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Geoethical elements in risk communication

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Risk communication process contains not only scientific but also ethical elements, which have been discussed only in recent years. A systematic and detailed discussion about this subject is necessary to be generally accepted by human societies. Risk communication on natural hazards is a three-way process involving: 1) scientists, 2) scientists and public authorities, and 3) scientists and the public and the mass media. It is important to note that the perception of risk is not only a matter of scientific and technical evaluations but also feelings of fear and outrage (including emotional and cultural aspects). It is necessary to expand the range of assessment taking into account the High-impact Low-frequency events, as well as incorporating new ways of thinking as the black swan theory. Crisis analysis should include the study of unusual or unexpected events in order to improve risk communication planning, additionally considering geoethical elements.

Introduction

Geoethics was born at a junction of geology and ethics (Nemec, 1992), and has developed for last two decades by extending its application to many field of geosciences (s.l.) including planetary geology (Martínez-Frías et al. 2009; Martínez-Frías et al. 2011; González and Martínez-Frías, 2011). The AGID (Association of Geoscientists for International Development) Working Group for Geoethics issued the International Declaration on Geoethics (AGID WG for Geoethics, 2011), in which the following recommendations are included:

- To emphasize the significance of geoethics in the context of facing extraordinary natural hazards and disasters in the course of recent years.
- To incorporate a geoethical approach to needed new legal aspects (including insurance policy) and to an ethical way of thinking.
- To strengthen the links of geoethics with the new aspects of the geosciences education.
- To recommend the inclusion of geoethical subjects into deontological codes.
- To emphasize the liaison with the mining engineers activities.
- To remark a need of searching new priorities for 3rd Millennium fitting the Word Millennium Goals.

- To recommend links for incorporating geoethics into any activity related with the abiotic world.

This Declaration was recently updated (2013) and extended with a new one in the context of the AGID's International Conference of Geoethics. Geoethics is clearly defined as follows in the main website of the International Association of Geoethics (IAGETH) (<http://icog.es.iageth>).

"Geoethics is an interdisciplinary field between Geosciences and Ethics, dealing with the way of human thinking and acting in relation to the significance of the Earth as a system and as a model. It includes not only scientific but also educational, technological, methodological and social-cultural aspects, such as sustainability, development, geodiversity and geoheritage, prudent consumption of mineral resources, appropriate measures for predictability and mitigation of natural hazards, geosciences communication, museology, and others".

The study of the geological record evidences that our planet has been constantly affected by extremely serious natural (terrestrial and cosmic) hazards. There is an increased interest about the causes and effects of these hazards to human societies. Crisis analysis should include the study of unusual or unexpected events in order to improve risk communication planning. Geoethical elements should be taken into the account in the framework of risk assessment and risk communication.

Geosciences information and duties relating natural hazards

A detailed search in the well-known Web of Science database crossing the terms: "geosciences", "information" and "risk" allows one to assess the "state of the art" about these issues. This search yields only 37 results in the Web research domains of "Science Technology" and "Social Sciences" confirming the need for incorporating social aspects in any geoscientific aspect of this issue. The research areas are: Geology, Engineering, Environmental Science, Ecology, Energy Fuels and Computer Sciences. The source journals are the following: Natural Hazards, Bulletin of Canadian Petroleum Geology, Comptes Rendus Geoscience, and Environmental Geology. The main Funding Agencies: the Australia Indonesia Facility for Disaster Reduction AIFDR, and Indonesian Agency for Disaster Management. All the documents appeared in the period 2000-2012. The results obtained are very similar if the term "risk" is substituted by "hazard" (32 results) although the source journals are different. In

this case they are: Episodes, Natural Hazards, Global and Planetary Change, and Journal of Geodynamics.

Geosciences information about matter related to natural hazards allows society to construct the safeguard system and to foresee and reduce the later damage. This information is also essential during the period in which a crisis is taking place. The crisis management of a natural hazard is an activity that is performed under time pressure, and requires decisions under uncertain conditions. In such a situation, any related geosciences information should be identified and used to develop options and the associated risks. These should be presented to politicians and other decision-makers. After a disaster has taken place, the missions are to rescue the people, and to recover and restore the damaged area. Crisis can arise from many natural hazards and can be sudden or slow in onset (Fig. 1). Effective communication on the risks associated with natural hazards during a crisis development is an essential and integral component of the crisis management process.

Figure 1. Crisis development from natural hazards.

The primary responsibility of geoscientists is to obtain detailed and advanced information through continuous scientific research on natural hazards. Geoscientists should act in an open way clearly transmitting the obtained information for the use by the society. Given that such information is very important and sensitive, its accuracy, reliability, speed, simplicity, acceptance and related characteristics should be examined in advance. Likewise, it is also necessary to prepare the guidelines on the dispatching the information at the site of the natural hazard, considering the content, level, method, timing and related issues (Nishiwaki, 2011). Geoscientists have not only scientific but also legal, social and ethical responsibility for their activities. Specifically in relation with natural hazards, the duties can be summarized as follow:

- To provide their knowledge and skills in risk mitigation to the society based on the current or previously published research.
- To cooperate with public authorities in crisis and disaster, by giving advice from scientific viewpoints.
- To assist in the transmission of information to society, by synthesizing and explaining the original information.

General principle of ethical element in risk communication

Geoscientists have both the rights and duties to keep independence

and impartiality in risk communication. They should deal with interferences from outside in serious and humble manner, distinguish clearly own and outside interests, and reject improper pressures and demand if necessary. It is their social responsibility to make professional decisions in accordance with public interests on safety, health and environment of citizens and area in the crisis. Cooperation with others (scientists, governments, citizens, etc) is a principal factor in the framework of risk communication, and ethical dimension and legal obligation should be kept in the process. Other ethical principle in risk communication is the principle of beneficence that consists of two obligations: (1) the duty to help others further their legitimate interests, and (2) the commitment to help weigh and balance possible goods against possible harms. All ethical elements can inspire a *deontological code* (Martínez-Frías et al. 2011, González and Martínez-Frías, 2011; Nikitina, 2012; Vasconcelos, 2014) or good practices protocol applicable to Geosciences communicators working during natural hazards. The main function of the code is to regulate an ethical behavior in a communication process during a natural hazard event. It also should serve to inspire, give courage and support to ethical geoscientists, but should also provide a basis for action against untrustworthy people. In contrast to the legal codes, *ethical codes* should not only prohibit conducts, but should have a positive emphasis and focus on desirable models of professional behavior.

Relations among scientists, authorities, mass media and the general public

As previously defined, risk communication on natural hazards is a three-way process, which takes place among scientists, between scientists and public authorities, and between scientists and the public and the mass media. The communicators on natural hazards, whenever possible, seek feedback from the recipients to assess whether and how messages are understood and accepted. It is also essential to obtain the scientific consensus in public communication, by learning to work with other professionals. The mutual agreement should be made in advance for the cooperation to put into practice scientific procedures in crisis. Open and tolerant attitude to external scientific vision is helpful for the constructive cooperation with other professionals. Effective dialogue (even from a geoeducational perspective) should be realized with public authorities. Team work is required for the communication. It is also important to transfer the concept of probability to public authorities, which is involved in the risk assessment of natural hazard, being aware of the differences of standpoints.

Geoscientists are requested to make scientific decisions in a limited time in crisis of natural hazard. Thus, they should learn and be trained to work under time pressure (although geoscientists are scientists, not the crisis managers). Regarding the contacts of geoscientists with the media on the natural hazards and its risk assessment, especially in the crisis, it is essential to use accurate language in the explanation, avoid distorted facts and facts out of the context, and prevent contradictory statements with other professionals. Appropriate geosciences information is vital for the accurate understanding of natural hazards. Publication of opinions based on geosciences information will enable people to form an informed opinion. It is also necessary to have a certain empathy with the local culture; this will facilitate the acceptance of the opinion/proposals from the outsiders.

Risk perception

Risk communication became more prominent in the late seventies. It resulted from industry effort to counter public concern about the use of technologies involving a perception of high risk, such as nuclear power and chemical pollution, for example. It was thought that clear and understandable information was enough for society to understand that the risks were less than what people feared. Nowadays, many experts believe that this approach is failing and is inadequate. The perception of risk is not only a matter of technical evaluation but feelings of fear and outrage (Sandman, 1993). The spectrum of risk perception can also be attributed to people's differing attitude and beliefs as well as wider social or cultural values, and the disposition that people adopt towards natural hazards (Haynes et al., 2008). Therefore, a risk communication that ignores the emotional and cultural aspects may be incomplete. Based on these criteria, we can distinguish four types of risk communication scenarios or crisis communication:

- *Scenario 1.* It coincides with a high risk situation and low hazard perception, to which citizens are apathetic. Communication should focus on promoting the reaction so that danger be well understood and the recommended actions can be carried out. In this situation one can find a government that wants to evacuate the population before an imminent natural hazard that is not socially perceived.
- *Scenario 2.* It occurs in a low risk situation and high hazard perception. The public is more concerned and angry than the danger required. In these cases, the messages should focus on reducing the alarm and explain the problem in a realistic way.
- *Scenario 3.* It matches a dangerous situation and balanced hazard perception, where the audience is not too apathetic or excessively active. The communication is based on interpersonal dialogue,

supplemented by the transmission of messages through specialized media.

- *Scenario 4.* It occurs in crisis situations, when the audience is concerned about a natural disaster that is about to happen or has already happened. In this case, the communicators must articulate a message that explains exactly what is happening and how to act.

New threats and challenges in risk communication

In the information age, people can easily access massive and diverse information (although the users themselves need to evaluate/verify such information). It is important to stress that in this scenario there are new types of threats. Increasing of information manipulation is a serious problem, as it can lead citizens to confusion or indecisiveness during a crisis. In a hyper connected world, the digital wildfire (or flaming) is easily invoked, regardless whether intentionally or accidentally. Such fire is extremely dangerous from a social perspective as can lead to a panic and riot. For instance, in 1938, thousands of Americans mistook the radio broadcast of the adaptation of the novel by H.G. Wells "The War of the Worlds" with a real event and everyone panicked believing that the world had been invaded by Martians. In 2012, an anonymous twitter user spread the false rumor that the New York Stock Exchange trading floor was flooded with water during Hurricane Sandy. This significantly increased the perception of risk in the population. Today, the rules of digital content are still being produced. Collaborative efforts among geoscientists are required in the social media to avoid dangerous consequences. Internet remains an uncharted domain in geoethical action. Controlling the spread of false information online on natural hazards and rapidly

Figure 2. Japan's coastline before and after the Tsunami. Courtesy: NASA

publishing accurate information should be a goal of Geoethics.

In the recent years the theory and techniques of risk assessment have been developed, and it becomes possible to assess more types and range of natural hazards. It is, however, necessary to introduce new perspectives. It is indispensable to enlarge the range of assessment, and include the High-impact Low-frequency (HILF) events (High-Impact Low-Frequency Event Steering Committee, 2010). Though the HILF are complex and uncertain, they should be studied and assessed because of their potential for tremendous damage. However, uncertainty is one of the main obstacles in risk communication. To make effective decisions a risk assessment is required, but often there are large gaps in our knowledge. Until the complete evaluation is available, it is necessary to learn to say “*we don’t know*”.

Recognizing the uncertainty of the HILF events, risk communication should contain messages that include statements such as “*our understanding of these risks is always improving*”, or “*we do not yet have all the facts*”. Honesty is a fundamental value in risk communication. Under uncertainty, communicators should never say “*don’t worry, there is no risk*”, or “*any concern is irrational*”. It is necessary to talk to people about possible unexpected crisis as a consequence of a natural hazard. Paradoxically, talking freely about worst case scenarios from crisis is likelier to calm people than to frighten them (Sandman, 2004).

It is necessary to supplement our common sense with new ways of thinking, such as the black swan theory (Taleb, 2007). An event with catastrophic effects (Fig. 2), which had been believed a rare and unforeseen event, may be identified as a common event when new evidence has been found and a new model developed outside of current theories. Many security challenges associated with rapid changes occur in a society which is increasingly interconnected. These changes and resulting crisis can be unpredictable. However, risks are expected to be connected with the fragility of the economic system and, consequently, monitoring threats is not enough. We should strengthen the analysis of the vulnerabilities and interdependencies among the different kinds of risks, as well as identify the crisis scenarios (González, 2013). Crisis analysis should include the study of unusual or surprising events in order to improve risk communication planning. These scenarios are plausible futures that violate one of the assumptions that underlie a crisis response plan. The specific purpose is to help planners develop signposts for keeping a flexible preparedness framework (Deward, 2002).

Final consideration

It is a fundamental role in geosciences to try to clarify and predict natural hazards. Risk assessment should be discussed from scientific and technological view point on information processing, hazard modeling and forecasting, disaster alarming and mitigation, and related issues. The resulting information should be published and communicated in a timely manner so that it can be utilized for disaster mitigation. The communication should contain not only scientific but also ethical elements. The latter elements have been addressed only in recent years, and a more systematic and detailed analysis is crucial for their general acceptance by human societies.

Acknowledgements

We want to thank Prof. Yildirim Dilek, Miami University (USA),

for his excellent review and extremely useful remarks, which have greatly improved the quality of our original manuscript. Thanks also to Dr. Yujiro Ogawa for his editorial work and our special thanks to Dr. Anthony Reedman (AGID) and Prof. Vera Kolb of University of Wisconsin-Parkside for their useful remarks and detailed revision of the English version.

References

- AGID WG for Geoethics, 2011, International Declaration on Geoethics. (Příbram, Czech Republic, October 2011) :http://tierra.rediris.es/Geoethics_Planetary_Protection/AGID_Geoethics_International_Declaration.htm
- Deward, J.A., 2002, Assumption-based planning: A tool for reducing avoidable surprises: Cambridge University Press, 268 p.
- González, J. L., and Martínez-Frías, J., 2011, Geoética: un reto para la deontología profesional: *Tierra y Tecnología*, no. 40, pp. 10-14.
- González, J.L., 2013, Aspectos civiles de la gestión de crisis. En “Situación de crisis en la UE, conducción de crisis y reforma del sector de la seguridad”: Documento de Seguridad y Defensa, no. 57, CESEDEN, abril 2013, pp. 47-73.
- Haynes, K., Barclay, J., and Pidgeon, N., 2008, The issue of trust and its influence on risk communication during a volcano crisis. *Bulletin of Volcanology*, v. 70, no. 5, pp. 605-621.
- High-Impact Low-Frequency Event Steering Committee, 2010, High-Impact, Low-Frequency Event Risk to the North American Bulk Power System: A Jointly-Commissioned Summary Report of the North American Electric Reliability Corporation and the U.S. Department of Energy’s November 2009 Workshop. NERC, 118 p.
- Martínez-Frías, J., Nemec, V., Nemcova, L., De la Torre, R., and Horneck, G., 2009, Geoethics and Geodiversity in Space Exploration: Implications in Planetary Geology and Astrobiology: 9th European Workshop on Astrobiology, EANA 09, 12-14 October 2009, Brussels, Belgium.
- Martínez-Frías, J., González, J. L., and Pérez, F. R., 2011, Geoethics and Deontology: From fundamentals to applications in Planetary Protection: *Episodes*, v. 34, no. 4, pp. 257-262.
- Nemec, V., 1992, Ethical Geology in the Education Process: 29th International Geological Congress, Kyoto, Japan, 24 August-3 September 1992. Section II-24-1 «New ideas and techniques in geological education», v. 3, no. 3, Abstract/Paper 06.
- Nikitina, N., 2012, Geoethics: theory, principles, problems. Monograph. M: LLC Geoinformmark, 2012. ISBN 978-5-98877-049-7, 155 p.
- Nishiwaki, N., 2011, Geoethical importance of information management before/after natural hazards: *Abst. Mining Příbram Symp.*, pp. G5.1-4.
- Sandman, Peter M., 1993, Responding to community outrage: strategies for effective risk communication: Falls Church, American Industrial Hygiene Association, 141 p., <http://www.petersandman.com/media/Responding toCommunityOutrage.pdf>.
- Sandman, Peter M., 2004, Worst Case Scenarios. The Peter Sandman Risk Communication Website, <http://www.psandman.com/col/birdflu.htm>
- Taleb, N. N., 2007, *The Black Swan: The Impact of the Highly Improbable*: London, Penguin Books, 366 p.
- Vasconcelos, L. (2014) The deontological and ethical code of Mozambique. AGMM, http://www.icog.es/iageth/wp-content/uploads/2014/06/Deontological-EthicalCode_Mozambique2.pdf