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MONITORING WATER BODIES TO DETERMINE THEIR CONNECTIVITY, SEASONAL VARIATIONS AND PERMANENCE IN THE GRIJALVA-USUMACINTA REGION.

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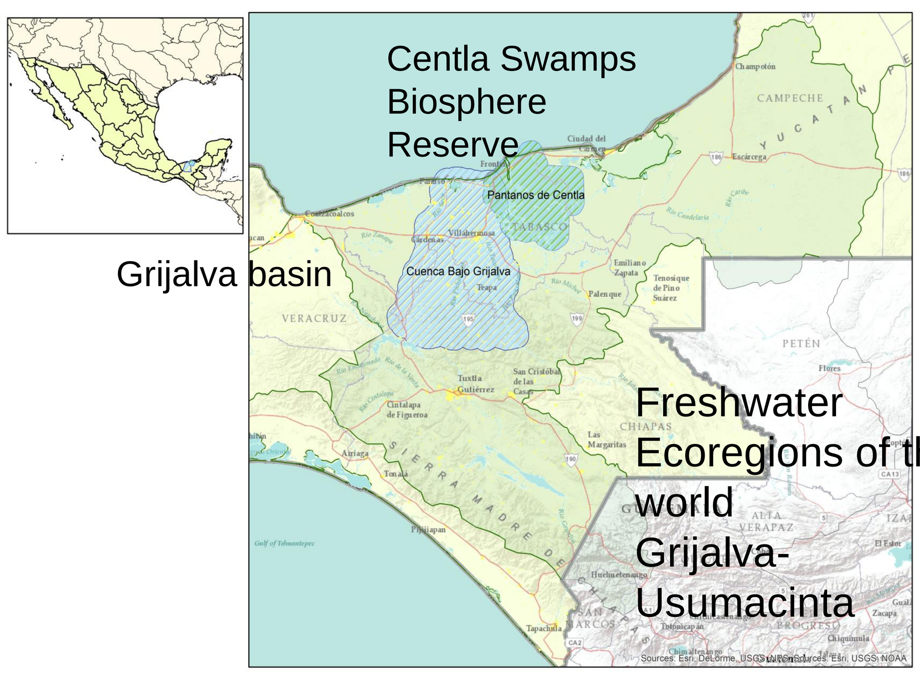
Motivation & Objectives

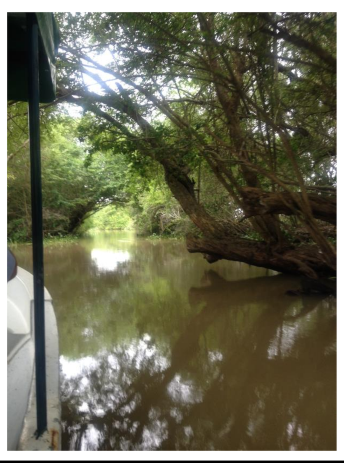
The objective of this work is to develop a monitoring procedure of continental waters of the Grijalva-Usumacinta eco-hydrological region, based on the identification and extraction of information on water surfaces in this study area, using series of images taken periodically by the Sentinel-1A.

In order to understand the spatial-temporal aspects during an annual period, two sub-ecosystems are considered, located in the lowland of this eco-hydrological region; the first is the Grijalva basin and the second is the Centla Swamps Biosphere Reserve (*Reserva de la Biósfera Pantanos de Centla*).

Study Area

The levels of the Grijalva and Usumacinta rivers and lakes in the state of Tabasco, in the southeastern region of the Mexico, must be continuously monitored when they reach a critical capacity.



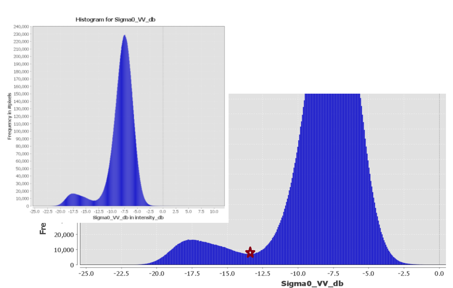


Methodology

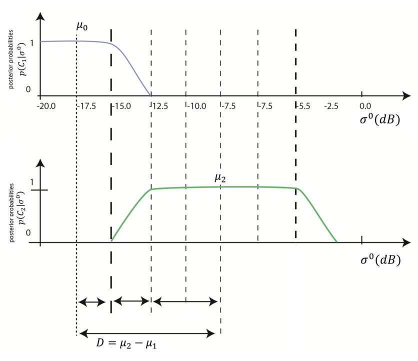
Calibration radiometrically corrects a SAR image so that the pixel values truly represent the radar backscatter of the reflecting surface.
Multiple looks may be generated by averaging over range and/or azimuth resolution cells improving radiometric resolution but degrading spatial resolution.
Speckle filters can be applied to the data to reduce the amount of speckle at the cost of blurred features or reduced resolution.
Geocoding converts an image from Slant Range or Ground Range Geometry into a Map Coordinate System. Terrain Geocoding involves using a Digital Elevation Model (DEM) to correct for inherent SAR geometry effects such as foreshortening, layover and shadow.
Sentinel 1A data were pre-processed using ESA's SNAP (Sentinel Application Platform) software.

Image Processing Binary Segmentation

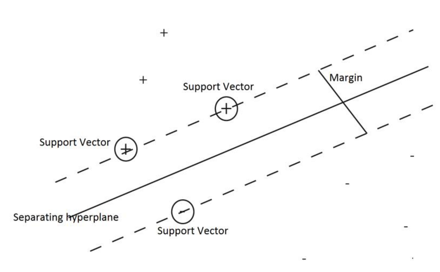
Thresholding method

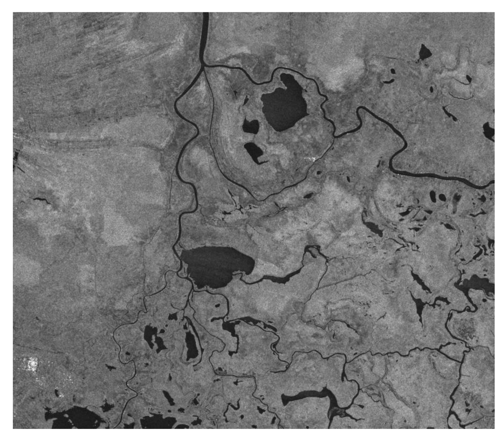


Bayesian method



Support Vector Machine method

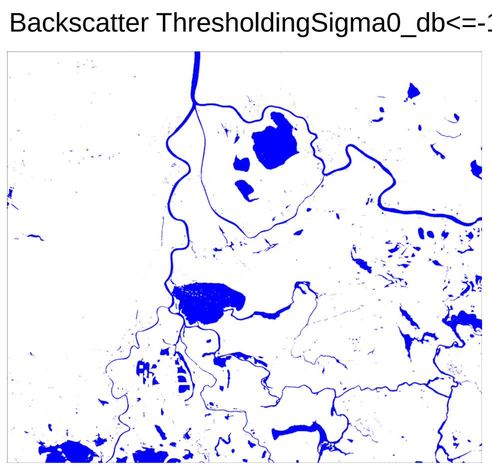


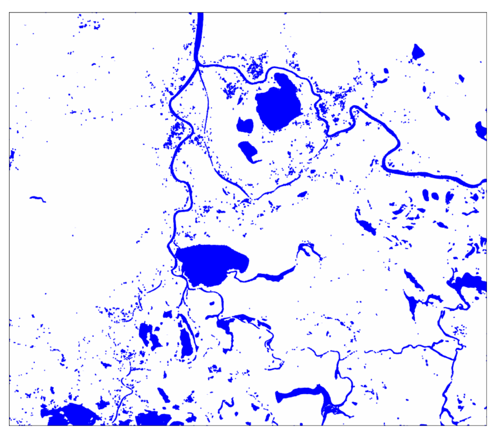


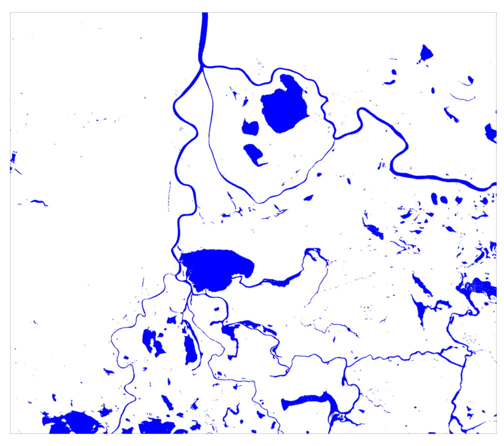
Sentinel 1A
C- band Synthetic Aperture Radar

Level-1 Ground Range Detected

Backscatter ThresholdingSigma0_db<=-13.44



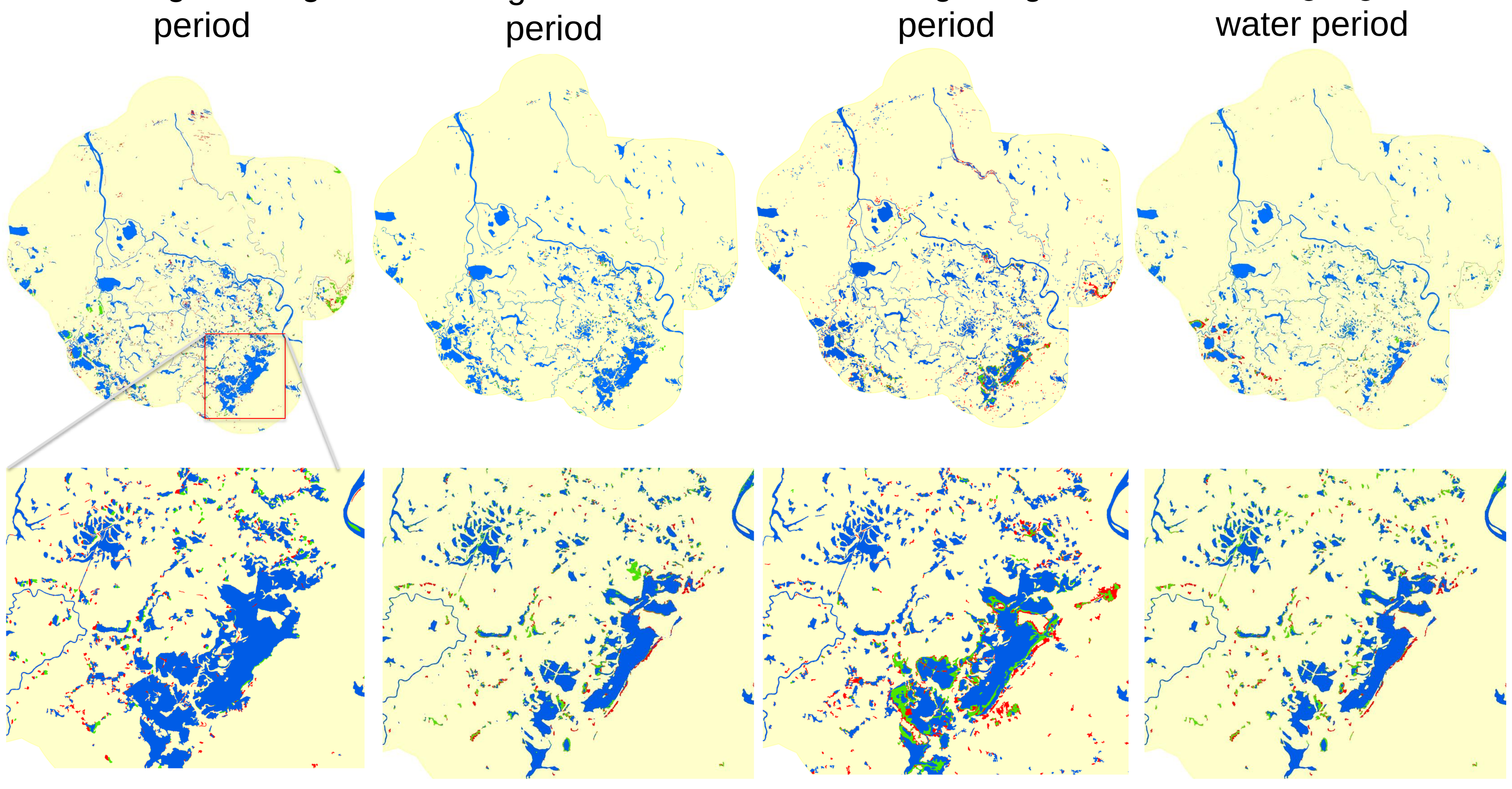




In the confusión matices, SVM method presented the higher value of identification pixels with Water Surface Area.

Seasonal results

During draining period | During low water period | During filling period | During high water period

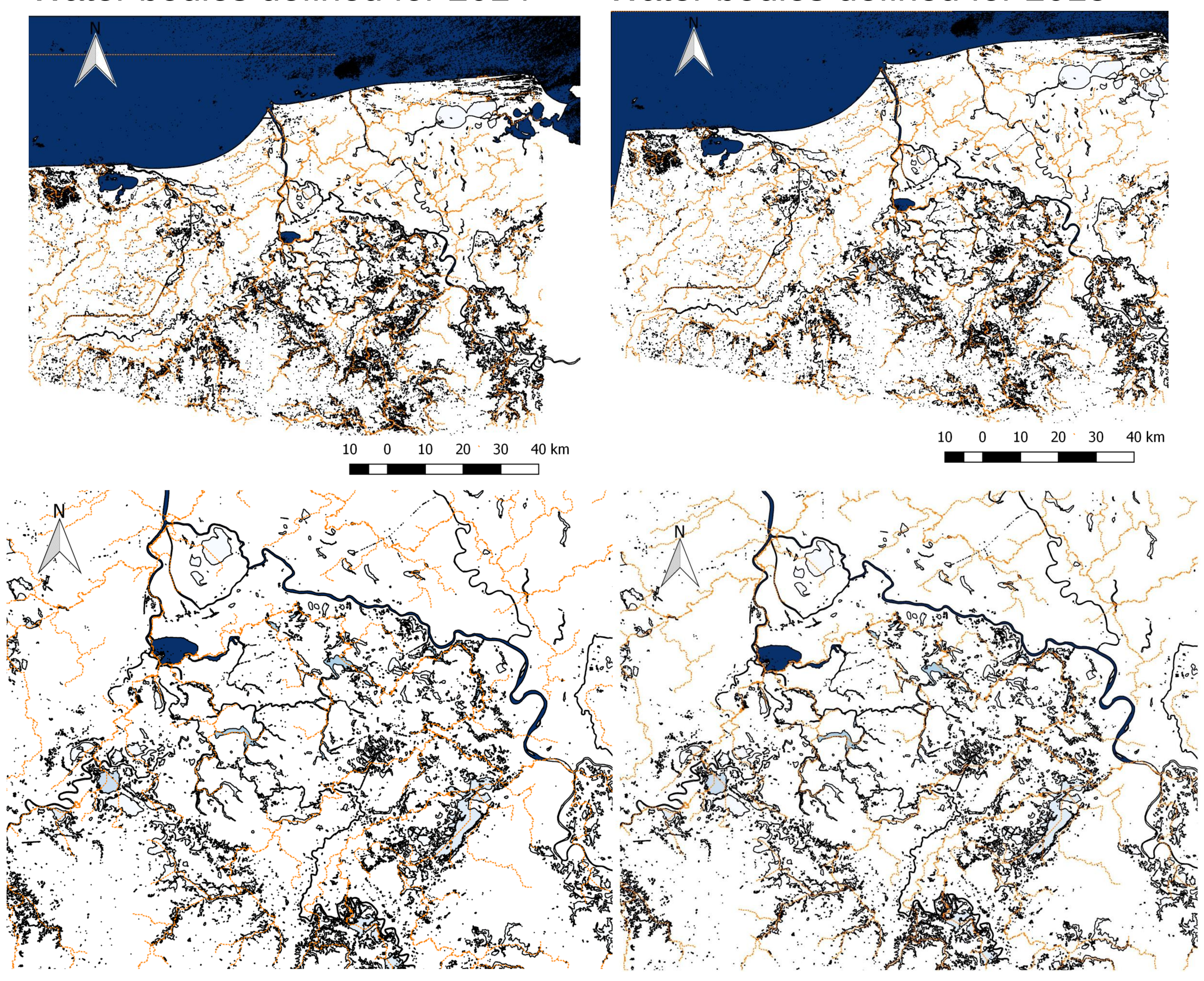


- Oct, Nov, Dec
- Jan, Feb, Mar
- Apr, May, Jun
- Jul, Ago, Sep

Centla Swamps buffer zone

Preliminary hydrologic results

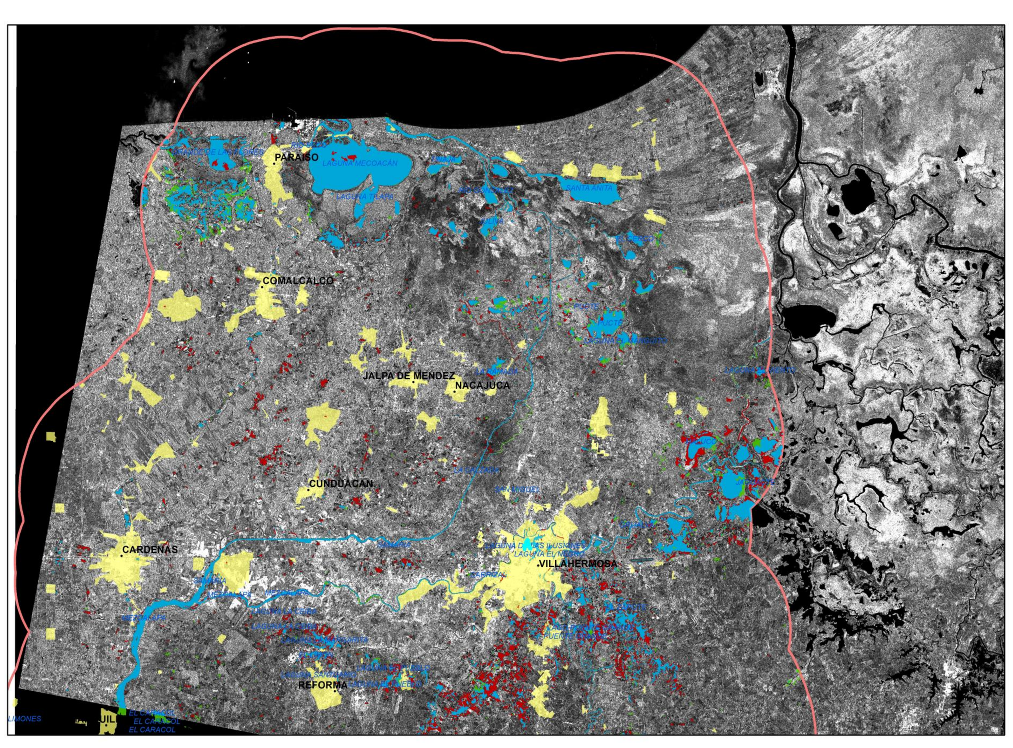
Water bodies defined for 2014 | Water bodies defined for 2015

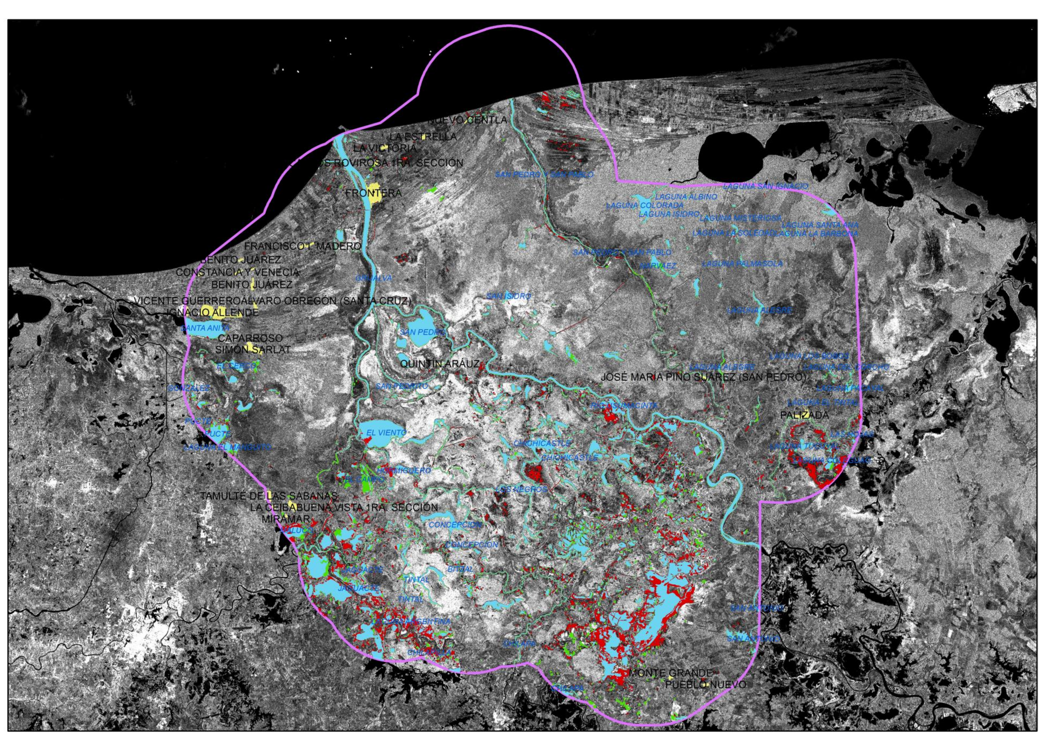


Graduation in blue of water flowing into
minimum maximum

Line indicating conectivity

Mapping water bodies bi-temporal change detection





October 2014 and October 2015

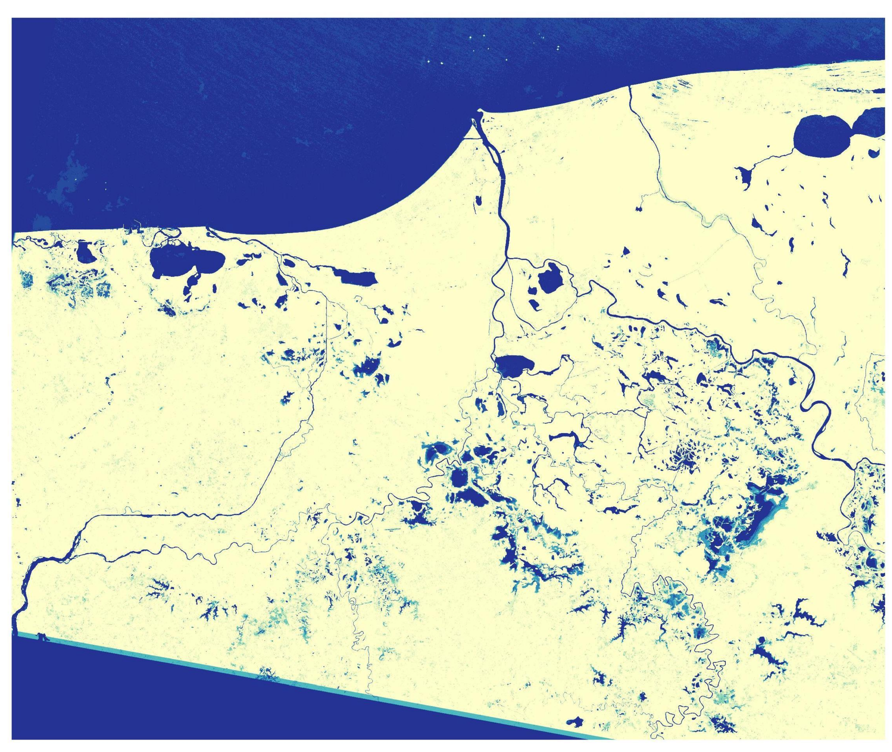
Increase water area extent
Area Water Bodies
Shrink area water extent

Grijalva Basin
Urban Area
Centla Swaps

Tabla1. Body Water Area (km^2)

Zone	Area (october 2014)	Area (october 2015)	Difference
Centla Wetland	508.2	393.8	114.4
Low Grijalva Basin	369.5	311. 9	57.6

Number of months with flooding per pixel



October 2014 to November 2015

0 1 2 3 4 5 6 7 8 9 10 11 12 13

Conclusion

*****The study shows the spatial-temporal behavior of form, size, distribution of water bodies that allows for the description of rivers, connectivity and drainage patterns.

*The year 2014 was a year with a greater amount of flooded areas than 2015. In the quarterly analysis of results, we found that during the months of July to September, there was a decrease in rainfall, compared to the April-June quarter. The method used was the SVM. We believe that the probabilistic method has to be optimized; it is a good contextual classifier.

Literature cited

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