

Role aerosols play in climate change unlocked by spectacular Icelandic volcanic eruption

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Plinian column of the eruption of Sarychev (Russia) on 12 June 2009. Credit: NASA

A spectacular six-month Icelandic lava field eruption could provide the crucial key for scientists to unlock the role aerosols play in climate change, through their interactions with clouds.

An international team of climate scientists, led by the University of Exeter, have meticulously studied the effects that the 2014-15 eruption at Holuhraun, in Iceland had on cloud formations in the surrounding region.

They found that the 2014-15 Holuhraun fissure eruption, the largest since Laki which erupted for eight months in 1783-4, emitted sulphur dioxide at a higher rate than all 28 European countries added together causing a massive plume of sulphate aerosol particles over the North Atlantic.

As would be expected, these aerosols reduced the size of cloud droplets, but contrary to expectations did not increase the amount of water in the clouds.

The researchers believe these startling results could significantly reduce uncertainties in future climate projections by outlining the impact of sulphate aerosols formed from human industrial emissions on climate change.

The pioneering study is published in leading scientific journal, *Nature*, on Thursday 22 June.

Dr Florent Malavelle, lead author of the study and from the Mathematics department at the University of Exeter said: "The huge volcanic eruption provided the perfect natural experiment in which to calculate the interaction between aerosols and clouds.

"We know that aerosols potentially have a large effect on climate, and

particularly through their interactions with clouds. However the magnitude of this effect has been uncertain. This study not only gives us the prospect of ending this uncertainty but, more crucially, offers us the chance to reject a number of existing climate models, which means we can predict future [climate change](#) far more accurately than ever before."

Aerosols play a pivotal role in determining the properties of clouds as they act as the nuclei on which water vapour in the atmosphere condenses to form clouds.

Sulphate aerosol has long been recognised as the most significant atmospheric aerosol from industrial sources, but other natural sources of sulphate aerosol also exist, including that formed from sulphur dioxide release as a result of volcanic eruptions.

The 2014-15 Holuhraun eruption is thought to have emitted between 40,000-100,000 tons of [sulphur dioxide](#) every single day during its eruptive phase. Using state-of-the-art climate system models, combined with detailed satellite retrievals supplied by NASA and the Université libre de Bruxelles, the research team were able to study the complex nature of the cloud cover formed as a result of the eruption.

They found that the size of the water droplets produce was reduced, which in turn led to cloud brightening - which results in an increased fraction of incoming sunlight being reflected back into space and, ultimately, providing a cooling effect on the climate.

Crucially however, these aerosols had no discernible effect on many other cloud properties, including the amount of liquid water that the [clouds](#) hold and the cloud amount. The team believe the research shows that cloud systems are "well buffered" against aerosol changes in the atmosphere.

Professor Jim Haywood, co-author of the paper and also from the University of Exeter added: "Explosive and effusive volcanic eruptions are very different. The massive explosive eruption of Pinatubo in 1991, which injected [aerosol](#) to altitudes of 25km+ into the stratosphere, has been the go-to event for improving our model simulations of the impact of explosive [volcanic eruptions](#) on climate.

"Now volcanoes have provided a new clue in the climate problem: how aerosols emitted at altitudes similar to those from human emissions impact the [climate](#). Without a doubt, the effusive [eruption](#) at Holuhraun will become the go-to study in this regard."

More information: Strong constraints on aerosol-cloud interactions from volcanic eruptions, *Nature* (2017).

[nature.com/articles/doi:10.1038/nature22974](https://doi.org/10.1038/nature22974)

Provided by University of Exeter

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