NASA DEVELOP National Program 2022 Summer Project Proposal

California – Ames South Slough Water Resources

Monitoring Changes in Water Quality to Identify Stressors in Eelgrass Extent throughout the Coos estuary

Project Overview

Project Synopsis: The South Slough Estuary provides a habitat for the local ecosystem with open water channels, tidal and freshwater wetlands, riparian areas, and forested uplands. Eelgrass provides nursery habitats for marine wildlife, including commercially and recreationally important fish and crab. However, eelgrass declines are caused by drivers such as harmful algal blooms, increasing water and air temperatures, marine heat waves, changes in sediment and water column turbidity, watershed disturbance, and changes in water column chlorophyll-a concentration. To improve the understanding of drivers of eelgrass declines and spatial changes to eelgrass populations, this project will partner with the South Slough National Estuarine Research Reserve (SSNERR) and the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians' (CTCLUSI) Department of Natural Resources. The project team will develop maps, charts, and time series analyses of water quality and temperature changes using data from Landsat 8 OLI, Landsat 9 OLI-2, Sentinel-2 MSI, Aqua MODIS, PlanetScope, and Suomi NPP VIIRS to better inform partners' resource management and water quality improvement efforts.

Study Location: South Slough estuary and Coos estuary, OR **Study Period:** January 2010 – August 2023

Advisor: Dr. Juan Torres-Pérez (NASA Ames Research Center) juan.l.torresperez@nasa.gov

Partner Organizations:					
Organization	Contact (Name, Position/Title)	Partner Type	Sector		
South Slough National	Ali Helms, Estuarine Monitoring	End User	State		
Estuarine Research Reserve	Coordinator; Jenni Schmitt,		Government		
	Watershed Monitoring				
	Coordinator; Jen Kirkland, GIS				
	Specialist				
Confederated Tribes of the	Janet Niessner, Water Protection	End User	Tribal		
Coos, Lower Umpqua, and	Specialist & Biologist				
Siuslaw Indians, Department of					
Natural Resources					

Partner Overview

End User Overview

End User's Current Decision-Making Process & Capacity to use Earth Observations: The South Slough National Estuarine Research Reserve spans 7,000 acres, with the responsibility of managing and protecting the estuary for the purposes of long-term research, education, and coastal stewardship. The SSNERR currently observes water quality with long term water quality stations and has produced eelgrass habitat maps that are limited spatially and temporally. The Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians' (CTCLUSI) Department of Natural Resources was established to conserve and manage resources on Tribally-held lands and to work with other governments to influence conservation and management of resources throughout the Tribes' Ancestral Territory. The SSNERR and CTCLUSI both prioritize the management of climate change, water quality, and habitat restoration within the estuary. The

organizations aim to update their methodologies for spatial mapping efforts and to further understand drivers of eelgrass decline with NASA Earth observations.

Platform & Sensor	Parameter(s)	Use			
Landsat 8 OLI	Surface Reflectance, Temperature, Turbidity	These data will be used to analyze changes in water quality parameters over the study period 2013– 2020 to observe drivers of eelgrass loss and monitor seasonal and annual trends.			
Landsat 9 OLI-2	Surface Reflectance, Temperature, Turbidity	These data will be used to analyze changes in water quality parameters over the study period 2021– 2023 to observe drivers of eelgrass declines and monitor seasonal and annual trends.			
Sentinel-2 MSI	Surface Reflectance, Turbidity, Chlorophyll-a	These data will be used to analyze changes in water quality parameters over the study period 2015– 2022 to observe eelgrass habitat changes and monitor seasonal and annual trends.			
Aqua MODIS	Temperature	These data will be used to analyze changes in water temperature over the study period and marine heat wave events to observe eelgrass habitat changes and monitor seasonal and annual trends.			
PlanetScope	Surface Reflectance	These data will be used to analyze the narrow channels in the study area and eelgrass distribution.			
Suomi NPP VIIRS Temperature		These data will be used to analyze changes in water temperature over 2011–2023 and marine heat wave events to observe drivers of eelgrass change and monitor seasonal and annual trends.			

Earth Observations Overview

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Ancillary Datasets:

- SSNERR and CTCLUSI Water Quality and Weather Monitoring Stations Dataset water and air temperature, turbidity, salinity, depth, pH, and dissolved oxygen data taken in 15 intervals will be used for validation
- SSNERR UAV pilot study 5 m2 plots from the Summer of 2019 and 2020 test feasibility to distinguish eelgrass and macroalgae and 30, 60, 80, 100, and 124 feet
- Pacific Marine and Estuarine Fish Habitat Partnership (PMEP) 2016 maximum observed extent of eelgrass map layers <u>https://www.pacificfishhabitat.org/data/west-coast-usa-eelgrass-habitat/</u>
- Coos Bay Hydrodynamic Model three-dimensional models of current, salinity, depth, sediment, and temperature. <u>https://partnershipforcoastalwatersheds.org/hydrodynamic-model-coos-bay/</u>

Modeling:

• Optical Reef and Coastal Area Assessment Tool (ORCAA 2.0) (POC: Haley Pippin,) – a Google Earth Engine tool developed to monitor the spatial and temporal variability of coastal water quality parameters

Decision Support Tool & End Product Overview

End Products:					
End Product	Partner Use	Datasets & Analyses			
Maps of Eelgrass Changes	Maps of spatial changes in eelgrass populations over time can be used to observe changes in water quality as they relate to eelgrass declines.	PMEP eelgrass extent map and PlanetScope data will be used to assess changes in eelgrass population			
Water Quality Timeseries Analyses	Seasonal and annual maps of turbidity, chlorophyll-a, and temperature over time can be used to observe changes in water quality as they relate to eelgrass declines.	Landsat 8 OLI, Landsat 9 OLI-2, Sentinel- 2, Aqua MODIS, and Suomi NPP VIIRS data will be used to assess changes in turbidity, chlorophyll-a, and temperature over time in relation to eelgrass declines.			

Project Timeline & Previous Related Work

Project Timeline: 1 Term: 2023 Summer

Similar Past DEVELOP Projects:

- 2019 Fall (JPL) Belize & Honduras Water Resources II: https://develop.larc.nasa.gov/2019/fall/BelizeHondurasWaterII.html
- 2021 Summer (LaRC) Jobos Bay Water Resources: https://develop.larc.nasa.gov/2021/summer/JobosBayWater.html
- 2021 Summer (ARC) Louisiana Water Resources: <u>https://develop.larc.nasa.gov/2021/summer/LouisianaWater.html</u>
- 2022 Summer (MSFC) Lake Champlain Water Resources: https://develop.larc.nasa.gov/2014/spring/LakeChamplainWaterResourcesII.html
- 2022 Fall (ARC) San Diego Water Resources: <u>https://appliedsciences.nasa.gov/what-we-do/projects/monitoring-pollution-plumes-due-storm-and-wastewater-runoff-san-diego-bay-and</u>
- 2022 Fall (MA) Gulf of Maine Water Resources: https://appliedsciences.nasa.gov/what-we-do/projects/assessing-use-nasa-earth-observations-identifying-harmful-algal-blooms-pseudo

Notes & References:

References:

Confederated Tribes of Coos, Lower Umpqua, Siuslaw. (2022, November). Department of Natural Resources & Culture. *Confederated Tribes of Coos, Lower Umpqua, Siuslaw Website*. <u>https://ctclusi.org/department-of-natural-resources-culture/</u>

Conroy, T., Sutherland, D.A. and Ralston, D.K., 2020. Estuarine exchange flow variability in a seasonal, segmented estuary. *Journal of Physical Oceanography*, *50*(3), pp.595-613.

Pew (2022, November). Oregon's Eelgrass Is Disappearing, With Potentially Big Impacts. *The PEW Charitable Trust Website*. <u>https://www.pewtrusts.org/en/research-and-analysis/articles/2019/07/16/oregons-eelgrass-is-disappearing-with-potentially-big-impacts</u>

South Slough National Estuarine Research Reserve. (2022, November). About South Slough Reserve. *State of Oregon Website*. https://www.oregon.gov/dsl/SS/Pages/About.aspx

Thomas, R., & Helms, A. (2021). Eelgrass Sediment Characteristics in the South Slough Estuary, OR. DOI: https://doi.org/10.1002/essoar.10509482.1 Quantum Spatial. 2017. Orthophotography and Eelgrass Feature Extraction Technical Data Report. Final report for PMEP Eelgrass Mapping of the Coos estuary 2016-2018.

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Rumrill, S.S. 2006. The Ecology of the South Slough Estuary: Site Profile of the South Slough National Estuarine Research Reserve. Salem, Oregon: NOAA, Oregon Department of State Lands Technical Report, 238 pp.