WP23_25: Geohazard Supersites and Natural Laboratories

1238,223

Basic Information

Full title of the Initiative

Geohazard Supersites and Natural Laboratories

Short Title or Acronym

GSNL

Current category in the 2020-2022 GWP

GEO Initiative

Proposed category in the 2023-2025 GWP

GEO Initiative

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Purpose

Objective

The Geohazard Supersites and Natural Laboratory initiative (GSNL) is a voluntary international partnership aiming to improve, through an Open Science approach, geophysical scientific research and geohazard assessment in support of Disaster Risk Reduction.

Please provide a short description of the Initiative

The goal of GSNL is to promote broad international scientific collaboration and open access to a variety of space- and ground-based data, focusing on geoscience fields with scientific knowledge gaps in locations that are at high risk from geohazards, like earthquakes and volcanic eruptions. Earthquakes, volcanic eruptions and landslides become disasters with deadly consequences when they coincide with vulnerability of the human environment. In the last 30 years, these hazards have claimed over 770,000 lives (56% of total disaster deaths), caused economic damages in excess of 785 B$/year, and affected over 135 million people and 25 million homes, most of which are located in lower-income countries. For these areas, designated as Supersites, a joint effort is carried out between: space agencies, who provide satellite imagery at no cost for scientific use;

monitoring agencies, who provide access to ground-based data; and the global scientific community, who exploit these data to generate state-of-the-art scientific results. Work at each Supersite is coordinated by local geohazard scientific institutions and researchers that are already providing authoritative geohazard information in support of emergency response managers and decision makers. This process ensures that the new knowledge generated by the wider scientific community is rapidly taken up by stakeholders to benefit hazard assessment, disaster monitoring, and response actions.

Why is this Initiative needed?

The disproportionate loss of life and property caused by geohazards like earthquakes, volcanic eruptions, and landslides, highlights the need for focused research into how these hazards can be forecast and mitigated. Too often such research is piecemeal owing to a lack of data availability. GSNL ensures that comprehensive suites of ground- and space-based data, which might not otherwise be freely available, are open to the scientific community, thereby promoting innovative and collaborative research at sites prone to geohazards and that can serve as natural laboratories for developing science useful for understanding phenomena in other locations around the world. However, Supersites are not only laboratories where new science is developed, but also places where the scientific information is rapidly delivered to national risk managers and becomes instrumental in preventing risk and managing emergencies.

What evidence is there to support this need?

In volcanology, it has long been a “best practice” to establish scientific observatories to monitor and research volcanic hazards. This approach has also been adopted by earthquake scientists in areas of seismic hazards. When both remote sensing and in situ datasets are combined and made freely available to the scientific community, and not just the responsible hazard monitoring agency, important scientific insights have resulted that have influenced the discipline and aided hazard forecasting and mitigation. Well-developed “observatories” with access to comprehensive suites of data, however, are few and far between. GSNL aims to address this gap by strengthening data availability and connecting researchers and stakeholders working in areas subject to geohazards.

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?

No

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
Ground displacement maps and time series at each Supersite	Regularly updated	Hawaii County Civil Defense, Icelandic Police – Dept. of Civil Protection, Italian Department of Civil Protection, Istanbul municipality Secretariat for Risk Management of Ecuador New Zealand Ministry of Civil Defence and Emergency Management, Greek Civil	

		Defence Ministry of Interior and Public Safety of Chile California Office of Emergency Services, FEMA, etc.	
Volcanic and seismic source models	Regularly updated	Hawaii County Civil Defense, Icelandic Police – Dept. of Civil Protection, Italian Department of Civil Protection, Istanbul municipality Secretariat for Risk Management of Ecuador New Zealand Ministry of Civil Defence and Emergency Management, Greek Civil Defence Ministry of Interior and Public Safety of Chile California Office of Emergency Services, FEMA, etc.	
Seismic and volcanic hazard assessment	Regularly updated	Hawaii County Civil Defense, Icelandic Police – Dept. of Civil Protection, Italian Department of Civil Protection, Istanbul municipality Secretariat for Risk Management of Ecuador New Zealand Ministry of Civil Defence and Emergency Management, Greek Civil Defence Ministry of Interior and Public Safety of Chile California Office of Emergency Services, FEMA, etc.	
Scientific support for situational awareness during seismic and volcanic crises	Occasionally updated	Hawaii County Civil Defense, Icelandic Police – Dept. of Civil Protection, Italian Department of Civil Protection, Istanbul municipality Secretariat for Risk Management of Ecuador New Zealand Ministry of Civil Defence and Emergency Management, Greek Civil Defence Ministry of Interior and Public Safety of Chile California Office of Emergency Services, FEMA, etc.	

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

We listed two products and the main services. A number of other scientific products are generated at each Supersite, depending on the site and the phenomena under investigation. In most cases they eventually become part of the scientific information delivered by the Supersite Coordinators to the National risk managers.

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

GSNL is primarily meant to support: 1) scientific research that will result in a better understanding of forecasting geohazards and mitigating their impacts at the Supersites, and 2) development of actionable information that is communicated to risk managers to support prevention of the potential impacts of hazardous geological events, like volcanic eruptions, earthquakes, and landslides.

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

Responses to hazardous geological activity require accurate and reliable information on the likely future course of the hazard. Such information can only be obtained through a thorough scientific understanding of the hazardous process. GSNL aims to facilitate that scientific understanding, by providing access to data and promoting international collaboration.

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 primary impacts of GSNL, in addition to increased scientific understanding of geologic hazards, are reduced loss of life and property through improved hazard assessment, risk mitigation and emergency response.

Added during revision:
GSNL addresses only one component of the Risk equation: Hazard. Since hazard is variable independent of human activities there is little involvement of the initiative into policy actions for DRR. These latter are more relevant to the other two components: Vulnerability and Exposure. Certainly the impact of GSNL in terms of DRR policy would increase if all the Risk components were part of its activities, however, this would be a major change, and at least for this GWP, it is not planned.

Earthquake and Volcano Early Warning systems can be already active at the Supersites, as part of the national risk management systems. Where they exist, they provide information to the decision makers and the public.

It should also be mentioned the important role that a Supersite can make, in low income countries, in raising the level of support for the Supersite coordinating institution by the national government and the international scientific community. This is presently occurring in DRC for the Virunga Supersite.

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 CEOS, the Committee for Earth Observation Satellites.

Describe the nature of the request.

Each Geohazard Supersite provides a biennial report to the CEOS, the Committee for Earth Observation Satellites.

Added during revision:
These reports are publicly available on our website geo-gsnl.org, under each Supersite page. We attach one

recent report as example.

Please provide supporting documentation of the request.

- icelandic_volcanoes_biennial_report_2020_2021.pdf (link)

Technical Synopsis

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

The primary method by which GSNL accomplishes its goals is by facilitating open data access, including both ground-based and satellite datasets. A holistic approach to hazards monitoring and mitigation will not only aid situational awareness during a crisis, but can also lead to improved forecasting and response practices through improvements gained via scientific research. GSNL is contributing to Priority 1 of the Sendai Framework. This is accomplished by improved earthquake/volcano monitoring capacities established with the CEOS satellite data support to the Supersites, which has already provided benefits on the hazard assessment and early warning throughout rural areas in Iceland, US, New Zealand, and major cities like Quito (Ecuador), Istanbul, Naples, Goma (Democratic Republic of Congo). The actual use of this improved information for the implementation of effective risk mitigation measures is the responsibility of local and national governments. The most direct contribution of GSNL to the Sendai Framework targets is related to augmenting the capacities of national multi-hazard early warning systems and providing enhanced hazard information to risk managers but also to the population. This is accomplished at each Supersite by the increased use of Earth Observation data by the Coordinating Institutions and through collaboration with the international scientific community. It is clear that without GSNL, the countries which host Supersites would have a limited access to the types of satellite data that are essential (and in some cases fundamental) for effective monitoring of volcanic and earthquake activity and fault-induced deformation. Moreover, GSNL contributes to the enhancement of international collaboration on disaster topics and to the development of better risk management capacities by the national authorities in charge.
From the technical point of view, the Supersite scientific community employs a number of analytic techniques to process and interpret the local data, pertaining to the fields of seismology, geodesy, remote sensing, geology, tectonics, etc.

Added during revision:
In situ data are a crucial component of the scientific information that the Supersite communities can use to investigate the local phenomena. Each Supersite is requested to provide open access to data from the local monitoring networks, so the initial Supersite proposals (available on our website) describe the list of in situ data which will be made available. In some less developed countries GSNL allows to negotiate a site specific data policy, which essentially aims at promoting the transfer of knowledge and capacities from the international scientific community to the local one.
Follwing the initial Supersite setup, the Coordinators should report every two years on the implementation of open access to in situ data. The biennial reports are available on our website under each Supersite page.
We attach a report as an example.

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

- marmara_biennial_review_report_2020_2022.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.

The most important challenge is the full implementation of Open Science for all Supersites. While there is also a policy component to be solved, since not all countries involved in GSNL have yet fully embraced Open Science as an important goal, there are also some technological bottlenecks to be resolved. For some data

there is a lack of standardised metadata and data formats, which makes the adoption of machine-readable databases a difficult task.

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.

For some Supersites in less developed countries (D.R. of Congo, Ecuador, Nicaragua) we are providing computing resources and capacity building to develop local capacities for earthquake/volcano monitoring and data analysis. We expect important progress in the next three years.

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)
InSAR analysis	Course on InSAR analysis for ground deformation monitoring	July 2022 in virtual format (can be repeated on request in the following years)
Scientific analysis of volcanic unrest/eruption	Course on volcano source modeling in collaboration with USGS-VDAP	August 2022 in Quito, Ecuador
Data processing/analysis resources	GSNL is providing Virtual Machines equipped with the relevant scientific software tools to process and analyse the EO data	At least up to december 2025

Resources

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

- Gap in financial resources

What is the estimated funding gap for the 2023-2025 period?

The funding gap concerns mainly Supersites in less developed countries (especially in D.R.Congo), where the ground-based monitoring networks are very substandard, and where computing and communication resources are also rather limited. An estimation of the funding gap for each of these Supersites is difficult to elaborate, but it would be in the 500 K to 1 M US $ range for each Supersite.

Added during revision:
In the table below we calculated the CEOS contributions by multiplying the cost of the images (when requested by scientific institutes) by the total number of images provided each year.
While some space agencies have open scientific calls, these calls normally allow to access only a limited amount of images (max 100 for CSK, much less for other satellites), and often only archive images. In addition these scientific proposals cannot be used for repetitive monitoring (they are one shot projects which last 1-2 years), and the image delivery is not near real time as for most Supersite satellite data.

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

The GSNL governance has promoted the needs of these Supersites with UNDRR, the WB, seeking also support from GeoSec. Some minor support is coming from the initiative partners, but is largely insufficient.

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
CEOS	CEOS - Committee on Earth Observation Satellites	Data	7-8 M	Euro
INGV	Italy	Financial	70 K	Euro
All Supersites	Multiple countries	Equipment	2-3 M	US $

Lessons from the 2020-2022 Period

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

No

Please describe which activities were delayed or not implemented and how has this affected plans for 2023-2025.

Our objective of ensuring that EO data from public space agencies are made fully open for risk management use, at least in developing countries, was not reached.
Our objective to fully implement Open Science in all the GSNL Supersites is not yet fulfilled and is a challenge for the present GWP.

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

No

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

No

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.

We plan to establish 1-3 new Supersites, mostly in less developed countries.
We plan to make our capacity development activities more structured and coordinated at central level of the GSNL Executive Board.

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).

Products and services (some examples are given in the section "Purpose") are generated continuously during

the monitoring activities. When they are deemed relevant, in terms of scientific quality and pertinence, they are released to the users (decision makers). We do not have aggregated feedback from users. In the Supersite biennial reports, the Supersite Coordinators describe the use of their scientific products and services by the national users.
The reports are available on the GSNL website, under each Supersite page: geo-gsnl.org

Added during revision:
We do not have direct information on the statistics of the use of Supersite products and services, and the consequent impact in risk management activities. However, there are a number of scientific publications (listed at the end of this period) which point out the reduction in fatalities due to volcanic eruptions over time and suggest that it is a result of increased monitoring, including InSAR. Since GSNL has strongly increased the use of EO data at the Supersites, and thus the quality of the monitoring by the local communities, we can certainly link the Supersite activities to life and economic loss reductions, albeit not in a quantitative way.
Publications linking inproved monitoring to loss reduction:
Auker et al., 2013 (https://link.springer.com/article/10.1186/2191-5040-2-2); Brown et al., 2015 (https://doi.org/10.1186/s13617-017-0067-4), Pallister et al., 2019 (https://doi.org/10.1186/s13617-019-0082-8).

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.

In the Supersite biennial reports, the Supersite Coordinators describe the use of their scientific data by the national users.
The reports are available on the GSNL website, under each Supersite page: geo-gsnl.org

Added during revision:
the Supersite biennial reports describe the impact that the scientific information generated in the response to a crisis or in risk prevention activities. However, what is normally described there is just a few examples. The decisions involved in risk management require many different pieces of information, sometimes affected by limited accuracy due to lack of observations, and there is a constant dialogue between scientists and decision makers. This process and its outcomes cannot be effectively described in a report, and the actual impact of the information on a decision is difficult to ascertain.
We attach another example of a biennial report describing the use of the scientific information by the local decision makers. During the Hawaii 2018 eruption, the Supersite EO data were both important to risk managers (the data helped with forecasting and situational awareness), and to the population. The latter was the target of public information campaigns showing the value of the EO data (for example, depicting the collapse of the summit via sequences of SAR images).

Please provide supporting documentation if available.

- hawaii_supersite_biennial_report_2019_2020.pdf (link)

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.

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

- AFRIGEO - African Group on Earth Observations
- AMERIGEO - Americas Group on Earth Observations
- ATLANTIC-EO - Earth Observations for the Atlantic Region
- EUROGEO - European Group on Earth Observations
- GEOSS Data, Information and Knowledge Resources - GEOSS Data, Information and Knowledge Resources

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.

We would like to engage development funds and international funding agencies, to support the full developement of the monitoring capacities of some GSNL Supersites in less developed countries as D.R. Congo, Ecuador, Nicaragua.

What are your plans to engage them?

Ask GeoSec to promote GSNL exploiting the convening power of GEO

Utilize contacts that GSNL community members have to national or other potential funding sources (development aid)
Promote the single Supersite needs with the regional GEOs

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.

As mentioned above, each Supersite coordinating institution is part of the national structure for Risk Management. Since in most cases these institutions are mandated by national laws to support the RM structure (users) with scientific information, there is normally a close relationship between the scientists managing the Supersite and the users. The relationship mainly consists in users providing requirements for the service, based on their contingent needs (e.g. a specific crisis). The scientists however, independently decide about the best technical and scientific strategies to monitor and interpret the phenomena.

Added during revision:
the Supersite biennial reports describe in a synthetic way the use of the scientific information generated in the response to a crisis or in risk prevention activities. Since there is a constant interaction between the local scientists and the users this process and its outcomes cannot be effectively described in a report, and the actual impact of each piece of information on a decision is not always easy to ascertain.

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?

No

Does the Initiative have a documented capacity development strategy?

No

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

We have a network of Supersite Coordinating institutions, some of which have a good level of resources and capacities. They are expected to support the Supersites which have less resources and capacities, at least with in kind resources, training, capacity development, knowledge sharing. The support is voluntary and is coordinated centrally.

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
GSH	Greece	Greece	Athens

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

No

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

Yes

Please describe these opportunities.

We plan to ask some commercial EO data providers to support the initiative in exchange of publicity in terms of scientific results for DRM obtained using their data.

Does the Initiative have a plan for commercial sector engagement?

No

Governance

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

Please see attached file

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).

Please see attached file

- the_geo_gsnl_governance_2022_2025.pdf (link)

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

- Email / e-newsletters
- Other

Please describe.

Until 2020 we used to have community splinter meetings twice per year, during the AGU and EGU scientific conferences. We will start having them again in 2023.
The governance bodies meet remotely at least twice per year

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.

- no answer given -

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

- Informal discussions with users / beneficiaries

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

No

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

- no answer given -

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.

- no answer given -

- no supporting documents provided -

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