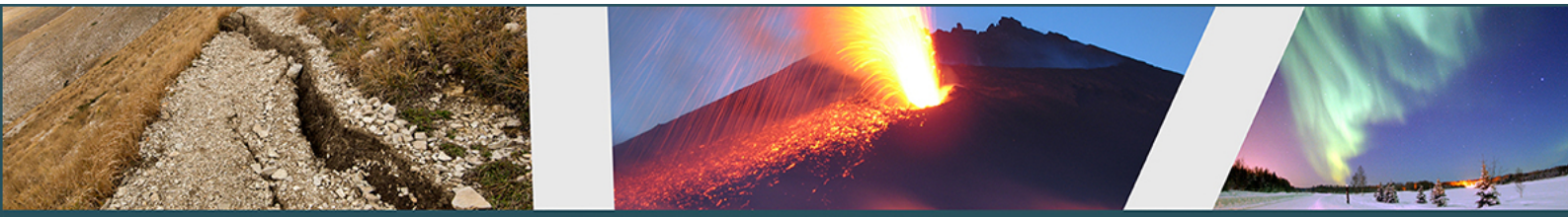

INGV ANNALS OF GEOPHYSICS

Volcanic Ash Cloud Observation using Ground-based Ka-band Radar and Near-Infrared Lidar Ceilometer during the Eyjafjallajökull eruption

Frank S. Marzano, Luigi Mereu, Mario Montopoli, Domenico Cimini, Giovanni Martucci

Abstract

Active remote sensing techniques can probe volcanic ash plumes, but their sensitivity at a given distance depends upon the sensor transmitted power, wavelength and polarization capability. Building on a previous numerical study at centimeter wavelength, this work aims at i) simulating the distal ash particles polarimetric response of millimeter-wave radar and multi-wavelength optical lidar; ii) developing and applying a model-based statistical retrieval scheme using a multi-sensor approach. The microphysical electromagnetic forward model of volcanic ash particle distribution, previously set up at microwaves, is extended to include non-spherical particle shapes, vesicular composition, silicate content and orientation phenomena for both millimeter and optical bands. Monte Carlo generation of radar and lidar signatures are driven by random variability of volcanic particle main parameters, using constraints from available data and experimental evidences. The considered case study is related to the ground-based observation of the Eyjafjallajökull (Iceland) volcanic ash plume on May 15, 2010, carried out by the Atmospheric Research Station at Mace Head (Ireland) with a 35-GHz Ka-band Doppler cloud radar and a 1064-nm ceilometer lidar. The detection and estimation of ash layer presence and composition is carried out using a Bayesian approach, which is trained by the Monte Carlo model-based dataset. Retrieval results are corroborated exploiting auxiliary data such as those from a ground-based microwave radiometer also positioned at Mace Head.

Keywords

Volcanic eruptions; radar; lidar

Full Text:

PDF

References

DOI: https://doi.org/10.4401/ag-6634

Published by INGV, Istituto Nazionale di Geofisica e Vulcanologia - **ISSN:** 2037-416X

ABOUT THE AUTHORS

Frank S. Marzano
http://www.diet.uniroma1.it

DIET, Università degli studi di Roma La Sapienza, Rome, ence di

l'Aquila, L'Aquila
Italy

Luigi Mereu
DIET, Università degli studi di Roma La Sapienza, Rome, and Center of Excellence CETEMPS, Università di l'Aquila, L'Aquila
Italy

Mario Montopoli
DIET, Università degli studi di Roma La Sapienza, Rome, and Center of Excellence CETEMPS, Università di l'Aquila, L'Aquila
Italy

Domenico Cimini
IMAA, CNR, Tito Scalo and Center of Excellence CETEMPS, Università di l'Aquila, L'Aquila
Italy

Giovanni Martucci
National University of Ireland, Galway and MeteoSwiss, Switzerland
Ireland

KEYWORDS

Central Italy Earthquake GPS Historical seismology Ionosphere Irpinia earthquake Italy Mt. Etna Seismic hazard Seismic hazard assessment Seismology UN/IDNDR earthquake earthquakes historical earthquakes ionosphere magnetic anomalies paleoseismology seismic hazard seismicity seismology