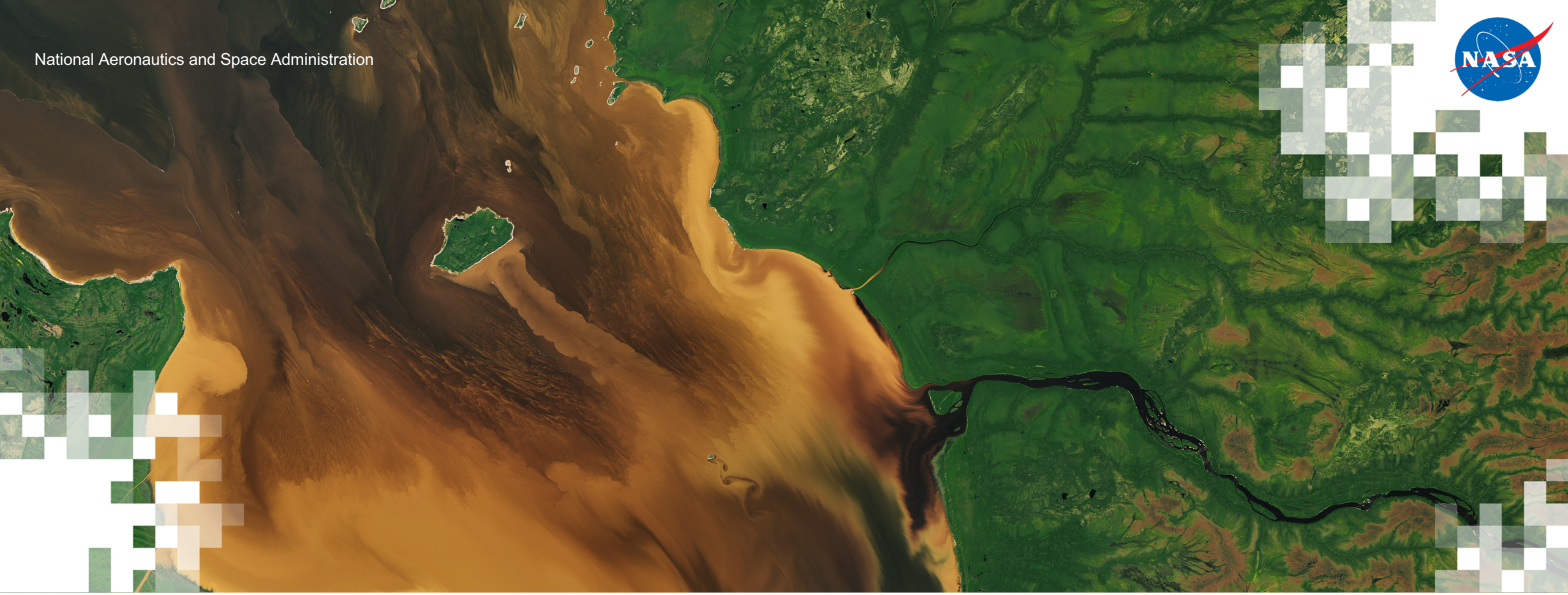
National Aeronautics and Space Administration



Monitoring Coastal and Estuarine Water Quality Using Remote Sensing and In Situ Data

Instructors: Amita Mehta, Sean McCartney, Selwyn Hudson-Odoi, Juan Torres-Pérez

7 December 2021

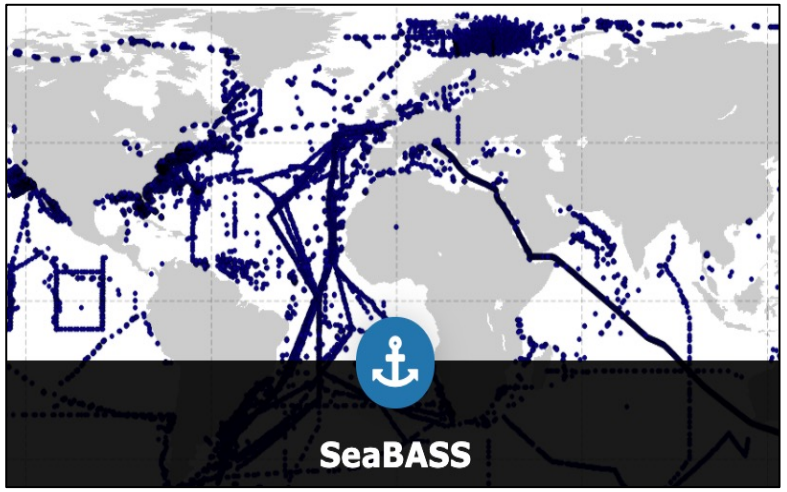
Prerequisites

- Install SeaDAS:
  - https://appliedsciences.nasa.gov/sites/default/files/2021-11/Install_SeaDAS_Edited_AM_SC_JO.pdf
- Install OceanColor Science Software (OCSSW):
  - https://appliedsciences.nasa.gov/sites/default/files/2021-11/Install_OCSSW_Mac_v5.pdf

Training Outline

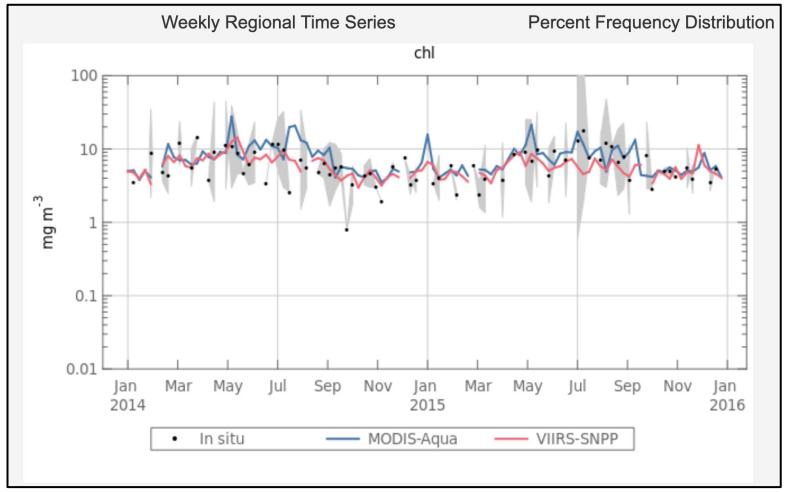
Two, 2-hour parts offered in English with materials available in Spanish.

Part 1: November 30, 2021



In Situ and Remote Sensing Data Acquisition

Part 2: December 7, 2021



Derive MODIS- and VIIRS-Based Water Quality and In Situ Data for a Selected Estuary/Coastal Region

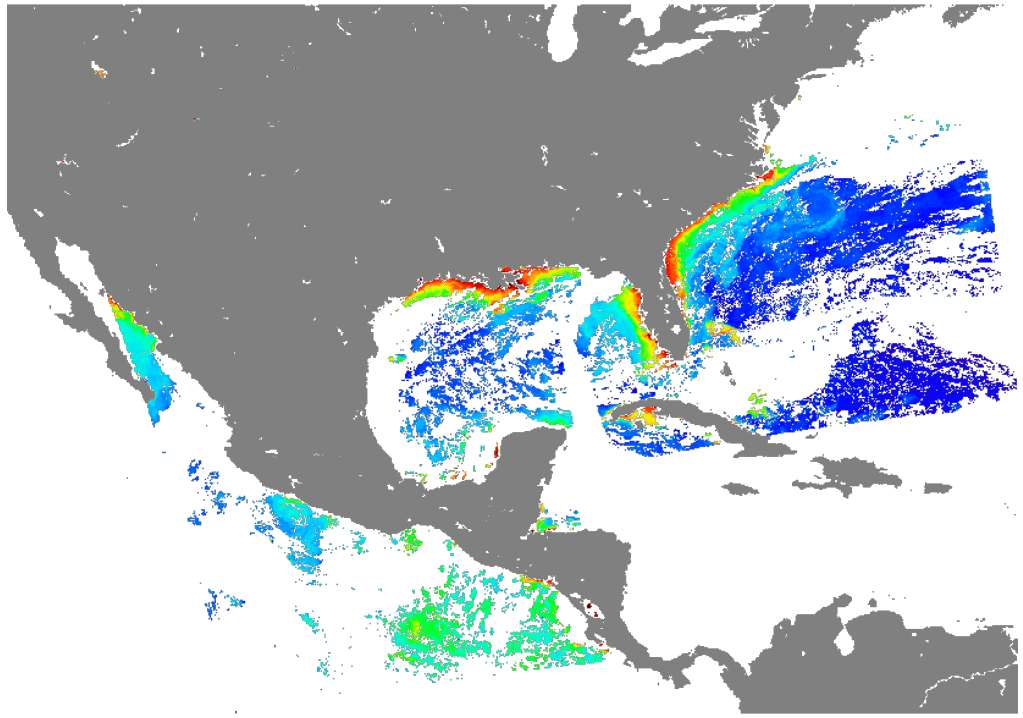
Homework and Certificate

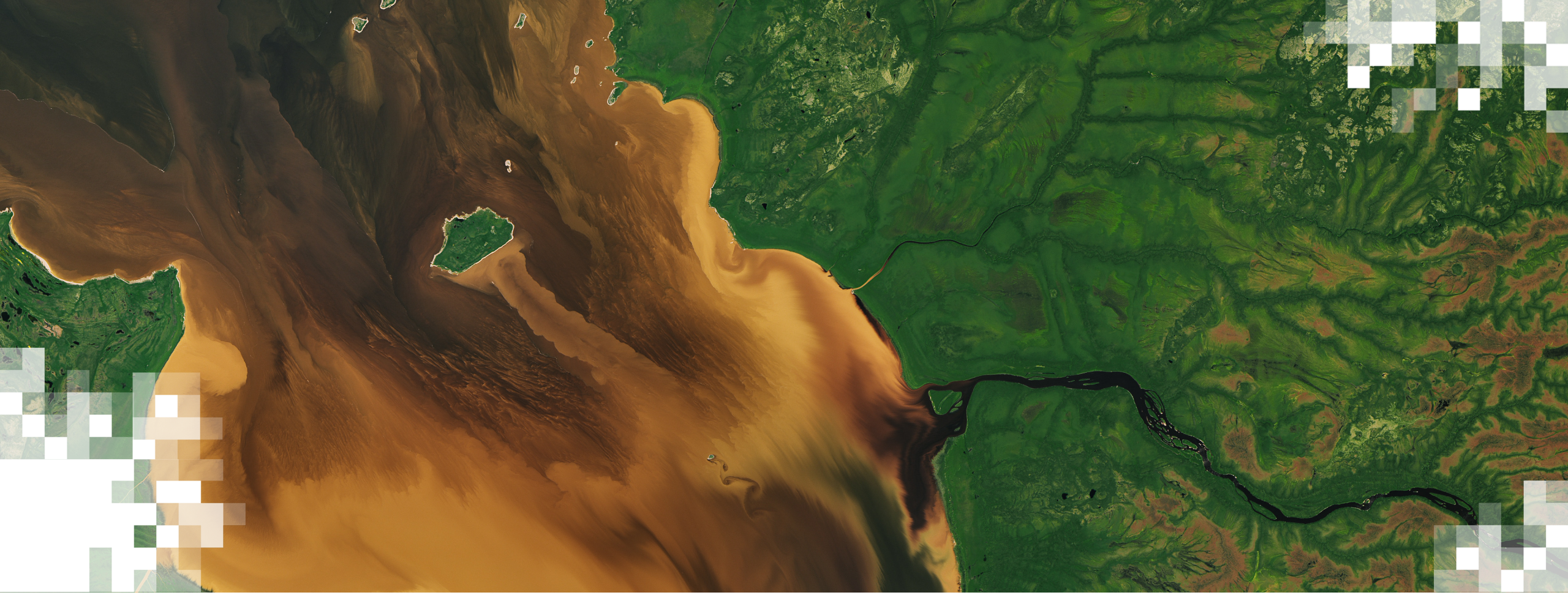
- One homework assignment:
  - Answers must be submitted via Google Form accessed from the ARSET website, and via ARSET email address
  - Homework will be made available on December 7, 2021.
  - Due date for homework: January 5, 2022.

- A certificate of completion will be awarded to those who:
  - Attend both live webinars and complete the exercises
  - Complete the homework assignment by the deadline
  - You will receive a certificate approximately two months after the completion of the course from: marines.martins@ssaihq.com

Outline for Part 2

- Review of Part 1/Lab-1: In Situ and Remote Sensing Data Acquisition
- Demonstration: Coastal Gulf of Mexico
  - Compare chlorophyll-a derived from in situ and remote sensing data (MODIS, VIIRS)
  - Procedure for developing algorithms for water quality parameters
- Lab Time: Work on **Exercise 2**

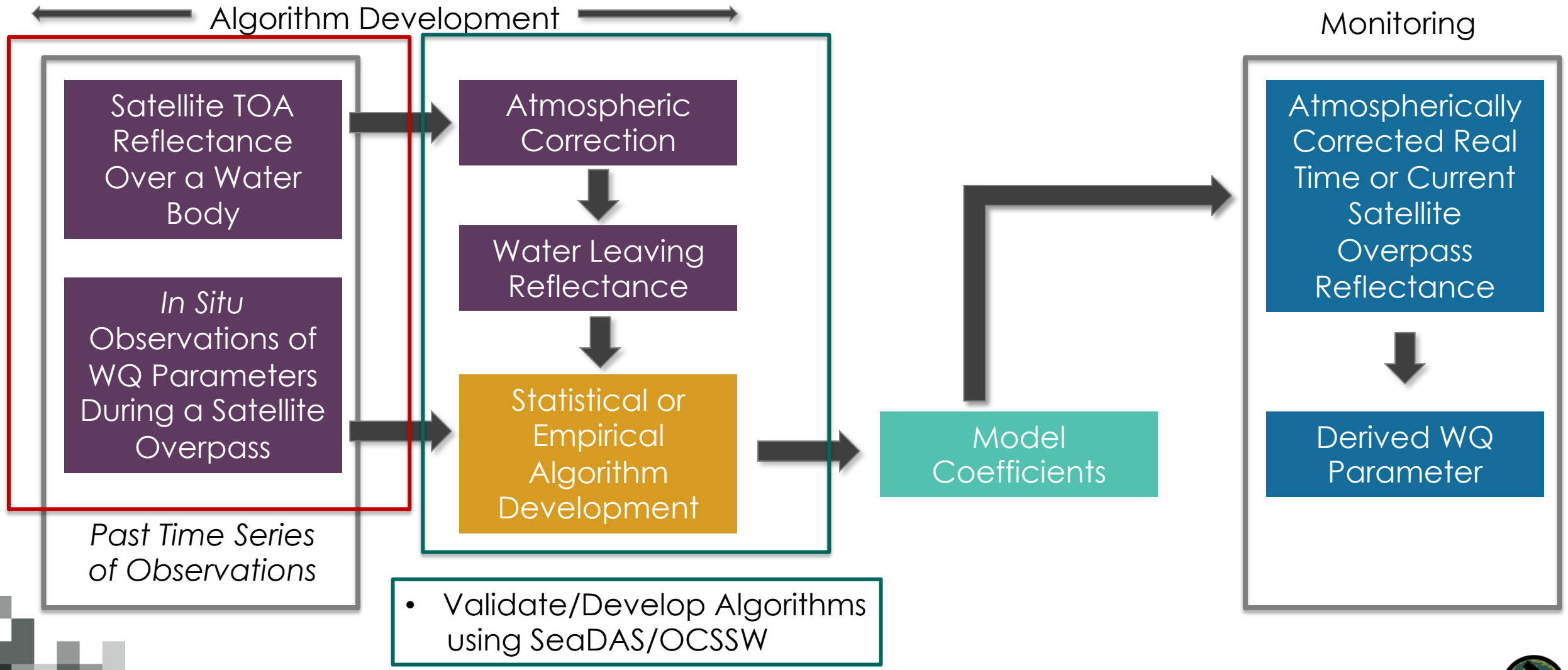




Review of Part-1/Lab-1:
In Situ and Remote Sensing Data Acquisition

Water Quality Parameters from Remote Sensing Observations

Quantitative Technique



Requirements for Algorithm Development

- Geographic region
- In situ water quality parameter measurements: spatial and temporal colocation with satellite overpass
- Spectral water reflectance from satellite images
  - Cloud-free scenes are necessary
- Seasonal to annual coverage of in situ and satellite data preferable
- Analysis and statistical algorithm coefficient derivations from the in situ and remote sensing observations
- Independent in situ data for algorithm validation

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- **Geographic region**
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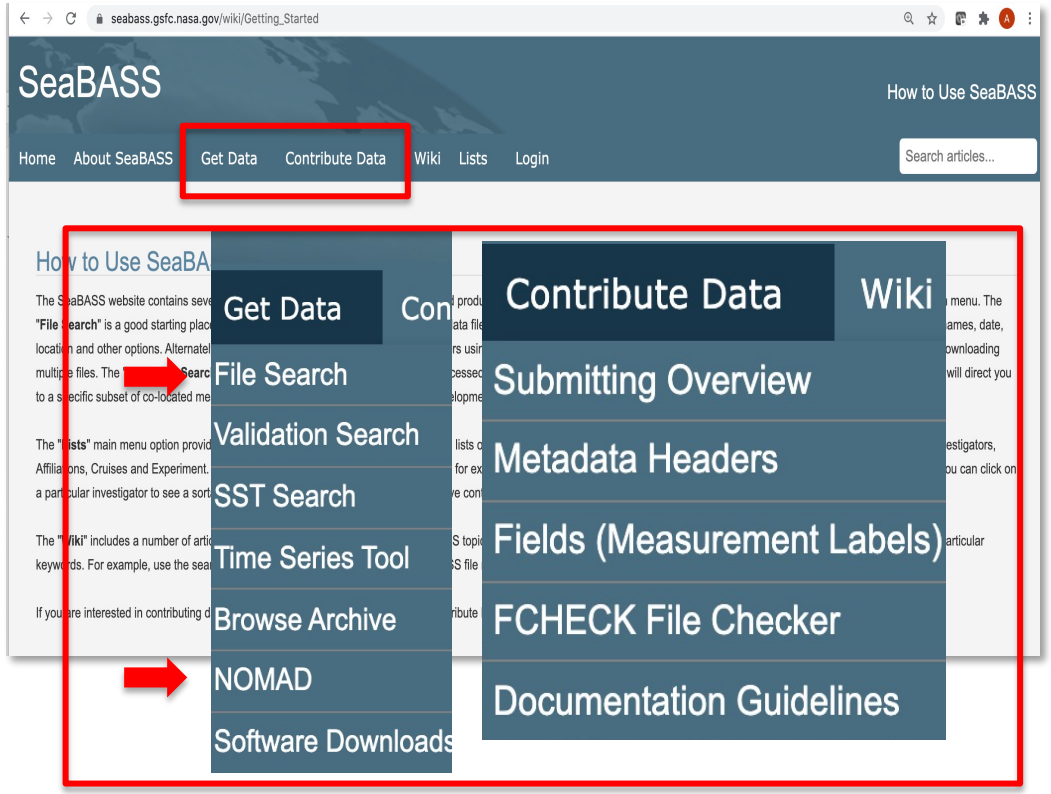
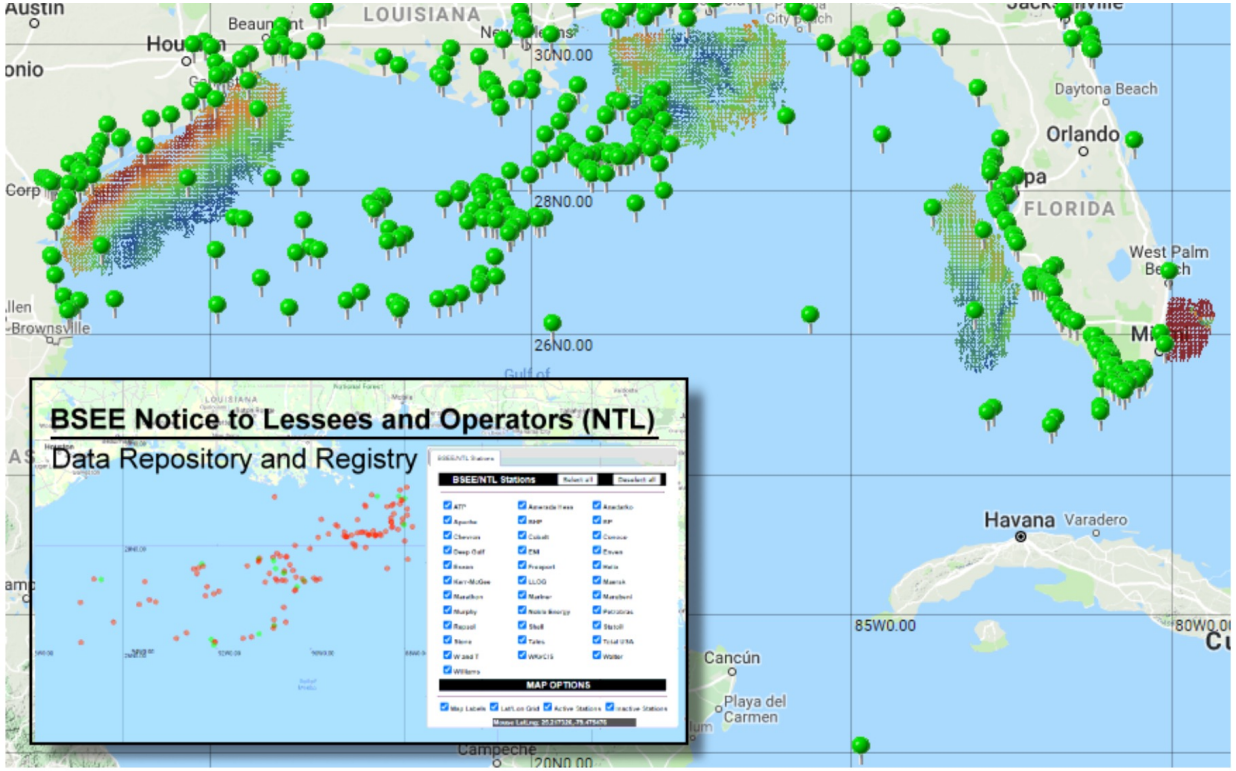
In Situ Data

SeaBASS



Gulf of Mexico Coastal Ocean Observing System (GCOOS)



In Situ Data Format and Reading in SeaDAS

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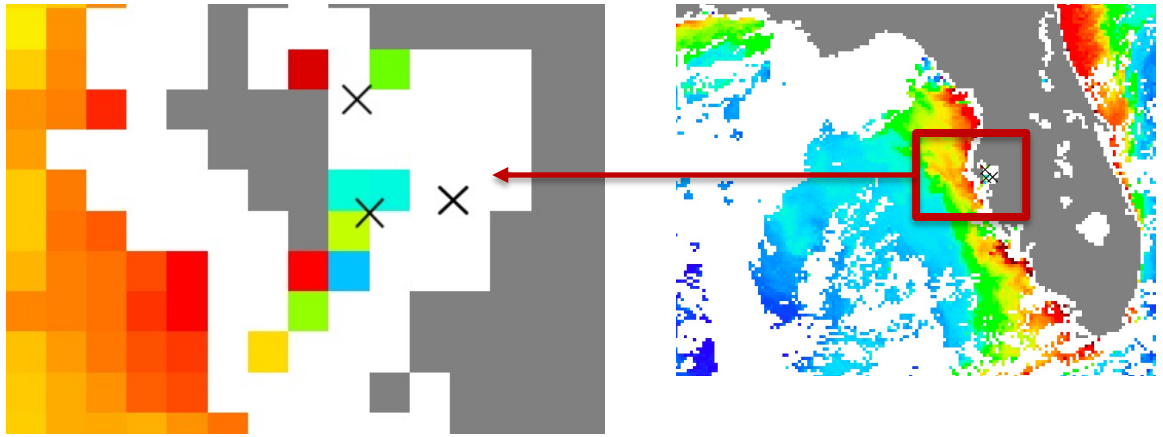
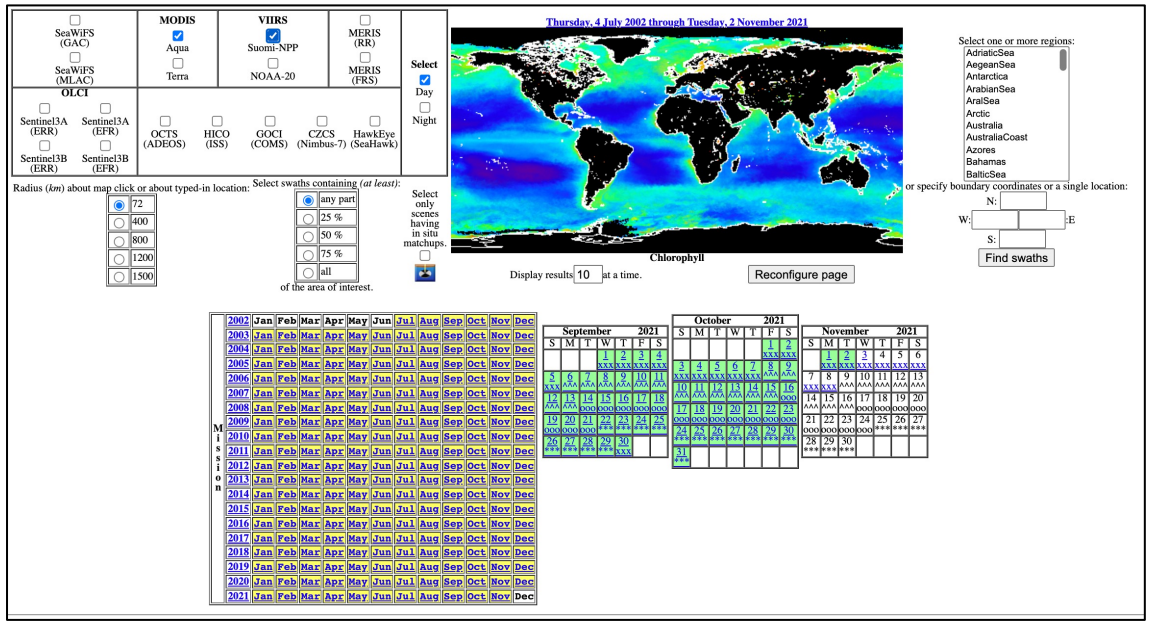


MODIS and VIIRS Data

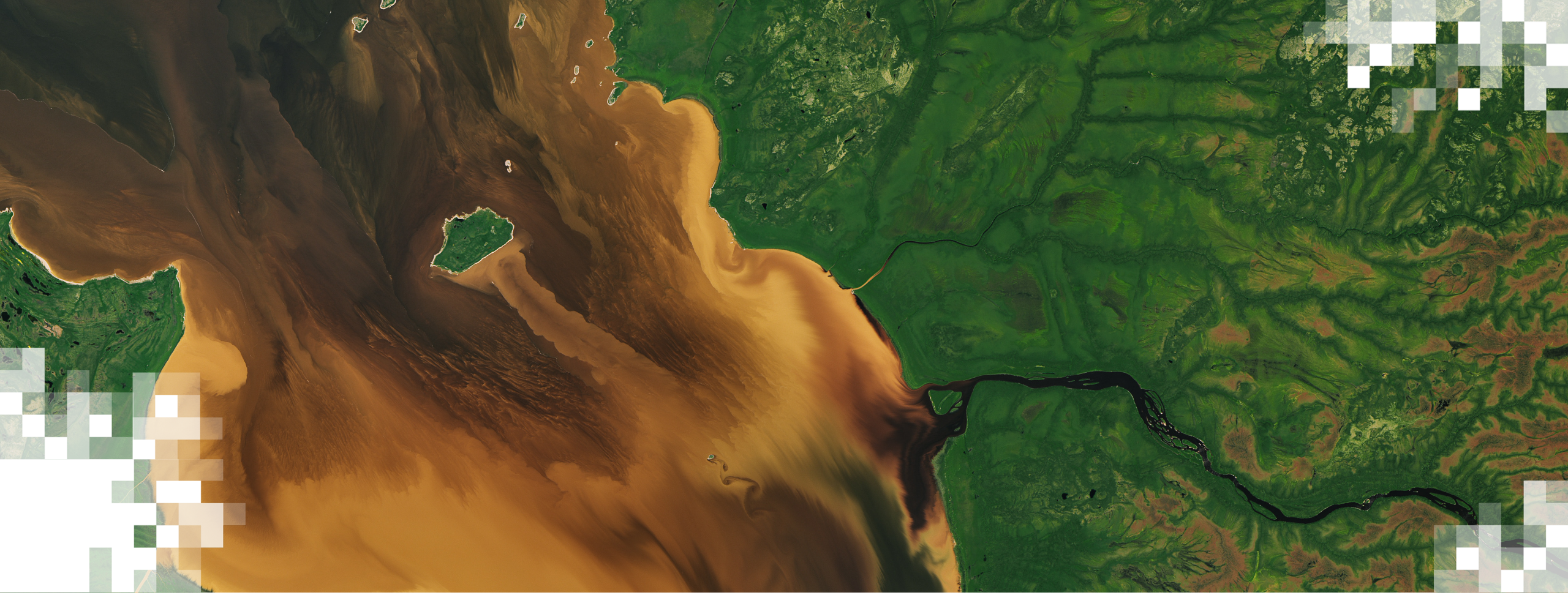
- Find cloud-free images:
  - For MODIS, use [NASA Worldview]
  - For VIIRS, use [NOAA STAR Ocean Color]

- Select and download Level-2 MODIS and VIIRS images* using [NASA OceanColor Web]

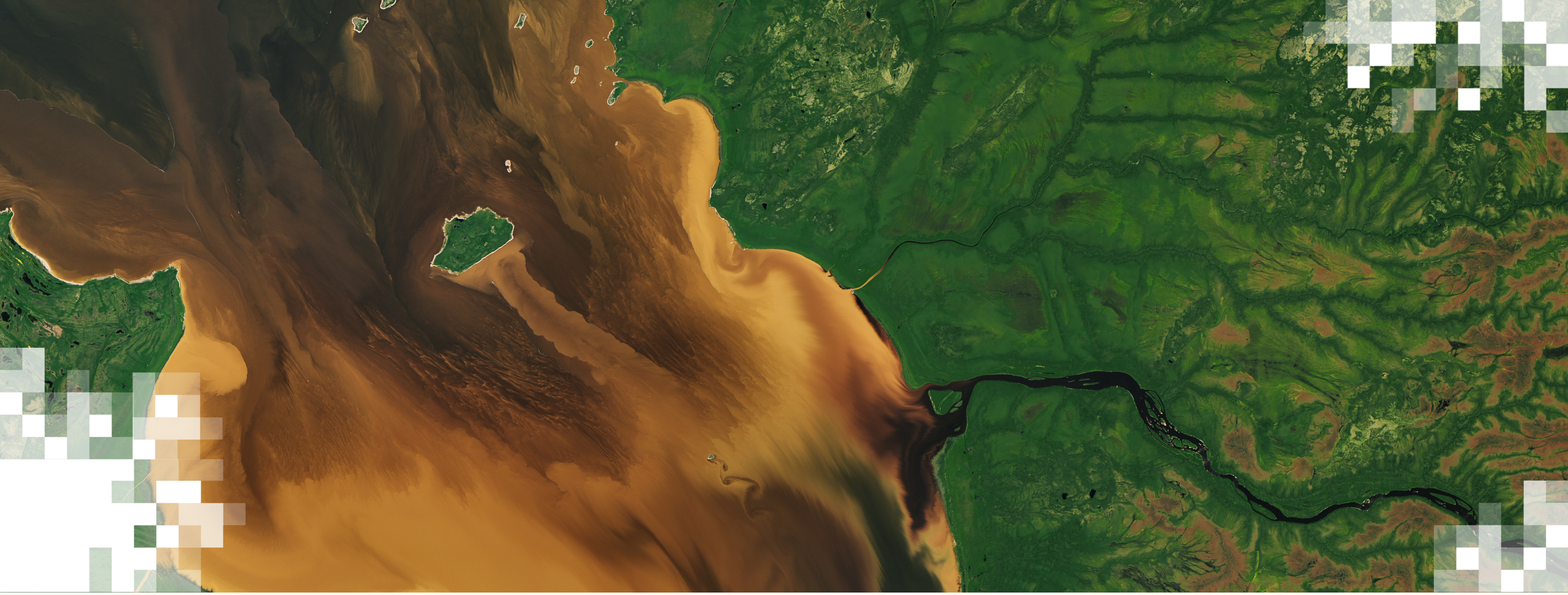


https://oceancolor.gsfc.nasa.gov/cgi/browse.pl?sen=amod

*Monitoring Coastal and Estuarine Water Quality: Transitioning from MODIS to VIIRS: https://appliedsciences.nasa.gov/join-mission/training/english/arset-monitoring-coastal-and-estuarine-water-quality-transitioning



Demonstration: Coastal Gulf of Mexico
Compare Chlorophyll-a Derived from In Situ and Remote Sensing Data (MODIS, VIIRS)

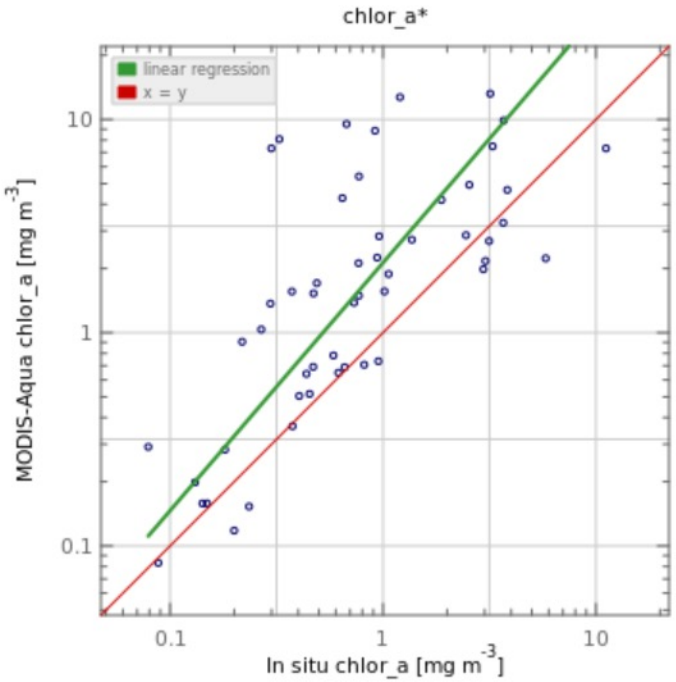


Demonstration: Coastal Gulf of Mexico
Procedure for Developing Algorithms for Water Quality Parameters

Important Note

- This training demonstrated water quality data validation and algorithm generation using sample data and the results presented are not statistically significant.
- In practice, many more observations spanning multiple seasons are required for the validation and algorithm generation from remote sensing and in situ data.

MODIS and In Situ Data Validation in SeaBASS for Gulf of Mexico



https://seabass.gsfc.nasa.gov/search_results/val

Summary

This training primarily focused on:

- Acquisition of available in situ data and MODIS and VIIRS images
- Preparation of in situ data in SeaBASS (SeaDAS – readable) format
- SeaDAS Features:
  - Open and display satellite Level-2 data
  - Mosaic satellite images
  - Import in situ data along with a satellite image
  - Correlate in situ and satellite-based chlorophyll-a data
- OCSSW:
  - Generate Level-2 data from Level-1 MODIS images
  - Get familiar with different processing options
  - Generate Chlorophyll Index (CI) using Level-2 water leaving reflectance from MODIS and VIIRS
- Outline of generating statistical algorithm based on the CI and in situ data

Useful Information

- Check for cloud-free images:
  - For MODIS, use NASA Worldview
  - For VIIRS, use NOAA STAR Ocean Color
- Find satellite overpass time over a geographical location for planning in situ data collection:

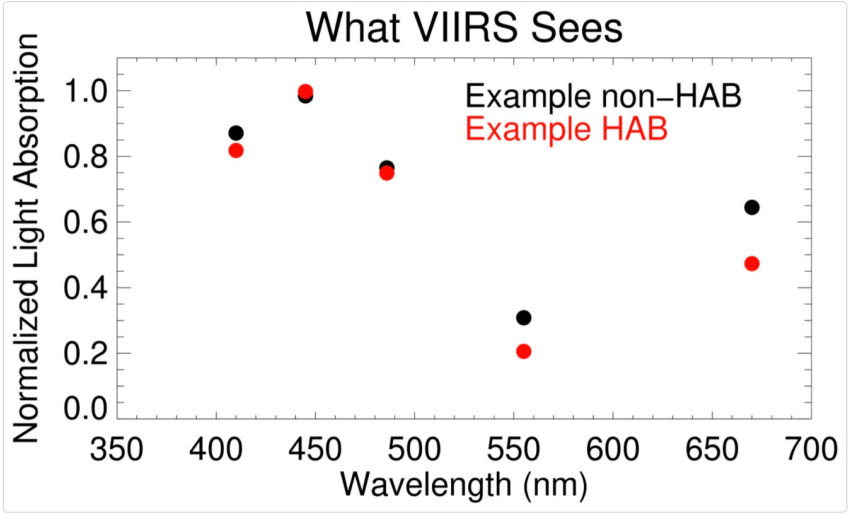
  OverPass Predictor
- For questions about SeaDAS/OCSSW, satellite data and processing:

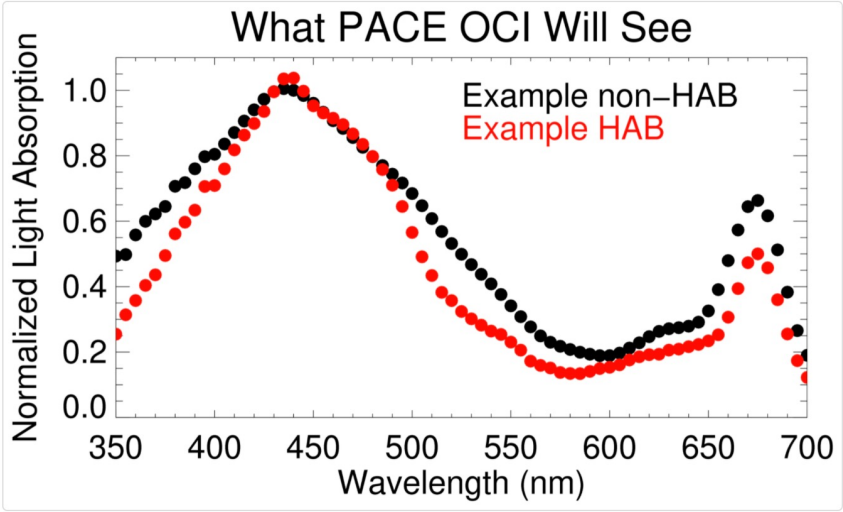
  NASS Ocean Color Forum

Upcoming Mission: PACE

https://pace.gsfc.nasa.gov/

- Plankton, Aerosol, Cloud, ocean Ecosystem mission is planned to be launched in 2022.
- PACE will carry Ocean Color Instrument (OCI), a spectrometer taking **hyperspectral** measurements in the 350 to 885 nm wavelength range at 5 nm intervals.
- PACE's hyperspectral coverage will provide the measurements to identify phytoplankton community composition.
- Designed improve our understanding of Earth's changing marine ecosystems, manage natural resources such as fisheries, and identify harmful algal blooms.





Upcoming Mission: SBG

https://sbg.jpl.nasa.gov/

- Surface Biology and Geology mission, currently in its design phase, is planned to be launched in 2026 or later.
- Current plans are for hyperspectral imagery in the visible and shortwave infrared, and multi- or hyperspectral imagery in the thermal IR.
- Observing Priorities:
  - Terrestrial vegetation physiology, functional traits, and health
  - **Inland and coastal aquatic ecosystem physiology, functional traits, and health**
  - Snow and ice accumulation, melting, and albedo
  - Active surface changes (eruptions, landslides, evolving landscapes, hazard risks)
  - Effects of changing land use on surface energy, water, momentum, and C fluxes
  - Managing agriculture, natural habitats, water use/quality, and urban development

Acknowledgments

- We thank the SeaDAS Team: Aynur Abdurazik, Daniel Knowles, Sean Bailey, and Yang Bing, for their help and guidance.
- We also acknowledge the help received from the NASA Ocean Color Forum.
- Special thanks to Sean McCartney and Selwyn Hudson-Odoi for their efforts in documenting the procedures for SeaDAS 8.1.0 and OCSSW installation and how to configure a virtual machine for Windows computers.

Lab Time: Exercise-2