

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

21st Report of the Scientific Advisory Committee on Montserrat Volcanic Activity¹

Based on a meeting held between November 7th and 10th, 2016 at the Montserrat Volcano
Observatory, Montserrat

Part I: Summary Report

Issued on January 3rd, 2017

- There has been no significant surface activity at the volcano during the last year and the current pause has extended to six and a half years. The absence of any pyroclastic flow or major rock fall activity implies that the major part of the lava dome remains stable. However, temperatures of volcanic gases that escape through fractures and fumaroles have remained high.
- Seismicity overall has remained on a low level except for occasional short bursts of volcano tectonic earthquakes. Observations of ground deformation indicate that the volcano remains in a state of internal unrest and that magma accumulation in a deep reservoir is still ongoing.
- Comparable to last year, our estimates remain at the similar level of risk to the people of Montserrat due to potential hazards from the volcano. For people living or working in Zone A we estimate the odds of an individual's death due to volcanic activity in the next year at about 1-in-50 million. For Zone B we estimate those odds at about 1-in-1.7 million, and for Zone C at about 1-in-110,000.

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.

Volcanic Activity

During the last year, volcanic surface activity has remained at a low level and no pyroclastic flows have occurred, although several mud flows went down Belham valley. Temperatures of volcanic gases derived from the deep magma reservoir and escaping through fractures and fumaroles in the lava dome have remained high, with the hottest fumaroles maintaining 600⁰C over the six and a half years since the last major activity. Due to instrument failure sulphur dioxide (SO₂) emission rates have not been measured during the last year. When some measurements were made in November 2016, the first estimates indicated that the SO₂ emissions remained in the range of 300 and 400 tonnes/day as in the preceding five years.

When gases are trapped somewhere in the volcano and a certain overpressure is reached, short bursts of volcano tectonic earthquakes (so-called VT strings) signal the opening of cracks and escape routes for the stored gas. Twelve VT strings have been detected over the last year, however none of these was accompanied by ash venting.

The monitoring of ground deformation shows a slow but steady lengthening trend over the island with a maximum uplift of about one centimetre over the last year. These trends are consistent with the activity we have seen over the previous 5 years. Tectonic processes, pressurisation through magma cooling and crystallisation, or new magma influx could explain these observations. However, after intensive computer modelling we consider that the most likely cause of this unrest is the slow but steady accumulation of magma in a reservoir 6 km below the volcano.

Based on current observations and monitoring results we conclude that the volcano remains in a state in which lava extrusion is still possible at short notice. However, there is no indication that this is imminent. We think there is less than 22% probability that magmatic surface activity, such as lava extrusion or explosions, will resume at some time during the next 12 months.

Volcanic Hazards

The major part of the lava dome remains stable but continuing erosion has the potential to destabilize steep parts of the dome. Hazards from rock falls, pyroclastic flows of limited reach, minor explosions and mudflows remain a possibility over the next year, even without lava extrusion. A collapse of the dome, with more extensive pyroclastic flows, also remains possible but less likely.

A resumption of lava extrusion would require magma to rise within the dome, likely producing an initial period of increased surface activity, such as ash venting, rockfall and small explosions. This initial activity is unlikely to be hazardous to Zones A, B and C but ash fall and, in more energetic explosions, small rocks might reach these areas. Such hazards would affect areas within Zone V, such as Plymouth and St George's Hill. If fresh magma pressurises the dome or reaches the surface, hazard levels could rise rapidly.

Assuming that gas measurements will resume and the monitoring networks will be maintained and upgraded, we consider it likely that signs of resuming lava extrusion would be detected by the MVO; however renewed volcanic activity without precursors cannot be ruled out completely.

Risks during the Next Year

We have carried out our standard quantitative risk assessment using expert judgment on the probability of future events, together with risk modelling. Note that the risk values will need to be re-assessed following any major change in behaviour, e.g. a resumption of lava extrusion or a significant increase in seismicity, ground deformation or gas emission.

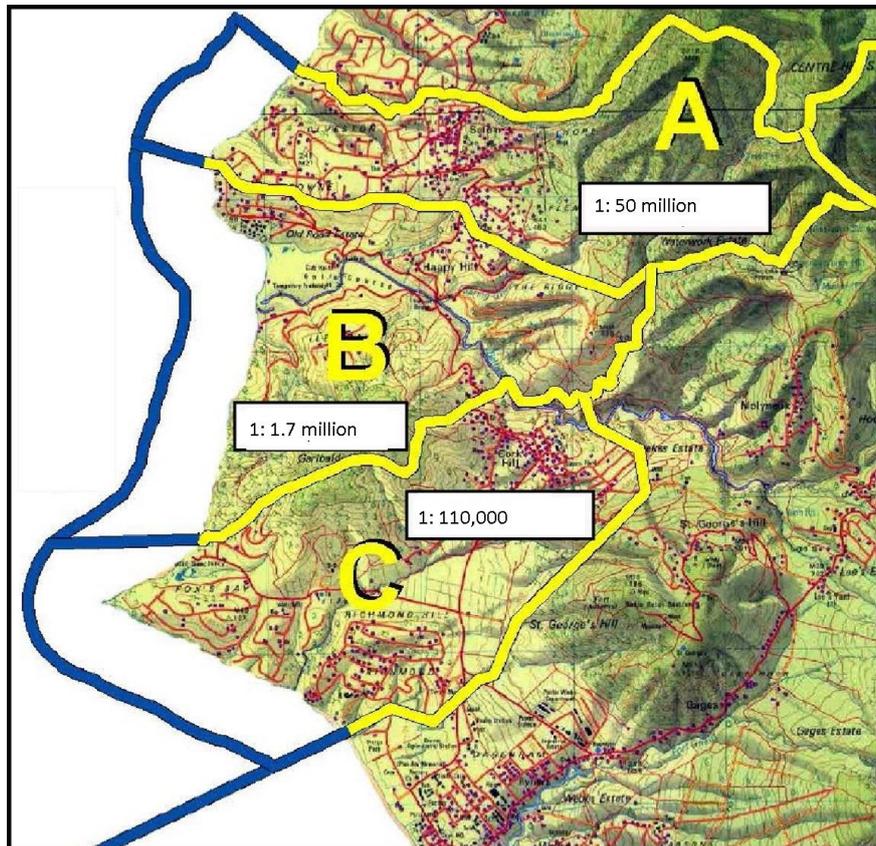


Fig. 1 Map of Hazard Level boundaries for Zones A-C together with estimated, rounded annual risks from volcanic hazards of death for full-time residents, averaged over zones A, B and C, respectively.

We assessed the current overall risk of death from volcanic hazards for the population of Montserrat to be similar to last year. For a full explanation of how these values are derived, see the Full Report.

Risks in Zones A, B & C

The average annual risks of a full-time resident individual being killed by volcanic activity have decreased to lower levels in all Zones (Figs 1 & 2). These values are expressed as ‘odds’ rounded to the nearest 1000, and compared with the estimates from the previous year:

Zone	SAC21	SAC20
A	1 in 50 million	1 in 4 million
B	1 in 1.7 million	1 in 17,000
C	1 in 110,000	1 in 8,000

For residents of Zone A, this exposure to volcanic risk is now less than that for hurricanes. For residents of Zone B it is less than the domestic risk of accidental death.

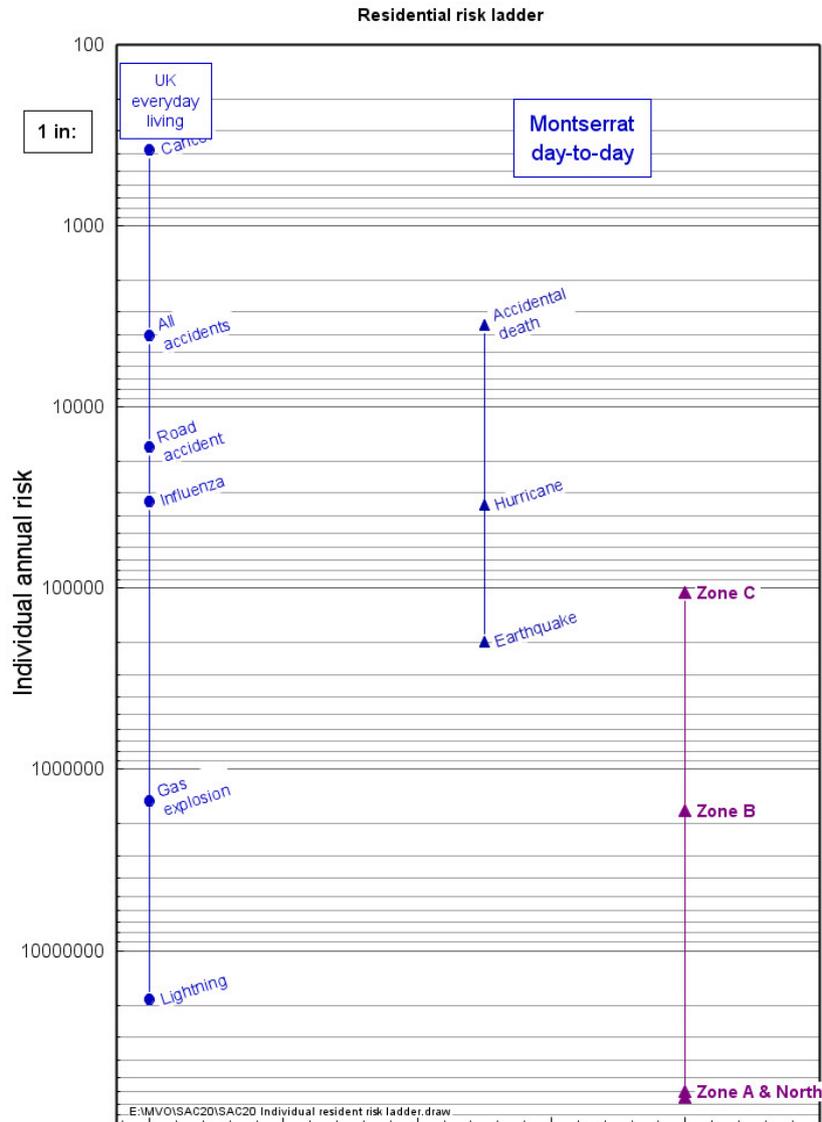


Fig.2 Relative individual annual risk from the volcano for full-time Montserrat residents compared with other non-volcanic risks in Montserrat (centre) and everyday risks in the UK (left). The scale of risk is logarithmic, increasing upwards and expressed numerically as odds (left-hand scale).

Risks in Zone V

Activities taking place in Zone V such as sand exports (from Plymouth), geothermal drilling, police operations, animal projects, metal reclamation, filming and tourist trips need to be managed in co-operation with the MVO. For corresponding risk-levels we refer to our report of SAC19.