

***ROLE AND OPERATION OF
NATIONAL METEOROLOGICAL AND
HYDROLOGICAL SERVICES***

***A Statement by the
World Meteorological Organization
for Directors of NMHSs***



***World Meteorological Organization
Weather • Climate • Water***

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Introduction

The Statement by the World Meteorological Organization (WMO) on the Role and Operation of National Meteorological and Hydrological Services (NMHSs) presents information on the role and operation of NMHSs worldwide. The four sections of the document present the functions of NMHSs, their contribution to social and economic development, the services they provide, the basic systems to support service delivery, legislative and institutional matters, including governance, partnership and cooperation, and future development opportunities among other issues.

It is recognized that weather, climate, water and related environmental conditions have a significant influence on the socio-economic development of countries worldwide. The increase in world population, and extension of settlements and life supporting activities in areas vulnerable to the impacts of weather-, climate- and water-related disasters makes it necessary to improve the capacities of NMHSs, especially in developing and least developed countries, to provide better services to reduce disaster risks, and support national development and life supporting activities. The increase in the frequency and intensity of natural hazards due to climate variability and change poses critical challenges to many countries.

The NMHSs, as recognized in the Convention of the World Meteorological Organization¹, are a fundamental part of national infrastructure and play an important role in supporting vital functions of governments. Inadequate infrastructure and limited human resources in some NMHSs, especially those in developing and least developed countries, are among the factors that limit their capacity to take advantage of the advances in science and technology to improve their services.

NMHSs undertake activities directed at improving our understanding of the weather, climate, and the hydrological cycle over both land and sea, undertake monitoring of weather-, climate- and water-related phenomena, provide forecasts, and provide weather, climate, water and related environmental services to a range of users to respond to relevant national, regional and global needs. National Meteorological and Hydrological Services will therefore play a central role in the Global Framework for Climate Services (GFCS) at the national and regional levels and in some cases at the global level as well. They will engage with other organizations at these different levels, providing coordination capacity for establishing and providing operational climate services at the national level where feasible.

¹ The Convention of the World Meteorological Organization, adopted on 11 October 1947 and revised in 2007 reaffirmed "the vital importance of the mission of the National Meteorological, Hydrometeorological and Hydrological Services in observing and understanding weather and climate and in providing meteorological, hydrological and related services in support of relevant national needs which should include the following areas:

- (a) Protection of life and property;
- (b) Safeguarding the environment;
- (c) Contributing to sustainable development;
- (d) Promoting long-term observation and collection of meteorological, hydrological and climatological data, including related environmental data;
- (e) Promotion of endogenous capacity-building;
- (f) Meeting international commitments;
- (g) Contributing to international cooperation."

The observations and data gathered by NMHSs form the foundation for the monitoring and prediction of weather, climate, water and related environmental conditions as well as the issuance of warnings and alerts. However, there is marked disparity in the observation networks with developing and least developed countries having sparse networks that do not adequately represent the weather and climate conditions affecting these countries. The sparse observation networks ultimately affect the quality and range of services that NMHSs can provide.

The NMHSs also use telecommunications networks which are vital for the exchange of data and products that enable them to fulfil their national mandates. The telecommunication networks used by some NMHSs are inadequate and obsolete hampering efficient flow of observations and products including multi-hazard early warnings.

The Climate Services Information System of the GFCS will build on the experiences and production systems of National Meteorological and Hydrological Services, as well as those of other organizations, for developing products and delivering services. It will utilize the World Meteorological Organization Information System as its primary underlying data dissemination system. National Meteorological and Hydrological Services own and operate an effective and extensive system for collecting and sharing climate observations over both land and sea and in some cases a system for disseminating climate forecasts as well.

The efficient provision and delivery of services can significantly reduce the impacts of hydrometeorological hazards which cause large loss of life and property worldwide.

The media offer an important means to deliver forecasts and warnings to the public, hence developing constructive relationships and partnerships with the media is important to enhance service delivery to the public.

This Statement is developed following the decision of the Fifteenth World Meteorological Congress (May 2007) to assist the Heads of NMHSs in addressing the evolving scientific, technological and societal challenges within the purview of their respective mandates, and in their collaboration with government agencies and the user sectors. It has been further updated in 2013, responding to Resolution 48 (Cg-XVI), to address the rapidly growing needs of the GFCS in support of adaptation planning and climate risk management. This Statement provides key elements for decisions to be taken by Heads of NMHSs and other decision-makers on further development of NMHSs.

PART 1: MISSION

Functions of NMHSs

1. *The National Meteorological and Hydrological Services own and operate most of the infrastructure that is needed for providing the weather, climate, water and related environmental services for the protection of life and property, economic planning and development, and for the sustainable exploitation and management of natural resources. Most of the NMHSs:*

- (a) Develop and distribute forecasts, warnings and alerts for safety of life and property and to support efforts to reduce the impacts of weather, climate, water and related environmental natural hazards;*
- (b) Provide essential data, information and products necessary for designing/planning, developing and managing infrastructure, settlements and essential sectors such as agriculture, water resources, energy and transport for improving the well being of societies;*
- (c) Maintain a continuous, reliable and comprehensive historical record of its national weather, climate, water and related environmental data;*
- (d) Provide relevant advice on weather, climate, water and related environmental issues for decision-making;*
- (e) Advance science and technology related to weather, climate and water as well as developing and improving their own operations and services through research and development;*
- (f) Participate in the development, implementation and operation of national multi-hazard early warning systems including those in seismology, volcanic ash monitoring, transboundary pollution, and in ocean-related phenomena such as tsunami;*
- (g) Fulfill relevant international commitments, including those under the Convention of the World Meteorological Organization, and further national interests through participation in the appropriate international programmes and activities;*
- (h) Establish and operate observing station networks that gather observations of the earth-atmosphere-ocean system in real time to support the provision of weather, climate, water and related environmental services and research activities including the assessment and projection of climate change;*
- (i) Establish and operate telecommunication networks for rapid exchange of observation, data and services;*
- (j) Acquire and operate data-processing and forecasting systems to provide real-time weather, climate, water and related environmental services including warnings and alerts to the public and sectors such as agriculture, water resources, energy, health, shipping, aviation, national defence and environment; and*
- (k) Acquire and operate a product dissemination system for efficient and effective delivery of information and services to users to enable planning, preparedness and decision-making for socio-economic development.*

Contribution to economic and social development activities in their countries

2. *Weather, climate, water and related environmental services are useful inputs for socio-economic planning and development. The influence of weather, climate, water and related environmental conditions continue to shape the cultures, traditions and development paths of societies worldwide. The challenges of climate variability and change will require efficient provision and application of weather, climate, water and related environmental services to enable societies to manage the associated risks. Improved understanding of weather, climate and hydrological processes together with their prediction enables NMHSs to provide better services to their countries. However, some NMHSs have not been able to take advantage of the advances in science and technology due to inadequate infrastructure and limited human resource capacity.*

3. *The potential benefits from enhancing the quality and use of meteorological, climate, and hydrological data, information and products in decision-making are enormous, but realizing these benefits will require improvement in infrastructure, human resources development, and engagement between the providers and users to improve the process for decision-making and realization of social and economic benefits. The efforts undertaken by NMHSs, in conjunction with other relevant national partners and institutions, in the context of the GFCS User Interface Platform, in particular at national level and below, are crucial to this.*

Contribution to international efforts on sustainable development

4. *Weather systems and changing climate conditions do not stop at national boundaries. In order to forecast weather and ascertain future climate conditions, NMHSs require meteorological, hydrological and environmental data, information and products not only from within their own territory but also from outside its borders. The requirement for sharing data and information in a common format has been recognized since the establishment of the first National Meteorological Services (NMSs) in the 1850s and motivated the formation of the International Meteorological Organization (IMO) in 1873 to coordinate data sharing and development of user/sector specific products and services. The World Meteorological Organization, an intergovernmental specialized agency within the United Nations system, replaced IMO in 1950.*

5. *The NMHSs make important contributions to international systems established by the Members of WMO to coordinate the collection of observations based on common standards of accuracy and reliability, to process these observations and data into weather forecasts and advisories, and to exchange information and products among all NMHSs in real time. The success in the operation of this established international system depends on the contribution of individual countries.*

6. *WMO carries out its work through ten major scientific and technical programmes. These are designed to assist all Members in providing, and benefiting from, a wide range of meteorological and hydrological services and in addressing present and emerging problems. The programmes are based on the concept and experience that mutual benefits are gained from cooperative use of the pool of knowledge that has been and is still being created by worldwide sharing of the meteorological, hydrological and related information among Members. The programmes of WMO make possible the provision of meteorological and related services through NMHSs in all countries at costs far below those that would be incurred if each Member acted alone.*

7. *The observational data gathered and kept by NMHSs hold tremendous tapped and untapped potential to provide useful information to advise national governments on international and regional environmental agreements and working arrangements related to weather, climate, water and the environment, particularly if leveraged as part of the GFCS User Interface Platform.*

PART 2: SERVICE DELIVERY

Services provided by NMHSs

8. *The NMHSs provide weather, water, climate and related environmental services to a wide range of sectors, including agriculture, water, energy, tourism, transport and health, to assist them in reducing the risks of, and deriving economic benefits from, the associated conditions. The provision of user-targeted products together with their application requires close collaboration between NMHSs and users to enable the integration of user needs in the development of services and facilitate feedback for their improvement. The rapid delivery of warnings and alerts needs close collaboration with the media and telecommunication service providers.*

9. *The NMHSs provide meteorological and related services to the agricultural community to help improve production; reduce losses and risks, reduce costs and increase efficiency in the use of water and energy, among others.*

10. *The NMHSs provide data, products and services to the civil aviation sector which contribute to the safety of aviation and economic operation of the sector both nationally and internationally. The measurements and forecasts of conditions en route and at, or in the approach to, terminal aerodromes are useful for minimizing aircraft operating costs. By increasing operating efficiency of flights, the NMHSs also contribute to reducing the negative impacts of aircraft emissions on global climate change and stratospheric ozone.*

11. *The NMHSs provide early warnings and alerts of extreme events which, when coupled with effective emergency response systems, contribute to reducing the impact of these events. NMHSs rely on communication infrastructure to issue timely warnings. The NMHSs in most countries are part of multi-sectoral systems for disaster risk reduction and response. Some of them participate in the development, implementation and operation of multi-hazard early warning systems including those in seismology and in ocean-related phenomena such as tsunamis. The integration of weather, climate, water and related environmental information into national planning and development policies is an essential element in reducing the risks associated with severe weather and extreme climate events.*

12. *The NMHSs provide forecasts and warnings of floods, water levels and discharge within river basins, watersheds and coastal areas. These products are critical for protecting life and property, safeguarding the environment, and for efficient management of water resources as a contribution to sustainable development. In some countries, National Meteorological Services and National Hydrological Services are provided by separate institutions making it essential for close collaboration for efficient delivery of services.*

13. *The NMHSs provide marine meteorological forecasts and warnings of coastal and open ocean conditions that are vitally important for marine transport and operations, safety of life and property in coastal areas and for operations of ports and harbours.*

14. *The NMHSs provide data, products, and services, such as daily forecasts of temperature, humidity and air-quality as well as long-range predictions and severe weather warnings, that help in monitoring disease outbreaks important for planning and providing public health.*

15. *The above-mentioned services of NMHSs are major contributions to the GFCS Climate Service Information System and an important part of the User Interface Platform.*

Basic systems to support the delivery of services

- **Observing and monitoring the atmosphere and related environment**

16. *Observations of the atmosphere and related environment form the foundation for the production of weather, climate, water and related environmental services. These observations are also essential for conducting research to improve services, assessing changes in the climate system, and for developing and operating systems in weather and climate dependent sectors such as agriculture, water, transport, and energy, among others, to support efforts of communities to reduce disaster risks and adapt to climate variability and change.*

17. *Observation is one of the pillars of the Global Framework for Climate Services, established by the Heads of State and Government, Ministers and heads of delegations, “to strengthen the production, availability, delivery and application of science-based climate prediction and services.” The pillar on Observation forms the foundation for achieving the expectations from the other pillars of the GFCS namely Climate Research, Modelling and Prediction; a Climate Services Information System; and a Climate User Interface Programme.*

18. *The NMHSs establish and operate observation networks that form the WMO Global Observing System (GOS), a component of the WMO Integrated Global Observing System (WIGOS). The system is comprised of operationally reliable surface- and space-based subsystems, owned and operated by WMO Members, which undertake to meet certain standards and responsibilities in the agreed global system, for the benefit of all nations.*

19. *The GOS forms the foundation for the development and implementation of the WMO Integrated Global Observing System. The WIGOS is a coordinated, standardized system of systems for gathering meteorological and other environmental observations on a global scale in support of all WMO Programmes. It aims to significantly improve the availability of observational data and products for all Members.*

- **National and international exchange of observations, data and products**

20. *The NMHSs establish and operate telecommunication networks that together form the WMO Global Telecommunications System (GTS) which facilitates rapid exchange of observations, data and products to enable NMHSs worldwide meet their national and international obligations. In the ocean domain, for example, this includes playing a key role in the dissemination of tsunami early warnings around the world and of in situ sea surface temperature (SST) observations, which are crucially important for climate assessment and prediction.*

21. *The GTS forms the foundation for the development and implementation of the WMO Information System (WIS). WMO Members are cooperating in the design and implementation of the WIS to improve the current data communications and dissemination of weather, climate and water data, information and products. By using a broader array of communication and data technologies, including the Internet, WIS will reduce the operation costs, enhance the reliability of data communications and provide easier, more user-friendly ways to share data and products internationally. In addition to its automated dissemination of observed data and products, WIS will provide data discovery, access and retrieval services for all weather, climate, water and related data and products produced by WMO centres and Members.*

22. WMO policy on the availability of meteorological and hydrological data is determined to a large degree by Resolution 40 (Cg-XII) and Resolution 25 (Cg-XIII), respectively. These resolutions commit “to broadening and enhancing the free and unrestricted international exchange” of meteorological, climatological, hydrological, and related data and products, as a fundamental WMO principle. These data and products are major contributions to the GFCS Climate Service Information System and an important part of the User Interface Platform.

- **Data processing and forecasting**

23. The observations and data gathered by NMHSs are processed to generate products that can support decision-making in addressing events such as tropical cyclones/hurricane, heatwaves, disease outbreaks, flash floods and drought among others. The quality of the products is dependent on the adequacy of processing facilities and human resources. All NMHSs contribute to these products through the sharing of observations, which are the basis for generating the forecasts and warnings.

24. WMO has designated some NMHSs as Regional Specialized Meteorological Centres (RSMCs) which provide forecast products to all other NMHSs. Specializations include geographical, tropical cyclone and emergency response. In addition, WMO has designated Global Producing Centres (GPCs) and Regional Climate Centres (RCCs) which focus on longer range predictions. The climate predictions and information provided by GPCs and RCCs are useful tools for planning and developing activities in climate sensitive sectors such as agriculture, water resources, energy and health among others.

25. The NMHSs can then utilize RSMC products to develop forecasts and warnings of severe weather and extreme climate events for their respective countries to support socio-economic development activities.

PART 3: ELEMENTS FOR SUCCESSFUL OPERATION OF THE NMHSs

Legislative and institutional matters

- **National legal instruments to define the mission and mandate of NMHSs**

26. *The legal instrument establishing an NMHS is an important element in its successful operation. The Thirteenth World Meteorological Congress reaffirmed the importance of having national legal instruments that define the mission and mandate of NMHSs to ensure clarity in the definition of their responsibilities and recognition of their contribution to society to facilitate allocation of adequate resources. The advantages of such a legal instrument are:*

- (a) Duties and areas of responsibility of an NMHS are defined for the benefit of both the NMHS and the government;*
- (b) The NMHS is clearly designated as the “official” weather, climate and flood warning service and as the “National Authority” in warning situations, to avoid public confusion;*
- (c) Ensuring legal protection of the field equipment and of officers in their duties;*
- (d) Direct access to essential international communications is assured;*
- (e) Coordination of various weather, climate, water and related environmental activities in the country is provided; and*
- (f) A basis for determining the level of funding needed to fulfil the agreed role is clarified; including provisions for retaining revenues earned to improve the NMHS.*

27. *Over half of the NMHSs operated by Members of WMO have formal legal instruments (such as a law, act, or decree) covering their responsibilities, establishment and operation of their facilities, state regulations, and legal responsibility. Other issues included in the legal instruments are the roles of NMHSs in the prevention/mitigation of natural disasters, international cooperation, and supplementary provisions and funding.*

- **Impacts of international agreements**

28. *Observations and data gathered, processed and archived by NMHSs provide useful information for addressing international conventions and agreements especially those related to climate, water and the environment. Most governments are parties to some international conventions, agreements, or declarations, such as the Millennium Declaration, including the Millennium Development Goals, the United Nations Framework Convention on Climate Change, the United Nations Convention to Combat Desertification, and the Vienna Convention for the Protection of the Ozone Layer. The NMHSs often, working with other national agencies, are involved in developing and supporting government positions at relevant international meetings such as those related to weather, climate, water and related environmental issues. The recent increase in the number of agreements addressing climate, water and related environmental issues together with the significant influence of climate on sustainable development will lead to more involvement of NMHSs in related activities. This will require improvements in the gathering, processing and archiving of terrestrial and marine meteorological and hydrological observations and data.*

Governance

29. *The governance structure of an NMHS has a strong influence on its operation and efficient delivery of services. The organizational structure of NMHSs, aimed at facilitating efficient provision of services to their countries, vary considerably from country to country. They are influenced by: (1) a government's approach or models for delivery of public services; (2) the size and character of the country, its population distribution, and the services provided; (3) the availability of trained staff and appropriate technology; (4) the availability of and means for obtaining resources; and (5) the nature of the user communities and the degree of outreach. They are also dependent on the types of NMHS, which include government agencies, semi-autonomous government agencies, government owned organizations, and private companies. In countries where private and government owned agencies exist, every effort needs to be made to assign clear responsibilities to minimize conflicts.*

30. *With the increasingly broad challenges facing countries and the international community, the NMHSs may need to adopt flexible organizational models and management strategies that allow for strengthened interactions with relevant national agencies, as well as international and regional institutions.*

Partnerships and cooperation

31. *The delivery of weather, climate, water, and related environmental services over land and sea is founded on cooperation among NMHSs worldwide. NMHSs are mutually dependent on the gathering and sharing of observations, data and products to provide services. WMO coordinates the policy and programmes for the global exchange of observations and data.*

32. *Many NMHSs have noted the advantages of closer regional and subregional cooperation to aid their operations, especially where they have been able to enhance joint capability through sharing of resources, reducing duplication or promoting capacity-building through technology exchange. Regional initiatives such as Regional Climate Outlook Fora that bring together providers and users of weather, climate, water and related environmental services in a region continue to play an important role in efforts to improve service quality and service delivery. The WMO Regional Training Centres (RTCs), Regional Instrument Centres (RICs), and Regional Climate Centres (RCCs) ensure that NMHSs can access cost-effective regional education, training and services. The WMO Regional Associations and Regional Offices play an important role in promoting capacity-building between developed and developing countries.*

33. *Given the magnitude of the scientific challenges of providing accurate and reliable weather, climate and water services and the difficulties of obtaining adequate resources, many NMHSs benefit from close cooperation with regional and international institutions. In particular, academic and research institutions offer the opportunity for developing user specific services to meet the ever evolving needs of the users. The partnership with the Association of Hydro-Meteorological Equipment Industry (HMEI) continues to provide good linkage between the developers and producers of hydrometeorological equipment, and the users. The NMHSs also have the opportunity to contribute to the activities of other United Nations agencies that can benefit their countries, such as those related to economic development and environmental protection.*

34. *Since the media offer an important means to deliver forecasts and warnings to the public, developing constructive relationships with global, regional, national, and local electronic and print media is important to enhance service delivery to the public.*

35. *NMHSs can bring their expertise in "service delivery through partnerships" as an important contribution to the GFCS, particularly as it pertains to the User Interface mechanism where the collaboration of service providers, researchers and economic sectors will be critical.*

PART 4: FUTURE DEVELOPMENT OF AND OPPORTUNITIES FOR NMHSs

Exploiting greater scientific understanding

36. *The services provided by NMHSs are dependent on the sustained investments of WMO Members in research and development (R&D), and capacity-building. Further improvement of current services will require: (1) effective transitioning of R&D results into fully operational products and services; (2) R&D that is responsive to the specific needs of NMHSs and their constituencies; and (3) effective means to develop linkages with decision-makers and users, especially through effective use of their Public Weather Services to communicate scientific research translated into tools, products and services, that are useful for decision-making, in easily understandable and actionable language.*

37. *Scientific research using a seamless approach to modelling allows Numerical Weather Prediction (NWP) and climate models to systematically include more realistic representations and additional components of the Earth system. This not only contributes to increased predictability, but also significantly increases the range of climate services possible and provides opportunities for NMHSs and their partners to address increasing climate service needs.*

Exploiting technological advances

38. *With the development of WIGOS and WIS, the NMHSs will benefit from access to more and better data including data to provide services. The WIS will also provide NMHSs with more effective ways to disseminate information and products to users.*

39. *The challenge for many NMHSs will be to develop the data processing and prediction systems that will effectively utilize these high-volume, complex data streams.*

40. *New modelling approaches, such as ensemble prediction and “seamless” prediction systems, benefit from improved supercomputing capabilities.*

41. *New and developing technologies and techniques, such as Internet delivery of data and products and networking, offer the NMHSs the opportunity to expand the availability and use of their products and services and thus of their influence.*

Education and training

42. *Education and training activities are focused on subjects such as meteorology (including marine meteorology and tropical meteorology), weather forecasting, agricultural and aeronautical meteorology, climate and climate prediction, disaster prevention, environment, hydrology, instruments (including satellite and in situ remote-sensing) and observations, oceanography, telecommunications.*

43. *Education and training is important not just on technical matters but also on applications to address the ability of users to integrated weather, climate, water and related environmental services into decision-making. Training is also required to improve the capacities in conducting targeted research to improve services; planning and institutional management; communication and public relations; and other administrative and support functions. Priority needs to be given to enhancing skills through education and training to improve the provision, delivery and application of services by NMHSs.*