THE EARTHQUAKE UNIT

Departmental Report August 2020 - July 2021

Dr. Donovan Campbell · Head of Unit

INTRODUCTION

The Earthquake Unit (EQU) is a research unit of the university that is funded directly by the Government of Jamaica (GOJ) as the sole agency responsible for the monitoring of earthquakes and research in seismic hazards in Jamaica. The Unit was established to understand seismic processes in Jamaica and the region as well as to advise the society about earthquake hazards, encourage community awareness and promote mitigation strategies for development. The Unit is responsible for operating and managing the Jamaica Seismograph Network (JSN), Jamaica Strong Motion Accelerograph Network (JSMAN), Jamaica Educational Seismic Network (JAESN), USGS Global Seismograph Network/ Caribbean Tsunami Warning MTDJ station (USGS_MTDJ), local GPS stations for the UNAVCO Continuously Operating Caribbean GPS Observational Network (COCONet) and also acts as the National Data Centre for the Comprehensive Nuclear Test Ban Treaty Organisation International Data Centre (CTBTO IDC). In addition to serving as the hub for earthquake monitoring and seismic research, the EQU is affiliated with other Caribbean and regional networks, maintains an earthquake database, inform the public about earthquakes felt in Jamaica, collect information about earthquakes, conduct research and host visits from schools or community groups. A key highlight for this year was the introduction of new staff members to the EQU team. This included the appointment of Kevin Tankoo who managed and coordinated the operations of the Unit throughout the period. Verdine Stephenson who went on pre-retirement leave in 2021 was engaged for some additional months in the first quarter of 2021 as there were delays with the approval for a replacement and to train Camille Wint who is now acting in the administrative assistant post. With budgetary

constraints the EQU focuses on requesting the priority allocations for its operations and continue to explore opportunities for growth.

Work of the Unit

The Earthquake Unit has remained both active and operational at all levels throughout the period spanning August 2020 to July 2021. With the addition of new staff members and the expansion of the EQU's network portfolio, a new strategic plan was drafted to revise and capture the future direction of seismic research, network operations and public education initiatives. This framework was developed to establish the short, medium and long term objectives along with a work plan for the Unit by building on the existing foundation. In addition to this, proposals for funding, collaborative research projects and staff development initiatives were developed and provides a promising outlook for the Unit. Since August 2020, the EQU embarked on a data sharing initiative with Cuban counterparts where assistance was provided with setting up a virtual machine at the Central Recording Station along with training for some of the staff members. A link to Cuba was established for data sharing and the Unit is awaiting a response from the partners to complete works. The installation of a new 48 port network switch and wireless access point for Wi-Fi access was completed and has improved the IT infrastructure for the office and network operations. In September 2020, the EQU was invited to be a member of Bay Front Vilas Earthquake Evacuation Drill Planning Committee at the request of Portmore Municipal Council where the Unit developed an earthquake scenario for Bay Front Evacuation Drill. The ACP-EU-CDB Portmore Disaster Risk Profile Project finally came to a close in November, the EQU played a key role in the proposal development and was a member of project steering committee. In addition to contributions to institutions such as the Office of Disaster Preparedness and Emergency Management (ODPEM) and the Planning Institute of Jamaica (PIOJ), the Unit also fulfilled multiple data requests, provided information on seismic activity and participated in numerous initiatives throughout the year. Improvements to the Central Recording Station for the period included equipment upgrades to the main data processing computer and the initial setup of a central data storage network attached storage (NAS). A significant highlight to the CRS operations was the addition of multiple regional seismic stations which are now streaming to the CRS. This new initiative now provides a real-time backup monitoring system to the network and has improved the accuracy for earthquake processing and solutions for Jamaica. Research initiatives throughout the year included seismic data analysis, revised solutions and the development of the 2010-2020 seismic bulletin data. In addition, preliminary workflows were established and an automatic solutions system was tested. The Unit also embarked upon a new seismic network project which would see the development of a complete network catalogue; work completed to date include site assessments for some of the stations and a review of the seismic equipment with technical specifications and configurations. A preliminary review of some of the network and data processing operations highlighted some major issues and corrective measures were immediately taken. For the academic

year, improvements were made to the quality of the GIS outputs and the standardization of map products. A geospatial database was also established with the updated archive of data held by the EQU, this was also complimented by the development of island-wide and sub-area digital elevation models and the start of a GIS building data collection initiative which will support future projects.

Throughout the academic year, the Unit continued to be active on the relevant disaster risk management committees and again supported the ODPEM as well as the PIOJ in its annual Economic and Social Survey Jamaica (ESSJ). As part of the Unit's standard operating procedures, a comprehensive hurricane plan and emergency SOP module was developed under the Multi-hazard Preparedness and Emergency Operations Manual which is currently being worked on. The plan was tested for two weather systems and was determined to provide a robust workflow design for managing the operations during emergency events. To compliment the activities and public initiatives for the academic year, the Unit also provided support in developing COVID 19 protocols for the Department of Geography & Geology. The EQU's public education material was also reviewed and additional resources are currently being developed to be added to the educational products of the Unit. The EQU also completed the design specification, data collection and content generation exercises for the new website which is under the direct management of the MITS department. The Unit is still waiting on MITS to complete its final draft and to launch the website.

Network Operations

Central Recording Station (CRS): The CRS comprises of a combination of data acquisition and processing equipment in an integrated and dedicated IT infrastructure. General maintenance to the backup solar power system was conducted along with some upgrades to the processing equipment. Remote links were established and maintained throughout the period to allow for work to be done during COVID 19 restrictions.

Jamaica Seismograph Network (JSN): The Jamaica Seismograph Network (JSN) includes 13 seismic stations with installations across the island comprising of 12 short period analogue seismographs and 13 broadband seismographs (figure 1). The data from the JSN stations are transmitted to the CRS at the Earthquake Unit, UWI Mona in real-time using radio equipment where the data is recorded on computers running data acquisition and processing software packages. For the period August 2020 – July 2021, 11 of the 13 broadband stations seismic stations were in operation with 9 of the broadband stations having an operational uptime of over 90%. The short period acquisition links continue to remain offline as new radio equipment to restore service to the analogue stations is required. Throughout the period, field trips to some of the stations were conducted for maintenance and repair works. The Unit successfully procured some of the critical communication and station equipment for replacement or installation. Some of the issues included the long

wait period for payments to suppliers, vandalism and theft at some sites, weather conditions and the Covid restrictions. A significant number of trips were conducted as a result of power issues at the sites, communication gaps and defective equipment.

Jamaica Strong Motion Accelerograph Network (JSMAN): The Jamaica Strong Motion Accelerograph Network include a combination of building and free field sensor installations. As of July 2021, there were 43 accelerographs installed island wide at seismic stations and at other locations and this has significantly improved the capacity of the EQU to record and solve the larger magnitude seismic events. The sensors operate in standby mode and are triggered by earthquakes, recording critical seismic data. This information is used for studying the response of sites to ground shaking and provides key data for developing seismic hazard assessments as well as for developing seismic parameters for construction or retrofitting important structures. Of the 43 installed stations 33 stations were operational throughout the period, with 23 stations having an uptime of over 80%. At a few sites, there were requests for relocation by the hosts and the EQU's equipment was subsequently removed. Work is ongoing with completing the communication links and upgrading the power for the JSMAN sites. Some of the issues encountered for the period included the long wait period for payments to suppliers, vandalism and theft (stolen batteries, solar panels and cables), weather conditions, defective equipment, the Covid restrictions and incomplete links due to lack of equipment.

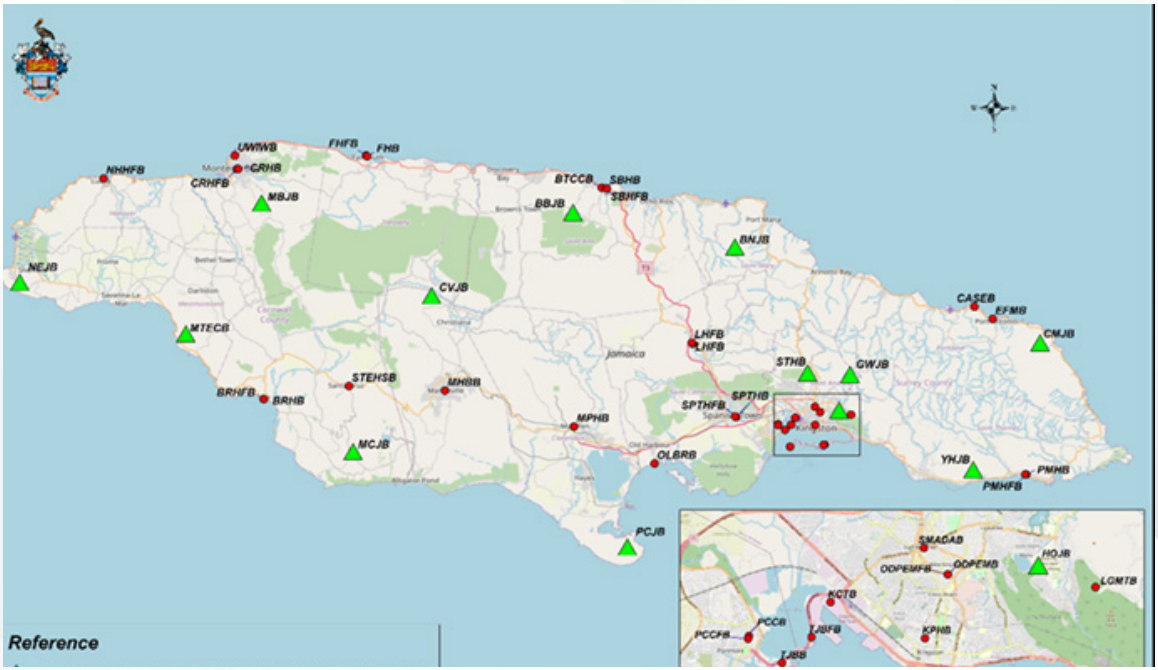
Jamaica Educational Seismic Network (JAESN): The JAESN includes five AS-1 educational seismometers installed at five (5) sites including four (4) secondary schools and one (1) at the Department of Geography & Geology, UWI Mona. The educational seismometers are tools that give students an opportunity to learn how earthquakes are recorded and how modern seismometers work to collect and interpret seismic data from strong earthquakes around the world. For the period some work was completed with OS updates and basic maintenance. Only two (2) of these seismographs were transmitting data at the end of July, challenges included access to the sites and communication delays with the contact persons.

USGS Global Seismograph Network/Caribbean Tsunami Warning (MTDJ/PIKE): The Earthquake Unit helps maintain the USGS station at Mount Denham/Pike (MTDJ/PIKE) and accesses the earthquake data from the USGS Global Seismograph Network (GSN), this data is also used with the local network to provide solutions of earthquake data. During the period, the station went offline as a result of defective batteries, new batteries were shipped and promptly replaced. The station went offline a second time and additional replacement equipment including a charge controller and power converter was shipped to the EQU and installed in a very short time.

UNAVCO Continuously Operating Caribbean GPS Observational Network (COCONet): The GPS Network include three (3) permanent GPS units installed at the Pedro Cays, Morant Cays and at UWI Mona and provides raw GPS data, GPS-PWV, surface measurements as

well as time and velocity field data. This network supports a broad range of geoscience investigations including monitoring fault movement and strain accumulation over time. Currently, the station at UWI Mona is the only operational station for Jamaica transmitting data; the stations at Pedro Cays and Morant Cays are offline. Visits to these sites have been delayed as the support contractors had to reschedule the trip to Jamaica due to the COVID 19 pandemic and uncertain conditions. In December 2020, the station at UWI Mona went offline due to power problems, this was repaired by the EQU and service was restored. Comprehensive Nuclear Test Ban Treaty Organisation (CTBTO) National Data Centre (NDC): The EQU continues to operate the National Data Centre for the CTBTO (NDC_JM). This system is linked to the International Data Centre (IDC) in Vienna with access to the seismic, hydro-acoustic, infrasound and radionuclide data from over 337 monitoring stations within the global CTBTO network. The EQU took delivery of a replacement UPS and also worked with the support team to upgrade the VSAT system. A field engineer contractor hired by HUGHES Network Systems, visited the EQU to install and configure the primary UPS backup. This installation was successful however a follow up visit by the contactor is pending. The CTBTO server went down shortly after and the Unit is in dialog with the support team to resolve these issues.

Figure 1: The Jamaica Seismograph Network and Strong Motion Accelerograph Stations



Seismic Activity

The Central Recording Station recorded and processed 393 events from August 2020 to the end of July 2021. This included 164 local earthquakes, 77 near region events, 77 regional events, 21 distant events and 54 blasts (table 1). During this period eight (8) earthquakes were reported as felt, the largest local event being a magnitude 4.6 earthquake with an epicentre in Manchester. This event occurred along the western extension of the Rio Minho – Crawle River Fault Zone and was reported as felt in multiple parishes. The most active sub area for the period was the Blue Mountain Block, followed by the Rio Minho – Crawle River Fault Zone then the Wagwater's north and south sub areas (figure 2). Figure 3 shows the locations of earthquakes across the island for the period.

Table 1: Events recorded by the Central Recording Station from August 2020 to July 2021

Year	Month	Recorded Events					Total Recorded	Felt Events
2020	Aug.	17	9	13	0	2	41	***4***
2020	Sept.	19	8	12	0	5	44	***0***
2020	Oct.	23	9	9	1	14	56	***0***
2020	Nov.	19	5	4	0	9	37	***1***
2020	Dec.	9	8	7	0	4	28	***0***
2021	Jan.	8	4	5	2	0	19	***0***
2021	Feb.	11	3	1	2	0	17	***1***
2021	March	12	4	3	1	0	20	***1***
2021	April	13	5	4	6	6	34	***0***
2021	May	13	11	7	5	7	43	***1***
2021	June	9	6	6	2	5	28	***0***
2021	July	11	5	6	2	2	26	***0***
All	**Total**						***393***	***8***

Figure 2: Seismicity by local sub-area for the period August 2020 to July 2021

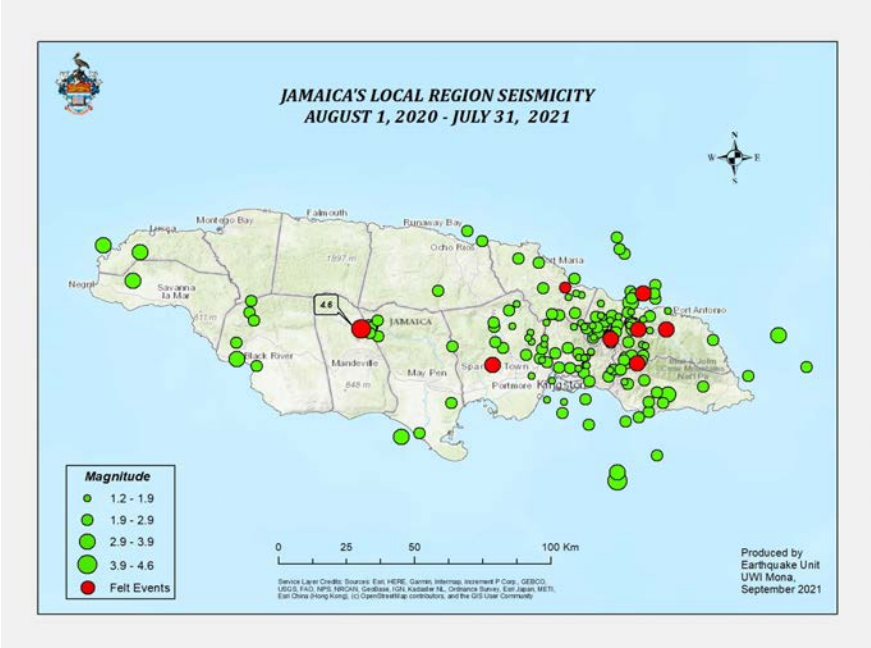
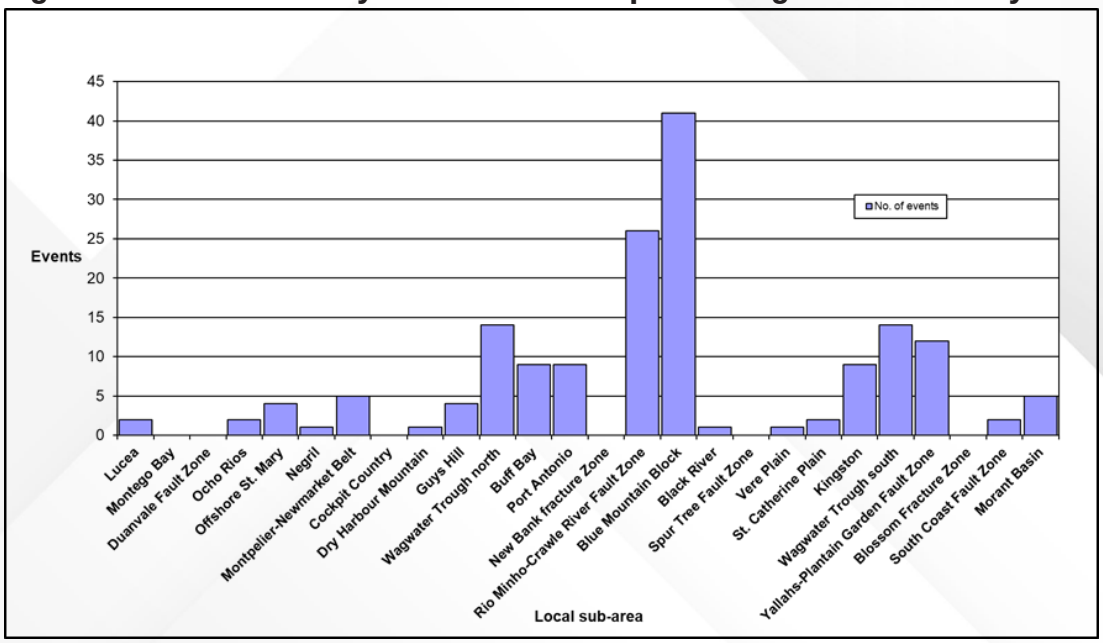


Figure 3: Seismic activity recorded for the period August 2020 to July 2021



Research Work & Project Involvement

Data sharing initiative between the Earthquake Unit, UWI Mona and the Cuban National Centre for Seismological Research (CENAIS)- This project will facilitate data sharing and technical support between Jamaica and Cuba for seismic monitoring/ research and is on-going Portmore disaster risk profile project- The EQU completed an earthquake scenario for Bay Front Evacuation Drill, this project came to a close in November 2020

- GPS Campaign Project- ongoing collaboration with University of Wisconsin. Additional GPS data was provided by the National Land Agency (NLA) from their 13 GPS networks, this data is currently being processed and a publication is in the pipeline
- Seismic Network Assessment Project- an in house research project is currently being undertaken, work at 11 sites have been completed to date and this project will set the stage for further projects and publications when completed
- Seismic Analysis & Catalogue Project- Another in house project which utilized the latest 10 year period of recorded seismic data from 2010 to 2020 was analysed, the events for this period were quality checked, revised and generated as a bulletin along with new decadal maps
- GIS Database & Building Project- This project is ongoing and a catalogue of GIS products has been archived and updated. Geospatial outputs produced from this project include a beta version interactive online map, the standardization of GIS map outputs, new maps for regional/local fault blocks, DEMs for sub-areas and building data for several communities, etc.
- Caribe Wave 2021- This initiative was organized by the Pacific Tsunami Warning Centre and included a desktop tsunami simulation exercise with ODPEM and other local agencies

Community Service & Presentations

- Interview for ODPEM's Earthquake Awareness Week, this included an outside broadcast and also a public education video on earthquakes which was taped at the ODPEM's office
- Review of the National Disaster Response Coordination Plan (draft)
- Guest lecture on earthquakes for Disaster Management undergrad course at the DOGG, UWI
- Support to ODPEM regarding queries from NHT on earthquakes
- Virtual presentation on Jamaica's vulnerability to earthquakes, tsunamis and individual preparedness for the DRM Workshop, Department of Community Health and Psychiatry
- Review and support for PIOJ's ESSJ report provided along with updated figures and maps
- The EQU facilitated numerous data requests for the period including data sharing and technical support with data to the ODPEM, annual earthquake data for UWI lecturers and external entities, felt events information to the Observer, seismic data to the JDF, risk assessment data and map for St. Benedict's School in St. Thomas and GIS shapefiles

plus metadata for the development of a National Vulnerability Ranking Index tool and general public data requests

Committees & Membership

- National Disaster Risk Management Council (NDRMC): Prevention and Mitigation Committee, Preparedness and Emergency Operations Committee, Recovery Planning Committee, Public Education and Information Committee
- Member of ACP-EU-CDB Project Steering Committee: Strengthening the Disaster Risk Management of the Portmore Municipal Council
- Member of the International Seismological Centre
- Member of the International Federation of Digital Seismograph Networks

Trainings, Workshops & Seminars

- Tsunami EWS Training- National Oceanic & Atmospheric Administration (NOAA) and the Pacific Tsunami Warning Centre (PTWC), completed by Kevin Tankoo and Karleen Black
- Marine Scientific Research in the Area workshop, hosted by the International Seabed Authority (ISA), China Ocean Mineral Resources Research and Development Association (COMRA), and the Hong Kong University of Science and Technology, attended by Kevin Tankoo
- The Future of Deep Sea Mining, hosted by Volterra Fietta (UK) with panellists from the International Seabed Authority (LTC), UK Seabed Resources and the University of Glasgow, attended by Kevin Tankoo
- AAPG seminars and society initiatives for the AAPG and regional LAC Chapter
- GIS webinars and training including ArcGIS Online events, Introduction to Remote Sensing, a SPSS training session, ArcGIS Dashboard webinar, Geoportal webinar hosted by ESRI, ArcGIS Hub and SenseFly technology webinars hosted by the NSDM, Geodesign of Manyatta and ArcGIS Field Apps seminars hosted by Spatial Innovision Limited and an ESRI User Conference hosted by ESRI, attended by Kevel Daley

Reports & Publications

- Tankoo, K.R. & Campbell, D. (2020) Earthquake Unit's strategic plan, in house publication
- Tankoo, K.R. (2020) Improvements to the Jamaica Seismic Network: a comparison of broad band and short period sensors and solutions, JSIF technical report
- Black, K., Tankoo, K.R. & Daley, K. (2021) Preliminary seismic risk assessment and fault map for St. Benedict's School in St. Thomas, Jamaica, technical report
- Tankoo, K.R. (2021) EQU hurricane plan and emergency SOP module, this represents one completed section of the Multi-hazard Preparedness & Emergency Operations Manual which is currently being developed
- Tankoo, K.R. & Stewart, R. (2021) Seismic bulletin catalogue for 2010 to 2020 including revised, earthquake solutions with error estimates and phase data along with the updated decadal GIS outputs and maps, in house technical report