Policy relevant summary of SREX by Radboud University Nijmegen, NL | 2012

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). It is a short version of the original SPM with the highlights only. The original SPM can be found at www.ipcc.ch. All underlying information can be found in the full report. This report assesses 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.

The character and severity of impacts from climate extremes depend not only on the extremes themselves but also on **exposure** and **vulnerability**. Climate extremes, exposure, and vulnerability are influenced by a wide range of factors, including anthropogenic climate change, natural variability, and socioeconomic development.

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Scientific key findings

It is *very likely*[1] that the frequency and intensity of extreme daily maximum and decrease of extreme daily minimum temperatures increased and that they increase in the future.
- Overall decrease in the number of cold days and nights, overall increase in the number of warm days and nights at the continental scale in North America, Europe, and Australia.
- Warming trend in daily temperature extremes in much of Asia, variable in Africa and South America

There is *medium confidence* in observed increases of duration and intensity of heat waves, but a *very likely* future increase.

There is *low to medium confidence* that droughts increase, but there are regional differences.
- More observed intense and longer droughts in southern Europe and West Africa.
- Less frequently observed and less intense, shorter droughts in central North America and northwestern Australia.
- Droughts will intensify in southern and central Europe, central North America, Central America and Mexico, northeast Brazil, and southern Africa.

There is *medium confidence* in a poleward shift of extra-tropical storms.

There is *no evidence* in increasing tropical cyclone activity (intensity, frequency, duration), but future increase is *likely*.
- Average 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.

It is *likely* that heavy precipitation events has increased and *likely* that they will increase in the future.
- particularly in the high latitudes and tropical regions, and in winter in the northern mid-latitudes

It is *likely* that incidences of extreme coastal sea levels has increased and a future increase is very likely.

An anthropogenic contribution to increasing trends is found for extreme daily maximum temperatures and incidences of extreme sea levels.

What has changed compared to previous IPCC reports?

The models have improved and there is more regional detail.
There is improved insight in the quality of climatologic data.
These improvements have changed the uncertainty qualification (see Box SPM.2) in observed and projected trends of some extremes[1]:

- The increase in hot days frequency has become more likely during day time.
- The upward trend in observed heat waves has changed from likely to medium confidence.
- The projected increase in heavy precipitation events has changed from very likely to likely.
- The upward trend in observed and projected droughts has changed from likely to medium confidence.
- The upward trends in observed tropical cyclone activity has changed from likely to no evidence (low confidence).
- The increase in incidences of extreme sea levels has changed from likely to very likely.

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[1] The treatment of uncertainty is explained in Box SPM.2 (Appendix)
[2] Direct comparisons between assessment of uncertainties in findings in this report and those in previous IPCC reports are difficult, because the uncertainty treatment has been revised, and because of specific differences in methodologies applied in the assessed studies.

Key findings impacts and disaster losses and risk management

Economic losses from weather- and climate-related disasters have increased, but with large spatial and interannual variability. Estimates of annual losses have ranged since 1980 from a few billion to above 200 billion USD (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.

Economic, including insured, disaster losses associated with weather, climate, and geophysical events[3] are higher in developed countries. Fatality rates and economic losses expressed as a proportion of GDP are higher in developing countries. 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. 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.

Increasing exposure of people and economic assets has been the major cause of the long-term increases in economic losses from weather- and climate-related disasters. In many regions, the main driver for future increases in economic losses due to some climate extremes will be socioeconomic in nature.

Extreme events will have greater impacts on sectors with closer links to climate, such as water, agriculture and food security, forestry, health, and tourism, and are expected to produce large impacts on infrastructure.

Disasters associated with climate extremes influence population mobility and relocation, affecting host and origin communities. If disasters occur more frequently and/or with greater magnitude, some local areas will become increasingly marginal as places to live. In such cases, migration becomes permanent and could introduce new pressures in areas of relocation.

Exposure and vulnerability are dynamic key determinants of disaster risk and related impacts, varying across temporal and spatial scales, and depend on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors.

Extreme and non-extreme weather and climate events also affect vulnerability to future extreme events, by modifying the resilience, coping capacity, and adaptive capacity.

Development practice, policy, and outcomes are critical to shaping disaster risk, which may be increased by shortcomings in development, 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. 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.

Inequalities influence local coping and adaptive capacity, and pose disaster risk management and adaptation challenges from the local to national levels.

Risk sharing and transfer mechanisms at local, national, regional and global scales can increase resilience to climate extremes. Mechanisms include informal and traditional risk sharing mechanisms, micro-insurance, (re)insurance, and national, regional, and global risk pools and 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.

Attention to the temporal and spatial dynamics of exposure and vulnerability 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 exposure and vulnerability over the longer term. For instance, dike systems can reduce flood exposure by offering immediate protection, but also encourage settlement patterns that may increase risk in the long-term.

Closer integration of disaster risk management and climate change adaptation, along with the incorporation of both into local, subnational, national, and international development policies and practices, could provide benefits at all scales.

Measures that provide benefits and low-regrets measures, are starting points for addressing projected trends in exposure, vulnerability, and climate extremes. They have the potential to offer benefits now and lay the foundation for addressing projected changes. Many of these low-regrets strategies produce co-benefits, help address other development goals, such as improvements in livelihoods, human well-being, and

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

biodiversity conservation, and help minimize the scope for maladaptation. Potential low-regrets measures include early warning systems; risk communication between decision makers and local citizens; sustainable land management, including land use planning; ecosystem management and restoration; improvements to health surveillance, water supply, sanitation, and irrigation and drainage systems; climate-proofing of infrastructure; development and enforcement of building codes; and better education and awareness.

Effective risk management generally involves a portfolio of actions to reduce and transfer risk and to respond to events and disasters. Integrated approaches are more effective when they are informed by and customized to specific local circumstances. Successful strategies include a combination of hard infrastructure-based responses and soft solutions like individual and institutional capacity building and ecosystem-based responses.

Opportunities exist to create synergies in international finance for disaster risk management and adaptation to climate change. International funding for disaster risk reduction remains relatively low as compared to the scale of spending on international humanitarian response. Technology transfer and cooperation to advance disaster risk reduction and climate change adaptation are important. A Lack in coordination on technology transfer and cooperation between these two led to fragmented implementation.

Integration of local knowledge with additional scientific and technical knowledge can improve disaster risk reduction and climate change adaptation. This local, self-generated knowledge, particularly about extreme weather events, can uncover existing capacity within the community and important current shortcomings.

Appropriate and timely risk communication is critical for effective adaptation and disaster risk management. Effective risk communication builds on exchanging, sharing, and integrating knowledge about climate-related risks. Perceptions of risk are driven by psychological and cultural factors, values, and beliefs.

An iterative process of monitoring, research, evaluation, learning, and innovation can reduce disaster risk and promote adaptive management in the context of climate extremes.

Effectively applying and combining approaches of climate change adaptation and disaster risk management may benefit from considering the broader challenge of sustainable development.

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 over the longer term. This involves overcoming the disconnection between local risk management practices and national institutional and legal frameworks, policy, and planning.

The interactions among climate change mitigation, adaptation, and disaster risk management may have a major influence on resilient and sustainable pathways.

More information can be found at:
www.knmi.nl/cms/content/102309/nieuw_ipcc-rapport_over_klimaat
www.ipcc-wg2.gov/SREX/
www.climatecentre.org/srex

Appendix

Table SPM.1 presents examples of how observed and projected trends in exposure, vulnerability, and climate extremes can inform 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. The confidence in projected changes in climate extremes at local scales is often more limited than the confidence in projected regional and global changes. This limited confidence in changes places a focus on low-regrets risk management options that aim to reduce exposure and vulnerability and to increase resilience and preparedness for risks that cannot be entirely eliminated.

	Information on Climate Extreme Across Spatial Scales			
Exposure and vulnerability at scale of risk management in the example	**GLOBAL Observed (since 1950) and projected (to 2100) global changes**	**REGIONAL Observed (since1950) and projected (to 2100) changes in example region**	**SCALE OF RISK MANAGAMENT Available information for example**	**Options for risk management and adaptation in example**
Impacts of heat waves in urban areas in Europe				
Factors affecting exposure and vulnerability 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 behavioural adaptation of the population; and urban infrastructure.	<u>Observed:</u> In many (but not all) regions over the globe with sufficient data, the length or number of warm spells or heat waves has increased. Overall increase in the number of warm days and nights at the global scale. <u>Projected:</u> Increase in length, frequency, and/or intensity of warm spells or heat waves over most land areas. Increase in frequency and magnitude of warm days and nights on the global scale.	<u>Observed:</u> Increase in heat waves or warm spells in Europe. Overall increase in warm days and nights over most of the continent. <u>Projected:</u> More frequent, longer, and/or more intense heat wave or warm spells in Europe. Increase in warm days and nights.	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.	Low-regrets options that reduce vulnerability and exposure across a range of hazard trends: • Early warning systems that reach particularly vulnerable groups (e.g. the elderly) • Vulnerability mapping and corresponding measures • Public information on what to do during heat waves, including behavioral advice • Use of social care networks to reach vulnerable groups Specific adjustments in strategies, policies, and measures informed by trends in heat waves include 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 approaches to cooling for public facilities; and adjustments in energy generation and transmission infrastructure.
Inundation related to extreme sea levels in tropical small island developing states				
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,	<u>Observed:</u> Increase in extreme coastal high water worldwide related to increase in mean sea level. <u>Projected:</u> Mean sea level rise will contribute to upward trends in extreme coastal sea levels. 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.	<u>Observed:</u> Tides and El Niño -Southern Oscillation have contributed to the more frequent occurrence of extreme coastal high water levels and associated flooding experienced on some Pacific Islands in recent years. <u>Projected:</u> The contribution of mean	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. While changes in storminess may contribute to changes in extreme coastal high water levels, the limited geographical	Low-regrets options that reduce exposure and vulnerability 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 • Mangrove conservation, restoration, and replanting 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 relocation,

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.	Average tropical cyclone maximum wind speed will increase, although increases may not occur in all ocean basins. The global frequency of tropical cyclones will either decrease or remain essentially unchanged.	sea level rise to increased extreme coastal high water levels, coupled with the increase in tropical cyclone maximum wind speed, is a specific issue for tropical small island states.	coverage of studies to date and the uncertainties associated with storminess changes overall mean that a general assessment of the effects of storminess changes on storm surge is not possible at this time.	for example, for atolls where storm surges may completely inundate them.
Droughts in the context of food security in West Africa				
Less advanced 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.	Observed: 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: Intensification of droughts in some seasons and areas, due to reduced precipitation and/or increased evapotranspiration. This applies to regions including southern Europe and the Mediterranean region, central Europe, central North America, Central America and Mexico, northeast Brazil, and southern Africa.	Observed: 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.	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.	Low-regrets options that reduce exposure and vulnerability across a range of hazard trends: • Traditional rain and groundwater harvesting and storage systems • Water demand management and improved irrigation efficiency measures • Conservation agriculture, crop rotation, and livelihood diversification • Increasing use of drought-resistant crop varieties • Early warning systems integrating seasonal forecasts with drought projections, with improved communication involving extension services • Risk pooling at the regional or national level

Box SPM.1: Definitions of concepts used in the SREX 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[4].

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 Chapter 3, 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.

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.

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 effect 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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[4] 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.

Box SPM.2: Treatment of uncertainty in scientific findings of the SREX report

There are 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. 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*.

• **Likelihoods**, quantified measures of uncertainty in a finding expressed probabilistically (based on statistical analysis of observations or model results, or expert judgment).

The following scheme provides an overview of the most commonly used qualifiers in this report. Likelihoods can only be used when the confidence level is high.