Satellite observations as a tool to monitor the volcanoes of ...



Elske de Zeeuw - van Dalfsen^{1,2}, Anouk Korevaar², Freek van Leijen², Reinoud Sleeman¹ and Diego Coppola³

© Authors. All rights reserved. ¹The Royal Netherlands meteorological Institute (KNMI), Netherlands, dalfsen@knmi.nl ²Department of Geoscience and Remote Sensing, Delft University of Technology, Delft, The Netherlands ³Department of Earth Sciences, University of Turin, Turin, Italy





Rationale for monitoring

- Lesser Antilles volcanic arc has 17 active volcanoes
- Volcanism due to ongoing subduction
- Montserrat started to erupt in 1995 after centuries of quietness.
- Martinique experienced 5th deadliest volcanic eruption in 1902
- Mnt. Scenery on Saba erupted ~1640
- The Quill on St. Eustatius erupted ~400

 \rightarrow Monitoring Mnt. Scenery and the Quill is important \rightarrow Currently only ground-based monitoring

Which Satellite observations are feasible to add to the existing ground-based monitoring network?



Current monitoring





Preliminary InSAR



Preliminary ALOS-2 L-band satellite interferograms in radar coordinates, for St. Eustatius (left) and Saba (right). Coherence is fair, but temporal resolution low for monitoring purposes.

- InSAR observations can be used to monitor surface deformation of volcanoes.
- Large spatial coverage over longer time periods can make subtle signals visible
- Problem is the loss of radar coherence caused by tropical rain forest.
- And the steep slopes which result in layover and shadowing effects.
- We process ALOS-2, PAZ and Sentinel data.



Preliminary MIROVA

MODIS (Moderate Resolution Imaging Spectroradiometer) data are used by MIROVA (Middle Infrared Observation of Volcanic Activity) to detect, locate and quantify thermal anomalies in near real-time(www.mirovaweb.it).

Thermal Remote Sensing for Global Volcano Monitoring: Experiences From the MIROVA System

Diego Coppola^{1,2*}, Marco Laiolo^{1,2}, Corrado Cigolini^{1,2}, Francesco Massimetti¹, Dario Delle Donne³, Maurizio Ripepe⁴, Hidran Arias⁵, Sara Barsotti⁶, Claudia Bucarey Parra², Riky Gustavo Centeno⁹, Sandrine Cevuard⁹, Gustavo Chigna¹⁰, Carla Chun⁹, Elsine Garaebit¹⁹, Dulce Gonzales¹⁰, Julie Griswold¹¹, Javier Juarez¹⁰, Luis E. Lara², Cristian Mauricio López¹², Orlando Macedo¹³, Celestin Mahinda¹⁴, Sarah Ogburn¹¹, Oktory Prambada¹⁵, Patricio Ramon¹⁶, Domingo Ramos¹⁷, Aline Pettier^{18,19}, Steve Saunders²⁰, Elske de Zeeuw-van Dalfsen²¹, Nick Varley²² and Ricardo William⁹

¹Dipartimento di Scienze della Terra, Università di Torino, Turin, Italy ²Centro Interdipartimentale sui Rischi Naturali in Ambiente Montano e Collinare, Università di Torino, Turin, Italy

ORIGINAL RESEARCH ARTICLE

Front, Earth Sci., 27 January 2020 | https://doi.org/10.3389/feart.2019.00362

Automatic triggering is challenging as Saba is a very small island (12 km²). False positives may occur due to the large contrast between the sea and island. Therefore observations are still in a test phase. As expected, currently no real anomalies have been observed.

© Authors. All rights reserved.

Final thoughts



- Satellite monitoring can be complementary to ground-based observations.
- It does not require local presence nor instruments.
- It is independent from local data transmission.
- The temporal resolution has increased in past years as more satellites have launched.

But...

- The sensitivity is not always good enough, especially considering the size of the islands (13 and 21 km²).
- Data availability sometimes depends on data proposal opportunities of space agencies.

However...

- First steps have been made to implement satellite data for monitoring of Mnt. Scenery and the Quill.
- More work is needed before combined monitoring can be made operational for these volcanoes.

© Authors. All rights reserved.

© image

laxa