



OBSERVING MOUNTAIN ENVIRONMENTS

## 2020-2022 GEO Work Programme

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## 1. Executive Summary

### Full title of the Initiative.

Global Network for Observations and Information in Mountain Environments

### Short title or acronym

GEO-GNOME

### Existing or proposed category

Existing GEO Initiative

### Overview

GEO-GNOME, an Initiative launched in 2016, aims at bringing together research institutions and mountain observation networks to collate and make available transboundary and inter- and transdisciplinary environmental and social-ecological data and information on global change in mountains. This is expected to facilitate access to key data and information to the research community for studies applicable to global assessments such as IPCC, as well as information for local, national and regional decision-makers, ensuring that ‘mountains’ as a topic is incorporated in the process of global agendas such as the 2030 UN Agenda and its Sustainable Development Goals (SDGs), on climate change through the Intergovernmental Panel on Climate Change (IPCC) and UNFCCC, as well as Sendai Framework for disaster risk reduction.

### Planned Activities

In addition to the already existing and completed tasks outlined in the current GEO-GNOME 2017-2019 work plan (see relevant section in this proposal), the following tasks have been identified as forming part of the next set of activities under GEO-GNOME proposed for the 2020-2022 work plan, that build on the previous 2017-2019 work plan:

Task Name	Task Description	Task Starting Year	Task Completion Year
<b>OBJECTIVE 1. Delineate accurately mountain regions using best available data</b>			
<i>Task 1.1b: Explore option to compile a new mountains mapping layer (K4)</i>	This task will aim to add one additional layer with information on socio-ecological systems superimposed to mountain delineations. A paper publication is envisaged to document the process and the results.	2018	2020
<i>Task 1.2b: Make GME accessible via GEOSS and linked via GEO-GNOME GEOSS portal</i>	A GEO-GNOME portal in GEOSS is currently on beta version, still requires mirroring of Global Mountain Explorer (GME) from USGS host site	2018	2020

	into GEOSS.		
<i>Task 1.4</i>	Series of regular webinars to enhance communication, exchange and engagement with GEO-GNOME community of interested parties, scientists, data providers, and data users to present GEO-GNOME developments with the GEOSS portal and seek feedback on utility and improvements.	2020	2022
<b>OBJECTIVE 2. Identify data providers and user knowledge needs</b>			
<i>Task 2.1: update existing database on data providers including GEO Flagships, Initiatives and Community Activities relevant to GEO-GNOME</i>	Registry of relevant data providers and GEO Flagships, Initiative, Community Activities that could connect to GEO-GNOME goals and objectives.	2019	2020
<i>Task 2.2: Engage and contact data stewards and researchers for other additional relevant data</i>	Registry of relevant data providers that could connect to and contribute to GEO-GNOME goals and objectives. Provide a gap analysis to identify and map data availability and their protocols, versus what is required for observations in mountain environments.	2019	2020
<i>Task 2.3: Identify user needs in the specification of data and information needs in line with GEO's strategy and global policy processes focus</i>	Conduct surveys and/or consultations to gather insights and inputs on specific user needs in line with GEO's strategy and areas of priority.	2019	2020
<b>OBJECTIVE 3. Improve monitoring and understanding of mountain processes</b>			
<i>Task 3.1: Support the development of UHOP to improve high-elevation climate data - from EDW to Elevation-Dependent Climate Change (EDCC)</i>	Identify suitable regions/areas for Unified High Elevation Observing Platform (UHOP) and document the existing capacities and infrastructure available to monitor and gather observation data as per needs / specific relevance for mountain environments.	2019	2021
<i>Task 3.2 Workshop on ECVs for mountains</i>	This workshop intended to identify the essential climate variables (ECVs) for climate and environmental transformations and changes in mountains and along altitudinal gradients, as well as to start identifying all other mountain-relevant variables for socio-ecological high-elevation systems. The workshop also intended to highlight the high value of combining in-situ observations,	25-27 June 2019	25-27 June 2019

	satellite data and modelling. Workshop results a good basis for Task 3.3.		
<i>Task 3.3 Workshop to identify essential mountain variables (EMVs) for social ecological systems (linked to new task under Task 1.1. to develop a new K4 layer)</i>	Workshop planned for February 2020 (20-21/02) as a back-to-back event to the World Biodiversity Forum (Davos, 23-28 February 2020) and linked to the June 2019 ECVs workshop (see Task 3.2). Position paper (gap analysis) and inventory is envisioned as output, as well as blue print for layer k4.	2020	2020
<i>Task 3.4 NEW task in support of Task 3.1 Workshop on elevational transects</i>	Workshop to derive foundation work and information on suitable locations for elevational transects and identify key local stakeholders/observatories (for 2020)	2019	End-2020
<i>Task 3.5 Explore and establish links with PAGES and other paleoclimate research communities</i>	Understanding the past evolution of the Earth's climate system in highly sensitive regions such as the mountain areas is crucial to better understand current conditions and to predict possible future scenarios of change, assess their impacts and develop appropriate strategies for supporting sustainable development and adaptation. At the same time, the availability of reliable observations of ECVs in mountains is essential to calibrate natural and documentary proxies from mountains. Given this two-fold advantage, this task aims at exploring a new link between GEO-GNOME and the existing paleoclimate communities, such as PAGES (Past Global Changes - <a href="http://www.pastglobalchanges.org">www.pastglobalchanges.org</a> ) or other smaller initiatives. As a first step, GEO-GNOME will connect to the paleo-communities through MRI-facilitated webinars to explore ways for cooperation. Based on the outcomes of these preliminary links, the possibility to organise a dedicated workshop will be explored.	2020	Mid-2022
<b>OBJECTIVE 4. Communicate, link, and develop reporting capacity that responds to policy needs</b>			
<i>Task 4.1 Communicate milestones and tasks results, and showcase products at key GEO events and at relevant global policy events</i>	Webinars to communicate results (from 2020), as well as workshop and events outcomes available and displayed online at GEO-GNOME GEO website and MRI's current information channels (website, newsletters and social media outreach)	2018	ongoing

<i>Task 4.2 Task 4.2 List and connect with other regional and national programmes relevant to EO in mountain environments, as well as international networks</i>	Calendar of events and registry of key contacts/global policy events to connect to for added value and impact.	2019	ongoing
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Other possible tasks are yet to be identified and specified, GEO-GNOME is in a process of co-design with GEO-GNOME funders (Swiss Agency for Development and Cooperation, SDC) during the current entry proposal design phase Feb-Sep 2019. Furthermore, exchange with other relevant GEO Flagships and Initiatives at the GEO Symposium in April 2019, revealed opportunities to identify additional tasks and activities that will be added to this plan in due course. The GEO WEEK 2019 as part of the GEO Ministerial meeting in November 2019, is a key opportunity to clarify and define these joint activities with other GEO Flagships and Initiatives accepted into the GEO Work Programme 2020-2022.

**Point of Contact (primary contact person(s) for the Initiative and their email address).**

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## 2. Purpose

**Rationale (i.e. evidence of need) for the Initiative.**

Mountains are globally distributed environments producing significant societal benefits, but the ability of mountain regions to provide goods and services to both highland and lowland residents is seriously threatened by climatic changes, environmental pollution, large-scale political and socio-economic transformations, unsustainable management of natural resources and serious gaps in the understanding of mountain systems.

Despite numerous research efforts focused on mountains, there are still gaps around network connectivity, availability and accuracy of high-altitude observations, inter-comparable methodologies to analyse the data, models able to correctly simulate mountain processes and provide reliable projections for high-altitude regions and addressing relevance for policy and decision-making contexts and processes.

GEO-GNOME, an Initiative launched in 2016, aims at bringing together research institutions and mountain observation networks to collate and make available transboundary and inter- and transdisciplinary environmental and social-ecological data and information on global change in mountains. This is expected to facilitate access to key data and information to the research community for studies applicable to global assessments such as IPCC, as well as information for local, national and regional decision-makers, ensuring that 'mountains' as a topic is incorporated in the process of global agendas such as the 2030 UN Agenda and its Sustainable Development Goals (SDGs), on climate change through the Intergovernmental Panel on Climate Change (IPCC) and UNFCCC, as well as Sendai Framework for disaster risk reduction.

**Description of any direct policy mandate received from an international body – required for GEO Flagships, optional for Initiatives.**

No direct policy mandate directed at GEO-GNOME from an international convention or UN agency, despite recognition and support for GEO-GNOME to contribute to a key component on observations for the new “Climate Change Adaptation in Mountain Regions” global programme of the Swiss Development Agency and Cooperation (SDC).

**Actual and/or planned outputs of the Initiative (i.e. data sets, open methods, information products or services, or other openly available results intended for external users) and their geographical scope.**

A summary of products and outputs envisaged for the next Work Plan include:

- Global Mountain Explorer (visualization tool based on different mountain definitions) to be made accessible via the GEO GEOSS portal, specifically the GEO-GNOME GEOSS portal currently in Beta (actual);
- List of identified Essential Climate Variables for monitoring climatic conditions and understand key processes in mountain environments globally, with a position paper or publication to document process and results (planned);
- List of other-than-climate (e.g. biodiversity, social, socio-ecological) essential variables for mountains, with a position paper or publication to document process and results (planned);
- Mapping between essential climate/mountain variables and processes of change in mountains, to answer questions such as “what the key variables are/would be to study that specific process and how they are currently measured?”, etc. (actual)-. A publication to document process and results is envisaged as concrete output;
- Datasets and data archives/portals (through GEOSS) of essential mountain variables (climate + others) made discoverable and accessible (planned);
- Measurement standards and protocols for detecting elevation-dependent climate change (planned) which are applicable across several mountain regions, in spite of their specificities and context. A paper for publication is envisaged to document process and results.
- Series of webinars and workshops to communicate results, planned from 2020 (see Task 4.1 in “Planned Activities” above)

Additional product and services may be considered as we undergo a process of co-design with GEO-GNOME funders to identify additional activities and tasks for the planned funded 4-year period.

**Actual and/or intended users of the outputs and the expected types of decisions these outputs are expected to inform.**

GEO-GNOME aims at providing data and information as outputs that are suitable to serve the knowledge and information needs of several diverse users. For instance, GEO-GNOME aims at facilitating the research work of scientists looking to access data and datasets based on observed in-situ or remote sensing EO sources in order to better understand key mountain processes such as elevation-dependent warming (EDW) or elevation dependent climate change and to e.g. improve the model description of key drivers and processes of change in the mountain space. Phenomena such as EDW, for example, can be assessed and understood only if long-term records (longer than at least 20 years) of climate variables at several locations

along elevational gradients are available and accessible for application, and only if a minimum set of variables, including (but not limited to) temperature, shortwave and longwave radiation, specific humidity, are measured.

Supporting the scientific community in these analyses and outputs also supports the global assessment efforts carried out by entities such as the IPCC, which also translates to being able to support the evidence-informed decisions and negotiations under global policy frameworks and conventions such as those overseen by the UNFCCC, which includes the Paris Agreement.

Our outputs are also expected to be useful and applicable to serve the knowledge and information needs of governments at various scales, as well as managers and those seeking to invest in the mountain space. Last but not least, the outputs envisaged via GEO-GNOME also serve as powerful means to present and visualise global change trends in mountain regions as an education tool in schools and universities, providing outputs that could be used for teaching and training purposes. For this, training online and/or physical courses on the use of EO and in-situ data and modelling tools to visualize current and projected changes in mountains and understand their impacts will be organised at the local level, by the researchers involved in GEO-GNOME.

The co-design of future GEO-GNOME tasks will be conducted with key stakeholders such as practitioners and policy makers to plan future activities based on their needs, future demands for information and inputs. This includes the organization of scoping webinars and/or workshops in close collaboration with decision makers, to review existing policy related indicators in view of the research outcomes and to plan new activities in view of the policy needs. The new global mountains programme by SDC provides the platform and dialogue spaces opportunities for linking directly with the practitioners and policy makers to learn and exchange these needs.

### **Expected outcomes, impacts and beneficiaries from adoption of the outputs from the Initiative.**

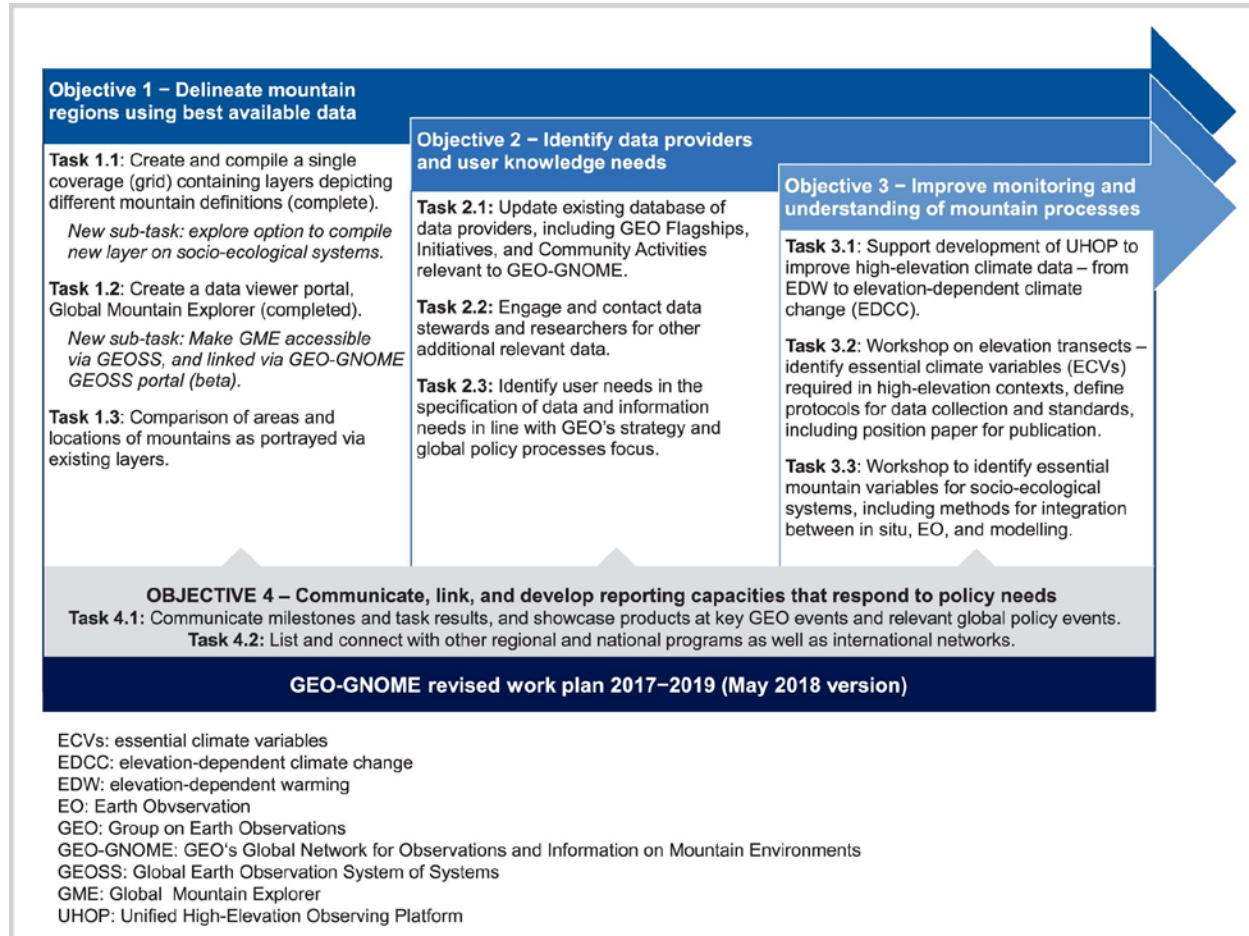
We expect to be able to offer tangible outputs that are usable and applicable for the mountain research community in their tasks to provide reviews, synthesis and assessments on the state of mountains, globally, and associated with these outputs that these are usable for application in decision-making, policy deliberations and management of natural resources in mountains. Our expectations in terms of impacts is that the outputs are used and referenced to the efforts undertaken by the community contributing to GEO-GNOME. More detailed impacts and measure of key performance indicators will be designed as part of the log frame being developed with GEO-GNOME funders during this entry proposal phase Feb-Nov 2019.

### **3. Background and Previous Achievements**

#### **Status of implementation of planned activities and outputs for the 2017-2019 period.**

Since the GEO-GNOME 2017-2019 Work Plan revision, conducted as part of the GEO-GNOME workshop in May 2018, a reorganisation and reformulation of objectives and tasks were agreed upon by the GEO-GNOME co-leads and participating core group members. This review also served as an opportunity to check

on progress and status on the implementation of tasks. Figure 1 (see [Adler, et al 2018<sup>1</sup>](#)) summarises the scope of objectives and activities and their status:



**Figure 1.** Scope of GEO-GNOME objectives and activities and their status in the 2017-2019 Work Plan

Tasks 1.1 and 1.2 are now completed under GEO-GNOME's Objective 1. GEO-GNOME is currently working to build and establish a data and information access portal via GEOSS, thereby fulfilling new identified Task under Task 1.2. GEO-GNOME completed Task 1.3, through the publication of [Sayer et al., 2018<sup>2</sup>](#).

GEO-GNOME is currently working to define a workplan to complete Objective 2 and its associates tasks, which will be facilitated through the establishment of a GEO-GNOME Secretariat at MRI towards the end of 2019. The task is not yet completed.

Objective 3 requires foundation work to strengthen the scientific basis and define scope for monitoring and observation in mountains. This will be facilitated through its associated Tasks, starting in 2019 (tasks 3.2 and 3.3), with further work envisioned as part of task 3.1 into the next Work Programme 2020-2022. An

<sup>1</sup> <https://doi.org/10.1659/MRD-JOURNAL-D-8-00065.1>

<sup>2</sup> <https://doi.org/10.1659/MRD-JOURNAL-D-17-00107.1>



additional workshop was identified as needed to support the foundational work under Task 3.1. This workshop will be conducted in 2020.

Task 4.1 under Objective 4 is an ongoing task. So far, we have updated the basic information relating to GEO-GNOME on the GEO website, given that a new website is under development and so we will reserve further development of content until this new website is set up. For Task 4.2, this is an ongoing task, and one which become operational once we establish a Secretariat.

Nevertheless, our presence at key GEO events such as GEO WEEK in Kyoto, and hosting side events, ensure we continue to engage and communicate the value of GEO-GNOME. We have also taken steps to ensure presence online, with social media. A new logo for GEO-GNOME has now been developed, and a Twitter account (@GEO\_Mountains) is also now active.

### **Evidence of use of the outputs of the Initiative, particularly by end users.**

Outputs generated from the activities carried out within GEO-GNOME in the past year have been applied by end users that are largely linked to the MRI network. Example of these output uses are:

- [MRI-CDE pilot desktop study \(2018\)](#). An evidence-informed preliminary assessment of an SDG indicator subset tailored to a ‘sustainable mountain development (SMD)’ context was performed in a desktop study from September to December 2017. Data availability and possibilities to disaggregate SDG indicator data to meaningful spatial contexts for SMD were assessed. The pilot accessed the GEO-GNOME Global Mountain Explorer tool and its shape files for analyses. See [Bracher C, Wymann von Dach S, and Adler C. \(2018\)](#).
- Issue Brief by MRI and the Centre for Development and Environment (CDE). Here the document presents initial steps towards localization of the 2030 Agenda to mountain areas. The Issue Brief highlights common development priorities in mountains, such as sustainable resource use, climate action, and strengthening people’s livelihoods and resilience. But it also reveals significant differences based on mountains’ diversity. Some of the analyses reported in this Issue Brief accessed the GEO-GNOME Global Mountain Explorer tool and its shape files for analyses. See [Wymann von Dach, S., Bracher, C., Peralvo, M., Perez, K., Adler, C., and a group of contributing authors. \(2018\)](#).
- The lead authors in the Chapter “High Mountains” in the IPCC Special Report on Ocean and Cryosphere in a Changing Climate (SROCC) SROCC accessed and used the shape files produced via GEO-GNOME and made available and downloadable via the GME, to produce figure maps that will be published in the special report in Sept 2019.
- The same shape files will be used by the IPCC AR6 Atlas author team to depict and map mountain regions, over which trends on Elevation Dependent Warming (EDW) in mountains will be overlaid and mapped (under development).
- The Global Mountain Biodiversity Assessment (GMBA) has also used previously generated databases and shape files that are now compiled and available via the GME created under GEO-GNOME.

### **Examples or evidence of outcomes and/or impacts based on use of outputs (e.g. policy decisions taken, behavior changes by users, risks mitigated).**

Evidence on this aspect of impact and uptake is yet to be gathered, given the relatively recent achievements with outputs generated to date. Monitoring this aspect of assessment and evaluation will be incorporated

into a future GEO-GNOME work plan, while in the meantime we will gather basic data in terms of use and engagement that indicate impacts of outputs.

### **Reflection on the effectiveness of the Initiative's governance structure and resourcing strategy.**

GEO-GNOME began its activities and operations with few resources for effective coordination and overview/delivery of tasks, which were largely all conducted through in-kind contributions. In the original GEO-GNOME proposal, there were few practical proposals for putting in place a governance structure that could be implemented in practical terms with the existing resources, especially since 'membership' to the Initiative remained rather aspirational and informal. This means that commitments towards contributions were often not effectively followed through. Furthermore, much of the burden regarding key decisions rested on the co-leads, without an effective mechanism in place for consultation and validation of measures or suggestions for moving forward. A 'core' group of individuals were identified and selected through their interest in the Initiative and active participation in key calls and virtual meetings, and this served as a default 'advisory body' in subsequent calls and decisions in shaping a new plan. In future, and as part of the 2020 plan, the idea is to certainly move towards a structure that allows us to identify more specifically the actual membership into this Initiative, ideally through a registry or membership mechanism that also gives visibility to members and their role in GEO-GNOME. The governance structure will also include a rotating role for advisory board members that comprise a mix of GEO participating organisations, GEO members and individual contributions and participants.

### **Summary of the results of any internal or external reviews or evaluations of the Initiative.**

GEO-GNOME became a GEO Initiative within the GEO Work Programme 2017-2019 at the end of August 2016, after having successfully addressed the comments and requests from the GEO Programme Board reviewers at the time. The review of the GEO-GNOME proposal, in fact, was overall positive, identifying GEO-GNOME as a potential new Initiative addressing a key area in dire need of EO in a coherent way, describing a multidisciplinary partnership with solid institutions and organisations, and with inputs and collaborations with other GEO initiatives, having relevant aims and overall strategy, including concrete activities and with good alignment with GEO strategic objectives, but highlighted weak points to be addressed. Weaknesses included the need to better clarify databases and products, primary users, capacity building, governance and monitoring & evaluation.

A virtual meeting was convened by Elisa Palazzi on June 26th, 2017, to review progress on agreed milestones, particularly in view of a change of leadership at the Mountain Research Initiative (MRI) in Bern, with a new Executive Director, Carolina Adler, appointment on 1 May 2017. In agreement with the GEO Programme Board, a revised version of the GEO Work Plan was then submitted. The principal aim of the revision was to review progress, consolidate activities within each task, and set new targets for monitoring and completion that are realistic and feasible within the resources of all partners involved in GEO-GNOME.

A subsequent internal review of the Initiative was conducted through the workshop convened and partially supported financially by MRI on behalf of GEO-GNOME (May 2018), where objectives and activities/tasks were scrutinised in terms of their feasibility in practical terms, as well as the suitability of content and goals in the time period left until the end of 2019. A simplified structure was reached with feasible targets in terms of activities to accomplish in the time remaining, effectively parking and setting aside those other objectives and tasks that required dedicated personnel and resources to the next plan when funding could

be secured. This was a pragmatic way to ensure GEO-GNOME kept 'moving' and avoid stalling completely. As far as we are aware, no external reviews or evaluation of GEO-GNOME were conducted by external entities or individuals.

In December 2018, following a call between the GEO-GNOME co-leads and the GEO Secretariat, an Interim Report was also produced and submitted summarising the main GEO-GNOME aspects concerning governance, operating environment, data flow, outputs, users and policy mandate, relationship with GEO and collecting recommendations to Programme Board.

**Lessons learned from (or challenges experienced in) the previous implementation period and proposed actions for amendments or improvements.**

Key lessons learned include:

- Personnel in a dedicated and resourced 'project manager' role are indispensable for making sure coordination of tasks are carried out effectively, as well as followed through with the tasks that members volunteered to pursue, as well as those tasks designated to Initiative members to conduct. With the funding source now flagged for GEO-GNOME from 1 October 2019, the task for the co-leads will be to recruit a suitable project officer/manager to be hosted at MRI.
- Regular virtual meetings are needed to ensure communication among those carrying out on progress on joint tasks/activities and to connect with other members, as well as information inputs on key events and meetings attended by the co-leads. These regular meetings would also serve to gather key information and insights/suggestions from members, effectively re-calibrating the set goals and practical implementation of objectives as the need arises.
- Physical meetings at least once a year are also important to maintain momentum and relevance, particularly if these can be combined with thematic workshops and content-related matter for elaboration and contribution to set tasks.
- Active participation at GEO-led events not only ensure we continue to link to and communicate our progress with respect to the overall GEO aims, but would also provide fruitful opportunities to engage more productively with other GEO Flagships, Initiatives and Community Activities that, on the one hand have relevance for our goals, and on the other hand for us to offer useful input to their efforts.

**Justification for acceptance as a GEO Flagship (if applicable).**

GEO-GNOME is still very much in planning and implementation mode, where we hope to tip the balance towards greater implementation of objectives starting in 2020 through the tasks and activities identified in the first 2017-2019 work plan. However, to date, there is no direct or explicit policy mandate by GEO members or other governmental entity to appoint GEO-GNOME to a specific policy knowledge need, even though much of what GEO-GNOME plans to deliver is policy relevant and applicable also to management and research settings.

The funding flagged to GEO-GNOME from 1 October comes from the Swiss Agency for Development and Cooperation (SDC), under the terms of its new 'Global Programme for Climate Change Adaptation in Mountain Regions', which identified the need for better coordinated access to data and information on observations and detection of signals of climate change in the mountain space and their resulting impacts. Adaptation responses, both in biophysical as well as human dimensions, are also envisaged for monitoring through data and information across mountain regions. Hence, why GEO-GNOME was selected to fulfil this

task given the recognised potential to deliver on these objectives. One could argue this would constitute a policy mandate to serve an investment decision made by SDC for mountains globally, however the GEO-GNOME co-leads expect that further implementation and track record is needed as an Initiative before further considerations towards a possible future Flagship status could be conceived.

#### 4. Relationship to GEO Engagement Priorities and to other Work Programme Activities

GEO-GNOME is currently focused on making sure we have the right base layers and structures and protocols in place (work plan 2020-2022) to then pin and overlay information for visualisation and reporting that may offer the opportunity for us to be more explicit with regards to actual SDGs that we could target as pilot/demonstration projects in the latter part of the next work plan, looking at the 2023-2025 horizon. For the time being we envisage to be able to bring GEO-GNOME to a point where we can identify and support the provision of mountain-specific and relevant data and information that respond to the following SDGs, as a longer-term goal (toward 2022 and beyond):

- SDG Target 1.4, specifically to be able to map for Indicator 1.4.2 *Proportion of total adult population with secure tenure rights to land, (a) with legally recognized documentation, and (b) who perceive their rights to land as secure, by sex and type of tenure* (GEO-GNOME Task on K4 layer and Tasks 2.3 and 4.1)
- SDG Target 2.4, specifically to be able to map for indicator 2.4.1 *Proportion of agricultural area under productive and sustainable agriculture* (GEO-GNOME Task on K4 layer and Tasks 2.3 and 4.1)
- SDG Target 3.9, specifically to map for indicator 3.9.1 *Mortality rate attributed to household and ambient air pollution* (GEO-GNOME Task on K4 layer and Tasks 2.3 and 4.1)
- SDG Goal 6, specifically to map for indicator 6.3.2 *Proportion of bodies of water with good ambient water quality*, 6.4.2 *Level of water stress: freshwater withdrawal as a proportion of available freshwater resources*, and 6.6.1 *Change in the extent of water-related ecosystems over time* (GEO-GNOME Task 2.3 and 4.1)
- SDG Target 7.1, specifically to map for indicator 7.1.1 *Proportion of population with access to electricity* (GEO-GNOME Task 2.3 and 4.1)
- SDG Target 9.1, specifically for indicator 9.1.1 *Proportion of the rural population who live within 2 km of an all-season road* (GEO-GNOME Task 2.3 and 4.1)
- SDG Target 31.1, specifically for indicator 13.1.1 on *Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population* (GEO-GNOME Task 2.3 and 4.1)
- SDG Goal 15, specifically for indicators 15.1.1 *Forest area as a proportion of total land area*, 15.3.1 *Proportion of land that is degraded over total land area*, 15.4.1 *Coverage by protected areas of important sites for mountain biodiversity*, and 15.4.2 *Mountain Green Cover Index*, linking to GEO-ECO and the outcomes of the soon-to-conclude EU project Ecopotential.

**Description of which activities or outputs of the Initiative, if any, are expected to support the Paris Agreement and identify which pillars are implicated.**

GEO-GNOME, through its involvement in the SDC-funded “Climate Change Adaptation in Mountain Regions” global programme of the Swiss Development Agency and Cooperation (SDC), will develop the means to provide access to data and information that is specifically relevant in the context of assessments such as those conducted by the Intergovernmental Panel on Climate Change (IPCC), which by extension would also

be relevant and applicable as information inputs to UNFCCC policy dialogues such as the Paris Agreement and UNFCCC negotiations at Conferences of Parties (CoPs).

For the 2020-2022 work plan, we envisage to be able to bring GEO-GNOME to a point where we can identify and/or report on the following pillars of the Paris Agreement, via inputs relevant for IPCC and for regional dialogues in mountain regions in the lead up to the Global Stocktake:

- Adaptation;
- Loss and Damage; and
- National Reporting / Global Stocktake.

**Description of which activities or outputs of the Initiative, if any, are expected to support achievement of the targets of the Sendai Framework and which targets are implicated.**

While there are no specifically targeted activities in the 2020-2022 work plan so far that target the information needs of the Sendai Framework, we expect to be able to define these during the course of the work plan to provide data and information for at least some of the targets specified in the Sendai Framework. We expect to be able to provide at least data and information that would allow the research and practitioner community to report at least provisionally in time for the next UN Disaster Risk Reduction Global Platform in 2021, with a ‘mountains’ perspective to report on:

- A. Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality rate in the decade 2020-2030 compared to the period 2005-2015.
- C. Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.
- D. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.
- G. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

**List of Flagships, Initiatives and Community Activities in the 2017-2019 GEO Work Programme that are relevant to this Initiative and a brief description of the relationship or plans for future engagement / collaboration.**

To improve synergy among overlapping areas, GEO-GNOME maintains close interaction with relevant GEO flagships and Initiatives. These include:

Flagships: GEO-GNOME is exploring and scoping the extent to which it can draw on the diverse products and EO data and information utility that the GEO Flagships, in the current Work Programme 2017-2019, offer as well as ways in which it could connect and/or contribute to their future work. GEO-BON is a very likely objective to target in this scope.

Initiatives: Earth Observations for Ecosystem Accounting (EO4EA), Geo Global Ecosystem Initiative (GEO ECO), Geo Cold Regions Initiative (GEOCRI), Geo Geohazard Supersites and Natural Laboratories (GSNL), and GEO Human Planet, to name a few. We identified and connected with additional Initiatives during the GEO Symposium 2019, from which we can derive additional specific joint tasks and activities that can be incorporated into this plan. Once the final GEO Work Programme for 2020-2022, and the individual GEO

work plan for Flagships, Initiatives and Community Activities are finalised and made available, this will provide a basis for better guided and targeted engagement to coordinate possible synergistic tasks.

GEO-GNOME values the participation in GEO as GEO provides legitimacy to contact GEO Members and bring together a global network for a defined purpose.

## 5. Stakeholder Engagement and Capacity Building

**Description of key organizations and stakeholders, particularly at the international level, which are relevant to this Initiative (operating environment of the Initiative).**

Key international organisations and boundary organisations include:

- **IPCC:** Linking to its community of assessment lead authors to engage with the knowledge needs relevant for assessment efforts. This would be a good way of designing usable outputs and calibrating and validating the utility and uptake of GEO-GNOME outputs.
- **WMO:** Though the envisaged High Mountains Summit later in 2019, there is momentum being gathered to address the paucity of climate observations worldwide in mountain areas. Furthermore, the WMO Executive Council Panel of Experts of Polar and High Mountain Observations, Research, and Services (EC PHORS<sup>3</sup>) is also a group to connect to and identify their needs and expectations on observations in mountains. Linking to WMO's planned pilot projects and funding campaigns as part of the Summit for supporting observatories, are relevant ways for GEO-GNOME to participate. Carolina Adler from MRI is one of the Co-chairs for this event later in October.

**Strategy for engaging stakeholders in the co-development / co-production of the Initiative, including determining user needs, and for building individual, organizational, and institutional capacity to use the outputs of the Initiative.**

Within the envisaged GEO-GNOME plan, there are provisions to ensure a strategy for engaging stakeholders in the co-development and co-production of the Initiative as it is implemented. GEO-GNOME, under the co-leadership of MRI, is undertaking co-design workshops and discussions with the principal support funders for the initiative in the new work plan, SDC, to identify key capacity building priorities for the regions that SDC wishes to support under its new global mountains programme, particularly in the domain of observations capacities and observatories in other countries. This will provide a key opportunity for GEO-GNOME to define a much concrete and broader strategy for stakeholder engagement, which up to now has mainly focused on engaging with contributors from research and data providers. This is an ongoing task in the current entry proposal phase with SDC, which will extend until September 2019.

**Current and/or planned activities to engage stakeholders and/or strengthen individual, organizational and/or institutional capacity and the expected outputs and outcomes of these activities.**

Concrete activities will be defined, and resources assigned once the strategy and direction is in place (see previous point).

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<sup>3</sup> See references to GEO-GNOME in inputs, resolutions and statements put forward by EC-PHORS that were later tabled at the WMO Congress in June 2019: <https://www.wmo.int/pages/prog/www/CBS-Reports/documents/EC-PHORS-9-Final-Report-Final.pdf>

**Current and/or planned activities to strengthen the capacity of the participants in the Initiative for successful implementation of the Initiative.**

GEO-GNOME Objective 3 requires foundation work to strengthen the scientific basis and define scope for monitoring and observation in mountains. This is facilitated through two targeted GEO-GNOME workshops, the “GEO-GNOME EVs Workshop Week”. A workshop focused on 1) Identification of Essential Climate Variables for mountain environments including methods for integration among in-situ and satellite data and modelling (held from 24th to 26th of June 2019) and a second workshop on 2) Biodiversity and Socio Economic aspects of monitoring in mountain regions, with a view to develop a concept for a K4 layer in the GME that captures this data, to be held in February 2020, back-to-back to the World Biodiversity Forum, Davos. A third workshop is envisaged in 2020, on 3) Definition of elevational transects including the variables to be measured along altitudinal gradients, and protocols for data collection and standards (to be likely held in the first half of 2020).

## 6. Governance

**Description of the governance structure for the Initiative, including the mandates of steering/advisory/management committees, if applicable.**

GEO-GNOME is currently co-led by the Mountain Research Initiative (MRI) and the Italian National Research Council (CNR) and driven by a core group comprising MRI (Switzerland), CNR (Italy), EURAC (Italy), University of Bern (Switzerland), the Global Mountain Biodiversity Assessment (GMBA) network (Switzerland), University of Geneva (Switzerland), University of Portsmouth (UK), University of Reading (UK), CONDESAN (Ecuador/Peru) and USGS (US).

As part of the next GEO-GNOME work plan, a governance structure will be developed and implemented that would allow us to appoint the current ‘core group’ as the steering committee to guide and advice on matters related to GEO-GNOME work plan. Likewise, a registry to account for ‘membership’ in GEO-GNOME will be incorporated, to ensure we make our membership visible and able to track activity among members. The registry of members and appointment of a steering committee will be carried out by June 2020. Members will include current GEO members, GEO participating Organisations and other individuals and institutions with expertise and contributions to offer that are relevant to achieving the GEO-GNOME goals.

**Description of the roles of key leadership positions.**

MRI, the leading organization of GEO-GNOME, is an international global change research network focused on mountain regions, consisting of more than 10000 members from 154 countries. MRI operates as a research and network coordination facility, which also engages and connects with key actors and stakeholders in mountain regions. MRI is supported by the Swiss Academies of Sciences (SCNAT) and is hosted by the Institute of Geography at the University of Bern, Switzerland. MRI is currently supporting the GEO-GNOME coordination function as an in-kind contribution. A dedicated Secretariat is yet to be

established, pending resource availability expected by the end of 2019. MRI is also a Participating Organisation in GEO and is currently appointed to the GEO Work Programme Board 2019-2022.

CNR, co-leading organisation of GEO-GNOME, supports in-kind the Initiative through scientific input, research expertise and projects dealing with mountains and the impact of climate changes on high-altitude environments. In particular, the project NextData (<http://www.nextdatapoint.it/>) ended in December 2018, a national research project devoted to collect existing data on mountains, implement measurement networks in remote areas and develop web portals to access meteo-climatic and atmospheric composition data on mountains; the H2020 ECOPOTENTIAL project (<http://www.ecopotential-project.eu/>) which explores the use of Earth Observations to monitor changes in European ecosystems and support their management, with mountain ecosystems as a specific sub-category; and the Belmont Forum launched Collaborative Research Action on “Mountains as Sentinels of Change”.

**Strategy for communication with participants and stakeholders, including the main communications channels used.**

Currently GEO-GNOME has no dedicated communication channels, other than what is offered in-kind via MRI (a website space with updates on key publications, events, and now a twitter feed @GEO\_Mountains, as well as regular updates published in the MRI Global Newsletters). The main way of communicating with GEO-GNOME members is via email, with a few meetings convened so far via the GEO Secretariat (Webex, to be migrated to Bluejeans). As part of our lessons learnt (see earlier section), establishing regular means of communicating among members (virtual or face-to-face) will be programmed, as well as enhancing online presence via the new GEO website that is currently under development. We expect that with the Secretariat in place, GEO-GNOME will be able to leverage resources to enhance its communications, online presence and outreach.

**Monitoring and evaluation activities to be undertaken within the Initiative or required by funders/contributors, including how the effectiveness of user engagement and capacity building activities will be assessed. Include a brief description of how the results of the monitoring and evaluation activities will be shared with the GEO community.**

These are currently being developed with the key funder, SDC, as part of the entry proposal phase until September 2019. A log frame in final draft form is expected to be in place by April-May 2019 which will specify monitoring and evaluation criteria and key indicators, as well as set activities for review. These will need to be checked in consultation with the GEO-GNOME co-leads and the core group.

**Risk management: description of the key risks that could prevent the full realization of the intended outcomes of the Initiative and the strategy for managing and/or mitigating the identified risks.**

Key risks that could undermine progress and achievement of set goals:

- Funding constraints from single source donors - As much as possible ensuring a diverse funding sources and inputs/contributions from GEO members and participating organisations would ensure a more resilient funding base from which to depend on.
- Personnel changes among key leading individuals managing specific tasks/activities, which may undermine continuity - Identify institutional capacities that go beyond individuals to ensure others can



take over tasks, as well as ensuring adequately detailed documentation of all processes and results/outcomes are recorded and made available to all GEO-GNOME contributors.

## 7. Resources

**Summary of the estimated resources required to implement the proposed activities for the 2020-2022 period, including financial, in-kind participation, and other in-kind resources (e.g. data, equipment, computing capacity, office space).**

MRI:

- In-kind contributions in terms of staff time that amount to approximately 140,000 CHF per year.
- Additional financial funding flagged from SDC of up to 250,000 CHF per year, initially for 4 years (paid to MRI as a contribution to GEO-GNOME). This would allow MRI to recruit a GEO-GNOME designated project manager, effectively contributing to the GEO-GNOME secretariat for coordination purposes.

CNR-DTA:

- In-kind contributions in terms of staff time that amount to approximately 15,000 CHF per year.
- The EU H2020-funded project ECO-POTENTIAL, coordinated by CNR-DTA, explores the use of Earth observations for the management of ecosystems, with mountain ecosystems as a specific sub-category. It was conceived as an EU contribution to GEO and has contributed/will contribute in-kind to Tasks 2 and 3.
- The NextData project, led by CNR-DTA and ended in December 2018, has contributed to Tasks 2 and 3 through the work of its researchers also involved in GEO-GNOME (in-kind contribution). The results achieved in NextData, in particular on the collection and construction of a data portal containing archives of mountain data (<http://geonetwork.igg.cnr.it>) will in particular support the achievement of Task 2.

USGS:

- The USGS Land Change Science Program has provided support for completing Objective 1 in 2017-2018, and continues to engage in the development and design of future activities.

A more detailed breakdown of contributions and costs will be elaborated once all tasks and activities have been identified in the entry proposal phase with SDC (to be finalised by Nov. 2019).

**Description of the extent to which confirmed contributions to the Initiative meet the identified requirements. Please note that the details of the contributions will be entered in Table B below.**

Contributions listed in Table b are confirmed.

**Strategy for mobilizing additional resources, either to meet gaps in confirmed contributions or to support future requirements.**

GEO-GNOME is currently also scanning for additional opportunities for funding that are likely to materialise via the Horizon 2020 Programme of the European Commission, where certain calls are flagged as requiring collaboration and partnership with GEO-GNOME. These calls are to be made public in late February 2019.

**Summary of existing commercial sector engagement in the Initiative, if any, and the strategy for engaging commercial sector organizations in future.**

To date, no known existing commercial sector engagement is active in this Initiative.

## **8. Technical Synopsis**

**Description of the principal data sets used by the Initiative (including space-based and in situ observations as well as non-EO data sets, such as socio-economic data), the sources from which the data are obtained, and whether the data are openly and freely accessible.**

This information will be derived and specified as part of the two workshops envisaged under Objective 3 in June 2019 and in February 2020. Currently GEO-GNOME has no person time capacity to compile this information, therefore this will most likely be compiled and finalised with the GEO-GNOME project manager to be appointed later in 2019.

**Description of the key methods used to transform the source data into the products and/or services that are or will be provided, including any workflows or open algorithms.**

This information will be derived and specified as part of the two workshops envisaged under Objective 3 in June 2019 and February 2020. Currently GEO-GNOME has no person time capacity to compile this information, therefore this will most likely be a task for the GEO-GNOME project manager to coordinate with members, and who is expected to be appointed later in 2019.

**Description of any significant scientific or technical issues that need to be resolved by the Initiative and the strategy to address them.**

Foundational tasks were identified in the current work plan that require scientific workshops to resolve. These are now scheduled to take place in June 2019 and a subsequent additional workshop in the European spring of 2020. An additional workshop sponsored by MRI with its EDW Working Group is planned as a side event at the European Geoscience Union General Assembly in Vienna in April 2019, where an updated synthesis paper will be produced on key drivers and processes of climate in mountains. This paper and contributions to it will all serve as scientific basis to inform and calibrate our state of knowledge on the subject matter.

## **9. Data Policy**

**Policy of the Initiative regarding data availability, including degree of adherence to the GEOSS Data Sharing Principles and GEOSS Data Management Principles.**

It is expected that the GEO-GNOME work plan 2020-2022 will make references to and request adherence to these GEO/GEOSS policies. MoUs or other forms of agreements to be reached with data providers will specify these requirements (to be developed).

**If key datasets are managed by the Initiative, a description of how the data are/will be Managed.**

No databases are explicitly managed by the Initiative to date, the intention so far rests on being able to mirror other sites with datasets/databases with access via GEO-GNOME GEOSS portal.

**Description of how the outputs of the Initiative, and the methods used to produce them, may be accessed, including relevant URLs or permanent identifiers. Please indicate whether this information is discoverable and accessible via the GEOSS Platform.**

GEO-GNOME currently has a dedicated GEOSS portal in Beta. it is expected that further development will be conducted in 2019 and 2020.

**Strategy for longer-term preservation of data and information produced by the Initiative.**

Yet to be developed, most likely in consultation also with SDC as primary funder, given the envisaged extension for GEO-GNOME support for another 4 additional years after the first phase ending in 2023.

## Tables

See separate Excel attachment accompanying this document.

- A. Individual Participants
- B. Confirmed Contributions
- C. Task / Work Package Structure
- D. Deliverables / Milestones

## Annexes

### I. Acronyms and abbreviations

EC PHORS	Executive Council Panel of Experts of Polar & High Mountain Observations, Research, & Services
EDCC	Elevation-Dependent Climate Change
EDW	Elevation Dependent Warming
ESA	European Space Agency
EVs	Essential Variables
ECVs	Essential Climate Variables
EBVs	Essential Biodiversity Variables
EO	Earth Observations
EU	European Union
EMVs	Essential Mountain Variables
ESVs	Essential Social Variables
FAO	Food and Agricultural Organization
FOEN	Swiss Federal Office for the Environment
GEO	Group on Earth Observations
GEOSS	GEO Systems of Systems
GMBA	Global Mountain Biodiversity Assessment
GME	Global Mountain Explorer
H2020	Horizon 2020
ICC	Implementation Coordination Committee
ICIMOD	International Centre for Integrated Mountain Development
ICS	International Science Council
IPCC	Intergovernmental Panel on Climate Change
MRI	Mountain Research Initiative
NSF	US National Science Foundation
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SES	Social-ecological system
SLC	Science Leadership Council (MRI)
SNSF	Swiss National Science Foundation
SROCC	IPCC Special Report on Ocean and Cryosphere
UHOP	Unified High Elevation Observing Platform
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization

## II. List of key scientific references describing the basis for the work of the Initiative

### Most recent papers relevant to GEO-GNOME Work Plan:

Adler, C., Palazzi, E., Kulonen, A., Balsiger, J., Colangeli, G., Cripe, D., Forsythe, N., Goss-Durant, G., Guigoz, Y., Krauer, J., Payne, D., Pepin, N., Peralvo, M., Romero, J., Sayre, R., Shahgedanova, M., Weingartner, R. & Zebisch, M. (2018). Monitoring Mountains in a Changing World: New Horizons for the Global Network for Observations and Information on Mountain Environments (GEO-GNOME). *Mountain Research and Development*, 38 (3), 265-269. [DOI: 10.1659/mrd-journal-d-8-00065.1](https://doi.org/10.1659/mrd-journal-d-8-00065.1)

Sayre, R., Frye, C., Karagulle, D., Krauer, J., Breyer, S., Aniello, P., Wright, D. J., Payne, D., Adler, C., Warner, H., Van Sistine, D. Paco & Cress, J. (2018). A New High-Resolution Map of World Mountains and an Online Tool for Visualizing and Comparing Characterizations of Global Mountain Distributions. *Mountain Research and Development*, 38 (3), 240-249. [DOI: 10.1659/mrd-journal-d-17-00107.1](https://doi.org/10.1659/mrd-journal-d-17-00107.1)

### Other papers of reference:

Becker, A. and Bugmann, H. (eds.), 2001. Global Change and mountain regions: The Mountain Research Initiative. Implementation Plan, IGBP Report #49 / IHDP Report #13 / GTOS Report #28, IGBP Secretariat, Stockholm, Sweden, 86 pp.

Kapos, V., Rhind, J., Edwards, M., Ravilious, C. and Price, M.F. 2000. Developing a map of the world's mountain forests in Sustainable Mountain Development: A State of Knowledge Report 2000. Wallingford, UK : CAB International

Körner, C., Paulsen, J., Spehn, E. 2011. A definition of mountains and their bioclimatic belts for global comparisons of biodiversity data. *Journal of Alpine Botany*. DOI 10.1007/s00035-011-0094-4

Ostrom, E. 2009. Social-Ecological Systems: A General Framework for Analyzing Sustainability. *Science* 325, 419-422. DOI: 10.1126/science.117213

Palazzi E., L. Mortarini, S. Terzago, J. von Hardenberg. (2018). Elevation-dependent warming in global climate model simulations at high spatial resolution, accepted for publication on *Climate Dynamics*, DOI: 10.1007/s00382-018-4287-z

Pepin, N. and the MRI Elevation Dependant Warming Working Group. 2015. Elevation- Dependent Warming in Mountain Regions of the World. *Nature Climate Change* 5:424-430. <http://dx.doi.org/10.1038/nclimate2563>

Renwick, J. 2014. MOUNTerrain: GEWEX Mountainous Terrain Precipitation Project. *GEWEX News* 24(4):5-6.

Sayre, R., J. Dangermond, C. Frye, R. Vaughan, P. Aniello, S. Breyer, D. Cribbs, D. Hopkins, R. Nauman, W. Derrenbacher, D. Wright, C. Brown, C. Convis, J. Smith, L. Benson, D. Paco VanSistine, H. Warner, J. Cress, J. Danielson, S. Hamann, T. Cecere, A. Reddy, D. Burton, A. Grosse, D. True, M. Metzger, J. Hartmann, N. Moosdorf, H. Durr, M. Paganini, P. DeFourny, O. Arino, S. Maynard, M. Anderson, and P. Comer. 2014. A New Map of Global Ecological Land Units — An Ecophysiological Stratification Approach. Washington, DC: Association of American Geographers. 46 pages.

### III. Brief CV of Project Leader(s)

#### **Carolina Adler**

Nationality: Dual national of Chile (birth) and Australia (citizenship); residency in Switzerland.  
Mountain Research Initiative, c/o Centre for Development and Environment, University of Bern,  
Mittelstrasse 43, 3012 Bern, Switzerland.  
Contact: [carolina.adler@giub.unibe.ch](mailto:carolina.adler@giub.unibe.ch) | T: +41 (0)31 631 51 41

#### Professional Biography

Carolina Adler, a dual national from Chile and Australia, is an Environmental Scientist and Geographer with an international career spanning both research and practice in the public and private sectors. She obtained her PhD at Monash University (Australia) in 2010, focusing on climate change adaptation and relevant policy processes for sustainable development in mountain regions, receiving the Harold D Lasswell Prize in 2010 for best thesis. Following a passion for mountaineering, she also shares her environmental expertise as delegate to the International Mountaineering and Climbing Federation (Union Internationale des Associations d'Alpinisme - UIAA) Mountain Protection Commission, later in 2016 assuming the role of President. Since living in Switzerland, she is Research Fellow at the Transdisciplinarity Lab (TdLab), at ETH Zurich in Switzerland, where she focuses her research on participatory approaches, particularly in the assessment and evaluation of such research on questions related to sustainable development in mountains. As the current Executive Director of the Mountain Research Initiative (MRI), hosted by the Swiss Academies of Arts and Sciences in Bern, she is also tasked with coordinating scientific research agendas and support regional and thematic networks on global change research in mountains. She is a current Lead Author for the "High Mountains" chapter of the Intergovernmental Panel on Climate Change (IPCC) special report on oceans and cryosphere (SROCC), due in 2019, as well as serving as Lead Author for Working Group II on Impacts Vulnerability and Adaptation and lead the coordination of the Cross-Chapter Paper on 'Mountains' for the Sixth Assessment Report (AR6).

#### Professional Experience

2017 - *Executive Director*, Mountain Research Initiative, Swiss Academies of Sciences, Bern, Switzerland;  
2011 - *Research Associate*, Department of Environment Systems Science, ETH Zurich:  
2010-11 - *Research Fellow*, Climate Change Adaptation Program, RMIT University, Australia.  
2007-10 - *PhD*, School of Geography & Environmental Science, Monash University, Australia:  
2004-10 - *Research Assistant & Lecturer*, Australian School of Business, UNSW, Australia.  
2001-04 - *Environmental and Management Consultant*, ENVIRON Australia Pty Ltd, Australia.  
1998 - *Ministerial Liaison Officer* – Sydney Water Corporation, Australia.

#### Academic qualifications

2010 Ph.D. (Geography & Environmental Science), Monash University, Australia.  
2009 Graduate Certificate (Research Management), Southern Cross University, Australia.  
2003 Graduate Certificate (Environmental Management), UNSW, Australia.  
2001 MSc. (Environmental Sciences), Wageningen University, The Netherlands.  
1999 BSc. Honours (Geography), UNSW, Australia.

#### Recent projects, consultancies and practical experience (selection)

2016-2018: Project (main investigator) “*What counts for transferability of knowledge across cases in transdisciplinary research?*” Funded by the Swiss National Science Foundation (SNF), in collaboration with the Centre for Development and Environment of the University of Bern, Switzerland;

2015-2018: Project (collaborator) “*New risks: trade-offs in switching from nuclear electricity to renewables in Switzerland*”, funded by the SNF under the National Research Programme “Energy Turnaround” (NRP 70), in collaboration with ETH Climate Policy Group;- · 2016: Consultancy “*Mountain Waste Management Outlook: ‘Mountaineering’*”, GRID Arendal and UNEP;

2015-2016: “*Teaching transdisciplinarity for sustainable development*”. Funded by Innovedum, (ETH Zurich), in collaboration with Department of Environment Systems Science “Transdisciplinarity Lab” (DUSYS TdLab);

2014-2017: “Moving towards adaptation to climate change: current practices developed in Chile, their usefulness, barriers to implementation, and opportunities for improvement [*Desarrollo e implementación del prototipo de una herramienta participativa para la evaluación de prácticas de adaptación al cambio climático a escala local*]”. Funded by CONICYT Chile, in collaboration with the University of Chile;

2014-2015: Consultancy “Evaluation of National Action Plan on Climate Change [*Plan de Acción Nacional de Cambio Climático, PANCC*] 2008-2012 and development of new action plan 2016-2021”. Funded by the Environment Ministry, Chile, with University of Chile and partners;

2011-2013: “*Learning from Indigenous Natural Resources Management in the Barmah-Millewa, Australia*”. Capacity building, training facilitation, and research on community participation for policy on climate change adaptation;

2010-2011: Principal Field Specialist, capacity building and workshop design and facilitation, “Tourism and Climate Change”, Kailash Sacred Landscape Conservation Initiative (Nepal), ICIMOD/GIZ, with RMIT University, Australia.

Publications (recent relevant peer-reviewed publications, as first author)

Adler, C., et al. (2018). Monitoring Mountains in a Changing World: New Horizons for the Global Network for Observations and Information on Mountain Environments (GEO-GNOME). [Mountain Research and Development](#), 38(3): 265-269.

Adler, C., Hirsch Hadorn, G., Breu, T., Wiesmann, U., Pohl, C. (2017). Conceptualizing the transfer of knowledge across cases in transdisciplinary research. [Sustainability Science](#).

Adler, C.E., Aldunce, P., Indvik, K., Bórquez, R., Galaz, V. (2015). “Resilience”. In K. Bäckstrand & E. Lövbrand (eds.) [Research Handbook on Climate Governance](#). Edward Elgar.

Adler, C.E., & Hirsch Hadorn, G. (2014). The IPCC and treatment of uncertainties: topics and sources of dissensus. [WIREs Climate Change](#), 5(5): 663–676.

Adler, C.E., McEvoy, D., Chhetri, P., & Kruk, E. (2013). The role of tourism in a changing climate for conservation and development. A problem-oriented study in the Kailash Sacred Landscape, Nepal. [Policy Sciences](#), 46(2): 161-178.

Roman, C.E., Lynch, A.H., & Dominey-Howes, D. (2011). What is the goal? Framing the climate change adaptation question through a problem-oriented approach. [Weather, Climate & Society](#), 3(1): 16-30.

Publications (other top 5 relevant peer-reviewed contributions)

Lillo-Ortega, G., Aldunce, P., Adler, C., Vidal, M., & Rojas, M. (2018). On the evaluation of adaptation practices: a transdisciplinary exploration of drought measures in Chile. [Sustainability Science](#);

Diaz, P., Adler, C., Patt, A. (2017). Do stakeholders' perspectives on renewable energy infrastructure pose a risk to energy policy implementation? A case of a hydropower plant in Switzerland. [Energy Policy](#);

Patterson, J., Schulz, K., Vervoort, J., van der Hel, S., Widerberg, O., Adler, C., Hurlbert, M., Anderton, K., Sethi, M., & Barau, A. (2017). Exploring the governance and politics of transformations towards sustainability. *Environmental Innovation and Societal Transitions*, 24: 1-16

Borquez, R., Aldunce, P., Adler, C. (2017). Resilience to climate change: from theory to practice through co-production of knowledge in Chile. *Sustainability Science*, 12(1): 163-176.

Sword-Daniels, V., Eriksen, C., Hudson-Doyle, E., Alaniz, R., Adler, C., Schenk, T., & Vallance, S. (2016). Embodied uncertainty: living with complexity and natural hazards. *Journal of Risk Research*;

#### Professional Services (selected)

2018 Lead Author IPCC AR6 WGII “Chapter 17: Decision-making options for managing risk” and Co-Lead Cross-Chapter Paper on Mountains;  
UNISDR Global Platform 2019: member of Organizing Team for High Level Dialogue on Achieving the SDGs through Climate and Disasters

2017 Lead Author IPCC Special Report on Oceans and Cryosphere in Changing Climate (SROCC), ‘High Mountains’;  
Co-Editor for Special Issue in the journal *Regional Environmental Change* titled “Impacts of climate change on the high-mountain cryosphere and associated responses”;

2016 New Directions Team (Contributing Author), Earth System Governance Project;  
2016- Member -IUCN World Commission on Protected Areas (WCPA) Tourism and Protected Areas Specialist Group;

2015- Community of Practice Moderator (facilitating a dialogue between science and policy), Global Environment Outlook (GEO-6) Assessment, UNEP;

2014- Steering Committee and Chair (Curriculum Work Group) - Policy Sciences Academy, Society of Policy Scientists;

2012 Member and President (since 2016), Mountain Protection Commission, UIAA;

2011- External Reviewer, Scientific Capacity Building and Enhancement for Sustainable Development, Asia-Pacific Network for Global Change Research;

2011- Fellow & Europe Regional Coordinator, Earth System Governance Project, Future Earth.

Other Memberships and Networks (selected)

Society of Policy Scientists (invited), member of the Executive Council; International Society for the Scientific Study of Subjectivity (Q-methodology); UZH/ETH Zürich Network for Interdisciplinary Climate Change Research; Mountain Research Initiative; ProClim-Swiss Forum for Climate and Global Change.

#### Prizes and acknowledgements

PhD thesis awarded the 2010 *Harold D. Lasswell Prize* by the Society of Policy Scientists Inc. in the USA, for best dissertation in the field of public policy on climate change adaptation.

Appointed ISSC World Social Sciences Fellow on [Risk Interpretation and Action](#) (2013).



**Elisa Palazzi**

Institute of Atmospheric Sciences and Climate, National Research Council (ISAC-CNR)

ORCID ID: [orcid.org/0000-0003-1683-5267](https://orcid.org/0000-0003-1683-5267)

*Education*

- June 2003: Laurea (degree) in Physics, Dept. of Physics - University of Bologna, Italy (110/110L), on the development of the Radiative Transfer Model “PROMSAR” (Processing of Multiple Scattered Atmospheric Radiation) for the simulation of radiation transport in the Earth’s atmosphere.
- June 2008: PhD in Physical Modeling for Environmental Protection, Dept. of Earth Sciences – University of Bologna, Italy, on the retrieval of the vertical profile of atmospheric constituents in the lower troposphere from remote sensing measurements performed using the Multiple-AXis Differential Optical Absorption Spectroscopy (MAX-DOAS) technique

*Employment*

- 2008-2009: Postdoctoral fellow at ISAC-CNR, Bologna, Italy. Diagnostics of mixing and transport mechanisms in the tropical tropopause layer (TTL) and across other dynamical barriers in the atmosphere (subtropical barrier and polar vortex barrier).
- 2009-2011: Short-term researcher at ISAC-CNR, Bologna, funded by the European Space Agency (ESA). Principal Investigator of the ESA-funded project “DIMITRI (Diagnostics of Mixing and Transport in the Atmospheric Interfaces)”, on the use of satellite data to study transport and mixing processes in the atmosphere and across dynamical barriers
- Since October 2011: Researcher at ISAC-CNR, Torino. Study of the climate system processes and interactions, with a particular focus on the hydrological cycle in the mountain regions, climate change and its impacts in the high-altitude cryosphere system and study of the elevation-dependent warming (amplification of warming with elevation) and its driving mechanisms.

*Specific scientific interests*

My research topics in the recent years have been mostly addressed to the study of the climate variability and changes in the mountain regions, with a particular focus on the changes in the hydrological cycle (including the analysis of precipitation, snow, and temperature). The specific activities include:

1. Study of the climate system and Earth-System processes, with a focus on the current and future evolution of the hydrological cycle in mountain regions. In particular, analysis of the precipitation climatology, characteristics, and changes in the Alpine region and in the Karakoram-Himalaya-Tibetan Plateau using in-situ observations, observation-based gridded datasets, satellite and reanalysis data, and the output of regional and global climate models (e.g. from the CORDEX and CMIP5 experiments, and the EC-Earth global model run at ISAC-CNR).
2. Study of elevation-dependent warming (EDW), the mechanism by which mountain regions are experiencing more rapid and intense warming than the surrounding areas or compared to the global mean, similar to the Arctic (or polar) amplification. Analysis of the factors driving EDW in different mountain regions of the world (in particular in the Alpine Region, the Rocky mountains and the Himalayas-Tibetan Plateau), and in the different seasons, using observations and climate model simulations.
3. Downscaling of climate scenarios: in particular, application of the stochastic rainfall downscaling procedure called RainFARM, developed at ISAC-CNR, for the generation of ensembles of high-resolution precipitation fields from coarser datasets. Recent advancements include the implementation in the model of an orographic correction accounting for the dependence of precipitation on orography.

4. Analysis of climate change hot-spots, i.e. geographical regions which display the largest variations in multiple statistics (mean, variability, and extremes) of key climate variables (e.g., temperature and precipitation) in historical data and future scenarios. This also includes the investigation of climatic and environmental changes in specific protected areas.
5. Use of earth system models of intermediate complexity to perform equilibrium and transient climate sensitivity experiments; analysis of possible tipping points in the climate system.
6. Study of the earth critical zone (ECZ) in mountain areas, through in-situ campaigns measuring CO<sub>2</sub> fluxes and exchange between the soil and the atmosphere and defining models for future changes in the ECZ characteristics.

*Relevant publications since 2013*

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### *Synergistic Activities*

- Teaching: Course “Physics of Climate”, University of Turin, Department of Physics, since 2013 (CFU 6); Teaching at the “Scuola di Studi Superiori” of the University of Turin Ferdinando Rossi (SSST), an institution of excellence and higher education for University Studies, since 2012; Series of seminars at the University of Pisa, within the course: “Meteoclimatology”, since 2018
- Teaching experiences in summer schools: 1) Alpine Summer School on "Fundamental processes in geophysical fluid dynamics and the climate system", Valsavarenche, Valle d'Aosta, Italy (2012, 2013); 2) ENVIMAT International Summer School on Environment-Material Interaction (2014, 2015)
- Referee for the following journals: *Climatic Change*, *Journal of Geophysical Research*, *Climate Dynamics*, *Nature Geoscience*, *Mountain Research and Development*, *Atmospheric Measurement Techniques*, *Earth System Dynamics*, *International Journal of Water Resources Development*, *Science of the Total Environment*, *International Journal of Climatology*, *Climate*.

### *Relevant Projects*

- 1) Co-coordinator from November 2011 to 2013 of the Italian PAPRIKA-Karakorum project focused on the evolution of water resources in the Kararoram/Himalaya region.
- 2) Coordinator of Subproject 2 on future projections and responsible of WP2.6 in the Italian NextData project (A national system for the retrieval, storage, access and diffusion of environmental and climate data from mountain and marine areas, 2012-2018) - ended December 2018.
- 4) Participant to the H2020 EU projects ECOPOTENTIAL (Improving future ecosystem benefits through earth observations, Task Leader of the Task on downscaling and future scenarios) and CRESCENDO (COORDINATED RESEARCH IN EARTH SYSTEMS AND CLIMATE: EXPERIMENTS, KNOWLEDGE, DISSEMINATION AND OUTREACH, participant) - ongoing.
- 3) Partner of the project “Innovative methods for water resources management under hydro- climatic uncertainty scenarios”, PRIN 2010-2011 (D.M. 1152/ric del 27/12/2011) - closed

### *Assignments*

- 1) Co-coordinator with the Mountain Research Initiative of the Global Network for Observations and Information in Mountain Environments (GEO-GNOME), a Group on Earth Observations (GEO) Initiative.
- 2) Member of the Working Group for Italy in the Belmont Forum (International Group of Funding Agencies) and GPC (Group of Program Coordinators) member of the Belmont Collaborative Research Action (CRA) “Mountains as Sentinels of Change”
- 3) Co-coordinator of the European Climate Research Alliance (ECRA) Collaborative Programme “Changes in the Hydrological Cycle”.
- 5) Member, since May 2018, of the Italian working Group on “Dynamics of the Paleoclimate” within CNR.
- 6) Since 2014 to 2017 in the Scientific Council of the Italian-French Alpine summer school on "Fundamental processes in geophysical fluid dynamics and the climate system" organized each year by the Institute of Atmospheric Sciences and Climate (ISAC) - CNR (Turin, Italy) and by the Centre national de la recherche scientifique (France).