'Apocalyptic volcanic super eruption that could DESTROY civilisation is much closer than we thought, say experts'

Jonathan (Jonty) Rougier

School of Mathematics, University of Bristol

Southampton, Nov 2018

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`https://doi.org/10.1016/j.epsl.2017.11.015`

Funders: Leverhulme Trust, NERC, EPSRC

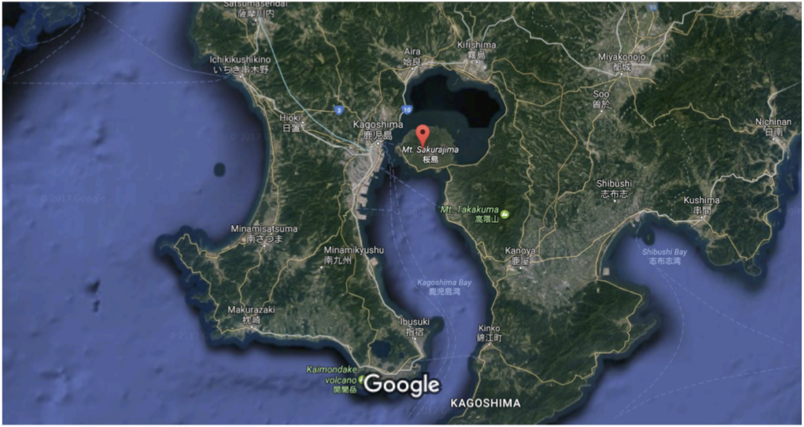
Gratuitous pictures of volcanoes

Sakurajima, Japan. One of the world's most active volcanoes.

Source: `https://www.hakaimagazine.com/sites/default/files/facebook-sakurajima.jpg`

Gratuitous pictures of volcanoes

Google Maps Sakurajima



Imagery ©2017 Landsat / Copernicus, Data SIO, NOAA, U.S. Navy, NGA, GEBCO, Map data ©2017 Google, ZENRIN 10 km

The Aira caldera. A magnitude 8.0 eruption about 28 ka ago.

A sense of scale

Magnitude is measured on the scale of Pyle (2000):

$$M = \log_{10}(\text{ejected mass in kg}) - 7.$$

So $M = 4$ is 100 Mt of mass, and $M = 5$ is 1 Gt, and so on.

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$M = 4$ A problem for your region

$M = 5$ A problem for your country

$M = 6$ A problem for surrounding countries too

$M = 7$ A problem for your continent

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$M = 7$ A problem for your continent

$M = 8$ A problem for the whole world—*super-eruption*.

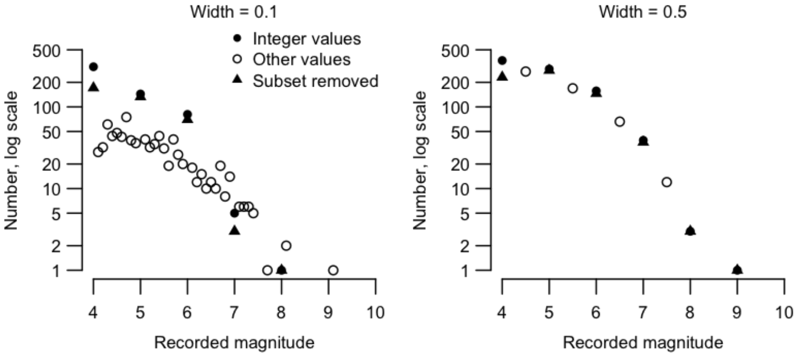
Problems with the record

Times and magnitudes are inferred from geology: this is not easy!

Source: `http://www.scielo.cl/fbpe/img/rgch/v31n2/img03-10.jpg`

Problems with the record

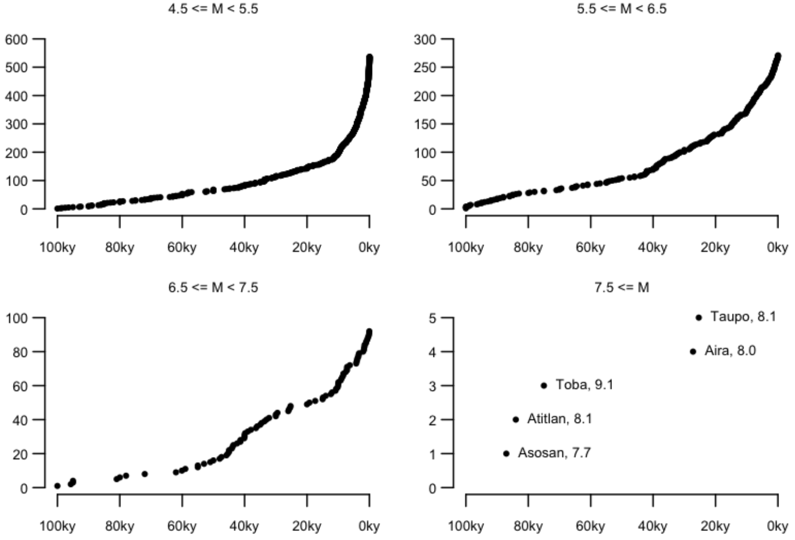
Lots of 'piling up' at the integers ('magnitude-rounding')



(nb, log scale!)

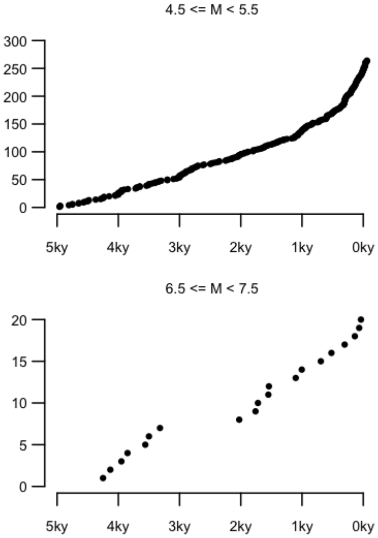
Problems with the record

Lots of under-recording



Problems with the record

Restrict attention to period where the recording probability is ≈ 1



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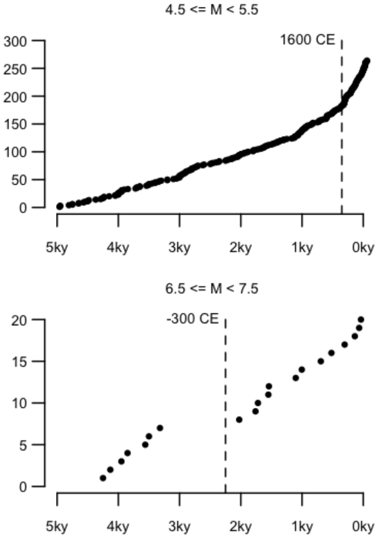
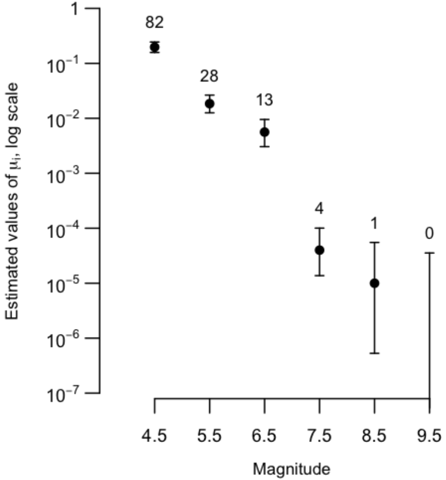


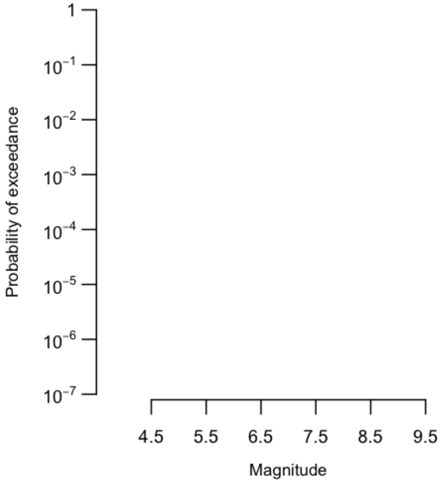
Estimating the magnitude/frequency curve

Semi-empirical estimate of the global exceedance probability curve for explosive volcanic eruptions. MLE and 95% confidence interval.



Estimating the magnitude/frequency curve

Fully parametric estimate of PEX, using Generalized Pareto distribution truncated at $M = 9.3$.



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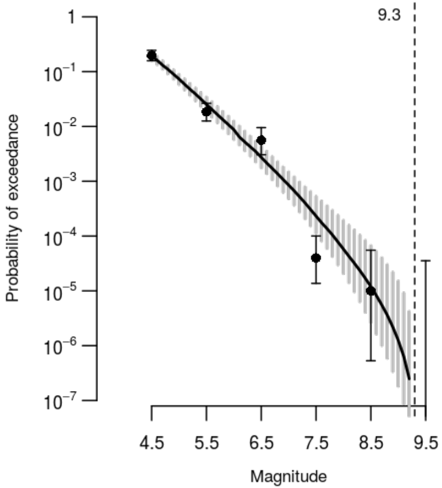

Mathematical interlude

Why can we overplot the probability of exceedance (PEX) curve with estimates of bin rates?

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Let $m_1 < \cdots < m_{k+1} = \infty$ be magnitude 'fence-posts'. Under our marked Poisson process model, eruptions in bin $[m_i, m_{i+1})$ have rate

$$\mu_i = \lambda \int_{m_i}^{m_{i+1}} \mathrm{d}F(m), \qquad i = 1, \ldots, k,$$

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$$\mu_i = \lambda \int_{m_i}^{m_{i+1}} \mathrm{d}F(m), \qquad i = 1, \ldots, k,$$

per year. The probability of exceedance at $M = m_i$ is

$$\begin{aligned}
\bar{P}(m_i) &= 1 - \exp\left(-\lambda \int_{m_i}^{\infty} \mathrm{d}F(m)\right) \\
&= 1 - \exp\left(-\sum_{j=i}^{k} \mu_j\right) \\
&\approx 1 - \exp^{-\mu_i} \approx \mu_i \qquad\qquad \text{as } 1 \gg \mu_i \gg \mu_{i+1}.
\end{aligned}$$

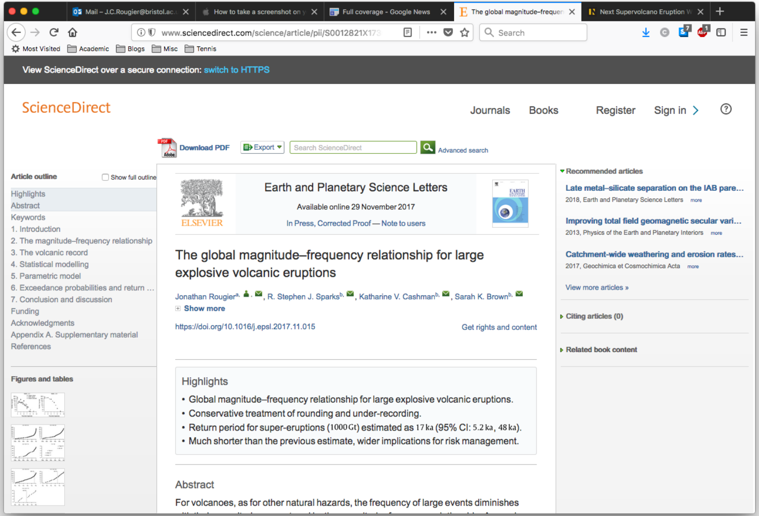
So we can overplot the PEX curve with estimates of bin rates if we put them at the lefthand end of the bin.

Estimating the magnitude/frequency curve

Return periods

Magnitude (or VEI)	Pyle (1995)	Mason et al. (2004)	Siebert et al. (2010)	Deligne et al. (2010)	Sheldrake and Caricchi (2017)	Us	95% CI
5	8		10	8	6	14	11, 17
6	59		200	35	51	110	80, 170
7	420		1–2 ka	370	420	1200	680, 2100
8		45–714 ka				17 ka	5.2 ka, 48 ka

What happened next?



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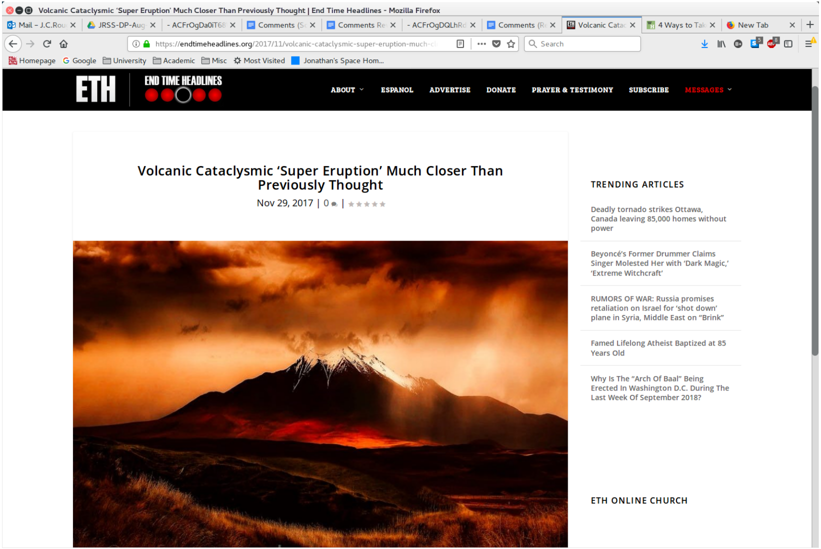

What happened next?

www.dailymail.co.uk/sciencetech/article-5125109/Supe

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Apocalyptic volcanic super eruption that could DESTROY civilisation is much closer than we thought, say experts

- An eruption would be capable of returning humanity to a pre-civilisation state
- The mammoth explosions could release over 1,000 gigatons of ash into the air
- Super eruptions may occur as regularly as once every 17,000 years
- The window between super-eruptions could be as short as every 5,200 years

By JOSEPH PINKSTONE FOR MAILONLINE
PUBLISHED: 22:06, 29 November 2017 | UPDATED: 22:25, 29 November 2017

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The next volcanic 'super eruption' with the power to return humanity to a pre-civilised state could be due much sooner than previously thought.

Experts have previously predicted that the massive eruptions are likely to occur roughly once every 45,000 to 714,000 years.

This assessment, made in 2004, is now being challenged by new findings which say that the most likely time frame is just 17,000 years.

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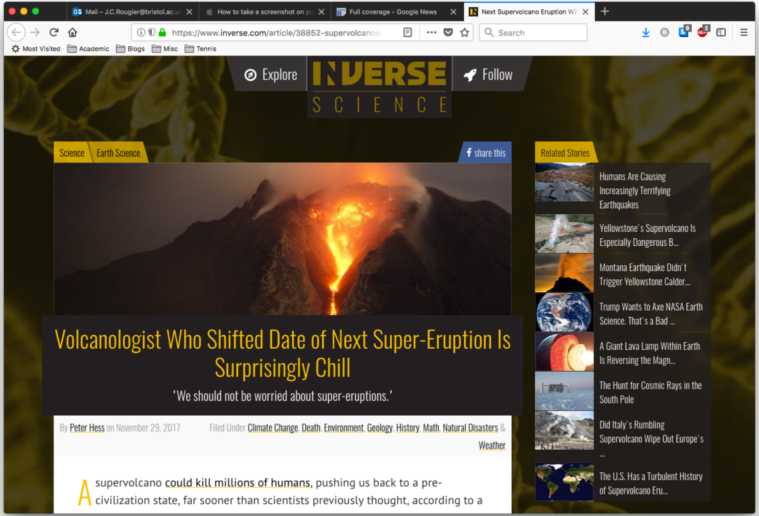

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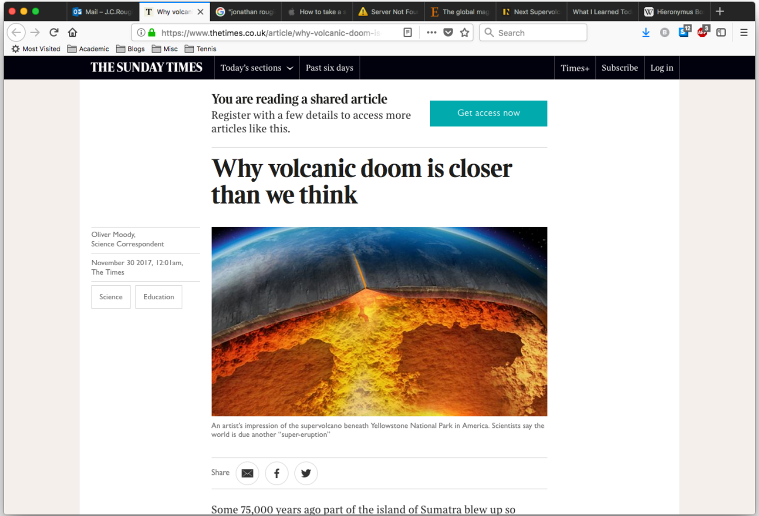
THE SUNDAY TIMES

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Why volcanic doom is closer than we think

Oliver Moody,
Science Correspondent

November 30 2017, 12:01am,
The Times

Science Education

An artist's impression of the supervolcano beneath Yellowstone National Park in America. Scientists say the world is due another "super-eruption"

Share

Some 75,000 years ago part of the island of Sumatra blew up so

Actually, there ARE some practical consequences

Actually, there ARE some practical consequences

1. National scale risk management

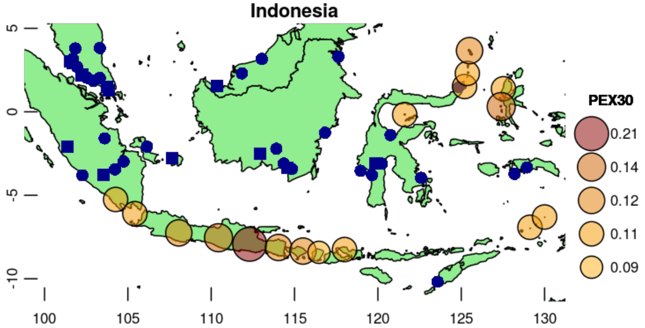
(A caricature:) If a volcanic super-eruption is going to wipe out most of the world's population **in about 17 thousand years**, then why are we managing the risk of 100 fatalities at a UK nuclear facility down to **once every 10 million years?**

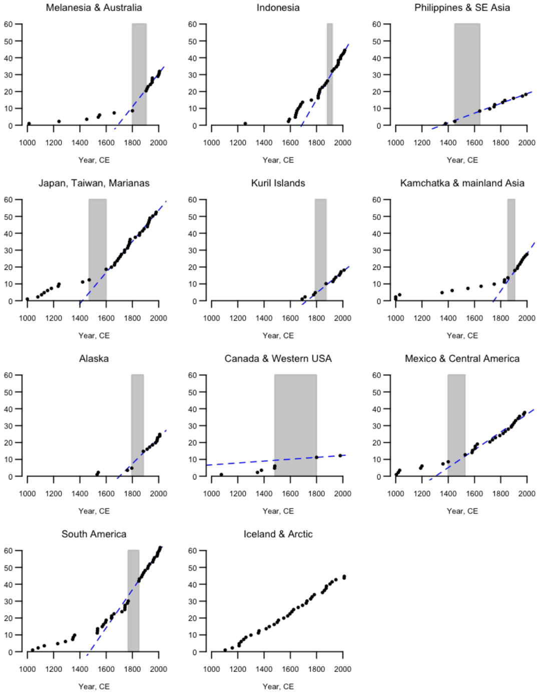
https://upload.wikimedia.org/wikipedia/commons/d/df/Hinkley_Point_Nuclear_Power_Station.jpg

Actually, there ARE some practical consequences

2. Local risk management

Using our insights from modelling the global catalogue, we are now modelling all of the world's dangerous volcanoes individually but simultaneously, in order to produce regional risk maps showing the interaction of hazardous volcanoes and populations. The following map for Indonesia is *still a work in progress*:





Melanesia & Australia
Indonesia
Philippines & SE Asia
Japan, Taiwan, Marianas
Kuril Islands
Kamchatka & mainland Asia
Alaska
Canada & Western USA
Mexico & Central America
South America
Iceland & Arctic
Year, CE
0
10
20
30
40
50
60
1000
1200
1400
1600
1800
2000

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