Toward collaboration between climate projection and its utilization

Izuru Takayabu@ MRI
IPCC symposium @ Tokyo
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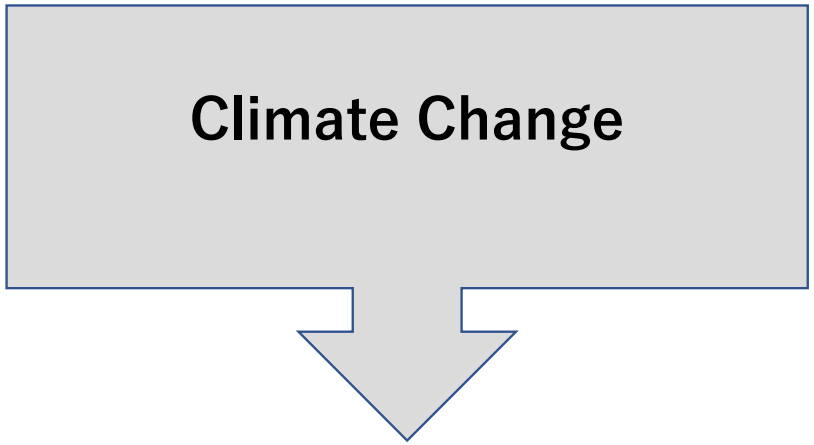


* How does it **influence** to our lives?
* How the **adaptation** may work?
* How the **mitigation** may work?

IPCC AR6
WG1: The physical science basis
WG2: Impacts, adaptaion and vulnerability
WG3: Mitigation of Climate Change

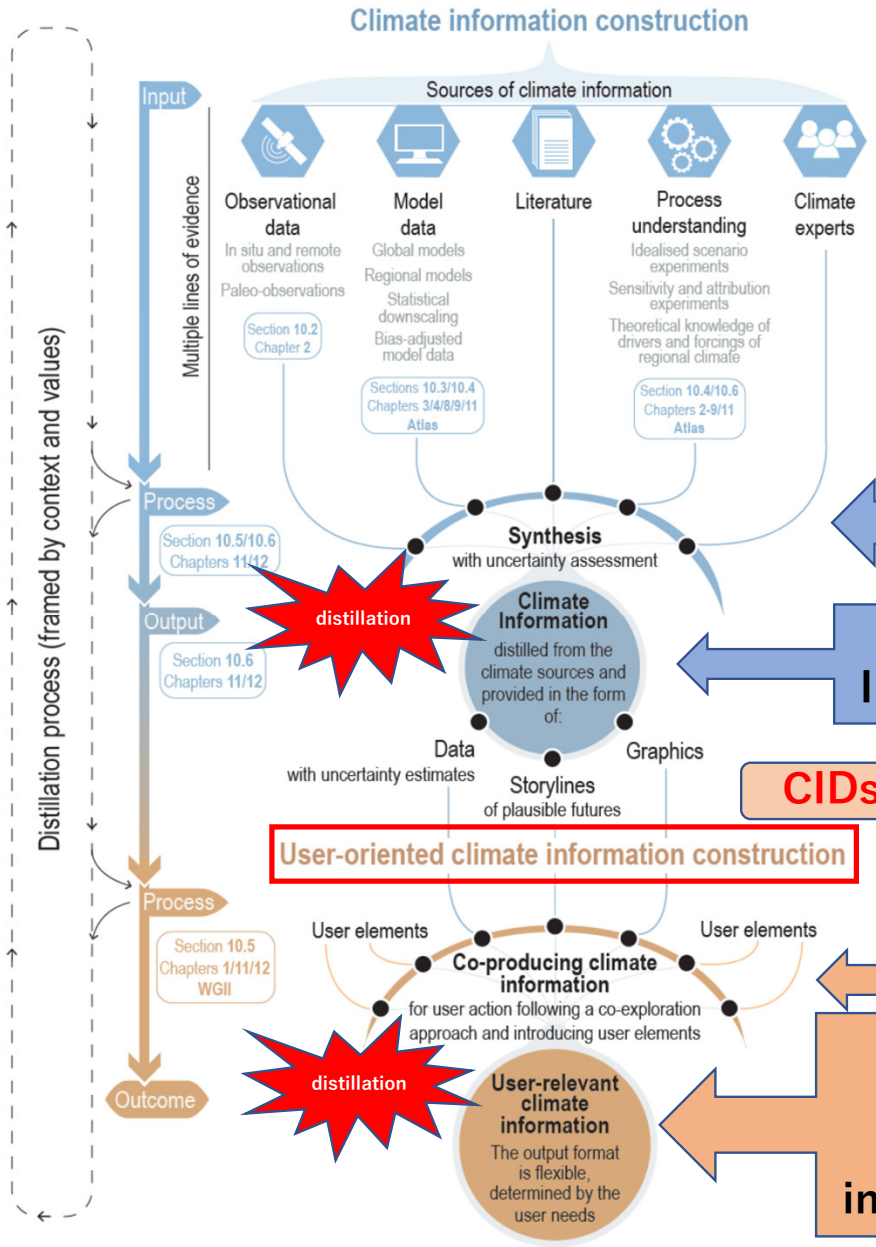
Contents

- Introduction of IPCC WG1 AR6
  - How they think on “handshaking”.
  - Some key-words
    - multiple lines of evidence
    - distillation of information
    - Climate Impact-Drivers: CIDs
    - Interactive Atlas
    - Sectoral FS

- Summary
  - How to realize “handshaking” among climate researchers and stakeholders.

IPCC WG1 **distilled multiple lines of evidence** to make user-relevant climate information.

Some explanations have been added to IPCC WG1 AR6 Fig. 10.1



IPCC WG1 AR6 Figure 10.1:
Diagram to indicate processes to produce regional climate information (Blue) and user-relevant climate information (Brown).

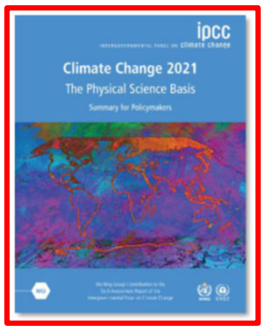
Multiple lines of evidence

Synthesis with uncertainty assessment

Climate Information

Co-producing climate information with users

User relevant climate information



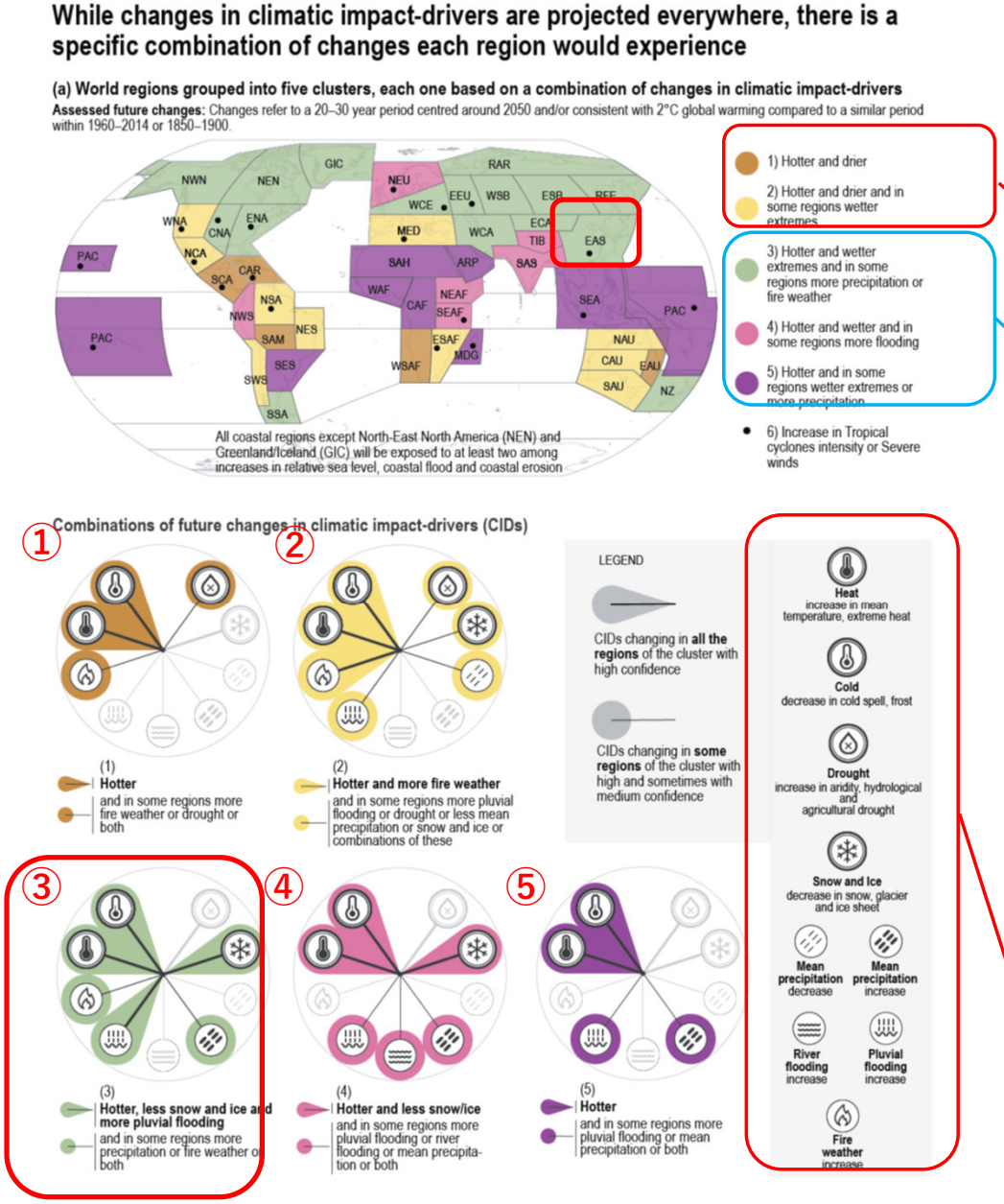
Multiple lines of evidence➔ Distillation
We need two steps distillation to deliver climate change data for users

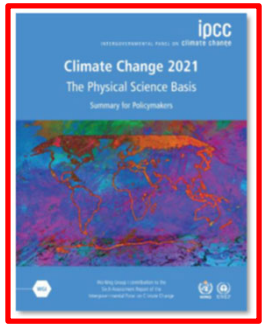
IPCC divided the whole world by estimating 33 Climate Impact-Drivers

The world divided into 5 categories with the difference in behavior of **water circulation**.

Region ① · ② become drier, but
region ③ · ④ · ⑤ become wetter

IPCC WG1 AR6 Fig. TS.22 panel A



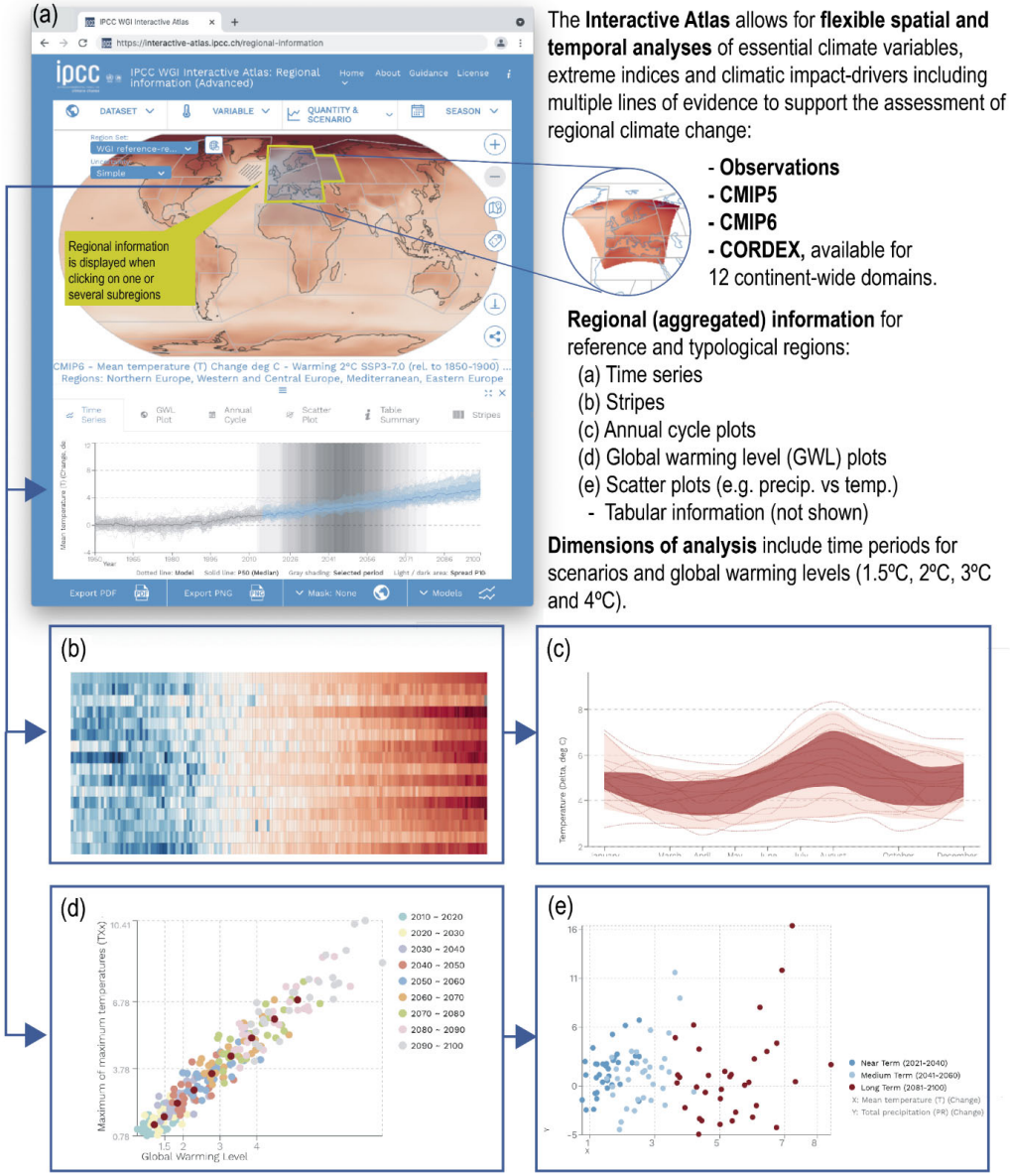


Become drier

Become wetter

Climatic Impact-Drivers（CIDs）

IPCC WG1 prepared the **Interactive Atlas**, which can draw many figures from the data used in the estimation in the report.



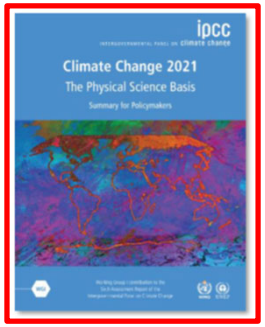
The **Interactive Atlas** allows for **flexible spatial and temporal analyses** of essential climate variables, extreme indices and climatic impact-drivers including multiple lines of evidence to support the assessment of regional climate change:

- **Observations**
- **CMIP5**
- **CMIP6**
- **CORDEX**, available for 12 continent-wide domains.

Regional (aggregated) information for reference and typological regions:

(a) Time series
(b) Stripes
(c) Annual cycle plots
(d) Global warming level (GWL) plots
(e) Scatter plots (e.g. precip. vs temp.)
- Tabular information (not shown)

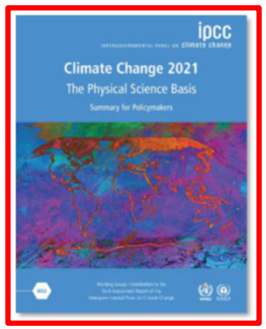
Dimensions of analysis include time periods for scenarios and global warming levels (1.5ºC, 2ºC, 3ºC and 4ºC).



IPCC WG1 AR6 Figure Atlas 8

https://www.ipcc.ch/report/ar6/wg1/

In Chap. 12, they connect WG1 and many sectors in WG2 by using CIDs



WG2 Ch.5

WG1 CIDs

Sector	Asset	Heat and Cold	Wet and Dry	Wind	Snow and Ice	Coastal	Open Ocean	Other
		Mean air temperature; Extreme heat	Mean precipitation; River flood; Heavy precipitation and pluvial flood; Landslide; Drought; Fire weather	Mean wind speed; Storm; Sand and dust storm	Snow, glacier and ice sheet; Sea ice; Hail; Snow avalanche	Relative sea level	Mean ocean temperature; Marine heatwave; Ocean acidity; Ocean salinity; Dissolved oxygen	Extreme weather; CO_2 at surface
Food, Fibre and Other Ecosystem Products (WGII Chapter 5)	Crop systems							
	Livestock and pasture systems							
	Forestry systems							
	Fisheries and aquaculture systems							
Cities, Settlements and Key Infrastructure (WGII Chapter 6)	Cities							
	Land and water transportation							
	Energy infrastructure							
	Built environment							
Health, Well-being and Communities (WGII Chapter 7)	Labour productivity							
	Morbidity							
	Mortality							
	Recreation and tourism[a]							
Poverty, Livelihoods and Sustainable Development (WGII Chapter 8)	Housing stock[b]							
	Farmland[b]							
	Livestock mortality[b]							
	Indigenous traditions							

[a] The Recreation and tourism asset category includes outdoor exercise and the tourism industry (including ecosystem services) assessed in many WGII chapters.
[b] This asset category is distinguished by the threat of a full loss of key investments and living environments rather than a recoverable damage or loss of productivity or profit.

Impacts and risk relevance

IPCC WG1 AR6 Table 12.2 2/2

For **Fisheries and aquaculture systems**, many **CIDs** of "**Coastal**" and "**Open Ocean**" are counted as "high" impact.

IPCC WG1 arrange fact sheets to highlight the CIDs relevant for many sectors of adaptation and mitigation.

FS of Marine Ecosystems, Fisheries and Aquaculture

Sea level rise

Heat wave

Ocean acidification

Change of Arctic sea ice area

SIXTH ASSESSMENT REPORT
Working Group I – The Physical Science Basis

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Climate information relevant for Marine Ecosystems, Fisheries and Aquaculture

Marine ecosystems encompass coastal land, intertidal and upwelling zones, coastal, shelf and polar seas, the open ocean and deep seas. {WG II, Chapter 3} The fisheries and aquaculture systems include food, fibre and other ecosystem products, and refer to industrial and artisanal fishing, harvesting wild fish and other aquatic organisms, and the farming of aquatic organisms. {WG II, Chapter 5} This Fact Sheet is focused on the marine environment, and information for freshwater systems is provided in the fact sheet for terrestrial and freshwater ecosystems.

Impacts and adaptation options for marine ecosystems, fisheries and aquaculture are assessed in WG II Report Chapters 3,5 {3.2,3.3, 3.5, 3.6 CCB; 5.8 CCB}, and their mitigation options are assessed in WG III Report Chapters 4,7,11,12. {SPM C11.1; TS 5.7; 4.4.2; 7.4.2; 11.4.4; 12.3.1; 12.4.1; 12.4.3}

Types of Climatic-Impact Drivers (CIDs) that are of high relevance for the sectors addressed in this fact sheet are: Heat and Cold, Snow and Ice, and Coastal and Oceanic. Oceanic CIDs can have implications for marine ecosystems from coral bleaching, changes in phytoplankton blooms, migration, growth, reproduction and survival of marine and aquatic organisms, with implications for fisheries and aquaculture. {WGI: Chapter 5 ES; 5.3.5; Chapter 9, Box 9.2; 12.3.6.1; 12.3.6.3} Coastal CIDs can affect coastal ecosystems, fisheries, aquaculture and tourism. {WG1:12.3.5.2; WGII: Chapter 3, 3.6, 5, 5.8; 5.9} Heat & cold CIDs can affect freshwater species ranges, ecosystem health and aquaculture suitability {WGI: 12.3.1.1; WGII: Chapter 5, 5.9}.

COASTAL CIDs with high relevance for marine ecosystems include relative sea level, coastal flooding and coastal erosion. Coastal flooding in coastal land and intertidal zones is also highly relevant for fisheries and aquaculture systems.

- Uncertainty in the timing of reaching different levels of global mean sea level rise is an important consideration for adaptation planning. {9.6.3}
- It is *very likely to virtually certain* that regional mean relative sea level rise will continue throughout the 21st century, except in a few regions with substantial geologic land uplift rates. Due to relative sea level rise, extreme sea level events that occurred once per century in the recent past are projected to occur at least annually at more than half of all tide gauge locations by 2100 *(high confidence)*. {SPM C.2.5}

TS_Box_4_Figure_1

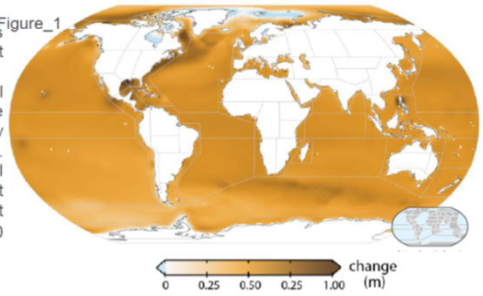
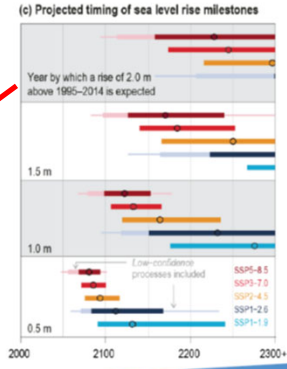


Figure 1: CMIP6 – Projected sea level rise for 2081-2100 (relative to 1995-2014) for medium (SSP2-4.5) emission scenario {Interactive Atlas}.



- Relative sea level rise contributes to increases in the frequency and severity of coastal flooding in low-lying areas and to coastal erosion along most sandy coasts *(high confidence)*. A vast majority of the world's regions are projected to experience an increase in coastal flooding throughout the 21st century *(high confidence)*. {SPM C.2.5; Tab.TS5, 12.4}

Figure 2: Timing of exceedance of global mean sea level thresholds of 0.5, 1.0, 1.5 and 2.0 m, under different SSPs. Lightly shaded thick/thin bars show 17th–83rd/5th–95th percentile low-confidence ranges for SSP1-2.6 and SSP5-8.5. {TS Box 4 Figure 1}{4.3.2, 9.6.1, 9.6.2, 9.6.3, Box 9.4}

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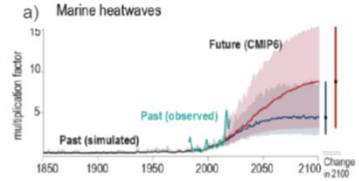
OCEANIC CIDs with high relevance for all parts of marine ecosystems include ocean temperature, marine heatwaves, ocean acidification, and can be relevant for fisheries and aquaculture systems. Dissolved oxygen is of high relevance for coastal & shelf seas and upwelling zones.

- It is *virtually certain* that the global upper ocean (0–700 m) has warmed since the 1970s. Marine heatwaves have approximately doubled in frequency since the 1980s (*high confidence*), and their frequency will continue to increase *(high confidence)* {SPM A.3.1; SPM A.1.6; SPM B.2.3}

y certain that surface s… the last 40 years, which is one of the major …indicating ocean acidif… *dence* that oxygen levels have dropped in …r ocean regions since …

…house ga… emissions s… …cean to future warming (*high confidence*), …acidificati… (*virtually c… confidence*) will continue to increase in the …21st century at rates dependent on future emissions. Changes are irreversible at centennial to millennial time scales in global ocean temperature (*very high confidence*), deep ocean acidification (*very high confidence*) and deoxygenation (*medium confidence*). {SPM B.5.1}



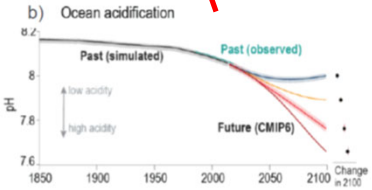


Figure 3: Past and future change in a) marine heatwave days and b) ocean surface pH under varying greenhouse gas emissions scenarios {Figure TS.11}

SNOW & ICE CIDs with potential relevance for marine ecosystems includes sea ice in polar

- In 2011–2020, annual average Arctic sea ice area reached its lowest level since at least 1850 *(high confidence)*. Since the late 1970s, Arctic sea ice area and thickness have decreased in both summer and winter, with sea ice becoming younger, thinner and more dynamic *(very high confidence)*. {SPM A.2.3; TS.2.5 }
- The Arctic is likely… September at leas… five illustrative sce… frequent occurrenc… There is *low confi…* of Antarctic sea ice…

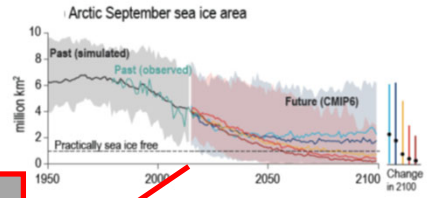
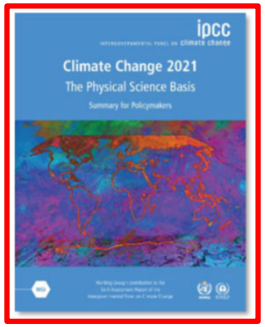


Figure 4: Past and future change in September Arctic sea ice area under varying greenhouse gas emissions scenarios {Figure TS.8}.

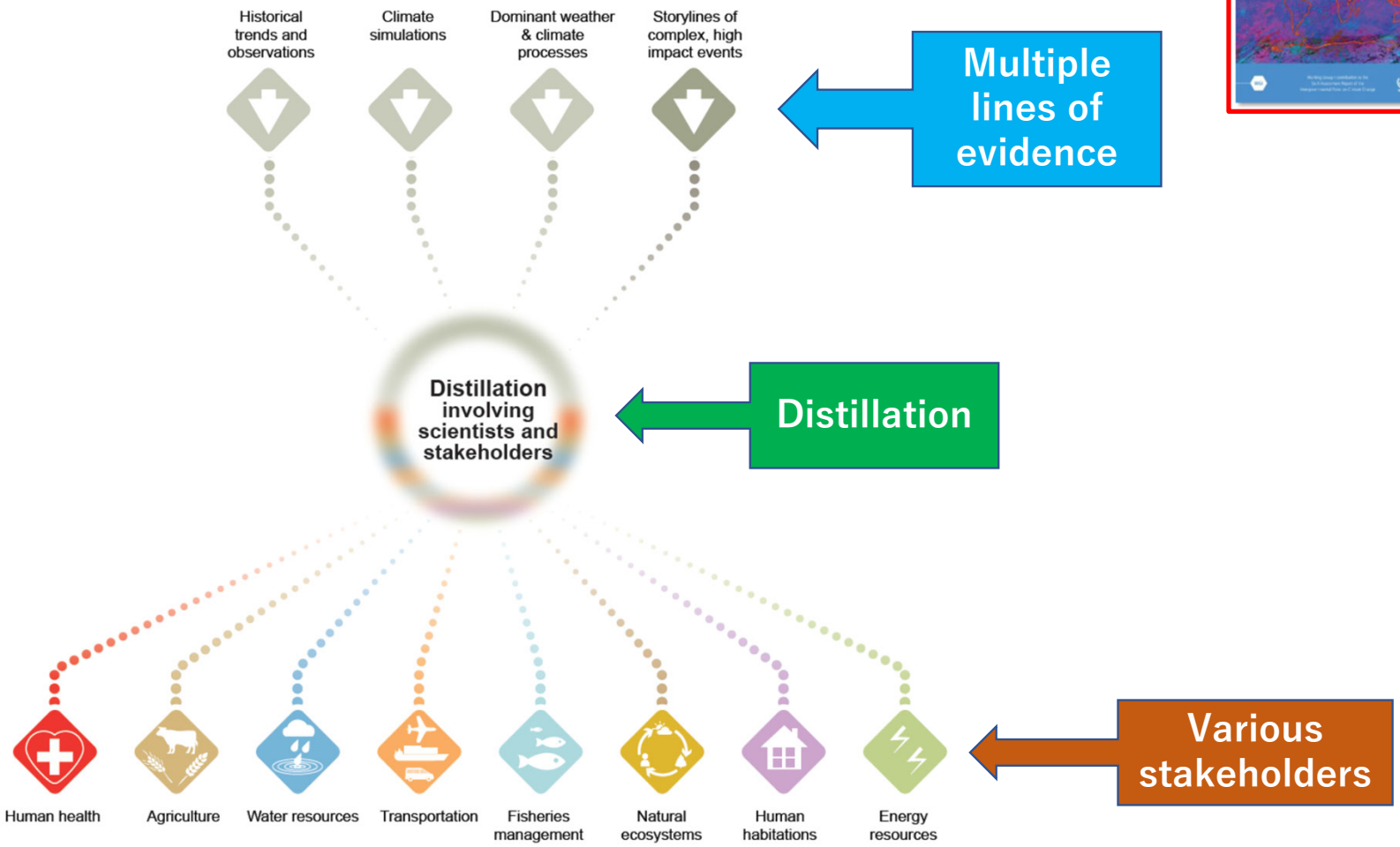
HEAT & COLD CID with high potential relevance for marine ecosystems includes surface temperature for coastal land and intertidal zones.

- Compared to 1850-1900, global surface temperature was 1.1ºC higher in 2011-2020, and will *very likely* be higher in 2081-2100, for example by 2.1-3.5 degree in the intermediate scenario (SSP2-4.5). {SPM A.1.2, SPM B.1.1}
- It is *virtually certain* that hot extremes have become more frequent and more intense across most land regions since the 1950s, and vice-versa for cold extremes. Some mid-latitude and semi-arid regions, and the South American Monsoon region, are projected to see the highest increase in the temperature of the hottest days (*high confidence*), and the Arctic is projected to experience the highest increase in the temperature of the coldest days (*high confidence*). {SPM A.3.1, SPM B.2.3}

Many stakeholders attend to the process of **distillation of information** are welcomed.



FAQ 10.1: **How can scientists provide useful regional climate information?**
In decision-making, climate information is more useful if the physical and cultural diversity across the world is considered.



IPCC WG1 AR6 FAQ10.1, Fig. 1:

Climate information for decision makers is more useful if the physical and cultural diversity across the world is considered.

IPCC WG1 AR6 FAQ 10.1 Fig. 1

Summary

- Handshaking among climate researchers and users is strongly recommended
- Internationaly, preparation of user relevant climate change information is expected.
- Same in domestically.
- Sometimes the demand from users has so large variety.
- In such cases, we found difficulty to shake hands with users.
- Interdisciplinary co-working is welcomed to realize handshaking.