WGII Data Use and Requirements

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INTERGOVERNMENTAL PANEL ON climate change
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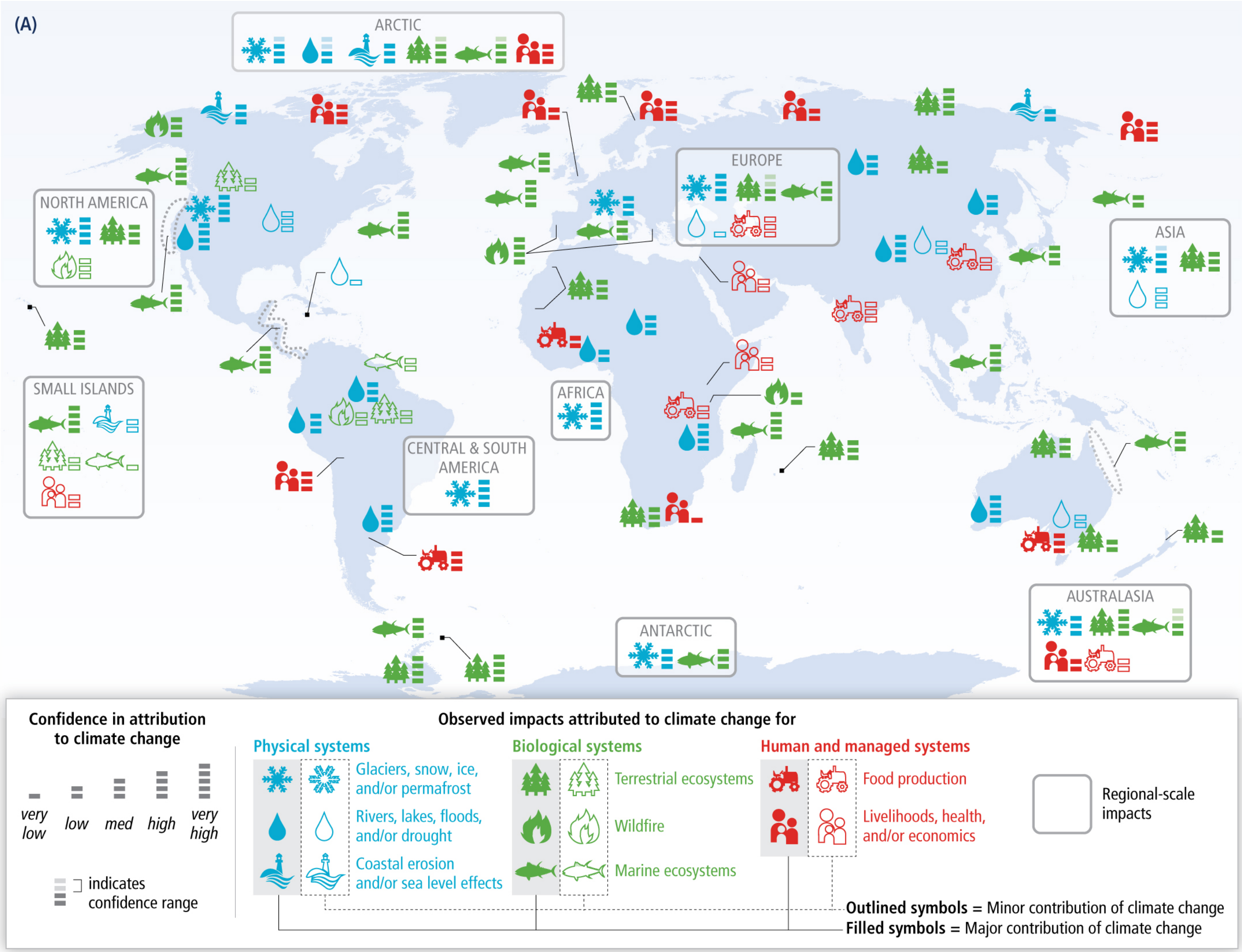
What disciplines does WGII cover?

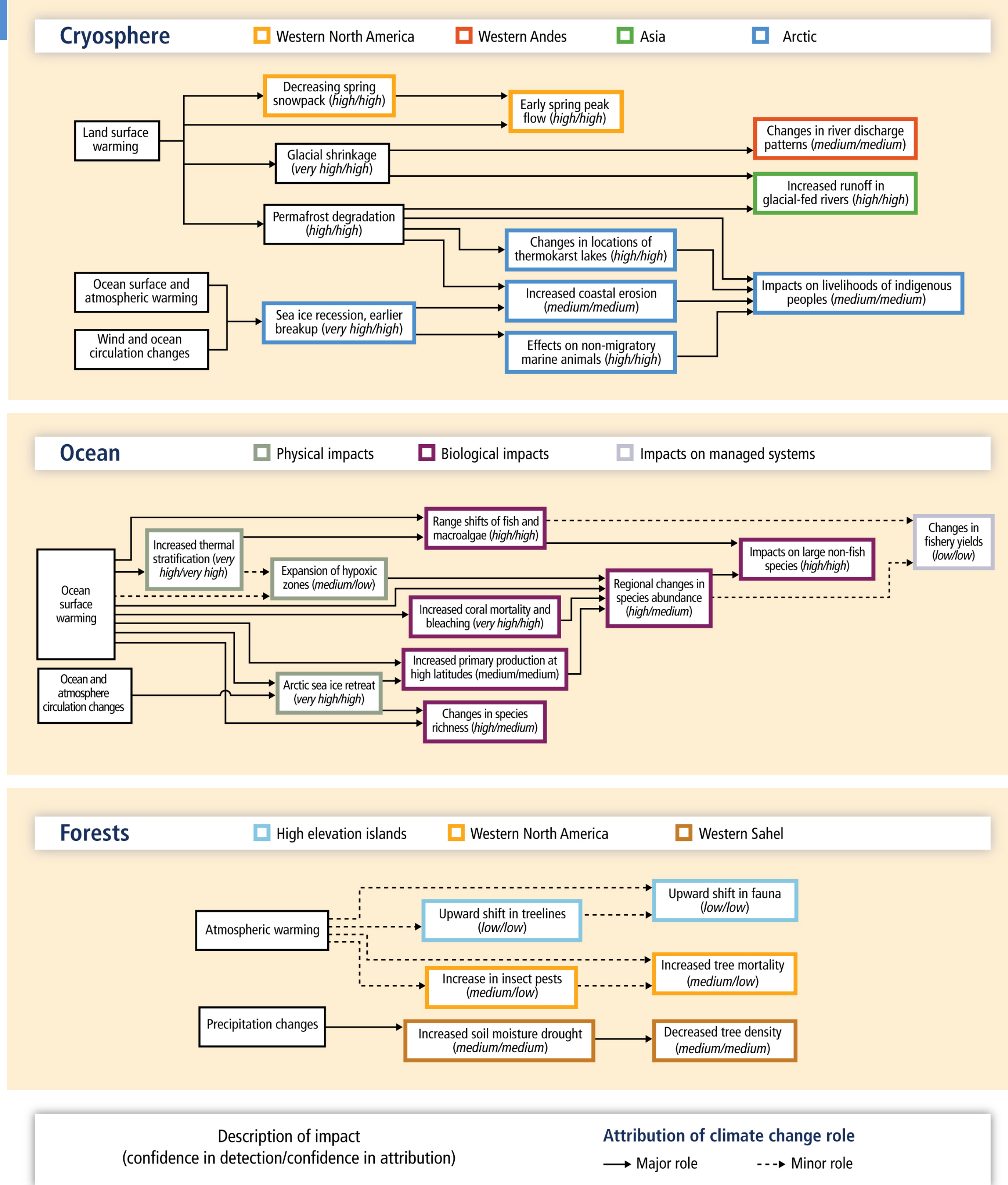
- Impacts, Adaptation, and Vulnerability
- Global, Sectoral and Regional Aspects
- Includes genetics, ecology, urban planning, health, economics, social science, …….

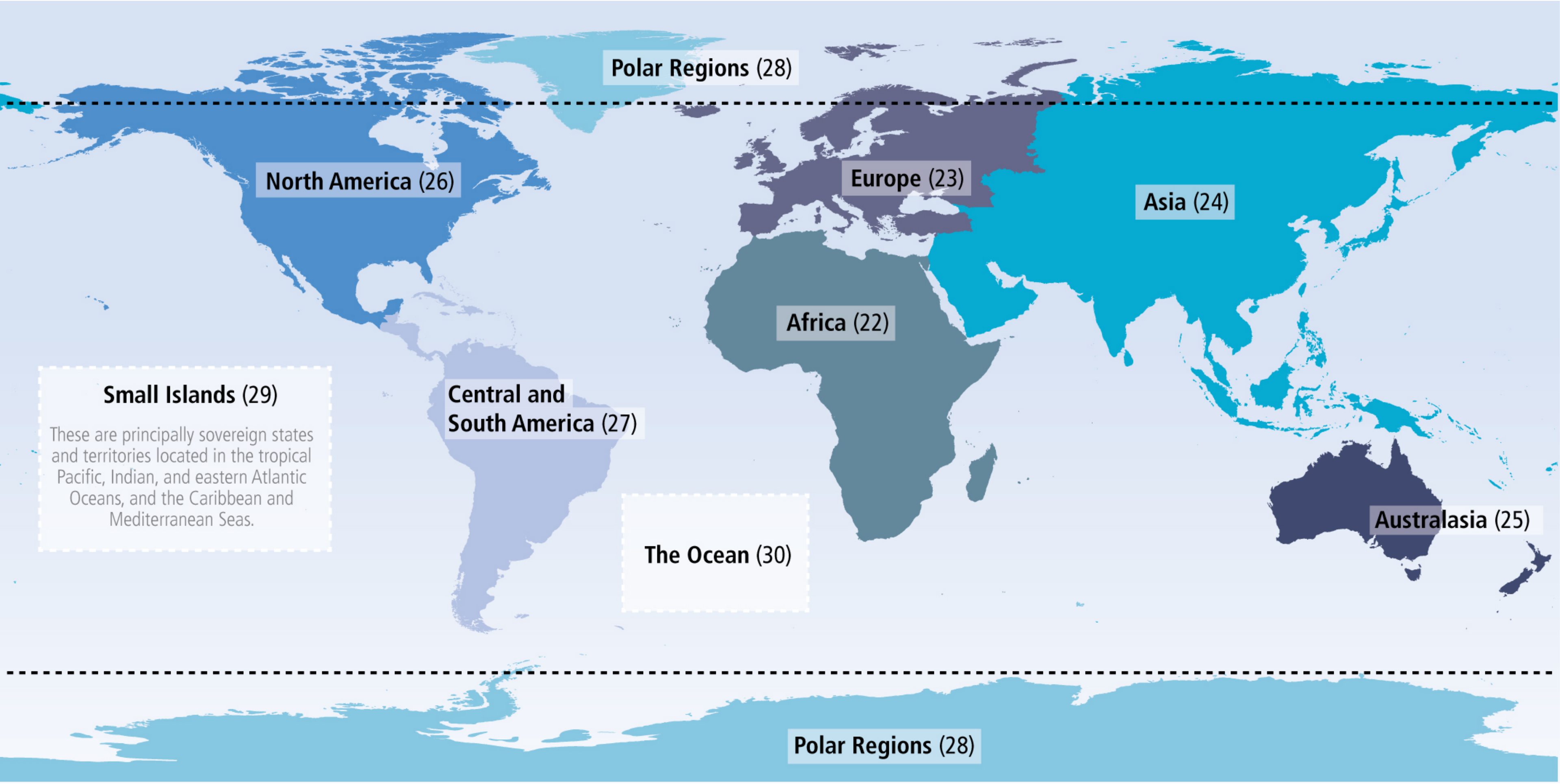
AR5 Impacts and Attribution



SPM and Chp 18

INTERGOVERNMENTAL PANEL ON climate change


Cryosphere
Western North America
Western Andes
Asia
Arctic
Land surface warming
Decreasing spring snowpack (high/high)
Early spring peak flow (high/high)
Glacial shrinkage (very high/high)
Changes in river discharge patterns (medium/medium)
Increased runoff in glacial-fed rivers (high/high)
Permafrost degradation (high/high)
Changes in locations of thermokarst lakes (high/high)
Ocean surface and atmospheric warming
Increased coastal erosion (medium/medium)
Impacts on livelihoods of indigenous peoples (medium/medium)
Sea ice recession, earlier breakup (very high/high)
Wind and ocean circulation changes
Effects on non-migratory marine animals (high/high)
Ocean
Physical impacts
Biological impacts
Impacts on managed systems
Range shifts of fish and macroalgae (high/high)
Changes in fishery yields (low/low)
Increased thermal stratification (very high/very high)
Impacts on large non-fish species (high/high)
Expansion of hypoxic zones (medium/low)
Ocean surface warming
Regional changes in species abundance (high/medium)
Increased coral mortality and bleaching (very high/high)
Increased primary production at high latitudes (medium/medium)
Ocean and atmosphere circulation changes
Arctic sea ice retreat (very high/high)
Changes in species richness (high/medium)
Forests
High elevation islands
Western North America
Western Sahel
Upward shift in fauna (low/low)
Atmospheric warming
Upward shift in treelines (low/low)
Increased tree mortality (medium/low)
Increase in insect pests (medium/low)
Precipitation changes
Increased soil moisture drought (medium/medium)
Decreased tree density (medium/medium)
Description of impact
(confidence in detection/confidence in attribution)
Attribution of climate change role
Major role
Minor role



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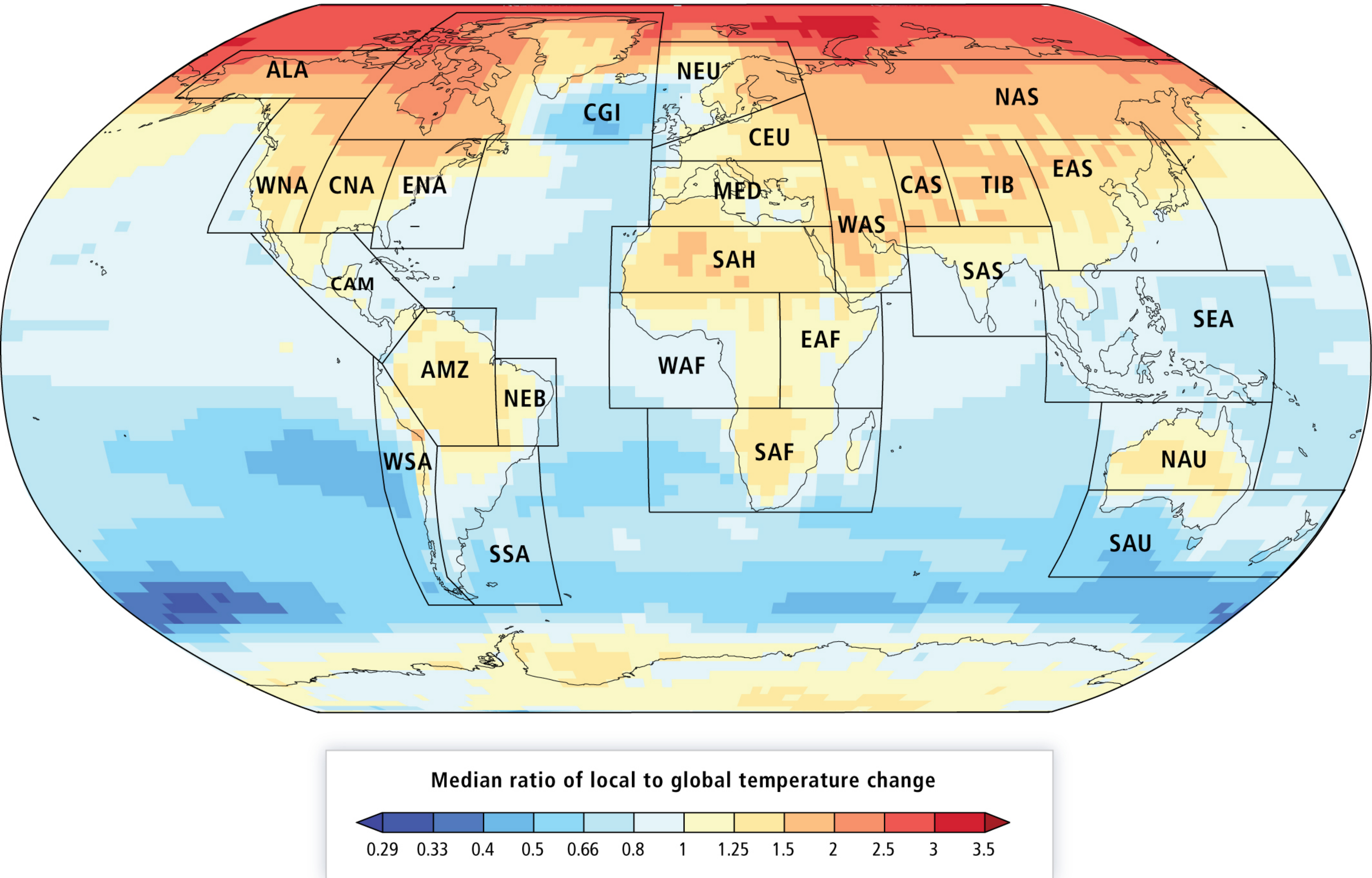
ALA
NEU
NAS
CGI
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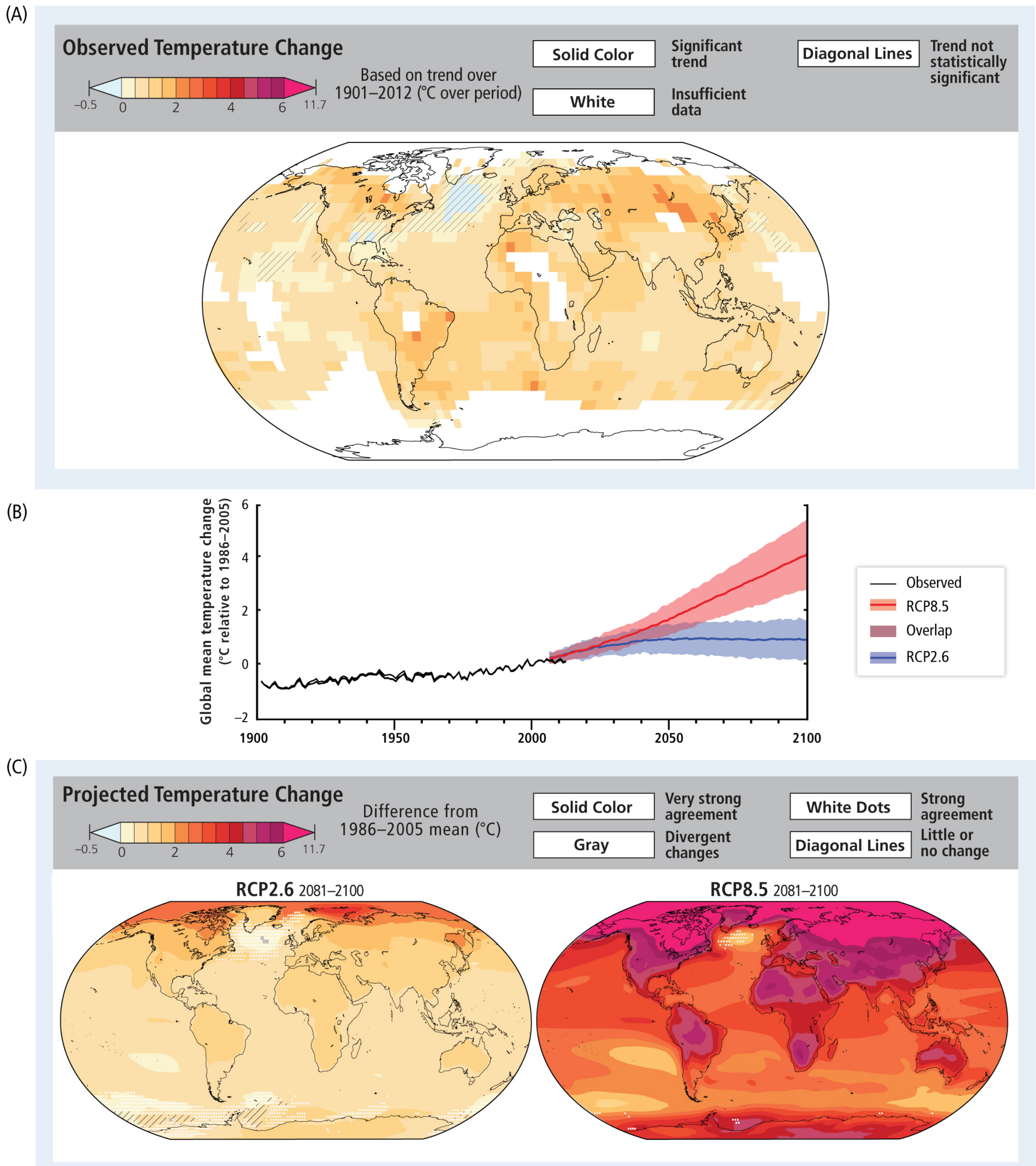
CNA
ENA
MED
CAS
TIB
EAS
WAS
SAH
SAS
CAM
SEA
EAF
AMZ
WAF
NEB
SAF
NAU
WSA
SSA
SAU
Median ratio of local to global temperature change
0.29
0.33
0.4
0.5
0.66
0.8
1
1.25
1.5
2
2.5
3
3.5

Observed and projected changes in climate inform risk

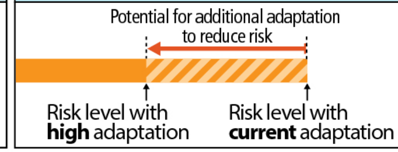


Assessment Box SPM.2 Table 1 | Key regional risks from climate change and the potential for reducing risks through adaptation and mitigation. Each key risk is characterized as very low to very high for three timeframes: the present, near term (here, assessed over 2030–2040), and longer term (here, assessed over 2080–2100). In the near term, projected levels of global mean temperature increase do not diverge substantially for different emission scenarios. For the longer term, risk levels are presented for two scenarios of global mean temperature increase (2°C and 4°C above preindustrial levels). These scenarios illustrate the potential for mitigation and adaptation to reduce the risks related to climate change. Climate-related drivers of impacts are indicated by icons.

Climate-related drivers of impacts

Warming trend	Extreme temperature	Drying trend	Extreme precipitation	Precipitation	Snow cover	Damaging cyclone	Sea level	Ocean acidification	Carbon dioxide fertilization

Level of risk & potential for adaptation



Africa

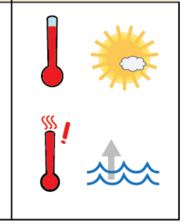
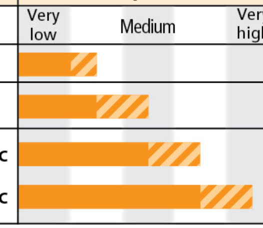
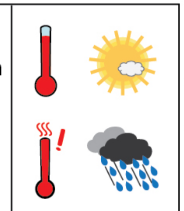
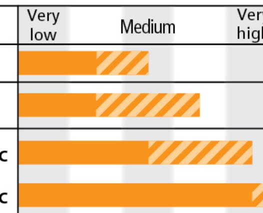
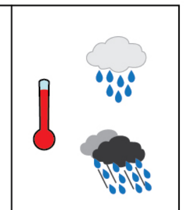
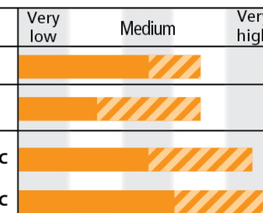
Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future, with drought stress exacerbated in drought-prone regions of Africa (*high confidence*) [22.3-4]	• Reducing non-climate stressors on water resources • Strengthening institutional capacities for demand management, groundwater assessment, integrated water-wastewater planning, and integrated land and water governance • Sustainable urban development		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	
Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national, and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure (*high confidence*) [22.3-4]	• Technological adaptation responses (e.g., stress-tolerant crop varieties, irrigation, enhanced observation systems) • Enhancing smallholder access to credit and other critical production resources; Diversifying livelihoods • Strengthening institutions at local, national, and regional levels to support agriculture (including early warning systems) and gender-oriented policy • Agronomic adaptation responses (e.g., agroforestry, conservation agriculture)		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	
Changes in the incidence and geographic range of vector- and water-borne diseases due to changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution (*medium confidence*) [22.3]	• Achieving development goals, particularly improved access to safe water and improved sanitation, and enhancement of public health functions such as surveillance • Vulnerability mapping and early warning systems • Coordination across sectors • Sustainable urban development		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	

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Table 30-1 | Regional changes in sea surface temperature (SST) over the period 1950–2009 using the ocean regionalization specified in Figure 30-1(a) (for further details on regions defined for analysis, see Figure SM30-1 and Table SM30-2, column 1). A linear regression was fitted to the average of all 1×1 degree monthly SST data extracted from the Hadley Centre HadISST1.1 data set (Rayner et al., 2003) for each sub-region over the period 1950–2009. All SST values less than –1.8°C, together with all SST pixels that were flagged as being sea ice, were reset to the freezing point of seawater (–1.8°C) to reflect the sea temperature under the ice. Separate analyses were also done to explore trends in the temperatures extracted from the coldest-ranked and the warmest-ranked month of each year (Table SM30-2). The table includes the slope of the regression (°C per decade), the *p*-value for the slope being different from zero and the total change over 60 years (i.e., the slope of linear regression multiplied by six decades) for each category. The *p*-values that exceed 0.05 plus the associated slope and change values have an orange background, denoting the lower statistical confidence in the slope being different from zero (no slope). Note that changes with higher *p*-values may still describe informative trends although the level of confidence that the slope is different from zero is lower.

Sub-region	Area	Regression slope			Total change over 60 years			*p*-value, slope different from zero		
		°C per decade (coolest month)	°C per decade (all months)	°C per decade (warmest month)	Change over 60 years (coolest month)	Change over 60 years (all months)	Change over 60 years (warmest month)	°C per decade (coolest month)	°C per decade (all months)	°C per decade (warmest month)
1. High-Latitude Spring Bloom Systems (HLSBS)	Indian Ocean	0.056	0.087	0.145	0.336	0.522	0.870	0.000	0.003	0.000
	North Atlantic Ocean	0.054	0.073	0.116	0.324	0.438	0.696	0.001	0.15	0.000
	South Atlantic Ocean	0.087	0.063	0.097	0.522	0.378	0.582	0.000	0.098	0.000
	North Pacific Ocean (west)	0.052	0.071	0.013	0.312	0.426	0.078	0.52	0.403	0.462
	North Pacific Ocean (east)	0.016	0.04	0.016	0.096	0.24	0.096	0.643	0.53	0.444
	North Pacific Ocean	0.033	0.055	0.015	0.198	0.33	0.09	0.284	0.456	0.319
	South Pacific Ocean (west)	0.043	0.017	0.044	0.258	0.102	0.264	0.016	0.652	0.147
	South Pacific Ocean (east)	0.047	0.031	0.052	0.282	0.186	0.312	0.000	0.396	0.003
	South Pacific Ocean	0.046	0.027	0.050	0.276	0.162	0.300	0.000	0.467	0.000
2. Equatorial Upwelling Systems (EUS)	Atlantic Equatorial Upwelling	0.101	0.090	0.079	0.606	0.540	0.474	0.000	0.000	0.000
	Pacific Equatorial Upwelling	0.079	0.071	0.065	0.474	0.426	0.39	0.096	0.001	0.071
3. Semi-Enclosed Seas (SES)	Arabian Gulf	0.027	0.099	0.042	0.162	0.594	0.252	0.577	0.305	0.282
	Baltic Sea	0.352	0.165	0.06	2.112	0.99	0.36	0.000	0.155	0.299
	Black Sea	–0.004	0.053	0.139	–0.024	0.318	0.834	0.943	0.683	0.009
	Mediterranean Sea	0.035	0.084	0.110	0.21	0.504	0.660	0.083	0.32	0.006
	Red Sea	0.033	0.07	0.047	0.198	0.42	0.282	0.203	0.138	0.042
4. Coastal Boundary Systems (CBS)	Atlantic Ocean (west)	0.137	0.123	0.127	0.822	0.738	0.762	0.000	0.000	0.000
	Caribbean Sea/Gulf of Mexico	0.023	0.024	0.019	0.138	0.144	0.114	0.193	0.498	0.281
	Indian Ocean (west)	0.097	0.100	0.096	0.582	0.600	0.576	0.000	0.000	0.000
	Indian Ocean (east)	0.099	0.092	0.080	0.594	0.552	0.480	0.000	0.000	0.000
	Indian Ocean (east), Southeast Asia, Pacific Ocean (west)	0.144	0.134	0.107	0.864	0.804	0.642	0.000	0.000	0.000
5. Eastern Boundary Upwelling Ecosystems (EBUE)	Benguela Current	0.062	0.032	0.002	0.372	0.192	0.012	0.012	0.437	0.958
	California Current	0.117	0.122	0.076	0.702	0.732	0.456	0.026	0.011	0.125
	Canary Current	0.054	0.089	0.106	0.324	0.534	0.636	0.166	0.014	0.000
	Humboldt Current	0.051	0.059	0.104	0.306	0.354	0.624	0.285	0.205	0.013
6. Subtropical Gyres (STG)	Indian Ocean	0.141	0.112	0.103	0.846	0.672	0.618	0.000	0.000	0.000
	North Atlantic Ocean	0.042	0.046	0.029	0.252	0.276	0.174	0.048	0.276	0.038
	South Atlantic Ocean	0.079	0.083	0.098	0.474	0.498	0.588	0.000	0.017	0.000
	North Pacific Ocean (west)	0.065	0.071	0.059	0.390	0.426	0.354	0.000	0.018	0.000
	North Pacific Ocean (east)	0.008	0.042	0.051	0.048	0.252	0.306	0.617	0.133	0.014
	North Pacific Ocean	0.034	0.055	0.051	0.204	0.33	0.306	0.001	0.053	0.000
	South Pacific Ocean (west)	0.060	0.076	0.092	0.360	0.456	0.552	0.002	0.000	0.000
	South Pacific Ocean (east)	0.055	0.056	0.088	0.330	0.336	0.528	0.000	0.058	0.000
	South Pacific Ocean	0.056	0.060	0.089	0.336	0.360	0.534	0.000	0.027	0.000

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IPCC Sixth Assessment Report Cycle

AR6 Assessment Report

- WGI The Physical Science Basis (2021)
- WGII Impacts, Adaptation, Vulnerability (2021)
- WGIII Mitigation of Climate Change (2021)
- Synthesis Report (2022)

Special Reports

- Global Warming of 1.5°C (2018)
- Climate Change and Land (2019)
- Ocean and Cryosphere in a Changing Climate (2019)

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

1. Framing and Context of the Report
2. High Mountain Areas
3. Polar Regions
4. Sea level rise and implications for low lying islands, coasts and communities
5. Changing ocean, marine ecosystems, and dependent communities
6. Extremes, abrupt changes and managing risks

Cross-chapter box: Low lying islands and coasts

INTERGOVERNMENTAL PANEL ON climate change

WGII AR6 Outline: from natural to human systems and regions to synthetic approaches

Summary for Policymakers

Technical Summary

1 Point of departure and key concepts

SECTION 1: Risks, adaptation and sustainability for systems impacted by climate change

2 Terrestrial and freshwater ecosystems and their services

3 Ocean and coastal ecosystems and their services

4 Water

5 Food, fibre, and other ecosystem products

6 Cities, settlements and key infrastructure

7 Health, wellbeing and the changing structure of communities

8 Poverty, livelihoods and sustainable development

SECTION 2: Regions

9 Africa

10 Asia

11 Australasia

12 Central and South America

13 Europe

14 North America

15 Small Islands

SECTION 3: Sustainable development pathways: integrating adaptation and mitigation

16 Key risks across sectors and regions

17 Decision-making options for managing risk

18 Climate resilient development pathways

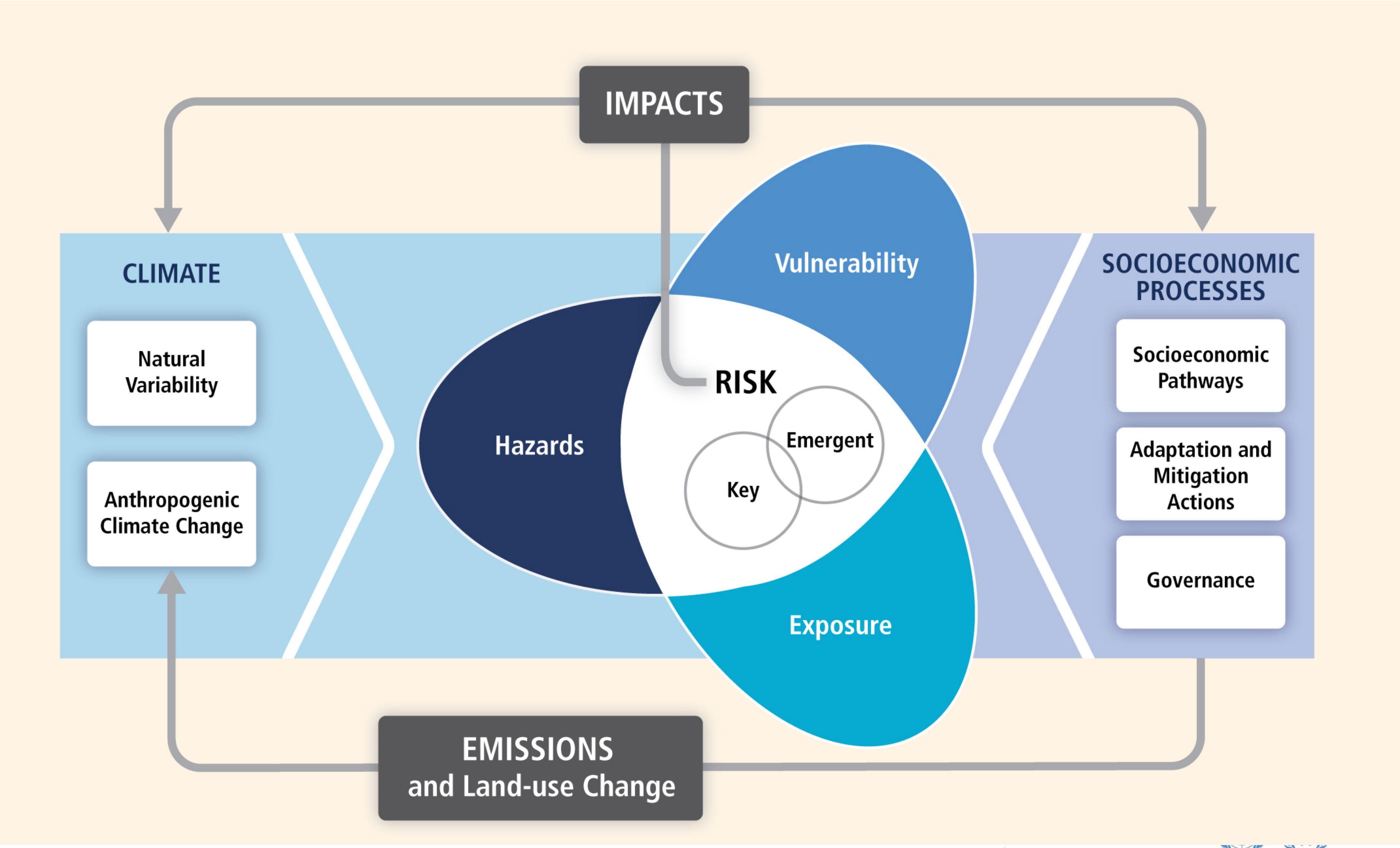
CROSS-CHAPTER PAPERS

ANNEXES

AR6 WGII Timetable

15 September – 27 October 2017	Call for nominations of Coordinating Lead Authors, Lead Authors and Review Editors
29 January – 4 February 2018	Selection of Authors
21–25 January 2019	First Lead Authors Meeting
8–12 July 2019	Second Lead Authors Meeting
21 October – 16 December 2019	Expert Review of the First Order Draft
27–31 January 2020	Third Lead Authors Meeting
7 August – 2 October 2020	Expert and Government Review of the Second Order Draft
2–7 November 2020	Fourth Lead Authors Meeting
11 June – 6 August 2021	Final Government Distribution of the Final Draft and Final Government Review of the Summary for Policymakers
4 – 8 October 2021	IPCC approval of the Summary for Policymakers and acceptance of the underlying Report

WGII Risk Framework



SECTION 2: Regions (Chapters 9-15)

9. Africa [~50 pages]
10. Asia [~50 pages]
11. Australasia [~30 pages]
12. Central and South America [~50 pages]
13. Europe [~40 pages]
14. North America [~40 pages]
15. Small Islands [~30 pages]

Common elements across all regional chapters

- Information on selected **regional and sub-regional climate characteristics and zones**
- Summary Table and/or figures with WGI and WGII information, combined with **risk assessment** (e.g., SREX SPM.1)
- **Detection and attribution** of observed **impacts** in natural and human systems on diverse time scales
- **Region specific information on exposure** and vulnerability
- Current sectoral **climate risks**, including specific regional and sub-regional considerations related to **land, coasts and regional oceans**
- **Cultural and psychological dimensions** (values, attitudes, ethical aspects, identity, behaviours, and different types of knowledge systems)
- Observed impacts and projected risks including identifying **key risks and residual risks as well as development pathways** depending on rate and level of climate change, including extremes and sea level rise
- **Diverse adaptation options** including opportunities, enablers, limits, barriers, adaptive capacity, and finances
- **Governance and economic aspects** including legal, institutional, financing, price responses, and trade
- **Cross sectoral, intra-regional, and inter-regional issues** including consideration of temporal scale
- Interaction of risks and responses to climate change with **sustainable development pathways**
- Lessons from case studies

AR6 SPECIAL REPORT LINKS TO WGII: REGIONAL CHAPTERS

SROCC

- *High Mountain Areas*
- *Polar Regions*
- *Sea Level Rise*
- *Changing Oceans*
- *Extremes, Changes, Risks*
- *(Low Lying Islands & Coasts)*

AR6 Regional Chapters

- *Detection & Attribution, Responses*
- *Sectoral Risks*
- *Cultural & Psychological Dimensions*
- *Impacts & Risks (incl Extremes & Sea Level Rise)*
- *Adaptation Options*
- *Governance & Economic Aspects*
- *Sustainable Development Pathways*

SR15

- *Compatible Mitigation Pathways*
- *Impact on Natural & Human Systems*
- *Global Response*
- *Sustainable Development*

SRCCL

- *Land-Climate Interactions*
- *Desertification*
- *Land Degradation*
- *Food Security*
- *Synergies, Trade-offs, integrated Response*
- *Risk Management & Sustainable Development*

THEMES CUTTING ACROSS WORKING GROUPS I, II, III

- Regional Aspects
- Risk and Uncertainty
- Adaptation-mitigation Interactions
- Cities and Climate Change
- Geoengineering
- Global Stocktake
- Scenarios

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Table 21-8 | Leading knowledge gaps and related research needs.

Knowledge gap	Research need
There is no clear understanding of how to integrate the diversity of climate change projections data. The full associated uncertainty is weakly characterized and quantifying how much of an observed or simulated climate change is due to internal variability or external forcings is difficult in many situations. Collectively, the results in data products with differing time and space resolution and differing dependencies and assumptions that can have conflicting messages. At present, individual products are plausible and mostly defensible insofar as they have a physical basis within the assumptions of the method. However, at decision-relevant scales, understanding where (or whether) the true outcome will lie within the range of the products collectively is often not possible and thus the products are often not strongly actionable.	Research is needed to distinguish the relative stochastic and deterministic sources of variability and change as a function of scale, variable, and application. The need is to develop further and build on physical understanding of the drivers of climate variability and change and to represent these realistically within models to understand the source of the spread and any contradictions in the regional projections at scales relevant to users, and then to provide guidance on a likely range of outcomes within which the true response would be expected to lie. Similarly, there is a need is to articulate the real inherent uncertainty within climate projection data and to understand when climate information is useful at the scales of need. This also requires stronger dialogues with users of climate information to inform choices of variables and ways to characterize envelopes of risk and uncertainties.
The growth of multi-model, multi-method, and multi-generational data for climate projections creates confusion for the Impacts, Adaptation, and Vulnerability (IAV) community. The lack of a clear approach to handling this diversity leads to choosing one or another subset, where one choice may substantially alter the IAV conclusion compared to a different subset.	Methodological and conceptual advances are needed to facilitate the synthesis of diverse data sets on different scales from methods with different assumptions, and to integrate these into cohesive and defensible understanding of projected regional change.
The attributes of regional climate change through which impacts are manifest, such as the intensity, persistence, distribution, recurrence, and frequency of weather events, is poorly understood. The information conveyed to the adaptation community is dominated by aggregates in time and space (e.g., IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) regional averages or time averages), which hide the important attributes underlying these aggregated changes. In part this is a consequence of the first row above.	The research need is to be able to demonstrate how to unpack the regional projections into terms relevant for impacts and adaptation. For example, how is the shape of the distribution of weather events changing (not just the extremes), or how stable are the critical global teleconnection patterns that contribute to the variability of a region?
The historical record for many regions, especially those regions most vulnerable to climate change, is poor to the extent that the historical record is at best an estimate with unknown uncertainty. This severely undermines the development of regional change analysis, limits the evaluation of model skill, and presents a weak baseline against which to assess change signals or to develop impacts, adaptation, or vulnerability baselines.	The research need is to integrate the multiplicity of historical data as represented by the raw observations into processed gridded products (e.g., climate research unit and Global Precipitation Climatology Project), satellite data, and reanalysis data sets. Involving national scientists with their inherent local knowledge and rescue and digitization of the many national archives still inaccessible to the wider research community would significantly enhance this research activity.
Impact model sensitivity studies and intercomparison exercises are beginning to reveal fundamental flaws and omissions in some impact models in the representation of key processes that are expected to be important under projected climate changes. For example, high temperature constraints and CO_2 and drought effects on agricultural yields are poorly represented in many crop models.	Intensified efforts are needed to refine, test, and intercompare impact models over a wider range of sectors and environments than hitherto. These should be supported, where applicable, by targeted field, chamber, and laboratory experiments under controlled atmospheric composition and climate conditions, to improve understanding of key physical, biological, and chemical processes operating in changed environments. Such experiments are needed across a range of terrestrial and aquatic biogeographical zones in different regions of the world.
New global scenarios are under development, based on climate projections for different Representative Concentration Pathways (RCPs) and socioeconomic scenarios based on shared socioeconomic pathways (SSPs). However, there is currently little or no guidance on how these projections are to be accessed or applied in IAV studies. Moreover, as yet, quantitative SSPs are available only for large regions (basic SSPs), and regional SSPs that are consistent with the global SSPs (extended SSPs) along with scenarios that include mitigation and adaptation policies (shared policy assumptions (SPAs)) have not yet been developed.	Extended SSPs for major subcontinental regions of the world, including variables that define aspects of adaptive capacity and guidance on how to combine RCP-based regional climate projections with regional SSPs and SPAs to form plausible regional scenarios for application in IAV analysis.
The determinants and regional variability of vulnerability, exposure, and adaptive capacity are not well understood, and methods for projecting changes in them are underdeveloped. Furthermore, given these lacks of understanding, uncertainties of these three elements are poorly characterized and quantified.	Case studies and underlying theory of these features of societies, and documentation of the effectiveness of actions taken, are needed in conjunction with methods development for projections. More attention needs to be placed on determining their uncertainties in national and regional assessments.

REGIONAL NATURE OF CLIMATE CHANGE

ITS IMPACTS

EVOLUTION OF SOCIETAL VULNERABILITY

DETERMINANTS OF REGIONAL VULNERABILITY AND ADAPTATIVE CAPACITY

WGII data

Accommodate WGII information

Connect to cross WG information

Baselines

Regional Atlas

SSPs - As socioeconomic factors are important contributors to both the vulnerability and adaptability of human and natural systems