
#SROCC
The Ocean and Cryosphere
in a Changing Climate
COP25, Madrid
5 December 2019
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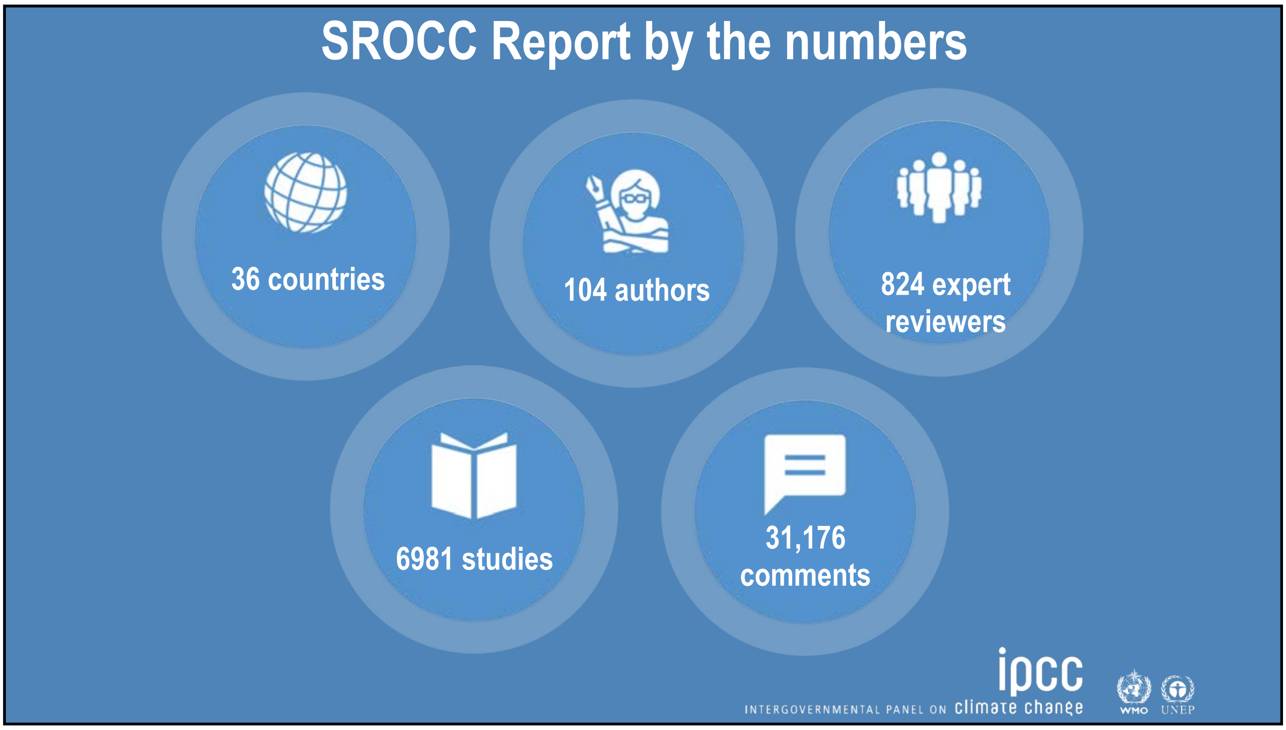
SROCC Report by the numbers
36 countries
104 authors
824 expert reviewers
6981 studies
31,176 comments
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Proposals for Special Reports in the Sixth Assessment Cycle

IPCC governments and observer organisations made seven proposals for ocean and/or cryosphere-related Special Reports at the start of the Sixth Assessment Cycle

- Impact of Climate Change on the Cryosphere (China)
- Climate Change and Ocean (China)
- Ocean and Climate Change (Monaco)
- Antarctic/Southern Ocean Region (South Africa)
- Oceans and Climate Change: Special Report on the Evidences, Impacts and Adaptation to the Climate Change of the Oceans (Spain)
- Global and Regional Consequences of Changes to the Frozen World (USA)
- Sea Level Rise and Glacial Melting (CAN Int)

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Proposals for Special Reports in the Sixth Assessment Cycle by IPCC Governments and observer organisations

In April 2016 the IPCC Panel decided that during the IPCC Sixth Assessment Cycle an ocean and cryosphere-related Special Report is to be developed:

IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC)

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SROCC joins:

The two other Special Reports on Global Warming of 1.5°C (SR15) and on Climate Change and Land (SRCCL)

and

The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Report on Biodiversity and Ecosystem Services

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Report Structure

Chapter 1: Framing and Context of the Report

Chapter 2: High Mountain Areas

Chapter 3: Polar Regions

Chapter 4: Sea level rise and implications for low lying islands, coasts and communities

Chapter 5: Changing ocean, marine ecosystems, and dependent communities

Chapter 6: Extremes, abrupt changes and managing risks

\+ **Integrative cross-chapter box:** Low-lying islands and coasts

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Structure of the Summary for Policymakers

A. Observed Changes and Impacts
- Physical Changes
- Impacts on Ecosystems
- Impacts on People and Ecosystem Services

B. Projected Changes and Risks
- Physical Changes
- Risks for Ecosystems
- Risks for People and Ecosystem Services

C. Implementing Responses to Ocean and Cryosphere Change
- Challenges
- Strengthening Response Options
- Enabling Conditions

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The world's ocean and cryosphere have been 'taking the heat' from climate change for decades.

Consequences for nature and humanity are sweeping and severe.

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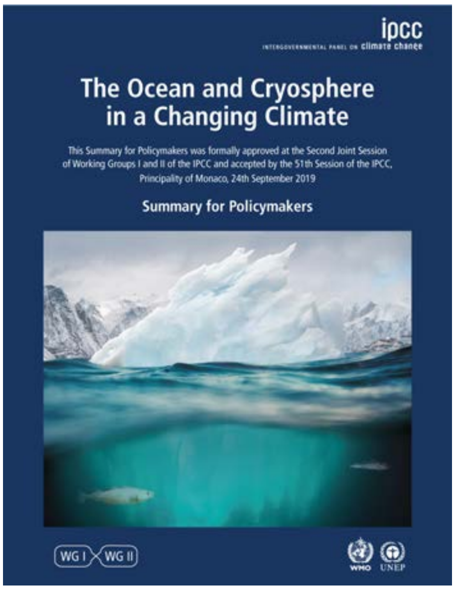

Background: Use of Scenarios in SROCC

- SROCC uses mainly **RCP2.6** and **RCP8.5** in its assessment, reflecting the available literature.
- **RCP2.6** represents a **low greenhouse gas emissions, high mitigation future,** that in CMIP5 simulations gives a two in three chance of limiting global warming to below 2ºC by 2100
- By contrast, RCP8.5 is a **high greenhouse gas emissions scenario** in the **absence of policies** to combat climate change, leading to continued and sustained growth in atmospheric greenhouse gas concentrations.

RCP: Representative Concentration Pathway

Observed changes in the mountain cryosphere

- **Mass change of glaciers in all mountain regions is -123 ± 24 Gt /yr in 2006–2015**
- In nearly all high mountain areas, **the depth, extent and duration of snow cover have declined** over recent decades, particularly at lower elevation
- **Permafrost temperatures**, averaged across polar and high mountain regions, **have increased** to record high levels from 1980s to present

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Observed regional hazards in the high mountain

Attributed to Cryosphere Change		Himalaya, Tibetan Plateau and other High Mountain Asia [2]	Low Latitudes [3]	Southern Andes	New Zealand	Western Canada and USA	European Alps and Pyrenees	Caucasus	Scandinavia [4]
Physical changes	Water availability	●●● increase and decrease	●●● increase and decrease	●● increase and decrease		●●● increase and decrease	●●● increase and decrease	● increase and decrease	●● increase and decrease
	Flood	● increase				● increase and decrease	● increase and decrease	● increase	
	Landslide	● increase			● increase	● increase	●●● increase		● increase
	Avalanche	● increase					●● increase and decrease	● increase	
	Ground subsidence								

Physical changes: increase; decrease; increase and decrease
Attribution confidence: ●●● high; ●● medium; ● low; (empty) no assessment

- Glacier, snow and permafrost decline has **altered the frequency, magnitude and location** of most **related natural hazards** such as landslides, avalanches, flooding, ground subsidence and wildfires

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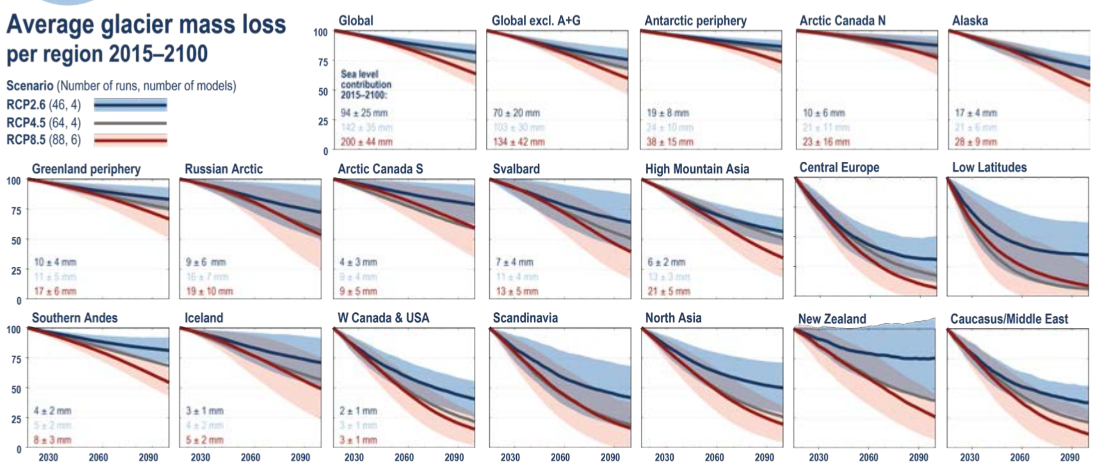
Observed impacts on ecosystems and human systems in the high mountain regions

Attributed to Cryosphere Change		Himalaya, Tibetan Plateau and other High Mountain Asia [2]	Low Latitudes [3]	Southern Andes	New Zealand	Western Canada and USA	European Alps and Pyrenees	Caucasus	Scandinavia [4]
Ecosystems	Tundra	●●● positive and negative	● positive and negative			●● positive and negative	●● positive and negative		●● positive and negative
	Forest	●● positive and negative				●● positive and negative			
	Lakes/ponds								
	Rivers/streams		● positive and negative	● negative	● negative	●● negative	●●● positive and negative		
Human systems and ecosystem services	Tourism	●● negative	● negative		● positive and negative	●● negative	●●● negative	● negative	● negative
	Agriculture	●● negative	● negative	● positive					● negative
	Infrastructure	●●● negative					●●● negative		
	Migration [6]	● positive	● positive						
	Cultural services	●● negative	●● negative			● positive and negative	●●● positive and negative		● positive

Systems: positive; negative; positive and negative
Attribution confidence: ●●● high; ●● medium; ● low; (empty) no assessment

- Lower-elevation **vegetation and wildlife have changed** abundance, extended upslope and established in **new areas**
- Changes in cryosphere also **alters the land and freshwater habitats** of mountain vegetation and wildlife
- Changes have contributed to declines Tourism in many regions and in agricultural yields including the Hindu Kush Himalaya and the tropical Andes

Future: glaciers, snow cover and permafrost are projected to continue decline in most regions



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Glaciers, snow cover and permafrost are projected to continue decline in most regions

- Projected **decreases in low elevation winter snow depth**, compared to 1986–2005, are likely 10–40% **by 2031–2050** (all RCPs), and 50–90% for RCP8.5 by **2081–2100**
- **Widespread permafrost thaw** is projected for this century and beyond. By 2100, projected near-surface permafrost area shows a **decrease of 24 ± 16% for RCP2.6 and 69 ± 20% for RCP8.5**

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Hazards are projected to occur in new locations and different seasons

- In many high mountain areas, **glacier retreat and permafrost thaw** are projected to further **decrease the stability of slopes**, and **the number and area of glacier lakes will continue to increase**
- **Floods** due to glacier lake outburst or rain-on-snow, landslides and snow avalanches, are projected to occur also **in new locations or different seasons**

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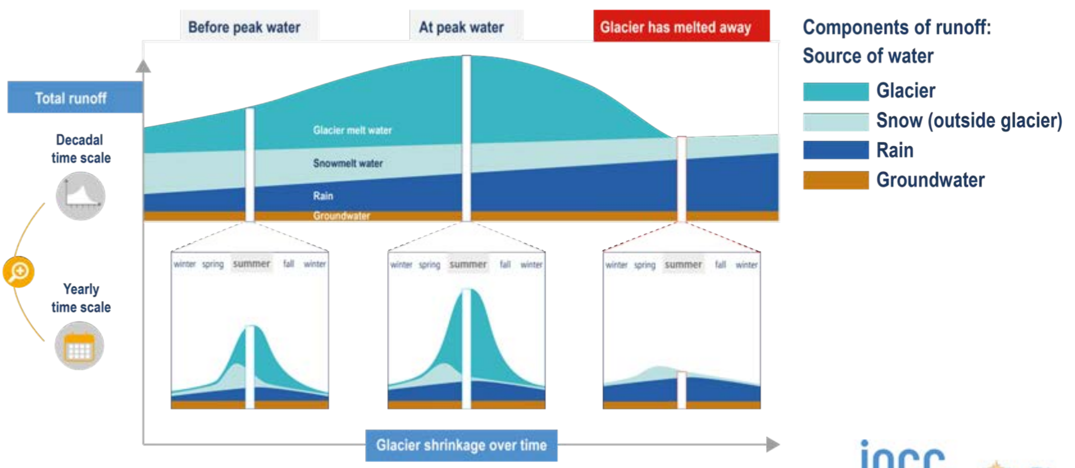
In all emissions scenarios, average annual and summer runoff from glaciers are projected to peak at or before the end of the 21st century then decline



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Projected risks for high mountain ecosystems

- Future cryosphere changes will continue to alter terrestrial and freshwater ecosystems with **major shifts in species distributions resulting in changes in ecosystem structure and functioning, and eventual loss of globally unique biodiversity.**
- Warm-adapted plant and animal species migrate upslope. **Cold- and snow-adapted species decrease and risk eventual extinction**, especially without conservation.
- Permafrost thaw and decrease in snow will **affect mountain hydrology and wildfire**, with impacts on vegetation and wildlife

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Projected risks for people

- **Hazards for people**, through landslides, snow avalanches or floods **will increase**
- The retreat of the cryosphere will continue to **adversely affect recreational activities, tourism and cultural assets**
- **Disaster risks** to human settlements and livelihood options are expected to **increase**
- **Changing water availability and water quality** affects households, agriculture, energy systems, and people both **in the region and beyond**

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Limiting global warming helps people to adjust to changes.

Significant risk reduction and adaptation strategies help avoid increased impacts.

Integrated water management and transboundary cooperation provide opportunities to reduce the impacts.

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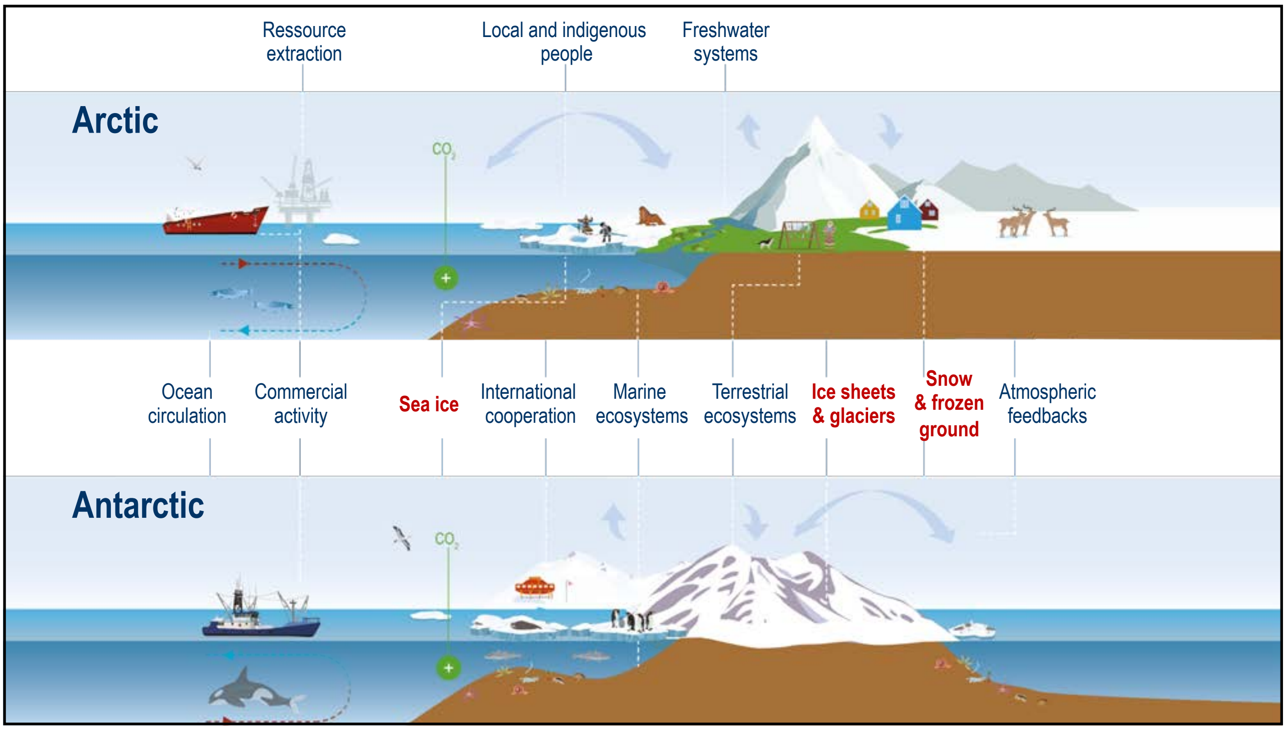
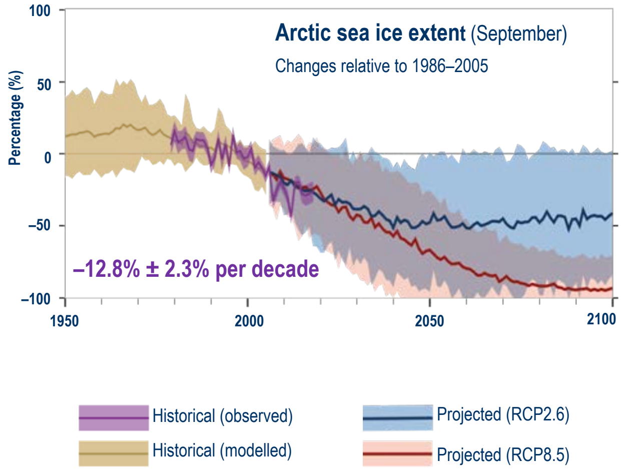
Photo: Jess Melbourne Thomas
Polar Regions


Ressource extraction
Local and indigenous people
Freshwater systems
Arctic
CO_2
Ocean circulation
Commercial activity
Sea ice
International cooperation
Marine ecosystems
Terrestrial ecosystems
Ice sheets & glaciers
Snow & frozen ground
Atmospheric feedbacks
Antarctic
CO_2

Arctic sea ice is shrinking and its loss is projected to continue depending on global warming

- September **Arctic sea ice extent has decreased** between 1979 and 2018
- Summertime Arctic **ship-based transportation** has **increased** over the past two decades
- At global warming of **1.5°C**, the **Arctic Ocean** will **rarely be free of sea ice** in September.
- At **2°C** warming, this would occur on average in **one to three times in ten years**



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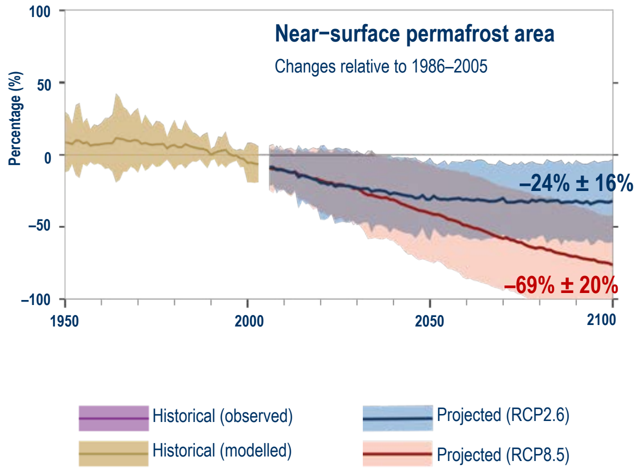
Arctic permafrost is warming, and widespread thaw is projected this century

- **Permafrost temperatures** have increased to **record high levels**
- **Widespread permafrost thaw** is projected for **this century**
- Arctic and boreal permafrost contain **almost twice the carbon** in the atmosphere
- It is **uncertain** whether northern permafrost regions are currently **releasing additional net methane and CO_2**



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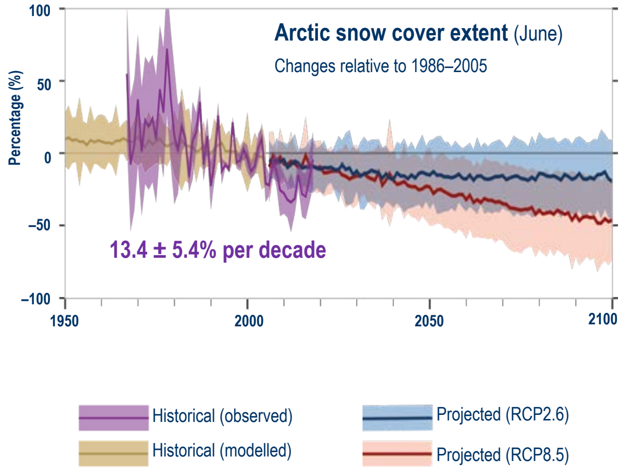
Arctic spring snow cover extent has decreased and is projected to decrease further

- Arctic June **snow cover** has **declined** since 1967
- **Feedbacks** from the loss of spring snow cover and summer sea ice have contributed to **amplified Arctic warming**
- **Strong reductions in greenhouse gas emissions** in the coming decades are projected to **reduce further changes** after 2050



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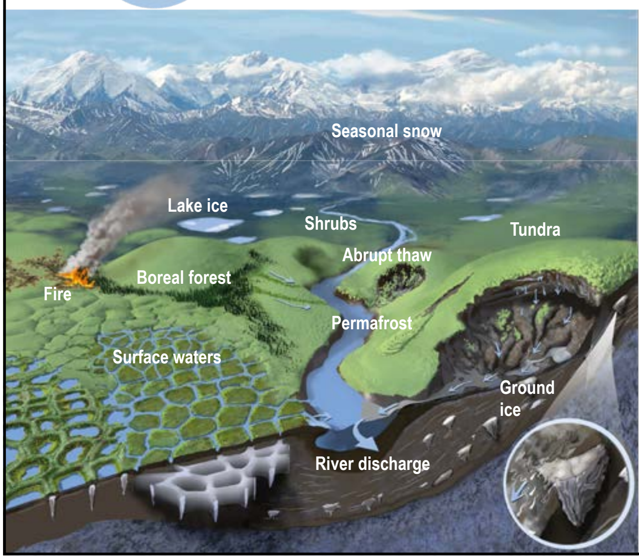
Shrinking Arctic cryosphere affects water, wildfire, ecosystems, human activities and infrastructure



- **Food and water security** have been **negatively impacted** by changes in cryosphere in many Arctic regions
- About 20% of Arctic land permafrost is vulnerable to **abrupt permafrost thaw and ground subsidence**
- The majority of **Arctic infrastructure** is located in regions **at risk** from permafrost thaw by 2050

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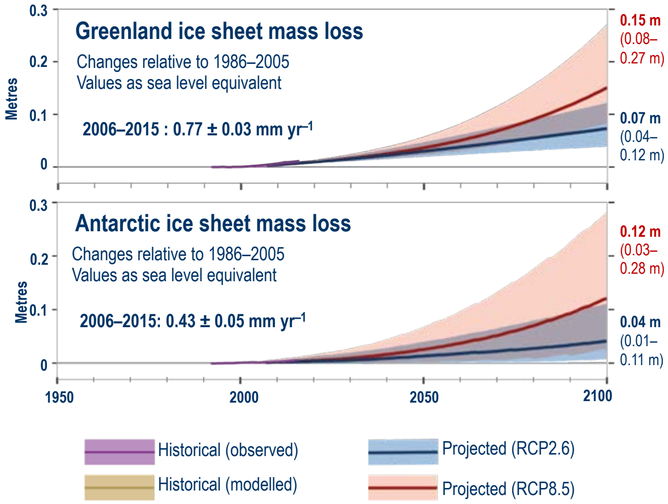
The Greenland and Antarctic ice sheets are losing mass

- **Mass loss** from the **Antarctic ice sheet** over the period 2007–2016 **tripled** relative to 1997–2006
- For **Greenland**, mass loss **doubled** over the same period
- **Acceleration of ice flow** is observed in the Amundsen Sea Embayment of West Antarctica and in Wilkes Land, East Antarctica
- Ice sheets are projected to **lose mass** at an **increasing rate**



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The polar regions will be profoundly different in future compared with today, and the degree and nature of that difference will depend strongly on the rate and level of global warming.

This will challenge adaptation responses regionally and worldwide.

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Global mean sea level is rising

Rates of global mean sea level rise 2006–2015

3.6mm/yr (range 3.1–4.1)

Of which :

Glaciers and ice sheets

1.8mm/yr (range 1.7–1.9)

Ocean

1.4mm/yr (range 1.1–1.7)

- It has **accelerated** in recent decades due to mass loss from the Greenland and Antarctic ice sheets, as well as continued glacier mass loss and ocean thermal expansion
- **Regional differences**, within ±30% of the global mean sea-level rise, result from land ice loss and variations in ocean warming and circulation
- **Extreme wave heights**, which contribute to extreme sea level events, have **increased** in the Southern and North Atlantic Oceans
- Anthropogenic climate change has **increased precipitation, winds, and extreme sea level events**, associated with some **tropical cyclones**

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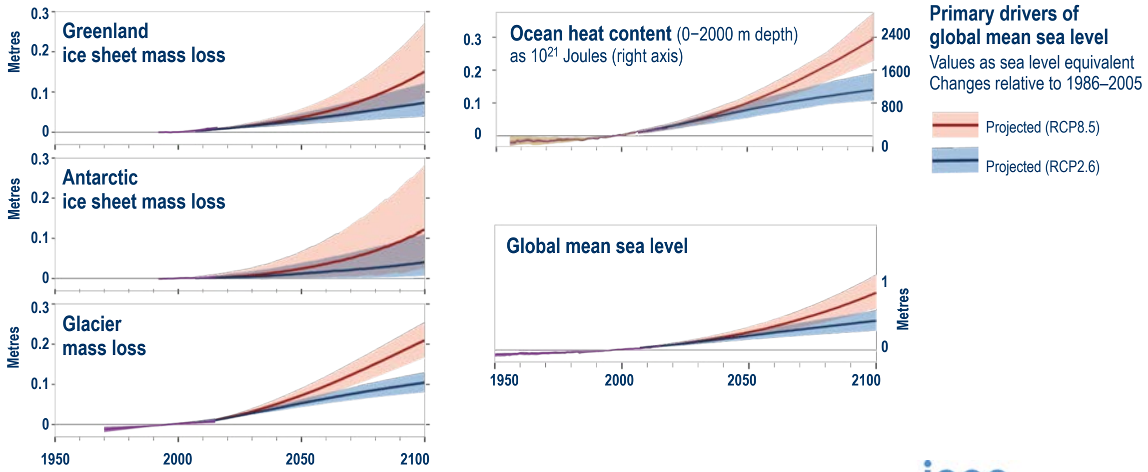
Sea level is projected to continue to rise at an increasing rate



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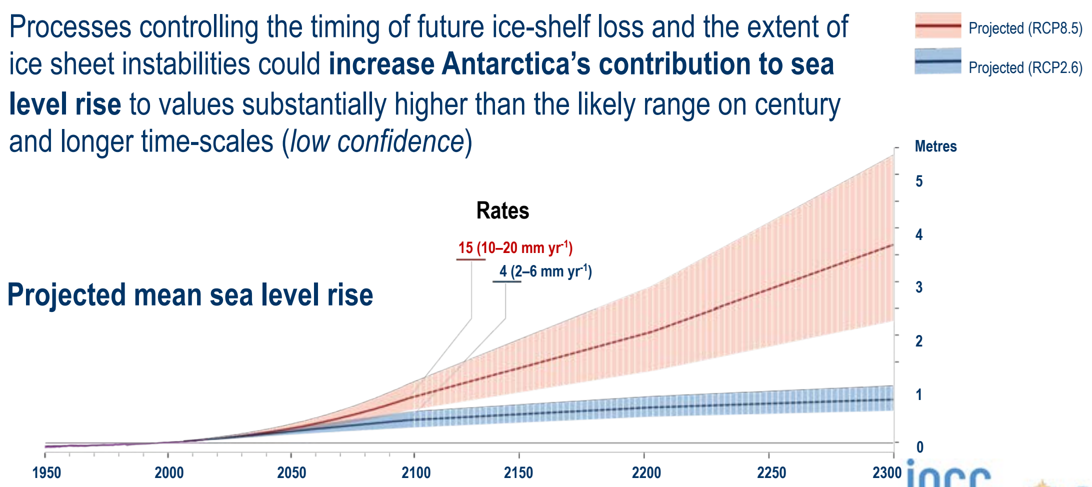
Sea level rise is projected to continue over centuries

Processes controlling the timing of future ice-shelf loss and the extent of ice sheet instabilities could **increase Antarctica's contribution to sea level rise** to values substantially higher than the likely range on century and longer time-scales (*low confidence*)



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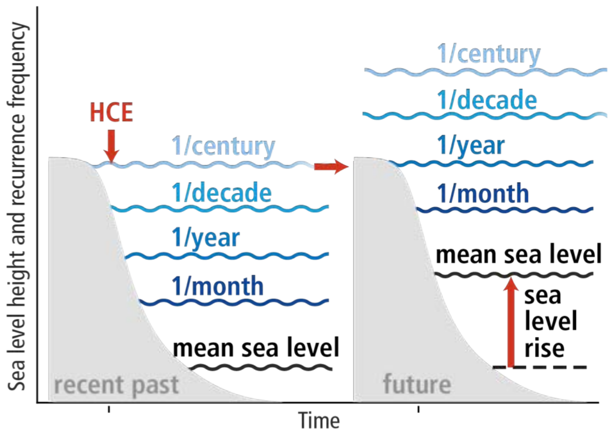
Global mean sea level rise will cause the frequency of extreme sea level events at most locations to increase



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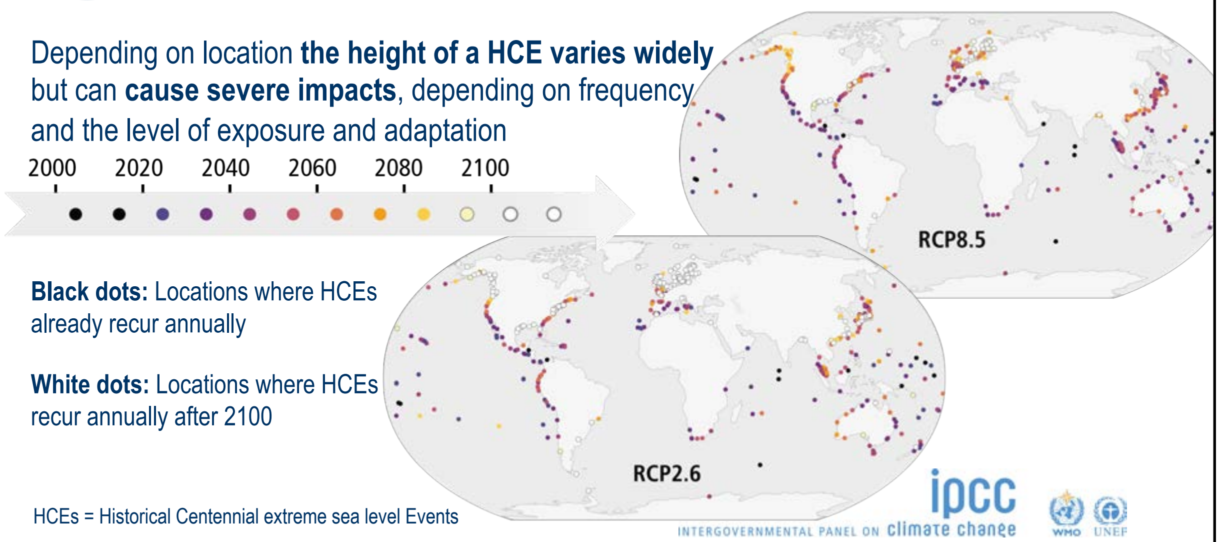
Many low-lying coastal cities and small islands will be exposed to risks of flooding and land loss annually by 2050

Depending on location **the height of a HCE varies widely** but can **cause severe impacts**, depending on frequency and the level of exposure and adaptation



Black dots: Locations where HCEs already recur annually

White dots: Locations where HCEs recur annually after 2100

HCEs = Historical Centennial extreme sea level Events

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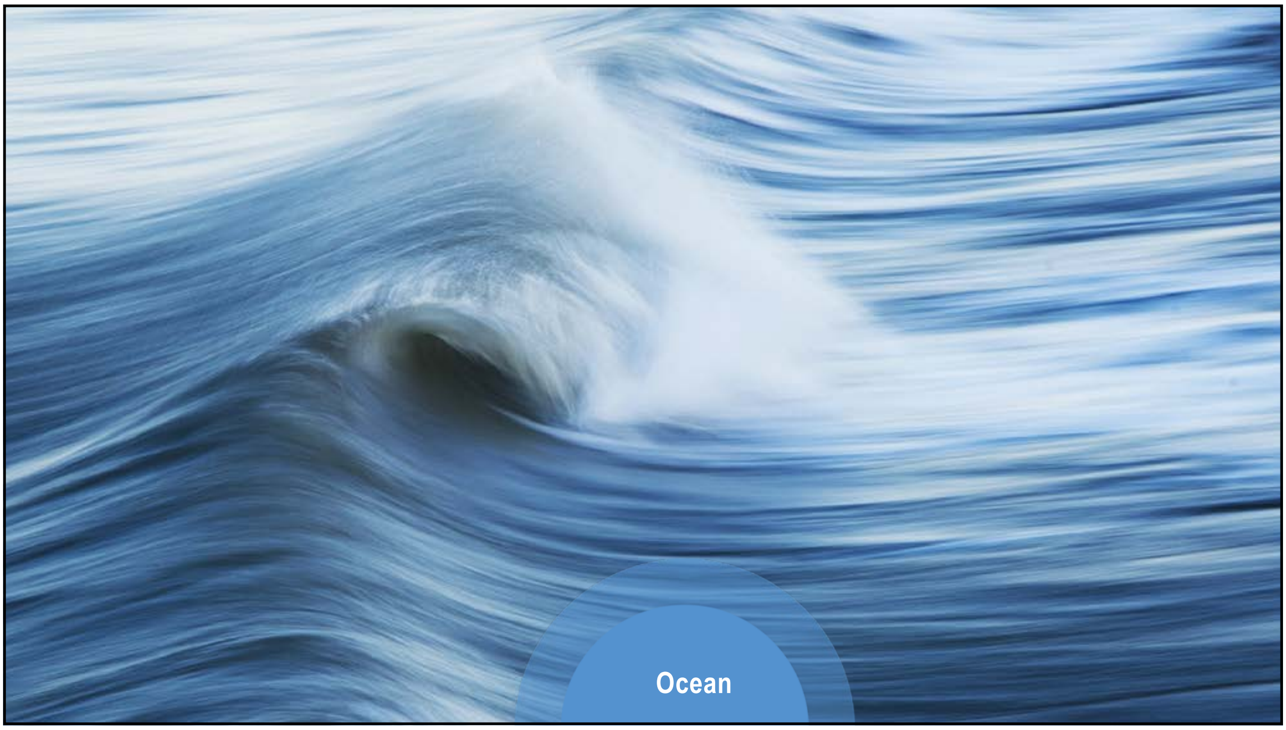
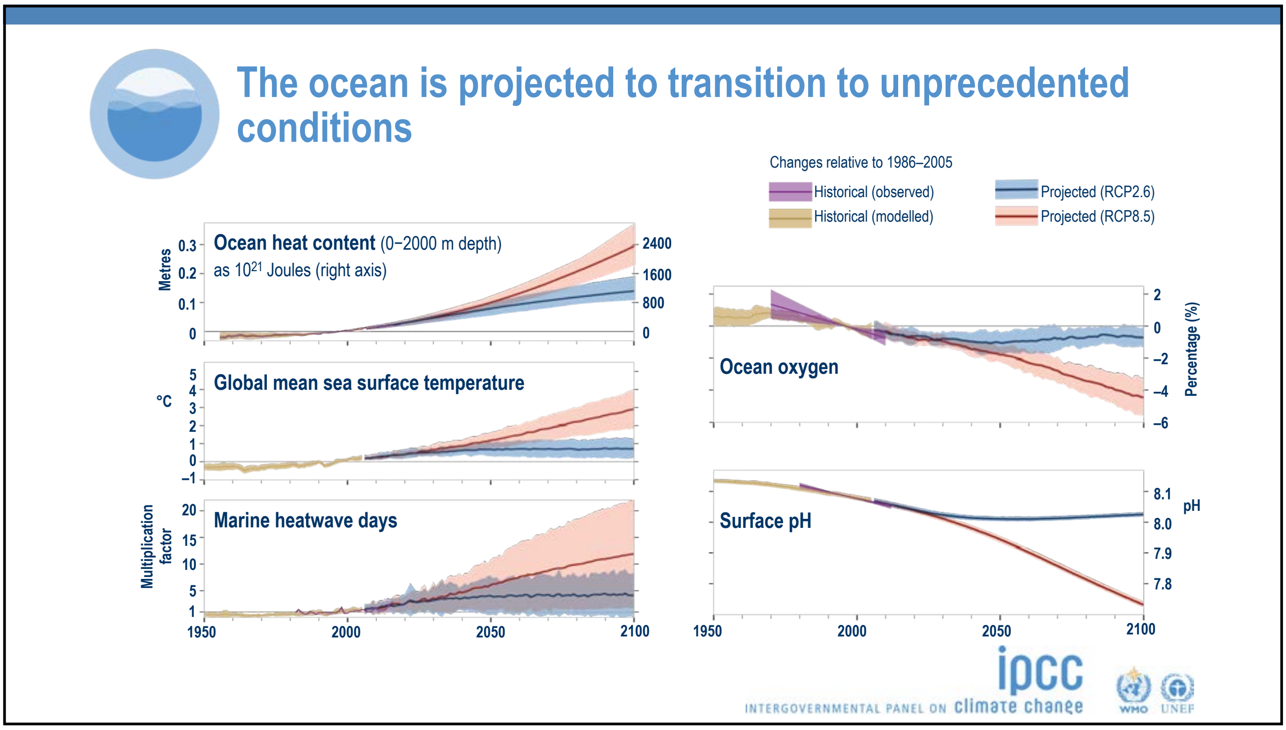

Ocean


The ocean is projected to transition to unprecedented conditions
Changes relative to 1986–2005
Historical (observed)
Historical (modelled)
Projected (RCP2.6)
Projected (RCP8.5)
Ocean heat content (0–2000 m depth) as 10²¹ Joules (right axis)
Metres
0.3
0.2
0.1
0
2400
1600
800
0
Global mean sea surface temperature
°C
5
4
3
2
1
0
–1
Marine heatwave days
Multiplication factor
20
15
10
5
1
1950
2000
2050
2100
Ocean oxygen
Percentage (%)
2
0
–2
–4
–6
Surface pH
pH
8.1
8.0
7.9
7.8
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Observed regional hazards and impacts in the ocean

			Arctic	EBUS[1]	North Atlantic	North Pacific	South Atlantic	South Pacific	Southern Ocean	Temperate Indian Ocean	Tropical Atlantic	Tropical Indian Ocean	Tropical Pacific
Attributed to Greenhouse Gases	Physical changes	Temperature	●● increase	● increase and decrease	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase	● increase and decrease
		Oxygen		● decrease	● decrease	● decrease	● decrease	● increase and decrease	● decrease	● increase and decrease	● decrease	● decrease	● decrease
		Ocean pH	●●● decrease	●●● decrease	●●● decrease	●●● decrease	●●● decrease	●●● decrease	●●● decrease	●●● decrease	●●● decrease	●●● decrease	●●● decrease
		Sea ice extent	●●● decrease						● increase and decrease				
		Sea level	● increase	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase	●● increase
Attributed to Climate Change	Ecosystems	Upper water column											
		Coral											
		Coastal wetlands											
		Kelp forest											
		Rocky shores											
		Deep sea											
		Polar benthos											
		Sea ice-associated											
	Human systems and ecosystem services	Fisheries											
		Tourism											
		Habitat services											
		Transportation/shipping											
		Cultural services											
		Coastal carbon sequestration											

Physical changes
- increase
- decrease
- increase and decrease

Systems
- positive
- negative
- positive and negative

Attribution confidence
- ●●● high
- ●● medium
- ● low

no assessment

[1] Eastern Boundary Upwelling Systems (Benguela Current, Canary Current, California Current, and Humboldt Current); {Box 5.3}

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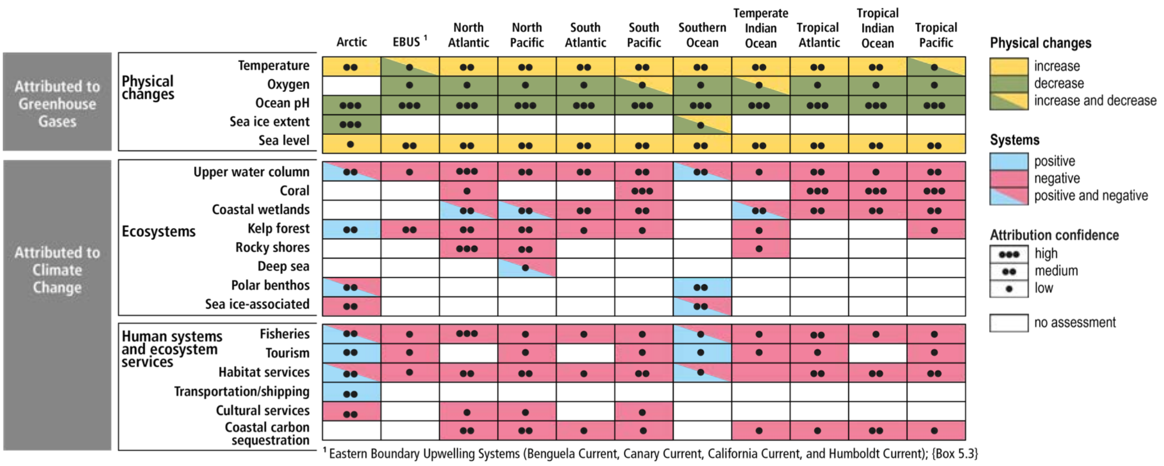
Observed regional hazards and impacts in the ocean



[1] Eastern Boundary Upwelling Systems (Benguela Current, Canary Current, California Current, and Humboldt Current); {Box 5.3}

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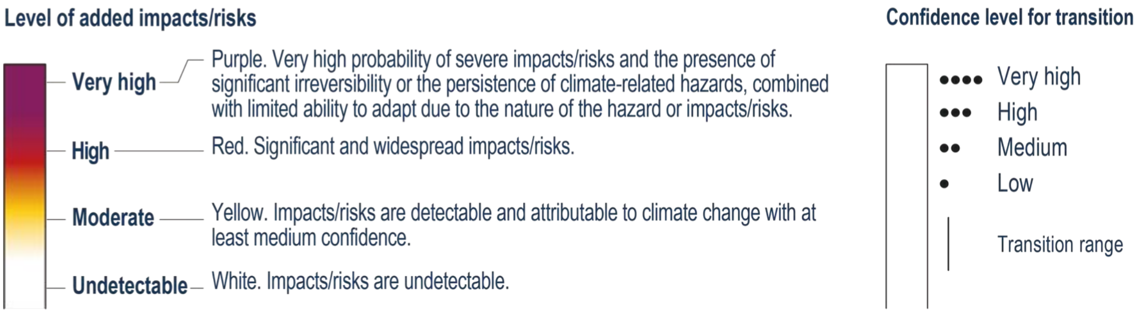
Interpretation of the burning embers



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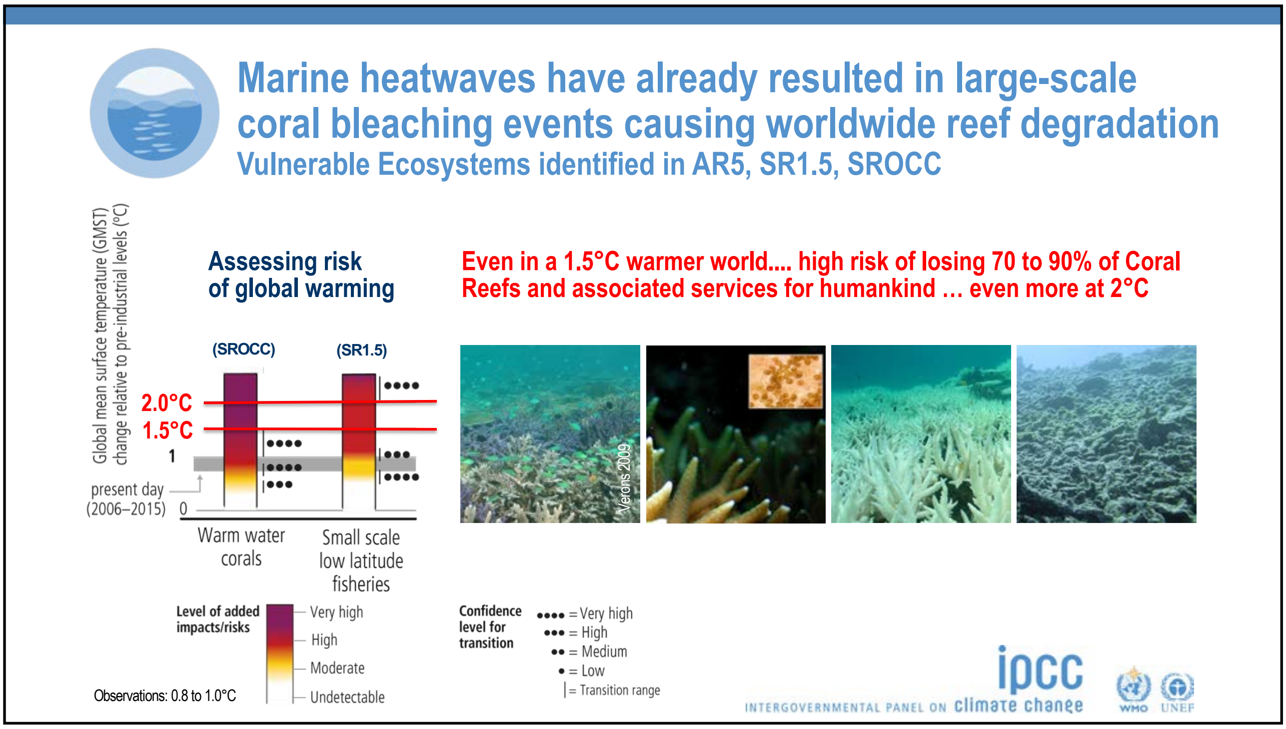

Marine heatwaves have already resulted in large-scale coral bleaching events causing worldwide reef degradation
Vulnerable Ecosystems identified in AR5, SR1.5, SROCC
Assessing risk of global warming
Even in a 1.5°C warmer world.... high risk of losing 70 to 90% of Coral Reefs and associated services for humankind … even more at 2°C
Global mean surface temperature (GMST) change relative to pre-industrial levels (°C)
(SROCC)
(SR1.5)
2.0°C
1.5°C
1
present day (2006–2015)
0
Warm water corals
Small scale low latitude fisheries
Veron 2009
Level of added impacts/risks
Very high
High
Moderate
Undetectable
Observations: 0.8 to 1.0°C
Confidence level for transition
•••• = Very high
••• = High
•• = Medium
• = Low
| = Transition range
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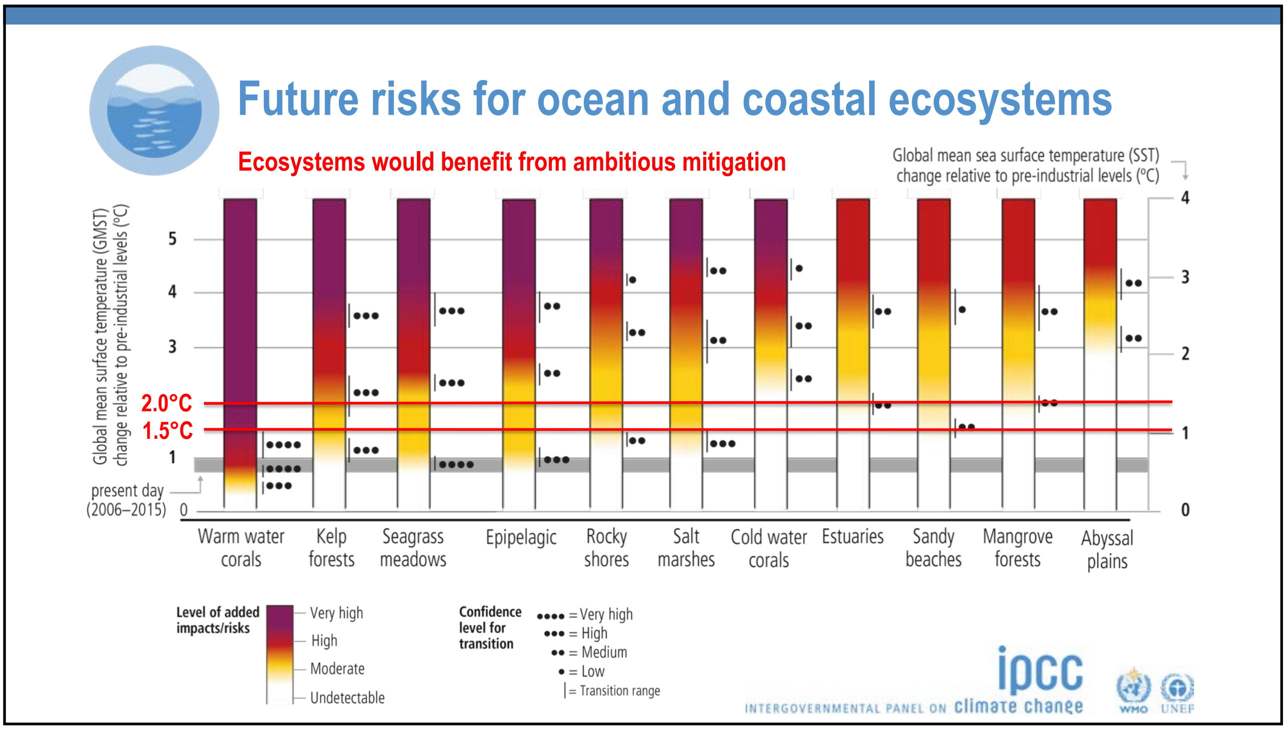

Future risks for ocean and coastal ecosystems
Ecosystems would benefit from ambitious mitigation
Global mean sea surface temperature (SST) change relative to pre-industrial levels (°C)
Global mean surface temperature (GMST) change relative to pre-industrial levels (°C)
5
4
3
2.0°C
1.5°C
1
present day (2006–2015)
0
Warm water corals
Kelp forests
Seagrass meadows
Epipelagic
Rocky shores
Salt marshes
Cold water corals
Estuaries
Sandy beaches
Mangrove forests
Abyssal plains
Level of added impacts/risks
Very high
High
Moderate
Undetectable
Confidence level for transition
•••• = Very high
••• = High
•• = Medium
• = Low
| = Transition range
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Risks to ocean and coastal ecosystems increase with the level of warming

- Projected ecosystem responses include **losses of species habitat and diversity**, and **degradation of ecosystem functions**
- Warm-water **corals** are at **high risk already** today
- Most **coastal ecosystems**, including seagrass meadows and kelp forests, are at moderate to high risk at 1.5ºC, and **risk increases at 2ºC**
- Ecosystems would benefit from **keeping warming at or below 1.5°C**

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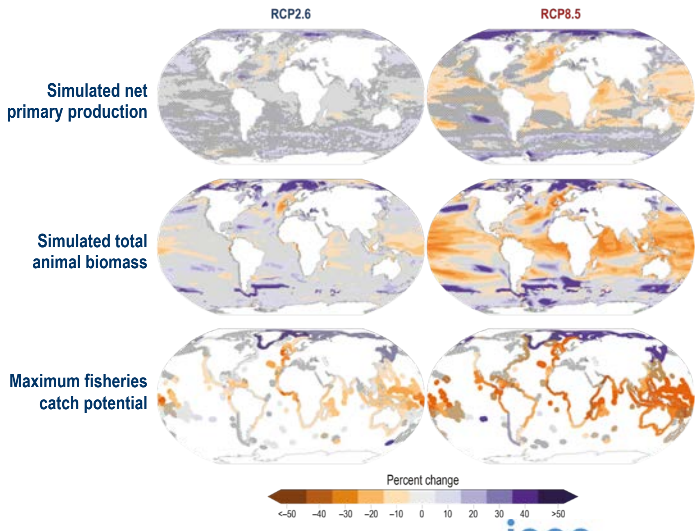
Future changes, impacts and risks for ocean ecosystems

- Physical and biogeochemical changes in the ocean affect primary production, i.e. the base of the oceanic food web
- Marine animals such as fish and invertebrates are directly and indirectly affected by the abiotic and biotic changes in the ocean



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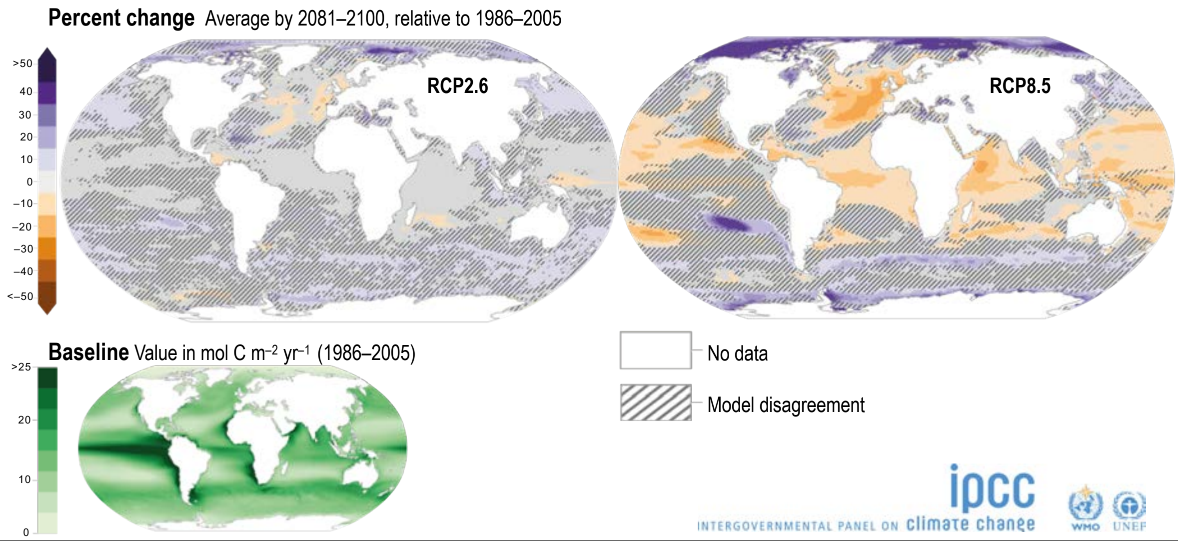
Future changes in net primary production



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Ocean warming and changes in net primary production alter biomass, production and structure of marine ecosystems.

- In recent decades, **Arctic** net **primary production** has **increased** in ice-free waters and is projected to further increase
- Cascading effects on **polar zooplankton** have affected **food web structure and function and fisheries**
- The habitat of **Antarctic krill**, a key prey species for penguins, seals and whales is projected to **contract southwards**
- Under high emissions scenario, net primary production in **tropical oceans** will **decline** 7-16% by 2100

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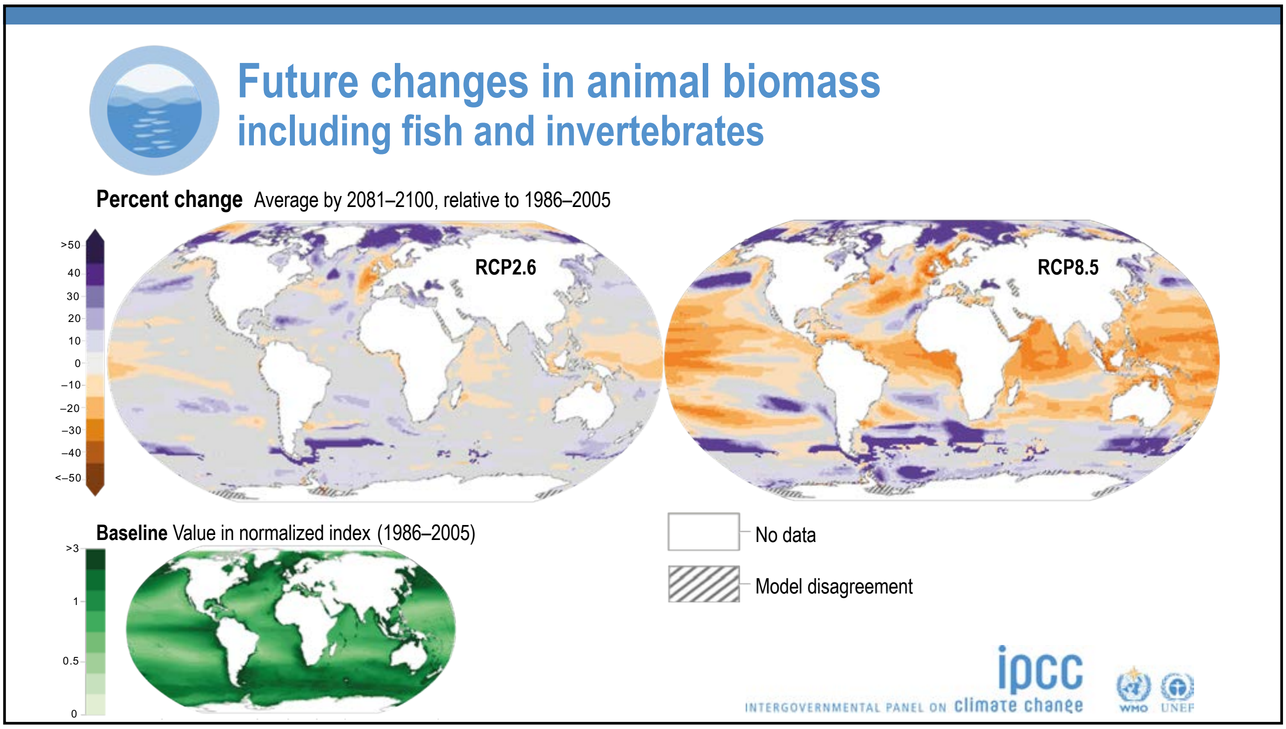
Future changes in animal biomass
including fish and invertebrates
Percent change Average by 2081–2100, relative to 1986–2005
>50
40
30
20
10
0
−10
−20
−30
−40
<−50
RCP2.6
RCP8.5
Baseline Value in normalized index (1986–2005)
>3
1
0.5
0
No data
Model disagreement
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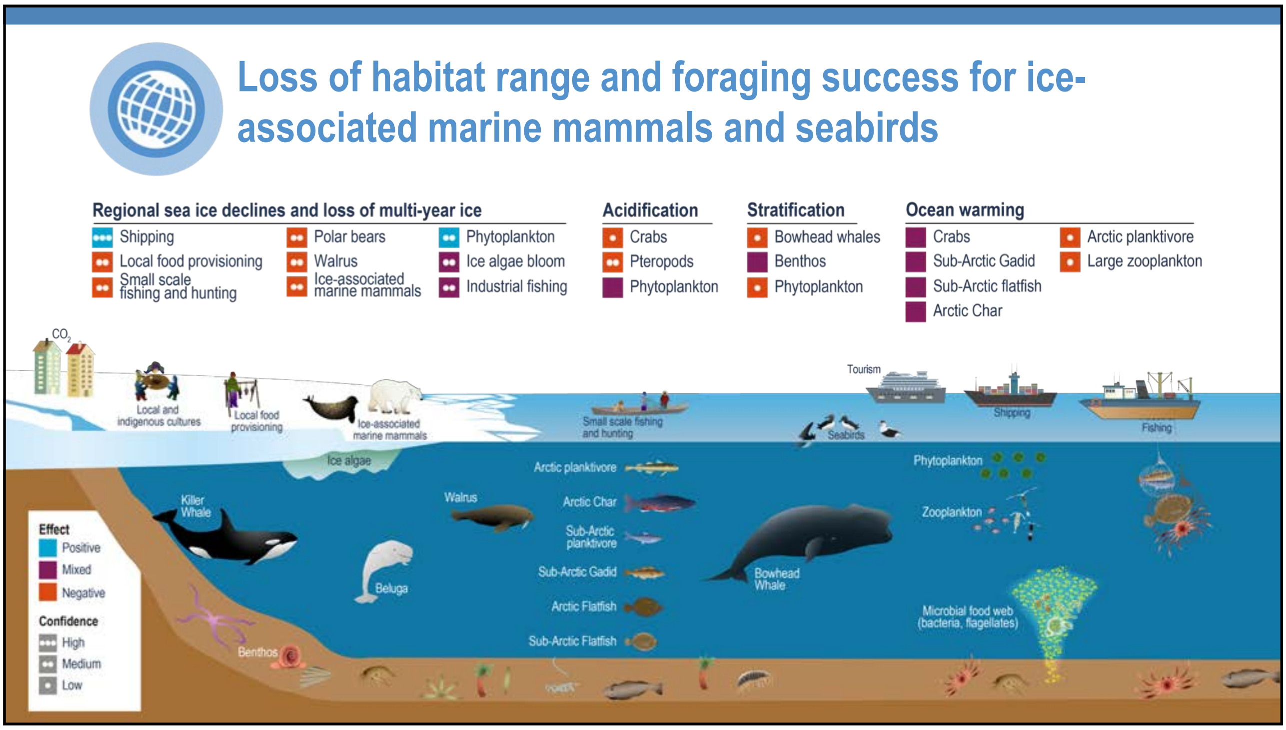

Loss of habitat range and foraging success for ice-associated marine mammals and seabirds
Regional sea ice declines and loss of multi-year ice
Shipping
Local food provisioning
Small scale fishing and hunting
Polar bears
Walrus
Ice-associated marine mammals
Phytoplankton
Ice algae bloom
Industrial fishing
Acidification
Crabs
Pteropods
Phytoplankton
Stratification
Bowhead whales
Benthos
Phytoplankton
Ocean warming
Crabs
Sub-Arctic Gadid
Sub-Arctic flatfish
Arctic Char
Arctic planktivore
Large zooplankton
CO2
Local and indigenous cultures
Local food provisioning
Ice-associated marine mammals
Small scale fishing and hunting
Tourism
Shipping
Fishing
Seabirds
Ice algae
Arctic planktivore
Arctic Char
Sub-Arctic planktivore
Sub-Arctic Gadid
Arctic Flatfish
Sub-Arctic Flatfish
Phytoplankton
Zooplankton
Killer Whale
Walrus
Beluga
Bowhead Whale
Microbial food web (bacteria, flagellates)
Benthos
Effect
Positive
Mixed
Negative
Confidence
High
Medium
Low

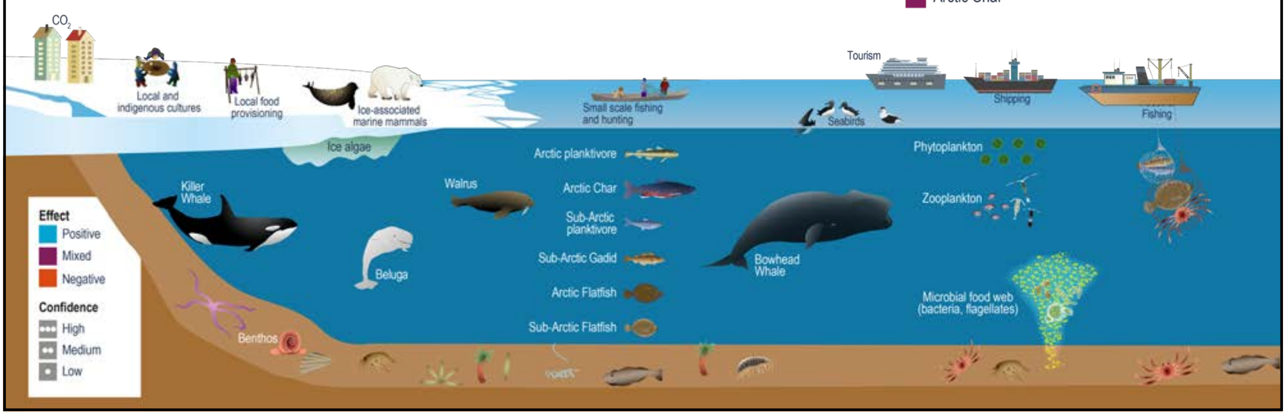
Expansion of sub-Arctic fish communities

Regional sea ice declines and loss of multi-year ice
- Shipping
- Local food provisioning
- Small scale fishing and hunting
- Polar bears
- Walrus
- Ice-associated marine mammals
- Phytoplankton
- Ice algae bloom
- Industrial fishing

Acidification
- Crabs
- Pteropods
- Phytoplankton

Stratification
- Bowhead whales
- Benthos
- Phytoplankton

Ocean warming
- Crabs
- Sub-Arctic Gadid
- Sub-Arctic flatfish
- Arctic Char
- Arctic planktivore
- Large zooplankton



Disrupted access to hunting and fishing areas for Arctic residents including Indigenous populations

Regional sea ice declines and loss of multi-year ice
- Shipping
- Local food provisioning
- Small scale fishing and hunting
- Polar bears
- Walrus
- Ice-associated marine mammals
- Phytoplankton
- Ice algae bloom
- Industrial fishing

Acidification
- Crabs
- Pteropods
- Phytoplankton

Stratification
- Bowhead whales
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Ocean warming
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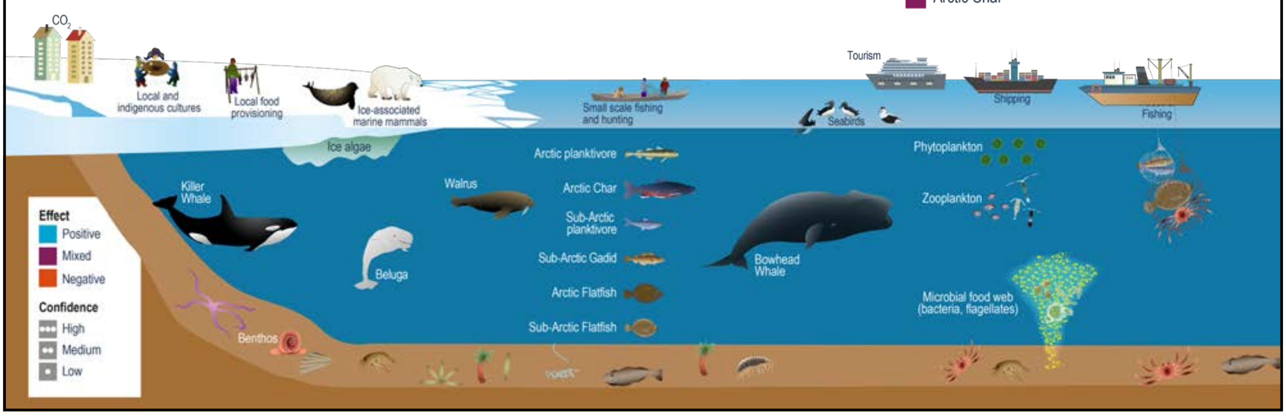
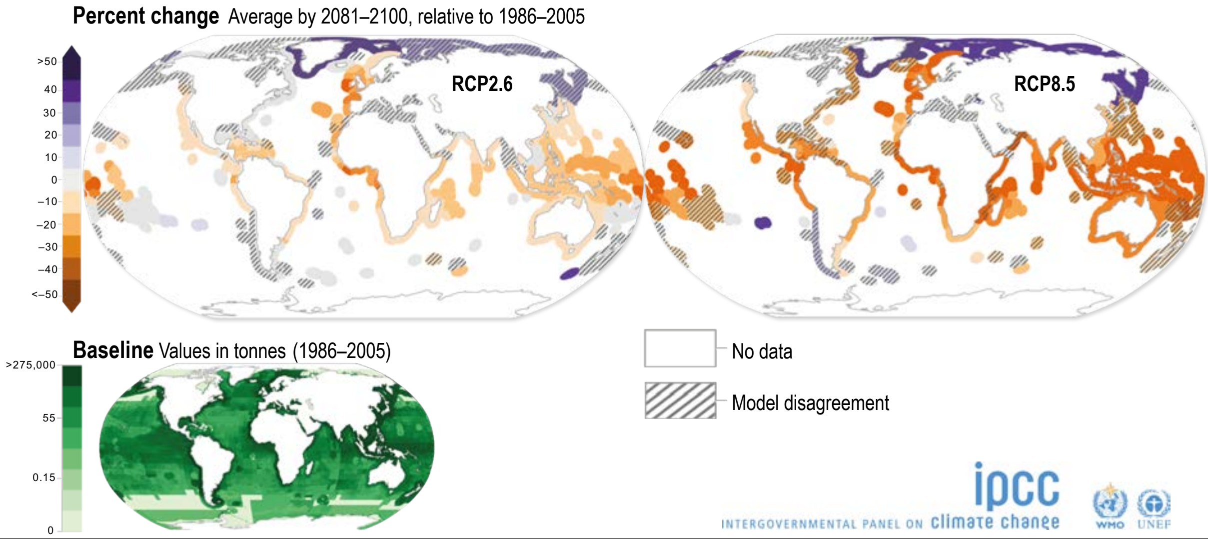


Future changes in maximum fisheries catch potential (in shelf seas)



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Future changes in marine species distribution and production

- Life is specialized on **limited temperature ranges**
- Changes in the ocean cause **shifts in fish populations** and **catch potential**
- These have **positive and negative impacts** on **catches, economic benefits, livelihoods, and local culture**
- Global warming and biogeochemical changes have already contributed to **reduced fisheries catches** in many regions
- Communities (e.g., **Arctic, Small Island Developing States**) that depend highly on seafood may face **risks to nutritional health and food security**

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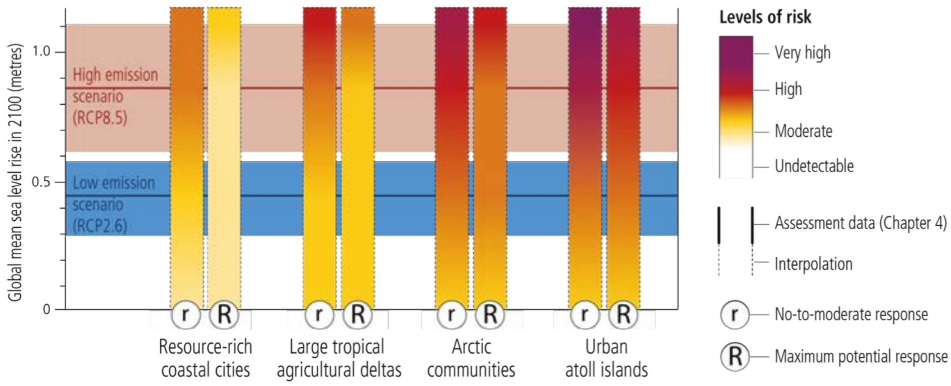
Sea level rise risk and responses

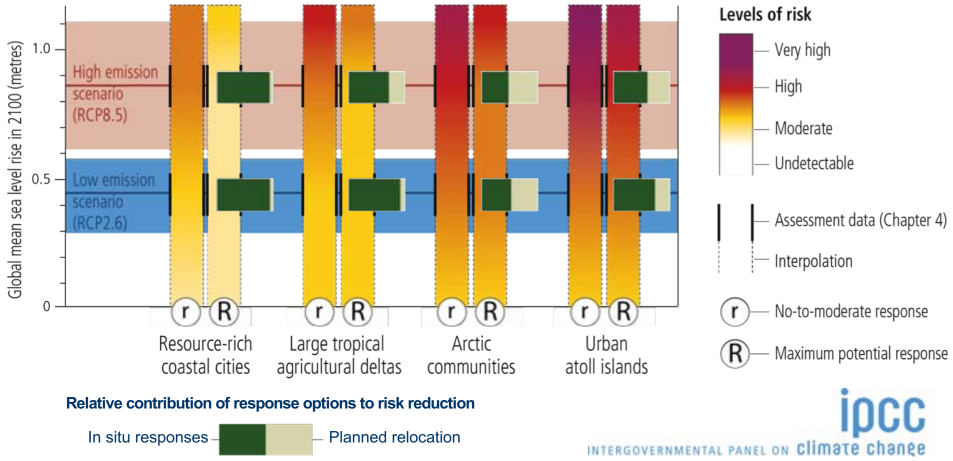
Risk for illustrative geographies based on mean sea level changes



Sea level rise risk and responses

Risk for illustrative geographies based on mean sea level changes

Response capacities and adaptation limits differ between locations and regions



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Various adaptation responses to sea level rise are already being implemented:

- Hard protection
- Sediment-based protection
- Ecosystem-based adaptation (corals, wetlands)
- Costal advance
- Coastal accommodation
- Retreat

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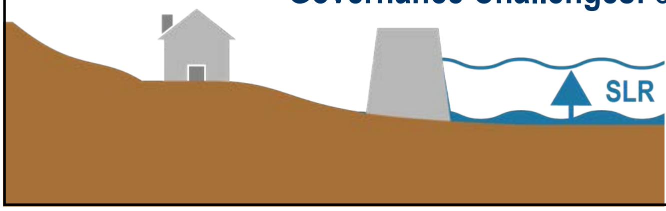
Hard Protection

- **Effectiveness:** multiple metres of Sea level Rise
- **Advantages:** predictable levels of safety
- **Co-benefits:** multifunctional dikes (e.g. recreation, other land use)
- **Drawbacks:** destruction of habitat
- **Economic Efficiency:** high if the value of assets behind protection is high
- **Governance Challenges:** often unaffordable for poorer areas



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Coastal Advance

- **Effectiveness:** multiple metres of sea level rise
- **Advantages:** predictable levels of safety
- **Co-benefits:** generates land and land sale revenues
- **Drawbacks:** groundwater salinisation, enhanced erosion and loss of coastal ecosystems and habitat
- **Economic Efficiency:** very high if land prices are high
- **Governance Challenges:** often unaffordable for poorer areas

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Ecosystem-based Adaptation

(coral and wetland conservation or restoration)

- **Effectiveness:** effective up to 0.5–1 cm y^{-1} sea level rise
- **Advantages:** opportunity for community involvement
- **Co-benefits:** habitat gain, biodiversity
- **Drawbacks:** corals: long–term effectiveness depends on ocean warming, acidification and emission scenarios; wetlands: safety levels less predictable, a lot of land required
- **Economic Efficiency:** limited evidence on benefit–cost ratios
- **Governance Challenges:** permits difficult to obtain, lack of finance, lack of enforcement of conservation policies

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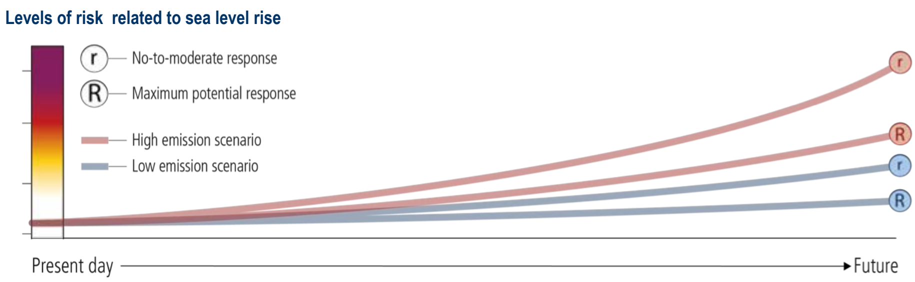
Time dependent risk reduction … time-limited benefits

- Schematic illustration of **risk reduction** and the **delay** of a given risk level through responses to sea level rise and/or mitigation
- The amount of risk reduction and delay depends on sea level and response scenarios and varies between contexts and localities



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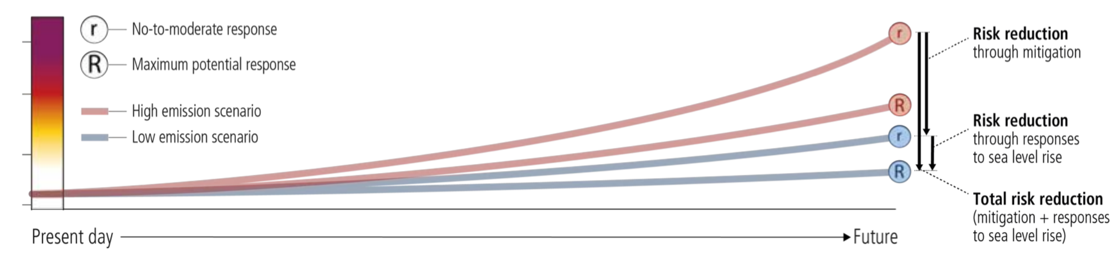

Time dependent risk reduction … time-limited benefits

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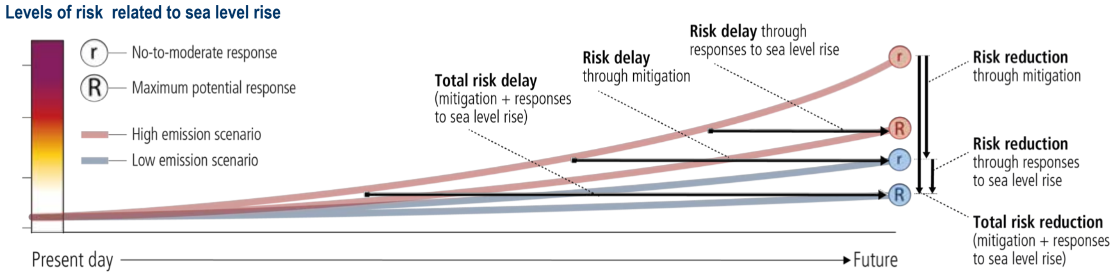

Benefits of responses to sea level rise and mitigation

- Risk may continue to increase at different rates, exemplified by sea level rise, also depending on the **capacity of responses**, i.e. local adaptation and/or retreat, as well as depending on **mitigation efforts**
- Risk reduction through adaptation may therefore be **time limited,**

…emphasizing the urgency of sufficient action

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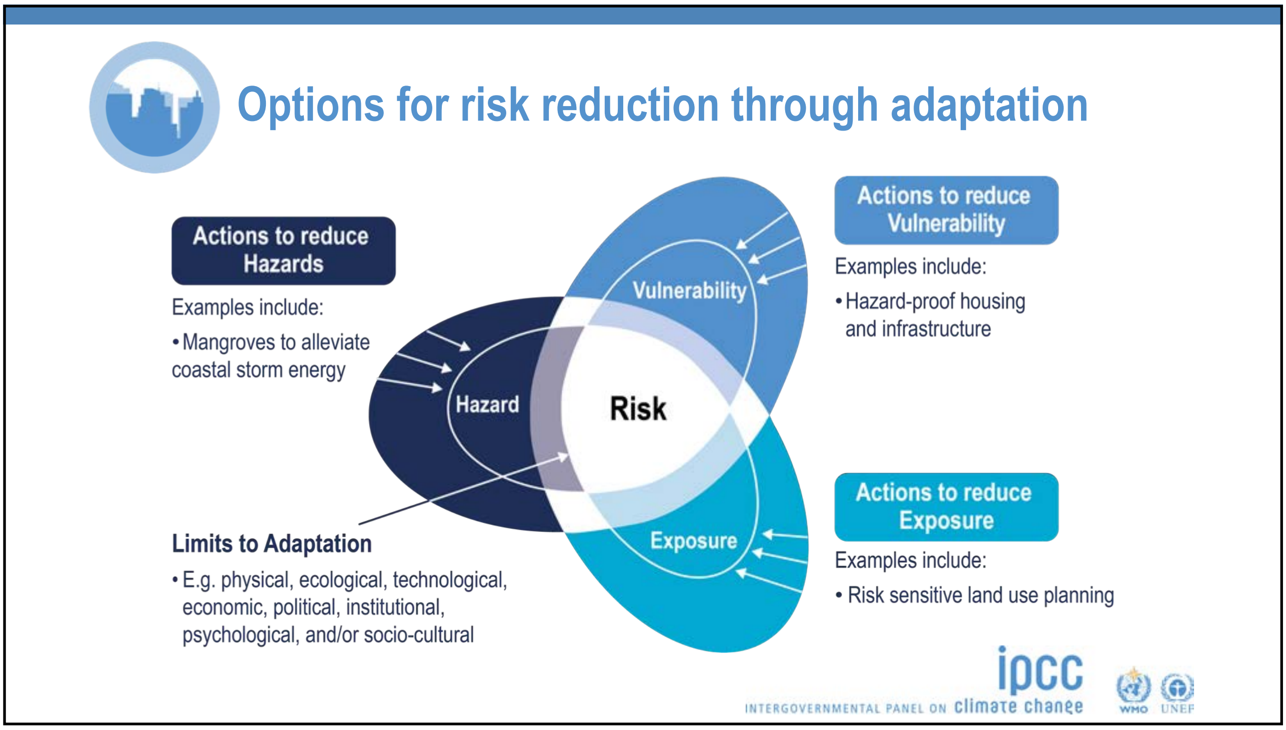
Governance
and policy
Photo: Kelly-Marie Davidson, PML


Options for risk reduction through adaptation
Actions to reduce Hazards
Examples include:
• Mangroves to alleviate coastal storm energy
Hazard
Vulnerability
Risk
Exposure
Actions to reduce Vulnerability
Examples include:
• Hazard-proof housing and infrastructure
Actions to reduce Exposure
Examples include:
• Risk sensitive land use planning
Limits to Adaptation
• E.g. physical, ecological, technological, economic, political, institutional, psychological, and/or socio-cultural
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Challenges to implementing responses to ocean and cryosphere change

The temporal scales of climate change impacts and their societal consequences operate **on time horizons which are longer than those of governance arrangements** including planning cycles, public and corporate decision making cycles, and financial instruments

Examples include:

- Sea level rise and low-lying islands and coasts

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Challenges to implementing responses to ocean and cryosphere change

- **Impacts** from climate-related changes in the ocean and cryosphere increasingly **challenge current governance efforts** to develop and implement adaptation responses from local to global scales
- In some cases **pushing governance systems to their limits**

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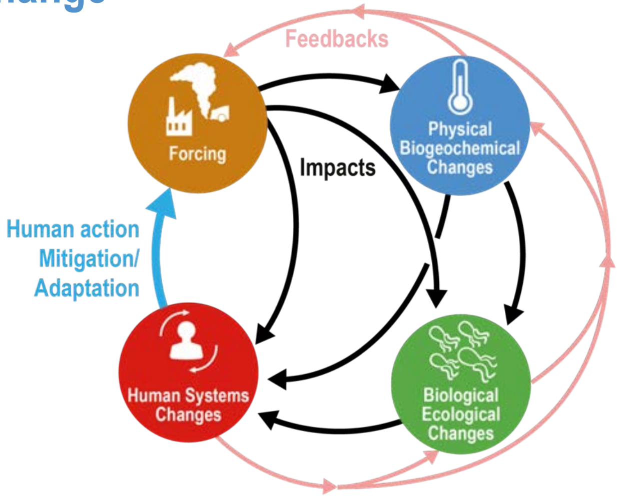
Challenges to implementing responses to ocean and cryosphere change

Governance arrangements are, in many contexts, **too fragmented across administrative boundaries and sectors** to provide integrated responses to the increasing and cascading risks from climate-related changes



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Challenges to implementing responses to ocean and cryosphere change

- Financial, technological, institutional and other **barriers exist** for **implementing responses** to current and projected negative impacts of climate-related changes
- **Adaptive capacity** continues to **differ** between as well as within **communities and societies**
- People with **highest exposure and vulnerability** to current and future hazards from ocean and cryosphere changes are often also those with **lowest adaptive capacity**

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Strengthening response options

- **Reducing other pressures** such as pollution and habitat modification will **help species** adjust to changes in their environment
- Policy frameworks for integrated water management, fisheries management and networks of protected areas **offer opportunities for people and species to adapt**
- **Nature-based adaptation** such as ecosystem restoration can be locally most effective when **community supported, science based** and connect with **local knowledge and indigenous knowledge**
- Such approaches bring **multiple benefits** for biodiversity, humans and, in some circumstances, climate mitigation

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Key enablers for implementing effective responses include:

- **Intensifying cooperation and coordination** across scales, jurisdictions, sectors, policy domains and planning horizons
- **Regional and transboundary cooperation**, including treaties and conventions
- **Investments in education and capacity building** including engagement of local communities and Indigenous peoples
- Addressing **social vulnerability and equity**

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SROCC reveals the benefits of ambitious mitigation and effective adaptation for sustainable development

and, conversely, the escalating costs and risks of delayed action

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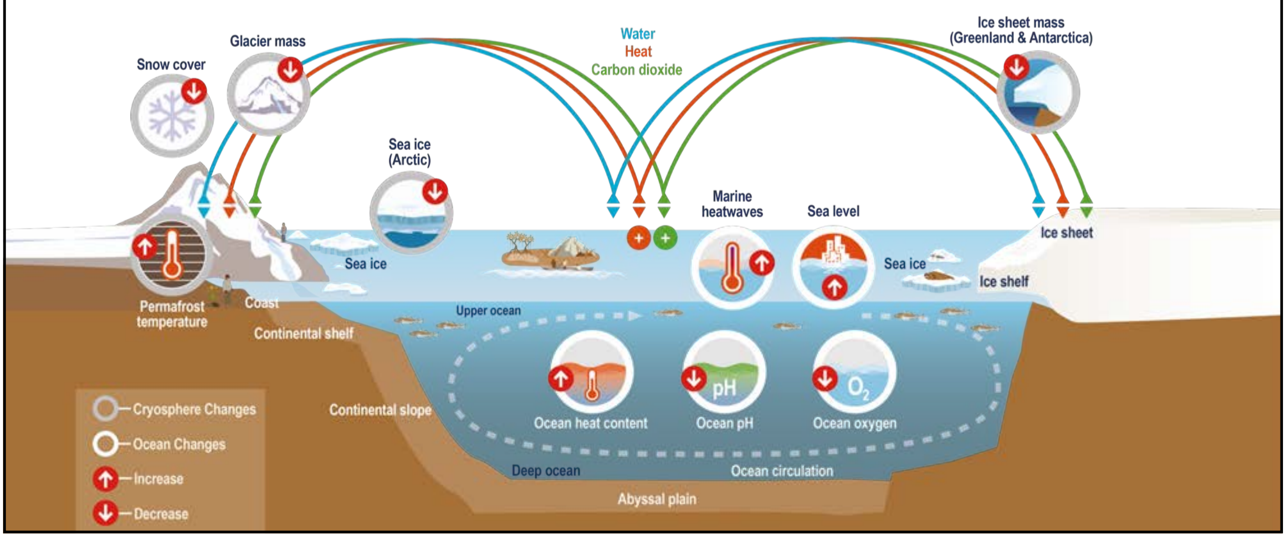
SROCC Summary

On 80% of the earth surface climate change affects the life sustaining systems - from the top of the mountains to the depth of oceans. These changes will continue for generations to come



SROCC: Knowledge for action

- Highlights the **urgency** of prioritizing timely, ambitious and coordinated action to address widespread and enduring changes in the ocean and cryosphere
- Shows that **protecting and restoring ecosystems** and careful management of natural resources **can reduce risks** and provide multiple societal benefits
- Empowers people, communities and governments to tackle the **unprecedented transitions in all aspects of society**
- Provides evidence of the **benefits** of combining scientific with local and indigenous knowledge
- Focuses, for the first time, on the **importance of education and climate literacy**

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The more decisively and earlier we act, the more able we will be to address unavoidable changes, manage risks, improve our lives and achieve sustainability for ecosystems and people around the world – today and in the future.

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Our ocean and cryosphere –
They sustain us.
They are under pressure.
Their changes affect all our lives.

The time for action is now.

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More Information:

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