Georgia Energy III

Identifying Habitat and Solar Site Conflict in Georgia by Developing an Environmental Sensitivity Public Mapping Tool

Project Team

Project Team:
Samantha Trust (Project Lead)
Alexander Burke
Jannatul Ferdush
Vineeth Jason Putti

Advisors & Mentors:
Dr. Marguerite Madden (University of Georgia)

Past or Other Contributors:
Lynn Abdouni
Emad Ahmed
Amanda Aragón
Natalia Bhattacharjee
Roger Bledsoe
Marie Bouffard
Christopher Cameron
Fabiola Clermont
Peter Hawman
Nick Morgan
Caren Remillard
Suravi Shrestha
Austin Stone

Team POC: Samantha Trust, s.trust18@gmail.com
Partner POC: Amy Gutierrez, amy.gutierrez@tnc.org

Project Overview

Project Synopsis:
Over the past decade, the solar energy market in the state of Georgia has rapidly developed. As a result, the habitats of critical species, such as the gopher tortoise (*Gopherus polyphemus*) and the American black bear (*Ursus americanus*), have been compromised. This has resulted in the need for a proactive, environmental impact-focused tool to improve solar farm development in a sustainable manner. Using NASA Earth observations, this project produced conflict maps for potential solar sites and environmentally sensitive areas as well as a publicly available web application which will allow our partners at The Nature Conservancy and the Georgia Department of Natural Resources to inform stakeholders in the Georgia solar industry about the locations of critical habitats.

Abstract:

The rapid expansion of the solar industry across the state of Georgia has a detrimental effect on the habitats of keystone and threatened species, such as the gopher tortoise (*Gopherus polyphemus*) and the American black bear (*Ursus americanus*). NASA DEVELOP collaborated with the Georgia Chapter of The Nature Conservancy (TNC) and the Georgia Department of Natural Resources to continue the research from two previous NASA DEVELOP projects in 2017. The team worked to assess the conflict between solar suitability and environmentally sensitive areas with the Land-Use Conflict Identification Strategy (LUCIS) and to determine how conflict has changed since the 2017 analysis. The project utilized Terra/Aqua Clouds and the Earth's Radiant Energy System (CERES) satellite data and other ancillary datasets to conduct and compare a general statewide LUCIS analysis from 2017 to 2019 and to complete an in-depth LUCIS analysis of Georgia's fastest-growing solar counties—Taylor, Twiggs, Decatur, and Brooks. The analysis indicated that between 2017 and 2019, the entire state saw high conflict areas increase by 38%. Project partners will use these findings to target areas for promotion of conservation policy and education efforts. The team also provided the TNC with a publicly available web application, called the Environmental Sensitivity Mapping Tool (ESMT), that can be updated as new data are released. The ESMT will be used to educate interest groups, such as solar developers and conservationists, to help them recognize and mitigate the negative effects of solar development on the environment.

Key Terms:
solar energy, gopher tortoise, American black bear, Terra/Aqua CERES, LUCIS, web application

National Application Area Addressed: Energy
Study Location: GA
Study Period: July 2017 to December 2019

Community Concerns:
- The rapid pace of utility-scale solar power development in the state of Georgia (30-45% annually) has made Georgia the 5th largest solar energy producer in the United States, creating more opportunities for a large-scale solar array installation. Such installations significantly alter the development sites and pose a threat to biodiversity, critical habitat, and the environment.
- Georgia counties, such as Taylor, Twiggs, Decatur, and Brooks, have observed a rapid increase in solar farm development. Assessment of siting for future solar farms and their impacts on gopher tortoise and American black bear habitats is needed for planning sustainable utility-scale solar farms.
- Endangered species habitats, land use and land cover, and environmental risks to critical wildlife need to be considered by stakeholders when selecting solar development sites in Georgia.

Project Objectives:
- Compare Land-Use Conflict Identification Strategy (LUCIS) analyses for utility-scale solar farms and environmentally sensitive areas across the state of Georgia in 2017 and 2019

- Perform an in-depth solar site suitability analysis in Taylor, Twiggs, Decatur, and Brooks counties
- Utilize LUCIS to highlight areas of conflict between areas suitable for solar development and environmentally sensitive areas in 2017, 2018, and 2019
- Provide decision-makers with user-friendly data tools to assist in visualizing and selecting sustainable solar development sites

Previous Terms:
2017 Fall (GA) – Georgia Energy II
2017 Summer (GA) – Georgia Energy

Partner Overview

Partner Organizations:

Organization	POC (Name, Position/Title)	Partner Type	Boundary Org?
The Nature Conservancy, Georgia Chapter	Amy Gutierrez, Climate and Lands Coordinator	End User	Yes
Georgia Department of Natural Resources	Matt Elliott, Assistant Chief, Wildlife Conservation	Collaborator	Yes

Decision-Making Practices & Policies:
The Georgia Chapter of The Nature Conservancy (TNC) uses the "Conservation by Design" framework for decision making and planning for conservation projects. This framework focuses on making decisions utilizing science-based knowledge and data from on-the-ground surveys, remote sensing (most often from freely available sources), or expert opinion. In addition, the TNC works with stakeholders to implement their input in the development of project goals and implementation strategies. By inviting various stakeholders to the discussion, the TNC can help reduce potential conflicts between interest groups and work toward a shared goal of conservation and sustainable practices. Project investments are overseen by senior managers within the TNC to ensure sound financial practices are utilized and project outputs are monitored. Additionally, stakeholders are required to comply with federal and state regulations. Applicable federal statutes often include the Clean Water Act, the Endangered Species Act, and the National Environmental Policy Act (NEPA).

Earth Observations & End Products Overview

Earth Observations:

Platform & Sensor	Parameter	Use
Aqua CERES	Cloud cover	NASA Prediction Of Worldwide Energy Resources (POWER) processed solar radiance data from Aqua CERES was used as an indicator for solar farm suitability and potential.
Terra CERES	Cloud cover	NASA POWER processed solar radiance data from Terra CERES was used as an

		indicator for solar farm suitability and potential.

Ancillary Datasets:

- Federal Emergency Management Agency (FEMA) National Flood Hazard Layer – Current effective flood zone data used as an input for the LUCIS models
- Georgia Department of Natural Resources Conservation Lands Layer – Provided the locations of conservation lands for a layer in the classifications and tool
- Georgia Department of Natural Resources Land Trusts Layer – Provided the locations of lands managed by land trusts for a layer in the classifications and tool
- Georgia Department of Natural Resources Protected Lands Layer – Provided the locations of protected land for a layer in the classifications and tool
- Homeland Infrastructure Foundation-Level Data (HIFLD) – Nationwide infrastructural data, such as transmission lines, used as input for LUCIS models
- LogicCore Parcel Point Data – Provides county-level parcel data to assist with LUCIS analyses
- *Space Use and Predictive Habitat Models for American Black Bears in Central Georgia, USA*, a thesis from Master of Science Kiersten Cook – Provided data and maps used to create a data layer for black bear habitats that was used as a layer in the Environmental Sensitivity Mapping Tool
- The Nature Conservancy Resilient Land Mapping Tool – Assisted in identification of sites marked as likely to sustain native plants, animals, and natural processes in the future
- United States Census Bureau TIGER (Topologically Integrated Geographic Encoding and Referencing database) – Used to download shapefiles for state and county boundaries, as well as, roads for each county of interest for years 2017, 2018, and 2019, as inputs for our analyses and visualization of results
- United States Department of Agriculture (USDA) CropScape Database – Provided information on land cover type and locations for mapping suitability
- USDA Soil Survey Geographic Database (SSURGO) – Soil type data across the state of Georgia used as an input in the LUCIS models for prime farmlands
- United States Geological Survey (USGS) Digital Elevation Model (DEM) – Provided raster data to calculate aspect and slope which were used as inputs to the Statewide Solar Suitability and LUCIS models
- United States Geological Survey (USGS) Sciencebase Range-Wide Habitat Suitability Maps for Gopher Tortoise – Provided polygons of gopher tortoise Habitats which was used as an input to the environmental sensitivity variable of the LUCIS model

Modeling:

- Land Use Conflict Identification Strategy (POC: Marguerite Madden, University of Georgia) – Identified suitable and sensitive land locations for solar development

Software & Scripting:

- Esri ArcMap 10.6 and 10.7 – Raster manipulation and analysis, image enhancement
- Esri ArcGIS Online – Web application and StoryMap creation
- RStudio 1.2.5019 – Graph tabular results
- Microsoft Excel Professional Plus 2019 – Tabular result analysis and comparisons

End Products:

End Products	Earth Observations Used	Partner Benefit & Use	Software Release Category
County-Level Conflict Bivariate Map Timeseries	Terra CERES Aqua CERES	Providing maps of the progression of conflict between solar sites and critical habitats since 2017 assisted partners in visualizing the transformation of the land and the rate of solar expansion within the counties of interest.	N/A
2017 vs 2019 Statewide Conflict Assessment	Terra CERES Aqua CERES	The partners acquired new knowledge that assists them in tracking the percent changes in environmental sensitivity and overall preference for solar development, as well as how these areas conflict with potential solar sites.	N/A
Change Statistic Graphs	Terra CERES Aqua CERES	The graphs generated will help partners by providing a visual, quantitative representation of the change statistics in a region of interest for each year and each individual class. The graphs also give partners a better understanding of which classes have seen the biggest and smallest	I

		changes through time.	
Environmental Sensitivity Mapping Tool (ESMT)	Terra CERES Aqua CERES	To assist the partner's conservation goals in Georgia, they shared this app with solar developers. This enables developers to select land sites that meet their desired characteristics and remain aware of the implications for animal habitats.	N/A
Land Use Conflict Identification Strategy (LUCIS) Mapping Guide	N/A	Partners will use this guide to produce additional conflict maps for future species studies.	N/A
ESRI Web Application Guide	N/A	Using this guide, the partners can update the existing ESMT for future species and LUCIS studies.	N/A
Reducing Habitat and Solar Site Conflict in Georgia by Developing an Environmental Sensitivity Mapping Tool (ESMT) Storymap	N/A	A story map to convey an overview of the project in a narrative format. This is a creative scientific communication tool that broadened the reach of the project to non-technical readers who are interested in the project.	N/A

Product Benefit to End User:
The Georgia Chapter of The Nature Conservancy will share the results and the web application with stakeholders in the renewable energy community, such as developers, conservationists, and policy makers. With results that visualize where sites suitable for solar energy are and where these sites conflict with environmentally sensitive areas, stakeholders can recognize the impact of current solar development patterns and re-envision their policies to avoid areas of conflict and develop habitat friendly siting plans.

References

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