Monitoring Volcanoes

An introduction to monitoring techniques

Name: ……………………………………….

Class: ……………………………………..

Date: ……………………………………..

Aims

To understand how volcanoes are monitored in order to predict when they will erupt

To understand the importance of photographs in predicting eruption

To understand the difference between infrared and millimeter waves

Gathering Techniques

Observation

Extracting information

Asking questions

Processing Techniques

Annotation

Calculations

Acknowledgments

Seismic Network

Throughout the eruption on Montserrat, volcanic activity has been preceded and/or accompanied by changes in seismic activity.

Seismic waves are .... generated by earthquakes, rockfalls, and the .... of .... inside the volcano. These vibrations travel through the earth and although they can be tiny, they can be detected at great distances by an instrument called a ....

Seismometers around the volcano continuously monitor the different types of seismic events caused by volcanic activity. By using a network of seismometers around the volcano the .... of the source of each event can be determined by comparing the .... at each seismometer.
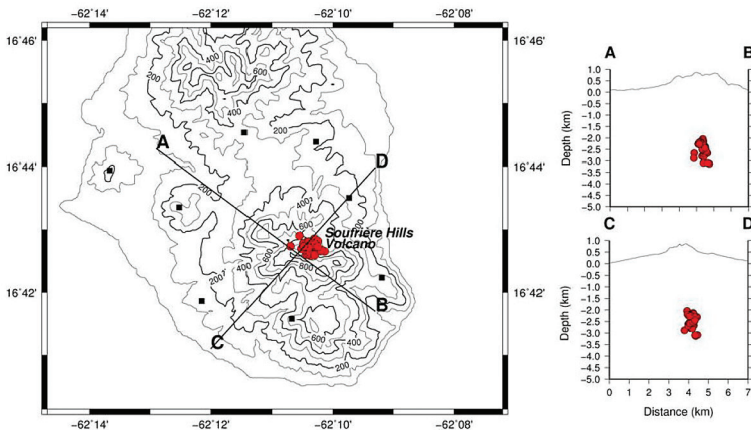
Volcano-tectonic:

Rockfall:
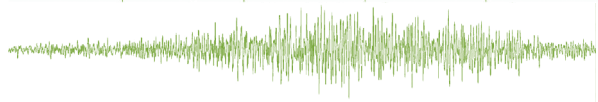
Seismic Network on Montserrat:

The black squares show the seismometer stations used to detect, and then locate, the source of each earthquake (shown by red dots).
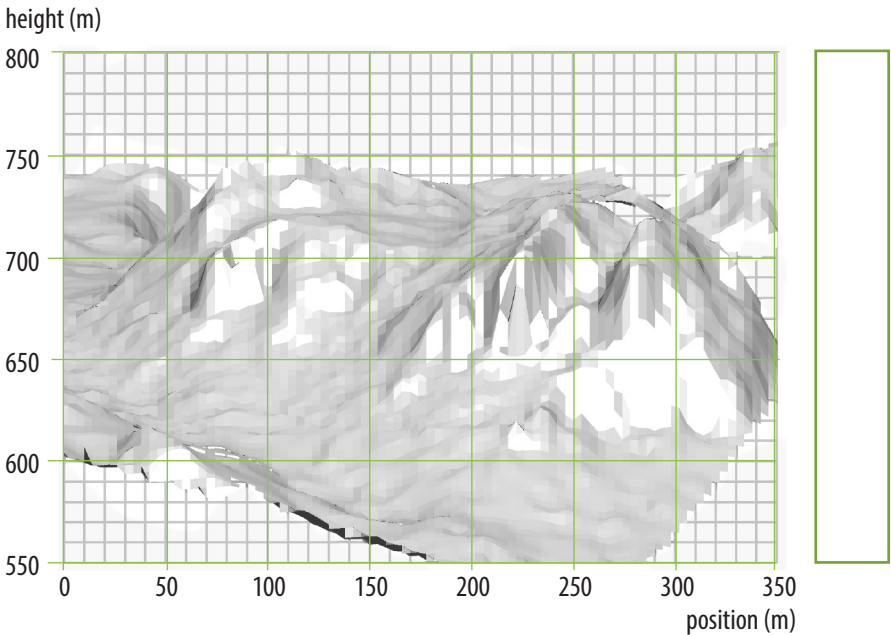
Infrared Monitoring

Below is a radar surface map of the volcanic lava dome on Montserrat.

Colour in the box on the right to show the infrared scale.

Whites, yellows and reds show hot areas whereas blacks and purples show cold areas.

Mark the minimum and maximum temperatures

Colour in the map to show the location of the hot and cold rocks.

height (m)

position (m)

Predicting Eruptions

Predicting eruptions is a tricky business - fill in the data using the sheet you completed during the experiment, including the difference between your prediction and 2nd erruption.

group	number of days to 1st eruption	predicted evacuation time (days)	number of days to 2nd eruption	difference between 2nd eruption and prediction
1				
2				
3				
4				
5				
6				
7				
8				
Average				
Minimum				
Maximum				

Did eruption 2 occur before or after you predicted?   BEFORE / AFTER
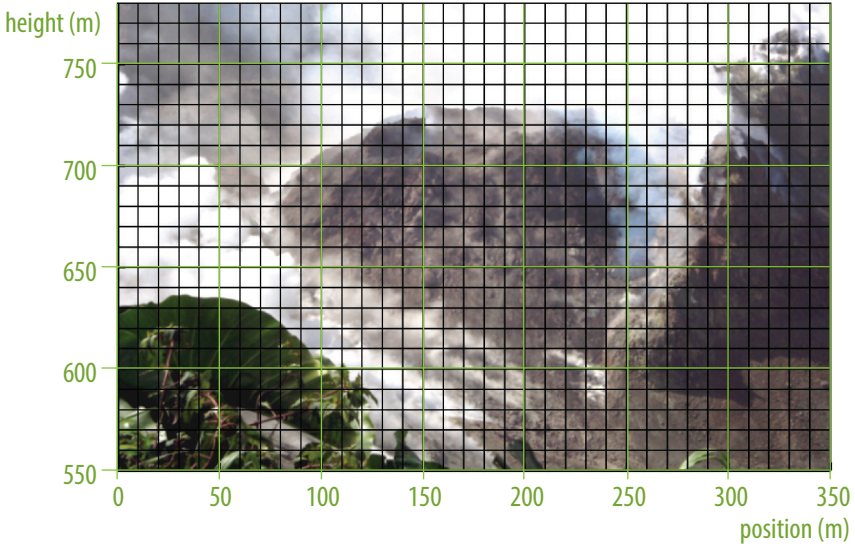
What is the difference (how many days early/late?)

What percentage of the population will be evacuated?

Photography

These photographs show 10 days of growth on the lava dome

25th October 2005 14:30

4th Novemebr 2005 14:30
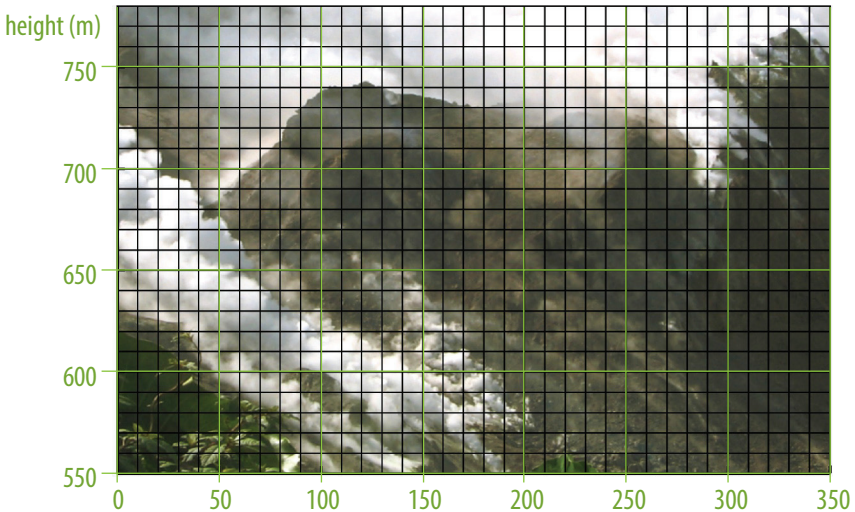
Photography

Sketch the outline of the lava dome for each day and estimate the height change between the two photographs.

Where the gas and steam obscure the view you will have to estimate the dome outline.
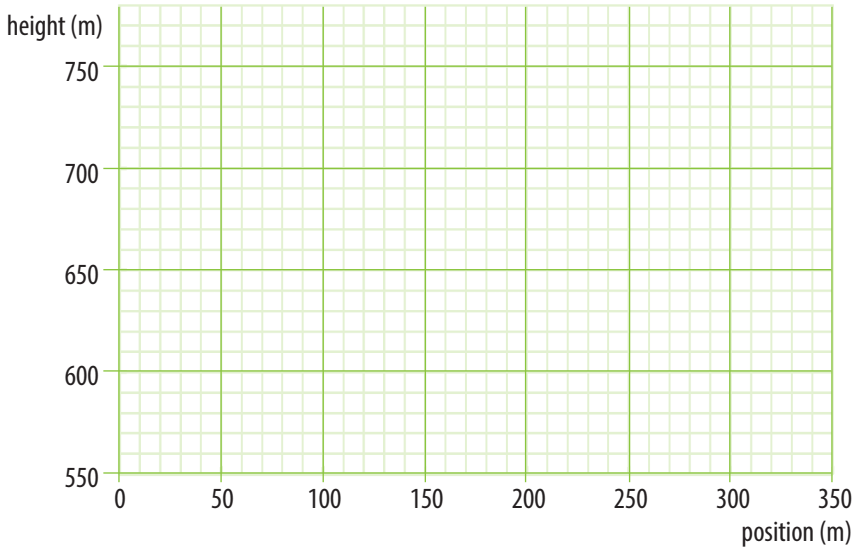
What is the largest change in height that you have measured on the dome? ....

How fast was the volcano growing in metres per day?

$$\text{RATE OF GROWTH (m/day)} \; = \; \frac{\text{CHANGE IN HEIGHT (m)}}{\text{NUMBER OF DAYS (day)}} \; = \; \underline{} \; = \; ....$$

Circle the area where you think that the ***largest dome growth*** has occurred.

Volcanoes Worldwide

On the map of the world below, colour or shade the areas where active volcanoes current exist.

© 2009 www.outline-world-map.com

Monitoring Volcanoes:

Volcanoes Worldwide

Does the distribution of volcanoes worldwide follow a pattern?

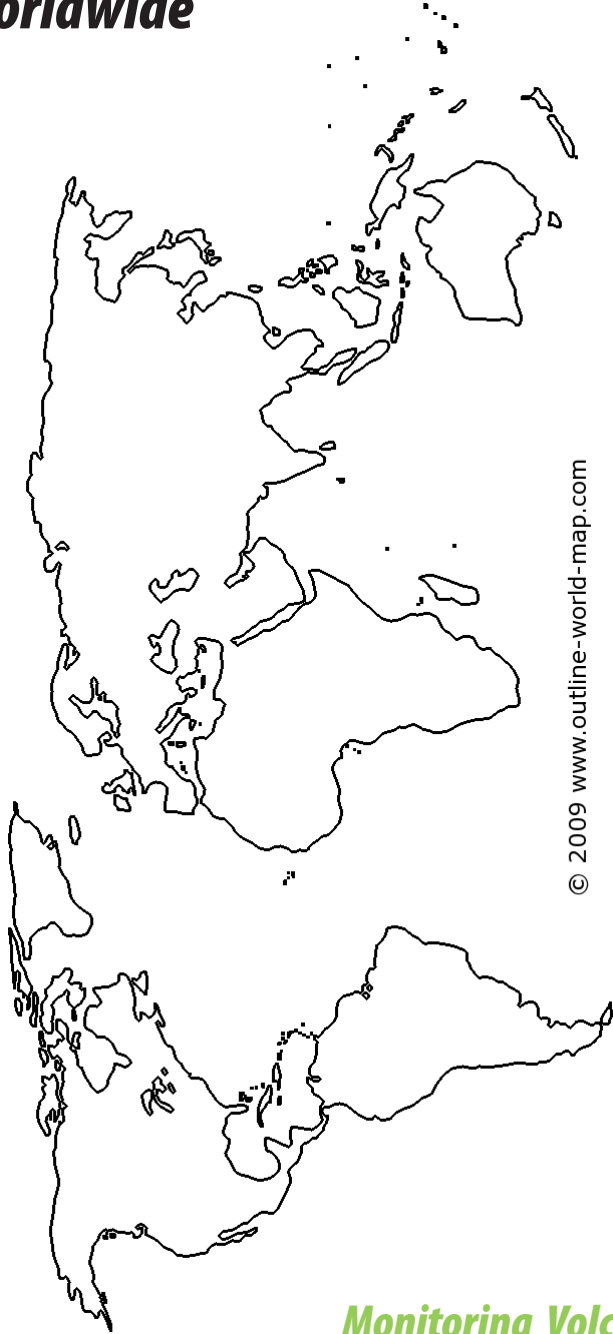..

What does this pattern show?

....

....

Why do volcanoes form here?

....

....

....

What are the main dangers associated with volcanoes?

....

....

....

Did you know?

? 350 million, (that's one in every 20) people in the world live within the 'danger range' of an active volcano

? The largest known eruption in the last 10,000 years was Tambora, in April 1815, which erupted more than 50 cubic kilometers of magma

? The last volcanic activity in the UK was around 55 million years ago, on the West Coast of Scotland on islands such as Skye and Mull

? Volcanic eruptions can send ash high into the air, over 30km (17 miles) above the Earth's surface

? About 1,900 volcanoes on Earth are considered active and are likely to explode again

? The volcano on Montserrat produces *andesite* lava which is so thick that it cannot flow, and instead it piles up to form a lava dome

? The object with the most volcanic activity in our solar system is Io, one of Jupiter's moons - its surface is constantly changing due to the amount of volcanic activity

For more facts on volcanoes, check out these National Geographic webpages, and the Montserrat Volcano Observatory website.

You can also find a visulisation of volcanic eruptions across the world in the last 50 years at http://volcano.si.axismaps.io/.

Monitoring Volcanoes:

Glossary

Volcano – a mountain or opening in the Earth's crust from which molten lava, ash and gases are ejected.

Seismic Network – a number of seismometers combined to measure the location and strength of earthquakes beneath a volcano.

Infrared – electromagnetic waves that contain the most amount of energy given off by heat. Infrared cameras are commonly used for thermal imaging.

Photograph – a record of the visible electromagnetic radiation (usually just referred to as 'light') in a scene.

Gas Monitoring – volcanoes emit a variety of gases, mainly sulphur dioxide ($SO2$) and hydrogen chloride (HCl) from deep inside the earth. The amount of gas being erupted on Montserrat is measured using a combination of space- and ground-based spectrometers (devices that can measure how much light is blocked by the gas in question).

Tiltmeters – an instrument designed to measure changes in angles from the horizontal.

GPS – Global Positioning System. A network of satellites orbiting the Earth transmitting signals that are used to calculate their time and position to a very high precision. A GPS receiver on the Earth uses this information from at least three satellites to work out its own position.

Radar – RAdio Detection And Ranging instruments can measure the distance to an object using electromagnetic waves. The first radars from around 100 years ago used radio waves, but most modern radars use shorter wavelength microwaves (cm) or millimetre waves (mm).

LIDAR – LIght Detection And Ranging is a laser-based version of radar that uses ultraviolet, infrared or visible light to measure the distance to an object.

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