Comparative analysis of the annual changes of land coverage of the “Cienaga de las Macanas” wetland

Author: Andrea Santamaría Domínguez
Co-Authors: Yvanna Serra, Dr. Jose Fábrega, Dr. Mauricio Hooper - Universidad Tecnológica de Panamá
Conrado de Leon - CREHO Ramsar

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UNIVERSITY of FLORIDA

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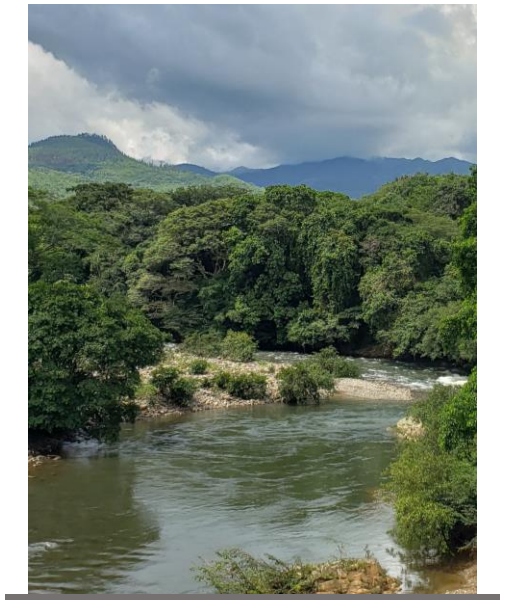
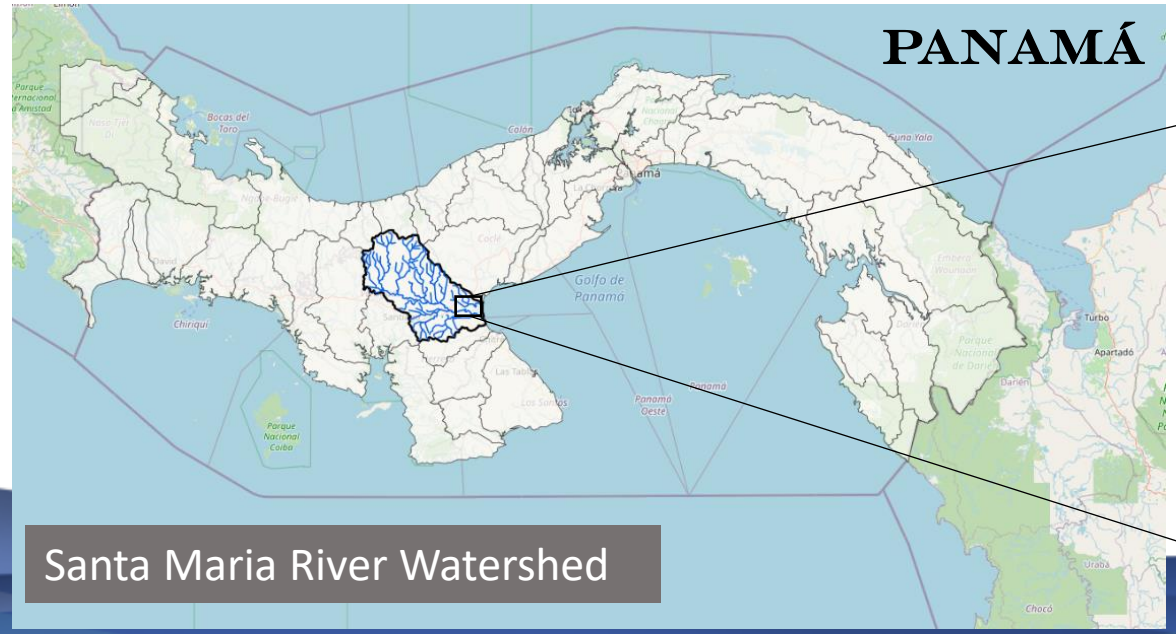
Background

Project:

Guaranteeing Water Security for the Forests and Wetlands of the Santa Maria River Watershed, Panama.

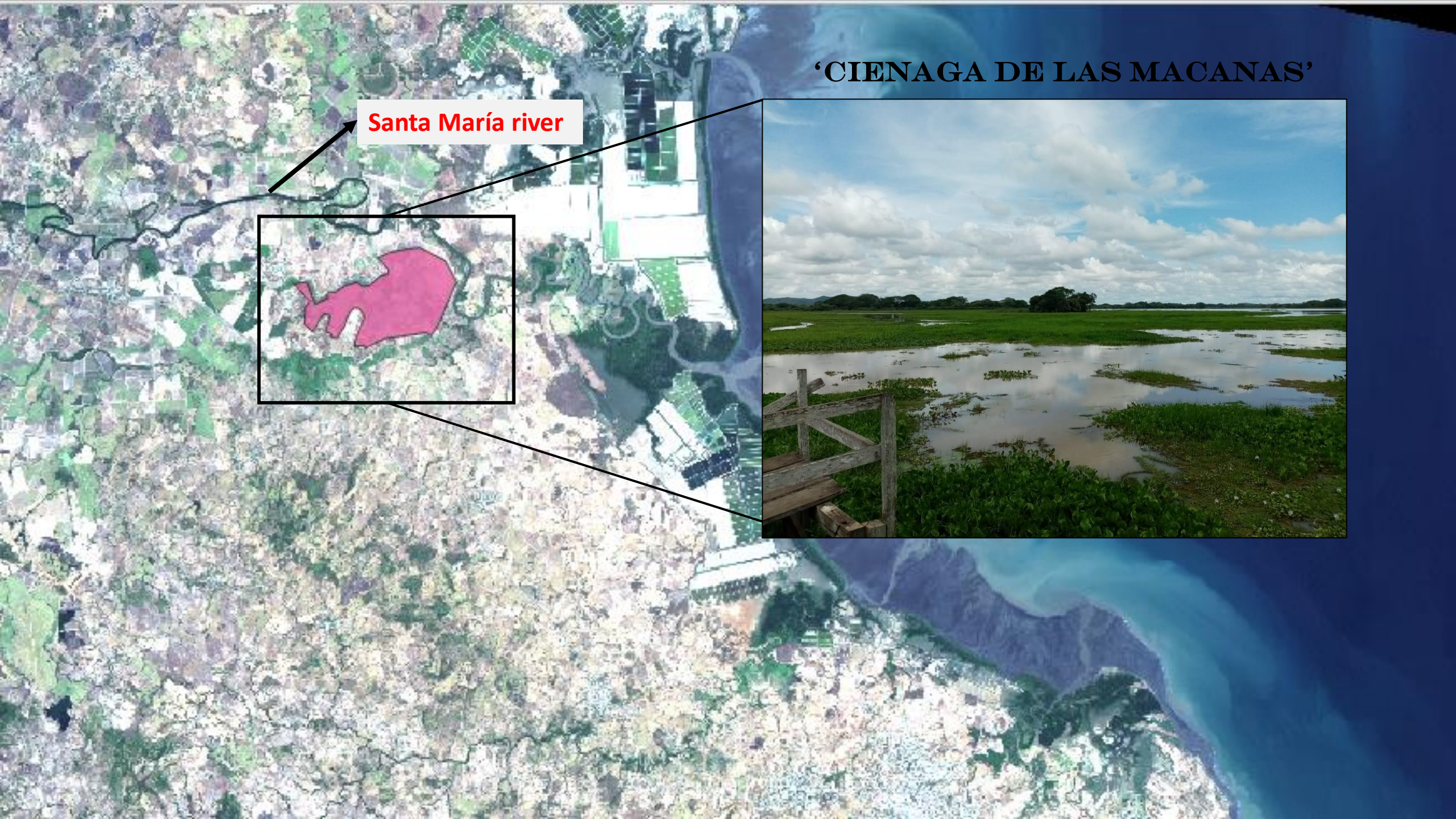


Santa Maria River



Santa Maria River Watershed

Cienaga de las Macanas wetland


Santa María river
'CIENAGA DE LAS MACANAS'

Cienaga de las Macanas wetland

ESCALA 1:25,000

LEGAL FRAMEWORK OF THE PROTECTED AREA

1987 -> Biological Reserve
1996 -> Cienaga de las Macanas Multiple Use Area
2016 -> Managed resource area

THE CIÉNAGA DE LAS MACANAS MANAGED RESOURCE AREA HAS AN SURFACE OF 857 HECTARES

UNIVERSIDAD TECNOLOGICA DE PANAMA
1981

Cienaga de las Macanas wetland

Research Questions:

1. What are the water needs of the wetland?

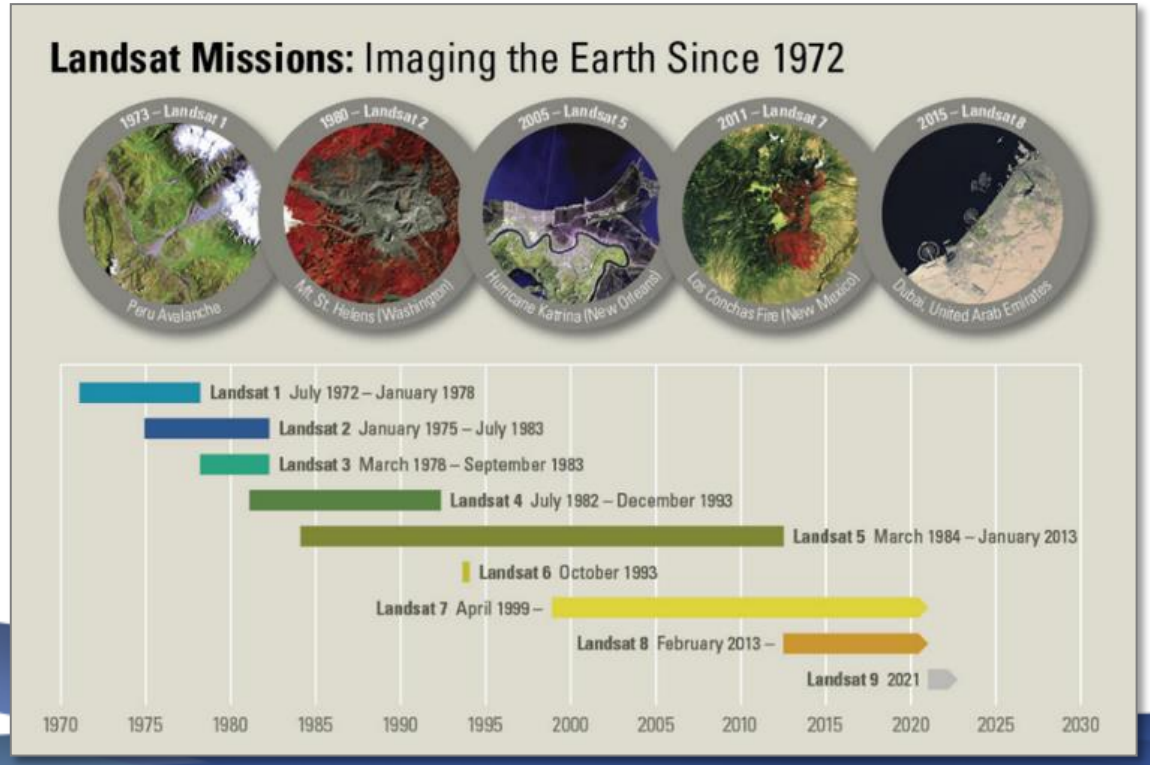
2. How has been the behavior of the coverage in recent decades?

3. What climatic and hydrological factores influence them?

ESCALA 1:25,000

METHODOLOGY

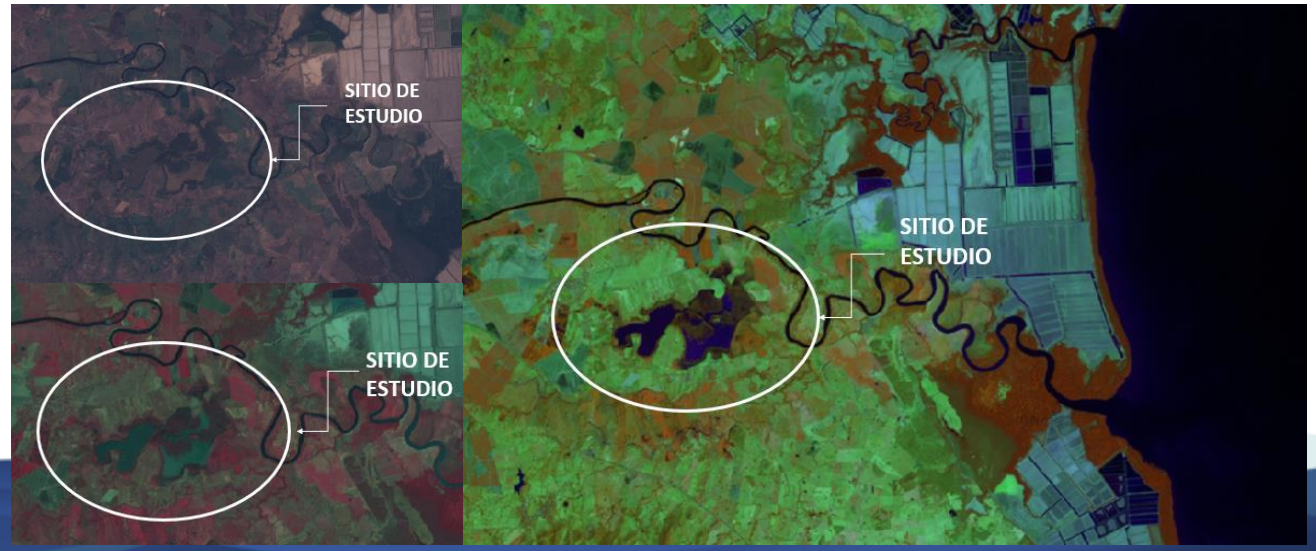
Remote Sensing: satellite images use and supervised classification



Satellite images(USGS – Earth Explorer) : Collection 1,Tier1

- LANDSAT 5 and 7 (Period 1: 1997 -2003); 53 images
- LANDSAT 8 (Period 2: 2014 – 2021) ; 87 images

Band combos: R/G/B; NIR/R/G; NIR/SWIR/R



METHODOLOGY

Remote Sensing: satellite images use and supervised classification

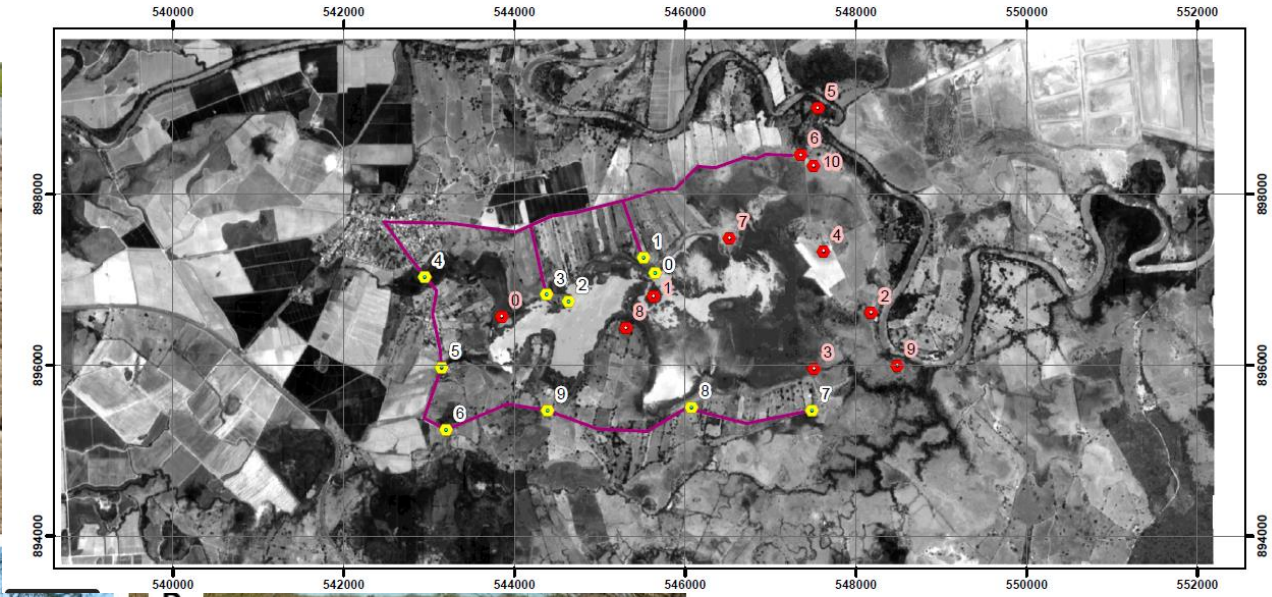
QuantumGIS (SCP):

- Atmospheric Correction + Pansharpening
- Band combination
- Study area cut

  Area = 1527.75 ha
- Supervised Classification
- Class area reports

Supervised Classification:

A. Water Mirror
B. Water with vegetation
C. Dry green vegetation
D. Bare soils/Dry land
E. Trees/Shrubs



Notice:
'Flooded area' = 'mirror water' + 'water with vegetation'

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Data contrasted with climatological and hydrological data

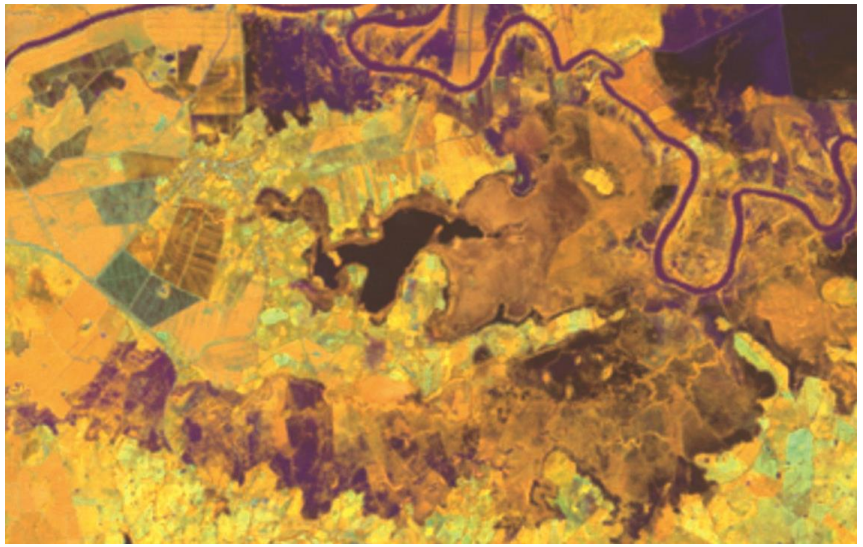
7km distance from the wetland

47km distance from the wetland

RESULTS

Band Combo: NIR/R/G

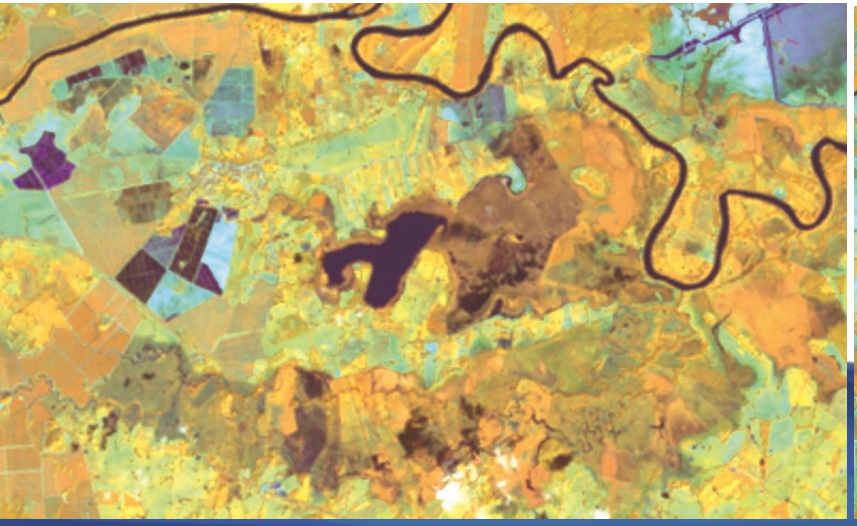
08/11/1998



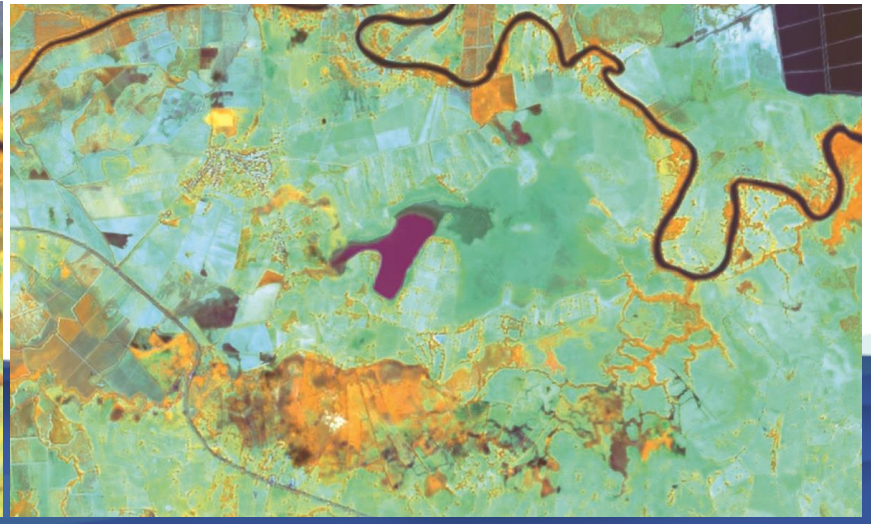
23/02/2000

23/04/2001

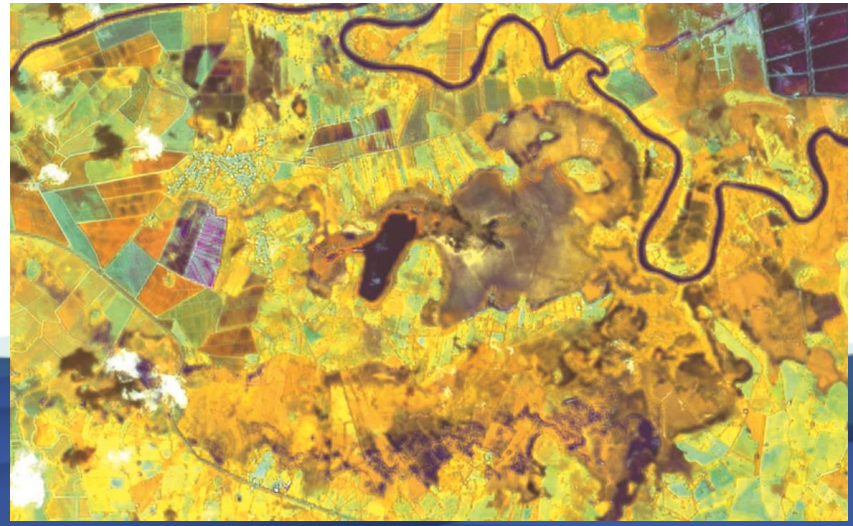
03/12/2001



25/06/2015



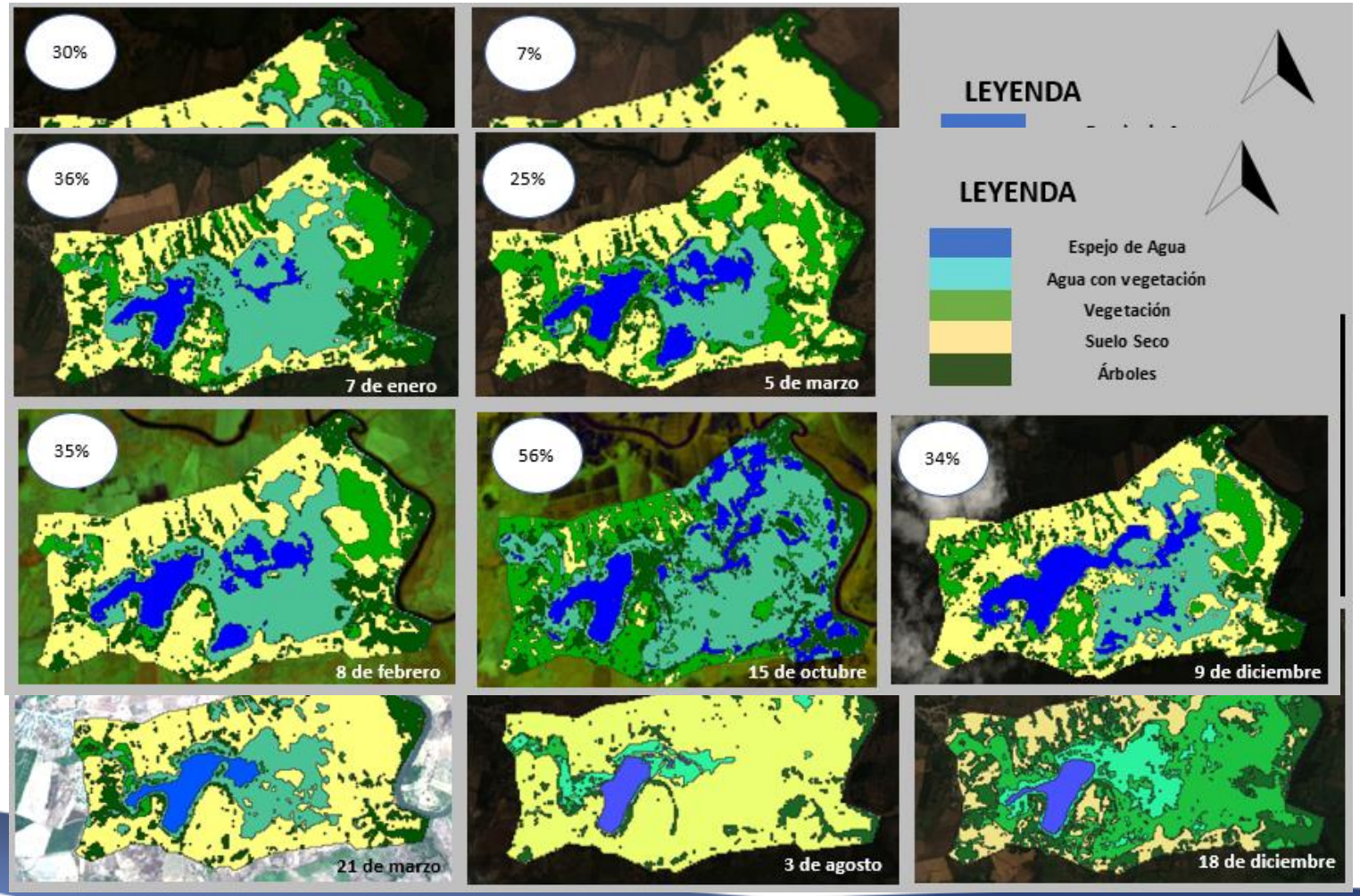
01/09/2020



RESULTS

Supervised Classification

Flooding area



2015 – Extreme dry

- Percentaje of flooded area
  5% - 30%
- 10 months with images available

2021 – extreme flood

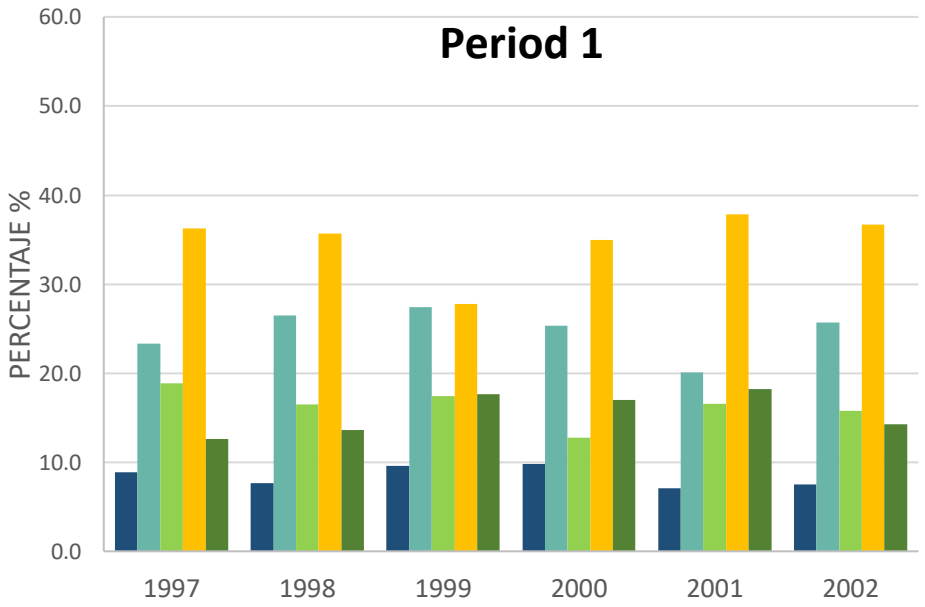
- Percentaje of flooded area
  25% - 56%
- 5 months with images available

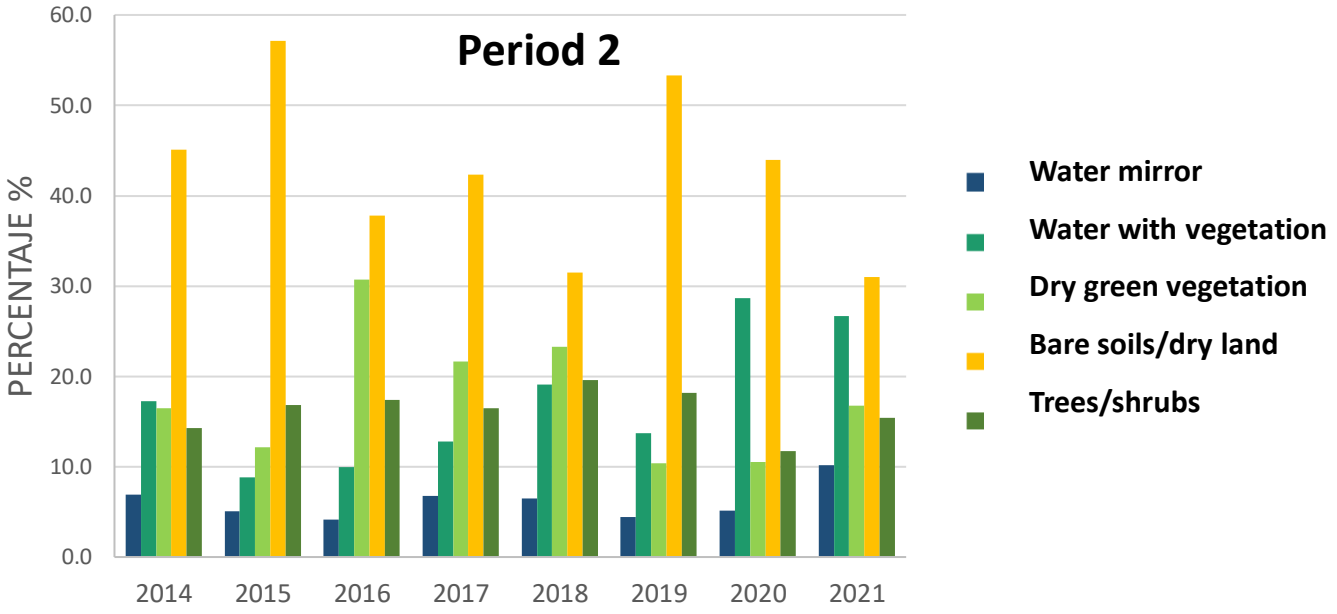
Notice: 'Flooded area' = 'mirror water' + 'water with vegetation'

RESULTS

Supervised Classification

Coverage percentage breakdown





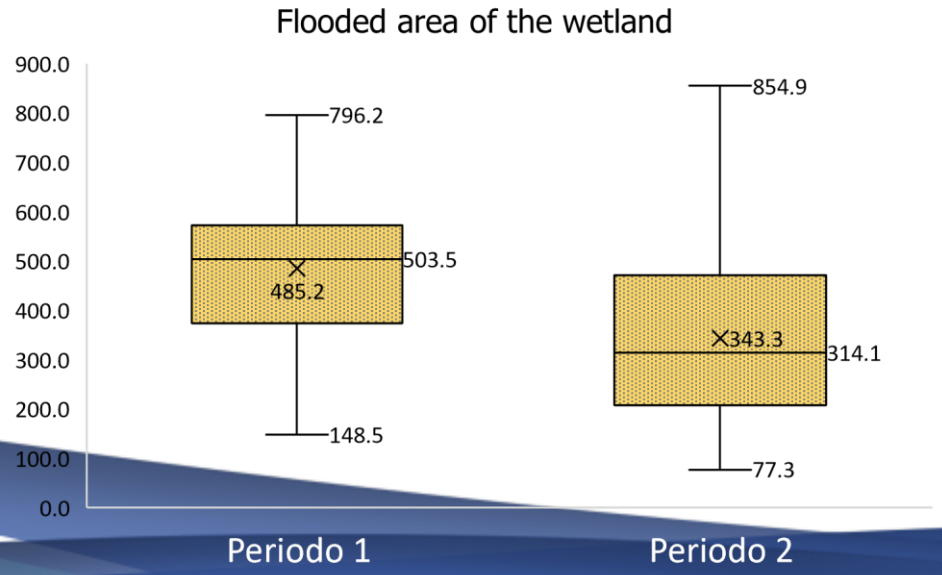
Water mirror: 7.1% - 8.9%
Bare soils/Dry land: 27% – 36%
Tress/Shrubs: increase del 12% al 18%

Water mirror: 5.1% – 5.9% ; Recovery in 2021 (10.2%)
Bare soils/Dry land: 31% - 57%
Tress/Shrubs: Variation between 14% al 19%

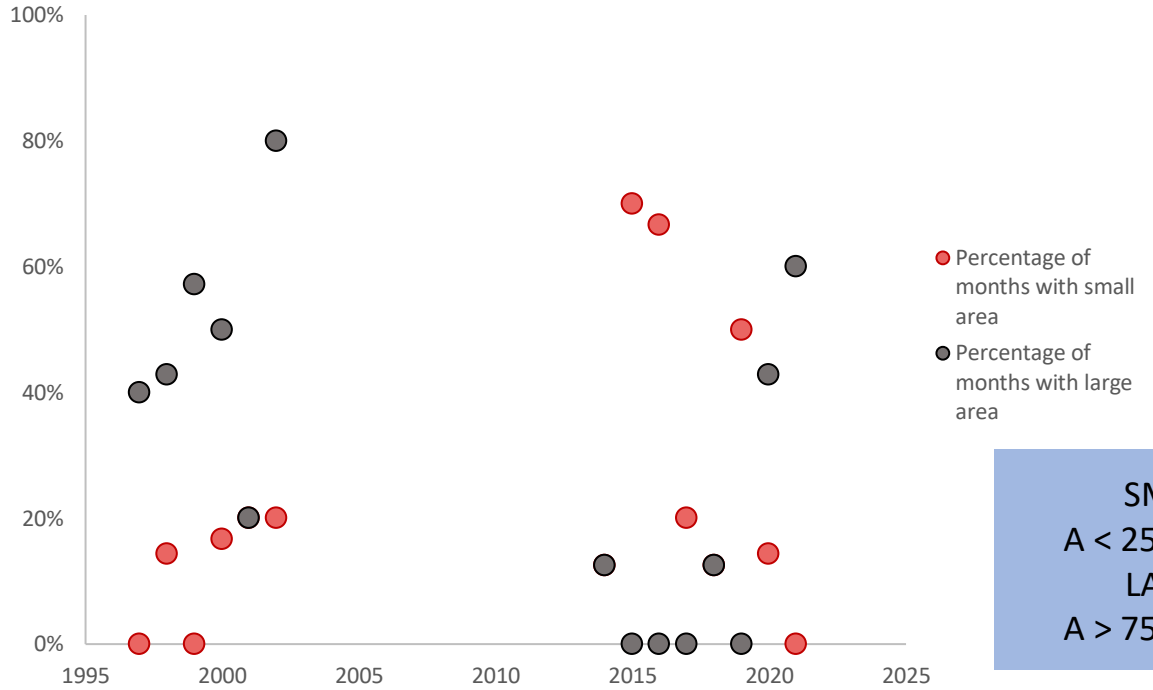
RESULTS

Table 1

	Period 1	Period 2
	1997 - 2003	2014 - 2021
Average (Ha)	485.2	343.3
Min (Ha)	148.5	77.3
Max (Ha)	796.2	854.9
Percentil 25 (Ha)	371.7	203.9
Percentil 75 (Ha)	575.5	476.1
CV (Coef. Variation)	31%	53%
Min Average (Ha)	271	173.79
Max Average (Ha)	706	550.29



Behavior of the flood area



SMALL AREA
A < 25th = 267.46 ha
LARGE AREA
A > 75th = 522.17 ha

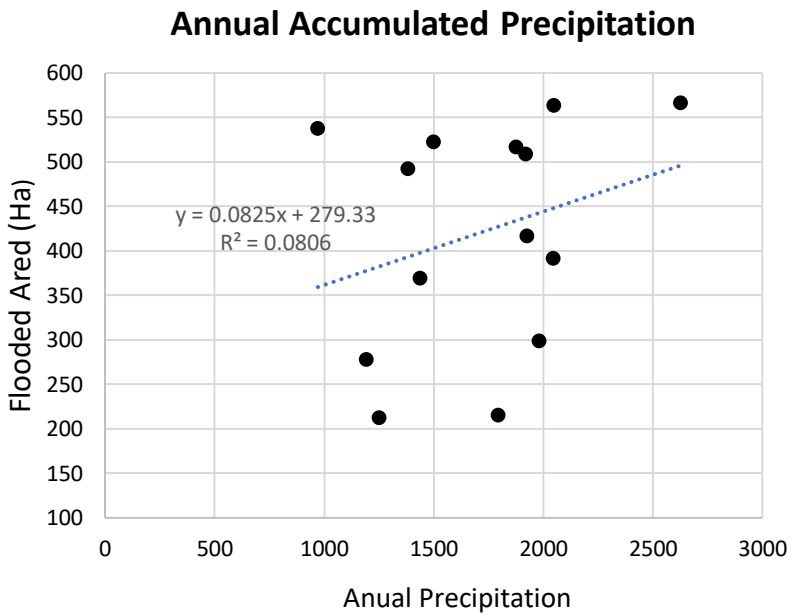
- Decrease in flooded area in Period 2
- Area variability increased in period 2
- Recovery of the wetland area between 2020 – 2021
- Period 1 with the highest percentage of months with a large area

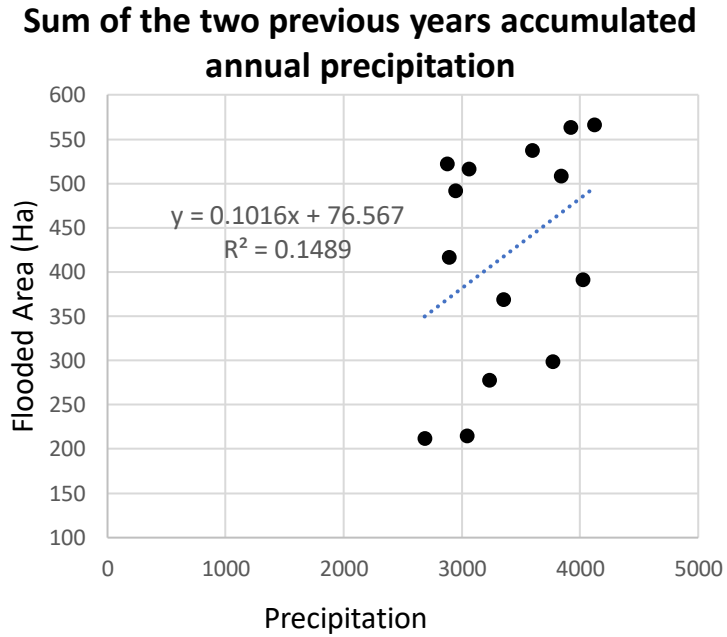
RESULTS

Comparison with climatological and hydrological data

Correlation of the flooded area with precipitation

7km distance from wetland





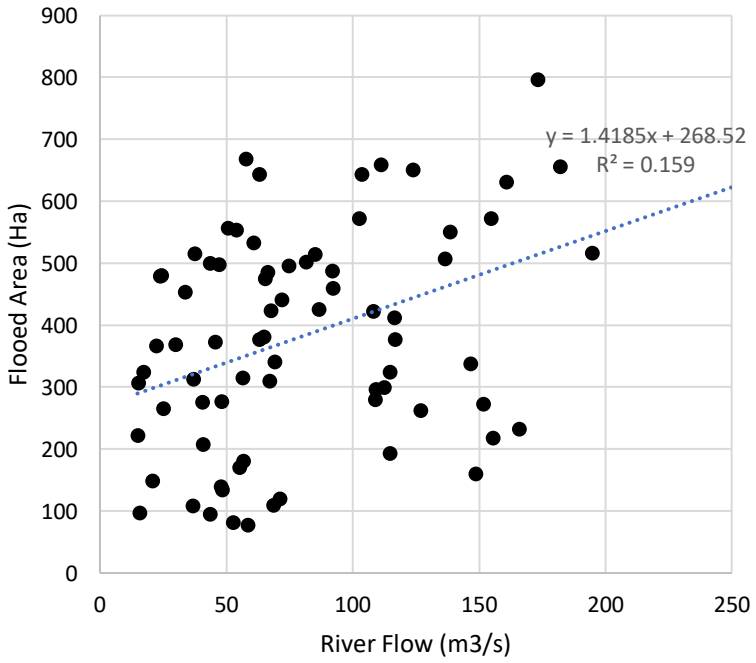
HIGHER CORRELATION

RESULTS

Comparison with climatological and hydrological data

Correlation of flooded area with the flow of the Santa María River in the previous month

Both periods



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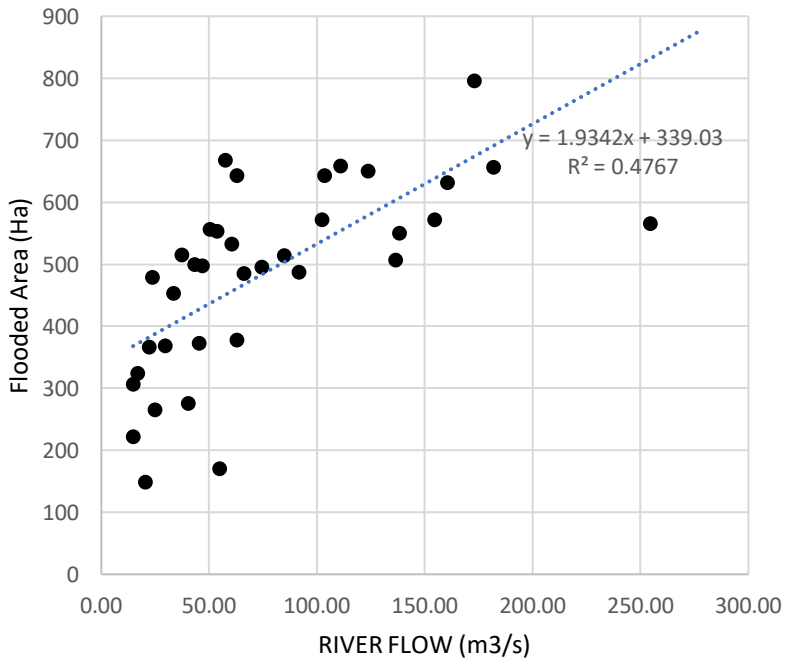
Period 1: 1997 - 2003



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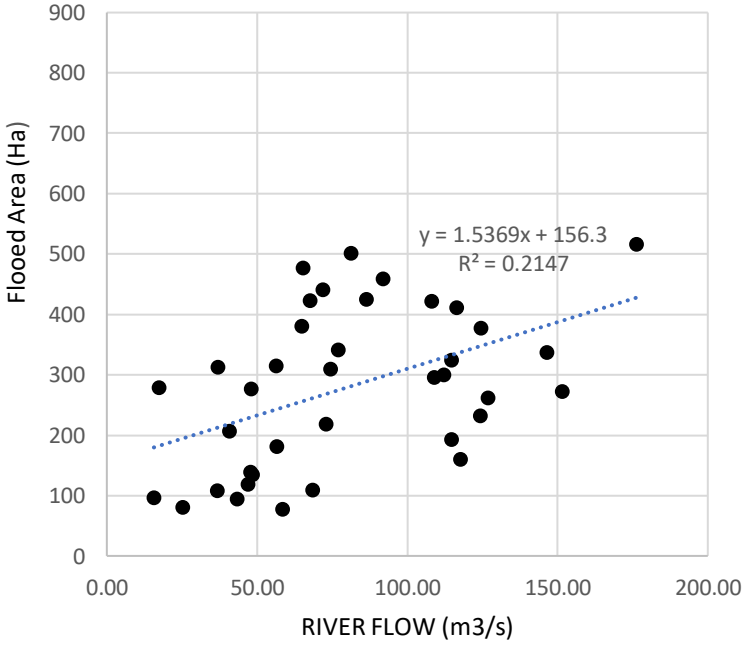
Period 2: 2014- 2021



HIGHER CORRELATION

CONCLUSIONS

- ✓ Supervised classification shows the increase in dry areas and bare soils in the surroundings of the wetland. As well as the decrease in the surface of the water mirror, caused by the increase in the coverage of aquatic plants on the water.
- ✓ The comparison between periods shows the notable decrease in the area flooded in recent years and a recent recovery in 2021. In addition, a greater variability in the surface of the flooded area, being less constant than the first period.
- ✓ About the influencing factors:
  - ✓ A certain influence of the interannual rains on the flood area is observed. Two consecutive years cause a greater subsequent impact on the wetland that one year alone.
  - ✓ The greatest effect is caused by the Santa María River, adjacent to the wetland, being an important inflow. And since the wetland is affected by the flow of the previous month, it means that there is a possible storage in groundwater.
- ✓ If the flow of the river has not undergone major changes, then the decrease in the flooded area could be caused by human action. If the water is extracted from wells or underground storage or if it is extracted from the same body of water, lowering the water level. A non-human factor could be the dragging of sediments by the river that would obstruct its flow towards the wetland.

THANK YOU!

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  – Sr. Cuba
- Grupo Gema – María Pinzón
- Ing. Víctor Pérez
- Ministerio de Ambiente (MiAmbiente)
- Eilyn Ríos
- Yvanna Serra

QUESTIONS?
Email: andgissel@hotmail.com

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