



Climate
Risk Index

Climate Risk Index 2025

Who suffers most from extreme weather events?

Published by **GERMANWATCH**



Authors:

Lina Adil, David Eckstein, Vera Künzel, Laura Schäfer

Contributors:

Elena Kemkes, Linus Nolte, Merle Riebandt,
Lydia Weinreich

Editor: Adam Goulston

Layout: DRID

Publisher: Germanwatch e.V.

Publishing date: 12.2.2025

The authors thank Pieter van Breevoort, Regina Below (EM-DAT), Simon Merschroth (PIK), Cornelia Auer (PIK), Barbora Sedova (PIK), Lena Klockemann (GIZ), Britta Horstmann (GIZ), Mirjam Harteisen (GIZ) for their valuable input and feedback during the methodological revision, preparation and review of this report. We extend our big thanks to our Germanwatch colleagues Jan Burck, Thea Uhlich, Lisa Schultheiß, Rixa Schwarz, Christoph Bals, Bertha Argueta, Christine Noel, Petter Lydén, Stefan Küper, Katarina Heidrich, Christoph Bornemann, Janina Longwitz, Christian Marquardt, Tobias Regesch, Merle Neehuis, Tobias Rinn for their valuable input and support during the preparation and review of the report.

The authors are responsible for the content of this publication.

This project measure “Revision, preparation and publication of the Germanwatch Global Climate Risk Index” is funded by the International Climate Initiative (IKI) on behalf of the German Federal Foreign Office (FFO). Germanwatch is implementing the project measure with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (giz) GmbH through the Climate Diplomacy Action Programme (CDAP). The IKI is a funding programme by the German Federal Government established in 2008 to promote climate action and biodiversity conservation.

Supported by:



on the basis of a decision
by the German Bundestag

Contents

Key Messages 6

1

Introduction 8

1.1 Qualifier: How to read the Index 10

2

Key results of Climate Risk Index 2025 11

2.1 Countries most affected in 1993–2022 11

2.2 Countries most affected in 2022 13

2.3 Detailed look at relevant events 16

3

Interpreting the CRI results 22

3.1 Unusually extreme events, continuous threats, and the new normal 22

3.2 How Global South and Global North countries are affected 23

3.3 Data gaps as a challenge to determining climate risks and impacts: A solution approach 25

4

Linking extreme weather events and climate change 30

4.1 Current scientific status of attribution science 30

4.2 Attribution of CRI event types to climate change 31

5

CRI context: Status quo of international climate and resilience policy 35

5.1 The large emissions gap 36

5.2 Status quo of international resilience building efforts 36

5.3 Dire outlooks for resilience finance: Countries urgently need to increase finance for the most vulnerable 38

5.4 The climate–security nexus 39

6

Method 41

6.1 Objectives and scope 41

6.2 Components and indicators 42

6.3 Calculating the CRI score 43

6.4 Time frames 45

6.5 Limitations of the index 45

Annex 51

References 66

List of abbreviations

AF	Adaptation Fund
AR6	IPCC Sixth Assessment Report
BRICS	Brazil, Russia, India, China, South Africa
C3S	Copernicus Climate Change Service
COP	Conference of the Parties
CRI	Climate Risk Index
DPO	UN Department of Peace Operations
DPPA	UN Department of Political and Peacebuilding Affairs
EM-DAT	Emergency Events Database
FRLD	Fund for responding to Loss and Damage
GBV	Gender based violence
GDP	Gross domestic product
GGA	Global Goal on Adaptation
GHG	Greenhouse Gas emissions
HDI	Human Development Index
ICJ	International Court of Justice
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
L&D	Loss and Damage
LDCs	Least Developed Countries
LLDCs	Least Developed Land-Locked Countries
MHEWS	Multi Hazard Early Warning Systems
NAPs	National Adaptation Plan
NCQG	New Collective Quantified Goal
ND GAIN	Notre Dame Global Adaptation Initiative
NDCs	Nationally Determined Contributions
PPP	Purchasing Power Parity
SB	Subsidiary Bodies
SDGs	Sustainable Development Goals
SIDS	Small Island Developing States
UNDP	UN Development Programme
UNDRR	United Nations Office of Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	UN General Assembly
UNOCHA	United Nations Office for Humanitarian Assistance
UNSG	United Nations Secretary-General
WMO	World Meteorological Organization

List of figures and tables

Figure 1: The 10 countries most affected in 1993–2022	11	Table 1: Overview of fatalities, affected people, and economic damage for the six event types in 2022	17
Figure 2: The 10 most affected countries in 2022	13	Table 2: Overview of fatalities, affected people, and economic damage for the six event types for 1993–2022	17
Figure 3: Fatalities by event in 2022	18	Table 3: CRI Indicator Overview	42
Figure 4: Fatalities by event in 1993–2022	19	Table 4: Climate Risk Index time frames	45
Figure 5: Number of people affected by event in 2022	20	Table 5: Climate Risk Index for 1993-2022 (annual averages)	51
Figure 6: Number of people affected by event in 1993–2022	20	Table 6: Climate Risk Index for 2022	58
Figure 7: Economic loss by event in 2022	21		
Figure 8: Economic loss by event in 1993–2022	21		
Figure 9: 10 countries most affected in 1993–2022 (HDI-corrected)	28		
Figure 10: 10 countries most affected in 2022 (HDI-corrected)	29		
Figure 11: Calculating the CRI score	44		
Figure 12: CRI indicators and weighting	44		

Key Messages

- I. The Climate Risk Index (CRI) ranking indicates that, in 1993–2022, **Dominica, China, and Honduras** were the countries most affected by extreme weather events' impacts.
- II. The ranking shows **Pakistan, Belize, and Italy** as the most affected by extreme weather events' impacts in 2022.
- III. From **1993 to 2022, 765,000+ people died worldwide and direct losses of nearly USD 4.2 trillion (inflation-adjusted)** directly resulted from 9,400+ extreme weather events.
- IV. **Floods, storms, heat waves, and drought** were the most prominent impacts from short- and long-term perspectives. From 1993 to 2022, storms (35%), heat waves (30%), and floods (27%) caused the most fatalities. Floods were responsible for half of the people affected. Storms caused, by far, the most significant economic losses (56% or USD 2.33 trillion inflation-adjusted), followed by floods (32% or USD 1.33 trillion).
- V. The most affected countries in the long-term index for 1993–2022 can be divided into two groups: (1) Countries most affected by highly unusual extreme events (**e.g. Dominica, Honduras, Myanmar, Vanuatu**) and (2) countries affected by recurring extreme events (**e.g. China, India, the Philippines**). Climate science clearly shows that climate change increases the risk for both categories and contributes to transforming uncommonly extreme events into continual threats, creating a 'new normal.'
- VI. **The CRI shows that all countries are affected.** Seven of the 10 most affected countries in 2022 belonged to the high-income country group¹. This clearly indicates that, while the coping capacities of high-income countries significantly exceed those of lower-income countries, higher-income countries should also increase their climate risk management. Over the long term, the ranking shows that extreme weather events' impacts particularly affect Global South countries. With five countries, the lower middle-income group is the largest country group among the 10 most affected countries, including three Small Island Developing States/Least Developed Countries, where coping capacities are significantly lower.

VII. The CRI ranking is based on the best publicly available historical data set on the extreme weather events' impacts. **Extreme weather events and their impacts are often underreported in Global South countries** because of data quality and coverage challenges and data gaps. As a result, this ranking may less accurately capture these impacts and, therefore, how Global South countries are affected.

VIII. Human-induced climate change affects the frequency and intensity of extreme weather events and leads to widespread adverse climate impacts. The latest climate science and significantly improved attribution science suggest climate change's influence on extreme weather events is 'on the same level of scientific confidence as the statement that human influence has warmed the climate.'²

IX. COP29 failed to deliver an ambitious New Collective Quantified Goal (NCQG) on Climate Finance. Considering the identified needs, and the great urgency of the climate challenges that developing countries face, the USD 300 billion annually by 2035 can only be seen as the bare minimum response to the escalating climate crisis. The NCQG also failed to include measures to address loss and damage. This gap must be filled as soon as possible. This situation is even more worrying given the extensive gaps in adaptation finance compared with the needs and commitments (even if progress was made). Substantially increased support by high-emitting countries and other polluters is needed for the most vulnerable in addressing climate impacts.

X. The CRI shows that a **lack of ambition and action in mitigation leads to being strongly affected**, even in high-income countries. It is in the interest of high-income and highly emitting countries to ramp up mitigation action, including higher climate targets and such action's implementation, with new nationally determined contributions (NDCs), to stay below (or as close as possible to) 1.5°C warming and keep impacts at a manageable scale.

1 World Bank 2024.

2 Otto 2023a.

1 Introduction

Scorching heat, heavy rainfalls, raging wildfires, deadly floods, and devastating storms – the manifestations of extreme weather events have become an all-too-common new reality worldwide.

As humanity navigates this warming planet’s rising tides and intensifying fires, the impacts of extreme weather events are already reshaping economies, societies, and ecosystems at an alarming pace. This year’s relaunch of the Climate Risk Index (CRI) underscores the severe toll of inaction and underscores the escalating human and economic costs. From 1993 to 2022, more than 765,000 people lost their lives worldwide and direct losses of nearly USD 4.2 trillion (inflation-adjusted) directly resulted from more than 9,400 extreme weather events.

The great number of such events in 2024 is a sobering illustration of the climate crisis’ new phase, as extreme events have become the ‘new normal.’ In the Amazon, the worst wildfires since 2005 consumed 22 million hectares—an area almost the size of the entire United Kingdom. Torrential rains and flooding in Brazil, which is set to host COP30, displaced more than 580,000 people and claimed many lives. Deadly heat waves swept across Asia, the Mediterranean, and Mexico, resulting in numerous fatalities and devastating impacts on the population and ecosystems. In September, deadly rains hit West and Central Africa, also bringing fatalities and displacing hundreds of thousands. In the United States, hurricanes Helene and Milton, fuelled by record Gulf of Mexico temperatures, killed hundreds and left

trails of destruction. And in October, in just minutes, heavy downpours caused flash floods in eastern Spain, sweeping away nearly everything in their path. More than 200 people died and thousands of livelihoods were devastated.

The World Economic Forum ranked extreme weather events as the second most pressing short-term global risk for 2025, projecting them to become even more severe and the leading threat within the next decade¹. As the world approaches the +1.5°C temperature threshold sooner than anticipated by the latest Intergovernmental Panel on Climate Change (IPCC) report, the associated irreversible impacts and risks are increasingly evident² and disproportionately affecting the most vulnerable people and countries. These climate impacts, both from extreme events and slow-onset processes, could fundamentally reshape societal trajectories.³ Moreover, there are increasingly clear indications that we are entering a ‘critical and unpredictable phase’⁴ of the climate crisis. It is critical because in the past two years, various historical air and sea surface temperature records and ice extent records have been broken many times over.⁵ The Earth recorded its hottest day ever on 22 July 2024, and 2024 was the hottest year ever recorded and the first year with an average temperature above 1.5°C (Copernicus 2025). The years 2023 and 2024 were, by far, the two years with the highest ever global sea surface temperatures.^{6,7} As anthropogenic global warming continues, critical climate systems are at risk of approaching tipping points.⁸ Regarding the possibility of self-reinforcing feedback effects and

1 World Economic Forum 2024.

2 Kotz et al. 2024.

3 Lam and Majsak 2022.

4 Ripple and Wolf 2024.

5 ibid.

6 Copernicus 2024.

7 Copernicus 2023.

8 McKay et al. 2022.

the consequences of tipping points, however, science can only give scenario probabilities and not a single, definite prognosis. Current studies show the North Atlantic is already weakened from climate change and may be approaching a tipping point.⁹ Similarly, some major coral reefs may already have passed their tipping points and certain coral species are now living at or near their thermal limits because of their narrow temperature tolerance.¹⁰ For forest systems, the possibility of the Amazon forest soon reaching a tipping point, triggering large-scale collapse of the forest, has raised global concern.¹¹ Studies have concluded that such a collapse is unlikely within the 21st century, but interactions and synergies among disturbances (e.g. frequent extreme hot droughts and forest fires) could trigger unexpected ecosystem transitions even in the forest system's remote and inner parts.¹²

Projections of economic losses due to climate change are also highly alarming. By 2050, climate change could cost the global economy up to USD 38 trillion annually. This cost is primarily through losses in agriculture, infrastructure, and public health.¹³ In absolute and relative terms, the Global South¹⁴ is particularly affected. Income losses in countries least responsible for climate change are likely to be 60% higher than in higher-income countries. Increasing climate change impacts primarily result in increased costs for adaptation and addressing loss and damage (L&D). The UN Environment Programme (UNEP) Adaptation Gap Report 2024 indicates USD 215–387 billion is needed annually for effective adaptation. Moreover, current estimates of climate finance needs for residual L&D in developing countries were USD 116–435 billion in 2020, rising to

USD 290–580 billion in 2030, USD 551–1,016 billion in 2040, and USD 1,132–1,741 billion in 2050.^{15, 16} Beyond economic losses, the geopolitical impacts on human security are also becoming more pronounced. In regions already vulnerable to conflict, such as East Africa, climate impacts are exacerbating existing challenges, with effects such as human insecurity, resource competition, and social tensions.

However, the path forward is not without hope. Effective climate adaptation and disaster risk management strategies have successfully reduced risks. Examples exist from around the world. Owing to effective risk prevention and adaptation, cyclone-related mortality in Bangladesh has fallen more than 100-fold in the last 40 years, from 500,000 deaths in 1970 to 4,234 in 2007. In Ahmedabad, India, a deadly heat wave in 2010 spurred a Heat Action Plan, which has saved lives and been replicated by more than 30 other Indian cities.¹⁷ These examples highlight the potential of targeted, localised adaptation and disaster risk management strategies to reduce climate-related deaths, build resilience, and alleviate economic burdens.

The CRI findings, viewed in this broader context, are a call to action and a reminder of the heavy toll extreme weather events are inflicting on communities and nations worldwide. Despite the urgent need for change, ambition for reducing emissions is alarmingly low. Fossil fuel companies and states continue to make billions in profit each day,¹⁸ only to reinvest it into fossil operations and lobbying to undermine climate action. Phasing out fossil fuels remains the first line of defence in the face of escalating climate impacts. Nations must

9 Schultheiß 2023a.

10 Schultheiß 2023b.

11 IPCC 2021a.

12 B.M. Flores et al. 2024.

13 Kotz et al. 2024.

14 **Disclaimer on the use of country grouping terms.**

1) The term 'Global South' has no fixed definition, nor is there a definitive list of countries it comprises. Referencing the G77 – a coalition of 134 nations in Latin America, Africa, Asia, and Oceania – which collectively refers to itself as the Global South is one way to identify such countries. In this report, the use of Global South is a deliberate effort to decouple the discourse on development from traditional, unsustainable growth models. However, it does not suggest that all traditionally classified developing countries are homogenous or can be grouped into one category. Instead, the term highlights a shared set of vulnerabilities and challenges these countries face, despite their vast economic, social, and political differences.

2) UNFCCC Context: When referring to developed and developing countries in the context of the UNFCCC, the distinction follows the Annexes classification, though this is solely for referencing purposes. 3) For the CRI results analysis, an income-based classification is applied, using the World Bank classification (July 2024) of low, lower-middle, upper-middle, and high-income groups. Using economic distinction is methodologically relevant, as the degree of economic effect is a key indicator in the CRI.

15 Markandya/ González-Eguino 2018: L&D finance needs estimates are based on a scenario where equilibrium temperatures rise by 2.5 to 3.4°C.

16 Markandya and González-Eguino 2018.

17 Gee 2019.

18 Carrington 2022.

immediately halt new fossil fuel projects, eliminate fossil fuel subsidies, and strengthen their commitments, such as by tripling renewable energy capacity, doubling energy efficiency by 2030, and drastically reduc-

ing methane emissions. In parallel, adequate climate finance and support for the most vulnerable countries are essential for ensuring resilience and equity amid escalating climate impacts.

1.1 Qualifier: How to read the Index

The CRI analyses how climate-related extreme weather events affect countries and, thereby, measures the consequences of realised risks for countries. This backward-looking index ranks countries by their economic and human effects (fatalities and affected, injured, and homeless people) with the most affected country ranked highest. The CRI aims to visualise how extreme weather events affected countries at a point two years before publication¹⁹ and over the preceding 30 years. Because of limited data availability on economic and human effects, it is not possible to include slow-onset processes in this index. The index is based on data from the EM-DAT international disaster database, World Bank, and International Monetary Fund (IMF). It examines absolute and relative impacts to create a country ranking based on six indicators: economic losses, fatalities, affected people – absolute and relative (see chapter 6 for further details on the methodology).

The CRI aims to contextualise international climate policy debates and processes with a view to the climate risk countries are facing. This index simplifies the aggregation and understanding of climate-related extreme weather events' impacts across different regions and periods. The countries that extreme weather events most strongly impact are ranked highest and should consider the CRI results as a warning sign of their being at risk of frequent events or rare and extraordinary extreme events.

Climate science and significantly improved attribution science clearly show that climate change is affecting the intensity, frequency, and duration of many extreme events. Such events' impacts on, for example, economic costs and human health, also can more clearly be attributed to climate change.²⁰

¹⁹ Due to the methodological revision, this CRI edition is published in February 2025.

²⁰ Otto 2023a.

2

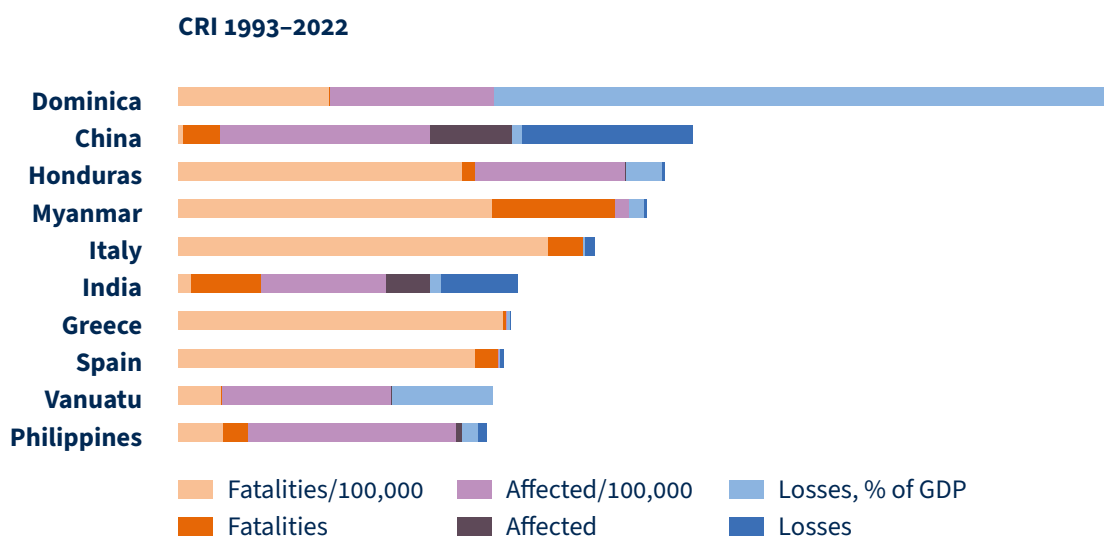
Key results of Climate Risk Index 2025

Climate change’s consequences are visible worldwide, manifesting in the increased intensity and severity of extreme weather events. Between 1993 and 2022, more than 9,400 such events directly caused more than 765,000 lost lives worldwide and direct losses of nearly USD 4.2 trillion (inflation-adjusted).

2.1 Countries most affected in 1993–2022

Dominica, China, and Honduras were the most affected countries from 1993 to 2022, followed by **Myanmar, Italy, and India**. Figure 1 shows the 10 most affected countries in the three-decade period, with their specific results for the six indicators analysed.

Figure 1: The 10 countries most affected in 1993–2022



Dominica (1st) ranks highest because of its high relative economic losses, as well as high relative fatalities and affected people. The island is regularly affected by tropical cyclones, such as Hurricane Debby in August 2000, Hurricane Omar in October 2008, Tropical Storm Erika in August 2015, Hurricane Maria in 2017, and Hurricane Dorian in August 2019. Dominica is one of the more hurricane-prone countries in the Caribbean, averaging a damaging storm about every two years. Hur-

ricane Maria was exceptionally severe, causing damage up to USD 1.8 billion, equalling 270% of the small island’s gross domestic product (GDP).

China (2nd) ranks second because of its high absolute loss and high relative numbers of affected people. China also shows considerably high numbers for absolute fatalities and people affected. China has faced numerous extreme weather events with substantial

societal, economic, and environmental impacts. Recurrent major floods, especially along the Yangtze River, have caused extensive damage, including the 1998 and 2016 floods that displaced hundreds of thousands and devastated agriculture and infrastructure. The country's coastal regions have endured powerful typhoons, such as Typhoon Fred in 1994 and Typhoon Saomai in 2006, which caused severe destruction and loss of life, with storm surges and landslides compounding the damage. Heat waves in northern and eastern China led to water shortages and wildfire risks, while droughts, such as in 1994, reduced crop yields and strained water resources in heavily populated areas. There were more than 600 extreme weather events during the examined period, resulting in losses of USD 706 billion (adjusted for inflation) and at least 42,000 fatalities.²¹

Honduras' rank (3rd) owes to its high number of relative fatalities and affected people, and its absolute fatalities and relative losses. Honduras is one of the poorest countries in the Western Hemisphere and vulnerable to climate change because of its high exposure to climate-related hazards (hurricanes, tropical storms, floods, droughts, and landslides) that devastate crops and critical infrastructure. In 1998, Hurricane Mitch destroyed an estimated 70% of the country's crops and infrastructure, causing more than 14,000 deaths and USD 7 billion in damage, significantly setting back the country's development process.²²

Myanmar (4th) has had exceptionally high absolute and relative numbers of fatalities. Smaller contributions to its ranking come from the relative values of affected people and economic losses. Myanmar is at risk of several natural hazards, including extreme temperatures, drought, cyclones, flooding and storm surges, and heavy rainfall events. Extensive flooding continues to overwhelm and displace populations in several regions. Cyclone Nargis in 2008 was particularly devastating, killing nearly 140,000 people in floods after the torrential rainfall. The event caused USD 5.7 billion in damage.

Italy (5th) ranks high mainly due to its high absolute and relative numbers of fatalities. The country has faced several extreme heat waves, especially in the previous 20 years, causing severe human and econom-

ic losses. The years 2003 and 2022 were notable for their exceptionally high numbers of fatalities associated with scorching temperatures and damage from droughts, wildfires, decreased agricultural productivity, infrastructure damage, and the strain on health services and energy grids. Heavy flooding, especially along the Po River, caused extensive damage, such as in the 1994 and 2000 Piedmont floods. Overall, Italy suffered economic losses of nearly USD 60 billion and more than 38,000 fatalities.

India (6th) shows high absolute fatalities and economic losses, as well as high absolute and relative numbers of people affected. The country has faced a variety of increasingly frequent extreme weather events, including floods, heat waves, cyclones, and drought. Floods and landslides resulting from heavy monsoons displaced millions and damaged agriculture. And cyclones devastated coastal areas, underscoring India's diverse climate risks. Notable events included the 1998 Gujarat and 1999 Odisha cyclones, Cyclones Hudhud and Amphan in 2014 and 2020, the 1993 floods in northern India, Uttarakhand floods of 2013, and severe floods in 2019. Recurring and unusually intense heat waves, all with temperatures around 50°C, claimed many lives in 1998, 2002, 2003, and 2015. There were more than 400 extreme weather events in the three decades, causing losses of nearly USD 180 billion (inflation-adjusted) and at least 80,000 fatalities.²³

Greece (7th) ranks high mainly because of its high absolute and relative number of fatalities. The country experienced a series of floods, wildfires, and heat waves from 1993 to 2022. It was hit especially hard by the highly unusual European heat wave in 2022, which led to widespread deaths. Wildfires – such as in 1998, 2007, and 2022 – have been a recurring threat, affecting livelihoods and causing severe agricultural damage. Total economic losses amounted to more than USD 7 billion over the 30-year period and more than 3,400 people lost their lives.

Spain (8th) also ranks high mainly because of its high absolute and relative terms number of fatalities. From 1993 to 2022, the country experienced many extreme heat waves, which led to substantial human and economic impacts. The years 2003 and 2022 were marked

21 Centre for Research on the Epidemiology of Disasters 2024.

22 World Bank 2024a.

23 Centre for Research on the Epidemiology of Disasters 2024.

by extremely high death tolls due to intense heat, while widespread damage was caused by droughts, wildfires, reduced agricultural yields, infrastructure strain, and overwhelming pressure on healthcare systems. Highly unusual events include the 1999 drought in southern Spain and heavy floods in 2019 in the southeast, resulting in casualties and massive losses to agriculture, property, and infrastructure. Over the three decades, Spain incurred about USD 25 billion in economic losses, with nearly 27,000 fatalities.

Vanuatu's rank (9th) owes to its high number of relative economic losses and affected people, as well as relative fatalities. As a Pacific island nation, Vanuatu has endured repeated cyclones, which have threatened homes and livelihoods. Cyclone Pam in 2015 was particularly devastating, destroying most food crops and affecting over two-thirds of the country's population.²⁴ Total damage incurred through Pam alone amounted to nearly USD 580 million, or around 60% of the country's GDP.

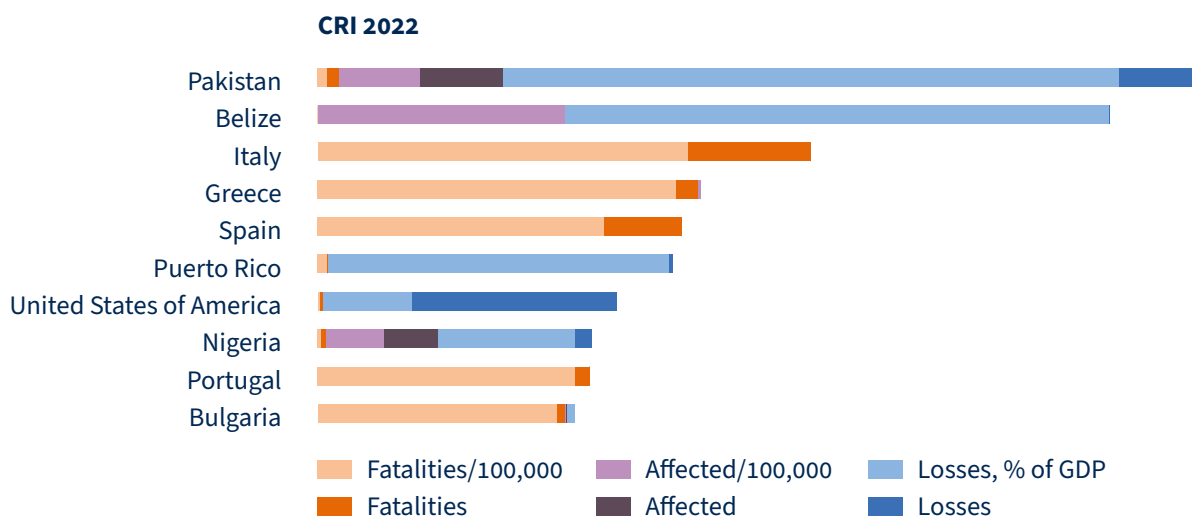
The Philippines (10th) ranks high mainly because of its relative number of people affected, accompanied by relative fatalities and economic losses. The Philip-

ines also shows considerably high numbers in absolute terms. Because of its geographical location, the archipelagic country is regularly hit by typhoons, such as Ketsana in 2009, Bopha in 2012, Hayan in 2013, Mangkhut in 2018, and Goni in 2020. Typhoon Haiyan in 2013 was the strongest recorded typhoon in the Philippines and one of the strongest ever recorded globally, killing more than 7,000 people, devastating nine regions, and resulting in 1.1 million homes damaged and agricultural and infrastructure damage of USD 802 million.²⁵ Total damage from Haiyan alone amounts to USD 13 billion. Apart from these exceptionally devastating typhoons, the Philippines was hit by multiple other tropical cyclones in every year between 1993 and 2022, making these events a continuous threat. A total of 372 extreme weather events in 1993–2022 caused USD 34 billion in (inflation-adjusted) losses.²⁶

2.2 Countries most affected in 2022

The CRI ranking indicates **Pakistan, Belize, and Italy** were the most affected countries in 2022, followed by **Greece, Spain, and Puerto Rico**. Figure 2 shows the 10 most affected countries in 2022, with the specific results relating to the six CRI indicators analysed.

Figure 2: The 10 most affected countries in 2022



Pakistan (1st) ranks highest mainly because of exceptionally high relative economic losses. Also, in absolute terms, economic losses were high, as well as the num-

bers of affected people in absolute and relative terms. Pakistan suffered from devastating floods, landslides, and storms from June to September 2022 owing to a

24 Reliefweb 2015.

25 World Bank 2024b.

26 Centre for Research on the Epidemiology of Disasters 2024.

heavy monsoon season with torrential rainfalls. The floods, described as the worst in the country's history, affected more than 33 million people, leading to more than 1,700 fatalities and causing accumulated damage of nearly USD 15 billion.²⁷ A national state of emergency was declared on 25 August 2022 because of the flooding, as 10% of the country was inundated.²⁸ In October 2022, the World Bank estimated reconstruction would cost over USD 16 billion,²⁹ making this one of the costliest disasters in world history. Climate change likely increased extreme monsoon rainfall by 50%, flooding vulnerable communities in the country.³⁰

An intense heat wave spanning March to the end of May 2022, reaching record temperatures of 49.5°C in the city of Nawabshah, immediately preceded the severe floods.³¹ The extreme temperatures, which also spread to India and Bangladesh, claimed more than 90 lives

across the three countries. A real-time extreme event attribution study by the World Weather Attribution project showed that climate change made the heat wave 30 times more likely.³² This finding underscores the growing significance of compound climate events (Zscheischler et al., 2020).

Belize (2nd) ranks second because of exceptionally high relative economic losses and affected people. Hurricane Lisa (Category 1) hit the country on 2 November 2022, bringing heavy rainfall that caused extensive and destructive flooding across much of the country. Dangriga and Belize City were the most affected regions. The hurricane significantly damaged houses, property, roads, drains, public infrastructure, and livestock.³³ Nearly 5,000 homes were damaged, with more than 172,000 people affected, many of whom sought refuge in state-managed shelters.³⁴ The economic loss was estimated at over USD 104 million.³⁵

An extraordinarily persistent heat wave affected **Italy** (3rd), **Greece** (4th), **Spain** (5th), **Portugal** (9th), and **Bulgaria** (10th), and large parts of the European continent. The Copernicus Climate Change Service indicated 2022 had the hottest summer ever recorded in Europe (at that time).³⁶ For most of southwestern Europe, the average daily temperature in 2022 was the highest recorded since 1950. Periods with unseasonably warm conditions occurred throughout the year, in some cases reaching extreme highs.³⁷ The prolonged hot and dry weather brought severe drought and wildfires spread across large parts of the continent. The European Drought Observatory called the scorching drought 'the worst in 500 years.'³⁸

Italy (3rd) ranks high mainly because of its high number of absolute and relative fatalities. The number of wildfires by the end of June 2022 was three times the average.³⁹ Rome's temperature reached 40.8°C on 28 June, a record at that time.⁴⁰ In July, 16 cities, including Rome, were put under a red state of alert, the country's

highest heat wave alert for warning of serious health risks. A state of emergency was declared in five northern regions in response to a severe drought in the Po Valley, the worst in 70 years, and later for Tuscany.⁴¹ Scientists concluded that the 2022 Po River drought was the worst of the last two centuries and highly like-

27 *ibid.*

28 Unosat 2022.

29 World Bank 2022.

30 Otto et al. 2022.

31 Centre for Research on the Epidemiology of Disasters 2024.

32 World Weather Attribution 2022a.

33 Reliefweb 2023.

34 Reliefweb 2022.

35 Centre for Research on the Epidemiology of Disasters 2024.

36 Copernicus 2022b.

37 *Ibid.*

38 BBC 2022.

39 The Local Italy 2022.

40 Centre for Research on the Epidemiology of Disasters 2024.

41 The Guardian 2022.

ly to have been triggered by global warming.⁴² More than 18,000 heat wave-related deaths were estimated for Italy.⁴³

Greece's rank (4th) owes to its high number of fatalities, especially in relative terms. Extreme heat reaching 42.1°C, such as in the city of Phthiotis, hit Greece during the summer months, claiming more than 3,000 lives.⁴⁴ Greece also experienced wildfires in several regions during July 2022, affecting 55,000 people.⁴⁵

Spain (5th) ranks high mainly because of its high absolute and relative number of fatalities. In 2022, the country suffered from forest fires in many regions due to extreme heat lasting from mid-June to mid-July, with a total of 3,500 people affected.⁴⁶ The scorching heat reached temperatures as high as 43.2°C, leading to more than 11,000 fatalities.⁴⁷ The early June temperatures were the highest recorded in at least 20 years⁴⁸ and severely impacted harvests, as grain and olive crops dried up.

Puerto Rico⁴⁹ (6th) shows high numbers for relative economic losses. The country was severely hit by Hurricane Fiona in September 2022, which made landfall along the island's southwestern coast. The country suffered its worst flooding since Hurricane Maria in 2017, leading to an island-wide blackout.⁵⁰ Fiona's torrential rainfall stripped road pavement, tore roofs off houses, and washed away at least one bridge. One million people, about 33% of the population, were left without drinking water⁵¹ and the hurricane caused 25 fatalities and damage up to USD 2.6 billion.

The **United States** (7th) ranks high because of high absolute and relative economic losses. Hurricane Ian dealt the country a major blow in September 2022 and was the third costliest tropical cyclone on record worldwide, causing widespread damage in Florida and the Carolinas. Ian claimed almost 150 lives in Florida alone and became the deadliest hurricane to strike that state in almost 90 years.⁵² More than 2.4 million people in Florida lost power during and after the storm.⁵³

Hurricane Nicole hit the same region just six weeks after Hurricane Ian. Despite being relatively weak, Nicole's large size brought widespread heavy rainfall and strong winds, knocking out power and inflicting significant damage in many areas⁵⁴ Eleven people died and economic loss was around USD 1 billion.

A drought accompanied by extreme heat affected all of the United States during 2022, leading to 136 fatalities across the states of Arizona, Nevada, California, Oregon, and Texas. Dozens of temperature records were surpassed. On 1 September, the 53°C recorded in Death Valley marked the hottest September day in world history. The drought was one of the costliest on record, with a range of direct impacts across different regions and industries,⁵⁵ causing nearly USD 23 billion in damage.⁵⁶

Winter storm Elliot hit the United States in late 2022, leading to record temperature drops within a very short period. The states of Montana, South Dakota, and Wyoming registered temperatures as low as -43°C.⁵⁷ Elliot intensified so strongly that it met the definition of a 'bomb cyclone' or rapid cyclogenesis. Most deaths

42 Chelli 2022.

43 Centre for Research on the Epidemiology of Disasters 2024.

44 Ibid.; Deutsche Welle 2022 a, b, c; Euronews 2022.

45 Centre for Research on the Epidemiology of Disasters 2024.

46 Ibid.

47 Ibid.

48 Burgen 2022.

49 Note: Puerto Rico is not an independent national state but an unincorporated US territory. Nevertheless, based on its geographical location and socio-economic indicators, Puerto Rico has different conditions and exposure to extreme weather events than the rest of the United States. The Global Climate Risk Index aims to provide a comprehensive and detailed overview of which countries and regions are particularly affected by extreme weather events. Therefore, Puerto Rico was considered separately from the rest of the United States in the analysis.

50 Ravipti 2022.

51 AccuWeather 2022a.

52 AccuWeather 2022b.

53 Cohen 2022.

54 Beven and Alaka 2023.

55 NOAA 2024.

56 Centre for Research on the Epidemiology of Disasters 2024.

57 Bushard 2022.

were in traffic accidents or from people freezing in snow-covered vehicles.⁵⁸ In the storm's aftermath, nearly 100 people were reported dead.⁵⁹ Through the first half of 2022, the United States was also hit by a series of six tornadoes, with winds speeds up to 275 kph. The storms claimed 30 lives and caused over USD 11 billion in total loss.⁶⁰

Nigeria's (8th) rank owes to high values for relative economic losses and absolute and relative numbers of people affected. In 2022, heavy flooding struck the country following torrential rainfalls from July to the end of October. The floods were among the country's worst ever, causing widespread devastation. More than 600 people died, and more than 3.2 million were affected across 34 states. The disaster displaced 1.4 million people, submerged entire communities, and damaged or destroyed more than 300,000 homes. Critical infrastructure, including roads and farmland, was severely impacted, exacerbating food insecurity and economic hardships. Heavy rainfall, worsened by climate change and the release of water from Cameroon's Lagdo Dam, contributed to the crisis. Many areas, such as Kogi, Bayelsa, and Jigawa states, were especially hard hit, with considerable loss of life and displacement. Humanitarian efforts, led by organisations such as UNICEF, provided emergency supplies, medical aid, and support for displaced people.^{61, 62} The total damage was estimated at over USD 4.2 billion.⁶³

Nigeria also experienced severe drought in 2022, part of a broader climate crisis impacting much of Africa. The drought exacerbated water insecurity in northern regions, including the Sahel, where climate change, conflict, and overuse of resources had already drastically reduced water availability. Millions of children

were particularly vulnerable, with many facing malnutrition and an increased risk of waterborne diseases. Nearly 20 million people were affected.⁶⁴

Portugal (9th) shows high absolute and relative numbers of fatalities. Temperatures in the country in 2022 reached 47°C in a period of extreme heat spanning the end of May to the beginning of September. More than 2,000 fatalities⁶⁵ were estimated. Portugal was hit by wildfires in several regions in mid-July 2022, leading to three fatalities and 187 injured.⁶⁶ The country also experienced drought due to the heat wave beginning in July 2022 and lasting well into the following year.⁶⁷

Bulgaria (10th) experienced high absolute and relative numbers of fatalities, and considerably high relative economic losses. The country also suffered under extreme heat, with persistently high temperatures reaching 39°C in some regions. Health authorities reported a surge in heat-related illnesses, such as heat stroke, hypertension, and dehydration, especially among vulnerable populations, such as older people and children.⁶⁸ The death toll was estimated at more than 1,200 people.⁶⁹

2.3 Detailed look at relevant events

The CRI analyses human and economic effects from extreme weather events on countries, including hydrological, meteorological, and climatological events. The greatest effect results from five event types: floods, storms, heat waves, drought, and wildfires. This section analyses which of these events are responsible for how many fatalities, degree of effect, and economic loss.

58 Brand 2022.

59 Centre for Research on the Epidemiology of Disasters 2024.

60 Ibid.

61 CERF 2022.

62 UNICEF 2022.

63 Centre for Research on the Epidemiology of Disasters 2024.

64 Ibid.

65 Ibid.

66 Ibid.

67 Ibid.

68 Grigorova 2022.

69 Centre for Research on the Epidemiology of Disasters 2024.

Table 1: Overview of fatalities, affected people, and economic damage for the six event types in 2022

Hazard	Fatalities ⁷⁰	Affected ⁷¹ (million)	Economic loss ⁷² (billion USD, inflation-adjusted)
Drought	2,601	107.35	35.65
Flood	8,050	57.55	46.78
Heat wave	61,782	0.029	0
Storm	1,605	16.98	137.43
Wildfire	76	0.245	1.12
Other	418	0.148	0

Table 2: Overview of fatalities, affected people, and economic damage for the six event types for 1993–2022

Hazard	Fatalities	Affected (billion)	Economic loss (trillion USD, inflation-adjusted)
Drought	25,026	1.87	0.273
Flood	205,000	2.91	1.33
Heat wave	225,600	0.005	0.032
Storm	264,000	0.97	2.33
Wildfire	363	0.018	0.163
Other ⁷³	43,248	0.105	0.065

Note that some of these five events are connected or interdependent. Compound events, defined as ‘a combination of multiple drivers and/or hazards that contribute to societal or environmental risk,’ account for many of extreme weather events’ most severe impacts;⁷⁴ For example, most floods can be linked to a storm.⁷⁵ In Belize, for instance, the second most affected country in 2022, a hurricane accompanied by heavy rainfall caused extensive and destructive flooding nationwide.

These combined events caused USD 104 million in economic loss that year. Heat waves, drought, and forest fires are also closely related. Extended periods of elevated temperatures with little precipitation can lead to drought conditions. Prolonged drought and heat waves increase the risk of wildfires.⁷⁶ Climate change exacerbates the occurrence of compound drought and heat waves.⁷⁷ For instance, the 2022 European heat

70 Fatalities include confirmed fatalities directly attributable to the disaster plus missing people whose whereabouts since the disaster are unknown, so they are presumed dead based on official figures. For some events, the proper quantification of fatalities is difficult, especially for heat waves. Most heat-related deaths result from increased risk of less obvious conditions, such as cardiovascular disease. These seemingly indirect deaths are not noted as being ‘heat-related’ at the time and can only be estimated via retrospective statistical methods (<https://ourworldindata.org/disaster-database-limitations>).

71 Affected is the total of injured, otherwise affected, and homeless people.

72 No data available for economic loss related to heat wave and other events.

73 Cold wave, severe winter conditions, mass movement, glacier lake outburst flood.

74 Zscheischler et al. 2020.

75 Yangchen 2021.

76 Hufe and Hortig 2022.

77 Wang et al. 2023.

wave caused widespread drought and wildfires across the continent.⁷⁸

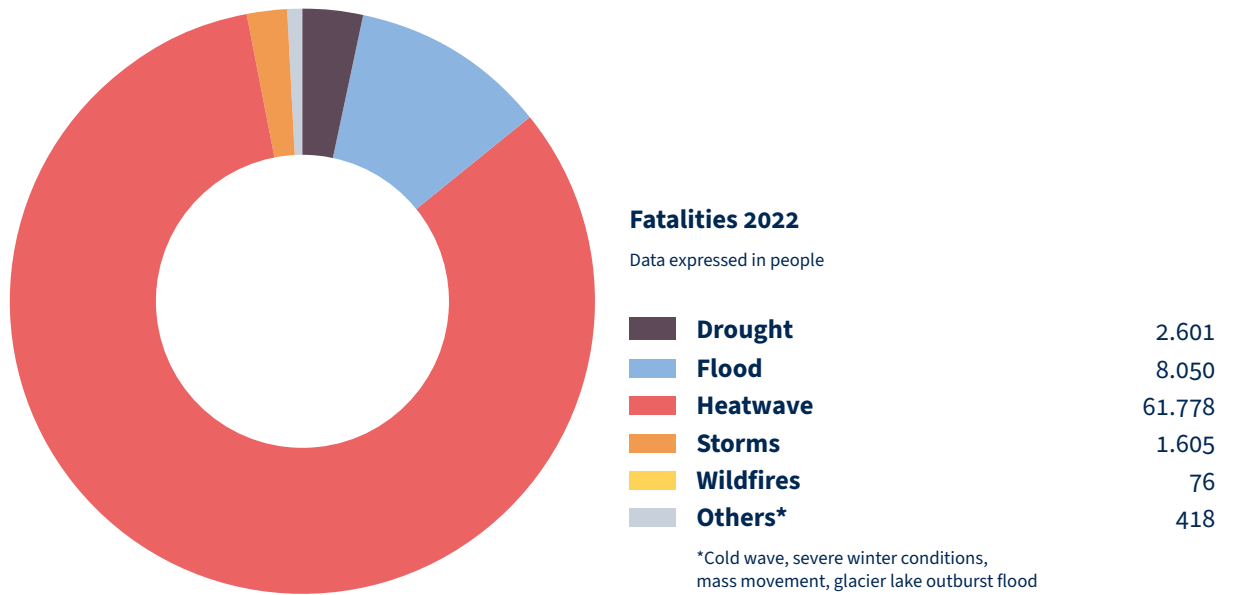
Fatalities

Heat waves were, by far, the deadliest extreme weather events in 2022. Table 1 shows heat waves were re-

sponsible for 83% of fatalities (61,782) in 2022. Floods (8,050) and drought (2,601) were next.

The 2022 European heat wave was the main cause of high fatalities due to heat waves. An unusually persistent heat wave affected Italy (3rd), Greece (4th), Spain (5th), Portugal (9th), and Bulgaria (10th), and large parts of the European continent.

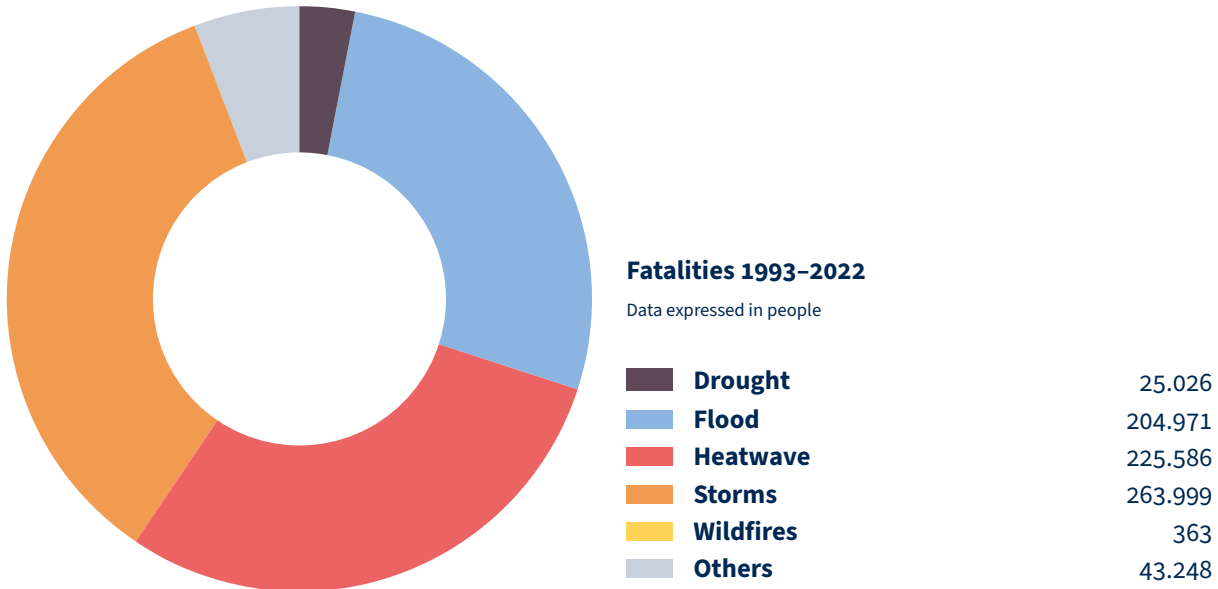
Figure 3: Fatalities by event in 2022



78 Copernicus 2022c.

From the long-term perspective (1993–2022), storms (35%), heat waves (30%), and floods (27%) caused the most fatalities.

Figure 4: Fatalities by event in 1993–2022



Affected people

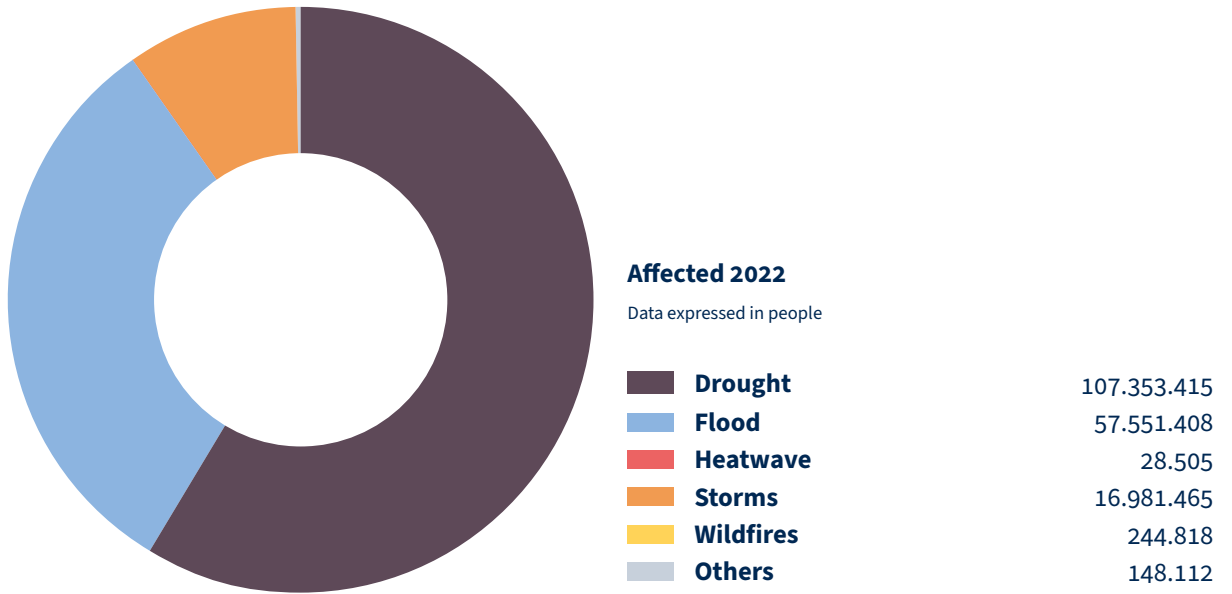
Drought led to the largest number of people affected in 2022 (59%; 107 million people). Those in seven African countries (Uganda, Burkina Faso, the Democratic Republic of Congo, Ethiopia, Nigeria, Sudan, and Niger) were particularly affected.

Floods (32%; 57 million people) and storms (9%; 16.98 million) are next. The floods in Pakistan (1st) were especially damaging, affecting more than 33 million people. A total of 8,168,000 people lost their homes and

were (internally) displaced,⁷⁹ as the floods destroyed 897,014 homes and damaged another 1,391,467.^{80, 81} With this, Pakistan had the highest number of people internally displaced by disasters in 2022.⁸² A lack of drinking water also led to waterborne diseases, including diarrhoea, cholera, dengue, and malaria, as well as skin infections.⁸³ In 2023 alone, disaster displaced another 26.4 million people worldwide, while conflict and violence led to another 20.5 million internally displaced.⁸⁴

79 Internal Displacement Monitoring Centre 2023.
 80 Finance Division Government of Pakistan 2022.
 81 Government of Pakistan 2022.
 82 Internal Displacement Monitoring Centre 2023.
 83 Thomas 2022.
 84 Internal Displacement Monitoring Centre 2024.

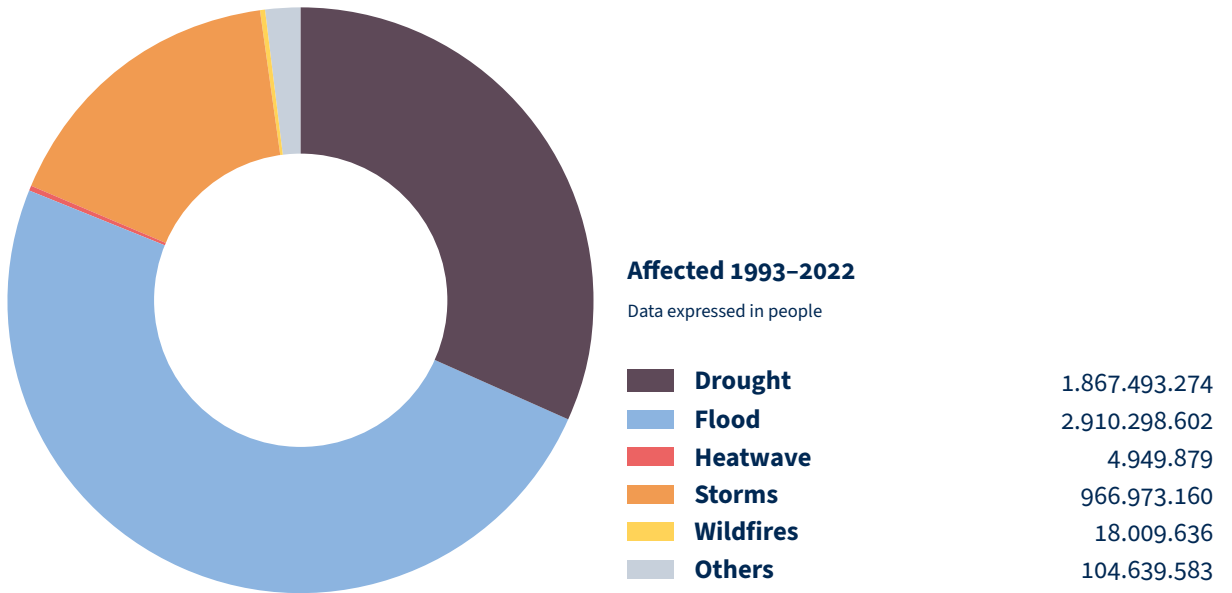
Figure 5: Number of people affected by event in 2022



In the 30-year perspective, floods were responsible for half of all people affected. This was often due to extreme flood events triggered by heavy rainfall following

severe storms, such as in Myanmar in 2008. Drought (32%) and storms (16%) also affected many people.

Figure 6: Number of people affected by event in 1993–2022

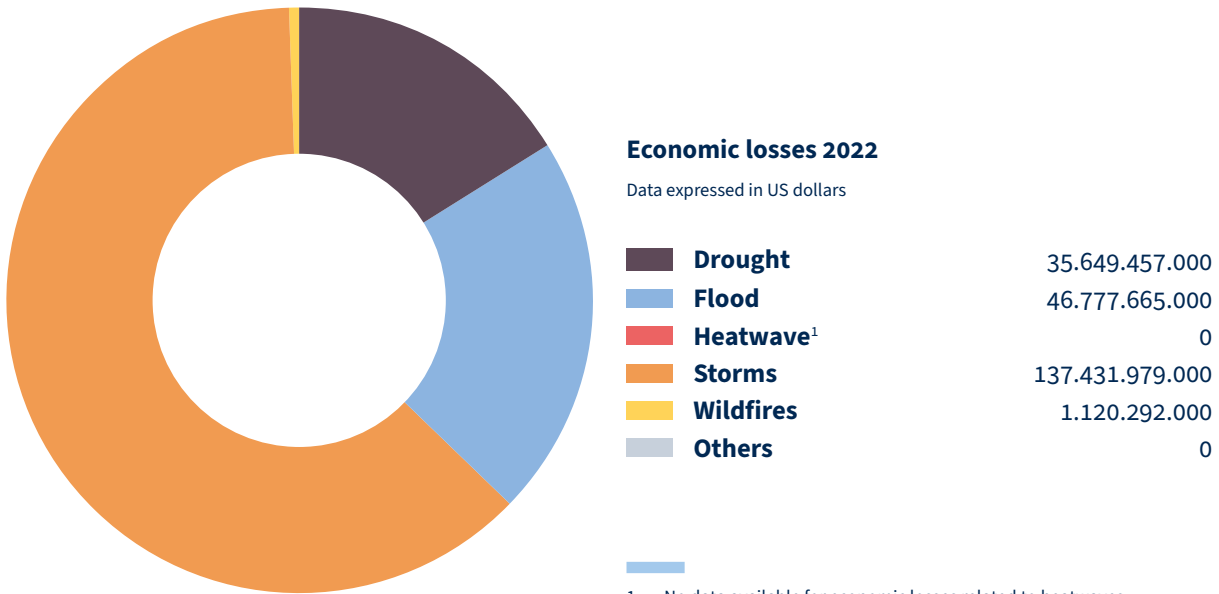


Economic loss

The greatest economic loss in 2022 was, by far, due to storms (62%; USD 137.43 billion). Hurricane Ian caused the largest share in the United States (USD 104 billion), making this the costliest extreme weather event of 2022.

Floods also caused substantial damage (USD 46.78 billion). Pakistan’s worst floods ever, causing nearly USD 15 billion in damage, were also behind its ranking as the most affected country in 2022. Drought (USD 35.65 billion) and wildfire (USD 1.12 billion) also caused massive economic loss.

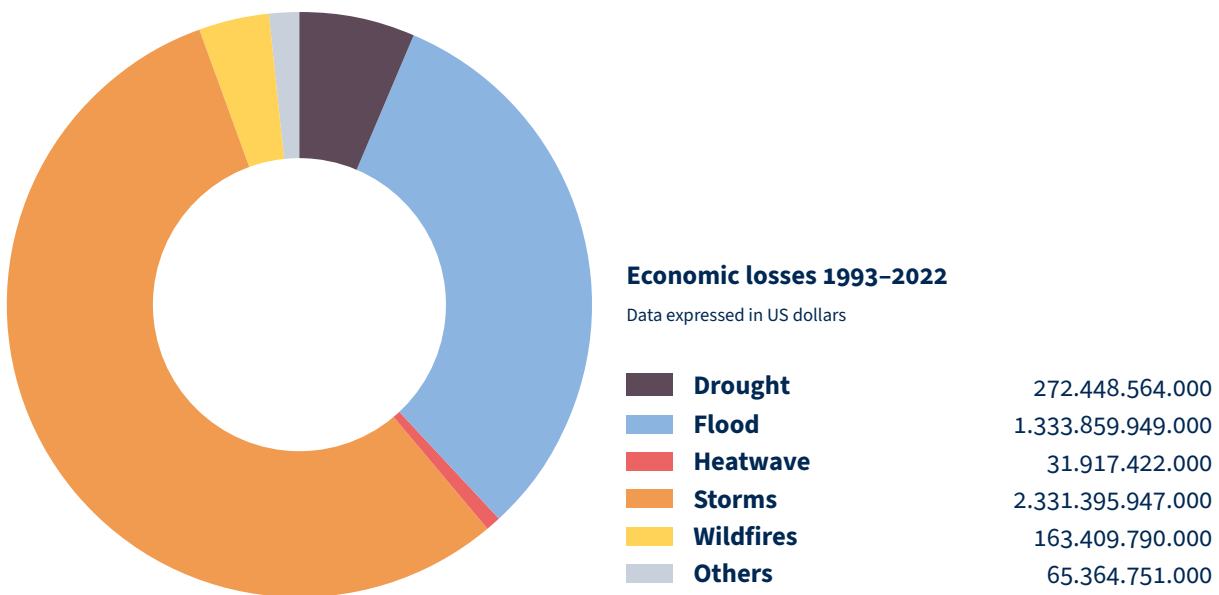
Figure 7: Economic loss by event in 2022



In the 30-year perspective, storms caused, by far, the greatest economic loss (56%; USD 2.33 trillion infla-

tion-adjusted) followed by floods (32%; USD 1.33 trillion).

Figure 8: Economic loss by event in 1993–2022



3

Interpreting the CRI results

3.1 Unusually extreme events, continuous threats, and the new normal

The CRI 2025, covering 1993–2022, is based on annual average values over a 30-year period. Countries covered in the long-term index can be divided into two groups:

1. **Most affected by unusual extreme events**
2. **Affected by recurring extreme events (continuous threats)**

Note that, in this context, CRI results reflect realised risks stemming from heightened exposure to hazards or increased vulnerability, signalling susceptibility to frequent or severe extreme weather events. Dominica, Honduras, Myanmar, and Vanuatu are among countries in the first category (unusually extreme events). In Dominica, Hurricane Maria caused USD 1.8 billion in damage, or 270% of the small island’s GDP. In Myanmar, Cyclone Nargis in 2008 caused over 95% of the damage and fatalities over the past **three** decades. These countries are also regularly affected by extreme weather events. There are clear indications that **climate change increases the risk for unusually extreme events**. There are also increasingly clear indications that we are entering a ‘critical and unpredictable phase’⁸⁵ of the climate crisis. It is critical because, in the previous two years, historical air and sea surface temperature records and ice extent records have been broken many times over.⁸⁶ On 22 July 2024, Earth’s

hottest day ever was recorded, while that February saw unprecedented global sea surface temperatures. It is unpredictable because the possible self-reinforcing feedback effects and the consequences of tipping points cannot be fully assessed scientifically. Studies show the North Atlantic Current is already weakened from climate change and may be approaching a tipping point.⁸⁷

China, India, the Philippines, and Pakistan are among those in the second category (continuous threats). The Philippines, for example, regularly experiences typhoons because of its perilous geographical location. The continuous threats can also include unusually extreme events (e.g. in Pakistan, which, while continuously hit by extreme weather events, suffered from the world’s costliest flood ever in 2022). The category of continuous threats has grown more relevant in the past few years. These countries continuously rank among the most affected in the long-term index and the index for the respective year. Also regarding this category are clear indications that climate change **contributes to transforming unusually extreme events into continuous threats**. Science can clearly demonstrate climate change’s significant effect on the frequency, intensity, and duration of extreme weather events (see chapter 4). Heat waves are a good example. The 2022 heat wave in Western Europe was why Italy, Greece, and Spain ranked high in the index. Though the heat wave and its potential consequences, such as drought and wildfires, are unusual extreme events, Western Europe

85 Ripple et al. 2024.

86 *ibid.*

87 Biló et al. 2024.

will be continually affected by heat waves.⁸⁸ Therefore, what used to be highly unusual threats have become the new normal.

3.2 How Global South and Global North countries are affected

Extreme weather events' impacts affect all countries. The long-term index over 30 years showed an especially strong effect on Global South countries. Five of the 10 most affected countries from 1993 to 2022 (Honduras, Myanmar, India, Vanuatu, and the Philippines; three being Small Island Developing States [SIDS]/least developed countries [LDCs]) were from the lower middle-income group, two (Dominica and China) from the upper middle-income group, and three (Italy, Greece, and Spain) from the high-income group. This is in line with the IPCC Sixth Assessment Report's high-confidence statement that, 'Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected.'⁸⁹

In the 2022 ranking, the picture changes, with two countries (Pakistan and Nigeria) from the lower middle-income group, one (Belize) from the upper middle-income group, and seven countries and territories (Italy, Greece, Spain, Puerto Rico, United States, Portugal, and Bulgaria) with high incomes (five are European countries) in the 10 most affected countries. Considering significance for overall degree of effect, the annual ranking is like a snapshot, while the 30-year index shows a more comprehensive picture.

The high degree of effect on European countries is notable for 2022. The specific meteorological and political backgrounds can help in understanding this situation. In 2022, Europe was hit by an **exceptionally strong heat wave** (see also chapter 2) and, for large parts of Europe, this was the hottest year on record (at that time). In Western Europe, the highest temperatures were about 10°C higher than typical summer maxi-

imum temperatures. The heat wave also was marked by a very early first "tropical day" in 2022, which was recorded already in mid-May, one month earlier than usual.⁹⁰

Generally, **Europe is the fastest-warming continent** in the world. Since the 1980s, it has warmed at twice the global average.⁹¹ Thus, highly unusual situations, such as in 2022, are expected to become more frequent. As Tebaldi et al. (2023) found, frequency and intensity of heat extremes can be identified because of an increase in global surface air temperature, and they have already increased (globally) since 1950.⁹² In Europe, regular weather patterns are changing. Heat and droughts are increasing, rainfall is declining, and more severe precipitation extremes are occurring, leading to highly unusual flooding.⁹³ Also, growing food and water insecurity are threatening public health, particularly for outdoor workers, while jeopardising energy and financial security.⁹⁴ A large-scale, severe drought has been affecting the western Euro-Mediterranean region. A lack of precipitation during the first two months of 2022, typically part of the wet season, caused dry conditions in the Iberian Peninsula, including Portugal and Spain. This shortfall posed challenges for the region in the later months of the year.⁹⁵ Meanwhile, water shortages already affect 30% of the European population each year.⁹⁶

Examples of extraordinary, unprecedented events show that many European countries are **not yet prepared for these events in terms of comprehensive risk management**. There is little focus on prevention and preparedness, and this leads to greater impacts. Even if there is overall progress, preparedness is low and policy implementation is 'lagging substantially behind quickly-increasing risk levels.'⁹⁷

Two recent examples of extraordinary events in Europe underscore this analysis. The **flood event in western Germany around the Ahr River** in July 2021, with 134

88 European Environment Agency 2024a.
89 IPCC 2023.
90 Copernicus 2022a.
91 European Environment Agency 2024b.
92 Tebaldi et al. 2023.
93 EEA 2024b.
94 EEA 2024b.
95 Toreti 2022.
96 EEA 2024b.
97 EEA2024b.

fatalities and 766 people injured, illustrates the lacking early warning system and lack of capacity in authority and population. Already days before the event, an extreme heavy rainfall event was detected to be developing over western and southwestern Germany, according to experts⁹⁸. They also found that on the day of the event, in the afternoon at the latest, it was undoubtedly clear there would be extreme flooding at a scale seen less frequently than every 100 years. Even with the German weather service's warning the day before the event, the state of emergency was declared only very late on the evening of the event. Experts assess the risk management in this case as a systemic failure, as either the warnings were not issued correctly or people did not know how to react properly.⁹⁹

For the **flood event in Spain's Valencia region in October 2024**, similar challenges led to high (especially human) impacts, with more than 200 fatalities. Spain's national weather agency (as in Germany) issued severe warnings well in advance but, at the local level, delayed communication and timely action. People also lacked knowledge on relevant issues, such as evacuation routes. Over half the victims were >70 years old, underscoring that the most vulnerable groups (e.g. older people) are most affected in Europe, as well. Additionally, risk perception in Spain at the national level was comparably low and the risk management approach failed to focus on prevention and preparedness.¹⁰⁰

In Global North and Global South countries, the **most vulnerable parts of the population are most affected**, such as with food security and health.¹⁰¹ The IPCC Sixth Assessment Report clearly points out that, 'across sectors and regions the most vulnerable people and systems are observed to be disproportionately affected. The rise in weather and climate extremes has led to some irreversible impacts as natural and human

systems are pushed beyond their ability to adapt.¹⁰² At the micro/household level, poorer households are more vulnerable, more exposed, and need more time to recover, especially in the Global South.¹⁰³ Inequality, poverty, and marginalisation because of gender, ethnicity, and low income can further exacerbate vulnerability and, thus, the degree of effect. This is especially true for Indigenous Peoples and local communities, and it hinders adaptation, leading to soft limits and resulting in disproportionate exposure and impacts for the most vulnerable groups.¹⁰⁴

Apart from extreme events' direct effects on households, there can also be lagged effects, when recovery is incomplete, especially for poorer households. Households in the Philippines have been shown to need years to recover after, for example, a typhoon event, and 90% of their total economic losses occur only in the recovery phase. There is a disproportionate effect because income losses cannot be offset.¹⁰⁵ With the climate crisis advancing, impacts that become L&D will increase and be strongly concentrated among the poorest vulnerable populations.¹⁰⁶

Apart from vulnerable groups, countries from the Global South are disproportionately affected over the long term, as the CRI ranking shows. The Notre Dame Global Adaptation Initiative (ND GAIN) index combines information on countries' vulnerability¹⁰⁷ and readiness¹⁰⁸ in its ranking. It shows the potential degree of effect and of coping capacities. It echoes the CRI results for the 30-year index, when showing the particular vulnerability of the Global South, and poorer countries specifically, with the lowest 43 ranks (the most vulnerable and least ready) from low or lower middle-income country groups and comprising countries in Africa, Latin America, and Asia-Pacific.¹⁰⁹ As the ND GAIN ranking already indicates, Global South countries' high vulnerability and lack of coping capacity play out in the degree of

98 Süddeutsche Zeitung 2022.

99 ibid.

100 Chavda 2024.

101 EEA 2024a.

102 IPCC 2022b.

103 Sauer et al. 2023.

104 IPCC 2022b.

105 Sauer et al. 2023.

106 IPCC 2022b.

107 Incl. exposure, sensitivity and ability to adapt to the negative impact of climate change.

108 A country's ability to leverage investments and convert them to adaptation actions, considering three components - economic readiness, governance readiness, and social readiness.

109 Notre Dame Global Adaptation Initiative 2024.

effect in the CRI ranking. These countries generally have lower coping capacities as (financial) means are scarcer. Human mortality from extreme weather events has generally been found substantially higher in vulnerable countries (in 2010–2022, 15 times higher than low-vulnerability regions).¹¹⁰

The Human Development Index (HDI) further reinforces this analysis. The HDI looks into the three key dimensions of human development – long and healthy life (through a life expectancy index), being knowledgeable (through an education index), and decent standard of living (through a gross national income index) – and ranks countries on these factors.¹¹¹ The ranking aligns with the ND GAIN findings and CRI results, as it shows countries with ‘low human development’ mainly are from the Global South, especially African countries and some Asia-Pacific countries, which are among the countries most affected by extreme weather events.

Pakistan is one example, as the country’s worst floods ever recorded were also why this was the most affected country in 2022, incurring nearly USD 15 billion in damage, with 1,700 fatalities and 8,168,000 people internally displaced.¹¹² This number does not include reconstruction costs, estimated at USD 16 billion. The number also does not include much-needed finance for supporting Pakistan’s adaptation to climate change and overall resilience to future climate shocks.¹¹³ Pakistan’s flood impact assessment noted, ‘the 2022 floods have shown Pakistan’s high vulnerability to climate change despite contributing less than one percent of global greenhouse gas emissions’¹¹⁴ The assessment also found the floods disproportionately impacted the poorest households in the poorest areas.

The floods’ impact is likely to exacerbate existing gender inequalities, revealing serious disparities in safety, education, decision-making, and employment. More than 800,000 Afghan refugees currently live in calamity-hit areas in Pakistan. Women have suffered particularly notable losses to their livelihoods, especially

those associated with agriculture and livestock, with associated negative impacts on their economic empowerment and wellbeing. The floods have increased women’s vulnerability to gender-based violence due to aggravated household tensions, harassment, and abuse related to displacement and lack of secure infrastructure.

Looking ahead, the IPCC (2022) indicates (with high confidence) that future human vulnerability will continue to concentrate where capacities of local, municipal, and national governments, communities, and the private sector are least able to provide infrastructure and basic services.

3.3 Data gaps as a challenge to determining climate risks and impacts: A solution approach

A vast amount of data must be analysed in preparing an index; thus, data availability and quality are central in the index’s quality. The data analysed for the CRI rely on scientific best practices and methodologies that are constantly evolving, with a view to ensuring the highest accuracy, completeness, and granularity. Several challenges arise regarding available data.

1. Data quality and coverage vary from country to country and within countries. This situation may incur geographical bias in EM-DAT resulting from unequal reporting quality and coverage across space.¹¹⁵ There are particular data gaps for Global South countries, which might lead to these countries’ misrepresentation in the CRI.¹¹⁶ This issue is particularly pronounced for heat waves, also with a view to EM-DAT. Heat waves are not well recorded for Sub-Saharan Africa.¹¹⁷ Extreme weather damage databases, such as EM-DAT, report no significant heat wave impacts in Sub-Saharan Africa since 1900, though the region has experienced several heat waves.¹¹⁸ About 52% of heat wave events in EM-DAT occurred in nine countries: Ja-

110 IPCC 2022b.

111 UNDP 2024.

112 Internal Displacement Monitoring Centre 2024.

113 World Bank 2022.

114 Finance Division Government of Pakistan 2022.

115 EM-DAT Project 2022.

116 Dinku 2019.

117 Otto and Harrington 2020c.

118 Otto and Harrington 2020b.

pan, India, Pakistan, and the United States, followed by western European countries (France, Belgium, United Kingdom, Spain, and Germany).

The existence of data gaps is well known. The Sendai Framework, for example, aims to ‘promote the collection, analysis, management and use of relevant data’ and, particularly, includes mortality data improvement as a high priority.¹¹⁹

There are numerous reasons for data gaps, including the following:

a. Distribution of meteorological stations: Meteorological stations are distributed very unevenly worldwide, leading to significant data gaps for developing countries in particular (see, for example, UNDRR 2023b).¹²⁰ Meteorological stations provide a wealth of high-quality data for observing global meteorological changes. The stations are needed for registering extreme weather events. Zhan et al. (2023)¹²¹ found that GDP and government spending were the main factors influencing the number of active stations in each country. The researchers also summarised that most meteorological stations are in developed countries. The WMO (2024) highlighted that, despite progress, there are still significant gaps in the coverage of observing networks, most notably in LDCs and SIDS, which are only collecting and internationally exchanging 9% of mandated Global Basic Observing Network data.¹²² The large difference between Global South and Global North becomes clearer when looking at the number of weather stations in the United States, European Union, and Africa. While the United States and European Union (population: 1.1 billion) have 636 weather radar stations, the entire African continent (population: 1.2 billion) has 37 (Otto 2023). Otto (2023)¹²³ also concluded that, ‘Floods are one of the deadliest natural disasters worldwide, but deaths linked with flooding aren’t

distributed evenly. They most often occur in places that lack weather data and warning systems — and most of those places are in the Global South.’

b. Insufficient systematic data collection and cataloguing: The data quantity and quality and the coverage of disaster events are insufficient in some areas.¹²⁴ For Global North countries, national governments provide numbers on fatalities, affected people, and economic losses. For Global South countries, however, this is often done by different non-governmental organisations that lack (sufficient) connection with meteorological services.¹²⁵ This shortcoming results in a severe lack of collated data that could accurately show losses. Systematic collection and cataloguing are needed for making information robust enough for planning and policymaking, especially for low-income, highly vulnerable countries and regions.^{126, 127}

c. Use of different data collection techniques: Countries use different techniques to collect data on extreme weather events, and this might lead to distorted index results. For instance, some countries use ‘excess mortality rate’ to determine heat wave-related fatalities (in contrast to an [officially] recorded number of such deaths). This rate is expressed as a percentage of additional deaths in a month compared with a baseline period. The higher the value, the more additional deaths compared with the baseline.¹²⁸

d. Under-representation of regions in research: Science clearly shows that research on climate change impacts is not evenly distributed worldwide. Campbell et al. (2018), focussing on heat wave and health impact research, found that ‘regions most at risk from heat waves and health impact are under-represented in the research’ (ibid). One reason for this outcome is that climate research is largely carried out by research institutes in Global North countries, resulting in a bias towards events in these countries.¹²⁹ Also, huge geo-

119 United Nations Office for Disaster Risk Reduction 2015.

120 United Nations Office for Disaster Risk Reduction 2023b.

121 Zhan et al. 2023.

122 World Meteorological Organization 2024b.

123 Otto 2023b.

124 Osuteye et al. 2017.

125 Otto and Harrington 2020c.

126 Otto and Harrington 2020b.

127 Ritchie and Rosado 2024.

128 eurostat 2020.

129 Otto and Harrington 2020c.

graphical differences exist in attribution science (see chapter 4).¹³⁰ Large attribution knowledge gaps are particularly found in Global South countries because of a lack of good weather data and well-evaluated climate models.¹³¹ Therefore, current attribution studies ‘provide very little information about those events and regions where the largest damages and socio-economic losses are incurred.’¹³² Attribution studies, thus far, have focused on Europe (22%), eastern and southeast Asia (22%), and Northern America (19%), with only 1% covering northern Africa and western Asia.¹³³

2. Methodological boundaries of data collection:

Accurately attributing human loss to a particular extreme event faces certain methodological boundaries for data collectors (e.g. in determining whether the death of an older person during a heat wave resulted from the extreme temperature or from their advanced age).

To balance out the potential misrepresentation of Global South countries due to data gaps, a CRI sensitivity analysis including HDI as a correcting factor is used for missing data. As studies concluded that data gaps correlate with GDP and government spending,¹³⁴ the HDI is used as a proxy for data availability. However, this correlation still is not fully consistent across all assessed countries. There are instances, for example, of SIDS with high HDI rankings but that still exhibit significant data gaps. The HDI is a summary measure of average achievement in key human development dimensions: a long and healthy life, being knowledgeable, and having a decent standard of living. The HDI is the geometric mean of normalised indices for each of the three dimensions and represented by a value of

0–1. Countries are ranked in four groups: low (<0.55), medium (0.55–0.699), high (0.7–0.799), and very high (≥ 0.8).

For the CRI, the HDI is incorporated as a proxy for data availability. First, the ‘HDI gap’ is determined for each country, illustrating the gap between a country’s HDI score and the ‘perfect’ HDI score of 1. The result is weighted and added to a country’s CRI score as an ‘HDI correction.’ So as not to overcorrect the factual data calculations in the CRI, a conservative weighting of 10% is used for the correction. Additionally, countries with a very high HDI score (≥ 0.8) are excluded under the assumption that data gaps are less likely within them.

Accordingly, the ‘HDI-corrected’ CRI score can be written as:

$$\text{CRI score}_{\text{HDI-corrected}} = \text{CRI score} \times 0.9 + \text{‘HDI gap’} \times 0.1$$

Figure 9 shows the HDI-corrected CRI ranking for 1993–2022. There are now nine developing countries (compared with seven in the uncorrected ranking) among the 10 most affected. Honduras, Vanuatu, the Philippines, and Haiti move up in the ranking because of the HDI correction. Italy, because of the very high fatalities resulting from the 2022 heat wave, still ranks in the uppermost 10, while all other developed countries move out of this group (including Greece and Spain). The HDI correction’s significance is also clearly visible with a view to the 20 most affected countries in 1993–2022. Developing countries now account for 17 of 20 (compared with 12 of 20 for the uncorrected ranking).

130 Clarke et al. 2022.

131 Friederike et al. 2020a.

132 *ibid.*

133 McSweeney and Tandon 2024.

134 Zhan 2023.

Figure 9: 10 countries most affected in 1993–2022 (HDI-corrected)

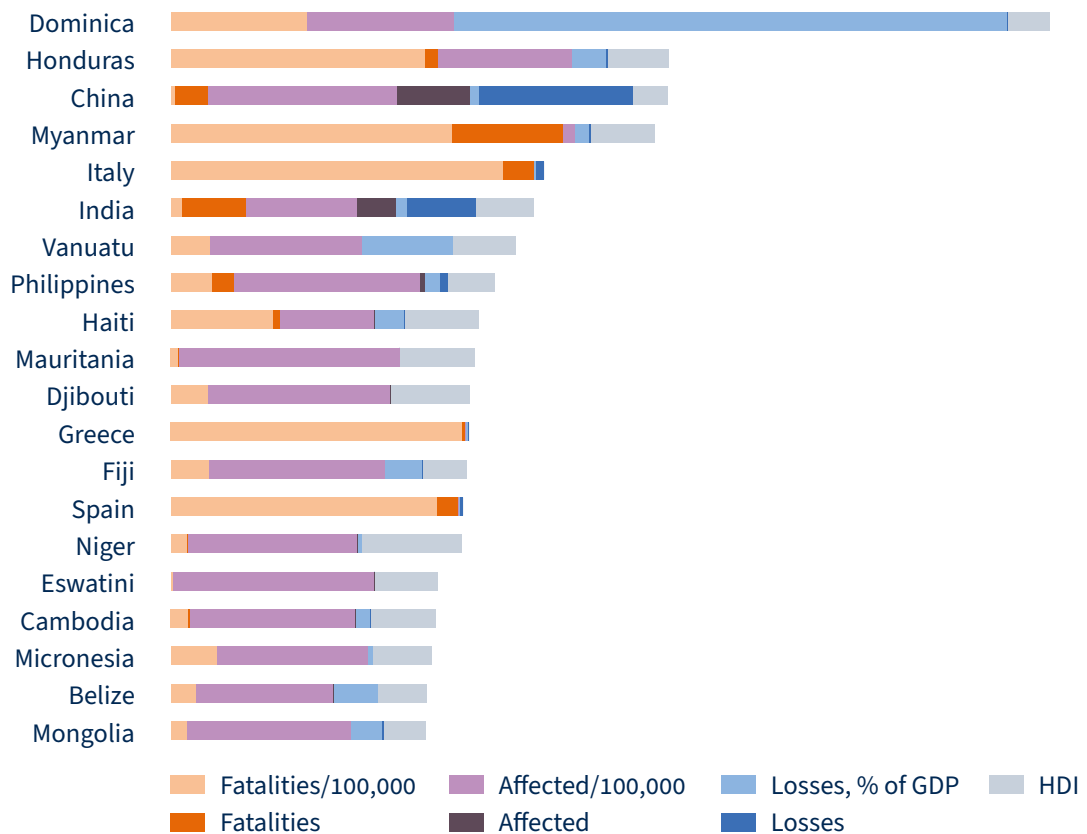
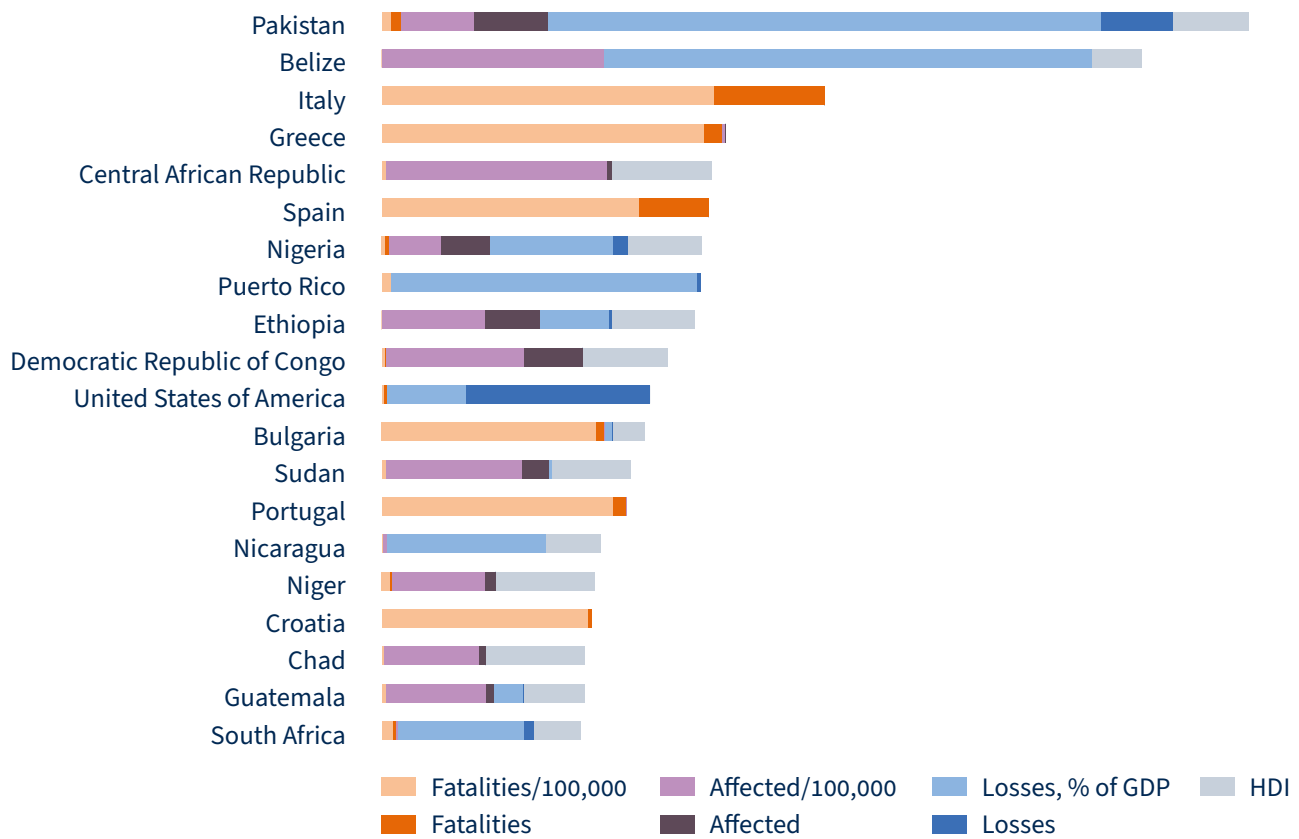


Figure 10 shows the HDI-corrected CRI ranking for 2022. There are now seven developing countries (compared with only four in the uncorrected ranking) among the 10 most affected. Developing countries, such as the Central African Republic, Nigeria, and the Democratic Republic of Congo, rise in the ranks, while developed countries, such as the United States, move out of the

uppermost 10. The HDI correction's significance is also clearly visible with a view to the 20 most affected countries in 1993–2022. Developing countries now account for 13 of 20 (compared with 10 of 20 for the uncorrected ranking).

Figure 10: 10 countries most affected in 2022 (HDI-corrected)



4

Linking extreme weather events and climate change

Extreme weather events' emergence and formation are complex. Many interrelated factors must be considered in explaining the specific causes. However, science clearly demonstrates climate change's significant effect on certain types of events' frequency, intensity, and duration. Understanding this relationship is essential for mitigating risks and preparing to deal with impacts. This chapter first presents the current scientific status of attribution of extreme weather events to climate change and then details climate change's effects on the most important hazard types for the CRI.

4.1 Current scientific status of attribution science

Science has thoroughly researched the connection between extreme weather events and climate change. The IPCC Sixth Assessment Report states with high confidence that, 'Human-caused climate change is already affecting many weather and climate extremes in every region across the globe. This has led to widespread adverse impacts and related losses and damages to nature and people.'¹³⁵

Above all, attribution science has built a solid evidence base on human-induced climate change's contribution to individual extreme weather events. By comparing real-world data with a simulated climate that excludes certain factors, such as greenhouse gas emissions (e.g. simulating a world without climate change), attribution science estimates climate change's influence on extreme weather events.¹³⁶ Attribution science, which emerged in the 1990s, has evolved from a new, seldom-applied method struggling to pinpoint causes of individual events to a multimethod approach with more than 600 studies on more than 750 events to date.¹³⁷ Across all 750 cases, 74% were made more likely or severe because of climate change, according to a meta-analysis by Carbon Brief.¹³⁸ Studies now can answer whether and to what extent human-induced climate change affected extreme weather events' likelihood, intensity, or impact.¹³⁹ The IPCC Sixth Assessment Report, therefore, notes that, 'Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5.'¹⁴⁰ Even rapid attribution following single events is possible.¹⁴¹

135 IPCC 2023.

136 Otto 2017.

137 McSweeney and Tandon 2024.

138 Ibid.

139 Otto 2023a.

140 IPCC 2022.

141 Taminga et al. 2025.

However, huge geographical differences exist in attribution studies, similar to general climate change data (see chapter 4).¹⁴² Large attribution knowledge gaps are especially present for Global South countries because of a lack of adequate weather data and well-evaluated climate models.¹⁴³ Therefore, current attribution studies ‘provide very little information about those events and regions where the largest damages and socio-economic losses are incurred.’¹⁴⁴ Such studies, thus far, have focused on Europe (22%), eastern and southeast Asia (22%), and Northern America (19%), with only 1% covering northern Africa and western Asia.¹⁴⁵

4.2 Attribution of CRI event types to climate change

Heat waves

‘Heat wave’ refers to a period of abnormally hot and/or unusually humid weather, lasting from two days to weeks.¹⁴⁶ Countries and regions apply different thresholds for temperature and duration in defining an event as a heat wave.¹⁴⁷ As heat waves are primarily influenced by thermodynamic factors, it is easier for attribution scientists to establish a causal link to climate change compared to other extreme weather events.¹⁴⁸ This fact has led to heat waves being studied more extensively than other extreme weather events. Extreme heat events appear to be growing more frequent because of climate change, and heat levels once considered very rare are now merely seen as unusual.¹⁴⁹ According to the IPCC Sixth Assessment Report, heat waves that had a 10% chance of occurring annually in the pre-industrial climate are now 2.8 times more frequent and 1.2°C hotter.¹⁵⁰ If 2°C of global warming is surpassed, the frequency will rise to 5.6 times, with 2.6°C temperature increases.¹⁵¹

For 2022, attribution studies found that human-caused climate change made the heat wave event in parts of western Europe at least 10 times more likely.¹⁵² Climate change also made devastating early heat in India and Pakistan 30 times more likely.¹⁵³

Heat waves negatively impact the health of affected people. The increased frequency and intensity of heat waves is followed by heat-related illnesses. Moreover, heat-related mortality has increased, with one study attributing 37% of heat-related deaths globally to climate change.¹⁵⁴ Rising temperatures disproportionately affect the most vulnerable groups in society – older people, children, and people with pre-existing medical conditions.¹⁵⁵ Additionally, a large part of the global population resides in hotter regions, where heat waves’ impacts are felt most acutely.

The data gaps in climate and attribution science for Global South countries (see chapter 4) are particularly pronounced regarding heat waves, including EM-DAT, which the CRI uses. Heat waves are, for instance, not well-recorded for Sub-Saharan Africa.¹⁵⁶ Extreme weather damage databases, such as EM-DAT, report no significant heat wave impacts in Sub-Saharan Africa since 1900, though the region has experienced several heat waves.¹⁵⁷ About 52% of heat wave events recorded in EM-DAT occurred in nine countries: Japan, India, Pakistan, United States, followed by western European countries (France, Belgium, United Kingdom, Spain, and Germany).

Floods

‘Flood’ is a general term for water overflow from a stream channel onto normally dry land in the floodplain (riverine flooding), higher than normal levels

142 Clarke et al. 2022.

143 Otto 2023a.

144 Ibid.

145 McSweeney and Tandon 2024.

146 Centre for Research on the Epidemiology of Disasters 2024.

147 Copernicus 2024a.

148 Tandon 2024.

149 Clarke et al. 2022.

150 IPCC 2022b.

151 Clarke et al. 2022.

152 World Weather Attribution 2022c.

153 World Weather Attribution 2022a.

154 Vicedo-Cabrera 2021.

155 Clarke et al. 2022.

156 Otto and Harrington 2020c.

157 Otto and Harrington 2020b.

along the coast and in lakes or reservoirs (coastal flooding), and ponding of water at or near where the rain fell; i.e., flash floods.¹⁵⁸ A 'flash flood' is heavy or excessive rainfall in a short period of time and that produces immediate runoff, creating flood conditions within minutes or a few hours during or after the rainfall.¹⁵⁹

Attribution science faces multiple challenges in analysing flood events. Scussolini et al. (2023) indicated a non-linear relationship between rainfall and flood occurrence or severity, as the relationship depends on various factors, such as hydrological processes, river and coastal management, and pre-existing conditions before rainfall. Human interventions, such as dam construction and land-use changes (e.g. agricultural development), also can influence flood dynamics by amplifying, mitigating, or outweighing climate change's effects.¹⁶⁰ Despite these complexities, the principal findings show heavy rainfall has become more frequent and intense in many parts of the world because of climate change.¹⁶¹ The aggregated findings in the latest IPCC report indicate that, at a global scale, a rainfall event that would be expected once in 10 years now has a 1.3-times chance of occurring every 10 years and will bring greater precipitation.¹⁶² This frequency is expected to increase as global warming continues.¹⁶³

The global temperature increase leads to rising global sea levels, which increase coastal flooding.¹⁶⁴ Additionally, the higher GHG emissions level leads to more tropical cyclones, which often cause floods.¹⁶⁵ Scientists also have found, with a high level of confidence, that increased precipitation extremes and inland flooding can be attributed to global surface air temperature warming.¹⁶⁶

Scientists have observed that annual monsoons in parts of Asia and Africa are changing because of cli-

mate change. Shorter but more intense rains are having negative impacts in many low- and middle-income countries, where large populations depend on monsoons for agriculture.¹⁶⁷ Hurricane Katrina was one event where attribution scientists could establish a clear link between a flood event and climate change. The hurricane struck the US southeastern coast in 2005, killing 1,800 and causing widespread destruction. Simulating sea level and climate conditions from 1900, Irish et al. (2013) unpacked climate change's influence on this event. Their findings suggest that 'flood elevations during Hurricane Katrina [...] were estimated to be 15 to 60% higher in coastal areas' because of sea level rise. Thus, while attribution science should account for different factors when examining floods, the general trend is that increased rainfall and sea level rise are already leading to more severe flooding in different parts of the world.

Drought

A drought is an extended period of unusually low precipitation, which brings a water shortage for people, animals, and plants.¹⁶⁸ Drought differs from most other hazards in that it develops slowly, sometimes even over years, and its onset is generally difficult to detect. The IPCC's latest report outlines various types of drought, including meteorological (precipitation deficits), agricultural (soil moisture deficits), ecological (plant water stress), and hydrological (shortages in reservoirs, lakes, and groundwater). All types of drought are interconnected, essentially describing a moisture shortage in different parts of the hydrological system.¹⁶⁹ Higher temperatures and precipitation deficits, either individually or together, are key drivers of drought. Attribution scientists face challenges in GHG emissions' indirect influence on precipitation and, in turn, on drought.¹⁷⁰

158 Centre for Research on the Epidemiology of Disasters 2024.

159 Ibid.

160 Scussolini et al. 2024.

161 Fischer 2021.

162 IPCC 2022.

163 Clarke et al. 2022.

164 IPCC 2022.

165 Irish et al. 2014.

166 Tebaldi et al. 2023.

167 Katzenberger et al. 2021.

168 Centre for Research on the Epidemiology of Disasters 2024.

169 McSweeney 2021.

170 Olsen et al. 2023.

The IPCC Sixth Assessment Report stated with medium confidence that ‘human-induced climate change has contributed to increases in agricultural and ecological droughts in some regions.’¹⁷¹ The report warns, with high confidence, that agricultural and ecological drought will continue to increase. Drought has severe impacts on people and ecosystems, leading to lower water quality, harm to aquatic ecosystems, crop failure, livestock losses, and reduced water availability. This is particularly detrimental to the agricultural sector, contributing to food insecurity, which can drive human conflicts and displacement.¹⁷² For instance, in the Horn of Africa, a severe drought since October 2020 has led to acute food insecurity for millions of people. Attribution scientists have shown that the conditions would not have led to such a drought in a 1.2°C-cooler world.¹⁷³

Regarding 2022, attribution studies have found that, for the Northern Hemisphere extratropics, human-induced climate change made the observed soil moisture drought much more likely, by a factor of ≥ 20 for root zone soil moisture and ≥ 5 for surface soil moisture.¹⁷⁴

Storms and tropical cyclones

The CRI includes several types of storms, with tropical cyclones being the most destructive. A tropical cyclone originates over tropical or subtropical waters.¹⁷⁵ It is characterised by a warm-core, non-frontal synoptic-scale cyclone with a low pressure centre, spiral rain bands, and strong winds. Depending on their location, tropical cyclones are also referred to as ‘hurricanes’ (Atlantic, Northeast Pacific), ‘typhoons’ (Northwest Pacific), and ‘cyclones’ (South Pacific and Indian Ocean). While these storms’ wind speed thresholds vary by region, the Saffir-Simpson Hurricane Wind Scale is a commonly used classification system. This scale categorises hurricanes into five levels based on their sus-

tained wind speeds, from 1 (minimal damage) to 5 (catastrophic damage). The scale helps estimate storms’ potential destruction and impact.

Climate change’s influence on tropical cyclones is more complex than for other types of extreme weather events, as heavy rainfall and extreme winds drive the impacts.¹⁷⁶ Moreover, the surrounding conditions, such as sea surface temperatures, are vital for storm formation. Warmer ocean temperatures, driven by climate change, act like fuel for tropical cyclones, intensifying the strength of these storms and, thus, potentially making them more destructive.¹⁷⁷ Additionally, as warmer air holds more moisture, these storms are likely to lead to heavier rainfall in affected regions.¹⁷⁸ The IPCC Sixth Assessment Report found, ‘it is likely that the global proportion of category 3-5 tropical cyclone instances and the frequency of rapid intensification events have both increased globally over the past 40 years.’¹⁷⁹

Attribution science findings show that climate change is strengthening conditions conducive to the most powerful hurricanes, with more intense rainfall totals and wind speeds.¹⁸⁰ Studies have repeatedly shown that recent extreme flood events can be attributed to climate change. The causes of these events include Superstorm Sandy¹⁸¹ (2012 in the Caribbean and the eastern United States) and Hurricane Katrina (2005 in Louisiana).¹⁸² Attribution science also found that climate change was a key driver for the catastrophic impacts of Hurricane Helene in the United States in 2024.¹⁸³

Wildfires

Wildfires are uncontrolled and unpredictable combustion or burning of plants in a natural setting, such as forest, grassland, brush land, or tundra, and that consume the natural fuels and spread depending on

171 IPCC 2023.

172 World Weather Attribution 2023.

173 Ibid.

174 World Weather Attribution 2022b.

175 Centre for Research on the Epidemiology of Disasters 2024.

176 World Weather Attribution 2024a.

177 IPCC 2019.

178 Ibid.

179 IPCC 2022.

180 World Weather Attribution 2024a.

181 Sweet et al. 2013.

182 Irish et al. 2014.

183 World Weather Attribution 2024a.

environmental conditions (e.g. wind, topography).¹⁸⁴ Wildfires are driven by factors such as high temperature, low humidity, lack of rain, fuel availability, and high wind speed.¹⁸⁵ While they can cause direct loss of human lives, their death toll tends to be lower than for other weather extremes.¹⁸⁶ However, inhaling wildfire smoke can lead to long-term respiratory health issues and wildfires are also associated with large losses of wildlife and other parts of the ecosystem. Wildfires are complex to study, as their occurrence depends on pre-existing weather conditions (such as drought) and whether vegetation was subjected to low humidity and rainfall.¹⁸⁷ As such, they are closely linked to other extreme weather events, such as drought and heat waves. Carbon Brief indicates wildfires are one of least-studied weather extremes in the context of attribution science.¹⁸⁸

The devastating bushfires in Australia in 2019/2020, with up to 19 million hectares burnt, are a prime example.¹⁸⁹ The wildfires were fuelled, in part, by the prolonged drought that preceded them. Van Oldenborgh et al. (2020) found that climate change made the event 30% more likely,¹⁹⁰ and concluded that increasing temperatures bring a higher risk of such extreme fire seasons.¹⁹¹ Similarly, Du et al. (2021) found that human-induced climate change was a driving force of the spring 2019 wildfires in southwest China.¹⁹² Researchers also identified a 'significant anthropogenic contribution to the risk of extreme fire weather' in Canada's unusually intense wildfire season of 2017.¹⁹³ Overall, wildfires' intensity and occurrence can be clearly linked to climate change, though further studies are needed.

184 Centre for Research on the Epidemiology of Disasters 2024.

185 Dowdy et al. 2009.

186 Clarke et al. 2022.

187 Van Oldenborgh et al. 2021.

188 McSweeney and Tandon 2024.

189 WWF 2018.

190 Van Oldenborgh et al. 2021.

191 Ibid.

192 Wang et al. 2019.

193 Kirchmeier Young et al. 2019.

5

CRI context: Status quo of international climate and resilience policy

“Climate catastrophe is hammering health, widening inequalities, harming sustainable development, and rocking the foundations of peace. The vulnerable are hardest hit.”

UN Secretary-General António Guterres¹⁹⁴

The CRI 2025 clearly shows that extreme weather events’ impacts are being felt worldwide as increasing climate change further exacerbates the situation. Over the 30-year span of 1993–2022, the index shows that Global South countries were particularly affected. Five of the 10 most affected countries were in the lower middle-income group of developing countries, with three LDCs or SIDS. These countries, and especially the population’s most vulnerable parts, are particularly affected by hazards’ damaging effects (as, for example, their livelihoods depend on fewer assets) and have a lower coping capacity (e.g. they cannot rely on savings to buffer the impacts and may need longer to rebuild and recover). In 2022, particularly high-income countries ranked very high in the index and were heavily affected by the impacts, while having better coping capacity to rebuild in the aftermath of a disaster. However, the most vulnerable groups (e.g. older people and

children) were especially affected and risk management needed improving in those countries.

The year 2024 was marked by international crisis and strong geopolitical tensions, exerting pressure on the multilateral system. In this year of a high number of elections (over half the world’s population in 72 countries were eligible to vote), the conflict between an often fossil-focussed authoritarian, radical right-wing camp and an increasingly fragmented more liberal camp dominated. In many countries, parties that want less international cooperation and an extension of the fossil fuel business model won. The collective outcome of these results will also have consequences for supporting the most vulnerable countries in dealing with climate change’s consequences. This impact was already evident at COP29, which concluded with a new climate target that fell far short of the countries’ needs. Meanwhile, records have been broken. After exceptionally high average monthly temperatures, 2024 was the hottest year on record¹⁹⁵ and the first full year at more than 1.5°C above pre-industrial temperatures, while extraordinary unprecedented extreme weather events have occurred worldwide.

194 World Meteorological Organization 2024b.

195 World Meteorological Organization 2024c.

Already today, around 3.3–3.6 billion people live in climate change-vulnerable conditions,¹⁹⁶ and extreme weather events have already led to irreversible impacts, adaptation limits have been reached and impacts materialised in economic and non-economic L&D. The impacts disproportionately affect the most vulnerable, with LDCs, Least Developed Land-Locked Countries (LLDCs), and SIDS suffering a higher share of fatalities due to disasters.¹⁹⁷ Increased human mobility and displacement are another consequence of those impacts, with SIDS being extremely affected (IPCC 2022). In 2023 alone, worldwide, 26.4 million more people were internally displaced because of disasters.¹⁹⁸ Assessments show that costs of around USD 143 billion due to extreme weather events are attributable to climate change.¹⁹⁹

5.1 The large emissions gap

Responsibility for the further-increasing climate crisis lies in GHG emissions, which impact global mean temperature changes, and the resulting intensification of slow- and rapid-onset processes and events and their related impacts. Countries' **mitigation actions** are failing dramatically and, thus, failing in implementing the Paris Agreement goals. Global GHG emissions, rather than decreasing, rose by 1.3% from 2022 to 2023, according to the latest emissions gap report.²⁰⁰ While a global emissions peak is expected soon,²⁰¹ without higher ambition, including in nationally determined contributions (NDCs), the world is on track for a temperature increase of 2.6–3.1°C by 2100. Staying below 1.5°C is technically still possible but it will require exceptional efforts,²⁰² needing roughly a halving of emissions by 2030. Countries vary widely in their emissions and emissions trends. Variation is also significant regarding different income levels. At the global level, the 10% of the population with the highest income accounted for 48% of emissions in 2022 (with two-thirds

living in developed countries), whereas the bottom 50% of the world population (with the lowest income) accounted for 12% of emissions.²⁰³ Extreme weather events are heavily and increasingly affecting all countries, and the 2022 ranking shows seven high-income countries among the 10 most affected. Substantially increasing mitigation action is also in those countries' self-interest. This is also true as global crises, such as supply chain interruptions and higher food prices, affect them as well.

5.2 Status quo of international resilience building efforts

At the same time, investment in countries' overall resilience is more important than ever. Efforts to achieve the 2015-adopted **Sustainable Development Goals (SDGs)**, focussing on key global challenges, including the climate crisis, remain insufficient. Even as some countries are progressing, none of the 17 SDGs will be achieved by the intended 2030, according to an SDG status report.²⁰⁴ Implementation of SDG 13 ('Take urgent action to combat climate change and its impacts') faces especially large challenges and progress is stagnating.²⁰⁵ Climate change, including extreme weather events' increasing frequency and intensity, is itself a hurdle for SDG achievement, such as in reduced food and water security.²⁰⁶ At the same time, the pace of SDG progress varies widely across country groups. Nordic countries lead in SDG achievement and BRICS countries are making substantial progress, while poor and vulnerable nations (those most existentially affected also by climate impacts) lag far behind.²⁰⁷ The gap between the world average SDG Index score and that of poor countries and SIDS, in fact, widened in 2023 compared with 2015. The COVID-19 crisis and its impacts were identified as the main reason for this gap.²⁰⁸ This scenario shows the importance of countries' resilience for buffering external shocks and shocks such as ex-

196 IPCC 2023.

197 UNDRR and WMO 2024.

198 Internal Displacement Monitoring Centre 2024.

199 Newmann and Noy 2023.

200 UNEP 2024a.

201 DNV 2024.

202 UNEP 2024a.

203 UNEP 2023a.

204 Sachs et al. 2024.

205 Ibid.

206 IPCC 2022b.

207 Sachs et al. 2024.

208 Ibid.

treme weather events, and their impacts, and the importance of increasing support for the most vulnerable countries. However, this support is lacking.

Throughout 2023, nearly 30 million more people needed **humanitarian assistance**. Only one-third of the required USD 57 billion for this assistance was received, according to the United Nations Office for Humanitarian Assistance (UNOCHA). It was also the first year since 2010 when funding declined from the previous year, while humanitarian assistance needs are expected to increase with the climate crisis as one of the three key drivers of this development.²⁰⁹

In terms of effective **resilience and risk management governance and approaches**, the implementation of the **Sendai Framework** (2015-2030) by the United Nations Office of Disaster Risk Reduction (UNDRR) is especially important. Countries generally have made progress in implementing the Sendai Framework with its seven global targets, but the progress has been uneven and varies across the targets. Notable achievements include the near-halving of global disaster mortality per 100,000 people, more than doubling of the number of countries with national strategies for disaster risk reduction, local governments in 108 countries having risk-reduction strategies, and the improved global coverage of multi-hazard early warning systems. At the same time, two-thirds more people were affected by disaster impacts, economic loss owing to disasters is still high and expected to further increase, disasters have disrupted basic services (e.g. education and health services), and international support for vulnerable countries in the Global South remains insufficient. Those most affected – such as SIDS, LLDCs, and LDCs – also still face severe challenges with data, statistical and technological capacity, disaster risk governance, and comprehensive risk management. This situation continues to hinder their progress.²¹⁰

The implementation of **Multi Hazard Early Warning Systems** (MHEWS) is an important part of the Sendai

Framework and supported by the UN Secretary General's **EWS4All-Initiative**. As of May 2024, fortunately, over half of the countries (55%) have MHEWS in place. Coverage of SIDS is at two-thirds, while, unfortunately, under half of all LDCs and LLDCs have MHEWS in place. While progress has been made and the situation is generally improving, the lack of risk knowledge still hampers the effectiveness of MHEWS.²¹¹

Country examples clearly show that effective climate change adaptation and disaster risk management strategies are reducing risks and impacts. In Bangladesh, risk prevention and adaptation significantly improved and led to a huge decline in cyclone-related mortality, from roughly 500,000 fatalities in 1970 to just 4,234 in 2007.²¹²

Efforts to improve adaptation to those impacts are another factor in strengthening countries' resilience to the climate crisis' impacts. A key instrument in this regard is **National Adaptation Plans (NAPs)**, which aim to identify countries' adaptation needs and provide strategies to respond to those needs. As of November 2024, 62 countries had formulated and submitted an NAP to the UNFCCC secretariat (15 LLDCs, 13 SIDS, and 22 LDCs).^{213, 214} Apart from Pakistan, which only submitted a NAP in mid-2023 (even after the heavy flooding in 2022), none of the 10 most affected countries in 2022 had submitted one. Of the 10 most affected countries in the 30-year span, only the Philippines had submitted an NAP and that was only in 2024.²¹⁵ More broadly, 171 countries have at least one national adaptation planning instrument (policy, strategy, or plan) in place.²¹⁶ Importantly, while the increased number of NAPs is a positive and vital development, implementing these NAPs is what will eventually make a difference in resilience-building, which, for now, is greatly lacking.

The **Global Goal on Adaptation (GGA)** established under the Paris Agreement and with a structure agreed upon at COP27 is another critical piece for global resilience-building. Two key priorities shaped negotia-

209 UNOCHA 2023.

210 UNGA 2024.

211 UNDRR and WMO 2024.

212 Haque et al. 2012.

213 United Nations Climate Change 2024.

214 UNFCCC 2024a.

215 UNFCCC 2024c.

216 UNEP 2024.

tions at COP29 in Baku: (1) Addressing whether and how means of implementation (finance, technology, and capacity) would be integrated into the GGA framework and (2) charting a clear roadmap for developing adaptation indicators to measure global adaptation progress. The technical phase advanced indicator refinement but the political phase saw diluted language on means of implementation and little progress in transformational adaptation. Outcomes included agreements to develop quantitative and qualitative indicators, including for means of implementation and the launch of the Baku Adaptation Roadmap to support GGA implementation. While GGA foundational elements are starting to take shape, there are still no actionable strategies for real-world impact. Evidence shows the value of adaptation; for example, a USD 16 billion annual investment in agriculture could prevent about 78 million people from starving or chronic hunger due to climate change impacts.²¹⁷ Similarly, a USD 1 billion investment in coastal flood adaptation yields a USD 14 billion reduction in damage. Ambitious adaptation can cut global climate risk by half under all warming scenarios,²¹⁸ but global adaptation finance flows are extremely low. The Adaptation Fund (AF), for instance, which is one of the few mechanisms delivering high-quality, grant-based, community-focused finance through direct access instruments to developing countries, is chronically underfunded. Contributions to the AF totalled USD 130 million in 2024, less than half of its USD 300 million annual funding target, which itself was a compromise figure. Inadequate and unpredictable resources for the AF have limited its ability to significantly scale up its adaptation actions.

5.3 Dire outlooks for resilience finance: Countries urgently need to increase finance for the most vulnerable

The year 2024 was a decisive one for **international climate finance**. After three years of discussions, technical expert dialogues, and exchange of expertise, the

New Climate Finance Goal (NCQG) for post-2025, as agreed to in Paris 2015, was decided at COP29 in Baku, Azerbaijan. Meanwhile, the current annual goal of USD 100 billion was achieved for the first time in 2022. Two years after the target year, developed countries provided and mobilised USD 115.9 billion in climate finance for developing countries.²¹⁹ The amount of public finance was increased to 80%. But only 32% of this public finance went to **adaptation finance**,²²⁰ failing to achieve the 50% targeted for a fair balance between mitigation and adaptation finance. While public adaptation finance for developing countries could be increased from USD 22 billion in 2021 to USD 28 billion in 2022, the gap between estimated adaptation needs (USD 215–387 billion annually) (UNEP 2024b) remains appalling. In fact, 87–93% of needs are not being financed. Even more troubling is that just 28% of total climate finance was provided as grants, with the majority in the form of loans.²²¹ Alarming, not all these loans were even concessional, as some were extended on market terms, further straining the recipient countries' fiscal capacities.²²² While many Global South countries are already highly in debt, this is particularly problematic, as instruments such as loans, especially for adaptation and L&D finance/measures, are further exacerbating the situation.

COP29 decided on an **NCQG** and this has been perceived as a great disappointment, especially by most vulnerable countries. It targets mobilising \geq USD 300 billion annually by 2035 for developing countries to mitigate and adapt to the climate crisis, without clear thematic subgoals or floors. A linear increase would mean an annual increase of USD 20 billion. The decision includes the request that developed countries 'take the lead' (with no clear definition of what this refers to), while developing countries are encouraged to contribute voluntarily. As the related decision²²³ recognised that \geq USD 1.3 trillion annually would be needed, it demonstrates the gap between the new goal and countries' actual needs and, thus, the target's insufficiency. The Baku to Belém Roadmap, to be agreed on

217 Sulser et al. 2021.

218 Magnan et al. 2021.

219 OECD 2024.

220 Ibid.

221 Ibid.

222 18% of bilateral finance were non-concessional loans, 59% non-concessional loans from climate funds, and 73% non-concessional loans from MDBs, OECD 2024.

223 UNFCCC 2024b.

in 2025, aims to increase the mobilisation of finance from public and private sources to USD 1.3 trillion annually by 2035 and will reduce this gap. The result will be vital for COP30 in 2025.

The situation worsens when looking into the outcome for strengthening resilience. The conference failed to include **L&D** as part of the new finance goal and, thus, does not specify the necessary obligations for developed countries to provide finance, while vulnerable developing countries are forced to further bear the brunt of the costs. The **Fund for Responding to Loss and Damage (FRLD)**, as part of the UNFCCC Financial Mechanism, is explicitly mentioned in the decision and potentially can channel finance. However, the thematic area of L&D as a whole is not included in the goal formulation, so it is at most a highly indirect inclusion.

L&D has not been included even in the current climate finance goal of USD 100 billion annually. The picture is even bleaker when considering the needs estimated for dealing with L&D. There are no officially accepted L&D finance need estimates and existing estimates vary widely. Such estimations are difficult. Needs heavily depend, for example, on the scale of mitigation and adaptation action and the magnitude by which extreme weather events intensify. Calculations thus far merely follow a top-down, rather than a more precise sector-to-sector, approach. Markandya/González-Eguino (2018) calculated a widely accepted estimate of around USD 290–580 billion of residual damage annually by 2030 for developing countries.

Though pledges have been made towards the newly established FRLD, few countries have announced a contribution and the overall volume of pledges (around USD 56 million USD) is very low compared with the needs. Pledges since COP28 in 2023 are an important signal but still only account for around USD 750 million and, thus, are far from what is necessary. Also, without explicit inclusion of L&D in the NCQG, the necessary traction for increasing this sum must come through other processes and initiatives. There is a high risk of undermining the successes of past COPs if the FRLD, which should be ready for disbursement

from 2025, remains inadequately equipped. There is a critical need to establish innovative finance instruments, based on the polluter pays principle and whose revenues would be used for L&D finance/for measures to address L&D. Fossil fuel companies have privatised their profits of USD 3.5 billion daily during the last 50 years and they should now also bear the external costs of their actions.

Looking ahead, the FRLD needs a reliable funding strategy if it is to remain relevant and capable of delivering on its mandate of ‘assisting developing countries that are particularly vulnerable to the adverse effects of climate change.’²²⁴ COP30 in B el em should approve such a strategy to be developed by the FRLD Board. Also, as not finalised in Baku at COP29, the 3rd Review of the Warsaw International Mechanism for Loss and Damage will be further discussed at SB62 in Bonn 2025. One key demand Global South countries raise in this regard is establishing an L&D Gap Report, comparable with the UNEP adaptation and mitigation gap reports.

While actors have already been taking the legal avenue²²⁵ to push for support for the most vulnerable countries because of slow progress at the international policy level, at the end of 2024, a landmark process started for **climate litigation**. The **International Court of Justice (ICJ)** is moving towards issuing an advisory opinion, which will clarify states’ legal obligations regarding climate change under international law, and the consequences for breaching them.²²⁶ Highly affected SIDS (the foremost being Vanuatu, ranked 9th in the long-term CRI) took the lead in pushing the UN General Assembly (UNGA) to request that the ICJ formulate this advisory opinion. This will not be legally binding, though it will send a powerful signal to justice and policy systems around the world, as results are expected for 2025.

5.4 The climate–security nexus

Climate change impacts are a fundamental challenge for people’s wellbeing and countries’ integrity. The climate–security nexus largely depends on the social, economic, and natural circumstances in which the fac-

224 UNFCCC 2022.

225 UNEP Nairobi 2023b.

226 International Court of Justice 2024.

tors unfold and can be understood as a threat multiplier²²⁷ towards peace and security. Burke et al. (2024) discussed potential mechanisms through which climate (change) affects conflict; they encompass economic conditions, socio-demographic factors, migration, politics, and psychological mechanisms.²²⁸ Despite growing scientific knowledge of these interlinkages, climate extremes' exact mechanisms in social conflicts remain unclear.²²⁹ In states with tension between different ethnic groups, where exclusion, discrimination, and polarisation exist, groups are particularly susceptible to developing conflict following an extreme event. For example, heavily agriculture-dependent and marginalised groups in Asian and African countries face increased risks of conflicts due to increased drought.²³⁰

Regarding the integrity of lives and livelihoods and, thus, human security, Adger et al. (2014) found that **'climate change is an important factor threatening human security** [see definition below] through undermining livelihoods, compromising culture and identity, increasing migration that people would rather have avoided and challenging the ability of states to provide the conditions necessary for human security.²³¹

In not only examining traditional concepts of security that foremost aim to protect states, the concept of **human security** addresses 'widespread and cross-cutting challenges to survival, livelihood and dignity of people.'²³² The concept advances comprehensive responses that address complex challenges' multidimensional causes and consequences. It combines aspects of human rights, human development, peacekeeping, and conflict prevention, and one dimension of the concept is already closely linked to further development of the UN human rights system regarding climate change. The appointment of the first **UN Special Rapporteur on the promotion and protection of human rights**

in the context of climate change in 2022 was a milestone. The connection between climate change impacts and human security already was identified in 1994 in the UN Development Programme (UNDP) Human Development Report.²³³

At the UN level, the UN Department of Political and Peacebuilding Affairs, UNDP, UNEP, and UN Department of Peace Operations joined forces and initiated the **Climate Security Mechanism**. This aims to better understand and address linkages between climate change, peace, and security.²³⁴

The climate–security nexus also has found its way into the **UN Security Council**, which holds the primary responsibility for maintaining international peace and security. After first being discussed in 2007 in an attempt to address the issue by the United Kingdom, the understanding of climate impacts' security implications has increased substantially and a full body of research has been conducted on the topic.²³⁵ Steps, such as the formulation of related resolutions, were also taken within the Security Council.

In 2018, the **Group of Friends of Climate and Security** was founded on the initiative of Nauru and Germany. Since then, the issue has been on the agenda, also with specific focus on climate change impacts, such as in January 2019, with a Dominican Republic-led debate on, 'Addressing the impacts of climate-related disasters on international peace and security.' The Group's demands aim to more systematically strengthen awareness of climate-induced security implications, such as through a regular comprehensive United Nations Secretary-General report on the peace and security implications of climate change's adverse effects in country- or region-specific contexts.

227 Schleussner et al. 2016.

228 Burke et al. 2024.

229 Vinke 2023.

230 von Uexkull et al. 2016.

231 Adger et. al 2014.

232 United Nations General Assembly 2012.

233 UNDP 1994.

234 UN 2024.

235 Burke et al. 2024.

6

Method

6.1 Objectives and scope

The CRI analyses climate-related extreme weather events' economic and human effects on countries and, thereby, measures the realised risks' consequences for countries. The index ranks countries according to their economic and human effect, with the most affected country ranked first. Climate science and significantly improved attribution science clearly show that climate change is affecting the intensity, frequency, and duration of many extreme weather events. Also, extreme weather events' impacts on, for example, economic costs and human health are more clearly attributable to climate change.²³⁶

The results and a high rank in the CRI should be understood as a warning signal for the respective countries. The strong connection between the increasing climate crisis and extreme weather events indicates hazards' potential to continue occurring and intensifying. Some changes are happening faster than scientists previously assessed and every fraction of a degree of warming will intensify these impacts.²³⁷

Aim of the CRI

The CRI aims to visualise how extreme weather events affected countries two years before publication and

over the preceding 30 years. It simplifies the aggregation and understanding of climate impacts²³⁸ across different regions and time periods, spotlighting nations that extreme weather events most severely affect. The index aims to contextualise climate policy debates and related policy processes with a view to the climate risks and impacts countries are facing. Apart from the ranking, the index brings forward concrete policy demands and formulates options for taking action, with a particular focus on the UN climate negotiations, debates, and processes on the climate–security nexus at different policy levels, and multilateral fora, such as G7 and G20.

Scope of the CRI

The CRI is a backward-looking index based on past data and giving an indication of 171 countries' realised risks. It is not intended to be used for linear projection of future climate impacts or as a standalone source of information for planning risk management and adaptation measures. The index covers the degree of effect from extreme weather events, including hydrological, meteorological, and climatological events, included

²³⁶ A detailed description of the CRI methodology can be found here: Adil et al. 2025: Methodology of the Climate Risk Index. Germanwatch.

²³⁷ Otto 2023a.

²³⁸ The authors acknowledge that risks and impacts are subject to value judgements and based on cultural and social conceptualisation (see e.g. Farbotko and Campbell 2022).

in EM-DAT. In these categories,²³⁹ the CRI includes the following seven hazards.²⁴⁰

1. Hydrological

- Flood (including general, flash flood, riverine flood)
- Mass movement wet (including avalanches wet, landslides wet, mudslides wet, rockslides wet)

2. Meteorological

- Storm (including extra-tropical storm, tropical cyclone,²⁴¹ severe weather, tornado, blizzard/winter storm, hail, derecho, lightning/thunderstorm, sand/dust storm, storm surge, wind action, connective)
- Extreme temperature (including severe winter conditions, heat wave, cold wave)

3. Climatological

- Wildfire (including wildfire general, forest fire)
- Drought
- Glacial lake outburst flood

The CRI investigates hazards and their related impacts²⁴² and, thus, countries' realised risks driven by extreme weather events. The index includes three hazard categories and seven hazards. Each hazard's impact factor is measured with three indicators, each measured in absolute and relative terms.

6.2 Components and indicators

Table 3: CRI Indicator Overview

CRI Indicators Overview		
1	Losses due to hazard	Absolute losses (in purchasing power parity)
		Relative losses due to hazard (per unit gross domestic product)
2	Fatalities ²⁴³ due to hazard	Absolute fatalities (absolute number)
		Relative fatalities (per 100,000 inhabitants)
3	Degree affected ²⁴⁴ due to hazard	Absolute affected (absolute number)
		Relative affected (per 100,000 inhabitants)

239 Following the EM-DAT categorization and definitions.

240 For definitions for all hazards included in CRI, see the method document here: Adil et al. 2025: Methodology of the Climate Risk Index. Germanwatch.

241 Depending on its location and strength, a tropical cyclone can be called a 'hurricane,' 'typhoon,' 'tropical storm,' 'cyclonic storm,' 'tropical depression,' or simply 'cyclone.' Hurricanes are strong tropical cyclones that occur in the Atlantic Ocean or northeastern Pacific Ocean and typhoons occur in the northwestern Pacific Ocean. In the Indian Ocean and South Pacific, comparable storms are referred to as 'tropical cyclones.'

242 IPCC definition of impact: The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability.

243 Fatalities include confirmed fatalities directly attributed to the disaster plus missing people whose whereabouts since the disaster are unknown and, therefore, they are presumed dead based on official figures.

244 Affected is the total number of injured, otherwise affected, and homeless people.

Relative and absolute indicators: While absolute numbers tend to more prominently represent populous or economically capable countries, relative values capture the proportional impacts on smaller and poorer countries. The CRI analysis is based on absolute and relative indicators in order to consider both effects. With double-weighting in the average ranking of all indicators generating the CRI score, more emphasis and, therefore, greater importance is placed on the relative indicators. Identifying relative values in the index represents an important complement to the otherwise often-dominating absolute values, as it allows for analysing country-specific data on damage in relation to real conditions and capacities in those countries. Clearly, for example, damage of USD 1 billion causes much lighter relative economic consequences for richer countries such as the United States and Japan, than for poor countries, where damage often amounts to a substantial share of the annual GDP.

Use of purchasing power parity values for a more comprehensive estimation of how different societies are affected

Absolute losses are counted in purchasing power parity (PPP) values. These values allow for a more appropriate expression of how the loss of USD 1 actually affects people compared with using nominal exchange rates. PPP is a measure of the price of specific goods in different countries and is used to compare the absolute purchasing power of the countries' currencies. For ex-

ample, this means a farmer in India can buy more crops with USD 1 than a farmer in the United States. Thus, the same nominal damage's relative economic impact is much higher in India.

Influence of economic and population growth on results:

It should be noted that values and, thus, country rankings in the CRI regarding the respective indicators may not only change because of extreme weather events' absolute impacts, but also because of economic and population growth or decline. If, for example, population increases (as in most countries), the same absolute number of deaths leads to a relatively lower assessment in the following year. The same applies for economic growth. However, this does not diminish this approach's significance. Society's ability to cope with damage through disaster risk management generally grows as economic strength increases, as greater resources often allow for better preparedness and response measures. Nevertheless, improved ability does not necessarily imply stronger implementation of effective preparation and response measures, or that such measures are applied equitably across different regions or communities in the country.

6.3 Calculating the CRI score

The CRI uses the following procedure for converting raw data into an index and calculating the CRI score, based on the process developed by the EU Competence Centre on Composite Indicators and Scoreboards.²⁴⁵

²⁴⁵ European Commission 2024.

Figure 11: Calculating the CRI score

- 1** Raw data from sources is selected (for sources see References and Annex). Data errors (i.e. tabulation errors coming from the source) are identified and corrected at this stage.
- 2** An indicator is labeled as 'missing' for a country, if data that is missing for one or more countries. This particular indicator will not be considered in the averaging process. The raw data was selected to cover a high number of UN countries (see chapter 6.1).
- 3** The CRI indicators are normalised by determining the distance from the group leader, which assigns 100 to the leading country and other countries are ranked as percentage points way from the the leader.
- 4** The absolute economic and human loss indicators are weighted 1/8 (12.5%), the relative economic and human loss indicators are weighted 3/8 (37.5%). The human loss indicator consists of fatalities (weighted 3/5 (60%)) and people affected (weighted with 2/5 (40%)).
- 5** The CRI score is calculated as follows:
CRI score = [3/5 (Absolute fatalities) + 2/5 (Absolute affectedness)] x 1/8 + [3/5 (Relative fatalities) + 2/5 (Relative affectedness)] x 3/8 + (Absolute losses) x 1/8 + (Relative losses) x 3/8

Figure 12: CRI indicators and weighting



Indicators

■ Fatalities, relative	22,50 %
■ Fatalities, absolute	7,50 %
■ Affected, relative	15,00 %
■ Affected, absolute	5,00 %
■ Economic losses, relative	37,50 %
■ Economic losses, absolute	12,50 %

6.4 Time frames

The CRI ranking addresses two time frames. **The short-term ranking** considers impacts of extreme weather events that occurred two years before publication. The two-year interval between events and publication is because of the index's data basis. The data were published in certain cycles. For a publication with a one-year interval, the World Bank dataset as the basis for determining/categorising countries' economic losses would not yet be fully available. The EM-DAT database's data quality also increases with the time lag to the year

of the events, as the data is validated and supplemented several times. The two-year interval, therefore, ensures higher data quality and better coverage.

The **long-term ranking** is based on average values over a 30-year period, which was chosen to cover a climate-relevant timeframe. This ranking allows showing of extreme-weather events' long-term degree of effect on countries. It shows the degree of effect by unusually extreme events and recurring extreme weather events.

Table 4: Climate Risk Index time frames

Short-term CRI	Most impacted countries, usually two years before publication (2022 for CRI 2025)
Long-term CRI	Most impacted countries over the preceding 30 years (1993–2022 for CRI 2025)

6.5 Limitations of the index

The CRI does not provide an all-encompassing analysis of countries' realised or future risks of anthropogenic climate change. It should be seen as one analysis, which helps explain countries' degree of effect from climate-related impacts and risks based, on the best publicly available historical data set on extreme weather events' impacts, alongside other analysis.²⁴⁶

The index is based on data reflecting current and past natural climate variability and on climate change, to the extent that it has already left a footprint on climate variability over the preceding 30 years.

Hazards and impacts:²⁴⁷ For collecting data, EM-DAT uses a threshold for defining which events to include

in the database. One of the following criteria must be satisfied for inclusion:

- 10+ reported deaths
- 100+ people reported affected
- Declaration of a state of emergency
- Call for international assistance

An international appeal for assistance, however, takes first precedence for entry, even if the first two criteria are not fulfilled.²⁴⁸

Due to the EM-DAT collection criteria, events that do not satisfy the outlined criteria are not included in the database and, therefore, also not in the CRI.

Phenomena included in the CRI

Climate change's effects can be divided into two categories in accordance with the temporal scale over which they occur and the differing speed of their impacts' manifestation: slow-onset processes and rapid-onset events. The CRI analysis only incorporates extreme weather (rapid-onset) events, including hydrological events, such as floods and mass movements, meteorological events, such as storms and temperature extremes, and climatological events, such as

²⁴⁶ Notre Dame Global Adaptation Initiative 2024.

²⁴⁷ EM-DAT Project 2022.

²⁴⁸ Sapir and Misson 1992.

wildfires, glacial lake outburst floods, and drought. The CRI does not include slow-onset processes, which are taken as ‘phenomena caused or intensified by anthropogenic climate change that take place over prolonged periods of time – typically years, decades, or even centuries – without a clear start or end point.’²⁴⁹ Slow-onset processes include: increasing mean temperatures, sea level rise, ocean acidification, glacial retreat, permafrost degradation, salinisation, land and forest degradation, and desertification, decreasing precipitation, and loss of biodiversity (see IPCC 2022, UNFCCC 2012, UNU 2017). Such processes cannot be included in this index because of the limited data availability on economic and human effects.

Geological events, including earthquakes, volcanic eruptions, and tsunamis, which are independent of weather, are also not included in this index and, thus, not attributable to climate change.

Level

The CRI compares how countries are affected at the national level. It does not allow for conclusions about damage distribution below that level.

Climate change parameters

The CRI’s event-related examination does not allow for assessment of continuous changes of important

climate parameters. For instance, the CRI cannot show a long-term decline in precipitation that was shown in some African countries and resulting from climate change. Nevertheless, such parameters often greatly influence important development factors, such as agricultural output and drinking water availability.

Impacts covered

Lagged impacts that manifest significantly later than an event occurred (e.g. a person’s death due to injuries as a consequence of an event’s impacts, or downstream economic damage due to the loss of economic buffers or loss of income in the recovery phase of affected people²⁵⁰), may not be included in the calculations of the CRI.

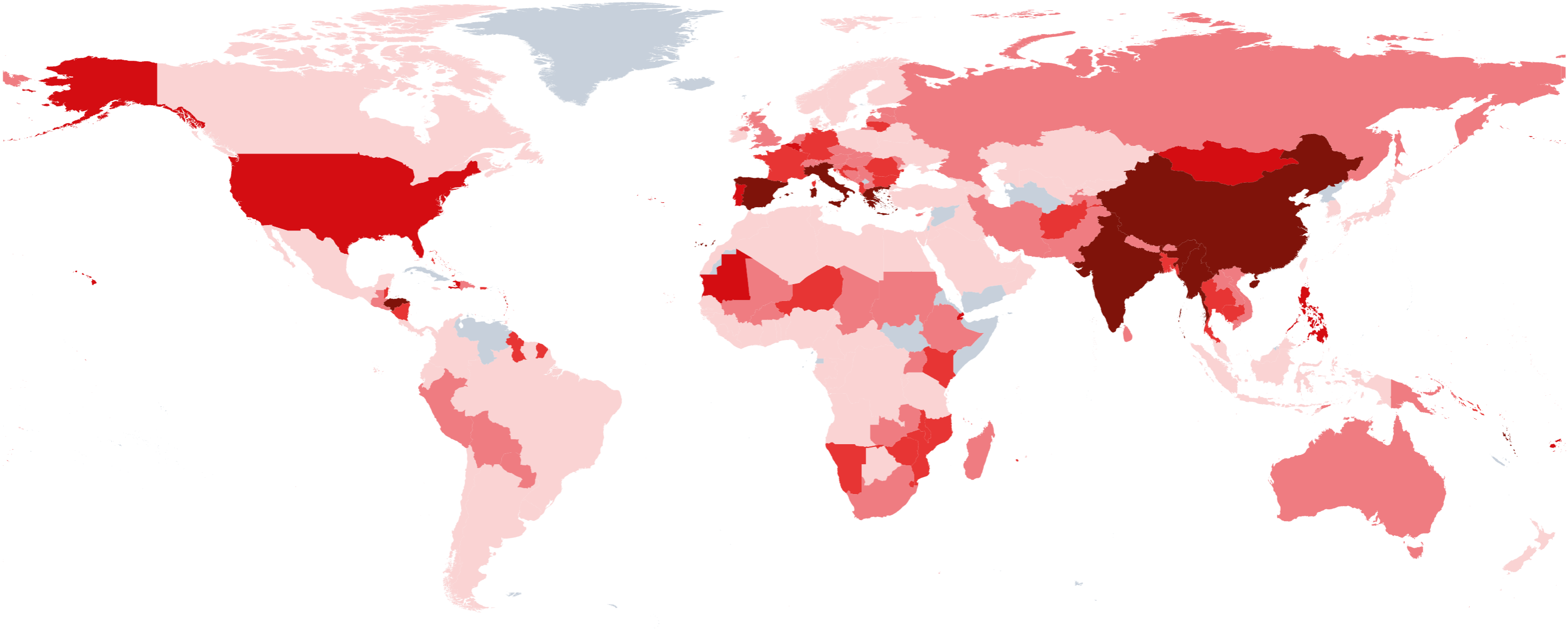
Climate change-related extreme weather events can cause both economic (including [a] physical assets and [b] income) and non-economic losses and damages (including [a] material and [b] non-material forms).²⁵¹ The index covers a broad range of economic and non-economic losses and damages. Measuring non-economic loss and damage is particularly challenging. Therefore, the index does not cover some forms of non-economic loss and damage (e.g. loss of heritage, identity and culture).

249 Schaefer et al. 2023.

250 see e.g. Sauer et al. 2023.

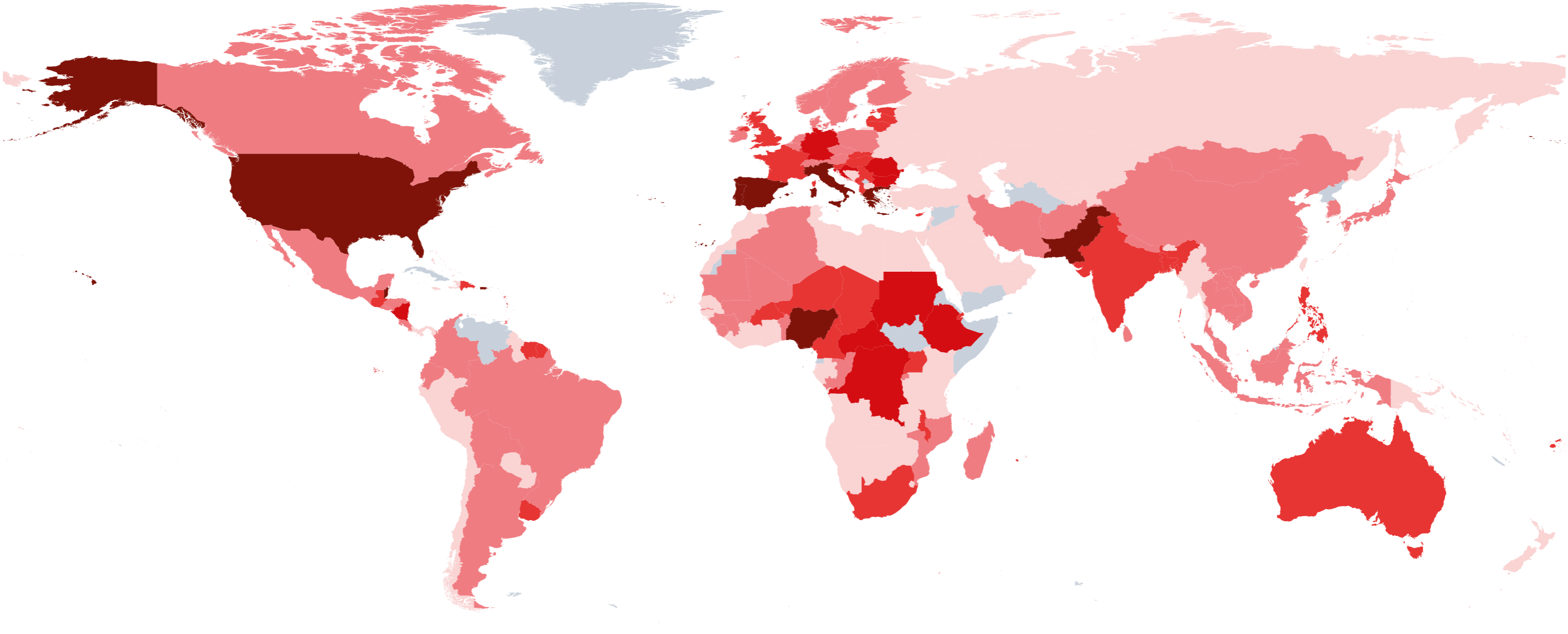
251 Serdeczny 2018.

**Climate Risk Index:
Overall Ranking 1993-2022**



- >100
- 51-100
- 21-50
- 11-20
- 1-10
- No Data

**Climate Risk Index:
Overall Ranking 2022**



- >100
- 51-100
- 21-50
- 11-20
- 1-10
- No Data

Annex

CRI= Climate Risk Index; PPP= Purchasing power parity; GDP= Gross Domestic Product

Table 5: Climate Risk Index for 1993-2022 (annual averages)²⁵²

Country	Rank 1993- 2022	CRI Score 1993- 2022	Fatalities (1993- 2022)	Fatalities per 100.000 (1993- 2022)	Affected (1993- 2022)	Affected per 100.000 (1993- 2022)	Losses in USD (PPP) (1993- 2022)	Losses % of GDP (1993- 2022)
Albania	42	0.103629	12.87	0.426	30,863	103.550	4,032,148	0.010%
Algeria	148	0.008564	57.87	0.028	19,140	5.127	164,382,637	0.037%
Angola	124	0.018524	29.30	0.018	207,335	77.924	3,796,871	0.001%
Antigua and Barbuda	53	0.085027	0.23	0.032	1,476	183.577	49,364,537	1.995%
Argentina	147	0.009236	14.97	0.005	70,014	17.498	1,055,743,805	0.100%
Armenia	142	0.010006	0.17	0.001	13,511	43.675	34,697,190	0.077%
Australia	85	0.046578	34.30	0.020	312,075	171.972	2,200,260,532	0.212%
Austria	94	0.037935	29.83	0.176	2,409	2.982	351,221,006	0.063%
Azerbaijan	132	0.015615	1.17	0.001	61,343	79.179	57,630,032	0.021%
Bangladesh	31	0.123559	579.37	0.051	6,357,577	461.334	2,991,631,701	0.352%
Barbados	161	0.002534	0.07	0.002	289	10.540	224,186	0.004%
Belarus	164	0.002209	2.03	0.002	6,957	7.199	39,965,990	0.014%
Belgium	18	0.147094	181.23	0.724	3,597	3.125	131,245,390	0.025%
Belize	21	0.140015	2.13	0.085	15,856	501.745	50,409,736	1.341%
Benin	119	0.020889	6.10	0.021	72,232	89.581	715,857	0.001%
Bhutan	88	0.045079	8.70	0.187	2,220	42.517	885,375	0.009%
Bolivia	74	0.056012	40.87	0.076	185,129	179.419	254,612,779	0.283%
Bosnia and Herzegovina	99	0.034709	1.60	0.005	56,084	154.380	97,559,143	0.213%
Botswana	149	0.008447	1.17	0.007	6,799	36.411	4,610,520	0.015%

²⁵² Zero values indicate that either there is no data available or that no events (fatalities, losses, etc.) occurred.

Country	Rank 1993- 2022	CRI Score 1993- 2022	Fatalities (1993- 2022)	Fatalities per 100.000 (1993- 2022)	Affected (1993- 2022)	Affected per 100.000 (1993- 2022)	Losses in USD (PPP) (1993- 2022)	Losses % of GDP (1993- 2022)
Brazil	101	0.032675	137.27	0.018	2,094,627	106.315	1,953,017,461	0.065%
Bulgaria	24	0.135757	48.27	0.666	2,618	3.589	170,403,199	0.120%
Burkina Faso	83	0.048597	5.63	0.006	469,711	245.785	18,203,362	0.068%
Burundi	102	0.032595	14.10	0.017	112,204	153.101	1,676,860	0.029%
Cambodia	25	0.135293	55.77	0.059	767,122	605.986	187,747,901	0.429%
Cameroon	150	0.008257	7.40	0.006	98,935	36.818	1,731,969	0.002%
Canada	120	0.020264	34.43	0.075	16,683	4.767	1,061,584,964	0.067%
Cape Verde	116	0.023108	0.43	0.013	6,041	110.307	81,171	0.003%
Central African Republic	103	0.032359	1.37	0.012	87,618	161.725	0	0.000%
Chad	64	0.065094	11.40	0.020	409,155	326.917	954,439	0.005%
Chile	144	0.009610	18.87	0.012	35,963	22.141	339,962,162	0.089%
China	2	0.313216	1.403.57	0.013	88,294,531	688.743	44,138,282,005	0.258%
Chinese Taipei	128	0.017039	50.20	0.024	114,234	50.021	463,235,491	0.043%
Colombia	108	0.029258	125.57	0.044	386,991	88.204	267,770,104	0.058%
Comoros	98	0.035712	0.47	0.006	14,092	183.146	371,364	0.021%
Costa Rica	100	0.034054	6.90	0.018	64,425	151.252	100,903,965	0.088%
Côte d'Ivoire	166	0.001882	8.17	0.008	2,967	1.190	0	0.000%
Croatia	20	0.140349	53.00	0.698	644	1.523	91,295,210	0.062%
Cyprus	71	0.059802	5.53	0.302	23	0.231	2,966,270	0.010%
Czech Republic	97	0.036520	29.23	0.109	54,226	51.844	769,847,136	0.140%
Democratic Republic of Congo	117	0.021637	42.63	0.015	916,246	93.894	1,338,090	0.002%
Democratic Republic of Timor-Leste	95	0.037823	1.63	0.113	9,535	75.810	2,694,963	0.066%

Country	Rank 1993- 2022	CRI Score 1993- 2022	Fatalities (1993- 2022)	Fatalities per 100.000 (1993- 2022)	Affected (1993- 2022)	Affected per 100.000 (1993- 2022)	Losses in USD (PPP) (1993- 2022)	Losses % of GDP (1993- 2022)
Denmark	106	0.030034	8.90	0.144	0	0.000	203,902,043	0.049%
Djibouti	16	0.148637	7.23	0.127	58,365	665.352	0	0.005%
Dominica	1	0.567107	3.27	0.465	3,782	539.387	153,870,616	16.767%
Dominican Republic	78	0.052620	47.13	0.056	193,815	191.739	353,592,361	0.195%
Ecuador	131	0.016052	37.67	0.044	30,077	21.337	227,230,702	0.102%
Egypt	162	0.002225	33.23	0.006	7,598	1.080	76,119,272	0.006%
El Salvador	72	0.058877	37.57	0.106	75,072	121.913	331,874,350	0.624%
Estonia	55	0.082533	5.93	0.415	3	0.025	12,631,377	0.024%
Eswatini	22	0.137785	0.47	0.004	79,638	738.217	6,039	0.000%
Ethiopia	63	0.065376	72.53	0.011	2,829,457	301.894	209,543,120	0.178%
Fiji	11	0.170623	7.10	0.130	56,804	641.147	99,486,783	1.148%
Finland	110	0.026721	7.50	0.135	13	0.025	0	0.000%
France	32	0.121400	1,097.00	0.470	139,723	22.833	2,250,538,866	0.066%
Gabon	160	0.002815	0.03	0.000	2,739	14.977	0	0.000%
Georgia	127	0.017330	2.03	0.005	29,203	72.986	69,589,859	0.113%
Germany	48	0.096330	601.70	0.373	19,201	2.338	4,371,285,334	0.102%
Ghana	140	0.010342	17.80	0.009	99,794	43.258	10,426,239	0.005%
Greece	7	0.202075	114.20	1.002	3,310	3.127	279,960,852	0.074%
Grenada	17	0.147542	1.30	0.119	2,010	183.508	68,590,827	4.021%
Guatemala	52	0.090573	109.07	0.122	476,827	306.145	470,104,054	0.297%
Guinea	158	0.004149	1.87	0.003	19,212	18.929	0	0.000%
Guinea- Bissau	145	0.009583	0.37	0.003	6,844	48.928	0	0.000%
Guyana	29	0.125369	1.13	0.015	43,075	568.743	142,815,830	0.741%
Haiti	14	0.158777	298.70	0.350	339,182	345.748	275,359,907	0.900%
Honduras	3	0.295863	525.97	0.874	416,080	491.137	630,805,255	1.005%
Hungary	87	0.045089	47.33	0.208	13,499	13.524	104,397,619	0.030%

Country	Rank	CRI Score	Fatalities	Fatalities per 100.000	Affected	Affected per 100.000 (1993-2022)	Losses in USD (PPP)	Losses % of GDP
	1993-2022	1993-2022	(1993-2022)	(1993-2022)	(1993-2022)	(1993-2022)	(1993-2022)	(1993-2022)
India	6	0.206412	2.674.77	0.038	46,645,209	409.376	19,681,088,627	0.314%
Indonesia	115	0.023156	257.03	0.018	528,995	23.245	3,559,758,158	0.113%
Iraq	137	0.011211	5.37	0.003	239,286	55.307	11,376,616	0.003%
Ireland	157	0.004183	1.63	0.019	163	0.433	27,799,576	0.008%
Islamic Republic of Afghanistan	45	0.100280	252.80	0.171	1,090,293	326.522	35,961,449	0.057%
Islamic Republic of Iran	66	0.062797	80.17	0.018	1,836,368	263.721	2,131,742,065	0.133%
Israel	125	0.017914	2.90	0.006	69,501	86.164	57,119,628	0.022%
Italy	5	0.253020	1.291.47	1.142	4,023	0.695	2,374,842,373	0.067%
Jamaica	104	0.032326	2.80	0.011	29,149	107.177	129,788,583	0.447%
Japan	122	0.019580	111.47	0.015	154,132	12.142	4,501,466,177	0.083%
Jordan	156	0.004542	1.67	0.002	11,010	22.026	180,506	0.000%
Kazakhstan	155	0.004752	7.57	0.005	28,952	18.244	37,187,219	0.009%
Kenya	36	0.114643	72.47	0.035	2,010,142	560.987	73,255,933	0.057%
Kiribati	70	0.060455	0.00	0.000	2,860	325.968	0	0.000%
Korea, Republic of	143	0.009811	59.93	0.019	33,116	6.903	1,100,820,390	0.054%
Kuwait	172	0.000098	0.10	0.000	7	0.038	0	0.000%
Kyrgyz Republic	105	0.030918	10.77	0.029	70,427	131.384	12,432,128	0.030%
Lao People's Democratic Republic	57	0.077408	11.70	0.020	203,964	353.485	130,545,771	0.328%
Latvia	92	0.040737	6.57	0.200	0	0.000	35,978,055	0.052%
Lebanon	141	0.010332	0.80	0.001	34,341	54.111	0	0.000%
Lesotho	40	0.107226	0.90	0.004	120,846	573.030	0	0.000%
Liberia	169	0.001305	0.47	0.002	1,978	5.281	0	0.000%
Libya	171	0.000522	0.67	0.001	734	1.128	5,639,214	0.003%

Country	Rank 1993- 2022	CRI Score 1993- 2022	Fatalities (1993- 2022)	Fatalities per 100.000 (1993- 2022)	Affected (1993- 2022)	Affected per 100.000 (1993- 2022)	Losses in USD (PPP) (1993- 2022)	Losses % of GDP (1993- 2022)
Lithuania	41	0.104492	16.17	0.459	26,000	70.602	27,072,329	0.027%
Luxembourg	60	0.069322	7.13	0.350	51	0.817	2,611,347	0.004%
Madagascar	67	0.062556	77.47	0.068	432,230	209.338	152,939,871	0.383%
Malawi	34	0.115971	37.77	0.049	813,366	544.093	41,336,015	0.194%
Malaysia	135	0.013492	22.67	0.021	113,286	37.820	321,334,876	0.051%
Maldives	170	0.000691	0.00	0.000	159	3.724	0	0.000%
Mali	84	0.047873	4.97	0.005	467,470	251.488	0	0.000%
Malta	50	0.094020	2.53	0.477	0	0.000	0	0.000%
Marshall Islands	89	0.044025	0.00	0.000	1,094	225.132	203,148	0.102%
Mauritania	15	0.155022	3.27	0.024	297,714	808.814	198,863	0.001%
Mauritius	152	0.006614	0.73	0.008	1,152	9.223	39,584,950	0.140%
Mexico	112	0.024714	136.60	0.018	478,197	44.561	3,121,839,633	0.135%
Micronesia	23	0.136512	1.77	0.158	6,081	551.701	505,980	0.135%
Moldova	58	0.074401	2.97	0.010	96,886	331.748	224,980,404	0.458%
Mongolia	19	0.144220	8.97	0.054	158,221	597.442	575,489,083	0.944%
Montenegro	75	0.054593	1.70	0.271	420	6.772	0	0.000%
Morocco	136	0.011402	42.27	0.017	103,467	30.371	147,967,376	0.059%
Mozambique	39	0.108093	98.47	0.067	848,747	383.406	272,806,282	0.940%
Myanmar	4	0.284678	4.662.90	0.967	226,055	45.283	688,753,303	0.406%
Namibia	38	0.112773	8.80	0.042	118,418	554.934	11,277,996	0.058%
Nepal	69	0.061661	249.70	0.189	199,080	75.840	221,330,917	0.258%
Netherlands	86	0.045906	108.63	0.214	8,837	5.719	213,302,149	0.020%
New Zealand	163	0.002214	0.50	0.002	663	1.513	105,373,644	0.059%
Nicaragua	33	0.120232	130.40	0.270	139,380	245.346	281,685,106	0.840%
Niger	27	0.129531	29.33	0.055	1,090,932	618.370	23,928,677	0.129%
Nigeria	123	0.018624	91.50	0.017	1,141,701	58.241	453,320,687	0.061%

Country	Rank 1993- 2022	CRI Score 1993- 2022	Fatalities (1993- 2022)	Fatalities per 100.000 (1993- 2022)	Affected (1993- 2022)	Affected per 100.000 (1993- 2022)	Losses in USD (PPP) (1993- 2022)	Losses % of GDP (1993- 2022)
North Macedonia	81	0.049322	2.30	0.013	45,375	230.574	56,931,810	0.167%
Norway	154	0.005241	1.53	0.025	262	0.574	30,333,359	0.006%
Oman	129	0.016568	6.10	0.036	889	3.097	451,375,794	0.343%
Pakistan	56	0.079537	564.17	0.065	3,204,997	159.694	4,851,813,029	0.657%
Panama	118	0.021275	7.00	0.085	7,116	19.894	24,355,247	0.032%
Papua New Guinea	93	0.040632	18.23	0.041	127,082	168.967	12,887,181	0.034%
Paraguay	91	0.040951	6.70	0.017	116,903	200.731	7,029,514	0.010%
Peru	90	0.041253	145.17	0.057	381,797	133.697	256,304,488	0.090%
Philippines	10	0.187456	927.57	0.139	6,403,807	681.578	2,335,669,829	0.431%
Poland	114	0.023429	101.17	0.090	11,963	3.113	815,269,696	0.069%
Portugal	12	0.169496	189.07	0.819	5,472	5.239	472,387,734	0.130%
Puerto Rico	46	0.099039	4.03	0.036	30,782	90.778	3,469,880,316	2.986%
Qatar	173	0.000043	0.00	0.000	50	0.181	539,181	0.000%
Republic of Congo	134	0.014488	2.40	0.028	23,448	48.535	22,966	0.000%
Romania	49	0.094075	112.50	0.445	13,930	6.366	632,508,239	0.087%
Russia	62	0.065817	1,985.23	0.140	143,630	9.815	1,586,929,497	0.033%
Rwanda	111	0.026593	18.03	0.048	71,592	85.394	7,748,347	0.045%
Samoa	107	0.029478	0.73	0.038	423	21.372	7,284,687	0.806%
Saudi Arabia	167	0.001779	14.23	0.005	940	0.357	104,886,266	0.009%
Senegal	121	0.020219	9.70	0.011	114,246	93.630	8,780,447	0.016%
Serbia	65	0.064516	22.27	0.291	6,582	9.184	192,176,904	0.204%
Seychelles	130	0.016098	0.17	0.022	516	59.705	663,631	0.035%
Sierra Leone	126	0.017865	44.20	0.064	9,435	19.224	3,307,855	0.041%
Slovak Republic	82	0.048812	18.97	0.238	1,989	3.689	64,138,001	0.037%
Slovenia	68	0.061820	15.13	0.295	2,237	10.850	43,289,485	0.064%

Country	Rank	CRI Score	Fatalities	Fatalities per 100.000	Affected	Affected per 100.000 (1993-2022)	Losses in USD (PPP)	Losses % of GDP
	1993-2022	1993-2022	(1993-2022)	(1993-2022)	(1993-2022)		(1993-2022)	(1993-2022)
Solomon Islands	44	0.101240	4.37	0.281	12,560	234.305	1,176,931	0.106%
South Africa	79	0.050487	56.37	0.043	1,054,833	198.707	611,308,684	0.096%
Spain	8	0.198138	895.93	0.914	1,492	0.350	987,034,494	0.051%
Sri Lanka	59	0.070218	58.87	0.037	623,281	305.918	302,301,329	0.191%
St. Kitts and Nevis	47	0.098803	0.17	0.038	449	101.727	45,893,627	3.237%
St. Lucia	43	0.102003	0.87	0.068	7,820	455.041	5,559,188	0.185%
St. Vincent and the Grenadines	73	0.057988	0.57	0.052	1,685	157.389	10,343,620	0.827%
Sudan	80	0.050371	51.67	0.039	808,060	212.130	136,875,214	0.080%
Suriname	151	0.006859	0.17	0.003	1,688	30.398	2,239,224	0.026%
Sweden	159	0.003661	1.97	0.014	450	0.432	128,306,192	0.024%
Switzerland	96	0.036744	48.27	0.172	249	0.336	347,868,461	0.049%
Tajikistan	51	0.091128	14.43	0.027	222,637	330.885	215,299,551	1.055%
Tanzania	113	0.023990	22.90	0.008	489,264	116.970	1,092,937	0.001%
Thailand	30	0.124775	113.03	0.021	3,266,860	491.337	5,483,635,205	0.578%
The Bahamas	28	0.128272	13.50	0.337	1,772	47.151	241,209,994	2.342%
The Gambia	109	0.027909	3.37	0.038	22,354	109.688	0	0.000%
Togo	146	0.009391	2.77	0.008	22,775	41.535	0	0.000%
Tonga	26	0.133947	0.13	0.012	4,903	467.266	12,585,373	2.003%
Trinidad and Tobago	139	0.010719	0.27	0.002	8,399	55.485	333,859	0.001%
Tunisia	168	0.001570	1.90	0.004	3,850	3.368	4,315,235	0.003%
Turkey	153	0.006004	32.00	0.010	77,588	11.637	343,664,571	0.020%
Tuvalu	37	0.114211	0.00	0.000	682	615.832	0	0.000%
Uganda	76	0.053144	126.70	0.196	200,666	67.017	1,044,565	0.001%
Ukraine	138	0.010781	41.00	0.010	96,777	19.283	743,778,316	0.122%

Country	Rank 1993- 2022	CRI Score 1993- 2022	Fatalities (1993- 2022)	Fatalities per 100.000 (1993- 2022)	Affected (1993- 2022)	Affected per 100.000 (1993- 2022)	Losses in USD (PPP) (1993- 2022)	Losses % of GDP (1993- 2022)
United Arab Emirates	174	0.000001	0.00	0.000	6	0.007	0	0.000%
United Kingdom	61	0.069049	248.90	0.306	25,423	4.194	1,291,571,350	0.044%
United States of America	13	0.167833	389.20	0.027	3,787,896	119.573	52,782,173,055	0.310%
Uruguay	133	0.015341	1.20	0.004	23,473	69.056	55,882,994	0.074%
Uzbekistan	165	0.002172	1.37	0.002	22,391	8.816	9,271,034	0.004%
Vanuatu	9	0.191043	2.20	0.132	14,862	557.309	18,345,271	2.756%
Vietnam	54	0.084059	400.50	0.063	1,920,513	228.414	4,042,685,008	0.547%
Zambia	77	0.052944	2.63	0.003	351,991	280.438	3,990,315	0.005%
Zimbabwe	35	0.115300	41.47	0.029	730,851	552.364	128,048,172	0.256%

Table 6: Climate Risk Index for 2022²⁵³

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Albania	23	0.094584	352	12.672	0	0.000	0	0.00%
Algeria	99	0.000966	44	0.098	6,768	1.507	0	0.00%
Angola	149	0.000000	0	0.000	0	0.000	0	0.00%
Antigua and Barbuda	157	0.000000	0	0.000	0	0.000	0	0.00%
Argentina	68	0.013958	0	0.000	124,085	26.838	1,530,198,015	0.12%
Armenia	165	0.000000	0	0.000	0	0.000	0	0.00%
Australia	36	0.058452	31	0.119	247,212	95.029	7,670,177,260	0.50%
Austria	53	0.036221	424	4.689	13	0.014	0	0.00%
Azerbaijan	147	0.000000	0	0.000	0	0.000	0	0.00%
Bangladesh	46	0.041459	176	0.103	8,200,000	479.010	1,343,012,958	0.10%

²⁵³ Zero values indicate that either there is no data available or that no events (fatalities, losses, etc.) occurred.

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Barbados	137	0.000000	0	0.000	0	0.000	0	0.00%
Belarus	127	0.000000	0	0.000	0	0.000	0	0.00%
Belgium	57	0.029229	436	3.731	0	0.000	0	0.00%
Belize	2	0.481448	0	0.000	172,150	4247.764	177,643,638	3.53%
Benin	82	0.004645	44	0.330	73,000	54.670	0	0.00%
Bhutan	126	0.000000	0	0.000	0	0.000	0	0.00%
Bolivia	67	0.015257	60	0.491	375,000	306.771	0	0.00%
Bosnia and Herzegovina	104	0.000564	1	0.031	3,000	9.278	0	0.00%
Botswana	134	0.000000	0	0.000	0	0.000	0	0.00%
Brazil	50	0.038724	528	0.245	224,081	10.407	10,277,225,038	0.26%
Bulgaria	10	0.156041	1,277	19.752	10,937	16.917	109,340,404	0.05%
Burkina Faso	32	0.059826	0	0.000	3,500,928	1544.044	0	0.00%
Burundi	144	0.000000	0	0.000	0	0.000	0	0.00%
Cambodia	80	0.005275	31	0.185	167,770	100.055	0	0.00%
Cameroon	48	0.039915	21	0.075	2,542,472	910.806	45,913,499	0.03%
Canada	96	0.001587	17	0.044	6,000	1.541	220,280,018	0.01%
Cape Verde	59	0.027511	0	0.000	46,093	777.090	0	0.00%
Central African Republic	11	0.155750	16	0.287	2,369,695	4247.417	0	0.00%
Chad	29	0.070371	22	0.124	3,235,591	1825.613	0	0.00%
Chile	111	0.000293	3	0.015	8,590	4.382	0	0.00%
China	51	0.038089	161	0.011	6,109,203	43.261	21,684,135,546	0.07%
Chinese Taipei	123	0.000007	0	0.000	100	0.043	828,633	0.00%
Colombia	79	0.005428	156	0.301	269,508	51.954	30,964,040	0.00%
Comoros	171	0.000000	0	0.000	0	0.000	0	0.00%
Costa Rica	63	0.020902	0	0.000	300,000	579.058	0	0.00%

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Côte d'Ivoire	105	0.000556	13	0.046	11,592	4.116	0	0.00%
Croatia	13	0.142357	731	18.959	0	0.000	0	0.00%
Cyprus	34	0.059724	101	8.070	0	0.000	0	0.00%
Czech Republic	64	0.020443	280	2.624	3	0.003	0	0.00%
Democratic Republic of Congo	14	0.135873	223	0.225	26,233,517	2649.577	0	0.00%
Democratic Republic of Timor-Leste	168	0.000000	0	0.000	0	0.000	0	0.00%
Denmark	54	0.032546	253	4.286	3	0.005	0	0.00%
Djibouti	31	0.060834	0	0.000	192,168	1714.486	0	0.00%
Dominica	158	0.000000	0	0.000	0	0.000	0	0.00%
Dominican Republic	42	0.047449	2	0.018	1,435,269	1278.201	0	0.00%
Ecuador	75	0.008530	76	0.422	35,379	19.654	115,571,016	0.05%
Egypt	170	0.000000	0	0.000	0	0.000	0	0.00%
El Salvador	77	0.006871	11	0.174	9,373	14.792	36,943,357	0.05%
Estonia	24	0.091674	167	12.381	0	0.000	0	0.00%
Eswatini	110	0.000313	0	0.000	1,058	8.804	0	0.00%
Ethiopia	12	0.155463	0	0.000	24,364,831	1974.781	1,680,956,158	0.50%
Fiji	27	0.074411	1	0.108	69,564	748.188	59,015,794	0.50%
Finland	56	0.030693	225	4.050	0	0.000	0	0.00%
France	28	0.072440	4.813	7.081	60,378	8.883	0	0.00%
Gabon	166	0.000000	0	0.000	0	0.000	0	0.00%
Georgia	107	0.000502	0	0.000	5,200	14.007	0	0.00%
Germany	17	0.109270	8.180	9.762	2	0.000	1,314,815,407	0.03%
Ghana	119	0.000060	0	0.000	5,000	1.494	0	0.00%
Greece	4	0.232704	3.092	29.654	55,000	52.748	0	0.00%

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Grenada	135	0.000000	0	0.000	0	0.000	0	0.00%
Guatemala	22	0.096125	52	0.300	3,347,334	1928.423	463,101,900	0.21%
Guinea	97	0.001337	0	0.000	49,536	35.742	0	0.00%
Guinea-Bissau	133	0.000000	0	0.000	0	0.000	0	0.00%
Guyana	113	0.000219	0	0.000	500	6.183	0	0.00%
Haiti	100	0.000889	7	0.060	13,000	11.221	0	0.00%
Honduras	73	0.008911	14	0.134	222,457	213.227	0	0.00%
Hungary	47	0.041224	513	5.320	0	0.000	0	0.00%
India	49	0.039806	2,210	0.156	2,196,260	15.497	15,254,391,270	0.13%
Indonesia	93	0.002079	55	0.020	353,570	12.834	208,579,752	0.01%
Iraq	118	0.000068	1	0.002	5,000	1.124	0	0.00%
Ireland	85	0.003982	27	0.527	0	0.000	0	0.00%
Islamic Republic of Afghanistan	74	0.008663	271	0.659	266,787	64.866	0	0.00%
Islamic Republic of Iran	76	0.007290	98	0.111	164,790	18.610	667,347,256	0.05%
Israel	140	0.000000	0	0.000	0	0.000	0	0.00%
Italy	3	0.300002	18,047	30.619	333	0.056	0	0.00%
Jamaica	159	0.000000	0	0.000	0	0.000	0	0.00%
Japan	69	0.011130	109	0.087	40,593	3.244	3,841,886,562	0.07%
Jordan	125	0.000000	0	0.000	0	0.000	0	0.00%
Kazakhstan	145	0.000000	0	0.000	0	0.000	0	0.00%
Kenya	131	0.000000	0	0.000	0	0.000	0	0.00%
Kiribati	128	0.000000	0	0.000	0	0.000	0	0.00%
Korea, Republic of	86	0.003941	28	0.054	55,856	10.810	652,022,794	0.03%
Kuwait	136	0.000000	0	0.000	0	0.000	0	0.00%

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Kyrgyz Republic	102	0.000722	0	0.000	13,850	19.857	0	0.00%
Lao People's Democratic Republic	92	0.002162	1	0.013	42,552	56.514	0	0.00%
Latvia	45	0.041491	105	5.587	0	0.000	0	0.00%
Lebanon	129	0.000000	0	0.000	0	0.000	0	0.00%
Lesotho	132	0.000000	0	0.000	0	0.000	0	0.00%
Liberia	156	0.000000	0	0.000	0	0.000	0	0.00%
Libya	130	0.000000	0	0.000	0	0.000	0	0.00%
Lithuania	21	0.100456	381	13.455	0	0.000	0	0.00%
Luxembourg	41	0.049689	44	6.737	0	0.000	0	0.00%
Madagascar	62	0.022924	224	0.756	490,384	165.605	51,537,737	0.10%
Malawi	26	0.075321	133	0.652	3,718,312	1822.227	0	0.00%
Malaysia	91	0.002378	50	0.147	90,719	26.731	655,080	0.00%
Maldives	141	0.000000	0	0.000	0	0.000	0	0.00%
Mali	55	0.031479	10	0.044	1,814,765	803.221	0	0.00%
Malta	18	0.105468	76	14.310	0	0.000	0	0.00%
Marshall Islands	52	0.038064	0	0.000	4,480	1077.726	0	0.00%
Mauritania	83	0.004431	14	0.296	28,926	61.075	0	0.00%
Mauritius	103	0.000625	1	0.079	139	1.101	0	0.00%
Mexico	98	0.001003	51	0.040	19,150	1.502	97,002,544	0.00%
Micronesia	155	0.000000	0	0.000	0	0.000	0	0.00%
Moldova	172	0.000000	0	0.000	0	0.000	0	0.00%
Mongolia	89	0.003577	0	0.000	33,931	99.845	0	0.00%
Montenegro	33	0.059736	50	8.101	0	0.000	0	0.00%
Morocco	154	0.000000	0	0.000	0	0.000	0	0.00%
Mozambique	66	0.017884	203	0.616	1,023,763	310.518	0	0.00%

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Myanmar	173	0.000000	0	0.000	0	0.000	0	0.00%
Namibia	169	0.000000	0	0.000	0	0.000	0	0.00%
Nepal	78	0.005453	190	0.622	7,105	2.326	0	0.00%
Netherlands	58	0.027512	473	2.672	0	0.000	697,291,681	0.06%
New Zealand	121	0.000049	0	0.000	690	1.348	0	0.00%
Nicaragua	16	0.111450	5	0.072	50,112	72.120	561,920,670	1.15%
Niger	25	0.077056	195	0.744	4,722,185	1801.812	0	0.00%
Nigeria	8	0.166457	610	0.279	21,914,398	1002.758	11,011,502,493	0.89%
North Macedonia	153	0.000000	0	0.000	0	0.000	0	0.00%
Norway	84	0.004164	30	0.550	0	0.000	0	0.00%
Oman	143	0.000000	0	0.000	0	0.000	0	0.00%
Pakistan	1	0.536269	1,765	0.748	33,016,869	1400.059	53,895,359,584	4.00%
Panama	122	0.000012	0	0.000	150	0.340	0	0.00%
Papua New Guinea	139	0.000000	0	0.000	0	0.000	0	0.00%
Paraguay	160	0.000000	0	0.000	0	0.000	0	0.00%
Peru	109	0.000326	11	0.032	3,613	1.061	0	0.00%
Philippines	43	0.043944	599	0.518	7,267,925	628.936	461,307,347	0.04%
Poland	65	0.018583	770	2.091	1,512	0.411	0	0.00%
Portugal	9	0.165572	2,215	21.278	187	0.180	0	0.00%
Puerto Rico	6	0.216232	25	0.776	0	0.000	3,037,576,884	2.22%
Qatar	150	0.000000	0	0.000	0	0.000	0	0.00%
Republic of Congo	71	0.009989	0	0.000	164,679	275.825	0	0.00%
Romania	19	0.104917	2,455	12.889	0	0.000	0	0.00%
Russia	112	0.000226	23	0.016	3,252	0.225	0	0.00%
Rwanda	94	0.001703	29	0.211	1,300	0.944	0	0.00%

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Samoa	142	0.000000	0	0.000	0	0.000	0	0.00%
Saudi Arabia	152	0.000000	0	0.000	0	0.000	0	0.00%
Senegal	108	0.000438	0	0.000	20,010	11.555	0	0.00%
Serbia	30	0.065676	574	8.613	0	0.000	0	0.00%
Seychelles	148	0.000000	0	0.000	0	0.000	0	0.00%
Sierra Leone	95	0.001627	12	0.139	12,982	15.085	0	0.00%
Slovak Republic	40	0.050896	365	6.720	0	0.000	0	0.00%
Slovenia	38	0.054222	154	7.292	0	0.000	0	0.00%
Solomon Islands	174	0.000000	0	0.000	0	0.000	0	0.00%
South Africa	20	0.103023	579	0.967	199,296	33.275	7,778,720,107	0.91%
Spain	5	0.221256	11,324	23.701	3,500	0.733	0	0.00%
Sri Lanka	88	0.003666	15	0.068	178,176	80.328	0	0.00%
St. Kitts and Nevis	146	0.000000	0	0.000	0	0.000	0	0.00%
St. Lucia	70	0.010807	0	0.000	5,500	305.798	0	0.00%
St. Vincent and the Grenadines	138	0.000000	0	0.000	0	0.000	0	0.00%
Sudan	15	0.115016	146	0.311	12,188,422	2600.241	29,936,483	0.02%
Suriname	35	0.059557	0	0.000	9,000	145.622	67,176,716	0.58%
Sweden	90	0.002969	40	0.381	0	0.000	0	0.00%
Switzerland	60	0.026543	302	3.441	0	0.000	0	0.00%
Tajikistan	162	0.000000	0	0.000	0	0.000	0	0.00%
Tanzania	115	0.000178	10	0.015	3,500	0.534	0	0.00%
Thailand	72	0.009482	21	0.029	1,381,745	192.720	39,025,294	0.00%
The Bahamas	167	0.000000	0	0.000	0	0.000	0	0.00%
The Gambia	87	0.003925	6	0.222	17,201	63.566	0	0.00%

Country	Rank 2022	CRI Score 2022	Fatalities (2022)	Fatalities per 100.000 (2022)	Affected (2022)	Affected per 100.000 (2022)	Losses in USD (PPP) (2022)	Losses % of GDP (2022)
Togo	101	0.000770	0	0.000	18,596	21.016	0	0.00%
Tonga	151	0.000000	0	0.000	0	0.000	0	0.00%
Trinidad and Tobago	61	0.023216	0	0.000	100,000	653.149	0	0.00%
Tunisia	114	0.000184	1	0.008	4,000	3.237	0	0.00%
Turkey	120	0.000056	3	0.004	3,115	0.367	0	0.00%
Tuvalu	124	0.000000	0	0.000	0	0.000	0	0.00%
Uganda	37	0.055463	2,541	5.378	599,164	126.808	0	0.00%
Ukraine	163	0.000000	0	0.000	0	0.000	0	0.00%
United Arab Emirates	164	0.000000	0	0.000	0	0.000	0	0.00%
United Kingdom	39	0.054134	3,475	5.126	0	0.000	587,871,686	0.02%
United States of America	7	0.181805	506	0.152	6,922	0.208	137,504,287,448	0.57%
Uruguay	44	0.042844	0	0.000	409,275	1195.734	0	0.00%
Uzbekistan	116	0.000126	5	0.014	165	0.046	0	0.00%
Vanuatu	161	0.000000	0	0.000	0	0.000	0	0.00%
Vietnam	81	0.005040	60	0.061	515,165	52.468	208,887,623	0.02%
Zambia	106	0.000536	3	0.015	21,582	10.781	0	0.00%
Zimbabwe	117	0.000069	0	0.000	3,000	1.838	0	0.00%

References

- Accuweather (2022a). Power Slowly Being Restored in Puerto Rico, but Severe Flooding Remains. Available at:** <https://www.accuweather.com/en/hurricane/80-of-puerto-rico-without-power-as-island-reels-in-aftermath-of-fiona/1250040> [Accessed January 16th, 2025]
- Accuweather (2022b). Florida Faces Grim Reality: Hurricane Ian is Deadliest Storm in State since 1935. Available at:** <https://www.accuweather.com/en/hurricane/florida-faces-grim-reality-hurricane-ian-is-deadliest-storm-in-state-since-1935/1257775> [Accessed January 16th, 2025]
- Adger, W.N.; Pulhin, J.M. (2014). Human Security. In: IPCC 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects, 755–91. Cambridge University Press. Available at:** <https://www.ipcc.ch/report/ar5/wg2/human-security/> [Accessed January 16th, 2025]
- Armstrong McKay, D.; Staal, A.; Abrams, J.; Winkelmann, R.; Sakschewski, B.; Loriani, S.; Fetzer, I.; Cornell, S.E.; Rockström, J.; Lenton, T.M. (2022). Exceeding 1.5°C Global Warming Could Trigger Multiple Climate Tipping Points. In: Science 377 (6611). Available at:** <https://doi.org/10.1126/science.abn7950> [Accessed January 16th, 2025]
- Axios (2022). Turkey, Greece and Cyprus covered in snow as climate change bites. Available at:** <https://www.axios.com/2022/09/18/puerto-rico-loses-power-hurricane-fiona> [Accessed January 16th, 2025]
- BBC (2022). Europe’s Drought the Worst in 500 Years - Report. Available at:** <https://www.bbc.com/news/world-europe-62648912> [Accessed January 16th, 2025]
- Beven, J. and Alaka, L. (2023). Tropical Cyclone Report: Hurricane Nicole. National Hurricane Center. Available at:** https://www.nhc.noaa.gov/data/tcr/AL172022_Nicole.pdf [Accessed January 16th, 2025]
- Biló, T.C., Perez, R.C., Dong, S. et al. Weakening of the Atlantic Meridional Overturning Circulation abyssal limb in the North Atlantic. Nat. Geosci. 17, 419–425 (2024). Available at:** <https://doi.org/10.1038/s41561-024-01422-4> [Accessed January 16th, 2025]
- Brand, K. (2022). Kaltfront lässt USA weiter Zittern. In: Tagesschau, December 25, 2022. Available at:** <https://www.tagesschau.de/ausland/amerika/usa-wetter-wintersturm-107.html> [Accessed January 16th, 2025]
- Bulgarian National Radio (2022). Recent Heat Wave Causes Worries for Citizens and Firefighters in Bulgaria. Available at:** <https://bnr.bg/en/post/101681905/recent-heat-wave-causes-worries-to-citizens-and-firefighters-in-bulgaria> [Accessed January 16th, 2025]
- Burgen, S. (2022). Spain in Grip of Heatwave with Temperatures Forecast to Hit 44C. In: The Guardian, June 10, 2022. Available at:** <https://www.theguardian.com/world/2022/jun/10/spain-heatwave-temperatures-forecast-hit-44c> [Accessed January 16th, 2025]
- Burke, M.; Ferguson, J.; Hsiang, S.M.; Miguel, E. (2024). New Evidence on the Economics of Climate and Conflict.” In: NBER Working Paper Series. Available at:** <https://doi.org/10.3386/w33040> [Accessed January 16th, 2025]
- Bushard, B. (2022). Winter Storm Elliott: Here’s Which Cities Set Record Low Temperatures (So Far). In: Forbes, December 24, 2022. Available at:** <https://www.forbes.com/sites/brianbushard/2022/12/24/winter-storm-elliott-heres-which-cities-set-record-low-temperatures-so-far/> [Accessed January 16th, 2025]
- Carrington, D. (2022). Revealed: Oil Sector’s ‘Staggering’ \$3bn-a-Day Profits for Last 50 Years. In: The Guardian, July 21, 2022. Available at:** <https://www.theguardian.com/environment/2022/jul/21/>

revealed-oil-sectors-staggering-profits-last-50-years [Accessed January 16th, 2025]

Centre for Research on the Epidemiology of Disasters (CREED) (2024). Emergency Events Database. Available at: <https://www.emdat.be/> [Accessed January 16th, 2025]

Central Emergency Response Fund (2022). Nigeria Rapid Response Flood. In: CERF Allocation Report on the use of Funds and Achieved Results. Available at: https://cerf.un.org/sites/default/files/resources/22-RR-NGA-56022_Nigeria_CERF_Report_0.pdf [Accessed January 16th, 2025]

Chavda, S. (2024). Spain Floods 2024. In: The 2024 Spain Floods: Failures in Early Warning, Action, Coordination, and Localisation (blog), December 2, 2024. Available at: <https://www.gndr.org/2024-spain-floods-early-warning-action-coordination-and-localisation/> [Accessed January 16th, 2025]

Chelli, G. (2022). Po River Drought in 2022 Was the Worst of the Last Two Centuries. In: Nature Italy. Available at: <https://doi.org/10.1038/d43978-023-00121-9> [Accessed January 16th, 2025].

Clarke, B.; Otto, F.; Stuart-Smith, R.; Harrington, L. (2022). Extreme Weather Impacts of Climate Change: An Attribution Perspective. In: Environmental Research Climate 1 (1). <https://iopscience.iop.org/article/10.1088/2752-5295/ac6e7d> [Accessed January 16th, 2025]

Cohen, L. (2022). Some Southwest Florida Counties 'off the Grid' after Hurricane Ian Wiped out Power to Millions. In: CBS News, September 29, 2022. Available at: <https://www.cbsnews.com/news/hurricane-ian-florida-power-outages/> [Accessed January 16th, 2025]

Copernicus (2022a). Extreme Heat. Available at: <https://climate.copernicus.eu/esotc/2022/extreme-heat> [Accessed January 16th, 2025]

Copernicus (2022b). Global Climate Highlights 2022. Available at: <https://climate.copernicus.eu/global-climate-highlights-2022> [Accessed January 16th, 2025]

Copernicus (2022c). OBSERVER: 2022: A Year of Extremes | Copernicus. Available at: <https://www.copernicus.eu/en/news/news/observer-2022-year-extremes> [Accessed January 16th, 2025]

Copernicus (2023). 2023 Is the Hottest Year on Record, with Global Temperatures Close to the 1.5°C Limit. Available at: <https://climate.copernicus.eu/copernicus-2023-hottest-year-record> [Accessed January 16th, 2025]

Copernicus (2024a). Heatwaves- A Brief Introduction. Available at: <https://datawrapper.dwcdn.net/l4Sn/21/> [Accessed January 16th, 2025]

Copernicus (2024b). New Record Daily Global Average Temperature Reached in July 2024. Available at: <https://climate.copernicus.eu/new-record-daily-global-average-temperature-reached-july-2024> [Accessed January 16th, 2025]

Copernicus (2025). 2024 - A Second Record-Breaking Year, Following the Exceptional 2023. Available at: <https://climate.copernicus.eu/sites/default/files/custom-uploads/GCH-2024/GCH2024.pdf> [Accessed January 16th, 2025]

Deutsche Welle (2022a). Greece and Spain evacuate hundreds during wildfires. Available at: <https://www.dw.com/en/greece-and-spain-evacuate-hundreds-during-prolonged-wildfires/a-62578859> [Accessed January 16th, 2025]

Deutsche Welle (2022b). Hundreds flee as fire engulfs Athens suburbs. Available at: <https://www.dw.com/en/greece-hundreds-evacuated-as-fire-engulfs-athens-suburbs/a-62534673> [Accessed January 16th, 2025]

Deutsche Welle (2022c). Cold snap shocks Turkey and Greece. Available at: <https://www.dw.com/en/snowstorm-brings-much-of-turkey-and-greece-to-a-halt/a-60542602> [Accessed January 16th, 2025]

Dinku, T. (2019). Challenges with Availability and Quality of Climate Data in Africa. In: Extreme Hydrology and Climate Variability. Monitoring, Modelling, Adaptation and Mitigation. Available at: <https://doi.org/10.1016/B978-0-12-815998-9.00007-5> [Accessed January 16th, 2025]

- DNV (2024). Energy Transition Outlook 2024. Available at:** <https://www.dnv.com/energy-transition-outlook/download/> [Accessed January 16th, 2025]
- Dowdy, A.; Mills, G.A.; Finkele, K.; Groo, W. (2009). Australian Fire Weather as Represented by the McArthur Forest Fire Danger Index and the Canadian Forest Fire Weather Index. The Centre for Australian Weather and Climate Research. Available at:** https://www.cawcr.gov.au/technical-reports/CTR_010.pdf [Accessed January 16th, 2025]
- Du, J.; Wang, K.; Cui, B. (2021). Attribution of the Extreme Drought-Related Risk of Wildfires in Spring 2019 over Southwest China. In: Bulletin of the American Meteorological Society 102 (1) 83–90. Available at:** <https://journals.ametsoc.org/view/journals/bams/102/1/BAMS-D-20-0165.1.xml> [Accessed January 16th, 2025]
- EM-DAT Project (2022). Specific Biases. Available at:** <https://doc.emdat.be/docs/known-issues-and-limitations/specific-biases/> [Accessed January 16th, 2025]
- EM-DAT (2024). The International Disaster Data Base. Available at:** <https://www.emdat.be/> [Accessed January 16th, 2025]
- Euronews (2022). Turkey, Greece and Cyprus Covered in Snow as Climate Change Bites. Available at:** <https://www.euronews.com/green/2022/03/16/turkey-greece-and-cyprus-are-in-the-middle-of-an-unseasonal-coldsnap> [Accessed January 16th, 2025]
- European Commission (2024). Composite Indicators & Scoreboards Explorer. Available at:** <https://composite-indicators.jrc.ec.europa.eu/explorer> [Accessed January 16th, 2025]
- European Environment Agency (EEA) (2024a). Extreme Weather: Floods, Droughts and Heatwaves. Available at:** <https://www.eea.europa.eu/en/topics/in-depth/extreme-weather-floods-droughts-and-heatwaves> [Accessed January 16th, 2025]
- European Environment Agency (EEA) (2024b). European Climate Risk Assessment. EEA Report 01/2024. Available at:** <https://www.eea.europa.eu/en/analysis/publications/european-climate-risk-assessment/european-climate-risk-assessment-report/@download/file> [Accessed January 16th, 2025]
- Eurostat (2020). Glossary: Excess Mortality. Available at:** https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Excess_mortality [Accessed January 16th, 2025]
- Farbotko, C. and Campbell, J. (2022). Who defines atoll ‘uninhabitability’? In: Environmental Science & Policy 138, 182-190. Available at:** <https://www.sciencedirect.com/science/article/abs/pii/S1462901122003008> [Accessed January 16th, 2025]
- Finance Division, Government of Pakistan (2022). Pakistan Floods 2022 Impact Assessment. Available at:** https://www.finance.gov.pk/survey/chapters_23/Annex_III_Pakistan_Floods_2022.pdf [Accessed January 16th, 2025]
- Finch, A. (2022). Power Slowly Being Restored in Puerto Rico, but Severe Flooding Remains.” Accu Weather. Available at:** <https://www.accuweather.com/en/hurricane/80-of-puerto-rico-without-power-as-island-reels-in-aftermath-of-fiona/1250040> [Accessed January 16th, 2025]
- Fischer, E. M. (2021). Increasing Probability of Record-Shattering Climate Extremes. In: Nature Climate Change 11 (8) 689–95.**
- Flores, B.M. (2024). Critical Transitions in the Amazon Forest System. In: Nature 626, 555–64.**
- Gee, A. (2019). 12 Great Examples of How Countries Are Adapting to Climate Change. Global Center on Adaptation. Available at:** <https://gca.org/12-great-examples-of-how-countries-are-adapting-to-climate-change/> [Accessed January 16th, 2025]
- Government of Pakistan (2022) NDMA Monsoon 2022 Daily Situation Report No 158. Available at:** <https://reliefweb.int/report/pakistan/ndma-monsoon-2022-daily-situation-report-no-158-dated-18th-nov-2022> [Accessed January 16th, 2025]
- Grigorova, D. (2022). Recent Heat Wave Causes Worries for Citizens and Firefighters in Bulgaria. Available at:** <https://bnr.bg/en/post/101681905/recent-heat-wave-causes-worries-to-citizens-and-firefighters-in-bulgaria> [Accessed January 16th, 2025]

- Haque, U.; Hashizume, M.; Kolivras, K.N.; Overgaard, H.J.; Das, B.; Yamamoto, T. (2012). Reduced Death Rates from Cyclones in Bangladesh: What More Needs to be Done? Bulletin of the World Health Organization 90 (2) 150-156. Available at: <https://doi.org/10.2471/blt.11.088302>. [Accessed January 16th, 2025]**
- Hufe, S. and Hortig, J. (2022). Two Extremes: How Often Droughts and Heat Waves Will Occur Together. Helmholtz Centre for Environmental Research GmbH. Available at: <https://www.preventionweb.net/news/two-extremes-same-time-how-often-droughts-and-heat-waves-will-occur-together>. [Accessed January 16th, 2025]**
- Internal Displacement Monitoring Centre (2024). Global Report on Internal Displacement. Available at: <https://api.internal-displacement.org/sites/default/files/publications/documents/IDMC-GRID-2024-Global-Report-on-Internal-Displacement.pdf>. [Accessed January 16, 2025]**
- Internal Displacement Monitoring Centre (2023). IDMC's Global Report on Internal Displacement (GRID). Available at: <https://www.internal-displacement.org/global-report/grid2023/>. [Accessed January 16th, 2025]**
- International Court of Justice (2024). Obligations of States in Respect of Climate Change. Available at: <https://www.icj-cij.org/sites/default/files/case-related/187/187-20241108-pre-01-00-en.pdf>. [Accessed January 16th, 2025]**
- Intergovernmental Panel on Climate Change (2019). An IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Cambridge University Press. Available at: <https://doi.org/10.1017/9781009157964>. [Accessed January 16th, 2025]**
- Intergovernmental Panel on Climate Change (2021a). Climate Change 2021: The Physical Science Basis. Available at: <https://www.ipcc.ch/report/ar6/wg1/#FullReport>. [Accessed January 16th, 2025]**
- Intergovernmental Panel on Climate Change (2021b). WGI Summary for Policymakers Headline Statements. Available at: <https://www.ipcc.ch/report/ar6/wg1/resources/spm-headline-statements/>. [Accessed January 16th, 2025]**
- Intergovernmental Panel on Climate Change (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability - Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change - Full Report. Available at: https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FullReport.pdf. [Accessed January 16th, 2025]**
- Intergovernmental Panel on Climate Change (2023). Climate Change 2023 Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Available at: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf. [Accessed January 16th, 2025]**
- Irish, J.L.; Sleath, A.; Cialone, M.A.; Knutson, T.R. (2014). Simulations of Hurricane Katrina (2005) under Sea Level and Climate Conditions for 1900. Climate Change 122 (4) 635–49. Available at: <http://dx.doi.org/10.1007/s10584-013-1011-1>. [Accessed January 16th, 2025]**
- Katzenberger, A.; Schewe, J.; Pongratz, J.; Levermann, A. (2021). Robust Increase of Indian Monsoon Rainfall and Its Variability under Future Warming in CMIP6 Models. Earth System Dynamics 12 (2) 367–386. Available at: <https://doi.org/10.5194/esd-12-367-2021>. [Accessed January 16th, 2025]**
- Kirchmeier-Young, M.C.; Gillett, N.P.; Zwiers, F.W.; Cannon, A.J.; Anslow, F.S. (2019). Attribution of the Influence of Human-Induced Climate Change on an Extreme Fire Season' Earth's Future, 2–10. Available at: <https://doi.org/10.1029/2018EF001050>. [Accessed January 16th, 2025]**
- Kotz, M.; Levermann, A.; Wenz, L. (2024). The Economic Commitment of Climate Change. Nature 628, 551–57. Available at: <https://doi.org/10.1038/s41586-024-07219-0>. [Accessed January 16th, 2025]**
- Lam, V. and Majszak, M.M. (2022). Climate Tipping Points and Expert Judgment. WIREs Climate Change 13 (6). Available at: <https://doi.org/10.1002/wcc.805>. [Accessed January 16th, 2025]**
- Magnan, A.; Pörtner, H.-O.; Duvat, V.K.E.; Garschagen, M.; Guinder, V.A.; Zommers, Z.; Hoegh-Guldberg, O. and Gattuso, J.-P. (2021). Estimating**

- the Global Risk of Anthropogenic Climate Change. *Nature Climate Change* 11, 879–85. Available at: <https://doi.org/10.1038/s41558-021-01156-w>. [Accessed January 16th, 2025]
- Markandya, A. and González-Eguino, M. (2019). *Integrated Assessment for Identifying Climate Finance Needs for Loss and Damage: A Critical Review*. In *Loss and Damage from Climate Change. Climate Risk Management, Policy and Governance*. Springer. Available at: https://doi.org/10.1007/978-3-319-72026-5_14. [Accessed January 16th, 2025]
- McSweeney, R. (2021). *Explainer: What the New IPCC Report Says about Extreme Weather and Climate Change*. Carbon Brief. Available at: <https://www.carbonbrief.org/explainer-what-the-new-ipcc-report-says-about-extreme-weather-and-climate-change/>. [Accessed January 16th, 2025]
- McSweeney, R. and Tandon, A. (2024). *Mapped: How Climate Change Affects Extreme Weather around the World*. Carbon Brief. Available at: <https://interactive.carbonbrief.org/attribution-studies/>. [Accessed January 16th, 2025]
- National Centers for Environmental Information (NCEI) (2022). *U.S. Billion-Dollar Weather and Climate Disasters 1980-2024*. Available at: [https://www.ncei.noaa.gov/access/billions/events/US/2022?disasters\[\]=all-disasters](https://www.ncei.noaa.gov/access/billions/events/US/2022?disasters[]=all-disasters). [Accessed January 16th, 2025]
- Newmann, R. and Noy, I (2023). *The Global Costs of Extreme Weather That Are Attributable to Climate Change*. *Nature Communications* 14. Available at: <https://www.nature.com/articles/s41467-023-41888-1>. [Accessed January 16th, 2025]
- Notre Dame Global Adaptation Initiative (2024). *Rankings*. Notre Dame Global Adaptation Initiative. University of Notre Dame. Available at: <https://gain.nd.edu/our-work/country-index/rankings/>. [Accessed January 16th, 2025]
- OECD (2024). *Climate Finance Provided and Mobilised by Developed Countries in 2013-2022, Climate Finance and the USD 100 Billion Goal*. Paris: OECD Publishing, 2024. Available at: <https://doi.org/10.1787/19150727-en>. [Accessed January 16th, 2025]
- Olsen, J.R.; Dettinger, M.D. and Giovannetone, J.P. (2023). *Drought Attribution Studies and Water Resources Management*. *Bulletin of the American Meteorological Society* 104 (2). Available at: <https://journals.ametsoc.org/view/journals/bams/104/2/BAMS-D-22-0214.1.xml>. [Accessed January 16th, 2025]
- Osuteye, E. (2017). *The Data Gap: An Analysis of Data Availability on Disaster Losses in Sub-Saharan African Cities*. *International Journal of Disaster Risk Reduction* 26, 24–33. Available at: <https://doi.org/10.1016/j.ijdrr.2017.09.026>. [Accessed January 16th, 2025]
- Otto, F. (2017). *Attribution of Weather and Climate Events*. *Annual Review of Environment and Resources* 42, 627–646. Available at: <https://doi.org/10.1146/annurev-environ-102016-060847>. [Accessed January 16th, 2025]
- Otto, F.; Harrington, L.; Schmitt, K.; Philip, S.; Kew, S.; van Oldenborgh, G.J.; Singh, R.; Kimutai, J.; Wolski, P. (2020). *Challenges to Understanding Extreme Weather Changes in Lower Income Countries*. Available at: <https://doi.org/10.1175/BAMS-D-19-0317.1>. [Accessed January 16th, 2025]
- Otto, F. and Harrington, L.J. (2020a). *Reconciling Theory with the Reality of African Heatwaves*. *Nature Climate Change* 10 (9) 796–98. Available at: <https://doi.org/10.1038/s41558-020-0851-8>. [Accessed January 16th, 2025]
- Otto, F. and Harrington, L.J. (2020b). *Why Africa's Heatwaves Are a Forgotten Impact of Climate Change*. Available at: <https://www.carbonbrief.org/guest-post-why-africas-heatwaves-are-a-forgotten-impact-of-climate-change/>. [Accessed January 16th, 2025]
- Otto, F.; Zachariah, M.; Saeed, F.; Siddiqi, A.; Shahzad, K.; Mushtaq, H.; AchutaRao, K.; Barnes, C.; Philip, S.; Kew, S.; Vautard, R.; Koren, G.; Pinto, I.; Wolski, P.; Vahlberg, M.; Singh, R.; Arrighi, J.; van Aalst, M.; Thalheimer, L.; Raju, E.; Li, S.; Yang, W.; Harrington, L.J.; Clarke, B. (2022). *Climate Change Likely Increased Extreme Monsoon Rainfall, Flooding Highly Vulnerable Communities in Pakistan*. *World Weather Attribution*. Available at: <https://www.worldweatherattribution.org/wp->

content/uploads/Pakistan-floods-scientific-report.pdf. [Accessed January 16th, 2025]

Otto, F. (2023a). Attribution of Extreme Events to Climate Change. Annual Review of Environment and Resources 48, 813–28. Available at: <https://doi.org/10.1146/annurev-environ-112621-083538>. [Accessed January 16th, 2025]

Otto, F. (2023b). Without Warning: Africa's Lack of Weather Stations Is Costing Lives. Available at: <https://africanarguments.org/2023/11/without-warning-africa-lack-of-weather-stations-is-costing-lives/>. [Accessed January 16th, 2025]

Ravipati, S. (2022). Puerto Rico Loses Power across Entire Island as Hurricane Fiona Nears. September 18, 2022. Available at: <https://www.axios.com/2022/09/18/puerto-rico-loses-power-hurricane-fiona>. [Accessed January 16th, 2025]

Reliefweb (2015). Tropical Cyclone Pam March 2015. Available at: <https://reliefweb.int/disaster/tc-2015-000020-vut>. [Accessed January 16th, 2025]

Reliefweb (2022). PAHO/WHO Supports Belize in the Aftermath of Hurricane Lisa. Available at: <https://reliefweb.int/report/belize/pahowho-supports-belize-aftermath-hurricane-lisa>. [Accessed January 16th, 2025]

Reliefweb (2023). Belize: Tropical Storm Lisa November 2022. Available at: <https://reliefweb.int/report/belize/belize-tropical-storm-lisa-november-2022-dref-final-report-appeal-no-mdrbz007>. [Accessed January 16th, 2025]

Ritchie, H. and Rosado, P. (2024). Is the Number of Natural Disasters Increasing? OurWorldinData.org. Available at: <https://ourworldindata.org/disaster-database-limitations>. [Accessed January 16th, 2025]

Ripple, W.J.; Wolf, C.; Gregg, J.W.; Rockström, J.; Mann, M.E.; Oreskes, N.; Lenton, T.M.; Rahmstorf, S.; Newsome, T.M.; Xu, C.; Svenning, J.-C.; Cardoso Pereira, C.; Law, B.E.; Crowther, T.W. (2024). The 2024 State of the Climate Report: Perilous Times on Planet Earth. In: *BioScience* 74 (12) 812–824. Available at: <https://doi.org/10.1093/biosci/biae087>. [Accessed January 16th, 2025]

Sachs, J.; Lafortune, G., Fuller, G. (2024). The SDGs and the UN Summit of the Future. Sustainable Development Report 2024. Available at: <https://sdgtransformationcenter.org/reports/sustainable-development-report-2024>. [Accessed January 16th, 2025]

Sapir, D. G. and Misson, C. (1992). The Development of a Database on Disasters. *Disasters* 16 (1) 74–80. Available at: <https://doi.org/10.1111/j.1467-7717.1992.tb00378.x>. [Accessed January 16th, 2025]

Sauer, I.; Walsh, B.; Frieler, K.; Bresch, D.N. (2023). Not Enough Time to Recover? Understanding the Poverty Effects of Recurrent Floods in the Philippines. Available at: <https://doi.org/10.21203/rs.3.rs-2911340/v1>. [Accessed January 16th, 2025]

Schäfer, L. (2023). Addressing Loss and Damage from Slow-Onset Processes. Key Facts and Figures. Available at: https://www.germanwatch.org/sites/default/files/gw_factsheet_ld_and_slow-onsets.pdf. [Accessed January 16th, 2025]

Schleussner, C.-F.; Donges, J.F.; Donner, R.V.; Schellnhuber, H.J. (2016). Armed-Conflict Risks Enhanced by Climate-Related Disasters in Ethnically Fractionalized Countries. *Proceedings of the National Academy of Sciences* 113 (33) 9216–21. Available at: <https://doi.org/10.1073/pnas.1601611113>. [Accessed January 16th, 2025]

Schultheiß, L. (2023a). Coral Reefs Could Pass Their Point of No Return This Decade. Blogpost. February 16, 2023. Available at: <https://www.germanwatch.org/en/87912>. [Accessed January 16th, 2025]

Schultheiß, L. (2023b). How the Atlantic Ocean Circulation Could Reach Its Switch-off Tipping Point. Blogpost. February 16, 2023. Available at: <https://www.germanwatch.org/en/87910>. [Accessed January 16th, 2025]

Scussolini, P.; Luu, L.N.; Philip, S.; Berghuijs, W. R.; Eilander, D.; Aerts, J. C. J. H.; Kew, S. F.; van Oldenborgh, G. J.; Toonen, W.H.J.; Volkholz, J.; Coumou, D. (2023). Challenges in the Attribution of River Flood Events. *Wiley Interdisciplinary Reviews. Climate Change* 15 (3). Available at: <https://doi.org/10.002/wcc.874>. [Accessed January 16th, 2025]

- Serdeczny, O. (2018). **Non-economic Loss and Damage and the Warsaw International Mechanism.** In: Mechler, R. et al.: **Loss and Damage from Climate Change, 205-220.** Available at: https://link.springer.com/chapter/10.1007/978-3-319-72026-5_8. [Accessed January 16th, 2025]
- Süddeutsche Zeitung (2022): **Kollektives Systemversagen.** January 14, 2022. Available at: **Hochwasserkatastrophe: Expertin rügt „kollektives Systemversagen“ - Politik - SZ.de** [Accessed January 16th 2025]
- Sulser, T.; Wiebe, K.D.; Dunston, S.; Cenacchi, N.; Nin-Pratt, A.; Robertson, R.D.; Willenbockel, D.; Rosegrant, M.W. (2021). **Climate Change and Hunger: Estimating Costs of Adaptation in the Agrifood System.** Food Policy Reports. International Food Policy Research Institute. Available at: <https://ideas.repec.org/p/fpr/fprepo/9780896294165.html>. [Accessed January 16th, 2025]
- Sweet, W.; Zervas, C.; Gill, S.; Park, J. (2013). **Hurricane Sandy Inundation Probabilities Today and Tomorrow.** In: **Bulletin of the American Meteorological Society** 94, 17-20. Available at: https://www.researchgate.net/publication/262186934_Hurricane_Sandy_Inundation_Probabilities_Today_and_Tomorrow [Accessed January 16th, 2025]
- Taminga, A.; Malena-Chan, R.; O'Connor, R.; Smith, R. (2025). **Rapid Extreme Weather Event Attribution system: Top Heat Events of 2024.** Available at: <https://climatedata.ca/rapid-extreme-weather-event-attribution-system-top-heat-events-of-2024/> [Accessed January 16th, 2025]
- Tandon, A. (2024). **The Evolving Science of ‘Extreme Weather Attribution.** In: **Carbon Brief, November 18, 2024.** Available at: <https://www.carbonbrief.org/qa-the-evolving-science-of-extreme-weather-attribution/>. [Accessed January 16th, 2025]
- Tagesschau (2022). **Wintersturm “Elliott” - Kaltfront lässt USA weiter zittern, December 25, 2022.** Available at: <https://www.tagesschau.de/ausland/amerika/usa-wetter-wintersturm-107.html> [Accessed January 16th, 2025]
- Tebaldi, C., Aðalgeirsdóttir, G., Drijfhout, S., Dunne, J., Edwards, T. L., Fischer, E., Fyfe, J. C., Jones, R. G., Kopp, R. E., Koven, C., Krinner, G., Otto, F., Ruane, A. C., Seneviratne, S. I., Sillmann, J., Szopa, S., & Zanis, P. (2023). **The hazard components of representative key risks. The physical climate perspective.** In: **Climate Risk Management, 40, 100516.** Available at: <https://doi.org/10.1016/j.crm.2023.100516>. [Accessed January 16th, 2025]
- The Guardian (2022). **Italy Declares State of Emergency in Drought-Hit Northern Regions, July 5, 2022.** Available at: <https://www.theguardian.com/world/2022/jul/05/italy-declares-state-emergency-drought-hit-northern-regions>. [Accessed January 16th, 2025]
- The Local Italy (2022). **Italian Wildfires ‘Three Times Worse’ than Average as Heatwave Continues.** June 27, 2022. Available at: <https://www.thelocal.it/20220627/heatwave-italian-wildfires-already-three-times-worse-than-average>. [Accessed January 16th, 2025]
- Thomas, M. (2022). **Disease Warning as Pakistan Flood Death Toll Rises.** BBC, September 3rd, 2022. Available at: <https://www.bbc.com/news/world-asia-62779533>. [Accessed January 16th, 2025]
- Toreti, A.; Bavera, D.; Acosta Navarro, J.; Cammalleri, C.; De Jager, A.; Di Ciollo, C.; Hrast Essenfelder, A.; Maetens, W.; Magni, D.; Masante, D.; Mazzeschi, M.; Niemeyer, S. and Spinoni, J. (2022), **Drought in Europe August 2022.** Publications Office of the European Union, Luxembourg. Available at: <https://dx.doi.org/10.2760/264241>. [Accessed January 16th, 2025]
- United Nations (2023). **Climate Change’s Impact on Coastal Flooding to Increase Five Times over This Century.** In: **Human Development Reports. United Nations, November 28, 2023.** Available at: <https://hdr.undp.org/content/climate-changes-impact-coastal-flooding-increase-five-times-over-century>. [Accessed January 16th, 2025]
- United Nations (2024). **Climate Security Mechanism.** Available at: <https://www.un.org/climatesecuritymechanism/en>. [Accessed January 16th, 2025]
- UNDP (1994). **Human Development Report 1994.** New York: Oxford University Press, 1994. Available

at: <https://hdr.undp.org/system/files/documents/hdr1994encompletenostats.pdf>. [Accessed January 16th, 2025]

UNDP (2015). Cyclone Pam Recovery In Tuvalu and Vanuatu, 2015. Available at: <https://www.undp.org/crisis-response/past-crisis/tuvalu>. [Accessed January 16th, 2025]

UNDP (2024). Human Development Index. Human Development Reports, 2024. Available at: <https://hdr.undp.org/data-center/human-development-index>. [Accessed January 16th, 2025]

UNDRR (2015). Sendai Framework for Disaster Risk Reduction 2015-2030. Available at: https://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf. [Accessed January 16th, 2025]

UNDRR (2023a). The Report of the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. UNDRR: Geneva, Switzerland. Available at: <https://www.undrr.org/publication/report-midterm-review-implementation-sendai-framework-disaster-risk-reduction-2015-2030> [Accessed January 16th, 2025]

UNDRR (2023b). Closing Climate and Disaster Data Gaps: New Challenges, New Thinking. Available at: <https://www.undrr.org/publication/closing-climate-and-disaster-data-gaps-new-challenges-new-thinking>. [Accessed January 16th, 2025]

UNDRR and WMO (2024). Global Status of Multi-Hazard Early Warning Systems.” Geneva, Switzerland. Available at: <https://www.undrr.org/publication/global-status-multi-hazard-earlywarning-systems-2024>. [Accessed January 16th, 2025]

UNEP (2023a). Emissions Gap Report 2023: Broken Record – Temperatures Hit New Highs, yet World Fails to Cut Emissions (Again). Available at: <https://wedocs.unep.org/20.500.11822/43922>. [Accessed January 16th, 2025]

UNEP (2023b). Global Climate Litigation Report-2023 Status Review. Nairobi. Available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/43008/global_climate_litigation_report_2023.pdf?sequence=3. [Accessed January 16th, 2025]

UNEP (2024a). Emissions Gap Report 2024: No More Hot Air ... Please! With a Massive Gap between Rhetoric and Reality, Countries Draft New Climate Commitments. Available at: <https://wedocs.unep.org/20.500.11822/46404>. [Accessed January 16th, 2025]

UNEP (2024b). Come Hell and High Water - Adaptation Gap Report 2024. Available at: <https://www.unep.org/resources/adaptation-gap-report-2024>. [Accessed January 16th, 2025]

UNFCCC (2022). Report of the Conference of the Parties on Its Twenty-Seventh Session, Held in Sharm El-Sheikh from 6 to 20 November 2022. Available at: https://unfccc.int/sites/default/files/resource/cp2022_10a01_E.pdf?download. [Accessed January 16th, 2025]

UNFCCC (2024). NAP Tracking Tool. Available at: <https://napcentral.org/nap-tracking-tool>. [Accessed January 16th, 2025]

UNFCCC (2024a). Draft Text on COP29 Agenda Item 2(f). Available at: https://unfccc.int/sites/default/files/resource/NAPs_cop29_2.pdf. [Accessed January 16th, 2025]

UNFCCC (2024b). Presidency Text CMA 6 Agenda Item 11(a): New Collective Quantified Goal on Climate Finance. Available at: https://unfccc.int/sites/default/files/resource/NCQG_2.pdf. [Accessed January 16th, 2025]

UNFCCC (2024c). Submitted NAPs from Developing Country Parties. NAP Central. Available at: <https://napcentral.org/submitted-naps>. [Accessed January 16th, 2025]

UNGA (2012). Resolution 66/290 on Human Security, September 10, 2012. Available at: <https://undocs.org/A/RES/66/290>. [Accessed January 16th, 2025]

UNGA (2024). Report of the Secretary-General on the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. Available at: https://digitallibrary.un.org/record/4060256/files/A_79_268-EN.pdf?ln=en. [Accessed January 16th, 2025]

UNICEF (2022). Nigeria Emergency Flood Response, December 2022. Available at: <https://www.unicef.org/media/132336/file/Nigeria-Floods-Flash-Update-December-2022.pdf>. [Accessed January 16th, 2025]

UNOCHA (2023). Global Humanitarian Overview 2024. Available at: https://reliefweb.int/attachments/0b25dbc1-7844-4a1d-8fb4-25d312657da7/GHO-2024-Abridged-EN_final.pdf. [Accessed January 16th, 2025]

UNOSAT (2022). Pakistan, August 26, 2022. Available at: https://unosat.docs.cern.ch/PK/FL20220808PAK/UNOSAT_A3_Natural_Landscape_FL20220808PAK_26Aug2022.pdf. [Accessed January 16th, 2025]

<https://unstats.un.org/sdgs/report/2024/The-Sustainable-Development-Goals-Report-2024.pdf>. [Accessed January 16th, 2025]

van Oldenborgh, G. J., Krikken, F., Lewis, S., Leach, N. J., Lehner, F., Saunders, K. R., van Wee, M., Haustein, K., Li, S., Wallom, D., Sparrow, S., Arrighi, J., Singh, R. K., van Aalst, M. K., Philip, S. Y., Vautard, R., and Otto, F. E. L. (2021). Attribution of the Australian Bushfire Risk to Anthropogenic Climate Change, *Nat. Hazards Earth Syst. Sci.*, **21**, 941–960, Available at: <https://doi.org/10.5194/nhess-21-941-2021>. [Accessed January 16th, 2025]

Vicedo-Cabrera, A.M.; Scovronick, N.; Sera, F.; Royé, D.; Schneider, R.; Tobias, A.; Astrom, C.; Guo, Y.; Honda, Y.; Hondula, D.M.; Abrutzky, R.; Tong, S.; de Sousa Zanotti Stagliorio Coelho, M.; Saldiva, P.H.N.; Lavigne, E.; Correa, P.M.; Ortega, N.V.; Kan, H.; Osorio, S.; Kyselý, J.; Urban, A.; Orru, H.; Indermitte, E.; Jaakkola, J.J.K.; Rytí, N.; Pascal, M.; Schneider, A.; Katsouyanni, K.; Samoli, E.; Mayvaneh, F.; Entezari, A.; Goodman, P.; Zeka, A.; Michelozzi, P.; de’Donato, F.; Hashizume, M.; Ahammad, B.; Diaz, M.H.; De La Cruz Valencia, C.; Overcenco, A.; Houthuijs, D.; Ameling, C.; Rao, S.; Ruscio, F.D.; Carrasco-Escobar, G.; Seposo, X.; Silva, S.; Madureira, J.; Holobaca, I.H.; Fratanni, S.; Acquaotta, F.; Kim, H.; Lee, W.; Iniguez, C.; Forsberg, B.; Ragetti, M.S.; Guo, Y.L.L.; Chen, B.Y.; Li, S.; Armstrong, B.; Aleman, A.; Zanobetti, A.; Schwartz, J.; Dang, T.N.; Dung, D.V.; Gillett, N.; Haines, A.; Mengel, M.; Huber, V.; Gasparrini, A. (2021). The Burden of Heat-Related Mortality Attributable to

Recent Human-Induced Climate Change. *Nature Climate Change* **11** (6) 492-500. Available at: <https://pubmed.ncbi.nlm.nih.gov/34221128/>. [Accessed January 16th, 2025]

von Uexkull, N.; Croicu, M.; Fjelde, H.; Buhaug, H. (2016). Civil Conflict Sensitivity to Growing-Season Drought. In: *Proc. Natl. Acad. Sci. U.S.A.*, **2016**. Available at: <https://doi.org/10.1073/pnas.1607542113>. [Accessed January 16th, 2025]

Vinke, K. (2023) Hitze, Dürre, Krieg – Klimawandel als Sicherheitsrisiko. *Aus Politik und Zeitgeschichte* **28-28/2023**. Bundeszentrale für politische Bildung. Available at: <https://www.bpb.de/shop/zeitschriften/apuz/hitze-duerre-anpassung-2023/522829/hitze-duerre-krieg/.8> [Accessed January 16th, 2025]

Wang, C.; Li, Z.; Chen, Y.; Ouyang, L.; Li, Y.; Sun, F.; Liu, Y.; Zhu, J. (2023). Drought-Heatwave Compound Events are Stronger in Drylands, *Weather and Climate Extremes*, **42**. Available at: <https://doi.org/10.1016/j.wace.2023.100632>. [Accessed January 16th, 2025]

World Bank (2022). Pakistan: Flood Damages and Economic Losses Over USD 30 Billion and Reconstruction Needs Over USD 16 Billion - New Assessment, 2022. Available at: <https://www.worldbank.org/en/news/press-release/2022/10/28/pakistan-flood-damages-and-economic-losses-over-usd-30-billion-and-reconstruction-needs-over-usd-16-billion-new-assessme>. [Accessed January 16th, 2025]

World Bank (2024). World Bank Country and Lending Groups, 2024. Available at: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>. [Accessed January 16th, 2025]

World Bank 2024a: Honduras. Available at: <https://climateknowledgeportal.worldbank.org/country/honduras/vulnerability> [Accessed January 16th, 2025]

World Bank 2024b: Philippines. Available at: <https://climateknowledgeportal.worldbank.org/country/philippines/vulnerability> [Accessed January 16th, 2025]

World Bank (2024c). Climate Change Knowledge Portal. Risk: Historical Hazards, 2024. Available

at: <https://climateknowledgeportal.worldbank.org/>. [Accessed January 16th, 2025]

World Economic Forum (2025): The Global Risks Report 2025, 20th Edition, Insight Report. Available at: https://reports.weforum.org/docs/WEF_Global_Risks_Report_2025.pdf [Accessed January 16th, 2025]

WMO (2024a) 2024 Is on Track to Be Hottest Year on Record as Warming Temporarily Hits 1.5°C, 11 November 2024. Available at: <https://wmo.int/news/media-centre/2024-track-be-hottest-year-record-warming-temporarily-hits-15degc>. [Accessed January 16th, 2025]

WMO (2024b). 2024 State of Climate Services Five-Year Progress Report (2019–2024). Geneva. Available at: <https://library.wmo.int/idurl/4/69061>. [Accessed January 16th, 2025]

WMO (2024c). State of the Climate Report- Update for COP29. Available at: https://library.wmo.int/viewer/69075/download?file=State-Climate-2024-Update-COP29_en.pdf&type=pdf&navigator=1. [Accessed January 16th, 2025]

World Weather Attribution (2022a). Climate Change Made Devastating Early Heat in India and Pakistan 30 Times More Likely – World Weather Attribution, 23 May, 2022. Available at: <https://www.worldweatherattribution.org/climate-change-made-devastating-early-heat-in-india-and-pakistan-30-times-more-likely/>. [Accessed January 16th, 2025]

World Weather Attribution (2022b). High Temperatures Exacerbated by Climate Change Made 2022 Northern Hemisphere Droughts More Likely – World Weather Attribution, 05 October, 2022. Available at: <https://www.worldweatherattribution.org/high-temperatures-exacerbated-by-climate-change-made-2022-northern-hemisphere-droughts-more-likely/>. [Accessed January 16th, 2025]

World Weather Attribution (2022c). Without Human-Caused Climate Change Temperatures of 40°C in the UK Would Have Been Extremely Unlikely – World Weather Attribution. 28 July, 2022. Available at: <https://www.worldweatherattribution.org/without-human-caused-climate-change-temperatures-of-40c-in-the-uk-would-have-been-extremely-unlikely/>. [Accessed January 16th, 2025]

World Weather Attribution (2023). Human-Induced Climate Change Increased Drought Severity in Horn of Africa – World Weather Attribution,” April 27, 2023. https://www.worldweatherattribution.org/human-induced-climate-change-increased-drought-severity-in-southern-horn-of-africa/. [Accessed January 16th, 2025]

World Weather Attribution (2024a). Climate Change Key Driver of Catastrophic Impacts of Hurricane Helene That Devastated Both Coastal and Inland Communities – World Weather Attribution, 09 October, 2024. Available at: <https://www.worldweatherattribution.org/climate-change-key-driver-of-catastrophic-impacts-of-hurricane-helene-that-devastated-both-coastal-and-inland-communities/>. [Accessed January 16th, 2025]

World Weather Attribution (2024b). Exploring the Contribution of Climate Change to Extreme Weather Events. Available at: <https://www.worldweatherattribution.org/>. [Accessed January 16th, 2025]

WWF (2018). In-Depth: Australian Bushfires. WWF Australia. Available at: <https://wwf.org.au/what-we-do/australian-bushfires/in-depth-australian-bushfires/>. [Accessed January 16th, 2025]

Yangchen, L. (2021). Global Compound Floods from Precipitation and Storm Surge: Hazards and the Roles of Cyclones.” *Journal of Climate* 34 (20) 8319–39. Available at: <https://doi.org/10.1175/JCLI-D-21-0050.1>. [Accessed January 16th, 2025]

Zhan, C. (2023). A Data-Driven Study of Active Meteorological Stations and the Factors Motivating Their Establishment. In: *Sustainable Energy Technologies and Assessments* 57. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S2213138823001406>. [Accessed January 16th, 2025]

Zscheischler, J. (2020). A Typology of Compound Weather and Climate Events. In: *Nature Reviews Earth & Environment* 1, 333–47. Available at: <https://doi.org/10.1038/s43017-020-0060-z>. [Accessed January 16th, 2025]