WMO OMM

World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
世界气象组织

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Secrétariat
7 bis, avenue de la Paix – Case postale 2300
CH 1211 Genève 2 – Suisse
Tél.: +41 (0) 22 730 81 11
Fax: +41 (0) 22 730 81 81
wmo@wmo.int – public.wmo.int

Наш исх.: 8712-16/OBS/OSD/EC-PHORS/TF ЖЕНЕВА, 20 декабря 2016 г.

Приложения: 3 (имеются только на английском языке)

Вопрос: Взнос в Целевой фонд ИС-ПВНИДО

Уважаемый господин/Уважаемая госпожа!

В соответствии с решением семнадцатой сессии Всемирного метеорологического конгресса (Кг-17, 2015 г.) о включении полярной и высокогорной деятельности ВМО в качестве одного из семи приоритетов, содержащихся в Стратегическом плане ВМО на 2016–2019 гг., а также в соответствии с резолюцией 40 (Кг-17) по полярной и высокогорной деятельности ВМО Исполнительный Совет ВМО на своей шестьдесят седьмой сессии (ИС-67, 2015 г.) учредил Группу экспертов Исполнительного совета по полярным и высокогорным наблюдениям, исследовательской деятельности и обслуживанию (ГЭИС-ПВНИДО) посредством резолюции 3 (ИС-67), содержащейся в приложении 1. ГЭИС-ПВНИДО обеспечивает механизм для интеграции, координации и осуществления полярной и высокогорный деятельности ВМО, поддержания связей с внешними учреждениями и организациями, а также взаимодействия по мере необходимости с техническими комиссиями и региональными ассоциациями ВМО.

В том что касается Глобальной службы криосферы (ГСК), Конгресс решил всесторонне внедрять и осуществлять ГСК в рамках программ ВМО в качестве сквозной деятельности. Конгресс также принял решение, что наземные пункты измерений ГСК, именуемые «КриоНет», должны стать одной из четырех компонентных систем наблюдений Интегрированной глобальной системы наблюдений ВМО (ИГСНВ). Для этих целей Конгресс поручил Генеральному секретарю учредить Бюро по проекту ГСК для координации деятельности ГСК в рамках системы Организации Объединенных Наций и других соответствующих международных организаций и программ. Хотя Бюро по проекту было учреждено в сентябре 2016 г., для продолжения работы Бюро по проекту ГСК в течение финансового периода требуется, по оценкам, 700 000 шв. фр. за счет сочетания средств из регулярного бюджета ВМО и внебюджетных ресурсов. Кроме того, финансовых ресурсов в рамках регулярного бюджета ВМО недостаточно для оказания поддержки полярной и высокогорной деятельности ВМО.

Группа экспертов под руководством сопредседателей г-на Дэвида Граймса и д-ра Сью Баррелл разрабатывает инициативы для реагирования на значительный интерес, проявленный Членами и Исполнительным советом на его шестьдесят восьмой сессии (ИС-68, 2016 г.), в отношении поддержания и расширения полярной и высокогорной деятельности, как кратко изложено в приложении 2. Я считаю важным, чтобы были предоставлены ресурсы для содействия этим усилиям. Краткая информация о текущей деятельности и прогрессе в отношении приоритета ВМО в области полярных и высокогорных регионов приводится в приложении 3.

Постоянным представителям Членов ВМО, представленных в ГЭИС-ПВНИДО (ограниченное распространение)
Президентам региональных ассоциаций

Копии: сопредседателям ГЭИС-ПВНИДО (для информации)

Я была бы чрезвычайно признательна за указание того, готова ли ваша страна рассмотреть возможность внесения вклада в Целевой фонд ВМО для полярных наблюдений, исследовательской деятельности и обслуживания. В качестве альтернативы поддержка могла бы быть выражена в форме предоставления консультаций экспертов для осуществления конкретных видов деятельности под руководством ИС-ПВНИДО. В случае положительного ответа мы были бы признательны, если бы в ближайшее время нам была передана информация о размере взноса, который вы могли бы внести в Целевой фонд, или об иных видах поддержки, которые вы готовы предложить.

Рассчитываю на встречу и сотрудничество с Вами в деле поддержания и расширения полярной и высокогорной деятельности на благо мирового сообщества.

С уважением,

(Е. Манаенкова)
за Генерального секретаря

Resolution 3 (EC-67)

EXECUTIVE COUNCIL PANEL OF EXPERTS ON POLAR AND HIGH MOUNTAIN OBSERVATIONS, RESEARCH AND SERVICES

THE EXECUTIVE COUNCIL,

Noting:

(1) Resolution 22 (Cg-17) – Global Observing System (GOS),

(2) Resolution 23 (Cg-17) – Pre-operational phase of the WMO Integrated Global Observing System (WIGOS),

(3) Resolution 41 (Cg-17) – Antarctic Observing Network (AntON),

(4) Resolution 42 (Cg-17) – Amendments to the *Manual on the Global Observing System* (WMO-No. 544), Volume II, Regional Aspects – The Antarctic,

(5) Resolution 48 (Cg-17) – Global Integrated Polar Prediction System (GIPPS),

(6) Resolution 49 (Cg-17) – Year of Polar Prediction (YOPP),

(7) Resolution 40 (Cg-17) – WMO Polar and High Mountain Activities,

(8) Resolution 57 (Cg-17) – Participation of the World Meteorological Organization in the International Polar Partnership Initiative (IPPI),

(9) Resolution 60 (Cg-XVI) – Global Cryosphere Watch,

(10) Resolution 5 (EC-LXIII) – Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS),

Considering:

(1) That the Polar Regions, the "Third Pole" and other high mountain areas, are extremely important in terms of their impacts on weather, climate and water, and the functioning of the Earth system,

(2) That the cryosphere, which encompasses approximately 100 countries, the Arctic ocean and the Antarctic, 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) That the Polar Regions are experiencing an increase in human presence and activities, requiring new or enhanced services linked to weather, climate, water and related environmental matters,

(4) That there are concerns about amplification of climate change at higher latitudes, combined with an increasing interest in Polar Regions by many governments, which calls for a better understanding of weather, climate, water and related environmental variability and change in order to improve our ability to make reliable, quantitative predictions across the range of time scales,

(5) Cryosphere-related feedbacks in the amplification of climate change cause impacts on weather, climate and water globally,

(6) That there remain key gaps in scientific understanding of processes and interactions in Polar Regions, including boundary layer behaviour, polar clouds and precipitation, sea ice/ocean dynamics, hydrology, permafrost and ice sheet dynamics, and the functioning of the Earth system,

(7) That there is a continuing need for weather, climate, hydrological 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 and the Global Framework for Climate Services (GFCS); and 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, observational networks in Polar Regions be

closely coordinated with the implementation of WIGOS, and designed to improve in a most efficient way the capability of Members to provide the widening range of operational services and to better serve research programme requirements,

(8) That there is an ongoing need to formalize the WMO responsibilities for the Antarctic as a region not covered by any of the WMO Regional Associations, and that the establishment and maintenance of an Antarctic Observing Network (AntON) of surface and upper-air stations to meet the requirements of Members are among the most important obligations of Members under Article 2 of the WMO Convention,

(9) That the density of the current Antarctic Observing Network of surface and upper-air stations is much less than what is needed to properly characterize Antarctic weather and climate,

(10) That cryospheric operational and research observing networks, including AntON, should be integrated within the framework of WIGOS and the WMO Information System (WIS) and be enhanced to include cryosphere-related variables according to the GCW Implementation Plan,

(11) That the Seventeenth Congress decided to continue the decadal endeavour towards a Global Integrated Polar Prediction System (GIPPS), as an International Polar Year (IPY) Legacy to benefit the global community,

(12) That the Seventeenth Congress noted the Concept for the International Polar Partnership Initiative (IPPI) and agreed to participate in IPPI,

(13) That the Seventeenth Congress decided to implement the Global Cryosphere Watch (GCW) during the next financial period as one of the major efforts of the Organization with the goal that GCW should become operational,

(14) That the High Mountain Activities will be a part of the development and implementation of the Global Cryosphere Watch (GCW),

Decides:

(1) To establish the Executive Council Panel of Experts on Polar and High Mountain Observations, Research and Services;

(2) That the Panel will be composed of members nominated by the Permanent Representatives of Members, including Parties to the Antarctic Treaty, and participants from other relevant organizations that have active meteorological, hydrological, oceanographic or cryospheric programmes, in particular in the Polar Regions;

(3) That observers from other groups may be invited to attend meetings of the Panel;

(4) That the Panel shall make recommendations to the Executive Council within its terms of reference, including the recommended Antarctic Observing Network and applicable standard practices, especially recommendations for updates of the relevant parts of the *Manual on the Global Observing System* (WMO-No. 544), the *Manual on the Global Telecommunication System* (WMO-No. 386), and the *Manual on the Global Data-processing and Forecasting System* (WMO-No. 485), as well as other relevant Manuals and Guides, such as those for WIS, WIGOS and services to users in the Polar Regions;

(5) That the Panel will undertake the following:

For Polar Regions:

(a) To develop and promote an integrated approach to understanding the global impact of changes in Polar Regions so that the required services may be provided to users and governments may be advised on aspects of adaptation;

(b) To ensure that operational and research observing networks in polar regions (including AntON) are integrated within the framework of WIGOS and WIS and are enhanced to include cryosphere-related variables;

(c) To engage in a concerted effort to involve WMO Members, Technical Commissions and Regional Associations, as well as relevant research and

international organizations and bodies, in improving predictive capability in Polar Regions on timescales from hours to centuries;

(d) To establish a high-level WMO partnership in activities aimed at securing the IPY observing system legacy in close cooperation with operational agencies in Member countries and international organizations that have a great interest in Polar Regions, such as the Sustaining Arctic Observing Networks (SAON);

(e) To oversee and guide the development and implementation of GCW in collaboration with technical commissions, regional associations and relevant WMO and international programmes, organizations, institutions and bodies;

(f) To oversee and guide the Polar Space Task Group (PSTG) that provides coordination across space agencies to facilitate acquisition and distribution of fundamental satellite datasets, and to contribute to or support development of specific derived products in support of cryospheric scientific research and applications;

(g) To guide the development of GIPPS in collaboration with technical commissions, regional associations and relevant international programmes, organizations and bodies;

(h) To coordinate WMO participation in the International Polar Partnership Initiative;

(i) To facilitate the acquisition, exchange and archiving of observational data from Polar Regions in compliance with WIGOS requirements related to instruments, data exchange (WIS) and the Quality Management Framework (QMF), and to underpin the provision of services required for the polar regions;

(j) To provide a forum for discussion of relevant scientific issues and make recommendations on meteorological, hydrological, oceanographic and cryospheric research and operations related to the Polar Regions;

(k) To provide regular input on issues related to polar meteorology, hydrology, oceanography and the cryosphere to support the activities of relevant groups or bodies, such as the World Climate Programme (WCP) that includes Global Climate Observing System (GCOS), World Climate Research Programme (WCRP) and the World Climate Services Programme (WCSP); the Global Atmosphere Watch programme (GAW) and the World Weather Research Programme (WWRP); the Global Framework for Climate Services (GFCS), and WMO Technical Commissions, Regional Associations and Programmes;

(l) To ensure close collaboration with and contribute to the other international organizations, committees and programmes concerned, such as the Antarctic Treaty Consultative Meeting (ATCM), the Arctic Council, the Scientific Committee on Antarctic Research (SCAR), the International Arctic Science Committee (IASC), the International Association of Cryospheric Sciences (IACS) and other relevant associations of the International Union of Geodesy and Geophysics (IUGG), the Council of Managers of National Antarctic Programmes (COMNAP), the Forum of Arctic Research Operators (FARO), and the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the International Hydrological Programme (IHP) of UNESCO;

For the Antarctic:

The Panel should cooperate, as appropriate, with other relevant international and regional entities:

(a) To promote the execution of the resolutions of Congress and the Executive Council in the area from 60ºS to 90ºS;

(b) To coordinate programmes of surface and upper-air meteorological observations in the Antarctic, working with relevant international scientific organizations, and liaise with regional associations in relation to sub-Antarctic observations;

(c) To coordinate design of the Antarctic Observing Network, comprising surface and upper-air stations, including the GCOS Surface Network (GSN), GCOS Upper-Air Network (GUAN), Global Atmosphere Watch (GAW) and other relevant observing components;

(d) To coordinate standardization of observing, coding, data exchange and data management practices applied for the Antarctic;

(e) To propose recommendations to the Antarctic Treaty System (ATS);

For the Arctic:

(a) While appropriate functions are covered by respective regional associations, the Panel may liaise with them in defining appropriate components of Arctic observing systems and services;

(b) To guide, in collaboration with the Commission for Hydrology, the development of the Arctic Hydrological Cycle Observing System (Arctic-HYCOS) Project;

For the High Mountain Regions:

Contribute to the work of the regional associations, technical commissions and programmes in defining appropriate components of high mountain regions' hydrometeorological and cryospheric observing systems and services;

Authorizes the Panel to establish sub-groups and task teams as and when required, including in particular an Antarctic Task Team (ATT), PSTG, a GCW Steering Group, and the GCW Teams, including a High Mountain Task Team;

Requests the Secretary-General:

(1) To maintain the membership of the Panel in accordance with the relevant Regulations in consultation with the co-chairpersons and Members concerned;

(2) To formally invite the Arctic Council Arctic Monitoring and Assessment Programme (AMAP), International Arctic Science Committee (IASC) and Scientific Committee on Antarctic Research (SCAR) to participate in the Panel as members;

(3) To provide the necessary support to activities and sessions of the Panel, including the GCW working structure, and liaise with relevant international organizations, programmes and bodies.

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Note: This resolution replaces Resolution 5 (EC-LXIII), which is no longer in force.

SUMMARY OF DECISIONS OF THE SIXTY-EIGHTH SESSION OF THE WMO EXECUTIVE COUNCIL (EC-68) RELATED TO POLAR AND HIGH MOUNTAIN ACTIVITIES

- **Decision 50 – Development of the Global Cryosphere Watch –** is endorsing the updated CryoNet concept as provided in the Annex of the Decision; it endorses a need to speed-up operationalizing the GCW Data Portal, expanding its interoperability with major data centres and all CryoNet stations/sites; agrees to embark on the development of regional snow trackers, providing a quick look at the current state of the cryosphere relative to the mean state over the last 2-3 decades, to support Polar Regional Climate Center(s); requests the EC Panel on Polar and High Mountain Observations, Research and Services to submit a draft resolution on CryoNet to EC-69; and urges Members to exchange in situ snow measurements in real-time.
- **Decision 51 - High-Mountain Activities –** endorses a need to organize regional workshops on high mountain activities, including tropical regions with a view to identify high mountain sites and assess them for a potential inclusion into CryoNet; agrees that EC-PHORS should facilitate development of high elevation cryosphere observational sites for inclusion into CryoNet, with attention also to sites over 4000 m; and requests EC-PHORS to engage with relevant institutions and international projects and experiments in the high mountain cryosphere.
- **Decision 52 – Polar Regional Climate Centres –** endorses the Arctic PRCC-Network as a joint initiative between RAs II, IV and VI; requests EC-PHORS to review technical details of potential contributions by Members to the Arctic PRCC-Network vis-à-vis the RCC designation requirements and guide the development of a draft implementation plan for the Arctic PRCC-Network in collaboration with CCl, CBS and JCOMM as needed; requests the Secretary-General to facilitate a coordinated development of the draft implementation plan, and bring its version endorsed by the concerned stakeholders, if available, to the attention of EC-69 for further consideration; and requests CCl to review and provide guidance to the demonstration phase of the Arctic PRCC-Network in close consultation with CBS, EC-PHORS and participating Members.
- **Decision 53 – Year of Polar Prediction –** Endorses the roadmap towards the Year of Polar Prediction as provided in the final report of the Year of Polar Prediction Summit available at the Polar Prediction Project website[1]; invites EC-PHORS and the Polar Prediction Project Steering Group to engage with relevant international projects and experiments in Polar Regions, such as: (a) Multidisciplinary drifting Observatory for the study of Arctic Climate (MOSAiC); (b) Forum for Arctic Modelling and Observational Synthesis (FAMOS); and (c) Horizon 2020 projects that will be funded by the European Commission through the calls BG-9 Integrated Arctic Observation System and BG-10 Impact of Arctic Changes on the Weather and Climate of the Northern Hemisphere; and urges Members to provide support and coordinate with the Polar Prediction International Coordinating Office.
- **Decision 54 – International Polar Partnership Initiative –** requests EC-PHORS to consider all opportunities to align WMO activities with the further development of the IPPI Concept and related planning documents, and to work with appropriate partners towards identifying and achieving benefits from mutual contribution to relevant polar and high-mountain initiatives and activities; and requests the Secretary-General to promote WMO polar activities through such intergovernmental mechanisms as the Arctic Council and the Antarctic Treaty System.

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[1] http://www.polarprediction.net/

SUMMARY OF CURRENT ACTIVITIES AND PROGRESS WITH REGARD TO WMO POLAR AND HIGH MOUNTAIN REGION WMO PRIORITY

I. Key achievements

1. Global Cryosphere Watch (GCW)

The main focus of the GCW work in 2014 and until the Seventeenth World Meteorological Congress (Cg-17, 2015) was on completing the GCW Implementation Plan (GCW-IP) for Cg-17 consideration, the formalization of the GCW working structure, including activation of a few teams to address immediate priorities, such as the development of the observing component of GCW, development of Integrated Products and development of Information and Services.

Congress, through Resolution 69 (Cg-17), decided that polar and high mountain regions become one of the seven priorities for 2016-2019. This was to improve operational meteorological and hydrological monitoring, prediction and services in polar, high mountain regions and beyond, among others, by operationalizing the Global Cryosphere Watch (GCW). Congress also decided, through Resolution 43 (Cg-17), to mainstream and implement GCW in WMO Programmes as a cross-cutting activity and that implementation activities will be undertaken during the seventeenth financial period as one of the major efforts of the Organization with the goal that GCW should become operational. Further, through Resolution 40 (Cg-17), Congress decided, among others, to improve services in the high altitude regions by promoting observations.

The Executive Council Panel of Experts on Polar and High-Mountain Observations, Research and Services (EC-PHORS) provides a governance to GCW (Resolution 3 (EC-67)).

2. The core GCW Observing Network - CryoNet

Based on the Concept adopted by Cg-17 through the GCW-IP and guidance from Cg-17, the pre-operational testing of CryoNet started in fall 2015. Based on this testing, the Concept of the network was updated (and endorsed by EC-68) to be better aligned with WIGOS as the GCW Surface Observing Network became a component observing system of WIGOS. The major GCW Surface Observing Network basic documents includes:

- CryoNet station/site Concept Document;
- Minimum requirements of a CryoNet station/site;
- Network design;
- Procedure for acceptance of new stations into CryoNet;
- GCW regulatory materials as provided in the *Manual on WIGOS* (WMO-No. 1160);
- GCW guide and manual for best practices (still under development).

As an outcome of the pre-operational testing of CryoNet, and the proposal submitted through an application process[1], the list of stations of CryoNet will be considered by the GCW Steering Group in January 2017 and EC-PHORS in March 2017 with a view of adopting CryoNet by EC-69 in June 2017.

3. GCW Data Portal

The GCW Data Portal[2] has been developed and implemented by the Norwegian Meteorological Institute. The GCW Data Portal exchanges cryosphere data, metadata, information and analyses among a distributed network of providers and users in support of informed decision-making. The first versions of the GCW Portal Interoperability Guidelines[3]: the Guidance for

[1] http://globalcryospherewatch.org/cryonet/questionnaire/
[2] http://gcw.met.no/
[3] https://drive.google.com/drive/folders/0B0DFbV705pJMR1FTakFhMmZLXzA

Data Centres Contributing to GCW[4] and the GCW Portal Operations Manual[5] have been developed and the GCW Data Portal is already interoperable with WIS and is in the process of becoming a DCPC. Major data portals are already interoperable with the GCW Data Portal and work on the integration of data from CryoNet stations/sites into the GCW Data Portal was initiated, starting with Weissfluhjoch-Davos (Switzerland), Sonnblick (Austria) and Sodankylä (Finland). Software interfaces developed by Weissfluhjoch-Davos will allow other CryoNet stations to speed-up this process.

Currently metadata are routinely harvested by the GCW Data Portal from the following data centres: British Antarctic Survey; CryoClim; Chinese National Arctic and Antarctic Data Center; National Institute of Polar Research (Japan) – Arctic Data Archive System; Norwegian Polar Institute; and National Snow and Ice Data Center of the USA. These data centres are now harvested twice daily. In addition, testing is either ongoing or planned for a number of other data centres.

4. GCW website

The GCW website[6] has been developed and is operated by the University of Wisconsin on behalf of WMO. The website differs from the GCW Data Portal in that it contains more dynamic information (news, state of the cryosphere plots, highlights, calendar), as well as background, higher-level information, GCW documents, and outreach material.

A webpage to show GCW surface network stations/sites by category and a database table and search tool for the Snow Watch inventory were completed. The CryoNet station/site questionnaire underwent some significant changes and is online for use by station/site managers wishing to contribute to CryoNet. Additional products were added to "Cryosphere Now" and a new code had to be developed for many of these initiatives, including a complete re-write of the code for the feed for "Cryosphere in the News". An initial inventory of existing documents describing practices for cryospheric measurements can be accessed from the GCW website.

5. Snow Watch activities

The Snow Watch activities aim at improving snow reporting and data availability, product intercomparisons, dataset inventory and snow trackers.

The maturity and accuracy of snow products is being assessed through an intercomparison project that started in 2013. ESA later initiated and funded a Satellite Snow Products intercomparison and evaluation Exercise, "SnowPEx", extending the work that Snow Watch began. With this perspective in mind, an initial inventory of snow products has been developed and is available online. The inventory is provided under three categories: (1) satellite-derived snow products and datasets; (2) analyses, reanalyses and reanalysis-driven snow products and datasets; and (3) in situ snow products and datasets. GCW's mandate is to be an authoritative source of cryospheric information for many users including the proposed Polar Regional Climate Centres. Therefore, the inventory provides users with some guidance about the suitability of snow products and datasets for various applications.

Snow Anomaly Trackers available on the GCW website, provide the near real-time tracking of the North Hemisphere snow extent and snow water equivalent from GlobSnow (developed for GCW by the Finish Meteorological Institute) and a daily snow depth analysis (by Environment Canada). New trackers are being developed, such as Surface Temperature Tracker (STT), Broadband Albedo Tracker (BAT) and Ice Thickness Tracker (ITT).

Snow Watch activities also focused on snow data availability and reporting. Together with IPET DRMM the new BUFR template 3 07 101 (Snow observation) was developed and adopted by CBS-Ext.(2014), which led to the availability of additional data from 1,300 stations from national networks in Europe that are now available in GTS and are being assimilated by ECMWF. Efforts are being made to fill the gaps that exist in Europe and in other Regions (e.g., USA, China, Southern Hemisphere). Snow Watch also identified the problem of biased "no

[4] https://www.wmo.int/pages/prog/www/polar/GCW/gcw-dm-guidelines-v0p1.pdf
[5] https://www.wmo.int/pages/prog/www/polar/GCW/gcw-dm-opermanual-v0p1.pdf
[6] http://globalcryospherewatch.org/

zero" depth data for assimilation purposes. For assimilation, observations of zero snow are as important as observations of snow so as to define the Snow Model extent. Therefore, Snow Watch proposed an observing practice for snow depth observations and reporting. It has been proposed that snow depth should be reported on a regular basis (00, 06, 12, 18 UTC) regardless of the state of the ground during the entire period in which snow can be expected. A draft recommendation was submitted to the sixteenth session of the Commission for Basic Systems (CBS-16, November 2016) for that purpose.

6. High Mountain activities

Regional workshops, such as the CryoNet South America (Santiago de Chile, Chile, 27-29 October 2014) and the CryoNet Asia Workshop (Salekhard, Russian Federation, 2-5 February 2016), have advanced efforts in high mountain environments. As a result of these workshops more than 50 high mountain sites were identified for inclusion in CryoNet.

Under consideration is engagement with existing projects, experiments and activities in high mountains that are relevant to CryoNet. They include:

- The UNESCO-IHP projects "The Impact of Glacier Retreat in the Andes: International Multidisciplinary Network for Adaptation Strategies" and the "Regional Program of Snow and Ice in Latin-America and the Caribbean", The International Atomic Energy Agency (IAEA) Interregional technical cooperation (TC) Project "Assessing the Impact of Climate Change and its Effects on Soil and Water Resources in Polar and Mountain Regions";
- The Danish Programme for the monitoring of the Greenland Ice Sheet (PROMICE), glacier monitoring in the Polar part of the Urals mountains;
- The Central Asia High Elevation International Geophysical Expedition (HEIGE) Project;
- The Third Tibet Plateau Atmospheric Scientific Experiment (TIPEX-3);
- The Swiss Permafrost Monitoring Network (PERMOS); and
- The Southern Alps Experiment (SALPEX) of New Zealand.

Following the outcomes of the CryoNet Asia Workshop (Salekhard, Russian Federation, February 2016) and the decision of EC-68 to facilitate development of high elevation cryosphere observational sites for inclusion into CryoNet, with attention also to sites over 4000m, the GCW is initiating the Asian High Elevation Cryosphere Observation (AHECO) project. Steps are being taken to clarify user requirement from the region, consolidate support from the concerned Members, and raise interest of potential funding agencies.

7. Polar Regional Climate Centres (PRCCs)

The concept of PRCCs is a WMO legacy, initiated following the 2007-2008 International Polar Year. With the (then) Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS) taking up oversight on PRCC development (EC-65, 2013), further development of the concept proceeded briskly. In 2013, the Government of Canada funded a 'Programme of Implementing the Global Framework for Climate Services (GFCS) on Regional and National Scales' and in 2014 at the fifth session of EC-PORS, its Services Task Team (STT) began consultations on an implementation strategy for PRCCs. A survey to gauge needs for and capability to support an Arctic PRCC was conducted in 2015 and, based on the interest shown by Members, a scoping workshop was held in November 2015. Members identified potential contributions to the Arctic PRCC in early 2016, which encouraged the next step, development of a concrete plan to launch a demonstration phase of an Arctic PRCC-Network. The support of EC-PORS and then EC-PHORS and its STT has been invaluable in solidifying the evolution of the PRCC concept in a unique situation for WMO, in which the cooperation across three WMO Regional Associations is required.

7.1 Arctic PRCC-Network

EC-68 endorsed the Arctic PRCC-Network as a joint initiative between Regional Associations II, IV and VI. It requested EC-PHORS to review technical details of potential contributions by Members to the Arctic PRCC-Network vis-à-vis the RCC designation requirements and guide

the development of a draft implementation plan for the Arctic PRCC-Network in collaboration with the Commission for Climatology (CCl), the Commission for Basic Systems (CBS) and the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) as needed. At the same time, CCl was requested to review and provide guidance to the demonstration phase of the Arctic PRCC-Network in close consultation with CBS, CCl, EC-PHORS and participating Members. At the same time steps were taken to develop plans for the Antarctic RCC-Network.

Under the leadership of the EC-PHORS Services Task Team (STT), a meeting on Arctic Polar Regional Climate Centre (PRCC) Network Implementation Planning was held (7-9 November 2016, Geneva, Switzerland) to facilitate the potential contributing agencies to discuss the technical and organizational arrangements for the proposed Arctic PRCC-Network and support the launch of a demonstration phase in 2017. Key decisions of the meeting included:

- The Arctic PRCC-Network will consist of three nodes with specific geographical domains of primary responsibility, each of which will perform all mandatory (and some additional high priority) RCC functions for a sub-region: Canada will lead the North American node (with Canada and USA as members of consortium); Norway will lead the Northern Europe and Greenland Node (with Denmark, Finland, Iceland, Norway, Sweden and possibly other interested European countries as members of consortium); and the Russian Federation will lead the Eurasian node;
- Each node will also take on a significant cross-node function for the entire pan-Arctic domain: Canada will lead development of Long-Range Forecasts (LRF); Norway will lead Operational Data Services based on WMO WIS processes); and the Russian Federation will lead development of Climate Bulletins;
- The PRCC-Network operational entities will adhere to Resolution 60 (Cg-17) on data exchange and access;
- The first priority in the demonstration phase will be to set up the necessary cooperation and technical processes to ensure that all mandatory functions are fully operational, in order to attain WMO designation as an RCC-Network;
- Important shared interests and objectives exist between the PRCC-Network, Global Cryosphere Watch (GCW) and the International Ice Charting Working Group (IICWG). All three have embed the intent to cooperate in their respective Terms of Reference and Implementation Plans;
- Identification of user requirements has been initiated by the STT: in addition to hazard identification and risk reduction requirements, high priority sectors that could eventually benefit from PRCC-Network products and services would include the marine, hydrological, natural resources and tourism communities. This will require development of products based on elements in addition to temperature and precipitation, many of which will be Essential Climate Variables as defined by the Global Climate Observing System (GCOS) and priority elements important to WMO and international bodies such as JCOMM, CHy, IICWG, GCW;
- Canada is taking steps to host the first Polar Regional Climate Outlook Forum in 2017, in conjunction with the research community, which aligns well with EC-PHORS priorities for Polar Regions;
- The proposed Arctic PRCC-Network will, to the extent feasible, take into account the Arctic Council recommendations on Aboriginal Traditional Knowledge;
- A timeline for completion of the Implementation Plan and having it presented to EC-PHORS and the WMO Executive Council in 2017 has been developed.

7.2 Third Pole RCC-Network

A "Regional Consultation on Climate Services for the Third Pole and other High Mountain Regions" was conducted in Jaipur, India, 9-11 March 2016. A range of stakeholders including NMHSs and sectoral representatives from the Hindu Kush-Himalayan (HKH) region, including Afghanistan, Bhutan, China, India, Mongolia, Myanmar, Nepal, Tajikistan, Uzbekistan and

experts from Germany, India, Thailand and the USA contributed to the Consultation. The Consultation facilitated the identification of appropriate mechanisms and networks to improve and sustain the flow of climate information for high mountain communities and other key users of this information. This included a mapping of the existing regional capacities for climate services in the Third Pole Region.

The Consultation considered the opportunities and ideas to address the gaps and enhance the capacities for the development of climate services to meet the unique requirements of the communities within the Third Pole Region. The participants agreed that an RCC-Network for the Third Pole Region, learning from the efforts to establish an Arctic PRCC-Network, could provide an effective regional mechanism to support the national efforts of countries within the region. The participants also agreed on the way forward to pursue the Third Pole RCC-Network, through a survey and scoping process, followed by the development of a concept note and implementation plan.

8. Engagement with the Arctic Council and the Antarctic Treaty Consultative Meeting (ATCM)

In 2015, the Arctic Council exercised a moratorium on observers to permit an assessment of their role and functions and the WMO request to become an observer was not taken on board. Therefore, in 2017, WMO will again pursue designation as an International Organization Observer to the Arctic Council. There are ongoing efforts to engage Arctic Council Working Groups to avoid duplication of efforts on, for example, climate change monitoring measures and standards and to optimize the implementation of the Year of Polar Prediction.

At ATCM-XXXIX in 2016, WMO presented six papers on: (i) The Antarctic Observing Network (AntON); (ii) The Year of Polar Prediction (YOPP) 2017-2019; (iii) WMO Antarctic Climate related activities; (iv)The Polar Challenge; (v) Polar Regional Climate Centres; and (vi) a WMO Annual update. The papers have been targeted to ATCM priorities and highlight areas where further engagement would be mutually beneficial.

9. Year Of Polar Prediction (YOPP)

As reflected in its mission statement, YOPP is an extended period of coordinated intensive observational and modelling activities, aimed at improving prediction capabilities for the Antarctic, the Arctic and beyond. This concerted effort will be augmented by research into forecast-stakeholder interaction, verification, and a strong educational component. Being rooted in the Polar Prediction Project, YOPP concentrates on time scales from hours to seasons. With its clear focus on polar prediction rather than a very broad range of polar science topics, YOPP is quite different from IPY (the International Polar Year 2007-2008).

The YOPP Summit (Geneva, Switzerland, 13-15 July 2015) was a successful high-level event and was a necessary element in the planning for the Year of Polar Prediction (YOPP). The purpose of the Summit was: to give an overview about the present level of planning; to identify stakeholder expectations and requirements; to develop priorities; to define intensive observing periods; to agree on the YOPP data legacy; to coordinate planned activities; and to gather formal commitments from parties interested in YOPP. As a consequence of the Summit Version 2.0 of the YOPP Implementation Plan has been finalized. The YOPP Summit was attended by the President of WMO, 120 scientists, stakeholders as well as representatives from weather and climate prediction centres, international bodies and funding agencies.

EC-68 endorsed the roadmap towards the YOPP as provided in the final report of the Year of Polar Prediction Summit available at the Polar Prediction Project website[7]. EC-68 also urged Members to support the improvement of the existing conventional observing systems over and near the Polar Regions, by increasing the frequency of routine synoptic and radiosonde observations during certain intensive observing periods during YOPP and to promote the development of the YOPP data legacy, through the implementation of a YOPP data portal that exploits the expertise gained with the Global Cryosphere Watch (GCW) Data Portal.

[7] http://www.polarprediction.net/

II. Remaining gaps and challenges

1. CryoNet:

The following gaps remain to be addressed with regard to the core GCW Observing Component, the CryoNet:

- Filling gaps in CryoNet in some regions with emphasis on the tropics and high mountain regions;
- Assessment of newly proposed sites for inclusion into CryoNet;
- Further development of CryoNet guide and manual on best practices; and
- Applying WIGOS Stations Identifiers to GCW stations.

2. GCW Data Portal:

The following gaps remain to be addressed with regard to the GCW Data Portal:

- The WMO Core Metadata Profile, based on the ISO 19115 metadata standard, is used by GCW for discovery metadata. ISO 19115 is a container that can be populated with several controlled vocabularies and their translation for mapping to search model is a challenge, for example with the Canadian Cryospheric Information Network (CCIN) and the International Arctic Systems for Observing the Atmosphere (IASOA);
- Availability of metadata from the World Glacier Monitoring Service (WGMS) in a proper form;
- Arctic and Antarctic Research Institute (AARI) – slow progress in interoperability due to limited human resources;.
- Development on metadata end points for the Global Terrestrial Network – Permafrost (GTN-P);
- Interoperability with remaining CryoNet stations/sites.

3. High Mountain issues

With regard to high mountain issues, the lack of high mountain sites, especially over 4000 m, for inclusion into CryoNet requires GCW working at facilitating the establishment of such sites.

4. Arctic PRCC-Network

Several important decisions are still pending at this point, the key one of which is identification of a lead agency to oversee the launch and process of the Arctic PRCC-Network demonstration phase. This is being urgently addressed.

Other gaps will be tackled before the end of the Arctic PRCC-Network demonstration including establishment of a regional Climate Watch System; setting up the required web portals and access mechanisms; creation of new, pan-Arctic products, some with polar projection; developing regional gridded datasets; and establishing a feedback and response mechanism for users.

The support and guidance of EC-PHORS and its STT will be very important to planning and holding the first (and subsequent) PCOFs, and to further identification of user requirements so that the PRCC-Network will increasingly become recognized and used by communities ranging from local communities to international businesses and international bodies such as the Arctic Council and other United Nations agencies.

A successful implementation of the Arctic PRCC-Network is expected to lead next, with the continued guidance of EC-PHORS, to the launch of PRCC/PRCC-Network for the Antarctic and the Third Pole regions.

5. The Third Pole RCC-Network

The following gaps remain to be addressed with regard to the establishment of the PRCC network in the Third Pole region:

- Lack of mapping of stakeholders and interaction among them; inadequate communication with users;
- Several RCCs exist covering countries in the Region, but there is no specific focus on the requirements of the Third Pole communities;
- Gaps in observation networks (particularly cryosphere), lack of engagement with GCW, data exchange restrictions;
- Outreach; cross-sectoral linkages and interfaces with stakeholders; engagement of WCRP; lack of national research capacities – except few; forecasting capacity;
- Disparity in capacities in the Region; technical capacity of staff at NMHSs (i.e. cryospheric watch); insufficient staffing of NMHSs; awareness and capacity of users; insufficient communication systems.

6. Engagement with Arctic Council and Antarctic Treaty Consultative Meeting

The following issues remain to be addressed with regard to the further engagement with the Arctic Council and the Antarctic Treaty Consultative Meeting:

- Pursue International Organization Observer status with the Arctic Council and improve engagement with this policy forum;
- Continue to ensure meaningful engagement with the Antarctic Treaty Consultative Meeting through targeted papers.

7. Year Of Polar Prediction (YOPP)

With regard to YOPP, the following issues remain to be addressed:

- Engagement of NMHS during the YOPP Core Phase (mid-2017 to mid-2019): logistic support to the field campaign, additional radio-soundings;
- During YOPP Summit sub-committees have been established. The existing sub-committees on: (i) Sea-Ice Prediction; (ii) Societal and Environmental Research and Applications (SERA); and (iii) Education, have been complemented with committees on: (iv) Southern Hemisphere aspects; (v) Coordinated Model Experiments; (vi) the YOPP Data Component; and (vii) Arctic Observations and Intensive Observing Periods. A substantial part of the further YOPP planning will take place within these sub-committees and on pre-YOPP workshops they are organizing, focused on their respective themes, to ensure the appropriate support to YOPP-related meetings.

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