UTokyo
Green
Transformation

Climate Change - Current Status and Future Outlook

University-wide Sustainability (GX) Literacy Education

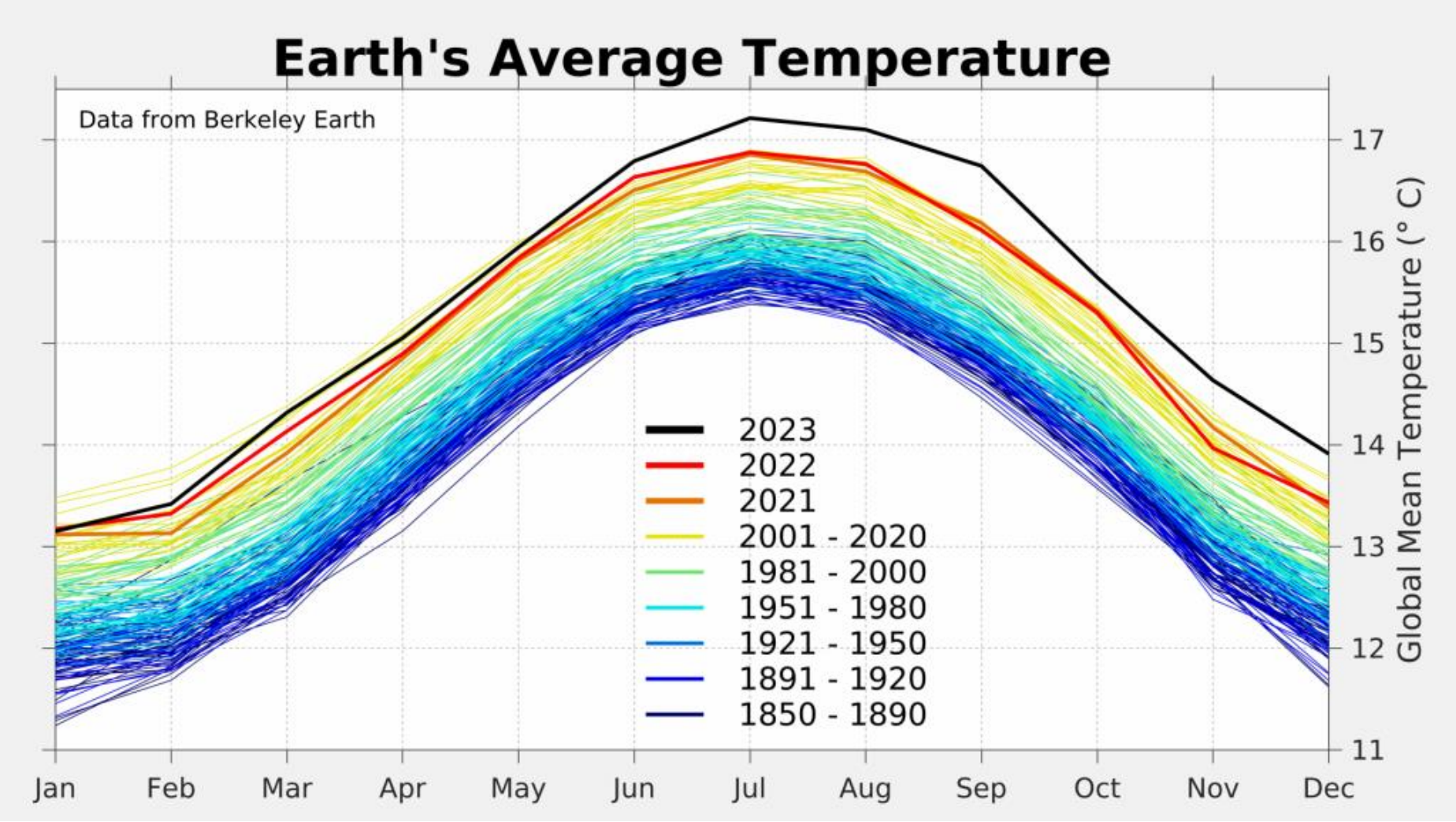
Institute for Future Initiatives

(Concurrent) Graduate School of Arts and Sciences

Seita Emori

Record high temperatures in 2023

Seasonal changes in global average temperature

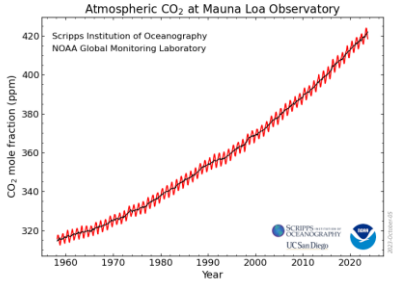


https://berkeleyearth.org/global-temperature-report-for-2023/

History of Climate Change Issues

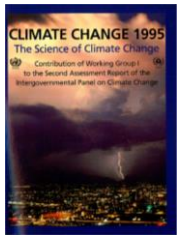
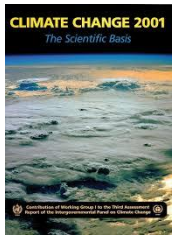
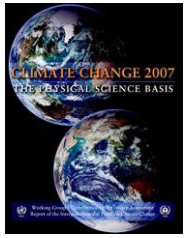
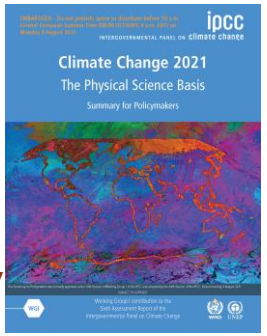
(Dawn) | (Full-scale period)

Late 19th century	1958	1960's	**1992**	**1997**	**2015**
The mechanism of global warming found	Continuous observation of the atmospheric CO_2 started	Modeling temperature rises due to CO_2 increase	**UN Climate Change Framework Convention adopted**	Kyoto Protocol adopted	Paris Agreement adopted
Foote Tyndall Arrhenius	Keeling	Manabe			



https://gml.noaa.gov/ccgg/trends/

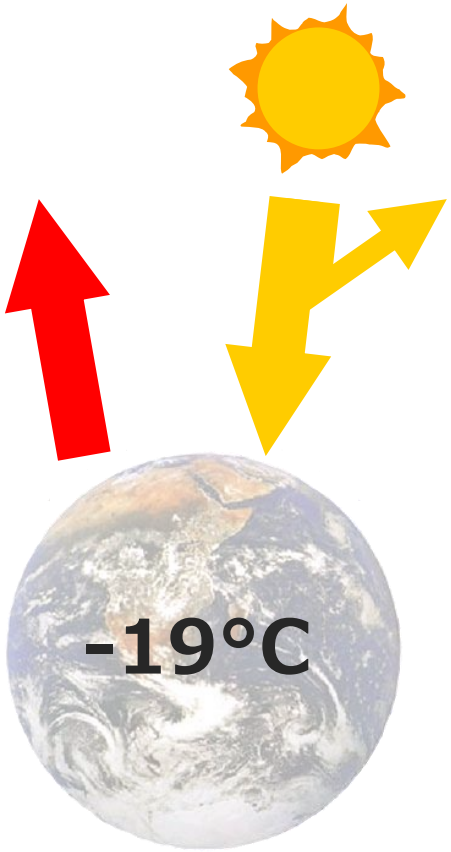
IPCC (Intergovernmental Panel on Climate Change) Report

1990 1st	1995 2nd	2001 3rd	2007 4th	2013 5th	2021 6th
					

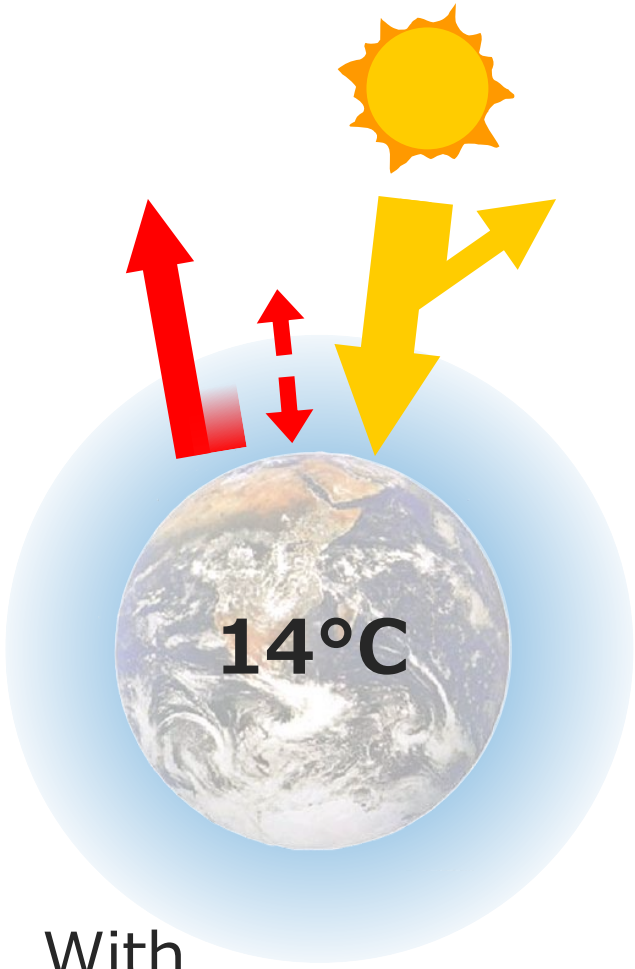
The likelihood of global warming being mainly caused by human activities is →

likely (>66%)	very likely (>90%)	extremely likely (>95%)

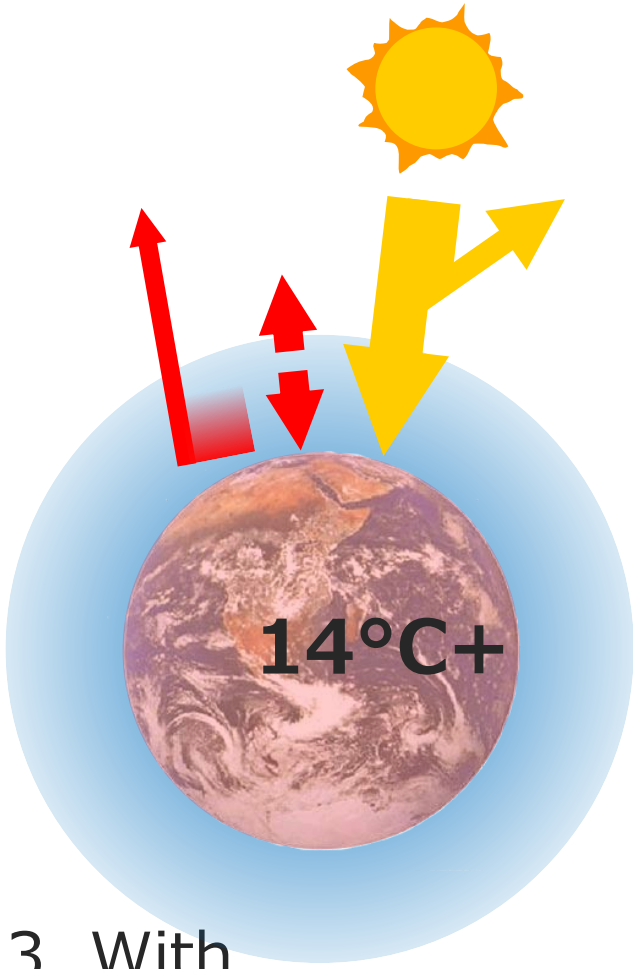
How Global Warming Works



1. Without greenhouse effect



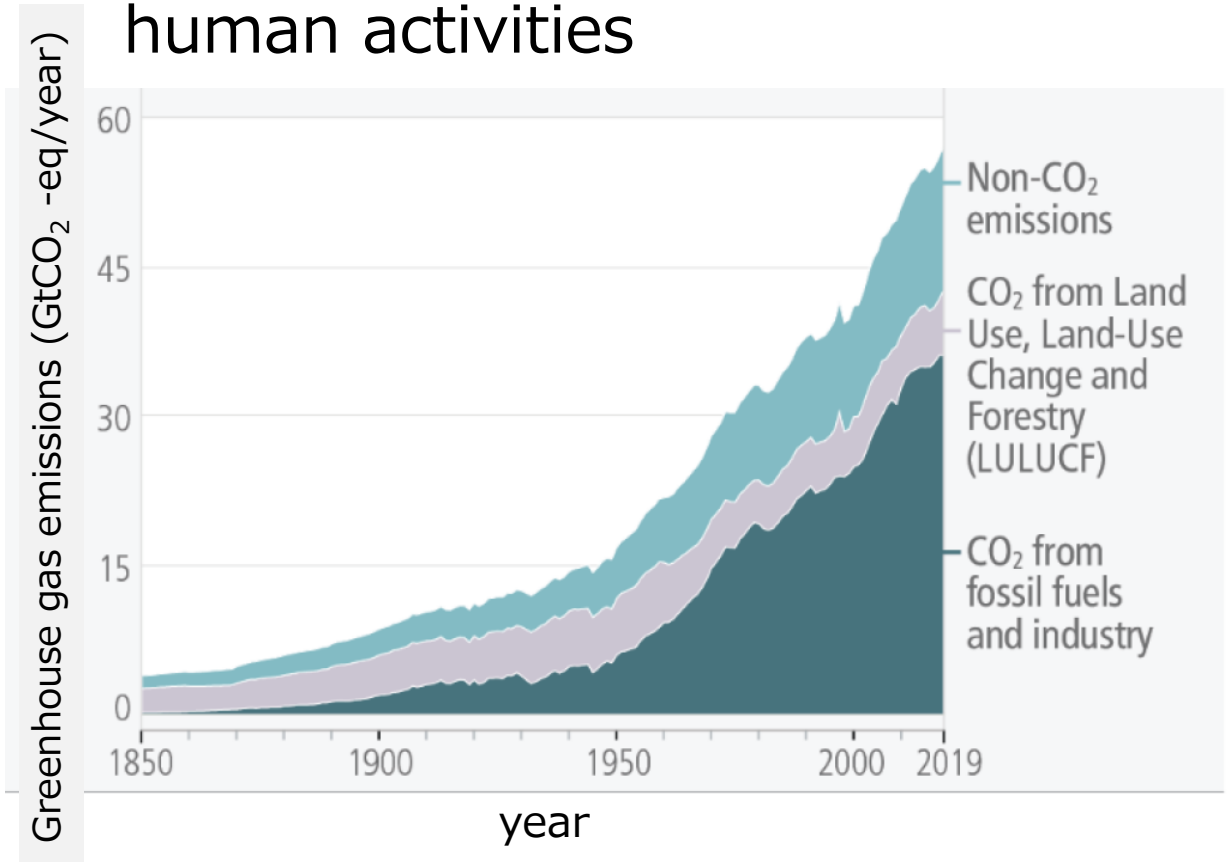
2. With greenhouse effect



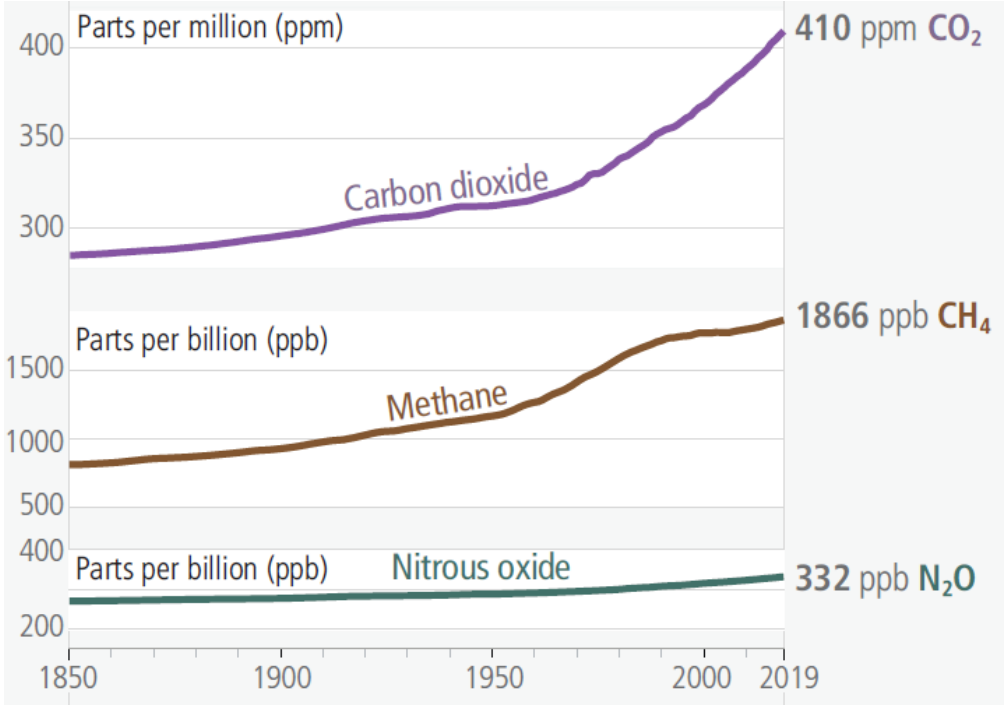
3. With intensified greenhouse effect

Greenhouse gas emissions and atmospheric concentrations continue to increase

Greenhouse gas emissions from human activities

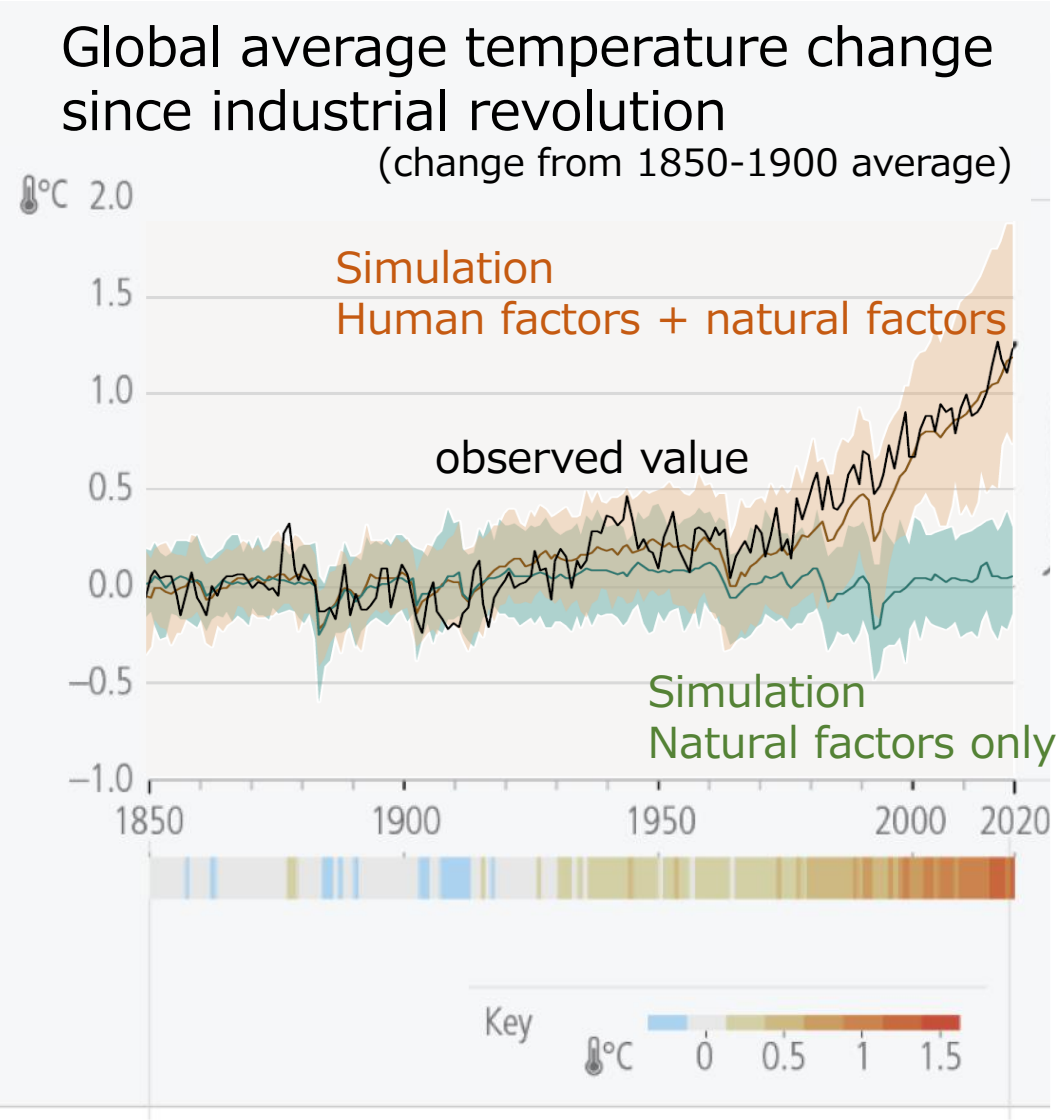


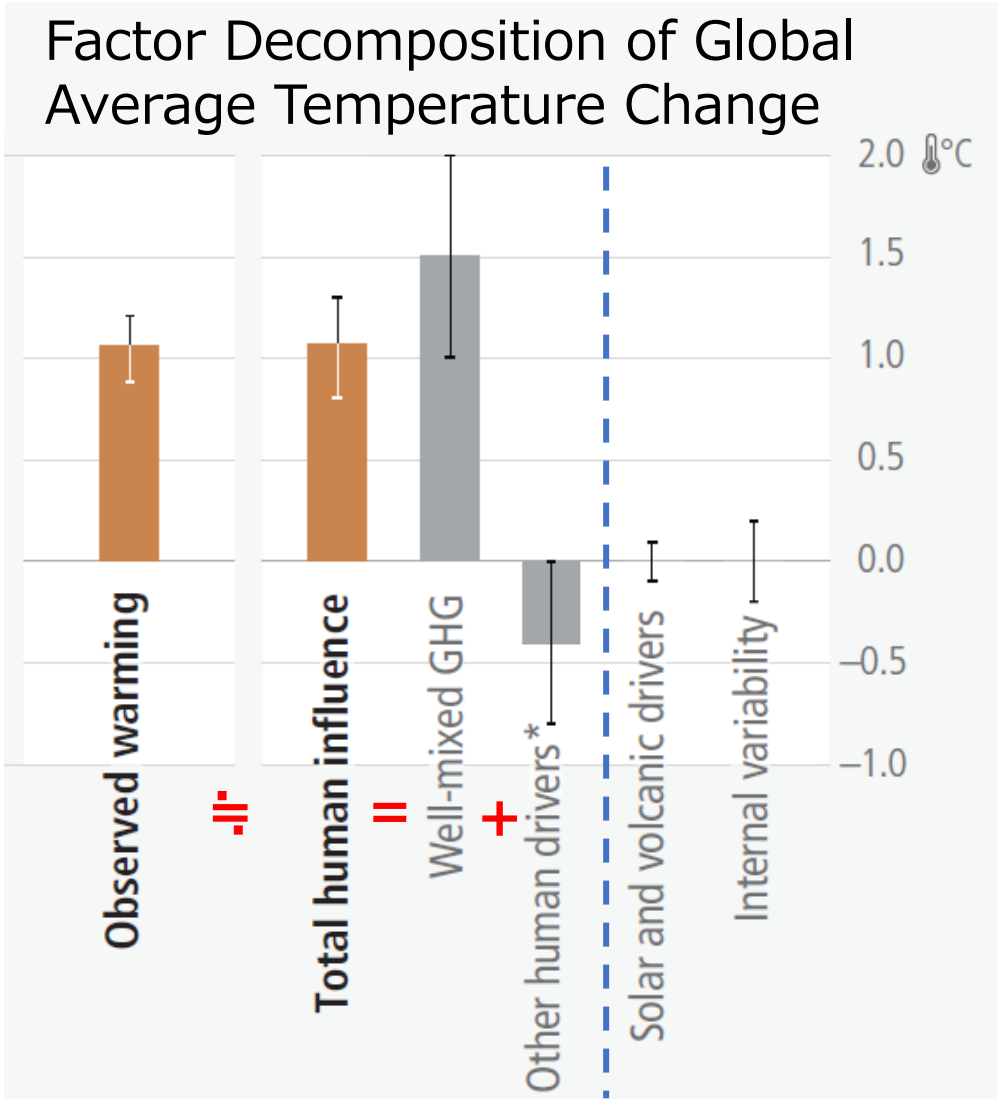
Atmospheric greenhouse gas concentrations



(IPCC AR6 SYR, Longer Report Fig.2.1a,b)

Already ~1.1°C global warming due to human influence



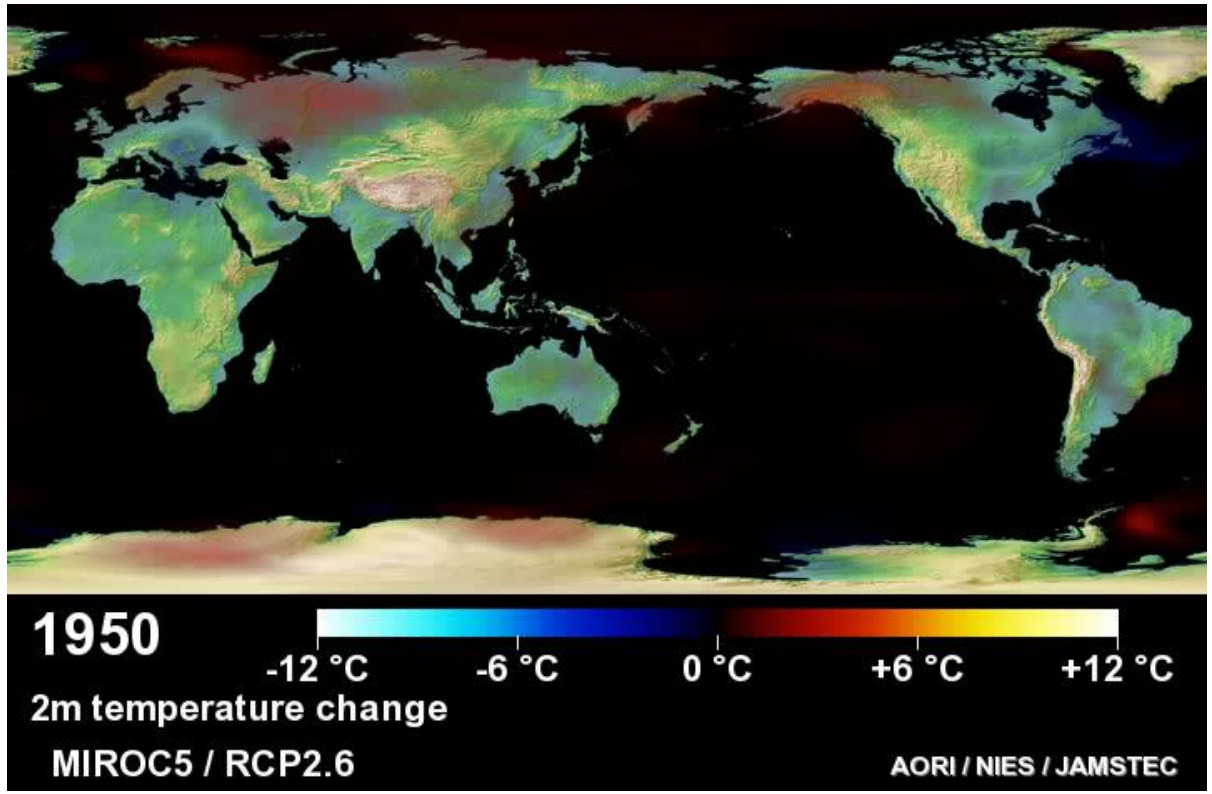


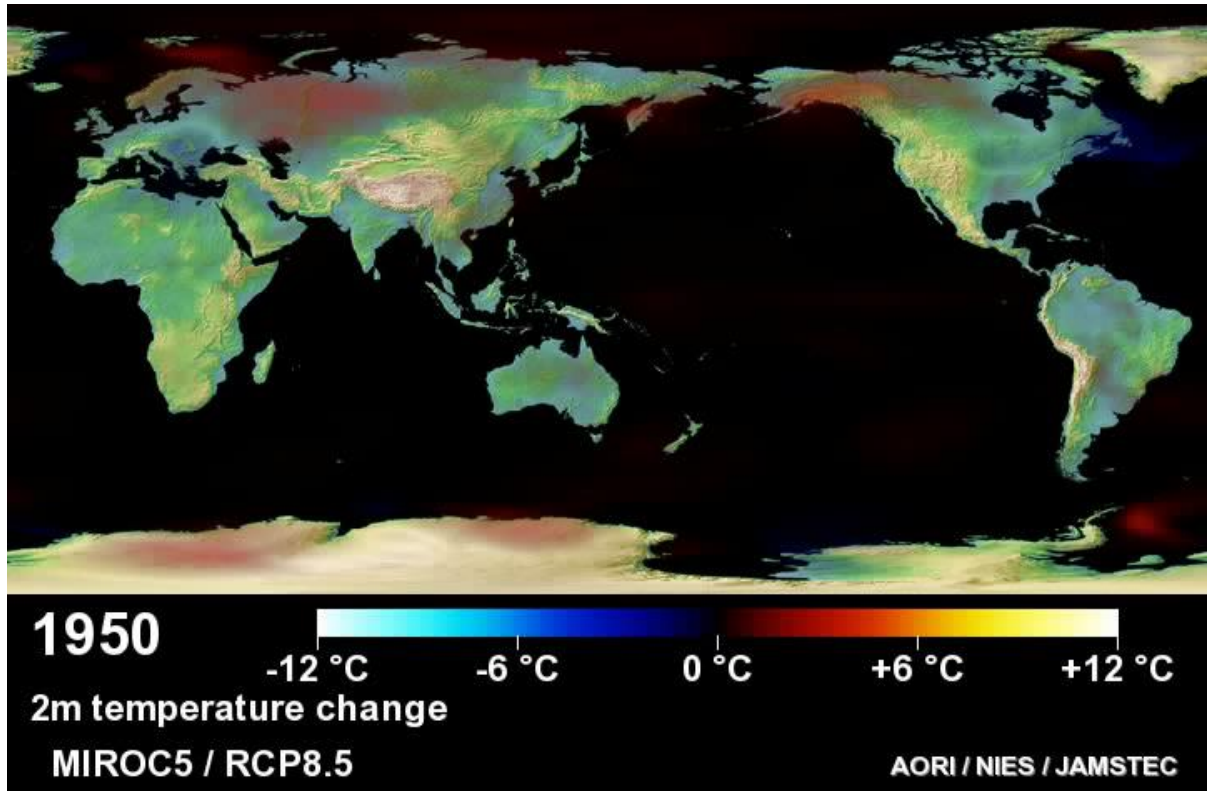
Human-induced global warming “unequivocal."

(IPCC AR6 SYR, Longer Report Fig.2.1c,d)

'Climate model' = Earth in a computer

Simulation of temperature change





Equivalent to "low" scenario
(~+2°C stabilization)

Equivalent to "very high" scenario
(no measures, fossil fuel dependent)

Based on MIROC5 climate model (AORI/NIES/JAMSTEC/MEXT)

21世紀末の日本は、20世紀末と比べ…

※ 黄色は2°C上昇シナリオ（RCP2.6）、
紫色は4°C上昇シナリオ（RCP8.5）による予測

年平均気温が約1.4°C/約4.5°C上昇

猛暑日や熱帯夜はますます増加し、
冬日は減少する。

海面水温が約1.14°C/約3.58°C上昇

温まりやすい陸地に近いことや暖流の影響で、
予測される上昇量は世界平均よりも大きい。

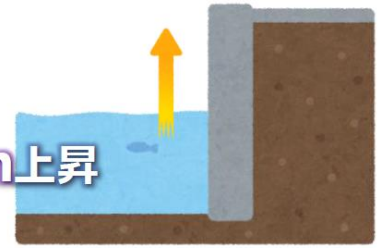
降雪・積雪は減少

雪ではなく雨が降る。
ただし大雪のリスクが
低下するとは限らない。

激しい雨が増える

日降水量の年最大値は
約12%（約15 mm）/ 約27%（約33 mm）増加
50 mm/h以上の雨の頻度は 約1.6倍/約2.3倍に増加

沿岸の海面水位が約0.39 m/約0.71 m上昇



3月のオホーツク海海氷面積は約28%/約70%減少

【参考】4°C上昇シナリオ（RCP8.5）では、
21世紀半ばには夏季に北極海の海氷が
ほとんど融解すると予測されている。

強い台風の割合が増加
台風に伴う雨と風は強まる

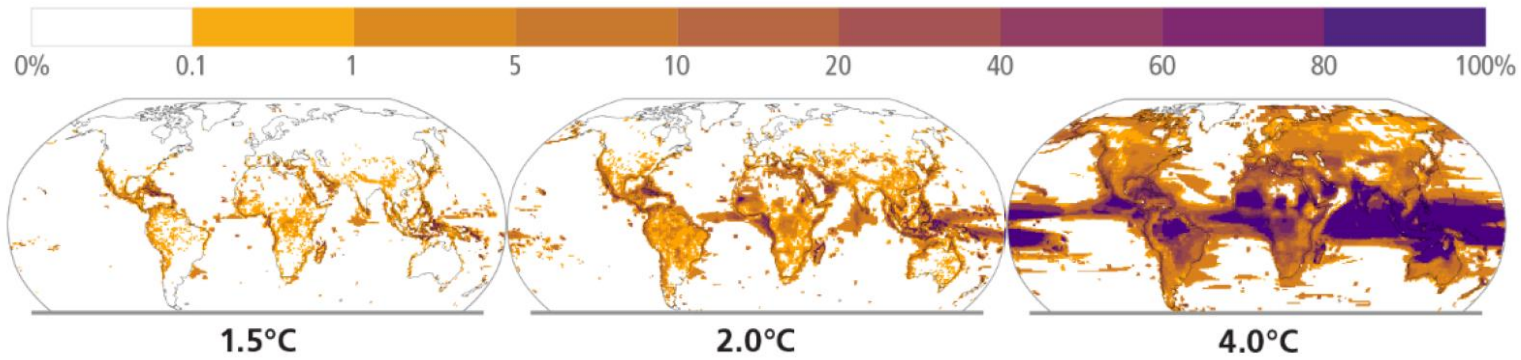
日本南方や沖縄周辺においても世界平均と同程度の速度で海洋酸性化が進行

※ この資料において「将来予測」は、特段の説明がない限り、日本全国について、21世紀末時点の予測を20世紀末又は現在と比較したもの。

From "Climate Change in Japan 2020" (Ministry of Education, Culture, Sports, Science and Technology, Japan Meteorological Agency)

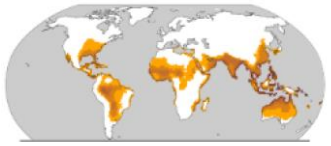
As warming worsens, impacts become more severe and regional differences widen

Risk of species loss

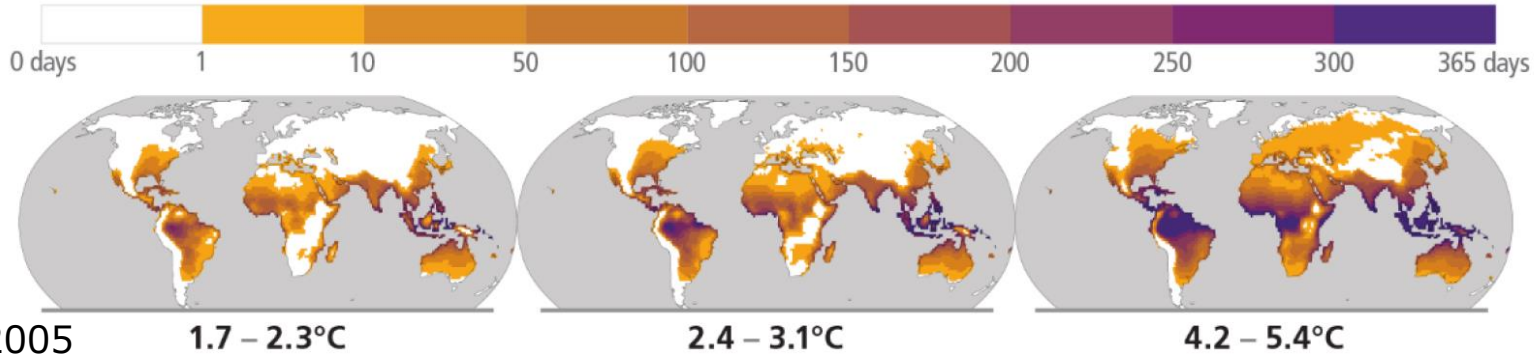


Percentage of animal and seaweed species exposed to hazardous temperatures. Species migration is not taken into account.

Human mortality risk due to high temperature and humidity



Actual results for 1991-2005



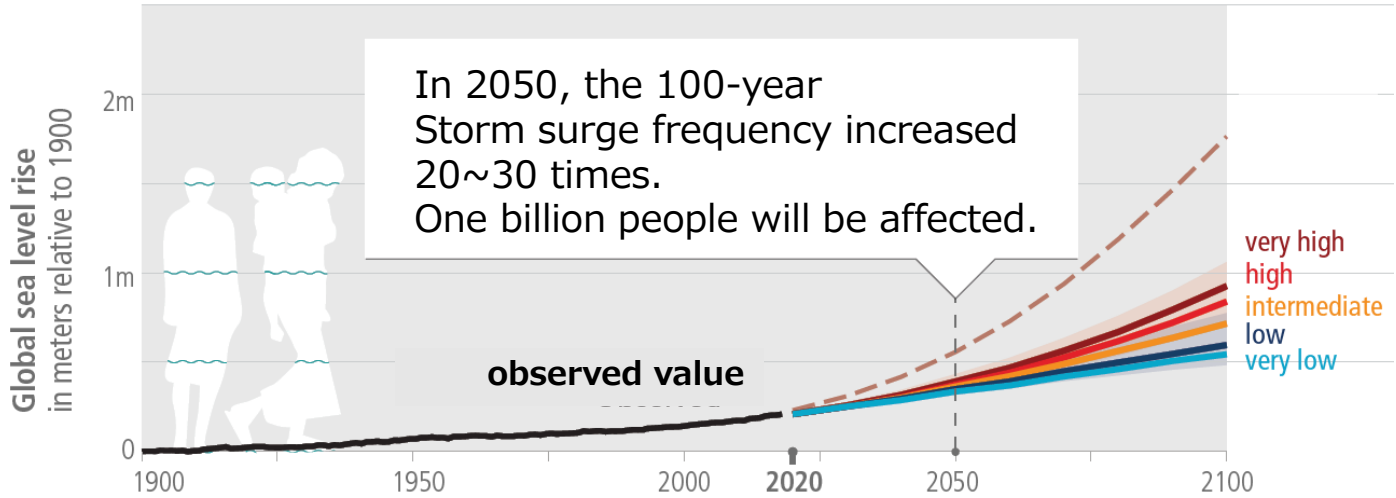
Number of days per year in which average daily temperature and humidity conditions are likely to cause deadly heat stroke.

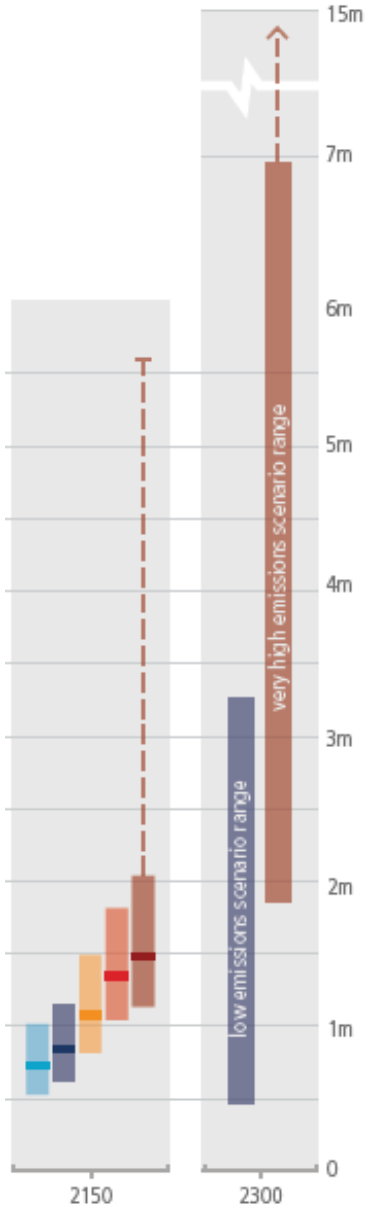
(IPCC AR6 SYR, Fig.SPM.3a,b)

Sea level rise will continue for thousands of years to come

Cannot rule out the possibility of Antarctic ice sheet destabilization and accelerated sea level rise(=> tipping phenomenon)
(---------- line in the figure)

Keeping warming low will also keep future sea level rise relatively low.



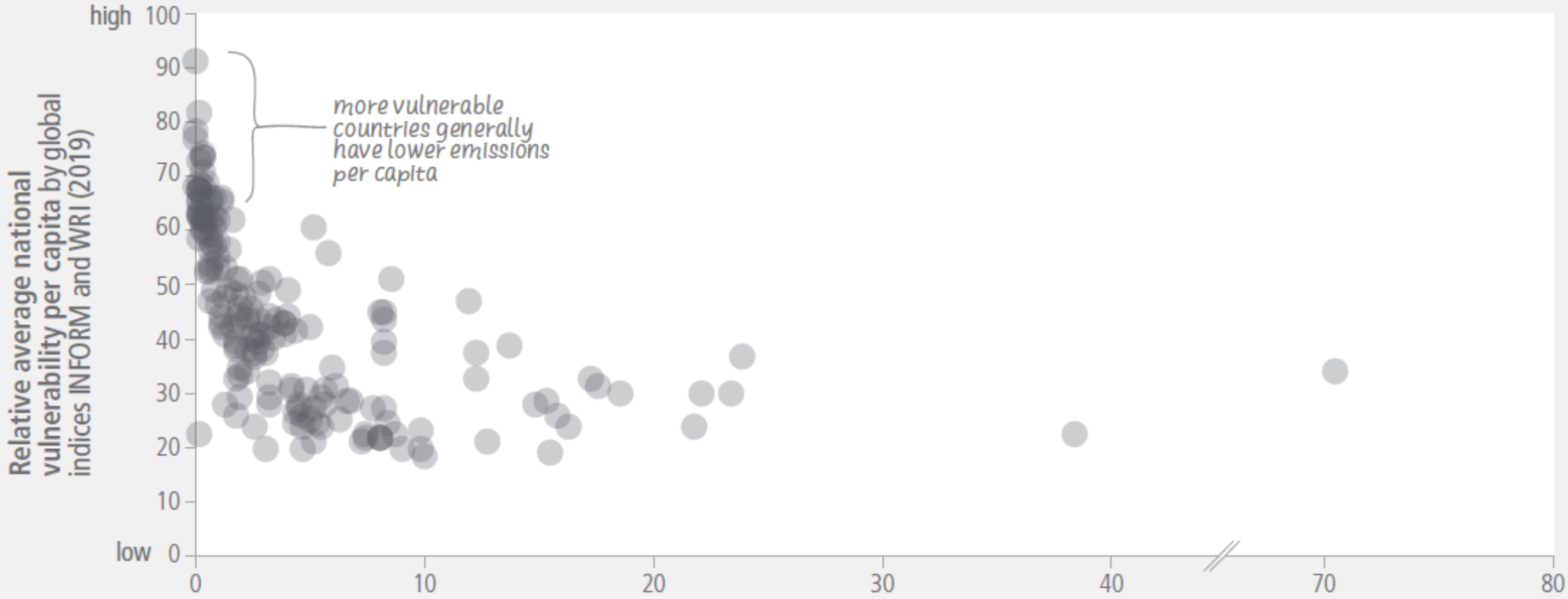


Scenario with “very high” emissions (no countermeasures).
Sea level rise in 2300 could be 2~7m
(If the Antarctic ice sheet were to be destabilized, we cannot rule out the possibility of 15m)

Scenario with “low” emissions (~2°C stabilization)
Sea level rise in 2300 would be 0.5~3m

(IPCC AR6 SYR, Longer Report Fig. 3.4a)

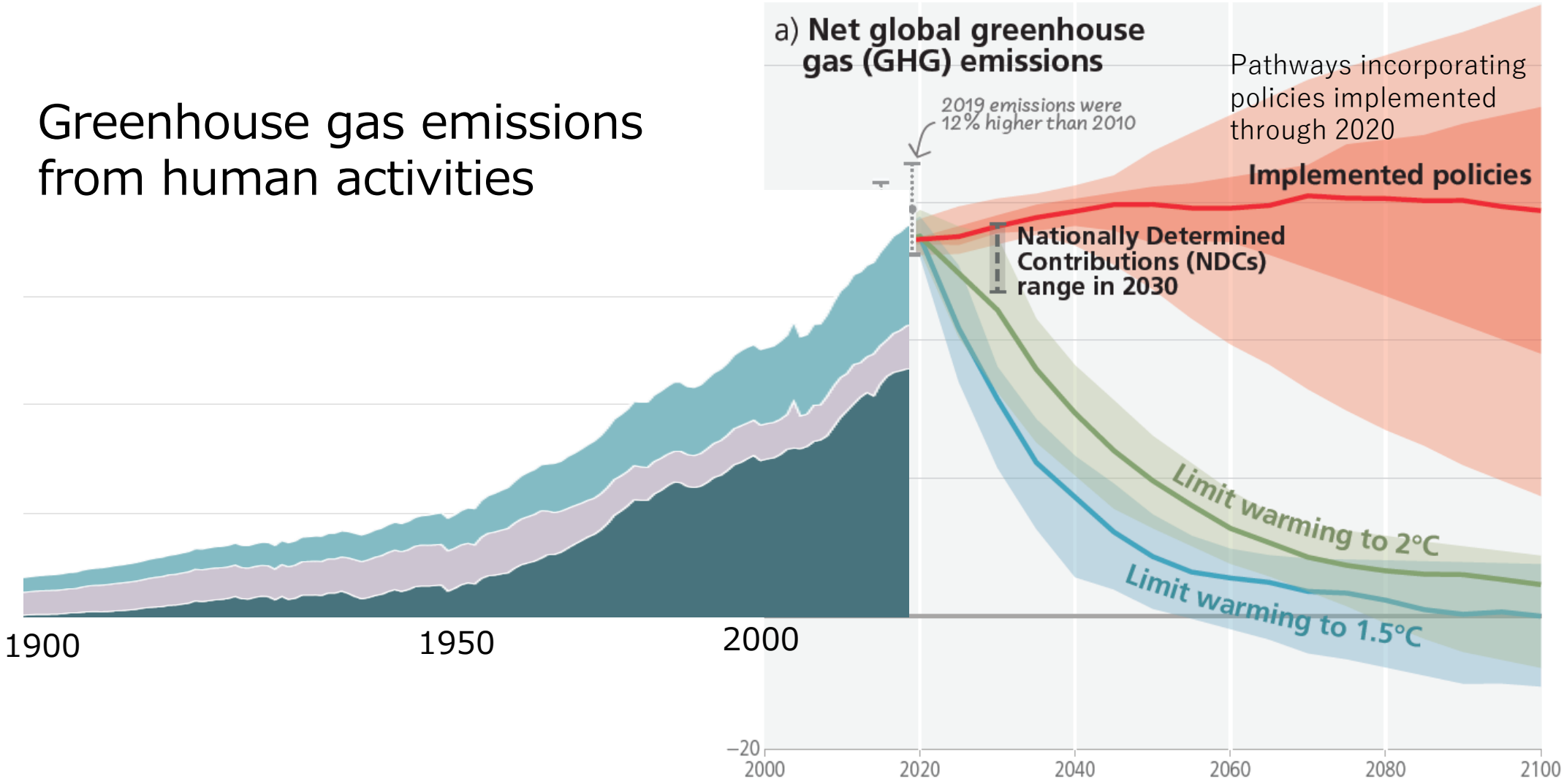
People who are not responsible for the cause will be severely affected



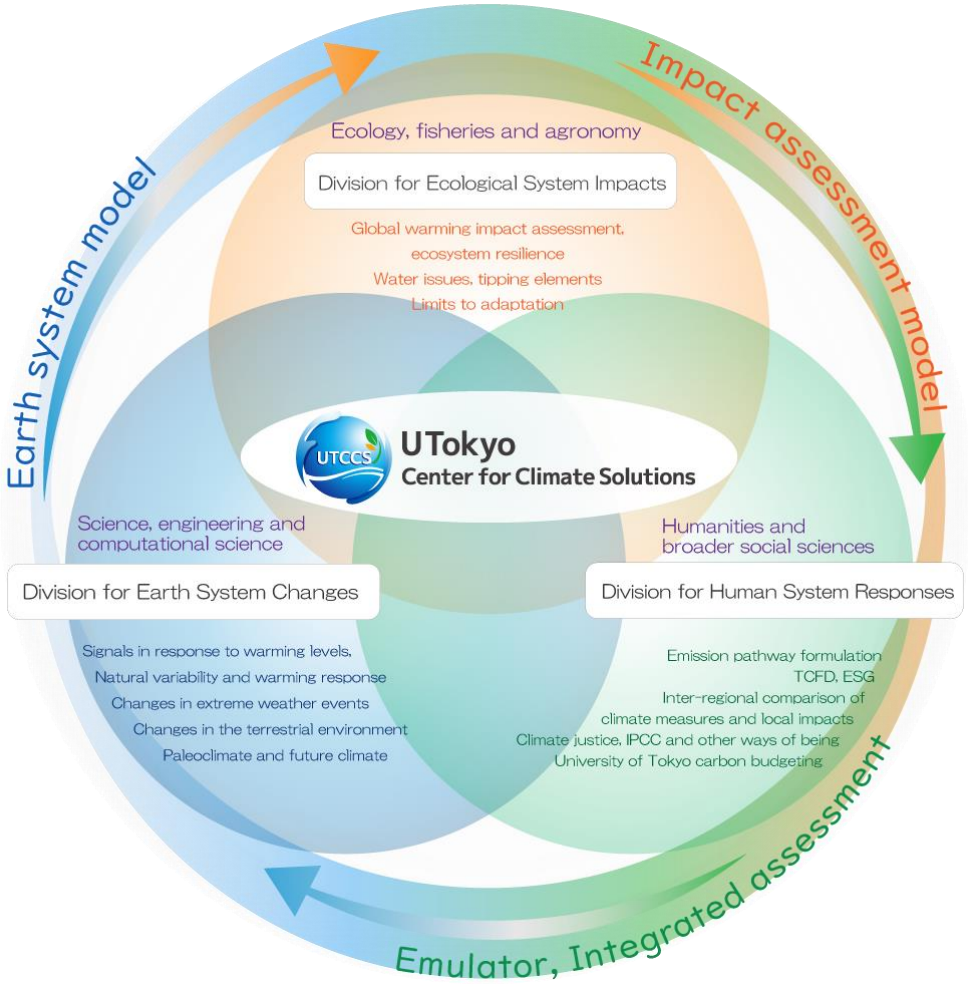
(IPCC AR6 SYR, Longer Report Fig.2.3b)

The current pace of emission reductions is not enough at all

Greenhouse gas emissions from human activities



(IPCC AR6 SYR, Longer Report Fig.2.1a, Fig.SPM.5a)



Science, Engineering and Computational Science

Understanding, modeling, and predicting Earth system change

- Natural variability and global warming response
- Changes in extreme events
- Paleoclimate and future tipping phenomena
- Assessment of uncertainty

Ecology, Engineering, Agriculture, Fisheries Science, Medicine

Climate change impacts on natural and man-made systems

- Impacts and feedback on ecological systems
- Impact on artificial systems
- Impact on food production and water resources
- Human health impact

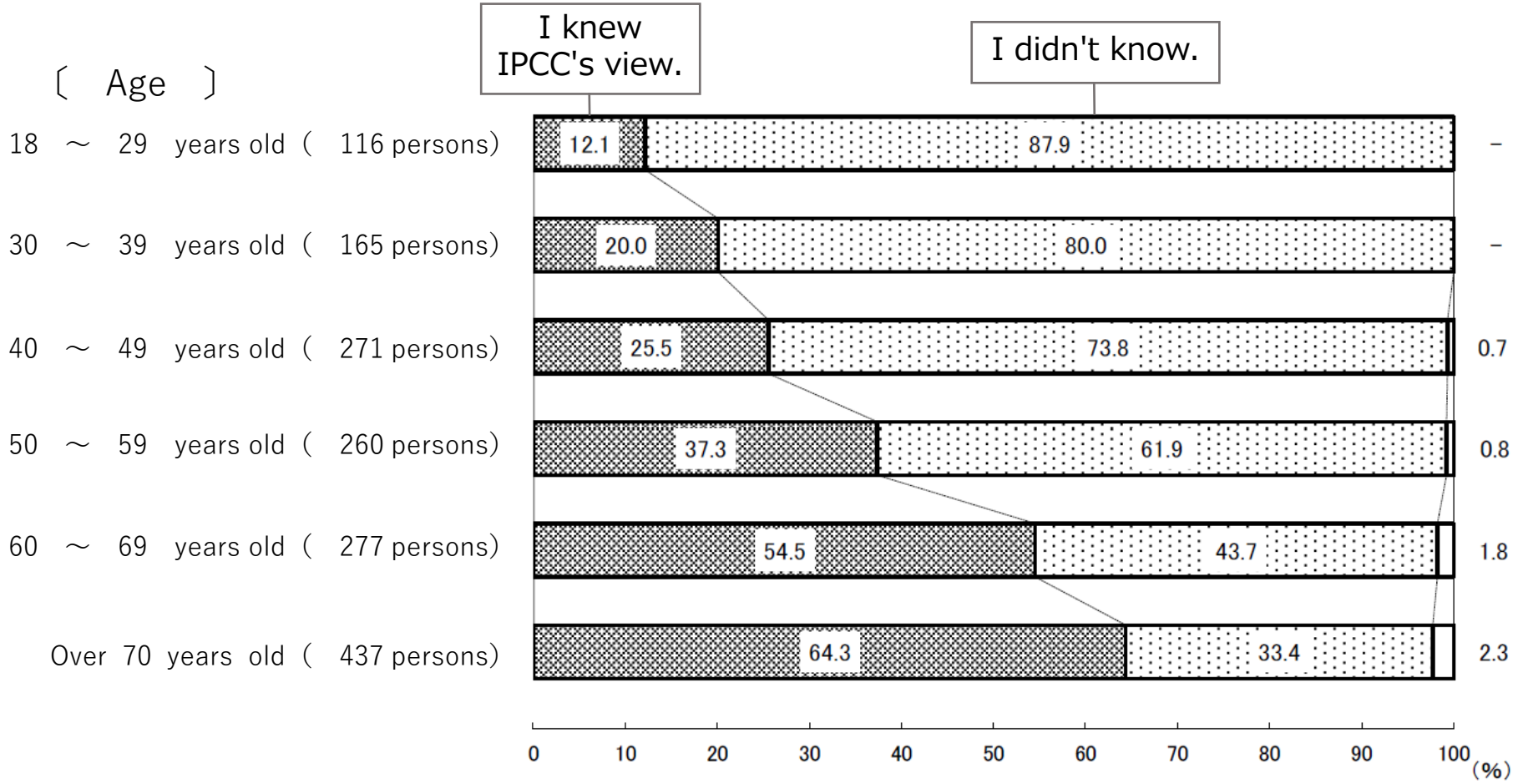
Humanities and Social Sciences

Social Dimensions of Climate Change Impacts

- Impact on social systems
- Vulnerability of society
- Inequity of impacts (climate Justice)

(3) Awareness of IPCC assessment reports

Q4: The IPCC, an intergovernmental organization established by the United Nations, has been releasing assessment reports related to climate change every five to seven years since 1990. Are you aware that in its latest report, for the first time, the IPCC concluded that human activities have caused global warming? (circle one).



From "Public Opinion Survey on Climate Change," Government Information Office, Cabinet Office, Government of Japan, 2023.11

UTokyo
Green
Transformation

Let’s understand climate change and confront the global risk