

A Disaster Risk Reduction Roadmap for the World Meteorological Organization

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Approved by:

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Foreword

The vision of the World Meteorological Organization (WMO) is to provide world leadership and expertise in international cooperation in the delivery and use of high-quality and authoritative weather, climate, hydrological and related environmental services by its Members, for the improvement of the well-being of societies of all nations. The successful contribution of WMO, and the National Meteorological and Hydrological Services (NMHSs) of its Members in particular, to disaster risk reduction (DRR), climate change adaptation (CCA) and increased resilience is and will be based on coordinated and collaborative initiatives between the WMO Members, partners, and specific communities whose aim is to reduce the risks and impacts of disasters due to meteorological, climatic, and hydrological hazards, at local to global levels.

This WMO DRR Roadmap was developed, in consultation with Members and in collaboration with the technical commissions and regional associations, at the request of the WMO Executive Council in 2014 as a “roadmap of prioritized and realistically achievable activities and deliverables that are consistent with the WMO Strategic and Operating Plans as well as the work plans for relevant WMO programmes and projects”. It was further called for a clear identification of the role of NMHSs and WMO, working with their partners, in the implementation of international frameworks on development, climate, environmental, humanitarian and urban issues, such as the *Sendai Framework for DRR 2015-2030*. These requests were timely, as 2015 marked a pivotal year in the global development agenda in which the rare alignment of international policy processes with national government, private sector, and civil society interests is an opportunity to position disaster risk management (DRM) as a cornerstone in the efforts to foster DRR, CCA and resilience as key components of sustainable development. It is also an opportunity for WMO to further demonstrate the wide range of services and products it has to offer for the global DRM community.

The Roadmap is first and foremost a document that can be used by both WMO Members, partners and users to understand how NMHSs in partnership with other agencies contribute to increasing the resilience of communities, nations, regions, and the world under the above-mentioned frameworks, through a coordinated WMO-wide plan of action on DRR. It is hoped that this Roadmap will guide the Organization, in particular the NMHSs as well as key partners, in the development of its strategic and operating plans that fully take into account the contributions of the WMO community to all components and phases of DRM. The document is intended to provide a framework for how to strengthen NMHSs capacities to serve their national but also regional and global DRR stakeholders through leveraging the leadership of WMO and its network and activities at all levels. It will discuss the broad activity categories required to address DRR as one of the seven WMO priority areas within the *WMO Strategic Plan 2016-2019*. Key features of this Roadmap are to leverage existing WMO mechanisms, activities and projects and to develop linkages to external initiatives in order to realise tangible benefits for WMO Members through collaboration and coordination at the national, regional and global levels. In this way, the document provides a means for the cross-cutting WMO DRR Programme to achieve its goals. This comprehensive, cross-cutting set of activities will also contribute to the realisation of other WMO priorities such as the *Global Framework for Climate Services (GFCS)* and capacity development.

The Roadmap will cover four inter-sessional periods of WMO, corresponding to the lifetime of the Sendai Framework for DRR 2015-2030. Over the course of time the DRR landscape is certain to change, and the timescales involved require the Roadmap to be a “living” document with updates that will be subject to endorsement by the WMO decision-making bodies. It will be complemented by implementation plans which correspond to the four-year inter-sessional periods and which will identify key milestones and deliverables, aligned with the global development agenda and WMO’s strategic and operational planning documents. .

Acknowledgements

This Disaster Risk Reduction (DRR) Roadmap for the World Meteorological Organization (WMO) is the result of a joint effort of WMO Members, constituent bodies and the Secretariat and led by the DRR Services Division of the WMO Weather and DRR Services Department (WDS).

Constructive feedback was received from representatives of the National Meteorological and Hydrological Services of WMO Members, from WMO technical commissions, regional associations and technical programmes (including their DRR Focal Points), and Secretariat colleagues.

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1 Introduction

1.1 Rationale

It is well documented that high-impact weather events and climate extremes, both rapid onset such as flash floods and slow onset such as droughts, have devastating effects throughout the world, resulting in injury and loss of life, displacement of people, and destruction of livelihoods and assets. Hazardous events of hydrometeorological origin continue to trigger the large majority of disasters. Between 2005 and 2014, 83 % (3253) of recorded disasters, 39 % (283 035) of recorded deaths, 95 % (1.6 billion) of the recorded total affected population and 70 % (US\$ 983 million) of the recorded total damage were linked to natural hazards related to weather, water and climate.¹

Despite achievements in reducing mortality and economic loss in certain countries, regions and cities and for some hazards², overall disaster risk and the frequency and intensity of disasters are on the rise (Figure 1) and significantly impede progress towards sustainable development.

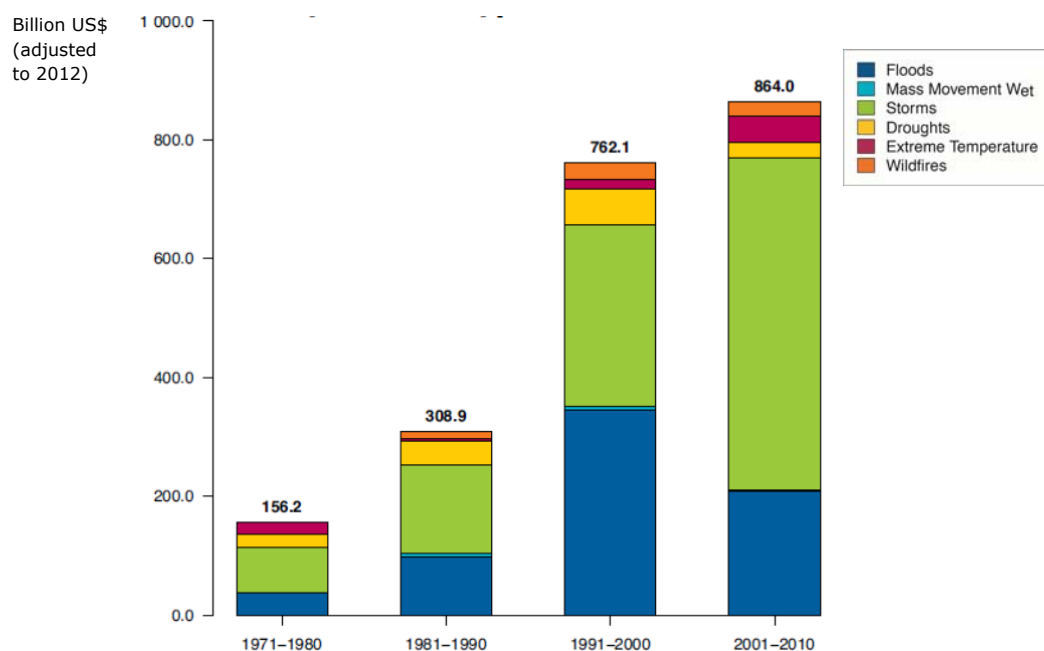


Figure 1: Recorded economic losses by decade by hazard type (1971-2010), in US\$ billion, adjusted to 2012 (Source: WMO and CRED, 2014³)

One especially alarming development is that both the mortality and economic loss associated with smaller-scale, recurrent localized disasters are trending up.⁴ Evidence indicates that exposure of people and assets in all countries has increased faster than vulnerability has decreased – especially to weather and climate extremes – thus generating new risk and a steady rise in disaster losses with significant socio-economic impact in the short, medium and long term, in particular at the local and community level. Urbanization as a global phenomenon is expected to accelerate, resulting in a rapid increase in population density in a growing number of megacities and large urban complexes, many of which include coastal areas which are prone to urban flooding

¹ Disasters recorded in the EM-DAT database between 2005 and 2014, available at: <http://www.emdat.be>.

² These achievements have largely been due to advancements in hydrometeorological science and technology and to stakeholder engagement which have led to improvements in preventing the creation of new risks, mitigation, early warning and community preparedness.

³ WMO and CRED, 2014: Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970-2012). Geneva, available at: http://library.wmo.int/opac/index.php?lvl=notice_display&id=16279#.VT01JmOfgRo. Note: "mass movement wet" includes any type of downslope movement of earth materials (such as snow avalanches, debris and mud flows, and rockfalls) that involves the occurrence, movement, and distribution of surface and subsurface water.

⁴ Pocket Global Assessment Report on Disaster Risk Reduction 2015, available at: http://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR15_Pocket_EN.pdf.

or water stress and have obsolete infrastructures. Through a cascading effect, which is exacerbated due to the global interdependency of economies, the impact of such natural hazards tends to broaden with indirect and lingering consequences (e.g. the 2010 eruptions of Iceland's Eyjafjallajökull volcano or the 2011 Thailand floods). These social and economic vulnerabilities will continue to exist and – most likely – grow, and together with prevailing high-impact hydrometeorological events as well as climate change and variability and their environmental consequences they pose elevated risks to the safety of lives and property, particularly in developing and least developed countries (LDCs) and in Small Island Developing States (SIDS). Typhoon *Haiyan* that devastated parts of the Philippines in 2013 is a stark reminder of this ongoing reality which imposes new challenges for building disaster resilience and prompts efficient post-disaster recovery.

In response to these challenges, disaster risk reduction (DRR) is central to the mission of the World Meteorological Organization (WMO) and the National Meteorological and Hydrological Services (NMHSs) of its (as of 2017) 191 Members and has been a priority for WMO for many years and a consistent theme for all NMHSs and throughout the WMO regional associations (RAs), technical commissions (TCs), programmes and projects. In fact, in the *WMO Strategic Plan 2016-2019*⁵, DRR is the first of the seven strategic priorities with the expected results of enhanced capabilities of Members to reduce risks and potential impacts of hazards caused by weather, climate, water and related environmental elements (e.g. air quality and biomass burning) through producing better weather, climate, hydrological and related environmental information, predictions, warnings and services to support DRR and climate change adaptation (CCA) strategies. As such, it is important that DRR is addressed in a coordinated manner. In this context, the Fourteenth World Meteorological Congress (Cg-XIV) in 2003 established the WMO DRR Programme with the aim to enhance the contributions of NMHSs to DRR and disaster risk management (DRM) through improved capabilities and cooperation at all levels and in a more cost-effective, systematic and sustainable manner (Annex I: Key decisions). The scope and the goals of the Programme are underpinned by the *Hyogo Framework for Action (HFA) 2005–2015: Building the Resilience of Nations and Communities to Disasters*⁶, which shifted the traditional focus of post-disaster response to a more comprehensive approach involving prevention and preparedness measures.

Some of the key expected benefits of capable NMHSs and coordinated support by WMO to its Members are reduced loss of lives and livelihoods, reduced economic and environmental losses, and increased resilience through improved sectoral planning (including increased use of weather, climate and hydrological services for long-term strategic planning and the design and implementation of preventive measures) and preparedness for response and recovery through more effective risk information and (MH)EWS.

Effective DRR related to hydrometeorology is centred on science-based weather, climate, and water information about potential hazards. NMHSs and other agencies (e.g. geological surveys, environmental agencies, disaster management and civil protection agencies, etc.) of WMO Members contribute to the safety and well-being of society through their efforts to provide information on natural and partly human-induced hazards and their impacts on lives and livelihoods. Such information is an essential input for DRR and CCA strategies, plans and measures, including sectoral plans such as for the improvement of the safety of transport on land, at sea and in the air and for human and environmental health. Climate information and products (including historical data and seasonal climate forecasts) are useful for planning of climate-sensitive activities, while the analysis of multi-year hazard patterns and trends, combined with decadal to century climate projections under various climate change scenarios, can underpin longer-term strategic planning, prevention, mitigation and disaster risk financing to reduce the impacts of disasters at various levels. For example, improving operational climate services through the Global Framework for Climate Services (GFCS) will enhance national capabilities to support climate-smart decision-making and better utilization of climate information in DRR aspects. This

⁵ WMO Strategic Plan 2016-2019, available at http://library.wmo.int/pmb_ged/wmo_1161_en.pdf

⁶ <http://www.unisdr.org/we/coordinate/hfa>

will further strengthen the resilience of society to longer-term climate variability and change. Critical to success are the service delivery interactions with the community of users, including open access to global weather, water and climate data and impact-relevant products and services.

Accurate, timely and impact-oriented weather, climate, water and related environmental products and services from WMO Members, in particular from their NMHSs, make a significant contribution to economic stability, efficiency and growth in many sectors. Examples include water resources management, food production, aviation and marine transportation, energy (especially hydro, solar and wind power) and insurance. Early warning services and forecasts inform economically-driven decisions that mitigate the effects of meteorological and hydrological hazards in the short and longer terms. Broader risk management planning allowing the design and implementation of preventative measures to reduce risk exposure needs to complement early warning activities. WMO Members also monitor space weather conditions and processes (e.g. solar flares, geomagnetic storms etc.) which can have significant impacts on economic sectors such as aviation, telecommunications, satellite operations, and electricity transmission. Governments and the aviation industry rely on WMO and its Members to provide advice on the dispersion of volcanic ash, a significant hazard to aircraft, with associated downstream impacts on numerous economic sectors. In response to nuclear or industrial accidents, WMO works in close collaboration with agencies such as the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO) to provide advice and information to reduce the impacts of these hazards.

WMO and its Members monitor the environment over time, providing insight into possible impacts on the world's climate, food and water security, natural ecosystems, and human health. Changes are occurring in rainfall and temperature, the chemical composition of the atmosphere, surface and groundwater availability, land cover and soil condition, the temperature and chemical balance of the oceans, and pollutants in the air, water, and soil. Subtle changes in these parameters can have profound consequences for ecosystems and biodiversity.

1.2 Policy drivers and WMO's commitment to servicing DRR

With the adoption of intergovernmentally negotiated and agreed policy frameworks between 2014 and 2016 (Table 1), these years were pivotal in the global development agenda which addresses the challenges and benefits outlined above. The three key documents for this Roadmap are:

- The *Sendai Framework for Disaster Risk Reduction 2015-2030*⁷, the successor to the HFA, was adopted at the *Third United Nations World Conference on Disaster Risk Reduction (WCDRR)* in Sendai, Japan, in March 2015.
- The outcome document of the *United Nations summit for the adoption of the post-2015 development agenda* held in New York, USA, in September 2015, *Transforming our world: the 2030 Agenda for Sustainable Development*⁸ was adopted in October 2015. Its set of *Sustainable Development Goals (SDGs)*⁹, of which DRM for achieving DRR is an integral part, supersedes the *Millennium Development Goals (MDGs)*¹⁰.
- In addition, at the *21st Session of the Conference of the Parties (COP21/CMP11)* to the United Nations Framework Convention on Climate Change (UNFCCC), in December 2015 in Paris, France, 195 countries adopted the *Paris Agreement*¹¹, the first-ever universal global climate agreement, which will be implemented from 2020 onwards. Provisions of this treaty include measures to reduce and transfer disaster risk and how to deal with loss and damage if climate change mitigation and adaptation are not sufficient.

⁷ <http://www.unisdr.org/we/coordinate/sendai-framework>

⁸ <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>

⁹ <http://sustainabledevelopment.un.org/?menu=1300>

¹⁰ <http://www.un.org/millenniumgoals/>

¹¹ <http://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf>

Table 1: Key international policy frameworks adopted between 2014 and 2016

Topic	Framework documents
DRR	Sendai Framework for DRR 2015-2030
SIDS	SIDS Accelerated Modalities of Action [S.A.M.O.A.] Pathway ¹²
Financing development	Addis Ababa Action Agenda (AAAA) of the Third International Conference on Financing for Development ¹³
Sustainable Development	Transforming our World: The 2030 Agenda for Sustainable Development (incl. the SDGs)
Climate change mitigation and adaptation	Paris Agreement
Humanitarian action	Agenda for Humanity ¹⁴ presented on the Platform for Action, Commitments and Transformation (PACT)
Urban issues	New Urban Agenda ¹⁵

This rare alignment of the international policy processes of national governments, the private sector, and civil society interests is an opportunity to position DRM as a cornerstone in the efforts to foster DRR, CCA and resilience as key components of sustainable development. As a Specialized Agency of the United Nations (UN), WMO is committed to the implementation of these frameworks, for which the WMO community has a wide range of services and products on offer. It is therefore vital that NMHSs and their partners continue to increase their technical and research capacities and their engagement with national decision makers in order to better serve the needs of their respective DRR stakeholders across all temporal and spatial scales.

With this Roadmap, the WMO DRR Programme is being realigned with the Sendai Framework (see Annex II for its provisions with immediate relevance to WMO), specifically with its four Priorities for Action through which States call to 1) strengthen the understanding of disaster risk, 2) strengthen disaster risk governance to manage disaster risk, 3) invest in DRR, and 4) enhance disaster preparedness for effective response, recovery, rehabilitation, and reconstruction ("build back better"). The Sendai Framework is built on elements that ensure continuity with the achievements made by countries and other stakeholders under the HFA. However, it introduces a number of innovations including a strong emphasis on DRM as opposed to disaster management; the substantial reduction of disaster risk and losses in lives, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries as an expected outcome; and a goal focused on preventing the creation of new risks, reducing existing risks and strengthening resilience. Furthermore, seven global targets (Annex III) were agreed on and will be measured at the global level by appropriate indicators to support the assessment of global progress in achieving the expected outcome. Moreover, national targets and indicators will also contribute to achieving the goal of this Framework. States also defined the role of stakeholders and of international cooperation and global partnership.

NMHSs play an important role in the entire DRM process and thus in achieving all seven Sendai targets. With their (often 24/7) operational capacities, dissemination mechanisms and expertise in the prediction of weather, climate and water hazards, NMHSs are uniquely placed for delivering multi-hazard early warnings, including those that are fast on-set for which 24/7 operations are beneficial, by increasing the *"availability of and access to national MHEWS and disaster risk information and assessments"* (Sendai target g)). Thereby NMHSs provide also hazard information for risk assessments which is used in the design, planning and implementation of preventative measures and for mitigation, preparedness, response and recovery activities. Combining these attributes will greatly contribute to decreasing societal exposure to hazards and consequently, losses and damages (targets a)-d)). Finally, WMO's role in international cooperation helps to implement the commitments made by the UN system and Member States (target f)).

¹² <http://www.sids2014.org/samoapathway>

¹³ http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/69/313

¹⁴ <http://www.agendaforhumanity.org/>

¹⁵ <https://habitat3.org/the-new-urban-agenda>

An increasing number of actors are demanding access to timely multi-hazard warnings and information, both on weather and climate time scales, in order to better inform their own tactical and strategic decision making. For many of these actors the demand for information is being successfully met by WMO and the NMHSs. However, this demand is also being served by third-party organisations including regional intergovernmental organizations, the private sector and non-governmental organisations (NGOs). While there may be other governmental agencies that have the mandate to provide climate (impacts and adaptation) information as well as third-parties providing high-quality and much needed support, with some NMHSs calling upon these to disseminate their information (or render information available to them), in some cases this may undermine the role of an NMHS and lead to ambiguous messages for decision makers.

1.3 Vision, objectives and benefits of the Roadmap

In alignment with WMO's and the DRR Programme's vision statements, objectives and strategic goals (Annex I: Key decisions), this WMO DRR Roadmap presents a **vision** for WMO's support of DRR and aims at guiding WMO activities in all components and phases of DRM required to realise that vision. As a prerequisite it will be necessary to establish a **baseline** of current service delivery practices and capacities for DRR. The Roadmap will be complemented by a coordinated, organization-wide **implementation plan** as a framework for implementation during each of the three four-year inter-sessional periods, with prioritized activities, deliverables and milestones aligned with WMO's strategic and operational planning documents and further detailed in shorter term work plans corresponding to the biannual budget periods.

The vision of the WMO DRR Roadmap is that WMO and the NMHSs of its Members are recognised as an authoritative and effective support mechanism within the national, regional and global DRR arenas with regard to weather-, water- and climate-related hazards. Such a NMHS – supported by WMO's structures as a whole – is able to:

- Co-design, co-produce, and co-deliver together with other NMHSs and partners user-driven services that support DRM measures in multiple sectors and at various spatial and temporal scales;
- Fully link vulnerability and exposure data to standardized hazard information in data processing, production, and service delivery in order to contribute to and use impact-based forecasts and risk-informed warnings of multiple hazards within the framework of MHEWS;
- Advance and apply science (natural and social) and technology to support the development and delivery of such products and services for DRR; and,
- Sustain its core operations, also after having been affected by disasters themselves.

Accordingly, the Roadmap will work towards the following **objectives**:

1. Provide a *framework* for WMO Members to assess, support and enhance *their NMHSs' contributions* to their national DRR efforts through strengthened capabilities and cooperation at all levels and in a more cost-effective, systematic and sustainable manner;
2. Provide a *mechanism* to enhance WMO programmatic coordination and collaboration with respect to DRR, especially through strengthening the *regional and global institutional infrastructure* to create sustained capacities for country-level implementation support;
3. Reference and make accessible *knowledge products* (standards, guidelines, tools, methods, good practices, QMF, competencies, etc.) to Members, the WMO operational and research networks, and the Secretariat for their support to local, national, regional, and global DRR activities; and,
4. Identify both tactical and strategic opportunities for enhancing the *role and visibility of NMHSs and WMO in national, regional and global policy processes* related to DRM through coordinated and focused engagement with the international stakeholders and service providers (e.g. the UN system, regional and sub-regional intergovernmental organizations¹⁶, the private sector, charities, and NGOs).

¹⁶ For example, the EU or the Economic Community of West African States (ECOWAS)

The expected **benefits** of the WMO DRR Roadmap include the focused coordination and enhancement of DRR activities across WMO constituent bodies and programmes, improved coordination and collaboration at the national level (among NMHSs, DRM agencies, etc.) as well as within regional and global development agendas, and an increased understanding and awareness of weather, climate and water information for DRR activities by different users and stakeholders.

Figure 2 provides a schematic overview of the Roadmap, highlighting how the latter will identify and design activities (Sections 3) which can then be delivered by existing and potential future programmes, projects, and frameworks – either with a DRR focus or complemented by DRR-specific components (Section 4 and further detailed in the WMO DRR Roadmap Implementation Plan). Where appropriate, this will be done in partnership with DRR-related third-party initiatives (e.g. through leveraging their respective plans, such as the UNFCCC's National Adaptation Programmes for Action (NAPAs) for Least Developed Countries (LDCs), which are an important component of increasing national DRR capacity).

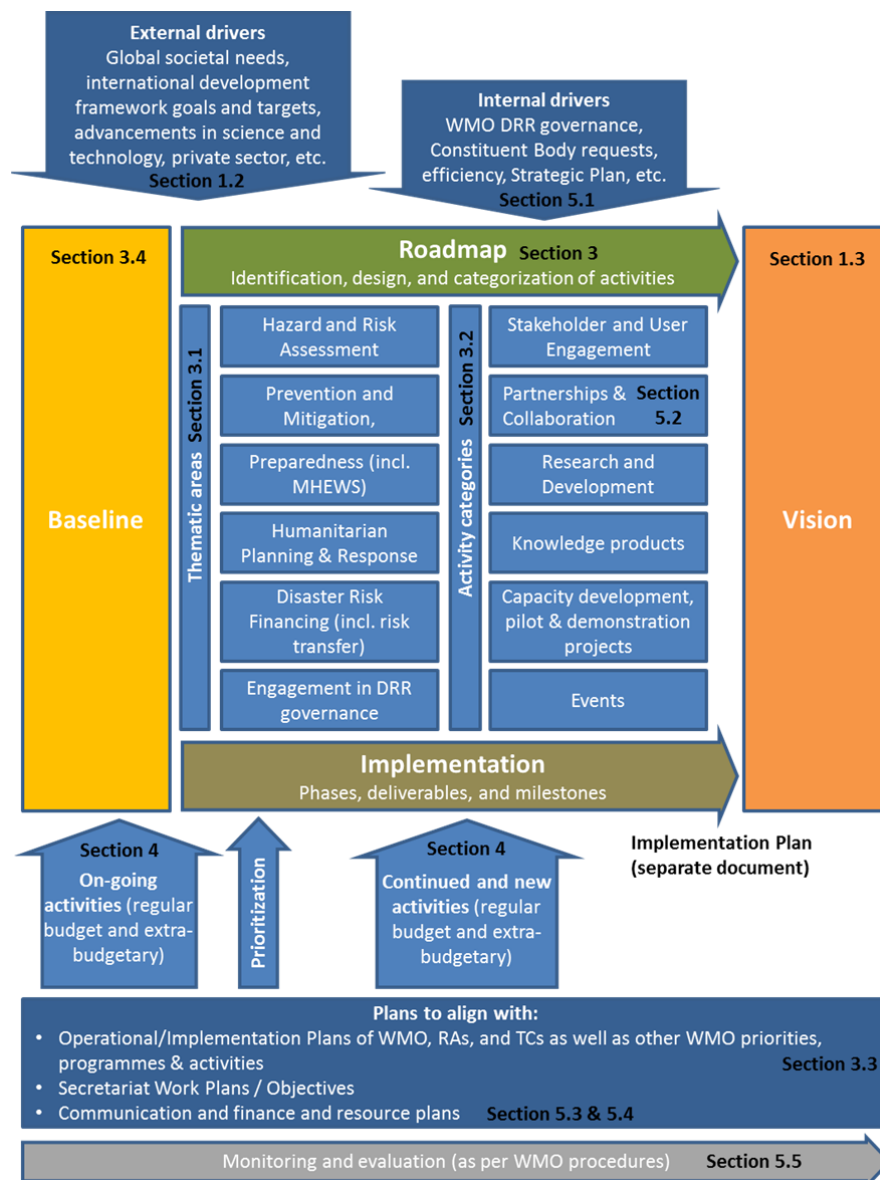


Figure 2: WMO DRR Roadmap – schematic overview

2 Conceptual framework –disaster risk reduction and management in the context of WMO

Over the years a number authoritative bodies have devised definitions of DRR (e.g. UNISDR 2009¹⁷ & 2015¹⁸, IPCC 2012¹⁹). It is generally accepted that DRR is a series of activities known as **disaster risk management (DRM)** which require multidisciplinary expertise involving numerous actors and which, when implemented, contribute towards assessing, avoiding and reducing, and transferring the risks and adverse impacts of disasters together with an increase in **resilience**.

A prerequisite of the DRR process is a **risk assessment** which determines the nature and extent of past, existing and potential future risks. It involves the quantitative identification, analysis and evaluation of i) hazards in terms of their location, intensity, frequency, duration and probability; ii) vulnerability in terms of its physical, social, economic and environmental dimensions; iii) exposure of people and assets; and iv) effectiveness of prevailing or alternative coping and adaptive capacities. Post-disaster hazard as well as loss and damage data serve as input for estimating future impacts. Such data needs to be, temporally and geographically referenced with the hazard event, quality-assured, consistently catalogued and properly archived. Risk assessment is applied differently in the recovery / prevention (or “cold”) phase of DRM, when long-term hazard, vulnerability and exposure analyses need to be conducted, and in the preparedness / response (or “hot”) phase, when real-time analyses are needed.

Equipped with such risk information, countries can develop **risk reduction** and adaptation strategies and activities that are frequently presented as a cycle or upward winding spiral, including four components:

1. **Prevention and mitigation:** Disaster prevention expresses the concept and intention to completely avoid the adverse impacts of hazard events through actions taken, normally, in the absence of or in advance of a potentially disastrous event. Since the adverse impacts of hazard events often cannot be fully prevented, their scale or severity can be substantially lessened by mitigation measures. Measures can also be taken during or after an event to prevent secondary hazards or their consequences, for example, air, soil or water contamination. Meteorological, hydrological and climate information is essential to determine effective risk prevention and mitigation measures, both structural (e.g. the design of the levels of embankments that protect flood-prone areas where settlement and economic activities are vulnerable) and non-structural (e.g. spatial planning, improved environmental policies, community-based emergency management planning and training and public awareness raising). It should be noted that in climate change policy, mitigation is defined differently by IPCC, being the term used for the reduction of greenhouse gas emissions.
2. **Preparedness:** Preparedness encompasses the application of knowledge and capacities to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters. Such coordinated actions aim at the efficient management of emergencies and orderly transitions from response through to sustained recovery, including activities such as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities. Multi-hazard early warning systems (MHEWS) are an essential component of preparedness.
3. **Response:** Response actions are taken during or immediately after a disaster in order to save lives, reduce impacts, ensure public safety and meet the basic subsistence needs of

¹⁷ UNISDR, 2009: UNISDR Terminology on Disaster Risk Reduction, available at: http://unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf

¹⁸ UNISDR, 2015: Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction available at: http://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf

¹⁹ IPCC (2012). Glossary of terms. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge, UK, and New York, NY, USA, pp. 555-564, available at https://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf

the people affected. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage. It is therefore the focus of humanitarian planning and assistance.

4. **Recovery:** Recovery decisions and actions are aimed at restoring or improving livelihoods, health, as well as economic, physical, social, cultural and environmental assets, systems and activities following an emergency or disaster, aligning with the principles of sustainable development and resilience, including building back better to avoid, reduce or adapt to future disaster risk.

Disasters affect human life and have profound impacts on local and national economies, sometimes setting back development gains by many years in those countries with limited resources. Weather, climate and hydrological services are therefore essential also for financial protection mechanisms in order to cope with residual risks. Residual risks that cannot be effectively reduced can be addressed by **disaster risk financing, including risk transfer**, such as government backed insurance schemes and weather-indexed insurance.

DRR is inextricably linked to, and informs, **adaptation to climate impacts and change (CCA)**. Natural hazards, including those associated and exacerbated by climate variability and change, threaten society. As reiterated by several UN World Conferences and Summits, DRR and CCA are therefore not only an imperative to protecting investments in development, but also an opportunity for a transformative shift towards a more resilient, sustainable development. Their mainstreaming into development activities is seen as a way to enhance their effectiveness and longer-term impacts. DRR and CCA both share the concern for reducing the negative impacts of hazards through prevention, mitigation, preparedness, response and recovery measures, for reducing vulnerabilities and exposure and for increasing resilience in the long-term. However, CCA deals rather with climate change and its impact on hazard patterns, while DRR deals with all hazards, including climate-related hazards but also geophysical or biological hazards. CCA also addresses more specifically the adaptation over the long-term (since climate is defined as average weather, although it also looks at the changing risks due to extreme weather events), while DRR deals with all time scales - , including sudden-onset hazards such as earthquakes and the response to them and slow-onset hazards such as drought and creeping environmental changes. CCA can therefore be seen as a focused subset within DRR, which in turn must be placed within its wider contexts of development and sustainability. Successful DRR requires consideration not only of the observed but also of the expected or possible changes in hazard characteristics, exposure and vulnerabilities.

An efficient and effective NMHS is a core component of DRR and CCA, providing essential and high-quality meteorological, hydrological and climate (hazard) information. For example, when “building back better” after a disaster, the location and construction of infrastructure should take into account various climate change scenarios. If construction cannot be undertaken to a certain level, then the appropriate EWS must be put in place to warn communities of when critical thresholds (depending on the accepted risk level, i.e. also the community’s coping capacity) that result in threats to lives and property are expected to be exceeded. National strategic plans for strengthening and modernizing the NMHSs should be derived from and consistent with broad national planning objectives with relevant areas including, inter alia, emergency management, sustainable development, CCA, aviation, agriculture, energy and water resources. These plans should also be consistent with, and specify linkages to, regional and global plans/policies in relevant areas of weather, climate and hydrological services, as appropriate, as well as compliant with WMO standards.

What does DRR mean to a NMHS? For a NMHS, DRR is the desirable outcome of effective design, development, and delivery of services that identify, provide and communicate hazard and risk information (including authoritative warnings) in such a way that the appropriate stakeholders, decision-makers, and general public can take actions to protect lives, reduce economic losses and disaster risks and ultimately increase community resilience through structural and non-structural measures – preventive, responsive and adaptive.

What does DRM mean to a NMHS? For a NMHS, DRM includes the processes by which a NMHS, working in partnership with other stakeholders, understands user requirements and disaster risks – hazards, exposure and vulnerabilities – and delivers effective and meaningful products and services to DRM decision makers.

What is the role of NMHSs in DRM? Meteorological, hydrological and climate observations, monitoring, (hazard and risk) assessments to generate risk knowledge, predictions and related data management and processing by NMHSs are a fundamental input into sound DRM. A NMHS's role in all phases of DRM is to:

1. Provide a single authoritative voice for meteorological, hydrological and climate hazard information and warnings (and for other hazards under their individual mandates) to be used in prevention, mitigation, preparedness (including early warning), response and recovery as well as for risk and loss/damage assessments and financial protection;
2. Provide advice and approaches that could be taken to reduce exposure to hazards and vulnerabilities and increase societal resilience, through both structural and non-structural measures such as the provision of design data climate advice which highlights the potential vulnerability of particular areas to known or expected hazards;
3. Inform, mobilize and partner with academic institutions and other experts that can contribute to this information and advice; and,
4. Educate and raise awareness of the general public and tactical and strategic decision-making authorities (governmental and non-governmental entities) to understand hazards and related risks, warnings and associated uncertainties.

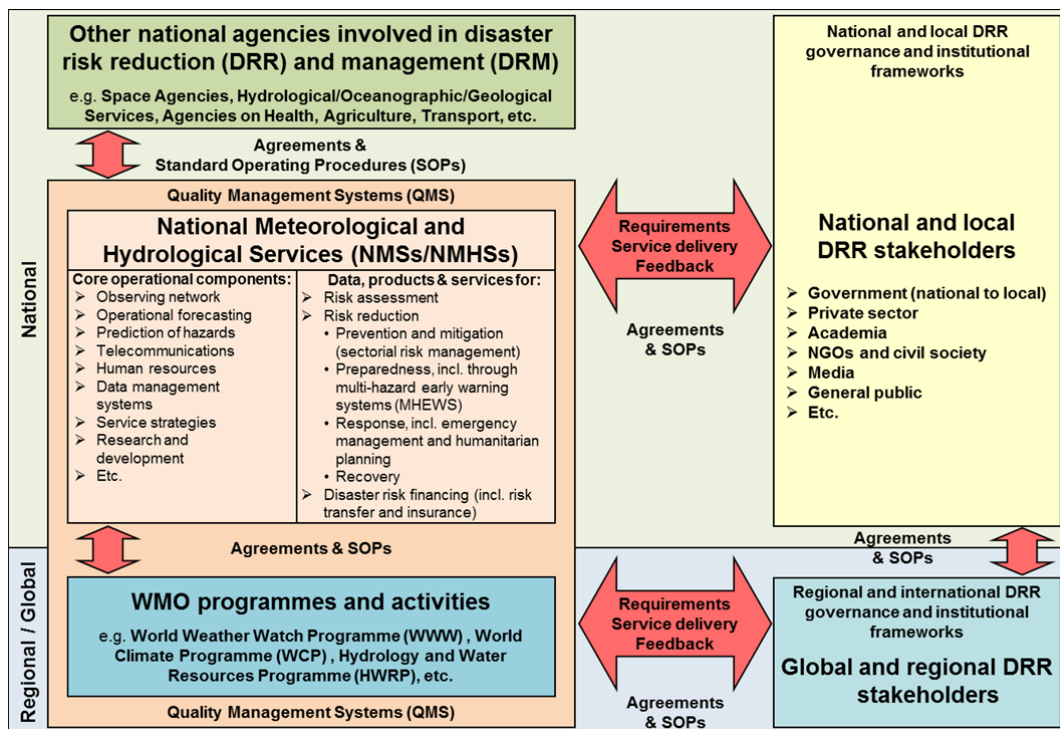


Figure 3: Overarching framework for the development and delivery of products and services by National Meteorological and Hydrological Services and their partners to support disaster risk management.

Figure 3 presents a high-level overview of the pivotal role a NMHS plays – or could play – in its national DRR governance and demonstrates both routine service delivery and more DRR-specific activities across all timescales, from weather- and flood-specific early warnings through to slower onset seasonal or climate-service related information. NMHSs also have a key role to play in prevention, thereby helping to reduce exposure of society to risks and increasing their resilience.

The importance of **service design, development and delivery** in the DRM cycle is most apparent in the descriptions listed above. Therefore, all of the activities described in later sections will align with the six elements of service delivery as defined in the WMO Strategy for Service Delivery.²⁰ Moreover, there is a strong argument for considering DRR across all stages of the service delivery cycle (Figure 4). The development of approaches by NMHSs to support DRR should therefore follow the basic principles of establishing user engagement and partnerships to ensure that the development and delivery of services will respond to user needs and be continually monitored and improved. The success of service delivery for DRR depends on these factors as well as on respective research, capacity development, and knowledge management.



Figure 4: Stages and elements of the WMO Strategy for Service Delivery (Source: WMO, 2014)

²⁰ WMO, 2014: The WMO Strategy for service delivery and its implementation plan, available at: http://www.wmo.int/pages/prog/amp/pwsp/documents/WMO-SSD-1129_en.pdf

3 Identification and design of priority activities

A key feature of this Roadmap is further to leverage existing WMO mechanisms, plans, activities and projects and to develop linkages to external initiatives in order to realise tangible benefits for WMO Members through collaboration and coordination at the national, regional and global levels (Section 0). In this section, the principles behind the identification and design of priority activities as the key element of the Roadmap will be described. Based on the capacities and needs of individual countries and the regions to be identified in a baseline exercise (Section), on-going and future WMO activities and projects related to DRR can be structured and mapped according to:

- **Thematic areas** (aligned with the Sendai Framework, Section 3.1);
- Cross-cutting **activity categories** (aligned with the WMO Strategy for Service Delivery, Section 3.2);
- The **country** and **region**²¹ they support and in which they take place (to be detailed in the Implementation Plan); and,
- An NMHS's **level of development** in terms of delivering services for specific DRR activities and to respective users and stakeholders (according to the Service Delivery Progress Model (SDPM), to be detailed in the Implementation Plan).

Since the time coverage of the Roadmap aligns with the Sendai Framework and spans almost four WMO intersessional periods (until 2030), the Roadmap will need to be a "living" document, complemented by an Implementation Plan which identifies key deliverables and milestones and corresponds to the four-year inter-sessional periods. Over the course of time the DRR landscape is certain to change, necessitating regular consultations on and updates to both documents, which will require endorsement from the WMO decision-making bodies. Sessions of these bodies and their working structures (see Annex IV) will be used to elicit inputs into these updates. Regular consultations will also take place within the Secretariat and among key partners and users.

3.1 Thematic areas aligned with the Sendai Framework

The implementation of the HFA has led to changes in national legal and institutional frameworks and policies on DRR, with implications on the role of and working arrangements for NMHSs. These changes provided opportunities for NMHSs such as increased recognition by their governments and stakeholders which could result in strengthened partnerships and increased resources. However, this also means that NMHSs face increasing demand and liabilities in terms of providing products and services to a larger and more diverse group of DRR decision-makers and stakeholders. To meet these challenges, the WMO DRR Programme has highlighted the contribution of NMHSs to DRR in a number of thematic areas, such as: 1) hazard and risk assessment, 2) prevention and mitigation, 3) preparedness, especially through MHEWS, 4) humanitarian planning and response, 5) disaster risk financing including transfer mechanisms, and 6) engaging in DRR governance. These thematic areas were derived from the general DRM framework (Section 2) and aligned with the HFA, also expressed as priority categories of activity for the implementation of the GFCS DRR Exemplar.²²

Each of these six DRR Programme themes remains valid and adheres to a "people-centred approach" which was ratified in the Sendai Framework. However, now that this new Framework is in force, with further implications for NMHSs and WMO, the WMO DRR Roadmap explicitly links to the four Priorities for Action of the Sendai Framework (Table 2) and identifies how NMHSs and WMO are already, or will be in the future, contributing to the implementation of each of these priorities. By doing so, it addresses also the DRR-related goals and priorities of other international development frameworks.

²¹ WMO has six Regions (Region I: Africa, Region II: Asia, Region III: South America, Region IV: North America, Central America, Caribbean, Region V: South-West Pacific, Region VI: Europe) and as of 2017 191 Members, see <https://public.wmo.int/en/about-us/members>.

²² http://www.gfcs-climate.org/sites/default/files/Priority-Areas/Disaster%20risk%20reduction/GFCS-DISASTER-RISK-REDUCTION-EXEMPLAR-FINAL-14467_en.pdf

Table 2: Linking the four Sendai Framework Priorities for Action to the six thematic areas of the DRR Programme and the core functions, operations and capacities of a NMHS

Core NMHS functions / operations and capacities	Thematic areas of the DRR Programme		Sendai Framework Priorities for Action
	Normal stage	Disaster phase	
Observations, monitoring, data assessment, data management and exchange, data processing, modelling and forecasting (and where possible seamless prediction from nowcasting to decadal projections) Enablers such as regulatory work (standards, manuals, guidelines, quality management, etc.), capacity development (demonstration projects, training, etc.), partnerships / cooperation and coordination	1) Long-term risk assessment (hazard and risk identification, analysis and evaluation) for different scenarios	1) Real-time risk assessment (hazard and risk identification, analysis and evaluation) for different scenarios	Understanding disaster risk (Priority 1)
	2) Prevention and mitigation to reduce risks in sectors through structural and non-structural measures	2) Prevention and mitigation through (temporary) structural and non-structural measures	Investing in DRR for resilience (Priority 3)
	5) Disaster risk financing and transfer		
	3) Preparedness for effective response and recovery through MHEWS* (impact-based early warning for slow-onset hazards)	3) Preparedness for effective response and recovery through MHEWS* (impact-based early warning for rapid-onset hazards)	Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction (Priority 4)
	4) Assistance to humanitarian planning (preparedness and recovery)	4) Assistance to humanitarian response (during emergencies)	
	6) Engagement of NMHSs and WMO in DRR governance at different levels		Strengthening disaster risk governance to manage disaster risk (Priority 2)

* MHEWS cut across all four Priorities for Action.

3.2 Activity categories aligned with the WMO Strategy for Service Delivery

The Roadmap aims at improving the development, delivery, and uptake of meteorological, hydrological and climate services for DRR in the six thematic areas of the DRR Programme. Each thematic area is addressed by the following six activity categories which largely correspond to the stages and elements of the WMO service delivery model²³ (Table 3).

Making this a reality requires substantial development of the research (explicitly with input from social sciences), operational and service capacities of many NMHSs, particularly in developing and least developed countries. As a strategy for achieving this, significant efforts have been undertaken to engage with NMHSs, Member governments, RAs, TCs, and the programmes, to participate in international networks, and to establish strategic partnerships and linkages with external activities.

²³ Based on the WMO DRR Work Plan 2012-2015 (Annex to Resolution 8 (EC-64)) and the WMO Strategy for Service Delivery.

Table 3: Activity categories of the WMO DRR Roadmap aligned with the WMO Strategy for Service Delivery

Activity categories of the WMO DRR Roadmap	Elements of the WMO Strategy for Service Delivery
1. Stakeholder and user engagement; 2. Partnerships and collaboration (including resource mobilization) 3. Capacity development through knowledge products (e.g. guidelines, standards, training modules (e.g. on high-impact weather for decision makers) as well as targeted research; 4. Capacity development through pilot and demonstration projects (showcasing and improving knowledge products, e.g. through training at workshops), including the identification of projects where an additional DRR focus could deliver improved results, such as a stakeholder engagement module for the WMO Severe Weather Forecasting Demonstration Projects (SWFDP) or the GAW Urban Research Meteorology and Environment (GURME) project; 5. Research and development; and, 6. Major DRR-related events (e.g. Global Platforms on DRR)	→ engage users and evaluate their needs and develop partnerships; → design and deliver services, link products and services to user needs, sustain services, develop skills and share good practices, develop and improve services → develop and improve services

Ref.: 12839/2017-1.2 WDS/DRR

3.3 Alignment with WMO plans and coordination with external initiatives

Recalling that Resolution 4.2/1 (EC-66) calls for “*coherent and consistent implementation of WMO DRR priorities within all relevant programmes and projects of WMO, in the light of the recommendations of RAs and, where appropriate, the advice of the TCs*”, the “*identification of the role of NMHSs ... among WMO partners, United Nations bodies, and external planning processes*”, and consistency “*with the WMO Strategic and Operating Plans, as well as the work plans for relevant WMO programmes and projects*”, there is a need to align these internal mechanisms and processes and link to a number of external ones that shape the DRR activities of WMO. Table 4 shows the strategic documents and implementation plans of the other WMO priorities which the Roadmap and its Implementation Plan need to link to. With this Roadmap for DRR, the DRR priority of the WMO Strategic Plan now also has its strategic and implementation documents.

Table 4: Strategic documents and implementation plans of the WMO priorities 2016-2019

WMO Priority	Strategic Document	Implementation Document
Overall	Strategic Plan 2016-2019	Operational Plan 2016-2019
	Strategic Plan of RAs, TCs and WMO programmes (Annex IV)	Operational Plan of RAs, TCs and WMO programmes (Annex IV)
Disaster Risk Reduction (DRR)	WMO Disaster Risk Reduction (DRR) Roadmap	WMO DRR Roadmap Implementation Plan
Global Framework for Climate Services (GFCS)	Implementation Plan for the GFCS and its Annex “User Interface Platform (UIP) Component”, which in turn contains the DRR Exemplar	GFCS 2016-2018 Operational and Resource Plan (ORP)
WMO Integrated Global Observing System (WIGOS)	WIGOS Development and Implementation Strategy (WDIS)	WIGOS Implementation Plan (WIP)
Aviation meteorological services	ICAO Global Air Navigation Plan (GANP) 2013-2028	
Polar and high-mountain regions		Global Cryosphere Watch (GCW) Implementation Plan
Capacity development	WMO Capacity Development Strategy and Implementation Plan	
Governance	White Paper submitted to the EC Working Group on Strategic and Operational Planning	

Other important work plans for relevant WMO programmes and projects that the Roadmap and its Implementation Plan need to consider, although not exhaustive are shown in Table 5.

Table 5: Other strategic documents for relevant WMO programmes and projects

Topic	Strategic Document	Implementation Document
Service Delivery	The WMO Strategy for Service Delivery and its Implementation Plan	
Quality Management	WMO Quality Management Framework (QMF) / Quality Management System (QMS) ²⁴	
Resource Mobilization	WMO Resource Mobilization Strategy ²⁵	
Social and Economic Benefits	Madrid Conference Statement (2007)	Madrid Action Plan ²⁶ (adopted by the International Conference on Social and Economic Benefits of Weather-, Climate-, and Water-related Information and Services)
Earth observation	Group on Earth Observations (GEO) 2016-2025 Strategic Plan: Implementing Global Earth Observation System of Systems (GEOSS) ²⁷	
Integrated Flood Management	Associated Programme on Flood Management (APFM) Strategic Plan 2014-2018	APFM Activity Plan
Integrated Drought Management	Integrated Drought Management Programme (IDMP) Framework	IDMP Work Programme 2017-2019

3.4 Establishment of a baseline and prioritization of activities

Underpinning all initiatives and activities outlined in this Roadmap and further detailed in the subsequent Implementation Plans will be an initial exercise to establish a solid baseline of Members' capacities, gaps, and requirements for DRR-related weather and climate services on which to move forward. This exercise may include:

- Survey of Members, RAs, TCs, other programmes and the Secretariat, identifying main activities and challenges supporting DRR on the regional, national and local levels, including a compendium of recent or current activities within WMO (e.g. the WMO DRR, Public Weather Services (PWS), Hydrology and Water Resources (HWR), and Capacity Development programmes, and the WMO technical commissions that they are serving, such as the Commission for Basic Systems (CBS), Commission for Hydrology (CHy), Commission for Climatology (CCI), etc.) addressing DRR and CCA;
- Symposium/conference that brings together Members, TCs, RAs, WMO Secretariat and external partners and experts to discuss the roles of WMO and NMHSs in the implementation of the Sendai Framework and other international frameworks and to identify new priorities for the DRR Programme (based on a thorough reading of these frameworks and the outcomes of the Survey); and,
- Activities to identify and understand complementary capabilities and hazard and risk assessment and early warning requirements of non-WMO actors and key global, regional, national, and local partners and users and appropriate private sector organizations (e.g. early warning requirements of organizations such as the European Union (EU), International River Basin Organizations, WHO, WFP or reinsurance companies).

A key outcome of this exercise will be the determination of a **NMHS's particular level of development in terms of delivering services for specific DRR activities and to respective users and stakeholders**, in line with the WMO Strategy for Service Delivery and its six elements (see Figure 4 above). This includes the activities expected of a NMHS having that level of development as well as the actions required to reach the next level of development²⁸. It will allow for the identification of capacities and gaps as well as targeted research, demonstration, and capacity development projects and respective investments. Furthermore, it provides a basis for prioritization according to standard criteria (to be developed) and for attracting extra-budgetary resources to realize these activities, especially to the benefit of developing countries.

²⁴ http://www.bom.gov.au/wmo/quality_management.shtml

²⁵ <http://www.wmo.int/pages/prog/dra/rmo.php>

²⁶ http://www.wmo.ch/pages/themes/wmoprod/documents/madrid07_ActionPlan_web_E.pdf

²⁷ https://www.earthobservations.org/geoss_wp.php

²⁸ The Service Delivery Progress Model (SDPM) defines five possible levels of service delivery capabilities: (1) Undeveloped; (2) Development started; (3) Development in progress; (4) Developed; and (5) Advanced.

4 Key WMO activities in support of disaster risk reduction

The WMO community has a wide range of services and products on offer for the implementation of the Sendai Framework. In the following, an attempt has been made to place a number of on-going and proposed activities²⁹ under the Priorities for Action of the Sendai Framework³⁰ based on a thorough benchmarking which will identify how past and on-going activities have contributed and still contribute to the implementation of these four priorities. The Implementation Plan will then further outline i) how future cross-cutting and specific WMO activities could contribute to the implementation of the Sendai Framework as well as the goals and targets, pertaining to DRR, of other international frameworks and ii) how these will be funded (regular budget or extra-budgetary resources). Table 6 provides an example of how these activities can be structured along the thematic areas and the activity categories.

Table 6: Suggested structuring of priority activities per thematic area and activity pillar, including examples of on-going activities (non-exhaustive list).

Activity Category Thematic Area	Stakeholder & User Engagement	Partnerships & Networks	Knowledge products	Pilot & Demonstration Projects	Research & Development	Events (WMO and external)
Hazard & Risk Assessment	DRR UI-WG HRA, GFCIS UIP	Warsaw Mechanism for Loss and Damage (UNFCCC), IRDR, INFORM, APFM, IDMP	WMO-CRED Atlas, Event identifiers / standardized hazard databases, Flood Mapping Manual	Country profiles	IPCC, HIWeather	COPs (UNFCCC)
Prevention & Mitigation	APFM, IDMP	UNISDR, WHO, APFM ³¹ , IDMP ³²	Manuals	APFM, IDMP	UNESCO-IHP, Health research	GP DRR, FloodRisk
Preparedness & MHEWS	DRR UI-WG MHEWS, GFCIS UIP	IN-MHEWS ³³ , UNEP, CADRI ³⁴	Guidelines, global/regional warning portals, e.g. MeteoAlarm	SWFDP, CIFDP, FFGS, CREWS ³⁵	HIWeather, ARISTOTLE	MHEW Conference, Madrid+10, GP DRR
Humanitarian Planning & Response	WMO Humanitarian TT	Coordination with GDACS ³⁶ , IASC ³⁷	Guidelines	Pilot projects		World Humanitarian Summit
Disaster risk Financing & Transfer	DRR UI-WG DRF	UNEP Finance Initiative	Guidelines, good practices			Understanding Risk Forum, IDRC
Governance	RCOFs	UN DRR Focal Points	UN Plan of Action on DRR			GP DRR

²⁹ By representatives of NMHSs of WMO Members

³⁰ See also the WMO Bulletin, Vol 64(2) article "Towards Substantially Reduced Disaster Risk in 2030" <http://www.wmo.int/bulletin/en/content/towards-substantially-reduced-disaster-risk-2030-0>

³¹ Associated Programme on Flood Management (APFM), <http://www.apfm.info/>

³² Integrated Drought Management Programme (IDMP), <http://www.droughtmanagement.info/>

³³ International Network for MHEWS (IN-MHEWS), <http://www.wmo.int/pages/prog/drr/documents/IN-MHEWS/IN-MHEWS.html>

³⁴ Capacity for Disaster Reduction Initiative (CADRI), <http://www.cadri.net/>

³⁵ Climate Risk and Early Warning Systems (CREWS) initiative, <http://newsroom.unfccc.int/lpaa/resilience/climate-risk-and-early-warning-systems-initiative-strengthening-the-systems-at-the-heart-of-resilience/>

³⁶ Global Disaster Alert and Coordination System (GDACS), <http://www.gdacs.org/>

³⁷ Inter-Agency Standing Committee (IASC) on Humanitarian Assistance, <http://www.humanitarianinfo.org/iasc/pagelocator.aspx>

Moreover, most activities will cut across all thematic areas, activity categories, and also the priorities for action of the Sendai Framework and could be considered in the longer term, for example:

- Use of existing and identification of potential new **partnerships** to assist with the initial set of core activities;
- Identification and compilation of **training initiatives** related to DRR at the regional, transboundary basin and national levels and potential for cross-sectoral or organizational learning activities and of opportunities for training through initiatives of the WMO Education and Training Programme (ETR) for NMHSs, as well as for users of information (e.g. through a WMO training symposium, sector-specific workshops as with Humanitarian Agencies);
- Establishment of a document library (including knowledge products such as **guidelines** and **good practices** in the thematic areas and activity categories mentioned earlier, e.g. the establishment of partnerships and help desks such as those on Integrated Flood and Drought Management);
- Strengthening of **platforms for user engagement**, including those for long-term preventative measures for floods and droughts (e.g., as established for the IDMP, APFM and GFCS);
- Build complementary **delivery platforms / help desks** (e.g., as established for the IDMP, APFM) with partner organizations to support the mandated role of the NMHSs while at the same time providing the required level of information to global and regional users such as humanitarian agencies;
- Establish coordinated **research and development activities focused on DRR** (in particular MHEWS) in partnership with academia; and,
- Conduct – towards the end of each intersessional period - **workshops and WMO cross-TC symposia on DRR** to 1) assess the approaches chosen and the projects implemented, 2) collect lessons learnt over the previous four years, and 3) to plan future activities and update the Roadmap and Implementation Plan as required.

4.1 Understanding disaster risk (Sendai Framework Priority 1)

In support of the Sendai Framework's first Priority for Action, Cg-17 decided in Resolution 9 (Annex I) to standardize weather, water, climate, space weather and other related environmental hazard information for loss damage assessment. It also decided to develop identifiers for cataloguing extreme and high-impact weather, water and climate events that are necessary for the development and implementation of standardized hazard databases, an example of a knowledge product. These measures will promote interoperability among datasets and facilitate Members' efforts to assess risks and track climate-related loss and damage. Enhanced capabilities to monitor and model future climate conditions will improve the attribution of extreme weather events to climate change. Such capabilities will also support preparedness and adaptation at all timescales and will provide quality assurance of these data, including the official designation / validation of extreme events³⁸ and archiving of event data and trend indices.

It should be noted that the effective use of data on hydrometeorological hazards and high-impact phenomena for DRR and CCA purposes also requires information on the physical and geographical as well as the socio-economic conditions of the disaster area (topography, population and demography, availability of various types of infrastructure, etc.). The joint cataloguing of hydrometeorological, physical and geographical as well as socio-economic data would enable NMHSs, jointly with the users of this information, to create impact models and to predict the consequences of hazards more successfully, as well as the use of the experiences of other NMHSs in areas with similar natural and economic conditions.

³⁸ The term "extreme events" may either relate to climatological / geophysical extremes (regardless whether they have an impact on society or not) or to extreme impacts, losses and damages (which may have been caused by an event that was not extreme in climatological terms).

WMO continuously improves the quality and quantity of hydrometeorological and other observational data, e.g. through the WMO Integrated Global Observing System (WIGOS), which enables the collection of long-term, homogenic and quality-controlled data from satellites, ocean buoys, aircraft, ships and land-based stations. However, in collaboration with key partners, NMHSs need to also gather impact and vulnerability information related to specific sectors and hydrometeorological hazards in order to support the conduct of hazard and risk analyses / assessments at national and local levels as well as impact-based forecasting and risk-informed warning and decision making. For this, it will be necessary to compile an overview of existing WMO guidance materials relevant to DRR in order to provide guidance on hydrometeorological hazard and risk analyses.

4.2 Strengthening disaster risk governance to manage disaster risk (Sendai Framework Priority 2)

Contributing to the second Priority for Action, WMO encourages NMHSs to actively engage in their national DRM fora and the wider disaster risk governance, e.g. at national, sub-regional, regional and global platforms for DRR. This can help to clarify the roles and responsibilities of various public- (including NMHSs) and private-sector actors and stakeholders who are providing and benefiting from weather and climate services. WMO advocates for reflecting these roles in national and local regulatory frameworks, planning, budgets, coordination/collaboration and operations, supported by, for example, standard operating procedures and good practice examples and guidelines on specific aspects.

WMO can also assist Members to develop relevant legislation on damage assessment methods on the national level, hazard monitoring and forecasting systems, and the development of risk and hazard maps and specific mitigation and adaptation mechanisms, especially in developing countries.

4.3 Investing in disaster risk reduction for resilience (Sendai Framework Priority 3)

Investments in disaster risk prevention, mitigation and reduction through structural and non-structural measures are essential to maintain and enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as of the environment. For example, activities undertaken within the Integrated Drought Management Programme (IDMP) and Associated Programme on Flood Management (APFM), both co-sponsored by WMO and Global Water Partnership (GWP), are consistent with and contribute to this action priority area.

For NMHSs, this third Priority for Action applies to the maintenance, modernization, integration and further development of core capacities, including:

1. Operational weather, climate and hydrological observations, information and services to inform risk reduction and adaptation measures and medium- and long-term strategic planning for community resilience in the context of climate change;
2. High-impact weather and climate research, including modelling. WMO is helping Members to access funding and showcase the socioeconomic benefits of weather and climate services and to implement capacity development and demonstration projects; and,
3. Contingency / business continuity planning for NMHSs and their observation networks (e.g. if affected by natural hazards).

It is equally important to ensure that investments are materialized in information and communications technologies (ICTs). ICTs facilitate monitoring of the environment, retrieving and processing vital data, and disseminating and receiving information before, during, and after disasters. This is important particularly for early warning where timely evacuation can save thousands of lives. These investments need to move beyond hardware requirements and ensure

that the human capital of the country is competent to develop, operate, and maintain such systems.

Therefore, an important activity in this field includes – building on the establishment of the baseline (Section 3.4) – the designing, in partnership with external stakeholders, of a generic NMHS DRR capacity assessment template and process to determine targeted investments, e.g. in observation systems, modelling facilities, information platforms, etc. A further area that will be explored is the identification of portable models for engagement of NMHSs with the private sector, especially disaster insurance organizations.

4.4 Enhancing disaster preparedness for effective response and build back better in recovery, rehabilitation and reconstruction (Sendai Framework Priority 4)

It is likely that the largest contribution WMO can make to the implementation of the Sendai Framework is under the fourth Priority for Action – “Enhancing disaster preparedness for effective response”. The focus is on supporting (MH)EWS which are defined as *“an interrelated and connected set of hazard monitoring, risk assessment, communication and preparedness activities that enable individuals, communities, governments, businesses and others to take timely action to reduce their risks in advance of hazardous events”* in the updated terminology, where MHEWS cover a range of hazards and impacts and are designed to be used in multi-hazard contexts where hazardous events may occur simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects. A MHEWS increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities, involving multiple disciplines for updated and accurate hazards identification and monitoring for multiple hazards. Effective “end-to-end” and “people-centred” early warning systems comprise four interrelated key elements:

1. Risk knowledge based on the systematic collection of data and risk assessments;
2. Detection, monitoring, analysis and forecasting of the hazards and possible consequences;
3. Dissemination and communication of authoritative, timely, accurate, and actionable warnings and associated information on likelihood and impact; and,
4. Preparedness and capabilities to respond to the warnings received.

These four interrelated elements need to be coordinated within and across sectors and multiple levels for the system to work effectively and effective feedback mechanisms need to be in place for continuous improvement. Failure in one component, or lack of coordination across them, could lead to the failure of the whole system – a critical issue since an EWS that does not warn effectively will not be trusted.

While the first component of MHEWS is dealt with under the first Priority for Action, the second component is supported by the WMO Global Data-Processing and Forecasting System (GDPFS). It involves three World Meteorological Centres (WMCs) and 40 Regional Centres, including Regional Specialized Meteorological Centres (RSMCs), Regional Climate Centres (RCCs) and Regional Drought Management Centres (RDMCs). These centres process data and routinely provide countries with analyses and meteorological forecasts, and support the early warning capacities of NMHSs.

Hazard-specific (for example, flash floods, tropical cyclones, coastal hazards or technological hazards) and sector-specific (for example, health, agriculture, land transportation, energy and humanitarian assistance) warning services are supported by several specific WMO programmes, e.g. through focusing on:

- Strengthening of impact-based forecast and risk-based warning services;
- Addressing weather, climate, water and environment-related DRR issues in the service delivery to the various sectors, especially in megacities and large urban complexes;

- Strengthening warning services of tropical cyclones through the regional support mechanisms of the Tropical Cyclone Programme to reduce the associated disaster risk;
- Promoting risk-informed decisions by the aviation community and transportation sector concerned with the impact of airborne dust and particles during volcanic eruptions, wildfires, sandstorms, dust storms and the like, through enhanced information systems and services; and,
- Developing approaches to deal with the emerging challenges and opportunities to access, use and manage Big Data, crowd sourced data and data obtained through social media, particularly those relevant to risk assessment.

The third component of MHEWS is supported by the WMO Global Telecommunication System (GTS) that interconnects all NMHSs for the collection and distribution of meteorological and related data, forecasts and alerts, including tsunami and seismic-related information and warnings. This system is being transformed into an overarching WMO Information System (WIS) that enables systematic access, retrieval, dissemination and exchange of data and information of all WMO and related international programmes. In addition, the Common Alerting Protocol (CAP) provides the international standard for emergency alerting and public warning for all hazards, including those related to weather events, earthquakes, tsunamis, volcanoes, public health, power outages and many other emergencies. This Protocol also applies to all media, including communications media ranging from sirens to mobile phones, faxes, radio, television and various web-based communication networks. The majority of NMHSs also disseminated directly to the public e.g. through radio, television, SMS, the internet and smartphone applications.

For the fourth component, emergency response is supported by WMO, especially on the global level. For example, through its work with the UN Operations and Crisis Centre (UNOCC), the Inter-Agency Standing Committee (IASC), the Global Disaster Alert and Coordination System (GDACS) and Copernicus (an EU programme aimed at developing European information services based on satellite Earth Observation and in situ (non-space) data) and the EU's Emergency Response Coordination Centre (ERCC), WMO links weather and climate services to international humanitarian agencies in order to improve humanitarian contingency planning, preparedness and response.

Other emerging and potential activities in support of especially this fourth Sendai Framework Priority for Action could include:

- Regional and/or global warning information platforms or portals such as MeteoAlarm³⁹ and MeteoAlert;
- The development of a WMO El Niño / La Niña Information System;
- Identifying a sample of WMO- and nationally-supported initiatives addressing the establishment of (MH)EWS and develop a respective service delivery 'blueprint';
- Developing and delivering pilot projects in collaboration with local or national level humanitarian agencies and other sectoral organisation involved in DRM, with the aim to ensure collaboration and exchange of relevant weather, water and climate information to these users (e.g. in SWFDP); and,
- Use identified learning opportunities, whether from the WMO community or partners, to outreach to and build capacity and awareness of communities and adopt practices with the aim of reducing the impacts of hydrometeorological hazards.

³⁹ <http://www.meteoalarm.eu/>

5 Implementation arrangements

5.1 WMO DRR governance, user-interface mechanisms and implementation support

A key principle of the Roadmap is to utilize existing WMO mechanisms and to leverage WMO activities and projects to realise the DRR Vision. These could be either modified, phased differently, or combined to produce a greater impact. The Roadmap will also seek to maintain and enhance existing partnerships, to establish new ones where necessary, and if appropriate forge links to external projects, programmes and initiatives. The WMO DRR Programme which was established as a cross-cutting programme to help focus activities of WMO under its DRR priority will be the primary implementing agent for the Roadmap and will provide a support and coordination function. The WMO DRR governance, implementation and user-interface mechanisms are defined in the decisions by the various WMO governing bodies (see Annex I).

Ultimate oversight of the DRR Programme is provided by Cg and the EC, with specific guidance currently given by the EC Working Group on DRR (EC WG/DRR). Further decisions are taken by the sessions of the RAs and TCs.

Furthermore and under the guidance of the EC WG/DRR, DRR focal points of the WMO RAs, TCs and relevant programmes (DRR FP RA-TC-TP) ensure coordination with these constituent bodies and provide advice on the implementation of DRR-related activities within WMO. The annual Meetings and Joint Meetings of the Presidents of Regional Associations (PRA) and the Presidents of Technical Commissions (PTC) provide another forum for guidance and exchange. In order to better respond to user needs, the implementation of the Programme is further guided by the UI-WGs on topics such as hazard and risk assessment, MHEWS, and disaster risk financing.

At the Secretariat, the Programme is supported by the DRR Services Division under the Weather and DRR Services (WDS) Department and the Steering Committee on DRR. This support entails for example coordination activities (across WMO and with external partners), populating the WMO Country Profile Database (CPDB) and various websites, portals and help desk, the compilation of progress and good practice reports, resource mobilisation, and monitoring and evaluation.

The implementation of the Roadmap will be divided into specific building blocks grouping complementary activities. The **WMO DRR Roadmap Implementation Plan** will provide the framework for Members, RAs, TCs and other bodies to implement the Roadmap and be valid for each financial (= inter-sessional) period and be updated as necessary. Each financial period may have different phases (as detailed, for example, in two-year DRR Work Plans) such as the development, implementation, operation, and evaluation of specific activities. However, some activities will span across these inter-sessional periods and therefore need to be planned accordingly to ensure budget continuity. The structure and scope of the Implementation Plan as well as the necessary updates to both the Roadmap and Implementation Plan will be decided by the appropriate governing body.

5.2 Partnerships

The complexity of the Earth system and the interconnections of weather, water, climate and related environmental processes are increasingly challenging the scientific and financial capacities of NMHSs to improve the quality and delivery of information, products and services. No single government or agency has the necessary resources to address all these challenges on its own. WMO is therefore forging and working in partnerships with stakeholders, such as international agencies, national and local governments, non-governmental organizations (NGOs), academia, the private sector and the media, and engaging in networks and other collaborative efforts is essential for meeting the objectives of the Roadmap.

The working relationships with implementing partners are defined through the WMO external relations⁴⁰ and include agreements (e.g. with IAEA, the African Union (AU), and the European Organization for Nuclear Research (CERN)), working arrangements (WHO, FAO, United Nations Educational, Scientific and Cultural Organization (UNESCO), International Maritime Organization (IMO), European Centre for Medium-Range Weather Forecasts (ECMWF), International Council for Science (ICSU), International Organization for Standardization (ISO), etc.), consultative status (International Association of Broadcast Meteorology (IABM), International Consortium on Landslides (ICL), IUCN (International Union for Conservation of Nature)), and memorandums of understanding (Inter-American Development Bank (IDB), African Centre of Meteorological Applications for Development (ACMAD), UN Economic and Social Commission for Asia and the Pacific (UNESCAP), European Commission (EC), International Research Institute for Climate and Society (IRI), UN Development Programme (UNDP), Asian Disaster Reduction Center (ADRC), National Oceanic and Atmospheric Administration (NOAA), World Food Programme (WFP), Secretariat of the Pacific Regional Environment Programme (SPREP), UK Met Office, International Federation of Red Cross and Red Crescent Societies (IFRC), The World Academy of Sciences (TWAS), UN Institute for Training and Research (UNITAR), etc.); and cooperation without formal agreement (Global Water Partnership (GWP), World Water Council (WWC), UNFCCC, UN Convention to Combat Desertification (UNCCD), etc.).

5.3 Financial and resource considerations

In line with the WMO Strategic and Operating Plans and the WMO results-based budget resources to implement these plans and hence this Roadmap will be identified. This will require routine (including in-kind) and extra-budgetary contributions by Member governments to their NMHSs and to WMO, but also from overseas development agencies, NMHSs in developed countries, development banks, stakeholder organizations and the UN system.

The WMO Office for Resource Mobilization and Development Partnerships (RMDP) focuses on securing development assistance for NMHSs in Member countries and territories in the form of financing (either direct or through the WMO Secretariat), transfer of technology and expertise, and leveraging strategic partnerships. This work is undertaken in close cooperation with the WMO Regional Offices and WMO technical programmes, as detailed in the WMO Resource Mobilization Strategy.

5.4 Communication and outreach

In order to achieve the objectives of the Roadmap, it will be necessary to develop adequate, up-to-date and regular information for and communication with a) WMO Members and their NMHSs and b) with external partners, stakeholders, and users. All these entities need to know that there is a framework available to develop and deliver hydrometeorological products and services for DRR, in line with a number of higher-level frameworks such as the Sendai Framework and the GFCS. They need to understand the benefits of such an approach and the related and required collaboration.

On the other hand, providers of hydrometeorological products and services for DRR, above all the NMHSs, need to be willing to take the time to understand their users' information requirements and what they use the hydrometeorological information and products for. User interfaces mechanisms to collect this information as well as any feedback will need to be established or enhanced.

The WMO public website and the DRR Programme website in the so-called Extranet serve as a primary communication channel for this purpose. It will include regular updates on the Roadmap. In addition, progress reports on the implementation of the Roadmap will be sent to all Members for information and further comments. Relevant events, activities, documents (work plans,

⁴⁰ <https://public.wmo.int/en/our-mandate/how-we-do-it/partnerships>

deliverables, etc.) as well as general information material (factsheets, DRR Programme leaflets, posters, etc.) will be made available on these websites.

5.5 Monitoring and evaluation aspects

Monitoring and evaluating the progress with the implementation of the Roadmap – as detailed in the Implementation Plan – will need to be carried out at two levels:

- At the Secretariat (Department / Division) and programme level with routine progress reports and assessments of the performance on achieving the agreed targets and milestones, utilizing quality assurance techniques in line with QMS⁴¹ standards. This will include the Internal Oversight Office and the Strategic Planning Office which coordinates the continuous strategic planning process of WMO (including the development of WMO Strategic and Operating Plans, Programme Performance Monitoring and Evaluation Plans, and related reports). It will further include the monitoring and assessment of pilot projects (by NMHSs and collaborative partners) to ensure product and service improvements.
- At the strategic level, by Cg and EC, based on progress reports by the Secretariat and in accordance with the overall WMO monitoring and evaluation framework and results-based planning Key Outcomes (KOs) and key performance indicators (KPIs) within the WMO Operating Plans against the Expected Results of the WMO Strategic Plans. This will include the EC WG/DRR and the EC Working Group on Strategic and Operational Planning (EC WG/SOP).

Further bodies involved in the monitoring and evaluation of the Roadmap include the WMO External Auditor, Financial Advisory Committee, and Audit Committee.

Every major disaster triggered by hydrometeorological hazards together with the response and assistance provided by the NMHS / WMO and whether the performance of the NMHS was affected, should be systematically evaluated for the purposes of continuous learning and the continuous improvement of products and services.

Eventually it will be necessary to ensure that all DRR measures and initiatives supported by NMHSs and WMO are monitored and measured to ensure their effectiveness in reducing risks and loss and damage. Efforts should also be made to examine what specific preventative measures had been undertaken (for example on droughts and floods), how they performed, and in conjunction with partner agencies, what additional preventative measures might most contribute to reduction of future losses by reducing overall societal exposure to the risk.

⁴¹ WMO 2013: Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services (WMO-No 1100, (https://googledrivecom/host/0BwdvoC9AeWiUazhkNTdXRXUzOEU/wmo_1100_en.pdf))

Annex

Annex I: Key decisions by the World Meteorological Congress and Executive Council pertaining to Disaster Risk Reduction

The Fourteenth World Meteorological Congress (Cg-XIV) in 2003⁴² established the WMO DRR Programme with the aim to enhance the contributions of NMHSs to DRR and DRM through improved capabilities and cooperation at all levels and in a more cost-effective, systematic and sustainable manner. The scope and the goals⁴³ of the Programme are underpinned by the HFA, which shifted the traditional focus of post-disaster response to a more comprehensive approach involving prevention and preparedness measures.

The WMO DRR Programme's goals, approved by the Sixteenth World Meteorological Congress (Cg-XVI) in 2011 (Resolution 52 (Cg-XVI))⁴⁴:

1. Development, improvement and sustainability of early warning systems (EWS) in particular related to scientific and technical infrastructures, systems and capabilities for research, observing, detecting, forecasting and warnings of weather-, water- and climate-related hazards;
2. Development, improvement and sustainability of standardized hazard databases and metadata, systems, methods, tools and applications of modern technologies such as geographical information systems for recording, analysing and providing hazard information for risk assessment, sectoral planning, risk transfer and other informed decision-making;
3. Development and delivery of warnings, specialized forecasts and other products and services that are timely, understandable to those at risk and driven by requirements of DRR decision processes and operations engaging socio-economic sectors;
4. Stimulate a culture of resilience and prevention through strengthening of capacities for better integration of meteorological, hydrological and climate products and services in DRR across all socio economic sectors, such as land use planning and infrastructure design and continued public education and outreach campaigns; and,
5. Strengthening cooperation and partnerships of WMO and NMHSs in national, regional and international user forums, mechanisms and structures for implementation of DRR.

Decision 3 (EC-68)– WMO Disaster Risk Reduction governance, user-interface mechanisms and WMO Disaster Risk Reduction Roadmap: Executive Council (EC) requested the Secretary-General to update the current draft of the Roadmap on the basis of the input and comments from Members, to submit it to the co-chairpersons of the EC Working Group on Disaster Risk Reduction (EC WG/DRR) for its consideration and to forward its recommendation to the President of WMO for his/her approval on behalf of EC, as per WMO General Regulation 44.

Resolution 5 (EC-67) – Executive Council Working Group on Disaster Risk Reduction through which the same was established[, one of their Terms of Reference (ToR) being the development of the WMO DRR Roadmap and its subsequent updates as required.

Resolution 9 (Cg-17) – Identifiers for cataloguing extreme weather, water and climate events, in which Congress decided to standardize weather, water, climate, space weather and other related environmental hazard and risk information and develop respective event identifiers.

Resolution 10 (Cg-17) – Sendai Framework for Disaster Risk Reduction 2015–2030 and WMO participation in the International Network for Multi-hazard Early Warning Systems (IN-MHEWS), in

⁴² Resolution 29 (Cg-XIV). The original name in 2003 was "Natural Disaster Prevention and Mitigation Programme" which was changed to "DRR Programme" by Cg-XV in 2007.

⁴³ Sixteenth World Meteorological Congress, 2011: Abridged final report with resolutions, available at: https://googledrive.com/host/0BwdvoC9AeWjUazhkNTdXRXUzOEU/wmo_1077_en.pdf

⁴⁴ Sixteenth World Meteorological Congress, 2011: Abridged final report with resolutions, available at: https://googledrive.com/host/0BwdvoC9AeWjUazhkNTdXRXUzOEU/wmo_1077_en.pdf

which Congress requested the regional associations (RAs) to assist with the development of IN-MHEWS, cooperate with regional bodies of international organizations as well as regional organizations, strengthen partnerships and support WMO Regional Centres in order to promote the implementation of the Sendai Framework, in particular MHEWS.

Resolution 8 (EC-66) – WMO Disaster Risk Reduction Roadmap, in which EC requested the Secretary-General to draft a WMO DRR Roadmap [“of prioritized and realistically achievable activities and deliverables that are consistent with the WMO Strategic and Operating Plans as well as the work plans for relevant WMO programmes and projects”];

Resolution 8 (EC-64) – Enhanced capabilities of Members to reduce risks and potential impacts of hazards caused by weather, climate, water and related environmental elements and its Annex – DRR Programme Work Plan, which endorsed the establishment of four WMO DRR User-Interface Expert Advisory Groups (UI-EAGs) on hazard and risk analysis (HRA), MHEWS, humanitarian assistance (HUM) and disaster risk financing (DRF).

Ref.: 12839/2017-1.2 WDS/DRR

Annex II: Provisions in the Sendai Framework for Disaster Risk Reduction 2015-2030 with immediate relevance to WMO

- Promoting the collection, analysis, management and use of relevant data and practical information in line with national circumstances and making use of space and in situ information that results from maintained and strengthened in situ and remotely- sensed Earth and climate observations;
- Ensuring dissemination of reliable data in an appropriate format and accessibility of non-sensitive information, taking into account the needs of different categories of users (including social and cultural requirements, in particular, gender);
- Strengthening disaster risk modelling, assessment, mapping, monitoring and multi-hazard early warning systems (MHEWS) through the strengthening of technical and scientific capacity to capitalize on and consolidate existing knowledge and through developing and applying methodologies and tools;
- Promoting and improving dialogue and cooperation among scientific and technological communities, the private sector, other relevant stakeholders and policymakers in order to facilitate a science/policy interface for effective decision-making in disaster risk management and for sharing good practices internationally;
- Strengthening disaster-resilient public and private investments in structural, non-structural and functional disaster risk prevention and reduction measures;
- Investing in, developing, maintaining and strengthening people-centred, multi-sectoral MHEWS, including telecommunications systems for hazard monitoring and emergencies, simple and low-cost early warning equipment and facilities, and broadened release channels for warning information that is tailored to different user needs;
- Promoting the further development of and investment in effective, nationally compatible, regional multi- hazard early warning mechanisms, where relevant, contributing to the Global Framework for Climate Services (GFCS), and facilitate the sharing and exchange of information across all countries;
- Supporting relevant UN entities to strengthen and implement global mechanisms on hydrometeorological issues in order to raise awareness and improve the understanding of water-related disaster risks; and,
- Promoting international cooperation for DRR and enhanced coordination of respective strategies of UN entities and other international and regional organizations, especially in developing countries, in particular, the least developed countries, Small Island Developing States (SIDS), landlocked developing countries and African countries.

Annex III: Global targets of the Sendai Framework

1. Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared to 2005-2015.
2. Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015 (Categories of affected people will be elaborated in the process for post Sendai work decided by the Conference).
3. Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

Annex IV: WMO constituent bodies and other WMO programmes and activities with their working groups related to DRR

Ref.: 12839/2017-1.2 WDS/DRR

Key working groups, task teams, or other entities related to DRR⁴⁵ of the WMO regional associations, technical commissions and other WMO programmes and activities (as of 2016)	
RA I Africa	<ul style="list-style-type: none"> Working Group on Improved Weather Forecasting, Natural Disaster Reduction, Service Delivery and Communication Working Group on Climate Services and Applications Working Group on Hydrology and Water Resources Tropical Cyclone Committee for the South-West Indian Ocean
RA II Asia	<ul style="list-style-type: none"> Management Group for RA II, Implementation Coordination Team on Disaster Risk Reduction Working Group on Weather Services (WGWS), Expert Group on Public Weather Services Delivery (EG-PWS) Working Group on Climate Services (WGCS) Working Group on Hydrological Services (WGHS),
RA III South America	<ul style="list-style-type: none"> Working Group on Hydrology and Water Resources Working Group on Climate
RA IV North America, Central America and the Caribbean	<ul style="list-style-type: none"> Management Group for RA IV, Task Team on Disaster Risk Reduction Working Group on Hydrology and Water Resources Hurricane Committee
RA V South-West Pacific	<ul style="list-style-type: none"> Working Group on Hydrological Services (WG-HYS), Task Team on DRR – Water-related Disasters (TT-DRR-W) Working Group on Weather Services (WG-WS) Working Group on Climate Services (WG-CS) Tropical Cyclone Committee, Task Team on the Severe Weather Forecast and Disaster Risk Reduction & Task Team on Coastal Inundation
RA VI Europe	<ul style="list-style-type: none"> Working Group on Service Delivery and Partnership (WG-SDP) Working Group on Climate and Hydrology (WG-CH) Task Team on Regional Operating Plan (TT ROP)
Commission for Agricultural Meteorology (CagM)⁴⁶	<ul style="list-style-type: none"> Focus Area (OPCAME) 3 - Natural hazards and Climate Variability/Change in Agriculture
Commission for Basic Systems (CBS)⁴⁷	<ul style="list-style-type: none"> OPAG on Data-Processing and Forecasting System (OPAG-DPFS) with five relevant expert / task teams The Expert Team on Meeting User Needs in Reducing the Impacts of Hydrometeorological Hazards (CBS/OPAG-PWS ET/DPM) (also referred to as the ET/DPM)
Commission for Climatology (CCI)⁴⁸	<ul style="list-style-type: none"> OPACE 2 Climate Monitoring and Assessment and its expert and task teams OPACE 3 Climate Prediction, Projection, and Delivery Mechanisms and its expert and task teams OPACE 4 User Interface for Climate Adaptation and Risk Management and its expert and task teams
Commission for Hydrology (CHy)	<ul style="list-style-type: none"> Open Panels of CHy Experts (OPACHE) with e.g. Theme Area 5 Water, Climate and Risk Management
Joint WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM)⁴⁹	<ul style="list-style-type: none"> Services and Forecasting Systems Program Area (SFSPA)

⁴⁵ Based on the information available on their respective websites in June 2016

⁴⁶ http://www.wmo.int/pages/prog/wcp/agm/cagm/cagm_en.php

⁴⁷ <http://www.wmo.int/pages/prog/www/BAS/CBS-info.html>

⁴⁸ http://www.wmo.int/pages/prog/wcp/ccl/index_en.php

⁴⁹ http://www.jcomm.info/index.php?option=com_content&view=featured&Itemid=100001

Key working groups, task teams, or other entities related to DRR ⁴⁵ of the WMO regional associations, technical commissions and other WMO programmes and activities (as of 2016)
<ul style="list-style-type: none"> Expert Team on Waves and Coastal Hazards Forecasting Systems (ETWCH)
Tropical Cyclone Programme (TPC) ⁵⁰ <ul style="list-style-type: none"> ESCAP/WMO Typhoon Committee⁵¹ WMO/ESCAP Panel on Tropical Cyclones, Working Group on DRR⁵²

Annex V: Acronyms

APFM – Associated Programme on Flood Management
 CBS – Commission for Basic Systems
 CCA – Climate Change Adaptation
 CCI – Commission for Climatology
 Cg – World Meteorological Congress
 CHy – Commission for Hydrology
 CIFDP – Coastal Inundation Forecasting Demonstration Project
 COP – Conference of the Parties
 DRM – Disaster Risk Management
 DRR – Disaster Risk Reduction
 EC – WMO Executive Council
 EWS – Early Warning Systems
 GAR – Global Assessment Report on Disaster Risk Reduction
 GDACS – Global Disaster Alert and Coordination System
 GFCS – Global Framework for Climate Services
 HFA – Hyogo Framework for Action:
 IAEA – International Atomic Energy Agency
 IBCS – Intergovernmental Board on Climate Services
 IDMP – Integrated Drought Management Programme
 IPCC – Intergovernmental Panel on Climate Change
 IRDR – Integrated Research on Disaster Risk
 MDGs – Millennium Development Goals
 MHEWS – Multi-Hazard Early Warning Systems
 NGO – Non-Governmental Organization
 NMHS – National Meteorological and Hydrological Services
 RA – WMO Regional Association
 RCC – Regional Climate Centre
 RDMC – Regional Drought Monitoring Centre
 RSMC – Regional Specialized Meteorological Centre
 SDGs – Sustainable Development Goals
 SIDS – Small Island Developing States
 SWFDP – Severe Weather Forecasting Demonstration Project
 TC – Technical Commission
 TP – Technical Programme
 UNFCCC – United Nations Framework Convention on Climate Change
 UNISDR – United Nations Office for Disaster Risk Reduction
 WCDRR – Third United Nations World Conference on Disaster Risk Reduction
 WHO – World Health Organization
 WMC – World Meteorological Centre
 WMO – World Meteorological Organization

⁵⁰ <http://www.wmo.int/pages/prog/www/tcp/organization.html>

⁵¹ <http://www.typhooncommittee.org/>

⁵² <http://www.ptc-wmoescap.org/>