WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM
World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
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11 October 2023

Annex: 1 (available in English only)

Subject: Conference Proceedings

Dear Sir/Madam,

I wish to refer to the Regional Conference on the Future Role of National Meteorological and Hydrological Services (NMHSs) which took place in Geneva from 2 through 4 November 2022 at WMO Headquarters. It was an occasion marked by insightful discussions, collaboration, and a shared commitment to addressing the pressing challenges faced by NMHSs in the Region.

I am delighted to inform you that the Conference Proceedings, including a concise briefing and a set of vital recommendations, are now available for your review and consideration. These documents encapsulate the collective wisdom and expertise shared during our conference, and they hold the potential to shape the future of NMHSs and, by extension, our shared commitment to sustainable development.

Our discussions delved into critical issues such as infrastructure for research and services, the core role of NMHSs in research activities, services to support their core functions, the State of Climate in Europe report, engagement with public, private, and academic sectors, leadership and management of NMHSs, and the strategic and legislative aspects. The resulting recommendations, meticulously crafted through the exchange of ideas and experiences, offer a roadmap to navigate these challenges effectively.

I would like to invite each of you to take the time to study these recommendations carefully, consider how they resonate with the work of your respective organizations and constituencies, and recognize the opportunities they present for collaboration and synergy. Our collective effort in implementing these recommendations can help drive a new era of excellence in meteorological and hydrological services, ensuring that we remain at the forefront of addressing weather and climate challenges.

As we embark on this journey towards implementation, I would like to extend my heartfelt gratitude for your unwavering commitment to our collaborative endeavours within the WMO community. Your dedication and expertise are invaluable assets as we work towards a sustainable and resilient future for our regional community and, indeed, the global community at large.

To: Permanent Representatives of Members of Regional Association VI (Europe)

cc: Speakers of the Regional Conference on the Future Role of NMHSs
Hydrological Advisers

Please do not hesitate to reach out directly to the Regional Office for Europe at roe@wmo.int should you have any questions or require further information regarding the Conference Proceedings and recommendations.

Thank you for your attention and your continued partnership.

Yours faithfully,

Prof. Petteri Taalas
Secretary-General

Ref.: 21377/2023-L4 MS/ROE

Ref.: 21376/2023-L1 MS/ROE

REGIONAL ASSOCIATION VI (EUROPE) CONFERENCE

FUTURE ROLE OF NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES: LEADERSHIP AND MANAGEMENT

GENEVA
and via ZOOM
2–4 November 2022

CONFERENCE PROCEEDINGS

Group photo, 2 November 2022, Geneva, WMO HQs

DISCLAIMER

CONTENTS

INTRODUCTION

Background

The Conference Proceedings document summarizes the conclusions, key messages, and recommendations of the "Conference on the Future Role of National Meteorological and Hydrological Services", held in Geneva from November 2–4, 2022. It highlights in-depth discussions on critical Weather, water, climate, and environmental issues. Additionally, it focuses on the Future Role of National Meteorological and Hydrological Services, showcasing a collaborative event that involves a wide range of stakeholders and organizations dedicated to advancing meteorology and hydrology efforts.

The "Conference on the Future Role of National Meteorological and Hydrological Services" was convened by the WMO Regional Association VI (RA VI) with the valuable support of the WMO Secretariat, notably the WMO Regional Office for Europe. The event delved into pivotal subjects encompassing leadership and management, legislation and strategy, infrastructure, and public-private engagement within the realm of meteorology and hydrology.

Objectives

The primary objective of the Conference Proceedings is to provide a comprehensive record of the discussions, presentations, and outputs of the Conference. It serves as a valuable resource for stakeholders, policymakers, and researchers to delve into the Conference's objectives, key findings, and recommendations (ref. Annex 1), thus fostering ongoing progress in the field of meteorology and hydrology with the view to support the implementation of various strategic objectives and resolutions set forth by the WMO, including the Unified Policy for the International Exchange of Earth System Data.

The Conference Proceedings document features the launch of the State of the Climate in Europe 2021 report (WMO-No. 1304), a flagship publication jointly produced by the WMO Regional Association VI and the European Centre for Medium-Range Weather Forecasts (ECMWF's) Copernicus Climate Change Service. To access the full report, please refer to *State of the Climate in Europe* report (WMO-No. 1304)

The agenda for the conference, including details of all presentations, can be found on the event site hosted by the World Meteorological Organization (WMO) at Regional Conference of the RA VI on the Future Role of National Meteorological and Hydrological Services: Leadership and Management and Launch of the 2021 State of the Climate in Europe Report | World Meteorological Organization (wmo.int)

Venue and Attendance

The conference took place from 2 to 4 November 2022 in Geneva, Switzerland, with approximately 300 representatives from WMO RA VI Member States, United Nations agencies, the European Commission, and regional private partner agencies, having the option to attend both in-person and online.

OPENING AND KEYNOTE

Roar SKÅLIN, RA VI Acting President

Roar Skålin, born 1964, first joined the Norwegian Meteorological Institute (Met Norway) in 1997 as Head of the IT division. In 2000, he became Director of Information Technology. He held this position until 2012, when he moved to the Research Council of Norway. Since 1 January 2017, he has been Director General of MET Norway. Roar Skålin holds an MSc and Dr Ing. in Mathematics from the Norwegian University of Science and Technology (NTNU) and an Executive Master of Management from the Norwegian Business School. He started his professional career in 1988 as a research scientist and project manager in applied mathematics and high -performance computing at SINTEF, a Norwegian contract research institute.

WELCOME REMARKS

Keynote: WMO KEY PRIORITIES

Petteri TAALAS, WMO Secretary-General

Key messages

- The World Meteorological Congress is set to make a final decision on the reform of its Constituent Bodies in 2023, aiming to enhance the effectiveness of its operations and decision-making processes.
- Discussions have been held with the European Commission and leading scientists to establish a new Centre with powerful supercomputing resources for high-resolution climate modelling, demonstrating the commitment to advancing climate research and modelling capabilities.
- The WMO, mandated by the United Nations (UN) Secretary-General, is preparing a plan for Early Warning Services, investing up to 1.5 billion dollars in basic infrastructure and communication systems, emphasizing the importance of timely and accurate Weather warnings to minimize impacts.
- The UNFCCC COP 27 at Sharm El Sheikh will handle the implementation plan for Early Warning Services, with support from key countries and a significant budget allocation of up to 40–50 billion dollars per year, underscoring the global commitment to addressing climate-related risks and vulnerabilities.
- A proposed joint venture between the WMO and organizations such as the UNDRR, UNESCO, FAO, ITU, and the Red Cross aims to facilitate knowledge dissemination and risk reduction in the context of Early Warning Services, emphasizing the need for collaborative efforts to address climate risks.

- The UN Water conference in March is expected to produce concrete outcomes related to an integrated water and climate approach, improved water data and information, and protection of glaciers, highlighting the importance of water management in the face of climate change.

- The WMO's upcoming water report will provide detailed information on changes in sea level, rainfall anomalies, stream flow, and water storages, offering valuable insights into the impacts of climate change on water resources.

- The implementation of the Multi-Hazard Early Warning Systems (MHEWS) is a crucial component in minimizing the impacts of hazardous weather events, with 60% of RA VI having appropriate MHEWS in place, but significant challenges and limitations remaining.

- An Executive Plan for Early Warning Services (EWS) is in place, awaiting adoption at the UNFCCC COP 27, highlighting the readiness to enhance Early Warning capabilities and response mechanisms.

- Improving ground-based observing systems is necessary, particularly with the goal of doubling energy supply from low emissions sources by 2030, and the Systematic Observations Funding Facility (SOFF) supported by a Steering Committee plays a role in funding investments in this area.

- The presence of power plants, hydropower dams, and nuclear power plants in high-water stress areas (33%, 26%, and 15% respectively) emphasizes the need to address water-related risks and vulnerabilities in the energy sector.

- Urgent rehabilitation of Ukraine's weather and climate observing system is required due to severe damage caused by the war, underlining the importance of maintaining and strengthening observing systems even in challenging circumstances.

INFRASTRUCTURE FOR RESEARCH AND SERVICES

Introduction

Through its programmes, Projects, Regional Office, as well as its partnerships, WMO Regional Association VI facilitates and coordinates an Earth system approach to the gathering and free exchange of observations, promotion and integration of research and the development and delivery of services in the areas of weather, climate, and water. Science and technology drive the advancement of numerical prediction.

Keynotes

Keynote 1: Adapting a successful European endeavour infrastructure to future needs

Florence RABIER, Director General, European Centre for Medium-Range Weather Forecasts (ECMWF)

Dr Florence RABIER has been Director General of the ECMWF since 2016. She is an internationally recognized scientist, whose leadership has contributed to delivering major operational changes at both ECMWF and Météo-France. She is especially well known for her key role in implementing an innovative method making an optimal use of satellite observations in weather forecasting and climate monitoring. She is currently chairing the Advisory Committee for Earth Observations of the European Space Agency and a Member of the International Scientific Board of the International Foundation Big Data and Artificial Intelligence for human development. She has been awarded the title of "Chevalier de la Légion d'Honneur" in 2014 and has been an Honorary Member of the American Meteorological Society since 2021.

Conclusions

ECMWF has continued to adapt its multi-purpose heterogenous IT infrastructure to support ECMWF's missions and facilitate the effective use of its products and services. Started providing cloud-based services by creating together with EUMETSAT the European Weather Cloud. Continued to evolve its HPC infrastructure by adding a GPU partition to support IFS adaptation to this accelerator technology and Artificial Intelligence (AI)/ML developments. ECMWF multi-purpose IT infrastructure can also support complex Member States projects and be relied on in case of emergencies.

Key messages

35 out of 51 RA VI Member States are supporting the European Centre for Medium Weather Forecasting. The most recent motivations of the Centre are: 1) to deal with increasing size of ECMWF data and products, by creating the European Weather Cloud Service, and by supporting enhanced application flexibility, 2) to upgrade the ECMWF supercomputing facilities in new Bologna data Centre, and 3) to ensure an infrastructure capable of supporting complex projects and supporting the Member states in dealing with urgencies.

The increasing resolution of weather and climate models is forcing users to reconsider how to make most effective use of the data (use of computer resources close to the data, increased use of web services). The increasing complexity of HPC, with wider use of GPUs and other accelerators, is making these systems more challenging to use effectively and should lead to increase collaboration between NMHSs both in terms of weather forecast model developments but also in terms of operating these infrastructures. The increasing availability of appropriate

HPC resources operated by cloud service providers should be an option to consider especially for back up purpose and for NMHSs with limited IT skills and resources.

Everyone is most welcome to make use of the EU Copernicus Climate and Atmosphere data store that is freely accessible to the public. ECMWF is also developing infrastructure for post-processing and data sharing.

Keynote 2: Lessons learned from INSPIRE and the evolution of data sharing policies in the EU (European Union)

Jordi ESCRIU, Joint Research Centre European Commission

MSc. in GIS. Geodesy and Cartography Engineer and Surveying Engineer. Working as Scientific Project Officer in the Digital Economy Unit, at the European Commission Joint Research Centre (JRC), Ispra (Italy), since August 2021. Deploying the INSPIRE Maintenance and Implementation Programme while contributing to research on how INSPIRE shall evolve into a digital Data Ecosystem, the Green Deal Data Space. Project Manager of the INSPIRE Geoportal. Collaborating as INSPIRE Expert and Facilitator from 2008. Past Member of the EuroGeographics Quality and INSPIRE KENs. Experience of more than 17 years in the Regional Mapping Agency of Catalonia (Spain) – ICGC (2003–2021). Technical Manager of the Regional Spatial Data Infrastructure (SDI) of Catalonia (Spain) - IDEC (2016–2021). European Commission Joint Research Centre (JRC) – Digital Economy Unit (B6) - INSPIRE Team (2021-Today).

Conclusions

INSPIRE is one of the biggest geospatial data sharing initiatives of Europe in the world. It is a public sector contribution to the European Green Deal Data Space. The directive entered into force in 2007, a roadmap for its implementation was developed in December 2021. It is not yet implemented due to the heterogeneity of the region; however, the discoverability and accessibility of data is growing. It has a multifaceted infrastructure with a rich ecosystem of tools

Key messages

The INSPIRE Central Components: INSPIRE Geoportal, INSPIRE Reference Validator, INSPIRE Registry, are based on open-source components decoupled from the infrastructure. Parallel implementations (national and INSPIRE SDI in Member States constitute an issue). INSPIRE should be built on top of national SDIs, and its objectives properly integrated in the national workflows. Data sharing initiatives shall be based on open international standardization which provides evidence of their benefits and successful implementation. Need to implement inclusive, flexible, and open governance approaches (community driven, based on open collaborative platforms, managing changes quickly, detecting emerging needs, standards, and technologies). Heterogeneous licensing approaches constitute a barrier to data usage. The Open Data Directive and the High Value Datasets are aimed at overcoming these issues. INSPIRE is evolving into a Data Ecosystem, the European Green Deal Data Space, based on all the lessons learned and the mandates of the European Strategy for Data.

Keynote 3: **European Weather Cloud support to operation production in Croatia**

Branka Ivančan-Picek, PR (Permanent Representative) of Croatia

Dr Branka Ivančan-Picek has been Director General of the Croatian Meteorological and Hydrological Service (DHMZ) since October 2017, after several years leading research and development department. The results of her research focused on mesoscale dynamics and modelling have been important for weather diagnostics and forecasting, particularly within extreme occurrences, which is vital for their early and timely notification in the alert system. She has over 70 publications and papers. She mentors graduate and PhD students, and participates in numerous national and international projects, such as the Storms and Natural Hazards in Croatia Project and the EU-CIRCLE Horizon 2020 project, a pan-European framework for strengthening critical infrastructure resilience to climate change.

Key messages

The earthquake in Croatia was a reminder of how hazards can endanger the critical role of NMHSs to serve society and protect lives and property.

Effective collaboration NMHSs and other European infrastructure key players is essential to ensure the resilience of its critical weather services in the time during and after some hazards.

Plenary

CHAIR, KEYNOTE SPEAKERS AND FACILITATORS

Roar SKÅLIN (CHAIR)
RA VI Acting President

Florence RABIER
Director-General, ECMWF

Jordi ESCRIU
European Commission, Digital Economy Unit, Joint Research Centre, European Commission

Branka IVANČAN-PICEK
PR of Croatia

Eoin MORAN
PR of Ireland, EUMETSAT Council Chair

Fernando BELDA
Chair of RA VI WG-Infrastructure

Anthony REA
Director of Infrastructure Department, WMO

Questions

Should the future infrastructure for data processing and Earth system forecast be built with multiple sector partners? Why and how to ensure it?

Are the Member States ICT systems prepared for the implementation of the Unified data policy? Do the ICT systems need an upgrade?

How can we switch business to cloud infrastructure?

Summary

The panel discussions emphasized the need for multi-sector partnerships, upgrading ICT systems, developing a transition roadmap for cloud infrastructure, and promoting collaboration and knowledge exchange within RA VI.

The Hydrological and Meteorological Services are essential for protecting public safety from increasing high-impact weather events. To ensure trust and reliability, infrastructure and numerical weather and climate prediction, nowcasting and flood forecasting, as well as climate change observation capabilities must be developed and maintained. RA VI is a leading example in this regard, with specialized centres, networks, and open data policies. However, Members need to switch to cloud infrastructure, partnering with private sectors and utilizing NWP for the whole world. ECMWF and EC JRC are ready to provide the necessary information and support for data sharing and capacity development.

The infrastructure of RA VI should consider natural hazard risk mitigation strategies and use EMI for security purposes. Small NMHSs can collaborate with others in cost-efficient ways, such as the United Weather Centres, which provides the best short-range weather forecasts for the member countries. RA VI should understand the importance of collaboration and use it to benefit academic activities.

The following set of actions is based on discussions and considered relevant for implementation to support the hydrological and meteorological services improve their reliability, data processing capabilities, and disaster risk mitigation strategies:

- **Establish Multi-Sector partnerships for infrastructure Development**: To ensure the future infrastructure for data processing and Earth system forecast is robust and comprehensive, it is crucial to involve multiple sector partners. Collaborate with private sector organizations, research institutions, and technology companies to leverage their expertise, resources, and innovative solutions. Engaging various stakeholders will lead to a more resilient and advanced infrastructure for hydrological and meteorological services.

- **Assess and Upgrade Member States' ICT systems**: Before implementing a unified data, policy and transitioning to cloud infrastructure, assess Member States' existing ICT systems. Identify any gaps or limitations that may hinder the adoption of new technologies and data policies. Provide necessary support and resources to upgrade and modernize ICT systems, ensuring compatibility and scalability to meet the requirements of cloud-based infrastructure and data processing.

- **Develop a Roadmap for Cloud infrastructure Transition**: Create a comprehensive roadmap outlining the process and steps for switching to cloud infrastructure. Collaborate with private sector partners, such as ECMWF and EC JRC, to provide guidance and technical expertise in adopting cloud solutions. The roadmap should address data migration, system integration, security measures, and capacity building to enable a smooth transition to cloud infrastructure for hydrological and meteorological services.

- **Foster Collaboration and Knowledge Exchange**: Recognize the importance of collaboration and knowledge sharing among Member States. Facilitate platforms for collaboration, such as joint research projects, academic exchanges, and training programs. Encourage cooperation between small National Meteorological and Hydrological Services (NMHSs) and established institutions like the United Weather Centres to promote cost-efficient ways of sharing expertise and resources. Collaboration will enhance the quality and effectiveness of services while fostering innovation and capacity development.

RESEARCH ACTIVITIES FOR SERVICES AS A CORE BUSINESS OF FUTURE NMHSs

Introduction

The WMO community in RA VI fosters integrated and multi-disciplinary research into weather, climate, water, and environment, and develops all elements of the value chain, from discovery science to serving society, in the context of the Earth System science. One of the principal elements of this research is to generate information, products, and services to serve various users and decision makers.

Key notes

Keynote 1: EU Research Infrastructure and collaboration of the academic and public sector

Jutta THIELEN-DEL POZO, JRC, European Commission

Jutta Thielen-del Pozo joined the Joint Research Centre of the European Commission in the year 2000 and has been Head of the "Scientific Development" Unit since 2016. Jutta holds a master's degree in meteorology from the University of Karlsruhe and a PhD in Environmental Physics from the University of Lancaster. After having developed her scientific career related to high-impact weather and flood forecasting, she is now heading a unit that aims at incubating innovative ideas for emerging societal issues and for closing gaps for the Organization.

Fabio Taucer is Senior Expert and Deputy Head of Unit at the JRC at the Unit for Scientific Development. He is responsible for coordinating JRC Research Infrastructures and implementing the free access strategy to JRC experimental facilities. He is also responsible for the coordination of all standardization related activities at the JRC, for linking research and innovation with standardization as part of the Joint Initiative on Standardization. In his previous post at the JRC, he matured a long-standing experience in managing transnational access to research infrastructures financed by DG RTD in earthquake engineering.

Conclusions

Research can oxygenize administration and policy; Balance innovation, underpin in house research and support for optimal operations; Leverage on synergies as medium-long-term strategies.

Key messages

The JRC is the science and knowledge service of the European Commission, providing evidence-based decision-making for EU policies. Through strategic collaborations with universities, JRC facilitates collaborative educational programmes and European Research Infrastructures. The European Strategy for Research Infrastructure is a Consortium of EU and associate states focusing on data computing, digital research infrastructure, energy, and environment. WMO Members may be able to use 11 research infrastructures related to the environment, with 17 already open and plans to open more. Key areas of research are agreed upon with partner agencies, and the output data is open 18 months after its availability, with possible charges for users.

Keynote 2: Towards 1 km resolution Earth System Model – where we are and how we will do it

Bjorn STEVENS, Managing Director Max-Plank Institute and Director of the Atmosphere in the Earth System Department

Bjorn STEVENS is the Managing Director Max-Plank Institute and Director of the Atmosphere in the Earth System Department. He is interested in how atmospheric water vapor, and clouds, shape climate — globally and regionally. Understanding how turbulent mixing and cloud microphysical processes influence cloud amount are instrumental in quantifying how clouds respond to warming, and how radiative forcing responds to aerosol perturbations. His research has identified diverse ways in which clouds organize themselves, how varied processes — such as precipitation, air sea interaction, and radiative cooling — influence this Organization, and how clouds couple to larger-scale circulation systems to help determine the pattern of climate change. These interests have led him to develop new observational techniques and to expand the frontiers of simulation science.

Key messages

The world is warming, and we need to know what that means. Operational services and researchers are increasingly called upon to provide climate information. This trend will strengthen. The high impacts occur locally and can be seen only on a km-scale. That is why most NMHSs moved towards 1 km scale. The importance of simulating at 1 km, the opportunities that it creates and the challenges that it imposes, makes an important case for cooperation.

We can continue to meet these demands by hoping for the continued vitality of outdated community approaches (e.g., CMIP (Coupled Model Intercomparison Project)), complemented by downscaling efforts (CORDEX); but this only adds detail to models which lack fidelity, moreover it is fundamentally inequitable, inefficient, and backward looking. Cooperating in the development, implementation and operationalization of km-scale climate models will change the game — also by highlighting the ability of operational services to be leaders in the development and application of digital technologies. EU's Destination Earth initiative (DestinE) is pioneering the latter approach, ECMWF (and its partners at ESA and EUMETSAT) is helping to articulate the most ambitious and foresighted undertaking by our community in at least 30 years. It needs our support.

Keynote 3: Utilizing the value chain from research to services to produce effective services at NMHS

Jussi KAUROLA, PR of Finland

Jussi Kaurola was born in Harjavalta, Finland in 1962. He completed MSc in meteorology at the University of Helsinki, Finland, in 1990, and he made PhD in meteorology in 1996. From 1988–1996, he was a research scientist at the Department of Meteorology at the University of Helsinki. Since 1996 he been working in the Finnish Meteorological Institute as senior scientist until 2013, as the Director of Weather and Safety during 2013–2018, as the Director of Weather, sea, and climate service centre during 2018–2020, and as the Director General since 2020.

Key messages

The focus of this paper is on the research and service activities at NMHSs providers. The operating environment of NMHS's is changing. There is available research funding based on societal challenges and megatrends, customers require tailored impact forecasting on their operations, and societies are becoming increasingly dependent on critical infrastructure to be available 100% of the time. To meet these challenges, we should direct research resources and actions towards the needs of society and business e.g., impact-based forecasting. We should get customers to engage early and get access to their impact data. And we should guide customers and ensure operational delivery can be achieved in a sustainable way.

The success factors for NMHS's are understanding customers and changes in the operating environment; understanding impacts and trends for various sectors; facilitating connections and discussions between research, operations, and customer interfaces; developing clear communication mechanisms; service Design as a tool to assist and guide development; and ensuring excellent user experience as a target.

Plenary

CHAIR, KEYNOTE SPEAKERS AND FACILITATORS

Kornélia RADICS (CHAIR)
Invited Expert

Jussi KAUROLA
PR of Finland

Jutta THIELEN DEL POZO
Head of Scientific Development, Joint Research Centre, European Commission

Roar SKÅLIN
PR of Norway, EUMETNET Assembly Vice-President

Fabio TAUCER
Deputy Head of Scientific Development, Joint Research Centre, European Commission

Adina-Eliza CROITORU
Chair of RA VI WG-Research

Bjorn STEVENS
Managing Director Max-Plank Institute and Director of the Atmosphere in the Earth System Department

Estelle DE CONING
Head, World Weather Research Division, WMO

Questions

How to ensure the transfer of research into operations?

How can we integrate research efforts to avoid duplication?

With the launch of MTG in 2022, what would be the new research questions for RA VI (and RA I) with the lightning imager on board this satellite?

High-resolution modelling is important – how do we combine efforts to serve the urban environment (many densely populated cities in RA VI), using new technology (Crowd sources data, AI, ML, Excascale computing etc.)?

Summary of discussions

The Panel discussions focused on establishing mechanisms for research-to-operations transfer, coordinating research efforts to avoid duplication, defining research questions with the MTG lightning imager, and promoting collaboration on high-resolution modelling for urban environments. The Norwegian Meteorological Institute has created an internal structure to facilitate collaboration between research and operational staff. It is recommended to collaborate on high-resolution modelling through workshops on AI and ML, and to use external funding of research and development (R&D) to ensure quality and avoid duplication. National and international policies are needed to encourage collaboration with the research centres, and centralized databases of research projects and results should be established at the European level, including data from non-EU countries. Crowd sourcing data is also important for high-resolution modelling. Awareness to encourage climate adaptation and mitigation is needed to support the integration of data from all countries. WMO's three research programs on climate, weather, and atmosphere use RA VI expertise to bridge the gap between academia and NMHSs. UN Sustainable Development Goals (SDG) 11 for urban areas is an important focus of weather research, with high-resolution data needing to be gathered, including crowd-sourced data and eventually car data. WMO Regional Association VI (RA VI) (Europe) and Regional Association I (Africa) need to collaborate on infrastructure, services, and research to promote innovation and business opportunities.

The following set of actions is based on discussions and considered relevant for implementation to support RA VI to ensure effective knowledge transfer, optimize research efforts, harness new observational capabilities, and leverage advanced technologies for improved weather services in the region:

- **Establish Mechanisms for Research-to-Operations Transfer**: Develop structured processes and mechanisms to facilitate the transfer of research findings and innovations into operational practices. This can involve establishing collaborative platforms and regular interactions between research institutions and operational staff. Encourage joint projects, knowledge exchange, and training programs to bridge the gap between academia and National Meteorological and Hydrological Services (NMHSs). By fostering collaboration, research outcomes can be effectively integrated into operational services.
- **Coordinate Research Efforts to Avoid Duplication**: Organize workshops and forums focused on high-resolution modelling, AI, and ML to bring together researchers from different institutions and countries. Encourage sharing of research plans, methodologies, and findings to identify areas of overlap and potential duplication. Utilize external funding for R&D projects to ensure quality, efficiency, and coordination. Develop national and international policies that promote collaboration and provide incentives for researchers to share their work and avoid duplication.
- **Define New Research Questions with EUMETSAT Meteosat Third Generation Lightning Imager**: With the launch of MTG and its lightning imager in 2022, RA VI should prioritize research questions related to this new technology. Focus on investigating lightning behaviour, its relationship with severe weather phenomena, and its impact on regional and local weather patterns. Explore the potential applications of lightning data in nowcasting, severe weather prediction, and climate studies. Foster collaborations between researchers, operational staff, and relevant stakeholders to maximize the benefits of this new observational capability.
- **Collaborate on High-resolution Modelling for Urban Environments**: Given the presence of densely populated cities in RA VI, collaborate on high-resolution modelling efforts tailored to the urban environment. Utilize new technologies such as crowd-sourced data, AI, ML, and Exascale computing to improve the accuracy and resolution of urban weather forecasting. Organize joint projects, knowledge sharing initiatives, and funding opportunities to combine efforts and expertise from different institutions within RA VI. Promote innovation and business opportunities by leveraging high-resolution modelling for urban planning, climate adaptation, and mitigation strategies.

SERVICES TO SUPPORT THE CORE BUSINESS OF NMHSs

Introduction

The core business of NMHSs is built around their responsibility to provide essential weather, climate, and related information to the community at large. In the provision of weather-, climate-, water-, and environment-related services, it is essential to put the users first. It is only by fully understanding why they need our services and how they use them in their decision-making that we can provide services which are optimal. By striving to provide services that best meet these needs, NMHSs ensure that they fulfil their statutory obligations and are consequently held in high regard by the public, governments, and users.

Key notes

Keynote 1: EUMETSAT Satellite Application Facility (SAF) as support to NMHSs' delivery of Services

Phil EVANS, Director General, EUMETSAT

Phil EVANS became EUMETSAT's fifth Director General on 1 January 2021. Phil brings to the role the experience gained from his extensive career in Board positions at the UK (United Kingdom) Met Office and a background in remote sensing and satellite instrumentation. More recently he led the provision of services and policy advice to governments and was the Met Office Chief Operating Officer. He also brings a strong commitment to collaboration with partners around the globe. Phil's guiding principle is that working with partners, from Member States' meteorological services to global satellite agency alliances, will be essential as extreme weather events will exact an increasingly heaving social and economic toll on communities. Monitoring those events to mitigate their impact and measure the effect of climate regulations will be crucial over the next 50 to 100 years. After leaving the Met Office and before joining EUMETSAT, Phil was Director of Physics programmes at the Institute of Physics, in 2020. There, he was a member of the Executive Board and Board of Trustees.

Key messages

Value in public and private decision-making relies on the successful integration of observations, numerical prediction, forecaster expertise, and forecast support. Satellite application facilities deliver operational products and services to users in a period of changing generations of people, Programmes, and Infrastructure

Keynote 2: **European EWS: Present and the Future**

Andreas SCHAFFHAUSER, PR of Austria

Andreas Schaffhauser is currently the acting director of the Austrian National Meteorological and Geophysical Service (ZAMG). As Head of the customer service division, Andreas was responsible for public weather services, climate- and environmental services, and commercial- and international activities. He managed Meteoalarm, an impact-oriented, common framework of authoritative warning information for meteorological and hydrological hazards of 37 NHMSs across the European domain from 2019 to 2021.

Key messages

Successful **implementation** always relies on close **cooperation** between the NHMSs and all relevant actors, especially the civil protection agencies and the authorities. Many of European NMHSs already provide **IBWs.** Nevertheless, most NMHSs are still in the transition phase from using fixed thresholds or climatology-based thresholds to impact-based warnings using subjective or objective criteria. The **technological advances** are quite impressive (e.g., cell broadcasting). But we still must tailor the systems to the needs of users, including social and cultural requirements and broaden all relevant release channels including social media for sharing disaster Early Warning information. The immense potential benefits of MHEWS can only be realized with a **successful crossing of the last mile** – that the warnings, and other related information generated are received, understood, and acted upon by the different user groups or individual users in future. We must ensure the consistent and timely **flow of information** from the producers of the warnings to the decision makers, various user groups and the public. **GMAS (Global Multi-Hazard Alert System)** can make extensive use of cooperation principles and technical solutions that have been successfully implemented.

Keynote 3: Hydrology in the WMO Regional Association VI: Infrastructure, Research, Services and Collaboration with Private and Academic sectors

Angela CORINA, RA VI Hydrological Adviser

Angela Corina is a Civil Servant at Italian Civil Protection Department. She has almost 20 years of experience in the management and development of the national warning system for meteo-hydrological risks. Responsible for the coordination of various research activities in the field of operational hydrology, designer of IT systems for data management and risk monitoring, she is involved as an expert in various international capacity building and technical assistance projects in DRR (Disaster Risk Reduction) sector. Italian representative in various working groups and technical commissions relating to EWS, DRR, and hydrology. In WMO she collaborates as an expert in SERCOM (Services Commission)- SC-HYD and is the focal point for hydrology in SC-DRR (Standing Committee for Disaster Risk Reduction), Hydrological Adviser of the PR of Italy, Regional Hydrological Adviser for Europe (Regional Association VI).

Key messages

Similar risks in the EU request similar approaches to bridge gaps, to manage the risks in the present and to look at what's going to happen in the future. There is a need for a vision and WMO has addressed this need with its strategic plan and the "vision and strategy for hydrology" encompassing several initiatives to intersect these common needs: GBON, SOFF, WIS2.0/ WHOS, HydroSOS, Hydro Hub, FFI.... To be implemented at regional level. One for all: the unified data policy represents the starting point of this vision.

Jan DAŇHELKA, Chair of Hydrological Coordination Panel (video message)

Jan Daňhelka is hydrology Director at the Czech Hydrometeorological Institute. He started his professional career as a flood forecaster experiencing a disastrous 2002 flood in Central Europe. He participated in Design and implementation of current Early Warning System in the Czech Republic, led, or contributed to numerous research projects and activities in the field of hydrology and risk management. He represented Czech Republic to working group for implementation of the EU Flood Risk Management Directive (2007/60/EC) and actively worked in implementation process at national scale. He provided expert support to the Czech vice-chairmanship during preparation of the third World Conference on DRR and Sendai Framework negotiation, as well as during the work of OEIWG on indicators and terminology following the Conference. He has actively participated in the work of various bodies of the WMO since 2005. In 2019, he was chosen to chair the WMO Hydrological Assembly and WMO Hydrological Coordination Panel.

Key messages

Stronger coordination/ governance is needed to integrate short- and long-term measures and shift from reactive to proactive approaches. Integrated approaches are needed for multi-hazard early warning systems, and to identify and manage correlated and cascading risks and events. Relate probabilities (likelihood of impacts) and consequences (impacts). The risk of over and underestimation of likelihood and impacts need to be considered for decision-making. Public-private engagement (PPE) and partnerships need to have a clear definition of roles and avoid different competing voices. Dissemination is a key component where PPE may increase reach and impact. Social awareness and political support are essential to preserve the role of NMHSs as the country authoritative voice on Weather, Climate, Water, and related environmental issues. Cooperation between country agencies and NMHSs need to build communities of practice to integrate hydrological services. Coproduction of services with public-private-academic partnerships should lead the way forward.

Keynote 4: Vision for Collaboration for RA VI in Infrastructure, Services and Research based on Earth System approach: Future of NMHSs

Danara ALIMBAYEVA, PR of Kazakhstan, Chair of the Interstate Council on Hydrometeorology of the Commonwealth of Independent States

Danara Alimbayeva is the Director General of the Republican State Enterprise "Kazhydromet". She has a BSc. of Meteorology, Al-Farabi Kazakh National University, MSc. of Applied ecology, Kazakh Leading Academy of Architecture and Civil Engineering and MSc. of Finance, Kazakh Institute of Law, and Market.

Key messages

Increased cooperation, training, and capacity building of Hydromet specialists remains a challenge. Effective partnerships and strong coordination are crucial.

Plenary

CHAIR, KEYNOTE SPEAKERS AND FACILITATORS

Elena MATEESCU (CHAIR)
PR of Romania

Phil EVANS
Director-General,
EUMETSAT

Andreas SCHAFFHAUSER
PR of Austria

Angela CORINA
RA VI Hydrological
Adviser

Jan DAŇHELKA
Chair of Hydrological
Coordination Panel

Danara ALIMBAYEVA
PR of Kazakhstan, Chair of the
Interstate Council on
Hydrometeorology of the
Commonwealth of Independent
States

Ian LISK
President of SERCOM

Johan STANDER
Director of Services
Department, WMO

Questions

What are the core and the new potential services NMHS can improve/ develop?

How can NMHS reaffirm their leadership in developing services through public-private partnerships

Is there value on improving and fostering the lead role of NMHSs and their relationships with Disaster Risk, Civil Protection, Agriculture, Water and Energy authorities at the national, local level? How can we address it?

Urban planning can significantly reduce exposure and vulnerability to weather, water, climate, and related environmental extremes, what is needed to improve and enforce urban planning.

Summary

The panel discussed the need to enhance and develop services offered by NMHSs through public-private partnerships, strengthen relationships with relevant authorities, and prioritize weather and climate considerations in urban planning processes.

The WMO has an action plan in place to address the challenges voiced out at the session regarding early warning, with gaps and matters to be addressed at both the high and low levels. Private sector and research community engagement are necessary to develop services, and messages must be tailored to the youth population (2/3 of the population). User-driven service delivery is essential for success. Numerical weather prediction needs to be downscaled to provide simple and easy to understand weather-related information to a wider audience, to empower collaboration between civil protection and other stakeholders. National Meteorological and Hydrological Services should lead the development and improvement of such services, through public-private-academic partnerships.

The following set of actions is based on discussions and considered relevant for implementations to support NMHSs improve their service delivery, address user needs, and contribute to building resilience and sustainable development:

- **Enhance Core and Develop New Services**: National Meteorological and Hydrological Services (NMHSs) should focus on enhancing their core services while actively developing new services. Core services such as weather forecasting, climate monitoring, and hydrological predictions should be continuously improved to meet the evolving needs of users. Additionally, NMHSs should identify emerging areas where they can provide valuable services, such as urban planning support, renewable energy forecasting, and climate change impact assessments.

- **Strengthen Leadership in Services through Public-Private Partnerships**: NMHSs can reaffirm their leadership in service development by actively engaging in public-private partnerships. Collaborate with the private sector and research community to leverage their expertise, resources, and technological advancements. Foster mutually beneficial partnerships that allow NMHSs to tap into innovative solutions and improve the delivery of weather, water, and climate services to the public and various sectors.

- **Enhance Relationships with Authorities at National and Local Levels**: Recognize the value of strengthening relationships between NMHSs and authorities responsible for Disaster Risk Management, civil protection, Agriculture, Water, and energy at the national and local levels. Actively engage in dialogue and collaboration with these authorities to understand their needs, provide tailored weather and climate information, and support decision-making processes. Develop frameworks for information sharing, joint planning, and coordination to address common challenges related to weather, water, and climate impacts.

- **Improve and Enforce Urban Planning**: Recognize the significant role of urban planning in reducing exposure and vulnerability to weather, water, climate, and environmental extremes. Collaborate with urban planning authorities and stakeholders to integrate weather and climate considerations into urban development plans. Provide weather-related information, data, and tools to support informed decision-making in urban planning processes. Advocate for the enforcement and implementation of urban planning regulations that consider climate resilience and sustainable development principles.

LAUNCH OF THE STATE OF THE CLIMATE IN EUROPE 2021 REPORT

Introduction

The WMO Regional State of Climate report for Europe provides evidence of the impacts of extreme weather and climate events in 2021, including floods, droughts, heatwaves, and wildfires, and highlights the need for improved Early Warning Systems and risk and impact assessment. The report encourages climate change mitigation and adaptation and provides guidance to UN Country Teams and UN Resident Coordinators on SDG. The report also serves as a tool for negotiating with the Climate Adaptation Fund for funding. The WMO Secretariat congratulates the experts for leading the scientific coordination and authorship of the report and thanks the WMO Members and UN agencies for their support in providing input and reviewing the report.

Statements on partnership to deliver the 2021 State of the Climate in Europe Report as contribution to UN Agenda 2030 (SDG13)

Key messages

Unit, UN Economic Commission for Europe (UNECE) Executive Secretary, Olga ALGAYEROVA

- The world is off-track for SDG 13; only in cooperation we can jointly and more efficiently assess climate change impacts, vulnerabilities and take climate actions.
- UN Water expert group on Water and Climate & Water and Climate Collation are key examples of strong partnership. For example, the expert group with more than 30 partners contributed to a new flagship product that is the World Water Development Report, to be launched at the UN Water conference 2023, supporting the achievement of the UN SDG 6.
- The State of the Climate in Europe report will help achieve the UN SDG 13 as a good reference and knowledge base for developing climate policies and actions and the UNECE is happy to contribute to it.
- Key messages UNECE – Executive Secretary- Olga Algayerova.

- Globally, climate impacts do not recognize borders, and 60% of global freshwater flow is in transboundary basins shared by 153 countries.

- Transboundary cooperation is important for implementation of SDG 6, SDG 13 as well as others such as on health, poverty reduction, food security, ecosystem protection and peace.

- The Water Convention provides a unique legal and inter-governmental framework for transboundary cooperation in climate change adaptation, including flood and drought management, through capacity building, developing guidance, exchange of experience and projects on the ground.

- Europe is one of the most advanced regions in transboundary cooperation in climate change adaptation where climate change adaptation strategies have been developed and are implemented in such basins as the Danube, the Dniester, the Drin, the Meuse, the Neman, the Rhine and the Sava.

- Good practices need to be exchanged to reduce greenhouse emissions from transport. Mobility is to be supported by Cycling and public transport through the recently created group of experts on Cycling infrastructure module in close partnership with THE PEP Partnership on Cycling Promotion/Active Mobility as a contribution to the Pan-European Master Plan for Cycling Promotion adopted in Vienna. WMO has been actively participating in the UNECE initiatives and more could be done jointly to support the knowledge transfer, decarbonization, and mitigation.

ECMWF Director General, Dr Florence RABIER

- Europe is warmer than it was. There is a collective responsibility to produce this report, collecting the key climate information from academia, scientific institutions, space agencies etc. to a broad audience, to remind us of extreme events which we may have already forgotten. As we approach the climate discussions and negotiations at the UNFCCC COP 27, the decision makers can draw the relevant information from the report for further actions.

- The long-standing relationship of ECMWF with WMO, and the more recent and productive collaboration with the European Commission has resulted in successful collaboration on the Statement of the Climate in Europe report.

Earth Observation, European Commission (Copernicus), Mauro FACCHINI

- Climate change and environmental degradation are already happening and pose an existential threat to Europe and the world. The EU, through its observation program, Copernicus, is fully committed to addressing those challenges.

- Climate change services (C3S) Programme is representing the Europe’s contribution to the global framework and climate services, useful to a wide range of industries, forestry and fisheries, agriculture, transport and mobility and tourism sectors, and policymakers and public authorities are the main users.

- The State of the Climate in Europe report is complementing the C3S report and is the result of a collaboration building on the latest research, standards, best practices and services. A continuous collaboration with this publication would ensure a regular monitoring of the State of the Climate in Europe.

Presentation

2021 State of the Climate in Europe Report, presented by: Petteri TAALAS, WMO Secretary-General Carlo BUONTEMPO, Director of Copernicus Climate Change Service, ECMWF

Presentation of Report, WMO Secretary-General, Petteri TAALAS & Director of Copernicus, Dr Carlo BUONTEMPO

- The 2021 State of the Climate in Europe report is the first in the series and is a joint venture of 45 NMHS, 6 UN agencies, ten International organizations, and over 50 international and regional experts.

- Society needs fresh, good quality information about climate, not just about record-breaking events, but constant monitoring of all climate indicators; this report is an important step forward.

- Europe is warming the fastest of all WMO regions, 1.5°C. Seas in Europe are warming and rising, glaciers are losing mass and sea ice is declining. However, the report is not only about the climate driver but also about the impact. 51 meteorological, hydrological and climate hazard events reported in Europe caused 297 fatalities and US$ 51500 million of damage and displacements. Floods had the highest share of total. 2020 GHG emissions targets were exceeded; thus, further implementation of impactful policies and measures are important to reach the 2030 target, to protect children and to cover 100% of the region with EWS. Transitioning to a net-zero carbon society could bring a range of near- and long-term health gains.

- Mitigation of climate change has already been a primary focus in Europe as countries nationally determined contributions, highlighting energy supply, agriculture, waste, and land use change and forestry as top mitigation priorities.

- Comprehensive heat-health action plans and Early Warning Systems have been shown to save lives and strengthen the resilience of communities and people to cope with extreme heat. WMO is leading international efforts through the UN global Early Warning initiative to strengthen Earth system observations and monitoring, predictive and warning capabilities. The new plan of UN, which will be presented at the UNFCCC COP 27, seeks to build on the existing capabilities such as GMAS, CREWS, GFCS & SOFF.

- 75% of people in Europe are covered by early warning, although hydrological capacity still needs to be developed. The integrated NMHSs are much better prepared to face this flood related challenges. Enhanced collaboration between National Meteorological and Hydrological Services is needed.

High-Level Panel: Partnerships to address climate change, extreme events, and DRR towards implementation of SDGs

Government Representatives: Ministers, Vice-ministers, Diplomatic corps

Key messages

Deputy Minister of Environment, Armenia –Mr Tigran GABRIELYAN

- Armenia is highly vulnerable to several hydrometeorological hazards, with approximately 32.5 million USD annually of loss and damage.

- A shift of paradigm is needed to the management risks and preventive measures from the post-disaster actions. The role of the NMHS is crucial to ensure reliable predictions from daily-seasonal-decadal basis are required, specifically better

development of human and technical capacities. It also requires the resource mobilization for implementation of projects, such as the RA VI recommended Multi-Hazard Early Warning System for Central Asia and South Caucasus. Regional events are platforms to reinforce collaboration towards sustainable development.

Minister of Agriculture, Forestry and Water Economy of the Republic of North Macedonia -Mr Ljupcho NIKOLOVSKI

- The State of the Climate in Europe report will update the citizens on the climate conditions in Europe and on the impacts of climate events. The Government of the Republic of North Macedonia remains committed to support all activities of the WMO RA VI and believes that the NMHSs would play a central role in the integration of the observing systems to ensure a regular monitoring of the State of the climate.

Minister of civil affairs, Bosnia & Herzegovina – Ms Ankica GUDELJEVIC

- Climate change is already happening in Bosnia & Herzegovina, leading to extreme floods and droughts affecting population, agriculture, forestry, tourism, and many other sectors. There is a need for investment in adaptation, specifically to support the establishment of the early warning systems for timely action. The role of NHMSs, civil protection agencies and policy administration is of utmost importance. NMHSs should be equipped with early warning hardware and software to prevent high-impact events.

Minister of agriculture, viticulture and rural development, Luxembourg
Mr Claude HAAGEN

- Climate change is affecting all regions in the world and Europe is no exception. The basis of the food production is particularly impacted by the hazard events. An inclusive partnership is essential on local, regional, and global level with public, private and academic representatives. Already working toward adaptation with an innovative insurance scheme, determining consequences of droughts on farmers, with Ministry covering 65% of costs. The adaptation solutions are to be found in collaboration with private and research sectors.

Ambassador, Permanent Mission of Romania – H.E. Mr Razvan Rusu

- The launch of the State of the Climate in Europe report marks a day of great importance for the regional meteorological community as it brings significant science and landmark contributions to the improvement of knowledge in the field of climate. As Romania will host WMO regional agrometeorology centre, this annual report will provide crucial information that will substantiate the decision-making in the field of agriculture in Romania. Agriculture has already been significantly affected by the climate change, the infrastructure and capacity of the NMA is being improved and modernized through an Infra-Meteo project for the monitoring and warning of the severe hydrometeorological phenomena to protect the lives and properties. It includes the reinforcement of the observing and processing systems. The Centre will strengthen cooperation between the NMHSs and will support the implementation of joint projects towards an enhanced data exchange and service delivery. The professional capacity of the Romanian experts in the field of agrometeorology is a valid argument of Romania to host the Centre.

Representatives of partner UN agencies contributing to the Report: UNECE, FAO, UNDRR, UNICEF, WHO, and WMO

Key messages

UNECE – Executive Secretary- Olga Algayerova

- Climate change impact and disasters do not know borders. The importance of water cooperation, particularly transboundary, is evident as 60% of water is shared and the disaster risk can be reduced through the joint actions developed. Transboundary cooperation is important to all SDGs. The UN Water convention is a unique legal transboundary mechanism to support food security and Europe is a region where climate change adaptation strategies are developed and being implemented on Nistru, Drin, Rhein, Sava, Danube basins. However, there is still room for improvement as the finance for adaptation is still a challenge to support the projects on the ground. Good practices need to be exchanged to reduce the transport impact on greenhouse emissions. Mobility is to be supported by cycling and public transport through the recently created group on cycling and infrastructure modules in close partnership with the Cycling promotion and green mobility as a contribution to the EU master plan for cycling promotion adopted in Vienna. WMO has been actively participating in the UNECE initiatives and more could be done jointly to support the knowledge transfer, decarbonization, and mitigation.

UNDRR – Regional Director for Europe and Central Asia- Octavian BIVOL

- UNDRR was pleased to support the publication with the relevant information related to impacts of the severe weather events. Despite the fact that Europe is one of the most advanced regions in transboundary cooperation and climate cations, much more needs to be done and commitments to mitigation should continue. Vulnerability and exposure can be reduced and for that, systems and practices need to be put in place now to reduce the impact of future crises. An inclusive approach is to be applied to implement the European Roadmap for DRR 2021–2030 for Europe and Central Asia that was endorsed last year in Portugal at the Regional Forum on DRR. It identifies challenges and opportunities and offers a platform for partnerships to support the local disaster risk reduction strategies.

UNICEF –Regional Director for Europe and Central Asia- Afshan KHAN

- Children have and will continue to endure most of the impacts, particularly those who have contributed the least to climate change. NDCs, NAPs & EWS need to take children and youth into account. The best investment for children is to ensure that the services they need to grow up and thrive are resilient to climate shocks and to provide them with the skills they need to transition. In the UNICEF reports released last week, leaders and governments are asked to protect children from climate devastation by adapting critical social services, including water sanitation and hygiene, health, education, social and child protection, to prepare children to live in a climate change world by providing children with the climate change education, disaster risk reduction education and green skills training, prioritize finance for children and youth by significantly increasing funding for adaptation. The Early Warning initiative, led by WMO, is an important climate adaptation measure to protect children and youth from the worst impacts of climate change. The recent report of the European Environment Agency highlights that only one in ten schools is equipped to withstand the impact of climate change. Therefore, UNICEF looks forward to closely collaborating with WMO to ensure that early warning systems are designed to protect children and youth. The inter-governmental declaration on children, youth and climate action has been signed by 50 Member states in Europe. This is first of its kind commitment to accelerate an inclusive child and youth-centred climate policies and actions at national and global level.

WMO Secretary-General – Petteri TAALAS

- WMO is thankful to all contributing agencies. So many partners involved in the publication clearly show that disaster and climate change are wider issue and are not internal to the NMHSs. It is encouraging ahead of COP27 and need to communicate these facts to decision makers, and other various actors to speed up mitigation and adaptation actions.

WHO Regional Office for Europe- Vladimir KENDROVSKI

- Climate change events are not happening in a remote landscape or a distant future, but here and now. Immediate actions are important. Evidence with policy advice is imperative and this is what is provided by the report. Low carbon societies are essential in achieving the UN 2030 Agenda. WHO Europe is promoting partnership on the regional, national, and local level that is needed to cut emissions in the health sector and put health on the global climate agenda.

UNECE Sustainable Transport Division – Lukas WYROWSKI

- Sustainable transport cannot exist without being resilient to climate hazards. The report highlights the impacts to transport systems that lead to impacts on economies and on individuals. Adaptation in the transport sector has not been realized therefore the information on the impact of transport is helping the countries to better understand that urgency. The infrastructure deployed yesterday cannot be resilient to the conditions to which we are exposed today. Countries need to be helped to understand how the thresholds will change un future and how the standards for the construction of the transport infrastructure need to adjust to build a resilient transport system. For that an inter-agency collaboration is crucial.

Freja VAMBORG, Senior Scientist, ECMWF- Stefan RÖSNER, RA VI RCC Coordinator, DWD (Deutscher Wetterdienst) Andrew FERRONE, PR of Luxembourg

- Pre-industrial is not well-defined enough to report on a regional basis, which is why WMO baseline is used throughout the report, rather than IPCC (Inter-governmental Panel on Climate Change) pre-industrial baseline. The governments, the UN agencies and the international and regional experts are thanked for the valuable contributions to the report.

Summary

There can be increased momentum and progress in addressing the challenges related to water, climate change, and the SDGs by:

- **Strengthening Collaboration and Partnerships**: This can be achieved by encouraging more organizations, governments, and stakeholders to join global and regional coalitions and work together towards achieving the SDG targets related to water and climate. By leveraging diverse expertise and resources, collective efforts can lead to more effective and comprehensive solutions.

- **Prioritizing Water-related Research and Knowledge Sharing**: This includes promoting interdisciplinary studies, fostering innovation, and creating platforms for sharing best practices and lessons learned. By strengthening the knowledge base, decision makers can make informed choices and develop effective policies for sustainable water management.

There can be increased awareness, engagement, and cooperation in addressing the climate challenges faced by Europe and the world by:

- **Enhancing Public Awareness and Engagement**: Given the increasing warming trends in Europe, it is crucial to raise public awareness about the impacts of climate change and the urgent need for action. The State on the Climate in Europe report can play a significant role in this regard. To maximize its impact, it is recommended to develop targeted communication strategies that effectively disseminate the report's findings to a broad audience. This can include utilizing various channels such as social media, public campaigns, educational programs, and collaborations with media outlets. By ensuring widespread accessibility and understanding of the report, it can serve as a reminder of extreme events and mobilize public support for climate action.

- **Strengthening International Cooperation**: The successful collaboration between the European Centre for Medium-Range Weather Forecasts (ECMWF), World Meteorological Organization (WMO), and the European Commission highlights the importance of international cooperation in addressing climate change. To build on this collaboration, it is recommended to further strengthen partnerships between scientific institutions, space agencies, and relevant organizations at the regional and global levels. This can involve sharing data, research findings, and best practices, as well as fostering joint initiatives and projects. By leveraging collective expertise and resources, countries can work together towards more effective climate policies, adaptation strategies, and mitigation measures.

That the Region can strengthen its commitment to addressing climate change, promote climate resilience in key sectors, and ensure regular monitoring of the State of the Climate in Europe by:

- **Strengthening Climate Resilience in Key Sectors**: This can be achieved by promoting the uptake of C3S data, tools, and information in key sectors such as agriculture, forestry and fisheries, transport and mobility, and tourism. Policymakers and public authorities should actively engage with the C3S Programme to incorporate climate considerations into decision-making processes and develop adaptive strategies. By integrating climate services into these sectors, Europe can enhance its resilience to climate change impacts and minimize vulnerabilities.

- **Establishing a Sustainable Monitoring Mechanism** for a regular assessment and report on the State of the Climate in Europe: This mechanism should involve continuous collaboration between scientific institutions, data providers, and relevant stakeholders. It should incorporate the latest research, standards, and best practices to ensure accurate and comprehensive reporting. Additionally, the monitoring mechanism should be aligned with international frameworks and initiatives to facilitate global comparisons and enhance knowledge sharing. By regularly monitoring the climate, decision makers can stay informed about emerging trends, assess the effectiveness of climate policies, and identify areas requiring further action.

The high-level panel underlined the need for strengthening meteorological services, investing in adaptation and early warning systems, fostering partnerships, enhancing transboundary cooperation, and prioritizing the protection and involvement of children and youth in climate change response efforts.

The following set of actions is based on the key messages and statements and considered relevant for implementation to Foster Collaborative Actions for Climate Resilience and Disaster Risk Reduction:

1. Strengthen National Meteorological and Hydrological Services (NMHSs):
    - Allocate resources and provide support for the development of human and technical capacities within NMHSs to ensure reliable predictions, early warning systems, and monitoring of climate conditions.
    - Equip NMHSs with advanced hardware and software for effective monitoring, prevention of high-impact events, and timely actions.

2. Invest in Adaptation, Early Warning Systems, and Partnerships:
    - Invest in adaptation measures, including the establishment of Early Warning Systems, to address the impacts of climate change on various sectors and enable timely actions for mitigation and resilience.
    - Foster inclusive partnerships at local, regional, and global levels, involving public, private, and academic representatives, to address climate change impacts, share best practices, and support knowledge transfer.

3. Enhance Transboundary Cooperation for Water Management and Disaster Risk Reduction:
    - Recognize the importance of transboundary water cooperation in reducing disaster risks and promoting sustainable development.
    - Support the implementation of the UN Water convention as a unique legal mechanism for transboundary cooperation, particularly in shared river basins.
    - Share good practices, improve finance mechanisms, and exchange lessons learned to support adaptation projects, reduce environmental impact, and enhance disaster risk reduction efforts.

4. Protect children and youth, Integrate Climate Education, and Child-Centred Approaches:
    - Integrate children and youth considerations into National Determined Contributions (NDCs), National Adaptation Plans (NAPs), and Early Warning Systems to address their specific vulnerabilities.
    - Prioritize funding for adaptation measures aimed at protecting children and youth, including critical social services, climate change education, disaster risk reduction education, and green skills training.
    - Collaborate closely with organizations like UNICEF and WMO to design child-centred early warning systems, climate policies, and enhance climate resilience for the younger generation.

ENGAGEMENT OF PUBLIC, PRIVATE AND ACADEMIC SECTORS

Introduction

The 2019 WMO Congress endorsed Resolution 79, which encourages dialogue between the public, private and academic sectors to analyse and build understanding of regional opportunities and challenges in PPE. The Geneva declaration was revised to consider how to work together and build trust between the sectors. The first morning session focused on generating data and collaboration on data, and the afternoon session was more on private sector business models and how to work together.

Morning session plenary

CHAIR AND KEYNOTE SPEAKERS

Michael STAUDINGER
(CHAIR)
Invited Expert

Roar SKÅLIN
PR of Norway
RA VI Acting President

Vassiliki KOTRONI
Research Director, Institute of Environmental Research National Observatory of Athens, Greece

Jordi ESCRIU
European Commission, Digital Economy Unit, Joint Research Centre, European Commission

Alois HOLZER
Director of Operations, European Severe Storms Laboratory

Keynotes

Keynote 1: Collaboration between NMHSs (National Meteorological and Hydrological Services) and with the public and academic sector in high performing computing infrastructure

Roar SKÅLIN, PR of Norway, RA VI Acting President

Roar Skålin, born 1964, first joined the Norwegian Meteorological Institute (Met Norway) in 1997 as Head of the IT division. In 2000, he became Director of Information Technology. He held this position until 2012, when he moved to the Research Council of Norway. Since 1 January 2017, he has been Director General of MET Norway. Roar Skålin holds an MSc and Dr Ing in Mathematics from the Norwegian University of Science and Technology (NTNU) and an Executive Master of Management from the Norwegian Business School. He started his professional career in 1988 as a research scientist and project manager in applied mathematics and high -performance computing at SINTEF, a Norwegian contract research institute.

Conclusions

Prerequisites of the successful collaboration with academia are to:

- Have a mutual understanding of the social missions and legal framework for both parties
- Be united with academia in science for services
- Create ownership among all participants
- Build trust over time
- Involve academia in R&D activities, including on infrastructure.

The common infrastructure is not the goal, it is a means to produce world class very short – and short -range NWP for the geographical areas of interest. Sharing competences and resources gives additional value for all. United Weather Centre established for collaboration on the NWP among Norway, Sweden, Finland and Estonia has been extended to 11 more Nordic countries and could serve as a good example to the other subregions of RA VI for collaboration on NWP with Private public engagement. Click HERE to read more of it

Key messages

Collaboration with academia and between NMHSs may facilitate efficient resource utilization and give access to more competence than a single NMHS can obtain.

Keynote 2: Performing observations and delivering services from academic sector to public and private entities

Vassiliki KOTRONI, Research Director, Institute of Environmental Research National Observatory of Athens, Greece

Dr Vassiliki KOTRONI, born in 1965, acts as Research Director at the National Observatory of Athens. She has a PhD in Dynamic Meteorology (University Clermont-Ferrand, 1993). She has authored/co-authored >160 papers published in refereed international journals, and four book chapters in the fields of dynamic meteorology, numerical weather prediction, weather monitoring, atmospheric electricity, climatology, dynamics, and societal impacts of weather-related natural hazards. Her citation report includes 3700 citations and an h-index 34 (10/22). She coordinates: (a) the operational weather prediction and related activities at NOA based on WRF and WRF-CHEM models, (b) the operation of ZEUS lightning detection network; (c) in collaboration with Dr K. Lagouvardos, the concept, development, and operation of www.meteo.gr. (>350.000 daily visitors). She has/is coordinating/participating in many national and international projects with a total funding for NOA >4.500.000 Euros.

Conclusions

The exploitation of the research funds can support not only the development but also the sustainable operation of monitoring networks.

There is an added value of the use of research results for the development of innovative tools and services for the public and private sector.

The research and academic sector can contribute to/develop the early warning systems that meet the needs of civil protection at local and regional level.

The research and academic sector can support the increasing and diverse needs of the stakeholders leveraging the more flexible and innovative character of the research & academia.

Research and academia can also contribute to such initiatives as the SEE-MHEW-A project.

Key messages

Data collection, data processing, including Earth system forecasting can be improved with the contribution of multiple sector partners. NMHSs, research institutions, and academia should collaborate & merge resources. Member states should endorse collaboration with research and academic institutions through inclusive initiatives. Data, services and tools that could contribute to the safety of society should be made available to all.

Keynote 3: Public, academic, and private engagement – a priory related to the European Strategy for Data

Jordi ESCRIU, European Commission, Digital Economy Unit, Joint Research Centre, European Commission

MSc. in GIS. Geodesy and Cartography Engineer and Surveying Engineer. Working as Scientific Project Officer in the Digital Economy Unit, at the European Commission JRC, Ispra (Italy), since August 2021. Deploying the INSPIRE Maintenance and Implementation Programme while contributing to research on how INSPIRE shall evolve into a digital Data Ecosystem, the Green Deal Data Space. Project Manager of the INSPIRE Geoportal.

Collaborating as INSPIRE Expert and Facilitator from 2008. Past member of the EuroGeographics Quality and INSPIRE KENs. Experience of more than 17 years in the Regional Mapping Agency of Catalonia (Spain) – ICGC (2003–2021). Technical Manager of the Regional SDI of Catalonia (Spain) – IDEC (2016–2021). European Commission JRC – Digital Economy Unit (B6) - INSPIRE Team (2021-Today).

Key messages

The new digital society needs data to be easily flowing across sectors, fostering innovation, in line with EU rules and values. According to the European Strategy for data, the public sector is no more the only one to be governed. Engagement of all sectors (public sector, academia, citizens, business) needs to be tackled:

- According to the legal framework derived from the EU Strategy for Data
- Through appropriate organizational frameworks and emerging technologies: Data Spaces
- Putting in place incentives for data altruism and collaboration for the benefit of society.

Crucial roles have:

- Private sector, as data intermediaries, fostering innovative solutions
- Academia, bringing innovative knowledge to the Market (capacity building).

Examples: Big Data capture, management, analytics, and modelling.

Keynote 4: **ESSLs (European Severe Storms Laboratory)' European Severe Weather Database (ESWD) – its manifold uses as an example of citizen science and NGO participation**

Alois HOLZER, Director of Operations, European Severe Storms Laboratory

Alois Holzer (born 1976) was chair of the founding assembly of the ESSL back in 2006 and since then served on the ESSL executive Board, now as Director of Operations. Before the current affiliation with ESSL, he was Head of the weather forecasting department at the public Austrian Broadcasting Corporation (ORF) in Vienna. His main background is climatology, forensic meteorology, severe convective storms forecasting, media meteorology and integral warning systems. Holzer is the main organizer of the series of European Conferences on Severe Storms and leads the ESSL Testbed activities on site at the ESSL Research and Training Centre in Wiener Neustadt, Austria.

Conclusion

The ESWD became a practical standard for the exchange of severe weather event and impact data between science and NHMSs. Further support will strengthen the data coverage for warning verification and manifold other uses and cater to all participating countries.

Key messages

ESSL is a service provider to the NMHSs and international organizations. It is happy to serve the 20 NMHSs of Europe, in addition to AustroControl, ECMWF and EUMETSAT, and is interested to enlarge its membership of the NMHSs, research institutes and the public authorities. It will include access to the ESWD of all Europe.

Plenary

FACILITATORS

Penny ENDERSBY
PR of UK

Willie MCCAIRNES
ECOMET Executive Director

Karl GUTBROD
PRIMET Board Member

Tatsuya KIMURA
Director, Public-Private Engagement Office, WMO

Questions

1. *What adaptations in management and operational environment should be made by NMHSs to sustain the infrastructure built by multiple actors?*

2. *Areas of research and innovation in which partnership with private sector and academia are most needed?*

3. *How to set the right legal framework to mobilize private sector's data to be shared for public good in face of severe weather events;*

4. *How can Regional Associations and Regional Offices work together to secure access to available data both from the private and public sector?*

5. *How could data from non-standard private sector sources be integrated into the current WIGOS system?*

Summary

The panel discussions underlined that public, private, and academic partnership is important for achieving common goals, such as MHEWS, and that building trust between the sectors is essential to make this possible. Examples of successful partnerships, such as the acquisition of data from the private satellite company Spire by EUMETSAT and NOAA, and the use of national funds for joint research projects in Europe, were shared. Another example is the partnership of the UK Met Office and Microsoft, which have partnered to provide public cloud services that will enable users to access data and modelling with a fair payment framework.

The Early Warning System for All initiative provides an excellent opportunity for all sectors to work together. It was noted that the legal framework of WMO may need to be updated to facilitate the inclusion of data from the private sector, and that an open consultative platform is important to reach an agreement. The WMO needs to find creative ways to attract more meteorologists and climatologists to the business and increase the visibility of their activities to make them more efficient. Enhancing the accessibility of data and creating synergies through inclusive collaboration will help leverage resources and support their efforts.

The WMO needs to find creative ways to attract more meteorologists and climatologists to the business and increase the visibility of their activities to make them more efficient. Enhancing the accessibility of data and creating synergies through inclusive collaboration will help leverage resources and support their efforts.

The following set of actions is based on the discussions and considered relevant for implementation to support NMHSs enhance their capabilities, strengthen partnerships, and foster a collaborative environment that leverages the expertise and resources of multiple sectors. This will contribute to more effective early warning systems, increased resilience to severe weather events, and improved service delivery to the public:

- **Foster Collaboration and Trust**: To sustain the infrastructure built by multiple actors, National Meteorological and Hydrological Services (NMHSs) should prioritize building strong partnerships and fostering trust with the public, private, and academic sectors. This can be achieved through open dialogue, joint research projects, and collaborative initiatives. Establishing platforms for regular consultation and engagement will facilitate the sharing of knowledge, data, and expertise, leading to sustainable management and operational environments.

- **Promote Research and Innovation Partnerships**: NMHSs should prioritize areas of research and innovation where partnerships with the private sector and academia are most needed. Collaborative efforts can focus on areas such as advanced modelling techniques, data analytics, AI applications, and technological advancements in observing systems. By leveraging the expertise and resources of

all stakeholders, NMHSs can drive innovation, develop cutting-edge solutions, and enhance the quality and accuracy of weather and climate information.

- **Develop a Robust Legal Framework for Data Sharing**: To mobilize private sector data for public good during severe weather events, it is essential to establish the right legal framework. NMHSs, in collaboration with relevant stakeholders, should work towards creating regulations and agreements that enable the sharing of private sector data for emergency response and disaster management. This can involve ensuring data privacy, defining data usage rights, and establishing fair payment frameworks that incentivize private sector participation while safeguarding public interests.

- **Strengthen Regional Cooperation and Data Access**: Regional Association and Regional Office should work collaboratively to secure access to available data from both the private and public sectors. This can be achieved by developing regional data sharing agreements, fostering data exchange platforms, and encouraging collaboration between NMHSs and private sector entities at the regional level. By enhancing data accessibility and promoting inclusive collaboration, NMHSs can strengthen their data resources and improve the accuracy and coverage of weather and climate information.

AFTERNOON SESSION PLENARY

CHAIR AND KEYNOTE SPEAKERS

Michael STAUDINGER
(CHAIR)
Invited Expert

Jonas WEISS
Senior Research Scientist, AI & Physics for Climate Impact, IBM Research Europe

Bertrand CALPINI
Deputy Director,
MeteoSwiss

Maxime HERVO
Project Coordinator,
MeteoSwiss

Josephine WILSON
HMEI Governing Council Member, Director of Business Development and Sustainability at OTT

Michal NAJMAN
PRIMET Board Member, CEO at Meteopress

Patrick BENICHOU
Président MFI

Keynotes

Keynote 1: IBM Climate Network for Early Warning Systems

Jonas WEISS, Senior Research Scientist, AI (Artificial Intelligence) & Physics for Climate Impact, IBM Research Europe

Dr Jonas Weiss is a senior research scientist and has been with IBM Research - Zurich (ZRL) for about 20 years. He received his masters and PhD degree in electrical engineering from the Swiss Federal Institute of Technology (ETH) in Zurich. Before joining IBM, he held various positions in the industry, designing medical electronics systems and integrated circuits for mobile devices. His scientific background and expertise include analog electro-optical high-speed chip and module design, large computer system analysis and specification and chronic disease monitoring with wearable devices. For many years he worked on analog cognitive computing devices, architectures and respective workloads and algorithms. Today, his focus is on Machine Learning and AI algorithms for satellite images in the context of climate change and sustainability, specifically for understanding the risks of extreme weather events and natural hazard risks and how they will affect society and businesses in the future. Jonas has (co-) authored over 50 peer reviewed scientific publications, has granted over 30 patents, and has held countless technical and invited presentations at high-level international conferences.

Key messages

The volume of geospatial data exceeds the capabilities of the single data centres; there is a need to run potential complex workflows with data and model federation across instances on a global scale. IBM created a Geolab/Node that is a network of instances with public-private data distributed around the globe. These are curated by Data Corpuses ingested into the Climate Impact Modelling Framework which are meant to be accessible by data users and decision makers through User Interfaces.

The outputs of the IBM ecosystem can be used for the MHEWS. The Weather Company is an IBM Business that can be used for global forecasts issued every 5 minutes, providing business support for billions to prepare for incoming weather.

Climate Network of IBM is also a data and model collaboration platform. IBM and the IBM Research have a long tradition of collaborating with industry, governments and academia with R&D labs/centres on all major continents, cultural and geographic differences and similarities are naturally reflected in the IBM work.

IBM is ready to collaborate in building trust starting with small projects and continuing with larger projects.

Keynote 2: PPP meteorological services in Switzerland: a win-win experience, and the specific Drone profiling study

Bertrand CALPINI, Deputy Director, MeteoSwiss

Bertrand Calpini is Deputy Director of the Federal Office of Meteorology and Climatology, MeteoSwiss, and Head of the Measurements and Data Department in MeteoSwiss. He studied physics, environmental science, and technology with a PhD degree in experimental physics at the Swiss Federal Institute of Technology EPFL (École polytechnique fédérale de Lausanne) in Lausanne. After a post-doctoral position in laser chemical vapor deposition at the Chemistry Department at EPFL, Bertrand Calpini was appointed Lecturer in the Environmental Engineering Department and Head of a research group specialized in remote sensing air quality measurement techniques including Lidar. He was later appointed Professor in Atmospheric Science at EPFL. For 8 years Bertrand Calpini was President of the Commission for Instruments and Methods of Observations CIMO at the World Meteorological Organization in Geneva (2010–2018).

Key messages

Only having a clear written process on the way, we address the quality issue we can build trust for values, in particular the extreme ones. Regular third-party auditing is important for continuous improvement of both private and public performances.

A private company can develop a tool but the data analysis, the quality assessment of data and the results is done by the NMHS in collaboration with academia.

Maxime HERVO, Project Coordinator, MeteoSwiss

Maxime Hervo is an Atmospheric physicist, in charge of the remote sensing network at MeteoSwiss. Maxime Hervo leads the remote sensing network at the Federal Office of Meteorology and Climatology, MeteoSwiss. He studied atmospheric physics, with a PhD degree in atmospheric physics at Blaise Pascal University, France. After a post-doctoral position on Lidar profiling at the National University of Ireland, Galway. Maxime Hervo developed the European network of automatics Lidars and ceilometers E-PROFILE, in the framework of EUMETNET.

Conclusions

Drones can monitor fog on sites of interest and in case of Switzerland at the Zurich airport, where fog events are frequently occurring. All predictions and analysis can be improved by meteorological drones monitoring and observations, of temperature, humidity and wind speed measurements on the profile. A Proof of concept helped to identify two challenges that reduce the drone’s performance and impacted the measurement of the high humidity and wind speed. It required some work by the private company (Meteomatics) on the algorithm improvement and replacement of sensors. This project is the first step at MeteoSwiss to contribute to the WMO un-crewed aircraft systems demonstration campaign that will start in 2024. Meteomatics continues fog measurements in Switzerland within the DETAF 2.0 project. More Meteo-drone profiling is planned across Switzerland to improve the observations.

Key message

To succeed you need time and engagement on both sides.

Keynote 3: Public-Private Engagement Modality – HMEI (Hydro Meteorological Industry) Perspective

Josephine WILSON, HMEI Governing Council Member

Jay Wilson is the Director of Business Development and Sustainability at OTT Hydromet, an instrument manufacturing company that provides technical expertise and solutions that seamlessly integrate hardware, software, and services across a range of environmental monitoring applications. In this role, she works with development partners, including UN (United Nations) agencies, funding institutions as well as regional and national hydrometeorological institutions, identifying mutually beneficial areas for meaningful collaboration and partnership. Jay is also the Association of Hydromet Industries (HMEI) Councilor for WMO (World Meteorological Organization) Commissions Collaboration. Prior to OTT Hydromet, she was the Head of the Project Management Division at the WMO where she oversaw over 180M US$ portfolio and managed the relationships with the project stakeholders, including donors. She also managed the development of multi-million-dollar projects and programmes globally, with particular focus on Africa, the Caribbean, and the Pacific.

Conclusions

The Association of Hydromet Industry affirms and supports the central role of met services as the single authoritative voice for weather alerts – public health and safety and believes that private sector engagement is an effective strategy to improve the quality and sustainability of hydromet services and can help close budgetary, technical and human resource gaps in national public institutions. Of the four elements of the early warning Systems, the HMEI is anchoring its perspective on the detection, observations, monitoring, analysis and forecasting of hazards supporting the development of services.

The existing gaps can be bridged by changing the status quo and revising policies. PPP is needed to enhance infrastructure, capacity and sustainability. Fit for context technology, multi-year project investment, Public-Private partnerships, Data rights and markets to enable PPPs and multi-stakeholder approach are the conditions for sustainable development.

Key messages

A PPP Framework is proposed to be established where governments/NMHSs, private sector and local industries, such as insurance, aviation, electrical, agriculture, mining, petroleum, mobile and many others should have each a specific role. To reduce the total operating costs of observing networks a partnership model is suggested for consideration where the governments /NMHSs would provide basic services and the burden would be shared by many players. This model would differ from one country to another. A mindset change is needed to see the private sector as a partner.

Keynote 4: Public-Private Engagement Modality – private sector perspective

Michal NAJMAN
PRIMET Board Member
CEO at Meteopress

Conclusions

A few scenarios of PPE may be considered based on the four business models.

1. **Full public owned and operated observing infrastructure** model is not the model in which private sector would have an interest in engagement due to the lack of offer, unless single components of observing systems are outsourced to the private sector for collaboration for instance on Radar and AI Nowcasting and data can be accessible by the private sector for commercial purposes with reference to the WMO data policy. Still this business model has its upsides and downsides, but an agile development can reduce the risks.

2. **The public owned and private operated observing infrastructure business model** is when the public NMHS is free to enter new types of contracts with the private constructor and operator of basic observing infrastructure and might extend the operating and maintenance period with the contractor. Commercial use of data by the contracted partner is possible. Still there are some upsides and downsides. The PPE is possible but complex and there is ow suppler motivation if the public NMHS owns all data.

3. **The public and private owned and operated observing infrastructure model** enables co-ownership of data, made available in the public domain free of charge, based on an inter-agency agreement. After the end of the contract the ownership of the system is transferred to the public NMHS, and the NMHS is free to enter into new types of contracts after this period if resources are limited. Long-term partnership with upgrades and operability and revenue sharing are parts of the upsides, while operational, managerial, and financial safety is low and there is no legal framework either on local or global level.

4. **Fully owned and operated, by a private company, observing infrastructure model** is a model where data can be made available to the public NMHS for the use of data free of charge as per WMO data policy. Still data can be used by the private partner for commercial services. The exclusive role of each player needs to be defined for a win-win solution. It still may have problems with the country's rules on the critical infrastructure. This model is still being explored, but there is no managerial and operational safety as the private sector can end the contract any time.

The Collaboration of the Meteopress and ZAMG on the Radar and AI Nowcasting is a good example of Public-Private Partnership, with the shared costs and benefits.

Key messages

Collaboration of the WMO with private companies might benefit the implementation of the MHEWS, for which AI for automatic severe storms warning may be used, by integrating the AI applications into the local MHEWS.

Keynote 5: Vision for Design – Build – Operate business model

Patrick BENICHOU, President Météo-France International

Patrick BENICHOU is the founder and President of Météo-France International (MFI). He is both a senior meteorologist graduate from National School of Meteorology (1982) and a businessperson with Executive MBA from HEC-Paris (2000). As a meteorologist he has been working with Météo-France, the leading French National Meteorological Service, until 2000. In 2002 he founded MFI as a private company subsidiary of Météo-France. Since then, he has been managing MFI based on the unique strategic positioning of "meteorological designer and integrator". As such and beyond the day-to-day operation and management activities, he is deeply involved in the design and implementation of complex Modernization Plans for National Meteorological Services (NMHSs) in countries like in Indonesia, India, Angola, or Cote d'Ivoire, and in the related interactions with local governments. He also promotes the concept of Public-Private Engagement, especially to help NMHSs secure and speed up the implementation of the Meteorological value chain following the Design – Build – Operate (DBO) business model.

Key messages

- **PPE-DBO (Design-Build-Operate) approach should be promoted** as it is the safest, quickest, and most effective way to achieve comprehensive NMHS modernization projects
- **Scaling up the DBO approach worldwide needs in-depth changes** in methodology, procurement, and roles of development agencies, WMO, private sector, to better align with the spirit of Geneva Declaration
- **UN EWS initiative is a unique opportunity** to bring such in-depth changes and implement the full Early Warning / Early Action value cycle through PPE-DBO approach, **as proposed in the W4ALL** multi-national approach driven by MFI

Plenary (afternoon session)

FACILITATORS

Marianne THYRRING
PR of Denmark, ECOMET Chair

Willie MCCAIRNES
ECOMET Executive Director

Karl GUTBROD
PRIMET Board Member

Tatsuya KIMURA
Director, Public-Private Engagement Office, WMO

Questions

A holistic Earth system approach will involve more stakeholders than NMHSs, should the future infrastructure for data processing and Earth system forecast be built with multiple sector partners? Why and how to ensure it?

It is expected that private sector's involvement will bring innovation, expertise and financing, what are the practical approaches to engage private sector in future infrastructure development (with focus on observation and information systems)?

The long-term operation and maintenance of the infrastructure has been a key concern to NMHSs. A multi-stakeholder scenario may bring further complexity. What adaptations in management and operational environment should be made by NMHSs to sustain the infrastructure built by multiple actors?

In the context of such new developments as Earth system modelling, AI/ML, what should be the priority areas of collaboration with private sector and academia? How to create an enabling environment for such collaboration?

A crucial issue for the meteorological community has been to find optimal solutions to maintain and improve the free and unrestricted exchange of meteorological data essential for saving lives and property. Over the past decades, both public-financed and commercial data and products have had a huge growth. What are the key policy issues in encouraging more open data sharing by public sector? How to mobilize private sector's voluntary commitment to sharing data for public good in face of severe weather events? What are the recommended practices in redistributing private sector's data for fulfilling Members' international commitment?

Summary

The panel discussions noted the need to help NMHSs foster multi-sector partnerships, engage the private sector in infrastructure development, adapt their management practices, and prioritize collaboration in key areas. Public and private sectors can collaborate to create solutions that improve the speed and security of technological innovation. Nations in Europe are collaborating with Amazon and IBM to develop storage systems and supercomputer solutions to enhance security policies and provide more reliable forecasts and warnings for different user communities. Public and private sector partnerships are being used to achieve this goal and empower NMHSs with more data. Public, private and academic partnership is beneficial for economic reasons, as it allows for competition in data aggregation and service delivery, while also increasing resource efficiency. The private sector can play a role, but needs to be well regulated, to ensure the best service delivery. The PPE is happening but not in a strategic way, how do we take this forward in a strategic way, not just looking at the incremental usage forward by the Regional Association but also by the WMO. We cannot tell every country how to do it, but we give examples and talk about it, and this could help.

NMHSs and the private sector must collaborate in order to create a reliable and secure environment. Data exchange and ownership must be considered, and in addition to the four business models, which were previously mentioned, a fifth business model can be adopted in which NMHSs act as regulators and the private sector as operators. Agreements and arrangements must be reached in order to ensure stabilization. The responsibility for when things go wrong lies with the ministries, but NMHSs can collaborate with the private sector to explain their solutions. It is a political responsibility for the ministers, not a technical one, and the NMHSs should get the best offer with faster innovation in collaboration with the private sector. There is a difference between responsibility and liability, with consequences varying between the private and public sectors. PR's responsibility is to ensure public safety, using the best technology, science and services regardless of their source. Collaboration between the public and private sector is necessary in order to ensure this responsibility is met. WMO is a platform to discuss the steps forward.

The session participants agreed on a **declaration (ref. Annex 2)**.

The following actions can be considered for implementation to ensure more resilient and efficient observation and information systems, improved forecasting capabilities, and enhanced collaboration between public and private sectors for the benefit of society:

- **Foster Multi-Sector Partnerships for Infrastructure Development**: The future infrastructure for data processing and Earth system forecast should be built with multiple sector partners to ensure a holistic and comprehensive approach. This can be achieved by fostering collaborations between National Meteorological and Hydrological Services (NMHSs), private sector entities, academia, and other stakeholders. It is important to establish mechanisms for inclusive decision-making, shared governance, and equitable resource allocation to ensure the involvement of all sectors in infrastructure development.

- **Engage Private Sector through Practical Approaches**: To engage the private sector in future infrastructure development, practical approaches can be adopted. This includes creating incentives for private sector participation, such as offering access to exclusive data sources, providing opportunities for co-development of technologies and services, and establishing fair and transparent commercial agreements. It is essential to establish clear guidelines and regulations to safeguard public interests, data privacy, and ensure the quality and accuracy of observation and information systems.

- **Adaptations in Management and Operational Environment**: NMHSs need to make adaptations in their management and operational environment to sustain infrastructure built by multiple actors. This involves enhancing coordination and communication channels between different stakeholders, developing protocols for data sharing and exchange, establishing interoperable systems, and adopting robust governance structures. It is crucial to ensure clear roles, responsibilities, and accountability frameworks to effectively manage and maintain the infrastructure.

- **Prioritize Collaboration with Private Sector and Academia in Key Areas**: In the context of new developments such as Earth system modelling, AI/ML, NMHSs should prioritize collaboration with the private sector and academia in key areas. This can include joint research projects, sharing of expertise and data, co-development of innovative modelling techniques, and leveraging AI/ML technologies for improved forecasting and warning systems. To create an enabling environment for collaboration, it is essential to establish platforms for knowledge exchange, promote intellectual property rights agreements, and facilitate funding mechanisms for joint initiatives.

NMHSs OF THE FUTURE: LEADERSHIP AND MANAGEMENT

Introduction

The top managers need a broad variety of skills in leadership and management to successfully implement the change management processes that include preparing the organization for change, planning, and implementation.

Key notes

Keynote 1: WMO Leadership and Management Programme: Activities and Available resources, including recent publication (WMO-No. 1289)

Mustafa ADIGUZEL, Scientific Officer, Education and Training Office

Member Services and Development Department, World Meteorological Organization

Mustafa ADIGUZEL has been working for the Education and Training Office of Member Services and Development Department of WMO as Scientific Officer for more than 15 years. Prior to joining WMO in 2007, Mustafa worked for the National Meteorological Service for 22 years in various positions and he was the Director of the WMO Regional Training Centre in Türkiye. In his current position, he supports the professional development of the staff of WMO Members; collaborates with WMO Technical Departments on their training deliveries; manages the Distance Learning Management System of the Education and Training Programme of WMO; and supports the WMO Regional Training Centres Network under the WMO Global Campus initiative. He also leads the Leadership and Management Programme related activities of WMO, especially for the Permanent Representatives and senior-level managers.

Key messages

As requested by the World Meteorological Congress and the WMO Executive Council, the WMO Secretariat has been organizing leadership and management courses, workshops, conferences, familiarization visits, and induction programmes for newly appointed Permanent Representatives and senior managers of the Members; published very useful resources like the latest the publication called, "A Primer on Public Policy and Management with a Focus on National Meteorological and Hydrological Services (WMO-No. 1289)"; and will continue offering these opportunities in collaboration with partners and with involvements of Regional Offices and WMO Regional Training Centres.

It is recommended that the NMHSs make use of available resources of WMO and benefit from the leadership and management activities organized for PRs and senior managers of NMHSs to reinforce their leadership and management skills.

Keynote 2: Recommendations from the High-level Task Team on Intra- and Inter-Regional Collaboration and Cooperation

Kornélia RADICS, Invited Expert

Kornélia Radics graduated as a meteorologist in 1997 and astronomer in 1999. She gained a PhD degree in 2004 with the focus of her research in wind field modelling, climate change, and renewable energy resources. She is a Lecturer at the Eötvös Loránd University, Budapest. She was appointed as the President of the Hungarian Meteorological Service in 2013. She is the former president of WMO RA (Regional Association) VI.

Key messages

There are well-established partnerships among NMHSs in our region. Partnership with the private sector is active across the value chain mostly on the national level. Urgent need has been determined to transform the current partnership of many NMHS's. Partnership with subregional/regional development partners needs to be enhanced. Most of the RA VI (Regional Association VI) member states would like to conclude new partnerships, focusing on service delivery.

Keynote 3: Experience with the Leadership and Management Programme Delivered to Ibero-American NMHS

Andrea GRANDE ROYO-VILLANOVA, RTC Spain Director

Andrea Grande Royo-Villanova is Head of the International Relations Department at AEMET and director of the Spanish Regional Training Centre, which performs several training activities oriented towards Ibero-American NMHSs.

Key messages

Public-Private Partnership and financial opportunities (2-hour course) -> a wider approach (e.g., successful case studies, peculiarities of each country, longer course, etc.) would also have been highly appreciated.

High demand of more international/Spanish cooperation. Some great opportunities are missed simply due to a lack of information or bad timing -> to be widely emphasized in future editions.

Given some of the topics covered high importance of a common language and culture between lecturers/participants. It promotes empathy and communication.

Keynote 4: Subregional Collaboration on WMO matters

Ra'ed RAFID

Permanent Representative of Jordan with WMO

Raed Rafid is the Director of the Jordan Meteorological Department (JMD) and Jordan Permanent Representative with WMO. He was the Director of Weather Forecasting Directorate at JMD for 4 years. He is the Representative of Jordan in the Permanent Arab Committee of Meteorology at the League of Arab States and Member of the Media and Awareness Committee at the League of Arab States.

Key messages

Regional cooperation and data exchange (climatic data, radar images, satellites, automatic observation stations and numerical model data), between neighbouring countries is essential in Middle East, particularly for forecasting and warning provision related to flash floods and dust storms.

Plenary (Part I)

CHAIR AND KEYNOTE SPEAKERS

Roar SKÅLIN (CHAIR)
RA VI Acting President

Andrea GRANDE ROYO-VILLANOVA
RTC Spain Director

Mustafa ADIGUZEL
Scientific Officer, WMO ETR Office

Ra'ed RAFID
PR of Jordan

Kornélia RADICS
Invited Expert

Volkan Mutlu COŞKUN
PR of Türkiye

Keynotes

Keynote 5: The Met Office Change Management Experience

Paul DAVIES, Chief Meteorologist, Principal Fellow, UK Met Office

Paul Davies is the Chief Meteorologist and Principal Fellow for meteorology at the Met Office. He is an expert in operational meteorology and has been a Chief Forecaster, Chief Hydrometeorologist, and founder of the Natural Hazards Partnership. Paul has also chaired the World Meteorological Organization's Impact Task Team and Commission for Basic systems OPAG Management group for GDPFS. He is responsible for ensuring the Met Office's professional and cultural approach to weather forecasting is globally recognized and for spearheading the use of new scientific, technological, and operational techniques.

Key messages

Change Management is a process of improving employee adoption and usage of a solution to drive project results and outcomes. It requires a customized and scaled approach that follows the project lifecycle and aligns with key milestones of successful transition (ADKAR). It takes time, requires a framework and needs to be owned by the business. Leadership and sponsor engagement are also essential for success.

Keynote 6: The need for leadership identity

Marianne THYRRING

Permanent Representative of Denmark with WMO

Marianne Thyrring is the Director General at the Danish Meteorological Institute since 2013. She graduated with a Master of Political Science in 1984 and has held several international and European Meteorological positions. She is the Chair of the Employer Panel for Physics, Chemistry and Nanoscience at the University of Copenhagen and was formerly the Permanent Secretary for the Ministry of Environment and Counsellor to the Minister for Economic Affairs and the Interior. She is married with three children.

Key messages

NMHS leadership is all about working the way towards a robust NMHSs in a resilient society.

Keynote 7: Role of Leadership and Management for Better Service

Volkan Mutlu COŞKUN

Permanent Representative of Türkiye with WMO

Volkan Mutlu COŞKUN was appointed as the Director General of the Turkish State Meteorological Service (TSMS) and PR of Turkey with the World Meteorological Organization (WMO) in August 2018. He holds two bachelor's degrees in Meteorological Engineering and Economics from Istanbul Technical University. He has 18 years of experience in engineering, chief, and director roles, and has also served as the Chief of Cabinet for the Minister of Food, Agriculture, and Livestock and as Deputy Undersecretary in the same Ministry. He is currently heading the TSMS, which belongs to the Ministry of Environment, Urbanization and Climate Change.

Key messages

NMHSs should be restructured to foster collaboration at national, regional and global levels, increase visibility through activities, adapt institutional frameworks for SDG implementation, and motivate staff and create a positive and productive work culture.

Keynote 8: Managing Competencies and Qualifications for Effective Service Delivery

Paul BUGEAC

Chief, Training Activities

Education and Training Office

Member Services and Development Department

World Meteorological Organization

Key messages

Competencies define what must be done, in other words, they describe the basic requirements for successful performance and have a key role in Human Resources Management in terms of organization stability, better services delivery and strategic planning. A system of continuing education and training is required for competencies to be maintained. Competency implementation enables an organization to successfully align its staff's skills, capabilities, and knowledge with organizational priorities, resulting in business improvement and efficiencies. WMO published the frameworks for most of the meteorological, climatological, and hydrological activities related competencies and the guide to competency gives all needed details related to competency implementation.

Plenary (Part II)

Questions

In the context of the evolving roles of forecasters, competency implementation has an extremely high-impact on strategic planning. Have you considered a competency management structure to be implemented in your organization, and to which branches of activity?

Stakeholders' requirements and technical support have increased their diversity every year. Considering this, the need to update staff skills is vital in delivering services. Which is your approach on this major challenge?

Smaller organizations that do not have the possibility to have training structures at the national level are meeting major challenges considering staff dynamics. Also, educational structures are not fully meet the requirements of the BIPs. What recommendations do you have for these organizations to satisfy their needs in education and training?

Summary of discussions

The panel highlighted the need to enhance the NMHSs capabilities to effectively manage competencies, support staff development, address the specific challenges faced by smaller organizations, enhance leadership capabilities, and foster user engagement.

The WMO Regional Training Centres have established procedures for implementing competencies and creating a system for competency management. These include managerial training programs to strengthen their capacity to accept the anticipated changes. To prevent silos, the Permanent Representatives and Directors of the NMHSs must create a collaborative work environment for their staff. Traditional collaboration focuses on capacity development and development; while it can be challenging to create a portfolio that complies with the demands dictated by the most recent trends, it is crucial. Regional Training Centres are constantly updating their programs to meet the demands of Members, including new topics into a variety of training courses targeted to learners with various skill levels, from beginners to experts. It guarantees ongoing qualification updates. Although the forecast is produced automatically, communication skills are essential and still need to be improved, as underlined by the delivered presentations through the shared examples. The NMHS directors must enhance their leadership skills to support the development of national adaptation and mitigation policies and the transition to a green economy while addressing the energy issue. Science for policy and science for services is important to solve socio-economic crisis. Empathy is a soft ability that must be cultivated to interact well with politicians and staff alike. Good networking and relationships are essential if one wants to transform business processes. Good governance is needed, and the related managerial qualities and skills are essential for the top managers. Leadership and management program out in place by the WMO Education and Training Office with the support of the WMO Regional Training Centres is highly recommended for the NMHSs directors. Users must be included in the processes so that they may participate in discussions and decision-making on things like the implementation of a unified and open data policy, the creation of goods like a climate atlas, or the development of a digital user interface.

The following set of actions is based on the discussions and considered relevant for implementation to contribute to the overall improvement of strategic planning, service delivery, and collaboration within the hydrometeorological community:

1. **Establish a Competency Management Structure**: Implement a competency management structure within the National Hydrometeorological Service to identify and define the essential skills and knowledge required for different roles. This structure should include competency frameworks, job profiles, and competency assessments to ensure staff have the necessary skills for strategic planning and service delivery.

2. **Prioritize Continuous Professional Development**: Recognize the importance of updating staff skills regularly to meet the evolving needs of stakeholders and advancements in

technology. Develop a comprehensive approach to continuous professional development that includes training programs, workshops, conferences, and collaborations with external partners to enhance staff competence.

3. **Support Smaller Organizations with Limited Resources**: Recognize the challenges faced by smaller organizations with limited training structures and resources. Provide targeted support and resources to assist these organizations in meeting their education and training needs. This can include partnerships with regional Training Centres, knowledge sharing platforms, and mentoring programs to enhance staff capabilities.

4. **Enhance Leadership and Managerial Skills**: Acknowledge the importance of leadership and managerial skills for NMHS directors in driving national adaptation and mitigation policies. Establish leadership and management programs specifically designed for NMHS directors, supported by the WMO Education and Training Office and the Regional Training Centres. These programs should focus on developing skills in strategic planning, governance, communication, and building collaborative relationships.

5. **Promote User Engagement and Collaboration**: Emphasize the inclusion of users in decision-making processes and foster collaboration between meteorological organizations and users. Encourage participation from users in discussions on data policies, product development, and User Interfaces. Create platforms and mechanisms for user engagement to ensure their needs and perspectives are considered in service delivery.

STRATEGY AND LEGISLATION

Introduction

Strategy and legislation are policy instruments for efficient and effective governance. It is critical to understand the legislative processes so that you can move forward specific objectives. With the newly adopted unified data policy, strategy and legislation may need to be adjusted. Institutional and coordination mechanisms are important, and strategic alignment is vital to avoid duplication of efforts and create synergies.

Keynotes

Keynote 1: UN Agenda 2030 for Sustainable Development: Progress and Challenges in Implementation

Monika LINN, Principal Adviser and Chief, Sustainable Development and Gender Unit, UN Economic Commission for Europe

Monika Linn is the Director of the Sustainable Development and Gender Unit, UN Economic Commission for Europe (UNECE). Ms Linn's Unit leads and coordinates UNECE's contributions to the implementation and review of the 2030 Agenda for Sustainable Development and for other cross-sectoral themes in the development field. Inter alia, she is responsible for organizing the annual Regional Forum on Sustainable Development. Ms Linn has 30 years of experience in multilateral work on environment and sustainable development. Before joining the United Nations in 2001, she worked for 10 years in the International Affairs Division of the Swiss Environment Agency and was involved in a wide range of multilateral meetings, conferences, and negotiation processes. Previous assignments in the UN include work in UNDESA (United Nations Department for Economic and Social Affairs) and UNEP (United Nations Environment Programme).

Key messages

Urgent Acceleration Needed: While some progress has been made towards achieving the UN's 2030 Agenda, the pace of implementation remains unsatisfactory. With only a quarter of the targets achieved so far, there is an urgent need for accelerated action to meet the goals in time.

Peace is Vital for Sustainable Development: Sustainable development cannot be realized without peace. Conflicts and the ongoing pandemic have had significant impacts on the implementation of the Sustainable Development Goals, emphasizing the need for peaceful environments to achieve sustainable outcomes.

Infrastructure for Green Transition: Additional investments in infrastructure development are critical for facilitating the transition to a greener future. Strengthening international cooperation and technological advancements have shown promising developments in this regard.

Environmental Challenges: Environmental issues, particularly pollution and greenhouse gas emissions, pose significant risks in Europe and require immediate action. Stress on regional river basins further highlights the need for collective efforts to address environmental challenges effectively.

Strengthening Disaster Risk Reduction: While there is a strong political commitment to sustainable development, there is a need to improve disaster risk reduction strategies.

Currently, only 65% of the population is covered, leaving a significant portion unaccounted for. Governance systems should be integrated to ensure effective coordination and implementation of the 2030 Agenda.

Regional Forum on Sustainable Development: The annual Regional Forum on Sustainable Development in Geneva provides a valuable platform for knowledge sharing and exchanging best practices among member states. It aims to address challenges in achieving sustainable development and identify effective strategies to overcome them.

Keynote 2: Water and Climate Coalition: Leadership and Engagement

Stefan UHLENBROOK, Director, Hydrology, Water and Cryosphere, World Meteorological Organization

Dr Stefan Uhlenbrook' s main expertise includes water management, hydrological processes, and modelling across scales (i.e., floods and droughts), and the water-energy-food-ecosystems nexus. He is a renowned academic and has led/contributed to many projects in Africa, Asia, Europe, and MENA that have demonstrated the impact of global changes on water, and they provided effective solutions to address these challenges through integrated approaches. He is experienced in translating science-based knowledge to effective policies, strategies and services that contribute to environmental, economic, and societal sustainability. Since September 2022, Stefan has led the Hydrology, Water and Cryosphere program of the World Meteorological Organization (WMO), the UN Specialized Agency for Weather, Climate and Water. He is excited to contribute to the Organization's program and, among other things, strengthen the early warning systems for floods and droughts and water resources assessment and management worldwide. During 2019–2022, he has focused his interest on water and food system transformations to provide healthy and nutritious food for all while considering the vital role of water and ecosystems. Previously, he served as the director of water, food, and ecosystems at IWMI (2019–2022, Sri Lanka), Coordinator of UNESCO's World Water Assessment Programme (WWAP, 2015–2019, Italy), and the Deputy Director and acting Director of UNESCO-IHE (now IHE-Delft, Netherlands, 2005–2015). He has been a professor at IHE-Delft (2005 onwards) and Delft University of Technology (2009–2020), The Netherlands. He did his PhD (1999) and habilitation (2003) at the University of Freiburg, Germany.

Summary

At the High-Level Policy Forum during the launch of the Decade of Action, the Water Climate Coalition, consisting of 160 member organizations, including UN agencies and the Global Water Partnership, was established. This coalition aims to address the integration of climate and water agendas, promote concrete actions and innovative solutions, and emphasize the importance of data and information for informed decision-making.

To expedite progress towards Sustainable Development Goal 6 (SDG 6) on water and sanitation, an acceleration framework was developed, encompassing five key tracks: data and information, financing, capacity development, innovation, and governance. This framework serves as a guide for prioritizing and advancing efforts within SDG 6.

The Coalition's Action Plan on Hydrology outlines the specific activities supported by the coalition. One of the key objectives is to enhance global water information services through the implementation of three components:

Hydrological Status and Outlook System (HydroSOS): This component focuses on providing seasonal to sub-seasonal timescale products. It facilitates the assessment of current hydrological conditions and provides outlooks for future trends, enabling stakeholders to make informed decisions related to water management and planning.

Annual Global State of Water Report: The coalition has planned to launch the first edition of this report on 28 November 2022. The report aims to present the State of water resources worldwide, with a specific focus on streamflow in 2021. It draws upon hydrological data from 515 basins and provides valuable insights into global water conditions.

Global Water Data Portal: This component aims to establish a centralized platform for accessing and sharing water-related data. The portal serves as a comprehensive repository of global water data, fostering collaboration, knowledge exchange, and evidence-based decision-making in the water sector.

Key messages

By strengthening global water information services through its three components, the Water Climate Coalition endeavors to enhance the understanding, management, and governance of water resources worldwide, ultimately contributing to the achievement of SDG 6 and addressing the challenges posed by climate change and water scarcity.

Keynote 3: WMO Capacity Development Strategy

John OGREN, Vice-Chair, Capacity Development Panel, WMO Executive Council

John Ogren is the Chief Learning Officer of NOAA's National Weather Service (NWS). As CLO, he oversees training for the entire workforce including weather and water forecasts and warnings, new science and technology, Decision Support Services, Electronics and IT, and leadership development. Within WMO, John serves as the Vice-Chair of the Capacity Development Panel. In this capacity, he leads the Task Team charged with revising the WMO Capacity Development Strategy.

Summary

The Capacity Development Panel of the EC has recently completed the update of the Capacity Development Strategy of the World Meteorological Organization (WMO). This updated strategy is slated to be presented for adoption at the upcoming session of the WMO Congress. The strategy encompasses three key components: human, institutional, and technological aspects, providing a comprehensive and integrated approach.

The revised version of the Capacity Development Strategy will first be presented at the forthcoming session of the WMO Executive Council before it proceeds to the Congress session. This sequential process ensures that the strategy receives thorough consideration and input from key stakeholders prior to its final adoption.

Key messages

The updated Capacity Development Strategy reflects the collective efforts of the Capacity Development Panel, and its submission to the WMO Congress for adoption demonstrates the commitment to advancing capacity development within the hydrometeorological community.

Keynote 4: Meteorology, Climatology and Environment in Recent Italian Legislative Framework

Luca BAIONE

Permanent Representative of Italy with WMO

Summary

In 2017, a new law was enacted in Italy, paving the way for the establishment of the Italian Meteorological and Climate Agency (Italia Meteo). This law aimed to consolidate various regional capabilities into a single agency, enabling the delivery of more tailored meteorological and climatological products and services. The creation of the Italia Meteo was driven by the need for a unified and comprehensive approach to meteorology and climate-related matters in the country.

To ensure the involvement of relevant stakeholders and promote a cross-cutting and integrated approach, a committee was formed, consisting of representatives from six ministries and six out of the total nineteen regions in Italy. This composition allowed for a diverse range of perspectives and expertise to be incorporated into the decision-making process, leading to more effective governance of meteorological and climate-related affairs.

The amendment process for the law was rigorous and time-consuming, requiring the approval of all relevant agencies involved. The aim was to ensure a thorough and comprehensive review of the proposed amendments, as well as to adhere to the legal framework and constitutional requirements. After a considerable period of deliberation and review, the law was officially published in the Official Journal on 8 February 2022, solidifying the establishment of Italia Meteo as a legally recognized entity.

Key messages

With the establishment of Italia Meteo, Italy aims to enhance its meteorological and climatological capabilities by harnessing the expertise and resources of various regional actors. This consolidation of efforts enables Italia Meteo to provide more tailored and localized services, better meeting the specific needs of different regions within the country. By centralizing these capabilities and promoting collaboration and coordination, Italia Meteo is well-positioned to address the challenges posed by weather and climate-related phenomena and contribute to informed decision-making at national and regional levels

Keynote 5: Regulatory and Legal Framework in Albania: Collaboration Aspects and Perspectives

Ylber MUÇEKU, Permanent Representative of Albania with WMO

Ph. D. Ylber MUÇEKU is a Full Professor in Engineering Geology, Polytechnic University of Tirana, Albania, in the Institute of Geosciences. Currently, He is the director of Institute of Geosciences (2020-on). Mr MuÇeku is the author and co-author of over 90 scientific papers in international journals and conferences and in 18 scientific studies with national impact. His area of expertise includes the engineering geology mapping for urban development and planning, mass movement and slope stability evaluation, sands liquefaction, geological hazards, soils improvements techniques and geotechnical evaluation of the motorway and tunneling etc. He has taken part in many scientific and organizing committees of international and national conferences and has been an invited speaker at several international and national conferences.
Mr Muceku is a member of several editorial Board of the scientific journals as are" Albanian Journal of Natural and Technical Sciences, published by Tirana Sciences Academy of Albania" and "Bulletin of Technical Sciences, published by the Polytechnic University of Tirana", as well as "Ghost Town: abandonment versus regeneration in the frame of human and territorial resilience, Sustainability an open access journal by MDPI"

Summary

The presentation briefly outlined the historical development of the Hydrometeorological Service in Albania, which originated in 1949 and later transformed into the Hydrometeorology Institute within the Academy of Sciences. Despite this transformation, the regulatory and legal framework governing the institute remained unchanged until 2020.

In 2020, a revision process was initiated, supported by various projects funded by international institutions and organizations. The revision process aimed to update and modernize the regulatory and legal framework of the Hydrometeorological Service in Albania. As part of this effort, a strategy and regulation were developed, along with the establishment of a hydrometeorology network.

Additionally, the ongoing development of a knowledge portal for climate and EWS highlights the commitment to improving the dissemination and accessibility of information related to climate and weather. Furthermore, a law focused on water, weather, climate, and related environmental services is being developed, which will provide a comprehensive legal framework for the sector.

In line with these advancements, plans are also underway to extend the observing network and enhance the data management system. These initiatives aim to strengthen the capacity of the Hydrometeorological Service in Albania, enabling more accurate and reliable data collection, analysis, and forecasting.

Key messages

The revision process and the development of new strategies, regulations, and infrastructure demonstrate Albania's commitment to modernizing and improving its hydrometeorological services.

These efforts will contribute to better understanding and management of weather, climate, and water resources, ultimately benefiting the country's resilience and sustainable development.

Keynote 6: Good practices of legal frameworks underpinning meteorological service

Tatsuya KIMURA
Director, Public-Private Engagement Office
World Meteorological Organization

Summary

The presentation provided a review of PPE policy & guidelines, possible key enablers for the PPE, a rationale for the sound national frameworks for PPE and concrete examples of provisions that enable PPE, supported by WMO and EU legislative instruments as good practices, referring to relevant items of the Geneva declaration of 2019, adopted at the eighteenth World Meteorological Congress. Outsourcing, acquisition, dissemination, and mission are other good PPE practices to be considered.

Key messages

Future actions on PPE and change management should be guided by the Geneva declaration of 2019 to support building an inclusive community for weather, climate, and water actions.

Putting in place appropriate legislation is one of the key enablers for a successful public-private engagement on the national level. It can guarantee relevant activities, as all stakeholders clearly understand their rights and obligations in the country.

Principal elements of national legislation on NMHS activity should ensure:

- the authoritative voice of the NMHS
- the fulfilment of international commitments
- the functions of the NMHS as promoter and a regulator of the weather enterprise (separation of roles, provision of support, data provision, licensing for quality assurance)
- the collaboration with private and academic sectors, users and civil society.

WMO publication (2017 edition, WMO-No. 1195) "Guidelines on the Role, Operation and Management of NMHS" has aspects that could be included in national legislation on NMHS activity.

Plenary

CHAIR AND KEYNOTE SPEAKERS

Milan DACIC
WMO Representative for Europe

Luca BAIONE
PR of Italy

Monika LINN
Principal Adviser and Chief, Sustainable Development and Gender Unit, UNECE

Ylber MUÇEKU
PR of Albania

Stefan UHLENBROOK
Director, Hydrology, Water and Cryosphere, WMO

Tatsuya KIMURA
Director, Public-Private Engagement Office, WMO

John OGREN
Vice-Chair, Capacity Development Panel

Gerard VAN DER STEENHOVEN
PR of the Netherlands

Questions

What mechanism is available on the Member State level to ensure the implementation of the WMO Strategy 2020–2023 as a contribution to the UN 2030 Agenda?

Can current legislation and strategy support the implementation of the Earth system approach and unified data policy, or amendments are needed?

Summary

This plenary discussed the importance of national legislation in supporting the implementation of the United Nations' 2030 Agenda and how hydrometeorological services can contribute to this process. In many countries, there is a need to define these services by law to enhance their visibility and status. The discussion emphasized the need for a coordinated, multi-stakeholder approach to achieve the Sustainable Development Goals (SDGs) and mentioned the importance of data collection in assessing progress. Collaboration between organizations like WMO and UNECE is encouraged to promote such coordination at the national level. The plenary also raised questions about the readiness of national legislation to implement the goals and strategic objectives of the WMO, particularly concerning unified data policies and the public-private engagement in meteorology. The countries' examples were cited, highlighting the use of international collaborations and efforts to update the laws to accommodate public-private engagement and prioritize public value. Overall, the plenary emphasized the significance of national legislation in facilitating the implementation of the UN 2030 Agenda and the role of hydrometeorological services in achieving Sustainable Development Goals.

The following set of actions based on discussions is considered relevant for implementation:

1. **Strengthen national legislation**: Member States should prioritize the development and implementation of comprehensive legislation that defines and supports hydrometeorological services. This legislation should enhance the visibility and status of these services, ensuring their effective contribution to the implementation of the UN 2030 Agenda. Amendments may be needed to align existing legislation with the goals and strategic objectives of the World Meteorological Organization (WMO), particularly in relation to unified data policies and public-private engagement in meteorology.

2. **Foster multi-stakeholder collaboration**: Member States should encourage a coordinated, multi-stakeholder approach to achieve the Sustainable Development Goals (SDGs). Collaboration between organizations such as the WMO and the United Nations Economic Commission for Europe (UNECE) should be promoted at the national level. By working together, stakeholders from government bodies, civil society, private sector, and academia can leverage their expertise, resources, and networks to address the challenges posed by climate change and improve the effectiveness of hydrometeorological services.

3. **Enhance data collection and assessment**: Member States need to prioritize data collection efforts to monitor progress towards the SDGs. Investments should be made in the development and implementation of robust data collection systems and methodologies. Additionally, mechanisms for assessing and analysing collected data should be established or strengthened. This will facilitate evidence-based decision-making and enable the monitoring and evaluation of the impact of hydrometeorological services on sustainable development. Public-private partnerships can play a vital role in data collection efforts, and frameworks should be established to ensure the responsible and ethical use of data while prioritizing public value.

Member States can improve the legal frameworks supporting hydrometeorological services, enhance collaboration between stakeholders, and strengthen data-driven decision-making, ultimately advancing the implementation of the UN 2030 Agenda and the goals of the WMO Strategy 2020–2023.

CONCLUSION AND RECOMMENDATIONS

The complexity of the global climate system often contributes to significant gaps between scientific and policy-oriented understandings of how climate change-related risks cascade through environmental, social, and economic systems. The WMO community addresses these gaps by connecting changes in the global climate system, as measured by state of the climate indicators, to the Sustainable Development Goals (SDGs). To see the connection of climate indicators to the SDGs click on Climate Indicators and the Sustainable Development Goals | World Meteorological Organization (wmo.int).The 2023 Regional Forum of the UNECE on Sustainable Development, planned for spring, will focus on reviewing SDG 6 (Water), SDG 7 (energy), SDG 9 (Infrastructure), SDG 11 (Sustainable Cities and Communities) and SDG 17 (Partnerships). The SDG 5 (Gender Equality) is also considered a cross-cutting component.

This regional conference led to a list of **Recommendations to the Member States of the WMO REGIONAL ASSOCIATION VI (RA VI)**. The RA VI supported by the WMO Regional Office for Europe will take opportunity of several high-level events such as the 2023 Regional Forum of the UNECE on Sustainable Development, the Water Ministerial Conference, to present the recommendations issued from the 2022 Regional Conference on Future Role of NMHSs: Leadership and Management. It will state their readiness to address the recommendations in support of the UN Agenda 2030 and Sustainable Development Goals and will motivate their peers to put these initiatives into practice.

Annex 1

RECOMMENDATIONS

Briefing: Regional Conference on the Future Role of NMHSs

Introduction: This briefing provides an overview of the Regional Conference on the Future Role of National Meteorological and Hydrological Services (NMHSs) held in Geneva, Switzerland. The conference, organized by the World Meteorological Organization (WMO), aimed to address key challenges faced by NMHSs and discuss strategies for their future role.

Participants: The conference convened high-level representatives from governments, United Nations (UN) agencies, regional organizations, the WMO, NMHSs, and stakeholders from the public and private sectors. Discussions focused on shaping the future role of NMHSs in response to evolving weather and climate challenges.

Key Issues Discussed:

1. Infrastructure for research and services
2. Research activities for services as a core business of future NMHSs
3. Services to support the core business of NMHSs
4. State of Climate in Europe report
5. Engagement of public, private and academic sectors
6. NMHSs of the future: leadership and management
7. Strategy and legislation

The discussions led to a list of recommendations to ensure a successful research and services infrastructure in support of the transformative pathways for accelerating the achievement of the UN 2030 Agenda.

The following recommendations primarily address the needs and responsibilities of National Meteorological and Hydrological Services (NMHSs), which are national agencies responsible for weather, climate, and water-related services. NMHSs play a crucial role in collecting, analysing, and disseminating accurate and reliable information related to weather and climate, and in providing essential services to various sectors of society.

While NMHSs are the key agency that needs to address these recommendations, successful implementation often requires collaboration and partnership with other institutions and stakeholders. These may include academia, private sector organizations, government agencies, civil protection authorities, and the public.

Therefore, the level of national agency that needs to address the recommendations ranges from the NMHS itself to other relevant government departments, regulatory bodies, and organizations involved in disaster management, environmental protection, research and development, education, and public outreach. Overall, the implementation of these recommendations requires a multi-sectoral approach, involving coordination and collaboration among various national agencies, each playing a specific role in achieving the desired outcomes. It's important to note that the priorities may vary depending on the specific context and needs of each country.

RECOMMENDATIONS TO THE MEMBERS OF WMO REGIONAL ASSOCIATION VI

Infrastructure for research and services:

1. Invest in high computing infrastructure for NMHSs' local-scale modelling using AI and ML algorithms.

2. Develop innovative technologies to ensure efficient and secure data exchange among NMHSs, research institutions, and stakeholders.

3. Support the creation of accessible and affordable early warning systems aligned with the UN's "Early Warning for All" initiative, leveraging IoT and mobile applications.

4. Foster collaboration platforms to effectively leverage expertise and resources among NMHSs, academia, private sectors, and stakeholders.

5. Invest in research on data-driven forecasting, including AI and ML techniques, to enhance the accuracy of weather predictions for NMHSs.

These recommendations prioritize the development of advanced infrastructure, technological advancements, data exchange, early warning systems, collaboration, and research in order to strengthen and improve the effectiveness of hydrometeorological services.

Research activities for services as a core business of future NMHSs:

1. Strengthen collaboration between NMHSs, academia, private sectors, and stakeholders to drive research for services infrastructure.

2. Allocate resources for R&D focused on advanced data processing technologies and real-time localized forecasts by NMHSs.

3. Advance research efforts on data-driven forecasting, including AI and ML techniques, to improve the quality of weather predictions by NMHSs.

4. Establish funding mechanisms and government grants to support scientific research and development, with a specific focus on advancing meteorological and hydrological sciences for NMHSs.

5. Coordinate research efforts to avoid duplication and foster collaboration on high-resolution modelling for urban environments.

These recommendations emphasize the importance of collaboration, resource allocation for R&D, data-driven forecasting, funding mechanisms, and coordination in advancing the capabilities and effectiveness of hydrometeorological services.

Services to support the core business of NMHSs:

1. Foster fully functioning and effective partnerships between NMHSs, government agencies, private sectors, and the public to enhance collaboration and service delivery.

2. Implement capacity building programs to enhance the technical skills and knowledge of NMHSs personnel, enabling them to provide improved and tailored services to end-users.

3. Enhance relationships with authorities at national and local levels to support decision-making processes and ensure the integration of weather, water, and climate services into policy and planning frameworks.

4. Promote public awareness of the value and benefits of hydrometeorological services, emphasizing the role they play in public safety, economic sectors, and sustainable development.

5. Invest in technological advancements and innovation to enhance the quality, accessibility, and timeliness of weather, water, and climate services provided by NMHSs.

These recommendations prioritize collaboration, capacity building, partnerships, public awareness, and technological advancements to strengthen and enhance the delivery of hydrometeorological services.

Engagement of public, private, and academic sectors:

1. Foster collaborative partnerships between NMHSs, private sectors, and academia to address meteorological and climatic challenges through innovative solutions and resource sharing.

2. Enhance public awareness through targeted education campaigns and collaboration with media outlets to promote the understanding of NMHSs' role in safety and environmental stewardship.

3. Strengthen coordination and governance through structured agreements and regulations that foster partnerships between NMHSs and stakeholders for effective data sharing and utilization.

4. Develop a robust legal framework for data sharing, ensuring privacy, defining data usage rights, and establishing fair payment frameworks to incentivize private sector participation while safeguarding public interests.

5. Encourage international cooperation by formalizing data sharing agreements, fostering collaboration between NMHSs, and participating in global initiatives to enhance weather and climate services.

These recommendations prioritize collaboration, public awareness, governance, legal frameworks, and international cooperation to strengthen and enhance the delivery of hydrometeorological services.

State of the Climate in Europe report:

1. Strengthen National Meteorological and Hydrological Services (NMHSs): a) Allocate resources and provide support for the development of human and technical capacities within NMHSs to ensure reliable predictions, early warning systems, and monitoring of climate conditions. b) Equip NMHSs with advanced hardware and software for effective monitoring, prevention of high-impact events, and timely actions.

2. Invest in Adaptation, Early Warning Systems, and Partnerships: a) Invest in adaptation measures, including the establishment of Early Warning Systems, to address the impacts of climate change on various sectors and enable prompt actions for mitigation and resilience. b) Foster inclusive partnerships at local, regional, and global levels, involving public, private, and academic representatives, to address climate change impacts, share best practices, and support knowledge transfer.

3. Enhance Transboundary Cooperation for Water Management and Disaster Risk Reduction: a) Recognize the importance of transboundary water cooperation in reducing disaster risks and promoting sustainable development. b) Support the implementation of the UN Water convention as a unique legal mechanism for transboundary cooperation, particularly in shared river basins. c) Share good practices, improve finance mechanisms, and exchange lessons learned to support adaptation projects, reduce environmental impact, and enhance disaster risk reduction efforts.

4. Integrate Climate Education and Child-Centred Approaches: (a) Integrate climate change education into national plans, including NDCs and NAPs, to ensure the involvement of children and youth. (b) Prioritize funding for adaptation measures aimed at protecting children and youth, including critical social services, climate change education, disaster risk reduction education, and green skills training. (c) Collaborate closely with organizations like UNICEF and WMO to design child-centred early warning systems, climate policies, and enhance climate resilience for the younger generation.

5. Provide Financial Support for Climate Monitoring Systems and the production of high-quality climate information, ensuring the availability of reliable data for NMHSs and researchers.

These recommendations emphasize the strengthening of NMHSs, investment in adaptation and early warning systems, transboundary cooperation, climate education, and financial support for climate monitoring and information.

NMHSs of the future: leadership and management:

1. Establish a Competency Management Structure: Implement a competency management structure within the National Hydrometeorological Service to identify and define the essential skills and knowledge required for different roles. Develop competency frameworks, job profiles, and competency assessments to ensure staff have the necessary skills for strategic planning and service delivery.

2. Prioritize Continuous Professional Development: Recognize the importance of updating staff skills regularly to meet the evolving needs of stakeholders and advancements in technology. Develop a comprehensive approach to continuous professional development that includes training programs, workshops, conferences, and collaborations with external partners to enhance staff competence.

3. Support Smaller Organizations with Limited Resources: Provide targeted support and resources to assist smaller organizations with limited training structures and resources in meeting their education and training needs. Establish partnerships with regional training centres, create knowledge sharing platforms, and implement mentoring programs to enhance staff capabilities.

4. Enhance Leadership and Managerial Skills: Establish leadership and management programs specifically designed for NMHS directors, supported by the WMO Education and Training Office and the Regional Training Centres. Focus on developing skills in strategic planning, governance, communication, and building collaborative relationships to enable NMHS directors to drive national adaptation and mitigation policies.

5. Promote User Engagement and Collaboration: Emphasize the inclusion of users in decision-making processes and foster collaboration between meteorological organizations and users. Encourage participation from users in discussions on data policies, product development, and User Interfaces. Create platforms and mechanisms for user engagement to ensure their needs and perspectives are considered in service delivery.

These recommendations prioritize the establishment of a competency management structure, continuous professional development, support for smaller organizations, enhancement of leadership and managerial skills, and promoting user engagement and collaboration.

Strategy and legislation:

1. Establish a national legal framework: Develop and implement a comprehensive national legal framework that enables efficient sharing of data and infrastructure among NMHSs, research institutions, and stakeholders while ensuring data privacy and security.

2. Streamline regulations for weather and climate services: Simplify and update regulations to create a conducive environment for the development of water, weather and climate services within NMHSs and private sectors. This streamlining will encourage innovation, collaboration, and the adoption of advanced technologies. By simplifying administrative processes and reducing burdensome requirements, organizations can allocate their resources more efficiently, thereby facilitating the exploration and implementation of innovative ideas.

3. Strengthen capacity in climate policies and monitoring systems: Align NMHSs' strategies with national climate change agendas and international commitments. Enhance their capacity in climate policies, action plans, and monitoring systems to effectively contribute to climate change mitigation and adaptation efforts.

4. Establish a governance framework: Develop a governance framework that promotes coordination, collaboration, and accountability among NMHSs, government agencies, and stakeholders involved in water, weather and climate services. This framework will ensure effective coordination and optimal utilization of resources.

5. Create an online knowledge sharing platform: Establish an online platform or knowledge sharing portal to facilitate the exchange of best practices, expertise, and resources among NMHSs, research institutions, and stakeholders. This platform will foster collaboration, learning, and innovation, enhancing the quality and effectiveness of water, weather and climate services. The platform can operate under controlled access, enabling participants to contribute and access information based on predefined levels of collaboration.

Annex 2

DECLARATION ON PUBLIC, PRIVATE AND ACADEMIC ENGAGEMENT

- **All of us**, working for weather, climate, water and other environmental services in an age of Digital Transformation, **reaffirmed the importance of working together in partnership, i.e., Public-Private-Academic Engagement,** to address global societal risks related to extreme weather, climate, water and other environmental events. Public-Private-Academic Engagement will add strength to the weather value chain and enable us to address the global meteorological and climatic challenges better and more efficiently.

- The **UN "Early Warning for All" initiative offers enormous opportunity** for accelerating the public-private-academic partnerships which will be crucial for achieving the ambitious goal of building universal global coverage with actionable and highly localized warning information in the next five years. Stakeholders from all sectors will be united by the common noble cause of the initiative and the common social responsibility of the global weather enterprise to build resilience for all, in particular for most vulnerable countries and societal groups.

We share the importance of

[DECISION SUPPORT]

- **Supporting decisions** in society for disaster risk reduction, climate change adaptation, and many other areas raised in SDGs, by maximizing our collective professional expertise and power of the public, private and academic sectors as well as civil societies.

[BUILDING TRUST and SETTING A FRAMEWORK]

- **Sharing mutually agreeable and beneficial goals and common factors** of collaboration and **setting a legal framework** to ensure further collaboration by making National Meteorological and Hydrological Services' and stakeholder's missions clearer.

[DATA]

- The importance of further **sharing of Earth System data** among sectors in line with WMO's new unified Data Policy, and such sharing will further unlock the potential of Earth System data and will support society and economy.

[INCLUSIVE APPROACH]

- Working collaboratively by sharing each professional expertise, including research and development, education and training, new practices on codesigning and new business models, while acknowledging each mission and embracing the cultural, and mission difference.

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