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| Group on Earth Observations |
| **GEO Cold Regions Initiative (GEOCRI)** |
| **Implementation Plan** |
| **(Draft)** |
| **GEOCRI Group** |
|  |
| **5/4/2016** |

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| This document is a draft and is awaiting input from GEOCRI participants in the form of specific language and text, feedback, comments, editing, improvements. The structure of the document may also be adapted slightly if deemed necessary. |

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## Executive Summary

*Approximately 2 pages*

*(****Action Need: Yubao Qiu, HS,---****) HS ok*

Might include:

Background (*overview of the cold regions and GEO/GEOSS*)

Driven Force (Why we need GEOCRI, including the scientific, and societal impact)

Vision: GEOCRI vision is to provide coordinated Earth observations and information services across a range of stakeholders to facilitate well-informed decisions and support the sustainable development of the Cold Regions globally.

Mission: GEOCRI mission is to develop a user-driven approach to Cold Regions information services to complement the current science-driven effort. The Cold Regions Information Service will strengthen synergies between the environmental, climate, and cryospheric research efforts and foster the collaboration between the Arctic, Antarctic and high mountain research communities for improved earth observations on a global scale.

Institution – leads, contributors, observers: GEOCRI community consists of a team of Task leads, contributors and observers. Contributors can join theme-specific Task Teams to work on specific activities according to their interests. The co-lead team works together on, for example, user engagement and general coordination and reporting of the GEOCRI activities. In addition, an institution can join GEOCRI as an Observer, which means that they will be updated about the progress and activities, without not directly taking part in the activities. A Scientific Advisory Committee, consisting of high-profile scientists will be convened in late 2016-early 2017 to provide advice on the GEOCRI activities. Terms of Reference will be developed in 2017 to verify the management and coordination structure of GEOCRI.

Plan with time, approaches, milestones, deliverables and task teams. The activities conducted in GEOCRI are grouped into six tasks: Data, Infrastructures, Training, Capacity Building and Knowledge Transfer, User Engagement and Communication, In situ and Remote Sensing Integration and S&T, and Monitoring. Each Task consists of activities with set milestones and deliverables during the Work Program 2017-2019. The range of deliverables varies from activity reports to stakeholder and user mapping to training and capacity building events and webinars. Majority of the milestones and deliverables of the 2017-2019 implemention plan are set to the two first years of the programme period in order to add new milestones and deliverables, geared towards the transition from implementation to operational stage starting in 2019 and during the next work programme period 2020 onwards.

Resources: Most of the GEOCRI’s resources are in-kind efforts, and are aimed at leveraging the resources of participating initiatives and organizations to align with GEOCRI’s objectives.

Outcomes at different phases

## Introduction

### GEOSS and GEO Initiatives (Scope)

*(****Action Need:*** *GEO Secretariat, Dominique Berod)*

The Group on Earth Observations (GEO) was launched in response to calls for action by the 2002 World Summit on Sustainable Development, which recognized that international collaboration is essential for exploiting the growing potential of Earth observations to support decision making in an increasingly complex and environmentally stressed world, which aims to build a comprehensive Global Earth Observation System of Systems (GEOSS).

*GEO Initiatives orientation: ?defnition on the Initiatives*

***Questions:*** *on the GEO Initiatives thematically and Regional GEOSS and the position of GEO CRI in the framework of GEOSS Giovanni Rum*

### GEOCRI’s Nature

***(Action Need: Yubao Qiu****, Martin Raillard, Massimo Menenti, Julie Friddell, Mike Sparrow and need more****)***

*Specifically address the its explicit characteristic of GEOCRI activation)*

The GEO Cold Region Initiative (GEOCRI) was initiated at GEO XII Pleanary in Nov. 2015,. It which aims to identify, address and fill observational gaps and improve networks through coordinated observation practices and information services worldwide, and coordinate the exiting efforts globally to provide Earth observations and information services over cold regions for policy makers, researchers, industry, local communities and other users.

GEOCRI complements existing Earth observation efforts in the cold regions, such as those by EC-PHORS, GCW, SAON, WCRP, YOPP, ICIMOD, PEEX, TPE, and others. [*How? Shall we need some more analysis here?*]

#### Vision (Driven force: science to actions…) Yubao Qiu , HS HS ok

*Vision: Why GEO CRI (Scientific recognition, Human and Society Impact; UN SDG, and global challenge), what the global communities would like to see… (To support the science, global platform, address the gaps globally)*

A dominant feature of the Cold Regions is frozen water in its various forms, which is relevant to GEO eight societal benefit areas, especially through the relevance of meltwater for water and food security in many parts of the world.. More than one hundred countries around the world have Cryospheric elements, where frozen water in various forms dominates the earth’s changing systems. These are the “Cold Regions” that include the Arctic, Antarctic, high-latitude oceans, Himalaya-Third Pole and Mountain cold areas. They are the most ecologically and environmentally sensitive areas to global and regional climatic and environmental change. The changes to these areas comprehensively affect the dynamic Earth system, impacting many aspects of society in all parts of the world. Recent scientific research is making it increasingly clear that “**What happens in the poles doesn’t stay in the poles**”.

GEOCRI vision is to provide coordinated Earth observations and information services across a range of stakeholders to facilitate well-informed decisions and support the sustainable development of the Cold Regions globally.

[*Need Reference: possible white paper from different international communities, and actions]*

#### Mission (Scope) HS ok

***Action Need: Yubao Qiu, HS (HS ok)***

*Mission: its own mission and how it addresses the global cold region’s challenges (together with other communities,, should be operational and realistically getting the aim of GEOSS 10 years’ strategy until 2025, and provide an overview of mission that the group can do in this ten year.*

With its strong link to user communities, GEO is developing a user-driven approach to Cold Regions that will complement the current science-driven effort [*Reference: communication from side event at early time of 2014*]. A global, comprehensive Cold Regions Information Service will strengthen synergies among the activities of the Environmental, Climate, and Cryospheric communities and foster the collaboration between the Arctic, Antarctic and high mountain research communities. In particular, it will support the efforts of scientists, experts and decision makers to ensure the sustainability of these environmentally stressed areas in an increasingly complex political and economic context.

### Objectives

*Action Need: Yubao Qiu, Hiroyuki Enomoto, for comments**, all HS ok*

GEOCRI aims to coordinate global, joint efforts to provide Earth observations and information services to decision-makers over the vast cold regions, including the poles and high mountain areas. GEOCRI will benefit users and stakeholders with a range of different needs and requirements, both within and beyond the cold regions.

Its goal is “*Promoting Earth observations data sharing and cooperation, enabling improved information services for the inter-continent cold regions, informing the stakeholder and decision makers, a mount of activities are conducted world widely*”.

#### Primary Objectives (for comments, all)

* Build a global **platform** to archive, manage, and provide earth observation data across environmental, ecological human, social and economy domains for monitoring the global cold regions, by working with existing initiatives towards the establishment of fully-integrated and sustained observing systems for the Arctic, Antarctic and high mountain regions at appropriate national, regional and global scales, and by incorporating both in situ and remotely sensed Earth observation data and information. And, fully integrate such systems with the Global Earth Observation System of Systems (GEOSS).
* Provide sustained observations and information **exchange mechanism**, advocate and broad open data policy, and free access to the earth observations data over Earth’s Cold Regions, enhance the interoperability capacity between the existing and emerging international distributed data sharing networks.
* Establish a **proactive framework** for the development of information and related services, such as the ***Global Cold Regions Community Portal***, to underpin the GEOSS implementation by expanding the outreach of, and maximizing synergies among, thematically wide GEO activities and thematically deep participant activities, thereby exploiting their complementary roles.
* Strengthen the **partnerships** and **synergies** with scientific communities, policy-makers, stakeholders, and funders over the cold regions’ ecological and engineering fields to address the fragile ecosystem and environmental challenges and societal influences, and improve the public awareness through the capacity building.
* Facilitate collaboration between the environmental, climate, and cryospheric research domains and between the Arctic, Antarctic and high mountain research communities for improved earth observations on a global scale.

#### Additional Practical Objectives (for comments, all)

* Improve discoverability, accessibility and usability of cold regions Earth observation data and information by advocating broad open data policies and strengthened capacity building.
* Facilitate full integration and interoperability of in situ and remotely sensed Earth observations in cold regions.
* Facilitate the full integration of cold region Earth observations with global Earth observations across all environmental, ecological and human domains.
* Support existing observation networks and systems in cold regions, sharing expertise and knowledge, as well as integrating observation products into GEOSS and the GEOSS Common Infrastructure (GCI).
* Provide a sustained mechanism to exchange Earth observation data and information to help understand ongoing climate, environmental, ecosystem and social change in cold regions. Help facilitate collaborations and synergies between different Earth observation efforts in cold regions to avoid duplication and maximize coverage as efficiently as possible.
* Increase the ability of all users and potential users to benefit from cold region Earth observations, including policy makers, researchers, local communities and industry, through ongoing capacity building.
* Strengthen synergies and partnerships between cold region Earth observation providers, users, funders and other stakeholders to increase efficiencies and ensure needs and requirements are effectively met.
* Identify the gaps for observations and data/information service over cold regions.

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## Need for action *(Need comments)*

Cold regions are an intrinsically interconnected component of the Earth system; for examplethe change in snow and ice cover induces downstream effects, including the change to the hazard, societal economy development and water resource supplement. The environmental and human issues facing cold regions are issues for the whole planet. As such, high-quality, reliable and sustained Earth observations in cold regions are in the global interest, benefiting environment, ecosystems and societies in all regions of the Planet.

### Existing Cold Region Activities and Gaps

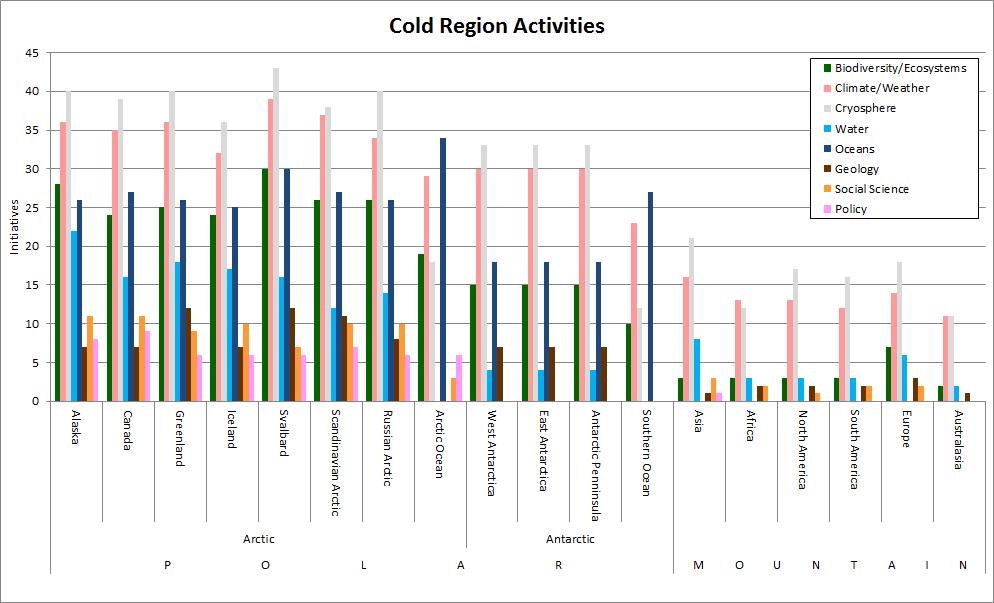
It is important for GEOCRI to identify, insofar as possible, different organizations, networks, systems, programs and projects active in cold regions. By mapping different cold region activities, GEOCRI will been able to identify areas where Earth observations are more abundant and their use for different applications common, and areas where gaps in activity exist, or where initiatives need to be strengthened and supported.

Figure 1 attempts to visualize the distribution of the significant initiatives in cold regions identified by GEOCRI, including both Earth observation providers and users, to clearly portray where activity is strong and where significant gaps exist. The initiatives included in Figure 1 are by no means an exhaustive list; additional initiatives exist in all domains but the figure nonetheless gives a good indication as to the current state of Earth observation-related activity across cold regions. It is important to note that the figure gives indication only to the number of initiatives in each region and domain, and not the quantity of work ongoing. Additionally, as the figure includes both providers and users of Earth observations, it does not indicate the quantity of Earth observations available in each region. Rather, Figure 1 attempts to indicate how much activity, related to Earth observations and GEOCRI, is ongoing in each region, broken down by domain.

Figure 1 identifies greater activity related to GEOCRI in Polar Regions, particularly the Arctic, than in mountain areas in all domains. This imbalance is an issue that GEOCRI must work to help address. Mountainous regions are home to or relied upon by large populations, meaning strengthened activity and Earth observation initiatives in these regions will have a significant effect in all of the GEO Societal Benefit Areas (SBAs).

Also highlighted by Figure 1 is the relative inactivity in some domains across all regions. Water, geology, social science and policy initiatives in cold regions are relatively few. GEOCRI must work to help increase activity in these domains, and fill gaps that may exist in related Earth observation data and information. Other domains, notably climate/weather, cryosphere, biodiversity/ecosystems and oceans (at the poles) appear to be highly active across cold regions. GEOCRI will continue to support efforts in these more active domains to ensure effective coordination and to ensure that cold region Earth observations are coordinated to effectively address the SBAs and have a real positive impact on environment, ecosystems and people in cold regions and beyond.

Figure 1 highlights key areas where GEOCRI is needed to support development of Earth observing and utilization of Earth observations in cold regions. Particular areas of focus must be increasing activity and supporting initiatives in mountain regions, as well as the strengthening of initiatives within the domains of water, geology, social science and policy.



*Figure 1 Activates related to Earth Observations and GEOCRI by domain*

### Cold Region Earth Observation Needs and Requirements

This section describes environmental and socio-political challenges facing cold regions, many of which are unique to cold regions, and outlines how specific Earth observations are needed to help address them. It identifies information or data needs associated with each issue, as well as networks, systems, infrastructure, etc. required to address issues. By addressing the Earth observation needs and requirements in cold regions to support efforts to tackle the identified issues, GEOCRI will contribute to all eight of SBAs outlined by GEO as well as the 2030 Agenda for Sustainable development and other initiatives.

Despite best efforts, the list of Earth observation needs and requirements for cold regions defined here are by no means exhaustive. The needs and requirements which GEOCRI aims to address will continuously grow and evolve as issues emerge and develop.

Cold region Earth observation needs and requirements are organized distinctly topic area; however many issues are cross-cutting and relevant across multiple or all domains. While these issues are categorized in a particular domain, addressing the issue will be beneficial to several need and requirement areas. For example, climate and weather is a cross-cutting issue, addressing which will be beneficial to issues in all or multiple domains to varying degrees, including biodiversity/ecosystem, agriculture, water, hazards, and others.

#### Climate & Weather

Global climate change is amplified in cold regions. The Poles are the most rapidly warming regions of the planet and unprecedented change is occurring in mountainous areas. Better understanding of climate and climate change in cold regions is essential for effective adaptation and mitigation, as well as identifying new opportunities and challenges presented by climate change. Earth observations can contribute to climate knowledge, through monitoring of climate systems and change.

Weather in cold regions is highly changeable and difficult to predict. Better understanding of weather and higher resolution, accurate forecasting (both spatially and temporally) is needed to provide accurate weather information to people living and working in the cold regions. This will improve safety as well as economic productivity, allowing people to plan and prepare their activities more appropriately for the weather.

Specific Earth observation needs and requirements for weather and climate in cold regions include:

* Improved meteorological observations throughout cold regions, including an improved network of weather stations and increased high-resolution remote sensing from satellites, unmanned aerial vehicles (UAVs) and aircraft. This is particularly needed in remote/inaccessible regions where data are sparse, regions where forecasting is currently poor (e.g. with steep orography), and where model error is frequent. Improved observations will help improve weather and climate forecasting at all temporal and spatial scales.
* Improved monitoring of the impacts of ongoing climate change on environments, ecosystems and society in all cold regions.

(Sources: EC-PHORS [1], IPCC [2], WCRP [3], WMO [4], CAS-NASA HMA [5])

#### Biodiversity & Ecosystems

Due to intense climate and environmental change, ecosystems are under threat in cold regions. Species are forced to adapt to change, and in many cases struggle. Further direct pressure is placed on biodiversity and ecosystems human activities, such as extractive industries, tourism, forestry, agriculture and hunting. A decline in biodiversity and diminishing ecosystem health in cold regions is a socio-political, as well as environmental, issue, with ramifications in areas of the planet beyond cold regions. Strong ecosystems in all regions are needed to support the planet and human activities in a number of areas, including food production, water, health and tourism.

Specific Earth observation needs and requirements for biodiversity and ecosystems in cold regions include:

* Detailed, accurate and ongoing ecosystem and biodiversity monitoring and assessment throughout cold regions via both in situ and remote sensing observations to assess and monitor ecological health and change.

(Source: CAFF [6], GEOBON [7], ICIMOD [8])

#### International Relations & Cooperation

Due to the complex opportunities and challenges presented in polar and mountain areas, many countries, organizations and groups have interests in cold regions. Without common understanding and cooperation between all stakeholders disagreements can potentially arise and escalate. Earth observations and Earth observation initiatives contribute to the process of settling disagreements and bringing stakeholders together to address common issues of importance peacefully.

Specific Earth observation needs and requirements for international relations and cooperation in cold regions include:

* Systematic international cooperation and sharing of Earth observation data, information and expertise regarding cold regions, and the promotion of broad open data policies as a default.
* Improved communications and infrastructure in cold regions to help better utilization of and access to Earth observations for all users.
* Improved international observation networks and systems at regional and global scales, particularly to support tackling trans-boundary issues such as water, pollution, biodiversity etc.
* Comprehensive and definitive independent land and sea floor surveys to help settle territorial disputes in cold regions (e.g. Arctic Ocean).
* Development of Earth observation campaigns in cold regions as opportunities for peaceful international scientific cooperation and collaboration that pave the way for improved relations between nations in all areas.

(Sources: Arctic Institute [9], GEO [10], ICIMOD [8], CAS-NASA HMA [5])

#### Sustainable Development, Indigenous Communities & Traditional Practices

As with all regions, sustainable development is essential in polar and mountain areas. Many cold regions encompass developing nations or communities with relatively high levels of poverty and limited access to services. Development opportunities are often scarce and there are many unique challenges facing development in cold regions, such as protecting the fragile environments. Sustainable development in cold regions, supported by Earth observations, needs a bespoke approach in order to address these specific and unique challenges.

Indigenous communities compose a large percentage of cold region inhabitants. These communities have their own specific needs and traditional practices, to which Earth observation efforts and initiatives must be sensitive. Supported by Earth observations, Indigenous populations can effectively conserve their cultures and way of life, while enjoying the benefits of the modern world, for example, having access to modern health care while maintaining traditional communities, practices and ways of living.

It is important to note that Indigenous and local communities can make real positive contributions to Earth observations, in addition to benefitting from Earth observations themselves. Traditional knowledge from Indigenous and local communities contributes valuable information to benefit cold region Earth observation efforts through active participation in research and community-based monitoring schemes. By engaging with or leading Earth observation efforts, local and Indigenous communities’ needs and requirements can be more effectively and appropriately met than if communities only engage with products of Earth observations.

Specific Earth observation needs and requirements for sustainable development, Indigenous communities and traditional practices in cold regions include:

* Full harnessing of traditional and Indigenous knowledge of environments, ecosystems and resources throughout the cold regions for the benefit of all.
* Engagement with local and Indigenous communities in Earth observation efforts at all levels and stages throughout the cold regions, with increased capacity to quantify, document and manage Earth observations.
* Development and improvement of community-based monitoring initiatives in cold regions to improve engagement, more effectively tailor Earth observation efforts to local needs, and improve efficiencies.
* Monitoring of species to help inform policies and enforce sustainable limits on traditional hunting, trapping, whaling and fishing, etc. in cold regions to ensure environmental and ecological protection while maintaining important cultural practices.
* Identification of unique regional characteristics in cold regions for high value economic exploitation (e.g. endemic species, beautiful scenery, natural resources etc.) to support communities and their sustainable development.

(Sources: Arctic Health [11], HRCF [12], ICIMOD [8], SDWG [13], AMAP [14], CAFF [6])

#### Health

Cold region populations often have lower levels of health compared to wider populations, and have less access to health services than in other regions. Earth observations related to health include monitoring environmental health indicators such as pollution, water quality and food contaminants, and can inform improved access to health services for remote and isolated communities.

Specific Earth observation needs and requirements for health in cold regions include:

* Monitoring of toxic substances, pollutants and contaminants in cold regions to which humans may be harmfully exposed, including in food sources, water sources, atmosphere and the environment generally.
* Land surveys to determine current best access to health services for remote and isolated communities, and inform efforts to improve accessibility.
* Monitoring of vector species in cold regions which carry parasites/diseases with potential harmful health effects, particularly vector species which carry new, previously absent parasites and diseases to cold regions.

(Sources: Arctic Health [11], ICIMOD [8], SDWG [13])

#### Agriculture, Fisheries, Hunting & Food

Due to the harshness of the environment and climate, opportunities for agriculture in cold regions are often limited. Earth observations can help identify opportunities to improve production to better meet the food needs of cold region populations, increase economic output, and help meet the growing demands for food globally.

Hunting and fishing, for food production and other goods, are key activities in cold regions. Earth observations can help inform policies and actions to ensure sustainable yields from hunting and fishing, while minimizing environmental and ecological damage.

Specific Earth observation needs and requirements for agriculture, fisheries, hunting and food in cold regions include:

* Assessment of the impact of ongoing climate and environmental change on agriculture in cold regions to inform adaptation where necessary.
* Identification of regions viable for new agricultural opportunities in light of ongoing climate and environmental change.
* Detailed soil surveys in cold region agricultural areas to inform sustainable yields and environmental protection.
* Crop surveys to identify opportunities for agricultural diversification and sustainable intensification of production in cold regions, and the development of "climate smart" agricultural policies and practices.
* Identification of endemic species, local climate, and soil conditions, etc. that provide new or locally specific agricultural opportunities, particularly for high-value produce.
* Monitoring of the impacts of agriculture on environments and ecosystems (irrigation, pesticides, over-grazing etc.) to inform sustainable regulatory policies where necessary.
* Accurate and ongoing monitoring of hunted species populations to inform and help enforce regulated sustainable hunting limits and policies.
* Accurate and ongoing monitoring herded species populations, herd health, size and density, and the condition of pastures to support effective, efficient and sustainable management.
* Accurate and ongoing monitoring of fish stocks in all cold regions waters to inform and help enforce regulated sustainable catch limits and policies.

(Sources: CAFF [6], ICIMOD [8], GEOGLAM [15], SDWG [13], AMAP [14])

#### Water

As with many areas of the globe, water is a key issue for cold regions. Regions such as the Hindu Kush – Karakorum – Himalayas (HKKH) provide water to over a billion people living down stream of glacially-fed rivers. Other cold regions are themselves water stressed, with water supplies for local communities scarce. Earth observations can help monitor water supplies within and from cold regions, for both quantity and quality, supporting effective sustainable water resources management that considers environmental, ecological and human needs.

Specific Earth observation needs and requirements for water in cold regions include:

* Improved network of hydrological stations, particularly in remote/inaccessible regions where data are sparse, and where hydrological model accuracy is currently poor.
* Improved glacier mass balance monitoring in regions reliant on melt water resources, especially in stressed areas and areas which supply water to large populations outside of the cold regions (e.g. the HKKH and the Andes).
* Detailed and ongoing monitoring of water table and reservoir levels in cold regions, particularly in water-stressed areas.

(Sources: ACAP [16], AMAP [14], CAFF [6], ICIMOD [8], SDWG [13], CAS-NASA HMA [5])

#### Pollution & Environmental Protection

The fragility and sensitivity of cold region environments and ecosystems means that they are particularly susceptible to the impacts of pollution and other environmental damage. EOs can help monitor pollution and environmental damage in cold regions, assess their environmental impacts and inform necessary responses.

Specific Earth observation needs and requirements for pollution and environmental protection in cold regions include:

* Accurate and precise real time monitoring and early warning systems of oil spills in cold region waters via remote sensing, to inform more effective clean up response. Monitoring updates should ideally be in the order of minutes to hours. Oil spill events must be followed by environmental impact assessments and recovery monitoring.
* Identification and monitoring of the sources, pathways, transport and deposition of pollutants, contaminants and toxic substances within, to, from and between cold regions, via the atmosphere, water, land, ecosystems and human activity.
* Identification and assessment of contaminated environments and monitoring of clean up and recovery.
* Monitoring of pollutant impacts on cold region ecosystems and environments, with particular attention to highly susceptible species (e.g. top predators due to bio-magnification) and selected indicator species.
* Ongoing environmental and ecosystem assessments to identify the need for environmental protection policies and protected areas in cold regions. Monitor the effectiveness of existing environmental protection efforts.
* Monitoring of black carbon sources, transport and deposition within, to, from and between cold regions, and assessments of its environmental impacts (increased glacier ablation etc.).

(Sources: ACAP [16], AMAP [14], PAME [17])

#### Hazards

Cold region related hazards include large-scale disasters that threaten entire communities or populations, e.g., avalanches, landslides, flooding, severe weather and tectonic hazards, and small-scale hazards to individuals. Earth observations can help identify hazards, determine risks, inform efforts to reduce risk, and inform effective response to events.

Specific Earth observation needs and requirements for hazards in cold regions include:

* A fully integrated snow and avalanche monitoring and warning system covering all populated regions where avalanches are a risk (particularly, but not limited to, mountainous areas).
* The expansion and integration of glacial lake monitoring systems across all glaciated regions to predict and mitigate glacier lake outburst floods (GLOFs), including monitoring of lake and river levels and moraine/ice dam structural integrity.
* A fully integrated slope stability monitoring close to populations and infrastructure, especially in mountainous regions. Integrate slope stability monitoring with GLOF prediction.
* Improved volcanic/seismic monitoring in tectonically active glaciated regions to forecast and mitigate geothermal melt outburst floods (jökulhlaups). Integrate tectonic monitoring with avalanche, GLOF and slope stability monitoring.
* Accurate, precise, real time tracking of wildfires throughout cold regions, using satellite observation to inform most effective and early response. Updates in the order of minutes.
* Improved land/vegetation surveys to improve fire management (e.g. identification of natural firebreaks).
* Improved weather forecasting, hydrological monitoring and land surveys, to improve flood prediction, monitoring, management, defenses, warning systems and response efforts throughout the cold regions.
* Detailed surveys of the natural and built landscape to facilitate better identification of populations and infrastructure at risk due to different hazards, and to inform effective protection, emergency response and evacuation efforts.
* Improved monitoring and tracking of potentially dangerous animals (e.g. polar bears) close to human populations in cold regions to inform safe response for all parties.

(Sources: C-DAC Glacier Lake Monitoring System [18], EPPR [19], ICIMOD [8], S:GLA:MO [20], CAS-NASA HMA [5])

#### Built Environment, Infrastructure & Transport

The harsh and difficult conditions in cold regions present unique challenges for the built environment, infrastructure and transport. Difficulties are escalated due to ongoing environmental change. Earth observations can help inform how and where to build in cold environments, as well as maintenance needs.

Specific Earth observation needs and requirements for the built environment, infrastructure and transport in cold regions include:

* Monitoring of permafrost active layer in areas where infrastructure has been built on tundra, and of the structural integrity and stability of buildings, roads, etc. in permafrost areas.
* Detailed surveys throughout cold regions to identify areas suitable for development.
* Comprehensive, accurate real-time monitoring of roads, rail and other transport networks, in all cold regions, including for ice, flooding, landslides and other potential hazards to users and infrastructure.

(Sources: GTN-P [21], ICIMOD [8], IPA [22], PAGE21 [23], SDWG [13])

#### Energy

The remoteness of many cold region communities often demands that energy is produced locally. This often means reliance on high-emission, polluting fuels for energy, such as diesel, which can be imported by air or sea. Earth observations can help improve energy infrastructure, increasing energy access, and develop renewable energy capabilities in cold regions, reducing emissions, costs and reliance on energy from other regions.

Specific Earth observation needs and requirements for energy in cold regions include:

* Extensive surveys throughout cold regions to assess the viability of developing different renewable energy sources (including wind, solar, geothermal and hydro) particularly for local clean energy production in isolated communities, reducing pollution and reliance on imported fuel.
* Land surveys to inform development of energy grids to deliver power to remote communities.

(Sources: ICIMOD [8], SDWG [13])

#### Mining & Fossil Fuels

Cold regions, particularly the Arctic, are home to abundant, potentially exploitable mineral and fossil fuel resources. The growing global demand for resources suggests that widespread resource extraction in cold regions may be inevitable. Earth observations can not only inform what resources exist in cold regions, and the viability of their extraction, but also responsible practices to minimize environmental and ecological impacts.

Specific Earth observation needs and requirements for mining and fossil fuels in cold regions include:

* Extensive and detailed geological surveys to identify viably exploitable minerals in cold regions, on land and at sea.
* Extensive and detailed fossil fuel surveys to identify viably exploitable resources in cold regions, on land and at sea.
* Monitoring and assessment of the environmental impacts of mining and fossil fuel exploration/extraction and related activities in cold regions to inform necessary mitigation.
* Assessments of likely environmental impacts of potential future mining and fossil fuel exploration/extraction and related activities in cold regions.

(Sources: ACAP [15], AMAP [14], EPPR [18], GEUS [24])

#### Forestry

Forestry is a key economic activity in cold regions. Earth observations can monitor forests and forestry to inform sustainable practices and necessary environmental protection.

Specific Earth observation needs and requirements for forestry in cold regions include:

* Extensive and detailed surveys to identify viably exploitable timber resources in cold regions.
* Forest extent, density and health monitoring throughout cold regions, particularly in areas of intensive logging.
* Monitoring and assessment of the environmental impacts of forestry and related activities in cold regions to inform necessary mitigation.
* Assessments of likely environmental impacts of potential future forestry and related activities in cold regions.
* Identification of opportunities for sustainable plantations with minimal impact on environment and ecology, and monitoring of the impacts of existing plantations, particularly where non-native species have been introduced.

(Sources: AMAP [14], GFOI [25], ICIMOD [8])

#### Shipping

Shipping, already a key activity in cold regions, is predicted to grow as environmental and climate changes open up new sea passages that offer shorter trade routes (i.e., diminishing sea ice in the Arctic Ocean). Nonetheless, shipping in polar waters remains dangerous, and many hazards to life and environment exist. Earth observations can help minimize risks for shipping, by identifying hazards and informing mitigation efforts.

Specific Earth observation needs and requirements for shipping in cold regions include:

* Comprehensive, accurate real-time sea ice monitoring and forecasting (hourly) systems in both the Arctic and Antarctic, including ice extent, concentration, thickness, drift and freeze/break up timing.
* Comprehensive, accurate real-time iceberg monitoring and forecasting (hourly) systems in both the Arctic and Antarctic. Including ice berg frequency, dimensions, draft, motion and disintegration.
* Detailed, accurate, high-resolution and regularly updated bathymetric surveys in all cold region waters, including within fjords and close to calving glaciers, using autonomous underwater vehicles (AUVs) where hazards prevent use of more conventional vessels.
* Establishment of baseline ecosystem conditions to monitor impact of invasive species from ballast waters.
* A comprehensive polar marine traffic awareness system, tracking vessels and improving communications and information sharing between vessels (e.g. local sea ice conditions).
* Continued monitoring of the environmental and ecological impacts of shipping and related activities in cold regions to inform necessary mitigation.
* Assessments of the likely environmental impacts of potential future shipping and related activities in cold regions, particularly in newly accessible waters.

(Sources: Arctic Institute [9], EPPR [18], PAME [16])

#### Tourism

Cold regions have long been attractive destinations for various forms of tourism, be it for the scenery, wildlife, culture, or sport such as skiing and mountaineering. Earth observations can support the development of sustainable tourism that does not damage environment or ecology, while providing much needed economic support for developing communities. In cold regions where tourism is already established, such as the European Alps, Earth observations can provide services for tourists and operators alike, such as snow monitoring and prediction for the skiing industry.

Specific Earth observation needs and requirements for tourism in cold regions include:

* Improved snow and ice forecasting and monitoring for winter and alpine sports.
* Continued monitoring of environmental and ecological impacts specifically related to tourism, e.g. erosion of footpaths and ski pistes, increased pollution, introduction of invasive species and litter.

(Sources: AMAP [14], ICIMOD [8], SDWG [13])

### Fundamental (General) Requirement for GEOCRI？

(A hierarchy structure for the data/observation gaps)

***Action Need: (****could be based on above paragraph****)***

#### In-situ Observations

*Network, like SAON, INTERACT, PEEX…*

#### Satellite Observations

#### Data Products (EVs) – assimilations or reanalysis?

Observations

Towards a comprehensive set of EV’s in the cold regions will be a useful framework for designing future sustainability EO systems

#### Information Services for Cold Regions

*Infrastructure*

*Operational capacity… Data center – gaps? – Operational?*

#### Data Sharing? Or common policy?

Peter Pulsifer

*Global statement – that could be achievable…and obstacle*

## Previous development and results

*Yubao Qiu – WP2012-2015 report? Annual Report?*

*GEO document – evaluation and monitoring document*

*AMBIO Publications, AOS Statement Communique*

*Snow Cover Workshop*

*ECPORS*

*EoE, UNEP*

## Activities description

### Overall planning

*Action Need:* ***Hannle Savela*** *, Siri Jodha Singh Khalsa , Mike Sparrow, Miroslav Ondras, Hiroyuki Enomoto, Yubao Qiu, Massimo* Dominique, Jan Rene Larsen*, and more… HS ok*

The activities conducted in GEOCRI are grouped into six tasks: Data, Infrastructures, Training, Capacity Building and Knowledge Transfer, User Engagement and Communication, In situ and Remote Sensing Integration and S&T, and Monitoring. Each task consists of activities with set milestones and deliverables during the Work Program 2017-2019. The range of deliverables varies from activity reports to stakeholder and user mapping to training and capacity building events and webinars. Majority of the milestones and deliverables in the Implementation Plan for 2017-2019 are set on the two first years of the programme period in order to later add new milestones and deliverables, geared towards transition to implementation and operational stage starting in 2019 and during the next work programme period 2020 onwards.

*To highlight:Capacity Building/Training activities.* Capacity building and training activities include events to educate new generation of scientists to work on Cold Region related questions, which can be done especially with a focus on supporting young scientists from developing regions of the high mountain and Arctic areas, including indigenous youth. Capacity building and training activities will be planned and conducted in collaboration with relevant key actors in the field (e.g. Universiyt of the Arctic network and APECS). Another focus are in training and capacity building will be in providing technical advice and facilitating institutions hosting cold regions data to register their datasets to GCI and/or GEOSS Data-Core.

### Tasks

*Actions: need a graph to demonstrate- Tasks definition and overall logic and phasing*

*Tasks description (for each of them: description, planning, partners responsibilities, resources)*

Tasks are overarching themes that consist of activities done with ***Task Teams(4-6 people could be best)***. There are 6 Tasks in GEOCRI:

Task 1：Data, (in-situ, remote sensing, and modeling, assimilation)

Task 2：Infrastructures, (GCI: brokering/research E-Infrastructures, physical Infrastructures: stations, ships…, information services related to these)

Task 3：Training and Capacity Building and Knowledge transfer)

Task 4：User Engagement and Communication, (gaps analysis)

Task 5：In-situ and Remote Sensing Integration, and (suggestion: move to data) S&T

Task 6：Monitoring

The Tasks and related activities are on a general level defined by the whole GEOCRI community, who can also suggest activities and their outcomes to be conducted under the tasks. Contributors can assign themselves to work for different tasks and related activities; these will form Task Teams. Task Teams will themselves decide on the planning and responsibilities of their activities, and the set milestones and deliverables will be reported to the co-leads and presented to contributors who will provide feedback.

Table below lists the Tasks and related activities, as well as the milestones and deliverables to be completed by the GEOCRI Task Teams, lead by nominated Task Coordinatorsduring the Work Programme 2017-2019. Some activities can be fulfilled quickly, whereas others require sustained efforts to fully implement. Some activities are relatively easy to realize, and others are more difficult, requiring significant resources or high-level mandates to be obtained. Majority of the milestones and deliverables are set on the two first years of the programme period, in order to later add new milestones and deliverables, geared towards transition to implementation and operational stage in 2019 and the next work programme period 2020 onwards.

The importance, difficulty and progress of each activity are roughly indicated by the following criteria (low scores indicate priority activities or ‘low hanging fruit’ that should be implemented first).

Importance:

1. An important activity, which if GEOCRI does not do, nobody will. GEOCRI will take the leading role
2. GEOCRI can offer support to other initiatives working towards this activity
3. GEOCRI supports this activity, but is not needed to actively participate directly

Difficulty:

1. Relatively easy, can be implemented quickly without additional resources or mandate
2. Will take time (maybe even years) and work to implement, but is possible without additional mandate. No political or funding barriers to action
3. Difficult to implement, requires political mandate or funding/other resources to be secured.

Progress:

1. Activity has already begun and is ongoing with progress
2. Activity has not started or has started but is not currently active. No significant barrier is preventing progress
3. Activity has not started, or has stopped. A significant barrier is currently blocking progress for the time being.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tasks** | **Importance** | **Difficulty** | **Progress** | **Contributing institutionss** | **Milestones and Deliverables & Time schedule** |
| **Task 1.Data**  **Task Team: Peter Pulsifer, Jeff Key, Yubao Qi, Julie Friddell, Tom Barry, Hiroyki Enomoto, NIPR, Massimo Menenti, CSIC** | | | | | |
| **Activity 1.1** Identify needs and requirements for cold region Earth observation data and information for all users, both within and outside of cold regions. Make regular updates as needs and requirements change and emerge. | **1** | **2** | **1** | **SAON ADC/CON CCIN/ PDC**  **RADI/CAS**  **GCW** | **Milestone:** Analysis of existing and ongoing consultations on user needs **(**XII 2017). **Deliverable (:** Summary of the identified needs and requirements and action plan to implement the findings.XII2018) |
| **1.2** Identify and map existing cold region Earth observation data and information collection efforts. Identify where there are gaps in cold region Earth observing efforts that must be filled to meet the needs and requirements defined in Activity 1.1 | **1** | **2** | **1** | **SAON ADC** | Milestones and deliverables led by SAON ADC and aligned with the ones in 1.1 |
| **1.3** Incorporate cold region databases, such as the Arctic Data archive System (ADS), the SAON data inventory and ICIMOD’s Regional Database System, The Arctic Biodiversity Data Service into the GCI. | **1** | **2** | **1** | **SAON** (in collaboration with EU-PolarNet) **CCIN/ PDC**  **RADI/CAS**  **CAFF**  **JAMSTEC**  **NIPR** | **Milestone :** Institutions hosting Cold region databases identified and contacted (XII 2017).  **Deliberable :** List of Cold Region database holders + promotional material (XII 2017) |
| **1.5** Engage with Arctic Portal to explore potential for incorporating datasets hosted on their websites with GCI. | **1** | **2** | **2** | **CCIN/ PDC** | **Milestone:** Arctic Portal contacted for discussions (VI2017) |
| **1.6** Support GCW in the development and expansion of CryoNet, identifying best practices for observations, sharing open data principles and capacity development activities. Incorporate CryoNet data into GCI. | **2** | **2** | **1** | **CCIN/ PDC**  **GCW?** | **Milestone:** Discussions initiated with GCW and possibilities for supported activities and related actions identified (VI2017). |
| **1.7** Support ICIMOD in developing a HimalyanGEOSS, sharing GEO’s broad open data principles and capacity building expertise, and incorporating Himalayan observations into the GCI. Connect other initiatives, such as TPE, WMO/GCW, PEEX, and WCRP/CliC to maximize the effectiveness and scope of the HimalayanGEOSS. | **1** | **2** | **1** | **GCW**  **RADI/CAS + TUD** | **Milestone**: ICIMOD contacted for discusisons (III2017)  **Deliverable :** Jointly produced action plan for possible collaboration and related activities (IX2017) |
| **1.8** Analyze and report on alignment between GEO/GEOCRI data principles and policies and the data principles and policies established by  SCAR, IASC and SAON. | **1** | **1** | **2** | **SAON**  **Others ?** | **Milestone:** Analysis completed (III 2018)  **Deliverable :** Report on the alignments in the data principles (XII 2018) |
| **Task 2 Infrastructures**  **Task Team: Hannele Savela, Jeff Key** | | | | | |
| **Activity 2.1** Create dialogue between infrastructure networks for collaboration and more efficient use of infrastructures | **1** | **2** | **2** | **INTERACT**  **GCW** | **Milestone 1:** Cold regions related infrastructure networks and projects invited to GEOCRI (III2017)  Milestone 2: Meeting arranged to facilitate collaboration (III2018)  **Deliverable**: Minutes of the meeting (IV2018) |
| **2.2** Advocate and support incorporation of different research infrastructure catalogues on cold regions (e.g. INTERACT, Eu-PolarNet, UArctic) to GCI. | **1** | **2** | **2** | **INTERACT**  **GCW**  **SAON CON** | **Milestone 1:** Cold regions related infrastructure catalogue hosts contacted(III2017)  **Milestone 2:** Training/webinar for technical support (III2018)  **Deliverable:** Summary of the development (XII2019) |
| **2.3** Consolidating operational users' needs and information gaps to support development of future Arctic infrastructure (e.g. ESA Polaris and EU PolarNet). | **2** | **2** | **2** | **ESA EOP?**  **EU-PolarNet?**  **INTERACT**  **Others?** | **Milestone:** Analysis of existing and ongoing consultations on user needs and information gaps (III 2018) **Deliverable :**Summary of the identified needs and gaps and action plan of the support process. **(**III2019) |
| **Task 3. Training and Capacity Building**  **Task Team:** Hannele Savela, Peter Pulsifer, Julie Friddell, other Co-leads? | | | | | |
| **Activity 3.1** Increase awareness of possibilities related to GEOCRI, GCI and GEOSS Data-CORE. and | **1** | **1** | **2** | **Co-leads team?** | **Milestones:** Ongoing process 2017-2019.  **Deliverables:** Promotional material, e-mail campaigns etc. in 2017-2019. |
| **3.2** Arrange practical training on incorporating data to GCI and GEOSS Data-CORE | **2** | **2** | **2** | **Co-leads team?** | **Milestone:** Webinar training on how to tag data to GEOSS Data-CORE and/or register it to GCI (XII2017, XII2018, XII2019). |
| **3.3** Arrange training to build capacity and educate new generation of researches on cold regions (e.g. via UArctic network and APECS) | **3** | **2** | **2** | **INTERACT**  **CSIC**  **SAON ADC (in collaboration with** APECS & SCADM) | **Milestone:** UArctic and APECS contacted and invited to collaborate(III2017)  **Deliverable:** Plan on possible jointly arranged training(IX2017) |
| **Task 4. User Engagement and Communication**  **Task Team:** Co-leads, Jan Rene Larsen | | | | | |
| Activity 4.1 Establish a science advisory group within GEOCRI to ensure awareness of science priorities established by such efforts as the SCAR Horizon Scan and the IASC ICARP III, and to identify any gaps based on the work of GEOCRI. | **1** | **1** | **2** | **Co-leads team**  **SAON**  **INTERACT** | **Milestone:** Potential Science Advisory Group members invited (I 2017)  **Deliverable**: Science Advisory group established and convened first time (VI 2017). |
| **Activity 4.2** Maintain regular communications with all GEOCRI participants, GEO secretariat and other members of GEO communitywith updates on activities. Help to forge synergies and collaborations between GEOCRI participants. | **1** | **1** | **2** | **INTERACT**  **Co-leads team?** | **Milestone:** GEOCRI meetings (on-line or physical (XII2017-2019)  **Deliverable:** Minutes of the meetings (XII2017-2019). |
| **4.3** Engage with current non-GEO member cold region countries to explore potential for membership –notably Bhutan, Bolivia, Kyrgyzstan, Mongolia and others. Engage existing members and participating organizations to participate in GEOCRI activities more actively. | **1** | **3** | **2** | **Co-leads?** | **Milestone:** Country representatives and potential new contributors contacted to initiate discussions (VI2017). |
| **4.4** Look to engage new organizations working in cold regions with GEOCRI and GEO, including also the private sector | **1** | **2** | **2** | **INTERACT**  **Co-leads team?** | **Milestone:** Campaign to invite new contributors to GEOCRI conducted (VI2017).  **Deliverable:** Promotional material (XII2019) |
| **4.5** Liaise with other GEO activities to find potential synergies and map potential overlaps with them. | **1** | **2** | **2** | **INTERACT**  **Co-leads team?** | **Mileston1e:** Related GEO activities contacted for dicussions (XII 2017).  **Milestone2:** Potential synergies and overlaps identified (VI2019).  **Milestone3:** Map of potential synergies and overlaps with an action plan of possible collaboration (XII2019). |
| **4.6** Promote and advocate the use of coordinated, comprehensive and sustained cold region Earth observations to inform decisions and actions by policy makers, industry, local communities, researchers and others. | **2** | **1** | **1** | **INTERACT**  **GCW**  **Co-leads team?** | **Milestone**: Participation with presentation(s) to joint forums with different stakeholders(ongoing 2017-2019)  **Deliverables:** Presentations, abstracts, statements, white papers. |
| **4.7** Advocate defining of cold regions earth observations essential variables to more effectively meet the cold region Earth observation needs and requirements of users. | **2** | **3** | **2** | **SAON? INTERACT** | **Milestone1:** Key actors for defining the cold region key variables identified (XII2017)  **Milestone2:** Key actors contacted for discussions (III2018)  **Deliverable:** Work plan for defining the cold regions earth obsrvations essential variables (XII2018) |
| **4.8** Develop GEOCRI logo and visual branding. Push for GEOCRI, GEO and GEOSS lto feature in cold region Earth observation relevant reports and documents where appropriate. | **1** | **1** | **2** | **RADI/CAS** | **Milestone:** GEOCRI logo and visual branding developed (XII2017)  **Deliverable 1:** Logo (XII2017)  **Deliverable 2:** Visual image instructions (XII2017) |
| **9** |  |  |  | **Co-leads**  **SAON** |  |
| **Task 5 Integrating In Situ and Remote Sensing Observations**  **Task Team:** Hannele Savela, Yubao Qi, CSIC?, Jeff Key, Massimo Menenti, Peter Pulsifer | | | | | |
| **Activity 5.1** Establish a forum for meeting and dialogue to encourage links and collaboration of cold regions in situ and remote sensing communities. | **1** | **2** | **1** | **INTERACT**  **RADI/CAS**  **CSIC：Emis**  **GCW, TUD**  **SAON ADC/CON** | **Milestone1:** Relevant community members identified and contacted.(IX2017)  **Milestone2:** Joint meeting or webinar arranged (III2019)  **Deliverable3**:Meeting minutes (IV2019)  **Deliverable4:** Joint publication? (XII2019) |
| **Task 6. Monitoring**  **Task Team:** Jeff Key, Hannele Savela, Someone from SAON?, JAMSTEC, Hiroyki Enomoto , Tom Barry, Julie Friddel | | | | | |
| **Activity 6.1** Support SAON to develop and maintain an inventory of existing cold region Earth observations initiatives including organizations, programs, projects, networks and systems, particularly those which are active or have impact internationally and regionally. | **1** | **1** | **1** | **SAON** (in collaboration with EU-PolarNet)  **INTERACT,**  **GCW** | **Milestone :** Existing cold region Earth observations initiatives identified (XII2019).  **Deliberable :** List of existing cold region EO initiatives (XII 2017) |
| **6.3** Leverage GEO’s international position to align other initiatives with Arctic Observing System efforts and SAON where this is not already the case, including WMO (EC-PHORS, GCW, PRCC, WWRP etc.) WCRP (CliC), PPP/YOPP, INTERACT, EU-PolarNet and the successful candidate for the H2020 topics BG-09 and BG-10 in 2016 and BG-11 in 2017. | **1** | **2** | **1** | **SAON**  JAMSTEC  NIPR | **Milestone:** Discussions initiated with SAON (III2017)  **Deliverable:** Plan of support activities to SAON (XII2017) |
| **6.2** Support SAON as the lead organization in establishing an Arctic Observing System. Support their existing efforts, share expertise. Explore the case for establishing SAON as a Regional GEO (i.e. GEO / Arctic) that would contribute to GEOCRI |  |  |  | **SAON**  **Co-leads team** |  |
| **6.4** Engage with GEOBON and CAFF/CBMP , to support the development of ArcticBON and integrate it as the biodiversity component of the Arctic Observing System. | **1** | **2** | **1** | **CAFF INTERACT**  **Co-leads team?** | **Milestone:** Start discussions with relevant representatives and initiatives for possible collaboration (III2017) |
| **6.5** Support AmeriGEOSS in developing observing systems for mountain regions in the Americas, including the Andes and Rockies, as well as North American Arctic and South American sub-Antarctic. Engage with other initiatives such as WMO/GCW, WCRP/CliC and others to collaborate and maximize the effectiveness and scope of cold region components of the AmeriGEOSS. | **1** | **2** | **2** | **CCIN/ PDC**  GCW | **Milestone:** AmeriGEOSS contacted for discussions (VI2017)  **Deliverables:** Minutes of the meeting(s) |
| **6.6** Support observing system networks, including WMO/EC-PHORS in developing, expanding and sustaining the terrestrial Antarctic Observing Network (AntON), and SCAR/SCOR with the interdisciplinary Southern Ocean Observing System as well as support the development of new observing systems such as SCAR's AntOS, working with key regional actors such as SCAR, SOOS, WCRP/CliC, WMO/GCW, PPP/YOPP, COMNAP etc. and research institutions active in the Antarctic (AAD, AARI, AntarcticaNZ, AWI, BAS, BAI, CSIC, USAP, etc.). | **1** | **3** | **2** | **GCW** | **Milestone:** Discussions initiated with Antarctic observing system netowks key actors (XII2018)  **Deliverable:** Summary of key support actions during the GEO Work Program 2017-2019 (XII2019) |
| **6.7** Engage with existing observing networks in cold regions, such as GTN-P, GLISN, GLMS, GCW, SIOS, etc. and emerging cold region regional observation networks to contribute to GEOCRI. Promote incorporation of data from these networks to GCI. | **1** | **2** | **2** | **INTERACT**  **CCIN/ PDC GCW** | **Mileston1e:** Existing networks contacted and invited(XII2017)  **Milestone2:** Emerging networks contacted (XII2017-2019**)**  **Deliverable:** Face-to-face or on-line meetings and their minutes. |
| **Reserve activities (Activated later on)** |  |  |  |  |  |
| Support for Arctic science agenda, building on international assessments (e.g. ICARPIII), projects (e.g. H2020 EU-PolarNet) and programs (e.g. ESA Polaris) and other similar initiatives throughout Cold Regions | **2** | **2** | **2** | **Whole GEOCRI community** |  |
| **1.4** Support the implementation of YOPP. Advocate broad open data policies for all YOPP activities and aim to incorporate Earth observations from YOPP initiatives and legacy initiatives into the GCI. | **2** | **2** | **1** |  |  |
|  |  |  |  |  |  |
| **6.4** Work to secure funding from GEO members to develop and maintain sustained observing systems for cold regions. | **1** | **3** | **2** |  |  |

## Impact

GEOCRI will have a positive impact on cold region Earth observation efforts. By leveraging GEO’s international position and coordinating power, GEOCRI can foster collaborations between different Earth observing initiatives to identify gaps, avoid duplications and improve efficiencies. Through GEOCRI, links can be developed between observation, research, and policy actors, creating synergies which contribute effectively and efficiently to GEO’s societal benefit areas (SBAs) as well as the UN’s 2030 Agenda for Sustainable Development.

### GEOCRI and existing cold region Earth observation efforts

GEOCRI adds value to existing efforts for Earth observations in cold regions in the following ways:

* GEO’s convening power allows GEOCRI to provide a **stakeholder forum** to discuss cold region Earth observations, identifying needs, requirements, opportunities, and best practices etc., complimenting existing cold region Earth observation initiatives.
* GEOCRI shares GEO’s **knowledge and expertise** for capacity building, enabling users to maximize their ability to benefit from Earth observations throughout cold regions.
* Through GEOSS and the GCI, GEOCRI can ensure cold region Earth observations data and information can be effectively integrated with global Earth observations and observing systems, and ensure the integration of both in situ and remotely sensed Earth observations.
* GEOCRI is able to leverage GEO’s **international position** to help secure the necessary mandates for cold region observing systems and broad open data policies at the highest government levels.
* GEOCRI provides a neutral **communication forum** to communicate policy-relevant cold region Earth observation results in international, national and regional levels based on science and tested best practices.

### GEOCRI and the Societal Benefit Areas

GEO’s Societal Benefit Areas (SBAs) are the domains in which Earth observations are translated into support for decision-making. GEO will facilitate the development of solutions to societal challenges within these SBAs by mobilizing resources including observations, science, modelling and applications, to enable end-to-end systems and deliver services for users. In order to address the unique challenges and issues associated with cold regions, GEOCRI must tailor its approach to the SBAs.

It is important to highlight the interconnected nature of cold region environments with other regions of the planet. SBAs are trans-regional, with issues emanating from cold regions impacting warmer areas and vice versa. Use of Earth observations must reflect the interconnectivity of the issues which they are intended to address. This is particularly true for cold regions.

While GEOCRI is officially an initiative within the Water Resources Management SBA, its relevance is cross-cutting: issues in cold regions are entrenched in all domains represented by the SBAs.

The SBAs are listed below with a brief summary of the issues specific to cold regions and how GEOCRI can help address them.

#### Biodiversity and Ecosystem Sustainability

Cold regions are home to some of the most sensitive and threatened ecosystems on the planet. GEOCRI, in collaboration with GEOBON, GFOI and others, can coordinate Earth observation efforts to effectively monitor biodiversity and ecosystems in cold regions.

#### Disaster Resilience

Cold regions are susceptible to a wide range of potential disasters, including from hazards which threaten all regions, and hazards specific to polar and mountain regions. Cold region Earth observations can help with all aspects of disaster management (mitigation, preparedness, warning, response and recovery) and build disaster resilience for vulnerable regions and populations.

#### Energy and Mineral Resources Management

Cold regions are home to a wide variety of resources with potential for exploitation. Earth observations can help inform appropriate actions to protect populations and environment while sensibly and appropriately exploiting resources. Furthermore, Earth observations can help to inform better use of energy and mineral resources in cold regions to improve sustainability and reduce negative impacts.

#### Food Security and Sustainable Agriculture

GEOCRI advocates the value of Earth observation data and information to support Food Security and Sustainable Agriculture in cold regions, particularly in order to adapt effectively to ongoing climate change. Environmental and climatic conditions often limit opportunities for agriculture in cold regions, but with Earth observations, yields can be sustainably increased and new opportunities established to improve food security for cold region populations. GEOCRI will collaborate closely with GEOGLAM to make progress in this SBA.

#### Infrastructure and Transportation Management

Due to environmental challenges, infrastructure and transportation are key issues in cold regions. Earth observations can inform the design, maintenance and management of all infrastructure and transport facilities including roads, energy networks, buildings and utilities. Earth observations can help address issues associated with cold regions, including infrastructure and transportation issues related to extreme temperature, permafrost and slope instability, and others.

#### Public Health Surveillance

GEOCRI advocates the value of Earth observations to support Public Health Surveillance, by yielding insight into the threat of vector-borne and environmentally-linked diseases in cold regions. Earth observations can help monitor environmental pollution and health risks, substantially reducing the number of fatalities and illnesses in cold regions. This is a particularly acute issue for Indigenous communities, of which there are many in cold regions, where poor health is often a greater problem than amongst the general population.

#### Sustainable Urban Development

Due to the sensitivity and fragility of polar and mountain environments and ecosystem, sustainable urban development is essential. Earth observations, coordinated by GEOCRI, can inform urban development decisions and monitor the impacts of urban areas throughout cold regions.

#### Water Resources Management

*Refer to water strategy (MM)*

Cold regions include some of the most water stressed areas of the planet. GEOCRI is able to coordinate Earth observations to accurately inform water resources management to ensure sustainability for populations and ecosystems. Cold regions are a source of water essential to sustaining billions of people in other regions. This adds further importance to effective water resources management in cold regions, which can only be achieved with appropriate Earth observations.

### GEOCRI and the 2030 Agenda for Sustainable Development

The United Nations’ 2030 Agenda for Sustainable Development provides a universal development agenda for all countries and stakeholders to use as a blueprint of action for people, the planet and prosperity. The agenda is anchored by seventeen Sustainable Development Goals (SDGs), associated targets, and a global indicator framework. Collectively, these items assist countries and the global community to measure, manage, and monitor progress on economic, social and environmental sustainability. GEOCRI, in collaboration with GEO Initiative 18 (Earth Observations in Service of the 2030 Agenda for Sustainable Development), will organize and realize the potential of Earth observations to advance the 2030 Agenda and enable societal benefits through achievement of the SDGs throughout cold regions.

The 2030 Agenda and the SDGs are highly relevant to cold regions, particularly in developing Arctic and mountainous regions. GEOCRI is uniquely positioned to coordinate both in situ and remotely sensed Earth observations to track progress within the indicator framework towards achieving the SDGs in cold regions.

Earth observations in cold regions will not only be important for monitoring SDG progress, but also for actively achieving the SDGs, with data and information informing best approaches and identifying new sustainable development opportunities.

Due to the interconnectivity and trans-regional nature of sustainable development issues, as outlined in the context of the SBAs above, Earth observations in cold regions are important for realizing the 2030 Agenda and achieving the SDGs in all regions of the planet. Cold region Earth observations are essential for sustainable development everywhere, particularly with regard to issues surrounding water, food, health, climate, energy and biodiversity.

Further, SDG targets are also of concern to people living in cold regions and thus many indicators affect related countries and communities. The table below highlights some of the approved SDG indicators for which cold regions Earth observations will be essential for monitoring. GEOCRI will work to coordinate Earth observation efforts in cold regions to ensure effective tracking and monitoring of progress for these indicators and others.

|  |  |
| --- | --- |
|  | **Indicators requiring cold region Earth observations** |
| 2.1.2 | Prevalence of population with moderate or severe food insecurity, based on the Food Insecurity Experience Scale (FIES) |
| 2.4.1\* | Percentage of agricultural area under sustainable agricultural practices |
| 2.5.2\* | Percentage of local crops and breeds and their wild relatives, classified as being at risk, not-at-risk or unknown level of risk of extinction |
| 6.3.1 | Percentage of wastewater safely treated |
| 6.3.2 | Percentage of water bodies with good ambient water quality |
| 6.4.1\* | Percentage change in water use efficiency over time |
| 6.4.2\* | Percentage of total available water resources used, taking environmental water requirements into account (level of water stress) |
| 6.6.1 | Percentage of change in water-related ecosystems extent over time |
| 9.1.1 | Share of the rural population who live within 2 km of an all season road |
| 9.4.1 | CO2 emission per unit of value added |
| 11.3.1 | Ratio of land consumption rate to population growth rate |
| 14.3.1 | Average marine acidity (pH) measured at agreed suite of representative sampling stations |
| 14.4.1\* | Proportion of fish stocks within biologically sustainable levels |
| 15.1.1\* | Forest area as a percentage of total land area |
| 15.2.2 | Net permanent forest loss |
| 15.3.1\* | Percentage of land that is degraded over total land area |
| 15.5.1 | Red List Index |
| \* | *Denotes indicators which have not yet been formally agreed upon* |

### GEOCRI and the Paris Agreement

### GEOCRI and the Sendai Framework for Disaster Risk Reduction 2015-2030

## Partners

(PROVISIONAL From GEO Work Programme. Does this need updating?)

*Need to insert the contacts section?? Yubao Qiu HS ok*

-

The following table lists the current GEOCRI Partners, whose status is expressed in relation to the level of involvement either as an co-lead, contributor or an observer.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Organisation** | **Country** | **Representation** | **Contact** |
| ***Co-leads*** |  |  |  |  |
| Yubao Qiu | Institute of Remote Sensing and Digital Earth, Chinese Academic of Science | China | RADI, CAS  HMA Group | GEOCRI Point of Contact [qiuyb@radi.ac.cn](mailto:qiuyb@radi.ac.cn) |
| Hannele Savela | Thule Institute, University of Oulu | Finland | INTERACT, UArctic?  EU-PolarNet | hannele.savela@oulu.fi |
| Person y |  |  |  |  |
| Hiroyuki Enomoto | National Institute of Polar Research (NIPR), Arctic Environment Research Center (AERC) | Japan |  | [enomoto.hiroyuki@nipr.ac.jp](mailto:enomoto.hiroyuki@nipr.ac.jp" \t "_blank) |
| Takeshi Kawano | JAMSTEC | Japan | JAMSTEC will conduct hydrographic observation in the Arctic ocean  for coming several years, and will provide data through the web (ADS,  our site, and so on). | [kawanot@jamstec.go.jp](mailto:kawanot@jamstec.go.jp) |
| **Contributors** |  |  |  |  |
|  |  |  | INTERACT |  |
|  |  |  | SIOS |  |
|  |  |  | EU Polar-Net? | HS will ask N. Biebow |
|  |  |  | UArctic? | HS will ask L. Kullerud |
|  |  |  | Click? | HS will ask L. Hislop |
|  |  |  |  |  |
| **Observers** |  |  |  |  |
| Emilio Garcia, Carolina Gabarro | Institute of Sea Science | Spain | CSIC | [cgabarro@icm.csic.es](mailto:cgabarro@icm.csic.es) |
|  |  |  | EC | HS will ask |
|  |  |  | ESA | HS will ask |

GEOCRI will also liaise and work in collaboration with other GEO initatives, including GEOBON, GFOI, AmeriGEOSS, HimalayanGEOSS, GECO, GEOGLOWS, GEO-GNOME, GSNL, Global Wildfire Information System, GEO-DARMA and GEOGLAM.

## User engagement

*Hannele Savela and all HS ok*

*How the established user communities link to the initiative*

Cold region Earth observation user communities include scientists, policy-makers, industry, business and commerce, students, and local communities. Earth observation data and information should meet the needs and requirements of these different user communities. GEOCRI User engagement will be done by utilizing several modalities ranging from face-to-face events and capacity building to on-line surveys and –ultimately- operational services developed in contact with the users.

In 2017-2019, the first stage of activities by the User Engagement and Communication Task Team will include the identification of current and potential user communities, and their specific features, and consultation with these user communities about their needs and expectations on the content and modality of the information services that they would like GEOCRI to offer. The second stage will be planning, development and implementation of the services based on the user community identification and consultation. Continuous dialogue and engagement with the user communities is needed at all stages of GEOCRI activities.

*How the activity would benefit stakeholders (in particular developing countries)*GEOCRI benefits its stakeholders by supporting the provision of accurate and timely Earth observation data and information. As outlined in chapter 5, GEOCRI contributes to all eight GEO SBAs.

In addressing all eight of the GEO SBAs, GEOCRI’s benefits are wide reaching with impacts in all domains as well as in cross-cutting issues like climate change. Furthermore, GEOCRI, through its contributors, engages with a range of stakeholders, including scientists, policymakers, local communities and businesses. Close stakeholder engagement will ensure that GEOCRI works to effectively address user needs and requirements to maximize benefit.

Examples of expected benefits to stakeholders include improved mitigation of the local inhabitants to the climate change effects, improved climate-change related decision making at national, regional, international and global level, more efficient use of research infrastructures in cold regions, and improved open data availability of cold regions related Earth observations.

*How the activity feeds into decision-making processes*

By leveraging the global visibility and convening power of GEO, GEOCRI makes a positive contribution to national, regional and international decision-making processes and science strategies. GEOCRI, via its contributors, feeds reliable, science-based Earth observation data and information to policy makers, enabling well-informed and more effective decisions in cold regions and beyond.

## Data policy & management

*Peter Pulsifer, Julie Friddell , Yubao Qiu*

*To include*

*Use of GEOSS resources*

The use of GEOSS resources will be advocated both within the GEOCRI and to the identified key Earth observation user communities. The dialogue will be two-directional in a manner that encourages both the use of the GEOSS resources and provision of new resources to GEOSS.

*Interfaces with GEOSS/GCI (of the datasets/products/services used or developed within the Initiative/Flagship) Yubao Qiu CP (Ken M.)*

The first stage is to integrate the existing cold regions datasets, products and services to the GCI via the GEO Discovery and Access Broker (GEO DAB) and GEOSS Data-CORE. The work in this field is led by the Data Task Team that will identify and approach the relevant data producers and facilitate the integration by provision of information and training. In the second stage, new datasets, products or services within GEOCRI community will be developed and integrated with the GCI and/or GEOSS Data-CORE.

*Data sharing & data management policy and practice for the Initiative/Flagship)*

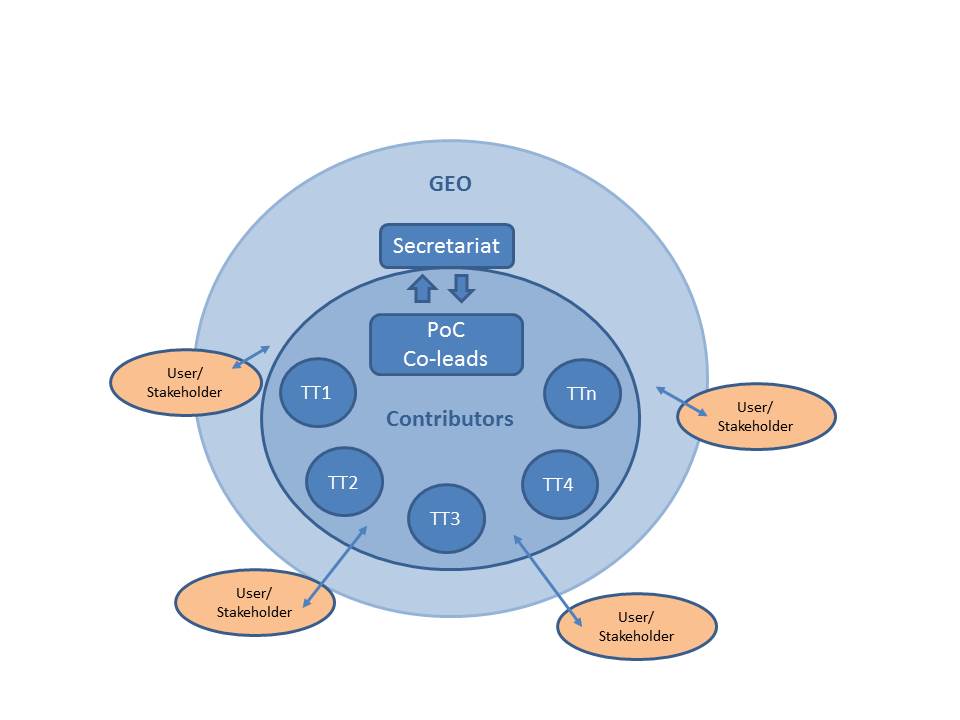
GEO’s advocating of broad open data policies and data sharing principles is replicated by GEOCRI as well as its contributors and community. GEOCRI shares knowledge, best practices and training to build capacity in this area.

## Management arrangements, monitoring and evaluation approach and reporting

### Management

*Hannele Savela, Yubao Qiu or others？HS ok*

The management structure for GEOCRI is presented in the Figure 2.



*Figure 2 GEOCRI Management Structure*

The GEOCRI community consists of contributors that are arranged into theme-specific Task Teams according to their interests. Each Task Team has a list of activities that they work on, and report their progress to the team of co-leads, consisting of seven GEOCRI members and the Point of Contact (*Yubao Qiu*). The co-lead team works together with the GEO Secretariat in producing the Implementation Plan and the Work Plan for the GEO Work Programme, and offer over all coordination of GEOCRI activities and efforts.

Task Teams convene when necessary, whereas the co-lead team convenes at least twice a year. All GEOCRI members are kept informed about the progress via summaries provided through an e-mailing list and by arranging face-to-face meeting where possible (e.g. as side events to GEO meetings and at major scientific conferences).

All GEOCRI contributors have a possibility to contribute to the work and implementation plans, and take part in those Task Teams where they find their contribution is most suitable.

In addition, an institution can join GEOCRI as an Observer, which means that they will be updated about the progress and activities, without not directly taking part in the activities.

A Scientific Advisory Committee, consisting of high-profile scientists will be convened in late 2016-early 2017. The group will convene when necessary to provide advice on the GEOCRI activities. Terms of Reference will be developed in 2017 to verify the management and coordination structure of GEOCRI.

### Monitoring and evaluation

The GEOCRI progress will be monitored by the GEO Program Board. The progress will also be monitored internally by collection of feedback from the GEOCRI community at regular time intervals.

### Reporting

Actions: shall we need more? HS ok!

Reporting on GEOCRI will be donevia progress reports of the Task Teams to co-leads and short summaries of the recent developments, presented to all contributors. Also, necessary reporting of the activities and plans – e.g. the implementation and work plan – will be provided to the GEO Secretariat and **Program Board**, then to the **GEO ExCOM** and **Plenary**. Summaries of GEOCRI activities and achievements will also be provided to the observers and stakeholders to keep them updated on the progress.

Note: Provide the summary to Future Earth, EC…

## Committed Resources and annual budget(s)

GEOCRI’s resources are predominantly in-kind efforts, and are aimed at leveraging the resources of participating initiatives and organizations to align with GEOCRI’s objectives.

List all contributed resources (financial, in kind, etc.) and the source,

*Yubao Qiu can handle these:*

**Here is the list for this year, that we might input as the early draft version for comments and input….**

* + The Global Cryosphere Watch (**GCW**) will hold its second Asia CryoNet meeting in February 2016 in Salekhard, Russia. The goal is to further develop a regional GCW group focused on surface measurements in the Third Pole region and the Russian Arctic. A similar effort is underway in South America, with a second South America workshop planned for 2016. ($120,000 for both workshops)
  + **SAON** will continue to work with these contributions: Documenting and understanding the Arctic data management ecosystem; Identifying and promoting common metadata elements; Engaging in data citation and publication movement; Promoting interoperability through action - interoperability experiment; Inventory of arctic observational projects as a contribution to EU PolarNet; Community Based Monitorin (CBM) atlas.
  + **CAFF/CBMP: Continues to develop and maintain the Arctic Biodiversity Data Service (ABDS) as the supporting framework to facilitate long-term biodiversity data sharing and as a source of data for ecosystem-based management. This includes a focus on interoperability with partners such as GBIF, OBIS and PDC.**

(The Circumpolar Biodiversity Monitoring Program (CBMP or Arctic BON) the cornerstone programme of the Conservation of arctic Flora and Fauna (CAFF) Arctic Council Working Group is an international network (involving eight ‘Arctic’ countries) of scientists, governments, indigenous organizations and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources. Launched in 2005, the CBMP has developed and is implementing pan-Arctic biodiversity monitoring plans for marine, coastal, terrestrial and freshwater ecosystems. The CBMP is endorsed by the Arctic Council and the CBD and is an official network of GEO BON.**)**

* + **INTERACT** continues building capacity for research and in-situ observations throughout its pan-arctic station network, and bridging of the in-situ and remote sensing communities via joint activities and events. Open access to metadata and data and will be advocated in the station network, as well as efforts to connect open access metadata and data with global data portals such as the GEOSS Data-CORE. Collaboration with arctic and polar scientific organizations and input to strategic and scientific assessments continues. Outreach activities to inform policy makers, other stakeholders and the general public will be continued in various forms. (in-kind, national and international resources for 2016 to be identified later in 2015)
  + **PEEX** will launch a comprehensive PEEX metadata collection and build a Modelling Demo ("PEEX View")
  + **SIOS** Implementation phase will become a full-fledged activity during 2016 with the establishment of the knowledge centre in Longyearbyen supported by Norway and several nations in the SIOS consortium. 2016 activities will focus on establishing an open access data portal, access and logistics program and identifying pilot projects for filling gaps in data acquisition for the Svalbard archipelago. (In kind and international resources for 2016 to be identified; Norway will contribute at least 1 000 000 EUR, Italy to CCT-IP: 100, 000 Euro).
  + **IADC** (Italian Arctic Data Centre) will be implemented as the portal of the Italian research activities in the Arctic. In the frame of the Antarctic Research National Programme (PNRA) a distributed cyber-infrastructure (National Antarctic Data Center- NDAC) will also be developed. Both actions, based on the brokering approach will be integrated in a unique Polar Data Infrastructure (PDI) (Euro: 200.000).
  + Establish flagship stations within the **Third Pole** region for observation and monitoring; (US Dollars : $200,000),Set up rain gauge along the altitudinal range from 2000 m to 6500 m in a river basin of the Tibetan Plateau, and to obtain the elevation-dependent precipitation data.
  + Snow Observations over Tibetan Plateau (**SOTP**) will continue to explore the remote sensing snow cover products over Tibetan Plateau, with in-kind and somehow $120,000 support from NSFC.
  + **ESA – MOST Dragon 4** Hydrology and Cryosphere Theme: It is expected that the current 10 projects under Dragon 3 will be clustered and continue through fewer but larger projects. As in Dragon 3, ESA is expected to provide limited support towards PhD / postdoc work under selected research projects. MOST / NRSCC supports Dragon projects through open Call for Proposals. Total resources committed to selected projects approximately estimated at 2 106 Є over the period 2016~2019.
  + CNR through Climate Change Integrated Project (**CCT-IP**) will continue to promote the upgrading of Ny Alesund as observation super-site in the Arctic ( Euro : 100.000).
  + A Chinese cubesat named **TW-1A** aiming for polar sea ice observation is scheduled to launch in October, 2015 and will provide satellite observations from December of 2015 in both Polar Regions. This satellite is proposed by Beijing Normal University and developed by Chinese Academy of Sciences.
  + The observations by the intended **Chinese Water Cycle Mission (WCOM)** with a dual frequency dual polarized microwave radiometer would fill a gap in current European observations and would be highly relevant to monitoring of water resources. The mission will provide observations of SWE, precipitation and soil moisture.( $1.5M).
  + Cryosphere Monitoring Programme (**CMP**) will continue to explore the snow, glacier, glacial lake and GLOF over Nepal. This program is extended to Bhutan and Pakistan with support from The Norwegian Ministry of Foreign Affairs ($700,000).
  + Through the Belmont Forum Initiatives Italy contributes to Cooperative Research Activities (**CRA**) of the Arctic Observing and Research for Sustainability and of the Mountains as Sentinels of Change. ( Euro : 200.000).
  + Japan Agency for Marine-Earth Science and Technology (JAMSTEC), National Institute of Polar Research (NIPR) and Hokkaido University will jointly conduct observations of ocean, land and atmosphere in the Arctic region and continue to promote Arctic Data Archive System (**ADS**), which will is a part of GEOSS Portal, along with the framework of the “Arctic Challenge for Sustainability Projects (ArCS)” supported by MEXT .
  + The “Modelling Freeze-Thaw Processes with Active and Passive Microwave Observations” (SAMP Freeze/Thaw) project supported by the Netherlands Organisation for Scientific Research.
  + Harmonizing and collecting observations in Greenland and surrounding waters by Denmark;

## Transition to operational phase

*Hannele Savela, Yubao Qiu or others？ HS ok*

*Action needed: suggestion? As a platform of operational service, develop, test and provide…*

*Five year？engage more projects from different country or organization to provide experience??*

*Business: private sectors*

GEOCRI was initiated the GEO Plenary in Nov 2015 and since then significant development has been done to organize the activities and make plans for the work programme 2017-2019. In 2016, most of the planned activities have proceeded, and GEOCRI for example published a statement in AOS2016 and was co-authoring a peer-reviewed scientific publication about snow cover changes and its consequences in the Arctic. GEOCRI is now proceeding to implementation stage and the tasks and activities conducted in 2017-2019 will lay the basis for transitioning to operational phase with services to users during the 2020-2022 work programme.

Majority of the milestones and deliverables of the 2017-2019 implemention plan are set to the two first years of the programme period in order to add new milestones and deliverables, geared towards the transition from implementation to operational stage starting in 2019 and during the next work programme period 2020 onwards.

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Action Need (Yubao Qiu, and all)

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## ANNEXES

### Technical Annex

### Acronyms and Abbreviations

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  | | --- | --- | | AAD | Australian Antarctic Division | | AARI | Arctic and Antarctic Research Institute | | AC | Arctic Council | | ACAP | Arctic Contaminants Action Program, AC Working Group | | ACAP | Arctic Contaminants Action Programme, AC Working Group | | ADS | Arctic Data archive System | | AH | Arctic Health | | AI | The Arctic Institute | | AMAP | Arctic Monitoring and Assessment Programme, AC Working Group | | AntarcticaNZ | Antarctica New Zealand | | AntON | Antarctic Observing Network | | AP | Arctic Portal | | APECS | Association of Polar Early Career Scientists | | Arctic BON | Arctic Biodiversity Observation Network | | AUV | Autonomous Underwater Vehicle | | AWI | Alfred Wegener Institute | | BAI | Bulgarian Antarctic Institute | | BAS | British Antarctic Survey | | CAFF  RADI, CAS | Conservation of Arctic Flora and Fauna, AC Working Group  Institute of Remote Sensing and Digital Earth, Chinese Academy of Science | | CAS-NASA HMA | Chinese Academy of Science - National Aeronautics and Space Administration High Mountain Asia Workshops | | CBMP | Circumpolar Biodiversity Monitoring Program | | CCIN | Canadian Cryospheric Information Network | | C-DAC | Centre for Development of Advanced Computing | | CliC | Climate and Cryosphere | | COMNAP | Council of Managers of National Antarctic Programs | | CSIC | Spanish National Research Council | | EC-PHORS | WMO Executive Council Panel of Experts on Polar and High Mountain Observations, Research and Services | | EPPR | Emergency Prevention, Preparedness and Response, AC Working Group | | ESA | European Space Agency | | FIES | Food Insecurity Experience Scale | | GCI | GEOSS Common Infrastructure | | GCW | Global Cryosphere Watch | | GECO | GEO Global Ecosystem Initiative | | GEO | Group on Earth Observations | | GEO DAB | GEO Discovery and Access Broker | | GEOBON | GEO Biodiversity Observation Network | | GEOCRI | GEO Cold Regions Initiative | | GEO-DARMA | GEO Data Access for Risk Management | | GEOGLAM | GEO Global Argicultural Monitoring Initiative | | GEOGLOWS | GEO Global Water Sustainability | | GEO-GNOME | GEO Global Network for Observation and Information in Mountain Environments | | GEOSS | Global Earth Observation System of Systems | | GEOSS Data-CORE | GEOSS Data Collection of Open Resources for Everyone | | GEUS | Geological Survey of Denmark and Greenland | | GFOI | GEO Global Forest Observations Initiative | | GINR | Greenland Institute of Natural Resources | | GLISN | Greenland Ice Sheet Monitoring Network | | GLMS | Glacier Lake Monitoring System | | GLOF | Glacial Lake Outburst Flood | | GSNL | GEO Geohazard Supersites and Natural Laboratories | | GTN-P | Global Terrestrial Network for Permafrost | | H2020 | Horizon 2020 | | HKKH | Hindu Kush – Karokorum – Himalayas | | HRCF | Himalayan Research and Cultural Foundation | | ICIMOD | International Centre for Integrated Mountain Development | | INTERACT | International Network for Terrestrial Research and Monitoring in the Arctic | | IPA | International Permafrost Association | | IPCC  JAMSTEC  NIPR | Intergovenmental Panel on Climate Change  Japan Agency for Marine-Earth Science and Technology  National Institute of Polar Research | | PAGE21 | Changing Permafrost in the Arctic and is Global Effects in the 21st Century | | PAME | Protection of the Arctic Marine Environment | | PDC | Polar Data Catalogue | | PEEX | Pan Eurasian Experiment | | PRCC | Polar Regional Climate Centre | | S:GLA:MO | Slope Stability and Glacial Lake Monitoring | | SAON | Sustaining Arctic Observing Networks | | SBA | GEO Societal Benefit Area | | SCAR | Scientific Committee on Antarctic Research | | SDG | Sustainable Development Goal | | SDWG | Sustainable Development Working Group, AC Working Group | | SIOS | Svalbard Integrated Arctic Earth Observing System | | SOOS | Southern Ocean Observing System | | TPE | Third Pole Environment | | UArctic | University of the Arctic | | UAV | Ünmanned Aerial Vehicle | | UN | United Nations | | USAP | United Stated Antarctic Program | | WCRP | World Climate Research Programme | | WMO | World Meteorological Organization | | YOPP | Year of Polar Prediction | |

### Others