Using daily PlanetScope imagery to estimate seagrass density and blue carbon.

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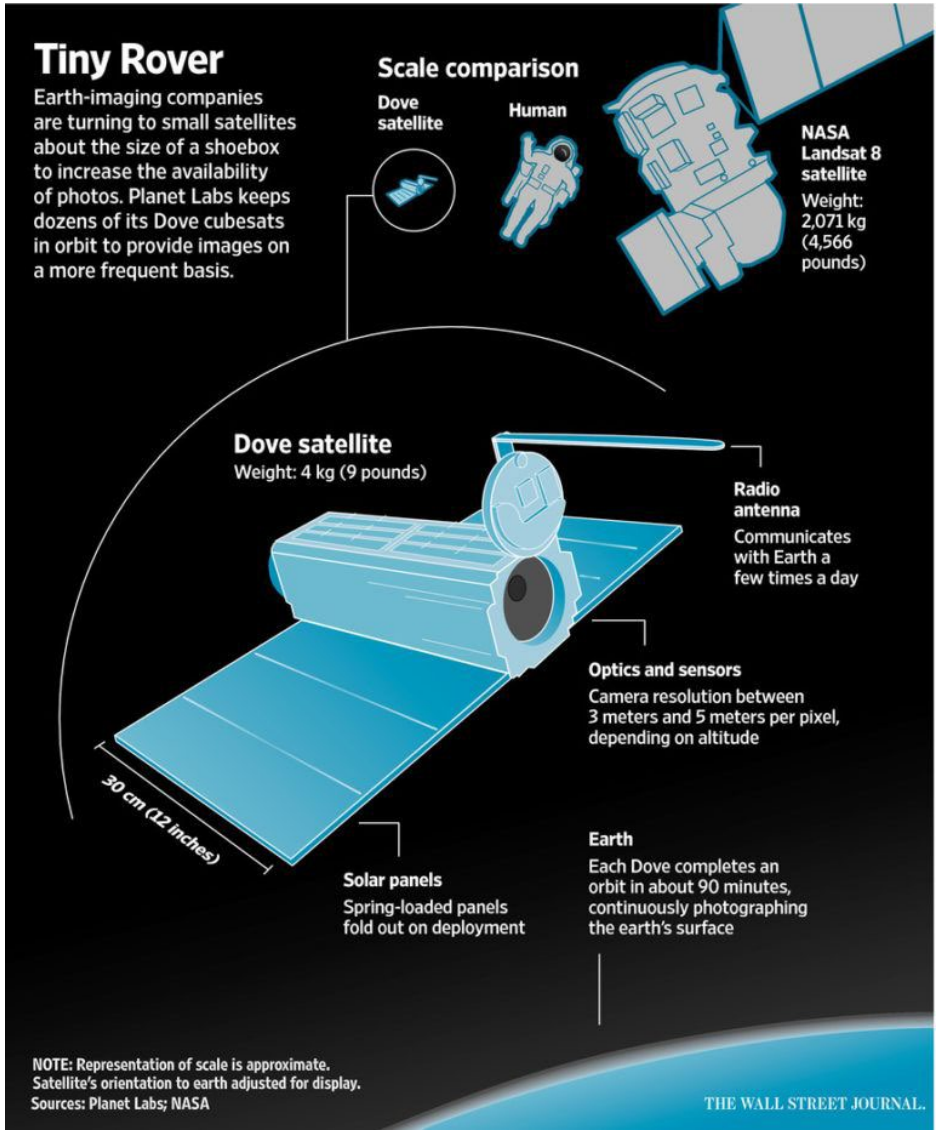
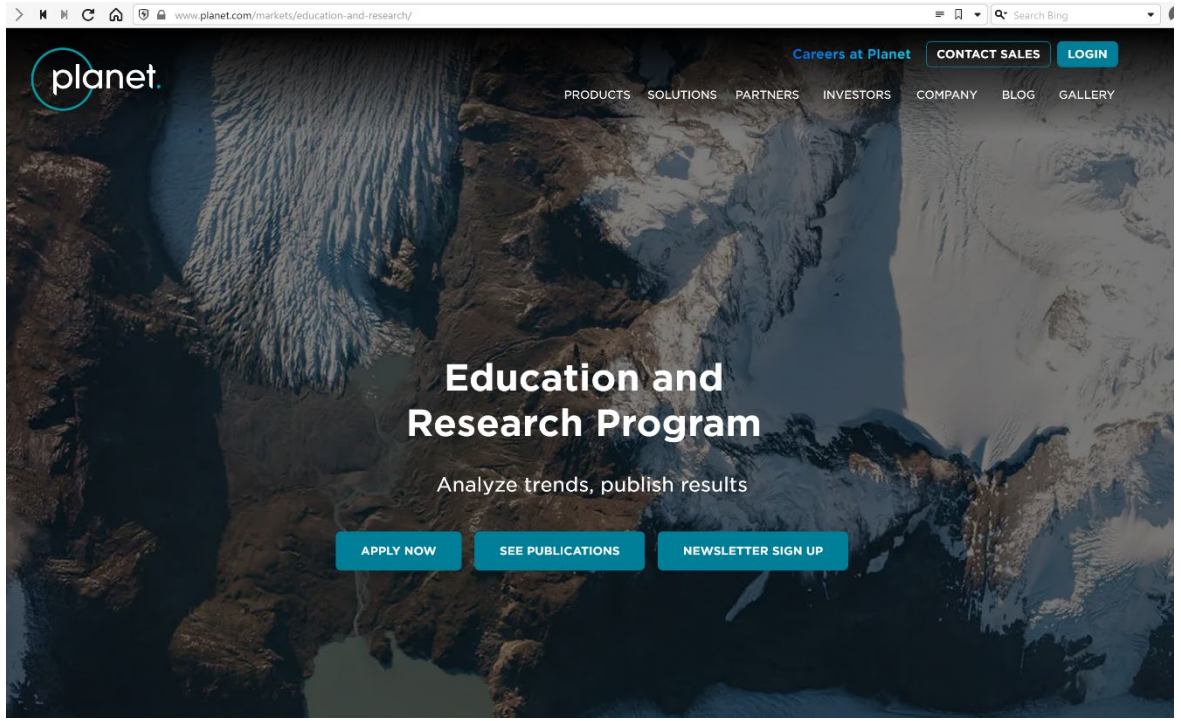
PlanetScope

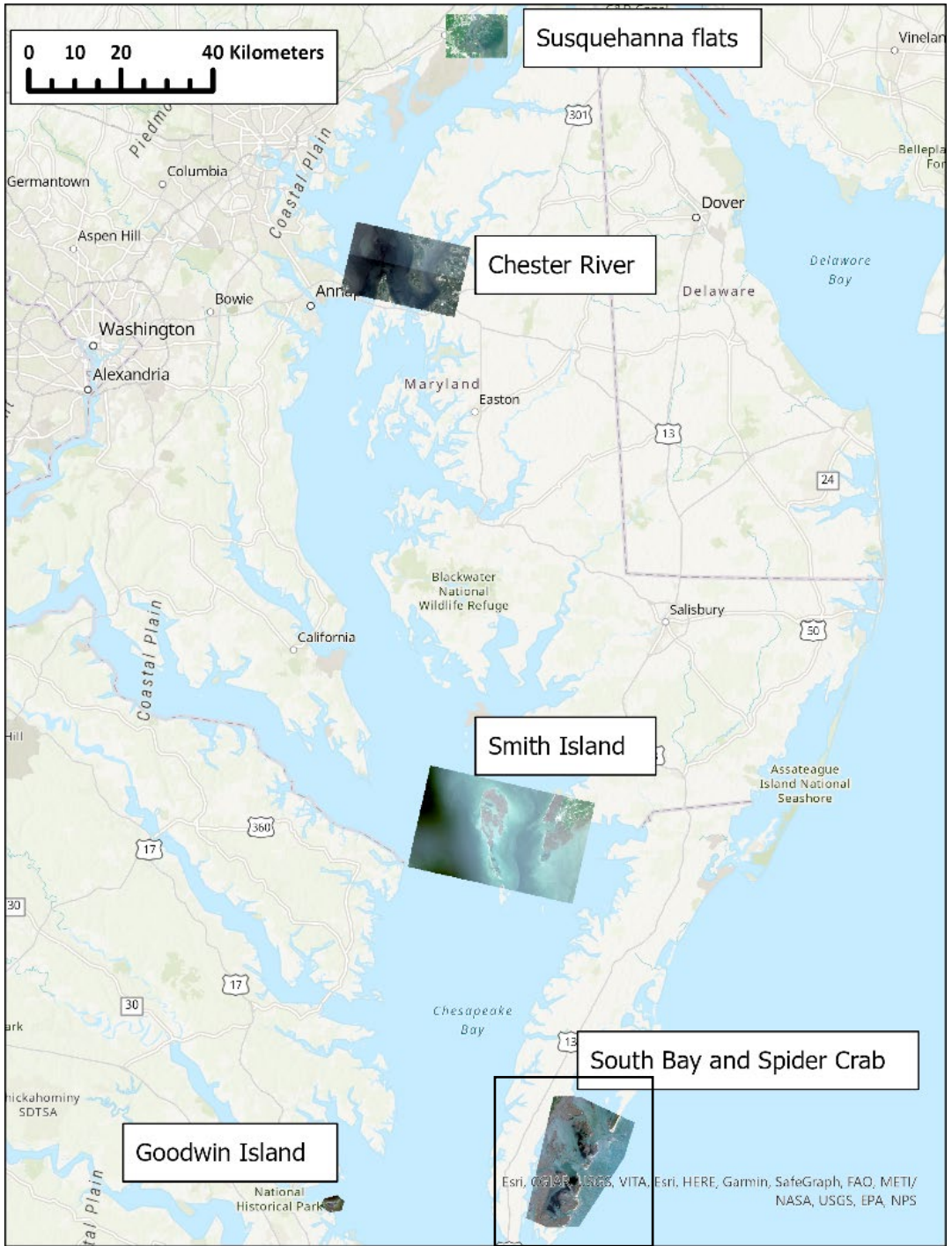


- Multispectral, high spatial resolution
  - 4 m - 3, 4 & 8 band multispectral
  - 1 m - multispectral (skysat)
  - Almost daily coverage (Over 100 satellites)



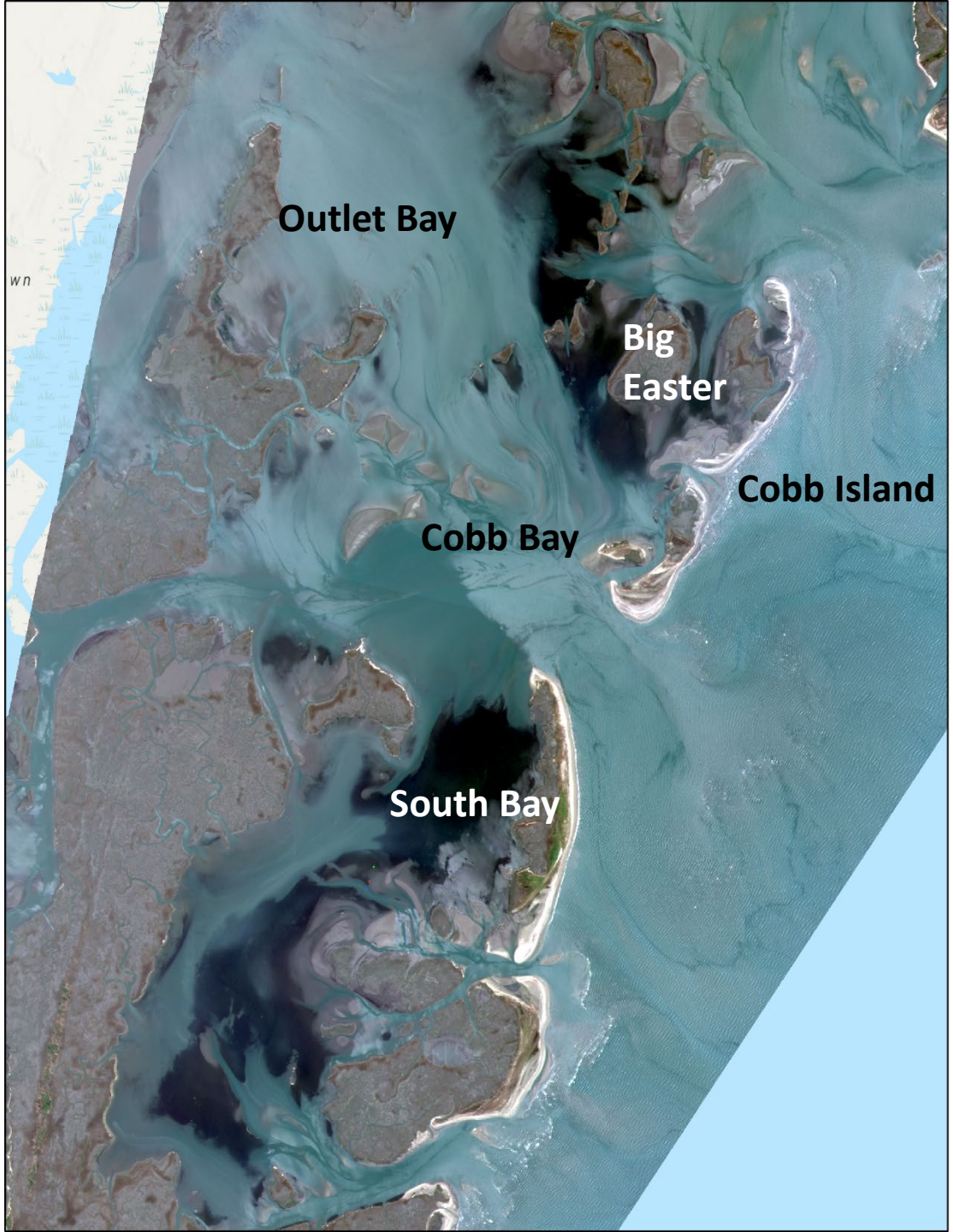
Chesapeake Bay sites of interest.

- 5 sites
- Ranging from saline to fresh

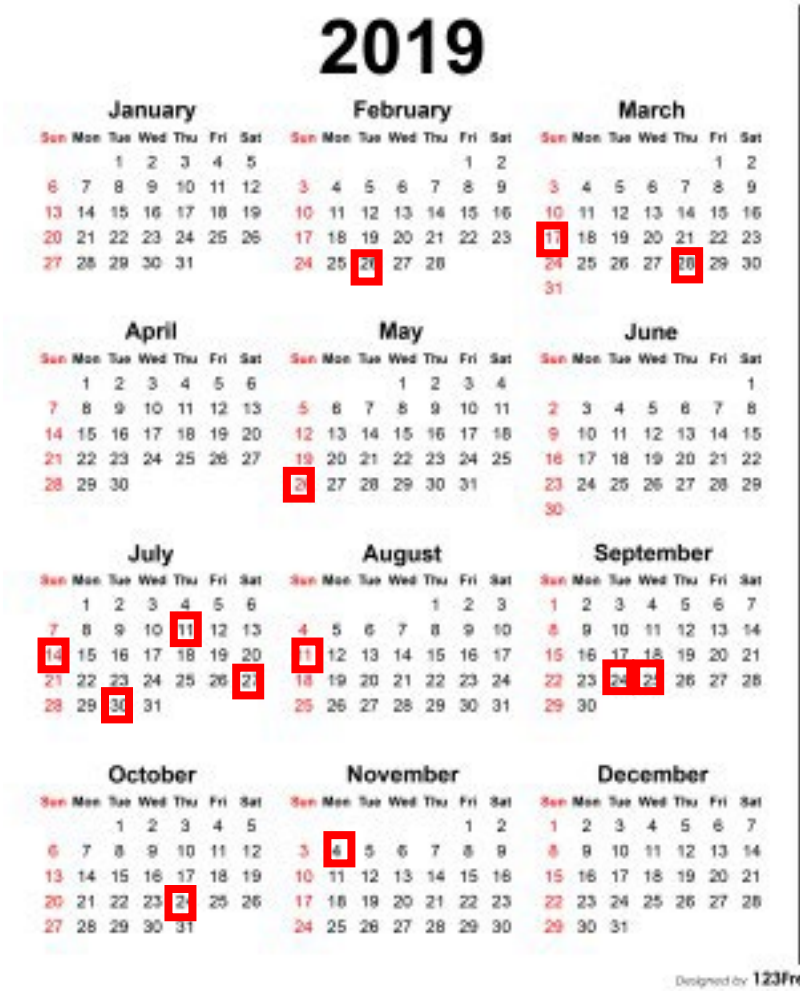


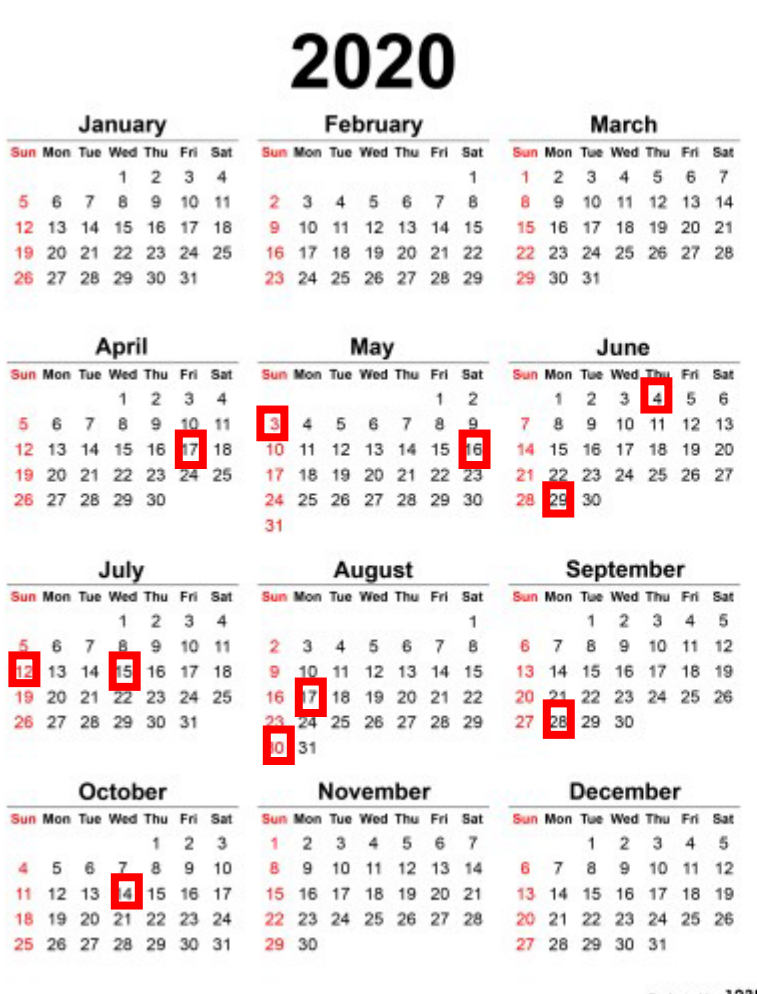
South Bay & Spider Crab

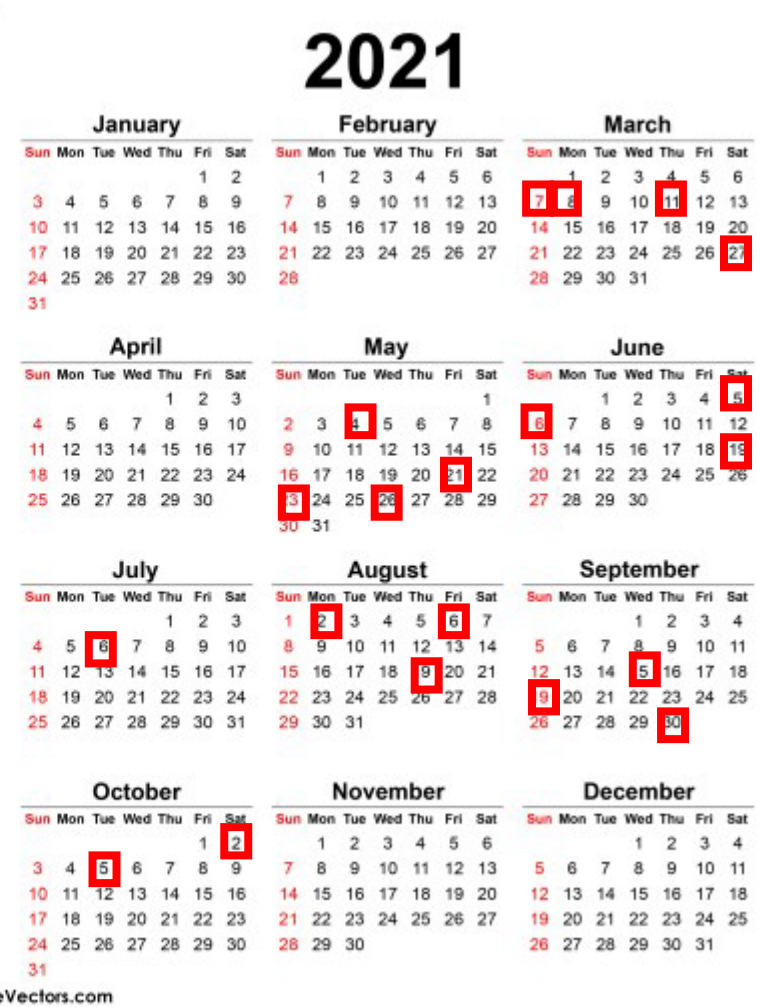
- Planet passes every day, often multiple passes from different sensors.
- Images good for seagrass identification.
  - Low tide
  - Low turbidity
  - Low cloud cover.



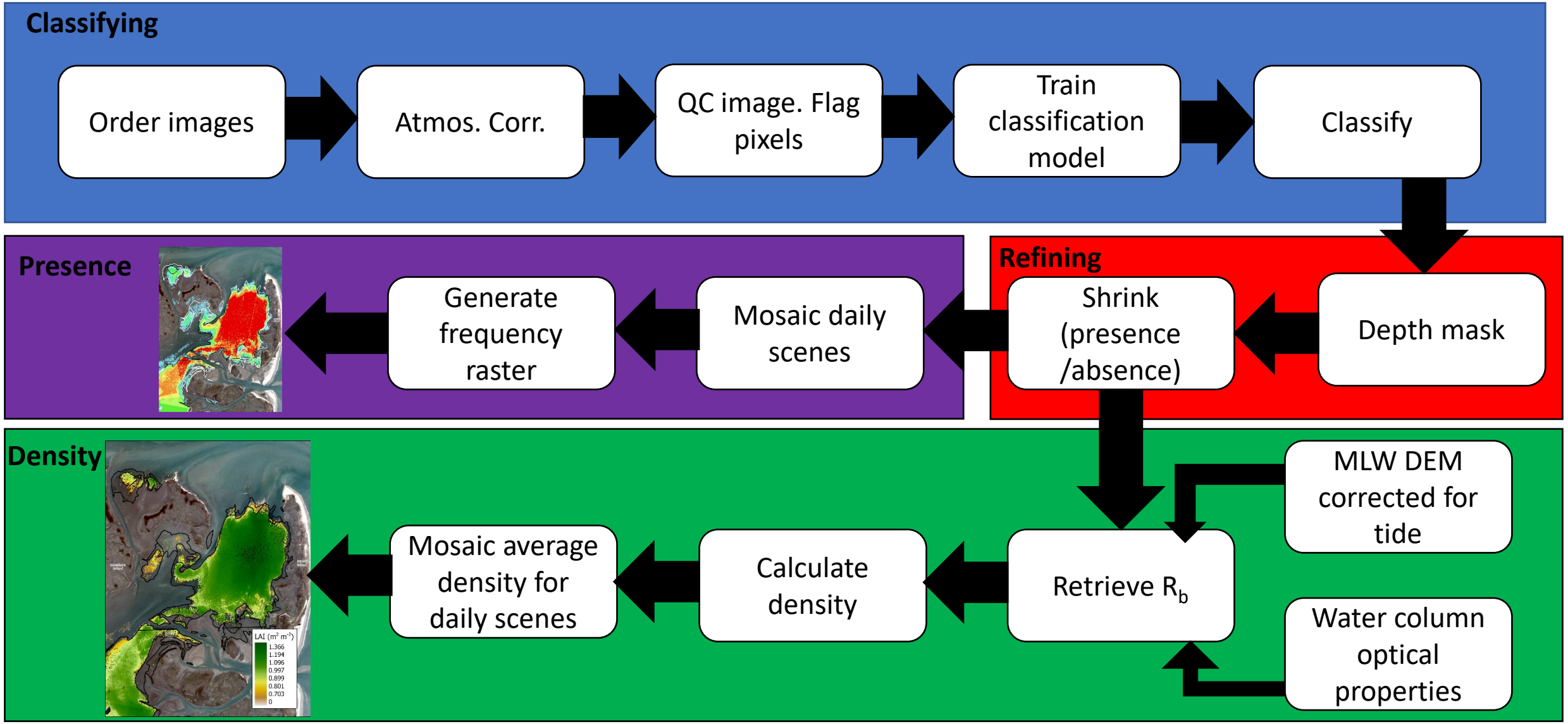
South Bay & Spider Crab



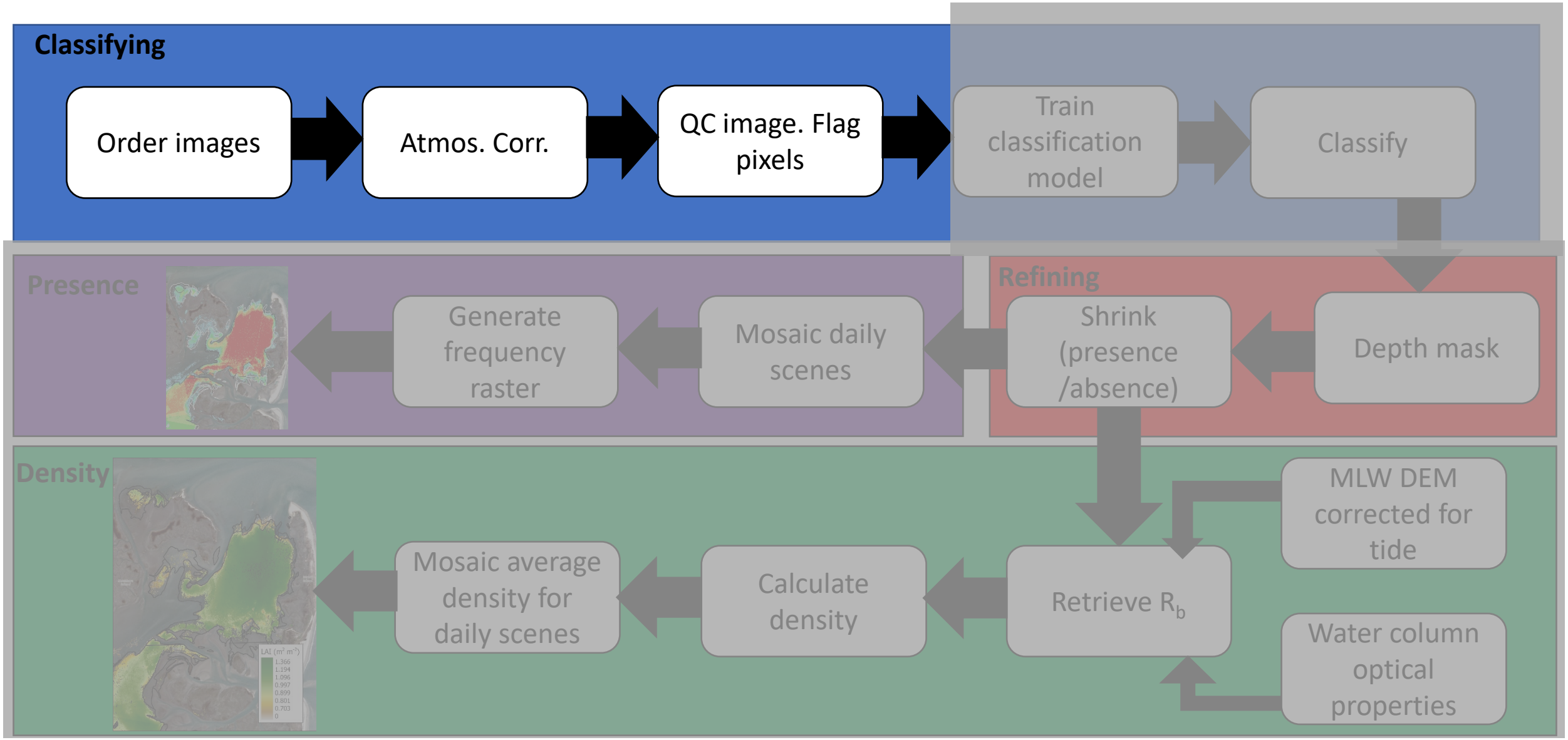




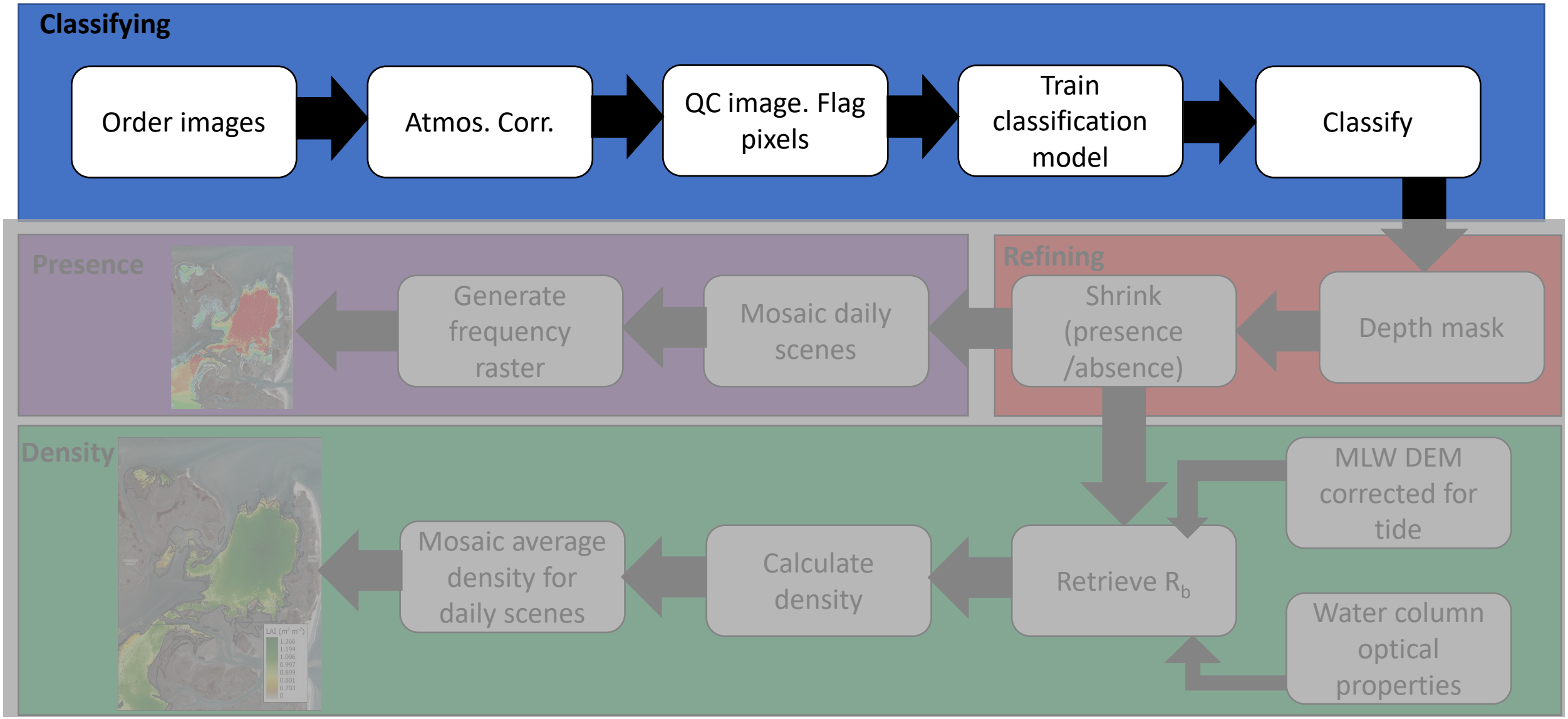
Processing workflow



Processing workflow

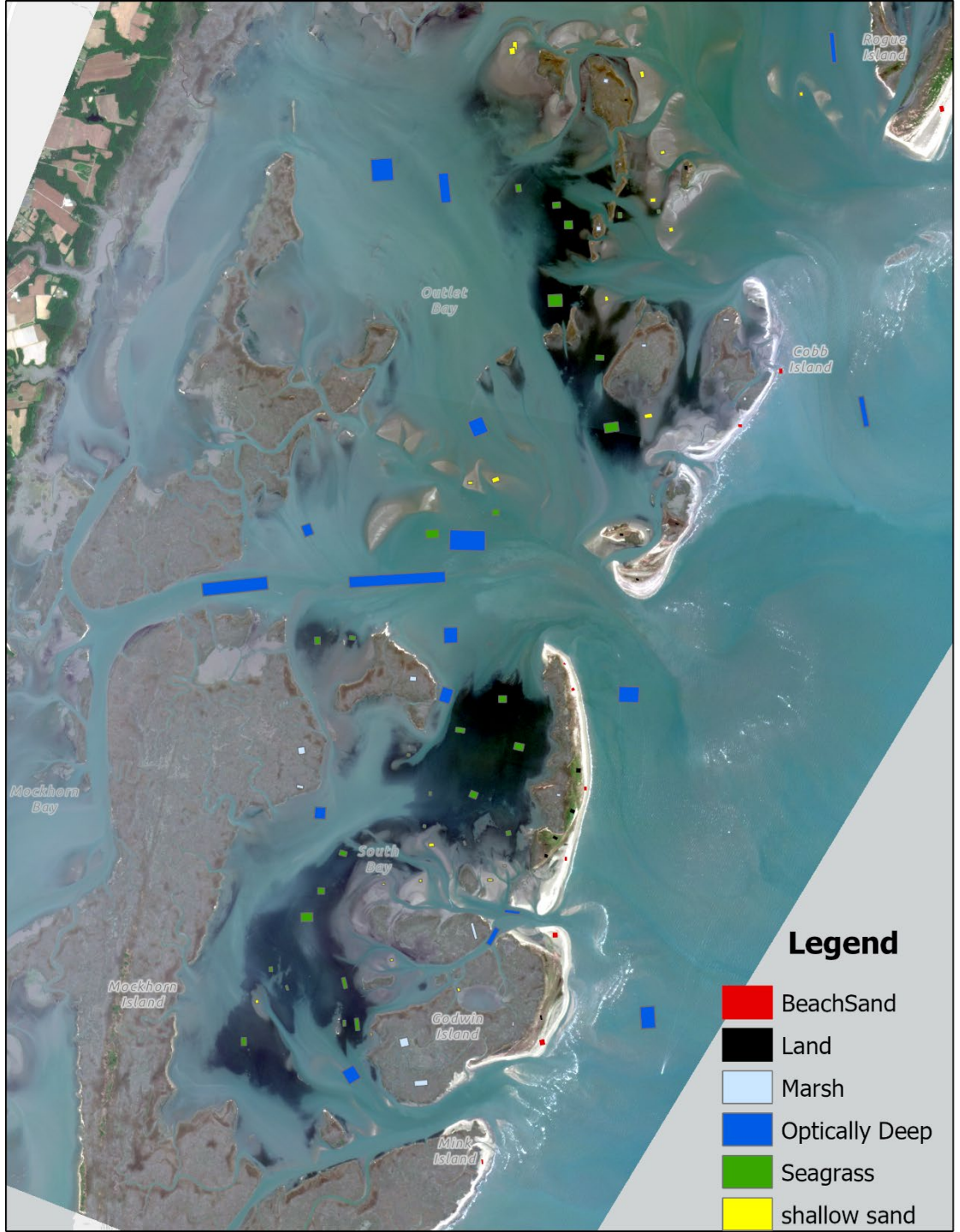


Processing workflow



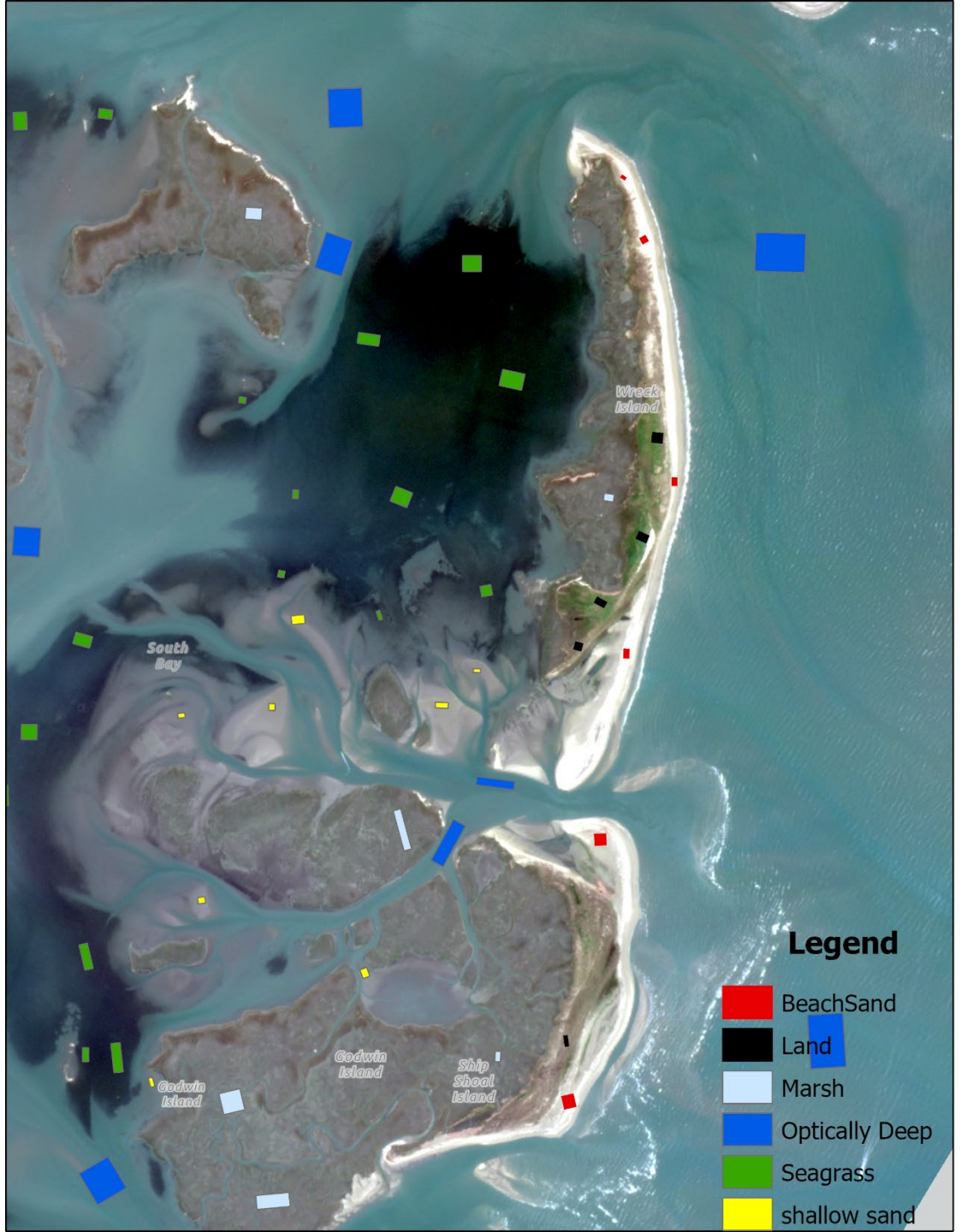
Classification

- Generate training patches for each target
  - Beach
  - Land
  - Marsh
  - Optically deep
  - Seagrass
  - Shallow sand

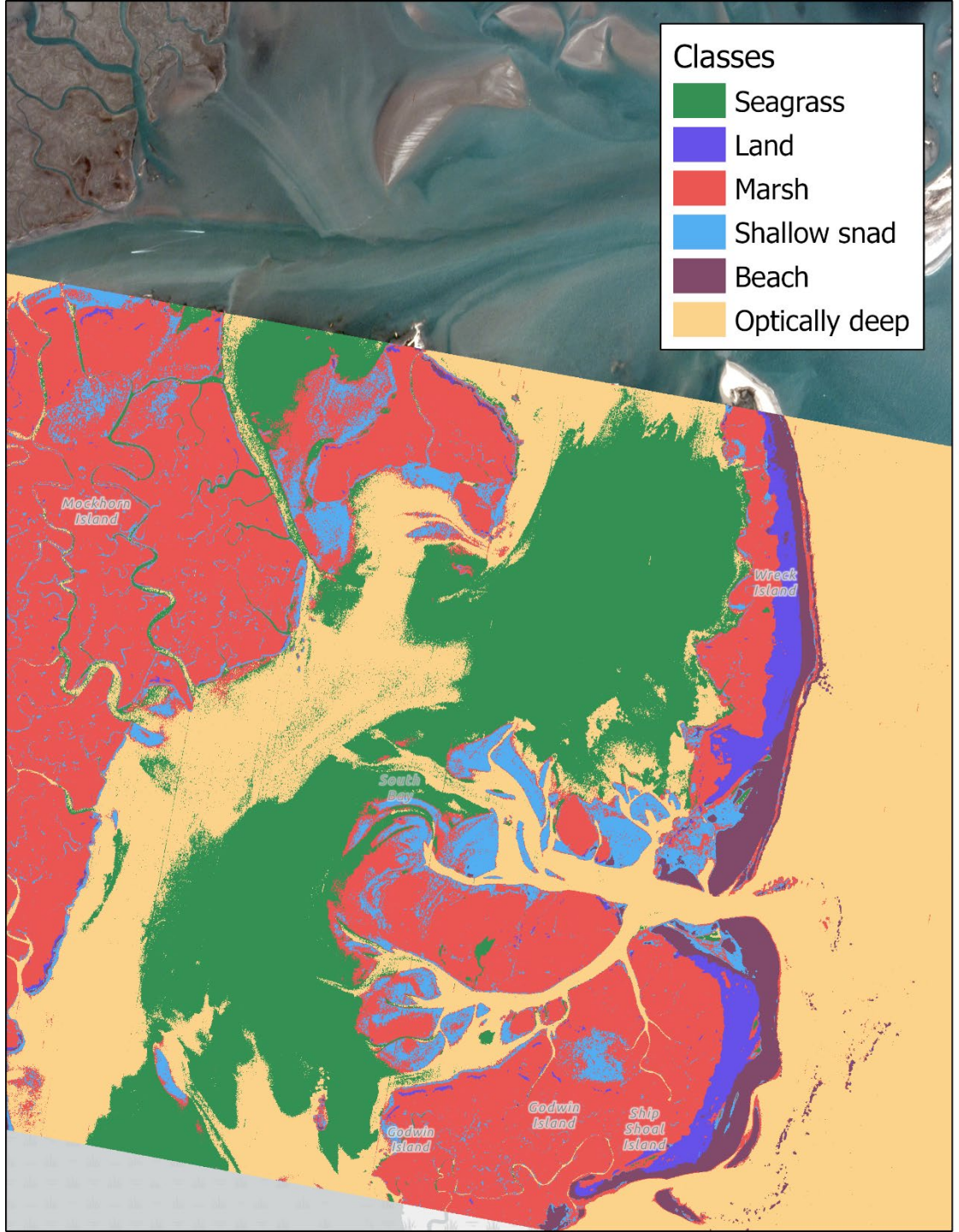


Classification

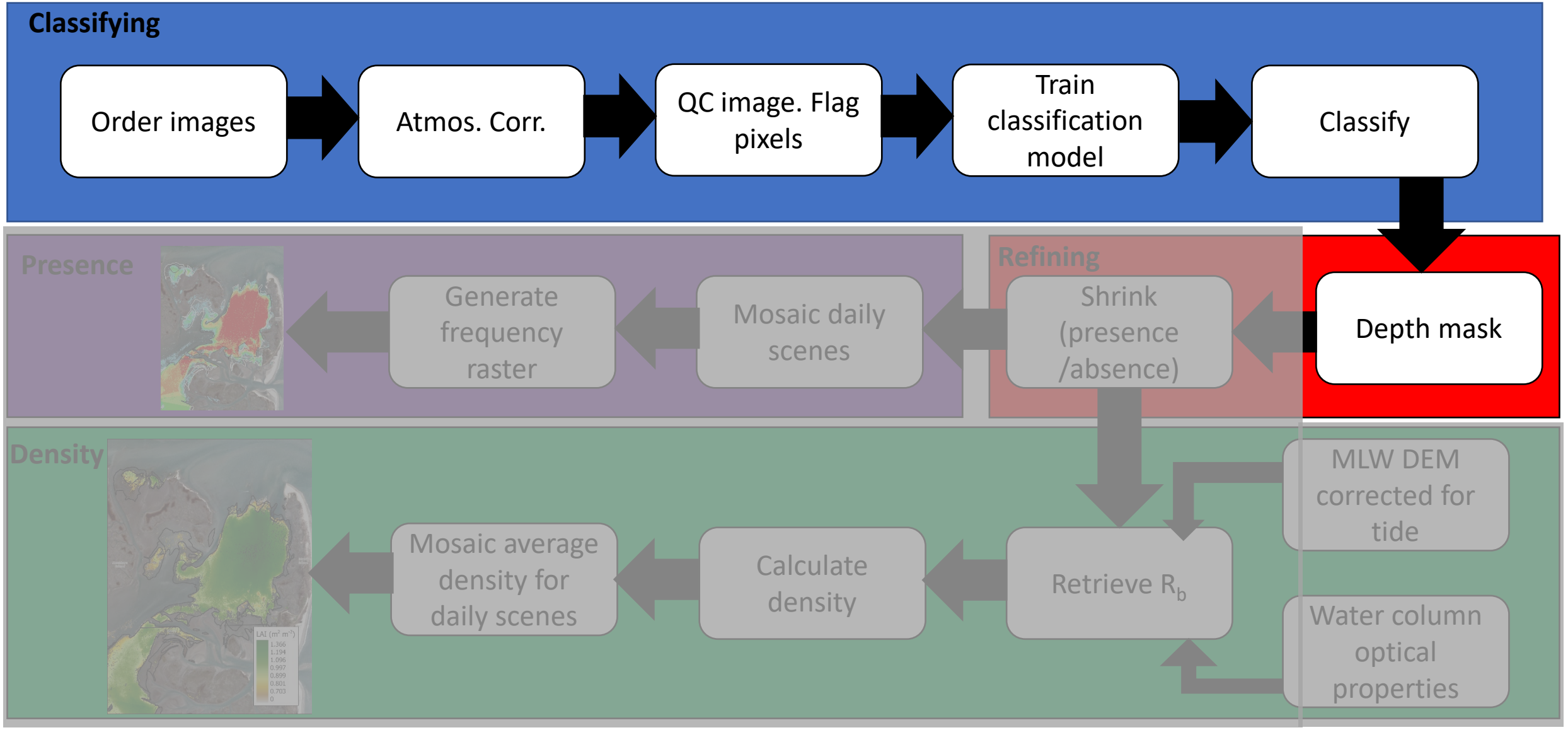
- Generate training patches for each target
  - Beach
  - Land
  - Marsh
  - Optically deep
  - Seagrass
  - Shallow sand
- Training patches for each image, or select areas that are consistent over time.
- Classification is run on all images using the same patch locations.
- Each individual image is trained and classified.



Classification

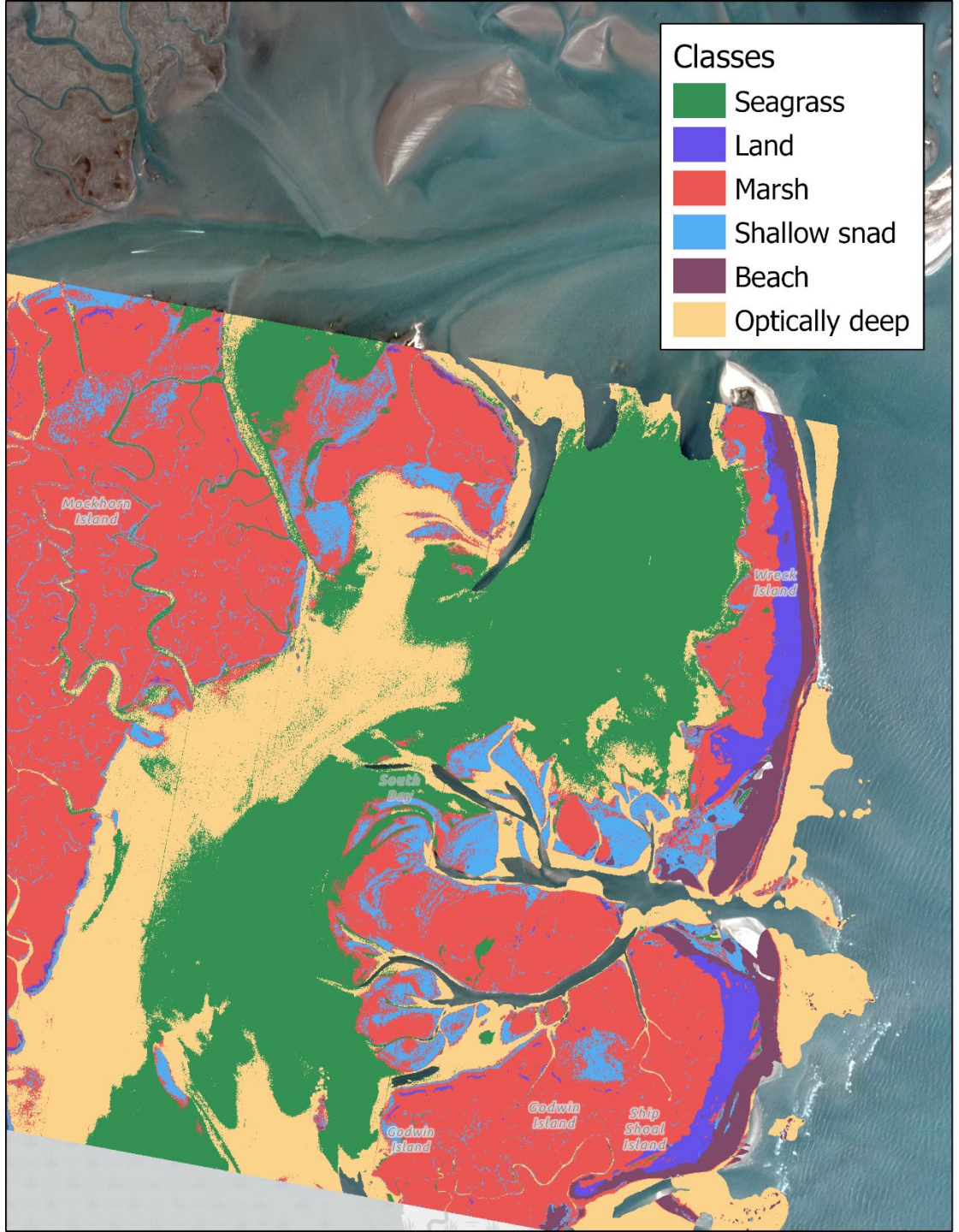


Processing workflow

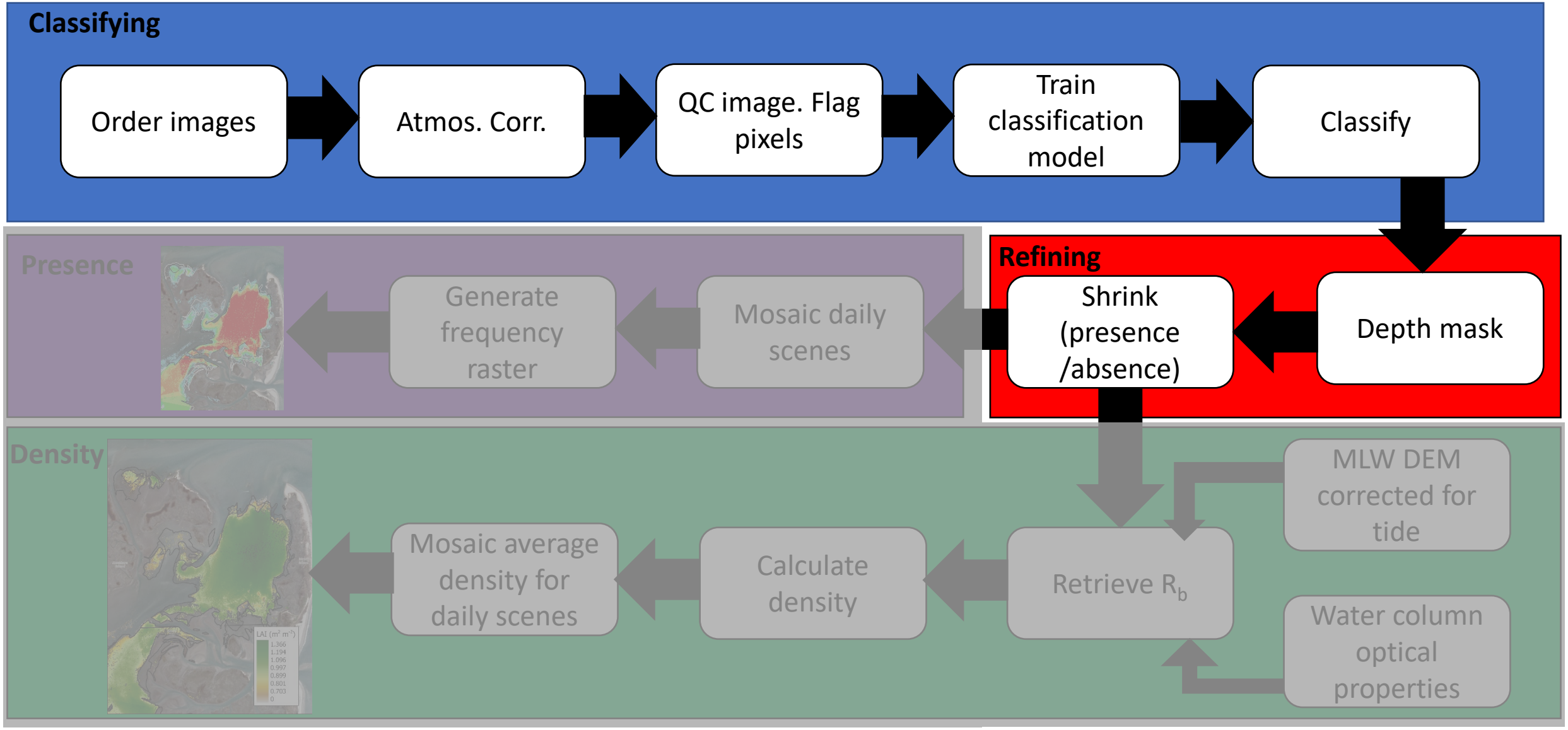


Classification

Depth mask removes green optically deep water.



Processing workflow



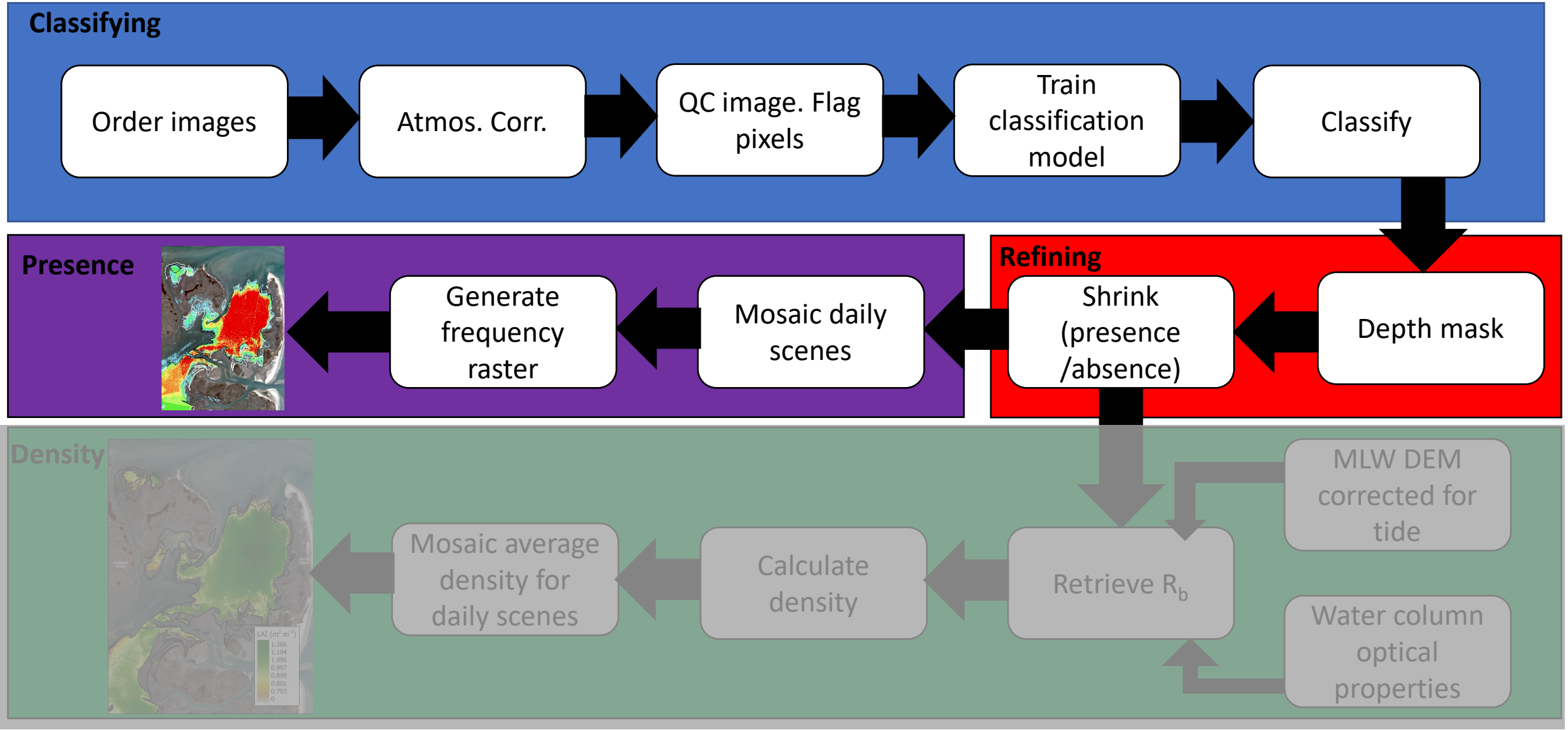
Shrink

Removes single seagrass pixels with no neighboring pixels

Shrink

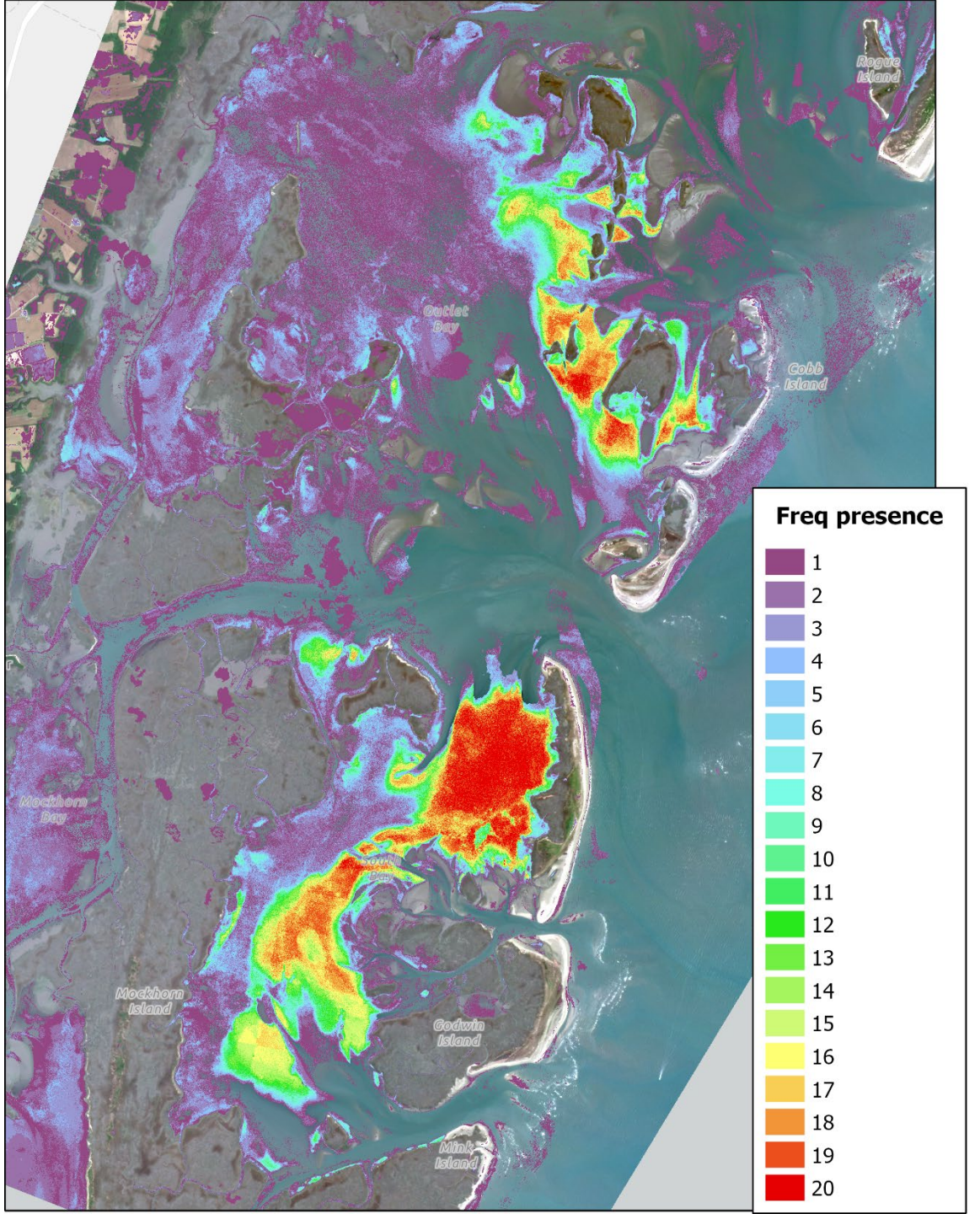
Removes single seagrass pixels with no neighboring pixels

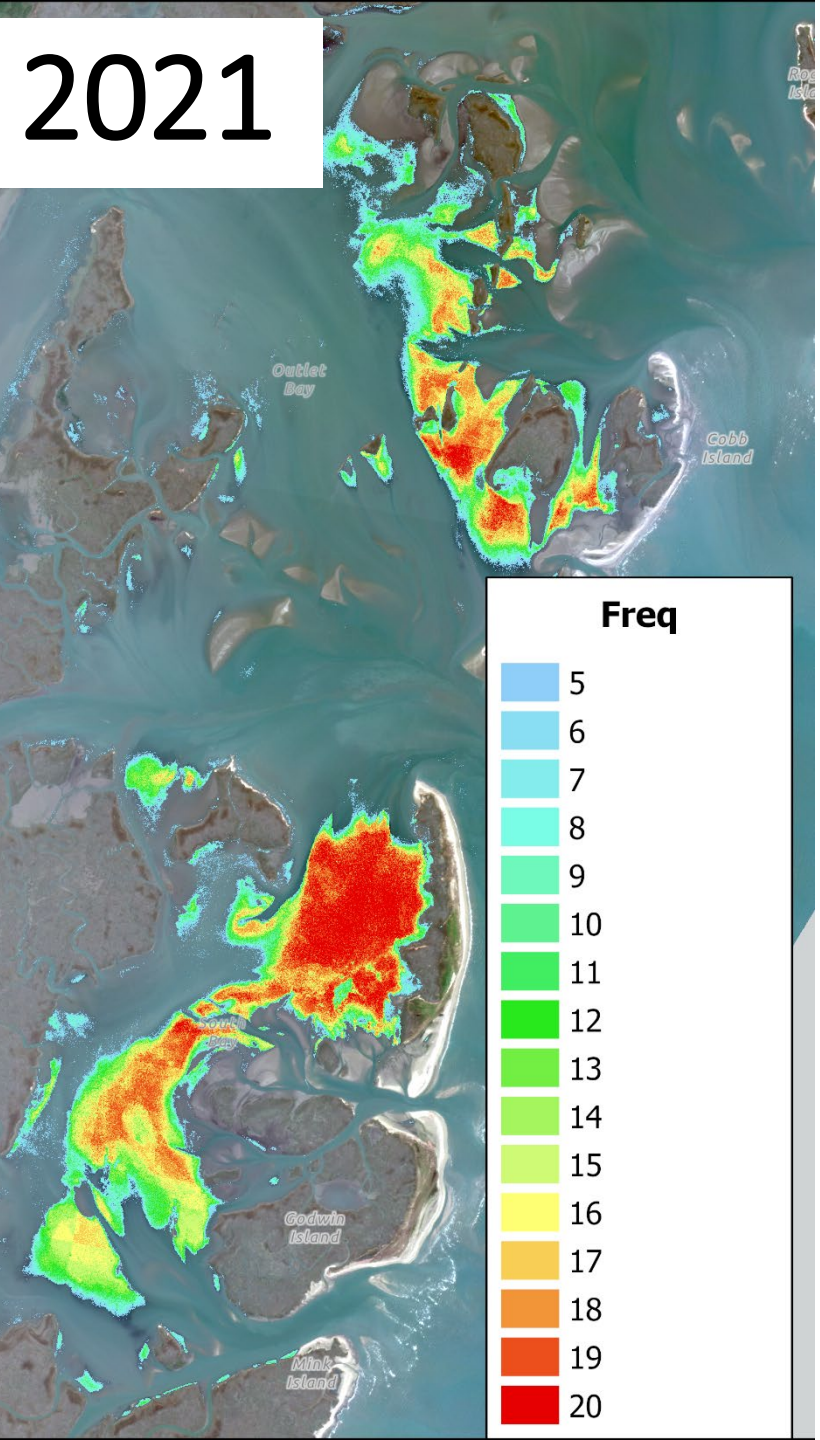
Processing workflow



2021 – frequency presence

- Some areas have very low frequency of seagrass presence.
- These are images with increased turbidity close to land.
  - Are they misclassifications?
  - Generate mask for these areas?
    - Generate seagrass habitat areas and use to mask
  - Not use those images – BUT they produce good classification in the seagrass meadows.
- Set a threshold for frequency presence.
  - Pixels with frequency less than 6 are set to null.




2021
Outlet Bay
Cobb Island
Godwin Island
Mink Island
Freq
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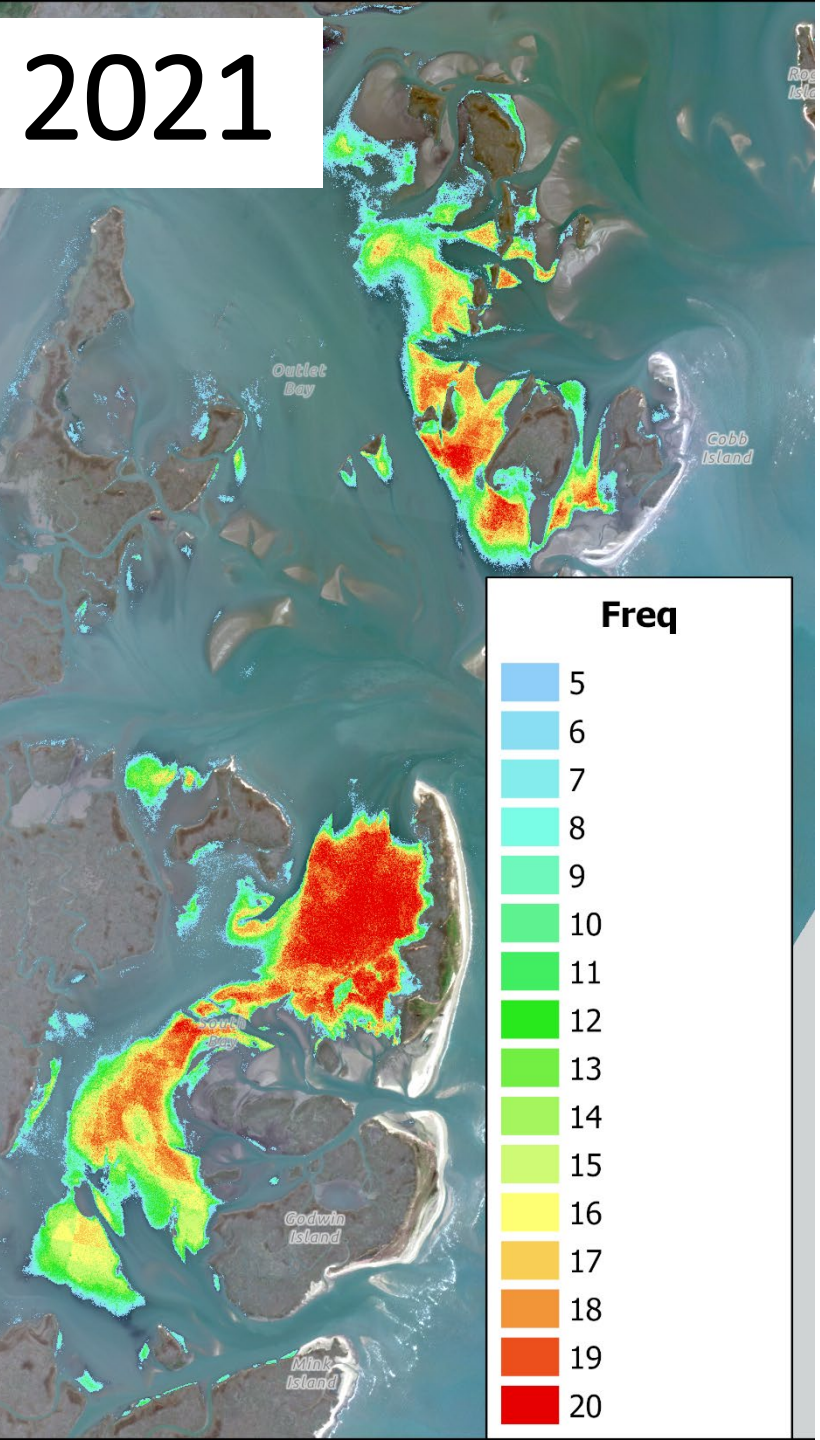
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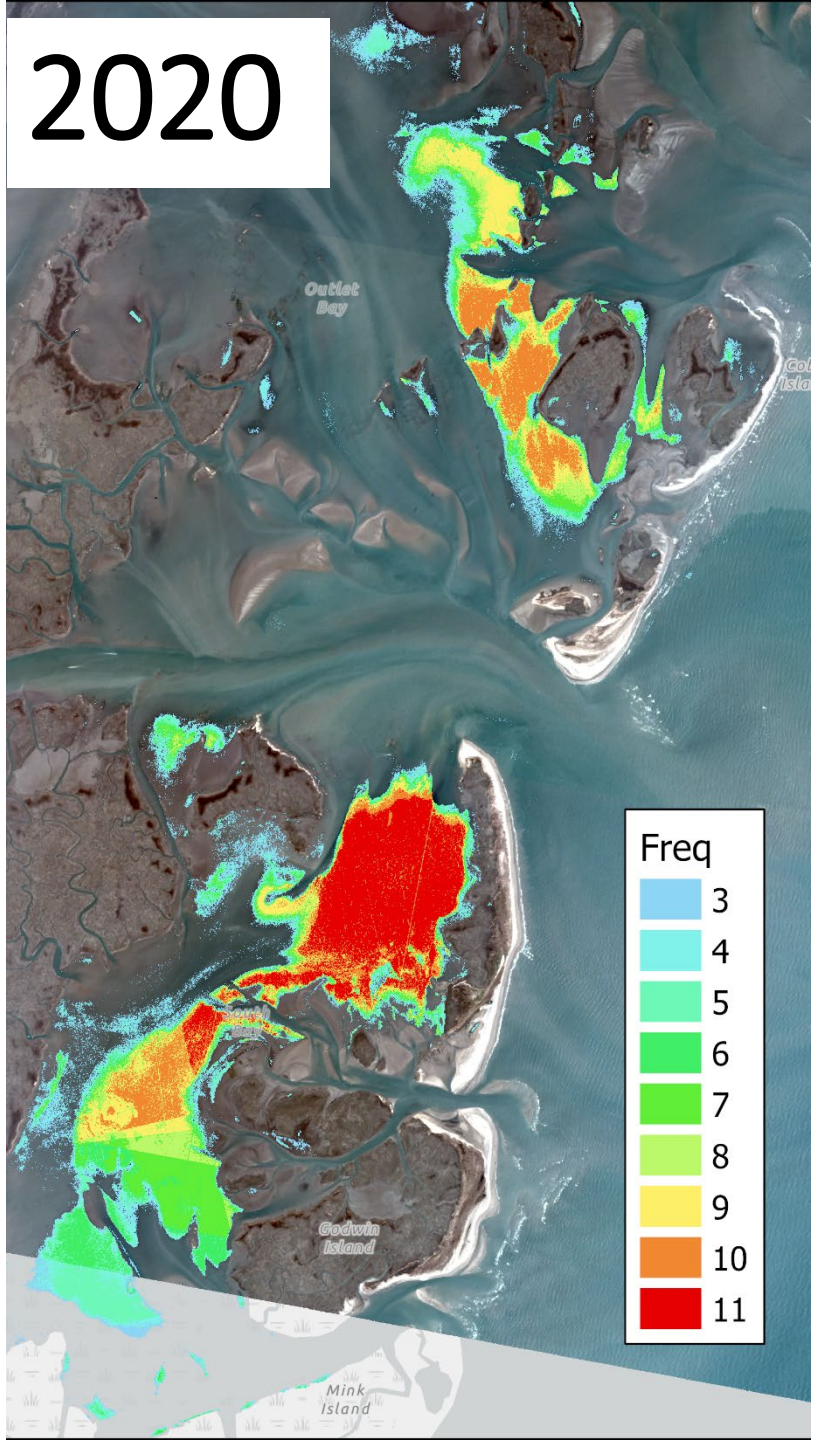
2020
Outlet Bay
Godwin Island
Mink Island
Freq
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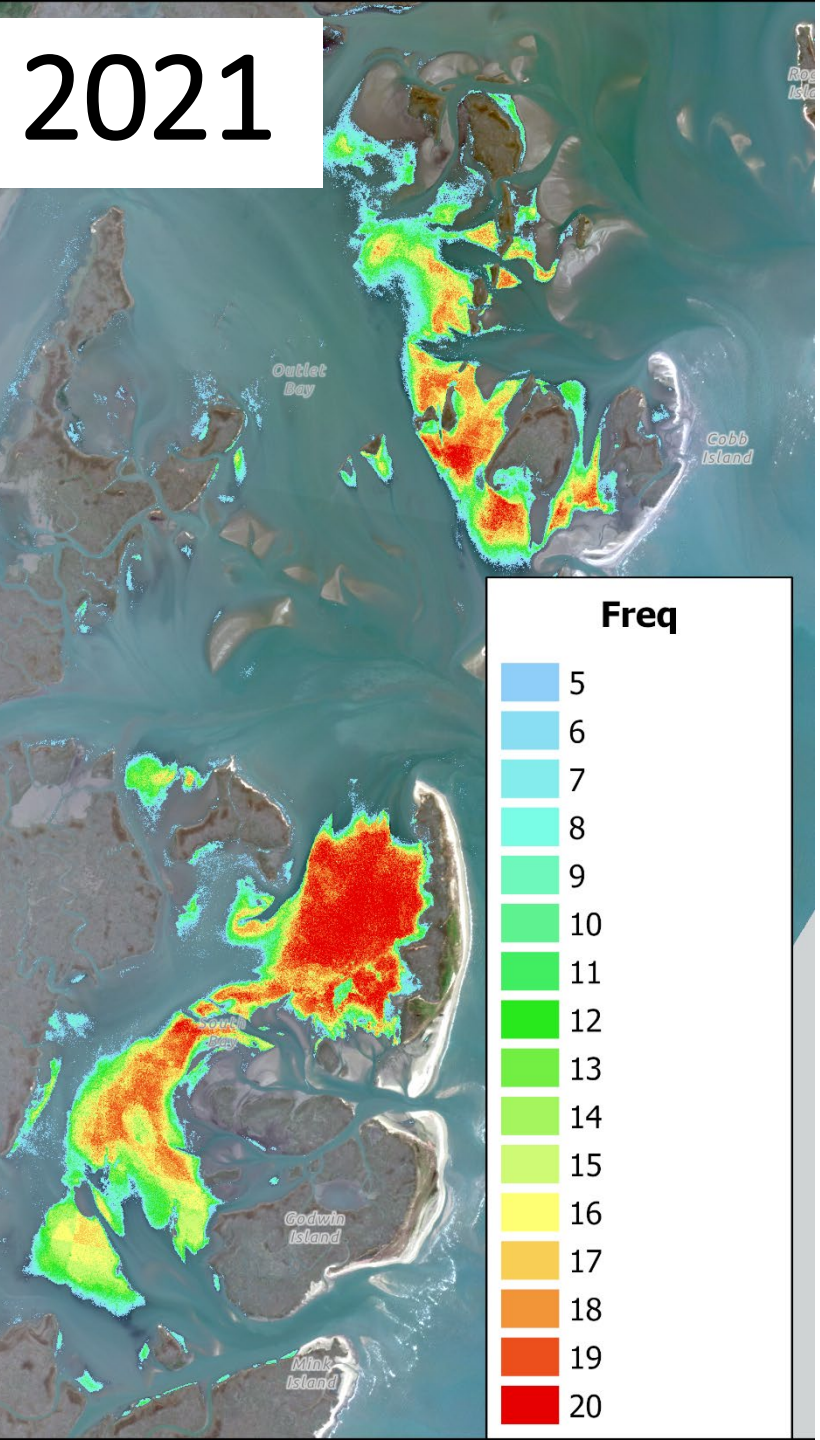
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Cobb Island
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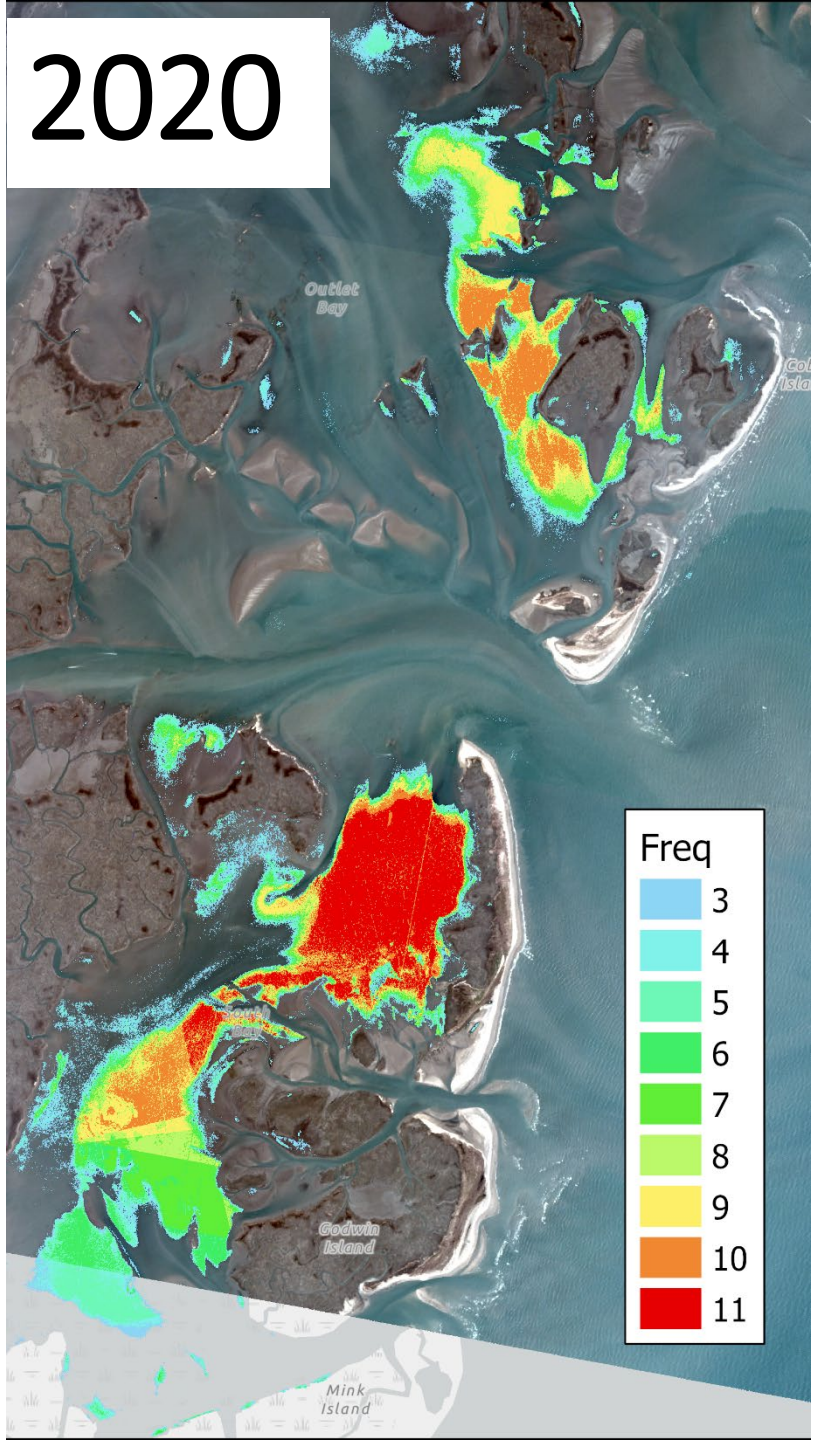
2020
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Mink Island
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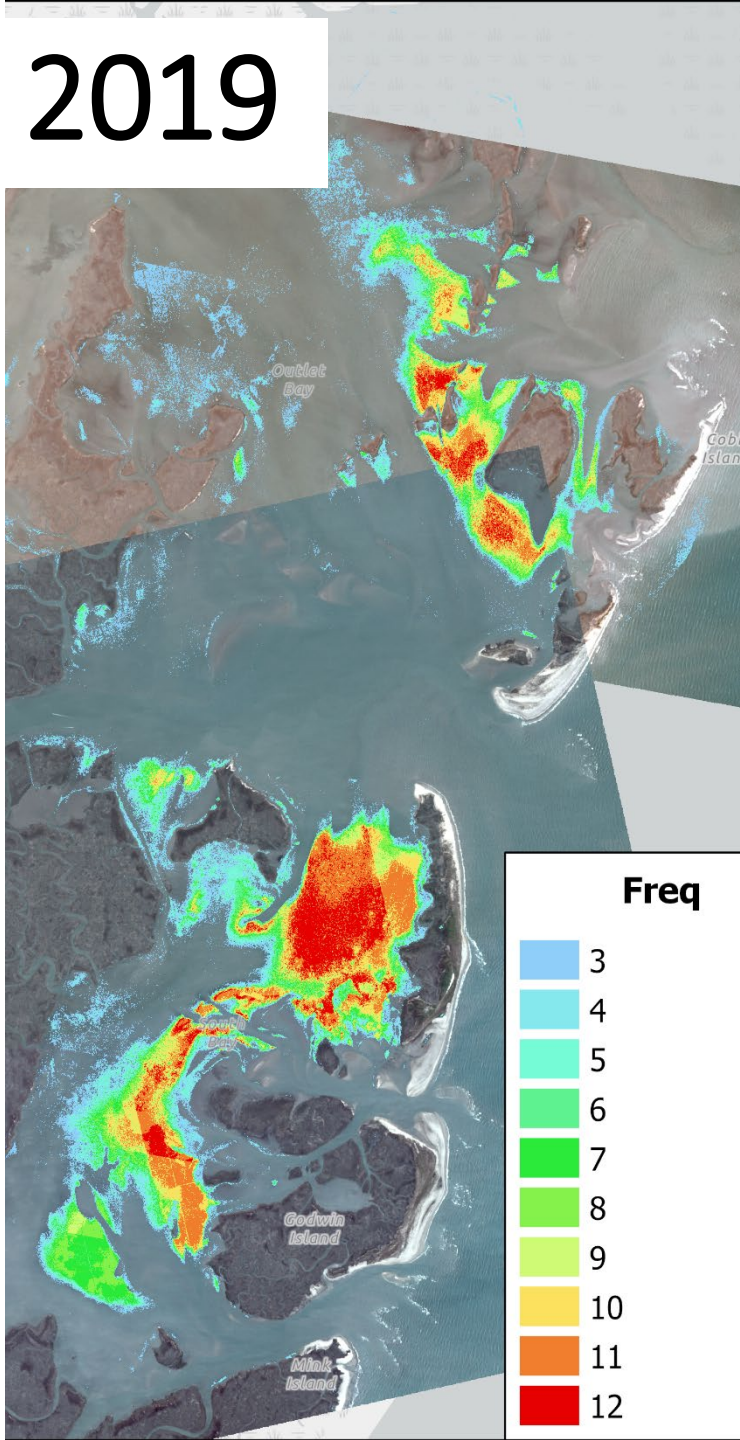
2019
Outlet Bay
Godwin Island
Mink Island
Freq
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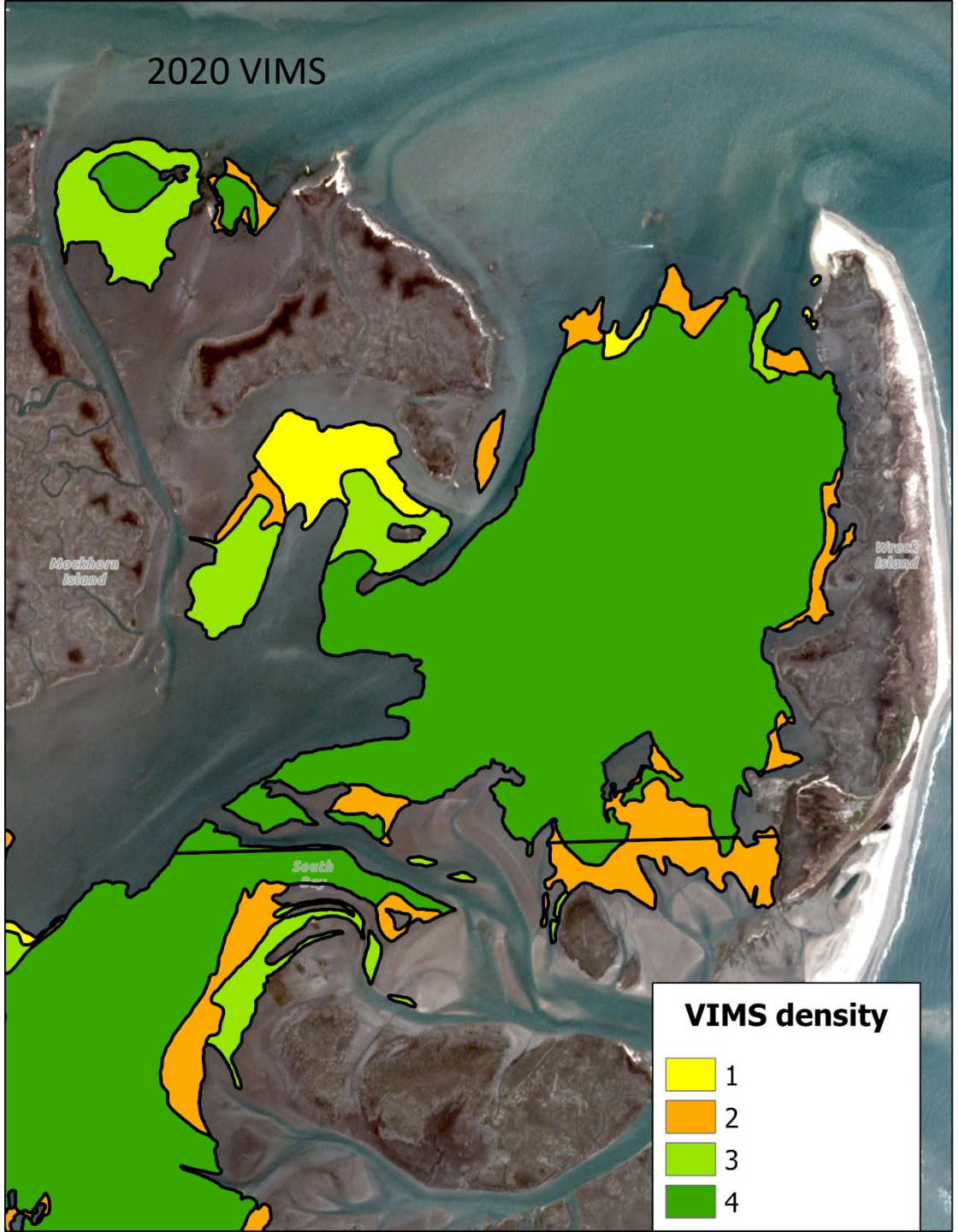
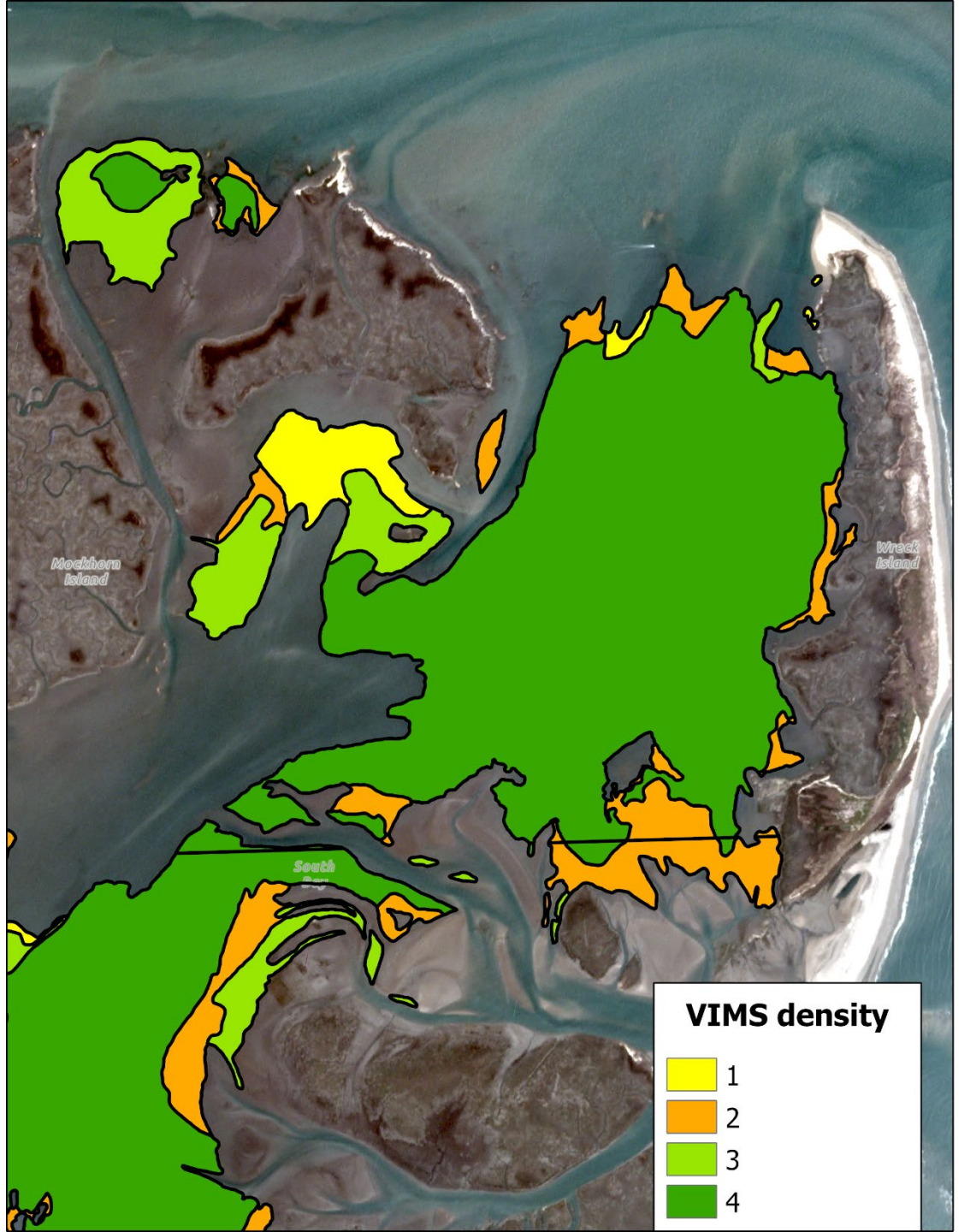
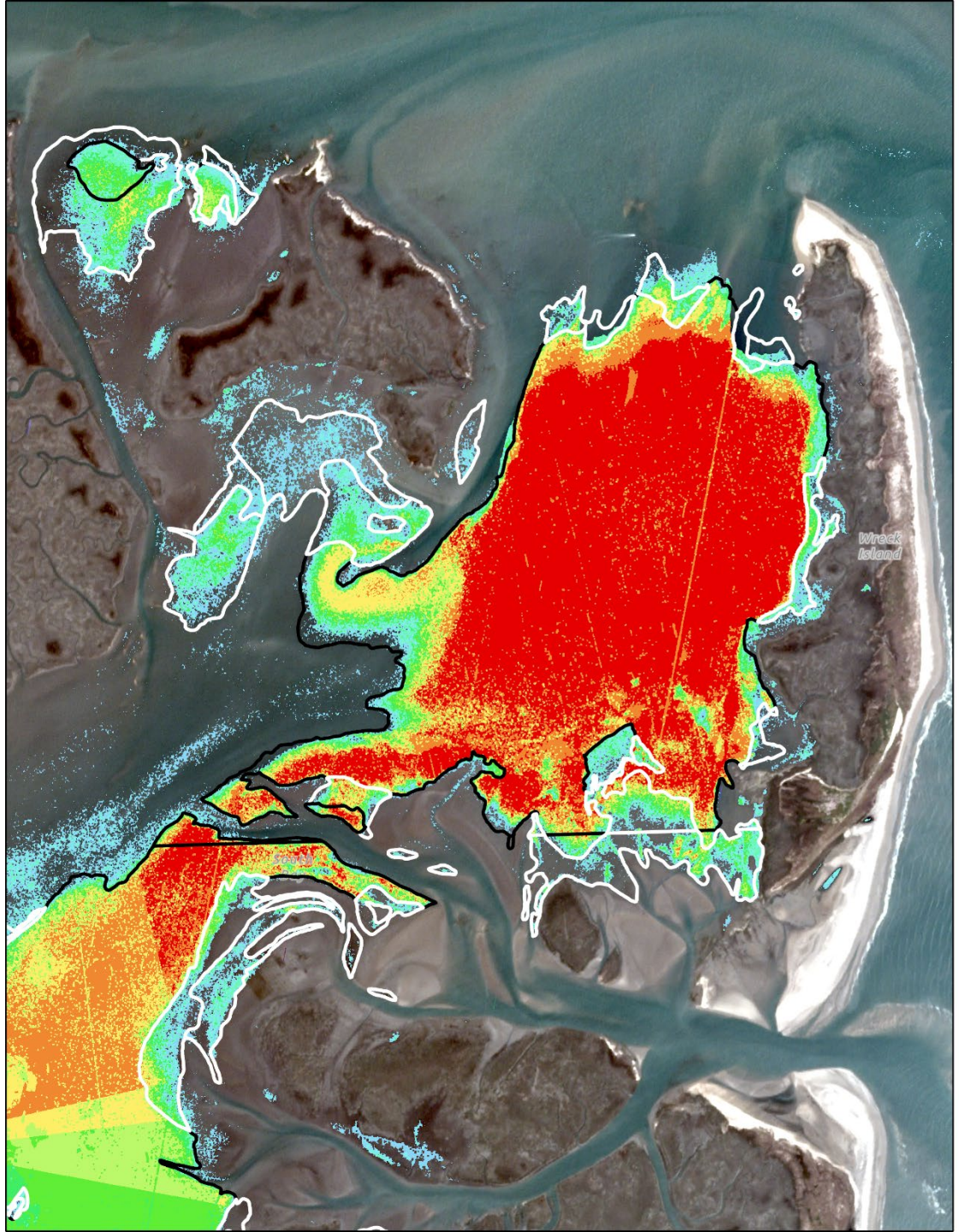
12

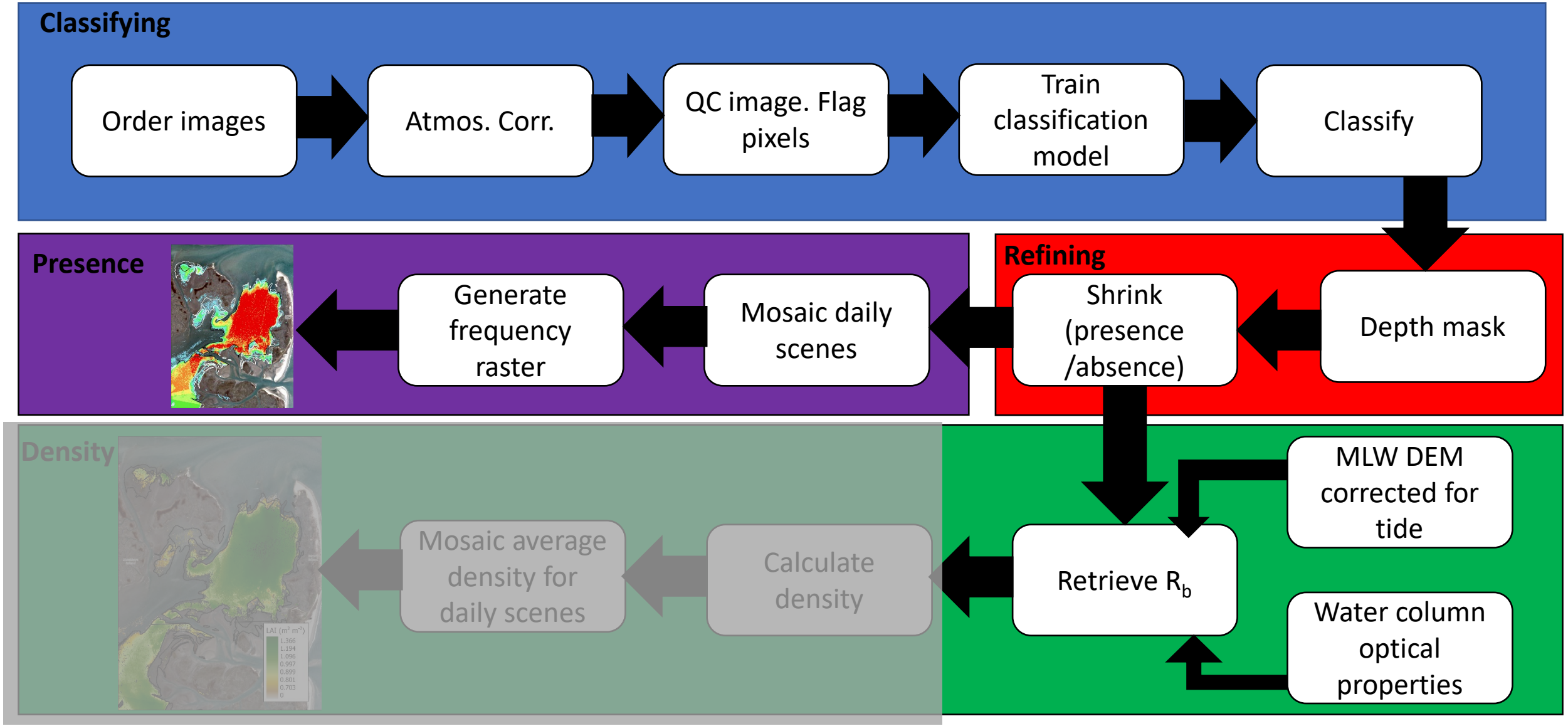

May 2020
Mockhorn Island
Wreck Island
South Bay


2020 VIMS
Mockhorn Island
Wreck Island
South Bay
VIMS density
1
2
3
4

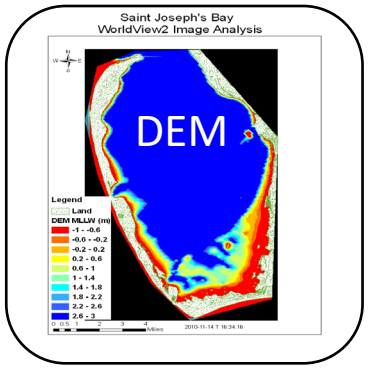

Mockhorn Island
Wreck Island
South
VIMS density
1
2
3
4

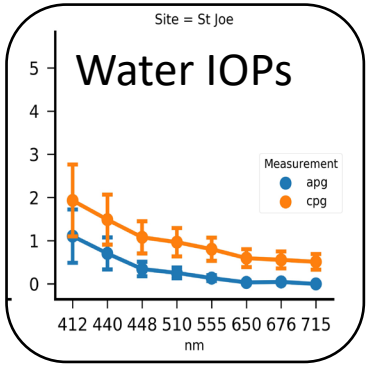

Wreck Island

Processing workflow



From distribution to density

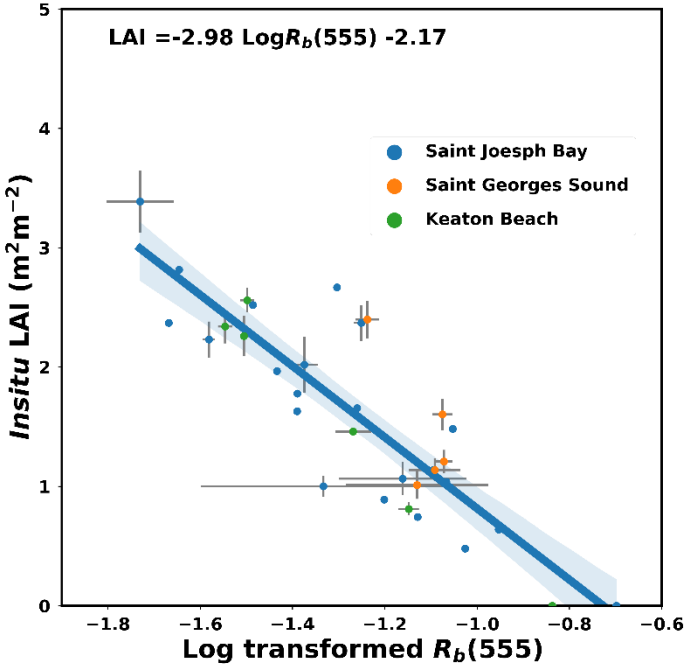




- ***Atmospherically corrected*** R_{rs} from imagery
- $Q_b = E_u(z_b)/L_u(z_b) = \pi$
- K_{Lu} & K_d from *Hydrolight* using measured IOPs
- Water depth, DEM + tide

$$R_b = \frac{R_{rs} Q_b}{t} \frac{\exp\left[-K_{Lu} z_b\right]}{\exp\left(K_d z_b\right)}$$

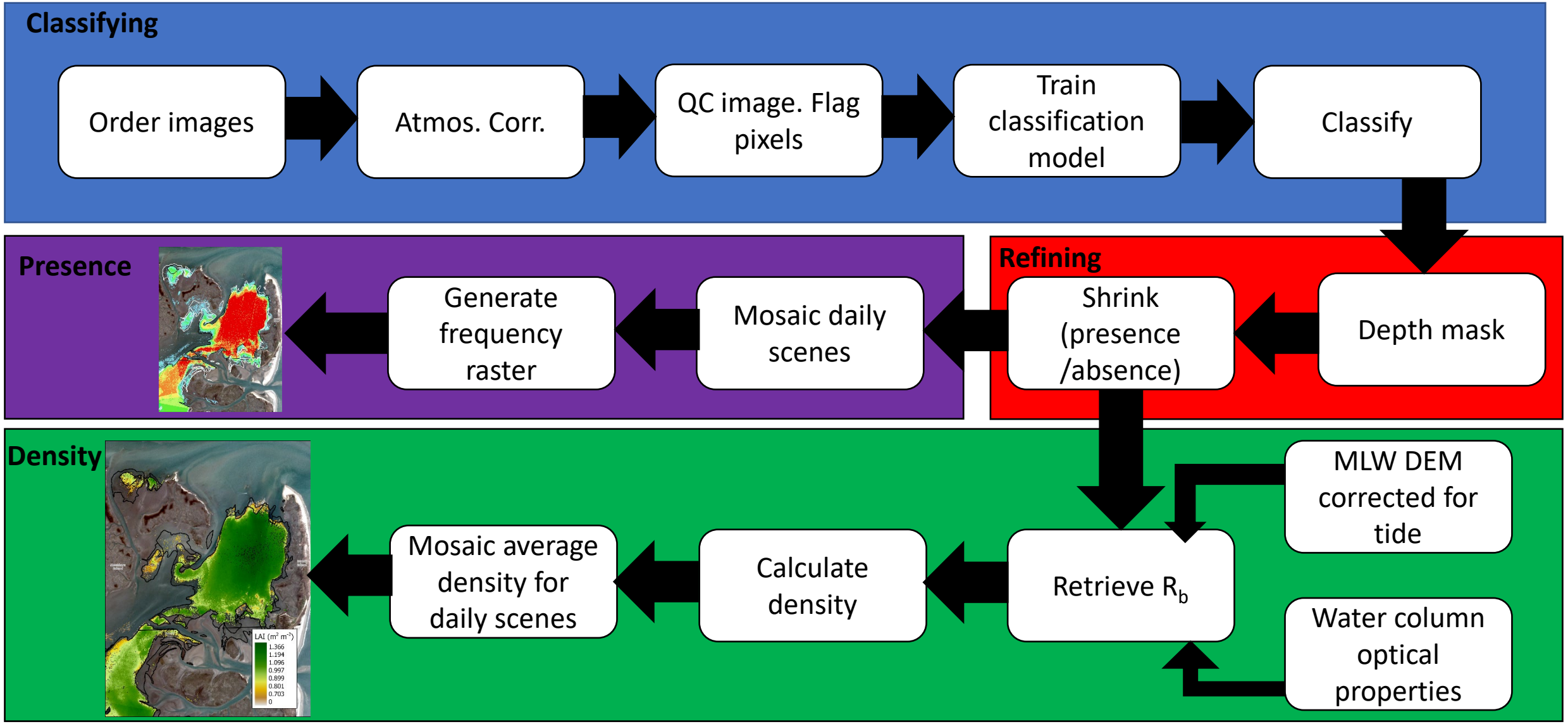
- z_b – bottom depth from acoustic survey
- t – air/sea transmittance of $L_u(0.54)$



Hill, V. J., Zimmerman, R. C., Bissett, P., Dierssen, H. M., & Kohler, D. (2014). Evaluating Light Availability, Seagrass Biomass, and Productivity Using Hyperspectral Airborne Remote Sensing in Saint Joseph's Bay, Florida. *Estuaries and Coasts, 37*. doi:DOI: 10.1007/s12237-013-9764-3.

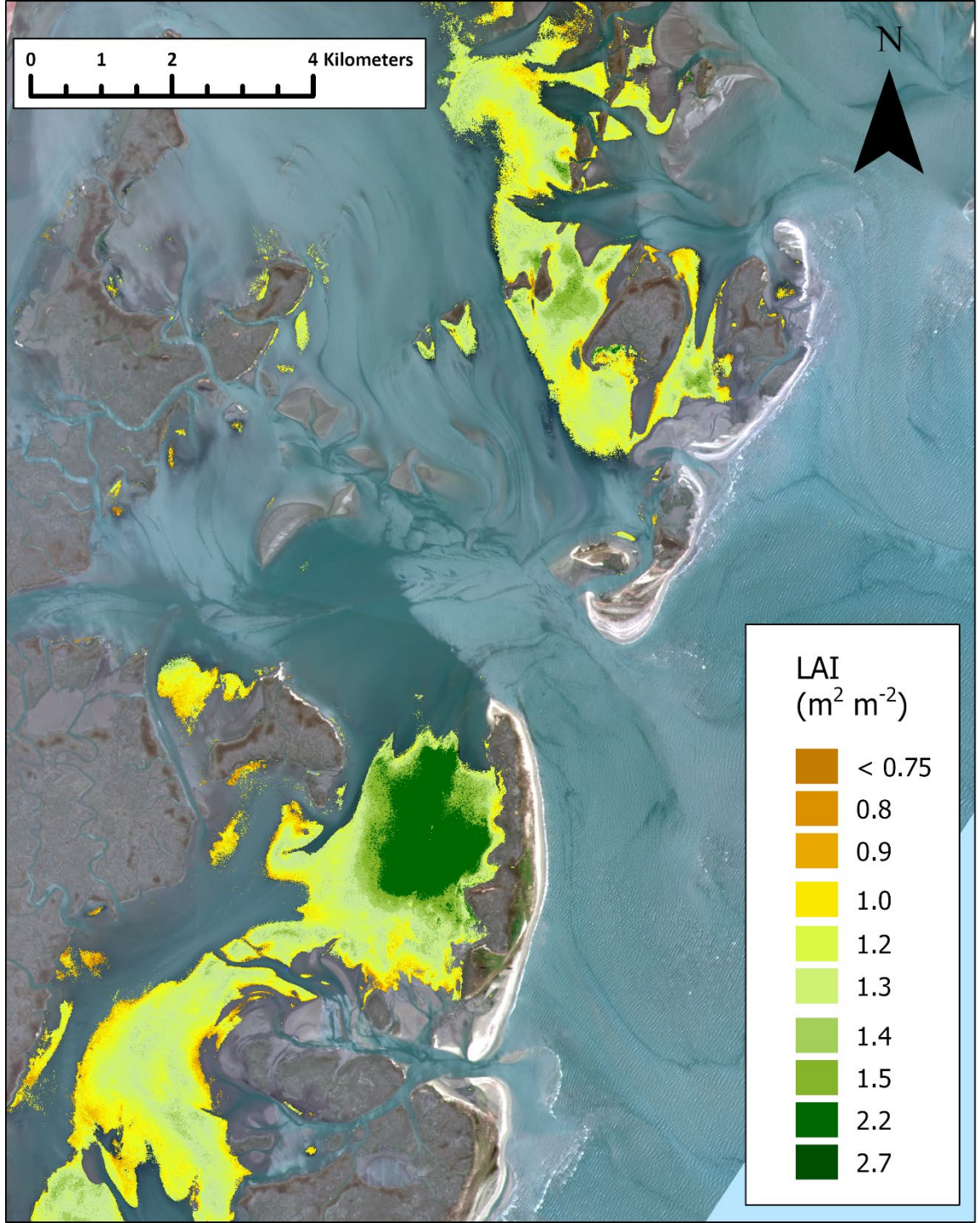
Dierssen, H., R. Zimmerman, R. Leathers, T. Downes, and C. Davis. 2003. Remote sensing of seagrass and bathymetry in the Bahamas Banks using high resolution airborne imagery. Limnol. Oceangr. **48: 444-455.**

Processing workflow



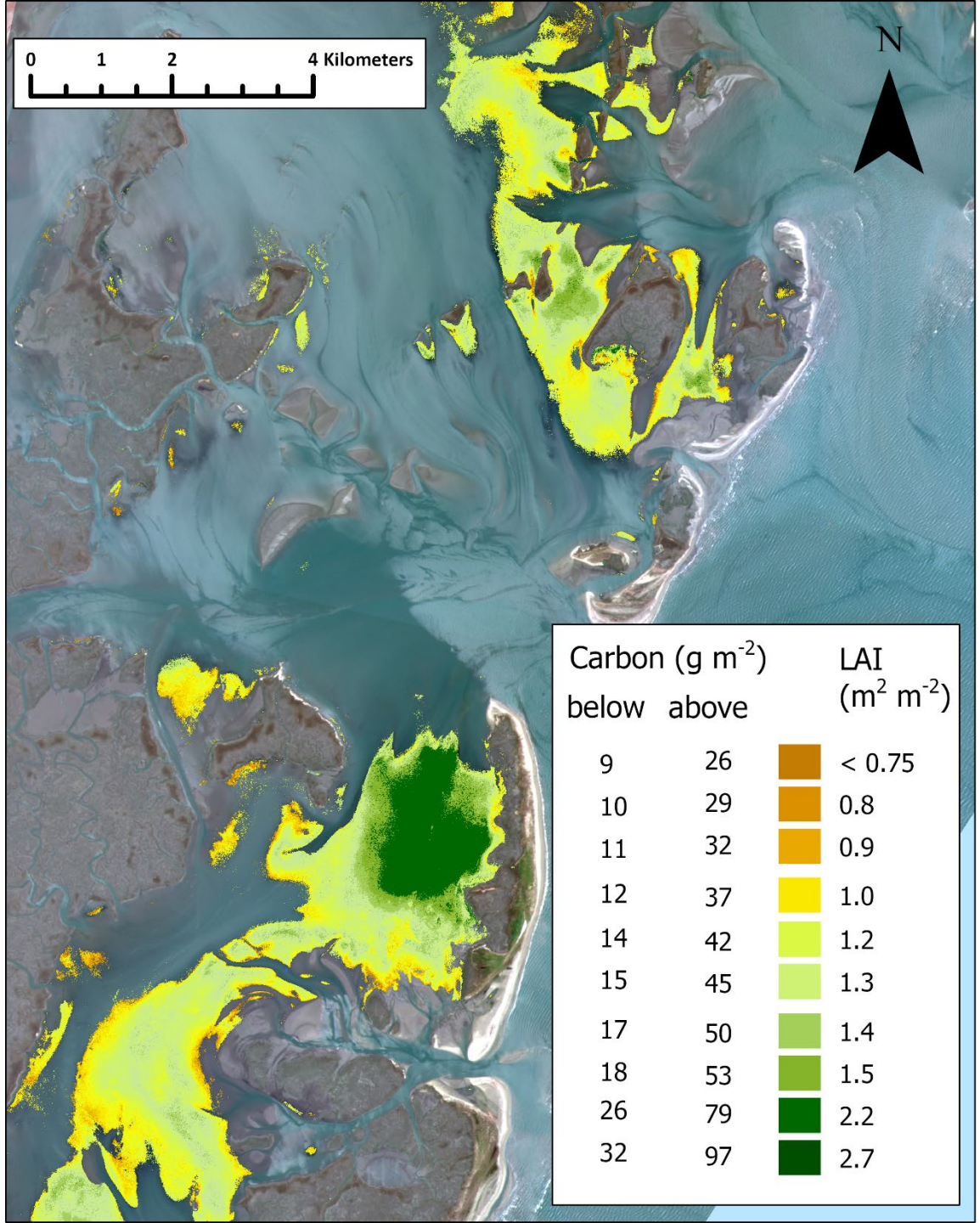
2021 – Leaf Area Index

- Average annual LAI
- Used frequency presence as a mask, values less than #6 were set to null.

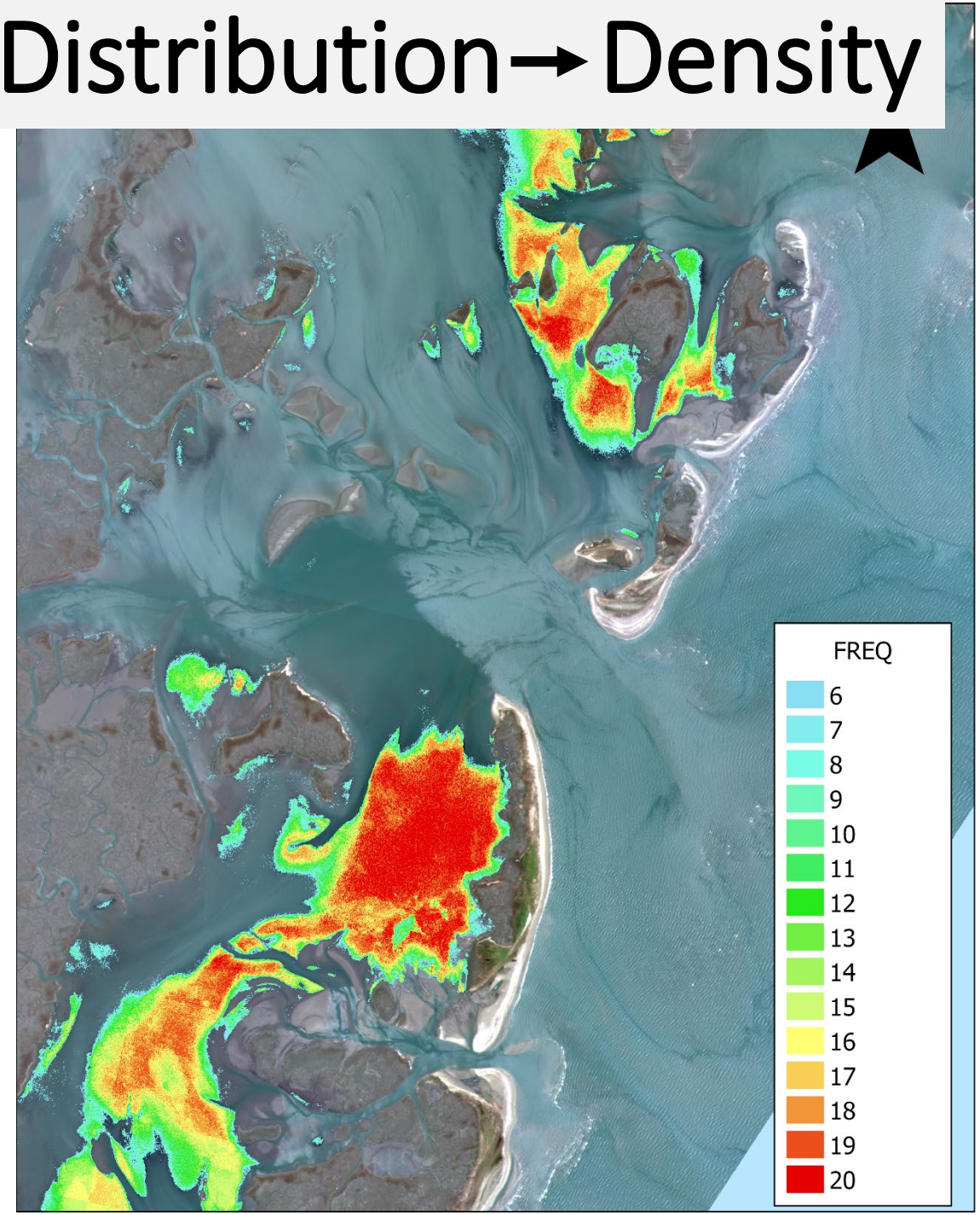


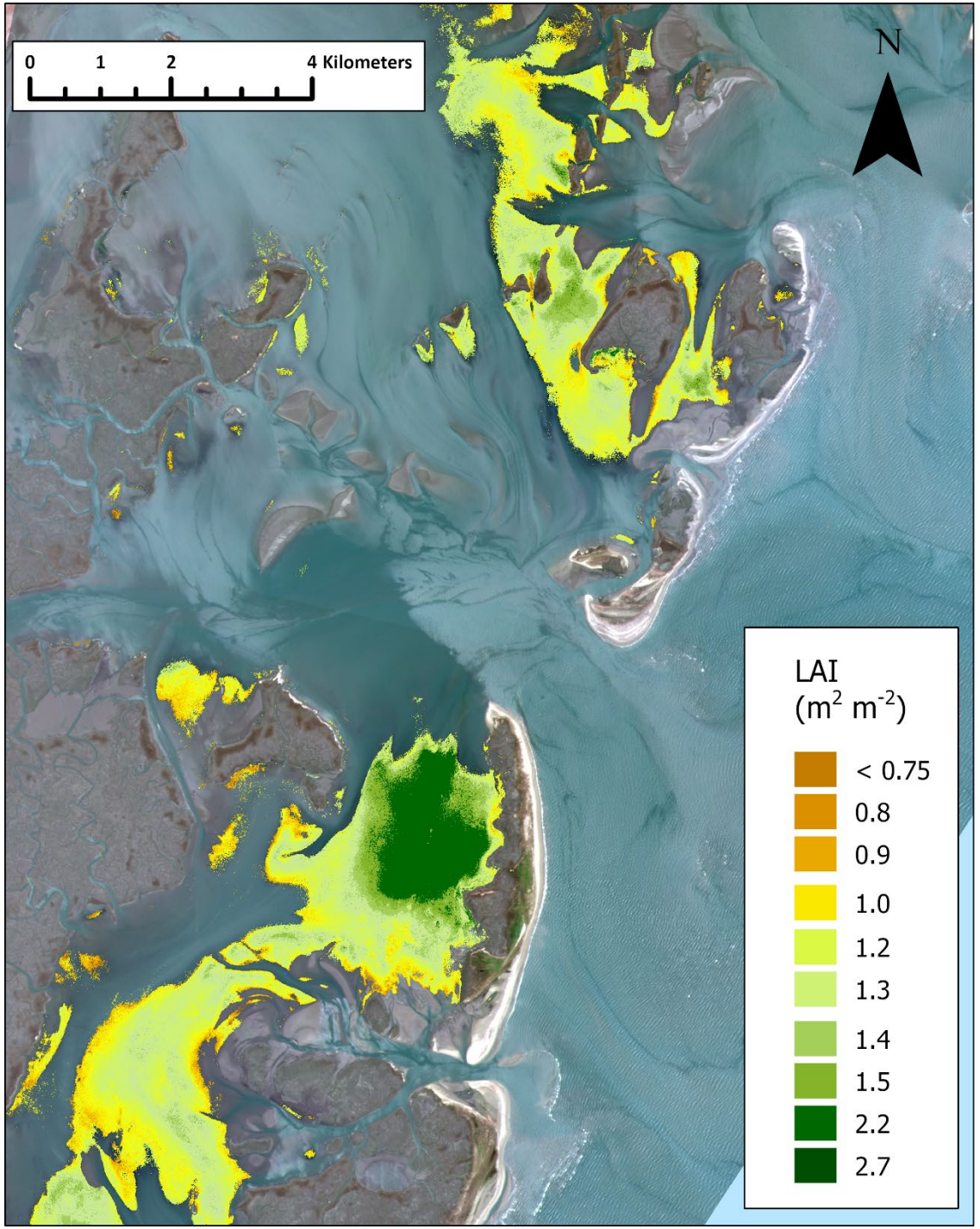
2021 – Carbon

- Use linear transfer coefficients to convert LAI to above and below ground carbon.
- Below ground carbon is based on in situ measurements. 1/3 of the above ground value.



Distribution → Density





Continuing work

- Partly automated processing.
- Working on training a machine learning algorithm to classify images without additional training.
- Refine QC techniques for each region.
- Frequency = density?

- Use high frequency of images to overcome turbidity and sparse areas.
- Sparse areas are still identified.
- Atmospheric correction needs to be addressed.