

Education and Training in a Period of Rapid Change:
Highlights of the Fourteenth Symposium on Education and
Training (SYMET-14)

2021

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Editorial Note and Copyright information

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Foreword

I am very pleased to provide the Foreword to this publication documenting the outcomes and recommendations of the Fourteenth World Meteorological Organization (WMO) Symposium on Education and Training (SYMET-14), Education and Training in a Period of Rapid Change. Four years ago, WMO-No. xxxx, An International Agenda for Education and Training in Meteorology and Hydrology was published following the outcomes SYMET-13. That publication documented the many challenges and opportunities facing the WMO Education and Training Programme, including the large number of growing learning needs in new disciplinary and service delivery areas, as well as needs to support and enhance learning institutions to address them.

It is now four years later, and while significant progress has been made, challenges and opportunities have multiplied, and their pace has accelerated. There has never been a more exciting or challenging time for the weather, water and climate communities. Climate change demands new actions and approaches, and improved technologies and systems are allowing National Meteorological and Hydrological Services (NMHSs) to work more closely with their constituencies to offer impacts-based services that directly communicate the likelihood of outcomes of the weather and climate phenomena. The observations and data communities are making great strides in developing a global network that meets new expectations. Interdisciplinary approaches are required, and these are indeed successfully being developed and leading to new answers to the questions of scientific research and needs for operations.

Ultimately, these many changes require both expanded and new approaches to offering learning opportunities, and the inputs and outputs of SYMET-14 demonstrate that the WMO Education and Training Programme (ETRP) is rising to challenges with innovations that will meet the growing needs despite times of financial constraints. The COVID-19 pandemic further challenged WMO Members, but the community has responded with many successes, at least partly due to the willingness to come together in many venues, like SYMET, to share strategies and resources. Served by a network of WMO Regional Training Centers, national centers and many universities that meet the needs of WMO Members, the ETRP community is diverse, highly skilled and extremely dedicated. Each of these providers was well represented well at SYMET-14.

The resulting recommendations contained in the Symposium Statement should inspire effective continued and new actions through the rest of the current decade and beyond. I was pleased to read recommendations directed to policy makers and governments, to the WMO and other international organizations, and to the education and training community as a whole, as well as general recommendations that express the urgency of propagating these results to further develop capacity into the future.

This publication will be of great interest to the WMO community to demonstrate the many potential pathways to meeting learning needs for the ever-evolving services we provide to society.

(Petteri Taalas)
Secretary-General

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Members of the International Advisory Committee (IAC), including Co-Chairs Prof. Andrew Charlton-Perez and Dr. Anna Timofeeva, offered substantial inputs to the organization and implementation of SYMET-14 by acting as reviewers, Chairs and Rapporteurs, and therefore contributed in many ways to the contents of this publication. The full list of members of IAC members is provided in Appendix C.

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Introduction

Background to SYMET-14

The Fourteenth World Meteorological Organization Symposium on Education and Training (SYMET-14) was held in virtual format, for the first time, due to COVID 19 travel restrictions for many of the targeted participants. The organization of SYMET-14 was an important component of the WMO ETR Office contribution to the WMO Strategic Operating Plan.

The Symposium was attended by 280 registered participants from 65 WMO Members, representing developed, developing and least developed countries, all WMO languages, with a gender ratio of 53% female and 47% male. Participants actively engaged in the presentations and discussions, and over the four days developed conclusions and recommendations which are included in the symposium statement and detailed further in this publication. Plenary Sessions saw over 160 attendees at many times during the four-day event. The opening ceremony was addressed by the Secretary-General of WMO, Professor Petteri Taalas; Dr. Agnes Kijazi, Third Vice-President of WMO, Chair of the WMO EC Capacity Development Panel; and the Director of the WMO Education and Training (ETR) Office, Dr Yinka Adebayo. It also including welcoming comments from the opening day Chair, Prof Andrew Charlton-Perez.

In his welcoming remarks, Professor Taalas emphasized the many changes that have been occurring within the WMO, including significant governance reforms, with structural changes driven by a focus on WMO's new Earth systems approach, rather than a collection of separate disciplines. While elaborating on the many new and developing WMO initiatives, including standards for a global basic observing system network (GBON), a new data policy, and the SOFF initiative to support investment in these, as well as the growing data storage needs for the increased observations data. He highlighted the need to involve the private sector among WMO's partners, noting the need for NMHS and academic partnerships as well. He noted many capacity development projects in which WMO is involved to improve early warning systems and climate services, as well as management training and advocacy support for NMHSs. He spoke on the important movements toward impact-based forecasting and multi-hazard early warning systems, including a joint centre on climate and DRR in partnership with UNDRR. Climate change and the need for improved climate forecasting and adaptation are additional critical drivers of change, and the Secretary-General highlighted the importance of human resources capacity development for all actors in roles necessary to make these initiatives possible, and for delivering quality services in keeping with these innovations. (See sections 1.1 and 1.2 for additional details.)

Professor Taalas thanked Members who offer education opportunities to those in need. He stressed the importance of SYMET as a coordination opportunity for WMO education and training providers. He also noted the need to adopt new, efficient delivery modes to meet the growing requirements for education and training. Finally, he thanked Dr. Louis Uccellini for his many years of service to the WMO community, and for agreeing to offer a Keynote Address for SYMET-14.

In her welcome, Dr Kijazi focused on the important roles of the new Executive Council Capacity Development Panel (CDP), which were further elaborated during the week. She

noted that SYMET-14 offered tremendous support for meeting the goals of the CDP, and that she looked forward to the SYMET-14 Statement as input to the Panel's work. She also noted the importance of the Meeting of Directors of WMO Regional Training Centers, which immediately followed SYMET-14.

In closing the welcome comments, Co-Chair, Prof. Charlton-Perez noted that the rapid changes we have been recently experiencing have both presented significant challenges and inspired us to achieve new innovations that present new opportunities.

The WMO education and training community, including regional centers, national training centers and universities, is tasked with improving the knowledge, skills and working methods of NMHS personnel to improve services globally. WMO Members have agreed to the courses of action to take, as elaborated in the WMO Strategic Plan. The aim of SYMET is to assist this community in working together to identify and address the challenges they currently face and will face in the coming years in implementing this plan.

[The importance of the SYMET-14 theme: Education and training in a period of rapid change](#)

In 1970, a best-selling book titled, *Future Shock* (Toffler, 1970), discussed the impacts of rapid socio-economic change on individuals, created by what it described as a transition to a post-industrial society. It noted that the accelerating rate of change at the time was causing feelings of disconnection and potentially extreme stress and disorientation. One of the features described of the new society was labeled "Death of Permanence," the title of Part One of his work. Note that the date of publication was approximately 15 years before the first commercially viable personal computers, and 23 years before the first internet web browser, yet the challenges of rapid change were already being recognized.

The extent of rapid change at the present time, however, is unprecedented. We live in a time that has been described as "liquid life," in which change occurs more rapidly than new habits can be formed, and old habits can be abandoned (Bauman, 2005). The outcome includes negative impacts, like those proposed by Toffler (1970), for many people. To avoid these disorienting impacts, liquid life calls for new responses to change and overcoming the desire for a high level of stability.

Due to recognized difficulties of change in organizations, change management processes became popular in the 1960's to help organizations and institutions introduce changes. The [ADKAR model of change management](#) has proved one popular approach, but many others exist. However, today many people feel that the concept of change management itself is a victim of change, and that instead we need to embrace change as a persistent quality of life and must learn to live and operate within continuous change without distress (Worley and Mohrman, 2014).

Change management is a concept based on the desire to return to equilibrium after major adjustments to an organization, for whatever reasons they are imposed. But if indeed we have entered a time of liquid life, as Bauman (2005) proposes, there is no equilibrium to return to. We need to learn how to function in disequilibrium. One clear answer is to better prepare people to be lifelong learners by offering them the skills to be solvers of complex problems (those with no clear right and wrong answers) and good seekers and critical users of information.

The nature of the rapid changes that WMO Members face arise from both positive and negative influences. The examples summarized below were treated in more depth during the

four Keynote Presentations offered during SYMET-14. See sections 1.6-1.9 for summaries of these in the context of recent WMO Executive Council and Congress decisions.

Some changes in operational and research-based Earth systems sciences reflect positive evolution in the related fields:

- Improved and standardized observations networks, especially through remote sensing, but also through more dense automated surface observations and innovative sources of data
- Improved Numerical Weather Prediction models and methods that increase forecast accuracy at increasing short ranges, as well as at seasonal ranges and in longer term projections
- Increased understanding of Earth system science principles due to advances in research
- Automation and artificial intelligence in forecast processes that allows increased time for NMHSs to communicate with customers and to customize products for specific customer sectors
- New service delivery areas introduced or greatly expanded and improved, such as climate services and sector-specific services
- Improved communication mechanisms for interacting with customers, including social networking and mobile devices
- Improvements in operational strategies and increased cooperation with emergency response agencies before and during disasters that reduce loss of life relative to similar past events
- Promotion of systems approaches to earth sciences in recognition of the high degree of interaction between traditionally distinct disciplines

Other changes in the Earth system science disciplines result from negative influences:

- Global warming that increases the likelihood of extreme weather and climate events
- Increased climate variability that makes traditional climatological expectations unreliable
- Potentially increasing disruptions to societies and international relations due to competition for resources and societal differences
- Continued or increased disparity in socio-economic and technological development status of WMO Members
- Unexpected impacts emerging from globalization, such as the health threats of the ongoing COVID pandemic that began in early 2020

Whether they originate from positive or negative sources of evolution, these changes create universal challenges in meeting societal expectations. The challenges of responding to change can be both cultural and practical.

While some people and cultures confront change more positively, many emphasize change as a threat to highly valued predictability. Some accept, or even embrace change and uncertainty, while others feel discomfort and avoid the uncertainty brought about by change. This dual response is both a cultural difference and an individual one (Hofstede & Hofstede,

2005). It reflects deeply rooted differences in our natures, differences which themselves create conflict due to potential misunderstanding and misinterpretation.

However, regardless of orientation, rapid change requires significant effort. Practical challenges to change include the need to invest in new resources, both technological and human, as well as the need for reorganization and process adaptations. New technological systems may be required, new expertise must be developed, and new organizational structures might need to be considered.

Why rapid change is particularly challenging for education and training institutions

Education and training institutions must be responsive to the changing needs of society. Yet this is not easy to accomplish when those needs are a rapidly moving target. Curricula revisions require careful attention, and usually place learning demands on those who will teach. They also require review cycles. However, these requirements are common to many design processes, and methods of rapid prototyping are now being applied in the design disciplines to help address the need for moving more quickly from conception, through design, to implementation to meet customer expectations. See [ETR-No. 27 WMO Global Campus Education and Training Innovations](#) for more description of rapid prototyping processes. To cope with curriculum revision challenges, some institutions have begun offering micro-degrees to help meet the need for continuing education in new specializations, which may lead to larger curriculum changes. Others are offering interdisciplinary degrees that draw from a blend of existing curricula.

Teaching, or knowledge construction in general, is inherently a cultural activity. Teaching is deeply embedded within its cultural context or contexts. Cultures arise from the shared values of a group of people who have geographical, race, goal-oriented or other interpersonal commonalities. In other words, those who share a discipline also share a disciplinary culture. Because of this, the act of teaching is also the act of propagating a culture or cultures (Parrish & Linder-VanBerschot, 2010). Education and training institutions can be particularly resistant to change—resistance from students, educators, and administrators alike—because cultural values are deeply held.

The changes to education and training are impacting not only what is taught, but who is qualified to teach it, methods for teaching, and how teachers themselves need to prepare to teach. The impact is multiplied in an international, multicultural context which has inherent potential for inequities in preparation of learners and facilities for teaching. The shift to interdisciplinary learning may also create cross-cultural communication and participation challenges, as well.

Many of the changes occurring to WMO Members are on the scale of paradigm shifts, requiring deeply rooted habits to be discarded. This means that learning needs to occur not just in specific knowledge, but also in our understanding of the systems in which we are operating and learning. In addition, the systems themselves are undergoing changes to meet the demands of these changes, which Gregory Bateson (1972), an early systems theorist, refers to as Third-Level Learning, the highest form of learning that people and their social systems can undergo.

1. Challenges for the Delivery of Education and Training Activities

1.1 Demands for new knowledge and skills created by evolving roles of NMHSs and related operational services

1.1.1 Instruments and Observations

In recent years, WMO has introduced several programmes and initiatives that reflect the evolution of technologies and scientific advances and will revolutionize the operational work of NMHSs. These will require significant training to be fully and globally operationalized. A number of these are highlighted below.

Improved instruments and metadata standards for observations networks require technical staff to modify their working methods. The WIGOS Metadata standard (Resolution 9, EC-73) entered its operational phase in 2020, requiring international compliance to better integrate all meteorological and climatological data. WIGOS includes the Global Observing System (GOS), the observing component of Global Atmospheric Watch (GAW), WMO Hydrological Observations (including WHYCOS), Observing component of Global Cryosphere Watch (GCW), and the co-sponsored Global Climate Observing System (GCOS). Newer supporting initiatives include the WMO Unified Policy for the International Exchange of Earth System Data Resolution 1 (Cg-Ext, 2021) and establishment of the Global Basic Observing Network (GBON) Resolution 2 (Cg-Ext, 2021), which will help to support the implementation and sustainability of the observing network, especially in developing countries, and particularly for surface-based, upper-air observations and automatic weather stations. In addition, a new WMO Basic Instructional Package for Meteorology Technicians (BIP-MT) will be introduced for approval in the coming year. The [WMO-No. 1209 Compendium of Competency Frameworks](#) includes four recently published competency frameworks on Instrumentation, calibration, meteorological observations, and observing programme and network management, which were approved to be included in the WMO technical regulations in 2018 (Resolution 15, EC-70). These new standards and frameworks are expected to be implemented by education and training institutions as soon as possible.

1.1.2 Multi-hazard Impact-based Forecasts and Warning Services

[WMO-No. 1150](#), WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services (IBFWS), was recently updated with the addition of Part II: Putting Multi-Hazard IBFWS into Practice, which distills and summarises knowledge gained in the implementation of IBFWS globally, providing examples of good practices in IBFWS and illustrating and augmenting existing insights. The IBFWS innovation is perhaps the greatest paradigm shift NMHS have faced in recent years, shifting from being scientific experts who only analyze, forecast and disseminate weather information, to becoming collaborating partners with users to communicate weather impacts to various public and private sectors. This change places a new emphasis on partnerships, communication, including risk and impacts communication, requiring new methods for analysis of potential impacts. While this practice has been in place in some larger NMHS and for specific sectors, such as aviation, previously, some with specialized staff members dedicated to this role, it is now being promoted as the NMHS service delivery model expected of all WMO Members (see [WMO-No. 1129: WMO Strategy on Service Delivery](#)). Additional time for NMHS staff members to assume these new responsibilities may become available due to increased accuracy in NWP forecasts, through improved modeling, increased data sources and data assimilation schemes, which can may mitigate the increased demands. In addition, utilization of the Global Data Processing and Forecast System (GDPFS) of world, regional, and national centres, can support efficient

efforts in developing and communicating accurate, impacts-based forecasts. The recently updated competency requirements for public weather service forecasters and advisers (see [WMO-No. 1209](#)) also highlight impacts-based service delivery in the framework for personnel working in the development and delivery of meteorological and hydrological products and services, and the framework for public weather service advisers supporting disaster prevention and mitigation and other user activities.

1.1.3 Climate Services

The Global Framework for Climate Services implementation plan was established by Resolution 1, Cg-Ext (2012). The GFCS defines the various sectors that need to be addressed by NMHS and other Climate Services entities, such as Regional Climate Centers, including agriculture and food security, disaster risk reduction, energy, health, and water. Finally, in 2018 a WMO Competency Framework for Provision of Climate Services was approved (Resolution 15, EC-70). This establishes job responsibilities, performance criteria, and expected learning outcomes that can guide training initiatives (see [WMO-No. 1209](#)). Climate services, as one of the newest service delivery areas, is perhaps the fastest growth areas for education and training providers. The development of a Basic Instructional Package for Climate Services is currently in development and will further guide capacity development efforts.

1.1.4 Hydrological Services

The WMO Water Declaration and Water and Climate Coalition (Resolution 2, Cg-Ext, 2021) highlights the growing importance of operational hydrology in addressing global water challenges and future opportunities in the broader WMO interdisciplinary context. The Vision and Strategy for Hydrology (Resolution 4, EC-Ext, 2021) calls for increased capacity development in hydrology and water management, the development of observation networks and data sharing consistent with the WMO Unified Policy for the International Exchange of Earth System Data (Resolution 1, Cg-Ext, 2021), and increased use of the Global Hydrometry Support Facility (Hydrohub) to develop low-cost technologies and methods of observation and data processing. It further promotes the development of the Flash Flood Guidance System with global coverage, as well as the more encompassing Flood Forecasting Initiative.

1.1.5 Marine Services

The WMO Marine Services Division is actively promoting training initiatives designed to address the WMO competency requirements framework for Marine Weather Forecasters (see [WMO-No. 1209](#)), and to address the call for increased capacity development to strengthen marine and coastal services (Resolutions 12 and 29, Cg-18). Training was also designed to support implementation of a new Guide (WMO-No. 471) and Manual (WMO-No. 558) for Marine Meteorological Services. A global training initiative to improve marine service delivery is already underway, and new training to address the more technical marine forecasting competencies is required. Competency assessment guidance for Members is likely to be an output of the Standing Committee on Marine Meteorological & Oceanographic Services (SC-MMO), as well as promoting the development of additional competency frameworks. A [poster on the Marine Services Course](#) was contributed to SYMET-14 through its poster session.

The examples above are critical, but just a sample of the service delivery areas in need of capacity development initiatives. This scope can be anticipated by the number of Guides, Manuals, and other publications called for in Resolution 81, Cg-18. Several areas that are new or given new focus include Integrated Urban Services (combining weather, hydrology, and climate), Atmospheric Composition and Air Quality, and Cryosphere Monitoring.

1.1.6 Technological Improvements

While changing roles require new processes, technological changes also impact NMHS and the way staff members carry out their work. New and improved graphical forecast systems are used to display and analyze data products and produce forecast products are one of these. Interpretation of advanced satellite products made available by new instruments on the latest generation of satellites are critical skills, although these satellite data are also critical to improved NWP. Using new Ensemble NWP products is yet another learning challenge. Many WMO Members are upgrading their observing systems and need to develop the skills to interpret the data they provide for local application. Utilizing and contributing to the GDPFS (WMO-No. 485), mentioned above, which will make operationally available products and services to all NMHS that might not have been available otherwise, introducing opportunities for improvements, but also new learning demands. The GDPFS will offer high resolution NWP and other forecast products from World Meteorological Centres and Regional Specialized Meteorological Centres, while national centres might prepare and share forecasts and warnings at all forecasting ranges. The GDPFS also will carry out many coordination mechanisms to improve service delivery globally.

1.2 Technological changes demanded in the delivery of education and training

Decision 2, EC-74, Addressing the challenges related to the COVID-19 pandemic and mitigating its impact, asked Members to pursue a flexible approach to meetings, including physical, hybrid and virtual meetings, aiming to maximize the participation of delegates and experts and to contain the carbon footprint of the Organization. This decision also can apply to learning opportunities, which has led disruption, but also to several positive outcomes. At WMO Regional Training Centers alone, participants served have more than doubled between 2016 and 2020, primarily due to the growth in distance learning delivery, both before and during the pandemic.

Due to the ongoing pandemic and the requirements for increased isolation from public spaces, most educators will immediately think of the need to implement online learning technologies as the primary change in how they provide education and training. But learning technologies have been innovating how classroom teaching takes place as well, not only, but including, the use of blended learning approaches, smart boards, and course management systems.

Course management systems (such as the free Moodle platform), which become the virtual learning environments (VLEs) that serve as the “classrooms” in online learning offerings, are also heavily utilized in traditional classroom delivery modes. They offer user-friendly ways to share resources and links, to submit assignments, to increase interactions with fellow students and teachers through online forums, and to manage assessment processes through the learning data analytics that the systems collect and display automatically for teachers.

Online conferencing systems, which have proved so valuable to organizations to maintain their operations, have been used by virtual teams to enable international collaboration for many years, but they have also been a key technology that enhances online learning beyond the use of asynchronous approaches. Online conferencing allows not only audio and video to enable discussion, information sharing and demonstrations, but also computer screen sharing, text chat discussion, polling and question capabilities, and the potential to record live events for review or for those not attending. Nearly all conferencing systems also allow participants to share gestures to express approval, disapproval, and lack of understanding, as well the practical gesture of a raised hand to ask a question.

Using such technologies imply developing not just new technical skills, but also new organizational and interpersonal skills—new ways of interacting with students require new ways of being a good teacher.

1.3 Pedagogical changes demanded in the delivery of education and training

Using new technologies, or new delivery methods like blended learning, do not in themselves represent pedagogical changes. (However, uses of blended learning in many incarnations do seem to stimulate innovative pedagogical approaches.) Pedagogies are strategies for determining which activities students should undertake and how learning should be assessed. Pedagogies are sometimes based on philosophical and cultural stances about how learning occurs, and sometimes based on research on learning, particularly cognitive psychological or sociological research, and are intended to improve the learning that occurs, no matter where it occurs—in the classroom, online, or in a blend of these. Pedagogical approaches might call for increased activities involving discussion, inquiry or problem solving, practical experience, cases or simulations, projects, practice and feedback, or lectures and readings. These can occur in all delivery modes in different ways.

The rapid changes occurring in our fields suggest several pedagogical approaches important to achieve learning goals. While none of these are new, the changes described in the previous sections suggest that they deserve new emphasis.

The first of these is the demand for increased practical exercises, driven by the variety of workplace competency being defined. To achieve competency-based outcomes, the skills to be learned require practice, assessment, and feedback on their achievement. The background knowledge required to perform the skills is critical, but if learning and assessment stops there, it is not yet helping to develop competency. Competency-based learning calls for more emphasis on practical learning and less emphasis on pure information exchange. It calls for learning by doing. The more learning activities resemble work tasks, the more they are likely to help develop practical skills. In other words, greater use of simulations, case studies, and projects directly related to work tasks may be called upon.

Another important change, suggested in the Introduction, is the need to prepare students to become life-long learners. This calls for making learners more responsible for their own learning, and less passive recipients of information. Practitioners who advocate for developing lifelong learning skills generally suggest the need for including tasks that call for independent and small group work, critical thinking and problem solving, and innovation. Also suggested is the need to encourage metacognition about learning, including asking students to reflect on what they learned by asking themselves what was difficult, what was most interesting, how they can use what was learned and how new learning relates to prior learning. It also calls upon learners to be goal-oriented and conscious of their time and tasks needed to meet their goals.

In times of rapid change, assessment becomes even more important. It needs to address not just what knowledge was acquired, but how this extends the skillsets of learners. For learning to be sustainable, assessment needs to focus on tasks that demonstrate that learning can be applied, not just recalled. To increase opportunities for feedback, formative assessment should be built into teaching, not left for a final (or summative) test of learning when it is too late for the teacher and learner to take corrective action. Opportunities for formative assessment are increased when learning is made more active through assignments and activities that call for application.

Finally, rapid change usually means there is more work and less time to devote to learning. In response, teaching needs to be either shorter and more targeted, or, when this is impossible due to the need to achieve larger learning goals, broken into sequences of smaller chunks that can fit into busy schedules. A secondary benefit of well sequenced learning with smaller individual lessons is that it offers more opportunities for reflection, assessment, and feedback. Another response to limited time is to build learning into work practices, to offer supportive environments for learning on the job, with coaching and other guidance provided.

1.4 Challenges in meeting these new demands

Facing numerous demands to change is challenging. As mentioned in the introduction, education and training institutions have deeply rooted cultures, so the first demand is to overcome the desire to continue doing things as they have been done in the past. This applies to trying out new pedagogical approaches suited to skills development and shifting from being only an information provider to also being a skillful coach of practical activity and provider of feedback.

Another pervasive challenge is the time to develop skills to use new instructional technologies. Teachers are often left to learn for themselves, which is not only harder but often disheartening. But sharing the burden by learning in teams or creating opportunities to share among colleagues can be of help. (Collaboration as an aid in learning new tools and techniques was a common theme in SYMET-14.) Using new tools for teaching also requires time to choose those that are the best fit for the needs and the institution. Of course, the cost to make technological changes is financial as well. Budgets need to reflect this.

1.5 Unique challenges faced by developing countries

In developing countries with limited resources, facing change offers even greater challenges. A primary challenge is that developing countries usually have fewer or smaller institutions that provide education and training. Obtaining it elsewhere is costly, and often requires travel away from family and their local context and culture.

Distance learning is an option, but it still has costs, especially for the developer and provider. It is also possible that learners in developing countries might have experience with distance learning and can lack skills to be independent learners, which is required in quality distance learning experiences. Teachers may lack experience teaching at a distance as well.

One of the greatest barrier frequently mentioned is affordable and reliable internet access. An unreliable electrical supply can also be a burden, as well as costly computer resources. While digital distance learning does not necessary rely on high-speed synchronous internet access and can even be based on other more reliable media, including resources that can be downloaded at slow speed or sent on small media, such as thumb drives, synchronous internet access is the predominate format for distance learning globally due to its parallels to classroom learning. However, even older technologies like radio augmented by print resources are possible. When distance learning resources are design for flexible use and accessibility, the challenges are at least mitigated.

1.6 Keynote Address by Dr. Louis Uccellini, Permanent Representative of United States

Dr. Uccellini offered the first Keynote address of SYMET-14 on the topic of Preparing the Earth Systems Scientist of 2040. He began by noting the movement away from pure meteorology to Earth system science approaches, which has become the basis of operational services who have come to realize that to serve customers in the face of multiple natural

hazards, we must focus on weather, water, and climate linkages. He noted that we must go beyond forecasts and warnings and provide impact-based decision support services (IDSS) to key partners, such as emergency managers and water resource managers.

He showed a slide noting the increase in extreme weather events in the USA alone reaching 22 disasters with losses exceeding \$1 billion each in 2020, while the average over the previous 40 years was only 6.6 events, and 13.8 events for the last 5 years. These disasters result primarily from severe convective storms, wildfires, tropical cyclones, floods, and droughts. While the slide addressed US disasters, he notes that this increase is a global phenomenon.

The USA has adopted a cross-disciplinary initiative called Weather-Ready Nation that seeks to build community resilience, involving daily interactions with community stakeholders, and not just government partners. This initiative has been extended to other countries by working with the WMO on the Weather Ready Nations initiative, which has had 9 pilot programs across the globe, but particularly in the Caribbean and Central America through the international training desk program hosted in Washington.

The IDSS process is achieved by initiating interactions with stakeholders well before severe events, including through practice “table-top” exercises, to begin understanding needs and to build trust and effective practices. The IDSS process involves an end-to-end process starting with open observations data, providing accurate and consistent forecasts and warnings, considering social science recommendations, but also finally focusing on working through government and local public and private partners, through multi-faceted communications mechanisms, to save lives and property. The IDSS process is an important addition to the jobs of those preparing weather, water and climate forecasts, and is considered necessary to achieve the mission of the National Weather Service.



Figure 1: The end-to-end IDSS process helps the NWS to realize its intrinsic value. Permission received via email, NOAA/NWS International Activities Office.

The NWS has noted differences between weather-based IDSS and water-based IDSS, especially in the longer recovery phase of flooding events. Similarly, Urban IDSS is not the same as Rural IDSS, which, due to the different population densities and degree of diversity, creates different communication challenges. Due to the benefits of longer lead times that

allow for earlier evacuations, the communication of uncertainty becomes increasingly important.

The IDSS processes are already showing successes in the form of more highly trusted forecasts to make the decisions to avoid unnecessary evacuations and also reducing deaths through earlier evaluations and preventative measures. Several successes were shared in tropical cyclone cases in the USA and the Caribbean. Winter blizzard success cases were also shared in which ground traffic issues have been greatly reduced, which also aids road clean-up processes. Wildfire responses to IDSS have also led to earlier evacuations by as many as several days and more effective and focused firefighting.

Using the case of the European floods of 2021 as one example, Dr. Uccellini demonstrated that even with good flood warnings, the decisions of local authorities to take necessary actions can be a missing link. This reinforced the need for greater coordination and trust, but also the extreme nature of recent events that are surprising in their intensity. This was further reinforced by the 2021 New York City flooding, which was predicted in terms of total rainfall and included urban flash flood warnings. But the extremely rapid rate of the rainfall, which reached, 3.15 inches in one hour in the city's Central Park, was not anticipated.

Dr. Uccellini noted that social inequality can deepen impacts to decaying infrastructures or improper overuse of buildings. An equitable approach to intervention is required. To ensure this, the US National Weather Service has worked directly with its Tribal Nations, Urban-Rural poorer populations, Spanish-speaking communities, Southwest Pacific Island states, and Native Alaskan communities.

In closing comments, Dr. Uccellini noted that the IDSS concept has become so embedded in the services provided by the NWS that it is now included in the NWS mission statement. Achieving this mission begins with having a skilled, highly-trained workforce. Some US universities now offer joint meteorology/emergency management degrees to meet the interdisciplinary necessities of IDSS. The new emphasis on Earth system science approaches is creating new training needs, and new forecast frontiers also create new learning needs in areas such as hypoxia in bodies of water, health vectors, renewable energy, arctic environmental changes and space weather. The nature of operations also calls for an advanced Unified Forecast System modeling approach, increased IT and IT security, as well as engineers, and a new emphasis on the social sciences and humanities to round out service delivery needs. Special IDSS training has been introduced for every forecaster through 30 hours of distance learning, and those who will be deployed during extreme events require 90 hours of advance training. This includes immersive simulations with core partners and multiple components of the NWS. Training for climate and water-hazard specific IDSS is in development.

(A recording of this keynote address can be found at <https://vimeo.com/656032993>.)

1.7 Keynote Address by Prof. Dwikorita Karnawati, Permanent Representative of Indonesia

Prof. Karnawati spoke on the topic of “The Increasing Importance of Education and Training in Promoting the Paradigm Shift to MHEWS for NMHSs.” She began by highlighting the international threat of earthquakes, tsunamis and volcanos, and how these recently increasing threats highlight the importance of the multi-hazard approach to issuing warnings. Each of these geological source events create many types of hazards similar to those of weather (flooding and landslides, for example). Tsunamis can also have meteorological origins during

extreme events. These linkages demonstrate that education and training must be broadened for NMHSs, who are the primary link to the public for warning dissemination.

In addition, climate variability is a significant factor in creating hazardous conditions. Prof. Karnawati provided the example of the combined impacts of the ENSO climate phenomena and the Indian Ocean Dipole Mode, both seasonal events, on weather in the regions surrounding Indonesia, demonstrating the complex nature of anticipating severe weather events, and the need for both additional research and more training.

She also referred to the CRED and UNDRR publication on the Human Cost of Disasters, noting that the number of geophysical, hydrological, meteorological and climatological disasters reported from 2000-2019 has increased significantly. The Sendai Framework offers common process for disaster risk reduction to meet these increased occurrences, in terms of understanding risks, strengthening governance to manage risk, investing in risk reduction for resilience, and enhancing disaster preparedness for response, recovery, rehabilitation and reconstruction. The framework has implications at all levels: global, regional, national and local.

These challenges require more robust and systematic observations and data, more systematic research and science-based decision support, more sophisticated technologies, and more skillful human resources, including observers, forecasters, and modelers. However, socio-economic diversity means that these actions alone will not create a safer society. NMHS partners and the public must be aware and understand the hazards and have the capacity for timely and appropriate response. This requires practical knowledge in how to use our products, and products designed with the end-users in mind. Training needs to include more practical examples and more exercises, including case-based and problem-based learning opportunities. Systematic and continuous learning opportunities are required, and they must include interdisciplinary and inter-sectoral approaches, including collaborative learning opportunities involving both forecasters and their user sectors. Advocacy must be used to sustain government support for ongoing learning efforts, which, without promotion, can lull during periods with decreased or lesser impact events.

Prof. Karnawati closed by describing a learning and capacity development strategy titled Case-based Practical Learning with Multi/Inter-Disciplinary and Pentahelix Approach by Applying Multimedia. The “Pentahelix Approach” means the involvement of not just operational forecast experts, but local and national government representatives, the community, the media, and university experts. The entire end-to-end early warning process must be demonstrated in the case-based learning used. It is critical that all communities are aware of the severity of the potential severe impacts of natural disasters, and practical examples help to illustrate this. The presentation ended with an example of how a local fisherman with knowledge gained through training by BMKG was able to save 120 citizens before an advancing tropical cyclone reached his village.

(A recording of this keynote address can be found at <https://vimeo.com/656033662>)

1.8 Keynote Address by Acad. Markku Kulmala, University of Helsinki

Acad. Kulmala offered a keynote address on “A look at the future of international meteorological and hydrological education.” He began by outlining the grand challenges of natural disasters, including climate change, volcanoes, earthquakes, air quality, energy needs, biodiversity loss, access to fresh water, ocean acidification, deforestation, food supplies, epidemic diseases and chemicalization.

Scientific diplomacy and interdisciplinary initiatives are needed in all continents. Many forms of data and information are required to provide the details, context, and the big picture of the current state, including ground-based data, satellite data and multiscale module outputs. We need both deeper understanding and practical solutions; we need empirical measurements and modeling to move from observations to new theories; we need to move from research to innovations to can create economic growth and human wellbeing. Underlying this will require improved knowledge transfer and seamless education and training opportunities.

The current observations are still fragmented. Greenhouse gases, aerosols, air quality, ecosystems, weather and climate observations require an integrated approach to understand feedbacks, reduce uncertainties, and to mitigate and adapt effectively. We need to understand how each element in the Earth System interacts. To accomplish this, University of Helsinki has developed a number of SMEAR (Station for Measuring Ecosystem-Atmosphere Relations) stations which make observation these interactions on a continuous, comprehensive basis by measuring over 1200 variables influencing forest ecosystem and atmosphere interactions. Acad. Kulmalla proposes 1,000 or more such stations could be constructed across the globe in key ecosystems, including urban environments. WMO could offer leadership in such an initiative.

To better understand the state of the environment and how it functions we need an integrated network of research institutions, a critical mass of interdisciplinary research, education and training, innovations, and science-society dialogue. The FMI has the Institute for Atmospheric and Earth System Research (INAR) initiative that brings together all these elements.

WMO: GLOBAL LEADERSHIP with CLEAR AND AMBITIOUS VISION



Figure 2: The comprehensive INAR Initiative of FMI, including the suggestion for global leadership from the WMO [Permission receive via email](#) from Markku Kulmalla

Quality education in the Earth System sciences of the future requires open data flows, well-educated data scientists, station networks for data collection, better models, and increased connections to stakeholders and across disciplines. Education needs must be considered global, and across all age groups.

Barriers to information can include lack of understanding the extensive data needs, limited trust between stakeholders, limited understanding due to disciplinary differences, limited access to data, information and education, and limited discovery due to inadequate research capabilities due to upstream barriers. True interdisciplinary research in the Earth systems sciences would include a research agenda that seeks to understand the relations of the atmospheric, aquatic, and land systems, as well as anthropogenic activities and feedbacks and biogeochemical cycles across these systems.

University of Helsinki organizes the PEEEX programme (Pan-Eurasian Experiment) that has been active in developing several innovative projects on higher education approaches in collaboration with a number of institutions. One of these is highlighted in WMO Global Campus Innovations ([ETR-No. 27](#)), Volume I, titled Research-oriented intensive courses foster multidisciplinary atmospheric science (Lauri A. et al., 2021). University of Helsinki has also developed several Massively Open Online Courses (MOOC), which offer many freely available online learning resources, as well as for-credit options.

Acad. Kulmalla closed by asking several open questions, including: What are the competencies we need to tackle climate change? How do we need to teach them? Who is a climate change expert? Why do atmospheric scientists hesitate in taking part in societal discussion? and What kind of collaboration do we need for effective climate action? Education, and education partnerships, are key responses to these questions. WMO could take a leadership role to bring such education about. Another key response to these questions is open educational practices: open data, open access, and open educational platforms. The [International Universities Climate Alliance](#) is one example.

(A recording of this keynote address can be found at <https://vimeo.com/656034328>)

1.9 Keynote Address by Prof. Komi Sélom Klassou, University of Lomé, Former Prime-Minister of Togo

Prof. Klassou offered a presentation on “Preparing for the rapid changes required in the operations of hydrological and climate services.” He began by outlining the background of climate change that is driving paradigm changes in how we do our work. Extreme events are increasing and are increasing hazards and creating greater damage. Rapid changes are required to improve strategies for planning and execution of operations in hydrological and climate services.

In Africa, over the last two decades, more than 75% of the population in West Africa have been affected by climate disasters on the average of once every two years, including flooding, droughts, heat waves and sandstorms. Data show that this is directly related with a clear increase in insolation and a resulting temperature increase. Data also show greater variability and irregularity of high and low precipitation events, creating difficulties for preparing a response. This demands increased responsiveness by NMHSs.

Quoting UN Secretary General, the professor noted that time is running out to address these increasing dangers, and that everyone must respond, not just NHMSs and scientists, but also the public. Prof. Klassou called for a paradigm shift in procedures that are multidisciplinary in nature. Each country needs to invest in addressing climate impacts, which are also socio-

economic and political in nature. However, developing countries are under-equipped to take the necessary actions.

Qualified staff who have received the necessary training and gained sufficient experience are lacking in developing countries, and in fact, decreasing (20% reduction in the last decade), which augments the gap between developing and developed countries. We need to reconsider how training can address this gap, both universities and specialized regional centres. An adequate and sustainable framework for education and training is required. SYMET-14 could create the impetus for this outcome by emphasizing the need for cooperation at the international level. Climate has no borders. Similarly, there should be an increase knowledge sharing and education opportunities between nations and institutions.

Looking at the UN Sustainable Development Goals, Climate Change is cross-cutting and requires immediate action. However, the most recent COP (Conference of the Parties) shows only mixed results. Decisions of previous COPs have still not been enacted. Some solutions have been identified, but it is yet to be seen if they will be addressed. Countries still need to invest in the areas identified to meet goals. Cooperation is required in training and in the formation of regional centres of excellence that can serve as the focus of cooperation in research and development, as well as in improvement of operations and transfer of skills and knowledge.

(A recording of this keynote address can be found at <https://vimeo.com/656034793>)

2. Addressing Challenges Through Increased Collaboration and Cooperation

2.1 Background on WMO Global Campus Initiative

The WMO Global Campus initiative has been built on the principles of collaboration, cooperation, and sharing in education and training. It is built upon the existing WMO Education and Training Programme, including the WMO Regional Training Center network, national and international training partners, regional partnerships and allied communities. The initiative was approved by Resolution 72 of WMO Congress-18.

The WMO Global Campus is dedicated to increase collaboration and sharing between training providers to increase training capacity for WMO Members through efforts such as those illustrated below.

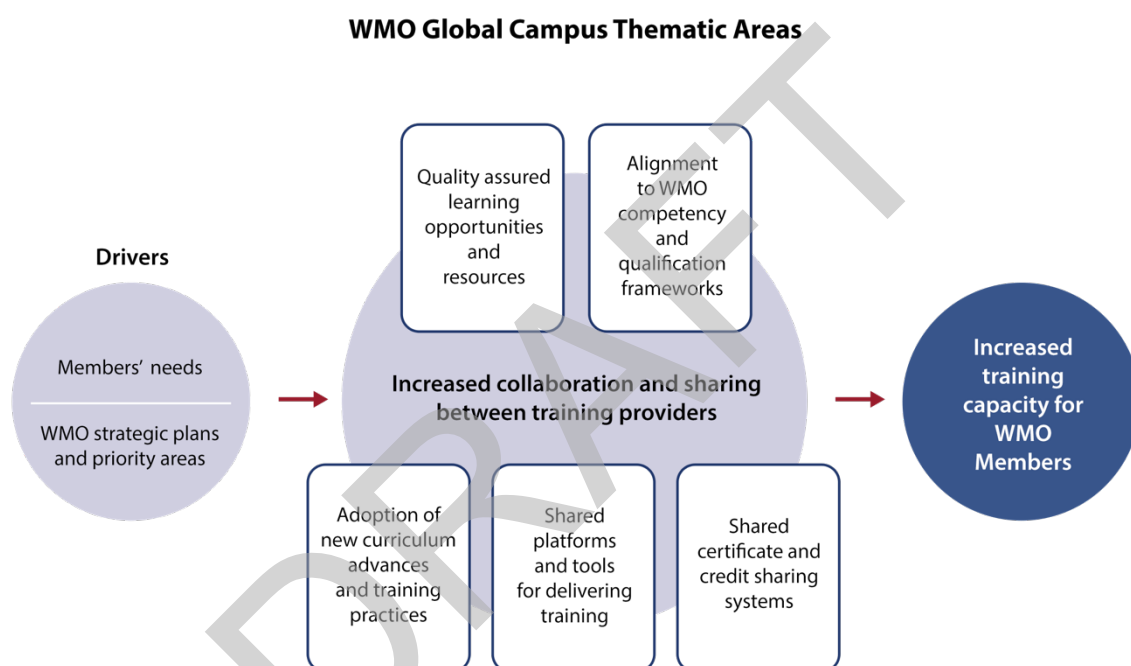


Figure 3: WMO Global Campus Thematic Areas

During the WMO Global Campus feasibility study period, several productive meetings were held to determine its potential. Several projects were also implemented. A Global Campus calendar was developed by the Caribbean Institute of Meteorology and Hydrology, in collaboration and in synchronization with other training calendars used by EUMETSAT and the WMO CGMS/VLab. In addition, an E-Library of training resources, organized by WMO competency frameworks was implemented within the existing WMO E-Library. The E-Library will move to another location to be identified in the coming year. Finally, a Translations Resource Center was developed. All of these can be found through the [WMO Learn portal on the WMO public website](#).

Two regional meetings of WMO Regional Training Centers were hosted to initiate greater regional collaborations. The first, for Spanish-language RTCs, was hosted in Lima, Peru and Santiago, Chile in 2018. The second, for RA-I RTCs, was hosted in Cairo, Egypt in 2019.

2021 had already seen two significant successes prior to the WMO Global Campus discussions that took place at SYMET-14. In January, a virtual meeting with over 200 participants titled, Addressing Challenges Beyond the New Normal: A WMO Global Campus Collaborative Webinar, was hosted by the WMO Secretariat. The outcomes of that meeting reside at <https://etrp.wmo.int/course/view.php?id=201>, and will be the subject of a publication in 2022. In February, the WMO Global Campus Innovations publication, [ETR-27](#), in four volumes, collected nearly 50 papers on education and training innovations implemented by WMO Members.

While the ambitious goals of the WMO Global Campus have not all been fully implemented, all have had progress and been discussed productively in different contexts. The discussion and action planning continued at SYMET-14

2.2 Outcomes of WMO Global Campus Panel discussion

The final activity on the first day of SYMET-14 was a panel and open discussion on the WMO Global Campus initiative, including proposals for carrying it forward into the future. Panel members included Prof. Andrew Charlton-Perez, Ms. Marinés Campos, Dra. Marina Baldi, and Prof. Tinguai Ma.

The panel noted many advances presented by the WMO Global Campus initiative. In the plenary discussion, many benefits, successes, and opportunities were noted, but all come with requirements for additional efforts from many partners.

Benefits noted were that:

- The initiative places more emphasis on the importance of Education and Training than previously existed.
- It provides opportunities that benefit learners, trainers, and also subject matter experts, and can be of special benefit to WMO RTCs.
- It also breaks geographical, language, economic and subject matter barriers by connecting all stakeholders.
- It can be a mechanism to support interdisciplinary initiatives.
- WMO Global Campus has boosted the concept and practice of collaboration, which is a cornerstone of WMO.
- Increased opportunities for collaboration with other training institutions have been realized.
- Opportunities to address the challenges of changing to online learning during the COVID pandemic were aided by the WMO Global Campus.
- The Global Campus Events Calendar allows us to see what is going in other regions and other institutions to help us all to improve our training offerings (as a benchmarking tool), and better understand global training needs.
- It offers a space for communications between trainers as well as between experts and trainers.

Successes mentioned included:

- WMO Global Campus Innovations (ETR-27) was published in 2021, which introduced WMO training partners to new learning models
- The [WMOLearn](#) portal offers access to learning resources, the learning events calendar, and descriptions of innovative projects.

- Members have the ability to search for learning events by the competency framework or Basic Instructional Package they address, and the ability to subscribe to be notified of events of interest
- The Learning Events Calendar has increased international applications to courses advertised in that venue.

Opportunities and recommendations suggested included:

- Taking the next steps to support more education and training innovation in our rapidly changing environment is critical. Input from all partners is required to support innovation.
- A focus on collaboration, and not competition, is required, placing the focus on the challenges we all face.
- We need to increase the visibility of the WMO Global Campus mechanisms to achieve more benefits.
- We all face challenges in learning assessment and training evaluation. WMO Global Campus collaboration can help with this.
- The initiative can help training institutions to implement WMO competency frameworks and find ways to offer common certification and credit sharing systems, particularly for competency-based training.
- WMO Global Campus, in concert with the WMO Strategic Plan, can be a mechanism for helping institutions upgrade their training capabilities and expand their curricula.
- The initiative can stimulate the formation an association of meteorological education and science and support existing ones.
- We might create a WMO Knowledge and Innovation Centre to inspire and support innovations.
- We must increase sharing of learning resources and improve access and searchability.
- We need to increase inputs to the Global Campus Events Calendar.
- We should work to increase the resources for trainers.
- We need to follow up on the WMO Global Campus Innovations course and publication and continue innovation processes.
- We can benefit by seeking to draw in other communities into the WMO Global Campus, particularly due to multi-disciplinary needs (EOTechDevNet—a network of networks on satellite skill applications, Earth system science contributors, Copernicus, Social science community, community-based flood approaches by International Federation of the Red Cross, the partners involved in Impacts-based Decision Support, partnerships between Universities and NMHSs to better understand partner communities and community needs, research institutions). The [International Universities Climate Alliance](#) also offers a good model and venue to collaboration.
- There is a need to give more visibility to the WMO Global Campus and to enhance the WMOLearn portal, perhaps with bulletins.
- We need to improve the WMOLearn website usability and offer an alerts capability.
- We should opt to use CALMet and WMO Courses for Trainers to expand the community.
- Users could benefit from the creation of a demonstration of the WMOLearn site.
- We need a clear and transparent way to take part in the Global Campus community, as well as any available support that can be sought.
- Mechanisms for offering and receiving training development and delivery support could be offered.

- There is a need or more shared experiences with instructional design and shared experiences—a virtual “room” to share new ideas
- We need standardize how we visibly link our training to the WMO standards, such as the competency frameworks.
- We would benefit from a place to post proposals for projects.
- The community would benefit from sharing more examples of international collaboration between experts.
- Create a method to acknowledge service provided to the Global Campus.
- Consider ways to better link NMHSs and Universities, as well as the Private Sector

3. Summary of Additional SYMET-14 Activities Leading to Its Outcomes

3.1 Thematic Working Groups

During the plenary sessions of Day 2, SYMET participants worked to develop recommendations based on nine themes identified by the International Advisory Committee, and then reported the outcomes of their discussions on Day 3. The Recommendations each group made were then analyzed before being incorporated into the SYMET Statement. The reported Recommendations from the Thematic Working Groups are collected in Annex B. Included in the Annex also is a summary of the background discussion that led to the resulting Recommendations.

The SYMET-14 Themes included:

Theme 1: Securing institutional commitment to share learning resources

Theme 2: Newly proposed WMO Education and Training Collaborating Partners

Theme 3: Micro-credentials and credit transfer: How could we proceed?

Theme 4: Considering new pedagogical approaches and assessment methods, including the future uses of blended learning

Theme 5: Technological barriers to online learning, and using partnerships between online education providers to overcome them

Theme 6: Supporting the lifecycle of professionals: From the decision to enter the discipline, to continuous learning, to maintaining job satisfaction and competency

Theme 7: What are the content area expertise gaps within our academic teaching staff members? How do we identify and fill these?

Theme 8: Update to the WMO Capacity Development Strategy

Theme 9: How do we identify the critical regional needs for the professional development of operational staff? How do we ensure that appropriately qualified participants attend our training events?

Working Group participants offered recommendations that at times overlapped, even if they were using different themes as starting points, which reveals the importance they were attributed. Some of the more frequently offered recommendations addressed:

- Recognition of the need to develop new knowledge and skills for teachers in both NMHSs and universities, including particularly online learning methods (both live and self-directed), engaging and sustaining commitment of online learners, using blended learning, using new pedagogical approaches, learning assessment
- The importance of training impact evaluation

- Recognition of the need to address scientific and technical skills gaps, many of which are increasing due to rapid changes in our disciplines
- Recognition of the need for interdisciplinary education and training (including Earth-system approaches), requiring greater interdisciplinary knowledge
- Need for increased training in impacts-based and multi-hazard forecasts and warnings
- Need to increase NMHS and university collaborations for mutual benefit, including knowledge sharing and collaborative efforts, and ensuring workplace knowledge and skill needs are met
- Recognition that the available time for training is limited, and efficient learning mechanisms need to be among the available options
- Need to consider alternatives to traditional training, such as coaching and mentorships
- Need for ongoing and more frequent curricula review, and recognition of workforce performance needs
- Need to promote sharing resources and designing resources that facilitate adaptation
- Need for an accessible and easy-to-use online platform for sharing resources, ideas, and experiences, as well as physical media, when possible
- Need for ongoing ways to share learning needs, expertise, review content, and discuss education and training challenges and solutions, through CALMet and WMO Global Campus events, for example
- Desire for mechanisms to promote collaborative creation of content and courses
- More translation of resources and increased use of machine translation, which continues to improve
- Methods for gaining greater commitment of WMO Members to the WMO Global Campus, and providing recognition for service and contribution to the initiative
- Ensuring quality standards for resources and courses shared through WMO Global Campus mechanisms, perhaps including training and content expert reviews, as well as user feedback
- Use of micro-credentials, such as digital badges, for finer granularity in the recognition for learning achievements, particularly related to competency frameworks
- Need for promoting full usage of existing WMO Global Campus tools, and for the potential expansion of these
- Recognizing regional and national differences, including technological barriers, financial resources for training and language differences
- Establishing regional collaborations to mitigate inequalities of WMO Members training capacity
- Need to address funding required to develop qualifications in disciplines represented by WMO
- Need to retain competent staff members through life-long learning and career enhancements
- Consideration of how to utilize online learning in ways that avoid feelings isolation, and to realize other limitations of remote learning exist
- Need for improved needs assessment methods
- Need for increased assessment in the selection of training participants to ensure their readiness for learning

3.2 Regional Working Groups

In addition to the Thematic Working Groups, Regional Working Groups met outside of plenary times to discuss the themes and to particularly evaluate the need to make region-specific recommendations.

The following Regional Working Groups met:

- Regional Working Group RA I, English
- Regional Working Group RA I, French
- Regional Working Group RA II, English
- Regional Working Group RA-III & IV, Spanish
- Regional Working Group RA-IV English

Resulting recommendations overlapped greatly with the Thematic Working Group outcomes, with several differences noted:

- Recommendations to increase and perhaps formalize, where they are not already, regional training partnerships and collaborative work
- Not all implementations of online learning were successful in engaging commitment from learners, the reasons for which should be investigated
- Need for training in regionally-specific weather and climate phenomena and impacts
- Desire for greater sharing of regional and national institution programmes and accomplishments
- Create forums for interaction of regional alumni of training institutions
- Establish regionally common credit systems for greater linkages of training received
- Use of cloud technology for more diverse technical training
- Need for competency framework toolkits for training and competency assessment
- Desire to increase SYMET connection opportunities with more frequent brief meetings between the larger events
- Request WMO to expand the set of competency frameworks into new operational areas

3.3 Participant Poster Sessions

In addition to the Working Groups, participants had the opportunity to contribute and to review posters in three separate poster sessions of approximately 1.5 hours each during plenary break times. Thirty-one posters were submitted, representing 30 institutions (including 5 universities and 9 NMHSs) and 22 countries. Themes of posters focused on experiences in online learning during the COVID pandemic, collaborative efforts for training development and delivery, innovative approaches to meeting new training needs, training evaluation, and micro-credentials.

To encourage interaction, an online service provider, Virtual Poster Session, was utilized. This system hosted the posters and offered asynchronous discussion forums for questions and comments, as well as an option for live interactions with the poster authors, if pre-arranged.

To generate increased participation in the poster sessions, SYMET-14 participants were asked to vote for three posters they considered most valuable. A total of 52 participants voted, and five posters were identified as most appreciated through this vote. Below is a list of all posters, with winning posters indicated. Posters can be accessed through links at <https://etrp.wmo.int/course/view.php?id=220>.

Exploration and Practice of "Cloud Teaching" Mode on the Background of Coronavirus
Pandemic Epidemic Prevention and Control

Liyao Zou; Xiuping Yao; Qiguang Wang; Miaoqing Suo; Yunhao Shi

Sharing the knowledge on Oceans – WMO's Earth System approach for Early Warning

R Venkatesan Sid Thurston

2nd Place shared Action Learning: A break through to bring learning to the workplace

Noer Nurhayati, Adityawarman, Roro Y Purwanti, Ratih Prasetya

2nd Place shared Eumetcal's approach to fulfil our European Education and Training needs

Heleen ter Pelkwijk (KNMI), Fabienne Werder (MeteoSwiss), Tomislav Marekovic (DHMZ)
and Tsvet Ross-Lazarov (COMET)

Remote delivery of SWFP training workshops in 2021 - Experience and lessons learned

Ata Hussain and Cyrille Honoré

World Climate Research Programme (WCRP) Academy

Angela Maharaj, Chris Lennard, Narelle van der Wel

Enhance public alerting for emergencies using the CAP standard

Eliot Christian

Summary of the Online Phase Training on Numerical Weather Prediction at RTC-Algeria for
Sub-Saharan Africa

Ahmed Bouzid

Hydro-climatological Education and Training in sub-Saharan Africa: Prospects and
constraints

Olusegun Adeaga

The Flipped Classroom Application in Vocational Training

Jin角度 Hou

New approaches to enhance training in RIII and RIV (Spanish speaking countries)

Maira Doyle, Marines Campos, Marcela Perez

CALMet - a valuable network for the worldwide Meteorological Education and Training
Community

Heleen ter Pelkwijk (KNMI), Marinés Campos (SMN) and Vesa Nietosvaara (EUMETSAT)

2nd Place shared Reaction of the WMO RTC Network to the Required Rapid Changes in
Education and Training

Mustafa Adiguzel, WMO ETR Scientific Officer, Patrick Parrish, Independent Researcher

WMO Marine Services Course: Innovation, Keeping Pace with Rapid Changes

Sarah Grimes, Misa Funaki, Patrick Parrish, Bruce Muller, NaYeon Kim

Development of education for climate enlightenment in Ukraine within the framework of the EU ERASMUS+ project of 'Multilevel Local, Nation- and Regionwide Education and Training in Climate Services, Climate Change
Sergej Zilitinkevich, Sergiy Stepanenko, Enric Aguilar, Hanna Lappalainen, Oleg Shabliy, Inna Khomenko

1st Place How to Break Ice in Online International Training
CHEN Jinyang, ZHANG Yi

Work together and achieve more: NWP blended learning training
HONG Fan

Maintaining and developing competencies in pandemic times
Alexandru Hozoc, Paul Bugeac

Online courses in Meteorology and Climate at the University of Reading
Hilary Weller

Delivering and Evaluating International Synchronous Training Activities
Elizabeth Page, Alan Bol, Wendy Gram, Paul A. Kucera

Making the Switch: Lessons learned moving meteorologist training online at BMTC
Mick Pope

5th Place Responding to a pandemic - ECMWF's move to virtual training
Sarah Keeley, Becky Hemingway and Chris Stewart

Development of Online Modules on Severe Wind Hazard and Risk Assessment for Tropical Cyclone Forecasters
Lambrento, John Carlo R., Cinco, Thelma A., Monteverde, Ma. Cecilia A., Estrebillo, Loren Joy D., Dolendo, John Mark I., Timbal, Karlo J., Canlas, Andrea M.

Challenges and opportunities in training and learning during the Covid-19 pandemic: Flash Flood Guidance System (FFGS) with global coverage example
Ms. Petra Mutic and Dr. Hwirin Kim

A Review of Meteorological International Online Training Held by CMATC
JI Wenbin

Remote learning: a challenge during pandemics
Octavian Paul BUGEAC

Training and Retraining Hydrologists for the Hydrometeorological Service of Ukraine: Present State and New Challenges
Viacheslav Manukalo, Valentyn Khilchevskyi, Vasyi Grebin

Online Trainings in Climate-Oriented Education
Alexander Mahura, Valeriya Ovcharuk, Tetyana Kryvomaz, Hanna Lappalainen, Katja Lauri, Inna Khomenko, Oleg Shablii, Veljo Kabin, Marek Frankowicz, Yurii Rashkevych, Larisa

Sogacheva, Putian Zhou, Antti Mäkelä, Svitlana Krakovska, Laura Riuttanen, Svyatoslav Tyuryakov, Irina Bashmakova

Education and Training Board
WMO Education and Training Office

Digital Open Badges: Micro-credentials for learning achievements
Patrick Parrish (Independent), Elena Rapisardi (CNR - IBE), Eduard Podgaiskii (RSHU),
Vieri Tarchiani (CNR - IBE), Mustafa Adiguzel (WMO ETR)

Evaluating the impacts of training: Building on our experiences and supporting our
community
Luciane Veeck, Barbara Bourdelles, Patrick Parrish, Daniela Schroeter, Alan Bol, Vieri
Tarchiani, Marina Baldi, Moussa Waongo, Leah Yeddes

DRAFT

4. The Way Ahead

This section is prelude to the SYMET-14 Statement, which can be found in Annex I. It first describes the context of education and training within the reformed WMO structure, noting particularly its cross-cutting nature.

4.1. Context of education and training in the WMO Reform

The WMO Mission states that “WMO works to facilitate worldwide cooperation in the design and delivery of meteorological services, foster the rapid exchange of meteorological information, advance the standardization of meteorological data, build cooperation between meteorological and hydrological services, encourage research and training in meteorology, and expand the use of meteorology to benefit other sectors such as aviation, shipping, agriculture and water management.” This demonstrates that education and training is fully embedded in the organization. Furthermore, the WMO strategic plan states that the WMO seeks the coordination of research and training in meteorology and related fields.

The key WMO governing bodies under the recent WMO reform include the WMO Meteorological Congress, which meets at least every four years and approves long-term plans and the budget for each four-year financial period. The Executive Council (EC) is elected by Congress and meets annually. It oversees the implementation of Congress decisions, manages the budget and acts on resolutions and recommendations from Regional Associations and Technical Commissions. Regional Associations are responsible for the coordination of meteorological, hydrological, and related activities, as well as training, in their respective regions. Technical Commissions contribute to the development and implementation of globally coordinated and harmonized observations and service delivery to enable decision making and realization of socioeconomic benefits by all user communities and by society as a whole. They also have the responsibility to ensure that competency and capacity development opportunities are available to Members. The Research Board translates the strategic aims of WMO into overarching research priorities and ensures implementation of research programmes. Other bodies streamline the work of the organization and its decision-making. These include the Technical Coordination Committee, Policy Advisory Committee (PAC), Scientific Advisory Panel (SAP), Joint WMO-IOC Collaborative Board and several additional panels.

Each of these bodies have subcomponents to enable those with appropriate expertise to achieve the Strategic Plan. The EC is supported by a variety of Panels, Committees and Task Teams. Regional Associations are supported by Management Groups, Working Groups and Task Teams. Technical Commissions are supported by Management Groups, Standing Committees, and Expert Teams. At the Expert Team level, new training initiatives and competency frameworks arise. Of course, training initiatives also arise from the education and training community as well. The workings of each body of the WMO can be seen within the WMO Community Platform at <https://community.wmo.int/governance>.

In addition to the Education and Training Office, located within the Member Services Department, the Secretariat includes Technical Departments, as well as Regional Offices located within the regions they serve. Regional Offices, also within the Member Services Department, are the main point of contact between Members, in particular the Members' Permanent Representatives to the WMO, and the Secretariat for capacity development aimed

at enhancing infrastructure and services, supporting resource mobilization, building partnership and for advocacy-related activities.

Capacity Development is a cross-cutting activity of the Secretariat, Technical Commissions, and the Executive Council. WMO assists in the capacity development of National Meteorological and Hydrological Services (NMHSs) by developing and improving human resources as well as technical and institutional capacities and infrastructure, particularly in developing, least-developed and small island developing states and territories.

The range of WMO capacity development activities includes support to countries for framing national legislation covering weather, water and climate activities through compliance with WMO regulations, education and training, demonstration projects, regional support, research, development partnerships and appropriate institutional arrangements. RTCs and WMO's training partners play a key role in nearly all capacity development activities.

An Executive Council Capacity Development Panel (EC-Capacity Development Panel) made up of Member experts, some from RTCs, works with the Secretariat departments through the Education and Training Office to support these broad efforts. The Panel also includes representatives of the Technical Commissions, the Research Board and key service delivery areas. The Panel monitors the priorities of, and activities under, the WMO Strategic Plan, the WMO Capacity Development Strategy and WMO Gender Equality Policy, including institutional, infrastructural, procedural and human resources capacity development. The initial Terms of Reference of the EC-Capacity Development Panel were established in Resolution 7 (EC-71).

4.1 Key current and future challenges

As described in the introduction to this document, the global Earth system science research and operations communities face myriad challenges as we move forward within this climate of rapid change. A long list these were offered in the Introduction, in Section 1.1, and in the Keynote Addresses.

Some changes reflect positive evolution:

- Improved and standardized observations networks
- Improved Numerical Weather Prediction models
- Increased understanding of Earth system science principles
- Automation and artificial intelligence in forecast processes
- New service delivery areas
- Increased impetus for interacting with customers
- Improvements in strategies for cooperation with emergency response agencies
- Promotion of systems approaches to weather, water and climate services

Other changes result from negative influences:

- Global warming that increases the likelihood of extreme weather and climate events
- Increased climate variability
- Potentially increasing disruptions to societies and political conflicts
- Continued or increased disparity in socio-economic status
- Health threats from both weather and climate events and from rapidly spread pandemics

The SYMET-14 Statement also contains open statements that note the sources of many of these changes, including many policy decisions.

4.2 Policy makers and governments

The SYMET-14 Statement calls for governments and regional economic groupings to support the development of NMHSs with the range of services necessary for sustainable development and disaster risk reduction. It asks them to acknowledge the importance of initial and continuous professional development needed to develop the workforce ready to address the challenges of today and tomorrow. It asks for the promotion and sustainment of careers in meteorology, hydrology, climate science and related environmental disciplines.

4.3 WMO and other international organizations

The SYMET-14 Statement ask for increased support by WMO and other international organizations to meet education and training needs in this time of rapid and increasing change. The WMO Global Campus is identified as a key mechanism to support the collaboration necessary. It calls for increased international partnerships between these organizations. It supports a new Board of Education and Training Collaborating Partners, as well is expanding the competency requirements of education and training providers. To develop and sustain excellence in services, it calls for increased planning, communication, legal awareness, advocacy, financial and personnel management skills.

The Statement recognizes the importance of translations, localization of training, learning needs assessment, learning assessment, training evaluation and appropriate credentialling for development toward meeting WMO standards. It calls for continued and increased support for the WMO Global Campus initiative through a variety of mechanisms.

4.4 The education and training community

Finally, the SYMET-14 Statement calls upon the education and training community to keep pace with the rapid changes in Earth system science and education and training practice. It notes the importance of cooperation to face the rapid changes ahead. One way is by contributing to the WMO Global Campus initiative.

Community institutions are encouraged to use online, blended learning and face-to-face modes, and to share expertise, resources and ideas for effectively meeting training needs.

References

Bateson, G. (1972) *Steps to an ecology of mind*. San Francisco: Chandler.

Bauman, Z. (2005) *Liquid life*. Oxford: Polity Press

Hofstede, G. and Hofstede G. J. (2005) *Cultures and organizations*. New York: McGraw-Hill.

Lauri A., Ruuskanen T., Riuttanen L., Kulmala M. and Hari, P. (2021) Research-oriented intensive courses foster multidisciplinary atmospheric science, in *WMO Global Campus Innovations: Volume I – New pedagogical approaches*. Geneva: World Meteorological Organization.

Parrish, P., & Linder-VanBerschot, J.A. (2010) Cultural Dimensions of Learning: Addressing the Challenges of Multicultural Instruction. *International Review of Research in Open and Distance Learning*, 11(2). Available online at www.irrodl.org/index.php/irrodl/article/download/809/1553.

Toffler, A. (1970) *Future shock*. New York: Random House

Worley, C. G. and S. A. Mohrman, 2014: Is change management obsolete? *Organizational Dynamics* (43:3), pp. 214-224. Available at <https://doi.org/10.1016/j.orgdyn.2014.08.008>.

Appendix A: Statement of the Fourteenth World Meteorological Organization Symposium on Education and Training

Symposium Statement

The participants of the Fourteenth World Meteorological Organization (WMO) Symposium on Education and Training (SYMET-14), held online 22 November - 25 November 2021:

Deliberating on the theme "Education and Training in a Period of Rapid Change",

Noting that new advances in science, technology and meteorological, hydrological, and climate services, along with the impacts of the COVID-19 pandemic, have accelerated changes in the content and delivery of meteorological, hydrological and climate training, leading to the need to develop of new content areas, define new expected learning outcomes, offer new delivery modes, and create new forms of instructional media and new pedagogical approaches

Noting further the likely longevity and increasing pace of these changes;

Noting also the various international and national initiatives and commitments to address global issues related to natural disasters, environmental degradation, the Paris Agreement, the Glasgow Climate Pact and the need for WMO to make significant contributions to the United Nation's 2030 Agenda for Sustainable Development, the SIDS Accelerated Modality for Action (SAMOA) Pathway and the Sendai Framework for Disaster Risk Reduction;

Noting further the decisions of the 18th WMO Congress and the Extraordinary Congress (2021) on the WMO governance reform to embrace a more comprehensive Earth system approach, Geneva Declaration (2019), other major initiatives and issues that are driving change within the WMO community, such as the new WMO data requirements, arrangements and policies for data exchange against the Earth System Strategy as stipulated in the WMO Unified Data Policy Resolution, the implementation of the Global Basic Observing Network (GBON), the shift to Impacts-based Forecasts and Warnings and Multi-hazard Early Warning Systems, the Global Framework for Climate Services, 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 upon key areas requiring further development to enable the WMO Education and Training community to address the changing and increasing education and training requirements, both during in SYMET-14, the previous SYMET-13 and previous WMO Global Campus meetings;

Expressed the following key observations and conclusions:

- The world has recently experienced dramatic and rapid shifts in our ways of living, interacting, and educating related to the COVID-19 pandemic. But rapid change driven by technological developments in particular has been recognized as the new normal for many years, and in many more ways than those resulting from the pandemic. Teaching experiences during the COVID-19 pandemic have highlighted many innovative approaches to online and blended learning that could be more widely adopted. Studies of the success (or challenges) of these approaches provide the means of testing where and for what purpose such technologies might be deployed.

- Technological innovations and social evolution continue to change our lives and work; society expects greater accuracy in and increased usability of weather, water and climate predictions, including more openness in our sharing of data and forecasts; climate change has accelerated and climate-related disasters and extreme weather and water events are now commonplace. Adapting to this change demands immediate action. At the same time, our workforce is becoming increasingly interdisciplinary, and accelerated progress in research and development uncovers new opportunities each year for service improvements.
- The WMO EC Capacity Development Panel that has been established by Resolution 7 (EC-71) is providing an effective means of driving forward innovation in capacity development.
- Cooperation between the Universities, NMHS training centres, WMO Regional Training Centres, WMO/CGMS VLab, CALMet 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 systems; and developing shared tools and platforms for developing, delivering and monitoring/reporting education and training activities.
- The decision to establish and promote the WMO Global Campus initiative helped education and training providers deal with changes to educational practice forced by the pandemic and many proved to be successful. The WMO Global Campus event “Responding to Challenges Beyond the New Normal”, which took place from 20 to 22 January 2021, helped to outline challenges that E&T providers are facing, served to exchange experience and offered some solutions that were successfully applied in many cases. Similarly, the [WMO Global Campus Innovations](#) publication (ETR-27), published in early 2021, highlighted many innovations in place prior to the impacts of the COVID-19 pandemic.
- Because the WMO Education and Training community works with students from many countries, language, gender and cultural awareness and diversity needs to be addressed across all activities.

The Symposium made the following recommendations:

General recommendations

- The WMO Secretariat is requested to play an active role in supporting and promoting the development and ongoing activities that comprise the WMO Global Campus initiative.
- SYMET-14 participants call for support and action at national, regional and global levels to support WMO and its National Meteorological and Hydrological Services to develop and deliver improved services to the Members through the provision of adequate facilities and resources for education and training in weather, water, climate and related fields.
- SYMET-14 participants strongly endorse the benefits to themselves, their institutions and the community of coming together to discuss the future of education and training. In the future, holding interim meetings between symposia is likely to reap important benefits for the community and help to broaden it as Earth system science and prediction changes rapidly. This would also help us to monitor the progress towards the recommendations in this statement.
- SYMET-14 participants further request the World Meteorological Organization to publish the outputs of this Symposium to enable widespread reference to, and use of, the key issues and recommendations.
- SYMET-14 participants call upon the World Meteorological Organization, international development partners, authorities of countries and territories, and other stakeholders to take

into account recommendations arising from this Symposium in their recurrent and development socio-economic endeavors.

To policy makers and governments

- For NMHSs to provide the range of services required to address sustainable development and DRR goals, increased funding is required to support the initial and ongoing education and training of NMHS personnel and those entering the field. New models of funding for the education and training of meteorologists, climatologists, hydrologists and those in related environmental science disciplines, trainers in these fields and related technical staff including loans and work-study schemes are urgently needed in many countries.
- Governments and regional economic groupings to acknowledge the importance of increasing support for continuous professional development of meteorologists, hydrologists, climate scientists, and those in related environmental science disciplines, trainers in these fields and related technical staff members because of our rapidly changing disciplines and advances in scientific research. Models of funding in which resources are shared regionally or internationally are likely to yield greatest benefit at highest efficiency. This includes funding for distance learning infrastructure – including internet access for developing countries.
- Promotion of careers in meteorology, hydrology, climate science and related environmental science disciplines at all educational levels from early education to professional training schools is a high priority to attract the best students into our fields.
- To retain highly trained NMHS staff, training center staff and University staff within the field, they need to be appropriately paid, rewarded and recognized for their contributions, particularly where their skill development makes them an attractive asset in other sectors.

To the World Meteorological Organisation and other international organisations

- The WMO Global Campus initiative is strongly endorsed as a mechanism to bring about and support existing international and regional collaboration needed to advance global Earth system science and prediction training needs. The concept should be broadened to include mentorship and peer-to-peer collaboration for the development of new resources and innovations.
- Noting international investment in Earth Systems programmes around the world, and their significant training elements, the WMO encourages relevant international programmes such as the EU Copernicus Programme and the AU GMES for Africa to participate in the WMO Global Campus, with mutual benefits for all.
- A new, sustainable technological solution that allows the WMO Global Campus goals to be met should be developed and supported. Partner resources and support, as well as commercial off-the-shelf knowledge management platforms, might provide the facilities needed to share resources and ideas within the WMO Global Campus. Partnerships or sponsorship should be explored to facilitate this, as part of broader collaboration with the private and philanthropic sectors which WMO is currently developing.
- The Board of Education and Training Collaborating Partners as a formal mechanism to achieve the goals of the WMO Global Campus initiative is also strongly endorsed.

- WMO to re-consider the competencies required of trainers to operate within a WMO Global Campus, which are broader than those traditionally acknowledged. There is a need to revise WMO documents 1114 and the trainer competencies in 1209 to reflect the evolving needs of WMO.
- The evolving requirements of users, increasing regulation and resource accountability by national governments and development partners requires managers in NMHSs to possess increased planning, communication, legal awareness, advocacy, financial and personnel management and change management skills. Part of the remit of the WMO Education and Training Programme should be used to help NMHS managers to develop these skills.
- New technologies have begun to break down language barriers that have traditionally prevented further sharing and cooperation. WMO is advised to seek and share guidance from other organisations on how best to take advantage of these new approaches.
- To ensure that learning needs are identified, the regular WMO training needs surveys and the Community Platform be used to seek community input.
- Gaining commitment from member states, institutions, and individuals is vital in the success of the WMO Global Campus. WMO could explore awarding public credentials to institutions or individuals who fully contribute to the WMO Global Campus to a level proportional to their size and resources.
- The proposed Board of Education and Training Collaborating Partners to develop a pilot system to support the adoption of micro-credentials through the use of open badges and a mutual credit sharing system that can be tested by a subset of institutions on a voluntary basis.
- Consideration of the local context for developing new training approaches should be paramount, including continued interaction between partners. This includes training in appropriate technologies, the technological constraints and appropriate localisation of case studies and examples. The proposed Board of Education and Training Collaborating Partners should produce guidelines for the community on ensuring the appropriate local context.
- Workshops that develop skills in learning assessment, competence assessment, and training impact evaluation should be organised.
- It is important for partners to promote and aid the transition to training for impact-based forecasting and warnings and multi-hazard early warning systems, drawing on the excellent work already done in many countries.
- Ensure the WMO Capacity Development Strategy makes appropriate reference to education and training. This should be future looking and collaborative in nature to promote innovation in training development and delivery.
- Working together, partners are recommended to ensure that training initiatives are in compliance with the development strategies of those served and that the selection of training participants and beneficiaries is in alignment with the intended learning outcomes of the training

To the education and training community

- The community is recommended to review the continuing professional development needs of their staff in the light of the rapid changes in Earth system science and education and training practice.
- The community is encouraged to review of their curricula in light of the new BIP-M and BIP-MT specifications and future Basic Instructional Packages and competency

frameworks. The emphasis on a broader range of skills for meteorologists, climatologists, hydrologists and those in related environmental science disciplines in the new BIP-M and BIP-MT specifications should encourage training institutions to consider the market need for new courses, including joint degrees, that link physical, social and technical science fields.

- The community is encouraged to advocate for greater cooperation wherever possible, particularly between NHMSs and Universities. One important aspect of this collaboration could be the offer of on-the-job training/work-based learning from universities and requesting Universities to add this element into their curricula where otherwise currently not available.
- The community is encouraged to commit the time of their staff to participating in the WMO Global Campus initiatives identified above, including the proposed Board of Education and Training Collaborating Partners. They should communicate this commitment to the ETR office, in return for the new recognition of their collaborating status.
- As part of this commitment, a set of institutions are invited to partner with WMO for the trial of micro-credentials and credit sharing.
- Community institutions are strongly encouraged to continue to develop and deliver training using online, blended learning and face-to-face modes, which would support reductions in the greenhouse gas emissions associated with training. Additionally, they are encouraged to explore new pedagogical approaches for teaching and assessment, embracing the new discoveries and skills acquired during the pandemic. As expertise, resources and ideas are developed, these should be shared through the WMO Global Campus and other collaboration mechanisms.
- Community institutions should develop mentoring schemes for staff at all levels, regardless of their job role. These initiatives are critical for retention of staff and ensuring equity for all people irrespective of nationality, gender, race or cultural background
- Community institutions are encouraged to use open licenses, such as Creative Commons, that allow for reuse and derivation of shared resources, and to design resources that facilitate translation and adaptation.

We express appreciation to WMO for hosting SYMET14 and for bringing together a broad group of institutions and experts to discuss the future of education and training during this particularly acute period of ongoing rapid change.

This statement was discussed and approved by the participants of SYMET-14 on the 25th of November 2021. 280 participants registered to attend SYMET-14, from which 253 attended live online sessions on the SYMET-14 Programme. SYMET-14 participants represented 61 countries including all WMO Regional Associations.

Appendix B: Working Group Inputs to the SYMET-14 Statement

SYMET participants worked to develop recommendations based on nine themes identified by the International Advisory Committee. The recommendations were then analyzed before being incorporated into the SYMET Statement (Annex A). The reported recommendations from the Working Groups that discussed each of these themes are collected in this annex.

The SYMET-14 Themes included:

Theme 1: Securing institutional commitment to share learning resources

Theme 2: Newly proposed WMO Education and Training Collaborating Partners

Theme 3: Micro-credentials and credit transfer: How could we proceed?

Theme 4: Considering new pedagogical approaches and assessment methods, including the future uses of blended learning

Theme 5: Technological barriers to online learning, and using partnerships between online education providers to overcome them

Theme 6: Supporting the lifecycle of professionals: From the decision to enter the discipline, to continuous learning, to maintaining job satisfaction and competency

Theme 7: What are the content area expertise gaps within our academic teaching staff members? How do we identify and fill these?

Theme 8: Update to the WMO Capacity Development Strategy

Theme 9: How do we identify the critical regional needs for the professional development of operational staff? How do we ensure that appropriately qualified participants attend our training events?

Regional Working Groups included :

Regional Working Group RA I, English

Regional Working Group RA I, French

Regional Working Group RA II, English

Regional Working Group RA-III & IV, Spanish

Regional Working Group RA-IV English

Theme 1: Securing institutional commitment to share learning resources

Recommendation 1

We recognize that commercial off-the-shelf knowledge management platforms might provide the facilities needed to facilitate sharing of resources and ideas within Global Campus. We recommend that WMO explores partnerships or sponsorship with the private and philanthropic sectors, who might be motivated to support education and training as part of capacity development and climate change adaptation efforts, to facilitate provision of a platform to host resources, aggregate resources on other platforms, and enable collaboration.

Sidenote. We are conscious that fast, reliable, internet connectivity is not yet universal and using alternative means to share resources and expertise using email and physical memory devices is a reality for many. The needs of these members should be explicitly considered in guidelines for resource design and review, and in platforms used to disseminate resources.

Recommendation 2

There is an ongoing need to bring people together to share learning needs, share expertise, contribute to the reviewing and creation of content and to discuss matters related to education and training. We recommend that WMO facilitates and advertises wide access to commonly used fora/bulletin boards, signposting venues in which these various conversations happen. We further recommend that exemplar informal agreements (rules of engagement) for working collaboratively are produced to assist people to clarify expectations around issues such as contributions, ownership of IP, etc.

Recommendation 3

Considering the competencies required of trainers to operate within Global Campus, we believe these are broader than those traditionally acknowledged. These competencies now include working collaboratively and in partnerships, dealing with accessibility, IP, and privacy issues, designing for ease of translation and localization, quality control and review of resources, managing online communities, and more. We recommend a review of contents of WMO 1114 and the trainer competencies in WMO 1209 to reflect the evolving needs, believing this would send a stronger message than issuing a separate document.

Recommendation 4

Translation of resources into different languages and provision of locally applicable case studies into learning resources is important for reasons of inclusivity and equity, and to enable better learning outcomes through connecting learning with concrete prior experiences. It is also important so that contributions from people written in languages other than the 6 UN languages can be brought to a wider audience. We recommend that WMO should seek information on requirements for resources to be available in different languages as part of its regular survey of members needs, and in other feedback mechanisms. We further recommend that WMO should encourage members to share and contribute to glossaries of technical terms which allow translation, and to contribute examples of best practice in translation, including translation of live sessions, use of machine translation.

Recommendation 5

Gaining commitment from member states, institutions, and individuals is vital in the success of Global Campus. Being publicly recognized as being a valued Global Campus contributor is an important motivator for many institutions. We recommend that WMO should award credentials (badge/certificate/mention on website) to institutions or individuals who fully contribute to Global Campus to a level proportional to their size and resources. These contributions would include taking part in working groups, conferences, symposia, etc., as well as contributing quality resources and expertise, reviewing the contributions of others, and the curation, translation and localization of resources.

Recommendation 6

Resources and expertise accessed through Global Campus must be trusted by users and other stakeholders as being authoritative and of a high standard. We recommend the establishment of a volunteer network of reviewers to assess contributions against agreed standards for good design, accessibility, and academic integrity. Recognizing the importance of constructive feedback in the continuous improvement, we further recommend that Global Campus platforms provide opportunity for users to pass both feedback and examples of the impact of resources to their creators. The combination of expert review and user feedback should be used to identify authoritative examples of resources on particular topic, as well as subsidiary examples and case studies of more local relevance.

Background to the Recommendations

Challenges or barriers to COMMITMENT (and to taking action)

- Quality assurance: fear of judgement, and lack of confidence
- Knowledge of what is needed by others and of how to share
- Intellectual property and attitude of sponsoring agencies
- Languages and translation
- Our courses and resources are not designed to be re-used
- Existing venues for sharing work for some, but difficult to navigate for others
- Collaborating can be frustrating and hard to justify
- Institutions and individuals' motivation to share – what's in it for me?

Theme 2: Newly proposed WMO Education and Training Collaborating Partners

Recommendation 1

Recognizing the value of the Education and Training Board concept as a formal mechanism to promote increased collaboration under the aegis of the WMO Global Campus, we recommend to further develop the concept and to establish the networking entity aimed at strengthening coordination and sustainability of education and training efforts in meteorology, hydrology and related environmental disciplines.

Suggestions to consider regarding the Recommendation:

1. When further developing the concept, the newly proposed entity should explore connections and benefit from existing mechanisms, networks and initiatives such as

CALMet, IAMES, network of WMO national focal points on education and training, etc.

2. The procedure of joining the entity needs to be further elaborated. This can be drawn from existing practices of some networking entities with an application form signed by the organization's director, outlining the expertise of the organization in education and training in meteorology, hydrology and/or related areas, and nominating the partner's focal point.
3. In composition of the entity's Management Group, to seek balance between representatives of the WMO-affiliated entities (including WMO RTCs) and actors from outside of the WMO domain
4. The Management Group may request reconfirmation of engagement from its members after four years period
5. Observation: There is a need to train the WMO Global Campus contributors to use the (calendar and e-library) systems; questions arise regarding the criteria for courses and materials to be listed; how to transform course advertisements into the WMO Global Campus descriptors; some features of the Global Campus Learning Events calendar such as alerts & subscriptions are not widely used.

Theme 3: Micro-credentials and credit transfer: How could we proceed?

Recommendation 1

Acknowledging that **Micro-credentials** are useful for demonstrating accomplishment of short or non-formal learning and can be **transferable and combinable** through credit transfer agreements, it is recommended that the WMO facilitate a collaborative initiative under the global campus involving RTCs and Contributing partners to adopt standardized micro-credentials for short and non-formal training.

Recommendation 2

Acknowledging that **Digital open badges** are a free and open technical standard that can be used by any organization, it is recommended that WMO and Partners define a minimum set of standard metadata for badges and propose an open badges sharing platform (such as Badgr.io). RTCs and collaborating partners are invited to participate in the community of open badges under the Global Campus and to adopt the minimum standard metadata for setting badges in their e-learning platforms

Recommendation 3

A mechanism for evaluating the process is set up and partners voluntarily adopting the open badges for some short-term training courses, as test, provide feedbacks to the community in order to evaluate the performance of the proposed solution

Background to the Recommendations

Challenges

1. Accreditation of issuing institutions: national level and international level both complicated and sensitive.
2. WMO is not an accrediting institution but can recognize institutions as RTCs or Contributing partners

3. Quality standards: how to be sure that quality standards are respected?
4. Technical standard to be adopted for micro-credential: who set them?
5. Which platform for sharing open badges to choose? free or charging
6. Competencies based Training: training courses should refer to a common CF and courses description, as well as micro-credentials, should include Skills & Knowledge, but not all CF of WMO are coherent or developed in the same way (for example CFCSP doesn't have yet S&K defined). CF doesn't exist for all profiles.

Opportunities

1. Existing network of Institutions contributing to the WMO Global Campus
2. RTCs are recognized by WMO, and the confirmation process ensure some quality standards
3. Contributing partners with agreements with WMO can be also recognized
4. Some experience in using micro-credentials and open badges
5. Free platforms for open badges sharing: Badgr.io is an example already used and interoperable with Moodle, Blackboard and other e-learning platforms
6. Standards and CF provided (or potentially provided) by WMO
7. WMO could advise on standard to be used by the community
8. WMO could include this subject in the ToT courses

How can collaborative action contribute?

1. RTCs and Contributing Partners can voluntarily test the use of microcredentials and open badges, building on the experience of partners already doing
2. A first community of institutions recognized by WMO could start the process
3. The community of WMO RTCs could be the starting point.
4. The network could be further enlarged with other «contributing partners» having an agreement with WMO
5. WMO and partners already using Open badges can collaborate to define standards and provide some guidance or advise on how to proceed (standard procedures and metadata of open badges)
6. At the RA-I WMO Global Campus Meeting in Cairo, December 2019, AGRHYMET-RTC Niger, AEMET-RTC Spain, COMET, RTC South Africa had expressed interest in participating in a preliminary test of the use of open badges as core testing partners with the potential further participation of EAMAC, VLC Morocco, RTC Algeria and RTC Egypt,

What steps might be required?

1. Defining the community: RTCs and collaborating partners
2. Proposing a basic standard (community identification, compulsory metadata, sharing platform)
3. Introduce voluntarily on partners training courses

Who is willing to take responsibility to contribute?

1. As RTCs:
 - DOST-PAGASA-RTC, Philippine
 - AGRHYMET-RTC Niger
 - IBE-CNR-RTC, Italy
2. As contributing partners:
 - Reading University, UK
 - ROSHYDROMET, Russia

- ENM, France
- To check if AEMET-RTC Spain, COMET are willing to participate

What contributions can offer?

1. WMO, RTC Italy and other experienced partners could suggest the basic standard to set the badges
2. All: Set-up badges in e-learning platforms (Moodle and Blackboard), Adopt a common interoperable platform, provide feedback and lessons learned within a year

Theme 4: Considering new pedagogical approaches and assessment methods, including the future uses of blended learning

Recommendation 1

Provide guidance on training personnel and resources necessary for various sizes of training events. Additionally encourage facilitation and collaboration among partners on how to help each other out.

Recommendation 2

Develop guidelines for facilitation and offer formal recognition by certification for where that service is provided. This ties into the other working group for continuing professional development and micro-credentials.

Recommendation 3

Continue to strive to deliver online training, not undermining the value of face-to-face, but rather embracing new discoveries and skills we have acquired during the pandemic.

Recommendation 4

Arrange workshops to explore learning assessment, competence assessment and topics and evaluating of impacts of training.

Recommendation 5

Create a formal WMO Global Campus Expert Team to take responsibility for promotion and sharing of new pedagogical approaches, and to take on other actions as decided.

Recommendation 6

Provide continued support and promotion for CALMet as an important mechanism for sharing training innovations and new pedagogical approaches.

Recommendation 7

Expand the function of the global training calendars. Include, for example, regularly scheduled annual events as well as special workshops and conferences.

Background to the Recommendations:

- The traditional pedagogical approach is “learning by knowledge transmission”. The value of “learning by doing” has been promoted in pedagogies for more than one hundred

years. In recent decades, the value of this latter approach has led to new pedagogical approaches.

- Learning by doing forms the basis of competency-based training, as promoted by WMO, by offering practice and feedback in applying new knowledge and skills in job-related activities.
- New pedagogical approaches are based on the introduction of a variety learning activities, such as
 - using the classroom for practice and feedback instead of information transfer (as in blended-learning),
 - assign a project- a problem/inquiry-based learning for providing active and authentic contexts for developing knowledge and skills,
 - encourage collaborative learning for student/participant groups to actively support one another in their learning,
 - case-based learning and simulations,
 - guided discussions,
 - and other approaches.

Goals/Desired Outcomes:

- New and diverse pedagogical approaches are formulated/tested and adopted/further adapted/rejected for addressing the needs of diverse learners and to aid in developing complex knowledge and skills.
- Successfully tested pedagogical approaches are documented and shared with other education and training institutions.
- Traditional and culturally appropriate pedagogical approaches continue to be respected alongside new pedagogies.
- Both classroom and online learning delivery modes are combined and enhanced with active pedagogical approaches that help learners develop and practice targeted competencies and maximize learning opportunities.
- New forms of pre (prior to and at the start of training), formative (during training) and summative (end-of-training) assessment are used that reinforce learning and confidently demonstrate achievement of targeted skills and knowledge outcomes
- Elevate the word ‘pedagogy’ to common usage. Promote pedagogy by defining what it means in simple terminology.
- From the existing framework, demonstrate various strategies to approach E&Tr to address the various audiences and levels of teachers/students/participants/experts for both traditional subjects (meteorology, hydrology, climate), cross-disciplinary subjects (social science, emergency management, others), and the general public.
- Perceived weaknesses in online learning assessment are mitigated by applying new strategies and technologies.
- To address diversity, equity, and inclusion: re-evaluate traditional assessment strategies to minimize poor performance
- Encourage active learning in the workplace through peer to peer exchanges and mentoring.
- Encourage informal learning through participation in WMO VLab Regional Focus Group Sessions.

Noted responses for Challenges to address, barriers to action, tasks to complete, resources required:

- What cultural and practical barriers must be overcome with both teachers and students to adopt new pedagogical approaches? Language barriers; stereotype threat; inflexible curriculum; inflexible government regulations. More specific to the virtual environment: less interaction between teachers and students; teachers need more time to implement the change from passive to active and in-person to virtual; students may prefer the passive classroom; availability of technology and internet connectivity
- How should new pedagogical approaches useful to WMO education and training providers be identified, compiled and examples shared? Start with having trainers submit their favorite, least favorite, and middle of the road approaches and why. Then have interested members assess them to see what patterns emerge. Include guidelines, examples from successful educational institutions in various forms, for example: model, infographic, video clip that easy to understand. This year SYMET offers great posters that have provided ideas for participants own training management.
- How can increased institutional collaboration enhance awareness and willingness to try new pedagogical approaches? Offer certificates from those institutes for the online courses that would have not been offered otherwise. Encourage peer to peer trainer and participant learning. Establish a community of members to interact via an official social media platform, e-learning platform and e-library cooperation.
- What are the most compelling reasons to use classroom, online, or blended learning delivery modes? Online education promotes self-learning by doing. It creates a new dimension of learning style that allows you to study anywhere, anytime. It works well in epidemic situations or emergency situations. In many instances, it saves cost and has no border restrictions.
- What pedagogical approaches are most conducive to skills development? The wide range of active methodologies; Problem-based learning, project-based learning, learning capsules, case studies, flipped classes, workshops, etc.; Reflective and inquiry based learning; Practice real time and from simulations; Exchanging and sharing experiences.
- How can formative assessment be used to maximize learning during training? Students are exposed to what to expect, teachers receive feedback on student prior knowledge and can adapt aspects of the lesson. As a teacher, evaluation is a process that does not end with the grade, but with the feedback to the student. To achieve a good evaluation experience, it is important to design adequate assessments and dedicate time to feedback.
- What summative assessment methods produce the most valid indicators of various types of learning (such as background knowledge versus skills)? The diagnostic assessment is a very good instrument for evaluating the learning acquired, session by session. It motivates the learner to continually review their learning.
- How can we enhance online communication and interaction for more effective and engaging learning experiences? Hold guided forums that invite collaboration, discussion, and the transfer of experiences; Develop ground rules for respectful engagement; Use AI to help translate languages to increase confidence and reduce language restrictions. Provide the opportunity to introduce yourself particularly in small groups.

Group Discussion

Challenges:

It may seem easier to continue teaching the way we have always done it, or the way our teachers taught us. It is difficult to maintain motivation and contact with students throughout the online-course, so they feel welcomed and supported. For a program looking to hire an instructional designer (and has not done so before), what resources exist? For example: job descriptions and instructional associations to tap into. It is important to motivate current and future instructors to prepare themselves as educators; the new paradigm of teaching-learning centered on the student, needs preparation in adequate methodologies, it is not enough just to be an academic expert. Obtaining administrative and financial support and finding extra planning time. Students may need preparation to be good online learners. Reference:

<https://etrp.wmo.int/mod/resource/view.php?id=8985>

Opportunities:

The pandemic forced us to move from the face-to-face classroom to the virtual classroom. Despite the difficulties, it opened up a new teaching-learning space, which has broken down borders with new challenges and undeniable opportunities. There are countless examples and experiences. Utilize existing resources from: VLab, CALMet, WMO Courses for Trainers, SYMET, education conferences like EDEN, AECT, Online Educa, etc. Encourage RTCs to build a local knowledge library and share with the global campus. Expand the function of the calendar. Include for example regularly scheduled annual events as well as special workshops and conferences.

Collaboration:

Collaboration with trainers from other countries or institutions is important 1) to make the training more relevant for others to take notice; 2) to attract new ideas and produce quality materials from diverse people with complementary skills; 3) promote standardization in order to comply with competencies and recommendations; 4) It potentially saves time - you will not have to wait a year for the expertise to be available, someone else from another country can contribute.

Spaces are generated where it is possible to contribute through the teaching of active methodologies and evaluation techniques, transfer of experiences, generation of support material, etc. Benefits can be realized from the existing collaboration between regional training centers (VLabs, RTCs, ...) to develop new online training courses and materials.

What steps might be required?

To be able to collaborate we need 1) to have virtual meetings, 2) a virtual space/resource depository to share drafts, 3) a list of persons/trainers and areas of expertise, instructional designers, IT assistance, and others.

Invite external teachers/trainers to our courses and sessions as observers to provide examples of and assist in transferring teaching skills.

Who is willing to take responsibility to contribute? What contributions they can offer?

Could a volunteer WMO Global Campus Task Team be formed to take responsibility for promotion and sharing of new pedagogical approaches?

ETR plans to identify a new source for Open Educational Resources, which can include pedagogical models to share.

RTC SMN (2 Univ, and the NMS) of Argentina is eager to contribute resources and trainers, especially in Spanish and English languages.

Theme 5: Technological barriers to online learning, and using partnerships between online education providers to overcome them

Recommendation 1

Recognise that each region will have experience of different technological barriers and need appropriate tools to overcome this.

Recommendation 2

Recognise that each country needs to invest in training, but resources required for online training can be a barrier. Every region/area needs access to its own set of properly working tools. We note that many free tools impose limitations on functionality.

We highlight the EUMETCAL model of funding to pool resources to give everyone access to greater resources (tools and training material) when working together.

This could be modelled at a regional level with tools and training (including training of trainers) in the appropriate context for the technology available.

Recommendation 3

To re-think on how we teach online/remotely. A new framework is needed for delivering training in an online/remote manner. For example, very poor and/or expensive internet connections makes it very hard to reach and engage the participants. The technology used to undertake training may vary widely (mobile phone, computer etc.).

We need to:

Make optimal use of online training opportunities (when available)

develop time and place independent training resources that can be taken home to study (see South Korean example of SSD delivery of NWP training)

Invest in how to create, deliver and assess the courses as a trainer (train the trainers), in the context of regional situation. This is desperately needed.

Recommendation 4

Investigate how to reuse and formulate material so that it can be translated into learners native language. Make use of new AI tools becoming available.

Recommendation 5

Training for the technological tools must not be over looked. It is important that all technology used aids learning rather than frustrating the learning experience for the trainer/learner.

Suggested actions

- Training support to help those starting to deliver training.
- Sharing of best practice and what has worked well (for example Calmet meetings).
- Collaboration and sharing of resources (each partner offers different expertise, infrastructure, funding and content) (EUMETCAL is an example of this).
- Encourage/empower those who are starting out on online learning to develop skills etc. by partnering with those who have more experience. (look at World Bank funding?)

Theme 6: Supporting the lifecycle of professionals: From the decision to enter the discipline, to continuous learning, to maintaining job satisfaction and competency

Recommendation 1

For the attraction to meteorology:

- a) Own and WMO publications on the importance and attractiveness of careers in meteorology and related disciplines are promoted, but this needs to be expanded to include documentation that is used on social networks as this is the medium new recruits use the most..
- b) Funding opportunities to study meteorology are suggested in countries where Universities charge for training. The funding is linked to work that needs to be done to pay back the funding. These opportunities are usually advertised on special forums but social networks can also be used.

Recommendation 2

For entry level Professional development

- a) Mentorship will be critical for development of new personnel within a NMHS as this will settle the new recruit and get faster growths and results .
- b) Formal further development should be encouraged.

Recommendation 3

For Retention strategies in the general lack of monetary funds

- a) NMHS staff members needs to be appropriately rewarded and recognized for their contributions.
- b) In the absence of growth due to administrative policies, it is suggested to look at dual career options (the administrative and the scientific career options that are equitable for each group) and policies to ensure that the scientific personnel are looked after.
- c) Ample Professional Development options needs to be explored like funded part time studies (with the time allocated to the studies), targeted short courses, conferences, symposiums etc. this can include alternative and affordable pathways to education, such as credit-sharing and collaborative degree programmes.
- d) Investigate opportunities to change policy to enhance careers like full public service to entities etc. so that the retention of staff can be become an option.
- e) Enhancement of careers that include exposure either publicly or professionally, i.e. consultancy work or international exposure on working groups, etc.
- f) Enhancement of scientific opportunities like expansion of instrumentation or computers equipment, etc. enhanced tool of the trade.

Background to the recommendations

Challenges to address

- a) Entry into Meteorology: The requirements of mathematics and science does limit the people that can come into meteorology. To make the decision more difficult, these subjects are the same requirements of doctors and engineers. (In French speaking countries the meteorologist are called engineers and might actually alleviate the problem)

- b) The training of entry level meteorologists (including forecasters) are critical so that they can function into the job
- c) The retention of experienced meteorologists is now becoming critical – especially with the great resignation that is happening after the covid experience where people realized more what they want out of their jobs.

Barriers to action

- a) In certain counties there are a shortage of learners that qualify with the mathematics and physical science required from meteorology.
- b) If there are no guidance given for entry level meteorologists, they will become frustrated and leave.
- c) Most of the time money is not available for the retention of the experienced scientists/forecasters and other options needs to be investigated. This is very true in the COVID epidemic due to funding/commercial revenue shortcomings

Theme 7: What are the content area expertise gaps within our academic teaching staff members? How do we identify and fill these?

Recommendation 1

WMO should identify current and future skills gaps within the training workforce and determine how the needs vary between regions. A more extensive survey, which is not restricted to WMO members and NMHSs, should be conducted.

Recommendation 2

Continuing professional development for the meteorological and hydrological training workforce should be encouraged in the following critical scientific areas: Earth-system science, impact-based forecasting, interpreting forecasts - particularly ensembles, data science and dealing with big data, machine learning, artificial intelligence, causal thinking, GIS and the application of real-time earth observations to fields beyond weather prediction such as disaster management. Furthermore, continuing professional development in the following non-physical science skill areas (“soft-skills”) is also encourage: science communication, forecast communication, risk assessment and management, and disaster management.

Recommendation 3

WMO should promote and aid the transition towards impact-based forecasting. This requires a change in mindset in trainers and particularly academic staff members away from “what will the weather be” to “what impact will the weather cause”. WMO should promote relevant existing publications and resources beyond NMHSs and draw inspiration from the US National Weather Services “Weather-Ready Nation” program and its ambassadors.

Recommendation 4

WMO should increase the visibility of the Global Campus and expand the courses and topics covered. “Train-the-trainer” courses should be included and promoted outside of NMHSs / regional training centers. Language of the training should be carefully considered. Interdisciplinary courses should be included and stronger alliances with closely related fields (e.g. Earth Observation) should be promoted. WMO should actively advertise how trainers and academic staff members can contribute to, and actively participate in, the global campus.

Recommendation 5

Curricula should be frequently reviewed and adapted flexibly to meet rapidly changing demands. Universities should actively collaborate with NMHSs and other employers of meteorologists and hydrologists when reviewing and developing curricula and degree programmes. It was noted that currently there can be a mismatch between what universities teach and what skills NMHSs require and also that universities take time to change so careful forward planning is required. WMO should provide universities with clear guidelines on anticipated education needs in the next 5 years.

Recommendation 6

WMO should encourage universities to develop joint degrees between physical science fields (meteorology, hydrology) and both social sciences (e.g. communication, journalism) and more technical fields (data science, machine learning). Universities should incorporate soft skills (scientific writing, science communication, research planning) into their single- subject degrees. WMO should provide clear guidance on the most relevant additional skills and should encourage universities and training centres to consider future training needs during the recruitment of staff.

Recommendation 7

WMO should promote and aid collaborations between academic staff members in traditional fields with those in complementary fields. WMO should acknowledge that the current meteorological and hydrological training workforce will not be able to teach all skills required in the future and that collaboration is essential. Furthermore, WMO should acknowledge that the training group needs to evolve to become more diverse and interdisciplinary in the near future.

Recommendation 8

WMO should acknowledge that increasing the skill level of trainers and academic staff members (as well as those we educate) makes these individuals highly employable outside of our field. WMO should ensure that the highly skilled workforce can be retained with the meteorology and hydrology field.

Recommendation 9

WMO should acknowledge that academic staff members and trainers lack time to develop new skills and often are required to teach a topic which they are not expert on. The WMO should require trainers and academic staff members to meet basic competencies and provide flexible training courses, for example MOOCs, to ensure this can happen.

Recommendation 10

WMO and its members should be aware of potential, future challenges resulting from the COVID-19 pandemic and the enforced sudden change to online training. Students' whose education and training was disrupted may lack certain subject specific skills or competencies. Furthermore, such students and learners may lack social skills, team working skills, and personal interactions skills as a consequence of studying alone and / or remotely for an extended period of time.

Goals/Desired outcomes

- The myriad challenges imposed and new knowledge and skill requirements created by rapid changes in scientific methods and operational requirements are met for both learners and the education and training staff who teach them.
- Institutional systems and policies are in place that help to address the ongoing requirements to respond to such fundamental changes to educational requirements.

- WMO Members work together to ensure that gaps between opportunities for capacity development in these growing new areas are minimized

Theme 8: Update to the WMO Capacity Development Strategy

Recommendation 1

Make the WMO Capacity Development Strategy more robust as it pertains to education and training.

Recommendation 2

Seek input from the RTC's, Universities and member states to collect challenges, needs and roles and responsibilities in capacity development

Recommendation 3

Ensure the Capacity Development strategy be future looking and collaborative in nature to promote innovation in training development and delivery.

Recommendation 4

Emphasize the need to be inclusive of the numerous languages of the world. Seek professional translators for the six official UN languages as well as make freely available to the RTC's for further translation.

Background on the theme:

- WMO Capacity Development cross cuts nearly every activity and programmes within the organization. WMO Education and Training provides critical services to aide in developing capacity in NMHS.
- The current Capacity Development Strategy was last written in 2015 and is out of date. Significant changes to WMO governance living in an evolving world requires an update to the strategy.
- A Task Team within the EC Capacity Development Panel has written a draft of the new CDS and request feedback and suggestion from the Education and Training community to ensure it is relevant and accurate in our future world.

Challenges

- Reinvention of the same training topics.
- Sorting through the numerous training opportunities and programmes for NMHS's
- Limited time for training
- Technological requirements
- Financial constraints
- Emerging technologies and weather service (IDSS, Space Weather, Climate change)

Needs and potential solutions

- Collaborative methods of training development and delivery to reduce repetitive development of similar training materials

- Innovative and cost saving technologies for virtual training delivery
- Build off of lessons learned from the pandemic. Don't go back to the way it was.
- Develop effective online/virtual training programs that combine the positive aspects of distance learning with local hands-on training
- Find balance between distance learning vs face to face or hands on training i.e. blended learning solutions
- Seek out solutions for language translations of training materials

Role of the WMO

- Enable opportunities to collaborate and share. Help to link local and regional needs and institutions to provide solutions.
- Provide the “global view” and to identify best practices and issues that NMHS's are facing.

Theme 9: How do we identify the critical regional needs for the professional development of operational staff? How do we ensure that appropriately qualified participants attend our training events?

Recommendation 1

When planning education and training activities, it is necessary to address critical regional needs identified through best practices shared by WMO Members and through WMO governance structures and the WMO Community Platform.

Recommendation 2

WMO education and training institutions should introduce assessment procedures for ensuring that the choice of training participants is in compliance to the development strategies of Members served. Member institutions require support in identifying the most valid assessment methods.

Background to the Recommendations

Identify the Critical Regional Needs?

- Two direction communication needed between Members and WMO/RTCs and affiliated institutions is critical
- Shift Members paradigm on assessment
- Proposal – changing the emphasis from training needs to Identifying Opportunities for Development for career progression

Identify the Critical Regional Needs?

- Increase the human capacity of Members/RTCs/WMO to effectively Identify Opportunities for Development
- Proposal - in the future WMO deliver Assessment Training Course (similar to past Train the Trainer Courses) including
- Technical aspects of assessment
- Assessment communication skills

Ensuring That Appropriately Qualified Participants Attend Our Training Events

- The help insure students have the maximum opportunity for success in completing a course/program the following recommendation are made (where appropriate).
- For advanced courses the use of pretests or prerequisite courses to be able to register for a course
- Use a blended learning course approach of a course/program where the completion of the first part will allow the student to progress to the next portion of the course.
- Also doing this is informative in identifying additional Opportunities for Development within the Region

Additional outcomes

- Members want to integrate more WMO training into their annual training plans
- They are looking for easy access to the different types of training available in the annual program of the WMO with registration details
- To have access to information regarding the planned activities early enough to incorporate them into the next years training plan.
- Member are looking for a database of experts for teaching different topics at a regional/global level
- How to get compensation for non-staff expert trainers
- There was a concern expressed that focusing on the operational staff would neglect the Technical/IT staff

Region I Working Group, English

Recommendation 1

Recommended that the English RA1 RTCs that do have facilities partner with other RTCs to assist them in running online courses.

Recommendation 2

Recommended that those RTCs that are confident with online training should assist and mentor those that are not confident and do not know how to build online training material.

Recommendation 3

It is recommended that the non-participation of learners is investigated so that the true reasons are known and might be solved.

Recommendation 4

It is recommended that online training is recorded for those participants that cannot attend.

Recommendation 5

It is recommended that each RTC/Training Institution that does not have online facilities investigate the possibilities within their country to partner with online training groups that do have the facilities.

Recommendation 6

It is recommended to exchange lecturers for online training and get monetary support for the exchange.

Recommendation 7

It is recommended that the RTCs should liaise with all governmental agencies or policy makers to help in providing these facilities.

Discussion leading to recommendations

1. Internet connections – are not stable or nation-wide.
2. Server shortage to host online material
3. Participants do not attend the lessons. How to manage this problem? Video on, recordings?

Sharing:

SA and Egypt willing to share online facilities by creating formal partnerships.

Participant challenge – why are they not attending? If personal – can solve the issues. Cost of data can be a problem – need sponsorship. Electricity rationed. Required equipment not available. Home activities interfere with online training.

Practical online training – videos etc.

Other countries willing to share? In-country with Universities.

Lecturer exchange/sharing possibilities for online training.

Regional Working Group RA I, French

Recommendation 1 (to WMO)

Regularly train teachers to the use of teaching methods and technological tools needed to teach and assess at a distance. These regular trainings could also make it possible to evaluate the methods and tools used by the participants and for them to acquire more appropriate methods and tools.

Recommendation 2 (to WMO)

Facilitate a forum for sharing experiences and resources between centres and universities on pedagogical methods, technological tools and training content.

Recommendation 3 (to WMO)

Develop a guide of advice and good practices for online assessment of acquired knowledge (methods and tools).

Recommendation 4 (to training organizers)

Encourage blended training both in terms of delivery modes (distance, presence) but also in terms of types of training sessions (synchronous versus asynchronous) to meet all needs and work around technological issues.

Recommendation 5 (to training organizers)

To minimize access issues (power cuts and internet outage) during distance learning, allow offline access to resources and training activities, for example by making them available on SD card, CD, external hard disk.

Recommendation 6 (to training organizers)

Broaden the scope of distance learning towards practical aspects and not only theoretical ones (e.g.: in forecasting, numerical weather prediction...)

Recommendation 7 (to training organizers)

Link acquired competencies during training to the WMO competency frameworks in order to promote the recognition of training between countries, in particular through the use of micro-credits and OpenBadges with standardized metadata.

Recommendation 8 (to training organizers)

Promote and support the motivation of experts to teach, both at a distance and in person, for example by training them, accompanying them in designing their courses and recognizing their skills:

- organizing very practical training in instructional design oriented towards multi-modal training, management and animation of a training course
- delivering standardized OpenBadges to recognize their skills as trainers.

Recommendation 9 (to WMO and all centres)

Encourage collaboration and mutual aid between training centres and universities, for example:

- creating a WMO cloud space to exchange training resources
- Provide content reference documents to teachers to build their teaching in terms of contents
- Organise training for teachers on new topics (such as machine learning, artificial intelligence, etc.)

Recommendation 10 (to WMO)

Promote the continuous training of forecasters from countries subject to similar extreme situations (e.g. Medicanes) through feedback workshops on recent situations. On the other hand, rely on the existing French-speaking forum to promote sharing of experience in semi-real time, and create similar forums in other languages.

Recommendation 11 (to WMO and all centres)

Announce the training courses offered, well in advance, in order to organize the work of the teams to allow participation in these courses. Currently, announcements are often too late to participate, due to the workload of teams.

Support, in material and legal terms, the creation of a training centre specific to IMN of Tunisia.

Regional Working Group RA II, English

Recommendation 1

WMO training programmes need to expand from meteorology and to encompass the earth system approach viz Ocean, Water, Hydrology and Cryo and similar structured pedagogy education programs evolved in the field of meteorology can be expanded and linkages can be given to existing training/education in other disciplines of Earth System.

Recommendation 2

Training Need Aspect is important. WMO can take the lead to develop a questionnaire on Training Need Aspect which each member country can follow to be more effective. To be effective these trainings can be more relevant to local /regional level

Recommendation 3

WMO is conducting a 4-year survey which is in progress can encompass in addition to evaluation and feedback from trainees, it can have feedback from respective PR on the effectiveness of training to the concerned attendee after 3 to 6 months. We understand WMO has been doing such practice which can be followed by RA

Recommendation 4

Language barrier is one impediment during regional training programmes by attendees. Here WMO can suggest methodology to have correct nomination from PR

Recommendation 5

WMO has a wealth of information submitted by RTC on annual training programmes including web links. Recommended to have easily accessible tools/methods in WMO website with keywords. This will also help RTC to develop or enhance new/existing training practices WMO Global campus needs to be popularised to member states and number of visits to this site to be improved

Recommendation 6

Recommend to have forum of Alumni of training attendees within RAs and to be linked to globally to share knowledge experience expertise without hindrance of language as a barrier

Background to Recommendations

The Capacity development is the most important ways WMO can bridge gaps in observation to services to reach science to the society. During the discussion of RA II members the training of human resources is required to apply new skills and knowledge to implement new technologies and to make service delivery improvements

The meeting noted that evaluating the impacts of training is a critical and Impact evaluation is described in the Guidelines for Trainers in Meteorological, Hydrological and Climate Services (WMO-No. 1114)

Discussion on SYMET Working Group Themes were on:

- Technological barriers to online learning and using partnerships between online education providers to overcome them.
- Supporting the lifecycle of professionals: From the decision to enter the discipline, to continuous learning, to maintaining job satisfaction and competency.

Recommendation 1

Enhance institutional communication within NHMSs, RTCs and universities encouraging active participation of education and training representatives in regional training meetings.

Recommendation 2

Work forward to establish a regional training network coordinating efforts, resources and experts and identifying funding sources

Recommendation 3

We recommend further discussion on a credit system common which might be recognized and adopted by the regional NHMS.

Recommendation 4

Enhance interaction between universities and NHMS encouraging regular dialogue about changes in operational services and research which might require modifications of meteorology education and training programmes.

Recommendation 5

Enhancing collaborations between universities (regionally and globally) to work on creating or adapting existing education programmes to local needs in order to keep up with IT advances and meet WMO standards.

Recommendation 6

Support translation to different languages and adaptation to local cases of existing shared resources and the co creation in native languages of new resources

Background to the Recommendations

This institutional diversity in the group gave us the possibility of discovering an ample variety of needs in the region and opened the region to future collaborations.

Which thematic areas did you choose to discuss?:

Our discussion was first started under

Theme #9 : How do we identify the critical regional needs for the professional development of operational staff? How do we ensure that appropriately qualified participants attend our training events? This thematic area was the most oriented towards a regional discussion which could encompass any other topic of interest which could emerge from the discussion group

Opportunities

The Ibero-American RTC Meeting held in Lima, Perú was a key event for our region creating the bases for a network among RTCs. The meeting was rewarded by the Santiago Declaration (2018). The network should now be extended to include other institutions and countries and realise a really collaborative work.

Ways of Identifying training needs

- One of the ways national and regional training needs have been identified in the past was through surveys. There is a past experience of competency based survey

completed by all the members of the region which identified common training needs. The results were shared with the different RTCs and constitute an important source of information to orient training different sectors within NMHSs.

- NHMs Strategic Plans for the future periods are another source to determine education and training needs.
- NHMSs also use international projects to identify training needs within the collaborating countries and which are common to the group. These projects are also identified as a possible funding source to develop and deliver required training for the region. (Examples are CLIMANDES, ENANDES, EUROCLIMA and BRAVA)
- WMO Train the Trainers Spanish course delivered in 2021 is a third source of information where common and particular training needs to a region can be identified. It also creates the possibility to work in collaboration to create regional training on common topics.
- The WMO Marine course delivered in South America was later adapted by the Marine Service in Chile and delivered to other members of the staff which had not been able to participate in the first edition and also reorganized it to address needs of other components of the Marine Service. The course helped the institution to identify different needs including training which were included in future plans for the institution. The regional course also resulted in a new collaboration with the Marine Service of Colombia.

Potential Directions

Training needs Identified by countries

The new technologies, methodologies and approaches used to deliver forecasts have created new training needs in the region which include

- Continuous life cycle training which is constantly being updated to meet international standards and keep up with IT innovations.
- Automatic weather service maintenance
- New computational modelling techniques, data assimilation, Machine learning, data mining-data science, HPC-cloud computing
- Training in the use of the new satellite products, not only focused on weather monitoring and forecasting, but also as part of a real time earth observation to be used in aid of an
- impact based decision support system
- Impact based forecasting techniques, there is an increasing demand for trained personnel particularly on account of the increase of extreme weather events and the impacts they are having on society.
- Soft skills: New communication skills to interact with different users and create tailored products; project impact assessment; interdisciplinary project management;
- Disaster Risk Reduction, social impact, vulnerability, exposure
- Credit system. Some institutions use a credit system to promote staff, hence trainees would benefit more from training delivered by other institutions if courses were under some kind of credit system.

Collaboration:

Each of the institutions briefly commented on the different ongoing training programmes which could be available to other institutions and countries. There are several courses

available for graduate and undergraduate students offered by universities and by Gulich Institute (which is specialized in satellite training)

More feedback between universities and NWS is needed. Though universities deliver education to comply with WMO standards, there is not always a close link between teaching and the research being developed by professors and their groups. Moreover, operational areas of particular interest to NWS, such as marine meteorology, aeronautical meteorology or polar meteorology, which are important for our region, lack university experts and therefore have serious training difficulties in these areas. A third gap identified is that NWS update technical or operational techniques to follow international standards but universities are not fully aware of these changes thus courses delivered by the university are not updated to meet NWS needs.

On the other hand, there are experts coming from universities in the field of water resources management, risk management and hydrological disasters, hydraulic and river engineering, hydrological simulation, hydrological forecasting and warning systems, new technologies in hydrological measurements, water security, eager to train in these fields.

What steps might be required:

- Increase communication between ARIII and ARIV RTCs, with the WMO Permanent Representative in America, and among training institutes
- Identify hydrology training needs within the different NHMS in AR III and IV
- Link experts from different institutions within thematic areas of priority interest for the region.

Proposed future steps:

- Compile list of training institutes within the region
- Series of webinars where different institutions present their strengths (areas of research/training/expertise), opportunities (offered to the region) and needs(which could be addressed by other institutions in the region). Invite all institutions identified to attend these webinars.
- Promote regular meetings between NHMSs, RTCs and different training providers (universities, institutes, local, regional and/or international) to enhance collaborations, keep up to date with training needs in the region, create necessary adjustments to new technologies, methodologies, etc. These meetings should be at least once a year.
- As part of an activity within the Leadership Course delivered by Aemet, RTC Argentina will present the outcomes of this regional training discussion group to the Latin American NHMSs leaders.

Who is willing to take responsibility to contribute (and contributions they can offer):

SERVIMET - Chile: is willing to collaborate and offers

IMO/WMO audit process and ISO:9001/2015 certification in maritime weather forecasting

GULICH INSTITUTE - Argentina is willing to collaborate and offers:

- scholarships to complete master or PhD degrees (geomatics and space systems) for Latin American countries covering priority topics identified by WMO or WMO RTCs
- funding possibilities for training development

RTC - SMN - Argentina is willing to collaborate and offers:

- experts and developed courses on different areas including: Radar, satellites, automatic weather stations, atmospheric observations, instrumental maintenance, data management, aeronautic meteorology and observations, climate extremes, climate services
- social sciences group with high skills in communication - Guide to Disaster Risk training

RTC - UBA/DCAO - Argentina is willing to collaborate and offers:

- experts and courses on: Space Weather, climate change, climate extremes, atmospheric modeling, agrometeorology, statistical and dynamical downscaling, seasonal forecasting, satellites, data assimilation and other courses within the educational atmospheric and oceanography programs

RTC - FICH- Argentina is willing to collaborate and offers:

- Courses and experts on: Integrated flood management; Integrated water resources management; Sustainable water management. Water Resources Engineering (master degree). In the near future, Sustainable Water Management (online master degree).

RTC-PERU is willing to collaborate and offers:

- Funding possibilities through ongoing collaborative projects

DRAFT

Regional Working Group RA-IV English

Recommended Action 1:

The adoption of new technologies within the workflow of personnel should be supported by dynamic training which may include the opportunity, for the trainee, to further share the acquired knowledge and developed competencies with others, as per train the trainer activities.

Item: Cultural or individual idiosyncrasies may limit the adoption of new practices

Opportunities:

- Applying 'on-the-job' practices within a regional or local focus;
- Expectations regarding active participation.
- Follow up opportunities to share the acquired knowledge through involvement in train-the-trainer activities;
- Training should be interactive, short and focussed
- Availability of training in multiple languages is required

Examples: Regional Focus groups and virtual forums

Recommended Action 2:

Opportunities to using cloud technology for other and more diverse training should be considered and include support in its use

Item: Technology available but not accessible or easily integrated

Opportunities:

Use of cloud technology when applicable, available or required has increased as a function of the pandemic's impact on work and training practices done remotely.

Recommendation 3:

Identifying and sharing current expertise in the ETR community and Technical/Scientific Subject Matters could be considered if not currently available (ex: list of experts)

Item: Impacts of retirements on the availability of expertise within NMHSs and the training community

This situation is of concern for some organisations in RA-IV in particular in a time of changing technologies and functions and in the context of adopting an earth system approach.

Recommendation 4:

Increase promotion of in-house/regional activities within regional forums (ex: Regional meetings and through ETR Focal points and Capacity development Focal points) in addition to that of the WMO Global Campus.

Item: Knowing what resources are readily available to support training

Opportunities:

The WMO Global Campus' calendar has proven to be an effective way to inform about training initiatives if its existence and access are known. The number of participants increase if training is relevant and accessible to a wider community.

Recommendation 5:

It would be beneficial if the Competency Frameworks include or refers to toolkits that include training and reference material (such as WMO-1205, 1209 and training available through the Global Campus, RTCs or Technical Commissions) and ways to assess training.

Item: Guidance as to what training opportunities are available to support the development of competencies

Opportunities:

The twinning of competency framework for aviation meteorologists with training and assessment toolkits have provided useful references for the development and delivery of training. In this situation, personnel must demonstrate that they understand and can perform functions related to the job description

Recommendation 6:

Lessons learned identified through CALMet (and potentially other efforts) and innovative practices in training delivery could be increasingly shared and promoted within the ETR Community at both the international and regional levels and other stakeholders developing and delivering training.

Item: Online and blended learning

Opportunities:

Forums such as CALMet have provided opportunities to exchange lessons learned during the last several months. Reference material available through the LEARN Portal, and the WMO Global Campus Innovation publication can help support changes in training practices.

Recommendation 7 :

As SYMET occurs every 4 years, and the water, weather and climate community will need to address many challenges regarding the evolution of its infrastructure, services and policies, we suggest that an interim update on the progress made since SYMET-14 could be considered before the next SYMET (document, short online session?). This would enable the following:

- Follow up on recommendations from SYMET-14.
- Demonstrate the high-level commitment to education and training.
- Support and foster continued collaboration within the ETR community and programs, the exchange of relevant information and the promotion of ETR practices and resources

Regional Working Group V English

Recommendation 1

The wider community needs to recognize just how much education and training has shifted in the past 2 years. We should embrace our learnings and apply them into the future.

Recommendation 2

When delivering teaching for other countries or agencies, member countries should find a mode of delivery that's accessible to all the students.

Recommendation 3

Give more emphasis to the life cycle of instructors. Consider the skill set of trainers and assessors and think about how to attract the next generation of training professionals, and how the organisation will support them.

Recommendation 4

Foster greater sharing of plug-ins and tools.

Recommendation 5

Ensure support for new pedagogical approaches and the creation of assessment tools.

Recommendation 6

Disseminate more information on sharing portals, including the WMO Global Campus!

Background to the Recommendations

Theme 1. Sharing resources

- The issue is that shared resources are often not able to be integrated into the students' existing Learning Management Systems.
- We should use technological advances to increase sharing, e.g. "gather.town".
- CALMet is a great forum for sharing!
- There was support for getting credits from other training centres, consistent with increased flexibility. (this also relates to theme 3)

Theme 4. Pedagogical approaches and blended learning

- Challenges in developing learning material within a LMS, and evaluating the effectiveness of online training, especially on technical topics
- During lockdowns, assessment of on-the-job training was done remotely by watching the assessees' activities on webcam and following up with a "vive" assessment.
- The group noted first-hand the large amount of time needed to develop online training resources, and the advantages and disadvantages of distance learning.
- Over the past two years the pandemic has forced people to see the benefits of online learning. People are now expecting more flexibility in their learning activities and general work.
- During the pandemic, distance learning was sometimes just a version of face-to-face learning repackaged on Zoom/Teams etc. We really need to move towards proper blended learning.
- Having been forced into some form of online learning, organisations should now reflect on what's working and what's not. They now have better plug-ins, authoring capability, portability and mobile-friendly apps.
- Flipped classes are seen as a very effective method!
- "Just-In-Time Teaching" and "constructivism" were also seen as effective methods of learning.
- Instructors should give online students opportunities to converse outside of planned classes (like meeting and chatting with others in the corridor).

5. Technological barriers

- The group learnt of example from students from a SIDS in the southwest Pacific region. Internet bandwidth was not good (it could be affected by heavy precipitation), meaning the students had to watch sessions twice. The students were expected to study a BIP-M course while working operationally.

- It was noted that good internet connectivity can be costly.
- When taught remotely in their home country, students from SIDS often have under-powered tools to display imageries and learn from.
- Communications about funding of face-to-face students can be erratic, which can be exacerbated if the learners are using only mobile devices.
- Time differences between instructors and learners in other countries are another barrier.

6 Lifecycle

- During the pandemic it has been critical to manage student health and well-being. Students have often been isolated and vulnerable, and pastoral care is essential.
- Changes in learning in recent years have reflected the broader changes in society, with increased flexibility and more people working from home

7. Gaps and 9. Regional needs

- Many NMHS's face huge operational demands. Getting instructors is difficult since they often come from technical divisions doing operational work, and need many months to familiarize with the material.
- Getting skilled competency assessors is a big issue due to the long "spin-up" time.
- meteorology is moving more towards "impact-based forecasting" which requires new skills of trainers.
- Training is seen as a vehicle of change. It's all very well to update warning systems but unless we are supported and able to re-train staff, the change will not happen.

Regional Working Group, RA-VI and II Russian

Recommendation 1

Improving meteorological and hydrological services requires developing the skills of NMHS personnel to transform meteorological and hydrological data (forecast model outputs, reanalysis data, including in situ data, remote sensing) into meteorological and hydrological products and services.

Such services require, as part of the NMHS, at least:

- professional forecasters with their own competencies, which are well known and regulated, including by WMO documents
- specialists in information technologies, technologies of information transmission systems
- as well as professionals who are directly involved in the provision of meteorological and hydrological services to sectors of the economy, municipalities and the population (communicators and administrators) with their specific professional and "soft" competencies.

This is practically a new multidisciplinary group of specialists in the hydrometeorological service, professionals who must have at least sufficient knowledge and skills in the field of:

- basic concepts of hydrology and meteorology,

- the impact of meteorological and hydrological phenomena on certain sectors of the economy and population groups, including their vulnerability associated with hazardous hydrological and meteorological phenomena
- management of natural risks associated with hazardous hydrological and meteorological events, including the definition and improvement of contingency plans
- creating specific hydrological and meteorological products that meet the needs of end users, transforming meteorological and hydrological data into meteorological and hydrological products and services, as well as mastering methodologies for determining the changing requirements of users, methods and technologies for providing services
- developing and delivering, in partnership with users, specific applications to facilitate the understanding and use of meteorological and hydrological products and services
- broad communication skills of working with end users and knowledge of social psychology.

Recommendation 2

It is assumed that training and advanced training of such specialists should be carried out within the framework of separate interdisciplinary educational programs "Provision of hydrological and meteorological services", as well as through self-education in the WMO Global Campus system.

It seems that this is an important component of the response of the meteorological education system to the challenges that humanity poses in the context of rapid changes.

Recommendation 3

- Approve the establishment of the Board for the further development of the WMO Global Campus

Recommendation 4

We support proposals for offsetting loans received in the system of non-formal and informal education

Recommendation 5

Consider/promote implementation of the Work-Based Learning model approach for degree programmes developed jointly by NMHSs and universities

Recommendation 6

We believe that practice-oriented teaching at universities requires a deeper immersion of teachers in the operational work of the NHMS and scientific organizations - the organization of courses for teachers at the enterprises of the NHMS and scientific organizations becomes a need for their development and more effective training of students

Recommendation 7

Approve capacity development strategy

Recommendation 8

We propose to conduct, together with human resources services, a preliminary assessment of the state of the personnel potential of the NMHS in the region. For this purpose, we propose to conduct a qualified questioning and interviewing of NMHS employees on the topics of advanced training that are most relevant to them. And also, more clearly formulate the requirements for the initial qualifications of students in a particular course

Recommendation 1

Eumetcal members, EUMETSAT, ECMWF, Copernicus entities, Universities, RTC's and private entities in RA-VI are strongly encouraged to take tangible action to prepare resources that can be shared, and to share education and training resources between each other and globally - within the Global Campus framework [the global campus resource sharing process will be really useful here]. Eumetcal is invited to take a role to promote sharing across RA-VI.

Use simple english / original language

Use generic diagrams that can be reused and adapted

Make cases easy to adapt to other parts of the work

Make the module / slice / lesson short [10mins!]

Don't hide your light - take the time to promote your resources! In Global Campus but also on social media, European joint training bulletin, twitter, instagram, facebook, telegram, whats app and in your networks ...

Recommendation 2

Use the opportunity afforded by YouTube to enable sharing where possible.

Recommendation 3

Training institutions are enthusiastically encouraged to use open licenses such as creative commons, that allow for derivation. (both for the material they produce and as input to the resources developed) - this makes resources reusable.

Recommendation 4

WMO Secretariat to support the finalisation the Competencies for Agriculture and Air Quality.

Recommendation 5

Explore Erasmus+ programme and how it might be used to enable Global Campus

Background to the Recommendations

Sharing resources really matters and we think we could do much better. We are good within our little networks but there is much scope to share more widely. These resources can be used in official / institutionally supported training (class/cohort based and self-paced) as well as self-directed.

There is quite some scope to increase the officially supported self-paced learning - but language is a big barrier here (most resources are in English).

Resources need to be developed in ways that make translation and reproduction / derivation in another language easier. The best resources are developed in our own language and with a local context (meteorology, warning systems etc). We need to be able to make derivations from good source materia. This requires materials that grant permission to derive and are easy to derive (edit).

- Use simple English / original language
- Use generic diagrams that can be reused and adapted
- Make cases easy to adapt to other parts of the work

- Make the module / slice / lesson short [10mins!]

Automatic translation can help but in some technical areas this can cause problems - watch out most for materials that relate to operational warnings and decision support.

Resources created in youtube are of particular interest - short how-to videos, these can have subtitles in the original language that can then be translated. These can be for technical topics as well as for public consumption. - paste link on WMO website or RTC webpage and easy to search link on website or webpage.

Micro credentials - at this time we have no framework or system to work within - how to start sharing between training organisations. Connecting resources to the competency frameworks is an important first step. Missing competency frameworks for agriculture and air quality are a barrier here. Has been explored in other working groups.

The European Union Erasmus+ programme is well established and supports the development of education and training - there may be quite some scope to explore projects that help our community meet its needs. Also initiatives are available with small money via EU-COST, EGU, EMS, EU-Horizon?

It may assist to tag resources with that language of origin - some people also use them to learn language.

We have a more diverse / broad background of people coming into the pipeline (geography, environmental science) this is a good thing (board background) but operational centres have to address the variation in the people that get recruited.

Data science and machine learning is exploding in our area now - we saw this a few years ago - it may be that we did not respond dynamically to the initial signals - but we are on it now. Many of the resources we prepare are cloud based now - which enables and limits sharing. AI translation will help in the future. Resources need to be designed for ease of translation. Hackathons on data have been interesting, hackathons on training resources may be interesting (EUMETSAT with Copernicus will try something in 2022). Very Python and Jupiter based - trainhub.eumetsat.int is one example of a notebook library.

Appendix C: International Advisory Committee for SYMET-14

Members of International Advisory Committee

Co-Chairs: *Dr Anna Timofeev*
Professor Andrew Charlton-Perez

Dr Anna Timofeeva

Executive Director of the WMO RTC in the Russian Federation
Russian Federation

Mr Omar Chafki

Director, Directorate of National Meteorology
Morocco

Professor Andrew Charlton-Perez

Joint Head of Department of Meteorology,
University of Reading

Mr Christophe Cudennec

Professor, Institut Agro, Agrocampus Ouest, IAHS
France

Dr Somenath Dutta

Scientist-F & Head of Meteorological Training Institute (MTI)
India

Dr David Farrell

Principal, Caribbean Institute for Meteorology and Hydrology (CIMH)
British Caribbean Territories

Dr Winifred Jordaan

Head of the Regional Training Centre
South Africa

Jennifer Milton

Retired Director, Canadian Meteorological Centre Operations Division,
MSC Canada

Prof Christoph Mueller

Director, Institute of Plant Ecology (IFZ)
Justus Liebig University Giessen

Prof Peter Odjugo

Professor, Director of RTC Nigeria
Nigeria

Mr John Ogren

Chief Learning Office, U.S. National Weather Service
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Dr Mary Scholes

Professor, University of the Witwatersrand, Johannesburg
South Africa

Mr Roger Stone

Director, Centre for Applied Climate Sciences
University of Southern Queensland
Australia

Dr Zhiqiang Wang

Deputy Director General
China Meteorological Agency (CMA)
China

Mr Christopher Webster

Meteorological Service of New Zealand

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