INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Climate Change 2022

Impacts, Adaptation and Vulnerability

Dr. Kirstin K. Holsman
NOAA AFSC
Lead Author IPCC Working Group II (Chp. 14, CCP6)

Climate Change

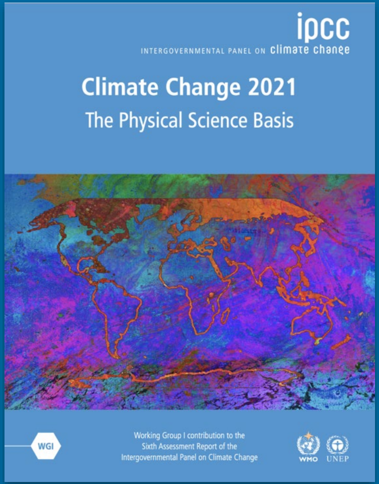
Causes
Drivers

Impacts
Adaptation

Mitigation

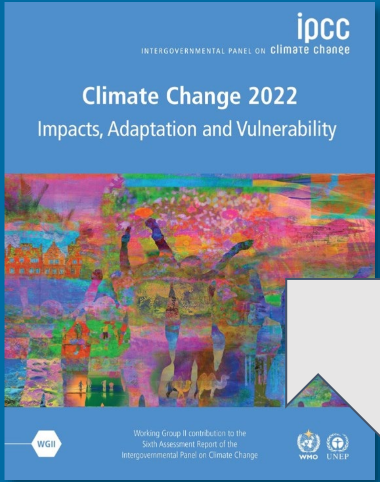
WGI

Aug 2021



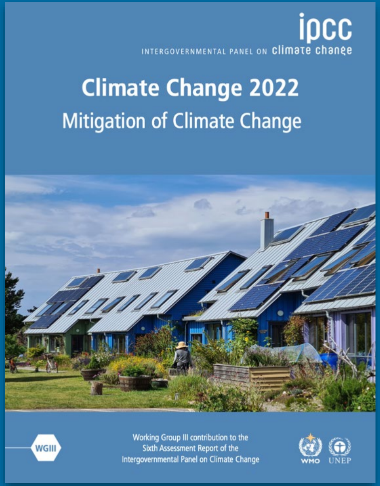
WGII

Feb 2022



WGIII

Apr 2022



Outline for today

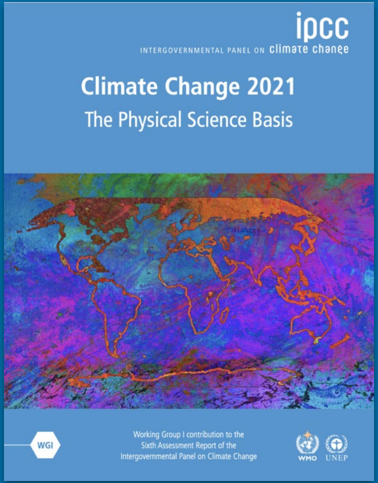
- Part 1: Key WGI findings
- Part 2: Key WGII findings
- Part 3: Relevant findings for Alaska Fisheries
  - Key sections for fisheries
  - Key recommendations for adaptation
- Part 4: WGIII findings relative to 1.5 ^{o}C target

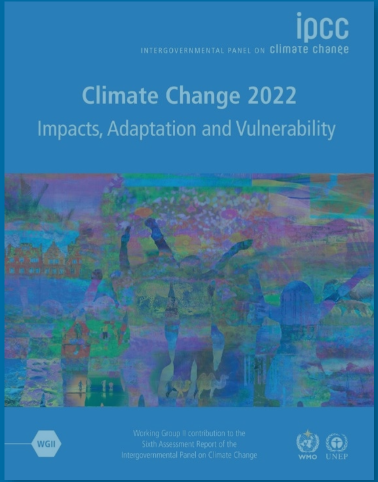
How to access the most recent (CMIP6) climate projections

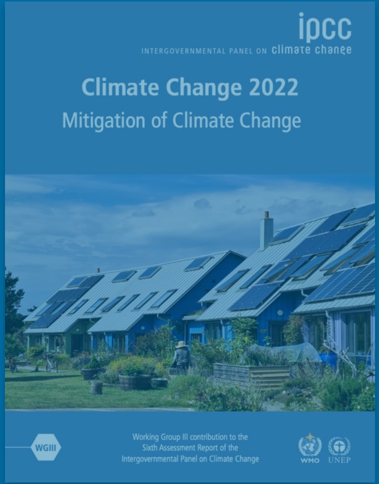
- IPCC Interactive Atlas (explore future variables and scenarios): https://interactive-atlas.ipcc.ch/
- PSL Climate Change portal (explore plots from CMIP6; similar to IPCC Atlas): https://psl.noaa.gov/ipcc/cmip6/
- ACLIM data portal : explore high res projections for the EBS including krill : https://data.pmel.noaa.gov/aclim/las/UI.html
- *Future: EBS Climate Change dashboard (via ACLIM3)*

Climate Change

Causes Drivers	Impacts Adaptation	Mitigation
WGI	WGII	WGIII
Aug 2021	**Feb 2022**	**Apr 2022**







AR6 WGI : The Physical Basis SPM

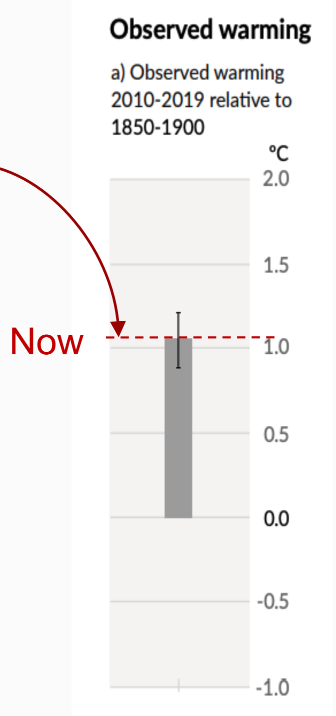
A.1 **It is unequivocal that human influence has warmed the atmosphere, ocean and land.** Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

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.

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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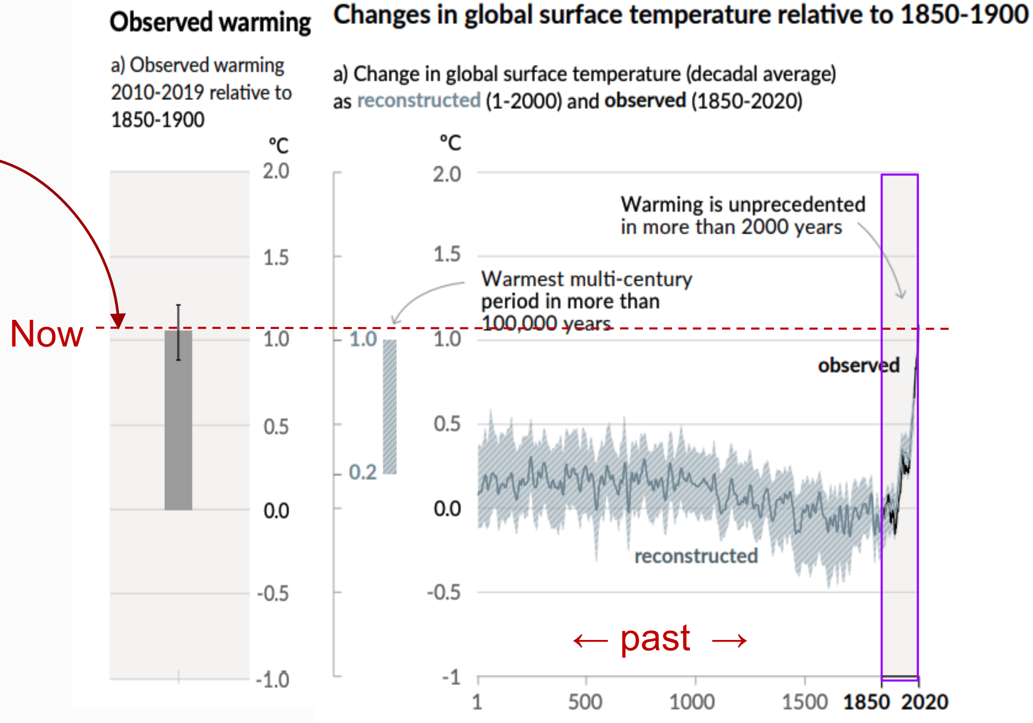
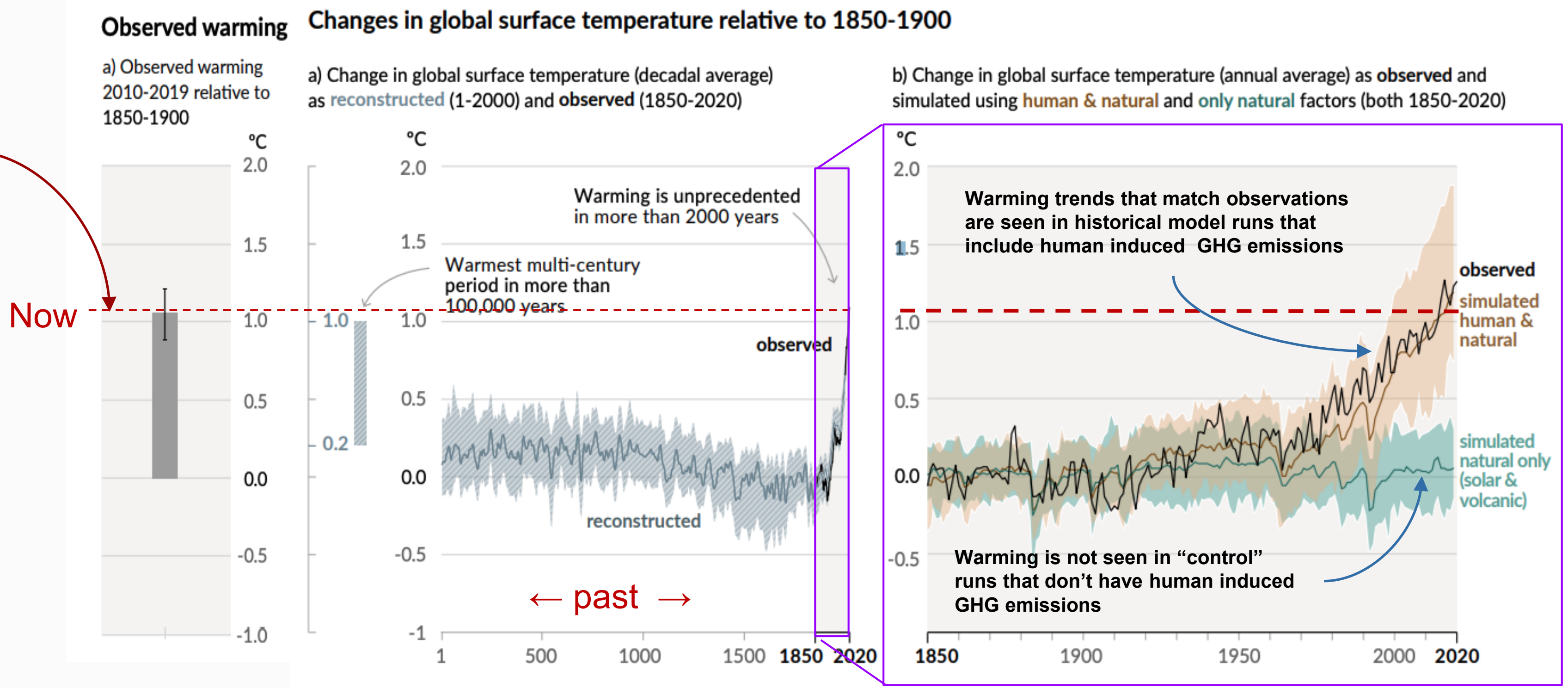


Recent Global Mean Warming is:

- Warmest period in more than 100,000 years
- Unprecedented warming in more than 2,000 years
- CO_2 concentrations in 2019 were higher than any time in at least 2 million years.

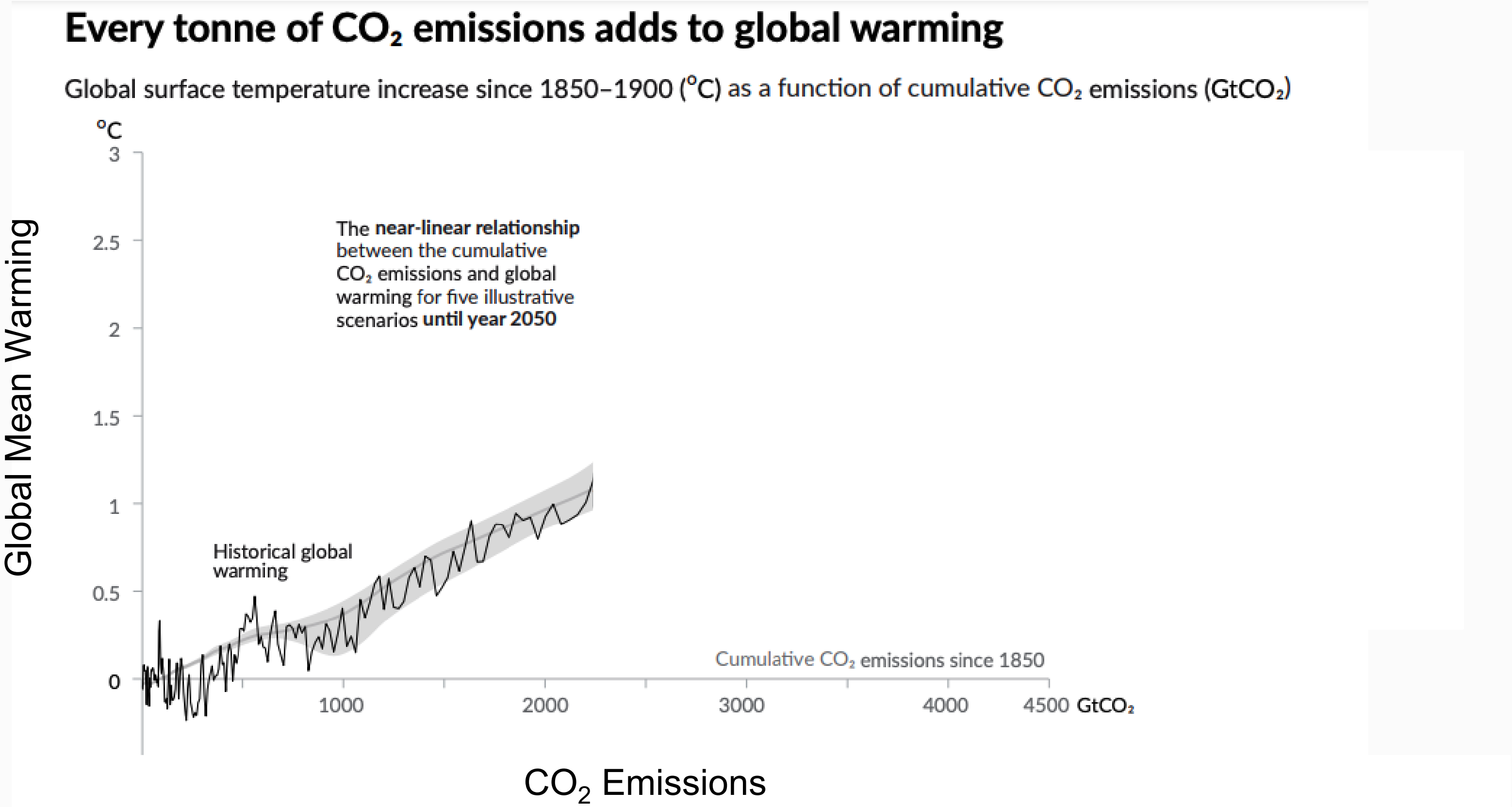
Climate change has already warmed the planet

"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



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

Near linear relationship between temperature & CO_2 emissions



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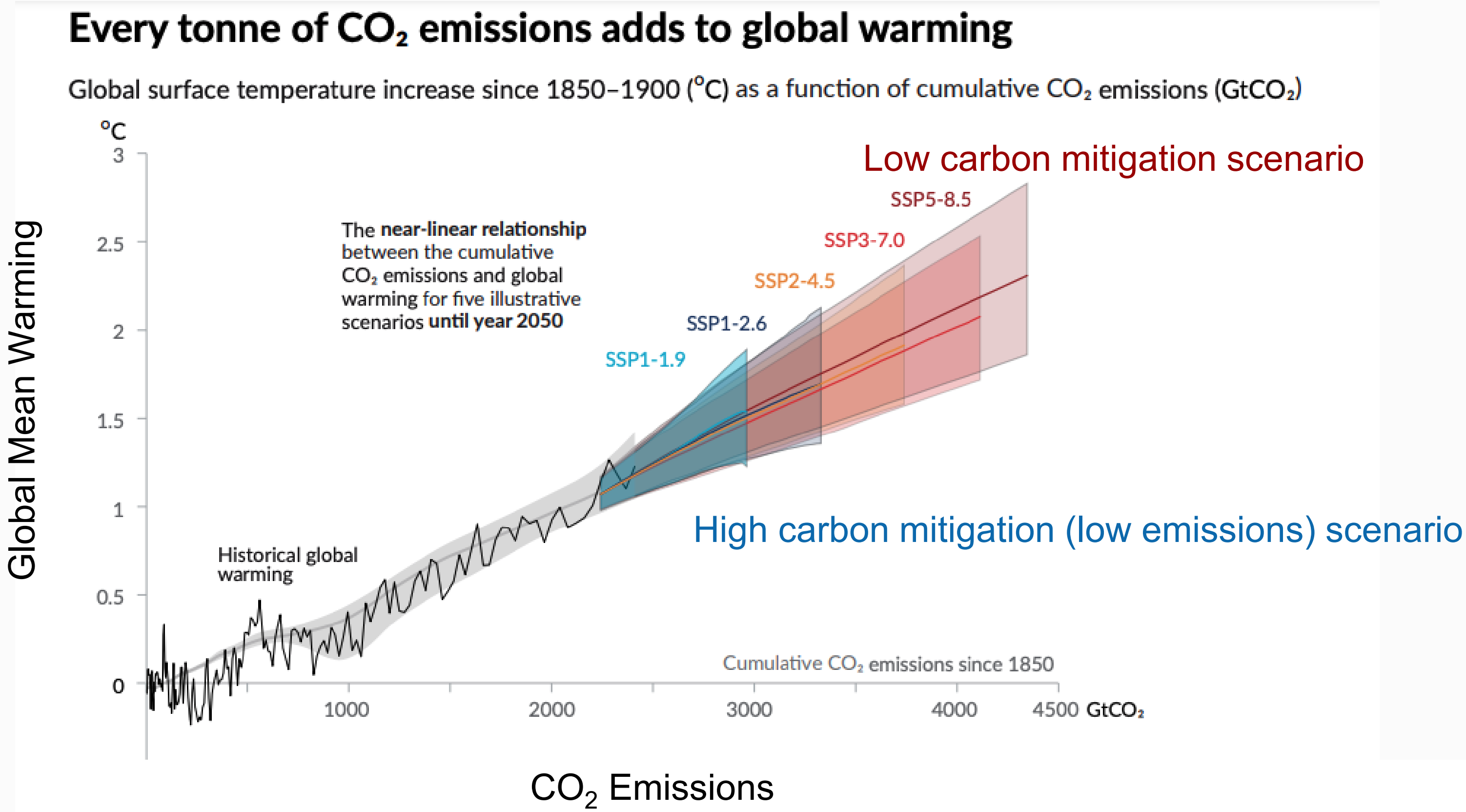
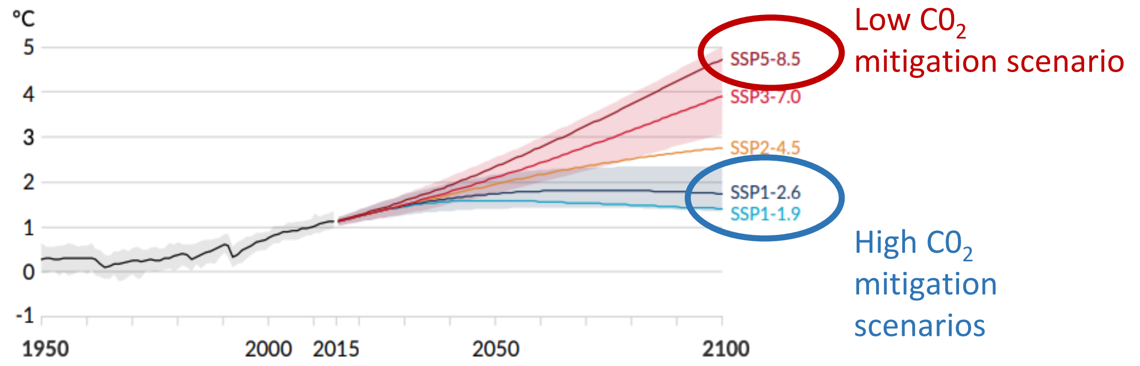


Climate change is expected to continue to impact AK Ecosystems & Fisheries



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

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

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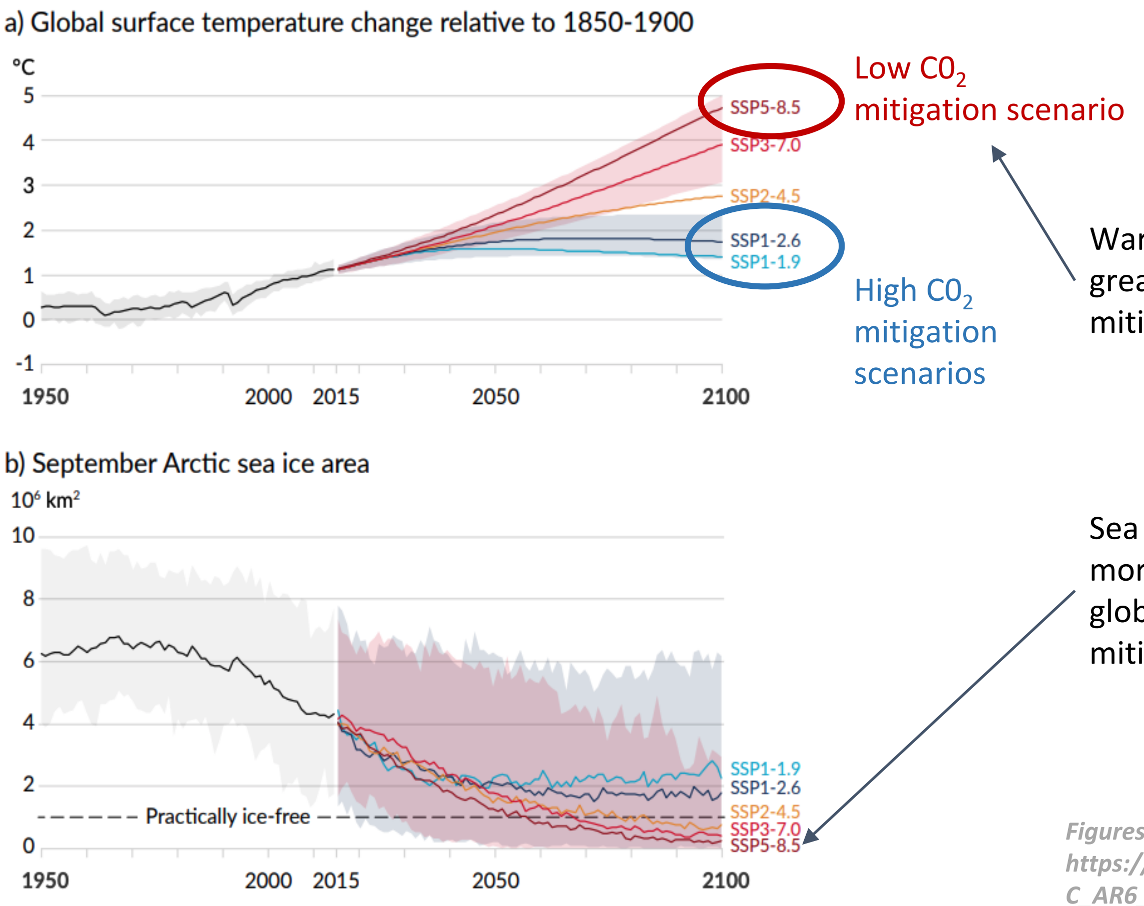
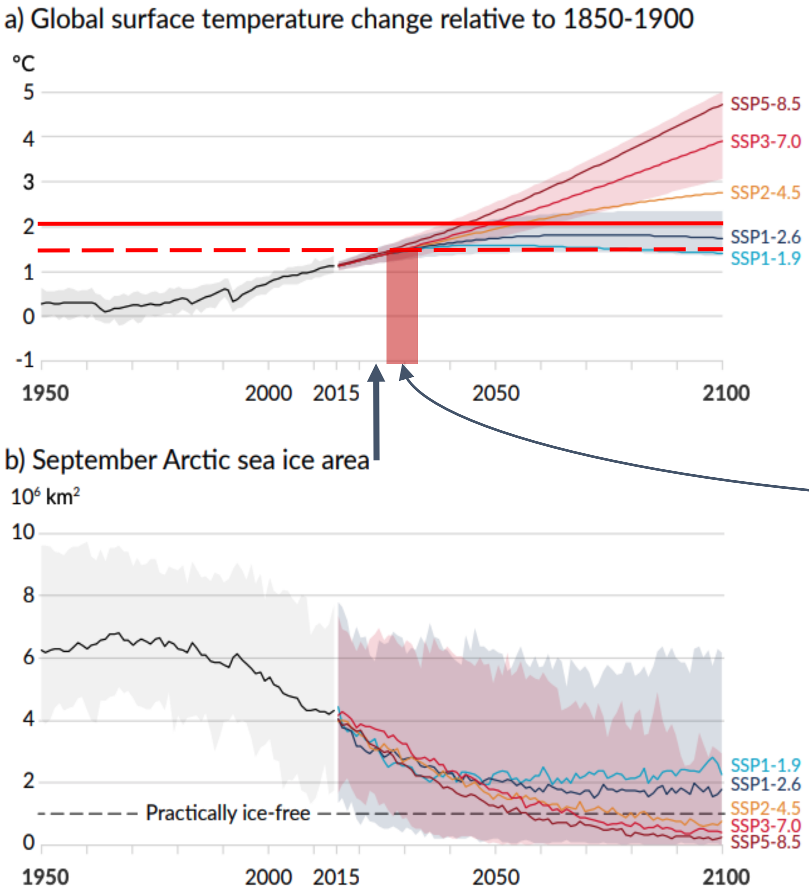


Warming will continue and is greater in scenarios with low CO_2 mitigation

Sea Ice will continue to decline, more so under scenarios with high global warming and low CO_2 mitigation

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

Climate change is expected to continue to impact AK Ecosystems & Fisheries



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.*

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

Warming in the Arctic is 2-3 x global average

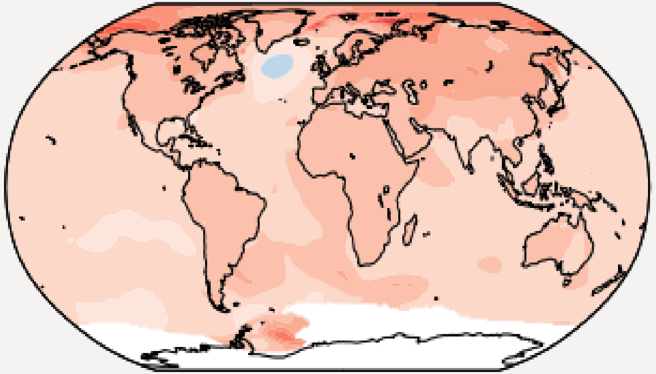
1.07ºC of "Global mean warming" = Warming of 2-3ºC in the Arctic

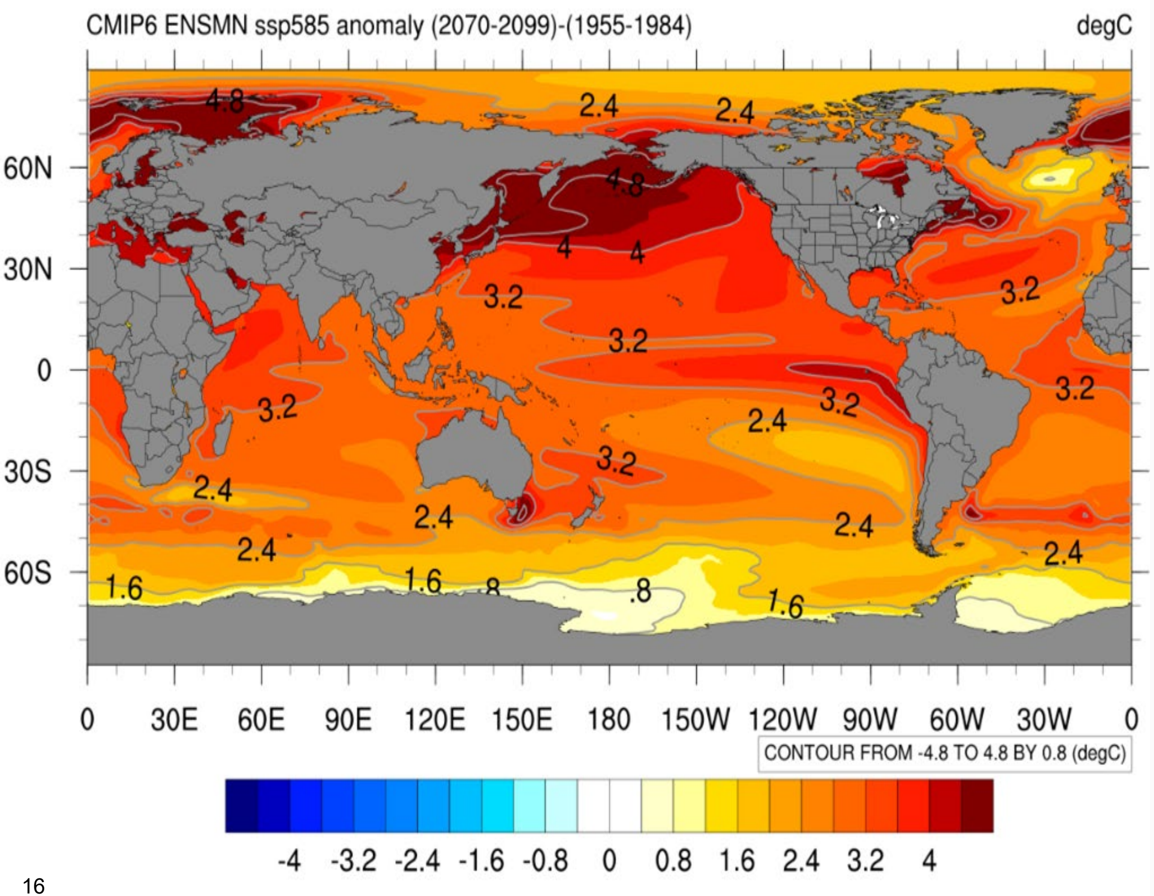
"Arctic Amplification"

a) Annual mean temperature change (°C) at 1 °C global warming

Warming at 1 °C affects all continents and is generally larger over land than over the oceans in both observations and models. Across most regions, observed and simulated patterns are consistent.

Observed change per **1 °C** global warming



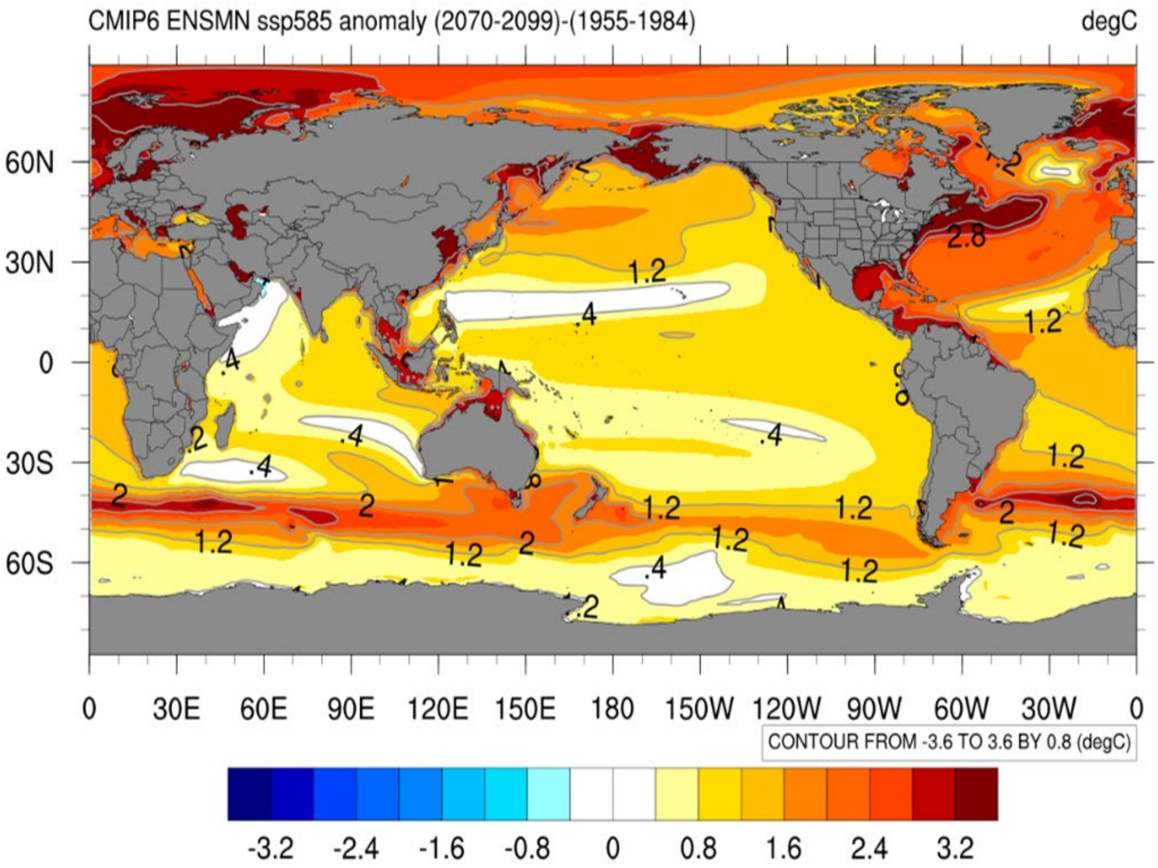


High Emissions (SSP585)

End of Century Change in Sea Surface Temperature (°C)

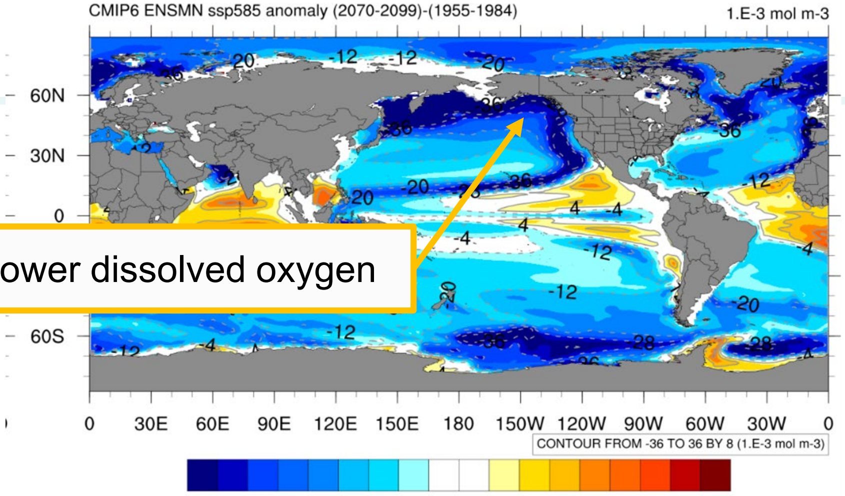
https://psl.noaa.gov/ipcc/cmip6/

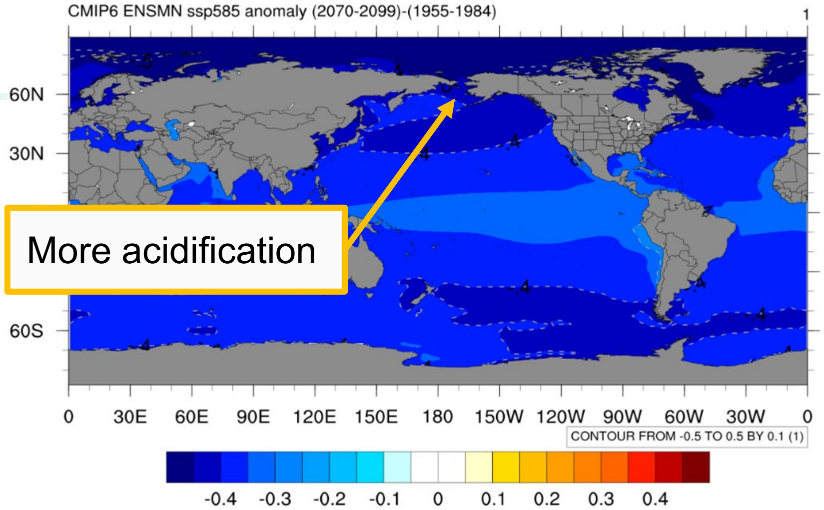
https://psl.noaa.gov/ipcc/cmip6/

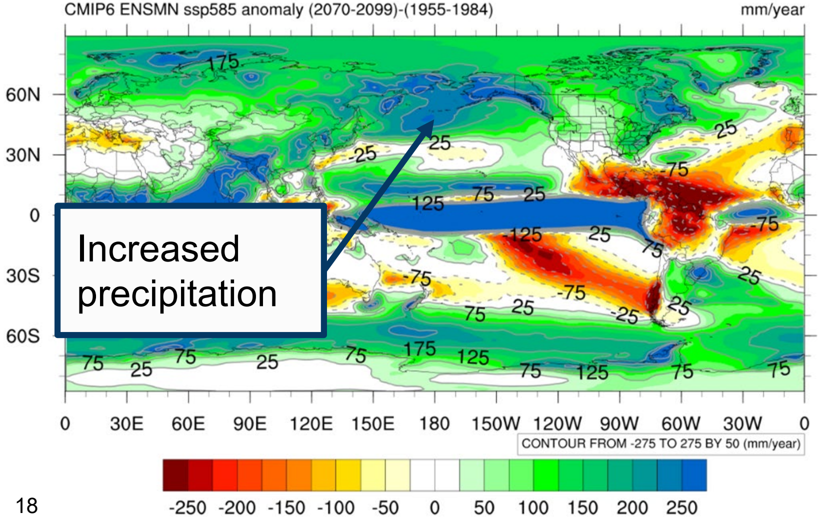


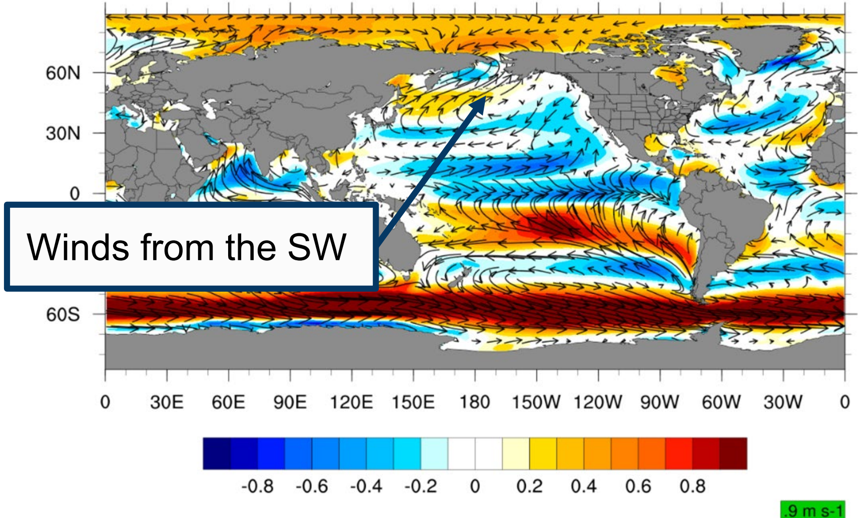
High Emissions (SSP585)

End of Century Change in Bottom Temperature (^oC)





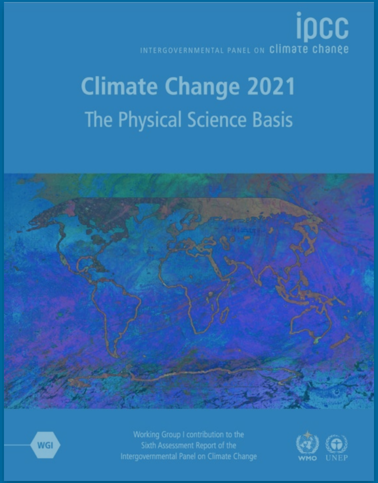


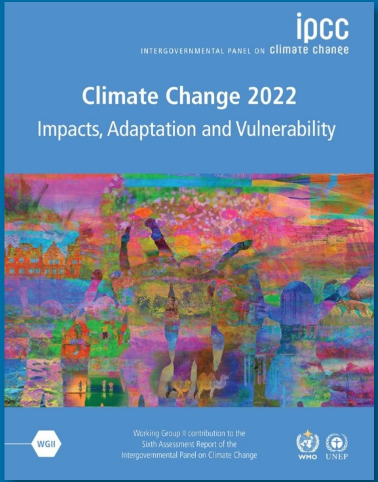


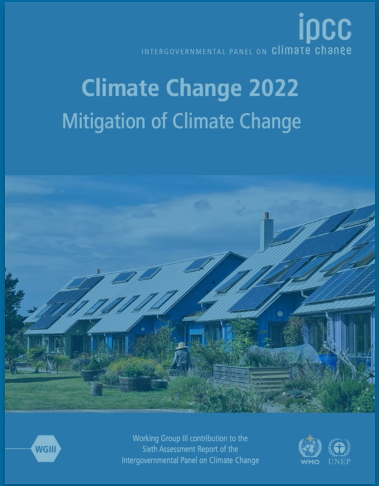
https://psl.noaa.gov/ipcc/cmip6/

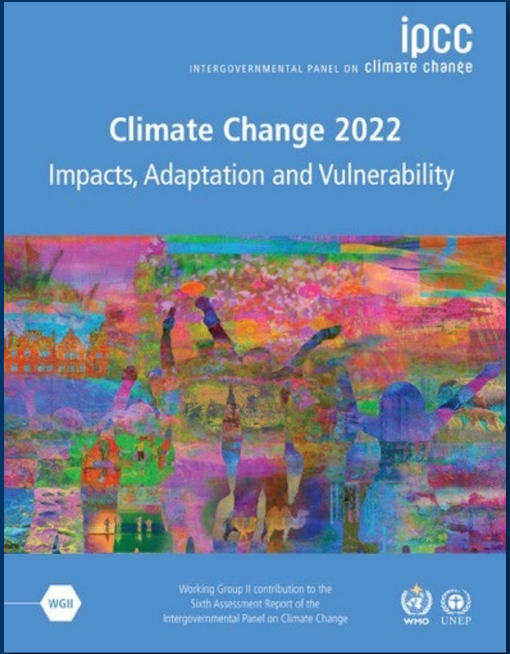
Climate Change

Causes Drivers	Impacts Adaptation	Mitigation
WGI	WGII	WGIII
Aug 2021	**Feb 2022**	Apr 2022









“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.

IPCC AR6 WGII Report by numbers

270 Authors

67 Countries

43 % Developing countries
57 % Developed countries

41 % Women / 59 % Men

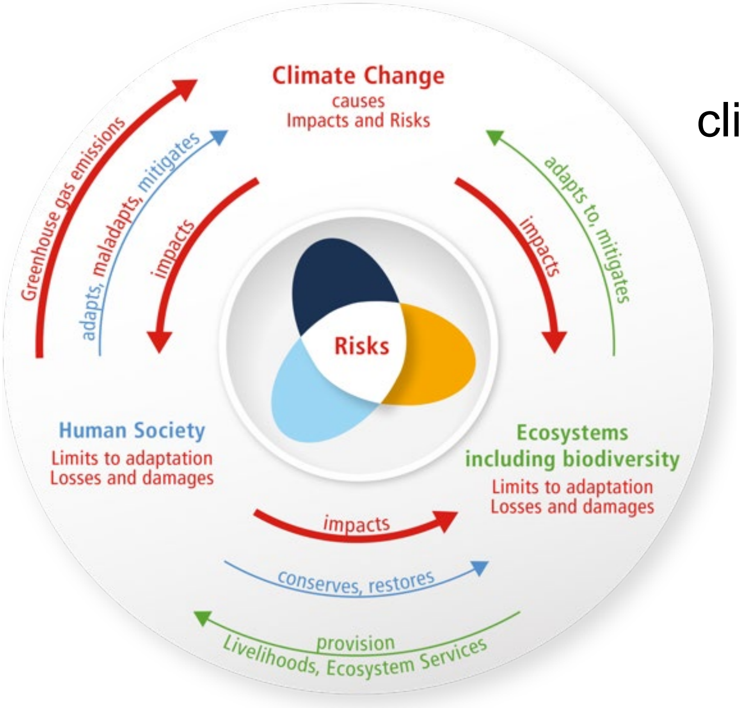
675 Contributing authors

More than
34,000 scientific papers

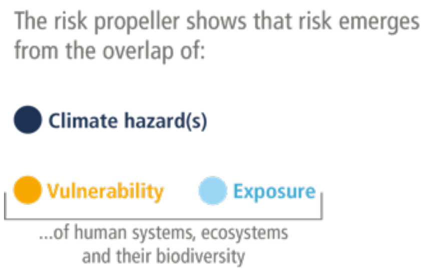
62,418
Review comments

Growing scientific knowledge gives us our best understanding yet

New understanding of interconnections



Consider coupled climate-ecological-social systems



Global warming
has caused dangerous and
widespread disruption in nature…

[Pacific Southwest Forest Service, USDA CC BY 2.0]

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

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

[Boskalis / Rijkswaterstaat]

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

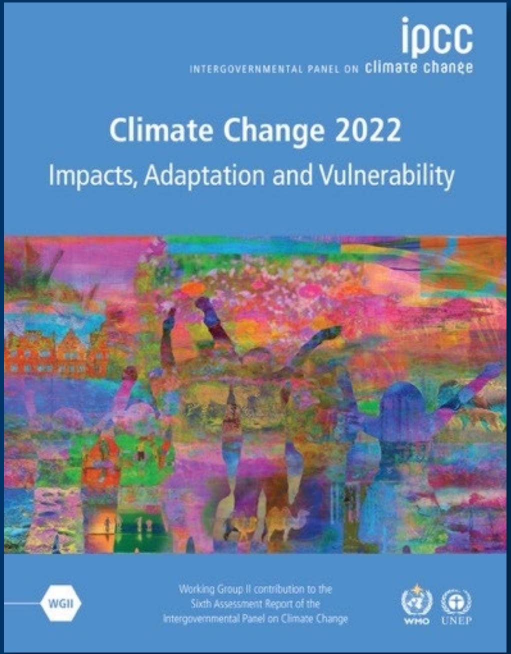
Health

Water filtration

Clean air

Climate regulation

Fisheries and Alaska



CCP6 : Polar Regions

Chapter 3: Oceans

Chapter 5: Food and Fibre

Chapter 14: North America

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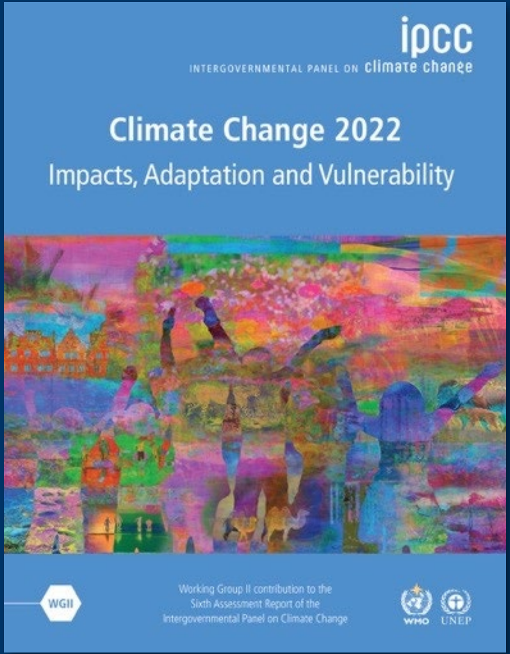

“

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.

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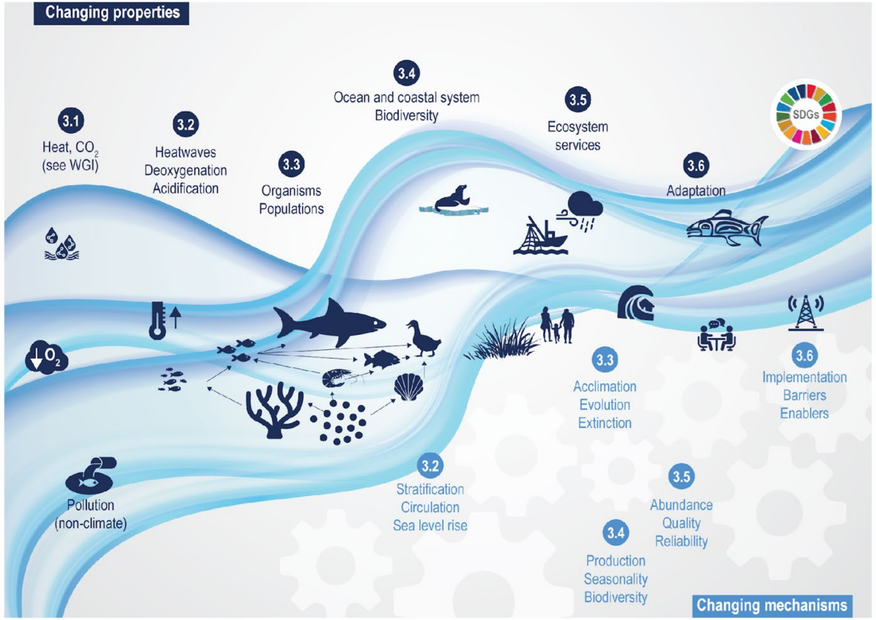
Example Impacts & Risks

- Shifting distributions & altered access
- Shifts in trophic pathways & size spectra
- Phenological mismatches & changes in productivity

- Reductions in fishery & subsistence resources
- Future risk to food & nutritional security
- 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)

- Increasing fishery emergencies & economic losses
- 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



Climate change has already caused: US Fishery impacts

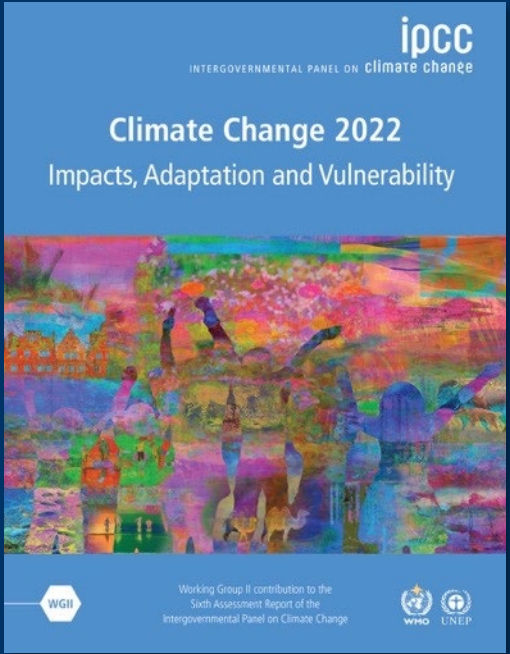
PeerJ

"Nationwide, 84.5% of fishery disasters were either partially or entirely attributed to extreme environmental events."

Table 2 Total U.S. Congressional fishery disaster assistance (2019 USD) by cause and by federalfisheries management region. One additional disaster had an allocation amount that was not reported, but the request letter cited economic impacts of $53.8-94.2M. Anthropogenic causes include pollution and overfishing; environmental causes include marine heatwaves, harmful algal blooms, hurricanes, extreme drought, etc.; and a combination includes both anthropogenic and environmental causes. Examples of fisheries being impacted by a combination of causes can be found in some Pacific northwest salmon fishery disasters, which were caused by low returns that resulted from marine heatwaves, drought, disease, habitat impacts, mismanagement, and overfishing.

Cause	Alaska	Greater Atlantic	Pacific Islands	Southeast	West Coast	To be determined	Total
Anthropogenic	$82,000,000	$132,996,669		$30,940,000	$7,600,000		$253,536,669
Environmental	$174,292,189	$41,572,622	$1,140,000	$505,938,343	$170,723,211		$893,666,365
Combination of Both	$75,588,349	$36,600,000		$37,098,200	$281,802,589		$431,089,138
To be determined						$414,103,069	$414,103,069
Total	$331,880,538	$211,169,291	$1,140,000	$573,976,543	$460,125,800	$414,103,069	$1,992,395,241

Bellquist et al. 2021. The rise in climate change-induced federal fishery disasters in the United States. https://peerj.com/articles/11186/

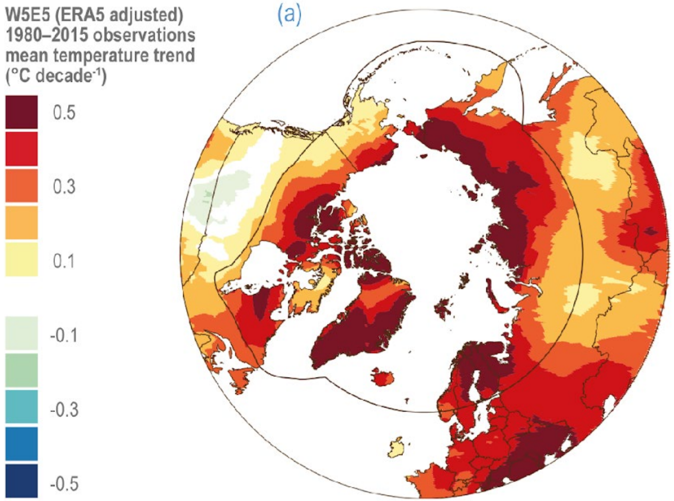


“ Contractions of the polar climate zones lead to distribution shifts and changes in food webs, induce declines in many species (*medium confidence*)

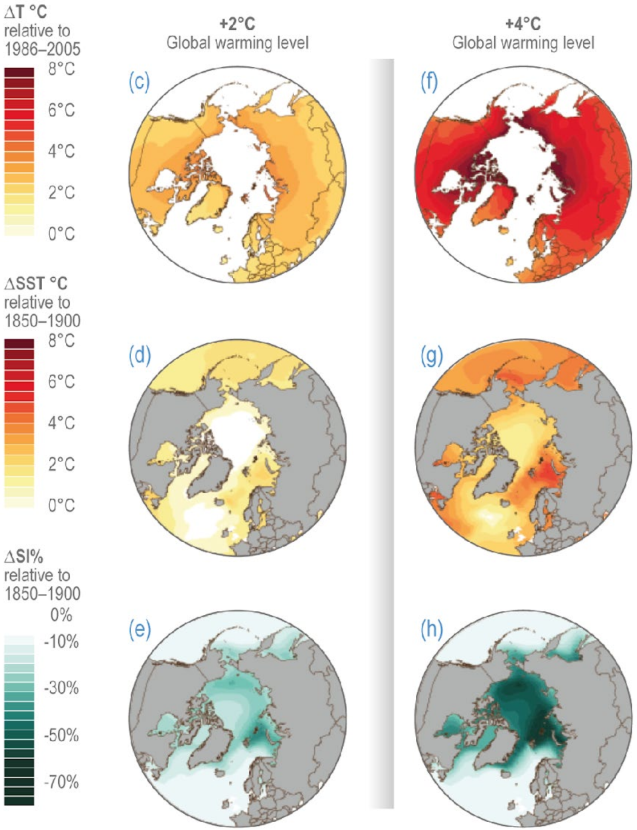
with impacts on subsistence harvests and commercial fisheries, and threaten global dependence on polar regions for substantial marine food production (*high confidence*).

Projected Impacts: Arctic

Warming to date



Future conditions



Land Temp.

Sea Surface Temp.

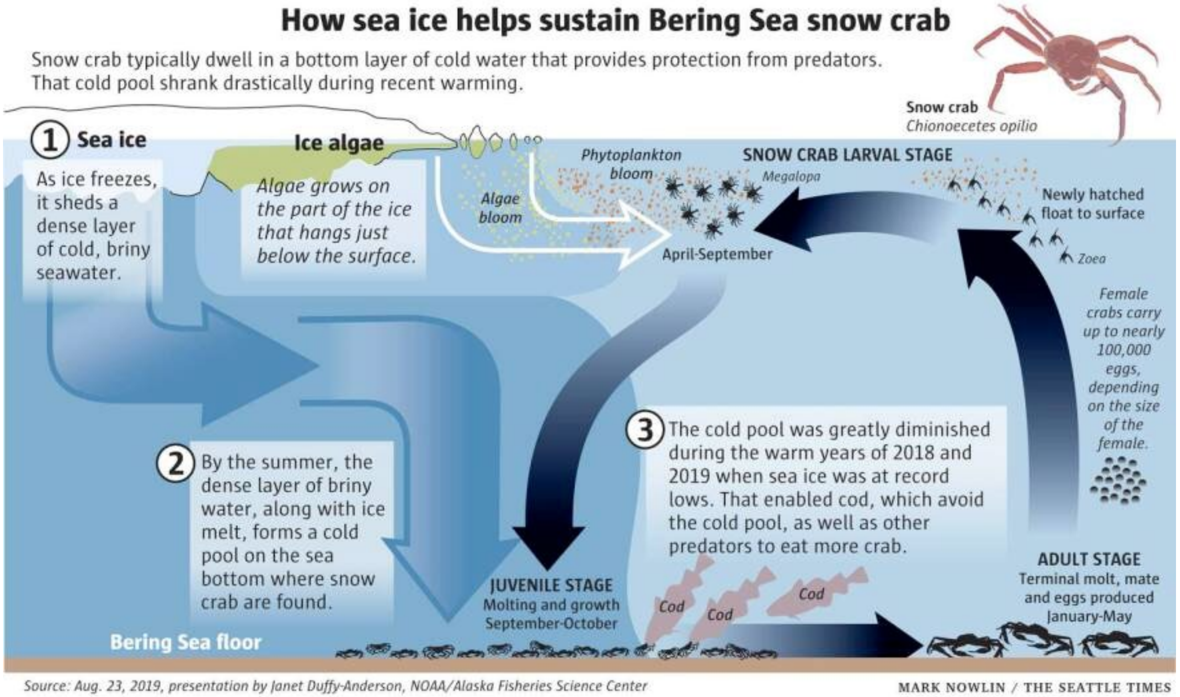
Sea Ice Loss

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

Example Impacts & Risks

https://www.noaa.gov/stories/unprecedented-2018-bering-sea-ice-loss-repeated-in-2019
https://www.seattletimes.com/seattle-news/as-bering-sea-ice-melts-nature-is-changing-on-a-massive-scale-and-alaska-crab-pots-are-pulling-up-cod/

Example Impacts & Risks

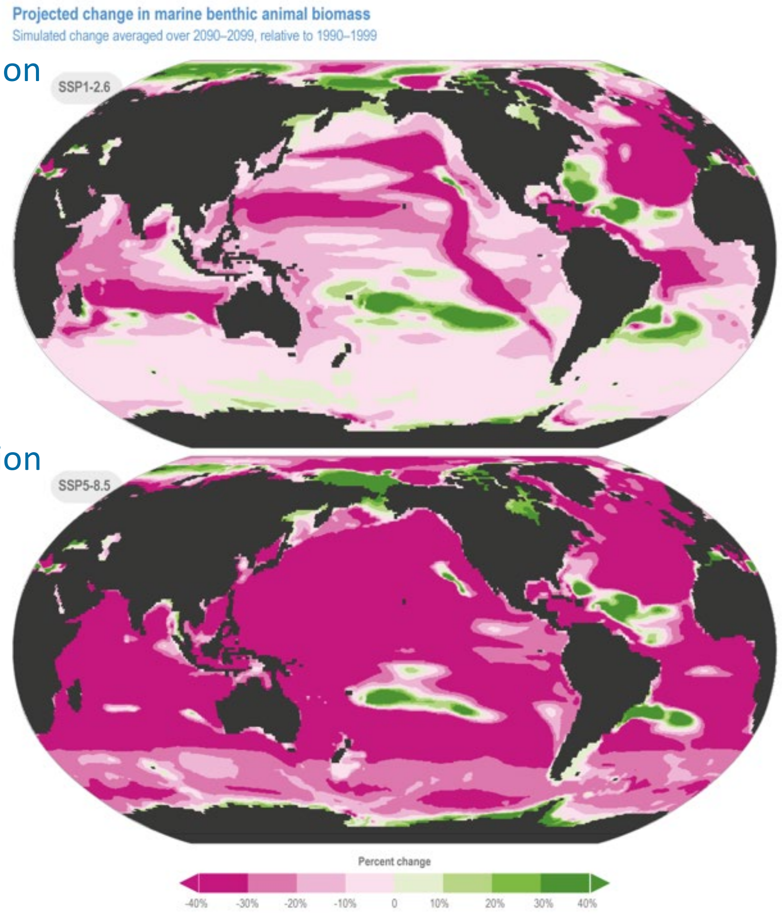


Projected Impacts

Declines in benthic biomass projected for most regions

High CO_2 Mitigation
Less warming
(SSP1 2.6)

Low CO_2 Mitigation
High warming
(SSP5 8.5)



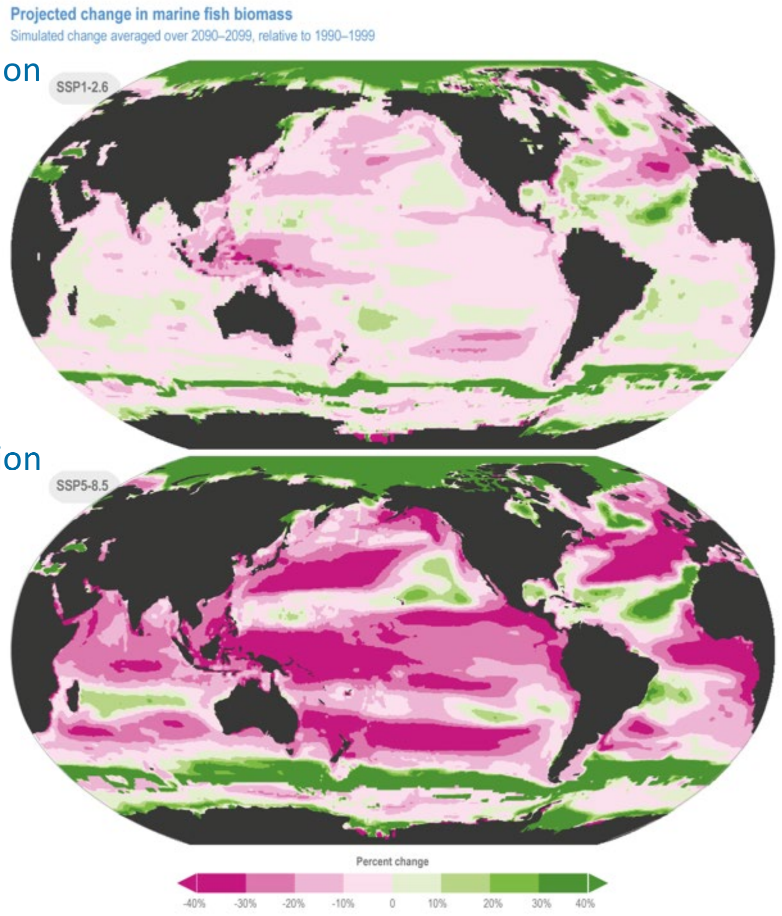
Projected Impacts

Declines in fish biomass projected for most regions

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

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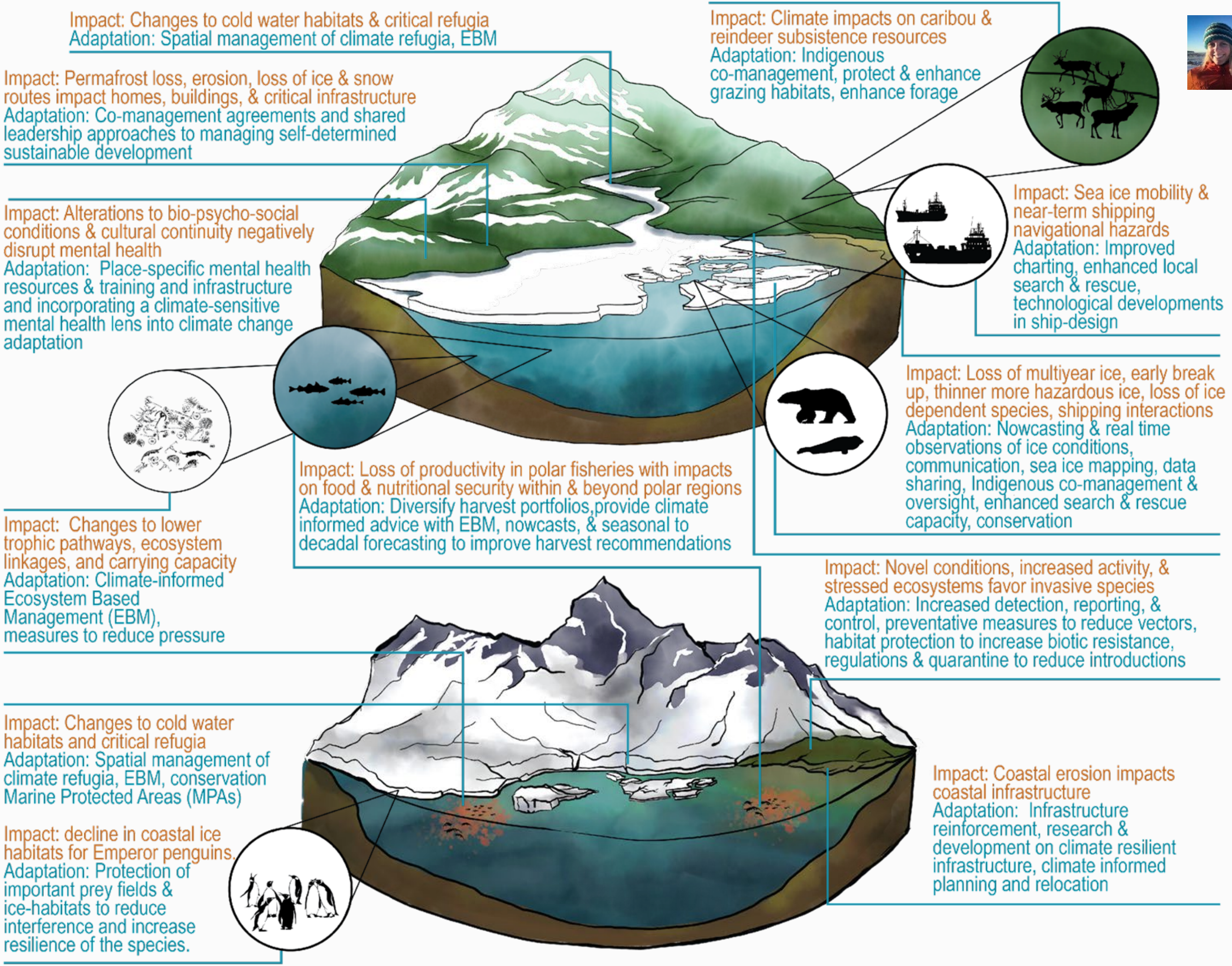
There are options we can take
to reduce the risks to people and nature.

[Il Vagabiondo / Unsplash]

Adaptation can reduce risks if coupled with CO_2 Mitigation

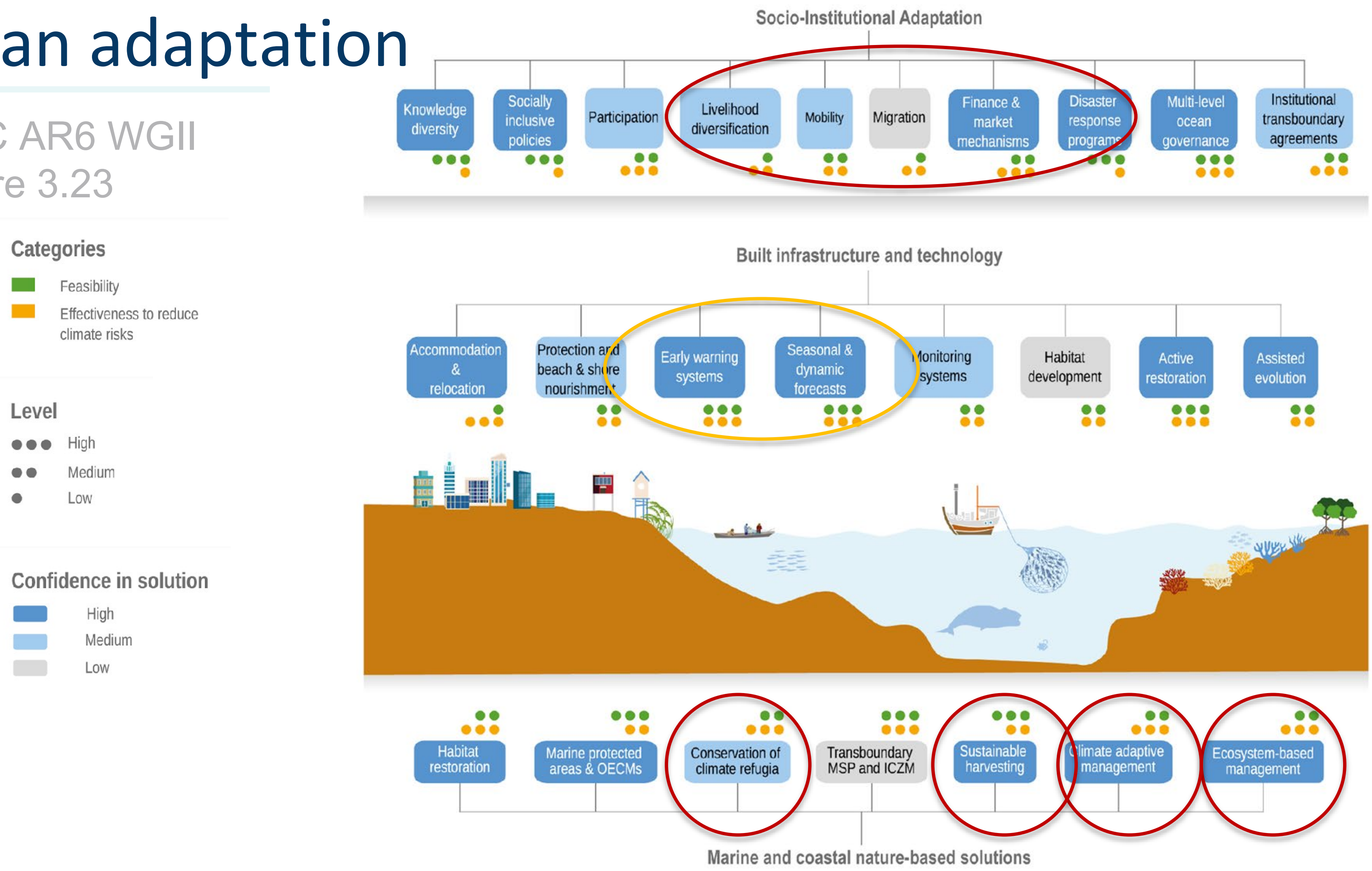
Urgent need for:

" Implementation of adaptive management that is closely linked to monitoring, research, and low cost and inclusive public participation"



Ocean adaptation

IPCC AR6 WGII
Figure 3.23



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

Steve Ringman / The Seattle Times

There are limits to adaptation

ACT NOW

“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.**

Climate Change

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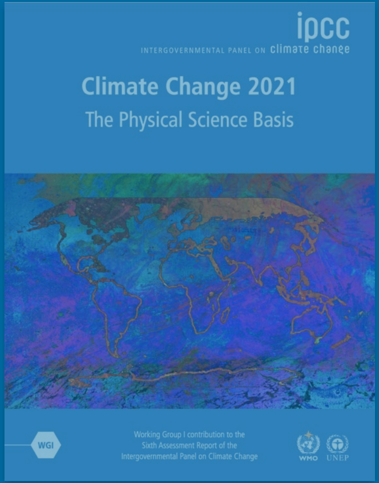
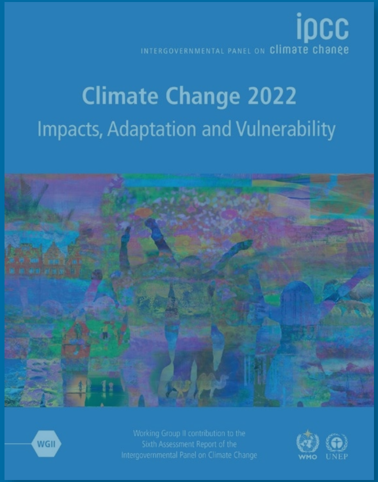
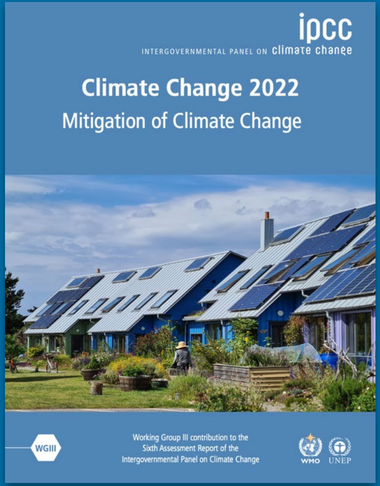
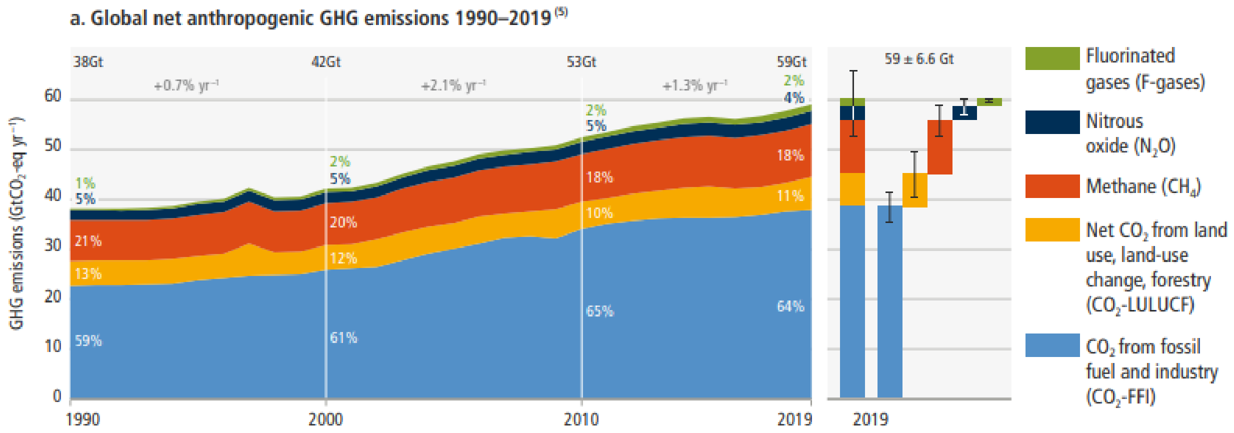






AR6 WGIII : Mitigation of Climate Change

Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases.



2019 total net anthropogenic GHG emissions

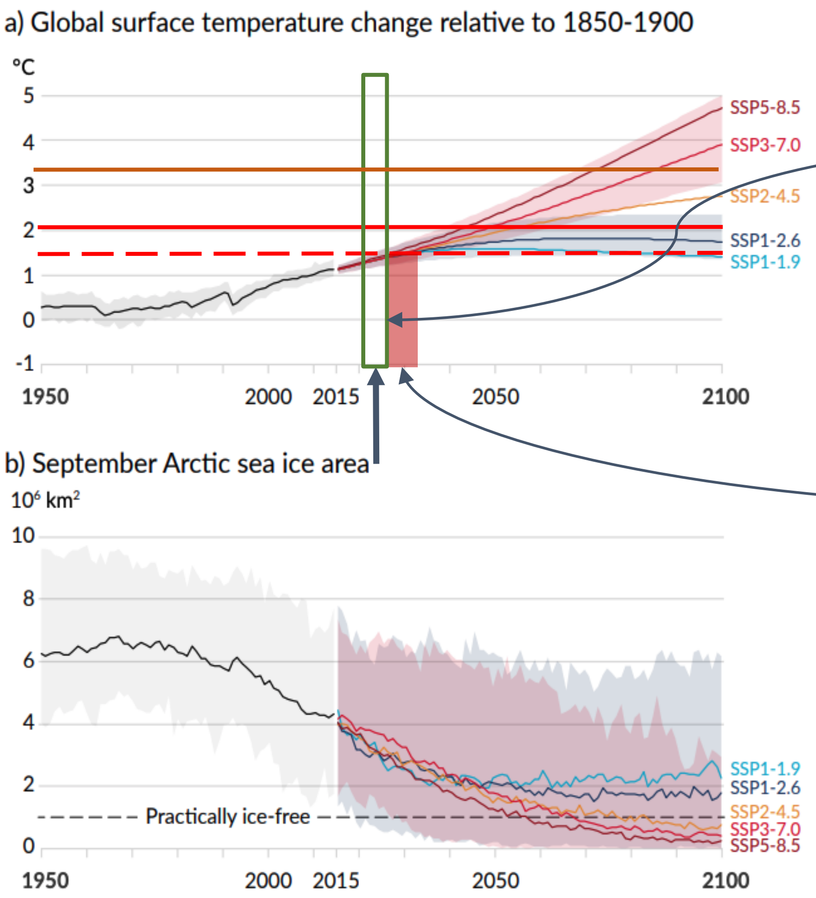
34% Energy Supply
24% Industry
22% Agriculture, forestry & land use
15% Transport
6% Buildings

AR6 WGIII : Mitigation of Climate Change

C.1 Global **GHG emissions are projected to peak between 2020 and at the latest before 2025 in global modelled pathways that limit warming to 1.5°C (>50%)** with no or limited overshoot and in those that limit warming to 2°C (>67%) and assume immediate action…
…Without a strengthening of policies beyond those that are implemented by the end of 2020, GHG emissions are projected to rise beyond 2025, **leading to a median global warming of 3.2** [2.2 to 3.5] °C by 2100.

C.3 All global modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, and those that limit warming to 2°C (>67%), involve **rapid and deep, and in most cases, immediate GHG emission reductions in all sectors.**

Climate change is expected to continue to impact AK Ecosystems & Fisheries



WGIII SPM

Range of action to remain below 1.5 °C GMW (2020-2025; emissions must peak now to limit warming to 1.5 °C)

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,** <u>ten years earlier</u> than the midpoint of the likely range assessed in the SR1.5,assuming no major volcanic eruption.*

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

This is solvable!

ACT NOW

“Overall, the latest studies on the net economic implications of decarbonisation – which also account for avoided climate damages – **point to overall benefit from the transition.**
-Prof Valentina Bosetti

If people are provided with opportunities to make choices supported by policies, infrastructure and technologies, there is an untapped mitigation potential to **bring down global emissions by between 40 and 70% by 2050** compared to a baseline scenario.
-Prof Joyashree Roy

The evidence is clear: there are now mitigation options available in all sectors that could together **halve global greenhouse gas emissions by 2030.**
-Dr Céline Guivarch

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INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP