**NASA DEVELOP National Program**

**2018 Summer Project Proposal**

**Georgia – Athens**

**Honduras Ecological Forecasting**

*Utilizing NASA Earth Observations to Develop a Forest Change Detection Tool for Land Conservation in Honduras*

**Project Overview**

***Project Synopsis*:** The Honduran Institute for Forest Conservation (Instituto de Conservación Forestal - ICF) is responsible for monitoring millions of acres of forested areas on private and publicly owned lands. There is a need for a local, higher resolution, and up-to-date forest monitoring product for the forests of central Honduras. Assessing land use changes in remote areas is often difficult, time-consuming, and costly. This project will create a localized decision-support tool in Google Earth Engine (GEE) to streamline the assessment of land use changes using existing boundaries of conservation areas and remotely sensed data from several Earth observations. Using Landsat, MODIS, and Sentinel data, this tool will leverage existing GEE code along with local data to help identify locations of land use changes and improve the effectiveness of ICF forest conservation efforts. This methodology used in this project has broader potential value to other ICF programs that have monitoring responsibilities and can benefit from having a standard remotely sensed change detection tool.

***Community Concern:*** By creating and managing conservation areas, the ICF attempts to protect forested land and mitigate impacts to threatened and endangered species while promoting sustainable forestry. Although conservation areas are increasingly common and have been successful in the past few decades, there are no independent business processes or tools in place to evaluate these areas and determine the extent of potential disturbances. However, limited resources in staff and expertise can result in inadequate follow-ups on independent monitoring. These checks are often critical to ensure conservation areas are undisturbed by a multitude of threats including invasive species or anthropogenic sources.

***Source of Project Idea:*** This project was first suggested by Otto Castillo from Zamorano University. The project was further developed out of a meeting between members of the Institute for Forest Conservation and DEVELOP.

***National Application Area Addressed:*** Ecological Forecasting

***Study Location:*** Central Honduras

***Study Period:*** January 1995 – May 2018

***Advisors:*** Dr. Kenton Ross (NASA Langley Research Center), Dr. Marguerite Madden (University of Georgia)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Instituto de Conservación Forestal (Honduras) | Hector Lagos, Head of Forest Monitoring | End User | No |
| Zamorano University | Otto Castillo, Research Scientist  Alexandra Manueles, Assistant Professor of GIS and Remote Sensing | Collaborator | Yes |

***End-User Overview***

***End User’s Current Decision-Making Process:***

The Honduran Institute for Forest Conservation uses remote sensing for monitoring millions of acres of forested areas on private and publicly owned lands. These findings help the ICF form management plans and set budgets for conservation plans. Assessing and validating land use changes in remote areas is often difficult, time-consuming, and costly.

***End User’s Capacity to Use NASA Earth Observations:***

Instituto de Conservación Forestal (Honduras)– The end user is familiar with GIS and NASA Earth observations, and currently implements several types of remotely sensed data in their decision-making processes. However, the broader application of this project’s results must account for varied levels of GIS and remote sensing capabilities, and build capacity within biologists and program managers involved with the ICF who lack proficiency with GIS applications.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

*Zamorano University* – The collaborators are familiar with GIS and NASA Earth observations, and currently

offers courses and training on the use of remotely sensed data for decision-making processes. The collaborator will help with ancillary data acquisition and processing. Additionally, Zamorano University can incorporate techniques developed in this proposal as part of their teaching curriculum.

***Dissemination by Boundary Organizations*:**

*Zamorano University* – Zamorano University is a world renowned learning center with students from all over Latin America that promotes a hands-on learning approach. Through their GIS & remote sensing lab, Zamorano University plans to incorporate techniques developed in this proposal as part of their teaching curriculum and plans to apply the methodology to other regions in country, thus aiding ICF and similar agencies within the country.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The Project Lead will be the main point of contact for the project during the term and the Center Lead will act as a secondary point of contact. The team will communicate with the project partners weekly via email to provide updates on project progress and to ask questions as needed. Weekly teleconferences or video calls will also be used to have more discussion about project methodology and results.

***Transition Plan*:** An initial project hand-off will occur at the end of the term, during which maps and other visuals will be given to the partners. The decision-support tool will be released to the partners once the software release process is completed.

***Letters of Support*:** Ing. Misael León, Executive Director, Honduran Institute for Forest Conservation

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Landsat 5 TM** | Surface Reflectance | Landsat 5 TM products will be used to assess land use change through spectral indices in specific testing regions in Honduras, and to create normalized burn ratio for masking fires. |
| **Landsat 7 ETM+** | Surface Reflectance | Landsat 7 ETM+ products will be used to assess land use change through spectral indices in specific testing regions in Honduras, and to create normalized burn ratio for masking fires. |
| **Landsat 8 OLI** | Surface Reflectance | Landsat 8 OLI products will be used to assess land use change through spectral indices in specific testing regions in Honduras, and to create normalized burn ratio for masking fires. |
| **Terra MODIS** | Vegetation Continuous Fields | The MOD44B.005 Vegetation Continuous Fields product will be used to help compare to Landsat-based results. |
| **Sentinel-1 C-SAR** | Backscatter | Sentinel-1 products will be used to compare with Landsat-based results. |
| **Sentinel-2 MSI** | Surface Reflectance | Sentinel-2 products will be used to compare with Landsat-based results. |

***Ancillary Datasets:***

Hansen Global Forest Change – validate Landsat based results

Global Forest Watch FORMA 500/250 deforestation alerts – validate Landsat based results and regions of interest.

ICF Geoportal Forest cover maps – validate Landsat based results

***Software & Scripting:***

Google Earth Engine API – manipulate data, create methodology

Esri ArcGIS – manipulate data, create visuals

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Landscape Anomaly Detection Tool** | This decision-support tool will assess landscape disturbances in conservation areas. Areas flagged with moderate- to large-scale disturbance will help focus program managers’ *in situ* monitoring efforts. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, MODIS, Sentinel-1 C-SAR, and Sentinel-2 MSI data will be processed to create spectral indices and then differenced from a threshold standard to determine moderate and large changes. | III |
| **Land Use Change Maps** | Annual land use change maps will be used to assess potential trends in land use change across Habitat Conservation Plan areas. They will also be used to determine the validity of the decision-support tool. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, MODIS, Sentinel-1 C-SAR, and Sentinel-2 MSI data will be processed to create spectral indices and then differenced from a threshold standard to determine moderate and large changes. | I |

***End-User Benefit*:** The ICF does not currently have an efficient way to evaluate conservation areas for disturbance. This decision-support tool would be the first step in establishing an independent assessment of conservation area resiliency to moderate- and large-scale disturbances using remotely sensed data, which will save ICF staff travel time and efforts. Furthermore, the tool can be reformatted to use other inputs beyond conservation areas, and thus could be utilized broadly across the agency.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2 Terms: 2018 Summer to 2018 Fall

***Multi-Term Objectives:***

* **Term 1 (Proposed Term):** 2018 Summer (GA) – Honduras Ecological Forecasting
  + The first term of this project will focus on developing a detection methodology for moderate- and large-scale forest disturbance for specific locations within Honduras. Additionally, this term will assess the various data sources (MODIS, Landsat, and Sentinel) for the most effective data to continue using for the decision-support tool. The creation of initial maps and time series will be used to enhance partner feedback on the tool.
* **Term 2:** 2018 Fall (GA) – Honduras Ecological Forecasting II
  + The second term of this project will focus on refining the methodology and creating the decision-support tool. More specifically, additional selection tools, outside validation inputs, exporting features, and predictive land cover maps are desired by the end user. The team will create an interface to allow users with less programming experience to efficiently utilize the tool. Additionally, the team will create a tutorial and workflow for dissemination within the ICF for continued use of the tool. If time permits, this project will explore the use the Open Data Cube technology to conduct studies of an active deforestation region in Honduras.

***Related DEVELOP Work:***

2017 Summer (LaRC) - Pacific Southwest Cross-Cutting II: Assessing and Improving Detection of Cover Changes in Habitat Conservation Plan Areas Using NASA Earth Observations

2017 Fall (LaRC) - Pacific Southwest Cross-Cutting II: Assessing and Improving Detection of Cover Changes in Habitat Conservation Plan Areas Using NASA Earth Observations

2018 Summer (LaRC) – Colombia Ecological Forecasting: Utilizing the Open Data Cube to Develop Deforestation Application Products for Colombia

**Notes & References:**

***Notes*:** This project is aligned with the AmeriGeoss 2016-2025 Strategic Plan and falls within its Biodiversity and Ecosystem theme.