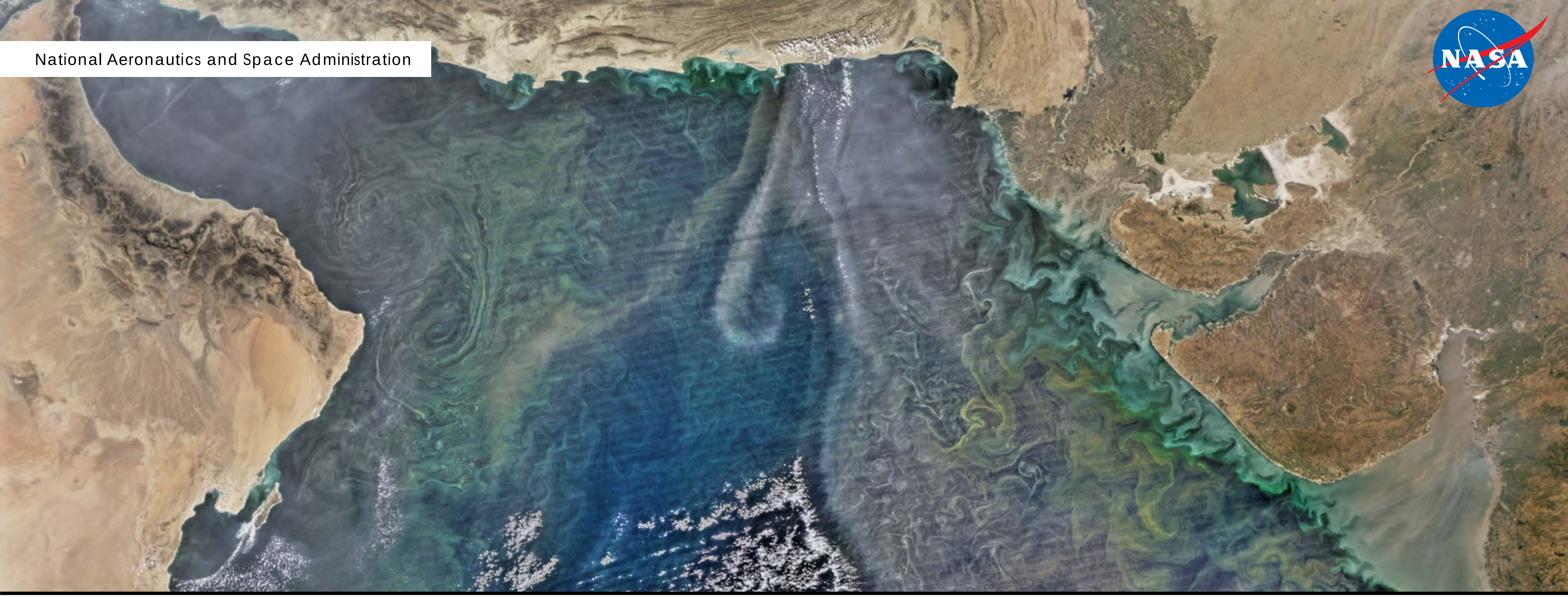


National Aeronautics and Space Administration

Monitoring Water Quality Using Satellite Image Processing

Africa Flores (SERVIR Global) and Amita Mehta

5, 12, and 19 September 2018

Course Outline

September 5

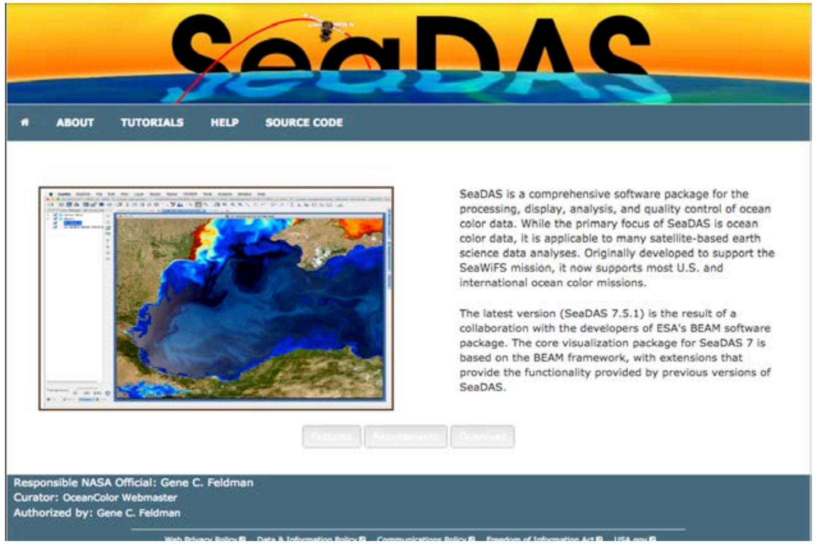
Overview and Analysis of NASA Remote Sensing Data for HAB Monitoring

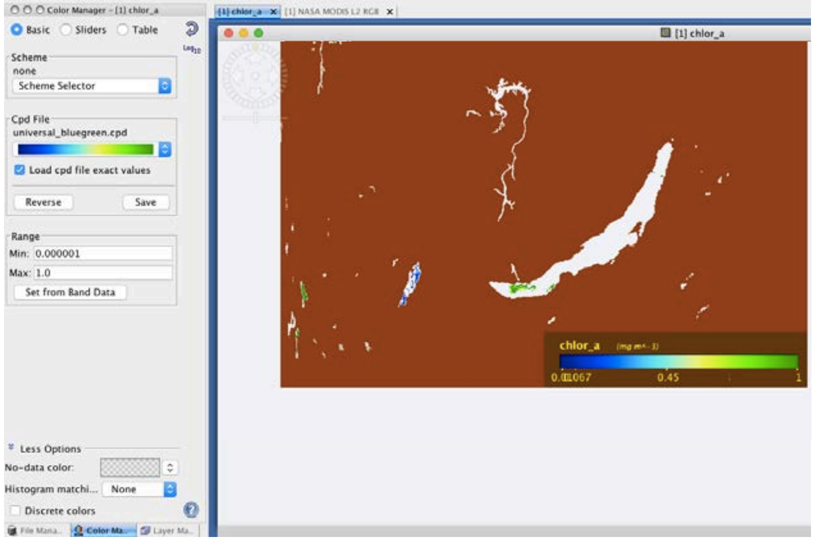
September 12

Introduction to SeaDAS for Image Processing and Data Analysis

September 19

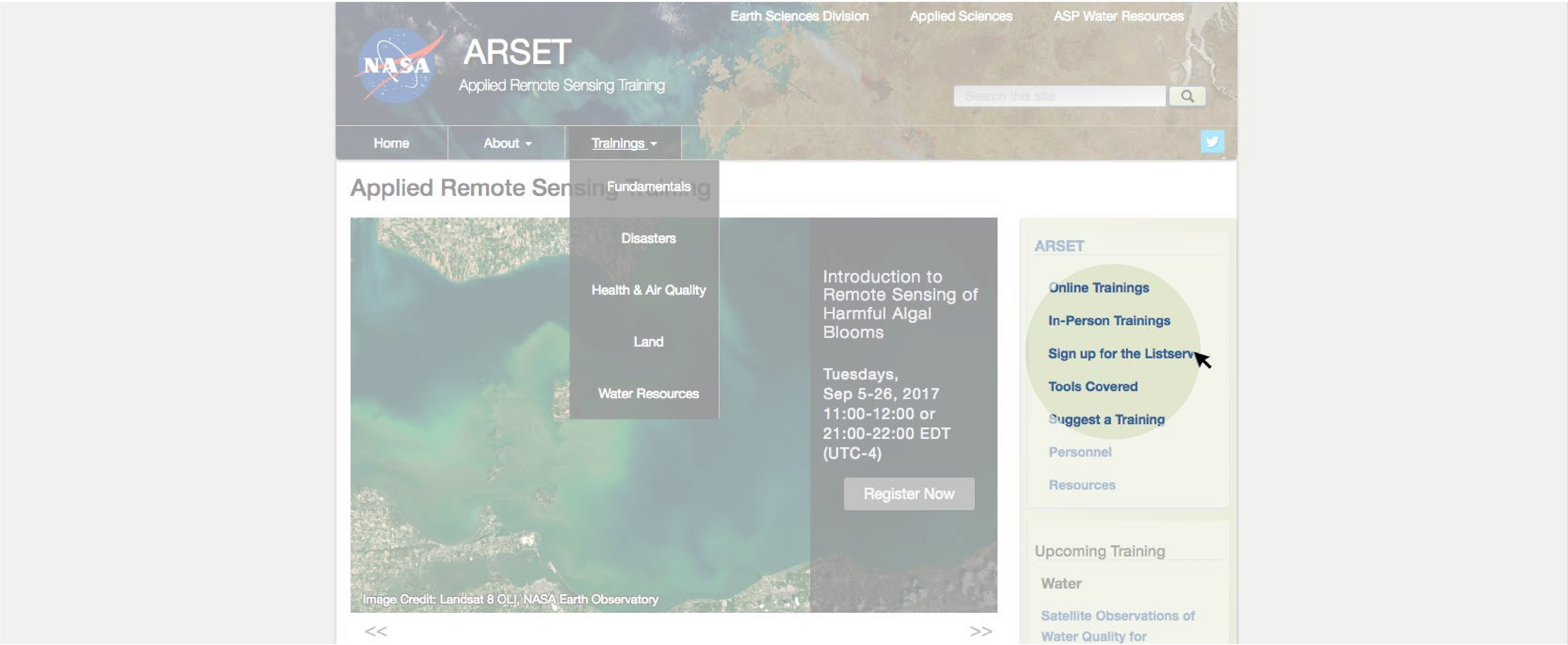
Image Analysis Exercise Using SeaDAS





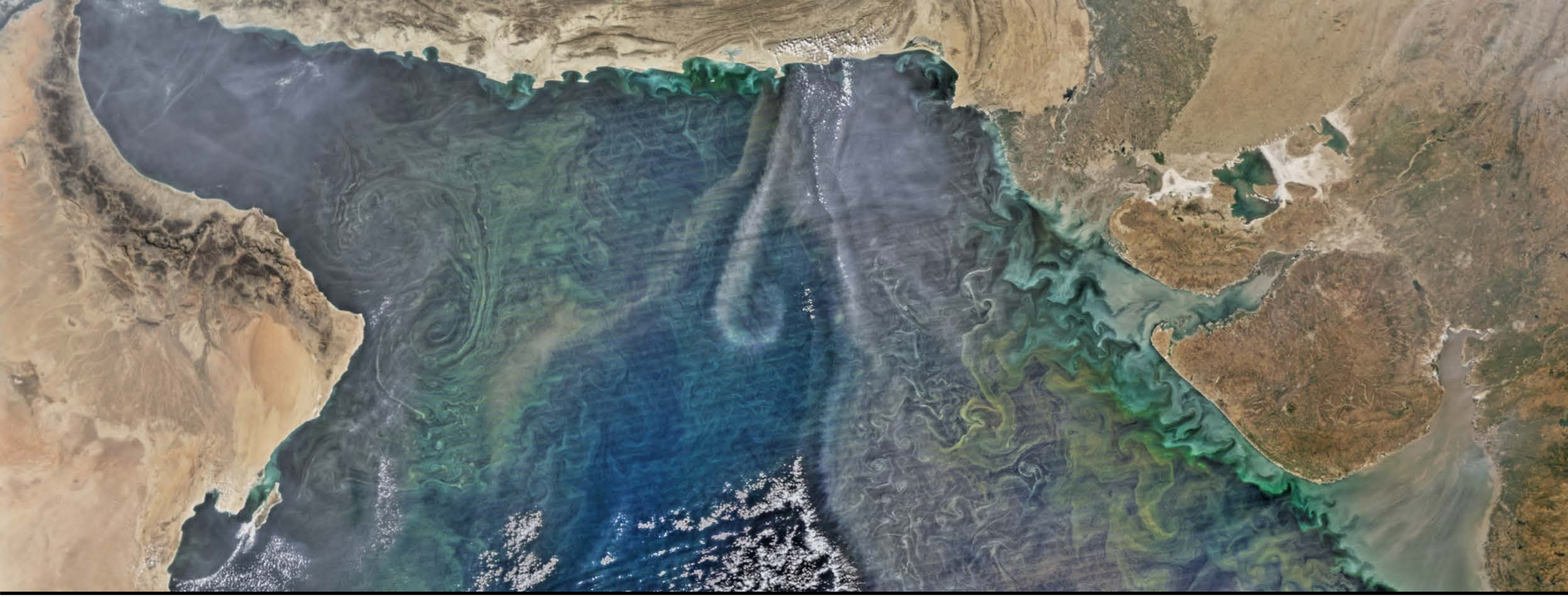
Learn More About ARSET

http://arset.gsfc.nasa.gov/



Outline for Week 3

- Overview of Image Processing
- Ocean Color Science Software (OCSSW)
- Demonstration: Analysis of Landsat-8 OLI Image Using SeaDAS/OCSSW
- Convert L-1 data to atmospherically corrected L-2 data
  – Focus: Lake Victoria
- Demonstration: Using Landsat-8 OLI Band Reflectance and In Situ Data for Algorithm Development
  – Focus: Gulf of Mexico
- Summary



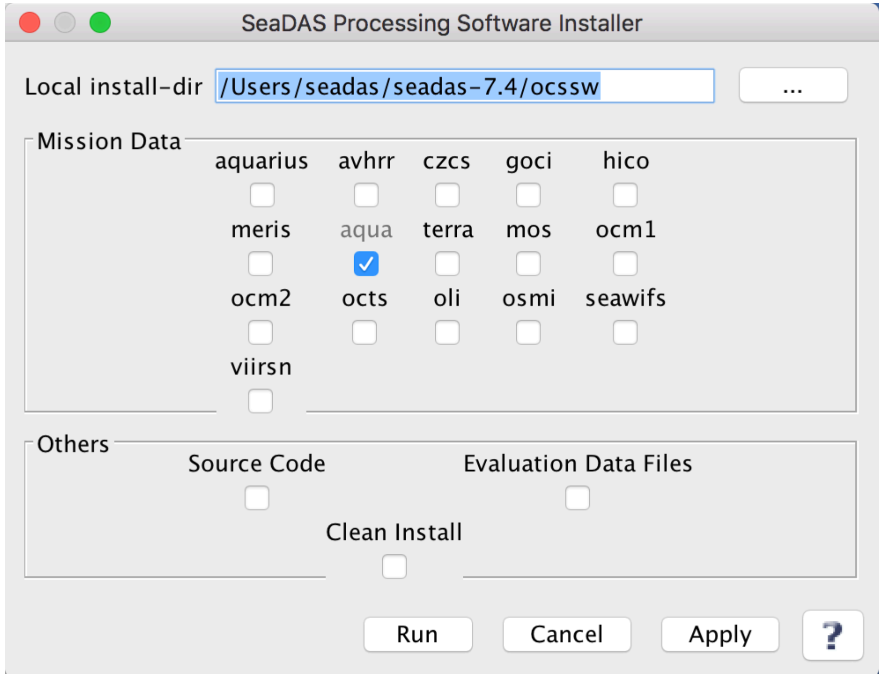
Overview of Image Processing: Ocean Color Science Software (OCSSW)

Acknowledgement: Daniel Knowles (Daniel.s.Knowles@nasa.gov)

Ocean Biology Processing Group

Installation of OCSSW

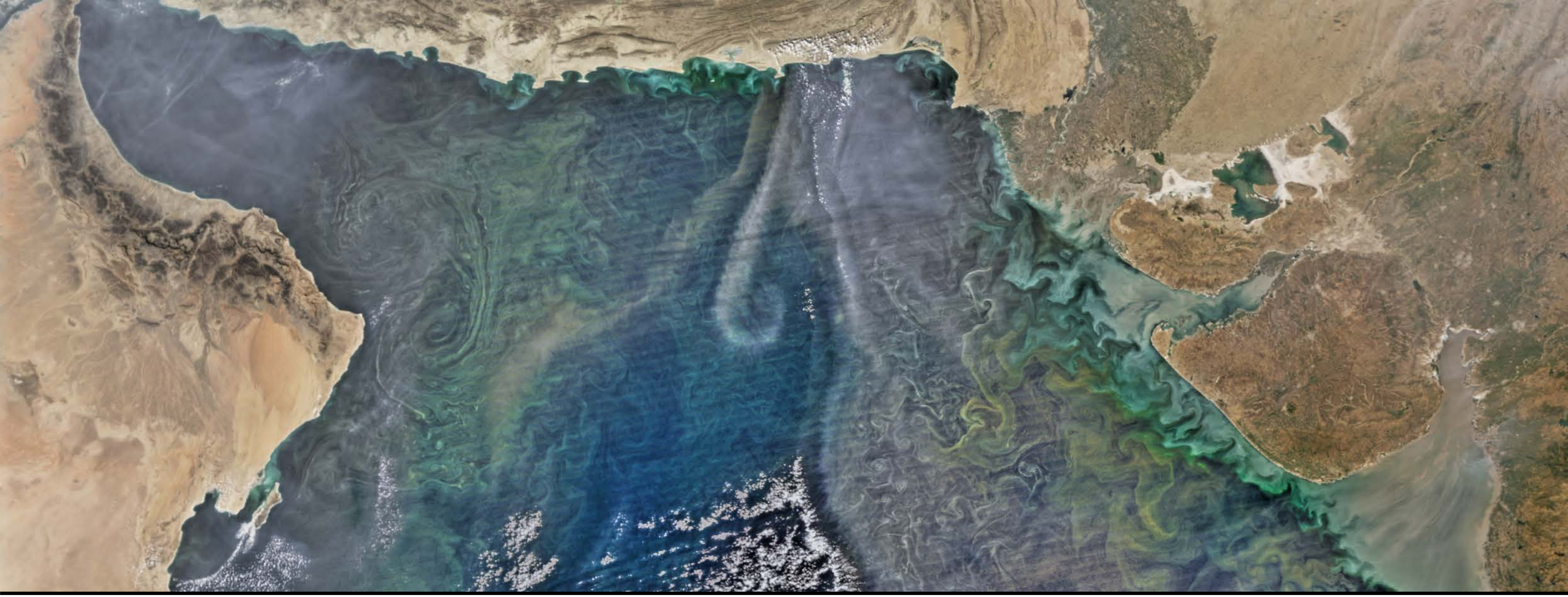
- OCCSW can be installed or updated for various sensors
- GUI Configuration
  - Automated or…
  - Edit ${SEADAS_HOME}/config/seadas.configseadas.ocssw.root = [OCSSW_root_dir]
- Command Line Configuration
  - User needs to set
  - Edit ".bashrc" (or equivalent) home file:
    export OCSSWROOT=${SEADAS_HOME}/ocssw
    source $OCSSWROOT/OCSSW_bash.env
- Processor failure will occur if mission not installed **(and log message may not identify problem)**



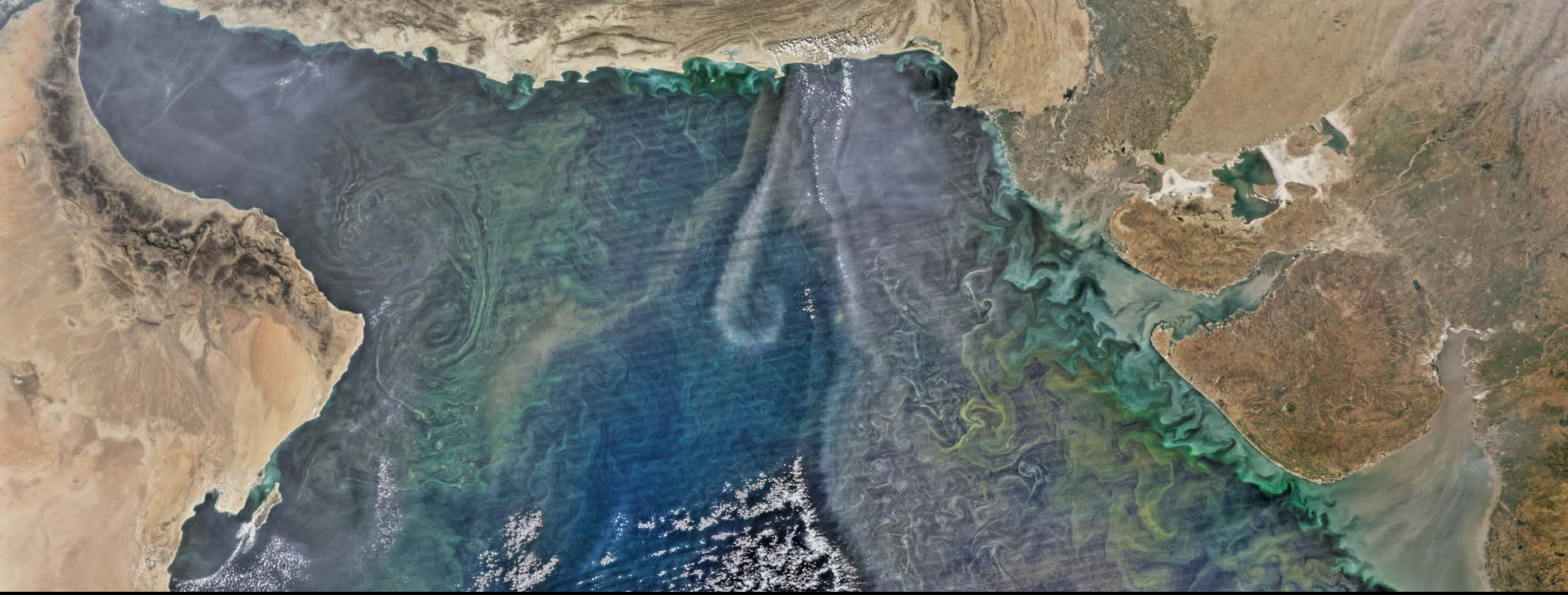
Note :For OLCI-S3A currently command line only available
To install: install_ocssw.py –i ${OCSSWROOT}–b v7.4 –-olci

OCSSW Processing Options

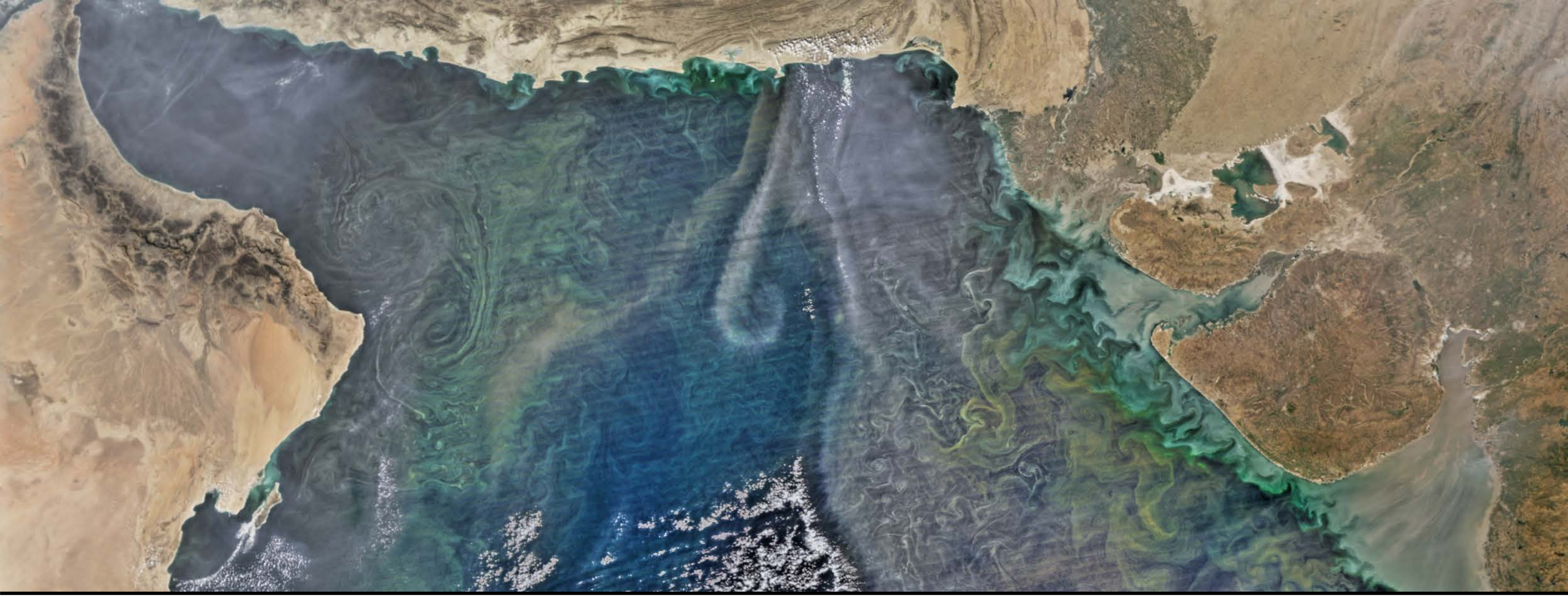
- Level-1: Browser and Map Generator
- Level-2: Browser and Map Generator
- Level-1 to Level-2 Generator
- Get Ancillary Data for Atmospheric Correction
- Geo-location and Calibration [for MODIS and VIIRS only]
- Extractors: Spatial and By Products
- Level-2 Binning For Level-3
- Level-3 Binning from multiple Level-3 files
- Level-3 Map Generator
- Level-3 Metadata Dump
- Multi-Level processing



Demonstration: Convert Landsat 8 (OLI) L-1 Data to Atmospherically Corrected L-2 Data



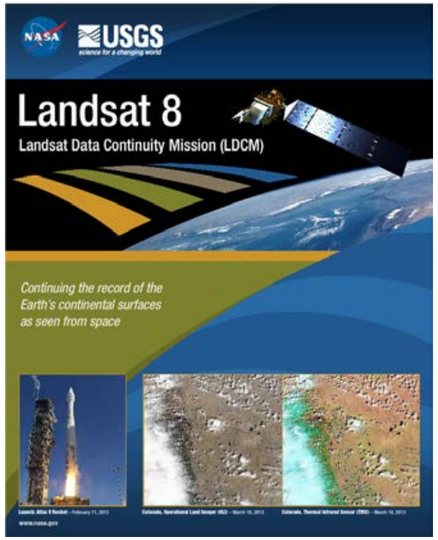
Demonstration: Assessing MODIS L2 data with In Situ Data – Use of custom algorithms to derive Chl-a

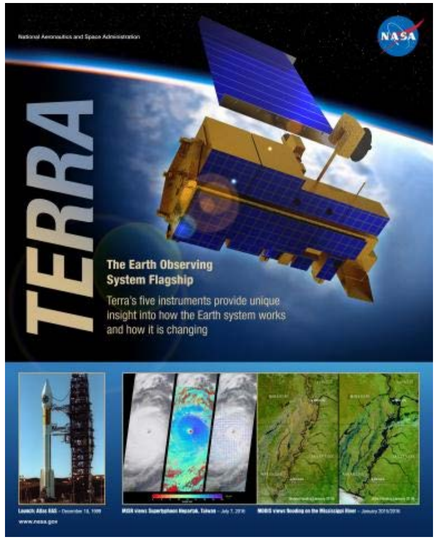


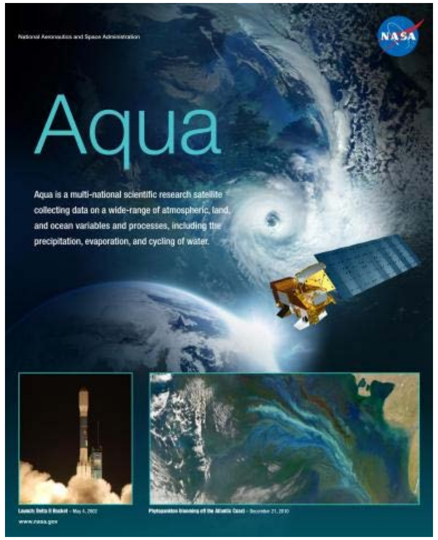
Summary

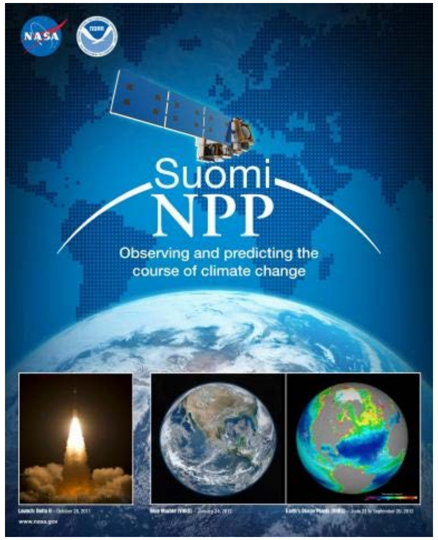
Current Satellite Missions for Water Quality Monitoring

- Landsat 7 (4/15/1999 – present)
- Landsat 8 (2/1/2013 – present)
- Terra (12/18/1999 – present)
- Aqua (5/4/2002 – present)
- Suomi National Polar Partnership (SNPP) (11/21/2011 – present)
- Joint Polar Satellite System (JPSS) (11/21/2017 – Present)
- Sentinel-2A (6/23/2015 - present)
- Sentinel-2B (3/7/2017 – present)
- Sentinel-3A (2/16/2016 – present)









Satellites and Sensors for Monitoring Water Quality

Satellites	Sensors	Resolution
Landsat 7	Enhanced Thematic Mapper (ETM+)	185 km swath; 15 m, 30 m, 60 m; 16 day revisit
Landsat 8	Operational Land Imager (OLI)	185 km swath; 15 m, 30 m, 60 m; 16 day revisit
Terra & Aqua	MODerate Resolution Imaging Spectroradiometer (MODIS)	2330 km swath; 250 m, 500 m, 1 km; 1-2 day revisit
Suomi NPP& Joint Polar Satellite System	Visible Infrared Imaging Radiometer Suite (VIIRS)	3040 km swath; 375 m – 750 m; 1-2 day revisit
Sentinel 2A and 2B	Multi Spectral Imager (MSI)	290 km swath; 10 m, 20 m, 60 m; 5 day revisit
Sentinel 3A	Ocean and Land Color Instrument (OLCI)	1270 km swath; 300 m; 27 day revisit

Reference

NASA Water Quality Data and Tools

Data Available from MODIS and VIIRS:

- Chlorophyll Concentration
- Sea Surface Temperature
- Particulate Organic Carbon
- Particulate Inorganic Carbon
- Inherent Optical Properties

Data Access Tools:

- Ocean Color Web: https://oceancolor.gsfc.nasa.gov/
- Giovanni: https://giovanni.gsfc.nasa.gov/giovanni/

Data Processing Software:

- SeaDAS: https://seadas.gsfc.nasa.gov/

Water Quality Parameters from Remote Sensing Observations

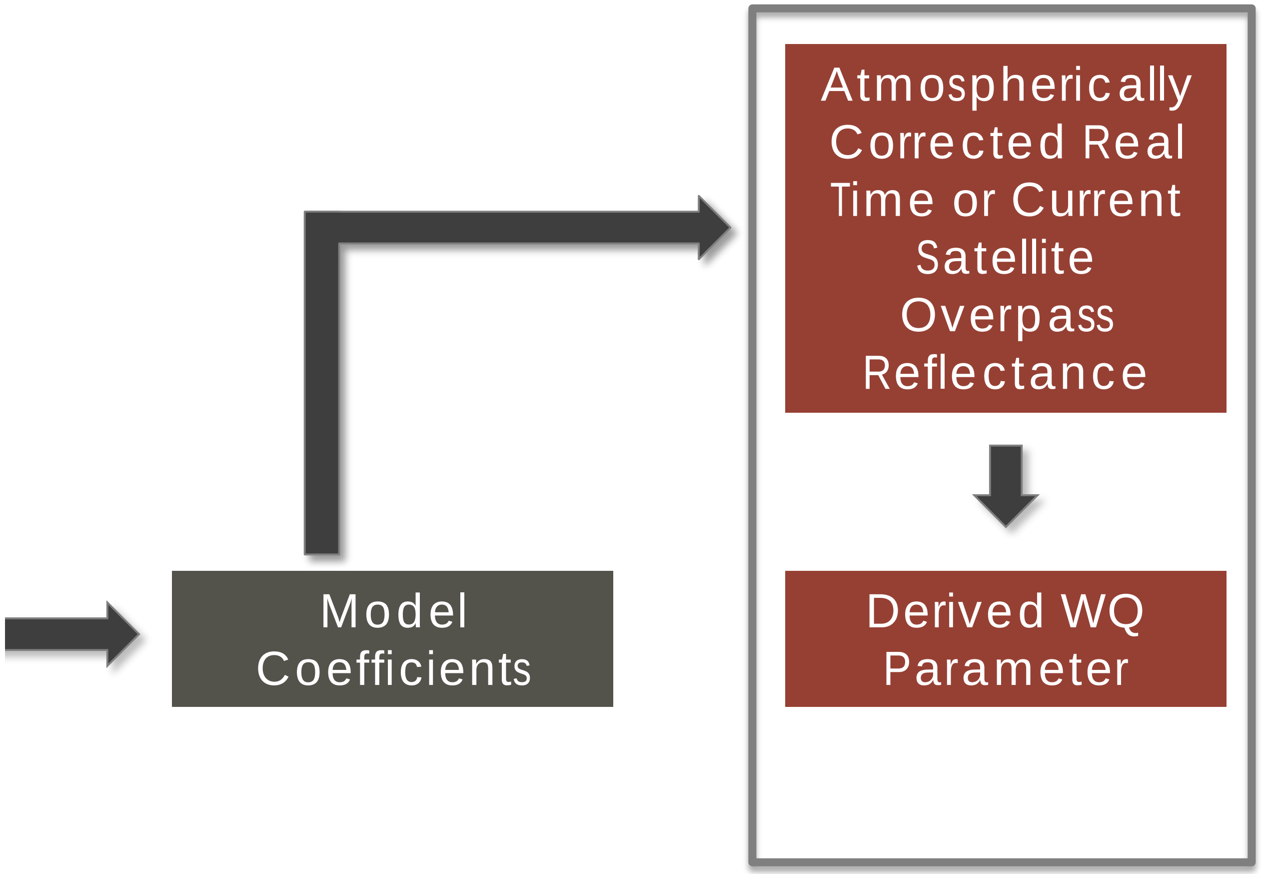
Quantitative Technique

Algorithm Development

Monitoring

Algorithms use optical, NIR, IR, and MW remote sensing observations for quantitative water quality monitoring in lakes, estuaries, and coastal oceans

See a review in Golizadeh et al., 2016 and references included in the review



Reference: Gholizadeh, M. H., A. M/ Melesse, L. Reddy, 2016: Spaceborne and airborne sensors in water quality assessment, International J. of Remote Sensing, 37, 3143-3180.

Challenges in Monitoring Water Quality (WQ)

- For accurate and quantitative WQ monitoring analysis of spatially and temporally co-located, in situ measurements and satellite observations are required
- Feasibility of WQ monitoring in coastal and inland water bodies depends on spatial, temporal, and spectral resolutions of remote sensing observations
- Difficult to separate WQ parameters when sediments, dissolved matter, and Chl-a all are present
- It is not possible to characterize algal types or toxins only from remote sensing observations
- Remote sensing reflectance has to be corrected to account for contributions from atmospheric constituents such as aerosols
- Optical remote sensing observations cannot view the surface in the presence of clouds

Operational Water Quality Monitoring

- Combination of data from multiple satellites is useful for monitoring water quality
- Monitoring water quality in inland lakes depends on the size of lakes
  - Landsat can monitor close to 170,240 lakes globally
  - MODIS/OLCI would resolve ~1,862 lakes globally [Wilson Salls, EPA]
- Examples of remote sensing-based regional water quality monitoring:
  - Cyanobacteria Assessment Network (CyAN)
  - Lake Erie HAB Tracker
  - NOAA Coast Watch
  - Copernicus Marine Environment Monitoring Service
  - Near Real-Time Algal Bloom Monitoring Services in the North Atlantic
  - All of these tools are discussed in the ARSET Training *Introduction to Remote Sensing for Harmful Algal Blooms*

Thank You