Project: **GISEC, Geographic Information Systems for Environment and Community**

GRANT: NVF – PIT UN – Miami Dade College – 009280

Awarded Institution: Miami Dade College

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Grant approved amount: $180,000

GISEC: **Geographic Information Systems for Environment and Community**

GISEC project was awarded by the Public Interest University Network (PIT-UN) with a grant of $180,000 for the 2019-2020 period. The main information related to GISEC is included in this report.

Proposal Summary:

> To create an academic pathway in Geographic information Systems (GIS) within an IT framework, with an environmental hazards and natural disasters risk reduction and public interest orientation. This pathway will include the creation of a College Credit Certificate (CCC) in GIS, the CCC will be a stackable component of an AS in IT; faculty development; a software platform for project learning and environmental hazard modeling and awareness; communication and relation with the community; and PIT UN network strengthening through multiple collaborations and partnerships.
>
> The goal is to enhance technological applications of public interest with an emphasis on environmental hazards awareness and community engagement in Miami-Dade County, a minority-majority urban area significantly impacted by, and at ongoing risk for, natural disasters.

Objectives:

- Increase faculty capacity in GIS and remote sensor knowledge
- Increase academic and government entities' ability to increase community awareness of environmental hazards and promote resilience building
- Strengthen partnerships among current PIT UN members and promote PIT UN to non-members
- Build academic faculty and researchers' capacity to support future program development, serve as expert consultants to governmental entities, and raise public awareness on natural disaster risk reduction and resilience

GISEC contributes to address:

Lack of minority representation in GIS workforce: While Miami-Dade County is a minority-majority community, with Hispanics representing 68.6% of the population, Black or African-Americans 18.2% and females 51.4%, there is a noticeably significant minority underrepresentation in GIS occupations. Across the county, Hispanics occupy only 23.8% of GIS positions, while Black, African-Americans and females fair worse with only 7% and 22.2% representation, respectively (EMSI, 2019).

Gap in GIS educational pipeline in South Florida: Entry into and advancement in GIS occupations requires a higher education degree. More than four of every five persons (85.9%) employed in GIS occupations have a college degree (EMSI, 2019); however, there are a lack of GIS-focused programs of study and a distinct academic pathway from high school-to-college-to-grad school for GIS in South Florida. To develop a pathway, there is also a need for faculty professional development.

Lack of public awareness disaster risk and mitigation: In a community such as South Florida where hurricanes occur almost annually and impacts of sea level rise are being felt in beachside cities populated by hundreds of thousands of people, there is a lack of community awareness of disaster impact and approaches to mitigate.

Method and Process: The main steps of this project are:

- Definition, elaboration and approval process of the GIS Technology College Credit Certificate. GIS competencies and courses; dual enrollment articulation in underrepresented areas and faculty coordination seminars.
- Articulation process: CCC with high school, inclusion in AS; articulation with BS and future articulation with graduate programs; [Relevant Work (RW) Ref 1-7]
- Creation of a Project learning- research platform. [RW Ref 8-14]
- Resilience knowledge building, networking and information sharing with students, governments, and community [RW Ref 15,16]

Other institutions working on similar projects:

Several Institutions and individuals study climate change and urban impact of environmental hazards. In Miami Dade County, most of the institutions that work on similar projects are included in the Metrolab network that promotes the Resilient 305 strategy; this network includes the Offices of Resilience of Miami Dade County and the cities of Miami and Miami Beach, Florida International University and the University of Miami. Other institutions also work on these problems, including FEMA, NOAA, The University of Florida, and several universities across the USA: Harvard University, MIT, University of Pennsylvania, University of Maryland, etc.

In GISEC, we work with several members of the Metrolab network, as well as professors of ITECH High School teacher, Golden Coast Community College.

Advance of public interest technology

GISEC advances the field of public interest technology through the development of a modeling platform for project learning, with real data capture, shows students (future members of the GIS workforce) the importance of collaboration and public responsibility to reduce vulnerability, builds resilience, and reduces the risk and impact of natural disasters.

The use of IT in the assessment of environmental risks in vulnerable areas, raising awareness of the political, ethical and societal urgency that climate change, natural disasters risk reduction and resilience building require, especially in vulnerable urban communities of Miami, is something that can be disseminated to citizens of communities – particularly those most at-risk.

GISEC benefits PIT-UN network and can be scaled to other institutions

The project benefits the PIT UN by linking PIT UN institutions in a common interest project. This cooperative project develops a networking and knowledge sharing platform among PIT UN members and institutions interested in becoming members. *GISEC* further links PIT UN to communities by enhancing attention to public interest in technological application for natural disasters risk reduction. Finally, the project engages members of the PIT UN network in creating programs that engage minorities who are underrepresented in GIS occupations. *GISEC* will also incorporate member of other academic institutions who might decide to join PIT UN.

The *GISEC* academic pipeline can be replicated by other educational institutions - particularly in areas with their own vulnerabilities to environmental disasters. The inclusion of a pilot dual enrollment program with M-DCPS iTech High School will provide the first step in expansion opportunities for other high schools in and outside Miami-Dade County. The engagement of collaborative personnel from institutions such as FIU and UM, promotes scaling to institutions that are part of PIT UN and to those that could plan to apply for membership in the network. The academic program (CCC + AS in GIS) continues to BS programs in IT and Graduate Certificate in GIS (at FIU). The academic pathway can feed FIU programs, especially those including GIS, defining a pathway from high school to graduate certificates. The modelling platform will be available at all *GISEC* collaborating institutions.

As part of GISEC, a free GIS online course was offered, oriented to a certification in ESRI-ArcGIS. The course was taught to 25 students, and allowed the dissemination of GIS, one of the objectives of GISEC.

Replication of the program

Any institution willing to replicate this project, can contact us. The College Credit Certificate, courses and competencies will be shared. The results of the risk assessment can also be shared with any educational or governmental institution willing to develop risk assessment capacities and to support community awareness of environmental treads. The approved dual enrollment process allows any high school that belongs to Miami Dade Public Schools, to join the program.

Diversity

Diversity, equity, and inclusion are woven into the fabric of the institution. In fact, when MDC opened in 1960, the student body of 1,428 students included the seven black students who made Dade County Junior, as MDC was called then, the first integrated junior college in Florida. Fast forward sixty years, MDC serves 165,000 students per year, enrolls more Hispanic undergraduate students than any other college or university in the country, and is the third largest to enroll Black non-Hispanic undergraduate students. The College is number one in the nation in Associates degrees awarded to

Hispanics and African Americans. In 2016, the College received the Higher Education Excellence in Diversity (HEED) Award from *INSIGHT Into Diversity* magazine. The HEED is the only national recognition honoring colleges and universities that exhibit outstanding efforts and success in the area of diversity and inclusion throughout their campuses. MDC embraces its mission as democracy's college, Miami Dade College changes lives through accessible, high-quality teaching and learning experiences. The College embraces its responsibility to serve as an economic, cultural and civic leader for the advancement of our diverse global community.

This project creates the opportunity to enroll students from the diverse community of Miami-Dade County, creating opportunities for currently underrepresented groups to enter the IT sector, and in particular, GIS. Minorities (primarily Hispanics and African Americans) will be able to participate in an academic pathway that is linked from high school, to college CCC and AS degree, and to BS and graduate certificates in GIS. Given the project's reach into a community that is more than two-thirds (68.6%) Hispanic and where nearly one-in-five persons (18.2%) are African-American the potential impact is significant.

Staff that developed the project:

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Results

The GISEC project has produced important accomplishments, and has surpassed its initial objectives:

a) **Academic program**: GISEC has accomplished the following goals in the creation of an academic pathway:

- Creation (preparation and approval process completed) of a College Credit Certificate at Miami Dade College in Geographic Information Systems. Approval of the Florida's Department of Education.
- Approval of Dual Enrollment articulation with Miami Dade Public Schools
- Inclusion of the CCC in the Associate of Sciences Degree of Information Technology at MDC
- Faculty development activities have taken place since December 2019. A seminar on GIS has been established and includes college and high school faculty and consultants. (December 2019 – September 2020, 28 seminars)
- Certification in GIS of an additional professor to teach advanced courses in GIS
- FAA Drone UAG pilot course with seven participants of MDC and FIU

- As an extension of the main faculty development efforts and in order to incorporate other candidates that might become part of the faculty team, other activities have been included within the framework of the GISEC project, supported by the PITUN grant, also with the purpose of expansion of the network :
  - A Free 8-week Online GIS course has been created and will begin on May 5th. 25 students have registered (and 26 more candidates asked to be included but could not be registered in this occasion). This course has allowed us to enhance and promote the network. We have invited (and included):
    - 2 members of the IT department of the local government of The City of Coral Gables, who will also open the path for internships in GIS for students.
    - One faculty of the Universidad Ana G. Mendez – Gurabo, in Puerto Rico. We have invited them to the course in order to promote the GISEC program and cooperation activities with Puerto Rico, given the high risks of natural disasters in that island.
    - A Sustainability student from the University of Florida (UF), who is graduating in summer 2020 and has shown interests in community engagement and sustainability. This will be a first step to include her in the project and to generate interchanges with faculty at UF.
    - MDC students and staff interested in GIS.
    - Two army officers
    - The rest of the 25 students include IT analysts, unemployed, and professionals willing to acquire GIS skills.
  - Cooperation with a graduate student in public policies at Carnegie Mellon University, who has asked our support for his final M.Sc. project and is working in flooding risk in Miami. He completed his M.Sc. degree and is ready to participate as professor of GIS at MDC.

b) **Project Learning and research platform**: GISEC has completed the first phase of the creation of a methodology for the assessment of the risk of urban areas impacted by hurricanes and flooding, with the goal to teach the experience to students and to reduce the risk of natural disasters. The methodology has been applied in a selected census tract and can be replicated in other areas. The activities include:

- Drone flights
- Photogrammetry and urban modeling
- Modeling and application of FEMA HAZUS methodologies at levels 1 and 2.
- Modeling and application of Hydronia for flooding analysis.
- Compilation of the required data available in the public records. Use of this data in the FEMA-HAZUS Models, detection of imperfections in the data, improvement of the data for the exposure and vulnerability assessment.
- Evaluation of risks under hurricane and flooding following deterministic and probabilistic approaches. The risk evaluation produces estimations of economic losses and social impacts.
- Preparation of the following guides: Risk Assessment, economic impact of natural disasters, Adaptation to climate change.
- In order to initiate the Project learning-research platform, equipment was purchased to create a lab, with the financial support of the PIT-UN grant, including computers, drones and required support supplies.

c) **Community and local government**. Miami Dade College is one of the members of the MetroLab network, that includes the Offices of Resilience of Miami Dade County and the cities of Miami and Miami Beach,

Florida International University and the University of Miami. This network leads the Resilient305 strategy for the development of the resiliency in the Great Miami and the Beaches (www.resilient305.com). The activities developed with the GISEC project have generated contributions to the network and to the resiliency efforts in the region. Several meetings have been held in order to develop the strategies that support the community with the main goal to reduce the risks of natural disasters in Miami, FL, an area directly impacted by environmental hazards including hurricanes and sea level rise.

Continuation of the Project:

GISEC project will continue in a second phase: GISEC 2, that has obtained financial support form the PIT-UN for the expansion of the project.

Academic program:

GISEC2 will integrate a career pipeline in GIS, linking the CCC with dual enrollment with High Schools, and the already approved articulation with the Associate of Sciences degree in IT at MDC, with the Bachelor of Sciences in IT at MDC. It includes as one of its goals, the articulation with a graduate Certificate in GIS at Florida International University. This effort will create a complete educational pathway for students from high school to graduate studies and will fill a gap in GIS educational pipeline in South Florida, with a special orientation to include minorities who are underrepresented in GIS occupations.

GISEC2 will work with the members of the MetroLab Network including the offices of resilience of Miami-Dade County and the cities of Miami, Miami Beach, FIU and UM, and the City of Coral Gables. All this cooperation will create internship opportunities for students in local governments.

GISEC2 will benefit PIT-UN by linking PIT-UN institutions in a common interest project and enhancing the participation of governments and NGOs. The project develops a knowledge sharing platform among PIT-UN members and links members to communities and governmental institutions by enhancing attention to public interest in technological application for natural disaster risk.

The academic pipeline generated by GISEC2 can be replicated in other educational institutions, particularly in areas with environmental disaster vulnerabilities. The inclusion of a dual enrollment program with Miami-Dade County Public Schools' iTech High School provides the first step in expansion opportunities for other high schools in and outside the county. GISEC2 is taking the first steps to develop cooperation with Ana G. Mendez University in Puerto Rico.

GISEC2 will enroll students from the diverse community of Miami-Dade County, creating opportunities for underrepresented groups to enter the IT sector, and in particular, GIS. Minorities (primarily Hispanics and African Americans) will be able to participate in an academic pathway. Internships in local governments will be created for students, preparing them to apply for jobs in GIS. Given the project's reach into a community that is more than two-thirds (68.6%) Hispanic and where 18.2% are African American the potential impact is significant. The cohorts will be mainly composed of students that belong to the dual enrollment program with iTech High School, which is located in Little Haiti. Little Haiti has a population of 28,346 people of which 73.4% are Black and 19.9% Hispanic.

Project learning and research platform: In relation to the project learning and research platform, GISEC2 performs the following tasks:

About the data: The data component of GISEC2 is related to the creation of models that will allow a more precise assessment of the risks due to environmental hazards. Improving data using remote sensing with high resolution (drones) will generate more precise data than the one available in FEMA-HAZUS. Improved data will lead to more precise urban and vulnerability models that will generate more accurate risk results under environmental threads.

In GISEC1 (year 2020) we developed the methodology needed to generate improved urban models. This methodology will be used for an expanded zone and will be improved further by the creation of additional data processing strategies. In GISEC1 we used drone flights data that produced models with higher accuracy than the ones included in FEMA-Hazus. Drone data generate more precise assessment of vulnerability characteristics, instead of global averages that is the data included in Hazus. High precision data (precision: ±0.06ft ; GSM=0.7in; RMS=0.034 ft) will be obtained from expanded areas and will improve the models and risk assessments, and will allow the use of Hazus levels 2 and 3. This will lead to better results than the ones available in Hazus level 1. Assessments of flooding risk have shown the need to improve FEMA's analysis [RW Ref 8,9].

GISEC2 will also explore in Social Vulnerability and Global Resilience indexes for communities.

Data/Research Plan

- Selection of target zone
- Running GPS references and drone flights to generate data
- Photogrammetry analysis
- Data processing and generation of Urban and Vulnerability models
- Definition of deterministic and probabilistic hazard scenarios
- Running models (hurricanes, flooding, earthquakes, tsunamis)
- Analysis of results
- Conclusions

Relevant Work

This section includes references that support the content of the GISEC project.
GISEC has two main axes: Career building focused on minorities and Institutional building

1. **Career building focused on minorities:** This aspect of GISEC includes the following steps:
   1.1. College Credit Certificate in GIS Technology (CCC in GIS) (21credit). See REF.1: www.mdc.edu/entec/grants/gisec.aspx
   1.2. Dual enrollment articulation with High Schools; in particular with ITech Magnet High School. REF.2: www.itechhighschool.com
   1.3. The A.S. Degree in Computer Information Technology includes the CCC in GIS as part of the program. REF.3: https://www.mdc.edu/computerinformationtechnology
   1.4. The next step in the career will be the articulation of the B.S Degree in IT. REF.4: https://www.mdc.edu/informationsystems/
   1.5. A graduate certificate in GIS will be the following articulation step, that will be developed with FIU. REF.5: https://case.fiu.edu/earth-environment/graduate-certificate-in-gis/
   1.6. Internships with the Office of Resilience of Miami Dade County (REF.6 http://www.miamidade.gov/global/economy/resilience/home.page) and the IT department of the City of Coral Gables (REF.7: https://www.coralgables.com/departments/InformationTechnology)

2. **Institutional Building:** Includes the following:

2.1. **Platform**: One of the main goals of GISEC is to expand the project learning platform for environmental risks simulation that will support the GIS courses. The platform will generate environmental awareness among students, faculty, staff and communities, and will support the efforts developed by the Office of Resilience of Miami Dade County, together with the members of the MetroLab Network (Offices of Resilience of Miami Dade County, and the cities of Miami and Miami Beach, and FIU, UM and MDC) already defined in the Resilience Strategy (Resilient 305).

2.1.1. The phase 1 of the modeling platform developed in GISEC-1 was mainly supported on data included in FEMA-Hazus Models. GISEC-2 will improve the data by using remote sensing with high resolution (drones). Improved data will lead to more precise urban and vulnerability models that will generate more accurate risk results under environmental threads and will also allow the use of Hazus levels 2 and 3 (more precise methodologies that require locally assessed data). This will lead to better results than the ones available in Hazus level 1. As an example, flooding risk evaluations conducted by First Street Foundation states: "At the national level, the First Street Foundation Flood Model identifies around 1.7 times the number of properties as having substantial risk compared to the FEMA 1-in-100 SFHA designation. This equates to a total of 14.6 million properties across the country at substantial risk, of which 5.9 million properties and property owners are currently unaware of or underestimating the risk they face because they are not identified as being within the SFHA zone." See REF.8: https://drive.google.com/file/d/1rJdWJqGY2TYGkObTlFVTUguN1KHr1pB8/view?us%20p=sharing pag.9 and REF.9: https://drive.google.com/file/d/1entyn1xRgXcMa9fGd8ujdo4st-a7qgGe/view

2.1.2. A summary of the procedures employed for data capturing using drones includes: the target zone of phase 1, sUAS platform, field work, deliverables, 3D model, high resolution orthomosaic, building footprints in GIS, digitalization of shoreline elevation, photogrammetry. REF 10: https://drive.google.com/file/d/1FzLKnz8n6OfT2FltBlYQP5rDDLE3Zmzn/view

2.1.3. The main support for the assessment of the environmental risks are the HAZUS technical manuals and software developed by FEMA that describe technical features and guides for the analysis of risks related to Earthquakes, Hurricanes, Floods and Tsunamis. See REF.11: http://www.fema.gov/hazus-mh-user-technical-manuals

2.1.4. In GISEC we have developed several guides that support the risk assessment procedures employed in the Risk Simulation Platform. One of them is included as reference. See REF.12: https://drive.google.com/file/d/1SRMhTT3X5LGSjMW_U3p3nyWsT53b2DHJ/view?%20usp=sharing

2.1.5. Hydronia is employed for flooding analysis REF.13 http://www.hydronia.com/

2.1.6. Analysis of the economic assessment of the impacts of natural disasters: REF.14 https://drive.google.com/file/d/14IlsfzoEmMtGHrS0nDiXDuI-PDygDV3s/view?%20usp=sharing

2.2. **Networking:** GISEC2 includes a strong component of networking, with a PIT- UN member: Florida International University, with Miami-Dade Public Schools, and in particular with ITech High School, with NGO's that promote education in underrepresented communities (see collaborating institutions and letters of support) and with the members of MetroLab Network; see REF.15:

https://metrolabnetwork.org/%20miami-profile/ . MetroLab Network is led by the Office of Resilience of Miami Dade County and has a comprehensive strategic plan for the development of a culture of resilience in the Great Miami and the Beaches, as well as the articulation of several initiatives with local institutions and communities; see: REF. 16 https://resilient305.com/