

# Monitoring Conservation Projects: Integrating Google Earth Engine, Google Colab and Python

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# Introduction



## CONTEXT

Islands are highly vulnerable to natural hazards



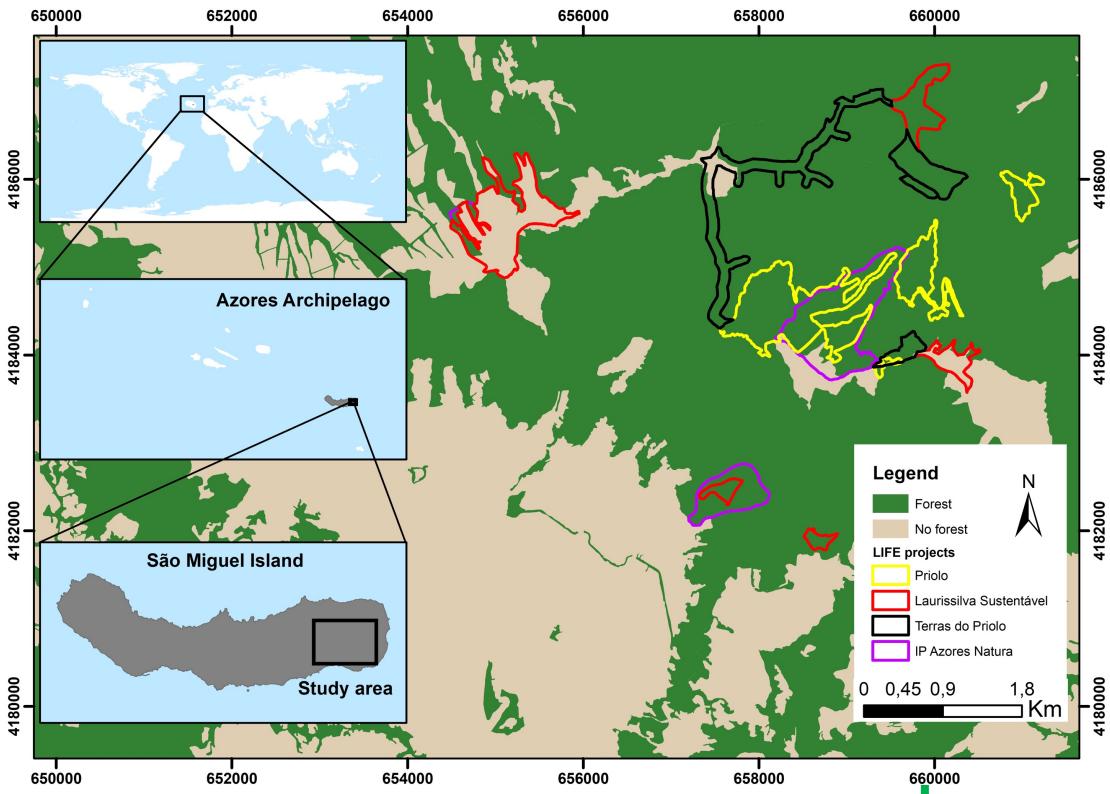
It is important to detect and monitor EU-LIFE-funded project interventions to understand their impacts



## OBJECTIVE

This study aims to explore RS approaches using Rao's Q-based LULCC monitoring to assess the effectiveness of these projects on insular and coastal ecosystems

# Study Area



The Azores Archipelago, located in the North Atlantic Ocean, consists of nine volcanic islands. The study focuses on the mountainous region in the eastern part of São Miguel, the largest island. This area includes the Special Protection Area "Pico da Vara/Ribeira do Guilherme," a designated Natura 2000 site.

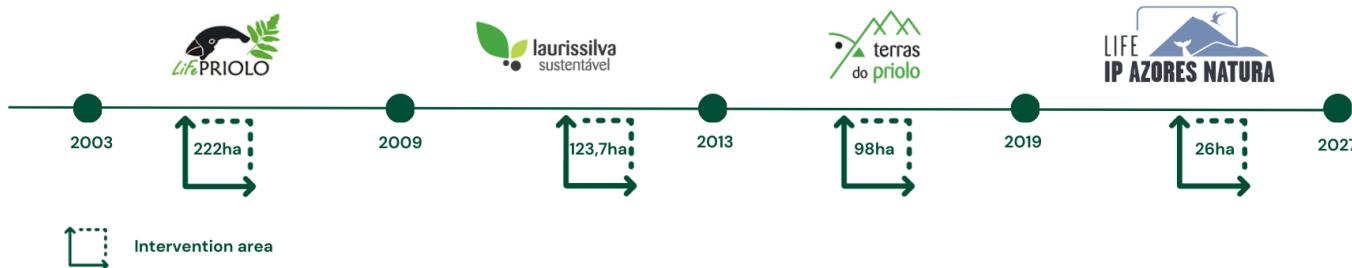
# LIFE Projects



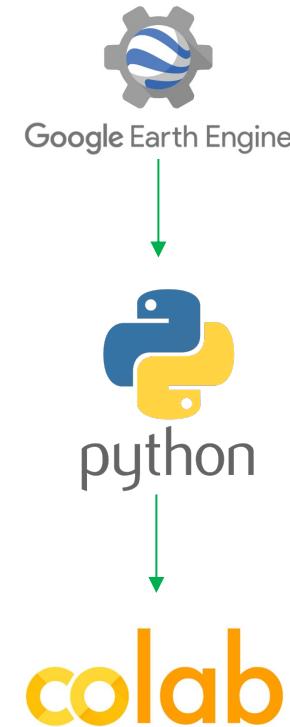
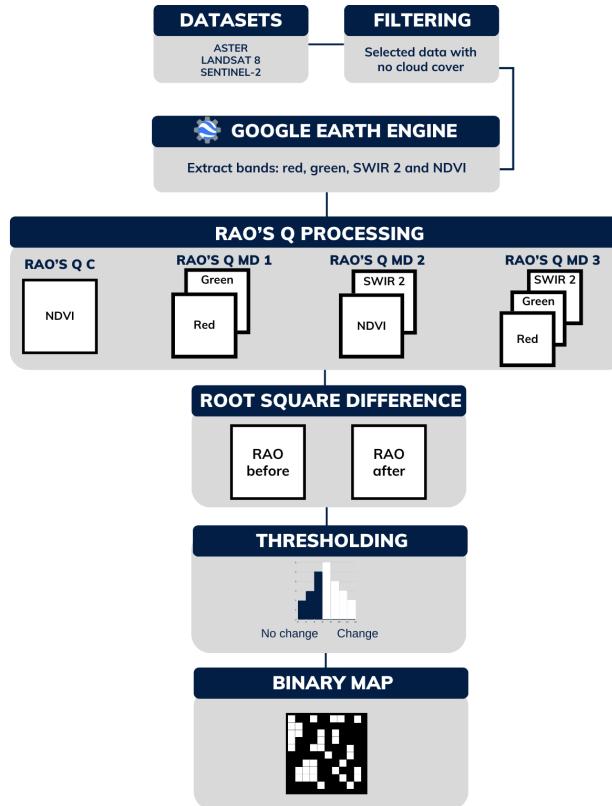
Various LIFE projects were implemented on São Miguel Island, targeting habitat conservation, species conservation, water management, among others.

Azores bullfinch

## LIFE PROJECT IN SÃO MIGUEL ISLAND TIMELINE



# Methodological Workflow



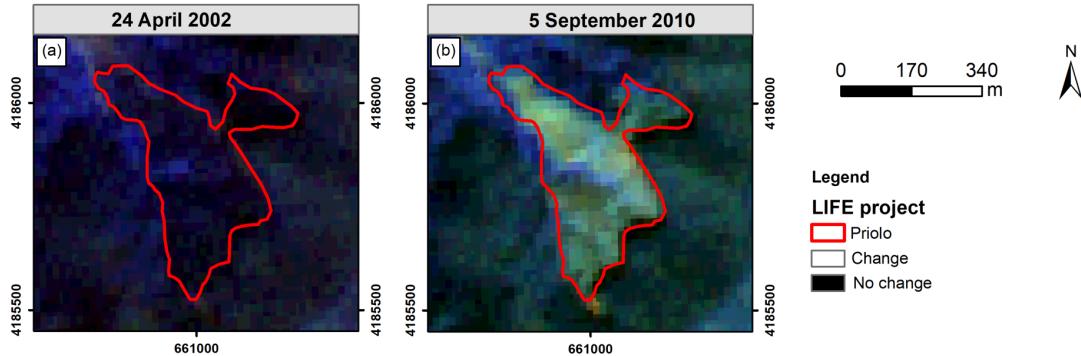
# Calculating Rao's Q index

Rao's Q is a quantitative measure used to assess the similarity or dissimilarity between spatial patterns or distributions of ecological variables

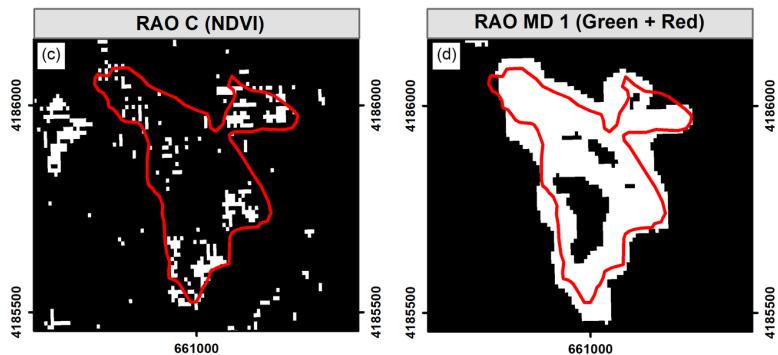
(Rocchini *et al.*, 2017)

# Results

RGB Composite (B2, B1, B3N) - ASTER



CHANGE DETECTION (24 April 2002 and 5 September 2010)



The classic Rao's Q with NDVI (c) could not identify much of the area with clear-cutting (the primary intervention carried out in the area) presenting an OA of 62.

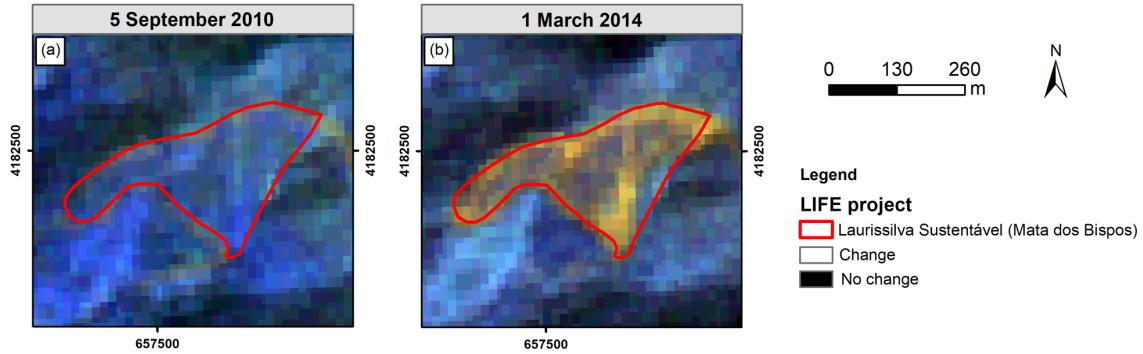
Rao's Q MD 1 (d) showed the best results identifying the vast intervention area by the Priolo Project and with a high OA (83).



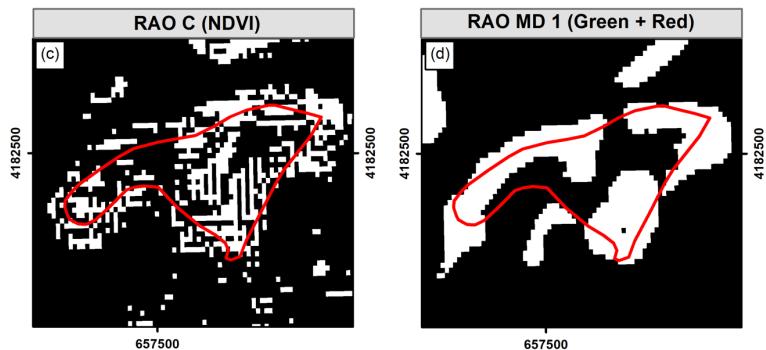
# Results



RGB Composite (B2, B1, B3N) - ASTER



CHANGE DETECTION (5 September 2010 and 1 March 2014)



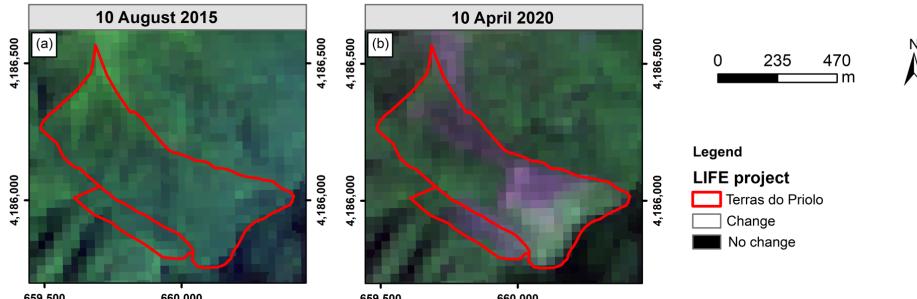
The classic Rao's Q with NDVI (c) proved to be effective (OA: 73), demonstrating robust results in identifying areas affected by interventions.

Rao's Q MD 1 (d) showed more promising and satisfactory results (OA: 79). This result can be explained by combining bands that increase the sensitivity in detecting changes in areas with heterogeneous alterations.

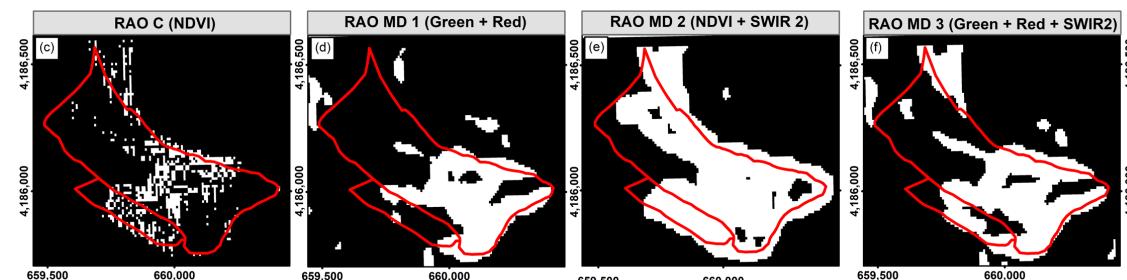
# Results



RGB Composite (B4, B3, B2) - Landsat 8



CHANGE DETECTION (10 August 2015 and 10 April 2020)



The Rao's Q classic with NDVI (c) could not identify much of the area (OA: 64).

Rao's Q MD 1 (d) detected the clear-cut area previously unidentified by classic Rao's Q with NDVI. This approach may indicate better results in detecting changes (OA: 74).

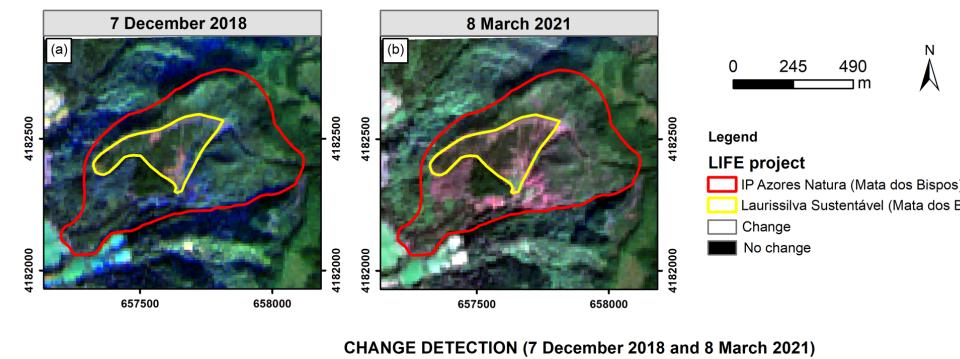
Rao's Q MD 2 (e) identified more altered areas (OA: 94). This result demonstrates that Rao's Q MD 2 can offer greater sensitivity for detecting changes in areas with mixed interventions.

The MD 3 (f) band combination demonstrated limited effectiveness in detecting changes in LULCC, with an OA of 74.

# Results



RGB Composite (B4, B3, B2) - Sentinel 2

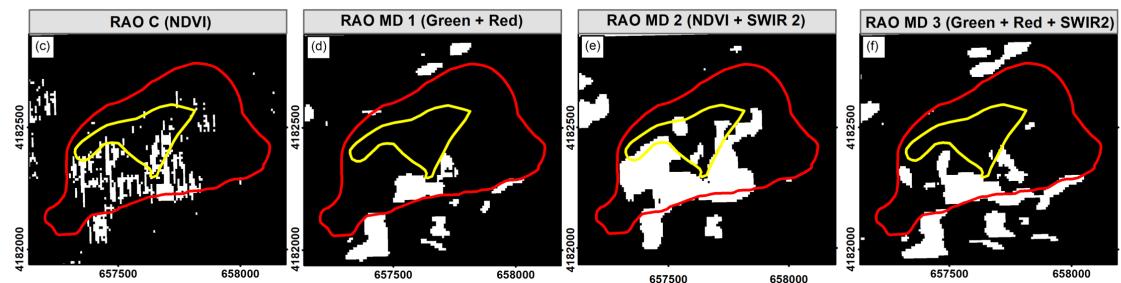


The analysis of Rao's Q classic using NDVI (c) revealed good results (OA:88) in detecting and identifying significant changes.

However, given the specific nature of the interventions in this area, Rao's Q MD 1 (d) identified a smaller number of altered areas (OA: 60).

Rao's Q MD 2 (e) showed good results (OA: 91), identifying the most part of the intervention area.

Rao's Q MD 3 (f) exhibited limited effectiveness in identifying alterations in LULCC, registering an OA of 68.

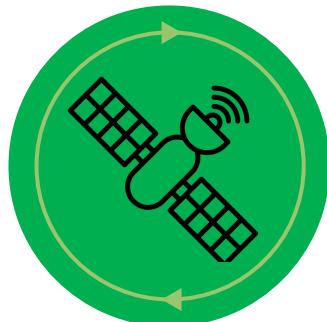


# Conclusions



-  Results from the ASTER, Landsat 8, and Sentinel 2 sensors were analyzed
-  Multidimensional approaches with the NDVI and SWIR 2 bands showed the highest agreement in detecting changes
-  If ASTER had SWIR active, the results for the LIFE Priolo and LIFE Laurissilva projects would have been better
-  This research significantly advances the use of RS techniques, particularly Rao's Q Index, to monitor and assess conservation projects with land cover implications, such as those funded by the EU-LIFE Programme
-  This monitoring approach can be adopted by various stakeholders, including scientists, conservation managers, funding agencies, and others, to enhance the cost-effectiveness of ecological restoration activities

# Conclusions



We encourage the  
further to:

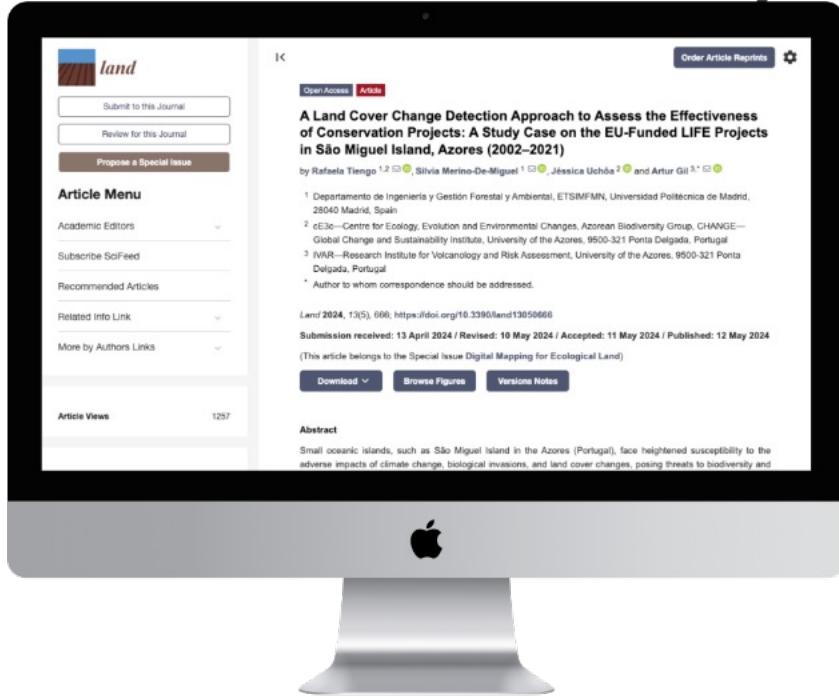


Explore new bands  
combination



Explore new sensors

# Read the Paper

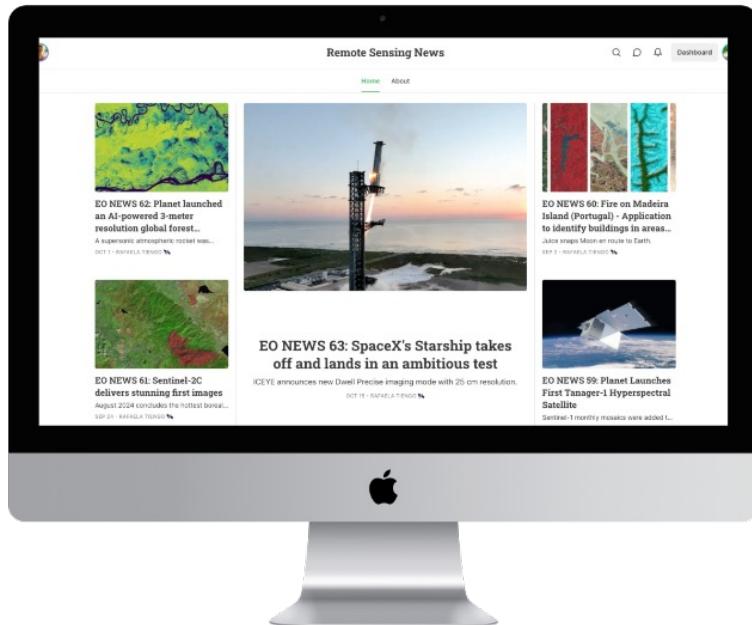


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Current research is focused on the development and validation of digital cartography in a Geographic Information System (GIS) environment under the project Marine Coastal Ecosystem Biodiversity and Services in a Changing World (MacBioS) whose main objective is to ensure efficient and integrated management and conservation strategies for European marine coastal ecosystems to face climate change.