NASA DEVELOP National Program 2023 Summer Project Proposal

California JPL

Southeast & Gulf Coast Ecological Conservation

Investigating the Development of Ghost Forests Due to Saltwater Intrusion along the Southeastern and Gulf of Mexico Coastlines of the United States

Project Overview

Project Synopsis: Shallow aquifers along the Gulf of Mexico and the southeastern US coastlines are experiencing saltwater intrusion from rising sea levels, changes in tidal cycles, and groundwater pumping. The freshwater saltwater boundary in these shallow aquifers is changing and leading to higher soil salinity which causes increased vegetation collapse. Ghost forests, or areas where vegetation has deteriorated due to salt water, are expanding along southeast coastlines. This project will evaluate the feasibility of identifying ghost forests due to saltwater intrusion in the aquifer using satellite data.

Study Location: Southeast Coast and Gulf of Mexico Coast (LA, FL) **Study Period:** January 2013 – January 2023

Advisors: Dr. Kyra H. Adams (NASA Jet Propulsion Laboratory, California Institute of Technology) <u>kyra.kim@jpl.nasa.gov</u>, Dr. Elliot White Jr. (Stanford Woods Institute for the Environment, Stanford University) <u>eewhite@standford.edu</u>

Partner Overview

Partner Organizations:						
Organization	POC (Name, Position/Title)	Partner Type	Sector			
USGS, Wetland and Aquatic	Dr. Ken Krauss, Research	End User	Federal			
Research Center (WARC)	Ecologist, Dr. Beth Middleton,		Government			
	Research Ecologist, Dr. Greg					
	Noe, Research Ecologist					
USDA, Southeast Regional	Dr. Steve McNulty, Director;	Collaborator	Federal			
Climate Hub	Michael Gavazzi, Coordinator		Government			

End User Overview

End User's Current Decision-Making Process and Capacity to use Earth Observations:

The USGS Wetland and Aquatic Research Center (WARC) leads in the efforts to understand, manage, conserve, and restore aquatic and coastal ecosystems and their related fauna and flora throughout the United States and the world.

In 2021, the USDA released its Action Plan for Climate Adaptation and Resilience, a guide to preparing American agriculturalists and land managers for the current and future impacts of climate change. The Climate Hubs and their partners build locally-specific tools to help increase climate change adaptation capacity nationwide.

The USDA and USGS have extensive knowledge utilizing NASA Earth observations and have applied NASA EO on several projects, including but not limited to land management, agriculture, ecological forecasting, disaster prevention and response, and carbon assessment. This project will produce ground cover change maps due to soil salinity by observing the effects on vegetation which can help end users' conservation efforts for these areas.

Earth Observations Overview

Earth Observations:		
Platform & Sensor	Parameter(s)	Use
Landsat 8 OLI	Surface reflectance, Dynamic Surface Water Extent (DSWE), Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI)	Spectral signatures and indices will identify the extent at a 30 m resolution. Variations in spectral signatures will indicate a significant change in coastal cover types and identify surface water and land change over time.
Landsat 9 OLI-2	DSWE, NDVI, EVI	Spectral signatures and indices will identify the extent at a 30 m resolution. Variations in spectral signatures will indicate a significant change in coastal cover types and identify surface water and land change over time.
Landsat 8 TIRS	DSWE, NDVI, EVI	Spectral signatures and indices will identify the extent at a 30 m resolution. Variations in spectral signatures will indicate a significant change in coastal cover types and identify surface water and land change over time.
Landsat 9 TIRS-2	DSWE, NDVI, EVI	Spectral signatures and indices will identify the extent at a 30 m resolution. Variations in spectral signatures will indicate a significant change in coastal cover types and identify surface water and land change over time.
ISS ECOSTRESS	Evaporative Stress Index (ESI), Evapotranspiration (ET)	ECOSTRESS will be utilized to assess vegetation stress due to soil salinization.
Terra MODIS	Surface Reflectance, NDVI, EVI	Surface water and land change detection over a long time period for historical analysis.

Ancillary Datasets:

- NLCD Provides land cover classification that will be used to identify land cover change
- NOAA Coastal Change Analysis Program (C-CAP) Provides detailed land cover classifications for coastal areas that will be used in conjunction with NLCD to identify land cover change.
- NOAA Tide Gauge Data This will be used to relate vegetation trends to the increase in sea level rise

Decision Support Tool & End Product Overview

End Products:		
End Product	Partner Use	Datasets & Analyses
Evaporative Stress Index Time Series	This time series will show monthly changes in the evaporative stress index which can be used to detect downward trends in vegetative health. End users can use this to identify areas of risk and vulnerability before these areas transform into ghost forests.	ECOSTRESS evaporative stress index will be summarized by month over a multi-year period.
NDVI Time Series	This time series will highlight yearly changes in vegetation NDVI which can be used to detect downward trends in	Landsat 8 OLI & Landsat 9 OLI-2 and MODIS will be used to create a

	vegetative productivity. End users can use this to identify areas of risk and vulnerability before these areas	decadal NDVI time series from 2013-2023.
	transform into ghost forests.	
Ground Cover Change Maps	These maps will show the historical trends and the extent of vulnerable land versus declining land. End users can use these maps to identify areas that are susceptible to saltwater intrusion and enact conservation efforts in these areas before they transform into ghost forests.	Utilizing MODIS, Landsat 8 OLI & 9 OLI-2, NLCD, NOAA C-CAP and NOAA Tide Gauge Data we will create ground cover change maps to highlight change over a decade.

Project Timeline & Previous Related Work

Project Timeline: 1 Term: Summer 2023

Similar Past DEVELOP Projects:

- 2022 Summer Lower Illinois River Valley Ecological Forecasting <u>https://appliedsciences.nasa.gov/what-we-do/projects/inundation-mapping-lower-illinois-river-valley-using-synthetic-aperture-radar</u>
- 2022 Summer New York Ecological Forecasting https://appliedsciences.nasa.gov/what-we-do/projects/assessing-coastal-resiliency-across-floridasaquatic-preserves-response
- 2021 Summer Coastal California Water Resources II <u>https://develop.larc.nasa.gov/2021/summer/CoastalCaliforniaWaterII.html</u>
- 2021 Spring Coastal California Water Resources <u>https://develop.larc.nasa.gov/2021/spring/CoastalCaliforniaWater.html</u>
- 2020 Spring Great Lakes Water Resources II https://develop.larc.nasa.gov/2020/spring/GreatLakesWaterII.html
- 2019 Spring Great Lakes Water Resources https://develop.larc.nasa.gov/2019/spring/GreatLakesWater.html

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