

# IMPROVE

European Training Network



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Newsletter n. 3

## Status of the IMPROVE Project

**IMPROVE has just entered its 3<sup>rd</sup> year of activity.** After three network schools (Iceland, Ireland, and Italy), two major field experiments (at the Krafla caldera, NE Iceland, and at Mount Etna, Sicily), two Specialized Short Courses (Orleans, France, and Bristol, UK), and a number of other research, training, dissemination and outreach activities, the 15 IMPROVE Early Stage Researchers start to be not anymore... that early. Instead, they are growing as valuable representatives of the next generation of lead volcanologists, ready to explore further such a fascinating field of science with a robust baggage made of quantitative and multi-disciplinary approaches. Together with them, other >50 young researchers from outside IMPROVE have benefited till now of the training opportunities provided by IMPROVE.

## SUMMARY

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IMPROVE  
Innovative Multi-disciplinary  
European Research training network on  
VolcanoEs

[www.improve-etn.eu](http://www.improve-etn.eu)



On May 14-20, 2023, the third IMPROVE network school took place in Carlingford, Ireland. It was organized and managed by the Dublin Institute for Advanced Studies (DIAS). The school was attended by 23 young researchers: 14 IMPROVE ESRs and 9 other participants, representing 10 different European countries.

The school focused on geophysical data inversion and numerical modeling, by exploring both theoretical and practical aspects of these techniques. Examples from seismic and acoustic source estimations, volcano deformation, and volcano imagery using seismology and magneto-tellurics were provided. The school also compared physics-based and data-driven inversion approaches, along with new hybrid inversion methods that integrate deep learning and physical laws. Additional soft skills training elements included project management, research leadership, and effective communication.

Last but not least, a field trip to the Giant's Causeway on the Northern Ireland coast was organized to observe interlocking

basalt columns. The field trip was led by Dr Michael J. Simms, Senior Curator of Geology at National Museums Northern Ireland, and Dr Mark Cooper, Chief Geologist at the Geological Survey of Northern Ireland (GSNI).

## Giulio Bini

*"The Carlingford School was a great chance to spend some time with the other ESRs and learn from other disciplines different from my background. As a geochemist, I learnt a lot about the inversion theory and its application to several geophysical problems and I appreciated the hours dedicated to practical exercises. There was also time for acquiring other skills that every scientist needs. I particularly found very interesting a lecture given by a theatre director for improving our communication skills and confidence in presenting our research, as well as some tips for writing a successful research project. Beyond the science, we also had time to explore Irish landscapes and have fun together. I particularly recommend kayaking and swimming in the Irish Sea, and a whisky tasting!"*

## IMPROVE Open day in Carlingford

The IMPROVE Open Day took place on May 17, 2023, at the Foy Centre in Carlingford, Ireland. Its goal was to engage and spark interest among various audiences, including primary and secondary school students, as well as the local community. The audience was involved in experiments led by IMPROVE ERSs, alongside other PhD students joining them, covering various aspects of volcanology and seismology.

The children generated their own earthquake by jumping on the floor and then observed the corresponding seismogram on a screen. Moreover, they had the opportunity to view live earthquakes from around the world on the Raspberry Shake website. Two trays of jelly and premade 'buildings' constructed from sticks and marshmallows were used to mimic various earthquake-resistant structures.

Slinkys and ropes were utilized to illustrate various types of seismic waves and their propagation, while different waveforms on the spectrogram were displayed using a keyboard and a guitar.

The children also observed a cross-section of a volcano created using a fish tank and various other materials designed to represent the internal composition of a volcano. They were able to examine several volcanic specimens, appreciating the density differences between tuff and basalt samples and learning about the magnetism associated with specific rocks. The rheology of magma was explained using Oreo cookies, and volcanoes were created using an old glass bottle, expanding foam, and paint. The eruption was instead simulated using vinegar and baking soda. An experiment was set up with water, ketchup, and honey in plastic cups, and air was blown into them using a straw to demonstrate the different viscosities of various fluids. A CO<sub>2</sub> meter was also introduced to simulate the increasing CO<sub>2</sub> levels during an eruption. Finally, the children witnessed an outdoor volcano eruption: a traffic cone was transformed into a real-life volcano. Inside the cone, Pepsi and Mentos were mixed together to create a highly explosive eruption!

The day attracted a total of 213 primary school students and members of the public. There were 182 students from two primary schools, along with 22 teachers and assistants in attendance. The feedback from the participants was extremely positive. The children found the day to be a fun and educational experience, and the teachers and staff appreciated the organization and management of the Volcano Open Day. Overall, it was a highly successful and beneficial public outreach event.



#### Patricia Fehrentz

*"Marble syrup became volcanic magma at the open day in Carlingford. Our goal was to bring a touch of volcanism to elementary school kids who might be the next generation of geologists exploring Etna, Krafla, or any other volcano. At the open day, there were a lot of interactive experiments and self-made models, that groups of 5 to 10 pupils could watch asking any questions coming to their minds. The highlight was a volcanic eruption consisting of two ingredients: Menthos and Coca-Cola. Activities like this one help to communicate science to the public and bring it out of the academic bubble. Moreover, it can be valuable to address all children, so in the future, we might have a more diverse community in science!"*

## IMPROVE Network School on Mount Etna

The Etna IMPROVE school took place from July 24th to July 28th, 2023, in Nicolosi, on the flank of Mount Etna. It was held at the INGV building, as well as in the nearby premises of the conference center of the Nicolosi municipality, which were generously made available. The school was attended by a total of 30 students, consisting of the 15 IMPROVE ESRs and an additional 15 external students who were selected through an open call from among nearly 40 applications received.

The students were trained in the use of sophisticated software, representing the culmination of several years of research and technological development at INGV and partner universities.

The ultimate goal was to provide the students with as much practical training as possible in "multiparametric volcano monitoring, data processing, analysis, and modeling".

The first day was dedicated to lessons and exercises on volcano deformation, complemented by a demonstration of the EPOS portal (<https://www.epos-eu.org/dataportal>) for accessing multi-parametric data from Earth observation systems, including data from volcano observatories. The second day was dedicated to volcano degassing, the fourth day focused on volcano seismicity, and the fifth day involved a simulation exercise. During the exercise the different



groups of students simulated a real volcano observatory dealing with a volcanic crisis, and had to use the instruments and tools provided and taught during the school to respond to the crisis. In the late afternoon, each group presented their results together with different statements prepared by them for communication to civil protection authorities and to the media, with ample discussion with senior researcher, particularly those from the INGV Etna Volcano Observatory. The third day of the school was dedicated to the field trip to Mount Etna. The trip was led by Boris Behncke from the Etna Observatory, who presented with engaging and compelling attitude the history and evolution of the volcano, adding stories and anecdotes about recent and past eruptions as well as about volcanologists who worked on the volcano.

#### Regina Maaß

*"It was very special to be directly on site at the slope of Etna while learning interdisciplinary methods of volcano monitoring. Several field trips, among others to the craters of Etna, showed impressively how important it is to monitor volcanoes through different disciplines in order to anticipate eruptions. In fact, the volcano erupted again only 10 days after we left Sicily. I was also fascinated by the history of Etna, which originally had only one crater instead of today's 4, and whose activity has increased rapidly over the last century. The fact that we got access to real data from an earlier eruption of Etna and were allowed to analyze it was really cool."*

## Multiparametric Experiment on Mount Etna

The IMPROVE field experiment on Mount Etna took place from July 23 to August 2, 2023. All of the IMPROVE ESRs actively participated in the experiment, which involved deploying instruments, periodically checking their functionality, downloading data and starting their analysis, and finally dismantling the instrumentation. The organization of the experiment primarily involved personnel from INGV – Etna Observatory, with secondary support from personnel from INGV Pisa. The experiment mainly focused on two aspects of the shallow Mount Etna dynamics: its degassing and the movement of magma.

The instruments deployed during the experiment included: two broadband seismic stations, four high frequency GNSS receivers, one clinometer and one diffused degassing measurement device, two seismic arrays with ~100 nodes, an about 1 km long fibre optic and dedicated acquisition system,

and finally a high speed visible and an infrared camera plus microphone positioned on the crater rim. This network worked together with the permanent monitoring network of the INGV Etna Observatory, consisting of about 200 multi-parametric instruments. The collected data provide the basis for the analyses by six ESRs who are developing their PhD on Mount Etna. Initial analyses triggered vivid discussion, particularly in the context of numerical solutions for the dynamics of magma convection in underground volcanic systems.

The experiment also included a two-day field trip aimed at providing the ESRs with an understanding of the structural complexities that characterize an active volcano. Specifically, the trip focused on the major structures along the North-East and East volcano flanks of Mount Etna and how these structures impact the setup of a volcano monitoring system.

#### Alejandra Vásquez Castillo

*"The multiparametric experiment at Etna offered us a number of significant experiences. We had the great opportunity to be involved in the logistics of instrument deployment while becoming more familiar with the complexity of the volcano and the signs of activity it exhibited. The experiment allowed us to measure and analyze multiple parameters simultaneously, such as seismic activity, ground deformation and gas emissions, helping us to have a more complete assessment and understanding of Mt. Etna's behavior and to develop our scientific criteria. I enjoyed the experiment, the time with my ESR colleagues and loved being there, at the top of this imposing volcano: "la mamma"*

