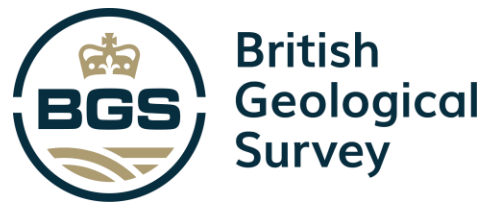


Coastal Change from Space CCN-2 Final Review

5 July 2023 – Frascati



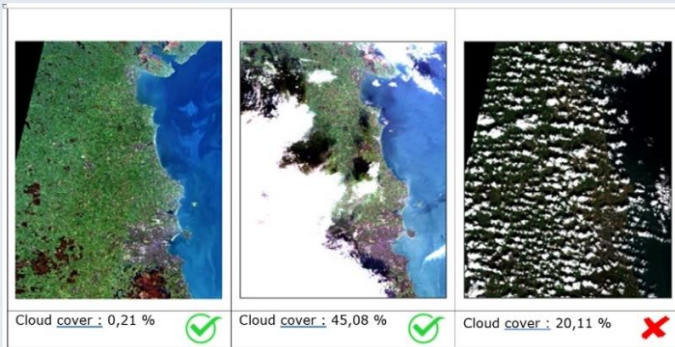
The Coastal Change from Space project



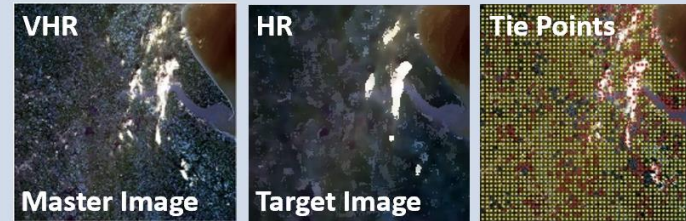
The Coastal Change from Space project

1. Preprocessing

Ensuring all suitable satellite images are collected.
Cloud filtering method – Percent over coastline.



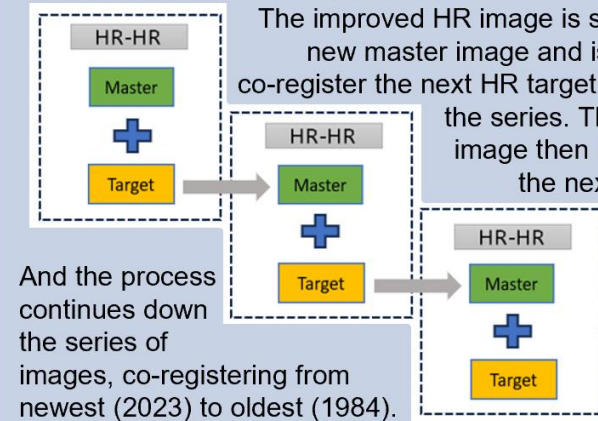
2. Geolocation



Tie points generated for the VHR image and 1 HR image. Spatial shifts are calculated for each tie point then applied to target image increasing its positional accuracy. These are filtered based on pixel value similarity to ensure only reliable shifts between the VHR and HR are applied. (Yellow = accepted and Red = failed)

3. Co-registration

The improved HR image is set as the new master image and is used to co-register the next HR target image in the series. This target image then becomes the next master image.



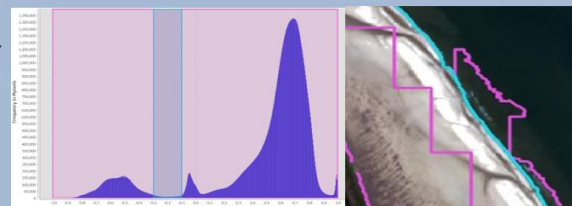
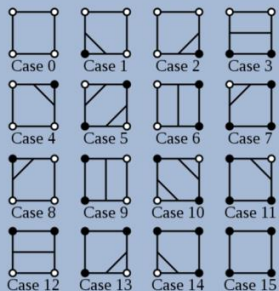
And the process continues down the series of images, co-registering from newest (2023) to oldest (1984).

4. The Waterline Processor

Generation of vector waterlines per satellite image.

(a) GDAL Marching Squares Algorithm:

Allows for interpixel line delineation generating smoother more accurate waterlines.



(b) Adaptive Thresholding:

While testing BNDVI, GNDVI and NDVI, the range is narrowed to remove noise. This allows for the best index to be identified and used on a per site/AOI basis.

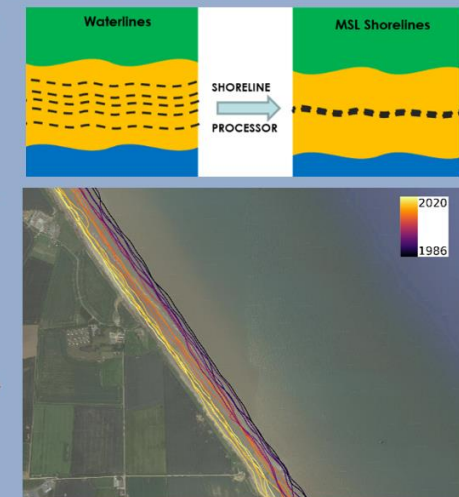
(c) Quality Control Metrics:

Waterlines are graded based on structural properties which allow for a more vigorous visual analysis to be carried out, ensuring only very accurate waterlines are passed through to The Shoreline Processor.

QC	
0-20	V. Low Con.
20-40	Low Con.
40-60	Fair Con.
60-80	High Con.
80-100	V. High Con.

5. The Shoreline Processor

The waterlines are converted into theoretical shorelines using auxiliary data collected on slope, tide height, mean sea level height, and the land-sea bearing at the sensing time. These can then be used to create a time series at the AOI.





PRESS RELEASE - ESA PROJECT "COASTAL EROSION FROM SPACE"

For the past 3 years a specialist consortium comprising the national geological and environmental/hydraulic experts from five nations have joined with specialists from industry in Earth Observation exploitation to design, develop, test, manufacture and validate a series of Earth Observation products that will revolutionize how coastal managers design their policies, plan their budgets and implement the changes required to mitigate the impacts of coastal erosion.

The consortium led by the British company ARGANS limited, were partnered by the British Geological Survey, the Geological Survey of Ireland, The Hydraulic Institute of Cantabria, the Italian Institute of Environment Protection and Research, and Arctus, a Quebec based company advising the province.

This project was funded by the European Space Agency (ESA).

Over the course of the project more than 7000km of coastlines from 5 countries were observed across numerous differing geomorphologies to demonstrate that the innovative techniques developed are truly scalable worldwide. The sites chosen were selected to represent a variety of coastal environments and climate change challenges.



The consortium has developed a method to optimise the number of customer ready location accuracy improved waterlines and datum reference shorelines covering 25 years that have been validated by the leading geoscience experts within the five partners' nations. These products deliver inter-pixel accuracy, use a locally adaptive method to accurately determine the position of the land/sea boundary precisely and can be scaled to cover complete nations worldwide. We have also developed a land classification map describing the coastal strip, to highlight coastal features and their inter-annual changes which enable beach width to be determined as well as the nature of the different coastal ecosystem.

These features enable analysis of coastal change associated with key events such as major storms and their surges, or manmade developments such as coastal defence or the unintended consequences of other engineering works.



- Identify and engage Users from National Medias (TV, Radio, Newspaper) one from each involved country
- **Develop a professional tutorial in 4 speaking languages (namely English, Spanish, French and Italian). Task 1: Develop Tutorial material**
- Develop communication about project results in the 6 targets countries with action toward TV, Newspapers and Radio medias. Task 2: Deliver Communication assets to target medias
- **Consolidates 3 gold products as appropriate.**
- **Task 4: Deliver Final Report**

Conference 2021-2022



GEO BLUE PLANET
5th SYMPOSIUM
24 - 28 October 2022 | Accra, Ghana
ON-PERSON EVENT WITH LIVE STREAMING



ICCE
2022
37th INTERNATIONAL
CONFERENCE ON
COASTAL ENGINEERING
4-9 December 2022
International Convention Centre
Sydney, Australia



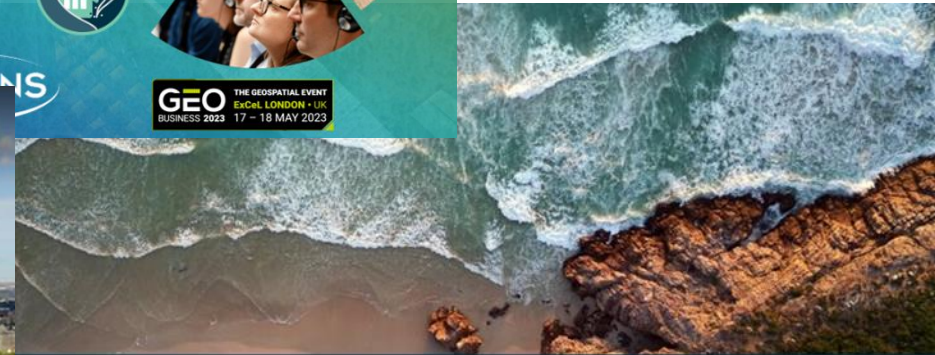
GEO
BUSINESS 2023
THE GEOSPATIAL EVENT
Coastal resilience for Global
Development Assistance
- Ghana and Dili -
Anne-Laure BECK
Martin JONES



OCRE
Open Clouds for Research
Environments
Assessment of coast
the last 38 years us
along Great Br
Joana Gafeira, British G
Martin Jones, A
British Geological
Survey
ARGANS




UK Coastal Research Conference
UK COASTAL RESEARCH CONFERENCE 2023
JULY 4-6 PLYMOUTH
REGISTRATION NOW OPEN
@UKCRC2023
Watch on YouTube





S. J. GAFEIRA, A.L. BECK, H. BAXTER, A. TAJI, F. COULIBALY, B. COOMBS & M. JONES
**THE COASTLINE POSITION OF GREAT
1984 TO 2022**
ARGANS
British Geological
Survey


CE Tutorial




Earth Observation for Coastal Management




Gestion côtière assisté par les outils d'observation de la Terre



L'Osservazione della Terra per la Gestione delle Coste



Observación de la Tierra para la Gestión de Zonas Costeras



Acknowledgments:
The Coastal Erosion from Space project, 4000126603/19/1-G, was commissioned under the Science for Society slice of the 5th Earth Observation Envelope Programme (EOEP-5) of the European Space Agency.



The Headlines The consortium developed a method to optimise the number of customer ready co-registered waterlines and datum referenced shorelines seasonally covering 25 years that have been validated by the leading technical geomorphological experts within the five partners' nations. Over 4000km of coastline was mapped. These products deliver inter-pixel accuracy, use a locally adaptive threshold method to accurately determine the position of the land/sea boundary precisely and can be scaled to cover complete nations worldwide. Indeed, each partner nation intends to continue this work to provide national coverage. We have developed a land classification map that describes the coastal strip, including coastal features and their inter-annual changes which enable beach width to be determined. Boundaries have been pushed using satellite derived bathymetry techniques based on a long history of this technology to observe features of interest even in the sediment laden waters.

This project has been led by ARGANS Ltd who formed a partnership consisting of an EO based information service provider group of Earth Observations and Data experts comprising ARGANS Ltd (UK/Fr), isardSAT (Spain) and adwioEO (Luxembourg) who delivered to an authoritative public User Group of national representatives from the British Geological Survey, the British government experts, the Cantabria in Spain on behalf of the Spanish government's Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO), Geological Survey Ireland, the Irish Department of Environment, Climate and Communications and ARCTUS representing the Canadian academic world and the local communities of Québec. For the CCN an additional national expert from Italy was added to the consortium, namely the Italian National Institute of Environmental Protection and Research.



Targeted at decision makers

The value of EO explained

CE Tutorial

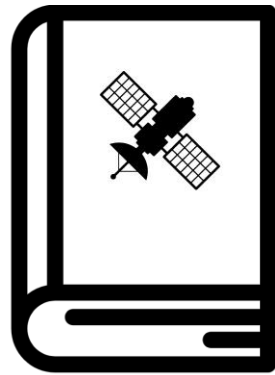


This document has been designed to help the reader (coastal managers) better understand the utility of Earth Observation (EO) products through an explanation of:

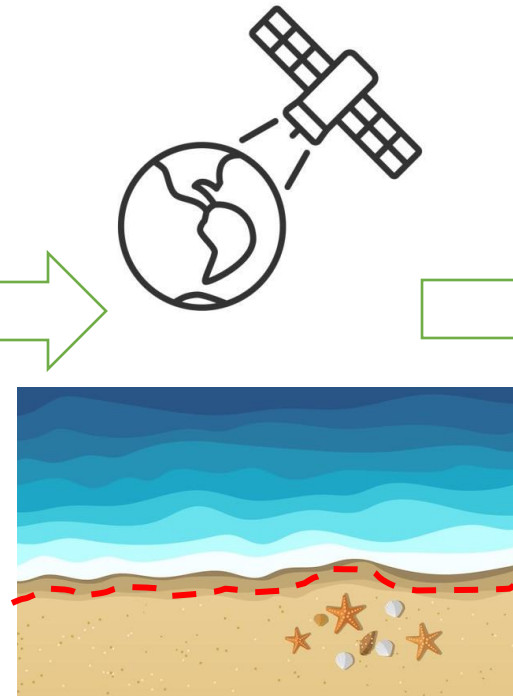
Introduction to Coastal Erosion



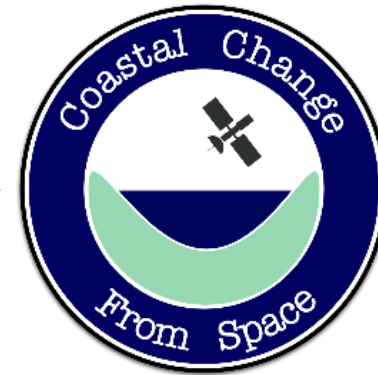
Satellite data in Marine Spatial Planning



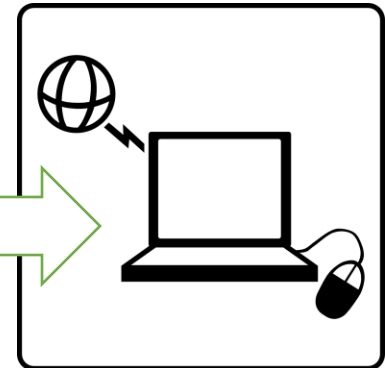
EO Products



Coastal change data service



Data access



CE Brochure



PROTECTING YOUR COASTLINES

Tailored products that enable cost-efficient coastal planning.

<p>BASELINE</p> <ul style="list-style-type: none"> • Sentinel-2 only. • Co-registration is conducted BUT imagery not provided. • All available waterlines. • Datum related shorelines. 	<p>PRECISION</p> <ul style="list-style-type: none"> • Sentinel-2 & LANDSAT • BASELINE + • Co-registered imagery. • Annual coastal strip classification map based on year of clients choosing. 	<p>PRECISION +</p> <ul style="list-style-type: none"> • Sentinel-2 & LANDSAT • PRECISION + • Datum shorelines supported by auxiliary data. • Annual coastal strip classification maps.
---	--	---

Coastal Erosion presents a pressing and increasing management problem with irreconcilable social and economic implications.

- Erosion is a natural process, amplified by climate change, that also varies due to season and human development.
- Mapping coastline change using satellite observations enables a nationwide perspective to monitor the effect of these changes over multiple timescales.

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Project initiated by

OPTIMISE COASTAL PLANNING DECISIONS

- ✓ COST EFFECTIVE
- ✓ SUITABLE FOR REMOTE & INACCESSIBLE AREAS
- ✓ APPLICABLE EVERYWHERE

EARTH OBSERVATION PRODUCTS AT SCALE

Coastal retreat can vary dramatically through the seasons and will be exacerbated by **climate change**.

These, analysing a range of spatial and temporal scales is the only option for a comprehensive understanding of coastline experiences long term change and also identifies the complex patterns of seasonal gain and loss. This knowledge will guide effective coastal protection management.

1. At a national scale, hotspots of coastal change can be identified.
2. Regional differences can be visualised to assess rapidly retreating parts of the coastline.
3. An annual shoreline product shows how the average location of the shoreline changes through time. This can demonstrate whether shoreline change is seasonal or part of a long term trend.
4. Annual shorelines are compiled to establish an erosion rate.

WATERLINES

The waterline processor automatically determines the extent of the **land-sea boundary from a satellite image**.

These waterlines are then projected using auxiliary data to provide a datum-based shoreline.

SHORELINE TIME-SERIES

Continuous shorelines can be mapped over decades using the Sentinel satellite data. Coastal change associated with seasonal variation, storm events and long-term trends can then be determined.

LAND USE ASSESSMENT

Land use maps help in the characterisation of risk for coastal management. The landward boundary of the littoral zone is delimited through three main coastal areas: the backshore, the buffer zone and the beach.

✓ QUALITY ASSURED

✓ PRODUCT VALIDATION

✓ SPEED OF DELIVERY

To spread the message at conferences, fayres and events

Press and Media



How can space data shape more robust coastal management plans?

In a turbulent climate, coastal managers can plan realistic possibilities and make better investment decisions by relying on insights from space data.

Using insights gleaned from Earth observation research is a win-win for coastal managers, says Martin Jones, coastal programme manager at satellite data processing company ARGANS.

Why we need space data

Space data can guide wiser investment decisions that protect and develop the coastline sustainably. This is especially true for coastlines whose change may accelerate due to climate change or for areas where resilience needs to be added as demographic changes develop more infrastructure near the coast.

"Nature-based solutions, for example, may have acted as a good buffer in the past from coastal erosion and other risks, but as more people move to the coast and more infrastructure — such as ports and railways — is built there, the landscape and associated resilience changes. Moreover, with climate change comes more extreme storms and rising sea levels. It means coastal investments are at risk and can become costly," warns Jones.

Multiple picture of coastlines

To efficiently analyse risks — ARGANS monitors and maps coastal processes using images from the European Space Agency to build a full picture of the coast's profile, factoring in elements such as coastal erosion, marine litter, saltmarshes, mangroves and carbon sequestration in seagrass.

"We look at all these variables, put this information together and provide data-driven evidence that can support investment decisions, rather than making assumptions based on anecdotes," says Jones.

Looking back to plan ahead

As well as understanding the current coastal scenario, planning requires observing historical patterns. ARGANS has access to data going back three decades, allowing a deep dive into the coastline's history. "This is one of the reasons we like using the scientific instruments from the European Space Agency as the Sentinel Mission is well calibrated, and you can see a change in an image going back years," says Jones.

"These images and data enable us to provide evidence for managers to form the basis of their management plan against the — obvious current and increasing — effects of climate change."



Martin Jones
Coastal Programme
Manager, ARGANS

BETHENNY
Sarah Brown



NEWS

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Coastal erosion



Beach beauty spot eroding into sea, residents fear

News - 1d



Noise warning ahead of coast defence piling work

Hampshire & Isle of Wight - 12 Jun



Work on £4.3m sea defence project to start

Wales - 10 Jun



New lifeboat launcher overcomes erosion challenge

Norfolk - 9 Jun



Youngsters pose for photos on rock fall cliff edge

Dorset - 26 May



Coast road at risk of 'catastrophic collapse'

Somerset - 25 May



Safety and erosion fears over parking on beach

Wales - 21 May



Public warned to stay clear of landslide

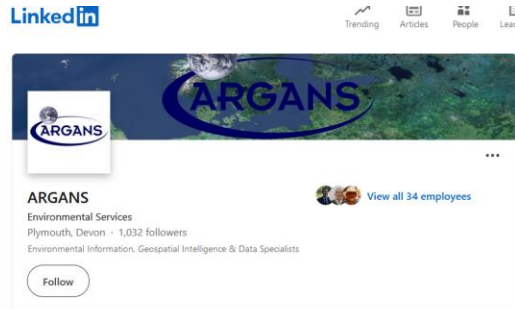
Hampshire & Isle of Wight - 21 May

Funded by ARGANS

Find out more at argans.co.uk



LinkedIn campaign



About us

ARGANS is a UK-registered company with headquarters based in Plymouth UK, offices in Sophia-Antipolis and Brest, and staff located in London and Southampton. We are specialists in satellite-based Earth Observation, remote-sensing applications and services, and geographical information systems used to map and monitor the marine, atmospheric and terrestrial environments.



ARGANS we're very pleased to present their work on improving Disaster Resilience in Ghana & East Timor at #GEOBusiness. The talk focused on coastal change identifying and monitoring how coastal resilience can be developed. Our approach showed that through improving terrain models & associated flood forecasting a better understanding of coastal dynamics can be achieved.

#EarthObservation #RemoteSensing #CoastalChange #flooding



It was great to meet with one of our previous clients Laurent Kerléguer - Director General of SHOM - at the International Hydrographic Organization (IHO) General Assembly this week.

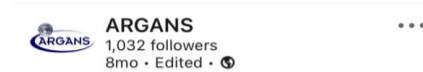
If you are interested in learning more about the project on the global application of Satellite Derived Bathymetry, please see our website at <https://sdb.argins.co.uk/>



Excited to announce that ARGANS Ltd. will be attending the International ...see more



Martin Jones from ARGANS has presented today at the Plymouth Coastal ...see more



ARGANS Ltd are at the GEO Blue Planet Symposium in Accra, Ghana, ...see more



Observing the Earth from Space.
Matching solutions to expectations.

Follow the link below to learn more



0 days 00 hours 07 minutes
Sentinel-2 constellation:
summer solstice

Future work



UKSA Enabling Technology

a global capability to support developing nations.



DEFRA Coastal monitoring and historical change. Adaptable methodology to determine coastal change in England and Wales



Department for Environment Food & Rural Affairs

European Open Science Cloud programme

COASTAL CHANGE FROM SPACE
Remote Sensing Solutions for Coastal Management

The ongoing effects of climate change could be devastating for coastal areas: sea level rise, more intense storm events and damage to coastal buildings and infrastructure can all have an impact on coastlines, while producing repercussions on people, the economy and the environment.

The Coastal Change from Space is a global service developed by ARGANS to detect annual and seasonal changes along long stretches of shorelines over 25 years of observations. This can provide significant insights into determining where investments by governments should be focused and how corrective actions can be best targeted, in the framework of a climate adaptation strategy.

OUR APPROACH TO PRODUCE SHORELINES

IMAGE CO-REGISTRATION
We correct spatial registration mismatches between very high resolution and Sentinel and Landsat imagery to increase the ground-position accuracy of the image. The slave image inherits the position of the master one, considered to be the best image of the area.

WATERLINE
Our processor takes the co-registered imagery and derives the land-water boundary using a remote sensing index tailored to a specific region. The waterline provides a basis for monitoring geomorphology over the last 25 years.

SHORELINE
The waterline is converted into a shoreline, which calculates the land-water boundary at a fixed water level, relying on in situ measurements or numerical models. By comparing old to new shorelines, erosion or accretion can be detected.

APPROACH VALIDATED
The original project involved four pilot sites in England, Ireland, Spain and Canada. Our approach was validated by national experts from these countries.

QUALITY GUARANTEED
Quality control is key in such an innovative sector. We engaged with scientists and end users to develop from a monitoring into a risk assessment and prediction service.

APPLICABLE EVERYWHERE
The service enables a large spatial scale and a high temporal and spatial resolution to be delivered in an affordable manner everywhere in the world.

OUR SERVICES VIA THE ESA NoR

BASELINE (S2 ONLY)

- Co-registration is conducted BUT the co-registered imagery is not provided
- All available waterlines (using best indices and threshold selection)
- Datum related shorelines (based on slope generation and MtdC data scraping)

PRECISION (S2 & L5/L8)

- BASELINE +
- Co-registered imagery provided
- An annual coastal strip classification map based on a year of the clients choosing

PRECISION PLUS (S2 & L5/L8)

- PRECISION +
- Datum shorelines supported by auxiliary data provided by client in specific areas
- Annual coastal strip classification maps based on three individual years of the clients choosing

The spatial accuracy of the shorelines derived is based upon the accuracy of the commercial WRS data selected during co-registration and is typically in the order of +/- 3m on the ground.

GET IN TOUCH
coastalerosion@argans.co.uk
coastalerosion.argans.co.uk

CE Discussion points



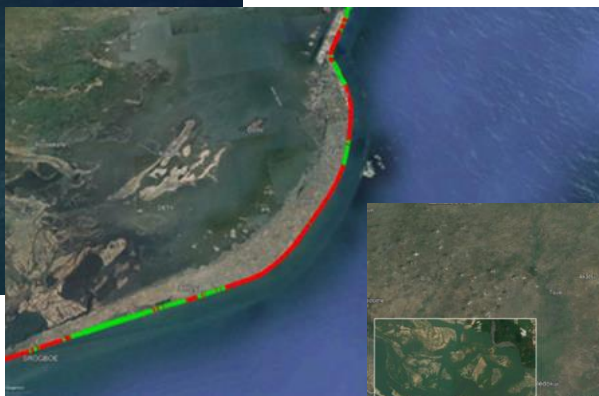
- **ESA Communications Department**
- **Working with a funded User Community of Experts**
- **Workshop with International Financial Institutions**
- **European Open Science Cloud (EOSC) “horizontal services**



New application of CE products



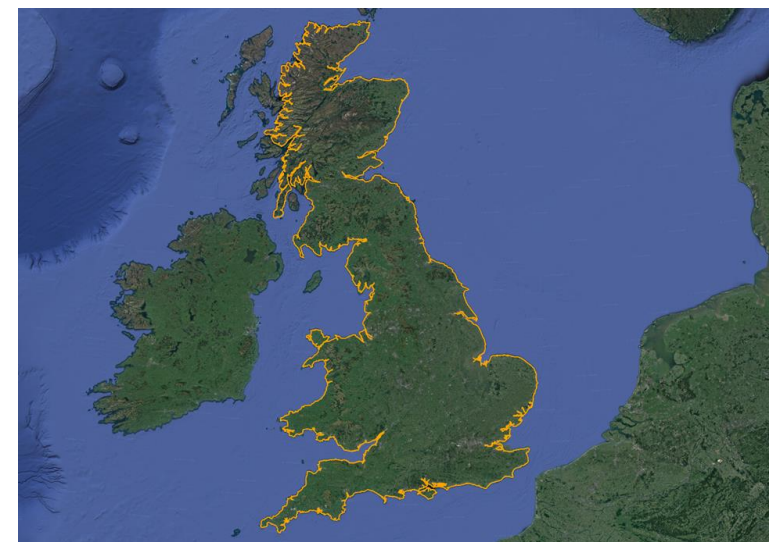
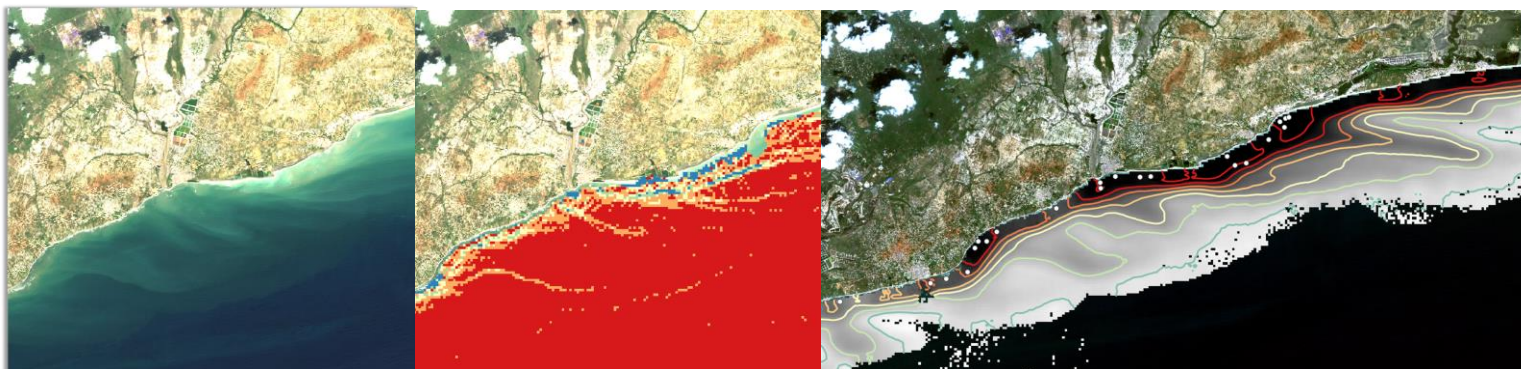
Time series in Ghana



Mapping the complete GB mainland



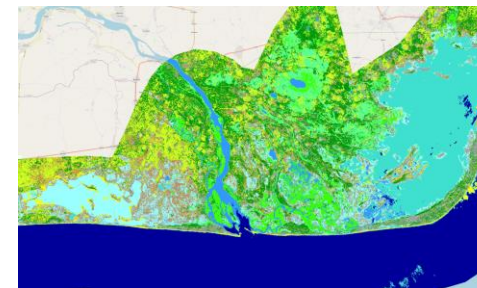
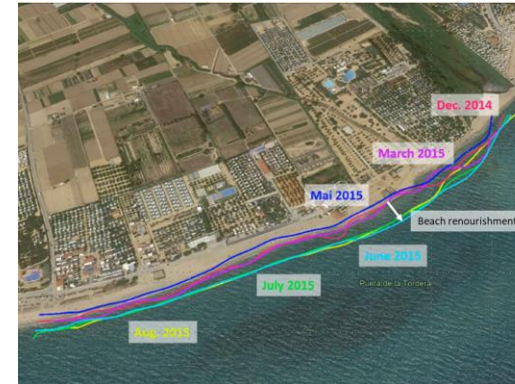
Linking to sediment sources



Product consolidation



- Satellite Derived Waterlines
- Datum Referenced Shorelines
- Coastal Land Classification
- Time series
- Final Report



CCN2 - Final Report (December 2022 to June 2023)
Ref:SO-RP-ARG-003-055
Date: 20/06/2023
Customer: ESA
Contract Ref.: 4000126603/19/1-LG





Thank you

