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| WEATHER CLIMATE WATER | **World Meteorological Organization**  **WORLD METEOROLOGICAL CONGRESS**  **Nineteenth Session** 22 May to 2 June 2023, Geneva | **Cg-19/Doc. 3.2(3)** |
| Submitted by: Chair of Plenary  29.V.2023  **APPROVED** |

**AGENDA ITEM 3: STRATEGIC PLAN AND BUDGET 2024–2027**

**AGENDA ITEM 3.2: Strategic Initiatives**

***AGENDA ITEM 3.2.3: Priorities to Address Global and Regional Impacts of Changes in the Cryosphere***

# prioritIES to Address Global and Regional Impacts of Changes in the Cryosphere



# GENERAL CONSIDERATIONS

### Priorities to Address Global and Regional Impacts of Changes in the Cryosphere

1. Draft Resolution 3.2(3)/1 (Cg-19) identifies five key priorities for action by WMO structures in collaboration with partners, for the 2024–2027 period. These priorities incorporate the critical elements of Strategic Objective 1.5 and reflect the full value cycle addressing the information needs of regions affected by changes in the cryosphere, in polar and high mountain regions, as well as downstream and lowlands regions, and the ocean. By undertaking these actions, Members will improve their capacity to address risks and impacts from accelerated and, largely, irreversible changes in the cryosphere.

2. These actions have global relevance. For example, Small Island Developing States (SIDS) are affected by melting glaciers and ice sheets via sea level rise, countries with seasonal snow cover may experience increased variability in water resources, changing risks of floods, flash floods, glacier lake outburst floods coastal inundation, droughts, etc. Globally, an increased number of countries are experiencing an increased likelihood of cryosphere related hazards (landslides, increased carbon release from permafrost, etc.).

The [annex](#Annex_to_Resolution) to draft Resolution 3.2(3)/1 (Cg-19) outlines the five high-level priorities and their respective key actions aimed at strengthening the capacity of Members to prepare and respond to impacts from the changing cryosphere. These actions reflect the 2024–2027 work priorities of the WMO structures and add the incremental focus on cryosphere as a component of the Earth system.

**Expected action**

3. Based on the above, the Congress may wish to adopt this resolution along the following lines:

(a) Decides to endorse the five high-level priorities identified in the [annex](#Annex_to_Resolution) to this resolution;

(b) Requests the Executive Council and all WMO structures to ensure that the five priorities identified in the [annex](#Annex_to_Resolution) to this resolution are reflected in the WMO Operating Plan   
2024–2027;

(c) Request the Executive Council to update the terms of reference of EC-PHORS;

(d) Urges Members to undertake the activities in the annex to this resolution.

# DRAFT RESOLUTION

## Draft Resolution 3.2(3)/1 (Cg-19)

## Priorities to Address Global and Regional Impacts of Changes in the Cryosphere

THE WORLD METEOROLOGICAL CONGRESS,

**Recalling:**

(1) [Resolution 1 (Cg-Ext(2021))](https://library.wmo.int/doc_num.php?explnum_id=11113#page=9) – WMO Unified Policy for the International Exchange of Earth System Data,

(2) [Resolution 48 (Cg-18)](https://library.wmo.int/doc_num.php?explnum_id=9827#page=162) – Key Directions of the Polar and High-Mountain Agenda for the next WMO Financial Period (2020–2023),

(3) [Resolution 3.1(1)/1 (Cg-19)](https://meetings.wmo.int/Cg-19/English/Forms/AllItems.aspx?RootFolder=%2FCg%2D19%2FEnglish%2F1%2E%20DRAFTS%20FOR%20DISCUSSION&FolderCTID=0x012000B201DF88DD6A2A41AD96184E1530A358&View=%7BA5F5A1D9%2DCDFC%2D4E69%2DB3FB%2D35146C93ECAB%7D) – Strategic Plan 2024–2027,

(4) [Resolution 3.2(1)/1 (Cg-19)](https://meetings.wmo.int/Cg-19/English/Forms/AllItems.aspx?RootFolder=%2FCg%2D19%2FEnglish%2F1%2E%20DRAFTS%20FOR%20DISCUSSION&FolderCTID=0x012000B201DF88DD6A2A41AD96184E1530A358&View=%7BA5F5A1D9%2DCDFC%2D4E69%2DB3FB%2D35146C93ECAB%7D) – UN Early Warnings for All (EW4All)[Islamic Republic of Iran] Initiative,

(5) [Resolution 4 (INFCOM-2)](https://library.wmo.int/doc_num.php?explnum_id=11575#page=76) – Closing the gap on the integration of the cryosphere in the Earth system approach of WMO,

(6) [Recommendation 3.1(18)/1 (EC-76)](https://meetings.wmo.int/EC-76/_layouts/15/WopiFrame.aspx?sourcedoc=/EC-76/English/2.%20PROVISIONAL%20REPORT%20(Approved%20documents)/EC-76-d03-1(18)-EC-PHORS-RECOMMENDATIONS-approved_en.docx&action=default) – Priorities to Address Global and Regional Impacts of Changes in the Cryosphere,

(7) [Resolution 3.2(2)/1 (Cg-19)](https://meetings.wmo.int/Cg-19/_layouts/15/WopiFrame.aspx?sourcedoc=/Cg-19/English/1.%20DRAFTS%20FOR%20DISCUSSION/Cg-19-d03-2(2)-GHG-MONITORING-INFRASTRUCTURE-draft1_en.docx&action=default) – WMO-coordinated Global Greenhouse Gas Monitoring Infrastructure,

**Having considered:**

(1) The evidence presented in the [Sixth Assessment Report](https://www.ipcc.ch/assessment-report/ar6/) (AR6) of the Intergovernmental Panel on Climate Change (IPCC) on the accelerated impacts at global and regional level, attributed to the irreversible changes in the cryosphere, including on ocean circulation [Guyana],

(2) The value of enhanced coordination and planning of WMO and of Members’ engagements in Antarctica (South of 60˚S) and the opportunity this presents for delivery of observations, services and research outcomes to improve our understanding of the Antarctic and Southern Ocean environment, especially in relation to future changes of Antarctica Ice Sheets,

**Takes note** of the United Nations General Assembly (UNGA) proclamation ofthe period   
2023–2027 as “Five Years of Action for the Development of Mountain Regions” [UNGA Resolution 77/172](https://www.undocs.org/Home/Mobile?FinalSymbol=A%2FRES%2F77%2F172&Language=E&DeviceType=Desktop&LangRequested=False) and of the [UNGA Resolution 77/443](https://www.undocs.org/Home/Mobile?FinalSymbol=A%2F77%2F443&Language=E&DeviceType=Desktop&LangRequested=False) proclaiming 2025 as the UN International Year of Glaciers’ Preservation;

**Noting:**

(1) The significant gap in monitoring the state of the permafrost, a high-carbon ecosystem, of the high mountain climate [United Republic of Tanzania]and our limited understanding of the climate change driven release of greenhouse gases from the thawing permafrost, as reported in the [Sixth Assessment Report](https://www.ipcc.ch/assessment-report/ar6/) (AR6) of IPCC,

(2) The evidence presented in the IPCC [Special Report on Ocean and Cryosphere](https://www.ipcc.ch/site/assets/uploads/sites/3/2022/03/01_SROCC_SPM_FINAL.pdf) on the accelerated retreat of ice sheets in Greenland and Antarctica (contributing to both sea level rise and irreversible ice sheet instability), the uncertainty arising from gaps in both observations and in the understanding of ice sheet processes; and the inadequate model representation of ice sheet processes in complex interactions between the atmosphere, ocean and ice sheets,

**Noting further** the preparatory work that has started for a fifth International Polar Year (IPY) in 2032–2033, under the coordination of the International Arctic Science Committee (IASC) and Scientific Committee on Antarctic Research (SCAR), and the opportunities that this presents for the active engagement of WMO,

**Welcomes:**

(1) The successful integration, post-reform, of many technical activities related to the cryosphere into the work programmes of WMO constituent bodies, i.e. INFCOM, SERCOM and the Research Board, in particular through the integration of the Global Cryosphere Watch in INFCOM;

(2) The roadmap set forth by the [Call to Action](https://highmountainsummit.wmo.int/en/call-action) arising from the 2019 WMO-led High Mountain Summit, with the active engagement of many WMO partners;

**Decides to endorse** the five high-level priorities identified in the [annex](#Annex_to_Resolution) to this resolution, which align with the five Long-term Goals of the Strategic Plan and serve as a roadmap for the work of the WMO bodies, in order to sustainably and equitably support all Members in understanding, responding, mitigating and adapting to the global and regional impacts of the irreversible changes in the cryosphere and their downstream impacts on freshwater resources, on [Secretariat] sea level rise, on global fisheries and food security [Guyana], and the [Secretariat] increased disaster risks;

**Requests** the Executive Council to:

(1) Ensure that the five priorities identified in the [annex](#Annex_to_Resolution) to this resolution are reflected and assigned accordingly in the WMO Operating Plan 2024–2027, based on their alignment with the Long-term Goals of the Strategic Plan;

(2) Update the terms of reference of EC-PHORS, to serve as a mechanism for engagement and advocacy in the execution of this resolution and as an interface with key partners and stakeholders;

**Requests** INFCOM, SERCOM, the Research Board, and the regional associations, in collaboration with EC-PHORS and other relevant WMO bodies, to integrate the actions identified in the [annex](#Annex_to_Resolution) to this resolution, in their work programmes;

**Urges** Members, particularly those that have operational activities on cryosphere and in polar and high mountain regions, to:

(1) Mobilize national institutions with relevant programmes to make available their data that contribute to meeting the priorities in the [annex](#Annex_to_Resolution) to this resolution, to the operational community in near real time and on a free and unrestricted basis and to support publicly funded research;

(2) Enhance their observing and monitoring programmes and services to enable the delivery of the priorities identified in the [annex](#Annex_to_Resolution) to this resolution;

(3) Maintain efforts for national coordination of agencies and authorities with responsibilities in polar and high mountain regions;

(4) Support the implementation of this resolution with in-kind and financial contributions;

**Calls on** Members, particularly those that have operational activities that may be impacted by the downstream effects of the cryosphere changes, to enhance their governance, monitoring and the context-specific and integrated response, which will enable the improved delivery of services, aligned with the priorities in the annex of this resolution; [Trinidad and Tobago],

**Recognizing** that the implementation of outputs associated with changes in the cryosphere and downstream impacts on water resources and sea level rise are subject to the outcome of budgetary decisions or the Secretary-General being able to identify efficiencies;

**Requests** the Secretary-General:

(1) To make the necessary resources available to support WMO’s coordination, planning and implementation of Polar and High Mountain activities, to the extent possible;

(2) To bring the present resolution to the attention of all concerned.

Note: This resolution replaces [Resolution 48 (Cg-18),](https://library.wmo.int/doc_num.php?explnum_id=9827" \l "page=162) which is no longer in force.[Secretariat]

[Annex: 1](#_Annex_to_draft_3)

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## Annex to draft Resolution 3.2(3)/1 (Cg-19)

### Priorities to Address Global and Regional Impacts of Changes in the Cryosphere

The WMO strategic goals of an Earth system approach require additional actions on the integration and use of cryosphere observations and data to close the gaps to a fully coupled cryosphere in the Earth system, which would enable effective services responding to emerging needs, e.g. development of early warning systems.

The changes in the cryosphere are felt well beyond the countries where they occur, being transmitted to vast human populations and the ocean via impacts on atmospheric circulation and hydrological systems, with cascading impacts on weather and climate.

The five high-level priorities identified reflect the full value cycle (i.e. all WMO Long-Term Goals) and have global relevance. They provide a clear framework for enhancing the capacity of Members to understand, respond, mitigate, and adapt to such impacts. For example, Small Island Developing States (SIDS) are affected by melting glaciers and ice sheets via sea level rise, countries with seasonal snow cover may experience increased variability in water resources, changing risks of floods, flash floods, glacier lake outburst floods coastal inundation, droughts, etc. Globally, an increased number of countries are experiencing an increased likelihood of cryosphere related hazards (landslides, increased carbon release from permafrost, etc.).

Addressing the capacity gap through coordination under the auspices of WMO as an intergovernmental organization, is essential and most beneficial to Members, by extending the well-established practices for weather and climate services [Armenia], to the integration of the cryosphere-related products [Armenia].

Under each priority, key actions are identified, which align with the existing workplans of all WMO bodies.

These priorities and their links to the WMO Long-Term Goals (LTG) are as follows:

(1) The urgency of global and regional emerging risks from the changing cryosphere in a changing climate, is understood and reflected in the workplans of WMO bodies and in global frameworks (LTGs 1, 2, 3, and 4);

(2) Collaborative and coordinated technical mechanisms are optimized to support advancing service delivery by Members, to address relevant gaps in polar and high mountain regions, at all scales (LTGs 1, 2, 3, and 4);

(3) Earth system predictions are enhanced through closing gaps in polar and high mountain observations; improving data sharing; and improved numerical models integrating research on cryospheric processes (LTGs 1, 2, 3 and 4);

(4) Partnerships and collaboration with research and external stakeholders advance knowledge sharing and amplify the existing capacity to deliver services, in a regional relevant manner (LTGs 1, 2, 3, 4 and 5);

(5) Antarctica: Members’ collaboration in collecting and sharing observations, conducting research, and developing and providing services, is enhanced (LTGs 1, 2, 3, and 5).

The delivery of these priorities will be supported by several flagship actions, as outlined below.

**(1) The urgency of global and regional emerging risks from the changing cryosphere in a changing climate, is understood and reflected in the workplans of WMO bodies and in global frameworks**(aligned with LTGs 1, 2, 3, and 4)

The following key activities will contribute to addressing this priority:

(a) Develop and promote high-level, long-term ambitions communicating the urgent need for global actions in addressing changes in polar and high mountain regions and their impacts downstream, including on coastal areas and SIDS;

(b) Improve the understanding of societal risks and opportunities in polar, high mountain, through to [New Zealand] lowlands, where cryosphere related impacts are felt, and advocate for their representation in the WMO strategies;

(c) Incorporate cryosphere-related service [Secretariat] requirements in the WMO Strategy for Service Delivery, reflecting the range of temporal and spatial scales applicable to polar and high mountain regions and across impact-based services;

(d) Advocate for a focused approach in the work plans of WMO bodies which contribute to enhancing the resilience of vulnerable communities and regions facing impacts of irreversible changes in the world’s cryosphere, through coordination, knowledge and capacity-sharing, rapid technology adoption, and enhanced services;

(e) Coordinate with advocacy for action through global campaigns to give new impetus to the international community’s efforts to address the information needs while balancing technical, scientific, operational, funding mechanisms, and policy aspects. Such campaigns include but are not limited to the UN International Year of Glaciers’ Preservation and the UNGA proclamation of the period 2023–2027 as “Five Years of Action for the Development of Mountain Regions”.

**(2) Collaborative and coordinated technical mechanisms are optimized to promote and support advancing service delivery by Members, to address gaps in polar and high mountain regions, at all scales** (aligned with LTGs 1, 2, 3, and 4)

The following key actions will contribute to addressing this priority:

(a) Develop requirements and plan pilot projects for regional mountain monitoring and warning centres, to address the intertwined hydrological, climate, ecosystem and social issues and policies that would support economies in areas surrounding high‑mountains and their communities (e.g. as identified in the Call for Action of the WMO High Mountain Summit);

(b) Within the framework of the WMO Integrated Processing and Prediction System (WIPPS), explore the potential to include new types of Regional Specialized Meteorological Centres to deliver region- and domain-specific products across all timescales, e.g. mountain monitoring and warning centres;

(c) Continue the implementation of Polar and High Mountain [Armenia] Regional Climate Centre Networks and Outlook Forums (Arctic, Antarctic, the Third Pole), [Decision 47 (EC-70),](https://library.wmo.int/doc_num.php?explnum_id=4981#page=216) with relevant partners, with a focus on addressing their emerging requirements for cryospheric products and the capacity development needs;

(d) Integrate cryospheric and related environmental hazards in the Multi-Hazard Early Warning System (MHEWS) and the catalogue of hazardous events, which would enable the development of necessary monitoring and early warning systems, with the engagement of relevant partners;

(e) Develop consistent indicators for monitoring and reporting on cryosphere changes and their impacts, which are to be included in the portfolio of weather and hydroclimate information services, e.g. the implementation of early warning systems as applicable to polar, high-mountains, coastal areas, and the monitoring of the release in the atmosphere of greenhouse gases from the thawing permafrost and glaciers, etc.;

(f) Use the opportunity of the completion of internationally coordinated research projects, e.g. the Year of Polar Prediction (YOPP) to develop approaches and pilot projects for translating mature research results into sustainable services, through appropriate mechanisms.

**(3) Earth system predictions are enhanced through closing gaps in polar and high mountain observations, improving data sharing, and improved numerical models integrating mature research related to cryospheric processes** (aligned with LTGs 1, 2, 3 and 4)

The following key actions will contribute to addressing this priority:

(a) Initiate the development of global high mountain Earth system forecasting and prediction capabilities, including Numerical Weather Prediction (NWP) verification and validation over high mountain areas, to inform and manage risks from mountain-based extreme events and climate change, both in the mountain headwaters and downstream;

(b) Foster the organization of demonstration projects to advance the effectiveness of forecasts and warning services and the development and the sustainability of the necessary capacity for vulnerable regions affected by the rapid changes in the cryosphere;

(c) Establish a framework for multinational fully integrated observatories (supersites) hosting projects on addressing critical knowledge gaps on the atmosphere-ocean-cryosphere-land interactions, including testing new technologies and methods; data assimilation, ground truthing and validation of models; and pilot projects to assess Early Warning Systems (EWS) solutions;

(d) Enhance the free and open exchange of data related to the cryosphere, as defined in the WMO Unified Data Policy, across all relevant stakeholders and ensure their effective integration through the WMO Integrated Global Observing System (WIGOS), the WMO Information System (WIS), and WIPPS;

(e) Foster the integration of cryosphere data into numerical and Earth system models to drive improved predictability and better understanding of the climate impacts of rapid changes in the cryosphere;

(f) Sustain advocacy for critical satellite observations and data over polar and high mountain regions to support risk monitoring and assessments and the development of necessary services.

**(4) Partnerships and collaboration with research and external stakeholders advance knowledge sharing and amplify the existing capacity to deliver services, in a regional relevant manner** (aligned with LTGs 1, 2, 3, 4 and 5)

The following key actions will contribute to addressing this priority:

(a) Take stock of and report on current and past research activities and results on changes in the cryosphere and their societal impacts to identify opportunities for transfer of research to operations and outstanding gaps in meeting emerging needs for information services, e.g. forecasts, warnings, hydrology, water resources, the link between cryosphere melt and carbon release in the atmosphere [Secretariat] etc.;

(b) Advocate for the representation of cryosphere related policy priorities of vulnerable regions in the work plans of WMO bodies;

(c) Advocate for the co-production of knowledge through coordinated integrated research projects in high mountain regions and Antarctica, modelled on the Polar Prediction Project and YOPP campaign, to improve access to critical data and knowledge on representing the rapid changes in polar and high mountain regions, to support future operational services;

(d) Pursue mutually beneficial engagements and partnerships with key partners, broader international research and academia, across the full value cycle, in addressing key concerns and needs related to cryospheric changes in a regionally relevant manner;

(e) Actively engage early career scientists and foster capacity development activities for local experts and communities, as a means[Secretariat] to sustain the development and delivery of services addressing urgent challenges related to drastic changes in the global cryosphere.

**(5) Antarctica**: **Members’ collaboration in collecting and sharing observations; conducting research; and developing and providing services, is enhanced** (aligned with LTGs 1, 2, 3, and 5)

The following key actions will contribute to addressing this priority:

(a) Conduct/organize high-level consultations and provide recommendations on the role of WMO on the coordination of activities of Members with an interest in Antarctica and its Southern Ocean environment (South of 60˚S), consistent with the Earth system approach and the WMO strategic plan, and taking into account the particularities of programmes on Antarctica;

(b) Engage Members with interests on Antarctica to evolve the necessary structure in WIPPS and WIGOS to meet effectively the information needs in support of activities of Members on Antarctica (South of 60˚S), integrating mature research results and considering the concepts of Regional WIGOS Centres, Regional Specialized Meteorological Centres and that for the Antarctic RCC-Network;

(c) Recommend a convening role for WMO on the understanding of the Antarctica icesheet melt and its impacts on sea level rise, globally, with a focus on monitoring and improvements in standardization and distribution of in-situ and satellite data over Antarctica, the data assimilation, and the communication of uncertainties as they relate to impacts;

(d) Develop an integrated service delivery model for Antarctic weather and marine services, including a coordinating role of WMO, in consultation with Members’ Antarctic operators and parties to the Antarctic Treaty Consultative Meeting (ATCM);

(e) Maintain active engagements between WMO structures, constituent bodies [Islamic Republic of Iran], and other groups [Islamic Republic of Iran], such as the SCAR, the Council of Managers of National Antarctic Programmes, and with regard to aspects of Antarctic meteorology of relevance to their functions.

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