**NASA DEVELOP National Program**

**Alabama - Marshall**

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*Project Summary – Fall 2017*

**North Alabama Ecological Forecasting**

*Spatial Modeling of the Fragmentation of Local Species Habitat from Increasing Urbanization in North Alabama*

**VPS Title:** Trust Me! Projecting Urban Growth’s Impact on Local Species Habitat in North Alabama Using Remote Sensing

**Project Team**

***Project Team*:**

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Helen Baldwin-Zook

Emily Kinkle

***Advisors & Mentors*:**

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)

***Other Contributors*:**

Maggi Klug

Dashiell Cruz

**Project Overview**

***Project Synopsis*:** Increased commercial development and urbanization in rural areas of western Madison and eastern Limestone counties of northern Alabama are altering the natural makeup of the landscape. This project addresses this issue by using Landsat data, hydrological and urbanization models, field data, Shuttle Radar Topography Mission data, and Socioeconomic Data and Applications Center (SEDAC) population data to map changes in the landscape that result in changes in the ecology of the area. These data sets will 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.

***Abstract*:**

Alabama is one of the four most biodiverse states in the United States, and has greatest diversity of aquatic species of any state in the U.S. This biodiversity is at risk as urbanization increases in Alabama. The Land Trust of North Alabama works to preserve green space and encourages stewardship through environmental education. The North Alabama Ecological Forecasting team partnered with the Land Trust of North Alabama to identify areas critical to maintaining local species habitat within Madison and Limestone counties. As urbanization increases within these counties, essential habitats are threatened. To identify where land cover changes are occurring and areas are most vulnerable to urbanization, the North Alabama Ecological Forecasting team conducted a supervised classification of land class types utilizing data from Landsat 5 Thematic Mapper (TM), Landsat 8 Operational Land Imager (OLI), and Shuttle Radar Topography Mission Version 4 (SRTM). The team then used the classification along with other parameters to produce an Urbanization Model Algorithm, Urbanization Prediction Tool, and a Landscape Fragmentation Map. These tools will enable the Land Trust of North Alabama to target land for acquisition and subsequent preservation and stewardship.

**Keywords:**

Remote sensing, Landsat 8, Landsat 5, land use, urban growth, biodiversity, North Alabama, SRTM

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

***Study Location:*** Madison and Limestone counties, AL

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

***Community Concern:***

* Limestone County is expected to have an urbanization boom in the coming years, creating the need for the Land Trust of North Alabama to expand its conservation efforts.
* Commercially developed lands compete with the natural hydrological cycle, affecting farmers and the existing population, as well as the flora and fauna.
* Without sufficient conservation efforts, many different species in the area could be put at risk, including 30 threatened and endangered species.

***Project Objectives:***

* Use Landsat data, SRTM data, hydrological and urbanization models, field data, and SEDAC population data to project changes in the landscape
* Use these parameters to make development trend predictions for Madison and Limestone county to assist the Land Trust of North Alabama in determining areas to procure for conservation efforts
* Provide the Land Trust of North Alabama with an automated tool that they currently do not have the resources to obtain
* Produce useful tools for the Land Trust of North Alabama to aid in decision making in regards to conservation efforts

**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 |

***Decision Making Practices & Policies***:

Current decision making practices for the Land Trust of North Alabama rely heavily on field studies and outsourced or volunteer research. The studies and research conducted are used to approach local land owners in efforts of gaining the rights to the land through either direct purchase or donation. Once the land is obtained, the Land Trust of North Alabama can work to preserve and protect areas of interest that are home to threatened or endangered species. There are some restrictions in place at the federal level, such as a building restriction on flood plains mandated by the Federal Emergency Management Agency. However, The Land Trust of North Alabama works to preserve land that would otherwise be available for development. They currently use field studies and independent research to determine areas for preservation.

***Project Benefit to End User***:

The deliverables, data, and maps that this project will present to the Land Trust of North Alabama will allow the Land Trust to more accurately determine areas that are in need of protection. This location analysis of critical species and their habitats will allow for a much stronger argument for land acquisition as well as influence policy that helps maintain preservation in these areas. The Land Trust of North Alabama expressed a strong desire to obtain information on forecasted urban development, particularly in Limestone County, so they can funnel the necessary resources to protect as much of the environment as possible before large scale development begins in the flourishing county. The generation of a broader urban growth analysis over Madison and Limestone counties will allow the Land Trust to better understand growth patterns that can be more readily available as opposed to costly small-scale field studies. The addition of a low cost, easily replicable methodology for determining urban growth in Limestone and Madison counties will allow for more resources to be focused on the preservation of these critical habitats and species.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Landsat 5 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 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** | Elevation | This dataset will be used to derive topographic indices for modeling hydrological features. |

***Ancillary Datasets:***

eBird Basic Dataset Cornell Lab of Ornithology – bird distribution and abundance

Land Trust of North Alabama Property Shapefile – physical boundaries for property owned by the Land Trust

NASA Socioeconomic Data and Application Center (SEDAC) Dataset – population density data at 1 km resolution

USGS National Land Cover Database (NLCD) – land cover and land cover change at the Landsat Thematic Mapper (TM) 30-meter resolution

USDA CropScape – crop-specific land cover data at from moderate resolution satellite imagery and agriculture ground-truth

***Modeling:***

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

***Software & Scripting:***

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

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Earth Observations Used**  | **Partner Benefit & Use** | **Software Release Category** |
| **Landscape Fragmentation Map** | Landsat 5 TM, Landsat 8 OLI, SRTM | This product displayed the changes in landscape in the study area over time to give the Land Trust information about historical impacts of urbanization. | N/A |
| **Urbanization Model Algorithm** | Landsat 5 TM, Landsat 8 OLI, SRTM | This algorithm incorporated urbanization indicators, including adjacency to developed or agricultural areas and proximity to roads, to classify areas that are at risk of development. This algorithm identifies areas susceptible to increased commercial development, providing data for the Land Trust to utilize in their acquisition process. | N/A |
| **Urbanization Prediction Tool** | Landsat 5 TM, Landsat 8 OLI, SRTM | This tool was created utilizing the Urbanization Algorithm and Fuzzy Logic Modeling in the Model Builder in ArcGIS. This tool assists the Land Trust in predicting what areas of land are at greatest risk for development. These findings provide a premise for the selection of specific lands for protection by the Land Trust. | N/A |

**Project Handoff Package**

**Transition Plan:**

At the conclusion of the term, the North Alabama Ecological Forecasting team will meet directly with the Land Trust of North Alabama at their office in Huntsville, AL. During this meeting, end-products will be exchanged and results drawn from the research discussed. The partner’s engagement throughout the term will provide for a smooth transition and clear explanation of all end-products. Our project partners will also be invited to attend a closeout presentation conducted at the National Space Science and Technology Center, which will cover the project more broadly for local representatives of the Earth Science branch.

**Team POC:** Nicholas McVey, nam0014@uah.edu

**Partner POC**: Marie Bostick, marie@landtrust.org

**Handoff Package:**

* Land Use Classification Maps from multiple years in the study period
* Landscape Fragmentation Map
* Urbanization Model Algorithm
* Urbanization Prediction Tool
* Tutorials details use and utilization of each data process being presented

**References:**

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