Developing a Machine-Learning Model Using Landsat 8 to Monitor Seagrass Area and Density in the Chesapeake Bay

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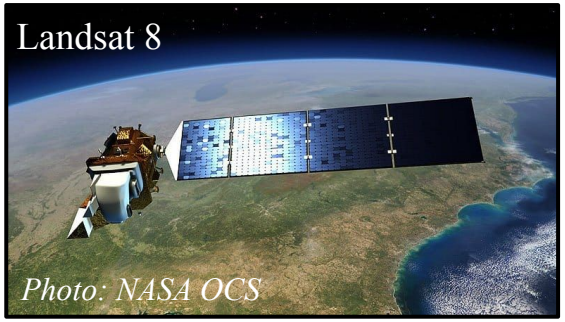
Objectives

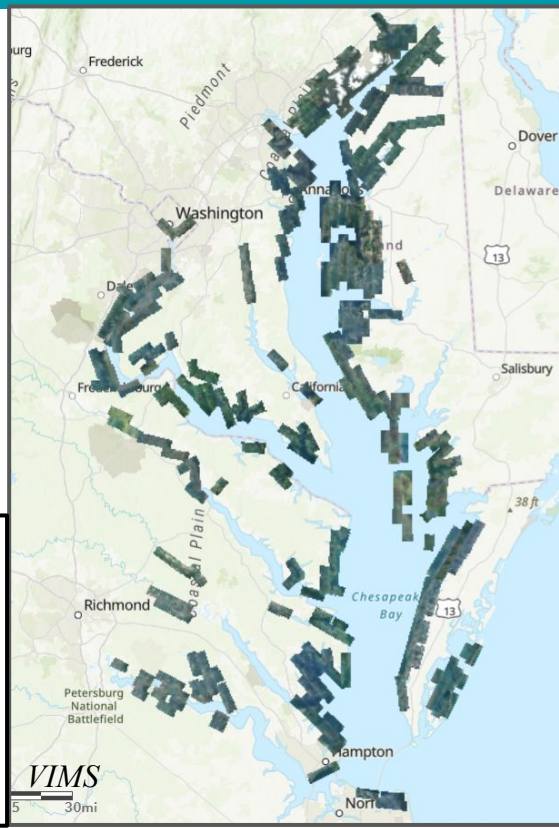
- Create a training dataset matching in-situ data of submerged aquatic vegetation (SAV) density, area, and observation dates with Landsat 8 imagery.
- Using the dataset, train a machine-learning model to monitor the area of SAV in the Chesapeake Bay.

Background information



Virginia Institute of Marine Science (VIMS)

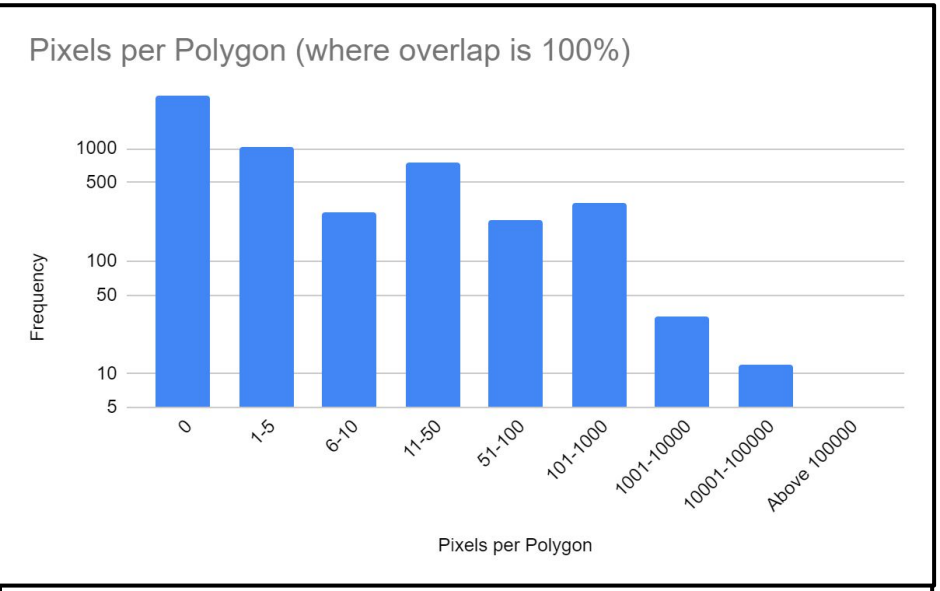
- Annual observations since 1984
- Aerial flights
- Becoming expensive to conduct surveys



SAV imagery from VIMS field survey flights. Each rectangle is a single flight (2019).

Data and Methods

Python (GeoPandas, Pandas, numpy, Shapely.geometry) used for in-situ data formatting and **Google Earth Engine** used for satellite data extraction



- The number of pixels that can fit in each SAV polygon, and the number of polygons of that area (2019 data)
- Extremely right-tailed
- 70.9% of polygons fit fewer than five pixels

SAV Density	Number of Pixels	
	2018	2019
No SAV	89669	56120
0-10% cover	6795	8817
10-40% cover	30295	28457
40-70% cover	97731	54683
70-100% cover	225421	130999

- Number of SAV pixels plus sampled non-SAV pixels
- Drop in higher density pixels
- Slight increase in lower density pixels.

SAV dataset after Landsat-8 imagery matchup using GEE (July 28, 2019)

	DENSITY	SHAPEID	pixelX	pixelY	BEDID	Date	Flight ID	B1	B2	B3	B4	B5	B6	B7	LANDSAT_PRODUCT_ID
0	3	2989	397337	4238605	AD	July 28, 2019	fl04_10_jul28_19_012320	0.1498	0.1273	0.1105	0.0780	0.0422	0.0164	0.0110	LC08_L1TP_0140…
1	3	2989	397337	4238635	AD	July 28, 2019	fl04_10_jul28_19_012320	0.1501	0.1272	0.1105	0.0779	0.0413	0.0158	0.0106	LC08_L1TP_0140…
2	3	2989	397337	4238665	AD	July 28, 2019	fl04_10_jul28_19_012320	0.1503	0.1279	0.1121	0.0795	0.0414	0.0162	0.0106	LC08_L1TP_0140…
3	3	2989	397367	4238605	AD	July 28, 2019	fl04_10_jul28_19_012320	0.1497	0.1273	0.1106	0.0779	0.0415	0.0160	0.0107	LC08_L1TP_0140…

- 120455 total rows for July 28, 2019
- Field survey data gathered over seven unique flight dates in 2019

Future Work and Conclusions

Plan for this Project

- Test two different machine learning models
- Evaluate the effectiveness of each
- Use model on current satellite imagery

Future Potential

- Sentinel-2
- Model additional metrics for seagrass
  - Species cover
  - Carbon sequestering

Summary

- Used VIMS data with SAV polygons and their densities and area
- Matched the data with flight dates
- Colocated the data with Landsat 8 satellite imagery
- Will test two models and evaluate effectiveness
- Will apply the more effective model to real-time imagery