

Climate Change and Health

**Climate- and climate-action related Health Impacts:
Evidence, Emerging Trends and Projections**

Tuesday 7 July 2026

**Extreme events,
risk management and mental health**

Professor Virginia Murray

Chair of UNDRR-ISC Steering Group for Hazard Information Profiles 2025 update

Member of CODATA international Science Council Executive Committee

Co-chair of the UNESCO-CODATA Data Policies for times of Crises facilitated by Open Science

Honorary Professor University College London



The IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

FLOODS IN THE WHO EUROPEAN REGION: HEALTH EFFECTS AND THEIR PREVENTION

Acute health effects associated with flood water and debris include

- Drowning
- Physical trauma
- Other health effects such as heart attacks

Longer term health effects as a consequence of flooding include

- Skin, respiratory and gut infections
- Rodent borne diseases
- Carbon monoxide poisoning
- **Mental health impacts**

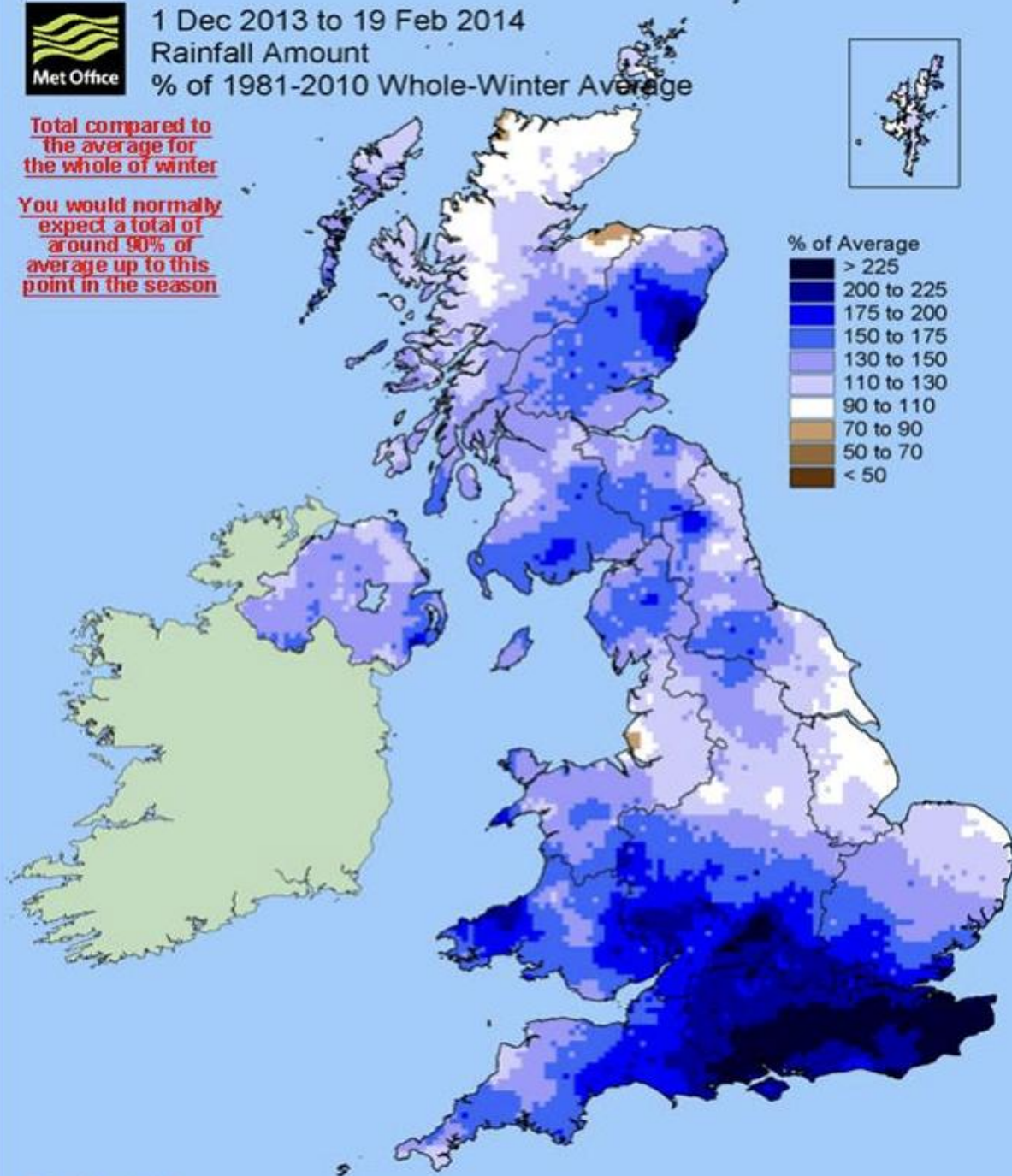




1 Dec 2013 to 19 Feb 2014
Rainfall Amount
% of 1981-2010 Whole-Winter Average

Total compared to the average for the whole of winter

You would normally expect a total of around 90% of average up to this point in the season

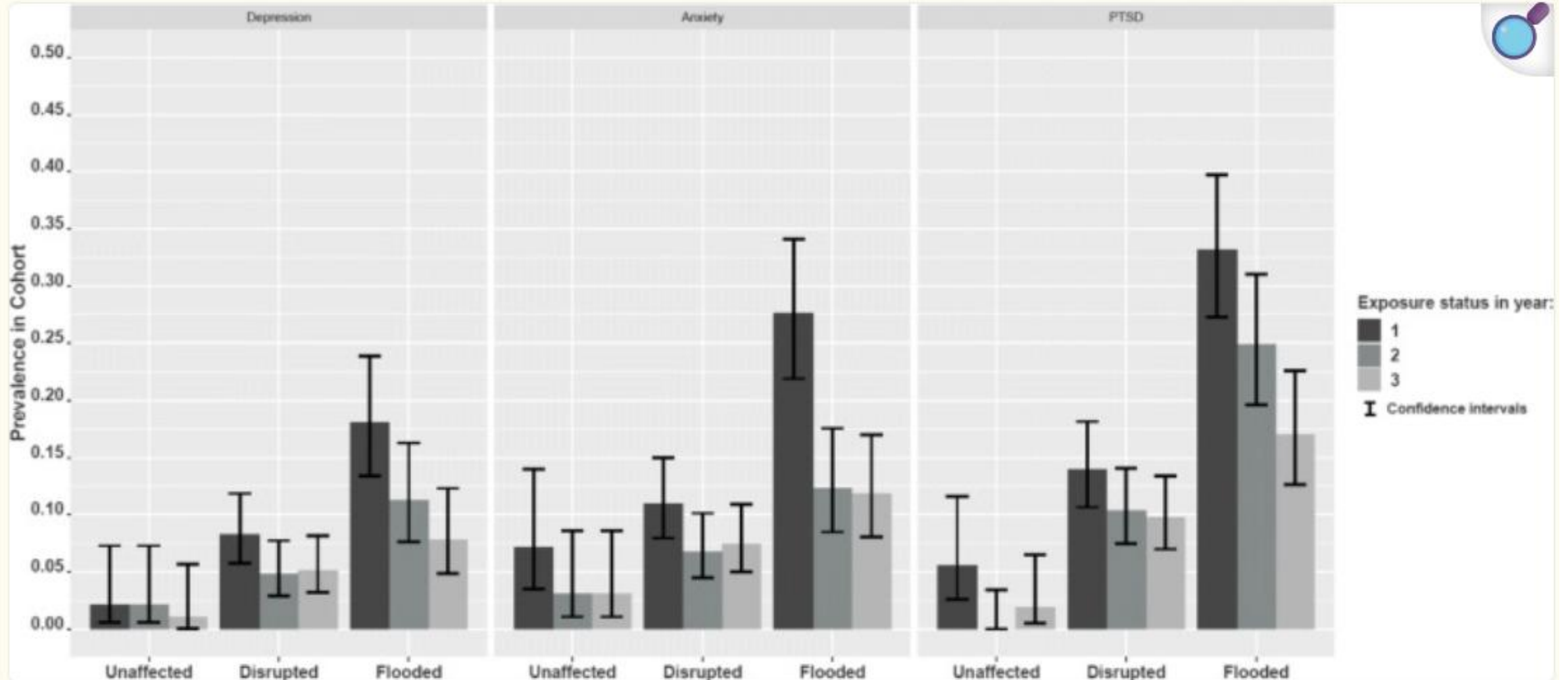


UK floods 2013-14

- Recurrent/prolonged flooding December 13 – February 19
- UK's wettest winter on record since 1910
- New records set for Wales east Scotland and southwest England
- Approximately 6,000 properties flooded

Mental Health impacts from flooding

Prevalence of mental health outcomes by exposure groups over 3 years post-flooding of participants who responded over 3 years



SPECIAL REPORT

Climate Change, Floods, and Human Health

Yao Wu, M.B., B.S., Bo Wen, M.B., B.S., Danijela Gasevic, Ph.D., Jonathan A. Patz, M.D., Andy Haines, M.B., B.S., M.D., Kristie L. Ebi, Ph.D., Virginia Murray, F.I.S.C., F.R.C.P., F.R.C.Path., F.F.P.H., F.F.O.M., Shanshan Li, M.D., Ph.D., and Yuming Guo, M.D., Ph.D.

Flooding is by far the most common climate hazard and wreaks devastating consequences (see Section S1 in the Supplementary Appendix, available with the full text of this article at NEJM.org).¹ From 2000 to 2019, more than 1.65 billion people were affected by floods, with approximately 104,614 lives lost.¹ A changing climate alters precipitation patterns, evapotranspiration, soil moisture, and the global cryosphere, leading to changes in the frequency, magnitude, and duration of floods.² Most countries had a higher average number of population-weighted flood days during the period of 2001–2021 than during 1985–2000 (Fig. 1, and see the interactive graphic, available with the full text of this article at NEJM.org). This increase is particularly evident in Australia, Russia, North America, central and southeastern Europe, West and East Africa, and South and Southeast Asia.

Projections based on a scenario of high greenhouse-gas emissions indicate that flood frequency will increase in 42% of worldwide land-grid cells during 2071–2100 (from 1971–2000 levels), including Southeast Asia, peninsular India, eastern Africa, and the northern half of the Andes (in South America).³ Correspondingly, annual worldwide flood exposure is projected to increase by a factor of approximately 14 from the period of 1971–2000 to 2071–2100.³ By 2100, an annual 20-year flood risk (i.e., a 5% chance of flooding each year) will be faced on land that is currently home to 59.4 million people (under a scenario of low greenhouse-gas emissions), 72.8 million (with intermediate levels of greenhouse-gas emissions),

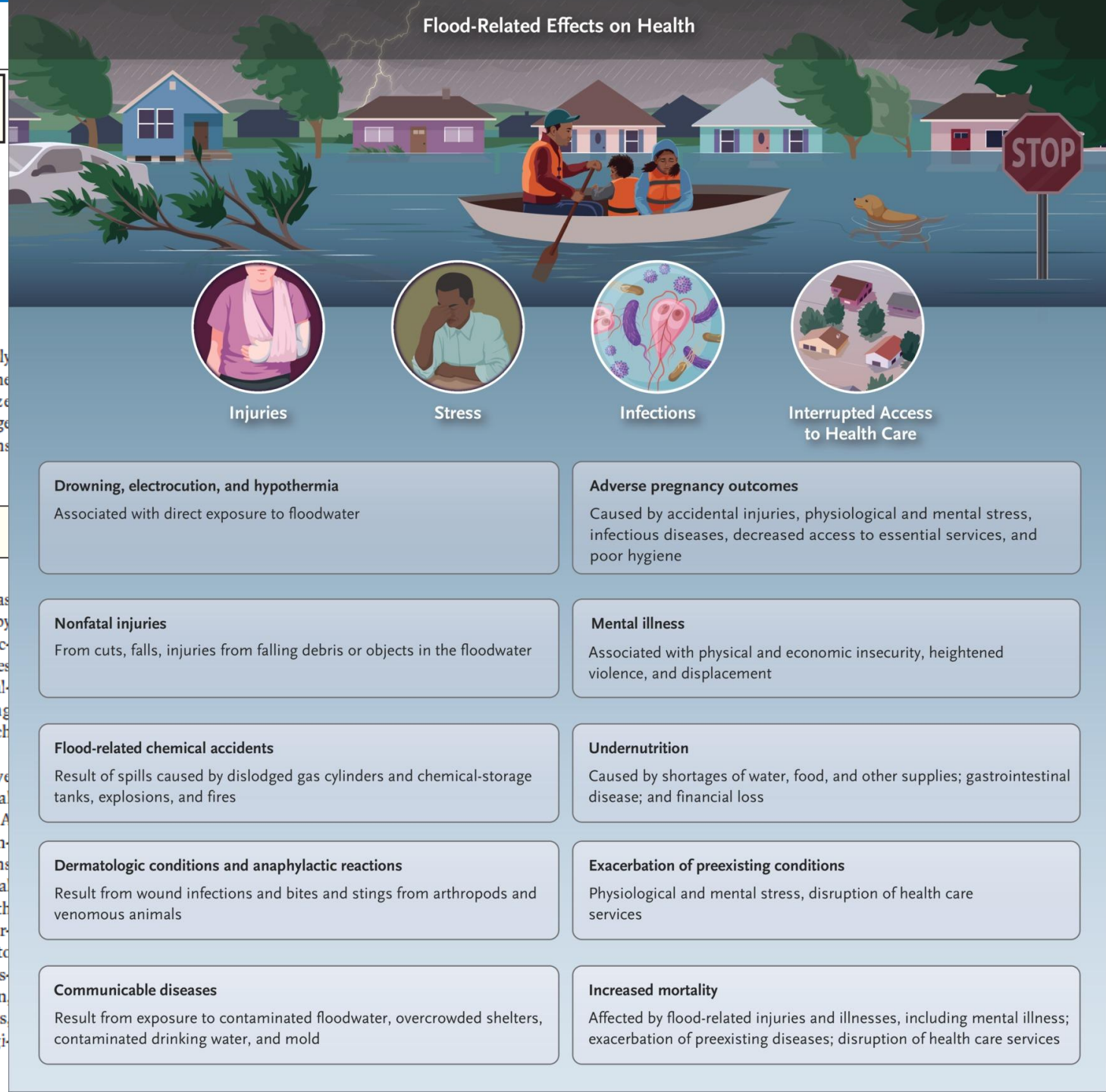
Flood exposure affects health both directly and indirectly, across short- and long-term time frames (Fig. 2). In this article, we summarize current knowledge — and gaps in our knowledge — about the health risks of floods and solutions to reduce those health risks.

HEALTH RISKS ASSOCIATED WITH FLOODS

DEATH

Traditionally, death associated with floods has been identified as deaths directly caused by flooding, such as drowning, hypothermia, electrocution, and flood-induced explosions and fires at chemical plants.^{6,7} Such deaths tend to be almost simultaneous with the onset of flooding and are influenced by flood characteristics, such as the speed of flow of floodwaters.

Beyond accidental death, several studies have documented an increase in the risk of natural causes of deaths that occur after floods.^{8,9} A multicountry study estimated a 2.1% relative increase in death from any cause within 2 months after floods.⁹ Although flood-related accidental deaths play a role, the increased risk of death from any cause is largely attributed to exacerbated diseases and premature death owing to the interruptions in disease management, disrupted access to clean water and sanitation, heightened exposure to waterborne pathogens, food insecurity, undernutrition, and psychological distress.^{6,8}



PREVENTION

To reduce the likelihood and severity of floods

Structural solutions

Levees, dams, retarding basins, flood bypasses, floodgates
Morphologic changes in river channels
Improving drainage systems
Improving the resilience of roads
Updating housing designs

Nature-based solutions

Widening natural floodplains
Restoring wetlands and coastal ecosystems
Investing in green infrastructure
Land-use planning

Reducing greenhouse gas emissions

Rapid transition to sustainable energy
Limits to the carbon footprint of flood protection plans

PREPAREDNESS

To promote more timely and effective response

Public awareness

Delivery of flood risk information
Communication regarding evacuation routes and flood zones
Communication regarding community response plans

Effective warning systems

Flood forecasting
Predicting effects of flooding

Preparedness of health care systems

Training for staff
Mental health support for health care providers
Backup resources secured
Critical equipment placed away from high-risk areas
Use of information-management techniques
Stakeholders involved in response planning

RESPONSE

To reduce the effects on health and ensure the well-being of affected communities

Ensure basic hygiene and sanitation

Handwashing
Clean drinking water
Preventing and addressing mold

Treat injuries and illness

Adequate medical supplies accessible
Telemedicine available
Vulnerable populations prioritized

Prevent and control infectious diseases

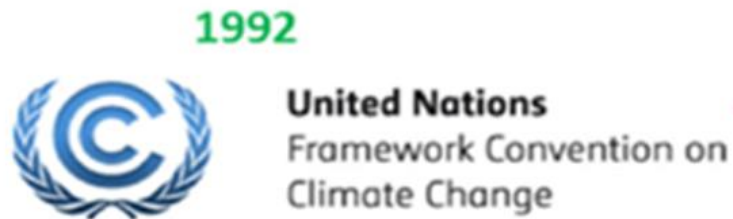
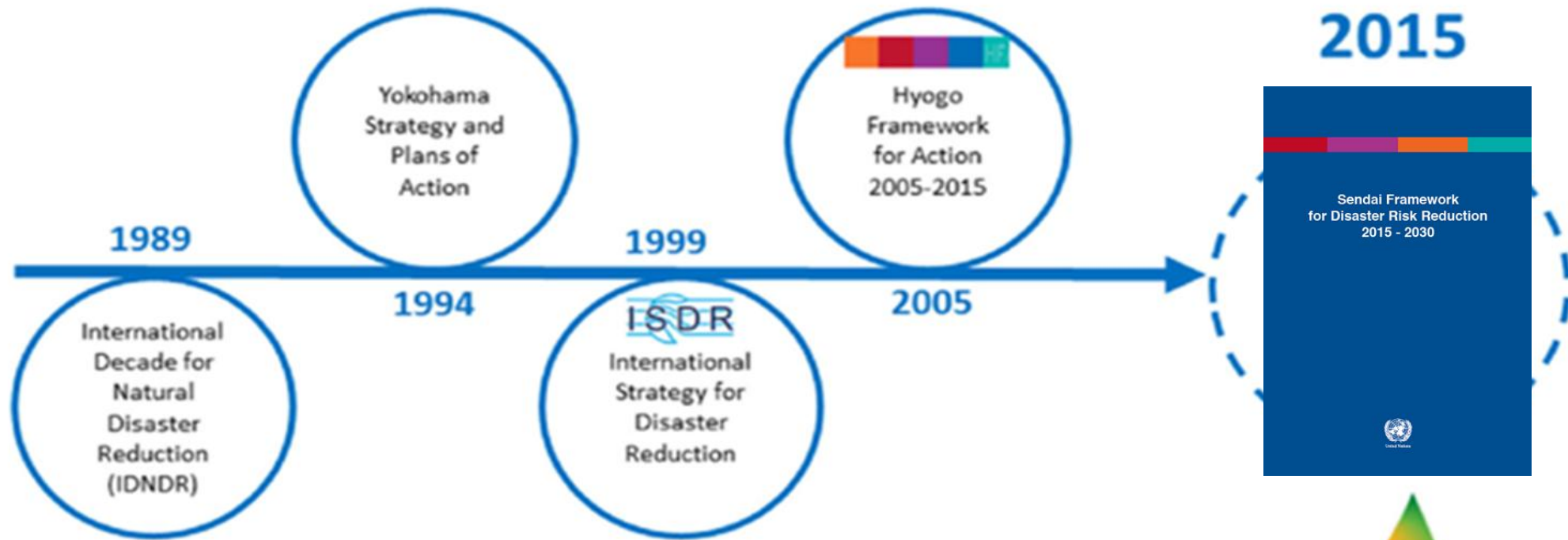
Vaccination programs
Surveillance plans
Early detection and contact-tracing plans

RECOVERY

To address the long-term health and social needs of persons affected by floods

Addressing long-term health and social needs

Ensuring effective management of chronic disease
Special focus on mental health
Telemedicine to improve access to health care
Financial support for immediate relief (e.g., shelters and essential resources) and long-term recovery





**Sendai Framework
for Disaster Risk Reduction
2015 - 2030**



United Nations

Sendai Framework for Disaster Risk Reduction 2015-2030

1 Global Outcome

13 Guiding Principles

4 Priorities for Action at all levels

7 Global Targets

7 GLOBAL TARGETS

Reduce

Mortality/
global population

2020-2030 Average << 2005-2015 Average

Affected people/
global population

2020-2030 Average << 2005-2015 Average

Economic loss/
global GDP

2030 Ratio << 2015 Ratio

**Damage to critical infrastructure
& disruption of basic services**

2030 Values << 2015 Values

Increase

Countries with national
& local DRR strategies
2020 Value >> 2015 Value

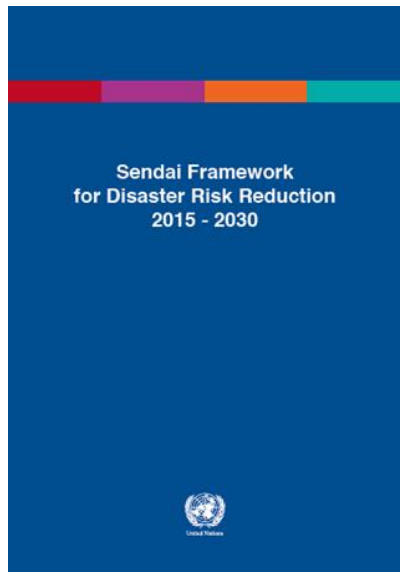
**International
cooperation**
to developing countries
2030 Value >> 2015 Value

**Availability and access
to multi-hazard early warning
systems & disaster risk
information and assessments**
2030 Values >> 2015 Values

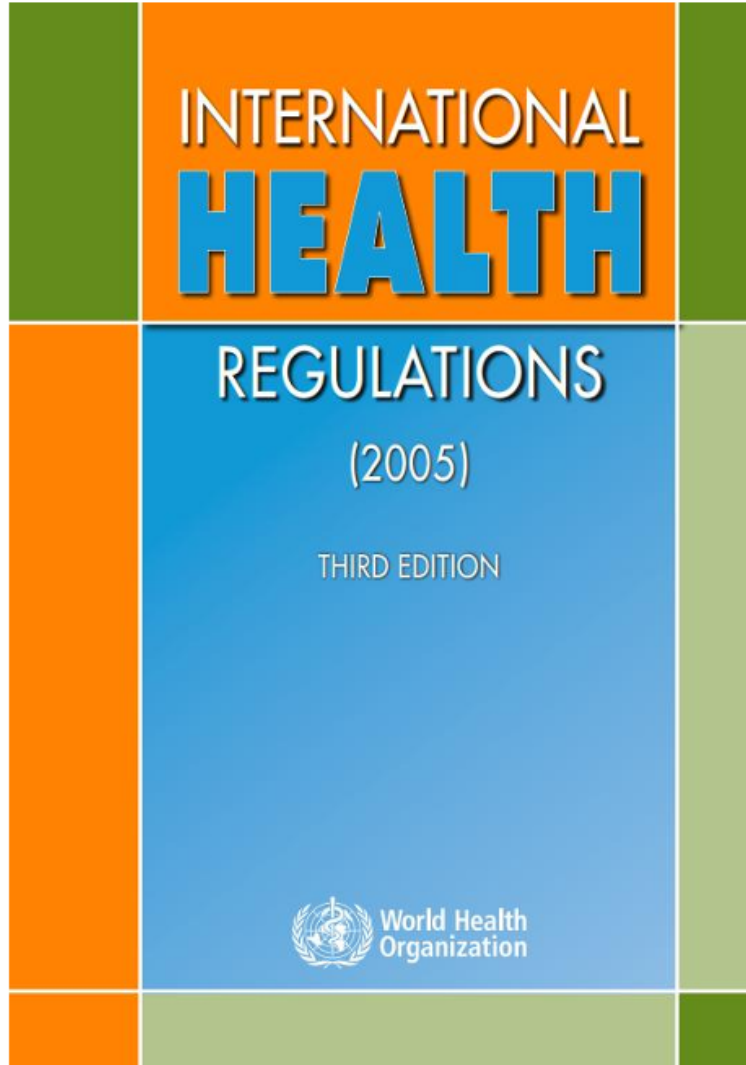
Sendai Framework for Disaster Risk Reduction 2015-2030



- Enhance the **resilience of national health systems**, **developing the capacity** of health workers; and promoting and enhancing the training capacities in the field of **disaster medicine**; in the implementation of the **International Health Regulations (2005)** of the World Health Organization (*Paragraph 30 j*)



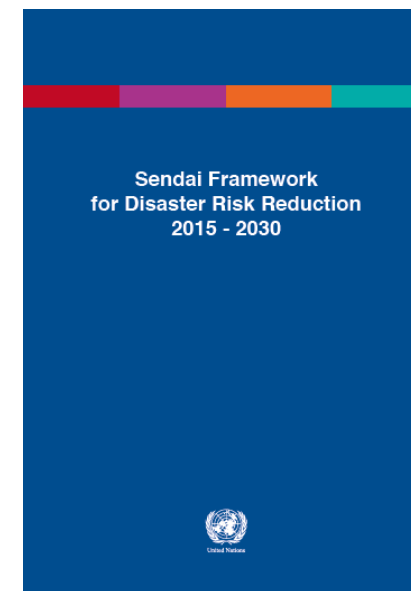
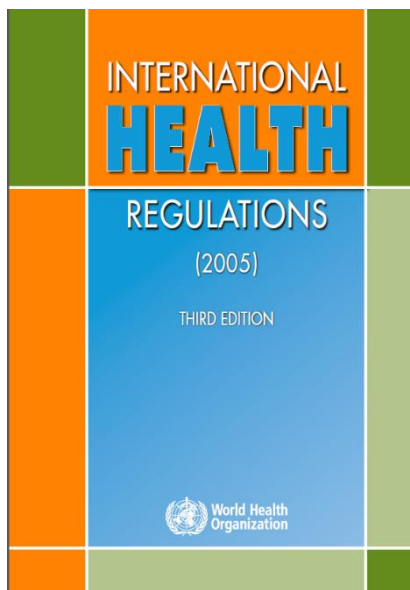
WHO International Health Regulations



- While disease outbreaks and other acute public health risks are often unpredictable and require a range of responses, **the International Health Regulations (2005) (IHR) provide an overarching legal framework that defines countries' rights and obligations in handling public health events and emergencies** that have the potential to cross borders.
- The IHR are an instrument of **international law that is legally-binding on 196 countries**, including the 194 WHO Member States. The IHR grew out of the response to deadly epidemics that once overran Europe.
- The Regulations also outline the criteria to determine whether or not a particular event constitutes a **“public health emergency of international concern”**.

WHO Health Emergency and Disaster Risk Management Framework

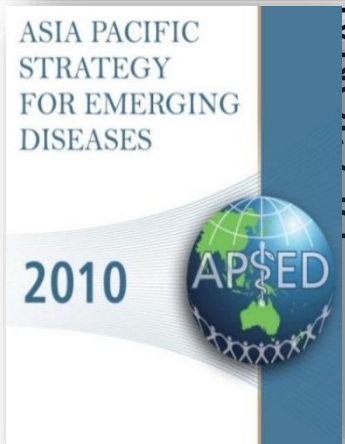
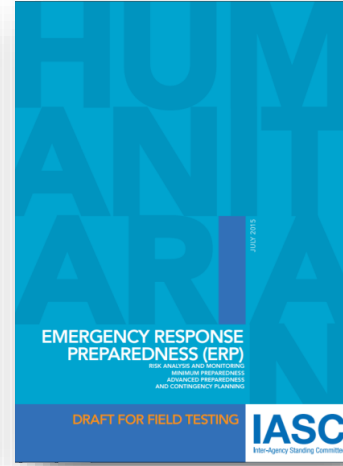
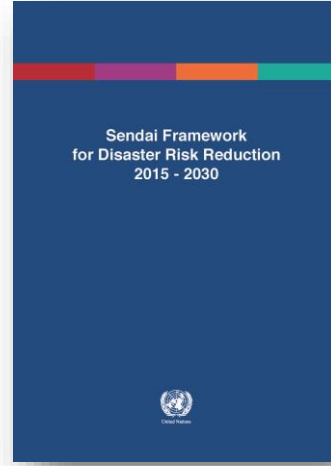
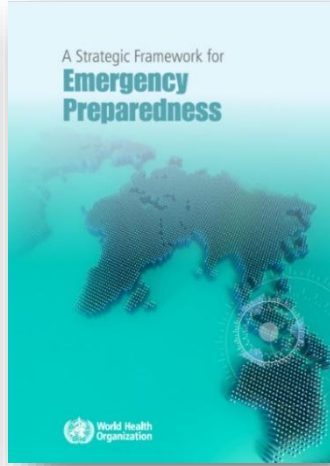
International Health Regulations



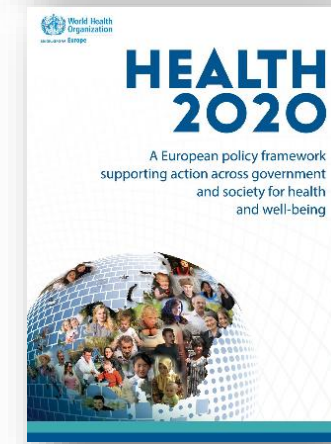
WHO Health Emergency and Disaster Risk Management Framework



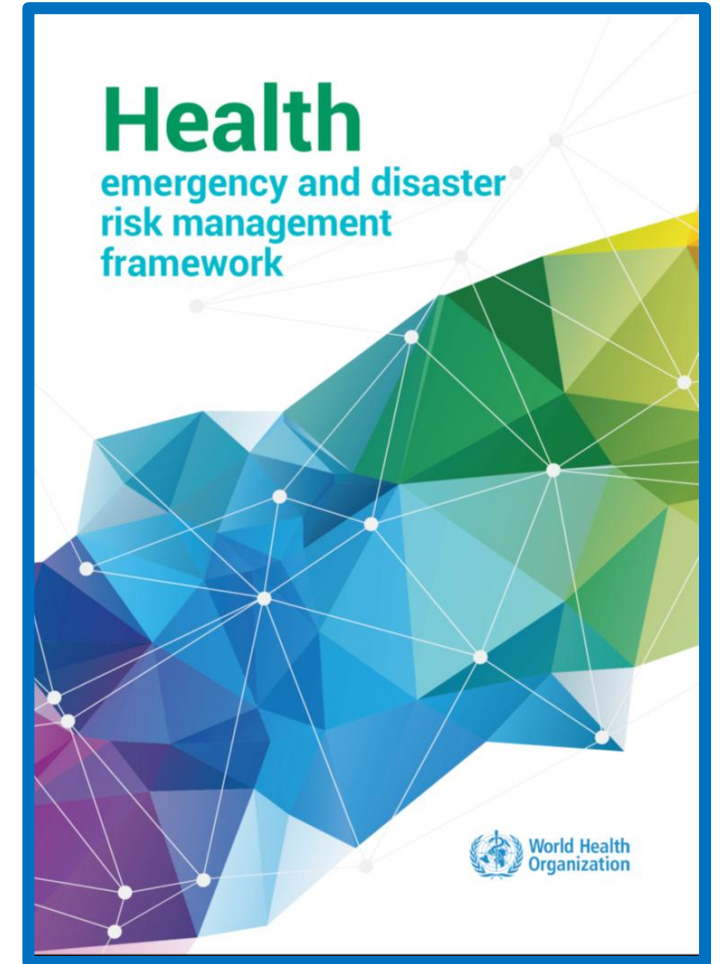
GLOBAL



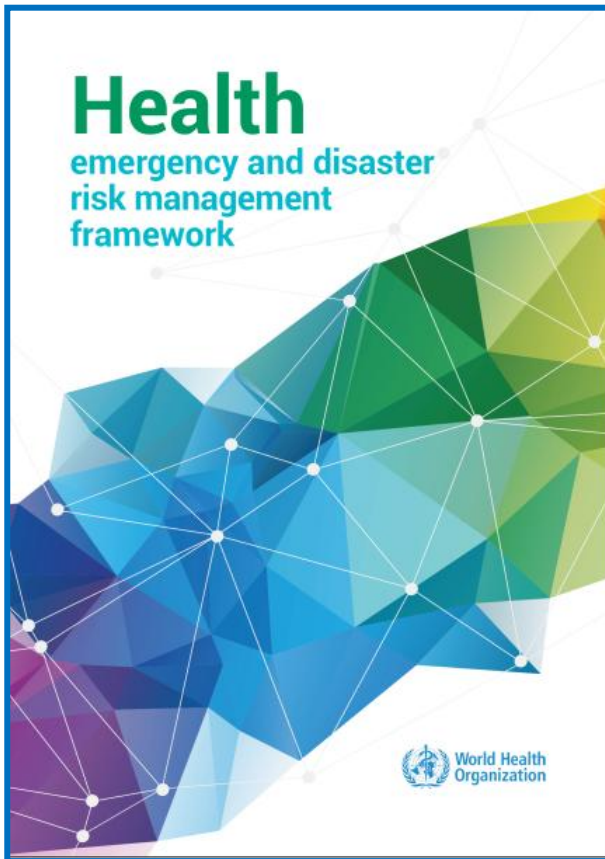
REGIONAL



+ PAHO Plan of Action for DRR 2016-2021, WPRO Framework for DRM for Health, SEARO Emergency Preparedness & Response Benchmarks, etc



WHO Health emergency and disaster risk management framework



- **Aligns global health security, disaster risk reduction, humanitarian reform, climate change & sustainable development agendas**
- **Bridges health and multi-sectoral communities**
- Derived from health systems, risk management, emergency and disaster management, epidemic preparedness and response and climate change adaptation

Published August 2019

<https://www.who.int/hac/techguidance/preparedness/health-emergency-and-disaster-risk-management-framework-eng.pdf?ua=1>

Climate change

Vulnerability

Vulnerability factors

- Demographic factors
- Geographic factors
- Biological factors & health status
- Sociopolitical conditions
- Socioeconomic factors

Exposure pathways

- Extreme weather events
- Heat stress
- Air quality
- Water quality and quantity
- Food security and safety
- Vector distribution & ecology

Health system capacity & resilience

- Leadership & governance
- Health workforce
- Health information systems
- Essential medical products & technologies
- Service delivery
- Financing

Climate-sensitive health risks

Health outcomes



Injury and mortality from extreme weather events



Heat-related illness



Respiratory illness



Water-borne diseases and other water-related health impacts



Zoonoses



Vector-borne diseases



Malnutrition and food-borne diseases



Noncommunicable diseases (NCDs)



Mental and psychosocial health

Health systems & facilities outcomes



Impacts on healthcare facilities



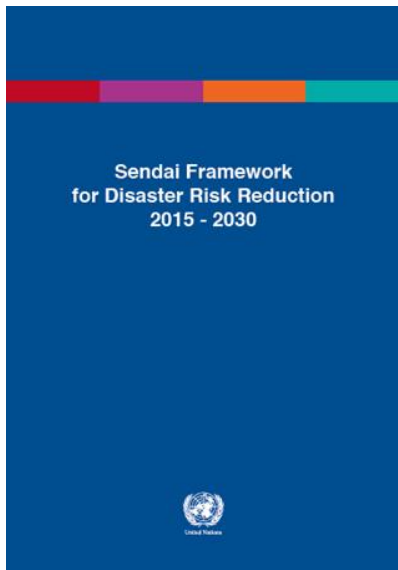
Effects on health systems

Health emergencies from climate change and variability are complex

as health impacts are often compounding, cascading and interacting

Sendai Framework for Disaster Risk Reduction 2015-2030

- **To strengthen technical and scientific capacity** to capitalize on and consolidate existing knowledge and to develop and apply methodologies and models to **assess disaster risks, vulnerabilities and exposure to all hazards;**
(paragraph 24 j)





SENDAI FRAMEWORK
FOR DISASTER RISK REDUCTION

MEASURING IMPLEMENTATION OF THE SENDAI FRAMEWORK

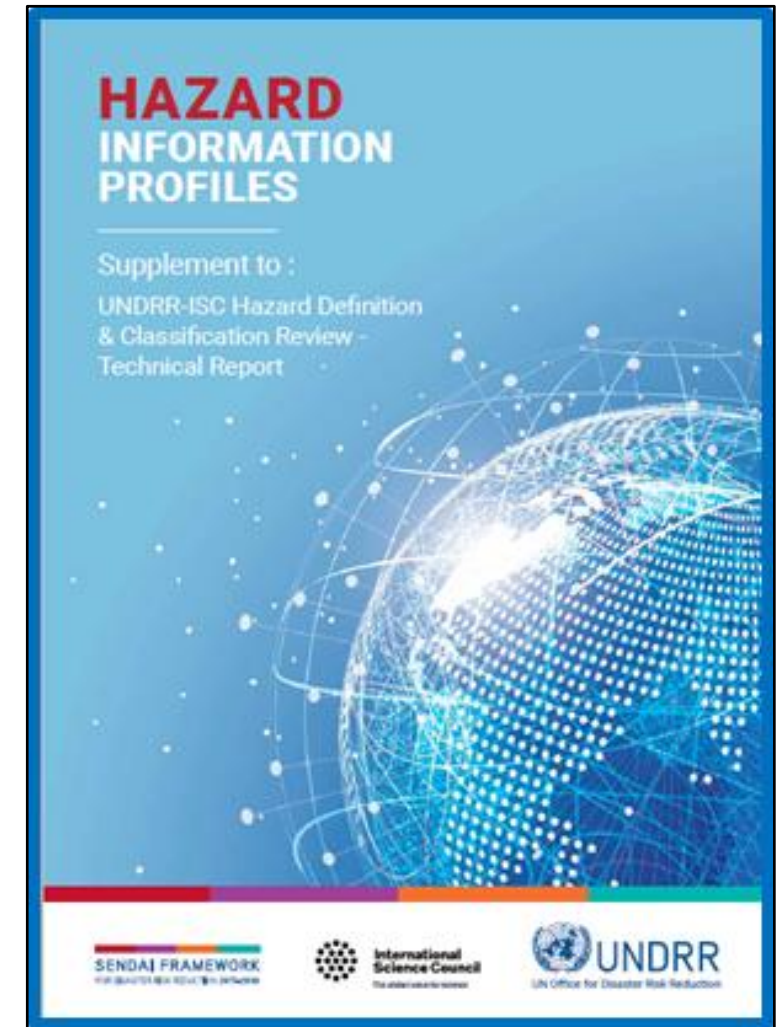
ANNOUNCEMENT

The Sendai Framework Monitor system is now live!

After the adoption of Sendai Framework in 2015, 38 indicators were defined to measure progress in achieving its 7 Global targets. This system is the official tool to report these indicators to both the Sendai Framework and SDG's reporting processes.



UNDRR / ISC Hazard Definition
and Classification Review
Technical Report
July 2020



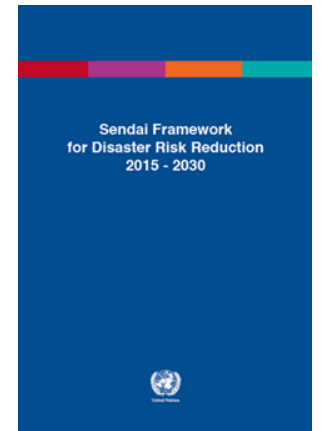
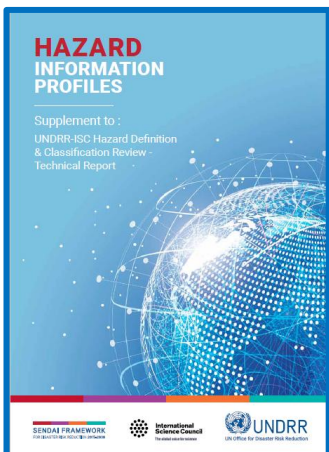
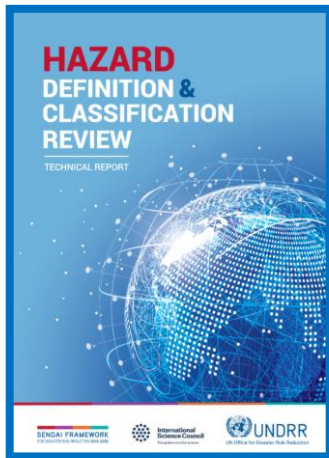
UNDRR / ISC Hazard Information Profiles
Supplement to UNDRR / ISC Hazard
Definition and Classification Review
October 2021



The UNDRR/ISC Hazard Definition and Classification Review Technical Report and Hazard Information Profiles support

Sendai Framework for Disaster Risk Reduction 2015-2030, Sustainable Development Goals of Agenda 2030 and Paris Agreement on Climate Change

by providing a
common set of hazard definitions
for monitoring and reviewing implementation



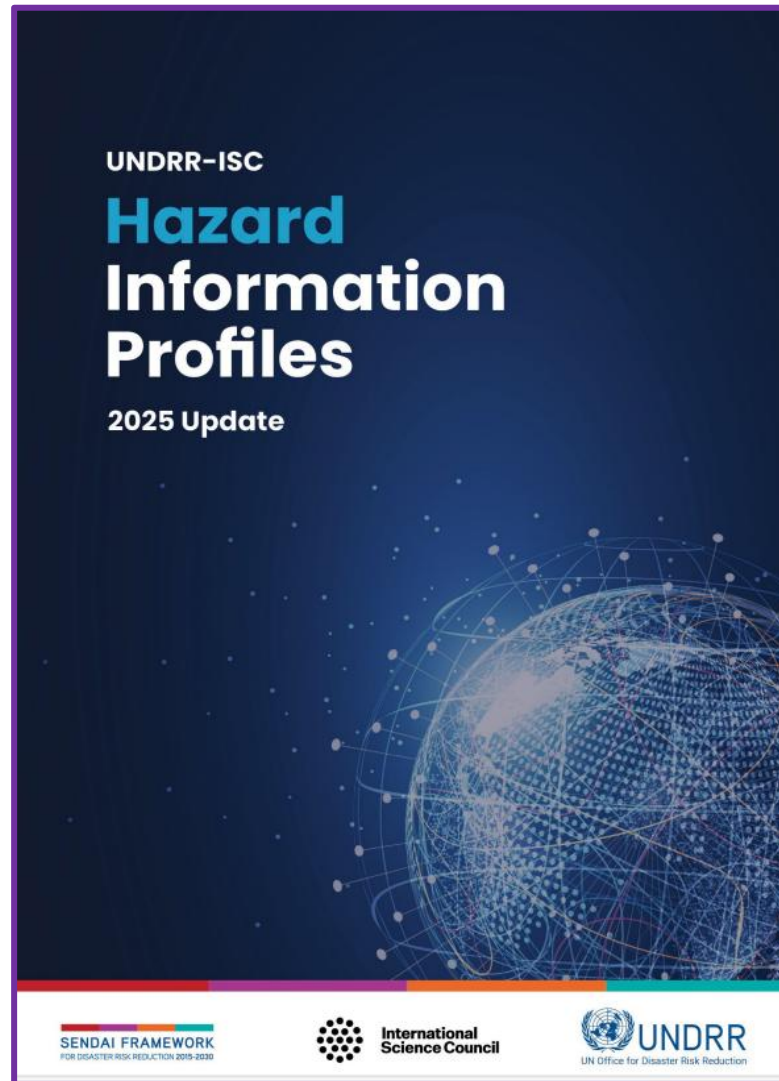
The Report of the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030



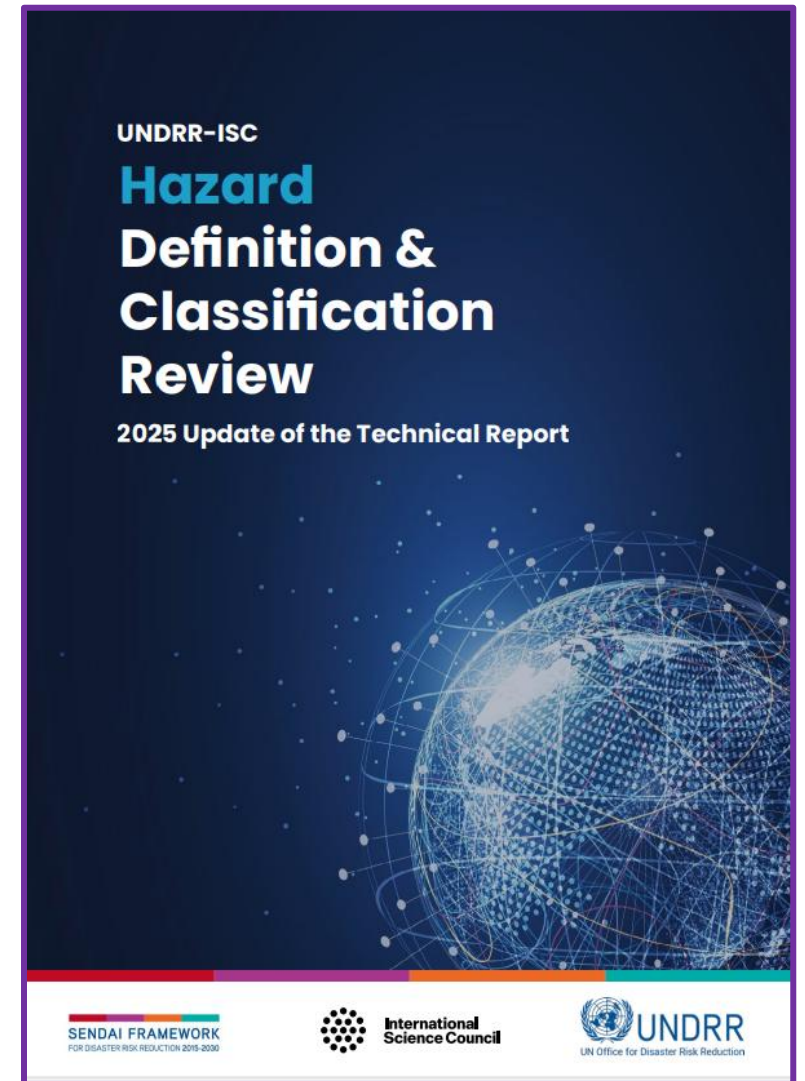
5.3.1. Terminologies

In developing standard DRR terminology, OIEWG has supported Sendai Framework implementation as well as the implementation and monitoring of progress of other agendas, agreements and intergovernmental processes.

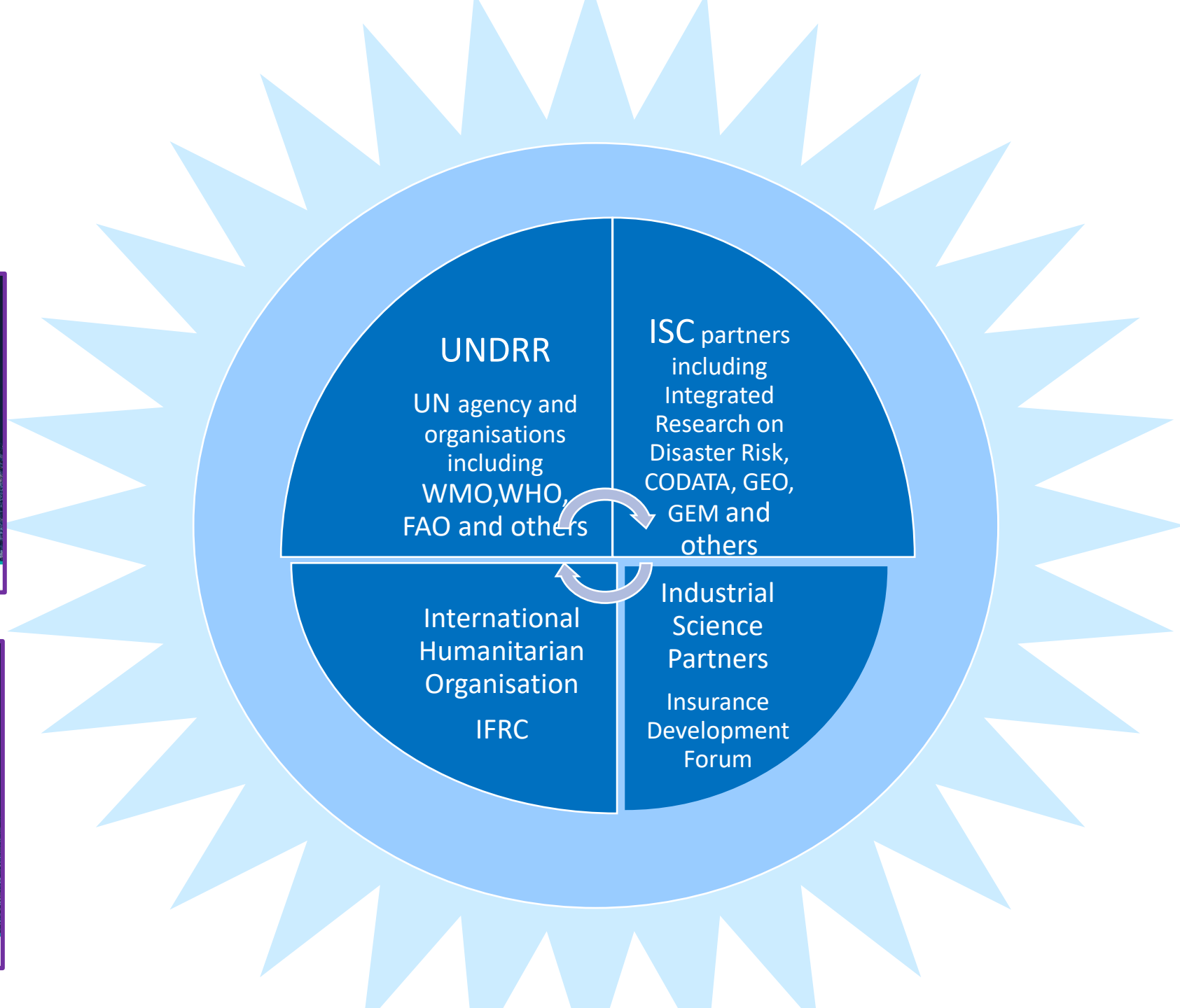
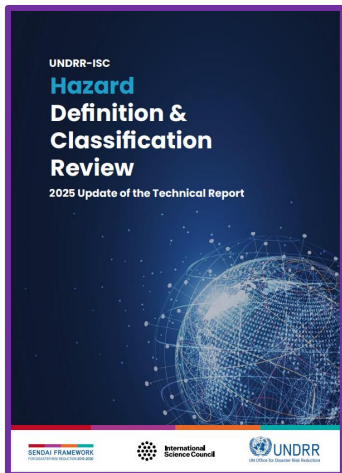
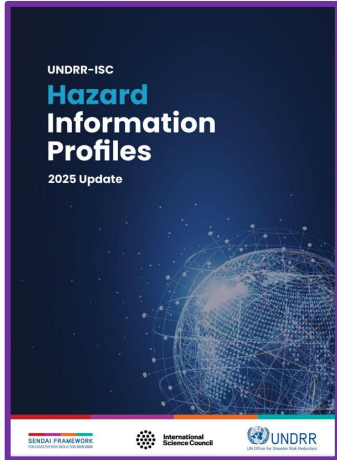
Work undertaken with the International Science Council (ISC) and the engagement of more than 800 partners from scientific institutions, including national scientific advisers, the research funding community and numerous international organizations, led to the **groundbreaking Sendai Hazard Definition and Classification Review Technical Report**. The report, which contains 302 **hazard information profiles**, is a key tool for building common definitions for developing comparable data sets for monitoring and review. It provides a common set of hazard definitions to governments and stakeholders to inform approaches, policies and investments, whether integrated in sectoral interventions or DRR strategies and actions.



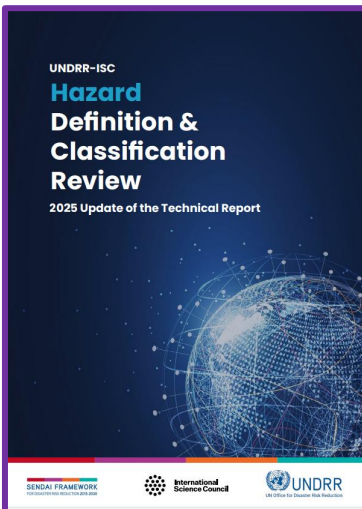
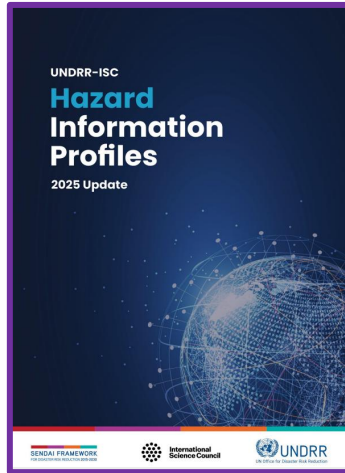
[UNDRR-ISC Hazard Information Profiles 2025 update](#)



[UNDRR-ISC Hazard Definition & Classification Review 2025 Update of the Technical Report](#)



UNDRR-ISC Hazard Information Profiles 2025 update



MH0600 / Meteorological & Hydrological

Flooding

Definition

Flooding is (1) an overflow or other body of water; (2) are not normally submerged (WMO and UNESCO, 2012).

Reference

WMO and UNESCO, 2012. *Definition of Flooding*. World Meteorological Organization (WMO) and UNESCO. <https://lib.wo.int/records/item/35589-international-glossary-of-terms-for-hydrology>. Accessed 16 May 2025.

Annotations

Synonyms

Flood, Inundation, High Water

Additional scientific description

Whereas floods are defined in hydrology as which the water level recedes at a slower rate (UNESCO, 2012), flooding represents the height of the water body.

Flooding can include:

- **Coastal Flood:** Coastal flooding occurs along riverine and flash floods near the coast and high winds coinciding with high pressure. In particular conditions, such as a combination of the shallowing of the riverine channel and high winds coinciding with high tides, the riverine flooding causes overflow near the coast (WMO, 2011). Therefore, it is called coastal flooding.
- **Flash Flood:** A flash flood is a flood that rises very rapidly.
- **Fluvial (Riverine) Flooding:** Overflow of a river (WMO, 2012).
- **Groundwater Flood:** A groundwater flood occurs when the level of groundwater rises above the level of the ground surface.
- **Ice-Jam Flood including Debris:** An ice-jam flood occurs when ice cakes, below ice cover. It is broken by local floods (WMO, 2012).
- **Ponding (Drainage) Flood:** A ponding flood occurs because it is falling faster than the rate of drainage.
- **Snowmelt Flood:** A snowmelt flood occurs during the winter (WMO, 2012).

- **Surface Water Flooding:** Surface water flooding occurs when water runs off or infiltrates after the rain event.
- **Glacial Lake Outburst Flood:** A glacial lake outburst flood is a flood caused by the sudden release of a large amount of water retained in a glacial lake.

Metrics and numeric limits

Key flooding metrics, such as flood depth at peak, flooding duration, sediment load, content of suspended solids (WMO, 2022). However, these indicators and metrics are not standardized.

- **Coastal Flood:** The extent and magnitude of coastal flooding is controlled by the topography and bathymetry (WMO, 2017).
- **Flash Flood:** A flash flood is a flood that rises very rapidly.

Key relevant UN convention(s) / multilateral agreement(s)

Sendai Framework for Disaster Risk Reduction 2015-2030

Examples of hazard drivers, impacts and monitoring

Hazard Drivers: Floods tend to be caused by pressure areas, thunderstorms, and tropical geography and whether it is an urban area or a rural area. A heavy rain event or far downstream away from the coast, storm surges, tsunamis, ice jams and glacial lake outburst floods, etc. (Geoscience Australia, 2013).

Impacts: More people are impacted by flood with developing countries most at risk. Almost 2 billion people live in flood-prone areas, causing mortalities and destruction of property.

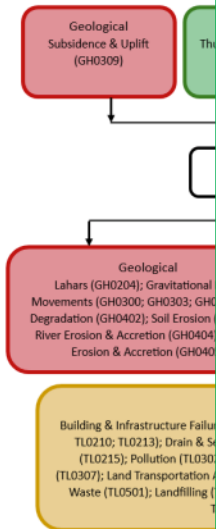
Health impacts from floods: The effects of flooding on human health are relatively easy to track, ascertain and prevent. Deaths associated with flooding include drowning, electrocution, carbon monoxide poisoning and other injuries (WHO, 2013).

Morbidity associated with floods is usually delayed (WHO, 2013). Hypothermia may occur in floodwaters (WHO, no date). There may also be exposure to flood waters and rain. Power cuts and increasing the risk of water-borne diseases (WHO, no date). Floods can potentially increase the risk of water-borne diseases.

The longer-term health effects associated with floods include the destruction of homes, delayed recovery and economic impacts from floods. According to the World Meteorological Organization (WMO), between 1970 and 2019, cyclones, with US\$1.3 trillion in economic loss, affected 1.5 billion people, and destroyed 100 million acres of agricultural activities, and damaged 100 million acres of infrastructure. For example, the event known as "The Great Flood" impacted areas along the Missouri River. The flood caused significant damage to agriculture, with the prolonged nature of the flood affecting various industries in the region except for shipping routes (Sun et al., 2022).

Multi-hazard Context: The figure below summarizes the multi-hazard context and should be used with caution and not be solely relied upon.

have been included. Note that hazardous events may be otherwise related to each other. Specific examples are provided in the sections above.



Monitoring: The section above and the table below provide information regarding EWS current and specific information regarding EWS responsible for disaster management.

Which institution(s) produce(s) Disaster Risk Data/Information?	<ul style="list-style-type: none"> • Meteorological • Hydrological • Coastal • Oceanic • Geological • Geospatial • Health • Water • Environmental • Land • Regional • Economic • Resilience • Environmental
How is the Hazard Observed/Monitored/Forecast?	Flooding rainfall, water level, alongside computerized monitoring of communities.

Risk Management: Climate variability and change, land use, ecosystem degradation and increased aggravating flood-related impacts (UNDRR, no date).

Integrated Flood Management (IFM) encourages the integration of land and water resources development (WMO, 2009).

An example of an initiative promoting an IFM approach is the concept of IFM to maximize net benefits from flood risk management and publications to support flood risk management.

Aside from risk management, there are several measures that can be taken to reduce flood risk:

- "Integrate flood risk assessment into urban planning and development."
- Avoid building on flood-prone land.
- Develop new building codes to reinforce flood resilience.
- Create more space for rivers, floodplains and wetlands.
- Ensure health of coastal reefs and mangroves.
- Maintain early warning systems, backed up by communication systems.
- Have an evacuation plan for those at risk.
- Catalyze finance and insurance schemes.
- Protect and evacuate animals" (UNDRR, 2019).

References

Bell, R., J. Lawrence, S. Stephens, S. Allan, P. B. New Zealand guidance. pp. 75-81. In: Australasia and the Pacific Islands.

BGS, 2010. Groundwater flooding research overview. <https://www2.bgs.ac.uk/groundwater/flooding/grc/>

Emmer, A., 2017. Glacier Retreat and Glacial Lake Outburst Floods. <https://oxfordre.com/naturalhazardscience/view/10.1093/oxfordhb/9780190228622/013/0001>. Accessed 16 May 2025.

Geoscience Australia, no date. Flood. Available from: <https://www.ga.gov.au/our-work/our-areas-of-interest/flood>. Accessed 16 May 2025.

Maranzoni, A., D'Oria, M., and Rizzo, C., 2022. Climate Change and Flood Risk Management. *Water*, 14(1). Available from: <https://www.mdpi.com/2076-3258/14/1/1>.

NOAA, no date a. Flash Flooding Definition. National Weather Service. Available from: www.weather.gov/phi/Flash_Flooding.

NOAA, no date b. Severe Weather 101: Flood Basics. <https://www.nssl.noaa.gov/education/svrwx101/flood/>

Sun, Q., Mann, J. and Skidmore, M., 2022. The Impact of Floods on Small Business. *Water Economics and Policy*. <https://worldscientific.com/doi/10.1142/S238262222150001>

UNDRR, no date. Hazards. Flood. UNDRR Prevention and Preparedness. <https://www.undrr.org/prevention/hazards/flood/>. Accessed 16 May 2025.

WMO and UNESCO, 2012. International Glossary of Basic Terms in Hydrology. United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://lib.wo.int/records/item/35589-international-glossary-of-terms-for-hydrology>

WMO, 2009. Integrated Flood Management, Concept and Practice. <https://www.wo.int/records/item/35589-integrated-flood-management>. Accessed 16 May 2025.

WMO, 2011. Manual on Flood Forecasting and Warning. <https://lib.wo.int/records/item/35881-manual-on-flood-forecasting-and-warning>

WMO, 2017. Regional Association IV - Hurricane Operational Plan for North America, Central America and the Caribbean, WMO-No. 1163. World Meteorological Organization (WMO). Available from: https://lib.wo.int/viewer/48739?medianame=RAIV_HC-45_OP2023_EN_#page=1&viewer=picture&o=bookmark&n=0&q=. Accessed 16 May 2025.

WMO, 2021. Technical Regulations. Volume III: Hydrology, WMO-No. 49. World Meteorological Organization (WMO). Available from: <https://library.wmo.int/records/item/35631-technical-regulations-volume-iii-hydrology?offset=15>. Accessed 16 May 2025.

WMO, 2022. Guidelines on Implementation of a Coastal Inundation Forecasting-Early Warning System, WMO-No.1293. World Meteorological Organization (WMO). Available from: <https://library.wmo.int/records/item/58169-guidelines-on-implementation-of-a-coastal-inundation-forecasting-early-warning-system>. Accessed 16 May 2025.

World Meteorological Organization, 2022. WMO Atlas of Mortality and Economic Losses from Weather, Climate, and Water Extremes (1970-2019) (WMO-No. 1267) 2022 update.

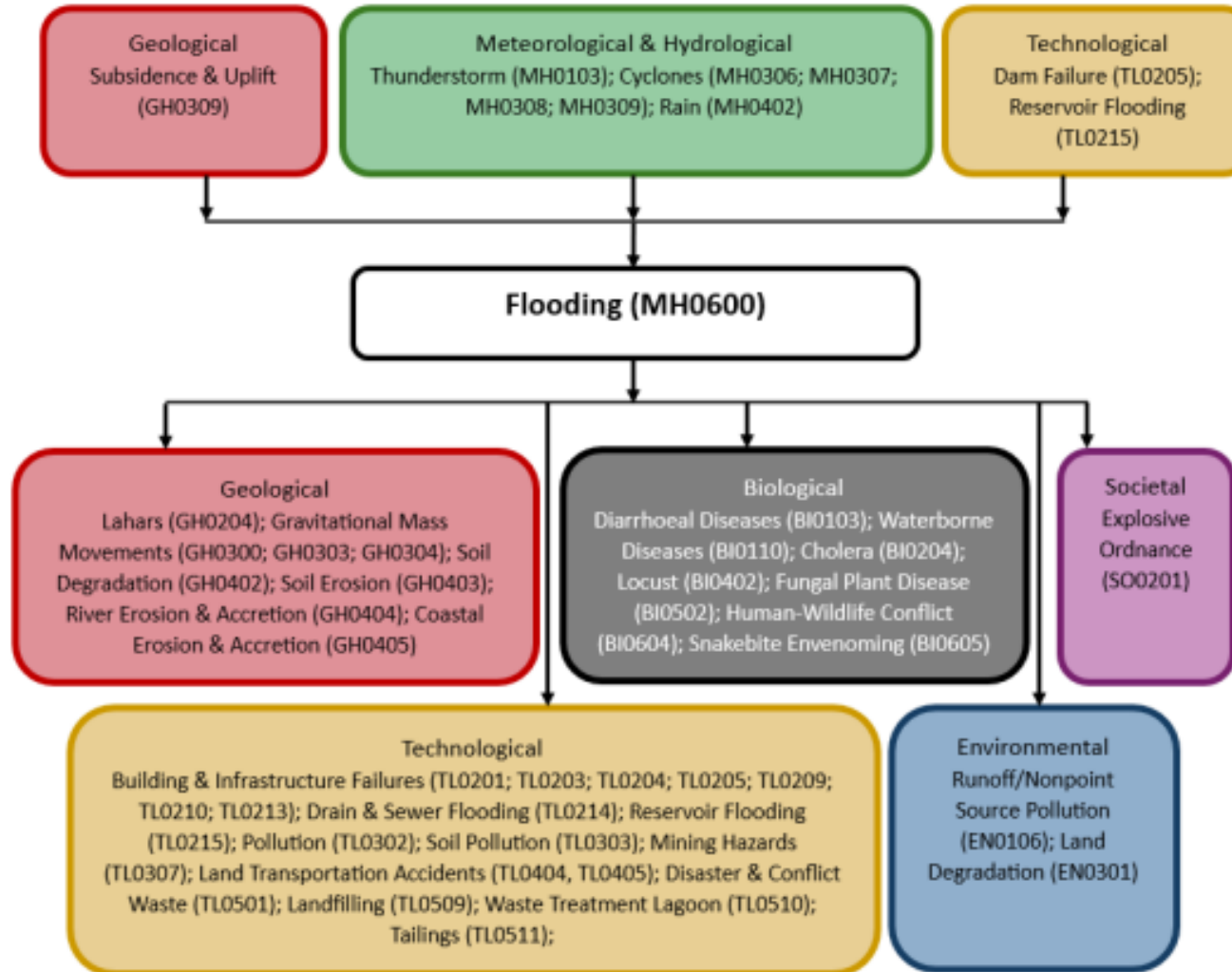
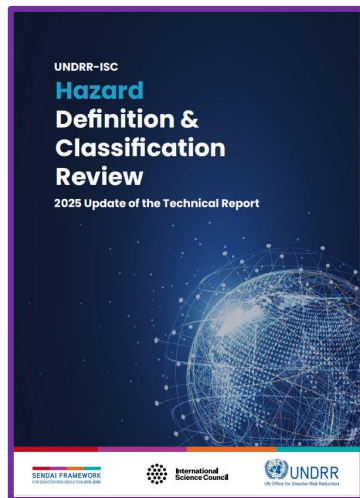
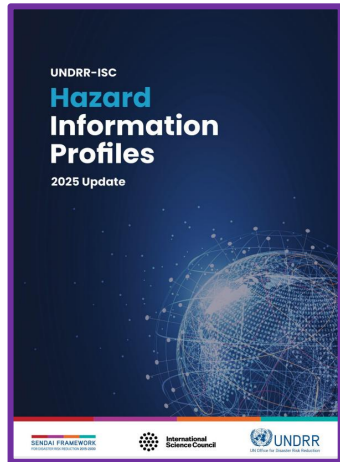
WMO, 2025: Floods. World Meteorological Organization (WMO). Available from: <https://wmo.int/topics/floods>. Accessed 16 May 2025.

WHO, no date. Flooding and communicable diseases fact sheet. World Health Organization (WHO). Available from: <https://iris.who.int/handle/10665/232690>. Accessed 16 May 2025.

WHO, 2013. Floods in the WHO European Region: Health effects and their prevention. World Health Organization (WHO), Regional Office for Europe. Available from: <https://apps.who.int/iris/handle/10665/108625>. Accessed 16 May 2025.

Coordinating agency or organisation

World Meteorological Organization (WMO).



2025 Hazard Information Profiles (HIPs) online reference

A description of each of the 281 hazard information profiles (HIPs), developed using a consultative process by scientists and experts across the globe.

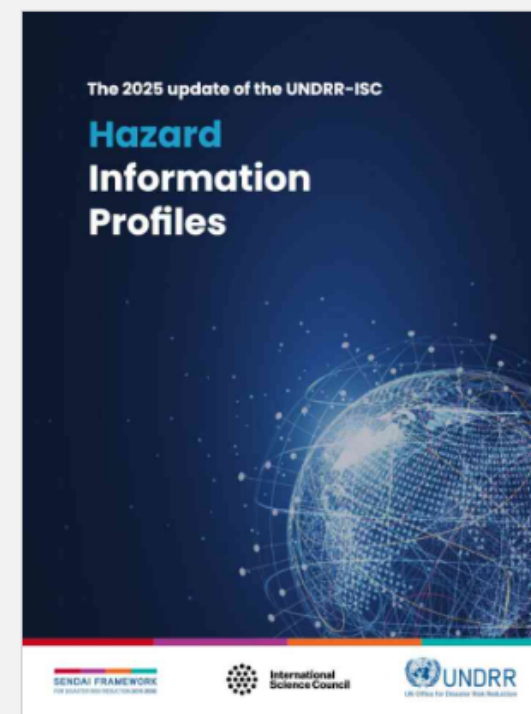


Following the recommendation for regular review and update, three years after their initial release, the UNDRR and the ISC undertook an update of the UNDRR-ISC HIPs: the [revised publication is available now](#) and the online resource below has been updated. A machine actionable data set will be available in the coming weeks.

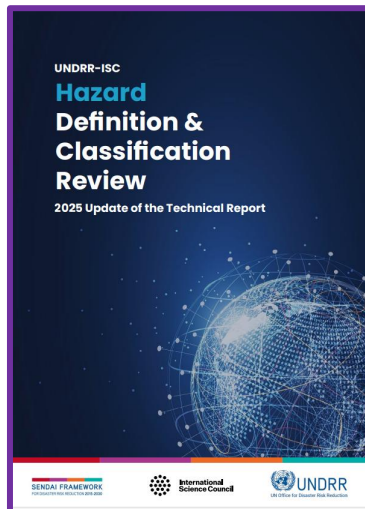
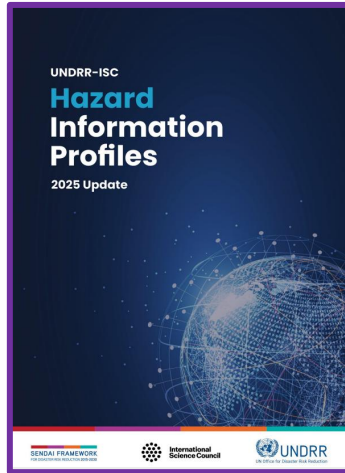
The HIPs serve as a trusted source of scientifically grounded, standardized hazard information used by governments, agencies, researchers and educators worldwide. They support risk assessment, disaster preparedness, loss tracking and multi-sectoral planning. Above all, they are a practical resource – valued because they are usable, useful and used.

The [Hazards Information Profiles](#) and the [Technical report](#) provide an important resource to support the implementation of disaster risk reduction and risk-informed investment, aligned with the Sendai Framework for Disaster Risk Reduction 2015–2030, but also the Sustainable Development Goals of Agenda 2030, the Paris Agreement on Climate Change and the Addis Ababa Action Agenda on Sustainable Financing. It provides a common set of hazard definitions to Governments and stakeholders to inform their strategies and actions on risk reduction and management.

The HIPs support the development and updating of national and local disaster risk reduction strategies and loss databases, as well as integrating disaster risk reduction into national statistics, legal, accounting and regulatory frameworks and public and private policy, financing and investment decisions.



[Read the 2025 publication](#)



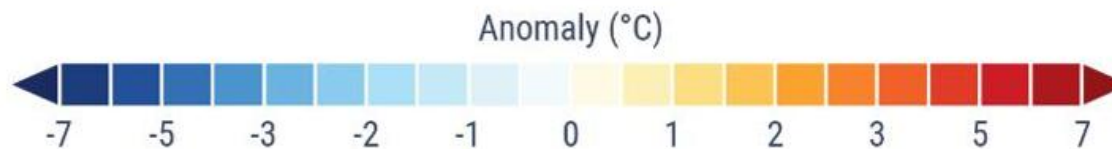
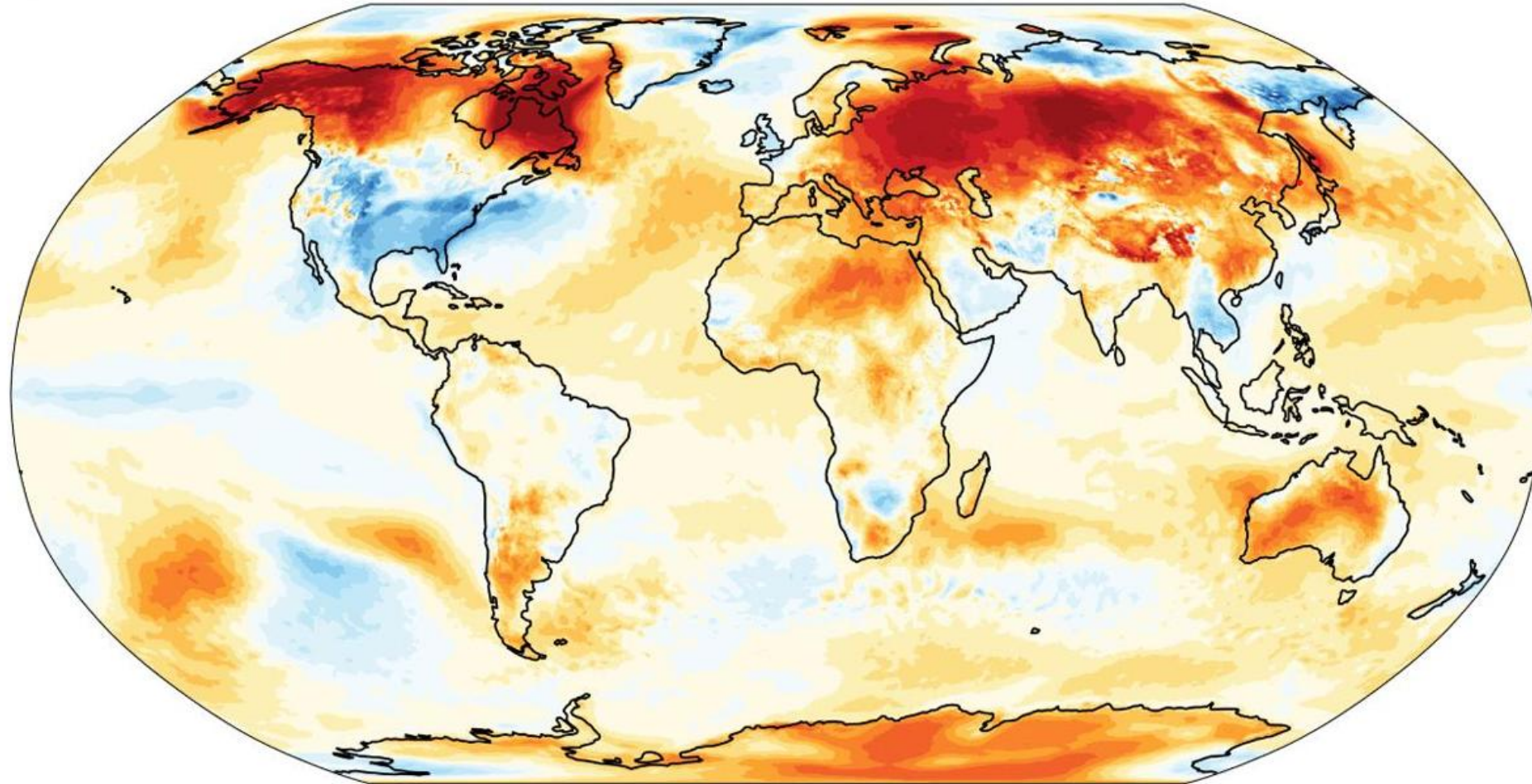
The Hazard Information Profiles are an encyclopedia for resilience





Surface air temperature anomaly in January 2025

Reference period: 1991–2020 • Data: ERA5 • Credit: C3S/ECMWF



PROGRAMME OF
THE EUROPEAN UNION



Copernicus:
January 2025
was the warmest
on record
globally, despite
an emerging La
Niña | Copernicus



| Earth is becoming hotter and more dangerous for everyone, everywhere. To tackle the root cause, countries must phase out fossil fuels – fast and fairly.

Secretary-General's Call to Action on Extreme Heat

Extreme events, risk management and mental health

