Can Multiscale Roughness Help Computer-Assisted Identification of Coastal Habitats in Florida?

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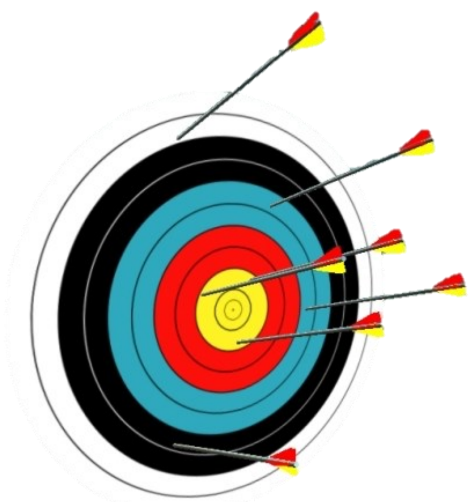
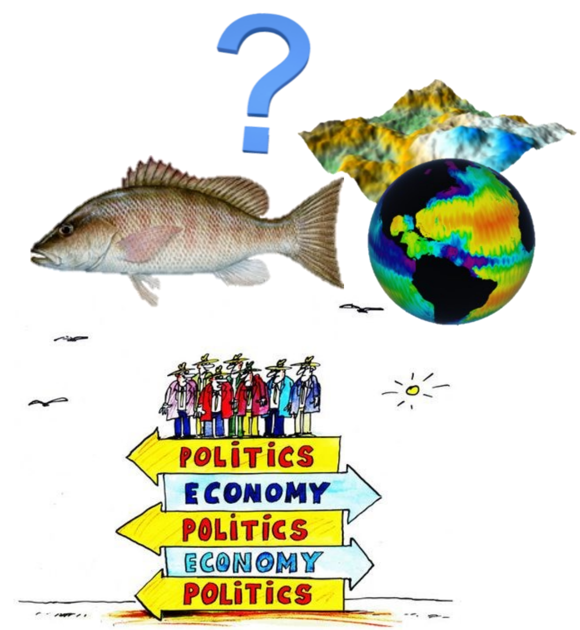
Coastal Habitats in Florida

Coastal habitats in Florida provide a wide range of critical ecosystem services (*e.g.*, protection from erosion and storms, opportunities for tourism and outdoor activities, provide habitats for other species, fisheries)

Many of these habitats and the services they provide are facing extreme pressure (*e.g.*, unsustainable tourism, inadequate protection and management, climate change, pollution)



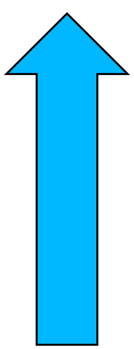


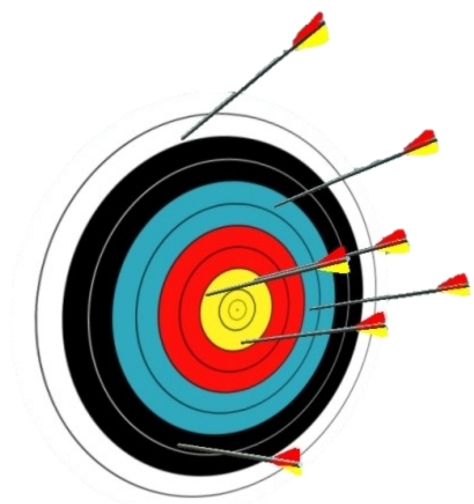
(Edgar *et al.*, 2008; Devillers *et al.*, 2014; Broderick, 2015; Orlikowska *et al.*, 2016)

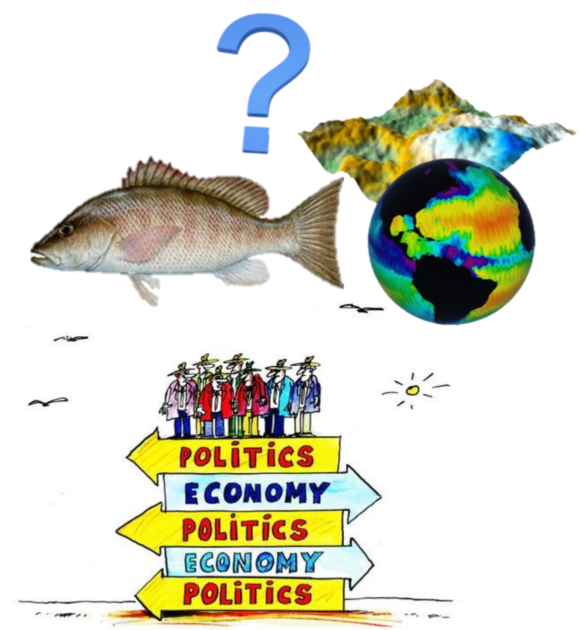
Coastal Habitats in Florida

Ongoing restoration and monitoring efforts do not have baseline data against which to quantify success

NEED FOR FREQUENT, EFFECTIVE, AND COMPREHENSIVE MAPPING AND MONITORING METHODS







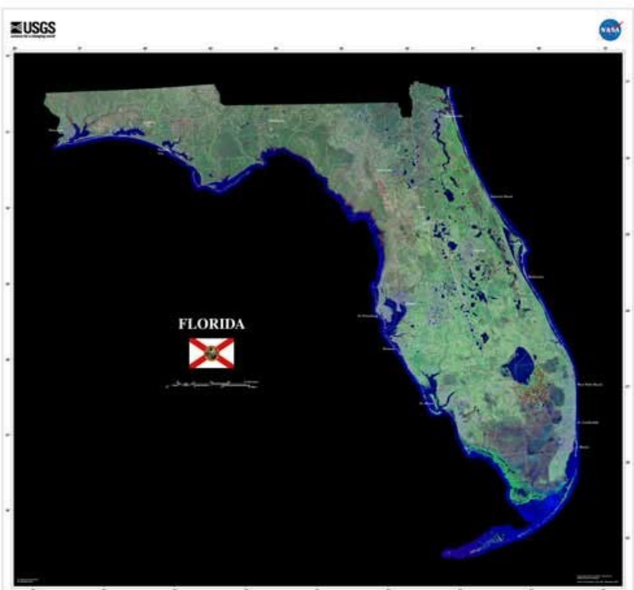
(Edgar *et al.*, 2008; Devillers *et al.*, 2014; Broderick, 2015; Orlikowska *et al.*, 2016)

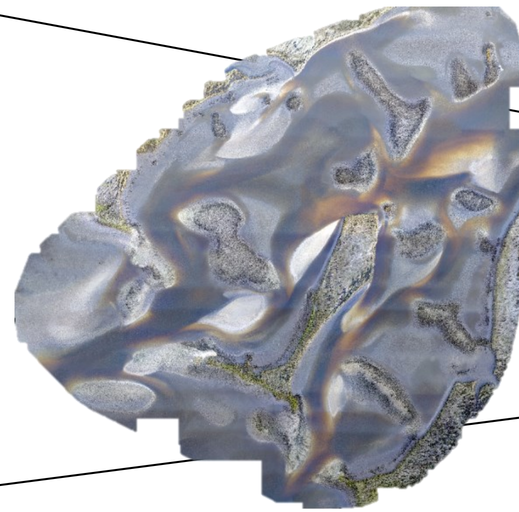
Coastal Habitats in Florida

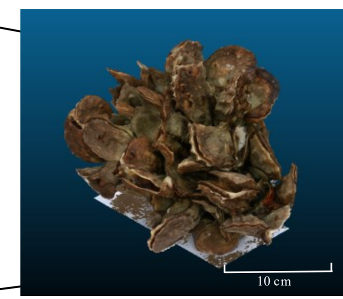
A multiscale framework for coastal habitat mapping and monitoring using remote sensing

The Marine Geomatics Lab
Bridging Ecological and Spatial Sciences

Broad-Scale







Fine-Scale

Images courtesy of USGS, Andrew Ortega and Kwanmok Kim

Oyster Mapping Framework

Dynamic environment means that we need to adopt an ecosystemic perspective

Coastal Habitat Mapping

remote sensing

MDPI

Article

Quantifying Intertidal Habitat Relative Coverage in a Florida Estuary Using UAS Imagery and GEOBIA

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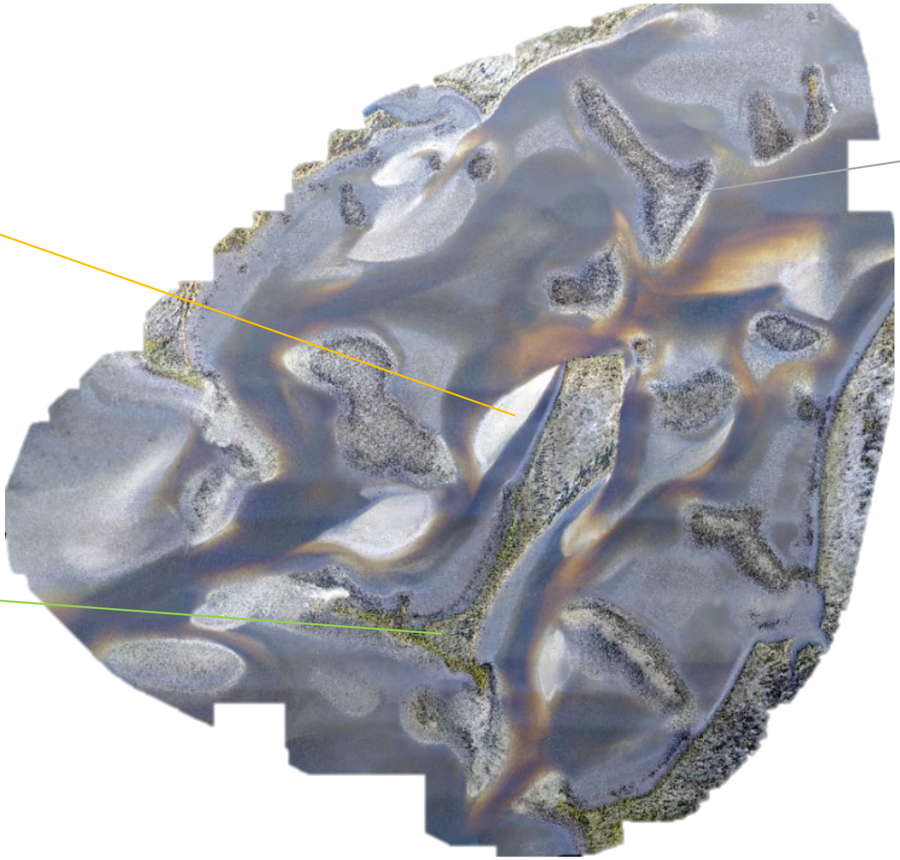
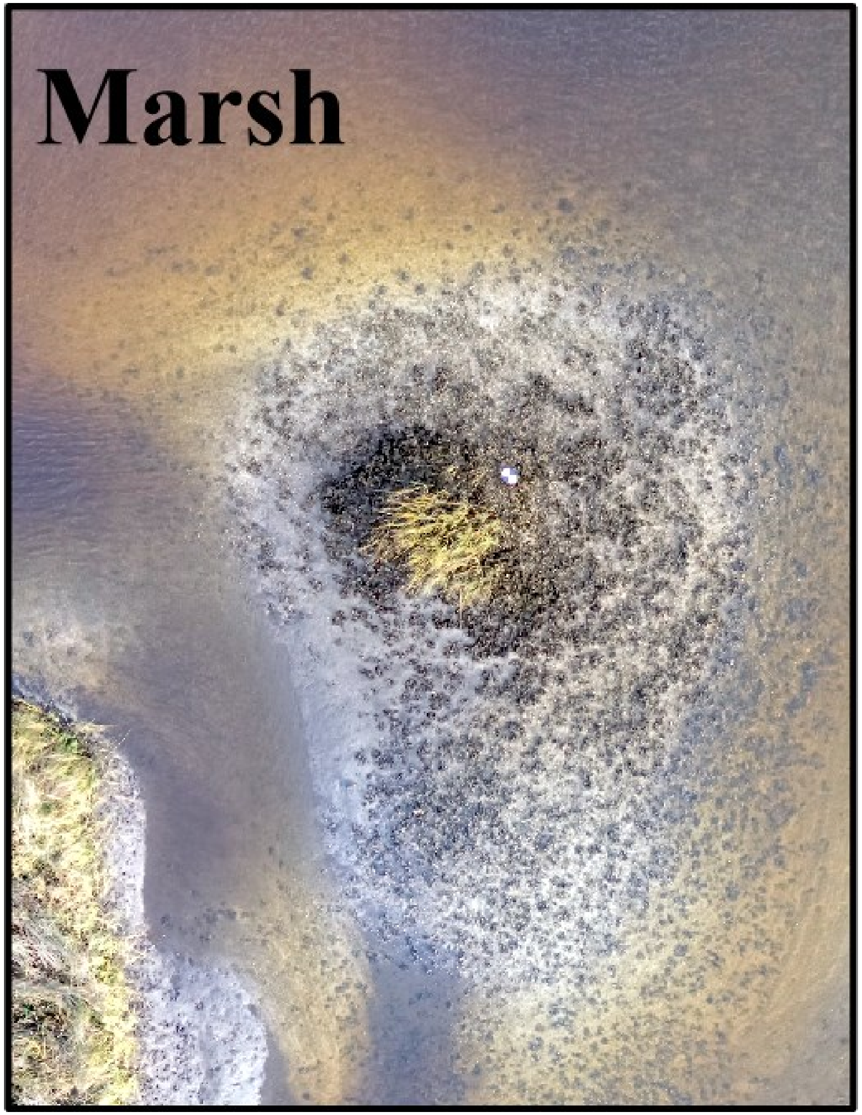
* Correspondence: michaelespriella@ufl.edu

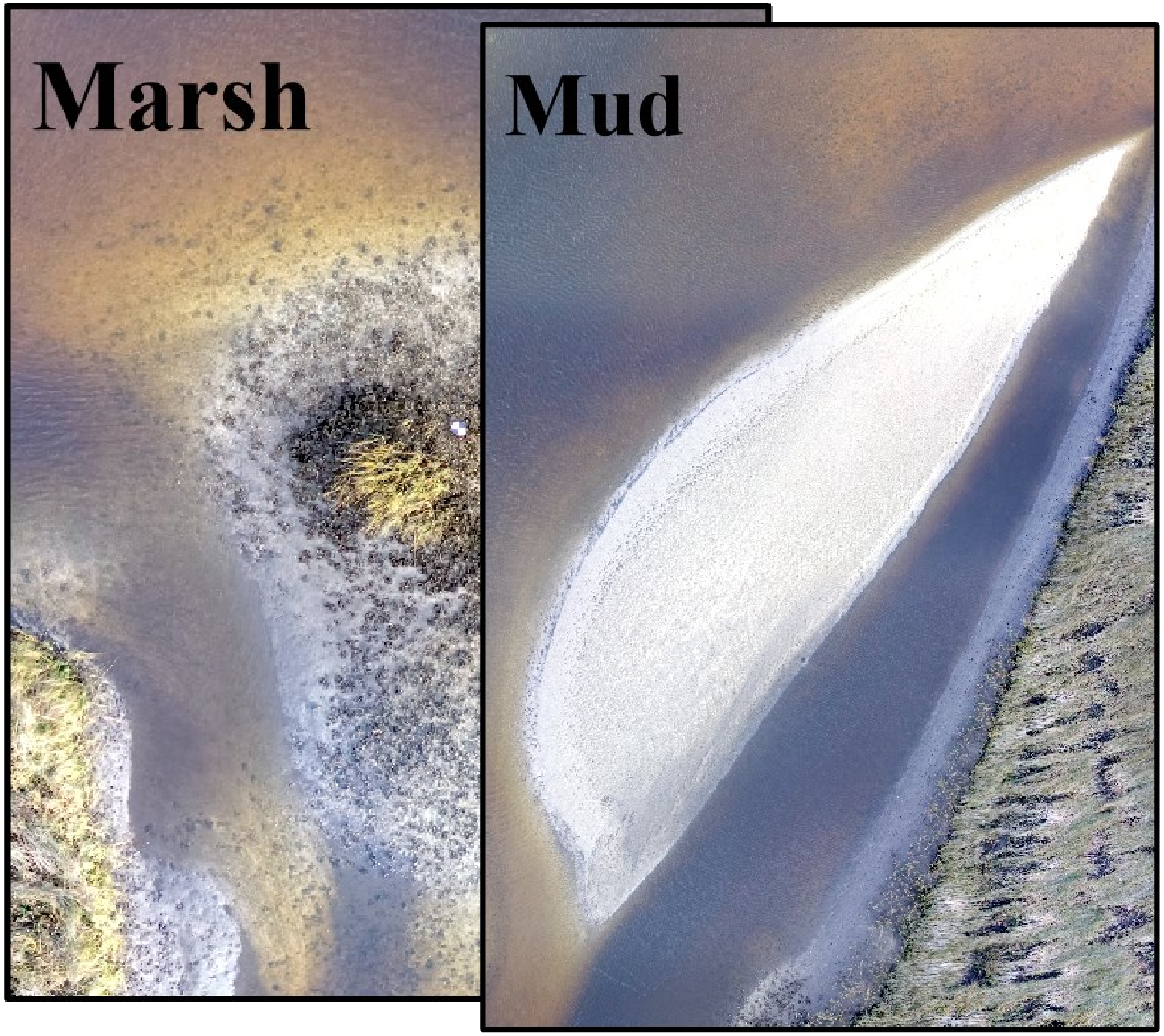
Coastal Habitat Mapping



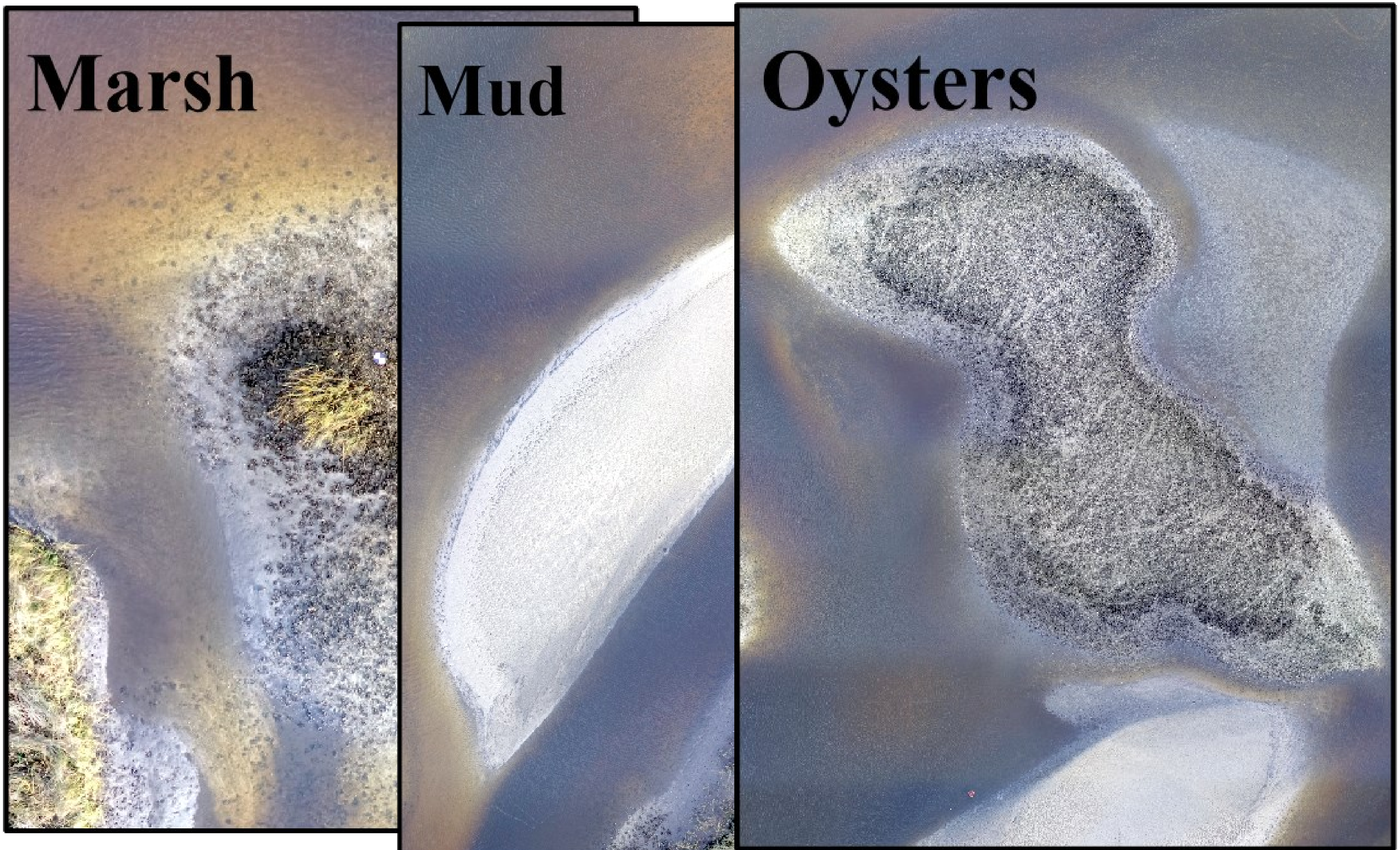
Images courtesy of Andrew Ortega and Michael Espriella


Marsh

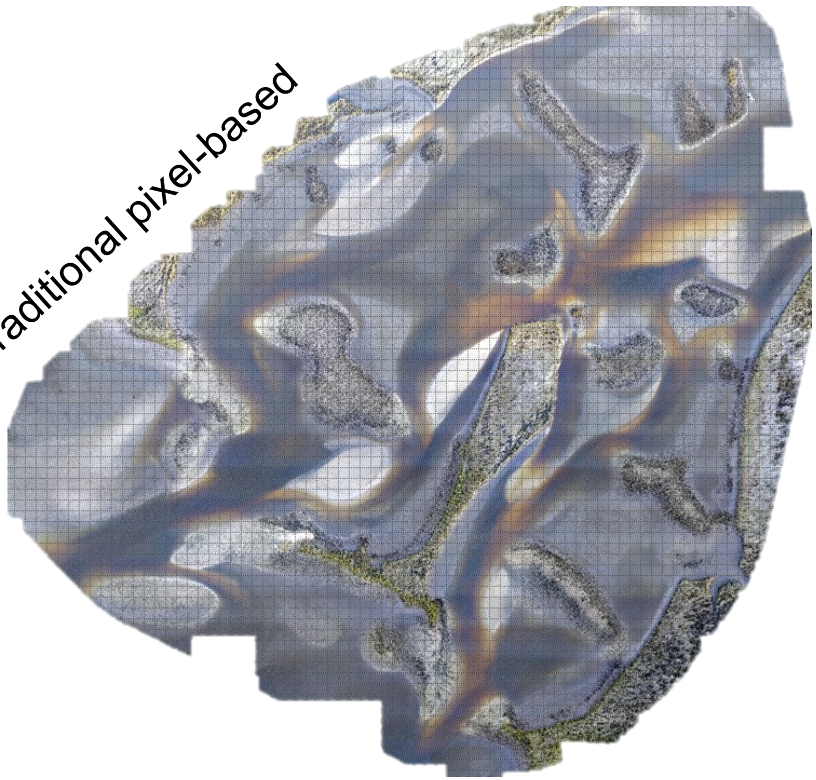
Coastal Habitat Mapping

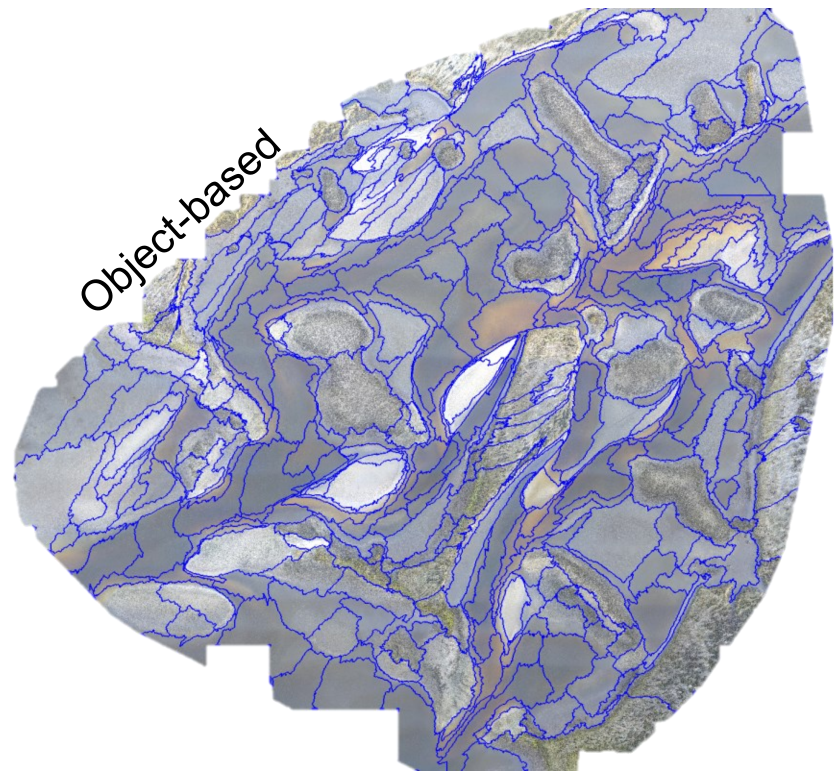


Coastal Habitat Mapping

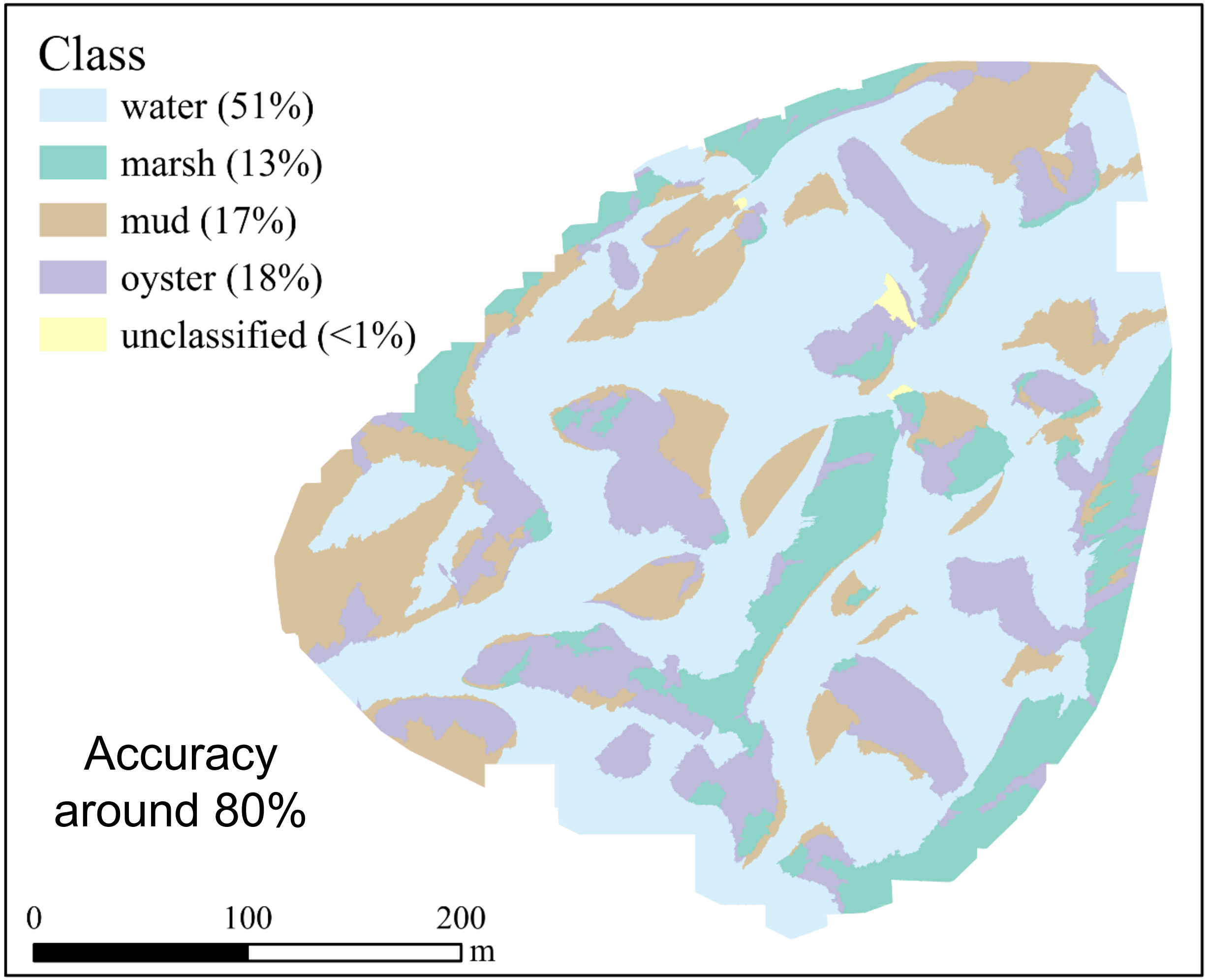


Object-based image analysis (OBIA)



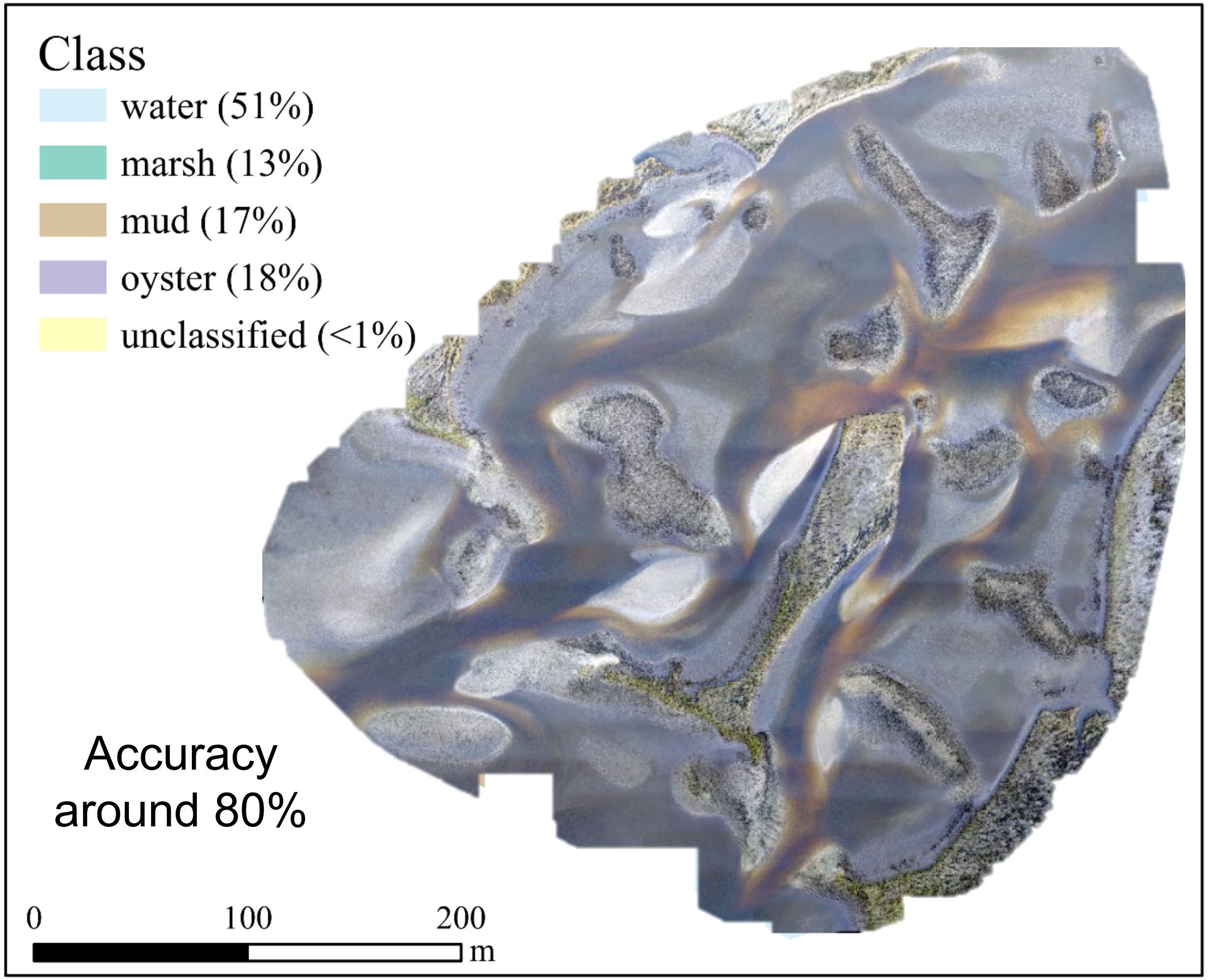


Coastal Habitat Mapping – Issues



Water / tidal movement causes spectral changes and artifacts in mosaic

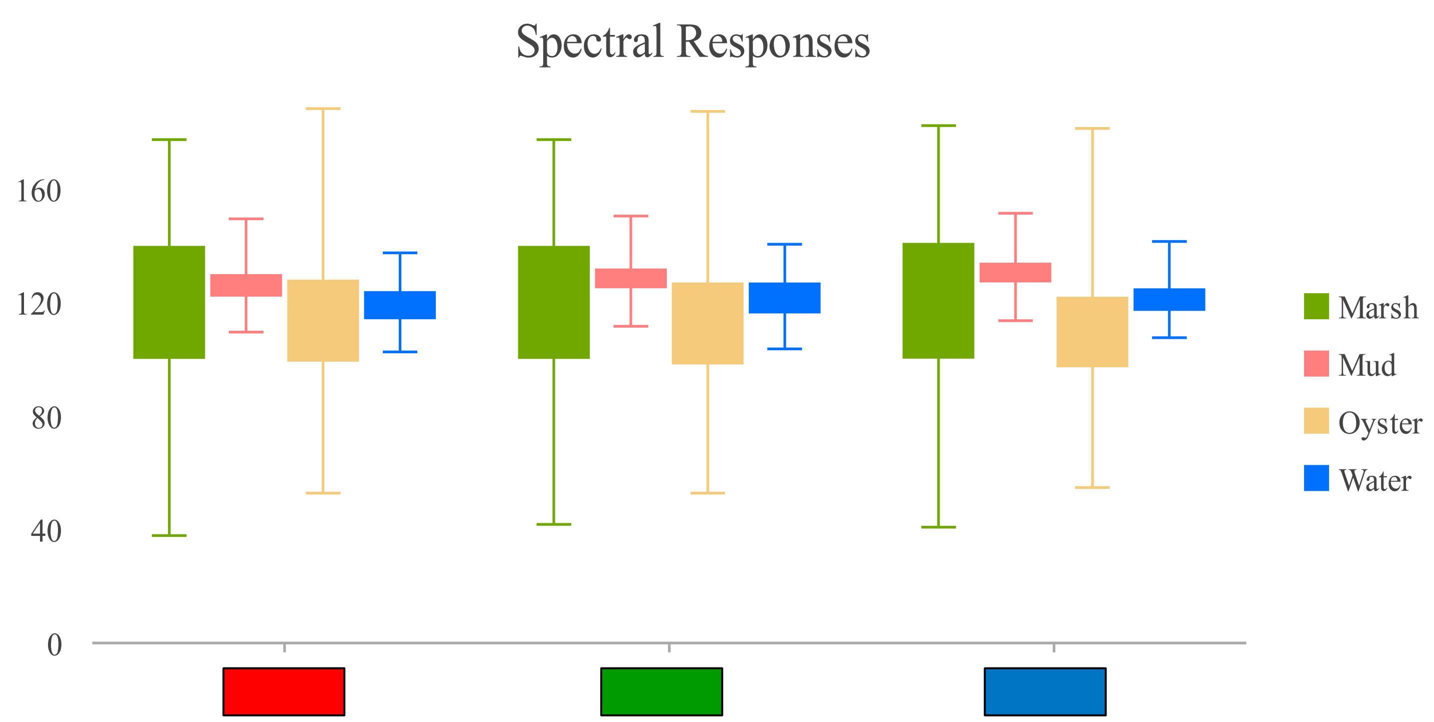
Coastal Habitat Mapping – Issues



Water / tidal movement causes spectral changes and artifacts in mosaic

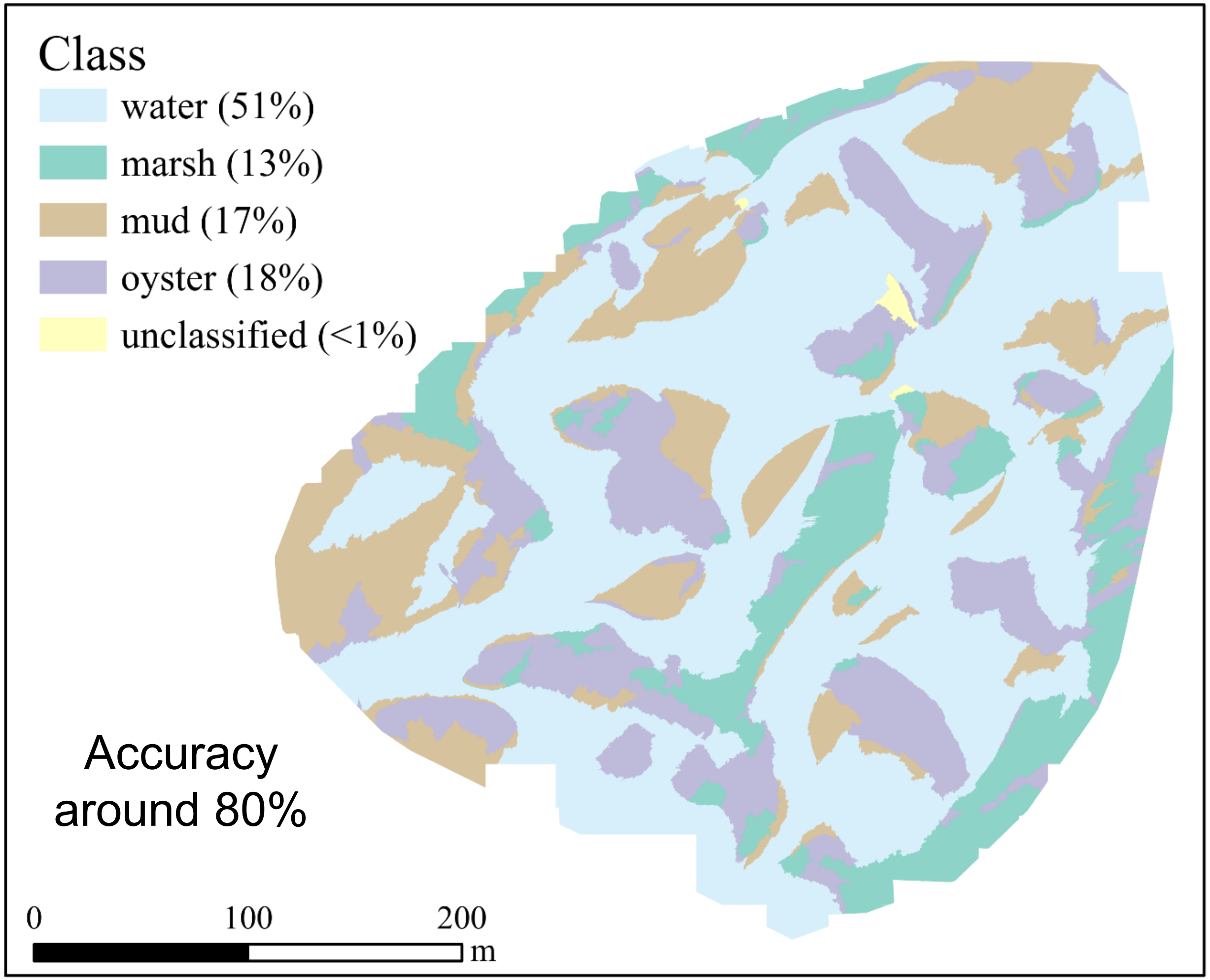
Coastal Habitat Mapping – Issues

Spectrally similar habitats



Data from Michael Espriella

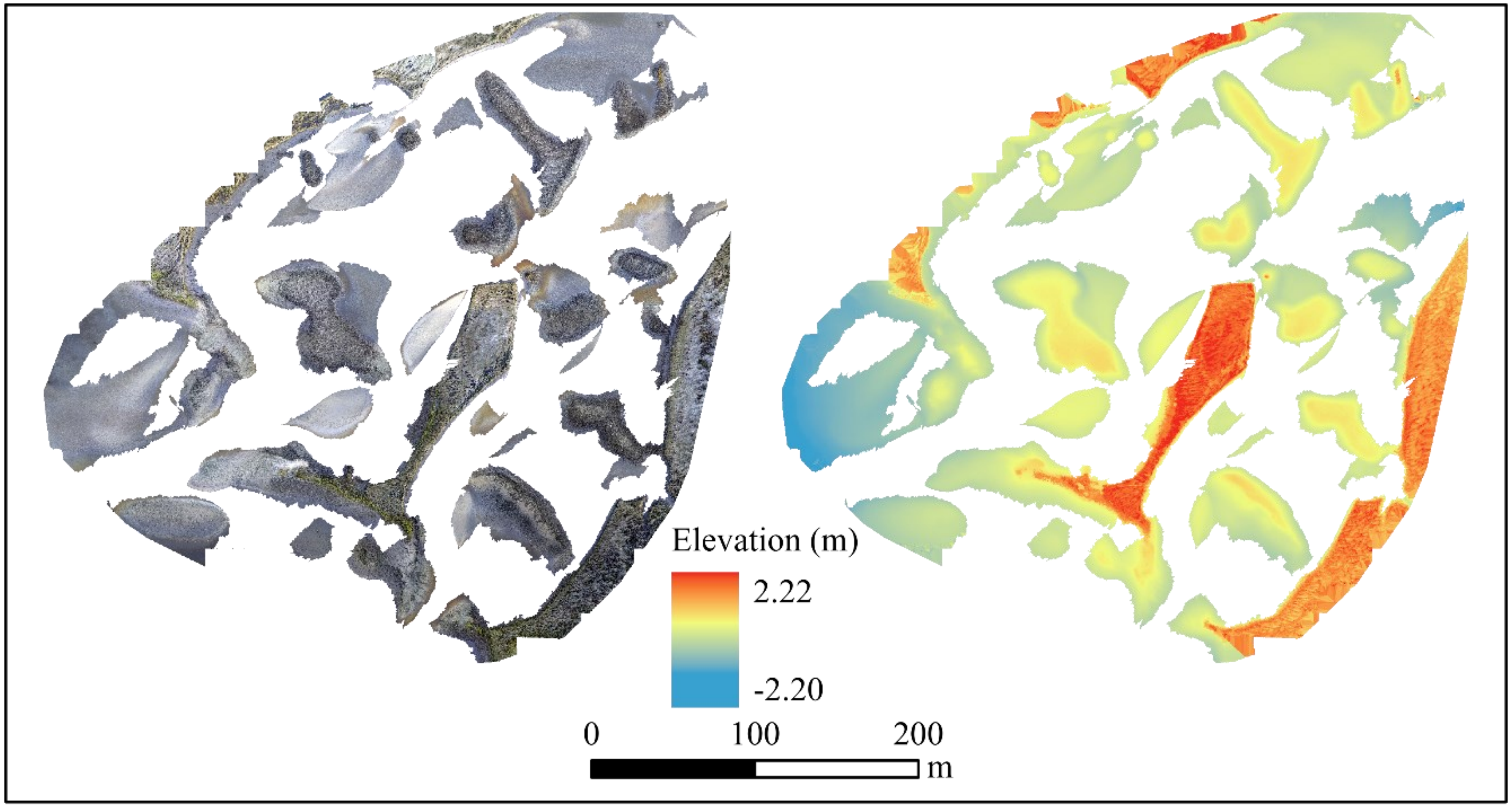
Coastal Habitat Mapping – Issues



For monitoring, we need to do better: what can we do?

Coastal Habitat Mapping – Issues

First, use structure-from-motion photogrammetry to produce a DSM…



…and then derive terrain variables (*e.g.*, slope, terrain complexity)

Issues of Spatial Scales

Different habitats are characterized by different features and patterns that relate to different ecological processes at different spatial scales

It is well-known in ecology that single-scale studies may fail to capture the relevant patterns and processes

Solution: Implement multiscale analyses

Multiscale Approaches

Can we use multiscale terrain characteristics to extract a topographic signature for our different habitat types?

Multiscale Approaches

WhiteboxTools

WhiteboxTools is an advanced geospatial data analysis platform developed at the University of Guelph's Geomorphometry and Hydrogeomatics Research Group (GHRG). The project began in January 2017 and quickly evolved in terms of its analytical capabilities.

- Contains **more than 445 tools** for processing various types of geospatial data.
- Many **tools operate in parallel**, taking full advantage of your multi-core processor.
- Written in the safe and **cross-platform** systems programming language Rust and **compiled to highly efficient native code**.
- Small stand-alone application with **no external dependencies**, making installation as easy as downloading the 8Mb zip file and decompressing it.
- **Simple yet powerful** Python scripting interface that allows users to develop custom scripted workflows.
- **Embed WhiteboxTools functions** into hetergenous scripting environments along with ArcPy, GDAL, and other geoprocessing libraries.
- Serves as an analytical back-end for other GIS and remote sensing software (e.g. the QGIS Whitebox for Processing plugin).
- Permissive MIT **open-source license** allows for ready integration with other software.
- Transparent software philosopy allows for **easy source code inspection** and rapid innovation and development.

See Download to obtain a copy of the WhiteboxTools software for your system.

WhiteboxTools

WhiteboxTools HOME
DOWNLOAD
USER MANUAL
SOURCE CODE REPO (GitHub)
SUPPORT
TUTORIALS
Whitebox GAT HOME

Contact Information

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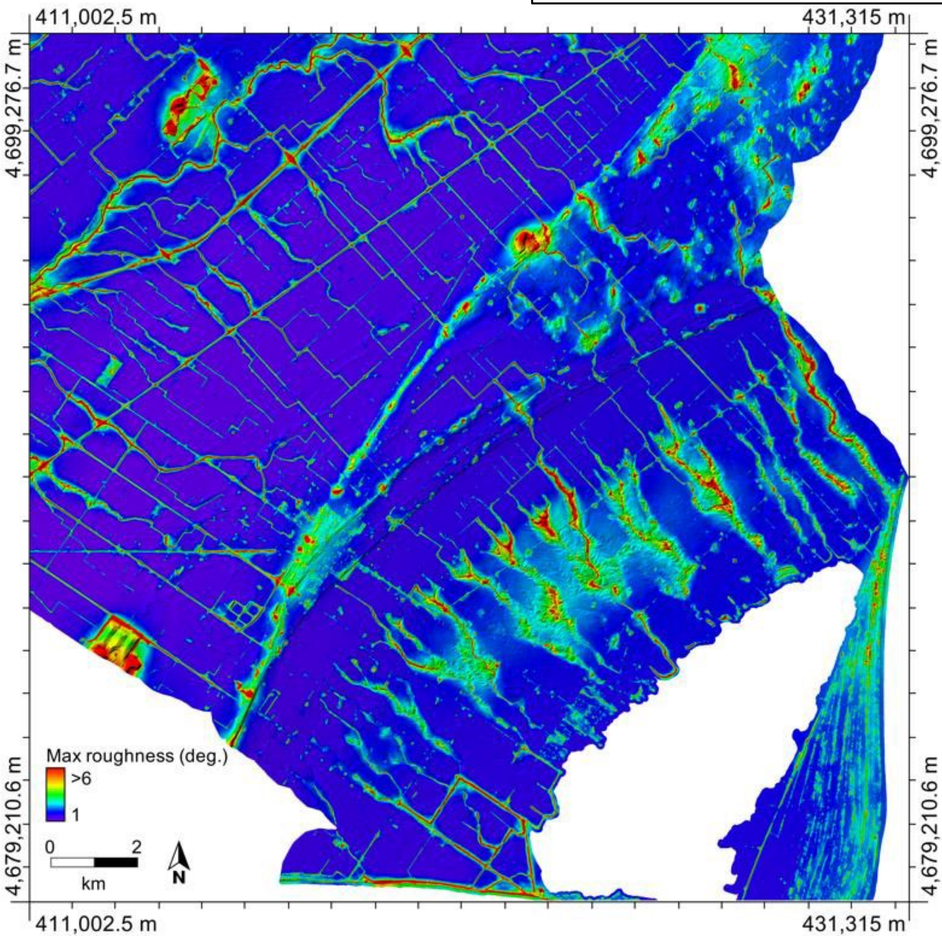
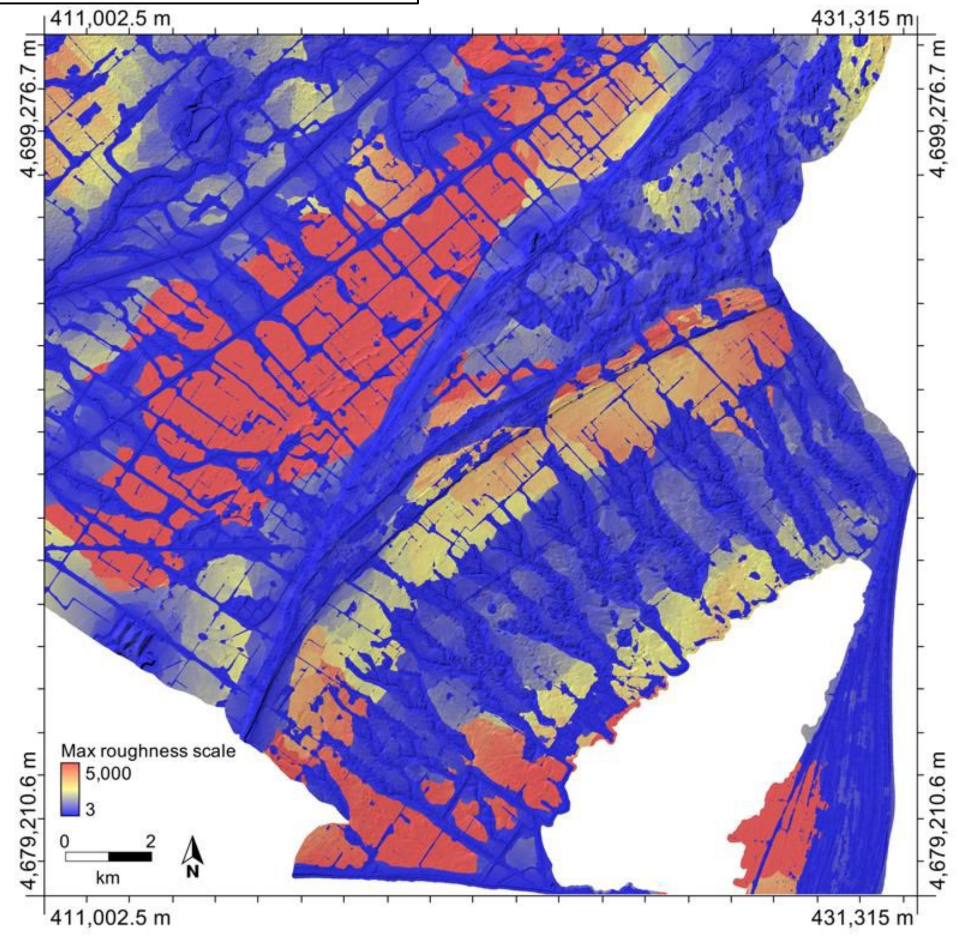
Multiscale Approaches

Geomorphometry.org/2018 Lindsay and Newman

Hyper-scale analysis of surface roughness

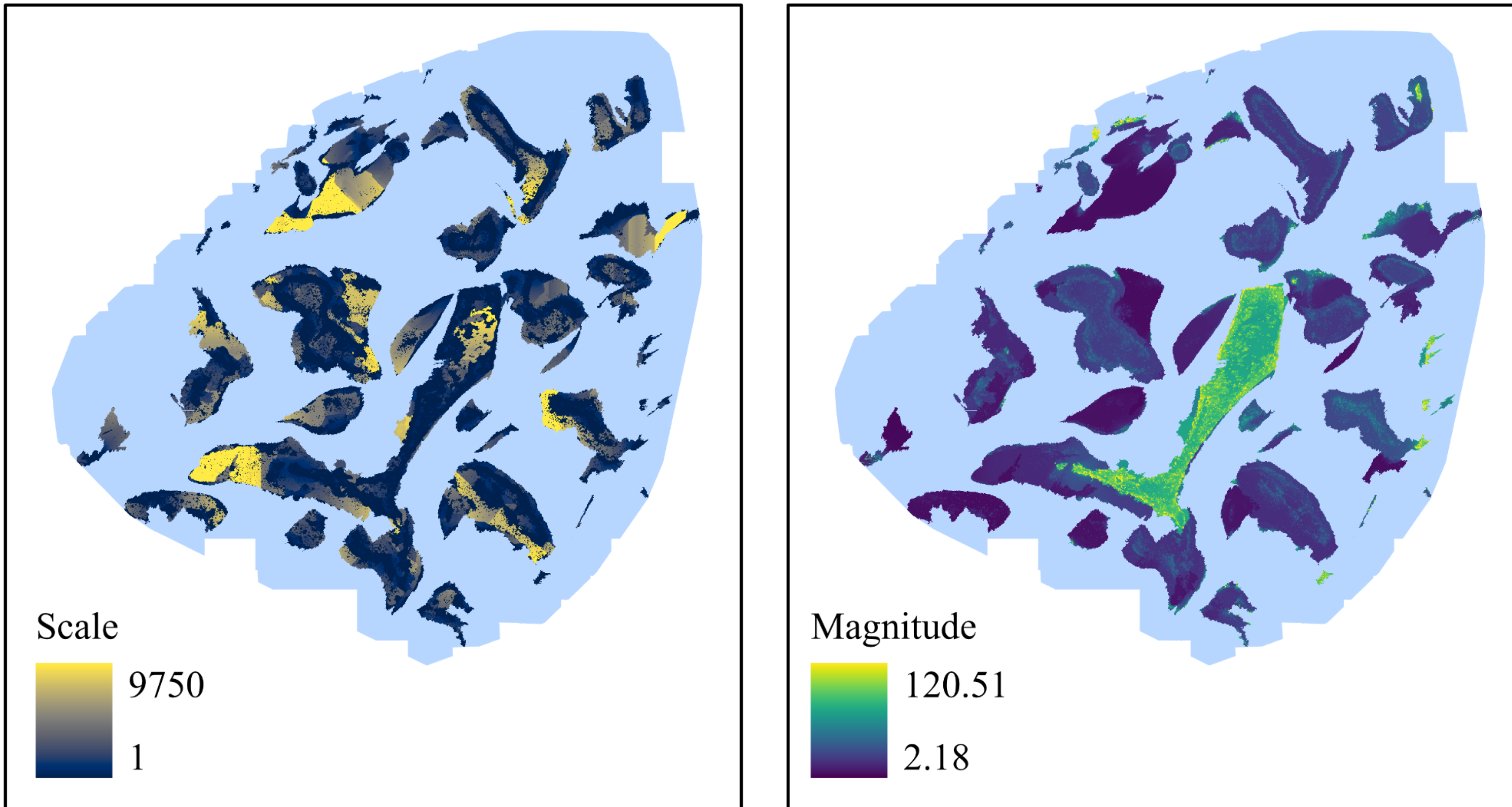
John B. Lindsay, Daniel R. Newman
Geomorphometry and Hydrogeomatics Research Group,
Department of Geography, University of Guelph
Guelph, Canada, Email: jlindsay@uoguelph.ca





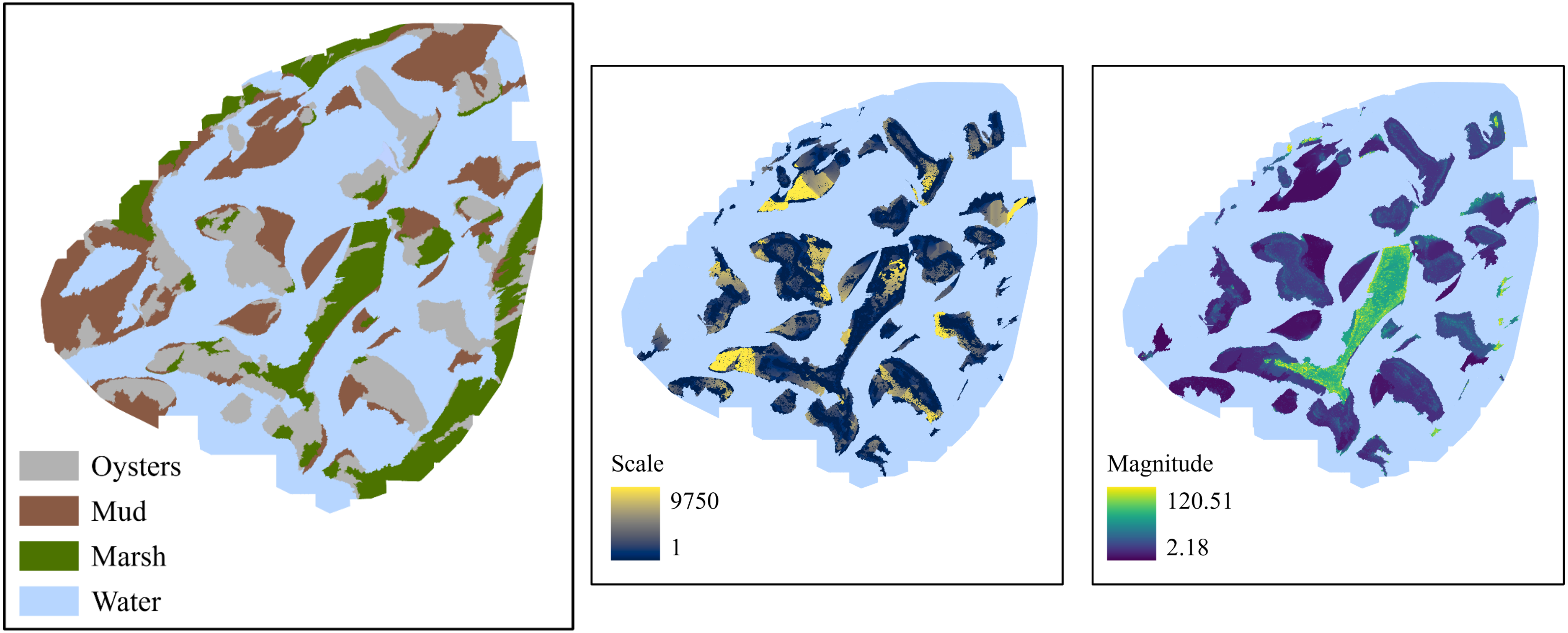
Multiscale Roughness

Multiscale Roughness



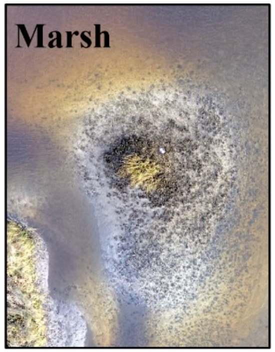
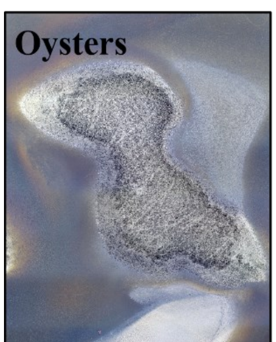
Analysis scales varying between 3 and 9750 (1.8 cm to 58.5 m)

Multiscale Roughness

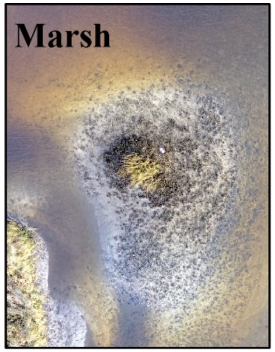
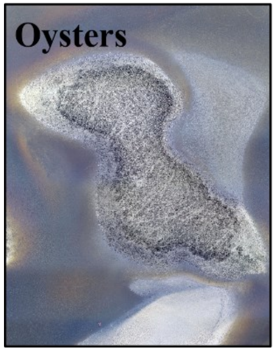


Analysis scales varying between 3 and 9750 (1.8 cm to 58.5 m)

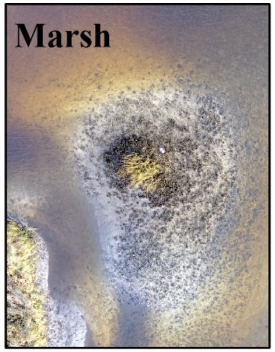
Multiscale Roughness

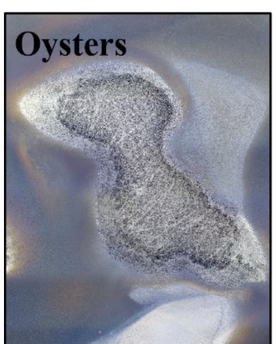
	Magnitude of Roughness	Scale of Roughness
	Highest	Finest
	Lowest	Broadest
	Relatively High	Relatively Fine

Multiscale Roughness

	Magnitude of Roughness	Scale of Roughness	Ecological Scale
	Highest	Finest	1.5 m
	Lowest	Broadest	12.9 m
	Relatively High	Relatively Fine	5.3 m

Multiscale Roughness



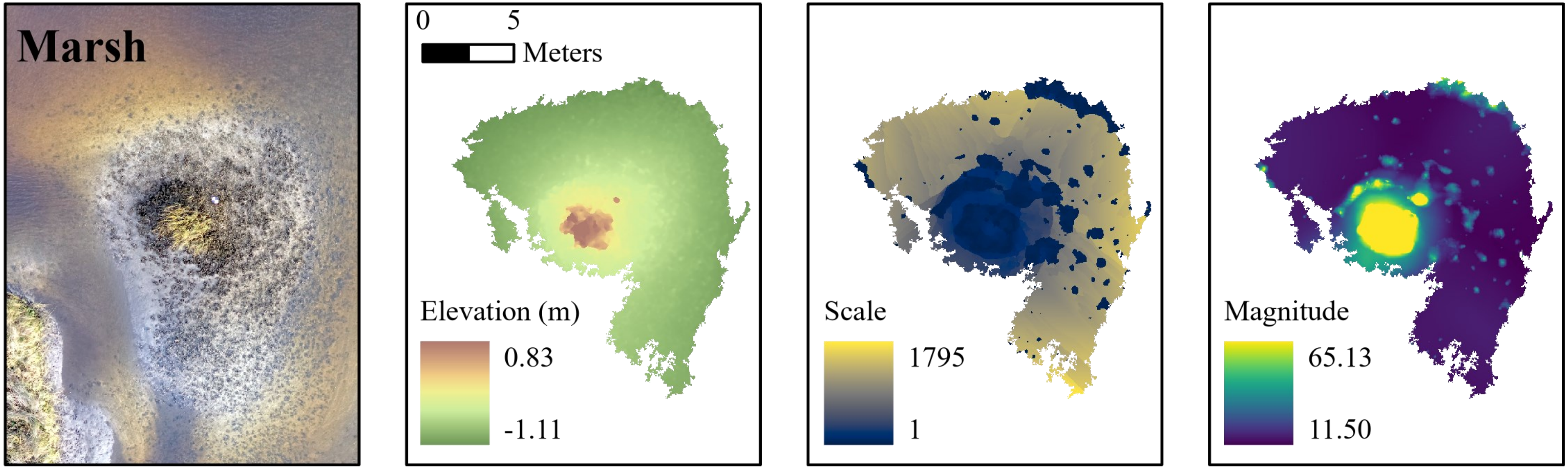


Magnitude of Roughness	Scale of Roughness	Ecological Scale
Highest	Finest	1.5 m
Lowest	Broadest	12.9 m
Relatively High	Relatively Fine	5.3 m

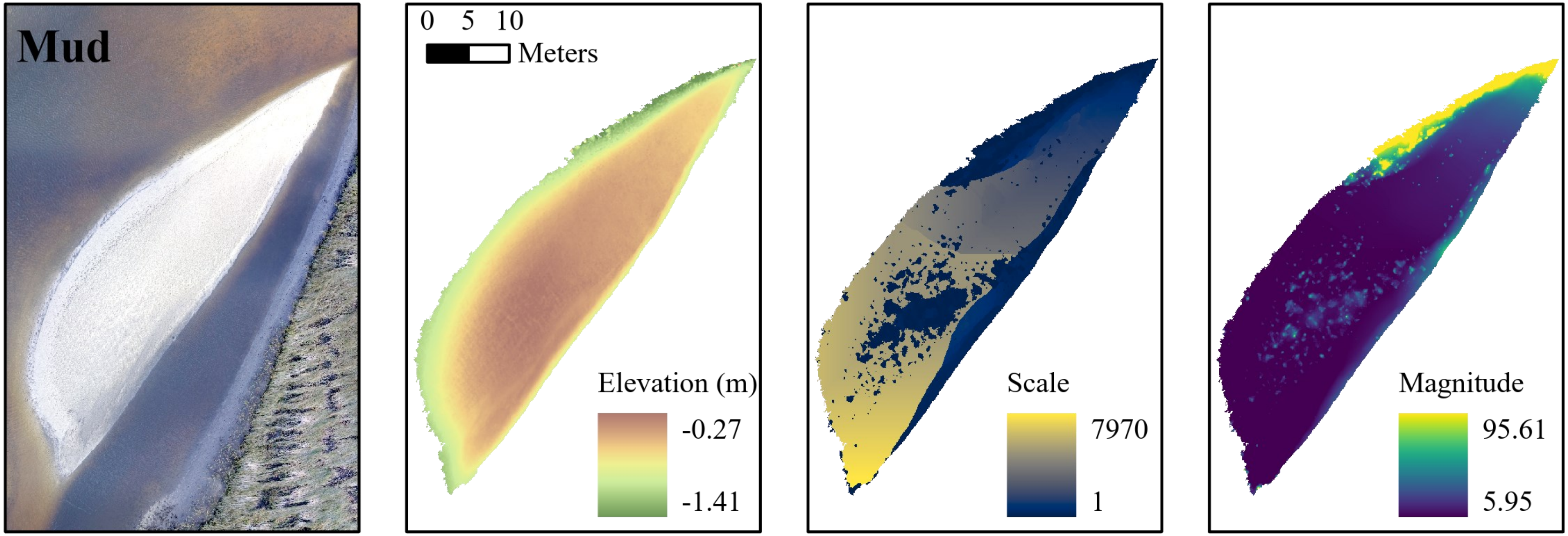
We can differentiate coastal habitats using their multiscale topographic characteristics

We can develop topographic signatures

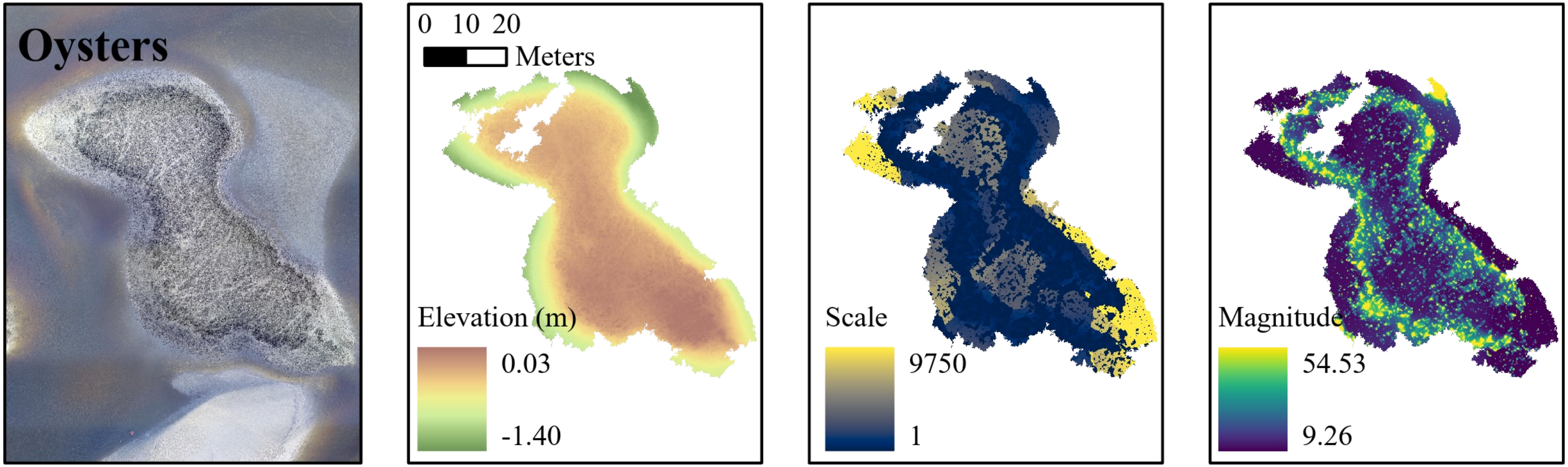
Multiscale Roughness



Multiscale Roughness



Multiscale Roughness



Conclusions

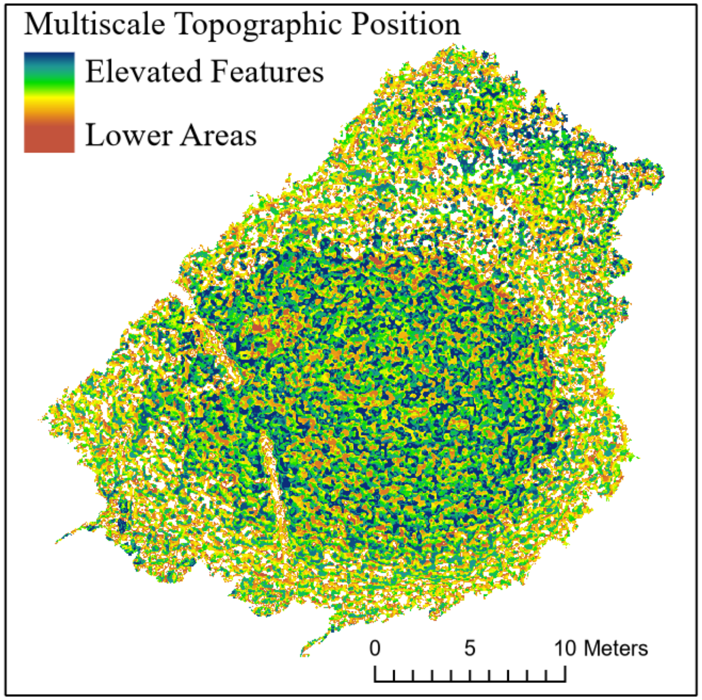
Good example of how geomorphometry can contribute to answering marine and coastal ecological questions

Developing topographic signatures for different coastal habitats is promising to address some important surveying and sampling challenges associated with intertidal environments

Conclusions

Next steps:

-Extending the analysis to other multiscale terrain variables

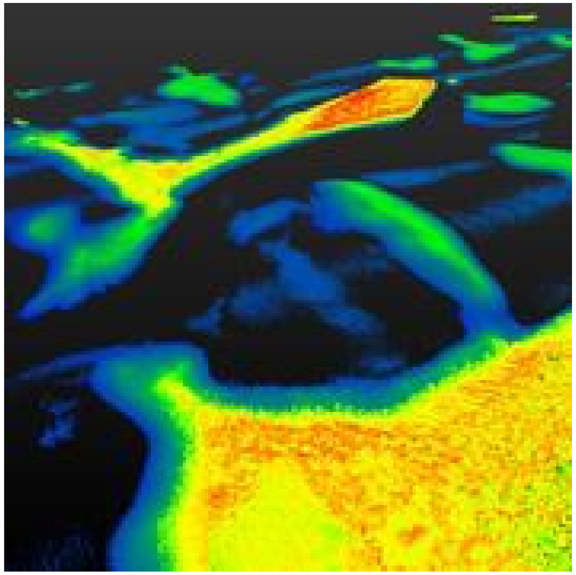


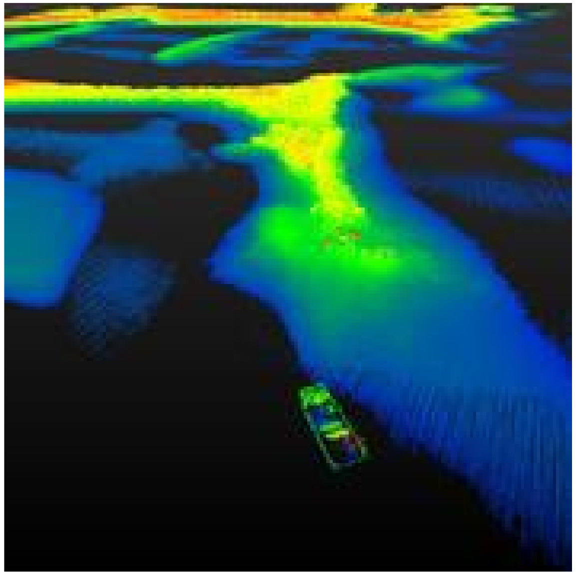
Conclusions

Next steps:

-Extending the analysis to other multiscale terrain attributes

-Comparing results from a DSM with results from a DTM and lidar data





Conclusions

Next steps:

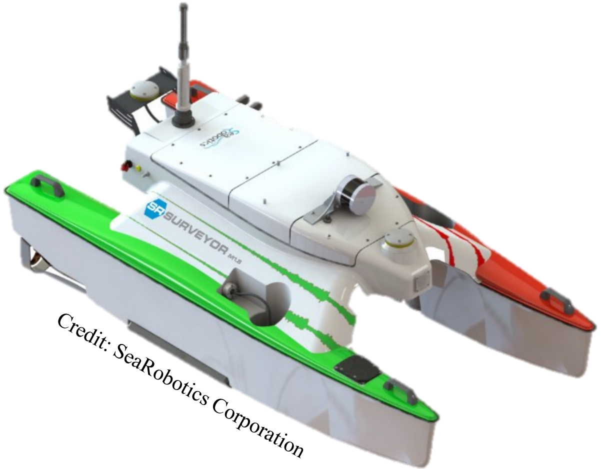
-Extending the analysis to other multiscale terrain attributes

-Comparing results from a DSM with results from a DTM and lidar data

-Integrating these multiscale variables in the GEOBIA workflow

-Compare the topographic signature of intertidal oysters to that of subtidal oysters

Credit: Sofar Ocean



Credit: SeaRobotics Corporation

Thank you!

The Marine Geomatics Lab

Bridging Ecological and Spatial Sciences

www.TheLecoursLab.org

University of Florida Fisheries & Aquatic Sciences Program SFRC

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