

GEOETHICS: A FRAMEWORK FOR THE MANAGEMENT OF THE GEOSPHERE AND GEO-RISKS

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Abstract

In a world where natural disasters are increasing and there is an urgent demand for an ethics of prevention, management and communication, a framework of ethical principles and standards for orienting geoscientists in conducting their professional activity becomes fundamental.

The defense against geo-risks involves many actors with different roles. Good relationships between them is necessary to assure efficiency while facing potential natural disasters.

Defining a (geo)ethical framework of values means to create a solid base on which a proper management of georisks can operate. By defining roles and responsibilities, Geoethics is a valuable reference to work in this direction and to improve the resilience of human community to disasters.

Introduction

Natural phenomena have always fascinated mankind, even in their most fearsome aspects. Extreme events can provoke opposing reactions in humans: wonder on the one hand, fear on the other. But in both cases, they remind us that the Earth is a living planet, with evolutions and transformations that are expression of the same force that created all living forms.

The relationship between mankind and natural phenomena has changed over time, influenced by historical, cultural and social changes that have accompanied the progress of our societies.

In ancient times the natural phenomena were considered expression of the divine will. Despite the fact that similar attitudes still live on, the development of science has modified the way natural phenomena are perceived. Humans have developed the scientific method to rationally analyze natural events and generate forecasting models. Since we are rational living beings, this implies the ethical duty to defend our fellow human beings from natural disasters that we are able to study and in many cases to predict.

Geoethics consists of research and reflection on the values which underpin respectful and sustainable behaviours and practices, wherever human activities interact with the geosphere. It deals with the ethical,

social, economic and cultural implications of using Earth sciences for societal benefits. Geoethics represents an opportunity for geoscientists to consider their activities under an ethical perspective and also a way for increasing the awareness of society about problems related to geo-resources exploitation and energy supplies, geo-environmental changes and geo-hazards (Peppoloni and Di Capua 2012, 2015).

Among the issues addressed by geoethics, aspects related to geo-risks management, mitigation and communication are of primary importance. In a world where natural disasters are increasing and there is an urgent demand for an ethics of prevention and communication, a framework of ethical principles and standards for orienting geoscientists in conducting their professional and research activity becomes fundamental.

When natural phenomena threaten human lives, activities and resources, it is necessary the integration of scientific knowledge, professional skills and individual responsibilities to effectively protect the land and the population that live in it. The defense against geo-risks involves many actors with different roles: geoscientists, decision makers, local authorities, mass media, citizens (Dolce and Di Bucci 2015; Peppoloni and Di Capua 2014). The relationships among them should guarantee efficiency during all the phases related to the disaster cycle (Peppoloni 2014).

The territory is the physical support of human activities, one of the founding elements of our individual and social identity, and also an important resource in economic terms. As such, it should be considered a common good, to be shared and safeguarded, and one should not neglect the ethical and social implications of those who have the responsibility to investigate and manage it (Peppoloni and Di Capua 2012).

Defining a (geo)ethical framework of values means to create a solid base on which to found a proper management of geo-risks, by defining roles and responsibilities through establishing protocols and procedures, so that overlapping and misunderstanding don't jeopardize population safety and economic activities (Peppoloni and Di Capua 2014). Geoethics is a valuable reference to work in this direction and to improve the resilience of human community to disasters.

It is therefore possible for mankind not to undergo passively natural events, but rather to appeal to the rational ability to face them and find effective solutions to co-exist with their dynamics. So, the defense against natural risks that can cause harm to humans is in our hands. A task of geoscientists and all the other actors involved in the risk management is to enhance the resilience of our communities.

Using science

The risk is the symbolic product of hazard, vulnerability and exposure. It is quantified as the loss produced on an element or group of elements at risk as a consequence of the occurrence of a given phenomenon of a given intensity. The hazard is the probability that a phenomenon of a given intensity occurs in a certain area in a given time interval. The vulnerability is the capability of an element to resist to a given phenomenon. Social vulnerability is related to the resilience of the community, namely to its ability to respond to a disaster, by restoring the material and spiritual conditions existing before the event. The exposure is the value of the elements at risk in the area (in terms of human lives, economic and historical-artistic value). The damage due to geo-hazards is not entirely avoidable, but can be reduced through correct land use and respect for geo-environment, through prevention and mitigation efforts, and through effective information to the population. The proper dissemination of scientific knowledge and an adequate preparedness can help to transform the fear into respect for the natural processes that govern the geosphere (Peppoloni 2014). The scientific approach, based on quantitative assessments of risks and probabilities of occurrence, helps to find strategies for mitigating their effects. It is also an effective way to curb irrational fears. Geoscientists have skills and appropriate knowledge to help society to face natural risks and learn to live with them. Their activity should include (Peppoloni and Di Capua 2014):

- making data and results of their studies public, easily accessible and user friendly;
- conducting their studies, verifying the sources of information, the adherence of results to observations and the related uncertainties and errors; accepting a fair debate with hypotheses and theories that disagree, without being overconfident in their own results;
- assuring their ongoing professional training;
- collaborating in the training of the skills of technicians and professionals;
- transferring advanced knowledge to industry and au-

thorities;

participating in educational campaigns for the population, paying attention to simplify concepts.

The acceptable limit of risk to society

Today we are able to predict, with some degree of uncertainty, the onset and development over time of some natural phenomena: we know them certainly better than in ancient times, although for many of them we continue to ignore the primary causes. Scientific knowledge is proving that it is possible to defend ourselves against natural risks, with careful and continuous monitoring, adequate prevention programs, careful land management, and appropriate building techniques, well calibrated with the hazardous characteristics of each area of the world. Therefore the process of scientific knowledge can allow us to achieve a more functional relationship with nature.

However, if on the one hand science offers us extraordinary possibilities of progress, on the other hand it does not provide absolute certainty. Even in the absence of full scientific certainty, we can find solutions that are acceptable, that allow us to live with the natural phenomena and to develop appropriate precautionary policies in risk management. But can we manage uncertainty? And how to do it?

With regards to geo-hazards, more than in other fields, uncertainty, chance and probability play important roles, because they affect the way in which we can know and manage the risks associated with natural phenomena (Albarello 2015; Tinti et al. 2015).

The use of the precautionary principle, formulated for the first time in the early seventies and entered in the Rio Declaration on Environment and Development which originated from the United Nations Conference in 1992, is today the foundation of the institutive treaties of European Union (Lucchesi and Giardino 2012). The principle states that we must suspend all activities potentially able to harm human health or the environment, even if there aren't scientific evidences of their negative effects or these evidences are partial, which is to say, even if there is not the absolute certainty that this activity does not cause damage.

How do we reconcile this principle with a science that cannot give absolute certainty due to its intrinsic limits? Do not we risk to block any possibility of progress for humanity by adopting the precautionary principle?

Giuseppe Grandori (1921-2011), one of the most distinguished scientists in the field of earthquake

engineering, said that “defending oneself from earthquakes means reducing the consequences of earthquakes (casualties and property damage) below a limit that society considers acceptable, taking into account the costs that a further reduction of the limit would imply” (Grandori 1987). Grandori offers us a simple and wise solution, that recalls us to prudence and common sense, rather than an attitude of absolute precaution.

Common sense is knowing how to assess the costs, but also the benefits of a risk mitigation strategy, which today may seem wasteful, but that may prove effective when evaluated in a larger perspective, looking at its likely outcome. Grandori shows us a way forward valid for all applied sciences, whenever the word “risk” is present. In his sentence the concept of sustainability is also included. Sustainability in itself contains the time dimension, the concept of continuity and long-term use of a resource. In reference to natural phenomena, this resource is the territory, and its sustainable management in relation to risks is essential to ensure the environmental, economic and social development of a community.

A (geo)ethical framework

What can geoscientists do in the defense against geo-risks? What is their social role and their responsibility towards colleagues and society?

The answer to these questions allows us to define a first framework of values that can guide geoscientists in their activities.

Skills

The thorough understanding of dynamics and effects of geological phenomena is possible by developing specific ability and improving our scientific preparedness throughout professional life. Our skills can be partially assessed through review processes among peers, but in part it should be an obligation arising from a personal ethical awareness. Geoscientists know that science progresses continuously, so it is their ethical and deontological duty to maintain a high quality level of their scientific expertise over time.

Multidisciplinarity:

Risk assessment involves sharing specific and complex knowledge. The multidisciplinary approach is thus a necessity in order to ensure completeness in risk analysis, and an essential requirement to develop a multi-faceted approach to a problem that implies many variables. Geoscientists involved in geo-hazards are called to work in multidisciplinary teams (Parkash 2015). Multidisciplinarity is not simply a

practical requirement, but is primarily a value of modern science to give more complete answers to complex problems.

Credibility

The scientist doesn't base his/her work on opinions. Instead, he/she founds his/her activities on science, by following the scientific method: this gives strength and credibility to his/her statements, assumptions and interpretation models. The credibility is derived from expertise, from open discussion and cooperation, and is rooted in the freedom of research and independence of thought from the political, economic, cultural and social constraints. Only a free geoscientist can act with full ethical consciousness.

A qualified geoscientist, credible and open to multidisciplinary collaboration, has the essential ethical requirements to effectively communicate his/her knowledge to the population, while paying attention to its instances and expectations.

An ethical dilemma

The continuous challenges of nature require a strong assumption of responsibility by all: scientists, politicians, legislators, mass media, citizens. To face natural risks is not only a scientific but also an ethical matter (Lucchesi and Giardino, 2012; Peppoloni and Di Capua 2014).

With few exceptions, an opportune risk education and culture is usually lacking among the populations, as well as the awareness about the level of hazards affecting the area in which they live. Generally, the social knowledge that citizens possess usually does not include the necessary basic knowledge about georisks, which may come to their aid in a situation of emergency. This gap is reflected in the constant unpreparedness to deal with not only extreme and rare but also common and frequent events (Peppoloni and Di Capua 2014).

The management of natural risks needs a careful short and long term land planning, a constant economic investment in the scientific research, in the structural reinforcement of buildings and in the education to citizens (Macedo 2014). These policies become extremely complex, or even impossible, in low-income countries (Limaye 2015), where funds are modest and primarily addressed to the solution of problems associated with the supply of primary sources of sustenance (food and water) and to literacy campaigns for the

population.

From this point of view the case of Nepal seems emblematic. On 25th April 2015 a Mw=7.8 earthquake (USGS 2015) struck the central area of this country, provoking more than 8,000 deaths and 20,000 injured, and severe damages to buildings in the capital city, Kathmandu, and many other villages.

While Nepalese population is continuing to suffer pains and mourning after the earthquake, we cannot forget that geoscientists have studied and calculated from years the seismic hazard of the Himalayan region and many times have launched warnings about potential destructive strong earthquakes.

Geoscientists are able to assess hazard, but cannot predict earthquakes; they cannot answer contemporary to the question: Where? When? How much strong will be the next seismic event?

They have sophisticated software to calculate 1D, 2D and 3D site amplification effects, they know methods to study attenuation laws and predict the ground motion, they manage mathematical models for losses estimation in risk analyses.

Unfortunately, for an effective defense against natural risks, all these tools and skills are not sufficient. Above all we need capable decision-makers and politicians, able to understand priorities for their communities. Geoscientists must give full support to society through their scientific knowledge, but only politicians can take decisions about economic investments in the safety of population (Datta 2014).

In any case, when funds are scarce and the poverty is so common in a country like Nepal, it's really difficult to decide to invest in building reinforcement for an earthquake that could occur in the next 100 years, while reducing money for food or for education policies in the next 10 years.

So, what to do in these cases? This situation is really an ethical dilemma. It is easy to affirm that the key for the earthquake safety is a strong building code properly enforced. This is often difficult to accomplish, even in wealthy countries.

In countries like Nepal, more likely a key for the future is to learn how to rebuild with available local materials, but especially using methods that provide greater security against seismic loading. Re-building

using the same methods might provide shelter more quickly, but could mean also to set the stage for the next tragedy (<http://croninprojects.org/Vince/Earthquake/EQconstruction.html>, courtesy of Vincent Cronin).

Conclusions

The defense against geo-risks is not only a technical problem, but also and above all a cultural, ethical and social issue.

It is necessary to increase the resilience of the populations exposed to risks, their capability to respond and react positively to the social consequences of geological disasters.

It is evident that geoscientists play a key role in achieving this purpose (Peppoloni and Di Capua 2014), but they must become more credible in front of the public opinion. Also politicians must assume a clear responsibility towards citizens, by adopting prevention policies having a large time horizon. The fruitful relationship among them is crucial.

Prevention of geo-hazards is the only weapon, effective over time, to defend our lives, infrastructures, productive activities and cultural heritage (Peppoloni 2014). Not investing in prevention means to transfer irresponsibly the social and economic costs of a disaster on the shoulders of future generations.

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