

# EARTH OBSERVATION FOR COASTAL ECOSYSTEM ACCOUNTING: A MATCH MADE IN HEAVEN FOR NATURAL CLIMATE SOLUTIONS

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Madagascar, Multi-annual Sentinel-2 mosaic

**GLOBAL  
SEAGRASS  
WATCH**  
serverless is more

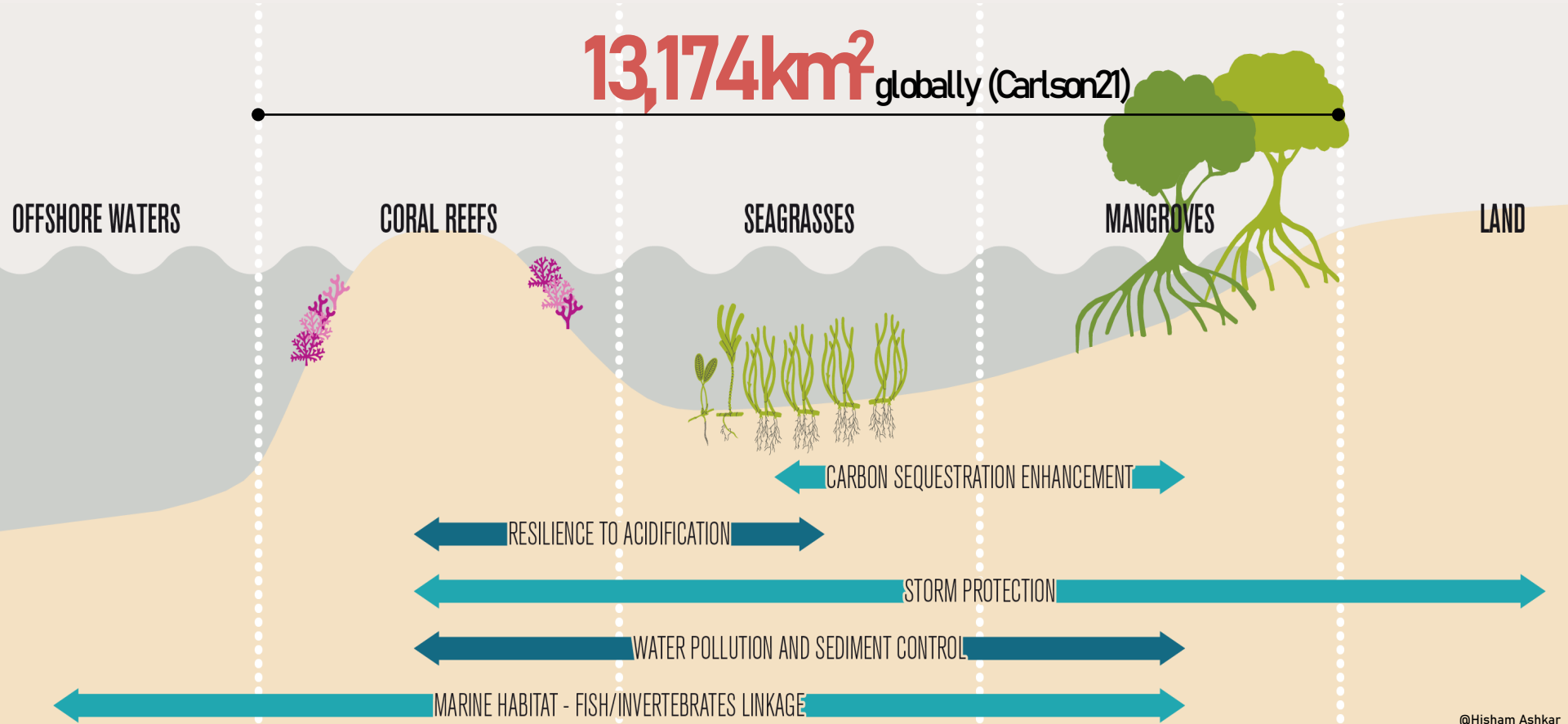


Deutsches Zentrum  
für Luft- und Raumfahrt  
German Aerospace Center

LPS22, A2.02 Ecosystem Accounting - 24.05.2022

# INTERCONNECTED COASTAL NATURAL CLIMATE SOLUTIONS

13,174km<sup>2</sup> globally (Carlson21)



# 100 million

Seagrasses provide coastal protection to more than 100 million people.

Seagrasses reduce wave strength and protect the coast from erosion.

# 159

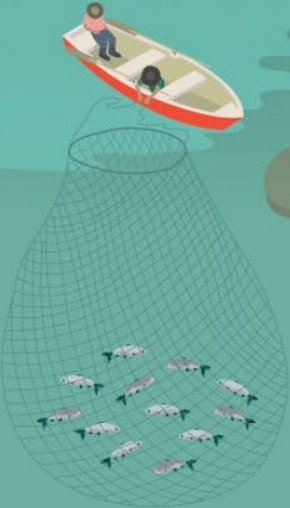
The countries which have seagrasses in their coastal extent.

# 350,000 km<sup>2</sup>

The approximate total global seagrass extent, almost the size of Germany.

# 25-50%

Reduction of Tidal Height



# 20%

The percentage of global fisheries supported by seagrasses.



# CO<sub>2</sub>



# 18%

The amount of the annual oceanic carbon sequestered by seagrasses.

This number is 29% more than the annual carbon emissions of the whole cruise ship industry.

# 50%

The reduction of marine pathogenic bacteria by seagrasses.

Seagrasses reduce exposure to bacterial pathogens known to cause diseases in both humans and marine organisms.



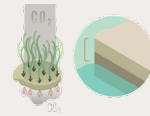
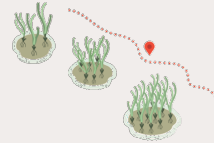
# KNOWLEDGE GAPS AND UNCERTAINTIES

- Uncertainty in global seagrass extent: **160,387–4,320,000 km<sup>2</sup>**  
(Fourqurean12; Jayatilake18; McKenzie20; UNEP18)
- Sparsity in scalable, standardized and spatially explicit monitoring frameworks
- Uncertainties in global seagrass ecosystem condition and services

Global carbon stock: **4.2–19.9 PgC** (Fourqurean12)

Global carbon sequestration rate: **4.8–87.3 TgCyr<sup>-1</sup>** (McLeod11)

- Only **17%** within MPAs vs **40%** of corals & **43%** of mangroves (UNEP20)
- Lack of relevant seagrass indicators & tracking of progress of pertinent Multilateral Environmental Agreements (CBD, IPBES, NDCs, SDGs, MPAs)



# THE GLOBAL SEAGRASS WATCH PROJECT

## GLOBAL SEAGRASS WATCH

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<https://www.linkedin.com/company/global-seagrass-watch>

**2019-2023**

**529,000 EUR**

technology transfer fund



DLR

Deutsches Zentrum  
für Luft- und Raumfahrt  
German Aerospace Center

**2020-2022**

**125,000 EUR**

technical support

Google Earth Engine

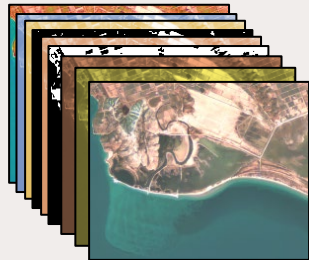




# OUR SCALABLE ECOSYSTEM ACCOUNTING PROTOTYPE

Powerful Cloud computing  
Google Earth Engine

TB-scale satellite data analytics  
(Sentinel-2, PlanetScope NCFI)



Machine Learning

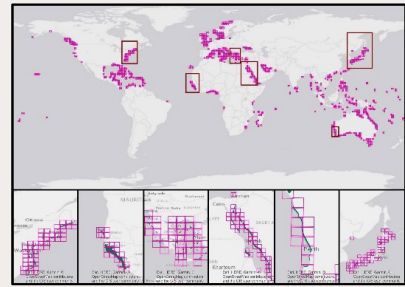


Big reference data



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WATCH**  
serverless is more

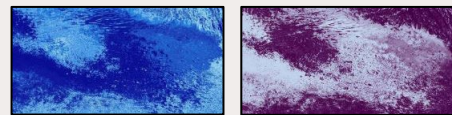
Spatially-explicit  
seagrass ecosystem extent



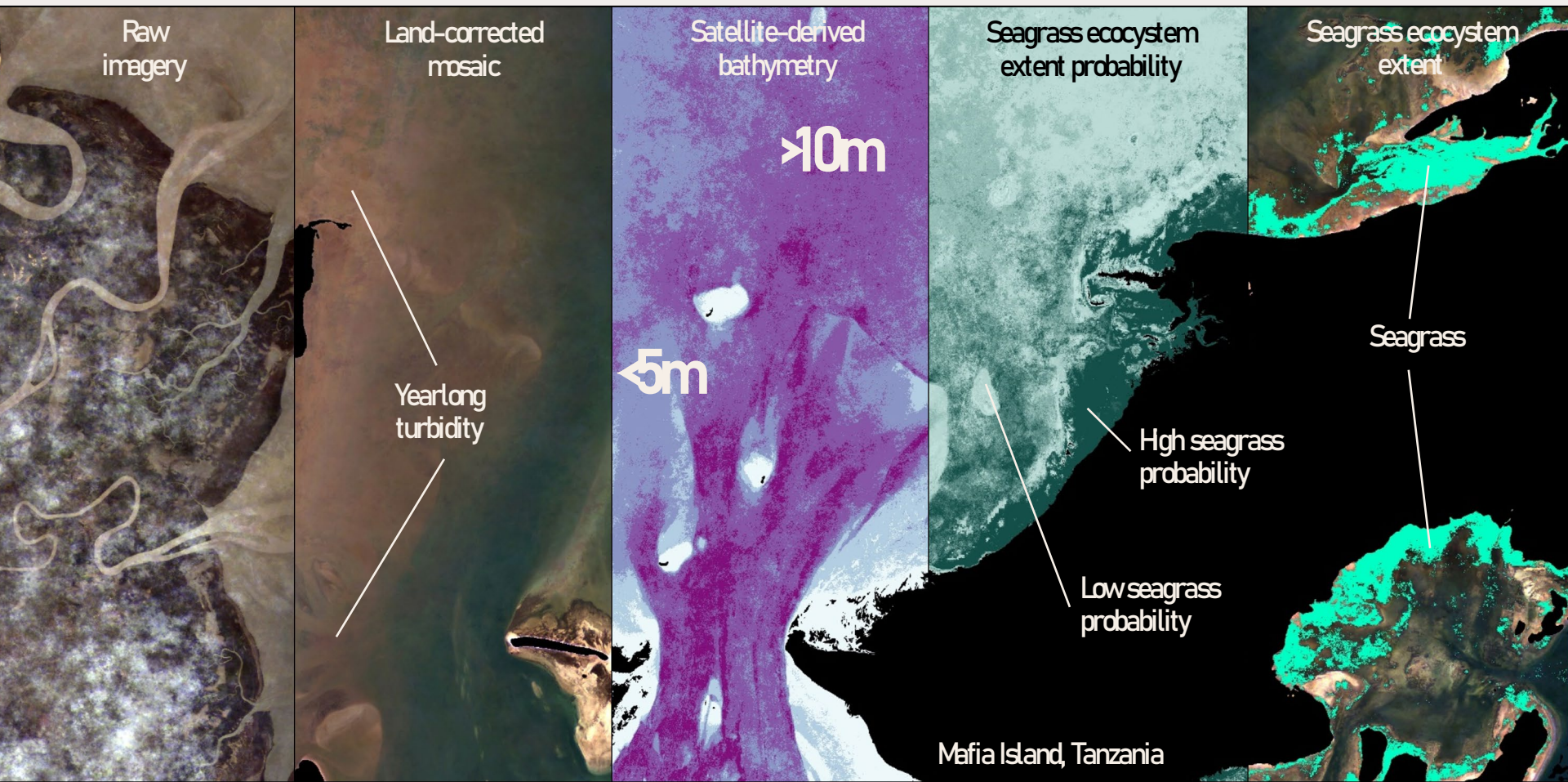
Spatially-explicit  
seagrass ecosystem condition & services



Per-pixel  
probabilities & uncertainties



# SPATIALLY-EXPLICIT SEAGRASS ECOSYSTEM ACCOUNTS



# MULTI-NATIONAL TEMPERATE SEAGRASS ECOSYSTEM ACCOUNTING (2019-20)



22

Mediterranean countries

56,783 km<sup>2</sup>

Mapped seabed area

>19,000 km<sup>2</sup>

Mapped seagrass area

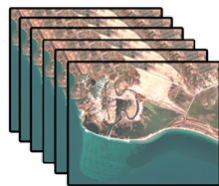
72 %

Overall accuracy



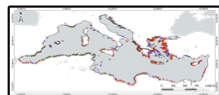
279,186

10-m Sentinel-2 image tiles (2015-2019)



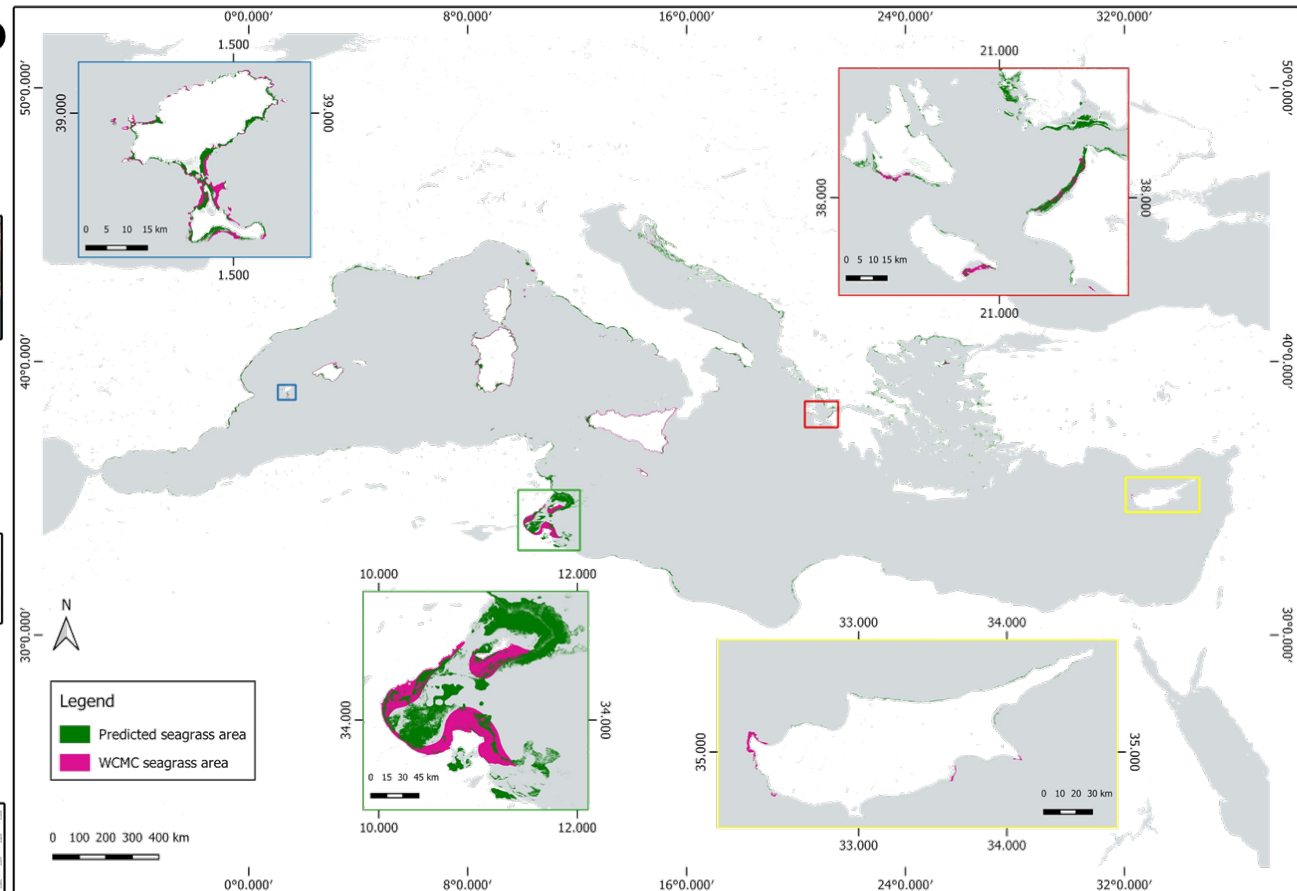
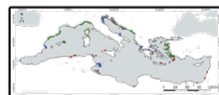
62,928

Human-labelled training pixels



2,480

Field-collected validation points

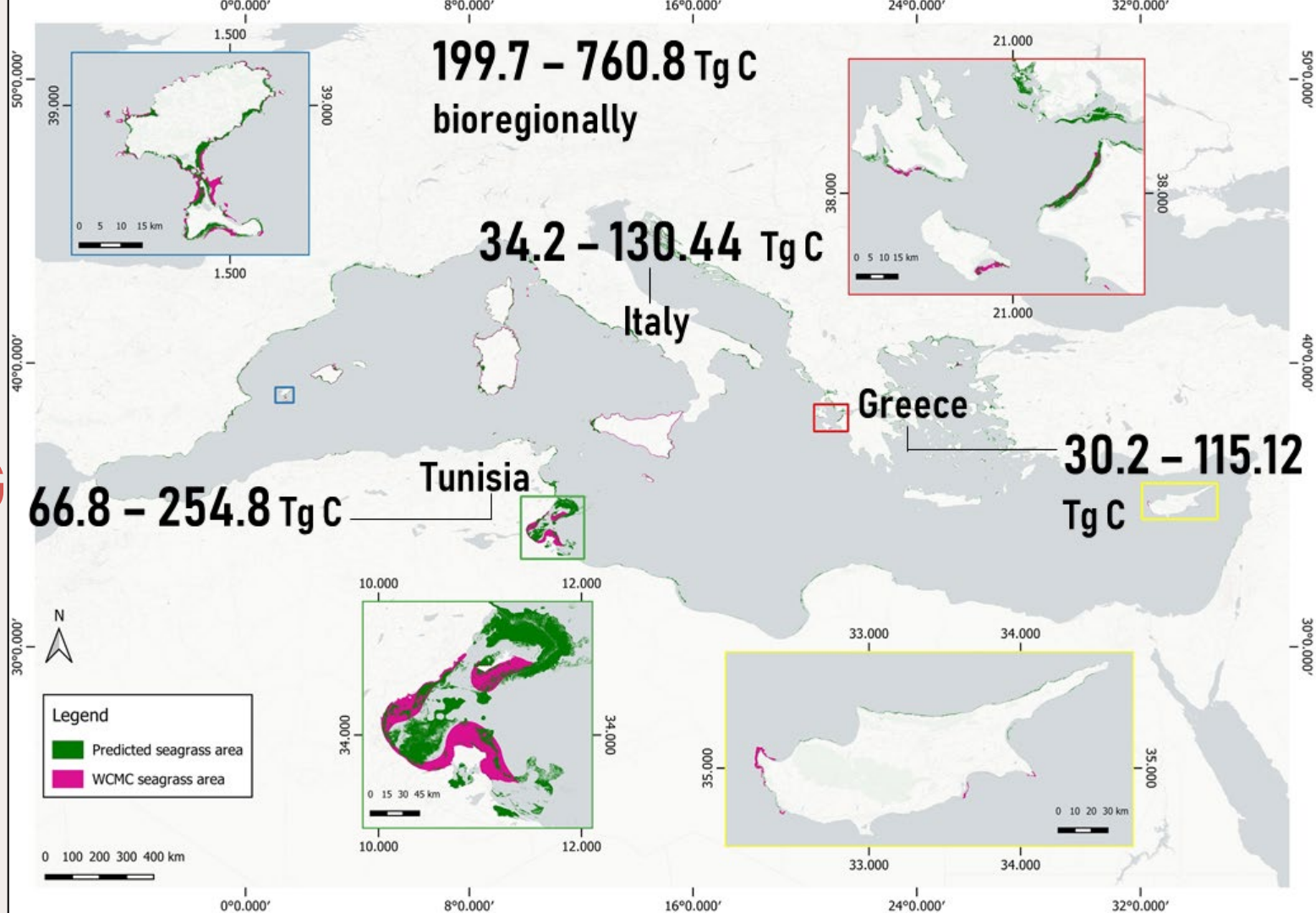


Traganos et al. (2020). *Cloud-native advances in Earth Observation reveal the pan-Mediterranean extent of the Posidonia oceanica seagrass ecosystem.* Manuscript submitted for publication.



# MULTI-NATIONAL TEMPERATE SEAGRASS ECOSYSTEM ACCOUNTING

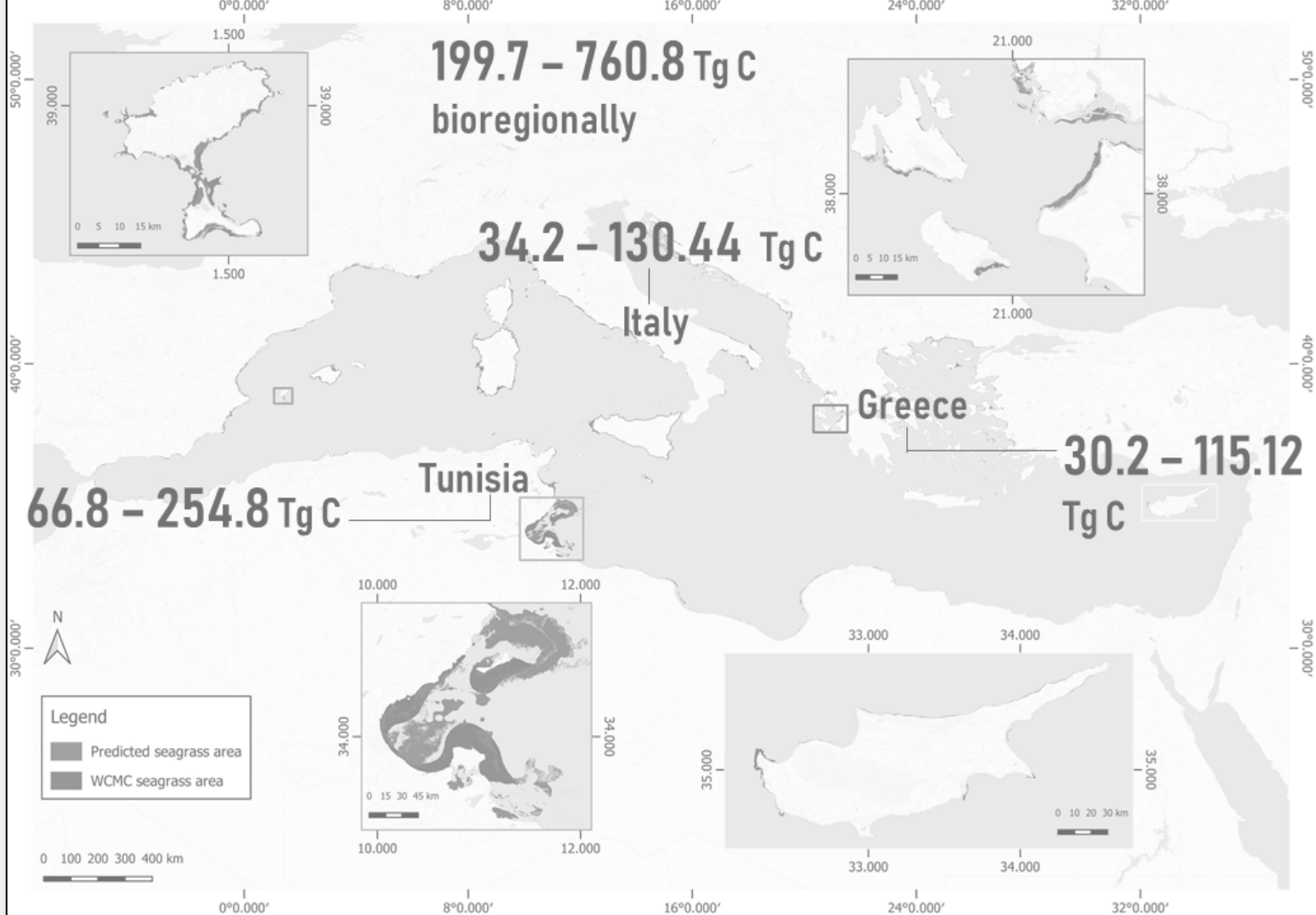
Tier 1 assessment (IPCC, 2013)



CHENFA  
BENJAMIN  
LEE

A8.11  
POSTER  
SESSION

TODAY-  
17:20



# EAST AFRICAN TROPICAL SEAGRASS ECOSYSTEM ACCOUNTING (2020-21)

**4,316 km<sup>2</sup>** of seagrass ecosystem extent

Up to **40.2 TgC** of total seagrass carbon stocks

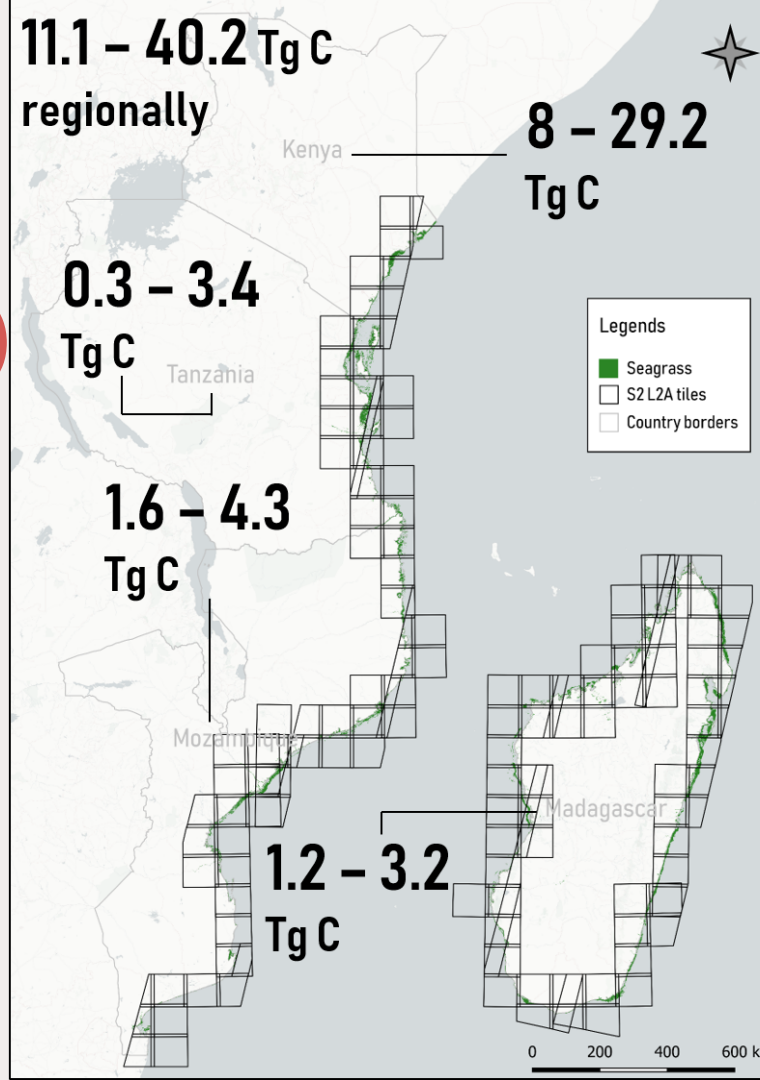
Tier 2 assessment (IPCC, 2013)

Public field-collected seagrass carbon stocks

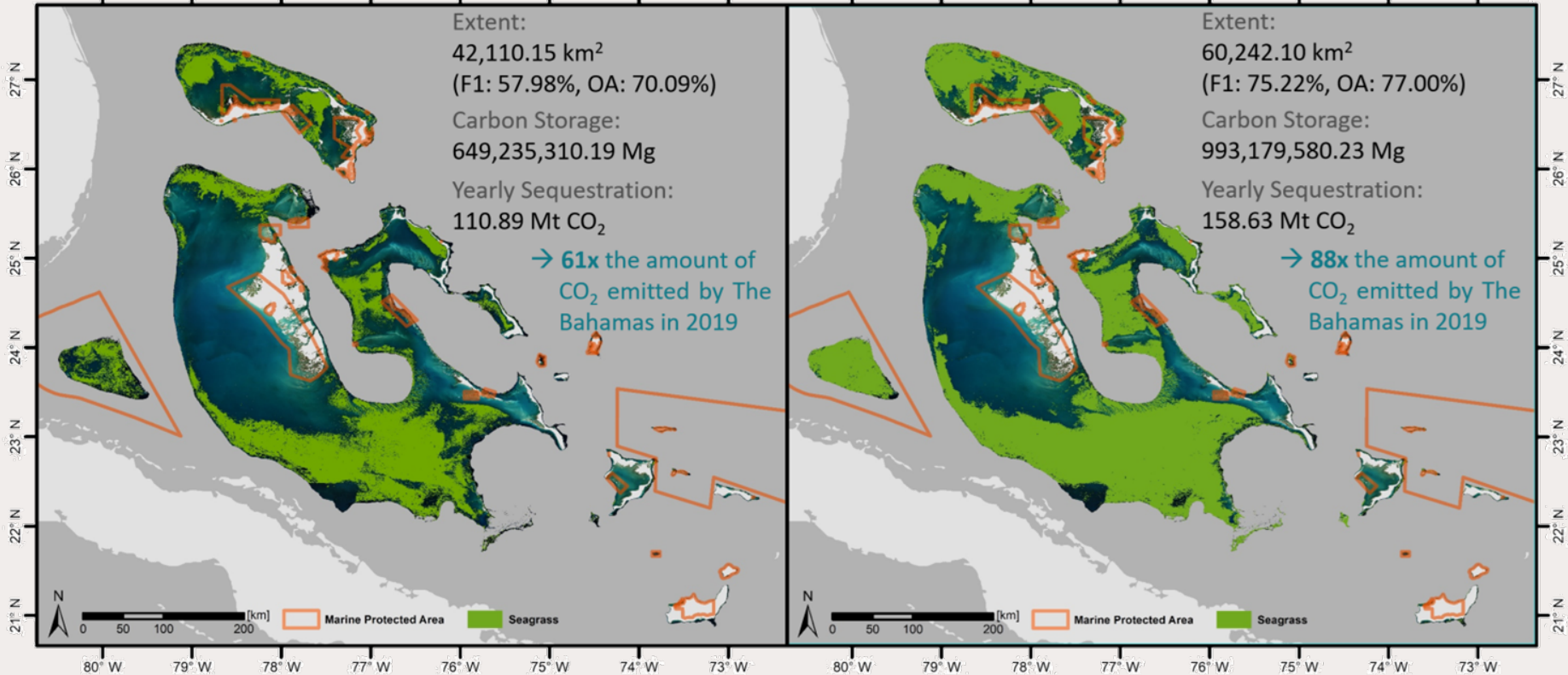


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*Earth Observation for Ecosystem Accounting:  
Spatially-explicit national seagrass extent and  
carbon stock in Kenya, Tanzania, Mozambique, and Madagascar*  
Accepted for publication in RSEC.

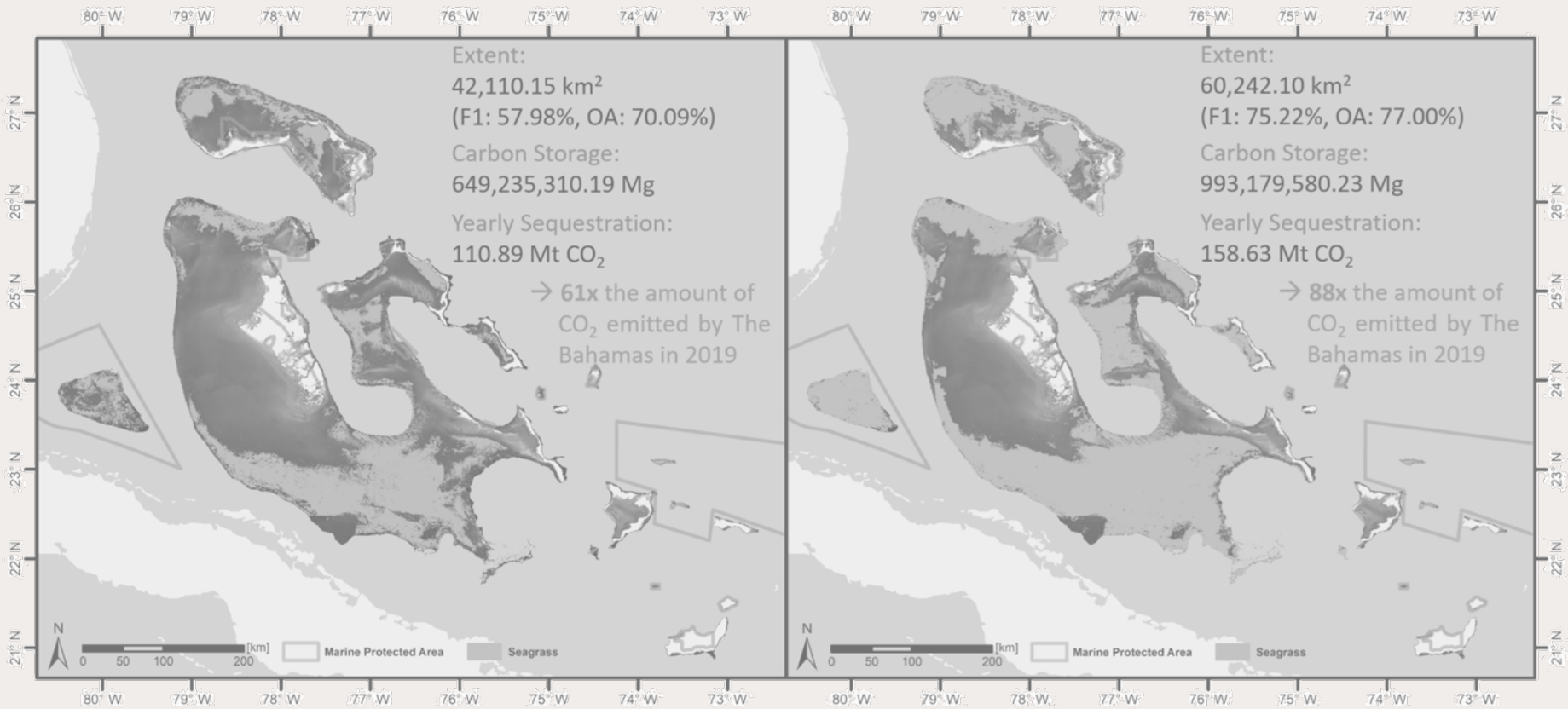


# BAHAMIAN SEAGRASS ECOSYSTEM EXTENT & CARBON ACCOUNTING (2021-22)





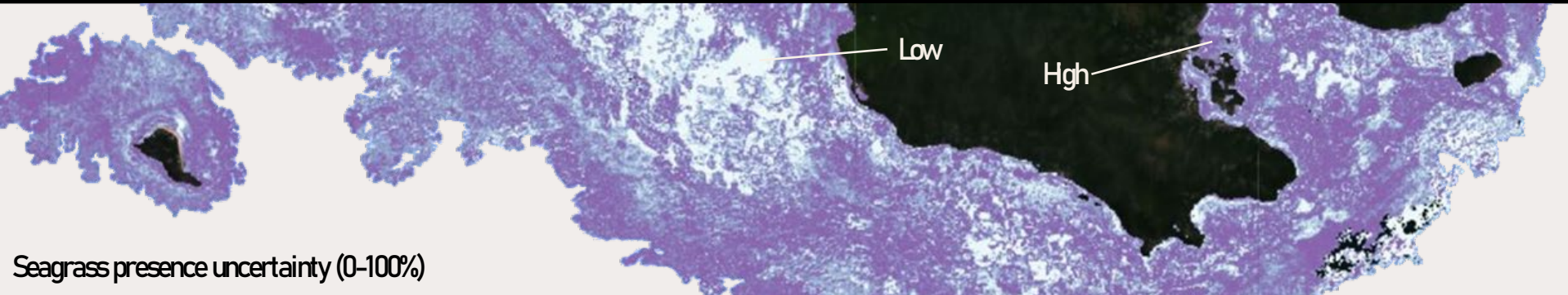
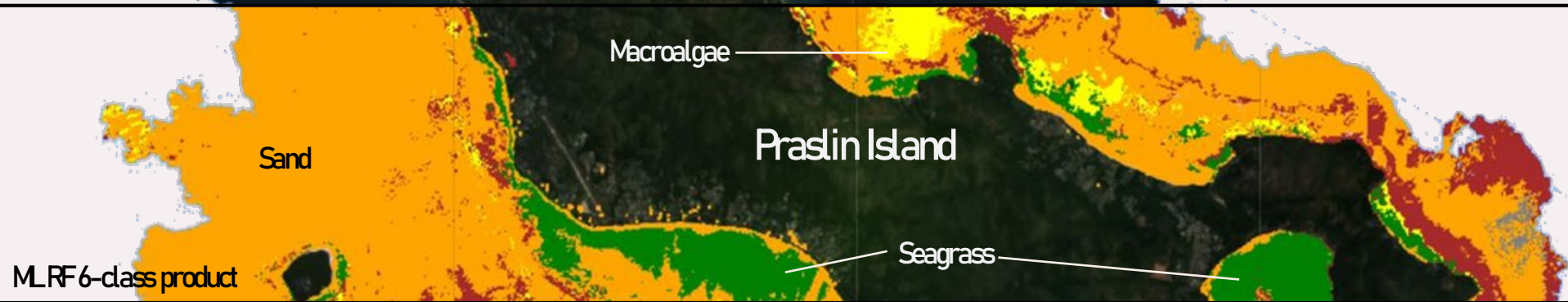
# ALINA BLUME A2.02 POSTER SESSION TODAY – 17:20



# SEYCHELLOIS SEAGRASS ECOSYSTEM EXTENT & CARBON ACCOUNTING (2021-22)

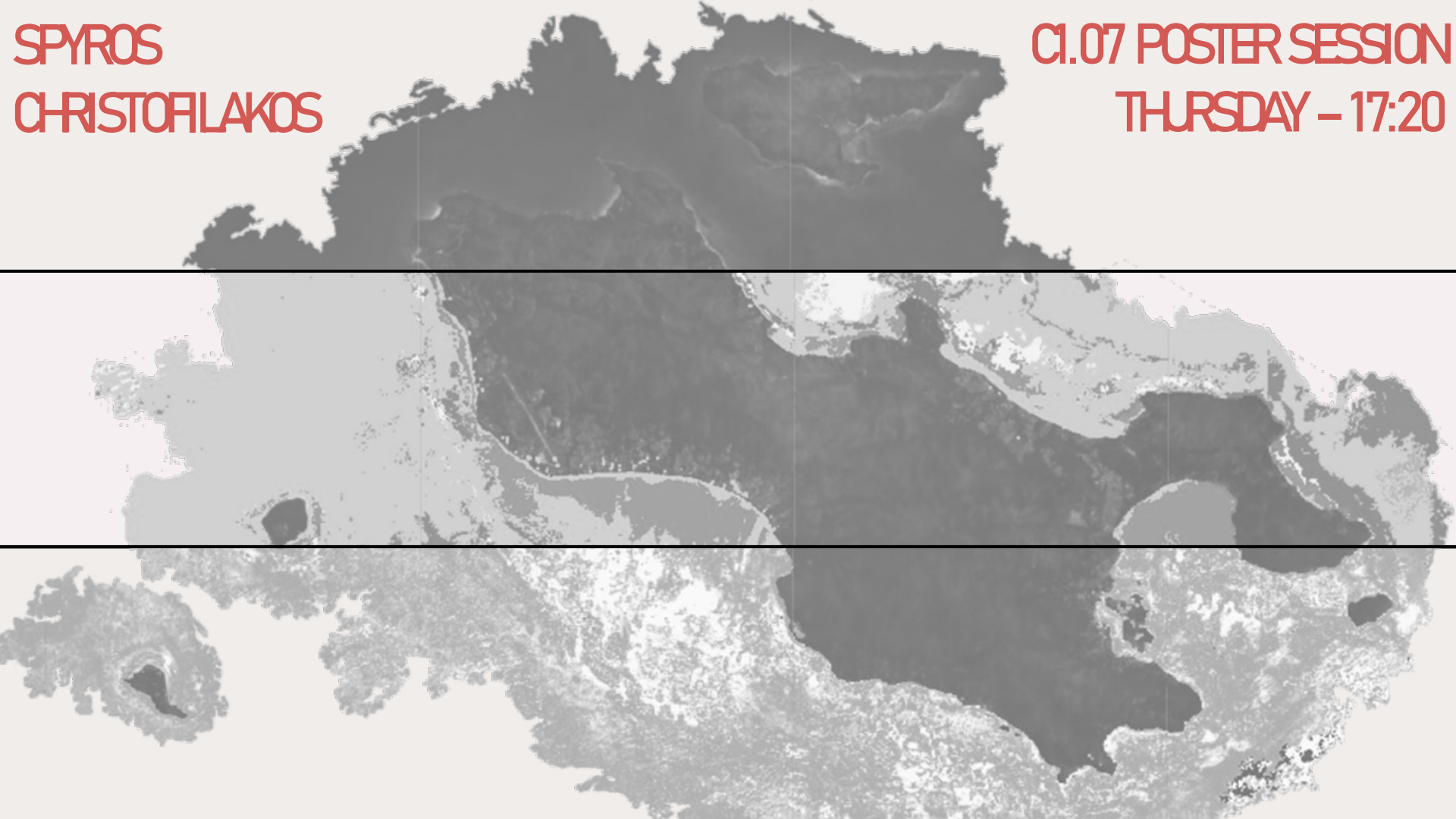


Multi-annual PlanetScope SR composite



SPYROS  
CHRISTOFILAKOS

C1.07 POSTER SESSION  
THURSDAY - 17:20



# ESA BICOME

# COASTAL BIODIVERSITY

# PROJECT (2021-23)

 @BcomeProject

ESA Biodiversity+ Precursors call (ESA/AO/1-10527/20/1-EF)

Spatially-explicit seagrass biodiversity accounts  
(Mozambique and Indonesia)

**PML** | Plymouth Marine  
Laboratory

  
UNIVERSITÉ DE NANTES

 **HYGEOS**

 **DLR**  
Deutsches Zentrum  
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German Aerospace Center

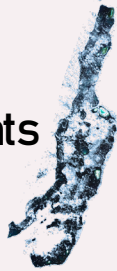
Indonesia, Multi-annual PlanetScope  
mosaic



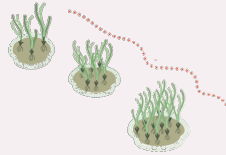


# THE PRESENT SHOWSTOPPERS

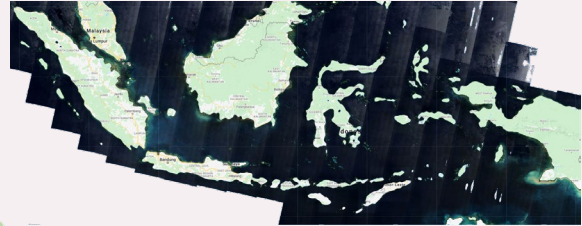
- Inaccurate deep seagrass extent accounts



- Lack of fit-for-purpose reference seagrass data



- Remaining challenges in scalable multi-temporal analytics



- Uncertainties in coastal ecosystem monetary accounting



- Problematic tracking of progress of relevant Multilateral Environmental Agreements (NDCs, SDGs, MPAs, CBD)



# THE FUTURE OF COASTAL ECOSYSTEM ACCOUNTING

- Holistic, spatially-explicit coastal ecosystem accounting at national spatial scales & interannual temporal scales
- Collaboration with scientists for integration of big field-collected coastal reference data & ecological modelling
- Collaboration with policy makers to streamline spatially- & uncertainty-aware coastal conservation and restoration
- Collaboration with governments, industry & NGOs to improve funding for long-term, holistic coastal ecosystem service accounting, reliant on ecology, translated into \$\$\$ & measurable targets



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Research Associate



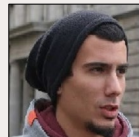
**Alina Blume**  
Research Associate



Bahamas, Multi-annual Sentinel-2 mosaic



**Benjamin Lee Chengfa**  
PhD Candidate



**Spyros Christofilakos**  
PhD Candidate



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