**NASA DEVELOP National Program**

**Fall 2015 Project Proposal**

NASA Langley Research Center

**North Carolina Ecological Forecasting II**

Evaluating the Application of NASA Earth Observations to Rapidly Detect and Forecast Change in Wetland Types at a Regional Scale

**Team Members:**

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**Objective:**

To evaluate how NASA Earth Observations can be applied to more rapidly detect, evaluate and predict future changes in wetland types at regional (broad landscape) scales.

**Community Concern:**

Despite the profound ecological importance of wetland conditions in the Albemarle-Pamlico estuarine system, data and resource limitations have prevented the Albemarle-Pamlico National Estuary Partnership (APNEP) from developing an indicator of wetlands extent. Active wetland monitoring programs by APNEP partners exist but have limited utility for ecosystem-based management in the Albemarle-Pamlico region. NOAA’s Coastal Change Analysis Program (C-CAP) assigns a variety of coastal land cover classifications using satellite imagery, including various wetland cover types. However, the extent of this effort does not include the upper portion of the Albemarle-Pamlico watershed, data is acquired on a five-year cycle and is often subject to multi-year delays between data collection and the release of digital products that are of use to managers.

**Partner Organizations:**

Albemarle-Pamlico National Estuary Partnership (APNEP) (End User, POC: Jim Hawhee, Policy and Engagement Manager, Dean Carpenter, Program Scientist)

Partnership with APNEP has been growing since the fall 2014 term. Jim Hawhee proposed this project with the intention of applying the methodology to all land cover types in the Albemarle-Pamlico region. The methodologies can also apply to all National Estuary Programs (28 total) across the United States, that would like to more rapidly and accurately evaluate wetland extent trends within their watershed. APNEP staff is well-positioned to disseminate the results of this project to other programs and consult with them regarding the utility of the effort for environmental management purposes.

**Decision Making Process:**

Currently, the method for classifying land cover is through the use of C-CAP, which applies a semi-automated algorithm with Landsat imagery (Classification and Regression Tree [CART] analysis) to characterize land cover types. The project team would evaluate this algorithm, make improvements if possible, and apply it to recent Landsat 8 data to evaluate the current extent of various wetland classes throughout the Albemarle-Pamlico region. If sufficient project resources are available, the algorithm would be applied to historic Landsat data as well, providing the basis to conduct a spatial trend analysis for wetlands throughout the Albemarle-Pamlico region. The methodology and protocol for routinely evaluating and updating new Landsat information to periodically characterize wetland extent through the Albemarle-Pamlico watershed would be of great benefit to APNEP.

**Earth Observations:**

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| --- | --- | --- |
| **Platform** | **Sensor** | **Geophysical Parameter** |
| **Landsat 7** | ETM+ | Land cover |
| **Landsat 8** | OLI/TIRS | Land cover |

**NASA Earth Observations Highlighted:**

Landsat 7 and 8 imagery will be used primarily to create a land cover classification for the Albemarle-Pamlico watershed with a focus on wetlands. In conjunction with C-CAP data, the imagery from Landsat 7 and 8 can help determine whether open access data can be substituted for higher-resolution data for use by national estuary programs nationwide.

**Ancillary Datasets:**

* NOAA’s Coastal Change Analysis Program (C-CAP)
* Ground truth surveys (provided by partners)
* LiDAR derived DEM (accessible through NCDOT)
* High Resolution Aerial Imagery (accessible through NC OneMap)

**Models:**

Random Forest land cover classification model (POC: Daniel Jenson, Geoinformatics Fellow)

TerrSet Land Change Modeler (POC: Jeff Ely, Geoinformatics Fellow)

Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Coastal Protection Model (POC: Dr. Kenton Ross, DEVELOP National Science Advisor)

**Decision Support Tools & Analyses:**

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| --- | --- | --- |
| **Proposed End Products** | **Decision to be Impacted** | **Current Partner Tool/Method** |
| Historic and Current Wetland Extent Maps | Development of future conservation policies in the region | C-CAP data |
| Map of Future Wetland Extents | Preparation of policy changes to preserve wetlands in areas of forecasted loss | None |
| InVEST Coastal Protection Risk Maps | Identification of areas of highest flood and erosion risk where mitigation and restoration efforts need to be focused.  | None |

*Historic and Current Wetland Extent Maps* – Through the use of a Random Forest model, the historic and current wetland extent will be mapped for the regions in the Albemarle-Pamlico watershed. These maps, along with the methodologies used to create them, were requested by the partner organization, APNEP.

*Map of Future Wetland Extent –* Through the use of Land Change Modeler in ArcGIS, the future extents of wetlands in the Albemarle-Pamlico watershed would be generated. This map will provide the partners with information that can be used in policy-making to ensure that the wetlands are preserved.

*InVEST Coastal Protection Risk Maps* – The InVEST Coastal Protection Model quantifies the protective services provided by natural habitats. These services include areas of erosion and flood risk. These outputs will be used to create risk maps identifying highest priority areas for mitigation or restoration.

**Project Details:**

**National Application Areas Addressed:** Ecological Forecasting, Climate

**Study Location:** North Carolina

**Period being Studied:** 1990-2015

**Advisor:** Dr. Kenton Ross (DEVELOP National Program)

**Previous Related DEVELOP Work:**

Spring 2015 (LaRC) - Great Lakes Climate: Monitoring the Impacts of Climate Change and Decreasing Water Levels on Wetlands in the Great Lakes Region of North America

Spring 2015 (Wise County) - Virginia Agriculture II: Providing a Quantitative Tool based on NASA Earth Observations for Assessing Virginia’s Growing Agriculture Economy

**Software & Scripting Requested:**

* ERDAS IMAGINE – Accuracy assessment of land cover maps
* ArcGIS - Raster manipulation/analysis, image enhancement & map creation of Landsat 7 ETM+ and Landsat 8 OLI/TIRS
* R – Random Forest for alternative land cover delineation