SIXTH ASSESSMENT REPORT
Working Group II – Impacts, Adaptation and Vulnerability

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Climate Change 2022

Impacts, Adaptation and Vulnerability

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Lead Author IPCC Working Group II (Chp. 14, CCP6)

Outline for today

- Part 1: Key WGI findings
- Part 2: General WGII overview
- Part 3: Focus on AK and Fisheries
  - Key sections for fisheries in AK
  - Key recommendations for adaptation

Part 1: Key WGI findings

6th IPCC Assessment Report (www.ipcc.ch/assessment-report/ar6/)

- The Working Group I contribution to the Sixth Assessment Report, *Climate Change 2021: The Physical Science Basis* was released on 9 August 2021.
- The Working Group II contribution, *Climate Change 2022: Impacts, Adaptation and Vulnerability* was released on 28 February 2022.
- The Working Group III contribution is scheduled to be released on 4 April 2022.
- The Synthesis Report will be the last of the AR6 products and is scheduled to be released in September 2022.

AR6 WGI : The Physical Basis SPM

A.1 **It is unequivocal that human influence has warmed the atmosphere, ocean and land.** Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

A.2 The scale of recent changes across the climate system as a whole – and the present state of many aspects of the climate system – are **unprecedented over many centuries to many thousands of years**.

A.3 **Human-induced climate change is already affecting many weather and climate extremes in every region across the globe.** Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5.

Excerpts from the WGI Technical Summary

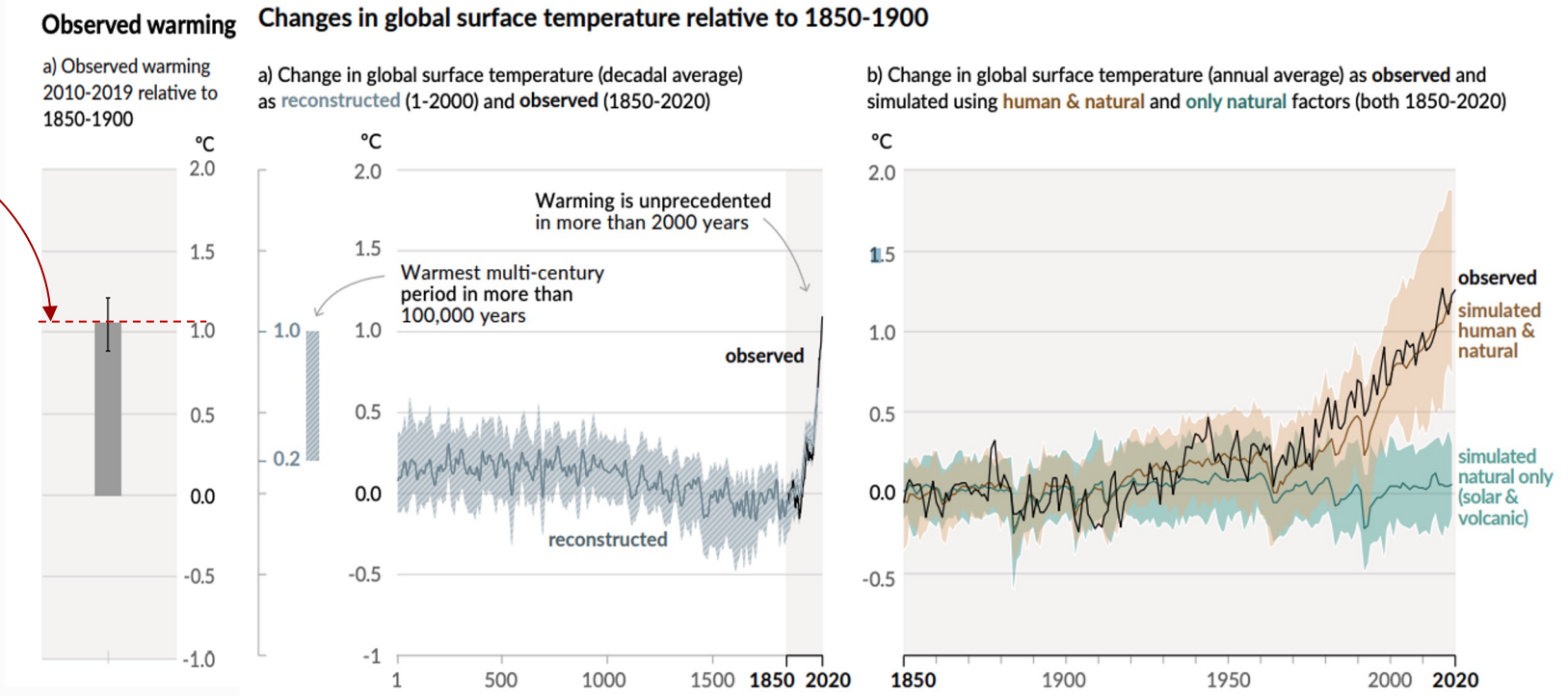
- *"**Human influence on the climate system is now an established fact**"*
- *"it is now an established fact that human-induced greenhouse gas emissions have led to an **increased frequency and/or intensity of some weather and climate extremes** since 1850, in particular for temperature extremes"*
- *"A combination of **improved observational records** and a series of very warm years since AR5 have resulted in a substantial increase in the estimated level of global warming to date...For the decade 2011–2020, the increase in global surface temperature since 1850–1900 is assessed to be1.09 [0.95 to 1.20] °C."*
- *"Over the past several decades, key indicators of the climate system are increasingly **at levels unseen in centuries to millennia** and are changing at rates unprecedented in at least the last 2000 years."*

Figures from the IPCC AR6 WGI Summary for Policymakers:
www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

Climate change has already warmed the planet

"The likely range of total human-caused global surface temperature increase from 1850–1900 to 2010–2019 is ***0.8°C to 1.3°C, with a best estimate of 1.07°C.***"

IPCC 2021 6th Assessment Report, WG 1, SPM



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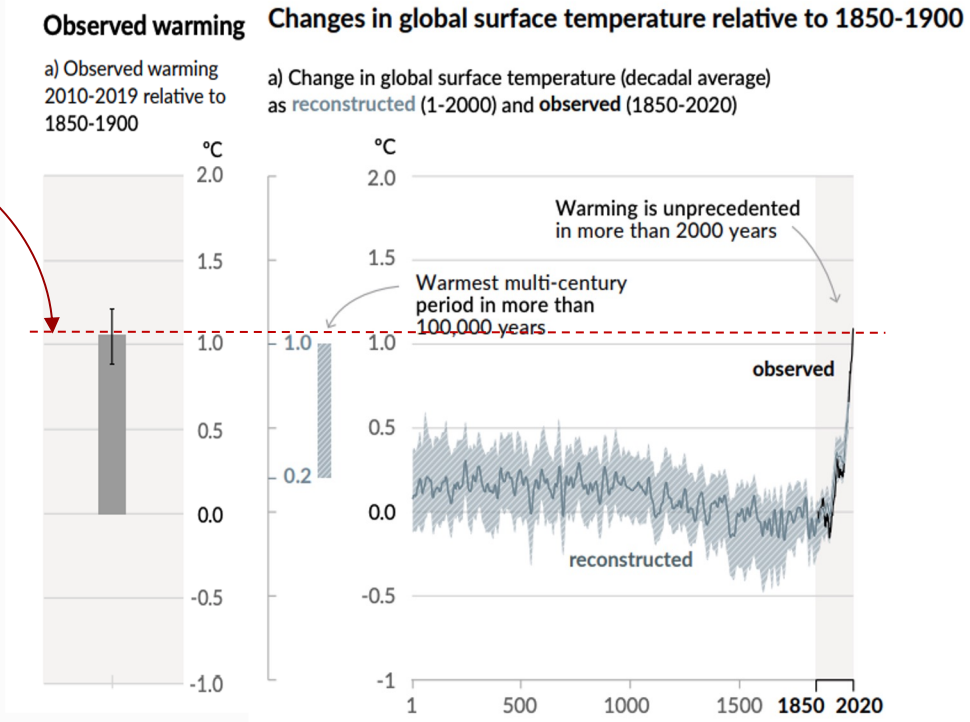

Recent Global Mean Warming is:

- Warmest period in more than 100,000 years
- Unprecedented warming in more than 2,000 years
- CO2 concentrations in 2019 were higher than any time in at least 2 million years.

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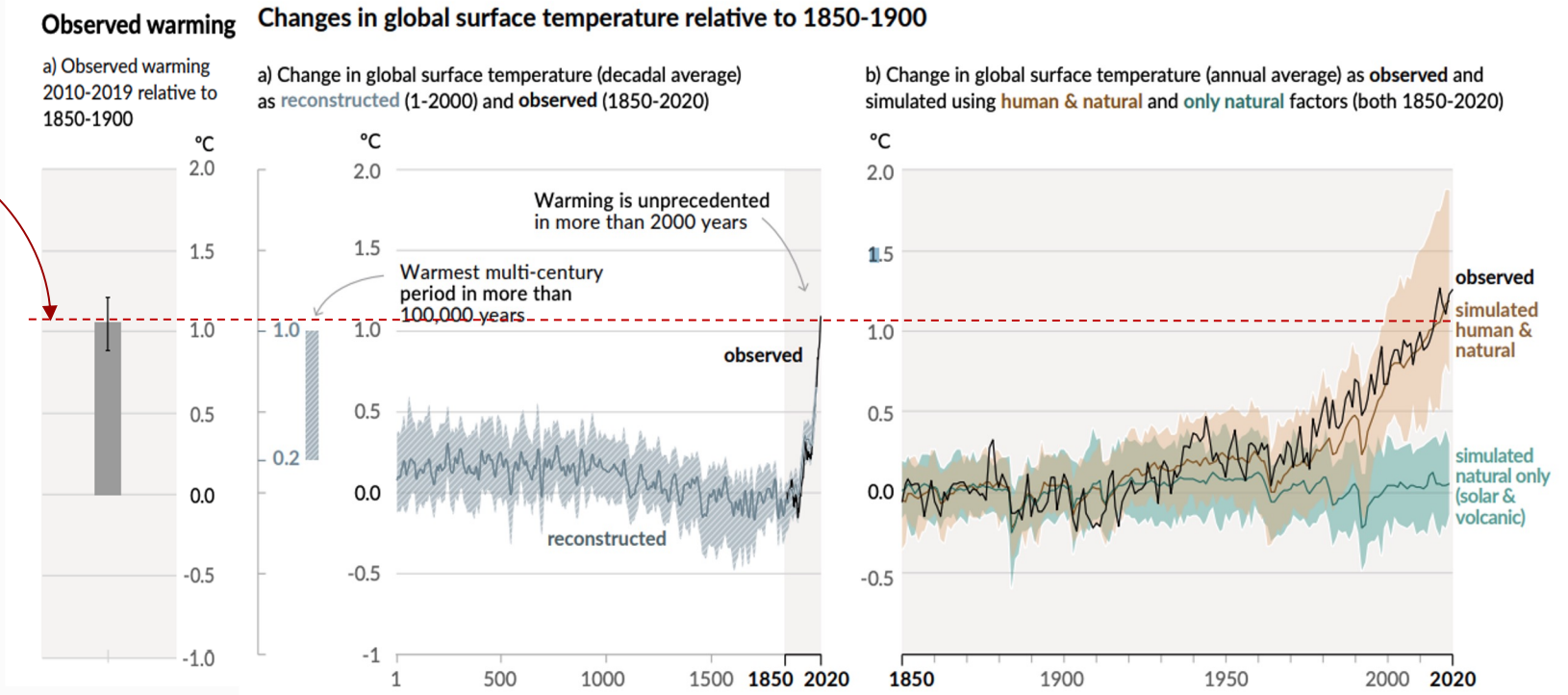
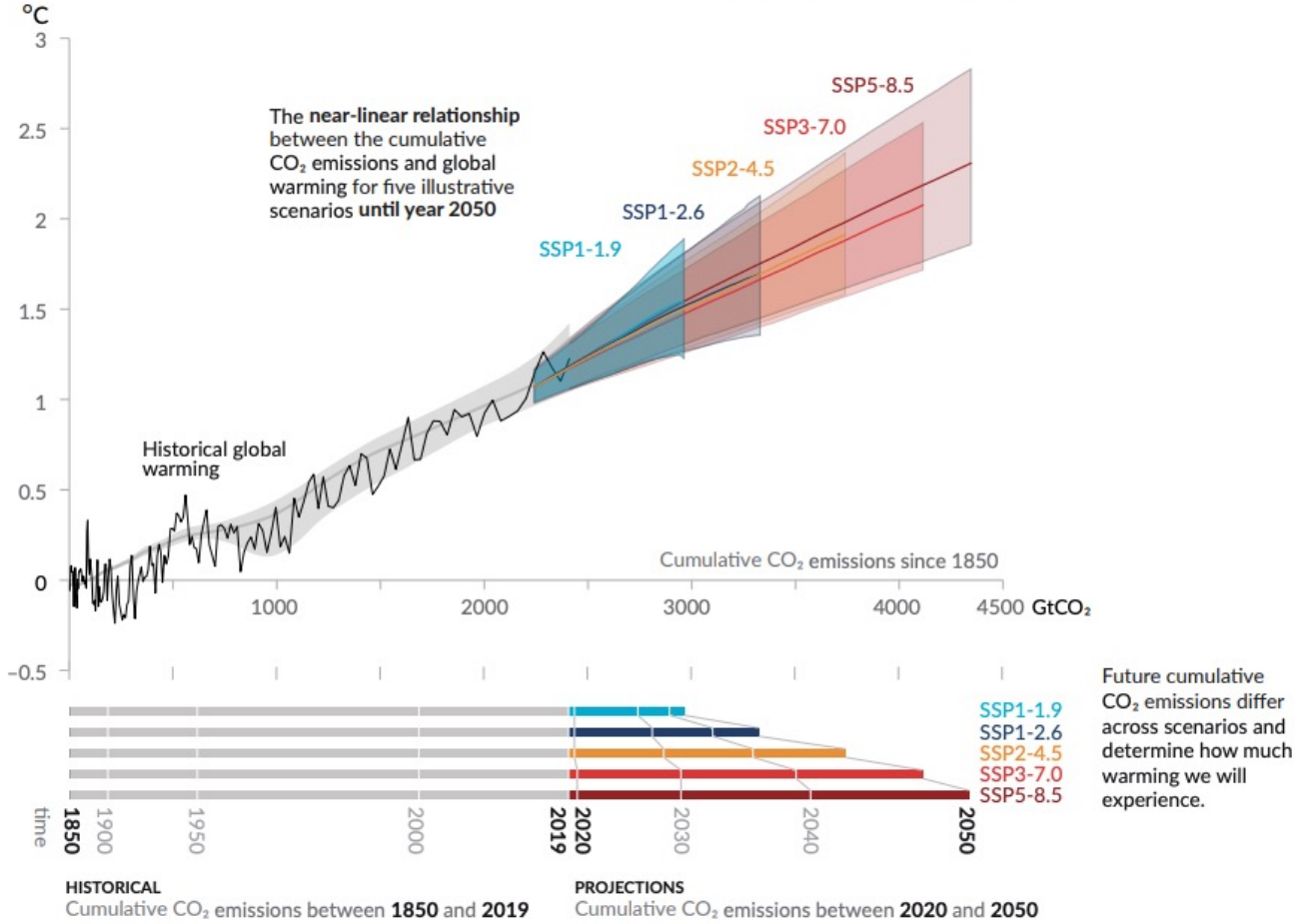


Every tonne of CO_2 emissions adds to global warming

Global surface temperature increase since 1850–1900 (°C) as a function of cumulative CO_2 emissions ($GtCO_2$)

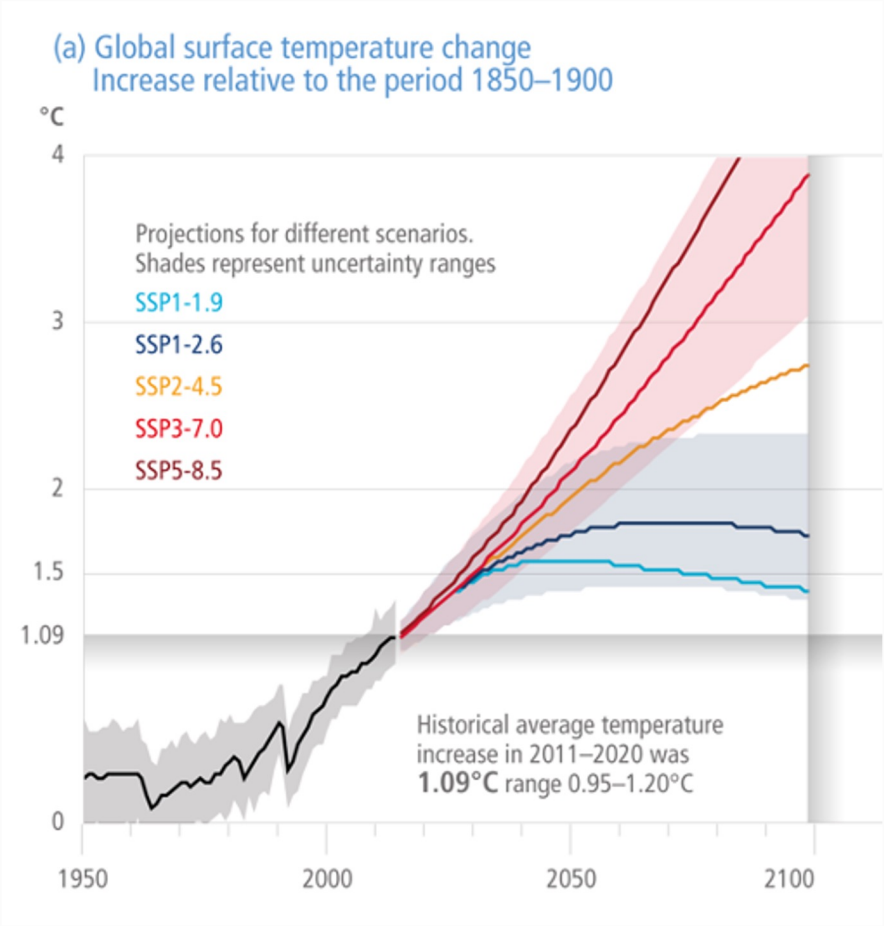


Future cumulative CO_2 emissions differ across scenarios and determine how much warming we will experience.

WGI TECHNICAL SUMMARY

- *"In AR6, combining the larger estimate of global warming to date and the assessed climate response to all considered scenarios,* ***the central estimate of crossing 1.5°C of global warming (for a 20-year period) occurs in the early 2030s,*** *ten years earlier than the midpoint of the likely range assessed in the SR1.5,assuming no major volcanic eruption.*

IPCC AR6 WGI

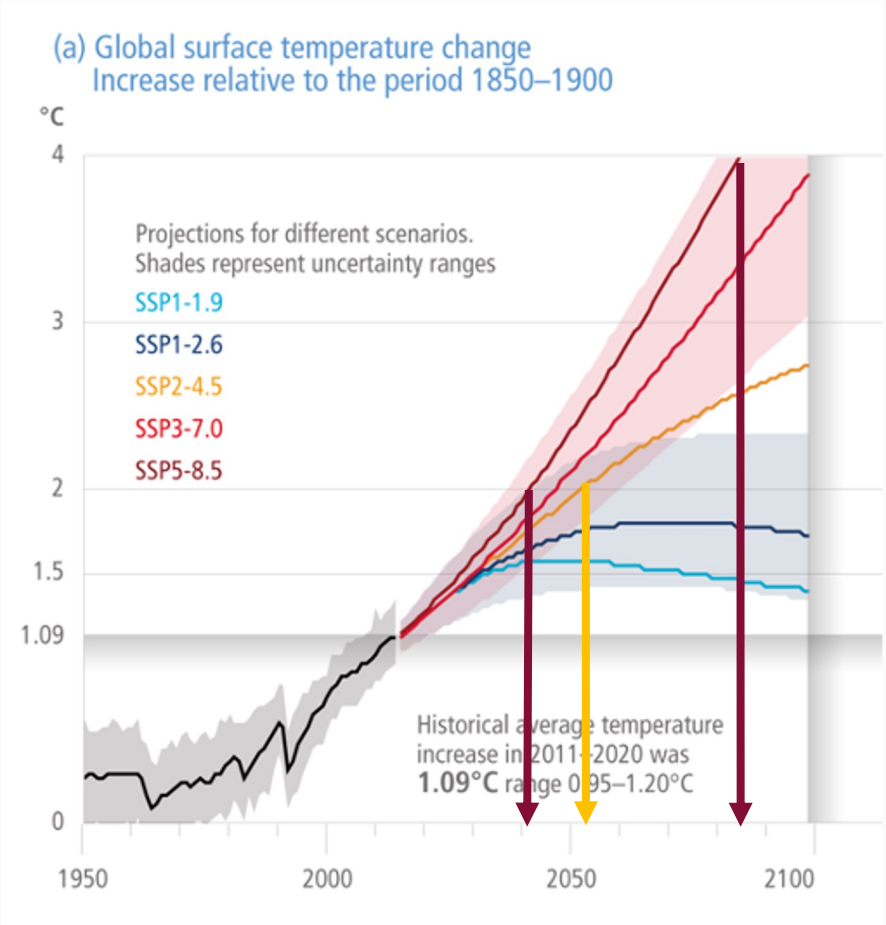


Carbon Emission Scenarios

"plausible descriptions of how the future may evolve with respect to a range of variables…they are not meant to be policy prescriptive, (i.e. no likelihood or preference is attached to any of the individual scenarios of the set)"

van Vuuren et al. 2011

IPCC AR6 WGI



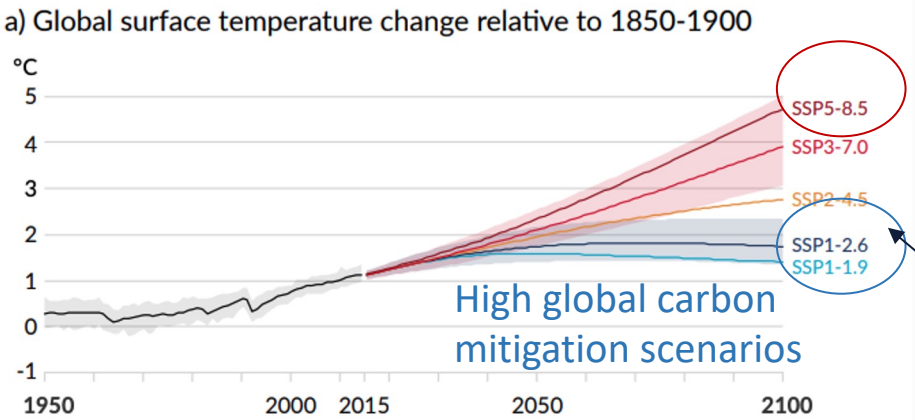
+4 oC Global Warming Level (GWL)

~2085

+2 oC Global Warming Level (GWL)

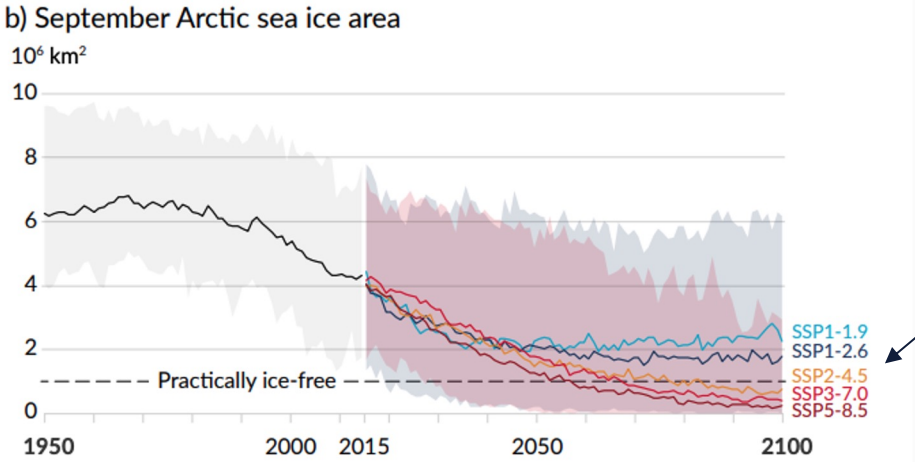
2040 - 2055

IPCC AR6 WGI



Low carbon mitigation scenarios

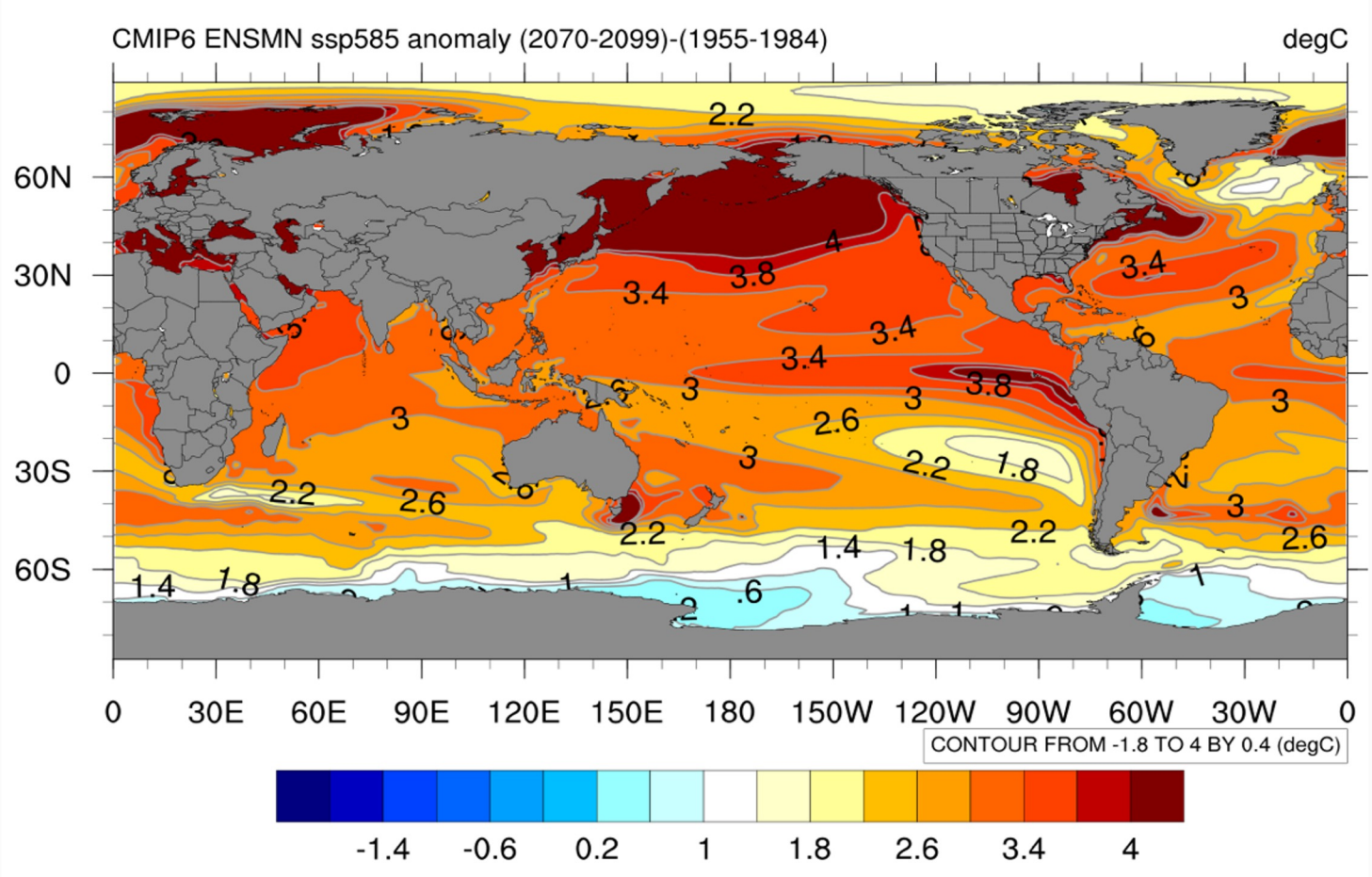
Warming will continue and is greater in scenarios with low carbon mitigation



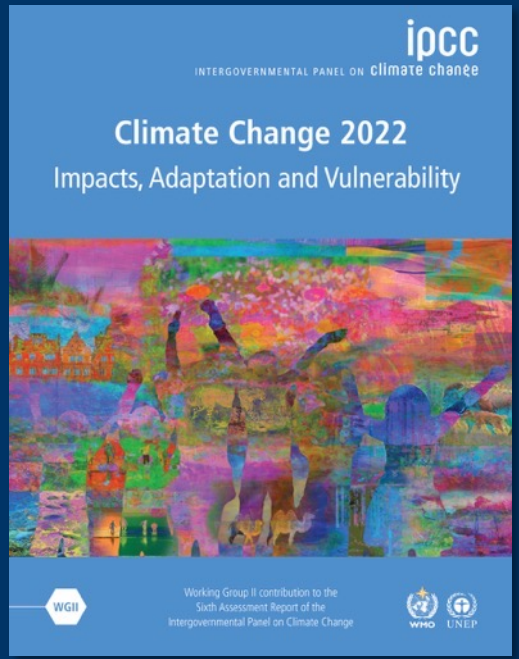
Sea Ice will continue to decline, more so under scenarios with high global warming and low carbon mitigation

Figures from the IPCC AR6 WGI Summary for Policymakers: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

https://psl.noaa.gov/ipcc/cmip6/



Part 2: General WGII overview



“ The science is clear.

Any further delay in concerted global action will miss a brief and rapidly closing window to secure a liveable future.

This report offers solutions to the world.

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Report by numbers

270 Authors

67 Countries

43 % Developing countries
57 % Developed countries

41 % Women / 59 % Men

675 Contributing authors

More than
34,000 scientific papers

62,418
Review comments

Growing scientific knowledge gives us our best understanding yet

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Global warming has caused dangerous and widespread disruption in nature…

[Pacific Southwest Forest Service, USDA CC BY 2.0]

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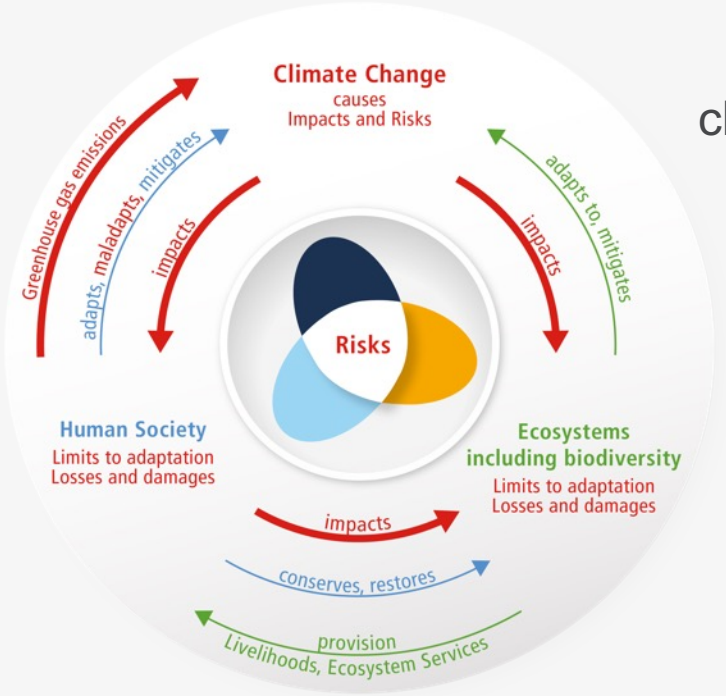
…and climate change is affecting the lives of billions of people, despite efforts to adapt.

Impacts are magnified in cities where more than half the world's population lives.

[Peter Nguyen / Unsplash]

New understanding of interconnections

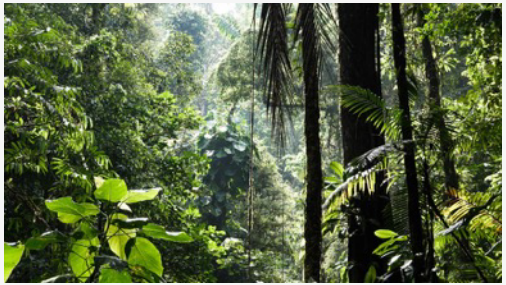


Consider coupled climate-ecological-social systems

The risk propeller shows that risk emerges from the overlap of:

- Climate hazard(s)
- Vulnerability
- Exposure

...of human systems, ecosystems and their biodiversity



[Axel Guibourg CC BY-NC-ND 2.0; Hugh Han / Unsplash; Axel Fassio/CIFOR CC BY-NC-ND 2.0]

Simultaneous extreme events compound risks

Multiple extreme events that compound risks are more difficult to manage

Overlapping challenges

- Limited access to water, sanitation and health services
- Climate-sensitive livelihoods
- High levels of poverty
- Weak leadership
- Lack of funding
- Lack of accountability and trust in government

[Denis Onyodi / KRCS CC BY-NC 2.0; Marco Dormino UN Photo CC BY-NC-ND 2.0; Markus Krisetya / Unsplash]

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Every small increase in warming will result in increased risks.

[Ocean Image Bank / The Ocean Agency]

Nature's crucial services at risk in a warming world

Pollination

Coastal protection

Tourism / recreation

Food source

Health

Water filtration

Clean air

Climate regulation

[Ocean Image Bank/ Shaun Wolfe, Dimitris Poursanidis; FAO/Kurt Arrigo, Unsplash, Axel Fassio/CIFOR CC BY-NC-ND

Future global climate risks

Heat stress

Exposure to heat waves will continue to increase with additional warming.

Water scarcity

At 2°C, regions relying on snowmelt could experience 20% decline in water availability for agriculture after 2050.

Food security

Climate change will increasingly undermine food security.

Flood risk

About a billion people in low-lying cities by the sea and on Small Islands at risk from sea level rise by mid-century.

Action on adaptation has increased but progress is uneven and we are not adapting fast enough.

[Boskalis / Rijkswaterstaat]

“There are increasing gaps between adaptation action taken and what’s needed.

These gaps are largest among lower income populations.

They are expected to grow.

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There are options we can take
to reduce the risks to people and nature.

[Il Vagabiondo / Unsplash]

Nature offers significant untapped potential.

[World Agroforestry / Julius Atia CC BY-NC-SA 2.0]

Water management

Options on farms:

- Irrigation
- Rainwater storage, water-saving tech
- Moisture conservation in soils

Economic and ecological benefits; reduced vulnerability

Wider options:

- Securing drinking water
- Flood and drought risk management
- Working with nature, land-use planning

Effectiveness declines with increased warming

Improving food security

Effective options:

- Cultivar improvements
- Agroforestry
- Farm and landscape diversification
- Community-based adaptation
- Strengthening biodiversity

Wider benefits:

- Food security and nutrition
- Health and well-being
- Livelihoods

[Jacquelyn Turner / CCAFS CC BY-NC-SA 2.0; FAO / Riccardo De Luca]

[Chuttersnap, Jordan Brierley / Unsplash; SDOT Photos CC BY-NC 2.0]

Transforming cities

By 2050 urban areas could be home to two-thirds of the world's population.

Effective options

- Nature-based and engineering approaches together
- Establishing green and blue spaces
- Urban agriculture
- Social-safety nets for disaster management

Wider benefits

- Public health improvements
- Ecosystem conservation

Adapting informal settlements

Effective options:

- Local knowledge
- Adequate capacity (information, funding, tools)
- Engagement of policymakers
- Involvement of residents in decision-making
- Institutional change (accountability, commitment, transparency)

Maladaptation

Adaptation that results in unintended consequences

The most disadvantaged groups are most affected by maladaptation.

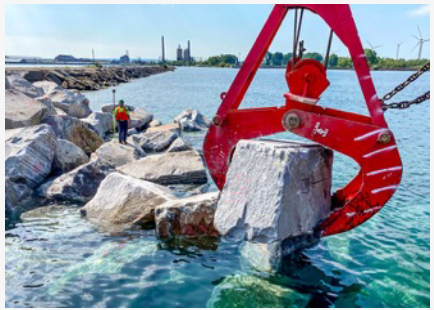
[Denis Onyodi / KRCS CC BY-NC 2.0]

There are limits to adaptation

- Even effective adaptation cannot prevent all losses and damages
- Above 1.5°C some natural solutions may no longer work.
- Above 1.5°C, lack of fresh water could mean that people living on small islands and those dependent on glaciers and snowmelt can no longer adapt.
- By 2°C it will be challenging to farm multiple staple crops in many current growing areas.

Financial constraints

- Current global financial flows are insufficient
- Most finance targets emissions reductions rather than adaptation
- Climate impacts can slow down economic growth



“To avoid mounting losses, urgent action is required to adapt to climate change.

At the same time, it is essential to make rapid, deep cuts in greenhouse gas emissions to keep the maximum number of adaptation options open.

[Axel Fassio/CIFOR CC BY-NC-ND 2.0]

Accelerating adaptation

- Political commitment and follow-through across all levels of government
- Institutional framework: clear goals, priorities that define responsibilities
- Enhancing knowledge of impacts and risks improves responses
- Monitoring and evaluation of adaptation measures are essential to track progress
- Inclusive governance that prioritises equity and justice – direct participation

The wider benefits of adaptation

For more than 3.4 billion people in rural areas: improved roads, reliable energy, clean water, food security

SDG 1: No poverty

Green buildings, green spaces, clean water, renewable energy, sustainable transport – in cities

SDG 3: Good health and wellbeing

Policies that increase youth access to land, credit, knowledge and skills can support agri-food employment

SDG 10: Reduced inequality

Restored and connected habitats can provide corridors for vulnerable species

SDG 14/15: Life on land & below water

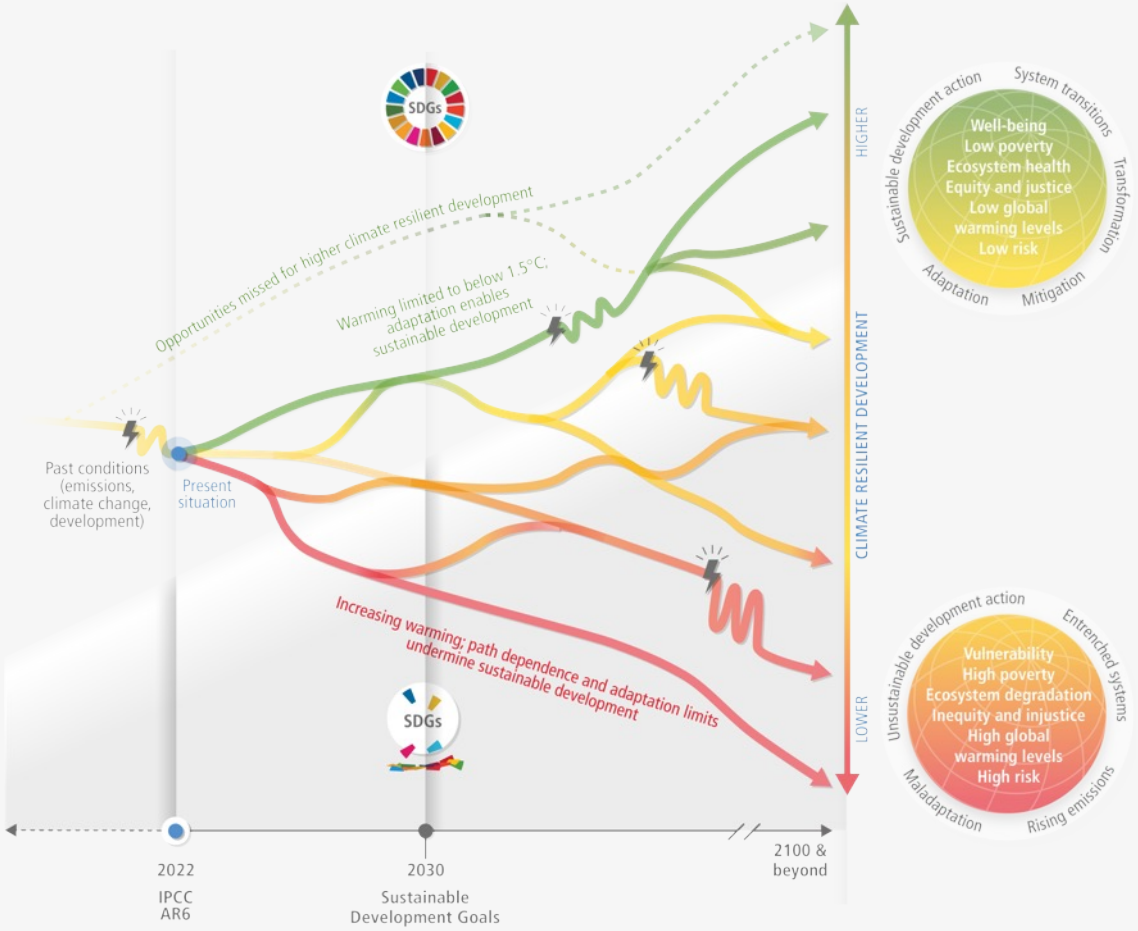
Climate Resilient Development

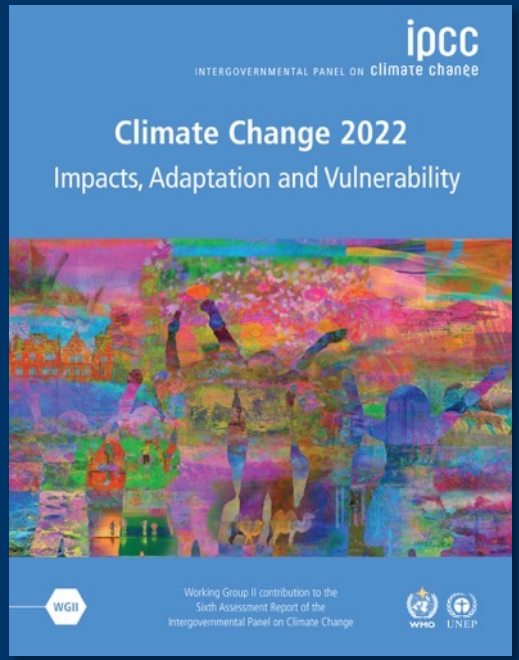
[Juan Pablo Sarmiento/CIFOR CC BY-NC-ND 2.0; Marlon del Aguila Guerrero/CIFOR CC BY-NC-ND 2.0]

Increasing urgency

Starting today, every action, every decision matters.

Worldwide action is more urgent than previously assessed.





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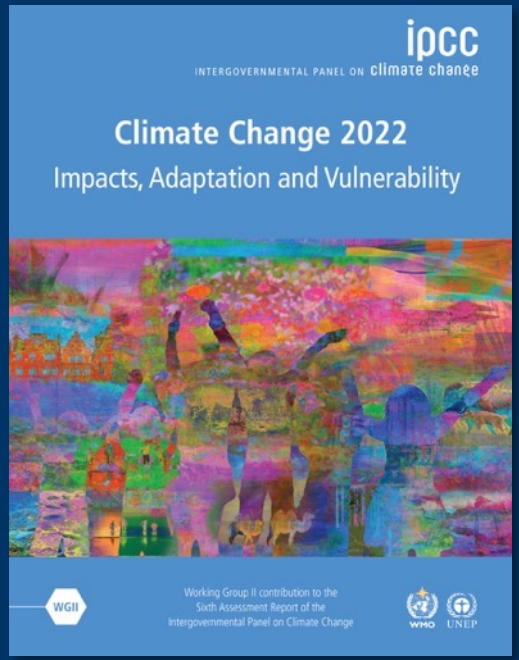
Part 3: Focus on AK and Fisheries



CCP6 : Polar Regions

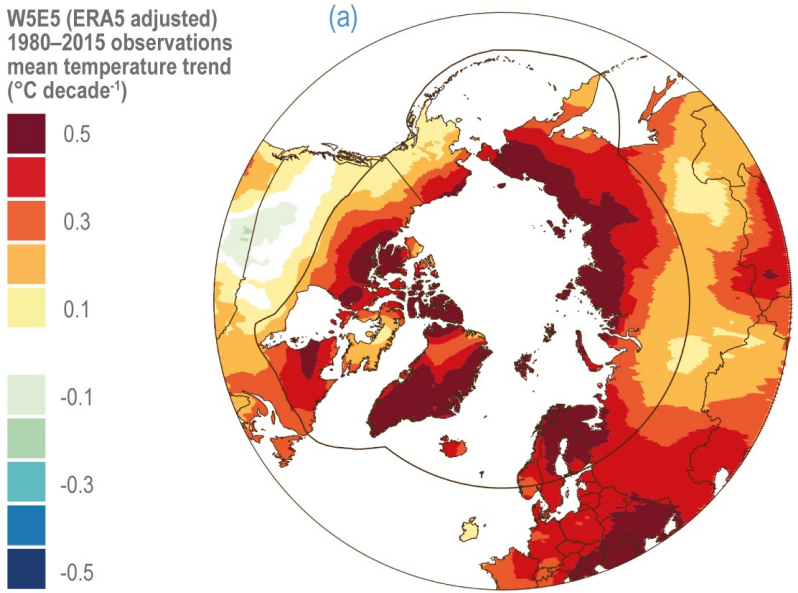
Chapter 3: Oceans

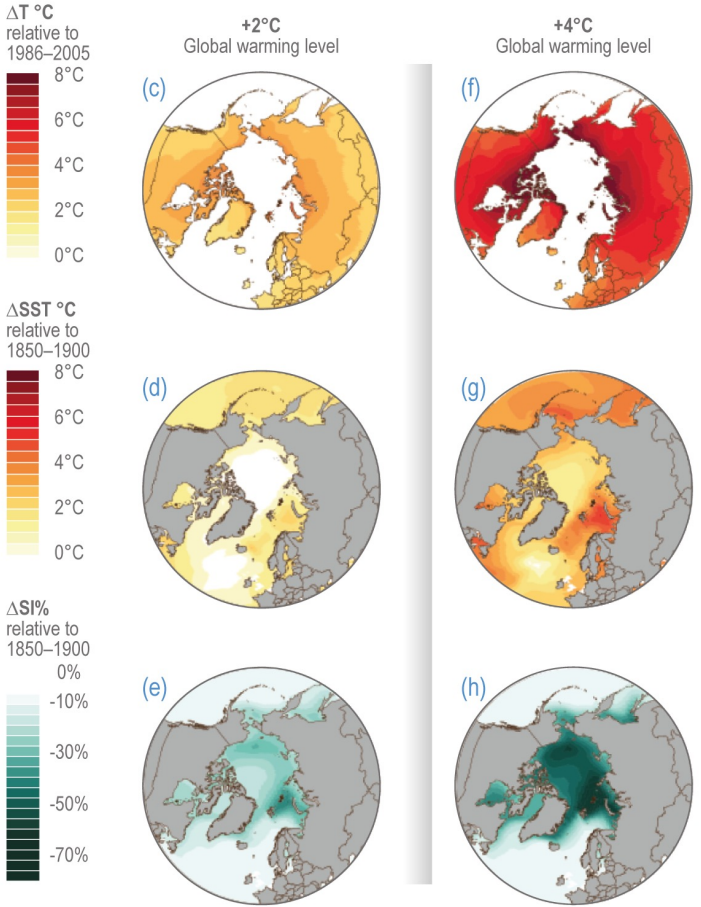
Chapter 5: Food and Fibre

Chapter 14: North America

Climate change is increasingly impacting Polar regions

Warming to date





https://interactive-atlas.ipcc.ch/

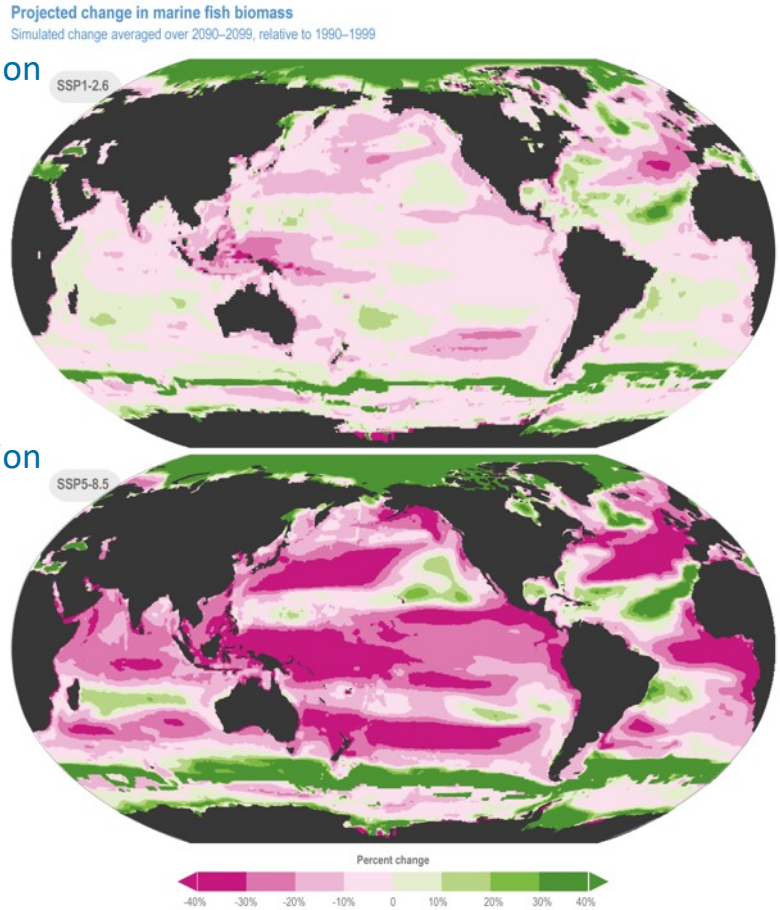
Increasing urgency

Declines in fish biomass projected for Bering Sea

Adaptation planning needed to minimize impacts

High CO_2 Mitigation
Less warming
(SSP1 2.6)

Low CO_2 Mitigation
High warming
(SSP5 8.5)



Atlas Figure A1.11

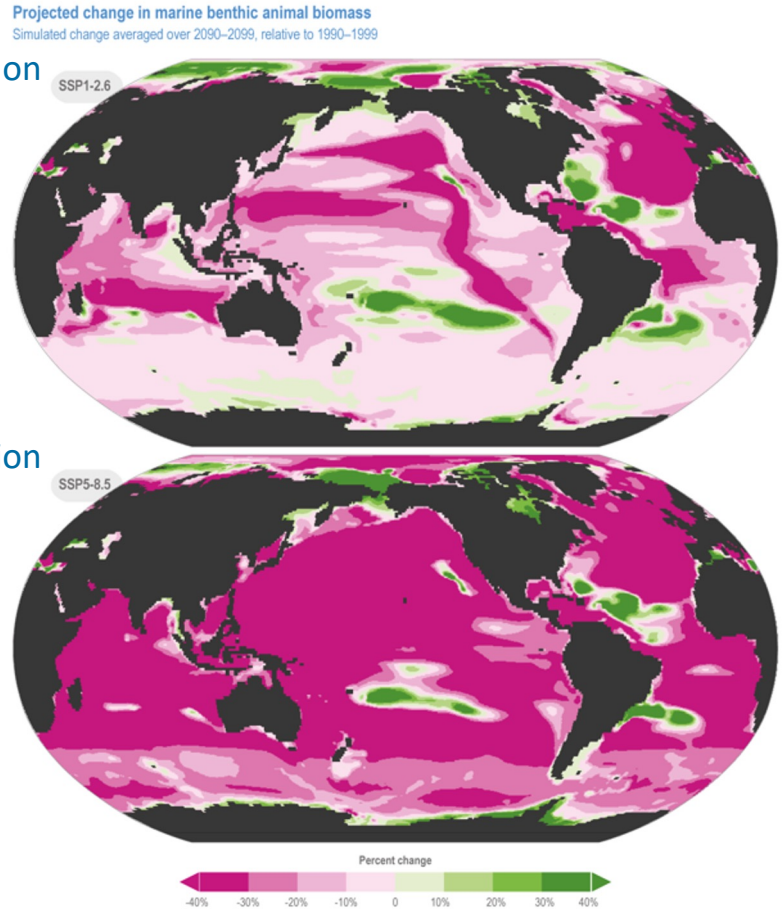
Increasing urgency

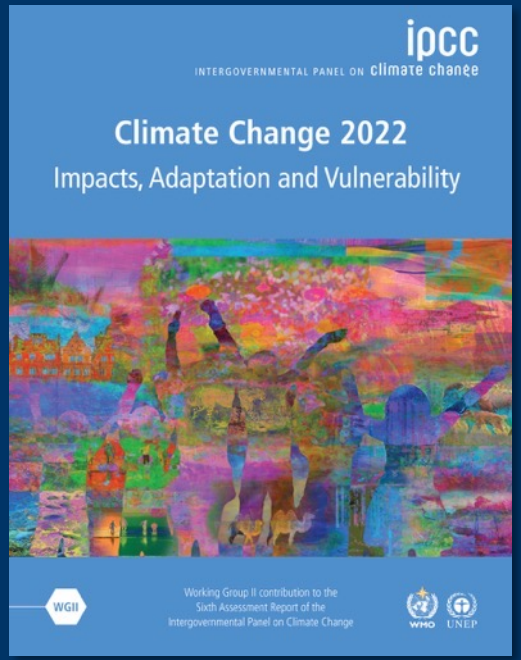
Declines in benthic biomass projected for SEBS, potential increases in NEBS

Adaptation planning needed to minimize impacts

High CO_2 Mitigation
Less warming
(SSP1 2.6)

Low CO_2 Mitigation
High warming
(SSP5 8.5)



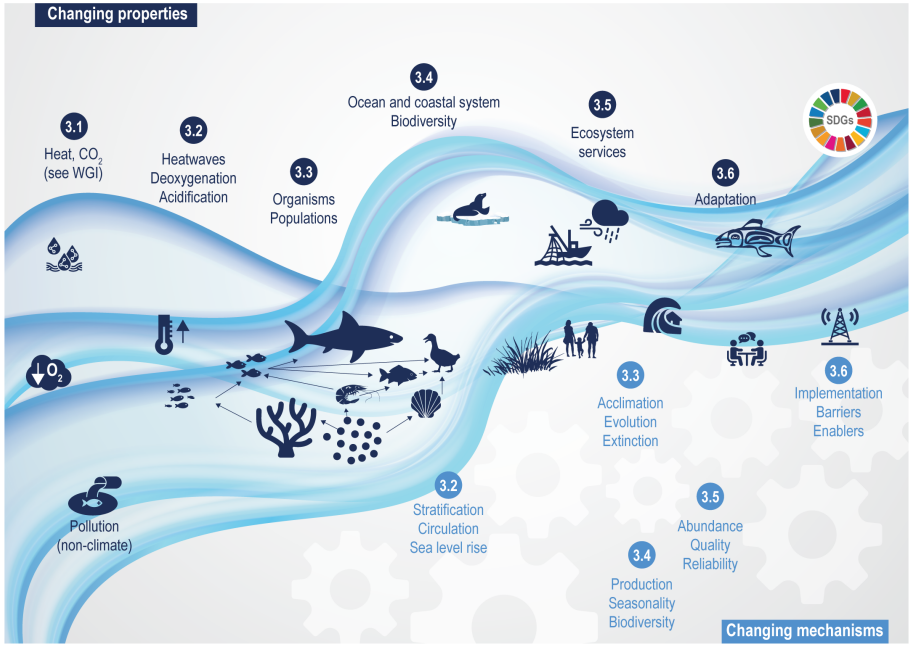


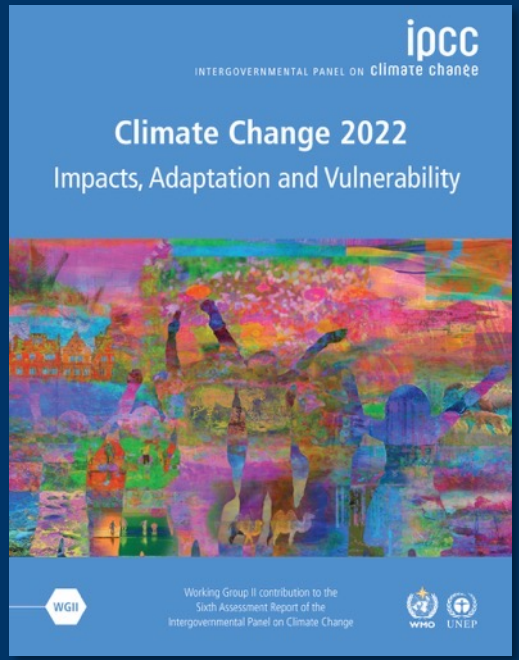
> Future shifts in fish distribution and decreases in their abundance and fisheries catch potential due to climate change are projected to affect income, livelihoods, and food security of marine resource-dependent communities.
>
> Long-term loss and degradation of marine ecosystems compromises the ocean's role in cultural, recreational, and intrinsic values important for human identity and well-being.

Example impacts & risks

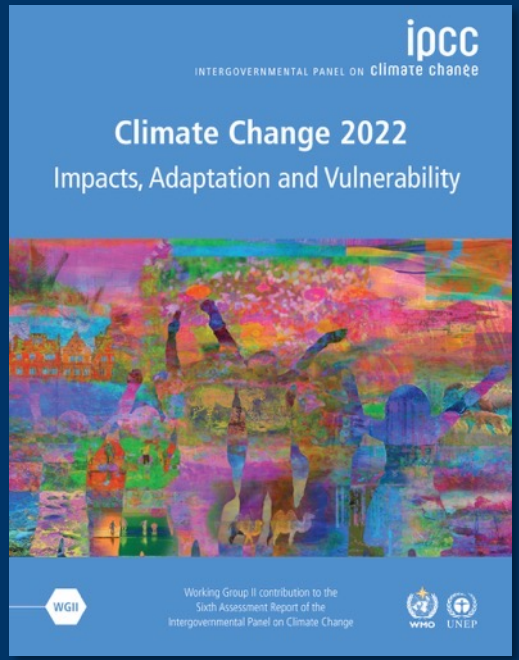
- Shifting distributions & altered access
- Geopolitical, survey, stock boundary challenges
- Increased interactions between protected species & fisheries (e.g., pot fisheries)
- Compound multiple climate impacts (MHW, HABs, and low DO) & non-climate pressures (e.g., pollution, shipping)
- Phenological mismatches & changes in productivity
- Reductions in fishery & subsistence resources
- Shifts in trophic pathways & size spectra
- Increasing climate shocks & extreme events
- Increasing fishery emergencies & economic losses
- Disparate impacts on subsistence, communities, & shore-based & small vessel operations
- Future risk to food & nutritional security
- Reduced confidence in management
- Supply chain disruption (e.g., ports)
- Changes in safety & security
- Changes in markets & demand (interactions with agriculture)

WGII AR6 Chapter 3 concept map





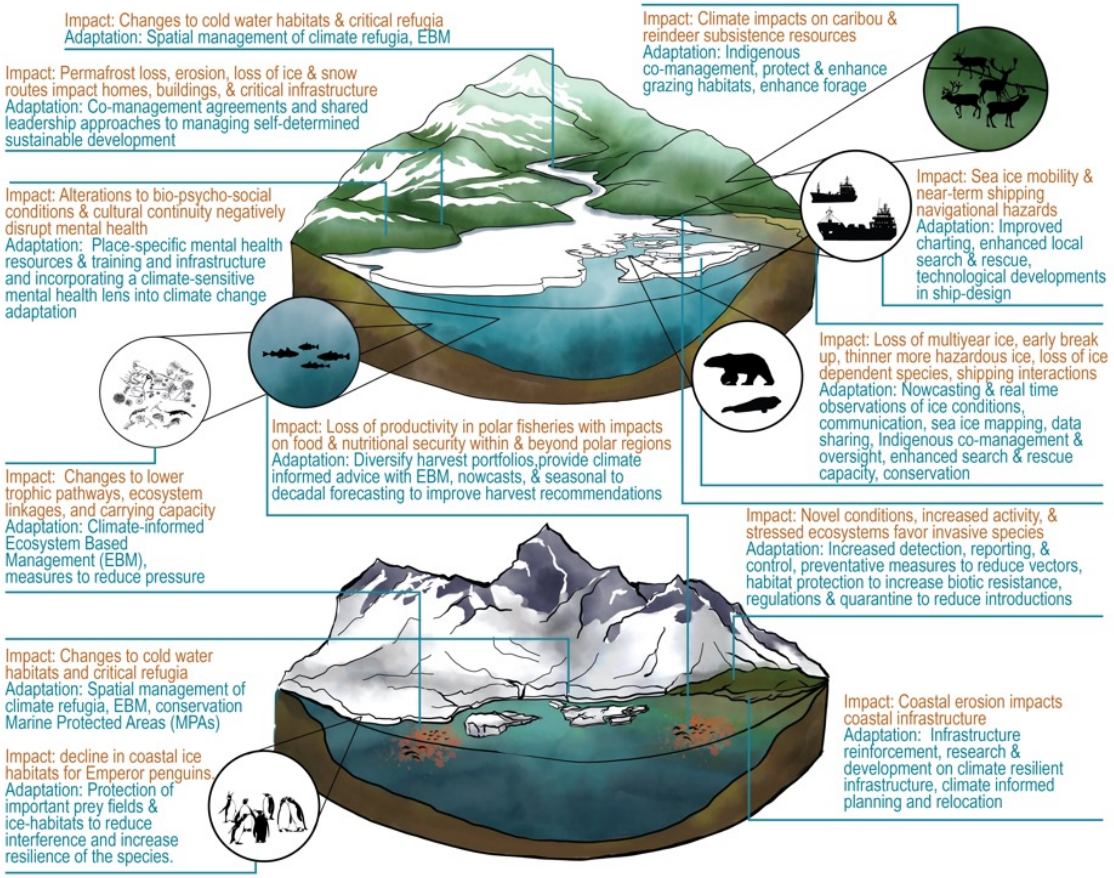
> Contractions of the polar climate zones lead to distribution shifts and changes in food webs, induce declines in many species (*medium confidence*)
>
> with impacts on subsistence harvests and commercial fisheries, and threaten global dependence on polar regions for substantial marine food production (*high confidence*).



> Cascading and interacting effects of climate change impacts in polar regions will reduce access to, and productivity of future fisheries, and pose significant risks to regional and global food and nutritional security that increase with atmospheric carbon levels and declines in sea-ice (*high confidence*).

Adaptation can reduce risks to polar fisheries if coupled with mitigation

“ Implementation of adaptive management that is closely linked to monitoring, research, and low cost and inclusive public participation in decisions, high resolution forecast and projection tools, climate-informed survey and monitoring design”



Key Aspects of Fisheries Adaptation

- Inclusive, participatory, & equitable decision making
- Responsive & flexible management
- Ecosystem Based Management
- Diversity in harvest options & livelihoods
- Ecological redundancy & high biodiversity
- Preserve ecosystem function & climate refugia
- Climate change planning & preparation
- Increased foresight & climate informed advice
- Monitoring & rapid response
- Emergency response

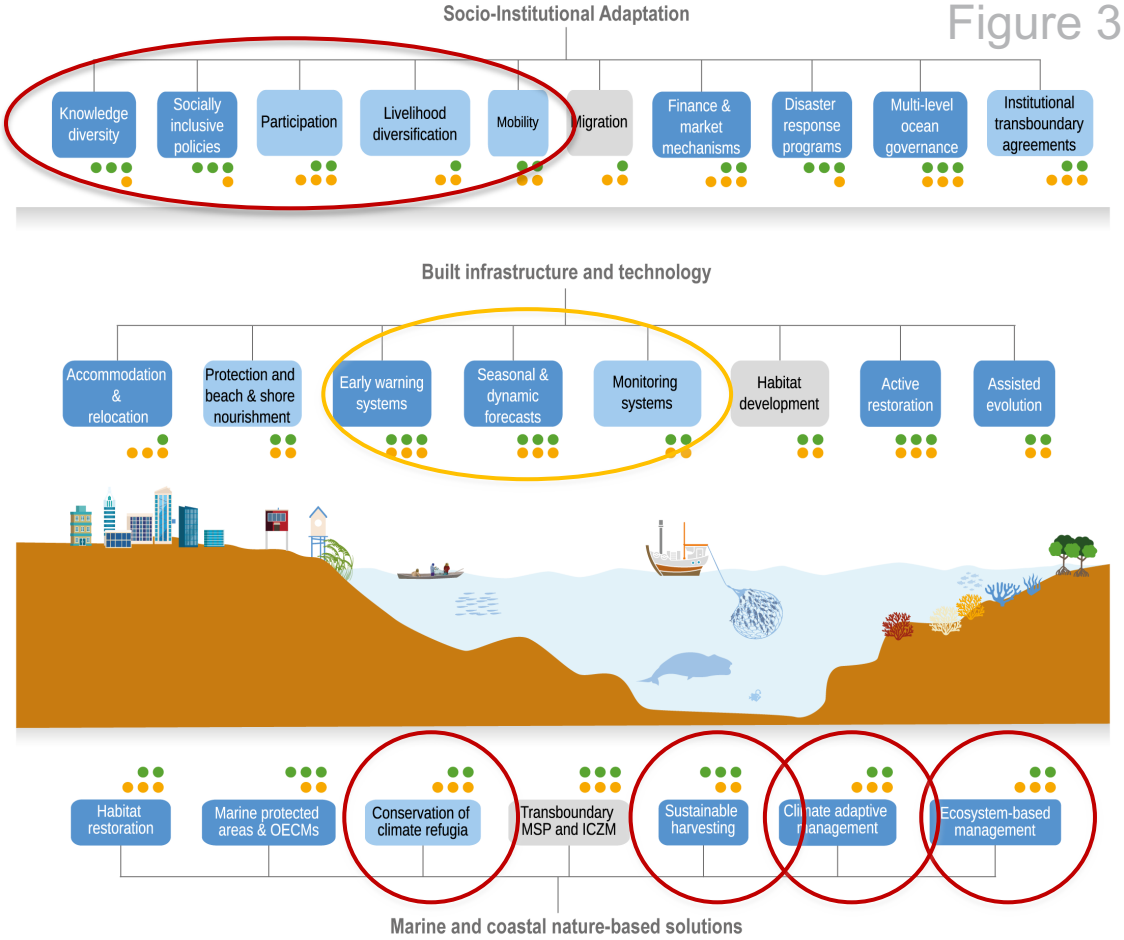
Figure 3.23

Ocean adaptation

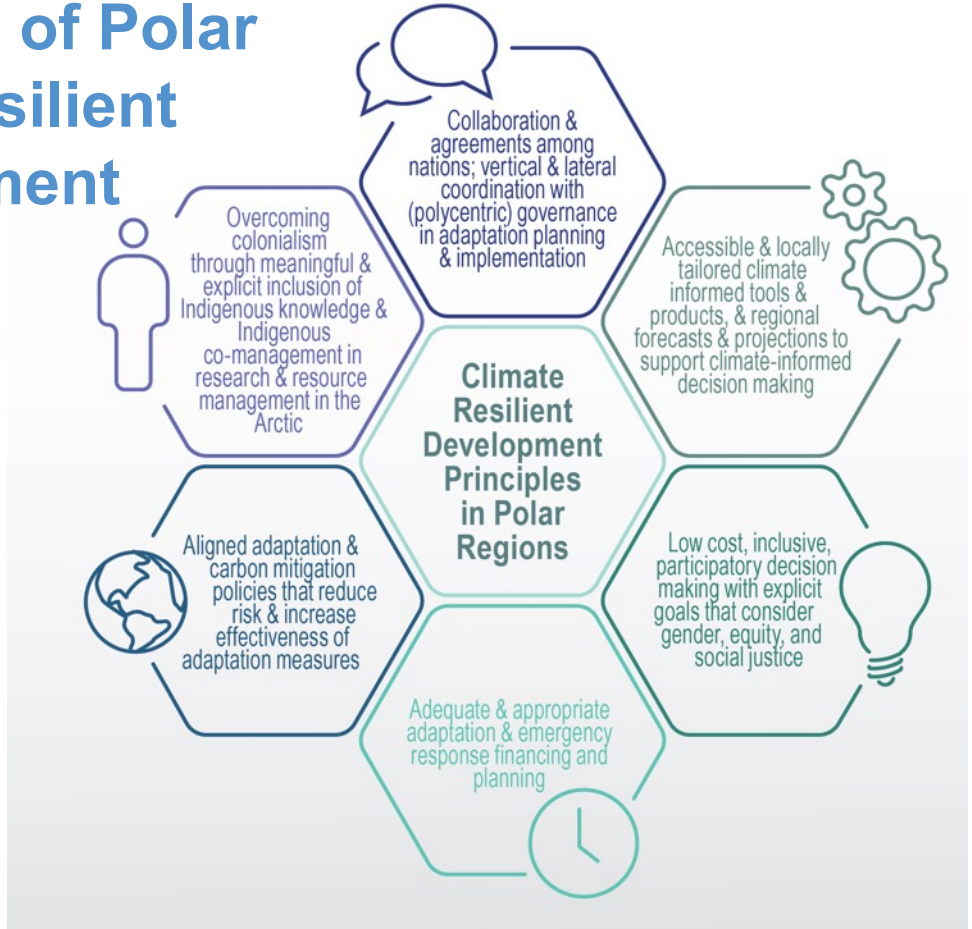
Categories
- Feasibility
- Effectiveness to reduce climate risks

Level
- ●●● High
- ●● Medium
- ● Low

Confidence in solution
- High
- Medium
- Low

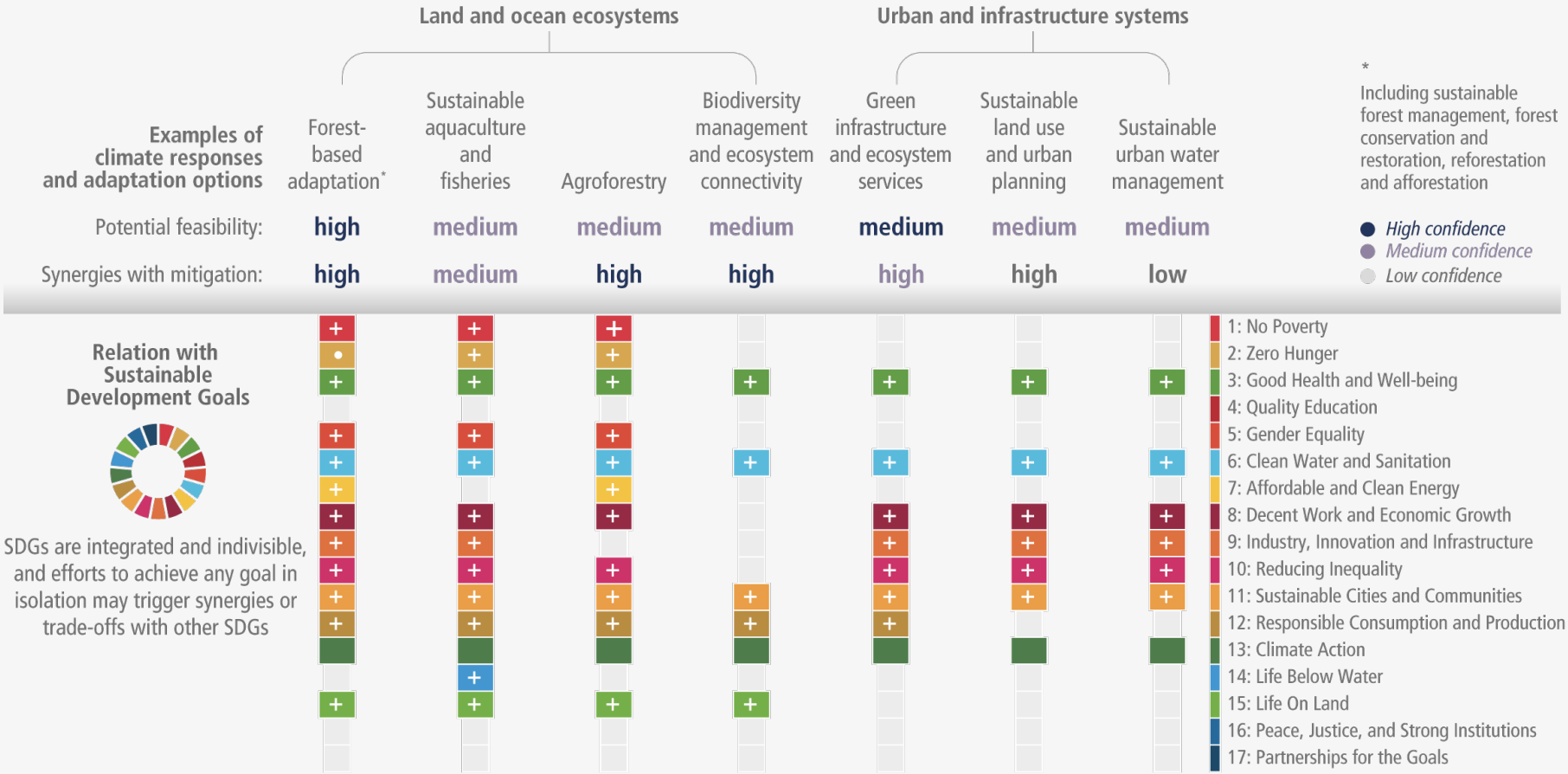


Key Elements of Polar Climate Resilient Development



ACT NOW

> Climate resilient development is already challenging at current global warming levels.
>
> The prospects will become further limited if warming exceeds 1.5°C and may not be possible if warming exceeds 2°C.


Land and ocean ecosystems
Urban and infrastructure systems
Examples of climate responses and adaptation options
Forest-based adaptation*
Sustainable aquaculture and fisheries
Agroforestry
Biodiversity management and ecosystem connectivity
Green infrastructure and ecosystem services
Sustainable land use and urban planning
Sustainable urban water management
Potential feasibility:
high
medium
medium
medium
medium
medium
medium
Synergies with mitigation:
high
medium
high
high
high
high
low
* Including sustainable forest management, forest conservation and restoration, reforestation and afforestation
High confidence
Medium confidence
Low confidence
Relation with Sustainable Development Goals
SDGs are integrated and indivisible, and efforts to achieve any goal in isolation may trigger synergies or trade-offs with other SDGs
1: No Poverty
2: Zero Hunger
3: Good Health and Well-being
4: Quality Education
5: Gender Equality
6: Clean Water and Sanitation
7: Affordable and Clean Energy
8: Decent Work and Economic Growth
9: Industry, Innovation and Infrastructure
10: Reducing Inequality
11: Sustainable Cities and Communities
12: Responsible Consumption and Production
13: Climate Action
14: Life Below Water
15: Life On Land
16: Peace, Justice, and Strong Institutions
17: Partnerships for the Goals