

REPORTING PERIOD: 1 AUGUST 2019 - 31 JULY 2020

1. Director's Summary

The UWI Seismic Research Centre (SRC) is the regional institution responsible for surveillance of and fundamental research into volcanoes and earthquakes for the English-speaking islands of the Eastern Caribbean. The SRC provides the governments of its 9 contributing territories¹ with accurate and up-to-date information about earthquake, volcanic and other geologic activity, including 19 live volcanoes, in the Eastern Caribbean. The Centre has been providing these services for over 65 years. Its work has and will continue to have direct impact on vulnerable island communities throughout the Eastern Caribbean. All aspects of the work undertaken by the SRC are of direct and immediate relevance and importance to public safety and sustainable development in the region.

The income received from our contributing territories continue to be inconsistent and provide only sufficient funds for routine monitoring (i.e. operation of a minimal seismic network). We continued to lobby vigorously during the year for payment of outstanding debts. All other work, including most research, major developments in the network and outreach, were undertaken through grant funding mainly from external sources or from applications to the SRC Departmental Consultancy Fund (DCF).

Geologically the high level of seismicity being seen in recent years, in the Eastern Caribbean, persisted, although at a somewhat reduced level in this reporting period. The seismograph network recorded more than 9,400 earthquakes, which includes more than 3,780 low magnitude volcanic earthquakes, occurring in the Dominica area and more than 1,430 associated with the Kick - 'em-Jenny submarine volcano. Locations were determined for about 2,060 earthquakes, of which 1,727 were of magnitude greater than 2.0. At least 33 of those events were reported felt. The largest earthquake for the period occurred north-west of Tobago/south-east of Grenada, on 2020/04/07, and was of magnitude 5.3. The areas north of Dominica and near the north coast of Saint Lucia continued to manifest a

¹ St. Kitts & Nevis, Antigua & Barbuda, Montserrat, Dominica, Saint Lucia, St. Vincent & the Grenadines, Barbados, Grenada, Trinidad & Tobago

significant level of low magnitude, shallow earthquakes. West of Trinidad, in the Gulf of Paria, there was also significant shallow seismicity. Moderate magnitude, shallow earthquakes located directly under densely populated urban centres have the potential to deal disastrous impact on cities. High-level activity is characteristic of the Antigua/Barbuda and Paria peninsula areas, and is more marked in recent years. Including the moderate magnitude earthquake already mentioned there were six events of magnitude 5.0 and larger and 81 in the magnitude range 4.0-4.9, during the period. Activity at the Soufrière Hills Volcano in Montserrat, which is now at a low level, continues to be closely monitored by the Montserrat Volcano Observatory. Volcanoes falling within our area of responsibility, other than the southern Dominica and Kick-‘em-Jenny systems, exhibited background levels of activity. Research being conducted at the SRC continues to suggest that the global seismogenic system is poised to deliver its largest earthquakes and the mega-earthquakes that have occurred, since 2004 support this conclusion. Our region has not seen its largest earthquake for well over 150 years. Since 2013, there has been a rate increase in earthquakes of magnitude greater than 6.0 and background seismicity patterns in the region are changing. It is for this reason that we seek to foster collaborations that allow us to enhance our monitoring and seismic hazard and risk capability, take an active role in promoting the development and legislation of Building Codes and our Education and Outreach thrust is being maintained at a high level.

2. Report

A. STAFF

Appointments

- Dr. Erouscilla Joseph – Research Fellow (Volcanology) assumed duty as Director of SRC on November 1, 2019.
- Dr. Graham Ryan - Research Fellow (Volcanology) assumed duty as Director of MVO by the Governor of Montserrat on advice of cabinet from August 1, 2019 for a two-year period.
- Mrs. Michal Camejo-Harry - Junior Research Fellow (Volcanology) assumed duty on March 1, 2020.

B. STUDENTS

Postgraduate Programme

During the reporting period the SRC's Postgraduate programme expanded with a total of seven (7) postgraduate students employed as Research Assistants working on projects that contribute to our key areas of research and monitoring. Of these, two (2) were registered for postgraduate degrees in Seismology and three (3) for postgraduate degrees in Volcanology. The other two (2) postgraduate students were part of joint projects in collaboration with the Departments of Geography and Engineering.

C. RESEARCH & INNOVATION

Volcanology

- i) **Disaster risk management in the Caribbean, support for the Seismic Research Centre.** This project funded by the Government of New Zealand through its Ministry of Foreign Affairs and Trade was extended by one year to allow completion of all activities. It involves GNS Science of New Zealand helping the SRC to build capacity in: a) continuous monitoring of volcano-hydrothermal systems using remote techniques; b) ground deformation monitoring using remote sensing and c) improved alerting systems for volcanic emergencies.

The prototype volcano-hydrothermal monitoring stations have since successfully been tested in New Zealand at White Island and Te Maari with the parameters of temperature and water levels of pools being monitored. The pilot "hydrothermal station" will be installed at Sulphur Springs in St. Lucia during the 1 - 15 December, 2019. (Project team members Dr. E. Joseph and Dr. G. Ryan)

- ii) **Geochemistry and microbial ecology of hydrothermal areas in Dominica, Lesser Antilles.** (CRP.3.MAR19.4) Funding: TT\$44,700.00 (Principal Investigator Dr. E. Joseph). The SRC is also collaborating with the Department of Life Sciences (Professor Jayaraj Jayaraman and Dr. Adesh Ramsubhag) to study the relationship between the geochemistry of hydrothermal gas and waters at various hydrothermal areas of Dominica in relation to the microbial ecology that exists at these sites. The results of this study will help contribute to the monitoring

of chemical changes in hydrothermal fluids at geothermal systems in Dominica, as well as to identify microbiotic species with the potential for bioprospecting.

- iii) **UK Global Challenges Research Fund (GCRF). Caribbean Resilience and Recovery Knowledge Network.** Funding: £144,963.00 (Project partner: Dr. Erouscilla Joseph) The SRC will contribute to the GCRF Caribbean Resilience and Recovery Knowledge Network in collaboration with Dr. Emily Wilkinson (Overseas Development Institute) and Dr. Donovan Campbell (UWI, Mona). The overall aim of the Caribbean Knowledge Network is to create a new culture for responding to and preparing for hazardous events; one that promotes sustainable and equitable recovery and resilient development pathways in Caribbean islands. Three key activities will all happen in the region: a forensic workshop, scenario roadshows and an interdisciplinary webinar series. New knowledge will be co-produced between the research, practitioner and policymaker communities. This will take the form of policy briefs, scenario exercises, new (bespoke) principles and strategies for disaster recovery and new research manifestos and proposals. (June 2019 – June 2021)

- iv) **Volcano-Ready Communities in St. Vincent.** (Project leader Prof. R. Robertson) This is a project funded by a grant of US\$618,700 from the Community Disaster Risk Reduction Fund administered by the Caribbean Development Bank that is being done in St. Vincent in collaboration with the National Emergency Management Organization of St. Vincent and the Grenadines. It involves the provision of scientific information and its downscaling to support community level volcano contingency planning, community-led multi-hazard mapping and capacity building for disaster risk reduction.

- v) **“Mountain Aglow” Montserrat.** Drs Karen Pascal, Victoria Miller, Adam Stinton and Thomas Christopher and Mr Dike Rostant (E&O Officer) assisted with development of a mobile exhibit entitled “Mountain Aglow” (<https://mountainaglow.com>) coordinated by Prof. Jenni Barclay at the University

of East Anglia. Dr Pascal visited the UK to assist with the launch of the exhibit at the Norwich Science Festival in October 2019, following which it arrived on Montserrat in November 2019 during Montserrat's annual Festival of the Word (14 -17 November).

- vi) **Quantitative methods for hazard assessment at the Soufriere Hills Volcano, Montserrat.** Dr. Victoria Miller (Principal Investigator) is leading a research project to employ quantitative methods for hazard assessment at the Soufriere Hills Volcano, Montserrat. A new hazard map will be developed in collaboration with researchers at The University of Edinburgh, scientists at UWI-SRC and the Government of Montserrat, with a focus on pyroclastic flows and lahars, to differentiate hazard levels within the existing Zone V (exclusion zone). The microzonation of Zone V will provide input to risk assessment for the volcano and an evidence base for decision-making regarding access management and long-term development planning on the island of Montserrat.
- vii) **SHV25 International Conference** (scheduled 20 -24 July 2020) postponed to July 2021 due to COVID-19. In commemoration of the start of the eruption on 18 July 1995, the MVO hosted and delivered a series of talks, interviews and panel discussions entitled MVO talks from 13 -17 July (available online through ZJB and the Government Information Unit).

Geophysics

- i) The UWI SRC Geophysics team continues this year to work on the **Trinidad & Tobago Microzonation project (TTMP)**, funded by the Ministry of Planning & Development. The area of investigation this year is Diego Martin basin, and operations included extensive geological surveys and geophysical prospecting. The team also got involved in the archaeometric investigation of the Banwari Burial Heritage Site in St. Francique, Siparia. Operations started in February 2019 and are expected to conclude in September 2019, and a comprehensive report to be submitted to The National Trust of Trinidad & Tobago early in 2020. (Project leader Dr. I. Papadopoulos).

- ii) The UWI SRC continues to expand the **urban strong-motion network** with additional installations of stations in Port of Spain and Diego Martin. Currently there are eight stations in Port of Spain and one in Diego Martin, recording continuously the seismic activity and online streaming data back to The UWI SRC. (Project leader Dr. I. Papadopoulos).

D. OUTREACH

The Education and Outreach section of the Centre aims to bridge the gap between the science of the geological hazards monitored by the UWI-SRC and public understanding and knowledge of these phenomena in the region. The section focuses on student outreach, stakeholder sessions, special projects and collaborations throughout the islands along with social media posts with the aim of raising awareness to the geological hazards and helping to reduce the risk via preparedness and mitigation messages. The start of 2020 saw the COVID-19 pandemic impact the work of the Centre and the section had to take steps to move to online platforms to conduct sessions. Our robust social media platforms were fully implemented and we engaged the online and general community through various activities.

Student Outreach

Tours continued at the Centre during the reporting period. Students of Tableland Government and North Gate Secondary school visited the Centre. The tour is modeled on following the 'Data Trail' of seismic data throughout the building and ends with an interactive session. The Tour can be adapted for the varying age groups and or subject(s) being studied by the visiting students.

Presentations were given to various schools and institutes in Trinidad and Tobago. The E&O team also participated with booths at certain school events. These activities covered a multitude of topics (see below).

School/Institution	EVENT	TOPIC
Lakshmi Girls High	Assembly Talk	Earthquake Science and Safety
Marabella North Secondary	Student Workshops	Geologic Hazards and Earth Science Careers
Trinity East	Booth at Technical Event	Booth showcasing technical aspects of the Centre
Smart Start Academy	Outreach at School	Sessions with all students
University of the Southern Caribbean	Booth at Conference	All topics

Table 1. List of student outreach activities for the period July 31st 2019- August 1st 2020.

Science and Safety Sessions

Science and safety presentations on either earthquakes, volcanoes, tsunamis or all three hazards are given to private firms, government offices and other entities in Trinidad and Tobago upon request. Sessions with Telecommunications Service of Trinidad and Tobago (TSTT) and The Power Generation Company (PowerGen) were carded but ultimately postponed. The sessions after March 2020 had to be conducted online due to the pandemic and requests also dwindled during the reporting period due to various lockdowns and changes to work policies. The section used the Zoom account and will switch to the Microsoft 365 Suite later in the year. Table 2 lists the sessions conducted for the reporting period.

<u>Company/Agency</u>	<u>Topics presented at Session</u>
Digicel	Earthquake Science and Safety & Microzonation Studies
Caribbean Union Conference for Seventh Day Adventists	Earthquake Science and Safety

Table 2. List of Agencies that requested Science & Safety Sessions for the period July 31st 2019 to August 1st 2020.

Collaborations/Special Events

Proposed Events

Proposed collaborations were a tsunami campaign (DEM – Barbados), Volcano Awareness Week – St. Vincent and the Grenadines, a geological hazards campaign for Saint Kitts and Nevis, the annual Trinidad and Tobago public awareness campaign, and the Seismology in Schools (SIS) and Creating Opportunity from Research Experience (C.O.R.E) internships. All these events were postponed due to the COVID-19 pandemic.

Caribbean Development Bank Volcano Ready Communities Project (VRCP)

The section began assisting the Project team with the production of new information material for all three geological hazards for both print and social media.

Online Activities during COVID-19 Lockdown

The following activities were trialled during the global lockdown:

- Tobago Anniversary Earthquake and Earthquake Safety Online Campaign
To commemorate the 1997 Tobago earthquake and conduct an online earthquake science and safety campaign, the Open house videos from the 2019 and infographics were shared in April 2020.
- SRC Chats ‘Quarantine Edition’
The section used the SRC Chat format from previous events to launch a ‘Quarantine Edition’ and seven episodes were filmed with the Centre’s staff. The videos aimed to

provide the general public with a behind the scenes look at the work undertaken by the various sections at the Centre and the challenges faced with doing this work during a lockdown.

- SRC ‘Snapchats’

To commemorate the 25th anniversary of the eruption of the Soufrière Hills Volcano (SHV), Montserrat, the section did two videos with senior scientists that recalled poignant memories during that eruption period. A slideshow video was also done and shared on the anniversary of the eruption.

- Dominica Unrest

As the Dominica volcanic unrest continued, the section shared the ‘2-minute science’ video done for the island and also information and graphics regarding the situation.

- Volcano Top Trumps Competition and ‘My Volcano Story – Saint Lucia’

In the previous reporting period, the section submitted a proposal for the Volcano Top Trumps Competition under the STREVA project as was successful. The proposal outlined a short film titled ‘My Volcano Story – Saint Lucia’ and aimed to dispel misconceptions regarding the Soufrière Volcanic Centre (SVC). Filming began in Saint Lucia in November 2019 with a local film producer and the film was to be reviewed and launched in Saint Lucia in 2020 but the pandemic caused a delay.

E. STRATEGY REVIEW

Please see Appendix I:

Appendix I: Report submitted to the Bursary for the Biennial Estimates 2020/2021-2021/2022

In addition to routine monitoring operations, the key projects with which the Centre was engaged during the period are summarized below with an indication of their alignment with the University's 2017-2022 Strategic Objectives provided in the footnotes. *All of these projects are ongoing and will continue during the 2020/2021 period.*

1. **Management of the Montserrat Volcano Observatory²**. Successful execution of the new contract signed in 2016 for the management of the Montserrat Volcano Observatory continued. The contract is for a **fixed sum of EC\$17.9 million** and largely supports the employment of 8 members of staff (6 based at MVO and 2 at SRC).
2. **Seismic Microzonation Studies in Trinidad and Tobago³** – This Ministry of Planning and Sustainable Development, Government of Trinidad and Tobago funded project continued with the collection of data moving to the Diego Martin area. It caters for microzonation of ten major population centres in Trinidad and Tobago over the next 10 years and has a total budget of **US\$1.7M**.
3. **C.O.R.E. (Creating Opportunity from Research Experience) Programme⁴**. This is the SRC annual summer internship program for highly motivated university level students interested in pursuing geoscience careers. The programme is **funded entirely** from the **SRC Departmental Consultancy Fund** and caters for up to three interns spending 2 months attached to the SRC either based in Trinidad or at the Montserrat Volcano Observatory.
4. **Disaster risk management in the Caribbean, support for the Seismic Research Centre⁵**. This project funded by the Government of New Zealand through its Ministry of Foreign Affairs and Trade was extended by one year to allow completion of all activities. It involves GNS Science of New Zealand helping the SRC to build capacity in: a) continuous monitoring of volcano-hydrothermal systems using remote techniques; b) ground deformation monitoring using remote sensing and c) improved alerting systems for volcanic emergencies.
5. **Seismology in Schools project⁶**. This is an ongoing collaboration with NIHERST, Trinidad that involves several involving UK based researchers from Imperial College, London; Durham University; British Geological Survey.
6. **Montserrat Geothermal Project⁷**. This is a multiple component project involving the analysis of drill cores and modelling of the Montserrat geothermal system by various techniques. Funding is from various sources including DFID, Campus Research Fund and SRC DCF.
7. **Volcano-Ready Communities in St. Vincent⁸**. This is a project funded by a grant of **US\$618,700** from the Community Disaster Risk Reduction Fund administered by the Caribbean Development Bank that is being done in St. Vincent in collaboration with the National Emergency Management Organisation of St. Vincent and the Grenadines. It

² Aligned to AC3 through expansion of CORE internship to MVO & AG2 through consultancy funding received.

³ Aligned to AC4

⁴ Aligned to AC3

⁵ Aligned to AC4

⁶ Aligned to AC3

⁷ Aligned to AC4

⁸ Aligned to AC4, AL3 & AG2

involves the provision of scientific information and its downscaling to support community level volcano contingency planning, community-led multi-hazard mapping and capacity building for disaster risk reduction.

Main objectives for the current academic year and planned activities for 2020/2021 indicating their alignment with the University's 2017-2022 Strategic Objectives

The income received from our contributing territories has been inconsistent (TT\$5.5-11.6M during the period 2010 - 2020) and provide **only sufficient funds for routine monitoring (i.e. operation of a minimal seismic network)**. All other work, including most research, major developments in the network and outreach, **has to be undertaken through grant funding mainly from external sources or from applications to the SRC Departmental Consultancy Fund (DCF)**.

In addition to routine monitoring operations and continuing of ongoing projects previously listed, the main new areas with which the Centre will be engaged during the 2019-2021 period are summarized below with an indication of their alignment with the University's 2017-2022 Strategic Objectives in footnotes.

- I. **Establish a communications hub co-located with a multi-parametric monitoring station (consisting of 3-component broadband seismic station, accelerometer & continuous GPS station) at Mt. St. Benedict's**⁹. This will involve the construction of a vault, erection of a communications tower and installation of seismic monitoring equipment. This work is being **entirely funded** from the SRC Departmental Consultancy Fund.
- II. **Explore options for developing and expanding work in terms of geothermal consultancy services**¹⁰. This will involve an investigation of the demand for and requirements of providing professional services to geothermal production companies in the Eastern Caribbean.
- III. **Ongoing improvement of existing facilities for post-graduate students**¹¹ including new offices, improvements in library services, support and encouragement to attend on overseas conference per year, training in monitoring techniques, attachment to the Montserrat Volcano Observatory and accessing funds for attachments to collaborating Universities for specialized training.
- IV. **Finalize the outfitting and occupation of the entire new SRC building**¹². This includes a) provision of space for postgraduate students and the Education and Outreach section; b) provision of space for lectures and c) transferral of our existing IT server room to the new building. We anticipate that we can raise sufficient funds from our DCF to enable these activities to be undertaken. It should be noted that thus far the entire outfitting and modifications necessary for occupation of the new building as with this planned work has been funded from **SRC DCF**.
- V. **Revised web site for the SRC & more effective use of social media and developing video products**¹³. Work on our revised website is now nearly completed and is expected to be

⁹ Aligned to AC4 & AG5

¹⁰ Aligned to AC2, AC4 & AG2

¹¹ Aligned to AC3

¹² Aligned to AG4 & AG5

¹³ Aligned to AL1 & AC3 as is all of the Education & Outreach work undertaken by the SRC.

launched during the 2019-2020 period. Attention will continue to be focused on enhancing the education and outreach work of the Centre to vulnerable island communities using social media but also developing short videos.

- VI. **Re-location of computer servers to new building and expansion of the SRC IT infrastructure**¹⁴. This work is still outstanding but expected to be completed during the upcoming year. The estimated cost is as follows: servers for data - **US\$32K**, storage for data - **US\$15K**, network infrastructure (racks, switches, UPS) - **US\$50K**. **(TOTAL ~US\$100K from Grant funding or SRC DCF)**

¹⁴ Aligned to AG4 & AG5

Appendix II: Conference Presentations and Publications

Book Chapters

- Salazar, Walter., **Mannette, Garth., Reddock, Kafele., Ash, Clewon.** (August 2019): Estimation of Shear Wave Velocity Profiles Employing Genetic Algorithms and the Diffuse Field Approach on Microtremors Array: Implications on Liquefaction Hazard at Port of Spain, Trinidad. Book Chapter 4 Page 293. Natural Hazards - Risk, Exposure, Response, and Resilience.

Conference Proceedings

- Johnson, A., Hickey, J., Williamson, B.J., **Pascal, K.** Using GPS and EDM to investigate the shallow magmatic system at Soufrière Hills Volcano. Conference: VMSG 2020. January 2020. Project: Improving the Understanding of Magmatic Systems with Multidisciplinary Numerical Deformation Models.
- **Smith, Patrick J.,** Bean, Chris. RETREAT - a REal-time TREMor Analysis Tool. In Geophysical Research Abstracts, volume 22, pages EGU2020–16164. (European Geosciences Union, General Assembly), May 2020.
- **Smith, P. J.,** Bean, C. J. (Sept.-Oct. 2019): Advances in Volcanic Tremor as a pre-eruptive monitoring tool. In Automatic detection, identification and classification of volcanic signals. ESC Working Group on seismic phenomena associated with volcanic activity, annual meeting, Garachico, Tenerife, Spain, 27 September-3 October, 2019.
- **Joseph, Erouscilla.,** Frey, Holli M., Manon, Matthew R. (September 2019): Recent temporal changes in the geochemistry of hydrothermal fluids of Dominica, Lesser Antilles. Volatiles in the Lesser Antilles (VoiLA) Workshop, 23-27 September 2019, UWI, St. Augustine.
- **Christopher, Thomas E.,** Mourné, Severine., Tamburello, Giancarlo., Bonifacie, Magali., Vincent, Robert., **Joseph, Erouscilla P.,** Venugopal, Swetha., Tivonne, Howe., Oswen, Carty. (September 2019): Plume chemistry for eight Lesser Antilles volcanoes obtained during the 2018-2019 Multi-Gas campaign. Volatiles in the Lesser Antilles (VoiLA) Workshop, 23-27 September 2019, UWI, St. Augustine.
- Bonifacie, M., Bardoux, G., Robert, V., Moretti, R., Moune, S., Agrinier, P., Dessert, C., Komorowski, J.C., Legendre, Y., **Joseph, E.,** Christopher, T. (September 2019): Chlorine isotopic composition of thermal springs along the Lesser Antilles arc and fumaroles from La Soufrière de Guadeloupe. Volatiles in the Lesser Antilles (VoiLA) Workshop, 23-27 September 2019, UWI, St. Augustine.

- Elenora van Rijsingen, Éric Calais, Romain Jolivet, Jean-Bernard de Chabali er, **Richard Robertson, Graham Ryan** (2019) Kinematics of the Lesser Antilles Subduction Zone, VOILA conference, University of the West Indies St. Augustine, Trinidad and Tobago, W.I., 23 -27 September 2019.
- **Racine Basant, Graham Ryan**, Oshaine Blake, Jared Peacock, Bridget Lynne (2019) Understanding the petrophysical properties of Montserrat’s geothermal reservoir (poster), VOILA conference, University of the West Indies St. Augustine, Trinidad and Tobago, W.I., 23 -27 September 2019.
- Machel Higgins, Peter C La Femina, John C Weber, Halldor Geirsson, **Graham Alexander Ryan** (2019) South-eastern Caribbean-South America Plate Boundary Deformation from Geodesy: Strain Partitioning and Fault Behaviour, AGU Fall Meeting, San Francisco, California, USA, 9-13 December 2019.
- Elenora van Rijsingen, Eric Calais, Romain Jolivet, Jean-Bernard de Chabali er, **Richard EA Robertson, Graham Alexander Ryan** (2019) Inferring Interseismic Coupling along the Lesser Antilles Arc: a Bayesian Approach, AGU Fall Meeting, San Francisco, California, USA, 9-13 December 2019.
- Elenora van Rijsingen, Eric Calais, Romain Jolivet, Jean-Bernard de Chabali er, Jorge Jara, Steeve Symithe, **Richard Robertson, Graham Ryan** (2020) Seismogenic behaviour in the Lesser Antilles: Insights from geodetic observations, 22nd EGU General Assembly, online, 4 – 8 May 2020.

Journal Manuscripts

- **Smith, P.J.**, Bean, C.J. (November 2020) RETREAT: A REal-Time TREmor Analysis Tool for Seismic Arrays, With Applications for Volcano Monitoring. *Frontiers in Earth Science*. doi:10.3389/feart.2020.586955
- Tucker, Maurice. E., Carey, Steven N., Stephen, R., Sparks, J., **Stinton, Adam.**, Leng, Melanie., Robinson, Laura., Li, Toao, Lewis, Jamie., Cotton, Laura. Carbonate crusts around volcanic islands: Composition, origin and their significance in slope stability. *Marine Geology* Volume 429, (November 2020) <https://doi.org/10.1016/j.margeo.2020.106320>
- Rijsingen, E. van., Calais, E., Jolivet, R., de Chabali er, J. B., Jara, J., Symithe, S., **Robertson, R., Ryan, G.A.** (July 2020). Inferring Interseismic Coupling along the Lesser Antilles Arc: a Bayesian approach. *Journal of Geophysical Research: Solid Earth*. DOI: 10.31223/osf.io/kn7hq
- Thompson, Glenn., Power, John A., Braunmiller, Jochen., Lockhart, Andrew B., **Lynch, Lloyd.**, McCausland, Wendy., Rowe, Charlotte A., Shea, Thomas., White, Randall A., Breithaupt, Charles I. (July 2020) Capturing, Preserving, and Digitizing Legacy Seismic Data from the Montserrat Volcano Observatory Analog Seismic

Network, July 1995–December 2004. *Seismological Research Letters* 91 (4): 2127–2140. <https://doi.org/10.1785/0220200012>.

- **Papadopoulos, Ilias., Reddock, Kafele., Manzano, Jevan., Latchman, Joan L.** (June 2020) The Trinidad and Tobago Microzonation Project: Port of Spain. *Geophys. Journal International*. Doi: 10.1093/gji/ggaa275.
- Davy, Richard., Collier, J. S., Henstock, Timothy J., Rietbrock, Andreas., Goes, S., Blundy, J., Harmon, Nicholas., Rychert, Catherine., Macpherson, Colin G., van Hunen, Jeroen., Kendall, Mike., Wilkinson, Jamie J., Tait, Stephen., Davidson, J., Wilson, Marjorie., Cooper, George F., Maunder, Ben., Bie, Lidong., Hicks, Stephen P., Allen, R., Chichester, Ben., **Robertson, Richard E. A., Latchman, Joan.**, Krueger, Frank. (April 2020) Wide-angle seismic imaging of two modes of crustal accretion in mature Atlantic Ocean crust. *Journal of Geophysical Research: Solid Earth*. DOI: [10.1029/2019JB019100](https://doi.org/10.1029/2019JB019100)
- Webb, T.L. Wadge, G. **Pascal, K.** Mapping water vapour variability over a mountainous tropical island using InSAR and an atmospheric model for geodetic observations. (December 2019.) *Remote Sensing of Environment* 237.
- Morales-Simfors, Nury., Bundschuh, Jochen., Herath, Indika., Inguaggiato, Claudio., Caselli, Alberto T., Tapia, Joseline., Choquehuayta, Fredy Erlington Apaza., Armienta, María Aurora., Ormachea, Mauricio., **Joseph, Erouscilla P., López, Dina L.** (November 2019): Arsenic in Latin America: A critical overview on the geochemistry of arsenic originating from geothermal features and volcanic emissions for solving its environmental consequences. *Science of the Total Environment*. <https://doi.org/10.1016/j.scitotenv.2019.135564>.
- Bie, Lidong., Rietbrock, Andreas., Hicks, Stephen., Allen, Robert., Blundy, Jon., Clouard, Valerie., Collier, Jenny., Davidson, Jon., Garth, Thomas., Goes, Saskia., Harmon, Nick., Henstock, Tim., van Hunen, Jeroen., Kendall, Mike., Krüger, Frank., **Lynch, Lloyd.**, Macpherson, Colin., **Robertson, Richard.**, Rychert, Kate., Tait, Stephen., Wilkinson, Jamie., Wilson, Marjorie. (2019): Along-Arc Heterogeneity in Local Seismicity across the Lesser Antilles Subduction Zone from a Dense Ocean-Bottom Seismometer Network. *Seismological Research Letters* Volume XX, Number XX – 2019. DOI: 10.1785/0220190147.
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- Rott, Stefanie, Scheu, Bettina, Montanaro, Cristian, Mayer, Klaus, **Joseph, Erouscilla P.**, Dingwell, Donald B. (September 2019): Hydrothermal eruptions at unstable crater lakes: Insights from the Boiling Lake, Dominica, Lesser Antilles.

Journal of Volcanology and Geothermal Research, Vol. 381, pp. 101-118, <https://doi.org/10.1016/j.jvolgeores.2019.05.020>.

- Barclay, Jenni., Few, Roger., Armijos, M. Teresa., Phillips, Jeremy C., Pyle, David M., Hicks, Anna., Brown, Sarah, K., **Robertson, Richard E. A.** (August 2019): Livihoods, Wellbeing and the Risk to Life During Volcanic Eruptions. *Frontiers in Earth Science* 7: 205. [DOI:10.3389/feart.2019.00205](https://doi.org/10.3389/feart.2019.00205).

Technical Reports

- **Latchman, Joan L., Papadopoulos, Ilias., Reddock, Kafele., Manzano, Jevan., George, Cory., Kanhai, Jason D., Ryan, Graham., Johnson, Monique., Lynch, Lloyd L., Robertson, Richard E.A., Edwards, Stacey., Ash, Clevon., Nath, Nisha., Juman, Ian.** (September 2020). 2018/08/21 Magnitude 6.9 West of Port of Spain Earthquake. Report on the 2018/08/21 Earthquake: Characteristics and Impact. Prepared for the Government of Trinidad and Tobago. The University of the West Indies Seismic Research Centre. SRC Open File Report 20180821_Magnitude 6.9_Earthquake_EQ1.
- **Joan L. Latchman** - 2019/08/25 – 2020/07/31 Weekly Dominica Scientific Advisories 45-97 201812_Dca_45-201812_Dca_97.
- **I. Papadopoulos, J. L. Latchman, R. Robertson, L. Lynch, K. Reddock, C. Ash, J. Manzano, C. Sobion, J. Seemungal** Trinidad and Tobago Microzonation Project Monthly Reports August 2019-July 2020
- **I. Papadopoulos, J. L. Latchman, R. Robertson, L. Lynch, K. Reddock and J. Manzano.** Quarterly Trinidad and Tobago Microzonation Project Progress Reports -25-29 2019
- James, D., **Miller, V.** (2020) Lahar Hazard Assessment for the Soufriere Hills Volcano, Montserrat. Open File Report OFR 20-02.
- **Miller, V.** and Calder, (2020): Site Specific Risk Assessment for the Upper Belham Valley of the Soufrière Hills Volcano, Montserrat July 2020 for Government of Montserrat: Open File Report OFR 20-03, pp. 16, Montserrat Volcano Observatory, Flemmings, Montserrat, W.I.
- **Miller, V.** and Calder, (2020): Site Specific Risk Assessment for Fort Ghaut, Plymouth of the Soufrière Hills Volcano, Montserrat July 2020 for Government of Montserrat: Open File Report OFR 20-04, pp. 17, Montserrat Volcano Observatory, Flemmings, Montserrat, W.I.

Press Releases and Non-refereed Articles

- Karen Pascal: April 2020 Interview for Télé Star magazine, France, ‘TEMOIGNAGE. Karen Pascal: "Le risque zéro n'existe pas"' (1 page)

- Karen Pascal and Thomas Christopher: Feb 2020 Interview and assistance with production of a TV documentary, 'Des volcans et des hommes' (26 mn, in production for ARTE channel, France)
- Karen Pascal 02nd Nov 2019 Interview on the radio program 'The Cultural Show' (ZJB public radio, 120 mn), regarding the 'Disaster Passed' project and the 'Mountain Aglow' exhibit.
- Karen Pascal: Oct 2019 Scientific advice for the production of a TV documentary, 'Lost places' (in post-production for ZDF channel, Germany)
- MVO Talks for July 2021: In commemoration of the start of the eruption on 18 July 1995. The MVO hosted and delivered a series of talks, interviews and panel discussions entitled MVO talks from 13 -17 July (available online through ZJB and the Government Information Unit)

Meetings & Workshops

- MVO seismologist Roderick Stewart visited MTA (General Directorate of Mineral Research and Exploration) in Ankara, Turkey for five weeks in September and October 2019. He was assisting MTA scientists to set up seismic monitoring of the Erciyes Dag volcano. This was a follow-up to a bilateral UK-Turkey project to build capacity in volcanology in Turkey.