Report on the GEOCUBE+@Etna ENVRI+ access from July 4 to July 21, 2018

The report can be downloaded from the page http://volcano.iterre.fr/geocubeplusetna

Aim of the access project: to design a light multi-parameter station based on the Géocube+ architecture

Objectives of the first mission of July 2018: to consolidate the results acquired during the previous year and consolidating the GNSS aspects of the Géocube, coupled experiments with aerosols sensors to assess in the field the issues to be solved to implement in the future Géocube+ the capability of recording information on gas and aerosols with appropriate add-on sensors.

Participants: Pierre Briole, Simon Bufféral (ENS, UMR CNRS 8538), Séverine Furst (Université de Montpellier, UMR 5243), Luca Terray (Université Clermont Auvergne, UMR 6524), Francesco Guglielmino, Boris Behncke, Salvatore Consoli (INGV – Observatory of Etna).

Scientist supported by ENVRI+: Simon Bufféral (whole mission from June 24 to July 21, but support requested for ~10 days only)

Pre-access period: Simon Bufféral arrived ten days prior to the effective start of the team access in order to prepare the experiment. For that he worked at INGV on two aspects: (1) with Boris Behncke (IGNV-OE) the aerosols aspects, taking advantage on the work he did with him in 2016 on the tephra of Etna, (2) with Salvatore Consoli (INGV-OE) preparation of the GPS surveys to be performed during the access period.

Access period: the rest of the team (except the local participants of INGV-OE) arrived on July 4 and most of the access in the field took place from July 4 to July 20.

Context: Our ambition is to develop an array of light and rugged multi-parameter stations organized around the original concept of Géocube (Fig. 1).

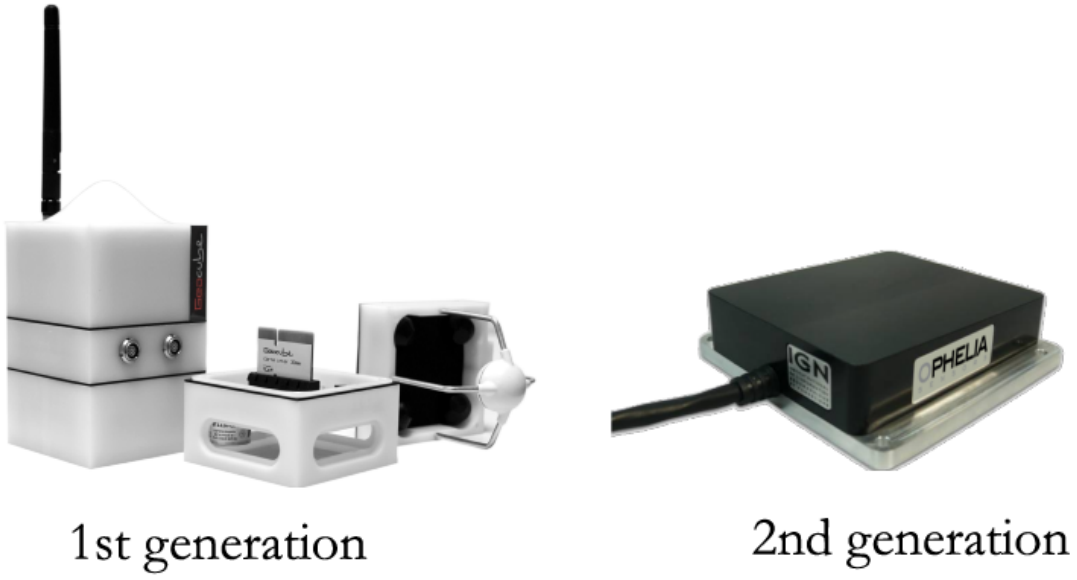

Figure 1. The two first generations of Geocubes. Those used at Etna, with a rugged industrial design, are those on 2nd generation. The sealed box includes the GPS receiver, the radio transmitter (except antenna) and a small battery.

The project gathers several scientists from the Istituto Nazionale di Geofisica e Vulcanologia, Italy, and from the Centre National de la Recherche Scientifique, the Institut Géogaphique National, and the Ophelia Sensors SME, France (originally Kylia SME). It takes advantage of the expertise acquired buy our team in previous instrumental projects at Etna.

The 2018 access: The 2018 campaign was aimed to re-observing the five sites (Fig. 2) where the Géocube prototypes were deployed originally in 2016-2017, and provide the last set of data needed by Amjad Lasri to complete his PhD.

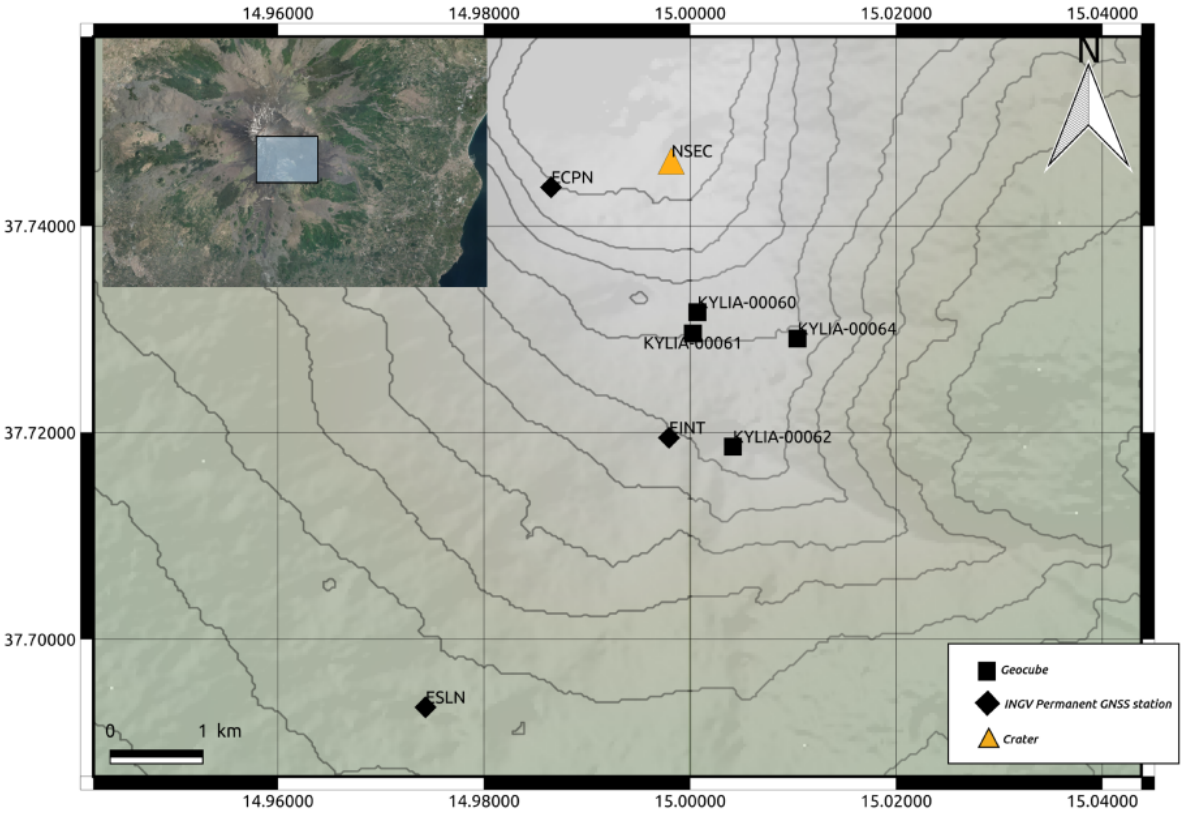

Figure 2. Location of the five Géocube stations on the south flank of Etna between the elevations 2600 and 2850 m. This area is right at the centre of the graben formed during the December 24, 2018 dyke injection at Etna.

In the field (Fig. 3) the Géocube is composed of the rugged sensor, a solar panel, a antenna for the telemetry. There is a small battery inside the sensor. The system is sealed and on Etna all the Geocubes were retrieved intact during the spring 2017 after one winter of operation. The 3rd generation in development, the Géocube+ will take advantage of the lessons learned at Etna during the 2016-2017 experiment and the conclusions of the PhD of Amjad Lasri (PhD defended at ENS on December 12, 2018).

During the access of July 2018, the first days (Fig. 4, 5, 6, 7) were devoted to the re-observation of the points so as to acquire an additional epoch of measurements to be used by Amjad Lasri to strengthen the conclusions of his PhD. Then the next phase (Fig. 8) was focused on the field investigation of areas where joint deformation and geochemistry observations could be performed by the future Géocube+.

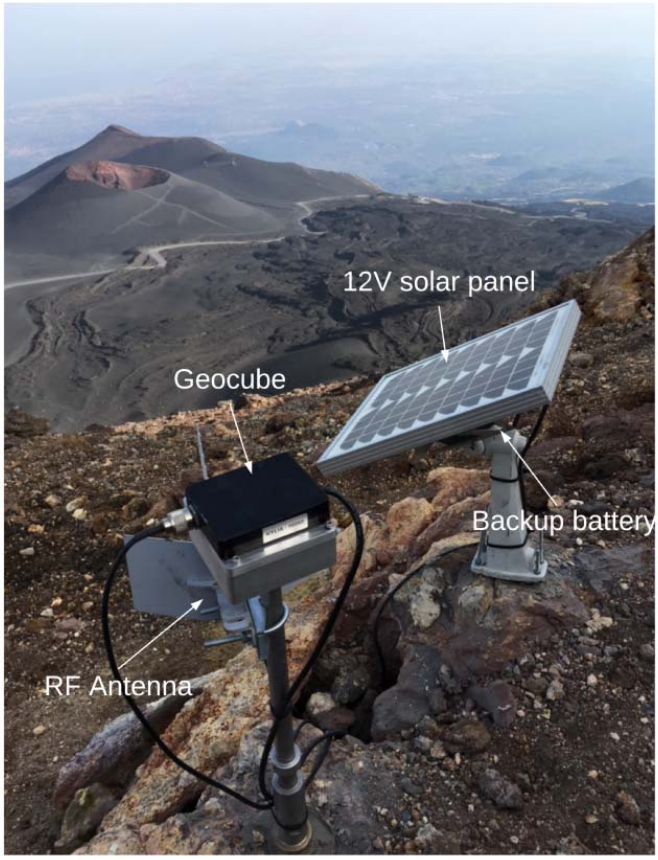

Figure 3. Deployment of the Geocube station in the field

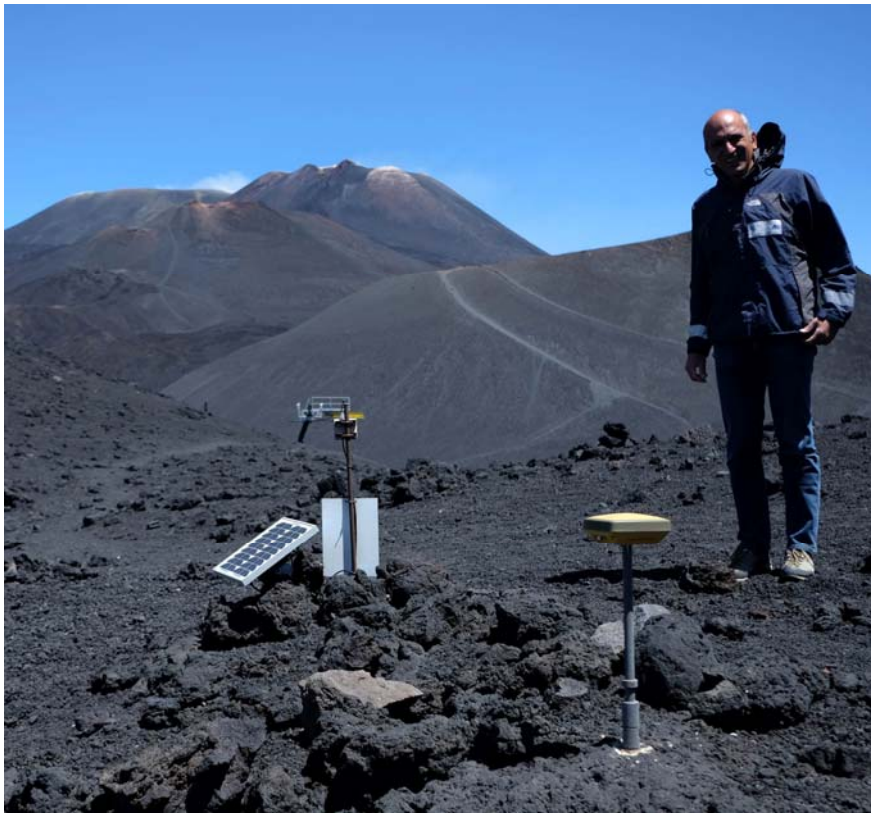

Figure 4. Francesco Guglielmino (INGV Catania) at the station "Géocube miracolato", elevation 2650 m, on July 6, 2018. In the back the south east summit crater of Etna

Figure 5. Luca Terray (left) and Simon Bufféral (right) at the station "Géocube miracolato", elevation 2650 m, on July 6, 2018. On the right the solar panel.

Figure 7. Simon Bufféral and Séverine Furst at the GPS point of Serra la Nave, elevation 1750 m, on July 8, 2018.

Figure 8. Luca Terray and Simon Bufféral performing analysis of the aerosols in the volcanic plume by using a Microtops II sun radiometer at the station Schiena del'Asino, elevation 2100 m, on July 12, 2018

Future investigations: The Geocubes+, initially planned for deployment in October 2018 has been delayed by some months. Tjarda Roberts, from the University of Orleans (LPC2E, UMR 7328) has sent to IGN sensors of SO2 and H2S to be implemented in the Geocubes+ along with an integrated accelerometer and the capacity to be connected to a geophone. Moreover the Géocube+ has a 4G modem on board which permits to avoid the previous system of telemetry and thus permits not deployments without limits of extension. The deployment of the Geocubes+ could take place in 2019, according to the interest of INGV-OE to pursue this experiment at Etna, and providing logistical support for another long term experiment including a winter period.

Participants to the project not involved in the field but in the laboratory: Amjad Lasri (IGN), Olivier Martin (IGN), Christian Thom (IGN), Alessandro Bonforte (INGV-OE), Frédéric Verluise (Ophelia Sensors), Tjarda Roberts (LPC2E), Pasquale Sellitto (ENS)

Version of this document: 20190305a

Date of this document: March 5, 2019