

ASSESSMENT OF THE HAZARDS AND RISKS ASSOCIATED WITH THE SOUFRIERE HILLS VOLCANO, MONTSERRAT

Sixteenth Report of the Scientific Advisory Committee on Montserrat Volcanic Activity

Based on a meeting held between 14 - 16 November, 2011 at the Montserrat
Volcano Observatory, Montserrat

Part I: Summary Report

- There has been very little surface activity at the volcano in the last year and we are approaching two years since lava was extruded.
- Measurements of the rate of gas emission and the deformation of the ground surface indicate that the volcano remains active at depth and capable of resuming the extrusion of lava. We estimate that the probability of a new lava extrusion or magmatic explosion in the next year is about 70%.
- The risk to the people of Montserrat due to potential hazards from the volcano has gradually fallen in the last year. For people living in Zone A we estimate the odds of an individual's death due to the volcano in the next year as about 1-in-30,000, which is about three times less than a year ago. For Zone B we estimate those odds at about 1-in-2,000, which is about half the estimated risk a year ago.
- The risk of death for individual workers involved in the proposed shipment of sand from Plymouth jetty is estimated to be about 1-in-3,500 per year, similar to values in the initial report. This compares with the risk to equivalent workers in the UK of 1-in-20,000.

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State of the Volcano

There has been very little activity at the volcano in the past year, apart from rockfalls and small pyroclastic flows caused by degradation of the lava dome. The frequency of these has decreased compared to 2010. Hot gases continue to escape from the same vents on the dome as a year ago, emphasizing that the dome has changed little.

Since the last period of lava extrusion in February 2010, MVO has measured the continued deformation of the land surface, upwards and outwards from the volcano. Also, sulphur dioxide has been emitted at a similar rate to that measured during some previous pauses. These observations are evidence that the deep parts of the volcano where magma is stored are still active and could produce another phase of lava extrusion, but low seismicity levels indicate that magma is not ascending. We think there is about a 70% probability that magmatic surface activity, such as lava extrusion or explosions, will resume at some time during the next 12 months.

In the coming months we will re-assess the long-term future behaviour of the volcano.

Volcanic Hazards

In its paused state, hazards from the volcano are reduced compared to periods when magma is reaching the surface as lava extrusions or explosions. These hazards include rockfalls, pyroclastic flows of limited reach, minor explosions and mudflows. A larger collapse of the dome with more extensive pyroclastic flows also remains possible but much less likely.

A re-start of lava extrusion will require magma to rise within the dome. This may involve a period, perhaps of a week to a few months, of increasing surface activity, such as ash venting and small explosions. The time-scale could be shorter. This initial activity is unlikely to be hazardous to inhabited areas but could produce ashfall. Small rocks might reach these areas in more energetic explosions, and these explosions could occur with little or no warning. Such hazards are more likely to affect areas within the exclusion zone, such as the Plymouth jetty.

Once lava reaches the surface, hazard levels could rise rapidly, and this partly depends on where that lava emerges. If the lava extrudes into the crater formed on 11 February 2010 hazard levels will be relatively low at first because it will take several weeks to fill the crater with enough lava to threaten the Belham Valley with pyroclastic flows. Alternatively, extrusion of lava near the current summit of the dome could destabilize it and generate pyroclastic flows. The

latter scenario is considered less likely. In either case, ensuing pyroclastic flows are likely to be much more energetic and more widely hazardous than those produced during the current pause.

Risks during the next year

We have applied our usual method of quantitative risk assessment using expert opinions on the probability of future events, together with risk modelling. The risk values will need to be re-assessed following any major change in behaviour, e.g. resumption of lava extrusion or significant increase in seismicity.

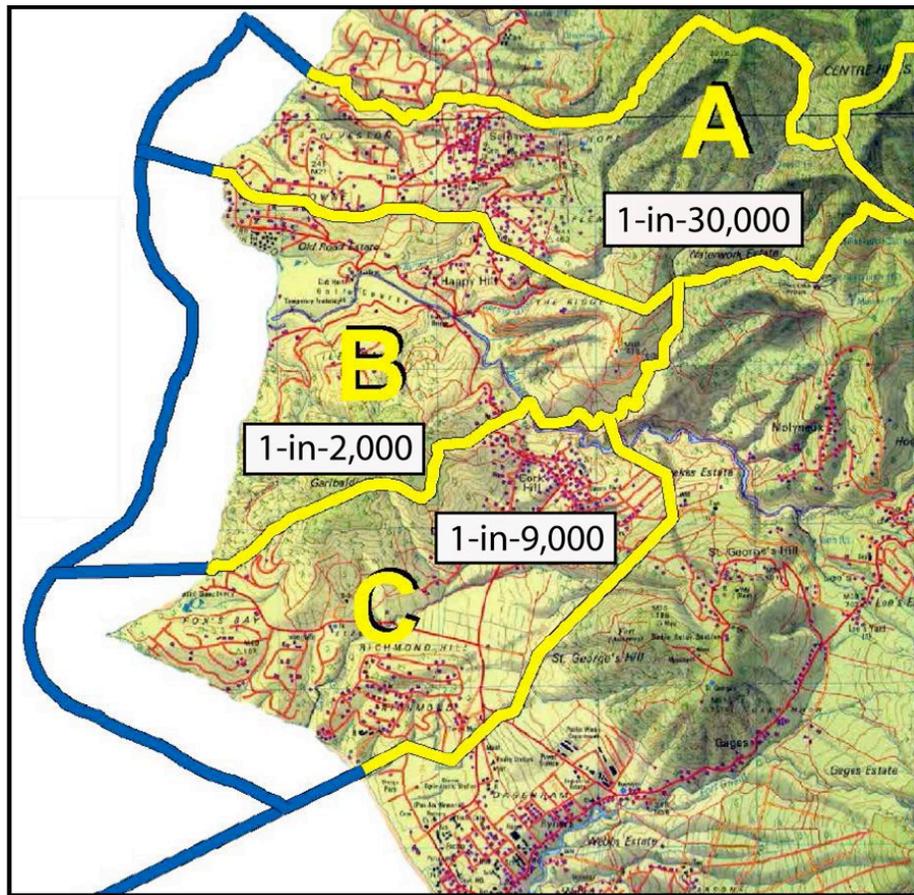


Fig. 1 Map of Hazard Level boundaries for Zones A-C together with estimated, rounded annual risks of death for residents from volcano hazards, averaged over zones A and B and for 4-hour daily visits to Zone C .

Island-wide

We assess the current overall risk of deaths from volcanic hazards for the population of Montserrat to have fallen in the last year. The main reasons for this

are the low levels of activity, which have further decreased over the last year, and the reduced likelihood of a large dome collapse with pyroclastic flows.

Lower Belham Valley

The average annual risks of a full-time resident individual being killed by volcanic activity in Zones A and B (Figs.1, 2) have fallen by a factor of about 2 to 3 since one year ago. The values expressed as odds have been "rounded" to the nearest 1,000 (below 10,000) and nearest 10,000 (above 10,000):

Zone A 1-in-30,000 (1-in-10,000 at SAC15)

Zone B 1-in-2,000 (1-in-1,000 at SAC15)

For residents of Zone A, this exposure to volcanic risk is similar to that for hurricanes, and to domestic risk of accidental death for residents of Zone B.

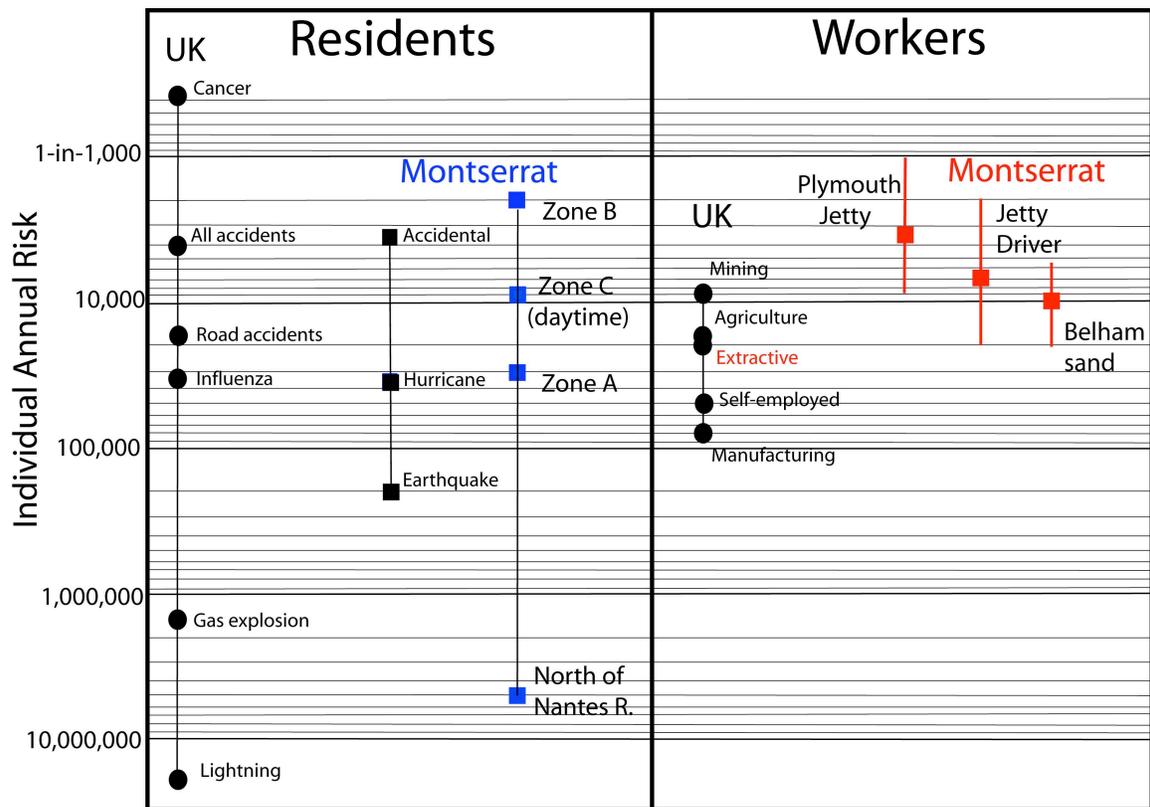


Fig.2 Risk ladder showing relative annual risks of death for individual residents (left) and workers (right) in Montserrat (squares) and the UK (circles). The scale of risk is logarithmic, increasing upwards and expressed numerically as odds (left-hand scale). Blue squares (left panel) and red squares (right panel) represent risk levels due to volcanic activity for residents and for workers respectively. The ranges of uncertainty on our assessment of the risk levels for Montserrat workers are shown by the red lines. Similar levels of uncertainty also apply to residents but are not shown.

Sand Mining/Shipment

Hazards for sand and gravel mining from the lower Belham Valley are similar to those for inhabitants of Zone B, but workers are not there full-time so the risk is much less: approximately, 1-in-10,000 per year. We have also analysed the risks to workers who might be involved in shipment of sand and gravel on barges from Plymouth jetty. The current annual risk of death to a worker at the jetty is estimated as 1-in-3,500, and 1-in-7,000 for a truck driver operating between Belham Valley and the jetty. These odds are about 6 times and 3 times higher than the respective risk exposure of a typical equivalent worker (extractive industry) in the UK (Fig.2).

See Part II, the Full Report, for the details of our assessment¹.

¹ The information provided in both parts of this Report is advisory. It is offered, without prejudice, for the purpose of informing the party commissioning the study of the risks that might arise in the near future from volcanic activity in Montserrat, and has been prepared subject to constraints imposed on the performance of the work. While Committee members believe that they have acted honestly and in good faith, they accept no responsibility or liability, jointly or severally, for any decisions or actions taken by HMG or GoM or others, directly or indirectly resulting from, arising out of, or influenced by the information provided in this report, nor can they accept any liability to any third party in any way whatsoever.