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Geoethics in communication of science: the relationship between media and geoscientists

FRANCO FORESTA MARTIN
Laboratorio-Museo di Scienze della Terra, Isola di Ustica, Palermo, Italy
sidereus@rocketmail.com

SILVIA PEPPOLONI
Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy
IAPG - International Association for Promoting Geoethics
silvia.peppoloni@ingv.it

Abstract

The themes addressed by geoethics are becoming central to all scientific debate. A growing number of scientists now consider geoethics as an effective tool to increase, in the scientific community and society as a whole, the awareness of local and global environmental problems that humanity faces. Geoethics deals with ethical, social and cultural aspects related to geosciences. Geoethics addresses fundamental issues such as the prudent and sustainable use of geo-resources, management of natural hazards, defence of geoheritage as a common value to be protected and enhanced. But above all, geoethics aims to raise, in the community of geoscientists, their awareness of responsibilities in conducting scientific and professional activity. In order to extend this awareness to the whole of civil society and also to foster the recognition of the usefulness of geosciences in daily life, geoscience communication should be recognized as a fundamental activity connected with scientific and professional work, since geoscience knowledge is a tool to contribute to the construction of social knowledge for human communities. But today what is the role played by geosciences in the scientific mass culture? Are the geosciences part of a collective "cultural heritage"? Do the publishing world and media offer adequate space to geosciences?
Through the analysis of two Italian case studies, the authors highlight the critical features of the relationship between geoscientists and the media and try to suggest some actions that are useful to make the relationship between these two separate fields more functional, with the goal of bringing citizens closer to geosciences and increasing the awareness of the individual and collective responsibility towards the Earth.

1. INTRODUCTION: WHAT IS GEOETHICS?

The International Association for Promoting Geoethics (www.geoethics.org) has defined geoethics as the "*research and reflection on the values which underpin appropriate behaviours and practices, wherever human activities interact with the Earth system*", those universal shared values on which to base correct behaviors and practices towards the Earth system, considering the different social and cultural contexts and the existing political and economic realities. So, geoethics deals with the ethical, social and cultural implications of Earth Sciences knowledge, education, research, practice and communication (Peppoloni & Di Capua, 2014; Bobrowsky et al., 2017).

Geoethics analyses ethical and social implications in a wide range of geoscience studies and practices, i.e in exploitation and use of geo-resources, the management of geo-hazards, climate change adaptation policies, impact of geo-engineering on the natural environments. But above all, geoethics aims to raise in the community of geoscientists their awareness of responsibilities in conducting scientific and professional activities. Geoscientists have to consider the indisputable ethical, social and cultural implications of geoscience research and practice and their personal possibility to influence decision-making in regards to land, water and air.

2. THE ROLE OF GEOSCIENTISTS IN BRINGING GEOSCIENCES CLOSER TO THE PUBLIC

In order to extend this awareness to the whole of civil society and also to foster the recognition of the usefulness of geosciences in daily life, it is important to develop proper communication of geological knowledge, that is capable to contribute substantially to the construction of social knowledge for human communities.
Scientific information presented in the media is one of the main themes discussed within geoethics and a growing number of geoscientists now consider geoethics as an effective tool to increase in society the awareness of local and global environmental problems that humanity faces. Geoscientists have peculiar knowledge and skills. As scholars of the planet Earth and experts of their territory, they can highlight the importance of geosciences as a group of disciplines that can contribute to the construction of correct social knowledge, by helping to dispel misconceptions about natural phenomena and to strengthen the link between the identity of human populations and land.

3. GEOSCIENCES AND COMMUNICATION

Do the publishing world and media in general offer an adequate space to geosciences? How are geoscientists treated and what is their influence in the field of media information?
In the case of geosciences the relationship with the media is particularly significant when focused on the issue of natural disasters that strike the earth (i.e. earthquakes, floods, volcanic eruptions). Surely there is an interest by the media towards these phenomena greater than other scientific arguments, since their impact on the population is often very strong. Consequently, the relationship between journalists and scientists, certainly already delicate in "normal" times, becomes critical after the occurrence of a natural disaster. On the occasion of the 2009 earthquake in L'Aquila (central Italy) the problem of the relationship between media and science was evident (Cocco et al., 2015). Did the media play a neutral role in that affair?

The communication to the public of the research work carried on in the field of Geosciences (Stewart & Nield, 2012), as well as that relating to other scientific disciplines that are the subject of information and explanation through the general media, is confronted today with two established trends: a) the crisis of print journalism; and b) the globalization and wider spread of scientific news through the internet. These two trends, which were outlined at the end of the last century and which were greatly expanded in the early years of the present century, contain positive and negative potential. Between science journalists and the broader field of scientific research, there is currently a subject of debate regarding the reasons for concern or optimism, as noted by a report on the practice and ethics of science journalism in the age of global communication (Bauer et al, 2013). On the one hand it could seem positive that information and science communication in the new media has found a fertile ground to multiply, as shown by the most recent surveys that indicate the online newspapers, websites, and even the social networks Facebook and Twitter, but especially individual blogs, act as the sources of scientific news more so than science journalists (Brumfield, 2009).

4. CRITICAL POINTS

However, it is a fact that while scientific news spreads on the web without the press, its quality is often considerably diminished. Two-thirds of a sample of nearly a thousand science journalists from around the world, interviewed on this subject (Bauer et al, 2013), admit that the pressures on their productivity, extracted from the publishers of the news media, ultimately damage the content of their work.
In Anglo-Saxon countries we are referring to "Web Churnalism" (from the verb "to churn out";
https://www.theguardian.com/science/the-lay-scientist/2011/apr/25/1) to indicate those journalists who merely compile articles by copying pieces of press release or other articles, without exerting any critical control on sources and content, only with the goal to meet the needs of continuous renewal of web pages

comprising topics of assured emotional grip. The Churnalists would be: "journalists who are no longer gathering news, but are reduced instead to passive processors of whatever material comes their way, churning out stories, whether real event or PR artifice, important or trivial, true or false" (Davies, 2008). With a definition, perhaps less effective but equally explicit, the authors of the aforementioned report on science journalism do not hesitate to speak, in these cases, of "Science news cut and paste journalist" (Bauer et al., 2013).
With all their limitations and approximations, the major print media , now in serious decline (https://www.theguardian.com/commentisfree/2013/oct/29/decline-print-media-journalism-web; Bauer et al, 2013), have the merit of having grown several generations of journalists specializing in scientific issues, of having dedicated sections of their pages to scientific news and dissemination of science, of having exercised a sort of review, although unconventional, on texts concerning the subjects of science. In case of disputes regarding content, the authors of the texts and the editorial staff are identifiable and accessible interlocutors, for any required clarifications and corrections.
On the web those newspapers that meet the principles of good quality of the information and science dissemination, as well as of a sound professional ethics, are dispersed in an undifferentiated milieu of individual websites, commercial initiatives and groups of opinion that offer few guarantees of fairness and in the midst of which the reader can easily get lost, without distinguishing the true from the false or likely.

5. A WARNING: THE EXTINCTION OF SCIENTIFIC JOURNALISTS

The decline of the printed newspaper in terms of sales, print runs and advertising revenue, among the many consequences, is leading to the progressive extinction of qualified science journalists who worked full-time for a masthead and are now removed and not replaced with similar professionals. "*The Securely employed specialist correspondent, writing for print and seriously investigating a story, is an endangered species,*" concludes the report on Science Journalism, taking up the data collected by the 2009 survey of Nature (Bauer et al., 2013).
The transition from scientific journalism practiced in the print media to online journalism highlights failures which should be rectified soon, especially considering that disciplines such as geosciences and environmental sciences suffer more heavily the repercussions of such failures, because of their strong impact on social safety, quality of life and environment, and on ethics of development.
We must consider that scientific news that is distorted or even totally invented, that is misleading or provides completely erroneous explanations, whether relating to the field of astronomy, particle physics or technology (just to name a few), is a detriment to the mass culture because quite often most readers incorporate these observations uncritically.
The same mistakes and incorrectness of information can be related to geosciences, if such indiscretions are made during a seismic event, or a hydrogeological or climate crisis, and can go far beyond the cultural implications and actually endanger human lives and material goods of society

6. TWO ITALIAN CASE STUDIES

In 2014 the Italian media dealt with a case that addressed the danger related to a wrong or distorted communication in the field of geosciences. The case became the subject of reflection on popular science magazines by seismologists from the Istituto Nazionale di Geofisica e Vulcanologia - INGV (Italian Institute of Geophysics and Volcanology) (Amato, 2014).
The case referred to a device, marketed and presented as a potential life-saving instrument, which would have been able to provide an appropriate visual and audible warning of the imminent arrival of a seismic shock above 3.0-3.2 Richter magnitude, taking advantage of the delay between the P and S waves (the latter potentially more destructive). So, in the opinion of the person who favourably presented this product, it would have been possible to have several seconds to evacuate a building or to be sheltered from a possible building collapse. But the seismic history of Italy teaches us that most

of the time earthquakes struck in areas very close to towns or villages, so the damages and casualties occur in the vicinity of the epicentre where the time difference between the S and P waves is negligible (Fig. 1); and that if this minimum forewarning was instinctively used to leave the house, people would have been exposed to dangers far more serious, for instance the collapse of stairs or cornices (Amato, 2014).

These considerations didn't prevent some media from speaking of the device as a technological innovation and from promoting it as a kind of "do it yourself" solution to seismic safety. More recently, on the occasion of earthquakes that occurred in central Italy starting from August 2016, another example of recurring "fake news" can be illustrated. It refers to the alleged manipulation of seismic data by the INGV, the scientific public body responsible for promptly transmitting the estimate of the magnitude of earthquakes to the Italian Department of Civil Protection. For some time now, after the occurrence of earthquakes of medium / high magnitudes, that are unfortunately frequent in the seismogenic areas along the Italian peninsula, some newspapers, magazines and social networks started to suggest that INGV underestimates the magnitude purposely, in order to reduce the refunds that the government provides to citizens for the damages suffered (since the magnitude would have been lowering below the refund threshold). This is a typical case of "conspiracy theory" that is refuted repeatedly by the publication of facts and details, but one that is resistant to any rational explanation. This particular type of "conspiracy theory" deliberately ignores two facts: the first concerns the scientific aspect, the second the normative aspect of the alleged plot.

As regards the scientific aspect of the issue, it is necessary to clarify that upon the occurrence of an earthquake, the INGV seismologists calculate firstly the value of the Richter magnitude - ML (also called "local magnitude"), that has the advantage of being obtained in a few tens of seconds, starting from the maximum amplitude of the oscillations registered by a Wood-Anderson seismometer. Thus, the value obtained is communicated to the Italian Department of Civil Protection within about two minutes, whereas the media receive the value via web after at least 12 minutes. However, this maximum amplitude on the seismometer does not account for all the energy released by the earthquake. To get a more accurate estimate it is necessary to calculate the so-called moment magnitude - Mw, which requires a longer processing time and is especially important for earthquakes with ML greater than 6: thus for these events the moment magnitude Mw can indeed be up to 0.5 higher than the local magnitude ML. Obviously, even the Mw values are disclosed to the media, but they lag behind the local magnitude (ML), which is communicated immediately after the earthquake.

On the occasion of the earthquake that occurred on 30 October 2016 (6h.40m UTC) in the province of Perugia (Lat. 42.83, Long. 13.11), the ML magnitude was 6.1, whereas the Mw 6.5. This was enough for some bloggers to launch a charge of government conspiracy.

As for the normative aspect, the Italian Law N. 100, dated 12nd July 2012, which regulates the remuneration criteria to the inhabitants of areas struck by earthquakes, makes no reference to the local magnitude, nor to the moment magnitude. The Law is based on the Mercalli-Cancani-Sieberg scale, which classifies earthquakes in relation to their effects on people and objects, and thus refers to the seismic intensity, connected to the extent of the damage. Therefore, any differences between the values of ML and Mw cannot be invoked to demonstrate the existence of a conspiracy, simply because gov-

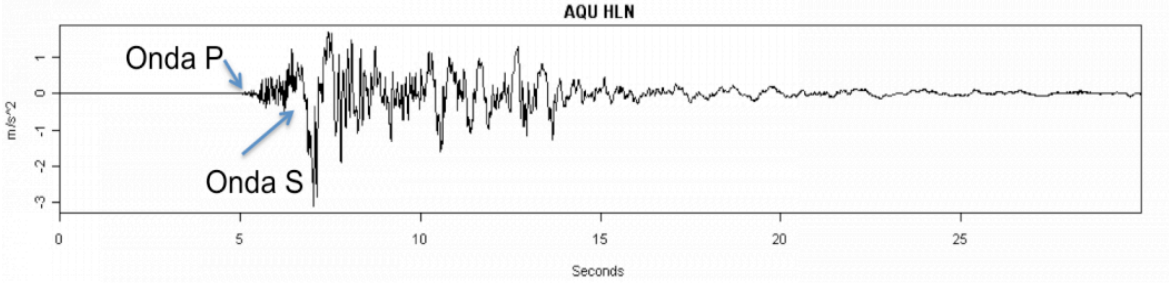

Figure 1: *Delay of just 2 seconds between the P and S waves in instrumental registration of the destructive main shock of the April 6th, 2009 L'Aquila earthquake, Italy (Amato, 2014).*

ernment refunds are based on seismic intensities, and not on magnitude values.
Since both of these refutations, scientific and normative, have got wide circulation on the same channels in which "conspiracy theories" are spread, the fact that the idea of a plot persists among the population is a case study to be treated with the mass psychology tools in the Internet era, rather than with the instruments of effective information and scientific dissemination.
This kind of communication misconduct by the media can have very negative repercussions on the social structure: the loss of trust in the institutions by citizens, the discrediting of science that is not perceived in its important function to serve society.

7. CONCLUSIONS

Geosciences have always had a difficult relationship with the general media. Newspapers have turned their attention to the geosciences, mostly, on the occasion of crises and natural disasters, rather than follow the most promising developments of the research in a balanced and constant way. This attention centered on the emergency phase after a disaster is probably due to the fact that the same researchers in the field of hazards studies are not committed enough to spread the content of their work in order to make them understandable and exciting for the general public. Specialists in other scientific disciplines have been able to manage this undertaking more successfully: disciplines no less "abstruse", counter-intuitive and complex than geosciences enjoy a more constant and productive relationship with the media.
The exploit of scientific communication through the Internet is now a great opportunity to reverse this trend because it offers an abundance of space and attention that the print media have not been able to provide, due to their own nature and publishing organization. At the same time the Internet has permission to open a direct dialogue between researchers and information professionals, through initiatives such as blogs, forums, social networks, and newsletters that are hosted in the corporate websites of scientific research institutes. An effective way to counter junk science and misinformation that is spreading on the web will require making more useful and attractive the spaces dedicated to the proper communication of geosciences for information operators. Some scientists and science journalists show a superficial attitude with respect to science dissemination. They should not underestimate the importance of transmitting reliable scientific information to citizens that should be their fundamental social task. How much are both entities (journalists and geoscientists) aware of the responsibility inherent to this activity? And how is it possible to strengthen this ethical responsibility?
The values of geoethics (Peppoloni & Di Capua, 2016), such as integrity, honesty, trustworthiness, accountability, accuracy and impartiality, can orient both scientists and science journalists to find the best way to cooperate, and to ensure the best service to the general population. In fact both groups should share the same ethical values and should aim for the same goal: to make scientific knowledge an integral part of social knowledge.

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