**NASA DEVELOP National Program**

Langley Research Center

**Spring 2015**

**North Carolina Water Resources**

*Utilizing NASA Earth Observations to Monitor Extent of Harmful Algal Blooms in the Albemarle-Pamlico Estuary*

**Project Team:**

Chad Smith (Project Lead), chad.k.smith@nasa.gov

Jelly Riedel

Keith Benjamin

Daniel Wozniak

Matthew Carter

**Advisors & Mentors:**

Dr. Kenton Ross (DEVELOP National Science Advisor)

**Past or Other Contributors**

University of Georgia DEVELOP Participants

Ames Research Center DEVELOP Participants

**Partner Organizations**

* USGS North Carolina Water Science Center, End-User, Michelle Moorman- Biologist
* Albemarle-Pamlico National Estuary Partnership (APNEP), End-User, Dr. Bill Crowell- Director

**Applied Sciences National Applications Addressed:**

Water Resources

**Study Area:** North Carolina

**Study Period:** 2004-2014

**Earth Observations & Parameters**

Aqua, MODIS-, multispectral reflectance

Landsat 8, OLI- multispectral reflectance

Landsat 7, ETM+multispectral reflectance

**80-100 Word Objectives Overview**

The objective of this project is to provide a ten year time series representation of harmful algal blooms (HABs) in the Albemarle-Pamlico National Estuary. Having more complete historical observations of the spatial and temporal characteristics of HAB activity will benefit all organizations concerned with maintaining water quality in the sound.

**Abstract**

Harmful algal blooms (HABs) caused significant ecological damage to aquatic systems by disrupting water chemistry, producing toxins, and blocking sunlight to submerged vegetation and other organisms. Humans who inhale toxins that HABs released into the air, drink water contaminated by HABs, or eat affected fish or shellfish may manifest gastrointestinal, neurological, dermal, or respiratory symptoms varying in severity from mild to fatal depending on the amount and type of HABs present (Keeping Tabs on HABs, pg. A208). In the Albemarle and Pamlico Sounds, the USGS North Carolina Water Science Center biologists monitored HABs by taking point samples throughout the region, but theylack a method to monitor the spatial extent of HABs throughout the entire sound during the year. Calculations using multispectral reflectance bands available from Aqua MODIS and Landsat 7 provided a method to detect the presence of chlorophyll-a and cyanobacteria on a large scale. End-users benefited from the knowledge of historical HAB activity in the Albemarle-Pamlico National Estuary.

**Community Concerns**

* Up to 74% of HAB events in North Carolina between 2005 and 2012 produced microcystin or other cyanobacterial toxins which are known to cause adverse health effects including death in domestic animals and wildlife.
* Submerged vegetation suffers when HABs block sunlight. The Albemarle-Pamlico Estuary contains 99% of the Atlantic Coast’s submerged vegetation outside of Florida.
* HABs affect water chemistry and create hypoxic zones during the decay process, which results in fish kills.

**Current Management Practices & Policies**

The USGS North Carolina Water Science Center biologists and other state entities take point samples of water content throughout the estuaries in an effort to monitor HAB extent. Some samples are only taken seasonally, and overall sampling frequency and spatial distribution vary across the Albemarle-Pamlico Sound. North Carolina has a standard limiting chlorophyll concentration in its waters, but no policies are in place to limit phosphorus or nitrogen. Artificial eutrophication from these excess nutrients have been positively linked with HABs. The USGS North Carolina Water Science Center and APNEP are interested in using their knowledge of the spatio-temporal characteristics of HAB events to influence decision-making regarding water quality standards.

**Decision Support Tools**

* HAB estimation maps at higher resolution during known bloom events from Landsat imagery
* Historical maps using MODIS data that show HAB extent with respect to time

**Benefit to End-User:**

* A more complete history of HAB extent going back 10 years (2004-2014)
* A larger scale of HAB monitoring to supplement information gathered from *in situ* data collection efforts

**Models Utilized**

* Floating Algae Index (FAI)

**Ancillary Datasets Utilized**

* North Carolina Water Science Center- *in situ* water sample data
* National Water Quality Monitoring Council- *in situ* water sample data

**Software Utilized**

SeaDAS- processing MODIS data

ArcGIS - Raster Manipulation/Analysis, Image Enhancement & Map Creation

Python- FAI script