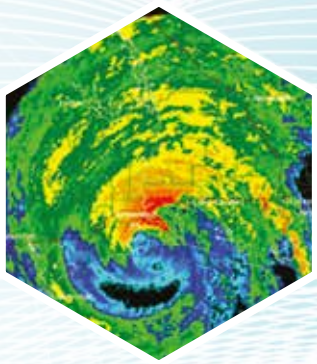
WORLD METEOROLOGICAL ORGANIZATION

WEATHER CLIMATE WATER

Public-Private Engagement Publication No. 1



Origin, Impact and Aftermath of WMO Resolution 40

WMO-No. 1244

In celebration of our Organization's 70th Anniversary
Public-Private Engagement Publication No.1

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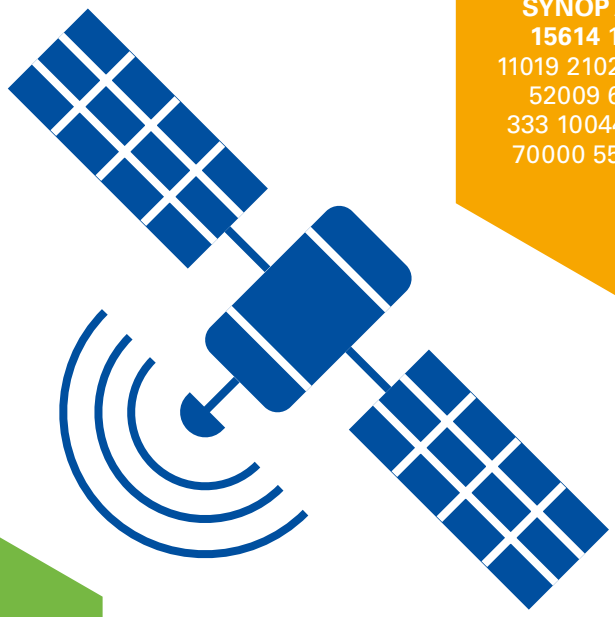

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CONVENTION OF THE WORLD METEOROLOGICAL ORGANIZATION

Authentic text

With a view to co-ordinating, standardizing, and improving world meteorological activities and to encouraging an efficient exchange of meteorological information between countries in the aid of human activities the contracting States agree to the present Convent ion, as follows: ...

CONTENTS

Midnight in the North

Foreword

The World Meteorological Organization (WMO) is proudly celebrating its 70th Anniversary in 2020 – recognizing 23 March 1950 as the date on which the WMO Convention came into force.

The rich history of international cooperation in meteorology, though, precedes this important date – and includes the vast achievements of WMO's predecessor, the International Meteorological Organization (IMO). The transition from the non-governmental IMO to the intergovernmental WMO marked an important time in history. With the signing of the WMO Convention by WMO Member States and Territories, today numbering 193, WMO became a United Nations specialized agency.

To commemorate our organization's 70th Anniversary, a series of special publications is being produced with inputs from leading scientists and experts around the globe. These publications are designed to be both retrospective and forward-looking. They will reflect on both the important historic milestones of the organization, including its contributions to meteorology around the world, as well as anticipated transformations and innovations as we enter a new decade and beyond.

I am very pleased, therefore, to introduce the first in the special WMO 70th Anniversary special publications series, entitled Origin, Impact and Aftermath of WMO Resolution 40.

Written by John Zillman (Prof.) of Australia, who served deftly as WMO President from 1995 to 2003, it provides a first-hand account of the historical processes and negotiations that led to the adoption of Resolution 40 by the Twelfth Session of the World Meteorological Congress in 1995 – one of the most dramatic episodes in WMO history.

This landmark decision by WMO Members confirmed the world's commitment to making essential meteorological data and products freely available, recognizing that these "are necessary for the provision of services in support of the protection of life and property and the well-being of all nations".

Among the thousands of resolutions adopted by the World Meteorological Congress in its seven decades of existence, Resolution 40 stands as a signature decision that has had immense impact on the development of meteorology over the last 25 years. It has ensured that the commercialization of meteorological data and services, which began in the 1980s, has not disrupted or undermined the global cooperation in collecting and exchanging meteorological data which was initiated more than 150 years ago.

Data sharing between nations is as relevant today as it was back in 1995, perhaps even more so with the advent of new data-driven meteorological tools, systems and services. The Eighteenth Session of the World Meteorological Congress, held in June 2019, recognized this. It established a task to review WMO data policies and practices, including those of Resolution 40, and called for WMO to convene a global Data Conference in 2020.

In view of these developments, the historical review of the WMO data policies is timely and useful. In this regard, I would like to acknowledge with much appreciation the work done by Professor Zillman in drafting this text and sharing his rich memories of this crucial period of WMO history.

In addition to serving as WMO President, during which time remarkable WMO achievements were realized, Professor Zillman was deeply involved in the development and the adoption of Resolution 40. He has continued to be actively involved with WMO ever since and is recognized as one of the great "influencers" in the field of global weather, climate and water – for more than three decades.

I hope you enjoy this interesting publication, and I look forward to continuing to celebrate the WMO 70th Anniversary with you throughout the year.

(Prof. Petteri Taalas)
Secretary-General

Summary

The first century (1873-1973) of international cooperation under the International Meteorological Organization (IMO) and the World Meteorological Organization (WMO) was built on almost universal voluntary sharing of observational data and scientific knowledge among their Members and between individual scientists and institutions.

This was reinforced in the 1970s and early 1980s through the WMO World Weather Watch and the Global Atmospheric Research Programme (GARP) which brought rapid scientific progress and an intensely cohesive international community that delivered great societal benefits from the new scientific, technological and service provision capabilities of Members' National Meteorological Services (NMSs).

However, despite the acknowledged efficiency of the WMO system of international data exchange and the enormous benefits it brought to all countries and virtually all sectors of national economies, it went through a period of severe stress in the late 1980s and early 1990s. Many NMSs were swept up in national public sector restructuring initiatives aimed at across-the-board adoption of market mechanisms for the delivery of public services that had previously been provided by government agencies. NMSs started withholding data from each other and from their national academic and private sectors and the underpinning philosophy of the WMO system of international cooperation began to crumble.

The feared data war and forecast collapse of international meteorological cooperation were eventually averted through the unanimous adoption by the 1995 World Meteorological Congress of Resolution 40 (Cg-XII) WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities.

The following decades brought a new wave of progress in international meteorological cooperation but they only partially succeeded in restoring the strength and comprehensiveness of data exchange inherited from the golden years of the World Weather Watch and GARP.

In 2020, WMO celebrates its seventieth anniversary, and its community is again presented with both opportunities and threats from scientific progress, new technologies and major shifts in public policy in many countries. Together, these suggest a need to re-examine the policy foundations of current practice.

It is, therefore, timely to review the origin, impact and aftermath of what has become known simply as "Resolution 40" for possible insights that might help identify optimal responses to the new challenges.

Introduction

WMO constituent bodies have adopted thousands of resolutions since 1950 but only one, Resolution 40 of the Twelfth World Meteorological Congress (WMO, 1995), has needed no other identifier and continues to be known throughout the WMO system simply as "Resolution 40".

Resolution 40 has the daunting official title of "WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities". For some of the meteorological old hands of the 1970s, 1980s and 1990s, it marked the end of the golden age of unconditional international cooperation under the World Weather Watch (WMO, 1967) and the Global Atmospheric Research Programme (GARP) (Joint Organizing Committee, 1969). For most of the 1990s WMO generation, however, its unanimous adoption after years of tension and difficult negotiation also saved international meteorology from seemingly inevitable collapse and helped re-build the trust and collaboration which provided the essential foundation for continuing progress in the twenty-first century (WMO, 1999). But, without doubt, all those who were involved in its negotiation look back on the adoption of Resolution 40 as a defining moment in the history of international cooperation in meteorology (Daniel, 1973; Zillman, 2008).

One of the important short-term legacies of the Resolution 40 experience was the sensitization of an entire WMO generation to the origin and benefits of the WMO system of international cooperation (Davies, 1990) and an awareness of how much the world would lose if it did not survive. There were few people who took part in the 1995 WMO Congress debates on data exchange that did not resolve to ensure that similar debates would never happen again.

But, with the data exchange crisis survived, international meteorological cooperation and service provision gradually settled back into a reasonably stable post-Resolution 40 regime based on the central role of the National Meteorological Service (NMS) and elaborated in the 1999 Geneva Declaration of the Thirteenth World Meteorological Congress (WMO, 1999). And, as those who had been deeply involved in the traumas of the early 1990s retired and left the WMO community, the collective memory of the issues faded and the initial resolve to build firmer policy foundations for the future seemed less urgent and was eventually largely forgotten.

The last decade, however, has witnessed dramatic changes in the broader field of data policy, technology and management (Chertoff, 2018), including the explosion of social media, artificial intelligence, machine learning, data analytics, cybersecurity and data privatization. These have already impacted widely across the established WMO system of international cooperation and data exchange underpinning the global weather and climate enterprise (Gunasekera, Manton and Zillman, 2018; Lewis, 2018; Thorpe and Rogers, 2018a, 2018b; Serra et al, 2018; American Meteorological Society, 2019; Australian Meteorological and Oceanographic Society, 2019; Barrell, 2019; Blum, 2019a, 2019b; WMO 2019a). Further, new NMS operating philosophies and business models (Rogers and Tsirkunov, 2013; World Bank, 2019) are challenging the established concept of operation of the traditional 20th century NMS (Zillman, 1999).

The WMO, for its part, has responded to the rapidly evolving data world and the need for much broader partnership between the public, private and academic sectors in meeting the global sustainability needs of the 2020s through the new Geneva Declaration – 2019: Building Community for Weather, Climate and Water Actions of the Eighteenth World Meteorological Congress (WMO, 2019b).

However, with a host of new scientific, technological, policy and business opportunities and threats now confronting the established system of international cooperation in meteorology, it becomes necessary to re-examine the foundations of Resolution 40 and re-consider the economic, legal and policy framework it provided for public, private and academic sector meteorology since the 1990s. It is timely, therefore, to review the origin and impact of Resolution 40 for insights that might inform the current debate.

To understand the significance of Resolution 40, though, it is first necessary to look back much further in meteorological history to the influences and events that shaped the long tradition of international cooperation and data exchange (Davies, 1990; Zillman, 2018a, 2018b) that the 1995 and 1999 WMO Congresses sought to save.

Origin of systematic data exchange

Meteorological observations were at the forefront of data collection and sharing among the scientists of the Enlightenment (Frisinger, 1977). But, while the early initiatives were largely driven by the quest for scientific knowledge for its own sake, it was also becoming clear by the mid-1800s that meteorological observations from coastal observatories and ships at sea could greatly improve marine navigation and safety. In a far-sighted practical initiative, United States of America (US) Navy Lieutenant Matthew Fontaine Maury convened an international conference in Brussels in 1853 to promote the standardized collection of meteorological observations from ships' logs as a basis for compilation of seasonal wind and ocean current charts for marine navigation (Maury, 1855).

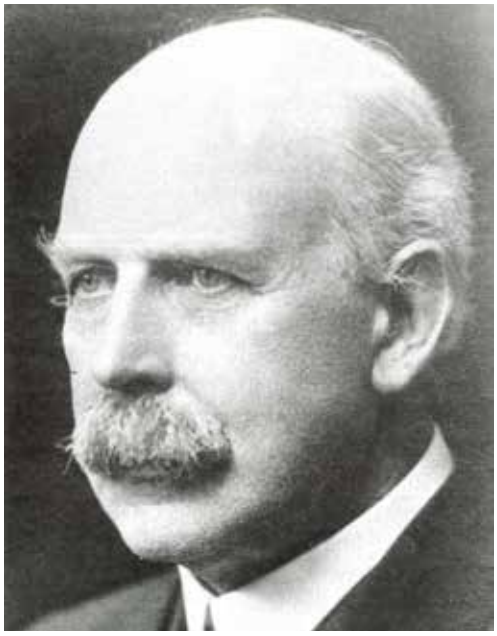
The Brussels Conference agreed on the need for international cooperation in data collection. In Maury's words, "This conference ... recommended a plan of observations which should be followed on board the vessels of all friendly nations. ... In peace and in war these observations are to be carried on and, in case any of the vessels ... may be captured, the abstract log ... is to be held sacred" (Maury, 1855). The Brussels Conference and its participants' assertion of the sacredness of meteorological data from ships at sea are generally credited with having provided the scientific and practical foundation for the now 150-year long tradition of voluntary international cooperation in meteorology.

The early 1850s also brought the first use of Morse telegraphy, invented in 1843, for real-time collection of observations to enable the tracking of weather systems and provide the basis for storm warnings to reduce the loss of life from the frequent shipwrecks of the times (Halford, 2004). This reinforced the Brussels Conference in inspiring the establishment of the forerunner of the United Kingdom (UK) Meteorological Office in 1854 (Walker, 2012), with similar initiatives taking place about the same time in France, Germany and several other countries. A little later in the US, following his successful collection and telegraphic distribution of weather reports, Professor Cleveland Abbe recorded that "I have started that which the country (he might well have said "the world") will not willingly let die" (Cox, 2002).

By the early 1870s, there was general agreement that the time had come to place international cooperation in the collection and exchange of meteorological observations on a more secure basis. In September 1873, under the leadership of the outstanding Swiss-Russian scientist Heinrich Wild, the Government of Austria convened the First International Meteorological Congress in Vienna to consider the mechanisms for "far-reaching coordination and standardization of the methods and procedures in use in different countries" (Daniel, 1973).

Participants in the first Conference of Directors of Meteorological Services, Munich, 1891.

The international meteorological organization years 1873-1950



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Sir William Napier Shaw, President of the International Meteorological Organization (IMO) from 1907 to 1923 who championed the collection and exchange of meteorological observations from a global network (*Reseau Mondial*) as the guiding principle for international cooperation in meteorology.

The 1873 Vienna Congress is generally regarded as marking the origin of the primarily non-governmental International Meteorological Organization (IMO), which provided the global framework for meteorological data exchange until its replacement by the intergovernmental WMO in 1950 (Davies, 1990).

All of IMO's seven Presidents and most members of its governing body, the Conference of Directors of Institutes and Observatories, were distinguished meteorologists of their day who were dedicated both to sharing of scientific data for the advancement of knowledge and to collection of the information that their mainly government-supported institutes needed for storm warning and other important practical services to their national communities (Daniel, 1973).

The IMO Conference of Directors established a substantial number of technical commissions for specialist tasks including standardization of instruments, coordination of observation networks and publication of climatological records from land and sea. In particular, it established the Commission for Meteorological Telegraphy in 1907, to coordinate the telegraphic collection and exchange of observations, and a more comprehensive Commission for Synoptic Weather Information in 1923 (Davies, 1990).

In addition to the gradual expansion and improvement of both telegraphic (for operational forecasting) and mail collection (for climatology and research) networks in all the major countries and their colonies, IMO Members organized two major coordinated observing and data collection initiatives in the polar regions through the First (1882-83) and Second (1932-33) International Polar Years (Daniel, 1973).

Already by the 1920s, IMO had developed visionary proposals for a global network of observing stations under the banner of the "Reseau Mondial" which was identified by Sir Napier Shaw as the guiding principle of international cooperation in meteorology that "the several countries of the world should maintain the stations necessary for their own meteorological or economic purposes and exchange the information so acquired, by telegraph in the case of observations necessary for the construction of the daily charts of weather of the respective countries, and by publication in an agreed form for the data for climatological stations" (Shaw, 1926).

The rapid growth of civil aviation in the inter-war years (1919-1939) brought new and much stronger practical needs for government involvement in the collection and exchange of operational meteorological data for the safety and efficiency of aviation. The new mostly government-sponsored meteorological networks complemented and built on the longer-established data collection and distribution arrangements in support of safety of life at sea.

Unsurprisingly, therefore, as World War II approached, the international meteorological community began work on a draft convention for an intergovernmental organization to succeed the primarily non-governmental IMO, but still based firmly on the established IMO principle of voluntary world-wide cooperation. This went on hold for the duration of the war but, very soon after the end of hostilities, work resumed to transform the IMO into the intergovernmental World Meteorological Organization (WMO) (Gibbs, 1994).

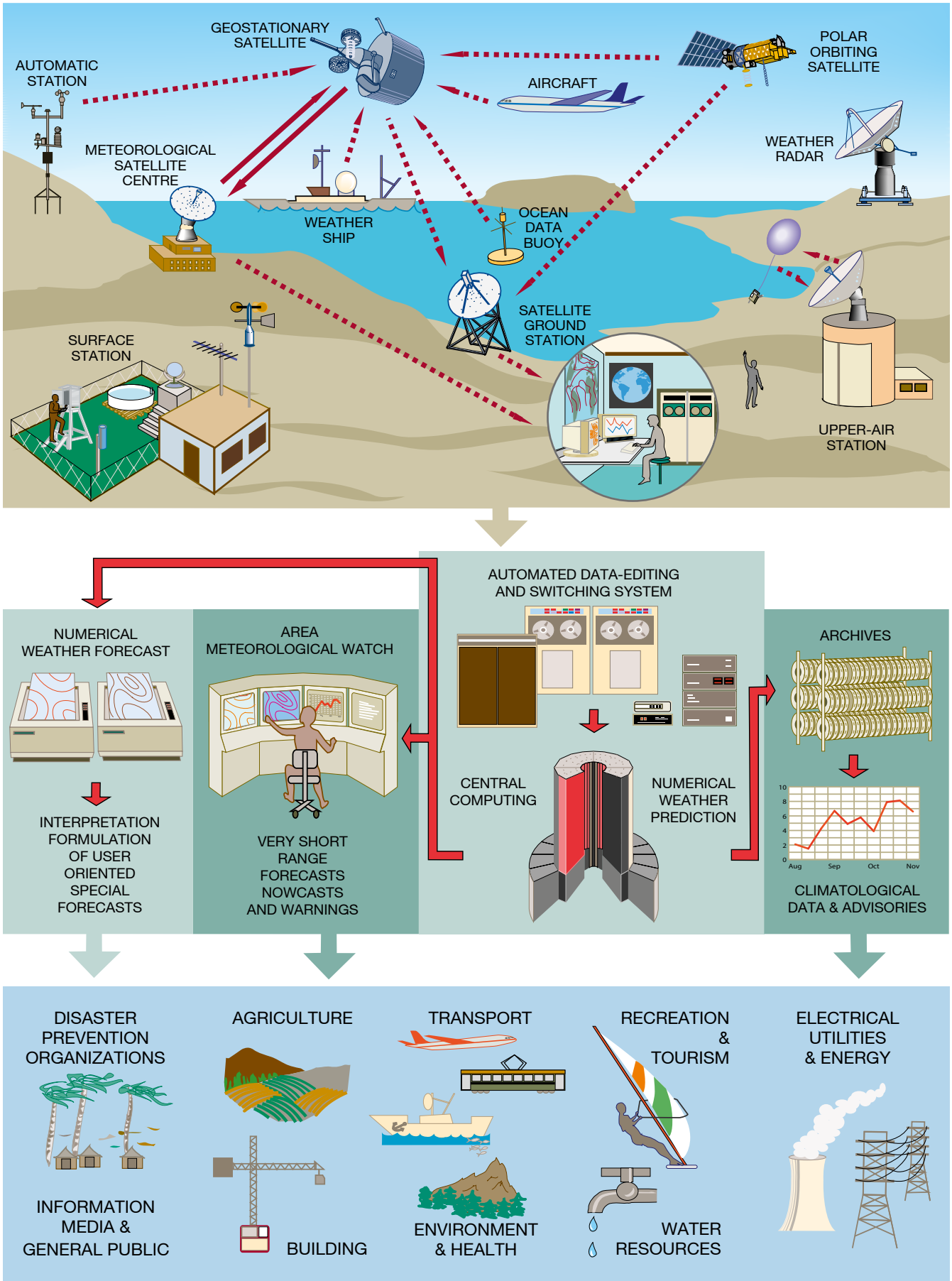
WMO, the International Geophysical Year, world weather watch and the global atmospheric research programme

The final text of the Convention of the World Meteorological Organization was negotiated to conclusion and signed by directors of 31 NMSs on behalf of their governments in Washington, DC in October 1947 (Davies, 1990). The preamble of the Convention's original text identified international data exchange as the central reason for the establishment of WMO through its contracting States' commitment to "coordinating, standardizing and improving world meteorological activities and to encouraging an efficient exchange of meteorological information between countries in the aid of human activities". This was then spelled out through the Convention's Article 2 elaboration of the first two of five agreed purposes of the organization as: "(a) To facilitate world-wide cooperation in the establishment of networks of stations for the making of meteorological observations ... ; and (b) To promote the establishment and maintenance of systems for the rapid exchange of weather information".

WMO formally came into existence as an independent intergovernmental organization in March 1950. Its First Congress, held in Paris in March 1951, put much emphasis on strengthening international data collection and exchange in support of the rapid growth of post-war aviation (Davies, 1990). But it was not long before the fledgling WMO was faced with a major new scientific challenge and opportunity in the form of proposals for an International Geophysical Year (IGY) in the mould of the earlier International Polar Years. The IGY was to be conducted under the primary scientific leadership of the non-governmental International Council of Scientific Unions (ICSU) but it was agreed that the data collection capabilities of WMO would be essential for its success.

The IGY provided a useful framework for enabling WMO to strengthen its conventional data collection. Its greatest contribution, however, was probably in helping to launch the space age and open the enormous possibilities of Earth observation from meteorological satellites. This was greatly facilitated by a land-mark agreement in March 1962, at the height of the Cold War, between the US and the Union of Soviet Socialist Republics (USSR) to cooperate in the development of Earth-orbiting satellites for meteorological purposes, especially the tracking and warning of potential natural disasters, for the benefit of all nations (Edwards, 2010). This inspired close US-USSR collaboration in the design and implementation of what was soon to become the WMO World Weather Watch (Rasmussen, 2003; Zillman, 2013).

US President John F Kennedy and Soviet Premier Nikita Krushchev who agreed in March 1962 to US-USSR cooperation in the provision of a system of operational weather satellites.



The planned integrated structure of the World Weather Watch with the Global telecommunication System (GTS) and the Global Data Processing System (GDPS) for the collection, processing and exchange of observations from the surface and space-based components of the Global Observing System (GOS).

The basic concept of the World Weather Watch was agreed in principle in 1963 and approved for implementation in 1967. Its purpose was "to ensure that all Members obtain the meteorological information they require both for operational work and for research" (WMO, 1967). It involved all WMO Member States and Territories collaborating in the use of new, including space-based, observational, telecommunications and data-processing technologies to: collectively operate a global observing system (GOS), exchange the global observing system data through a global telecommunications system (GTS), and build an integrated network of world, regional and national meteorological centres as part of a global data-processing system (GDPS).

It was envisaged that the integrated operation of the World Weather Watch GOS, GTS and GDPS would provide all countries with the data and processed products necessary for their NMSs to provide the full range of meteorological services needed to meet their international obligations, especially to international shipping and aviation, and to support the safety and well-being of their national communities.

In the words of one of the fathers of World Weather Watch, academician E K Fedorov of the USSR, echoing and building on Sir Napier Shaw's characterization of the IMO Reseau Mondial forty years earlier:

> National Services will continue their efforts in four main fields, namely observations, the collection and dissemination of information, the processing and analysis of information and ... scientific research. This cooperation is ... voluntary and is based on the principle that each service will provide all that it can to, and obtain all that it requires from, the common fund. This cooperation is ... possible only under peaceful conditions and ... it should be planned and established exclusively on (that) basis (Fedorov, 1966).

The late 1960s and 1970s saw the rapid implementation of World Weather Watch as an enormous globally cooperative scientific, technological and geopolitical endeavour with substantial new resources made available by governments. Many advanced countries contributed directly to the implementation of World Weather Watch facilities in developing countries. Services to international civil aviation and shipping were established, in accordance with existing international agreements, on the foundation of the basic data, products and services of World Weather Watch. It became widely regarded as the core programme of WMO (Zillman, 2013).

The late 1970s also brought the culmination of GARP, a parallel joint WMO-ICSU research initiative to advance the predictability of weather and the physical understanding of climate (Joint Organizing Committee, 1969). One of the specific objectives of the 1979 GARP Global Weather Experiment was to guide the design of an improved World Weather Watch. This then proceeded, under the WMO Commission for Basic Systems, through an Integrated Systems Study in the early 1980s.

In internal WMO planning (WMO, 1983; Zillman, 1984), one of the most important challenges of the coming decade was seen as bridging the remaining gap between the capabilities of developing and advanced countries' NMSs. This included through both WMO technical cooperation and joint activities with development agencies such as the World Bank and the United Nations Development Programme.

The outstanding immediate result of the broadly based WMO and ICSU involvement in World Weather Watch and GARP design and implementation was a strong sense of global partnership among the public, private and academic sectors of meteorology. This included unwritten understandings that all NMSs would support each other and their national private and academic sectors, where these existed, in delivering the benefits of meteorology to their national communities. It was also generally understood that the private and academic sectors, for their part, would support and complement the work of their NMSs and respect the authority of their "single official voice" for public warning purposes. While minor public-private and other tensions surfaced in a few places, all countries and all sectors took shared pride in the benefits to national communities, which were already beginning to flow from the enhanced services made possible by the scientific and technological progress of the preceding decades and the international trust and cooperation it had inspired (WMO, 1983; 1987). The future looked extremely bright for both scientific and operational meteorology.

The commercialization and data exchange crisis of the 1980s and early 1990s

Just as the benefits of World Weather Watch and GARP were beginning to flow strongly to both developed and developing countries in the early 1980s, a series of fundamental changes in economic philosophy began to be adopted internationally, which challenged the established role and modus operandi of the conventional NMS and the long-standing IMO/WMO tradition of global cooperation. The political trigger was the 1979 election of the Thatcher Government in the UK, followed closely by the Reagan Administration in the US. This resulted in a fundamental shift in the UK, several British Commonwealth countries and some European countries away from government service provision and towards the delivery of traditionally government-funded public services through market mechanisms (Self, 1993; Lane, 2000). It brought widespread commercialization, corporatization and privatization of government service agencies, as well as the outsourcing of many formerly core government functions. In several countries, public-private partnership took the form of governments contracting the private sector to deliver public services (Chapman, 1990; Kelly, 1992; Monbiot, 2000).

The new philosophy was soon extended to the UK Meteorological Office (Walker, 2012) and several other European and British Commonwealth NMSs as "reforming" national governments enthusiastically set out to implement commercialization, privatization and outsourcing agendas across the board with little awareness of, or regard for, the unique features of long-established specialist fields such as meteorology.

Some NMSs embraced the new challenge, especially those with newly appointed directors from business backgrounds while others reluctantly adopted what they saw as damage minimization commercialization strategies. Some, however sought to completely fend off commercialization by arguing the public good character of meteorology and stressing the potential dangers from the expected loss of previously freely exchanged data and products.

Among those NMSs that recognized that some form of commercialization as inevitable, some introduced organization-wide business methods and charging policies while others sought to quarantine their commercial activities in separate business units operating, as nearly as possible, on a level playing field with their national private sector service providers, where these existed.

Most of the international development agencies supporting meteorology embraced the market model. Their support for developing country NMSs soon included requirements for undertakings to generate revenue through sale of their national meteorological (especially climatological) data and other services as a contribution to meeting their cost of operation.

By the mid-1980s, tensions were developing on many fronts with some NMSs introducing heavy charges, including to their national academic and private sectors, for previously free data. Some also began restricting the flow of their World Weather Watch data to their neighbours, to prevent potential customers from obtaining for free from other countries the data and products that they needed to sell.

The WMO Executive Council did its best to provide guidance to NMSs on how to handle these rapidly escalating tensions. The Council, however, found itself increasingly split between those members who supported, or reluctantly accepted, the commercialization agenda on the one hand and those on the other who were strongly opposed to any commercialization of NMSs or their data.

By 1987, there was a general realization that commercialization and competition were imperilling the long-standing and previously unquestioned IMO/WMO system of voluntary international cooperation and especially the continued free and unrestricted exchange of data and products through World Weather Watch. It was recognized, with an element of dismay, that the founding fathers of WMO had regarded free and unrestricted exchange as so fundamental to the basic purposes of the organization that they had not bothered to elaborate "free and unrestricted" in the WMO Convention. So, belatedly, in its Second Long-term Plan, the 1987 World Meteorological Congress unanimously adopted a WMO policy that "[t]he principle of free and unrestricted international exchange of meteorological data between national Meteorological Services should be maintained" (WMO, 1987).

It was, however, too late. The tensions over commercialization escalated rapidly between countries, and between NMSs and their national and international user communities. This was especially the case between NMSs and the growing community of national and international private sector service providers who sought to take advantage of the increasing economic and commercial value of meteorological services made possibly by the scientific and technological advances of the previous decades.

As a potential framework for managing the escalating commercialization crisis, WMO introduced a distinction between "basic services" – services provided by an NMS in discharging its governments' sovereign responsibilities for the safety of its national community and for meeting its legal obligations to international shipping and aviation – and "special services" – those beyond basic services including the provision of special data and products.

To help contain the threat to data exchange from commercialization, the 1990 session of the WMO Executive Council adopted the Guidelines on International Aspects of Provision of Basic and Special Meteorological Services (WMO, 1990). These urged governments, inter alia, to:

> **"Reaffirm their commitment to the free and unrestricted international exchange of basic data and products as defined in the World Weather Watch ... ", to "[c]ommit themselves to the free and unrestricted exchange of data and products necessary for the global monitoring of climate change ... " and, most importantly, to "[a]ct in a manner which does not adversely affect (the core responsibilities of) other Members' ... NMSs".**

In parallel with the internal WMO debates, a subset of the WMO community that remained deeply committed to the preservation of free exchange, became involved in the negotiations for establishment of the United Nations Framework Convention on Climate Change and the Global Climate Observing System in order to help consolidate the international commitment to WMO's historic policy of free data exchange. This resulted in the principle of "full and open exchange" of climate data being written into the key documents and procedures of both initiatives.

The Tenth World Meteorological Congress (1987) adopted the second WMO Long-Term Plan (1988-1997); The principle of "free and unrestricted international exchange of meteorological data between national Meteorological Services" was adopted as part of the General Polices of the Plan.

Article 4, 1(h) of the 1992 United Nations Framework Convention on Climate Change commits governments to "[p]romote and cooperate in the full, open and prompt exchange of relevant scientific ... information related to the climate system and climate change ... " (UNFCCC, 1992).

The WMO-UNESCO-UNEP-ICSU Plan for the Global Climate Observing System (GCOS) Version 1 included six principles for the proposed GCOS Data System of which the second was "full and open sharing and exchange of GCOS-relevant data and information" (GCOS, 1995).

The divisions, however, gradually sharpened within WMO between those who remained strongly committed to WMO's established system of cooperation and a growing band who were either sold on the competitive "business model" for meteorology or had concluded that they could no longer resist the national and international pressures for commercialization. Both those enthusiastic and those reluctant to sell their services began to accept that free and unrestricted data exchange could become an unavoidable casualty of the commercialization of public service meteorology.

The 1991 World Meteorological Congress attempted to quell concerns and play down the increasing polarization in WMO circles by emphasising the potential of the newly introduced Executive Council guidelines on "basic" and "special" services to provide a framework for complementarity and mutual support between the public good and commercial sectors. It also, though, recognized the seriousness of the threat to international cooperation and called explicitly on the incoming Executive Council to establish a Working Group on Commercialization to contain the problems and avert the complete breakdown of international data exchange (WMO, 1991).

The international situation, however, continued to deteriorate, with seemingly irreconcilable differences developing even within the senior ranks of the Executive Council. An increasing number of European NMS directors embraced the commercial business model, in part to head off what they saw as unfair intrusion into their own territory by the US private sector. For their part, the US private sector, which was concerned at the potential loss of international data, along with the US academic community, backed the "free exchange" position adopted by the Permanent Representative of the US with WMO (Dr E W (Joe) Friday) in his capacity as a member of the Executive Council. He was, in turn, backed by the then First Vice-President of WMO (John Zillman of Australia, author of this publication).

At one stage, as the focus of contention moved from "commercialization" to "data exchange", the WMO situation on data exchange was summarized colourfully but imprecisely as "[t]he US and Australia against Europe and the rest". The US position was characterized as "[t]he taxpayer having funded the collection of data, it would be immoral to then charge the taxpayer a second time for making use of those data" and the European position as "[t]he taxpayer having funded the collection of data, it would be immoral to not reimburse the taxpayer by charging those who profited from their use".

The Executive Council Working Group on Commercialization, under the chairmanship of Third Vice-President Dr Andre Lebeau of France and with Mr Manuel Bautista Perez of Spain as Vice-Chair, struggled through 1992 and 1993 to identify the elements of a general solution to the policy dilemmas of commercialization and data exchange. It also struggled with finding solutions to the host of problems breaking out in and among individual countries, including threatened legal action between some countries' NMSs. Without explicitly endorsing their content, the 1994 session of the Executive Council (WMO, 1994) adopted a set of three complementary resolutions (Resolutions 20-22) drafted by its Working Group on Commercialization and requested their further development by the working group for submission to the 1995 World Meteorological Congress. These were:

- WMO policy on the exchange of meteorological and related data and products (Resolution 20);
- Proposed new practice for the exchange of meteorological and related data and products (Resolution 21, with lengthy explanatory annexes); and
- WMO guidelines on commercial meteorological activities (Resolution 22, with annexes on commercial relations between NMSs, and between NMSs and the private sector).

However, despite the useful guidance provided by the Executive Council's Resolutions 20-22, the situation continued to deteriorate through 1994 and early 1995 and, as the 1995 Congress approached, international media speculation started to appear on the likelihood of an imminent global meteorological "data war".

The 1995 World Meteorological Congress

The Twelfth World Meteorological Congress opened on 30 May 1995 with seemingly irreconcilable divisions on the data issue. The responsible Congress Working Committee immediately assigned the issue to a smaller open sessional working group under the chairmanship of Mr Manuel Bautista Perez of Spain. The working group, with most of the 160 or so national delegations participating at some stage, worked with versions of the 1994 Executive Council Resolutions 20-22 as the starting point.

But, after two weeks of negotiation, there was little indication of the prospect of their acceptability or any sign of acceptable alternative solutions. Many of the delegations already bogged down in internal or bilateral conflict at home found themselves examining each newly suggested word or phrase in terms of its implications for their own sensitive national negotiations. Several influential Permanent Representatives from developing countries retained their historical belief in the benefits of free exchange but had concluded that the only chance for survival of their NMSs might be to withhold their national data from the US private sector and other potential commercial service providers in their countries. They believed this was the only way to protect their NMS' established national role in data provision and service delivery. The mood in the working group swayed backwards and forwards as the Congress progressed.

Eventually, with Congress Plenary deadlines bearing down on the debate and with an element of "consensus by exhaustion" taking hold, the off-line Bautista Perez group reached fragile consensus on the wording of a Working Committee Pink report (Pink 64) to the Plenary. Pink 64 included just a single integrated draft resolution on the proposed new policy and practice reaffirming the WMO principle of free data exchange and committing WMO to its broadening and enhancement for the future.

Twelfth World Meteorological Congress, 1995 (from left to right): Dr A. S. Zaitsev, Assistant Secretary-General; Dr J. W. Zillman, First Vice-President; Mr Zou Jingmemg, President; Professor G. O. P. Obasi, Secretary-General; and Mr M. J. P. Jarraud, Deputy Secretary-General (WMO/Bianco)

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Mr Manuel Bautista Perez of Spain who led the two weeks of negotiations in off-line Congress working group that eventually agreed the text of what would become Resolution 40.

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WMO Presidents of the Resolution 40 era: Mr Zou Jingmeng of China (President from 1987to 1995) who presided over the negotiation of Resolution 40 (right) and Dr John Zillman of Australia (President from 1995 to 2003) who presided over its implementation (left).

When Pink 64 came up for consideration in Congress Plenary, under WMO President Zou Jingmeng, on the afternoon of 21 June 1995, the atmosphere in the room was electric. Following a few brief general remarks from conciliatory delegations, the President invited specific comment and waited tens of seconds for indication of countries wishing to speak. Delegations all looked around to see who would intervene to shatter the fragile consensus. No national flags were raised but, as the President brought down the gavel to declare the resolution adopted and the Pink approved, New Zealand asked for the floor. The room, though, had already erupted in standing ovation with emotional applause continuing for almost a minute. When the applause subsided and the President invited New Zealand, represented by Dr Neil Gordon, to speak, delegations gulped in apprehension at the prospect of collapse of the near euphoria of moments earlier. Instead of raising issues with the document, however, Dr Gordon embarked on a memorably whimsical set of awards of bottles of New Zealand wine to several of the earlier protagonists in the debate.

The sense of relief amongst the Congress participants was palpable as was the pride and satisfaction in every delegation that a global "data war" had been averted and that the WMO community was again united in its commitment to the free and unrestricted international exchange of data and products as the foundation for meteorological research and services throughout the world. By far the most frequent comment remarked at social events that evening was that "we must never again let WMO get so close to collapse".

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Dr Neil Gordon of New Zealand whose whimsical last-minute intervention in the Resolution 40 approval process collapsed the tensions of the previous weeks and helped restore the spirit of unity in the Congress community.

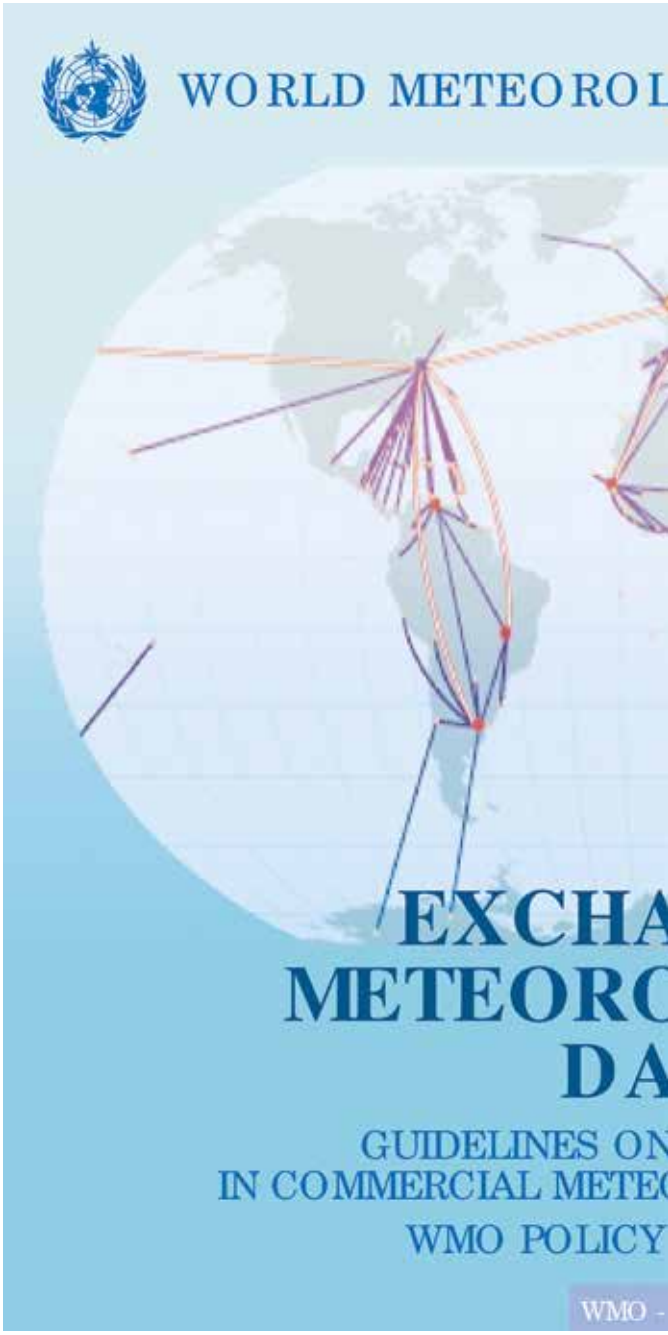
WMO Resolution 40

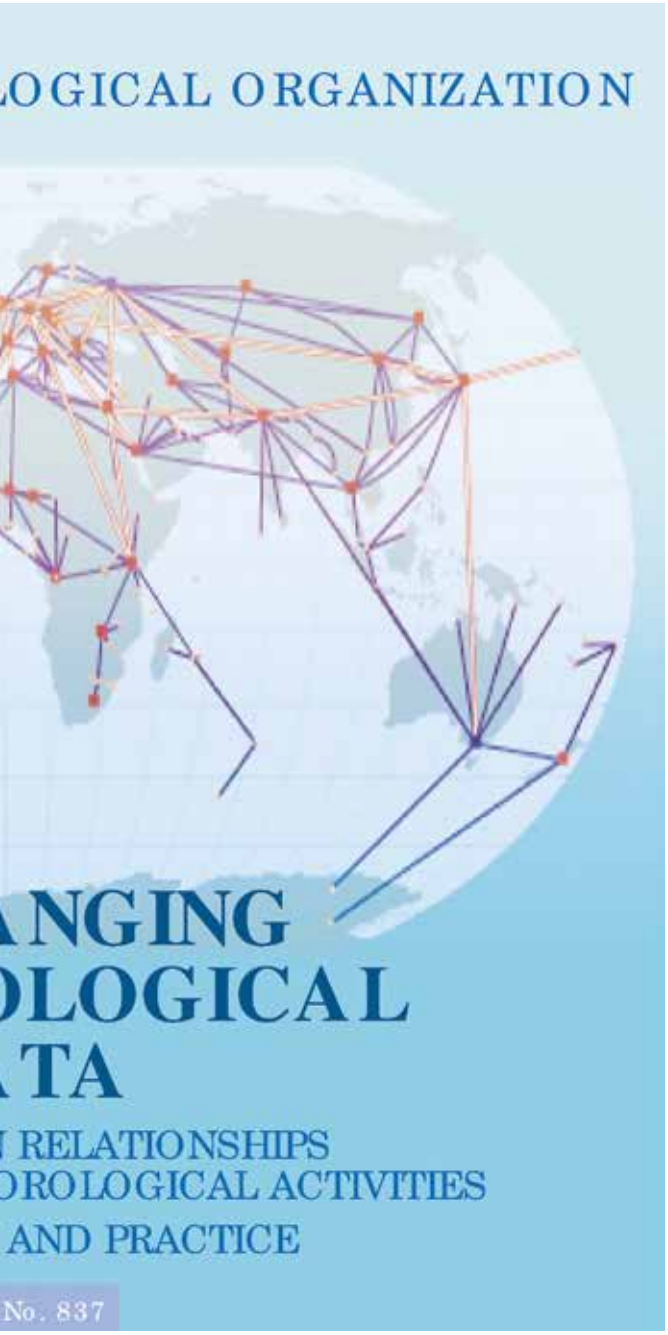
In the numbering system that follows WMO constituent body sessions, the resolution which contained the essential elements of the unanimously adopted "solution" became Resolution 40 of the Twelfth World Meteorological Congress: *WMO Policy and Practice for the Exchange of Meteorological and Related Data and Products including Guidelines on Relationships in Commercial Meteorological Activities*, to be known forever after in WMO circles simply as "Resolution 40".

Resolution 40 consisted of two pages of text and three pages of annexes (WMO, 1995) dealing with:

- Data and products to be exchanged without charge and with no conditions on use (Annex 1);
- Guidelines for relations among National Meteorological or Hydrometeorological Services (NMSs) regarding commercial activities (Annex 2);
- Guidelines for relations between National Meteorological or Hydrometeorological Services (NMSs) and the commercial sector (Annex 3); and
- Definitions of terms in the practice and guidelines (Annex 4).

Inevitably for a fiercely debated compromise text, the Resolution contained some ambiguous and awkward wording. But the essence of the Resolution 40 solution was an unambiguous reaffirmation of "free and unrestricted international exchange" as a "fundamental principle" of WMO. This was coupled with a new distinction between what would become known as "essential" and "additional" data and products.





The supporting text noted that "free and unrestricted" meant non-discriminatory and without charge where "without charge" meant at no more than the cost of reproduction and delivery, without charge for the data and products themselves.

The critical distinction between "essential" and "additional" was spelled out in a formulation of the new practice for international exchange of meteorological and related data and products as follows:

1. 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;

2. Members should also provide the additional data and products which are required to sustain WMO Programmes at the global, regional and national levels and, further, as agreed, to assist other Members in the provision of meteorological services in their countries. While increasing the volume of data and products available to all Members by providing these additional data and products, it is understood that WMO Members may be justified in placing conditions on their re-export for commercial purposes outside of the receiving country or group of countries forming a single economic group, for reasons such as national laws or costs of production; and

3. Members should provide to the research and education communities, for their non-commercial activities, free and unrestricted access to all data and products exchanged under the auspices of WMO with the understanding that their commercial activities are subject to the same conditions identified in (2) above.

The new statement of WMO policy read as follows:

> **As a fundamental principle of the World Meteorological Organization (WMO) and in consonance with the expanding requirements for its scientific and technical expertise, WMO commits itself to broadening and enhancing the free and unrestricted international exchange of meteorological and related data and products.**

The text of Resolution 40 and the elaborative Section 11.4 of the Abridged Report of the Twelfth Congress (WMO, 1995) also set down a range of follow-up activities for implementation of the new policy and practice. These included the need for coordination with other international organizations, the role of WMO's own constituent bodies, and a number of matters bearing on relations between the public and private sectors as set down in the annexes to the resolution. The new Resolution 40 policy and practice were disseminated widely through WMO and other channels (Greenfield et al, 1995; Bautista Perez, 1996; WMO, 1996a; Zillman, 1997).

Follow-up to Resolution 40

Notwithstanding the high level of satisfaction of all those at the 1995 Congress with the unanimous adoption of Resolution 40, it soon became clear that there were still many difficult problems ahead. Many from the academic and private sectors felt they had not been adequately involved in the WMO deliberations, either in formulation of their national positions for the 1995 Congress or in the Congress debates themselves. The climate community felt there was insufficient guidance in respect of climatological data and products and it was not clear as to the extent to which the resolution's inclusion of the term "and related" would enable the policy to embrace hydrological and oceanographic data. It was also recognized that there was insufficient detail for clearly distinguishing between "essential" and "additional" data.

This involved, inter alia:

a. Detailed follow-up through the WMO Commission for Basic Systems to refine and operationalize the definition of "essential" data and to implement systems for monitoring and broadening the exchange of the various types of data and products (WMO, 1996b);

b. Work through the Commission for Climatology to refine the interpretation and implications of Resolution 40 for climatological data and provide the necessary guidance on the international exchange of climate data and products (WMO, 1997);

c. Collaboration with ICSU on compatibility with the policies and practices of the ICSU Committee on Data for Science (CODATA) and the impact of Resolution 40 on the complementary operations of the ICSU and WMO World Data Centres (ICSU, 2006);

d. Incorporation of the issues of meteorological data exchange into broader national and international debates then underway, including through the 1999 World Conference on Science, on access to scientific and environmental data (National Research Council, 1997; 2001);

e. Implementation of a range of experimental national and multinational arrangements for handling the commercial activities of NMSs or groups of NMSs within the spirit of Resolution 40, for example the Australian SSU (Special Services Unit) and the European ECOMET respectively;

f. Ongoing tensions and debate at the public-private interface on the implications of Resolution 40 for private sector meteorology in various parts of the world (Saarikivi, Soderman and Newman, 2000; White, 2001);

g. Various national reviews aimed at better defining and strengthening the public-private-academic partnership in meteorological services (National Research Council, 2003);

h. The 1999 Geneva Declaration of the Thirteenth World Meteorological Congress, which was formulated as an explicit WMO appeal to all governments to support their NMSs and their broader national meteorological communities in their efforts to conform with the letter and spirit of Resolution 40 in support of sustainable development and the continuing benefits of meteorological cooperation world-wide (WMO, 1999);

i. Adoption by the 1999 Thirteenth World Meteorological Congress of a companion framework of cooperation for hydrological data and products. Its Resolution 25, Exchange of Hydrological Data and Products, recognizing both the similarities and differences of hydrological and meteorological data, adopted "a stand of committing to broadening and enhancing, whenever possible, the free and unrestricted international exchange of hydrological data and products, in consonance with the requirements for WMO's scientific and technical programmes." (WMO, 1999);

j. Adoption by the 2003 Assembly of the Intergovernmental Oceanographic Commission (IOC) of a companion framework for oceanographic data exchange. After lengthy debate through various ocean science fora under the leadership of Dr Angus McEwan, Resolution 6 of the Twenty-Second IOC Assembly, IOC Oceanographic Data Exchange Policy, agreed on IOC policy for international exchange of oceanographic data and metadata in terms of six clauses of which the first stated: "Member States

Members already in legal conflict with other Members or with the private sector found themselves arguing different interpretations of the resolution in support of their national positions and courts questioned the legal status of the voluntary cooperation regime of WMO even though adopted through formal intergovernmental processes under the WMO Convention. For their part, many in both the US and European private sectors felt that the whole emphasis of Resolution 40 was far too strongly on protecting the interests of NMSs at their expense. Many developing country NMSs in turn felt insufficiently protected from the international private sector.

It gradually became clear that much work lay ahead in re-building the fully cooperative regime of the golden years of the World Weather Watch and GARP (Zillman, 2018b).

In fact, it took a decade for the sensitivities and aftershocks of the 1990s upheavals to subside and for a new generation in WMO, who had not been through the trauma of the 1995 Congress debates, to gradually re-institutionalize the essential spirit of international meteorological cooperation on the WMO scene.

shall provide timely, free and unrestricted access to all data, associated metadata and products generated under the auspices of IOC programmes". (IOC, 2003);

k. Implementation of new arrangements for coordination of WMO activities in Earth observation from space with the programmes and activities of the European Organisation for the Exploitation of Meteorological Satellites, the Committee on Earth Observation Satellites and the various other national and international space agencies and coordination mechanisms (WMO, 2003);

l. Tensions with the World Intellectual Property Organization over its proposals, eventually abandoned, for a sui generis international treaty on intellectual property in databases, which sought to "enhance and stimulate ... international trade in databases". (Reichman and Samuelson, 1997; Gunasekera and Zillman, 2004);

m. Tensions with the World Trade Organization on the application to WMO activities of the competition provisions of the General Agreement on Trade in Services (GATS) (Gunasekera and Zillman, 2004);

n. A succession of national reviews and debates on environmental data access generally, which tested the robustness of the WMO system in several national jurisdictions (Productivity Commission, 2001);

o. Initiatives through the intergovernmental Group on Earth Observations, established in 2003, to build data policies for the Global Earth Observation System of Systems on the foundation of the WMO system of data exchange (GEO, 2005);

p. Implementation of the Global Observing System for Climate in Support of the United Nations Framework Convention on Climate Change in terms of what became known as "essential climate variables" (GCOS, 2010);

q. Efforts through WMO and other mechanisms to more strongly institutionalize the role of the NMS and better define the optimum features of public-private partnership in the delivery of value-added services (WMO, 1999; 2003);

r. Progressive recasting of the terminology and architecture of the data collection and exchange components of World Weather Watch in terms of a WMO Integrated Global Observing System and WMO Information System (WMO, 2011); and

s. Attempts, both within and ancillary to WMO, to establish a rigorous economic foundation for the WMO system of data exchange as part of a larger global economic and legal framework for meteorology (Zillman and Freebairn, 2001; Gunasekera, 2003; WMO, 2015) based on the theory of global public goods (Kaul, Grunberg and Stern, 1999; Tirole, 2017).

t. Adoption by the 2015 Seventeenth World Meteorological Congress of Resolution 60, on a policy for the international exchange of climate data and products to support the implementation of the Global Framework for Climate Services (GFCS). It continues to promote the commitment to the free and open exchange of climate-relevant data, tools and scientifically-based methods while respecting national and international policies (WMO, 2015a);

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The 18th World Meteorological Congress (2019, Geneva) adopted the Geneva Declaration 2019: Building Community for Weather, Climate and Water Actions. It reaffirmed "the commitment of Members to broaden and enhance the free and unrestricted exchange of meteorological, hydrological and climatological data and products."

Conclusions

The unanimous adoption of Resolution 40 by the 1995 Twelfth World Meteorological Congress averted the widely feared collapse of international meteorological cooperation and re-established the long-standing IMO/WMO principle of "free and unrestricted international exchange of data and products" as the continuing policy foundation for international meteorological cooperation in the twenty-first century. Looking back, it appears that Resolution 40 succeeded in saving the WMO system of data exchange in the 1990s for three main reasons:

- The fact that "free exchange" had been unanimously endorsed by more than 160 national governments restored its perceived validity and moral authority as the overriding principle of international cooperation through the WMO;

- Having glimpsed the implications of the collapse of international data exchange, the participants of the 1995 WMO Congress were so afraid of it happening again that they did everything possible for the rest of their careers to head off anything that would risk precipitating a repeat of the early 1990s; and

- While the guidelines on commercial relationships were far from perfect, they provided useful philosophical and practical guidance for managing the ongoing tensions between commercially operating NMSs and between the public and private sectors.

However, notwithstanding the extensive effort subsequently directed into practical implementation of the letter and spirit of Resolution 40, including the many refinements, extensions and new initiatives summarized in points (a) to (s) above, it did not prove possible to fully restore the universality, sense of ownership and perceived robustness of the earlier pre-Resolution 40 data regime. Within the strategic policy organs of WMO, the main attention after 1995 moved from commercialization and data exchange per se to broader matters bearing on the role and operation of NMSs (Zillman, 1999) and the role of National Meteorological and Hydrological Services in "alternative service delivery" (WMO, 1999).

While the 1999 Geneva Declaration went a long way towards reframing the global weather and climate enterprise for the twenty-first century – through closer NMS relations with the media, academia, equipment suppliers and private sector service providers in addressing the challenges of natural disaster reduction and climate change – inter-NMS and public-private tensions continued to cause difficulties in several parts of the world. Unfortunately, perhaps, their fear of a new round of threats to international cooperation left the Resolution 40 generation excessively reluctant to reopen the data exchange "can of worms" at succeeding Congresses and even unwilling to risk such re-opening by embracing proposals to incorporate the essence of Resolution 40 permanently into the WMO Convention.

The new Geneva Declaration (WMO, 2019b) makes clear that WMO is again facing many of the same issues and challenges that led to the negotiation of Resolution 40. Twenty-five years on from the trauma of the early 1990s, there are reasons to believe that much of the basic philosophy of Resolution 40 will remain central to the effectiveness and stability of the evolving public-private-academic-media partnership on which the integrated global system for provision of essentially all weather and climate services in every country depends (Zillman, 2014). There are also strong grounds for concluding that the uniquely public good character of most essential public forecasting, warning and information services makes the cooperative provision of the underpinning global meteorological infrastructure a fundamental ongoing responsibility of national governments and free and unrestricted international exchange of data and products a continuing global imperative for meteorology in the twenty-first century.

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