GEO and GEOGLAM: a Model for Arctic Observing Systems Cooperation

White paper

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Purpose of Document

The purpose of this document is to provide background on the Group on Earth Observations (GEO), and how it could serve as an example to coordinate and federate Earth observation systems and open data access across the Arctic region in support of an observing system for the Arctic. In particular, the Global Agricultural Monitoring (GEOGLAM) Flagship of the Group on Earth Observations (GEO) will be presented as a model for using Earth observations (EO) in support of Food Security for the Arctic.

GEO's Background

The need for strengthened cooperation and coordination among global observing systems and research programmes in order to provide integrated global observations for the achievement of sustainable development was widely recognized at the World Summit on Sustainable Development (WSSD) (Johannesburg, 2002). Subsequent Earth observation Summits (Washington D.C., 2003; Tokyo, 2004) underscored the importance of comprehensive, coordinated and sustained Earth observations - exchanged fully and openly - as a basis for informed decision making, and, building on existing systems, called for the establishment of a "system of systems" approach to deliver those observations.

The political will and commitment demonstrated at these Summits, confirmed by the G-8 endorsement of strengthened international cooperation on global observation of the environment (Evian, 2003), reached their culmination at the Third Earth Observation Summit (Brussels, 2005) when GEO was formally launched as a partnership of Member governments and Participating Organizations working together to implement the Global Earth Observation System of Systems (GEOSS). GEOSS is a set of coordinated, independent Earth observation, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors. GEOSS links these systems to strengthen the monitoring of the state of the Earth. It facilitates the sharing of environmental data and information collected from the large array of
observing systems contributed by countries and organizations within GEO. GEOSS was designed to deliver the data and information necessary for bringing qualitative improvements in understanding the Earth system so that global policy- and decision-making abilities that promote the environment, human health, safety, and welfare would be enhanced. Further, GEOSS ensures that these data are accessible, of identified quality and provenance, and interoperable to support the development of tools and the delivery of information services. Thus, GEOSS increases our understanding of Earth

processes and enhances predictive capabilities that underpin sound decision-making.

Beyond addressing major policy initiatives, and building on existing local, national, regional, and international initiatives, GEO also promotes the benefits of GEOSS through enhancing capacity; engaging globally with a broad range of user communities, from managers, policy makers and scientific researchers and engineers, to civil society, governmental and non-governmental organizations, international bodies and the commercial sector; and providing Earth observations data and information yielding advances in knowledge across societal benefit areas (SBAs), as defined by purpose and scope. Political support for full and open access to Earth observation data and information was affirmed by the Cape Town Declaration (2007) which called for implementation of the GEOSS Data Sharing Principles and improvements in interoperability of data systems. The Beijing Declaration (2010) took the commitment to sharing of Earth observation data and information a step further by establishing the GEOSS Data Collection of Open Resources for Everyone (GEOSS Data CORE), while urging governments to take the measures necessary to sustain and enhance both in-situ and space-based observation systems. In 2014, GEO's mandate was renewed for another decade with the Geneva Declaration, which also called for both strengthening engagement with developing countries, and broadening engagement with diverse stakeholders, including non-governmental and non-profit organizations and the private sector, while taking into account commitments to UN sustainable development themes.

GEO's Vision

GEO, a global partnership of governments and organizations, envisions a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations

GEO's Convening Power

Because of its broad intergovernmental membership and variety of contributing organizations, GEO is able to assemble and coordinate expertise from across different disciplines and communities. GEO uses this convening power to bring together the unique combinations of partners required to address societal challenges faced by communities across the globe at every scale, from individuals to countries, to continents, drawing on comprehensive, coordinated and sustained Earth observations.

The strengths of GEO lie in its distinctive characteristics:

- a unique, multidisciplinary initiative that occupies an upstream coordination position on Earth observations in the international community;
- a flexible and agile forum for governments, public sector agencies, UN bodies, specialized organizations, universities and the private sector to work together on improving the quality, timeliness, range and availability of Earth observations, data, information and knowledge about the Earth system; and
- a facilitator of policy-level dialogue on the importance and GEO's Scope Advocate, Engage and Deliver coordination of Earth observation systems

(including ground-, air-, water- and space-based sensors, field surveys, and citizen observatories).

Given these strengths, GEO is strategically situated to:

- leverage its convening power to bring together those who need information for sound decision-making, those who collect information about the Earth, and those who turn information into knowledge and package it as user-friendly tools, applications and services;
- identify existing information and observation gaps, as well as gaps in institutional and technological capacities that hinder the use of information even when it is available;
- mobilize action to mitigate these gaps by empowering countries and organizations to strengthen and develop their own contributions of Earth observation resources to GEOSS, and to leverage partner networks to expand and maximize access of Earth observations to the benefit of GEOSS; and
- link GEOSS to relevant socio-economic data through partnerships with, for example, the UN Statistics Division (UNSD) and other statistical agencies to provide enhanced information for decision-making.

GEOSS Data Sharing Principles

GEO recognizes that the societal benefits arising from Earth observations can only be fully achieved through the sharing of data, information, knowledge, products and services. GEO has therefore promoted fundamental principles for data sharing, expanding the trend towards open data worldwide. Thus, with the support of its Member governments, GEO works to implement the following GEOSS Data Sharing Principles:

- data, metadata and products will be shared as Open Data by default, without charge or restrictions on reuse, subject to the conditions of registration and attribution when the data are reused;
- where international instruments, national policies or legislation preclude the sharing of data as Open Data, data should be made available with minimal restrictions on use and at no more than the cost of reproduction and distribution; and all shared data, products and metadata will be made available with minimum time delay.

GEOGLAM

A lack of coordination among EO-data sources led to gaps in spatial and temporal coverage in key agricultural areas and during important periods of the agricultural growing season. Even when there was adequate spatio-temporal coverage, gaining access to these data could be impeded by lack of connectivity, computational, storage, and/or licensing. As such, one of the core activities of GEO Global Agricultural Monitoring (GEOGLAM) Flagship is the coordination of Earth observation data for food security. This includes:

- Fostering open communication and coordination with the Committee on Earth observation Satellites (CEOS) to ensure representation of agricultural requirements and acquisition requests to the world's space agencies.

- Characterization and quantification of observation requirements to derive agricultural variables.
- Definition of "Essential Agricultural Variables for GEOGLAM"

Thus, the main objective of GEOGLAM is to reinforce the international community's capacity to produce and distribute relevant, timely, and accurate information on agricultural land use and production at national, regional, and global scales, using Earth observation (EO) data, toward enhancing knowledge and improving sustainable decisions related to agriculture and food security.

Governance

GEOGLAM has adopted a relatively "light" governance model to maintain administrative efficiency. Nonetheless, so far this approach has been very successful. GEOGLAM governance is split between the following roles:

- **The GEOGLAM Executive Committee (Ex-Com).**

  The Ex-Com consists of major contributors to the GEOGLAM work program, including the Ex-Com Co-Chairs, leads of thematic teams, regional networks, major contributing initiatives, and the Program Director. The Ex-Com provides operational and strategic advice for the GEOGLAM work program, and through the Director reports on implementation progress.

- **GEOGLAM Ad Hoc Working Groups and Regional Network Coordination.**

These are ad hoc working groups that consist of representatives of the projects, tasks and activities (both funded and in-kind) that contribute to achieving the GEOGLAM work program goals and objectives. The working group Co-Chairs provide input to the Executive Committee on project progress towards meeting the program and theme objectives as well as their perspectives on direction, planning, and development of the program. Current thematic teams include Capacity Development, Data Coordination and Essential Agricultural Variables, and regional teams including AsiaRice, Agriculture in the Americas, and AfriGLAM.

- **The GEOGLAM Secretariat.**

The GEOGLAM Secretariat, administered by the Program Director is the coordinating body of GEOGLAM, composed of individuals who represent formal, direct contributions to GEOGLAM. The primary role of the Secretariat is to support the implementation of the Program. The Secretariat is the formal, outwardly liaising body of GEOGLAM to partner organizations including GEO. The Secretariat provides coordination and support for GEOGLAM initiatives and program reporting (eg. G20, GEO work programme, and GEO Programme Board as required), program outreach, and communications, including development and management of the GEOGLAM web site. The Secretariat facilitates fundraising efforts, and ensures that the financial contributions to GEOGLAM (in-kind, indirect, and direct alike) are coordinated and well managed within the WMO trust fund.

Outside of the Secretariat, Ex-Com and Working Groups, the heart of GEOGLAM is the many projects that contribute to GEOGLAM program outcomes. These projects are generally in-kind contributions from participating nations and institutions. Understanding that the "whole is greater than the sum of the parts", the primary role of the GEOGLAM governance is the coordination of these contributions to achieve the greater vision for National to Global monitoring in support of food security and agricultural markets.

Essential Agricultural Variables

GEOGLAM aims to produce information on the current state of, and monitoring change in, agricultural land cover and land use. GEOGLAM must have a way to simplify complexity and provide clarity to communicate its potential contribution to custodian agencies while enhancing our ability to integrate knowledge and information across science and policy domains. Consequently, GEOGLAM needs to clearly define the minimum set of variables we require to meet current and evolving policy drivers, these we refer to as Essential Agricultural Variables for GEOGLAM (EAVs). In the GEOGLAM context, these state variables track essential aspects of agricultural production and can be considered Essential Agricultural Variables (EAVs) for GEOGLAM.

In essence, EAVs represent information "building blocks" that are rudimentary indicators of state and change in the agricultural domain and as such, these low-level indicators can be built up and integrated with other information for monitoring across multiple policy dimensions (e.g. SDGs, Paris Accord, and Sendai Framework for Disaster Risk Reduction).

Surveys and discussions preceding and during the GEOGLAM Operational Requirements Meeting identified high priority information products, including cropland mask, crop type map and planted area, yield forecast, and crop growth condition assessment. The working group for establishment of the EAVs works to:

- reach consensus on the information products and EAVs;
- reach consensus on the spatial, spectral, and temporal resolutions, and latency of the underlying observations;
- reach consensus on the levels of pre-processing necessary to empower routine EAV creation by agricultural monitoring entities (analysis ready data);
- clearly document the decision support and policy need;
- work with Earth observation coordination mechanisms such as CEOS to meet the requirements.

Implications for the Arctic

The Arctic community could adopt a similar approach to that of GEOGLAM for the establishment of a federated Arctic observing system, one that would be capable of tackling challenges such as food security for the region. A light, flexible governance structure as outlined with the GEOGLAM example could well serve the multi-national Arctic region, providing a framework for observing system coordination and cooperation in research and development, while respecting national sovereignty.

Further, defining essential variables for the Arctic would be a key component of success. A working group could be set up to find consensus and define these variables. In terms of food security, example of variables to be defined could be related to domains such as Arctic fisheries and aquaculture. Indigenous knowledge would, of course, need to be incorporated in this process in a spirit of co-design.

Once established, the EO data to needed to monitor the essential Arctic variables should be documented in detail, for discussion with GEO entities such as CEOS and the GEO Marine Biodiversity Observation Network (MBON) to meet gaps in spatial and/or temporal resolution coverage. Finding variables that represent common concerns for all regions of the Arctic would also be a way to promote data sharing, particularly at the in situ level, as national confidentiality concerns give way to solidarity in tackling the greater good represented by challenges common to the region.

Finally, the presence of a political mandate for supporting food security in the Arctic is another key component for success. As has been shown by the GEOGLAM experience, having the endorsement of the G-20 Ministers is essential for giving the initiative the necessary gravitas, authority and credibility to rally international cooperation in a non-binding, best efforts context. Receiving such a mandate at the time of the next Arctic Science Ministerial would be an optimal way accelerate efforts towards establishing an observing system for food security in the Arctic.