**NASA DEVELOP National Program**

**2017 Fall Project Proposal**

**Alabama - Marshall**

**North Alabama Ecological Forecasting**

*Spatial Modeling of the Fragmentation of Riparian Species Habitat from the Overtaking of North Alabama Agricultural and Forested Lands by Increasing Urbanization*

**Project Overview**

***Project Synopsis*:** Urbanization in rural areas of western Madison and eastern Limestone counties of northern Alabama is altering the natural makeup of the landscape. Commercial development has increased over the past 30 years in this region. This project addresses this issue by using Landsat data, hydrological and urbanization models, field data, and SEDAC population data to map changes in the landscape. These indices will also be used to make development trend predictions for this area which will assist the Land Trust of North Alabama in determining areas they should procure for conservation efforts.

***Community Concern:*** The Land Trust of North Alabama’s mission is to preserve and protect land and its legacies, including wildlife habitats, farms, historic sites, waterways, and mountains for conservation, public recreation, and environmental education to enhance quality of life in North Alabama. A recent urbanization boom in Madison County highlights the challenges and necessity for the Land Trust to expand its conservation efforts into neighboring Limestone County. Commercially developed lands compete with the natural hydrological cycle, affecting farmers and the existing population, as well as the flora and fauna.

***Source of Project Idea:*** This project originated from a conversation between Marshall’s Science advisor, Dr. Robert Griffin and Executive Director to the Land Trust of North Alabama, Marie Bostick.

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

***Study Location:*** Alabama (AL)

***Study Period:*** 1985 –2017; Forecasting to 2045

***Advisors:*** Dr. Jeffrey Luvall (NASA Marshall Space Flight Center), Dr. Robert Griffin (University of Alabama in Huntsville), Leigh Sinclair (University of Alabama in Huntsville/Information Technology and Systems Center)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Land Trust of North Alabama | Marie Bostick, Executive Director | End User | No |

***End-User Overview***

***End User’s Current Decision-Making Process:***Land Trust managers currently use extensive field work and *in situ* measurements to track development in their territory. They use their surveys work with local governments to procure land that can be preserved from commercial development. Results from this project can be used as a supplement to these surveys to provide a more accurate assessment of development in their territory

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

*Land Trust of North Alabama* – The Land Manager and other faculty at the Land Trust of North Alabama have shown a familiarity with NASA Earth observations such as Landsat, MODIS, and VIIRS, but don’t currently have the capacity to perform such analysis. At the moment, resources are mainly allocated for field surveys and data collection.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Communication will begin with the team and the Land Trust of North Alabama via the team lead of the project during the first week of the term. Weekly or bi-weekly meetings will be held in-person or over telecons during the term considering the close proximity of MSFC to the Land Trust.

***Transition Plan*:** Currently, plans have been setup to invite the Land Trust to the closeout at MSFC. It is here that this team will present their findings to the project partner in person, as well as hand off the project data and deliverables. The main DEVELOP POC will be the team lead.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 5 Thematic Mapper (TM)** | Surface reflectance | This dataset provides the temporal and spatial resolution required to model the progression of development in the study area with imagery beginning in 1985. |
| **Landsat 8 Operational Land Imager (OLI)** | Surface reflectance | This dataset provides the temporal and spatial resolution required to model the progression of development in the study area with imagery beginning in 2013. |
| **SRTM Version 3** | Elevation | This dataset will be used to derive topographic indices for modeling hydrological features. |
| **Sentinel-2 MultiSpectral Instrument (MSI)** | Surface reflectance | This dataset will provide land cover change for environmental monitoring as well as inland water monitoring. |

***Ancillary Datasets:***

Land Trust of North Alabama – *in situ* data – provides physical boundaries for property owned by the Land Trust.

NASA – Socioeconomic Data and Application Center Data Set (SEDAC) – provides population density data at 1 km resolution to identify areas with a projected increase in population density.

US Geological Survey (USGS) – National Land Cover Database (NLCD) – mapping change in the landscape over time.

US Department of Agriculture (USDA) – CropScape – mapping change in the landscape over time.

***Modeling:***

Fuzzy Logic Model (POC: Maggi Klug, NASA DEVELOP)

***Software & Scripting:***

Esri ArcGIS 10.4 – Landsat imagery processing, indices derivation, map production

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Landscape Fragmentation Map | This product can display the changes in development of the landscape in the study area over time to show the risk of urbanization to local lands. | Data from Landsat 5 TM and Landsat 8 OLI, SRTM v3, Sentinel-2 MSI, and the Land Trust’s field data will be used to identify local species’ habitats that have been fragmented due to urbanization. | N/A |
| Urbanization Model Algorithm | The end user can use this algorithm to identify areas that have the qualities of land susceptible to increased commercial development in the study area. | This algorithm will be created to use numerous parameters, including adjacency to developed or agricultural areas and proximity to roads, to classify areas that are at risk of urban development. Data used to create this are derived from Landsat 5 and 8, SRTM v3, Sentinel-2 MSI, and the Land Trust’s field data. | N/A |
| Urbanization Prediction Tool | This tool will be used to assist the Land Trust in predicting what areas of land is at the most risk for development. They can use this to identify what species habitats are predicted to be fragmented by development. The hope is for these findings to be able to provide reasoning for the protection of forested and agricultural lands in North Alabama. | The Urbanization Algorithm will be applied in this ArcGIS tool that will be created through Model Builder using Fuzzy Logic Modelling. The tool will allow the user to show a predicted development threat on habitats based on user-input severity levels of urbanization. Data used to create this are derived from Landsat 5 and 8, SRTM v3, Sentinel-2 MSI, and the Land Trust’s field data. | N/A |

***End-User Benefit*:** The products of this research will allow the Land Trust of North Alabama, located in Madison County, to build a relationship with government officials in Limestone County by highlighting the need for mitigating over development in the area. Furthermore, the urbanization prediction tool will empower the Land Trust by providing them with an automated resource that they currently cannot afford to pay someone to develop.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Fall

***Related DEVELOP Work:***

2015 Fall (MSFC) – North Mexico Ecological Forecasting: Using NASA Earth Observations to Monitor and Manage Ocelot Habitat Loss in North Mexico

2015 Summer (GA) – Ocmulgee Ecological Forecasting: Utilizing NASA’s Earth Observations for Forecasting Land Use Change and Wildlife Disturbances along the Ocmulgee River Corridor