A conversation with Sean Brocklebank on April 18, 2013

Participants

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Note: This set of notes was compiled by GiveWell and gives an overview of the major points made by Sean Brocklebank.

Summary

Sean Brocklebank is an economist at the University of Edinburgh and a GiveWell supporter. GiveWell spoke with him as a part of our investigation of opportunities to reduce the humanitarian risk from large volcanic eruptions. The main subjects of discussion were possible damage to the food system, opportunities to mitigate such damage, and the potential cost-effectiveness of a global volcanic eruption early detection system.

Risk of very large volcanic eruptions

The chance of a potentially catastrophic volcanic eruption (Volcanic Explosivity Index of 8, or VEI 8) occurring in a given year is thought to be about one in 30,000. There is little consistency in timing, however, as the frequency in volcanic eruptions varies on multiple levels, so it is hard to predict the likelihood of large eruptions occurring in the future more precisely than the historical average.

The distribution of volcanic eruption *frequency* by size has a thin upper tail (the frequency of an eruption of a given size drops off very quickly as the size of the eruption increases in the range of catastrophic risks). Nonetheless, the distribution of volcanic eruption *damage* may actually have a fat upper tail because the damage to civilization increases so dramatically as the volcano size increases.

Possible damage from large eruptions

With a VEI 8 volcano, the effects could be globally harmful but human extinction would be unlikely. Ash clouds could cover millions of square kilometers with ash that's half a meter or a meter in depth, wiping out at least a year's worth of crops (not including the sunlight blocking effects that would likely reduce crop yields worldwide). The food loss would be the largest potential threat. If you imagine the total damage was on the order of 20% of gross world product (sum of all countries' GDPs) and lasted for five years (this is possibly an underestimate of both intensity and duration), then the total impact would be on the order of one year's GWP, which is about $72 trillion. Multiplying through by the 1 / 30,000 probability from above, then the total expected damage every year comes out to just over a couple billion dollars. Reducing these expected damages by even 1% should be worth at least $20 million per year.

If humans responded optimally, such as by using crops currently dedicated to livestock feed for human consumption, and by transporting food from areas that were still arable to the ash-covered lands, it might be possible to avoid massive starvation, therefore reducing the expected damages. Currently, only 7-10% of staple crops in the world are transported across international borders, indicating that

getting food from parts of the world that have stored or are still producing food to barren areas might be very difficult. Additionally, the likelihood of this response from a geo-political perspective is unclear.

For a massive flood basalt eruption such as the Deccan Traps (about 65 million years ago, mya) and Siberian Traps (250mya), the damage could be far more extensive. Those eruptions may have led to the extinction of a large portion of all species living at the time. A similar flood basalt eruption today would destroy human civilization and could possibly cause human extinction. Since the events are so rare in earth's history (on the order of once every billion years), and since a flood basalt eruption would almost be impossible to prepare for, it doesn't seem very helpful to worry about this type of eruption.

Mitigating damage from large eruptions

Large volcanic eruptions can't be stopped with current or easily foreseeable technology. Perhaps the best strategy for damage mitigation is to first get better at detecting pending eruptions, and then if we get a few years' warning on a massive eruption, turn attention toward how to prepare.

Monitoring

While we can't currently predict medium-size eruptions (of the type that happen every few years), there are reasons to expect that we might be able to detect VEI 8 eruptions years in advance, due to the types of deformations that seem to have occurred prior to such events in the past. See the *Nature* article, “Decadal to monthly timescales of magma transfer and reservoir growth at a caldera volcano” by Druitt et al, 2012.

Some monitoring is already happening, in many cases as a side effect of earthquake studies. But the data is incomplete and not linked together across the world. But given expected annual damages of a couple billion dollars, if these expected damages could be reduced by even 10% - 20% through a global monitoring system, then it should be worth as much as $200 - $400 million per year to fund such a system. And while the costs of such a system are not known, intuition suggests that it should cost substantially less than $200 million per year.

Preparing

Since the biggest damage is to food supply, preparing would likely center around building up a large food supply (perhaps partially by reducing the portion of crops going to livestock), developing a plan for getting the food to the ash-covered areas that can't produce any food for a year or more, and planning for temporary alternate patterns of cultivation around the world to deal with global temperatures which may be 5 to 15ºC lower for a period of several years.

Coming up with a global response plan could help not only prepare for a VEA eruption but also for other global catastrophic risks with similar atmospheric effects such as nuclear winter or possibly asteroid impact. (Alan Robock at Rutgers has written about some of these issues.)

Comparing large volcanic eruptions to other GCRs

Comparing the chance of a large volcanic eruption with a given energy release to the chance of an asteroid with the same energy release, the volcanic eruption is about 10 times more likely. You can't as

easily prevent an eruption from happening, but the damages could perhaps be mitigated since most of the damage is loss of food, which can be prepared for with advance warning.

Further resources for GiveWell

- Relevant chapters of "Global Catastrophes and Trends: The Next 50 Years" by Vaclav Smil, 2008.
- Hans-Peter Plag, Research Professor at the University of Nevada, Reno.

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