Research Networking Programmes

Science Meeting – Scientific Report

Scientific report (one single document in WORD or PDF file) should be submitted online within two months of the event. It should not exceed seven A4 pages.

***Proposal Title**:*

Workshop on Satellite-Data-Driven Detection, Tracking and Modeling of Volcanic Hot Spots

Application Reference N°:

MeMoVolc - Science Meeting 4743

1) Summary (up to one page)

Between the 28 and 30 May, 2013, a workshop on Advanced Satellite Modelling of Volcanic Hot Spots was held at the Maison International of the Université Blaise Pascal in Clermont-Ferrand. The title of the workshop was "*Workshop on Satellite-Data-Driven Detection, Tracking and Modelling of Volcanic Hot Spots*", and the final program is given in Annex 4a.

The workshop aim was, within the theme of satellite detection and modelling of active lavas, to:

1. Present, review and collate all capabilities in the remote sensing and modelling communities;

2. Through round table discussion, identify key issues that currently need to be addressed;

3. Identify standards and formats, and a platform, to allow products to be handed between each group for comparison, error testing, full probabilistic appraisals and ingestion into crisis response models;

4. Agree on a common data set and carry out a test during which data and products are fed through the chain from remote sensor through modeller to operational responder.

5. To formalise a working group with a common interest in *satellite-data-driven detection, tracking and modelling of volcanic hot spots.*

The working group comprised 48 delegates from France (including Réunion), Italy, UK, Germany, Switzerland, Portugal (Azores) and Iceland. The group, as listed in Annex 4b, also included seven delegates from the USA and one from Japan. Thematically, the group comprised four fields:

- Hot Spot Detection and Deliverables (nine delegates);
- Towards Operational Tracking and Dissemination Systems (seven delegates);
- Lava Flow Modelling and Deliverables (seven delegates);
- Crisis Management: Requirements (seven delegates).

Added to this there were the three conveners:

- Andrew Harris (LMV, Université Blaise Pascal);
- Philippe Labazuy (OPGC, Université Blaise Pascal);
- Tom De Groeve (IPSC, European Commission Joint Research Centre).

Plus four masters student representatives from Laboratoire Magmas et Volcans (LMV), and nine LMV staff members.

The group were supportive of the following actions:

1. The establishment of a formal working group, or at the very least a series of follow up meetings, and establishment of an email distribution list to allow up-dates, information sharing and discussion of logistical, scientific and operational issues.

2. The identification of common data sets on which members of the group can run their various algorithms and models to produce a library for demonstration of product types available and comparison.

3. Proposal of a book to IAVCEI special publications in volcanology series collating:
    i. the algorithms, models and response experiences presented at the meeting,
    ii. the results of the group exercise (i.e., the library of item 2), and
    iii. the initial findings and recommendations of the working group.

Currently support for a follow up meeting, likely to be held in Catania during 2014, is being discussed.

2) Description of the scientific content of and discussions at the event (up to four pages)

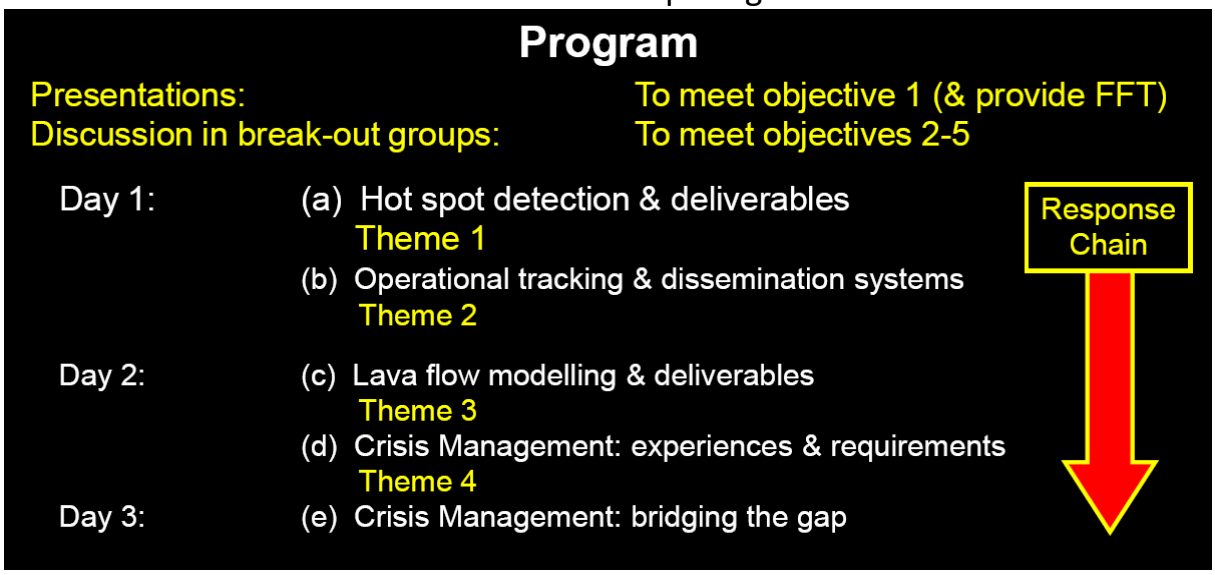
3)

The workshop began with an introduction by conveners defining the main objectives of the meeting. These were listed as being to:

(1) Present, review and collate all current capabilities;
(2) Identify key issues that currently need to be addressed;
(3) Agree on standards and formats;
(4) Set up a data sharing hub:
    Items 3 and 4 together allow products to be handed between each group and ingestion into crisis response models;
(5) Agree on a common data set and carry out a test:
    During the test data and products will be fed through the chain from remote sensor through modeller to operational responder;
(6) To formalise a working group.

The program proceeded as follows, with themes building progressively through the response chain from hot spot detection and tracking (Day 1) through modeling (Day 2) to crisis response (Days 2 and 3). The full program detail is given in Annex 4a.

Overview of Workshop Program



FFT = Food for Thought

Day 1 involved presentations on algorithms designed to detect volcanic hot spots and deliver "source term" parameters to the modelers. This first day was split into three parts. Part 1 involved presentation of four well-established and mature algorithms: OKMOK, MODVOLC, RST-VOLC and AVHotRR. Part 2 involved a review of new, cutting-edge approaches, and Part 3 was a review of operational (satellite-data-based) volcanic hot spot tracking systems.

Day 2 was split into two parts. The first part reviewed operational models used for simulations of lava flow emplacement, and the second considered issues regarding use of remote sensing and modelling during eruptive crises, with case studies from Hawaii, Italy, Réunion, Iceland and the Azores. Day 3 involved two presentations from the Research Center of

the European Commission and British Geological Survey regarding operational needs for effective and politically-correct response.

At the end of each of days 1 and 2, each theme group would gather for 1-2 hours of discussion, during which issues relating to the theme(s) addressed during the day would be discussed. Discussion points tabled for consideration during each break-out are listed in the program as attached in Annex 4a.

The composition of each discussion group was as follows (all participants are listed in Annex 4b):

(1) Hot Spot Detection and Deliverables (Reporter: Dehn)

1.	Talfan Barnie	Cambridge University, UK
2.	Diego Coppola	University of Turin, Italy
3.	Jonathan Dehn	AVO, University of Alaska Fairbanks
4.	Fanny Garel	Imperial College London, UK
5.	Yannick Guéhenneux	LMV, Université Blaise Pascal, France
6.	Valerio Lombardo	INGV – Rome, Italy
7.	Nicola Pergola	University of Basilicata, Italy
8.	Robert Wright	University of Hawaii, USA
9.	Klemen Zaksek	University of Hamburg, Germany

(2) Towards Operational Tracking and Dissemination Systems (Reporter: Carn)

1.	Simon Carn	Michigan Technological University, USA
2.	Thibault Catry	Station SEAS-OI, Reunion
3.	Ashley Davies	Jet Propulsion Laboratory (USA)
4.	Gaetana Ganci	INGV-Catania, Italy
5.	Mathieu Gouhier	OPGC, Université Blaise Pascal, France
6.	Andrew Harris	LMV, Université Blaise Pascal, France
7.	Matthew Patrick	USGS - Hawaiian Volcano Observatory, USA

(3) Lava Flow Modelling and Deliverables (Reporter: del Negro)

1.	Noé Bernabeu	University of Grenoble, France
2.	Benoît Cordonnier	ETH Zürich, Switzerland
3.	Eisuke Fujita	Nat. Res. Inst. Earth Sci. & Disas. Prev., Japan
4.	Karim Kelfoun	LMV, Université Blaise Pascal, France
5.	Ciro del Negro	INGV-Catania, Italy
6.	Simone Tarquini	INGV-Pisa, Italy

(4) Crisis Management: Requirements (Reporter: Guðmundsson)

1.	Sonia Calvari	INGV-Catania, Italy
2.	Tom de Groeve	JRC-Ispra, Italy (EC)
3.	Anthony Finizola	University of Reunion, Reunion
4.	Magnús Guðmundsson	University of Iceland, Iceland
5.	James Kauahikaua	USGS - Hawaiian Volcano Observatory, USA
6.	Giovanni Macedonio	INGV – Osservatorio Vesuviano, Italy
7.	José Pacheco	University of the Azores, Portugal
8.	Kay Smith	British Geological Survey, UK

Each group collected minutes for their discussions, which were presented in a feed-back session on the final morning of the workshop. These reports are given Annex 4c.

4) Assessment of the results and impact of the event on the future directions of the field (up to two pages)

The group agreed to support and pursue five initiatives:

Initiative 1: Formalization of a working group
The group agreed to set up a formal working group entitled "*Advanced Satellite Modeling of Volcanic Hot Spots*" (ASMVolc). An email distribution list has already been set up to allow communication between group members, and liaison over group-wide projects and initiatives (Annex 4d). A web-site will be also set up, hosted at OPGC and linked to the MeMoVolc and ESF web-sites, to disseminate information regarding ASMVolc meetings and projects, both within the group, as well as to the wider community and public. Initially, we will upload details regarding the May 2013 workshop (program, abstracts, PDF of presentations, reports, press, etc.).

Initiative 2: Working group book
There was unanimous support for a book that would present the state-of-the-art for satellite-based volcanic hot spot detection, lava flow modeling and simulations, as well as their use for operational monitoring and crisis response. Chapters will comprise write-ups of the presentations given by each delegate, followed by a write up of the reports that review outstanding issues and priorities identified by the working group (a working version of which is attached in Annex 4c). A proposal is in preparation for submission to IAVCEI Special Publications, from whom such a proposal has already been encouraged.

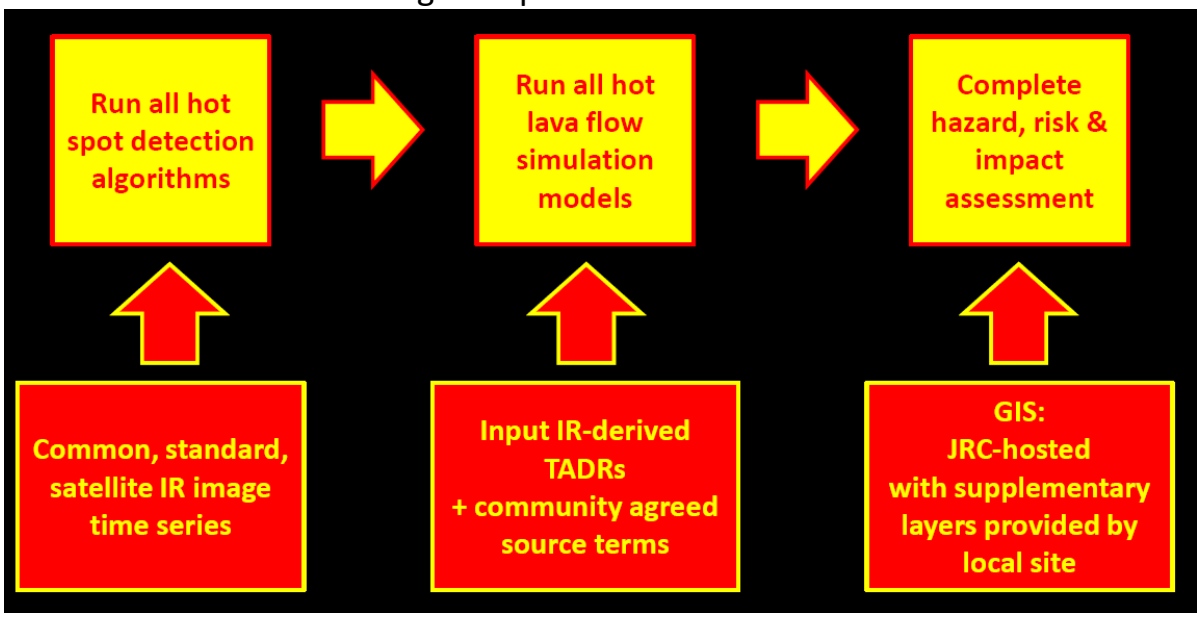
Initiative 3: Complete a hot spot detection algorithm test on a common data set
As part of this initiative, two data sets were mooted for testing of all algorithm and data treatment routines presented by the remote sensing sub-group. Two data sets are good candidates: (i) a set of SEVERI data for a short fountaining event on Etna during 12-13 January 2011, and (ii) a set of MODIS data for a long effusive event with variable effusion rates on Etna during 2008-2009. Both data sets contain many cloud-free (and cloud-contaminated) images, and also have good ground truth data against which algorithm output can be compared. Algorithm output will be compared in terms of number of images, and number/location of pixels on each image, for which hot spots were detected, as well as output parameters such as spectral radiance, lava flow area, heat flux, time-averaged discharge rate and erupted lava volume, as well as errors on these.

Initiative 4: Apply all lava flow simulation models to a common data set
We plan to run all lava flow simulation models over a common DEM and compare output. Two eruptions in the Chain des Puys (France) have been proposed as test cases: those of the Grave Noire (high effusion rate, fountain-fed event) and the Petit Puy du Dome (longer-duration event). Both lava flows are well mapped, and appropriate source term data can be supplied. Both flows also underlie the current urban area of Clermont Ferrand. Results of these tests and comparisons should allow us to address several of the issues raised by the sub-groups, as noted in the working group report (Annex 4c).

Initiative 5: Test the information chain
The results of the hot spot detection algorithms will be fed into each lava flow model. The 12-13 January data will be used for Grave Noire, and Etna 2008-2009 for Petit Puy du Dome. Simulations of inundated area, and the development with time will then be fed into a GIS hosted at the Joint Research Center hosted to assess impacts on Clermont Ferrand and its hinterland.

While the ASMVolc web-site may be a good hub for data pick-up and sharing, the book maybe a good place to present results of these tests and exercises.

Working Group "Information Chain"



Yellow boxes = actions
Red boxes = required input / resource
Arrows = direction of information flow

Follow up

There is general support for a follow up meeting, where results from these initiatives can be presented, and further initiatives and projects discussed. Delegates from the Instituto Nazionale di Geofisica e Vulcanologia in Catania have expressed interest in hosting the next workshop on Etna. This would be an excellent site, as it may allow an on-site, real-time exercise simultaneous with ground-truthing.

Day I (Tuesday 28 May): Hot Spot Detection, Tracking and Dissemination

08:30 Welcome, Review of Workshop Objectives and Proposal of Initiatives

Part 1 (Hot Spot Detection and Making the Measurement):

09:00 Jonathan Dehn (AVO – University of Alaska Fairbanks)
20 years of thermal satellite monitoring at the Alaska Volcano Observatory

09:20 Robert Wright (HIGP – University of Hawaii)
MODVOLC: 13 years of autonomous observations of global volcanism

09:40 Nicola Pergola (Istituto Di Metodologie per l'Analisi Ambientale – CNR)
RST-VOLC, an original algorithm for automatic detection and near real-time monitoring of volcanic hotspots from space: main achievements, issues and future perspectives

10:00 Valerio Lombardo (INGV - Rome)
AVHotRR: near real time routine for volcano monitoring using IR satellite data

10:20 Coffee Break

10:40 Diego Coppola (University of Turin)
Hot-spot detection at Stromboli volcano using MODIS: Results from the MIROVA system

11:00 Yannick Guéhenneux (Université Blaise Pascal)
NTI-MSG an adaptation of the Normalized Thermal Index algorithm for the HOTVOLC observing system

11:20 Talfan Barnie (University of Cambridge)
Extracting thermal anomalies from geostationary satellite images using Independent Component Analysis, and modelling their temporal evolution with physically based and empirical kernel convolution models

11:40 Fanny Garel (Imperial College London & Cardiff University)
Interpreting the surface thermal signal of lava flows in terms of dynamics: insights from analogue experiments

12:00 Klemen Zaksek (University of Hamburg)
Constraining the uncertainties of monitoring effusive volcanic activity using Kalman filter

12:20 Lunch

Part 2 (Towards Operational Tracking and Dissemination Systems):

13:20 Gaetana Ganci (INGV - Catania)
HOTSAT: satellite thermal monitoring of volcanic activity

13:40 Mathieu Gouhier (Université Blaise Pascal)
HOTVOLC: Real-time satellite-data-driven system designed for operational monitoring of volcanic eruptions

14:00 Michael Ramsey (University of Pittsburgh)
Synergistic use of satellite hot-spot detection and science: A decadal perspective using ASTER

14:20 Matthew Patrick (USGS - Hawaiian Volcano Observatory)
Operational satellite thermal monitoring of volcanic activity in Hawaii

14:40 Ashley Davies (Jet Propulsion Laboratory – California Institute of Technology)
The NASA Volcano Sensor Web, Advanced Autonomy, and the Remote Sensing of Volcanic Eruptions

15:00 Tea Break

15:20 Simon Carn (Michigan Technological University)
VHub perspective and synergistic use of spaceborne thermal IR and SO_2 measurements

Part 3 (Group discussion for Themes 1 and 2):

15:40 Group breakouts

Key issues:

- What can be provided by the thermal remote sensing community?
- What do we need that is not currently provided?
- What does the modelling and response community need that the thermal remote sensing community can potentially provide?

- How fast can products be delivered following detection?
- Is it fast enough?
- Can we increase the speed of turn around, and if so, how?
- How can we best disseminate the data?

- What are the precision of the measurements, and their reliability?
- How can we improve the measurements?
- Is it possible to monitor at a high temporal frequency the concurrent advance of lava flow and its surface thermal signal?
- What deliverables do we need to provide, and in what format?

- What extra capabilities do we need?
- How can we best integrate the various capabilities that we already have?

17:00 Report Back

Evening: Dinner at Brasserie du Jardin (20:00)

Day II (29 May): Lava Flow Modelling and Operational Response

08:50 Introduction to Day 2

Part 1 (Lava Flow Modelling):

09:00 Ciro Del Negro (INGV - Catania)
Numerical simulations of lava flows using the MAGFLOW physics-based model

09:20 Eisuke Fujita (National Research Institute for Earth science and Disaster prevention)
LavaSIM: its physical base & applicability

09:40 Karim Kelfoun (Université Blaise Pascal)
VolcFlow capabilities and perspectives of development for the simulation of lava flows

10:00 Giovanni Macedonio (INGV - Osservatorio Vesuviano)
Numerical simulation of lava flows based on depth-averaged equations

10:20 Coffee Break

11:40 Simone Tarquini (INGV - Pisa)
Simulating the area covered by lava flows by using the DOWNFLOW code

11:00 Andrew Harris (Université Blaise Pascal)
FLOWGO: An updated version and results of calibration tests on Hawaiian lavas

11:20 Mary Grace Bato (Université Blaise Pascal)
InSAR Volcano Monitoring in Piton de la Fournaise: What have we been doing over the last 3 years?

12:00 Lunch

Part 2 (Application in crisis-mode: experiences and requirements):

13:00 Jim Kauahikaua (USGS - Hawaiian Volcano Observatory)
The Hawaiian Volcano Observatory's approach to forecasting lava flow hazards

13:20 Sonia Calvari (INGV - Catania)
Satellite-derived effusion rates during volcanic crises: the example of Etna

13:40 Magnus Gudmundsson (University of Iceland)
Thermal signals from eruptions in ice-covered volcanoes, experience from Iceland

14:00 Thibault Catry (SEAS-OI, La Reunion)
The SEAS-OI Satellite platform: monitoring and risk assessment on active volcanoes in the Indian ocean using RADAR imagery

14:20 José M. Pacheco (Azores University, Portugal)
Volcano monitoring and risk assessment at the Azores archipelago

14:40 Tea Break

15:00 Benoit Cordonnier (ETH Zurich / UC Berkeley): Benchmarking volcanic mass flow models

Part 3 (Group discussion for Themes 3 and 4):

15:20 Group breakouts

Key issues:

- What can be provided by the modelling community?
- What are the key source terms, input data and relations the models need?
- What can the thermal remote sensing community provide?
- What are the key DEM problems (spatial resolution, coverage, up-dating … …)?
- What are the precision on the model runs, and their reliability and uniqueness?
- How can we improve the models, and what extra capabilities do we need?
- What deliverables do we need to provide, in what format and how can we best disseminate the data?
- How can we best integrate what we already have both across the modelling community, and between the modelling and remote sensing communities?
- Can we design a community-wide (open access) fully-integrated rapid response system?
- Can the modeling community provide thermal outputs comparable to thermal remote-sensing deliverables?
- Can model runs be adjusted/updated using thermal remote-sensing data?

17:00 Report Back

Evening: Cocktails and UNESCO project presentation at:
Salle d'Assemblée du Conseil Géneral du Puy de Dôme

Dinner at Crêperie Le 1513 (20:00)

Day III (30 May): Working Group: Bridging the Gap

08:30 Introduction to Day 3

08:40 Tom de Groeve (Research Center of the European Commission)
Towards a global humanitarian volcano impact alert model integrated in a multi-hazard system

09:00 Kay Smith (British Geological Survey)
Towards a global humanitarian volcano impact alert model integrated in a multi-hazard system

09:20 Group Reports

- What does the operational system need – current status, issues and holes?

10:00 Coffee Break

11:20 Discussion of follow up initiatives

- Identification of validation data sets on which to test the detection algorithms and define standards;
- Identification of a common data set on which to test and compare lava flow simulation models;
- Definitions of test criteria and output standards;
- Collation of global capabilities and generation of a "provider" directory.

- Planning of follow up work, including sharing of validation-test results between detection and modelling groups.
- Proposal for common (IAVCEI- and GDACs-supported) document to implement the results and conclusions reached by the working group:

  Book covering workshop themes and initiatives for Special IAVCEI Publications?

- Proposal for a communal site for communication, dissemination and interaction.
- Proposal for creation of hot spots working group.

12:00 Check out / Transfer

12:30 Tour of La Chaine des Puys

Stop 1: Tour of the lava flows of the Gravenoire and Tiretaine valley

Stop 2: Train to summit of Puy de Dôme, and tour of the summit

Stop 3: Tour of Vulcania (http://www.vulcania.com/), followed by
- Premiere of the film “Volcans Sacrés”
- Dinner at Vulcania

Annex 4b: Full list of speakers and participants

1.	Andrew Harris	LMV, Université Blaise Pascal, France
2.	Philippe Labazuy	OPGC, Université Blaise Pascal, France
3.	Tom De Groeve	European Commission Joint Research Centre, Italy
4.	Talfan Barnie	Cambridge University, UK
5.	Diego Coppola	University of Turin, Italy
6.	Jonathan Dehn	AVO, University of Alaska Fairbanks
7.	Fanny Garel	Imperial College London, UK
8.	Yannick Guéhenneux	LMV, Université Blaise Pascal, France
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16.	Gaetana Ganci	INGV-Catania, Italy
17.	Mathieu Gouhier	OPGC, Université Blaise Pascal, France
18.	Matthew Patrick	USGS - Hawaiian Volcano Observatory, USA
19.	Michael Ramsey	University of Pittsburgh, USA
20.	Noé Bernabeu	University of Grenoble, France
21.	Benoît Cordonnier	ETH Zürich, Switzerland
22.	Eisuke Fujita	Nat. Res. Inst. Earth Sci. & Disas. Prev., Japan
23.	Karim Kelfoun	LMV, Université Blaise Pascal, France
24.	Ciro del Negro	INGV-Catania, Italy
25.	Simone Tarquini	INGV-Pisa, Italy
26.	Sonia Calvari	INGV-Catania, Italy
27.	Anthony Finizola	University of Reunion, Reunion
28.	Magnús Guðmundsson	University of Iceland, Iceland
29.	James Kauahikaua	USGS - Hawaiian Volcano Observatory, USA
30.	Giovanni Macedonio	INGV – Osservatorio Vesuviano, Italy
31.	José Pacheco	University of the Azores, Portugal
32.	Kay Smith	British Geological Survey, UK
33.	Olivier Roche	LMV, Université Blaise Pascal
34.	Jean Battaglia	LMV, Université Blaise Pascal
35.	Mary-Grace Bato	LMV, Université Blaise Pascal, France
36.	Maxime Bombrun (student)	LMV, Université Blaise Pascal, France
37.	Benjamin Latutrie (student)	LMV, Université Blaise Pascal, France
38.	Bénédict Robert (student)	LMV, Université Blaise Pascal, France
39.	Marina Valer (student)	LMV, Université Blaise Pascal, France