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TITLE: Disaster Risks Reduction for Extreme Natural Hazards

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ABSTRACT BODY: Mega disasters associated with extreme natural hazards have the potential to escalate the global sustainability crisis and put us close to the boundaries of the safe operating space for humanity. Floods and droughts are major threats that potentially could reach planetary extent, particularly through secondary economic and social impacts. Earthquakes and tsunamis frequently cause disasters that eventually could exceed the immediate coping capacity of the global economy, particularly since we have built mega cities in hazardous areas that are now ready to be harvested by natural hazards. Unfortunately, the more we learn to cope with the relatively frequent hazards (50 to 100 years events), the less we are worried about the low-probability, high-impact events (a few hundred and more years events). As a consequence, threats from the 500 years flood, drought, volcano eruption are not appropriately accounted for in disaster risk reduction (DRR) discussions.

Extreme geohazards have occurred regularly throughout the past, but mostly did not cause major disasters because exposure of human assets to hazards was much lower in the past. The most extreme events that occurred during the last 2,000 years would today cause unparalleled damage on a global scale and could worsen the sustainability crisis. Simulation of these extreme hazards under present conditions can help to assess the disaster risk.

Recent extreme earthquakes have illustrated the destruction they can inflict, both directly and indirectly through tsunamis. Large volcano eruptions have the potential to impact climate, anthropogenic infrastructure and resource supplies on global scale. During the last 2,000 years several large volcano eruptions occurred, which under today's conditions are associated with extreme disaster risk. The comparison of earthquakes and volcano eruptions indicates that large volcano eruptions are the low-probability geohazards with potentially the highest impact on our 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 infrastructure and social systems. Resilience does not primarily result from the robustness of infrastructure but mainly is a function of the social capital. While it is important to understand the hazards (the contribution of geosciences), it is equally important to understand the processes that let us cope with the hazards, or lead to failure (the contribution of social sciences and engineering). For the latter, we need a joint effort of social sciences and engineering and a revised science-policy relationship. Democratizing knowledge about extreme geohazards is very important in order to inform deliberations of DRR through increased resilience and reduced fragility. The current science-society dialog is not fully capable of supporting deliberative governance. Most scientific knowledge is created independent of those who could put it to use, and a transition to co-design and co-development of knowledge involving a broad stakeholder base is necessary for DRR, particularly for extreme events. This transition may have the consequence of more responsibility and even liability for science.

KEYWORDS: 4302 NATURAL HAZARDS Geological, 4329 NATURAL HAZARDS Sustainable development, 4332 NATURAL HAZARDS Disaster resilience, 4313 NATURAL HAZARDS Extreme events.

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