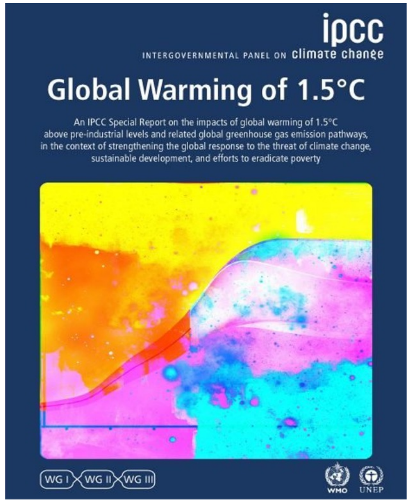
INTERGOVERNMENTAL PANEL ON climate change

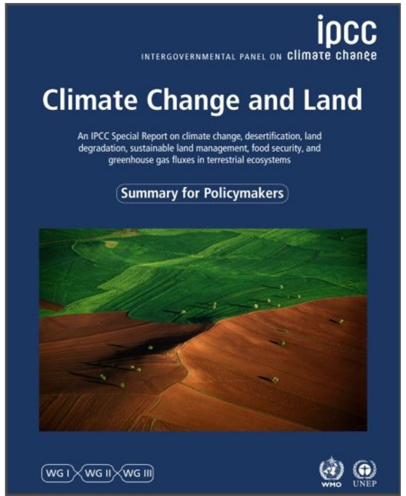
WMO UNEP

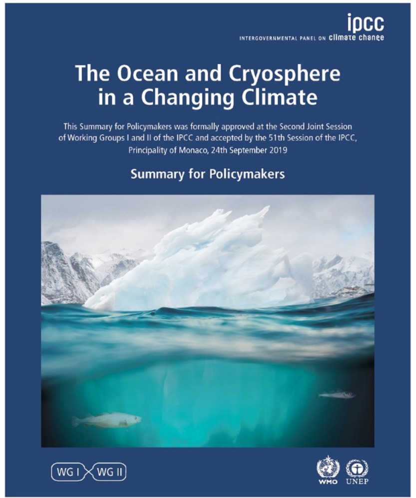
IPCC Workshop on the Use of Scenarios in AR6 and Subsequent Assessments

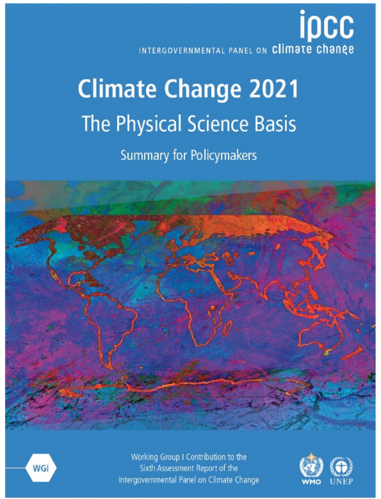
There are no “IPCC scenarios”

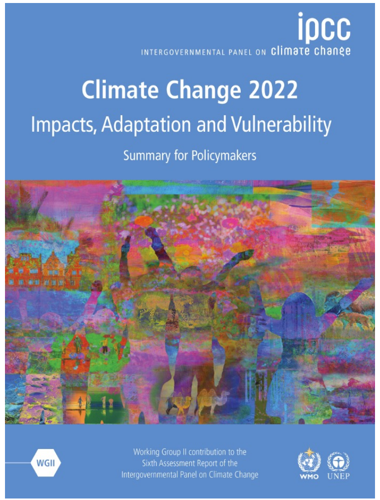
There are only scenarios assessed by IPCC

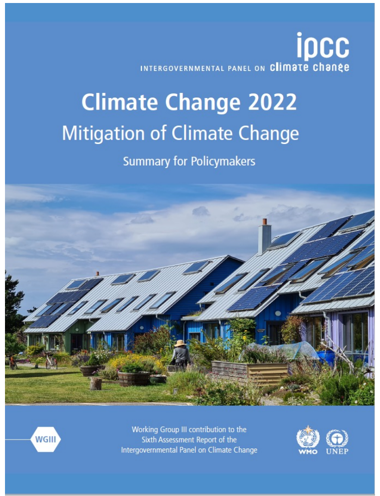


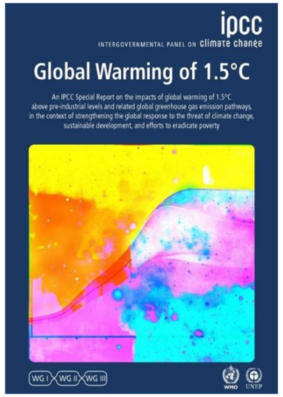


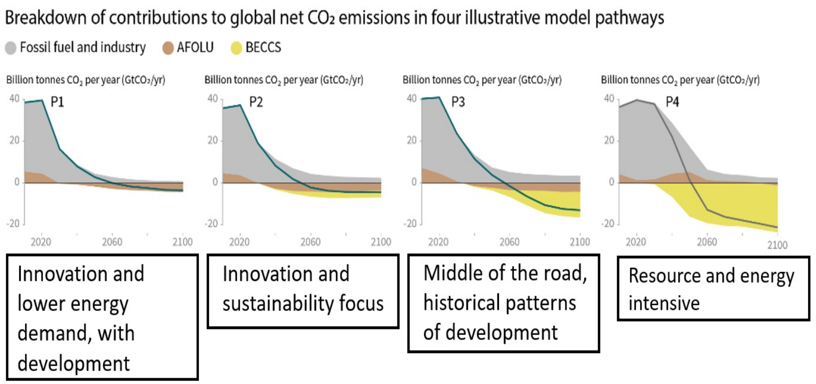




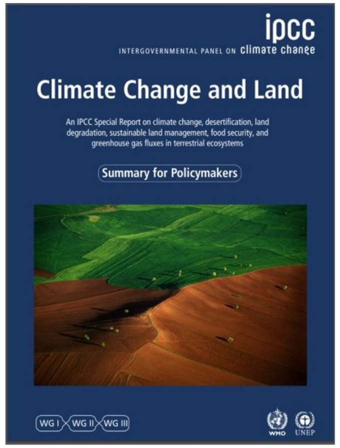








Illustrative pathways in the summary



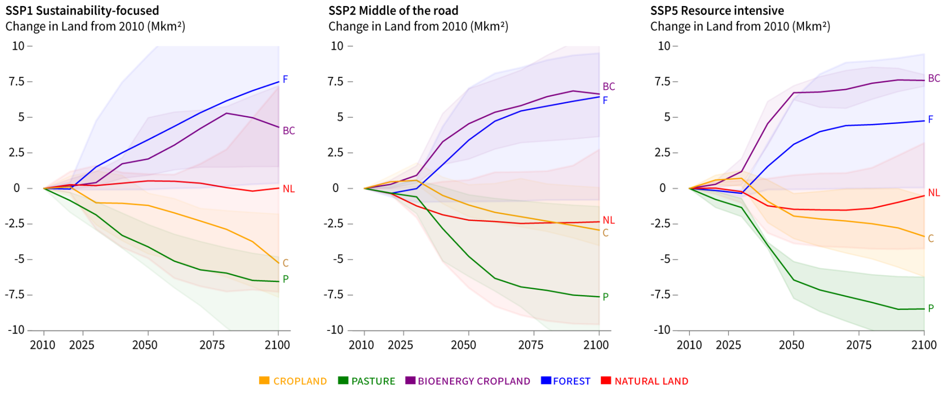
A. Pathways linking socioeconomic development, mitigation responses and land

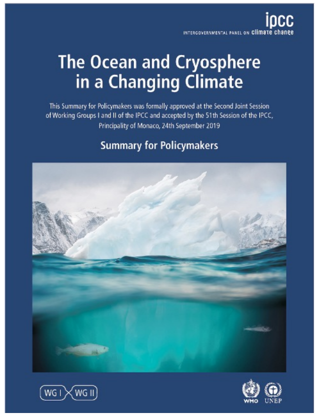
Socioeconomic development and land management influence the evolution of the land system including the relative amount of land allocated to CROPLAND, PASTURE, BIOENERGY CROPLAND, FOREST, and NATURAL LAND. The lines show the median across Integrated Assessment Models (IAMs) for three alternative shared socioeconomic pathways (**SSP1**, **SSP2** and **SSP5** at **RCP1.9**); shaded areas show the range across models. Note that pathways illustrate the effects of climate change mitigation but not those of climate change impacts or adaptation.

A. Sustainability-focused (SSP1)
Sustainability in land management, agricultural intensification, production and consumption patterns result in reduced need for agricultural land, despite increases in per capita food consumption. This land can instead be used for reforestation, afforestation, and bioenergy.

B. Middle of the road (SSP2)
Societal as well as technological development follows historical patterns. Increased demand for land mitigation options such as bioenergy, reduced deforestation or afforestation decreases availability of agricultural land for food, feed and fibre.

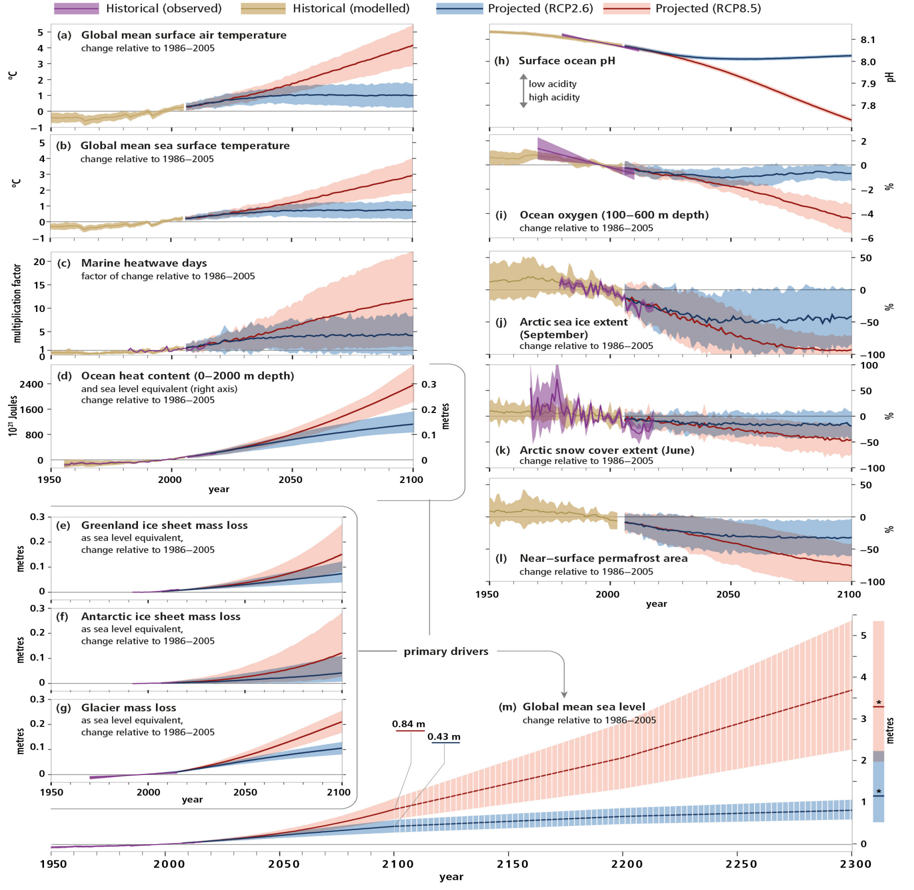
C. Resource intensive (SSP5)
Resource-intensive production and consumption patterns, results in high baseline emissions. Mitigation focuses on technological solutions including substantial bioenergy and BECCS . Intensification and competing land uses contribute to declines in agricultural land.





Past and future changes in the ocean and cryosphere

Historical changes (observed and modelled) and projections under RCP2.6 and RCP8.5 for key indicators



Box SPM.1 The use of scenarios and modelled pathways in the AR6 Synthesis Report

Modelled scenarios and pathways[19] are used to explore future emissions, climate change, related impacts and risks, and possible mitigation and adaptation strategies and are based on a range of assumptions, including socio-economic variables and mitigation options. These are quantitative projections and are neither predictions nor forecasts. Global modelled emission pathways, including those based on cost effective approaches contain regionally differentiated assumptions and outcomes, and have to be assessed with the careful recognition of these assumptions. Most do not make explicit assumptions about global equity, environmental justice or intra-regional income distribution. IPCC is neutral with regard to the assumptions underlying the scenarios in the literature assessed in this report, which do not cover all possible futures.[20] *{Cross-Section Box.2}*

WGI assessed the climate response to five illustrative scenarios based on Shared Socio-economic Pathways (SSPs)[21] that cover the range of possible future development of anthropogenic drivers of climate change found in the literature. High and very high GHG emissions scenarios (SSP3-7.0 and SSP5-8.5[22]) have CO_2 emissions that roughly double from current levels by 2100 and 2050, respectively. The intermediate GHG emissions scenario (SSP2-4.5) has CO_2 emissions remaining around current levels until the middle of the century. The very low and low GHG emissions scenarios (SSP1-1.9 and SSP1-2.6) have CO_2 emissions declining to net zero around 2050 and 2070, respectively, followed by varying levels of net negative CO_2 emissions. In addition, Representative Concentration Pathways (RCPs)[23] were used by WGI and WGII to assess regional climate changes, impacts and risks. In WGIII, a large number of global modelled emissions pathways were assessed, of which 1202 pathways were categorised based on their assessed global warming over the 21st century; categories range from pathways that limit warming to 1.5°C with more than 50% likelihood (noted >50% in this report) with no or limited overshoot (C1) to pathways that exceed 4°C (C8). *{Cross-Section Box.2} (Box SPM.1, Table 1)*

Global warming levels (GWLs) relative to 1850-1900 are used to integrate the assessment of climate change and related impacts and risks since patterns of changes for many variables at a given GWL are common to all scenarios considered and independent of timing when that level is reached. *{Cross-Section Box.2}*

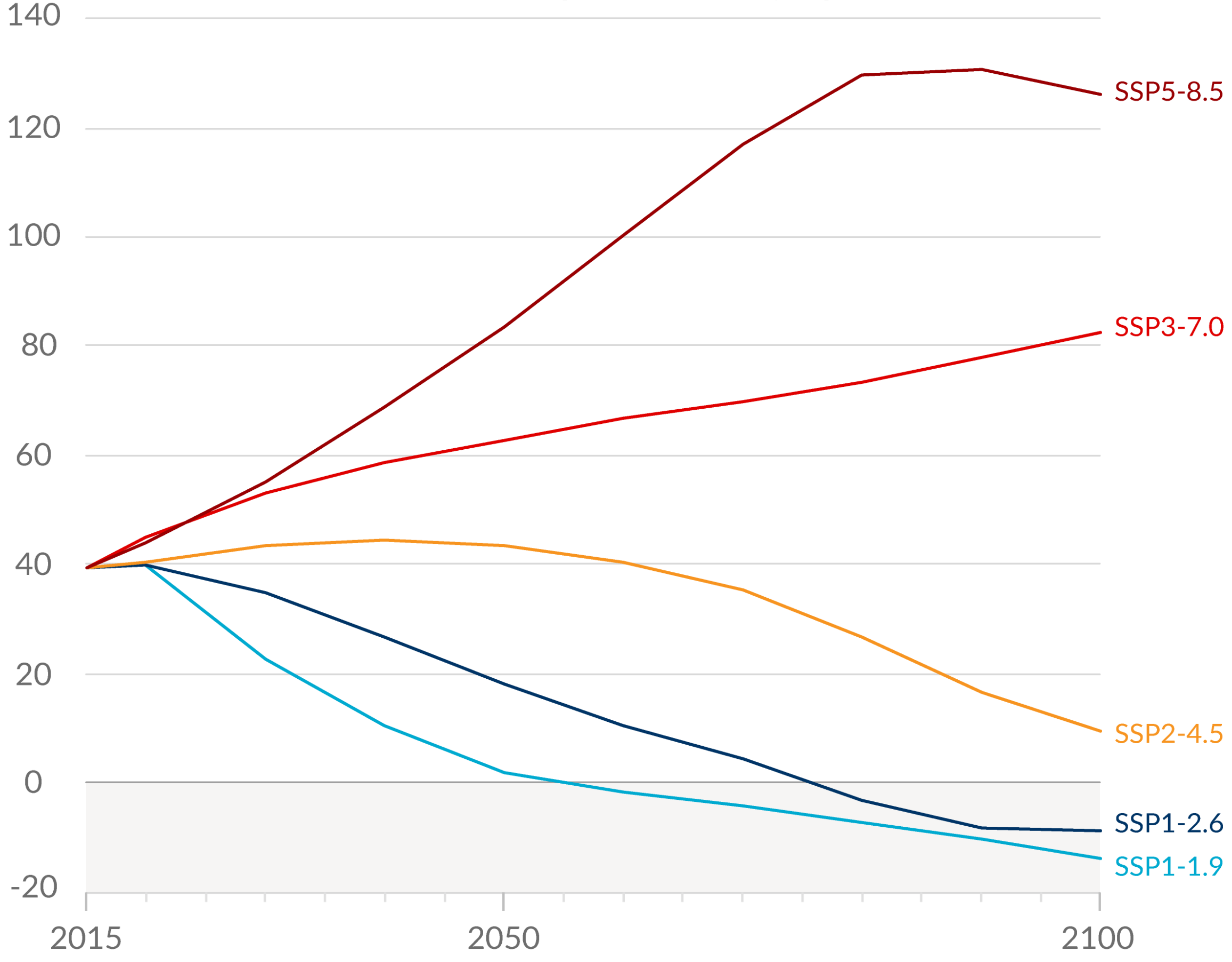
Scenarios and modelled pathways considered across the AR6:

Category in WGIII	Category description	GHG emissions scenarios (SSPx-y*) in WGI & WGII	RCPy** in WGI & WGII
C1	limit warming to 1.5°C (>50%) with no or limited overshoot***	Very low (SSP1-1.9)	
C2	return warming to 1.5°C (>50%) after a high overshoot***		
C3	limit warming to 2°C (>67%)	Low (SSP1-2.6)	RCP2.6
C4	limit warming to 2°C (>50%)		
C5	limit warming to 2.5°C (>50%)		
C6	limit warming to 3°C (>50%)	Intermediate (SSP2-4.5)	RCP 4.5
C7	limit warming to 4°C (>50%)	High (SSP3-7.0)	
C8	exceed warming of 4°C (>50%)	Very high (SSP5-8.5)	RCP 8.5

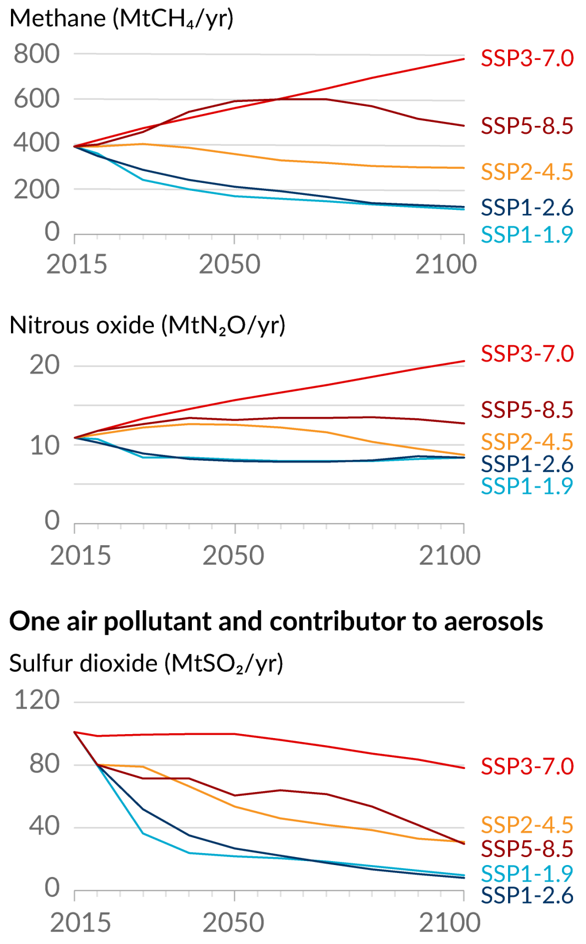
SYR Box SPM.1 Table 1

Scenarios used in IPCC AR6 WGI

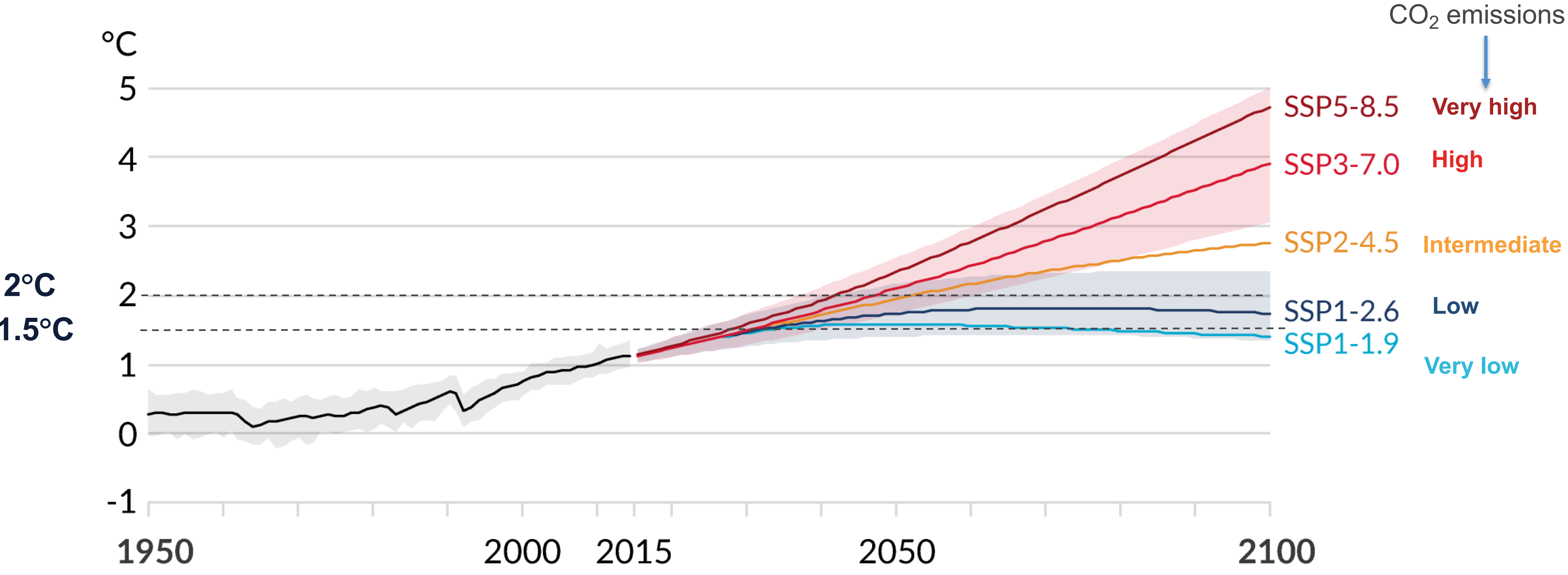
CO_2 emissions ($GtCO_2$/yr)



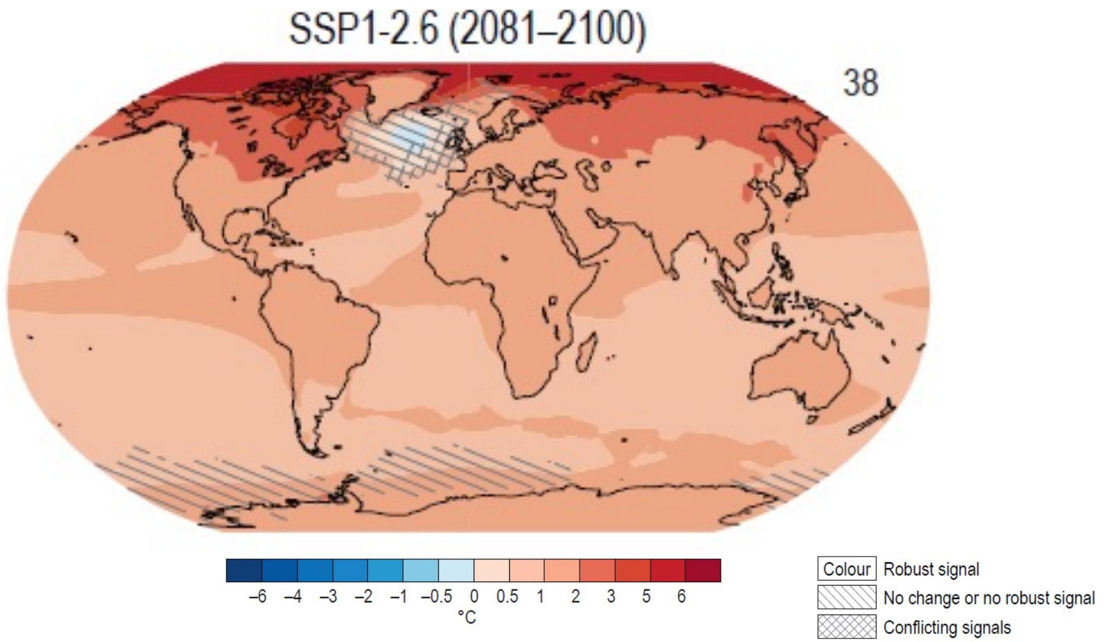
… and non-CO_2 emissions



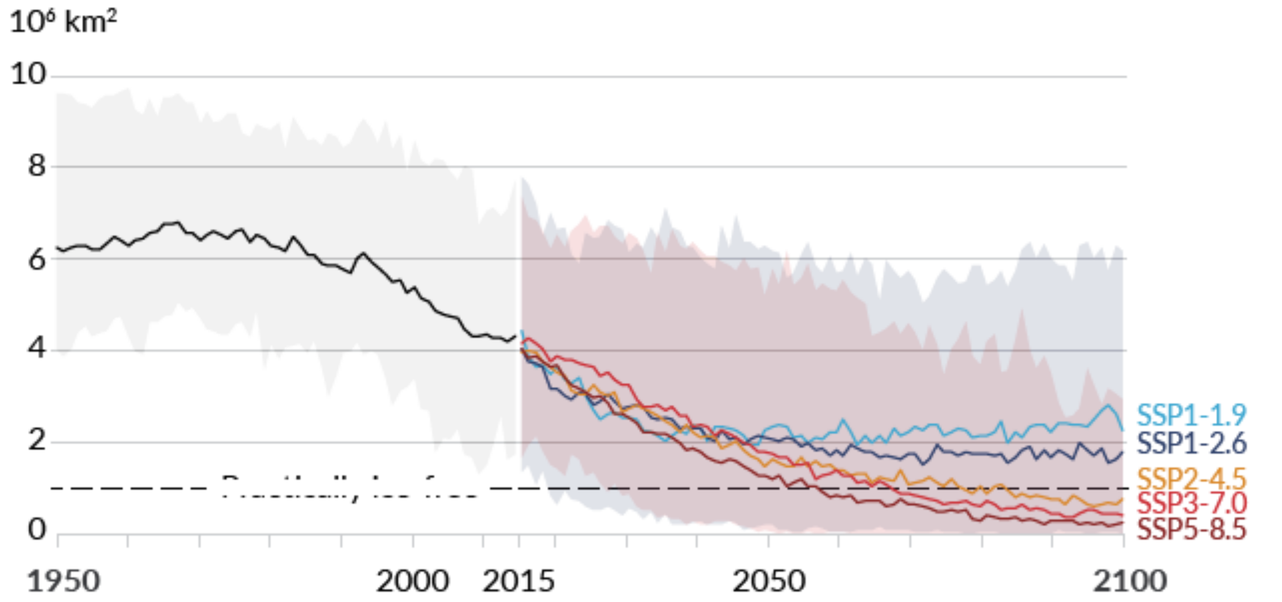
Global surface temperature change relative to 1850-1900



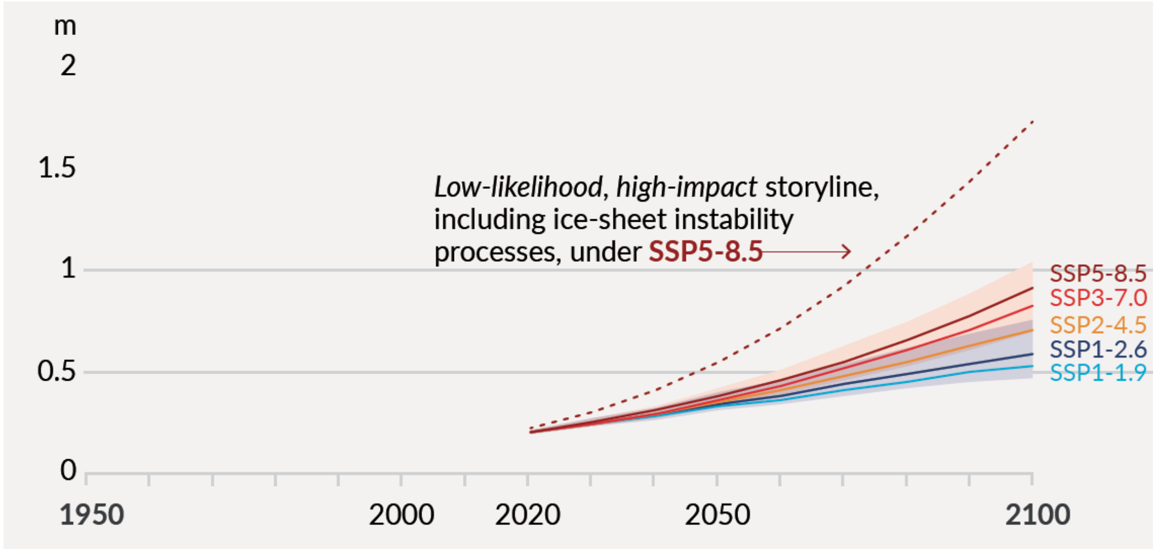
Annual mean temperature change



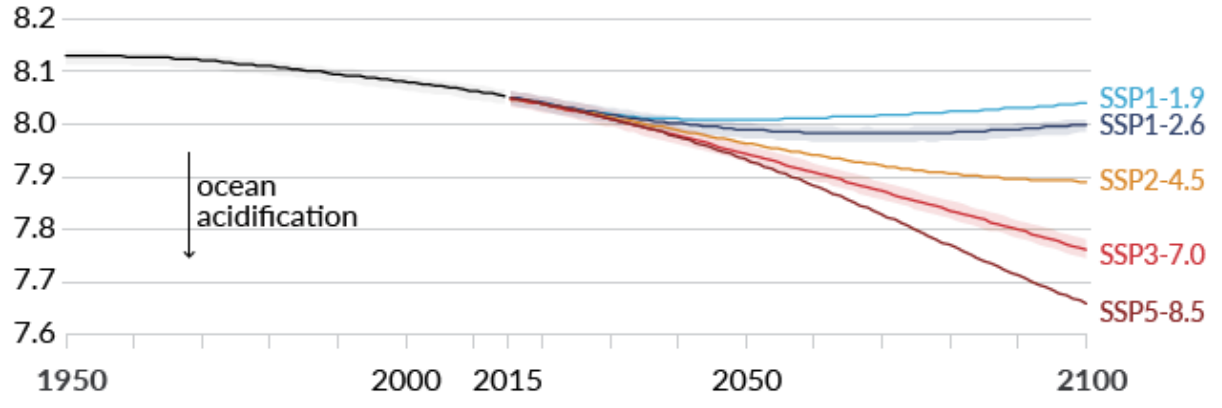
September Arctic Sea Ice

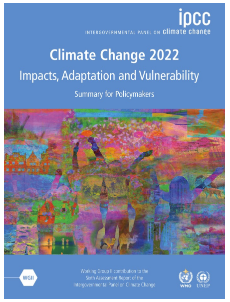


Global mean sea level change relative to 1900



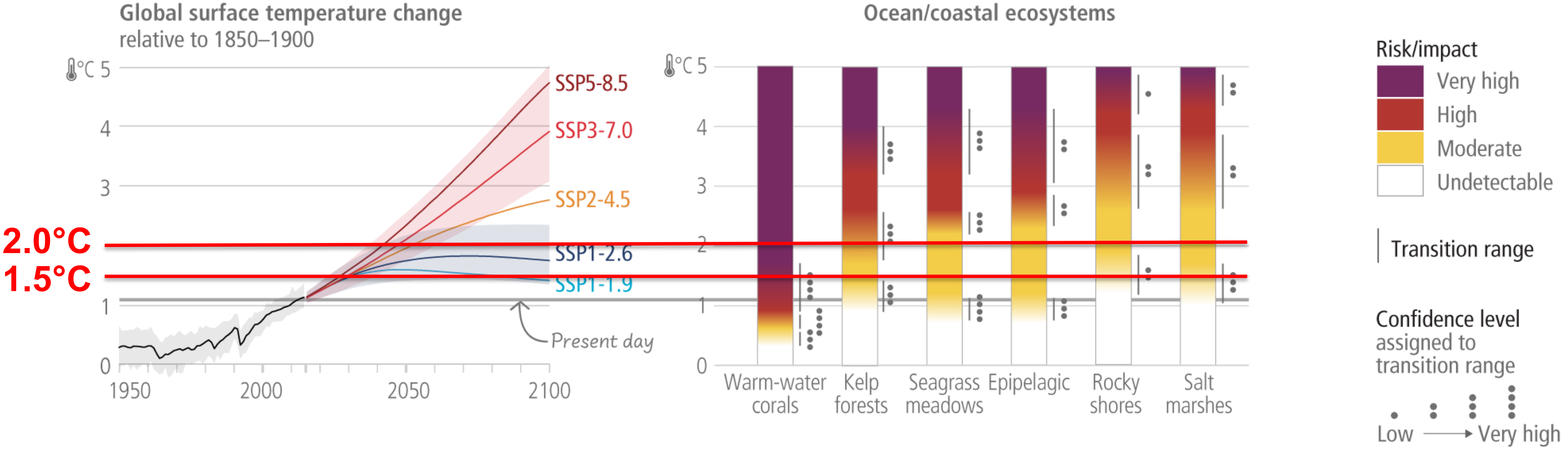
Global ocean surface pH



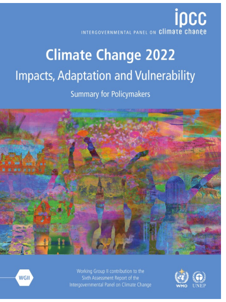


Concentration and land use scenarios (constrained climate projections)

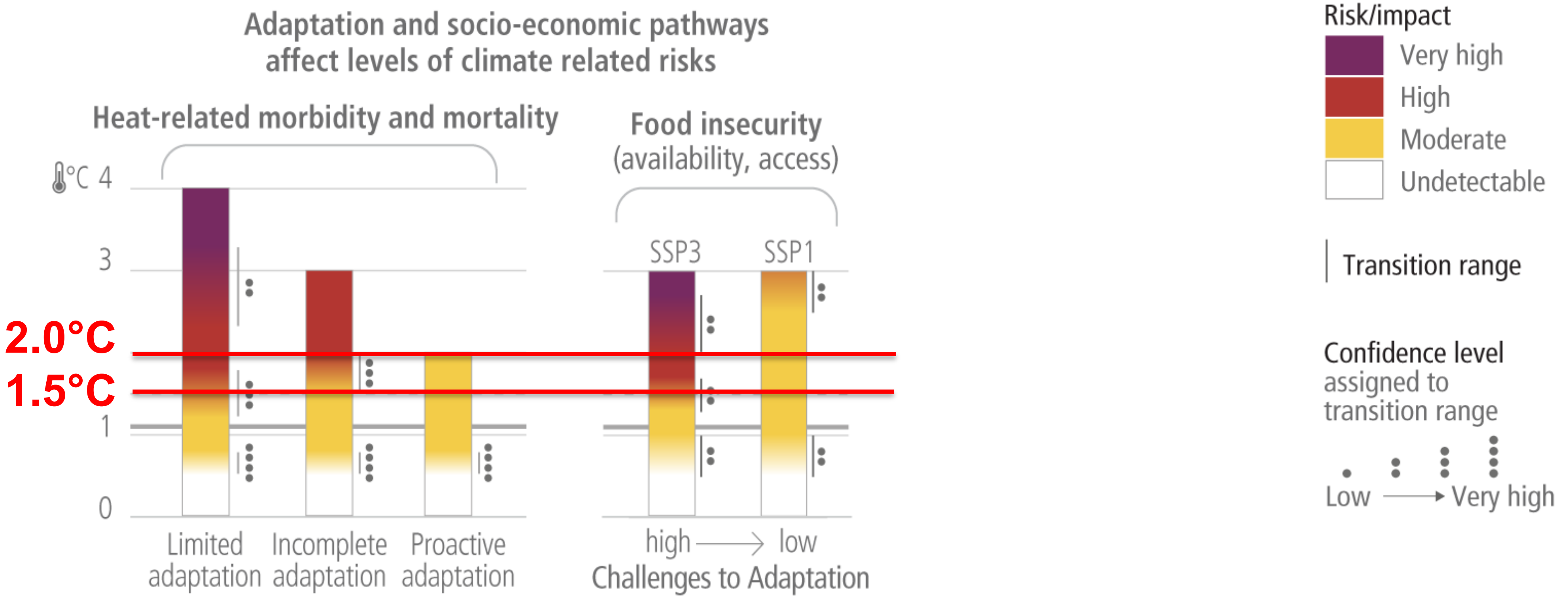
Impact literature, including scenario-based



IPCC AR6 WGII
Figure SPM.3

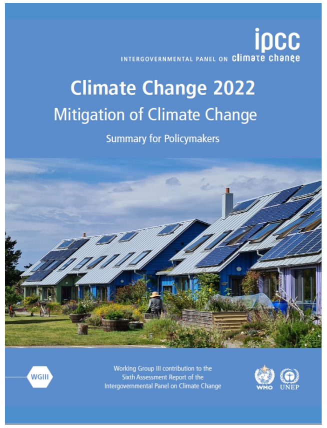


Exploring how risk changes with changes in adaptation, exposure, vulnerability (using SSPs)

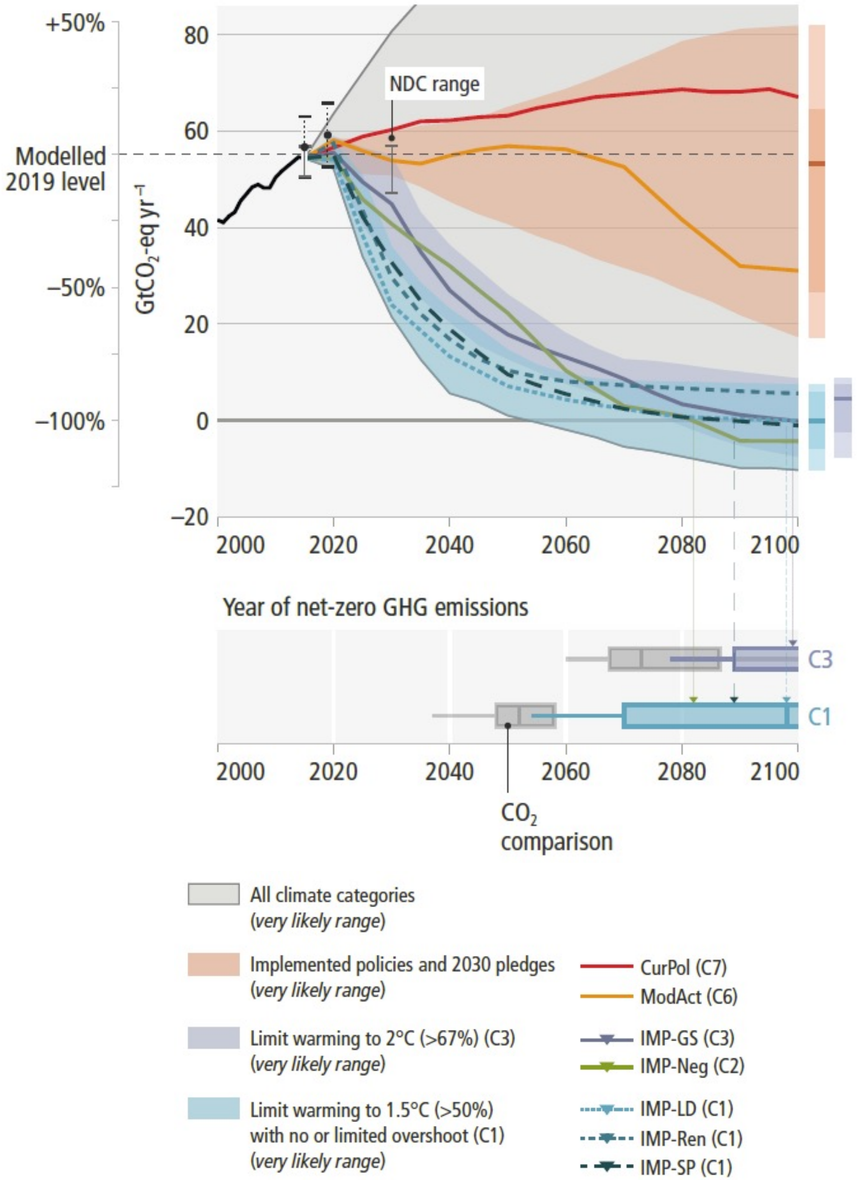


IPCC AR6 WGII
Figure SPM.3

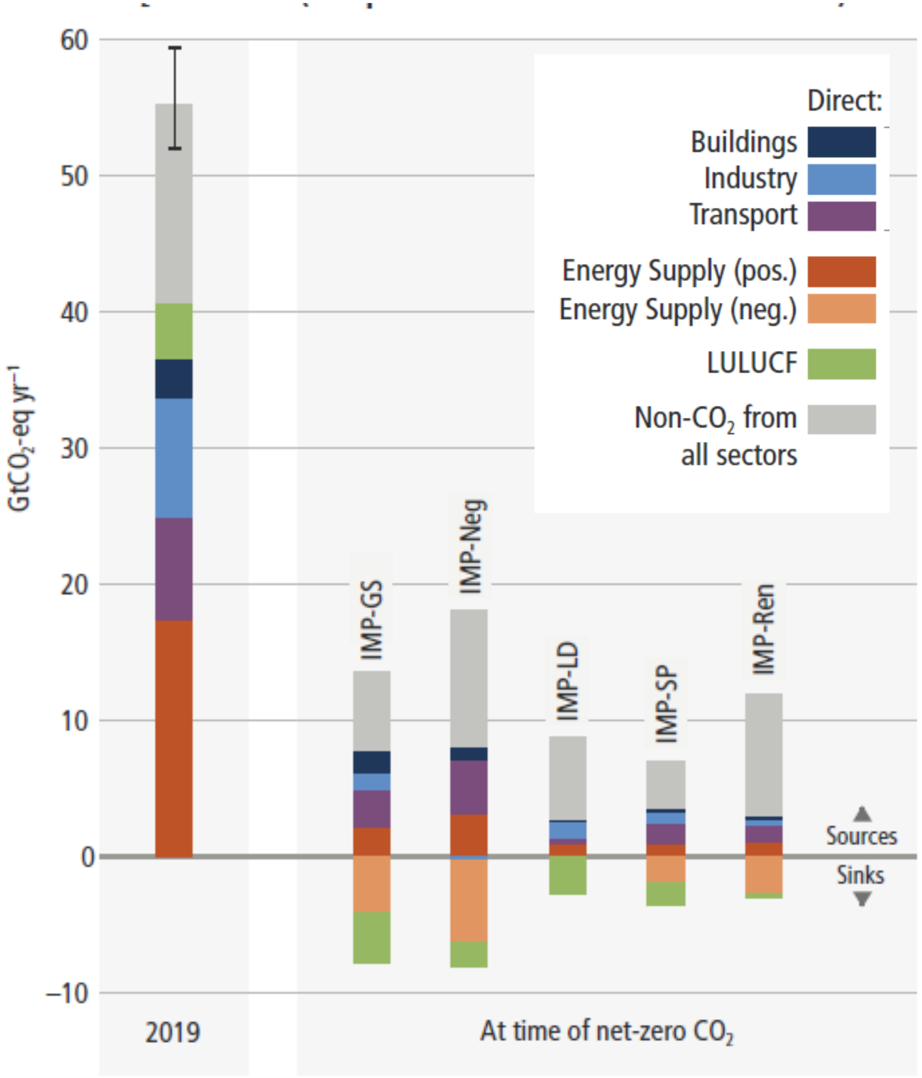
Scenario Workshop 2023



Net global GHG emissions



Sectoral GHG emissions at the time of net-zero CO_2 emissions



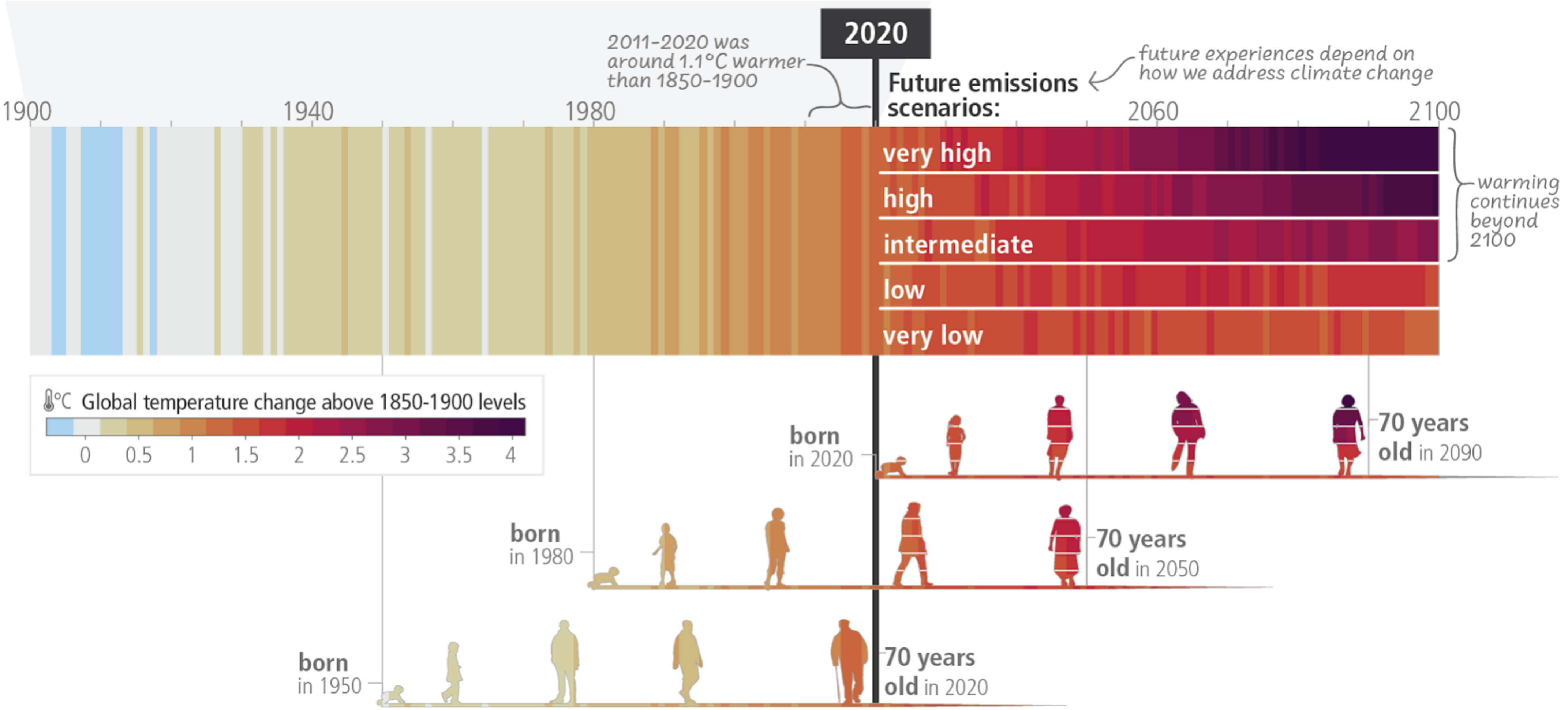
Categories

p50 [p5–p95] [a]			GHG emissions ($GtCO_2$-eq yr^{-1}) [g]			GHG emissions reductions from 2019 (%) [h]			Emissions milestones [i, j]				Cumulative CO_2 emissions ($GtCO_2$) [m]		Cumulative net-negative CO_2 emissions ($GtCO_2$)	Global mean temperature changes 50% probability (°C) [n]		Likelihood of peak global warming staying below (%) [o]		
Category [b, c, d] [# pathways]	Category/subset label	WGI SSP & WGIII IPs/IMPs alignment [e, f]	2030	2040	2050	2030	2040	2050	Peak CO_2 emissions (% peak before 2100)	Peak GHG emissions (% peak before 2100)	Net zero CO_2 (% net zero pathways)	Net zero GHGs (% net zero pathways) [k, l]	2020 to net zero CO_2	2020–2100	Year of net zero CO_2 to 2100	at peak warming	2100	<1.5°C	<2.0°C	<3.0°C
Modelled global emissions pathways categorised by projected global warming levels (GWL). Detailed likelihood definitions are provided in SPM Box1. The five illustrative scenarios (SSPx-yy) considered by AR6 WGI and the Illustrative (Mitigation) Pathways assessed in WGIII are aligned with the temperature categories and are indicated in a separate column. Global emission pathways contain regionally differentiated information. This assessment focuses on their global characteristics.			Projected median annual GHG emissions in the year across the scenarios, with the 5th–95th percentile in brackets. Modelled GHG emissions in 2019: 55 [53–58] $GtCO_2$-eq.			Projected median GHG emissions reductions of pathways in the year across the scenarios compared to modelled 2019, with the 5th–95th percentile in brackets. Negative numbers indicate increase in emissions compared to 2019.			Median 5-year intervals at which projected CO_2 & GHG emissions peak, with the 5th–95th percentile interval in square brackets. Percentage of peaking pathways is denoted in round brackets. Three dots (…) denotes emissions peak in 2100 or beyond for that percentile.		Median 5-year intervals at which projected CO_2 & GHG emissions of pathways in this category reach net zero, with the 5th–95th percentile interval in square brackets. Percentage of net zero pathways is denoted in round brackets. Three dots (…) denotes net zero not reached for that percentile.		Median cumulative net CO_2 emissions across the projected scenarios in this category until reaching net zero or until 2100, with the 5th–95th percentile interval in square brackets.		Median cumulative net-negative CO_2 emissions between the year of net zero CO_2 and 2100. More net-negative results in greater temperature declines after peak.	Projected temperature change of pathways in this category (50% probability across the range of climate uncertainties), relative to 1850–1900, at peak warming and in 2100, for the median value across the scenarios and the 5th–95th percentile interval in square brackets.		Median likelihood that the projected pathways in this category stay below a given global warming level, with the 5th–95th percentile interval in square brackets.		
C1 [97]	limit warming to 1.5°C (>50%) with no or limited overshoot		31 [21–36]	17 [6–23]	9 [1–15]	43 [34–60]	69 [58–90]	84 [73–98]				2095–2100 (52%) [2050–...]	510 [330–710]	320 [–210 to 570]	–220 [–660 to –20]	1.6 [1.4–1.6]	1.3 [1.1–1.5]	38 [33–58]	90 [86–97]	100 [99–100]
C1a [50]	… with net zero GHGs	SSP1–1.9, SP LD	33 [22–37]	18 [6–24]	8 [0–15]	41 [31–59]	66 [58–89]	85 [72–100]	2020–2025 (100%) [2020–2025]		2050–2055 (100%) [2035–2070]	2070–2075 (100%) [2050–2090]	550 [340–760]	160 [–220 to 620]	–360 [–680 to –140]	1.6 [1.4–1.6]	1.2 [1.1–1.4]	38 [34–60]	90 [85–98]	100 [99–100]
C1b [47]	… without net zero GHGs	Ren	29 [21–36]	16 [7–21]	9 [4–13]	48 [35–61]	70 [62–87]	84 [76–93]				…–… [0%] […–…]	460 [320–590]	360 [10–540]	–60 [–440 to 0]	1.6 [1.5–1.6]	1.4 [1.3–1.5]	37 [33–56]	89 [87–96]	100 [99–100]
C2 [133]	return warming to 1.5°C (>50%) after a high overshoot	Neg	42 [31–55]	25 [17–34]	14 [5–21]	23 [0–44]	55 [40–71]	75 [62–91]	2020–2025 (100%) [2020–2030]	[2020–2025]	2055–2060 (100%) [2045–2070]	2070–2075 (87%) [2055–...]	720 [530–930]	400 [–90 to 620]	–360 [–680 to –60]	1.7 [1.5–1.8]	1.4 [1.2–1.5]	24 [15–42]	82 [71–93]	100 [99–100]
C3 [311]	limit warming to 2°C (>67%)		44 [32–55]	29 [20–36]	20 [13–26]	21 [1–42]	46 [34–63]	64 [53–77]	2020–2025 (100%) [2020–2030]	[2020–2025]	2070–2075 (93%) [2055–...]	...–... (30%) [2075–...]	890 [640–1160]	800 [510–1140]	–40 [–290 to 0]	1.7 [1.6–1.8]	1.6 [1.5–1.8]	20 [13–41]	76 [68–91]	99 [98–100]
C3a [204]	… with action starting in 2020	SSP1–2.6	40 [30–49]	29 [21–36]	20 [14–27]	27 [13–45]	47 [35–63]	63 [52–76]	2020–2025 (100%) [2020–2025]		2070–2075 (91%) [2055–...]	...–... (24%) [2080–...]	860 [640–1180]	790 [480–1150]	–30 [–280 to 0]	1.7 [1.6–1.8]	1.6 [1.5–1.8]	21 [14–42]	78 [69–91]	100 [98–100]
C3b [97]	… NDCs until 2030	GS	52 [47–56]	29 [20–36]	18 [10–25]	5 [0–14]	46 [34–63]	68 [56–82]			2065–2070 (97%) [2055–2090]	...–... (41%) [2075–...]	910 [720–1150]	800 [560–1050]	–60 [–300 to 0]	1.8 [1.6–1.8]	1.6 [1.5–1.7]	17 [12–35]	73 [67–87]	99 [98–99]
C4 [159]	limit warming to 2°C (>50%)		50 [41–56]	38 [28–44]	28 [19–35]	10 [0–27]	31 [20–50]	49 [35–65]	2020–2025 (100%) [2020–2030]		2080–2085 (86%) [2065–...]	...–... (31%) [2075–...]	1210 [970–1490]	1160 [700–1490]	–30 [–390 to 0]	1.9 [1.7–2.0]	1.8 [1.5–2.0]	11 [7–22]	59 [50–77]	98 [95–99]
C5 [212]	limit warming to 2.5°C (>50%)		52 [46–56]	45 [37–53]	39 [30–49]	6 [–1 to 18]	18 [4–33]	29 [11–48]			...–... (41%) [2080–...]	...–... (12%) [2090–...]	1780 [1400–2360]	1780 [1260–2360]	0 [–160 to 0]	2.2 [1.9–2.5]	2.1 [1.9–2.5]	4 [0–10]	37 [18–59]	91 [83–98]
C6 [97]	limit warming to 3°C (>50%)	SSP2–4.5 ModAct	54 [50–62]	53 [48–61]	52 [45–57]	2 [–10 to 11]	3 [–14 to 14]	5 [–2 to 18]	2030–2035 (96%) [2020–2090]	2020–2025 (97%)				2790 [2440–3520]			2.7 [2.4–2.9]	0 [0–0]	8 [2–18]	71 [53–88]
C7 [164]	limit warming to 4°C (>50%)	SSP3–7.0 CurPol	62 [53–69]	67 [56–76]	70 [58–83]	–11 [–18 to 3]	–19 [–31 to 1]	–24 [–41 to –2]	2085–2090 (57%) [2040–...]	2090–2095 (56%)	no net zero		no net zero	4220 [3160–5000]	no net zero	temperature does not peak by 2100	3.5 [2.8–3.9]	0 [0–0]	0 [0–2]	22 [7–60]
C8 [29]	exceed warming of 4°C (≥50%)	SSP5–8.5	71 [69–81]	80 [78–96]	88 [82–112]	–20 [–34 to –17]	–35 [–65 to –29]	–46 [–92 to –36]	2080–2085 (90%) [2070–...]					5600 [4910–7450]			4.2 [3.7–5.0]	0 [0–0]	0 [0–0]	4 [0–11]

Key characteristics

- GHG emissions ($GtCO_2$-eq/yr)
- GHG emissions reductions from 2019 (%)
- Emissions milestones
  - Peak CO_2 emissions
  - Peak GHG emissions
  - Net zero CO_2
  - Net zero GHGs
- Cumulative CO_2 emissions
- Cumulative net-negative CO_2 emissions
- Global mean temperature changes 50% probability
- Likelihood of peak global warming staying below (%) <1.5°C <2.0°C <3.0°C

Scenario Workshop 2023



Goals of the workshop

- Taking stock of the use of scenarios in the AR6, their strengths and weaknesses
- Identifying any gaps in the approach, considering the needs and expectations of users
- How best to build on the RCP-SSP framework in the future
- How to pursue innovations in the scenario approach with research communities, e.g., with biodiversity
- How to further develop cross-Working Group collaboration
- Improvements in institutional mechanisms for developing, applying and curating scenario data, e.g., the role of TG-Data
- How to improve the diversity of contributors into the scenario-building processes

Workshop structure

Day 1

Looking back and reviewing AR6

Day 2

Challenges, focused topics

Day 3

Outlook towards recommendations

- Scientific communities involved in modelling
- Scientific communities not involved in modelling
- Research funders
- IPCC
- Communicating scenarios

Lessons learned, challenges

Looking back and reviewing AR6, challenges and focused topics

Day 1: What worked and what could have worked better	Day 2: Challenges
1.1: Earth systems modelling, emulators and mitigation scenario categorisation **1.2:** Climate drivers, hazards, risks and risk reduction **1.3:** Socio-economic context. Mitigation/ adaptation pathways and climate action	**3.1:** Scenario architecture: designing scenario sets. **3.2:** Likelihood and other approaches to uncertainty **3.3:** Scale (time and space) **3.4:** Justice and equity in scenarios **3.5:** Communication of scenarios to users
2.1: Scenario data and curation **2.2:** Scenario architecture: the design of scenario sets **2.3:** Coordination and collaboration across scientific domains	**4.1:** Hard adaptation limits for species, ecosystems and human societies **4.2:** Multi-level scenarios (Including sub-national and cities) **4.3:** Overshoot **4.4:** Plausibility and feasibility **4.5:** Scaling up near-term actions **4.6:** Adaptation pathways

What climate scenarios have been successful for…

Scenarios as integrating tools

- **Common scenario architecture**, with similar assumptions, allows comparability among results from different research communities.
- **RCP/SSP combination** covers a wide range of uncertainty.
- Greater use of **climate emulators** to represent complex Earth System Models by WGI
- Successful assessment of **scenario-based information across WGI-WGIII**, using WGI climate emulators to categorise WGIII scenarios according to climate outcomes.
- **Global warming levels** and **scenario-based evidence** to underpin the **burning ember diagrams**, achieving integration across WGI and WGII.

But…

- **Lags in literature** resulted in different scenarios being used in the WG assessments.
- **Advance planning needed**, e.g coordinated timelines and infrastructure to support handshakes between communities.

Plausibility and feasibility of future outcomes

- The **likelihood of an individual scenario cannot be defined**….but a full range of scenarios addresses uncertainty and is valuable in relation to risk-averse response strategies.
- **Scientific** uncertainty is distinct from **scenario** uncertainty.
- **Deep scenario uncertainty** cannot be equated with **low likelihood/high impact outcomes** – clear communication needed.
- Need to **explore plausible high-impact outcomes**, e.g. combining plausible high-end emission scenarios with higher end climate sensitivity.
- **Use of storylines** as part of the assessment report to summarise information and findings, including unexpected surprises (such as high climate sensitivity)

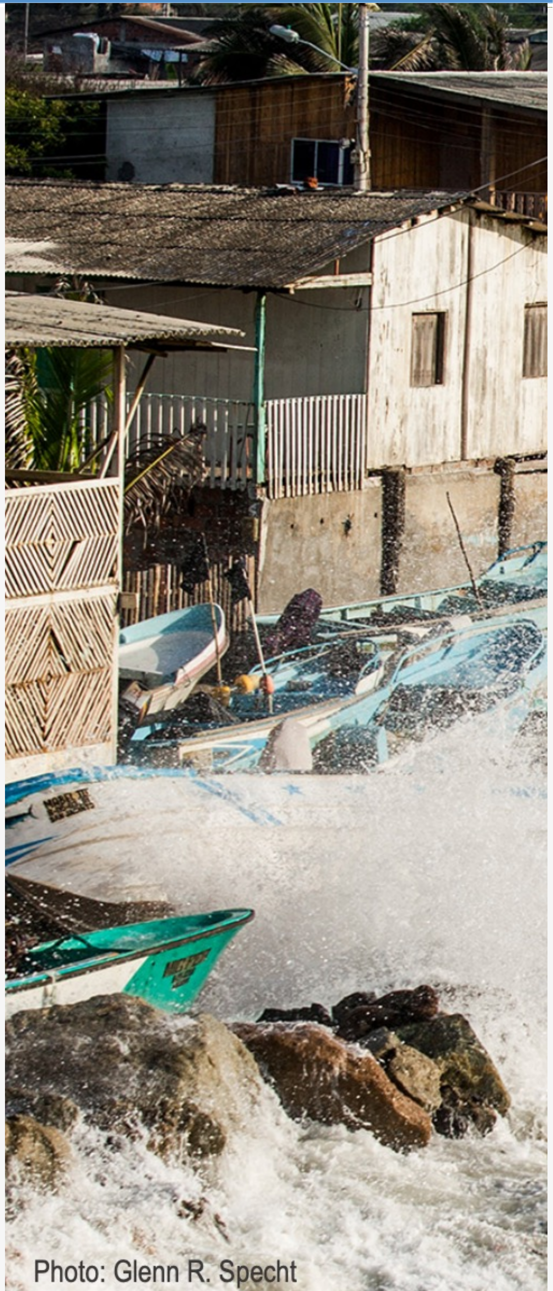


Photo: Glenn R. Specht

Improvements

- The **naming of scenarios**: “low”/SSP2-45; RCPs; illustrative scenarios; illustrative mitigation pathways etc.
- Most studies **focus on the “middle-of-the-road”** shared socio-economic pathway (SSP2).
- Growing **demand for regional and sectoral scenarios**, connecting top-down/bottom-up.
- Understanding and estimating **climate feedbacks, uncertainties and climate responses.**
- **High-end and low-end emissions scenarios** to explore: carbon cycle and climate feedbacks; air pollution control; ecosystems consequences of overshoot; ‘worlds avoided’.
- Need **better representation of adaptation** in mitigation scenarios.
- For scenario-based information to be relevant for adaptation, **information is needed at local scales**.
- **Beyond GDP** as a metric of progress.
- Community agreement on **historical/baseline emission estimates**?

Emerging challenges

- **Scenarios in the context of development** and other challenges, e.g. SDGs, biodiversity.
- Representing **future shifts** from one pathway to another; tipping points (physical, biological systems, social systems); overshoot and irreversible changes; shocks and recovery.
- Exploring **disequilibrium responses**, rates of change, low-likelihood, high impact events / shocks and recovery, representation of stability and instability, lag of some climatic impact drivers changes, e.g. in cryosphere and ocean.
- Stronger **integration of vulnerability and exposure** change as well as socio-economic drivers of risk, increasing focus on **adaptation scenarios** and regional, local, city level-scales.
- The **societal distribution of risks:** gender, ethnicities, wealth/income, generational as well as regional.

Strengthening linkages

- Challenges related to **weak or missing links between some communities**, e.g. **economic modelling and social sciences** communities or lack of awareness of what scenarios were available.

- **Social science input to the design and production of scenarios**: qualitative foresight studies, assessment of feasibility and plausibility, equitable outcomes by design, alternatives to the maximisation of utility at the global level.

- **Climate, biodiversity and resources:** links between IPCC and other global assessments (e.g. IPBES, International Resources Panel) – and between WGs II and III.

Scenarios data curation and access

- **Transparency**: Implementation of FAIR (Findabile, Accessibile, Interoperabile, and Reusabile) data principles.
- Broadening the **WG I Interactive Atlas** approach for user-friendly access to data.
- The hundreds of scenarios assessed by WG III (the AR6 database) were **vetted, harmonised and "infilled"**: work is needed on the emerging **science of scenario assessment.**
- **Burden of submission** to the AR6 scenario database lowered the diversity of scenarios available.
- Support needed to **increase diversity of scenarios** and increase eligibility for submission (e.g. more national, sectoral scenarios).
- Resources for: **data infrastructure**; **capacity development** for assessment.

Key Messages and Outlook

Key challenges with using scenarios to inform policymakers…

Inclusivity and diversity

- **Transparency and inclusivity** in the scenario design and choices of scenarios for climate model simulations.
- Facilitating **co-production** between policymakers and the science community
  - Participation of non-modellers, users and stakeholders in scenario planning, design and vetting
  - Facilitate ownership over the design process
- Building **modelling capacity** in regions of the world, e.g., via the IPCC scholarship fund, to enhance diversity among modelers, institutions, and model inputs
- Modelling group-/ capacity building programs to examine how **equity and justice** can be usefully implemented in scenarios

Bridging spatial and temporal scales

- **Long-term scenarios** to improve scientific understanding committed change, the climate response to temperature stabilisation/ the zero emissions commitment, sea level rise, and the long term durability of carbon dioxide removal technologies
- **Mismatch** between scenario time and spatial scales and those required by decision-makers
  - scenarios relevant to country NDCs
  - what does a net-zero world look like on the regional scale
- **Connect scenarios** to other lines of evidence

Bridging spatial and temporal scales

- Grey literature for **regional/ local scenarios**
- Emerging role of **deep learning / artificial intelligence** to compute higher spatial and temporal resolutions
- Integrating biodiversity to address **climate change and biodiversity loss** together

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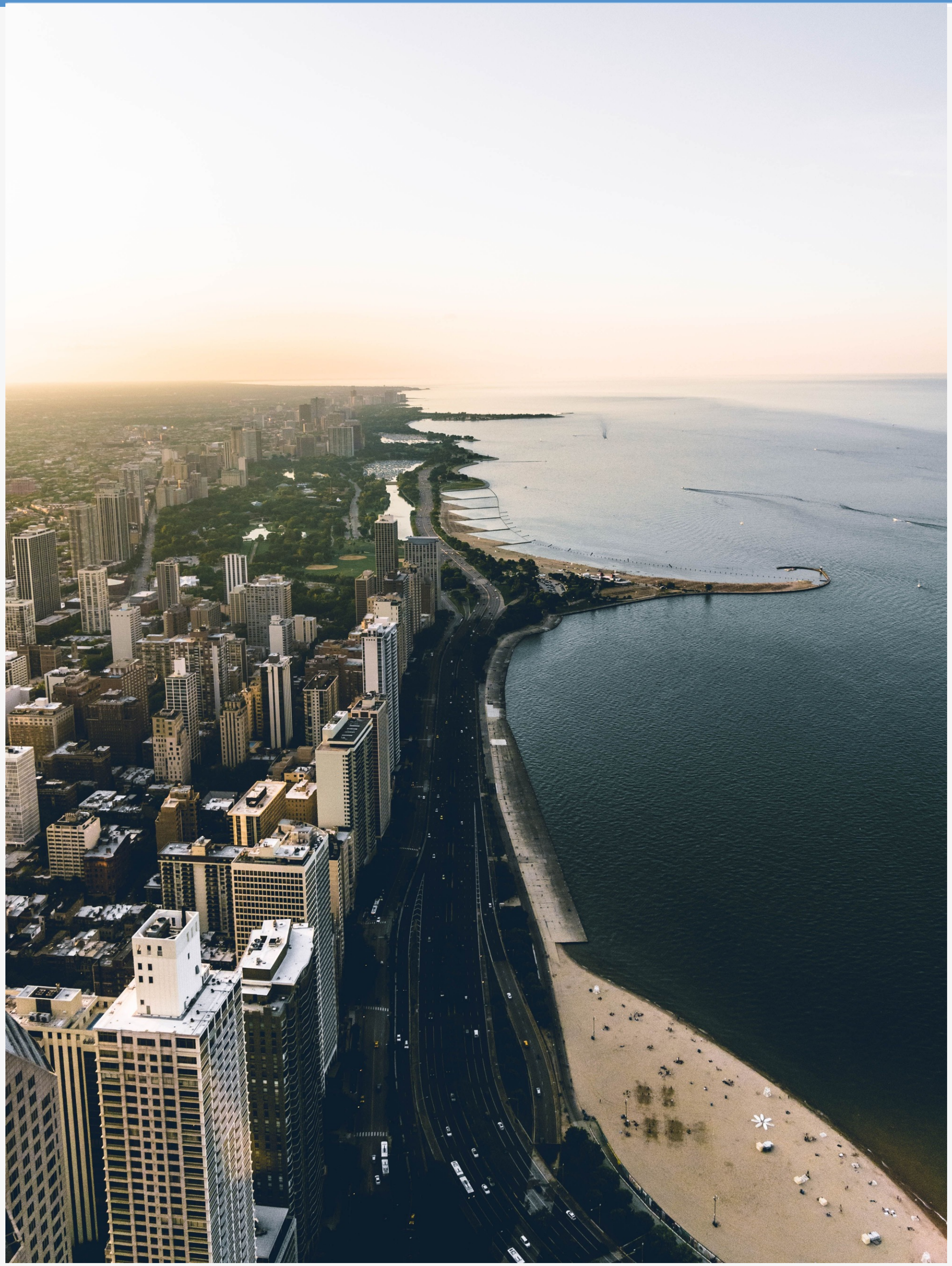
Near-term action

- Long-term focus should not deflect attention away from the need for **near-term action** in this critical decade of transition
- Scenarios with **near-term variability** - how to incorporate extreme events, associated losses and damages, as well as adaptation measures
- **Integration with other communities** that produce scenarios relevant for near-term action e.g., Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
  - Building narratives including timelines for permits for renewables, readiness of supply chains, and regulatory time
- Exploring avoided emissions, enabling and other conditions in models for **near-term action**
- **Linking near-term and long-term scenarios,** implications of near-term action on long term
  - development objectives and the complexity of adaptation and integration with mitigation
  - Climate resilient development



Cities and urban settlements

- **Advances** include quantitative urban emissions scenarios based on consumption-based emissions, qualitative assessments, including urban adaptation gaps to current climate risks, an evaluation of mitigation options by urban typologies
- **Diversity of cities**, degree of informality, geophysical context, development priorities to be covered in a more coherent manner
  - scenario development using urban typologies and archetypes
  - AR7 potential Special Report on Cities

Mason Hopfensperger unsplash

Cities and urban settlements

- **Downscaling and risk assessment**
  - drivers in urban areas e.g., infrastructure, land use, and urban form, energy and emission profiles, hydrological cycle, aerosol release
  - issues that can be tackled jointly, e.g. the urban heat island effect, flooding, and air quality
- Capture **dynamics** of cities
  - differing **socio-economic contexts** including urban poverty and vulnerability
  - fast-growing cities, rapid suburban development, coastal cities, landlocked cities, small cities, informal settlements

Marco Domino

Risk, adaptation and limits

- **Improved contextualisation** of adaptation
  - Global to regional and local scales
  - Differential capacities for adaptation
  - Implementation and response times
  - Existing conditions and societal trends
- **Co-development** of adaptation pathways (quantitative and qualitative)
- Implications of **delaying costs and action** (to reflect risks associated with non-action) in both locally-specific and dynamic scenarios; lock-in times
- **Transboundary risk -** how adaptation in one area affects adaptation capacities elsewhere
- **Adaptation-mitigation interactions** e.g. afforestration
- **Limits** to adaptation
  - Projection/hindcasting/backcasting experiments to explore limits
  - Global Warming Levels, rate of change
  - Tipping points in societal and socio-economic systems
  - Compound and cascading risks

Justice and equity

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- Models do not capture many dimensions of equity and justice
- Develop a **justice framework** that could be applied to scenarios, building on the robust literature on justice, fairness, and equity
- Include **inequity in adaptation** in scenarios - such as financial inequities, vulnerabilities, losses and damages, and governance issues

Justice and equity

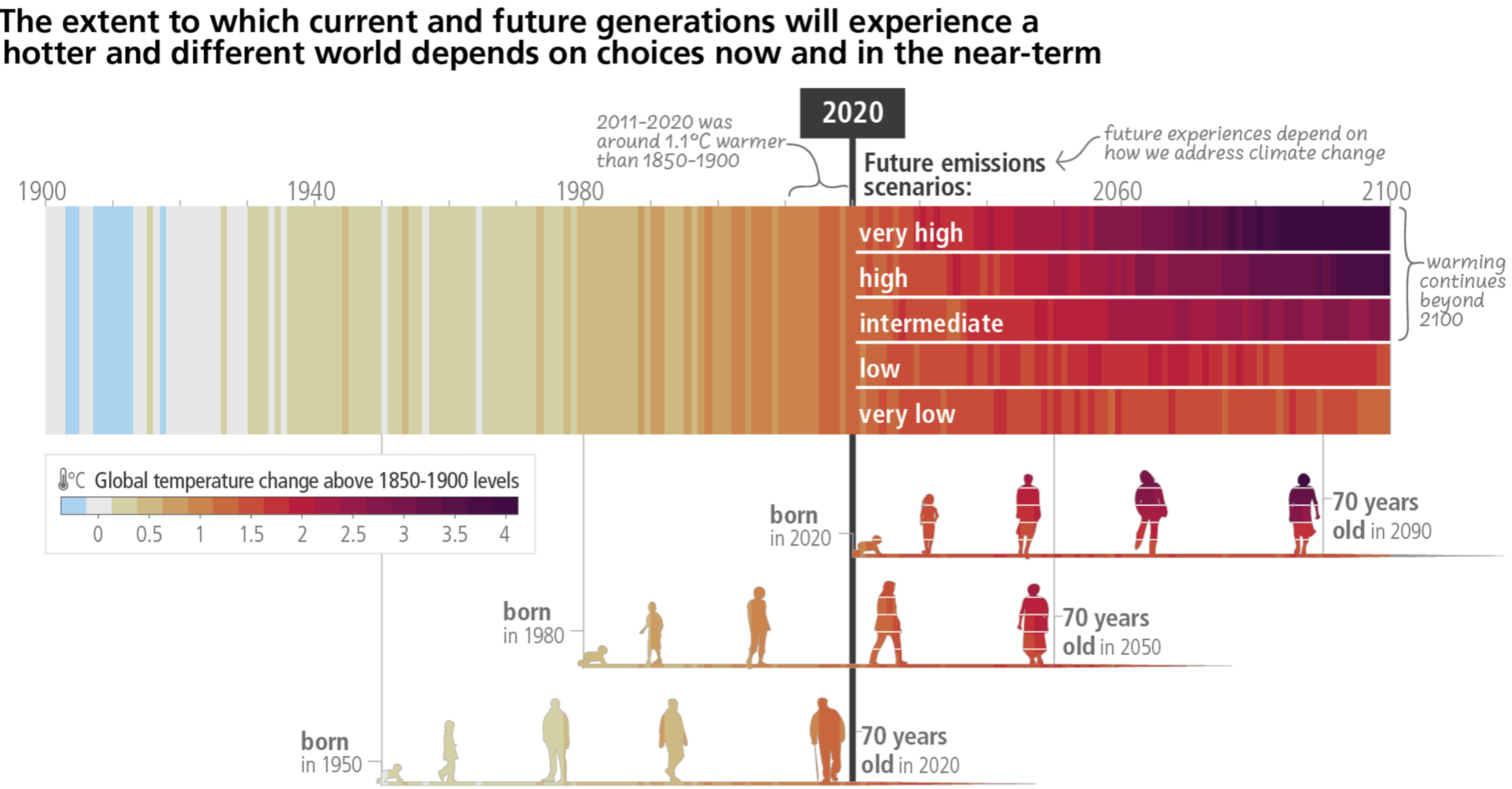
- **Distribution aspects** e.g. equity in terms of global consumption, country avoided emissions
- Use **indicators beyond GDP** e.g. multi-dimensional indicators of well-being
- **Beyond** least cost mitigation pathways
- Mix of **qualitative and quantitative narratives and scenarios** including adaptation and equity assumptions e.g. on transitions across the SSPs

Communication

- Customise communication of scenarios for **different audiences** eg policy, business, research disciplines
  - Bridge gap between end-user expectations and scenario constraints
  - Improve transparency of scenario assumptions
- Development of **scenario storylines** and associated communication material on how scenarios evolve over time
- Clearer **scenario labelling** on scenario purpose to ensure consistent interpretation e.g., to explore climate response to radiative forcing, pollution control policies
- Provide documentation and webinars of **scenario development histories** and assumptions to improve transparency and understanding for end-users as well as the next generation of researchers
- **Regional workshops** on downscaling and providing tailored regional-local-sectoral scenarios

Scenario Workshop 2023

Thank you



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