

WP23_25: Global Ecosystems and Environment Observation Analysis Research Cooperation

1296,147

Basic Information

Full title of the Initiative

Global Ecosystem and Environment Observation Analysis Research Cooperation

Short Title or Acronym

GEOARC

Current category in the 2020-2022 GWP

Community Activity

Proposed category in the 2023-2025 GWP

GEO Initiative

Points of Contact

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Purpose

Objective

Focus on Global Ecosystem and Environment Observation Analysis Research Cooperation, the overarching objective of GEOARC is to constantly provide technological information and product services to support the GEO priorities, such as Sustainable Development Goals (SDGs), Climate Action, Disaster Risk Reduction, Urban Resilience and Human Settlements etc.

Please provide a short description of the Initiative

GEOARC will closely collaborate with all work groups focusing on Ecosystem Service Functions, Biodiversity Protection, Carbon Sequestration, Food Security and Drivers, Vegetation in Arid Regions, Hydrology and Ecology in Large River Floodplains, Arctic Sea Ice Remote Sensing Observation and Application, Human Activities and Carbon Cycle Cooperation, Products and Validation, Data Sharing and Services, provide solutions to support the GEO priorities, Global Environmental Protection and Sustainable Development.

To monitor global and/or regional terrestrial ecosystem and environment conditions and to provide analysis data for sharing service by integrating multi-source data and products from GEO GLAM, GEO MUSYQ, GLASS, GlobalLand30, FROM-GLC30, GF1-11 etc. To organize GEO side events and/or special sessions in various

international symposia, host and attend training workshops for promotion of Annual Report, Data Products, Methodology/Algorithm and Demonstration Applications.

Why is this Initiative needed?

Since the mid-20th Century, rapid development of global economy has resulted in degradation of terrestrial ecosystems and loss of biodiversity. Driven by both human activities and climate change, the sustainable development of global ecosystem is under threats and tough challenges as never before. GEOARC plays a significant role in Global Ecosystem and Environment Observations a prerequisite to informed decision making on sustainable development. Contributions under the GEOARC framework from 2012 to 2021 include the release of 29 reports of “Global Ecological Environment Remote Sensing Observation” and 109 datasets to the world users free of charge by China GEOSS.

What evidence is there to support this need?

Providing global ecological environment remote sensing monitoring information to UNEP (United Nations Environment Programme) on a regular basis, fostering international cooperation network for all participants on data sharing, product validation, information dissemination, and improvement on the standardized methodology/algorithm for ecological and environmental monitoring globally and/or on regional scope. GEOARC promotes a cooperation network to release annual reports and share related datasets through training courses and workshops constantly in the past decade. <http://chinageoss.cn/geoarc/en/index.html>

Is this Initiative open to participation by representatives of any GEO Member, Participating Organization, and GEO Associate?

Yes

Are you aware of other projects or initiatives at a global or regional scale (both in GEO and externally) that provide similar products or services?

Yes

Please describe.

The ongoing dryland ecosystem project (Global-DEP) emphasizes on the interaction between dryland ecosystem functions and processes. GEOARC puts more emphasis on changes in vegetation patterns in arid zones. The Global-DEP will be potential user of GEOARC-WG2.

ArcticGEO emphasizes more on filed observations, combined with SOAN. WG4 under GEOARC focuses on generating remote sensing sea ice products from data acquired by sensors onboard Chinese satellites. Additionally, we have target users to whom the information system and planning services will be provided.

GEOMUSYQ data products have been directly used and will be continuously used to support the GEOARC report during 2023-2025. The reports and methods of GEOARC and GEOGLAM are consistent each focuses on different aspects. The GEOGLAM forms seasonal reports on agricultural meteorology and crop growth conditions in a continuous time-series fashion, while GEOARC report focuses on the synthesis analyses about the supply situation of grain and oil crops annually.

AOGEO is a regional GEO for ASIA-OCEANIA region, its Task Group 7 “Environment Monitoring and Protection” aims to monitor and evaluate the terrestrial ecological environment status in the said region. GEOARC on the other hand conducts ecological and environmental monitoring at global and/or regional scales.

How is this Initiative unique?

GEOARC will keep close connection with other related Activities, Initiative or Flagship programs such as GEOMUSYQ, GEOGLAM and AOGEO in the Work Programme 2023-2025. Based on the past work and experiences, GEOARC will focus on sustainable agriculture and water resources, sustainable clean energy, sustainable ecosystem and its serving function, land degradation/desertification, global carbon source and sink, global glacier variation and its climate change responses, global natural disasters, and so on.

The services provided by GEOARC are unique. Annual reports and datasets are released to users around the world in a standardized and timely fashion, useful especially for continuous decision-making processes on ecological environmental protection in the global regions.

Please identify the most important actual and/or intended outputs (products, services, etc.) produced by the Initiative, along with their intended and/or actual users. This list does not need to be comprehensive but should identify the outputs which are most used and are expected to have the greatest potential impact.

Output	Status	Users	Additional info
2021-Sustainable Development Trend of Global Terrestrial Ecosystems	Regularly updated	UNEP, ICIMOD, FAO, Government and Researchers	Completed
2021-Ecological and Environmental Status of Global Typical Lakes	Regularly updated	UNEP, Government and Researchers	Completed
2021-Eurasia Grassland Ecological Status	Regularly updated	UNEP, UNCCD, IPCC, FAO, Government and Researchers	Completed
2021-Crop Production Outlook and the State	Regularly updated	FAO, Government and Researchers	Completed
2020-Changes in Antarctic Ice Sheet	Regularly updated	Government and Researchers	Completed
2020-Grain Production Outlook and the State of Food Security	Regularly updated	Government and Researchers	Completed
2020-Global Urban Land Composite and Expansion in 2000-2020	Regularly updated	Government and Researchers	Completed
2019-Global forest cover and changes	Regularly updated	Government and Researchers	Completed
2019-Trend in global land degradation since 2000	Regularly updated	Government and Researchers	Completed
2019-The typical severe natural disasters and their impacts	Regularly updated	Government and Researchers	Completed
2018-Regional Ecosystem Trends along the Belt and Road	Regularly updated	Government and Researchers	Completed
2018-Supply Situation of Maize, Rice, Wheat and Soybean	Regularly updated	Government and Researchers	Completed
2018-Temporal Dynamics and Spatial Distribution of Global Carbon Source and Sink	Regularly updated	Government and Researchers	Completed

2017-The Belt and Road Initiative Ecological and Environment Conditions	Regularly updated	ASEAN,Government and Researchers	Completed
2017-The Impacts of Global Natural Disasters on Vegetation	Regularly updated	Government and Researchers	Completed
2016-Supply situation of Maize, Rice, Wheat and Soybean	Regularly updated	Government and Researchers	Completed
2015-The Belt and Road Initiative Ecological and Environmental Conditions	Regularly updated	ASEAN,Government and Researchers	Completed
2015-Supply situation of Maize, Rice, Wheat and Soybean	Regularly updated	Government and Researchers	Completed
2014-Supply situation of Maize, Rice, Wheat and Soybean	Regularly updated	Government and Researchers	Completed
2014-Large Area Wetlands of International Importance	Regularly updated	Government and Researchers	Completed
2014-Africa Land Cover	Regularly updated	AfriGEO,Government and Researchers	Completed
2014-China-ASEAN Ecological and Environmental Conditions	Regularly updated	Government and Researchers	Completed
2013-Growth Conditions of Global Terrestrial Vegetation	Regularly updated	Government and Researchers	Completed
2013-Large Terrestrial Surface Water Areas 2013-Supply Situation of Maize, Rice, Wheat and Soybean	Regularly updated	Government and Researchers	Completed
2013-Urban and Rural Resident Land Cover Distribution between 2000-2010	Regularly updated	Government and Researchers	Completed
2012-Dynamics of Global Vegetation Leaf Area Index (LAI) from 1982 to 2011	Regularly updated	Government and Researchers	Completed
2012-Global Land Surface Water 2010 and Dynamic Changes of Sample Lakes 2001-2011	Regularly updated	Government and Researchers	Completed
2021 Global 30m Land	Regularly updated	Government and	Completed

Cover Dataset (2015)		Researchers	
2021 Global 30m Land Cover Dataset (2020)	Regularly updated	Government and Researchers	Completed
2021 Global 1km Land Cover Change Dataset (2015-2020)	Regularly updated	Government and Researchers	Completed
2021 Global 1km/5-day Normalized Difference Vegetation Index Dataset (2010-2020)	Regularly updated	Government and Researchers	Completed
2021 Global 500m/4-day Vegetation Leaf Area Index Dataset (2010-2020)	Regularly updated	Government and Researchers	Completed
2021 Global 500m/4-day Fractional Vegetation Cover Dataset (2010-2020)	Regularly updated	Government and Researchers	Completed
2021 Global 0.05° Vegetation Anomaly Index Dataset during ENSO Events (2010-2020)	Regularly updated	Government and Researchers	Completed
2021 Global 1km Anthropogenic Stressor Index Change Dataset (2010-2020)	Regularly updated	Government and Researchers	Completed
2021 Global 1km/3-hour Photosynthetically Active Radiation Dataset (2015-2020)	Regularly updated	Government and Researchers	Completed
2021 Global 1km Light-temperature Potential Productivity Dataset (2015-2020)	Regularly updated	Government and Researchers	Completed
2021 Long-term water area-level dataset of global lakes (2000-2020)	Occasionally updated	Government and Researchers	Completed
2021 Long-term water storage dataset of global lakes (2000-2020)	Occasionally updated	Government and Researchers	Completed
2021 Time series of maximum algal blooms area in global eutrophic lakes (2000-2020)	Regularly updated	Government and Researchers	Completed
2021 Time series of algal blooms frequency in global eutrophic lakes (2000-2020)	Regularly updated	Government and Researchers	Completed

2021 Basic data list of global eutrophic lakes (2000-2020)	Regularly updated	Government and Researchers	Completed
2021 Long-term water area-level dataset of Chinese lakes (2000-2020)	Regularly updated	Government and Researchers	Completed
2021 Long-term water storage dataset of Chinese lakes (2000-2020)	Regularly updated	Government and Researchers	Completed
2021 Edible forage yield of Eurasia grassland (2000-2020)	Regularly updated	Government and Researchers	Completed
2021 Theoretical carrying capacity of Eurasia grassland (2000-2020)	Regularly updated	Government and Researchers	Completed
2021 Aboveground standing biomass of the main grazing grasslands in Eurasia (2000-2020)	Regularly updated	Government and Researchers	Completed
2021 Utilization intensity index of the main grazing grasslands in Eurasia (2000-2020)	Regularly updated	Government and Researchers	Completed
The Belt and Road 1km/5-day Fractional Vegetation Cover Dataset (2016-2019)	Occasionally updated	ASEAN, Government and Researchers	Completed
2021 The Belt and Road 1km/5-day Normalized Difference Vegetation Index Dataset (2016-2019)	Occasionally updated	ASEAN, Government and Researchers	Completed
2021 The Belt and Road 500m/4-day Vegetation Net Primary Productivity Dataset (2016-2019)	Occasionally updated	ASEAN, Government and Researchers	Completed
2021 The Belt and Road 1km/5-day Light-temperature Potential Productivity Dataset (2016-2019)	Occasionally updated	ASEAN, Government and Researchers	Completed
2021 The Belt and Road 0.05° Solar Power Potential Dataset (2016-2019)	Occasionally updated	ASEAN, Government and Researchers	Completed
2021 The Belt and Road 0.05° Solar Resource	Occasionally updated	ASEAN? Government and Researchers	Completed

Dataset (2016-2019)			
2021 China-ASEAN 1km/5-day Fractional Vegetation Cover Dataset (2016-2019)	Occasionally updated	Government and Researchers	Completed
2021 China-ASEAN 1km/5-day Normalized Difference Vegetation Index Dataset (2016-2019)	Occasionally updated	Government and Researchers	Completed
2021 China-ASEAN 500m/4-day Vegetation Net Primary Productivity Dataset (2016-2019)	Occasionally updated	Government and Researchers	Completed
2021 China-ASEAN 1km/5-day Light-temperature Potential Productivity Dataset (2016-2019)	Occasionally updated	Government and Researchers	Completed
2021 China-ASEAN 0.05° Solar Power Potential Dataset (2016-2019)	Occasionally updated	Government and Researchers	Completed
2021 Global Large Terrestrial Surface Water Areas Spatially Distributed Update Dataset (2018-2019)	Occasionally updated	Government and Researchers	Completed
2021 Global 1km/8-day Vegetation Leaf Area Index Dataset (2018-2019)	Regularly updated	Government and Researchers	Completed
500m Global Vegetation Growth Index products	Available but not updated	UNEP, Government and Researchers	New Task
10m Impervious surface products in Lancang Mekong Region	Available but not updated	UNEP, Government and Researchers	New Task
3.3km PM 2.5 products in Lancang Mekong Region/	In development	UNEP, Government and Researchers	New Task
Asia-Oceania Environment Monitoring Platform	In development	UNEP, AO GEO, Government and Researchers	New Task
Hydro-ecological Observation Datasets	Planned	UNEP, Government and Researchers	New Task
Hydrological Connectivity Assessment Platform	Planned	Government and Researchers	New Task
16m Land cover map at experimental sites in	Planned	Government and Researchers	New Task

three consecutive years			
Develop methods on monitoring and evaluating of dryland vegetation dynamics and their driving forces in conjunction with multi-platform remote sensing and ground observation network such as Flux-net, C-Flux, NEON, CNERN and CARIN.	Planned	FAO, UUCDD, UNEP, IPCC, Future Earth NEXUS KAN	New Task
Develop new generation of vegetation dynamic models to analyze the changes and trends of ecosystem functions, such as carbon uptake and land erosion.	Planned	Carbon Stock/Market, etc.target users	New Task
develop a set of practical intelligent grazing products, including grazing robots and decision-making software.	Planned	Government and Researchers	New Task
Arctic Sea Ice products	Planned	Scientists, Arctic shipping vessels	New Task
Sea Ice information system and route planning services	Available but not updated	Arctic shipping vessels	Completed
An international joint Arctic expedition	Planned	Government and Researchers	New Task
Study on renewable energy facilities remote sensing recognition methods and share method toolset in cloud platform.	Planned	Needs users	New Task
Produce and assess the global 1km terrestrial ecosystem carbon disturbance products from 2000 to 2020.	Planned	Needs users	New Task
Research report of the global terrestrial ecosystem carbon disturbance considering the distinction between natural and human disturbances.	Planned	Needs users	New Task
Involve researchers from	Planned	Needs users	New Task

Denmark, Canada, Bangladesh and Pakistan to share their previous field observation data and jointly build an international cooperation network for global terrestrial ecosystem carbon disturbance monitoring;			
Research report of the construction status of regional renewable energy power stations in Europe and Asia.	Planned	Needs users	New Task
Provide a platform for the hydrological connectivity assessment, serving on the water resource regulation and biodiversity conservation in large river floodplains.	Planned	NRA, WI	New Task

If needed, please provide additional comments or explanation to accompany the outputs table

Remote Sensing Product Generation based on the Multi-source Synergized remote sensing data. The products include: Land Cover (LC), Solar Radiation (SR), Photosynthetically Active Radiation (PAR), Photosynthetic Thermal Productivity (PTP), Precipitation, Evapotranspiration (ET), Fraction of Vegetation Cover (FVC), Leaf Area Index(LAI),Vegetation Index(VI), Biomass, Phenology, Fraction of Absorbed Photosynthetically Active Radiation(FAPAR),Albedo, Net Primary Productivity (NPP), Gross Primary Productivity(GPP), Urban Heat Island, Arable Land use Intensity, Cropping Index, Farmland Planting Proportion, Arthropod-borne, etc.. Annual Reports composed by experts from various organizations or countries to analyze the ecosystem and environment conditions, to evaluate the realizability of SDGs, to propose suggestions for policy-making based on the remote sensing products and comprehensive analysis; Data products, Annual Reports, Methodology/Algorithm and demonstration applications released to the public on the GEOSS portal. Organizing Side Events, attending in international conferences, hosting training workshops to publicize the annual reports and data products, to discuss the methodology/algorithm, and to present demonstration applications, in GEO Week, AOGEO symposium, etc. Cloud Service Platform conduct research and develop specialized remote sensing products for environmental monitoring based on domestic satellite data. Research on remote sensing monitoring methods for comprehensive ecological environment studies, forest change, urban impervious surface and atmospheric environment, and develop analysis software covering? comprehensive monitoring of ecosystems, forests, cities, and atmosphere, and a display platform for real-time update of monitoring results. Capacity building for remote sensing monitoring of environmental changes such as deforestation, urban expansion and air quality for developing countries.

What kinds of decisions are the outputs of this Initiative primarily intended to support?

GEOARC may provide global ecological environment remote sensing monitoring annual reports and datasets to UNEP regularly; Cooperation in fields such as farmland protection with FAO (Food and Agriculture Organization of the United Nations) and UNCCD (United Nations Convention to Combat Desertification); Information and products served for the Paris Agreement...

How will these decisions benefit from the outputs of this Initiative?

GEOARC pays more attention to the priorities of the GEOSS, which focuses on eight social benefit areas (SBAs), namely disaster prevention and reduction, food security and sustainable agriculture, water management, energy and natural resources management, human health monitoring, environmental impact of

biodiversity and ecosystem protection, urban development, infrastructure and traffic management, to provide product services and solutions for Global Environmental Protection and Sustainable Development.

What kinds of impacts (for example, reduced loss of life, monetary savings, conservation of biodiversity, etc.) are anticipated as a result of the use of the outputs of this Initiative?

The impact outputs of GEOARC are highly related to GEO work programme, Paris Agreement, Sendai Framework for Disaster Risk Reduction, and support to SDGs, i.e. SDG2, 3, 6, 7, 11, 13, 14, 15, 17... Zero Hunger End hunger, achieve food security and improved nutrition, and promote sustainable agriculture SDG2 Zero Hunger:End hunger, achieve food security, improve nutrition and promote sustainable agriculture. SDG3 Ensure healthy lives and promote well-being for all at all ages; SDG6 Ensure availability and sustainable management of water and sanitation; SDG7 Ensure access to affordable, reliable, sustainable and modern energy; SDG11 Make cities and human settlements inclusive, safe, resilient and sustainable; SDG13 Take urgent action to combat climate change and its impacts; SDG14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development; SDG15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss; SDG17 Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development. The data products, monitoring results and case analysis furnished in the report may offer scientific data support for the implementation of the 2030 Agenda for Sustainable Development. Based on global hotspot issues, assist other countries to formulate policies on environmental protection, biodiversity conservation, sustaining quality of cultivated land, provide cooperation countries to implement SDGs services, and improve the operational capabilities of remote sensing monitoring. Effectiveness: It provides an efficient mechanism for monitoring the ecological environment which is time-saving and cost-effective.

Has this Initiative been asked to provide specific information (for example, reports, data, services) on an ongoing basis to an international convention, organization, or other multilateral body?

Yes

Please identify the requesting organization.

The GlobeLand30 dataset produced by the special topic "Distribution of Urban and Rural Construction Land" in 2013 has been used by more than 130 countries, more than 400 domestic and foreign research institutions and more than 570 universities since it was shared, and the number of applications has exceeded 37,000 times, and have played an important role in sustainable development, disaster reduction and other fields, supporting the United Nations and more than ten agencies under it to carry out ecological protection, desertification control, disaster emergency mapping, and other activities. In addition, by the end of 2021, the topics of which the dataset has exceeded 10,000 downloads also include: "China-ASEAN Regional Ecological Environment" in 2014, "Temporal and Spatial Distribution of Global Carbon Sources and Sinks" in 2018, and food production and security released continuously since 2013 Situation-related thematic dataset products. The data sets of "Global 1km Resolution Best Vegetation Condition Index" and "Global 1km Resolution Best Vegetation Condition Index Cultivated Land Planting Status" produced by special topics related to food production and security situation are available in the Global Agricultural Situation Remote Sensing Rapid Report System (CropWatch; <http://cropwatch.com.cn/newcropwatch/main.htm?language=ch>) and the Food and Agriculture Organization of the United Nations Data Sharing Platform (FAO; <https://data.apps.fao.org/>) provides online map services.

Describe the nature of the request.

In order to extend the influence of the results of the annual report, the writing teams of each theme engaged the National Comprehensive Earth Observation Data Sharing Platform, the Global Change Scientific Research Data Publishing System (<http://www.geodoi.ac.cn/>), and the National Earth System Science Data Center. (<http://www.geodata.cn>), Earth Big Data Science Project (Casearth; <http://data.casearth.cn/>) and Ocean Remote Sensing Online Analysis Platform (SatCO2; <http://www.satco2.com>) and other domestic data product sharing platforms, as well as international data product sharing platforms such as Zenodo (<https://zenodo.org/>). The global high-resolution land cover product (FROM-GLC) produced by the 2014

"African Land Cover" was shared on the Tsinghua Data Platform (<http://data.ess.tsinghua.edu.cn>), with more than 60 million downloads .

Please provide supporting documentation of the request.

- [annual_reports_downloads.pdf](#) ([link](#))

Technical Synopsis

Please provide a brief description of the methods used by the Initiative to produce its (actual or planned) outputs.

This Initiative mainly focuses on ecological and environmental monitoring and assessment at the global or regional scales, to provide datasets, reports and tools, to jointly build international cooperation networks and cloud service platforms to the international users, and to support the GEO priorities, including the United Nations 2030 Agenda for Sustainable Development, the Paris Agreement, the Sendai Framework for Disaster Risk Reduction, Urban Resilience and Human Settlements.

1) Products, shared field data and training workshops

Integrate multi-source data acquired by sensors onboard the domestic satellites and foreign earth observation satellites, as well as the products from GEO MUSYQ, GLASS, FROM-GLC30, shared field data and so on, to monitor global or regional terrestrial ecological and environment conditions, and to provide analysis-ready data for sharing. Organize side events at the GEO Plenary and special sessions in international conferences; hold or attend training workshops for the datasets applications.

Products include: Land Cover (LC), Fraction of Vegetation Cover (FVC), Leaf Area Index(LAI), Vegetation Index(VI), Phenology, Net Primary Productivity (NPP), Gross Primary Productivity(GPP), Cropping Index, Farmland Planting Proportion, ecosystem carbon cycle products, renewable energy facility mapping products, sea ice concentration, ice thickness, ice type, drift speed, ice surface temperature, water transparency, total suspended particulate, biomass and diversity of wetland vegetation, inundation depth, water temperature and soil moisture, hydrological connectivity for floodplains, etc..

2) Research Reports

The Reports will be completed based on the following steps: topic selection, scheme appraisal, data collection, monitoring analysis, report writing, expert and advisory group consultation, report releasing, and publicity promotion. Invite various industries or countries to work together and engage experts from various fields and disciplines to analyze the conditions and changes of ecosystems and environment, make suggestions for the local development if dimmed necessary on human health issues and the environment before finalizing the reports. The reports will include: 1) Research report in 2023 on global terrestrial ecosystem carbon disturbance by considering the distinction between natural and human disturbances; 2) Research report in 2025 on the construction status of regional renewable energy power stations in Europe and Asia, etc..

The reports will be shared via the GEOSS portal (<http://www.geoportal.org/>; <http://www.geodoi.ac.cn/WebCn/>) and China GEOSS DNet (<http://www.chinageoss.org/geoarc/>).

3) Tools and Cloud service platform

The Asia-Oceania Environment Monitoring platform will demonstrate the integrated environmental monitoring results focusing on urban expansion, air quality, vegetation change, to develop environmental monitoring remote sensing thematic products, to conduct research on remote sensing monitoring methods of ecological environment synthesis, to develop analysis software system and display platform for real-time update of monitoring results, and to build the capacity for remote sensing monitoring of environmental changes in developing countries.

Combined with sea ice remote sensing, field observation and model simulation, a comprehensive environment information system is constructed to provide near real-time sea ice information and route planning services for Arctic shipping users.

Explore decision making tools for adaptive management of ecosystems, especially smart management of rangelands, by using software and cloud computing technology, and to deliver the outputs to different regions, countries or organization.

If you would like to provide further details on the technical methods, you may upload one or more documents here.

- [2021_crop_production_outlook_and_the_state_of_food_security.pdf](#) ([link](#))

- 2021_ecological_and_environmental_status_of_global_typical_lakes.pdf ([link](#))
- 2021_eurasia_grassland_ecological_status.pdf ([link](#))
- 2021_sustainable_development_trend_of_global_terrestrial_ecosystems.pdf ([link](#))

Are there any significant scientific or technical challenges that need to be resolved by the Initiative during the 2023-2025 period?

Yes

Please describe these challenges and the steps being taken to solve them.

1) The annual reports were mainly completed by China work groups, lacking full participation of foreign teams, and unified standards and specifications at the global scale have yet to be formulated. It is hoped that all groups at home and abroad will work together to achieve the common technical process, framework, standards and reports, to bring the annual reports to a higher level. 2) Through the international cooperation to meet the global users' demands and to provide better service and products. 3) Verification of global product is a great challenge; the validation is expected to be improved through international cooperation in field sample collection.

Does the Initiative expect to complete any key new outputs, improvements to existing outputs, or improvements to the methods of producing outputs, in the 2023-2025 period?

Yes

Please describe these new outputs or improvements.

New outputs or improvements include: 1) Establish a cooperative network oriented to user needs and provide decision support for users. 2) The reports have become important data and monitoring resource. The original versions of annual reports were all in Chinese, the annual reports and cloud service platform are planned to provide full English version in order to better serve the international users. 3) The products originally provided have low resolution. In order to provide better services on the decision support for the international uses, some new products with high spatial and temporal resolution will be added, such as 16m global land cover, etc.. 4) Provide analyzing tools for more users, i.e. grazing robots and decision-making software, hydrological connectivity assessment platform, etc..

Please identify the key tasks that must be implemented to ensure delivery of these changes, with target dates for completion.

Task	Task description	Expected completion (month/year)
English version of the existing report	Translate the annual reports in the last three years to full English version.	12/2023
Establishment of cooperation system	Communicate with end users, and establish a cooperative service system.	12/2023
Release new Annual Reports	Global terrestrial ecosystem carbon disturbance considering the distinction between natural and human disturbances Annual assessment and report to provide technical support for policy makers to frame the drought mitigation polices and regulations	12/2023
Release new Annual Reports	Supporting the UNCCD or	12/2025

	<p>Sustainable Development Goals to better planning and use of natural resources. Integrative Observation of Hydrology and Ecology in Large River Floodplain</p> <p>The construction status of regional renewable energy power stations in Europe and Asia. Best practices report showcasing the contribution of China, India, Pakistan and some other countries to promote the sustainable agriculture and policy making support report.</p>	
Tools, platforms and systems	<p>Develop a set of practical intelligent grazing products, including grazing robots and decision-making software.</p> <p>Develop a risk assessment model for ships in polar regions, build an integrated system for Arctic waterway environmental information, and provide Arctic waterway users with near real-time environmental information reports and intelligent route planning services. Develop Asia-Oceania Environment Monitoring platform for urban expansion, air quality, vegetation change monitoring, and to display real-time update of monitoring results, and to build the capacity for remote sensing monitoring of environmental changes in developing countries. Develop artificial intelligence framework for agricultural infrastructure identification.</p>	12/2025
Products	<p>Produce and assess the global 1km terrestrial ecosystem carbon disturbance products from 2000 to 2020. Form a multi-scale Arctic sea ice remote sensing dataset, extent, density, thickness, type, drift, and surface temperature of Arctic sea ice. Provide 16m Land cover and other terrestrial vegetation common products.</p>	12/2024
Capacity building	<p>Conduct capacity building in developing countries to enhance the knowledge and the capacity in sustainable agriculture and food security governance.</p>	10/2025

Resources

Have all resources required to implement the Initiative's planned work in the 2023-2025 period been secured?

- Gap in access to data

What data sets are needed by the Initiative but are not currently available?

Reliable long-term and continuous ground observation validation datasets are needed at global scales in this initiative. The quantitative remote sensing products should be evaluated and compared with ground observations. The global ground observation datasets for validation are essential for products validation. In this initiative, ground observation validation data from China and from other partner countries have been collected continuously through international cooperation. Still, the long-term continuous datasets from all continents are needed to meet the requirements for validation of multi-level and multi-scale remote sensing products.

What actions is the Initiative taking to obtain the required resources?

The global ground observation validation datasets are mainly collected through ground observation networks and comprehensive field experiments. The global flux observation Network (FLUXNET), the aerosol ground observation Network (AERONET) and the International Soil Moisture Network (ISMN) have been established in cooperation with partner countries in the present-day. China has also established Chinese Ecosystem Research Network (CERN), Chinese Forest Ecosystem Research Network (CFERN), among others. Furthermore, comprehensive field experiments were carried out for quantitative remote sensing methodology research and products validation.

With the release of more multi-level and multi-scale remote sensing products, collecting global ground observation validation datasets needs to be urgently addressed, and these data will be collected in the following ways:

- 1) Obtaining standard ground observation data from partner countries through international cooperation projects;
- 2) Exchanging the demand and application of ground observation data extensively through academic communications and international conferences;
- 3) Collaborating with major global ground observation networks for long-term data sharing within the GEO framework;
- 4) Communicating with other GEO projects, such as IN-SITU-ESC, to achieve the goal of cooperation.

Please list all financial and non-financial contributions to the Initiative (other than in-kind, voluntary participation by individual contributors) having a value of more than USD 50,000.

Contributing Organization	GEO Status	Type of Resource	Value	Currency
China Centre for Resources Satellite Data and Application	China	Data	450,000	RMB
National Satellite Meteorological Center	China	Data	450,000	RMB
National Remote Sensing Center of China	China	Financial	12,000,000	RMB
Ministry of Science and Technology of the People's Republic of China	China	Financial	58,290,000	RMB
Asian Development Bank	UNESCAP - United Nations Economic and Social Commission for Asia and the Pacific	Financial	500,000	USD
Aerospace Information Research Institute, Chinese Academy of Sciences	China	Equipment	900,000	RMB
GEOVIS	China	Equipment	450,000	RMB
National Remote Sensing Center of China	China	Other	675,000	RMB
State Key Laboratory of Remote Sensing Science?Chinese Academy of Sciences	China	Other	1,350,000	RMB

Lessons from the 2020-2022 Period

Were all planned activities for the 2020-2022 period implemented as expected?

Yes

Were there any key challenges faced by the Initiative in the 2020-2022 period?

Yes

Please describe.

1) Verification and international cooperation were not well carried out due to the COVID-19 and other

objective reasons.

2) The end-user abutment with the GEOARC and the decision support for international organization were equivocal.

Were there any impacts or changes to operations due to COVID-19?

Yes

Please describe.

The pandemic has affected overseas communication and field verification work.

Please describe the key changes proposed for the 2023-2025 period, for example, new projects, new areas of focus, or adjustments to the activity governance.

1) New work groups are redesigned according to the work plans.

WG1: Annual report service

WG2: GEO MuSyQ & Global Joint Product and Verification Service

WG3: Food Security and Driving Factor

WG4: Vegetation in Arid Regions

WG5: Joint Observation of Hydrology and Ecology in Large River Floodplain

WG6: Arctic Sea Ice remote sensing observation and application

WG7: Human Activities and Carbon cycle Cooperation

2) New projects, areas, contents are included in the initiative, such as Vegetation in Arid Regions, Hydrology and Ecology, Arctic Sea Ice and Carbon cycle, etc..

3) CA GEO MuSyQ is integrated into the initiative of GEOARC to continually support as the main data source during 2023-2025.

4) The GEOARC will start with the user requirements and then move on to the reports-writing, tools-making and products-producing, etc..

Does the Initiative have outputs (products, services, etc.) available to users now, even if only on a pilot or testing basis?

Yes

Please provide any available information describing this usage (for example, user statistics, results of user testing) and/or feedback from users (for example, user comments, evaluations).

From 2012 to 2021, the annual report focused on three major themes of the global ecological environment: typical elements of the global ecological environment, hot-spot issues and key regions. Twenty-nine special reports and 109 datasets have been released in 10 issues and related remote sensing datasets and products have been shared for free via the GEOSS portal (<http://www.geoportal.org/>; <http://www.geodoi.ac.cn/WebCn/>) and China GOESS DSNNet (<http://www.chinageoss.org/geoarc/>). The English simplified version was released in GEO side event from 2017 to 2021.

Up to December 2021, the Chinese version report had been downloaded 86,590 times and the English version 32,687 times. From 2012 to 2016, the average downloads were 1,149 (612 in Chinese and 537 in English); Downloads surged after 2016, more than six times as many as 6,521 downloads (4,914 for Chinese and 1,607 for English) between 2017 and 2021.

The annual report was widely publicized by Media such as Xinhua News Agency (1.036 million views), Economic Information Daily (160,000 views), etc., and it was reprinted from hundreds of websites.

The 30-meter resolution global land cover dataset was provided to the United Nations free of charge. A letter sent by the GEO Secretariat conveyed high appraisals to the annual report. The annual report of "Changes in Antarctic Ice Sheet" was included in the 2020 GEO Highlights Report and publicized on the front page of the GEO official website.

Special reports such as "Crop Production Outlook and the State of Food Security", and "The Belt and Road Initiative Ecological and Environment Conditions" have stirred enthusiastic responses internationally. United Nations agencies such as the United Nations Food and Agriculture Organization, the United Nations Economic and Social Commission for Asia and the Pacific, and the United Nations Environment Programme have all expressed their extremely high interest.

Please provide supporting documentation if available.

- no supporting documents provided -

Do you have evidence of any impacts that have occurred in part as a result of using the outputs of the Initiative (for example, policy decisions taken, behaviour changes by users, risks mitigated)?

Yes

Please provide examples, with evidence where available.

The annual reports have gained widespread recognition, played a positive role in raising public awareness, attracted governments' attention, and supported decision-making.

- 1.The Cropwatch and annual report of Crop Production Outlook and the State of Food Security supported Uganda and Zambia to carry out grain monitoring services and provided policy support for relevant countries.
- 2.The Annual Reports of the Belt and Road Initiative Ecological and Environment Conditions put forward suggestions on ecological and environment protection, which provided a decision basis and reference for the Chinese government to announce the cancellation of thermal power generation and the realization of clean energy.
- 3.The annual report of Temporal Dynamics and Spatial Distribution of Global Carbon Source and Sink provided scientific support for announcing carbon peak and carbon neutral goals to the Government of China, and for the implementation of the Paris Agreement policy.

Please provide supporting documentation if available.

- no supporting documents provided -

Have there been any internal or external reviews or evaluations of the Initiative since 2019?

No

Please indicate any GEO Work Programme activities with which you have ongoing collaboration.

- AOGEO - Asia-Oceania Group on Earth Observations
- GEOGLAM - GEO Global Agricultural Monitoring
- GEOARC - Global Ecosystems and Environment Observation Analysis Research Cooperation
- MUSYQ - Multi-source Synergized Quantitative Remote Sensing Products and Services

Please indicate any additional GEO Work Programme activities with which you would like to establish new collaborations.

- EO4EA - Earth Observations for Ecosystem Accounting
- EO4SDG - Earth Observations for the Sustainable Development Goals
- GEO BON - GEO Biodiversity Observation Network
- GEO Engagement Priorities Coordination - GEO Engagement Priorities Coordination
- GEO-EV - GEO Essential Variables
- GEO-ECO - GEO Global Ecosystems
- GEO-LDN - GEO Land Degradation Neutrality
- GEO Work Programme Support - GEO Work Programme Support
- GEOSS Data, Information and Knowledge Resources - GEOSS Data, Information and Knowledge Resources
- GEOSS Infrastructure Development - GEOSS Infrastructure Development
- LAND-COVER - Global Land Cover
- IN-SITU-ESC - In-Situ Observations and Applications for Ecosystem Status of China and Central Asia

Stakeholder Engagement and Capacity Building

Are there specific countries or organizations that your Initiative would like to engage?

Yes

Please list these countries, regions or organizations.

University of Technology Sydney (UTS), Australia
University of New South Wales (UNSW), Australia
Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia
Ministry of Environment, Cambodia
University of Chittagong, Bangladesh
Centre d'Etudes Spatiales de la Biosphère (CESBIO), France
Centre National de la Recherche Scientifique (CNRS), France
Federal University of São João del Rei, Brazil
University of British Columbia (UBC), Canada

What are your plans to engage them?

- 1) Conducting academic communications and seminars to explore the good capacity of partner organizations;
- 2) Leveraging knowledge, resources, and skills of partner organizations in collective support of the GEOARC Initiative;
- 3) Participating in quantitative remote sensing product algorithm research, such as related research at UTS and UNSW;
- 4) Carrying out field experiments to obtain historical and current ground observation data, such as work of this nature at CSIRO and at Cambodia Ministry of Environment;
- 5) Recommending ways of implementation in countries and regions by supporting members in application research of remote sensing monitoring, such as related activities at University of Chittagong;
- 6) Providing appropriate financial support to partner organizations.

Does your Initiative engage users in the work of the Initiative (for example, consultation, testing, co-design)?

Yes

Please briefly describe the Initiative's approach to engaging users.

The prime users of GEOARC Initiative are United Nations Environment Programme (UNEP), Food and Agriculture Organization of the United Nations (FAO), government departments and other major groups and stakeholders.

UNEP acts as a catalyst, advocate, educator, and facilitator to promote the wise use and sustainable development of the global environment. The GEOARC Initiative has already discussed with UNEP on data exchange, and policy issues on copyright or performance evaluation. Quantitative remote sensing products pertaining to SDG15 such as sustainably manage forests and combat desertification will be shared on the UNEP website. We believe that a sound cooperation mechanism will be established with UNEP.

FAO leads the international efforts to fight hunger. It is both a forum for negotiating agreements between the developing and the developed countries and a source of knowledge and information to aid development. The GEOARC Initiative has shared data on agricultural monitoring, for example seasonal maximum Vegetation Condition Index (VCIx) and Cropped Arable Land Fraction (CALF) from 2011 to 2021 on the FAO website. In addition, the initiative has established connections with FAO on research for monitoring and evaluation of dryland vegetation dynamics and their driving forces. Data Sharing will be continued and extended to crop monitoring and dryland vegetation dynamics monitoring etc..

Does the Initiative have a user engagement strategy or similar kind of document?

No

Are there categories of users that are not represented at this time, but you would like to engage?

Yes

Please list these user categories or regions.

Non-governmental organization

What are the plans for further engagement of users in the Initiative?

Year 2023:

Draft user engagement strategy and data sharing agreement?

Cooperate with Initiative is United Nations Environment Programme (UNEP) under this agreement.

Year 2024:

Explore potential user communities through academic communications and international conferences;

Discuss and draft a data sharing agreement with Asia-Pacific Space Cooperation Organization (APSCO) to provide quantitative remote sensing products and application services to the member states of APSCO;

Discuss and draft a data sharing agreement with Agriculture Organization of the United Nations (FAO) to provide quantitative remote sensing products on the FAO website.

Year 2025:

Provide opportunities for training workshops, knowledge transfer, and resource and knowledge sharing;

Engage United Nations Convention to Combat Desertification (UCCD), Intergovernmental Panel on Climate Change (IPCC), International Centre for Integrated Mountain Development (ICIMOD) as a user in the Initiative.

Does the Initiative have a documented capacity development strategy?

No

Please describe the approach to capacity development that is being implemented by the Initiative?

Through the open data sharing principles, tools, cloud service platform and the organization of special events in international conferences to develop the capacity of the Initiative. In addition, the capacity development in the member countries is organized by GEOARC partners in cooperation with other stakeholders.

Are there any commercial sector organizations participating in this Initiative?

Yes

Please list the commercial sector organizations.

Organization name	GEO Member/PO/...	Country in which the organization is based	City in which the organization is based
GEOVIS	China	China	Beijing
PIESAT	China	China	Beijing

Are there opportunities for commercial sector uptake of the outputs of the Initiative?

Yes

Please describe these opportunities.

There are many opportunities for commercial sector uptake of the outputs in the Initiative.

- 1) The output software tools can be provided to commercial sector to extend and promote the application of these tools;
- 2) The quantitative remote sensing products can be provided to commercial sector for post-processing and promotion of their applications;
- 3) The output monitoring methods and the Annual Reports can be provided to commercial sector to promote and to provide decision-making support.

Is there already commercial uptake occurring?

Yes

Please describe the nature of this uptake and the relevant commercial sector organizations.

We have had some success working with the commercial company GEOVIS to develop sharing platform for dissemination of quantitative remote sensing products.

Are there opportunities for further commercial sector participation in the Initiative?

Yes

Please describe these opportunities.

The Initiative is always open to commercial sector. We also continue to explore more and new opportunities and cooperation mechanism for further involvement of the commercial sector. The opportunities mainly focus on inversion algorithms, software tools, quantitative remote sensing products and the user resources, etc..

Does the Initiative have a plan for commercial sector engagement?

Yes

Please describe this plan or upload the relevant document.

- 1) Continue to cooperate with GEOVIS to release and share quantitative remote sensing products;
- 2) Explore the cooperation mechanism with PIESAT to achieve the commercial application of quantitative remote sensing product inversion algorithm and the software tools;
- 3) The GEO commercial engagement guidelines have been quite useful for us to attract more commercial opportunities.

- no supporting documents provided -

Governance

Please describe the roles of each of the key leadership positions, as well as any team structures involved in day-to-day management.

Leadership

GEOARC is organized by the National Remote Sensing Center of China, assisted by the State Key Laboratory of Remote Sensing Science, Aerospace Information Research Institute, Chinese Academy of Sciences. GEOARC is co-led by Mr. Zhichun Liu (NRSCC, China), Prof. Qinhua Liu (AIRCAS, China), Prof. Alfredo Huete (UTS, Australia) and Prof. Jiaguo Qi (MSU, USA). GEOARC is divided into seven work groups and steering committee group.

Workgroups

The top research teams at home and aboard were organized interdepartmentally, giving full use of the advantages of remote sensing technology, the ecological environment of long-term dynamic change monitoring by remote sensing was conducted at the global, regional and national scales, to analyze the ecological environment change rule and driving factor, to release the Annual Report and datasets, to share the products, tools and cloud service platforms. The co-leaders of WGs act as the members of the executive committee of GEOARC governing board. The work groups are listed as:

WG1: Annual reports service

Co-leaders: Zhichun Liu, Jing Zhang

Invite various industries or countries to work together and engage experts from various fields and disciplines to analyze the conditions and changes of ecosystems and environment, make suggestions for the local development if dimmed necessary on human health issues and the environment before finalizing the reports.

Focusing on topic selection, scheme appraisal, data collection, monitoring analysis, report writing, expert and advisory group consultation, report releasing, and publicity promotion.

WG2: GEO MuSyQ & Global Joint Product and Verification Service

Co-leaders: Qinhuo Liu, Alfredo Huete

Basic products such as Land cover, quantitative remote sensing products from MuSyQ, GLASS and terrestrial vegetation common products are regularly updated. Provide ecological environment monitoring products and integrated software display platform based on satellites to serve global users. Conduct the joint validation at global scale and share the datasets and service for free. Strengthen services for end users and decision-support for national and international organizations.

WG3: Food Security and Driving Factor

Co-leaders: Bingfang Wu, Andries Potgieter, Diego De Abelleira

Focusing on the limiting factors to food production and the possible impacts on food security at national, regional and global scales, including (1) agricultural drought and effects of measures on drought mitigation, (2) water productivity (crop production per drop) and crop yield gap, (3) agricultural infrastructure development.

WG4: Vegetation in Arid Regions

Co-leaders: Xiaoping Xin, Jianguo Qi

Focusing on (1) Development of methods on monitoring and evaluating of dryland vegetation dynamics and their driving forces in conjunction with multi-platform remote sensing and ground observation network such as Flux-net, C-Flux, NEON, CNERN and CARIN. (2) Development of new generation vegetation dynamic models to analyze the changes and trends of ecosystem functions, such as carbon uptake and land erosion. (3) Release of Annual Reports and data products in support of the UNCCD or Sustainable Development Goals to better planning and use of natural resources. (4) Exploring decision making tools for adaptive management of ecosystems, especially smart management of rangelands, by using software and cloud computing technology, to deliver the outputs to different regions, countries or organizations.

WG5: Joint Observation of Hydrology and Ecology in Large River Floodplain

Co-leaders: Qi Zhang, John Melack, Jeffrey Walker

Focusing on joint hydrological and ecological observations in large river floodplains, the Yangtze River Delta, the Amazon and the Murray River basins, and construct a representative ecological factor habitat with parameter/threshold recommendation, data preprocessing, connectivity analysis and result preview as the main functions. A simulation platform for suitability assessment, serving and supporting decisions on biodiversity conservation such as demarcation of protected areas, optimization of connectivity paths, and regulation of water resources.

WG6: Arctic Sea Ice remote sensing observation and application

Co-leaders: Xiao Cheng, Gunnar Spreen, Stefan Kern, Jiping Liu, Leif Eriksson, Mohammed Shokr

Focusing on Arctic sea ice remote sensing observations, form a multi-scale Arctic sea ice remote sensing dataset with domestic independent satellite data as the core and foreign satellite data as support to monitor the extent, density, thickness, type, drift, and surface temperature of Arctic sea ice. The rapid changes in time and space of various parameters such as inter-glacial waterways, the authenticity of the products are verified through the international joint inspection of the Arctic Ocean, and the international and domestic satellite observation data and various sea ice remote sensing data products are released and shared. Combined with sea ice remote sensing observation, polar field observation and sea ice model simulation, develop a risk assessment model for ships in polar regions, build an integrated system for Arctic waterway environmental information, and provide Arctic waterway users with near real-time environmental information reports and intelligent route planning services.

WG7: Human Activities and Carbon cycle Cooperation

Co-leaders: Li Wang, Martin Rudbeck Jepsen, Rachhpal Jassal

Focusing on the proposed monitoring of global terrestrial ecosystem carbon disturbance and remote sensing monitoring of clean energy facilities in Asia and Europe to serve the "carbon neutrality" target and sustainable development and mitigation of climate change. (1) Carry out carbon loss/gain assessment of global terrestrial ecosystems, quantify the carbon budget of terrestrial ecosystems in various regions of the world, assess the pattern and variability of carbon sources and sinks in global terrestrial ecosystems, and further reveal the impact of natural and human activities on carbon disturbances. (2) Carry out remote sensing monitoring of clean energy facilities (photovoltaic, hydropower, wind power, etc. in key regions of the world, evaluate the development and investment process of clean energy in key regions of the world, and analyze the development status and trends of clean energy in Asia and Europe.

Steering committee

Co-leaders: Guanhua Xu, Barbara. J. Ryan

The advisory/expert group gives suggestions to ensure the successful conduction of GEOARC.

Secretariat

The secretariat gives support to ensure the orderly and smooth work.

Is there a steering committee or other governance bodies that advise the Initiative but are not involved in day-to-day management?

Yes

Please describe the roles of each body. If there are multiple governance bodies, please describe the relationships among them (such as through a governance structure diagram).

Director: Guanhua Xu, Barbara. J. Ryan,

The committee is formed by recommendations from various countries and user communities.

- no supporting documents provided -

What methods does the Initiative use to communicate with its participants?

- Email / e-newsletters
- Regular conference calls
- Website
- Regular events

Please describe the key risks that could delay or obstruct the completion of the planned activities and outputs of the Initiative, along with any actions taken to mitigate these risks.

Description of the hazard	Description of the possible impacts	Scale of impact	Likelihood of occurrence	Mitigation measures
COVID-19	Verification work abroad is difficult to be carried out, and international cooperation and exchange blocked.	Moderate	Very likely	Strengthen online communication

What methods are used by the Initiative to monitor its effectiveness?

- Informal discussions with users / beneficiaries
- User or beneficiary surveys
- Website statistics
- Consultations or events
- Evaluations

Would the Initiative be interested in assistance from the GEO Secretariat for developing an impact plan?

Yes

How are the results of the monitoring and evaluation activities shared with participants and the wider GEO community?

Jointly carry out side-events with other GEO communities.

Are any monitoring or evaluation activities required by funders/contributors?

No

Participants

Please list the active individual participants in the Initiative

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Other information

Please provide any other comments or information that was not included in the previous sections, but you would like to appear in the Implementation Plan.

GEOARC shares the latest research results with global scientists by actively participating in international academic activities of GEO, AOGEO, between and within working groups etc. ,to support biodiversity conservation and sustainable development.

Activities: Organizes GEO week side events and attend AOGEO symposiums actively; Releases the latest research contributions on Global Ecological Environment Remote Sensing Observation .

Publicity: Through various media publicity and promotion to improve public awareness and social impacts;

Training: Organizing and participating in international training courses to help researchers from developing countries to improve their remote sensing monitoring capabilities;

GEO Highlights Report: Selected in GEO Annual Highlights 2020;

Provide public products for the international community;
Promote and application of international standards and technical methods;
Expand the regional cooperation network to involve more countries and organizations;
Contribute the wisdom and remote sensing power of GEOARC to the Global Earth Observing System (GEOSS);
Promote Advances on Global Earth Observation Technology Jointly .

- impact_of_geoarc.pdf ([link](#))

Co-Editor Management

List of co-editors for this initiative

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