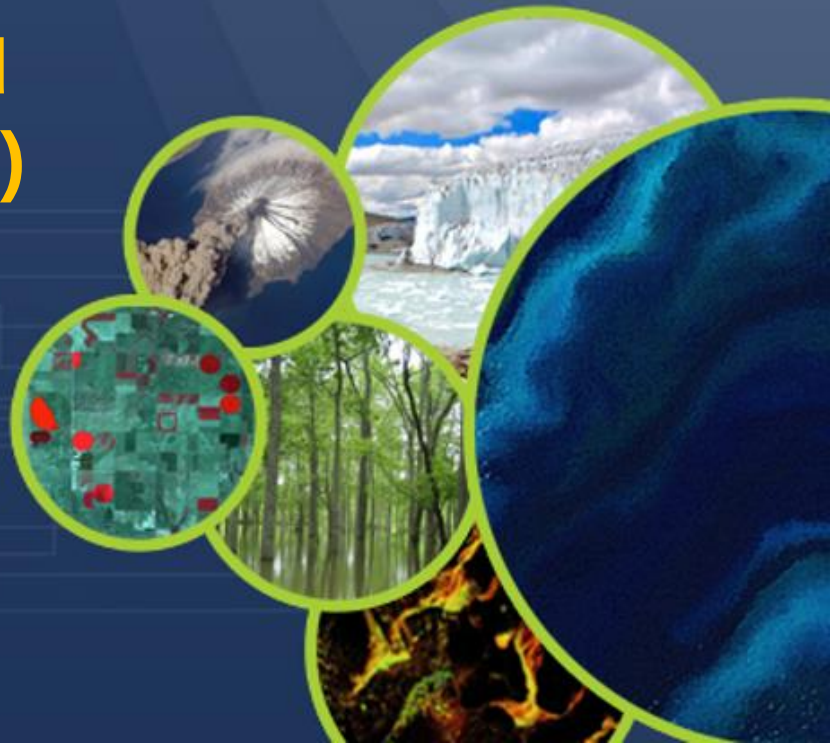
Committee on Earth Observation Satellites

Leveraging Satellite-Based Earth Observations (SBEO) for Coastal Monitoring



April 29, 2022

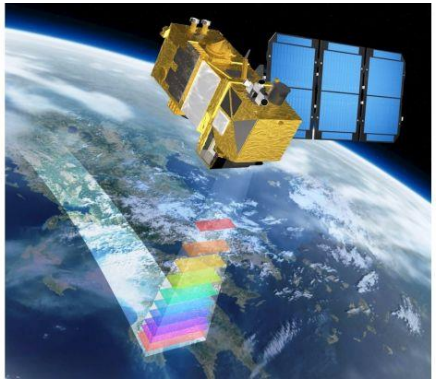
Nicole Bartlett, NOAA Regional Coordinator, North Atlantic
CEOS COAST Chesapeake Bay Team
Stakeholder Engagement Lead

Equity Considerations

- NOAA is centering equity in all we do: from developing our workforce to ensuring all communities are able to develop, use, and benefit from our resources. With equity as our lens:
  - How do we grow understanding of satellite-based applications?
  - How do we scale up projects and methods that put satellite data & information into the hands of more people?

Why now?

- SBEO are no longer too coarse for coastal applications (e.g. Sentinel-2 mission (polar-orbiting, multispectral high-resolution imaging) launched in 2015 (2A) and Sentinel-2B (2017) w 5 day repeat at 10m resolution)
- Accessibility is better than ever (e.g. Global Earth Engine, datacube framework)
- Continued significant global investments and collaboration in the advancement of sensors, algorithms and applications



However

…we still need to connect the data provider and user community to derive the most utility for SBEO.

Partnerships

Satellite data / imaging

Satellite data/imaging processing capabilities

Expertise in satellite algorithm development

Analytical tools/capabilities

Local knowledge/ groundtruthing ability

In situ data, existing models

Understanding of local needs/applications

Analytical tools/capabilities

Image courtesy from Social Zoom Factor

Virginia's Middle Peninsula

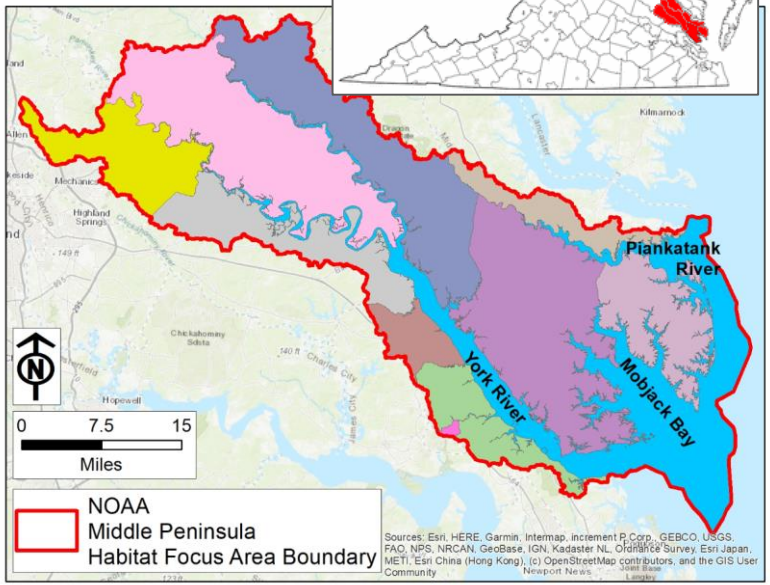
A system of 3 watersheds: York River, Piankatank River,

Area is experiencing:

- Decline in oyster reefs
- Climate change impacts on shorelines
- Restoration capacity limitations

Restoration here is a high priority for:

- NOAA
- National Fish & Wildlife Foundation
- US Army Corps of Engineers
- Commonwealth of Virginia
- Chesapeake Bay Program



Habitat Focus Area

- ## Value of the HFA framework

  Raise the visibility of an often-overlooked region - draw more resources to strengthen green infrastructure and enhance resilience through increased capacity.

  Leverage external resources - USACE, NFWF, Virginia, Chesapeake Bay Program.

  Develop framework for strategic coordination & communication across NOAA offices & partners = increased efficiency & effectiveness.

- ## Opportunity for Impact

  Advance regional climate resilience & support local blue economy

  Promote locally relevant science and research

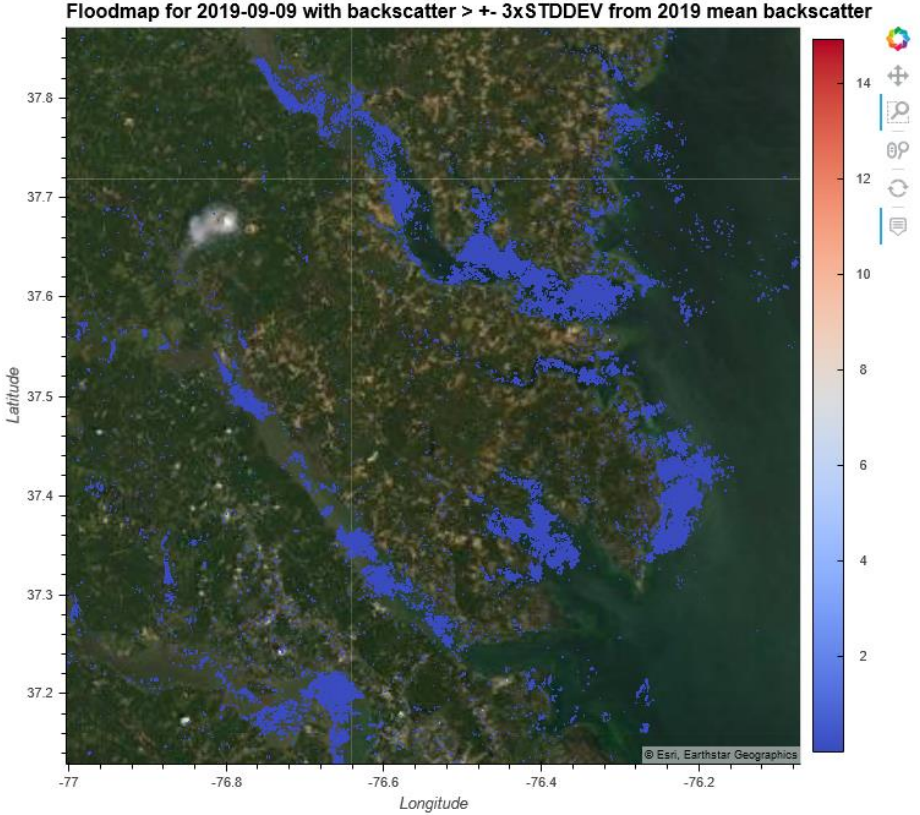
  Connect NOAA expertise with cross-sector stakeholders

Within the HFA

- Providing existing and emerging satellite data for this area and the broader Chesapeake Bay region.
- Engage stakeholders in the co-design and co-development of satellite products to meet identified data gaps; leverage in situ data for product validation.
    - Focus on products supporting flooding and water quality applications
    - CoastWatch support through training, user engagement
- Develop and evaluate satellite-derived data products through an online toolbox - the coastal knowledge hub.
- Leverage the Committee for Earth Observation Satellites (CEOS) Coastal Observations Applications Services & Tools (COAST) to share lessons learned and capabilities from other agencies and regions.

Possible Restoration Applications

- Identifying flood prone areas and detect changes over time
- Optimizing and/or co-locating habitat restoration
- Targeting wetlands for large scale marsh restoration
- Combatting shoreline erosion with natural infrastructure



Engagement with Middle Peninsula Stakeholders

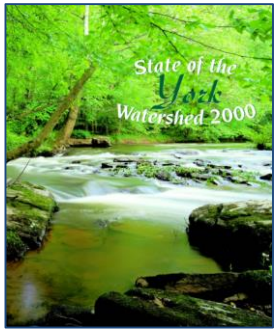
- Nov 2020 - Initial reach out to gauge interest in exploring new satellite data products
- April 2021 - High level summary of data needs providing to satellite product developers
- Summer 2021 - Mid-Atlantic interns added to explore satellite capabilities
- Fall 2021 to date - Satellite product exploration/development
- Today - stakeholder feedback

VIMS | William & Mary
Virginia Institute of Marine Science

Center for Coastal Resources Management
Virginia Institute of Marine Science

Middle Peninsula Planning District Commission

Chesapeake Bay National Estuarine Research Reserve Virginia



Pamunkey Indian Tribe & Reservation
Virginia

Questions to be thinking about

CEOS
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Earth Observation Satellites

- Which of these products are most germane to your work in the Chesapeake Bay?
- Where do you see opportunities to contribute to co-development of these products, either with data or expertise?
- Are there other potential SBEO applications we have not considered or discussed?

Introduction to COAST: Coastal Observations, Applications, Services, and Tools

CEOS
Committee on
Earth Observation Satellites

Coastal Observations, Applications, Services, and Tools

Who is CEOS? **Committee on Earth Observation Satellites**

What is CEOS COAST? **Coastal Focused Team**

- **Use Earth Observation data (satellite + in situ) to tackle coastal problems affecting society - Coverage | Frequency | Resolution**
- **Engage with regional coastal stakeholders**
  - Endorsed as a Contribution to the UN Ocean Decade, potential for funding to sustain this over the Decade

How might CEOS COAST help you?

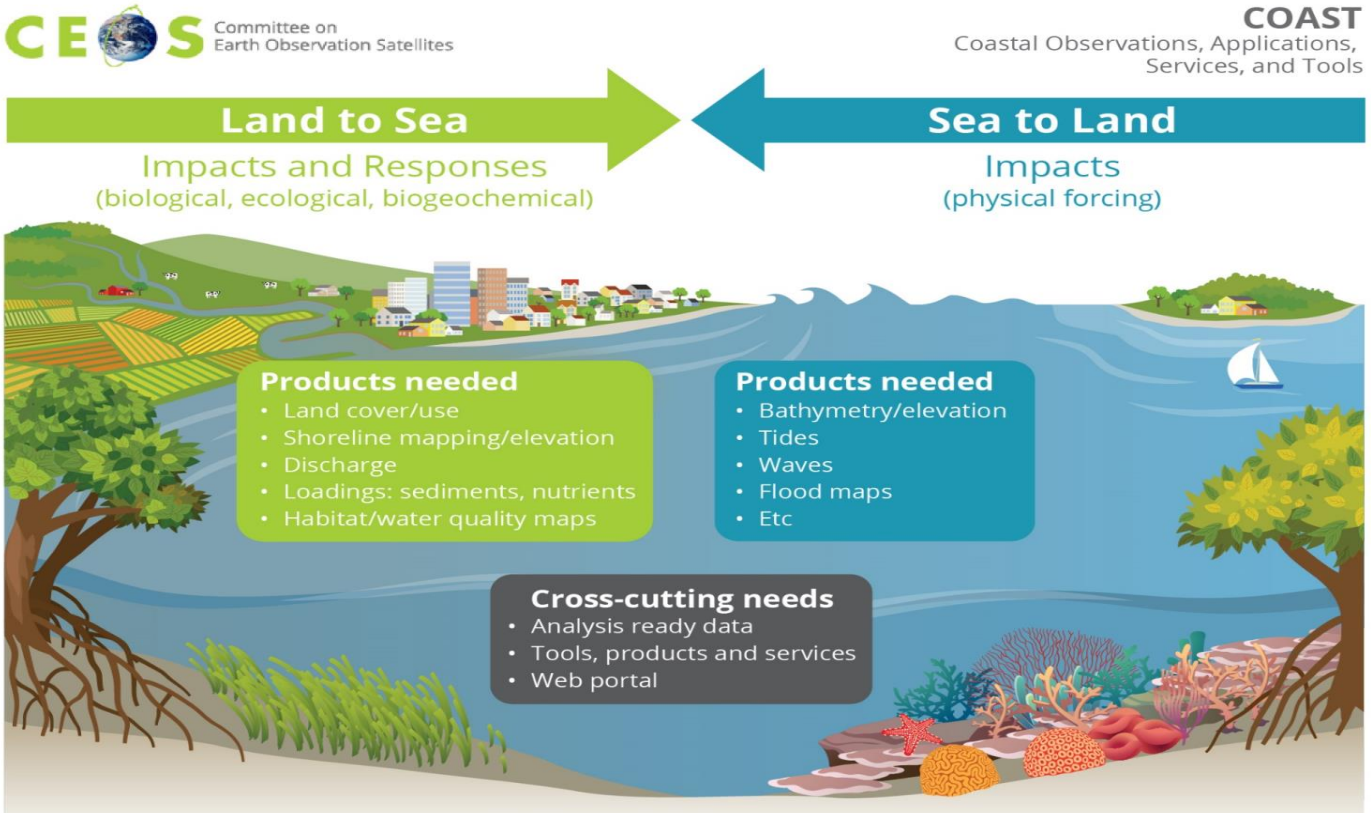
- **Leverage global satellite data for high impact issues affecting YOUR community.**
- **Co-develop coastal information products to solve YOUR information needs.**
- **Advance products and features YOU want and will be easy for you to use**

Phase 2: 2020-2022

Identified 2 Pilot Projects to develop coastal products, services and tools

Themes:

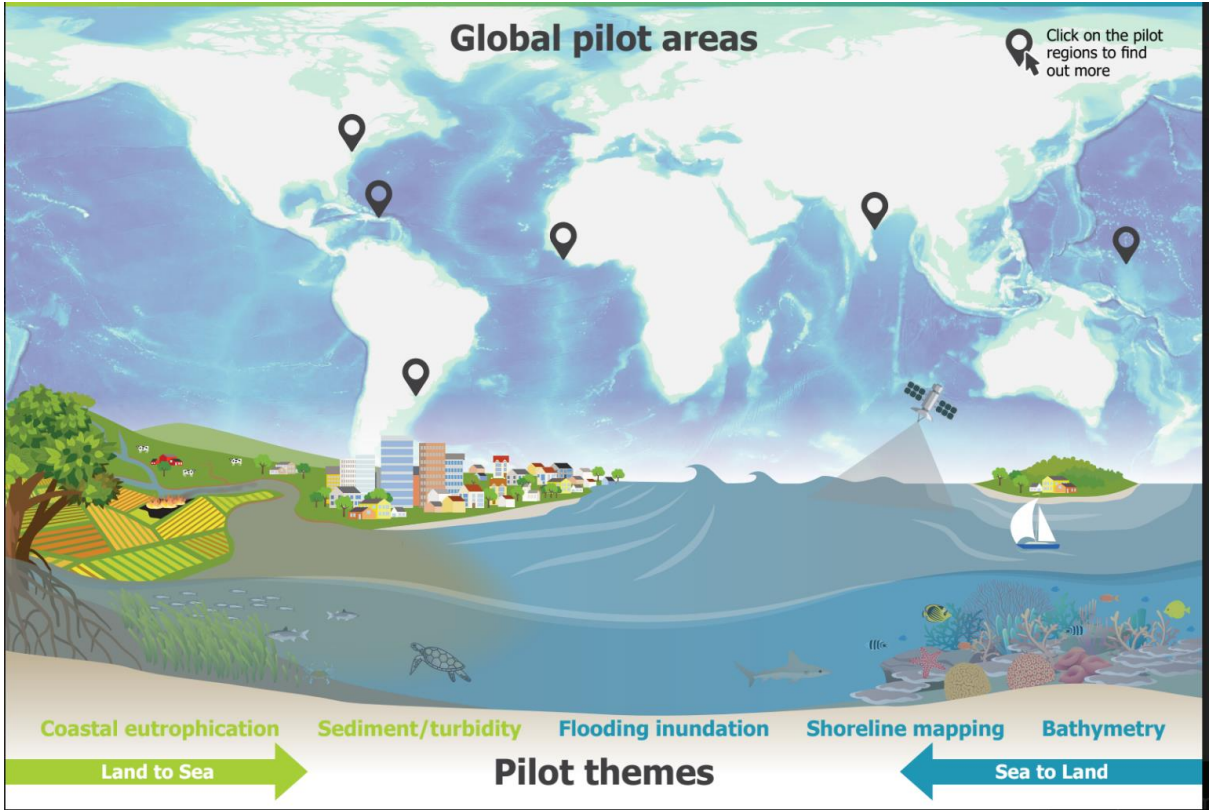
- Shoreline mapping
- Bathymetry/
- Flooding
- Turbidity & Sediment Loading
- Coastal Eutrophication



Initial COAST Pilot Locations

Continental:
Chesapeake Bay (USA)
Odisha/Bay of Bengal
West Coast of Africa
Rio de la Plata region (Latin America)

Small Island Nations:
Caribbean: USVI
Pacific: Marshall Islands



Why CoDevelopment?

- **Build something useful and user-friendly**
- unique coastal satellite data products, **low barrier of entry** skillwise
- **One-Stop-Shopping Access to various data** types, including in situ data (cal/val) YOU can supply!
- **Enhanced access to trusted data sources**
  - help seeking a funding source for sustainment of products
- **Free and open source** products enables customization by anyone.
- Regional Pilots enable **product testing for scalability**

WHEN? May-July 2022……

CEOS COAST DATA NEEDS

- Shoreline mapping/coastal elevation
  - island elevations
  - Shore line validation data
  - Flood maps/Flood extent data
  - Bathymetry data
  - Coastal elevation & Intertidal Mapping -
    - Optical EO data, validation (GPS, LiDAR, in-situ)
- Precipitation temporal & spatial
  - antecedent moisture conditions (soil moisture)
- Digital Elevation Models
- River Discharge/Dam location & specs
- Land Use /Cover datasets
- Water Temperature
- Salinity - river discharge/mixing models/Density gradients - plume dispersal (i.e. settling velocity)
- Tidal Data - altimetry, winds
- Wave Data - statistics from Altimeters & buoys
  - significant wave height/direction/periodicity
  - wave spectra data
  - Wave refraction nearshore
- Ecosystem Status/Change
  - Habitat maps
  - coral health data
  - SAV classification
  - mangrove classification & health
  - coastal sediment maps - deposition & rate of accumulation
- Eutrophication Indicators (in situ data)
  - Turbidity/Sediment data & loadings datasets
    - Point source discharges (volume & conc.)
  - Nutrient loadings datasets
  - water quality maps
  - Water color maps (airborne or in situ)

Coastal Eutrophication and Sediment Products

CEOS
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Earth Observation Satellites

Coastal Eutrophication and Sediment Products

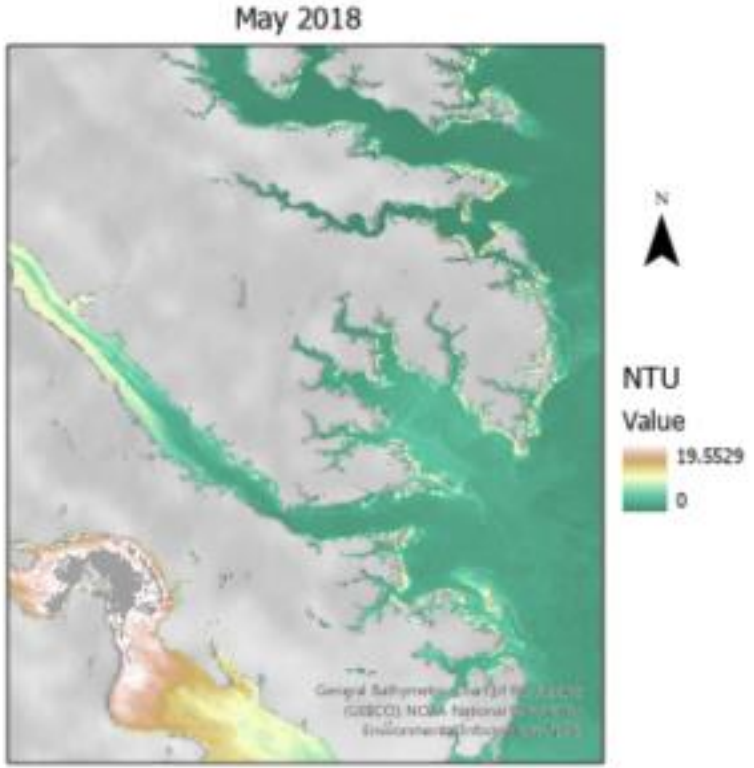
- **Codevelopment product:**
  - Seagrass habitat suitability mapping
- **Products from CEOS partners**
  - GEO Blue Planet: Coastal Eutrophication indicator products
  - Chlorophyll-*a* anomaly / chlorophyll-*a* anomaly ratio
  - Suspended particulate matter product
  - GEO Aquawatch turbidity products
- **Future work**
  - AI-based satellite chlorophyll model
  - AI-based hypoxia model for Chesapeake Bay

Codevelopment: Seagrass Habitat Mapping

- Exploration of water quality impacts on habitats
- High resolution images: better understanding of sediment conditions in the bay
- Codevelopment with partners with VIMS for product on seagrass habitat conditions

Codevelopment: Seagrass Habitat Mapping

- Satellite derived turbidity, chlorophyll, light attenuation, and sea surface temperature
- Layers useful in characterizing seasonal habitat conditions
- Providing both temporal and spatial resolution
- Period from 2015-present



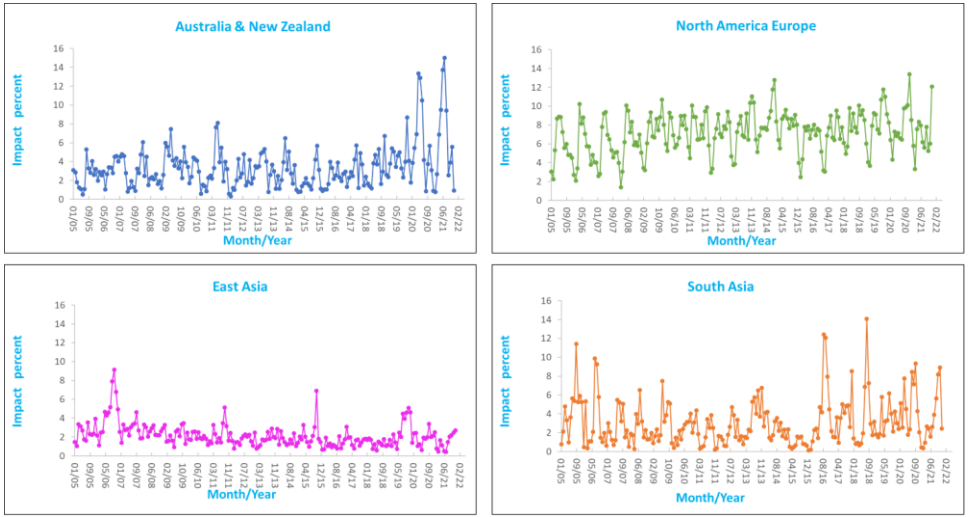
Codevelopment: Seagrass Habitat Mapping

- Future steps in development
  - Extend geography with Landsat imagery
  - Incorporate hourly sea surface temperature
  - Evaluate findings with known SAV beds
- Looking forward:
  - Any similar areas of habitat characterization that could benefit from satellite imagery?

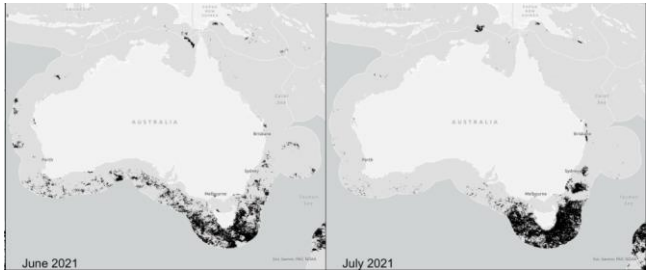
Partner Work: Coastal Eutrophication Product

- GEO Blue Planet - Coastal Eutrophication product
- Developed in conjunction with NOAA Coastwatch, ESRI, and UN Environment
- Development of two sub-indicator products
  - Chl-a deviation relative to baselines from 2000-2004
  - Chl-a anomalous areas within each year

Regional EEZ Chlorophyll-a Deviation from Baseline (2005 – 2021)



Distribution of Deviating Pixels in the Australian Region for June/July 2021



Partner Work: Coastal Eutrophication Product

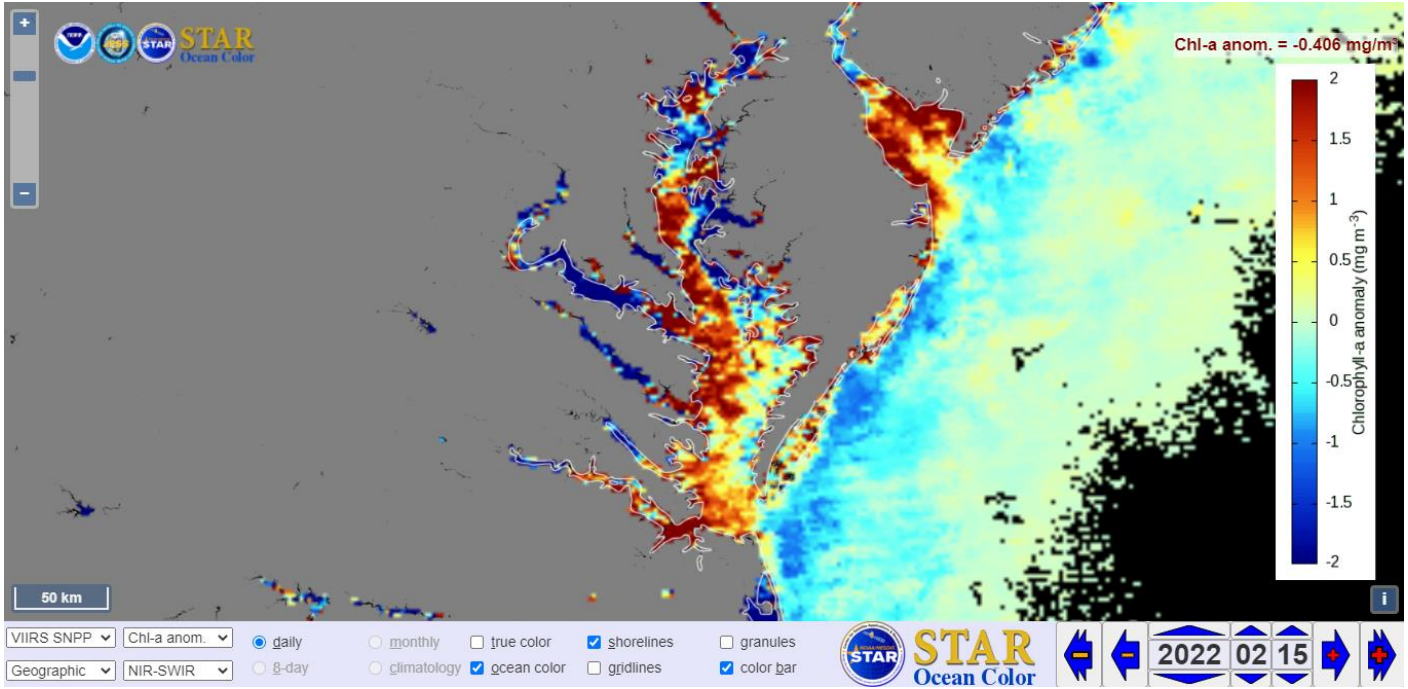
- You can be a beta tester!
  - Early access to satellite derived product
  - Customized refinement of product on your region of interest
  - Contribution to the production of peer-reviewed publication on indicators
  - Be a part of next phase: machine learning model for satellite-derived chlorophyll

Chlorophyll-*a* Products: Available to CEOS COAST

NOAA STAR Chlorophyll-*a* Anomaly - daily product

Blended images from VIIRS (Visible Infrared Imaging Radiometer Suite)

https://www.star.nesdis.noaa.gov/socd/mecb/color/ocview/

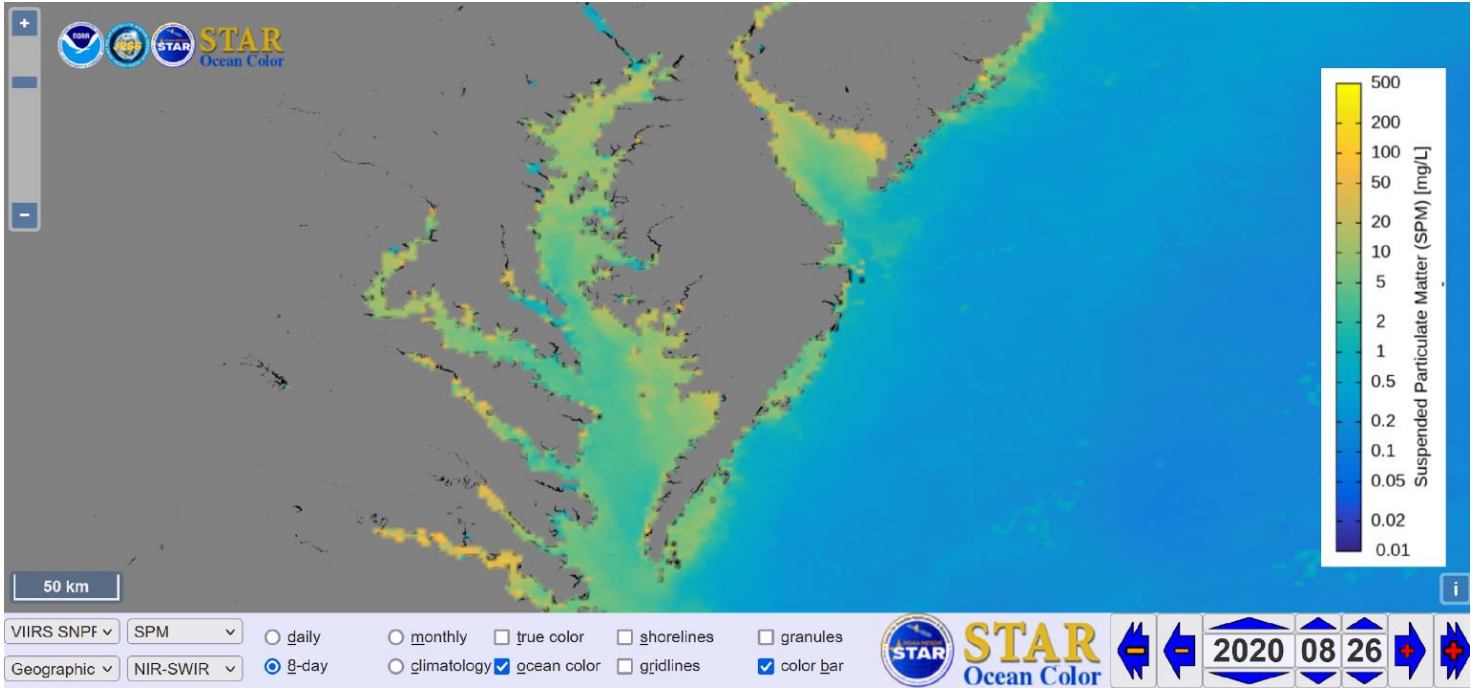


Turbidity & Sediment Products: Available to CEOS COAST

NOAA STAR Suspended Particulate Matter (SPM) - daily, 8-day, monthly product

Blended images from VIIRS and OLCI-S3A (Ocean and Land Colour Instrument)

https://www.star.nesdis.noaa.gov/socd/mecb/color/ocview/

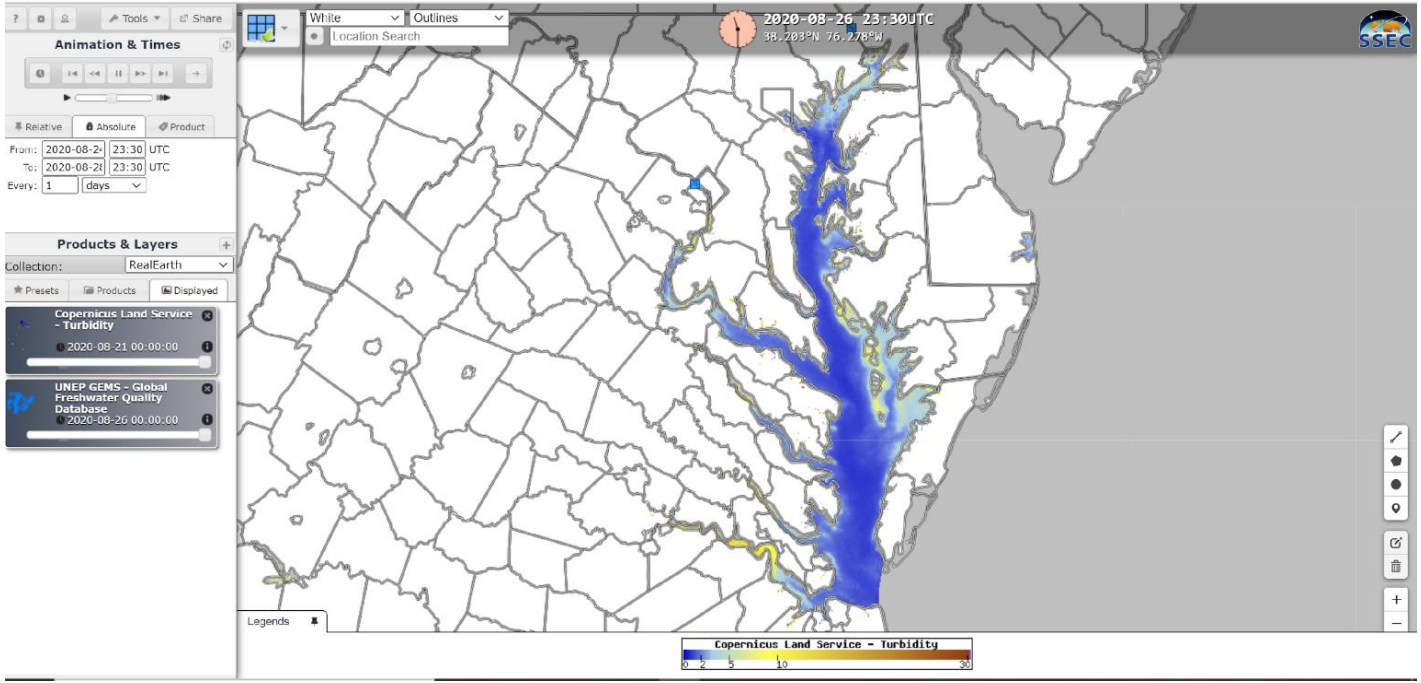


Turbidity and Sediments Products: Available to CEOS COAST

European Space Agency: Copernicus Global Land Service

10-day Turbidity Product from Sentinel-2 MultiSpectral Instrument (MSI)

Access via University of Wisconsin RealEarth Portal https://realearth.ssec.wisc.edu/

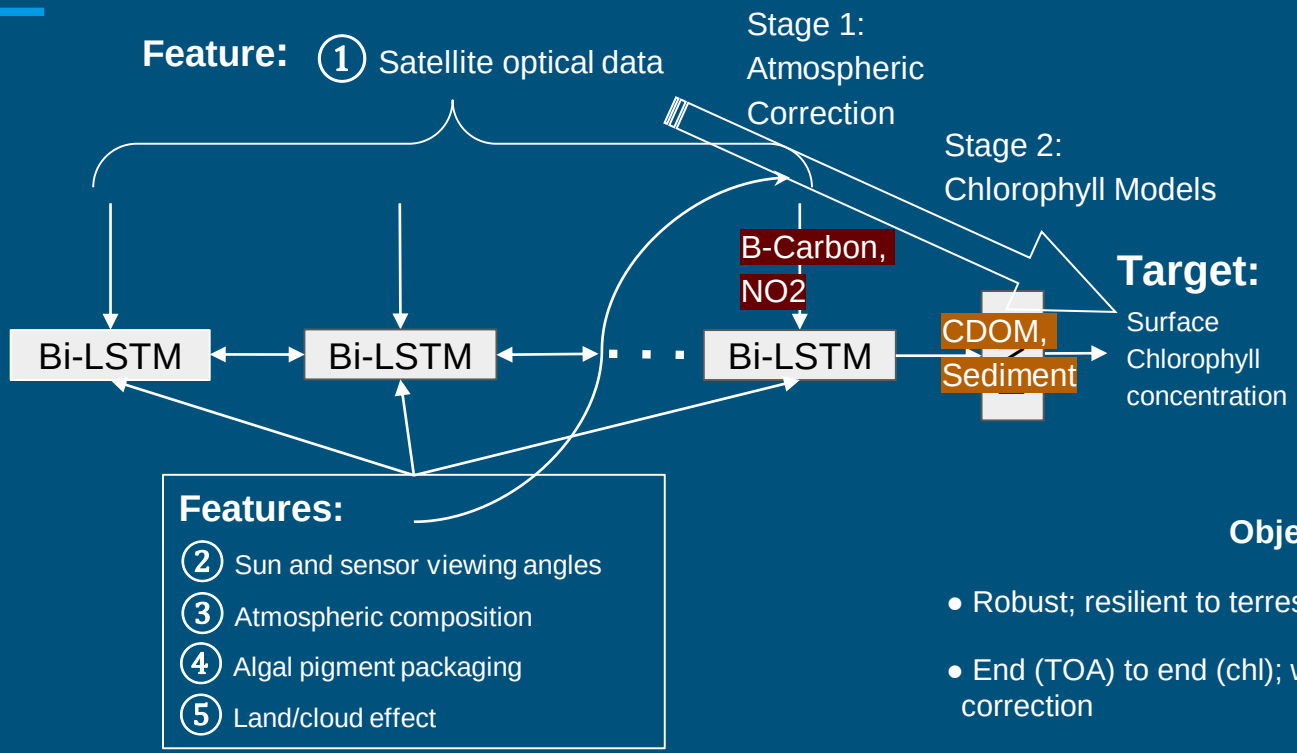


Turbidity and Sediments Products: Available to CEOS COAST

- Next steps in turbidity products
  - A collaborative project between GEO AquaWatch, the World Bank, Conservation International, UNESCO and Google Earth Engine (GEE) to provide fit-for-purpose water quality information for inland and coastal waters
  - Enable processing turbidity data on the cloud in real time through GEE
  - Expected later this summer

Artificial Intelligence-based satellite chlorophyll model

Given a Top-of-Atmosphere (TOA) spectrum, estimate the chlorophyll concentration



Objectives:

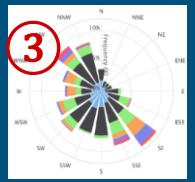
- Robust; resilient to terrestrial interferences
- End (TOA) to end (chl); with implicit atmospheric correction
- One algorithm fits all sensors

AI for Hypoxia prediction: Data and Preprocessing

① **MODIS-Aqua Satellite**:
- Rayleigh-corrected reflectance at 16 bands
- Weekly minimum (1st percentile)
- 2002-2020

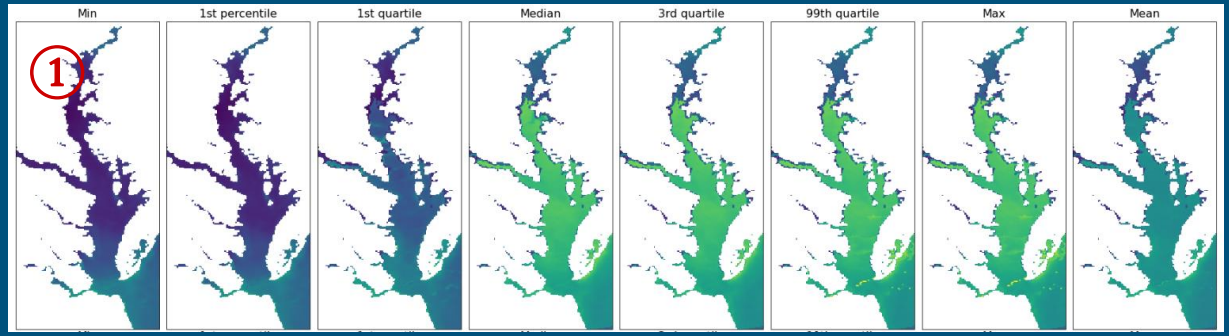
② **Virginia Institute of Marine Science (VIMS)**:
- Chesapeake Bay Environmental Forecast System (**CBEFS**)
- Currents (u, v, & w)
- Water temperature (T), Salinity(S)
- 3-D reprojected to fixed grids.
- Weekly mean

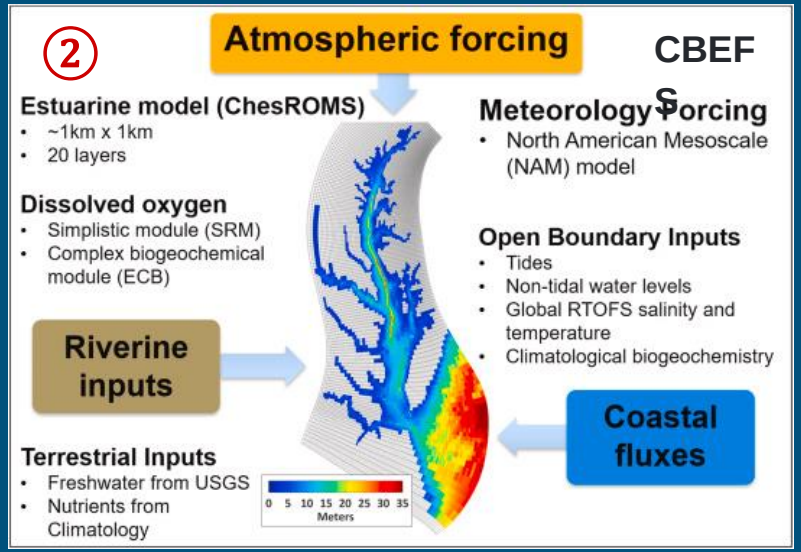
③ **ECMWF ERA5**:
- Wind (u & v)
- Hourly data
- Wind rose tabular data



④ **Chesapeake Bay Program (CBP)**:
- Field-measured Dissolved Oxygen concentration
- Mainstem stations only

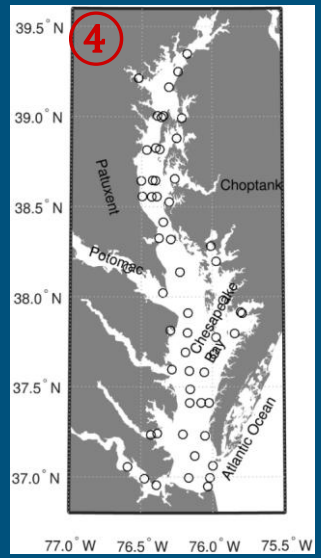
MODIS weekly statistics





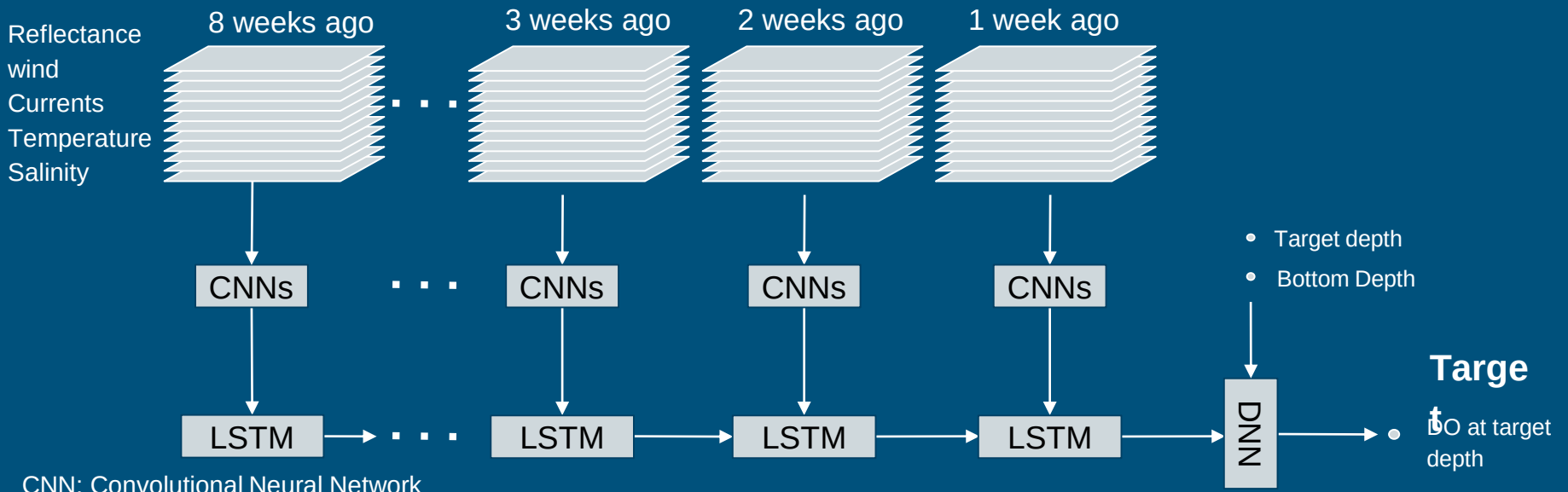
[Bever et al., *Environ. Model. Soft.*, 2021]

CBP Stations



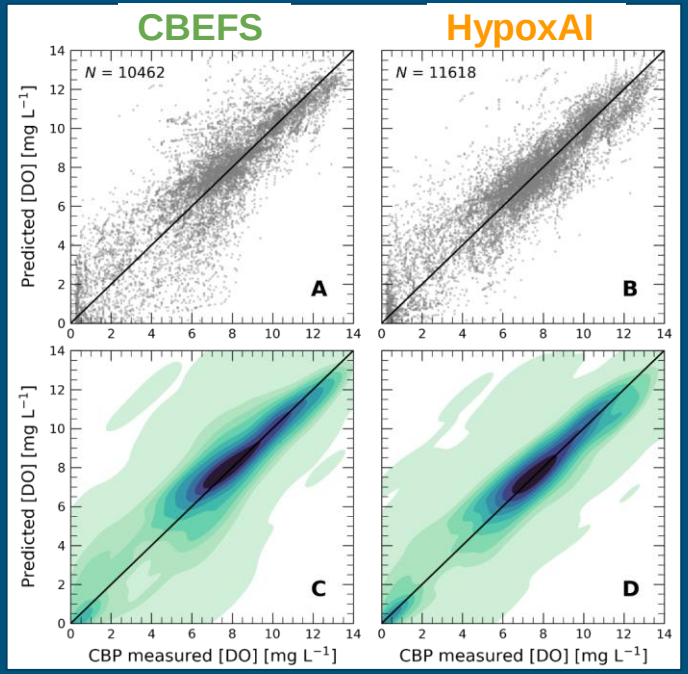
HypoxAI - prediction of Chesapeake Bay Hypoxia with deep learning

Features



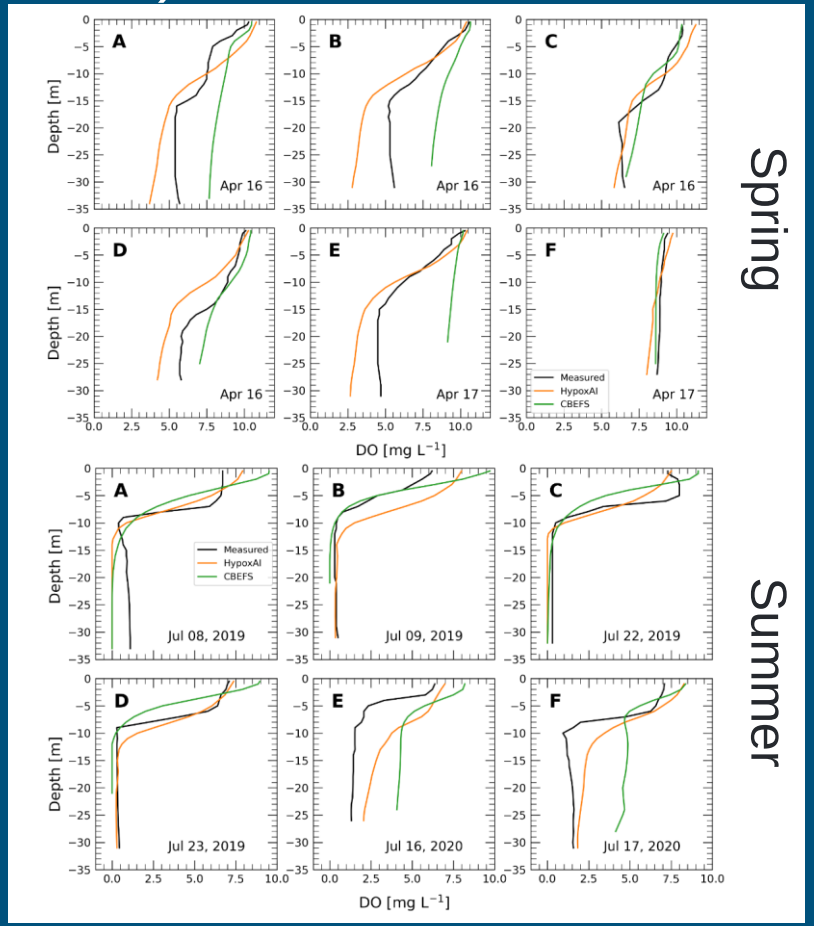
CNN: Convolutional Neural Network
LSTM: Long and Short Term Memory
DNN: Deep Neural Network

Model Evaluation on Testset (2019-2020)



- HypoxAI outperforms CBEFS
- HypoxAI generally predicts realistic DO profiles

Metrics	RMSE	MAE	R^2	Slope	Bias	*N*
HypoxAI	1.255	0.905	0.849	0.868	0.119	11618
CBEFS	1.538	1.098	0.763	0.892	0.155	10462



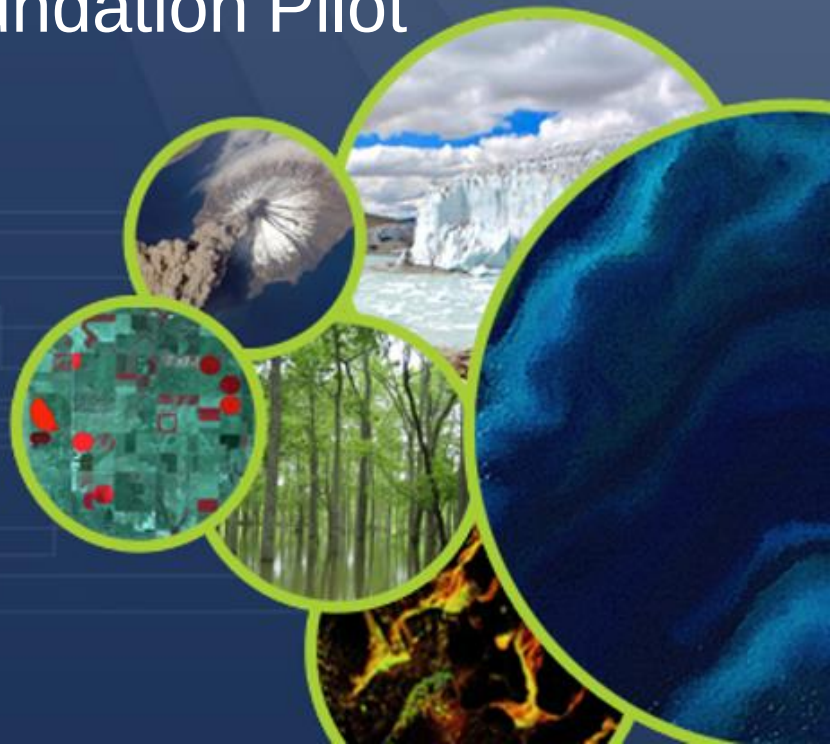
Questions and Feedback

- What features or aspects work are of the most interest to you?
- Are there any new products that you would like to see developed that would be useful to you?
- What suggestions do you have in order to improve products?

Committee on Earth Observation Satellites

GEO / LEO / SAR Coastal Inundation Pilot

Sean Helfrich, Josef Kellndorfer, Sanmei Li Frank Monaldo, William Straka, Ian Olthof, and Vincent Decker, Rachel Lazzaro, Olivia Fey, Mitch Goldberg, Bill Sjoberg, Qingyuan Zhang, Xinyi Chen, Christopher Jackson, Tyler Ruff, and Nicole Bartlett



CEOS COAST Chesapeake Pilot Region

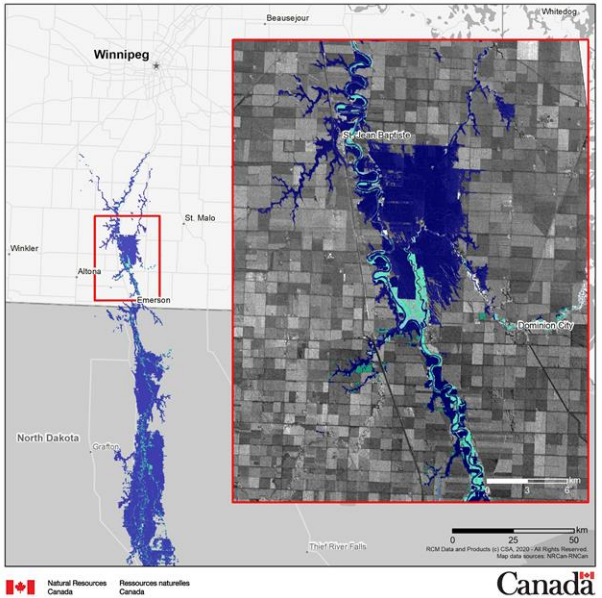
April 29, 2022

Topics

- CEOS GEO / LEO / SAR goals and partners (Flood & COAST)
- Flood and Inundation Mapping Algorithms
  - VIIRS / ABI
  - SAR
- SAR Flood and Inundation Product Development in Pilot Regions
  - Red River of the North CEOS Flood pilot
  - Coastal Inundation Mapping – Chesapeake Bay Pilot Region
  - Coastal Erosion
  - Hurricane Dorian

Flood Pilot Goals

- The CEOS WGDisasters Pilot seeks to bring together CEOS partnering agencies to address the following goals:
  - Learn about the current and upcoming efforts to map water and flood extent from a diversity of low-Earth orbit (LEO), geostationary (GEO) and synthetic aperture radar (SAR)
    - From this, understand the technical requirements and future needs for sustaining and improving upon these efforts
  - Using regional events from Pilot partners, demonstrate how LEO, GEO, and SAR can be combined most effectively
    - Canada / US Red River of the North
    - Chesapeake Bay.

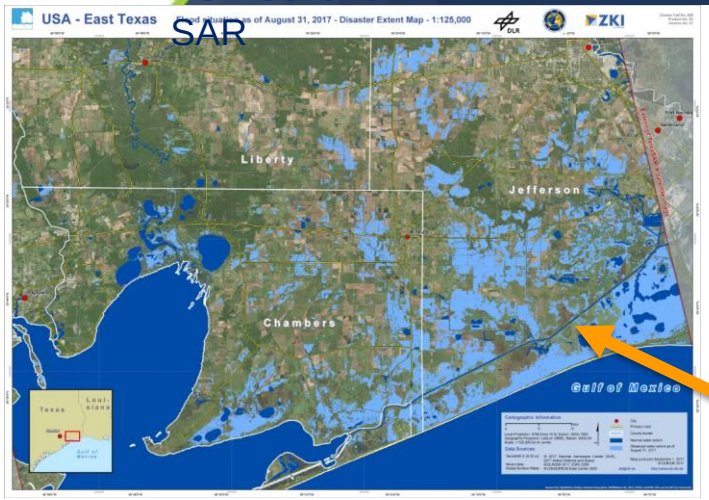


NOAA Flood / Coastal Inundation Mapping Development Products

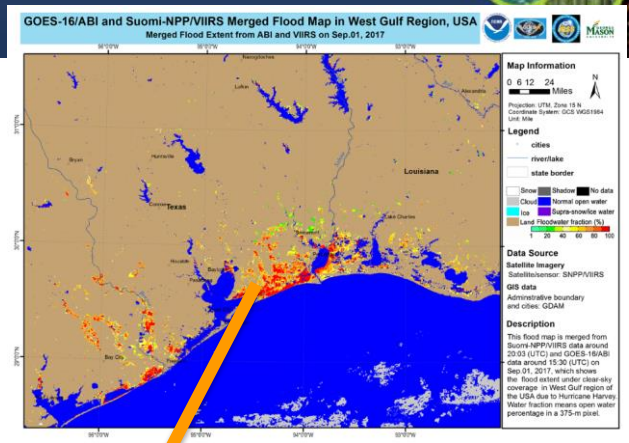
- **VIIRS Flood Detection - US** (3 products)
  - *NWS NRT; NWS Daily Composite; NWS 5-day Composite*
- **VIIRS Flood Detection - Global** (3 products)
  - *Global NRT; Global Daily composite; Global 5-day Composite*
- **Synthetic Aperture Radar (SAR) (1 Product)**
  - *(Sentinel 1, RadarSat Constellation Mission (RCM), RadarSat 2, ALOS 4 (2023), and NISAR (2023)*
- **ABI US Flood Detection Products** (2 products)
  - *Hourly Composite; Daily Composite*
- **Blended Flood Detection - VIIRS/ABI and VIIRS/SAR** (2 products)
- **Downscaled VIIRS and Blended VIIRS/SAR** (2 Products)

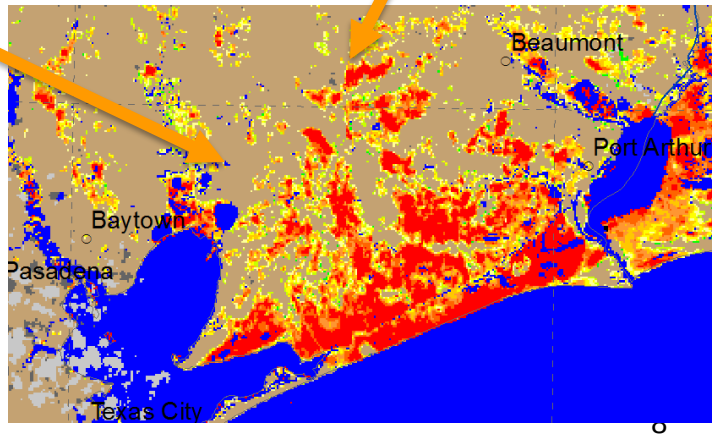
LEO/GEO's VIS/NIR + SAR Capabilites

ESA Sentinel 1 SAR



SNPP VIIRS and GOES-16 ABI





GEO and LEO provides larger areal extent – limited by cloud cover

SAR often provides view through clouds

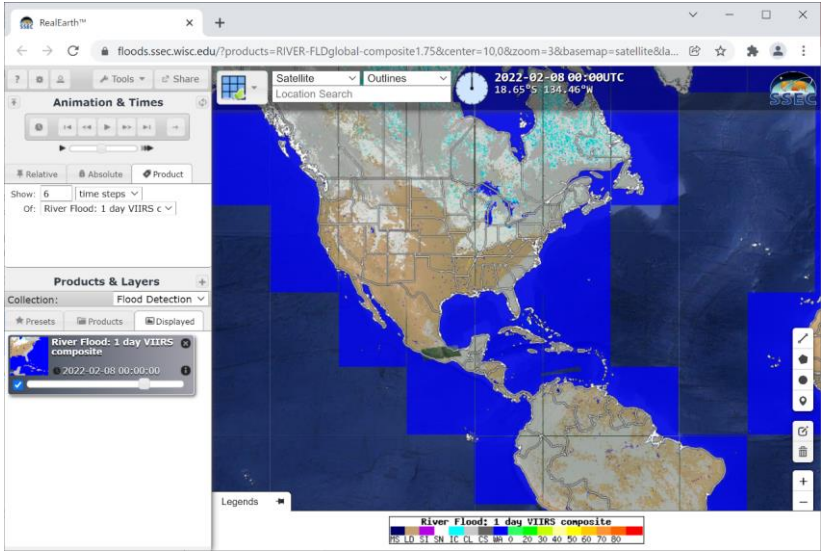
Good agreement when both are available

From : AMS (Virtual) Annual Meeting, 2021

/

VIIRS / ABI Flood Mapping Test Portal

- All NRT VIIRS and ABI Flood Fraction Products are available
- Flood Data can be compared with other datasets to leverage the utility of the data
- Working to operationalize this product to ensure routine production, sustained development, and archival.

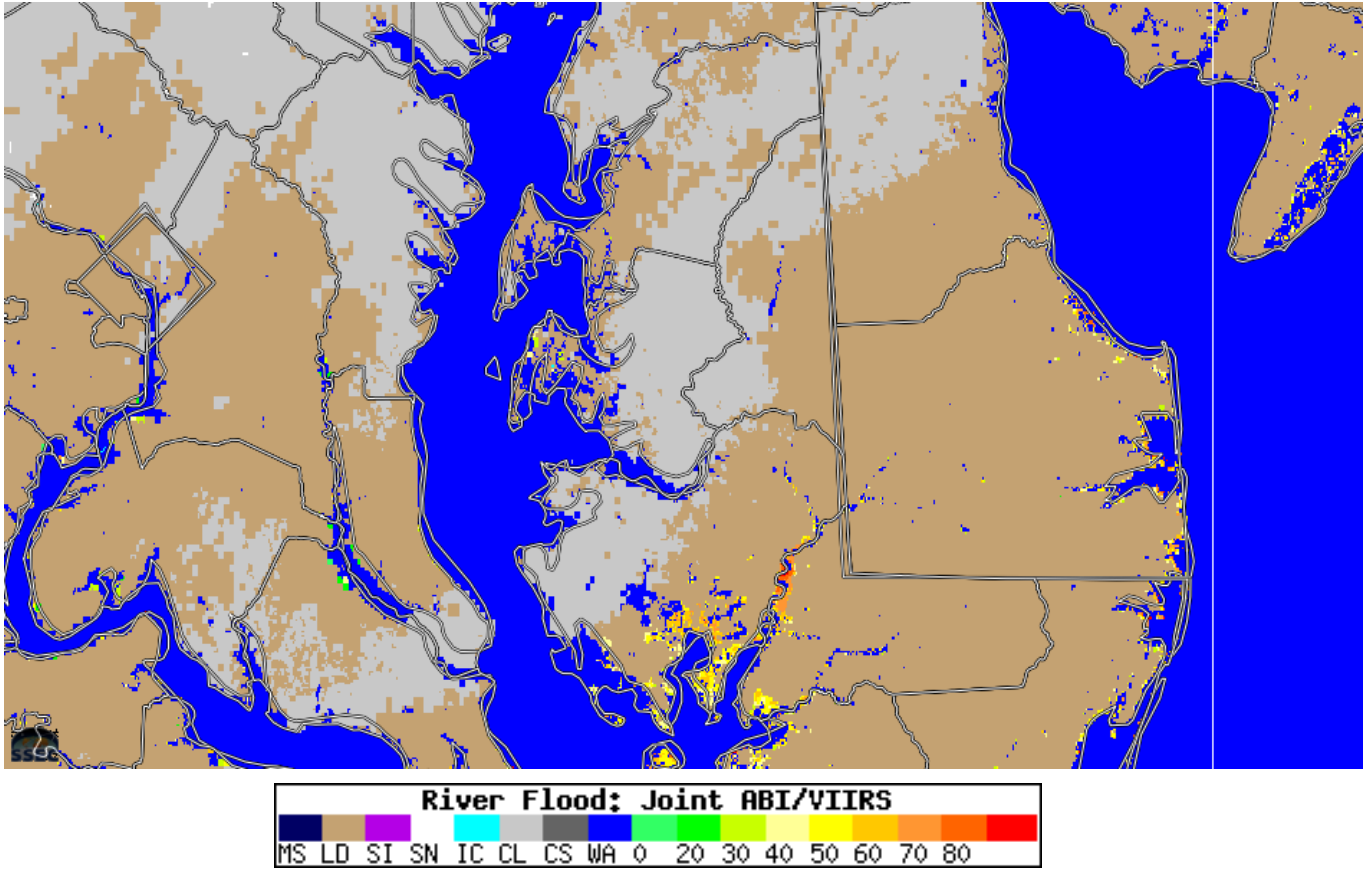


https://realearth.ssec.wisc.edu/#

VIIRS / ABI Flood Mapping Test Portal

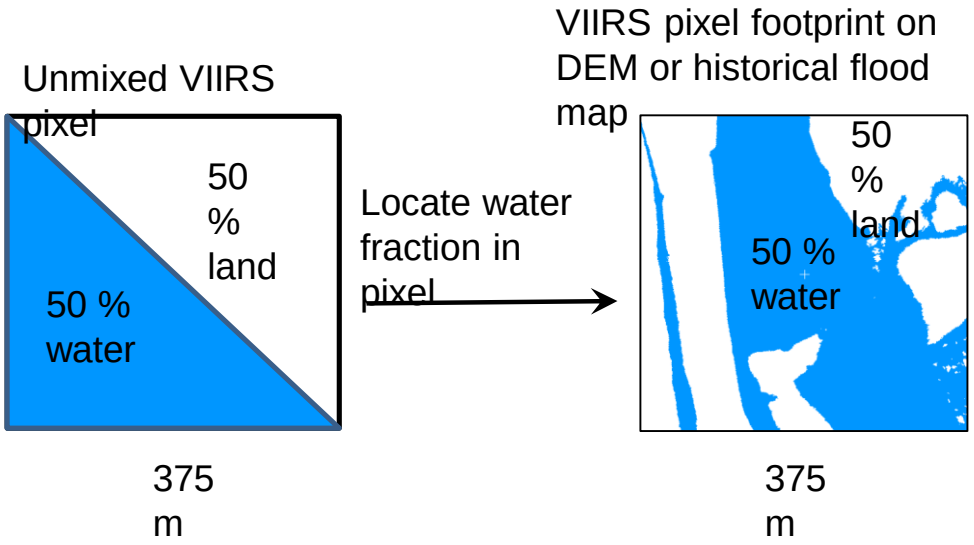
GEO and LEO provides larger areal
Extent but is limited by cloud cover and has limitations under dense vegetation.

Gray = Clouds



Downscaling VIIRS Flood Extents

- Due to the need for street and local level flood monitoring, NOAA is testing generate finer-scale VIIRS and ABI Flood Extent
  - spectral unmixing water fractions
  - downscaling using DEM data

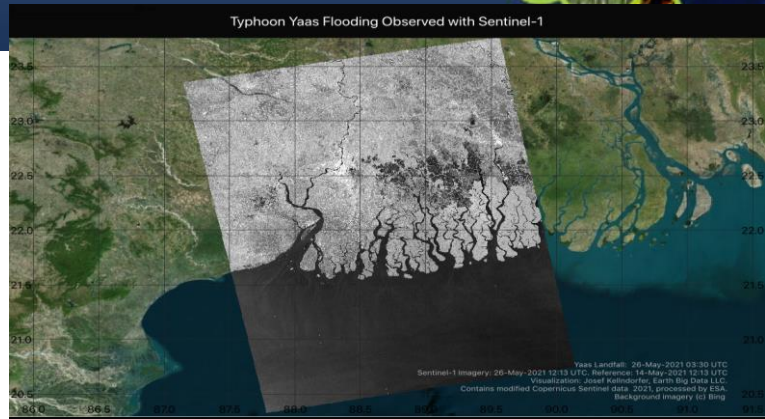


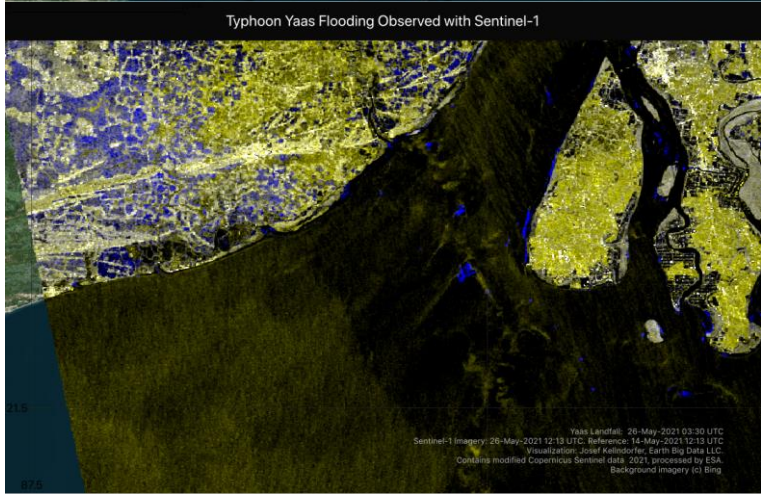
Currently, JPSS provides daily (unmixed) water fractions at a global scale, while generation of downscaled extents and flood depths is semi-operational over selected sites

By integrating SAR data, can we improve VIIRS water fraction estimates? Can different DEM data and downscaling techniques be used to improve downscaled flood extents?

NOAA's Sentinel Flood Mapping Test Portal

In order to test backscatter over flood areas, the performance SAR Flood Mapping Algorithms and demonstrate the algorithms to customers; STAR in collaboration with Earth Big Data developed a SAR Flood testing portal.





Daily automated Sentinel-1 processing of all pilot regions to add to time series data stacks

Check for new available scenes at NASA DAAC

Process new available scenes with restitute precision orbit

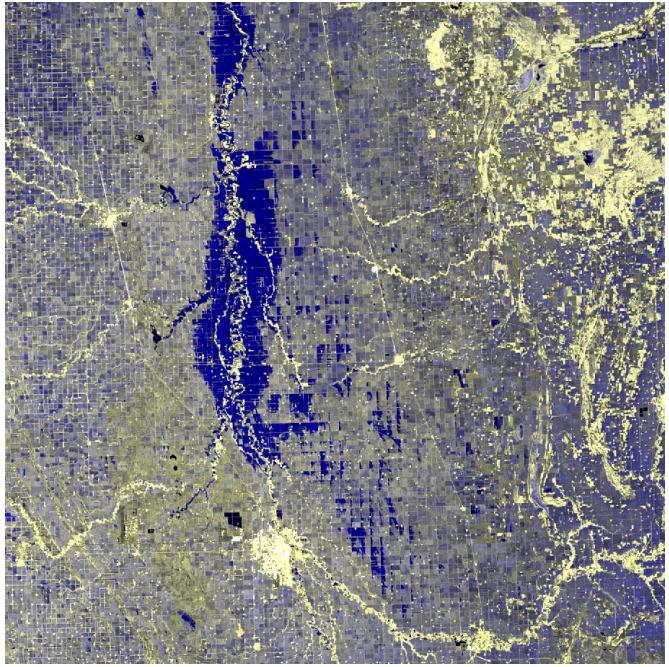
Automated updates of MGRS tiles at

http://remotesensing.earth

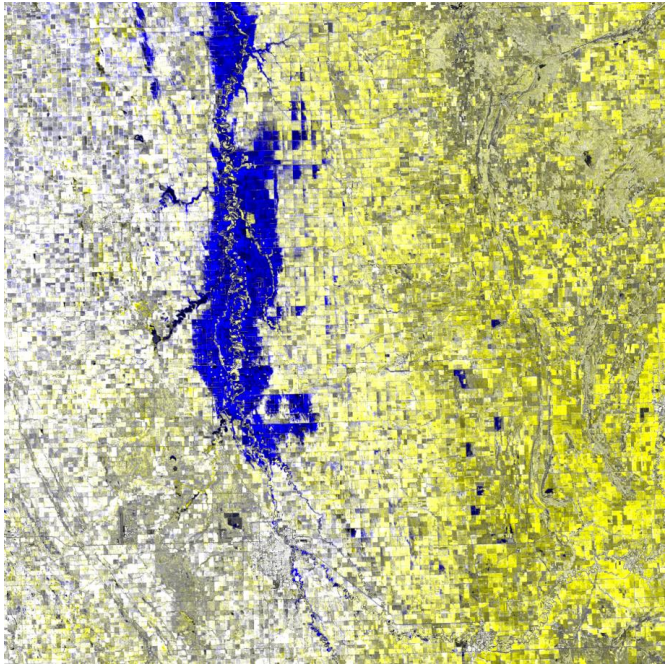
-> enables visual check on detected flood events or river openings from ice

Sentinel-1 C-Band VV Polarization mulit-temporal image composites

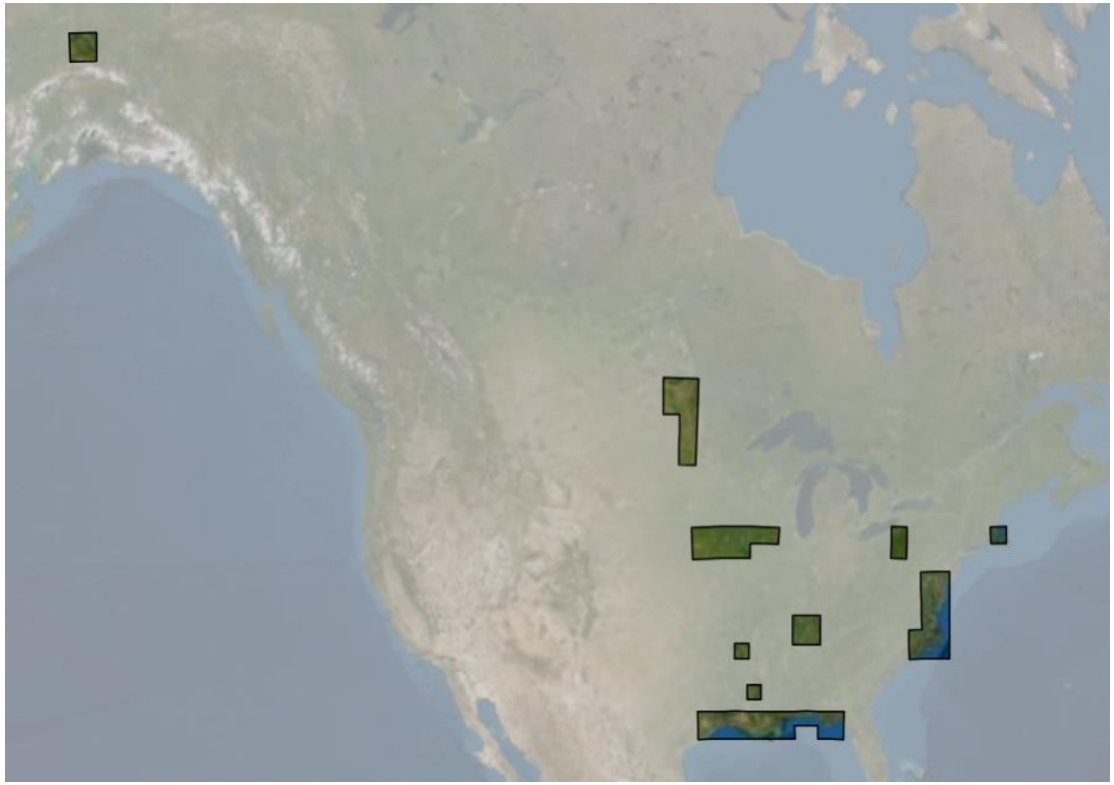
Sentinel-1 VV Time Series Metrics
R Minimum
G Minimum
B Median



Sentinel-1 VV
R 2019-04-17
G 2019-04-17
B 2019-04-05



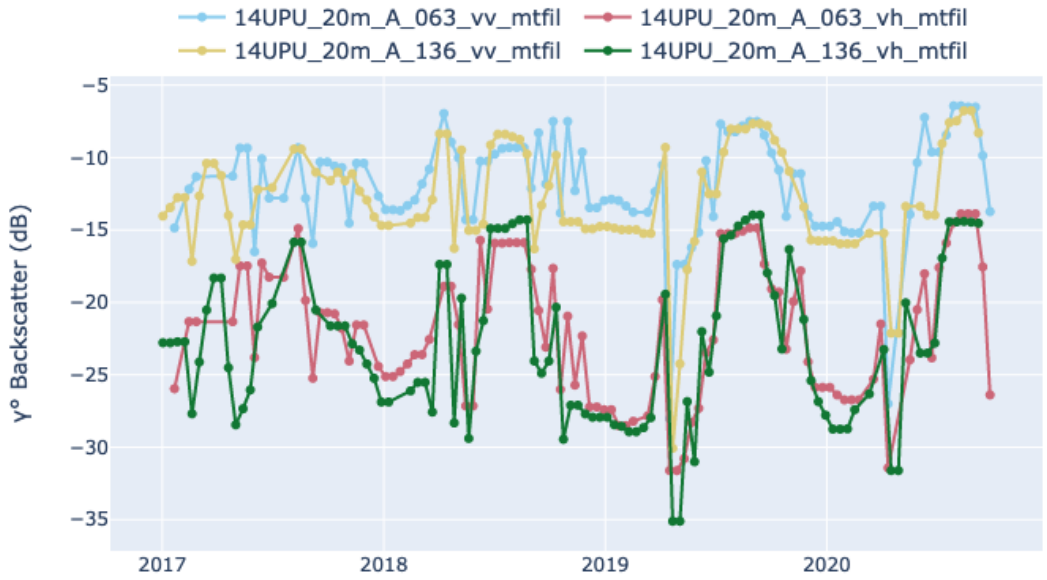
SAR Testing Areas



- 5 Test Areas to examine differing flood causes
  - **Iowa**
  - **Central Alaska**
  - **Gulf Coast**
  - **Red River of the North**
  - **Chesapeake Bay**

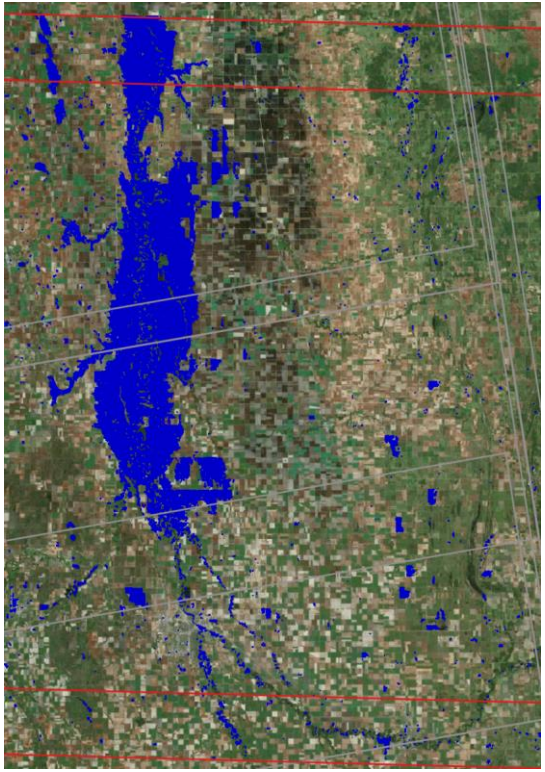
http://remotesensing.earth

Sentinel-1 C-Band Time Series: Red River



Deep Learning Algorithm Prediction

randomForest (with Sieve)



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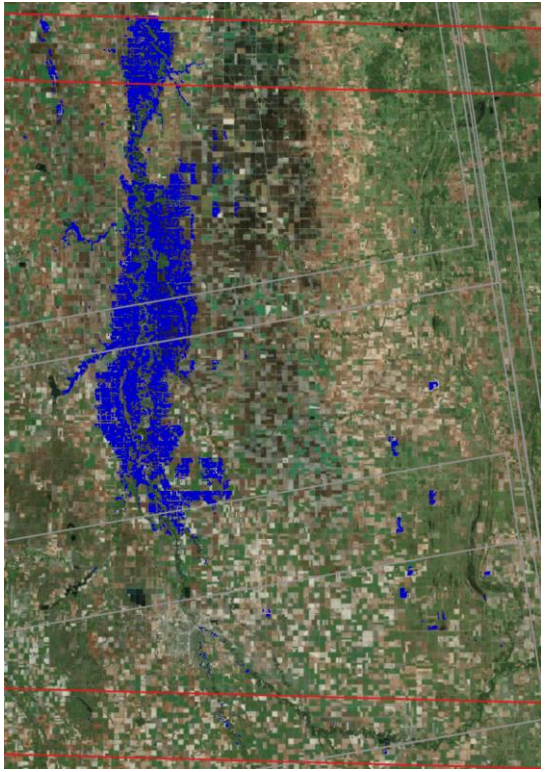
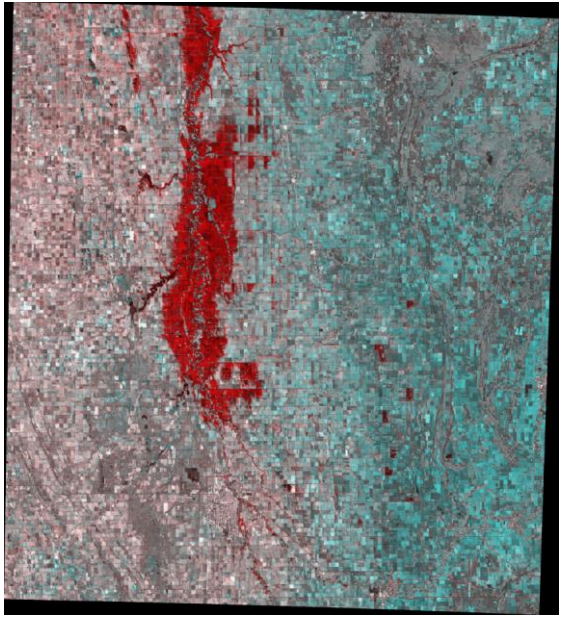


2019-04-17 SAR RGB

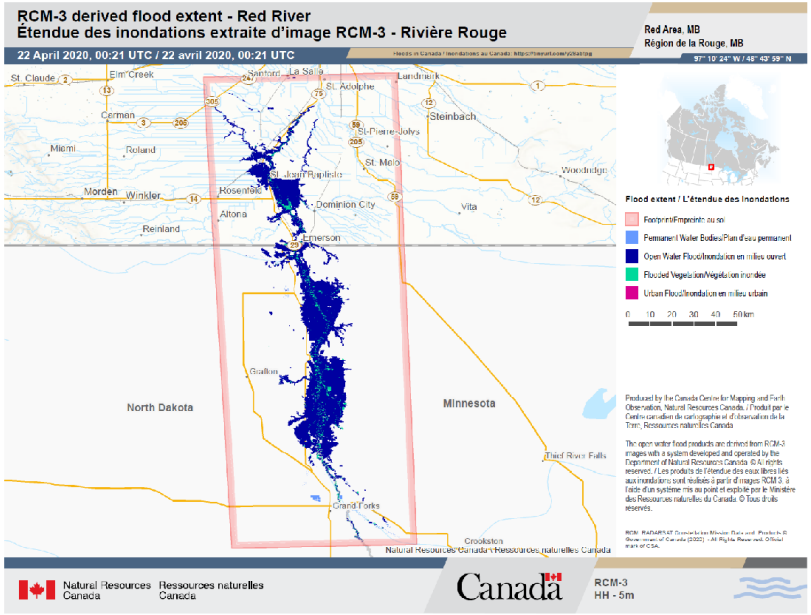
(with 4/5)

North Tile 14UPU

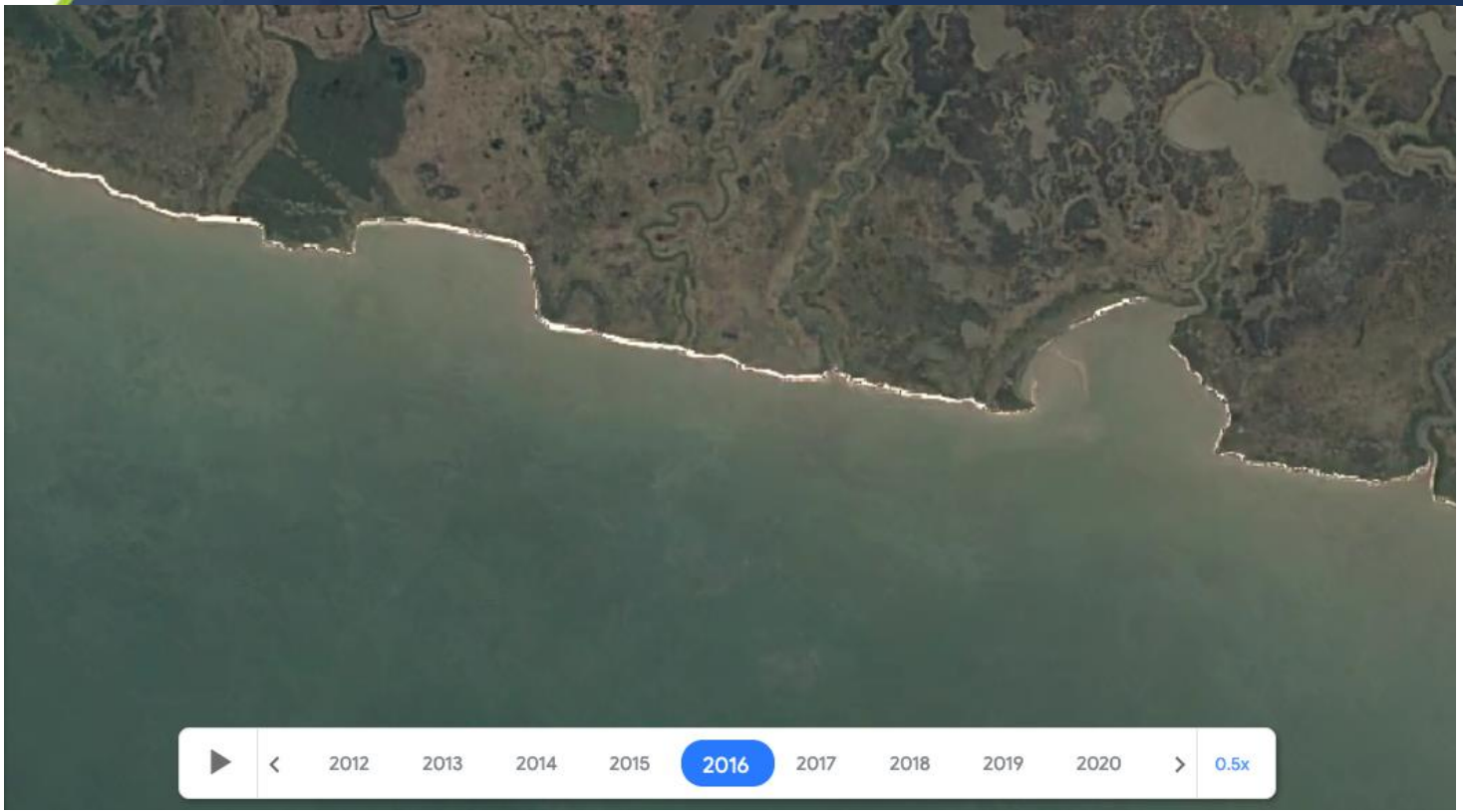


NRCan Emergency Geomatics Services Canada

- EGS maps floods in Canada and US from RadarSat 2 and RCM as primary data sources
  - open water
  - flooded vegetation
  - urban on a best-effort basis by combining other sources of data

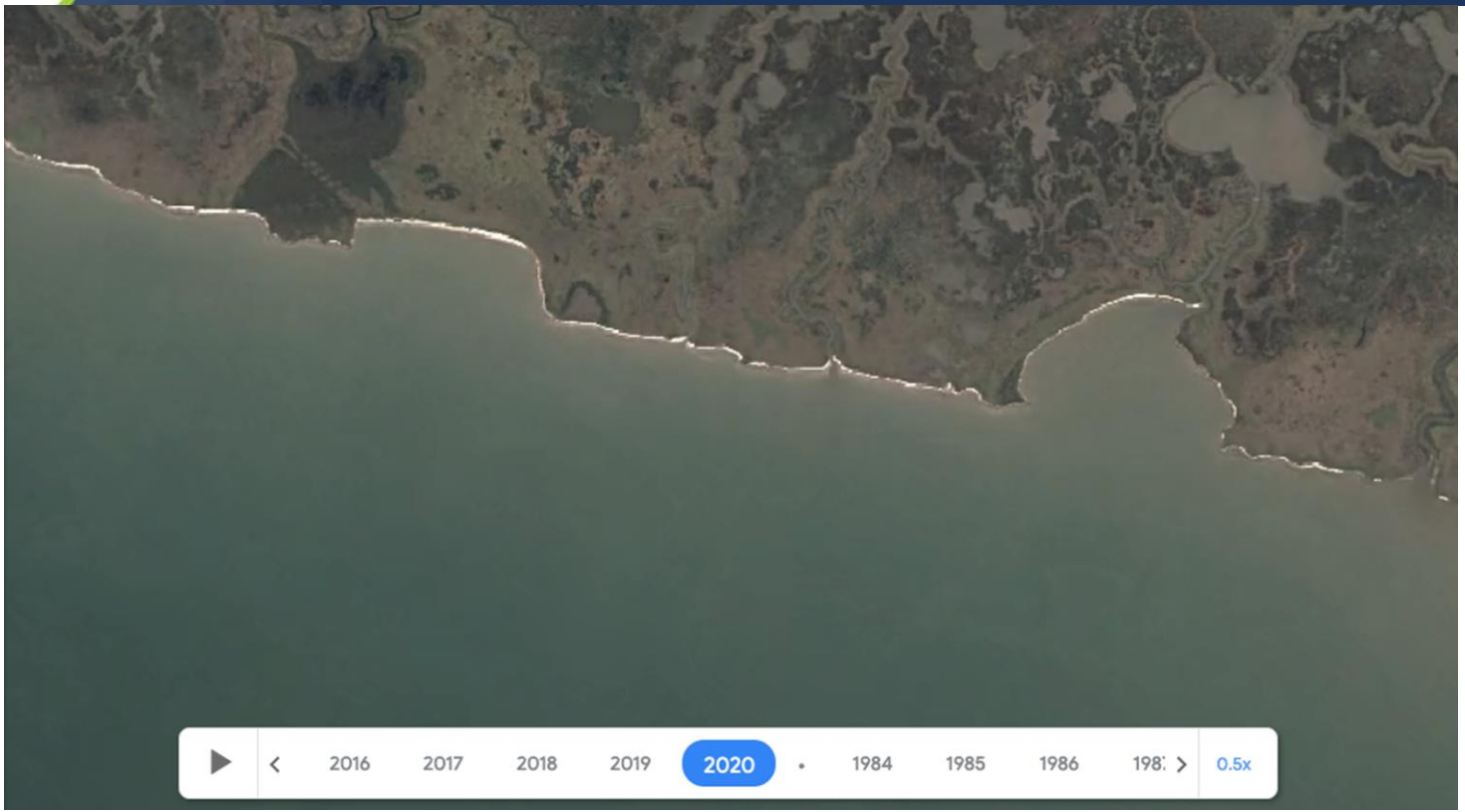


Gulf Coast Erosion



Source: https://earthengine.google.com/timelapse

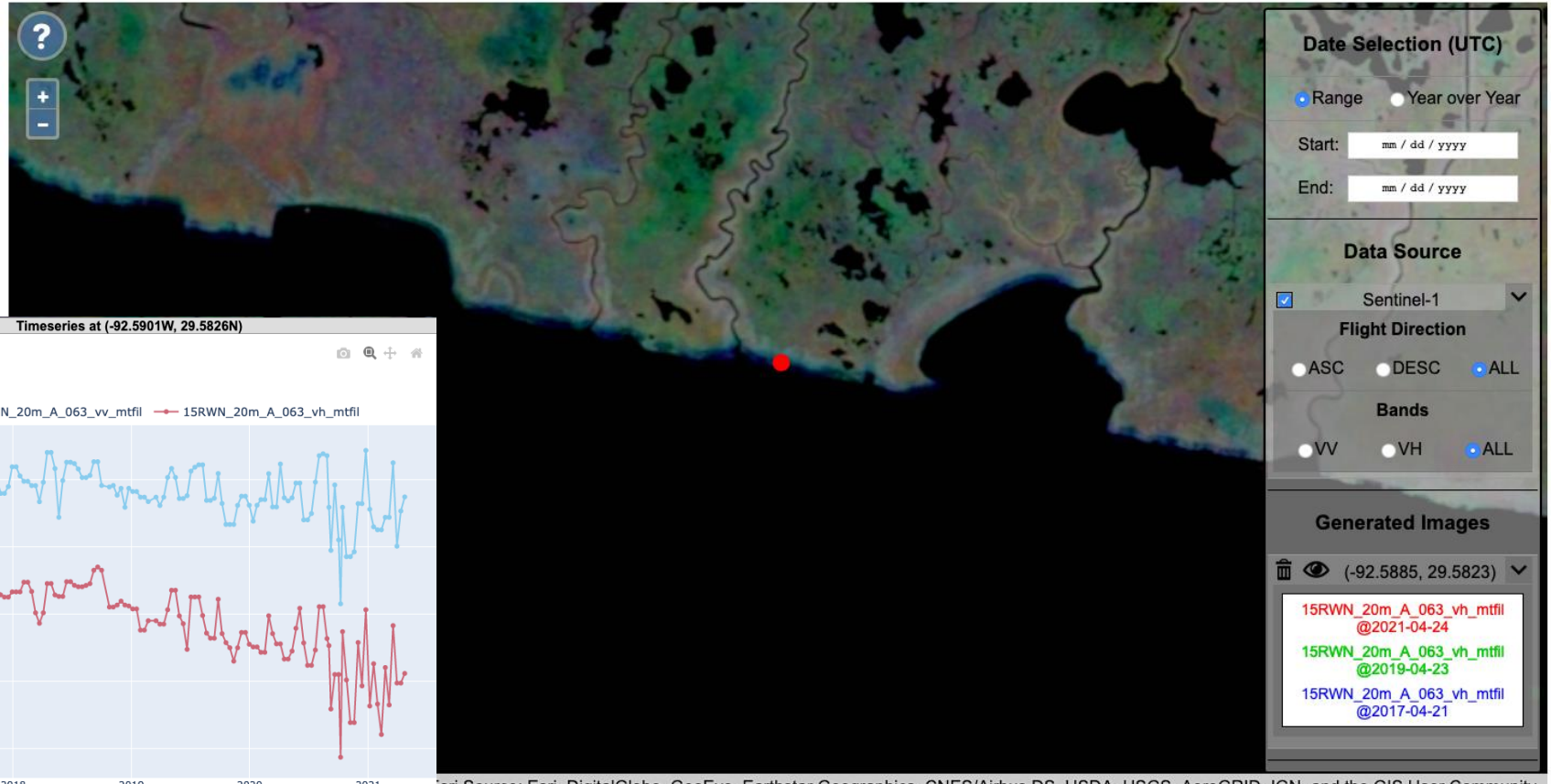
Gulf Coast Erosion



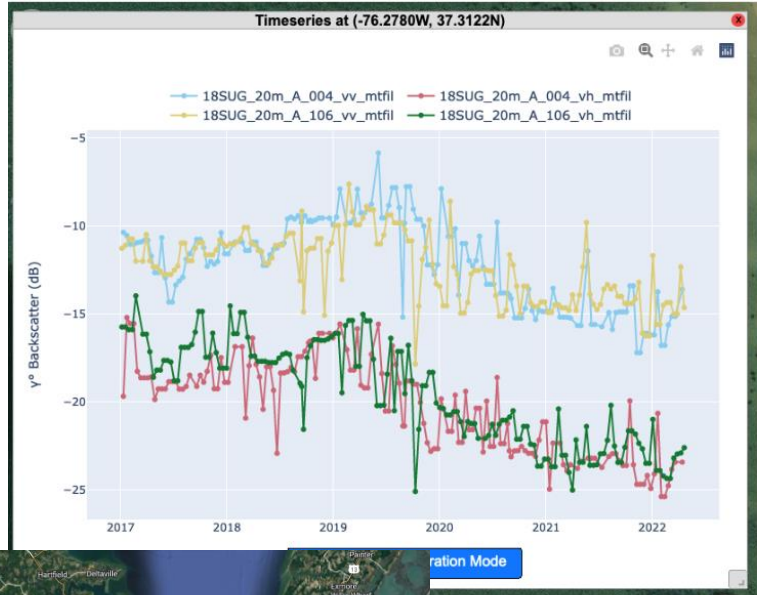
Source: https://earthengine.google.com/timelapse

Sentinel-1 Observations

EARTH BIG DATA

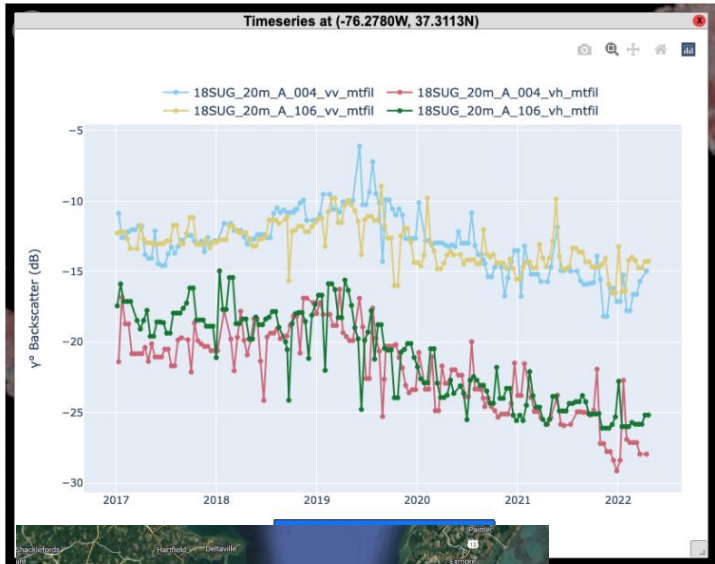


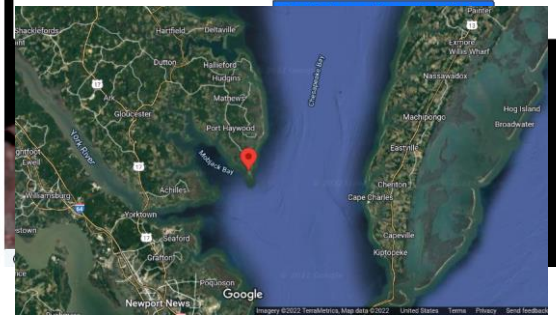
New Point Comfort, VA Time Series

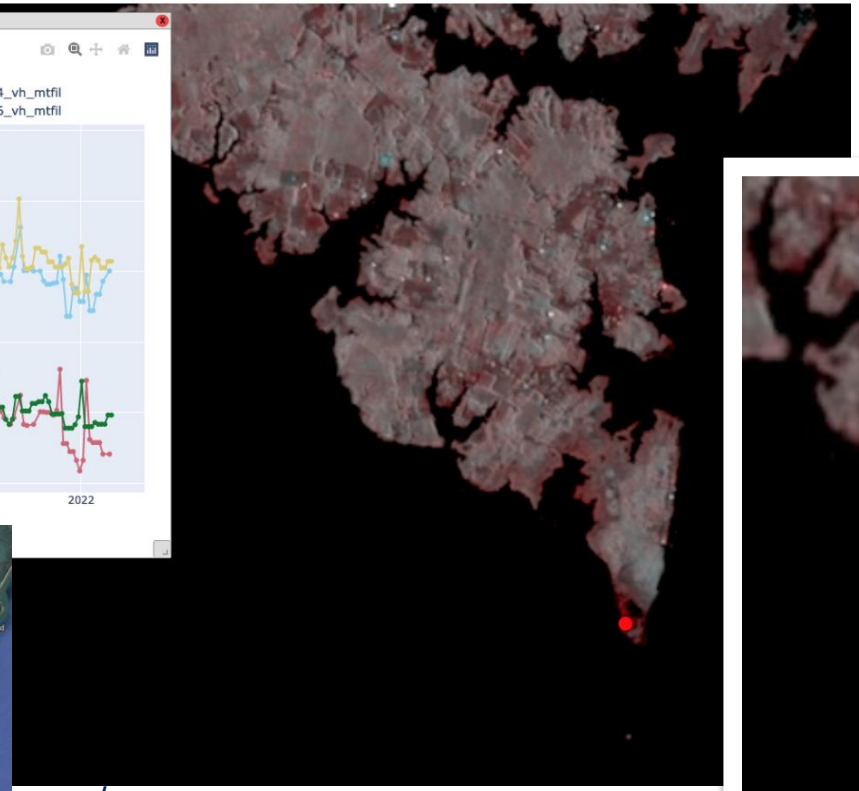


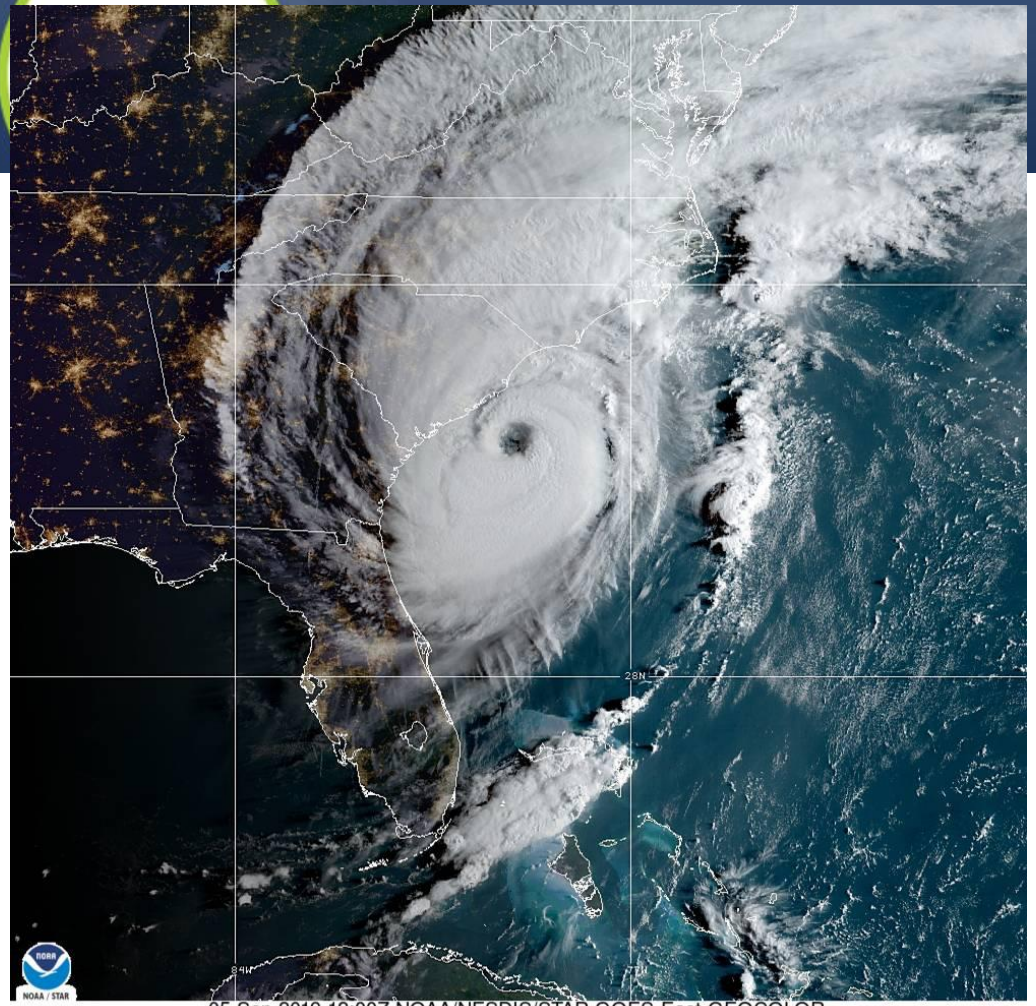
New Point Comfort, VA Time Series

EARTH BIG DATA









05 Sep 2019 12:00Z NOAA/NESDIS/STAR GOES-East GEOCOLOR

2019 Hurricane Dorian:

August 24 – September 10

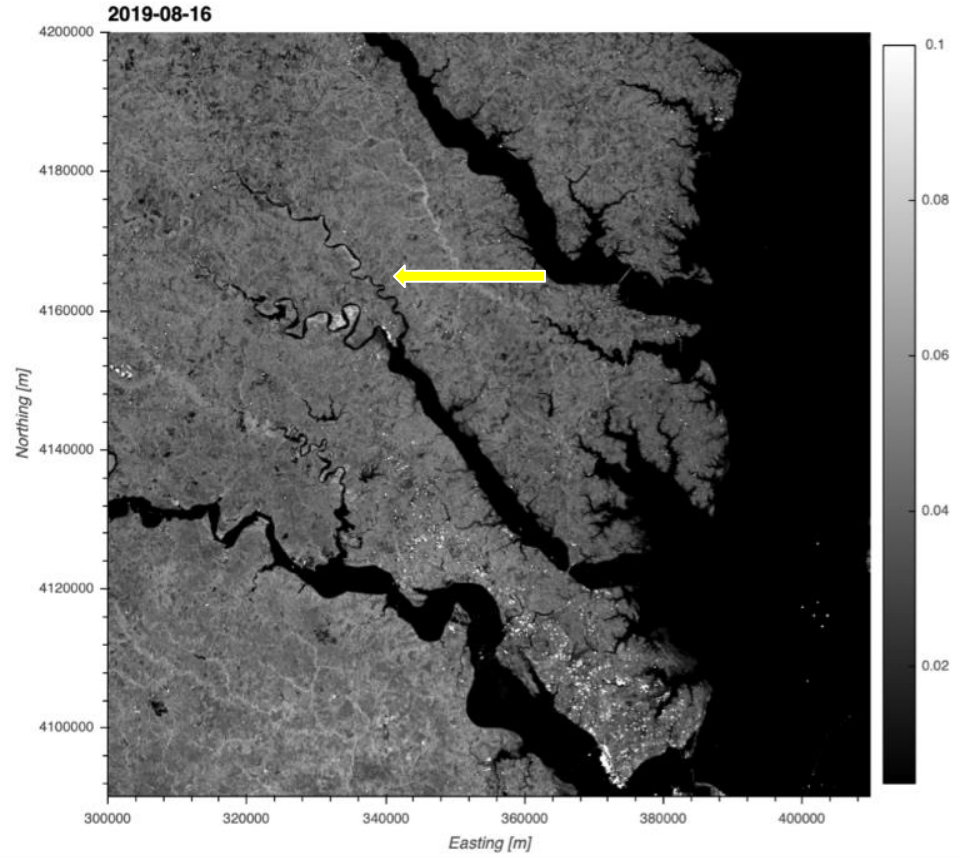
Middle Peninsula Impact: Sept. 6

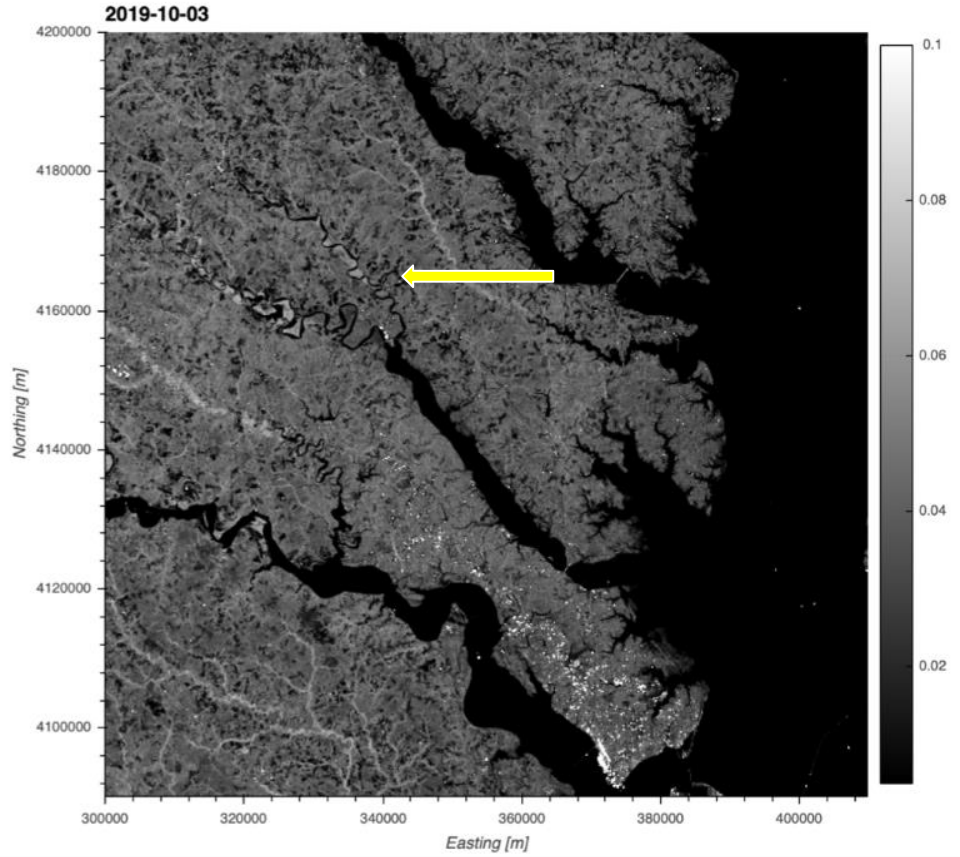
2020 Hurricane Isaias:

July 30 – August 5

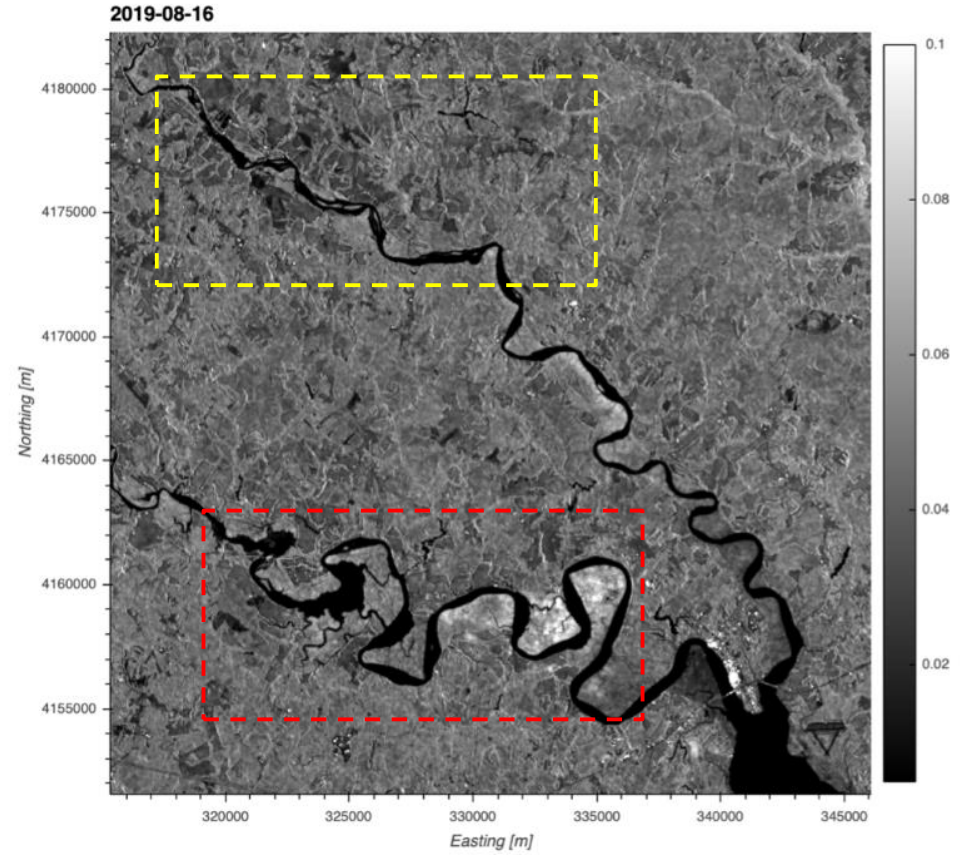
Middle Peninsula Impact: Aug

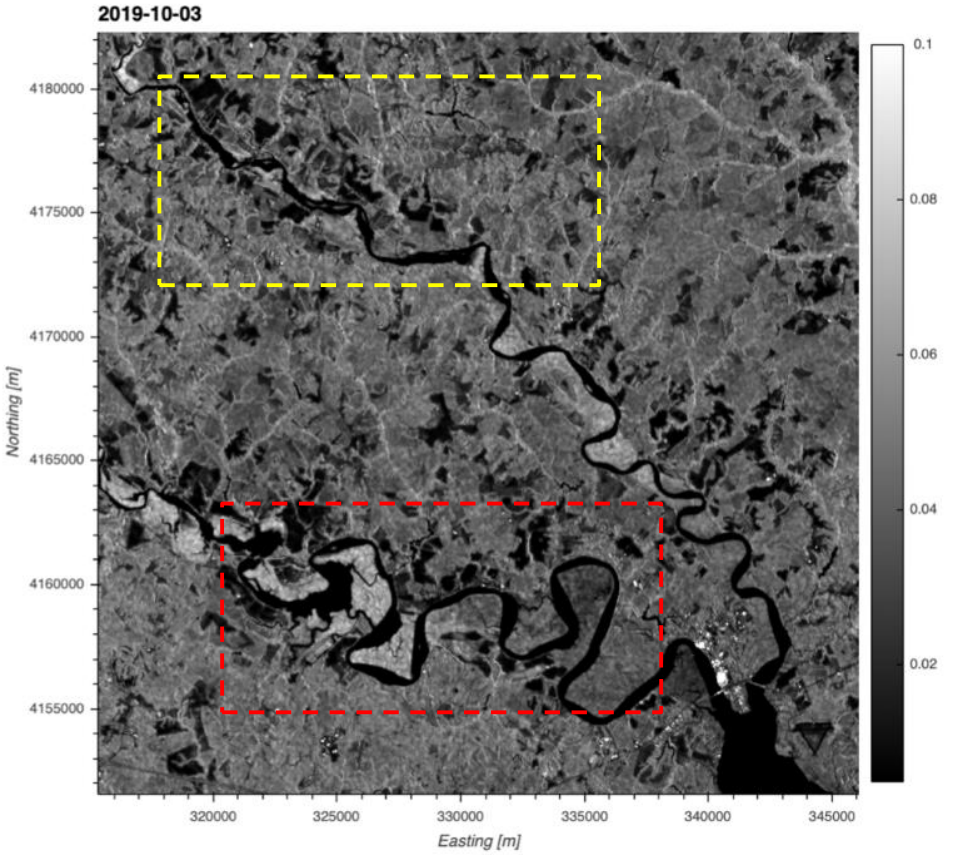
SAR Backscatter Before & After Dorian



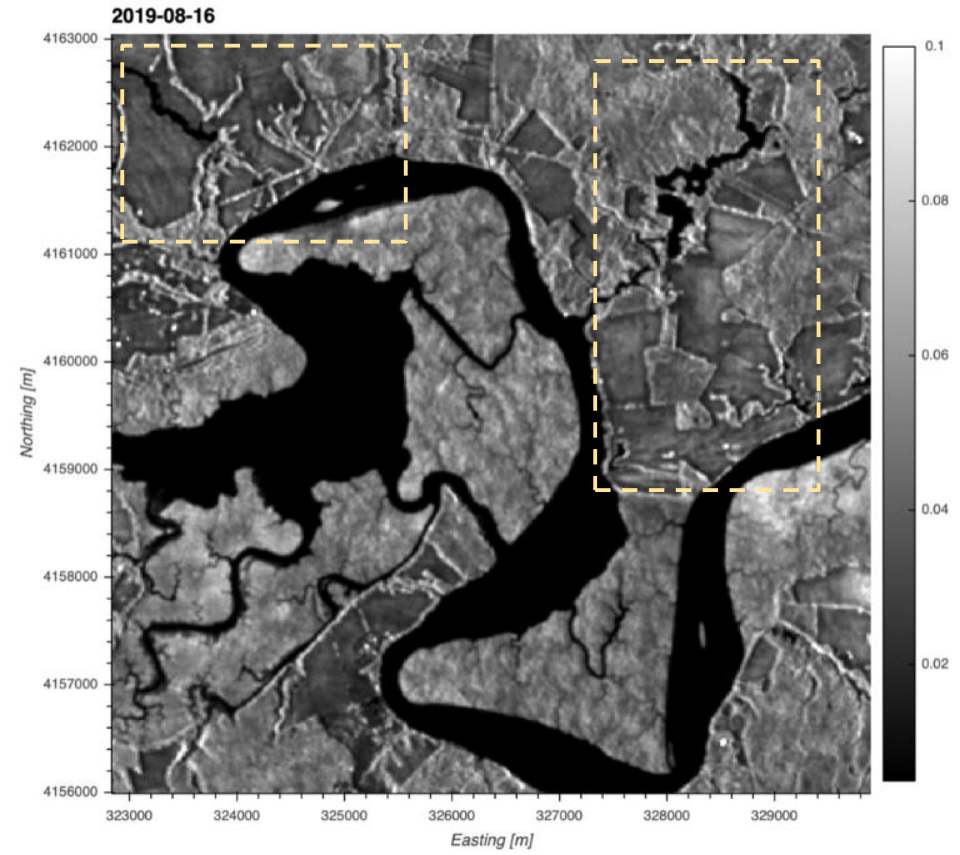


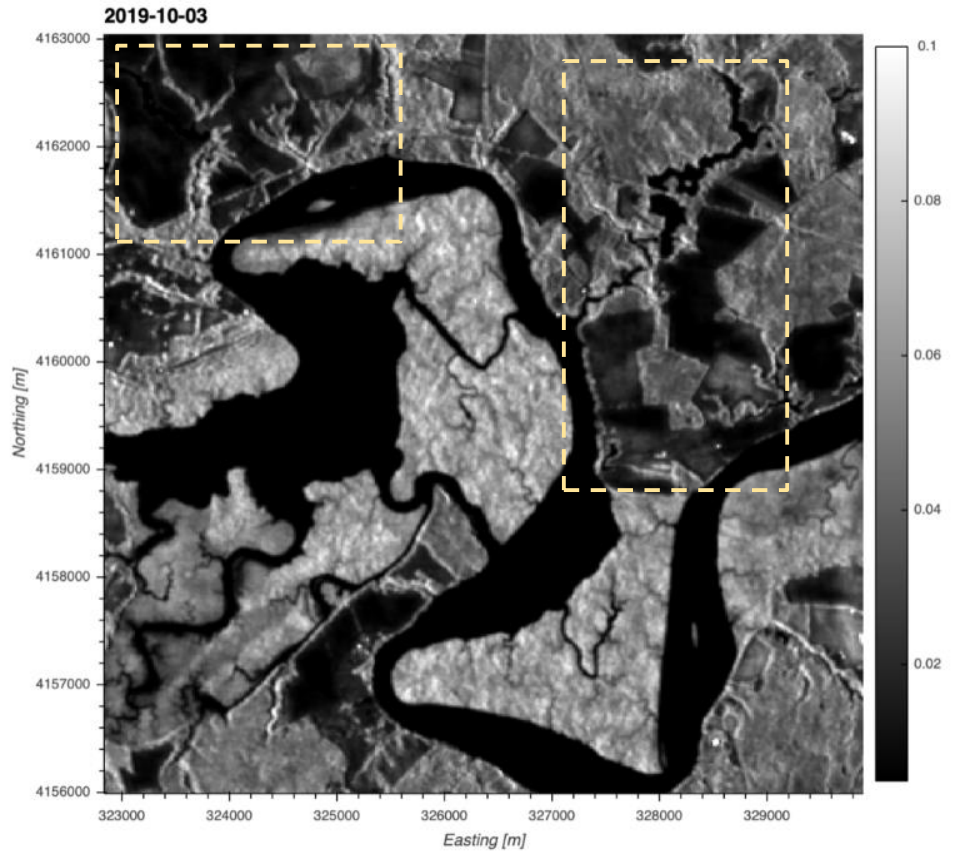
SAR Backscatter Before & After Dorian



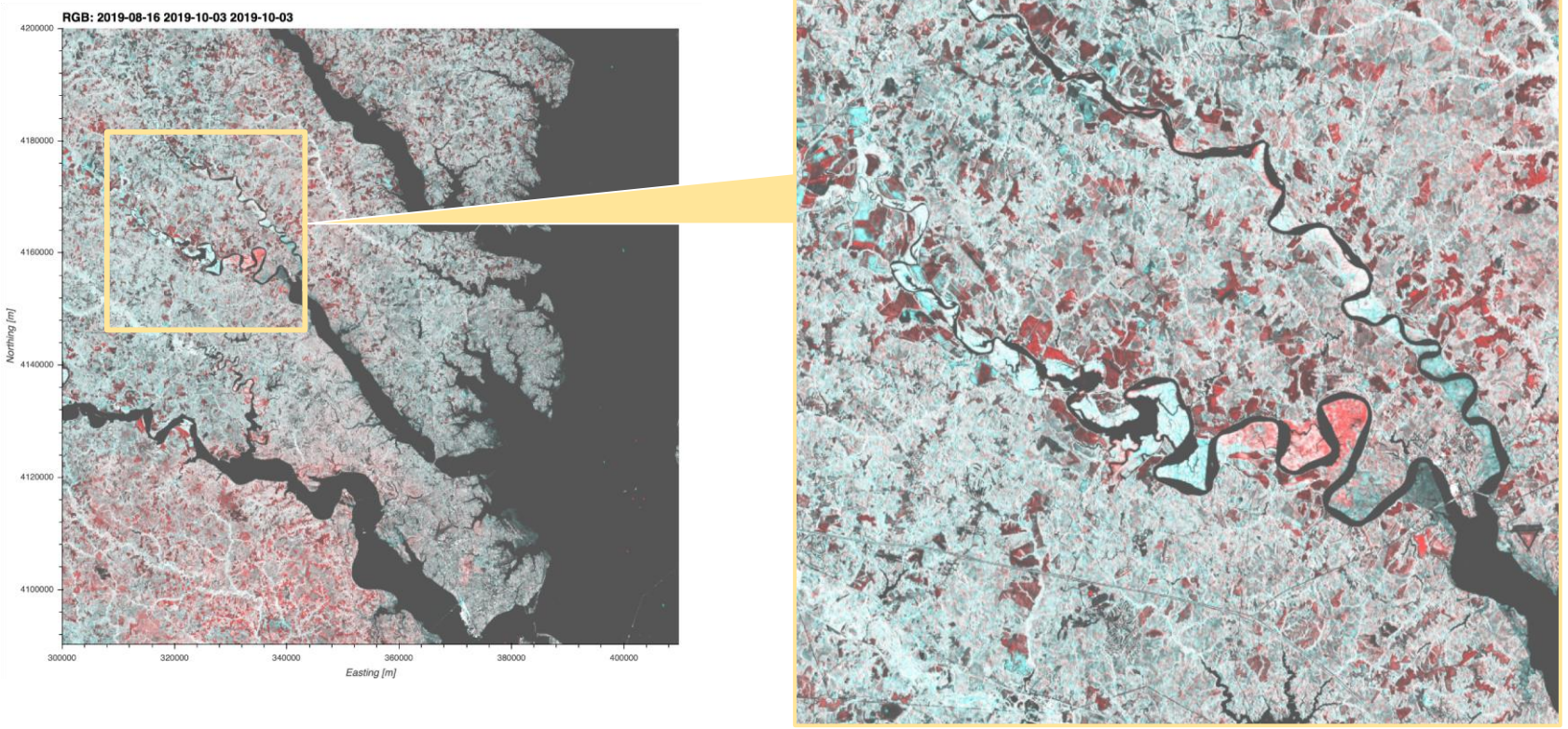


SAR Backscatter Before & After Dorian





RGB Image via Time Series



Ongoing and Future Work for Satellite Flood Mapping

- Implement VIIRS and ABI into NOAA operations
- Test downscaling approaches
- Continue evaluation and validation of SAR flood algorithms
- Expand integration of more SAR Satellites into Production
- Examine Flood Algorithm Performance for Chesapeake Bay pilot area
- Generate historical inundation maps and frequencies for validation and downscaling
- Generate flood depth maps in Chesapeake Bay
- Examine temporal changes for coastal inundation and impacts on periodic flooding
- Integrate into Knowledge Hub and Real Earth Environments

BREAK

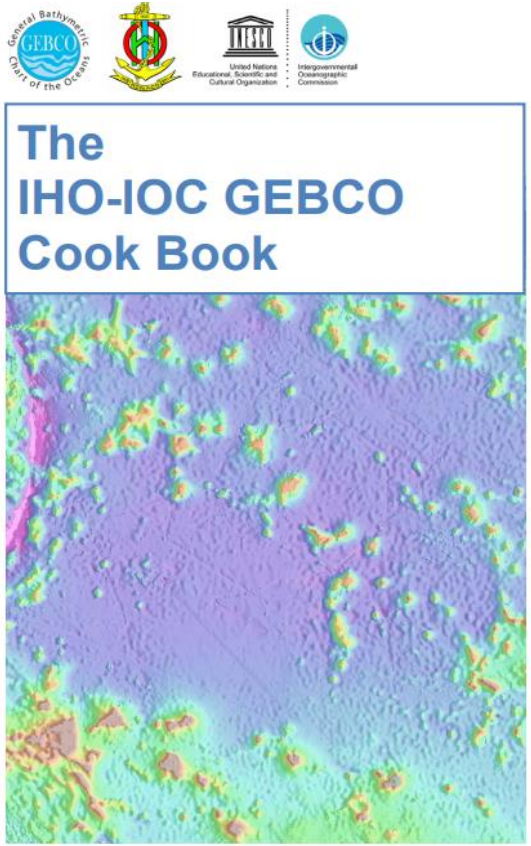
Hello We are on a short 10 minute break

We are reconvening at 14:30pm

Satellite Derived Bathymetry for shallow coastal water

Rick Stumpf, Gretchen Imahori
NOAA National Ocean Service

Isabel Caballero,
Instituto de Ciencias Marinas de Andalucia (ICMAN-CSIC)



Our goal, to mostly automate SDB at 10 m resolution, with national and global application

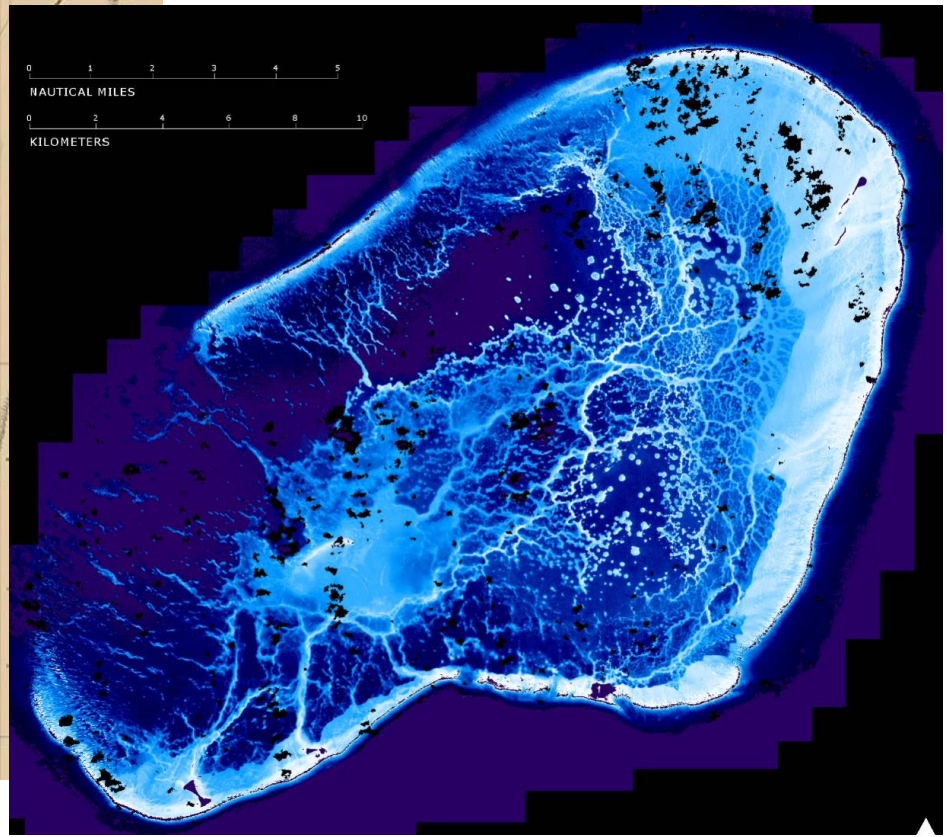
Improvements support NOAA and potentially international community through IHO

common SDB Methodology

- Step by Step cookbook, all manual
- ArcGIS
- Stumpf et al. (2003) bathymetric algorithm
- Typically do not convert to absolute depths

Pearl & Hermes Atoll, NW Hawaiian Islands

Chart and first SDB map from NCCOS



NCCOS | NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

Value of SDB

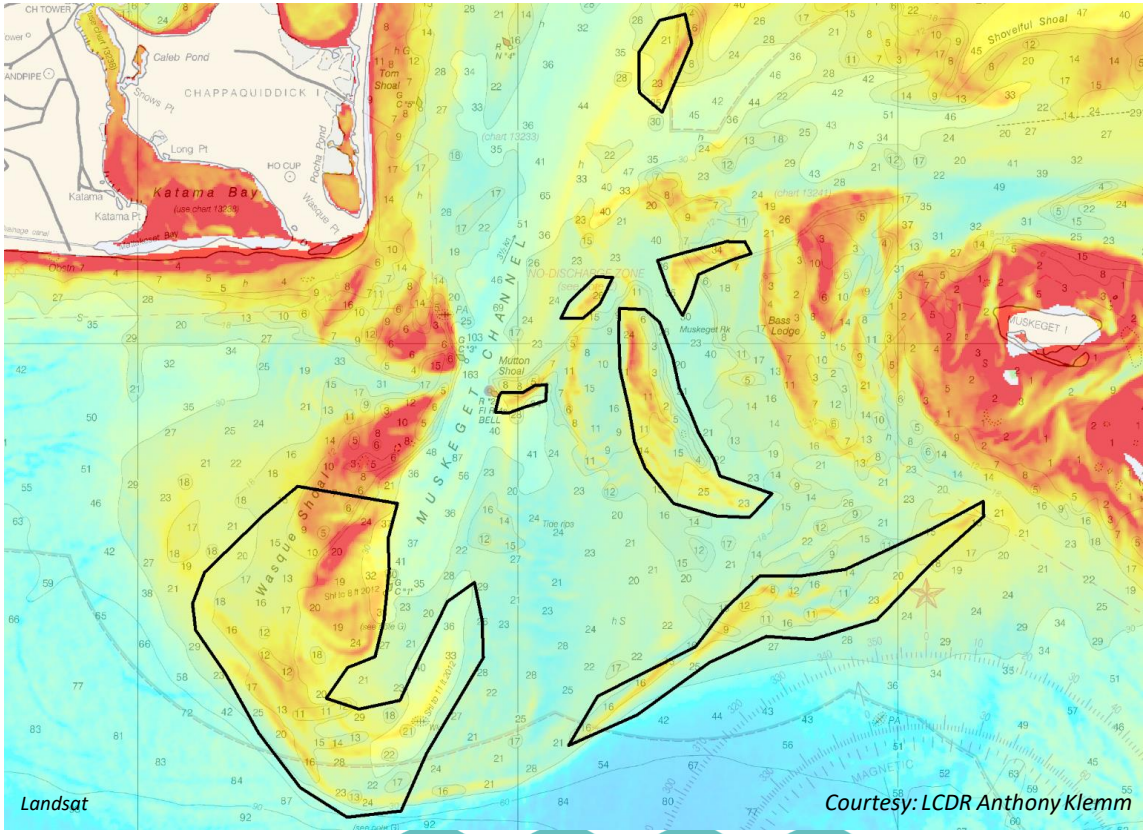
Reconnaissance of remote areas

Monitoring of shoals

Storm response

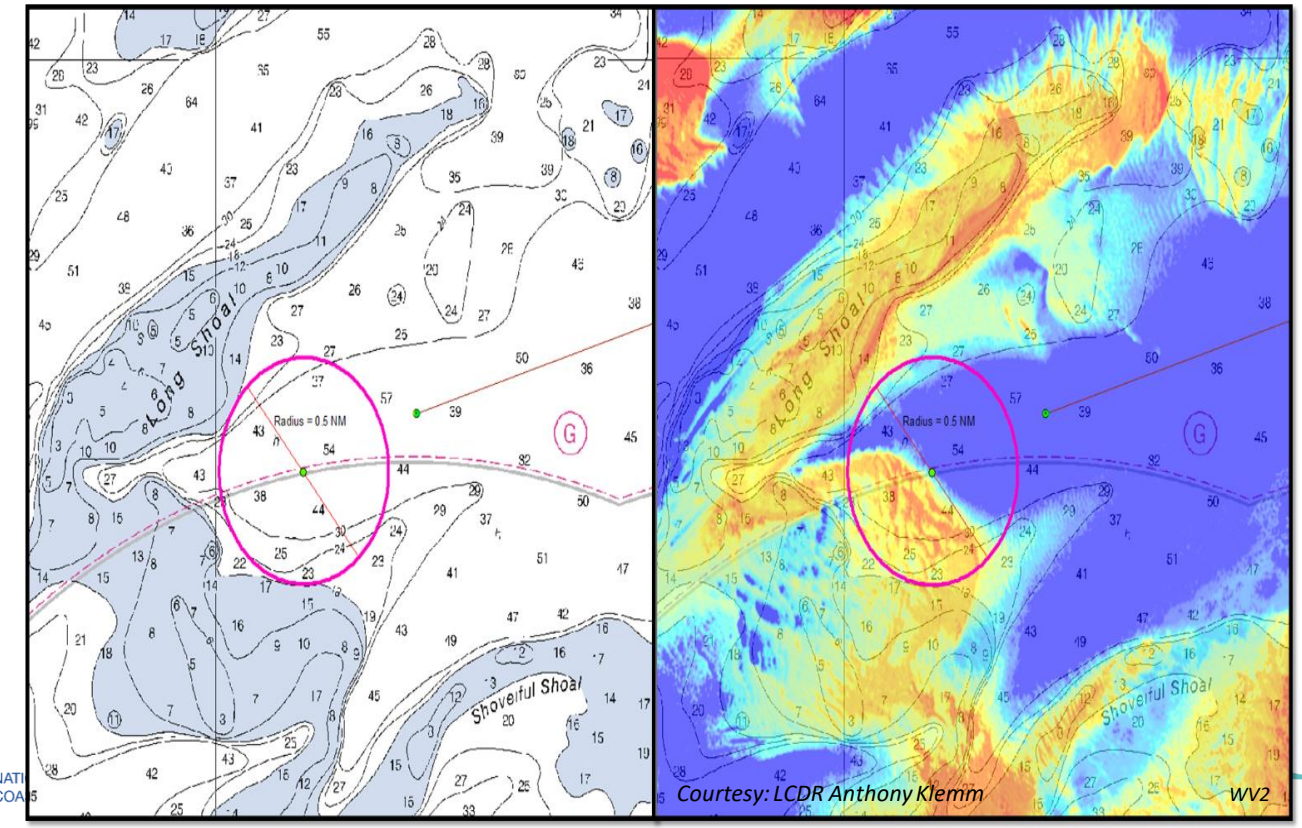
Infilling of lidar/multi-beam

Mission planning



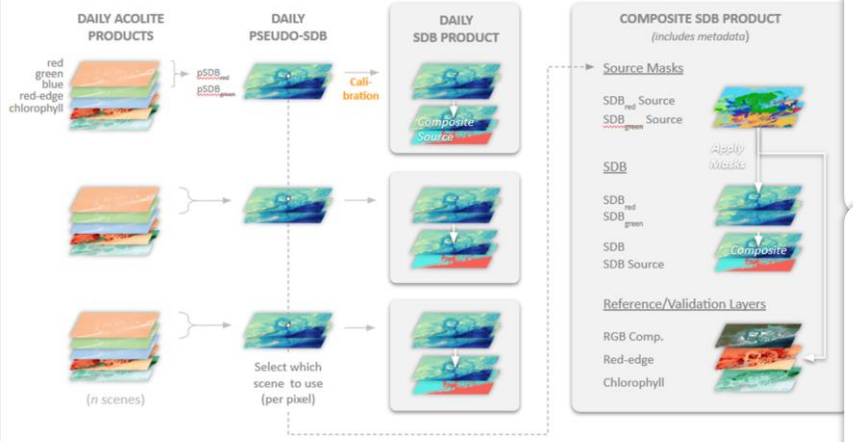
Operational Planning

NOAA Ship *Thomas Jefferson* SDB validation in Nantucket Sound



Courtesy: LCDR Anthony Klemm *WV2*

Automating process to retrieve more data



remote sensing

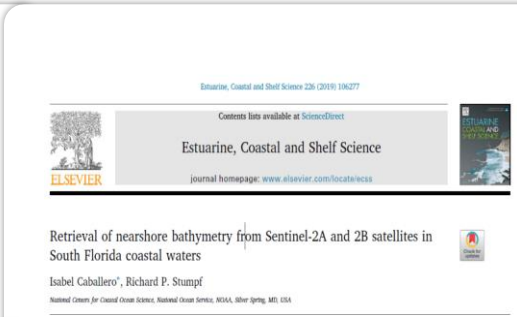
MDPI

Article

Preliminary Assessment of Turbidity and Chlorophyll Impact on Bathymetry Derived from Sentinel-2A and Sentinel-3A Satellites in South Florida

Isabel Caballero [1,*], Richard P. Stumpf [1] and Andrew Meredith [2]

[1] National Centers for Coastal Ocean Science (NCCOS), National Oceanic and Atmospheric Administration (NOAA), Silver Spring, MD 20910, USA; richard.stumpf@noaa.gov
[2] National Centers for Coastal Ocean Science (NCCOS), National Oceanic and Atmospheric Administration (NOAA), Charleston, SC 29412, USA; andrew.meredith@noaa.gov
* Correspondence: isabel.caballero@icman.csic.es



Estuarine, Coastal and Shelf Science 226 (2019) 106277

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

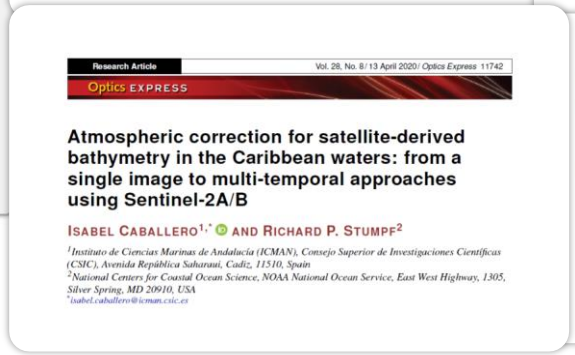
journal homepage: www.elsevier.com/locate/ecss

ELSEVIER

Retrieval of nearshore bathymetry from Sentinel-2A and 2B satellites in South Florida coastal waters

Isabel Caballero*, Richard P. Stumpf

National Centers for Coastal Ocean Science, National Ocean Service, NOAA, Silver Spring, MD, USA



Research Article

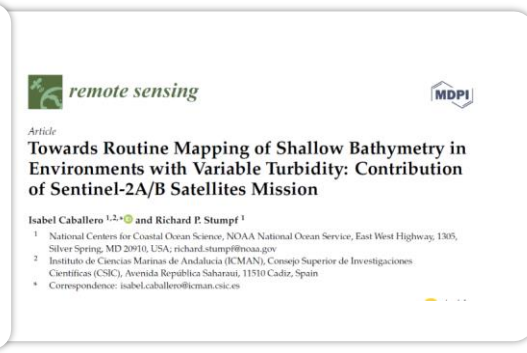
Vol. 28, No. 8 / 13 April 2020 / Optics Express 11742

Optics EXPRESS

Atmospheric correction for satellite-derived bathymetry in the Caribbean waters: from a single image to multi-temporal approaches using Sentinel-2A/B

ISABEL CABALLERO[1,*] AND RICHARD P. STUMPF[2]

[1]Instituto de Ciencias Marinas de Andalucía (ICMAN), Consejo Superior de Investigaciones Científicas (CSIC), Avenida República Saharaui, Cadiz, 11510, Spain
[2]National Centers for Coastal Ocean Science, NOAA National Ocean Service, East West Highway, 1305, Silver Spring, MD 20910, USA
*isabel.caballero@icman.csic.es



remote sensing

MDPI

Article

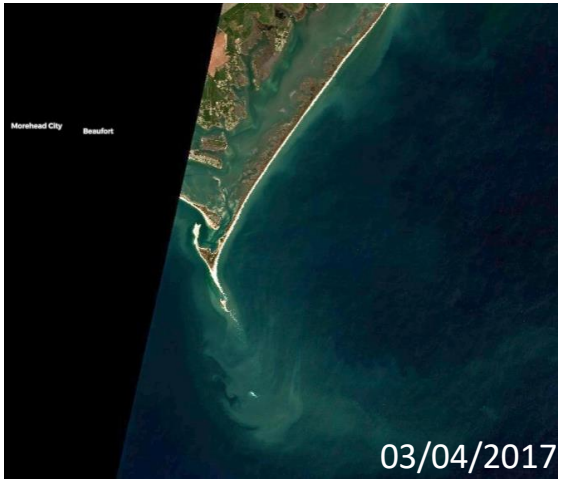
Towards Routine Mapping of Shallow Bathymetry in Environments with Variable Turbidity: Contribution of Sentinel-2A/B Satellites Mission

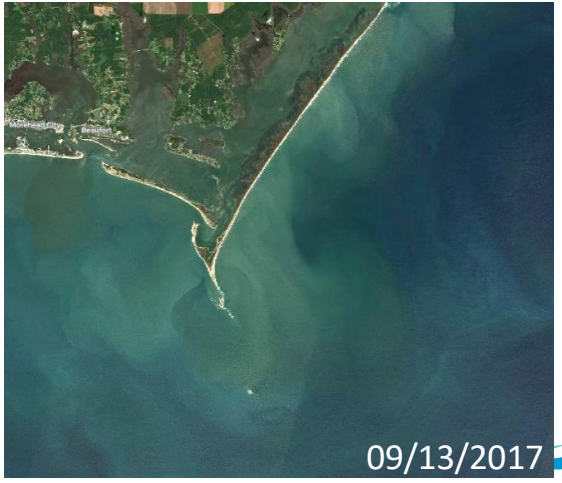
Isabel Caballero [1,2,*] and Richard P. Stumpf [1]

[1] National Centers for Coastal Ocean Science, NOAA National Ocean Service, East West Highway, 1305, Silver Spring, MD 20910, USA; richard.stumpf@noaa.gov
[2] Instituto de Ciencias Marinas de Andalucía (ICMAN), Consejo Superior de Investigaciones Científicas (CSIC), Avenida República Saharaui, 11510 Cadiz, Spain
* Correspondence: isabel.caballero@icman.csic.es

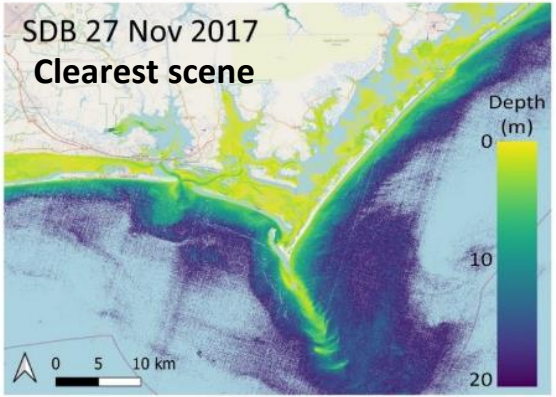
Clouds, atmospheric haze, sunglint on the water, transient turbidity in the water are all factors in impacting SDB retrieval.

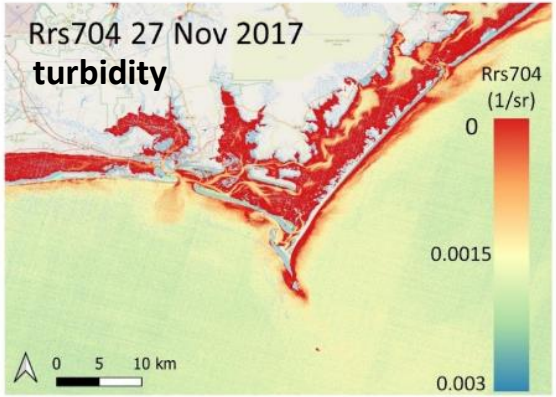
We are not trying to pick a single optimal scene, example Cape Lookout



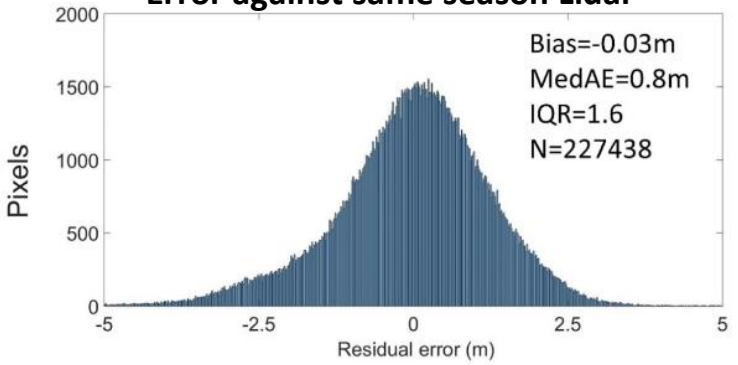


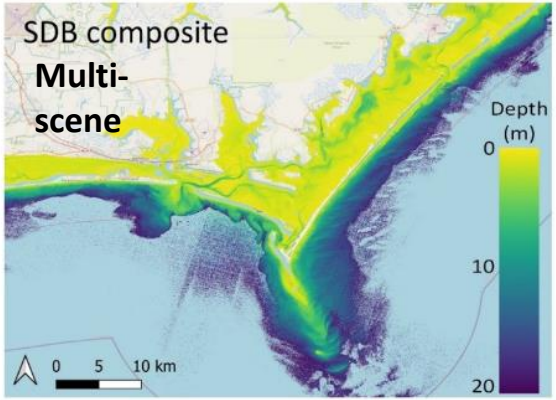
Composite multiple days to reduce turbidity

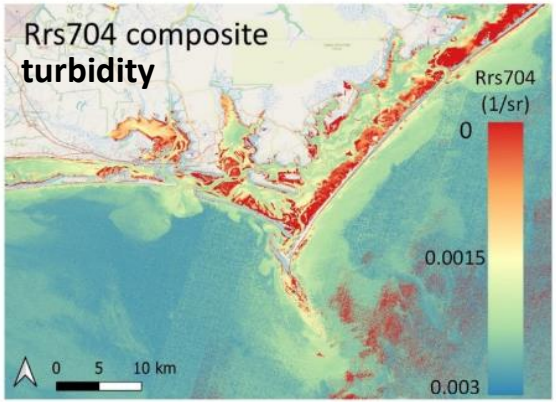


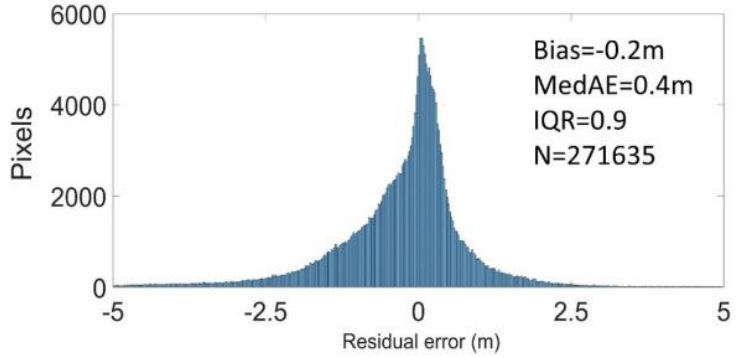


Error against same season Lidar

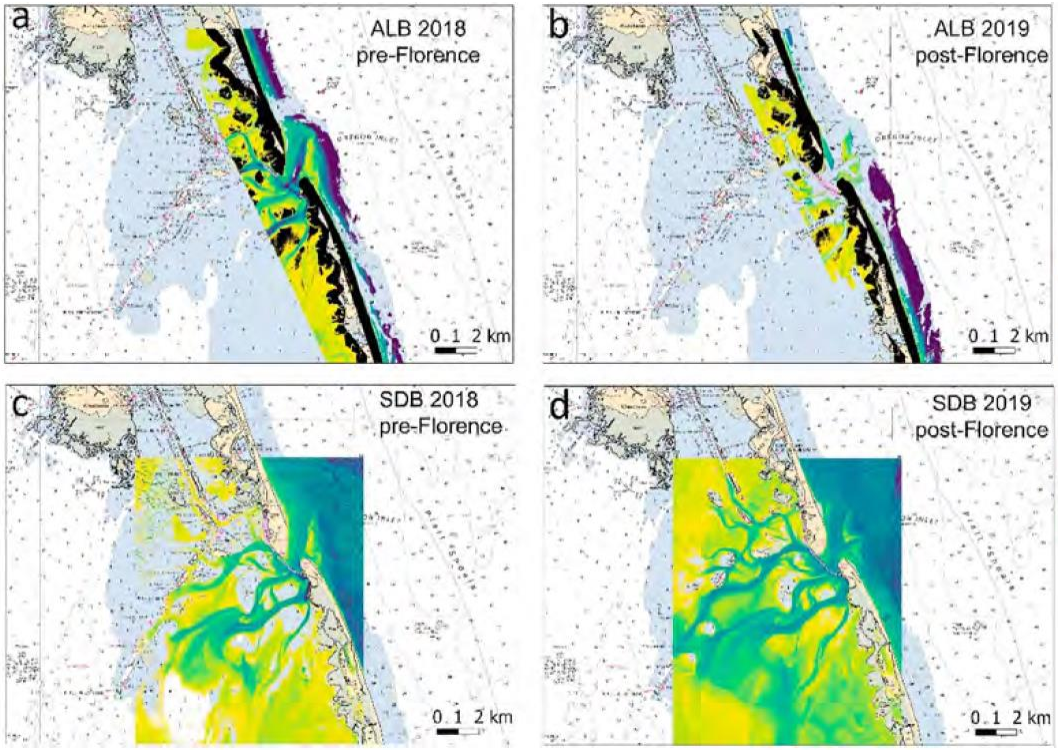


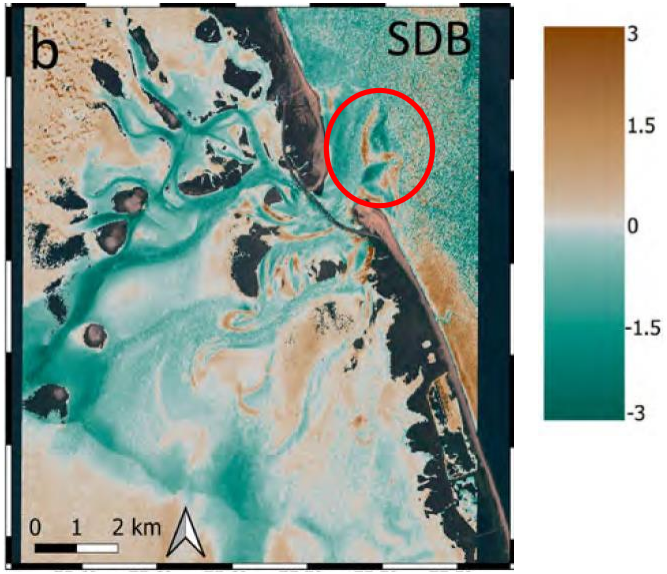


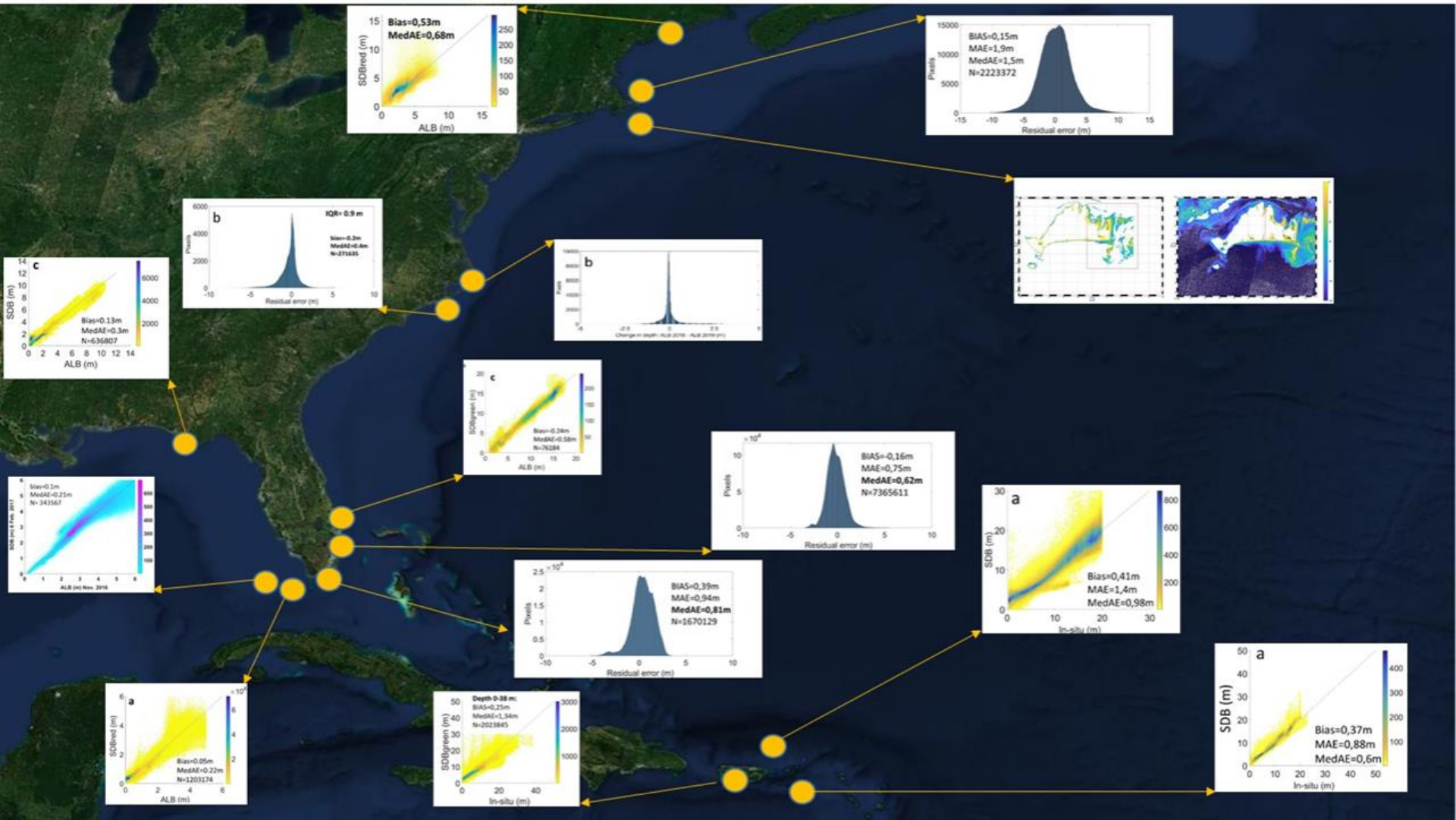




Change detection around Oregon Inlet NC



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MedAE=0,68m
SDBred (m)
ALB (m)
BIAS=0,15m
MAE=1,9m
MedAE=1,5m
N=2223372
Pixels
Residual error (m)
b
IQR= 0.9 m
Residual error (m)
b
c
Bias=0.13m
MedAE=0.3m
N=636807
SDB (m)
ALB (m)
c
Bias=-0.24m
MedAE=0.58m
N=76184
SDBgreen (m)
ALB (m)
BIAS=-0,16m
MAE=0,75m
MedAE=0,62m
N=7365611
Residual error (m)
Bias=0.1m
MedAE=0.21m
N= 343567
ALB (m) Nov. 2016
BIAS=0,39m
MAE=0,94m
MedAE=0,81m
N=1670129
Residual error (m)
a
Bias=0,41m
MAE=1,4m
MedAE=0,98m
SDB (m)
In-situ (m)
a
Bias=0.05m
MedAE=0.22m
N=1203174
SDBred (m)
ALB (m)
Depth 0-38 m:
BIAS=0,25m
MedAE=1,34m
N=2023845
SDBgreen (m)
In-situ (m)
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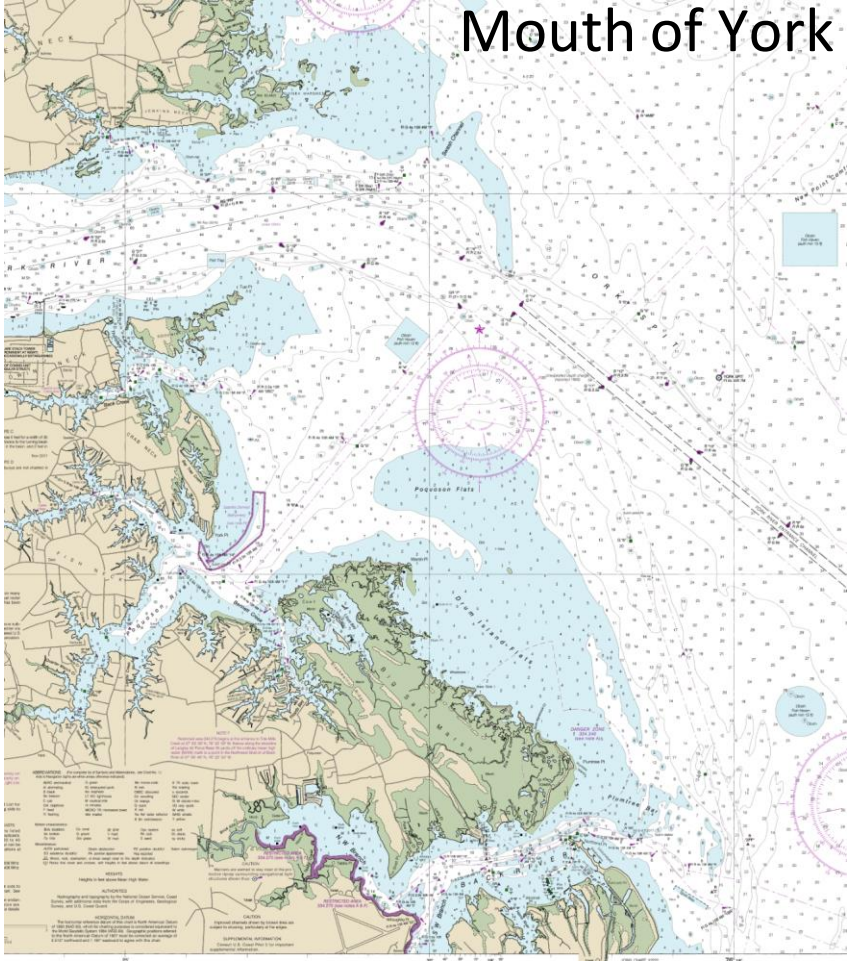
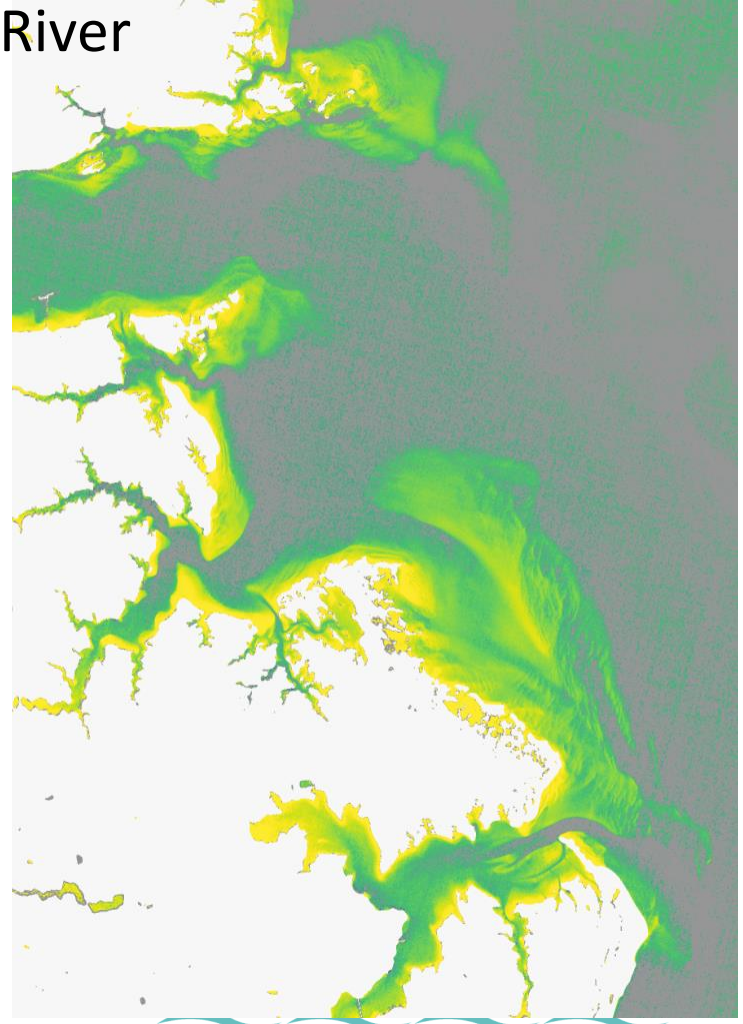
Bias=0,37m
MAE=0,88m
MedAE=0,6m
SDB (m)
In-situ (m)

Mouth of York River





Chesapeake Bay

SDB: if you cannot “see” the bottom, cannot retrieve a depth.

Residual turbidity affects calibration to absolute depth. Variations in turbidity cause false shoaling.

We need to refine “Extinction depth”: maximum depth retrievable. This depends on turbidity (and the water depth)

Mouth of Rappahannock and Piankatank Rivers

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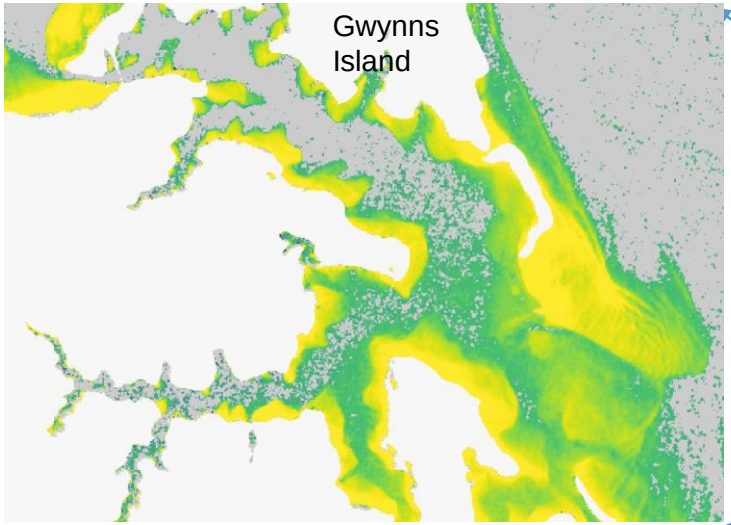

Questions and Discussion?

See the Shoreline Mapping Slides and Knowledge Hub Video

What next??

Proposing to meet with interested CB stakeholders (as available) regularly throughout May, June, and July (perhaps into August if needed).

- To introduce and refine existing products and the portal based on your feedback
- This could also include outreach and training development

Any other thoughts? Better ideas?