Mapping aquatic classes in coastal regions of Mozambique, Senegal, and Liberia

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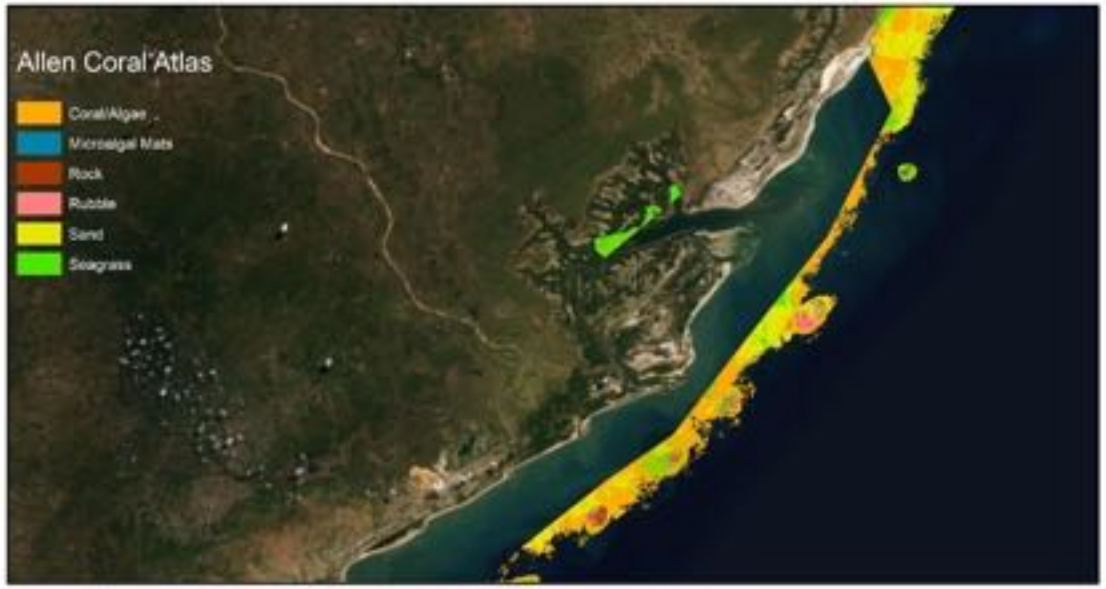
Background

- Aquatic natural capital accounts have lagged behind terrestrial accounts
    - Aquatic remote sensing challenges
    - Differences between terrestrial and aquatic remote sensing products
- Key services are identified, including fisheries, transportation, and recreation
    - Marine classes are often represented by a single class[1]
- Inclusion of seagrass, coral, and substrate is possible with Allen Coral Atlas or national mapping efforts.
- However, these products are lacking in many of our areas of interest



[1]Molnar, M., M. Kocian, and D. Batker. 2012. Valuing the aquatic benefits of British Columbia’s Lower Mainland: nearshore natural capital valuation. David Suzuki Foundation and Earth Economics, Vancouver, British Columbia, Canada.

Methodology – IceSAT-2 derived bathymetry

C-SHELPh – select the bathymetry training data in a semi-automated fashion[2] (https://github.com/nmt28/C-SHELPh)

Extract optical data to training points

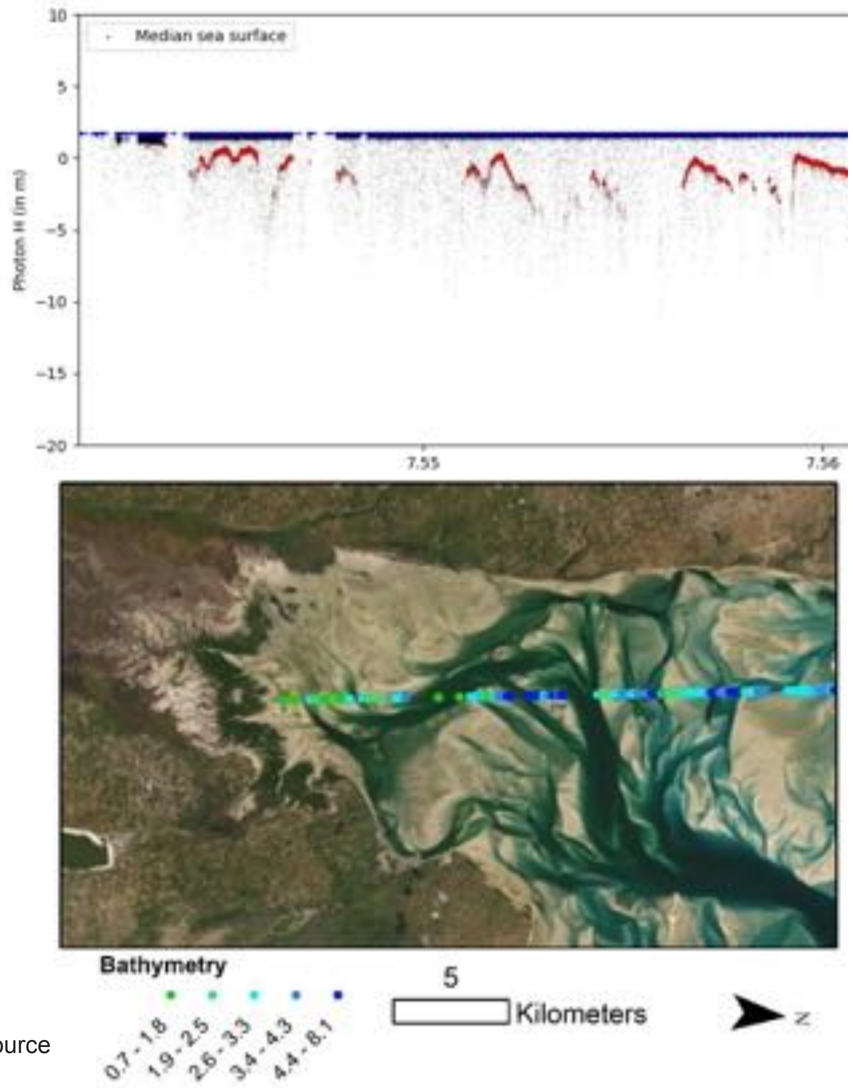
Machine learning regression model (XGBoost)

Convert depth classes (0-4 m, 4-8 m, 8-12 m, and >12 m)

Morphological refinement and elimination of speckle

Validation

Class Conversion



[2]Thomas, N., Lee, B., Coutts, O., Bunting, P., Lagomasino, D. and Fatoyinbo, L., 2022. A purely spaceborne open source approach for regional bathymetry mapping. *IEEE Transactions on Geoscience and Remote Sensing*.

Training data

N =1186
Mean = 3.7 m
Min = 0 m
Max = 19 m
SD = 3.5

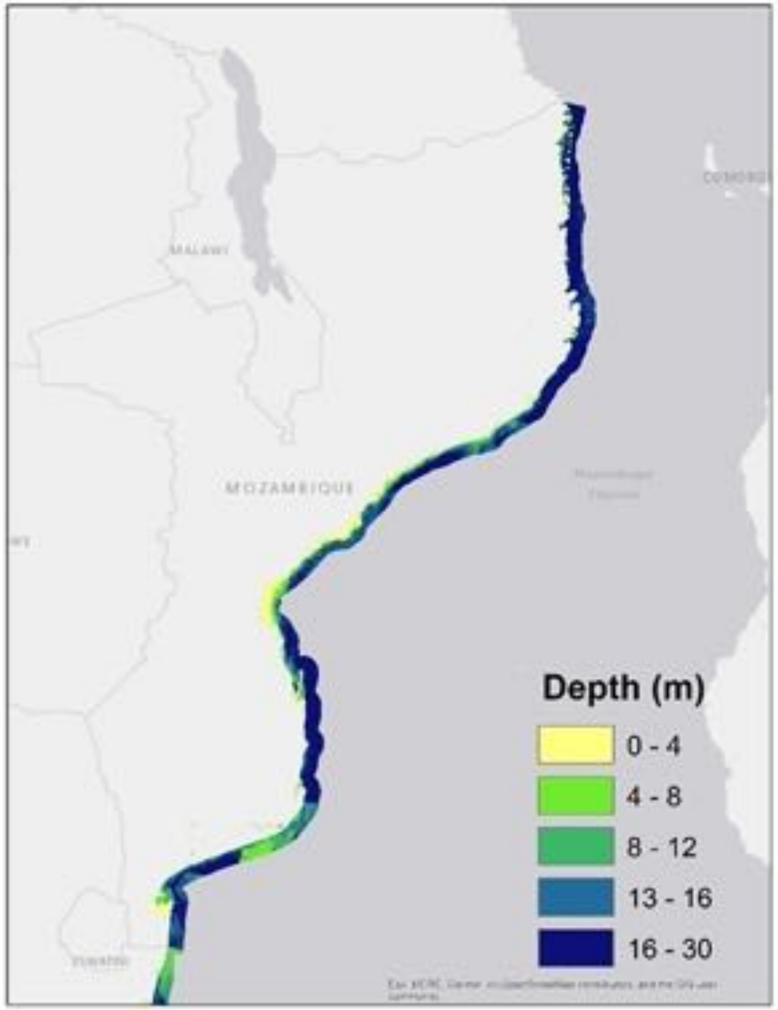
N =1510
Mean = 7.2 m
Min = 0.26 m
Max = 30 m
SD = 5.5 m

N =Landsat: 44,886
Mean = 2.7 m
Min = 0.74 m
Max = 31.5 m
SD = 2.5

Mozambique

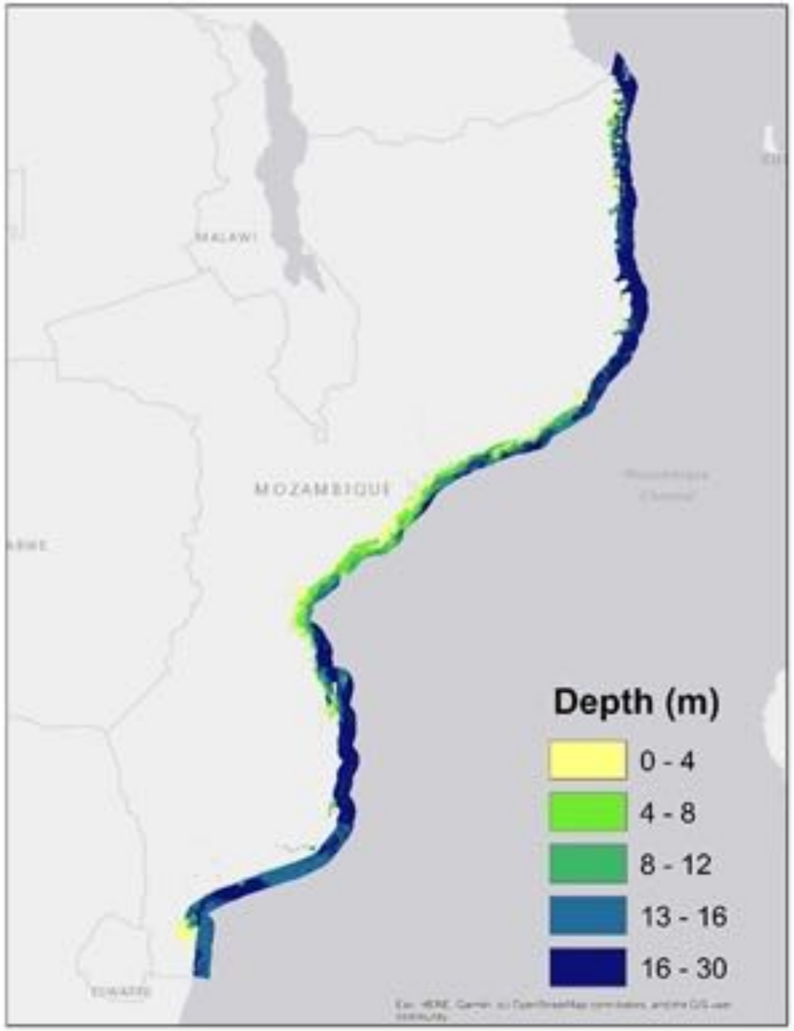
Landsat 9

RMSE:
South: 1.3 m
Mid: 0.98 m
North:1.4 m
37 scenes



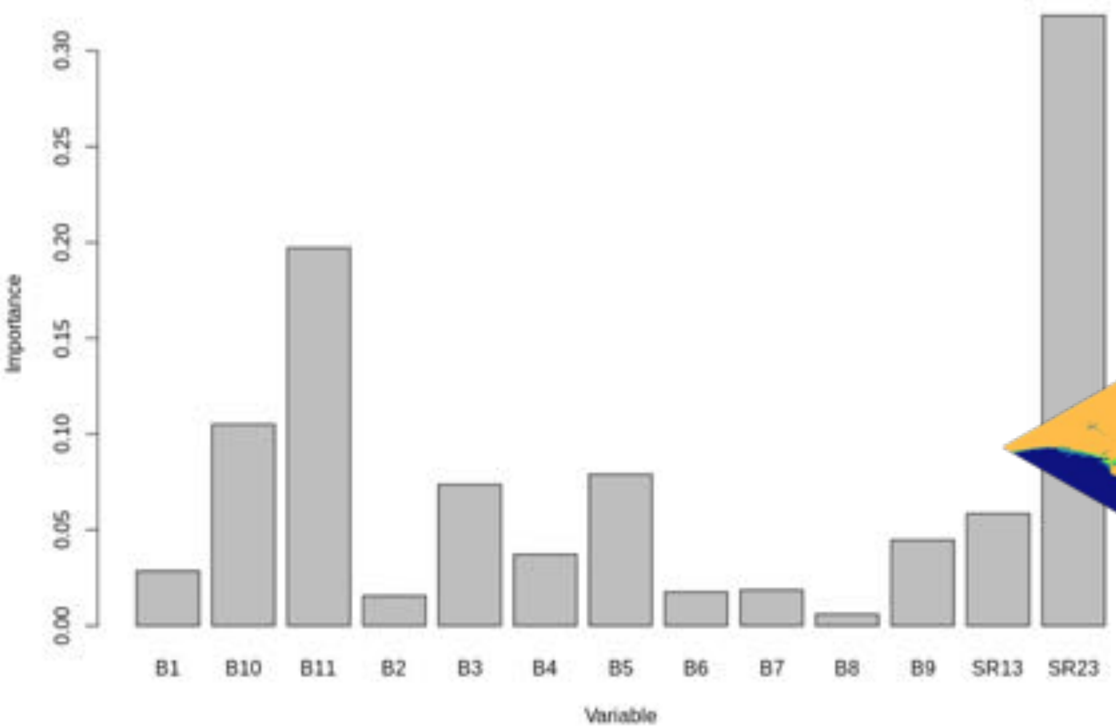
Landsat 8

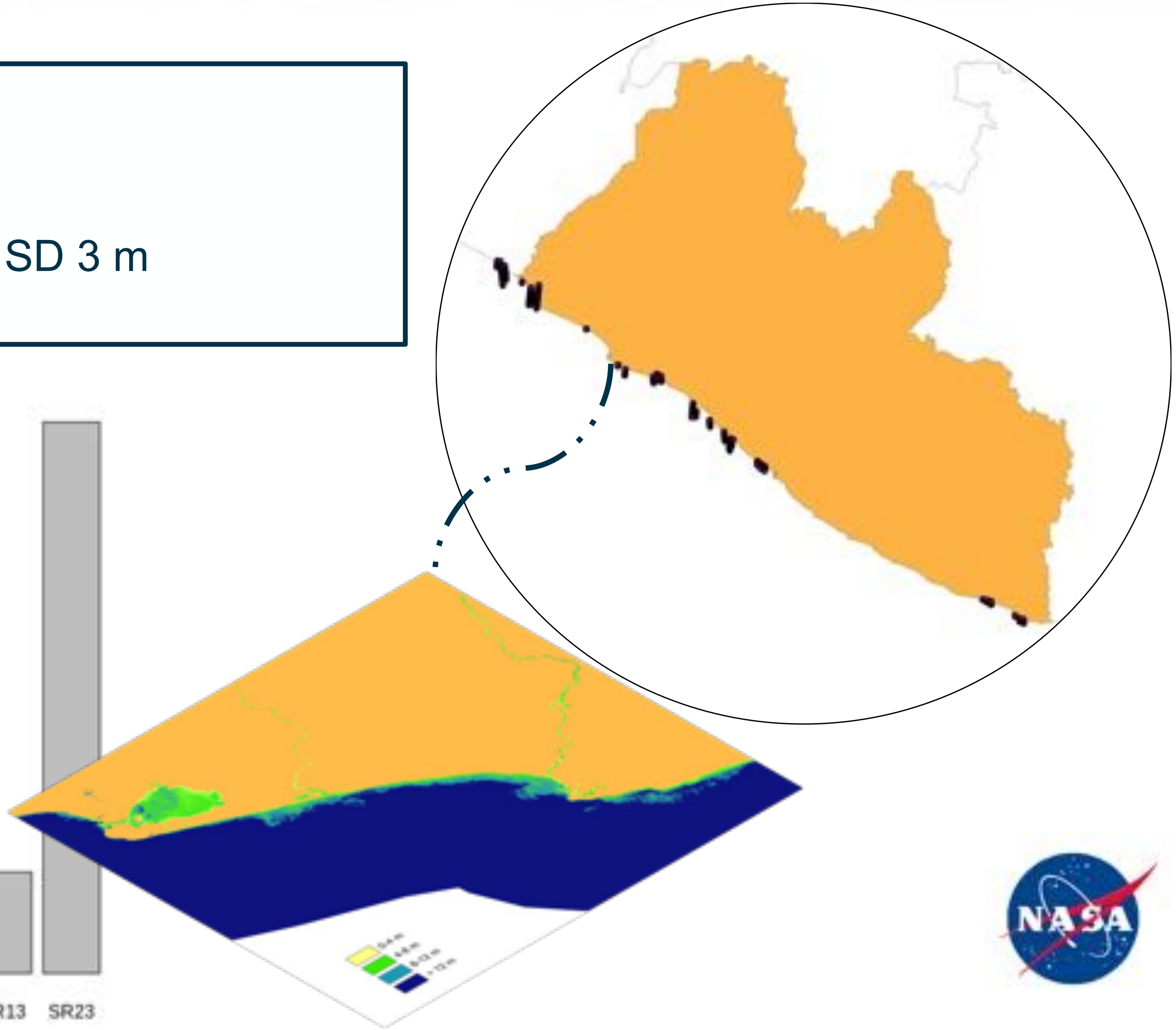
RMSE:
south: 1.40 m
mid: 0.93 m
north: 1.35 m
26 scenes



Liberia - Landsat 9

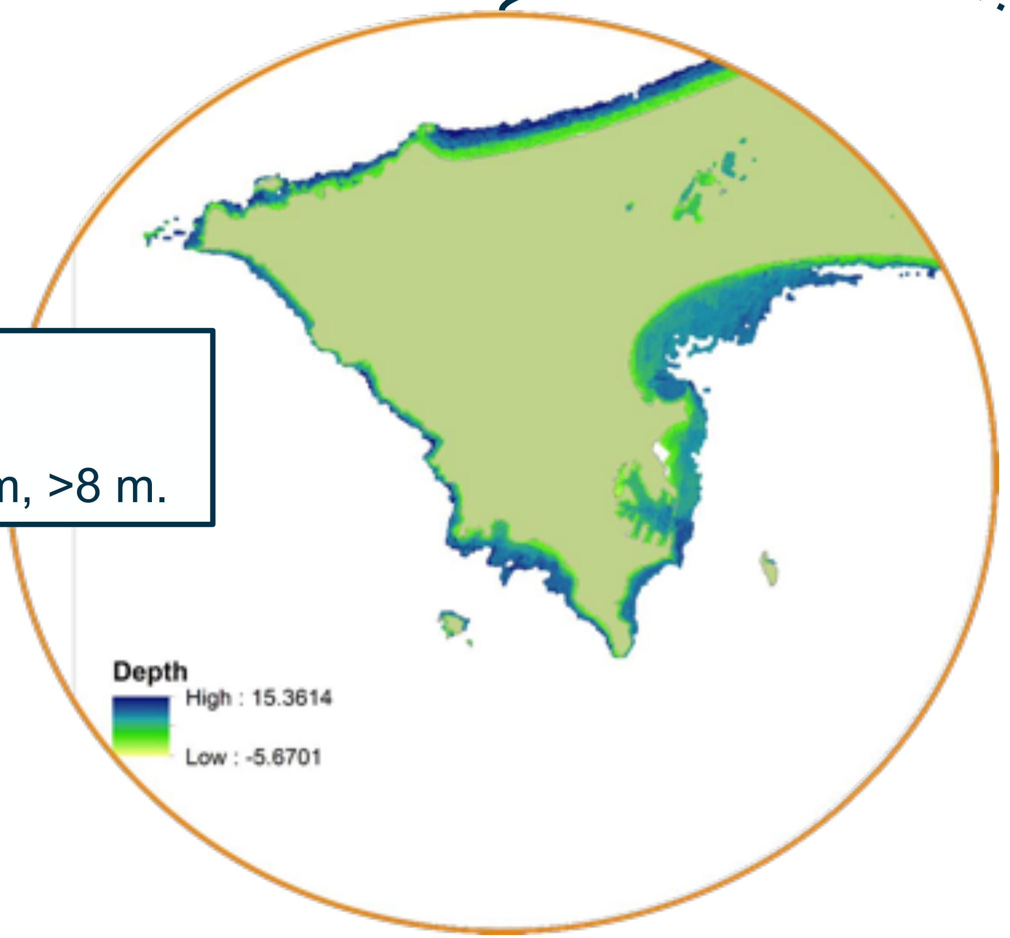
RMSE: 2.4
11 scenes
Classes: 0-4 m, 4-8 m, 8-12 m, >12 m
< 12 m (classes 1-3): Mean 7.9 m, Max 33 m, SD 3 m

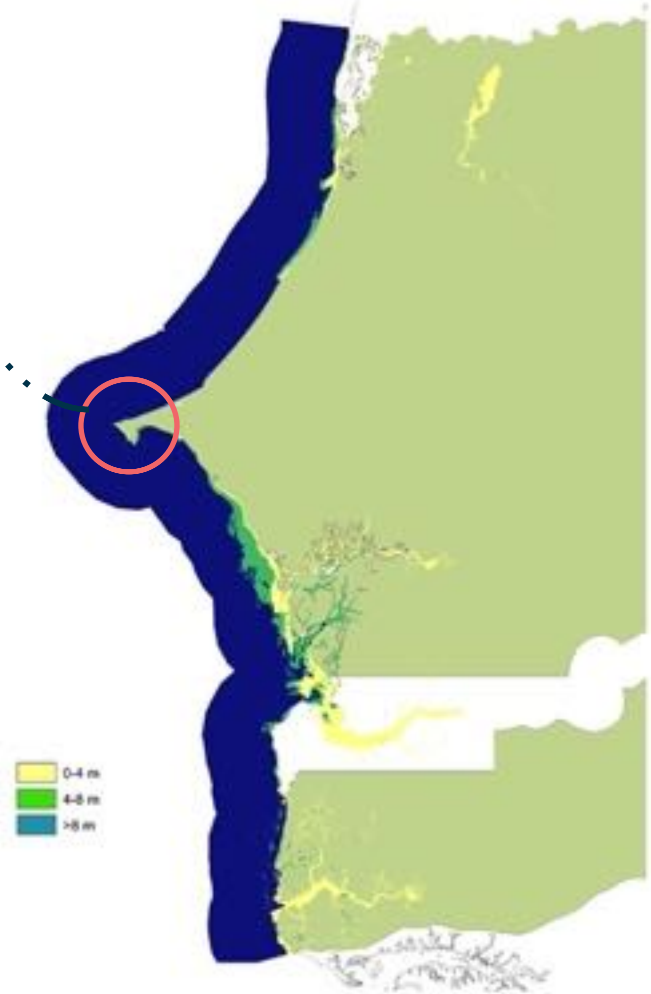




Senegal – Landsat 9

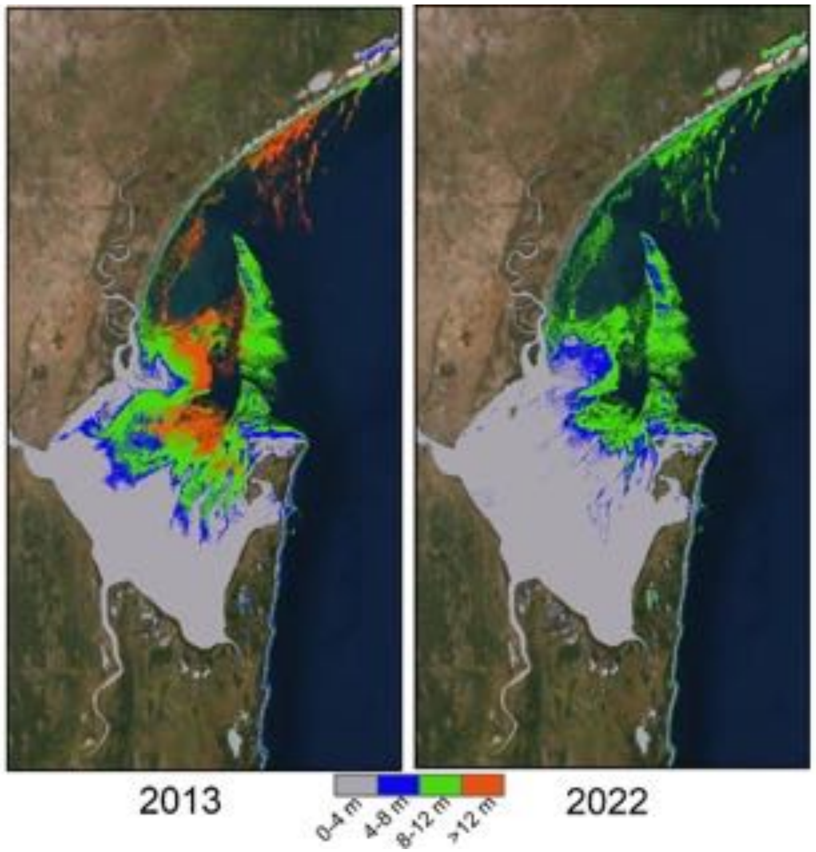
RMSE: 1.1 m
5 scenes
Classes: 0-4 m, 4-8 m, >8 m.





Temporal resolution - Mozambique

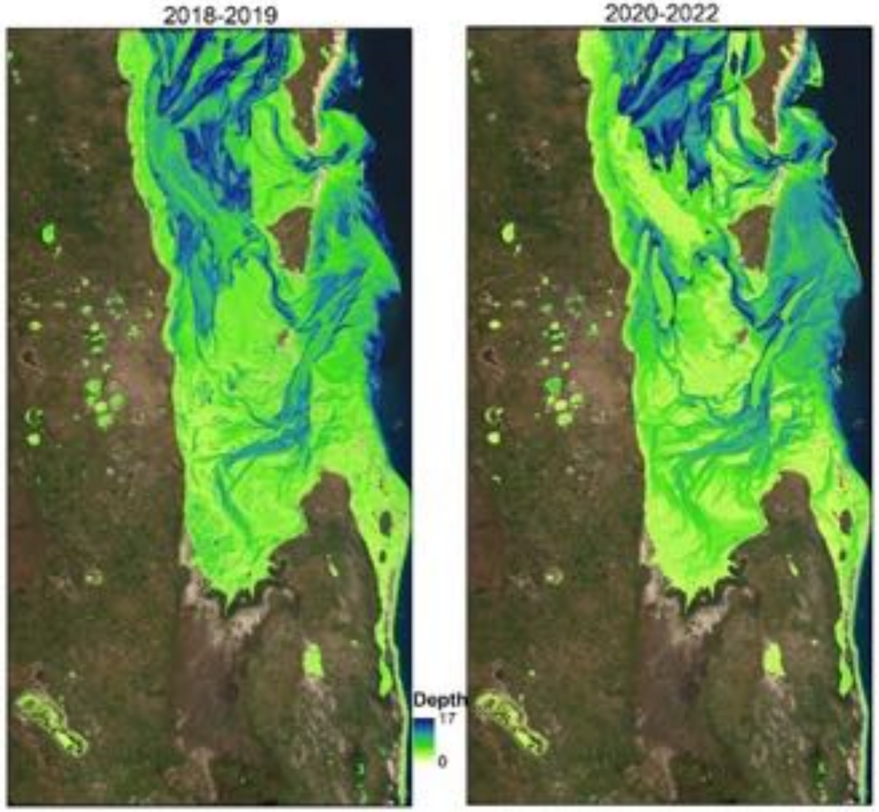
1. Trained model applied across time



2. Training data from t1 and t2

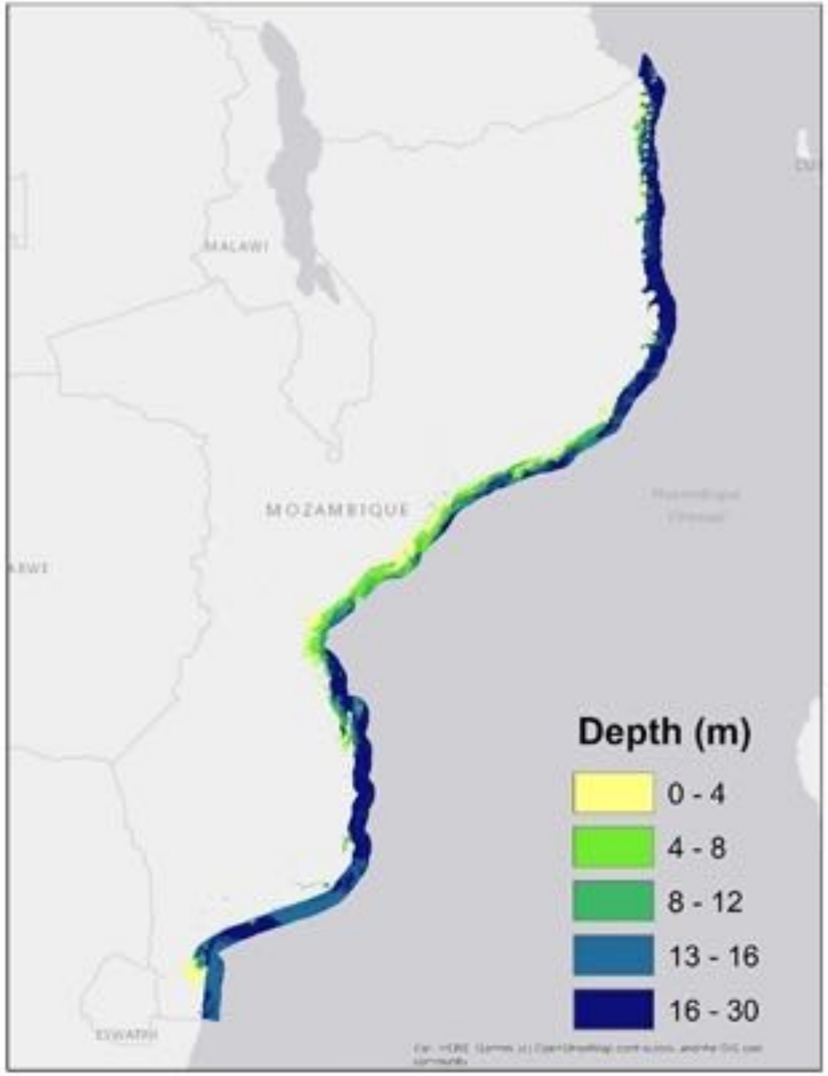
T1 RMSE: 1.0

T2 RMSE: 0.8



Future work and refinements

- Validation with existing products
- Bathymetry
    - Water Clarity/Quality – visibility, limiting productivity, check on depth information
    - Exposure intensity – sea surface anomalies and distance to high intensity regions
    - Distance from shoreline – gradients of productivity, estuaries, islands
- Towards classes representative of aquatic productivity gradients
- T1 to T2 comparison more feasible as additional IceSAT-2 data are collected coincident with high quality optical data.



EO challenges, opportunities and recommendations.

Challenges:

- Product accuracy limited by remote sensing data quality
- Validation

Opportunities

- Differentiate marine nearshore environments
- Expand the limited extent of existing products

Recommendations

- EO methods need to be applicable to a wide range of countries
- Representative of IUCN aquatic classes
- Potential to calculate a time 1 to time 2 comparison
  - Detect meaningful change