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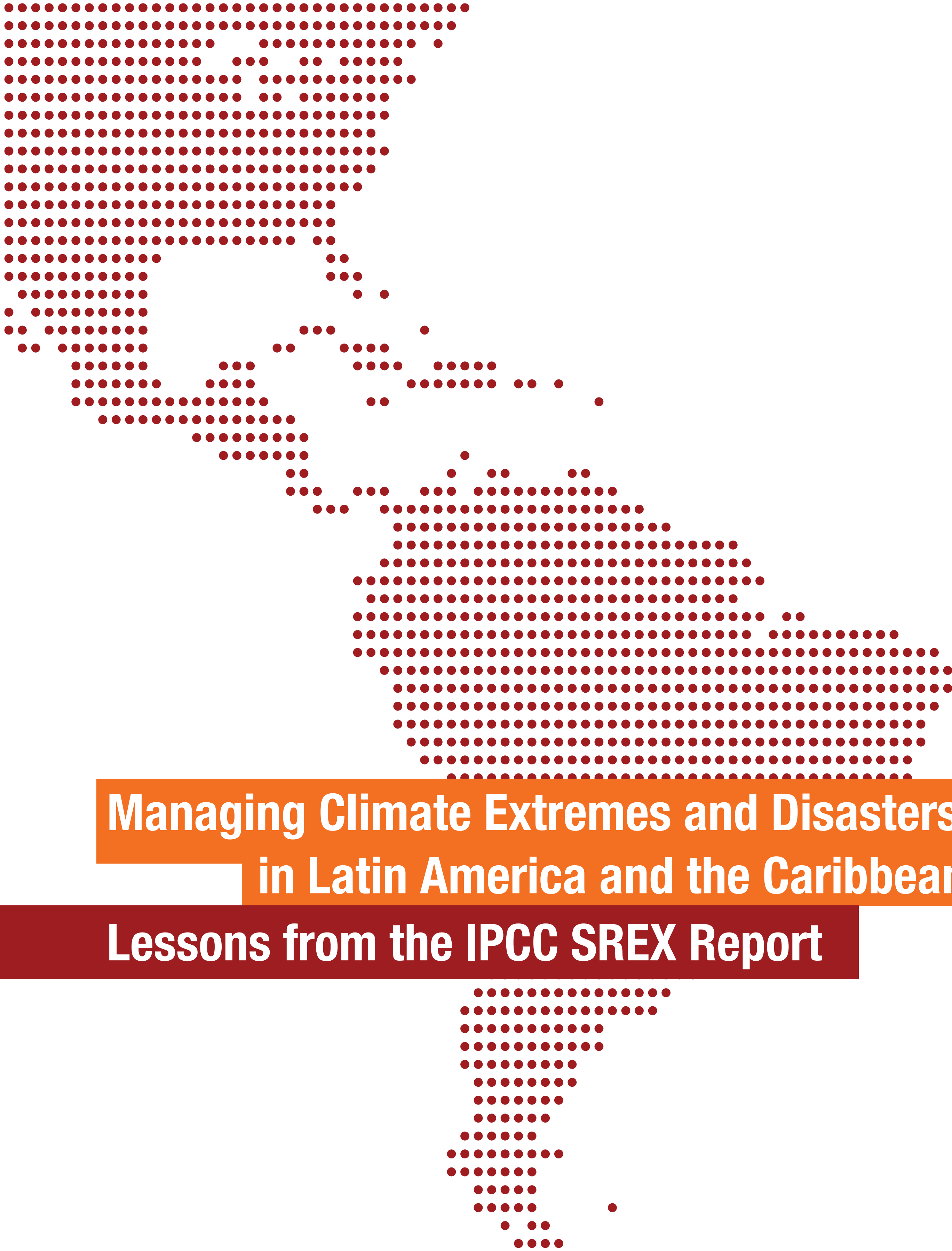

Managing Climate Extremes and Disasters in Latin America and the Caribbean: Lessons from the IPCC SREX Report

Contents

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1. Introduction to the Special Report

1.1 About the SREX report

The Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) was commissioned by the Intergovernmental Panel on Climate Change (IPCC) in response to a recognised need to provide specific advice on climate change, extreme weather and climate events ('climate extremes'). The SREX report was written over two and a half years, compiled by 220 expert authors, 19 review editors and taking account of almost 19,000 comments. It went through three rigorous drafting processes with expert and government review. The findings were approved by world governments following a four day meeting, where the Summary for Policy Makers was agreed. It thus provides the best scientific assessment available to date. It comprises a policy summary released in November 2011 and the full report released in March 2012 (available online at http://ipcc-wg2.gov/srex).

This summary highlights the key findings of the SREX report including an assessment of the science and the implications of this for society and sustainable development. The SREX report considers the effects of climate change on extreme events, disasters, and disaster risk management (DRM). It examines how climate extremes, human factors and the environment interact to influence disaster impacts and risk management and adaptation options (see Figure 1). The SREX report considers the role of development in exposure and vulnerability, the implications for disaster risk, and the interactions between disasters and development. It examines how human responses to extreme events and disasters could contribute to adaptation objectives, and how adaptation to climate change could become better integrated with DRM practice. The SREX report represents a significant step forward for the integration and harmonisation of the climate change adaptation, disaster risk management and climate science communities.

Although not an official publication of the IPCC, this summary has been written under the supervision of co-authors of the SREX report and it has been thoroughly reviewed by an expert scientific panel. The summary includes material directly taken from the SREX report, where the underlying source is clearly referenced, but it also presents synthesis messages that are the views of the authors of this summary and not necessarily those of the IPCC. It is hoped that the result will illuminate the SREX report's vital findings for decision makers in Latin America and the Caribbean, and so better equip them to make sound investments to reduce disaster risk in a changing climate.

1.2 Ten Key Messages

Key summary messages from the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation for the Latin American and Caribbean region:[1]

1. Even without taking climate change into account, disaster risk will continue to increase in many countries as more vulnerable people and assets are exposed to weather extremes, for example in the growing informal settlements in Colombia, Venezuela and Peru among others.
2. Based on data since 1950, evidence suggests that climate change has changed the magnitude and frequency of some extreme weather and climate events in some global regions already. While it remains very difficult to attribute individual events to climate change, in July 2009, flooding in Brazil set record highs in 106 years of data records.
3. In the next two or three decades, the expected increase in climate extremes will probably be relatively small compared to the normal year-to-year variations in such extremes. However, as climate change impacts become more dramatic, its effect on a range of climate extremes in Latin America and the Caribbean will become increasingly important and will play a more significant role in disaster impacts.
4. There is better information now available on what is expected in terms of changes in extremes in various regions and sub-regions, rather than just globally (see Table 1 and Figure 2); though for some regions and some extremes, uncertainty remains high (e.g. dryness and drought trends in South America).
5. High levels of vulnerability, combined with exposure to more severe and frequent weather and climate extremes, may result in some places in the region being increasingly difficult places in which to live and work.
6. A new balance needs to be struck between measures to reduce risk, transfer risk (e.g. through insurance) and effectively prepare for and manage disaster impact in a changing climate. Examples can be found in Mexico, Colombia and many Caribbean countries, which include contingencies in their budgetary processes. This balance will require a stronger emphasis on anticipation and risk reduction.
7. Existing risk management measures need to be improved as many countries are poorly adapted to current extremes and risks and so are not prepared for the future. This would include a wide range of measures such as early warning systems, land use planning, development and enforcement of building codes, improvements to health surveillance, or ecosystem management and restoration.
8. Countries' capacity to meet the challenges of observed and projected trends in disaster risk is determined by the effectiveness of their national risk management system (e.g. Cuba's system is well studied). Such systems include national and sub-national governments, the private sector, research bodies, and civil society including community-based organisations.
9. More fundamental adjustments are required to avoid the worst disaster losses and tipping points where vulnerability and exposure are high, capacity is low and weather and climate extremes are changing.
10. Any delay in greenhouse gas mitigation is likely to lead to more severe and frequent climate extremes in the future and will likely further contribute to disaster losses.

1.3 The implications of this for the LAC region are as follows:

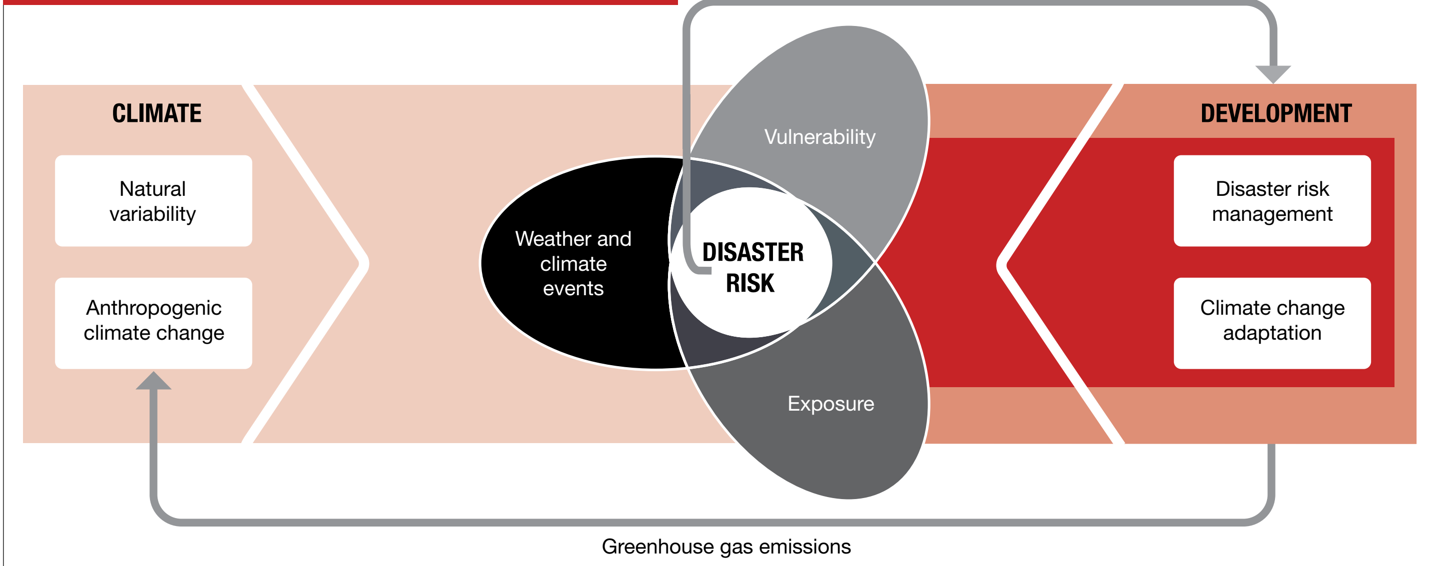
- There is a need for countries to reassess their vulnerability and exposure in order to better manage disaster risk. This needs to be fully integrated into planning processes.
- There is a need for new disaster risk assessments that take climate change into account, which may require countries and people to reassess their thinking on what levels of risk they are willing and able to accept.
- It will be important to strengthen new and existing partnerships for reducing risk.
- There is a need to strengthen the integration of financial and programming mechanisms to support adaptation and risk management across development sectors.
- It will be important to highlight changing climate-related disaster risks to regional policy makers working in other policy domains.
- There is a need to reaffirm the importance of mitigating greenhouse gases globally in order to avoid the worst climate extremes and the associated impacts in Latin America and the Caribbean.
- There must be consideration that in some cases today's climate extremes will become tomorrow's 'normal' weather. Tomorrow's climate extremes may therefore stretch our imagination and challenge our capacity to manage change as never before.
- There is a need for much smarter development and economic policies that consider changing disaster risk as a core component. Without this it is likely that an increasing number of people and assets will be adversely impacted by future climate extremes and disasters.

1. Highlights are derived and extended from a note by Dr. Tom Mitchell, Overseas Development Institute and Dr. Maarten van Aalst, Red Cross/Red Crescent Climate Centre available at http://cdkn.org/2011/11/ipcc-srex

2. Changing disaster risks

This section looks at the components of changing disaster risk in more detail. The inter-linkages between the core concepts discussed in the SREX are illustrated in Figure 1. This shows how both changes in vulnerability and exposure and changes in weather and extreme climate events can contribute and combine to create disaster risk, hence the need for both disaster risk management (DRM) and climate change adaptation (CCA) within development processes.

Figure 1: The inter-linkages between the core concepts of the SREX



2.1 Changes in vulnerability and exposure[2]

Vulnerability and exposure are dynamic and depend on economic, social, demographic, cultural, institutional, and governance factors. Individuals and communities are also differentially exposed based on factors such as wealth, education, gender, age, class/caste, and health. Lack of resilience and capacity to anticipate, cope with and adapt to extremes are important factors of vulnerability. For example, a tropical cyclone can have very different impacts depending on where and when it makes landfall. Similarly, a heat wave can have very different impacts on different population groups depending on their vulnerability. Extreme impacts on human, ecological, or physical systems can therefore result from individual extreme weather or climate events, from non-extreme events where exposure and vulnerability are high, or from a compounding of events or their impacts.

High vulnerability and exposure are generally the outcome of skewed development processes, for example, environmental mismanagement, demographic change, rapid and unplanned urbanisation, failed governance, and a scarcity of livelihood options. This can result in settlements in hazard prone areas, the creation of unsafe dwellings, slums and scattered districts, poverty and lack of awareness of risks. For example, those with awareness, transferable livelihoods, money and access to transport can move away from disaster and live more comfortably out of danger. Those without these assets may be forced to locate their homes in hazard prone areas where they are more vulnerable and exposed to climate extremes. They will also have to deal with the impacts of disaster on the ground, including no water, food, sanitation or shelter. An example of such differences, comparing the different outcomes of two hurricanes in Central America, is shown in Box 1.

2. Draws on material from SREX Chapter 2, Cardona, O.M. et al, 'Determinants of Risk: Exposure and Vulnerability', and Chapter 4, Handmer, J. et al, 'Changes in Impacts of Climate Extremes: Human Systems and Ecosystems'.

Box 1: An example of different impacts depending on vulnerability and exposure

Hurricanes in Central America[3]

Central America and Mexico (Mesoamerica) are heavily affected by strong tropical storms. In October 2005, Hurricane Stan, a relatively weak storm that only briefly reached hurricane status, affected the Atlantic coast of Central America and the Yucatan Peninsula in Mexico. Guatemala reported over 1,500 fatalities and thousands of missing people, El Salvador 72 fatalities, and Mexico 98. Hurricane Wilma hit one week later causing 12 fatalities in Haiti and 8 in Mexico.

Hurricane Stan mainly affected the poor indigenous regions of Guatemala, El Salvador and Chiapas, while Wilma affected the international beach resort of Cancun. Damages caused by Wilma were estimated at $1.74 billion, 25% direct damages and 75% indirect costs due to lost tourism. A joint study of Mexico's response to the hurricanes, funded by the World Bank, showed that Stan caused damages of about $2.2 billion in Mexico, 65% in direct losses and 35% due to future impacts on agricultural production. About 70% of these damages were reported in the state of Chiapas, representing 5% of state GDP.

Comparing the management of the two hurricanes by Mexican authorities highlights important issues in DRM. Evacuation of areas affected by Stan only started during the emergency phase, when floods in 98 rivers had already affected 800 communities. 100,000 people fled from the mountain regions to hastily improvised shelters. In comparison, following the early alert for Wilma, people were properly evacuated and emergency groups were mobilised to re-establish water, electricity, communications and health services. All ministries were involved in reopening the airport and tourism facilities as quickly as possible.

Population trends within the Central America region have increased vulnerability by heightening exposure of people and property in areas that are affected by extreme events, for example population in coastline regions of the Gulf of Mexico increased by 150% from 1960 to 2008. Some literature also indicates that hurricane losses, when corrected for population and wealth in Latin America and the Caribbean have not increased since the 1940s; and that growing population and assets at risk are the main reason for increasing impacts. Heavy rainfall and flooding also affects environmental health in urban areas because surface water can be quickly contaminated. Urban poor populations in low- and middle-income countries can experience higher rates of infectious disease after floods, such as cholera, cryptosporidiosis, and typhoid fever. Studies indicate that the extent of the vulnerability to climate variability and climate change is shaped by both the dependence of the national economy and livelihoods on climate-sensitive natural resources and the resilience or robustness of the country's social institutions to equitable distribution of resources under climate change.

Changing patterns of vulnerability and exposure are a key driver of risk and disaster losses. 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. Decision and policy making therefore needs to be based on the nature of vulnerability and exposure and not only on the hazard itself.

3. Draws on material from SREX Chapter 9, Murray, V. et al, 'Case Studies'.

2.2 Changes in extreme events

Defining climate extremes[4]

A changing climate leads to changes in the frequency, intensity, spatial extent and duration of weather and climate extremes, and can result in unprecedented extremes. "An *extreme (weather or climate) event* is generally defined as 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" (see glossary).

Box 2: What can policy makers expect from climate science?

- **The quality of information will differ between global, regional and local scales.**
- **There will be differences in what the science can say about extremes, e.g. the links between rises in temperature and sea level rise are more clear than the links between rises in temperature and an increase in frequency or intensity of storms.**
- **Variability is always important. Climate trends are usually only one factor in the probability of hazards – in some regions and for some decisions, seasonal variability may be more important than long-term trends.**
- **For decisions affecting just the next decade, it may be more important to think about what has changed already and what the near-term range of variability is, rather than what will happen in the coming century.**
- **In many cases, all we know is that risks are rising, because uncertainty is increasing, with sometimes some hints on future trends or ranges of uncertainty – there is seldom specific information on precise future probabilities of particular extremes.**
- **These factors should be considered when reviewing climate science for decision- and policy-making. However, uncertainty should not be used as a reason for inaction with regard to investing in reducing vulnerability and exposure. SREX provides enough information to show that more people and assets are in harms way and much more can be done to reduce exposure, vulnerability and risk.**

4. Draws on material from SREX Chapter 3, Nicholls. N. et al, 'Changes in Climate Extremes and their Impacts on the Natural Physical Environment'.

2.3 Changes in climate extremes affecting the region

The SREX provides robust scientific information on what can be expected from changes in weather and climate extremes in various regions and sub-regions of Latin America and the Caribbean. A summary of this information is captured in Table 1 and Table 2.

Key

Symbols

- Increasing trend
- Decreasing trend
- Varying trend
- Inconsistent trend/insufficient evidence
- No or only slight change

Level of confidence in findings

- Low confidence
- Medium confidence
- High confidence

Table 1: Observed changes in temperature and precipitation extremes since the 1950s[5]

Table 1 shows observed changes in temperature and precipitation extremes, including dryness in regions of Latin America since 1950, with the period 1961-1990 used as a baseline (see Box 3.1 in Chapter 3 of SREX for more information).

Region and Sub-region	Trends in maximum temperature (warm and cold days)[6]	Trends in minimum temperature (warm and cold nights)[7]	Trends in the heat waves/warm spells[8]	Trends in heavy precipitation (rain, snow)[9]	Trends in dryness and drought[10]
Amazon	Insufficient evidence to identify a significant trend	Insufficient evidence to identify a significant trend	Insufficient evidence	Increase in many areas, decrease in a few areas	Decrease in dryness for much of the region. Some opposite trends and inconsistencies
Northeastern Brazil	Increases in the number of warm days	Increases in the number of warm nights	Insufficient evidence	Increases in many areas, decreases in a few areas	Varying and inconsistent trends
Southeastern South America	Spatially varying trends (increases in some areas decreases in others)	Increases in number of warm nights (decreases in number of cold nights)	Spatially varying trends (increases in some areas, decreases in others)	Increases in northern areas Insufficient evidence in southern areas	Varying and inconsistent trends
West Coast South America	Spatially varying trends (increases in some areas decreases in others)	Increases in number of warm nights (decrease in number of cold nights)	Insufficient evidence	Increases in some areas, decreases in others	Varying and inconsistent trends
Central America and Mexico	Increases in the number of warm days, decreases in the number of cold days	Increases in number of warm nights (decrease in number of cold nights)	Spatially varying trends (increases in some areas, decreases in others)	Increases in many areas, decreases in few areas	Varying and inconsistent trends

5. Period 1961-1990 used as a baseline.
6. Refers to the number of warm days and cold days with maximum temperature above or below extreme values e.g. the 90th/10th percentile with respect to the 1961-1990 reference period.
7. Refers to the number of warm nights and cold nights with minimum temperature above or below extreme values, e.g. the 90th/10th percentile with respect to the 1961-1990 reference period.
8. Warm spell refers to periods of at least six days where maximum temperature values exceed the 90th percentile with respect to the 1961-1990 reference period.
9. Refers to the number of days with precipitation above an extreme value, e.g. the 90th percentile, with respect to the 1961-1990 reference period.
10. Dryness is calculated in relation to a number of variables including: number of consecutive dry days (dry is defined as daily precipitation with <1 mm); soil moisture anomalies; and drought severity index. Dryness refers to a hydro-meteorological water deficit, whereas drought is extended and continuous water shortage. More information is given in Box 3.3 of Chapter 3 in the SREX report.

Table 2: Projected changes in temperature and precipitation extremes at the end of 21st century[11]

Table 2 shows projected changes in temperature and precipitation extremes, including dryness in Latin America. The projections are for the period 2071-2100 (compared with 1961-1990) or 2080-2100 (compared with 1980-2000) and are based on GCM and RCM[12] outputs run under the A2/A1B emissions scenario.

Region and Sub-region	Trends in maximum temperature (the frequency of warm and cold days)[13]	Trends in minimum temperature (the frequency of warm and cold nights)[14]	Trends in the heat waves/warm spells[15]	Trends in heavy precipitation (rain, snow)[16]	Trends in dryness and drought[17]
Amazon	Warm days *likely* to increase (cold days *likely* decrease)	Very *likely* increase in warm nights (*likely* decrease in cold nights)	*Likely* more frequent and longer heat waves and warm spells	Tendency for increases in heavy precipitation events	Inconsistent trends
Northeastern Brazil	Warm days *likely* to increase (cold days *likely* decrease)	*Likely* increase in warm nights (*likely* decrease in cold nights)	*Likely* more frequent and longer heat waves and warm spells in some studies. Non-significant signal in others	Slight or no change	Increase in dryness
Southeastern South America	Warm days *likely* to increase (cold days *likely* decrease)	Very *likely* increase in warm nights (*likely* decrease in cold nights)	Tendency for more frequent and longer heat waves and warm spells	Increases in northern areas Insufficient evidence in southern areas	Inconsistent trends
West Coast South America	Warm days *likely* to increase (cold days *likely* decrease)	*Likely* increase in warm nights (*likely* decrease in cold nights)	*Likely* more frequent and longer heat waves and warm spells	Increases in tropics Insufficient evidence in extratropics	Varying and inconsistent trends
Central America and Mexico	Warm days *likely* to increase (cold days *likely* decrease)	*Likely* increase in warm nights (*likely* decrease in cold nights)	*Likely* more frequent, longer and/or more intense heat waves/warm spells in most of the region	Inconsistent trends	Increase in dryness in Central America and Mexico, with less confidence in trend in extreme South of region

11. Projections are for the end of the 21st century vs end of the 20th century (e.g. 1961-1990 or 1980-2000 vs 2071-2100 or 2080-2100) and for the A2/A1B emissions scenario.
12. GCM refers to Global Circulation Model, RCM refers to Regional Climate Model.
13. Refers to the number of warm days and cold days with maximum temperature above or below extreme values e.g. the 90th/10th percentile in 2071-2100 with respect to the 1961-1990 reference period.
14. Refers to the number of warm nights and cold nights with temperature extremes above or below extreme values, e.g. the 90th/10th percentile in 2071-2100 with respect to the 1961-1990 reference period.
15. Warm spell refers to periods of at least six days where extreme temperature values exceed the 90th percentile in 2071-2100, with respect to the 1961-1999 reference period.
16. Refers to the number of days with precipitation above an extreme value, e.g. the 95th percentile, or above 10mm in one day in 2071-2100, with respect to the 1961-1990 reference period.
17. Dryness is calculated in relation to a number of variables including: number of consecutive dry days (dry is defined as daily precipitation with <1 mm); soil moisture anomalies; and drought severity index. Dryness refers to a hydro-meteorological water deficit, whereas drought is extended and continuous water shortage. More information is given in Box 3.3 of Chapter 3 in the SREX report.
18. These refer to three of the six possible IPCC emissions scenario groups used throughout their reports.
B1 describes a convergent world with rapid changes towards a service and information economy and introduction of clean and resource efficient technologies.
A1B describes rapid economic development and growth, with balanced technological development across all sources, i.e. neither fossil intensive nor all non-fossil sources.
A2 is a heterogeneous world with self reliance and local identity, regional economic development, fragmented and slower growth. See www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf Figure 1 for more information.
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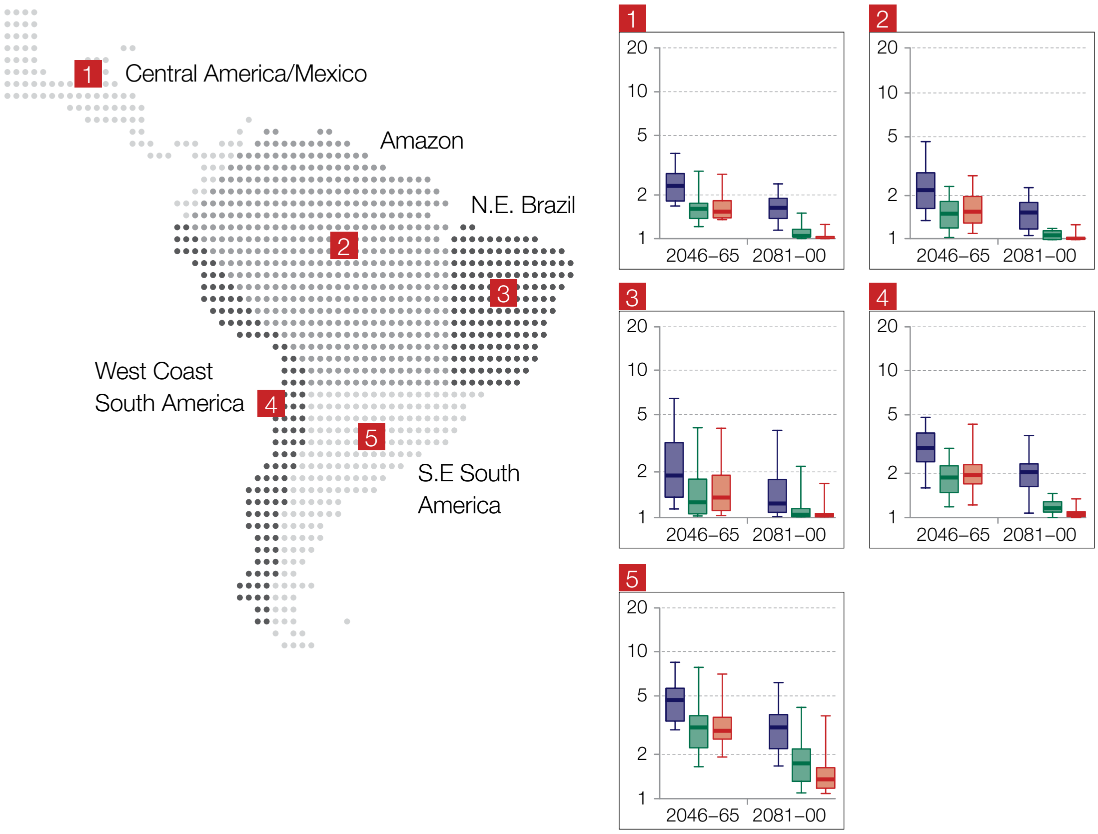
A2 is a heterogeneous world with self reliance and local identity, regional economic development, fragmented and slower growth. See www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf Figure 1 for more information.

Figure 2: Projected return period (in years) of late 20th century 20-year return values of annual maximum (a) of the daily maximum temperature; and (b) 24-hour precipitation rates

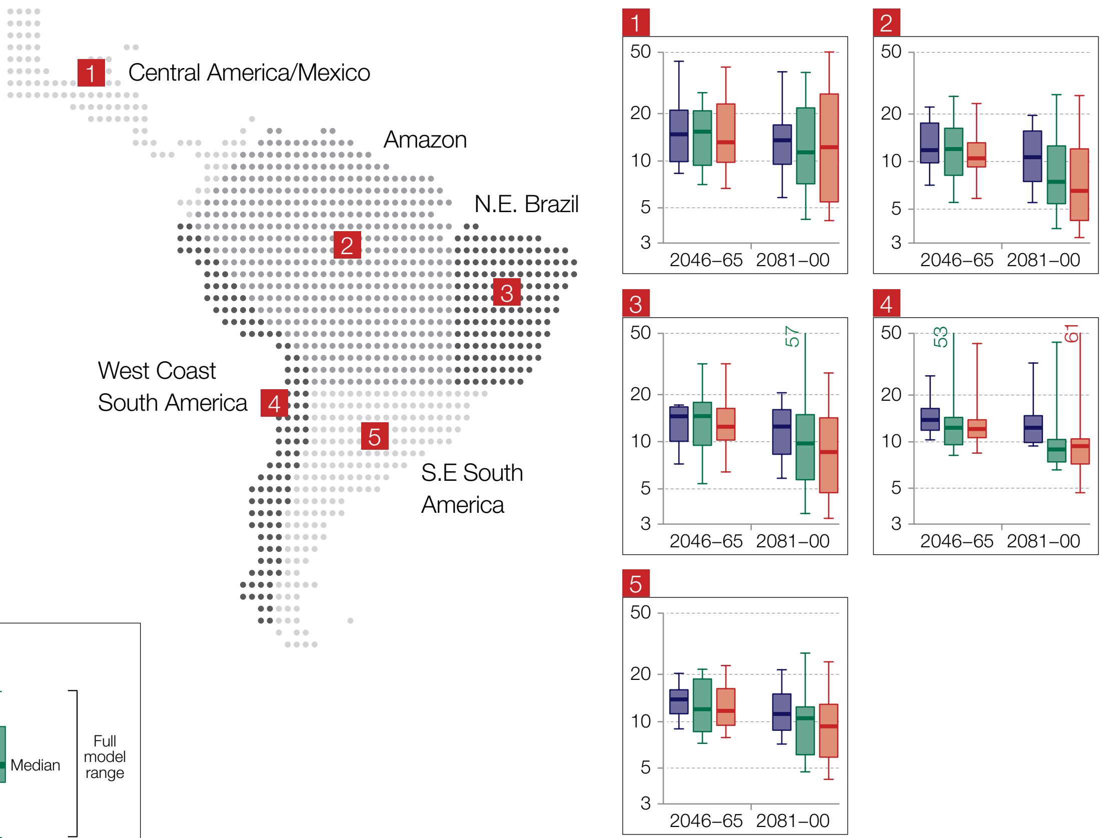
(a) Temperature

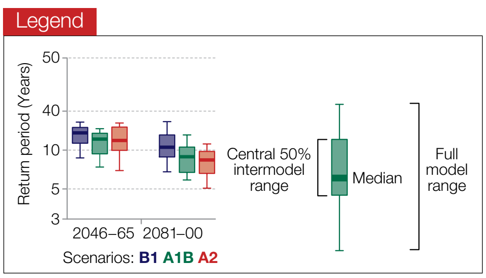
These graphs show how often the hottest day in the last 20 years of the 20th century will be experienced by the middle and end of the 21st century. These are shown under three different emissions scenarios: B1, A1B and A2.[18] For example, in N.E. Brazil, the hottest day experienced in the last 20 years at the end of the 20th century will happen annually or biannually by the end of the 21st century. So what are now considered temperature extremes will become much more like 'normal' temperatures in 70 years' time.



(b) Precipitation

These graphs show how often the wettest day in the last 20 years of the 20th century will be experienced by the middle and end of the 21st century. These are shown under three different emissions scenarios: B1, A1B and A2.[19] For example, in N.E. Brazil, the wettest day experienced in the last 20 years at the end of the 20th century will happen more like every 10 years by the end of the 21st century depending on which emissions scenario is followed.





Observations and projections of trends in tropical cyclones globally and other relevant extremes are given in Table 3.

Table 3: Overview of considered extremes and summary of observed and projected changes on global scale

Phenomena related to weather and climate extremes	Observed changes (since 1950)	Attribution of observed changes	Projected changes (up to 2100) with respect to late 20th century
Monsoons	*Low confidence* in trends because of insufficient evidence.	*Low confidence* due to insufficient evidence.	*Low confidence* in projected changes of monsoons, because of insufficient agreement between climate models.
El Niño and other modes of variability	*Medium confidence* of past trends towards more frequent central equatorial Pacific El Niño Southern Oscillation (ENSO) events. Insufficient evidence for more specific statements on ENSO trends. *Likely* trends in Southern Annular Mode.	*Likely* anthropogenic influences on identified trends in Southern Annular Mode.[20] Anthropogenic influence on trends in NAO are *as likely as not*. No attribution of changes in ENSO.	*Low confidence* in projections of changes in behaviour of ENSO and other modes of variability because of insufficient agreement of model projections.
Tropical cyclones	*Low confidence* that any observed long-term (i.e. 40 years old or more) increases in tropical cyclone activity are robust, after accounting for past changes in observing capabilities.	*Low confidence* in attribution of changes in tropical cyclone activity to anthropogenic influences (insufficient data quality and physical understanding).	*Likely* decrease or no change in frequency of tropical cyclones. *Likely* increase in mean maximum wind speed, but possibly not in all basins. *Likely* increase in heavy rainfall associated with tropical cyclones.
Extratropical cyclones	*Likely* poleward shift in extratropical cyclones. *Low confidence* in regional changes in intensity.	*Medium confidence* in anthropogenic influence on poleward shift.	*Likely* impacts on regional cyclone activity but *low confidence* in detailed regional projections due to only partial representation of relevant processes in current models. *Medium confidence* in a reduction in the numbers of mid-latitude storms. *Medium confidence* in projected poleward shift of mid-latitude storm tracks.

20. The Southern Annular Mode refers to the shifts (north and south) of atmospheric mass between middle and high latitudes. It is the most significant mode of variability outside the tropics in the Southern Hemisphere and plays an important role in climate variability in these latitudes. It has been associated with cooler than normal temperatures over most of Antarctica and Australia, with warm anomalies over the Antarctic Peninsula, southern South America, and southern New Zealand, and with anomalously dry conditions over southern South America, New Zealand, and Tasmania and wet anomalies over much of Australia and South Africa (e.g., Hendon et al., 2007).

Box 3: Climate Extremes in the Caribbean

The small land area and often low elevation of small island states make them particularly vulnerable to rising sea levels and impacts such as inundation and saltwater intrusion into underground aquifers. Short record lengths and the inadequate resolution of current climate models to represent small island states limits the assessment of changes in extremes. This is why the Caribbean region is not represented in the maps and tables above. However, there is medium confidence of observed increases in warm days and nights and decreases in cold days and nights over the Caribbean. There is medium confidence in the projected temperature increases across the Caribbean. 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 small islands states in the Caribbean.

2.4 Consequences of climate extremes[21]

This section builds on the information presented in Table 1 and 2 and Figure 2 to highlight how climate extremes could affect Latin America and the Caribbean. It provides examples of the consequences and impacts that arise from a sample of climate extremes common to the LAC region. The science base also shows how incremental climate-related impacts, rather than extreme events per se, can have extreme consequences where vulnerability is high.

Floods (whether due to climate change or environmental degradation and other social factors) may lead to a geographical shift of malaria epidemic regions by changing breeding sites for vector mosquitoes. Outbreaks of malaria were associated with changes in habitat after the 1991 floods in Costa Rica's Atlantic region.

Heat stress: Heat extremes can claim casualties even in tropical countries, where people are acclimatised to a hot climate. A study evaluated the relation between daily temperature and mortality in mid- and low-income countries, and reported that higher mortality was observed on very hot days in most cities, including tropical cities, such as Salvador, Brazil.

Coral bleaching: In the Western Caribbean average regional temperatures in 2005 were the warmest for more than 150 years. These extreme temperatures caused the most severe coral bleaching ever recorded in the Caribbean: more than 80% of corals surveyed were bleached, and at many sites more than 40% had died. As detailed in Box 3, there is *medium confidence* in projected temperature increases and the likelihood of increased heat waves and warm spells across the Caribbean.

Tropical cyclones: Damages from tropical cyclones are perhaps most commonly associated with extreme wind, but storm-surge and fresh-water flooding from extreme rainfall generally cause the great majority of damage and loss of life. Other direct and indirect impacts of tropical cyclones can also cause significant damage, for example mudslides during the landfall of Hurricane Mitch in Central America in 1998. Projected sea level rise is expected to further compound tropical cyclone surge impacts.

Sea-Level Rise can exacerbate inundation, erosion, and other coastal hazards, threaten vital infrastructure, settlements and facilities, and thus compromise the socio-economic wellbeing of island communities and states. At Mar del Plata, in Argentina, sea-level rise has been linked to an increase in the number and duration of positive storm surges in the decade 1996 to 2005 as compared to records from previous decades. In the Caribbean this could lead to a reduction in island size and could impact negatively on infrastructure, including international airports, roads, and capital cities, which tend to predominate in coastal locations. In the Caribbean more than 50% of the population lives within 1.5 km of the shore.

Box 4: Extreme weather events in Latin America and the Caribbean – beyond SREX

Between 1980 and 2010 South America reported 68,250 fatalities as a result of natural catastrophes.

In January 2011 landslides and flashfloods in Brazil killed 900 people and destroyed thousands of houses.

In October 2011 floods and landslides in Central America, especially in El Salvador, caused 124 deaths and resulted in tens of thousands of houses being destroyed.

In 2010-2011 two La Niña events hit Colombia. Between September and December 2011 alone, flooding killed 108 people, injured 95, and affected 420,000. 67,000 homes were also destroyed. Colombian President Juan Manuel Santos stated there had "never been a tragedy of this scale" in the country's history. Venezuela and Panama were also affected.

Source: Münchener Rückversicherungs-Gesellschaft, Geo Risks Research, NatCatSERVICE, 2011; the Telegraph (www.telegraph.co.uk) 2011; Colombia Reports (www.colombiareports.com), December 2011

21. Draws on material from SREX Chapter 4, Handmer, J. et al, 'Changes in Impacts of Climate Extremes: Human Systems and Ecosystems'.

3. Future impacts

This section looks ahead to explore the range of possible future impacts for the region, considering points 3, 4 and 5 in the key messages (section 1.2) in more detail.

Impacts of extremes on human systems and eco systems

As shown in section 2, climate extremes may result in a broad range of impacts on both human and ecosystems including economic losses, impacts on different sectors such as tourism and agriculture, on urban settlements and on small island states. The severity of these impacts will depend strongly on the level of exposure and vulnerability to climate extremes. Collectively such impacts can also have a significant adverse affect on the population and can harm national, regional and global development. Some examples are provided below.

3.1 Increasing economic losses[22]

There is *high confidence* that economic losses from weather- and climate-related disasters are increasing, albeit with large inter-annual variability. Increasing exposure of people and economic assets has been a major cause. Whilst measured economic losses from disasters are largest in developed countries, there is *high confidence* that fatality rates and economic losses as a proportion of GDP are higher in developing countries. The largest absolute adaptation costs are expected in East Asia and the Pacific, followed by the Latin American and Caribbean region as well as Sub-Saharan Africa.

Increases in exposure will result in higher direct economic losses from tropical cyclones. Low-lying states are especially vulnerable to cyclones and tropical storms. In October 1998, Hurricane Mitch caused direct and indirect damages to Honduras of $5 billion USD, equivalent to 95% of the country's GDP in that year. In some particularly exposed countries, including many small island developing states, wealth losses expressed as a percentage of GDP can be extremely high, with the average costs over disaster and non-disaster years close to 10%, such as reported for Grenada and St. Lucia. In extreme cases, the costs of individual events can be as high as 200% of annual GDP as experienced for Hurricane Ivan in Grenada in 2004.

3.2 Sector vulnerability[23]

Extreme events have the greatest impacts on sectors that are closely linked with or dependent on the climate, for example water, agriculture and food security, forestry, health and tourism. There is *high confidence* that changes in the climate could seriously affect water management systems. Climate extremes also have large adverse impacts on infrastructure, e.g. roads cracking, railways buckling, and flooding of airports, particularly in coastal areas. Coastal inundation due to storm surges and floods can affect terminals, freight villages, storage areas, and cargo, and disrupt supply chains and transport. This may have far reaching implications for international trade, as more than 80% of global trade in goods (by volume) is carried by sea. Small island states are particularly at risk as their transportation facilities are mostly located along the coast. The tourism sector is also sensitive to the climate; particularly given that climate is a key factor in tourism demand. The Caribbean has been identified as a vulnerable hotspot region in terms of extreme impacts of climate change on tourism revenues.

3.3 Urban settlements[24]

Changes in settlement patterns, urbanisation, and socio-economic status in Latin America and the Caribbean have all influenced observed trends in vulnerability and exposure to climate extremes. Rising population trends within the Central America region, for example, have heightened the exposure of people and property in areas affected by extreme events. In many coastal areas growing urban settlements have also affected the ability of natural coastal systems to respond effectively to extreme climate events, thus rendering them more vulnerable. Flooding regularly disrupts cities and urban food production, which can undermine food security, particularly in poor communities. Heavy rainfall and flooding can also contaminate surface water and affect environmental health in urban areas.

22. Draws on materials from SREX Chapter 4, Handmer, J. et al, 'Changes in Impacts of Climate Extremes: Human Systems and Ecosystems', and SREX Chapter 6, Lal, P. N. et al, 'National Systems for Managing the Risks from Climate Extremes and Disasters'.
23. Draws on materials from SREX Chapter 4, Handmer, J. et al, 'Changes in Impacts of Climate Extremes: Human Systems and Ecosystems'.
24. Draws on materials from SREX Chapter 4, Handmer, J. et al, 'Changes in Impacts of Climate Extremes: Human Systems and Ecosystems'.

4. Managing the risks of climate extremes and disasters

This section considers the ranges of responses required in order to try to better manage the risks of climate extremes and disasters. It considers the key messages 6-10 in more detail (see section 1.2).

Managing the risk at different scales/levels[25]

Disaster risk will continue to increase in many countries as more vulnerable people and assets are exposed to climate extremes. Increases in the occurrence of such weather-related disaster risk will magnify the uneven distribution of risk between wealthier and poorer countries. Climate change is altering the geographical distribution, intensity and frequency of weather-related hazards, threatening to exceed the capacities of poorer countries to absorb losses and recover from disaster impacts. So risk management becomes critical. This section considers the risk management options at local, national and international levels.

Closer integration of disaster risk management and climate change adaptation, along with the incorporation of both into local, sub-national, national, and international development policies and practices, could provide benefits at all scales. 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. When considering the linkages between disaster management, climate change adaptation and development, timescales play an important role. For example, during disaster reconstruction tensions frequently arise between demands for speed of delivery and sustainability of outcome. Response and reconstruction funds tend to be time limited, often requiring expenditure within 12 months or less from the point of disbursement. This pressure is compounded by multiple agencies working with often limited coordination. Time pressure and competition between agencies tends to promote centralised decision-making and the sub-contracting of purchasing and project management to non-local commercial actors. Both outcomes save time but miss opportunities to include local people in decision-making and learning from the event, with the resulting reconstruction in danger of failing to support local cultural and economic priorities. Strategies and policies are more effective when they acknowledge multiple stressors, different prioritised values, and competing policy goals.

4.1 Local level DRM[26]

Integrating local knowledge with additional scientific and technical knowledge can improve disaster risk reduction and adaptation. This self generated knowledge can uncover existing capacity, as well as important shortcomings. The social organisation of societies dictates the flexibility in the choice of protective actions. In Cuba the organisation of civil defence committees at block, neighbourhood, and community levels working in conjunction with centralised governmental authority is a good example of local level DRM. In Costa Rica, implementing community early warning systems is also helping communities to become more proactive in their hazard mitigation approaches. Box 5 provides a further example of social organisation and local level DRM in Garifuna, Honduras.

25. Draws on materials from SREX Chapter 8, O'Brien, K. et al, 'Toward a Sustainable and Resilient Future'.
26. Draws on materials from SREX Chapter 5, Cutter, S. et al, 'Managing the Risks from Climate Extremes at the Local Level'.

Box 5: Community-based DRM

The Garifuna women of Honduras belong to a socially, economically and politically marginalised ethnic group. They depend upon a subsistence economy and lack access to education, health and other resources. Despite their vulnerability, these women have reduced their communities' exposure to hazards and vulnerability to disasters through the Comité de Emergencia Garifuna de Honduras, a grassroots, community-based group developed in the wake of Hurricane Mitch in 1998. The Comité repaired houses, businesses and public buildings, and campaigned to buy land for relocating housing to safer areas. They have also focused on livelihood activities to ensure food security and to build up an asset base. These activities have helped prevent soil erosion and reduced vulnerability to natural hazards.

Although good local level DRM does exist, it is important to overcome the disconnect that remains between local risk management and national institutional and legal policy and planning. Local level DRM for example can, and should, be supported by environmental planning, urban land use planning, livelihood strengthening and improvement in health surveillance, water supply, sanitation, and irrigation and drainage systems. Such integrated approaches are visible in Bogota, São Paulo and Santiago where urban adaptation efforts are working to support existing DRM strategies.

4.2 National level DRM[27]

National systems are at the core of countries' capacity to meet climate challenges. Effective national systems comprise multiple actors from national and sub-national governments, the private sector, research bodies and civil society, including Community-Based Organisations (CBOs), each playing differential but complementary roles to manage risk according to their accepted functions and capacities. Greater efforts are required to address the underlying drivers of risk and generate political will to invest in disaster risk reduction. Changes in weather and climate extremes also pose new challenges for national DRM systems, which are often poorly adapted to current risks. However, there are relatively few examples where mainstreaming adaptation to climate change and DRM issues have been priorities for over extended time periods and have made significant progress. However, The Caribbean Mainstreaming Adaptation to Climate Change (MACCC) project, implemented from 2004 to 2007, is an example of such an approach.

In some high-risk regions rapid development of national platforms of Civil Society Organisations (CSOs) and CBOs is helping to push for the transformation of policies and practices related to disaster risk reduction. In several countries of Latin America, CSOs and CBOs are now considered by law as part of national systems for civil protection. In countries with weak national institutions, bi-lateral and multi-lateral agencies regularly channel resources through CSOs with the intention of ensuring resources reach the poorest and most vulnerable. This is a valuable DRM approach, although funders must be careful not to undermine the development of national institutions.

A set of factors has been identified that make efforts to systematically manage disaster risk more successful. These are captured in Box 6.

Box 6: Factors for more successful management of disaster risk[28]

- **Risks are recognised as dynamic and are mainstreamed and integrated into policy and strategy, for example the Caribbean Development Bank has integrated weather and climate disaster risks into its Environmental Impact Assessments for new development projects.**
- **Legislation for managing disaster risk is supported by clear regulations that are enforced.**
- **Disaster risk management functions are co-ordinated across sectors and scales and led by organisations at the highest political level.**
- **Risk is quantified and factored into national budgetary processes, for example as in Mexico, Colombia and many Caribbean countries.**
- **Decisions are informed by the right information, using a range of tools and guidelines.**
- **Early Warning Systems work, for example community-based flood warnings in Costa Rica have helped to save lives and property.**
- **Responses cover hard infrastructure-based options as well as soft longer-term options building capacity and conservation measures, for example the preservation of over 30 million ha of biodiversity-rich forests in Brazil under the Amazon Protected Areas Program.**

27. Draws on materials from Chapter 6, Lal, P. N. et al, 'National Systems for Managing the Risks from Climate Extremes and Disasters'.
28. Draws on material from Chapter 8, O'Brien, K. et al, 'Toward a Sustainable and Resilient Future'.

4.3 Risk management at the international level[29]

International actors can also play a useful enabling role in risk management as summarised in Box 7.

Box 7: The role of IFIs, donors and other international actors in developing catastrophic risk financing mechanisms

International agencies can play a strongly catalytic role in the development of catastrophic risk financing solutions in vulnerable countries, most notably by:

- **exercising convening power and coordinating initiatives**
- **supporting public goods for development of risk market infrastructure**
- **providing technical assistance and sharing experience**
- **creating enabling markets, for example in the banking sector**
- **financing risk transfer, for example through micro-insurance.**

International funding mechanisms such as the LDC (Least Developed Countries) Fund, the Special Climate Change Fund, the Multi-donor Trust Fund (MDTF) on Climate Change, and the Pilot Programme for Climate Resilience (PPCR) under the Climate Investment Fund (CIF) are making funding and resources available to developing countries to pilot and mainstream climate risk management and resilience building into development. This provides incentive for scaled-up action and transformational change, although funding is inadequate.

Risk transfer (usually with payment) and risk sharing (usually informal with no payment) mechanisms are also recognised by international actors as an integral part of DRM and adaptation. A number of international organisations are already supporting countries most at risk from climate impacts to explore the potential for risk transfer, for example through enabling access to insurance against extreme weather events. The international transfer and sharing of risk is an opportunity for individuals and governments of all countries that cannot sufficiently diversify their portfolio of weather risk internally, and especially for governments of vulnerable countries that do not wish to rely on ad hoc and often insufficient post-disaster assistance. Some specific examples of risk transfer in Latin America and the Caribbean are illustrated in Box 8.

Box 8: Risk transfer examples

Insurance in Mexico

Mexico is located within one of the world's most active seismic regions and in the path of hurricanes and tropical storms originating in the Caribbean Sea, and the Atlantic and Pacific Oceans. Severe hurricanes and earthquakes have created large fiscal liabilities and imbalances. In 1994 the Mexican Government passed a law, requiring federal, state and municipal public assets to be insured to relieve central government of having to pay for reconstruction of public infrastructure. In 1996 the national government established a system of allocating resources for disaster spending (FONDEN) to enhance financial preparedness for disaster losses. FONDEN provides last-resort funding for uninsurable losses, such as emergency response and disaster relief expenditure. In 1999 a reserve fund was created to accumulate surplus from the previous year's FONDEN budget.

Due to regular demands on the funds in non-disaster years, budgeted FONDEN resources began to decline and outlays often exceeded budgeted funds. In 2005, after a severe hurricane season affecting large parts of coastal Mexico, the fund was finally exhausted. This forced the Mexican Government to look at alternative risk financing strategies, including hedging against disaster shocks, providing government agency insurance independent of FONDEN, and FONDEN only indemnifying losses exceeding the financial capacity of the federal, local or municipal government.

In 2006 Mexico became the first economy in transition to transfer part of its public sector catastrophe risk to international reinsurance and capital markets. In 2009 the transaction was renewed for another three years to cover hurricane and earthquake risk.

Intergovernmental risk sharing (insurance and other risk transfer mechanisms)

In 2007 the world's first regional catastrophe insurance pool was launched in the Caribbean: the Caribbean Catastrophe Risk Insurance Facility.

The facility aims to provide immediate liquidity to cover around 50% of costs that participating governments expect to incur while providing relief and assistance for recovery and rehabilitation. Because it does not cover all costs, CCRIF also incentivises governments to invest in risk reduction and other risk transfer tools. The cost of participation is based on estimates of the respective countries' risk (measured as probability and cost).

Insofar as weather extremes are increased by climate change, the CCRIF contributes directly to DRM and climate change adaptation. It enables governments to restore critical infrastructure important for reducing long-term human and economic impacts. Experience with CCRIF also shows the importance of designing programs that reflect the needs of participating countries. Finally, it demonstrates how international assistance can support disaster management in tandem with national responsibility.

29. Draws on materials from Chapter 7, Burton, I. et al, 'Managing the Risks: International Level and Integration Across Scales'.

5. Conclusions: What does this mean for decision makers in Latin America and the Caribbean?[30]

This final section considers the implications for the Latin America and Caribbean region in more detail. As climate change impacts become more dramatic, the effects on a range of climate extremes will become more important and will play a more significant role in disaster impacts and DRM. The capacity of Latin American and Caribbean countries to meet this challenge will be determined by the effectiveness of their national risk management systems, including adaptation and mitigation measures. Some are poorly prepared and need to reassess their vulnerability, exposure and investments in order to better manage disaster risks. A new balance needs to be struck between measures to reduce and transfer risk, and to effectively prepare for and manage disaster impacts in a changing climate.

5.1 Links to the mitigation of greenhouse gases

Rapid and comprehensive reduction of greenhouse gas emissions is required in order to reduce the need for future adaptation and DRM in the longer term. Creating synergies between adaptation and mitigation can increase the cost-effectiveness of action and make them more attractive to stakeholders including potential funding agencies. Opportunities for synergies are greater in some sectors (agriculture and forestry, buildings and urban infrastructure) but are more limited in others (coastal systems, energy and health). Examples include where adaptation leads to effects on mitigation such as watershed planning including hydro-electricity affecting greenhouse gas emissions, or where mitigation can affect capacity to adapt, such as community carbon sequestration affecting livelihoods.[31] A specific example is the creation of a 30 million+ ha mosaic of biodiversity-rich forest reserve combining state, provincial, private, and indigenous land in Brazil, which has resulted in an estimated reduction in emissions of 1.8 billion tons of carbon through avoided deforestation.

5.2 Coping, adapting and learning

How well a community responds to and survives disaster depends upon the resources that can be used to cope. Adaptation in anticipation of extreme events can help to limit the ‘coping’ that may be required to survive the next disaster. Adaptive capacity focuses on longer term and more sustained adjustments, e.g. better rainwater harvesting techniques, changing crops, or building further in land or on higher ground. As possible climate futures are uncertain, ‘no regrets’ adaptation strategies are often recommended. They have net benefits over the range of anticipated future climate and associated impacts. Learning is essential to risk management and adaptation. Research on learning emphasises the importance of action-oriented problem solving, learning-by-doing, and concrete learning cycles.

5.3 Integrating DRM, climate change adaptation and sustainable development

Sustainable development involves finding pathways that achieve a variety of socioeconomic and environmental goals, without sacrificing any one for the sake of the others. As a result, the relationships between adaptation, disaster risk management and sustainability are highly political. Successful reconciliation of multiple goals “lies in answers to such questions as who is in control, who sets agendas, who allocates resources, who mediates disputes, and who sets rules of the game”.[32] This means that conflicts of interest must be acknowledged and addressed, whether they are between government departments, sectors, or policy arenas, and suggests that simple panaceas are unlikely without tradeoffs in decision-making. The effectiveness of actions to reduce, transfer, and respond to current levels of disaster risk could be vastly increased. Exploiting potential synergies between DRM and adaptation to climate change will improve management of both current and future risks, and strengthen adaptation processes. Disaster risk management and adaptation to climate change literatures both now emphasize bottom up, grass roots approaches, as well as the value of more holistic, integrated approaches.

There are many potential synergies between DRM and climate change adaptation that can contribute to a sustainable and resilient future. A practical example is provided in Box 9.

Although there is no single approach, framework or pathway to achieve such an integrated approach some important contributing factors have been identified. These include reducing exposure, reducing vulnerability, transferring and sharing risks and adequate preparation, response and recovery. These are captured in Figure 4.

Box 9: Integrating DRM, Climate Adaptation, and Resilience-Building: a practical example[33]

Between 2007 and 2009, the Brazilian Santa Catarina State Civil Defence Department, with the support of the Executive Secretariat and the state university, undertook a public awareness initiative to reduce social vulnerability to disasters. 2,000 educational kits were distributed to 1,324 primary schools and the project jointly launched a communications network in partnership with media and social networks to promote better dissemination of risk and disasters amongst the most vulnerable populations. A pilot project for 16 communities, precariously perched on a hill prone to landslides, featured a 44-hour course on risk reduction. Community participants elaborated risk maps and reduction strategies, which were put to use immediately as heavy rains battered the state, triggering a state of emergency. The participants' risk reduction plans highlighted the removal of garbage and large rocks as well as the building of barriers. On international disaster risk reduction day, representatives of the community, Civil Defence and other public entities, visited the hill community, planted trees, installed signs pointing out risky areas and practices, distributed educational pamphlets and discussed risk. One of the topics of discussion was improper refuse disposal and the consequent blocking of drains, causing flooding.

Figure 4: Integrating adaptation and DRM approaches for a changing climate

RISKS ACCEPTANCE THRESHOLD

REDUCE RISKS

REDUCE VULNERABILITY

- Poverty reduction
- Health improvements
- Access to services and productive assets enhanced
- Livelihood diversification
- Access to decision-making increased
- Community security improved

REDUCE HAZARDS AND EXPOSURE

- Mainstream risk management into development processes
- Building codes and retrofitting
- Defensive infrastructure and environmental buffers
- Land use planning
- Catchment and other ecosystem management
- Incentive mechanisms for individual actions to reduce exposure

POOL, TRANSFER, AND SHARE RISKS

- Mutual and reserve funds
- Financial insurance
- Social networks and social capital
- Alternative forms of risk transfer

MANAGE RESIDUAL RISKS AND UNCERTAINTIES

PREPARE AND RESPOND EFFECTIVELY

- Early warning and communication
- Evacuation plan
- Humanitarian: relief supplies
- Post-disaster livelihood support and recovery

INCREASE CAPACITY TO COPE WITH 'SURPRISES'

- Flexibility in decision-making
- Adaptive learning and management
- Improved knowledge and skills
- Systems transformation over time

30. Draws on materials from SREX Chapter 6, Lal, P. N. et al, 'National Systems for Managing the Risks from Climate Extremes and Disasters' and Chapter 8, O'Brien, K. et al, 'Toward a Sustainable and Resilient Future'.
31. These examples are from WGII, chapter 18 of the IPCC Fourth Assessment Report.
32. Wilbanks, 1994: 544.
33. Draws on material from SREX Chapter 2, Cardona, O.M. et al, 'Determinants of Risk: Exposure and Vulnerability'.
34. Draws on materials from Chapter 5, Cutter, S. et al, 'Managing the Risks from Climate Extremes at the Local Level', Chapter 6, Lal, P. N. et al, 'National Systems for Managing the Risks from Climate Extremes and Disasters', and Chapter 7, Burton, I. et al, 'Managing the Risks: International Level and Integration Across Scales'.

A further set of critical factors to successfully integrate DRM, climate adaptation and resilience building have also been identified and are highlighted in Box 10.

Box 10: Eight critical factors for integrating DRM, Climate Adaptation, and Resilience Building

1. **The capacity to reconcile short-term and long-term goals**
2. **The willingness to reconcile diverse expressions of risk in multi-hazard and multi-stressor contexts**
3. **The integration of DRM and climate change adaptation into other social and economic policy processes**
4. **Innovative, reflexive, and transformative leaders (at all levels)**
5. **Adaptive, responsive, and accountable governance**
6. **Support for flexibility, innovation and learning, locally and across sectors**
7. **The ability to identify and address the root causes of vulnerability**
8. **Long-term commitment to managing risk and uncertainty and promoting risk-based thinking**

5.4 Building long-term resilience: from incremental to transformational[34]

If extreme climate and weather events increase significantly in coming decades, climate change adaptation and DRM are likely to require not only *incremental (small, within existing technology and governance systems)* changes, but also *transformative (large, new systems, new ways in thinking)* changes in processes and institutions. This will involve moving away from a focus on issues and events towards a change in culture and overall approach, elaborated in the following areas:

Partnerships: among the most successful DRM and adaptation efforts are those that have facilitated the development of partnerships between local leaders and other stakeholders, including extra-local governments. This allows local strength and priorities to surface, while acknowledging that communities and local governments have limited resources and strategic scope to address the underlying drivers of risk on their own.

Leadership can be critical for DRM and climate change adaptation, particularly in initiating processes and sustaining them over time. Change processes are shaped by the action of individual champions (including those resisting change) and their interactions with organisations, institutional structures and systems. Leadership can be a driver of change, providing direction and motivating others to follow. A number of private sector organisations have demonstrated this at Chair and CEO level enabling transformational change within their organisations.

Identifying the drivers of hazard and vulnerability in ways that **empower all stakeholders** to take action is key. This is done best where local and scientific knowledge is combined in the generation of risk maps or risk management plans, as in the Santa Catarina case study in Box 9. Greater use of local knowledge and local capacity can initiate enhanced accountability in integrated risk decision-making. There is also need for better co-ordination and accountability within governance hierarchies and across sectors.

International actors can help by providing an institutional framework to support experimentation, innovation and flexibility, financing risk transfer and supporting funding for adaptation.

Technology is an essential part of responses to climate extremes, at least partly because technology choices and uses are so often a part of the problem. Enhancing early warning systems is one example where technology can play an important role in DRM, particularly in considering 'hard' (engineering) and 'soft' (social and administrative) technology. Although technology is an essential part of our response to climate change, responses can also be improved by addressing social vulnerability, rather than focusing exclusively on technological approaches.

Transformation can imply loss of the familiar, creating a sense of disequilibrium and uncertainty. Desirable or not, transformations are occurring at an unprecedented rate and scale, influenced by globalisation, social and technological development, and environmental change. Climate change itself represents a system-scale transformation that will have widespread consequences on ecology and society, including through changes in climate extremes.

Responses to climate change and changes in disaster risk can be both incremental and transformational. Transformation calls for leadership, both from authority figures who hold positions and power, and from individuals and groups who connect present-day actions with building a sustainable and resilient future.

For further information

The Summary for Policy Makers, full report, fact sheet and video is available at: http://ipcc-wg2.gov/srex

Other useful links including videos and recommended reading are on the CDKN website here: http://cdkn.org/2011/11/ipcc-srex

IPCC SREX Glossary of Terms

Core concepts defined in the SREX and used throughout the summary 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.

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 of the SREX report.

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.

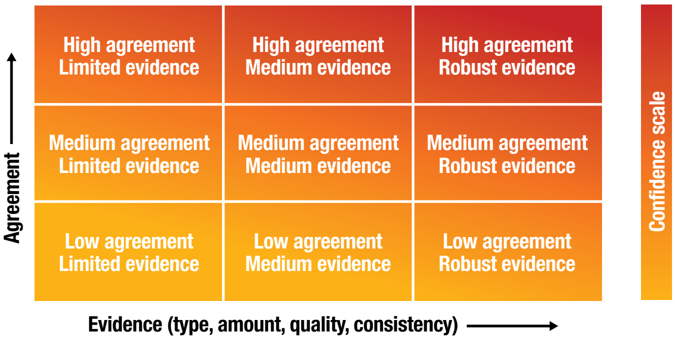
Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected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

IPCC Uncertainty Guidance

The standard terms used to define levels of confidence in this report are as given in the IPCC SREX Uncertainty Guidance Note, namely:



The standard terms used in this report to define the likelihood of an outcome or result where this can be estimated probabilistically are:

Term[35]	Likelihood of the outcome
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33-66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

35. Additional terms that were used in limited circumstances in the Fourth Assessment Report (extremely likely: 95-100% probability, more likely than not: >50-100% probability, and extremely unlikely: 0-5% probability) may also be used when appropriate.

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