

# Risk Management Strategy of Climate Change

**ALPS International Symposium**

**RITE, February 27, 2015**

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# Issue recognition

- Pathways to below 2°C through pledges at COP21 would be challenging.
  - The possibility to mitigate below 2°C will be small.
  - COP21 is not 'the end' but 'the beginning'
- How could we risk-manage the world exceeding 2°C

# Statements

➤ The impacts of global warming are not well elucidated.

→ Proposal for improving communications on “extreme weather”

➤ “Time axis” is crucial for risk management

→ Proposal of “warming velocity target”

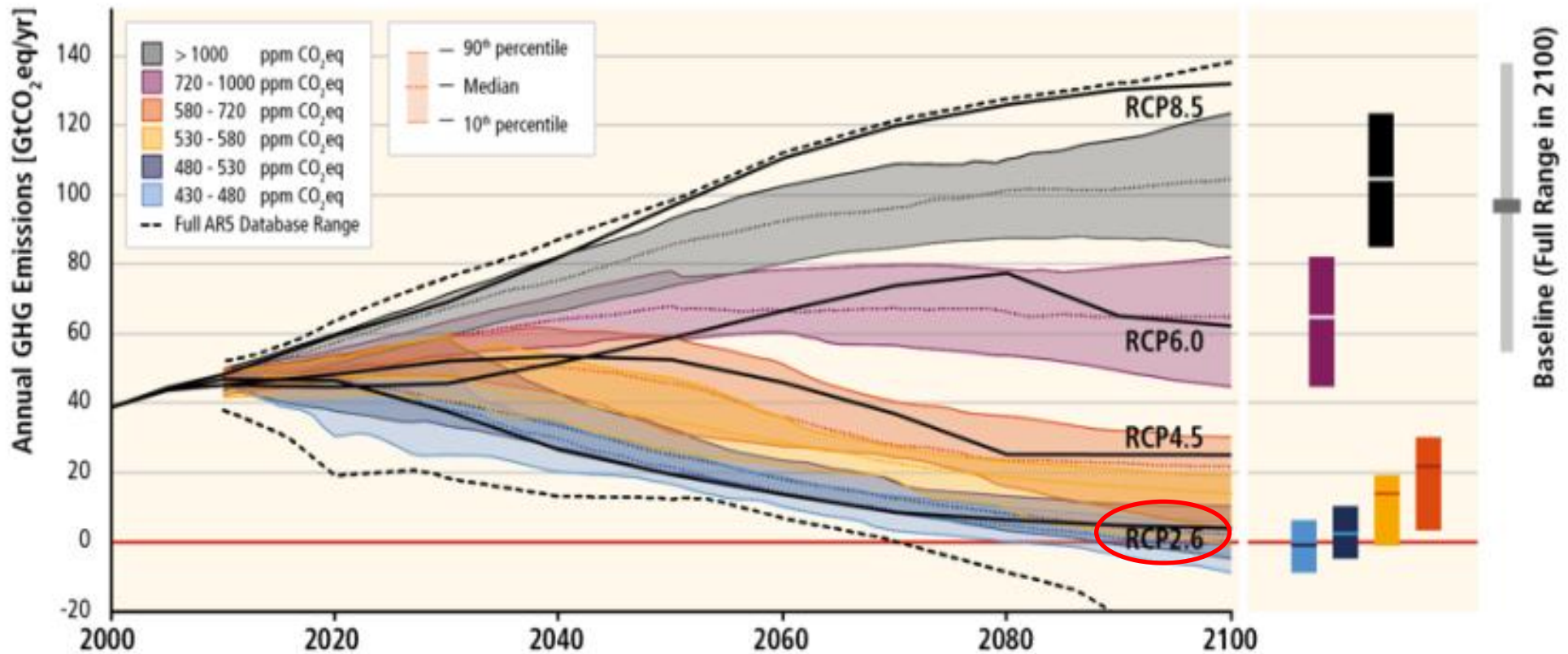
→ Proposal of adaptive management

→ Reconsideration of the roles of geoengineering and CCS

The Possibility to Mitigate below 2°C  
will be Small.

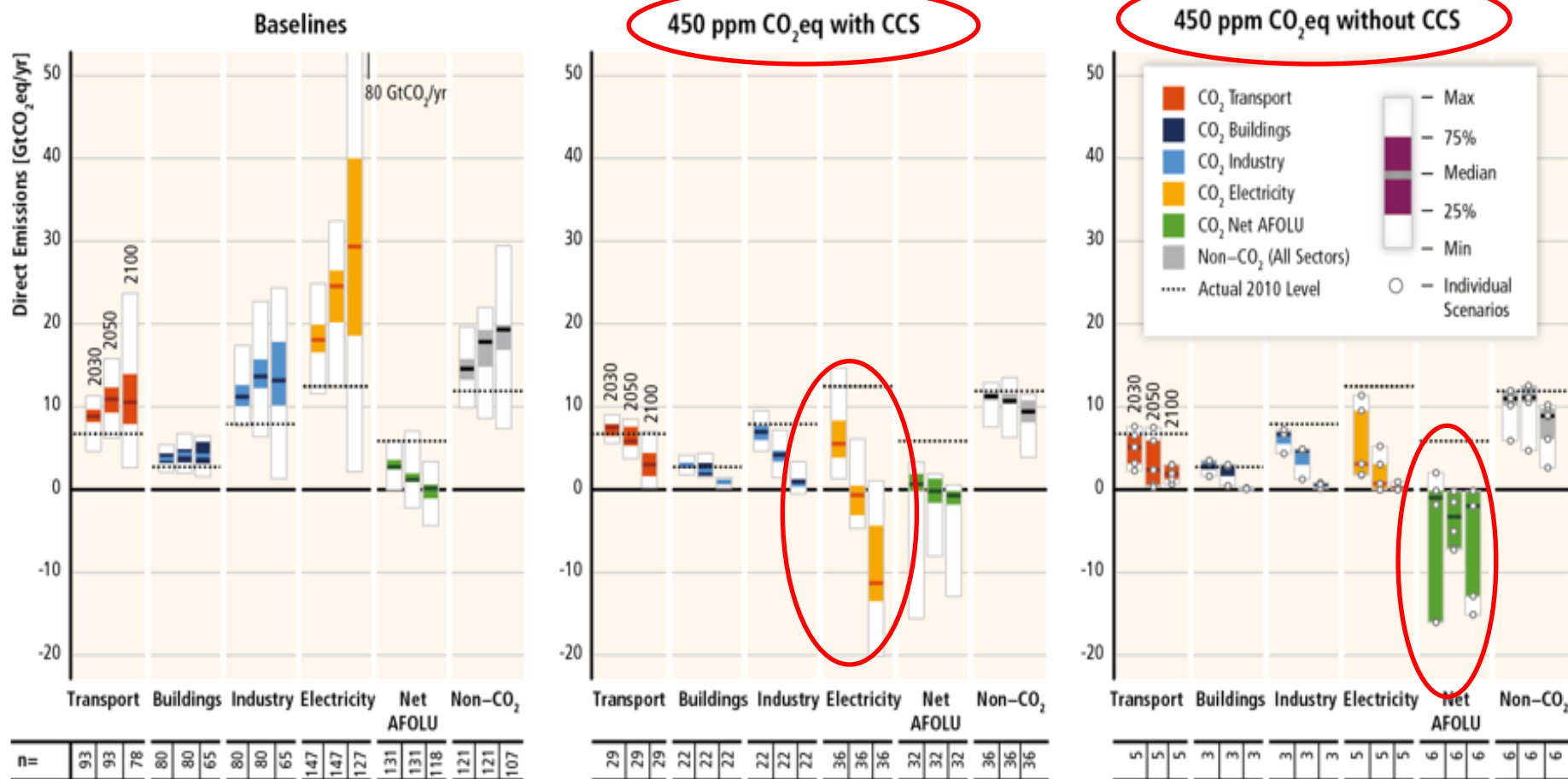
# Scenarios: Global GHG emissions

GHG Emission Pathways 2000-2100: All AR5 Scenarios

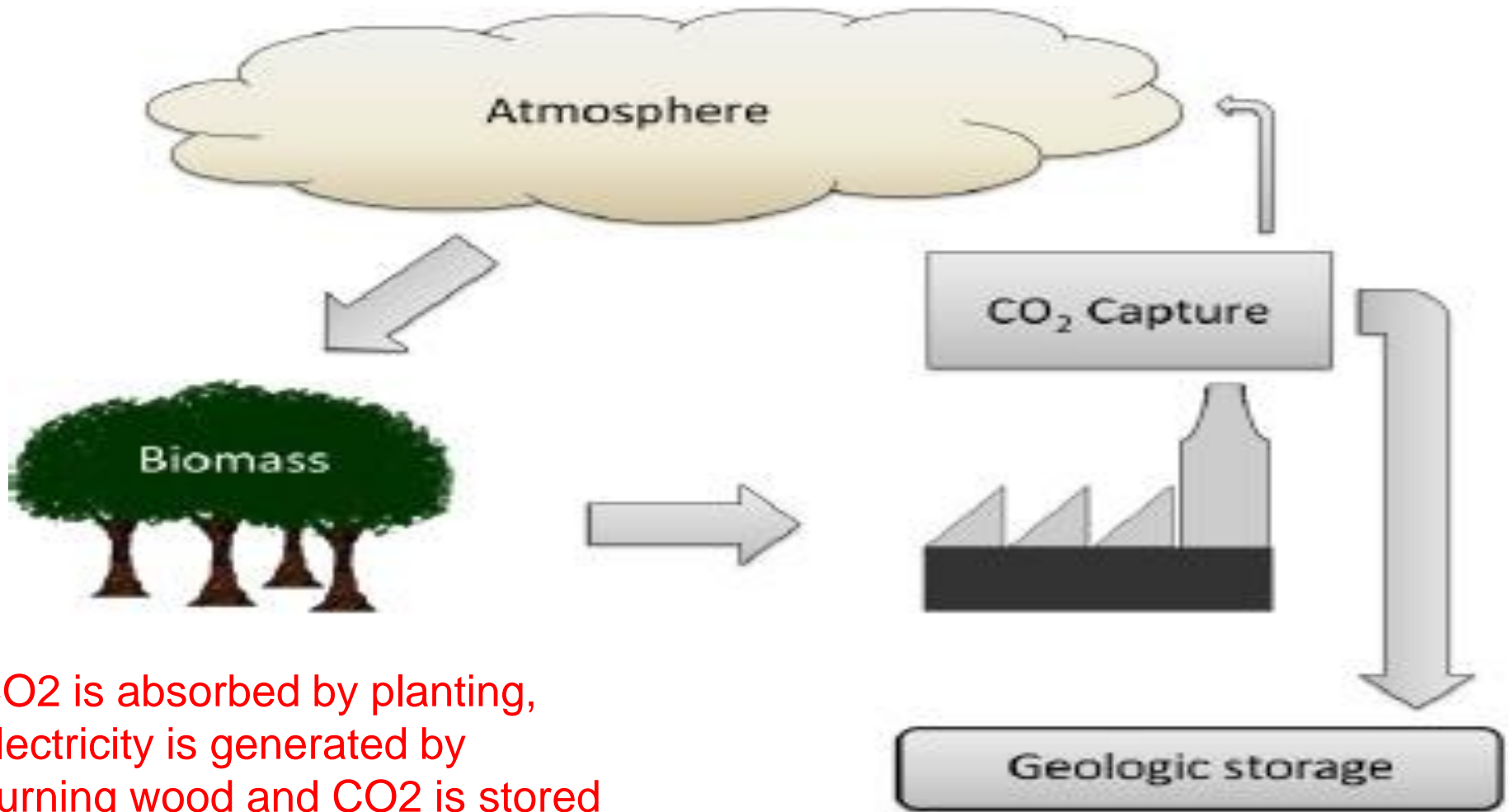


# Sectoral emissions in scenarios

Direct Sectoral CO<sub>2</sub> and Non-CO<sub>2</sub> GHG Emissions in Baseline and Mitigation Scenarios with and without CCS



# Bioenergy and CCS



CO2 is absorbed by planting, electricity is generated by burning wood and CO2 is stored in the ground.

Global CCS institute

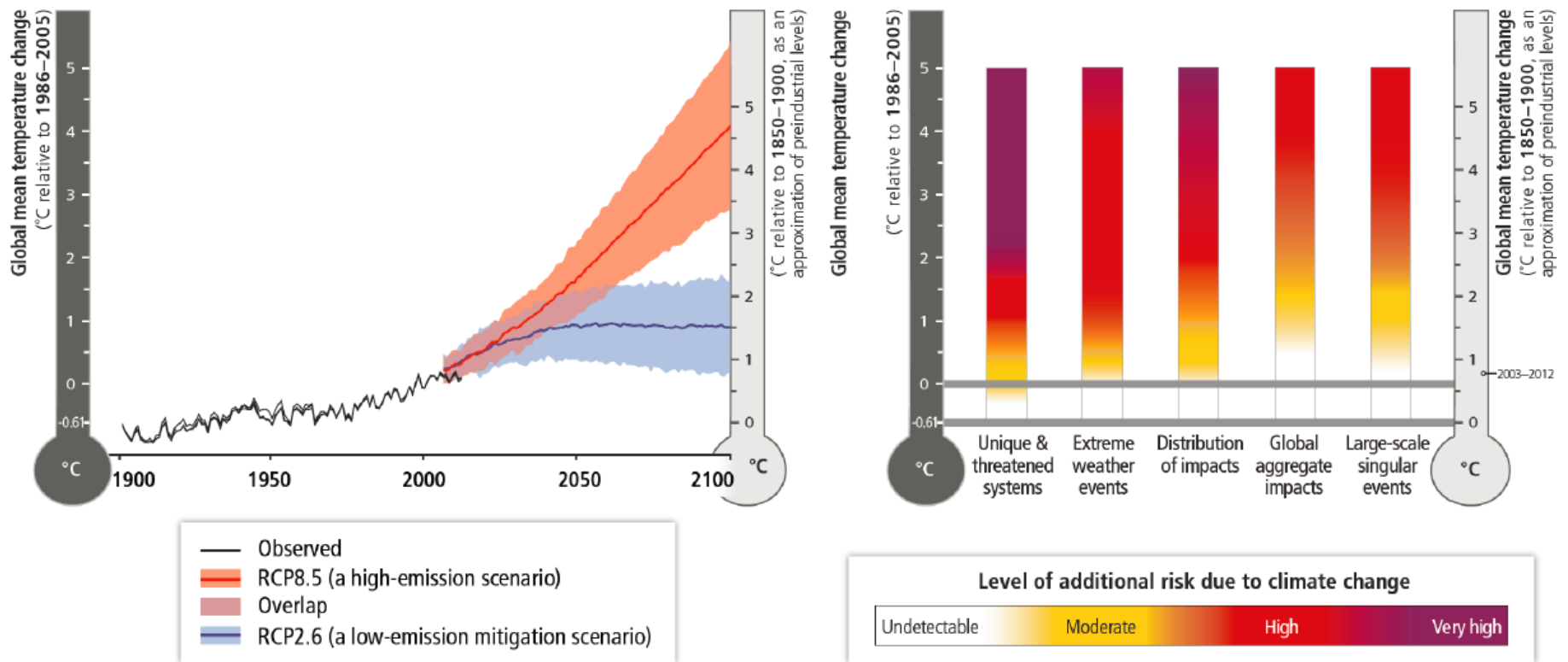
# Two Assumptions in Scenarios

- ◆ **Technological Innovation**: “A number of mitigation technologies will progress and diffuse“  
In 2°C scenario, bioenergy and CCS are assumed to diffuse in the second half of the 21st century as large as the current coal and oil have diffused.
- ◆ **International cooperation**: “The world works together toward emission reductions”  
IPCC scenarios depend on numerical models which oversimplify the real world. Resources and efficiency/cost of technology are taken into account. However, concerns about **security** and **international competition** are never taken into account.  
  
→ It is clear that **miraculous changes are crucially required**, viewed from the status quo. This means “**the challenge is huge, huge, huge**”, as Prof. **Edenhofer**, Co-Chair of Working Group III stated in the press release.



The Impacts of Global Warming are not Well Elucidated.

# “Expert judgments” - “Relatively high risks” ...Absolute risk levels are unexplained



Assessment Box SPM.1 Figure 1.

# IPCC AR5 WG2 SPM

- ◆ About specific sectoral environmental impacts, several figures in SPM are considered;
  - Fig SPM.5 (Impacts on ecosystems)
  - Fig SPM.6 (Impacts on fishery industry)
  - Fig SPM.7 (Impacts on food production)
- ◆ Notation in this presentation:
  - Red: impressions from figures
  - Blue: Speaker's opinions

# Impacts on Ecosystems (Fig. SPM.5)

# Preparation: Climate velocity

- Climate velocity (km/decade)
  - Speed at which global warming makes an isothermal shift from the equator to the poles
  - Slow in mountain areas and fast in flat areas
- Maximum speed at which species can move
  - Speed at which species can move with global warming.
- climate velocity  $>$  maximum speed at which species can move, then extinction ...

Maximum speed at which species can move

Climate velocity

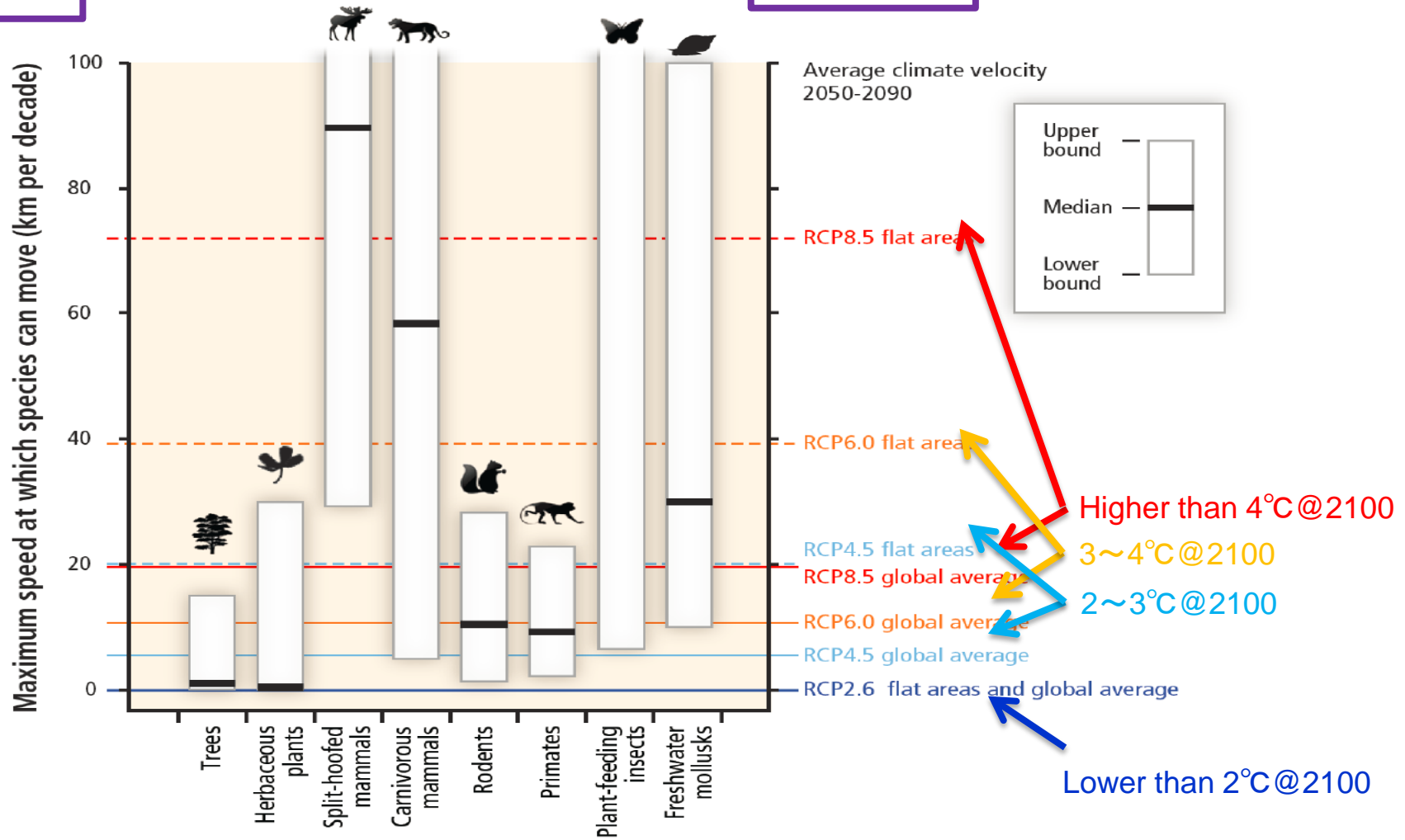
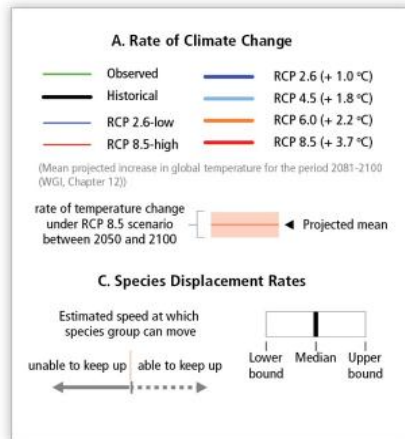
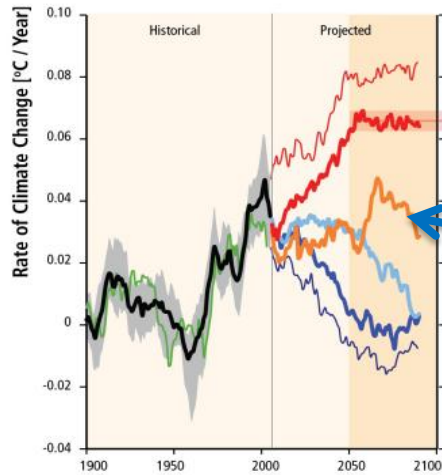


Figure SPM.5.

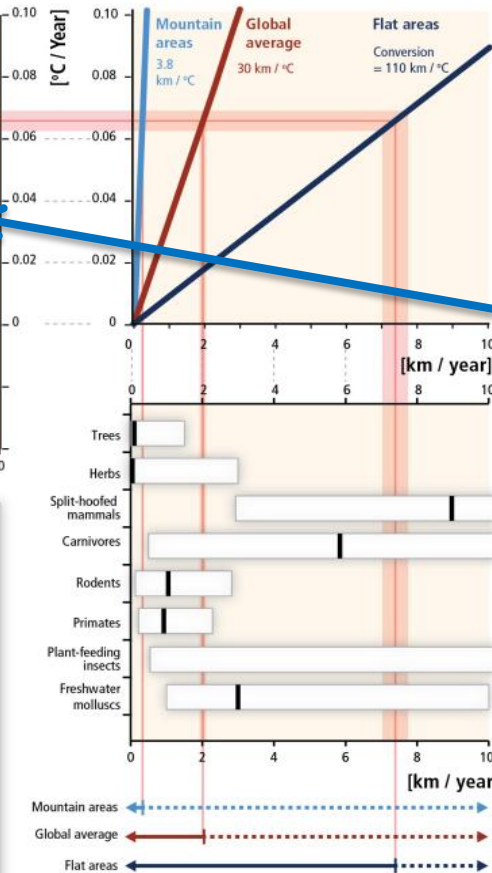
Impacts on ecosystems (SPM.5)

**Large scale extinction!?**

A. Climate Change Scenarios



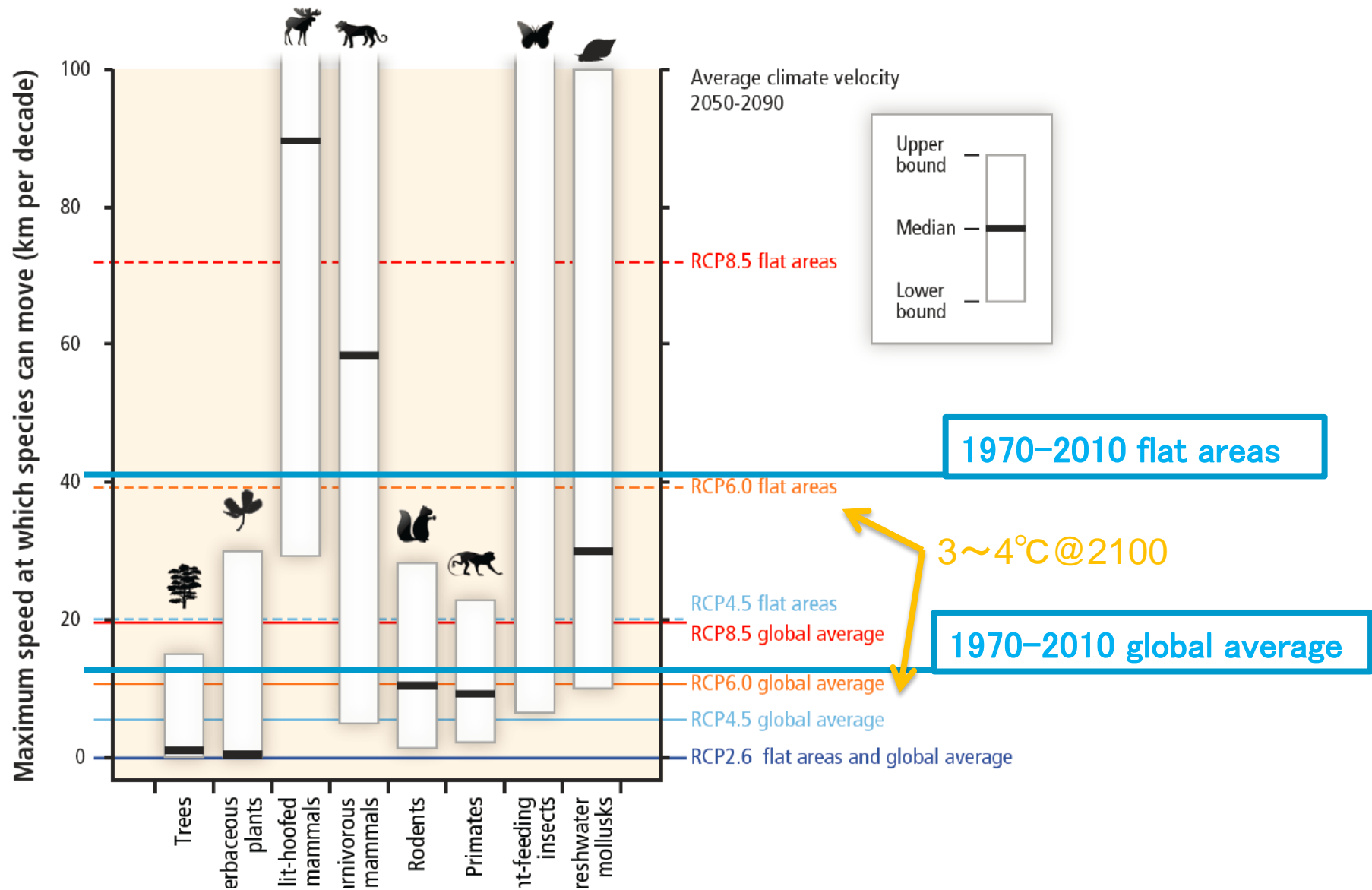
B. Estimate of Climate Velocity to Determine Rate of Displacement



C. Species Displacement Rates (required to track climate velocity)

Figures in TS show the past climate velocity (1970-2010) is similar to RCP6.0 (3~4°C)

Figure TS.7.

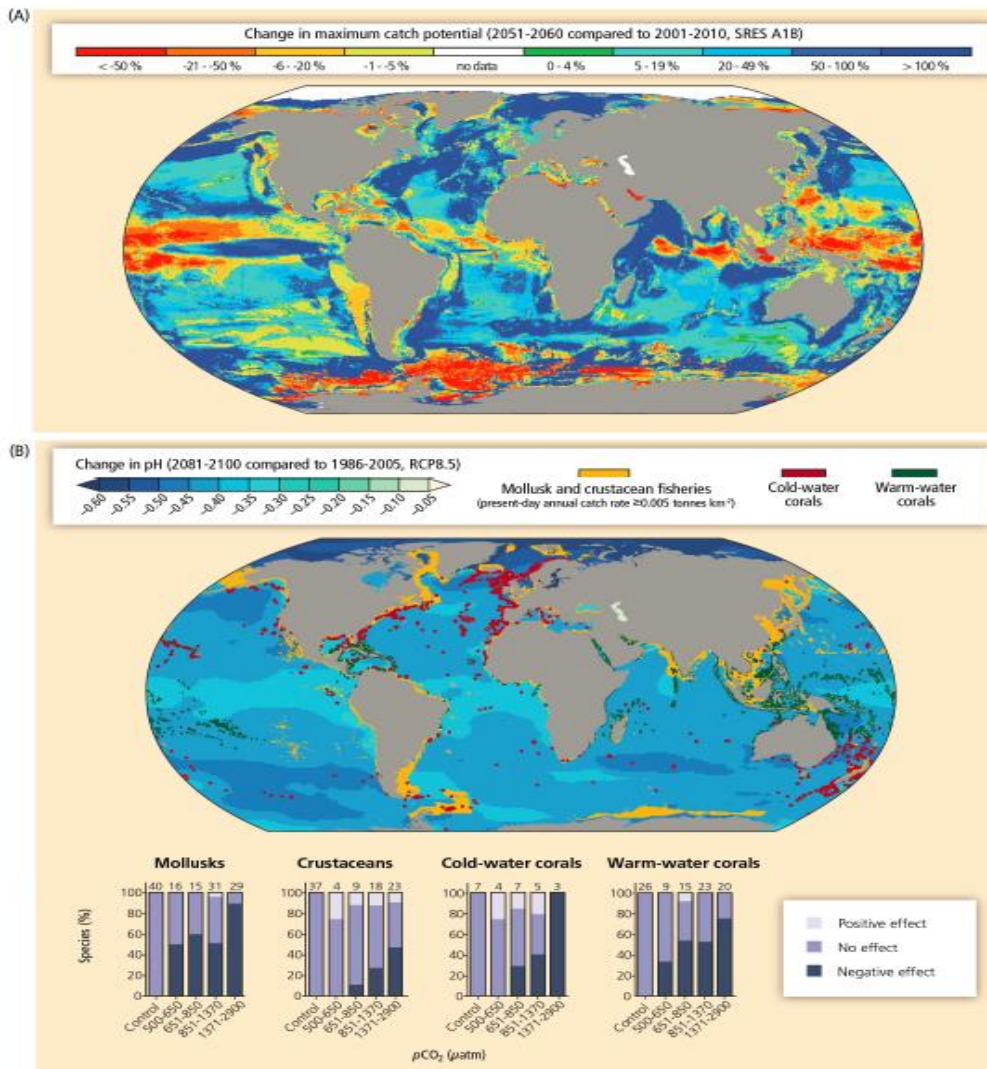


In case of 3-4 °C rise, the speed is as fast as the past.  
Any species have never come into extinction due to global warming

Figure



# Impact on Fishery Industry (Fig. SPM.6)



Significant reductions in fisheries ?

Estimates under a number of assumptions.

“Low confidence” in WGII AR5

No mention in SPM

Figure SPM.6.

# Impacts on fishery industry (SPM.6)

# Impacts on Agriculture (Fig. SPM.7)

# Impacts on agriculture (SPM.7)

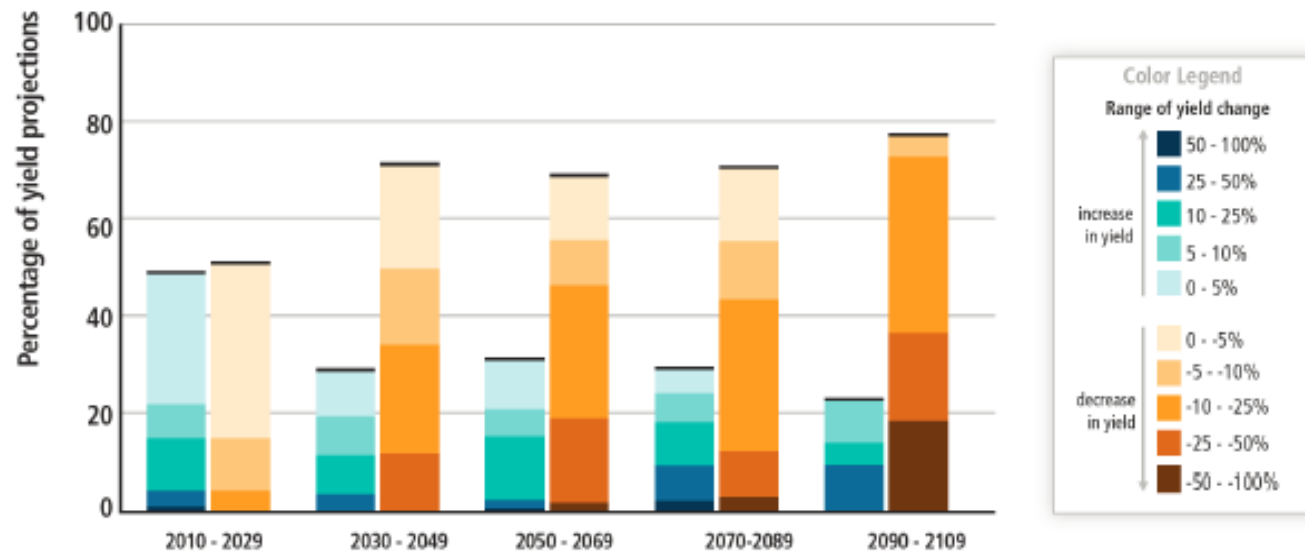
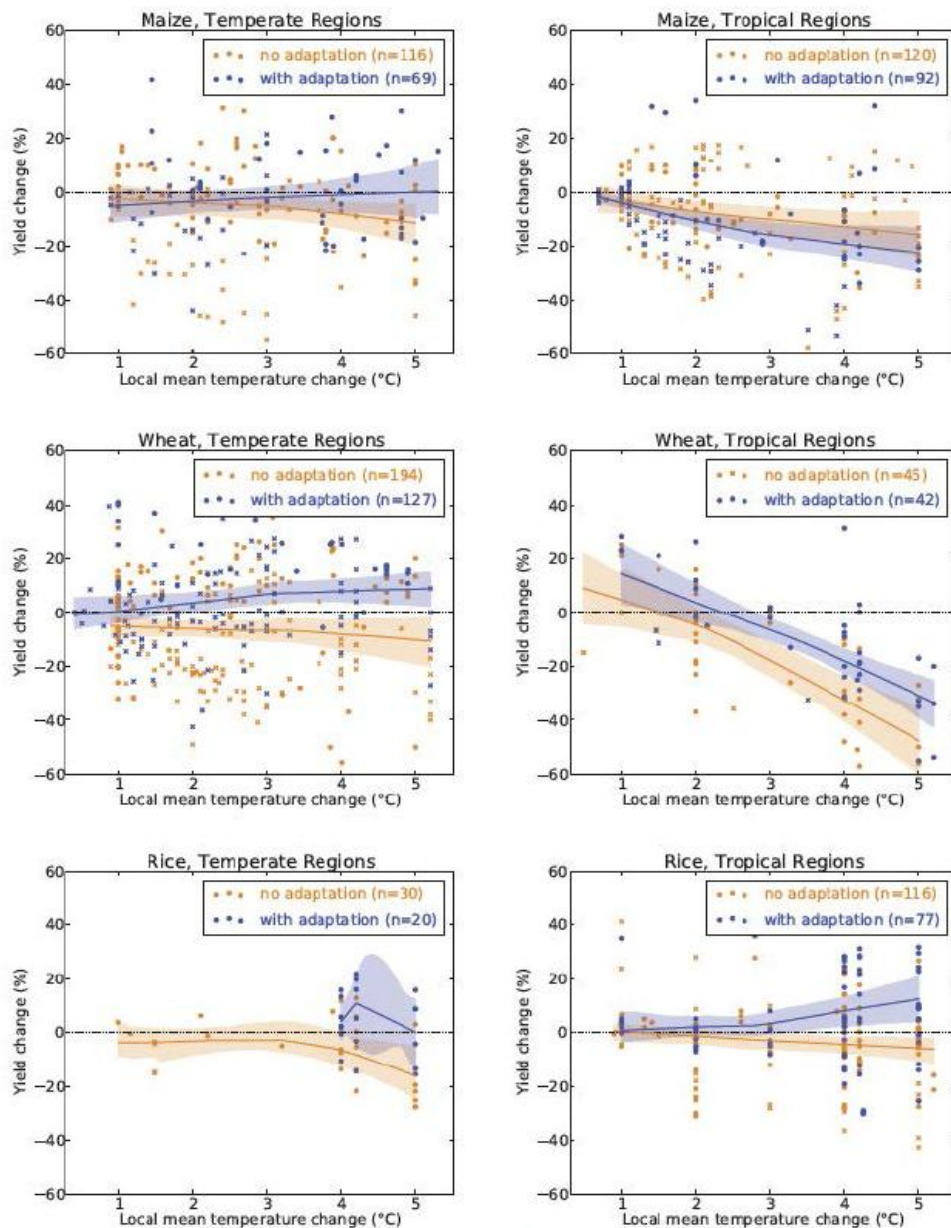


Figure SPM.7.

The grain yield reduction!?

Adverse effect sizes should not be measured by the number of papers



Poor harvest of  
wheat and corn!?

Although the yield  
of wheat/corn in  
tropical will be  
reduced,  
the one of rice will  
not be reduced

Figure 7-4: Percentage simulated yield change as a function of local temperature change temperature for the three major crops and for temperate and tropical regions. Dots indicate where a known change in atmospheric CO<sub>2</sub> was

# Key Problem of CC env. risk assessment

Much literature say:

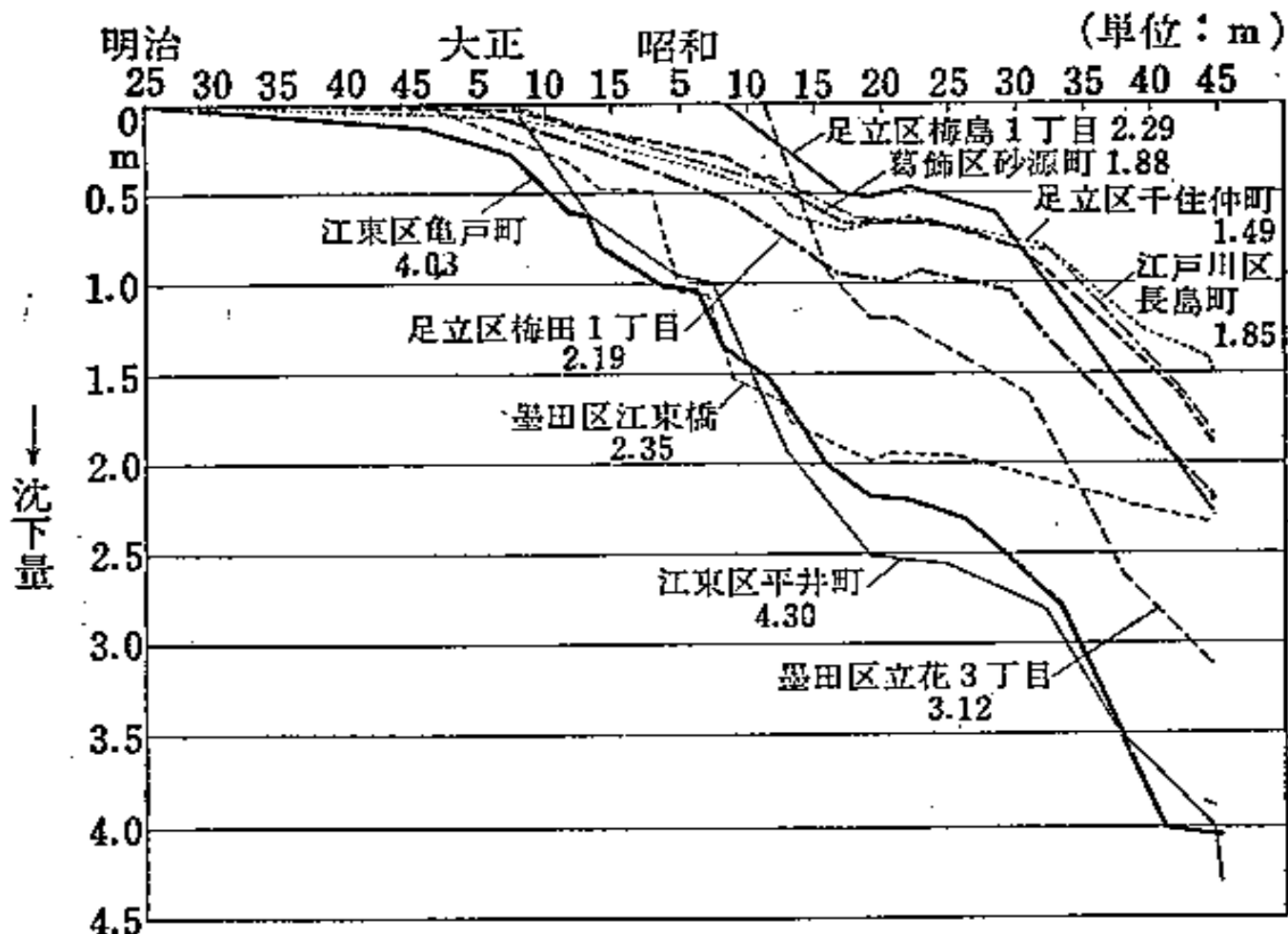
“Others things being  
equal,  
human-induced climate  
change increase risks”

but

1. If “other things” dwarf “human-induced-CC”, other policies are more important than CC policy.
2. Risk increases – trivial. The size of risk matters.

# Adverse Effects of Climate Change << Anthropogenic Nature Modification

図18 東京都における地盤沈下量の推移



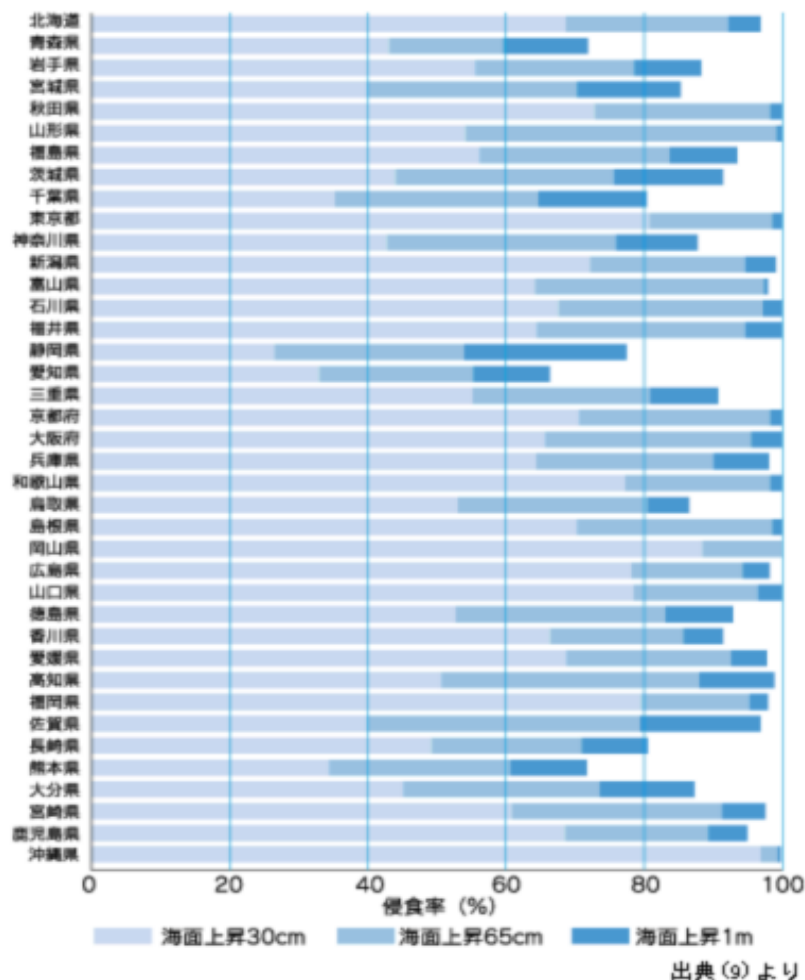
Land subsidence ranged to 4m during 50 years in Tokyo.

(注) 『建設白書』(昭和45年版)より



# Sand beach extinction?

90% of sand beach is lost with the 1m sea level rise



<https://www.env.go.jp/earth/cop3/ondan/eikyoku4.html>

此數用器外野空此  
其本等四國其國行前編



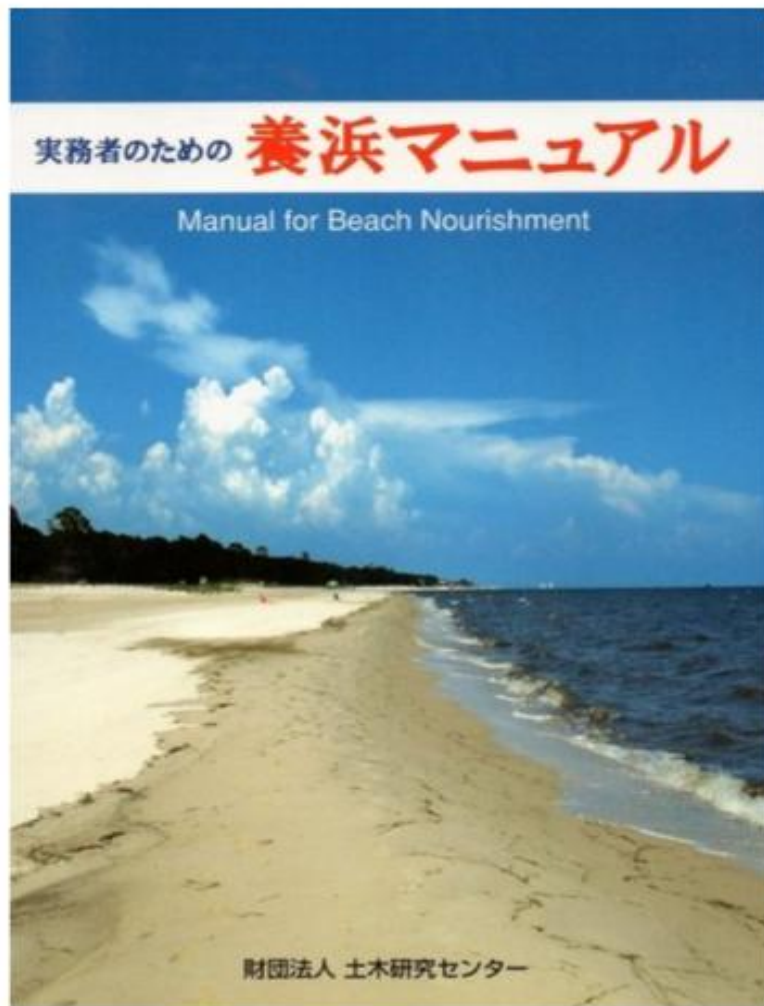






Carry-out locations  
(Sagami reservoir)

Carry-in locations  
(Chigasaki seashore)



Dr. Takaaki Uda

“Manual for Beach Nourishment”

# Adverse Effects of Climate Change << Social Issues

# What is Tuvalu risk ?



[http://blog-imgs-31-origin.fc2.com/s/c/i/scienceplus2ch/photo\\_6\\_convert\\_20100628123101.jpg](http://blog-imgs-31-origin.fc2.com/s/c/i/scienceplus2ch/photo_6_convert_20100628123101.jpg)



Before flood



Source: Japan Center for Climate Change Actions,  
<http://www.jccca.org/>



After flood



Source: Japan Center for Climate Change Actions,  
<http://www.jccca.org/>



<http://www.noguchi-ken.com/M/imgs/3/7/37663587.jpg>

# MIRAB economics

- ◆ Migration
- ◆ Remittance
- ◆ Aid
- ◆ Bureaucracy

Ultimate isolate island economy

Beyond the existing borders,

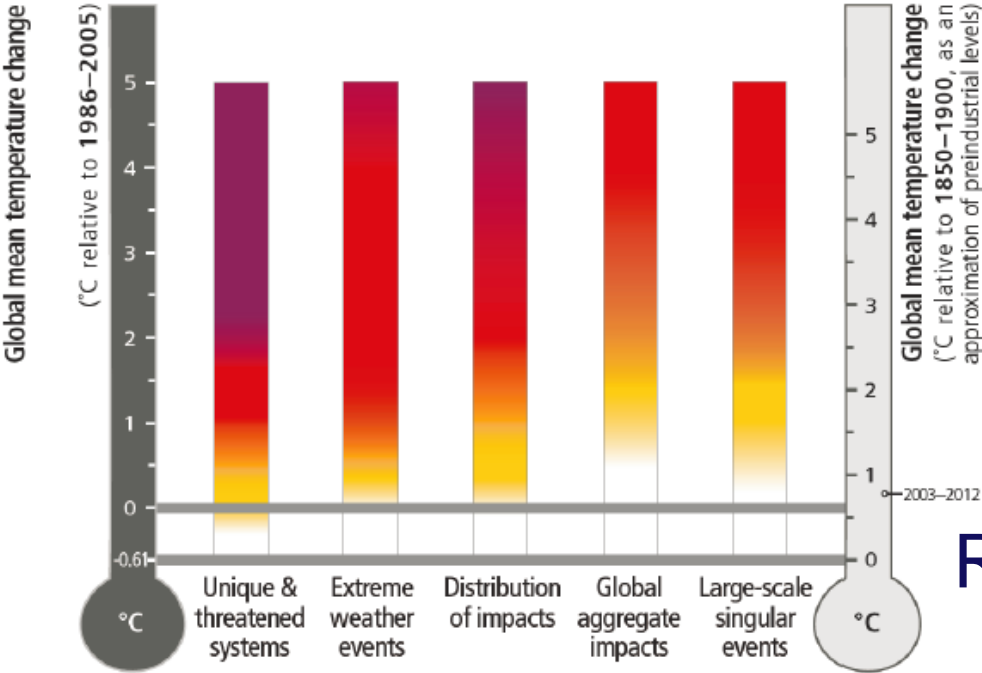
“A new imagery of nations is required.”

(Prof. Izumui Kobayashi, Osaka Gakuin University )

# What does “risk increase” mean?

“Relative risk” is judged by “experts”

Representation of poor contents. The degree of risk is crucial.







# More Frequent Extreme Weather?

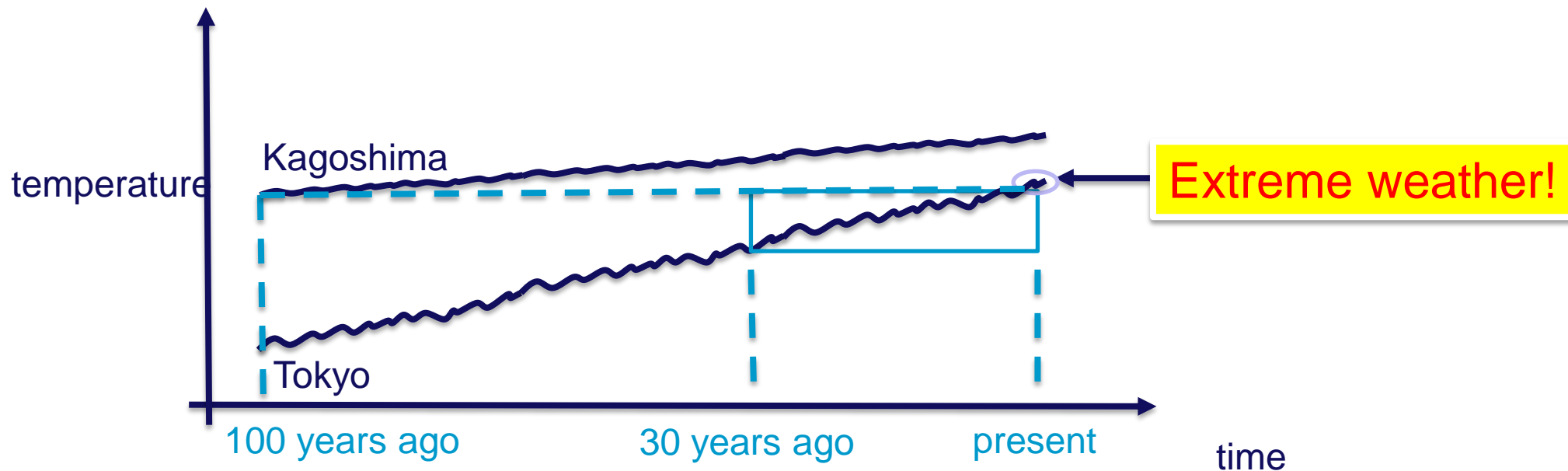
- ◆ Extreme weather = once every 30years
  - > ▪ naturally occurs
  - occur more frequently, if there are trends
  - is not directly linked to the risk

“Risk increase”  
“Extreme weather”  
  
“More frequent  
extreme weather” in  
Tokyo



Proposal

Expression using “Weather  
Analogue”  
  
“Tokyo’s temperature has  
become as that of Kagoshima of  
100 years ago”





By global warming, typhoons of Tokyo: are “at risk of intensification”: Unclear communication

→ Proposal → → →

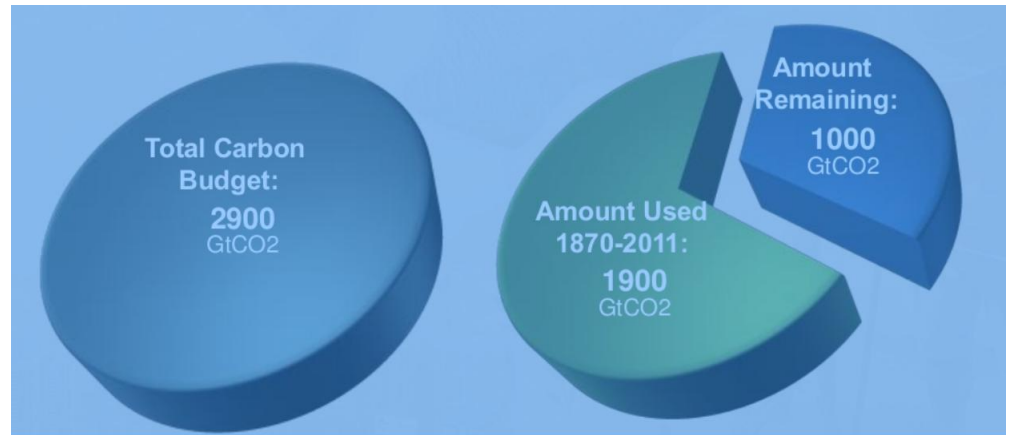
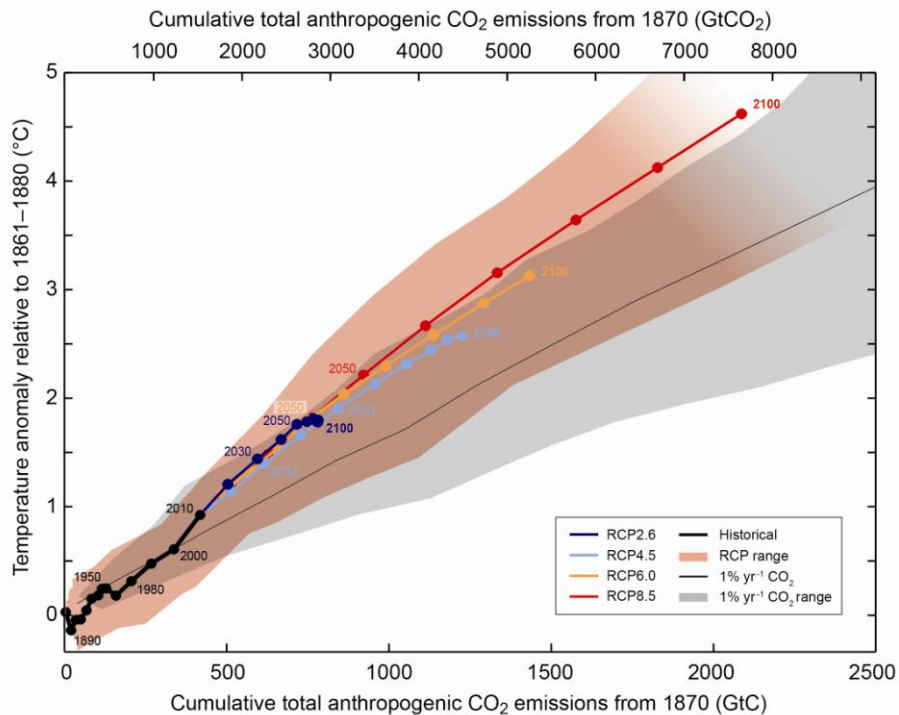
Expressions, “as strong as the current level of Kyushu’s” or “as humans have never experienced” should be used.



ISS009E21526

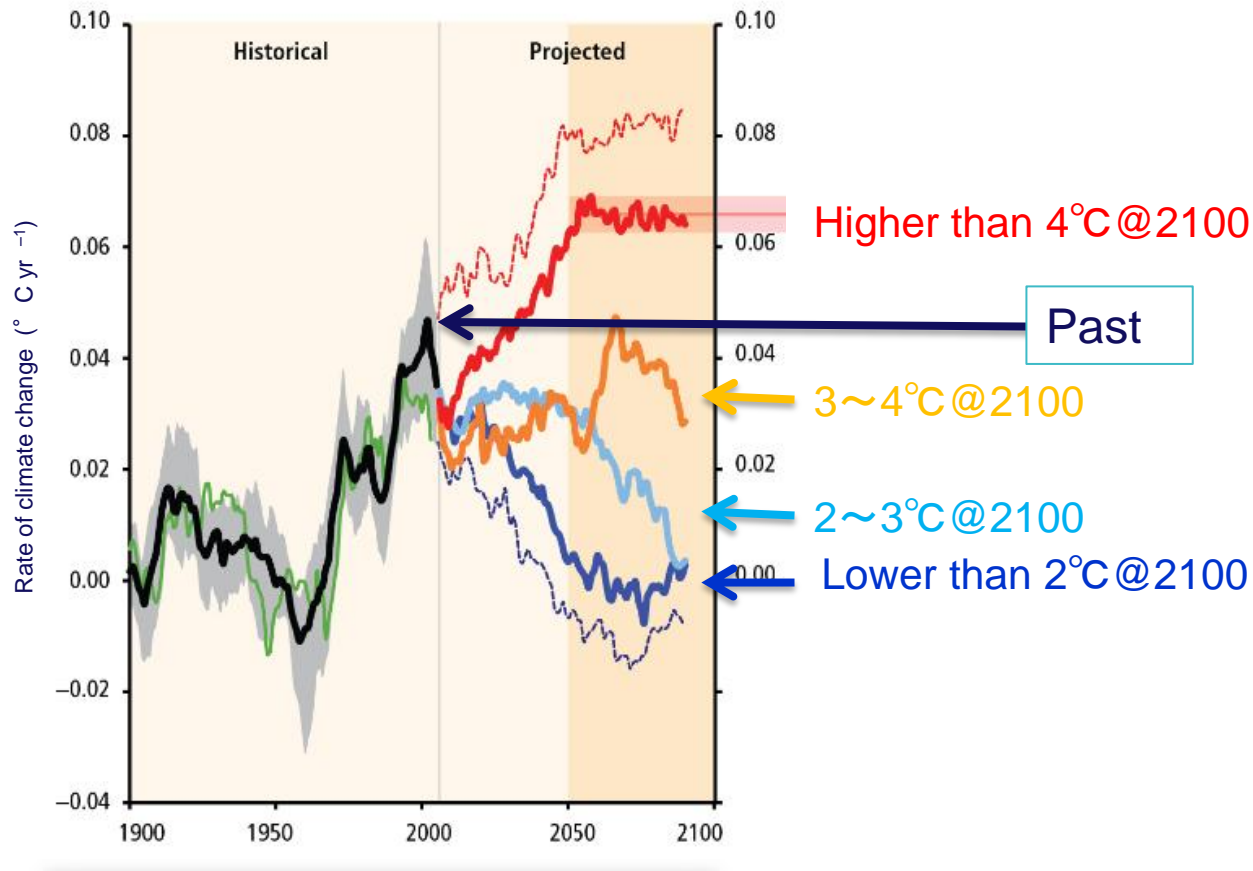
<http://ja.wikipedia.org/wiki/%E5%8F%B0%E9%A2%A8>

# “Time Axis” in Risk Management



Carbon budget: No time axis

# “Climate velocity”: Time-axis



Even though the temperature rises 3-4  $^{\circ}\text{C}$  by 2100 , warming speed is as similar as the past.

Added notes based on IPCC AR5 WG2 Fig 4-5

# A time axis of extreme events (IPCC AR4 SYR)

- ◆ Greenland ice sheet, 19°C-4.6°C rise, contributes to sea level rise of 7m. Complete elimination will take **millennia**.

Contraction of the **Greenland** ice sheet is projected to continue to contribute to sea level rise after 2100. Current models suggest virtually complete elimination of the **Greenland** ice sheet and a resulting contribution to sea level rise of about 7m if global average warming were sustained for millennia in excess of 1.9 to 4.6°C relative to pre-industrial values. The corresponding future temperatures in **Greenland** are comparable to those inferred for the last interglacial period 125,000 years ago, when palaeoclimatic information suggests reductions of polar land ice extent and 4 to 6m of sea level rise. {3.2.3}

- ◆ Ice sheet loss on polar land: meters of sea level rise occurs over **millennial** time scales (More rapid sea level rise over century time scales cannot be excluded.)

Partial loss of ice sheets on polar land could imply metres of sea level rise, major changes in coastlines and inundation of low-lying areas, with greatest effects in river deltas and low-lying islands. Such changes are projected to occur over **millennial** time scales, but more rapid sea level rise on century time scales cannot be excluded. {3.4}

# A time axis of society / economy

- ◆ 1789 French Revolution
- ◆ 1868 Meiji Restoration
- ◆ 1885 Invention of the automobile
- ◆ 1914 The World War I
- ◆ 1939 The World War II
- ◆ 1945 Invention of the atomic bomb
- ◆ 1989 The collapse of the Soviet Union  
The Tiananmen Square protests
- ◆ 1989 Invention of the Internet

# A time axis of anthropogenic nature modification



# A time axis of anthropogenic nature modification



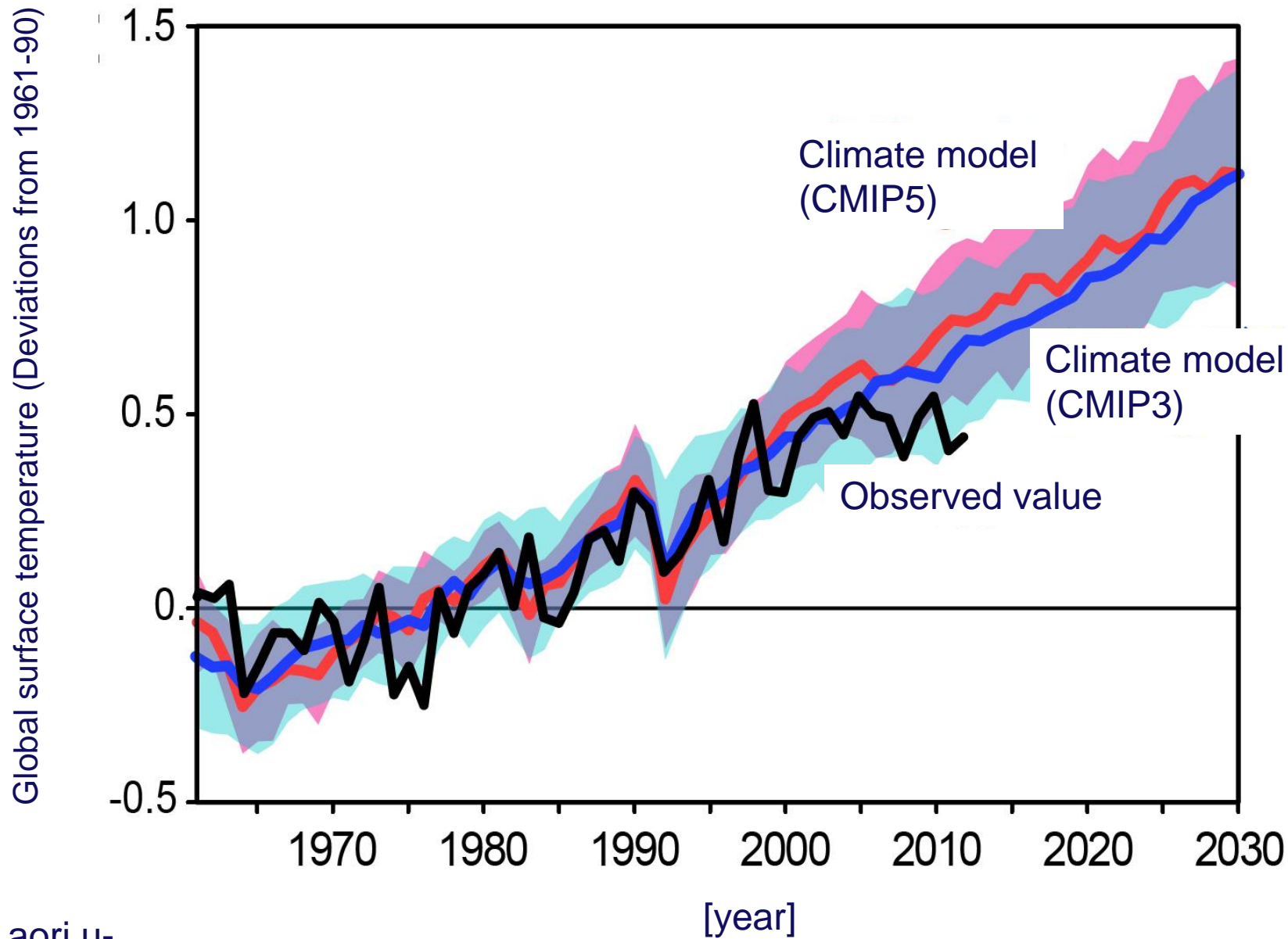
明治32年（施工中）

<http://quercus.ashita-sanuki.jp/c1323.html>



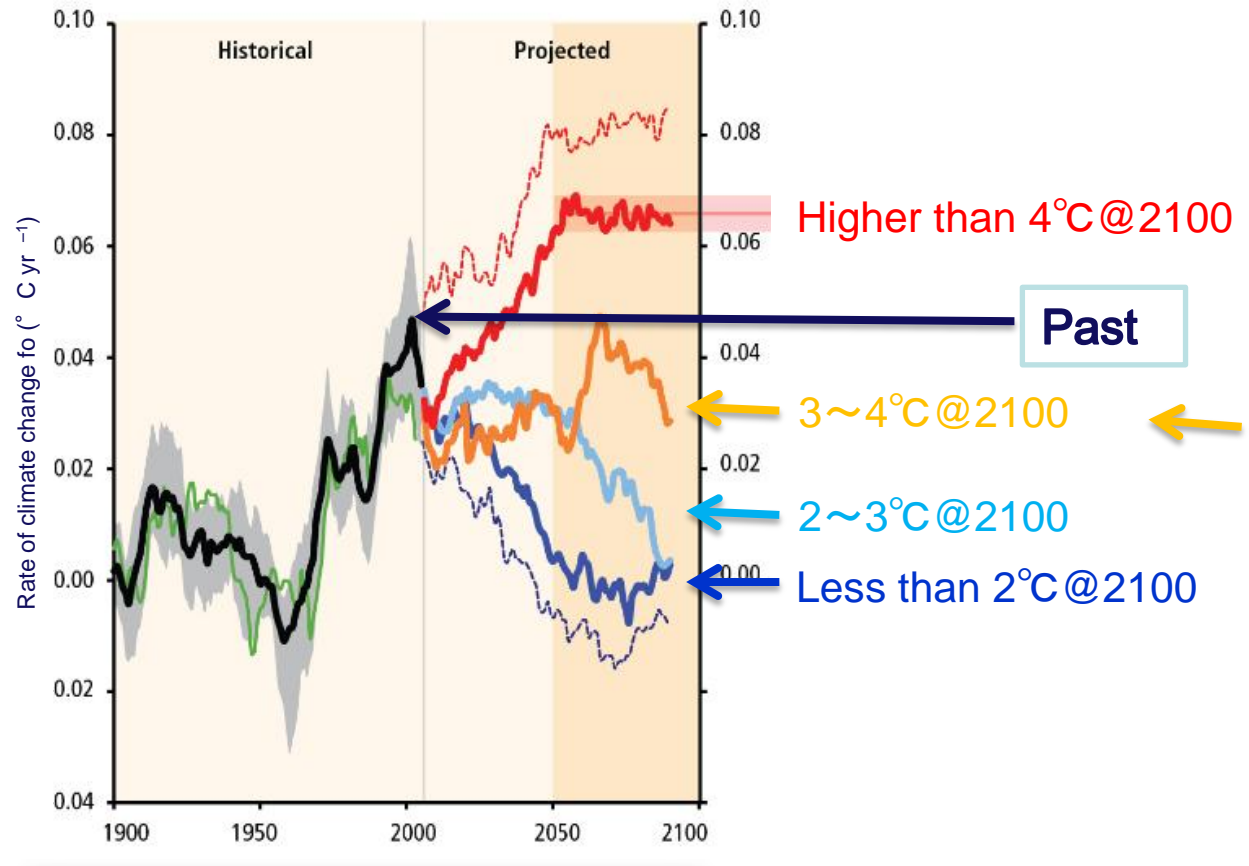
# Proposal of Adaptive Management

1.5°C < 2 × CO<sub>2</sub> < 4.5°C



<http://www.aori.u-tokyo.ac.jp/research/news/2013/20130718.htm>

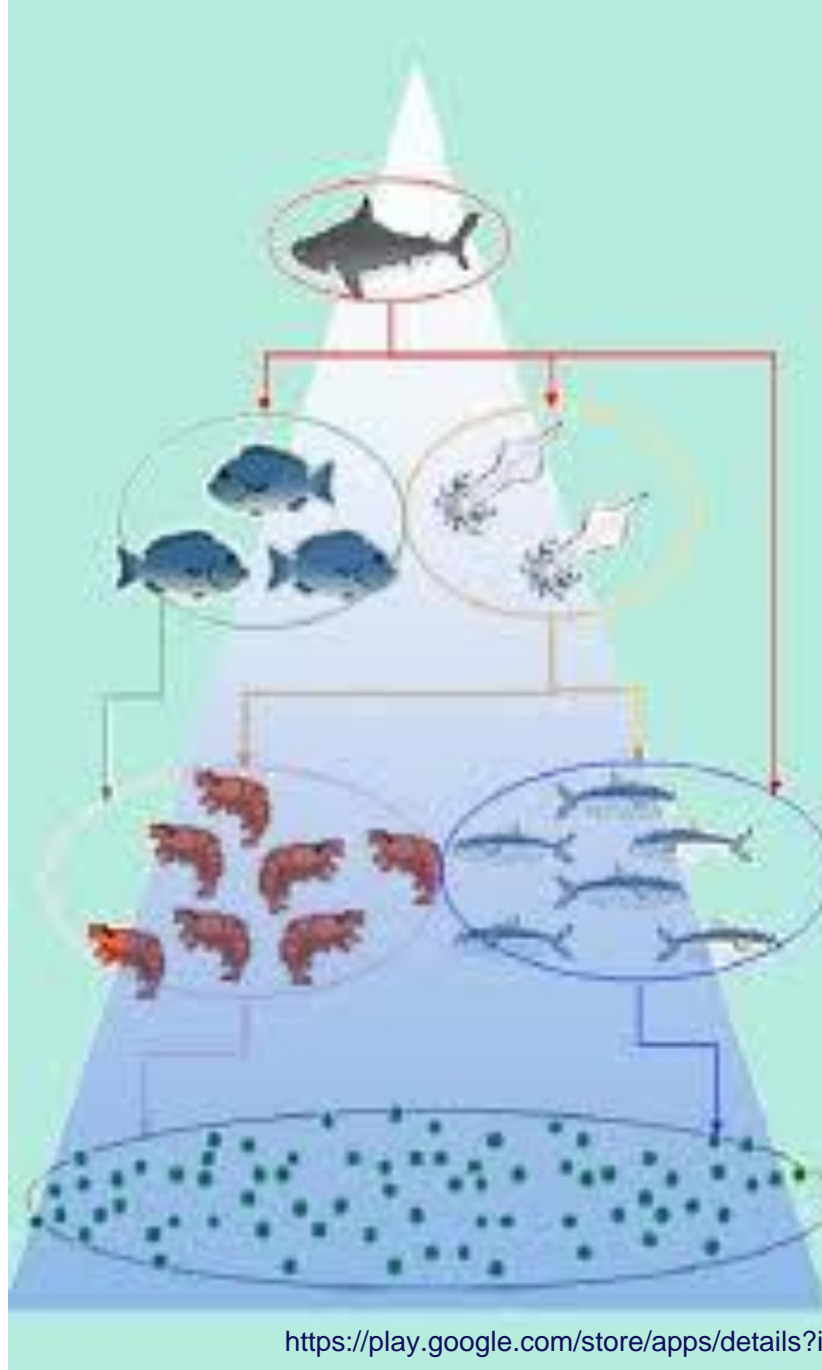
# Adaptive management of climate velocity target



I propose a management goal would be 0.3 ~ 0.4 °C / decade for the immediate future, and to cut it down if necessary in the future?

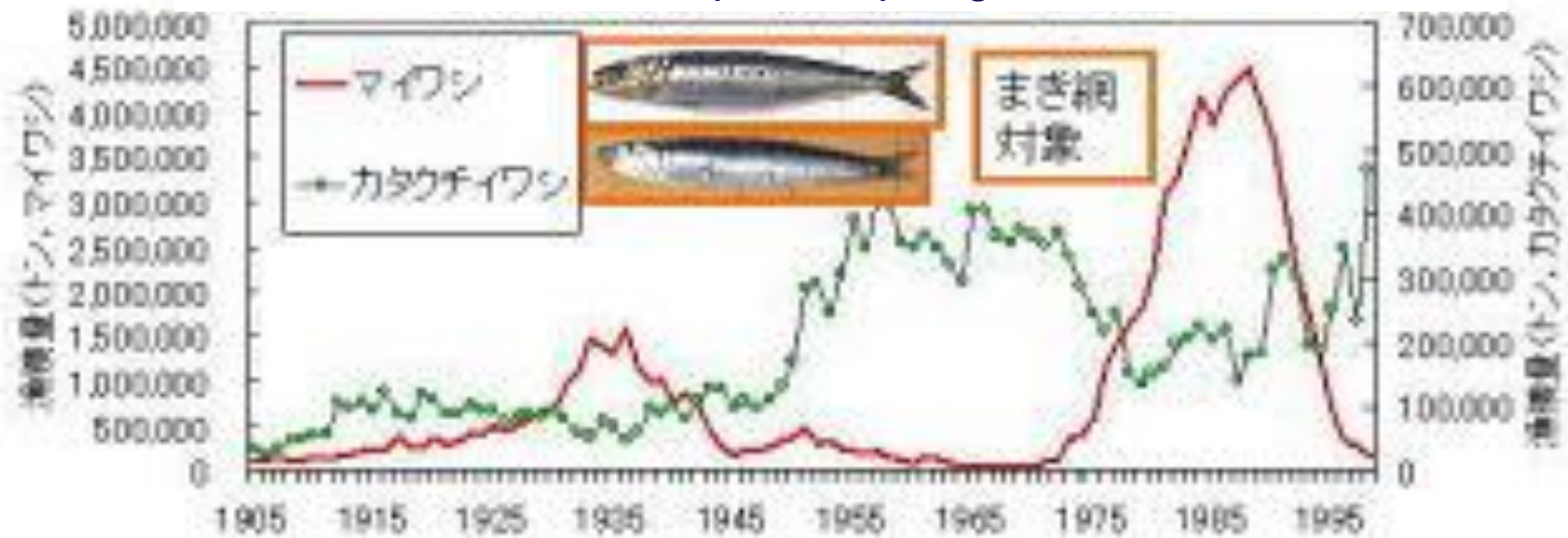
Even though the temperature rises 3-4 °C by 2100, warming speed is as similar as the past.

Added notes based on IPCC AR5 WG2 Fig 4-5



<https://play.google.com/store/apps/details?id=Food.Chain2&hl=ja>

# Transition of dominant Japanese pelagic fish catch 1905~



<http://nrifs.fra.affrc.go.jp/intro/doutai/Index-lab->

# Adaptive Management of climate velocity target



- A target that is more directly connected to the risk of climate change than the absolute value target
- Appropriate way, since there are large uncertainties in natural science & social science and inexpensive solutions are unknown.



- Dependent on the natural variability (such as decadal oscillation)
- Due to the inertia of climate system and social system, climate velocity can not be changed rapidly and is not much different from the absolute value target after all?

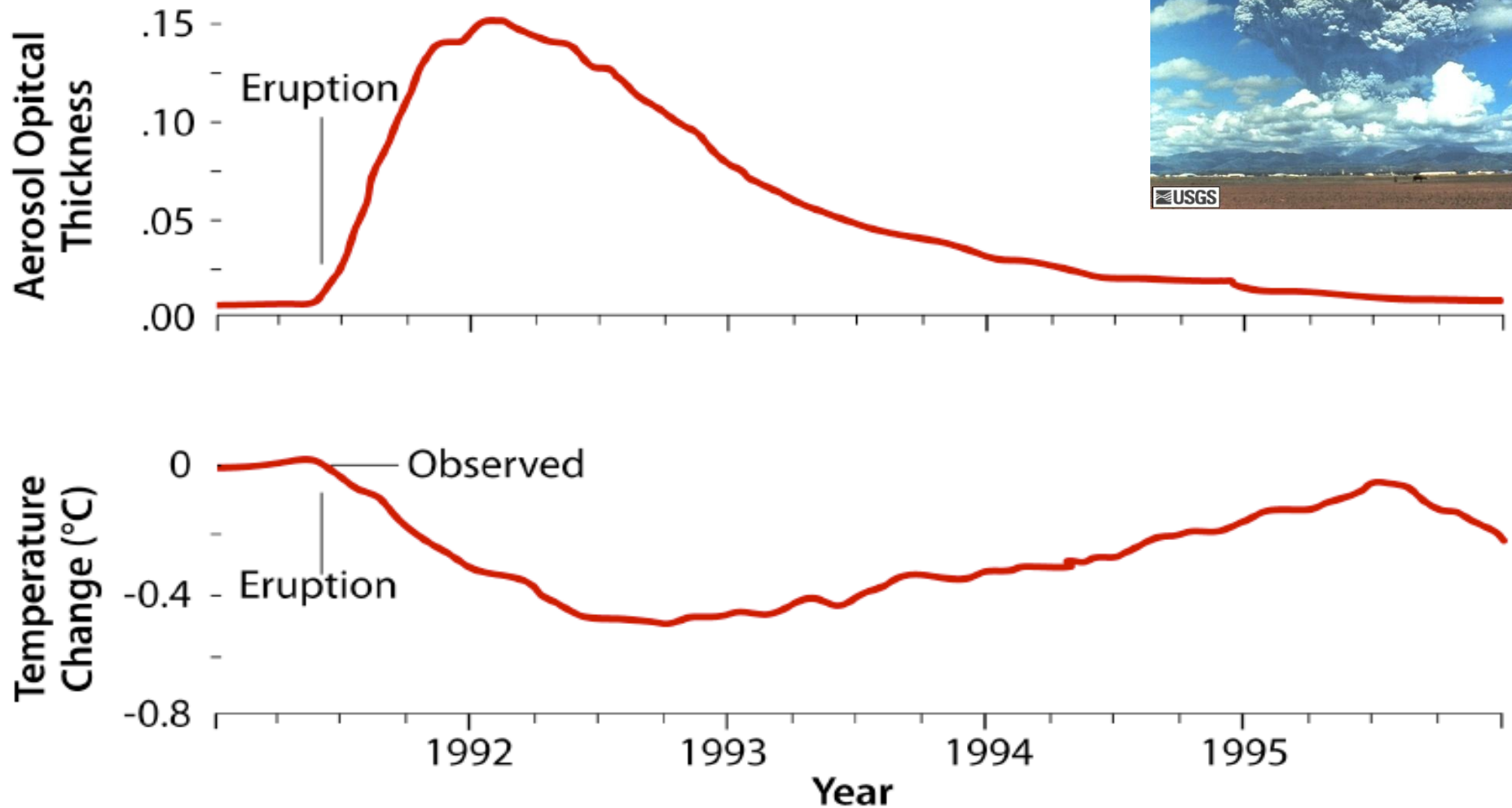
# Reconsideration of Geoengineering Adaptive Management/ Measures to Lower Climate Velocity



# SRM: Aerosol injection into the stratosphere

Source: USGS

Pinatubo volcanic eruption in the Philippines



# Ocean CCS

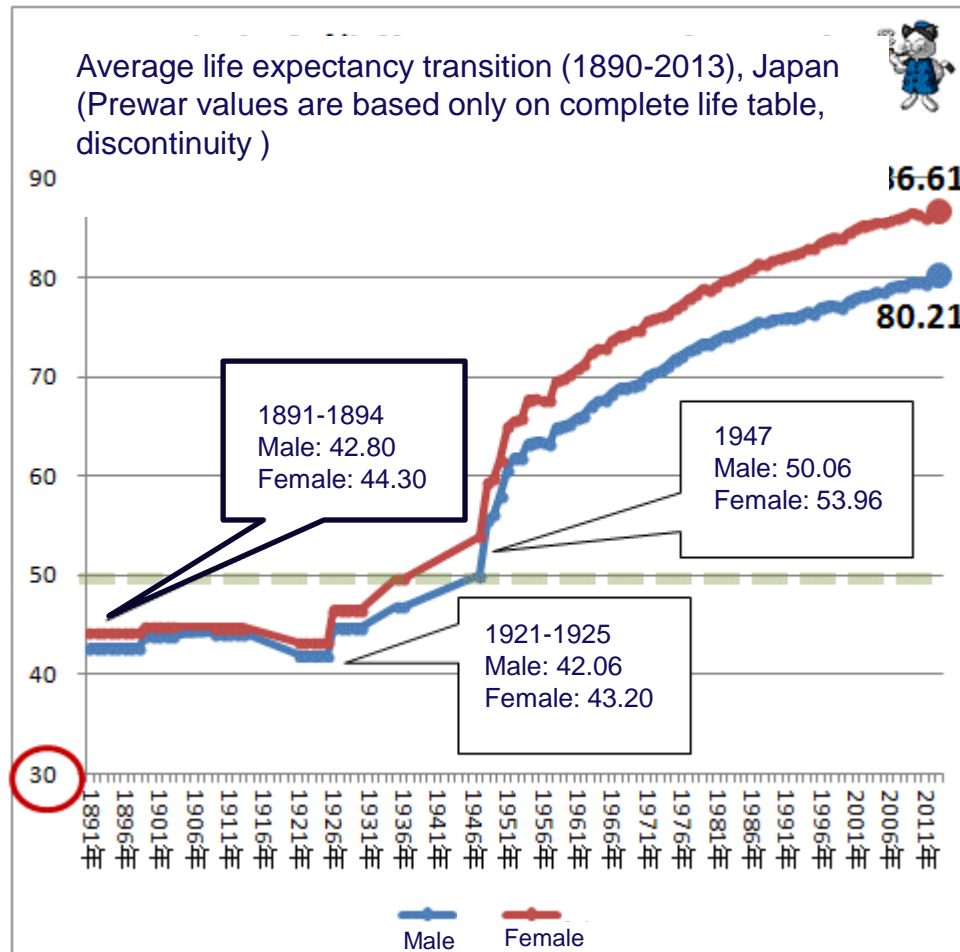
Table TS.7. Fraction of CO<sub>2</sub> retained for ocean storage as simulated by seven ocean models for 100 years of continuous injection at three different depths starting in the year 2000.

year	Injection depth		
	800 m	1500 m	3000 m
2100	0.78 ± 0.06	0.91 ± 0.05	0.99 ± 0.01
2200	0.50 ± 0.06	0.74 ± 0.07	0.94 ± 0.06
2300	0.36 ± 0.06	0.60 ± 0.08	0.87 ± 0.10
2400	0.28 ± 0.07	0.49 ± 0.09	0.79 ± 0.12
2500	0.23 ± 0.07	0.42 ± 0.09	0.71 ± 0.14

"100% CO<sub>2</sub> storage" has been required up to now. However, if we regard CCS as "technology to buy time", the value will skyrocket "Half-life" is 100 years for the 800m, 300 years for the 1500m, and more than 500 years in the 3000m.

# Risk Psychology of Climate Change

# Safety is the very nature of changes



<http://www.garbagenews.net/archives/1940398.html>

# Tokyo, 600 years ago (image)



<http://www.soundofhope.org/node/295662>

# Tokyo, present

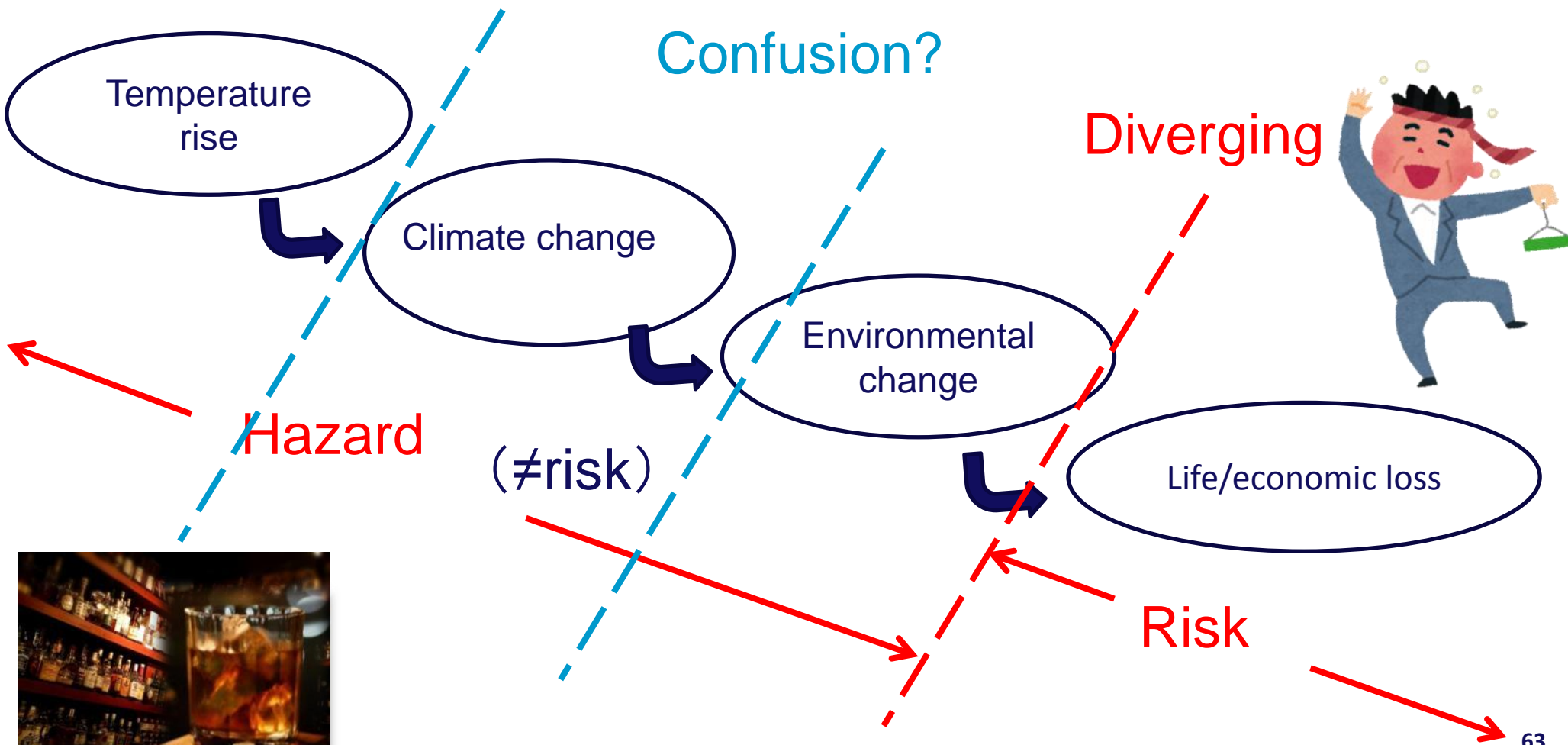


# Tone River moving to the east: Large scale modification of the River



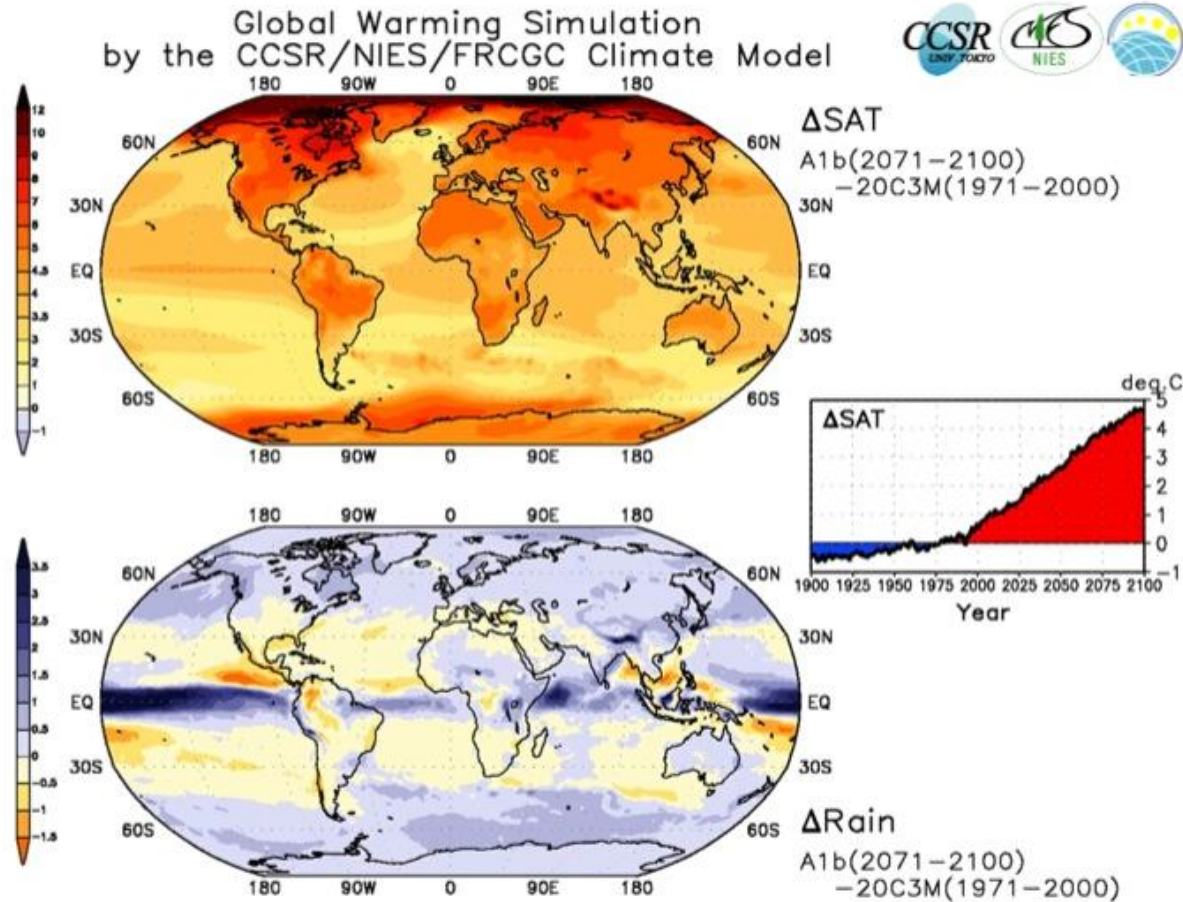
Safety is the very nature of changes.

# The End Point Confusion of the risk assessments = "Change" Itself Should not Be a Risk..





# Is “Change” itself the object of concern?



[http://jp.photaki.com/picture-illustration-science\\_149827.htm](http://jp.photaki.com/picture-illustration-science_149827.htm)

Is “safety in the middle of change” safe enough?

# For More Details...

## Books



## IEEI HP



## Wedge HP



## climatepolicy.jp

