# NASA DEVELOP National Program (Georgia – Athens)

Summer 2024 Project Summary

### Platte River Basin Water Resources II

Predicting Land Cover Change in the Platte River Basin to Select Wetland Protection Sites Vulnerable to Urban Encroachment

## Project Team

**Project Team:** Nancee Uniyal (Project Lead) Olivia Kirkland Shaibal Ahmed Yulia Shaffer

### Advisor:

Dr. Marguerite Madden (Center for Geospatial Research, University of Georgia)

### Past Projects & Other Contributors:

#### Previous Term:

2024 Spring (GA) - Platte River Basin Water Resources I

- Jennifer Mathis
- Jackie Encinas
- Olivia Kirkland
- Emma Vail

*Node Lead:* Megan Rich (Georgia – Athens)

*Team Contact:* Nancee Uniyal, <u>nanceeuniyal@uga.edu</u> *Partner Contact:* Melissa Mosier, <u>melissa.mosier@audubon.org</u>

#### **Project Overview**

#### **Project Synopsis:**

Platte River Basin wetlands are crucial for migratory birds but face threats from anthropogenic activities, climate change, and urbanization, leading to habitat and wetland loss. Our team partnered with Audubon Great Plains to analyze future development potential of the region and its impact on wetlands using Landsat 8 OLI, Suomi-NPP VIIRS, and population projections sourced from NASA SEDAC. We simulated urban growth potential up to 2050 using the FUTURES model, and our findings indicate significant risks of urban encroachment on wetlands, especially if they are not formally protected.

#### Abstract:

The Platte River Basin (PRB) represents a critical dynamic ecosystem where wetlands play a pivotal role as essential habitats for local and migratory birds, as well as various flora and fauna. It also provides many crucial ecosystem services that directly and indirectly benefit human welfare. However, it is threatened by anthropogenic activity, climate change, and urbanization. Our team partnered with Audubon Great Plains (AGP), the regional office of a national non-governmental organization (NGO), to analyze the future potential development of the region and its potential impact on the wetlands. We utilized remotely sensed data, such as Landsat 8 Operational Land Imager (OLI) and Suomi National Polar Orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) as well as National Aeronautics and Space Administration (NASA) Socioeconomic Data and Application Center (SEDAC) data, to simulate urban

growth potential up to 2050 using the open-source model FUTure Urban-Regional Environment Simulation (FUTURES) model. Our results for two proposed scenarios (all wetlands are protected, and no wetlands are protected) did show that at least 56 counties out of 81 in the PRB would experience growth by the year 2050. The results for the first scenario show that there will be no loss of wetlands in future. However, the results for the second scenario indicate a basin-wide reduction of 43.22 square kilometers (0.58 %) in wetland areas, leading to a significant loss of bird habitat, critical for conservation. The results will help Audubon Great Plains' Urban Woods and Prairies Initiative to lead awareness workshops for communities about wetland protection and to form impactful conservation strategies.

## Key Terms:

FUTURES, urban growth model, Platte River Basin, urban development, wetland loss, land use/land cover change

## Application Area: Water Resources

*Study Location:* Platte River Basin in CO, NE, WY *Study Period:* January 2001 to December 2021, Forecasting to 2030, 2040, & 2050

## Community Concerns:

- Urban growth in the PRB has damaged the basin's ability to mitigate flooding and sustain wetland habitats.
- Nearby cities are at a higher risk of flooding and wetland habitats for endangered bird species are degrading and fragmenting.
- As urban growth continues in the basin, these consequences are expected to worsen, which will negatively impact human health and safety as well as animal biodiversity and the basin's ecological stability.

## Project Objectives:

- Project urban growth within the PRB up to the year 2050
- Create Land Use/Land Cover (LULC) change maps for 2030, 2040, and 2050
- Identify wetlands vulnerable to urban encroachment

### Partner Overview

Partner Organization:						
Organization	Contact (Name, Position/Title)	Partner Type	Sector			
Audubon Great Plains	Melissa Mosier	End User	Non-profit			

## Decision-Making Practices & Policies:

Audubon Great Plains (AGP), a regional office of the National Audubon Society for Nebraska, North Dakota, and South Dakota, uses a combination of scientific research, habitat restoration, community outreach, and educational programs to tackle the various threats birds face in the Great Plains region. Through their Platte River Initiative, AGP focuses on forging partnerships with local conservation groups and federal agencies to create effective strategies for restoring and protecting the delicate wetlands of the Platte River Basin. In addition to conservation efforts, AGP is dedicated to ensuring that these strategies also consider and address the local community's needs, promoting a balanced and sustainable regional development approach.

### Earth Observations & End Products Overview

## Earth Observations:

Platform & Sensor	Parameters	Use
Landsat 8 OLI	True Color Composites (RGB), Normalized Difference Vegetation Index (NDVI)	Used for assessing vegetation health and change within the study area
Suomi NPP VIIRS	Day/Night Band, Nighttime lights	Used to show visible artificial lights at night, representative of populous areas

# Ancillary Datasets:

- United States Geological Survey (USGS) National Land Cover Database (NLCD) for modeling LULC change
- National Historical Geographic Information Systems (NHGIS) and U.S. Census Bureau Population Estimations utilized in the model to train data on population estimation trends
- NASA's SEDAC population data future population projections to predict land use demand
- Topologically Integrated Geographic Encoding and Referencing (TIGER)/Line Census study area boundaries (states, counties, and urban centers) used for the spatial extent of the study area
- TIGER/Line Census physical properties (roads, hydrology) physical characteristics used as predictors for data training purposes in the urban growth model
- USGS 3D Elevation Program, Digital Elevation Model 1-arc elevation data for deriving the slope of the study area
- USGS Protected Areas Database of the United States (PADUS) used as an input in the model to identify protected areas

# Model:

• FUTURES – **FUT**ure Urban-**R**egional Environment Simulation (POC: Georgina Sanchez - NC State University) – used for simulating urban growth and landscape change. It is integrated with GRASS GIS to analyze and predict land use changes over time.

# Software & Coding Languages:

- GRASS GIS 8.2 Add-ons (r.futures, r.sample.category) GRASS GIS is used for geospatial data management, analysis, image processing, spatial modeling, and visualization. The add-ons enable the use of the FUTURES model in GRASS GIS.
- R 4.4 Packages (MuMIn, lme4, optparse, rgrass) used for statistical modeling, model selection, command-line option parsing, and interfacing with GRASS GIS.
- ArcGIS Pro 3.1.1 used for visualization
- Google Earth Engine Used for NDVI and Nighttime light imagery

End Products	Earth Observations Used	Partner Benefit & Use
Urban Growth Forecast Maps	Landsat 8 OLI, Suomi-NPP VIIRS	The partner will use these maps for communication with local communities and organizations and education efforts.
Wetland Vulnerability Maps	Landsat 8 OLI, Suomi-NPP VIIRS	The partner will use these maps to determine which wetlands are most vulnerable to future urban encroachment. This will focus their protection and restoration efforts that aim to prevent severe habitat degradation in the future.

# End Products:

Additional End Products:

End Products	Description	Partner Benefit & Use
Story Map Template	Creative communication	The partner will use it to
		communicate with communities.
Code Tutorial	Tutorial with the steps for running	The partner will follow these
	the FUTUREs model	tutorials to learn and understand
		the results

# Product Benefit to End User:

The partner seeks to identify wetland areas that are vulnerable to future urban encroachment. We established a methodology involving the FUTURES urban growth model, demonstrating both its versatility and its applicability to their objectives. This methodology will allow the partner to replicate our study and create additional custom scenarios of urban growth to focus on various points of interest. Additionally, the maps we produced will enable the partner to begin selecting vulnerable wetland areas for protection and restoration efforts and to begin education and outreach efforts to nearby communities. Using our study, the partner will be able to make science-based decisions in choosing where to focus their crucial environmental and community efforts.

## References

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