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Extreme Geohazards: Reducing Disaster Risk and Increasing Resilience

Hans-Peter Plag (1), Seth Stein (2), Sean Brocklebank (3), Shelley Jules-Plag (4), and Paola Campus (5)

(1) Old Dominion University, Climate Change and Sea Level Rise Initiative, Norfolk, United States (hpplag@odu.edu), (2) Department of Earth & Planetary Sciences, Northwestern University, Evanston, IL, USA, (3) University of Edinborough, U.K., (4) Tiwah, UG, Rossbach, Germany, (5) European Science Foundation, Strasbourg, France

Extreme natural hazards have the potential to cause global disasters and to lead to an escalation of the global sustainability crisis. Floods and droughts pose threats that could reach planetary extent, particularly through secondary economic and social impacts. Earthquakes and tsunamis cause disasters that could exceed the immediate coping capacity of the global economy, particularly in hazardous areas containing megacities, that can be particularly vulnerable to natural hazards if proper emergency protocols and infrastructures are not set in place. Recent events illustrate the destruction extreme hazards can inflict, both directly and indirectly, through domino effects resulting from the interaction with the built environment. Unfortunately, the more humanity learns to cope with relatively frequent (50 to 100 years) natural hazard events, the less concerns remain about the low-probability (one in a few hundred or more years) high-impact events. As a consequence, threats from low-probability extreme floods, droughts, and volcanic eruptions are not appropriately accounted for in Disaster Risk Reduction (DRR) discussions.

With the support of the European Science Foundation (ESF), the Geohazards Community of Practice (GHCP) of the Group on Earth Observations (GEO) has developed a White Paper (WP) on the risk associated with low-probability, high-impact geohazards. These events are insufficiently addressed in risk management, although their potential impacts are comparable to those of a large asteroid impact, a global pandemic, or an extreme drought. The WP aims to increase awareness of the risk associated with these events as a basis for a comprehensive risk management. Extreme geohazards have occurred regularly throughout the past, but mostly did not cause major disasters because the exposure of human assets to such hazards and the global population density were much lower than today. The most extreme events during the last 2,000 years would cause today unparalleled damage on a global scale for a globally connected and stressed society. In particular, large volcanic eruptions could impact climate, damage anthropogenic infrastructure and interrupt resource supplies on a global scale. The occurrence of one or more of the largest volcanic eruptions that took place during the last 2,000 years under today's conditions would likely cause global disasters or catastrophes challenging civilization.

Integration of these low-probability, high-impact events in DRR requires an approach focused on resilience and antifragility, as well as the ability to cope with, and recover from failure of infrastructures and social systems. Resilience results from social capital even more than from the robustness of infrastructure. While it is important to understand the hazards through the contribution of geosciences, it is equally important to understand through the contribution of social sciences and engineering the societal processes involved with coping with hazards or leading to failure. For comprehensive development of resilience to natural hazards and, in particular, extreme geohazards, synergy between geosciences, engineering and social sciences, jointed to an improved science-policy relationship is key to success. For example, a simple cost-benefit analysis shows that a comprehensive monitoring system that could identify the onset of an extreme volcanic eruption with sufficient lead time to allow for a globally coordinated preparation makes economic sense. The WP recommends implementation of such a monitoring system with global coverage, assesses the existing assets in current monitoring systems, and illustrates many benefits, besides providing early warning for extreme volcanic eruptions. However, such a monitoring system can provide resilience only via the capability of the global community to react to early warnings. The WP recommends achieving this through the establishment of a global coordination platform comparable to IPCC's role in addressing climate-change related issues to assess knowledge and related adaptive capabilities for disasters due to extreme geohazards.