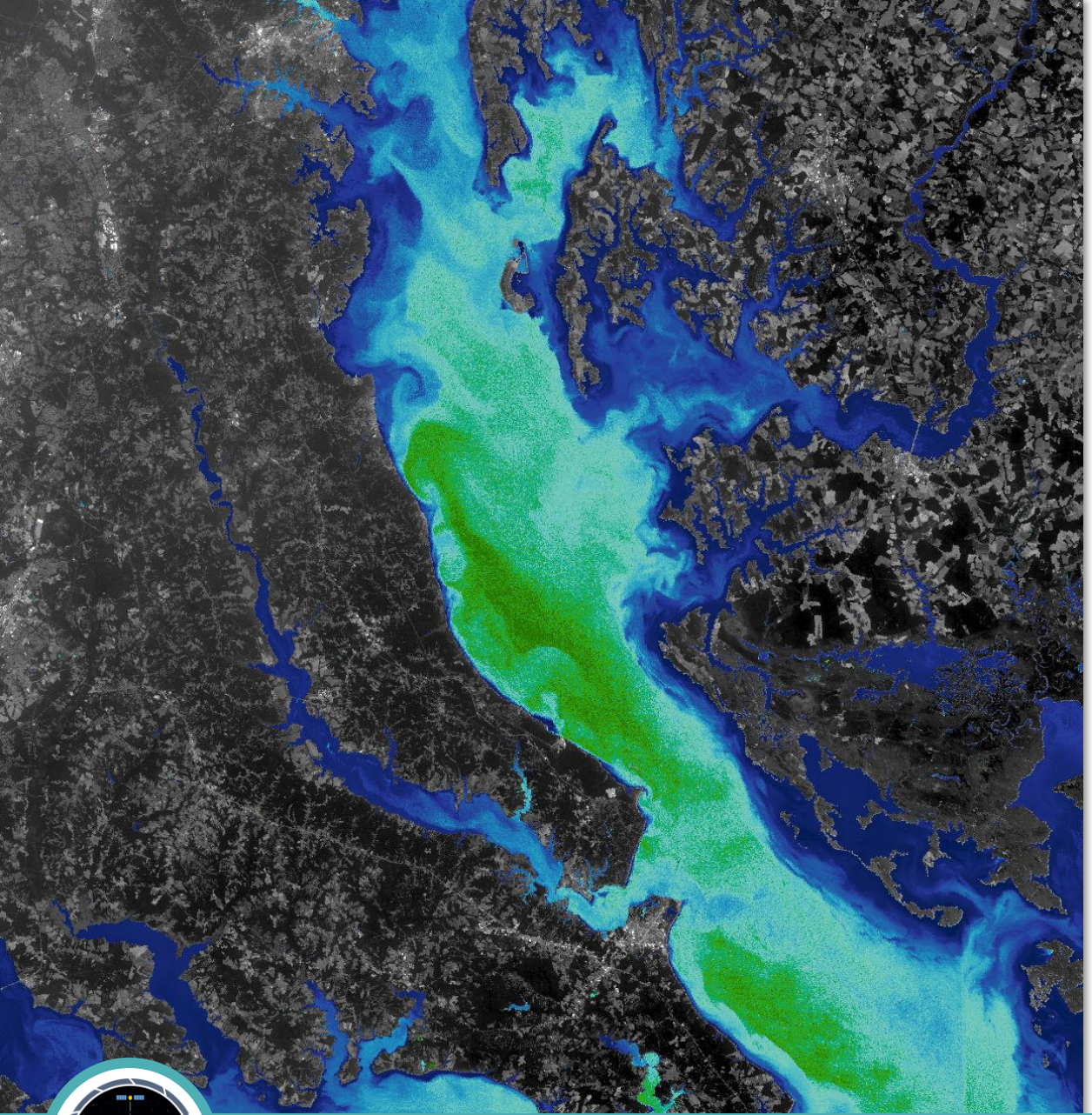


National Aeronautics and Space Administration

CHESAPEAKE BAY WATER RESOURCES

Using Earth Observations to Assess Spatial and Social Disparities in Water Quality Trends Shaping Fishing and Swimming Access in the Chesapeake Bay

Spencer Harman

Rima Wahab

Simone Schneider

Nisuka Williams

Maryland – Goddard | Fall 2024

Meet the Team

Nisuka Williams
Team Lead

Spencer Harman

Simone Schneider

Rima Wahab

Image Credits: Alicia Pimental

Background

- **Chesapeake Bay** is the largest marine estuary in the United States
- The bay is a source of **recreation and food** for local communities
- Major **land use changes through** urbanization and farming have led to increased **anthropogenic stressors**
- Accelerated nutrient loads lead to an increase in **turbidity** and **harmful algal blooms**

Image Credit: NASA

Background

With more than 18 million people residing in the bay watershed, there is **limited direct physical access** to recreational activities at the bay open waterways.

Many people cannot access their local water bodies due to **private land** restrictions, **unsafe** conditions, or lack of **awareness** about open waterways.

Image Credit: Ben Schumin

Partners

Ocean Conservancy

A **science and policy advocacy group** that works to protect the ocean from today's greatest global challenges, creating evidence-based solutions for a healthy ocean and the wildlife and communities that depend on it.

Blacks of the Chesapeake Foundation

A community advocacy non-profit that works to ensure **equitable access** to green and blue spaces around the Chesapeake Bay.

DEVELOP Team and Partners
Credit: Isabel Lubitz

Community Concerns

Turbid Water

Harmful Algal Blooms

Image Credits: NASA Goddard, F. Lamiot

Objectives

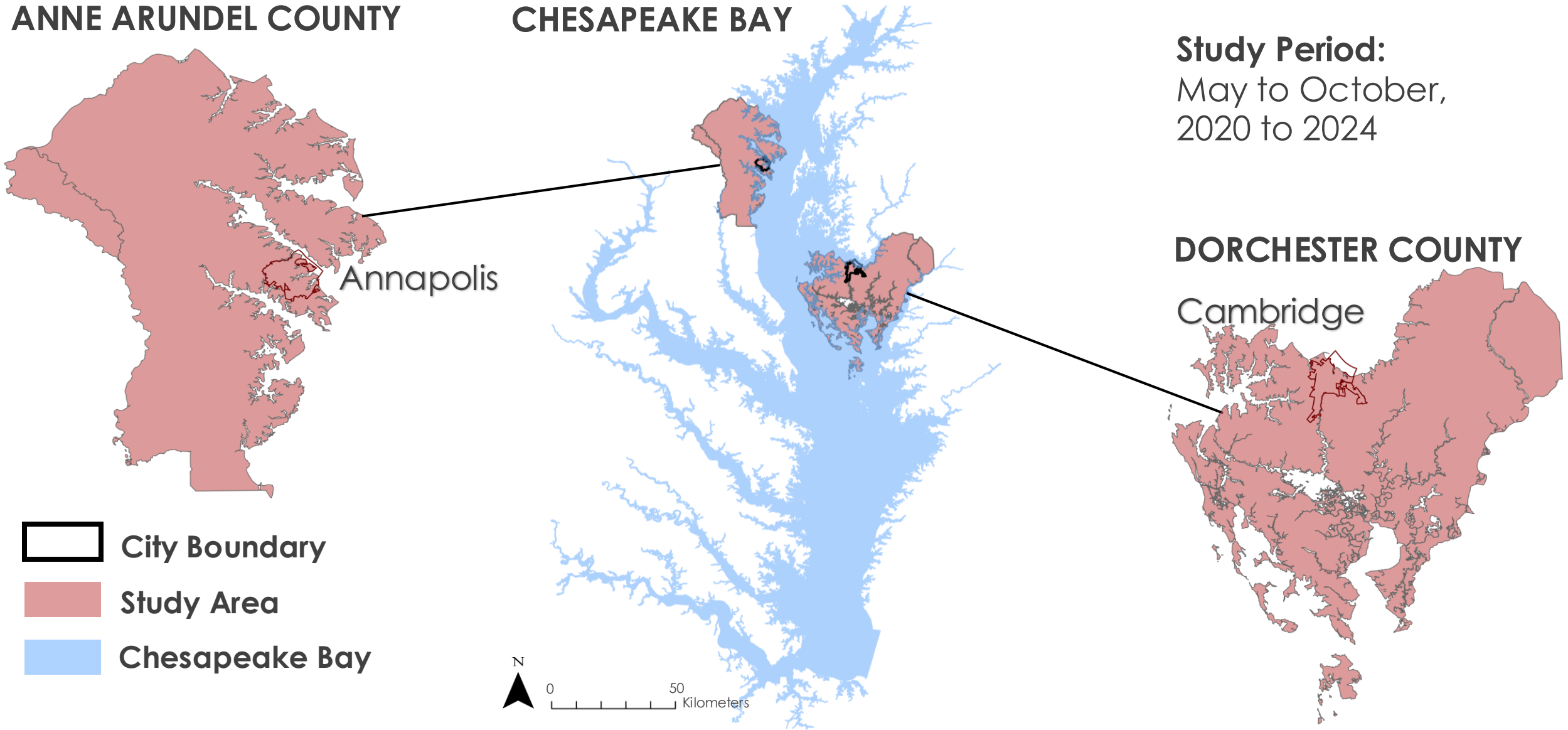
Evaluate satellite-based maps of chlorophyll-a and turbidity, comparing results to in situ data

Map areas with persistent chlorophyll-a exceeding harmful thresholding levels

Identify communities with high social vulnerability and low access to recreational fishing and swimming locations

Image Credits (L-R): NASA, Adrian Jones, daveynin

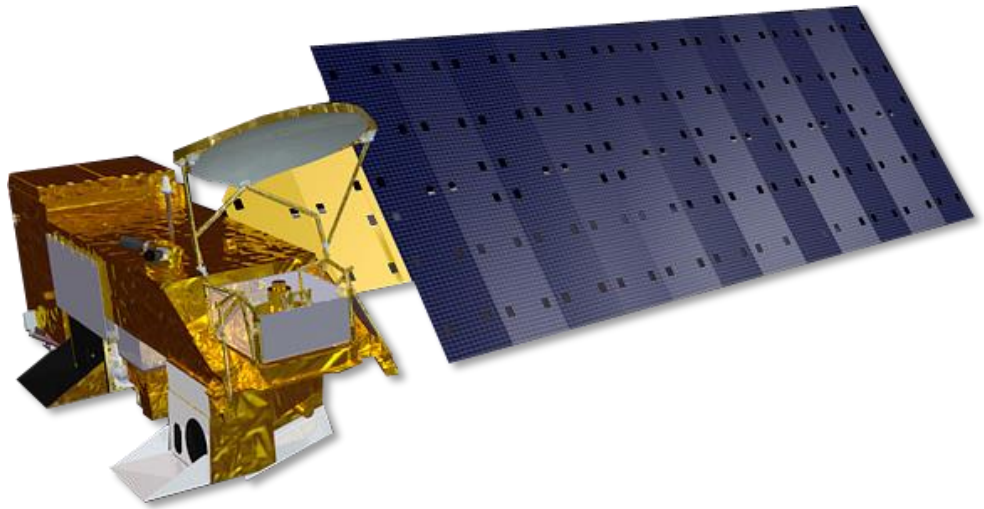
Study Area and Period



Study Period:
May to October,
2020 to 2024

Earth Observations

Aqua MODIS



Sentinel-3 OLCI

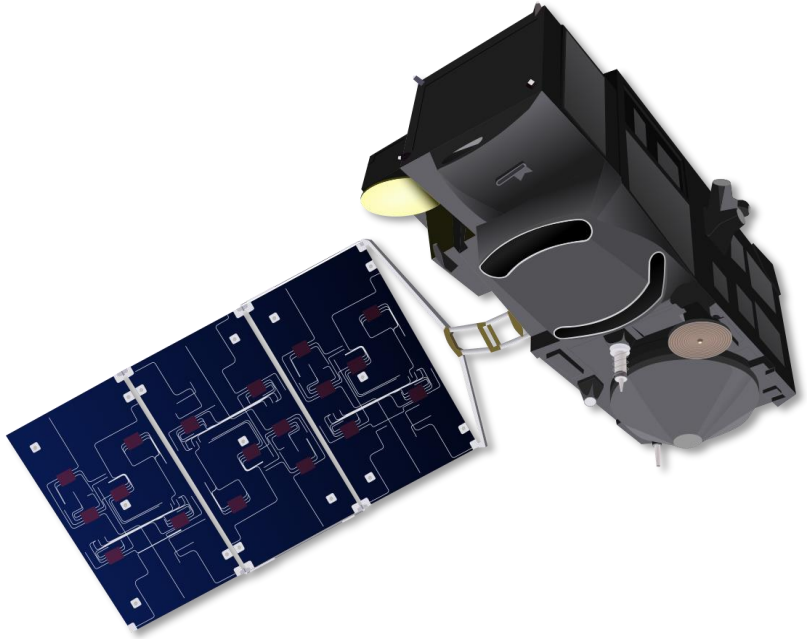
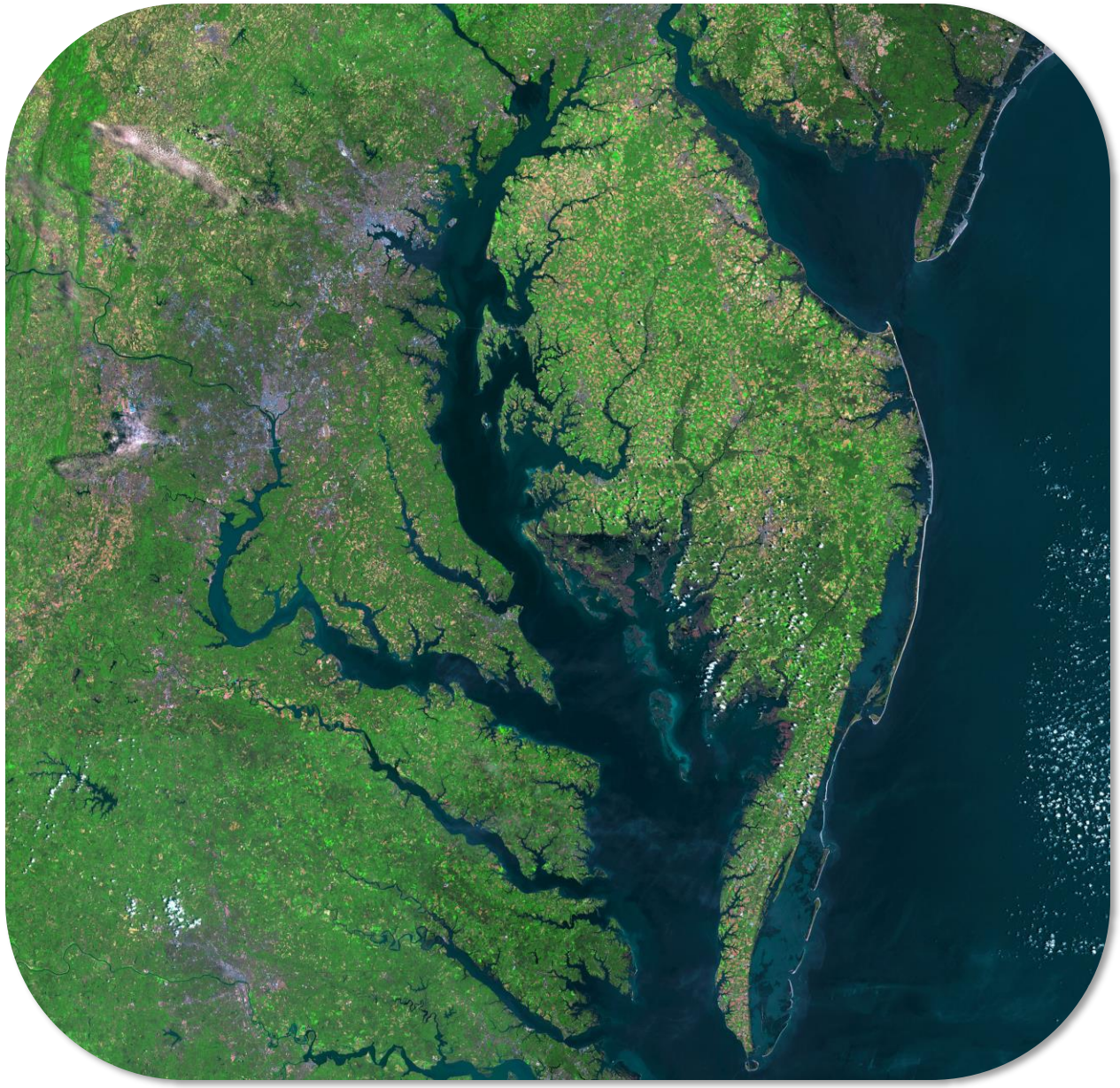


Image Credits: NASA, SkywalkerPL

Water Quality Over Time



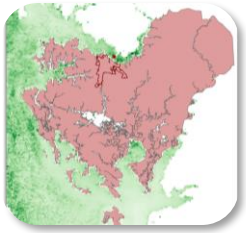
Landsat 5 Mosaic Image of Chesapeake Bay
Image Credit: NASA

Time Series Methods

Chlorophyll-a

Kd490

Biweekly Mean Composites (2020 – 2024)

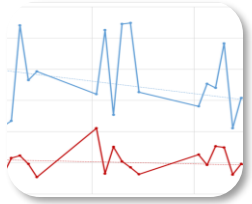


Water Quality Time Series Visual

Recreational Sites (Swimming and Fishing)

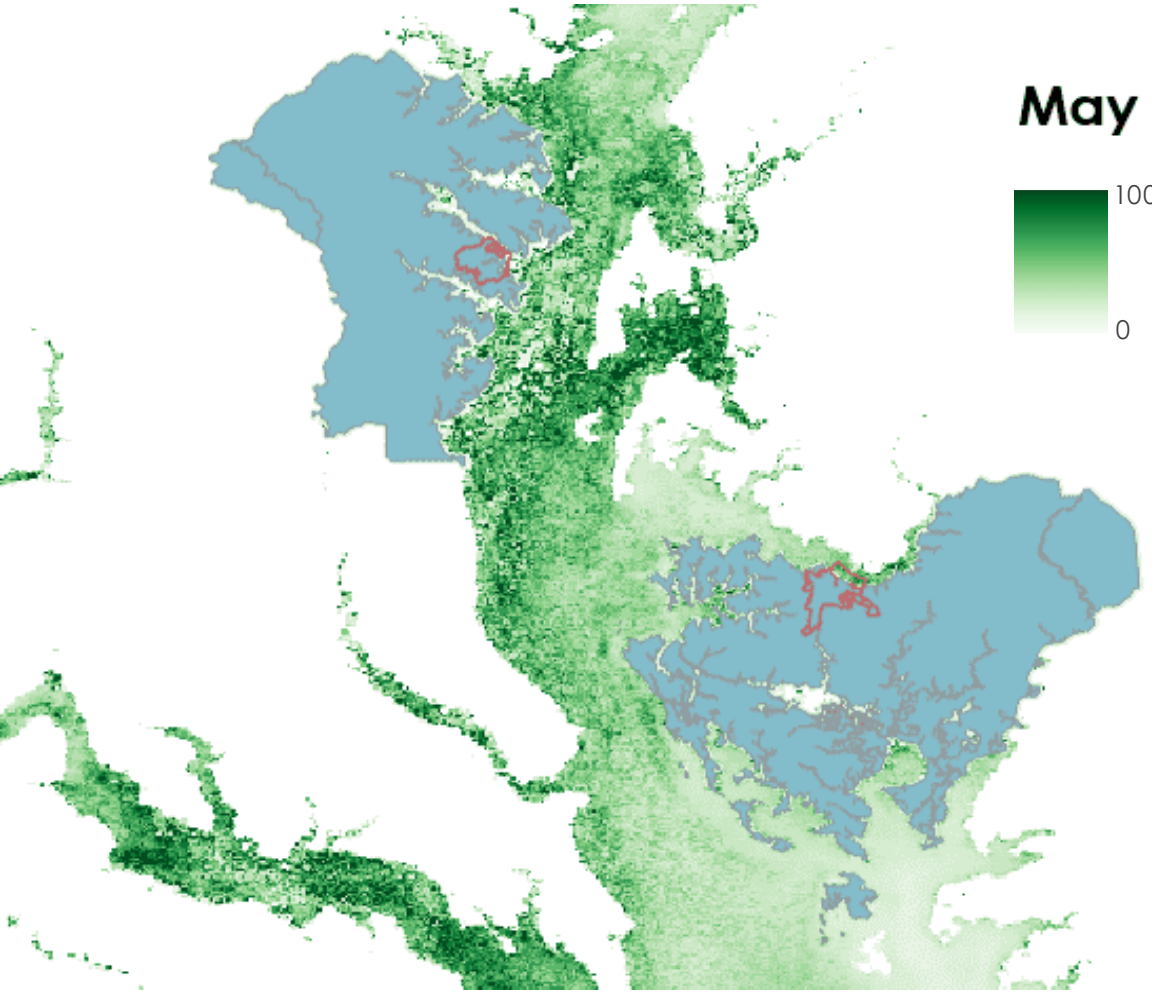
In Situ Water Quality Measurements

Case Study Sites

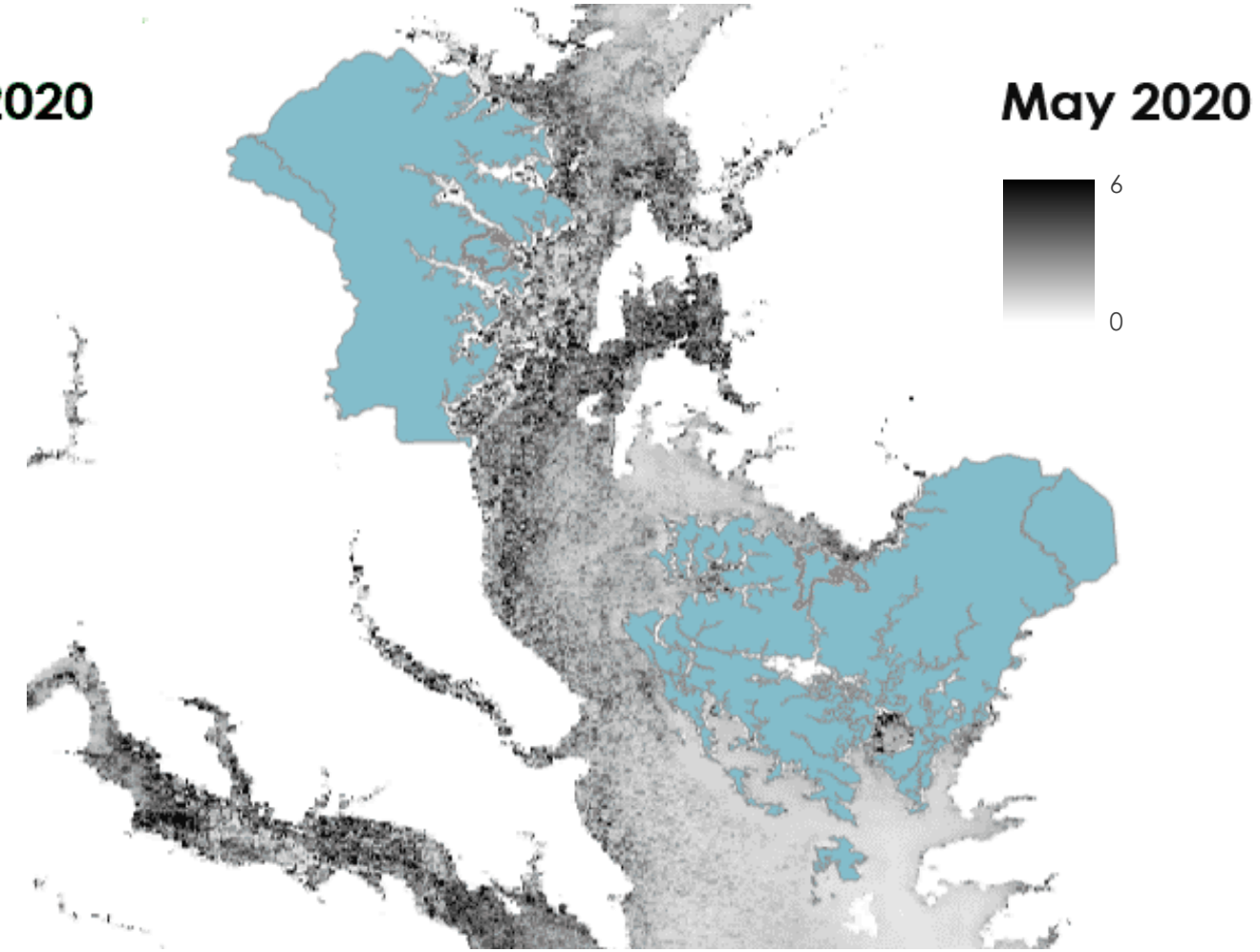


Water Quality Time Series Case Studies

Time Series

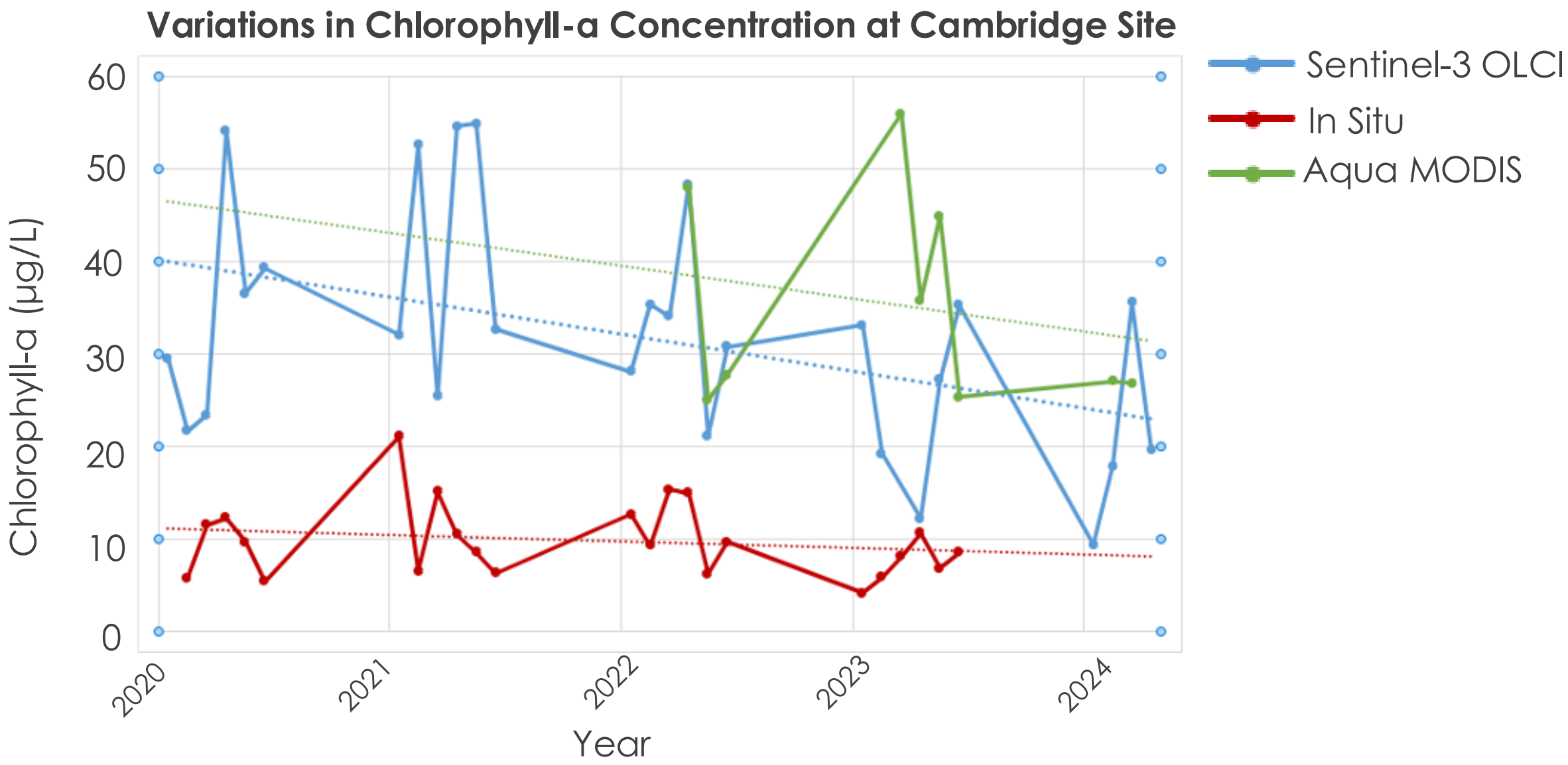


May 2020 – 2024
Chlorophyll-a (µg/L)



May 2020 – 2024
Kd490

Chlorophyll-a Time Series



Chlorophyll-a Persistence

Fish kill in Choptank River likely caused by algal bloom
Image Credit: Adrian Jones

Chlorophyll-a Persistence Methods

Chlorophyll-a Threshold: Above 50 ug/l indicates a significant harmful algal bloom

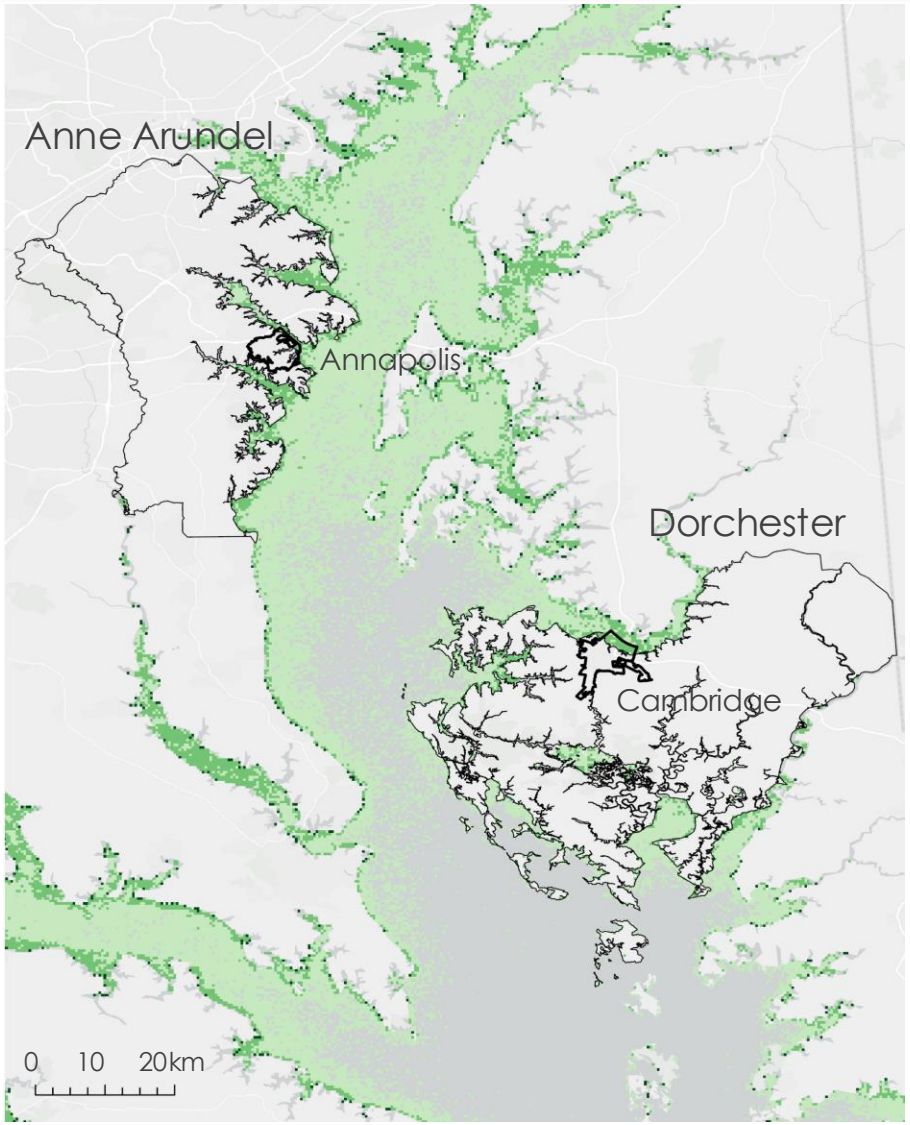
Data: Bi-weekly Composites Sentinel-3 OLCI Chlorophyll-a Product

0	1	+	0	0	=	0	1	=	**0**	**0.5**
0	1		1	1		1	2		**0.5**	**1**

Count **Persistence Index**

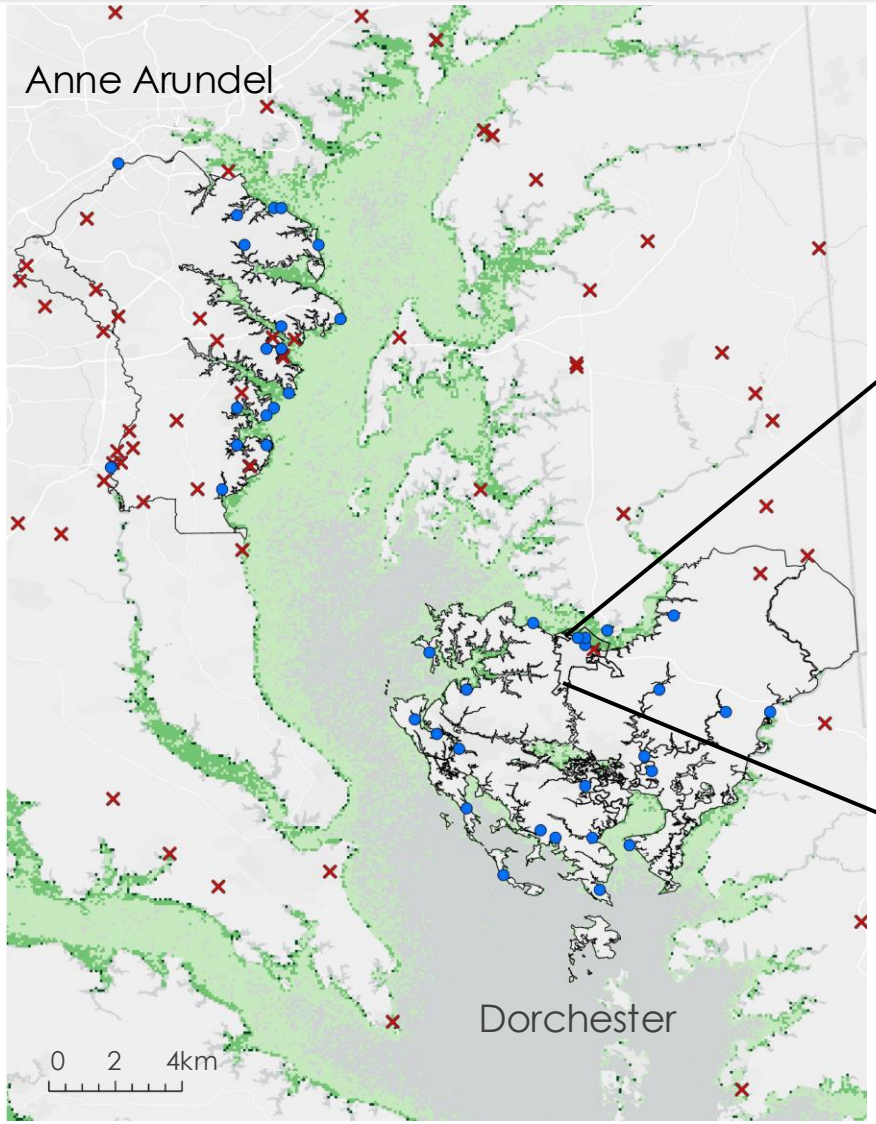
PERSISTENT CHLOROPHYLL-A

- HIGH
- MEDIUM
- LOW

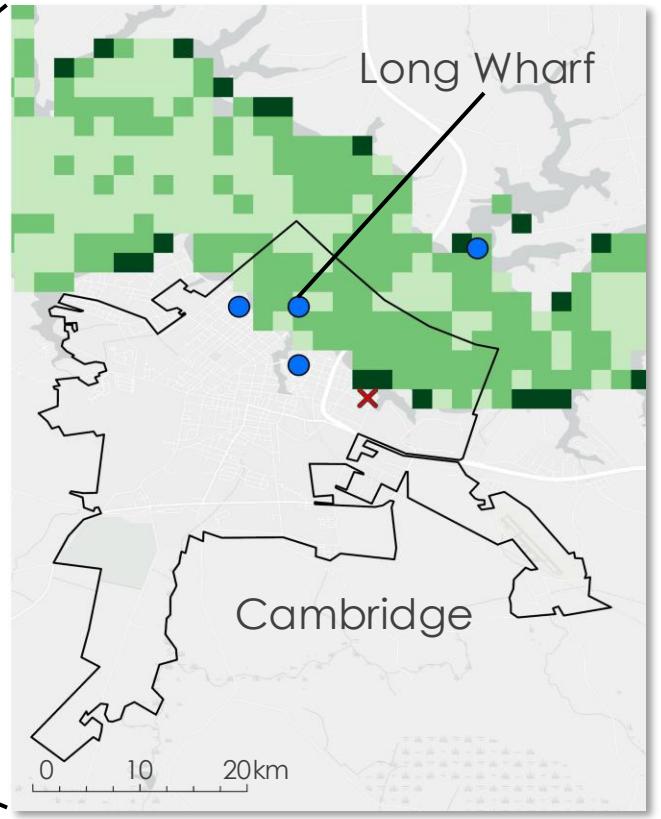


Basemap Credit: VGIN, Esri, TomTom, Garamin, SafeGraph, METI/NASA, USGS, EPA, NPA, USDA, USFWS, County of Anne Arundel

Results – Chlorophyll-a Persistence



Basemap Credit: VGIN, Esri, TomTom, Garamin, SafeGraph, METI/NASA, USGS, EPA, NPA, USDA, USFWS, County of Anne Arundel and Dorchester



Basemap Credit: VGIN, Esri, TomTom, Garamin, SafeGraph, METI/NASA, USGS, EPA, NPA, USDA, USFWS, City of Cambridge

PERSISTENT CHLOROPHYLL-A

- HIGH
- MEDIUM
- LOW

- Waste Water Treatment Sites
- Public Access Sites

Social Vulnerability & Public Fishing and Swimming

Fishing Poles on the Chesapeake Bay
Image Credit: Simone Schneider

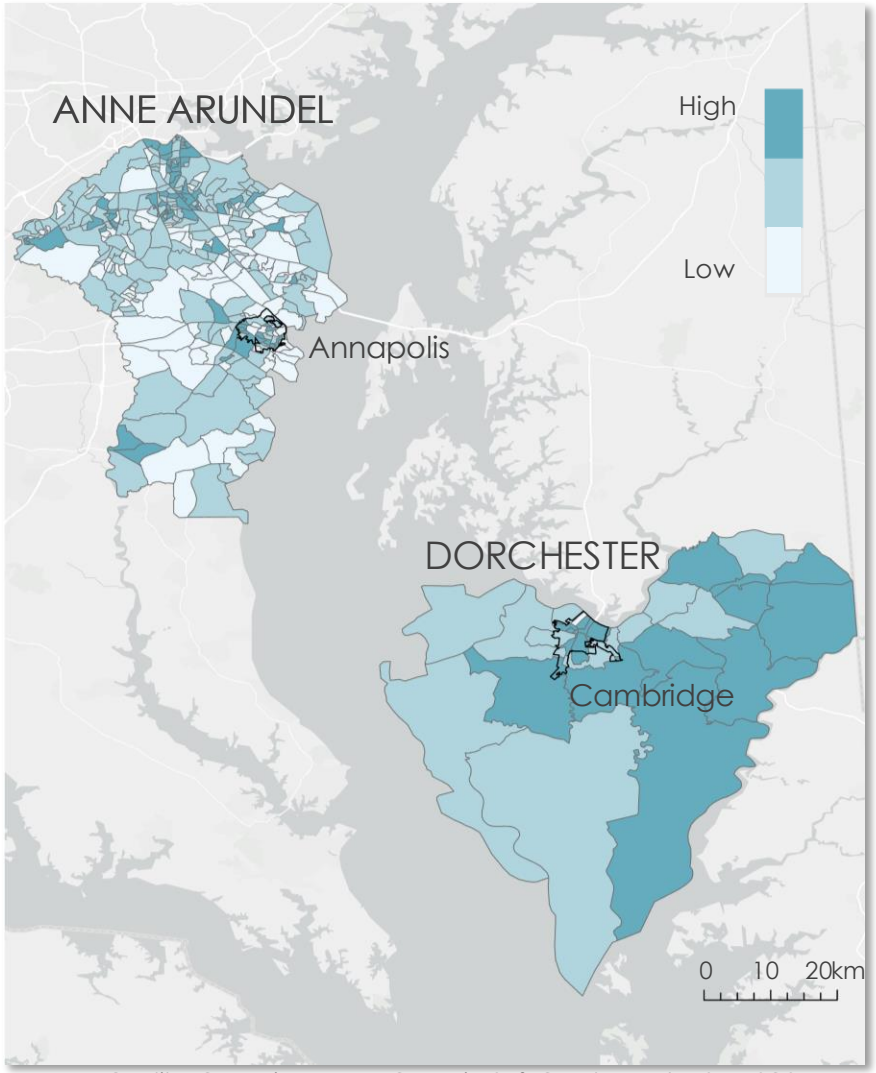
Social Vulnerability Index

- People of Color
- Low Income
- Unemployment
- Limited English
- Age < 5
- Age > 64
- < High School Education
- Disability

Data: EPA EJ Screen Tool from US Census 2018 – 2022

Geometry: Block group level

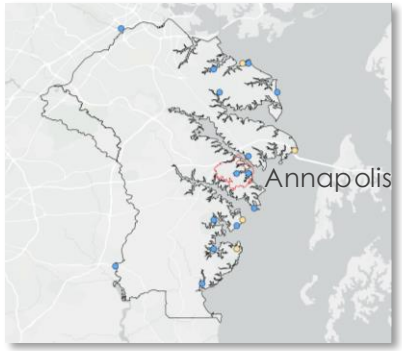
Social Vulnerability Index (SVI)



Basemap Credit: VGIN, Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPA, USDA, USFWS, County of Anne Arundel

Public Swimming & Fishing Access

Anne Arundel County



Data: Chesapeake Progress

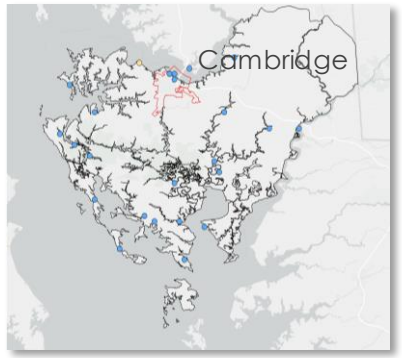
Geometry: Block group level

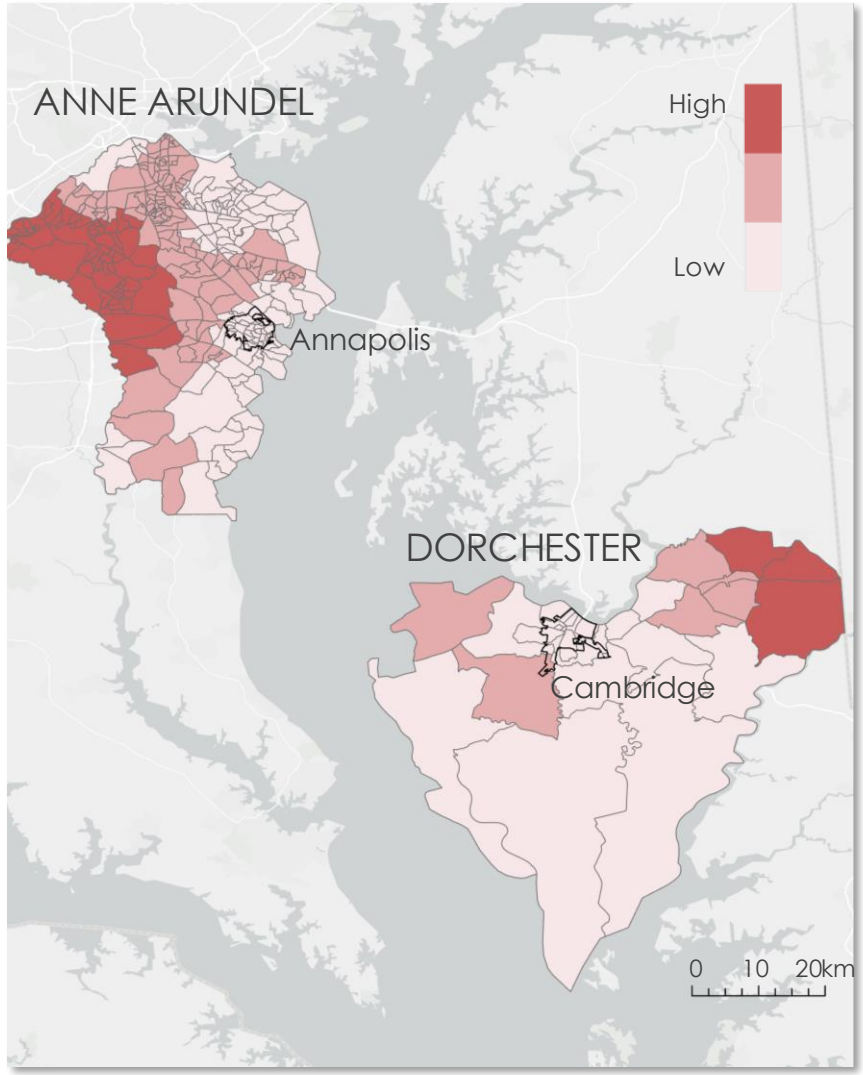
Public Swimming

Public Fishing

Distance to Recreational Site

Dorchester County

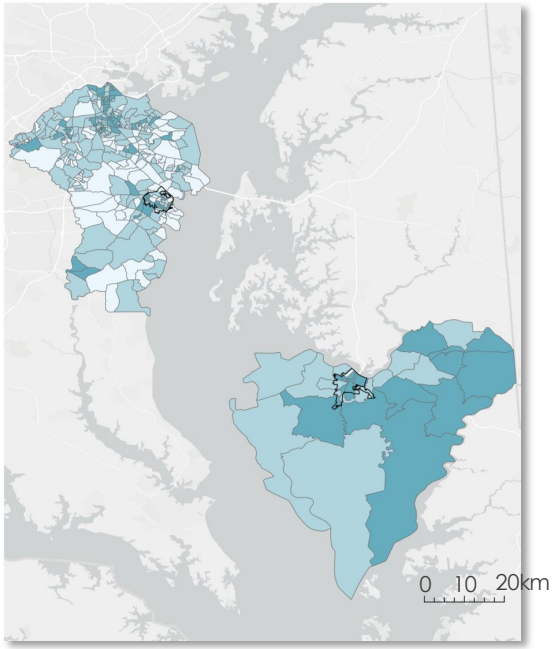




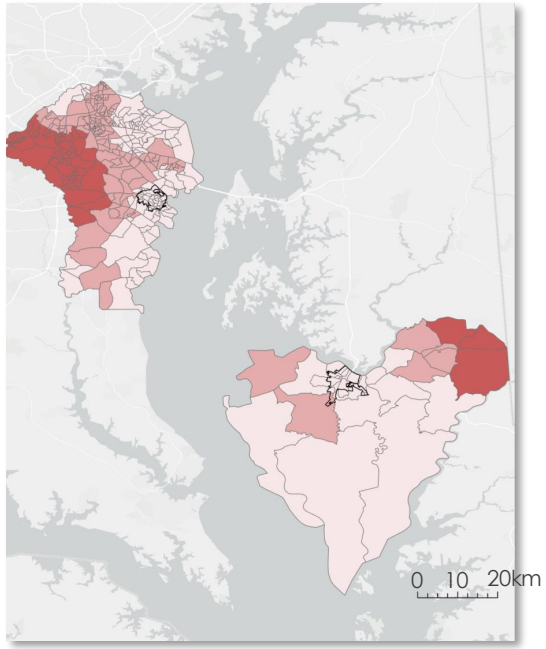
Basemap Credit: VGIN, Esri, TomTom, Garamin, SafeGraph, METI/NASA, USGS, EPA, NPA, USDA, USFWS, County of Anne Arundel

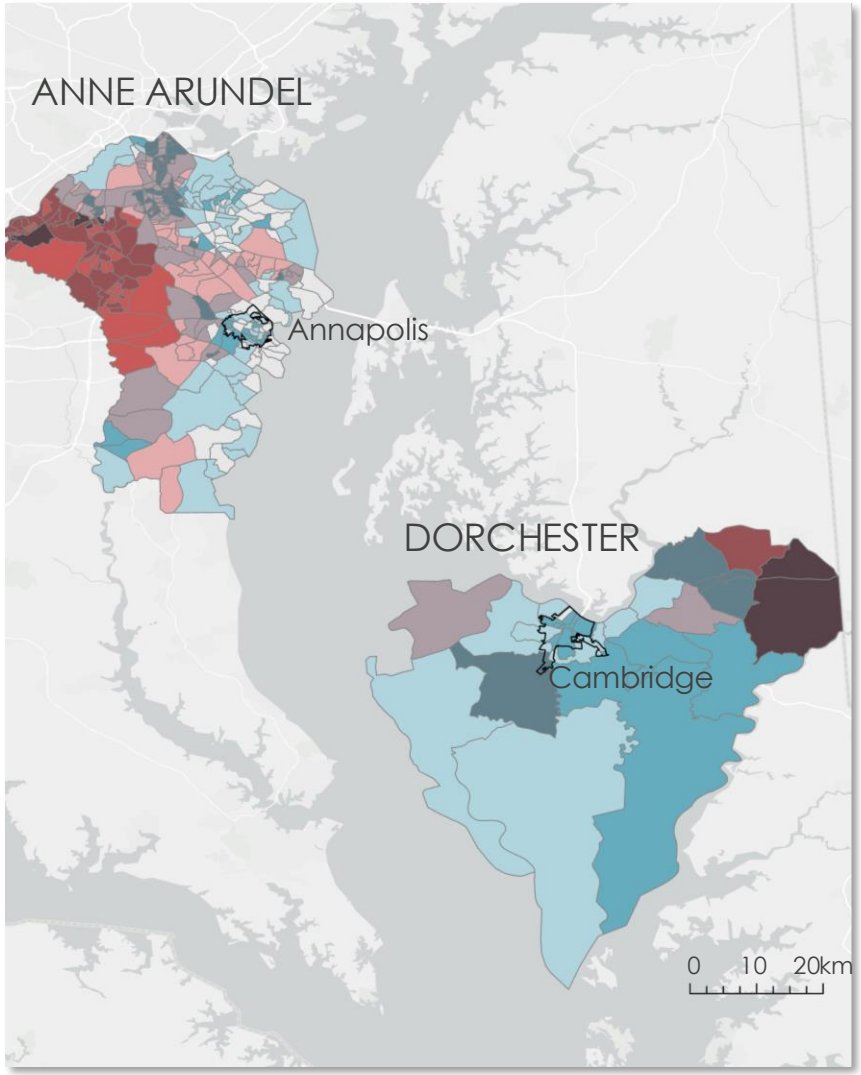
SVI & Recreational Access Bivariate

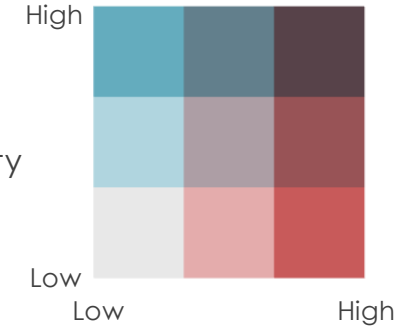
Social Vulnerability



Distance to Recreation Site







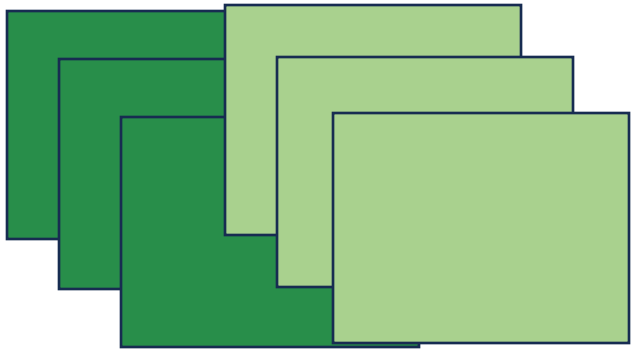
Basemap Credit: VGIN, Esri, TomTom, Garamin, SafeGraph, METI/NASA, USGS, EPA, NPA, USDA, USFWS, County of Anne Arundel

Uncertainties

Coarseness of Spatial Resolution

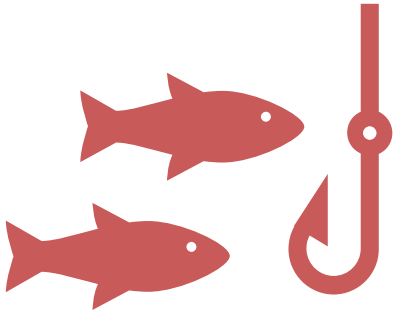
Credit: NASA Earth Observatory

15 Day Mean Composites



Lack of Co-location of Monitoring and Recreation Sites

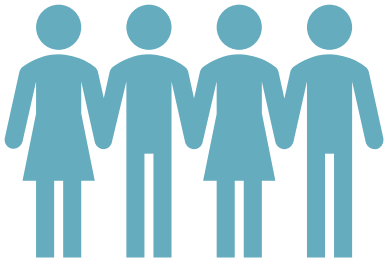
Conclusions



Downward trend in chlorophyll-a over the past 5 years

Lack of turbidity monitoring data

Sustained algal blooms occurred at numerous sites in both counties



No significant relationship between SVI and access sites

Feasibility Assessment

- Evaluate chlorophyll-a and turbidity, comparing results to in situ data
- Map areas with persistent chlorophyll-a levels exceeding harmful thresholding levels
- Identify communities with high social vulnerability and low access to recreational fishing and swimming locations

Fishing Boat on the Chesapeake Bay
Image Credit: Blacks of the Chesapeake Foundation

Partner Implementation

- Distribute Information
- Direct Resources
- Work with Stakeholders
- Empower Youth

Vince Leggett, Founder of Blacks of the Chesapeake Foundation
Image Credit: Simone Schneider

Acknowledgments

Blacks of the Chesapeake Foundation
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Ocean Conservancy
Aspen Bataille, Henry Huntington, Mikayla Spencer

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Marisa Smedsrud – Geoinformatics & Project Coordination Fellow

Sean McCartney – Science Advisor

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