IPCC SREX Summary for Policymakers

A. CLIMATE EXTREMES AND DISASTERS: CONTEXT

This Summary for Policymakers presents key findings from the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX). The SREX approaches the topic by assessing the scientific literature on issues that range from the relationship between climate change and extreme weather and climate events (“climate extremes”) to the implications of these events for sustainable development. Much of the assessment concerns the interaction of climatic, environmental, and human factors that can lead to impacts and disasters, options for managing the risks posed by impacts and disasters, and the important role that non-climatic factors play in determining impacts. Box SPM.1 defines concepts central to the SREX.

The character and severity of impacts from climate extremes depend not only on the extremes themselves but also on vulnerability and exposure. Adverse impacts are considered disasters when they produce widespread damage and cause severe alterations in the normal functioning of communities or societies. Climate extremes, exposure, and vulnerability are influenced by a wide range of factors, including anthropogenic climate change, natural variability, and socioeconomic development (Figure SPM.1). Disaster risk management and adaptation to climate change focus on reducing vulnerability and exposure and increasing resilience to the potential adverse impacts of climate extremes, even though risks cannot fully be eliminated (Figure SPM.2).

This report integrates perspectives from several historically distinct research communities studying climate science, climate impacts, adaptation to climate change, and disaster risk management. Each community brings different viewpoints, vocabularies, approaches, and goals, and all provide important insights into the status of and gaps in the knowledge base. In the interdisciplinary setting of the SREX, many of the key assessment findings come from the interfaces among these communities. These interfaces are also illustrated in Table SPM.1. To accurately convey the degree of certainty in key findings, the report relies on the consistent use of calibrated uncertainty language, introduced in Box SPM.2.

[INSERT FIGURE SPM.1 HERE:
Figure SPM.1: Illustration of the core concepts of the SREX. The report assesses how vulnerability and exposure to weather and climate events determine impacts and the potential for disasters (disaster risk). It evaluates the influence of natural climate variability and anthropogenic climate change on weather and climate events, as well as on the vulnerability and exposure of human society and natural ecosystems. It also considers the role of development in trends in vulnerability and exposure, implications for disaster risk, and interactions between disasters and development. The report examines how disaster risk management and adaptation to climate change can reduce vulnerability and exposure to weather and climate events and thus reduce disaster risk, as well as increase resilience to the risks that cannot be eliminated. Other important processes are largely outside the scope of this report, including the influence of development on greenhouse gas emissions and anthropogenic climate change. [1.1.2, Figure 1-1]]

[INSERT FIGURE SPM.2 HERE:
Figure SPM.2: Adaptation and disaster risk management approaches for reducing and managing disaster risk in a changing climate. This report assesses a wide range of complementary adaptation and disaster risk management approaches that can reduce the risks of climate extremes and disasters and increase resilience to remaining risks as they change over time. These approaches can be overlapping and can be pursued simultaneously. [6.5, Figure 6-3]]

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Box SPM.1: Definitions Central to the SREX

Core concepts as defined and used in this report include the following terms. The SREX glossary defines these and other terms used throughout the report.

Climate Change: a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Extreme (weather or climate) event: the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends ("tails") of the range of observed values of the variable.

Exposure: the presence of people, livelihoods, environmental services and resources, infrastructure, and economic, social, and cultural assets, in places that could be adversely affected.

Vulnerability: the propensity or predisposition to be adversely affected.

Disasters: severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Adaptation: in human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.

_____ END BOX SPM.1 HERE _____

Exposure and vulnerability are key determinants of disaster risk. [1.1.2, 1.2.3, 1.3, 2.5] For example, a tropical cyclone can have very different impacts depending on where and when it makes landfall. [3.1] Similarly, a heat wave can have very different impacts on different populations depending on their vulnerability. [Box 4-4, 9.2.1] Extreme and non-extreme weather and climate events also affect vulnerability to future extreme events, by modifying the resilience, coping capacity, and adaptive capacity of communities, societies, or social-ecological systems exposed to such events. In particular, the cumulative effects of disasters at sub-national or local levels can substantially affect livelihood options and resources and the capacity of societies and communities to prepare for and respond to future disasters. [2.2, 2.7]

A changing climate leads to changes in the frequency, intensity, spatial extent, and duration of extreme weather and climate events, and can result in unprecedented extreme weather and climate events. Irrespective of the magnitude of any anthropogenic changes in climate over the next century, a wide variety of natural weather and climate extremes will occur. Changes in extremes can also be linked to changes in average or mean climate conditions, particularly if the average conditions in the future correspond to events that are currently considered to be extreme (i.e., they fall within the tail ends of present-day distributions). Some climate extremes (e.g., droughts) may be the result of an accumulation of weather or climate events that are not extreme when considered independently. [3.1]

The severity of the impacts of extreme and non-extreme weather and climate events depends strongly on the level of vulnerability and exposure to these events. [2.2.1, 2.3, 2.5] Extreme impacts on human, ecological, or physical systems can be associated with individual extreme or non-extreme events, or a compounding of events or their impacts. [1.1.2; 1.2.3; 3.1.3] For example, drought, coupled with extreme heat and low humidity, can increase the risk of wildfire. [Box 4-1, 9.2.2]

B. OBSERVATIONS OF EXPOSURE, VULNERABILITY, CLIMATE EXTREMES, IMPACTS, AND DISASTER LOSSES

The impacts of climate extremes and the potential for disasters result from the climate extremes themselves and from the exposure and vulnerability of human and natural systems. Observed changes in climate extremes reflect the influence of anthropogenic climate change in addition to natural climate variability, with changes in exposure and vulnerability influenced by both climatic and non-climatic factors.

EXPOSURE AND VULNERABILITY

Vulnerability and exposure are dynamic, varying across temporal and spatial scales, and depend on economic, social, demographic, cultural, institutional, and governance factors (*high confidence*). [2.2, 2.3, 2.5] Individuals and communities are differentially vulnerable and exposed based on factors such as wealth, education, race/ethnicity/religion, gender, age, class/caste, disability, and health status. [2.5]

Settlement patterns, urbanization, and changes in socioeconomic status have all influenced observed trends in vulnerability and exposure to climate extremes. [4.2, 4.3.5] Coastal settlements are exposed and vulnerable to climate extremes in both developed and developing countries, such as in Small Island States and Asian megadeltas. [4.3.5, 4.4.3, 4.4.6, 4.4.9] Vulnerable populations also include refugees, internally displaced people, and those living in marginal areas. [4.2, 4.3.5] Rapid urbanization and the growth of megacities, especially in developing countries, have led to the emergence of highly vulnerable urban communities, particularly in informal settlements *(high agreement, robust evidence*). [5.5.1] See also case studies 9.2.8 and 9.2.9.

CLIMATE EXTREMES AND IMPACTS

There is evidence from observations gathered since 1950 of changes in some extremes. Confidence in observed changes in extremes depends on the quality and quantity of data and the availability of studies analyzing these data. It consequently varies across regions and for different extremes. Assigning "low confidence" in observed changes of a specific extreme on regional or global scales neither implies nor excludes the possibility of changes in this extreme. Global-scale trends in a specific extreme may be more or less reliable than some regional-scale trends, depending on the geographical uniformity of the trends in the specific extreme. The following paragraphs provide further details for specific climate extremes. [3.1.5, 3.2.1]

It is *very likely* that there has been an overall decrease in the number of cold days and nights, and an overall increase in the number of warm days and nights, on the global scale, i.e., for most land areas with sufficient data. It is *likely* that these changes have also occurred at the continental scale in North America, Europe, and Australia. There is *medium confidence* of a warming trend in temperature extremes in much of Asia. Confidence in observed trends in temperature extremes in Africa and South America generally varies from *low* to *medium* depending on the region. Globally, in many (but not all) regions with sufficient data there is *medium confidence* that the length or number of warm spells, including heat waves, has increased since the middle of the 20th century. [3.3.1, Table 3.2]

It is *likely* that there have been statistically significant increases in the number of heavy precipitation events in more regions than there have been statistically significant decreases, but there are strong regional and subregional variations in the trends. [3.3.2]

There is *low confidence* that any observed long-term (i.e., 40 years or more) increases in tropical cyclone activity are robust, after accounting for past changes in observing capabilities. [3.4.4]

There is *medium confidence* that since the 1950s some regions of the world have experienced more intense and longer droughts, in particular in southern Europe and West Africa, but in some regions droughts have become less frequent, less intense, or shorter, e.g., in central North America and northwestern Australia. [3.5.1]

There is *limited* to *medium evidence* available to assess climate-driven observed changes in the magnitude and frequency of floods at regional scales because the available instrumental records of floods at gauge stations are limited in space and time, and because of confounding effects of changes in land use and engineering. Furthermore, there is *low agreement* in this evidence, and thus overall *low confidence* at the global scale regarding even the sign of these changes. [3.5.2]

It is *likely* that there has been an increase in extreme coastal high water related to trends in mean sea level in the late 20th century. [3.5.3]

There is evidence that some extremes have changed as a result of anthropogenic influences, including increases in atmospheric concentrations of greenhouse gases. It is *likely* that anthropogenic influences have led to warming of extreme daily minimum and maximum temperatures on the global scale. There is *medium confidence* that anthropogenic influences have contributed to intensification of extreme precipitation on the global scale. It is *likely* that there has been an anthropogenic influence on increasing extreme sea levels via mean sea level contributions. There is *low confidence* in attribution of changes in tropical cyclone activity to anthropogenic influences. [3.3.1, 3.3.2, 3.4.4, 3.5.3, Table 3.1]

DISASTER LOSSES

Economic losses from weather- and climate-related disasters are increasing, but with large interannual variability (*high confidence*). Global weather- and climate-related disaster losses reported over the last few decades reflect mainly monetized direct damages to assets, and are unequally distributed. Annual accumulated estimates have ranged from a few billion to about 200 billion USD (in 2010 dollars), with the highest value for 2005 (the year of Hurricane Katrina). In the period 2000-2008, Asia experienced the highest number of weather- and climate-related disasters. Many impacts, such as loss of human lives, cultural heritage, and ecosystem services, are difficult to measure as they are not normally given monetary values or bought and sold, and thus they are poorly reflected in estimates of losses. Impacts on the informal or undocumented economy may be very important in some areas and sectors, but are generally not counted in reported estimates of losses. [4.5.1, 4.5.3, 4.5.4]

Measured economic and insured losses from disasters are largest in developed countries. Fatality rates and economic losses as a proportion of GDP are higher in developing countries (*high confidence*). For example, during the 25-year period from 1979 to 2004 over 95% of deaths from natural disasters occurred in developing countries. The relative economic burden in terms of direct loss expressed as a percentage of GDP has also been substantially higher for developing countries. Middle income countries with rapidly expanding asset bases have borne the largest burden, and during the period from 2001-2006 losses amounted to about 1% of GDP, while this ratio has been about 0.3% of GDP for low income countries and less than 0.1% of GDP for high income countries. In small exposed countries, particularly Small Island Developing States, these wealth losses expressed as a percentage of GDP and averaged over both disaster and non-disaster years can be considerably higher (at close to 10%). [4.5.2]

Increasing exposure of people and economic assets is the major cause of the long-term changes in economic disaster losses (*high confidence*). Long-term trends in normalized economic disaster losses cannot be reliably attributed to natural or anthropogenic climate change, particularly for cyclones and floods (*medium evidence, high agreement*). This conclusion is contingent on a number of factors: (i) data availability, as most data are available for standard economic sectors in developed countries; (ii) type of hazards studied, as most studies focus on cyclones, where confidence in observed trends and attribution of changes to human influence is *low*; (iii) the processes used to normalize loss data over time; and (iv) record length. [4.5.3]

C. DISASTER RISK MANAGEMENT AND ADAPTATION TO CLIMATE CHANGE: PAST EXPERIENCE WITH CLIMATE EXTREMES

Past experience with climate extremes contributes to understanding of effective disaster risk management and adaptation approaches to manage risks.

Trends in vulnerability and exposure are major drivers of changes in disaster risk (*high confidence*). [2.5] Understanding the multi-faceted nature of both vulnerability and exposure is a prerequisite for determining how weather and climate events contribute to the occurrence of disasters, and for designing and implementing effective adaptation and disaster risk management strategies. [2.2, 2.6] Vulnerability reduction is a core common element of adaptation and disaster risk management. [2.2, 2.3]

Increasing global interconnectivity, population and economic growth, and the mutual interdependence of economic and ecological systems can serve both to reduce vulnerability and to amplify disaster risk (*high confidence*). [7.2.1] Development practice, policy, and outcomes are critical to shaping disaster risk. [1.1.2, 1.1.3] High vulnerability and exposure are generally the outcome of development processes such as those associated with environmental degradation, rapid and unplanned urbanization in hazardous areas, failures of governance, and the scarcity of livelihood options for the poor. [2.2.2, 2.5] Effective national development and sector plans include considerations of disaster risk, with adoption of climate change adaptation strategies, policies, and measures that target vulnerable areas and groups. [6.2, 6.5.2]

Data on disasters and disaster risk reduction are lacking at the local level, especially in developing countries, which can constrain improvements in local resilience (*high agreement, medium evidence*). [5.7] There is *limited evidence* of national disaster risk management systems and associated risk management measures explicitly integrating knowledge of and uncertainties in projected changes in vulnerability, exposure, and climate extremes. [6.6.2, 6.6.4]

Inequalities influence local coping and adaptive capacity, and pose disaster risk management and adaptation challenges (*high agreement, robust evidence*). These inequalities reflect socioeconomic, demographic, and health-related differences and differences in access to livelihoods and entitlements. [5.5.1] Developed countries are often better equipped financially and institutionally to adopt explicit measures to effectively respond and adapt to projected changes in exposure, vulnerability, and climate extremes than developing countries, although all countries face challenges in assessing, understanding, and acting on projections. [6.6]

Humanitarian relief is often required when disaster risk reduction measures are absent or prove unsuccessful (*high agreement, robust evidence*). [5.2.1] In particular, smaller or less diversified countries face critical challenges in providing the public goods associated with disaster risk management, in absorbing the losses caused by climate extremes and disasters, and in providing relief and reconstruction assistance. [6.2.1]

Post-disaster recovery may provide a critical opportunity for reducing weather- and climate-related disaster risk and for improving adaptive capacity (*high agreement, robust evidence*). Typically, there is an emphasis on rapidly rebuilding houses, reconstructing infrastructure, and rehabilitating livelihoods at the local level. This urgency often overrides the need to avoid recovering in ways that recreate or even increase existing vulnerabilities. [5.2.3] See also assessment in 8.4.1 and 8.5.2.

Risk sharing and transfer mechanisms can increase resilience to climate extremes at local, national, and international scales. Mechanisms include insurance, reinsurance, microinsurance (including weather-index microinsurance), and national and international risk pools. [5.6.3, 6.4.3, 6.5.3, 7.4] Insurance and other forms of risk transfer are linked to disaster risk reduction and climate change adaptation by providing means to finance relief, recovery of livelihoods, and reconstruction, reducing vulnerability and providing knowledge and incentives for reducing risk. [5.5.2.; 6.2.2; 9.3.3] Under certain conditions, however, such mechanisms can provide disincentives for reducing disaster risk at the local level. [5.6.3] See also case study 9.2.13.

Attention to the temporal and spatial dynamics of vulnerability and exposure is particularly important given that the design and implementation of adaptation and disaster risk management strategies and policies can reduce risk in the short term, but may increase vulnerability and exposure over the longer term (*high agreement, medium evidence*). For instance, dyke systems can reduce hazard exposure by offering immediate protection, but also encourage settlement patterns that may increase risk in the long-term. [2.4.2, 2.5.4, 2.6.2] See also assessment in 1.4.3, 5.3.2, and 8.3.1.

Closer integration of disaster risk management and climate change adaptation, along with the incorporation of both into local, national, and international development policies and practices, will provide benefits at all scales (*high agreement, medium evidence*). [5.4, 5.5, 5.6, 6.3.1, 6.4.2, 6.6, 7.4] Addressing social welfare, quality of life, infrastructure, and livelihoods, and incorporating a multi-hazards approach into planning and action for disasters in the short term, facilitates adaptation to climate extremes in the longer term. [5.4, 5.5, 5.6] Strategies and policies are more effective when they acknowledge multiple stressors, different prioritized values, and competing policy goals. [8.2, 8.3, 8.7]

D. FUTURE CLIMATE EXTREMES, IMPACTS, AND DISASTER LOSSES

Future changes in exposure, vulnerability, and climate extremes resulting from anthropogenic climate change, natural climate variability, and socioeconomic development can alter the impacts of climate extremes on natural and human systems and the potential for disasters.

CLIMATE EXTREMES AND IMPACTS

Confidence in projecting changes in the direction and magnitude of climate extremes depends on many factors, including the type of extreme, the region and season, the amount and quality of observational data, the level of understanding of the underlying processes, and the reliability of their simulation in models. Assigning “low confidence” for projections of a specific extreme neither implies nor excludes the possibility of changes in this extreme. The following assessments of the likelihood and/or confidence of projections are generally for the end of the 21st century and relative to the climate at the end of the 20th century. Uncertainty in the sign of projected changes in climate extremes over the coming two to three decades is relatively large because climate change signals are expected to be relatively small compared to natural climate variability. For projected changes by the end of the 21st century, either model uncertainty or uncertainties associated with emissions scenarios[1] used becomes dominant, depending on the extreme. Low-probability high-impact changes associated with the crossing of poorly understood thresholds cannot be excluded, given the transient and complex nature of the climate system. [3.1.5, 3.1.7, 3.2.3]

[INSERT FOOTNOTE 1: Emissions scenarios for radiatively important gases result from pathways of socioeconomic and technological development. This report uses a subset of the 40 scenarios extending to the year 2100 that are described in the IPCC Special Report on Emission Scenarios (SRES). None of the scenarios includes policies explicitly addressing climate change.]

Models project a substantial warming in temperature extremes by the end of the 21st century. It is *virtually certain* that increases in the frequency and magnitude of warm daily temperature extremes and decreases in cold extremes will occur through the 21st century on the global scale. It is *very likely* that the length, frequency and/or intensity of warm spells, including heat waves, will continue to increase over most land areas. In terms of absolute values, 20-year extreme annual daily maximum temperature (i.e, return value [2]) will likely increase by about 1°C to 3°C by mid-21st century and by about 2°C to 5°C by late-21st century, depending on the region and emissions scenario (considering the B1, A1B and A2 scenarios). See Figure SPM.3A. [3.3.1, 3.1.6, Table 3.3, Figure 3.5]

[INSERT FOOTNOTE 2: A value that occurs on average only once in a given period of time (return period). The return period in this instance is 20 years).]

[INSERT FIGURE SPM.3A HERE:
Figure SPM.3A: Projected changes (°C) in 20-year return values of annual maximum of the daily maximum temperature. That is, the projected changes in a daily temperature value that occurs on average only once during a 20 year period. The bar plots (see legend for more info) show results for regionally averaged projections for two time horizons, 2046 to 2065 and 2081 to 2100, as compared to the late-20th-century, and for three different SRES emission scenarios (B1, A1B, A2). Results are based on 12 GCMs contributing to the CMIP3 (Fig. 3.5). See inset map for defined extent of regions (Fig. 3.1). Values are computed for land points only. The “Globe”(inset box) displays the values computed using all land grid points. [3.3.1. Fig. 3.1, Fig. 3.5]

It is *likely* that the frequency of heavy precipitation or the proportion of total rainfall from heavy falls will increase in the 21st century over many areas of the globe. This is particularly the case in the high latitudes and tropical regions, and in winter in the northern mid-latitudes. Heavy rainfalls associated with tropical cyclones are *likely* to increase with continued warming induced by enhanced greenhouse gas concentrations. There is *medium confidence* that, in some regions, increases in heavy precipitation will occur despite projected decreases of total precipitation. For a range of emission scenarios (B1, A1B, A2), a one-in-20 year annual maximum 24-hour precipitation rate is *likely* to become a one in 5- to 15-year event by the end of the 21st century in many regions, and in most regions the higher emissions scenarios (A1B and A2) lead to a stronger projected decrease in return period. See Figure SPM.3B. [3.3.2, Table 3.3, Figure 3.7]

[INSERT FIGURE SPM.3B HERE:
Figure SPM.3B: Projected return periods (in years) for late-twentieth-century 20-year return values of annual maximum 24-hour precipitation rates. That is, the projected new return periods for a daily precipitation event that would previously have occurred on average only once during a 20 year period. The bar plots (see legend for more info) show results for regionally averaged projections for two time horizons, 2046 to 2065 and 2081 to 2100, as compared to the late-20th-century, and for three different SRES emission scenarios (B1, A1B, A2). Results are based on 14 GCMs contributing to the CMIP3 (Fig. 3.7). See inset map for defined extent of regions (Fig. 3.1). Values are computed for land points only. The “Globe” (inset box) displays the values computed using all land grid points. [3.3.2, Fig. 3.1, Fig. 3.7]

Mean tropical cyclone maximum wind speed is *likely* to increase, although increases may not occur in all ocean basins. It is *likely* that the global frequency of tropical cyclones will either decrease or remain essentially unchanged. **There is *medium confidence* that there will be a reduction in the number of mid-latitude cyclones averaged over each hemisphere.** While there is *low confidence* in the detailed geographical projections of mid-latitude cyclone activity, there is *medium confidence* in a projected poleward shift of mid-latitude storm tracks. [3.4.4, 3.4.5]

There is *medium confidence* that droughts will intensify in the 21st century in some seasons and areas, due to reduced precipitation and/or increased evapotranspiration. This applies to the Mediterranean region, central Europe, southern North America, northeast Brazil, and southern Africa. Definitional issues, lack of observational data, and the inability of models to include all the factors that influence droughts preclude stronger confidence than *medium* in the projections. Elsewhere there is overall *low confidence* because of inconsistent projections of drought changes (dependent both on model and dryness index). See Figure SPM.4. [3.5.1, Table 3.3, Box 3.3]

Figure SPM.4: Projected annual changes in dryness assessed from two indices. Left column: Change in number of consecutive dry days (CDD, days with precipitation < 1mm). Right column: Changes in soil moisture (Soil moisture anomalies, SMA). Increased dryness is indicated with warm colors (positive changes in CDD and negative SMA values). Differences are expressed in units of standard deviations, derived from detrended per year annual or seasonal estimates, respectively, from the three 20-year periods 1980-1999, 2046-2065 and 2081-2100 pooled together. The figures show changes for two time horizons, 2046-2065 and 2081-2100, as compared to late-20th-century values, based on GCM simulations under emission scenario SRES A2 relative to corresponding simulations for the 20th century. Results are based on 17 (CDD) and 15 (SMA) GCMs contributing to the CMIP3 (Figure 3.9). Shading is only applied for areas where at least 66% (12 out of 17 for CDD, 10 out of 15 for SMA) of the models agree in the sign of the change; stippling is applied for regions where at least 90% (16 out of 17 for CDD, 14 out of 15 for SMA) of all models agree in the sign of the change. [3.5.1, Figure 3.9]

Projected temperature and precipitation changes imply changes in floods, although overall there is *low confidence* in projections of changes in fluvial floods. Confidence is *low* due to *limited evidence* and because the causes of regional changes are complex, although there are exceptions to this statement. There is *medium confidence* (based on physical reasoning) that projected increases in heavy rainfall would contribute to increases in local flooding, in some catchments or regions. [3.5.2]

It is *very likely* that mean sea level rise will contribute to upward trends in extreme sea levels in the future. There is *high confidence* that locations currently experiencing adverse impacts such as coastal erosion and inundation will continue to do so in the future due to increasing sea levels, all other contributing factors being equal. The *very likely* contribution of mean sea level rise to increased extreme sea levels, coupled with the *likely* increase in tropical cyclone maximum wind speed, is a specific issue for tropical small island states.[3.5.3, 3.5.5, Box 3.4]

There is *high confidence* that changes in heat waves, glacial retreat and/or permafrost degradation will affect high mountain phenomena such as slope instabilities, movements of mass, and glacial lake outburst floods. There is also *high confidence* that changes in heavy precipitation will affect landslides in some regions. [3.5.6]

There is *low confidence* in projections of changes in large-scale patterns of natural climate variability. Confidence is *low* in projections of changes in monsoons (rainfall, circulation), because there is little consensus in climate models regarding the sign of future change in the monsoons. Model projections of changes in El Niño – Southern Oscillation variability and the frequency of El Niño episodes are not consistent, and so there is *low confidence* in projections of changes in the phenomenon. [3.4.1, 3.4.2, 3.4.3]

HUMAN IMPACTS AND DISASTER LOSSES

Extreme events will have greater impacts on sectors with close links to climate. For example, while it is not possible to project specific changes at the catchment scale, there is *high confidence* that changes in climate have the potential to seriously affect water management systems. However, climate change is in many instances only one of the drivers of future changes, and is not necessarily the most important driver at the local scale. Climate-related extremes are also expected to produce large impacts on infrastructure, although detailed analysis of potential and projected damages are limited to a few countries, infrastructure types, and sectors. Other sectors with links to climate include, for example, agriculture and food security, health, and tourism. [4.3.2, 4.3.5]

Direct economic losses from tropical cyclones will increase in the absence of additional protection measures (*high confidence*). Losses due to extra-tropical cyclones will also increase, with possible decreases or no change in some areas (*medium confidence*). Although future flood losses in many locations will increase in the absence of additional protection measures (*high agreement, medium evidence*), the size of the estimated change is highly variable, depending on location, climate scenarios used, and methods used to assess impacts on river flow and flood occurrence. [4.5.4]

For some climate extremes in many regions, the main driver for future increases in losses will be socioeconomic in nature (*medium confidence*, based on *medium agreement, limited evidence*). The frequency and intensity of extreme weather and climate events are only one factor that affects risks, but few studies have specifically quantified the effects of changes in population, exposure of people and assets, and vulnerability as determinants of loss. However, the few studies available generally underline the important role of projected changes (increases) in population and capital at risk. [4.5.2]

Disasters resulting from climate extremes influence population mobility and relocation, affecting host and origin communities (*medium agreement, medium evidence*). If disasters occur more frequently and/or with greater magnitude, some local areas will become increasingly marginal as places to live or in which to maintain livelihoods. In such cases, migration becomes permanent and could introduce new pressures in areas of relocation. For locations such as atolls, in some cases it is possible that many residents will have to relocate. [5.2.2]

E. PREPARING FOR AND RESPONDING TO CHANGING RISKS OF CLIMATE EXTREMES AND DISASTERS

Adaptation to climate change and disaster risk management provide a range of complementary approaches for managing the risks of climate extremes and disasters (Figure SPM.2). Effectively applying and combining approaches may benefit from considering the broader challenge of sustainable development.

Low-regrets measures for managing current disaster risks are starting points for addressing projected trends in exposure, vulnerability, and climate extremes, as they have the potential to offer benefits now and lay the foundation for addressing projected changes (*high agreement, medium evidence*). Many of these low-regrets strategies produce co-benefits, help address other development goals, such as improvements in livelihoods, human well-being, and biodiversity conservation, and help minimize the scope for maladaptation. [6.3.1]

Examples of effective low-regrets measures include early warning systems; risk communication between decision makers and local citizens; sustainable land management, including land use and zoning; and ecosystem management and restoration. Other measures include improvements to health surveillance, water supply, sanitation and drainage systems; climate proofing of major infrastructure and enforcement of building codes; and better education and awareness. [5.3.1, 5.3.3, 6.3.1, 6.5.1, 6.5.2**]** See also case studies 9.2.11 and 9.2.14 and assessment in 7.4.3.

An iterative process of monitoring, evaluation, learning, and innovation can reduce disaster risk and promote adaptive management in the context of climate extremes (*high agreement, robust evidence*). [8.6.3, 8.7] Adaptation efforts benefit from iterative risk management strategies because of the complexity, uncertainties, and long time frame associated with climate change (*high confidence*). [1.3.2] See also assessment in 6.6.

Effective risk management generally involves a portfolio of actions to reduce and transfer risk and to respond to events and disasters, as opposed to a singular focus on any one action or type of action (*high confidence*). [1.1.2, 1.1.4, 1.3.3] Approaches are more effective when they are informed by and customized to specific local circumstances (*high agreement, robust evidence*). [5.1] Successful strategies include a combination of hard infrastructure-based responses as well as soft longer-term solutions such as building individual and institutional capacity. [6.5.2]

Multi-hazard risk management approaches provide opportunities to reduce complex and compound hazards (*high agreement, robust evidence*). Considering multiple types of hazards reduces the likelihood that risk reduction efforts targeting one type of hazard will enhance risk to other hazards, in the present and future. [8.2.5, 8.5.2, 8.7]

Integration of local knowledge with external scientific and technical knowledge can improve local participation in disaster risk reduction and climate change adaptation (*high agreement, robust evidence*). Locals document in many different ways their experiences with the changing climate, particularly extreme weather events, and this self-generated knowledge can uncover existing capacity within the community. [5.4.4] Community based adaptation can benefit management of disaster risk and climate extremes, but is constrained by the availability of human and financial capital and of disaster risk and climate information customized for local stakeholders (*medium agreement, medium evidence)*. [5.6]

Appropriate and timely risk communication is critical for effective adaptation and disaster risk management (*high confidence*). Explicit characterization of uncertainty and complexity strengthens risk communication. [2.6.3] Effective risk communication requires exchanging, sharing, and integrating knowledge about climate-related risks among all stakeholder groups. Among individual stakeholders and groups, perceptions of risk are driven by psychological and cultural factors, values, and beliefs. [1.1.4, 1.2.2, 1.3.1, 1.4.2] See also assessment in 7.4.5.

Observed and projected trends in exposure, vulnerability, and climate extremes can guide design of risk management and adaptation strategies, policies, and measures. The importance of these trends for decision making depends on their magnitude and degree of certainty at the temporal and spatial scale of the risk being managed and on the available capacity to implement risk management options (see Table SPM.1).

[INSERT TABLE SPM.1 HERE
Table SPM.1 provides illustrative examples of how adaptation and risk management decisions can be informed by changes in exposure, vulnerability, and climate extremes. In each example, information is characterized at the scale directly relevant to decision making. Observed and projected changes in climate extremes at global and regional scales illustrate that the direction, magnitude, and/or degree of certainty for changes may differ across scales.

Regional and global changes in climate extremes imply some probability of events at smaller scales, but confidence in projected changes at the smaller scales is often more limited. Limited confidence in changes places a focus on low-regrets risk management options that aim to reduce exposure and vulnerability and to increase resilience to risks that cannot be eliminated. Higher-confidence projected changes in climate extremes, at a scale relevant to adaptation and risk management decisions, can inform more targeted adjustments in strategies, policies, and measures. [3.1.6, Box 3.2, 6.3.1, 6.5.2]

IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT

Actions that range from incremental steps to transformational changes are essential for reducing risk from climate extremes (*high agreement, robust evidence*). Incremental steps aim to improve efficiency within existing technological, governance, and value systems, whereas transformation may involve changes to the systems themselves. Where vulnerability is high and adaptive capacity low, changes in climate extremes can make it difficult for systems to adapt sustainably without transformational changes**.** Vulnerability and loss are often concentrated in lower income countries or groups, although higher income countries or groups can also be vulnerable to climate extremes. [8.6, 8.7]

A prerequisite for sustainability is addressing the underlying causes of vulnerability and the structural inequalities that create and sustain poverty and constrain access to resources (*medium agreement, robust evidence*). This involves integrating disaster risk management in other social and economic policy domains, as well as a long-term commitment to managing risk. [8.6.2, 8.7]

Short-term and long-term perspectives on disaster risk management and adaptation to climate change can be difficult to reconcile (*high agreement, medium evidence*). There are trade-offs between current decisions and long-term goals linked to diverse values, interests, and priorities for the future. Reconciling short-term and long-term goals for vulnerability reduction involves overcoming the disconnect between local risk management practices and national institutional and legal frameworks, policy, and planning. The most effective adaptation and disaster risk reduction actions are those that offer development benefits in the relatively near term, as well as reductions in vulnerability in the longer-term. However, limits to resilience are faced when social and/or natural systems exceed thresholds or tipping points. [8.2.1, 8.3.1, 8.3.2, 8.5.1, 8.6.1]

Progress towards resilient and sustainable development benefits from questioning assumptions and paradigms and stimulating innovation to encourage the generation of new patterns of response (*medium agreement, robust evidence*). Transformations, where they are required, are also facilitated through increased emphasis on adaptive management and learning. Responding successfully to multiple stressors, including disaster risk, often involves broad participation in strategy development, the capacity to combine multiple perspectives, and contrasting ways of organizing social relations. [8.2.5, 8.6.3, 8.7]

There are many approaches and pathways to a sustainable and resilient future**.** [8.2.3, 8.4.1, 8.6.1, 8.7] The interactions among climate change mitigation, adaptation, and disaster risk management may have a major influence on resilient and sustainable pathways. Trade-offs and synergies between the goals of mitigation and adaptation in particular will play out locally, but have global consequences. [8.2.5, 8.5.2] Choices and outcomes for adaptive actions to climate events must reflect divergent capacities and resources and multiple interacting processes. Actions are framed by trade-offs between competing prioritized values and objectives, and different visions of development that can change over time. Iterative approaches allow development pathways to integrate risk management so that diverse policy solutions can be considered as risk contexts evolve over time. [8.2.3, 8.4.1, 8.6.1, 8.7]

_____ START BOX SPM.2 HERE _____

Box SPM.2: Treatment of Uncertainty

Based on the Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties,[3] this Summary for Policymakers relies on two metrics for communicating the degree of certainty in key findings, which is based on author teams' evaluations of underlying scientific understanding:

- Confidence in the validity of a finding, based on the type, amount, quality, and consistency of evidence (e.g., mechanistic understanding, theory, data, models, expert judgment) and the degree of agreement. Confidence is expressed qualitatively.
- Quantified measures of uncertainty in a finding expressed probabilistically (based on statistical analysis of observations or model results, or expert judgment).

[INSERT FOOTNOTE 3: Mastrandrea, M.D., C.B. Field, T.F. Stocker, O. Edenhofer, K.L. Ebi, D.J. Frame, H. Held, E. Kriegler, K.J. Mach, P.R. Matschoss, G.-K. Plattner, G.W. Yohe, and F.W. Zwiers, 2010: *Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties*. Intergovernmental Panel on Climate Change (IPCC). Available at <http://www.ipcc.ch>.]

This Guidance Note refines the guidance provided to support the IPCC Third and Fourth Assessment Reports.

Each key finding is based on an author team's evaluation of associated evidence and agreement. The confidence metric provides a qualitative synthesis of an author team's judgment about the validity of a finding, as determined through evaluation of evidence and agreement. If uncertainties can be quantified probabilistically, an author team can characterize a finding using likelihood or a more precise presentation of probability. Unless otherwise indicated, *high* or *very high* confidence is associated with findings for which an author team has assigned likelihood.

The following summary terms are used to describe the available evidence: *limited*, *medium*, or *robust*; and for the degree of agreement: *low*, *medium*, or *high*. A level of confidence is expressed using five qualifiers *very low*, *low*, *medium*, *high*, and *very high*. Box SPM.2 Figure 1 depicts summary statements for evidence and agreement and their relationship to confidence. There is flexibility in this relationship; for a given evidence and agreement statement, different confidence levels can be assigned, but increasing levels of evidence and degrees of agreement are correlated with increasing confidence.

[INSERT BOX SPM.2 FIGURE 1 HERE:
Box SPM.2 Figure 1: A depiction of evidence and agreement statements and their relationship to confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality evidence.

The following terms have been used to indicate the assessed likelihood:

Term*	**Likelihood of the outcome**
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33 to 66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

* Additional terms that were used in limited circumstances in the AR4 (*extremely likely* – 95-100% probability, *more likely than not* – >50-100% probability, and *extremely unlikely* – 0-5% probability) may also be used in the AR5 when appropriate.

_____ END BOX SPM.2 HERE _____

Table SPM.1. Table SPM.1 provides illustrative examples of how adaptation and risk management decisions can be informed by changes in exposure, vulnerability, and climate extremes. In each example, information is characterized at the scale directly relevant to decision making. Observed and projected changes in climate extremes at global and regional scales illustrate that the direction, magnitude, and/or degree of certainty for changes may differ across scales.

Regional and global changes in climate extremes imply some probability of events at smaller scales, but confidence in projected changes at the smaller scales is often more limited. Limited confidence in changes places a focus on low-regrets risk management options that aim to reduce exposure and vulnerability and to increase resilience to risks that cannot be eliminated. Higher-confidence projected changes in climate extremes, at a scale relevant to adaptation and risk management decisions, can inform more targeted adjustments in strategies, policies, and measures. [3.1.6, Box 3.2, 6.3.1, 6.5.2]

Vulnerability and exposure at scale of risk management in example region	**Information on Climate Extreme Across Spatial Scales**			**Risk management/adaptation options in example region**
	Observed (since 1950) and projected (to 2100) global changes	**Observed (since 1950) and projected (to 2100) changes in example region**	**Available information at scale of risk management in example region**	
Mortality and morbidity due to **heat waves in urban areas** in Western Europe				
Factors affecting vulnerability and exposure include age; pre-existing health status; level of outdoor activity; socioeconomic factors including poverty and social isolation; access to and use of cooling; physiological and behavioral adaptation of the population; and urban infrastructure. [2.5.2; 4.3.5; 4.3.6; 4.4.5; 9.2.1]	Observed: *Medium confidence* that the length or number of warm spells, including heat waves, has increased since the middle of the 20th century, in many (but not all) regions. *Very likely* increase in number of warm days and nights on the global scale. Projected: *Very likely* increase in length, frequency, and/or intensity of warm spells, including heat waves over most land areas. *Virtually certain* increase in frequency and magnitude of warm days and nights on the global scale. [Table 3.1; 3.3.1]	Observed: *Medium confidence* in increase in heat waves in Europe. *Likely* increase in warm days and nights over most of the continent Projected: *High confidence* in *likely* increase in heat wave frequency, duration, and/or intensity in Europe. *Very likely* increase in warm days and nights. [Table 3.2; Table 3.3; 3.3.1]	Observations and projections can provide information for specific urban areas in the region, with increased heat waves expected due to regional trends and urban heat island effects. [3.3.1, 4.4.5]	Low-regrets options that reduce vulnerability and exposure across a range of hazard trends: • Early warning systems that reach particularly vulnerable communities (e.g. the elderly) • Vulnerability mapping • Public information on what to do during heat waves, including behavioral advice • Use of social care networks to reach vulnerable elderly Specific adjustments in strategies, policies, and measures informed by trends in heat waves: • Awareness raising of heat waves as a public health concern • Changes in urban infrastructure and land use planning, for example increasing urban green space • Changes in standards for cooling capacity, particularly for public facilities and critical infrastructure • Adjustments in energy generation and transmission infrastructure [Table 6.1; 9.2.1]

Increasing **losses from hurricanes** in the USA and the Caribbean				
Vulnerability and exposure are increasing due to growth in population and increase in property values, particularly along the Gulf and Atlantic coasts of the United States. Some of this increase has been offset by improved building codes. [4.4.6]	Observed: *Low confidence* that any observed long-term increases in tropical cyclone activity are robust, after accounting for past changes in observing capabilities. Projected: *Likely* that the global frequency of tropical cyclones will either decrease or remain essentially unchanged. *Likely* increase in mean maximum wind speed, although increases may not occur in all ocean basins. Heavy rainfalls associated with tropical cyclones are *likely* to increase. Projected sea level rise is expected to further compound tropical cyclone surge impacts. [Table 3.1; 3.4.4]	See global changes column.	Limited model capability to project changes relevant to specific settlements or other locations, due to the inability of global models to reproduce accurate details at scales relevant to tropical cyclone genesis, track, and intensity evolution. [3.4.4]	Low-regrets options that reduce vulnerability and exposure across a range of hazard trends: • Adoption and enforcement of improved building codes • Improved forecasting capacity and implementation of improved early warning systems (including evacuation plans and infrastructures) • Regional risk pooling In the context of high underlying variability and uncertainty regarding trends, options can include emphasizing adaptive management involving learning and flexibility (e.g., Cayman Islands National Hurricane Committee) [5.5.3, 6.5.2, 6.6.2, Box 6.7, Table 6.1, 7.4.4, 9.2.5, 9.2.11, 9.2.13]
Flash floods in Nairobi's informal settlements				
Rapid expansion of poor people living in informal settlements around Nairobi has led to houses of weak building materials being constructed immediately adjacent to rivers and to blockage of natural drainage areas, increasing vulnerability and exposure. [6.4.2, Box 6.2]	Observed: *Low confidence* at global scale regarding (climate-driven) observed changes in the magnitude and frequency of floods Projected: *Low confidence* in global projections of changes in flood magnitude and frequency because of insufficient evidence. However, *medium confidence* (based on physical reasoning) that projected increases in heavy precipitation will contribute to rain-generated local flooding in some catchments or regions. [Table 3.1; 3.5.2]	Observed: *Low confidence* regarding trends in heavy precipitation in East Africa, because of insufficient evidence. Projected: *Likely* increase in heavy precipitation indicators in East Africa. [Table 3.2; Table 3.3; 3.3.2]	Limited ability to provide local flood projections, partly due to lack of projections at the catchment/river-basin scale, but also due to lack of knowledge of changes in local hydrology. [3.5.2, 4.4.2]	Low-regrets options that reduce vulnerability and exposure across a range of hazard trends: • Strengthening building design and regulation • Focused poverty reduction schemes • City-wide drainage and sewerage improvements The Nairobi Rivers Rehabilitation and Restoration Programme includes installation of riparian buffers, canals, and drainage channels and clearance of existing channels; attention to climate variability and change in the location and design of wastewater infrastructure; and environmental monitoring for flood early warning. [6.3, 6.4.2, Box 6.2]

Inundation related to **extreme sea levels** in tropical SIDS				
Small island states in the Pacific, Indian, and Atlantic oceans, often with low elevation, are particularly vulnerable to rising sea levels and impacts such as erosion, inundation, shoreline change, and saltwater intrusion into coastal aquifers. These impacts can result in ecosystem disruption, decreased agricultural productivity, changes in disease patterns, economic losses such as in tourism industries, and population displacement – all of which reinforce vulnerability to extreme weather events. [3.5.5, Box 3.4, 4.3.5, 4.4.10, 9.2.9]	Observed: *Likely* increase in extreme high water worldwide related to trends in mean sea level in the late 20th century Projected: *Very likely* that mean sea level rise will contribute to upward trends in extreme sea levels. *High confidence* that locations currently experiencing coastal erosion and inundation will continue to do so due to increasing sea level, in the absence of changes in other contributing factors. [3.5.3; 3.5.5]	Observed: Tides and El Niño – Southern Oscillation have contributed to the more frequent occurrence of sea level extremes and associated flooding experienced at some Pacific Islands in recent years. Projected: The *very likely* contribution of mean sea level rise to increased extreme sea levels, coupled with the *likely* increase in tropical cyclone maximum wind speed, is a specific issue for tropical small island states. [Box 3.4, 3.4.4; 3.5.3]	Sparse regional and temporal coverage of terrestrial-based observation networks and limited in situ ocean observing network, but with improved satellite-based observations in recent decades. Short record lengths and the insufficient resolution of current climate models to represent small island states, limiting assessment of changes in extremes. [Box 3.4; 3.5.5]	Low-regrets options that reduce vulnerability and exposure across a range of hazard trends: • Maintenance of drainage systems • Well technologies to limit saltwater contamination of groundwater • Improved early warning systems • Regional risk pooling Specific adaptation options include, for instance, rendering national economies more climate independent and adaptive management involving iterative learning. In some cases there may be a need to consider permanent evacuation, for example, for atolls where storm surges may completely inundate them. [4.3.5, 4.4.10, 6.3.2, 6.6.2, 7.4.4, 9.2.9, 9.2.11, 9.2.13]
Droughts and food security in West Africa				
Inefficient agricultural practices render region vulnerable to increasing variability in seasonal rainfall, drought, and weather extremes. Vulnerability is exacerbated by rapid population growth, degradation of ecosystems, and overuse of natural resources, as well as poor standards for health, education, and governance. [2.5, 4.4.2, 9.2.3]	Observed: *Medium confidence* that some regions of the world have experienced more intense and longer droughts, but in some regions droughts have become less frequent, less intense, or shorter. Projected: *Medium confidence* in projected increase of duration and intensity of soil moisture and hydrological drought in some regions. Elsewhere there is overall *low confidence* because of inconsistent projections. [Table 3.1, 3.5.1]	Observed: *Medium confidence* of an increase in dryness. Recent years characterized by greater interannual variability than previous 40 years, with the western Sahel remaining dry and the eastern Sahel returning to wetter conditions. Projected: *Low confidence* due to inconsistent signal in model projections. [Table 3.2, Table 3.3, 3.5.1]	Sub-seasonal, seasonal, and interannual forecasts with increasing uncertainty over longer timescales. Improved monitoring, instrumentation, and data associated with early warning systems, but with limited participation and dissemination to at-risk populations. [5.3.1, 5.5.3, 7.3.1, 9.2.3, 9.2.11]	Low-regrets options that reduce vulnerability and exposure across a range of hazard trends: • Traditional rain and groundwater harvesting and storage systems • Water demand management and improved efficiency measures • Conservation agriculture, crop rotation, and soil conservation practices • Increasing use of drought-resistant crop varieties. • Early warning systems integrating seasonal forecasts with drought projections • Risk pooling at the regional or national level [2.5.4; 5.3.1: 6.5; 9.2.3, 9.2.11]

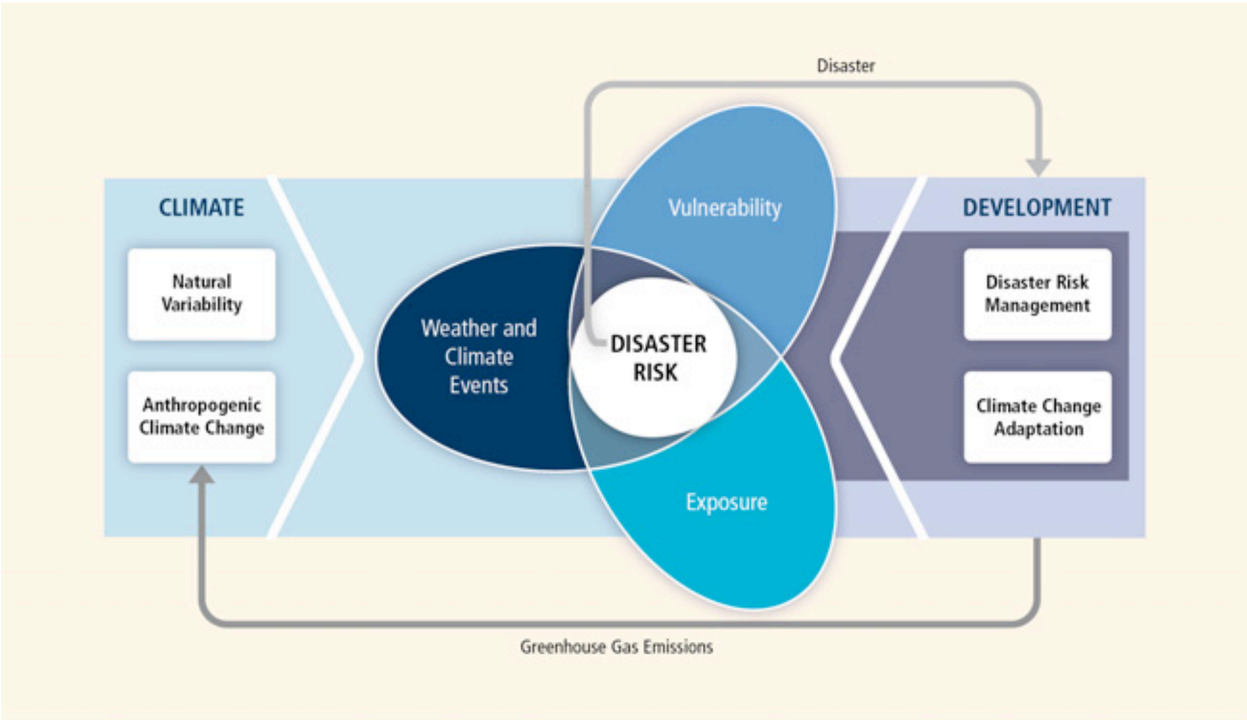


Figure SPM.1: Illustration of the core concepts of the SREX. The report assesses how vulnerability and exposure to weather and climate events determine impacts and the potential for disasters (disaster risk). It evaluates the influence of natural climate variability and anthropogenic climate change on weather and climate events, as well as on the vulnerability and exposure of human society and natural ecosystems. It also considers the role of development in trends in vulnerability and exposure, implications for disaster risk, and interactions between disasters and development. The report examines how disaster risk management and adaptation to climate change can reduce vulnerability and exposure to weather and climate events and thus reduce disaster risk, as well as increase resilience to the risks that cannot be eliminated. Other important processes are largely outside the scope of this report, including the influence of development on greenhouse gas emissions and anthropogenic climate change. [1.1.2, Figure 1-1]

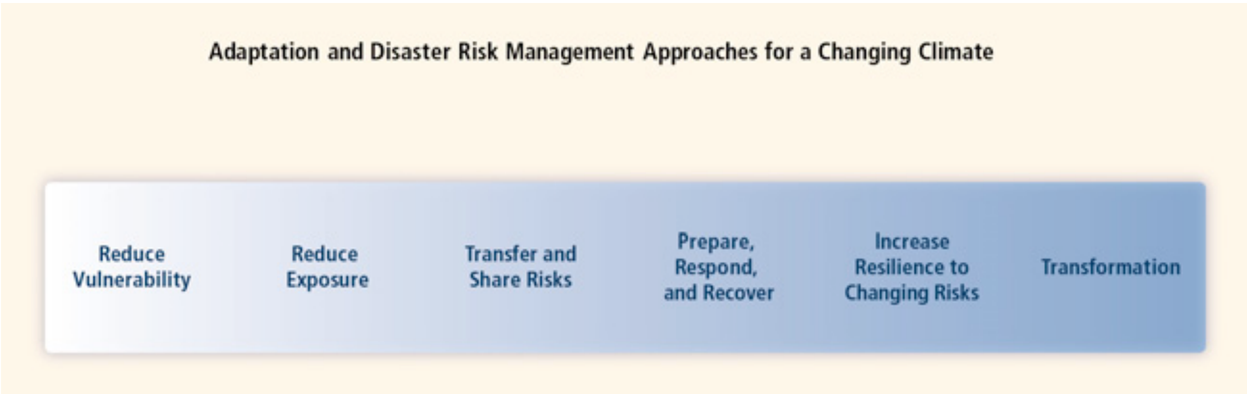


Figure SPM.2: Adaptation and disaster risk management approaches for reducing and managing disaster risk in a changing climate. This report assesses a wide range of complementary adaptation and disaster risk management approaches that can reduce the risks of climate extremes and disasters and increase resilience to remaining risks as they change over time. These approaches can be overlapping and can be pursued simultaneously. [6.5, Figure 6-3]

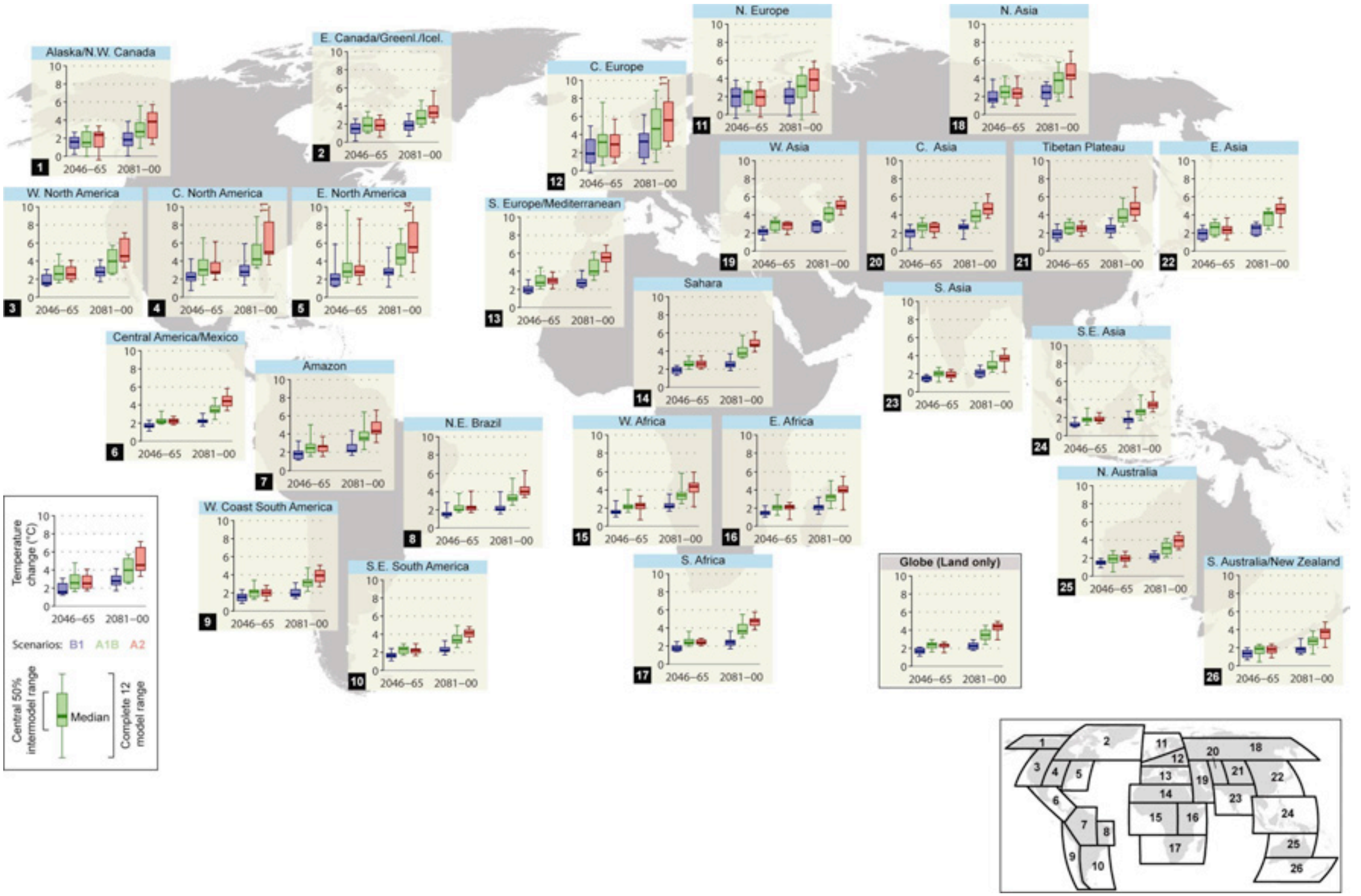


Figure SPM.3A: Projected changes (°C) in 20-year return values of annual maximum of the daily maximum temperature. That is, the projected changes in a daily temperature value that occurs on average only once during a 20 year period. The bar plots (see legend for more info) show results for regionally averaged projections for two time horizons, 2046 to 2065 and 2081 to 2100, as compared to the late-20th-century, and for three different SRES emission scenarios (B1, A1B, A2). Results are based on 12 GCMs contributing to the CMIP3 (Fig. 3.5). See inset map for defined extent of regions (Fig. 3.1). Values are computed for land points only. The "Globe"(inset box) displays the values computed using all land grid points. [3.3.1. Fig. 3.1, Fig. 3.5]

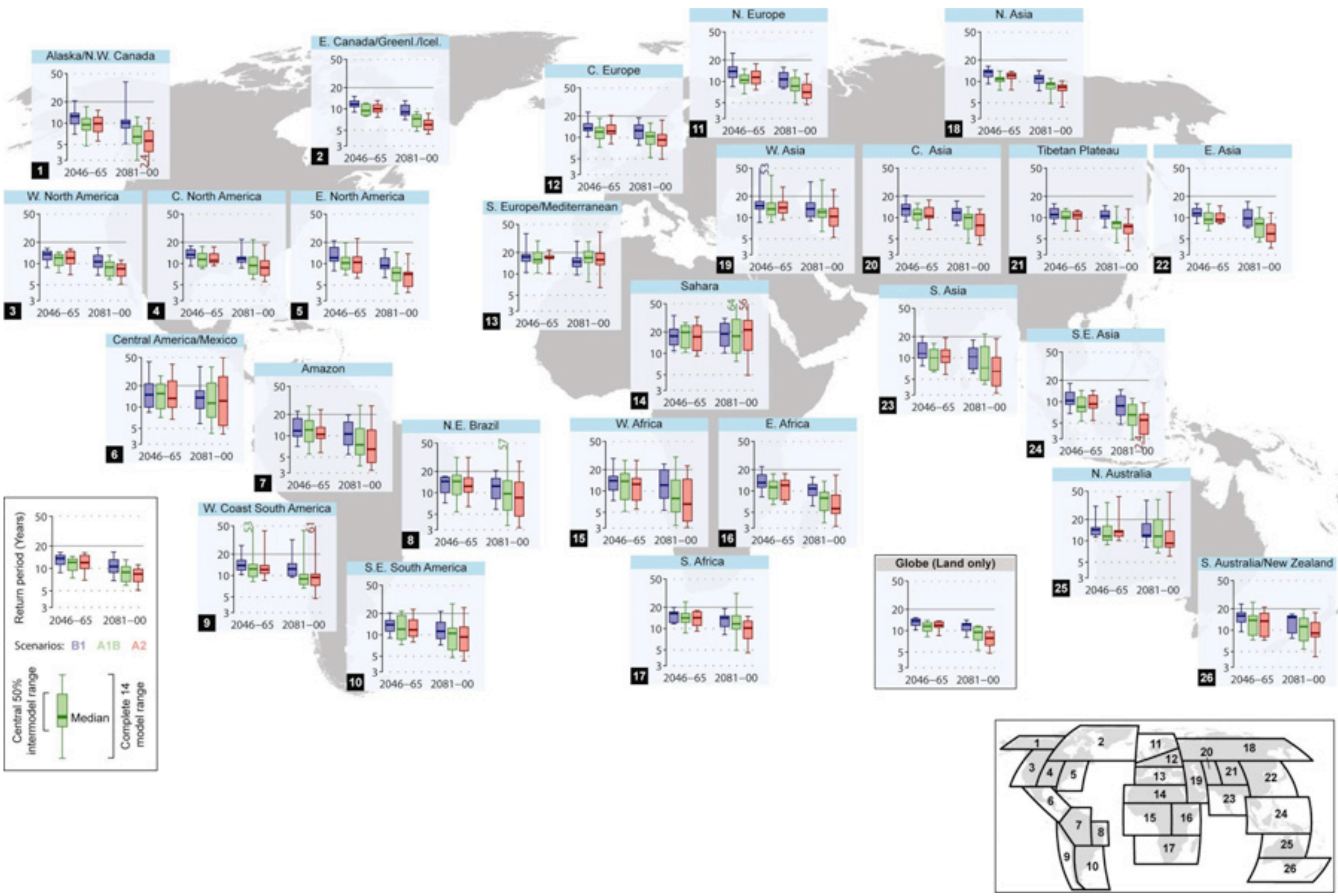


Figure SPM.3B: Projected return periods (in years) for late-twentieth-century 20-year return values of annual maximum 24-hour precipitation rates. That is, the projected new return periods for a daily precipitation event that would previously have occurred on average only once during a 20 year period. The bar plots (see legend for more info) show results for regionally averaged projections for two time horizons, 2046 to 2065 and 2081 to 2100, as compared to the late-20th-century, and for three different SRES emission scenarios (B1, A1B, A2). Results are based on 14 GCMs contributing to the CMIP3 (Fig. 3.7). See inset map for defined extent of regions (Fig. 3.1). Values are computed for land points only. The “Globe” (inset box) displays the values computed using all land grid points. [3.3.2, Fig. 3.1, Fig. 3.7]

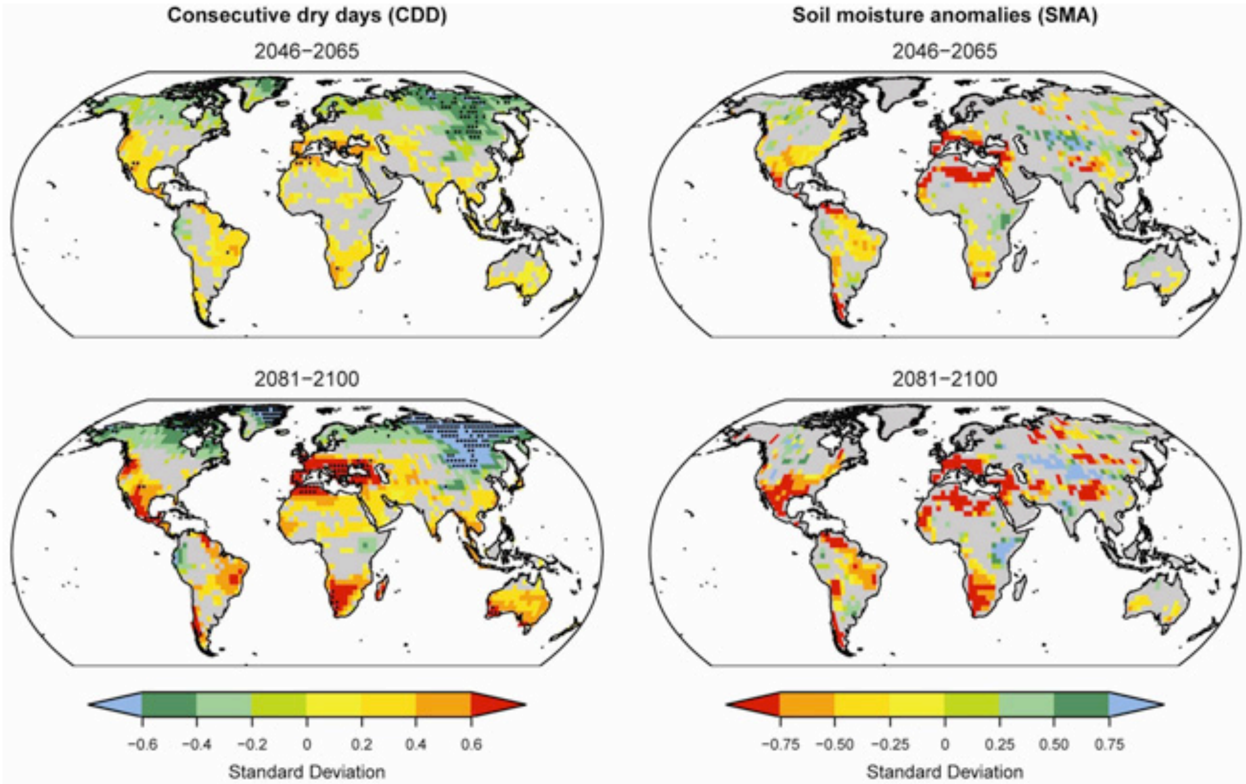
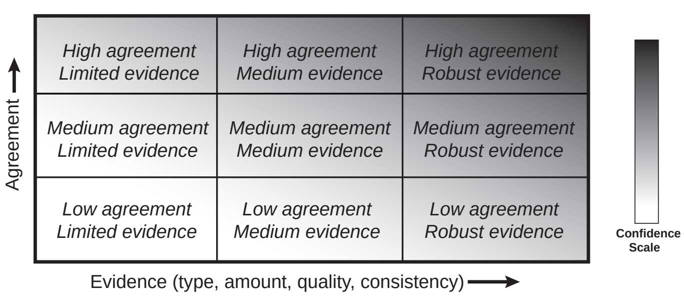


Figure SPM.4: Projected annual changes in dryness assessed from two indices. Left column: Change in number of consecutive dry days (CDD, days with precipitation < 1mm). Right column: Changes in soil moisture (Soil moisture anomalies, SMA). Increased dryness is indicated with warm colors (positive changes in CDD and negative SMA values). Differences are expressed in units of standard deviations, derived from detrended per year annual or seasonal estimates, respectively, from the three 20-year periods 1980-1999, 2046-2065 and 2081-2100 pooled together. The figures show changes for two time horizons, 2046-2065 and 2081-2100, as compared to late-20th-century values, based on GCM simulations under emission scenario SRES A2 relative to corresponding simulations for the 20th century. Results are based on 17 (CDD) and 15 (SMA) GCMs contributing to the CMIP3 (Figure 3.9). Shading is only applied for areas where at least 66% (12 out of 17 for CDD, 10 out of 15 for SMA) of the models agree in the sign of the change; stippling is applied for regions where at least 90% (16 out of 17 for CDD, 14 out of 15 for SMA) of all models agree in the sign of the change. [3.5.1, Figure 3.9]



Box SPM.2 Figure 1: A depiction of evidence and agreement statements and their relationship to confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality evidence.