Professor Wyss Yim (Geology 74)

El Hierro

Climatic impacts of the October 2011 to March 2012 El Hierro submarine volcanic eruption

Volcanic eruptions are a natural cause of climate change. However, the study of their climatic impacts has been restricted to sub-aerial volcanic eruptions, while the role of submarine volcanic eruptions has been neglected. This account highlights the October 2011 to March 2012 submarine eruption of the El Hierro volcano located in the Canary Archipelago, off the northwest African coast, in switching on hot seawater in the Atlantic Ocean to act as the trigger for weather-related events or patterns which have occurred within the North Atlantic Basin the same year.

The North Atlantic Oscillation (NAO) is a climatic phenomenon in the North Atlantic Ocean caused by changes in atmospheric pressure at sea level between the Icelandic low and the Azores high. Two extreme phases exist, positive NAO and negative NAO, when the pressure contrast between the two regions increases and decreases respectively. This exerts control on the strength and direction of westerly winds and storm tracks across the North Atlantic, but is variable without any periodicity. The Atlantic Multi-decadal Oscillation on the other hand is a mode of natural variability in sea surface temperatures of the North Atlantic Ocean with a period of between 60 to 80 years. Because sub-aerial volcanic eruptions and submarine volcanic eruptions are responsible for temperature, pressure and humidity changes, they may be important as triggers for weather-related events or patterns within the North Atlantic Basin. This account is a look-back-and-learn study of one submarine volcanic eruption.

NASA Earth Observatory image by Jesse Allen and Robert Simmon, using EO-1 ALI data

NASA image of the El Hierro submarine eruption acquired on January 4, 2012

The submarine eruption of the El Hierro volcano, south of El Hierro Island, the smallest and farthest south and west of the Canary Archipelago in the Atlantic Ocean, 460 km west of the coast of Morocco, has been documented by Wikipedia (http://bit.ly/IE19El_Hierro). On October 10, 2011, the shallow underwater eruption occurred 2 km south of the fishing village La Restinga. On that day, patches of pale-coloured and sulphurous smelling seawater with dead fish were reported. Eruption 'jacuzzis', occasionally reaching 10-15 m high above the sea surface, were seen during the most energetic eruptive episodes. A confirmed Surtseyan type of eruption phase started with several plumes aligned along a north to south fissure on November 7, 2011. On November 25, 2011 the eruption was ongoing with vigorous explosive bubbles emerging. On November 27, 2011 the Spanish coastguard vessel Salvamar Adhara collected pumice clasts, colloquially nicknamed 'floating lava bombs' or 'lava balloons', some of many that had been ejected by the underwater eruption and floated to the surface of the sea before sinking again.

In early December, swath bathymetry mapping revealed the depth of the submarine volcano to be 60 m below sea level. On December 21, 2011 the eruption appeared to be subsiding but activity increased again in early January 2012 with a wider area of the sea producing steaming pumice clasts and 'jacuzzis' activity. During one stage, the seawater was measured to be heated up by 18.8 degrees Celsius above normal and the pH reached a minimum value of 2.8. By late February 2012 a decrease in seismicity, deformation and gas release was noted. In early March 2012, the El Hierro authority declared the eruption to be over.

In mid-April 2012, webcams revealed the top of the cone was at 86 m below sea level. As of June 2012, passive degassing continued at the main Restinga underwater vent. The total volume of lava released by the vents during the submarine eruption was estimated to be 329 million m^3 excluding blobs carried away by currents or trundled into deeper water.

The 'sudden' switching on of hot seawater in the southeastern part of the North Atlantic

NASA Earth Observatory image by Robert Simmon

with data courtesy of the NASA/NOAA GOES Project Science team

NASA image of Hurricane Sandy acquired on October 28, 2012

Date	Affected region	Notable weather-related events or pattern
April-July	England and Wales	Wettest summer in England and Wales in 100 years with annual rainfall of 1331 mm (115% above average) and severe flooding
May-August	Central North America	Drought estimated damage US$30 billion; most severe since 1895
Summer	Arctic Ocean	Record low sea ice
Summer	Northern/central Europe	Abnormally wet summer with moisture able to penetrate the continental interiors
June-November	US east coast	Extremely active hurricane season, tied with 1887, 1995, 2010 and 2011 for having the third-most named storms on record but few made landfall
July	Virginia	Hottest on record
July	Greenland	Period of extended surface melting across almost the entire ice sheet
July-October	Western/central Africa	Abnormally wet with flood conditions
October	US east coast	Hurricane Sandy estimated damage US$65 billion; 147 fatalities
October	North Atlantic	Tropical storm Nadine tied record for the longest lasting Atlantic storm
November	England	Wettest week in last 50 years with severe flooding
Winter	US east coast	Abnormally cool and wet due to the active polar airstream
Winter	British Isles	Abnormally cold due to the active polar airstream

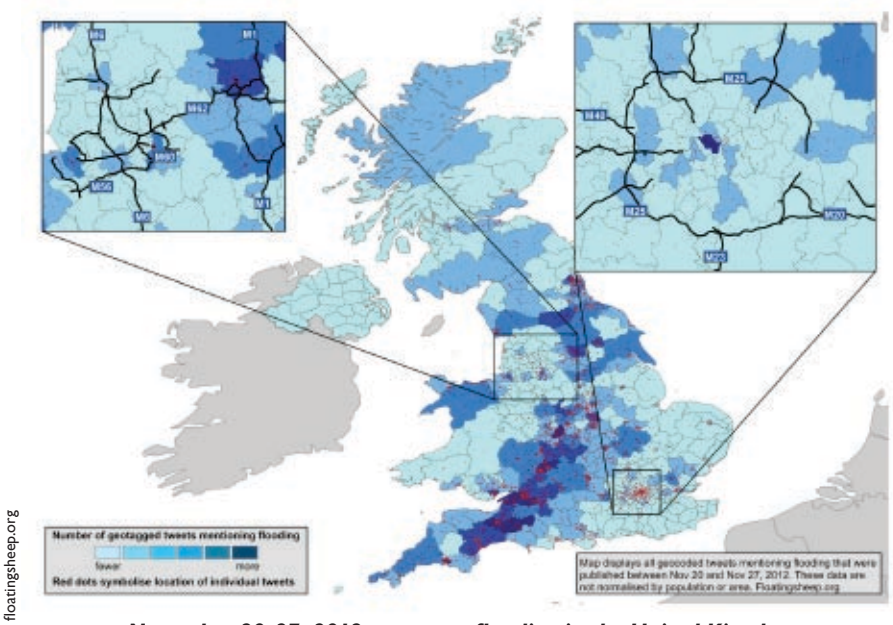
Summary table of notable weather-related events or patterns in the North Atlantic Basin during 2012 after the switching on of hot seawater in the Atlantic Ocean by the El Hierro submarine volcanic eruption. Based mainly on National Climatic Data Center, the Meteorological Office and the Browning Newsletter

Ocean has three main climatic impacts. First, the hot and low density seawater immediately beneath the surface speeded up the tropical Atlantic currents, rushing the tropical waters northwards. Second, the hot seawater warmed the atmosphere above causing a fall in air pressure to generate depressions. Third, the polar jet stream was drawn further south than normal in the North Atlantic Ocean. Consequently both the 'normal' oceanic circulation and atmospheric circulation were drastically altered. The combination effect is an extremely negative NAO including the development of a 'Greenland block'.

Notable weather events or patterns during 2012 in the North Atlantic Basin are summarised in the Table above.

Because the El Hierro submarine eruption was initiated during mid-autumn 2011 in the northern hemisphere when seawater was already cooling (and seawater is a poor conductor of heat), it took a while for the hot water to have an impact. Hot seawater means lower pressure over the ocean with an increase in the rate of evaporation and the total number of depressions. This was responsible for an abnormally busy hurricane season in the North Atlantic and a long succession of frontal activity storms bringing heavy rainfall to the northern/central Europe during 2012. The summer in England and Wales was the wettest in 100 years, while the wettest week in the last 50 years in England, with severe flooding, occurred in November. The hot Atlantic Ocean also accounted for the record low sea ice in the Arctic Ocean as well as a period of extended surface melting across almost the entire Greenland ice sheet in July 2012 reported in the journal Nature. Away from the Atlantic Ocean, prolonged high pressure conditions led to the severe summer drought over central North America while prolonged low pressure conditions led to abnormally wet conditions in western/central Africa. In October 2012, Hurricane Sandy, one of the few hurricanes making landfall during the year due to the 'Greenland block', resulted in an estimated damage of US$65 billion with 147 fatalities.

In this look-back-and-learn analysis of the submarine eruption of the El Hierro volcano it is concluded that we have grossly underestimated the role played by submarine volcanic eruptions as a trigger of weather-related events or patterns within the North Atlantic Basin. Unlike the conclusions drawn by a number of workers, it is unnecessary to attribute such weather-related events or patterns to anthropogenic global warming.



November 20-27, 2012 tweets on flooding in the United Kingdom

Professor Wyss Yim DSc PhD DIC FGS was at Imperial College in the Department of Geology from 1971-1974. After that he spent 35 years until retirement at the University of Hong Kong where he taught civil engineering, geosciences and environmental management students, and, helped found the Department of Earth Sciences. He was awarded the DSc by the University of London in 1997. Wyss served as the Deputy Chairman and a member of the Climate Change Science Implementation Team of UNESCO's International Year of Planet Earth 2007-2009.