

KHEOBS Day 2024

KHmer **E**arth **OBS**ervation **D**ay

28 May 2024

Institute of Technology of Cambodia, Phnom Penh

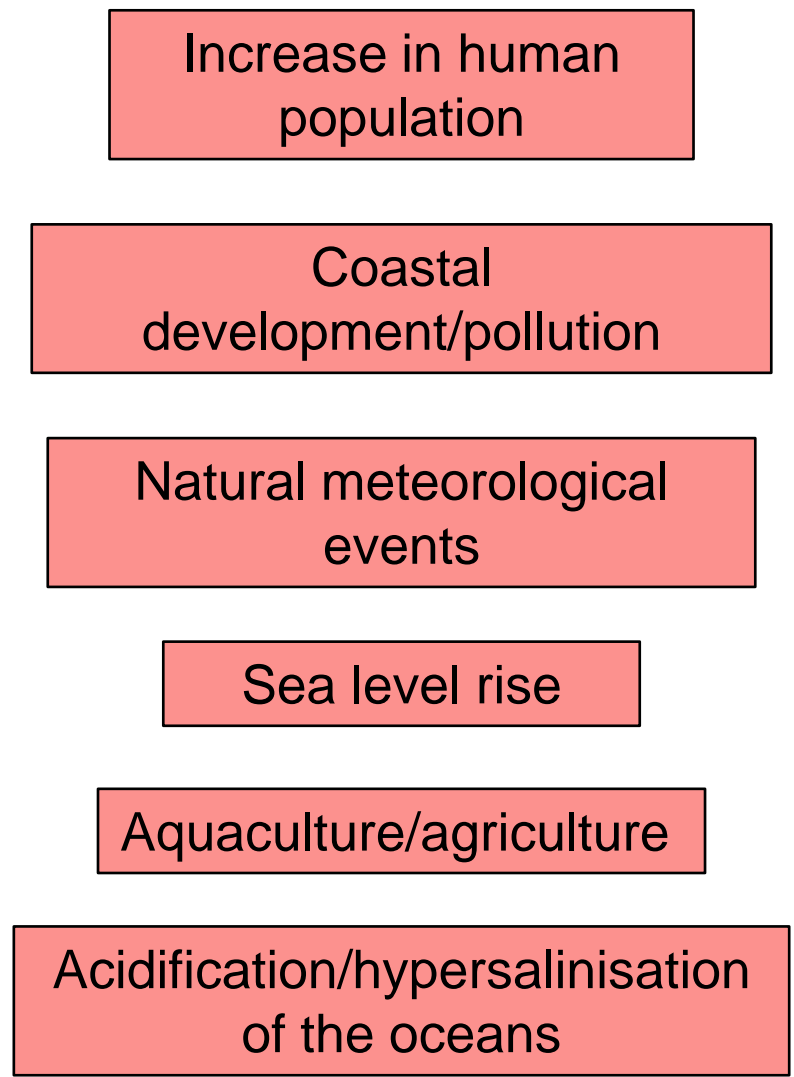
An open-source multi-sensor methodology for the mapping of mangrove structural types using remote-sensing

Thibault Catry, Quentin Marsal, Elodie Blanchard, Jean-François Faure,

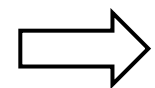


Context

mangroves = highly productive tropical and subtropical coastal ecosystems

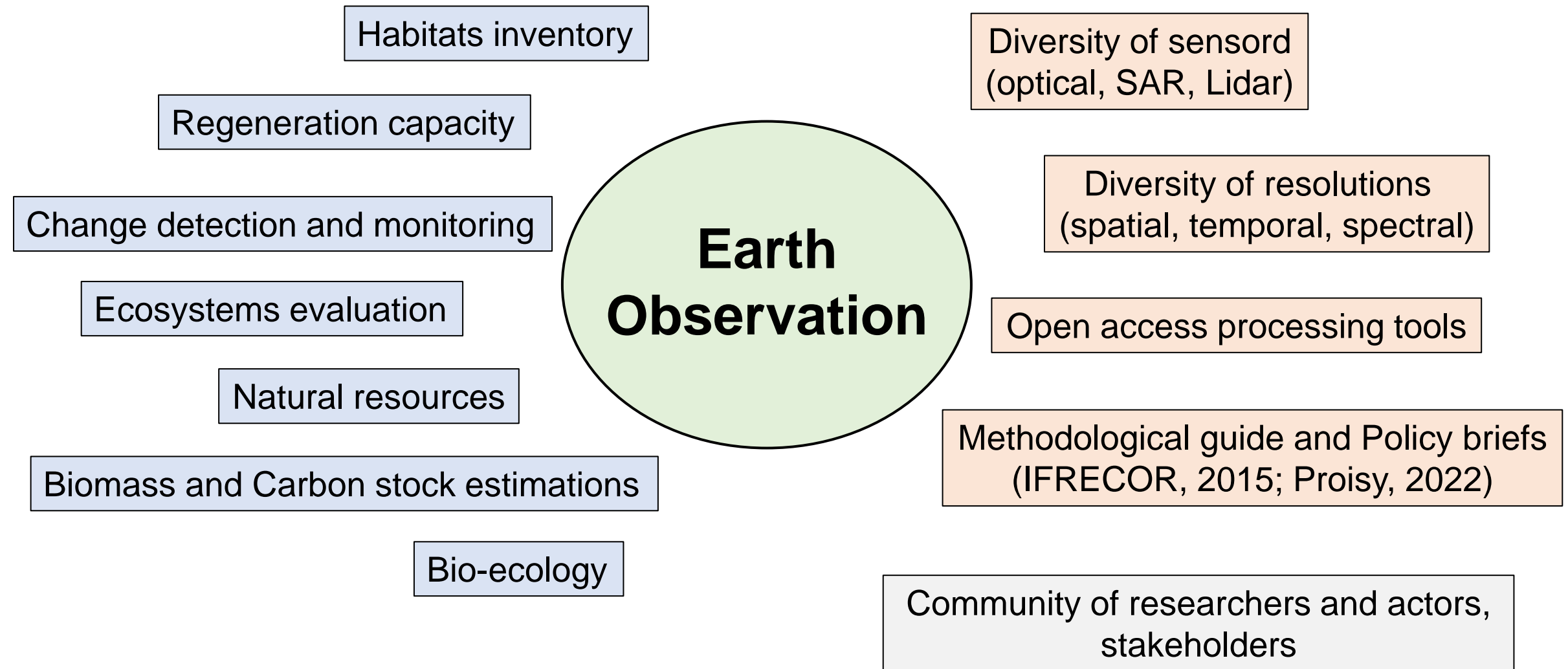


Mangrove extent: net loss of 6000 km², reduced by 4,3% between 1996 and 2016

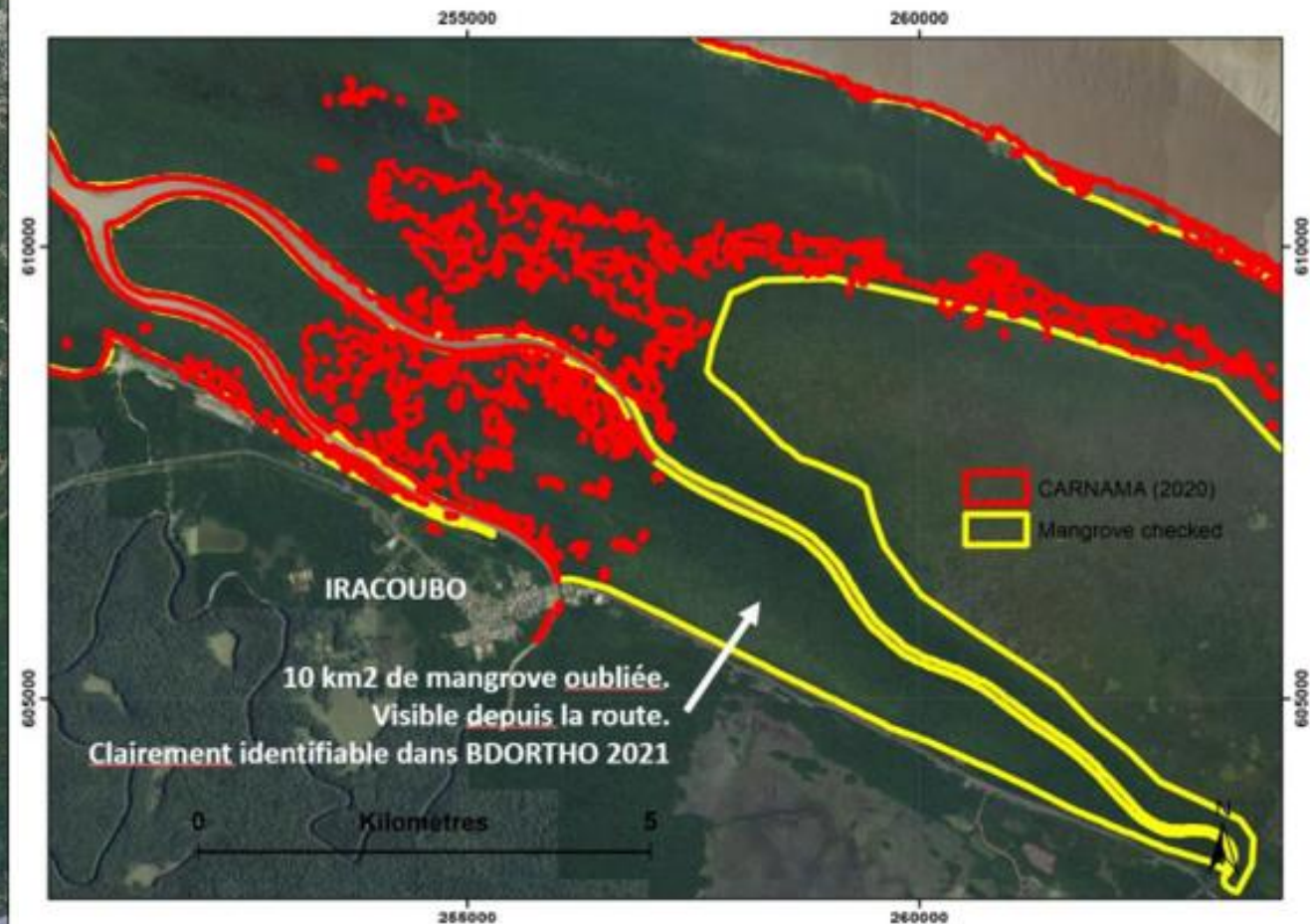
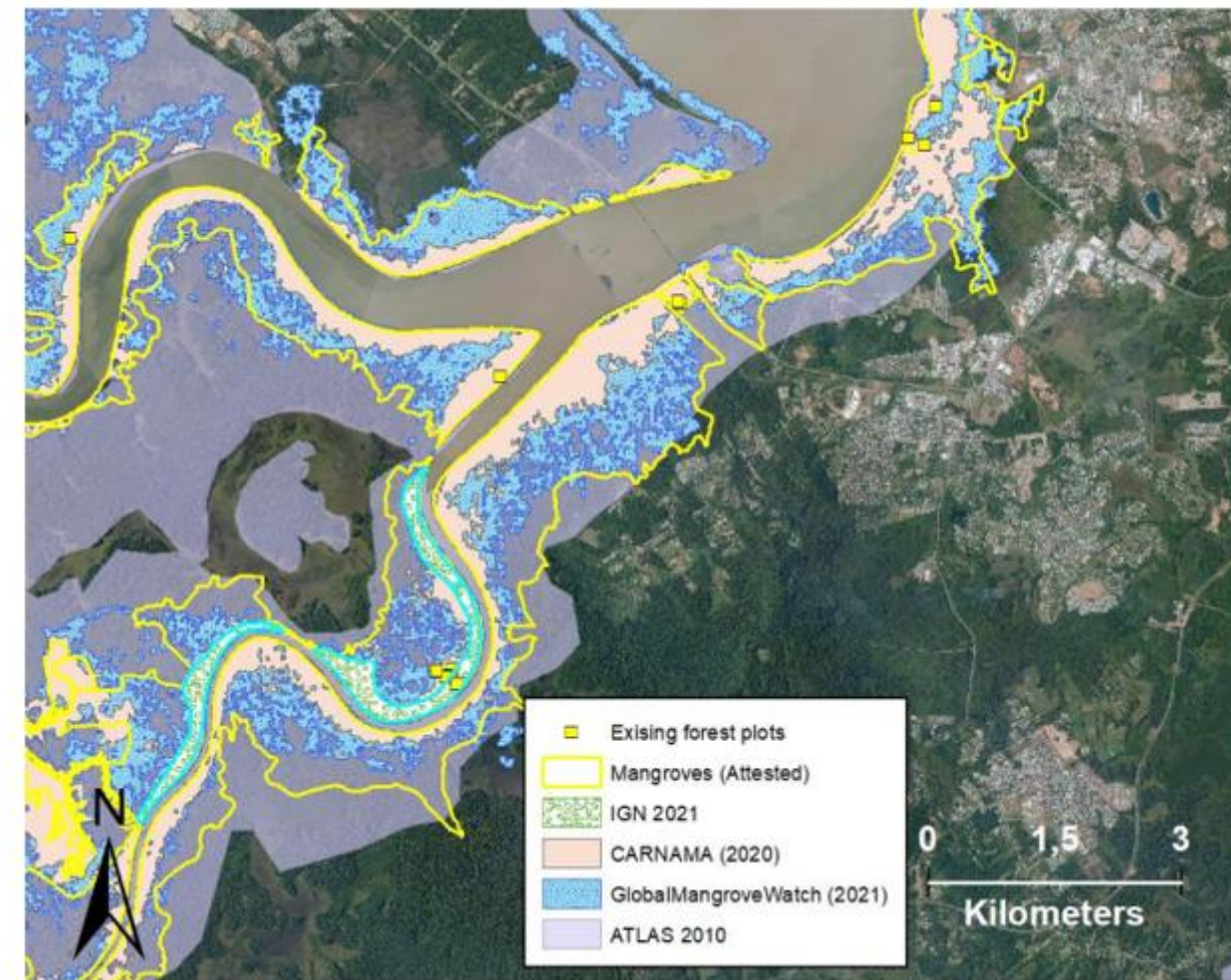


Conservation and protection international agreements (CITES, CDB, RAMSAR)

Many international research and conservation programs in the last 15 years



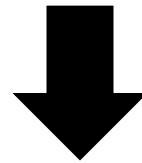
Context



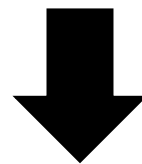
2 examples in French Guiana

Research question and objectives

How can we improve the knowledge on mangrove ecosystems, taking advantage of the current diversity of available Earth observation data, from the examples of Madagascar and Cambodia?

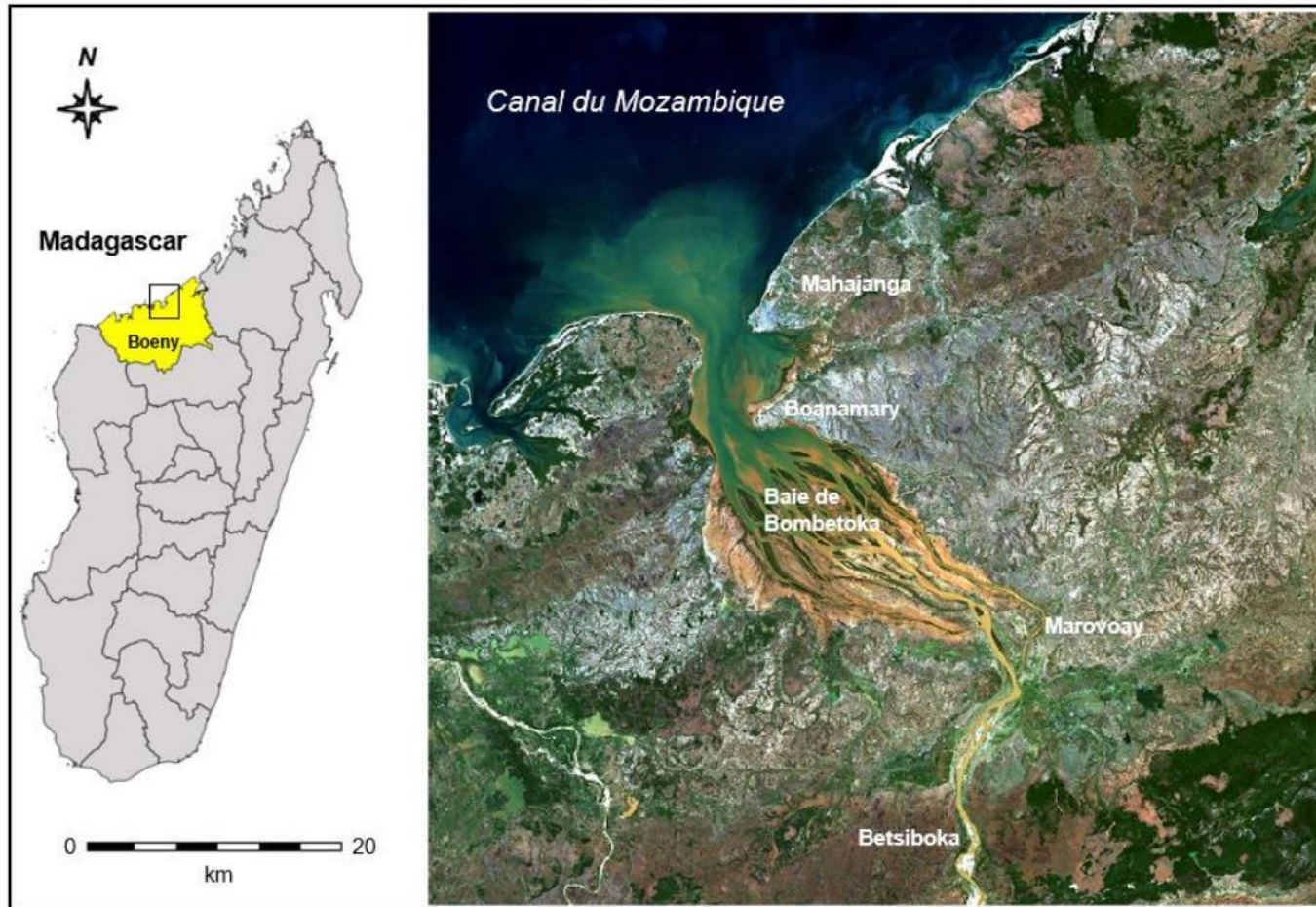


An open-source multi-sensor methodology for the mapping of mangrove structural types using remote-sensing

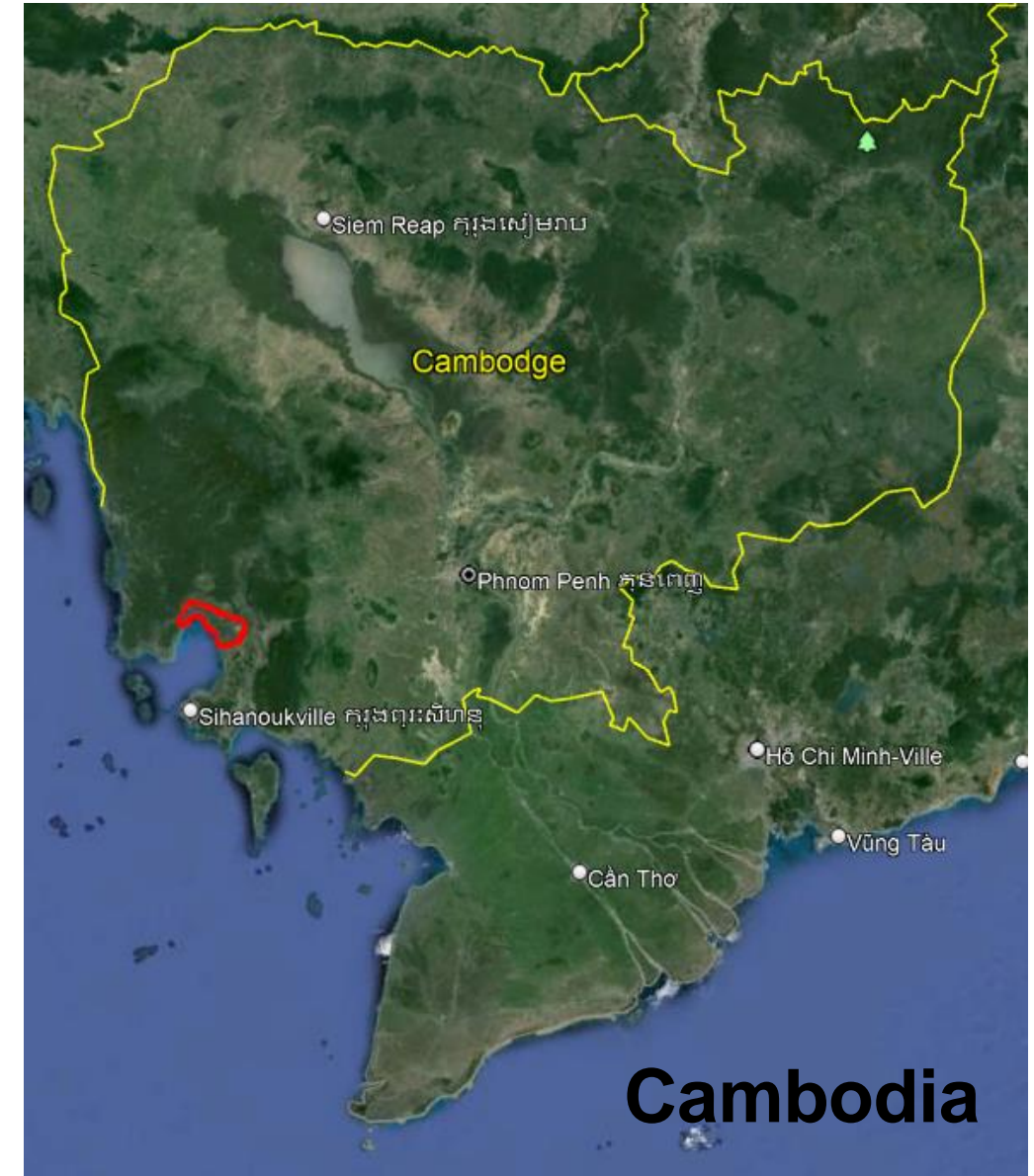


Combining earth observation data and products at high and very high spatial resolutions

Study sites

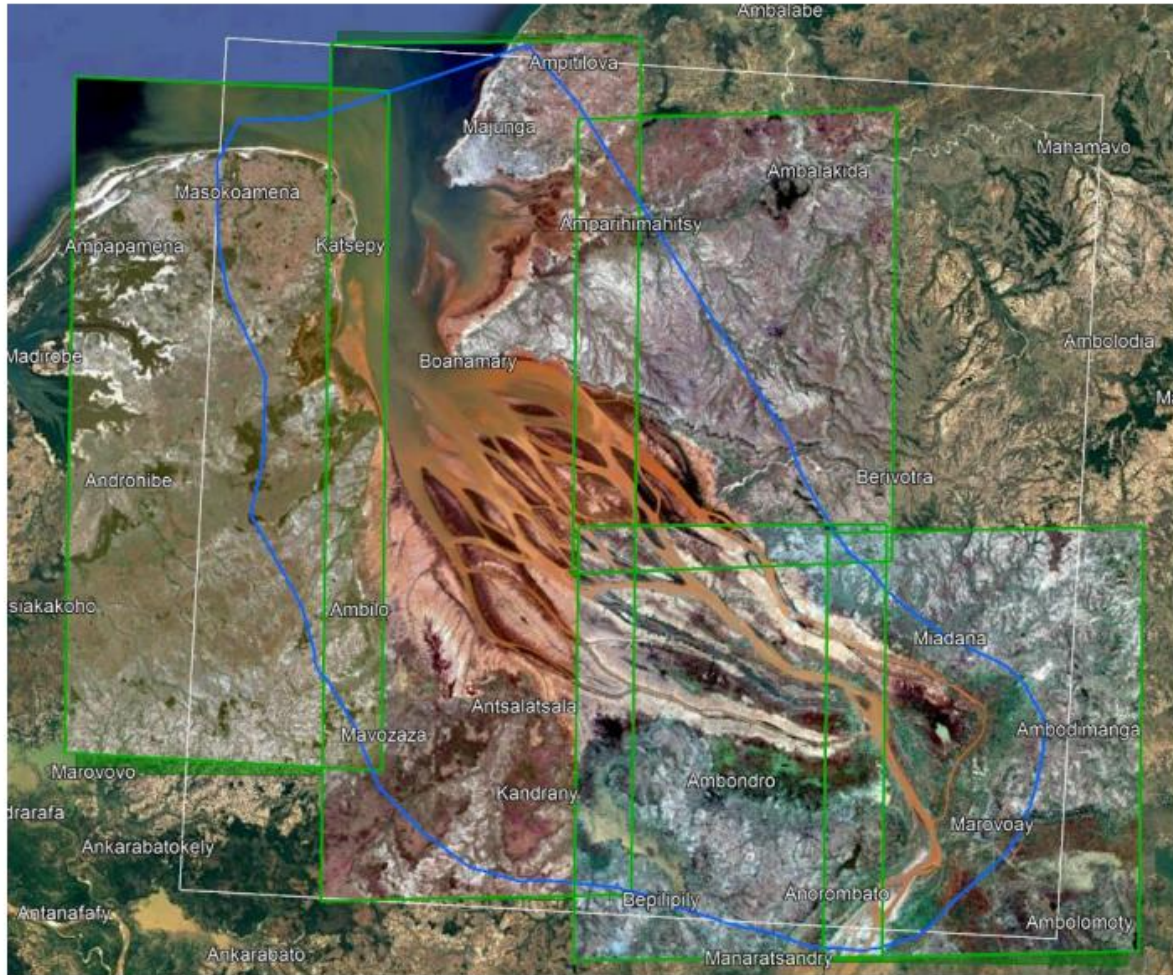


Madagascar



Cambodia

Madagascar



Pléiades mosaic, 50 cm resolution, may 2023
(Madagascar) and march 2019 (Cambodia)

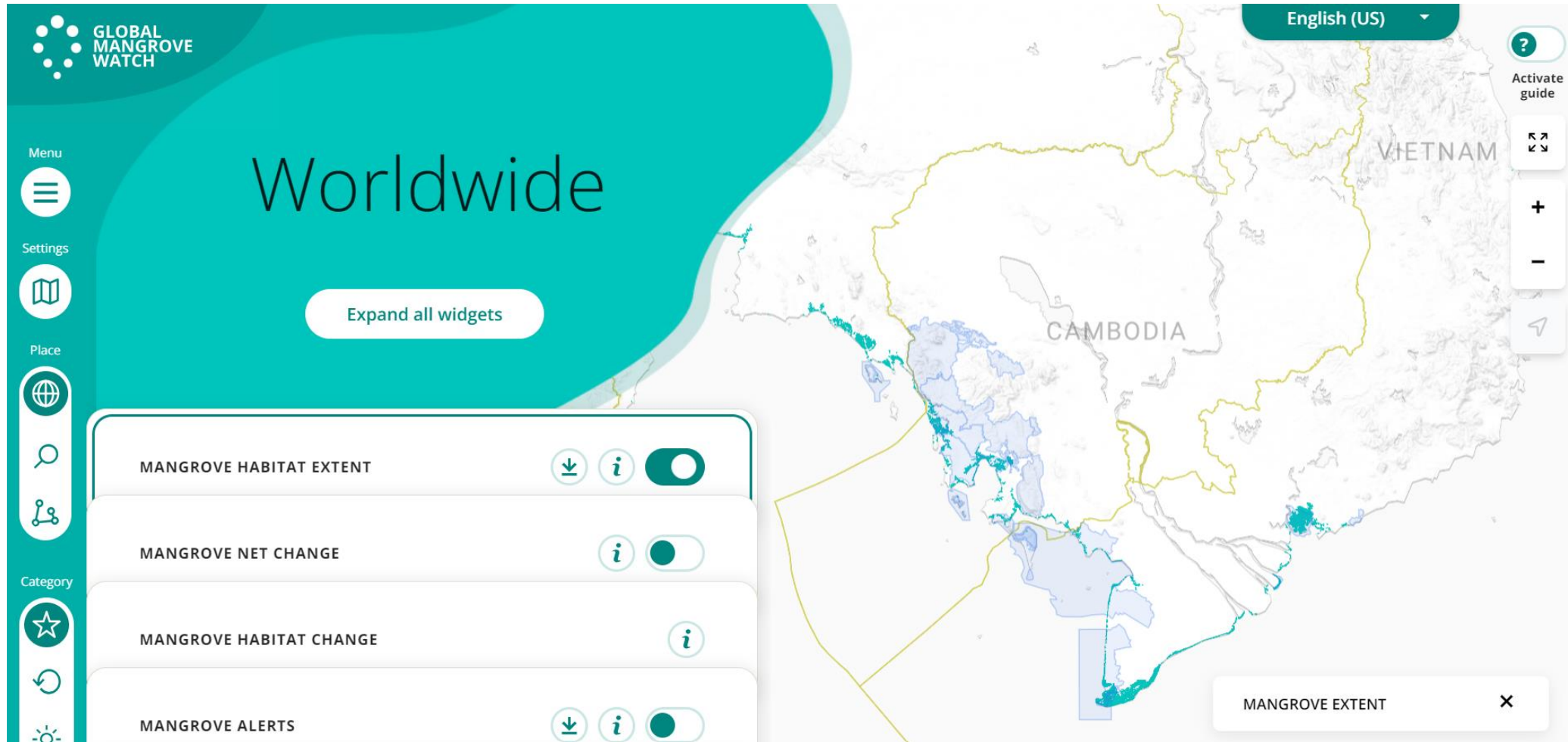
Cambodia



Access to images: DINAMIS/DataTerra

Data: reference mangrove extent

Global Mangrove Watch (GMW) is an online platform that provides the remote sensing data and tools for monitoring mangroves. GMW is used as the reference map of mangrove extent



Methodology

Texture of mangrove canopy

VERY HIGH SPATIAL RESOLUTION IMAGES

CANOPY TEXTURE = WHAT THE UPPER LAYER OF VEGETATION LOOKS LIKE
IN THE IMAGE

~500 m

Methodology

Texture of mangrove canopy

VERY HIGH SPATIAL RESOLUTION IMAGES

**CANOPY TEXTURE = WHAT THE UPPER LAYER OF VEGETATION LOOKS LIKE
IN THE IMAGE**

**OPEN CANOPY
ADULT MANGROVE**



**CLOSED CANOPY
YOUNG MANGROVE**



~500 m

Methodology

Sentinel 2, Global Mangrove Watch, ...

Identification of mangrove extent using **high resolution** earth observation data or products

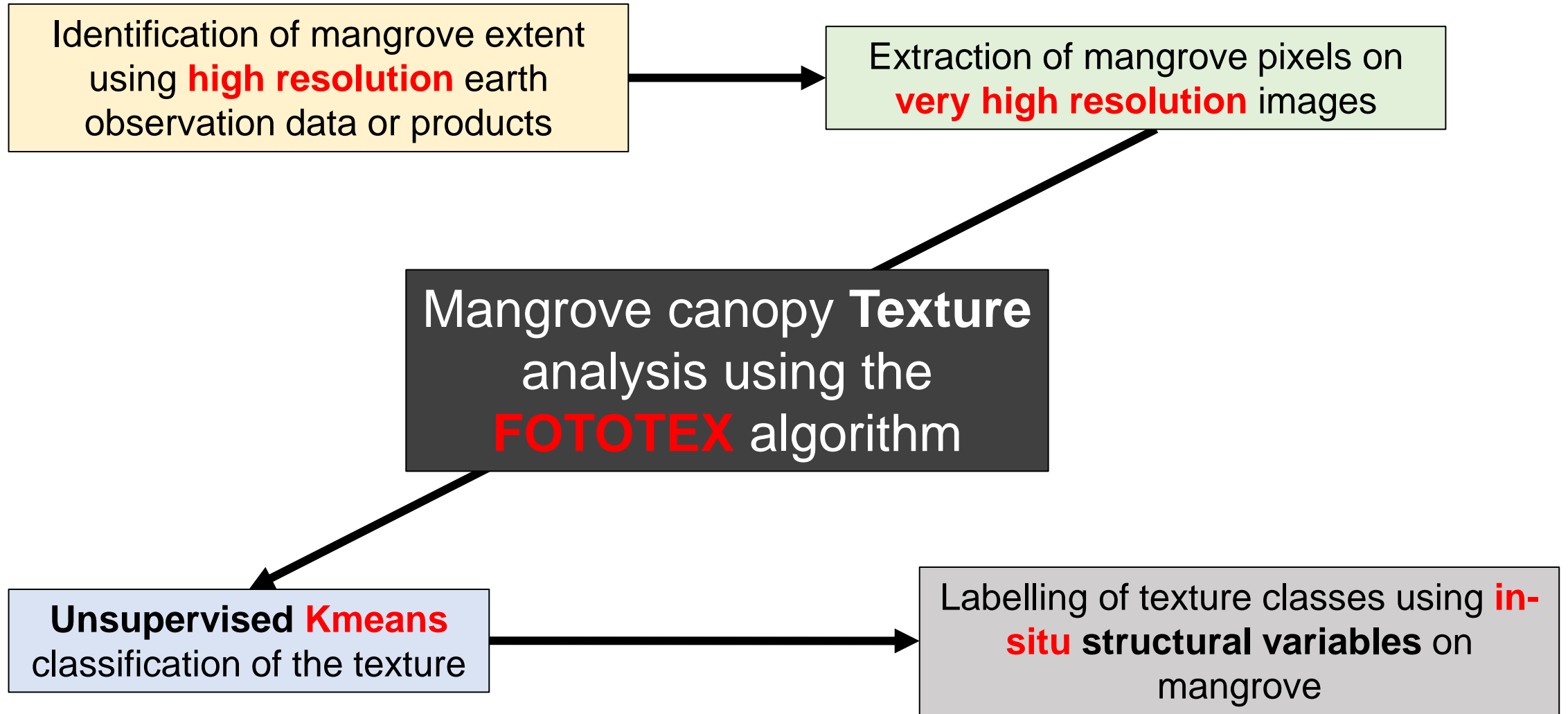
Pléiades

Extraction of mangrove pixels on **very high resolution** images

Mangrove canopy **Texture** analysis using the **FOTOTEX** algorithm

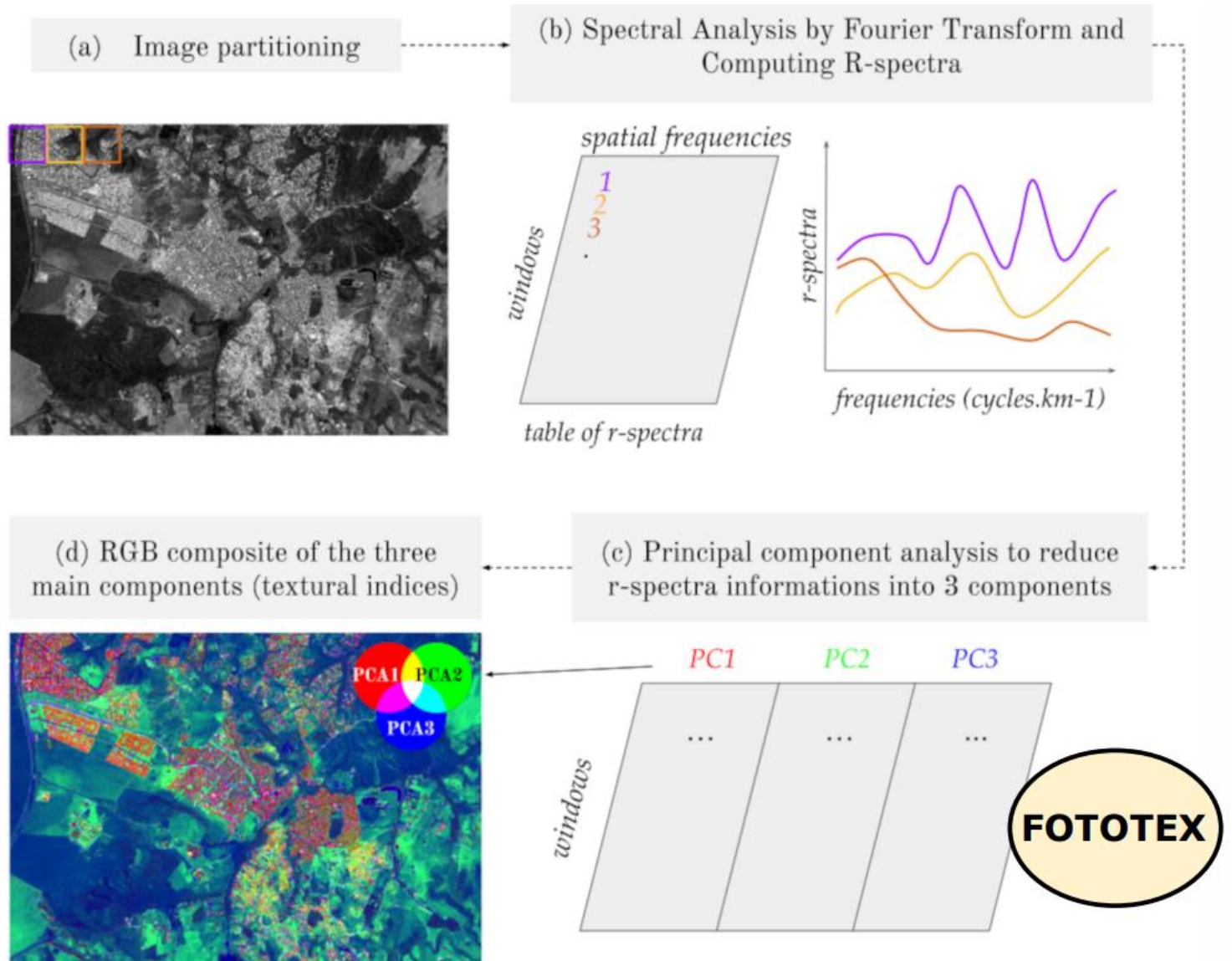
Unsupervised Kmeans classification of the texture

Labelling of texture classes using **in-situ structural variables** on mangrove



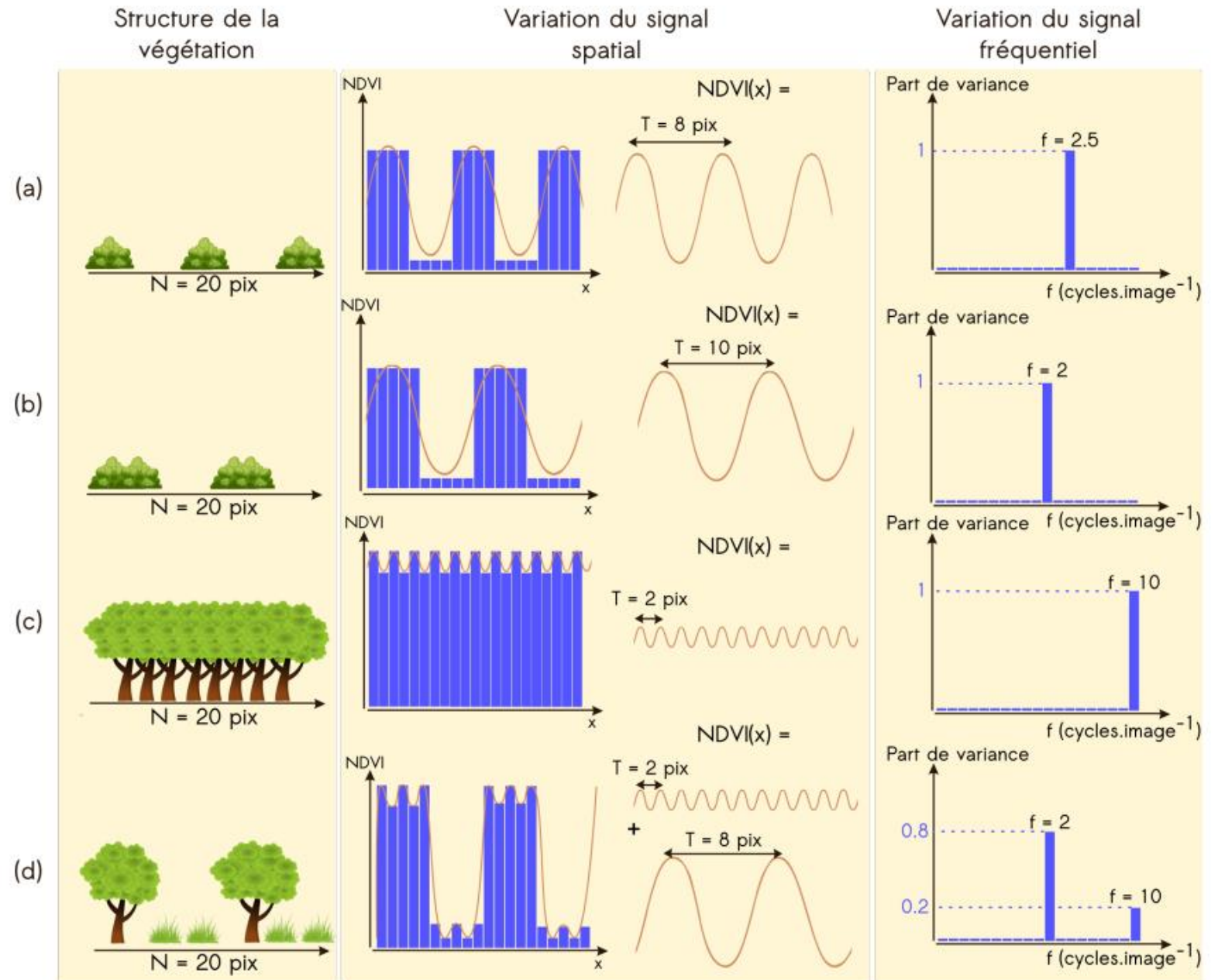
FOTOTEX

an algorithm for texture extraction, based on the conversion of spatial signal into frequency signal



FOTOTEX

an algorithm for texture extraction,
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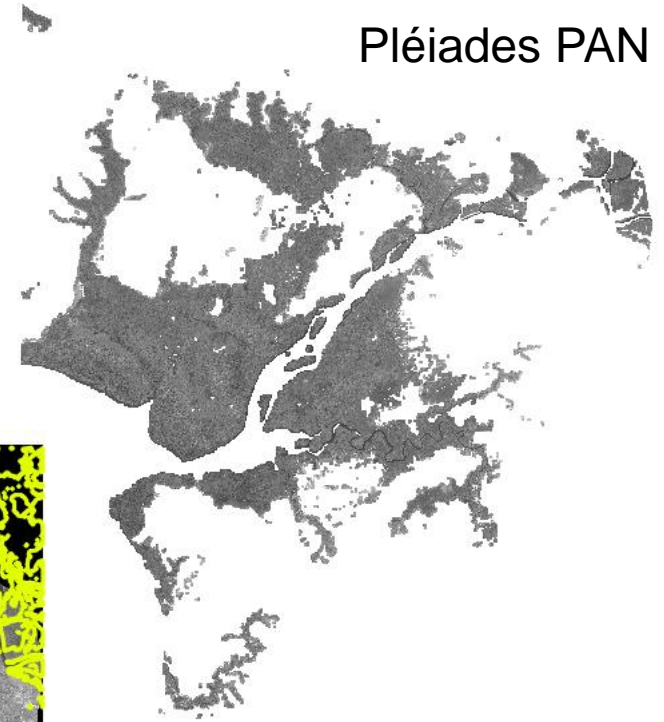
Results: mangrove pixels extraction on Pleiades

Pleiades PAN

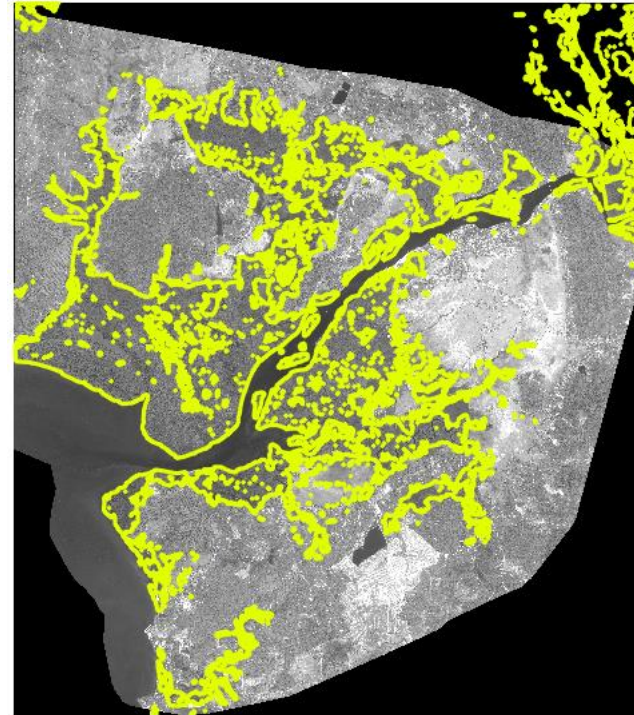
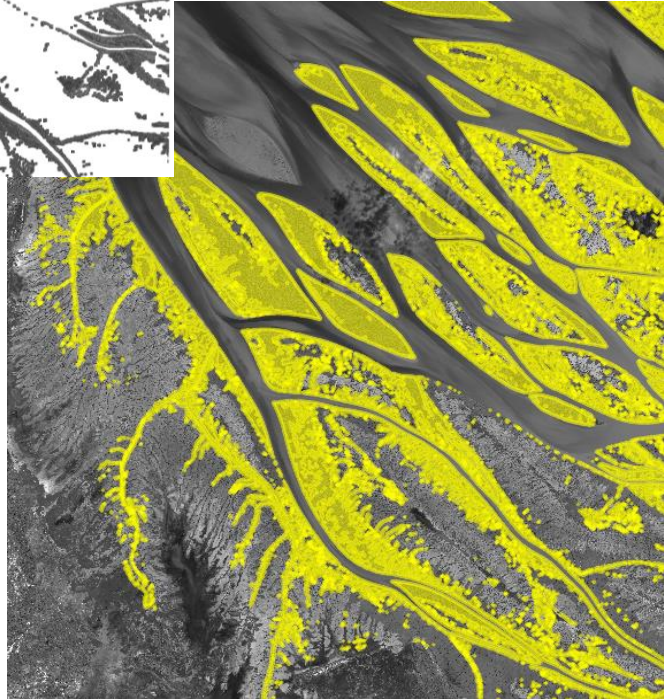


Extraction of Pleiades mangrove pixels using the **GMW** mangrove extent

Pleiades PAN



Madagascar



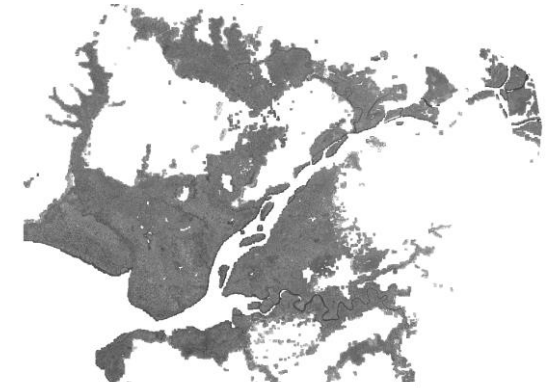
Cambodia

Results: extraction of canopy texture information on Pleiades with FOTOTEX

Textural information on canopy
Red = PC1, Green = PC2, Blue = PC3

Madagascar

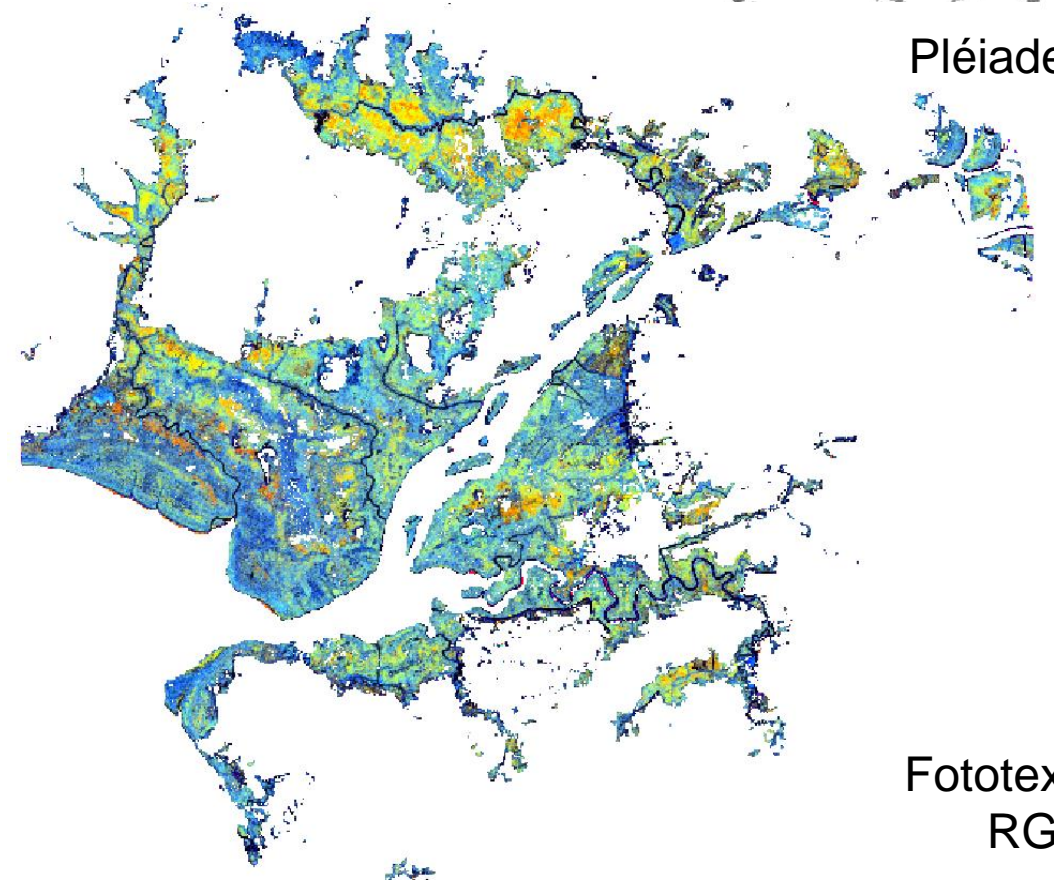
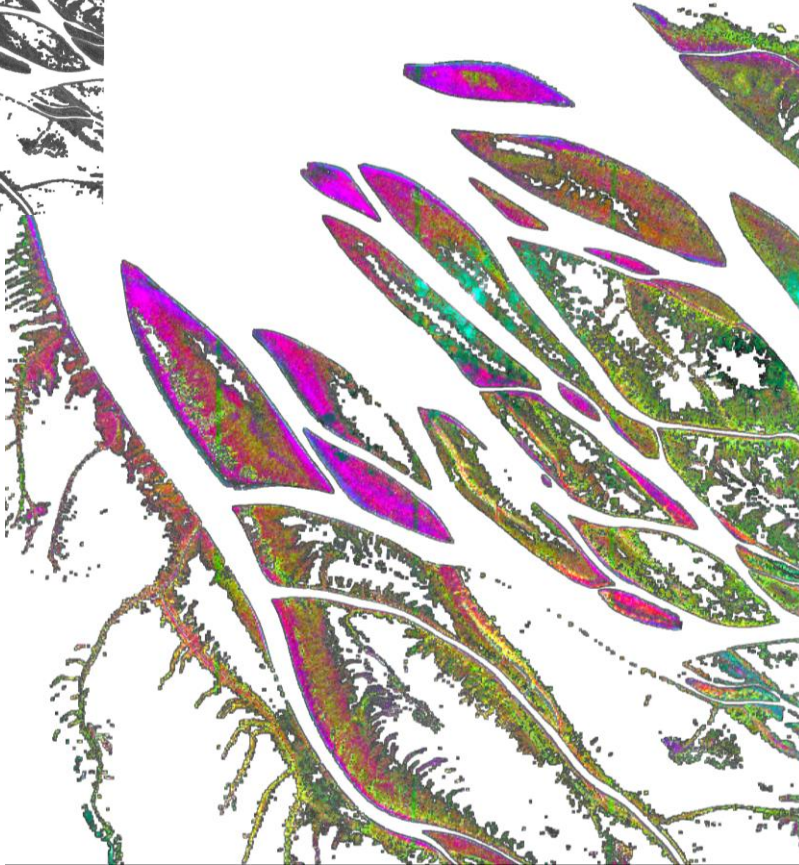
Cambodia



Pleiades PAN

Pleiades PAN

Fototex PCA
RGB



Fototex PCA
RGB

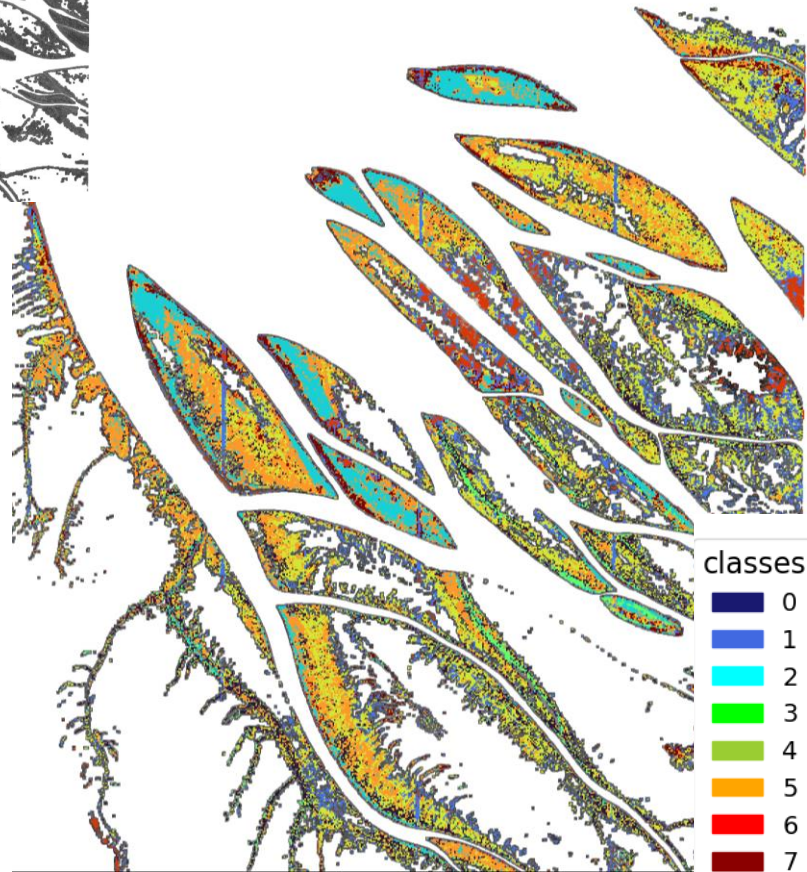
Results: Unsupervised Kmeans classification of textural

Pléiades PAN



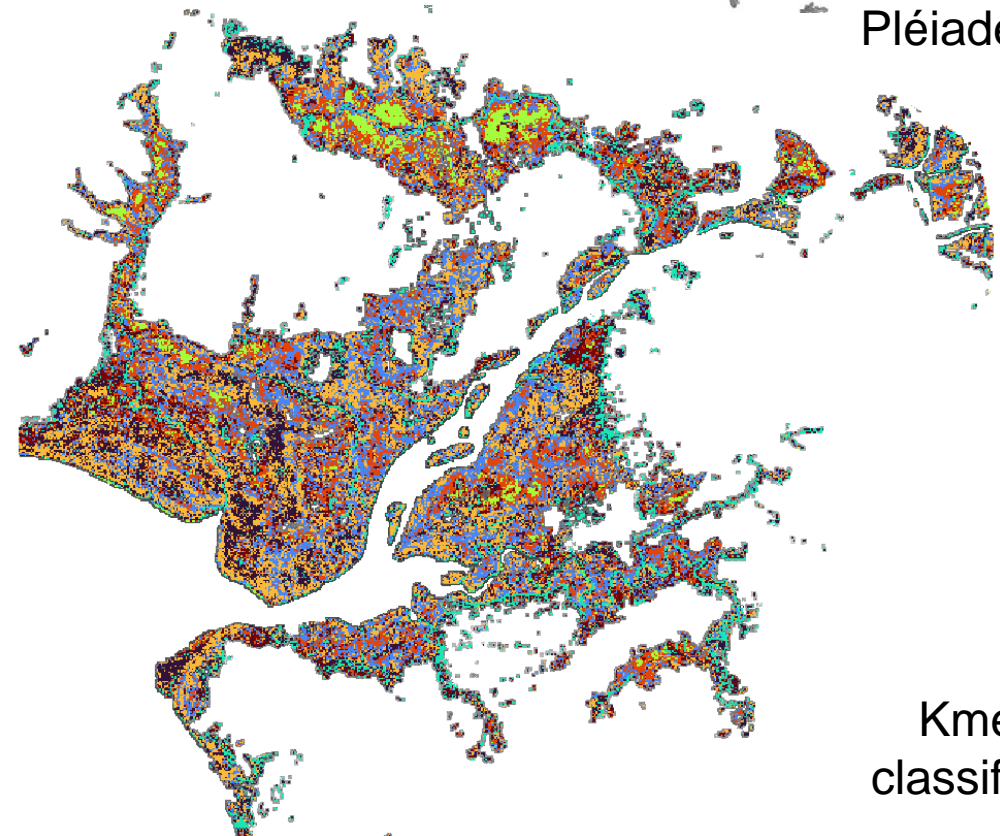
7 to 8 classes are identified, purely based on canopy texture

Madagascar

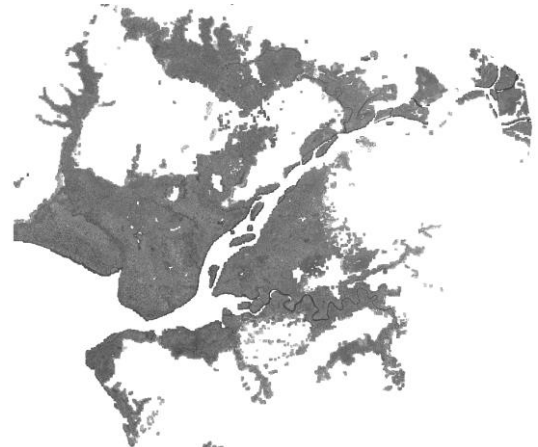


Kmeans classification

Cambodia



Kmeans classification

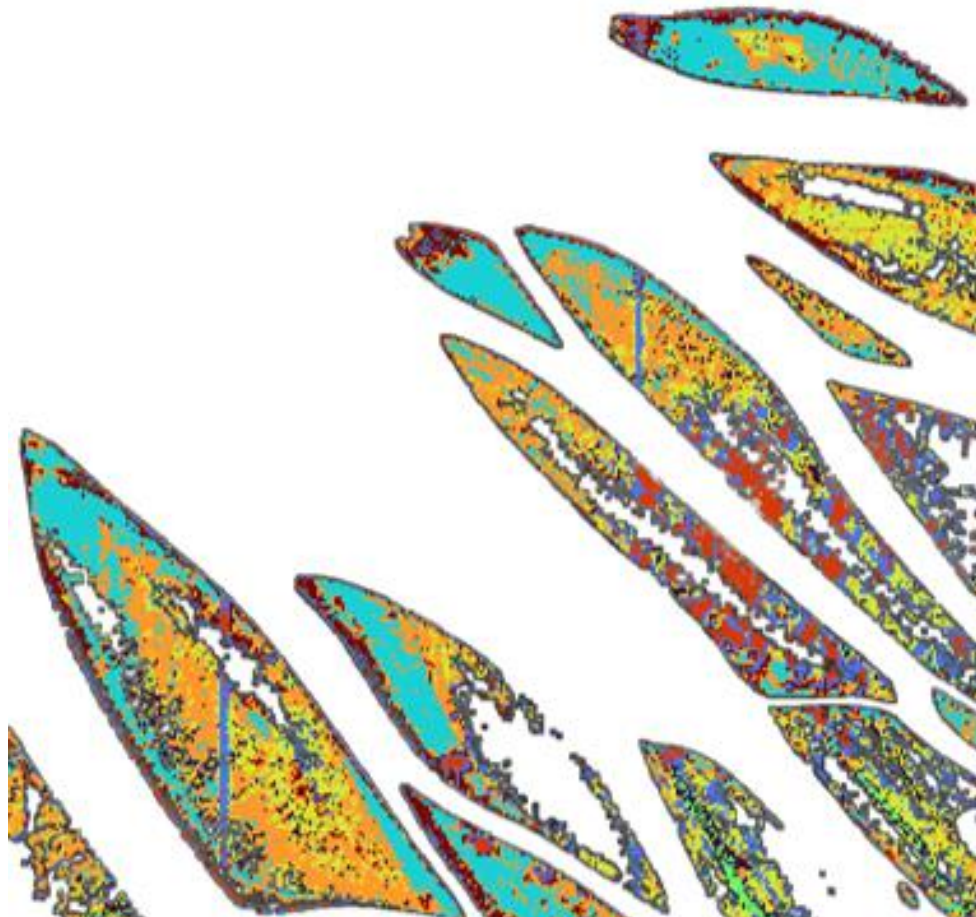


Pléiades PAN

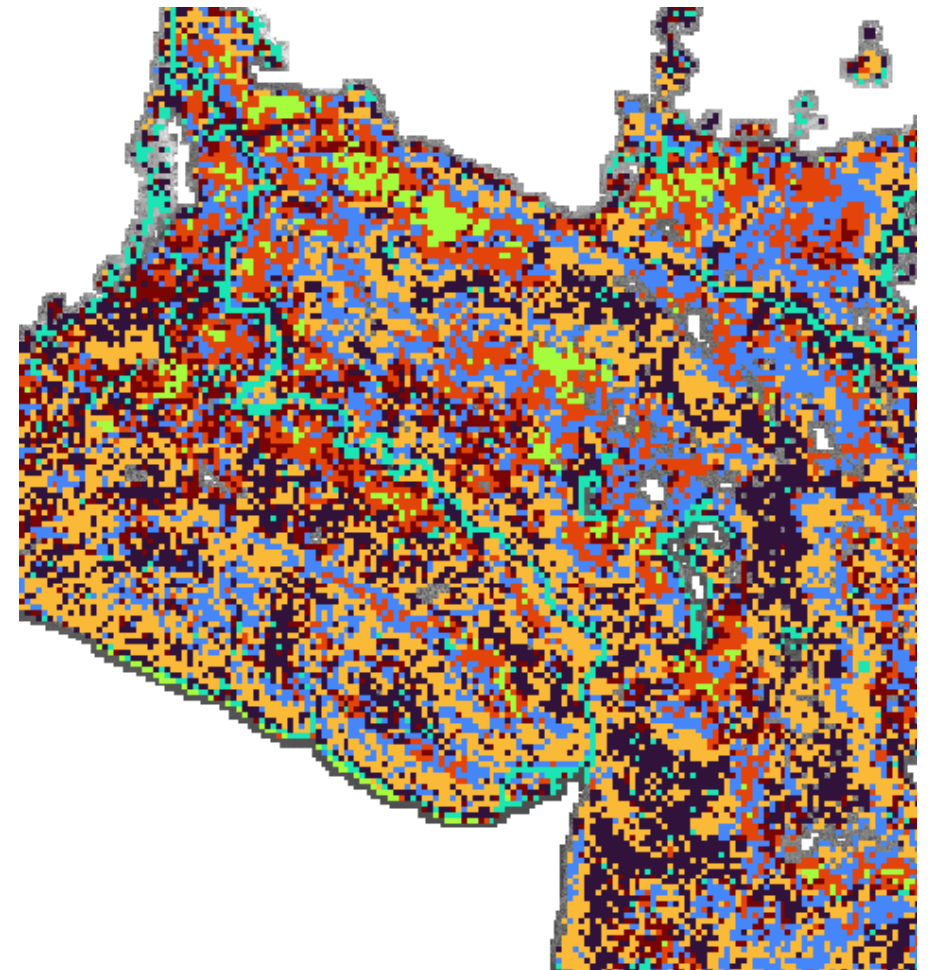
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Madagascar

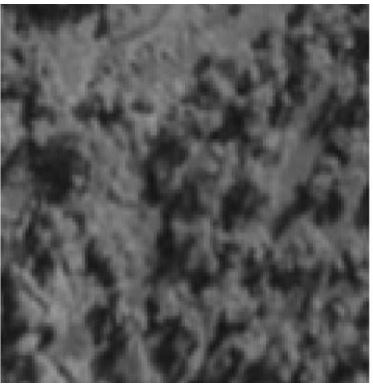


Cambodia

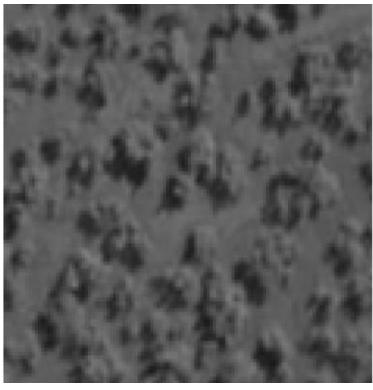


Results: labelling classes, Madagascar

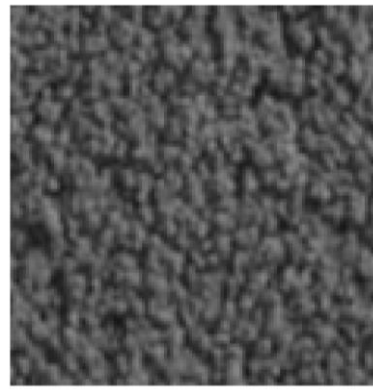
Class 0



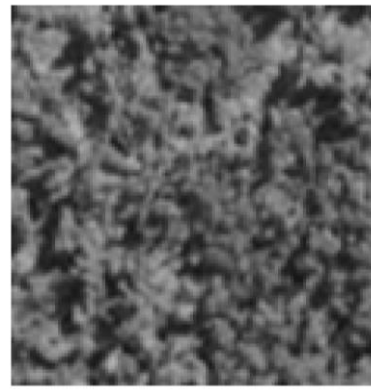
Class 1



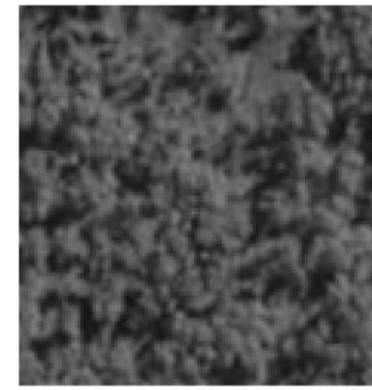
Class 2



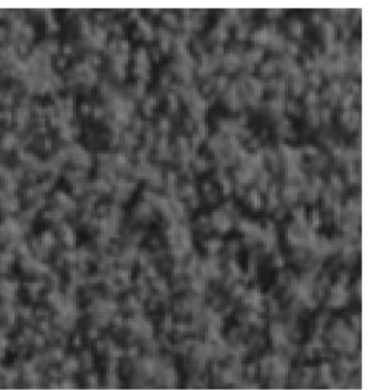
Class 3



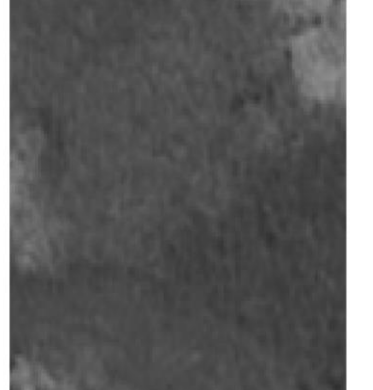
Class 4



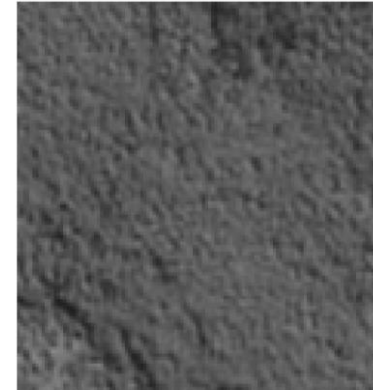
Class 5



Class 6

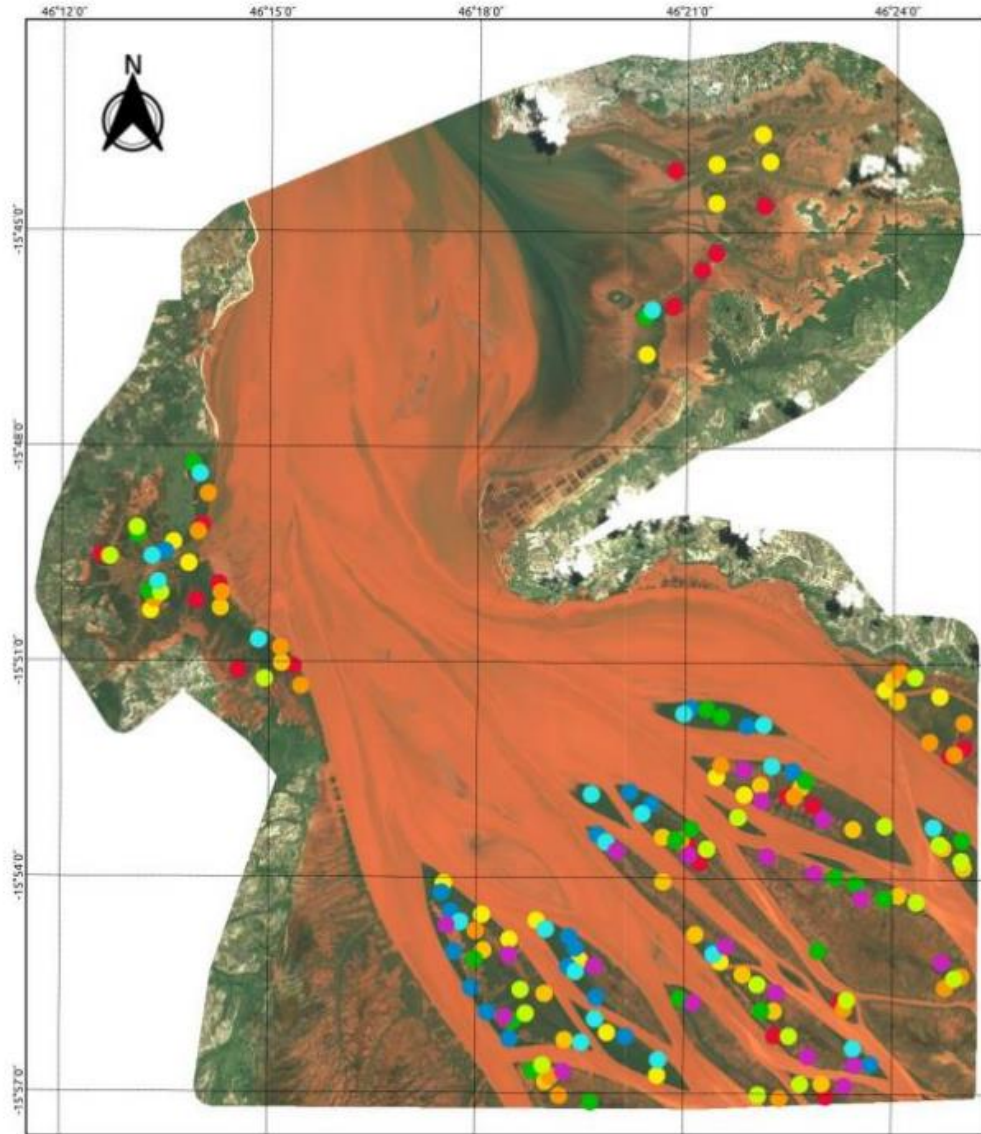


Class 7



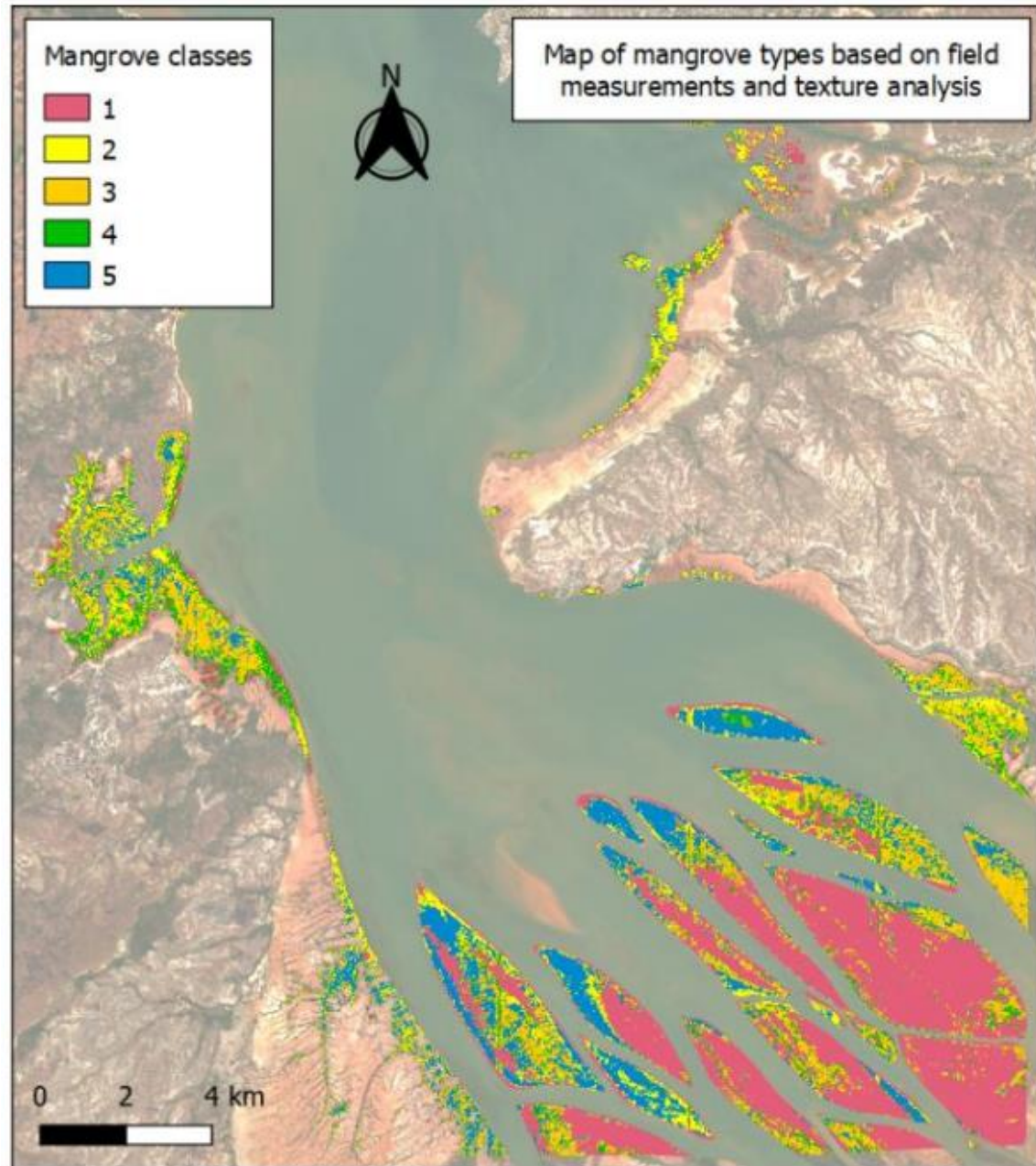
Examples of Panchromatic Pleiades subsets for the 8 classes identified from texture

In-situ measurements of structural variables



68 points collected in 2023 + 132 points collected in 2024 = 200 points in total

Results: labelling classes, Madagascar



classe	stade	espèce	densité moyenne	circonférence moyenne	hauteur moyenne
1	Adultes sénéscents	Avicennia, Sonneratia	20	36	9
2	Adultes matures	Avicennia	20	55	12
3	Adultes	Avicennia, Ceriops, Rhizophora	45	35	7
4	Adultes	Avicennia	35	38	7
5	Jeunes et adultes	Avicennia	10	20	5

MangMap an online monitoring platform that produces and distributes environmental information on mangrove forests



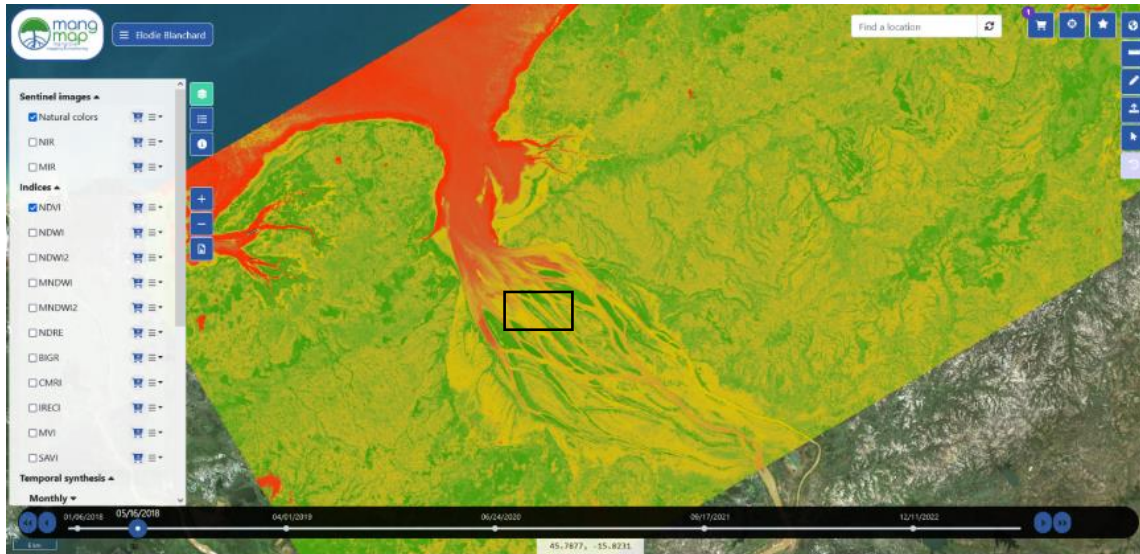
The goals are to:

- Improve scientific knowledge, preservation, monitoring of mangrove distribution & health,
- Make available standardized, reliable, updated and easily accessible information characterizing the state of the mangroves (diagnostics) and the current dynamics (retrospective analyses),
- Identify in space and time the risks and threats to mangrove ecosystem.

The processing chain of the MangMap platform, from Sentinel 2 images to products and services

Products made available regularly:

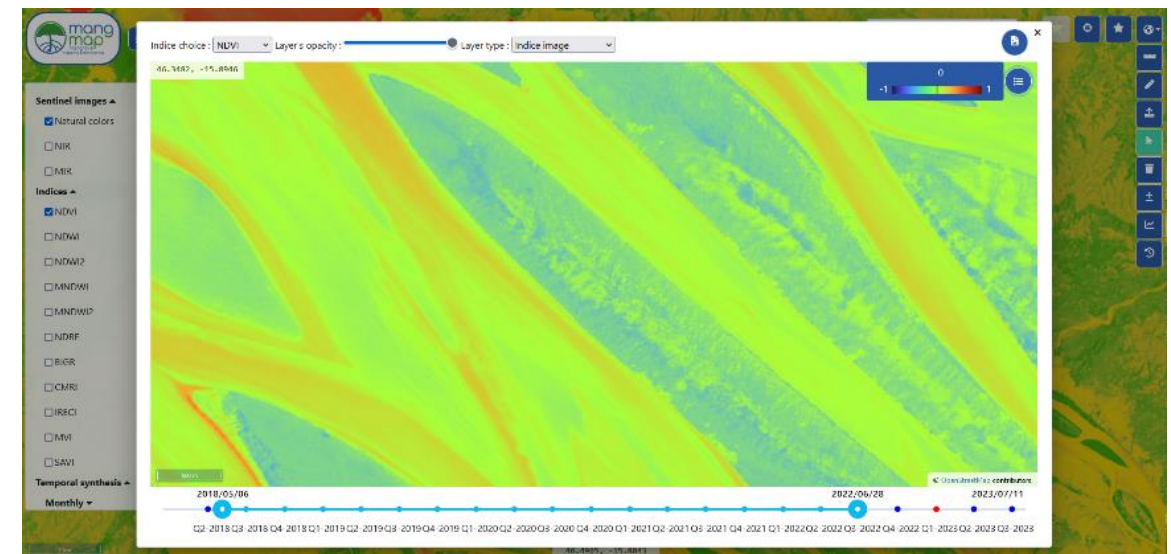
11 spectral indexes* defining mangrove environments: every 5 days, raster



Screenshot of a raster NDVI, 2018/05/16 –
In black, user's polygon

On-demand Services:

Date to date raster differences in temporal composites values: within polygons, image



Screenshot of the evolution of mangrove areas between 1st quarter 2018 and 1st quarter 2022 (user polygon)

The processing chain of the MangMap platform, from Sentinel 2 images to products and services

Products made available regularly:

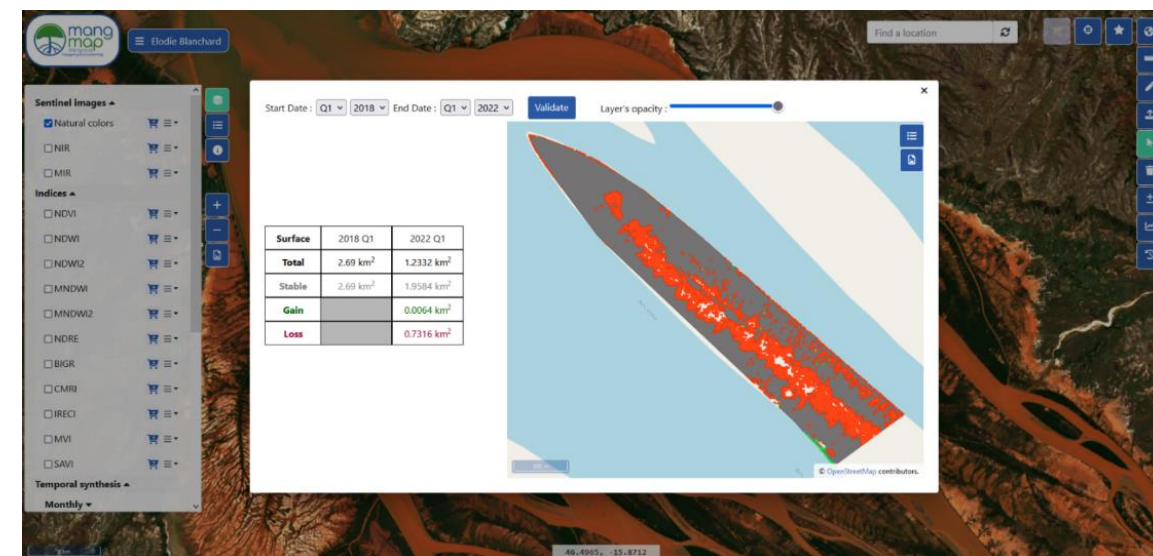
Mangrove extent: quarterly, vector



Screenshot of a vector contour of mangrove spatial distribution, 2nd quarter 2018 - *In yellow, user's polygon*

On-demand Services:

Estimation of mangrove spatial evolution: within polygons, image and table



Screenshot of the evolution of monthly NDVI synthesis, from January 2018 to April 2023 (user polygon)

Thanks for your attention

