

UTILIZATION OF WORLD METEOROLOGICAL ORGANIZATION MANDATED DATA SHARING PROTOCOLS IN AFRICA



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Executive summary

In the present report a review is set out of the World Meteorological Organization (WMO) resolution 40 (Cg-XII) on WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities. The particular focus is the implementation of resolution 40 in Africa with a view to supporting the development of climate information services and promoting sustainable climate change adaptation and resilient development. In application of resolution 40, WMO Member States share “essential” data and products with one another and with research and educational institutions on a “free and unrestricted” basis. However, Member States may impose conditions before sharing “additional” data and may allow private sector stakeholders to impose charges for those services. In that regard, the Intergovernmental Authority on Development Climate Prediction and Applications Centre (ICPAC) launched a data sharing policy in collaboration with the national meteorological and hydrological services in countries in the Horn of Africa, while the Regional Training Centre for Agrometeorology and Operational Hydrology and their Applications (AGRHYMET), the Southern African Development Community Climate Service Centre (SADC-CSC) and the Climate Application and Prediction Centre of Central Africa (CAPC-AC) have launched or are launching similar policies in West, Southern and Central Africa, respectively. WMO is also collaborating to that end with national meteorological and hydrological services in North Africa.

This report highlights a number of best practices at continental, regional and national levels. At the continental level, WMO runs a data management facility known as the WMO Information System (WIS), which collects and disseminates weather and climate data through the WMO Global Telecommunication System. All data from African national meteorological and hydrological services and other data collection or production centres are gathered at a continental data hub in Casablanca, Morocco, for global redistribution and exchange. At the regional level, best practices include the convening of regional climate outlook forums and the establishment of regional centre data repositories. At regional climate outlook forums, all WMO Member States share their data, tools and methodologies, strive to reach a climate information consensus for the next rainy season, identify impacts and implications of climate events, formulate climate event response strategies and widely disseminate research outcomes. Regional centre data repositories collate data provided by national meteorological and hydrological services, which are further quality controlled and processed to generate tools and products. The enhanced data and products are shared with WMO Member States to support climate-related initiatives.

At the national level, most meteorological and hydrological services maintain good relationships with universities, research scientists and the private sector. Requested data are, in most cases, supplied provided that certain conditions are met. A recently developed best practice is the involvement of national meteorological and hydrological services in research and service projects. This promotes the exchange of data and products among all relevant stakeholders. Furthermore, many African countries are strengthening their political and institutional coordination to streamline processes for drawing up national plans for disaster risk management, strengthen data and information generation and oversight and promote collaboration among national and technical institutions, private sector companies and other relevant data users.

A number of barriers continue to impede efficient data sharing in Africa. These include the voluntary nature of WMO resolution 40, in which the twelfth WMO Congress recognized the right of Member States to choose the extent to which they make meteorological and related data and products available, both domestically and to stakeholders abroad. Furthermore, certain users have been known

to make inappropriate use of climate data, which had discouraged many national meteorological and hydrological services from disseminating those data. National legislation may also restrict access to meteorological and related data, including on grounds of national security. Finally, governments often lack a clear understanding of the value of data sharing and tend to consider meteorological and related data as commodities for which fees can be charged to offset the costs of meteorological infrastructure and equipment.

At the operational level, many data providers lack sufficient human and technical resources, while public scrutiny or criticism of their data can make them reluctant to share data with relevant stakeholders. In addition, data discovery and access is a key operational barrier. In fact, it is often difficult to determine whether relevant data have been gathered for specific regions because most data are still not published online. Moreover, the procedures that must be followed to access data are often far from clear, while the failure of data generating authorities to agree on a standardized format for data collection and dissemination impedes system interoperability and data sharing within regions. WMO has, however, taken action to address those challenges, including by establishing WIS and promoting the use of a standard computer software suite for the storage and management of climatic data.

In the light of the above, the report includes a number of recommendations. These include the amendment of WMO resolution 40, the extension of WIS to cover all data providers, closer collaboration among data providers and users through the adoption of a “win-win” business approach, the harmonization of technical procedures for data discovery and access, and the convening of data monitoring meetings in all African subregions. In particular, efforts must be made to enhance coordination among and strengthen the role of WMO Regional Climate Centres, in collaboration with the African Climate Policy Centre (ACPC). Finally, it is proposed that a data sharing authority should be established within an operational institution with a continental mandate. Potential institutions include ACPC, the African Centre of Meteorological Applications for Development (ACMAD) and the WMO Regional Office for Africa. The authority, which should be governed by a board consisting of heads of African States or relevant ministries, should seek to mobilize public support for open access to meteorological data in Africa and develop policies, regulations and guidelines to promote data sharing. The board of the authority would also seek to mobilize long-term donor support and secure funds to support countries’ equipment maintenance and data collection needs. On a daily basis, the board could oversee data exchange activities, provide clearance for all research and or/service projects in Africa, and resolve complaints submitted by members on the basis of legally sanctioned modalities.

1. Introduction

1.1. SETTING THE SCENE: CLIMATE INFORMATION SERVICES

Climate change constitutes a serious threat to many development sectors in Africa, including, in particular, the agricultural, water and energy sectors (Intergovernmental Panel on Climate Change, 2014; Sylla and others, 2016; Economic Commission for Africa, 2017). To address the adverse effects of a changing climate, the development and implementation of adaptation strategies have become a crucial process on the continent. Adaptation can be incremental, when coping with current climate variability, or transformational, when taking action to address anticipated severe climate change impacts in the future (Howden, Crimp and Nelson, 2012). While the latter builds on long-term climate change projections, the former requires day-by-day or season-by-season information.

Climate information services, which involve the generation, packaging and delivery of weather and climate data and their subsequent uptake by users, are rapidly expanding in Africa and are being used to support climate adaptation measures and resilient development (Kadi and others, 2011). Climate information services can describe historical, current and future weather and climate conditions and can include future predictions on daily, monthly, seasonal or decadal timescales and projections at multidecadal and centennial scales (WMO, 2014a). Climate information services also takes into account the impact of weather and climate conditions on natural and human systems. Traditional climate information service providers in Africa include national meteorological and hydrological services, whose activities are supported by a network of weather stations taking measurements of, among other parameters, precipitation and temperature, with guidance provided by WMO. Climate information service providers also include national institutes, regional research centres and consultancy firms, national associations, insurance companies and private sector stakeholders.

1.2. THE IMPORTANCE OF DATA SHARING IN SUPPORT OF CLIMATE INFORMATION SERVICES

Climate information service providers do not necessarily generate their own weather and climate data. Indeed, they may make use of available data from other providers and use their specialist knowledge and expertise to generate the information needed by specific users (Feinstein and Llovet, 2014). The data needed to monitor and predict weather and climate patterns and to generate climate information service tools and products are usually provided by national meteorological and hydrological services. The monitoring and forecasting of severe weather events, including tropical cyclones and mesoscale convective systems, and the development of climate information service tools requires data from beyond national boundaries (Snow and others, 2016; WMO, 2014b). Moreover, climate research centres and private sector stakeholders often have strong technical expertise and the capacity to develop tools that can add substantial value to the data generated by national meteorological and hydrological services. Data sharing standards and procedures must therefore be developed to regulate the exchange of data among Member States on the one hand, and among Member States, regional research centres and other non-governmental actors on the other. Such data exchanges are key for establishing an environment that supports a collaborative approach to climate information service provision and efforts to ensure the safety of Africans.

1.3. EXAMPLES OF DATA SHARING STANDARDS

Several data sharing policies have been adopted on the exchange of hydrometeorological data. The guiding principles that underpin those policies are enshrined in WMO resolution 40 (Cg-XII), adopted by the twelfth WMO Congress in 1995. Those policies are also based on provisions contained in WMO resolution 25 (Cg-XIII) on the exchange of hydrological data and products, adopted in 1999, and WMO Resolution 60 (Cg-17) on WMO policy for the international exchange of climate data and products to support the implementation of the Global Framework for Climate Services, adopted in 2015. In Africa at the regional level, such policies on data sharing co-exist with policies established by the Regional Climate Centres and relevant national meteorological and hydrological services. For example, ICPAC, based in Nairobi, Kenya, has implemented a data sharing policy with such national services in countries in the Horn of Africa, while AGRHYMET, based in Niamey, Niger, SADC-CSC, based in Gaborone, Botswana, and CAPC-AC, based in Douala, Cameroon, are implementing similar data sharing policies with national meteorological and hydrological services in West, Southern and Central Africa, respectively.

2. Objectives of the report

The overall objective of this report is to review the hydrometeorological data sharing standards and procedures that have been adopted in Africa pursuant to WMO resolution 40 with a view to strengthening climate information services and promoting their use across the continent. Specific objectives of this report include the following:

- Reviewing current data exchange practices under resolution 40;
- Identifying best practices and success stories;
- Highlighting the challenges that continue to impede data sharing;
- Formulating recommendations on data sharing to promote climate information service uptake in Africa.

3. Current data sharing practices under WMO resolution 40

3.1. WHAT'S IN WMO RESOLUTION 40?

WMO resolution 40 (Cg-XII) stipulates that “Members shall provide on a free and unrestricted basis essential data and products which are necessary for the provision of services in support of the protection of life and property and the well-being of all nations, particularly those basic data and products, as, at a minimum, described in Annex 1 to this resolution, required to describe and forecast accurately weather and climate, and support WMO programmes.” Those essential data and products include, but are not limited to: surface synoptic data; all available in situ observations from the marine environment; all reports from the network of stations recommended by the regional associations (that is, associations in Africa, Asia, South America, North and Central America, South-West Pacific and Europe), as necessary, to provide a good representation of climate; and those data and products from operational meteorological satellites that are agreed between WMO and satellite operators. (These should include data and products necessary for operations regarding severe weather warnings and tropical cyclone warnings.) Those satellite operators can be public entities, private sector stakeholders or intergovernmental agencies.



“Free and unrestricted” means non-discriminatory and without charge. “Without charge” in the context of resolution 40 (Cg-XII), means at no more than the cost of reproduction and delivery, without charge for the data and products themselves. The resolution also focuses on the provision of data under the

above conditions to the research and education communities, namely to researchers, teachers and students in academic and research institutions, in other research institutions within governmental and non-governmental organizations, and those institutions themselves, as provided for in national laws and regulations, for non-commercial purposes.

Activities undertaken for commercial purposes, namely for recompense beyond the incremental cost of reproduction and delivery, may be subject to different policies and approaches. Indeed, in resolution 40, the WMO Congress urges WMO Member States to provide additional data and products required to sustain WMO programmes at the global, regional and national levels and, as agreed, to assist other Member States in the provision of meteorological services in their countries. At the same time, it is understood that Member States may be justified in placing conditions on the re-export of such data and products for commercial purposes, either physically or electronically, outside the receiving country or group of countries forming a single economic group, for reasons relating to national legislation or costs of production. In that regard, resolution 40 recognizes the right of governments to choose the manner by which and the extent to which they make data and products available domestically or for international exchange. Research and education community commercial activities are subject to the same conditions.

3.2. APPLICATION OF RESOLUTION 40

WMO resolution 40 was adopted by the WMO Congress to promote the free and unrestricted international exchange of meteorological and climate data in order to facilitate efforts by WMO Member States to generate and provide forecasts and warnings. As WMO Members are defined as countries, resolution 40 applies not only to national meteorological and hydrological services but also extends to other national and intergovernmental weather networks. In resolution 40, the WMO Congress recognizes the importance of sharing data in climate research, including research into extreme climate and severe weather events with a view to issuing early warnings, and in efforts to help communities adapt to climate change. It also recognizes the dependence of the research and education communities, many of which provide climate services, on access to meteorological and related data and products but underscores the existence of a trend towards the commercialization of many meteorological and hydrological activities.

In implementation of resolution 40, Member States upload essential data to the WMO Global Telecommunication System every three hours. Those data are then made freely available and may be shared with stakeholders worldwide.

While the adoption of resolution 40 constitutes a significant step towards free and unrestricted international data exchange, its effectiveness depends, primarily, on the willingness of Member States to uphold its provisions. No legal mandate requires Member States to comply with the resolution and implementation by States remains uneven. Indeed, by upholding the right of governments to choose the manner by which and the extent to which they make data and products available domestically or for international exchange, resolution 40 empowers Member States to restrict access to information for reasons relating to national policies and legislation.

Furthermore, it is important to note that a distinction is made in resolution 40 between “essential data and products” and “additional data and products” and that, in the context of observational data for weather and climate applications, the word “essential” may be interpreted in various ways. For example, some users consider data that are particularly critical to their activities to be “essential”, while other stakeholders, including, in particular, data providers, often categorize data as essential simply because they are distributed free of charge in an open manner, with no limitations on how they may be used (WMO, 2016). In any case, resolution 40 allows for the adoption of different data sharing policies by

Member States. This means, in practice, that national meteorological and hydrological services have the power to decide which of their data should be made available as “essential data”, namely, the minimum data required to describe and forecast accurately weather and climate and support WMO programmes, and which data should be categorized as “additional data”. Certain Member States have adopted data sharing policies that promote unrestricted data distribution without charge and categorize all their data as essential, while others with more restrictive policies allow the commercial distribution of certain data, which they categorize as additional, and categorize all other data as essential. This is a serious issue that continues to impede data sharing and climate information service uptake.

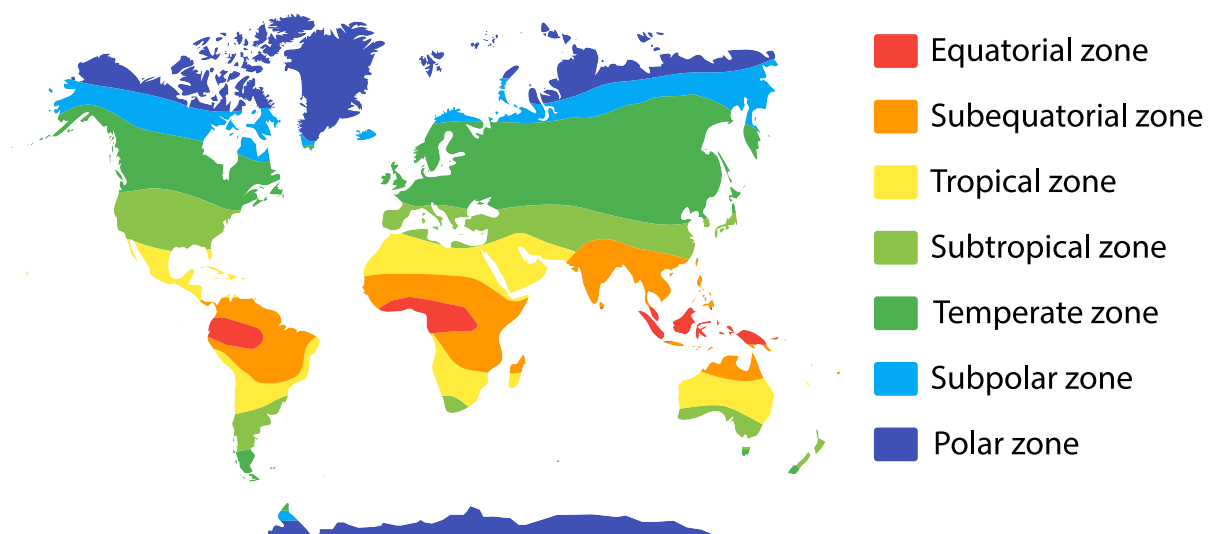
Although resolution 40 establishes the concepts of essential and additional data to discourage the commercialization of meteorological and climate data provision, the fact that many stakeholders charge a fee for data restricts the amount and quality of data that are readily available to researchers, forecasters and modellers and undermines the capacity of such experts to develop and promote the use of climate information service tools and products.

What is more, resolution 40 does not guarantee equal and timely access to data for all climate information service providers, fails to address the issue of pricing and places no limits on the commercial activities of WMO Member States.

4. Best practices and success stories

4.1. CONTINENTAL LEVEL

At the continental level, climate information service best practices and success stories often involve WIS. Pursuant to resolution 40, WMO Member States, acting primarily through their national meteorological and hydrological services, upload observed data every three hours into WIS, which is a coordinated global system of telecommunication and data management facilities designed for the routine collection and automated dissemination of observed data and products in support of WMO programmes. WIS also facilitates data discovery and access to and retrieval of all weather and climate related products and information. WIS uses a hierarchical three-level structure involving Global Information System Centres, Data Collection or Production Centres, and National Centres, which were formerly known as National Meteorological Centres. Every National Centre is responsible for distributing data at the national level and for collecting and providing weather and climate data and products for global and regional distribution to the relevant Global Information System Centre or Data Collection or Production Centre. Similarly, every Data Collection or Production Centre collects or generates sets of data, forecast products and processed or value-added information, and provides archiving services for relevant National Centres. Finally, the Global Information System Centres serves as global collection and distribution centres for routine global dissemination of data, products and information. Most Global Information System Centres are former Regional Specialized Meteorological Centres or Regional Telecommunication Hubs, which were formerly responsible for compiling data from their regions before sharing them with the World Meteorological Centres. In Africa, all national meteorological and hydrological services act as National Centres, but only eight countries, namely, Algeria, the Congo, Egypt, Kenya, Morocco, the Niger, Senegal and South Africa, host Data Collection or Production Centres. All Data Collection or Production Centres and National Centres collaborate with the Global Information System Centre, based in Casablanca, Morocco, which compiles all African weather and climate data and related products and information for global distribution.



It is worth mentioning that ACMAD, which is headquartered in Niamey, facilitated efforts by a number of countries to preserve their meteorological data, much of which had formerly been stored as hard-copy paper records; those countries were able to preserve their data sets in microfiches and later in digital form.

ACMAD has also helped certain regions to organize their seasonal prediction forums. ACMAD preserves collected and rescued data sets in its central database.

4.2. REGIONAL LEVEL

At the regional level, two best practices should be highlighted:

Regional climate data repositories

Regional Climate Centres have been established in most African regions to address hydroclimate issues. These include AGRHYMET in West Africa, ICPAC in East Africa, SADC-CSC in Southern Africa, and CAPC-AC in Central Africa. In North Africa, WMO is collaborating with all national meteorological and hydrological services to that end. Regional Climate Centres produce and disseminate meteorological, environmental and hydrometeorological information to help improve disaster risk reduction.

To that end, the Centres process and quality control climate data to generate basic statistics, including climatological baselines, and statistics on extreme climate events. They also monitor, predict and provide early warning information regarding high impact weather events, develop climate data tools and maintain national and regional databases and information systems required to promote risk reduction initiatives and research to support climate resilient development. Every Regional Climate Centre has signed a data sharing policy with the national meteorological and hydrological services in the countries in its respective region. WMO Member States, acting through their ministries and other relevant institutions, also provide critical support for and promote implementation of those data sharing policies.

Countries process their raw data and share them with the relevant Regional Climate Centre on a regular basis. For example, countries in East Africa share their data with ICPAC every 10 days. The Centres, which then process data provided by countries together with remotely sensed data, have sometimes played a critical role in backing up and restoring countries' hydroclimate data when national data storage mechanisms have failed and climate data have been lost. That practice has substantially improved data and information exchange between countries and the Regional Climate Centres and could be extended to cover other regional research and service institutions.

Regional climate outlook forums

Regional climate outlook forums, which bring together a wide range of stakeholders, including climate scientists, policymakers and members of the wider user community, produce consensus-based and user-relevant climate information and products to support development sectors, including water resources and agriculture, and issue early warnings of climate-related risks.

Several regional climate outlook forums are coordinated by the Regional Climate Centres on a regular basis. For example, AGRHYMET coordinates the Regional Climate Outlook Forum for Sudano-Sahelian Africa (known by its French acronym, PRESASS), which covers 17 countries in West and Central Africa, and the Regional Climate Outlook Forum for the Gulf of Guinea Countries (known by its French acronym, PRESAGG), which covers the Coastal Atlantic region of West and Central Africa. ACMAD coordinates the Southwest Indian Ocean Countries Climate Outlook Forum (SWIOCOF), which covers island countries in the south-west Indian Ocean in addition to Mozambique, South Africa, and the United Republic of Tanzania, and the Regional Climate Outlook Forum for Central Africa (known by its French acronym, PRESAC), which covers countries in Central Africa, including Sao Tome and Principe. ICPAC coordinates the Greater Horn of Africa Climate Outlook Forum (GHACOF), which covers 11 countries in or near the

Horn of Africa, while SADC-CDC coordinates the Southern African Regional Climate Outlook Forum (SARCOF), which covers all 14 SADC member States.

It should be noted that the Regional Climate Outlook Forum for Northern Africa (known by its French acronym, PRESANORD), which covers five countries in North Africa, joined the Southeastern Europe Climate Outlook Forum (SEECOF) to form the Mediterranean Climate Outlook Forum (MedCOF), coordinated by the State Meteorological Agency of Spain (AEMET) with additional support provided by ACMAD.

At the conclusion of each regional climate outlook forum, a final communiqué is issued and a press conference held. All forum outcomes and products are published online. Regional climate outlook forums are thus an excellent example of good practices in the area of data and information sharing at the regional level, and the scope of such data sharing could be extended to cover the whole continent of Africa.

4.3. NATIONAL LEVEL

In many African countries, national meteorological and hydrological services and the Regional Climate Centres provide data to students, universities and research scientists involved in non-commercial activities. Most of those data are provided free of charge provided that certain conditions are met. If data pertaining to a specific location are needed, a request is submitted to the relevant national services or other providers, which will then decide whether or not to provide the requested data. In most cases in which the data are requested for non-commercial purposes, the data are released, provided that the user agrees not to share them with third parties and acknowledges the source of the data or agrees to co-authorship with the data-providing authority.

A fee may be charged for the data requested if the requesting authority or individual is engaged in paid consultancy work or the data are requested by a private sector institution. Most national meteorological and hydrological services use any fees charged to offset data processing costs or the costs of new equipment or maintaining climate observation networks.

Finally, many countries in Africa are enhancing their national disaster risk management strategies and early warning systems, inter alia by strengthening coordination and data sharing among institutional and political actors at all levels, including national meteorological and hydrological services, water resource authorities, river basin commissions, farmers, urban area officials, insurance companies and the media.

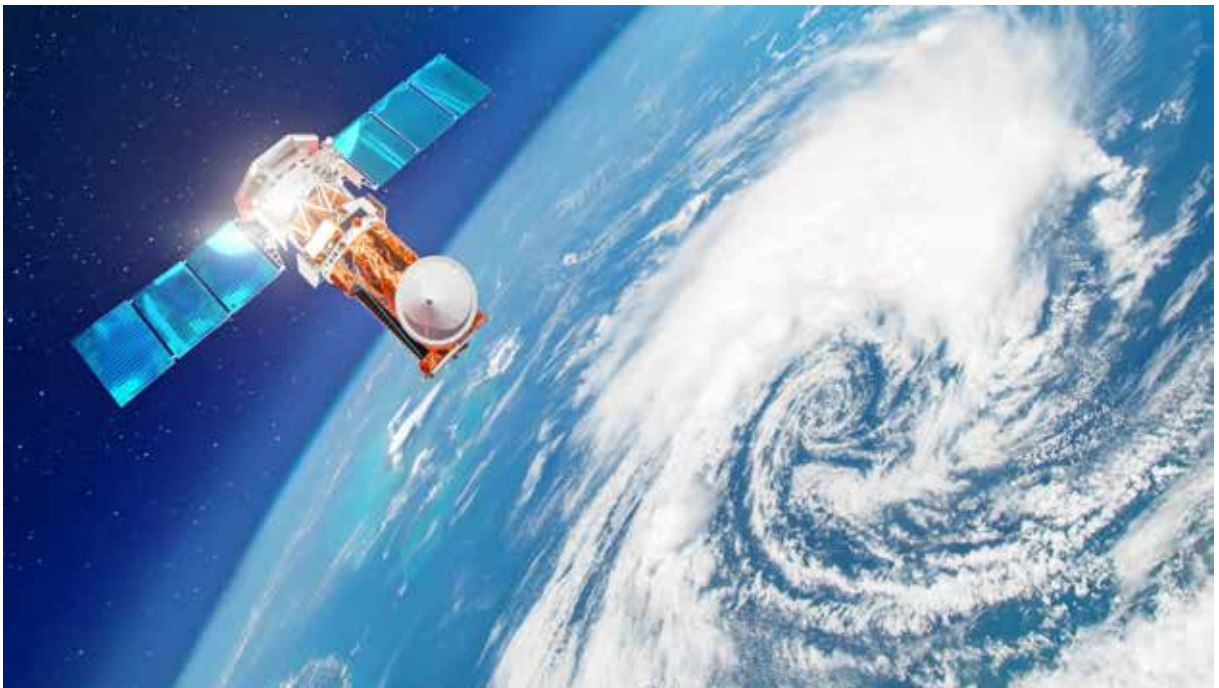
5. Barriers to data sharing

5.1. STRATEGIC LEVEL

The voluntary nature of WMO resolution 40 and a lack of understanding of its provisions

Resolution 40 was formulated with a view to finding common ground among stakeholders with conflicting policies on data sharing (Yost, 2016). Although it calls on countries to share “essential” data and products with each other and with research and educational institutions on a “free and unrestricted” basis (WMO, 1995), countries are under no legal obligation to do so. Indeed, resolution 40 recognizes the right of Governments to choose the manner by which and the extent to which they make data and products available and governments can thus decline data requests on any grounds. It is not possible to file an appeal against a government decision not to make available the requested data or products.

Many Governments, national meteorological and hydrological services and other data providers withhold data simply because they fail to understand the potential benefits of data sharing, which can help save lives, safeguard property and other physical infrastructure, and reveal data gaps or errors of which the data provider is unaware



Inappropriate use of climate data by users

Many data providers are reluctant to release their data because of a history of inappropriate use of data by users. Indeed, data provided by national meteorological and hydrological services and research centres have often been released to the wider public, published without the data owner’s explicit consent or altered in contravention of established WMO rules and procedures. Most offenders fail to obtain data through official channels or submit data requests without disclosing how they truly intend to use the data. For example, some users submit data requests in which they falsely claim that the data will be used exclusively for non-commercial purposes, and even academic users have been known to file multiple data requests under the names of several of their students in order to obtain all data sets available on a

certain country or region with a view to furthering their for-profit activities. Other users have been known to purchase part of a data set, which they then exchange informally with other users to obtain all the data they need without the knowledge or consent of the data owner. Finally, individuals and organizations have been known to request assistance with the digitization of microfiche weather records and then to use the digitized data for purposes for which authorization has not been granted. It must be emphasized that data acquired from national meteorological and hydrological services are often subject to stringent conditions, including that the data will be used only for the purpose stated in the submitted data request and that the data will not be shared with third parties. Regrettably the misuse of data means that many Governments are now very reluctant to share any of their data with legitimate users.

National legislation

Because of national security concerns and entrenched protectionist attitudes, many Governments in Africa have passed laws to restrict access to weather and climate data compiled by their national meteorological and hydrological services.

To be fair, geospatial data can reveal much about countries' strengths and weaknesses. For example, satellite data from certain regions at a particular period of the year can provide useful information about crop yields. For strategic reasons, Governments may thus treat climate data as classified information and pass legislation that grants only governmental or national institutions the right to access those data. Such legislation is often cited as grounds for rejecting data requests even though a simple review may confirm that the release of the requested data would pose no threat to national security.

Furthermore, data requests are often denied because of data providers' conflicts of interest. Indeed, national meteorological and hydrological services often develop their own value-added products from the raw data they compile and, to maintain a competitive advantage, often cite relevant legislation as grounds for the denial of all raw data requests submitted by potential commercial competitors.

Certain countries' legislative frameworks can thus seriously impede legitimate data sharing in Africa, and the Regional Climate Centres must often submit multiple data requests to countries before those countries will agree to share critical climate data.

Infrastructure cost recovery

Although some climate information service providers make their information available free of charge, others restrict or charge fees for the information they provide or are actively engaged in commercial activities. There is, moreover, growing interest among national meteorological and hydrological services in restricting and charging fees for their data as a means of offsetting the costs associated with climate-related infrastructure, such as weather stations and data transmission, storage and distribution networks, and limiting competition from private sector stakeholders. Indeed, due to budgetary constraints, the financial resources made available by governments to finance countries' hydrometeorological infrastructure are often far from adequate, even though financial assistance is often provided by WMO, the World Bank and other international institutions and programmes. As a result, many countries have witnessed a deterioration in their meteorological and hydrological observation networks and continue to rely on outdated technology, equipment and methodologies. Data owners increasingly view their data as a vital economic resource that can help address those challenges.

5.2. OPERATIONAL LEVEL

Human and technical resources

Data from Africa are shared globally via the WMO Global Telecommunication System and regionally and locally via emails, external hard drives copying or posting. Very few institutions provide data punctually using the File Transfer Protocol. In a process of data exchange, additional data processing, such as coding and running scripts, and additional resources, including powerful servers and large storage disks, are needed to make the data available for sharing or to access user databases. Many data owners and receivers lack some of these resources and the human resources needed to transfer the data effectively. In addition, although data should be shared with WMO every three hours through the WMO Global Telecommunication System, many national meteorological and hydrological services are only able to supply those data during the day, and not at night, because of insufficient human and technical resources. Furthermore, relevant data are sometimes acquired by the relevant national meteorological and hydrological services only after the deadline for submission has passed: such data can no longer be uploaded into the Global Telecommunication System, giving rise to significant data gaps in WMO databases. Another challenge is posed by technical problems affecting the Global Information System Centres, which have sometimes impeded the timely submission of data. Human and technical resource gaps therefore constitute a serious challenge to data sharing in Africa.

Data discovery, access and quality

To facilitate data sharing, users must first know that the data they require actually exists. This is not always the case, however, particularly with regard to data compiled by national meteorological and hydrological services. Users are often able to access the data they require only if they already know someone who has access to those data. Furthermore, most data owners store their data locally and do not publish relevant metadata online in ways that makes the data discoverable, intelligible and accessible. Even when relevant metadata are published and accessible, data owners rarely give clear instructions explaining how users can access relevant databases. Furthermore, data owners are often reluctant to share their data because they do not want the quality of their data to be subjected to public scrutiny.

Data formats and interoperability

A number of technical challenges stem from the failure of data providers and owners to adopt a standard format for the exchange of meteorological and hydrological data. In fact, American Standard Code for Information Interchange, Microsoft Excel, comma-separated values, General Regularly-distributed Information in Binary form and Network Common Data Form are all used to transmit and exchange data, potentially impeding interoperability.

In addition, certain historical data are still stored only in microfiche form and cannot be shared electronically. To address that challenge, ACPC and ACMAD have supported data rescue and digitization initiatives in several African countries.

While most data providers and owners in Africa store data in Microsoft Excel and comma separated values formats, very few use General Regularly-distributed Information in Binary form or Network Common Data Form, despite the clear advantages of using those formats to store large amounts of weather data. Furthermore, among data providers and owners using Microsoft Excel and comma separated values formats, there is no standard method for reporting data. For example, some data providers display information about time steps (hours, days, months or years) in file columns and information on recorded meteorological parameters in file rows, while other data providers invert that arrangement.

Similar interoperability challenges may also impede information exchange among stakeholders that use General Regularly-distributed Information in Binary form or Network Common Data Form in different ways to manage, process and store their data. WMO is striving to address those challenges inter alia, by promoting the use of WIS in tandem with CLIMSOFT, a software suite for storing climate data in a secure and flexible manner and for extracting useful information from the data.

6. Recommendations

The following recommendations are made with a view to strengthening hydrometeorological and climate data exchange and promoting the development and use of climate information services in Africa.



6.1. AMEND AND STRENGTHEN WMO RESOLUTION 40 (CG-XII) AND EXTEND THE SCOPE OF WIS

To promote data sharing in Africa, WMO resolution 40 should be amended so that it no longer refers to “essential data”, “additional data” and “all available data”, as reference to those terms in the resolution has encouraged national meteorological and hydrological services to engage in for-profit commercial activities and restricted the amount of data that is freely shared. As an alternative to those terms, the expression “all data currently collected or held” could be used. Member States should be encouraged to share all data currently collected or held upon request, provided that the request is justified. Alternatively, an extensive list of minimum data sets, including all those needed by the climate information service community should be categorized as “essential data”. So that the amended resolution addresses the needs of the community effectively, a broad-based survey of climate information service stakeholders, including national meteorological and hydrological services, national, regional, international and intergovernmental centres and private sector actors, should be conducted to inform the resolution drafting process time frame, the amended resolution should specify clearly that no charges should be made for meteorological and related data and products themselves and that charges should be limited to the cost of handling data requests. WMO should provide pricing guidelines in that area.

The amended resolution should also provide clear time frames for the exchange of data, specifying whether certain data should be provided on a monthly or annual basis. Finally, the resolution should encourage data owners to make their data available to research centres and non-profit climate service

providers without charging either for the data or related products themselves or to cover the costs of reproduction and delivery. That would undoubtedly foster innovation and economic growth across Africa. Charges should still be made, however, for the provision of meteorological and related data and products in the context of for-profit commercial activities.

WIS has proven to be an effective data management, discovery and sharing system and should be extended to cover all regional and national research and service centres operating weather observation networks or providing climate services free of charge in Africa.

6.2. FOSTER WIN-WIN BUSINESS RELATIONSHIPS THAT BENEFIT BOTH DATA PROVIDERS AND USERS

Efforts should be made to establish mutually beneficial relationships among data providers and users, in particular, regional research centres and national meteorological and hydrological service. WMO is encouraging regional research centres to generate more high quality regionally-focused meteorological and related data and products, including regional climate watch bulletins. Mutually beneficial relationships could be established between data providers and regional research centres, which could carry out quality controls and add value to the raw data supplied by those data providers, thereby helping to strengthen the capacity of national meteorological and hydrological services to meet national climate information needs and their role as climate data repositories.

As most data providers charge fees for their data in order to offset the costs associated with their climate-related infrastructure, regional research centres could help to reduce those costs by offering to install and maintain key infrastructure, including automatic weather stations and transmission and storage equipment. They could also provide data backup services and support capacity-building activities. In return, data providers would share their data with regional research centres on a real-time, daily or monthly basis.

Funding agencies and planning organizations must fully acknowledge the costs associated with data acquisition and management and provide adequate financial resources to support those activities. In that regard, regional research centres should be required to include the national meteorological and hydrological services headquartered in their respective regions in joint and collaborative research or service projects to ensure that they receive sufficient funding to maintain and run the required infrastructure at least for the duration of that project. During the project implementation phase, regional research centres should be granted full and open access to the data needed to achieve the objectives of the project, provided that they sign agreements clearly stipulating that they will not share data with third parties unless clearance is granted by the data provider.

6.3. HARMONIZE TECHNICAL PROCEDURES FOR DATA DISCOVERY AND ACCESS

To enhance meteorological data exchange in Africa, both human users and machines must be able to discover and access those data, which should be made available using uniform formats and quality-control standards and associated with harmonized and comprehensive metadata detailing the characteristics of the data and their history. The procedures that must be followed to access the data must also be clear. Data should be stored in ways that ensure their long-term preservation and interoperability and established national and international repositories should be used to minimize technological redundancy. Ideally, data sets should be published on password-protected websites that make use of a common user interface. Data must be published on the Internet and downloadable by means of the File Transfer

Protocol. To achieve those objectives, many staff employed by data owners and providers will require in-depth training in programming, coding and scripting. Data owners and providers must also upgrade their information technology infrastructure and archiving mechanisms and ensure that they can rely on high-speed Internet connections. It is clear that African countries would derive significant benefits from the adoption of a common data management system at the continental level and more extensive use of CLIMSOF software.

At the national level, observation networks operated by national institutions should be regulated and coordinated with input from the relevant national meteorological and hydrological services. Furthermore, all data and metadata obtained should be recorded in an easily-accessible format and, ideally, observation networks should use the interface, transmission, storage and management systems used by the relevant national meteorological and hydrological services to ensure interoperability.

6.4. STRENGTHEN THE REGIONAL CLIMATE CENTRES AND POLICY COORDINATION

To respond to and address the impact of climate change, African countries must make more efficient use of weather and climate information. To that end, WMO Regional Climate Centres must be strengthened so that they can more effectively provide key technical data management support. To further enhance collaboration and knowledge exchange at the continental level, additional support must be provided for the Climate Research for Development in Africa initiative, which was developed by ACPC, the African Ministerial Conference on Meteorology, WMO and the Global Framework for Climate Services to align climate science research and climate information needs in support of development planning across the continent. ACPC could also collaborate with governments to mobilize funding and formulate legislation in support of climate information services.

6.5. CONVENE REGIONAL DATA MONITORING MEETINGS IN ALL AFRICAN REGIONS

The regional hubs and national meteorological and hydrological services organize an annual regional data monitoring meeting in East Africa to review implementation of WMO resolution 40. The meeting facilitates the sharing of best practices and facilitates debate on ways to address challenges encountered in East Africa. Similar annual regional data monitoring meetings should be held in all other African regions, and a high-level data monitoring forum should be convened at the continental level with a view to formulating recommendations on data sharing in Africa and climate information service tools and products.

6.6. ESTABLISH A DATA SHARING AUTHORITY

Although numerous operational institutions have been established in Africa, none specifically and comprehensively address the issue of data sharing. An authority should therefore be established within an operational institution to promote data sharing within the African continent. Potential institutions include the ACPC, ACMAD and the WMO Regional Office for Africa. The structure and manner in which the proposed authority would function are described below.

The governing board

The authority should be governed by a board consisting of heads of African States or relevant ministries. It should seek to mobilize public support for open access to meteorological data in Africa. Prior to board meetings, the authority should prepare a list of key actions to be implemented and an annual budget, which would be submitted to the board for approval.

The mandate of the authority

The authority should develop policies, regulations, guidelines and legislation to promote data sharing and monitor the impact of interventions. On a daily basis, the board should oversee data exchange activities, provide clearance for all research and service projects in Africa, and resolve complaints submitted by Member States on the basis of legally sanctioned modalities.

Key actions by the authority

To develop effective guidelines and regulations for efficient data sharing standards within Africa, a number of actions should be taken. Those include:

- Identifying all climate information service tool developers and all data owners, producers and providers in Africa;
- Identifying data access needs and gaps;
- Identifying the activities of climate information stakeholders and classifying these as either non-commercial or commercial activities;
- Developing legal tools to promote the distribution of data without charge for non-commercial climate service tools development and information production;
- Developing legally-sanctioned modalities for dealing with data requests submitted by private sector stakeholders for commercial purposes.

Membership of the authority

The authority should bring together stakeholders from governments, relevant ministries, national meteorological and hydrological services, universities and national, regional, international and intergovernmental research and service centres in addition to all climate information service producers and providers, including those from the private sector, from across the African continent.

The involvement of African Governments is of paramount importance in order to ensure strong leadership and public and country support for policies, regulations, actions and budgets adopted by the board. Relevant ministries should play a key role in identifying and prioritizing data needs and gaps, including in areas such as water, energy, agriculture and urban development. The involvement of national meteorological and hydrological services, which own most weather and climate data that would be subject to the policies and regulations issued by the authority, would ensure the successful establishment of the authority. Indeed, these national services could play a leading role in national coordination and provide critical technical support. The information generated by national meteorological and hydrological services is often complemented by information provided by other climate information service producers and providers, including those within the private sector, which should also be included in the authority's membership. Finally, research centres and universities should also be included as members, as they often develop, test and refine the tools and methodologies required to generate climate information service products.

Funding the authority

Funding agencies must be made aware of the importance of data acquisition and management. The authority should seek their commitment with a view to mobilizing the financial resources it will need to support countries' equipment maintenance and data collection needs. Ideally, the authority would operate core infrastructure, including automatic weather stations in strategic locations within each

country, satellite receivers and large servers, and provide all data obtained using that infrastructure on a free and unrestricted basis to climate information service producers and providers. Other funding mechanisms should be explored. One option would be to make mandatory the inclusion of data management in all projects in Africa, with a certain percentage of project budgets being allocated to the authority.

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