II Summary for Policymakers

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Excerpt
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A. 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 society and sustainable development. 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 exposure and vulnerability. In this report, 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 climate variability, and socioeconomic development (Figure SPM.1). Disaster risk management and adaptation to climate change focus on reducing exposure and vulnerability and increasing resilience to the potential adverse impacts of climate extremes, even though risks cannot fully be eliminated (Figure SPM.2). Although mitigation of climate change is not the focus of this report, adaptation and mitigation can complement each other and together can significantly reduce the risks of climate change. [SYR AR4, 5.3]

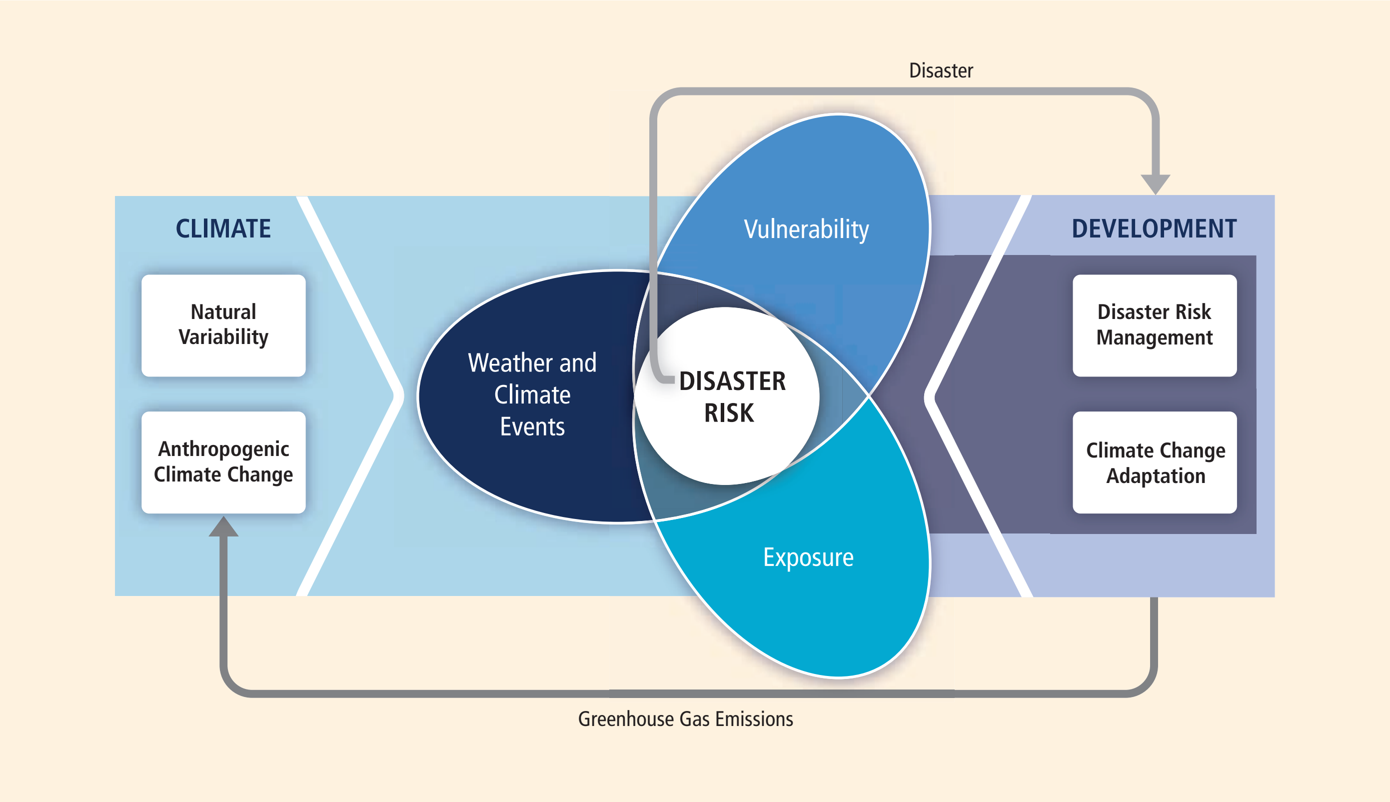

Figure SPM.1 | Illustration of the core concepts of SREX. The report assesses how exposure and vulnerability to weather and climate events determine impacts and the likelihood of disasters (disaster risk). It evaluates the influence of natural climate variability and anthropogenic climate change on climate extremes and other weather and climate events that can contribute to disasters, as well as the exposure and vulnerability of human society and natural ecosystems. It also considers the role of development in trends in exposure and vulnerability, implications for disaster risk, and interactions between disasters and development. The report examines how disaster risk management and adaptation to climate change can reduce exposure and vulnerability 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, and the potential for mitigation of anthropogenic climate change. [1.1.2, Figure 1-1]

Box SPM.1 | Definitions Central to SREX

Core concepts defined in the SREX glossary[1] and used throughout the report include:

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.[2]

Climate Extreme (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 of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as 'climate extremes.' The full definition is provided in Section 3.1.2.

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

Vulnerability: The propensity or predisposition to be adversely affected.

Disaster: 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.

Disaster Risk: The likelihood over a specified time period of 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.

Disaster Risk Management: Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, resilience, and sustainable development.

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.

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Transformation: The altering of fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems).

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[1] Reflecting the diversity of the communities involved in this assessment and progress in science, several of the definitions used in this Special Report differ in breadth or focus from those used in the Fourth Assessment Report and other IPCC reports.

[2] This definition differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change is defined as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.

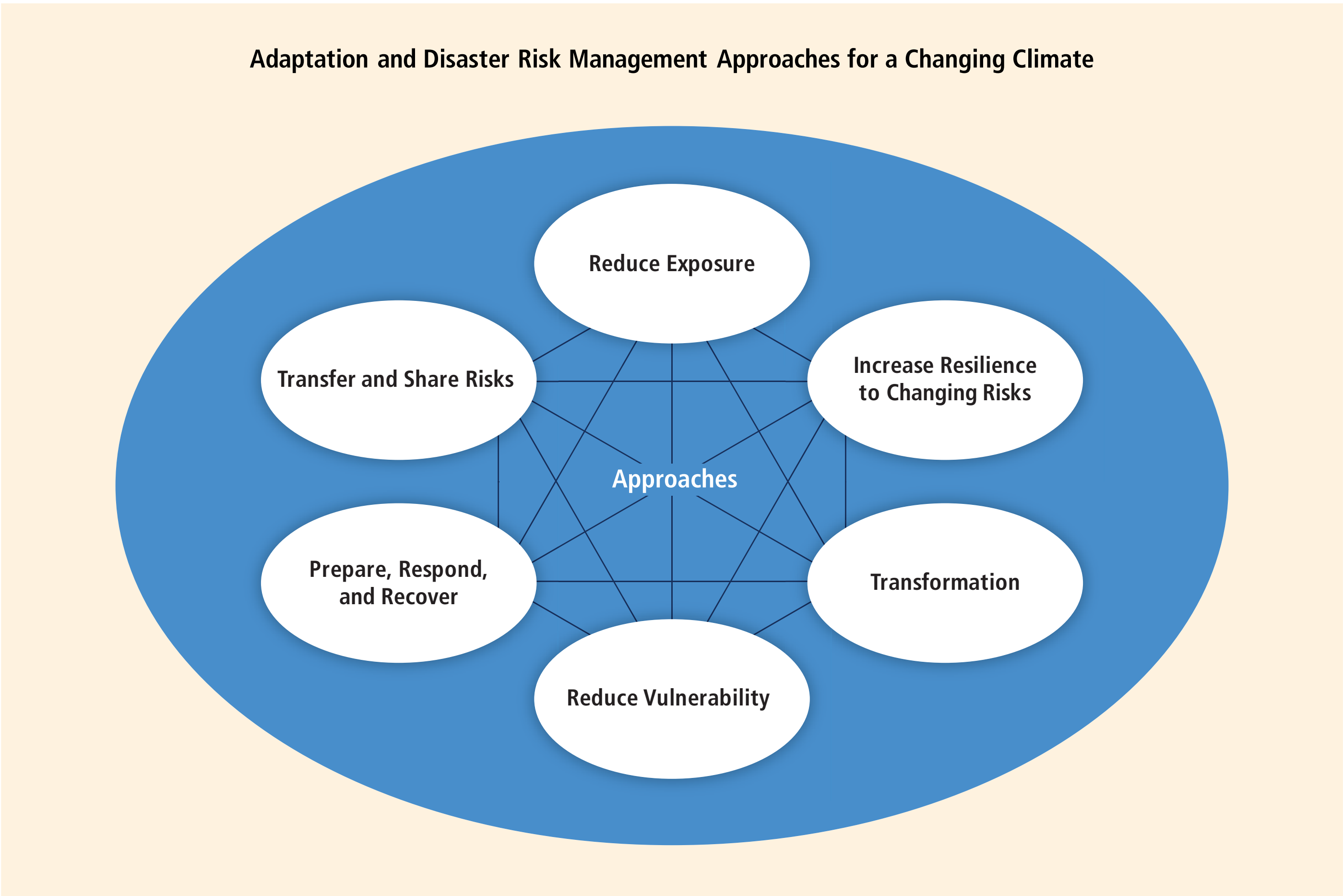

Figure SPM.2 | Adaptation and disaster risk management approaches for reducing and managing disaster risk in a changing climate. This report assesses a wide range of complementary adaptation and disaster risk management approaches that can reduce the risks of climate extremes and disasters and increase resilience to remaining risks as they change over time. These approaches can be overlapping and can be pursued simultaneously. [6.5, Figure 6-3, 8.6]

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 the knowledge base and its gaps. 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. The basis for substantive paragraphs in this Summary for Policymakers can be found in the chapter sections specified in square brackets.

Exposure and vulnerability are key determinants of disaster risk and of impacts when risk is realized. [1.1.2, 1.2.3, 1.3, 2.2.1, 2.3, 2.5] For example, a tropical cyclone can have very different impacts depending on where and when it makes landfall. [2.5.1, 3.1, 4.4.6] Similarly, a heat wave can have very different impacts on different populations depending on their vulnerability. [Box 4-4, 9.2.1] Extreme impacts on human, ecological, or physical systems can result from individual extreme weather or climate events. Extreme impacts can also result from non-extreme events where exposure and vulnerability are high [2.2.1, 2.3, 2.5] or from 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]

Extreme and non-extreme weather or climate events affect vulnerability to future extreme events by modifying resilience, coping capacity, and adaptive capacity. [2.4.3] In particular, the cumulative effects of disasters at local or sub-national 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, duration, and timing of extreme weather and climate events, and can result in unprecedented extreme weather and climate events. Changes in extremes can be linked to changes in the mean, variance, or shape of probability distributions, or all of these (Figure SPM.3). 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. Many extreme weather and climate events continue to be the result of natural climate variability. Natural variability will be an important factor in shaping future extremes in addition to the effect of anthropogenic changes in climate. [3.1]

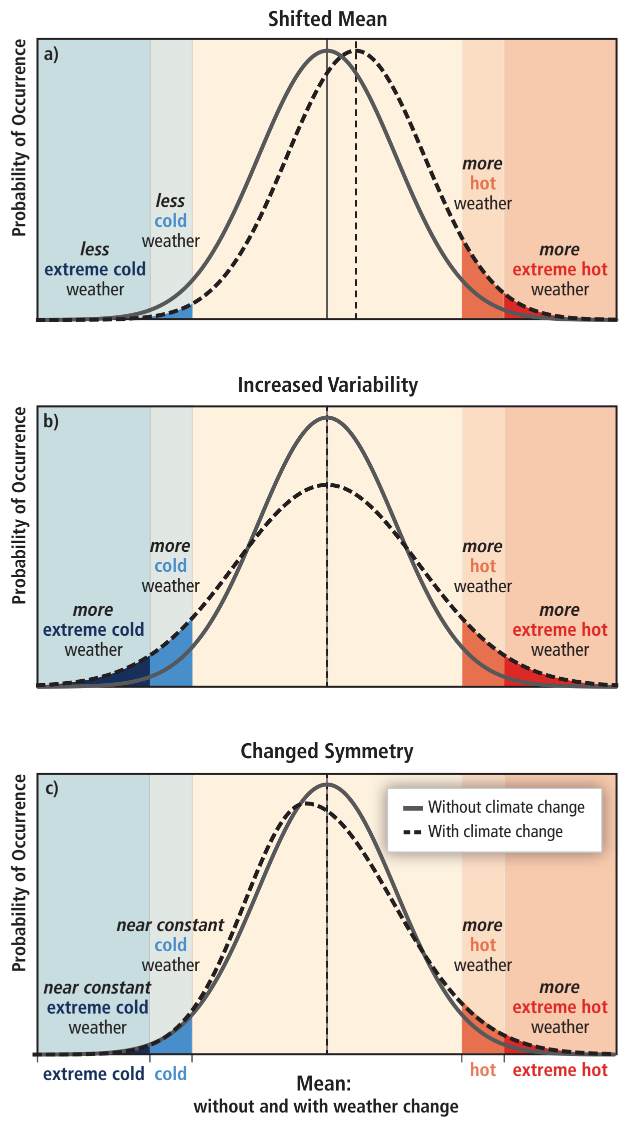

Figure SPM.3 | The effect of changes in temperature distribution on extremes. Different changes in temperature distributions between present and future climate and their effects on extreme values of the distributions: (a) effects of a simple shift of the entire distribution toward a warmer climate; (b) effects of an increase in temperature variability with no shift in the mean; (c) effects of an altered shape of the distribution, in this example a change in asymmetry toward the hotter part of the distribution. [Figure 1-2, 1.2.2]

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

Exposure and vulnerability are dynamic, varying across temporal and spatial scales, and depend on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors (*high confidence*). [2.2, 2.3, 2.5] Individuals and communities are differentially exposed and vulnerable based on inequalities expressed through levels of wealth and education, disability, and health status, as well as gender, age, class, and other social and cultural characteristics. [2.5]

Settlement patterns, urbanization, and changes in socioeconomic conditions have all influenced observed trends in exposure and vulnerability to climate extremes (*high confidence*). [4.2, 4.3.5] For example, coastal settlements, including in small islands and megadeltas, and mountain settlements are exposed and vulnerable to climate extremes in both developed and developing countries, but with differences among regions and countries. [4.3.5, 4.4.3, 4.4.6, 4.4.9, 4.4.10] Rapid urbanization and the growth of megacities, especially in developing countries, have led to the emergence of highly vulnerable urban communities, particularly through informal settlements and inadequate land management (*high agreement, robust evidence*). [5.5.1] See also Case Studies 9.2.8 and 9.2.9. Vulnerable populations also include refugees, internally displaced people, and those living in marginal areas. [4.2, 4.3.5]

Climate Extremes and Impacts

There is evidence from observations gathered since 1950 of change 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, which vary across regions and for different extremes. Assigning 'low confidence' in observed changes in a specific extreme on regional or global scales neither implies nor excludes the possibility of changes in this extreme. Extreme events are rare, which means there are few data available to make assessments regarding changes in their frequency or intensity. The more rare the event the more difficult it is to identify long-term changes. Global-scale trends in a specific extreme may be either more reliable (e.g., for temperature extremes) or less reliable (e.g., for droughts) 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 from observations since 1950. [3.1.5, 3.1.6, 3.2.1]

It is *very likely* that there has been an overall decrease in the number of cold days and nights,[3] and an overall increase in the number of warm days and nights,[3] at the global scale, that is, 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* in a warming trend in daily temperature extremes in much of Asia. Confidence in observed trends in daily temperature extremes in Africa and South America generally varies from *low* to *medium* depending on the region. In many (but not all) regions over the globe with sufficient data, there is *medium confidence* that the length or number of warm spells or heat waves[3] has increased. [3.3.1, Table 3-2]

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

There is *low confidence* in any observed long-term (i.e., 40 years or more) increases in tropical cyclone activity (i.e., intensity, frequency, duration), after accounting for past changes in observing capabilities. It is *likely* that there has been a poleward shift in the main Northern and Southern Hemisphere extratropical storm tracks. There is *low confidence* in observed trends in small spatial-scale phenomena such as tornadoes and hail because of data inhomogeneities and inadequacies in monitoring systems. [3.3.2, 3.3.3, 3.4.4, 3.4.5]

There is *medium confidence* that 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, for example, 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]

[3] See SREX Glossary for definition of these terms: cold days / cold nights, warm days / warm nights, and warm spell – heat wave.

It is *likely* that there has been an increase in extreme coastal high water related to increases in mean sea level. [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 at the global scale. There is *medium confidence* that anthropogenic influences have contributed to intensification of extreme precipitation at the global scale. It is *likely* that there has been an anthropogenic influence on increasing extreme coastal high water due to an increase in mean sea level. The uncertainties in the historical tropical cyclone records, the incomplete understanding of the physical mechanisms linking tropical cyclone metrics to climate change, and the degree of tropical cyclone variability provide only *low confidence* for the attribution of any detectable changes in tropical cyclone activity to anthropogenic influences. Attribution of single extreme events to anthropogenic climate change is challenging. [3.2.2, 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 have increased, but with large spatial and interannual variability (*high confidence*, based on *high agreement*, *medium evidence*). Global weather- and climate-related disaster losses reported over the last few decades reflect mainly monetized direct damages to assets, and are unequally distributed. Estimates of annual losses have ranged since 1980 from a few US$ billion to above 200 billion (in 2010 dollars), with the highest value for 2005 (the year of Hurricane Katrina). Loss estimates are lower-bound estimates because many impacts, such as loss of human lives, cultural heritage, and ecosystem services, are difficult to value and monetize, and thus they are poorly reflected in estimates of losses. Impacts on the informal or undocumented economy as well as indirect economic effects can 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]

Economic, including insured, disaster losses associated with weather, climate, and geophysical events[4] are higher in developed countries. Fatality rates and economic losses expressed as a proportion of gross domestic product (GDP) are higher in developing countries (*high confidence*). During the period from 1970 to 2008, over 95% of deaths from natural disasters occurred in developing countries. Middle-income countries with rapidly expanding asset bases have borne the largest burden. During the period from 2001 to 2006, losses amounted to about 1% of GDP for middle-income countries, 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, based on *limited evidence*. In small exposed countries, particularly small island developing states, losses expressed as a percentage of GDP have been particularly high, exceeding 1% in many cases and 8% in the most extreme cases, averaged over both disaster and non-disaster years for the period from 1970 to 2010. [4.5.2, 4.5.4]

Increasing exposure of people and economic assets has been the major cause of long-term increases in economic losses from weather- and climate-related disasters (*high confidence*). Long-term trends in economic disaster losses adjusted for wealth and population increases have not been attributed to climate change, but a role for climate change has not been excluded (*high agreement, medium evidence*). These conclusions are subject to a number of limitations in studies to date. Vulnerability is a key factor in disaster losses, yet it is not well accounted for. Other limitations are: (i) data availability, as most data are available for standard economic sectors in developed countries; and (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*. The second conclusion is subject to additional limitations: (iii) the processes used to adjust loss data over time, and (iv) record length. [4.5.3]

[4] Economic losses and fatalities described in this paragraph pertain to all disasters associated with weather, climate, and geophysical events.

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.

The severity of the impacts of climate extremes depends strongly on the level of the exposure and vulnerability to these extremes (*high confidence*). [2.1.1, 2.3, 2.5]

Trends in exposure and vulnerability are major drivers of changes in disaster risk (*high confidence*). [2.5] Understanding the multi-faceted nature of both exposure and vulnerability 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]

Development practice, policy, and outcomes are critical to shaping disaster risk, which may be increased by shortcomings in development (*high confidence*). [1.1.2, 1.1.3] High exposure and vulnerability are generally the outcome of skewed 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] Increasing global interconnectivity and the mutual interdependence of economic and ecological systems can have sometimes contrasting effects, reducing or amplifying vulnerability and disaster risk. [7.2.1] Countries more effectively manage disaster risk if they include considerations of disaster risk in national development and sector plans and if they adopt climate change adaptation strategies, translating these plans and strategies into actions targeting vulnerable areas and groups. [6.2, 6.5.2]

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

Inequalities influence local coping and adaptive capacity, and pose disaster risk management and adaptation challenges from the local to national levels (*high agreement, robust evidence*). These inequalities reflect socioeconomic, demographic, and health-related differences and differences in governance, access to livelihoods, entitlements, and other factors. [5.5.1, 6.2] Inequalities also exist across countries: 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 are developing countries. Nonetheless, all countries face challenges in assessing, understanding, and responding to such projected changes. [6.3.2, 6.6]

Humanitarian relief is often required when disaster risk reduction measures are absent or inadequate (*high agreement, robust evidence*). [5.2.1] Smaller or economically less-diversified countries face particular 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. [6.4.3]

Post-disaster recovery and reconstruction provide an opportunity for reducing weather- and climate-related disaster risk and for improving adaptive capacity (*high agreement, robust evidence*). An emphasis on rapidly rebuilding houses, reconstructing infrastructure, and rehabilitating livelihoods often leads to recovering in ways that recreate or even increase existing vulnerabilities, and that preclude longer-term planning and policy changes for enhancing resilience and sustainable development. [5.2.3] See also assessment in Sections 8.4.1 and 8.5.2.

Risk sharing and transfer mechanisms at local, national, regional, and global scales can increase resilience to climate extremes (*medium confidence*). Mechanisms include informal and traditional risk sharing mechanisms,