

National Aeronautics and Space Administration



WEEKS BAY WATER RESOURCES

Using NASA Earth Observations to Evaluate Changes in Water Quality in the Weeks Bay Watershed

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DEVELOP

Alabama – Mobile | Spring 2019

Study Area and Period

Weeks Bay Watershed

Sub-estuary of Mobile Bay in South Alabama

Area
 498.425 km²

Time period
January 2014 to June 2018



Image Credit: Weeks Bay Water Resources Team

Community Concerns



Water Quality **Degradation**

Rapid Urban Development





Land Cover **Conversion**

Project Partner

 Alabama Department of Conversation and Natural Resources (ADCNR), Weeks Bay National Estuarine Research Reserve (NERR)



N ATIONAL E STUARINE R E S E A R C H R E S E R V E S Y S T E M

Objectives

Identify sub-watersheds of special concern for prioritizing conservation efforts aimed at improving water quality in Weeks Bay **Demonstrate** how to collect data from NASA Earth observations to contribute to the knowledge base of the Weeks Bay NERR **Conduct** a comparative analysis of a previous SWAT model derived from *in situ* data to a SWAT model informed primarily by NASA Earth observations



Soil & Water Assessment Tool Model



Image Credit: swift

Methodology



Data Processing from SWAT

Example of SWAT Output File

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15	BIGSUB	6	0	1.21	234E	+02 0	.811	E+02 (0.000	E +00	0.64	40E+0	00.	429E	E +00	0.24	10E	+03	0.3	36E-
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17	BIGSUB	8	0	1.10	966E	+02 0	.7738	E+02 (0.000	E +00	0.64	41E+0	00.	485E	E +00	0.22	21E	+03	0.3	62E-
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19	BIGSUB	10	0	1.2	2137	E+00 (0.773	E+02	0.000	E+00	0.6	41E+(0 00	.359	E+00	0.1	898	E+03	0.4	431E
20	BIGSUB	11	0	1.24	4649	E+02 (0.641	E+02	0.000	E+00	0.6	41E+(0 00	.417	E+00	0.2	098	E+03	0.	381E
21	BIGSUB	12	0	1.13	3902	E+02 (0.773	E+02	0.000	E+00	0.6	41E+(0 00	.372	E+00	0.2	18	E+03	0.4	418E
22	BIGSUB	13	0	1.13	2623	E+02 (0.773	E+02	0.000	E+00	0.6	42E+(0 00	.426	E+00	0.1	83	E+03	0.4	450E

Inputs from SWAT model	Process	Output
Organic Nitrogen, Surface Nitrogen, Groundwater Nitrate, Lateral Nitrate	Sum of all	Total Nitrogen in kg/ha
Organic Phosphorus, Soluble Phosphorus, Mineral Phosphorus	Sum of all	Total Phosphorus in kg/ha

Earth Observations

GPM IMERG Precipitation Data

Landsat 7 ETM+

Surface Reflectance

SRTM

Digital Elevation Model

Ancillary Datasets

Data Used for SWAT Input

- Digital Elevation Model (DEM): Shuttle Radar Topography Mission (SRTM) 30 m DEM
- Soil Data: United States Department of Agriculture & Natural Resources Conservation Service (USDA-NRCS)
- Weather Data: Texas A&M SWAT Database
- Land Cover: National Land Cover Dataset 2011, Multi-Resolution Land Characteristics (MRLC) Consortium

Data Used for Validation

- In Situ Water Quality Measurements: Alabama Department of Environmental Management (ADEM)
- Water Quantity: USGS Stream Gauge Data

Data Used for Comparison

Inputs for previous SWAT Model: Thompson Engineering Firm

End Products

Sub-Basin Water Quality Impairment Risk Map

> Comparative analysis report of NASA EO-derived SWAT to non-NASA outputs

> > Weeks Bay NERR SWAT tutorial

Sub-Basin Water Quality Impairment Risk



Time-Lapse of Monthly Totals with VizSWAT



Video Credit: Weeks Bay Water Resources Team

Validation – Magnolia River



Validation – Fish River



Validation – Fish River









Watershed Discharge



	DEVELOP AL	Thompson Engineering				
	MODEL BUILDING					
DEM	SRTM 30 m	USGS NED/3DEP 10 m				
Land Cover	NLCD 2011	NLCD 2011 National Cropland Data (NCLD) layer 2011				
Soil	SSURGO	SSURGO				
Precip	GPM IMERG	Parameter-elevation Regressions on Independent Slopes Model (PRISM)				
Temperature	SWAT Weather Database	PRISM				
Stream Network	Delineated in SWAT	National Hydrography Dataset (NHD) v2				
Atmospheric Deposition	N/A	National Atmospheric Deposition Program (NADP)				
	CALIBRATION					
Daily Streamflow	N/A	USGS Gauge Stations				
Water Quality Data	N/A	Alabama Department of Environmental Monitoring (ADEM)				





2017 Modeled Sediment Yield

Image Credits: Thompson Engineering, Weeks Bay Water Resources Team

2011Phosphorus Yield Thompson Model



2017 Modeled Phosphorus Yield



Image Credits: Thompson Engineering, Weeks Bay Water Resources Team

2011 Nitrogen Yield Thompson Model





2017 Modeled Nitrogen Yield

Image Credits: Thompson Engineering, Weeks Bay Water Resources Team

Limitations

- Uncalibrated model
- Small study area
- Temporal range of GPM IMERG
- Study period data not widely available
 - Stream gauge
 - Water quality
 - NLCD

Future Work

Calibrate model with SWAT-CUP

Further validation

- Build model with
 - More sub-basins ~100
 - Updated NLCD, USDA NCDL, or NOAA C-CAP
 - Separate Fish and Magnolia Watersheds
 - Longer precipitation history
- Could incorporate more ground data and examine more output parameters
 - > Water treatment facility inputs, bacteria, pesticide use, & etc.

Conclusion

- Our simple model successfully identified sub-basins of concern for improving water quality.
- Further calibration and validation would improve the model and increase its utility for modeling water quality parameters throughout the Weeks Bay Watershed.
- This kind of modeling approach could be valuable to the Weeks Bay NERR in its efforts to manage and protect the estuary.
- NASA Earth observations could fill in gaps in the Weeks Bay NERR's current monitoring program.

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