

Sargassum transport prediction through the Dominican Republic using artificial intelligence

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ABSTRACT

The abnormal influxes of sargassum in the Caribbean have shown to be growing in coverage area and mass since 2011. Several efforts have been made for the detection, monitoring, tracking and prediction of the arrival of sargassum to the marine region and coasts in the Greater and Lesser Antilles. Within the regional studies, monitoring and prediction tests have been carried out in the Lesser Antilles, Jamaica, Puerto Rico, and the Mexican Caribbean. However, studies carried out in the Dominican Republic are unknown in the literature. The ideal parameters to detect sargassum using satellite images have already been established. However, there is uncertainty in the prediction, especially in real time, due to the dynamic cloud coverage and low temporal resolution of the satellite systems used and due to the properties of the natural markers (current, sea wind, marine geography, among others) that affect the predictions. The high volume of data from these variables open the doors to investigate which automated methodologies can best serve for effective analysis. This ongoing work proposes the evaluation of the historical pattern of sargassum on the Dominican marine region using a random forest algorithm that will serve to predict the path of future clusters of sargassum, thus creating an early warning system for the country.

OBJECTIVE

We propose the evaluation of the historical time series of drifting sargassum to identify possible transport patterns using artificial intelligence techniques. The research will be carried out using satellite imagery, oceanographic tide and wind data obtained from mathematical models and geostationary satellites, from the years 2020 and 2022. The model will be validated against known 2023 occurrences.

METHODOLOGY

The proposed strategy will evaluate the 2020 and 2022 sargassum occurrences in the eastern Caribbean (Lesser Antilles, Puerto Rico, and Dominican Republic) and select the best year with sequential images and least cloud coverage (max. of 2/8th of cloud coverage) to teach the time series machine learning model, estimated to be random forest. The images will be taken from MODIS, OLI and OLCI satellite sensors and will be processed using the Alternative Floating Algae Index (AFAI) and are collected from the University of South Florida's Optical Oceanography Laboratory database. A postprocessing algorithm will create a single mosaic from the available data each day, the mosaic is then masked to use only the pixels where sargassum has been identified.

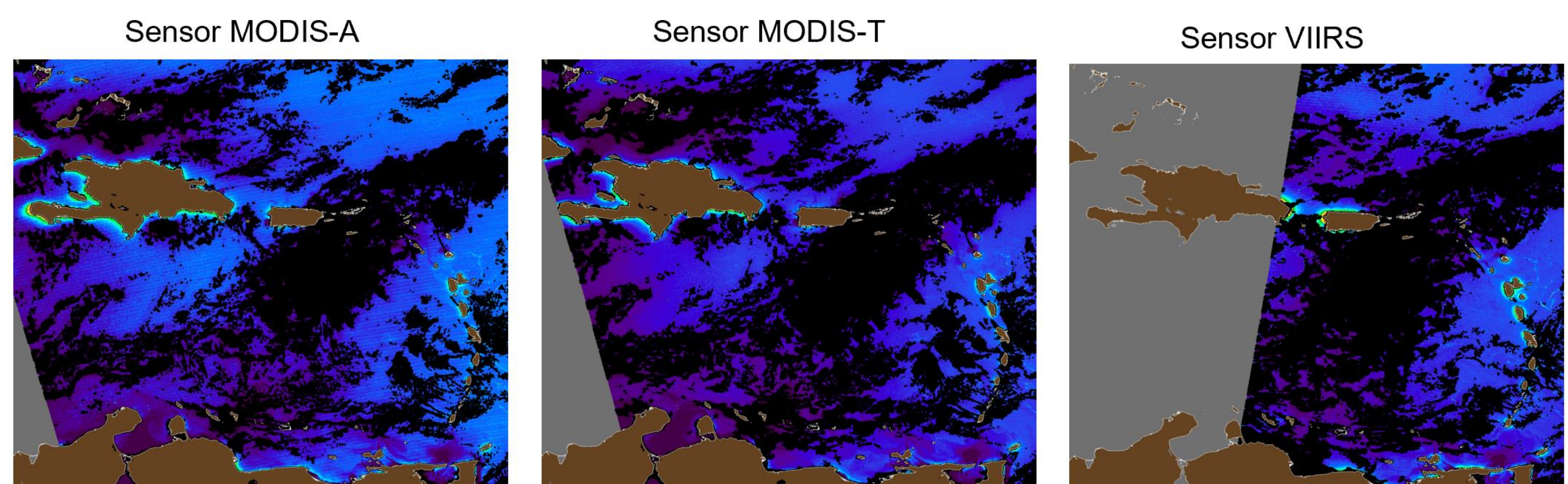
Following this activity, the program will identify the centroid of the most relevant cumuli and will evaluate the vector performance in direction and translational movement. Oceanographic current and wind data will be fed to the model to sharpen the prediction capabilities.

RESULTS

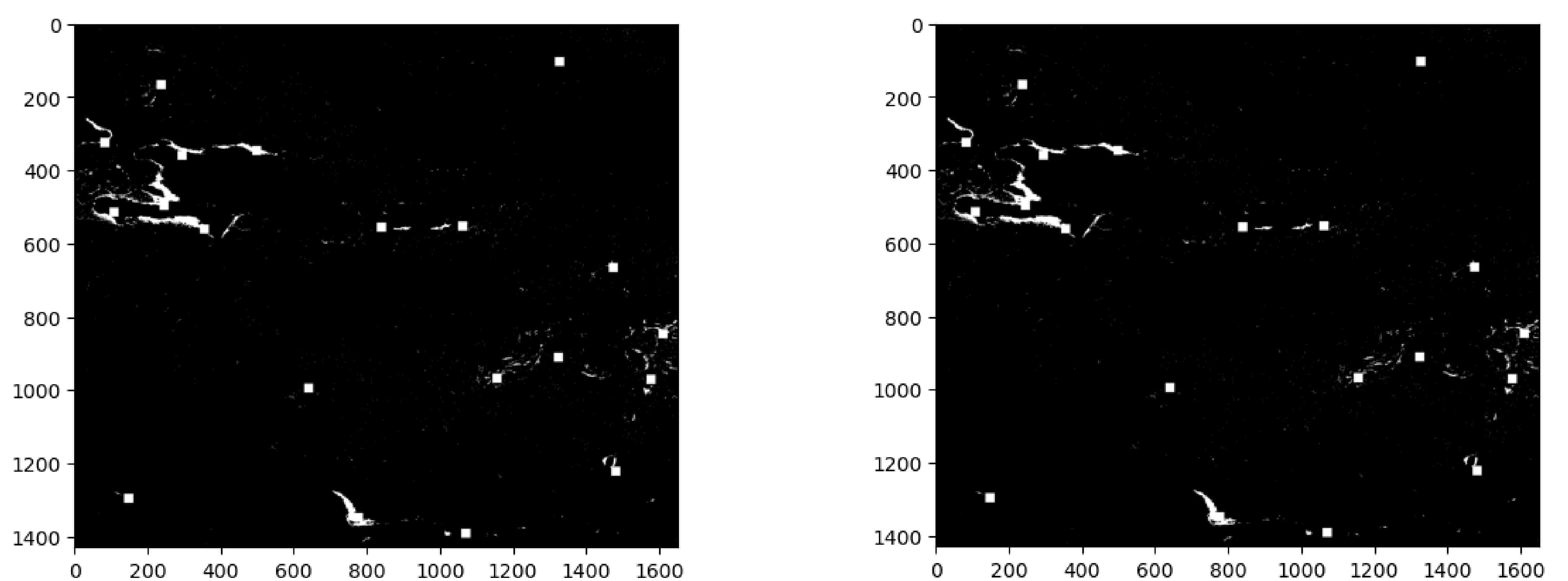
We have been able to generate the mask image from the single mosaic, highlighting only the pixels where sargassum has been identified. Additionally, we have been able to automatically identify the centroid of up to 20 sargassum cumuli per image, as shown in Figure 1(b). A virtual grid is used to identify the translational vector of the cumuli on the mosaic.

Future results are expected to identify a transport pattern of the sargassum drifts, and to improve the learning process using oceanographic current and wind data. The model is expected to help with predictions where strong cloud coverage impedes sargassum sighting using satellite remote sensors.

Figure 1. Image postprocessing, converting to mosaic after collection from database.



(a) Sample of images collected from University of South Florida's Optical Oceanography Laboratory database on the 27th day of 2020, before postprocessing.



(b) Generated mask from image mosaic highlighting only sargassum pixels (left) and cumuli centroids (right).

CONCLUSION

As this research is still on-going, and is part of a doctoral thesis, the presented results are preliminary. Different machine learning tools are being tested to identify which yields the best centroid estimations to measure the translational vectors. We expect to generate a predictive model using artificial intelligence that can counter the satellite uncertainties and technological gaps the Dominican Republic encounters, such as no recurrent empirical ocean current information collection.

The prediction of sargassum transport, and future beaching probabilities, is a responsibility of each nation to a regional and local level. We would expect to lure interested institutions into working with us using this methodology in the near future.

DATOS DE ESTA INVESTIGACIÓN

Área Académica Ciencias Básicas

Duración del proyecto: 3 años

Objetivos de Desarrollo Sostenible: ODS13

Palabras claves: Sargazo, inteligencia artificial, monitoreo, predicción

Keywords: Sargassum, artificial intelligence, monitoring, prediction