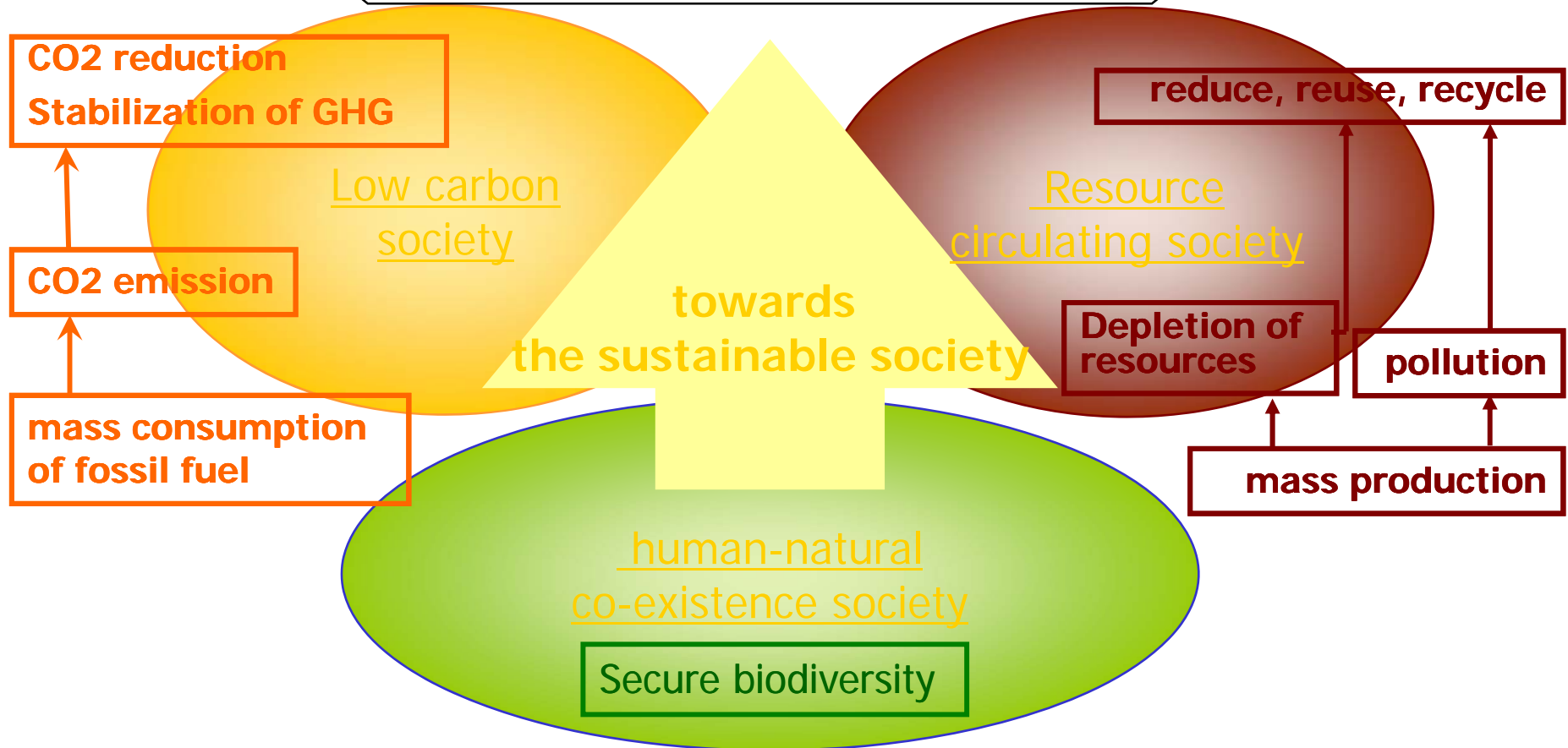
So, a vision to construct the world in the 21<sup>st</sup> Century is needed.

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- For this,
- escape from global warming
- recycling
- bio-diversity
- These factors must be considered totally.

# IR3S Focus Area

Research focus on the linkages between low carbon society and resource circulating society





## To realize this

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- we don't have to have same ideas.
- We may sleep in the same bed, but we have different dreams.
- For example, International Red Cross and Red Crescent Movement
- Be ambitious to confront the future.
- A star will be born in Japan in the early 21<sup>st</sup> Century has a talent to confront the times. The times will choose him.