

2020-2022 GEO Work Programme
Track 1 – Guidance for Development of Implementation Plans for
GEO Initiatives and GEO Flagships Implementation Plan

Final Draft - v1 - 15 February 2019
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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, which 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 2020-2022 work plan:

Task Name	Task Description	Task Starting Year	Task Completion Year
OBJECTIVE 1. Delineate accurately mountain regions using best available data			
<i>Task 1.1b: Explore option to compile a new layer (K4)</i>	This task will aim to add one further layer with information on socio-ecological systems superimposed to mountain delineations. A paper	2018	2020

Task Name	Task Description	Task Starting Year	Task Completion Year
	publication is envisaged to document the process and the result		
<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, still requires mirroring of GME from USGS host site into GEOSS.	2018	2020
OBJECTIVE 2. Identify data providers and user knowledge needs			
<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
OBJECTIVE 3. Improve monitoring and understanding of mountain processes			
<i>Task 3.1: Support the development of UHOP to improve high-elevation climate data - from EDW to Elevation-Dependent Climate Change (EDCC)</i>	Identification of suitable regions/areas for UHOPs 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 is intended to identify the essential climate variables 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 is also intended to highlight the high value of combining in-situ observations, satellite data and modelling.	2019	July 2019

Task Name	Task Description	Task Starting Year	Task Completion Year
<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 June 2019 as a back-back event to the ECVs workshop (see Task 3.2). Position paper (gap analysis) and inventory is envisioned as output.	2019	2019
<i>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	Mid-2020
OBJECTIVE 4. Communicate, link, and develop reporting capacity that responds to policy needs			
<i>Task 4.1 Communicate milestones and tasks results, and showcase products at key GEO events and at relevant global policy events</i>	Workshop and events outcomes report 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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41 Other possible tasks are yet to be identified and specified, GEO-GNOME is in a process of co-design with
42 GEO-GNOME funders (Swiss Agency for Development and Cooperation, SDC) during the current entry
43 proposal design phase Feb-Sep 2019. Furthermore, exchange with other relevant GEO Flagships and
44 Initiatives at the upcoming GEO Symposium in April 2019 may reveal opportunities to identify additional
45 tasks and activities that will be added to this plan in due course.

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

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49 Dr Carolina Adler, Mountain Research Initiative (Switzerland), carolina.adler@giub.unibe.ch
50 Dr Elisa Palazzi, National Research Council (Italy), e.palazzi@isac.cnr.it

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52 **2. Purpose**

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

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56 Mountains are globally distributed environments producing significant societal benefits, but the ability of
57 mountain regions to provide goods and services to both highland and lowland residents is seriously
58 threatened by climatic changes, environmental pollution, large-scale political and socio-economic

59 transformations, unsustainable management of natural resources and serious gaps in the understanding of
60 mountain systems.

61
62 Despite numerous research efforts focused on mountains, there are still gaps around network connectivity,
63 availability and accuracy of high-altitude observations, inter-comparable methodologies to analyse the data,
64 models able to correctly simulate mountain processes and provide reliable projections for high-altitude
65 regions and addressing relevance for policy and decision-making contexts and processes.

66
67 GEO-GNOME, an Initiative launched in 2016, aims at bringing together research institutions and mountain
68 observation networks to collate and make available transboundary and inter- and transdisciplinary
69 environmental and social-ecological data and information on global change in mountains. This is expected
70 to facilitate access to key data and information to the research community for studies applicable to global
71 assessments such as IPCC, as well as information for local, national and regional decision-makers, ensuring
72 that 'mountains' as a topic is incorporated in the process of global agendas such as the 2030 UN Agenda and
73 its Sustainable Development Goals (SDGs), on climate change through the Intergovernmental Panel on
74 Climate Change (IPCC) and UNFCCC, as well as Sendai Framework for disaster risk reduction.

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

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

83
84 **Actual and/or planned outputs of the Initiative (i.e. data sets, open methods, information products or**
85 **services, or other openly available results intended for external users) and their geographical scope.**

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

- 88
- 89 • Global Mountain Explorer (visualization tool based on different mountain definitions) to be made
90 accessible via the GEO GEOSS portal, specifically the GEO-GNOME GEOSS portal currently in Beta
91 (actual);
 - 92 • List of identified Essential Climate Variables for monitoring climatic conditions in mountain
93 environments globally (planned), with a position paper to document process and results;
 - 94 • List of other-than-climate (e.g. biodiversity, social, socio-ecological) essential variables for mountains
95 (planned), with a position paper to document process and results;
 - 96 • Mapping between essential climate/mountain variables and processes of change in mountains, to
97 answer questions such as "what the key variables are/would be to study that specific process and how
98 they are currently measured?", etc. A publication to document process and results is envisaged as
99 concrete output;
 - 100 • Datasets and data archives/portals (through GEOSS) of essential mountain variables (climate + others)
101 (planned) made discoverable and accessible;
 - 102 • Measurement standards and protocols for detecting elevation-dependent climate change (planned)
103 which are applicable across several mountain regions, in spite of their specificities and context. A paper
104 for publication is envisaged to document process and results.
- 105

106 Additional product and services may be considered as we undergo a process of co-design with GEO-GNOME
107 funders to identify additional activities and tasks for the planned funded 4-year period.
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109 **Actual and/or intended users of the outputs and the expected types of decisions these**
110 **outputs are expected to inform.**

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112 GEO-GNOME provides outputs that are suitable to serve the knowledge and information needs of several
113 diverse users. For instance, GEO-GNOME facilitates the research work of scientists looking to access data
114 and datasets based on observed in-situ or EO sources in order to improve the parametrization of models
115 used to describe key drivers and processes of change in the mountain space. Phenomena such as Elevation
116 Dependent Warming (EDW), for example, can be assessed and understood only if long-term records (longer
117 than at least 20 years) of climate variables at several locations along elevational gradients are available and
118 accessible for application, and only if a minimum set of variables, including (but not limited to) temperature,
119 shortwave and longwave radiation, specific humidity, are measured.
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121 Supporting the scientific community in these analyses and outputs also supports the global assessment
122 efforts carried out by entities such as the IPCC, which also translates to being able to support the evidence-
123 informed decisions and negotiations under global policy frameworks and conventions such as those
124 overseen by the UNFCCC. Our outputs are also useful and applicable to serve the knowledge and
125 information needs of governments at various scales, as well as managers and those seeking to invest in the
126 mountain space. Last but not least, the outputs envisaged via GEO-GNOME also serve as powerful means to
127 present and visualise global change trends in mountain regions as an education tool in schools and
128 universities, providing outputs that can could be used for teaching and training purposes.
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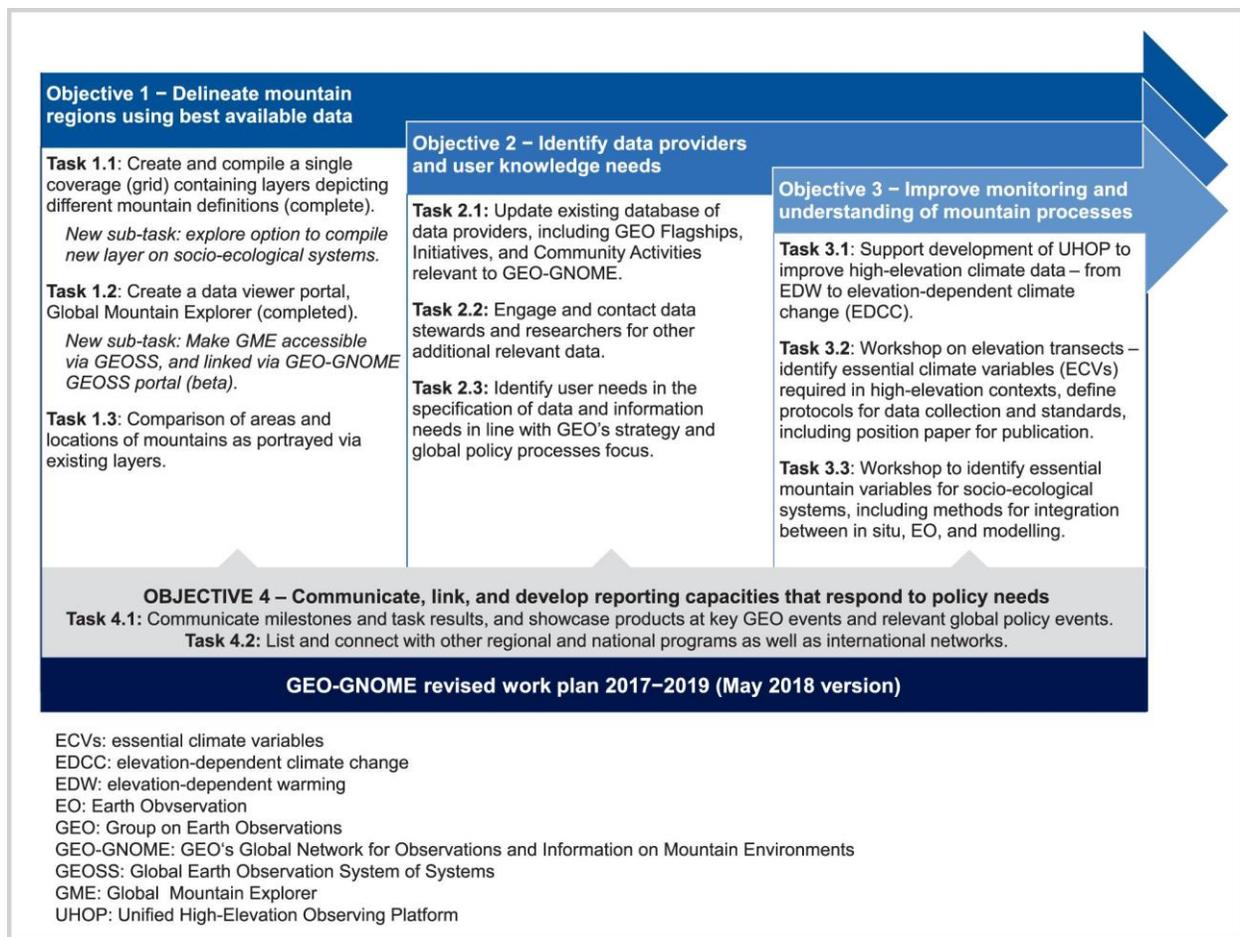
130 **Expected outcomes, impacts and beneficiaries from adoption of the outputs from the**
131 **Initiative.**

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

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

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145 Since the GEO-GNOME 2017-2019 Work Plan revision, conducted as part of the GEO-GNOME workshop in
146 May 2018, a reorganisation and reformulation of objectives and tasks were agreed upon by the GEO-
147 GNOME co-leads and participating core group members. This review also served as an opportunity to check
148 on progress and status on the implementation of tasks. Figure 1 (see [Adler, et al 2018](#)) summarises the
149 scope of objectives and activities and their status:
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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](#).

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 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 reserved 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

174 presence online, with social media. A new logo for GEO-GNOME has now been developed, and a Twitter
175 account (@GEO_Mountains) is also now active.

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

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

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

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205 **Examples or evidence of outcomes and/or impacts based on use of outputs (e.g. policy decisions taken, 206 behavior changes by users, risks mitigated).**

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208 Evidence on this aspect of impact and uptake is yet to be gathered, given the relatively recent achievements
209 with outputs generated to date. Monitoring this aspect of assessment and evaluation will be incorporated
210 into a future GEO GNOME work plan.

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

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214 GEO-GNOME began its activities and operations with few resources for effective coordination and
215 overview/delivery of tasks, which were largely all conducted through in-kind contributions. In the original
216 GEO-GNOME proposal, there were few practical proposals for putting in place a governance structure that
217 could be implemented in practical terms with the existing resources, especially since 'membership' to the
218 Initiative remained rather aspirational and informal. This means that commitments towards contributions
219 were often not effectively followed through. Furthermore, much of the burden regarding key decisions
220 rested on the co-leads, without an effective mechanism in place for consultation and validation of measures
221 or suggestions for moving forward. A 'core' group of individuals were identified and selected through their

222 interest in the Initiative and active participation in key calls and virtual meetings, and this served as a
223 default ‘advisory body’ in subsequent calls and decisions in shaping a new plan. In future, and as part of the
224 2020 plan, the idea is to certainly move towards a structure that allows us to identify more specifically the
225 actual membership into this Initiative, ideally through a registry or membership mechanism that also gives
226 visibility to members and their role in GEO-GNOME. The governance structure will also include a rotating
227 role for advisory board members that comprise a mix of GEO participating organisations, GEO members and
228 individual contributions and participants.

229

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

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232 GEO-GNOME became a GEO Initiative within the GEO Work Programme 2017-2019 at the end of August
233 2016, after having successfully addressed the comments and requests from the GEO Programme Board
234 reviewers at the time. The review of the GEO-GNOME proposal, in fact, was overall positive, identifying
235 GEO-GNOME as a potential new Initiative addressing a key area in dire need of EO in a coherent way,
236 describing a multidisciplinary partnership with solid institutions and organisations, and with inputs and
237 collaborations with other GEO initiatives, having relevant aims and overall strategy, including concrete
238 activities and with good alignment with GEO strategic objectives, but highlighted weak points to be
239 addressed. Weaknesses included the need to better clarify databases and products, primary users, capacity
240 building, governance and monitoring & evaluation.

241

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

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249 A subsequent internal review of the Initiative was conducted through the workshop convened and partially
250 supported financially by MRI on behalf of GEO-GNOME (May 2018), where objectives and activities/tasks
251 were scrutinised in terms of their feasibility in practical terms, as well as the suitability of content and goals
252 in the time period left to end of 2019. A simplified structure was reached with feasible targets in terms of
253 activities to accomplish in the time remaining, effectively parking and setting aside those other objectives
254 and tasks that required dedicated personnel and resources to the next plan when funding could be secured.
255 This was a pragmatic way to ensure GEO-GNOME kept ‘moving’ and avoid stalling completely. As far as we
256 are aware, no external reviews or evaluation of GEO-GNOME were conducted by external entities or
257 individuals.

258

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

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264 **Lessons learned from (or challenges experienced in) the previous implementation period and proposed 265 actions for amendments or improvements.**

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267 Key lessons learned include:

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- 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

270 members volunteered to pursue, as well as those tasks designated to Initiative members to conduct.
271 With the funding source now flagged for GEO-GNOME from 1 October 2019, the task for the co-leads
272 will be to recruit a suitable project officer/manager to be hosted at MRI.

- 273 • Regular virtual meetings are needed to ensure communication among those carrying out on progress on
274 joint tasks/activities and to connect with other members, as well as information inputs on key events
275 and meetings attended by the co-leads. These regular meetings would also serve to gather key
276 information and insights/suggestions from members, effectively re-calibrating the set goals and
277 practical implementation of objectives as the need arises.
- 278 • Physical meetings at last once a year are also important to maintain momentum and relevance,
279 particularly if these can be combined with thematic workshops and content-related matter for
280 elaboration and contribution to set tasks.
- 281 • Active participation at GEO-led events not only ensure we continue to link to and communicate our
282 progress with respect to the overall GEO aims, but would also provide fruitful opportunities to engage
283 more productively with other GEO Flagships, Initiatives and Community Activities that, on the one hand
284 have relevance for our goals, and on the other hand for us to offer useful input to their efforts.

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

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

292 The funding flagged to GEO-GNOME from 1 October comes from the Swiss Agency for Development and
293 Cooperation (SDC), under the terms of its new 'Global Programme for Climate Change Adaptation in
294 Mountain Regions', which identified the need for better coordinated access to data and information on
295 observations and detection of signals of climate change in the mountain space and their resulting impacts.
296 Adaptation responses, both in biophysical as well as human dimensions, are also envisaged for monitoring
297 through data and information across mountain regions. Hence, why GEO-GNOME was selected to fulfil this
298 task given the recognised potential to deliver on these objectives. One could argue this would constitute a
299 policy mandate to serve an investment decision made by SDC for mountains globally, however the GEO-
300 GNOME co-leads expect that further implementation and track record is needed as an Initiative before
301 further considerations towards a possible future Flagship status could be conceived.

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

303 **Description of which activities or outputs of the Initiative, if any, are expected to inform the achievement**
304 **of SDG targets and/or the measurement of SDG indicators. Identify which targets and/or indicators are**
305 **implicated.**

306 GEO-GNOME is currently focused on making sure we have the right base layers and structures and protocols
307 in place (work plan 2020-2022) to then pin and overlay information for visualisation and reporting that may
308 offer the opportunity for us to be more explicit with regards to actual SDGs that we could target as
309 pilot/demonstration projects in the latter part of the next work plan, looking at the 2021-2022 horizon. For
310 the time being we envisage to be able to bring GEO-GNOME to a point where we can identify and/or report
311 on the following SDGs in mountain regions, as a longer-term goal (toward 2022 and beyond):

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- 319 ● SDG Target 1.4, specifically to be able to map for Indicator 1.4.2 *Proportion of total adult population*
- 320 *with secure tenure rights to land, (a) with legally recognized documentation, and (b) who perceive their*
- 321 *rights to land as secure, by sex and type of tenure* (GEO-GNOME Task on K4 layer and Tasks 2.3 and 4.1)
- 322 ● SDG Target 2.4, specifically to be able to map for indicator 2.4.1 *Proportion of agricultural area under*
- 323 *productive and sustainable agriculture* (GEO-GNOME Task on K4 layer and Tasks 2.3 and 4.1)
- 324 ● SDG Target 3.9, specifically to map for indicator 3.9.1 *Mortality rate attributed to household and*
- 325 *ambient air pollution* (GEO-GNOME Task on K4 layer and Tasks 2.3 and 4.1)
- 326 ● SDG Goal 6, specifically to map for indicator 6.3.2 *Proportion of bodies of water with good ambient*
- 327 *water quality*, 6.4.2 *Level of water stress: freshwater withdrawal as a proportion of available freshwater*
- 328 *resource*, and 6.6.1 *Change in the extent of water-related ecosystems over time* (GEO-GNOME Task 2.3
- 329 and 4.1)
- 330 ● SDG Target 7.1, specifically to map for indicator 7.1.1 *Proportion of population with access to electricity*
- 331 (GEO-GNOME Task 2.3 and 4.1)
- 332 ● SDG Target 9.1, specifically for indicator 9.1.1 *Proportion of the rural population who live within 2 km of*
- 333 *an all-season road* (GEO-GNOME Task 2.3 and 4.1)
- 334 ● SDG Target 31.1, specifically for indicator 13.1.1 on *Number of deaths, missing persons and directly*
- 335 *affected persons attributed to disasters per 100,000 population* (GEO-GNOME Task 2.3 and 4.1)
- 336 ● SDG Goal 15, specifically for indicators 15.1.1 *Forest area as a proportion of total land area*, 15.3.1
- 337 *Proportion of land that is degraded over total land area*, 15.4.1 *Coverage by protected areas of*
- 338 *important sites for mountain biodiversity*, and 15.4.2 *Mountain Green Cover Index*.
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340 **Description of which activities or outputs of the Initiative, if any, are expected to support the Paris**

341 **Agreement and identify which pillars are implicated.**

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343 GEO-GNOME is currently focused on making sure we have the right base layers and structures and protocols

344 in place (work plan 2020-2022) to then pin and overlay information for visualisation and reporting that may

345 offer the opportunity for us to be more explicit with regards to actual SDGs that we could target as

346 pilot/demonstration projects in the latter part of the next work plan, looking at the 2021-2022 horizon. For

347 the time being we envisage to be able to bring GEO-GNOME to a point where we can identify and/or report

348 on the following pillars of the Paris Agreement:

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- 350 ● Adaptation
- 351 ● Loss and Damage
- 352 ● Capacity Development / Technology Transfer
- 353 ● National Reporting / Global Stocktake
- 354 ● Mitigation
- 355

356 **Description of which activities or outputs of the Initiative, if any, are expected to support**

357 **achievement of the targets of the Sendai Framework and which targets are implicated.**

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359 GEO-GNOME is currently focused on making sure we have the right base layers and structures and protocols

360 in place (work plan 2020-2022) to then pin and overlay information for visualisation and reporting that may

361 offer the opportunity for us to be more explicit with regards to actual SDGs that we could target as

362 pilot/demonstration projects in the latter part of the next work plan, looking at the 2021-2022 horizon. For

363 the time being we envisage to be able to bring GEO-GNOME to a point where we can identify and/or report

364 on the following targets of the Sendai Framework, by providing access to monitoring data and information

365 with a ‘mountains’ perspective to report on, specifically:

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- 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.
 - B. Substantially reduce the number of affected people globally by 2030, aiming to lower average global figure per 100,000 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.

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

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

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384 Flagships: GEO-GNOME is exploring and scoping the extent to which it can draw on the diverse products and
385 EO data and information utility that the GEO Flagships, in the current Work Programme 2017-2019, offer as
386 well as ways in which it could connect and/or contribute to their future work. GEO-BON is a very likely
387 objective to target in this scope. We anticipate being able to identify and connect with additional Flagships
388 during the GEO Symposium 2019, from which we can derive additional specific joint tasks and activities that
389 can be incorporated into this plan.

390
391 Initiatives: Earth Observations for Ecosystem Accounting (EO4EA), Geo Global Ecosystem Initiative (GEO
392 ECO), Geo Cold Regions Initiative (GEOCRI), Geo Geohazard Supersites and Natural Laboratories (GSNL). We
393 anticipate being able to identify and connect with additional Initiatives during the GEO Symposium 2019,
394 from which we can derive additional specific joint tasks and activities that can be incorporated into this
395 plan.

396
397 GEO-GNOME values the participation in GEO as GEO provides legitimacy to contact GEO Members and bring
398 together a global network for a defined purpose.

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400 **5. Stakeholder Engagement and Capacity Building**

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

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405 Key international organisations and boundary organisations include:

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412
413
- **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) 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

414 supporting observatories, are relevant ways for GEO-GNOME to participate. Carolina Adler from MRI is
415 one of the Co-chairs for this event later in October.

416
417 **Strategy for engaging stakeholders in the co-development / co-production of the Initiative, including**
418 **determining user needs, and for building individual, organizational, and institutional capacity to use the**
419 **outputs of the Initiative.**

420
421 Within the envisaged GEO-GNOME plan, there are provisions to ensure a strategy for engaging stakeholders
422 in the co-development and co-production of the Initiative as it is implemented. GEO-GNOME, under the co-
423 leadership of MRI, is undertaking co-design workshops and discussions with the principal support funders
424 for the initiative in the new work plan, SDC, to identify key capacity building priorities for the regions that
425 SDC wishes to support under its new global mountains programme, particularly in the domain of
426 observations capacities and observatories in other countries. This will provide a key opportunity for GEO-
427 GNOME to define a much more concrete and broader strategy for stakeholder engagement, which up to now has
428 mainly focused on engaging with contributors from research and data providers. This is an ongoing task in
429 the current entry proposal phase with SDC, which will extend until September 2019.

430
431 **Current and/or planned activities to engage stakeholders and/or strengthen individual,**
432 **organizational and/or institutional capacity and the expected outputs and outcomes of these activities.**

433
434 Concrete activities will be defined, and resources assigned once the strategy and direction is in place (see
435 previous point).

436
437 **Current and/or planned activities to strengthen the capacity of the participants in the**
438 **Initiative for successful implementation of the Initiative.**

439
440 GEO-GNOME Objective 3 requires foundation work to strengthen the scientific basis and define scope for
441 monitoring and observation in mountains. This will be facilitated through two targeted GEO-GNOME
442 workshops, the "GEO-GNOME EVs Workshop Week". A workshop will focus on 1) Identification of Essential
443 Climate Variables for mountain environments including methods for integration among in-situ and satellite
444 data and modelling (which will be held from 24th to 26th of June 2019) and a second back-to-back
445 workshop on 2) Biodiversity and Socio Economic aspects of monitoring in mountain regions, with a view to
446 develop a concept for a K4 layer in the GME that captures this data. A third workshop is envisaged in 2020,
447 on 3) Definition of elevational transects including the variables to be measured along altitudinal gradients,
448 and protocols for data collection and standards (to be likely held in the first half of 2020).

449
450 **6. Governance**

451
452 **Description of the governance structure for the Initiative, including the mandates of**
453 **steering/advisory/management committees, if applicable.**

454
455 GEO-GNOME is currently co-led by the Mountain Research Initiative (MRI) and the Italian National Research
456 Council (CNR) and driven by a core group comprising MRI (Switzerland), CNR (Italy), EURAC (Italy), University
457 of Bern (Switzerland), University of Geneva (Switzerland), University of Portsmouth (UK) and USGS (US).

458
459 As part of the next GEO-GNOME work plan, a governance structure will be developed and implemented that
460 would allow us to appoint the current 'core group' as the steering committee to guide and advice on
461 matters related to GEO-GNOME work plan. Likewise, a registry to account for 'membership' in GEO-GNOME

462 will be incorporated, to ensure we make our membership visible and able to track activity among members.
463 Members will include current GEO members, GEO participating Organisations and other individuals and
464 institutions with expertise and contributions to offer that are relevant to achieving the GEO-GNOME goals.
465

466 **Description of the roles of key leadership positions.**
467

468 MRI, the leading organization of GEO-GNOME, is an international global change research network focused
469 on mountain regions, consisting of more than 10000 members from 154 countries. MRI operates as a
470 research and network coordination facility, which also engages and connects with key actors and
471 stakeholders in mountain regions. MRI is supported by the Swiss Academies of Sciences (SCNAT) and is
472 hosted by the Institute of Geography at the University of Bern, Switzerland. MRI is currently supporting the
473 GEO-GNOME coordination function as an in-kind contribution. A dedicated Secretariat is yet to be
474 established, pending resource availability expected by the end of 2019. MRI is also a Participating
475 Organisation in GEO and is currently appointed to the GEO Work Programme Board 2019-2022.
476

477 CNR, co-leading organisation of GEO-GNOME, supports in-kind the Initiative through scientific input,
478 research expertise and projects dealing with mountains and the impact of climate changes on high-altitude
479 environments. In particular, the project NextData (<http://www.nextdataport.it/>) ended in December
480 2018, a national research project devoted to collect existing data on mountains, implement measurement
481 networks in remote areas and develop web portals to access meteo-climatic and atmospheric composition
482 data on mountains; the H2020 ECOPOTENTIAL project (<http://www.ecopotential-project.eu/>) which
483 explores the use of Earth Observations to monitor changes in European ecosystems and support their
484 management, with mountain ecosystems as a specific sub-category; and the Belmont Forum launched
485 Collaborative Research Action on “Mountains as Sentinels of Change”.
486

487 **Strategy for communication with participants and stakeholders, including the main communications**
488 **channels used.**
489

490 Currently GEO-GNOME has no dedicated communication channels, other than what is offered in-kind via
491 MRI (a website space with updates on key publications, events, and now a twitter feed @GEO_Mountains,
492 as well as regular updates published in the MRI Global Newsletters). The main way of communicating with
493 GEO-GNOME members is via email, with a few meetings convened so far via the GEO Secretariat (Webex, to
494 be migrated to Bluejeans). As part of our lessons learnt (see earlier section), establishing regular means of
495 communicating among members (virtual of face-to-face) will be programmed, as well as enhancing online
496 presence via the new GEO website that is currently under development. We expect that with the Secretariat
497 in place, GEO-GNOME will be able to leverage resources to enhance its communications, online presence
498 and outreach.
499

500 **Monitoring and evaluation activities to be undertaken within the Initiative or required by**
501 **funders/contributors, including how the effectiveness of user engagement and capacity building activities**
502 **will be assessed. Include a brief description of how the results of the monitoring and evaluation activities**
503 **will be shared with the GEO community.**
504

505 These are currently being developed with the key funder, SDC, as part of the entry proposal phase until
506 September 2019. A log frame in final draft form is expected to be in place by April-May 2019 which will
507 specify monitoring and evaluation criteria and key indicators, as well as set activities for review. These will
508 need to be checked in consultation with the GEO-GNOME co-leads and the core group.
509

510 **Risk management: description of the key risks that could prevent the full realization of the intended**
511 **outcomes of the Initiative and the strategy for managing and/or mitigating the identified risks.**
512

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

- 514 ● Funding constraints from single source donors - As much as possible ensuring a diverse funding source
515 and inputs/contributions from GEO members and participating organisations would ensure a more
516 resilient funding base from which to depend on.
- 517 ● Personnel changes among key leading individuals managing specific tasks/activities, which may
518 undermine continuity - Identify institutional capacities that go beyond individuals to ensure others can
519 take over tasks, as well as ensuring adequately detailed documentation of all processes and
520 results/outcomes are recorded and made available to all GEO-GNOME contributors.

521

522 **7. Resources**

523

524 **Summary of the estimated resources required to implement the proposed activities for the 2020-2022**
525 **period, including financial, in-kind participation, and other in-kind resources (e.g. data, equipment,**
526 **computing capacity, office space).**
527

528 MRI:

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

534

535 CNR-DTA:

- 536 ● In-kind contributions in terms of staff time that amount to approximately 15,000 CHF per year.
- 537 ● The EU H2020-funded project ECOPOTENTIAL, coordinated by CNR-DTA, explores the use of Earth
538 observations for the management of ecosystems, with mountain ecosystems as a specific sub-category.
539 It was conceived as a EU contribution to GEO and has contributed/will contribute in-kind to Tasks 2 and
540 3.
- 541 ● The NextData project, led by CNR-DTA and ended in December 2018, has contributed to Tasks 2 and 3
542 through the work of its researchers also involved in GEO-GNOME (in-kind contribution). The results
543 achieved in NextData, in particular on the collection and construction of a data portal containing
544 archives of mountain data (<http://geonetwork.igg.cnr.it>) will in particular support the achievement of
545 Task 2.

546

547 USGS:

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

550

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

553

554 **Description of the extent to which confirmed contributions to the Initiative meet the identified**
555 **requirements. Please note that the details of the contributions will be entered in Table B below.**
556

557

Contributions listed in Table b are confirmed.

558
559 **Strategy for mobilizing additional resources, either to meet gaps in confirmed contributions or to support**
560 **future requirements.**

561
562 GEO-GNOME is currently also scanning for additional opportunities for funding that are likely to materialise
563 via the Horizon 2020 Programme of the European Commission, where certain calls are flagged as requiring
564 collaboration and partnership with GEO-GNOME. These calls are to be made public in late February 2019.

565
566 **Summary of existing commercial sector engagement in the Initiative, if any, and the strategy for engaging**
567 **commercial sector organizations in future.**

568
569 To date, no known existing commercial sector engagement is active in this Initiative.

570 571 **8. Technical Synopsis**

572
573 **Description of the principal data sets used by the Initiative (including space-based and in situ**
574 **observations as well as non-EO data sets, such as socio-economic data), the sources from which the data**
575 **are obtained, and whether the data are openly and freely accessible.**

576
577 This information will be derived and specified as part of the two workshops envisaged under Objective 3 in
578 June 2019. Currently GEO-GNOME has no person time capacity to compile this information, therefore this
579 will most likely be compiled and finalised with the GEO-GNOME project manager to be appointed later in
580 2019.

581
582 **Description of the key methods used to transform the source data into the products and/or services that**
583 **are or will be provided, including any workflows or open algorithms.**

584
585 This information will be derived and specified as part of the two workshops envisaged under Objective 3 in
586 June 2019. Currently GEO-GNOME has no person time capacity to compile this information, therefore this
587 will most likely be a task for the GEO-GNOME project manager to coordinate with members, and who is
588 expected to be appointed later in 2019.

589
590 **Description of any significant scientific or technical issues that need to be resolved by the Initiative and**
591 **the strategy to address them.**

592
593 Foundational tasks were identified in the current work plan that require scientific workshops to resolve.
594 These are now scheduled to take place in June 2019 and a subsequent additional workshop in the European
595 spring of 2020. An additional workshop sponsored by MRI with its EDW Working Group is planned as a side
596 event at the European Geoscience Union General Assembly in Vienna in April 2019, where an updated
597 synthesis paper will be produced on key drivers and processes of climate in mountains. This paper and
598 contributions to it will all serve as scientific basis to inform and calibrate our state of knowledge on the
599 subject matter.

600 601 **9. Data Policy**

602
603 **Policy of the Initiative regarding data availability, including degree of adherence to the GEOSS Data**
604 **Sharing Principles and GEOSS Data Management Principles.**

605

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

609
610 **If key datasets are managed by the Initiative, a description of how the data are/will be**
611 **Managed.**

612
613 No databases are explicitly managed by the Initiative to date, the intention so far rests on being able to
614 mirror other sites with datasets/databases with access via GEO-GNOME GEOSS portal.

615
616 **Description of how the outputs of the Initiative, and the methods used to produce them,**
617 **may be accessed, including relevant URLs or permanent identifiers. Please indicate whether this**
618 **information is discoverable and accessible via the GEOSS Platform.**

619
620 GEO-GNOME currently has a dedicated GEOSS portal in Beta. It is expected that further development will be
621 conducted in 2019 and 2020.

622
623 **Strategy for longer-term preservation of data and information produced by the Initiative.**

624
625 Yet to be developed, most likely in consultation also with SDC as primary funder, given the envisaged
626 extension for GEO-GNOME support for another 4 additional years after the first phase ending in 2023.

627
628 **Tables**

629 See separate Excel attachment accompanying this document.

- 630
631 A. Individual Participants
632 B. Confirmed Contributions
633 C. Task / Work Package Structure
634 D. Deliverables / Milestones

635
636

637 **Annexes**

638

639 I. Acronyms and abbreviations

640

641 EC PHORS Executive Council Panel of Experts of Polar & High Mountain Observations, Research, & Services

642 EDCC Elevation-Dependent Climate Change

643 EDW Elevation Dependent Warming

644 ESA European Space Agency

645 EVs Essential Variables

646 ECVs Essential Climate Variables

647 EBVs Essential Biodiversity Variables

648 EO Earth Observations

649 EMVs Essential Mountain Variables

650 ESVs Essential Social Variables

651 FAO Food and Agricultural Organization

652 FOEN Swiss Federal Office for the Environment

653 GEO Group on Earth Observations

654 GEOSS GEO Systems of Systems

655 GMBA Global Mountain Biodiversity Assessment

656 GME Global Mountain Explorer

657 H2020 Horizon 2020

658 ICC Implementation Coordination Committee

659 ICIMOD International Centre for Integrated Mountain Development

660 ICS International Science Council

661 IPCC Intergovernmental Panel on Climate Change

662 MRI Mountain Research Initiative

663 NSF US National Science Foundation

664 SDC Swiss Agency for Development and Cooperation

665 SDG Sustainable Development Goal

666 SES Social-ecological system

667 SLC Science Leadership Council (MRI)

668 SNSF Swiss National Science Foundation

669 SROCC IPCC Special Report on Ocean and Cryosphere

670 UHOP Unified High Elevation Observing Platform

671 UN United Nations

672 UNFCCC United Nations Framework Convention on Climate Change

673 WMO World Meteorological Organization

674

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

676

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

678

679 Adler, C., Palazzi, E., Kulonen, A., Balsiger, J., Colangeli, G., Cripe, D., Forsythe, N., Goss-Durant, G., Guigoz,
680 Y., Krauer, J., Payne, D., Pepin, N., Peralvo, M., Romero, J., Sayre, R., Shahgedanova, M., Weingartner, R. &
681 Zebisch, M. (2018). Monitoring Mountains in a Changing World: New Horizons for the Global Network for
682 Observations and Information on Mountain Environments (GEO-GNOME). *Mountain Research and*
683 *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)

684

685 Sayre, R., Frye, C., Karagulle, D., Krauer, J., Breyer, S., Aniello, P., Wright, D. J., Payne, D., Adler, C., Warner,
686 H., Van Sistine, D. Paco & Cress, J. (2018). A New High-Resolution Map of World Mountains and an Online
687 Tool for Visualizing and Comparing Characterizations of Global Mountain Distributions. *Mountain Research*
688 *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)

689

690 Other papers of reference:

691

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

695

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

699

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

702

703 Ostrom, E. 2009. Social-Ecological Systems: A General Framework for Analyzing Sustainability. *Science* 325,
704 419-422. DOI: 10.1126/science.117213

705

706 Palazzi E., L. Mortarini, S. Terzago, J. von Hardenberg. (2018). Elevation-dependent warming in global
707 climate model simulations at high spatial resolution, accepted for publication on *Climate Dynamics*, DOI:
708 10.1007/s00382-018-4287-z

709

710 Pepin, N. and the MRI Elevation Dependant Warming Working Group. 2015. Elevation- Dependent Warming
711 in Mountain Regions of the World. *Nature Climate Change* 5:424-430.

712 <http://dx.doi.org/10.1038/nclimate2563>

713

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

715

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

722 III. Brief CV of Project Leader(s)

723

724 **Carolina Adler**

725

726 Nationality: Dual national of Chile (birth) and Australia (citizenship); residency in Switzerland.

727 Mountain Research Initiative, c/o GIUB University of Bern, Hallerstrasse 12, 3012 Bern, Switzerland.

728 Contact: carolina.adler@giub.unibe.ch | T: +41 (0)31 631 51 41 | M: +41 (0)789 228 254

729

730 Professional Biography

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

748

749 Professional Experience

750 2017 - *Executive Director*, Mountain Research Initiative, Swiss Academies of Sciences, Bern, Switzerland;

751 2011 - *Research Associate*, Department of Environment Systems Science, ETH Zurich:

752 2010-11 - *Research Fellow*, Climate Change Adaptation Program, RMIT University, Australia.

753 2007-10 - *PhD*, School of Geography & Environmental Science, Monash University, Australia:

754 2004-10 - *Research Assistant & Lecturer*, Australian School of Business, UNSW, Australia.

755 2001-04 - *Environmental and Management Consultant*, ENVIRON Australia Pty Ltd, Australia.

756 1998 - *Ministerial Liaison Officer* – Sydney Water Corporation, Australia.

757

758 Academic qualifications

759 2010 Ph.D. (Geography & Environmental Science), Monash University, Australia.

760 2009 Graduate Certificate (Research Management), Southern Cross University, Australia.

761 2003 Graduate Certificate (Environmental Management), UNSW, Australia.

762 2001 MSc. (Environmental Sciences), Wageningen University, The Netherlands.

763 1999 BSc. Honours (Geography), UNSW, Australia.

764

765 Recent projects, consultancies and practical experience (selection)

766 2016-2018: Project (main investigator) "*What counts for transferability of knowledge across cases in*
767 *transdisciplinary research?*" Funded by the Swiss National Science Foundation (SNF), in collaboration with
768 the Centre for Development and Environment of the University of Bern, Switzerland;

769 2015-2018: Project (collaborator) "*New risks: trade-offs in switching from nuclear electricity to renewables*
770 *in Switzerland*", funded by the SNF under the National Research Programme "Energy Turnaround" (NRP 70),
771 in collaboration with ETH Climate Policy Group;- · 2016: Consultancy "*Mountain Waste Management*
772 *Outlook: 'Mountaineering' "*, GRID Arendal and UNEP;
773 2015-2016: "*Teaching transdisciplinarity for sustainable development*". Funded by Innovedum, (ETH Zurich),
774 in collaboration with Department of Environment Systems Science "Transdisciplinarity Lab" (DUSYS TdLab);
775 2014-2017: "Moving towards adaptation to climate change: current practices developed in Chile, their
776 usefulness, barriers to implementation, and opportunities for improvement [*Desarrollo e implementación*
777 *del prototipo de una herramienta participativa para la evaluación de prácticas de adaptación al cambio*
778 *climático a escala local]*". Funded by CONICYT Chile, in collaboration with the University of Chile;
779 2014-2015: Consultancy "Evaluation of National Action Plan on Climate Change [*Plan de Acción Nacional de*
780 *Cambio Climático, PANCC]* 2008-2012 and development of new action plan 2016-2021". Funded by the
781 Environment Ministry, Chile, with University of Chile and partners;
782 2011-2013: "*Learning from Indigenous Natural Resources Management in the Barmah-Millewa, Australia*".
783 Capacity building, training facilitation, and research on community participation for policy on climate
784 change adaptation;
785 2010-2011: Principal Field Specialist, capacity building and workshop design and facilitation, "Tourism and
786 Climate Change", Kailash Sacred Landscape Conservation Initiative (Nepal), ICIMOD/GIZ, with RMIT
787 University, Australia.

788
789 Publications (recent relevant peer-reviewed publications, as first author)

790 Adler, C., et al. (2018). Monitoring Mountains in a Changing World: New Horizons for the Global Network
791 for Observations and Information on Mountain Environments (GEO-GNOME). [Mountain Research and](#)
792 [Development](#), 38(3): 265-269.
793 Adler, C., Hirsch Hadorn, G., Brey, T., Wiesmann, U., Pohl, C. (2017). Conceptualizing the transfer of
794 knowledge across cases in transdisciplinary research. [Sustainability Science](#).
795 Adler, C.E., Aldunce, P., Indvik, K., Bórquez, R., Galaz, V. (2015). "Resilience". In K. Bäckstrand & E. Lövbrand
796 (eds.) [Research Handbook on Climate Governance](#). Edward Elgar.
797 Adler, C.E., & Hirsch Hadorn, G. (2014). The IPCC and treatment of uncertainties: topics and sources of
798 dissensus. [WIREs Climate Change](#), 5(5): 663–676.
799 Adler, C.E., McEvoy, D., Chhetri, P., & Kruk, E. (2013). The role of tourism in a changing climate for
800 conservation and development. A problem-oriented study in the Kailash Sacred Landscape, Nepal. [Policy](#)
801 [Sciences](#), 46(2): 161-178.
802 Roman, C.E., Lynch, A.H., & Dominey-Howes, D. (2011). What is the goal? Framing the climate change
803 adaptation question through a problem-oriented approach. [Weather, Climate & Society](#), 3(1): 16-30.

804
805 Publications (other top 5 relevant peer-reviewed contributions)

806 Lillo-Ortega, G., Aldunce, P., Adler, C., Vidal, M., & Rojas, M. (2018). On the evaluation of adaptation
807 practices: a transdisciplinary exploration of drought measures in Chile. [Sustainability Science](#);
808 Diaz, P., Adler, C., Patt, A. (2017). Do stakeholders' perspectives on renewable energy infrastructure pose a
809 risk to energy policy implementation? A case of a hydropower plant in Switzerland. [Energy Policy](#);
810 Patterson, J., Schulz, K., Vervoort, J., van der Hel, S., Widerberg, O., Adler, C., Hurlbert, M., Anderton, K.,
811 Sethi, M., & Barau, A. (2017). Exploring the governance and politics of transformations towards
812 sustainability. [Environmental Innovation and Societal Transitions](#), 24: 1-16
813 Bórquez, R., Aldunce, P., Adler, C. (2017). Resilience to climate change: from theory to practice through co-
814 production of knowledge in Chile. [Sustainability Science](#), 12(1): 163-176.
815 Sword-Daniels, V., Eriksen, C., Hudson-Doyle, E., Alaniz, R., Adler, C., Schenk, T., & Vallance, S. (2016).
816 Embodied uncertainty: living with complexity and natural hazards. [Journal of Risk Research](#);

817
818 Professional Services (selected)
819 2018 Lead Author IPCC AR6 WGII “Chapter 17: Decision-making options for managing risk” and Co-Lead
820 Cross-Chapter Paper on Mountains;
821 UNISDR Global Platform 2019: member of Organizing Team for High Level Dialogue on Achieving the SDGs
822 through Climate and Disasters
823 2017 Lead Author IPCC Special Report on Oceans and Cryosphere in Changing Climate (SROCC), ‘High
824 Mountains’;
825 Co-Editor for Special Issue in the journal *Regional Environmental Change* titled “Impacts of climate change
826 on the high-mountain cryosphere and associated responses”;
827 2016 New Directions Team (Contributing Author), Earth System Governance Project;
828 2016- Member -IUCN World Commission on Protected Areas (WCPA) Tourism and Protected Areas
829 Specialist Group;
830 2015- Community of Practice Moderator (facilitating a dialogue between science and policy), Global
831 Environment Outlook (GEO-6) Assessment, UNEP;
832 2014- Steering Committee and Chair (Curriculum Work Group) - Policy Sciences Academy, Society of Policy
833 Scientists;
834 2012 Member and President (since 2016), Mountain Protection Commission, UIAA;
835 2011- External Reviewer, Scientific Capacity Building and Enhancement for Sustainable Development, Asia-
836 Pacific Network for Global Change Research;
837 2011- Fellow & Europe Regional Coordinator, Earth System Governance Project, Future Earth.
838 Other Memberships and Networks (selected)
839 Society of Policy Scientists (invited), member of the Executive Council; International Society for the Scientific
840 Study of Subjectivity (Q-methodology); UZH/ETH Zürich Network for Interdisciplinary Climate Change
841 Research; Mountain Research Initiative; ProClim-Swiss Forum for Climate and Global Change.
842
843 Prizes and acknowledgements
844 PhD thesis awarded the 2010 *Harold D. Lasswell Prize* by the Society of Policy Scientists Inc. in the USA, for
845 best dissertation in the field of public policy on climate change adaptation.
846 Appointed ISSC World Social Sciences Fellow on [Risk Interpretation and Action](#) (2013).
847
848

849 **Elisa Palazzi**

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

851 ORCID ID: orcid.org/0000-0003-1683-5267

852

853 *Education*

854 • June 2003: Laurea (degree) in Physics, Dept. of Physics - University of Bologna, Italy (110/110L), on the
855 development of the Radiative Transfer Model “PROMSAR” (Processing of Multiple Scattered Atmospheric
856 Radiation) for the simulation of radiation transport in the Earth’s atmosphere.

857 • June 2008: PhD in Physical Modeling for Environmental Protection, Dept. of Earth Sciences – University of
858 Bologna, Italy, on the retrieval of the vertical profile of atmospheric constituents in the lower troposphere
859 from remote sensing measurements performed using the Multiple-AXis Differential Optical Absorption
860 Spectroscopy (MAX-DOAS) technique

861

862 *Employment*

863 • 2008-2009: Postdoctoral fellow at ISAC-CNR, Bologna, Italy. Diagnostics of mixing and transport
864 mechanisms in the tropical tropopause layer (TTL) and across other dynamical barriers in the atmosphere
865 (subtropical barrier and polar vortex barrier).

866 • 2009-2011: Short-term researcher at ISAC-CNR, Bologna, funded by the European Space Agency
867 (ESA). Principal Investigator of the ESA-funded project “DIMITRI (Diagnostics of Mixing and Transport in the
868 Atmospheric Interfaces)”, on the use of satellite data to study transport and mixing processes in the
869 atmosphere and across dynamical barriers

870 • Since October 2011: Researcher at ISAC-CNR, Torino. Study of the climate system processes and
871 interactions, with a particular focus on the hydrological cycle in the mountain regions, climate change and
872 its impacts in the high-altitude cryosphere system and study of the elevation-dependent warming
873 (amplification of warming with elevation) and its driving mechanisms.

874

875 *Specific scientific interests*

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

- 879 1. Study of the climate system and Earth-System processes, with a focus on the current and future
880 evolution of the hydrological cycle in mountain regions. In particular, analysis of the precipitation
881 climatology, characteristics, and changes in the Alpine region and in the Karakoram-Himalaya-Tibetan
882 Plateau using in-situ observations, observation-based gridded datasets, satellite and reanalysis data, and
883 the output of regional and global climate models (e.g. from the CORDEX and CMIP5 experiments, and the
884 EC-Earth global model run at ISAC-CNR).
- 885 2. Study of elevation-dependent warming (EDW), the mechanism by which mountain regions are
886 experiencing more rapid and intense warming than the surrounding areas or compared to the global mean,
887 similar to the Arctic (or polar) amplification. Analysis of the factors driving EDW in different mountain
888 regions of the world (in particular in the Alpine Region, the Rocky mountains and the Himalayas-Tibetan
889 Plateau), and in the different seasons, using observations and climate model simulations.
- 890 3. Downscaling of climate scenarios: in particular, application of the stochastic rainfall downscaling
891 procedure called RainFARM, developed at ISAC-CNR, for the generation of ensembles of high-resolution
892 precipitation fields from coarser datasets. Recent advancements include the implementation in the model
893 of an orographic correction accounting for the dependence of precipitation on orography.
- 894 4. Analysis of climate change hot-spots, i.e. geographical regions which display the largest variations in
895 multiple statistics (mean, variability, and extremes) of key climate variables (e.g., temperature and

896 precipitation) in historical data and future scenarios. This also includes the investigation of climatic and
897 environmental changes in specific protected areas.

898 5. Use of earth system models of intermediate complexity to perform equilibrium and transient
899 climate sensitivity experiments; analysis of possible tipping points in the climate system.

900 6. Study of the earth critical zone (ECZ) in mountain areas, through in-situ campaigns measuring CO₂
901 fluxes and exchange between the soil and the atmosphere and defining models for future changes in the
902 ECZ characteristics.

903

904 *Relevant publications since 2013*

905

906 ● Hoke, W., Swierczynski, T., Braesicke, P., Lochte, K., Shaffrey, L., Drews, M., Gregow, H., Ludwig, R., Nilsen,
907 J. E. Ø., Palazzi, E., Sannino, G., Smedsrud, L. H., and ECRA network: The European Climate Research
908 Alliance (ECRA): Collaboration from bottom-up, *Adv. Geosci.*, 46, 1-10, [https://doi.org/10.5194/adgeo-46-](https://doi.org/10.5194/adgeo-46-1-2019)
909 1-2019, 2019.

910 ● Adler C., E Palazzi, A Kulonen, J Balsiger, G Colangeli, D Cripe, N Forsythe, G Goss-Durant, Y Guigoz, J
911 Krauer, D Payne, N Pepin, M Peralvo, J Romero, R Sayre, M Shahgedanova, R Weingartner and M Zebisch,
912 "Monitoring Mountains in a Changing World: New Horizons for the Global Network for Observations and
913 Information on Mountain Environments (GEO-GNOME)," *Mountain Research and Development* 38(3), (1
914 August 2018). <https://doi.org/10.1659/MRD-JOURNAL-D-8-00065.1>

915 ● Terzago, S., Palazzi, E., and von Hardenberg, J.: Stochastic downscaling of precipitation in complex
916 orography: a simple method to reproduce a realistic fine-scale climatology, *Nat. Hazards Earth Syst. Sci.*,
917 18, 2825-2840, <https://doi.org/10.5194/nhess-18-2825-2018>, 2018.

918 ● Palazzi E., L. Mortarini, S. Terzago, J. von Hardenberg. Elevation-dependent warming in global climate
919 model simulations at high spatial resolution, accepted for publication on *Climate Dynamics*, DOI:
920 10.1007/s00382-018-4287-z, 2018

921 ● Pasetto D., S. Arenas-Castro, J. Bustamante, R. Casagrandi, N. Chrysoulakis, A. F. Cord, A. Dittrich, C.
922 Domingo-Marimon, G. El Serafy, A. Karnieli, G. A. Kordela, I. Manakos, L. Mari, A. Monteiro, E. Palazzi, D.
923 Poursanidis, A. Rinaldo, S. Terzago, A. Ziemba, G. Ziv. Integration of satellite remote sensing data in
924 ecosystem modelling at local scales: practices and trends, Accepted for publication on *Methods in Ecology*
925 and *Evolution*, doi: 10.1111/2041-210X.13018, 2018

926 ● Massimiliano Alvioli, Massimo Melillo, Fausto Guzzetti, Mauro Rossi, Elisa Palazzi, Jost von Hardenberg,
927 Maria Teresa Brunetti, Silvia Peruccacci, Implications of climate change on landslide hazard in Central
928 Italy, *Science of The Total Environment*, 630, 1528-1543, <https://doi.org/10.1016/j.scitotenv.2018.02.315>,
929 2018.

930 ● Terzago, S; J von Hardenberg; E. Palazzi, A. Provenzale, Snow water equivalent in the Alps as seen by
931 gridded data sets, CMIP5 and CORDEX climate models, *The Cryosphere*, 11, 1625-1645,
932 <https://doi.org/10.5194/tc-11-1625-2017>, 2017.

933 ● Palazzi E., Filippi L., von Hardenberg J., Insights into elevation-dependent warming in the Tibetan Plateau-
934 Himalayas from CMIP5 model simulations, *Clim. Dyn.*, 48 (11-12), 3991-4008, 2017.

935 ● Palazzi E., Provenzale A., Water in the climate system, in "The Fluid Dynamics of Climate", pp: 161-182,
936 Springer Vienna, 2016.

937 ● Norris, J., Carvalho, L.M.V., Jones, C. Cannon, F., Bookhagen, B., Palazzi, E., Tahir A. A., The spatiotemporal
938 variability of precipitation over the Himalaya: evaluation of one-year WRF model simulation, *Clim Dyn.*,
939 doi:10.1007/s00382-016-3414-y, 2016.

940 ● Pepin, N., Bradley, R.S., Diaz, H.F., Baraer, M., Caceres, E.B., Forsythe, N., Fowler, H., Greenwood, G.,
941 Hashmi, M.Z., Liu, X.D., Miller, J.R., Ning, L., Ohmura, A., Palazzi, E., Rangwala, I., Schöner, W., Severskiy, I.,
942 Shahgedanova, M., Wang, M.B., Williamson, S.N., Yang, D.Q., Elevation- dependent warming in mountain
943 regions of the world (2015) *Nature Climate Change*, 5 (5), pp. 424-430. DOI: 10.1038/nclimate2563, 2015.

- 944 ● Turco, M., E. Palazzi, J. von Hardenberg, and A. Provenzale, Observed climate change hotspots. *Geophys. Res. Lett.*, 42, 3521–3528. doi: 10.1002/2015GL063891, 2015
- 945
- 946 ● Soncini, A., Bocchiola, D., Confortola, G., Bianchi, A., Rosso, R., Mayer, C., Lambrecht, A., Palazzi, E.,
- 947 Smiraglia, C., Diolaiuti, G. Future hydrological regimes in the upper Indus basin: A case study from a high-
- 948 altitude glacierized catchment, *Journal of Hydrometeorology*, 16 (1), pp. 306-326. DOI: 10.1175/JHM-D-
- 949 14-0043.1, 2015.
- 950 ● Palazzi, E., Von Hardenberg, J., Terzago, S., Provenzale, A. Precipitation in the Karakoram- Himalaya: a
- 951 CMIP5 view, *Climate Dynamics*, Vol 45, pp. 21-45, DOI: 10.1007/s00382-014- 2341-z, 2015.
- 952 ● Filippi, L., Palazzi, E., Von Hardenberg, J., Provenzale, A. Multidecadal variations in the relationship
- 953 between the NAO and winter precipitation in the Hindu Kush-Karakoram, *Journal of Climate*, 27 (20), pp.
- 954 7890-7902. DOI: 10.1175/JCLI-D-14-00286.1, 2014.
- 955 ● D'Onofrio, D., Palazzi, E., Von Hardenberg, J., Provenzale, A., Calmanti, S. Stochastic rainfall downscaling of
- 956 climate models, *Journal of Hydrometeorology*, 15 (2), pp. 830-843. DOI: 10.1175/JHM-D-13-096.1, 2014.
- 957 ● Terzago, S., von Hardenberg, J., Palazzi, E., Provenzale, A. Snowpack changes in the Hindu Kush-
- 958 Karakoram-Himalaya from CMIP5 global climate models, *Journal of Hydrometeorology*, 15 (6), pp. 2293-
- 959 2313. DOI: 10.1175/JHM-D-13-0196.1, 2014.
- 960 ● Garcia-Aristizabal, A., Bucchignani, E., Palazzi, E., D'Onofrio, D., Gasparini, P., Marzocchi, W. Analysis of
- 961 non-stationary climate-related extreme events considering climate change scenarios: an application for
- 962 multi-hazard assessment in the Dar es Salaam region, Tanzania, *Natural Hazards*, 75 (1), pp. 289-320. DOI:
- 963 10.1007/s11069-014-1324-z, 2014.
- 964 ● Palazzi, E., Von Hardenberg, J., Provenzale, A. Precipitation in the hindu-kush karakoram himalaya:
- 965 Observations and future scenarios, *Journal of Geophysical Research: Atmospheres*, 118 (1), pp. 85-100.
- 966 DOI: 10.1029/2012JD018697, 2013.
- 967

968 *Synergistic Activities*

- 969 - Teaching: Course “Physics of Climate”, University of Turin, Department of Physics, since 2013 (CFU 6);
- 970 Teaching at the “Scuola di Studi Superiori” of the University of Turin Ferdinando Rossi (SSST), an institution
- 971 of excellence and higher education for University Studies, since 2012; Series of seminars at the University of
- 972 Pisa, within the course: “Meteoclimatology”, since 2018
- 973 - Teaching experiences in summer schools: 1) Alpine Summer School on "Fundamental processes in
- 974 geophysical fluid dynamics and the climate system", Valsavarenche, Valle d'Aosta, Italy (2012, 2013); 2)
- 975 ENVIMAT International Summer School on Environment-Material Interaction (2014, 2015)
- 976 - Referee for the following journals: *Climatic Change*, *Journal of Geophysical Research*, *Climate Dynamics*,
- 977 *Nature Geoscience*, *Mountain Research and Development*, *Atmospheric Measurement Techniques*, *Earth*
- 978 *System Dynamics*, *International Journal of Water Resources Development*, *Science of the Total*
- 979 *Environment*, *International Journal of Climatology*, *Climate*.
- 980

981 *Relevant Projects*

- 982 1) Co-coordinator from November 2011 to 2013 of the Italian PAPRIKA-Karakorum project focused on the
- 983 evolution of water resources in the Kararoram/Himalaya region.
- 984 2) Coordinator of Subproject 2 on future projections and responsible of WP2.6 in the Italian NextData
- 985 project (A national system for the retrieval, storage, access and diffusion of environmental and climate data
- 986 from mountain and marine areas, 2012-2018) - ended December 2018.
- 987 4) Participant to the H2020 EU projects ECOPOTENTIAL (Improving future ecosystem benefits through earth
- 988 observations, Task Leader of the Task on downscaling and future scenarios) and CRESCENDO
- 989 (COORDINATED RESEARCH IN EARTH SYSTEMS AND CLIMATE: EXPERIMENTS, KNOWLEDGE, DISSEMINATION
- 990 AND OUTREACH, participant) - ongoing.

- 991 3) Partner of the project “Innovative methods for water resources management under hydro- climatic
992 uncertainty scenarios”, PRIN 2010-2011 (D.M. 1152/ric del 27/12/2011) - closed
993
994 *Assignments*
995 1) Co-coordinator with the Mountain Research Initiative of the Global Network for Observations and
996 Information in Mountain Environments (GEO-GNOME), a Group on Earth Observations (GEO) Initiative.
997 2) Member of the Working Group for Italy in the Belmont Forum (International Group of Funding
998 Agencies) and GPC (Group of Program Coordinators) member of the Belmont Collaborative Research Action
999 (CRA) “Mountains as Sentinels of Change”
1000 3) Co-coordinator of the European Climate Research Alliance (ECRA) Collaborative Programme
1001 “Changes in the Hydrological Cycle”.
1002 5) Member, since May 2018, of the Italian working Group on “Dynamics of the Paleoclimate” within
1003 CNR.
1004 6) Since 2014 to 2017 in the Scientific Council of the Italian-French Alpine summer school on
1005 "Fundamental processes in geophysical fluid dynamics and the climate system" organized each year by the
1006 Institute of Atmospheric Sciences and Climate (ISAC) - CNR (Turin, Italy) and by the Centre national de la
1007 recherche scientifique (France).