Full bandwidth remote sensing for total geophysical parameterization of volcanic emissions at Stromboli

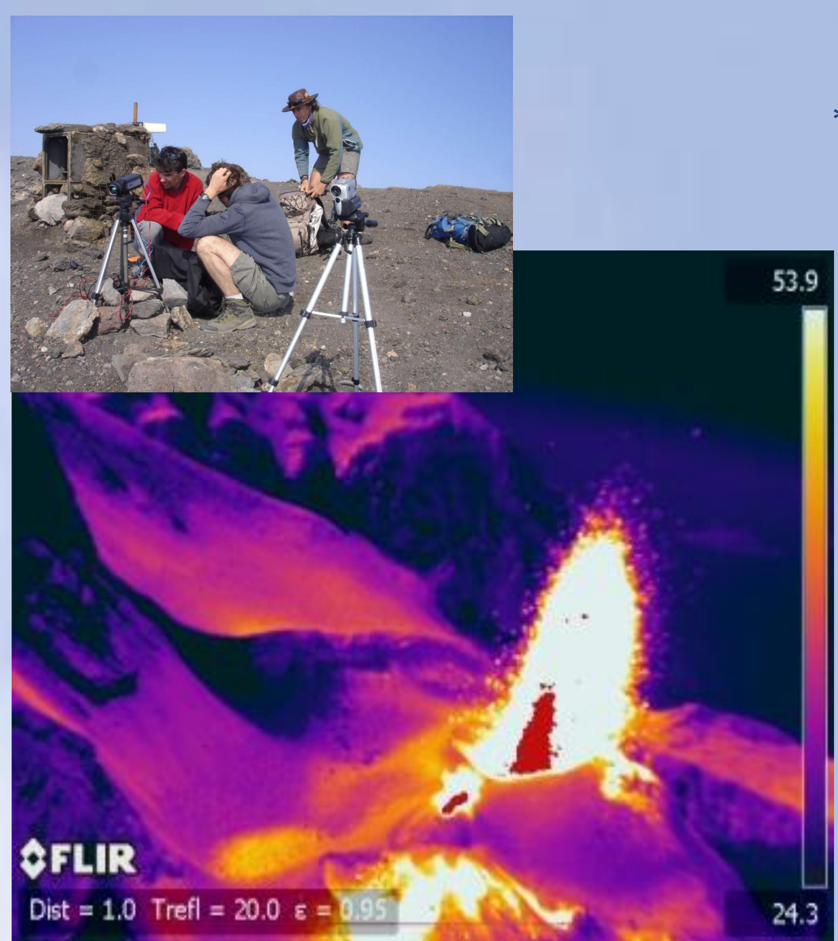
A.J.L. Harris, F. Donnadieu, P. Labazuy, K. Kelfoun, L. Gurioli, S. Valade, M. Bombrun, G. Sawyer, J. Battaglia, S. Moune, C. Hervier*, P. Freville*, T. Latchimy*, M. Bontemps*, C. Reymond*, C. Bernard*

Laboratoire Magmas et Volcans (LMV)
**Observatoire de Physique du Globe de Clermont-Ferrand (OPGC), Université Blaise Pascal, Clermont-Ferrand*

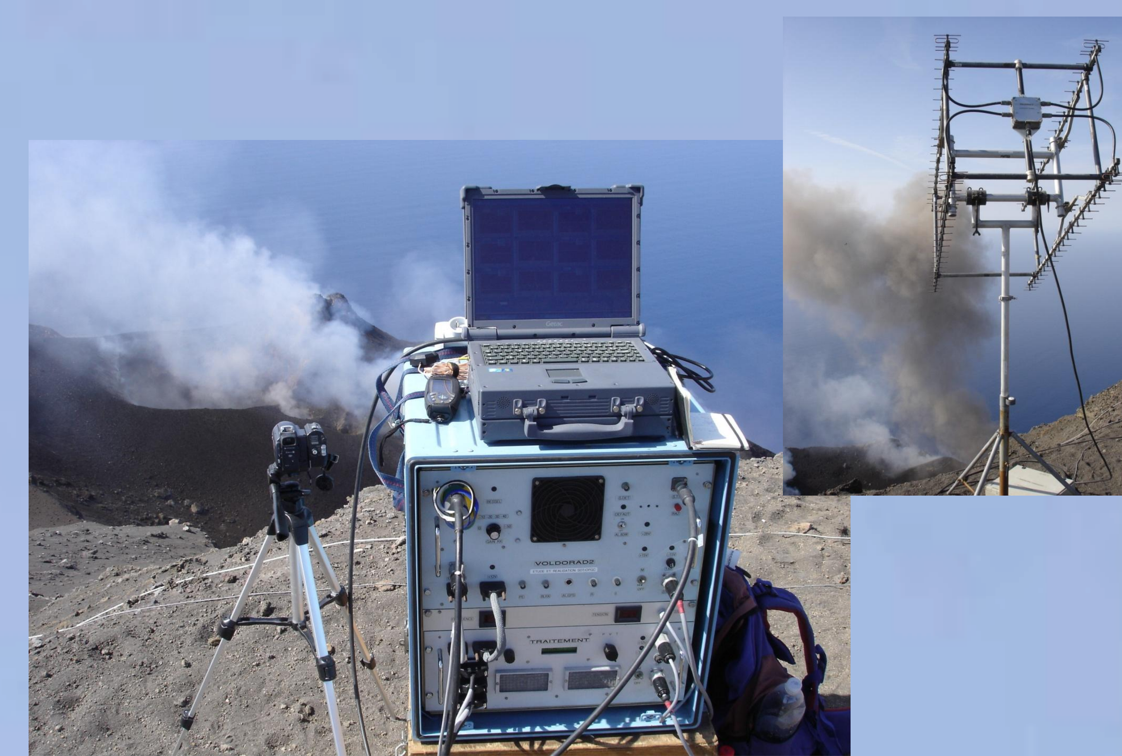
The remote sensing group of LMV-OPGC completed an unprecedented multiparametric experiment at Stromboli volcano (Eolian islands, Italy) during Sept. 27 – Oct. 7, 2012 to :

(i) Characterize explosive eruption dynamics at the highest possible spatio-temporal resolution, with the aim of quantifying the emitted products and to better understand the processes that control the emission and ascent of volcanic plumes.

(ii) Test the combined deployment of a complete geophysical instrument package, and evaluate its potential for operational ash plume tracking.



Two thermal infrared cameras
(FLIR Systems cameras, 8-14 microns)
One camera was deployed to track, at 200 Hz, hot gas and particle velocities, particle size distributions and mass fluxes across a narrow window immediately above the vent. A second camera imaged, at 30 Hz, plume ascent and dispersion.

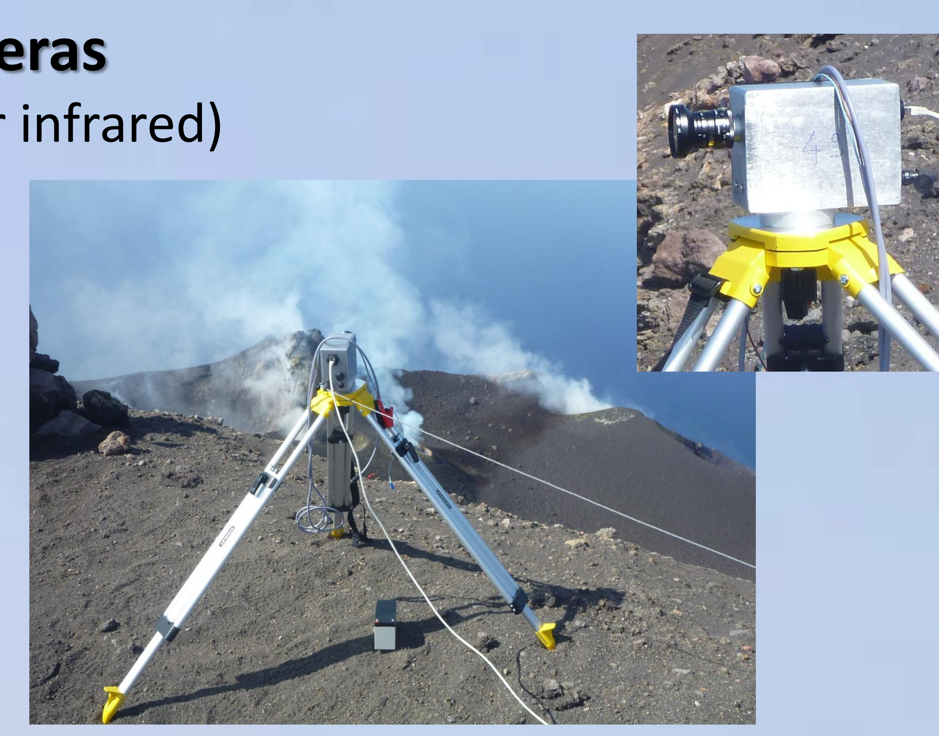


One Doppler radar
(VOLDORAD 2/OPGC, 23.5 cm wavelength)
VOLDORAD2 was deployed to quantify the mass and ejection velocities of ballistics. Using these data, we will be able to simulate the reflected energy at VOLDORAD's wavelength to compare with measured radar echoes and with results of a ballistic model to infer source parameters including pyroclast initial velocity, mass, and mass flux.

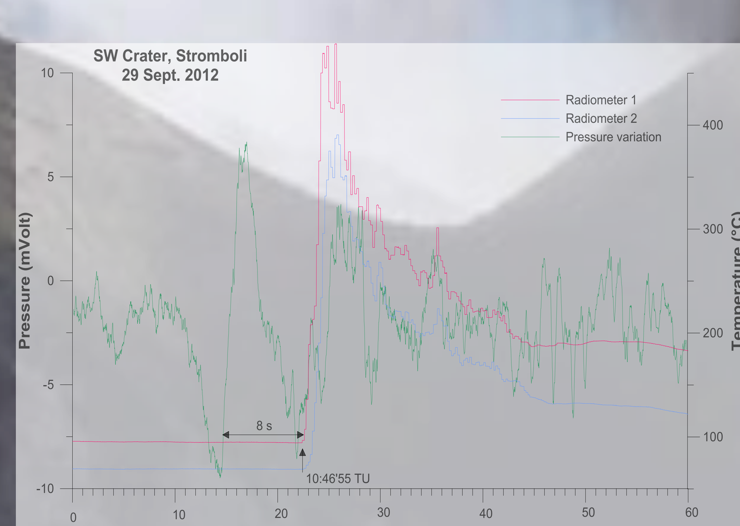
One SO_2 camera
Acquiring in 2 channels (310 and 330 nm) to quantify the mass of SO_2 (and total gas by coupling with relative proportions of gas species measured by FT-IR spectroscopy).

One very high frame rate camera
(Photron Fastcam SA3)
A high speed camera was operated at up to 2000 fps. Acquiring a 1024*1024 pixel image spanning the visible and near-infrared allows us to characterize the highest velocities for particles carried by by the gas phase.

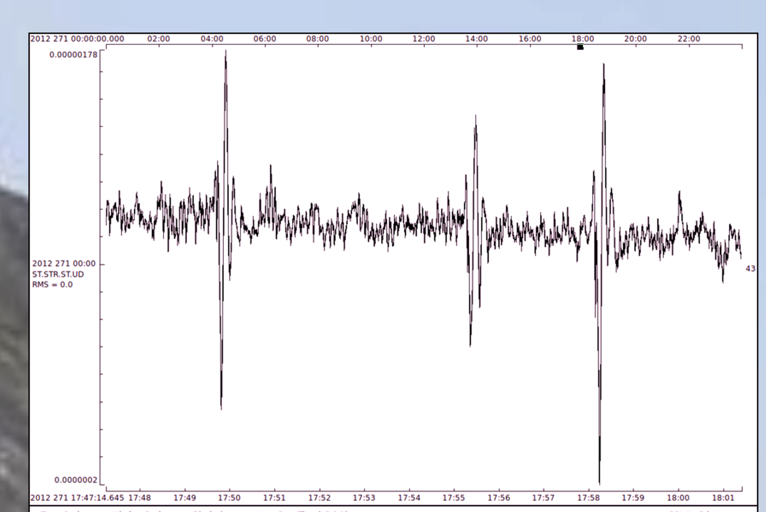
Two stereoscopic cameras
(IP Basler, visible and near infrared)
These were used to reconstruct the 3-D trajectories of bombs and constrain their sizes.



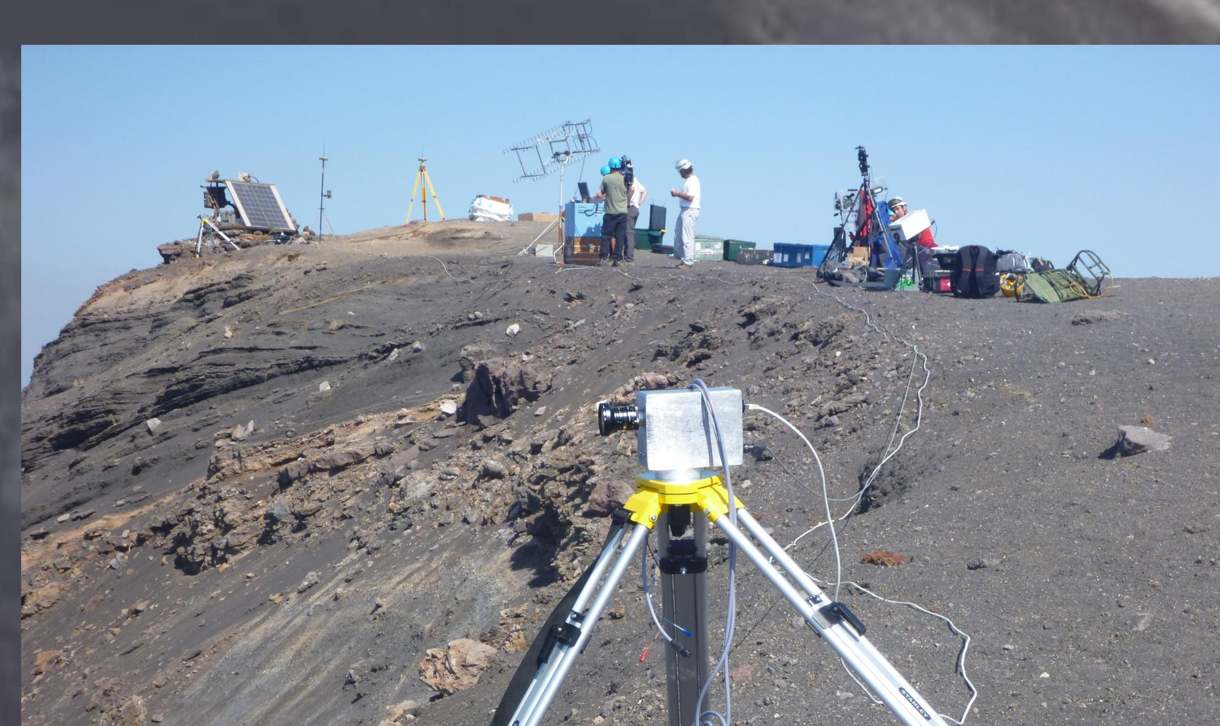
Two thermal infrared radiometers
(Cyclops 300AF, 8-14 microns)
These were coupled to a SETRA **pressure sensor** and sampled at 50 Hz to obtain thermal time series associated with the emission of pyroclasts, pressure variations, and the depth of the explosions through analysis of the time delays.



Permanent and temporary broadband seismometers and **pressure sensors** of the University of Firenze (M. Ripepe, D. Delle Donne, G. Lacanna) were used to complete the multiparametric network.

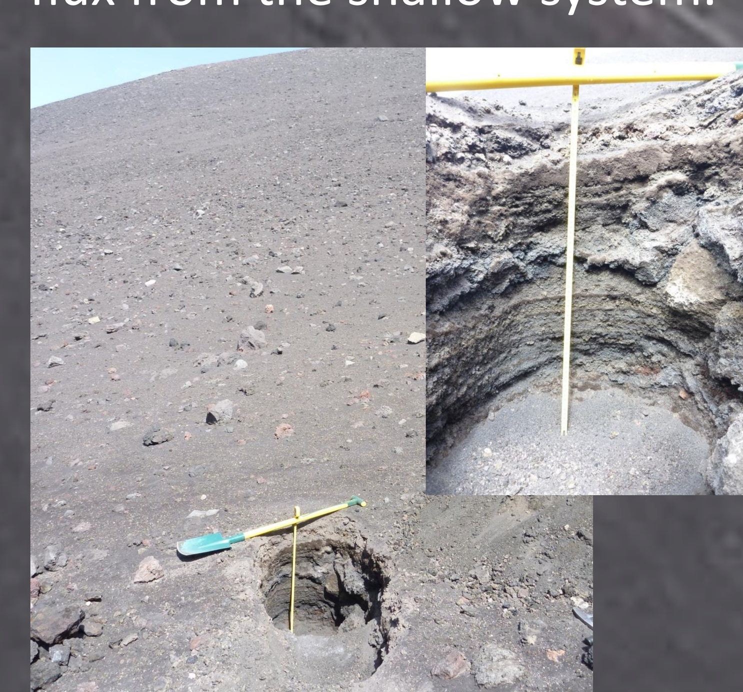


Ejecta sampling was completed to provide particle size distribution, vesicularity, crystallinity, chemistry and rheology. This will allow us to characterize the properties of magma residing in the shallow system and its role in the explosive process, as well as to better understand the relationship with our remote geophysical measurements for plume emission and ascent.



One laser disdrometer (Parsivel OTT)
This was deployed to test its potential application to collect information on the sizes of ash particles, along with ash collectors and direct sampling.

Three ground thermal stations each equiped with four temperature sensors were buried at 10, 30, 50, 70 cm on a radial line running away from the SW crater to track heat flux from the shallow system.



• Acknowledgments: M. Ripepe, D. Delle Donne, G. Lacanna (Univ. Firenze), M. Burton (INGV Pisa), P. Madonia (INGV Palermo), DPC Roma, COA Stromboli, Helijet (Lipari) and the people of Stromboli
• Funding: Région d'Auvergne, CLERVOLC, OPGC, LMV, INSU-TERMEX