FIG Working Week 2024
19-24 May
Accra, Ghana
Your World, Our World: Resilient Environment and Sustainable Resource Management for All

Presented at the FIG Working Week 2024,
19-24 May 2024 in Accra, Ghana

Study of the mangrove forest with earth observation technologies: the integration of hyperspectral field data with satellite images

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Paper 12654

Instituto Geográfico Agustín Codazzi (IGAC) of Colombia

May 2024

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Your World, Our World: Resilient Environment and Sustainable Resource Management for All

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INSTITUTO GEOGRÁFICO AGUSTÍN CODAZZI

WHAT DO WE DO?

We produce the official map and cartography of Colombia

We train and educate professionals in geographic information technologies

We are the Cadastral authority

We carry out geographical investigations

We carry out an inventory of the characteristics of the soils

We coordinate the Colombian Spatial Data Infrastructure (ICDE)

Research and Prospective technical direction

- Research Center recognized. SNCTeI .
- CIAF. More than 50 years of experience in research, development and training in geospatial technologies. 25.000 students from Colombia and the Latin American region.

R&D

Prospective

Cadastral Real Estate Dynamics

Training and qualification

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Introduction: The mangrove forest in Colombia (pacific region): challenges facing climate change.

Security

Housing

Livelihood

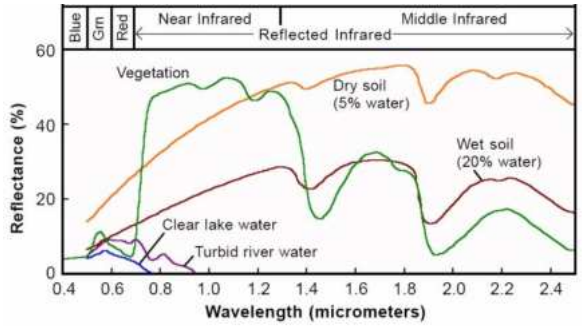
Introduction: The mangrove forest in Colombia (pacific region): challenges facing climate change.

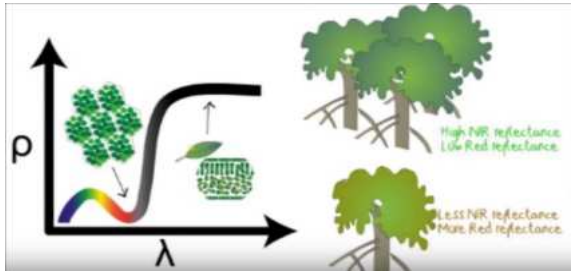
Food Security

Piangua - *Anadara tuberculosa.*

The Pacific Scientific Expeditions: Colombian Ocean Commission (CCO) and IGAC

Field spectroradiometry: spectral characterization of mangrove forest and roof materials

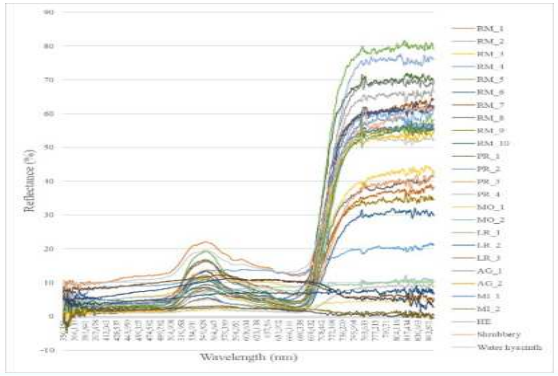




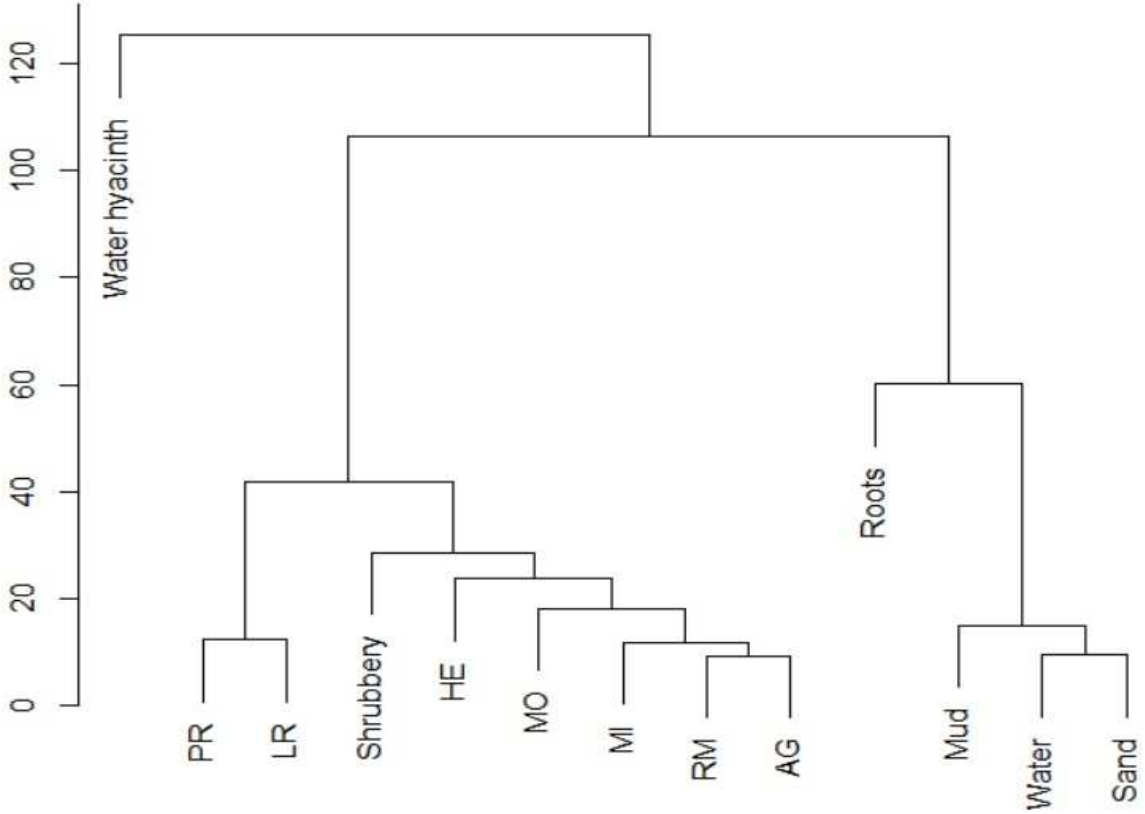
Three scientific expeditions on field spectroradiometry: 2021-2023

Field work and endmembers generation:

Separability Library



Separability Analysis: endmember for species/material



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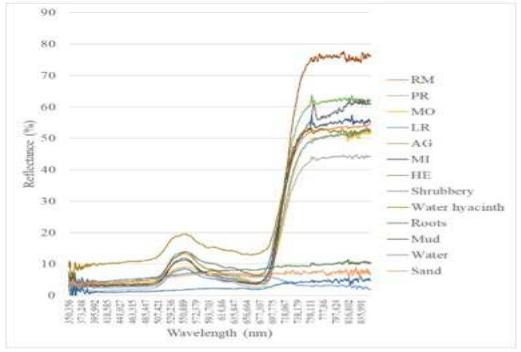
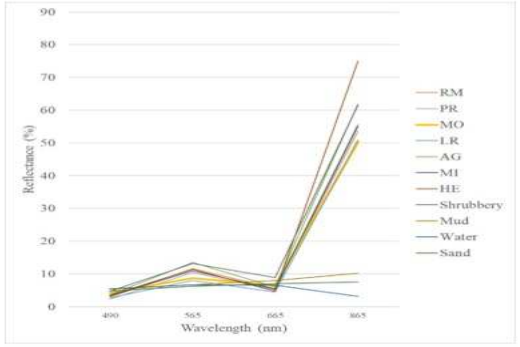
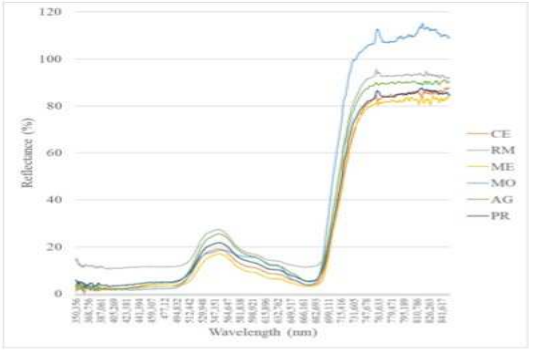
Spectral libraries and satellite images: resampling from 650 bands (aprox.) to 5 bands (Planet Scope)

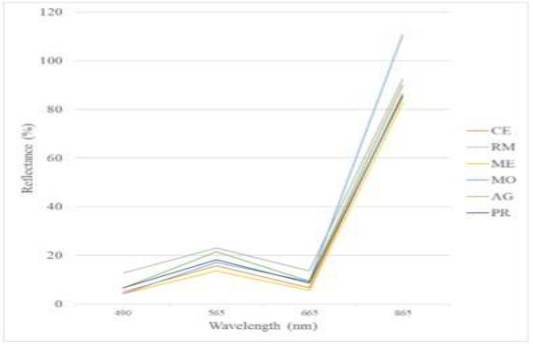
NNP Sanquianga: 64 mangrove signatures, 6 endmembers*



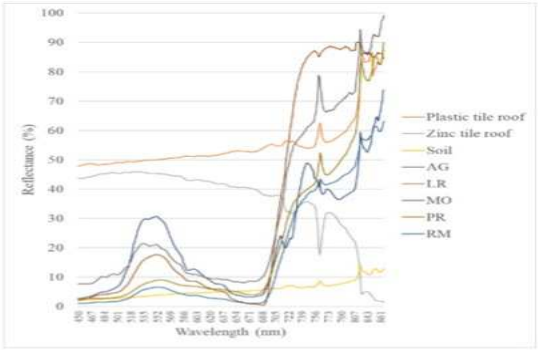


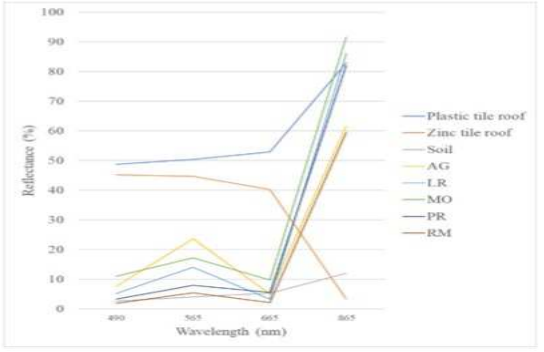
NNP Málaga Bay: 23 mangrove signatures, 6 endmembers*





Gulf of Tribugá: (65) 12 mangrove signatures, 5 endmembers*





Planetscope (PS2.SD)

Spectral region	PlanetScope spectral range	Wavelength center
Ultraviolet (<450)		-
Blue	450-520	490
Green	540-600	565
Red	640-700	665
NIR<900	840-900	865
NIR>900	900-1000	-

Mangrove species identified

Name	Scientific Name	Ab.
Black mangrove	*Avicennia germinans*	AG
Majagua (non mangrove)	*Hibiscus elatus*	HE
White mangrove	*Laguncularia racemosa*	LR
Nato mangrove	*Mora oleífera*	MO
Red mangrove	*Rhizophora mangle*	RM
Piñuelo mangrove	*Pelliciera rhizophorae*	PR

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Exploring PlanetScope classification with spectral libraries: Sanquianga National Natural Park

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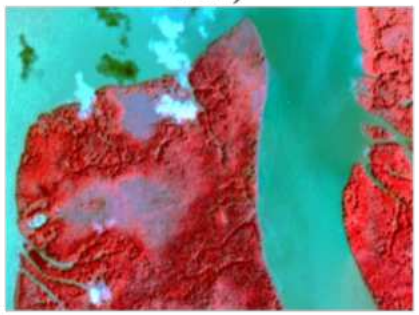
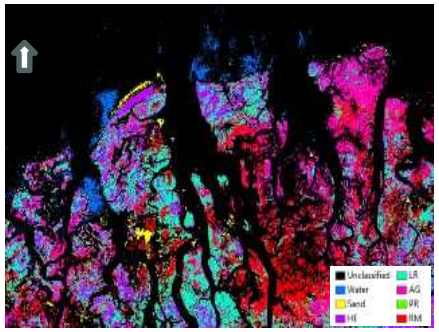
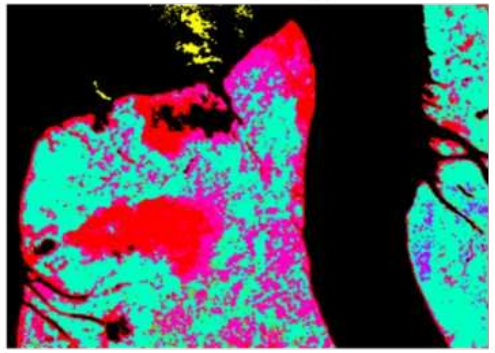
Spectral Angle Mapper SAM

PlanetScope (standard false color)

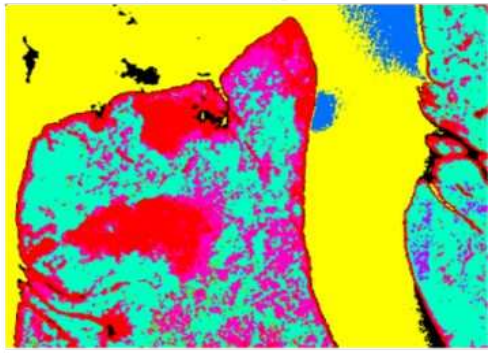




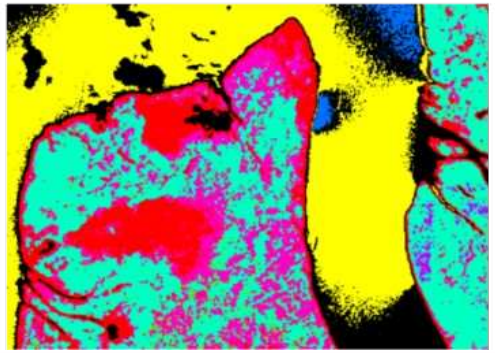
SAM (max. angle= 0.10)



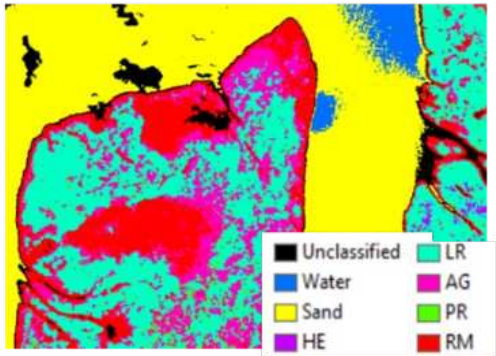
SAM (max. angle= 0.30)



SAM (r max. angle= 0.20)



SAM (max. angle= 0.25)



Sanquianga Natural Park			
Name	Scientific Name	Abbreviation	**Number of signatures**
Black mangrove	*Avicennia germinans*	AG	**4**
Majagua (non mangrove)	*Hibiscus elatus*	HE	**1**
White mangrove	*Laguncularia racemosa*	LR	**5**
Nato mangrove	*Mora oleifera*	MO	**8**
Red mangrove	*Rhizophora mangle*	RM	**23**
Piñuelo mangrove	*Pelliciera rhizophorae*	PR	**18**
Red and nato mangrove	*Mora oleifera y Rhizophora mangle*	MO_RM	**1**
Piñuelo and red mangrove	*Rhizophora mangle y Pelliciera rhizophorae*	RM_PR	**5**
Other: Plastic roof, zinc roog, soil	-	-	**29**
Total (mangrove):			**64**

"The variability in pixel values after classification indicates a potencial spectral discrimination image-spectral library"

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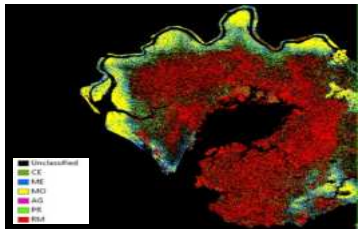
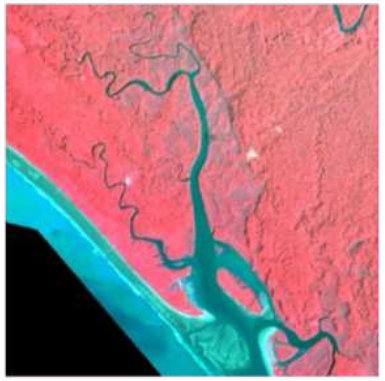
Exploring PlanetScope classification with spectral libraries: Uramba Málaga Bay National Natural Park

Spectral Angle Mapper SAM

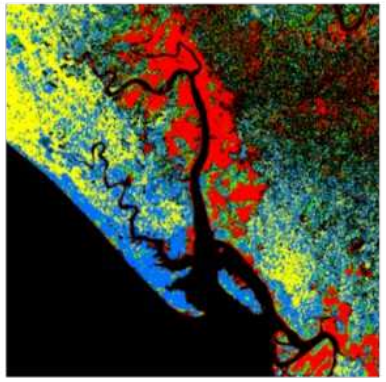


Málaga Bay			
Name	*Scientific Name*	Abbreviation	**Number of signatures**
Black mangrove	*Avicennia germinans*	AG	**2**
Majagua (non mangrove)	*Hibiscus elatus*	HE	**1**
White mangrove	*Laguncularia racemosa*	LR	**3**
Nato mangrove	*Mora oleífera*	MO	**2**
Red mangrove	*Rhizophora mangle*	RM	**10**
Piñuelo mangrove	*Pelliciera rhizophorae*	PR	**4**
Grafted mangrove	-	MI	**2**
Other: Water, sand, mud, water hyacinth, shrubbery	-		**9**
Total (mangrove):			**23**

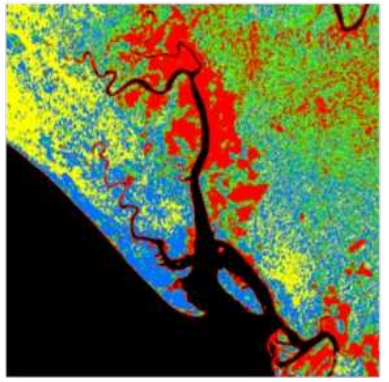
PlanetScope (standard false color)



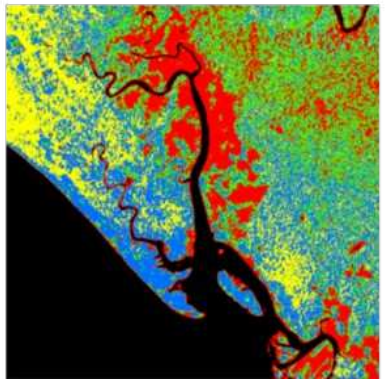
SAM (max. angle= 0.10)



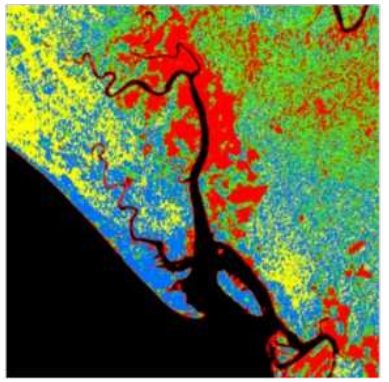
SAM (max. angle= 0.30)



SAM (r max. angle= 0.20)



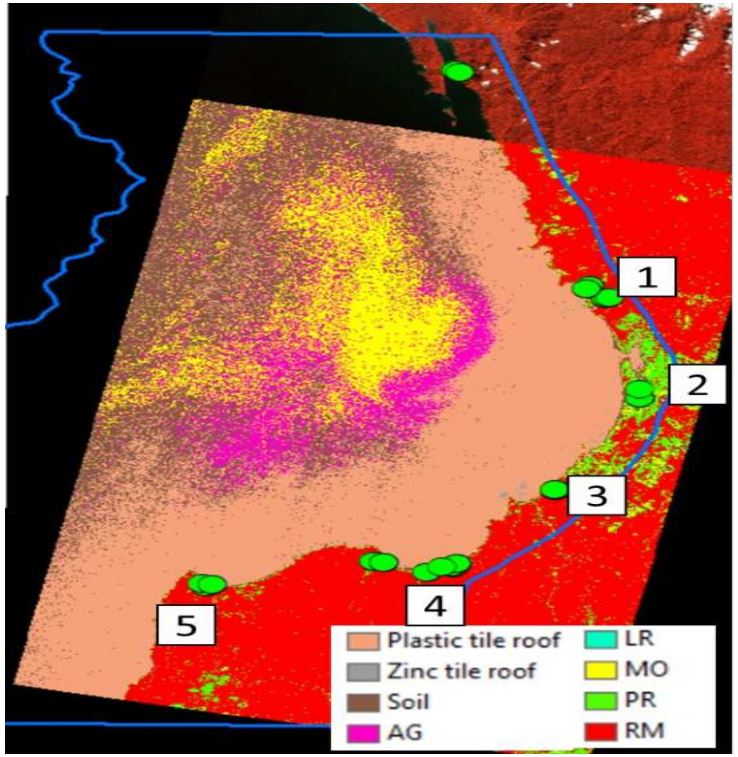
SAM (max. angle= 0.25)



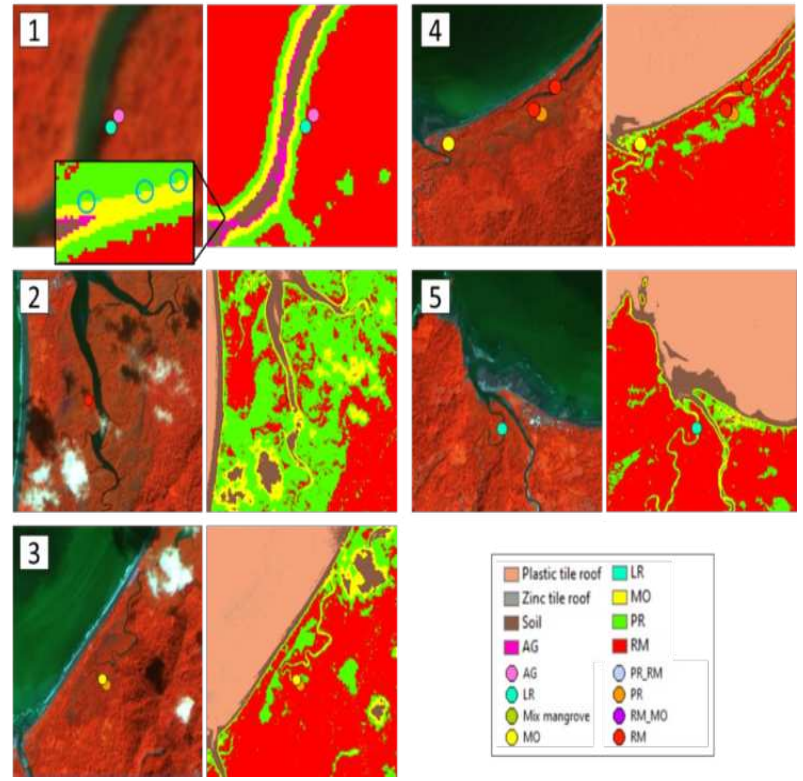
"The tendencies and patterns in pixel values distribution is directly related to the succession of mangrove species."

Gulf of Tribugá:

Spectral Angle Mapper



Tribugá Gulf			
Name	Scientific Name	Abbreviation	**Number of signatures**
Black mangrove	*Avicennia germinans*	AG	**4**
Nato mangrove	*Mora oleífera*	MO	**1**
Red mangrove	*Rhizophora mangle*	RM	**2**
Piñuelo mangrove	*Pelliciera rhizophorae*	PR	**2**
Botoncillo mangrove	*Conocarpus erectus*	CE	**2**
Dwarf mangrove	-	ME	**1**
Total (mangrove):			**12**



1) Jurubida, 2): Tribugá, 3): Pangui, 4): Coqui, and 5): Jovi

"The satellite image and field spectra relation is clearly stablished, the correct assignment of classes (species/group of species/targets) is the challenge"

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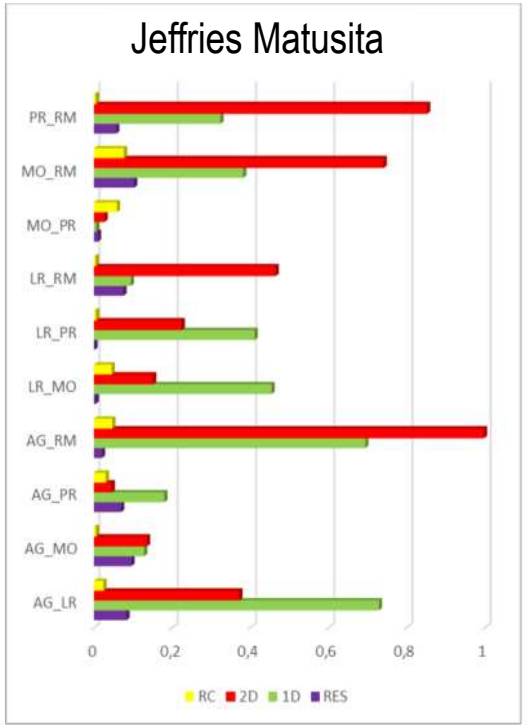
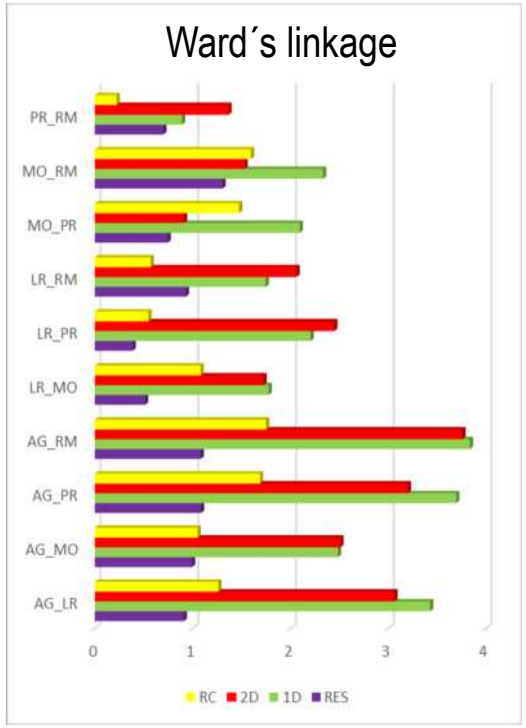
Complementary and future work:

Further analysis and image processing in spectral analysis and classification using AI.





Total number of signatures
(Expeditions to the Pacific Coast of Colombia

Name	Scientific Name	Total number of signatures
Black mangrove	*Avicennia germinans*	10
White mangrove	*Laguncularia racemosa*	8
Nato mangrove	*Mora oleífera*	11
Red mangrove	*Rhizophora mangle*	35
Piñuelo mangrove	*Pelliciera rhizophorae*	24
Red and nato mangrove	*Mora oleifera y Rhizophora mangle*	1
Piñuelo and red mangrove	*Rhizophora mangle y Pelliciera rhizophorae*	5
Botoncillo mangrove	*Conocarpus erectus*	2
Other mangrove	-	3
Total mangrove signatures	-	99
Other targets	-	40

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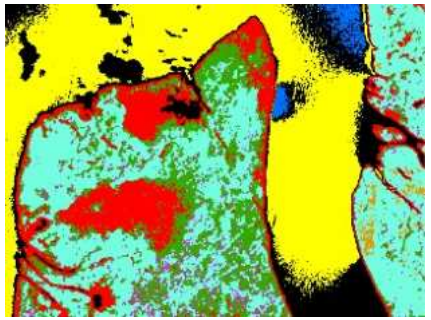
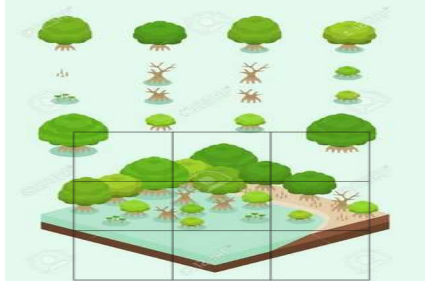
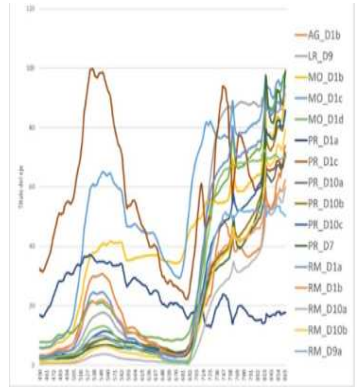




Conclusions, recommendations, ongoing and future work

- The PlanetScope images, despite their limitations (spectral, radiometric and spatial), gave a clearly differentiated result in the classification with the spectral signatures (**atmospheric correction is vital**).
- Field protocols must be adjusted to sampling the different strata of the mangrove forest, considering the presence, distribution and relationship of species in a sampling area, and the effect of the ground and the tide.
- Is highly recommended to stablish monitoring plots of mangrove forest specifically for earth observation data.
- Additional field campaigns are needed to validate the classification results
- Current and trending AI techniques on endmember generation and image classification could led to better results.
- Explore further biophysical variables into the analyses.



Thank you

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