Summary

Acronym: GRACIA
Title: Geo-hydrological Risk Assessment under Climate change In mountain Areas
Funding Request: 818
Time Request: 407.4

Investigators:

ID	Role	Family Name	First Name	Funding Agency	K€	Time	Country	Institution
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Project Information

Title: Geo-hydrological Risk Assessment under Climate change In mountain Areas

Acronym: GRACIA

Themes: 1 - Drivers of Change
4 - Hazards Vulnerability and Risks
5 - Adaption and Resilience

Duration: Start: 1/3/2016 **End:** 1/3/2019 **Months:** 36

Summary:
In mountain regions, landslides (including debris flows) cause fatalities and severe economic damage. Landslides result from a variety of natural conditions and triggers, and human actions. The design of effective mitigation, adaptation and landslide risk reduction strategies requires proper understanding of the effects of global changes, including climate changes, on the environment and their impacts on population and society. This is especially important in mountain areas, given their fragility and the on-going and expected increase of settlements and activities in landslide prone regions. Adopting a multi-scale approach, GRACIA will use existing and new historical landslide catalogues, climate (precipitation, temperature) records and predictions from global and regional downscaled models, and state-of-art regional statistical and physically based slope-stability models, to ascertain the expected geographical and temporal variations of landslide hazard in the mountain regions of Gansu Province (China) and of the Italian and the French Alps. Results will inform a socio-economic analysis of landslide risk in the mountain regions. GRACIA will base the analysis on the assessment of exposure (current and predicted by existing climate change scenarios) including an evaluation of the population exposure, the economic value of human-made assets, and the ecosystem services. GRACIA will investigate the vulnerability and resilience to landslides of local socio-economic systems affected by high impact events, and by slow systemic changes induced by the predicted climate variations. Vulnerability and resilience will be studied adopting a cost benefit approach, fostering interest of local stakeholders. GRACIA will perform dedicated training to engage end users, and will organize workshops to increase awareness of local communities. We expect the results of GRACIA to support evidence based policy making, to sustain the design of effective and sustainable local and regional adaptation strategies, increasing awareness to climate-induced hazards and economic risk.

Key Words:
Landslide, landslide hazard, climatic change, landslide risk management, landslide vulnerability, landslide resilience, Italian Alps, French Alps, Gansu Province (China), awareness of landslide risk.

8. Executive summary

In mountain regions, landslides (including debris flows) cause disruption, economic damage and fatalities. Intense and prolonged rainfall, rain on snow, rapid snowmelt, and freeze-and thaw cycles are the main meteorological triggers of landslides, that pose a significant threat to communities, infrastructures, forests, agriculture, and environmental and economic systems in mountain areas. Assessing the potential socio-economic damage of landslides in mountain areas is important for decision and policy making, for regional and local planning and for businesses, including construction, energy, forestry, tourism and insurance. The design and the implementation of effective and sustainable landslide management and adaptation strategies require proper understanding of the effects of climate change on the natural environment. This is of paramount importance in mountain regions, given their inherent natural fragility and the expected increase of settlements and economic activities in unstable or potentially dangerous areas.

GRACIA, **Geo-hydrological Risk Assessment under Climate change In mountain Areas**, is designed to respond to the mounting demand for safety in mountain areas through the implementation of a novel modelling framework aimed at understanding the effects of climate change on landslide impact to the population and society.

GRACIA has two **scientific objectives**, namely:

1. To study variations in the location, frequency and magnitude of landslides in response to predicted climate changes in mountain regions, and
2. To assess the socio-economic risk posed by landslides under different climate scenarios.

To achieve these objectives, GRACIA will:

- Analyse existing and new information on past and recent landslides in selected mountain areas in Asia and Europe;
- Investigate links between landslides and meteorological and environmental conditions, and how they are affected by climate change;
- Produce climate projections exploiting state-of-art stochastic downscaling techniques;
- Determine if landslide hazard is likely to increase or decrease in the selected study areas, based on the climate projections;
- Assess the socio-economic vulnerability to landslides to help select suitable actions and investments to minimize the costs and to maximize resilience; and
- Engage stakeholders managing natural and ecological resources, and dealing with the direct and indirect socio-economic consequences of landslides in mountain areas.

GRACIA integrates state-of-the-art capabilities and innovative modelling tools to advance knowledge on climate induced landslide hazards and related economic risk. This is achieved through synergic modelling tool and methods, including:

- Stochastic downscaling methods to obtain high resolution climate projection;
- Tools for determining empirical landslide size (area, volume) statistics;
- Tools to define functional relationships between rainfall and landslide occurrence and their validation;
- Spatially distributed modelling tools for the prediction of shallow rainfall-induced

landslides;
- Tools to analyse landslide impact on transportation networks;
- Methods for the socio-economic analysis of landslide economic risk; and
- Tools to identify indicators measuring baseline characteristics of mountain communities to help foster resilience.

Evaluating the socio-economic risk posed by landslides in a changing climate is a complex problem that requires multi/inter-disciplinary expertise. To respond to the challenge, the GRACIA partnership brings together qualified experts in a wide range of complementary fields, covering climate modelling, landslide hazard modelling, landslide impact and vulnerability assessment, socio-economic analysis, dissemination and outreach. The partnership has the human, technological and information resources needed to complete the research, and to address the need to develop and deploy innovative methods and tools to promote resilience to landslides in mountain regions. The GRACIA consortium is a balanced team of natural scientists (physicists, geologists, hydrologists, forest scientists, ecologists), engineers and economists with a track record of executing research and publishing results. The seven partners of the GRACIA consortium are:

- Consiglio Nazionale delle Ricerche, Italy (lead partner)
- Catholic University of Milan, Italy
- Centre National de la Recherche Scientifique, France
- Institut national de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture, France
- Institute of Geo-Environment Monitoring of Gansu Province, China
- Lanzhou University, China
- United Nations Educational, Scientific and Cultural Organization, France

Three partners are from research centres, two from Universities, and one is a technical agency. UNESCO brings to the project their global contacts and unique outreach capacity. The geographical location of the partners facilitates the spreading of the project results in Asia and Europe, and globally though UNESCO.

Outreach and dissemination activities are key to the success of GRACIA. Specific dissemination actions will raise the awareness on landslide hazards and the associated socio-economic risk in mountain areas in a changing climate. The activities will reach out to a large audience, well beyond the academic community, including international and regional stakeholders and the general public. Eleven relevant stakeholders have expressed their interest in being engaged in GRACIA, including local authorities, environmental, forestry and planning agencies, an insurance company, a natural museum and two Geoparks. The stakeholders are:

- The Environmental Agency of the Veneto Region (Italy);
- The Autonomous Province of Bozen (Italy);
- The Adamello Brenta Global Geopark (Italy) and the Haute Provence Global Geopark (France), of the UNESCO network of Geoparks;
- The MUSE Science Museum of Trento (Italy);
- The Assicurazioni Generali S.p.A. (Italy);
- The Département des Hautes-Alpes and the Service de Restauration des Terrains en

Montagne, of the Office National des Forêts (France);

- The Department of Land and Resources Management, Longnan Government (China),
- The Longnan Geohazards Emergence Response Centre, Gansu Province (China),
- The Geohazards Emergence Response Centre, Tianshui Government (China).

We expect the results of GRACIA to support and foster evidence-based policy and decision making, to sustain the design of effective and sustainable local and regional adaptation strategies, increasing awareness to climate-induced hazards and economic risk.

9. Project description (Maximum 35000 characters; includes spaces)
Graphics can be included in this section. Graphics up to half a page count as 200 characters per graphic, over a half page and up to a full page as 400 characters per graphic.

9.1 Background

In mountain regions, landslides (including debris flows) (Cruden & Varnes 1996) cause disruption, economic damage and fatalities (Petley 2012; Guzzetti et al 2005a; Hu et al 2012). Intense and prolonged rainfall, rain on snow, rapid snowmelt, and freeze-and thaw cycles are the main meteorological and climatic triggers of landslides in mountain areas. Landslides pose a significant threat to mountain and rural communities, infrastructures, forests, agriculture, and environmental and economic systems. Assessing the potential socio-economic losses caused by landslides in mountain areas is important for decision and policy makers, for regional and local planners, and for a variety of business including construction, energy, forestry, tourism and insurance.

There is worldwide mounting demand for safety, matched by an increasing need for high-quality data on landslide vulnerability, organized information and tools for modelling and forecasting landslide impact on physical and cultural systems, and for modelling tools to support the mitigation, preparedness, recovery and reconstruction phases of the landslide management cycle. The design and the implementation of effective and sustainable landslide management and adaptation strategies require understanding the effects of climate changes on the natural environment (Fuchs et al 2015). This is of paramount importance in mountain regions, given their inherent natural fragility, and the expected increase of settlements and economic activities in unstable or potentially dangerous areas.

GRACIA, **Geo-hydrological Risk Assessment under Climate change In mountain Areas**, is a partnership between China, France, Italy, and UNESCO (see Table 1) to address the need to develop and deploy innovative tools to promote resilience to landslides in mountain regions.

Table 1. List of participant to GRACIA consortium.

Participant	Short name	Country
Consiglio Nazionale delle Ricerche	CNR	Italy
Catholic University of Milan	UNICATT	Italy
Lanzhou University	LZU	China
Institute of Geo-environment Monitoring of Gansu Province	CIGEM	China
Centre National de la Recherche Scientifique	CNRS	France
Institut national de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture	IRSTEA	France
United Nations Educational, Scientific and Cultural Organization	UNESCO	France

A multi-disciplinary team of natural scientists, engineers, and economists supported by stakeholders contribute to the project, focusing on mountains in South Gansu Province, China, and on the Italian and French Alps. In particular, GRACIA study areas are located (i) in the Tianshui and Wudu regions in South Gansu, lying in the Western Qinling Mountain range (sometimes called the Szechuan Alps) running east-west direction across China, (ii) in the central and eastern sectors of the Italian Alps and (iii) in the northern and southern French Alps. The study areas are representative of wider regions in the Western Qinling and the Alps, making the results of GRACIA wide ranging.

GRACIA **scientific objectives** are:

1. Study variations in the location, frequency and magnitude of landslides in response to predicted climate changes in mountain regions in Asia and Europe, and
2. Assess the socio-economic risk posed by landslides under different climate scenarios, and evaluate the direct and indirect costs.

To achieve the objectives, GRACIA will:

- Analyse existing and newly collected information on past and recent landslides in the selected mountain areas;
- Investigate links between landslides and meteorological and environmental conditions, and how they are affected by climate change;
- Produce climate projection exploiting state-of-art stochastic downscaling techniques;
- Determine if landslide hazard is likely to vary in the study areas based on climate projections;
- Assess the socio-economic vulnerability and risk to help select actions/investments to minimize the cost of the expected climate-related events, maximizing resilience;
- Engage stakeholders managing natural/ecological resources, and dealing with the direct/indirect socio-economic consequences of landslides in mountain areas.

GRACIA integrates state-of-the-art capabilities, and innovative tools to fill gaps in the current knowledge of climate induced landslide hazards and related economic risk. GRACIA exploits: (i) stochastic downscaling methods to obtain high resolution climate projections, (ii) tools for determining empirical landslide size (area, volume) statistics (Malamud et al 2004), (iii) tools to define functional relationships between rainfall and landslide occurrence and their validation (Brunetti et al 2010; Peruccacci et al 2012; Gariano et al 2015), (iv) a consolidated spatially distributed model for the prediction of shallow, rainfall-induced landslides (Baum et al 2008), (v) tools to analyse landslide impact on transportation networks (Jomelli et al 2011), (vi) methods for the socio-economic analysis of landslide risk (Salvati et al 2010), and (vii) tools to identify indicators measuring baseline characteristics of mountain communities to help foster resilience (Cutter et al 2010).

GRACIA uses existing and new historical information on landslides and their triggering conditions, including: (i) a record of more than 1000 historical landslides in two areas in the South Gansu province, China, with information on casualties and economic damage; (ii) a database of historical debris flows for the French Alps compiled by the National Office of Forests, with information on the location and the date of occurrence of the failure, the mobilized volume, and the local setting (lithology, elevation of source area, vegetation type); (iii) a catalogue of 453 rainfall events that have triggered 509 landslides in the Italian Alps with location and date/time of occurrence; and (iv) a catalogue of about 400 debris flows collected by the Autonomous Province of Bozen. Italy. GRACIA study areas are also locally instrumented for landslide monitoring (Navratil et al., 2013, Comiti et al., 2014). During the project, recent (post-2008) debris-flow events in the French Alps will be analysed using information collected by the Restauration des Terrains de Montaigne service.

GRACIA uses an advanced version of RainFARM (Rebora et al 2006a,b; D'Onofrio et al 2014), a state-of-art stochastic downscaling technique, to prepare ensembles of high-resolution precipitation scenarios for selected mountain areas. Evaluation of the local-scale impact of climate change needed for impact studies requires very-high-resolution information for the correct representation of land-surface processes, and of the sub-grid scale variability, particularly for highly intermittent variables such as precipitation. This raises the need for appropriate climate downscaling techniques, like stochastic rainfall downscaling techniques (Ferraris et al 2003a,b). Stochastic downscaling has the potential for estimating uncertainties in rainfall scenarios, by generating ensembles of synthetic small-scale precipitation fields that can be compared with measured data (Brussolo et al 2008). Precipitation extremes and small-scale variability are essential drivers in landslide hazard studies. However, the spatial resolution achieved by global / regional climate models is insufficient to identify the fine structure of precipitation intensity fields. RainFARM overcomes the problem, improving the representation of the precipitation power spectra and eliminating artefacts (D'Onofrio et al 2014).

GRACIA explores the links between landslide occurrence and meteorological and environmental conditions (morphometry, sediment sources, geology, land-use) based on existing observations and modelled meteorological/climate records. Adopting a consolidated modelling approach (Guzzetti et al 2005b) and a multi-scale approach, the data are used to determine the variation of landslide hazard based on climate projections at the regional and catchment scales.

For regional investigations, existing (Wu 2003; Marchi et al., 2008; Jomelli et al 2009; Brunetti et al 2014) and new catalogues of landslides, meteorological records (rainfall, temperature), and the constructed precipitation scenarios are combined. The objective is to recognize trends on the temporal occurrence and size of landslides (Brunetti et al 2009; Rossi et al 2010; Nikolopoulos et al 2015), and to establish empirical rainfall

thresholds for possible landslide occurrence using probabilistic methods (Brunetti et al 2010; Peruccacci et al 2012), and for the quantitative validation of the thresholds (Pavlova et al 2011, 2014; Gariano et al 2015). For selected areas (in France), near-real-time rainfall fields at 1 km², 15-minute resolution obtained by X-band polarimetric radars (Westrelin et al 2012) are used to construct high-resolution spatial-temporal rainfall records. GRACIA exploits the existing and the new catalogues, and modern statistical modelling tools to determine the spatial frequency-size statistics of landslides (Malamud et al 2004), an information used to define landslide activity and its variations. GRACIA also exploits homogenized (Caussinus & Mestre 2004) time series of landslides to determine the temporal frequency of the landslide events, in terms of frequency over time or return periods (Innes 1985; Van Steijn 1996). Further, GRACIA uses landslide triggering conditions calibrated at monitoring stations to determine proxies of convective precipitation from regional atmospheric patterns and profiles documented from re-analyses (Turkington et al 2014), and derives regional landslide triggering scenarios from downscaled precipitation data.

For catchment scale investigations, landslide occurrence is forecasted using the Transient Rainfall Infiltration and Grid-Based Regional Slope-Stability (TRIGRS) model, which predicts the stability/instability conditions of individual grid cells, given local terrain and rainfall conditions (Baum et al 2008). TRIGRS is capable of reproducing the size distribution of the patches of terrain predicted as unstable by the model, which matches the frequency size statistics of natural landslides (Alvioli et al 2014). TRIGRS is used to predict the geographical and temporal occurrence and the magnitude of the expected landslide events, under different climate scenarios. This represents a novel, explicit link between landslide model predictions and climate change scenarios.

Different approaches for landslide risk and related cost assessment exist, including *ex post* or *ex ante* approaches, cost surveys and risk analyses (Meyer et al 2013). GRACIA defines landslide risk and performs landslide cost analysis using the concepts of vulnerability and resilience. Vulnerability measures the degree of loss of an asset (e.g., a building, a road, a road network), and is expressed as the percentage of the value lost in the damaging event (Galli & Guzzetti 2007; Papathoma-Köhle 2012). Vulnerability curves are constructed from past damaging landslide events (Galli & Guzzetti 2007), and used to anticipate the type and extent of the losses caused by future, similar landslide events. Resilience is the ability of a (physical, social) system to respond and recover from a disaster, to learn and to adjust using all forms of knowledge, self-organization strategy, and institutional practices that help in the face of a hazard (Modica & Reggiani, 2015). Resilience includes inherent conditions allowing the system to absorb impacts, and cope with them during and after an event using adaptive processes that facilitate the ability of the system to re-organize, change, and learn in response to a threat (Cutter et al 2008).

GRACIA provides a methodology to select a set of indicators for measuring baseline characteristics of mountain communities that foster resilience (Cutter et al 2010).

According to past literature (Fothergill & Peek 2004) the risk perception and preparation, and the way affected people respond to natural hazard, are different according to their socio-economic status. When considering their resilience, low-income populations can suffer a strong impact due to factors such as building quality and social exclusion. Therefore, a comparison between Chinese and European situations is necessary to underline commonalities and differences in two very different socio-economic contexts.

A cost-benefit analysis of risk reduction measures will be carry out, considering both impacts on inhabited areas and on transport networks, that are particularly vulnerable in mountain environments (Sterlacchini et al 2007; Jomelli et al 2011; Papathoma-Kohle et al 2011; Klose et al 2014). Recent studies focus on the direct impacts of landslides on road networks using fragility/vulnerability curves for infrastructures (Papathoma-Khöle et al 2012; Winter et al 2013). Other studies concern the indirect consequences of the disruption to a network due to a debris flow (Perrin et al 1998; Demoraes & D'Ercole 2009). Road network vulnerability assessment implies the study of potential degradation of the road system (Jenelius & Mattsson, 2015) and the related impact, such as business interruption (Meyer et al 2013). The objective of GRACIA is to estimate the impact of the disruption to the whole road network considering both direct and indirect costs of landslides.

The proposed GRACIA activities builds upon previous research projects and their results, and on currently funded projects. CNR is currently involved in a project supported by the Italian National Department for Civil Protection for the prediction of rainfall-induced landslides and associated risk in Italy. CNR collaborates to the NextData project (www.nextdataproject.it) for retrieval, storage, access and diffusion of environmental and climate data from mountain and marine areas. Climate projections in GRACIA will be performed in collaboration with the PRACE Partnership for Advanced Computing in Europe (https://ec.europa.eu/research/infrastructures/index_en.cfm?pg=prace). CNR and UNICATT are involved in a project about the costs of natural hazards funded by the Assicurazioni Generali insurance company. French teams will benefit from previous results and experiences developed in several national and international projects such as Acqwa (www.acqwa.ch), on climate impacts and on the quantity and quality of water and Arnica on the assessment of risks on transportation networks resulting from slope instability and climate change in the Alps.

9.2 Research plan

To reach its goals, GRACIA will adopt a chained-modelling approach organized in 7 Work Packages (WPs). WP2 and WP3 execute preparatory actions and provide inputs to the GRACIA research/modelling chain executed in WP4, WP5 and WP6. WP2 characterizes the study areas and prepares geo-databases with relevant thematic and environmental data and information. WP3 prepares high-resolution climate projections for the study areas. WP4 models the geographical and temporal occurrence and the

magnitude of the expected landslides. Using the results of WP3 and WP4, WP5 determines whether landslide hazard is likely to vary based on the climate projections. WP6 evaluates the socio-economic aspects of landslide vulnerability and economic risk, and helps selecting actions/investments to minimize the cost of the expected climate-related landslides. WP7 is dedicated to outreach, dissemination and training activities. WP1 executes management and coordination activities.

WP1: Management & Coordination

Start month: 1 | **End month**: 36

Objectives:

- Manage GRACIA ensuring that objectives are achieved and deliverables prepared on time and within budget.
- Facilitate interactions between the consortium and the Belmont Forum (BF), and assure the BF has a complete vision of the progress and outcomes of GRACIA.

WP1 provides management and coordination for GRACIA. It facilitates interactions between partners, and assures that the BF and the funding agencies have an accurate vision of the progress made and the results obtained. Activities in WP1 include (1) design and maintenance of project documents, (2) preparation and execution of meetings, (3) implementation and maintenance of the collaborative website.

WP Owner: CNR

Participants: All partners

Links: WP1 is connected to all other WPs.

Deliverables

D1.1 / Month 3 – Project Website (collaborative section) up and running

D1.2 / Month 18 – Mid-term Project Report

D1.3 / Month 36 – End-of-term Report

Milestones

M11 / Month 3 – Project Website (collaborative section)

M12 / Month 18 – Mid-term Project Review

WP2: Landslide and thematic information collection and organization

Start month: 2 | **End month:** 15

Objectives:

- Select and characterize the GRACIA study areas based on landslide, geographic,

climatic and socio-economic conditions.

- Collect and organize existing and new information on past and recent landslides and their impacts, including vulnerability information and curves.
- Collect and organize existing meteorological and thematic data.
- Prepare geo-databases for the study areas.

WP2 characterizes the project study areas. Thematic and environmental information useful to execute the planned research are collected and organized, including information on (1) landslides, (2) rainfall conditions responsible for failures, (3) impact and damage caused by landslides, (4) structures, infrastructure and socio-economic factors. Existing catalogues and geo-databases will be merged to build a single geo-database that will also contain new data and information. Rainfall data will be collected from rain gauge measurements and radar estimates. Landslide information will be obtained from different sources (newspapers, reports, online sources) and instrumented sites.

WP Owner: LZU

Participants: CIGEM, CNR, IRSTEA, UNICATT

Links: WP2 provides inputs to WP4, WP5 and WP6, and contributes to WP7.

Deliverables

D2.1 / Month 4 – Description of project study areas

D2.2 / Month 15 – Geo-database for project study areas

Milestones

M21 / Month 15 – Geo-database for project study areas ready

WP3: Climate change projections

Start month: 2 | **End month:** 34

Objectives:

- Provide climate change projections for the study areas using numerical climate models.

WP3 delivers climate change projections for the study areas. It executes 3 tasks: (1) provide gridded observations and climate model simulations, considering the following sources: (i) global climate model simulation data from the Coupled Model Intercomparison Project Phase 5 (CMIP5) and the COordinated Regional climate Downscaling EXperiment (CORDEX) archives, (ii) simulations with the Weather Research & Forecasting (WRF) non-hydrostatic regional model run in the Euro-CORDEX domain forced with EC-Earth CMIP5 projections, (iii) extremely high-resolution climate simulation data from simulations performed with the EC-Earth v3 global climate model

forced with observed and future estimated sea-surface temperatures and sea-ice cover over 30-year long present and future periods (Representative Concentration Pathway RCP 8.5 scenario) at 16, 25, 40 and 80 km resolutions with multiple ensemble realizations. The activity will be performed in collaboration with the PRACE supercomputing project CLIMATE Stochastic Physics HIgh resolutioN eXperiments. (2) Bridge the scale gap between available climate simulations and observation data and the scales needed for landslide modelling and risk assessment using the RainFARM stochastic technique to generate high resolution (up to 1 km) precipitation fields. (3) Run a pilot study to derive regional triggering scenarios for landslides from proxies or downscaled precipitation data. Empirical-statistical error correction and downscaling methods will be developed and applied to generate localized and error corrected scenarios.

WP Owner: CNR

Participants: CIGEM, LZU

Links: WP3 provides input to WP4 and WP5, and contributes to WP7.

Deliverables

D3.1 / Month 12 – Archives of selected climate fields from high resolution EC-Earth simulations

D3.2 / Month 16 – Archive of downscaled precipitation fields for the study areas

D3.3 / Month 34 – Report on WP3 pilot study

Milestones

M31 / Month 16 – Availability of climate datasets and downscaled precipitation archives

WP4: Links between meteorological & environmental conditions and landslides

Start month: 12 | **End month:** 24

Objectives:

- Investigate links between meteorological and environmental conditions and landslide occurrence.
- Analyse variations of the links between meteorological and environmental conditions and landslide occurrence, due to climate change.

WP4 studies the relationships between landslides occurrence and meteorological and environmental conditions, at different geographical scales. WP4 executes 3 tasks: (1) catchment scale modelling of the geographical / temporal occurrence and the size of the expected landslides, under different climate scenarios. This is performed using a modified version of the TRIGRS model, considering the local terrain and environmental conditions. (2) Determine regional scale empirical rainfall thresholds for possible

landslide occurrence exploiting landslide, thematic and rainfall information. The role of environmental variables (e.g., sediment sources, land-use, geology, morphometry) and the climate trend observed over the last decades will be considered. (3) Execute a pilot regional study in the study area in China exploiting Synthetic Aperture Radar (SAR) images (available to the team) for monitoring deep-seated landslides, and to determine the rate or landslide activity in relation to meteorological/climate variations. For Differential Interferometric Synthetic Aperture Radar (DInSAR) monitoring, the consolidated Small BAseline Subset (SBAS) technique will be used.

WP Owner: CNRS

Participants: CIGEM, CNR, IRSTEA, LZU

Links: WP4 uses input from WP2 and WP3, provides input to WP5, and contributes to WP7.

Deliverables

D4.1 / Month 24 – Report on catchment-scale modelling

D4.2 / Month 24 – Report on regional modelling and the definition of empirical rainfall thresholds

D4.3 / Month 24 – Report on DInSAR modelling and landslide activity

Milestones

M41 / Month 14 – Critical analysis of catchment-scale and regional modelling approaches

WP5: Landslide hazard variation

Start month: 15 | **End month:** 34

Objectives:

- Determine landslide temporal frequency and magnitude in the study areas.
- Assess landslide hazard for the study areas.
- Investigate expected variations of landslide hazard based on climate projections.

WP5 is dedicated to landslide hazard assessment, and the evaluation and quantification of its variations under different climatic conditions. WP5 executes three tasks. (1) Using thematic and landslide data provided by WP2, it evaluates the landslide temporal frequency and magnitude using statistical tools. (2) Next, adopting a consolidated modelling approach, integrating the modelling results of WP4 with the results of the previous task, it prepares landslide hazard scenarios using statistically-based and physically-based modelling tools. (3) Lastly, expected geographical and temporal variations in landslide hazard due to the different climate scenarios (from WP3) are analysed and quantified.

WP Owner: CNR

Participants: CIGEM, CNRS, IRSTEA, LZU

Links: WP5 uses input from WP2, WP3 and WP4, provides input to WP6, and contributes to WP7.

Deliverables

D5.1 / Month 20 – Report on landslide temporal frequency and magnitude

D5.2 / Month 26– Report on landslide hazard scenarios

D5.3 / Month 34 – Report on climate-driven variation in landslide hazard

Milestones

M51 / Month 26 – Critical analysis of landslide hazard scenarios

WP6: Socio-economic analysis of vulnerability and risk & resilience assessment

Start month: 18 | **End month:** 35

Objectives:

- Evaluate socio-economic vulnerability to landslides and related economic risk.
- Assess resilience and select actions/investments to minimize the cost of expected climate-related landslides.

WP6 analyses the socio-economic aspects of landslide vulnerability and economic risk, and assesses resilience to help selecting actions/investments to minimize the social cost of the expected climate-related landslides. WP6 executes 3 tasks: (1) A quantitative assessment of the economic risk posed by past and potential future landslides, adopting both an *ex-post* and *ex-ante* point of view, with specific focus on road networks. Vulnerability curves are developed and exposure is evaluated in terms of economic values subject to risk. (2) A cost-benefit analysis of risk reduction measures considering impacts on inhabited areas and transport networks. (3) The analysis of the characteristics of the system resilience in the different study areas. When building resilience, WP6 will focus on how socio-economic context (income, GDP or population size) changes the sensitivity of economies to landslide events, comparing Chinese and European situations and underlining commonalities and differences. WP6 uses hazard models from WP5, and exposure maps and vulnerability curves from WP2.

WP Owner: UNICATT

Participants: CIGEM, CNRS, IRSTEA, LZU

Links: WP6 receives input from WP2 and WP5, and contributes to WP7.

Deliverables

D6.1 / Month 28 – Report on socio-economic vulnerability to landslides and economic risk

D6.2 / Month 35 – Report on strategies/investments to minimize the cost of expected landslides

Milestones

M61 / Month 24 – Critical analysis of landslide impact and vulnerability data

WP7: Outreach, Dissemination & Training

Type of activity: Outreach

Start month: 3

End month: 36

Objectives:

- Inform a wide range of stakeholders about their vulnerability to landslides and the related economic risk, communicate strategies and produce general guidelines.
- Obtain and analyse feedback from relevant stakeholders.
- Inform students and the general public on the vulnerability to landslides and the related economic risk, in a changing climate.
- Disseminate broadly the GRACIA results.

WP7 performs general outreach and dissemination activities, and executes training for stakeholders, students and the general public. Social aspects and gender issues will be considered. Relevant stakeholders include the Environmental Agency of the Veneto Region (Italy), the Autonomous Province of Bozen (Italy), the Adamello Brenta Global Geopark (Italy), the MUSE Science Museum of Trento (Italy), Assicurazioni Generali S.p.A. (Italy), the Département des Hautes-Alpes (France), the Office National des Forêts (France), the Service de Restauration des Terrains en Montagne de l'Office National des Forêts (France), the Haute Provence Global Geopark (France), the Department of Land and Resources Management, Longnan Government (China), the Longnan Geohazards Emergence Response Centre, Gansu Province (China), and the Geohazards Emergence Response Centre, Tianshui Government (China). Other stakeholders may be identified during the project. GRACIA social and physical scientists will communicate the results obtained to the stakeholders, the students and the public, contributing to the effective dissemination of the project results. WP7 executes 4 tasks: (1) fostering of international academic cooperation, including participation in international conferences; (2) involvement of community, including organization of relevant stakeholders to present GRACIA results and to obtain and analyse the feedback; (3) education activities, including summer schools for students; (4) awareness raising activities, including

designing and maintenance of GRACIA website.

WP Owner: UNESCO

Participants: All partners

Links: WP7 uses results from WP2, WP3, WP4, WP5 and WP6.

Deliverables

D7.1 / Month 6 – Website (public section) up and running

D7.2 / Month 6 – Report on the planned outreach, dissemination & training activities

D7.3 / Month 36 – Report on the performed outreach, dissemination & training activities

Milestones

M71 / Month 6 – Plan on the performed outreach, dissemination & training activities

9.3 Interdisciplinarity, transdisciplinarity and complementarity of the team (added value of the consortium)

Evaluating the socio-economic risk posed by landslides in a changing climate is a complex problem that requires multi/inter-disciplinary expertise. GRACIA brings together qualified experts in a wide range of complementary fields, covering climate modelling, landslide hazard modelling, landslide impact and vulnerability assessment, socio-economic studies, dissemination and outreach. GRACIA has the human, technological and information resources needed to complete the proposed research.

A balanced team of natural scientists (physicists, geologists, hydrologists, forest scientists, ecologists), engineers and economists has the necessary expertise to complete the research, and track a record of executing research and publishing results. The consortium consists of 7 partners, including 2 partners in Italy (CNR, UNICATT), 3 in France (CNRS, IRSTEA, UNESCO), and 2 in China (CIGEM, LZU). The geographical range of the partners facilitates the spreading of the project results in Asia, Europe and globally (UNESCO). Three partners are from research centres (CNR, CNRS, IRSTEA), 2 from Universities (LZU, UNICATT), and one is a technical agency (CIGEM). UNESCO brings to the project its global visibility and contacts, and its unique outreach capacity.

CNR (Italy) coordinates the GRACIA partnership, and participates with the Research Institute for Geo-hydrological Protection (IRPI, www.irpi.cnr.it) and the Institute of Atmospheric Sciences and Climate (ISAC, www.isac.cnr.it). IRPI brings to GRACIA long-lasting experience in landslide mapping and time series analysis, landslide hazard, vulnerability and risk modelling, and the design of best practices for landslide mitigation / adaptation / risk reduction. IRPI leads WP5, is responsible for the production of the landslide hazard assessments and the evaluation of their variation under the changing climate, and contribute time series of landslides and thematic data for the Italian study

areas. ISAC leads WP3 bringing to the project relevant experience in the study of complex processes, climate dynamics and variability, numerical modelling of regional and global climate, high-mountain climates, downscaling techniques, and the analysis of climate change impacts. ISAC leads WP3, and provides the climate projections.

UNICATT (Italy) participates with the Department of International Economics, Institutions and Development (DISEIS, www.unicatt.it). UNICATT brings to GRACIA expertise in economic modelling and cost-benefit analysis of risk reduction measures applied to environmental, economic, and social system resilience analysis. UNICATT coordinates WP6, and is responsible for delivering the economic analyses and advice on actions/investments to reduce the cost of future climate-related landslides.

CNRS participates with the Laboratoire de Géographie Physique: Environnements Quaternaires et Actuels of the Institute of Ecology and Environment (LGP, www.lgp.cnrs.fr). CNRS brings to GRACIA expertise in climatology, geomorphology, and sedimentology with a special focus on the response of cryosphere to climate changes and its implication to natural hazards and risk. CNRS leads WP4 on the links between meteorological and environmental conditions and landslides.

IRSTEA participates with the research unit Érosion Torrentielle, Neige et Avalanches (ETNA, www.irstea.fr). IRSTEA brings to GRACIA expertise in geomorphology, physical and numerical modelling of debris flows, field monitoring, and statistics. They also contribute relevant debris flow , thematic and vulnerability information for the French test sites.

UNESCO (www.unesco.org) participates with the Earth Sciences and Geo-Hazards Risk Reduction Natural Science Sector (SC/EES/EGR), which brings to GRACIA outreach expertise and dissemination/education capacity. UNESCO SC/EES/EGR leads WP7, coordinates the dissemination and training efforts, and the relationships with the many stakeholders, collecting and analysing their feedbacks.

CIGEM (www.cgp.gov.cn) contributes to the project with expertise in climate change, hydrology, geomorphology, remote sensing, and risk and vulnerability analysis. CIGEM carries on activities on landslides resilience in the Gansu Province, in close collaboration with the Lanzhou University. CIGEM also provide thematic and landslide information for the Chinese study areas.

LZU (en.lzu.edu.cn) brings to GRACIA expertise on geo-hazards in NW China, including geotechnical engineering and seismic hazard modelling, remote sensing, GIS and computer modelling of slopes, relevant landslide, thematic and remote sensing (SAR) data, and the socio-economic information necessary for economic risk assessment and vulnerability analysis for the Chinese study areas. LZU leads WP2 on the characterization of the project test areas, and brings to the project relevant and unique landslide, thematic, meteorological and vulnerability information for the Chinese test

sites.

Collectively, the GRACIA partners have constructive working relationships with several stakeholders. In Italy, CNR has worked with the Environmental Agency of the Veneto Region and the Autonomous Province of Bozen. In France, CNRS and IRSTEA have worked with the Département des Hautes-Alpes, and the Office National des Forêts. In China, LZU has cooperated with a number of regional governments and agencies, including the Department of Land and Resources Management of the Longnan Government, the Longnan Geohazards Emergence Response Centre of Gansu Province, and the Geohazards Emergence Response Centre of the Tianshui Government. UNESCO assists since 1998, the Global Network of National Geoparks, including Adamello Brenta and Haute Provence global geoparks.

The cross-sectorial approach of GRACIA will offer decision/policy makers a 360° view on landslide hazards and the associated economic risk in a changing climate, contributing to the design and the implementation of effective and sustainable mitigation policies and adaptation strategies, changes in planning and land management, and investments in risk awareness and preparedness.

The GRACIA partnership will interact intensively to develop feasible strategies, spatial scenarios and guidance tools that enable adaptive governance, collaborative decision-making and behavioural changes. Close collaboration will be developed through secondments, exchanges and other mechanisms. The partnership ensures that GRACIA will have an impact on practise, delivering directly to local decision-makers tools, methods and guidelines to effectively design and manage territorial strategies towards more resilient mountain environments.

10. Management Plan (Maximum 17500 characters; includes spaces)
Graphics can be included in this section. Graphics up to half a page count as 200 characters per graphic, over a half page and up to a full page as 400 characters per graphic.

10.1 Project consortium and stakeholders

GRACIA consortium is composed by seven partners (see Table 1).

Table 1. List of participants to GRACIA consortium.

Participant	Short name	Country
Consiglio Nazionale delle Ricerche	CNR	Italy
Catholic University of Milan	UNICATT	Italy
Lanzhou University	LZU	China
Institute of Geo-environment Monitoring of Gansu Province	CIGEM	China
Centre National de la Recherche Scientifique	CNRS	France
Institut national de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture	IRSTEA	France
United Nations Educational, Scientific and Cultural Organization	UNESCO	France

Stakeholders involved in the GRACIA project are:

1. Environmental Agency (ARPA) of the Veneto Region, Italy;
2. Autonomous Province Bozen-Bolzano, Italy;
3. Adamello Brenta Global Geopark (UNESCO world network of Geoparks), Italy;
4. MUSE Science Museum of Trento, Italy;
5. Assicurazioni Generali S.p.A., Italy
6. Département des Hautes-Alpes, France;
7. Service de Restauration des Terrains en Montagne de l'Office National des Forêts, France;
8. Haute Provence Global Geopark (UNESCO world network of Geoparks), France;
9. Department of Land and Resources Management, Longnan Government, China;
10. Longnan Geohazards Emergence Response Centre, Gansu Province, China;
11. Geohazards Emergence Response Centre, Tianshui Government, China.

CNR (Italy) will manage the GRACIA consortium. Project management and coordination activities will be performed in WP1 according to a management structure and decision making procedures designed to ensure that all coordination, scientific, financial, and organizational activities are carried out as planned.
The project management activities will include:

1. Coordination of the interactions within the members of the consortium, and between the consortium and the Belmont Forum;

2. Coordination of the project activities, ensuring that all objectives are achieved and all milestones are issued according to schedule and within budget;
3. Preparing, updating and managing the Consortium Agreement between the partners;
4. Ensuring the dissemination of the project results;
5. Managing the project risks.

10.2 Project meetings and communication

The main vehicle for information exchange within GRACIA will be working papers, consortium meetings, workshops, conference calls and e-mails.

We agreed to have three GRACIA consortium meetings. The first is the kick off meeting to be held in Rome, Italy (first year); the second is the mid-term meeting in Lanzhou, China (second year); and the third is the end-of-term meeting in Paris, France (third year). Workshops with the participation of local stakeholders are foreseen in China, France and Italy along the project duration. Extraordinary meetings will be held when required, with priority to VoIP (Voice over IP) meetings (e.g. skype calls, teleconferences) between members of the consortium.

In addition, GRACIA will participate to a mid-term and to an end-of-term meeting for the Belmont Forum International Opportunities Fund Programme to share progress about the projects.

The GRACIA collaborative website developed at the early stage of the project under WP7 will be used for information exchange between partners to assure easy access to data documents and know-how. The web site will be set up to facilitate the project documents and deliverables repository, as well as dissemination of project contents and achievements.

It will contain tools for internal communication and document management. This platform will allow partners to co-operate in all aspects, technical, and administrative, reducing time and geographical distance.

10.3 Work package relationships (PERT diagram)

The GRACIA PERT diagram is illustrated in Figure 1.

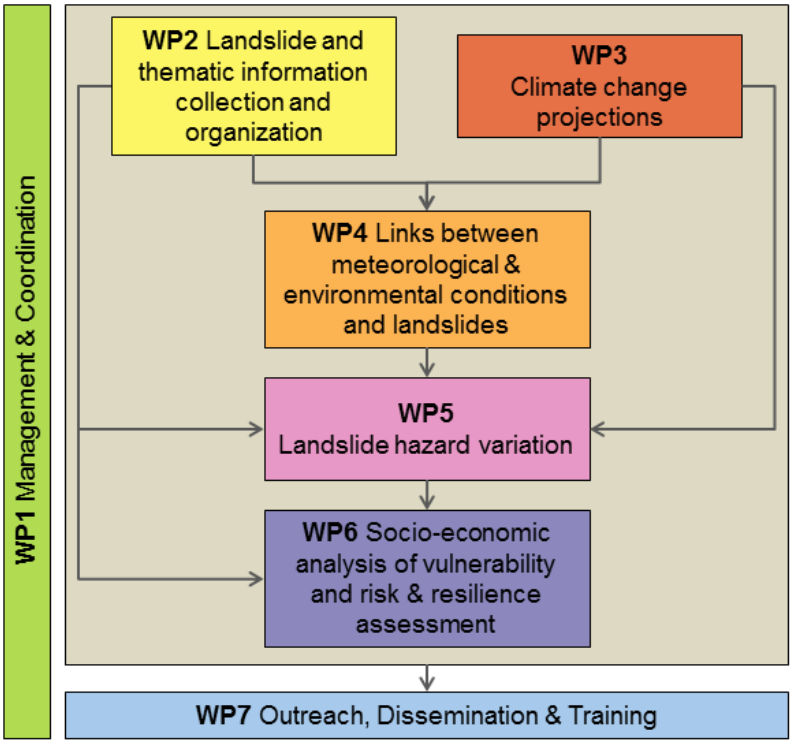

Figure 1. PERT diagram of GRACIA.

- WP1 is connected to all other WPs.
- WP2 provides inputs to WP4, WP5 and WP6, and contributes to WP7.
- WP3 provides input to WP4 and WP5, and contributes to WP7.
- WP4 uses input from WP2 and WP3, provides input to WP5, and contributes to WP7.
- WP5 uses input from WP2, WP3 and WP4, provides input to WP6, and contributes to WP7. WP6 receives input from WP2, and WP5, and contributes to WP7.
- WP7 disseminates results from WP2, WP3, WP4, WP5 and WP6.

10.4 Roles of members

Table 2 lists the GRACIA consortium member participation at each work package (WP).

Table 2. Member participation at each WP.

ID	Participant	WP1	WP2	WP3	WP4	WP5	WP6	WP7
1	CIGEM	✓	✓	✓	✓	✓	✓	✓
2	CNR	✓	✓	✓	✓	✓		✓
3	CNRS	✓			✓	✓	✓	✓
4	IRSTEA	✓	✓		✓	✓	✓	✓
5	LZU	✓	✓	✓	✓	✓	✓	✓
6	UNESCO	✓						✓
7	UNICATT	✓	✓				✓	✓

Below is described the role of each member of the GRACIA consortium.

10.2.1 CNR

CNR will be in charge of management and coordination (WP1) of the project, and will lead activities on climate change projections (WP3) and of landslide hazard variation (WP5). CNR will participate at collecting and organizing landslide and thematic information (WP2); at analyzing the links between landslide occurrence and meteorological and environmental conditions, and their variations (WP4); and at informing a range of stakeholders on the expected changes in landslide risk and the related socio-economic consequences and performing trainings to the selected stakeholders (WP7).

10.2.2 UNICATT

UNICATT will lead activities on socio-economic analysis of vulnerability and risk and resilience assessment (WP6). UNICATT will participate at collecting and organizing landslide and thematic information (WP2); at informing a range of stakeholders on the expected changes in landslide risk and the related socio-economic consequences and performing trainings to the selected end-users (WP7); and will contribute to management and coordination (WP1).

10.2.3 LZU

LZU will lead activities on collecting and organizing landslide and thematic information (WP2). LZU will participate at activities of climate change projections (WP3); at analyzing the links between landslide occurrence and meteorological and environmental conditions, and their variations (WP4); at analyzing landslide hazard variation (WP5); at activities on socio-economic analysis of vulnerability and risk and resilience assessment (WP6); at informing a range of stakeholders on the expected changes in landslide risk and the related socio-economic consequences and performing trainings to the selected stakeholders (WP7) and will contribute to management and coordination (WP1).

10.2.4 CIGEM

CIGEM will participate at collecting and organizing landslide and thematic information (WP2); at activities on climate change projections (WP3); at analyzing the links between landslide occurrence and meteorological and environmental conditions, and their variations (WP4); at analyzing landslide hazard variation (WP5); at activities on socio-economic analysis of vulnerability and risk and resilience assessment (WP6); at informing a range of stakeholders on the expected changes in landslide risk and the related socio-economic consequences and performing trainings to the selected stakeholders (WP7) and will contribute to management and coordination (WP1).

10.2.5 CNRS

CNRS will lead activities on the links between landslide occurrence and meteorological and environmental conditions, and their variations (WP4). CNRS will contribute at analyzing at analyzing landslide hazard variations (WP5); at activities on socio-economic analysis of vulnerability and risk and resilience assessment (WP6); at informing a range of stakeholders on the expected changes in landslide risk and the related socio-economic consequences and performing trainings to the selected stakeholders (WP7) and will contribute to management and coordination (WP1).

10.2.6 IRSTEA

IRSTEA will participate at collecting and organizing landslide and thematic information (WP2); at analyzing the links between landslide occurrence and meteorological and environmental conditions, and their variations (WP4); at analyzing landslide hazard variations (WP5); at activities on socio-economic analysis of vulnerability and risk and resilience assessment (WP6); at informing a range of stakeholders on the expected changes in landslide risk and the related socio-economic consequences and performing trainings to the selected stakeholders (WP7) and will contribute to management and coordination (WP1).

10.2.7 UNESCO

UNESCO will lead activities of informing a range of stakeholders on the expected changes in landslide risk and the related socio-economic consequences and performing trainings to the selected stakeholders (WP7). UNESCO will contribute to management and coordination (WP1).

10.5 Timing of the planned activities (GANTT chart)

The Gantt chart is reported in Figure 2.

GANTT for GRACIA		Start	End	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1	Management & Coordination	1	36			M															M																	
WP2	Landslide and thematic information collection and organization	2	15															M																				
WP3	Climate change projections	2	34																M																			
WP4	Links between meteorological & environmental conditions and landslides	12	24														M																				
WP5	Landslide hazard variation	15	34																									M									
WP6	Socio-economic analysis of vulnerability and risk & resilience assessment	18	35																								M										
WP7	Outreach, Dissemination & Training	3	36						M																													

Figure 2. Gantt chart of GRACIA. **M** indicates a milestone.

WP1: Management & Coordination

Start month: 1 | **End month**: 36

Milestones

M11 / Month 3 – Project Web site (collaborative section)

M12 / Month 18 – Mid-term Project Review

Deliverables

D1.1 / Month 3 – Project Web site (collaborative section) up and running

D1.2 / Month 18 – Mid-term Project Report

D1.3 / Month 36 – End-of-term Project Report

WP2: Landslide and thematic information collection and organization

Start month: 2 | **End month:** 15

Deliverables

D2.1 / Month 4 – Description of project study areas

D2.2 / Month 15 – Geo-database for project study areas

Milestones

M21 / Month 15 – Geo-database for project study areas ready

WP3: Climate change projections

Start month: 2 | **End month:** 34

Deliverables

D3.1 / Month 12 – Archives of selected climate fields from high-resolution EC-Earth simulations

D3.2 / Month 16 – Archive of downscaled precipitation fields for the study areas

D3.3 / Month 34 – Report on WP3 pilot study

Milestones

M31 / Month 16 – Availability of climate datasets and downscaled precipitation archives

WP4: Links between meteorological & environmental conditions and landslides

Start month: 12 | **End month:** 24

Deliverables

D4.1 / Month 24 – Report on catchment and regional modelling and the definition of empirical rainfall thresholds.

D4.2 / Month 24 – Report on DInSAR modelling and landslide activity

Milestones

M41 / Month 14 – Critical analysis of catchment-scale and regional modelling approaches

WP5: Landslide hazard variation

Start month: 15 | **End month:** 34

Deliverables

D5.1 / Month 20 – Report on landslide temporal frequency and magnitude.

D5.2 / Month 26– Report on landslide hazard scenarios

D5.3 / Month 34 – Report on climate-driven variation in landslide hazard

Milestones

M51 / Month 26 – Critical analysis of landslide hazard scenarios

WP6: Socio-economic analysis of vulnerability and risk & resilience assessment

Start month: 18 | **End month:** 35

Deliverables

D6.1 / Month 28 – Report on socio-economic vulnerability to landslides and economic risk.

D6.2 / Month 35 – Report on strategies/investments to minimize the cost of expected landslides.

Milestones

M61 / Month 24 – Critical analysis of landslide impact and vulnerability data

WP7: Outreach, Dissemination & Training

Type of activity: Outreach

Start month: 3

End month: 36

Deliverables

D7.1 / Month 6 – Web site (public section) up and running

D7.2 / Month 36 – Report on the performed outreach, dissemination & training activities

Milestones

M71 / Month 6 – Plan on the performed outreach, dissemination & training activities

10.6 Managing the project risks

Specific risks are assessed, including impacts and suitable solutions. Table 3 lists such risks together with related mitigation measures.

Table 3. Implementation risks and proposed mitigation measures.

WP	Description of risk	Impact of risk	Proposed mitigation measure
1	Difficulties to meet deadlines. Conflicts among partners.	Achieving goals and delivering.	Decision-making mechanisms will be discussed among the partners and decided by the Leading PI
2	Delay in preparing the geo-database.	Delay of research and development activities	Leading PI and WP owner will search for alternative sources of thematic and environmental data for the selected study areas.
3	Delay in providing climate projections.	Delay of research and development activities.	Leading PI and WP owner will search for alternative sources of information
4	Problems with the implementation of the tool to run the model at catchment and regional scale	Delay in the production of the physically based landslide model	WP owner and WP participants will cooperate to obtain alternative models.
5	Delay or failure in preparation of the landslide hazard scenario	Delay in the analysis of landslide hazard variation	WP owner and WP participants will cooperate to obtain the landslide hazard. scenario
6	Delay on quantifying of economic risk and vulnerability curves.	Delay in selection of action to minimize Resilience and select actions/investments to minimize the cost of expected climate-related landslides.	WP owner and WP participants will cooperate to obtain the quantifying of economic risk and vulnerability curves.
7	Difficulties to meet deadlines.	Achieving goals of dissemination and training activity	WP owner and participants will modify the dissemination strategy case by case.

11. Impact, Engagement and dissemination plan (17500 character limit; includes spaces)

11.1 Impact and Engagement

GRACIA responds to the expected impacts of the Belmont Forum Collaborative Research Action on “Mountains as Sentinels of Change” that aims at fostering research on climate, environmental and related societal change in mountain regions, considering both new measurements, recovery of existing data, and the development and use of integrated modelling strategies by adopting a strong trans- and inter-disciplinary approach.

For the purpose, GRACIA proposes to execute innovative research to develop and deploy innovative tools to fill gaps in the current knowledge of climate induced landslide hazards and related economic risk in mountain regions.

Through a set of various communication activities, GRACIA project targets to raise awareness about landslides hazard by reaching beyond the academic community to larger audience, including international stakeholders as well as general public. GRACIA engaged a stakeholders including local authorities, environmental, forestry and planning agencies, an insurance company, as well as a science museum and Global Geoparks. Expression of interest from eleven stakeholders has already been achieved during the organizational stage of the proposal. GRACIA will involve stakeholders to provide feedbacks, and to suggest correction actions, if necessary.

Another aspect of GRACIA, responding to the call objectives, will be to target areas in Europe and Asia, prioritising mountain regions where landslides are likely to occur. GRACIA will focus on mountains in South Gansu Province, China, and on the Italian and French Alps. In particular, GRACIA study areas are located (i) in the Tianshui and Wudu regions in South Gansu, lying in the Western Qinling Mountain range (sometimes called the Szechuan Alps) running east-west direction across China, (ii) in the central and eastern sectors of the Italian Alps and (iii) in the northern and southern French Alps. The study areas are representative of wider regions in the Western Qinling and the Alps, making the results of GRACIA wide ranging.

To ensure effective and widespread dissemination of the project results, a dedicated website will be implemented and regularly updated. The GRACIA website developed at the early stage of the project will be used also for information exchange between partners to assure easy access to data documents and know-how. The website will store the project documents and deliverables, and will contribute to disseminate to the wider scientific and user community project contents and achievements. All new data generated in GRACIA will be made publicly available in the GRACIA website. This will have a positive long-term impact on the use of the data.

GRACIA will also promote results to a larger public through the Global Geopark network. The Global Geopark Network provides a platform of cooperation and exchange between experts and practitioners in geological heritage matters. At present, there are 120 Global Geoparks in 33 countries. Involvement of Global Geoparks in project activities will considerably raise the visibility, practical significance and impact of project results.

11.2 Dissemination Plan

A high level dissemination strategy will be developed to achieve the goals of GRACIA and maximise the impact of the project in Europe and Asia. Under the leadership of UNESCO's Natural Science Sector, Earth Sciences and Geo-Hazards Risk Reduction Section (SC/EES/EGR) a Dissemination Plan will be implemented for the entire project duration, from the beginning of the project, addressing various target groups, each having different needs.

According to the different targets addressed by GRACIA, the Dissemination Plan will be based on the following tools:

1. GRACIA website based activities
2. Specific dissemination activities for relevant stakeholders
3. Education activities
4. Social network services
5. A movie on methodologies of landslide risk assessment
6. Scientific publications and participation to conferences and workshops
7. Final conference

1. GRACIA will implement and maintain a project website. Key project documents, workshop and conference documentation, experience notes and other project products, will be published in the website.

2. Involvement of relevant stakeholders is vital for the success of GRACIA. GRACIA stakeholders will be informed on project results and will provide feedbacks, and suggest correction actions, if necessary.

3. UNESCO's SC/EES/EGR will organize two summer schools for young specialists (at Master level) from project countries on the landslides risk assessment. A dozen young specialists from project countries will be selected by the organizers to participate in a course in the according country. Two practical trainings will be conducted at: (i) Haute Provence Global Geopark, in France; and (ii) a Chinese Global Geopark (TBC). A week long training will include theoretical and practical sessions on landslide hazard conducted by GRACIA consortium experts. The logistics of trainings will be organized by UNESCO.

4. GRACIA will produce content for social network related pages of the project (Facebook, Twitter, LinkedIn, Instagram) with up to date and regular information.

5. To promote GRACIA results to a wider scientific and user community, UNESCO will create a movie on methodologies of landslide risk assessment in the frame of GRACIA project. The movie will be disseminated via the GRACIA website.

6. GRACIA activities will be further disseminated through publication of project research outcomes in highly rated international peer reviewed journals and conference proceedings. Examples of appropriate journals include:

- Earth Surface Processes and Landforms
- Geomorphology
- Landslides
- Natural Hazards
- Journal of Hydrometeorology
- Climatic Change
- Journal of Climate
- Journal of Geophysical Research: Atmospheres
- Journal of Environmental Planning and Management
- The Journal of Environment & Development
- Ecological Economics
- International Review of Applied Economics

Partners of the project will also present results at thematic conferences and workshops. A preliminary list of thematic conferences is reported in Table 1.

Table 1. Preliminary list of thematic conferences proposed for the dissemination of GRACIA results.

Conference	Description	Preliminary date
European Geosciences Union (EGU) General Assembly	The annual EGU General Assembly is the largest and most prominent European geosciences event. It attracts over 11,000 scientists from all over the world, of which more than a quarter are students. The meeting's sessions, typically over 500, cover a wide range of topics, including geomorphology, hydrology, natural hazards and climate. General Assemblies have around 4,500 oral presentations and over 9,000 posters.	Vienna, Austria April 23 – 28, **2017** Vienna, Austria April 8 – 13, **2018**
4th World Landslide Forum	The World Landslide Forum brings together government officials, scholars, international research and development communities, NGO representatives and numerous	Ljubljana, Slovenia May 29 – June 2, **2017**

	segments of the private industries to present their latest results on geo-hazard mitigation, especially, on landslide reduction and to exchange ideas on how to improve geo-environment safety around the world.	
ICECC: 20th International Conference on Environment and Climate Change	The 20th ICECC aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Environment and Climate Change. It also provides the premier interdisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns, practical challenges encountered and the solutions adopted in the field of Environment and Climate Change.	Singapore, SG March 29 – 30, **2018**

7. A final conference of GRACIA, with the participation of stakeholders, will be held in Paris. The conference will focus on the results of the project.

Budget for Brunetti, Maria Teresa (1941)

Brunetti, Maria Teresa (ID: 1941)	Year 1	Year 2	Year 3	PI Totals
Time (in months)	19.3	3.3	3.3	25.9 Mo
Salaries	32	14	14	60 K€
Travel	6	14	14	34 K€
Overheads	16	7	7	30 K€
Consumables	0	0	0	0 K€
Facilities and Equipment	0	0	0	0 K€
Fellowships	26	0	0	26 K€
Other (inc. sub-contract)	0	0	0	0 K€
Total Requested Funding	80	35	35	150 K€
External Funding / Support	0	0	0	0 K€

Budget for Zoboli, Roberto (1991)

Brunetti, Maria Teresa (ID: 1941)	Year 1	Year 2	Year 3	PI Totals
Time (in months)	0.3	6.7	6.5	13.5 Mo
Salaries	2	4	3	9 K€
Travel	1	4	2	7 K€
Overheads	1	5	4	10 K€
Consumables	0	0	0	0 K€
Facilities and Equipment	0	0	0	0 K€
Fellowships	0	12	12	24 K€
Other (inc. sub-contract)	0	0	0	0 K€
Total Requested Funding	4	25	21	50 K€
External Funding / Support	0	0	0	0 K€

Budget for Yue, Dongxia (2591)

Brunetti, Maria Teresa (ID: 1941)	Year 1	Year 2	Year 3	PI Totals
Time (in months)	44.0	44.0	44.0	132.0 Mo
Salaries	0	0	0	0 K€
Travel	37	19	19	75 K€
Overheads	14	7	7	28 K€
Consumables	11	5	5	21 K€
Facilities and Equipment	4	2	2	8 K€
Fellowships	15	8	8	31 K€
Other (inc. sub-contract)	1	2	2	5 K€
Total Requested Funding	82	43	43	168 K€
External Funding / Support	0	0	0	0 K€

Budget for Li, Zhiheng (2614)

Brunetti, Maria Teresa (ID: 1941)	Year 1	Year 2	Year 3	PI Totals
Time (in months)	35.0	35.0	35.0	105.0 Mo
Salaries	0	0	0	0 K€
Travel	25	12	12	49 K€
Overheads	9	5	5	19 K€
Consumables	7	4	4	15 K€
Facilities and Equipment	3	1	1	5 K€
Fellowships	7	7	7	21 K€
Other (inc. sub-contract)	1	1	1	3 K€
Total Requested Funding	52	30	30	112 K€

External Funding / Support	0	0	0	0 K€

Budget for Jomelli, Vincent (2631)

Brunetti, Maria Teresa (ID: 1941)	Year 1	Year 2	Year 3	PI Totals
Time (in months)	10.0	22.0	23.0	55.0 Mo
Salaries	0	0	0	0 K€
Travel	11	11	8	30 K€
Overheads	2	5	5	12 K€
Consumables	8	3	2	13 K€
Facilities and Equipment	0	0	0	0 K€
Fellowships	0	46	46	92 K€
Other (inc. sub-contract)	0	0	0	0 K€
Total Requested Funding	21	65	61	147 K€
External Funding / Support	0	0	0	0 K€

Budget for Liébault, Frédéric (2633)

Brunetti, Maria Teresa (ID: 1941)	Year 1	Year 2	Year 3	PI Totals
Time (in months)	9.0	21.0	10.0	40.0 Mo
Salaries	0	0	0	0 K€
Travel	7	12	13	32 K€
Overheads	1	5	2	8 K€
Consumables	5	5	5	15 K€
Facilities and Equipment	0	0	0	0 K€
Fellowships	0	46	0	46 K€
Other (inc. sub-contract)	0	0	0	0 K€
Total Requested Funding	13	68	20	101 K€
External Funding / Support	0	0	0	0 K€

Budget for Makarigakis, Alexandros (2636)

Brunetti, Maria Teresa (ID: 1941)	Year 1	Year 2	Year 3	PI Totals
Time (in months)	12.0	12.0	12.0	36.0 Mo
Salaries	16	15	9	40 K€
Travel	0	0	0	0 K€
Overheads	4	4	3	11 K€
Consumables	0	0	0	0 K€
Facilities and Equipment	0	0	0	0 K€
Fellowships	0	0	0	0 K€
Other (inc. sub-contract)	13	13	13	39 K€
Total Requested Funding	33	32	25	90 K€
External Funding / Support	0	0	0	0 K€

13. External Funding from other sources (including current and pending support)

No external funding.

14. Funding justification

Consiglio Nazionale delle Ricerche (CNR)

CNR will dedicate 25.9 months to GRACIA: 13.9 of permanent staff and 12 of one fellowship.

Salaries of permanent staff amount to 60 k€ and a fellowship for one year amounts to 26 k€.

Total travel expenses are 34 k€. They are estimated considering the participation to the following activities.

First year, 6 k€:

- A GRACIA kick off meeting in Rome (Italy) for 8 people.
- A field survey (1 week) in Lanzhou (China) for 1 person.

Second year, 14 k€:

- A GRACIA consortium meeting in Lanzhou (China) for 4 people.
- A workshop with Italian stakeholders in Italy for 8 people.
- Attendance to International Conferences for 2 people.

Third year, 14 k€:

- A workshop with Italian stakeholders in Italy for 8 people.
- Attendance to International Conferences for 2 people.
- A GRACIA consortium meeting in Paris (France) with the participation of Italian stakeholders for 11 people.

According to Italian national rules, overheads amount to 30 k€ (20% of the CNR budget).

Catholic University of Milan (UNICATT)

UNICATT will dedicate 13.5 months to GRACIA: 1.5 of permanent staff and 12 of a fellowship for one year.

Salaries of permanent staff amount to 9 k€ and a fellowship amounts to 24 k€.

Total travel expenses are 7 k€. They are estimated considering the participation to the following activities.

First year, 1 k€:

- A GRACIA kick off meeting in Rome (Italy) for 2 people.

Second year, 4 k€:

- A GRACIA consortium meeting in Lanzhou (China) for 2 person.
- A workshop with Italian stakeholders in Italy for 2 people.

Third year, 2 k€:

- A workshop with Italian stakeholders in Italy for 2 people.
- A GRACIA consortium meeting in Paris (France) with the participation of Italian stakeholders for 2 people.

According to Italian national rules, overheads amount to 10 k€ (20% of the UNICATT budget).

Lanzhou University (LZU)

LZU will dedicate 132 months to GRACIA: 84 months of permanent staff and 48 months of 4 post-doc fellowship for the three years of the project and 10 postgraduate students will be involved (31 k€).

Total travel expenses are 75 k€. They are estimated considering the participation to the following activities.

First year, 37 k€:

- A GRACIA kick off meeting in Rome (Italy) for 4 people.
- Field surveys in the Tianshui and Wudu regions in South Gansu.
- A workshop with Chinese stakeholders in China.
- Attendance to National and International Conferences for 4 person.
- International Cooperation and Exchange.

Second year, 19 k€:

- A GRACIA consortium meeting in Lanzhou (China).
- Field surveys in the Tianshui and Wudu regions in South Gansu.
- Attendance to National and International Conferences for 4 person.
- International Cooperation and Exchange.

Third year, 19 k€:

- Field surveys in the Tianshui and Wudu regions in South Gansu.
- Attendance to International Conferences for 4 person.
- A GRACIA consortium meeting in Paris (France) for 4 people.

Consumables: 21 k€ (computers, software licenses, satellite images).

Facilities and equipment: 8 k€ (horizontal/multipoint displacement, earth pressure, piezometer, groundwater level, soil moisture, tensiometers).

Other (including sub-contract): 5 k€ (publishing/literature/ info dissemination/intellectual property rights, consultation and advisory).

According to China national rules, overheads amount to 28 k€ (17% of the LZU budget).

Institute of Geo-environment Monitoring of Gansu Province (CIGEM)

CIGEM will dedicate 105 months to GRACIA: 69 months of permanent staff and 36 months of one post-doc fellowship for the three years of the project and 2 postgraduate students will be involved (21 k€).

Total travel expenses are 49 k€. They are estimated considering the participation to the following activities.

First year, 25 k€:

- A GRACIA kick off meeting in Rome (Italy) for 2 people.
- Field surveys in the Tianshui and Wudu regions in South Gansu.
- Attendance to National and International Conferences for 3 person.
- International Cooperation and Exchange.

Second year, 12 k€:

- A GRACIA consortium meeting in Lanzhou (China).
- Field surveys in the Tianshui and Wudu regions in South Gansu.
- Attendance to National and International Conferences for 3 person.
- International Cooperation and Exchange.

Third year, 12 k€:

- Field surveys in the Tianshui and Wudu regions in South Gansu.
- Attendance to National and International Conferences for 3 person.
- A GRACIA consortium meeting in Paris (France) for 3 people.

Consumables: 15 k€ (computers, software licenses, satellite images).

Facilities and equipment: 5 k€ (horizontal/multipoint displacement, earth pressure, piezometer, groundwater level, soil moisture, tensiometers).

Other (including sub-contract): 3 k€ (publishing/literature/ info dissemination/intellectual property rights, consultation and advisory).

According to China national rules, overheads amount to 19 k€ (17% of the CIGEM budget).

Centre National de la Recherche Scientifique (CNRS)

CNRS will dedicate 55 months to GRACIA: 31 months of permanent staff and 24 months of post-doc fellowship (92 k€) for the last two years of the project.

Total travel expenses are 30 k€. They are estimated considering the participation to the following activities.

First year, 11 k€:

- A GRACIA kick off meeting in Rome (Italy) for 3 people.
- A field survey (1 week) in the French Alps for 1 person.

Second year, 11 k€:

- A GRACIA consortium meeting in Lanzhou (China) for 2 people.
- A field survey (1 week) in the French Alps for 1 person.
- Attendance to International Conferences for 1 person.

Third year, 8 k€:

- Attendance to International Conferences for 2 people.
- A GRACIA consortium meeting in Paris (France) for 5 people.

Consumables: 13 k€ (computers, software licenses, cosmogenic dating of debris-flow and regional meteorological data).

According to France national rules, overheads amount to 12 k€ (8% of the CNRS budget).

Institut national de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture (IRSTEA)

IRSTEA will dedicate 40 months to GRACIA: 28 months of permanent staff and 12 months of post-doc fellowship (46 k€) for the second year of the project.

Total travel expenses are 32 k€. They are estimated considering the participation to the following activities.

First year, 7 k€:

- A GRACIA kick off meeting in Rome (Italy) for 3 people.

Second year, 12 k€:

- A GRACIA consortium meeting in Lanzhou (China) for 4 people.
- A workshop with French stakeholders in France for about 30 people.
- Attendance to International Conferences for 3 people.

Third year, 13 k€:

- Attendance to International Conferences for 2 people.
- A GRACIA consortium meeting in Paris (France) with the participation of French stakeholders for 6 people.

Consumables: 15 k€ (computers, maintenance of debris-flow monitoring stations).

According to France national rules, overheads amount to 8 k€ (8% of the Irstea budget).

UNESCO, Section on Earth Sciences and Geo-Hazards Risk Reduction (SC/EES)

The Section on Earth Sciences and Geo-Hazards Risk Reduction (SC/EES) team will dedicate 36 months to GRACIA.

Salaries of temporary staff amount to 39 k€, including travel expenses of 3 k€.

Total Other (including sub-contract) are 39 k€. They are estimated considering the participation to the following main activities.

First year, 13 k€:

- Organization of 2 summer schools (in France/Italy and China) for students at Global Geoparks.

Second year, 13 k€:

- Performing the video on landslide risk assessment methods with case studies at Global Geoparks.

Third year, 13 k€:

- Organization of a final workshop in UNESCO HQs in Paris.

According to UNESCO rules, overheads amount to 11 k€ (13% of the UNESCO budget).

Investigator

ID	First Name	Family Name	Institution	City	Country	Agency	Role in Consortium
1941	Maria Teresa	Brunetti	Consiglio Nazionale delle Ricerche (CNR)	Perugia	Italy	CNR-DTA (Italy)	Lead PI
1991	Roberto	Zoboli	Catholic University of Milan	Milan	Italy	CNR-DTA (Italy)	Partner PI
2591	Dongxia	Yue	Lanzhou University	Lanzhou	P.R.China	NSFC (China)	Partner PI
2614	Zhiheng	Li	Institute of Geo-environment Monitoring of Gansu Province	Lanzhou	P.R.China	NSFC (China)	Partner PI
2631	Vincent	Jomelli	CNRS Université Paris 1 Pantheon Sorbonne	Meudon	France	ANR (France)	Partner PI
2633	Frédéric	Liébault	Irstea Grenoble	Saint-Martin-d'Hères	France	ANR (France)	Partner PI
2636	Alexandros	Makarigakis	United Nations Educational, Scientific and Cultural Organization, Unesco	Paris	France	ANR (France)	Partner PI

Investigator 1941: Brunetti, Maria Teresa

Investigator Information (Inv. ID: 1941)

Family Name: Brunetti
First Name: Maria Teresa
Funding Agency: CNR-DTA (Italy)
Role: Lead PI

Organization / University / Research Institute (Inv. ID: 1941)

Org. Name: Consiglio Nazionale delle Ricerche (CNR)
Org. Address: Piazzale Aldo Moro, 7, 00185 Roma, Italy

Org. Website: http://www.cnr.it
Department: Istituto di Ricerca per la Protezione Idrogeologica
Area of Research: Earth Sciences
Position: Research scientist, permanent staff

Contact Information (Inv. ID: 1941)

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Cedex/State/Province: Perugia
Country: Italy
Postal/Zip code: 06128

Website: http://www.irpi.cnr.it/

Additional Details (Inv. ID: 1941)

Highest Academic Qualification: PhD in Earth Science and Geotechnologies

Previous Experience:
Research scientist with the Italian National Research Council (CNR) at the Research Institute for Geo-Hydrological Protection (IRPI) in Perugia. She graduated in Physics from the University of Perugia (1991). Before 2007, she worked in the fields of astrophysics and

particle physics in international collaborations with NASA (National Aeronautics and Space Administration), ESA (European Space Agency), and CERN (Conseil Européen pour la Recherche Nucléaire). From 2008 to 2011 she was a research fellow at the CNR IRPI in Perugia. In 2014, she received a PhD in Earth Sciences and Geotechnologies from the University of Perugia with the thesis "Statistics of terrestrial and extraterrestrial landslides". At present, she works in the terrestrial and planetary geomorphology, and in the natural hazard fields. Her main research topics are: (1) definition and validation of empirical rainfall thresholds for the possible initiation of landslides, (2) reconstruction of rainfall events, and of rainfall conditions responsible for landslide occurrence, (3) landslide early warning systems, (4) detection and mapping of landslides on Mars, the Moon, and Mercury, and (5) comparison between terrestrial and extraterrestrial landslide size (area and volume) distributions. She is co-author of more than 40 papers in international journals, and of 4 contributions in books.

Publications:

S.L.Gariano, M.T.Brunetti, G.Iovine, M.Melillo, S.Peruccacci, O.Terranova, C.Vennari, F.Guzzetti, (2015). Calibration and validation of rainfall thresholds for shallow landslide forecasting in Sicily, southern Italy. Geomorphology, 228: 653-665.

M.T.Brunetti, F.Guzzetti, M.Cardinali, F.Fiorucci, M.Santangelo, P.Mancinelli, G.Komatsu, L.Borselli, (2014). Analysis of a new geomorphological inventory of landslides in Valles Marineris, Mars. Earth and Planetary Science Letters, 405: 156-168.

S.Peruccacci, M.T.Brunetti, S.Luciani, C.Vennari, F.Guzzetti, (2012). Lithological and seasonal control on rainfall thresholds for the possible initiation of landslides in central Italy. Geomorphology, 139-140: 79-90.

M.T.Brunetti, S.Peruccacci, M.Rossi, S.Luciani, D.Valigi, F.Guzzetti, (2010). Rainfall thresholds for the possible occurrence of landslides in Italy. Natural Hazards and Earth System Sciences, 10: 447-458.

M.T.Brunetti, F.Guzzetti, M.Rossi. Probability distributions of landslide volumes, (2009). Nonlinear Processes in Geophysics, 16: 179-188.

Investigator 1991: Zoboli, Roberto

Investigator Information (Inv. ID: 1991)

Family Name: Zoboli
First Name: Roberto
Funding Agency: CNR-DTA (Italy)
Role: Partner PI

Organization / University / Research Institute (Inv. ID: 1991)

Org. Name: Catholic University of Milan
Org. Address: Largo Gemelli 1

Org. Website: www.unicatt.it
Department: DISEIS
Area of Research: Environmental economics and policy
Position: Professor of Economic Policy

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Website: www.unicatt.it

Additional Details (Inv. ID: 1991)

Highest Academic Qualification: Full professor

Previous Experience:

Roberto Zoboli is Full Professor of Economic Policy at Catholic University. His main fields of research are environmental and resource economics, economics of innovation, environmental policy analysis. He worked in private research institutions (NOMISMA S.p.A. 1983-1990; Economic Studies Department of Montedison S.p.A. 1991-1993; Cariplo Foundation for Scientific Research 1994) before joining the Italian National Research Council as Research Director (1995-2007). At the CNR he has been director of institute in 1999-2001 and he is presently Associate Researcher of IRCrES-CNR, Milan Unit. At the Catholic University he lectures on Economic Policies for Resources and the Environment. He has the scientific responsibility of European and national research projects, including the partnership in the international consortium ETC/WNGE (European Topic Center on Waste and Materials in the Green Economy, 2014-2018) for the EEA (European Environment Agency); the contribution of IRCrES to the FP7 project ?EMInInn: Environmental Macro Indicators of Innovation'. He is currently leading the Catholic University's participation to the H2020 project ?green.eu' (2015-2018) and the joint CNR-INGV-SEEDS project ?The economic evaluation of natural disasters in Italy' (2014-2016).

Publications:

Marin G., Marzucchi A., Zoboli R. (2015), SMEs and barriers to Eco-innovation in the EU: exploring different firm profiles, Journal of Evolutionary Economics, online April 2015, DOI 10.1007/s00191-015-0407-7.

Cainelli G., Mazzanti M., Zoboli R. (2013) Environmental performance, manufacturing sectors and firm growth: structural factors and dynamic relationships, Environmental Economics and Policy Studies, 15:367?387.

Mazzanti M, Zoboli R. (2013), Resource taxation and regional planning: Revenue recycling for local sustainability in the aggregate sector, Journal of Environmental Planning and Management, 56(6): 893-916.

Cainelli G., Mazzanti M., Zoboli R. (2011), Environmental innovations, complementarity and local/global cooperation: evidence from North-East Italian industry, Int. J. Technology, Policy and Management, 11(3/4), 328-368.

Cainelli G., Mazzanti M., Zoboli R. (2011), Environmentally-oriented innovative strategies and firm performance in services. Micro-evidence from Italy, International Review of Applied Economics, 25(1), 61-85.

Investigator 2591: Yue, Dongxia

Investigator Information (Inv. ID: 2591)

Family Name: Yue
First Name: Dongxia
Funding Agency: NSFC (China)
Role: Partner PI

Organization / University / Research Institute (Inv. ID: 2591)

Org. Name: Lanzhou University
Org. Address: 222 South Tianshui Road, Lanzhou, 730000, Gansu Province, China

Org. Website: http://geoscience.lzu.edu.cn/
Department: College of Earth and Environmental Sciences
Area of Research: Ecosystem and Geohazards
Position: Professor and Deputy Dean of the College of Earth and Environmental Sciences, Lanzhou University

Contact Information (Inv. ID: 2591)

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Postal/Zip code: 730000

Website: http://wel.lzu.edu.cn/fh/07/ucnxcxu.htm

Additional Details (Inv. ID: 2591)

Highest Academic Qualification: Ph.D. in Ecology

Previous Experience:
She has led several research projects funded by the Ministry of Sciences and Technology of China(MSTC), the National Natural Science Foundation of China (NSFC) and the Department of Sciences and Technology of Gansu Provincial Government on geohazards and ecosystem security in Gansu Province, China, including " Monitoring and Early-warning Systems for Geohazards in Southern Gansu Based on Integration of PS-InSAR and Internet of Things " by MSTC and " Spatiotemporal Evaluation of Biological Capacity of Shiyang River Basin, Gansu" by NSFC. Following achievements have been reached: 1) inventively identified moving landslides and potential unstable slopes in South Gansu by using Ps-InSAR techniques; 2) present the spatiotemporal analysis method of biocapacity with high resolution and dynamic NPP evaluated in Shiyang River Basin, Gansu; 3) quantitatively estimated the biocapacity of Northwestern China based on RS and GIS; 4) analyzed the spatial pattern of geohazards and human activities in Bailong River Basin, South Gansu; 4) assessed the sustainable development state based on a comparison of the?pre- and post- disaster biocapacity and ecological footprint in Zhouqu County, China; 5) present the spatial-temporal pattern of the vulnerability to geohazards in Bailong River Basin

Publications:
Zhang,J.J., Yue,D.X.*, Wang,Y.Q., Du, J., Guo, J.J., Ma, J.H., Meng, X.M., 2012. Spatial Pattern Analysis of Geohazards and Human Activities in Bailong River Basin?Advanced Materials Research, 518-523?5822-5829.

Yue, D.X.,Guo,J.J,Hui,C.,2013. Scale dependency of biocapacity and the fallacy of unsustainable development, Journal of Environmental Management 126:13-19.

Yue, D.X., Zhang, S., Zhao, F.M.,X.Z., MO, F., Zhang, J., Wang, R., Wang, G.R., Hickey, G.M., Wang, H.L., Wang, Y.Q., and Xiong,Y.C., 2012. Policy Strategy for Ecosystem Conservation of Minqin Oasis of Northwest China. Pakistan Journal of Botany, 44(2): 51-57.

Yue, D.X., Xu, X.F., Hui, C., Xiong, Y.C., Han, X.M., Ma, J.H., 2011. Biocapacity supply and demand in Northwestern China: a spatial appraisal of sustainability. Ecological Economics. 70 (5):988?994.

Yue, D.X., Zhang,J.J., Guo, J.J., Du,J., Ma, J.H., Meng,X.M., 2012. An Analysis of Sustainable Development Based on a Comparison of The Pre- and Post- disaster Biocapacity and Ecological Footprint in Zhouqu County, China, Advanced Materials Research, 361-363 : 663-670.

Investigator 2614: Li, Zhiheng

Investigator Information (Inv. ID: 2614)

Family Name: Li
First Name: Zhiheng
Funding Agency: NSFC (China)
Role: Partner PI

Organization / University / Research Institute (Inv. ID: 2614)

Org. Name: Institute of Geo-environment Monitoring of Gansu Province
Org. Address: 120 Jianlanxincun?Qilihe District, Lanzhou, 730050, Gansu Province, China

Org. Website: http://www.gsigem.com/
Department:
Area of Research: Hydrology and Geohazards
Position: Director

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Website: http://www.gsigem.com/

Additional Details (Inv. ID: 2614)

Highest Academic Qualification: Ph.D in Hydrology and Engineering Geology

Previous Experience:
Engaged in professional research on water conservancy and geohazards prevention for 36 years. Led more than ten national key projects on geohazards prevention, monitoring and warning. Chaired and completed the missions of more than 20 times dealing with geo-disaster emergence response and rescue, which had successfully saved more than 2300 people and properties worth over 50 million yuan. Directed almost all Gansu provincial government funded projects on geohazards prevention and geo-environment protection, and achieved remarkable success in local economic, ecological and environmental conservation. The projects include "geo-environmental protection for mine fields in Gansu Province", "geo-environment survey and assessment in Gansu Province", "study of landslide hazards in Yongjing County, Gansu". Received five awards from the Ministry of Sciences and technology of China in the last five years.

Publications:
Z.H. Li, Y.J. Zhang and S.Y. Liang, 2014. Urban Geohazards and Human Engineering Activities in Lanzhou City. Journal of Lanzhou University (Natural Sciences), Vol. 50: 588-593.

Z.H. Li, L.F. Zhu, X.D. Hu, G.Q. Yu, G.Y. Jia and R.D. Li, 2011. Characteristics of Zhouqu Debris Flows. Northwest Geology.

M.S. Zhang, Z.H. Li, P.P Sun, C. Zhao, X.D. Hu and Q.M. Zeng, 2011. Characteristics of Sanyanyu Debris Flow and Strategies of Risk Reduction. Northwest Geology.

Z.H. Li, 2003. Relationship Between Loess Landslides and Ground Water Infiltration-A Case Study of Gaolanshan Landslides, Lanzhou. Journal of Gansu Sciences.

Z.H. Li and K.F. Zeng, 2000. Multiple Mitigation Strategies and Effects Analysis for Guanjiagou Debris Flow, Wen County, Gansu Province. Geo-science Information.

Investigator 2631: Jomelli, Vincent

Investigator Information (Inv. ID: 2631)

Family Name: Jomelli
First Name: Vincent
Funding Agency: ANR (France)
Role: Partner PI

Organization / University / Research Institute (Inv. ID: 2631)

Org. Name: CNRS Université Paris 1 Pantheon Sorbonne
Org. Address: 1 place A. Briand 92195 Meudon

Org. Website: http://www.dr5.cnrs.fr/
Department: Geography
Area of Research: Cryosphere, Mountain hazards, Risks
Position: Senior scientist, permanent staff

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Additional Details (Inv. ID: 2631)

Highest Academic Qualification: PhD in Physical Geography and Geomorphology

Previous Experience:
Born February 4, 1968, PhD in Physical Geography and Geomorphology from the University Paris 7, Vincent Jomelli is senior scientist at LGP-CNRS (UMR 8591) with a special focus on the response of cryosphere to climate changes and its implication to natural hazards and risk. He has been recently involved in several research projects relative to snow avalanches and debris flow dynamics in the French Alps (FP7 Acqwa, Arnica ANR Mopera, Imfrex), which gave the opportunity to develop a regional assessment of mountain hazards in the French Alps and related risks. Classical methodological approaches are based on stochastic modeling, field campaigns, GIS and remote sensing analysis. Key words: snow avalanche, debris flows, vulnerability assessment, field monitoring.

Publications:
Utasse, M., Jomelli, V., Leone, F., Grancher, D. (2015). Institutional and functional vulnerability assessment related to impacts of debris flows on roads in the French Alps. (Under review).

Jomelli, V., Pavlova, I., Eckert, N., Grancher, D., Brunstein. (2015). A new hierarchical Bayesian approach to analyse environmental and climatic influences on debris flow occurrence. (Accepted for publication)

Pavlova, I., Jomelli, V., Grancher, D., Brunstein, D., Martin, E. Déqué, M., (2014). Debris Flow activity related to current climate conditions in the French Alps: a regional investigation based on Safran reanalyzed data. Geomorphology, 219, 248-259.

Jomelli, V., Pavlova, I., Utasse, M., Chenet, M., Grancher, D., Brunstein, D., Leone, F. (2011). Are debris floods and debris avalanches responding univocally to recent climatic change: A case study in the French Alps. In: Climate change 1, Intech Blanco J.A. Kheradmand, H. (Eds) ISBN 978-953-307-419-.

Jomelli, V., Déqué, M., Brunstein, D., Grancher, D. (2009). Impacts of future climate change (2070-2100) on debris flows occurrence: A case study in the Massif des Ecrins (French Alps). Climatic Change DOI 10.1007/s10584-009-9616-0.

Investigator 2633: Liébault, Frédéric

Investigator Information (Inv. ID: 2633)

Family Name: Liébault
First Name: Frédéric
Funding Agency: ANR (France)
Role: Partner PI

Organization / University / Research Institute (Inv. ID: 2633)

Org. Name: Irstea Grenoble
Org. Address: Domaine Universitaire, 2 rue de la Papeterie, 38402 Saint-Martin-d'Hères, France

Org. Website: www.irstea.fr
Department: ETNA research unit (snow avalanches and torrent control)
Area of Research: Mountain geomorphology, debris flows, sediment transport, mountain streams
Position: Research scientist, permanent staff

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Postal/Zip code: 38402

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Additional Details (Inv. ID: 2633)

Highest Academic Qualification: PhD in Physical Geography and Geomorphology

Previous Experience:
Born January 25, 1973, PhD in Physical Geography and Geomorphology from the University of Lyon, Frédéric Liébault is research scientist at Irstea Grenoble (UR ETNA) with a special focus on the understanding of earth surface processes and landforms in mountainous terrains and applications to natural hazards and sediment management in fluvial systems. He has been recently involved in several research projects relative to debris flow dynamics in the French Alps (Alpine Space Paramount and SedAlp, Interreg Alcotra Risknat, CPER-PACA Rhytmme, ANR Risknat Gestrans), which gave the opportunity to deploy the first debris flow monitoring stations in France. Important works were also dedicated to the regional detection of debris flow prone torrents, based on remote sensing and GIS analysis, in collaboration with practitioners of natural hazards management in the French Alps. Coauthors of 28 peer-reviewed papers in scientific journals, and 6 chapters in edited books. Co-supervisor of 4 PhD students (Joshua Theule, Mélanie Bertrand, Sandrine Lallias-Tacon, Coraline Bel).

Publications:
Theule, J.I., Liébault, F., Laigle, D., Loye, A., Jaboyedoff, M., 2015. Channel scour and fill by debris flows and bedload transport. Geomorphology 243, 92-105.

Navratil O, Liébault F, Bellot H, Travaglini E, Theule J, Chambon G, Laigle D. 2013. High-frequency monitoring of debris-flow propagation along the Réal Torrent, Southern French Prealps. Geomorphology 201: 157-171.

Liébault F, Lallias-Tacon S, Cassel M, Talaska N. 2013. Long profile responses of alpine braided rivers in SE France. River Research and Applications 29(10): 1253-1266. 10.1002/rra.2615.

Bertrand, M., Liébault, F., Piégay, H. 2013. Debris-flow susceptibility of upland catchments. Natural Hazards 67(2): 497-511.

Liébault, F., Bellot, H., Chapuis, M., Klotz, S., Deschâtres, M., 2012. Bedload tracing in a high-sediment-load mountain stream. Earth Surface Processes and Landforms 37(4): 385-399.

Investigator 2636: Makarigakis, Alexandros

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Additional Details (Inv. ID: 2636)

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Previous Experience:

Total of more than 18 years of progressively responsible experience in the field of environmental sciences, 12 of which on the international platform on issues of development in developing and developed countries with focus on natural resources management (water and environment). Experience includes representing UNESCO's Natural Science sector at Windhoek Cluster Office, at Addis Ababa Liaison Office and Chief of the Cross Cutting Thematic Unit on Disaster Risk Reduction (DRR).
The purposes of UNESCO in the field of disaster risk reduction are to: promote a better understanding of the distribution in time and space of natural hazards and of their intensity; strengthen environmental protection for the prevention of natural disasters; enhance preparedness and public awareness through education and training in communication and information; foster post-disaster investigation, recovery and rehabilitation; and promote studies on the social perception of risks, etc.
In furthering an interdisciplinary approach to natural hazards, UNESCO aims to support national and regional efforts to develop capacities for the reduction of risks arising from natural disasters with a focus on policy advice, knowledge sharing, awareness-raising, and education for disaster preparedness, paying particular attention to integrating gender and youth perspectives.

Publications:
Disaster preparendess and mitigation. UNESCO's role (2007). Ed.: James, B. UNESCO PRESS, Paris.

Sassa, K., Briceño, S., He, B.,Rouhban, B.,McSaveney, M. (2013). Landslides: global risk preparedness. Heidelberg, Germany, Springer, 385 p.

Sassa, K., Canuti, P., Yueping Y. (2014). Landslide science for a safer geoenvironment, vol. 1: The International Programme on Landslides (IPL). Cham, Springer, 2014, 493 p.

Gilbrich, W.H., Struckmeier, W.F., Richts, A., Duscher, K., Günther, A., Philipp, U., Winter, P. (2014). Fifty years of hydro(geo)logical mapping activities under the auspices of UNESCO, CGWM, IAH and BGR. UNESCO PRESS, Paris, 79 p.

Messerli, B., Ives, J. D. (1997). Mountains of the world: a global priority. New York, Parthenon Publishing, 495 p.

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1979	Luca	Mortarini	Research Institute of Atmospheric Sciences and Climate-CNR	Italy	Senior Personnel	Brunetti, Maria Teresa(1941)
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1982	Paola	Salvati	Research Institute for geo-hydrological protection-CNR	Italy	Senior Personnel	Brunetti, Maria Teresa(1941)
1986	Matteo	Cesca	Environmental Agency (ARPA) of Veneto region	Italy	Stakeholder	Brunetti, Maria Teresa(1941)
1988	Pierpaolo	Macconi	Autonomous Provine Bozen-Bolzano	Italy	Stakeholder	Brunetti, Maria Teresa(1941)
1993	Elisabetta	Genovese	Research Institute on Sustainable Economic Growth, IRCrES-CNR	Italy	Collaborator	Zoboli, Roberto(1991)
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2619	Yongjun	Zhang	Institute of Geo-environment Monitoring of Gansu Province	China	Collaborator	Li, Zhiheng(2614)
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2643	Daniel	Brunstein	Laboratoire de Géographie Physique-CNRS	France	Senior Personnel	Jomelli, Vincent(2631)
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Conferences

Suggested International Conferences
European Geosciences Union 2017, 2018

18. References cited

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Museo delle Scienze
Prot. 0007034 del 14/09/2015
Tipo P Class. B.1.2

To: Whom it may concern

Letter of Intent
for the participation in the

GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION

Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned,

confirm on behalf of my organization, MUSE – Museo delle Scienze, our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.

The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.

We believe that the **GRACIA** project is in line with the goals and aspirations of MUSE, and is consistent with the strategies of our organization for the protection of the Alpine environment.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Trento, 14th September 2015

PhD Michele Lanzinger
DIRECTOR

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PARCO NATURALE ADAMELLO BRENTA Geopark

Prot. n. 4564 / 9.4
Strembo, 30th September 2015

To: Whom it may concern

Letter of Intent
for the participation in the

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GRACIA project

submitted as a project proposal within the call BELMONT FORUM
COLLABORATIVE RESEARCH ACTION
Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned,
confirm on behalf of my organization, Adamello Brenta Nature Global Geopark, our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.
The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.
We believe that the **GRACIA** project is in line with the goals and aspirations of Adamello Brenta Nature Global Geopark, and is consistent with the strategies of our organization for the protection of Unesco Geopark. We'd like also to host a Nationale Stakeholder Workshop.
We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

The Director
Dr. Roberto Zoanetti

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To: Whom it may concern

Letter of Intent
for the participation in the
GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION
Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned, Martini Guy, Haute Provence Geopark Director
confirm on behalf of my organization, : Haute Provence Geopark our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.
The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.
We believe that the **GRACIA** project is in line with the goals and aspirations of the Haute Provence Geopark, and is consistent with the strategies of our organization for the development of the UNESCO Global Geoparks
We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Date, 29th October 2015
The Director of the Haute Provence Geopark

Guy Martini

To: Whom it may concern

Letter of Intent
for the participation in the

GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION

Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned,

confirm on behalf of my organization, *Office National des Forêts, département Risques Naturels*, our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.

The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.

We believe that the **GRACIA** project is in line with the goals and aspirations of the *département Risques Naturels de l'Office National des Forêts*, and is consistent with the strategies of our organization for the protection against natural hazards in mountains and the management of mountain watersheds.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Date, 30th September 2015

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38026 GRENOBLE Cedex 1

Le Chef du Département
Risques Naturels

Olivier MARCO

Le chef du département Risques Naturels

Olivier MARCO

Hautes-Alpes
le département

Pôle Aménagement Développement et Déplacements

To: Whom it may concern

Letter of Intent
for the participation in the
GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION

Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned, Isabelle CHOUQUET

confirm on behalf of my organization, Département des Hautes-Alpes our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission. We'll also propose to provide the data of monitoring of debris-flow propagation along the Rif Cros and Roubion torrents.

The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.

We believe that the **GRACIA** project is in line with the goals and aspirations of Département des Hautes-Alpes, and is consistent with the strategies of our organization for the management of Alpines Rivers, especially to increase the resilience of communities with respect to extreme weather phenomena.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Date, 30th September 2015

The service manager

Pour le Président et par
Le Chef du Service des Ressources
et des Risques

Isabelle CHOUQUET

ARPAV
Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto

REGIONE DEL VENETO

Sistema di Gestione Certificato UNI EN ISO 9001:2008

Direzione Generale
Servizio Pianificazione, Progettazione e Sviluppo
Via Ospedale Civile, 24
35121 Padova Italy
Tel. +39 049 8239345
Fax +39 049 660966
e-mail: progetti@arpa.veneto.it
Dirigente: Dott. Riccardo Guolo
Referente: Dott.ssa Da Rugna Lucia

To: Whom it may concern

Letter of Intent
for the partecipation in the

405-2015-10-30-18-28-38.pdf

GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION

Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned,

confirm on behalf of my organization, **ARPAV - Regional Agency for Environmental Protection and Prevention of Veneto**, our interest in the above mentioned GRACIA project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.
The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.

We believe that the **GRACIA** project is in line with the goals and aspirations of **ARPAV**, and is consistent with the strategies of our organization for the risk prevention and adaption related to landslides and debris flows; in particular **ARPAV** is mainly interested in exchanging information with other stakeholders and target groups and in the activities related to the investigation of the links between landslide occurrence and meteorological (rainfall threshold assessment) and environmental conditions and their variations due to climate change.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Padova, 22 OTT. 2015

General Director
Dott. Carlo Emanuele Pepe

AUTONOME PROVINZ BOZEN - SÜDTIROL
Abteilung 30 - Wasserschutzbauten

PROVINCIA AUTONOMA DI BOLZANO - ALTO ADIGE
Ripartizione 30 - Opere idrauliche

Prot. Nr. 30. – A/9 – **590750/2015**

Bozen/Bolzano, 22.10.2015

Bearbeitet von:
Dr. Pierpaolo Macconi/tap
Tel. 0471 41 45 88
Pierpaolo.macconi@provinz.bz.it

Research Institute for Geo-Hydrological Protection (IRPI)
National Research Council (CNR)
Corso Stati Uniti, 4
35127 Padova

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Letter of Intent
for the participation in the

GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION
Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned, confirm on behalf of my organization, the Department of Hydraulic Engineering of the Province of Bolzano, our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.

The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.
We believe that the **GRACIA** project is in line with the goals and aspirations of the Department of Hydraulic Engineering, and is consistent with the strategies of our organization for the protection of mountain areas in the Province of Bolzano.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

The Head of Department of Hydraulic Engineering

Dr. Rudolf Pollinger

Der Stellvertreter - Il sostituto
Dr. Ing. Arturo Magno

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2015-10-30

To: Whom it may concern,

Letter of Intent
for the participation in the

GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION

Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned, confirm on behalf of my organization, Department of Land and Resources Management, Longnan Government, Gansu Province, China, our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.

The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.

We believe that the **GRACIA** project is in line with the goals and aspirations of the Department of Land and Resources Management, and is consistent with the strategies of our organization for the protection of lives and livelihoods in the Longnan District, Gansu Province, China.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Mr. Xianliang Zhang

Head of the Department of Land and Resources Management

Longnan Government

Gansu Province, China

20th October 2015

Address: 2 Dongjiang New district, Department of Land and Resource Management of Longnan District, Wudu, Gansu Province, China, 746000

To: Whom it may concern,

Letter of Intent
for the participation in the

GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION

Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned, confirm on behalf of my organization, the Geohazards Emergence Response Centre, Longnan Government, Gansu Province, China, our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.

The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.

We believe that the **GRACIA** project is in line with the goals and aspirations of the Geohazards Emergence Response Centre, and is consistent with the strategies of our organization for the protection of lives and livelihoods in the Longnan District, Gansu Province, China.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Mr. Longshun Du

Head of the Geohazards Emergence Response Centre

Longnan Government

Gansu Province, China

22nd October 2015

To: Whom it may concern,

Letter of Intent
for the participation in the

GRACIA project

submitted as a project proposal within the call BELMONT FORUM COLLABORATIVE RESEARCH ACTION

Topic: CRA 2015 - Mountains as Sentinels of Change

I the undersigned, confirm on behalf of my organization, Geohazards Emergence Response Centre, Tianshui Government, Gansu Province, China, our interest in the above mentioned **GRACIA** project, within the call of the Belmont Forum Collaborative Research Action. We would like to be kept informed about the progress of this project and support the project submission.

The **GRACIA** project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas.

We believe that the **GRACIA** project is in line with the goals and aspirations of the Geohazards Emergence Response Centre, and is consistent with the strategies of our organization for the protection of lives and livelihoods in the Tianshui District, Gansu Province, China.

We therefore fully support this initiative. We encourage the Belmont Forum to fund this project and wish every success to the **GRACIA** international team and for the accomplishment of the proposed work.

Mr. Yu Sun

Head of Geohazards Emergence Response Centre

Tianshui Government

Gansu Province, China

20th October 2015

Address: 37 Minshan Road, Department of Land and Resource Management of Tianshui District, Gansu Province, China, 746000

GENERALI

To whom it may concern

Trieste, 23 October 2015

Re: Letter of Support

Catastrophe Modelling
gcm@generali.com

Prot. 830.017 ACA

Assicurazioni Generali S.p.A.
p.zza Duca degli Abruzzi, 2
34132 Trieste / Italy
P.O.Box 538
T +39.040.671111
F +39.040.671600

contact@generali.com
generali.com

On behalf of Assicurazioni Generali S.p.A., we would like to confirm our interest in the **GRACIA project**, within the call of the *Belmont Forum Collaborative Research Action*.

Assicurazioni Generali S.p.A. is the leading global insurer based in Italy, which provides comprehensive solutions, including catastrophe insurance cover, to its clients worldwide.

The GRACIA project has the ambition to represent a substantial advancement at an international level with respect to the landslide risk assessment under climate change in mountain areas, including Italy, France and China, with the support of the UNESCO Earth Sciences and Geo-Hazards Risk Reduction Natural Science Sector.

For this reason, we believe that the GRACIA project is in line with the goals and aspirations of Assicurazioni Generali SpA, and is consistent with the strategies of our organization for the protection against the serious threat that is posed by the frequency and severity of catastrophes, including landslides, that may occur in vulnerable regions.

Hence, Assicurazioni Generali S.p.A. is ready to provide a non-financial contribution in the form of an endorsement of the project's activities and in providing advice in the requirements and specifications of the project, to help ensure that the outcome can also be of support of the insurance role in this sector. We therefore fully support this initiative and encourage the Belmont Forum to fund this project and wish every success to the GRACIA international team and for the accomplishment of the proposed work.

Yours sincerely,

Assicurazioni Generali S.p.A.

Name: Franco Urlini
Title: Group Head of Reinsurance

Name: Andrea Carlesi
Title: Head of Catastrophe Modelling