**NASA DEVELOP National Program**

**2017 Spring Project Proposal**

**NASA Langley Research Center**

**Chesapeake Bay Water Resources**

*Assessing Water Clarity to Identify Potential Areas of Submerged Aquatic Vegetation (SAV) in the Chesapeake Bay*

**Project Overview**

***Project Synopsis*:** In an effort to assess the feasibility of remote sensing of turbidity to determine water clarity thresholds for submerged aquatic vegetation (SAV), the NASA DEVELOP team will utilize Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI to assist the Virginia Department of Environmental Quality (VADEQ) and the EPA-Bay Program Office in exploring new avenues to increase their temporal sampling of the Chesapeake Bay. Annual maps of water clarity for the main stem of the Bay and its tidal tributaries will be produced and compared to both aerial flyover data and water sampling data for validation.

***Community Concern:*** Submerged aquatic vegetation (SAV) is an important coastal ecosystem that provides habitat and food resources, and stabilizes near-shore sediments. However, SAV is particularly affected by water clarity conditions. As SAV is dependent on sunlight attenuating through the water column, sediments and other particulate matter that wash into the Bay affect the growth and resiliency of SAV patches. Currently, the VADEQ does not have the resources or manpower to completely monitor the Bay annually, thus, pursuing the feasibility of remotely sensing water clarity could increase their temporal and spatial sampling.

***Source of Project Idea:*** The idea for this project originated from a conversation between members of the Virginia Department of Environmental Quality (VADEQ) and DEVELOP representatives Jamie Favors and Dr. Kenton Ross after previously working with the VADEQ on Virginia Water Resources projects.

***National Application Area Addressed:*** Water Resources

***Study Location:*** Chesapeake Bay, VA

***Study Period:*** January1995 to December 2015

***Advisor:*** Dr. Kenton Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Virginia Department of Environmental Quality | Tish Robertson, Office of Ecology – Water Quality Monitoring and Assessment | End-User | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:***The VADEQ monitors and assesses water clarity every two years to identify potential areas that are habitable to SAV. These water clarity assessments drive Total Maximum Daily Load (TMDL) regulations that are managed by the EPA. VIMS collects water quality and SAV presence data for the VADEQ, which is used to create acreage goals for subsets of the Chesapeake Bay and its tributaries. However, the size of the Bay makes it difficult to sample more than a few tributaries each year, and thus the VADEQ is unable to provide an annual, Bay-wide snapshot of water clarity.

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

*Virginia Department of Environmental Quality* – The end-user is familiar with NASA Earth observations, and previously worked on a project with DEVELOP in Summer 2015 and Fall 2015. However, they do not currently have a system in place to utilize remotely sensed data to assess water clarity.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The team will communicate weekly with the partners through email updates on the project. Additionally, the team will meet partners via telephone or video calls biweekly to facilitate discussion and feedback on project methods and end products. The main POCs will be the team lead, and the LaRC Center Lead as needed.

***Transition Plan*:** End products will be provided to the partners via an in-person meeting (if available) or a video conference at the end of each term so that the maps can immediately be integrated into the VADEQ’s decision-making process. The tool finalized in the second term of this project will be delivered to the partners after completing the software release process.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI** | Surface reflectance | Create water clarity map |

***Ancillary Datasets:***

VIMS – *in situ* water clarity measurements – validate and calibrate map products

***Software & Scripting:***

Google Earth Engine API – Landsat analysis

ESRI ArcGIS – map creation

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Annual Water Clarity Maps (Bay-wide) | Used to assess water clarity across the entire Bay each year | Landsat 5 TM; Landsat 7 ETM+; Landsat 8 OLI; creation of model to synthesize all parameters | I |
| Annual Water Clarity Maps (Tributaries) | Used to assess water clarity in specific tributaries | Landsat 5 TM; Landsat 7 ETM+; Landsat 8 OLI; creation of model to synthesize all parameters | I |
| Automated Tool for Continued Monitoring of Water Clarity | To assist in continued monitoring of water clarity | N/A | III or IV |

***End-User Benefit*:** The results of this project will benefit the VADEQ by providing them with map products that have greater spatial and temporal assessments of the Bay than what they currently have based on *in situ* and aerial data. By assessing the feasibility of remotely sensing water clarity, and providing an automated tool for the VADEQ to continue monitoring into the future, the NASA DEVELOP team will provide means to reduce the time and effort spent on monitoring water clarity.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2 Terms: 2017 Spring (Start) to 2017 Summer (Completion)

***Multi-Term Objectives:***

* **Term 1 (Proposed Term):** 2017 Spring (LaRC) – Chesapeake Bay Water Resources
	+ Calibration of water clarity regressions to tributaries and the main stem of the Bay
	+ Create annual maps of water clarity
* **Term 2:** 2017 Summer (LaRC) – Chesapeake Bay Water Resources II
	+ Focus on partner handoff – update maps once calibration is complete
	+ Create tool for partners to continue utilizing methodology in the future

***Related DEVELOP Work:***

2009 Summer (LaRC) – Chesapeake Bay Water Resources: The Integration of NASA Earth Observation Data into the Chesapeake Bay Watershed Model

2009 Fall (LaRC) – Chesapeake Bay Water Resources and Eco Forecasting: Mapping Submerged Aquatic Vegetation in the Chesapeake Bay Watershed Using Remote Sensing and GIS Algorithms

2010 Spring (LaRC) – Chesapeake Bay Water Resources and Eco Forecasting: Mapping Submerged Aquatic Vegetation in the Chesapeake Bay Watershed Using Remote Sensing and GIS Algorithms

2010 Summer (WFF) – Chesapeake Bay and Delmarva Peninsula Water Resources and Eco Forecasting: Detection and Analysis of Phytoplankton Blooms in the Chesapeake Bay and Delmarva Peninsula Using NASA Products and Technologies

2015 Fall (WC & LaRC) – Virginia Water Resources II: Utilizing NASA Earth Observations to Identify Algal Hotspots in the Chesapeake Bay

2015 Summer (PHB) – Virginia Water Resources: Monitoring Harmful Algal Blooms through NASA Earth Observations in the James River for Improved Water Management

2016 Summer (UGA) – Southeast Ecological Forecasting III: Utilizing NASA Earth Observations and Proximal Remote Sensing for Mapping the Spatio-Temporal Distribution of *Hydrilla verticillata*

**Notes & References:**

***References:***

Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll *a* for the Chesapeake Bay and Its Tidal Tributaries. September 2008. United States Environmental Protection Agency. EPA 903-R-08-001.

Virginia Water Quality Standards. January 2011. State Water Control Board. 9 VAC 25-260.