

living planet symposium | BONN 23–27 May 2022

TAKING THE PULSE
OF OUR PLANET FROM SPACE



Detecting coastal change from space: a demonstration case based on the analysis of time series for the Mediterranean coast of Spain

Noelia Abascal Zorrilla (Argans Ltd)
on behalf of
Paula Gomes da Silva and Jara Martinez Sanchez (IH Cantabria)

24/05/2022

- 1 The Project *Coastal Erosion from Space*
- 2 Requirements of the end-users
- 3 Satellite-derived Products: new developments
- 4 Validation of the products in Spain
- 5 Evaluation of the products and conclusions



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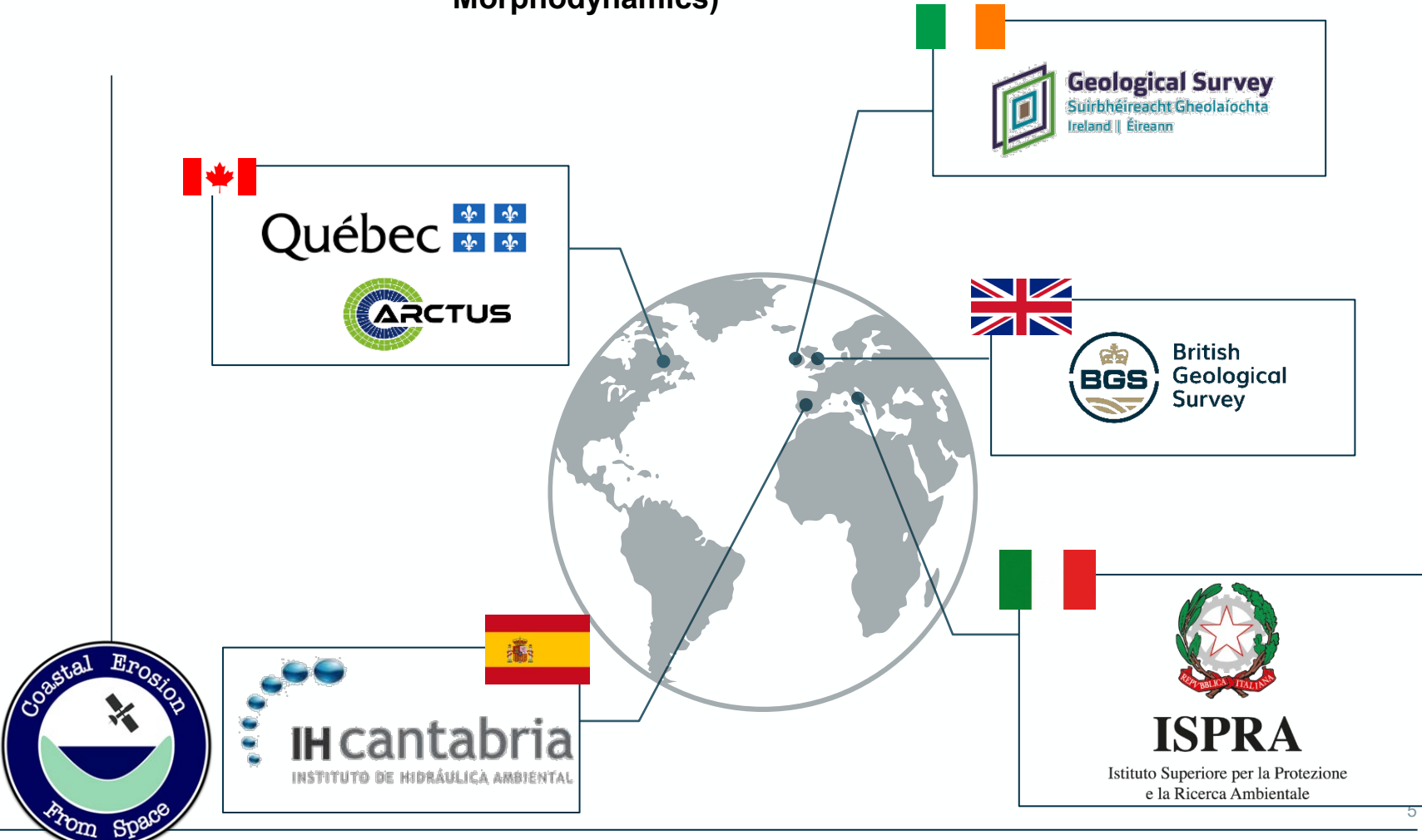


The Project *Coastal Erosion from Space*: Stakeholders

SERVICE PROVIDERS
(Specialists in satellite-based Earth Observation)



END-USERS
(National Experts in Coastal Morphodynamics)



The Project *Coastal Erosion from Space*: Stakeholders

Coastal Erosion = Beach Erosion

Soft and hard coastal engineering measures



Tourism: 12% of Spanish GDP

Beach fill numbers, rates and volumes

Country (year started)	Total volume (10 ⁶ m ³)	Number of fills	Number of sites
FR (1962)	12	115	26
IT (1969)	15	36	36
DE (1951)	50	130	60
NL (1970)	110	150	30
ES (1985)	110	600	400
UK (1954)	20	35	32
DK (1974)	31	118	13



The Project *Coastal Erosion from Space*: Stakeholders

Broader end-user community



Spanish Champion End-User

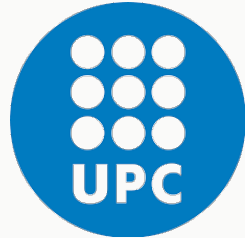
General Directorate for the Coast and the Sea (Ministry of the Environment)



Governmental institutions



Universities



Companies



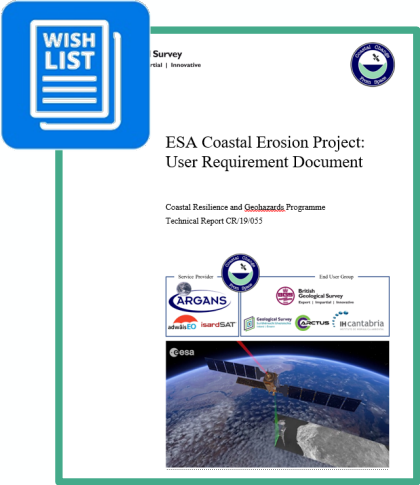
Port de Barcelona



The Project Coastal Erosion from Space: Steps



1. End-User Requirements



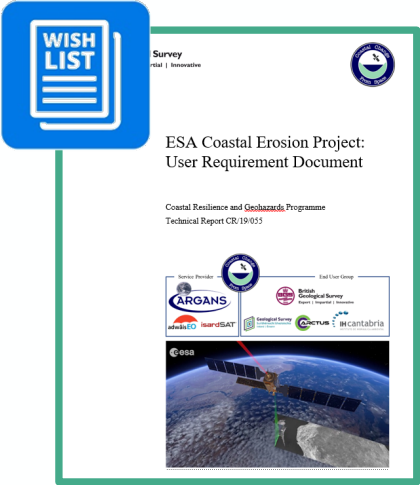
User Requirements Document
(champion end-user and broader community)



The Project Coastal Erosion from Space: Steps



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2. Viability of the requirements



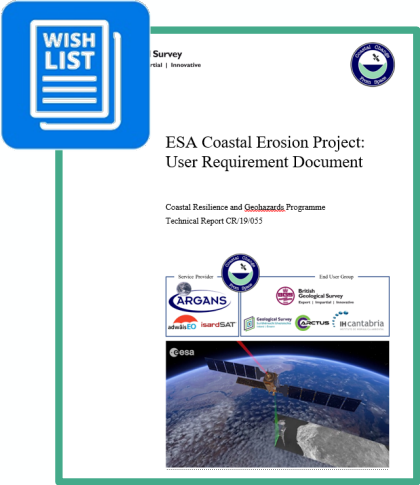
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The Project *Coastal Erosion from Space*: Steps



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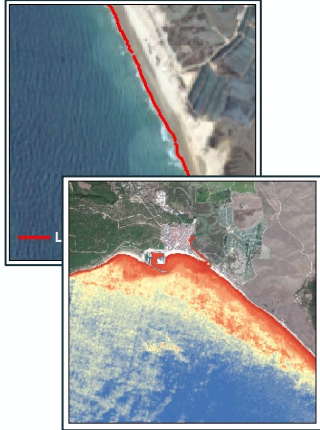
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3. Development

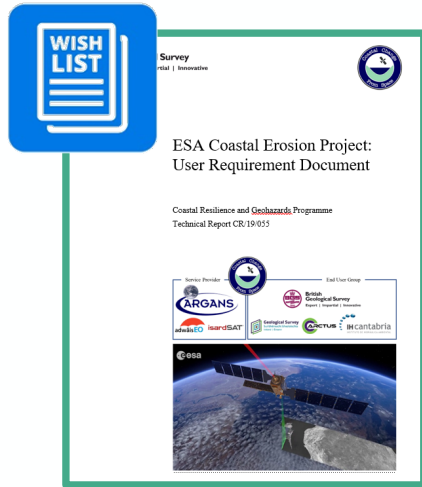


Satellite-derived products



The Project *Coastal Erosion from Space*: Steps

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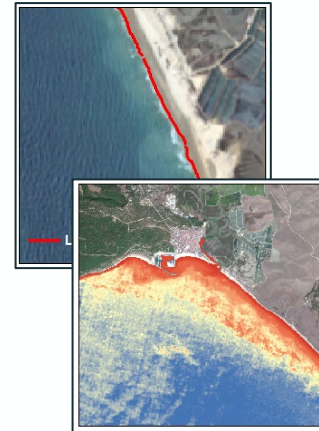
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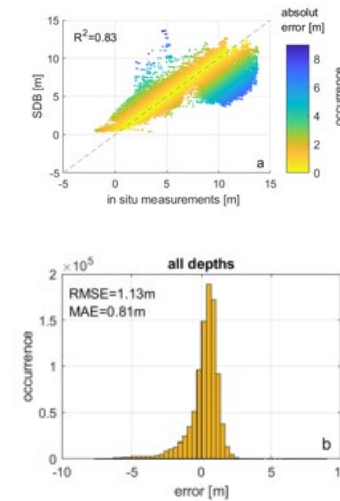
Requirement Baseline Document

3. Development



Satellite-derived products

4. Validation

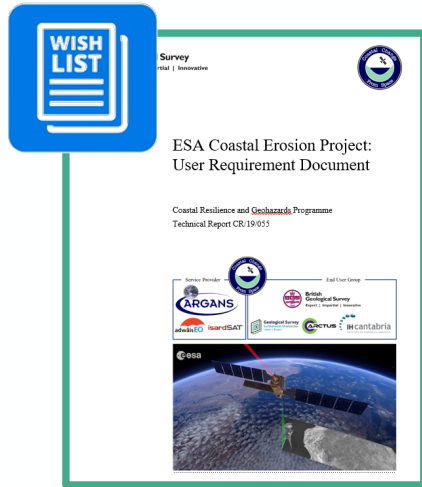


Comparison with in-situ data



The Project *Coastal Erosion from Space*: Steps

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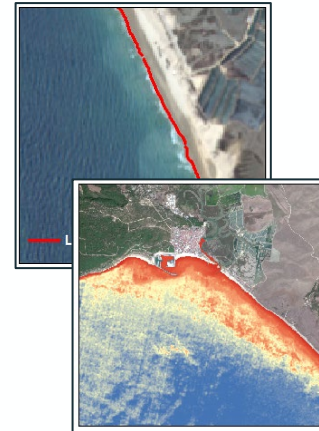
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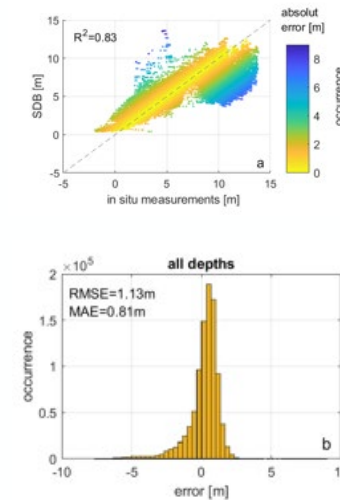
Requirement Baseline Document

3. Development



Satellite-derived products

4. Validation



Comparison with in-situ data

5. Evaluation



Applicability of the products to the current practices.

Query to other end-users in Spain

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Requirements of the end-users

Products:

Extraction of waterlines based on different indicators

Change in the application of products from 1D to 2D and 3D

Development of indicators of the coastal state as a subcategory of the products



Characteristics:

Overcome the horizontal precision limitations of the images

Extended coastal zone (nearshore-offshore)

> 25 years temporal series



Satellite-derived Products:

- Satellites: Landsat 5, Landsat 8, Sentinel 2
- Types of products: 1D (shoreline) and 3D (bathymetry)



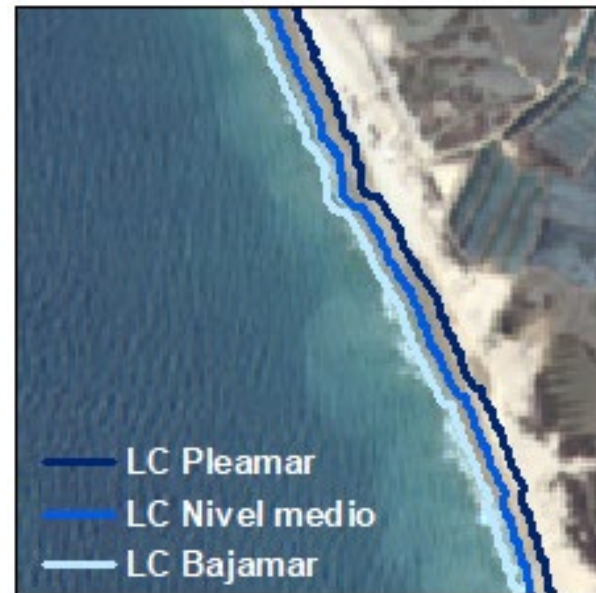
Waterline:

Snapshot of the tide position as the satellite passes over.



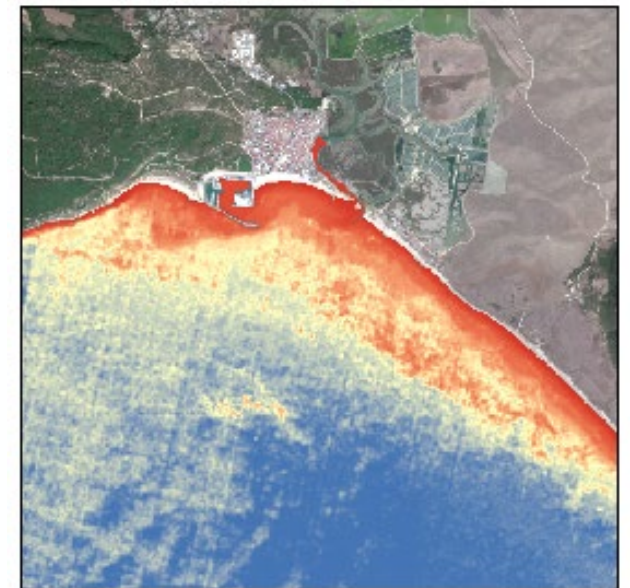
Shoreline:

Corrected waterline corresponding to a Tidal Datum.



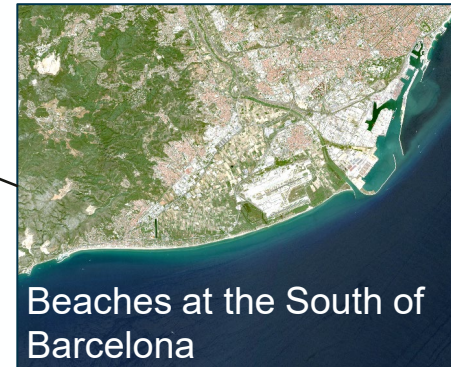
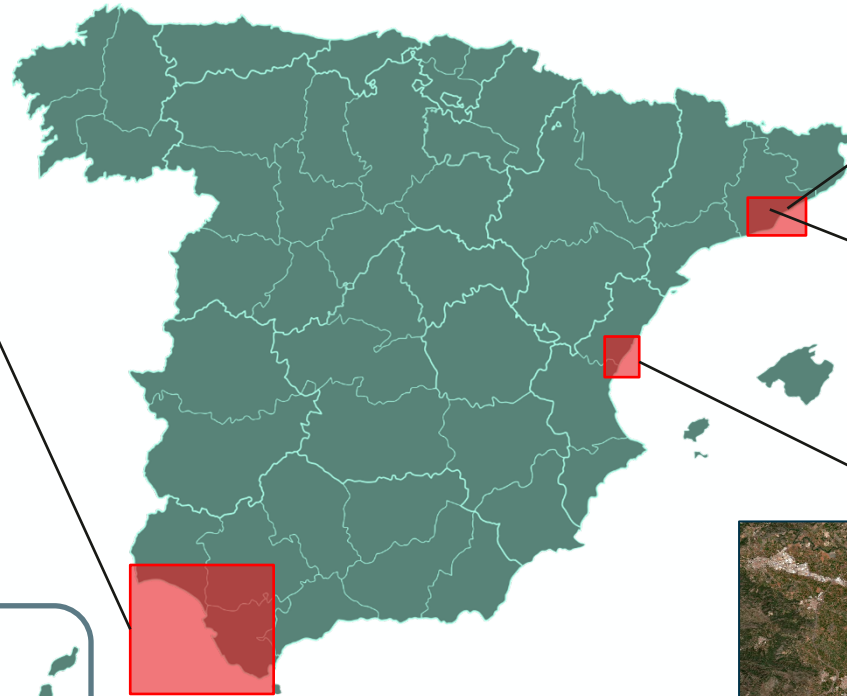
Bathy-morphology

Bathymetry of the coastal area.



Requirements of the Champion Spanish End-User

Pilot sites:

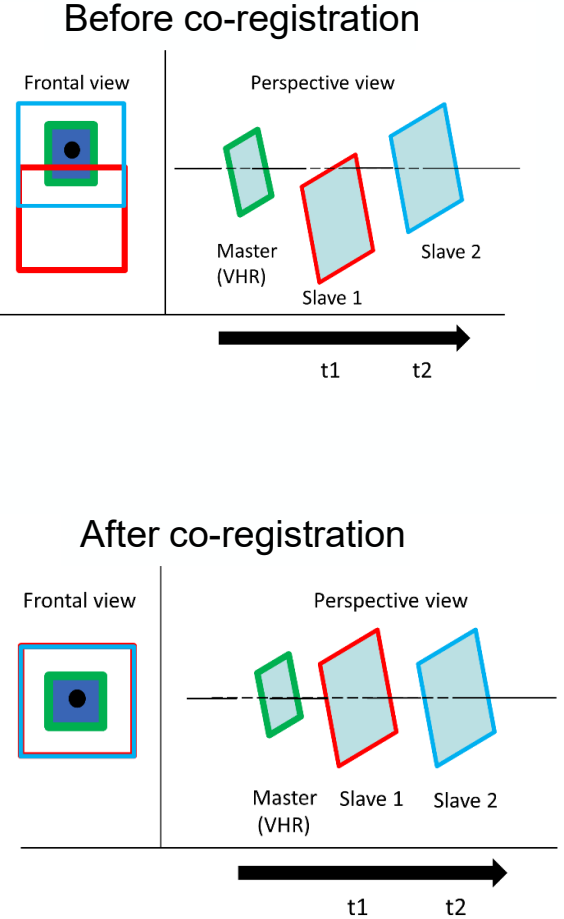


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Satellite-derived Products: new developments

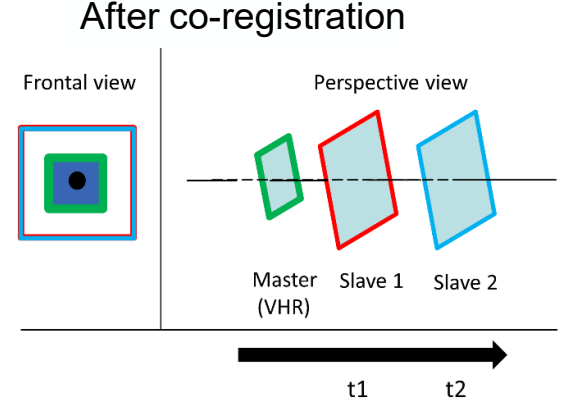
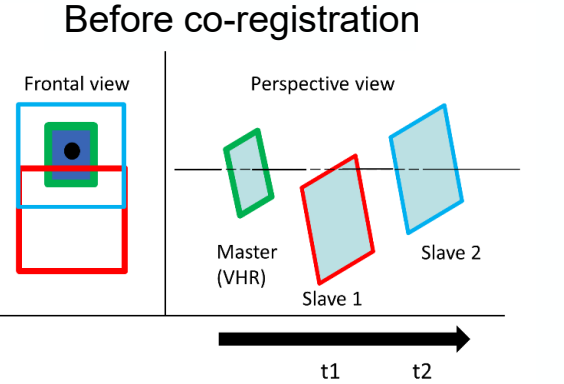
Images co-registration



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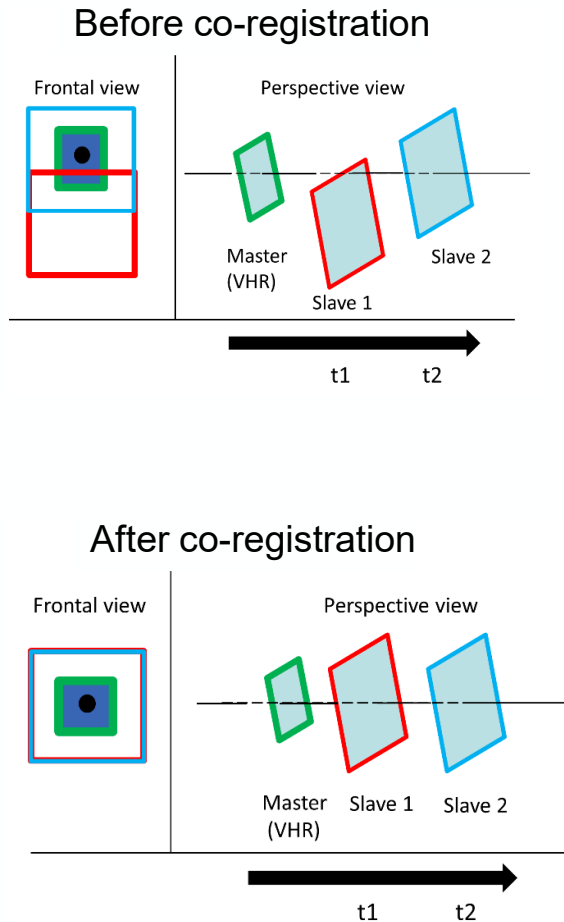
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Specific information on each site is provided in the development of the products.



Satellite-derived Products: new developments

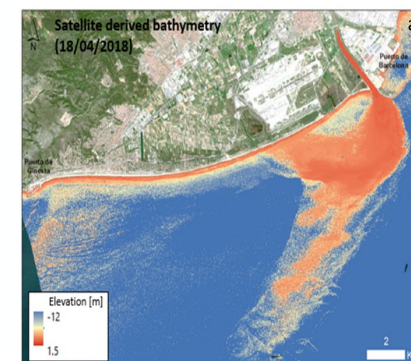
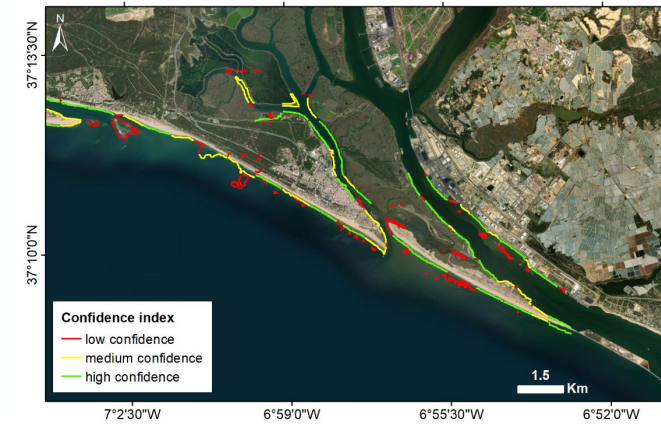
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what's new?

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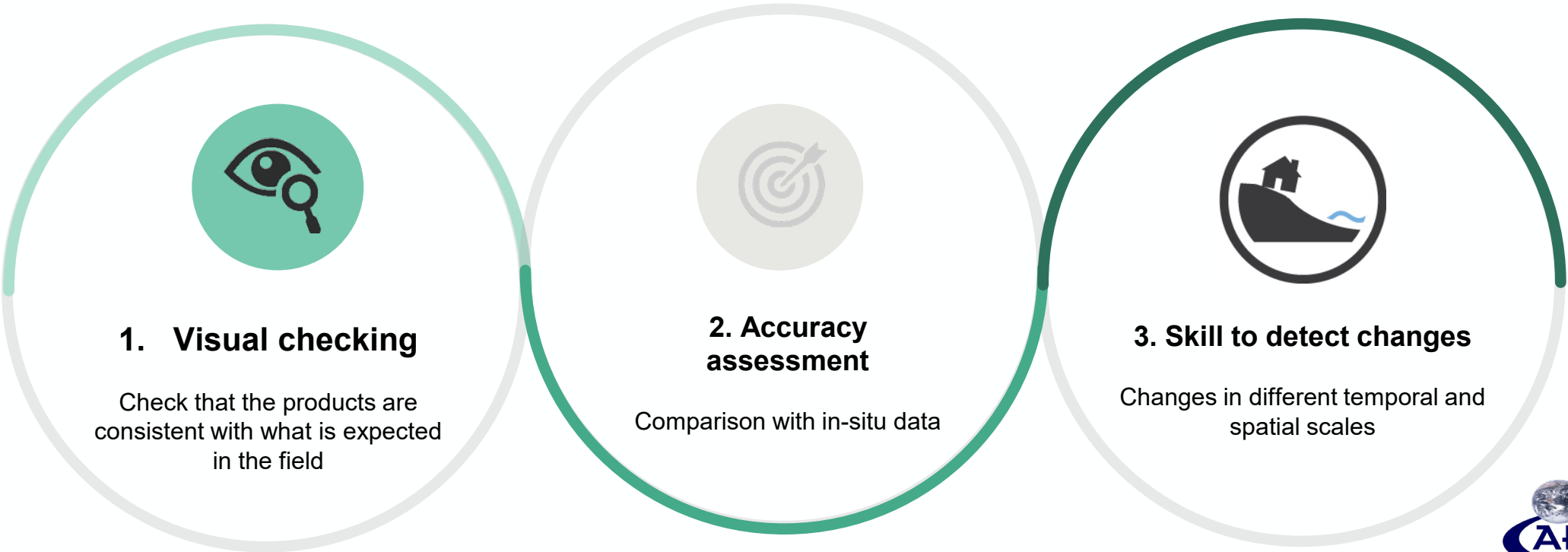
Confidence indexes



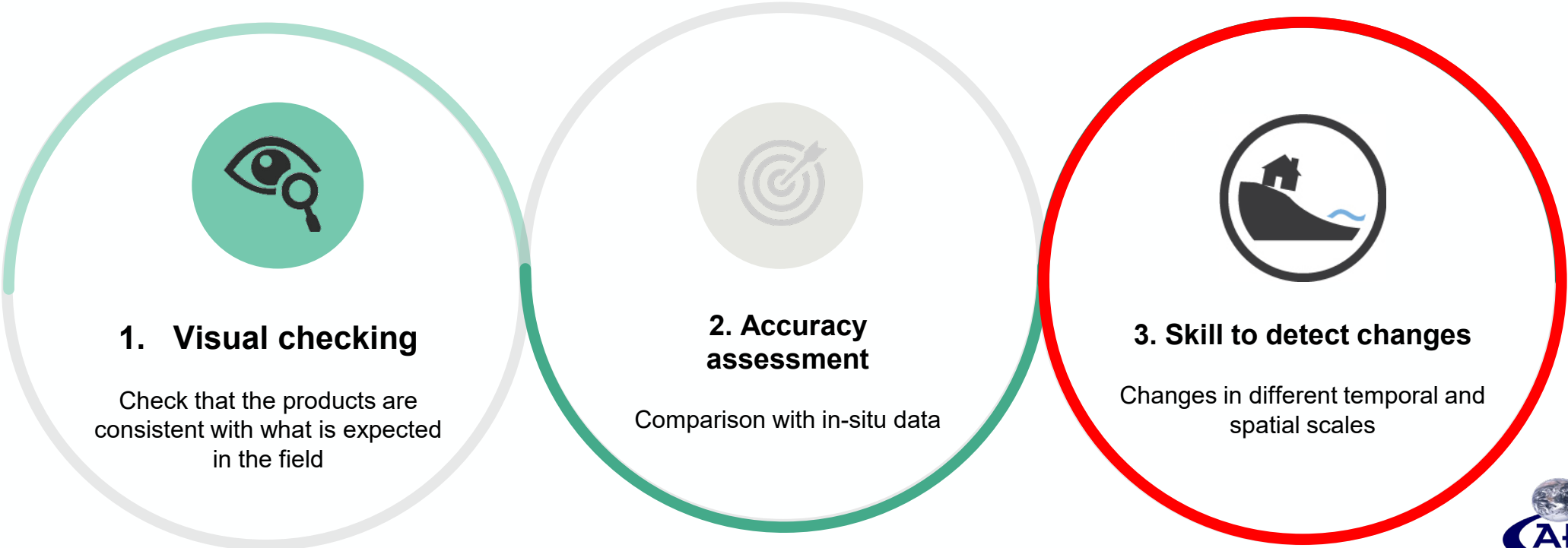
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Validation methodology:



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Validation of the products in Spain

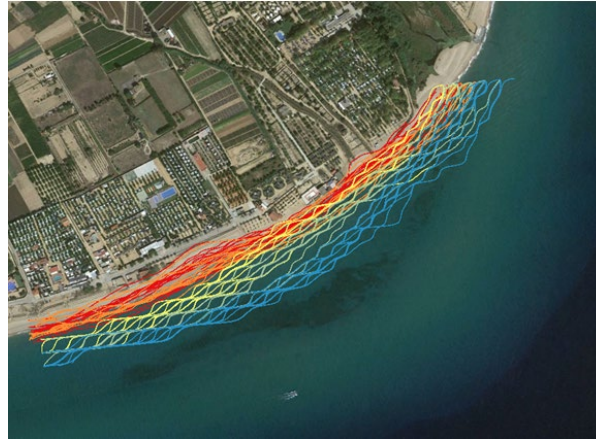


Capacity to represent coastal erosion at different temporal and spatial scales
Detection of chronic erosion in Malgrat de Mar (Tordera)

LONG-TERM

Local

Regional

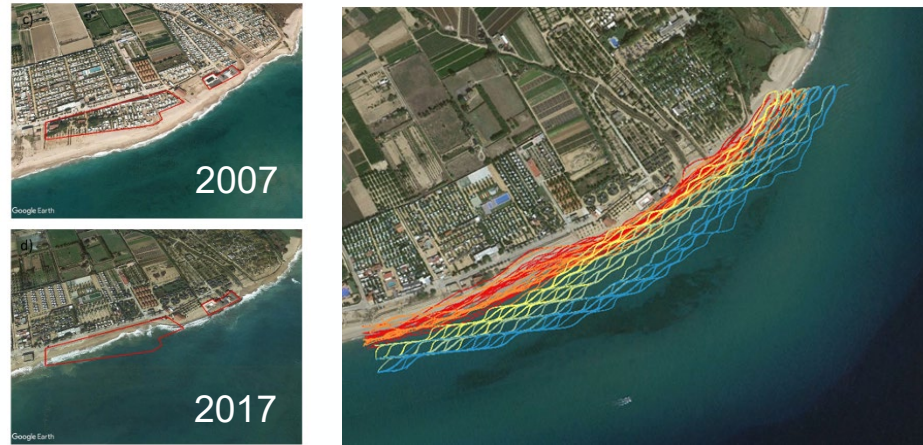


Validation of the products in Spain



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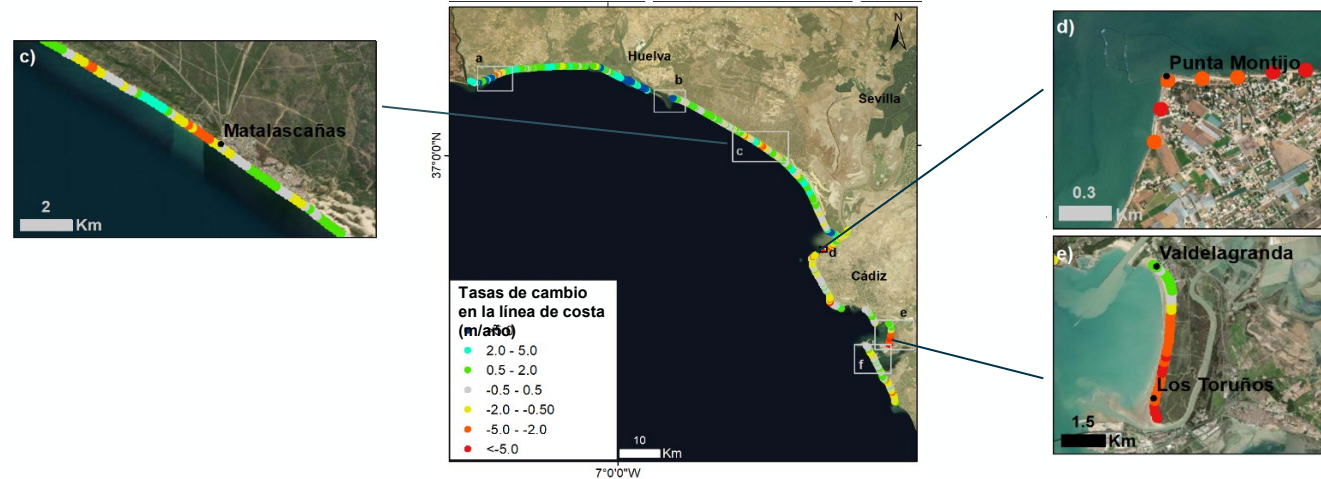


Local

LONG-TERM

Regional

Identification of critical erosion points in the coast of the Gulf of Cádiz



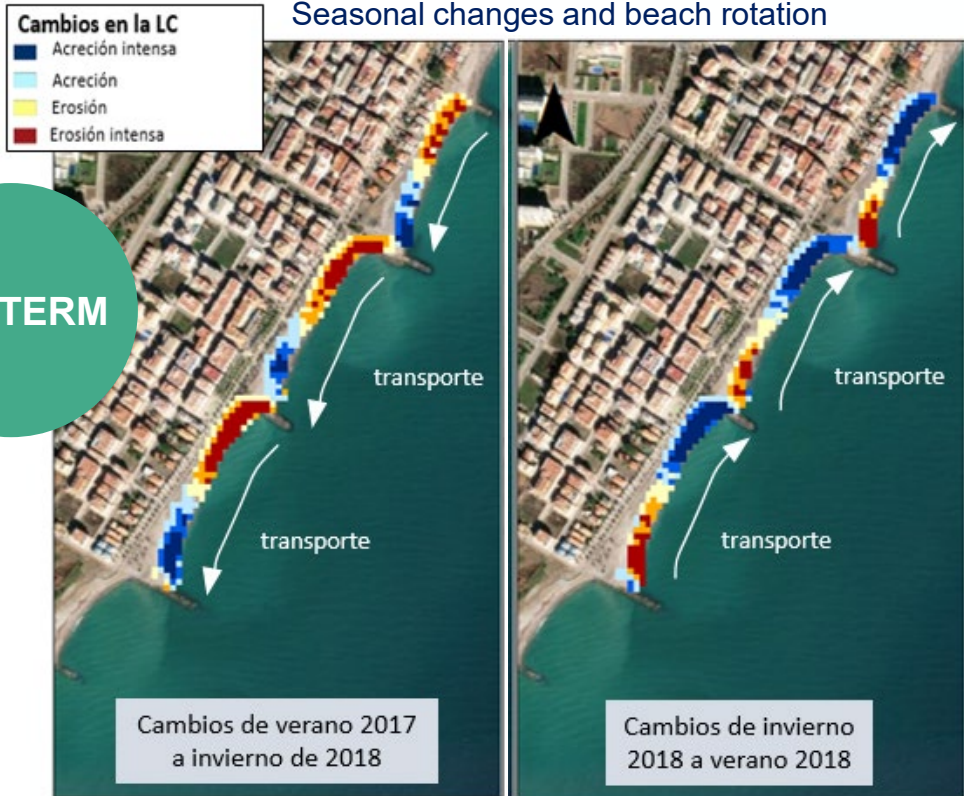
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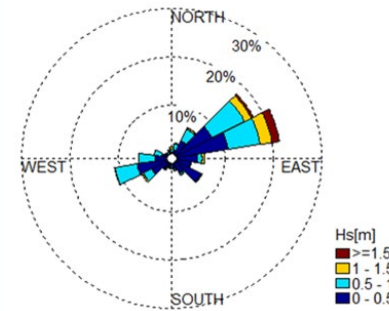
Detection of beach rotation due to seasonal changes in wave in the coast of Castellón

Analysis of Sentinel 2 shorelines:
Seasonal changes and beach rotation

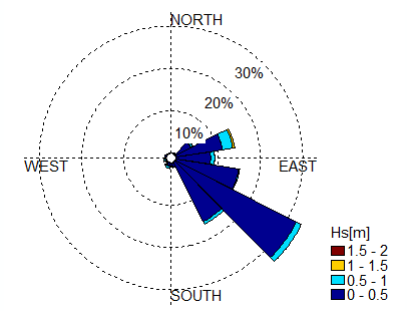


MID-TERM

Winter 2018



Summer 2018

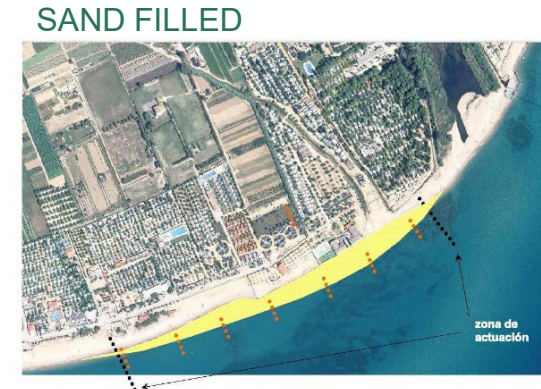
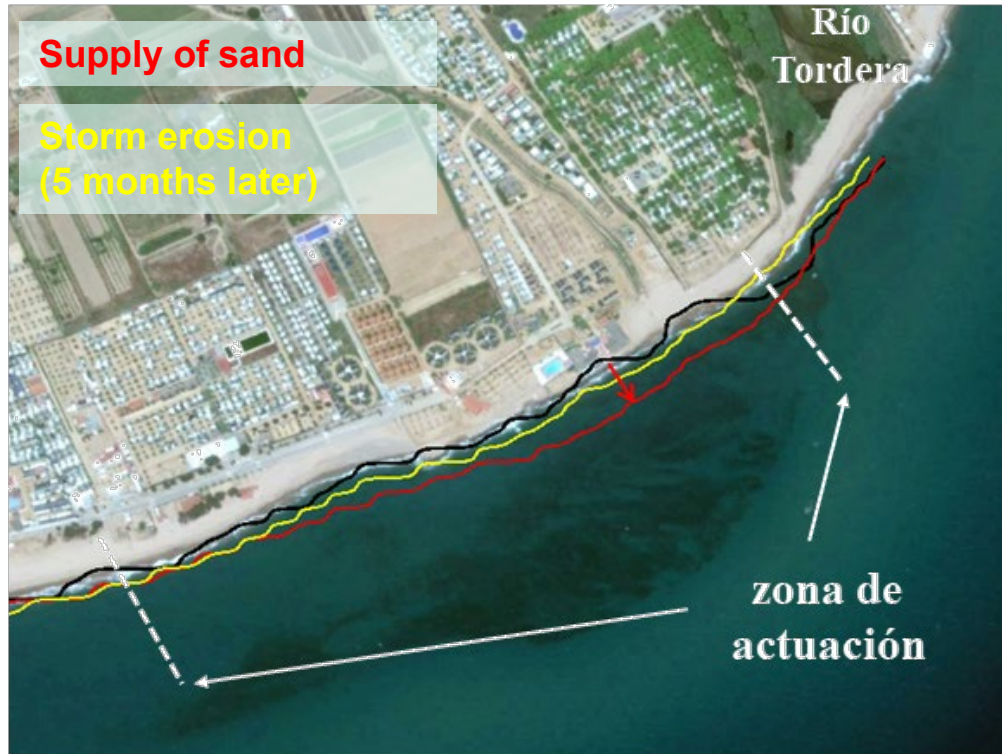


Validation of the products in Spain



Capacity to represent coastal erosion at different temporal and spatial scales

Detection of sand filled accretion and erosion due to a storm in Malgrat de Mar (Tordera)



SHORT-TERM

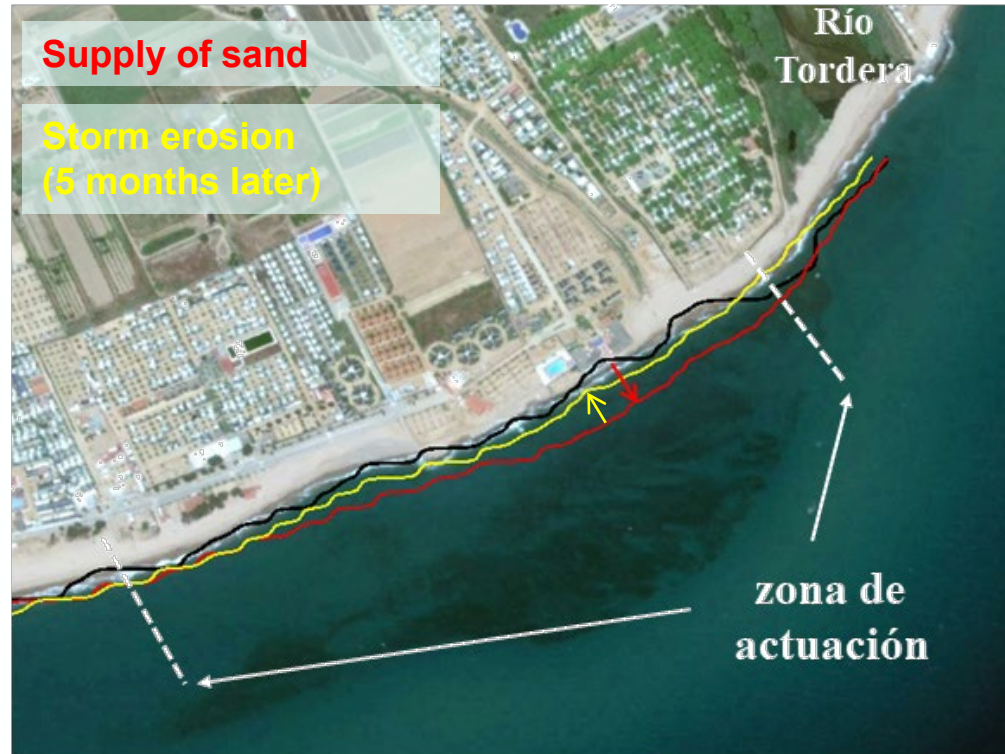


Validation of the products in Spain



Capacity to represent coastal erosion at different temporal and spatial scales

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SAND FILLED



STORM

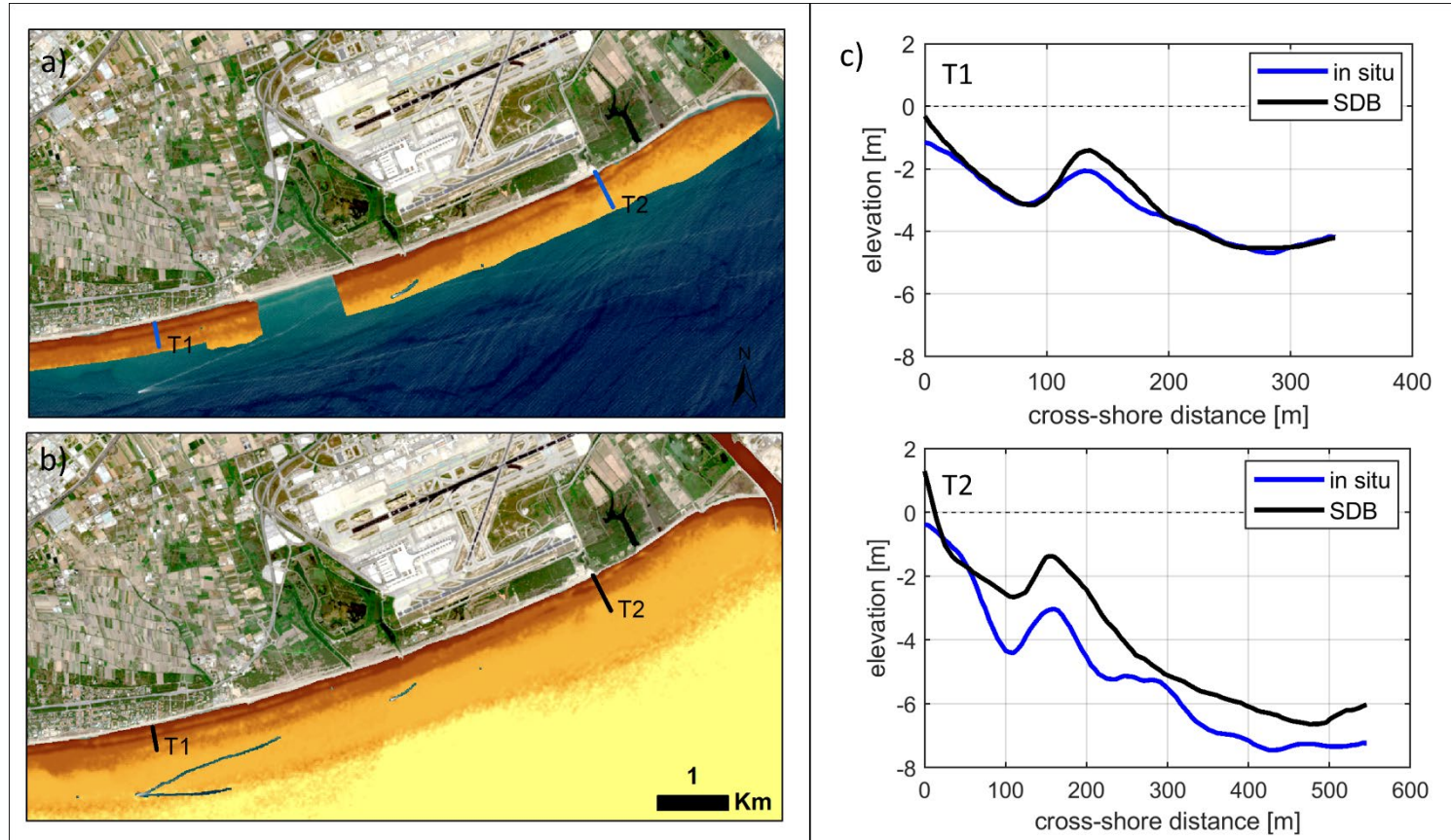


Validation of the products in Spain



Capacity to represent coastal erosion at different temporal and spatial scales

Detection of bedforms in the beaches at the South of Barcelona



Limitations to quantify changes in the bathymetry



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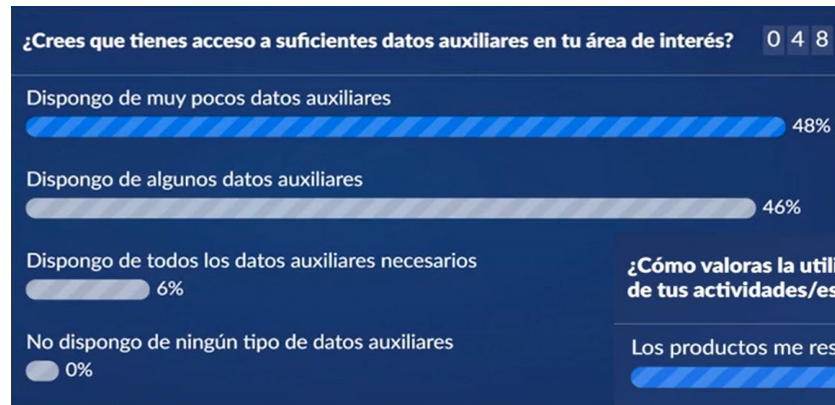


Evaluation of the products and conclusions

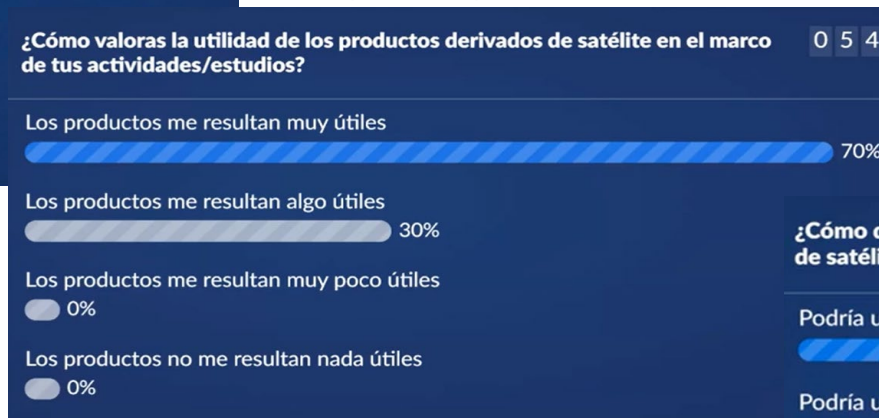
Evaluation – applicability of the products in current practices

- Participation of the general community of the broader end-users community (other institutions, academies, companies)
- Workshop Nov/2020:

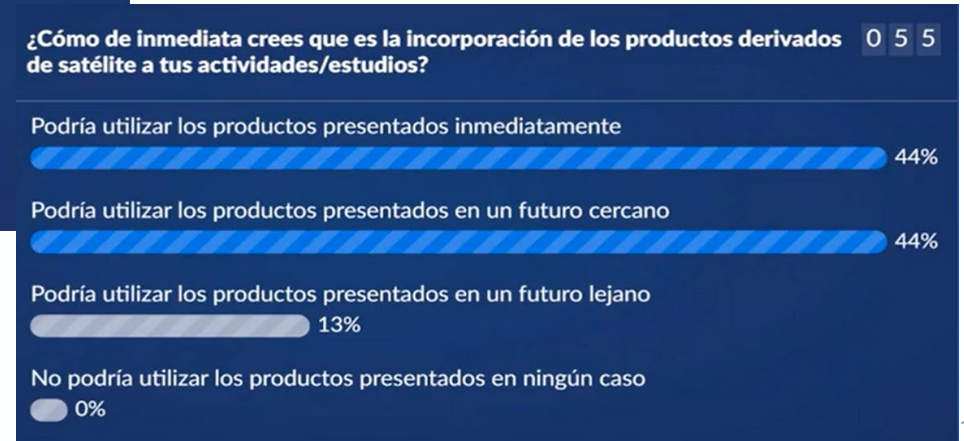
Availability of auxiliary data to develop the products



Utility of the products



Possibility to immediately apply the products



- Satellite-derived products were developed according to the **requirements of the End-Users**.
- The **available products are already valid to be applied in many of the monitoring practices** done nowadays.



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- Shorelines allowed the verification of morphodynamical processes at **diverse temporal scales** and the identification of **critical erosion hotspots**.
- Even under high sediment concentrations, it was possible to produce **quality bathymetry under the specific conditions**. However, the available 3D products today do not allow the monitoring required by the final End Users.

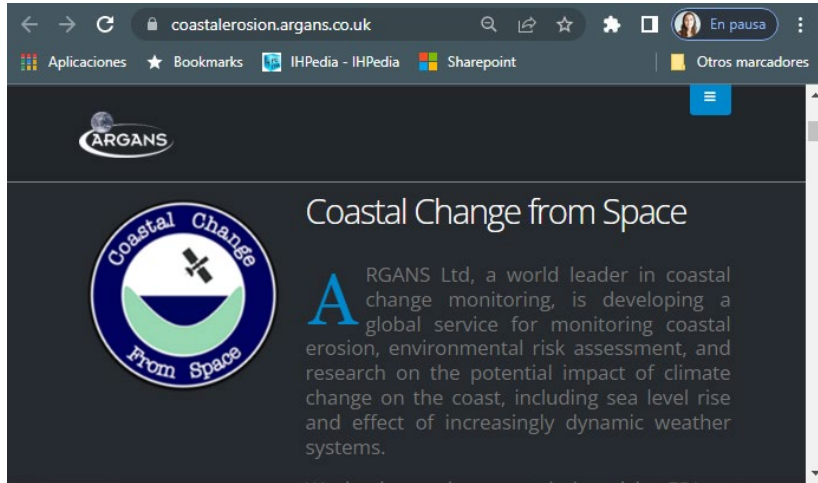


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- **Phase 2** of the Project is under development to complete the validation and evaluation of other products (e.g. beach width) and in other pilot sites (e.g. beaches in the north of Spain).

Available information in:

PROJECT WEBSITE

coastalerosion.argans.co.uk



VIDEOS OF THE SPANISH WORKSHOP

Morning session: <https://vimeo.com/480714920>

Afternoon session: <https://vimeo.com/480717649>



WORKSHOP VIDEO END OF PHASE 1

<https://coastalerosionwebinar2021.esa.int/>







PAPER (PRE-PRINT):



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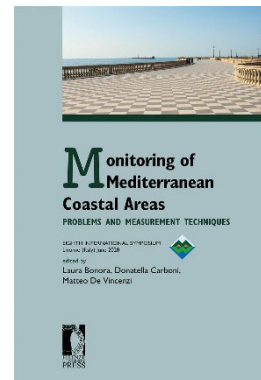
On the use of satellite information to detect coastal change: Demonstration case on the coast of Spain

Authors

Paula Gomes da Silva  , Jara Martínez Sánchez, Raul Medina, Anne-Laure Beck , Mohamed Amine Taji 

Published Online: Fri, 8 Apr 2022 | <https://doi.org/10.1002/essoar.10511027.1>

CONFERENCE PAPER:



BOOK CHAPTER

Advances on coastal erosion assessment from satellite earth observations: exploring the use of Sentinel products along with very high resolution sensors

Paula Gomes da Silva Anne-Laure Beck Jara Martinez Sanchez Raúl Medina Santanmaria Martin Jones Amine Taji

