ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

il Direttore

Gestione WEB

Al Presidente
Al Direttore Generale f.f.
Ai Componenti del Consiglio Scientifico
Ai Direttori di Dipartimento
Ai Direttori di Sezione
Al Dott. Guido VENTURA
Al Dott. Paolo AUGLIERA
Ai Referenti Nazionali delle Linee di Attività
Al Responsabile del Centro Servizi per il Coordinamento delle Attività
a Supporto della Ricerca

Oggetto: Pubblicità atti

Si notifica in copia, come richiesto dagli uffici competenti, al fine di dare seguito alla pubblicazione, l'allegata Delibera n. 183/2020 del 30/09/2020 - Allegato I al Verbale n. 08/2020 concernente: "Valutazione Progetti di ricerca interni PIANETA DINAMICO - 2021/2022".
La scrivente Direzione Centrale è deputata alla mera trasmissione dell'atto.
Ad ogni buon fine, si segnala il disposto di cui all'art. 7 del d.lgs. n. 33/2013, in base al quale i documenti, le informazioni e i dati oggetto di pubblicazione obbligatoria ai sensi della normativa vigente, resi disponibili anche a seguito dell'accesso civico di cui all'articolo 5, sono pubblicati in formato di tipo aperto ai sensi dell'articolo 68 del Codice dell'amministrazione digitale, di cui al decreto legislativo 7 marzo 2005, n. 82, e sono riutilizzabili ai sensi del decreto legislativo 24 gennaio 2006, n. 36, del decreto legislativo 7 marzo 2005, n. 82, e del decreto legislativo 30 giugno 2003, n. 196, senza ulteriori restrizioni diverse dall'obbligo di citare la fonte e di rispettarne l'integrità".

Dott.ssa Alessia DI CAPRIO

Alessia Di Caprio

DIREZIONE CENTRALE
AFFARI DEL PERSONALE

Via di Vigna Murata, 605 | 00143 Roma| Italia | Tel.: +39 39.0651860456 | Fax: +39.0651860576
direzione.centrale1@ingv.it | aoo.roma@pec.ingv.it | www.ingv.it

Delibera n. 183/2020
Allegato I al Verbale n. 08/2020
Oggetto: Valutazione Progetti di ricerca interni PIANETA DINAMICO – 2021/2022.

IL CONSIGLIO DI AMMINISTRAZIONE

VISTO il Decreto legislativo 29 settembre 1999, n. 381, costitutivo dell'Istituto Nazionale di Geofisica e Vulcanologia (INGV);
VISTO il Decreto legislativo 25 novembre 2016, n. 218, recante la Semplificazione delle attività degli Enti Pubblici di Ricerca ai sensi dell'art. 13 della Legge 7 agosto 2015, n. 124;
VISTO lo Statuto dell'INGV, approvato con Delibera del Consiglio di Amministrazione n. 372/2017 del 9 giugno 2017, come modificata con Delibera del Consiglio di Amministrazione n. 424/2017 del 15 settembre 2017, e pubblicato sul Sito WEB istituzionale (Avviso di emanazione pubblicato sulla Gazzetta Ufficiale della Repubblica Italiana - Serie generale - n. 27 del 2 febbraio 2018);
VISTO il Regolamento di Organizzazione e Funzionamento dell'INGV, emanato con Decreto del Presidente n. 36/2020 del 22/04/2020, pubblicato sul Sito WEB istituzionale e in particolare, l'art. 3, comma 5, il quale prevede che: "*5. Su richiesta del Consiglio di Amministrazione, il Consiglio Scientifico può essere chiamato a valutare progetti di ricerca interni all'INGV, se necessario servendosi anche di revisioni esterne*";
VISTO il Regolamento di Amministrazione, Contabilità e Finanza, emanato con Decreto del Presidente n. 119/2018 del 14/5/2018, pubblicato sul Sito WEB istituzionale;
VISTO il Decreto del Direttore Generale n. 37 del 21/04/2020, avente a oggetto il conferimento dell'incarico di Coordinatore Progetto PIANETA DINAMICO;
VISTO il Progetto di PIANETA DINAMICO, il quale prevede, tra i vari obiettivi, anche quelli della ricostruzione tridimensionale del sottosuolo nazionale, dello studio dei cambiamenti climatici, dei precursori sismici e di quelli vulcanici;
PRESO ATTO che il MIUR con decreto n. 1118 del 04/12/2019, ha assegnato all'INGV la quota di risorse pari a 30.000.000,00 euro, a valere sul "Fondo finalizzato al rilancio degli investimenti delle amministrazioni centrali dello Stato e allo sviluppo del Paese" di cui all'articolo 1, comma 95, della legge 30 dicembre 2018, n. 145, ripartita per ciascun anno dal 2019 al 2033;
PRESO ATTO delle Terms of Reference 2021-2022, elaborate dai Responsabili amministrativo e scientifico del Progetto Pianeta Dinamico 2020-2022) con il

contributo dei Direttori dei Dipartimenti Ambiente, Terremoti e Vulcani, e dei responsabili nazionali delle Linee di Attività, concernente lo sviluppo di un modello univoco per le dinamiche terrestri;
CONSIDERATO che il progetto Pianeta Dinamico per il biennio 2021-2022 prevede una fase di raccolta e valutazione di proposte basate sui temi indicati nelle sopra citate Terms Of Reference;
CONSIDERATO che le proposte possono essere sottomesse dai ricercatori e/o tecnologi dell'INGV a tempo indeterminato;
su proposta del Presidente,

DELIBERA

di dare mandato al Consiglio Scientifico dell'INGV, che può avvalersi anche di referees esterni, di valutare le proposte progettuali interne, pervenute relativamente al Progetto PIANETA DINAMICO, come rappresentato nelle Terms of Reference, allegato alla presente delibera che ne costituiscono parte integrante e sostanziale (All.1) .

Letto, approvato e sottoscritto seduta stante.

Roma, 30/09/2020

La segretaria verbalizzante
(Dott.ssa Maria Valeria INTINI)

Firmato digitalmente da

MARIA VALERIA INTINI

CN = INTINI MARIA VALERIA
O = INGV
C = IT

IL PRESIDENTE
(Prof. Carlo DOGLIONI)

Firmato digitalmente da DOGLIONI CARLO
C: IT

Developing a unifying model of Earth dynamics: how lithosphere, hydrosphere, atmosphere and space interact and change our planet from micro to global scale, from seconds to million years

(Earthquakes (EQ), Volcanoes (VOL), Environment (ENV))

A cura di Paolo Augliera e Guido Ventura (Responsabili amministrativo e scientifico del Progetto Pianeta Dinamico 2020-2022) con il contributo dei Direttori dei Dipartimenti Ambiente, Terremoti e Vulcani, e dei Referentinazionali delle Linee di Attività.

Earth dynamics is controlled by endogenous and exogenous processes acting on a wide range of temporal and spatial scales. Orogens and rifts form on a time scale of million years whereas earthquake and volcanic eruptions occur within time intervals of few seconds/minutes and hours/years, respectively. However, how these short-time and local manifestations are able to change the Earth's interior and surface over long times and large spatial scales is still unknown lacking a well-established link of the 'intermediate' scales and a full understanding of the processes involved.

The understanding of the physical and chemical processes occurring on Earth needs of a 'zero' starting point, which, in the geological/geophysical field, consists of an accurate knowledge of the present-day surface and deeper structure. This is required to (a) link the past to the present (and future), (b) identify dynamically active zones, and (c) correctly model the interactions between different processes. We also need scaled experiments and theoretical models able to reproduce natural phenomena and increase our understanding of the physics and chemistry of the Earth dynamics.

Italy and the surrounding regions (Europe, Mediterranean area) are the ideal natural laboratory to analyze the Earth's dynamics because they include, in a relatively restricted geographic space, orogenic belts, rifts, and intraplate areas. Our country is characterized by deformation, volcanism, earthquakes, tsunami, morphological changes related to exogenous and endogenous processes, atmospheric and climate changes even of large magnitude. Therefore, the development of a unifying Earth model has immediate implicationon the evaluation of the associated multi-hazards/multi-risks and resilience capability of our society to long- and short-term destructive phenomena including volcanic eruptions, earthquakes, tsunami, landslides, sea level changes, gas release, geomagnetic and ionospheric storms, space weather events impacting on the near-Earth, uplift and subsidence.

Themes

1. Fault rupture processes and fault linkage (EQ)

Field and laboratory data show that the fault rock strength and rheology evolve with both rock microstructure and mineralogy with time, emphasizing the fact that the mechanical response of an individual fault can change over time. New experimental approaches show that during dynamic rupture and coseismic slip, dramatic changes in frictional strength may arise from frictional melting and thermal pressurization at depth. How these processes control the propagation to the surface of fault rupture remains an open question. The life cycle of faults and earthquakes depend on several factors and if we wish to use map- to micro-scale observations to read the rock record of earthquakes, we must understand the missing link between these interacting physical and chemical factors, including the changes induced by the progressive fault activity and aseismic creep. Geophysical and geological investigations are needed to link the micro-, meso- and macro-scale of the faulting processes. In addition, to fully understand how faults are related to the rheology of the upper crust, we must analyze the factors governing the elastic and inelastic behavior. Where the energy of earthquakes comes from? Faults are passive features where part of the energy is radiated during the earthquake: in which crustal volume is stored the energy during the interseismic period? What is the role of the brittle-ductile transition? Are there differences among the three main tectonic styles? Why the b-value is different among thrust, strike-slip and normal faults? How strain rate variations may be useful as seismic precursors? What are the most reliable possible seismic precursors? We need (a) a much clearer understanding of rates, durations, and the episodic nature of deformation in the crust, as well as the mechanisms controlling these factors, (b) physically based and mechanically plausible models for earthquake sources and rupture propagation, along with an understanding of the driving forces and energy balance of earthquakes and the earthquake cycle, (c) a better understanding of the role of chemical and hydrologic processes in rock deformation, (d) how the material properties changes over space and time, (e) the physics and chemistry of fault weakening processes (e.g., flash heating, porosity and permeability variations, phase transition, melting), (f) how and why deformationlocalize into faults, (g) how fault systems develop and the mechanics of fault growth, linkage and propagation in space and time, (h) how fluids behave during the seismic cycle and how they change their chemistry, temperature, level, etc. during the preparatory phase of an earthquake?

2. Mechanisms of formation and evolution of large magma reservoirs and eruptive mechanisms of high magnitude eruptions (VOL)

How fluids and magmas coming from the mantle accumulate in the crust is still an open problem lacking high-resolution geophysical data. This prevents our understanding of how water/fluid crustal reservoirs and large magma chambers form. These processes of large magma accumulation are of primary importance because such reservoirs likely represent a pre-requisite for the occurrence of high magnitude eruptions, the most catastrophic and hazardous events on Earth, able to alter the climate atglobal scale. In addition, the geometry (composite vs single reservoir), depth, and timing of storage zone formation are still open questions. The chemistry and mineralogical composition of magmas control the evolution, migration time and surface delivering of magmas. The reconstruction and numerical modeling of the dynamics of such extremely voluminous, caldera-forming or large, flood-like basaltic reservoirs, and of the associated eruptive phenomena represent a challenge of modern volcanology. Geological, stratigraphic, and petrochemical investigation aimed to reconstruct the long- to medium-term conditions for the emplacement and evolution of reservoirs. This information, along with the medium- and short-term monitoring data will allow us to fill the temporal gap and scale problems between long and short terms magmatic/tectonic processes. Particularly important and challenging is to link the recorded signals from geophysical and geochemical monitoring networks to the expected scenarios as well as to assimilate multidisciplinary observational data of the ongoing event into predictive numerical models of the phenomena. Also, the post-caldera feeding system and its physical and chemical evolution is a still debated question. Such systems may consist of remnants of early, larger reservoirs, or relatively independent storage zones, or, finally, ephemeral reservoirs activated during short eruptive phases triggered by deep magma arrivals. We still need to develop a unifying model able to explain the timing, evolution and feeding mechanisms of such post-caldera reservoirs. Similarly, the eruption mechanisms and phenomena of high magnitude eruptions (e.g., conduit flow, ring-fault controlled eruptions, Plinian and ultra-Plinian eruptions, syn-collapse pyroclastic flow generation, ash generation and dispersal, etc.), their hazards and effects on the environment and surface processes are also poorly known and need to be quantitatively described by sounded physical, numerical and statistical models. Early warning signals of eruptions are of paramount importance and should be investigated in detail.

3. Geomagnetic field, Sun-Earth interactions, and Climate changes (ENV)

Earth is characterized by an internal magnetic field, which is generated in the fluid outer core and produces a mostly dipolar field permeating the near Earth environment and enveloping the planet in a region known as magnetosphere. Magnetosphere constitutes an effective shield against the harmful effects of Solar wind and highly energetic galactic rays. The geomagnetic field varies continuously in a range spanning from milliseconds to tens of millions years. It is unclear how it varied in time, when the inner core solidified (models span between 2.5 and 0.5 Ga) and how this may have modified the shape and intensity of the magnetic field. Has the magnetic field axis been stable and migrating about the Earth's rotation axis or it shifted in the past at lower latitudes? Variations shorter than a few years are due to interactions with the Solar wind and can result in geomagnetic and ionospheric storms that may compromise the efficiency of many modern technological systems. Space Weather involves the study of the conditions on the Sun, the solar wind, and Earth's magnetosphere, ionosphere and thermosphere that can affect the performance and reliability of space-borne and ground-based technological systems and endanger human life or health. The study of Space Weather processes requires continuous monitoring of different components of the Sun-Earth system and development of new models for effective and timely prediction services. The mechanisms which originate the geomagnetic field are still only partially known and their understanding is a longstanding challenge in Earth Sciences and Physics. Whatever the driving mechanisms, the processes occurring in the Earth's core makes the geomagnetic field highly dynamic over geological times. Some variations are extreme - such as polarity reversals and excursions - and were never observed in historical times with direct measurements. Anyway, since rocks can retain memory of past geomagnetic fields for time intervals which extend even beyond the Earth's age, we can retrieve information on geomagnetic field variations from direct measurements on rock samples. Paleomagnetism can thus provide a scientific tool to investigate details and rates of secular and extreme geomagnetic field variations through geological times. The continuous decrease of the geomagnetic field intensity observed since the first direct measurements by Gauss may lead to a major field instability in the next few decades to centuries. The study of the geomagnetic field variability is a hot topic in geophysics.

Several Earth's geochemical and geophysical cycles and processes combine to determine global and regional climates and their variations at various time scales. The study of climate changes requires monitoring and integrations of various experimental data sets, involving both natural and anthropogenic components of the Earth's systems, as well as variation in solar activity and Sun-Earth interactions. Particularly important are theanalyses focused on atmosphere-hydrosphere-cryosphere-lithosphere-biosphere dynamics with exchanges of energy, gases and matter and on the response of environmental components to anthropogenic emissions. Study of past climate and environmental changes can provide an empirical basis to evaluate the rates and processes of natural variability and to understand possible amplification feedback between distinct climate components. Models linking the different environmental processes and feedback are critically important to formulate scenarios of possible evolution for the next decades and centuries, with specific concern on effects on human societies and natural ecosystems. Some regions are particularly sensitive to climate variations, such as both polar regions and the Mediterranean, and deserve particular attention by scientists.

4. Lithospheric deformation (EQ, VOL, ENV)

Earth is continuously changing and deforming at different rates. We still do not have a demonstrated mechanism for driving plate tectonics. Where the energy for moving the lithosphere comes from? This understanding is the base for and endless number of geological phenomena, including natural hazards. Deformations recorded from satellite and GNSS data reveal long term trends at varying spatial scales and shorter variations related to transient phenomena of different nature and possibly due to the superimposition of endogenous and exogenous processes. The role of recent and ancient deep structures in controlling the present-day deformation field is also of interest. Actual and past deformations may be associated to changes in the crust and mantle related to earthquakes, magma intrusions and volcanic eruptions, water discharge/recharge phases in the shallower crust, erosion processes, coastal processes (sea wedging, sea level changes) as well as by larger scale plate dynamics, which involves ductile flow in the mantle and lower crust. A novel quantitative and physics-based approach linking the depth to the surface, the present-day and past deformation trends reconstructed from geological and geophysical data, and criteria to separate trends related to different, often interacting, processes still not constrained is needed and encouraged.

5. Volcano-Earthquake-Climate-Space interactions (EQ, VOL, ENV)

Our planet includes lithosphere, hydrosphere, and atmosphere; however, how these three 'spheres' and some extraterrestrial solar and planetary phenomena (e.g. gravitational and electromagnetic effects) interplay is poorly constrained because of the complexity of such interactions. As an example, variations in the electromagnetic field may precede, in some cases, volcanic eruptions and earthquakes, but an accepted theory on such types of interactions is, at the present, far to be attained. As concerns the connections between Earth's endogenous and exogenous processes, it has been shown that rain and storms may trigger microseismicity, which, in turns, progressively weaken the physical properties of surface rocks, hence promoting gravity instability processes and landslides. The role of rain in triggeringlarge earthquakes is also a still open question although recent findings suggest that, if a fault is close to rupture, small variations in stress linked to the recharge/discharge cycles of large aquifers by rain or dry/wet periods associated to climate changes could be, in part, responsible for a such type of events. In addition, the unloading processes on the Earth's crust related to human activity, 'dry' climate, sea level variations, and ice melting by global warming favor the uprising and discharge of fluids, e.g. methane and carbon dioxide, into the atmosphere, and induce changes in the stress in the crust so allowing (or not) the occurrence of earthquakes and volcanism. It has also been demonstrated that significant variations in atmospheric pressure related to rain and storms may favor the triggering of volcanic eruptions in magmatic systems close to their 'critical state'. Viceversa large volcanic eruptions can significantly affect and influence atmospheric and climatic conditions as well as the surrounding environments. Among these poorly constrained cause-effect relationships between endogenous and exogenous processes, how earthquakes and volcanoes are co-related, if any, is also a still debated question. In particular, it has been shown that large earthquakes may trigger unrest at volcanoes located hundreds of kilometers from the epicenter and different models have been invoked lacking a unifying reference theory. Geothermal activity may also be affected by earthquakes and volcanic fluids as well as by changes in the hydrothermal reservoirs due to self-sealing processes or uprising of deep fluids. Fluids play also a major role in the triggering mechanisms of earthquakes and related fault activity; this is particularly relevant for earthquakes associated with subduction zones, where fluids are continuously discharged from the slab due to phase changes. Phase transformations during earthquakes may control the weakening mechanisms of faults and then their rupture dynamics. Open problems in earthquake triggering mechanisms also include (a) the role of viscous flow and fluids in the lower crust and mantle in accumulating strain at the base of the seismogenic faults in the shallower crust, (b) how the slip on faults at the surface records the effective displacement. Tidally induced gravity oscillations, electromagnetic field variations and changes in atmospheric parameters may also lead towards a characterization of signals preceding large scale natural events and detect changes in the crust and lithosphere. Effects of past climate changes and their role in modulating natural phenomena may allow us to construct future scenarios, as well as new data analyses, monitoring systems and related models can help investigate further the relations among different phenomena.

6. Changes in the crust composition and rheology, the fluid-deformation relationships (EQ, VOL, ENV)

Magma intrusions modify the chemical composition of the Earth's layers and, when associated with earthquakes or tectonic stresses, they modify the rheological/physical properties of the rocks so changing their response to further solicitations. Important modifications of the Earth's layers are also induced by the passive/active uprising of fluids of different nature from the mantle, subducting slabs, and the crust. Our understanding of the links among these different physical and chemical changes, their effects on the rocks, i.e. the elastic-inelastic transition and their mutual interactions is at a seminal stage and deserves to be analyzed to understand the short- and long-term Earth's dynamics and evolution, including the inception mechanisms of earthquakes, volcanic eruptions and the transition from mountain building to rift (and vice-versa). The composition of the mantle and crustal fluids associated (or not) to earthquakes and volcanic eruptions and the mechanisms of fluid release into the atmosphere are of primary importance to quantify the budget of Earth degassing processes and to analyze the mantle-crust interaction and its evolution with time.

7. Sea Interactions (EQ, VOL, ENV)

The evolution of continental coastal areas and islands largely results from the complex interactions between air (e.g. wind, storms, aeolian transport, etc), land (e.g. beaches, rocks, erosion, earthquakes, eruptions, etc.) and sea (e.g. water circulation, waves salinity, tides, sediments, earthquakes-, volcano- and gravity-induced tsunamis, etc.). The changes of the sea-land-boundary environment can change over long to short time scales depending on the energy and timing of the involved processes. Human impact along the coasts, e.g. by industrial, construction and pollution activities, may alter the ecosystem equilibrium and impact on its evolution. The effects of submarine natural phenomena like earthquakes and volcanic eruptions may also alter the morphology of the seafloor and favor instability processes ranging from seabed sliding to giant slope collapses, thus potentially triggering tsunamis. The dynamics of submarine eruptions still need to be fully investigated by sound and multidisciplinary quantitative models too. At the present, very few data or monitoring/alert systems on submarine volcanoes and seismogenic faults exist in the Mediterranean Sea and studies on landslide-triggered tsunamis are very sparse. The analysis of the effects of such phenomena on the coastal areas as well as on the navigation routes is of primary relevance for the planning and defense of the maritime regions and infrastructures. In addition, the amount and type of degassing phenomena from the submarine portion of continental volcanoes, submarine volcanoes, and seismogenetic submerged faults is, at present, largely unknown and should be evaluated along with the effects of gas release (CO_2 and/or CH_4) on the biogenic community and coastal ecosystems. The possible triggering of microseismicity by tides, storms, winds, and geomagnetic storms, and the role of such microearthquakes in weakening over longer time scales active coastal and submarine active faults and volcanoes should be investigated. The effects of storms, pollutionand climate changes on the thermal equilibrium and chemical composition of the sea water, as well as on the patterns of marine currents and their evolution are also poorly constrained, although these changes may heavily affect the biogenic communities and the human society. Finally, the exploration of the seafloor of the Italian seas should be improved to identify and characterize mineral deposits, and fluid release areas of likely geothermal or oil exploration interest.

8. Monitoring and hazards of Earth processes: from data to analyses, models, early-warning and multi-hazard/multi-risk assessments (EQ, VOL, ENV)

The above examples and considerations clearly show that a unifying model of Earth dynamics is needed and several, often interrelated processes, should be analyzed together. In this framework, we need to take advantage of the often huge, long time series of geological, geochemical, hydrological, deformation, seismic, volcanological, environmental and space high-quality data collected on large portions of the Earth. These data should be classified, shared and further analyzed by adopting advanced numerical and statistical tools including big data analysis and machine learning techniques to detect potential spatial and temporal relations and identify possible precursors of large magnitude events that may impact on our society. This is particularly true for multiparametric monitoring data acquired by INGV permanent and temporary seismic, geodetic, geophysical and geochemical observatories and networks, whose data are, at present, not always jointly stored and fully analyzed. Time and magnitude variations of different physical and chemical parameters must be detected and analyzed to search for the probability of occurrence of different phenomena and to find out the possible cause-effect relationships. We also need experimental data, realistic physical models and innovative statistical analyses able to include the main effective time- and physical/mechanical-dependent parameters. Development and use of physical-mathematical models exploiting high-performance computing techniques for the study of earthquakes, volcanic eruptions, climate and large scale inverse problems are also encouraged. Moreover, multi-hazard and multi-risk assessments and early-warning systems (EWS) for earthquakes, earthquake-, volcano- and landslide-triggered tsunami, volcanic eruptions, geomagnetic storms, ionospheric storms, space weather events,and the study of their effects on the society and human health are also crucial research topics for the implementation of actions aimed at reducing the impact of destructive natural phenomena and increasing the resilience of our society.
