European volcanological supersite in Iceland: a monitoring system and network for the future

Report

D9.1 - Outcomes of Exercise 1

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Abstract

In June 2014 an exercise was conducted by the FUTUREVOLC consortium led by the members of WP9 to test alerting and communications between partners. Pre and post-exercise questionnaires were conducted to enable the exercise to be evaluated. Three real events in 2014 also allowed the FUTUREVOLC response capabilities to be tested, both in terms of use of monitoring equipment and communications. These included flooding and gas emissions at Mýrdalsjökull and a major rockslide within the Askja caldera, causing a tsunami in Lake Öskjuvatn. In August 2014, the start of unrest and the subsequent eruption in the Bárðarbunga volcanic system led to a major amount of work for the FUTUREVOLC partners and proved a real test of the consortium. Communications within the FUTUREVOLC consortium and the contributions of partners to these events are reviewed here.

The findings show that FUTUREVOLC has had a direct impact on the response to the Bárðarbunga unrest and eruption through the rapid utilisation of equipment installed by many partners both before and during the event. Due to the nature of the eruption (effusive lava eruption) not all partners have been involved in the response to Bárðarbunga. For those that could respond, the timely alerts introduced as a result of requirements identified in the exercise process allowed them to react quickly and mobilise data and field equipment.

At the annual meeting in September 2014 a wash-up session was held, which reviewed all of these events and evaluated improvements and areas where future developments are needed. Since the start of the FUTUREVOLC project and following the exercise significant steps have been made, but the results show that there is still further work needed. An action plan of eleven activities has been formulated based on these findings. These span five identified key areas: alerting, response, communication, data sharing and data discussion.

Improving communication across the whole consortium for discussing the obtained data is a key area. Whilst there are excellent examples of smaller scale communications within individual work packages or between individual partners, integration of all the different disciplines and observations can be improved.

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1 Introduction

The main aim of WP9 of FUTUREVOLC is to demonstrate that the project is working and having an influence on response activities in Iceland over all timescales. Fundamental to this is being able to show the pull through of new science into operations. What this means in practice for the work package includes:

- Facilitating work to determine how FUTUREVOLC partners will support the Icelandic Met Office (IMO), University of Iceland (UoI) and Iceland Civil Protection (NCIP) during a volcanic unrest or eruption situation,
- Making sure IMO, and the situation response in general, can make the best use of all data from FUTUREVOLC partners and equipment,
- Ensuring FUTUREVOLC partners can discuss multi-disciplinary data in near real time.

To achieve this aim, the main components of WP9 are to run two exercises during the course of the project and feed back lessons learnt and areas where improvements can be made. This report summarises the work conducted in Year 2 related to the first exercise. It also considers the FUTUREVOLC responses to activity in Iceland during this time, including the unrest and eruption in the Bárðarbunga volcanic system up to the end of September 2014.

2 Analysis of communications within FUTUREVOLC before Exercise 1

WP9 has been working closely with WP3 to evaluate the relevant communications channels. The primary distinction between the work packages is that WP3 has focused on communications outside of Iceland and WP9 on communications within Iceland and within the FUTUREVOLC consortium.

To establish a baseline for internal communications a questionnaire was sent to all 26 FUTUREVOLC partners prior to Exercise 1. The list of questions is provided in Annex 1. Sixteen partners responded and the results have been analysed. For some questions, multiple answers were given by partners (e.g. we use email and the telephone for communications) and these have all been considered in the summary statistics. The main findings were as follows:

- IMO and UoI Institute of Earth Sciences were the main sources of information about volcanic unrest for FUTUREVOLC partners, although the media also plays a significant role. Direct email and the web were the main communications tools for notification of unrest (Figure 1).

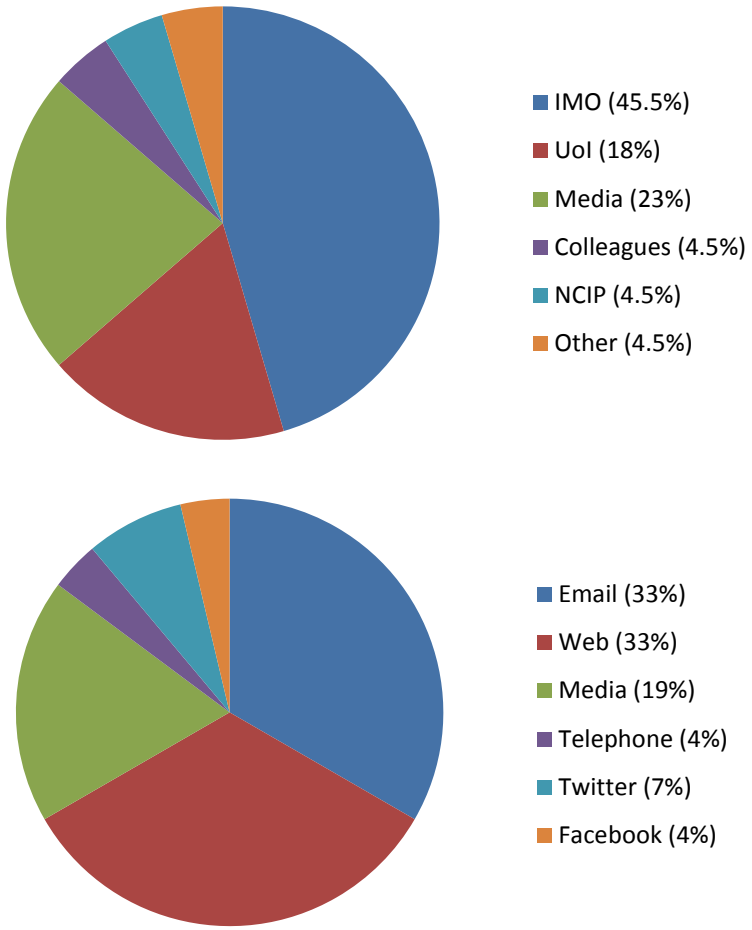

Figure 1: Answers to the question "How do you currently find out about volcanic unrest or activity on Iceland?" split by reference to (a) the source organisation and (b) the communication tool used.

- Websites are the main tool for partners to make results available in general, but the majority of partners said that email was the main communications tool for sharing data with both Iceland and FUTUREVOLC partners. Telephone calls are also mentioned by many partners for communication with Icelandic institutes and FUTUREVOLC partners.
- File sharing protocols such as FTP and secure copy (scp) were mentioned by multiple partners. Other communications tools that were mentioned for sharing data were: Dropbox, Twitter, Facebook and the FUTUREVOLC Basecamp site.
- A large number of file formats would be produced across all of the partners including: text, png, ascii, gcf, jpeg, sql, tsx, tdx, Novac, Binary, Matlab, NetCDF.
- The UoI Institute of Earth Sciences was mentioned as the main destination in Iceland for data and information generated by partners, with IMO and then NCIP also listed as the key recipients (Figure 2).

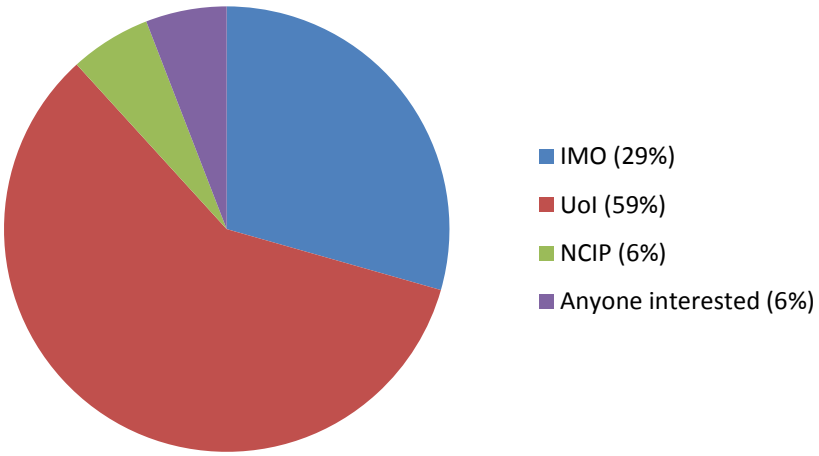

Figure 2: Answers to "If there was unrest or an eruption on Iceland tomorrow who would you disseminate/share your data/results and interpretation with in Iceland?"

These findings demonstrate that during an eruption the email and telephone burden on the University of Iceland and IMO will be extremely high and additional to the increased demands that there will already be on their time. The majority of communications tools listed do not readily allow for ongoing discussion of what the data are showing and the wide variety of file formats is a challenge for data sharing. This makes multi-disciplinary interaction with partners outside of Iceland difficult.

Partners were asked: "What would you want/need to improve the dissemination and discussion of essential information?". A number of areas were highlighted for improvement in communications. Top of the list were web pages and web tools for sharing data and communicating.

3 Overview of Exercise 1

3.1 Planning

In April 2014, planning for the first exercise took place at the EGU General Assembly meeting in Vienna. At this time it was recognised that if there was an eruption in the summer of 2014 then this would replace a large-scale exercise, but that the project still needed to have mechanisms in place to allow FUTUREVOLC partners to respond in such an eventuality and make sure that they are able to share and discuss their results within the FUTUREVOLC consortium. Consequently a 2-phase plan was drawn up for exercises in Year 2:

- Phase 1: test of alerting & communications - June
- Phase 2: test of data interpretation (with database) – August/September
- Wash-up at annual meeting - September

The objectives of the June Phase 1 exercise were to:

- Define an alert process and test this alert system
- Test communication procedures
- Test the response of FUTUREVOLC members (contact persons at each institution, coordinators at IMO and UoI)
- Understand current FUTUREVOLC communication and data sharing routes in conjunction with WP3

As events have transpired, the eruption in the Bárðarbunga volcanic system, which started at the end of August 2014, has supplanted the requirement to hold Phase 2 and has provided many real life opportunities to test communications and data interpretation. The eruption ended on 27 February 2015.

3.2 Pre-exercise Developments

The results from the pre-exercise questionnaire and discussions during the planning meeting at EGU identified a number of gaps in the current FUTUREVOLC communications chain. Responding to these gaps the following measures were put in place:

- A wordpress FUTUREVOLC blog (Figure 3), owned by IMO, that would be used for data sharing between partners whilst the WP2 database was in development and also allow discussion of data and findings between partners.
- A FUTUREVOLC alerting process and management chain, which outlined the roles and responsibilities between the three main Icelandic partners (IMO, UoI, NCIP). The process diagram is shown in Figure 4.
- An SMS alert system specifically for FUTUREVOLC partners, operated by the NCIP control centre.

Prior to the FUTUREVOLC project, an alert system was already in place at IMO. This alert process has subsequently been refined to ensure all FUTUREVOLC partners can be kept informed of new and unusual volcano-tectonic activity occurring in Iceland and therefore decide how to react. The Advisory Group is composed of experts from IMO, UoI and NCIP who have experience of volcanic eruptions and represent the different scientific disciplines of volcanology (seismology, gases, hydrology, physical volcanology, deformation, etc). In the revised process, they are able to discuss any unusual signals and decide how best to respond and communicate to FUTUREVOLC thanks to joint interpretation.

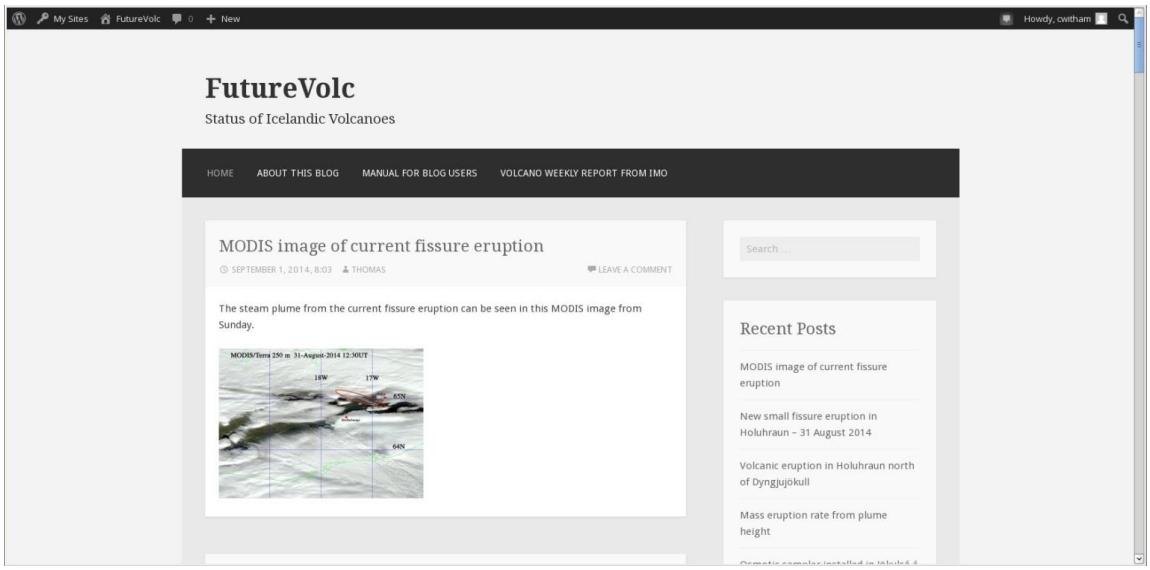

Figure 3: Screen-shot of the FUTUREVOLC blog site, which was created in the lead up to Exercise 1 by IMO.

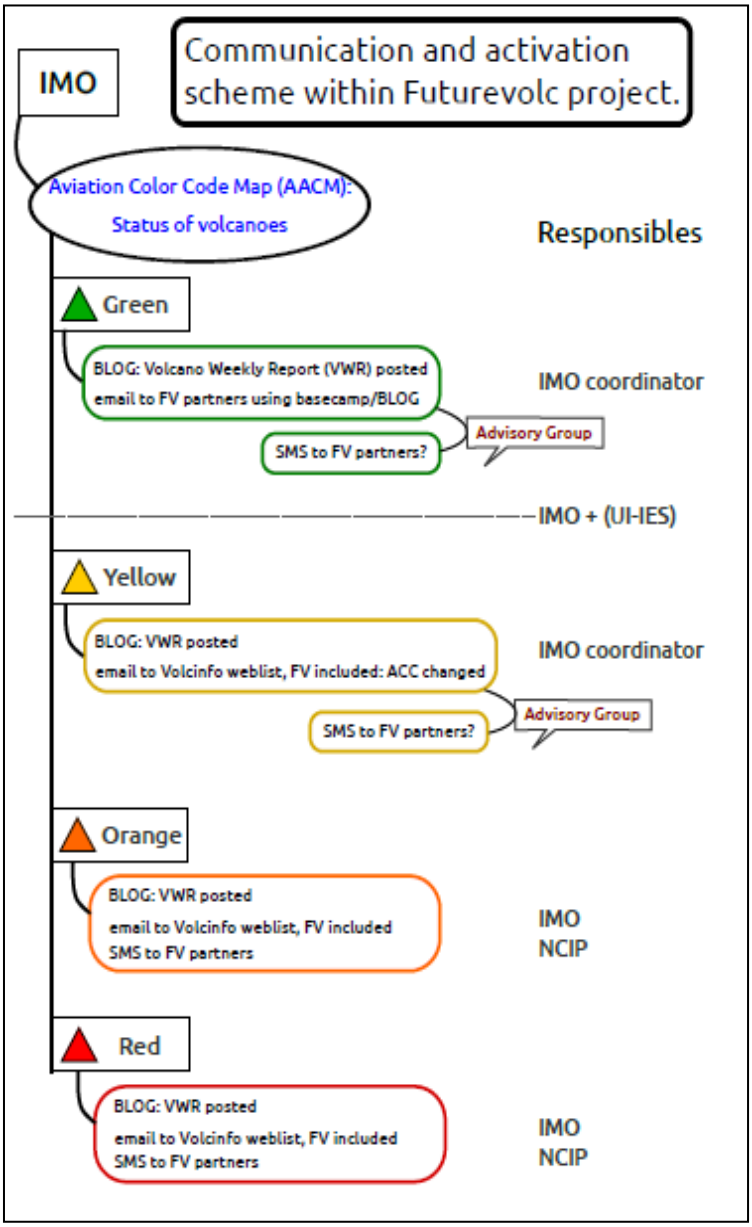

Figure 4: The FUTUREVOLC (FV) alert process and management chain as of September 2014. The institutions responsible for making decisions are indicated on the right of the scheme. Three main communication channels are considered here, email, posts to the FUTUREVOLC blog, and SMS text messages. (The Volcinfo weblist is the email dissemination list owned by IMO that is used to send out information on volcanic activity in Iceland; all FUTUREVOLC members have been included in this list). The Advisory group, which is composed of experts from IMO, UoI and NCIP, discuss the activity and depending on how unusual the event is, e.g. if it is of pure scientific interest and/or requires monitoring, they will decide whether to update different stakeholders including the FUTUREVOLC consortium.

3.3 Execution of Exercise 1

The timeline for the planning and execution of Phase 1 of the exercise is given in Table 1. During the planning phase it was decided to merge the exercise with the existing IMO/London VAAC "VOLCICE" exercise program. This is a regular series of exercises

conducted every month between IMO, ISAVIA (the air service provider in Iceland) and the London VAAC, where a volcanic eruption in Iceland or Jan Mayen is responded to over the course of a working day. During the exercises the main actions listed in each organisation's contingency plans are practiced and checked. The main aim of these exercises is to keep the warning system and the emergency response as fast and effective as possible to be ready for the next eruption. Coinciding with a VOLCICE exercise brought more realism and tested the end-to-end processes at IMO.

IMO were given responsibility for devising the exercise scenario, for which they chose a large (up to 20 km column height) but short-lived (4.5 hours) eruption at Hekla volcano. The exercise was held on 18 June 2014, with the timings of the exercise start and end chosen to account for time differences with FUTUREVOLC partners in Europe.

Task	Date
Exercise planning and preparation	May & June
Pre-exercise questionnaire distributed	9 June
Official announcement of exercise	9 June
Start of exercise	09:00 UTC 18 June
End of exercise	14:30 UTC 18 June
Wash-up telecon between WP9 leads	19 June
Post-exercise questionnaire distributed	27 June
Review at Annual Meeting	September
D9.1 Report on Exercise 1	early 2015

Table 1: Timeline for Exercise 1 (Phase 1) in 2014.

On the day of the exercise, 19 June 2014, the exercise was led and coordinated by IMO. Table 2 outlines the evolution of the eruption scenario that was played out, together with the response actions at IMO and NCIP. The exercise was started at IMO at 09:00 UTC and FUTUREVOLC partners were alerted by an SMS at 09:21 (Figure 5). The majority of the alerting and communications about the start of an eruption were done within the first hour. The remainder of the day then tested how partners responded and shared/communicated their data and reacted to changing activity. The exercise was ended at 14:30 by an email to all partners and a post on the blog site.

Figure 5: The SMS alert issued by NCIP to the FUTUREVOLC partner contacts to announce the start of the eruption under the exercise.

TIME (UTC)	Volcanic signals and status	Actions
09:00	Exercise Starts • Elevated seismicity • SO2 detection from DOAS	
09:12		• NCIP called by IMO
09:21		• SMS alert issued by NCIP
09:27		• Colour code map changed to red by IMO
09:30	• Confirmation from the radar of 20 km high column • Tremor	• Posts on the blog • Eruption alert posted to blog by NCIP
09:41		• Email received at NCIP regarding change or volcano status to red
09:42		• Email sent to FUTUREVOLC people list by IMO
09:43		• UoI IES called by IMO
10:00	• Column still up to 20 km • Ash fallout reported	• Posts on the blog by IMO • Meeting held at UoI gathering most people from the institute to coordinate the response (who may go to the field? What equipment? Which car?). Discussions organized in small groups to define the plans per team and fill in the documents (contact person, aim, planned schedule, areas to visit).
11:30	• Column decreasing • Lava flow starts	• Daily status report started at IMO
12:30	• Strombolian explosions • Decrease in lava discharge rate	• Posts on the blog by IMO • IMO ask FUTUREVOLC participants for confirmation of lava flows – 2 answers received
13:30	• Eruption ends	• IMO change colour code map to orange
14:05		• Email sent to FUTUREVOLC people list by IMO regarding change in colour code • Meeting held at UoI to discuss the response, the coordination (especially for field observations), and also about insurance policy.
14:30	Exercise ends	• Email to FV participants (14:37) • Post on the blog

Table 2: The evolution of Exercise 1 and corresponding actions taken by IMO and NCIP.

3.4 Evaluation of Exercise 1

Overall the exercise was a successful test of the FUTUREVOLC alerting and communications procedures with many partners taking part in the exercise. The newly established blog site received 41 posts and 14 comments from 13 different partners (Figure 6). However, many lessons were learnt about both the running of an exercise such as this and the communications channels.

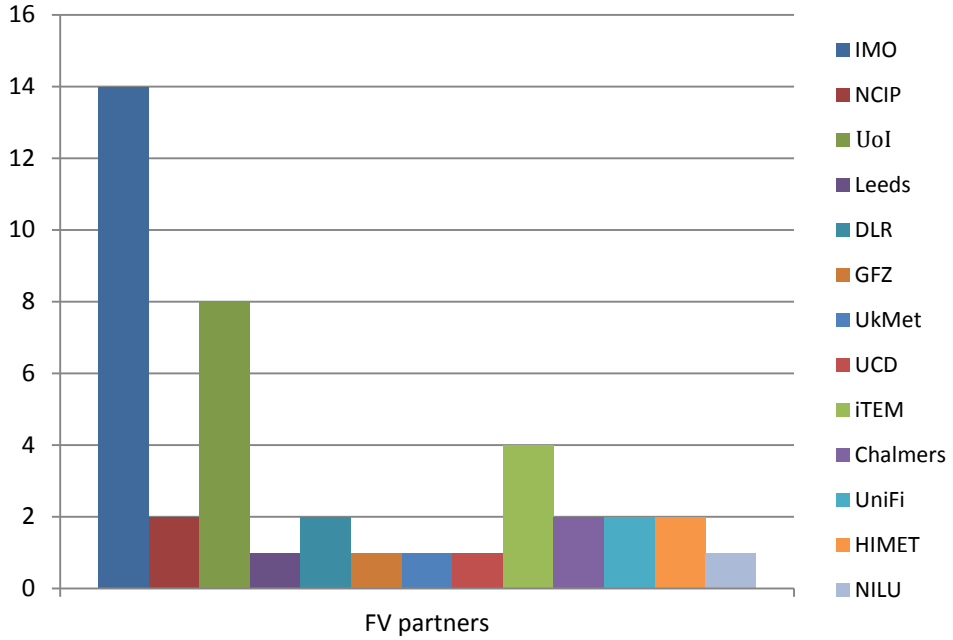

Figure 6: The number of blog posts from each partner during Exercise 1.

Key lessons for the next exercise include:

- Don't try to accomplish too much in each exercise.
- Participants require more information in advance of the exercise to understand their role and what is expected.
- Decisions are needed in advance regarding the text content of SMS and email announcements.

The final point came about as both the SMS and FUTUREVOLC email were new alerting processes introduced by FUTUREVOLC, which had not been tested before and appropriate guidelines for their use and contents had not been established.

Key issues identified by the WP9 team with the communications channels included:

- Many people didn't receive the alerts (SMS and/or email).
- There were delays in notification between IMO and UoI. For example, UoI were not called until 09:43, which was after the FUTUREVOLC alert had been activated. This was due to the checklist for the seismologist on duty at IMO taking a long time to complete and this item occurring low down on the checklist.
- There is room for improvement in communications within Iceland (between and within each organisation and also for making sure the field team is aware of the changes in the eruptive activity).
- Some people did not have access to the FUTUREVOLC blog, or had forgotten their password.
- A number of limitations of the blog were identified including:
  - No time stamp on posts
  - Inability to add certain types of files (.txt, etc)

  - Further categorisation of posts/topics is required
- It was clear that the blog was not the most suitable tool for keeping people informed of significant changes in activity.

Because the blog had been set-up just prior to the exercise, this was the first real test of its use as a communications tool. The exercise revealed a number of weaknesses, which might limit its suitability. For example, there was minimal discussion of data on the blog, which was one of the prime intended purposes, and suggests that it may not best tool for this in reality.

3.5 Results from post-exercise questionnaire

To determine what changes in communications may have occurred due to Exercise 1 and the procedures and technologies put in place in advance of it, a follow-up questionnaire was sent out to all 26 partners. This time only fourteen partners responded in any way (Figure 7). The main findings were:

- Quite a lot of people did not get the SMS alert but nearly everybody received the email alert.
- A number of partners were unable to contribute on the day of the exercise as they were:
  - out of the country (1)
  - in the field (1)
  - did not have equipment out in the field yet or any relevant data (3)
- The general view was that the information supplied in the alerts and communications was sufficient.
  - a location map would be a useful addition to the initial alert
- The exercise allowed partners to test their response plans and identify areas of improvement.
- The majority of partners did not contact IMO/UoI directly during the exercise.

The lack of direct communication and contact (via email, telephone) from partners to IMO/UoI during the exercise is a significant change to the primary communications routes identified in the pre-exercise questionnaire (Section 2). The reason for this change in communication routes is the introduction of the blog, where most of the correspondence took place during the exercise. However, this change in behaviour may be a reflection of the somewhat artificial nature of the exercise rather than because the blog represents a workable solution. This is explored further in following sections.

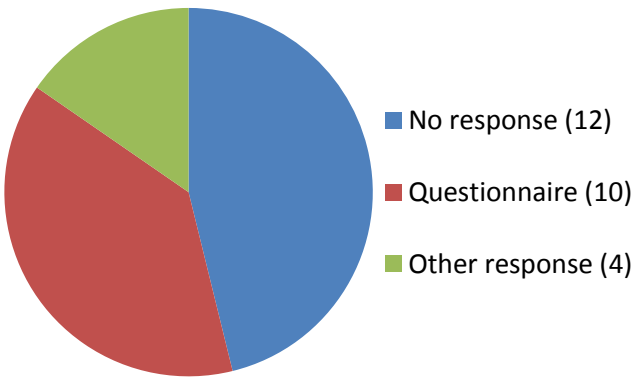

Figure 7: Number of responses to the post-exercise questionnaire.

3.6 Actions arising from Exercise 1

A number of areas for improvement were identified by Exercise 1. Actions that were implemented immediately following the exercise included:

- The addition of missing people to the SMS and email lists.
- Revised SMS procedures so that all SMS alerts now start "FutureVolc Alert:".
- Activation and communications processes updated at IMO. In particular, UoI are now called much earlier in the response process.
- UoI have updated their communications and safety procedures.
- New field safety procedures were implemented by UoI and NCIP.
- Updates have been made to the blog including the addition of:
  - Date stamps
  - User instructions
  - Affiliations can be added under "My Profile"
  -

4 Overview of other events in 2014

Prior to the eruption of Bárðarbunga there were two other periods of unusual activity in 2014 (Figure 8). These are briefly summarised here, together with information on how the FUTUREVOLC consortium was alerted to these events and how it contributed to the response activities.

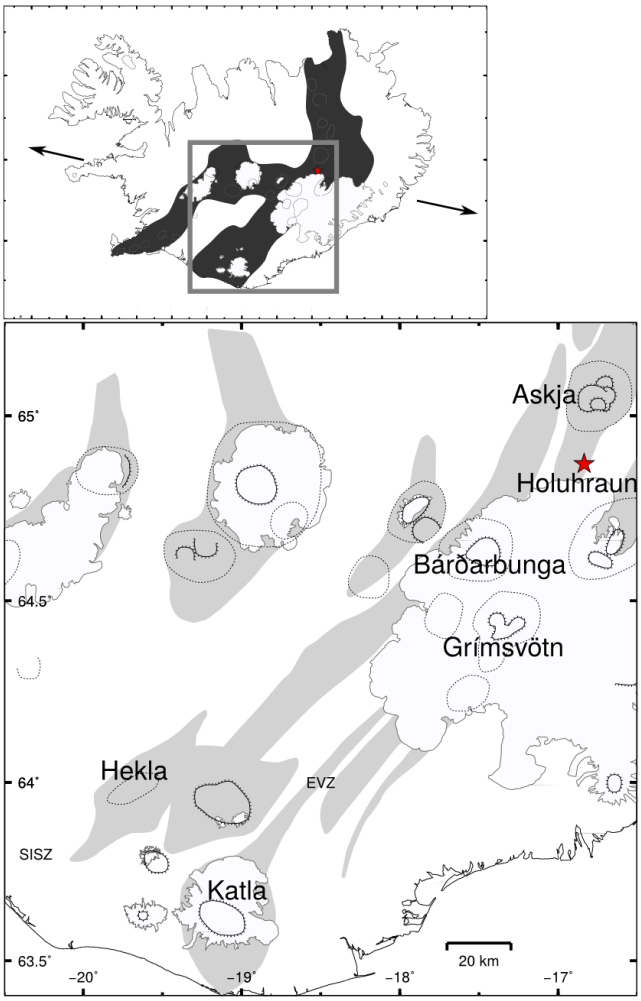

Figure 8: Top: The location of the Eastern Volcanic Zone and the South Iceland Seismic Zone and the limits of the divergent plate boundaries; the box shows the area of the main figure. Bottom: Map of the areas and volcanoes experiencing activity in 2014: Katla volcano under the Mýrdalsjökull glacier, Askja, Bárðarbunga (located below the Vatnajökull ice-cap) and the Holuhraun lava field. The map shows ice caps (white), central volcanoes (dotted lines), calderas (hatched lines) and fissure swarms (grey shading). The location of the 2014 effusive eruption is located with a red star.

4.1 Floods and gases at Mýrdalsjökull in early July

From 3 July 2014 onwards, a significant increase in electrical conductivity was detected in Jökulsá á Sólheimasandi and Múlakvísl. Continuous measurements of conductivity from sensors in both rivers, together with frequent hand-held measurements, showed that solute-laden meltwater was draining simultaneously from two separate water catchments on Mýrdalsjökull. At Sólheimajökull, conductivity values increased by ~100 microsiemens, whereas at Múlakvísl the overall increase was ~150 microsiemens. In addition to heightened conductivity, the discharge of both rivers increased and a strong sulphurous odour was noted, especially at the edge of Sólheimajökull.

4.1.1 Sequence of events and response

Table 3 briefly outlines the timeline of response and communications activities associated with FUTUREVOLC for this event.

Date	Response/Communications
3 July	Internal communication within IMO and toward NCIP.
9 July	Two teams of scientists from IMO went to Sólheimajökull for gas measurements.
10 July	A FUTUREVOLC blog post was issued by IMO reporting the event of the floods occurring at Myrdalsjökull.
13 July	A FUTUREVOLC blog post was issued by IMO reporting the measurements done with the multigas unit from IMO in collaboration with University of Palermo during 12-14 July.

Table 3: Summary of response to activity in July 2014.

4.1.2 Summary of FUTUREVOLC contribution

Communication channels:

- No SMS alert triggered
- No comments from FUTUREVOLC consortium on IMO's Basecamp messages
- University of Palermo was contacted for interpretation of gas measurement

FUTUREVOLC tools used:

- Multigas (Univ. of Palermo)

4.2 The 21 July Askja rockslide

On 21 July 2014 at 23:30 a rockslide in the eastern caldera wall of Askja triggered a tsunami in Lake Öskjuvatn. A white cloud formed over the Dyngjufjöll mountains and initial observations suggested wave heights reached in the order of 40-50 m and spilled over to the north-east into the adjacent Viti Lake. This area was therefore closed for safety reasons.

4.2.1 Sequence of events and response

Table 4 briefly outlines the timeline of response and communications activities associated with FUTUREVOLC for this event.

Date/Time	Response/Communications
21 July 23:30	Phone communications between UoI, rangers and park manager from the Vatnajokull National Park to find out the nature of the event at Askja.
22 July 14:00	• Meeting at UoI to show the first data (field observations, seismicity) and a first analysis about what happened at Askja. • Calls between IMO people to find out what happened at Askja. • The FUTUREVOLC group in Florence, operating the infrasound network, was contacted directly.
23 July ~ 14:00	• A meeting was held at UoI with people from IMO, UoI, NCIP and the rangers at Vatnajökull (via Skype). • First message posted on FUTUREVOLC Basecamp describing the event. This post was commented on by IMO to give more information related to the seismic signal. • Weekly report from IMO was posted on the FUTUREVOLC blog commenting on the landslide in Askja
24 July All day	A delegation including 6 scientists from UoI and IMO and representatives from NCIP went to Askja with the Coast Guard helicopter to investigate the changes, make some measurements and help to assess the risk.
25 July	IMO field team conduct gas measurements at Viti

Table 4: Sequence of response after the landslide at Askja volcano.

The delegation which went to Askja on July 24, investigated the changes in Askja caldera and what risk they represented. Their actions included:

- Estimating the risk of additional rockslides, by trying to identify weaknesses such as new fractures which could have indicated slope instabilities.
- Using a FLIR camera to measure the temperature where the landslide occurred and therefore to detect possible changes in the geothermal activity.
- Taking ground and air-based photos with GPS measurements to map the outlines of the rockslide.

The observations on July 24 allowed a first-order estimate of the rockslide volume. All the data available (most of which was provided by FUTUREVOLC instruments: seismic and infrasound arrays, FLIR and optical cameras and GPS) were considered to study the mechanism of the rockslide.

An IMO field team was at the site on 25 July and was able to do gas measurements from Viti. They operated a Multigas unit for measuring volcanic gas ratios. The results were comparable with data from a previous campaign in 2012. Nothing raised the suspicion of a magmatic signature of the event. The prospect that a volcanic explosion could have triggered, or been triggered by, the rockslide was considered in the evening of the 21 July when a photo, taken by rangers working in the area, showed a white plume rising straight up from Askja caldera. In the following days this was explained as a consequence of the rockslide itself, which lifted material including fragments of rocks, dust, as well as water once it fell into the lake, and also exposed shallow geothermal areas leading to a steam plume.

A final report has been written to summarize the events and to propose an interpretation (Helgason et al, 2014a,b).

4.2.2 Summary of FUTUREVOLC contribution

Communication channels:

- No SMS alert triggered
- No posts on the FUTUREVOLC blog
- No comments from FUTUREVOLC consortium on Basecamp messages
- University of Florence was contacted by IMO for information on the infrasound data interpretation by phone
- University of Palermo was contacted for interpretation of gas measurement in Viti

FUTUREVOLC tools used:

- Seismic network
- Infra-sound network
- FLIR camera
- GoPro
- Multigas
- Camera and GPS equipment for aerial photography.

4.2.3 Lessons learnt from the Askja rockslide

Table 4 highlights that the Askja rockslide was first managed internally by Icelandic institutions. The FUTUREVOLC consortium was informed 2 days after the events, only using an email sent through Basecamp. No message was posted on the blog set up for the exercise, and no alert was triggered to send an SMS to FUTUREVOLC members.

Although the FUTUREVOLC community was informed a bit late, it is noticeable that FUTUREVOLC contributed to the better understanding of the event through the different instruments available at UoI and IMO. In addition, even there was no official communication involving FUTUREVOLC partners (no comment on Basecamp or posts on the blog), direct communications occurred between IMO or UoI and some partners.

The following lessons were learnt from these two events:

- The FUTUREVOLC community should be contacted faster whatever the nature of the event for two reasons:
    1. Partners may react and provide their expertise and data to understand the event and participate in the risk assessment.
    2. Such events offer an opportunity for partners to better understand a natural event (= scientific purpose), if they are interested.

5 Overview of communication related to the Bárðarbunga unrest and eruption up to end-September 2014

In August 2014 the start of unrest at Bárðarbunga led to a major increase in work for many FUTUREVOLC partners, particularly those in Iceland. The ongoing nature of the activity meant that plans for a Phase 2 of Exercise 1 were immediately put on hold. Instead Bárðarbunga has provided a real-life test for many of the communications channels and monitoring tools implemented as part of FUTUREVOLC. Here we review communications during the first 1.5 months of the activity, which was included in the evaluation and Exercise 1 wash-up conducted at the FUTUREVOLC annual meeting in September 2014 (Section 6).

5.1 Bárðarbunga response evolution

5.1.1 National response and timeline

On the 16th of August, Bárðarbunga volcano entered a new phase of unrest. Elevated seismicity in the area generated thousands of earthquakes per day in conjunction with a significant deformation rate observed NE of the Bárðarbunga caldera. In this area a dike intrusion was observed for almost two weeks (Figure 9), until a small and short-lived effusive eruption started on the 29th August 2014 in the Holuhraun lava field to the north of the Vatnajökull ice cap. Two days later a second, more intense, fissure eruption took place that continued until 27th February 2015.

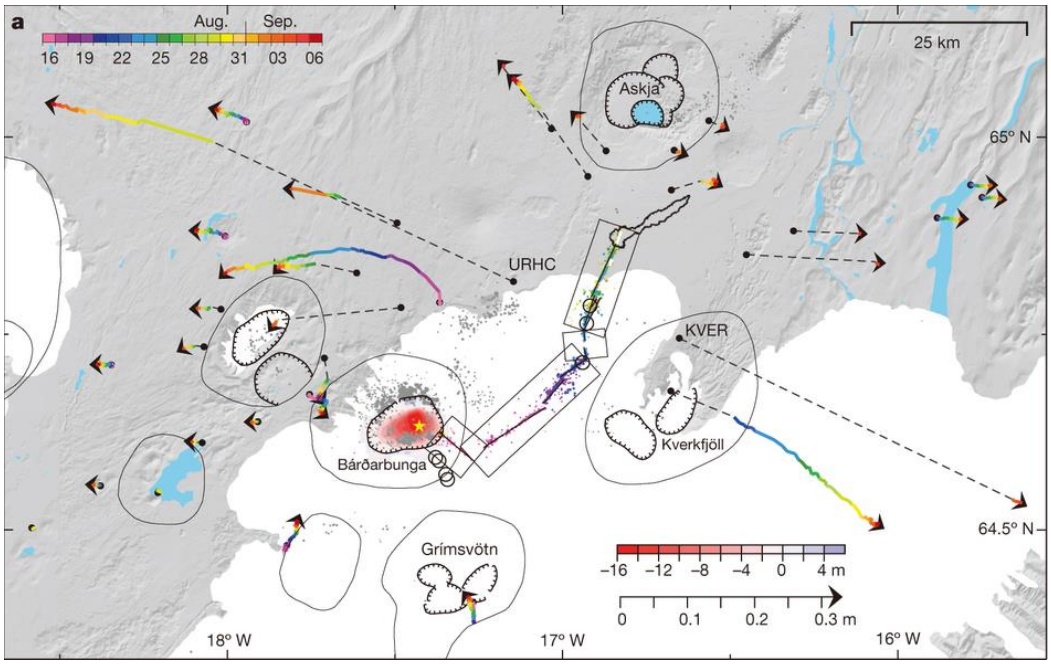

Figure 9: Summary of the observed activity in the early stages of the Bárðarbunga unrest and eruption (from Figure 1 in Sigmundsson et al., 2015). Earthquakes from 16 August to 6 September 2014 (dots) and horizontal ground displacements measured by GPS (arrows) are shown along with central volcanoes (oval outlines), calderas (hatched), and northern Vatnajökull. Relatively relocated epicentres and displacements are colour coded according to time of occurrence (key at top left), other single earthquake locations are in grey. Rectangles, and the thin lines within them, mark the inferred dyke segments. The red shading at Bárðarbunga caldera shows subsidence up to 16 m

inferred from radar profiling on 5 September. The star marks the location of the magma source inferred from modelling. Also shown are ice cauldrons formed (circles), outline of lava flow mapped from radar image on 6 September, and eruptive fissures (white).

Bárðarbunga volcano is part of a large volcanic system that last erupted in 1910. This system is partially covered by ice within the Vatnajökull ice cap and has a fissure swarm extending far to the NNE and the SW. Based on historical data, eruptive activity within the system has been predominantly characterized by explosive eruptions, originating beneath the ice cap, and important effusive eruptions in the ice-free part of the system. The largest explosive eruptions have taken place in the southern side of the fissure system and the Veidivötn eruption (1477 AD) produced abundant ash. Bárðarbunga volcanic system is one of the target volcanoes within the FUTUREVOLC Project.

Due to the extension and location of this volcanic system, the range of eruptive scenarios and associated hazards is large. Possible hazards include: inundation due to glacial outburst; tephra fallout due to an ash-rich plume generated by magma-water interaction; release of abundant volcanic gases; and lava flows. In addition, the temporal and spatial evolution of the geophysical monitoring signals (the seismicity, the deformation, the hydrology) created a very dynamic picture of the ongoing events. For these reasons, scientists were asked for rapid re-evaluation of potential outcomes and hazard assessment on a daily basis.

The Icelandic Meteorological Office is in charge of monitoring all kinds of natural phenomena in Iceland, evaluating their related hazards, and issuing warnings to the public, as well as providing information regarding volcanic eruptions of concern for aviation. IMO had been monitoring the Bárðarbunga unrest phase since its beginning and, in collaboration with the University of Iceland, was providing scientific support and interpretation of the ongoing phenomena to the Icelandic Civil Protection (NCIP). These institutions met regularly around a common table to discuss the scientific data, their analyses and interpretation. Additionally, the scenarios towards which the current situation could evolve were discussed and agreed before being communicated to the public and Administrative and Governmental Institutions. Based on this information and advice, Civil Protection made decisions regarding precautionary measures including limiting accessibility to the eruption site, the evacuation of exposed areas, and issuing of warnings and information for mitigating discomforts to inhabitants and tourists.

In order to show the time evolution of the response since the beginning of the volcanic crisis, a time line, based on the aviation color code, has been created (Figure 10). This table summarizes the changes in the aviation color code, together with the observations and data available and the communication channels used. The mitigating actions taken by the National Civil Protection in Iceland are also reported along the same timeline. The table shows the three dates on which the color code for Bárðarbunga was raised to red (eruption imminent with emission of ash into the atmosphere). In the first event the seismic tremor, indicating magma-ice interaction, triggered the red status for an on-going sub-glacial eruption (although this never reached the surface). On the 29th and 31st of August two effusive eruptions started (the first lasting only 4 hours) and the aviation color code was raised to red before being rapidly moved back to orange indicating an on-going eruption with no threat to aviation.

Month	August 2014										September - October 2014								October 2014 - February 2015	February - March 2015			
Day	15	16-17	18	19	20-22	23-26	27-28	29	30	31	1	2	3	4	5-6	7	8-10	11-8 Oct	9-27	28-3	4-10	11-16	16-25	26-now
Eruption and associated direct hazards						*Magma-ice interaction*																		
Ice-surface observations and measurements				?																				
Monitoring data (*)	BG	S, G	S, G	S, G	S, G	ST	V	ST, V	S, G	V	V	V	V, ST	V	V	V	V	V	V	V, S, VG, G	S, VG	S, VG	S, VG	S, VG
Aviation color code																								
Installation of new monitoring equipment (**)					*1 GPS site + 2 seismo-meters*		*1 GPS site*	*1 GPS site*	*2 GPS sites*		*1 new seismo-meter*	*Scanning DOAS for SO_2 fluxes*						*GPS on top of BB + 1 seismo-meter*	*On 15 November an accelerometer has been installed within the caldera*					*Muligas and SO_2 sensors at the lava edge*
Mitigation actions					Evacuation for flood hazard	Check-points in the area						NO access	NO access + evacuation	NO access		NO access + gas issues					partial access (Dettifoss)		access (no lava field)	
Communication to the public		VP, WP, ST	VP, WP, ST	FS, VP, DSR	FS, VP, DSR	FS, VP, DSR, VAR, SIG, SMS, WP, FT	FS, VP, WP, ST	FS, SIG, VAR, VP, SMS, WP, ST	FS, WP, ST	FS, VP, SMS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	FS, WP, ST	WP, ST	WP, ST	WP, ST

(*) Changes across this matrix have been done based on these observable/data; (**) This instrumentation has been crucial for monitoring the ongoing event and assessing the hazards

Legend for obs:	S = Seismicity				VG = Volcanic gases					**Legend:**	VP = Volcinfo postlist email (IMO)					FS = FactSheet (IMO+UI+NCP)				Ice-cauldron			Effusive	
	ST = Seismic tremor				V = visual observation						DSR = Daily Status Report (IMO+UI)					SMS = sms to FV partners (NCP)				formation			Eruption	
	G = Deformation by GPS				BG= Normal background seismic activity						VAR = Volcanic ash report (IMO)					WP = web-page (IMO, UI, NCP)				Caldera			Gas	
											SIG = Sigmet (IMO)					ST = Social tools (IMO, UI, NCP)				subsidence			Pollution	

Figure 10: Time line of the response to the Bárðarbunga volcanic crisis based on the aviation color code, eruption progress, observations in the field, mitigation actions and communication systems. The aviation color codes, which are in accordance with recommended International Civil Aviation Organisation (ICAO) procedures, are intended to inform the aviation sector about a volcano's status. Their meaning is: GREEN: Volcano is in normal, non-eruptive state or, after a change from a higher alert level: Volcanic activity considered to have ceased, and volcano reverted to its normal, non-eruptive state; YELLOW: Volcano is experiencing signs of elevated unrest above known background levels or, after a change from higher alert level: Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase; ORANGE: Volcano is exhibiting heightened unrest with increased likelihood of eruption or, Volcanic eruption is underway with no or minor ash emission; RED: Eruption is forecasted to be imminent with significant emission of ash into the atmosphere likely or, Eruption is underway with significant emission of ash into the atmosphere.

5.1.2 International collaboration

As shown in Figure 10, Icelandic Civil Protection activated FUTUREVOLC partners through the use of the SMS alert system (issued SMS shown in Figure 11) on the 23rd, 29th and the 31st August, when an eruption was declared by IMO. During August some of the scientific collaborations between different partners (mostly the geophysical and deformation teams) had already been active and involved in following the evolution of the seismic events.

Figure 11: The Alert SMSs that were issued to FUTUREVOLC partners on 23rd August

FUTUREVOLC members were also activated by communications in the following channels:

- IMO "volcinfo" email list – wide distribution list
- Personal telephone calls
- FUTUREVOLC blog
- FUTUREVOLC Basecamp

5.2 Blog use

Analysis of access to the FUTUREVOLC blog during July-September (Figure 12) shows a considerable spike in the number of log-ins to the Blog at the start of the unrest at Bárðarbunga in mid August as people looked there for information. There is a further spike on the 23rd August when the first SMS alert was issued and the aviation colour code was raised to red, and again on the 29th. However, neither spike corresponds to an increase in posts or comments. Consequently, the overall trend is that blog access rapidly decreased and by the start of the main effusive activity on 31st August there was very little traffic. After this there was minimal use of the blog, demonstrating that it was not being used for data sharing or data discussion. Reasons for this have been explored during the Annual Meeting feedback session and are discussed in Section 7.

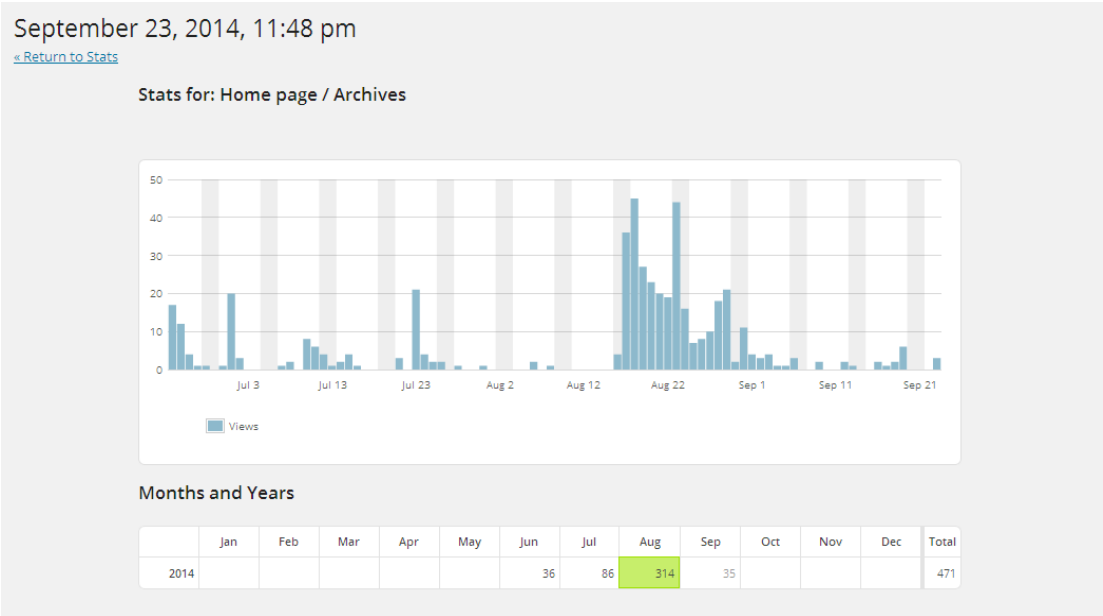

Figure 12: Number of views of the FUTUREVOLC blog from July-September 2014.

5.3 Contribution of FUTUREVOLC equipment and data to response activities

FUTUREVOLC has had a direct impact on the response to Bárðarbunga. During the eruption much FUTUREVOLC equipment has been used for monitoring purposes. Additional instrumentation has been installed in the field and, in some cases, the data have been streamed directly to the monitoring room at IMO (e.g. infrasound arrays, infra-red camera, DOAS, Multigas). Many partners have sent staff into the field to help with movement of equipment to the Holuhraun region and/or its operation. This required many to change their plans and bring new and additional instruments to monitor the ongoing eruption.

Table 5 summarises all the contributions from the different FUTUREVOLC partners to the monitoring of the crisis and the eruption, showing which input and data have been provided for monitoring activity and the timing of the involvement.

Equipment from collaborators outside of FUTUREVOLC has also contributed to the response, including DOAS and ash data from the University of Dusseldorf and FTIR from INGV.

Research Group	Data/observation provided	Time of involvement
IMO	Seismic network, GPS network, hydrological stations network, Radar, FTIR, OPC, accelerometer	Before and during the eruption
UoI	GPS; over flights; InSAR and other satellite images; lava, particle and water sampling; FTIR; mapping of the lava; theodolite; Go-pro; time-lapse with optical camera; osmotic pump for river water chemistry	Before and during the eruption
University College Dublin	Seismic arrays	Before and during the eruption
University of Florence	Infrasound arrays	During the eruption
UNIPA	Multigas	During the eruption
Chalmers University	DOAS (mobile and scanning)	During the eruption
BGS	FTIR	During the eruption
University of Cambridge	DOAS	During the eruption
University of Cambridge	Temporary seismic stations	Before and during the eruption
University of Leeds	InSAR	Before and during the eruption
NICARNICA	Thermal camera	During the eruption
NCIP	Web-cams	During the eruption
Blaise Pascal University	Lava sampling, gas composition	During the eruption
GFZ	Optical cameras	During the eruption

Table 5: Main FUTUREVOLC data and equipment contributions to the ongoing response to the Bárðarbunga eruption.

6 Identified improvements in response

At the FUTUREVOLC annual meeting in September 2014 a discussion session was held with break-out groups to ascertain the positive changes that people felt had occurred since prior to the first exercise. Naturally this included many things specific to the Bárðarbunga unrest and eruption. Future improvements and lessons learnt were also discussed and these are considered in the next section. The responses have been divided into five key areas: alerting, response, communication, data sharing and data discussion.

Alerting

- Alerts worked well – kept people informed
- Most people got an alert whatever the communication channel used (email, SMS, etc)
- On receiving the alert most people followed their institution's procedures
- The different alert levels have kept people aware of the changing activity
- Expansion of the SMS alert list after the exercise worked well for Bárðarbunga

Response

- Lots of people and partners contributed quickly to the Bárðarbunga response
- Support from IMO to FUTUREVOLC partners was incredible, staff are very knowledgeable and extremely hard working

- Based on the alerts, many people changed their plans, for example:
    - Devising and implementing plans to move monitoring equipment and adapt data processing
    - Incorporating new observations into modelling
- Additional Tetra radios purchased by IMO and UoI after the exercise have been very useful to reinforce communication and safety for teams in the field.

Communication

- The factsheets and daily status reports issued by the Iceland organisations are extremely useful:
    - These helped FUTUREVOLC partners from outside Iceland with their fieldwork planning and provided lead time to set up equipment
    - The move to a fixed format in September was welcomed and was a significant enhancement
    - The decision to merge the IMO daily report and the Science Advisory Board factsheet into one during the early weeks of the eruption has simplified communications and is less-timing consuming for the Icelandic organisations. This improved practice also now has a structured process in place.
- WP7 held teleconferences to discuss how they could contribute, which worked well and allowed a fast response to new activity at Bárðarbunga
- Improvements to field communication procedures between UI, IMO, NCIP have been implemented:
    - Tetra radios are routinely used in the field.
    - Forms are submitted to Civil Protection prior to staff commencing field work, providing information concerning the members of the field team, vehicles being used, contact phone numbers and areas to be visited.
    - Gas masks and monitors are also made available.
- Addition of scenarios to factsheets is useful
- Both IMO and UI websites contained constant streams of info, somewhat like a blog, helping to inform others as to what is happening
- The UoI and NCIP Facebook pages now contain a lot of information.

Data sharing

No feedback was received under this item.

Data discussion

- Discussions within specific topic teams were very efficient

The overall conclusion is that since the start of the project the alerting procedure has been greatly improved, as have communications between the Icelandic organizations and out to the FUTUREVOLC partners via a variety of channels. The response to the Bárðarbunga unrest and eruption has involved many people and the connections established through FUTUREVOLC have facilitated fieldwork to enhance data gathering and data sharing.

7 Areas for future improvements

Discussions on areas for future improvements were strongly influenced by the Bárðarbunga response. This provides an excellent real-world focus to the WP9 work and identifies genuine problems and areas for improvement. A range of issues were identified under each of the five areas where things had not gone smoothly and/or could be improved.

Alerting

- Some people still did not receive alerts at the start of Bárðarbunga so everyone needs to be on the communications list for SMS and email
- Not clear at the start who was receiving SMS and why, but this has improved, although still can be added to
- Delays to SMS at start - in some cases the messages arrived several hours late. Further testing needed
- The coordinates of the event need to be contained in the initial alert

Response

- The FUTUREVOLC role needs to be made more clear on the IMO website and in communications that come out of Iceland
- It would be good to have an overview of FUTUREVOLC partner expertise and what equipment everyone has available
- Not clear whether people from non-Icelandic institutions were allowed in to the eruption area – increased logistics for IMO, it could be worth employing someone to be in charge
- It was difficult to give partners outside Iceland a definitive yes or no answer on whether they should travel to Iceland immediately during the phase of unrest
- IMO and UoI staff exhausted – how can tasks be allocated to others? – can FUTUREVOLC contribute?
- Unclear how people should contact IMO about equipment etc
- It was unclear to some partners how they should react, i.e. if they have to wait for a request from Icelandic institutions or not.

Some specific issues regarding response for those required to work in the field were identified including:

- More information on the threats to field workers is needed (e.g. outburst flooding) and the best escape routes
- Need for improved coverage of Tetra base stations. Approximately 30% of the area in which campaign GPS equipment was deployed had no reception on the Tetra radios, which means that field staff are not automatically informed of any serious changes in volcanic activity
- UoI could invest in more satellite phones for back up where there is no mobile signal
- Urgent need for additional training to field staff on the correct use of field safety equipment, including Tetra radios, gas masks and oxygen tanks.

Communication

- Although the introduction of the factsheets was a major positive there were a few issues raised:
    - Factsheets need GPS coordinates
    - Are they archived anywhere for referring back to?
    - The content can be vague and does not always provide an indication of all the activity and how this is changing
    - Clarity was needed in the early stages of Bárðarbunga as to whether these represented the minutes of the Iceland Scientific Advisory Board
- Daily reports from the ground team need to be disseminated to all FUTUREVOLC members
- Not clear who is doing what in FUTUREVOLC to all the partners
    - The structure of the FUTUREVOLC consortium could be outlined better so that people can be identified and contacted easily during a volcanic crisis. Should members be listed in terms of their expertise and available field equipment/data-sets?
- Although communications have improved, the end of day meetings between IMO/UoI that occurred during previous events have been lost, which some felt was a negative step

- There is no integrated overview of the different observations and disciplines available to all partners
- How do we communicate with collaborators outside of FUTUREVOLC – is there scope to extend email and SMS lists to others?
- Too many daily email messages so important info may get lost (particularly from IMO) – also emails were being sent separately in English and Icelandic
    - A single operational email address sending out information, factsheets etc would reduce confusion outside of Iceland
    - Would it be possible to establish an email post-list, whereby FUTUREVOLC members subscribe to receive updates via email? Options could include hourly, daily, or weekly e-mail updates. This would allow the user to control how often they receive monitoring updates from IMO and IES.
- There was a lack if information on the FUTUREVOLC Facebook page
- Use of Twitter for updates?
    - One suggestion was that all non-Icelandic partners should be asked to write a regular twitter post linked to e.g. #FUTUREVOLC on their response activities.
    - However, it was also noted that use of Twitter is limited in Iceland.
- The contributions of FUTUREVOLC need to be made more visible through the project web page

Many issues were specifically related to the blog. Although it worked well during the exercise, it was clear to all that it had not really been used during the unrest/eruption, implying that it was not fit for purpose. One of the main reasons suggested was that people checked the blog at the start of the unrest and eruptive phases, but because there was no information there (i.e. no posts by those within Iceland) they stopped using it. Feedback from IMO and UoI was that there was simply not enough time for them to update all communications channels simultaneously. Other issues raised with the blog included:

- Blog is hard to find, it needs to be linked to from the FUTUREVOLC website
- Blog needs to be mobile phone friendly
- Comments on blog posts do not rise to the top, so you can't see the latest comments that have been made
- Blog was not used as it is not the best tool
- People have not had time for using the blog
- Suggested ways to improve its use included:
    - Can all partners update blog with what they are doing as a first overview and also with what might be useful to them
    - Both Icelandic institutes (IMO, UoI) should share responsibility for updating the blog
    - Labels/tags on the blog posts are needed to help identify the purpose and content of different posts.
    - Giving it a more logistical focus to help coordinate between partners, particularly with respect to fieldwork plans, e.g. to know who is planning to do what, where, when, etc.

There were also some concerns about communications to those in the field and that a process was missing here:

- Partners and others are collecting field data that IMO doesn't know about
- Requests for information from the field by IMO are not getting through to the people who are out in the field
- It is not clear how FUTUREVOLC partners can contact people in the field
- A process to provide oversight and coordination as to what field work is most beneficial to the combined response also appears to be missing or in need of refinement

Data sharing

- Blog could be right place for scientific discussion, but not data sharing
- Unclear to some partners how their data might be used by IMO, for example just for monitoring purpose or just for science. Better definition of this for the future may help partners deliver observations/models faster if required.

Data discussion

- Need a platform for collaboration between groups (the blog is not appropriate)
- Visualisation of the deployment of FUTUREVOLC field equipment on a map (e.g. Google map) would enhance knowledge. It could also serve as good publicity.
- Scientific and technical discussion aspects are missing from current communications
- Communications between partners:
    - FUTUREVOLC needs to provide an integrated overview of what people are doing during crisis
    - There is no way to contribute to multi-disciplinary discussions e.g. between different Work Packages
- More insider information (e.g. about specific science issues of concern in Iceland) would be useful to non-Icelandic partners and would allow FUTUREVOLC members to respond and investigate

8 Recommendations for follow-up

A number of clear areas for improvement have been identified in response to the post-exercise questionnaires and the annual meeting feedback session. Actions relating to these areas are summarised in Table 6.

One of the significant changes implemented for the exercise was the introduction of the blog. During the events in 2014 and the Bárðarbunga activity it quickly became clear, however, that the blog was not being used by the majority of partners. There was also a split in the feedback with some suggesting that it could be an appropriate vehicle for scientific discussion of data, although not for the sharing of the data, but others less sure that it served a real purpose. The introduction of the WP2 data platform should provide a more appropriate tool for data sharing; however there is clearly a need for an improved platform for data discussion that doesn't increase the burden on IMO and UoI communications. Extending the functionality of the blog should be explored, but it may be that an alternative platform will ultimately be required. Suggested potential solutions to explore include:

- Having a platform more akin to a web-based forum.
- Dedicating a person to the task of updating the FUTUREVOLC blog during a volcanic crisis.
- Placing more emphasis on IMO's web-site during an eruption. The rolling news format of the site is similar to a blog format. At the beginning of an eruption, URL links should be distributed to the FUTUREVOLC consortium so that they can check for news updates.

The FUTUREVOLC Scientific Advisory Board also provided feedback at the Annual Meeting and raised the following points for follow up:

- The Review of August-September 2014 communication among partners/ stakeholders (as now encapsulated in this report) will be instructive – but FUTUREVOLC should consider organising a Bárðarbunga review workshop, addressing both the science and the communications aspects.
- The project still needs an eruption (or exercise) that produces ash to demonstrate capability and improvements in this area.

- Are all partners being engaged in near-real time discussion of the Bardarbunga eruption, or is it limited to Icelandic core members? The board suggested that FUTUREVOLC:
    - Organise a weekly or bi-weekly video conference (or use web-based, "meeting" software) among all partners to discuss new data, interpretations, etc, during the ongoing eruption.
    - Enable/encourage the participation of young scientists at all partner organizations in these science meetings and discussions of what advice to give to Civil Protection, etc, to aid their training and development.

#	Action	Area	Who
1	Further people need to be added to the sms and alert list and testing conducted	Alerting	NCIP
2	Streamlining of email information and move to use of a single email address for outwards communications	Alerting & communications	NCIP and IMO
3	Further develop field safety procedures, including purchase of additional equipment and further training/briefing materials	Response & communications	UoI, NCIP, IMO
4	Refine processes for fieldwork coordination and oversight for all partners (and others)	Response & communications	IMO, UoI
5	Create a document outlining the structure of FUTUREVOLC, together with member's expertise, equipment/datasets, contact details. (An excel sheet already exists that gathers information on all instruments, and who is responsible for them both within the partners and at IMO. This has circulated between UoI and IMO, but should be updated and uploaded on basecamp.)	Response & communications	WP1, IMO
6	Improve reporting of FUTUREVOLC contributions to eruptions on the website and Facebook page. Consider use of Twitter.	Communications	Project web and communications team (WP10)
7	Provide details to partners on how their data is/will be used and contributes to the Icelandic response	Data sharing	IMO
8	Implement a process for involving all Work Packages in response activities and promoting discussion between and within WPs (regular telecons/Skype/other)	Data discussion	UoI with WP leaders
9	Investigate suggested improvements to the blog to improve suitability as a platform for data discussion	Data discussion	IMO
10	Investigate alternative data discussion tools	Data discussion	IMO
11	Investigate whether it is possible to add all FUTUREVOLC sensors (of all types) onto the WP2 database GUI map	Data discussion	WP2 partners

Table 6: Actions stemming from the FUTUREVOLC Exercise 1 and responses to activity in Iceland in 2014.

9 Conclusions and Next Steps

Since the start of the FUTUREVOLC project significant steps have been made in communications and data sharing within the consortium, but the results here show that there are still improvements that can be made in each of the five identified key areas: alerting, response, communication, data sharing and data discussion.

Of the priority actions identified in Section 8, a number have already been implemented following the FUTUREVOLC 2014 annual meeting, but others still require consideration. The duration of the Bárðarbunga eruption and the work time that this has taken up, particularly for the Icelandic organisations, mean that some of these actions have not been able to be progressed. One area that requires consideration in 2015, once the WP2 data platform is available, is whether a combination of the WP2 data platform for data sharing and an improved blog site for data discussion would resolve some of the issues currently identified in these areas.

Positively, FUTUREVOLC has had a direct impact on the response to the 2014 unrest event at Mýrdalsjökull and the 2014 Askja rockslide through provision of equipment, and the Bárðarbunga unrest and eruption through the rapid utilisation of equipment installed by many partners both before and during the event. (The refinements to field safety procedures following the exercise should also not be overlooked). Due to the nature of these events not all partners have been involved in the response (including Bárðarbunga) as their equipment/expertise was not relevant to the activity style and/or location. However, for those that could respond to Bárðarbunga, the timely alerts and information provided allowed them to react quickly and mobilise data and field equipment. Immediate alerting following any unusual activity in Iceland should be considered beneficial.

Improving communication across the whole consortium for discussing the obtained data is a key area. Whilst there are excellent examples of smaller scale communications within individual work packages or between individual partners, an integrated overview of the different disciplines and observations is lacking.

The eruption in the Bárðarbunga volcanic system also means that there is considerable uncertainty as to whether there will be a second FUTUREVOLC exercise. The DOW states "Should an eruption occur on Iceland during the project period, FUTUREVOLC will respond accordingly and this will replace the exercises." It is therefore at the discretion of the FUTUREVOLC management team and Work Package leaders as to whether a further exercise will be conducted. Advantages of a second exercise would be the capacity to test the WP2 database and the flexibility to choose a scenario that would involve those partners whose data and expertise was less relevant to Bárðarbunga (e.g. related to ash emissions). Disadvantages include the heavy work load that many partners have been under for many months due to Bárðarbunga and the need for people to be able to learn from and publish the science from this activity.

Irrespective of whether a second exercise takes places, as the project nears completion the role and scope of the SMS alert will need to be considered. The membership of this alert list may want to be increased to incorporate other important partners who are outside of the current FUTUREVOLC project.

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11 Appendix 1: Pre-exercise Questionnaire

The questions sent to each partner prior to the June exercise are given in Table A1. These address issues under both WP9 and WP3.

No.	Question:
1.	How do you currently find out about volcanic unrest or activity on Iceland?
2.	If there was unrest or an eruption on Iceland tomorrow where can your data/results be found by others? If at all?
3.	What form is this data in?
4.	Who would you disseminate/share this data and your interpretation with in Iceland?
5.	How would you disseminate/share this data and your interpretation with Iceland?
6.	Who would you disseminate/share this data and your interpretation with among other FV partners?
7.	How would you disseminate/share this data and your interpretation with other FV partners?
8.	What would you want/need to improve the dissemination and discussion of essential information?
9.	Would you talk to the media about unrest/eruption? If so,
	a) Who are you most likely to talk to?
	b) What information source would you use?
	c) Who would initiate the interaction – media, yourself, press office?
10.	Would you use social media? If so what?
11.	Would you put information on a website? If so please provide the link.
12.	Do you advise any government departments about volcanic unrest/eruption? If so, what departments and what is their role?

Table A1: The pre-exercise questionnaire questions sent to all partners.

12 Appendix 2: Post-exercise Questionnaire

The questions sent to each partner following the June exercise are given in Table A2. These were broken into 4 categories representing the main aims of the exercise:

A. Alert system and process (Q1-4)
B. Response procedures (Q5-10)
C. Communications, data and information sharing (Q11-16)
D. Lessons learnt from the exercise (Q17-22)

No.	Question:
1a.	Did the people in the sms list at each institution receive the SMS from Iceland Civil Protection on the day of the exercise? Please fill in Table 1.
1b.	Did the people in the futurevolcpeople list receive the emails from IMO on the day of the exercise? If not, please provide the missing or wrong email addresses.
2.	Would you want to add additional people to the alert contact lists? If yes, please specify who.
3a.	Was the information provided in the SMS sufficient?
3b.	If not, what would you prefer to receive?
4a.	Was the information provided in the email sufficient?
4b.	If not, what would have been more useful?
5a	Were you kept informed on the day of the exercise by the primary contact of your institution, as indicated on basecamp? If no, by who?
5.	Did your institution's response to the exercise follow a pre-arranged "response plan"?
6.	Had individuals been pre-allocated roles for responding?
7.	What problems did you encounter with responding? (please give issues with the blog in the next set of questions)
8.	How does your response during the exercise reflect what you would do in a real event?
9.	Would you be able to respond in the same time-frame with real data (i.e. how long would real-time data processing take)?
10.	Have you any instrumentation that needs to be deployed in the field during an eruption?

For those who answered yes to question 10:

10a.	During the exercise did you simulate deployment of equipment? If not, why?
10b.	If you were not in Iceland, did you contact local staff to assist with field equipment?
10c.	Did you encounter any issues communicating with your key contact at IMO or elsewhere for deploying/checking instruments?
10d.	How do you determine what field areas in Iceland are safe to enter or remain working in during an eruption of an Icelandic volcano?
10e.	Did you try to obtain this information during the exercise? If not, why?

11a.	Did your institution post to the blog?
11b.	If not, why not (busy, in the field, out of office, not interested, no relevant data, …)?
12.	Were you able to easily access and post to the blog?
13.	Was the blog suitable for sharing and discussing your data?
14.	What changes would you suggest to improve the usability of the blog?
15.	Did you contact anyone directly in Iceland during the exercise (i.e. not using the

	blog)? If so, who and why?
16.	Did you contact any other Futurevolc partners directly during the exercise (i.e. not using the blog)? If so, who and why?
17.	Did your institution have an internal review following the exercise?
18.	Will you do anything differently as a consequence of this exercise?
19.	Do you have any suggestions for improving the communications within FV during a real eruption?
20.	Did any other problems/concerns arise during the exercise that are not covered by these questions?
21.	Do you have any other comments on this exercise?
22.	Would you be willing to participate in a second exercise within the next 6 months?