The 2017 CariUSA STEM WORKGROUP

Promoting STEM education for the betterment of all people.

March 13-15

# Meeting Report

## Executive Summary

### Overview

The CariUSA Workgroup comprised representatives from academia, the business sector, regional and national government agencies, geoscience professional organizations, non-governmental organizations (NGOs), and other stakeholders who are committed to the creation of a Caribbean geoscience workforce with the knowledge and skills to address energy development, the long risks of climate change and geohazards, and disaster management and risk reduction. CariUSA Workgroup participants aim to work collaboratively to plan and implement initiatives that advance this goal.

At the 2017 inaugural CariUSA meeting, U.S., Jamaican and CARICOM participants considered (1) the intersection of national and regional priorities with the geosciences; (2) workforce needs;(3) the value of geoscience knowledge and the roles that geoscientists and engineers play in addressing geoscience-related issues of societal relevance in Jamaica and throughout the Caribbean region; and (4) opportunities to promote strong economic growth through the management of natural and climate-change induced disasters, strategies to reduce exposure to geohazards, and energy development.

The meeting was organized around panel discussions, short presentations and theme-based working groups (WGs). Participants developed strategic partnerships to launch projects and develop programs that improve the ability of CARICOM nations to infuse geoscience and environmental engineering education into STEM education at the undergraduate and secondary levels, and organize scholarly exchanges between Jamaica, CARICOM and U.S. academic institutions.

Recommendations emphasized university and pre-college geoscience education and outreach, data archival and sharing, the translation of the geoscience research results into products that highlight societal and economic benefits, and ways of engaging more effectively with the private sector and government agencies in order to realize the long-term goal of developing capacity and partnerships that flourish beyond the CariUSA 2017 meeting.

Through CariUSA 2017, many participants forged professional connections that transcend national boundaries and explored opportunities for U.S. and Caribbean academic institutions, international professional organizations, environmental non-governmental organization (ENGOs) and communities to collaborate on common science issues of intellectual, societal and economic relevance. Proposed activities range from initiatives that are regional and international in scope to those that address local community issues.

The ultimate success of the CariUSA Workgroup and participants' plans to carry forward the activities proposed at the first meeting will depend on three key elements. First, investment in the fledgling international science relationships that emerged between U.S., Jamaican and CARICOM participants. Support for international visits among CariUSA stakeholders is necessary to nurture and grow existing relationships and create new opportunities for collaboration and knowledge transfer**.** Second, international and in-country (region) support for regular annual meetings is needed to sustain and expand the professional interactions and synergies that were created. These activities will require new resource streams. Therefore, a third and vital element is translating the economic importance of the geosciences and geoscience-derived products to the private sector. Opportunities that offer geoscientists access to the business community can increase the potential for private investment and support for mutually beneficial projects and programs, as well as provide geoscientists with a deeper appreciation for the context in which business decisions concerning water resource management, climate mitigation, and natural hazards are made. One ***s***uggested mechanism to bring geoscientists and the business community together is the creation of a CariUSA subcommittee that would function as a formal liaison to the Jamaica Chamber of Commerce for the purpose of cultivating formal connections between the geoscience and the private sector.

Note: "Geoscience" as used in this reports refers to a broad range of disciplines, including: Geology, geography, geophysics, geochemistry, hydrology, oceanography, marine geology, climate science, environmental science, environmental engineering, and petroleum engineering.

## Recommendations

### *Community Engagement*

1. Elevate the profile of the geosciences through community outreach and engagement with key industries and organizations.
    - **a.** Emphasize that the work of geoscientists is critical for Jamaica's [and CARICOM] economic and social prosperity**.**
    - **b.** Tourism is a vital industry throughout the Caribbean. Geoscientists should publicity advocate with local and regional tourism planning agencies/ boards to call attention to (a) the role that they can play, especially in collaboration with architects, on hotel location, construction; and (b) in promoting environmental and hazards awareness among tourists.
    - **c.** Underscore the significant untapped resources (in the form of expertise) in the university systems in Jamaica and the Caribbean region.
2. Cultivate formal and informal connections to the private sector
    - ***a.*** Create a CariUSA subcommittee to function as a formal liaison to the Jamaica Chamber of Commerce.
    - **b.** Provide geoscience-derived products and services to the private sector (initially at no or little cost).

### *Education and Training*

1. Geoscience university student education should include formal career development/internship programs, training in entrepreneurship, preparation in mathematics, computational science, and

computer applications (e.g., GIS), and include a research or application project at both the undergraduate and post-graduate (graduate student) levels.

Two ideas on the integration of meaningful research into the academic program emerged.

a. Investigator-driven initiatives that include graduate students from the Caribbean and the U.S. Funding to support student research should be sought from academic/government/ private sector partnerships, including the NSF and NSF-USAID programs, and CARICOM programs.

b. Academic/government/private sector partnerships that allow university students to participate in research experiences in the U.S., such as those offered through research experience for undergraduate programs (e.g., IRIS Summer Internship Program, UNAVCO RESESS) and U.S. students to collaborate in CARICOM research experience programs, such as that offered by the UWI's Seismic Research Centre in Trinidad.

2. Integrate existing educational resources and tools available on the Internet, including curricular materials freely available from credible providers (e.g. SERC) into coursework at the university and pre-college levels.
3. Make education and outreach a key priority, particularly at the high-school equivalent level or below. This requires long-term investment.
4. Use the excitement about new technologies and increased public awareness about issues that geoscientists can address (energy development, geohazards, climate change, and water resources management) as a vehicle to infuse geoscience into subjects other than geography at the pre-college level (e.g., mathematics, physics, computer science, etc.).
5. Professional development for the current workforce is needed to enhance knowledge transfer, improve technical skills and to allow participants to keep up with new discoveries/ information/ technologies. This will also help to strengthen existing ties to planning and disaster response organizations.
6. Faculty exchanges (between U.S. and Caribbean institutions) to support collaboration, knowledge transfer and to strengthen secondary, university and professional education. These could be funded through the U.S. Fulbright program, as well as academic/ government/private sector partnerships.

Participants identified two obstacles. First, there was concern that there are not enough jobs (in Jamaica and CARICOM nations) for those trained in geoscience and environmental engineering. Graduates find employment outside of their degrees or emigrate to countries with better employment prospects. Second, pre-college students do not consider the geosciences as a career option. Students interested in STEM prefer to pursue medicine.

To overcome these obstacles and to increase the appeal of geoscience careers, participants suggested the following:

1. Geoscientists should become stronger advocates of the value of their discipline and its role in economics, risk reduction and management, hotel siting and construction, and tourism.
2. Efforts should educate the government about and encourage government to publicly acknowledge the importance of geoscience and environmental science.

3. The creation of small geo-consulting companies that work at the interface between government agencies and the private sector would both fulfill a need for geoscience services, information and products and increase employment opportunities for geoscience graduates.

### *Open-access Geo-focused Data Repositories*

1. Endorse open-access data archival in geo-focused data repositories and support strategies that promote public data access. A variety of audiences, including students, researchers, government agencies, NGOS, and the private sector could use these data if they were freely available in repositories.

2. Strengthen protocols to ensure that data are high quality and adhere to appropriate standards to facilitate sharing and exchange.

3. Fund more graduate students and post-doctoral fellows to carry out projects to collect, analyze and share data, and interpret results to address issues such as geohazards and water resources management.

4. Invest in formal student internships to train students in data collection, analysis, tools and platforms (e.g., GIS). These could be funded through academic/government/private sector partnerships.

5. Geoscientists should explore opportunities to collaborate on data collection and archival across departments and schools. For example, geoscience researchers can partner with information scientists (libraries) on data archival.

6. Support the commercialization of data through academic-private sector (businesses) collaboration, permitting the creation of value-added products available to users for purchase.

The reluctance to share data is a major obstacle rooted in the social and academic culture in Jamaica. To overcome this, a process to identify and remove obstacles to data sharing must be developed. Participants suggested three approaches:

1. Make a case for the pros of data sharing (e.g. visibility, helping others, sense of public good, and academic recognition).
2. Implement policies that force data sharing at trustworthy, credible repositories. This would apply to researchers whose work was supported by local and regional government funds, and international funds.
3. Translate scientific gains into digestible information and useful products (e.g., for hazards management, and building design and construction) and call attention to the societal benefits.

### *Seismic Hazards*

1. Create a Seismic Hazards working group that consistently meets and consistently pushes the idea that earthquakes and earthquake hazards must be addressed in life (via building codes, infrastructure development in different locations).
    a. The working group should meet (in face or on the phone) at least once every 6 months to develop/adjust goals, outline progress, and define future directions.

   b. The working group should write clear, concise statements in layman's terms that can be shared with legislators, and other civil servants with broad influence in order to contribute to the greater goal of reducing Jamaican's exposure to seismic risk.

2. Create a unified regional Caribbean earthquake catalogue.
3. Promote conformity in earthquake reporting and analysis on a regional scale by supporting the routine exchange of data analysts between the UWI Earthquake Unit in Jamaica and regional partners, including the Puerto Rico Seismic Network (PRSN) and the Seismic Research Centre (SRC) at UWI, St. Augustine.
4. Focus research on constraining Caribbean regional tectonics through the **i**ntegration of seismic, geodetic, fault maps, and other available geospatial data (inSAR**?)** in the coming years.
5. Encourage collaboration of local scientists, emergency managers, and community leaders with the NOAA Caribbean Tsunami Warning to help facilitate tsunami education and participation in the Caribbean TsunamiReadi Program.

Caribbean nations have different seismic networks and stations and this poses obstacles that would need to be overcome (Network magnitude scales, catalog completeness, and station gaps for a more complete Caribbean network).

## CariUSA Conferences Outcomes

1. The Texas Advanced Computing Center at the University of Texas (TACC), Austin is proposing to collaborate with the Department of Library and Information Sciences (DLIS) at The University of the West Indies, Mona to:
   a. Mentor two graduate students per year on a capstone project each during one semester.
   b. Host a faculty member from DLIS at UT Austin for a specific amount of time to focus on data infrastructure and management for digital curation with a focus on geosciences and natural hazards datasets. The visiting faculty member would require support, for example through a Fulbright grant. Dr. Suzanne Pierce, a geoscientist (hydrologist) at TACC and Jackson School of Geosciences and Dr. Maria Esteva have offered to guide aspects of the exchange. Dr. Pierce is a former Fulbright NEXUS scholar.
2. There is an opportunity for the Jackson School of Geosciences, UT Austin, to collaborate with the University of Technology, Jamaica (Utech) and the University of the West Indies (UWI) System to collaborate on energy education and pre-college geoscience preparation.
   a. <u>Energy Education</u>
   Utech has a new Master of Science in Sustainable Energy and Climate Change program, which integrates engineering, natural and social sciences, humanities and the built environment (architecture) into the curriculum. The JSG Energy and Earth Resources (EER) graduate program offers a Master of Arts and a Master of Science in Energy and Earth Resources (MAEER and MSEER, respectively), as well as dual degrees with the LBJ School of Public Affairs (MPAFF and MGPS) and the Red McCombs School of Business (MBA). Faculty from the Jackson School of Geosciences, the Cockrell School of Engineering, the McCombs School of Business, the LBJ School of Public Affairs and the School of Law teach courses and lead research projects.

i. Utech is interested in scholarly exchanges between faculty and/ or students in enrolled in their Master's program and the JSG EER program, and opportunities for Utech students to enroll in EER.

ii. EER is interested in recruiting excellent students. Both Utech and UWI System, which has Law Schools (Mona Law, Jamaica and St. Augustine, Trinidad) and an excellent business program, Mona School of Business and Management, could serve as sources of qualified applicants for the JSG EER program.

b. Undergraduate Geoscience Education

The Science Education Resource Center (SERC) at Carleton College awarded Dr. Trisha Alavarez, Assistant Professor of Petroleum Engineering at the University of Trinidad and Tobago, a travel stipend to attend the six-day Earth Educators' Rendezvous at the University of New Mexico in Albuquerque, NM in July 2017. Sponsored by the U.S. National Science Foundation, Geological Society of America, the American Geophysical Union, and the National Association of Geoscience Teachers the Rendezvous brings together researchers and practitioners working in all aspects of undergraduate Earth education, including college faculty and administrators, graduate students, and K-12 teachers from all disciplines who are interested in improving their teaching about Earth.

c. Pre-college geoscience preparation

i. Teacher preparation. There is interest in improving teaching preparation as it relates to the Seismographs in School projects in Jamaica (Jamaica Educational Seismic Network [JAESN]) and in Trinidad (administered by Seismic Research Centre at UWI, St. Augustine) through the delivery of a sustained program of teacher professional development. Discussions are ongoing between the JSG and the Seismic Research Centre. A conference call is planned in July 2017 with the Seismic Research Centre primary sponsor, the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which has expressed interest in supporting education initiatives related to seismic and volcanic hazards in the Caribbean.

ii. CARICOM GeoFORCE/ STEMFORCE. There is also interest in creating a pre-college STEM field learning program that would be modeled after GeoFORCE Alaska or expanding the Bahamas STEMFORCE program to include Jamaica and Trinidad, with a focus on trips within the Caribbean region. Potential partners are the UWI System, the Scientific Research Council (Jamaica), the Caribbean Energy Information System, PetroJam, the Seismic Research Centre, UWI St. Augustine, and Dr. Lyndon Brown at Lone Star College, Texas. College. The Bahamas has a single industry sponsor interested in partnering with other private sector sponsors in the region to expand the program.

3. The American Geophysical Union (AGU) Thriving Earth Exchange (TEX) and the Jamaica Environment Trust (JET) are exploring opportunities for collaboration on a community project in Jamaica. TEX specializes in building multi-sector partnerships for effective and sustainable community-owned projects that will develop solutions that have local impact and global implications. TEX does this by bringing together Earth and space scientists and community leaders and helping them combine science and local knowledge to solve on the-ground challenges related to natural hazards, natural resources, and climate change. JET is Jamaica's most highly

regarded non-profit, non-governmental organization with a demonstrated history of success in environmental education, advocacy and conservation.

4. Participants interested in water resources are planning to submit a proposal for a workshop or pilot project that merges data collection, data management and data publication as a functional pipeline. The effort will be associated with a prototype repository and data management model, and test data gathering protocols / data quality verification procedures/ data description/ data publication and citation, and data reuse. The idea is for a pilot project that focuses on water resources as a first step.

   Four CariUSA participants are conveners of a topical session Geological Society of America (GSA) Annual Meeting in Seattle, October 2017: GSA T22. *Water Resources and Management in Coastal and Inland Aquifers—Emphasis on Small Island Developing States of the Caribbean*. Presentations will focus on current research on Caribbean water resources. Highlighted topics include water quality and effective measures for improving wastewater treatment. GSA's Hydrogeology Division, International/International Interdisciplinary Interest Group, Geology and Health Division, Geology and Society Division, and the Environmental and Engineering Geology Division are sponsors of the session.

5. Researchers from Southern Methodist University (SMU) are providing assistance to landowners and a local community in St. Ann, Jamaica.

   In October 2016 a major landslide occurred near Orange Hall, St Ann occurred, following a major rain event. The slide destroyed a road and water pipeline connecting a pump-house in the gorge below on the banks of the White River to a water tank located on a nearby farm (elevation 341 meters). The pipeline not only supplies water to two large farms (cattle ranches), but also to small communities in the area. The CariUSA conference was the catalyst for a graduate student from Jamaica who is studying Geophysics at Southern Methodist University (SMU) to meet with the landowners in the area and carry out a site characterization of the landslide under the supervision of Dr. Matt Hornbach, Associate Professor of Geophysics at SMU. The results of this landslide survey and site characterization are guiding the engineering solution that is being implemented to permit vehicles to service the pump-house. Information scientists at TACC have offered to assist SMU to archive the site characterization the White River Landslide with data and documentation on the Design Safe website (https://www.designsafe-ci.org/) , making this case study available to academics, landowners, government agencies, and the private sector in Jamaica and beyond. DesignSafe is a comprehensive cloud-based research environment for researchers to steward data from its creation through archive, but also the workspace in which to understand, analyze, collaborate, and publish that data. There is no cost to register to use DesignSafe.

## Conclusion

The outcomes of CARIUSA 2017 Meeting clearly underscore the interest of both Jamaican/ CARICOM and U.S. participants to build strategic partnerships that advance the development of a Jamaican/ Caribbean geoscience workforce. In order to sustain and expand the professional interactions and synergies that were created and realize the long-term goal of developing capacity, a reliable, uninterupted source of funding is essential for future annual meetings and to seed initiatives that merit pursuing. This cannot be one-sided with the U.S. as the primary funding source.

## Acknowledgements

An award from the U.S. State Department through the U.S. Embassy in Jamaica to the Jackson School of Geosciences at The University of Texas at Austin provided support for the 2017 inaugural meeting of the CariUSA Workgroup. We thank Dr. Parris Lyew-Ayee, Jr. and his team at Mona GeoInformatics for their heroic but unsuccessful efforts to try to secure funding for Jamaican and CARICOM participants to attend CariUSA 2017. We also thank the Jamaica Water Resources Authority for the loan of projection equipment for use during the meeting and the UWI Earthquake Unit for their role in leading the field trip to the Blue Mountains. The Earthquake Unit, IRIS and the Department of Geography and Geology at UWI, Mona jointly organized an afternoon workshop for teachers participating in the JAESN project. We thank Immaculate Conception High School for hosting the mini-workshop and for the use of their computer facilities.

The University of Texas and meeting organizers are deeply grateful to Ms. Sonya Parchment, Senior General Manager of Trafalgar Travel Limited in Kingston, Jamaica for her assistance in arranging all travel, lodging and meeting logistics at the Pegasus Hotel. We thank Mrs. Diana Marley of Hertz Jamaica for arranging rental vans and providing excellent drivers for the field trip to the Blue Mountains. Mrs. Prudence Simpson, Director of Sales at the Jamaica Pegasus Hotel, ensured that the meeting facilities and equipment, coffee breaks, luncheons, and service met all expectations and were of the highest possible standard.

All participants thoroughly enjoyed the tour of the Craighton Coffee Estate in Irish Town and the opportunity to sample authentic Jamaican Blue Mountain coffee. Thanks to Ms. Robin Fox for hosting us at EITS Café after the field trip to the Blue Mountains. Robin extended a gracious and heartfelt Jamaican welcome. The dinner was exceptional, the view magnificent and the company excellent. Participants were all in agreement that the dinner at EITS Café was the highlight of CariUSA 2017.

Finally, we thank Dr. Cathy Manduca and the Science Resource Education Center (SERC) at Carleton College in Minnesota for hosting the meeting website at https://serc.carleton.edu/cariusa/meetings.html.