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Loss and Damage:
Unavoidable Impacts of Climate Change on Ecosystems

What is Loss and Damage?

Anthropogenic climate change is underway and will continue for the foreseeable future. It is manifesting more rapidly and more intensely than many expected.[1,2] The most recent global assessment by the Intergovernmental Panel on Climate Change indicates that the world has become 0.85°C warmer than in the late nineteenth century and extreme weather events are likely to become more frequent. Increase in the frequency, intensity and/or amount of heavy precipitation is to be expected; drought is to become more intense and prolonged in many regions; and incidence and/or magnitude of extreme high sea level is likely to increase.[1] These climatic changes and extreme events pose an unprecedented threat to people, ecosystems, assets, and economies.

Mitigation and adaptation–described as avoiding the unmanageable and managing the unavoidable, respectively–remain the most important paths to reduce the adverse effects of a changing climate.[3,4] However, given the delays over the last 25 years in accomplishing mitigation and the late start on tackling adaptation, scientific evidence indicates that limits to adaptation are clear and that losses and damages from climate change in human and natural systems are inevitable.[5-8]

While there is no universally agreed definition to date,[8-11] the term 'loss and damage' may be used to describe the adverse effects of climate change that cannot be avoided through mitigation measures or managed through adaptation efforts. Loss and damage become evident when adaptation measures are unsuccessful, insufficient, not implemented, or impossible to implement; or when adaption measures incur unrecoverable costs or turn out to be measures that increase vulnerabilities, called maladaptations.[11]

Loss and damage can occur from a spectrum of climate change impacts, ranging from sudden onset events such as cyclones, hurricanes, flash floods, and landslides to slow-onset processes such as increasing average temperature, sea level rise, drought, soil salinization, and ocean acidification.[12-15] Extreme events alter ecosystems. As a result, they disrupt food production, water supply, infrastructure and settlements, and human lives and livelihoods.[2] With more than 60 per cent of the ecosystems and their services already degraded or exploited unsustainably.[16] Climate change will cause further changes and adverse consequences, including alterations in the efficiency of ecosystem services.[17-19] Understanding the serious implications of loss and damage should motivate policy makers, governments, communities, and individuals to minimize, and ultimately prevent, losses and damages.

Video: **Interview with Frans Berkhout, King's College London**

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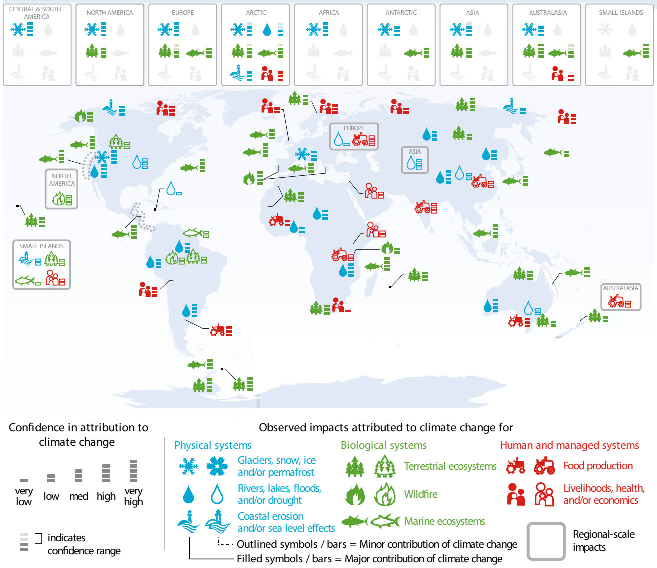
Global patterns of observed climate change impacts



Global patterns of observed climate change impacts reported since AR4. Each filled symbol in the top panels indicates a class of systems for which climate change has played a major role in observed changes in at least one system within that class across the respective region, with the range of confidence in attribution for those region-wide impacts indicated by the bars. Regional-scale impacts where climate change has played a minor role are shown by outlined symbols in a box in the respective region. Sub-regional impacts are indicated with symbols on the map, placed in the approximate area of their occurrence. The impacted area can vary from specific locations to broad areas such as a major river basin. Impacts on physical (blue), biological (green), and human (red) systems are differentiated by color. This map represents a graphical synthesis of Tables 18-5, 18-6, 18-7, 18-8, and 18-9. Absence of climate change impacts from this figure does not imply that such impacts have not occurred.

IPCC (2014)[2]

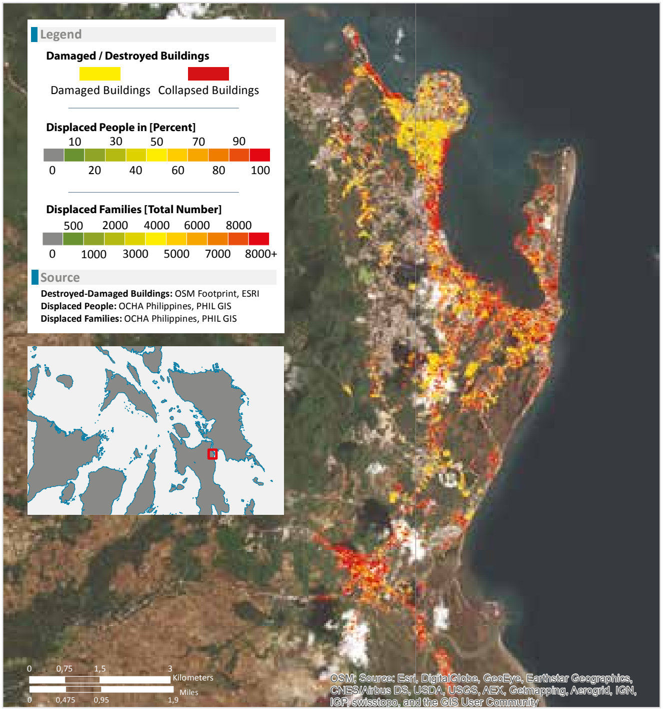
Expected loss of ecosystems and their services

There are a number of sudden- and slow-onset events in recent years that may be attributable to climate change and have caused losses and damages to human systems and ecosystems. Since 1950 heat wave frequency has increased in large parts of Europe, Asia, and Australia.[1] The European heat wave of 2003 is seen as the shape of things to come, reflecting temperature that are extreme now, but projected as normal summers in the later 21st century.[20,21] To some degree this event can be attributed to climate change. Recent studies suggest that severe heat waves, formerly occurring twice a century, are now expected to occur twice a decade.[22] Direct and indirect consequences of the 2003 heat wave on human and ecosystems were devastating. At least 30,000 people died as a consequence of the high temperatures and their persistence over a period of three months.[23] The economic losses in the European Union's agricultural sector amounted to US$14.7 billion.[24] It caused a significant decrease in glacier volumes across the continent and damaged montane permafrost through increased thawing. Alpine glacier mass reduced by 10 per cent in that year.[25] Water resources, already stressed from high temperatures and precipitation deficit, were put under further pressure from substantially increased demand for water supply and electricity generation.[23,26-29]

Examples of sudden-onset events include the powerful typhoon Haiyan (Yolanda) in 2013 that killed 6,300 and left nearly 800,000 people displaced.[30] Aside from this direct harm to people, both agriculture and ecosystems were affected, especially in coastal zones.[31] An estimate of 260,000 tons of rice production was lost due to strong winds and continuous inundation.[32] Haiyan's storm surges were exceptionally high.[33,34] The sea level rise associated with climate change can increase the height of storm surges.[35] For the Philippines, the sea level was already 30 centimetres higher than that in 1993.[36] A storm surge in Tacloban was found to reach a maximum inundation height of 7 metres above sea level.[34] Along Samar Island, the surge contaminated surface water and deeper aquifers that supply water to local communities. It will take many years to recover.[37]

The Sahel and the semi-arid drylands of East Africa are in many ways emblems of climate change vulnerability. The regions have faced challenges such as crop and livestock losses, food insecurity, displacement, cultural losses including traditional livelihood systems, and conflict. Many of these challenges are caused by climate variability and exacerbated by climate change. At the beginning of 2015 an estimated 20.4 million people were food insecure as a result of ongoing drought mostly in Niger, Nigeria, Mali, and Chad where conflict and poverty compound food insecurity.[38] The Sahel seesaws between drought and flood events, and increased drying temperatures have partially offset the recovery of rainfall since

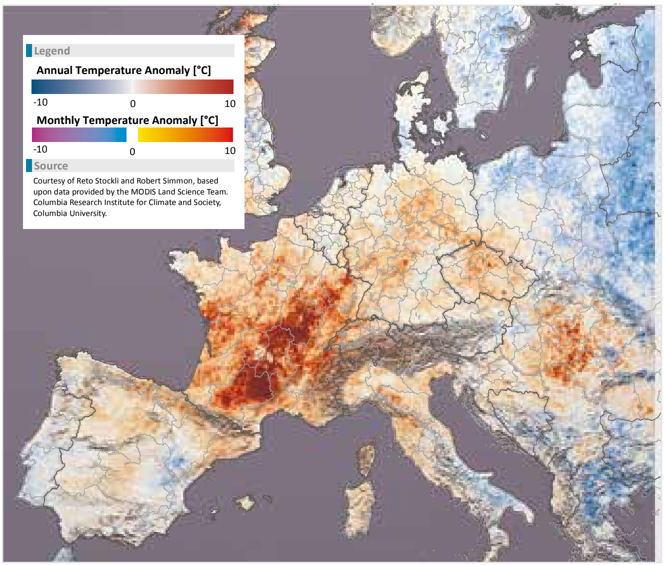
Loss and damage to people and properties due to Typhoon Haiyan



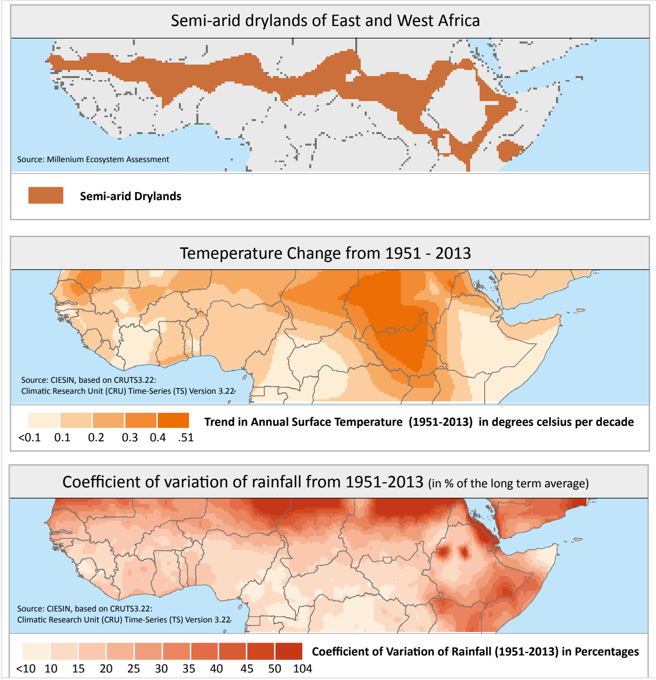
the great drought of the 1980s. During the same period in much of East Africa, rainfall trends have declined.[39-42]

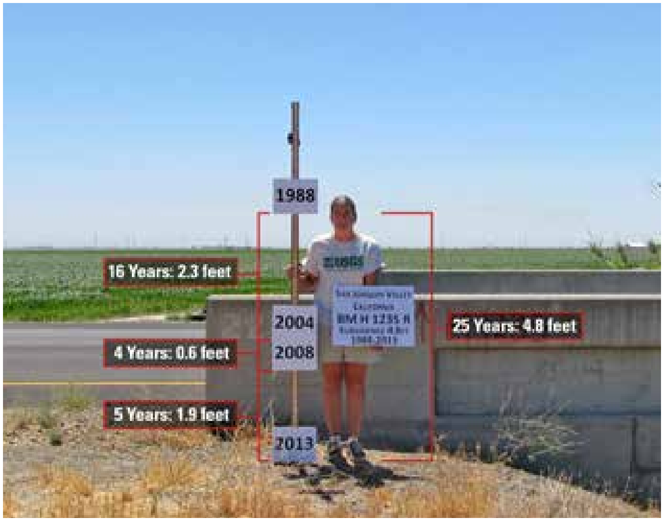
From 2012 through 2015, California experienced the most severe drought in the last 1,200 years.[43] A range of scientific research has suggested a link between anthropogenic warming and an increase in the occurrence, strength, and length of high impact droughts in this region of the U.S. The economic impacts of drought on California agriculture in 2015 alone were estimated at US$2.7 billion.[44] About 60 per cent of water supply to California comes from groundwater.[45] The groundwater storage has been overdrawn for many decades. The long period of drought drastically increased groundwater withdrawal and, as a result, lowered the groundwater level and storage capacity.[46] Reduced rainfall also means less replenishment for the underground aquifer. This has led to an irreversible aquifer-system compaction, causing the land to subside. In 2014 a large area measured 96 kilometres long subsided further by 33 centimetres as a result of this recent drought.[47]

Temperature anomaly in the Central and Western Europe



Temperature and rainfall variation in East and West Africa





Land subsidence in California from 1988 to 2013
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Reducing risks associated with climate change

The Sendai Framework for Disaster Risk Reduction 2015-2030 is an internationally agreed framework that guides the risk management of multiple hazards including those associated with climate change.[48] A number of risk management strategies and instruments described in the framework can be considered as transitional through mitigation and adaptation to loss and damage. These include: risk reduction, risk retention, risk transfer, and approaches to specifically deal with slow-onset events. Applying these strategies, and following through, could reduce loss and damage by enabling management through adaptation.

Risk reduction measures are implemented before the advent of a weather event or climatic process to prevent loss and damage and can be structural or non-structural.[49] For example, sea level rise is considered a slow-onset threat and often not apparent until a convergence of circumstances delivers an extreme event. Most recent projections of sea level suggest a global average rise of up to 1.30 metres by 2100.[50] Further research suggests that global average sea level will continue to rise for at least 5,000 years.[51] These projections of rise in sea level may seem gradual and in a distant future. However, when extreme low pressure, high tides, an unobstructed angle of approach, strong winds, and a long fetch converge to produce extreme storm surges, ever rising sea level becomes a more relevant part of coastal life. This is what happened in the case of Typhoon Haiyan and also when Hurricane Sandy hit the Greater New York City region in 2012.[52] New York City had been implementing an adaptation strategy before the event, since 2008, so when Sandy arrived decision makers could reduce risks through strategic actions during the event.[52]

Risk transfer is a practice of formally or informally redistributing the risk of financial consequences for particular negative events from one party to another.[53] The variety of risk transfer mechanisms, such as insurance, form an essential part of disaster risk management strategies. Insurance tools play a role in preventing and managing loss and damage caused by events which cannot be foreseen when and where they occur.[54] Insurance is used to address the consequences of extreme weather events but is not generally feasible for slowly developing and foreseeable events that happen with high certainty under different climate change scenario.[55] Insurance is not optimal for events that occur with very high frequency, such as recurrent inundation of flood plains.[56]

Risk retention refers to approaches that allow country to "self-insure" against climate stressors by means of its own social, economic, cultural, and other resources.[49] For example, social protection measures can help societies to bounce back from the onset of unexpected severe weather events, and build resilience of the population to slow onset climatic processes. Establishing financial reserves to cushion the unexpected financial consequences from climate change impacts help repair the damage, and help societies recover from losses.[49] Risk retention works more effectively when implemented together with other risk management approaches.[56]

Video: **Interview with Koko Warner, United Nations University**

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Progress on addressing Loss and Damage

In 2013 the UNFCCC specifically addressed loss and damage associated with the adverse effects of climate change by establishing the Warsaw International Mechanism on Loss and Damage. The Paris Agreement that emerged from the 2015 UNFCCC Conference of the Parties strongly recognised loss and damage by making the Warsaw International Mechanism a permanent institution. The Agreement calls on Parties to recognise "the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage".[57]

The Paris Agreement proposes several areas for international cooperation and facilitation to enhance understanding, action, and support including early warning systems; emergency preparedness; slow onset events; events that may involve irreversible and permanent loss and damage; comprehensive risk assessment and management; risk insurance facilities, climate risk pooling, and other insurance solutions; non-economic losses; and resilience of communities, livelihoods, and ecosystems.[57]

Increasing international efforts to support developing countries to avert, minimise, and address loss and damage including through the Warsaw International Mechanism will be important. The UNFCCC, the 2030 Agenda for Sustainable Development, and the Sendai Framework for Disaster Risk Reduction provide a framework through which loss and damage can be addressed. Institutional and legal frameworks that are applicable at various scales will also be essential.

To implement comprehensive risk management strategies that reduce and avert loss and damage, decision makers will need a better understanding of the potential range, magnitude, and location of future climate change impacts. Enhancing understanding of the role of ecosystem services to human well-being is crucial to informing policy responses.

When ecosystems are not functioning at optimal standards, their provisioning capacity becomes unstable and their regulating of Earth systems can fail.[58] Averting loss and damage must include ways to safeguard ecosystems and their services that underpin human abilities to protect against loss and damage. The research community has a critical role to play in developing innovative tools and measures to address loss and damage. But the most important role is to deliver capacity to communities at the frontline of ecosystem destruction who need substantial investment and incentive to avert damage to and loss of ecosystems and their services. With the growing scientific knowledge on the residual impacts of climate change, it is imperative that societies anticipate loss and damage, and are prepared well enough to avert it.

Video: **Interview with Saleemul Huq at COP 21 in Paris**

Video Link: https://www.youtube.com/watch?v=kJI8F_6mGmY

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