

## VOLCANOS AND CLIMATE

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On 17 June 1996, Mt Ruapehu erupted sending clouds of steam and ash high into the middle and upper atmosphere where strong

southwest winds were blowing (Figure 1). Within a few hours the ash cloud spread northeast across the Bay of Plenty and out

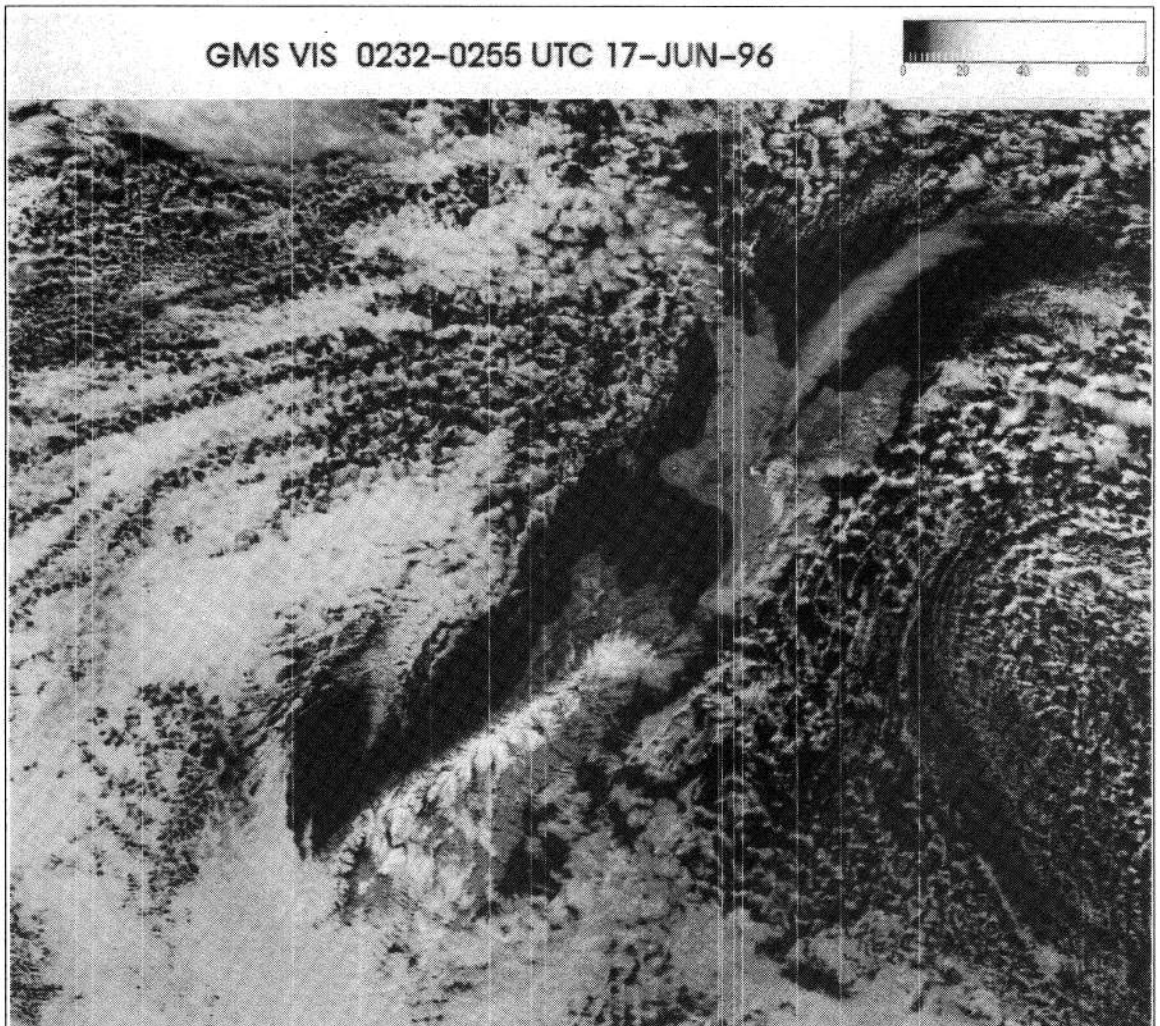


Figure 1: GMS satellite visible image, 3pm NZST, 17 June, 1996.

over the Pacific before curving around an upper trough that lay to the east of New Zealand. Falling ash drastically reduced the visibility over a large part of the Bay of Plenty with Rotorua Airport reporting visibility of 5000 metres for several hours around the middle of the day.

As volcanic ash clouds constitute a serious hazard to aircraft, particularly their engines, considerable effort went into forecasting the height and movement of these clouds as the eruptions continued over the weeks that followed. The size of these eruption was similar to those that occurred last year, and well below that likely to have a significant effect on climate.

The eruption of Mount Pinatubo in June 1991 was many times larger than Ruapehu's. It affected the weather world wide and has been blamed for a decrease in global average temperatures of half a degree, which is about half the difference between conditions now and during the Little Ice Age that affected Europe from the fourteenth to the nineteenth century.

The extent of a volcanic eruption's influence on the weather is thought to depend on how much sulphur there is and how high it is blown. The sulphur turns to sulphuric acid in the atmosphere and forms a thin cloud high in the stratosphere. This will spread around the whole world if the eruption is within 20 degrees latitude of the equator. This cloud reflects some of the sun's radiation back into space, thus cooling the Earth.

One of the most spectacular volcanic eruptions in human history occurred in the Aegean about 1450BC when the island of Santorin blew up, overwhelming the Minoan civilisation based on the island of Crete. The amount of rock and ash blown into the atmosphere has been estimated as more than 5 times that from the Krakatau eruption of 1883, and the dust cloud produced may have lowered summertime temperatures in the far north by as much as 3 to 4 degrees.

Pollen analysis in the Canadian north has shown that about this time the northern limit of the forest, right across Canada, retreated 200 to 400 kilometres away from the Arctic and never returned. This was accompanied by widespread fires presumably started by lightning strikes on the dead standing timber. After this, tundra became established and remains to this day.

In Scandanavia, this was a time when spruce came to replace trees that preferred a warmer climate. Some trace of these events may be found in the Norse legend of *Fimbulvinter* as recorded in the Edda poem written about 1220AD by Snorri Sturluson. In this poem, he records a time when "snow drives from all quarters with a biting wind; three such winters follow one another and there is no summer in between." This is followed by a great fire, which again could be the burning of thousands of dead trees killed by the cold weather.

The largest volcanic eruption of the last 200,000 years was the massive Toba eruption in Sumatra 73,500 years ago. Recent calculations suggest that this may have caused land temperatures, in the zone 30° north to 70°, to have been 5-15°C colder than normal, leading to a "volcanic winter" similar to the proposed nuclear winter effects of a nuclear war.

The Toba eruption occurred as the last Ice Age was beginning and dramatically intensified its onset. Because the Ice Age had already begun it has been suggested that sea level fall may have contributed to triggering the eruption itself, by reducing the weight of water pressing down on an unstable magma chamber.

Volcanic eruptions in the 1700s and early 1800s have also been blamed for prolonging the Little Ice Age. Eruptions in Iceland and Japan in 1783 were followed by a series of summer droughts and cold winters in Europe. By the eve of the French Revolution food shortages were so bad that a French labourer was spending 88% of his income on bread alone.

In April 1815 the volcano Tamboro in the East Indies erupted, sending an estimated 15 cubic kilometres of solid matter into the atmosphere. The ash cloud joined with clouds from previous large eruptions of other volcanoes in 1812 and 1814.

It was followed in 1816 by the summer that never was, when snow fell in the United States as far south as 42 north. Crop failures in many areas were followed by disease. The typhus epidemic of 1816-19 was the most extensive in the history of Europe. There was an outbreak of the plague in southeast Europe and the eastern Mediterranean, and the first great world wide cholera epidemic started in

Bengal. Combined with the famine this was one of the greatest world wide disasters associated with climate.

At one remove, the effects of these events can still be felt today. The clouds of sulphuric acid high in the sky made striking sunsets which were recorded by painters such as Turner. And the disasters of 1816 are said to have helped inspire Mary Shelley to write the novel *Frankenstein*.

Note: The historical incidents described here are mostly taken from H.H. Lamb's classic book - *Climate, History and the Modern World*, Methuen, London, 1982.