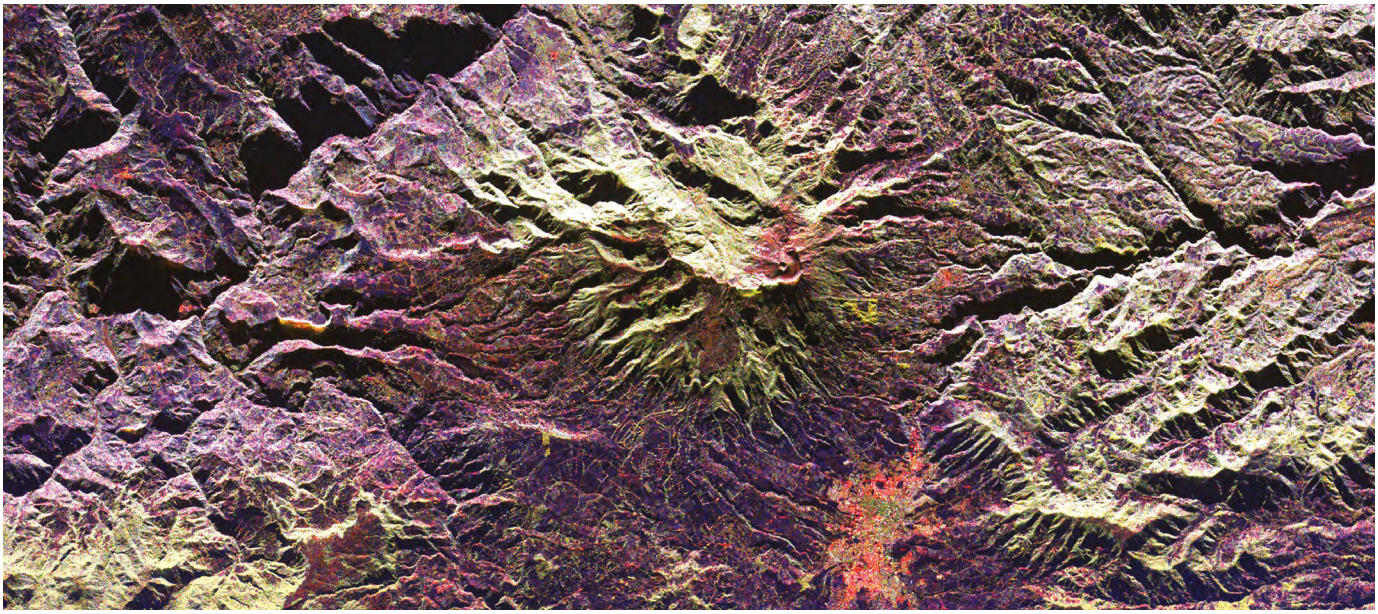
HEXAGON

Volcanic hazard maps improve disaster preparedness in Colombia

Volcanic eruptions are infrequent. When they do occur, however, eruptions can be sudden, violent and explosive, often resulting in a spew of molten rock that creates a path of destruction down valley from the volcano's cone. Eruptions from a single volcano are usually not likely to take place more than once during a person's lifetime. Such is not the case for the Galeras volcano in Colombia.

Volcanic hazard maps used in addition to remote sensing data and digital elevation models help decision-making in any hazardous volcanic situation.



This radar image of the area surrounding the Galeras volcano shows the ability of multi-frequency radar to map volcanic structures that can be dangerous to study on the ground. Pasto, shown in orange, is eight kilometers from the main crater. Image source: NASA/JPL.

Galeras volcano

Located in the Cordillera Central of the Andes mountain range, Galeras volcano is one of the most active volcanoes in Colombia. At an altitude of 4200 meters above sea level, the Galeras volcano's main crater is eight kilometers from the city of Pasto. The capital of the department of Nariño, Pasto has more than 300,000 inhabitants. Other settlements in the area, such as Jenoy and Nariño, are located within five kilometers of the crater. On the flanks of the volcano are other municipalities, such as Sandona, Consaca and Yacuanquer, with a combined population of approximately 80,000.

Since the establishment of Pasto nearly 500 years ago, Galeras has had more than 20 eruptive periods, some lasting for several years. On January 14, 1993, the Galeras volcano unexpectedly erupted, killing six scientists and three tourists on an expedition to its summit. It erupted again in 2005 and 2008.

Volcanic hazard zone maps

Volcanic hazard zone maps are perhaps the most easily understandable resources that public officials and citizens can use in planning for volcanic emergencies. The most common means by which a volcano's history and potential for future activity can be presented is a map outlining areas of risk from a particular kind of volcanic or hydrologic hazard. The hazard zones must outline an area likely to be affected by an event, and should also give some idea of its recurrence interval. An alert issued immediately after the onset of any eruption could provide enough time for the people to escape, if they are informed and prepared in advance. Additionally, government authorities must evaluate volcanic hazard zone maps, along with socio-economic and political factors, to develop long-range land-use plans.

Galeras volcano has three hazard zones around its crater. The high-hazard zone corresponds to an area where volcanic events of high severity will take place. In this zone, there will be no survivors and property will be destroyed. The medium-hazard zone is a transition zone that corresponds to an area that could be affected by the same volcanic phenomena as the high hazard zone, but only in the event of larger eruptions. The low-hazard zone is the largest area. Although the severity is lowest for people and property in this zone, the possibility of volcanic impact should be considered when planning any type of construction.

To influence the decisions made by civil authorities during a volcanic crisis, volcanologists must establish more effective communication with elected officials, news media and local citizens. Creating an effective visualization tool, such as volcanic hazard maps, is one way to accomplish it. Without this sort of visual aid, damaging consequences may follow scientific statements that are not fully understood or believed by civil leaders or the public.

Remote sensing aids volcanic disaster planning

Remote sensing imagery offers many applications for hazard assessment of volcanic processes, if used with ground-based information. Volcanic hazard maps used in addition to remote sensing data and digital elevation models help decision-making in any hazardous volcanic situation. Using ERDAS IMAGINE, the entire spectrum of data covering different types of hazards in a given volcanic area may be displayed when needed. A Landsat 5 Thematic Mapper (TM) mosaic was assembled from the two scenes that record the Galeras volcano influence area. Two color composites were generated, one to help the local people visualize the landscape, and another for geological purposes. The Galeras volcano hazard map polygons were superimposed to the first color composite to enable users to query attributes of image and vector data interactively in 3D.

Every map uses elevation data, symbols and sections to represent a 3D world in two dimensions. From the study area topographic map, a digital elevation model was created by averaging the elevations within the cells of a grid and creating a digital matrix of these elevations.

Digital maps offer more choices for relating hazard zones to the landscape. Several types prove especially effective in helping volcanologists communicate with the public. An effective method to improve a lay person's visualization and comprehension of any volcanic hazard map is to drape the different hazard zones, as well as remote sensing images, over a digital elevation model.

Volcanic hazard maps used with remote sensing data and digital elevation models are proving to be effective in helping people responsible for the public welfare of communities exposed to volcanic risk explain volcanic hazardous situations. They are also being used to develop long-range land use, as well as design emergency evacuation routes. The perspective views generated by this rendering in 3D methodology allow the non-geologist to see any volcanic hazard map as a three-dimensional representation of a 3D world, where topography and its influence on volcanic hazard are evident.

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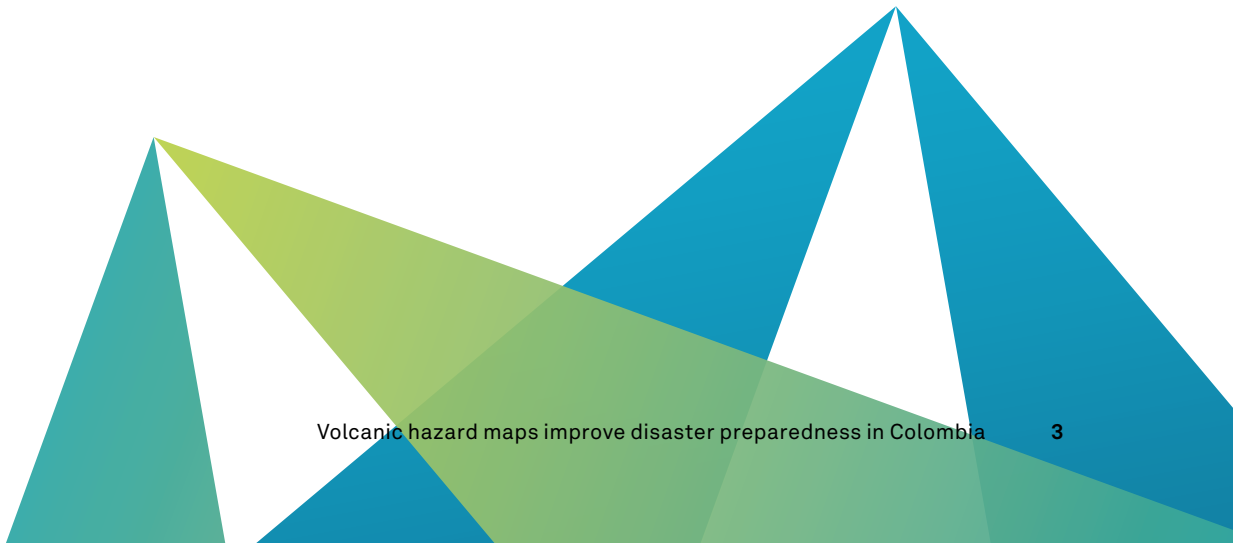

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