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OTHER CROSS-CUTTING MATTERS

WMO Polar Activities

Report to Plenary on item 11.9

REFERENCE:

Cg-XVI/C/WP 11.9

APPENDICES:

A. Draft text for inclusion in the general summary on item 11.9
B. Draft Resolution 11.9/1 (Cg-XVI) - The Antarctic Observing Network (AntON)
C. Draft Resolution 11.9/2 (Cg-XVI) - Amendments to the *Manual on the GOS*, Volume II - Regional Aspects - The Antarctic
D. Draft Resolution 11.9/3 (Cg-XVI) - Global Integrated Polar Prediction System (GIPPS)
E. Draft Resolution 11.9/4 (Cg-XVI) - WMO Polar Activities
F. Draft Resolution 11.9/5 (Cg-XVI) - International Polar Decade Initiative
G. Draft Resolution 11.9/6 (Cg-XVI) – Global Cryosphere Watch

ACTION REQUIRED:

It is recommended that the draft text given in Appendix A be included in the general summary of the work of the session and that the draft resolutions in Appendices B, C, D, E. F and G be adopted.

DRAFT TEXT FOR INCLUSION IN THE GENERAL SUMMARY OF Cg-XVI

11.9 OTHER CROSS-CUTTING MATTERS *(agenda item 11.9)*

WMO Polar Activities

11.9.1 Congress noted with appreciation the great effort of all Members who have operational activities in the Polar Regions, recognizing that the Polar Regions are extremely important in terms of their global impacts on weather, climate and water. It supported the need to establish an observational framework for Polar Regions, including the "Third Pole" (Himalaya and Tibetan Plateau) that balances space-based observations with in situ measurements while developing a methodology to address new observational requirements, including the identification of key polar variables from both a research and services perspective. Congress noted the success of the IPY Space Task Group (IPY-STG) in coordinating, across research and operational agencies, the planning, processing and archiving of Earth observation data sets supported the continuation of these efforts and requested the Executive Council to create the appropriate structures to oversee these future developments. Congress agreed that operational and research observing networks in Polar Regions should be integrated within the framework of the WMO Integrated Observing System (WIGOS) and the WMO Information System (WIS), be enhanced to include cryosphere related variables and it recognized that a major contribution to this objective will be through development of the Global Cryosphere Watch.

11.9.2 Congress agreed with the Executive Council that it is desirable to integrate all Antarctic networks into an Antarctic Observing Network (AntON) that will comprise all operational stations, all of which should produce climate messages, and adopted Resolution 11.9/1 (Cg-XVI) - The Antarctic Observing Network. Congress also extended its appreciation to other organizations, such as the University of Wisconsin, who fund and operate over half of these stations as automatic weather stations (AWS). Congress also noted with appreciation that the *Manual on the Global Observing System* (WMO-No. 544) was reviewed and adopted Resolution 11.9/2 (Cg-XVI) - Amendments to the *Manual on the GOS*, Volume II - Regional Aspects - The Antarctic.

11.9.3 Congress noted with concern that data from many Antarctic stations funded by research agencies are not available in real-time and, therefore, are not available to NWP systems. It noted that the high communication cost involved in using Iridium satellites is also a limiting factor. Congress requested the Executive Council and the Secretary-General, in collaboration with CBS and JCOMM, to investigate possible ways to reduce such costs through an international forum of users of satellite data telecommunication systems. It also expressed its desire that WIS would provide a suitable environment for collection and dissemination of data from research observing stations.

11.9.4 Congress recognized the importance of the relationship between WMO and the Antarctic Treaty Consultative Meeting (ATCM) and strongly encouraged the Executive Council and the Secretary-General to work with the ATCM on issues of mutual responsibility and to ensure representation of WMO at future ATCM meetings.

11.9.5 Congress noted with interest the decadal initiative to develop a Global Integrated Polar Prediction System (GIPPS), capable of providing information to meet user needs for decision making on timescales from hours to centuries. It noted the global benefits of such a system in enabling service delivery and developing observing strategies in Polar Regions, and in addressing key uncertainties in weather, climate, water and related environmental variability and change, thereby improving global prediction, contributing to all WMO high priorities, in particular Disaster Risk Reduction, and the Global Framework for Climate Services (GFCS). Congress agreed to embark on a multi-year endeavour towards GIPPS, as an IPY Legacy to benefit the global

community. It also agreed that GIPPS shall engage regional associations, technical commissions, and relevant international organizations and academic research communities in the development of such a system. Noting the Concept Paper on GIPPS (see Annex to this paragraph) and recognizing the importance of this initiative, Congress adopted Resolution 11.9/3 (Cg-XVI) - Global Integrated Polar Prediction System (GIPPS).

11.9.6 Congress agreed that "Services" are an important driver that anchors the work of WMO Polar Activities. It appreciated that the Executive Council has completed an initial inventory of existing weather, climate, water and cryosphere services currently provided in the Polar Regions and agreed that further consultations to validate user requirements should be conducted. Congress urged the Executive Council to develop a comprehensive description of the global community's polar service requirements and articulate the value to be delivered, and through mechanisms such as Polar Regional Climate Centres and Polar Climate Outlook Forums contribute to GFCS and by the GIPPS.

11.9.7 Congress noted with appreciation the accomplishments in WMO Polar Activities during the last four years. It noted that WMO Polar Activities were thus far funded from the PORS Trust Fund and encouraged Members to continue providing support to WMO's Polar Activities through this Trust Fund and through supporting activities identified in the Project Compendium for Voluntary Funding (2012-2015). Congress agreed that WMO needs to have a focus on polar observations, research and services to meet its responsibilities on regional and global weather, climate, water and related environmental matters, and adopted Resolution 11.9/4 (Cg-XVI) - WMO Polar Activities.

International Polar Decade Initiative

11.9.8 Congress noted with satisfaction that at the Workshop on International Polar Decade (IPD) Initiative (St. Petersburg, Russian Federation, April 2011) representatives from key international environmental organizations as well as from leading polar associations and institutions had unanimously supported an IPD initiative. Congress also noted the Nuuk Declaration of the Seventh Ministerial Meeting of the Arctic Council (12 May 2011, Nuuk, Greenland), which tasked the Senior Arctic Officials to consider supporting a proposal to arrange an International Polar Decade Initiative. Congress agreed that the IPD planning should continue to maintain the momentum generated by the IPY, to engage existing programmes and available resources, and to align them with the targeted set of objectives that would take a decade to advance.

11.9.9 Congress agreed with the workshop conclusion that any scientific efforts under the auspices of an IPD must be aligned to meeting broad societal needs such as WMO desired societal outcomes and be anchored on delivering better, more reliable scientific information to inform risk-based decision and policy making activities in the Polar Regions. In this light, the climate component of an IPD would have the potential to strongly contribute to the implementation of the Global Framework for Climate Services.

11.9.10 Congress further agreed that the scientific focus of an IPD should include topics such as:

(a) Development of improved polar weather, water, cryosphere and climate prediction systems and their use for service delivery and decision-making support;

(b) Better understanding of the polar climate predictability and the role of Polar Regions in the changes of the global carbon cycle and sea level;

(c) Optimization and development of observational methods, systems and networks in the Polar Regions;

(d) A “peoples, societies and cultures” initiative to integrate new understanding into practices and culture and improve livelihoods and health of indigenous and other northern communities and the ecosystems upon which they depend.

11.9.11 Congress expressed its deep appreciation to the WMO/ICSU IPY Joint Committee for the publication of a comprehensive summary of all IPY activities and its legacies given in “Understanding Earth’s Polar Challenges: International Polar Year 2007-2008” (http://www.icsu.org/publications/reports-and-reviews/ipy-summary/ipy-summary) and pointed out that many elements of the IPY networks and initiatives described in the Summary could provide the building blocks for a comprehensive polar observing system in IPD. Congress confirmed that early establishment of data management arrangements and an open and free data access policy should be one of the first steps of IPD preparation if the initiative is to be launched. Continued support for existing data centers and related IPY legacy initiatives such as the Polar Information Commons (PIC) as well as early WIS involvement will be essential and necessary elements of the IPD.

11.9.12 Congress agreed that unlike the IPY, which was mostly a bottom-up collection of research with funding allocated on the basis of scientific merit within themes and focus areas that differed from nation to nation and from one funding agency to another, the IPD should address uniform programme goals that meet specific needs. The goals should be developed through interactions among stakeholders, funding agencies and the scientific community and should be implemented through the coordination and cooperation of funding agencies best equipped to help achieve the negotiated goals.

11.9.13 With respect of the IPD timeline, Congress recognized that there should be a balance between the need to keep the momentum of most important and promising activities developed during IPY and avoiding discontinuation of the current valuable activities, and the need to properly design, plan and support integrated IPD activities. The actual length and initiation of IPD should be determined as a part of the planning process and it should be noted that the IPD duration does not need to be exactly ten years.

11.9.14 Congress agreed that to move the IPD idea forward a consultative process would be needed. A steering group, in which key stakeholders would be represented, should be established in due course to lead the consultation and drafting process. Congress noted with appreciation and accepted the offer by the Workshop co-chairs to serve as initial leaders of such a group. The steering group should be supported by a small secretariat, which will help synthesizing information and preparing drafts of the IPD Concept Document. Congress agreed that WMO Members should further develop this Concept Document and noted with appreciation that the Research Council of Norway had kindly offered to seek some human resources for this purpose, and the International Arctic Science Committee would similarly provide some assistance. Congress agreed that WMO Secretariat will serve as the initial point of contact for such a secretariat. A critical milestone would be the Montreal 2012 IPY Conference “From Knowledge to Action”, at which a draft IPD Concept Document would be reviewed, corresponding community decisions recommended, and possible commitments expressed. Congress adopted Resolution 11.9/5 (Cg-XVI) - International Polar Decade initiative.

Global Cryosphere Watch (GCW)

11.9.15 Congress stressed the importance of the cryosphere, noting that it is global, existing in various forms spanning all latitudes and occurring in approximately one hundred countries, in addition to the Antarctic continent. It noted the unparalleled demand for authoritative information on past, present and future state of the world’s snow and ice resources.

11.9.16 Congress considered the “Implementation Strategy for the Global Cryosphere Watch” developed by the Executive Council’s Panel of Experts on Polar Observations, Research and Services (EC-PORS). It noted that countries from all six Regions have expressed their desire to be involved in WMO’s cryosphere initiative and especially noted the interest from Members, where snow and ice does not occur, but were concerned about the impact of a changing cryosphere on their nation through changes in weather, climate, water resources and sea level rise. Congress noted with appreciation the efforts of the Norwegian Meteorological Institute in developing a WIS compliant web portal for GCW that would be interoperable with NMHS and external cryospheric data centres.

11.9.17 Congress agreed with the next steps for developing GCW as outlined in the GCW Implementation Strategy (see Annex to this paragraph). It encouraged Members to participate in the development of GCW and urged Members to support implementation on a shared basis through Project 4.4.1.50 on Implementation of activities of the EC Panel on Polar Observations, Research and Services (EC-PORS) in the Compendium for Voluntary Funding (2012-2015), thus complementing insufficient resources from the WMO regular budget. Congress agreed that WMO needs to have a focus on global cryosphere issues to be able to provide authoritative information to meet Members’ responsibilities on regional and global weather, climate, water and related environmental matters, and adopted Resolution 11.9/6 (Cg-XVI) - Global Cryosphere Watch. Congress requested the Executive Council and the Secretary-General to oversee GCW’s initial development to ensure optimal management of, and support to, the initiative. Congress also noted that GCW would be an important contribution of WMO to a potential International Polar Decade (IPD), if this were to be initiated.

Annex to paragraph 11.9.5 of the general summary

Concept Paper
Global Integrated Polar Prediction System (GIPPS)

EC-PORS Research Task Team:
Peter Lemke (leader), Johan Stander, Steve Pendlebury, Neil Adams (consultant)
Version 3, January 2011

GIPPS in context

The World Meteorological Organization's (WMO) Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS), at its Second Session in Hobart in October 2010, agreed to the concept of a major decadal initiative to develop a Polar Prediction System. The Panel entitled this new initiative the **Global Integrated Polar Prediction System** (GIPPS). The word 'Global' reflects that it would be an international effort and that the poles, including the *third* pole[1], affect systems (weather, climate, hydrological, biological, chemical, etc.) globally; 'Integrated' reflects the interconnections between all these systems, and also because the System itself will be based on the principles of research, observations and services that are integrated and aligned[2]. For polar areas, GIPPS is seen as becoming a foundation of delivering the WMO's substantial contribution to "*the protection of life and property against natural disasters, to safeguarding the environment and to enhancing the economic and social well-being of all sectors of society in areas such as food security, water resources and transport*[3]."

The basic aims of GIPPS

In championing a '*Polar Prediction System*' EC-PORS is mindful that it should be primarily service-driven (i.e. is operational in focus) and provides 'predictions' from daily to inter-decadal time-frames (and possibly beyond). In other words, GIPPS needs to:

- Meet 'user requirements';
- Accurately predict the future state of the atmosphere, ocean, and hydrosphere/cryosphere for high northern and southern latitudes, particularly where prediction systems that are tuned for lower latitudes are less robust; and,
- Be supported by appropriate observational systems and enabling scientific research and development.

Three time scales are envisaged for GIPPS to cover:

- Short-term prediction underpinned by deterministic fully coupled models (hours-days) and, perhaps by ensemble approaches for the days to weeks periods;
- Medium-term (months to decades) prediction, most likely relying on ensemble approaches; and,
- Long-term projections (in the IPCC sense) of ice sheet mass balance, sea level and climate variability and change for the next few centuries, perhaps based on the scenario approach.

There is evidence that polar processes are not well modelled in current global systems and getting the polar atmospheric physics right will not only improve polar forecasting but should improve global forecasting as well.

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1 Himalaya and Tibetan Plateau region

2 See Section 6.4 at http://www.wmo.int/pages/prog/www/WIGOS_6_EC_PORS/Final_Report2010.pdf

3 http://www.wmo.int/pages/about/index_en.html

Values of a Polar Prediction System

A Polar Prediction System will deliver benefits to a very wide range of users and communities. Not only will it enhance the scientific understanding of polar meteorology, but also will fundamentally underpin improved services for those engaged in polar activities. An effective polar prediction system will also directly contribute to the global modelling effort and provide benefits to communities at all latitudes. Benefits that will flow from a polar prediction system include:

- Improved services to key users, including those involved in transportation, logistics and planning, biological and energy resource management, water resources, tourism, marine and aviation activities and Disaster Risk Reduction (DRR);
- Improved understanding of key physical process that drive the polar weather and climate system and to diagnose the benefits of particular observational technologies and approaches;
- Providing input to global models to ensure that polar processes and teleconnections are effectively captured.

In addition to typical synoptic variables, a Polar Prediction System should focus on specialized variables, such as sea ice, permafrost, polar clouds, ice sheet mass balance, and snow cover.

Stakeholders

Partners in specifying GIPPS – the end-users:

Primacy in this task is that GIPPS should be “service-driven”. In other words, the Polar Prediction System needs to provide outputs which provide end-users with intelligence about their environment that will enable them to maximize the best outcomes from their activities. To this end the EC-PORS Services Task Team will develop a White Paper that comprehensively describes the global community’s polar services requirements and articulates the value to be delivered by a GIPPS - the White Paper itself will be made available for consideration at the next session of EC-PORS in the boreal autumn of 2011.

As a foray into understanding end-user requirement the EC-PORS Research Task Team undertook an initial ‘gap analysis’ which asked simple questions concerning perceived service/observational/modelling deficiencies in current polar prediction systems. The respondents to this pilot survey were mostly operational or research-based professionals in the areas of meteorology; the cryosphere; the hydrosphere; and numerical modelling. And so it is not surprising that many of the gaps identified were of a technical nature. For example, the need for more comprehensive sea-ice modelling across both polar areas, and the need for better observations and modelling of boundary-layer fluxes. And so it will be the task of the EC-PORS Services Task Team to articulate the requirements of the ‘real’ end-users, that is, the ‘expeditioners’ (e.g.: geologists; glaciologists; biologists) who work ‘in the field’ in both polar areas; the citizens and utility providers of, in particular, the northern polar area; polar shipping and aviation, including tourism, fisheries and other commercial ventures. It is likely that there will be synergies between end-user requirements and service providers – for example, the aforementioned sea-ice modelling will lead to more efficient and safer routing of ship traffic in polar waters.

Partners in developing GIPPS

It is clear from above that the *‘Polar Prediction System*’ will need to be an end-to-end, fully supported, *operational* prediction system, if it is to serve polar citizens in a completely reliable way – reliable not only in the underpinning science, but also in the robustness of supporting processing (computer modelling resources) and communication infrastructure. Therefore, it is equally clear that the skills, requirements and ideas of researchers and modellers (atmospheric; cryospheric; hydrospheric; chemistry; oceanographic; soil, etc.) will need to be at the forefront of the *‘Polar*

Prediction System' development, as do the institutions, agencies and national hydrological, meteorological and oceanographic services that are the foundation of year-round, day-by-day operational service delivery. The proposed development of cross-regional Polar Regional Climate Centres (RCCs) and Polar Climate Outlook Forums (PCOFs) would be very useful for addressing services in the Polar Regions.

Supporting and steering the substantial depth of energy already in play in the polar prediction area will be a key focus for EC-PORS who can tap the work of *Research and Observational Groups* such as: the Antarctic Mesoscale Prediction System (AMPS) developers; the Antarctic Meteorological Observations, Modelling and Forecasting Workshop (AMOMFW) forums; the Scientific Committee for Antarctic Research (SCAR) Operational Meteorology Group; various Working Groups of the International Arctic Science Committee (IASC); the International Commission on Polar Meteorology (ICPM); WMO's World Weather Research Programme (WWRP) and The (WMO) Observing System Research and Predictability EXperiment (THORPEX), and the World Climate Research Programme (WCRP); the British Antarctic Survey (BAS); and the Byrd Polar Institute etc. All are key players specifying the observational and research requirements for a '*Polar Prediction System*'. Moreover *Operational Numerical Weather systems* such as: the European Centre for Medium-Range Weather Forecasts (ECMWF); the US National Centers for Environmental Prediction (NCEP); and various national NWP centres all will have key implementation roles, not to mention key roles in informing the overall process as to what can be pragmatically/realistically implemented on a sustainable operational basis.

GIPPS: a 10-year milestone

The International Polar Year (IPY) 2007-08[4] continued the success of outcomes underpinned by concentrated efforts into polar research facilitated by IPYs in 1882-3, 1932-3, and 1957-8. There are sure to be more IPYs and no doubt polar prediction will *incrementally* improve as the operational global prediction systems become more fully coupled and earth-system integrated. The word, *incrementally*, is deliberately emphasized here since globally focused modellers tend to focus on globally-measured improvements (e.g. skill scores), not on individual regional outcomes. Therefore, EC-PORS sees a fully operational, end-to-end, polar-tuned but Global(ly) Integrated, Polar Prediction System, which meets the contemporary needs of the citizens of Polar Regions and beyond, as a decadal endeavour towards an operational GIPPS.

[4] http://www.ipy.org/

Annex to paragraph 11.9.17 of the general summary

GLOBAL CRYOSPHERE WATCH (GCW)

GCW IMPLEMENTATION STRATEGY

1.0 BACKGROUND:

The cryosphere collectively describes elements of the Earth System containing water in its frozen state. It includes solid precipitation, snow cover, sea ice, lake and river ice, glaciers, ice caps, ice sheets, permafrost, and seasonally frozen ground. The cryosphere is global, existing not just in the Arctic, Antarctic and mountain regions, but at all latitudes and in approximately 100 countries. Frozen water and its variability and change in the atmosphere, on land, and on the ocean surface has direct feedbacks within the climate system, affecting energy, moisture, gas and particle fluxes, clouds, precipitation, hydrological conditions, and atmospheric and oceanic circulation. The cryosphere provides some of the most useful indicators of climate change, yet is one the most under-sampled domains of the Earth System. Improved cryospheric monitoring is essential to fully assess, predict, and adapt to climate variability and change.

All of these issues require a coordinated international and cross-disciplinary mechanism, thus the proposal for the establishment of an operational Global Cryosphere Watch (GCW).

2.0 GCW Meets User Needs

GCW will provide data, information and products that will help Members and the wider user community reduce the loss of life and property from natural and human-induced disasters, improve management of energy and water resources, contribute to a better understanding of environmental factors affecting human health and well-being, understand, assess, predict, mitigate and adapt to climate variability and change, improve weather forecasts and hazard warnings, aid in management and protection of terrestrial, coastal and marine ecosystems, and support sustainable agriculture.

GCW will provide information for informed decision making and policy development related to climate, water and weather, for use in real time, for climate change adaptation and mitigation, and for risk management. Over time, this information will become more service-oriented. During GCW consultation, Members emphasized the national and global impact of the cryosphere, particularly:

- Sea level rise threatens vital infrastructure, settlements and facilities of small island states and low-lying coastal zones;
- Changes in sea-ice affect access to the polar oceans and surrounding seas, in turn affecting economic development, accessibility to resources, navigation, tourism, marine safety and security. Declining summer sea-ice may also impact ocean circulation and weather patterns in the mid-latitudes;
- Permafrost thawing impacts infrastructure and is a potential major source of methane, a greenhouse gas;
- Changes in the cryosphere have major impacts on water supply, food production, availability of potable water, freshwater ecosystems, hydropower production, and the risk of floods and droughts;
- Natural hazards such as icebergs, avalanches and glacier outburst floods create risks for transportation, tourism and economic development;
- Cryospheric data and information are required for improved numerical weather prediction and climate monitoring and prediction in polar and alpine regions as well as globally;

- Changes in large scale dynamics such as the Arctic Oscillation (AO) Index have major and currently not well predicted impacts on climate in North America, Europe and Asia.

3.0 Mission and Objectives

GCW will be an international mechanism for supporting all key cryospheric in-situ and remote sensing observations, from research and operations, and for implementing the recommendations of the Integrated Global Observing Strategy Partnership (IGOS-P) - Cryosphere Theme (hereinafter "CryOS").

To meet the needs of WMO Members and partners in delivering services to users, the media, public, decision and policy makers, GCW will provide authoritative, clear, and useable data, information, and analyses on the past, current and future state of the cryosphere. In its fully developed form, GCW will include observation, monitoring, assessment, product development, prediction, and research. It will provide the framework for reliable, comprehensive, sustained observing of the cryosphere through a coordinated and integrated approach on national to global scales and deliver quality-assured global and regional products and services. GCW will organize analyses and assessments of the cryosphere to support science, decision-making and environmental policy. To meet these objectives, GCW will encompass:

- *Requirements:* Meet evolving cryospheric observing requirements of WMO Members, partners, and the scientific community, by making CryOS a living document and contributing to the WMO Rolling Review of Requirements (RRR) process;
- *Integration:* Provide a framework to assess the state of the cryosphere and its interactions within the Earth System, emphasizing integrated products using surface- and space-based observations, while including a mechanism for early detection of, and support for, endangered long-term monitoring series, aimed at optimizing knowledge of environmental conditions and exploiting this information for predictive weather, climate and water products and services, thus contributing to the proposed WMO Global Integrated Polar Prediction System (GIPPS) and Polar Regional Climate Centres;
- *Standardization:* Enhance the quality of observational data by improving observing standards and practices for the measurement of cryospheric variables, by addressing differences and inconsistencies in current practices used by Members, partner organizations and the scientific community;
- *Access:* Improve exchange of, access to, and utilization of observations and products from WMO observing systems and those of its partners;
- *Coordination:* Foster research and development activities and coherent planning for future observing systems and global observing network optimization, especially within the WMO Integrated Global Observing System (WIGOS), by working with all WMO Programmes, technical commissions (TCs), regional associations (RAs), partner organizations and the scientific community.

GCW will be an essential component of WIGOS and will coordinate cryospheric activities with the Global Climate Observing System (GCOS), which includes the climate-related components of the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS), enhancing GCOS support to the UNFCCC. GCW will strengthen the WMO contribution to the Global Framework for Climate Services (GFCS). Through WIGOS and the WMO Information System (WIS), GCW will also provide a fundamental contribution to the Global Earth Observation System of Systems (GEOSS).

4.0 GCW and the WMO Strategic Plan

The cryosphere, by its nature, is intrinsically interdisciplinary. GCW, in the context of the WMO Strategic Plan 2012-2015, is a crosscutting activity contributing to all five priority areas and to

achieving the expected results of all Strategic Thrusts. It cuts across all the WMO technical departments (Observing and Information Systems, Research, Climate and Water, Weather and Disaster Risk Reduction Services), joint sponsored activities (e.g. WCRP, GCOS) and WMO TCs. GCW will

- Enhance capabilities to produce better climate predictions and assessments, hydrological forecasts and assessments, weather forecasts and warnings;
- Provide the mechanism to integrate the atmospheric, terrestrial (including hydrology) and marine cryosphere Essential Climate Variables (ECVs) within GCOS;
- Coordinate cryospheric observations of WMO and other agencies and organizations;
- Be part of the WIGOS and WIS.

5.0 GCW Implementation

5.1 Phases

GCW Definition Phase (2007 - 2011)

Following a review of the feasibility study for developing and implementing GCW within WMO, EC-LXI endorsed the next steps for developing GCW with the guidance of its EC Panel of Experts on Polar Observations, Research and Services (EC-PORS). Extensive consultation contributed to developing the rationale, concept, principles and characteristics of GCW as well as the engagement of WMO Programmes and TCs, key partners from other agencies, institutes and organizations, and the scientific community who could contribute to the development and implementation of GCW. Pilot and demonstration projects are being identified to test GCW implementation. The Secretariat has provided support for initial GCW development through the EC-PORS Trust Fund.

GCW Implementation phase (2012-2019)

The Implementation phase, to be undertaken between 2012 and 2019, will be coordinated by WMO and its partners. It will focus on developing and implementing GCW through tasks and activities that will form the GCW Implementation Plan. Initial timelines and deliverables are given in Figure 1.

GCW Operational Phase (2020 onward)

Once the framework is established, GCW enters its Operational Phase. It will continue to evolve to improve service delivery and support decision-making in response to the needs of users and technological opportunities.

5.2 Tasks

Based on the feasibility study and continuing consultation with WMO Members and potential partners by the EC-PORS GCW Task Team, initial key tasks were identified for implementation:

1. Implement recommendations of CryOS;
2. Initiate pilot and demonstration projects;
3. Establish cryosphere reference sites;
4. Develop an inventory of satellite products for GCW;
5. Develop a web portal and interoperability for cryosphere users and providers;
6. Capacity building;
7. Communication and outreach;
8. Monitor scientific progress.

GCW Expert and Technical Teams will be established to lead these activities with experts from WMO and its partners. A summary of the initial tasks follows.

Implementation of CryOS recommendations

CryOS provides a framework for developing and implementing GCW. Developed through widespread consultation and review within the global cryosphere community, it details observational capabilities and requirements, and gives recommendations for filling gaps. It proposes measures to develop and coordinate cryospheric components of the WIGOS, GCOS/GOOS/GTOS and other systems, so that cryospheric products will meet most user requirements within approximately 10-15 years. It describes arrangements to ensure that existing cryospheric data and products are openly accessible to users in a timely and interoperable manner. It highlights the need for the identification and coordination of resources to continuously improve observations as requirements and technology evolve, and reiterates the need for commitment by observing system operators to sustain and augment cryospheric observations and products. GCW will build on these recommendations to ensure a comprehensive, coordinated and sustainable system of observations and information to allow for a full understanding of the cryosphere and its changes.

Pilot and Demonstration Projects

Pilot projects will be implemented to demonstrate: (a) the types of data and information that GCW could provide for cryosphere components globally, regionally and nationally; (b) how GCW could build on existing efforts by the cryospheric community; (c) the time and resources required to create a fully functional integrated cryosphere information system; (d) how to document standards and best practices for observing and product development; and (e) challenges/gaps/needs that GCW could address. Demonstration projects would focus on regional or national contributions to standardization, integration and interoperability.

Projects will involve contributions of WMO Members, Programmes and TCs, and contributing partners. Potential projects which can contribute to demonstrating GCW's operation include CIMO's intercomparison of measurement of solid precipitation, snowfall and snow depth; Norway's CryoClim initiative to develop new operational services for long-term systematic climate monitoring of the cryosphere; ESA's "Global Monitoring of Essential Climate Variables" programme (Climate Change Initiative) for the cryosphere; the World Glacier Monitoring Service (WGMS), University of Zurich, Switzerland, which is operated under the auspices of the International Council for Science World Data System (ICSU/WDS), International Association of Cryospheric Sciences of the International Union of Geodesy and Geophysics (IUGG/IACS), UNEP, UNESCO and WMO; Nordic Centre of Excellence (NCoE): SVALI - Stability and Variations of Arctic Land Ice; USGS Benchmark Glacier Programme and the IPY Data and Information Service (IPYDIS) global partnership of data centres, archives, and networks creating interoperability between cryosphere data centres in Norway, USA, Canada and the UK. GCW will build on existing programmes and projects, but other pilot and demonstration projects need to be established in different regions, including alpine areas, central Asia (notably the "Third Pole"), the tropics, and Antarctica.

Reference Sites

GCW will initiate a comprehensive cryosphere observing network called "CryoNet", a network of reference sites or "supersites" in cold climate regions, on land or sea, operating a sustained, standardized programme for observing and monitoring as many cryospheric variables as possible. CryoNet will provide reference sites for validation of satellite and model outputs. Initially, it will build on existing cryosphere observing programmes or add standardized cryospheric observations to existing facilities to create supersite environmental observatories. As encouraged by GCOS, GCW

will facilitate the establishment of high-latitude supersites with co-located measurements of key variables, especially permafrost and snow cover, thus enhancing GCOS/GTOS Networks for Permafrost (GTN-P), Glaciers (-G) and Hydrology (-H) and including the measurements of solid precipitation. GAW stations and WCRP/Coordinated Energy and Water Cycle Observations Project (CEOP) reference sites in cold climates are potential candidates.

Members, through their cryosphere focal points, are being asked to recommend suitable sites. China has established supersites in the “Third Pole” region where the High Asian cryosphere (HAC) serves as the Asian “water tower” for over a billion people. They would like to merge into the proposed GCW network and help lead the development of standardized cryosphere observing programmes. Another proposed contribution is the Sodankylä-Pallas supersite in the boreal forest of northern Finland. Its infrastructure is designed for integrated monitoring of soil-snow-vegetation-atmosphere interaction and provides reference measurements for satellite sensors on a continuous basis.

Reference sites will lead in the effort to establish best practices, guidelines and standards for cryospheric measurement. This will include consideration of data homogeneity, interoperability, and compatibility of observations from all GCW constituent observing and monitoring systems and derived cryospheric products.

Inventory of Satellite Data Products

This task involves developing an inventory of candidate satellite products for GCW which are mature and generally accepted by the scientific community. It includes an intercomparison of products to assess quality and to ensure an authoritative basis. The Polar Space Task Group of EC-PORS, with its direct connection to Space Agencies, will work with GCW to identify new satellite products to support GCW pilot projects and services.

Currently, the WCRP/SCAR/IASC Climate and Cryosphere Project (CliC) is sponsoring a workshop on the evaluation of satellite-derived sea ice extent and concentration products. This task was identified as a pilot project in the GCW feasibility study. The results of the intercomparison will provide valuable information to GCW on the many available products and on the process for determining “authoritative” information. The WCRP Observation and Assimilation Panel (WOAP) is organizing a workshop on essential climate variables (ECVs), where an inventory of satellite and in situ ECV products will be compiled with information on product maturity, accuracy, users, applications, and adherence to the GCOS guidelines for ECV datasets. For example, the United States National Oceanic and Atmospheric Administration (NOAA) is supporting work on satellite-derived climate data records (CDRs) for snow and ice, and the European Space Agency (ESA) Climate Change initiative will provide ECVs that meet GCOS requirements, and will support efforts to validate and improve current methods for extracting cryospheric geophysical parameters from satellite data.

GCW Web Portal

The GCW web portal will make GCW data and information available to WMO Members, their partners, and users while providing the ability to exchange data and information among a distributed network of providers of data and products. The portal, as a part of WIS, will allow for rapid exchange of data, metadata, information, and analyses. The concept for the flow of information to the portal is given in Figure 2.

The portal and associated data and information will be capable of including all elements of the cryosphere at national, regional and global scales. It will provide access to data and information on past, present and future cryospheric conditions, and be able to draw on operational and research-based observation and monitoring and modelling. GCW will ensure access to real time, near-real

time and historical cryospheric data and products through WIS. GCW will respect partnership, ownership and data-sharing policies of partners. It will allow new types of information to be widely distributed, such as real-time cryospheric “hot news” (e.g. extremes, physical or socio-economic impacts, new research results).

A prototype GCW web portal for GCW is being developed by the Norwegian Meteorological Institute (METNO), building on their web-based tool for searching data. IPY data centres/portals, such as METNO, Canadian Cryosphere Information Network (CCIN), British Antarctic Survey (BAS), and US National Snow and Ice Data Centre (NSIDC) are already interoperable. This approach will facilitate seamless access with NMHSs and external data centres holding relevant cryospheric data and information at the national or global scale.

Capacity Building

GCW must develop an effective capacity building strategy. A coordinated capacity building effort should respond to the needs at national and regional levels, as identified by Members, which would assist all countries in improving and sustaining observation and exchange of cryospheric data and information. For developing and the least developed countries there is a need to ensure access to, and effective utilization of, observations, data and products, related technologies and new knowledge. For example, information on potential sea level rise, loss of mountain, including tropical, glaciers, and improved understanding of the impact of cryospheric changes in the Antarctic on extreme weather and climate in tropical and sub-tropical regions has been identified by Members as a need to which GCW can contribute.

Capacity building will be coordinated with existing WMO efforts and will take advantage of mechanisms established by WIGOS and other WMO Programmes, RAs, TCs, and GCW partners.

Communications and Outreach

GCW will have numerous, diverse stakeholders both within WMO and with its partners. GCW will establish an effective communication, outreach and education strategy in collaboration with WMO Members, Programmes, RAs and TCs. It will take advantage of outreach programmes developed and effectively deployed through IPY and with organizations such as Association of Polar Early Career Scientists (APECS) and the Global Learning and Observations to Benefit the Environment program (GLOBE) program. The GCW portal will provide relevant information on communication, outreach and capacity building, aimed at complementing, not duplicating, others’ efforts.

6.0 Collaborations, Partnerships, Sponsorship

WMO Members have responded strongly and positively to GCW and, so far, over 30 Members from all WMO Regions have nominated GCW focal points. These focal points will be involved in the development of GCW and will help integrate the global initiative with their national plans. In addition to Members with specific national or regional activities in the Polar Regions, interest was expressed by Members (e.g. Maldives, Thailand, Ethiopia, Tajikistan) who are concerned about changes in the cryosphere and the potential impact on their country.

GCW will engage WMO co-sponsored programmes, TCs, RAs, and other organizations that have cryospheric responsibilities. GCW partnerships are being identified, including government agencies and institutions that measure, monitor, or archive cryosphere data and information from in-situ and satellite research and operational networks and model sources. International bodies, such as International Permafrost Association (IPA), World Glacier Monitoring Service (WGMS), Global Precipitation Climatology Centre (GPCC), and national institutions, such as the US National Snow and Ice Data Center (NSIDC) have already indicated their willingness to support GCW.

WMO's co-sponsored programmes are essential partners. WCRP/CliC coordinated the development of the GCW feasibility study and co-led with SCAR the development of CryOS. The WMO-IOC-UNEP-ICSU Steering Committee for GCOS endorsed the creation of GCW as a mechanism for integrating cryospheric observations.

Potential co-sponsorship is being investigated. The IOC of UNESCO, which has been engaged in the GCW process from the beginning, has already indicated its interest in being a co-sponsor. Memorandum of understanding or agreements would be established between all sponsors.

EC-PORS and its GCW Task Team will lead the discussion with partners.

7.0 GCW Management and Governance

7.1 *Conceptual Framework for GCW*

GCW's organizational, programmatic, procedural governance will be based on WMO structures and interfaced with those of partner organizations. Cryospheric data, information, products and knowledge will be provided not only from National Meteorological and Hydrological Services (NMHSs), but also from national and international partner organizations, agencies and the scientific community. Collaboration and cooperation through co-sponsorship and partnership is essential. GCW will include an effective interface with the user community. Capacity building and training will be included in all aspects of the GCW framework. Expert, technical and regional task teams would be responsible for developing, implementing and managing the GCW tasks. A GCW Advisory Committee will initially steer activities, tasks, and the establishment of teams within the available resources. An initial framework, or conceptual model, for GCW is given in Figure 2. It illustrates the "why, what, and how" of GCW operation.

7.2 *Deliverables and Milestones*

Upon approval and within available resources, GCW will address tasks associated with the key deliverables and milestones. Figure 1 shows the key milestones and timelines. The aim is to begin now to implement tasks, recognizing the complexity of engaging NMHSs and their national partner agencies, national and international institutes and the scientific community.

7.3 Resources

The successful launch of GCW depends directly on the availability of resources. Support of the definition phase has been through funding by Members to the GCW and EC-PORS Trust Funds (namely, part-time temporary staff and consultative meetings), supplemented by in-kind contribution from Members for technical expertise. However, additional resources will need to be provided through the WMO Secretariat for both staff and non-staff costs for the implementation and coordination that goes beyond the programmatic activities of the Secretariat to date. One full staff position would be needed in the WMO Secretariat for GCW implementation activities and should be funded jointly by the WMO regular budget and other sources, including:

- GCW and EC-PORS Trust Funds to supplement the WMO regular budget;
- In-kind contributions, e.g. Task Office/activity funded by a Member(s);
- Staff secondments;
- Project Compendium that includes a request for GCW funding from voluntary contributions (seeking contributions totalling CHF2.4M for implementation of EC-PORS activities over four years, including GCW to support the advisory committee and expert teams in implementing GCW and provide some Secretariat support for GCW development, coordination and implementation).

7.4 *Governance within WMO*

GCW requires cooperation, collaboration and coordination within WMO and with external partners, for which working arrangements between WMO and partners would be established. WMO provides a legitimate, valued and unique entry point on cryospheric issues related to weather, climate, water and other environmental matters in 189 countries.

A GCW Secretariat (Project Office) will be established in the WMO Secretariat to support all GCW activities, including coordination with partners, monitoring of implementation, reporting and follow-up actions. It will also provide support to national focal points and activities.

GCW is a truly cross-cutting activity. However, at the beginning of the Implementation Phase observational aspects (e.g. reference sites, observing practices, data compatibility, interoperability, etc.) may prevail. This would likely shift later in the Implementation Phase, as services become more prominent. At the beginning, the links would be strongest with WIGOS and WIS, several of the TCs, and co-sponsored programmes. Hence, the Executive Council, through its EC-PORS, would be best positioned to oversee GCW's initial development and implementation, recognizing that the structure of the Secretariat will have to adapt, as and when appropriate, to ensure optimal management of, and support to, the initiative.

Figure 1: GCW Milestones and Deliverables

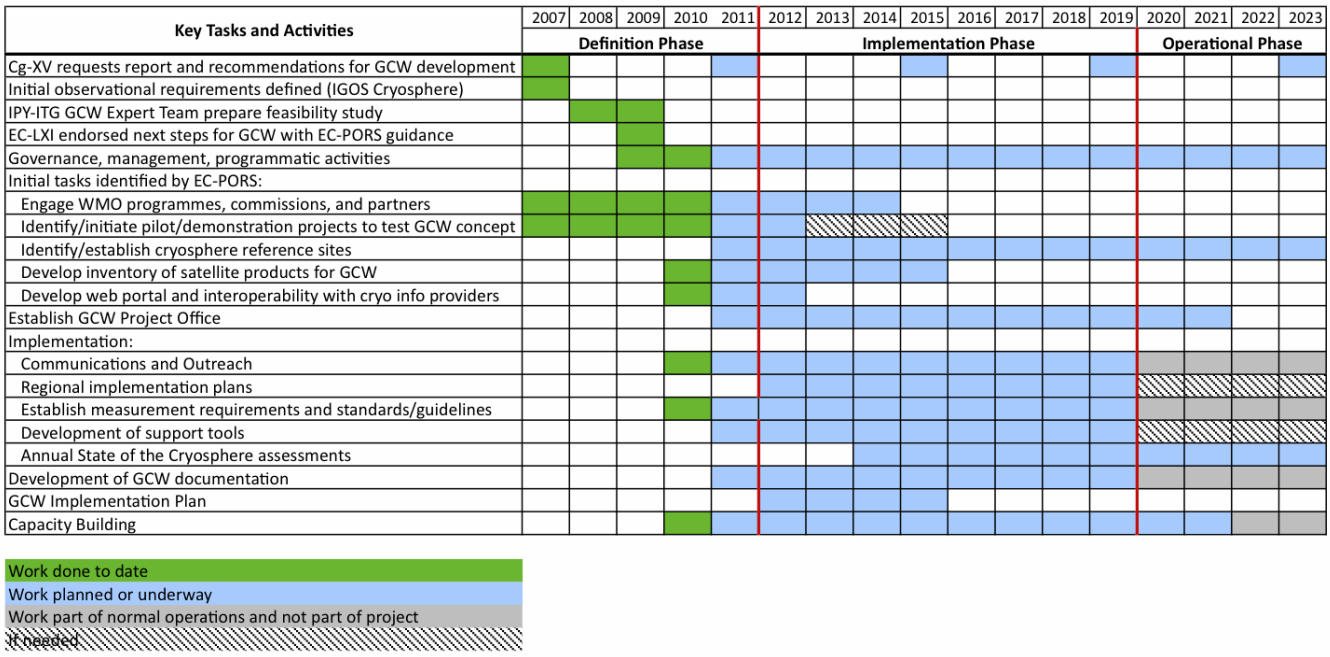
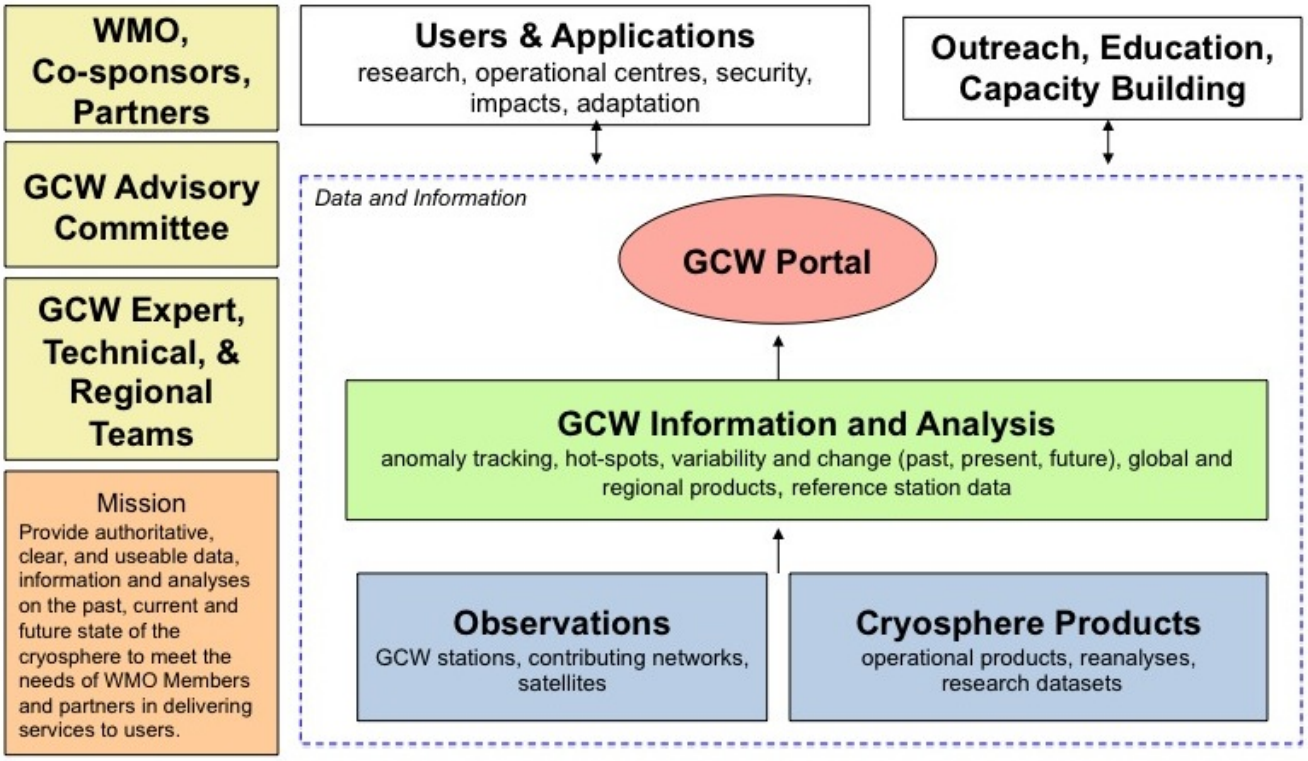


Figure 2: Conceptual Framework for GCW Operation



DRAFT RESOLUTION

Res. 11.9/1 (Cg-XVI) - ANTARCTIC OBSERVING NETWORK (AntON)

THE CONGRESS,

Noting:

(1) Resolution 14 (EC-LIX) - Antarctic Basic Synoptic Network (ABSN),

(2) Resolution 15 (EC-LIX) - Antarctic Basic Climatological Network (ABCN),

(3) The *WMO Technical Regulations* (WMO-No. 49), Regulation (B.1) 3.1.1.2,

(4) The WMO Strategic Plan as it relates to observations in the Antarctic,

(5) The *Manual on the Global Observing System* (WMO-No. 544), Volume I, Part III, paragraphs 2.1.3 and 2.1.4,

(6) The *Manual on the Global Observing System* (WMO-No. 544), Volume II, The Antarctic,

Considering:

(1) That the establishment and maintenance of an Antarctic Observing Network (AntON) of surface and upper-air stations to meet the requirements of Members, constitutes one of the most important obligations of Members under Article 2 of the WMO Convention,

(2) That the density of the current Antarctic Observing Network (AntON) of surface and upper-air stations is much less than that desirable to properly characterize Antarctic weather and climate,

(3) That in order to provide a good representation of climate for Antarctica, there is no need to distinguish between a synoptic and climate network,

(4) That manned stations in Antarctica also contribute vital ozone and other observations to the GAW,

(5) The need for further integration of Antarctic observing systems,

(6) The needs of the research community as expressed by the Scientific Committee for Antarctic Research (SCAR),

Decides:

(1) That the name “Antarctic Observing Network (AntON)” be used for a description of the Antarctic network composed of surface and upper-air stations and including all GCOS (GSN and GUAN) and GAW stations;

(2) That the stations and the observational programmes listed in the Annex to this resolution constitute the Antarctic Observing Network;

Urges Members:

(1) To spare no effort in their endeavours to secure full implementation of the network of stations and observational programmes set forth in the Annex to this resolution, particularly those contributing to GCOS;

(2) To seek to maintain, and where possible restore, radiosonde stations in Antarctica;

(3) To consider the possibility of cooperating with other Members in sharing the costs of re-opening and operating silent stations;

(4) To comply fully with the standard times of observation, the coding procedures and the data-collection standards, as laid down in the *WMO Technical Regulations* and the *Manuals on the GOS*, *on Codes*, *on the GTS* and *on the GDPFS*;

(5) To validate station positions and elevations using modern surveying techniques against those given in *Weather Reporting* (WMO-No. 9) Volume A at the required resolution and to communicate the results of these measurements to the WMO Secretariat;

(6) To ensure that traceable calibration certificates are available for instrumentation, in line with ISO Quality Management certification;

(7) To ensure that appropriate metadata are maintained and provided with all observational datasets (and accessible through WIS);

(8) To make available historic research and routine observational data to the appropriate Antarctic Data Collection and Production Centres (DCPCs) for archiving for climate purposes;

(9) To incorporate existing research and new installations into the AntON;

(10) To ensure that feedback is given to stations when NWP detects problems with data or its transmission;

Requests the Secretary-General to bring any changes to the Antarctic Observing Network to the attention of the Members of WMO.

Annex: 1

Annex to draft Resolution 11.9/1 (Cg-XVI)

WMO Antarctic Observing Network (AntON)

This list shows the stations currently comprising the Antarctic Observing Network (AntON). It shows whether the stations currently contribute synoptic (S), climate (C) or upper-air (U) synoptic observations to the GTS, whether they are GCOS Surface Network (GSN), GCOS Upper-Air Network (GUAN) or GAW stations. Key stations are those that are GCOS stations or are over 200 km distant from a GCOS station. Station numbers beginning AA are sent on the GTS in SYNOP MOBIL code form. All operational AntON stations are expected to produce CLIMAT messages from 1 February 2011 (i.e. the January 2011 CLIMAT), provided that they have suitable data.

Note: In addition to AntON stations, a number of other stations in the Southern Ocean (within the responsibility of RAs I, III and IV) lie in the EC-PORS zone of interest and are, therefore, listed below AntON for information.

Abbreviations: X = message or data expected; NO = not operational; A = annual download; Add = suggestion for addition to the RBCN; Closed = GAWSIS indicates station is closed or inactive.

Antarctic stations									
WMO no	***Station***	***Operator***		***S***	***U***	***Key***	***GSN***	***GUAN***	***GAW***
88963	Esperanza	Argentina		X		X	X		
88968	Orcadas	Argentina		X		X	X		
89002	Neumayer	Germany		X	X	X	X	X	X
89003	Halvfarryggen EP11	Netherlands	AWS	X					
89004	SANAE	South Africa		X		X	X		
89009	Amundsen-Scott	USA		X	X	X	X	X	X
89013	Baldrick	UK (BAS)	AWS	X		X			
89014	Nordenskiold	Finland	AWS	X		X			
89016	Wasa EP5	Netherlands	AWS	X					
89018	Svea EP6	Netherlands	AWS	X					
89020	Brunt	UK (BAS)	AWS	X					
89022	Halley	UK (BAS)		X	X	X	X	X	X
89034	Belgrano II	Argentina		X		X			X
89049	AGO-2	USA (USAP)	AWS	X		X			
89050	Bellingshausen	Russia		X		X	X		
89053	Jubany	Argentina		X		X			
89054	Dinamet	Uruguay		X					
89055	Marambio	Argentina		X	X	X	X	X	X
89056	Frei	Chile		X		X	X		X
89057	Arturo Prat	Chile	AWS	X					
89058	Great Wall	China		X					
89059	O'Higgins	Chile		X		X			
89061	Palmer	USA		X		X			X
89062	Rothera	UK (BAS)		X	X	X	X		X
89063	Vernadsky	Ukraine		X		X	X		X
89064	Juan Carlos I	Spain		NO					
89065	Fossil Bluff	UK (BAS)	AWS	X		X	X		

Antarctic stations									
WMO no	***Station***	***Operator***		***S***	***U***	***Key***	***GSN***	***GUAN***	***GAW***
89066	San Martin	Argentina		X		X			X
89087	Thiel Mountains	USA (ANI)	AWS	X		X			
89108	Henry	USA (UoW)	AWS	X		X			
89132	Russkaya	Russia	AWS	A		X			
89251	King Sejong	Rep. of Korea		X					
89252	Comandante Ferraz	Brazil		X					
89253	Joinville Island	Brazil	AWS	X					
89257	Limbert	UK (BAS)	AWS	X		X			
89262	Larsen Ice Shelf	UK (BAS)	AWS	X		X	X		
89266	Butler Island	UK (BAS)	AWS	X		X	X		
89269	Bonaparte Point	USA (UoW)	AWS	X					
89272	Sky Blu	UK (BAS)	AWS	X		X	X		
89314	Theresa	USA (UoW)	AWS	X		X			
89324	Byrd Station	USA (UoW)	AWS	X		X	X		
89327	Mount Siple	USA (UoW)	AWS	X		X	X		
89329	Harry	USA (UoW)	AWS	X		X	X		
89332	Elizabeth	USA (UoW)	AWS	X		X			
89345	Siple Dome	USA (UoW)	AWS	X		X	X		
89376	Gill	USA (UoW)	AWS	X		X	X		
89377	Lettau	USA (UoW)	AWS	X		X	X		
89504	Troll	Norway	AWS	X		X			
89507	Kohnen EP9	Netherlands	AWS	X		X			
89512	Novolazarevskaya	Russia		X	X	X	X	X	X
89514	Maitri	India		X					X
89528	AGO-3	USA (USAP)	AWS	X					
89532	Syowa	Japan		X	X	X	X	X	X
89542	Molodeznaja	Russia	AWS	A		X			
89564	Mawson	Australia		X	X	X	X	X	Closed
89570	Davis (Whoop Whoop)	Australia	AWS	X					
89571	Davis	Australia		X	X	X	X	X	X
89573	Zhongshan	China		X		X	X		X
89574	Progress	Russia		X		X	X		
89575	Druzhnaya 4	Russia	AWS	A					
89577	Dome A	Australia	AWS	X		X	X		
89578	Eagle	Australia	AWS	X		X			
89586	Davis (Mount Brown)	Australia	AWS	X		X			
89592	Mirnyj	Russia		X	X	X	X	X	Closed
89598	AGO-4	USA (USAP)	AWS	NO		X			
89606	Vostok	Russia		X		X	X		Closed
89610	Casey (Cape Poinsett)	Australia	AWS	X		X			
89611	Casey	Australia		X	X	X	X	X	Closed
89614	Wilkins Runway West	Australia	AWS	X					
89615	Wilkins Runway East	Australia	AWS	X					
89625	Concordia	Italy		X	X	X	X		X

Antarctic stations									
WMO no	***Station***	***Operator***		***S***	***U***	***Key***	***GSN***	***GUAN***	***GAW***
89628	AGO-1	USA (USAP)	AWS	X		X			
89642	Dumont d'Urville	France		X	X	X	X	X	X
89643	Port Martin	USA (UoW/France)	AWS	X					
89646	Sitry (Irene)	Italy	AWS	X		X			
89648	Mid Point (Giulia)	Italy	AWS	X		X			
89657	Leningradskaya	Russia	AWS	A		X			
89659	Priestley Nevee (Modesta)	Italy	AWS	X		X			
89661	Cape Phillips (Silvia)	Italy	AWS	X		X			
89662	Mario Zuchelli Station	Italy		X	X	X	X		
89664	McMurdo	USA		X	X	X	X	X	X
89665	Scott Base	New Zealand				X			X
89666	Cape Ross (Arelis)	Italy	AWS	X		X			
89667	Pegasus North	USA (UoW)	AWS	X		X			
A20629	Plateau	Netherlands	AWS	X		X			
89734	Dome Fuji	USA (UoW/Japan)	AWS	X					
89744	Relay Station	USA (UoW/Japan)	AWS	X		X	X		
A20631	Pole of Relative Inaccessibility	Netherlands	AWS	X		X			
89767	Amery Ice Shelf (G3)	Australia	AWS	X		X			
89768	Minna Bluff	USA (UoW)	AWS	X					
89769	Linda	USA (UoW)	AWS	X					
89799	Nico	USA (UoW)	AWS	X		X			
89807	Casey (Snyder Rocks)	Australia	AWS	X					
89809	Casey Skiway South	Australia	AWS	X		X			
89811	Casey (Law Dome Summit)	Australia	AWS	X		X			X
89815	Casey (Haupt Nunatak)	Australia	AWS	X					
89828	Dome C II	USA (UoW)	AWS	X		X	X		
89832	D-10	USA (UoW/France)	AWS	X					
89834	D-47	USA (UoW/France)	AWS	X					
89836	D-85	USA (UoW/France)	AWS	NO		X			
89864	Manuela	USA (UoW)	AWS	X					
89865	Whitlock	USA (UoW)	AWS	NO		X	X		
89866	Marble Point	USA (UoW)	AWS	X		X	X		
89868	Schwerdtfeger	USA (UoW)	AWS	X					
89869	Marilyn	USA (UoW)	AWS	X		X	X		
89872	Ferrell	USA (UoW)	AWS	X		X	X		

Antarctic stations									
WMO no	***Station***	***Operator***		***S***	***U***	***Key***	***GSN***	***GUAN***	***GAW***
89873	Elaine	USA (UoW)	AWS	X					
89879	Possession Island	USA (UoW)	AWS	X		X	X		
AAALE	Cape King (Alessandra)	Italy	AWS	X					
AABIR	Cape Bird	USA (UoW)	AWS	X					
AABRI	Brianna	USA (UoW)	AWS	X		X			
AACAR	Carolyn	USA (UoW)	AWS	X		X			
AADIS	Dismal Island	USA (UoW)	AWS	X					
AADEN	Cape Denison	USA (UoW/Australia)	AWS	X		X			
AAEMI	Emilia	USA (UoW)	AWS	X					
AAERC	Eric	USA (UoW)	AWS	X		X			
AAERI	Erin	USA (UoW)	AWS	X		X			
AAKIR	Kirkwood Island	USA (UoW)	AWS	X		X			
AAKOM	Kominko-Slade	USA (UoW)	AWS	X					
AALAU	Laurie II	USA (UoW)	AWS	X					
AALIT	Little Mac (Mega A)	USA (UoW)	AWS	X					
AALOL	Tourmaline Plateau (Lola)	Italy	AWS	X					
AAMAR	Mary	USA (UoW)	AWS	X					
AAMIZ	Mizuho	USA (UoW/Japan)	AWS	X		X			
AAPEG	Pegasus South	USA (UoW)	AWS	X					
AAPET	Peter I Oy	USA (UoW)	AWS	X		X			
AAPIG	Pine Island Glacier	USA	AWS	X		X			
AARIT	Enigma Lake (Rita)	Italy	AWS	X					
AASOF	Sophia-B	Italy	AWS	X					
AASWI	Swithinbank	USA (UoW)	AWS	X					
AAUNI	Union Glacier	USA (ANI)	AWS	X		X			
AAVIT	Vito	USA (UoW)	AWS	X		X			
AAWIL	Willie Field	USA (UoW)	AWS	X					
AAWIN	Windless Bight	USA (UoW)	AWS	X					
AAZOE	Zoe (Mega B)	USA (UoW)	AWS	X					
AAZOR	Priestley Glacier (Zoraida)	Italy	AWS	X					
	Shackleton	Russia	AWS			X			
	PANDA-North	China/Australia	AWS			X			

Sub Antarctic stations (in Region I, III or V)											
WMO no	***Station***	***Operator***	***Type***	***S***	***RBSN***	***C***	***RBCN***	***GSN***	***U***	***GUAN***	***GAW***
61997	Isle Crozet	France		X	X	X	X	X			X
61998	Isle Kerguelen	France		X	X	X	X	X	X	X	X
68906	Gough Island	South Africa		X	X	X	X	X	X	X	

68992	Bouvetoya	Norway		NO	X	X	X	X			
68994	Marion Island	South Africa		X	X	X	X	X	X	X	Closed
88878	Pebble Island	UK	AWS	X							
88883	Weddell Island	UK	AWS	X			Add				
88889	Mount Pleasant Airport	UK		X	X	X	X	X	X	X	
88897	Sea Lion Island	UK	AWS	X							
88900	Bird Island	UK (BAS)	AWS	X		X	Add				X
88903	Grytviken	UK (BAS)	AWS	X	X	X	Add	X			X
88986	South Thule Island	South Africa	AWS	X			Add				
93929	Enderby Island	New Zealand	AWS	X	X						
93947	Campbell Island	New Zealand	AWS	X	X	X	X	X			
94997	Heard Island (The Spit)	Australia		X	X						
94998	Macquarie Island	Australia		X	X	X	X	X	X	X	X
95997	Heard Island (Atlas Cove)	Australia		X							

DRAFT RESOLUTION

Res. 11.9/2 (Cg-XVI) - AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* – VOLUME II – REGIONAL ASPECTS – THE ANTARCTIC

THE CONGRESS,

Noting:

(1) Draft Resolution 11.9/4 (Cg-XVI) – WMO Polar Activities,

(2) Resolution 20 (EC-LIX) – Amendments to the *Manual on the Global Observing System* (WMO-No. 544), Volume II – Regional Aspects – The Antarctic,

(3) The WMO Strategic Plan as it relates to the World Weather Watch and to the Antarctic,

Decides to amend the *Manual on the Global Observing System* – Volume II – Regional Aspects – The Antarctic, as given in the Annex to this resolution;

Requests the Secretary-General:

(1) To make the appropriate amendments as given in the Annex to this resolution;

(2) To bring this resolution to the attention of Members.

Annex: 1

Annex to draft Resolution 11.9/2 (Cg-XVI)

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* (WMO-No. 544), VOLUME II – REGIONAL ASPECTS – THE ANTARCTIC

To replace the text of section 7 “THE ANTARCTIC” with the following:

7.1 Antarctic Observing Network of surface and upper-air observing stations in the Antarctic

7.1.1 Composition of the Antarctic Observing Network (AntON)

7.1.1.1 The Antarctic Observing Network is composed of surface and upper-air stations, adequate to meet the requirements of Members and constitutes one of the most important obligations of Members under Article 2 of the WMO Convention.

7.1.1.2 The AntON is reviewed by a dedicated subsidiary body of the Executive Council and adopted by the WMO Congress or the WMO Executive Council in a resolution. The list of stations constituting the AntON is given in the annex to a resolution approved by Congress or the Executive Council. Changes are announced in the “Operational Newsletter” issued by the WMO Secretariat (see paragraph 7.1.6 below).

7.1.1.3 Manned surface land stations included in the AntON shall conform to the specifications laid down for land stations in Volume I of this Manual.

7.1.2 Surface synoptic observations

All manned surface stations included in the AntON should make surface observations at the four main standard times of observation, i.e., 0000, 0600, 1200 and 1800 UTC. Whenever possible and desirable, observations should also be made at some or all of the four intermediate standard times of observation, i.e., 0300, 0900, 1500 and 2100 UTC. The carrying out of the observations at the main standard times of observations should be given first priority.

7.1.3 Upper-air synoptic observations

All upper-air stations included in the AntON should make radiosonde and/or radiowind observations at 0000 and 1200 UTC. Other considerations permitting, those stations that are unable to carry out the full upper-air observing programme should give priority to the observations that maintain the historic record. Stations that are separated by no more than about 600 km may wish to consider bilateral arrangements whereby each undertakes one of the ascents so as to complete between them the full observing programme required.

7.1.4 *Climatological observations*

7.1.4.1 As far as possible, all AntON surface stations shall report CLIMAT messages for better monitoring of climate.

7.1.4.2 CLIMAT reports from AntON stations shall be regarded as essential data in the sense of Resolution 40 (Cg-XII).

7.1.5 Operational Procedures

Members are urged to comply fully with the global coding procedures and data collection standards in accordance with procedures laid down in the WMO Technical Regulations and the Manuals on the GOS, on Codes, and on the GTS when operating the stations in the AntON.

7.1.6 *Arrangements and procedures for updating and amending the AntON*

Certain minor changes in the AntON of surface and upper-air stations which do not affect the data requirements for the Antarctic as a whole are inevitable. To provide a simple and rapid means of effecting changes by Members, the following procedure shall be followed:

(a) The WMO President may approve, at the request of the Member concerned, on the advice of the Chairman of a dedicated EC subsidiary body, and in consultation with the Secretary-General, minor changes to the AntON. Any proposed significant change in the composition of AntON would still require formal agreement of Members operating components of the AntON;

(b) The Secretary-General shall notify all Members of WMO through the Operational Newsletter or by circular letter of changes.

7.2 Weather reporting by traverse parties

Members operating stations in the Antarctic are encouraged to instruct all traverse parties to make surface observations wherever circumstances permit when they are more than 200 km away from their base. The observations, which should be carried out as close as possible to the standard times of observations, should be transmitted at least once a day.

7.3 Automatic weather stations in the Antarctic

Members are encouraged to use automatic weather stations as a part of the AntON, taking advantage of the data-collection capabilities of the near-polar-orbiting satellites and, in some cases, of the geostationary meteorological satellites.

7.4 Ships operating in Antarctic waters

7.4.1 Members should ensure that all research vessels, supply vessels and tourist ships operating in the Antarctic make regular surface synoptic observations at main and intermediate synoptic hours, and transmit these data in real-time. When these data cannot be transmitted in real-time they should be submitted in delayed mode or as historic data.

7.4.2 Members should also ensure that vessels, whenever practicable, also make upper-air observations, and that any observations made are transmitted in real-time.

7.5 Surface Drifting Buoys

Members are encouraged to enhance their deployment and maintenance of surface drifting buoys, which shall be equipped with at least atmospheric pressure and sea surface temperature sensors, transmitting data in real-time. Members are also encouraged to further develop buoy technology to enhance operations and real-time reporting both on and off the ice.

7.6 Aircraft reports

Members are encouraged to arrange for making, recording and distributing in real-time, observational reports from all flights to/from and within the Antarctic.

7.7 Additional and extended observations

Members are encouraged to arrange for making, recording and distributing in real-time, additional and extended observations from ships and stations in the Antarctic. A list of observations made for the GAW should be recorded in the GAW Station Information System (GAWSIS).

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DRAFT RESOLUTION

Res. 11.9/3 (Cg-XVI) - GLOBAL INTEGRATED POLAR PREDICTION SYSTEM (GIPPS)

THE CONGRESS,

Noting:

(1) Resolution 36 (Cg-XV) - International Polar Year 2007-2008,

(2) EC-LXII agreement that it would be highly desirable for coordinated international efforts to secure and develop an IPY legacy process,

Considering:

(1) The concerns about amplification of anthropogenic climate change at higher latitudes combined with an increasing interest of many governments in Polar Regions calls for a better understanding of weather, climate, water and related environmental variability and change to improve our ability to make reliable, quantitative predictions out to seasons, decades and centuries ahead,

(2) The increased economic and transportation activities in Polar Regions, and the associated long-term requirement for sustained integrated observational and predictive weather, climate and water information to support decision making,

(3) That there remain key gaps in:

  (a) Scientific understanding of processes and interactions in Polar Regions, including stable boundary layers, polar clouds and precipitation, sea ice/ocean dynamics, hydrology, permafrost and ice sheet dynamics,

  (b) Sustaining in-situ and satellite observations in Polar Regions, including reference observations,

  (c) Products and services for Polar Regions,

(4) The global benefits of a Polar Prediction System, enabling not only service delivery and observing strategies in Polar Regions, but also addressing key uncertainties in weather, climate, water and related environmental variability and change, thereby improving global prediction, contributing to all WMO high priorities, in particular Disaster Risk Reduction, and to the Global Framework for Climate Services,

(5) That this cannot be accomplished by WMO alone, and will require collaborative research and development involving WWRP/THORPEX and WCRP, other WMO Programmes and external partners,

Acknowledging in particular the contributions of Members' national operational and research programmes to monitoring and real-time data provision, process studies, and current prediction systems for Polar Regions,

Decides:

(1) To embark on a decadal endeavour towards a Global Integrated Polar Prediction System (GIPPS), as an IPY Legacy to benefit the global community;

(2) That the GIPPS should provide information to meet user needs for decision making on timescales from hours to centuries;

Requests the Executive Council:

(1) To develop a scalable, detailed strategic plan for GIPPS, laying out a path that WMO will take to identify and address gaps in our scientific understanding of polar processes, improve data and service delivery, and promote or establish national research programmes;

(2) To implement this decision and establish the initial governance mechanism by providing broad oversight, guidance and monitoring of progress;

(3) To ensure there is broad consultation and participation from other international organizations and agencies that wish to contribute to the development of GIPPS;

(4) To submit a comprehensive report on the development of GIPPS to the Seventeenth Congress;

Requests technical commissions and regional associations to support the work of the Executive Council through the coordinated international research, development and implementation of GIPPS and to advise on possible future governance structures;

Invites relevant national bodies and international organizations, academic research programmes, such as the International Council for Science (ICSU), Scientific Committee on Antarctic Research (SCAR), UNESCO's Intergovernmental Oceanographic Commission (IOC), and International Arctic Science Committee (IASC), the International Association of Cryospheric Sciences (IACS) and other relevant associations of IUGG and WMO co-sponsored and WMO-led Programmes such as WCRP and GCOS, to join in the multi-year endeavour towards an operational GIPPS;

Requests Members:

(1) To support efforts to address the key gaps in scientific understanding of the Earth system and environmental processes and interactions in Polar Regions;

(2) To promote and/or establish national research programmes towards this endeavour;

(3) To provide adequate voluntary resources to support development of GIPPS;

Requests the Secretary-General:

(1) To strengthen coordination and collaborate closely with relevant international partner organizations and programmes in pursuing this endeavour;

(2) To take any further actions necessary to implement these decisions;

(3) To bring this resolution to the attention of all concerned.

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DRAFT RESOLUTION

Res. 11.9/4 (Cg-XVI) - WMO POLAR ACTIVITIES

THE CONGRESS,

Noting:

(1) Resolution 7 (Cg-XV) - WMO Antarctic Activities,

(2) Resolution 11 (EC-LXII) - Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS),

(3) The WMO Strategic Plan,

Considering:

(1) That there is increasing human presence and activities in Polar Regions,

(2) That the Polar Regions are extremely important in terms of their global impacts on weather and climate, and the functioning of the Earth system,

(3) That there is a continuing need for weather, climate, water and related environmental data from the Polar Regions, including enhancement and development of instruments and methods of observation suited to these areas, for the full implementation of the World Weather Watch, for the full realization of the value of research, monitoring and prediction of hydrology, climate change, atmospheric composition and the ozone layer over the Polar Regions,

(4) That arrangements ensuring the legacy of the IPY-enhanced observational networks are crosscutting, and should be closely coordinated with the implementation of WIGOS and WIS, and designed to improve the capability of Members to provide a widening range of operational services and to better serve research programme requirements,

(5) That there is a continuing need to coordinate WMO activities with other international organizations active in Polar Regions,

(6) That there is an ongoing need to formalize responsibilities for the Antarctic as a Region not covered by any of the WMO Regional Associations,

(7) The achievements of the Executive Council through its Panel of Experts on Polar Observations, Research and Services (PORS) in ensuring coordination of the operational activities in the Antarctic and in engaging technical commissions, regional associations and international organizations and entities in enhancing observations, research and services in Polar Regions, in particular within the framework of IPY legacy initiatives,

Decides:

(1) That an integrated approach is needed to understand global impact of changes in Polar Regions so that required services may be provided to users and that governments may be advised on aspects of adaptation and mitigation;

(2) That operational and research observing networks in Polar Regions (including the Antarctic Observing network (AntON)) should be integrated within the framework of WIGOS and WIS and be enhanced to include cryosphere related variables;

(3) That concerted effort should be made to engage WMO Members, technical commissions and regional associations, as well as relevant research and international organizations and bodies, to improve predictive capability in Polar Regions on timescales from hours to centuries;

Invites Members, particularly those that have operational activities in Polar Regions:

(1) To ensure continuity of their weather, climate, water and related environmental programmes in Polar Regions;

(2) To provide additional observations in Polar Regions by using automatic weather and hydrometric stations, atmospheric soundings, and other geophysical observatories on land, by recruiting additional voluntary observing ships, by equipping aircraft with appropriate means of recording and distributing observations, and by deploying automated observing platforms on and under the sea and ice, in order to meet the needs of NWP, hydrological services, climate studies and research programmes;

(3) To enhance their satellite programmes in delivering appropriate satellite observing system infrastructure and products and services required for Polar Regions;

(4) To consider the possibility of cooperating with other Members in sharing the costs of re-opening and operating previously functioning stations, in expanding existing stations or in deploying new observing and communication systems;

(5) To support WMO Polar Activities by providing both human and financial resources in its endeavours to enhance observations, research and services in Polar Regions;

Requests the Executive Council to:

(1) Promote the coordination of weather, climate, water and related environmental activities in Polar Regions;

(2) Ensure close collaboration with other international organizations concerned such as the Antarctic Treaty Consultative Meeting (ATCM), the Scientific Committee for Antarctic Research (SCAR), the International Arctic Science Committee (IASC), the International Association of Cryospheric Sciences (IACS) and other relevant associations of IUGG, the Arctic Council, the Council of Managers of National Antarctic Programmes (COMNAP), the Forum of Arctic Research Operators (FARO), and the Intergovernmental Oceanographic Commission (IOC);

(3) Ensure that WMO Polar Activities support the WMO Strategic Plan 2012-2015 and beyond;

Requests regional associations and technical commissions to support WMO Polar Activities;

Requests the Secretary-General to bring this resolution to the attention of all concerned.

Note: This resolution replaces Resolution 7 (Cg-XV), which is no longer in force.

DRAFT RESOLUTION

Res. 11.9/5 (Cg-XVI) – INTERNATIONAL POLAR DECADE INITIATIVE

THE CONGRESS,

Noting:

(1) Resolution 36 (Cg-XV) – International Polar Year 2007-2008,

(2) Resolution 11 (EC-LXII) - Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS),

(3) The Report of the Workshop on an International Polar Decade (IPD) initiative, St. Petersburg, 14-15 April 2011, the first international stakeholder consultation, organized in accordance with the guidance by the sixty-second session of the Executive Council (June, 2010),

(4) The Nuuk Declaration on the occasion of the Seventh Ministerial Meeting of the Arctic Council, 12 May 2011,

Considering:

(1) That the preliminary results of the IPY 2007-2008 confirmed the global significance of polar processes and the role of the Polar Regions as drivers of change in global weather and climate, extreme events, global carbon cycle, and sea-level rise,

(2) The urgent need to observe, understand and predict the extremely rapid and significant environmental changes occurring in high latitudes,

(3) That substantial research investments made by many countries in IPY have resulted in new scientific knowledge and infrastructure, including new technologies for observations and analysis and improved models for prediction of all Earth System components,

(4) The substantial societal benefit to be gained by capitalizing on these IPY investments by improving services including better predicting and assessment capabilities, for example, in securing shipping routes, managing risks related to resource mapping, exploration and development, protecting the fragile polar environment and improving welfare of indigenous and other northern communities,

(5) That some governments are continuing to make added commitments, particularly in the Arctic, and that the Arctic Council countries have produced or are preparing strategies for economic development, environmental stewardship and support to indigenous communities to adapt to changes in polar environment,

Recognizing:

(1) That the first international stakeholder consultation on the International Polar Decade (IPD) supported an IPD initiative and recommended that the IPD would start beyond 2015 to align to a set of agreed decadal scale polar initiatives,

(2) That WMO polar initiatives such as Global Integrated Polar Prediction System and Global Cryosphere Watch would provide a substantial contribution to an IPD, if an IPD is implemented, and would strongly benefit from contributions by partner organizations;

Approves the WMO participation in the IPD should this initiative be endorsed by relevant international organizations as key stakeholders to build on the solid foundation that IPY has established;

Invites relevant international organizations and programmes, such as Arctic Council (AC), Antarctic Treaty Consultative Meeting (ATCM), the International Council for Science (ICSU), International Arctic Science Committee (IASC), Scientific Committee on Antarctic Research (SCAR), the International Association of Cryospheric Sciences (IACS) and other relevant associations of IUGG, UNESCO's Intergovernmental Oceanographic Commission (IOC), United Nations Environment Programme (UNEP), Arctic Council Indigenous Peoples, Council of Managers of National Antarctic Programmes (COMNAP), Forum of Arctic Research Operators (FARO), European Commission, European Science Foundation, European Environment Agency, Arctic Monitoring and Assessment Programme (AMAP), International Arctic Social Sciences Association (IASSA), Association of Polar Early Career Scientists (APECS), and others to participate in the IPD consultative process and identify their role and commitments to the IPD;

Requests the Executive Council through its Panel on Polar Observations, Research and Services:

(1) To secure the WMO representation in a steering group that would be established to lead the IPD consultative process and prepare a draft IPD Concept Document for submission to the Montreal 2012 IPY Conference "From Knowledge to Action" (22-27 April 2012);

(2) To consult with the relevant international organizations to define the framework, objectives, resource requirements, timing, and organizational structure of an IPD;

(3) To coordinate the role and participation of WMO in the relevant initiatives that would be conducted under the auspices of an IPD;

(4) To review and approve the IPD Concept Document at its sixty-fourth session with a view of determining modalities and the level of WMO participation in the initiative;

Requests the Secretary-General to bring this resolution to the attention of all concerned.

Note: This resolution replaces Resolution 36 (Cg-XV), which is no longer in force.

DRAFT RESOLUTION

Res. 11.9/6 (Cg-XVI) - GLOBAL CRYOSPHERE WATCH

THE CONGRESS,

Noting:

(1) Resolution 11.9/5 (Cg-XVI) – International Polar Decade Initiative,

(2) That Fifteenth Congress welcomed the proposal to create a Global Cryosphere Watch (GCW) as an important part of the International Polar Year legacy,

(3) That EC-LXII agreed that it would be highly desirable for coordinated international efforts to secure and develop an IPY legacy process,

(4) The GCW Implementation Strategy developed under the auspices of the Executive Council,

Considering:

(1) The cryosphere is global, existing in various forms spanning all latitudes and occurring in approximately one hundred countries in addition to the Antarctic continent,

(2) The cryosphere is an integrative element within the climate system and provides one of the most useful indicators of climate change, yet it is arguably the most under-sampled domain in the climate system,

(3) The role of the cryosphere-related feedbacks in the amplification of anthropogenic climate change in Polar Regions, including the “Third Pole” and the significant impact of a changing cryosphere on weather, climate and water globally,

(4) The cryosphere, its changes, and its impacts, not only have received increased scientific scrutiny in recent years, but also now receive continual attention by decision makers and coverage by the media, creating an unparalleled demand for authoritative information on past, present and future state of the world’s snow and ice resources,

(5) GCW is significant component of WIGOS and WIS, particularly in promoting interoperable and reference observations, and near-real time data and information exchange,

(6) GCW can only succeed by working with WMO Members and with other organizations which have cryospheric interests,

Acknowledging in particular the contributions of Members’ national operational and research programmes to monitor and provide data on the cryosphere,

Decides to embark on a development of the Global Cryosphere Watch (GCW), as an IPY Legacy with a view of an operational GCW;

Urges Members and **Invites** international partner organizations and programmes to:

(1) Collaborate actively in, and give all possible support to, the development and implementation of this initiative;

(2) Support the Global Cryosphere Watch by providing both human and financial resources to implement GCW;

Requests the Executive Council to:

(1) Establish a mechanism to steer and monitor the activity and to achieve the broadest possible collaboration and cooperation;

(2) Ensure the active participation and representation of the principal bodies concerned and also the participation, as appropriate, of technical experts and representatives of agencies undertaking observing and research initiatives relevant to the cryosphere;

(3) Submit a comprehensive report including an updated implementation plan of GCW to the Seventeenth WMO Congress;

Requests the regional associations and technical commissions to include this activity in their work programmes in order to fully accommodate the cross-programme nature of this cross-cutting initiative;

Requests the Secretary General:

(1) To strengthen coordination and collaborate closely with relevant international partner organizations and programmes in pursuing this endeavour;

(2) To put in place an appropriate mechanism in the Secretariat to ensure optimal management of, and support to, the initiative.

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