

Irish chronicles reveal links between cold weather and volcanic eruptions

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The eruption of Mount St. Helens in 1980. Credit: Austin Post, USGS

Medieval chronicles have given an international group of researchers a glimpse into the past to assess how historical volcanic eruptions affected the weather in Ireland up to 1500 years ago.

By critically assessing over 40,000 written entries in the *Irish Annals* and comparing them with measurements taken from ice cores, the researchers successfully linked the climatic aftermath of [volcanic eruptions](#) to extreme cold [weather events](#) in Ireland over a 1200-year

period from 431 to 1649.

Their study, which has been published today, 6 June, in IOP Publishing's journal *Environmental Research Letters*, showed that over this timescale up to 48 explosive volcanic eruptions could be identified in the [Greenland Ice Sheet](#) Project (GISP2) ice-core, which records the deposition of volcanic sulfate in annual layers of ice.

Of these 48 volcanic events, 38 were associated, closely in time, with 37 extreme cold events, which were identified by systematically examining written entries in the *Irish Annals* and picking out directly observed [meteorological phenomena](#) and conditions, such as heavy snowfall and frost, prolonged ice covering lakes and rivers, and contemporary descriptions of abnormally [cold weather](#).

Lead author of the study, Dr Francis Ludlow, from the Harvard University Center for the Environment and Department of History, said: "It's clear that the scribes of the *Irish Annals* were diligent reporters of severe cold weather, most probably because of the negative impacts this had on society and the biosphere.

"Our major result is that [explosive volcanic eruptions](#) are strongly, and persistently, implicated in the occurrence of cold weather events over this long timescale in Ireland. In their severity, these events are quite rare for the country's mild maritime climate."

Through the injection of sulphur dioxide gas into the stratosphere, volcanic eruptions can play a significant role in the regulation of the Earth's climate. [Sulphur dioxide](#) gas is converted into sulphate aerosol particles after eruptions which reflect incoming sunlight and result in an overall temporary cooling of the Earth's surface.

Whilst the global effects of recent eruptions are quite well-known, such

as the Mount Pinatubo eruption almost 22 years ago (15 June 1991), less is known about their effects on climate before the beginning of instrumental weather recording, or their effects on regional scales; the *Irish Annals* provided an opportunity to explore both of these issues.

The *Irish Annals* contain over one million written words and around 40,000 distinct written entries, detailing major historical events on an annual basis, and providing both systematic and sustained reporting of meteorological extremes.

The dating and reliability of the Annals can be gauged by comparing reported events to those which are independently known, such as solar and lunar eclipses.

"With a few honourable exceptions, the Irish record of extreme events has only been used anecdotally, rather than systematically surveyed and exploited for the study of the climate history of Ireland and the North Atlantic, and so the richness of the record has been largely unrecognized," continued Dr Ludlow.

Although the effect of big eruptions on the climate in summer is largely to cause cooling, during the winter, low-latitude eruptions in the tropics have instead been known to warm large parts of the northern hemisphere as they cause a strengthening of the westerly winds that brings, for example, warmer oceanic air to Europe; however, this study identified several instances when low-latitude eruptions appeared to correspond to extreme cold winters in Ireland.

One example is the 1600 eruption in Peru of Huaynaputina, which the researchers found, against expectations, to be associated with extreme cold winter weather in Ireland in the following years.

"The possibility that tropical eruptions may result in severe winter

cooling for Ireland highlights the considerable complexity of the volcano-climate system in terms of the regional expression of the response of climate to volcanic disturbances.

"It is on the regional scale that we need to refine our understanding of this relationship as ultimately, it is on this scale that individuals and societies plan for extreme weather," continued Dr Ludlow.

More information: 'Medieval Irish chronicles reveal persistent volcanic forcing of severe winter cold events, 431-1649 CE' Francis Ludlow, Alexander R Stine, Paul Leahy, Enda Murphy, Paul A Mayewski, David Taylor, James Killen, Michael G L Baillie, Mark Hennessy and Gerard Kiely, 2013 *Environ. Res. Lett.* 8 024035.
iopscience.iop.org/1748-9326/8/2/024035/article

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