WP3 : MONITORING AND MITIGATION OF COASTAL EROSION

Spatialization of a coastal vulnerability index characterizing the role of coastal ecosystems (mangrove, seagrass beds, coral reefs) in the protection against coastal erosion in the Caribbean by remote sensing

Context

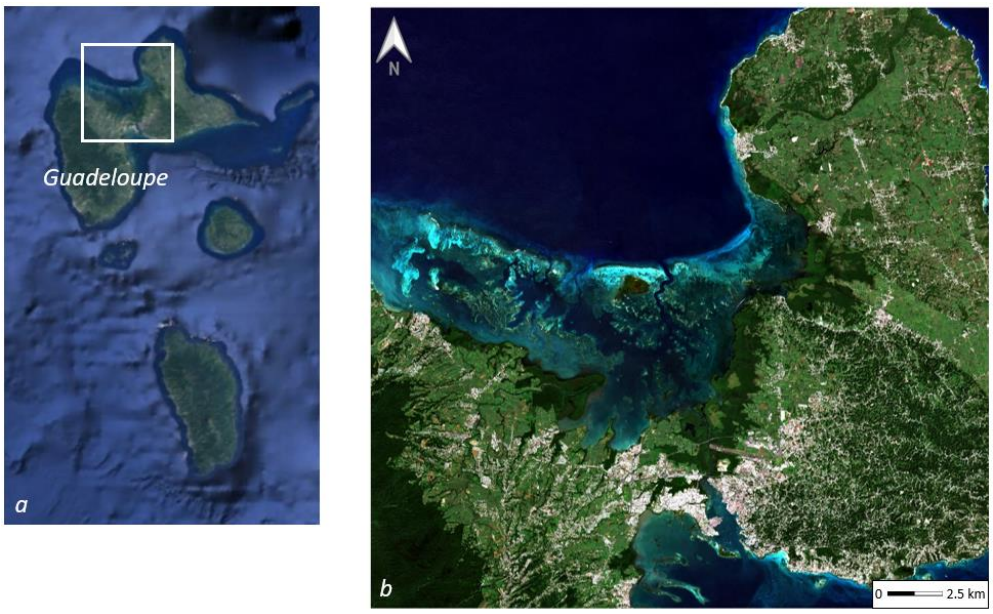
Although island coasts are naturally subject to erosion, the current context of climate change and human activities are among the sources of accentuation of this phenomenon. In particular, the increase in the frequency and/or intensity of climatic disturbances (cyclones, swells, rise in sea level, etc.) is responsible for an amplification of this erosion which has a strong impact on the Caribbean coasts and threatens both natural ecosystems, and activities such as tourism. In addition to anthropogenic infrastructure, coastal ecosystems naturally have a role to play in protecting and mitigating the phenomenon of coastal erosion. This is particularly the case for mangroves, sea grass beds and coral reefs. Part of the work carried out by IRD/UMR Espace-Dev in collaboration with Telescop in WP3 of the CARIBCOAST project consisted in taking advantage of the availability of satellite images and cartographic products from Earth observation to spatialize a coastal vulnerability index (EBCVI for Ecosystem-Based Coastal Vulnerability Index) characterizing the role of these coastal ecosystems in protecting against coastal erosion in the Caribbean.

Data and Methods

For each of the pilot sites of the project, the creation of this spatialized index is based on the use as input data of:

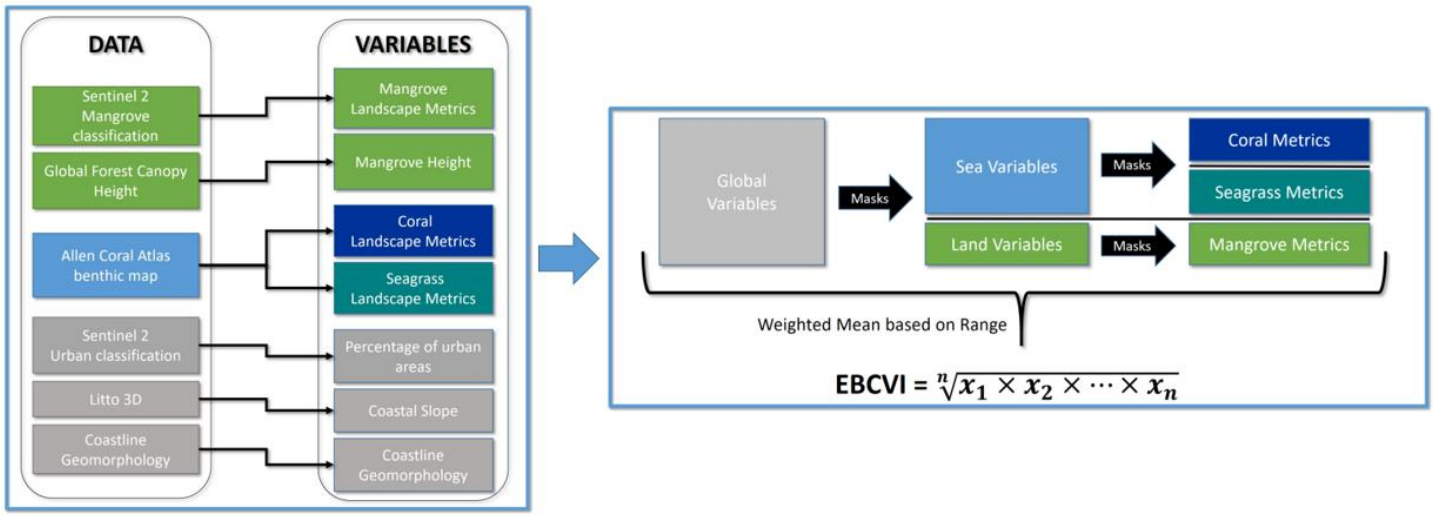
- Mapping of urban areas and mangroves at 10m spatial resolution from Sentinel 2, produced as part of this project by IRD/UMR Espace-Dev in collaboration with Telescop
- Mapping of seagrass beds and coral reefs from the Allen Coral Atlas (https://allencoralatlas.org/), and obtained from Planetscope images (https://earth.esa.int/eogateway/missions /planetscope)
- Mangrove height maps provided by the 2019 Global Forest Canopy Height product (https://glad.umd.edu/dataset/gedi) from the GEDI sensor

The example presented below on the Cul-de-Sac area (Guadeloupe) illustrates the method used.



Sentinel 2 (©ESA, 2020) image of January 2020 on Cul de Sac (b) in Guadeloupe (a, GoogleEarth background).

From a methodological point of view, the distribution maps of the ecosystems mentioned above make it possible to calculate and spatialize a set of landscape metrics describing the configuration of the coastal landscape (density of ecosystems, fragmentation, height, width, etc.). These metrics provide a set of descriptive variables that are weighted according to the distance to the coast and the presence of an urban area. These weighted variables are finally associated in a linear combination to calculate an EBCVI per pilot site.

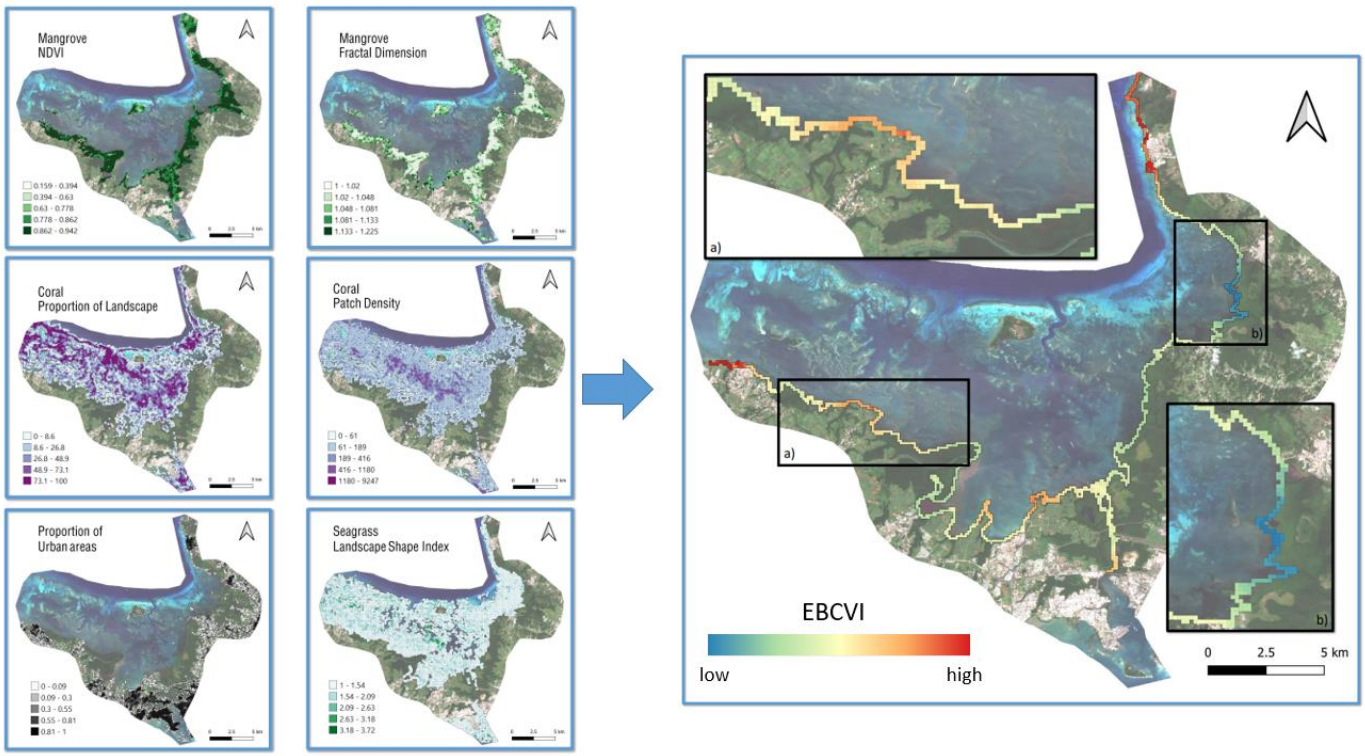


Methodological diagram of the production of the EBCVI on the CARIBCOAST pilot sites

The production of this spatialized coastal vulnerability index is semi-automated and is based on the use of an algorithm developed in Python and QGIS.

Results

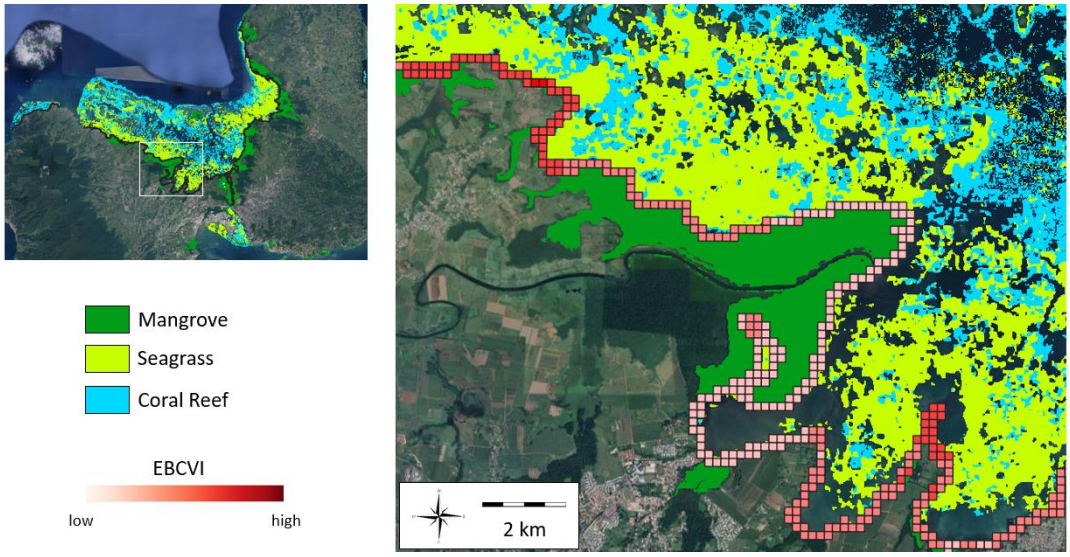
The use of products from satellite imagery as well as descriptive variables of the landscape configuration allow the spatialization of the coastal vulnerability index characterizing the role played by coastal ecosystems in protection against erosion.



The different variables (left) from the landscape metrics describing the configuration of the landscape and used for the production of the EBCVI in Cul-de-Sac (Guadeloupe, right).

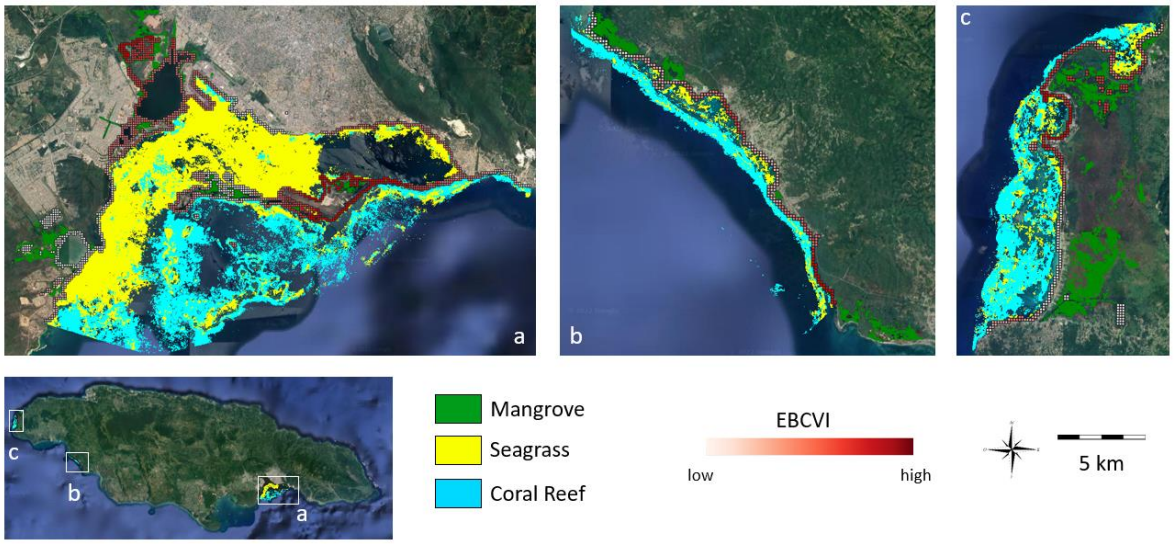
This index is normalized, minimum values corresponding to low coastal vulnerability (high protection of the coast by coastal ecosystems) and maximum values to high coastal vulnerability (low protection of the coast by coastal ecosystems). The EBCVI maps on all the pilot sites of the project are presented below, and can be viewed on the digital portal of the CARIBCOAST project.

Guadeloupe



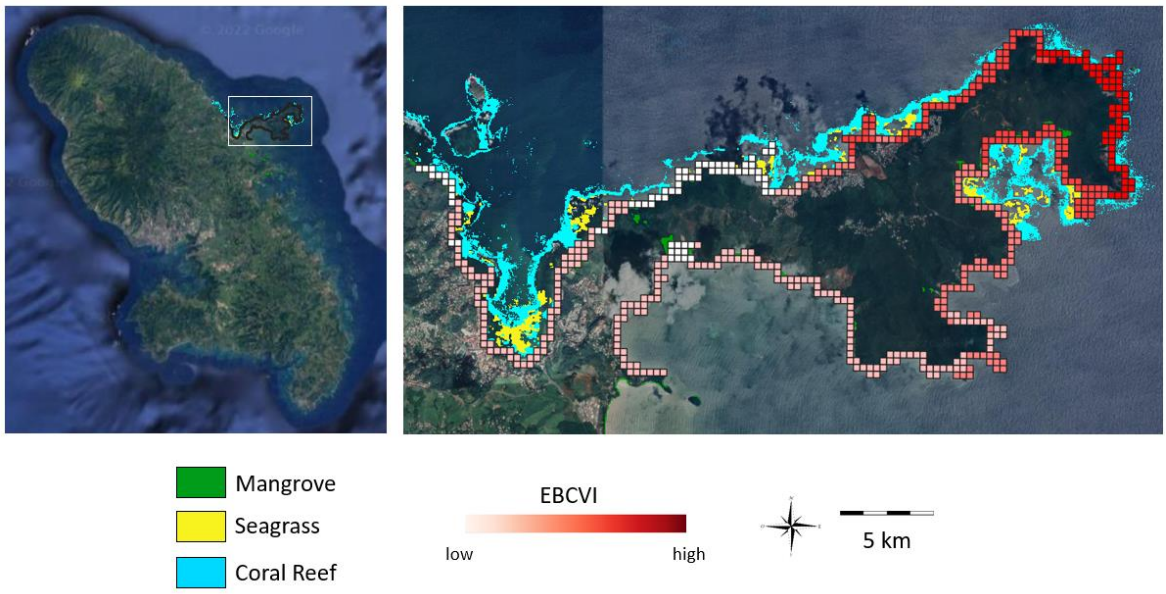
Distribution of coastal ecosystems and EBCVI on the pilot sites of Guadeloupe, with the example of Cul-de-Sac.

Jamaïca



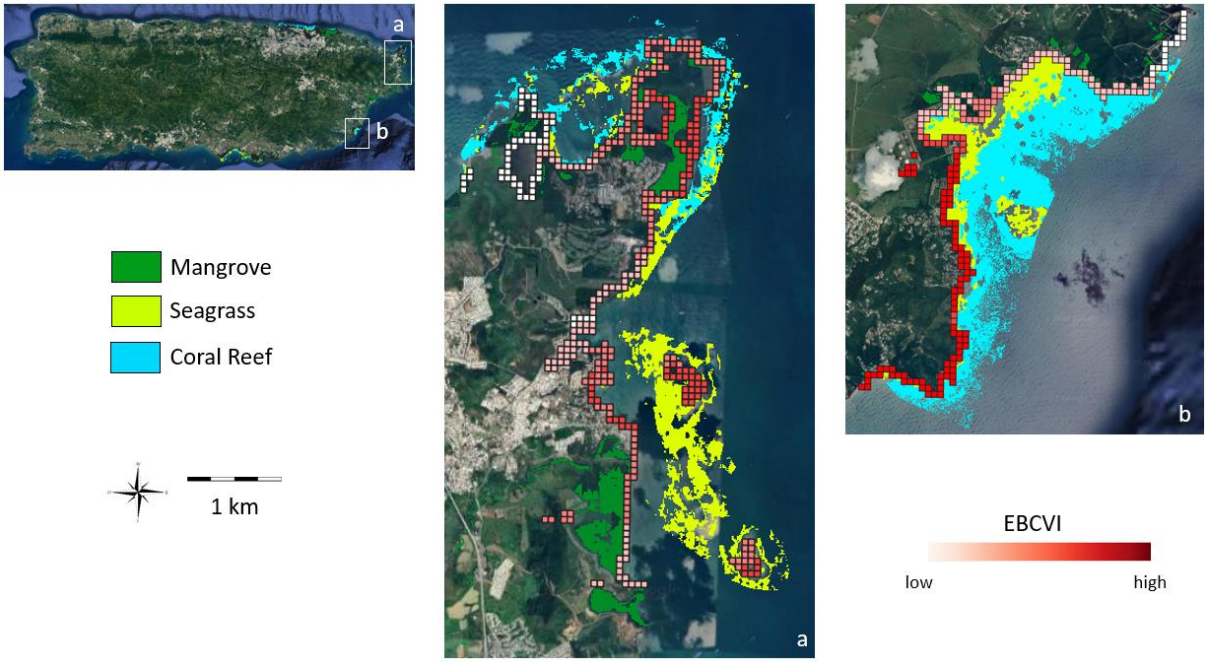
Distribution of coastal and EBCVI ecosystems at pilot sites in Jamaica, with Kingston (a), White House (b) and Negril (c).

Martinique

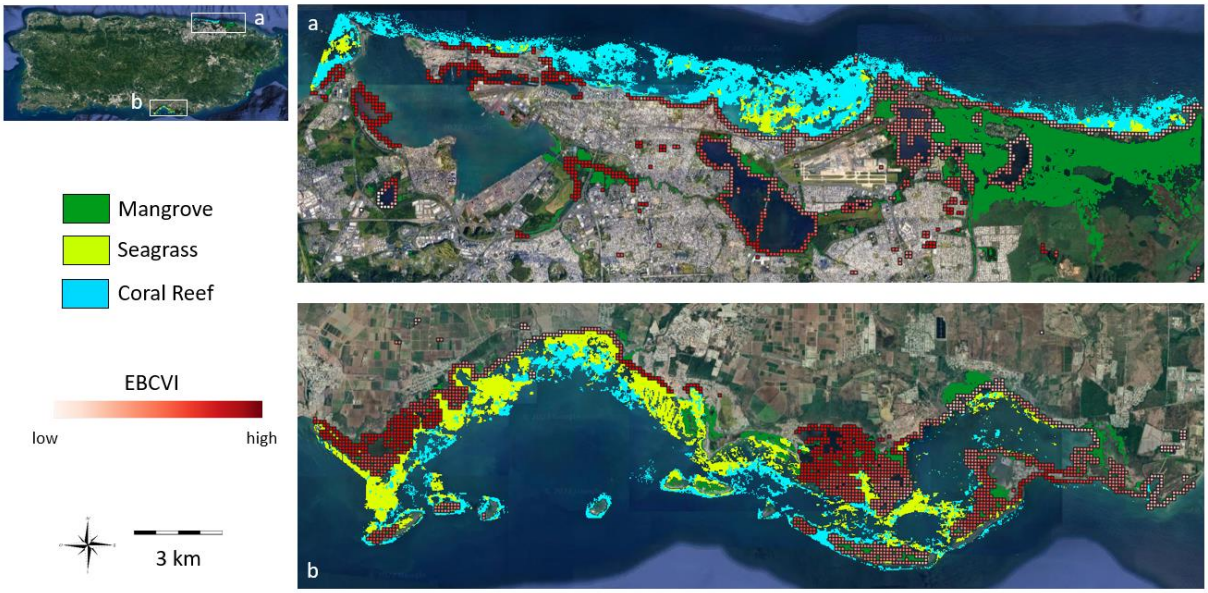


Distribution of coastal ecosystems and EBCVI on Anse-Etang (Martinique).

Puerto-Rico

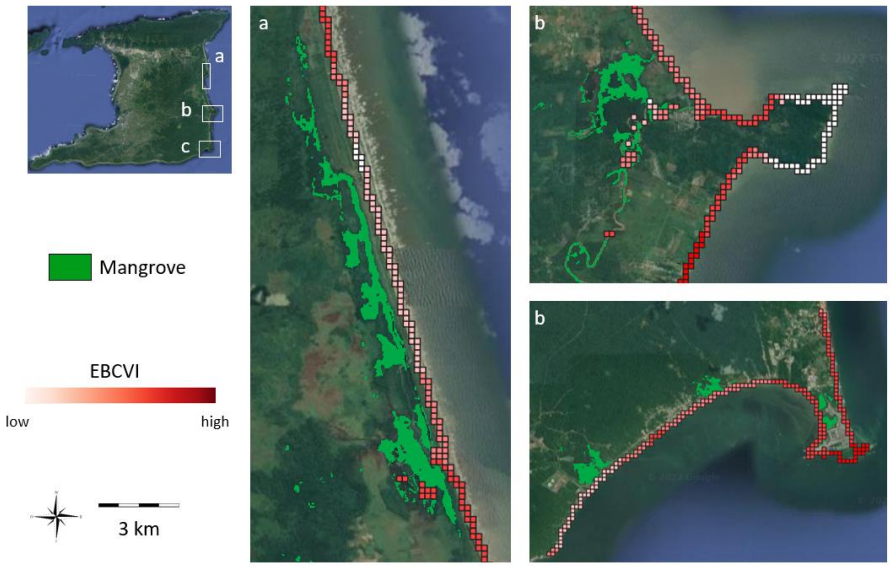


Distribution of littoral and EBCVI ecosystems in Puerto Rico at the sites of (a) Yabucoa and (b) Fajardo.



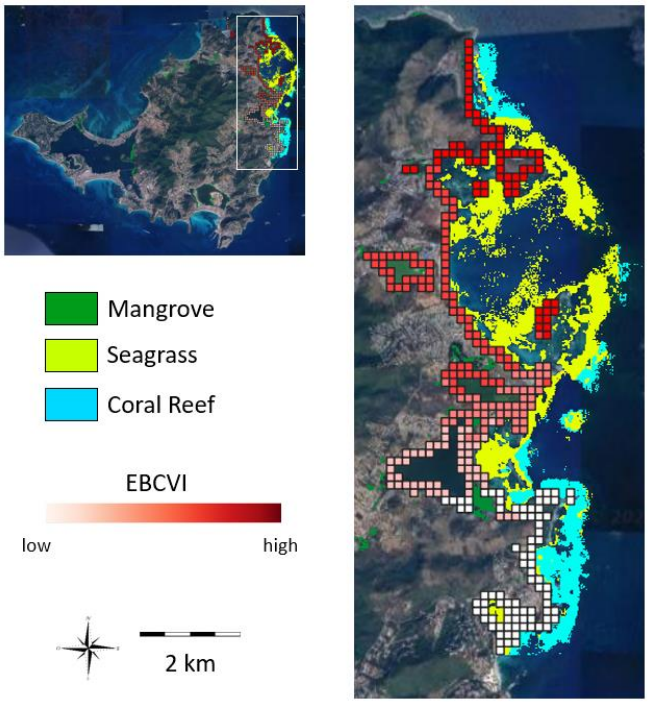
Distribution of Littoral and EBCVI Ecosystems in Puerto Rico at (a) Isla Verde and (b) Jobos Sites.

Trinidad and Tobago



Distribution of coastal ecosystems and EBCVI in Trinidad and Tobago on the sites of Manzanillas (a and b) and Cocos (c).

Saint-Martin



Distribution of coastal and EBCVI ecosystems in Saint-Martin on the Etang Barrière aux Poissons site.