Natural hazards and scientific advice: Interactions among scientists, decision makers and the public

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The death toll of natural hazards has been dramatically increasing for a few decades. This is mainly a consequence of the increase of population density and of the vulnerability of many hazard prone areas. False and missed alarms have been harshly questioned by the population and sometimes by governmental authorities. An extreme case is the first level conviction of seven Italian scientists for the information given to the public before the Mw6.3 earthquake hitting the city of L'Aquila (Italy) and surrounding municipalities on April 6, 2009. Similar and greater disasters occurred after 2009 due to natural hazards, such as the Tohoku exceptionally violent earthquake and tsunami hitting Japan in 2011, the Christchurch earthquake sequence in New Zealand, the large floods covering central and south eastern Europe in 2006 and 2013, the floods triggered by Hurricane Irina in NE USA in 2012 etc. The reactions of public and legal authorities have been different, not reaching the extremes of L'Aquila sentence. The reactions of people and authorities to scientific information appears to be strongly conditioned by the level of risk-awareness and memory of past events. However, all the reactions of public and administrators have a common background: the lack of consciousness that we live in a probabilistic world where all scientific assessments concerning natural hazards and risks have a probabilistic character and a related uncertainty. This concept is missing in the legislation of many countries. The court of L'Aquila sentence had immediate negative consequences, at least in Italy, triggering a strongly defensive attitude in all the actors of crisis management during a natural event, hindering the implementation of innovative methodologies, such as those of early warning, that can save many lives but have inherently significant levels of false and missed alarms. Future scenarios of science - decision making people interactions must consider seriously the pros and cons of the rapidly growing role of social networks in immediate pre or during crisis information. The complexity of future communication scenarios can be approached by a widespread and transparent use of a probabilitic approach in risk governance, an advanced pre-event formation of people and administrators, and the establishment of operational risk reduction guidelines. Finally a reformulation, where necessary, of the legislation on the management of risks should clarify duties and responsibilities and introduce the concept that false and missed alarms may be significant in any risk management method.

Mantle source heterogeneity beneath the Garrotxa Volcanic Field (NE Spain)

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The Neogene volcanism in NE Spain, which is related to the rift-type extensional tectonics affecting the eastern margin of Iberia since late Oligocene, is well represented in the basalts and basanites from the Garrotxa Volcanic Field (GVF). Geochemistry of the GVF magmas is comparable to that of the Cenozoic Eastern Atlantic and Euro-Mediterranean eruptive centers related to the European Astenospheric Reservoir (EAR). The EAR is thought to have originated by the mixing between plume-like material (carrying a HIMU signature) and the shallower depleted mantle (DMM). The GVF mantle source and the EAR share comparable trace element distribution, enrichment levels and characteristic ranges of trace element ratios (e.g., Ba/La, K/La, Zr/Nb). However, isotope data from the GVF magmas call for the presence of a compositionally heterogeneous mantle source, which is considered to be the result of the mixing between two end-members. While a first end-member presents relatively high $^{143}Nd/^{144}Nd$ and $^{206}Pb/^{204}Pb$ values and shows geochemical features close to average EAR, the second end-member is characterized by relatively lower $^{143}Nd/^{144}Nd$ and $^{206}Pb/^{204}Pb$ and slightly higher $^{87}Sr/^{86}Sr$ ratios that are recurrent in EMI-type magmas. To constrain the isotope features of the GVF magmas, their Sr, Nd and $^{206}Pb/^{204}Pb$ isotopic compositions together with those of worldwide OIB, anorogenic European rocks, and lithosperic and crustal samples from the Pyrenean and Iberian domains were projected into a tethraedron with the four classical mantle end-members (DMM, EMI, EMII, HIMU) as vertices. The three-dimensional perspective indicates that the GVF mantle source isotope characteristics are consistent with a heterogeneous lithosphere, variously metasomatized by both the EAR and EMI components, and strongly related to the local tectonic structure, e.g., crustal thinning.

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