Ash clouds? You ain't seen nothing yet

June 13 2011

Volcanic Eruption. Credit: Krumma from Flickr

The recent volcanic eruptions in Iceland upset airline bosses and caused a lot of fuss, but they were trivial by comparison with what could happen next, according to Clive Oppenheimer's new book.

If you thought the Icelandic volcano was bad – think again. According to a new study, the recent ash clouds that grounded aircraft and marooned holiday-makers were “just a taste” of the widespread air pollution, public health problems and agricultural crises that future, bigger eruptions could bring.

These are just a few of the conclusions of what, rather ironically, claims to be a “non-catastrophist” new book by the University of Cambridge volcanologist, Dr. Clive Oppenheimer, entitled Eruptions That Shook The World and published by Cambridge University Press.

It explores both the nature and history of volcanoes, showing how eruptions that we may think of as disastrous for their local communities actually had dramatic consequences for the Earth's climate, and therefore sometimes for societies on the other side of the world.

Volcanic activity, Oppenheimer argues, was at least part of the reason for numerous major events in world history – among them the collapse of Minoan civilisation, medieval bubonic plague, the 19th century prairie trail migrations to the American West; even the rise of anti-Semitism in Europe.

That may not sound particularly non-catastrophist, but his concern is with sifting through real evidence – from the volcanic rocks themselves, as well as from archaeology, historical documents, mythology, and ancient climate records. "What we need is a reality check – a forensic test to see how far claims about catastrophes changing the world really hold up," Oppenheimer said.

Oppenheimer believes that volcanoes remain widely misunderstood: "There is a lot to learn about volcanoes and they affect our lives in so many ways, even if we don't live near one." With, according to one estimate, 10% of the world's population and at least 12 major cities now located within range of a volcano, a more accurate perspective is needed on what they can do, so that rational plans can be drawn up in preparation for future events.

"The Japanese earthquake, tsunami and knock-on effects at the Fukushima nuclear plant shows that cascading failures can have massive impacts on societies," he added. "The problem for governments is that the potential scale of the damage that really big eruptions cause is difficult to consider against the improbability of them occurring. We need effective tools for making informed decisions about how to prepare. This means deducing as much as we can from past eruptions."

Beyond the geological information proffered by volcano sites, much of the evidence comes from natural records like sulphate found in the polar ice cores and tree rings. Worryingly, this points to a number of as yet undiscovered eruptions – one as recently as 1809. The largest sulphur fallout of the last 7,000 years was in 1259. Nobody knows which volcano was responsible.

This evidence also shows why the repercussions of volcanoes are felt far beyond the impact zone. The large eruptions of the past few millennia produced huge clouds of sulphurous dust. These caused dramatic climatic swings.

One case, in 1783, shows what a bigger eruption in Iceland could do. That year an eruption took place at Laki that was 200 times the size of the 2010 example. It emitted 122 megatonnes of sulphur dioxide, wiped out a fifth of the country's population and coincides strikingly with tens of thousands of deaths in England and France.

The reason for the scale of the catastrophe may be linked to the sulphuric cloud that spread over Europe. Documented at the time as a mysterious "haze", this initially interacted with an area of high pressure over the continent, causing a heat wave that killed thousands. A very severe winter then followed – the result of a temperature drop as the sulphuric particles in the atmosphere reflected solar radiation that should have been reaching the Earth back into space. First the Thames and other rivers froze. Then, as the snow melted, there was widespread flooding.

These changes in the climate resulted in dramatic crop and livestock failure and the spread of disease. The death rate in England spiked in both the summer of 1783 and the following winter; an estimated 25,000 people lost their lives overall.

Laki is far from the only example of volcanoes having disastrous consequences far away. 3,600 years ago an eruption entombed the island of Santorini in the Mediterranean and, as debris hit the ocean, caused a tsunami which contaminated farmland elsewhere. Within a few generations the Minoan civilisation that had dominated the region collapsed.

In 536, a still-unidentified volcano again caused a climate swing and an agrarian crisis. It is probably no coincidence that the first pandemic of bubonic plague happened at the same time – rats would have abandoned the dying fields and headed for man-made grain stores where they spread the bacterium.

And in 1815, global cooling caused by 30 megatonnes of sulphur emitted from an eruption on Sumbawa, Indonesia, led to the infamous “year without a summer” of 1816 in both Europe and the Eastern United States. In the latter, the failure of crops in places like Connecticut sparked a wave of migrations westwards. In Europe, where the Napoleonic Wars had just ended, an economic crisis occurred. Amid the riots and looting were a number of pogroms – violent reprisals against Jews. They were the first in an ongoing chain of such events that reached their final, terrible conclusion with the rise of the Nazis.

These scenarios may seem unlikely today, but, Oppenheimer argues, volcanoes could still wreak havoc if we don’t prepare for larger eruptions. A Laki-type event in Iceland now would do far more than upset a few indignant tourists; its sulphur cloud could add to the air pollution in modern European cities and produce a serious public health crisis. Then there is the possibility of a super-eruption, which would cause a major humanitarian disaster. The last one we know about happened 26,000 years ago. Oppenheimer estimates that there is roughly a 1/500 chance of one recurring in the next century – odds long enough for governments to ignore, but short enough to cause serious concern.

His study recommends that international organisations already exist that could introduce measures like spot traffic bans or distribution of dust masks in a repeat of the Laki eruption. For those who find themselves in the immediate vicinity of a volcano, however, Oppenheimer says evacuation is the only real solution – adding that governments should consider creating and maintaining plans for this in potential disaster zones.

In spite of that, however, his conclusion is oddly optimistic. “Humankind has yet to run into the buffers as the result of a volcanic eruption and may have learned to adapt and benefit from them in the long-term,” Oppenheimer said. “As the global population heads towards 10 billion, the human track record shows that we can manage the consequences of eruptions with resolve, flexibility and creativity – if we prepare properly.”

Provided by University of Cambridge