Pontificia Universidad Católica Madre y Maestra (PUCMM)
Scientific Caribbean Foundation (SCF)

SPRING 2019

Saturday Research Academy in Disaster Risk Management

Pre-College Research Symposium

Saturday, June 8, 2019
Engineering and Health Sciences Building - Pontificia Universidad Católica Madre y Maestra
Santo Domingo, Dominican Republic.

PONTIFICIA UNIVERSIDAD CATÓLICA MADRE Y MAESTRA
AND THE
SCIENTIFIC CARIBBEAN FOUNDATION

ARE PROUD TO HOST THE

SPRING 2019 PRE-COLLEGE RESEARCH SYMPOSIUM

SHOWCASING HIGH SCHOOL STUDENTS' MENTORED RESEARCH

Leadership at

PONTIFICIA UNIVERSIDAD CATÓLICA MADRE Y MAESTRA
AND THE
SCIENTIFIC CARIBBEAN FOUNDATION

Professor Ashley Morales-Cartagema
Head of School Civil and Environmental Engineering

Juan F. Arratia, Ph. D.
President and Founder
Research Professor and Mentor

SANTO DOMINGO, DOMINICAN REPUBLIC

JUNE 8, 2019

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MISSION

The Saturday Research Academy in Disaster Risk Management at PUCMM is part of the effort of the Scientific Caribbean Foundation (SCF). The SCF founded by Dr. Juan F. Arratia, a 2006 US Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring recipient, to continue the success of the Model Institutions for Excellence (MIE). This project was developed thanks to a grant awarded by the National Science Foundation (NSF) to transform Universidad Metropolitana (UMET) into a nationally recognized undergraduate research institution, and a model in science, technology, engineering and mathematics (STEM). Mentoring of undergraduates and pre-college students by research mentors was the cornerstone of the MIE Project. Dr. Arratia was the Principal Investigator of the MIE grant at UMET. We believe that creative research is one of the best ways to prepare students to become persistent and successful in college, graduate school and professional careers. Today, the Student Research Development Center (SRDC), which is part of the SCF, is the entity that will continues the MIE strategy by impacting pre-college and university students from institutions in around the world.

EXECUTIVE SUMMARY

The MIE ended in 2009 at UMET. The outcome of the program was over 280 UMET STEM-C majors completed their BS degrees and 175 were transfered to graduate school, with 65 achieving doctoral status (PhD, MD, VVM, Pharm D). In order to increase the number of BS degrees transferred to graduate school, we will continue with the strategy of an early research program and partnership with key research institutions in Puerto Rico, the US mainland and abroad. Research mentoring will be the central component of the knowledge transfer and creative thinking activities at SCF. Project based learning, collaborative learning strategies, presentations at scientific conferences, scientific writing and co-authorship, technology literacy, and preparation for graduate school are activities that are transforming the philosophy of competive institutions.

GOALS

The main goal of the Spring 2019 Pre-College Research Symposium is to encourage pre-college research with research mentors, develop students' written and oral communication skills, provide a forum in the Caribbean for students to foster interest in undergraduate education, particularly in STEM-C fields, and set national research standards for pre-college research presentations. The subject selected for this particular group was to contribute to increase the resilience of the Dominican Republic by building capacity in Disaster Risk Management, including topics from geology and earthquakes to hurricanes and high-school education in natural disasters. This was done thanks to the contribution of the U.S. Department of State through their Alumni TIES program.

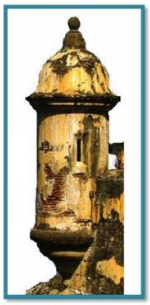
PONTIFICIA UNIVERSIDAD CATÓLICA MADRE Y MAESTRA
SCIENTIFIC CARIBBEAN FOUNDATION

SPRING 2019 PRE-COLLEGE RESEARCH SYMPOSIUM

CONFERENCE AT A GLANCE

SATURDAY, JUNE 8, 2019	ROOM FCSI-901

8:30-10:00 a.m.	**Registration**
10:00–10:20 a.m.	**Opening Ceremony** **Prof. Ashley Morales-Cartagena** **Head of School Civil and Environmental Engineering** **Dr. Juan F. Arratia** **Research Professor and Mentor**
10:20–11:30 p.m.	**Poster-Oral Sessions** **Disaster Risk Management**
11:30–12:00 p.m.	**Awards Ceremony and Closing Remarks**
12:00 m.	**Symposium Adjourns**



Scientific Caribbean Foundation

June 8, 2019

Dear Pre-College Students:

The Spring 2019 Pre-College Research Symposium is the culmination of the activities and dissemination process of the Saturday Research Academy at PUCMM. For a period of four months, since February 2019, pre-college students from private and public high schools from Dominican Republic worked long hours in the research laboratories of PUCMM campus, with the guidance and mentorship of faculty-mentors in research projects in Disaster Risk Management.

One of the objectives of the Spring 2019 Pre-College Research Symposium is to offer young motivated high school researchers the opportunity to learn and to practice their English communication skills in a formal professional scientific meeting. A second objective is to give high school students of Dominican Republic a forum for the presentation of the outcomes and findings of their research projects to research mentors, family members, and the educational community at large.

We at Scientific Caribbean Foundation are proud of the results obtained by the pre-college students and their mentors in the Spring 2019 Saturday Research Academy Program. I hope your experience inspires you and your peers to select science, technology, engineering, mathematics and computer science (STEM-C) as your field of study in the near future.

My sincere appreciation goes to the funding agency, PUCMM, research mentors and pre-college research studentsfor their effort and commitment to implement the Spring 2019 Pre-College Research Symposium.

Sincerely yours,

Juan F. Arratia, Ph. D.
Founder and President
Research Professor and Mentor
Scientific Caribbean Foundation

Keynote Speaker's Biosketch

Juan F. Arratia, PhD
Research Professor and Mentor
Scientific Caribbean Foundation

Dr. Juan F. Arratia was born in Pomaire, Chile. He graduated from Universidad Técnica del Estado with a BS in Electrical Engineering in 1973. He was awarded a MSc in Engineering from Louisiana Tech University, Ruston, Louisiana, in 1979 and a Ph.D. in Electrical Engineering from Washington University, St. Louis, Missouri in 1985. He has taught and conducted research at universities in Chile (Universidad Técnica del Estado and Universidad Austral de Chile), Puerto Rico (Universidad Interamericana de Puerto Rico and the University of Puerto Rico-Mayaguez), and in the US mainland at Washington University, St. Louis, and Louisiana Tech University, Ruston, Louisiana. He has lectured and given conferences on advanced automation, robotics, vision systems, artificial intelligence, total quality management and science and engineering education in Chile, Bolivia, Ecuador, Guatemala, Panama, Mexico, Brazil, Nicaragua, Perú, Canada, Spain, the Netherlands, Turkey, Japan, Philippines, Singapore, Australia, China, Puerto Rico and in the US mainland. He was the Advanced Manufacturing Manager for Medtronic, Inc., a leading pacemaker company, and is a consultant in advanced automation for pharmaceutical and medical devices companies in Puerto Rico. From 1998 to 2008, he was the Director and Principal Investigator of the Model Institutions for Excellence (MIE) Project, a National Science Foundation sponsored program based at Universidad Metropolitana in San Juan, Puerto Rico. From 2008 to 2018, he was the Executive Director of the Ana G. Méndez University System (AGMUS) Student Research Development Center, designed to disseminate MIE best practices at Universidad del Turabo and Universidad del Este. For twenty year he was part of AGMUS and during his tenure he wrote proposal to NSF and was awarded more than 85 million USD for MIE, CCCE, AGMUS Institute of Mathematics, MRI-AMISR, MRI-Puerto Rico Laser, Administration of Arecibo Observatory among others. Since 2018 to present he is the President of Scientific Caribbean Foundation in San Juan Puerto Rico. In November 2007, he was awarded the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring at a ceremony in the White House in Washington DC.

RESEARCH MENTORS

Ricardo Hernández, PhD
Hydrology Professor
Pontificia Universidad Católica Madre y Maestra (PUCMM)

Ricardo Hernández Moreira is an assistant professor in the area of water resources of the Pontificia Universidad Católica Madre y Maestra and at the Universidad Iberoamericana, both in Santo Domingo, DR. Civil Engineer with more than 15 years of experience; he received his doctorate degree at the University of South Carolina. His research interest is framed in the intersection of civil engineering and geology, focused on the transport of sediments in fluvial, coastal and submarine environments, the environmental impacts of it and how it modifies the natural landscape. Former Fulbright Scholar, promotes scientific education and intercultural exchange of ideas for the creation of a more just and friendly society.

Ashley Morales-Cartagena, MSc
Geotechnical Engineering Professor
Pontificia Universidad Católica Madre y Maestra (PUCMM)

Ashley Morales-Cartagena is a professor in Geology and Geotechnical Engineering and Head of the School of Civil and Environmental Engineering at the Pontificia Universidad Católica Madre y Maestra in Santo Domingo, DR. In addition, she works as a Geotechnical Engineer and Risk Management Analyst at the National Bureau of Seismic Evaluation (ONESVIE). She is a civil engineer passionated about earthquakes and education. Her main research interest are the study of liquefaction hazard, site-specific response analysis and probabilistic seismic hazard analysis. She aims to close the gap between academia and decision makers in the Dominican Republic. She has a M.Sc. in Geotechnical Engineering Concentration in Geotechnical Earthquake Engineering from the University of Illinois at Urbana-Champaign (UIUC), where she attended as a Fulbright Scholar. Founder and faculty advisor of the Earthquake Engineering Research Institute PUCMM Student Chapter and member of the American Society of Civil Engineers (ASCE) and the Dominican Society of Geology (SODOGEO). She loves the ocean and practices scuba diving, enjoys traveling and mostly she adores mentoring female students in STEM.

PRE-COLLEGE PRESENTERS

José Minaya is a student at Centro Educative Marillac. He is currently doing his senior year in the accounting technical modality. He is aiming to make an impact for good on the environmental, start business at young age and found his own company. He likes sports such as basketball, dirt bikes (motocross), he also likes music and reading articles about future science and economy.

Jade Peralta is a junior student in Instituto San Juan Bautista. She is an outgoing person who enjoys researching and learning new things. She feels fortunate to be from the Dominican Republic because there are many different topics to research about, and the best part: take action to bring about change and take the country to another level. She is an SRA student who has done research in fields such as Seismic Vulnerability. Her future plan is to become a Chemical Engineer or Biomedical Engineer in the United States, one of the leading countries in terms of innovation, training and research in the area. She likes to play sports and to read books.

Jana Dulovic is a junior student in Saint Joseph School, Santo Domingo, and D.R. She was born in Belgrade, Serbia and is now seventeen years old. She is really interested in science, especially in biology, and she has a special interest in mathematics, technology, engineering, and innovation. Her passions include playing volleyball, reading books, hanging out with her friends and playing with her dogs. She is currently part of the SRA program and her project consists of Disaster Safety and Risk Management, using GIS and implementing basic planning response and community preparedness in the Dominican Republic. Her future plan is to become a scientist and to be able to create an extraordinary project that will break scientific barriers and be able to change the world.

Oscar Calderon was born in Santo Domingo, Dominican Republic on May 25, 2002. He is 16 years old. He is a student of ISAJUBA School (Institute San Juan Bautista). He is junior student. He is a SRA student whose research is about Disaster Risk Management, specifically in Seismic Vulnerabilty. He is a hard-working, caring, solidary, believer in God and likes that the things do well. He likes dancing, playing sports, watching TV, listening to music and studying math. His goals are extend his knowledge about natural disasters and know how to do a good research. His future plan is to be Civil or Industrial Engineer.

Alice Segura Souffront is a 17 years old Dominican student in the San Juan Bautista Institute (ISAJUBA). She is a senior in this high school. She's a curious and adventurous girl who wants to learn as many things as possible. She always shows interest in having knowledge of everything. She's an SRA student whose research is in the field of Earthquake Engineering and Geology. Her project is based on the microzonation and the importance of soils. She likes to read, play sports like volleyball, listen to music and dance. One of her passions is languages. She's capable of speaking four. Spanish, which is her mother tongue, English, French and Portuguese and she's willing to learn more. Her future plan is to be a civil engineer that helps the communities and her country.

Diego Gonzalez is a student at Saint Joseph School. He is a high school junior, and forms part of his school's student council. His project is based mostly around floodings and risk preparedness with the contribution of geology, hydrology and emergency management. He likes practicing mathematics, playing soccer and talking with his friends. His future plan is to become an engineer or to study something related to mathematics.

Pia Emilia Iturbides Buriticá is a 17-year old senior student at New Horizons Bilingual School. Although born and raised in the Dominican Republic, she is the daughter of a Colombian mother and Chilean father. She has a passion for debating and soccer, representing her nation in the Buenos Aires Youth Olympic Games 2018. As a debater, she was recognized in three different instances at one of the biggest conventions in the country, Conferencia Internacional de las Américas. Through positions of leadership at her school's debate team, she organized conferences and assisted fellow debaters. She maintains the highest grade point average of her class and hopes to attain a degree in Environmental Science in a university outside of the country. She strives to dedicate her life to the preservation of the environment, specifically that of marine ecosystems since she grew up around these.

SCHEDULE OF EVENTS

SATURDAY, JUNE 8, 2019	PUCMM CAMPUS

10:20 – 11:30 a.m.	POSTER/ORAL SESSION	ROOM FCSI-901

Chairperson: Professor Ashley Morales-Cartagena

DISASTER RISK MANAGEMENT

10:20 – 10:30 a.m. **Oscar Calderon,** Institute San Juan Bautista, Santo Domingo, Dominican Republic.

Rapid Visual Evaluation of the Seismic Vulnerability of San Juan Bautista Buildings

10:30 – 10:40 a.m. **Jana Dulovic,** Saint Joseph School, Santo Domingo, Dominican Republic.

Implementation of GIS in Disaster Risk Management in the Dominican Republic

10:40 – 10:50 a.m. **Diego Gonzalez,** Saint Joseph School, Santo Domingo, Dominican Republic.

Tactical Assistance Centers Under the Threat of Floods in the Province of Santiago

10:50 – 11:00 a.m. **Pia Emilia Iturbides Buriticá,** New Horizons Bilingual School, Santo Domingo, Dominican Republic.

Carbon Sequestrationby Mangrove in the National Park los Haitises, Dominican Republic

11:00 – 11:10 a.m. **José Minaya,** Centro Educativo Marillac, Santo Domingo, Dominican Republic.

Disaster Risk Management Education in Public Schools

11:10 – 11:20 a.m. **Jade Peralta,** Institute San Juan Butista, Santo Domingo, Dominican Republic.

Structure Vulnerability of Housing Buildings of the Terrenas, Samaná Province

11:20 – 11:30 a.m. **Alice Segura Souffront**, Institute San Juan Bautista, Santo Domingo, Dominican Republic.

Methodology on How to Develop a Seismic Micro-Zonation on the Dominican Republic

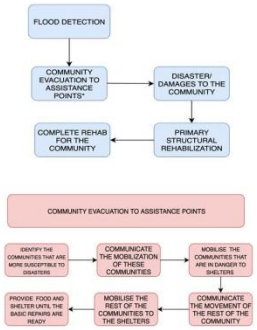
RESEARCH POSTERS

Tactical Assistance Centers Under the Threat of Floods in the Province of Santiago

Gonzalez, D; Arratia, J and Hernandez, R
SRA, PUCMM

Introduction:

Every year, the Dominican Republic faces major structural and economic losses due to many types of natural disasters. Moving water has great destruction potential. A flood is a natural disaster that occurs when water invades or inundate land that is normally dry [1]. It is almost impossible to prevent damages from floods, so many investigations and programs focus mainly on improvement [2]. The key objectives of the study is to analyze the nature of floods (the way they work and how they affect the community); to explain past examples of floods in the Dominican Republic, and comparing them to other floods globally; and to find various solutions that can improve our resilience and adaptability to overcome the damages that we face. The solutions is to develop different assistance centers that could support and aid the population in case of any major emergency, and accelerate the process of recovery. Each center is based on the floods, and even though it is the point of focus, the centers can also help the population in case of any other type of natural disaster.



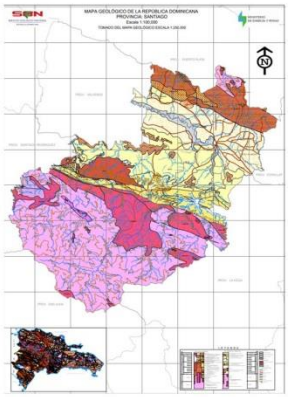
Abstract

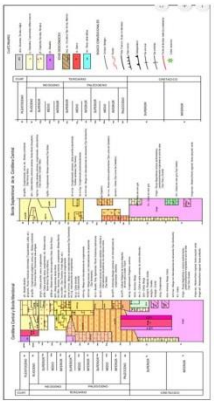
Moving water has great destruction potential. Each year, many places face different natural disasters that cause massive structural and economic damage. These types of natural disasters involving water in dry land are known as floods. Each year, the Dominican Republic faces various floods that cause physical damage to the community. The investigation includes information from different scientific articles, as well as news reports and information given by different humanitarian organizations. By analyzing past examples in our country, and comparing them to other floods in the world, we can come up with a solution: the creation of "safe zones" or "Assistance centers", to provide medical supplies to the hurt. These centers will also be provided with different tools and machinery to accelerate the immediate response after the disaster. The region of focus of the investigation is the province of Santiago. This region is located in the center of the country, near the highest mountain range in the country. Some of the geographical characteristics are that Santiago has is that it is located near the cordillera Septentrional, it's a valley, has various rivers and streams, such as de Yaque del Norte, and is a region that is very prominent to the threat of floods [3]. Due to its weather, it is a high agricultural producer of the country, having a high production of rice and tobacco, making it an important region to the economy [4]. The objective of this case is to find ways to improve our recovery time and resilience; as well as to decrease the damages that a flood can cause by taking different precautions. We have to identify our past mistakes and work to achieve the best possible return these terrible hazards.

Materials and Methods:

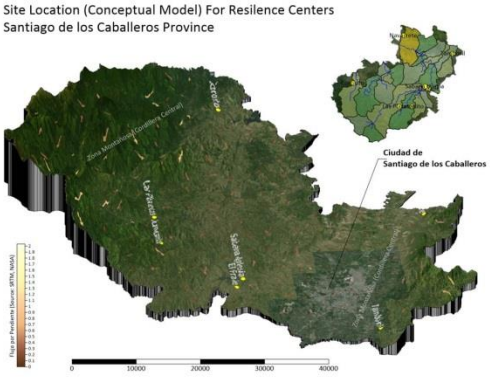
After investigating the threat that the region faces, and identified our solution, we continued to learn more about the region, so that we could locate the centers under strategic points to cover the imminent necessities of the population. To visualize and understand the circumstances, different maps were used. The maps presented the location of any nearby river, small communities in the surrounding areas and the type of ground that each zone had.

After the information was analyzed, with the help of professor Marco Perez, we created a three dimensional map that represented the areas of interest. The application used was GlobalMapper, and we used various sources of data to show the physical model.





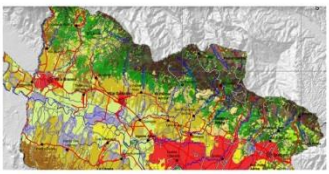
Results:



The model above is the conceptual representation of the different centers. The investigation focused on the community of El Faire, and its surroundings. The center is going to cover the nearby communities of La Zanja, Yerba de Culebra, Baitoa and Sabana Iglesia. The center can also provide help to other communities at a greater distance if it is necessary, but it might not be able to support more than its limit with the shelter. In any case, there can be a mobilization of different tools, materials and medicine, to the different shelters that are already provided by the government. The place of the cite was put carefully. The floor type was taken in consideration, and the distance to the Rio Jaqua. This part of the province is made out of limestone.

Future experiments:

Future experiments might include the expansion of the centers to increment the area of help. Some of the planified areas that could benefit from the project in the province are the municipality of Las Lavas, in the west of the province. The center will cover the near communities of Villa Bisono and Navarrete, both areas that have a higher population density. Other center can be near Tambori, covering the northern part of the region.



References:

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5. D.R. topographic map. (n.d.). Retrieved from http://en-gb.topographic-map.com/places/Dominican-Republic-9209452/

Acknowledgements:

Thanks to Juan Arratia, Ricardo Hernandez, Marco Perez and Ashley Morales for mentoral advice, and Patrick Pimentel and Edward Almonte for assistance with the investigation. Thanks to SRA for providing me this great opportunity to research. The Embassy of the United States in Dominican Republic for providing fundings for this project to be possible.

Further information:

For further information of the investigation, contact me through my email, diegogonzalezsjs@gmail.com

Disaster education and Risk Management in public schools

DEPARTMENT OF STATES – UNITED STATES OF AMERICA, PONTIFICIA UNIVERSIDAD CATOLICA MADRE Y MAESTRA – PUCMM , World Learning, Alumnities.

INTRODUCTION – 2

According to GFDRR (GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY) the Dominican Republic is considered a hotspot for natural disasters1. The country is exposed to droughts, earthquakes, flooding, hurricanes, landslides, temperature extremes (heat waves), tropical storms and tsunamis. From 1980 to 2008, 40 natural disasters affected 2.65 million people, almost a quarter of the country's population.

Land degradation, rapid and unplanned urbanization since the 1960s, and weak enforcement of building codes and zoning regulations are the main drivers of vulnerability. The country's external debt limits available resources to recover from disasters and to provide social welfare. The scientific community is concerned that the Septentrional Fault, along the country's northern coast, is overdue for a large earthquake.

According to what is established in Law 66-97, article 31: "the academic structure of the educational system is organized according to levels, cycles, degrees, modalities and subsystems". On the other hand, Article 32 of Law 66-97 states that: "The Dominican education system includes the following levels: Initial Level, Basic Level, Medium Level, Higher Level".

According to SOS CHILDREN'S VILLAGES INTERNATIONAL poverty remains a widespread phenomenon in the Dominican Republic and that one in five citizens is chronically undernourished, therefore a correlation between hunger and lack of education is existing.

This is a problem that we have to solve; we propose a program that lets our students be aware and understand seismic activity and also the risk it represents.

ABSTRACT – 1

Our public-school system is not prepared and its personnel does not have any sort of knowledge about seismic activity, with that in mind: imagine if an earthquake happened in a school in Puerto Plata. They are not prepared for it and they do not have the knowledge of what to do in this case. Since we don't have that type of education in our schools, the need to create an educational program to teach the right way to the students of the Dominican Republic is vital. There are ways to accomplish this and I mean integrating this type of information in the schools by creating an educational program about seismic activity and the risk it represents. As a result of this research an educational program is developed with the purpose of understanding seismic activity and how to react to earthquake events. The type of information that was used is from a wide variety. It goes from what to do, or how to evacuate in case of an earthquake, to faults, boundary plates, its dynamics, frequency of earthquakes, what is an earthquake, what is a tsunami, why is it helpful to understand them and how to acknowledge this information, and much more; preparing our communities for the worst.

MATERIALS AND METHODS – 3

Three new technical modality shall be created:

Technical modality Geophysics

***10th grade (4to Secundaria)**
- Introduction to Geophysics
- Basic concepts

***11th grade (5to Secundaria)**
- Internal Geophysics:
  - >Seismology
  - >Geothermometric
  - >Geodynamics
  - >Geophysical prospecting
  - >Geophysics engineering
  - >Tectonophysics

***12th grade (6to Secundaria)**
- External Geophysics:
  - >geomagnetism
  - >paleomagnetism
  - >gravimetry
  - >oceanography
  - >meteorology
  - >Aeronomy
  - >climatology
- -Disaster Risk Management

Technical modality Structural Engineering

***10th grade (4th High School)**
- Intro Structural Engineering
- Basic Concepts

***11th grade (5th High School)**
- Structure of matter

***12th grade (6th High School)**
- Structural elements
- Disaster Risk Management

Technical modality Hydrometeorology

***10th grade (4th H.S.)**
- Intro hydrometeorology
- Basic Concepts

***11th grade (5th H.S.)**
- Hurricanes
- Floods
- Hail

***12th grade (6th H.S.)**
- Water cycle
- Dynamics of wet processes
- Objective analysis of precipitation fields measured rainfall and radar.
- Computer simulations
- Disaster Risk Management

RESULTS - 4

As a result of this research, the students of the public education centers, a professional technical modality, conclude a period of teaching of three school periods, these being 4th year of secondary school, 5th year of secondary school and 6th of secondary school, which was established in the Ten Year Plan of Education 2008-2018: "A low-middle-income country should concentrate its attention on middle and higher education. This concentration in secondary education is explained by the need to have qualified people who can integrate into the labor market with competitive salaries and achieve their certification as competent bachelors for their insertion in the economy or to enter the upper level "(P.40 -41). Another result of this new modality are students with knowledge about natural disaster and risk management.

FUTURE EXPERIMENTS –5

The need to create a new class and integrate it to the school system has to be developed for outstanding academic students with the knowledge the students already have, to develop the best professionals in this area of the Caribbean since the Dominican Republic tends to have frequent and dangerous seismic activities.

REFERENCES – 6

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General information on the Dominican Republic. (n.d.).

2- Retrieved from https://www.sos-childrensvillages.org/where-we-help/americas/dominican-republic

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ACKNOWLEDGMENT – 7

Thanks to Dr. Juan Arratia for mentor advice, Dir. Ashley Morales, Patrick Pimentel, Marleni De Los Santos, World Learning, PUCMM and Embassy of United States for giving me the opportunity to participate on the Saturday Research Academy – Disaster Risk Management.

Structure Vulnerability of housing buildings of Las Terrenas, Samaná province

Peralta, J, Márquez, P, and Arratia, J
Department of Civil Engineer,
Pontifica Universidad Católica Madre y Maestra.

INTRODUCTION

Countries that have suffered more disasters than the Dominican Republic have developed innovative solutions to create a better way to build resistant buildings. The handling of the first response is vital because they are avoiding a catastrophe.

For the case of the Dominican Republic the first efforts are being made to carry out a project of quick visual evaluations based on the weaknesses presented by Las Terrenas structures and later to be able to study them in a deeper way.

However, in the last years the COE (Centro de Operaciones de Emergencia) and the FN-PMR (Fondo Nacional de Prevención, Mitigación y Respuesta ante Desastres) in association with some other organizations are developing and improving new ways to teach and create awareness in our country of the prevention in front of some natural hazards.

The scope of this research is to reveal the weaknesses of the municipality and review the evidence of why the houses need a detailed study to really know how resistant they can be to an earthquake in the community of Las Terrenas and what methods should be used for knowledge and preparation in terms of structures.

EVALUATION HOUSES

ABSTRACT

Samaná is one of the most vulnerable places and there is no protocol that dictates the vulnerability of structures in this province. In order to determine if the buildings of Las Terrenas would resist an earthquake and if the need a thorough structural evaluation, we developed a pilot plan to evaluate a selected houses to do a rapid evaluation. Additionally, the construction of their houses in some spaces where the rocks are not resistant enough plus the construction of structures without the construction code can amplify the danger in case of a natural disaster.[3]. Finally, the results revealed that some of the four structures selected for the study needs a deep seismic evaluation.

METHODOLOGY

The methodology is based on the material and the recognition of the weaknesses of the structures in the community of Las Terrenas in Samaná.

First, in field work, one must find the structures to make a Rapid Visual Screening (RSV) of buildings for potential seismic hazard of selected houses of Las Terrenas. According to Sen, Z. (2010). the Rapid Visual Handbook can be used by trained personnel to identify, inventory, and screen buildings that are potentially seismically vulnerable. The RSV procedure compromises a method and several forms that help users quickly identify and score buildings according to the risk of collapse if hit by a major earthquake.

In addition, I used literature review to recollect data from some organizations such as: FEMA and COE were used to get newer and more options of how to manage the risks. I used Google Earth Pro to take some pictures of the municipality and check some communities with the facilities of the use of the satellite.

RESULTS

BUILDING	RESISTANT SYSTEM	FLOORS	SCORE	DETAILED STRUCTURE EVALUATION	YEAR BUILD	USE
HOUSE 1	HOUSE BUILT WITH WOODEN FRAMES AND LIGHT ZINC ROOF	1	2.2	NO	1960	FAMILY HOUSE
HOUSE 2	TWO-STORY UNREINFORCED MASONRY BUILDING	2	0.5	YES	1993	RESTAURANT AND FAMILY HOUSE
HOUSE 3	REINFORCED MASONRY	1	3.8	NO	2012	FAMILY HOUSE
CASA DELFIN	UNREINFORCED MASONRY AND STEEL DECK ROOF	2	0.3	YES	2001	HOTEL

- The results show that the wooden buildings, typical in the Terrenas area are predicted to perform better (higher score) in case of a seismic event, contrary to the modern masonry structures as they are not reinforced correctly.
- Grades in the Rapid Visual Seismic Evaluation are evaluated based in a scale of 2, if the building gets less than two in the return, that means that the structures will need a deepest vulnerability evaluation.
- The results demonstrate that 2 of 4 structures will need a deep seismic vulnerability evaluation because they got less than 2.

FUTURE EXPERIMENTS

Research that could contain more communities in Samaná with the same probable risks. Also, examine the possibilities of developing an earthquake simulator and determining where would be the most affected places in case of the natural hazard. In addition, the creation of a construction project that will include schools that are resistant and secured for the community because it would be guided by the anti-seismic construction code.

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FURTHER INFORMATION

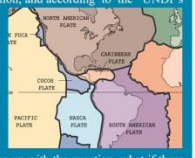
Due to high incidence of earthquakes in Chile and Japan, developed countries, structures are built to resist high magnitude earthquakes.

Implementation of GIS in Disaster Risk Management in the Dominican Republic

Jana Dulovic | SRA Program | Saint Joseph School

Introduction

Did you know that the Dominican Republic is considered a hotspot for natural disasters, due to its exposition to tropical storms, hurricanes, tsunamis, earthquakes, heat waves, droughts, and floods? From 1980 to 2008, exactly 40 natural disasters affected approximately 2.5 million people in the Dominican Republic, which is almost a quarter of its population; and according to the UNDP's Global Report on Reducing Disaster Risk (UNDP, 2004) "75% of all economic losses was caused by inadequate spatial planning leading to increased and avoidable vulnerability in the country". This impacting data has long been heard, yet not taken into account for any sort of solution, thus making us come up with the question, what if there existed a sort of software that could gather, manage and analyze data and could then deliver real-time situational awareness and also be able to forecast future hazards? This is the definition of GIS (Geographical Information System) and it is also what this research paper will consist of. I will show you how the community could possibly implement the use of GIS in disaster management in the D.R., along with basic planning and emergency response to disasters, using this type of software; and finally, being able to create high level community preparedness in case of a catastrophe.



Studies carried out using satellite images and measurements with the GPS system (Global Positioning System), found that the internal distribution of displacement of the Caribbean plate (20 ± 2 mm / year) between the fault systems, establishes that the Northern fault accumulates displacements of 8 ± 2 mm / year, the Hispaniola fault of 5 ± 1 mm / year and the South system of 8 ± 1 mm / year. These failure displacement rates give it the potential to produce earthquakes of magnitude greater than 6.5.

Abstract

Due to its geographical location, the Dominican Republic is highly vulnerable to disasters, such as tropical storms, hurricanes, tsunamis, earthquakes, heat waves, droughts, and floods; and three quarters of the consequences brought by these, are caused by the lack of preparedness that exists in the Dominican communities. This has brought the question, is it possible to use a programme that might help assess disaster management in a community? That is why this paper will consist of the description of a software that will be able to identify issues driven by geography, deliver real-time situational awareness, forecast hazards, set priorities based on spatial analysis, and most importantly gain insight into data that might be missed. The software used is known as ArcGIS (Solutions for Emergency Management), and it includes a set of available maps and apps, as well as support mission and critical activities that will contribute in emergency management. By using ArcGIS, and being able to implement it in the Dominican community, it will become possible to provide a common operational platform to respond to, recover from, and most importantly diminish natural threats and hazards. The results of this project are expected to be successful, since the methods used will be able to triumphantly improve basic planning and emergency response in case of natural risks in the Dominican Republic. . As Brene Brown once said, "Vulnerability is the birthplace of innovation, creativity and change.", and the main purpose of this project is to be able to improve the preparedness as well as the resilience of the dominican community, while preparing a software that will change the existing methods of disaster responses as well.

Materials and Methods

Materials

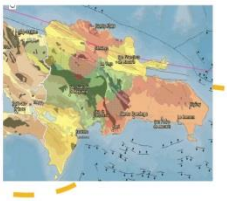
- ArcGIS Software
- QGIS Software

Methodology

- Determine the information you will input, and the amount of layers you will display.
- Decide which type of base map you will use.
- Then, you start adding the layers you will need depending on your topic.

Results

- The results of this project as expected, were successful, since the GIS software used, will be able to triumphantly improve basic planning and emergency response in case of natural hazards. By using softwares such as ArcGIS or QGIS, we can victoriously assess and manage any type of disaster management in the Dominican Republic, thus helping reduce the drastic consequences they drag along.



Future Experiments

If this project gets properly funded and is successfully used, then as a future experiment it might expand not just for a certain area in the Dominican Republic, but for the whole country. Since at this instant, it is only focused on this small area, in the future, we can implement even more layers and tools in order to implement the software for disaster management in the whole Dominican Republic. Along with this, the study could also be expanded even further, along with programming and real-life simulation

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METHODOLOGY ON HOW TO DEVELOP A SEISMIC MICRO-ZONATION ON THE DOMINICAN REPUBLIC

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INTRODUCTION

A natural hazard is defined as the probability of a potentially damaging phenomenon occurring within a specified period of time and within a given area. In this context, seismic hazard represents the probable occurrence of earthquakes and seismically induced processes, which include ground motions, liquefaction and land sliding.

Seismic micro-zonation is the process of subdividing a potential seismic area into zones with respect to some geological and geotechnical characteristic for estimating the response of soil layers under earthquakes excitations. It also includes delineation of the zones that are homogenous in seismological characteristic and a description of the zone by associating dynamic parameters with the specified zone.
Mapping of seismic hazards at local scales to incorporate the effects of local soil conditions is called seismic micro-zonation.

Site safety during earthquakes is related to geotechnical phenomena, such as amplification, landslides, mudflow and liquefaction. Assessments of these phenomena are executed in different ways, but there have been few attempts to formalize a standard approach.

This graphic reviews methods for hazard assessments of three types of geotechnical phenomena: ground motions, liquefaction and slope instability. For each type phenomenon, three grades are described.

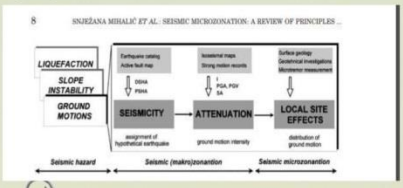
The most important factor in defining surface ground motions is local site effects. Therefore, assessment of site effects depends on the level of zonation. I.e., on the mapping scale.

Table 1. Use of input data depending on the scale of mapping, i.e., the level of zonation (ESSEM, 1998).

	Grade I	Grade II	Grade III
Ground motions	• historical earthquakes and existing information • geological maps • interviews with local residents	• microtremor • simplified geotechnical studies	• geotechnical investigations • ground response analysis
Slope instability	• historical earthquakes and existing information • geological and geomorphologic maps	• air photos and remote sensing • field studies • vegetation and precipitation data	• geotechnical investigations • analysis
Liquefaction	• historical earthquakes and existing information • geological and geomorphologic maps	• air photos and remote sensing • field studies • interviews with local residents	• geotechnical investigations • analysis
Scale of mapping	1:1000000–1:50000	1:100000–1:10000	1:25000–1:5000

Slope failures and rock falls during earthquakes have resulted in a great number of casualties and have been a major cause of damage to structures and facilities constructed on or near the slopes.

Liquefaction susceptibility is a function of the capacity for sediment to resist liquefaction when subjected to ground shaking, their potential depends not only on soil liquefaction susceptibility, but also the level of seismic activity in the region.



ABSTRACT

Seismic micro-zonation provides the basis for risk analysis and it is used as a tool to improve the state of land use management and assist in the mitigation of earthquake damage. In the Dominican Republic, only three micro-zonation studies have been made so far. These took place in the Gran Santo Domingo, Santiago and Salcedo. However, there are twenty-nine vulnerable provinces that have not been studied. My research is based on previous studies from other vulnerable countries all around the world, among them Japan, Colombia, Turkey and India and on how seismic micro-zonation helped prepared many communities. An example: All the available data was transformed into GIS format and the results are evaluated to obtain a micro-zonation with respect to site amplification, liquefaction susceptibility and landslide hazard (1). Seismic micro-zonation requires multiple contributions as well as understanding of the effects generated on man-made structures. My objective is to develop a guide that describes the proper methodology on how to conduct a seismic micro-zonation. Also, the principles of this study along with some current practices and the grade-based study with methods used for estimating a hazard. As a researcher, the outcome that I am expecting from this investigation is to elaborate a guideline on how to perform these zonations to serve this generation of engineers as a point of reference, in order to prepare the communities as well as the structures from all Dominican Republic in case of a hazard

MATERIALS AND METHODS

The structure of the manual is composed into 5 basic phases and each one explaining a determined phase of the seismic micro-zonation (5):

- Compilation of the available geological and geotechnical data
- Evaluation of the earthquake hazard for the study
- Microtremor measurements in the pilot area and interpretation of the results obtained
- Evaluation and analysis of the available geotechnical data
- Final evaluation from the studies conducted (liquefaction susceptibility and landslide).

The information was taken from other micro-zonation manuals such as: Seismic micro-zonation: Methodology for vulnerable cities of South Asian Countries (2), Manual for Zonation on Seismic Geotechnical Hazards (3), Study of the seismic hazard and the physical vulnerability of the Great Santo Domingo (Estudio de la amenaza sísmica y la vulnerabilidad física del Gran Santo Domingo) (4) and more.

RESULTS

Seismic micro-zonation can be considered as being composed of three main phases. In the first phase, the earthquake source characteristics for the study area needs to be determined more accurately in a probabilistic manner to satisfy the requirements of the civil engineering and urban planning.
The second phase is the investigation of the geological and geotechnical site conditions, taking into consideration all relevant factors (i. e., variations in the soil stratifications). This information is an essential part for the assessment of site dependent seismic hazard studies.
The third phase is the is the analysis and interpretation of the accumulated data in the first two phases to establish suitable and applicable micro-zonation parameters that could be utilized for urban planning and earthquake risk Mitigation (6).

FUTURE EXPERIMENTS

In the future as I course my studies to major in Civil Engineering in the university UNIBE, I am going to continue my investigations on micro-zonation and the studies linked to it (previously mentioned on the poster). I would gather the required resources and conduct a micro-zonation alongside other engineers interested on expanding this project.

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Rapid Visual Evaluation of the Seismic Vulnerability of San Juan Bautista Institute Buildings

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PUCMM, Oficina Nacional de Evaluación Sísmica y Vulnerabilidad de Infraestructuras y Edificaciones

INTRODUCTION

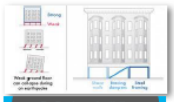
An earthquake is a sudden breaking of rocks at the meeting points of the tectonic plates (faults), inside the Earth. This sudden release of energy spreads in the form of waves that cause the movement of the ground. Popularly, an earthquake refers to a telluric movement of less intensity. Intensity is the best measure of the seismic effects on school buildings.[3]

Earthquake in Puerto Plata, Dominican Republic (2003)

For example, a building on firm soil that experiences a distant, deep, and high magnitude seismic movement will suffer less damage than a building on weak soil that experiences a nearby, shallow, and lower magnitude seismic movement.

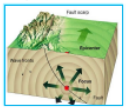
Either way, a seismic movement can impart tremendous loads on all elements of a building and generally result in some level of damage .[3] Unfortunately, there is no technology to predict them and when we register them, it is because they have already happened.

The chances of a person being safe at the time of an earthquake depend on how safe the structure is and on whether the building will collapse or not. It is very important that from time to time a series of tests be



Soft-story building

carried out on these structures to ensure that they are in optimal conditions. However, to be able to perform a deep and effective analysis to know how vulnerable a building is, a series of processes is needed. After this, the necessary measures can be taken to reinforce these structures and ensure that they can resist a high rank earthquake.



ABSTRACT

Structural vulnerability is a possibility to help find essential difficulties in the family environment, and it is also the quality of having little resistance of buildings. However, why would a structure be vulnerable? It will be sensitive in the case of seismic if the design is not suitable for this type of natural disaster. The buildings of the San Juan Bautista Institute constructed in 1970, probably not designed with any seismic arrangement, because most of the buildings were made before the Uniform Construction Code of 1976, the 2000 International Construction Code and the 2011 Code. According to the form of quick visual evaluation made with the data obtained from the school, it can be affirmed that the structures of the San Juan Bautista Institute are vulnerable, that is, a more detailed evaluation of the buildings is needed.

MATERIALS AND METHODS

A study was carried out of all the buildings at San Juan Bautista Institute, evaluated to determine its seismic vulnerability. This study manages the collection of data, according to the rapid visual inspection under seismic hazard. The "Moderately High Seismicity" planning was selected, since the school is located in zone II (Middle Seismicity Zone).

Also, the "Google Earth" app was technically used to access satellite images, maps, and 3D photographs. This app gave the global image, the measurements of the total area, latitude, and longitude of the institution. To get a better perception of the structures, then use AutoCAD that allowed designing school layout.

RESULTS

San Juan Bautista Institute located on Arrayanes Street, Helios, Bella Vista, Santo Domingo, Dominican Republic. It has eight buildings belonging to a total floor area of approximately 8,935.12 m², have N 18 ° 27 '08 .72 " latitude and O 69 ° 56 '28.99' 'in length. The number of occupants at the time of evaluation was 1,114 approximately. The complex has several structural systems, which are: concrete porticoes resistant to moments (C1), concrete porticoes of masonry filling without contact (C3) and reinforced masonry with flexible floor and ceiling diaphragm (RM1).[1] According to the administrative data, there were no damages caused by the earthquakes that occurred in 2003 at Puerto Plata and in 2010 in Haiti.

Block	Type of resistant	Total floor area (m²)	Number of Occupants	Final Score	Requires Detailed Structural Evaluation
I	Concrete moment-resisting frame buildings	1340 m²	222 est.	1.2	Yes
II	Concrete frame buildings with unreinforced masonry infill walls	2000 m²	334 est.	1.2	Yes
III	Concrete frame buildings with unreinforced masonry infill walls	910.12 m²	272 est.	0.6	Yes
IV	Concrete moment-resisting frame buildings	594 m²	95 est.	1.9	Yes
V	Concrete frame buildings with unreinforced masonry infill walls	652 m²	130 est.	0.5	Yes
VI	Concrete frame buildings with flexible floor and roof diaphragms	2700 m²	600 est.	0.6	Yes
VII	Concrete moment-resisting frame buildings	148 m²	40 est.	1.3	Yes
VIII	Concrete moment-resisting frame buildings	178 m²	3 est.	0.9	Yes

Quick Visual Evaluation Data Sheet

Reinforced concrete buildings in good condition, with metal furniture extensions attached to the building, others in concrete and steel. Some structures are slightly linked and connected with a large castle covered with foam and cement. Besides, in the front part of the administrative building, there are metallic designs in curved shapes. In conclusion, according to the collection of data and the seismic visual evaluation of the San Juan Bautista Institute, the structures of the buildings require a detailed structural evaluation, which tells us if structures are vulnerable to an earthquake, this is because the final score level 1, SL1 is less than 2 (cut-off limit value).

FUTURE EXPERIMENTS

Further deepen the structures of the school for to be able to contribute to the improvement, both internal and external. Also to do the Rapid Visual Evaluation to differents schools for see if the structures are vulnerable to seismic or not and be able to improve them.

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FURTHER INFORMATION

People interested in reducing the risk of natural hazards will be considering the safety of an existing school facility. Schools typically comprise more than one building, often built at different times. The seismic vulnerability of school facilities should be assessed one building at a time. Potential vulnerability includes issues with the site, issues with the structure of the building, which could lead to severe damage or even collapse, and issues with the nonstructural components and contents of the building, which can create falling hazards and internal disruption.[3]

Carbon sequestration by mangroves in the National Park Los Haitises, Dominican Republic

Pia Iturbides Buriticá
Saturday Research Academy at PUCMM

ABSTRACT

Mangroves are the key of Los Haitises eco touristic's allure. Yet, this is a secondary role compared to their role in the environment. Specifically, their role in the battle against climate change, since they ameliorate coastal erosion and the impacts of extreme events; and are important sites of sediment, carbon, nutrient, and contaminant accumulation. In order to preserve this highly productive ecosystems, this study strives to estimate the amount of carbon that *Rhizophora mangle*, the most abundant mangrove specie in los Haitises sequesters. The amount of carbon sequestered was measured by creating 3 circular plots with 7 meter radius, in which the diameter of the tree was measured. In most cases the measurement was done where the stilt roots converge into the tree, or at breast height (1.37 m). The diameter is the input of allometric equations, which establish a relationship between wood density, diameter and biomass of the mangrove. Carbon represents certain percentage of this biomass, and with the relationship between the molecular weight of CO2 and Carbon, and the amount of mangrove hectares in National Park Los Haitises, we estimate the amount of CO2 sequestered by these mangroves. Which resulted in 1,555,379,206 kg of CO2 per year.

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INTRODUCTION

According to the Climate Risk Index developed by the Germanwatch, Dominican Republic (DR) is the 12th country of the world most vulnerable to the impact of climate change. Mangrove forests, which account for 0.533% of the DR's surface area, are key in the battle against climate change. Especially due to their role as carbon sequestrators, in which they remove and store carbon dioxide from the atmosphere. As sequestrators, mangroves retain the biggest carbon pools amongst forest types (Donato et. al, 2011). And although they represent only 0.5% of the coastal area, sequester 14% of the world's oceanic carbon (Alongi, 2014). Due to their unique structure, most of the carbon they sequester is stored underground, making mangroves carbon sinks that can last for centuries (Ibid). Sadly, mangrove forests in the Caribbean are predicted to decline as sea level rises and there is little or no upland space to colonize (Alongi, 2015). Furthermore, the world lost one-third of its mangrove population in the last half of the 20th century (Alongi, 2002). In order to raise awareness of the vital role of mangroves, it is important to provide a better estimate of their impact in the Dominican Republic. In addition to the efforts of the Dominican Environmental Education Program (DEEP), this paper has strived to **estimate the quantity of carbon sequestered by mangroves in the National Park Los Haitises.**

METHODS AND MATERIALS

We followed the protocol listed by Kauffman and Donato in "Protocols for the measurement, monitoring, and reporting of structure, biomass and carbon stocks in mangrove forests" (2012):

1. First one tree is chosen to create a plot of 7m radius
2. With a measuring tape one measures the diameter at breast height (dbh) of the trees
   i. For Rhizophora mangle one measures the diameter where the roots meet
3. The diameter is the input for the allometric equations, which measure the carbon sequestered
4. The process was repeated for all of the trees of 3 plots. The plots shall be located 25 meters north from each other, attempting to follow the riverbank.
5. After the information was collected we apply the specific allometric equations, which relate **D** *(diameter at breast height)*, **p** *(wood density)*, with **B** *(aboveground biomass of tree)* or **W** *(belowground biomass)*.
6. After biomass is found we take the percentage that makes up carbon from the biomass:
   i. 39% of the belowground biomass is carbon
   ii. 48% of the aboveground biomass is

$$B = 0.722D^{1.731}$$

Figure 1. Aboveground biomass of Rhizophora mangle developed by Smith and Whelan (2006)

$$W_R = 0.199p^{0.899}D^{2.22}$$

Figure 2. Belowground biomass for common mangroves developed by Komiyama et al. (2005)

RESULTS

- We created 3 circular plots of 7 meter radius each.
  - Plot A had 43 trees with an average diameter of 8 cm
  - Plot B had 22 trees with an average diameter of 7.9 cm
  - Plot C had 57 trees with an average diameter of 5.4 cm
- We calculated Aboveground (AG) Biomass and Belowground (BG) Biomass with the aforementioned equations. Rhizophora mangle has a wood density of 0.83 gm/cm^3 (Simpson, 1996).
- In order to convert the carbon stocks to carbon Dioxide stocks we multiply by 3.67, the ratio of molecular weights between CO2 and carbon
  - Total Carbon measured → 2349 kg
  - Total CO2 measured → 8,623 kg
  - Average C per subplot → 783 kg
  - Average CO2 per subplot → 2874 kg
  - Average C per Hectare → 50,875 kg
  - Average CO2 per Hectare → 186,710 kg

Figure 3. Red mangrove in the National Park Los Haitises

	Average AG Biomass per tree	Average BG biomass per tree	Average Carbon AG	Average Carbon BG	Carbon Stock
PLOT A	35.8	23.8	17.2	9.3	26.5
PLOT B	30.6	19.9	14.7	7.7	22.4
PLOT C	15.1	7.9	7.2	3.1	10.3

Table 1. Average carbon sequestered and biomass from mangroves tallied in April 2019. All measurements in *(kilograms)*

	Area Surveyed (m2)	Avg Carbon per Hectare (kg)	Avg CO2 sequestered per Hectare (kg)
March 2017	924	98,088	359,982
February 2018	462	111,548	409,514
March 2018	616	151,920	557,545
April 2019	385	50,875	186,710
Avg. for Los Haitises Mangroves	**616**	**103,117**	**378,438**

Table 2. Summary of findings from trips

DISCUSSION

Compared to previous plots in the nearby area our findings encompassed a denser quantity of mangroves, yet the amount of carbon sequestered was smaller. This can arise due to either the lack of 2 meter radius plots or the age of the trees. Since younger trees are smaller and sequester less carbon. It is important to note that Los Haitises has undergone several reforestation campaigns and thus the population has vast age differences in certain areas.

Compared to the carbon stocks of Monte Cristi mangroves previously studied by Kauffman et. al in 2014, which ranged from 706 to 1131 t/ha, our mangroves stand at a mere 113 t/ha, clearly lacking. This might be the cause of the carbon present in components which were not measured in our study, such as dead trees, soil, saplings and seedlings, leaves and litter. These are important parts of the mangrove ecosystem that should be taken into account in future studies.

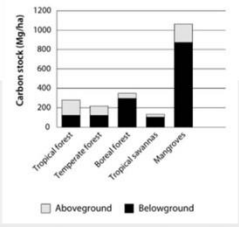

Figure 4. Total ecosystem carbon pools (aboveground and belowground) for some major land cover types of the world from IPCC (2001), Laffoley and Grimsditch (2009). (Donato et al. 2011, Kauffman et al. 2011)

CONCLUSIONS

Mangroves are key ecosystems in the fight against climate change, yet they are in grave peril. Los Haitises lost 27% of it's mangroves from 1969 to 2012, and the trend keeps rising. Sequestering 1,555,379,206 kg of CO2 per year (the equivalent of the CO2 emitted by 285,752 cars) they represent a powerful tool in our fight against climate change, one we are about to lose due to negligence.

FUTURE LINES OF RESEARCH

In order to create a more accurate estimation of the carbon stock of mangroves in Los Haitises we need to take into account 2 key considerations:

- The four different mangroves species present, we only tallied *Rhizophora mangle*
- Better sampling tools in order to take into account for canopy density and tree height, in order to compare estimates from different allometric equations

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