15. REPORT OF THE EXPERT TEAM ON POLICY DEVELOPMENT AND INSTITUTIONAL MATTERS (CDP-ET-PDIM)

15.1 Report on activities of CDP-ET-PDIM

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Invited Members:

15.2 Meetings and other discussions

Project details:

The current project details are the following:

A) Identify the current policy to the compliance and capacity of Members, particular developing countries, to WMO standards and recommended practices, including the free exchange of data, delivery of services.
Task A will thus concentrate on current gaps to compliance of members to WMO standards and recommended practises including identification of gaps in policies addressing capacity and free exchange of data

B) legislative matters, strategic and operating plans that include gender equity action plans.

Task B will look at legislative matters, strategic and operating plans that include gender equity action plans

C) Communication, promotion of global meteorology, hydrology and climatology including authoritative voice common standards and product sharing.

Task C will look at communication, promotion of global meteorology, hydrology and climatology including authoritative voice common standards and product sharing.

D) Advocacy efforts to governments, end-users, decision-makers on the socioeconomic benefits of investments in NMHSs:

E) Develop strategies to assist NMHs to implement WMO and national requirements: This item will only become active as soon as the WMO strategy has been finalized.

F) Additional: ***Compile best practices from the National Meteorological and Hydrological Services (NMHSs) considered to be meeting global standards in the delivery of services. This compilation to be used in promotion of standards worldwide***

15.3 Progress:

One Teams meeting was held with the first draft of the report. Input was received from the participants and a second draft was circulated for input. Minimum input was received and thus the report was updated to the final draft.

Looking at the simplified task the following reports were provided with the minimum people working on the projects:

A) *Concentrate on current gaps to compliance of members to WMO standards and recommended practises including identification of gaps in policies addressing capacity and free exchange of data*:

- The WMO data policies development was important as it addresses critical issues for NNMHSs that depend on the capital that the selling of data is bringing in, thus this issued was followed.
- The 2021 Extraordinary World Meteorological Congress (11-22 October) approved the WMO Unified Data Policy, along with two other sweeping initiatives – the Global Basic Observing Network (GBON) and the Systematic Observations Financing Facility (SOFF) – to dramatically strengthen the world's weather and climate services through a systematic increase in much-needed observational data and data products from across the globe.
- The Unified Data Policy, GBON and SOFF have been painstakingly developed through extensive consultation with thousands of experts and other stakeholders around the globe to meet the explosive growth in demand for weather and climate data products and services from all sectors of society.
- Approval of the Unified Data Policy provides a comprehensive update of the policies guiding the international exchange of weather, climate and related Earth system data between the 193 Member states and territories of WMO. The new policy reaffirms the commitment to the free and unrestricted exchange of data, which has been the bedrock of WMO since it was established more than 70 years ago.
- The ultimate goal of the activities coordinated through WMO is to enable the citizens and economies of all WMO Members to benefit from weather, climate and related environmental services. This is accomplished via the meteorological value chain, which starts with observations, our basic source of knowledge about the atmosphere and the climate system and ends with effective decision-making based on the services they enable.
  The value chain can be schematically described as follows:
- Weather and climate observations are routinely made all over the globe.
- Those observations are exchanged internationally, including with global Numerical Weather Prediction (NWP) Centres.
- Global NWP output, monitoring and prediction data for weather and climate are generated and shared with all WMO Members (193 States and Territories).
- Global NWP output is used by National Meteorological and Hydrological Services (NMHSs) and other entities as a basis for weather and climate information.
- Weather and climate information services are delivered to users, including national and local authorities, businesses, media, academia and the general public.
- Effective decisions in response to weather and climate information are made by authorities, agents in all economic sectors and individuals.
- Looking at the list, the full value chain capacity development needs include observations, knowledge around meteorology, climatology, network, Numerical

weather prediction (NWP), use of NWP, weather and climate decision making etc.

- Another issue registered is with the implementation of the free data exchange. There need to be a gateway to withdraw the data independently and that will take development and financial commitment that is not available. It is suggested that a generic programme that can withdraw data be made available that will serve the purpose or capacity need to be built within the NMHSs to be able to do so.

- A list of the standards and competencies was made. As the aviation competencies are mandatory it is of course necessary to follow that.
- It must be noted that the new BIPs (updated WMO 1083) will only be approved in Congress 2023.
- Need to follow the implementation of new BIP-M and BIP-MT curriculums as soon as it is approved.

- Other standards and competencies will have to wait until there is a real need unless there is a specific request. Marine might be identified as important as well.
- WMO support in coordinating and cooperating with Global Model Providers to get their commitment in providing the global model with higher resolutions would also be important for Members.
- Group was reminded it needs to identify the general issues and link capacity development to the issues and link to policies.

B) legislative matters, strategic and operating plans that include gender equity action plans

- After a review of draft 4 of the Capacity Development Strategy, it was noted that the topic of gender equality was not addressed. The unintentional omission has been noted by the vice chair of the CDP and the topic of gender equality will be added to the draft strategy document prior to the CDP meeting in September 2022.
- Best practice on how Members put gender equity action plans in their national legislative matters, strategic and operating plans would be very helpful to other Members.
- From the result of Resource Mobilization, Partnership, and Development Assistance (RMPDA) conducted by the ET-RMPDA, it was shown that some Members especially in LDCs has not developed their strategic plan in Resources Mobilization.

C): Communication, promotion of global meteorology, hydrology and climatology including authoritative voice common standards and product sharing:

- Product share will be important to follow, especially with the MTG implementation. The display of the MTG is becoming critical and EUMETSAT is looking at options. The roll-out of the MTG products is starting with the development of ASMET14. Request has been made for training (capacity Development of personnel) with the implementation of the MTG.
- Product sharing should also include collection of training materials including any reference, module, guidance, and best practice materials to be put in WMO Library in order to have a widely opened access by all Members.

- The new BIP-M and BIP-MT updated document WMO 1083) will be important, and the communications of the draft standards will have to be communicated clearly.
  It must be noted that while the BIP-M was updated, it was the BIP-MT that had major changes. There are specialities listed that will be taken up by the relevant NMHSs that is using the specialities.

- Looking at the data required for the country data base sent out to all WMO members in 2021: it links again to the competency standards and the output of that will be important to assimilate. The group need to have access to the information gathered.
- Engagement of private sectors in communication, promotion of global meteorology, hydrology and climatology including authoritative voice common standards and product sharing should be further enhanced under collaborative approach by the Secretariat.

D) Advocacy efforts to governments, end-users, decision-makers on the socioeconomic benefits of investments in NMHSs

- Efforts has been made by the Secretariat by the provision of information of socio-economic benefits of investments in NMHSs as well as the presence of WMO in Members important events shall be continued and increased.
- Public Private Engagement (PPE) are encouraged to for product and information sharing.
- It is of interest to any country to know the social benefits of their different actions especially in Weather and Climate

E) Develop strategies to assist NMHs to implement WMO and national requirements: This item will only become active as soon as the WMO strategy has been finalized.

- A draft was put forward to the CDP panel and input was requested. The person that updated the strategy was promoted and left the team. The updating will continue with the CDP 5 and needs to be finalized for submission to Congress 2023.
- The WMO Capacity Development Strategy (CDS) is planned to be submitted to the WMO Congress in 2023. A 4th draft of the CDS is being presented at the 5th meeting of the Capacity Development Panel in September 2022. Once approved by the CDP, the document will be sent throughout the WMO community for a final review prior to being submitted to the formal WMO governance process.

19-23 September 2022	Fifth Meeting of Capacity Development Panel (CDP-5), Geneva	• CDS Draft version 3 revised to Version 4 during the write shop (first 3 days dedicated to this effort)
September 26 – October 7, 2022	Revise and Adjudicate comments from CDP-5	• Comments adjudication matrix prepared • EC-76 draft resolution prepared
October 3-14, 2022	CDS materials posted	• WMO prepares documents for CDP-6 and loads to meeting website • CDS Draft version 4 sent out to relevant constituents ahead of CDP-6 for final comments.

		Lines numbered and comment sheet for specific changes provided.
October 17 – 21, 2022	Final revisions to CDS materials	• Make final revisions to documents. CDS Draft version 5 prepared from specific comments. • Upload final Draft CDS version 5 to website for CDP-6 adoption
•		
February 2023 (Date TBC)	76th Session of the Executive Council (EC-76)	• Revised WMO CDS to be proposed for EC approval
March 2023 (Date TBC)	Seventh Meeting of Capacity Development Panel (CDP-7), Online	• In case changes to the Strategy are proposed by EC-76, CDS Team to revise Strategy and share the revised final draft with CDP members ahead of the meeting for final comments. • The main outcome expected from this meeting (related to the Strategy) is the approval of the revised final draft of CDS by CDP members, so it can be submitted to Congress.
22 June to 2 May 2023	Nineteenth World Meteorological Congress (Cg-19)	• Revised WMO CDS to be proposed for adoption

- Please note that task E is officially is on hold until the WMO strategic plan is developed to give guidance to other NMHSs.

F) Additional:

Compile best practices from the National Meteorological and Hydrological Services (NMHSs) considered to be meeting global standards in the delivery of services. This compilation to be used in promotion of standards worldwide

To compile the best practices from the national meteorological and hydrological services to be meeting the global standards in the delivery of services, there has to be taken note of the already existing published best practices from WMO and other met services.

The list that could be traced included the following (input of listed documents summarized in Appendix A):

a) Guidelines on Best Practices for Climate Data Rescue (WMO-No. 1182)

Published by: WMO ; 2016 (2016 edition) ISBN: 978-92-63-11182-1

This document gives guidelines on Climate Data Rescue and is intended to provide guidance already in the form of best practices.

b) Best Practices for the Management of the WWW Operational Information (on the WMO website)

This document provides information on why, when and how to update the operational information, and how to be kept informed of amendments to operational information.

The following operational information is posted on the WMO server:

c) Best Practices in Warning Systems

The guidelines examine the role of National Meteorological and Hydrological Services (NMHSs) in developing early warning activities and best practices, such as the Shanghai Multi-hazard Early-Warning System (MHEWS), one of the first of its kind, which has been used to train World Bank staff members and clients.

d) Training Materials and Best Practices for Chemical Weather/Air Quality Forecasting ETR- No. 26

Capacity development of Chemical Weather and Air Quality Forecasting (CW-AQF) is summarized in this document.

e) Best Practices for the Dissemination of Weather Warnings to the Public

A Best Practice Statement of the American Meteorological Society

(Adopted by the AMS Council 7 January 2018)

The best practices are intended to be for the benefit of the public; thus, the audience includes the general public as well as providers of weather alerting services, both public and private sector.

f) Best practice from Palu, Indonesia multi hazards-earthquake, tsunami and liquefaction events

From the Palu, Indonesia multi hazards-earthquake, tsunami and liquefaction events, it is noted that the interruption of modern communication when extreme events occur must also be anticipated. Communication media that can really be relied upon during extreme events must continue to be explored and developed to ensure early warning received by the community in a timely manner. Updated best practice on this issue should also be shared to Members. Local wisdoms related to the community communication including empowerment of community in developing their standard operating mechanism for the extreme event should also be more explored.

g) Best Practices for Data Management (AMS statement)

American Meteorological Society Statement on Full, Open, and Timely Access to Data (2019):

h) 6 Best Practices Used by Aviation Meteorologists for Pre-Flight Planning

Given the availability of different online tools – including meteorological tools – operators have many options. In many cases, these tools provide sufficient information for crew members or aircraft dispatchers. However, for international trips, operators should consider using meteorologists, who offer benefits a do-it-yourself tool doesn’t. For example, a meteorologist can be contacted on short notice with

questions about challenges such as impeding weather. He or she can also help plan your next trip by providing outlooks for your intended stops. And he or she can identify problems that might not be readily apparent to an operator. The six key components your aviation meteorologist uses to help you plan your trips are summarized in Appendix A:

i) Best Practices on Weather, Climate and Ocean Literacies for Community and Stakeholders – Indonesia

In order to enhance the weather, climate, and ocean literacy of the communities and other related stakeholders in Indonesia, the Government of the Republic of Indonesia has conducted the Climate Field School for Farmers Program, Weather Field School for Fisherman, Shrimp Farmers, and Salt Miners Program, and Earthquake and Tsunami Field School for the communities Program.

The Programs aim to enhance the capacity of the community and other related stakeholders in understanding the weather, climate, ocean, as well as earthquake information and how to best use of the information to support their activities for enhancing their safety and welfare.

The Programs, which are also included as one of the commitments made by the government of the Republic of Indonesia to the UN Decade of Ocean Science of the IOC UNESCO, have also been conducted to enhance capacity of other Members in the Region through the training program held by the Regional Training Center of Indonesia in collaboration with other Ministries in Indonesia as well as with WMO and other international organization.

j) Guide to marine meteorological services. 2018 edition. (WMO) (WMO-No. 558),

Internationally agreed methods of providing services to the marine community around the world are described in the Manual on Marine Meteorological Services (WMO-No. 558), Volume I.

k) Guide to Meteorological Instruments and Methods of Observation WMO-No. 8

Consist of out of the different variables to measure and with what instrumentation.

l) Epidemiological versus meteorological forecasts: Best practice for linking models to policymaking from ScienceDirect.

Weather forecasts, climate change projections, and epidemiological predictions all represent domains that are using forecast data to take early action for risk management. However, the methods and applications of the modelling efforts in each of these three fields have been developed and applied with little cross-fertilization. This perspective identifies best practices in each domain that can be adopted by the others, which can be used to inform each field separately as well as to facilitate a more effective combined use for the management of compound and evolving risks. In light of increased attention to predictive modelling during the COVID-19 pandemic, we identify three major areas that all three of these modelling fields should prioritize for future investment and improvement: (1) decision support, (2) conveying uncertainty, and (3) capturing vulnerability.

m) AMS: Best Practices for Sharing Weather Information on Social Media on MephisWeather.Netblog

Earlier this year at the American Meteorological Society's (AMS) 2017 Annual Meeting in Seattle, the AMS Council adopted a set of "best practices" for publicly sharing weather information via social media. This blog summarizes the best practices.

n) Best Practices and Lessons Learned in the Implementation of Global Framework for Climate Services—Adaptation Programme in Africa: Tanzania-Experience Paper published in Scientific Research.

Some of the best practices documented during the implementation of GFCS programme are described. The highlighted best practices focus on various categories of climate services value chain and formulation, and implementation of the National Framework for Climate Services. These include information sharing, user-engagement including training and awareness, and governance mechanism.

O) African Regional Climate Outlook Forums Best Practices Published by United Nations Economic Commission for Africa

The innovative WMO concept of regional climate outlook forums is now well established in Africa. There are now seven operational outlook forums in Africa coordinated by WMO-designated regional climate centres under each regional economic commission. The process of organizing an outlook forum includes a training session, a pre-forum, a forum and an outreach session. The differences in regional context, capacity and policy mean that there are likely to be variations in organization, funding mechanisms, consensus development, communication, dissemination and stakeholder engagement. It is thus crucial to highlight best practices to improve exchange between the various outlook forums and foster standardization of the process across the continent.

P) Fit for purpose? Transforming National Meteorological and Hydrological Services into National Climate Service Centers - published in ScienceDirect.

Examples given from:

a) Caribbean Institute for Meteorology and Hydrology, Husbands, St. James, Barbados

b) School of Geography and Development, University of Arizona, Tucson, AZ, United States

c) Institute of the Environment and School of Natural Resources and Environment, University of Arizona, Tucson, AZ, United States

d) Udall Center for Studies in Public Policy, University of Arizona, Tucson, AZ, United States

Global Data Processing and Forecasting System (GDPFS) Manual

q) Other WMO STANDARDS & BEST PRACTICES 2012

Technical Regulations (WMO-No. 49)
Mandatory publication):

1. International Cloud Atlas (WMO-No. 407), Volume I - Manual on the observations of clouds and other meteors
2. Manual on Codes (WMO-No. 306)
3. Manual on Global Telecommunication System (WMO-No. 386) and Manual on the WMO Information System (WMO-No. 1060)
4. Manual on Global Data Processing and Forecasting Systems (WMO-No. 485)
5. Manual on Global Observing System (WMO-No. 544)
6. Manual on Marine Meteorological Services (WMO-No. 558)
7. Manual on the Implementation of ETR standards

B. Guides (recommended practices):

- Guides on GOS, GDPFS, GTS,
- Guide to Met. Instruments and Methods of Observation
- Guide to Hydro Practices
- Guides to Practices or Services for different app areas, such as Climatology, Agrometeorology, Aviation, Marine

C. Other Technical Documents needed for general understanding

METEOTERM

Manual on the Global Observing System, WMO-No. 544

r) WMO Integrated Global Observing System (WIGOS) Manual on the WMO Integrated Global Observing System (WMO-No. 1160): Annex VIII to the WMO Technical Regulations

Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8

s) WMO Intercomparisons

t) Others:

Basic Instruction packages for Meteorologists and Meteorological Technicians (WMO-1083)

Compendium of WMO Competency Frameworks (WMO-1209)

15.4 Challenges:

The main challenge identified is the time and capacity available to work on these different projects.

15.5 Recommendations:

Recommendation 1: NMHSs are encouraged to accept the WMO 1083 (BIP-M and BIP-MT recommended Curriculums) as a recommended standard and to adapt to it as a matter of policy.

Recommendation 2: Encourage all NMHSs to implement the relevant competencies by using advocacy and advertising of the benefits of competency implementation and its complexity.

Recommendation 3: Encourage all meteorological training institutions beyond RTCs to make relevant training material/resources available to WMO secretariat as open access for other to use free of charge.

Recommendation 4: Encourage all NMHSs to build up institutional capacity to establish mutually beneficial and effective collaboration with private sector and other stakeholders, including data/information sharing, service delivery, and advocacy for the essential public functions of meteorological services in issuing warnings, maintaining basic infrastructure and promoting the uptake of WMO standards and recommended practices by all**.**

Recommendation 5: Empathize the need for governments on policy level to take into account any social benefit of any measures what they take.

15.6 Way Forward:

The group will have to continue with the work set out in the different projects to come to some outcomes although most of them will have to continue into the future as the pace of progress is slow.

For the additional project identified: It will be a continuous process to identify already published good practices, but the project needs to move to the next step to start collating additional information that might be available from the different NMHSs that has not been published as yet.

Appendix A

a) Guidelines on Best Practices for Climate Data Rescue (WMO-No. 1182)

Published by: WMO ; 2016 (2016 edition)

The Guidelines on Climate Data Rescue are intended to provide guidance already in the form of recommended best practices. Because of the diversity of National Meteorological and Hydrological Services (NMHS) with respect to the size and stage of technological development, along with the variability of weather types and climate, some practices may not be useful for every WMO Member. That being said, the Guidelines cover a wide range of guidance that should provide assistance on how to organize and implement data rescue and provide generalized technological solutions for every Member. More specific technological information, as well as informative illustrations and photos, may be found at the International Data Rescue (I-DARE) portal that is maintained by WMO with the assistance of the Royal Netherlands Meteorological Institute and the WMO Commission of Climatology Expert Team on Data Rescue.
While specific to weather and climate data, these best practices could also be applied to the rescue of data in other scientific fields, both within the remit of WMO and beyond. In particular, the rescue of hydrological, marine and other environmental data follows similar overall principles and practices and is basically considered to be within the scope of these Guidelines. Specificities of such data, however, need to be identified and taken into account in close collaboration with the respective communities, including, for example, the WMO Commission for Hydrology and the WMO–Intergovernmental Oceanographic Commission (UNESCO) Joint Technical Commission for Oceanography and Marine Meteorology.

b) Best Practices for the Management of the WWW Operational Information

This document provides information on why, when and how to update the operational information, and how to be kept informed of amendments to operational information.

The following operational information is posted on the WMO server:

- WMO Publication No. 9: Volume A - Observing Stations
- Catalogue of Radiosondes and Upper-air Wind Systems in use by Members
- Regional Basic Synoptic and Climatological Networks
- WMO Publication No. 9: Volume C1 - Catalogue of Meteorological Bulletins
- WMO Publication No. 9: Volume C2 - Transmission programmes
- Rooting catalogues of bulletins
- Monitoring Reports: Data Quality Monitoring and Quantity Monitoring reports
- WMO Publication No. 9: Volume D - Information for Shipping
- WMO Publication No. 47: International List of Selected, Supplementary and Auxiliary Ships
- Operational Newsletter on the World Weather Watch and Marine Meteorological Services
- Additional data and products as defined in Resolution 40 (Cg-XII)

c) Best Practices in Warning Systems

The guidelines examines the role of National Meteorological and Hydrological Services (NMHSs) in developing early warning activities and best practices, such as the Shanghai Multi-hazard Early-Warning System (MHEWS), one of the first of its kind, which has been used to train World Bank staff members and clients.

Guidance on Early Warning and Multi-Hazards Early Warning System that already in place, such as ISO 22328-1 "Security and resilience — Emergency management — Part 1: General guidelines for the implementation of a community-based disaster early warning system" published by Indonesia in 2020, should also be made available for Members reference by the Secretariat.

Best practices from Indonesia NMHS's experience in developing Impact Based Forecast (IBF) in collaboration with its Disaster Management Authority for weather prediction and it's efforts in sharing this experience including capacity development on Numerical Weather Prediction with other Members in the Region could be one model that could increase the Members' capacity in shifting paradigm of the early warning system into the impact based forecast.

Collection of training materials including any reference, module, guidance, and best practice materials in open access WMO library regarding the early warning system would be one excellent tools for Members in enhancing its capacity on early warning.

Five priorities emerged from the 2005 World Conference on Disaster Reduction:

(1) ensuring that disaster risk reduction is a national and local priority with a strong institutional basis for implementation;

(2) identifying, assessing, and monitoring disaster risks and enhancing early warning;

(3) better managing knowledge for building a culture of safety;

(4) reducing the underlying risk factors; and

(5) enhancing preparedness for an effective response.

An effective warning system embodies the three essential requirements of government leadership, multiagency coordination, and community participation. Core elements of a people-centered warning system include risk knowledge; monitoring and warning service; dissemination and communication; and response capability.

d) Training Materials and Best Practices for Chemical Weather/Air Quality Forecasting

Capacity development of Chemical Weather and Air Quality Forecasting (CW-AQF) attracts considerable attention from research communities and governments worldwide for a number of reasons. Increasing numbers of human mortality rates due to human exposure to ambient and indoor air pollution are reported. Recent scientific advancements in numerical weather prediction (NWP) and CW-AQF have been made using 3-D integrated meteorology-chemistry modelling systems and advanced data assimilation techniques combined with near-real time observations.

There is a need for governments to utilize information from CW-AQF to issue health-related alerts, with increasing involvements of National Meteorological and Hydrological Services (NMHSs) and other federal and state-level environmental protection agencies in CWAQF and Multi-hazard Early Warning Systems (MHEWS). Consequently, a growing number of forecasters use 3-D numerical models worldwide for CW-AQF and MHEWS. On the other hand, those models become progressively complex and would be difficult to adapt for real-time deployment and operation of CW-AQF without adequate training and guiding materials.

An important step towards the development of WMO competency for CW-AQF would be to train and guide appropriate experts. As part of its mandate to contribute to the protection of lives and property, WMO pays attention to the development of the training capacity of experts dealing with atmospheric pollution. Recognizing the urgent need for the successful implementation and application of 3-D numerical models for CW-AQF, WMO, through the Education and Training Office and Global Atmosphere Watch Scientific Advisory Group on Applications (GAW SAG APP), initiated the development of training materials and best practices for CW-AQF.

The overarching goals of this initiative are to disseminate some practices from NMHSs and the academic community with the aim of building the scientific capacity of researchers and operational meteorologists in developing countries. Hence this publication aims to help forecasters worldwide, especially those in developing countries, to use 3-D CW-AQF models and NWP for operational forecasting, early warning, policymaking, and action-taking to reduce air pollution and associated human health effects and provide climate co-benefits in the most appropriate and efficient way. It will also provide practical information about the best operational CW-AQF practices and standardized procedures for successful deployment and application. Finally, it will assist in preparing materials that could be adapted for training by NMHSs, WMO training centers, and other users from environmental authorities and academic institutions.

The publication has been developed by some 80 experts on numerical weather prediction, air quality forecasting, anthropogenic and natural emissions (including wildfires, dust storms, air toxics, and volcanic eruptions), data assimilation, as well as ensemble and probabilistic forecasting. It also contains a review of existing worldwide research and development experience and real-time CW-AQF, incorporates existing education materials, recommendations and best practices in recognized meteorological training institutions, and identifies the critical needs for management competence enhancement in CW-AQF.

This is the first edition of this publication and efforts will be made to revise it in the future. We expect that this publication will enhance the capacity of all stakeholders in their efforts to develop and implement chemical weather and air quality forecasting systems by bringing more scientific knowhow into relevant operations on air quality forecasting. In this way, tangible contributions will be made, from the perspective of the science-policy interface, towards the implementation of relevant policy and decision support aimed at improving quality of life and environmental protection.

e) Best Practices for the Dissemination of Weather Warnings to the Public

A Best Practice Statement of the American Meteorological Society

(Adopted by the AMS Council 7 January 2018)

Historically the delivery of emergency messages to the public was primarily through broadcast media and NOAA Weather Radio. With the growth in smart technology and social media there has been a proliferation in methods for delivering emergency weather information. Providers of emergency weather communication services range from governmental to media outlets to private-sector individuals. While these services provide valuable communication improvements to the warning system, there are no enterprise-wide established guidelines in place to ensure that the services provided are timely and accurate. These Best Practices represent the next step in encouraging the continued collaboration and cooperation between the various sectors of America’s Weather, Water, and Climate Enterprise to ensure the public receives the highest quality warnings.

The best practices are intended to be for the benefit of the public; thus, the audience includes the general public as well as providers of weather alerting services, both public and private sector.

A best practice from Palu, Indonesia multi hazards-earthquake, tsunami and liquefaction events

From the Palu, Indonesia multi hazards-earthquake, tsunami and liquefaction events, it is noted that the interruption of modern communication when extreme events occur must also be anticipated. Communication media that can really be relied upon during extreme events must continue to be explored and developed to ensure early warning received by the community in a timely manner. Updated best practice on this issue should also be shared to Members. Local wisdoms related to the community communication including empowerment of community in developing their standard operating mechanism for the extreme event should also be more explored.

Best Practice characteristics

One of the most important roles of the weather enterprise is to provide timely and accurate warnings to the public. The public is far better off today in receiving warnings than they were 20 years ago, when the only way to receive a warning was via radio, television, or sirens.

The many new ways to receive warnings offer tremendous upside so long as information remains coordinated. In most cases, the National Weather Service (NWS) produces and issues warnings through various dissemination channels and the private sector also disseminates or communicates those warnings to the public. Because of the short-term nature of many warnings and the associated imminent hazardous weather, it is of great importance that NWS warnings are relayed to the public in as timely a fashion as possible and that the warnings are for the same geographic location warned by the NWS. While it is important that all warnings are actually relayed to the public, users can be given the ability to filter warnings to those most appropriate for their use

The National Weather Service is the official government source for weather warnings. Many private-sector weather information companies produce their own warnings in addition to relaying government warnings. Guidelines for adding distinctiveness between public-sector and private-sector warning messages are addressed below.

Any company or organization that disseminates NWS warnings to the public via web pages, e-mail, telephone, push notification to mobile devices, SMS text messages, or other means should take care to ensure that those warnings are provided from an infrastructure that can handle the number of alerts that must be sent to the consuming public. Caution must be used to adapt quickly when a particular technology can no longer guarantee successful dissemination of warnings. Care must also be taken to ensure that all NWS warnings are received from the NWS and decoded in a timely manner.

f) Best Practices for Data Management (AMS statement)

American Meteorological Society Statement on Full, Open, and Timely Access to Data (2019):

Research and education in the atmospheric and related sciences have been consistently dependent on data. Given the expansion and sophistication of the data networks, increasing volumes of both observations and model data, and the need for analysis, it is critical to consider data management strategies and accepted practices

for optimal use. Data management practices can better facilitate collaboration and reuse of data. Furthermore, with public access mandates from federal agencies concerning dissemination and sharing of research results including a data management plan, investigators are expected to share their data with the greater research community, and for that matter, the public. Despite the diversity of data management practices, which depend on factors including project type and data volume, there are few established standards for data management. As such, it would be beneficial to the community to develop accepted practices with a focus on principles of data management and general guidelines. The AMS Board on Data Stewardship advises and serves the Society on issues related to data stewardship including coordination of activities and services to enhance functional and meaningful access to and use of data. The Board on Best Practices has reviewed the most recent AMS Open Data Statement (2019) to ensure coordination and compatibility with this document. The Society recognizes the need to provide guidance in the area of data management for the community of researchers, educators, practitioners, and others who either produce or use data in different contexts.

The best practices outlined below aim to provide guidance for effective data management practices for the community of research scientists and educators, as well as for all that produce data or provide access to data. They are intended for a broad audience and are informed by other organizational guidelines gathered from the community. The purpose of this best practices document is to provide guidance not only for making data more easily understood and more usable, but also for addressing issues related to data sharing and management, such as intellectual property, provenance, privacy, and effective preservation.

What the recommended best practices are

Data management includes a broad spectrum of activities in the data lifecycle, including data collection, governance, sharing, storage, and archival practices. From a best practice viewpoint, the following principles and guidelines on data management need to be considered in order to adhere to community practices:

2. **Data access plan:** Devise a plan for how users will be able to access and retrieve data, supporting the access points such as setting up and maintaining a data portal, and the practice and policies regarding the release of data.
3. **Data costs:** Identify costs for open data access, management, and long-term storage and preservation.
4. **Data products:** List and describe the types of data, data products, and formats that will be generated, including software and curricular materials.
5. **Data formats:** Describe the format in which the data or products are stored to indicate the context in which the data were produced. This component should include a mechanism to indicate whether the dataset is complete and when and how the dataset has changed. It is critical that data formats follow accepted community standard formats, if possible, through a self-documenting format that supports interoperability and reuse.
6. **Intellectual property:** Describe potential licensing, copyright, restrictions on data access, and tangible research property.
7. **Quality assurance (data integrity and source):** Describe the processes applied for quality assurance. Identify the initial data source and describe any inclusion of other data sources.
8. **Data from other sources and provenance tracking:** Identify and describe any data used from other sources that may be a part of the original dataset and clarify whether there are any restrictions related to sharing of this data.

9. **Reuse, re-distribution, and production of derivatives:** Describe policies regarding the use of data provided via general access or sharing, and conditions for the use of data in other settings, if applicable.
10. **Data preservation and archiving:** Describe whether, how, and where data will be archived and how preservation will be handled. This should include protection of data in an environment for long-term access and reuse, transfer of data to different format(s) in response to changes in technology, and accessible indexing of data. This component may also contain guidelines for a routine process to guarantee data integrity associated with appropriate metadata to ensure sustained access.
11. **Data Governance:** Identify which policies (e.g., Public Access to Research Results) from which entities (agencies, professional societies, publishers, etc.) will guide the data management plan and its implementation. Describe the established project timeline for compliance with policy conventions.
12. **Data in publications:** Include information on how data referenced in publications should be archived, cited, and accessible to the community in raw and interim formats.

g) 6 Best Practices Used by Aviation Meteorologists for Pre-Flight Planning

Given the availability of different online tools – including meteorological tools – operators have many options. In many cases, these tools provide sufficient information for crew members or aircraft dispatchers. However, for international trips, operators should consider using meteorologists, who offer benefits a do-it-yourself tool doesn't. For example, a meteorologist can be contacted on short notice with questions about challenges such as impeding weather. He or she can also help plan your next trip by providing outlooks for your intended stops. And he or she can identify problems that might not be readily apparent to an operator. Below are six key components your aviation meteorologist uses to help you plan your trips:

1. Determining trip feasibility with preliminary weather briefings

Preliminary weather briefings – an important element in trip planning – are valuable for prediction purposes. These briefings are used to determine the feasibility of many different types of operations. They assist in planning ultra long-range missions, selecting tech stops and alternates and avoiding tropical weather systems. Your aviation meteorologist can give you an overview on destination weather issues and en-route weather problems, along with recommended options.

2. Using historical data in trip planning

Historical winds and climatology data are available for any location worldwide for any month of the year. Meteorologists can provide this information to operators upon request. This type of package usually includes Boeing winds data, as well as wind component and altitude data. Your meteorologist will use a full range of weather resources and, in conjunction with a professional flight planner, create test flight plans based on historical winds for trip-planning purposes.

3. Monitoring volcanic activity

Aviation meteorologists will use the latest volcanic activity information available to monitor how such activity can impact a flight. This information will include generated graphics and interpretation of volcanic databases on information received from different Volcanic Ash Advisory Centers. (There are nine of them.) When there is a volcanic observation available, meteorologists will use data produced by it to provide relevant and detailed information on volcanic ash cloud dispersion. Your meteorologist

will create and send customized briefings to assist crews and ensure the proposed route avoids ash activity.

SIGMET Coordination has also been operated in some Member countries including one in Asia region (Hongkong, Indonesia, Japan, Philippines, and Singapore). This collaborative effort is very important in addressing the gap in the provision of SIGMET information in the boundary.

4. Creating custom vs. generic forecasts

Customized weather – as opposed to online services – is highly beneficial to both domestic and international operations. Full-service weather routinely includes advanced notification regarding inclement weather conditions that could jeopardize your flight, layover or technical stops. Custom forecasts for specific arrival and departure timeframes (for example, customized terminal aerodrome forecasts, not generic ones) can be forwarded via all means of communication upon request or along with your flight plan and weather package.

5. Referencing numerous weather information sources

Aviation meteorologists have available information from various meteorological services and sources to provide operators with the best possible briefings to support trip planning. They use numerous systems and resources to build detailed, accurate, trip-specific forecasts. These include weather models, radar and satellite imagery.

6. Being available 24/7

In a day and age where data is available through many technological avenues, having meteorologists available 24/7 is a great advantage. You'll benefit when you have an experienced aviation meteorologist on the line that can answer questions and assist with planning and day-of-operations concerns. A larger weather department will have meteorologists with diverse educational backgrounds and expertise, coming from both military and academic schools of thought. Additionally, there are long-range forecasters that can provide early warnings about weather hazards for your important trip.

It is noted that 24 hours call center for weather briefing is required for aviation services. Contingency Plan due to Covid and other extreme Situation would also be required to be developed by Members. Best practices on how this Contingency Plan is developed in some countries would also be very helpful and required by Members.

h) Best Practices on Weather, Climate and Ocean Literacies for Community and Stakeholders – Indonesia

In order to enhance the weather, climate, and ocean literacy of the communities and other related stakeholders in Indonesia, the Government of the Republic of Indonesia has conducted the Climate Field School for Farmers Program, Weather Field School for Fisherman, Shrimp Farmers, and Salt Miners Program, and Earthquake and Tsunami Field School for the communities Program.

The Programs aim to enhance the capacity of the community and other related stakeholders in understanding the weather, climate, ocean, as well as earthquake information and how to best use of the information to support their activities for enhancing their safety and welfare.

The Programs, which are also included as one of the commitment made by the government of the Republic of Indonesia to the UN Decade of Ocean Science of the

IOC UNESCO, have also been conducted to enhance capacity of other Members in the Region through the training program held by the Regional Training Center of Indonesia in collaboration with other Ministries in Indonesia as well as with WMO and other international organization.

i) Guide to marine meteorological services. 2018 edition. (WMO)

Weather information has always been vital for the safety and efficient operation of marine industries, particularly transport and fishing. Early in the twentieth century, wireless telegraphy allowed regular communication between ship and shore, and weather broadcasts to shipping began. The first International Convention for the Safety of Life at Sea (SOLAS Convention) called for all shipping lanes and fishing grounds to be covered with weather information broadcast by radio; governments agreed to share responsibilities for these broadcasts. The International Maritime Organization (IMO)/WMO Worldwide Met-Ocean Information and Warning Service (WWMIWS) provides uniform coverage of forecasts and warnings to ships traversing the oceans. The IMO Polar Code provides additional guidance on the provision of suitable marine meteorological and sea-ice services to support safe shipping in polar waters.

Internationally agreed methods of providing services to the marine community around the world are described in the Manual on Marine Meteorological Services (WMO-No. 558), Volume I. The purpose of this Guide is to complement the Manual by:
(a) Describing the requirements for the various types of service;
(b) Explaining the rationale for the agreed methods of providing services;
(c) Giving guidance on how to set up and maintain marine meteorological services.
It follows the same structure as the Manual on Marine Meteorological Services.

The need to enhance collaborative efforts made for capacity development in marine services, such as collaboration between Regional Training Centers available in WMO (WMO RTC) and IOC UNESCO (Ocean Teacher Global Academy) in order to optimize the strengthening efforts of capacity in Members.

j) Guide to Meteorological Instruments and Methods of Observation WMO-No. 8

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k) Epidemiological versus meteorological forecasts: Best practice for linking models to policymaking

Weather forecasts, climate change projections, and epidemiological predictions all represent domains that are using forecast data to take early action for risk management. However, the methods and applications of the modeling efforts in each of these three fields have been developed and applied with little cross-fertilization. This perspective identifies best practices in each domain that can be adopted by the others, which can be used to inform each field separately as well as to facilitate a more effective combined use for the management of compound and evolving risks. In light of increased attention to predictive modeling during the COVID-19 pandemic, we identify three major areas that all three of these modeling fields should prioritize for future investment and improvement: (1) decision support, (2) conveying uncertainty, and (3) capturing vulnerability.

l) AMS: Best Practices for Sharing Weather Information on Social Media

Earlier this year at the American Meteorological Society's (AMS) 2017 Annual Meeting in Seattle, the AMS Council adopted a set of "best practices" for publicly sharing weather information via social media. As most of you are aware, there are **many** choices when it comes to consuming weather information. From local TV, to national cable channels, to government and private company websites, to NOAA Weather Radio, to social media, to mobile apps, and even your refrigerator... anyone (or anything) can produce weather data. That information may originate from a degreed or certified meteorologist, a broadcaster or reporter, a young person with passion but little to no training (that was me 25 years ago!), or (more often these days) just a computer model run through the Internet of Things.

Best Practices for Publicly Sharing Weather Information Via Social Media

The overall goal should be delivering a time-sensitive product that communicates weather information clearly and professionally commensurate with the users' understanding of the science. A quality social media weather information service should:

- Differentiate between short-range forecasts, extended-range forecasts, and outlooks. (In short- or medium-range forecasts (i.e., less than 7 days), offer as much detail as the science allows. Do not imply that extended-range forecasts (i.e., 8 days and beyond) are as reliable as short-range forecasts. Clearly identify outlooks as such and avoid misrepresenting an outlook as a specific forecast of weather elements for a specific area.)
- Recognize the limitations of numerical weather predictions. (When displaying or sharing computer model forecasts, identify them as such.)
- Communicate uncertainty and be transparent. (When displaying or sharing forecasts that are highly complex and/or involve longer lead times, communicate the full range of scenarios. Communicate the degree of

confidence in their forecasts and educate their users about the level of agreement among forecast models and the likelihood of a particular outcome. Respond to all comments and replies to their social media posts in a manner that offers insight into their forecast reasoning while being professional and respectful.)

- Carefully and responsibly craft headlines and key messages. (If providers work in organizations where they do not have total control of all weather-related content, they should work diligently to educate and influence the appropriate content producers regarding the responsible communication of weather information.)
- Offer a schedule for updates (While a regular schedule may not be applicable, providers of social media weather information should advise users when they can expect more information.)
- Include NOAA watch, warning, and advisory products or hazardous weather outlooks.
- Use discretion when disagreeing with "official" NOAA forecasts, especially during high-impact events. (The reasoning behind the forecast and the disagreement should be explained.)
- Alert the public about appropriate response to severe weather events.
- Include climatology information. (Put the current or predicted weather conditions into perspective with background climatology.)
- Identify where and when weather data originated and provide appropriate credit.
- Provide links to other relevant data. (This is especially true during hazardous weather situations when the user may need a source for weather alerts or information about the appropriate response to the hazardous weather.)

l) Best Practices and Lessons Learned in the Implementation of Global Framework for Climate Services—Adaptation Programme in Africa: Tanzania-Experience

5.1. Best Practices

Some of the best practices documented during the implementation of GFCS programme are described. The highlighted best practices focus on various categories of climate services value chain and formulation, and implementation of the National Framework for Climate Services. These include information sharing, user-engagement including training and awareness, and governance mechanism.

5.1.1. Information Sharing Using Mobile Phones

GFCS programme aimed at enhancing information dissemination to end users using various channels, and in a more accessible and cost-effective manner. The use of short mobile text messages (SMS) and voice services of mobile phones were preferred options among many end users. More than 42,500 farmers (end users) in the pilot project districts received weather and climate information via FarmSMS system (text message) or through Beep 4 weather system (voice message). The Beep 4 weather system provides access of weather and climate information to those who are unable to read text messages properly. Furthermore, for those who could not understand Swahili properly, the translation of climate information to Maasai language was done for enhanced understanding.

5.1.2. Dialogues between Providers and Users of Climate Services

GFCS-APA implementation used dialogues platforms among stakeholders, especially between providers and users of climate services. It was an opportunity for climate service provider to understand user needs; it also assisted better understanding and dissemination of climate services provided by TMA. Various platforms for sustained dialogue between providers and users of climate services were established and strengthened. These include the platforms between TMA experts and Media communities three times a year during preparation of the seasonal climate outlook for Tanzania, platform between TMA experts and stakeholders from climate sensitive sectors including stakeholders from Agriculture, Livestock, Water, Energy, Health and Disaster Risk Reduction sectors. Other stakeholders involved include extensionist, civil societies, security agencies and Local government authorities.

5.1.3. Use of Participatory Integrated Climate Services for Agriculture (PICSA) Tools in Designing and Executing Climate Service Programs

PICSA involved agriculture extension officers working with groups of farmers/pastoralists ahead of each growing season. A participatory needs assessment studies ensured that, differing information needs across vulnerable groups were considered in the on-going co-production of climate information products and services and ensuring that were evaluated on an on-going basis to further refine the products over time. Agriculture extension officers worked closely with farmers and pastoralists; to analyse historical climate information; to choose crops, livestock and livelihood options that best suit to individual farmers' circumstances. The tool facilitated small scale farmers in the GFCS pilot areas to improve their resilience in the context of increasing climate variability and climate change manifested through decreasing rainfall patterns, shifting in rainfall seasonality and increasing temperature. The use of PICSA tool has enabled pastoralists to sustainably manage their livestock despite the changes in climatic conditions. Extension officers and NGO staffs were able to facilitate farmers and pastoralists to use complex information on historical climate, seasonal and short-term forecasts as well as crop, livestock and livelihood options in decision making leading to improved outputs. However, the tool needs to be translated into local languages for better understanding and enhanced uptake by the respective communities.

5.1.4. Governance Mechanism Ensuring High Level Involvement of Government Machinery in Steering the Implementation of GFCS and Establishment of Multi-Institutional Technical Committee

Project governance mechanism at national level is an important mechanism for smooth implementation of national projects and programmes. During GFCS implementation, National Steering Committee (NSC) and Project Delivery Team (PDT) were formed to governed smooth implementation of GFCS activities at national level. The NSC role was taken by the Tanzania Disaster Management Council (TADMAC) having the role of overseeing the implementation of GFCS and development of National Framework on Climate Services. It provided political support, sustainability, and platform to assess and measure project achievements. Whilst PDT was established as the technical committee with the role of coordinating and managing the implementation of program activities and was supported by GFCS desk officer and GFSC senior technical advisor.

O) African Regional Climate Outlook Forums Best Practices

The innovative WMO concept of regional climate outlook forums is now well established in Africa. There are now seven operational outlook forums in Africa coordinated by WMO-designated regional climate centres under each regional economic commission. The process of organizing an outlook forum includes a training session, a pre-forum, a forum and an outreach session. The differences in regional context, capacity and policy mean that there are likely to be variations in organization, funding mechanisms, consensus development, communication, dissemination and stakeholder engagement. It is thus crucial to highlight best practices to improve exchange between the various outlook forums and foster standardization of the process across the continent.

One of the most important best practices in organizing a regional climate outlook forum is the involvement of operational meteorologists, climatologists and researchers from national meteorological and hydrological services, and regional and international centres for the development of consensus products; media experts for communication and dissemination; and users from the main climate-sensitive socioeconomic sectors for decision-making. Moreover, the training session and the fact that it takes place before the forum itself is key for the acquisition, testing and assimilation of new methodologies and tools, the capacity-building of critical mass in national meteorological and hydrological services and the evaluation of the performance of the previous seasonal forecast regionally, based on ground truths provided by climate scientists from national meteorological and hydrological services. During the development phase, the good practices that lead to improved results and consolidate the consensus based regional climate outlook are: verification of the products over specific areas with historical data sets, triggering further models and tools development; and the consideration of multi-models and/or multi-tools ensembles, rather than using a single method.

P) Fit for purpose? Transforming National Meteorological and Hydrological Services into National Climate Service Centers

a) Caribbean Institute for Meteorology and Hydrology, Husbands, St. James, Barbados

b) School of Geography and Development, University of Arizona, Tucson, AZ, United States

c) Institute of the Environment and School of Natural Resources and Environment, University of Arizona, Tucson, AZ, United States

d) Udall Center for Studies in Public Policy, University of Arizona, Tucson, AZ, United States

Global Data Processing and Forecasting System (GDPFS) Manual

u) WMO STANDARDS & BEST PRACTICES 2012

Technical Regulations (WMO-No. 49)
Mandatory publication):
– Volume I: General Meteorological Standards &
Recommended Practices
– Volume II: Meteorological Service for
International Air navigation
– Volume III: Hydrology
– Volume IV: QM
– Seven Annexes: WMO Manuals

A. Manuals (standard practices):

1. International Cloud Atlas (WMO-No. 407), Volume I - Manual on the observations of clouds and other meteors

2. Manual on Codes (WMO-No. 306)

3. Manual on Global Telecommunication System (WMO-No. 386) and Manual on the WMO Information System (WMO-No. 1060)

4. Manual on Global Data Processing and Forecasting Systems (WMO-No. 485)

5. Manual on Global Observing System (WMO-No. 544)

6. Manual on Marine Meteorological Services (WMO-No. 558)

7. Manual on the Implementation of ETR standards

B. Guides (recommended practices):

• Guides on GOS, GDPFS, GTS,

• Guide to Met. Instruments and Methods of Observation

• Guide to Hydro Practices

• Guides to Practices or Services for different app areas, such as Climatology, Agrometeorology, Aviation, Marine

C. Other Technical Documents needed for general understanding

v) WMO Regulatory Material 2012

International Meteorological Vocabulary

METEOTERM

Manual on the Global Observing

System, WMO-No. 544

Part I. General Principles Regarding the Organization, Design and Implementation of the Global Observing System

• Part II. Requirements for Observational Data - WMO Rolling Review of Requirements

• Part III. & Part IV Surface- and Space-based Subsystems: Composition & Implementation of Elements

• Part V. Quality Control

¾ Need for a review of existing GCW practices ? ; "GCW Manual"?

w) **WMO Global Observing System (GOS**) still valid?

1. A process named the Rolling Review of Requirements (RRR) has been instituted for continuously reviewing the requirements of Members and international programmes.

2. Through RRR WMO generates guidance to Members, named Statements of Guidance.

3. The Vision of the GOS provides high-level goals to guide the evolution of the Global Observing System in the coming decades (currently Vision for 2025).

4. Responding to the above Vision, the Implementation Plan for the Evolution of global observing systems (EGOS-IP) is a key document providing Members with clear and focused guidelines and recommended actions in order to stimulate cost-effective evolution of the observing systems to address in an integrated way the requirements of WMO programmes and co-sponsored programmes.

5. As a general principal, the evolution of the system is based on proven techniques and represents the best mix of observing elements that:

– satisfies to the maximum extent the data requirements in respect of accuracy, frequency and spatial resolution;

– is operationally and technically feasible;

– meets the cost-efficiency requirements of Members;

– is able to meet long-term needs of relevant WMO Programmes and a wide variety of purposes;

– covers ocean and data-sparse areas adequately;

– permits making new technologies available at affordable costs, so that all Member countries can maintain and satisfactorily operate their national components of the system and benefit from them in a sustainable and self reliant manner;

– permits the availability and accessibility of data for operational, research and educational purposes.

WMO Rolling Review of Requirements

1. Global NWP	7. Ocean applications
2. High resolution NWP	8. Agricultural met.
3. Synoptic met.	9. Hydrology
4. Nowcasting & VSRF	10. Climate monitoring

5. Seasonal & Inter-Annual F	. 11. Climate appl.
6. Aeronautical met.	12. Space weather
7. Atm. Chemistry New?:	Cryosphere

☐

x) Guide to Meteorological Instruments and Methods of Observation, WMO-No.

8 Centres of Excellence in support of calibration, traceability, data compatibility and integration

16 Regional Instrument Centres (RICs) and

2 Regional Marine Instrument Centres (RMICs):

• Must operate calibration laboratories based on international standards, such as ISO 17025

• Must maintain a set of standard instruments

• Must assist WMO Members in calibrating their ntl standards

7 Testbeds and Lead Centers:

• Must provide guidance in integration of ground-based remote-sensing and in situ observations, as well as in the development of standard procedures and advice related to instrument use and operation

• WMO-CIMO **Testbed** for In-situ Remote Sensing Instrument, **Sodankylä**, Finland. => opportunity for synergy

y) WMO Intercomparisons

• Intercomparisons:

– To determine and intercompare performance characteristics of instruments under field or laboratory conditions

– To link readings of different instruments – data compatibility & homogeneity

• CIMO Survey on National Summaries of Methods and Instruments for Solid Precipitation Measurements at AWSs, WMO/TDNo.1544, 2010

• **WMO Solid precipitation intercomparison (including snowfall &**

snow depth, 2011-2014

z) Others:

Basic Instruction packages for Meteorologists and Meteorological Technicians (WMO-1083)

Compendium of WMO Competency Frameworks (WMO-1209)