



A volcano comes to life – satellite picture of Bardarbunga on Iceland

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Bardarbunga, (Bárðarbunga) in Iceland, one of the largest volcanoes in Europe and located beneath the biggest glacier in Europe, became active again in mid-August. For several years now, German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) researchers have been keeping a close eye on Bardarbunga and the system of volcanoes associated with it - an enormous network of subterranean magma channels, vents and craters. The German Earth observation satellite TerraSAR-X has now provided important data on the volcano's latest activity.

The image shown here covers an area of approximately 30 by 50 kilometres, and the recently ejected lava covers an area of roughly 10 square kilometres. The brighter areas, which are also highlighted in red for better visibility, indicate changes in amplitude (the intensity of the radar signals returned to the satellite). Since the rough surface of freshly-cooled lava reflects the radar signals back very strongly, it appears bright and is easily visible on the lava flow at the lower right in the image or on the two arcs at the right edge of the image (the northern edge of Vatnajökull). Smooth surfaces, such as water, reflect the incoming radar signals away from the satellite and so appear dark on the images.

In the bottom half of the image, the lake in the caldera of the Askja volcano is visible as a black area. A landslide occurred recently on this volcano, triggering a tsunami in the lake - with a wave height of up to 30 metres. From this image, it is clear that the area adjacent to the water is darker in colour than the more elevated regions. This is very probably due to flooding associated with the tsunami.

The story so far

Activity in the Bardarbunga volcano system began with earthquakes having magnitudes of up to 5.7 in the Richter scale, indicating that magma beneath the surface was moving and rising. On 27 August, volcanologists discovered several new depressions in the ice to the south of the caldera of Bardarbunga, with depths of up to 15 metres. This is another indication that a heat source lies beneath the ice sheet of the glacier. On 29 August, a lava flow escaped from a breach in the Holuhraun lava field to the north of the glacier - an ice-free area. On 31 August, a second eruption occurred there. The Holuhraun lava field has now grown to cover an area of over 19 square kilometres. If the lava had escaped directly beneath the ice and forced its way to the surface, there would have been a large steam explosion, reducing the lava to tiny particles of ash and forming an ash cloud. This is exactly what happened in 2010 with the eruption of Eyjafjallajökull, another subglacial volcano in this region, which led to significant disruption for air traffic.

Early warning system for volcanic eruptions

The systems of volcanoes on Iceland have been at the focus of research by scientists at the DLR Remote Sensing Technology Institute (Institut für Methodik der Fernerkundung; IMF) for several years. The aim is to understand volcanic processes more exactly and develop new methods for the early detection of eruptions. Radar satellites provide comprehensive, highly precise data for this, regardless of the weather conditions and time of day. The process of detecting movements in Earth's surface - radar interferometry - has been especially optimised at DLR for the TerraSAR-X satellite. The remote sensing experts will now be generating more radar images of Bardarbunga and analysing changes in Earth's surface throughout the process.

The DLR IMF is investigating processes for early detection of volcanic eruptions as part of a joint project called IsViews (Iceland subglacial Volcanoes interdisciplinary early warning system). An early warning system can help limit the effects of volcanic activity on air traffic and the local population. In addition, the Institute is working as part of the European FUTUREVOLC project, which is pursuing the development of a comprehensive volcano monitoring system. Both research teams are using high-resolution remote sensing data from satellites including TerraSAR-X and TanDEM-X.

DLR conducts research into the effects of volcanic ash in the Volcanic ash impact on the Air Transport System (VolcATS) project. This project includes a satellite-based technique to determine the distribution of ash in the air at short notice and predict its movement. This contributes to a flexible air traffic management system in which information about those areas that are ash free and therefore safe for air traffic can be shared. The still inadequately understood effects of volcanic ash on aircraft engines are being studied and an ash warning system is being developed for commercial aircraft. Participants include the DLR Institutes of Atmospheric Physics, Flight Guidance, Materials Research, Propulsion Technology, and Air Transportation Systems, together with DLR Flight Experiments.

During the Eyjafjallajökull eruption in 2010, the airspace over Germany was able to be reopened on the basis of measurement flights performed by the DLR Falcon. The Falcon is the only research aircraft in Europe that is legally able to fly at high altitudes and over long distances in volcanic ash clouds.

About the image

Two separate images, acquired on 13 August and 4 September, have been combined to create the image presented here. These were low-resolution preview images (Quicklooks). The images were acquired by TerraSAR-X in stripmap mode, with a resolution of around three metres per pixel.

About the TerraSAR-X mission

TerraSAR-X is being implemented on behalf of the German Aerospace Center DLR with funds from the German Federal Ministry of Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie). It is the first German satellite manufactured under what is known as a Public-Private Partnership (PPP) between DLR and Airbus Defence and Space.

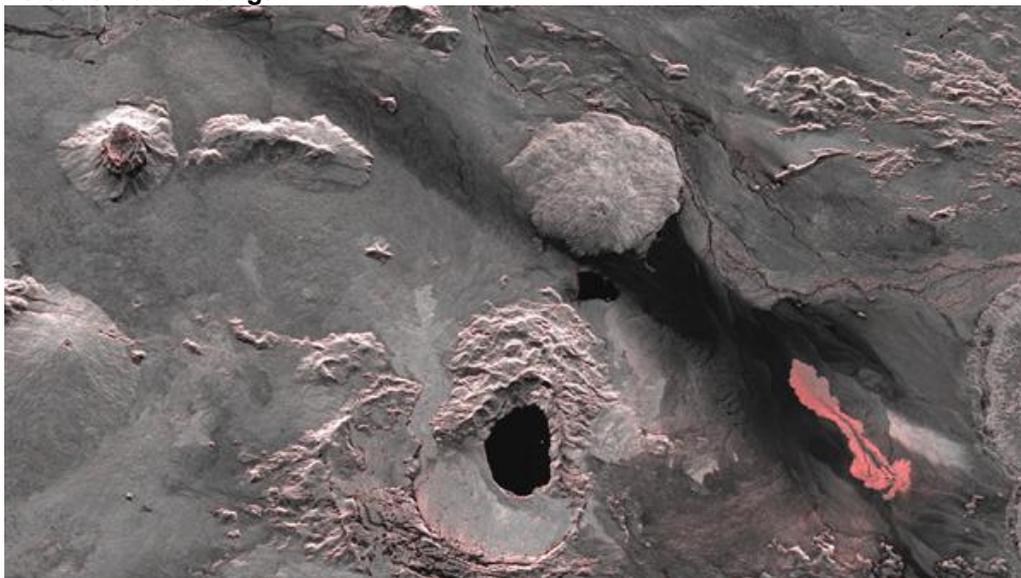
DLR is responsible for using TerraSAR-X data for scientific purposes; it is also responsible for planning and implementing the mission as well as controlling the satellite. Airbus Defence and Space built the satellite, shared the costs of developing it and is sharing the costs of operating it. The programme line 'Geo-Intelligence', part of the 'Communication, Intelligence and Security' business line of Airbus Defence and Space, is responsible for marketing the data commercially.

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Lava eruption in the Holuhraun lava field, 40 kilometres north of the central volcano Bardarbunga



Holuhraun is a lava field in Iceland's highlands, north of Vatnajökull glacier; it is part of the Bardarbunga volcanic system. In this image, acquired by the German radar satellite TerraSAR-X, the freshly exposed lava can easily be seen in the right-hand part of the picture. The lighter areas in the image, which have been coloured red to enhance their visibility, show a variation in amplitude – the intensity of the radar signal that comes back to the satellite. The rough surface of the freshly cooled lava reflects the radar signals very strongly, and thus appears bright. Smooth surfaces such as water reflect the incident radar beam away from the satellite and therefore appear dark in the image, like the crater of the Askja volcano in the lower centre of the image.

Credit: DLR.

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