A conversation with Stephen Sparks 04/16/13

Participants

- Stephen Sparks —Professor, School of Earth Sciences, University of Bristol
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Note: This set of notes was compiled by GiveWell and gives an overview of the major points made by Stephen Sparks.

Summary

Stephen Sparks is a volcanologist who has studied very large volcanic eruptions. GiveWell spoke with Professor Sparks to learn about the risks due to large volcanic eruptions, and interventions to mitigate the damage. He highlighted eruptions that would have a global disruptive impact but are smaller than the largest eruptions on record, and which occur every few hundred years, as being especially worthy of attention.

Interventions to mitigate the damage of very large eruptions are (i) studying what their impact would be, so as to prepare accordingly and (ii) developing better techniques to locate of volcanoes with high potential for very large eruptions (iii) prioritize the monitoring and investigation of these volcanoes.

Volcanic eruptions, their frequency, and their magnitude

There are about 50 volcanic eruptions a year around the world.

While a given volcano may be characterized by stable average eruption frequency, the time between its successive eruptions varies considerably.

Volcanic eruptions vary in magnitude, and their magnitudes are represented on a logarithmic scale. The eruptions that have potential to have a globally significant impact are those of magnitude 7 or greater.

The higher the magnitude, the more rare the eruptions are:

- Magnitude 7 eruptions occur every few hundred years.
- Magnitude 8 eruptions occur every 10k-15k years
- Magnitude 9 eruptions occur every 30k-40k years

Current frequency estimates are based on new data from a 6-year long international effort to compile data, and they are higher than previous estimates. The updated estimates have not yet been published, because the data are so new.

The above estimates are probably in the right ballpark, but there's more work that can and should be done to generate more robust estimates. The uncertainty is the largest for the eruptions of greatest magnitude.

Eruptions of magnitude 9 are unlikely to cause human extinction. Humans and their ancestors have survived for millions of years despite the occurrence such eruptions. The most recent magnitude 9 eruption occurred about 75k years ago at Lake Toba in Sumatra, and archeological records in India indicate that some of the locations that were covered with ash were repopulated within 1000 years.

Because magnitude 9 eruptions are unlikely to cause extinction, and because they're rarer than magnitude 7 eruptions, which already have substantial disruptive potential, the focus of the study of very large eruptions should be on eruptions of magnitude ~7 rather than magnitude ~9 eruptions.

The impact of a magnitude 7 eruption

An eruption of magnitude 7 would emit ash and acid aerosols high into the atmosphere and cool the earth's atmosphere for several years.

- This could have negative impacts on the environment, and for example, affect food security.

  In 1815 there was a magnitude 7 eruption on Mount Tambora in Indonesia, which resulted in crop failure as far away as New England due to frosts in the summer of 1816. This caused a wheat price shock, and resulted in New England farmers migrating to the Midwest and beyond.

  Since the world today is more interconnected and closer to carrying capacity, a disruption in the food supply could damage human society even more than in the 1800's.

- The ash will interfere with airplane travel.

- There are many other possible environmental effects, and there's a lot of research to be done on what they would be.

Research on the frequency and magnitude of past volcanoes

Stephen Sparks was involved in an international collaboration with the Smithsonian Institute and colleagues around the world to compile data on past volcanic eruptions. The collaborators have compiled a database on volcanic eruptions from the last 2 million years, which is available at (www.globalvolcanomodel.org/).

The research on the frequency and magnitude of past volcanoes uses ash fall deposits on land. There's much more work to be done on studying the ice cores in Greenland and Antarctica, and in studying sediment cores in the ocean.

Interventions to mitigate the impacts of very large volcanic eruptions

The energy released by volcanoes is far too large to prevent them by geoengineering.

Possible interventions to address very large volcanic eruptions are:

1. Better modeling of what would happen in the event of a very large eruption, so as to better prepare to for the contingency

2. Improving eruption prediction capacity, for example, by identifying new volcanoes with high potential for large explosive eruptions.

3. Monitoring and characterizing the history and interior structure of these volcanoes

It is currently possible to use satellites to identify volcanoes showing unrest, which may be sign of imminent eruption. However, it's not currently possible to be sure that these volcanoes will erupt or how large the magnitude of the eruption will be. It's difficult to develop methods for determining the magnitude of a potential very large eruption, because very large eruptions happen sufficiently rarely so that data are lacking, and because techniques for imaging the inside of volcanoes are not good enough yet.

If it were possible to determine the amount of magma inside of volcano near eruption, one could determine those that have the potential for very large eruption. So working on improving imaging techniques could be valuable for predicting very large eruptions.

Funding for research on large volcanic eruptions

There is relatively little funding available for the study of large volcanic eruptions.

- There is some funding from the National Science Foundation (NSF) and the European Union (EU) for individual academic researchers.

- The U.S. Geological Survey funds the Yellowstone Volcano Observatory.

- The Smithsonian Institute is the one organization that is funded for the public good to collect data on volcanic eruptions. Currently the Global

Volcano Model network of institutions is collecting data on very large volcanic eruptions. This work principally involves Bristol University (UK), the British Geological Survey, the Geological Survey of Japan and the Smithsonian Institution.

- The insurance industry is interested in large volcanic eruptions, but has not been funding research in this area, instead it currently prioritizes research on tsunamis as well as floods, earthquakes and tropical cyclones.

The project that Stephen Sparks was involved in to create a database of volcanic eruptions from the last 2 million years cost around a million dollars.

Volcano eruptions in the context of other disasters

Very large magnitude volcanic eruptions, asteroid strikes, and major natural disasters in metropolitan areas are the only natural disasters that could have a global impact.

In terms of natural hazards events that are likely to have global reach very large explosive eruptions are much more frequent than asteroid strikes.

People for GiveWell to talk to

- Stephen Self, Senior Volcanologist with the US Nuclear Regulatory Commission. He is one of the leading experts in the study of very large volcanic eruptions.

- Jacob Lowenstern, Scientist-in-Charge at Yellowstone Volcano Observatory

- The Smithsonian Institute Global Volcanism Program (Dr Liz Cottrell)

Materials for GiveWell to read

The main report of "Volcano Hazard and Exposure in GFDRR Priority Countries and Risk Mitigation Measures," conducted for the World Bank. The document is 300 pages, but the main report is only 30 pages. It was written for economists rather than experts in the field, and so is particularly readable.