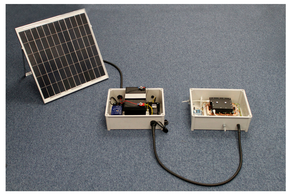
WHEN THE HAZARD YOU ARE MONITORING IS THE LEAST OF YOUR TROUBLES...

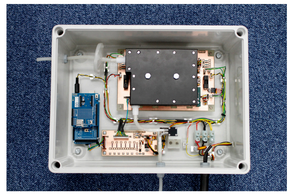
THE EARLY DAYS OF A UBIQUITOUS COMPUTING CITIZEN SCIENCE INITIATIVE ON ACTIVE VOLCANOES

Saskia M van Manen[1]
Mike Richards[2]
Robert Seaton[2]
Ian Cameron[2]
Geoffroy Avard[3]
Maria Martinez[3]

Design

Careful consideration was given to the station design in light of the harsh conditions it may encounter. The first two prototypes that were built (a low sensivity one – PT-1A, and a high sensitivity one –PT-1B) were tested in laboratory and field settings to provide initial assessments of the design, sensor noise, robustness and reliability.

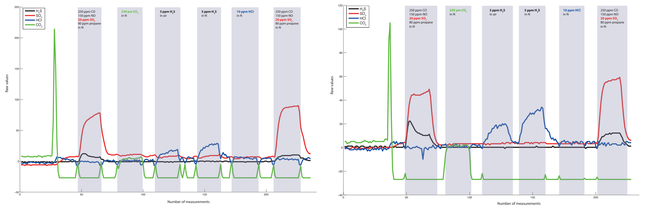




[LEFT] The complete sensor station setup. The solar panel trickle charges a battery in the power box, which supplies power to the sensor box. [RIGHT] The interior of the sensor box. The Arduino Mega with an SD card shield is located on the left. The sensor block is the black box at the top of the image. Gases enter at top left and are exhausted bottom centre.

Lab Testing

Prior to field deployment lab tests were performed on the prototypes. These consisted of connecting standard gas bottles to the air-inlet and letting the unit pump for 5-10 minutes. Units were also tested once returned from the field to assess any potential sensor degradation.

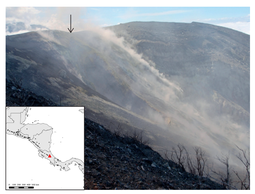


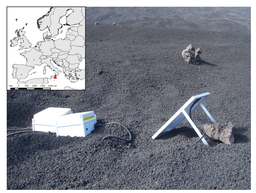
Lab test results from the PT-1B. Gray bars indicate the type of standard gas use. Baselines of these values have been shifted to aid legibility [LEFT] Before field-testing. [RIGHT] Post field-testing. Results show interference of other gases with some of the sensors, notably H_2S.

Field Testing

PT-IA was deployed without the solar panel on February 4 2014 on the western rim of the west crater at Turrialba volcano (Costa Rica) directly downwind of the predominant plume direction. The battery was periodically replaced to ensure the unit kept running for the duration of the 2 week fieldwork period.

PT-1B was tested at Etna (Italy) between August 30 and September 24, 2014. It was set up with the solar panel to avoid having to swap the batteries.





[LEFT] Prototype PT-1A at Turrialba. Arrow indicates position of the unit. [RIGHT] The field-testing of PT-1B at Etna.

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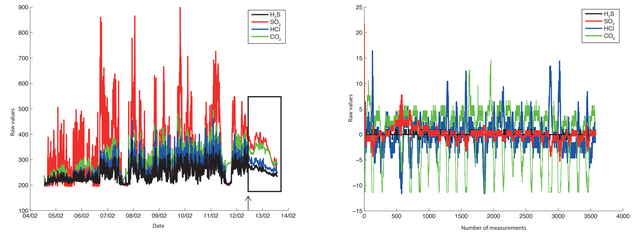
Introduction

Approximately 500 million people live in close proximity to one or more of the world's 1500 active volcanoes, and this number is set to increase. The corresponding human, social, environmental and economic costs of volcanic activity are likewise set to rise. Monitoring of active volcanoes is imperative to minimize the impact of volcanic activity. However, people's responses towards risk are not just determined by objective scientific information, but also by socio-cognitive factors such as hazard salience; risk perception; anxiety levels and sense of self efficacy.

This project aims to take a citizen science approach to the monitoring of hazardous volcanic gases: a low-cost automated ubiquitous technology station will increase spatial and temporal data resolution while providing citizens access to relevant, accurate, timely, and local information. This means a single data stream can be used to develop a better understanding of volcanic degassing and raise levels of hazard salience and increase feelings of self efficacy. A year and two prototypes into the project, this work presents the lessons learnt to date.

Preliminary results & Discussion

Upon retrieval from the field both stations were still operating and had recorded data. However, unfortunately PT-1A had been vandalised: the gas in- and outlet and battery cable had been tampered with. This resulted in the filter becoming undone and any data recorded being rendered useless.



[LEFT] Data from PT-1A at Turrialba. The arrow indicates when the vandalism occurred and the rectangle outlines the subsequently worthless data. [RIGHT] Data from PT-1B at Etna.

Photos of the vandalised PT-1A prototype. [LEFT] Tugging on the gas intlet resulted in the filter disconnecting [RIGHT] The armourmed cable between the power and sensor boxes was damaged.

A post-fieldwork lab of PT-1A initially suggested that the sensors were malfunctioning. However, an autopsy of PT-1A indicated that the vandalism resulted corrosion of the connection points and arduino rather than sensor malfunction. A second attempt at field testing PT-1B in Costa Rica was thwarted by customs: despite having completed the required paperwork in English and Spanish they requested extra funds prior to releasing the equipment claiming that there was no Spanish paperwork.

PT-1B was subsequently field tested at Etna, but unfortunately changing meteorological conditions meant that the unit spent the majority of its time outside of the plume, and therefore did not record meaningful data.

Conclusions

It wasn't until the prototypes were taken into the field that unexpected challenges were encountered: humans. During the very first field trial the prototype was vandalised, our second attempt was thwarted by customs and courier services. Changes in meteorological conditions such as occured at Etna were expected but unfortunate.

Following lab and field results, we've had to be flexible in our approach and adapt our strategy and station design in response to our findings and these events, which will eventually result in a better outcome. A second significantly revised prototype is currently being built and will be lab- and field-tested early next year.

This case study serves as a reminder of the importance of considering factors beyond the equipment, data, interpretation and involvement of the public, when planning and implementing a citizen science initiative.