An International Agenda for Education and Training in Meteorology and Hydrology

2018 edition

WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

WMO-No. 1219

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EDITORIAL NOTE

METEOTERM, the WMO terminology database, may be consulted at http://public.wmo.int/en/resources/meteoterm.

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Chairperson, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box 2300
CH-1211 Geneva 2, Switzerland

Tel.: +41 (0) 22 730 84 03
Fax: +41 (0) 22 730 81 17
Email: publications@wmo.int

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FOREWORD

I am pleased to provide the foreword to this publication which brings together the outcomes, discussions and recommendations from the Thirteenth World Meteorological Organization (WMO) Symposium on Education and Training (SYMET-13) as well as the follow-on Meeting of the Directors of WMO Regional Training Centres (RTCs). These two meetings identified the major challenges and opportunities for education and training institutions wishing to contribute to the capabilities of the global workforce involved in providing meteorological, hydrological and climatological services, particularly at the national level. These services are used by individuals, businesses, governments and international development agencies to increase the socioeconomic wellbeing of countries and reduce the risk of loss of life and property from natural disasters.

The rapid changes in technology and our increasing ability to model natural phenomena and provide predictive meteorological, climatological and hydrological services means that the role of the global workforce, particularly that of the National Meteorological and Hydrological Services (NMHSs) of WMO Members, is constantly changing. These changes require that personnel regularly undertake continuous professional development in science and technology to keep up-to-date with the changes. Additionally, there is an increasing need for personnel to be proficient in communicating with users of the services and fulfilling management roles ranging from leading small teams to, in some cases, leading organizations of many thousands.

The WMO community has been well served by the RTCs, NMHS training centres and university partners for over fifty years. However, the increasing complexity and diversity of the education and training challenges we are facing requires increased collaboration, cooperation and coordination among the traditional partners of the WMO Education and Training community as well as reaching out to new partners who can help increase the capability of the current partners and address areas the current partners cannot or do not have the mandate to address.

An ongoing challenge for WMO Members as well as the WMO Secretariat is addressing these increasing education and training needs within tight financial constraints. In this regard, I am very pleased to note that this Symposium further expanded the discussion about partnership development and resource mobilization, encouraging the WMO Education and Training community to look outside the traditional funding areas for new opportunities for finance and resources to better support its Members. I was also pleased to see that the role and requirements of the private sector, which makes up a significant part of the total global workforce, were also taken into account.

I believe that this publication will be of interest and use to a wide range of audiences inside the WMO community as well as to those who have the potential to contribute to, and benefit from, an increasingly knowledgeable and skilled global workforce in meteorology and hydrology.

(Petteri Taalas)
Secretary-General

ACKNOWLEDGEMENTS

The manuscript was prepared by Jeffrey Charles Wilson, Australia, in collaboration with Yinka Adebayo, Director, Education and Training Office, WMO, and Patrick Parrish, Chief, Training Activities Division, WMO.

Members of the International Advisory Committee (IAC), session chairpersons and rapporteurs of the Thirteenth World Meteorological Organization Symposium on Education and Training (SYMET-13) listed in Appendix B, contributed in various forms to the preparation of this publication.

BACKGROUND

The Thirteenth World Meteorological Organization Symposium on Education and Training (SYMET-13) was held in Bridgetown, Barbados, from 30 October to 1 November 2017. The Symposium was hosted by the Caribbean Institute for Meteorology and Hydrology (CIMH) with financial support from the National Weather Service of the United States of America.

The Symposium was attended by 81 participants from 33 WMO Members and consisted of opening and closing ceremonies, three theme sessions with breakout groups and a poster session. The opening ceremony was addressed by: the President of WMO, Dr David Grimes via a video message; from the Secretary-General of WMO, Professor Petteri Taalas in a statement read by the Assistant Secretary General of WMO, Dr Wenjian Zhang; the Permanent Representative of the British Caribbean Territories with WMO, Mr Tyrone Sutherland; the Permanent Representative of Barbados with WMO, Ms Sonia Nurse; the Permanent Secretary of the Department of Agriculture in Barbados and Chairman of the CIMH Board, Mr Andrew Gittens; and the Director of the WMO Education and Training (ETR) Office, Dr Yinka Adebayo.

The WMO education and training community has been tasked by the World Meteorological Congress with improving the knowledge, skills and working methods of NMHS personnel so that they can address the rapidly developing requirements for new and improved services. Consequently, the ultimate aim of SYMET was to assist the international community as a whole, in particular the National Meteorological and Hydrological Services (NMHSs), in identifying the meteorological and hydrological education and training challenges that are expected to arise over the next five to ten years. The key themes were: enhancing community awareness and knowledge of service-specific education and training needs; identifying opportunities to increase education and training capacity; and enhancing awareness and utilization of partnership and resource mobilization opportunities.

The 81 SYMET-13 participants representing developed, developing and least developed countries, all WMO languages, with a gender ratio of 40% female and 60% male, actively engaged in the presentations and discussions, and over the three days developed conclusions and recommendations which are included in the symposium statement and detailed further in this publication. Some recommendations from the Meeting of the Directors of Regional Training Centres (RTCs), which followed the Symposium and was attended by most of the SYMET participants, have also been included in the reported outcomes.

INTRODUCTION

In 1969, the WMO Executive Committee (now Executive Council), at its twenty-first session, decided that the inaugural symposium on meteorological education and training should be held in Rome in March of the following year. Noting the success of the symposium held in Rome earlier in the year, the twenty-second session of the Executive Committee in mid-1970 decided that a similar symposium should be held every four years. The role of the symposium would be to address the limited opportunities provided through other mechanisms to bring together senior managers in the WMO education and training community to discuss and debate issues related to the implementation and future direction of the WMO Education and Training Programme. Thirteen symposia have been held to date with themes that tackle issues of critical importance to WMO Members from the perspective of education and training.

Recent SYMETs have addressed issues around qualifications and competency of aeronautical meteorological personnel, overall competency implementation, a major update of the Basic Instruction Packages for Meteorologists and Meteorological Technicians, responsibilities and future challenges for the WMO Regional Training Centres and the introduction of the WMO Global Campus concept. Starting with SYMET-11 in 2010 increased opportunities for all participants to contribute to the SYMET theme discussions were introduced by mixing plenary sessions with small-group discussions and workshops.

The four-yearly SYMETs still provide the only regular opportunity for face-to-face discussion for senior leaders within the WMO Education and Training community and groups providing education and training of interest to WMO Members. To ensure the maximum benefit from these meetings, they investigate the recurrent and emerging challenges and opportunities for the WMO Education and Training Programme in supporting the needs of the global meteorological and hydrological enterprise. The demands upon the global meteorological and hydrological enterprise are growing with changes in information and communication technology (ICT), increased demand for services to reduce loss of life and property, increasing use of meteorological, climatological and hydrological services and their underlying science, and a range of United Nations initiatives and agreements to address sustainable development, climate change and disaster risk reduction activities.

In deciding to hold SYMET-13, the WMO Executive Council underscored the need to engage wider communities and better prepare participants for discussion by taking advantage of information and communication technology prior to, during and after the Symposium.

This publication summarizes the main conclusions and recommendations from SYMET-13 and includes the Statement agreed by the participants on the final day of the Symposium.

Readers wishing to learn more about the education and training challenges and opportunities in their country are encouraged to contact the Permanent Representative of their country with WMO (typically, but not exclusively, the head of the National Meteorological and Hydrological Service). For further information on the WMO Education and Training Programme, readers can visit the following web page, https://public.wmo.int/en/programmes/education-and-training-programme, or contact the ETR Office via email at etr@wmo.int.

1. CONTEXT OF THE WMO EDUCATION AND TRAINING PROGRAMME

As a specialized agency of the United Nations, WMO is dedicated to international cooperation and coordination of activities focusing on the state and behaviour of the Earth's atmosphere, its interaction with the land and oceans, the weather and climate it produces and the resulting distribution of water resources.

The National Meteorological and Hydrological Services in each WMO Member State and Territory work around the clock to provide vital weather, water and climate information worldwide. Their early and reliable warnings of severe weather, fluctuations in air quality, and climate variability and change allow decision-makers, communities and individuals to be

better prepared for weather and climate events. Their warnings help save lives and property, protect resources and the environment, and support socioeconomic growth. For NMHSs to fulfil their mandates they need a skilled and capable workforce to carry out the required services. The World Meteorological Organization supports NMHSs in this work and in meeting their international commitments in the areas of disaster risk reduction, climate change mitigation and adaptation, and sustainable development through a number of WMO Programmes.

The Organization's Programmes support NMHSs by facilitating and promoting:

- The establishment of networks of observational stations to provide weather, climate and water-related data;
- The establishment and maintenance of data management centres and telecommunication systems for the provision and rapid exchange of weather, climate and water-related data;
- The creation of standards for observation and monitoring in order to ensure adequate uniformity in the practices and procedures employed worldwide and, thereby, ascertain the homogeneity of data and statistics;
- The application of science and technology in operational meteorology and hydrology to aviation, transport (air, land and maritime), water resource management, agriculture and other focus areas;
- Activities in operational hydrology and closer cooperation between National Meteorological and Hydrological Services in states and territories where they are separate;
- The coordination of research and training in meteorology and related fields.

Within the WMO community, the Seventeenth World Meteorological Congress in 2015 identified the following priority areas for the period 2016–2019:

- Disaster risk reduction;
- Global Framework for Climate Services;
- WMO Integrated Global Observing System (WIGOS) and WMO Information System (WIS);
- Aviation;
- Polar and high-mountain regions;
- Capacity development;
- Governance.

It is anticipated that activities addressing these priority areas will continue well past 2019 as they are part of WMO and its Members' direct and indirect contribution to the implementation of international agreements such as the 2030 Agenda for Sustainable Development, the Paris Agreement, the Small Island Developing States (SIDS) Accelerated Modalities of Action (SAMOA) Pathway and the Sendai Framework for Disaster Risk Reduction.

Businesses and organizations operating across international boundaries know the value of weather, water and climate services and now expect to receive similar products of similar standards wherever they operate. The Organization expects to meet this challenge using the network of global, regional and national centres and institutions operated by Members. Ensuring the capability of the global NMHS workforce to fulfil the necessary roles is therefore a foundational requirement to meet this challenge. Part of the goal of this publication is to encourage national and international foundations and projects to pay more attention to

meteorological, climatological and hydrological research, education and training relevant to all potential audiences so that their efforts might better respond to the challenging environmental problems.

The issue of personnel capability is examined in the following section which deals with challenges and opportunities for the WMO Education and Training Programme over the next five to ten years. Sections 2, 3 and 4 contain text boxes summarizing the observations and recommendations from the SYMET-13 participants and the follow-on Meeting of Directors of Regional Training Centres. The SYMET-13 observations and recommendations make up the final conference statement in Appendix A.

2. CHALLENGES AND OPPORTUNITIES FOR THE WMO EDUCATION AND TRAINING PROGRAMME

In the late 1990s the global training demand for personnel involved in the provision of meteorological and hydrological services started to change due to: an increasing need for more practical learning outcomes, signalling the start of the era of competency-based training; increasing numbers of trainees as people from the large recruitment drives of the 1960s and 1970s reached retirement age; a growing realization of the need for education and training of specialist staff at all levels in management and leadership skills; and an increasing requirement for training in areas such as use of Numerical Weather Prediction model data and products, satellite data and products and radar data and products. These demands were common to NMHSs in all Member States and Territories as ICT technologies started to change the way that forecasts and warnings were produced, delivered and used by the wider community.

Two decades later these demands have evolved but the same basic challenges remain: ensuring that the global NMHS workforce is competent to carry out the allocated roles, that there are processes to deal with education and training of new staff, that position-appropriate management and leadership skills are developed at all levels of the NMHS, and that processes are in place to develop and deliver education and training in new and emerging areas.

These challenges and opportunities for the WMO Education and Training Programme are considered in the following subsections.

2.1 Unmet learning demand

The WMO Education and Training Programme focuses particularly on the staff of NMHSs of the 191 WMO Members, but it is also extremely relevant for the growing meteorology workforce in the private sector and for universities and other governmental environmental bodies.

In 2017 the WMO Education and Training Office conducted a global survey of NMHS staffing profiles and needs (see *Status of Human Resources in National Meteorological and Hydrological Services* (ETR-21). More than 150 responses were received indicating a total NMHS global workforce in excess of 170 000 people. At this stage there is no estimate of the size of the global meteorological workforce in the private sector.

The results of the 2017 survey suggest that the meteorological workforce of more developed countries is generally larger whilst that of least developed countries and small island developing States is generally smaller, often less than 100 people (see Figure 1).

As meteorology and climate are relatively niche areas and the national demand for staff is small (refer to Figure 1), the national education and training system of many WMO Members does not provide specific learning pathways for NMHS specialist staff. Thus NMHSs are faced with running their own education and training programmes, sending students to other countries, retraining existing staff (some of whom may not be fully qualified) to undertake specialist operational roles and increasingly utilising online training options whilst new staff are on the job.

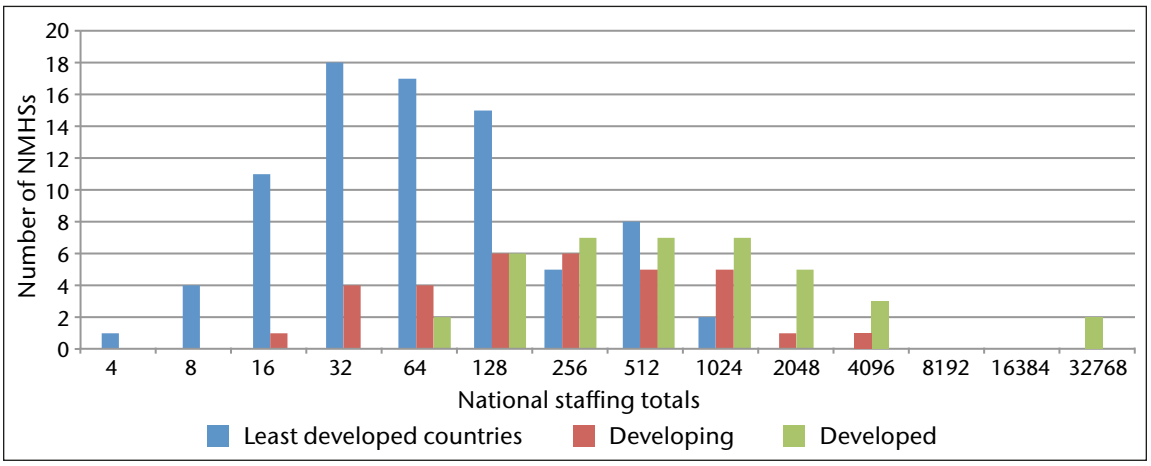


Figure 1. Breakdown of NMHS staff based on the 2017 survey. Coloured bars show the pseudo development status which is based upon the Members' assessed contribution to WMO.

Responses to the 2017 survey carried out by the WMO Education and Training Office identified an unmet global training demand for nearly 40000 employees including managers, meteorologists, meteorological technicians, hydrologists, hydrological technicians, climatologists, researchers and support staff, or more than 20% of the global NMHS workforce. For each of these staffing categories the unmet training demand was at least 20% of the total global staffing in that category. In addition to this current unmet demand, the survey shows that the average age for the global workforce is quite high, with two out of three of the respondents to the survey reporting that more than half of their workforce was over 40 years of age.

On average, 27% of Members' managerial staff are due to retire prior to 2022 and approximately 20% of their meteorologists, meteorological technicians, hydrologists and hydrological technicians are due to retire in a similar timeframe. Exacerbating this situation is the time it potentially takes to recruit, educate and train replacement staff. In most of the developing and least developed countries there are few if any suitably qualified individuals available for recruitment. Due to this shortage of suitable qualified and competent replacement staff, new recruits typically need to be taken through university or other suitable courses in foreign countries and to undertake on-the-job training for six months to a year. It takes four to six years for staff moving into professional areas to go through this pipeline. Thus those NMHSs that have not been successful in getting new staff into this pipeline will soon be suffering additional shortages of qualified staff making their services less able to provide the required services.

Noting that NMHSs in developed and developing countries potentially have the financial and other resources to address much of this need, the scope of the problem can be reduced somewhat by focusing only on the least developed countries. In the 2017 survey, 81 responses came from Members that could be categorized as least developed countries (LDC). Of these, 30 reported that more than 30% of their staff were due to retire in the next five years.

Whilst it is possible to consider options for addressing some of this unmet learning demand using online learning in one language, the actual number of languages, the computing infrastructure and internet bandwidth, the need for substantial practice and feedback opportunities to develop practical skills, the diversity of potential student academic backgrounds and capabilities and the wide range of knowledge, as well as skills and behaviours that need to be supported and updated on an ongoing basis make addressing this unmet demand a larger challenge than any single solution can handle. Addressing the looming shortfall in NMHS staff in many developing and least developed countries will require concerted effort by governments, regional development partners and the international aid community. Failure to address this shortfall will most likely lead to failures in services and potentially the NMHSs themselves. Provided funds can be found, the education and training challenge will require a concerted effort by the education and training community using a mix of traditional classroom, online learning, mentoring and coaching and self-guided learning methods.

SYMET-13 observations

- The 2017 survey on human resources requirements of NMHSs, carried out by the WMO Education and Training Office, reveals a growing deficit in the capability and numbers of adequately educated and trained staff required to provide meteorological, climatological and hydrological services in many countries and territories;
- Rapid advances in scientific innovation and technological developments require corresponding update training of NMHS personnel;
- The research capability of the current and future generations needs to be developed as a critical part of a robust training programme;
- NMHS personnel and the broader user community across the globe are increasingly accessing meteorological products, data and education and training opportunities via the Internet. Whilst some countries are still experiencing limited bandwidth and access, the situation is improving and the WMO Education and Training community is continuing to improve its online as well as classroom courses and delivery;
- As the WMO Education and Training community works with students from many countries, language, gender and cultural awareness need to be addressed across all activities.

SYMET-13 recommendations

Encourage national and international foundations and projects to pay more attention to meteorological, climatological and hydrological research, education and training relevant to all potential audiences, to respond to challenging environmental problems.

RTC Directors' meeting recommendations

RTCs should actively participate in raising resources for fellowships and other education and training activities.

Additional recommendations arising from the breakout groups

Increase training capacity, efficiency and effectiveness through further development of training skills and capabilities to use new training methods and technologies, including a clear pathway for those new to training to develop their skills.

One of the key findings of the 2017 survey was the diversity of the NMHSs in terms of size, roles and accountability, gender breakdown and languages. This diversity is both a strength and a weakness and means that there is no single solution for developing and delivering global education and training opportunities. Rather, the recommended approach is to develop and maintain high-level globally agreed outcomes to support the initiatives of the WMO Congress that can be regionally and nationally adapted to suit the roles, services, personnel structure and size, cultures and resources of the NMHS of each WMO Member.

In terms of long-term sustainability, it is essential that every Member has some staff with research skills and capabilities in meteorology and hydrology. Clearly, the level and number of staff and their range of skills and capabilities will be dependent upon the size and role of the NMHS and other institutions in the country. However having a core of personnel with these skills is essential for robust scientifically-based services. These researchers play two key roles: addressing or bringing national research questions to the attention of other research groups to help address them, and ensuring that global and regional models or other frameworks correctly address national problems or conditions.

Observations and recommendations from the SYMET-13 participants and the follow-on Meeting of Directors of Regional Training Centres are summarized in the box above.

2.2 Growing learning needs

Compounding the challenge of the current unmet training demand referred to in the previous section is the changing nature and types of service that are being sought by governments, businesses and industry. Increasingly, the users of meteorological, climatological and hydrological services are expecting the NMHSs to provide impact-based forecasting services rather than the traditional services that outline the state of the meteorological variables and

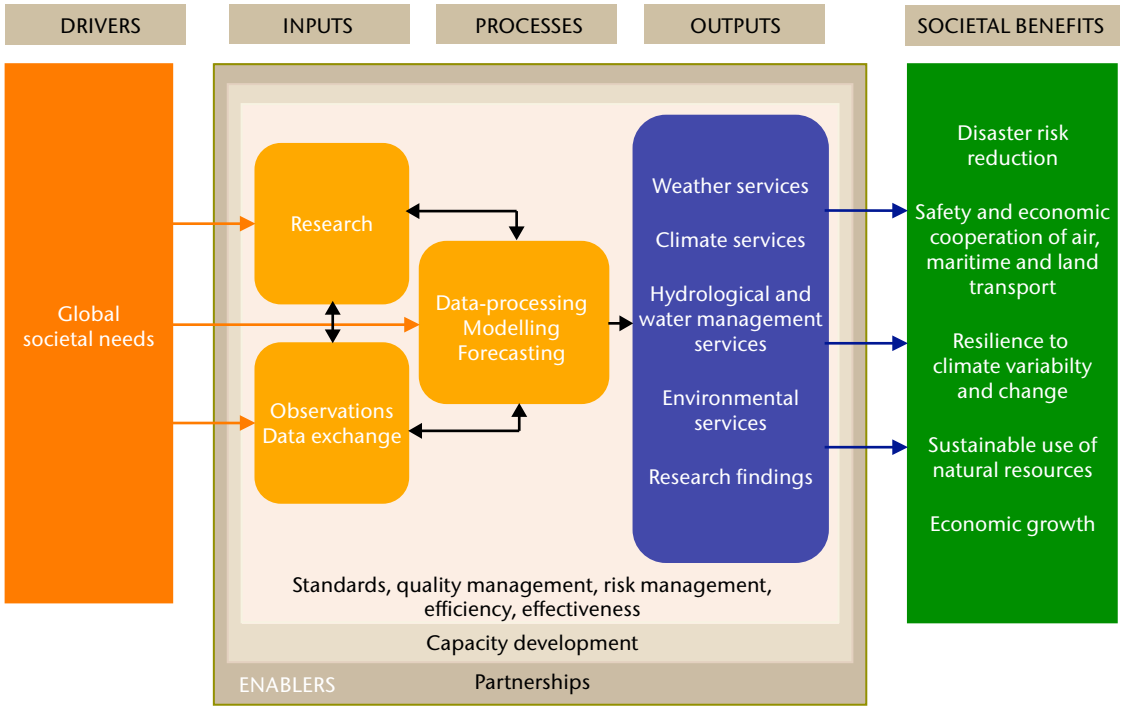


Figure 2. Processes involved in delivering effective weather, climate and hydrological services, and the means to achieve that, linked with the WMO mandate.

leave it up to the user to infer the impact of the weather, climate or hydrological event on their activities. Increasingly users are also requesting that they receive training in the use of meteorological and hydrological products and data—further underlining the need for training resources to be available in multiple languages.

As the NMHSs may not be responsible for the issuing of all warnings in their country, the move to impact-based forecasting requires NMHS personnel to have skills to liaise and communicate with the media and stakeholder groups such as emergency services, industry and the national government. To this end, governments, as well as national and international stakeholders, need to be made more aware of the importance of increasing support for formal education and continuous professional development of meteorologists and hydrologists to ensure that the NMHSs have the personnel needed to deliver the services required by their governments.

At the same time increasingly sophisticated and accurate numerical weather prediction models at global, regional, national and sub-national scales, supported by advanced automated surface and remote-sensing observations, are now capable of supplying much of the standard output regarding the state of the meteorological variables in time and place, potentially freeing NMHS staff to take on some of these new roles, provided they can develop the required knowledge, skills and behaviour to deliver the new impact-oriented services.

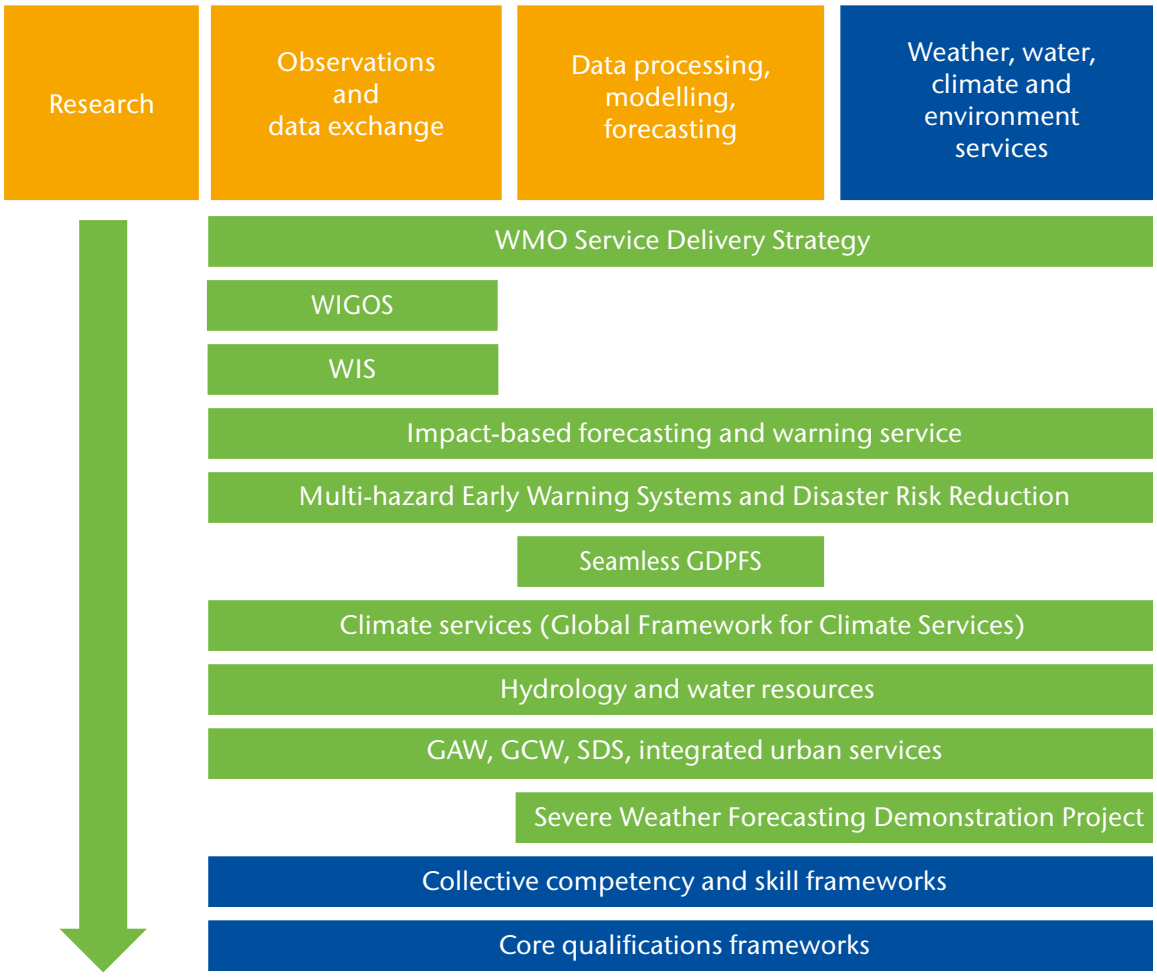
Noting the changing roles of the NMHS personnel referred to above, the regulations, content and scope of the initial and ongoing education and training for NMHS personnel will also need to evolve to ensure that they have the appropriate knowledge, skills and behaviour to provide the evolving services. Noting the diversity in capability of the NMHSs and the need to ensure that new regulations do not unduly penalize Members, the requirements may need to be split into mandatory requirements, which will evolve slowly, and recommended practices. This perhaps better reflects the evolving roles of personnel in NMHSs in response to increased automation and new service delivery requirements.

The processes involved in delivering effective weather, climate and hydrological services are schematically linked with the WMO mandate illustrated in Figure 2 (taken from *WMO Strategic Plan 2016–2019* (WMO-No. 1161). The elements in the box at the centre of the diagram represent

the domain of WMO and the weather, climate and hydrological service providers (particularly the NMHSs) of its Members. The green box on the right shows the key areas of benefit to society that the WMO Members support through the services generated by the various providers.

Figure 2 can be further rearranged to reflect the key internal initiatives set by the Seventeenth World Meteorological Congress in 2015 (see Figure 3). Each of the various initiatives indicated in Figure 3 is global in nature and has education and training implications that have not necessarily been fully identified or resourced.

Until 2011 much of the WMO Education and Training Programme offerings were based on syllabi describing only course topics. In 2011 the Sixteenth World Meteorological Congress approved new regulations outlining initial education programmes in terms of learning outcomes (see *Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology* (WMO-No. 1083), Volume I – Meteorology). The Sixteenth Congress also approved the development of competency frameworks for the key WMO service areas. These two subtle but very important changes help ensure that the education and training activities required to support the initiatives in Figure 3 are academically and practically sound.



GAW = Global Atmosphere Watch
GCW = Global Cryosphere Watch
GDPFS = Global Data-processing and Forecasting System
SDS = Sand and Dust Storms
WIGOS = WMO Integrated Global Observing System
WIS = WMO Information System

Figure 3. Schematic depicting the linkage of the internal WMO initiatives with the various processes and outputs outlined in Figure 2

Since WMO Members own and operate the observing and communication networks, and have their own NMHSs, Members are responsible for educating and training their NMHS staff to take on these new roles and for supporting the agreed international initiatives. However, as more than 140 of the WMO 191 Member States have characteristics of least developed or developing countries, international support for capacity development of personnel, infrastructure, legal and legislative roles and development of institutional sustainability is essential to ensure that the increasingly integrated national, regional and global systems function satisfactorily.

The need for financial and other support, as well as greater regulation and resource accountability by national governments and development partners, require managers in NMHSs to possess greater planning, communication, legal, advocacy, financial and personnel management skills. Thus aid projects need to include these requirements in their initial planning and the WMO Education and Training community need to introduce these topics into the initial and continuous professional development programmes for meteorological and hydrological professionals.

Observations and recommendations from the SYMET-13 participants and the follow-on Meeting of the Directors of Regional Training Centres are summarized in the following box.

SYMET-13 observations

- Governments, as well as national and international stakeholders, need to be made more aware of the importance of increasing support for formal education and continuous professional development of meteorologists and hydrologists;
- Managers in NMHSs need to possess increased planning, communication, legal, advocacy, financial and personnel management skills;
- The development of the WMO competency and qualification frameworks and their inclusion in the WMO Technical Regulations have raised the importance of, and need for, support of education and training within the NMHSs.

SYMET-13 recommendations

- Management, leadership, communication and advocacy skills need to be introduced into initial and continuous professional development programmes for meteorological and hydrological professionals;
- The WMO regulatory material concerning competencies and qualifications of meteorological, climatological and hydrological personnel should be regularly reviewed and updated;
- The WMO technical commissions should be requested to consider how to assist service providers in streamlining the workload associated with setting up and maintaining competency systems and assessment tools.

RTC Directors' meeting recommendations

- The resource material on management development training being prepared by the WMO ETR Office should be published as a WMO information note and shared with RTCs and other training institutions as soon as possible;
- When the Basic Instruction Package for Meteorologists (BIP-M) and Basic Instruction Package for Meteorological Technicians (BIP-MT) are reviewed, learning outcomes related to management development should be included;
- RTCs should align their programmes to support the WMO competency and qualification frameworks;
- RTCs should provide participants with documentation showing what sections of the various competency frameworks were addressed in the training intervention;
- RTCs to consider running management development courses;
- RTCs should consider the rapid changes in technology and user-orientated services whilst developing and revising their education and training programmes.

2.3 Support for enhancing learning institutions

WMO and its Members typically use a national and regional approach to meet education and training challenges in the NMHSs. This approach takes into account the capacity of each country's education and training institutions, including the NMHS, as well as the designated WMO Regional Training Centre. WMO currently recognizes 27 of its Member States and Territories as operating a WMO Regional Training Centre, which may be composed of one or more institutions. Regional Training Centres may include components such as universities, technical colleges, research institutions and NMHS training institutions.

The WMO Regional Training Centre concept was originally developed in the 1960s when many countries were gaining political independence, and funding for capacity building was readily available from international aid sources. The establishment of Regional Training Centres benefited the students who attended the long-term education programmes and short-term training courses that were offered, and raised student numbers for the host countries, thus increasing the viability of component institutions. In most cases, but not all, funding for international students attending the WMO Regional Training Centres was provided by a third party such as the United Nations Development Programme (UNDP) or another development partner.

In the late 1990s, UNDP funds for the education and training of personnel involved in meteorology and hydrology were in steep decline, reducing the number of students able to attend courses in foreign countries. This had a double impact: (a) the NMHSs of those WMO Members that relied on UNDP funds to train their staff were restricted in their access to education and training opportunities at a time when the demand for education and training was changing, and (b) the institutions, particularly the RTC components serving international students, had fewer students, making it much more difficult for them to make a case for increased funding for technology, infrastructure and upskilling of their training staff in order to deal with the emerging global education and training demands.

SYMET-13 observations

- Cooperation provides a solid foundation for: increased sharing of resources and approaches; collaboration in offering learning opportunities; developing model or common accreditation, certification, evaluation and assessment systems and their underlying quality control procedures; and developing shared tools;
- The feasibility study activities in the WMO Global Campus demonstration show good progress.

SYMET-13 recommendations

The resourcing for infrastructure and personnel of the national and regional educational and training institutions needs to be increased.

RTC Directors' meeting recommendations

- The RTCs should prepare a regularly updated list of national and regional institutional specialties in all WMO priority areas;
- It is strongly recommended that RTCs and other training institutions share resources and strive to develop relationships to advance training and capacity development;
- RTCs should follow the rapid evolution in technology and changes in services;
- RTCs should collect research results of cooperating institutions and make them available to their students and other RTCs;
- RTCs should encourage research institutions to assist in developing new services and products;
- RTCs should share their documents and information with the ETR Office for dissemination.

Additional recommendations arising from the breakout groups

Training providers should share experience and tools to measure and report the benefits of training interventions to demonstrate the added value to NMHSs.

As governments, businesses and the general public have become more aware of the usefulness and applicability of weather, water and climate services to their core activities, more education and training institutions have developed or adopted programmes and courses to meet the needs of the new users of these services. These "new" institutions have the potential to supplement and complement courses and programmes offered by the traditional WMO education and training partners if appropriate partnering mechanisms can be identified.

3. ADDRESSING CHALLENGES THROUGH INCREASED COLLABORATION AND COOPERATION

One of the strengths of WMO as an international organization is the willingness of its Members to collaborate in the development of new regulations, processes and procedures for the benefit of the global community; to openly share information and resources; and, within national and organizational constraints, to provide support to NMHSs and their associated institutions from least developed and developing countries.

This willingness also extends to the area of education and training, where cooperation among universities, NMHS training centres, WMO Regional Training Centres and international education and training partners has led to sharing of teaching and learning resources and approaches; collaboration in the development and delivery of education and training opportunities; discussion on model or common courses and accreditation, certification, evaluation and assessment systems and their underlying quality control procedures; and shared tools and platforms for developing, delivering, monitoring and reporting on education and training activities.

To capture the WMO Education and Training community's interest in collaboration and sharing and to provide a framework to start addressing the current and emerging unmet education and training demand, the concept of a WMO Global Campus was launched at the Twelfth WMO Symposium on Education and Training in 2013.

The WMO Global Campus concept essentially represents a change of mindset. It encourages individuals and institutions to move away from considering only what they can develop or deliver themselves to meet their immediate requirements to how they can benefit from or contribute to the wider WMO ETR community. By sharing information and resources and collaborating to meet the emerging ETR requirements, it should be possible to increase capacity in all institutions, particularly those in developing and least developed countries and small island developing States.

The desire to collaborate and share is the first step towards changing the mindset in the community. By following the general WMO principles of partnership and resource mobilization, the community could take the second step of working together to deal with requirements that they cannot address individually. In the previous section a range of agreed WMO activities were highlighted that all WMO Members are expected to implement. Rather than each Member developing its own education and training material and courses from the existing regulatory material, the WMO Global Campus concept envisages groups of training institutions working together with expert advice from the appropriate WMO technical commission teams to develop and deliver common resources and courses ready for translation into other languages. Such collaborative activities have occurred previously, but the idea of the WMO Global Campus is to more systematically encourage multilateral collaboration and, by providing a framework and encouraging institutions to work together, enable them to consider bidding for funding from development partners as part of larger projects.

Recalling that it will be the institutions of Members that will provide the education and training opportunities, the existing governance mechanisms (Congress, the Executive Council and the Executive Council Panel of Experts on Education and Training) for the WMO Education and Training Programme will also be responsible for WMO Global Campus activities. As the WMO Global Campus concept matures, it may be necessary for these governance mechanisms to develop additional guidelines and recommendations for how groups can work together.

SYMET-13 observations

The feasibility activities in the WMO Global Campus demonstration show good progress.

SYMET-13 recommendations

- The WMO Global Campus concept should be further developed by the WMO Education and Training community for operational implementation during the 2020–2023 financial period;
- The WMO Secretariat should play an active role in supporting the development and ongoing activities of the WMO Global Campus concept.

RTC Directors' meeting recommendations

Operationalization of the WMO Global Campus should be fast tracked and WMO should consider seeking regional consultation on its development.

Additional recommendations arising from the breakout groups

- The WMO Global Campus should include methods for sharing training and content expertise among training providers;
- The WMO Global Campus should include mechanisms for shared platforms and learning technologies that all providers could use in training, and should facilitate the sharing of resources.

4. SUMMARY OF SYMET-13 BREAKOUT GROUP DISCUSSIONS

During the Symposium more than 25 presentations including three key note papers were considered in plenary and poster sessions. Four breakout sessions were scheduled around language groupings to enable discussion without interpretation services. The breakout groups met during the session to ensure that participants had the opportunity to debate and discuss the content of the papers and to identify missing elements or suggest possible actions to address issues raised in the papers. The content for the conference statement was developed from these discussions and the papers presented.

The main thrusts of the breakout discussions have been combined and are summarized below. They were wide-ranging, touching upon most, if not all, aspects of the WMO Education and Training Programme. This section ends with a text box showing how the breakout group discussions were captured at a very high level.

Increasing the visibility of education and training institutions. It was noted that the institutions making up the WMO Education and Training community were quite heterogeneous, ranging from major universities to training centres created by multiple countries, to NMHS training centres and non-profit organizations supporting atmospheric and environmental training. Some institutions are able to promote themselves and their graduates, as well as bid for development projects and grants. But this is not the norm. In many cases the training institutions are not promoted or encouraged to seek outside funding by their parent organizations due to organization or government policy. This lack of visibility makes it hard to attract or seek additional funding for fellowships and infrastructure improvement, support and even students.

The SYMET-13 participants noted the importance of the Permanent Representatives, the WMO Regional Associations and the WMO Secretariat in encouraging the institutions making up the WMO Education and Training community to engage with the broader educational and development communities nationally, regionally and globally.

The SYMET-13 participants noted that through approaches such as the WMO Global Campus it may be possible for groups of institutions working together to bid for training components of development grants related to meteorology, climatology and hydrology. Such grants could provide funding for additional fellowships as well as strengthening training centres so that they could better promote themselves whilst still meeting organization or government requirements.

A number of the breakout groups stressed the need to further investigate provision of services to the private sector meteorological community and the benefits of employing graduates from the WMO training programmes. The breakout groups recognized that institutional and government rules and regulations could create difficulties in this area, particularly with regard to cost recovery or charging the private sector or other government institutions for services.

Competency-based training. The SYMET-13 participants requested further information and support for the implementation of competency-based learning. Requests included the creation of more competency frameworks, with frameworks for management and user communication and liaison; common assessment systems, ensuring that existing and new frameworks were regularly reviewed and updated; a help desk for questions on competency-based training and even regionally-specific competency frameworks. The participants also requested that the WMO ETR Office ensure strong liaison and communication with the WMO Secretariat technical departments and through them with the WMO technical commissions. Participants noted the importance of ensuring that the publications produced by the technical commissions, including recommendations on implementation as well as reference material, be published in multiple languages, and that copies be made available to all institutions in the WMO Education and Training community.

Improving training skills and increasing the number of trainers. The SYMET-13 participants raised the issue of insufficient or no full-time trainers in' their organizations. In many cases this was being addressed by the use of domain experts who sometimes have little or no training experience or awareness. The SYMET participants noted that recent WMO online courses for trainers included a learning pathway for such experts and requested that this learning pathway be continued in future courses. Participants further suggested that the circular letter advertising the course request the Permanent Representatives to encourage their domain experts to undertake at least this part of the online train-the-trainer course. Similarly, there were calls for trainers, particularly from the Regional Training Centres, to have priority for places on technical training courses to ensure that they continued to have current skills and knowledge in the domain areas they covered in their training courses. Some of the breakout groups requested that the WMOLearn website include information regarding individuals or institutions that would be willing to provide training outside of their own institutes.

Improving training quality and training methodology. During the breakout discussions, SYMET-13 participants reiterated the importance of the Education and Training community continuing to follow professional practices when developing and delivering training interventions. The competency framework for the training function was deemed very useful, but to get full value all steps needed to be considered and followed. The first competency statement, which addresses analysis of the organizational context, underscored the value of training in supporting organizational change. The breakout groups identified that a training intervention could actually create subsequent changes in organizational culture and practice leading to even further training requirements. SYMET-13 participants encouraged all training centres to either undertake their own organizational training needs analysis or to work with their human resources departments to have one completed that included impact of retirements on the NMHS workforce in the coming years.

The SYMET-13 participants noted the need for common platforms and tools to support partnership activities such as coordination and sharing of resources and delivery of training activities. For the smaller training centres, the introduction of shared platforms was extremely important as many of them would not be able to access these technologies (simulators, Massive Open Online Courses (MOOCs), mobile platforms, learning management systems, conferencing and video systems) or develop skills in using them independently. The SYMET-13 breakout groups called upon the WMO Secretariat to actively support the development and operationalization of the WMO Global Campus as it provides a cohesive framework for such activities and platforms. The use of common platforms would further encourage the sharing and reuse of educational and learning material as well as training development planning and curricula.

Regulatory and guidance material. As with competency-based training, the breakout groups identified the need to keep the regulatory material (Basic Instruction Packages) under review and to update the Guides accordingly. Some of the breakout groups suggested developing additional

guidance on learning pathways for staff as they progressed through their careers and for experts in other domains who need to access and use meteorological products and data. They also suggested developing material on introducing meteorology to primary and secondary school students. Recalling the future service delivery challenges and the changes that some of the NMHSs were already making to their training programmes to ensure that their staff could carry out new roles, SYMET-13 participants requested these changes be considered for inclusion in the BIP-M and BIP-MT, but not as mandatory requirements in the first instance until the majority of the NMHSs had moved or were moving to the new service delivery modes.

Demonstrating the value of training and training institutions. A number of the breakout groups commented on the need for sharing experience and tools within the community for measuring the benefit of training interventions. As government funding is becoming harder to obtain, it is becoming increasingly important for training institutions and their parent organizations to be able to demonstrate that they are adding value to the NMHSs.

Certification. The concept of digital badging was raised as an option for providing a global framework for certification of training courses that were not part of academic study. Digital badges can cover face-to-face courses as well as online training courses and would allow individuals to demonstrate that they have mastered, for example, some or all of the knowledge components of competency frameworks in a structured manner. Where an organization does not have its own training institution covering all of the expressed training requirements, this could be useful for documenting and monitoring the compliance of staff with national and international regulations.

Partnerships. Partnerships were seen as important for meeting the current demands through sharing of existing resources as well as providing a pathway to at least partially address future demands by working together to develop or deliver new material or creating groupings to bid for specific development projects. Partnerships for the development and sharing of existing resources, in multiple languages and using a variety of delivery methods, on common needs such as those covered in the Basic Instruction Package for Meteorologists were seen as a top priority.

The SYMET-13 participants noted that the WMO Global Campus concept was predicated on the development of partnerships within the existing Education and Training community as well as providing a mechanism to encourage new organizations, including the private sector, to contribute to strengthened capabilities for development activities. By encouraging institutions to work together, through suitable bilateral or other partnership agreements, new funding opportunities would be opened up. By sharing expertise and resources, weaknesses would also be mitigated.

The SYMET-13 participants further noted that the active use of partnerships, particularly combined with mechanisms such as the WMOLearn event calendar and proposed catalogue on the WMOLearn website, should ensure a much higher level of coordination and collaboration between training providers. The use of partnerships to minimize undue competition between providers was seen as critical for the overall health of the Education and Training community, particularly by ensuring that education and training opportunities would be available locally and in the local language.

The text in the box below captures the main points of the breakout group discussions summarized in the conference statement.

The SYMET-13 participants:

- Called for support and action to develop and deliver improved services to Members through the provision of adequate facilities and resources for education and training in weather-, water- and climate-related fields;
- Called upon the World Meteorological Organization, international development partners, authorities of countries and territories and other stakeholders to take into account the recommendations arising from this Symposium in their socioeconomic development endeavours;
- Recalled their critical role in following the recommendations as well as influencing their institutional, national and regional authorities to implement the recommendations from this Symposium;
- Requested the World Meteorological Organization to publish the outcomes of this meeting to enable widespread reference to, and use of, the key issues and recommendations from the Symposium;
- Noted the potential of the publication of the Symposium outcomes in promoting and setting the agenda for meteorological, climatological and hydrological education and training for the next decade.

5. THE WAY AHEAD

The Thirteenth WMO Symposium on Education and Training was attended by 81 participants from 33 WMO Member States and Territories. Such diversity of participants provided many perspectives from which to examine the challenges and opportunities for the WMO Education and Training Programme over the next five to ten years.

The key objectives for SYMET-13 were to enhance community awareness and knowledge of service-specific education and training needs, to identify opportunities to enhance education and training capacity, and to increase awareness of how to develop partnership and resource mobilization opportunities. The resulting recommendations demonstrate that these objectives were well met. However, much work remains to be done. During the breakout groups, participants expressed the value of the rare opportunity this Symposium provided to bring together senior members of the Education and Training community to address its challenges. Yet this rare opportunity can be built upon to achieve more.

Whilst the challenges ahead are many, the WMO Education and Training community is deeply committed to working more closely together, both as a network of RTCs and also under the WMO Global Campus initiative. The Symposium is evidence that by expanding the community further we strengthen our understanding and therefore the potential of our proposed solutions.

Having used SYMET-13 to identify a range of challenges and opportunities and having offered some initial ideas on how to address them, it is up to participants to ensure that the next steps forward build further momentum. This will require action at various levels: individual, training team, NMHS, WMO Secretariat, Regional Association, Executive Council and Congress. All of these actions, however, will commence with SYMET participants reviewing the papers, discussions and outcomes of the meeting, such as this publication, in light of their institutional and national situations. The recommendations documented here are substantial, but we need to recognize that SYMET took place over only four days, and that much more can be learned about the challenges we face and the potential solutions that can be brought to bear. Recommended actions will evolve and increase as they receive institutional and regional scrutiny.

Participants are expected to use their knowledge and influence within their training institutions and parent organizations to present the issues discussed in Barbados and their suggestions for addressing national challenges, but also to call for action by Regional Associations and other formal WMO bodies. The scope of the challenges suggests that each of us must play a role in meeting them by sharing or reusing learning resources and expertise, promoting the value of individual training organizations and the global training community, and contributing to the national, regional and global discussions and debate on how to fund and address the challenges.

Critically important to the success of SYMET is continuing to work as a collaborative, global community to address these challenges. In many cases this will begin by working together at the regional level. The WMO Education and Training Office is also expected to play a key role, in collaboration with its many partners, in providing tools through which the community can continue to communicate and collaborate, as well as providing an authoritative source of resources and information.

The final outcomes of SYMET-13, which will be revealed only over the next four years, depend upon the actions that each and every participant takes in their home institutions. Individuals must accept the responsibility to push for changes or the challenges will continue to grow unabated and will lessen the ability of the ETR community to support NMHSs in expanding their roles and contributing to the safety and well-being of their countries.

APPENDIX A: STATEMENT OF THE THIRTEENTH WORLD METEOROLOGICAL ORGANIZATION SYMPOSIUM ON EDUCATION AND TRAINING

The participants in the Thirteenth World Meteorological Organization (WMO) Symposium on Education and Training (SYMET-13), held in Needham's Point, Bridgetown, Barbados, from 30 October to 1 November 2017,

Deliberating on Education and Training for Human Resources Development in Meteorological and Hydrological Services,

Noting the various international and national initiatives and commitments to address global issues related to natural disasters, environmental degradation, the Paris Agreement, the 2030 Agenda for Sustainable Development, the Small Island Developing States (SIDS) Accelerated Modalities of Action (SAMOA) Pathway and the Sendai Framework for Disaster Risk Reduction,

Noting further the major initiatives and issues that are driving change within the WMO community as well as the initiatives and issues that are driving change within the wider education and training sector of the global economy,

Recalling the agreed key thematic areas requiring further development to enable the WMO Education and Training community to address the increasing education and training requirements,

Made the following key observations and conclusions:

- The 2017 WMO Education and Training survey of the human resources requirements of NMHSs reveals a growing deficit in the capability and numbers of adequately educated and trained staff for meteorological, climatological and hydrological services in many countries and territories;

- Rapid advances in scientific innovation and technological developments require corresponding update training of NMHS personnel;

- The research capability of the current and future generations needs to be developed as a critical part of a robust training programme;

- NMHSs should provide the range of services needed to attain sustainable development and disaster risk reduction goals; increased funding is required to support the initial and ongoing education and training of NMHS personnel;

- Governments, as well as national and international stakeholders, need to be made more aware of the importance of increasing support for formal education and continuous professional development of meteorologists and hydrologists;

- The evolving requirements of users and increasing regulation and resource accountability by national governments and development partners require managers in NMHSs to possess greater planning, communication, legal, advocacy, financial and personnel management skills;

- The development of the WMO competency and qualification frameworks, particularly those related to the provision of aeronautical meteorological services, and their inclusion in the WMO Technical Regulations have raised the importance of, and support for, education and training within the NMHSs;

- NMHS personnel and the broader user community across the globe are increasingly accessing meteorological products, data and education and training opportunities via the

Internet. Whilst some countries are still experiencing limited bandwidth and access, the situation is improving and the WMO Education and Training community is continuing to improve its online as well as classroom courses and delivery;

- As the WMO Education and Training community works with students from many countries, language, gender and cultural awareness need to be addressed across all activities;

- Cooperation among universities, NMHS training centres, WMO Regional Training Centres and international education and training partners provides a solid foundation for: increased sharing of teaching and learning resources and approaches; collaboration on development and delivery of education and training opportunities; developing model or common accreditation, certification, evaluation and assessment systems and their underlying quality control procedures; and shared tools and platforms for developing, delivering, monitoring and reporting on education and training activities;

- The feasibility activities in the WMO Global Campus demonstration show good progress;

Made the following recommendations:

- The resourcing for infrastructure and personnel of the national and regional educational and training institutions should be increased to meet the growing demands for meteorological, climatological and hydrological education and training across all societal sectors;

- Management, leadership, communication and advocacy skills should be introduced into initial and continuous professional development programmes for meteorological and hydrological professionals;

- National and international foundations and projects should be encouraged to pay more attention to meteorological, climatological and hydrological research, education and training, relevant to all potential audiences, to respond to challenging environmental problems;

- The WMO regulatory material concerning competencies and setting of standards for initial education and training of meteorological, climatological and hydrological personnel should be regularly reviewed and updated in light of the evolving service requirements;

- The WMO technical commissions should be requested to consider how to assist service providers in streamlining the workload associated with setting up and maintaining competency systems and assessment tools;

- The WMO Global Campus concept should be further developed by the WMO Education and Training community for operational implementation in the 2020–2023 financial period;

- The WMO Secretariat should be requested to play an active role in supporting the development and ongoing activities of the WMO Global Campus concept.

The SYMET-13 participants called for action at national, regional and global levels to support WMO and National Meteorological and Hydrological Services in development and delivery of improved services to Members through the provision of adequate facilities and resources for education and training in weather, water and climate related fields.

The SYMET-13 participants called on WMO, international development partners, authorities of countries and territories, and other stakeholders, to take into account the recommendations arising from this Symposium in their ongoing and future socioeconomic endeavours.

The SYMET-13 participants recalled their critical role in following the recommendations as well as influencing their institutional, national and regional authorities to implement the recommendations from this Symposium.

The SYMET-13 participants requested WMO to publish the outcomes of this meeting to enable widespread reference to, and use of, the key issues and recommendations from the Symposium. The SYMET-13 participants noted the potential of the publication of the Symposium outcomes in promoting and setting the agenda for meteorological, climatological and hydrological education and training for the next decade.

The participants expressed their appreciation to the Government of Barbados for hosting the Symposium, to WMO for promoting the event, to the Caribbean Meteorological Organization and the Caribbean Institute for Meteorology and Hydrology for organizing it, and to the United States National Oceanic and Atmospheric Administration (NOAA) National Weather Service for providing the resources that made it possible.

Bridgetown, Barbados, 1 November 2017.

APPENDIX B: MEMBERS OF THE INTERNATIONAL ADVISORY COMMITTEE, SESSION CHAIRPERSONS AND RAPPORTEURS OF THE THIRTEENTH WORLD METEOROLOGICAL ORGANIZATION SYMPOSIUM ON EDUCATION AND TRAINING

International Advisory Committee (IAC)

Mr Robert Riddaway (Convenor and Co-Chairperson), United Kingdom

Dr David A. Farrell (Co-Chairperson), Barbados

Ms Stella Aura, Kenya

Ms Claudia Campetella, Argentina

Dr Richard Jeffries (invited member of the co-sponsoring country), United States

Dr Winifred Jordaan, South Africa

Ms Jennifer Milton, Canada

Ms Heleen ter Pelkwijk, Netherlands

Mr Christopher Webster, New Zealand

Session chairpersons and rapporteurs

Session rapporteurs:

Theme 1: Service-specific education and training needs

Chairperson: Dr Gao Xuehao, China

Rapporteur: Ms Winifred Jordaan, South Africa

Presenter: Dr Patrick Parrish, WMO, and Ms Heleen ter Pelkwijk, Netherlands

Theme 2: Increasing education and training capacity for WMO Members

Chairperson: Dr Anna Timofeeva, Russian Federation

Rapporteur: Dr Moira Doyle, Argentina

Presenter: Dr Liz Page, United States

Theme 3: Partnership and resource mobilization

Chairperson: Dr David Babb, United States

Rapporteur: Mr Didier Reboux, France

Presenter: Ms Michelle Hardy, Canada, and Dr Mark Higgins, Germany

Small group rapporteurs

Ms Stella Aura, Kenya

Ms Marina Baldi, Italy

Dr Andrew Charlton-Perez, United Kingdom

Ms Marinés Campos, Argentina

Ms Cynthia Celebre, Philippines

Mr Alessandro Chiariello, Finland

Mr Elhosary Ali Mahmoud Ali, Egypt

Ms Michelle Hardy, Canada

Dr Herizal, Indonesia

Dr Mark Higgins, Germany

Mr Diakaria Kone, Niger

Mr N. Kanchibhatla Mohan, India

Dr Elizabeth Mulvihill Page, United States

Mr John Ogren, United States

Dr Alfred Opere, Kenya

Mr Didier Reboux, France

Dr Jesús Riesco, Spain

Ms Suchun Wang, China

Ms Heleen ter Pelkwijk, Netherlands

Dr Anna Timofeeva, Russian Federation

Ms Sally Wolkowski, United Kingdom

For more information, please contact:

World Meteorological Organization

7 bis, avenue de la Paix – P.O. Box 2300 – CH 1211 Geneva 2 – Switzerland

Communication and Public Affairs Office

Tel.: +41 (0) 22 730 83 14/15 – Fax: +41 (0) 22 730 80 27

Email: cpa@wmo.int

public.wmo.int

JN 18628