Digital Twin Earth

Coastal Processes and Extremes

Présentation Paris – 29 juin 2026

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Digital twin ?

Digital Twin : digitial replica of phenomena or mecanisms (of environmental, societal, economical … origins) with the help of all inputs parameters (causes) and outputs parameters (consequences)
This allows **evaluation of processes** between parameters and their **exploitation through scenarios**

Organisation of	Data	Harvesting, formatting, QC, merging, uncertainties estimates
What is the situation	Now	Derivation of processes between causes and consequences (deterministic modelling, statistical approach, AI, hybrid…) Evaluation of the processes quality/reliability/accuracy on a regular basis through continuous acquisition of data (link with Data)
What will be the situation	Next	Application of known scenarios (e.g. IPCC) to the processes, accounting for known reliability and accuracy
What could be the situation	If	Derivation of scenarios on extreme (and potentially unmet) causes Application of these scenarios to the processes, accounting for know reliability and accuracy

Coastal and Extremes Digital Twin Component

ARGANS Ltd, UK	ARGANS
ACRI ST, France	ACRI ST
AdwäisEO, Luxembourg	adwäisEO
BIOSFERA, Spain	BIOSFERA EDUCACIÓ AMBIENTAL CONSERVACIÓ RECERCA
BGS, UK	BGS British Geological Survey
CLS, France	CLS
COVARTEC, Norway	COVARTEC Coastal Sustainability & Valorisation
LIST, Luxembourg	LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

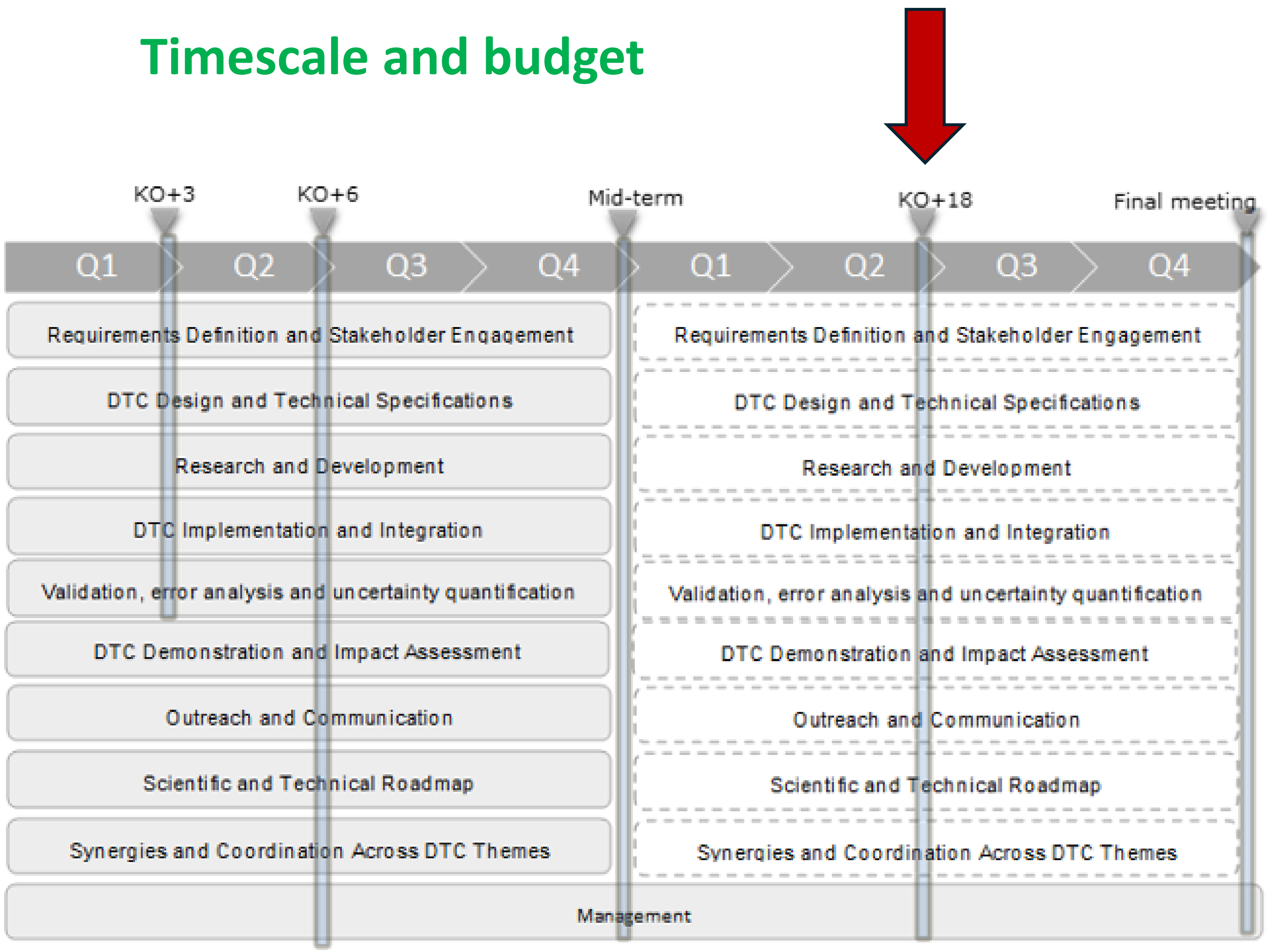
Specification, development of the Coastal Digital Twin and onboarding on DESP

Setting up of 4 use cases

- **Coastal change (erosion/accretion)**
- **Coastal and compound flooding**
- **Mangroves (link with blue carbon)**
- **Sargassum proliferation**

Coastal and Extremes Digital Twin Component

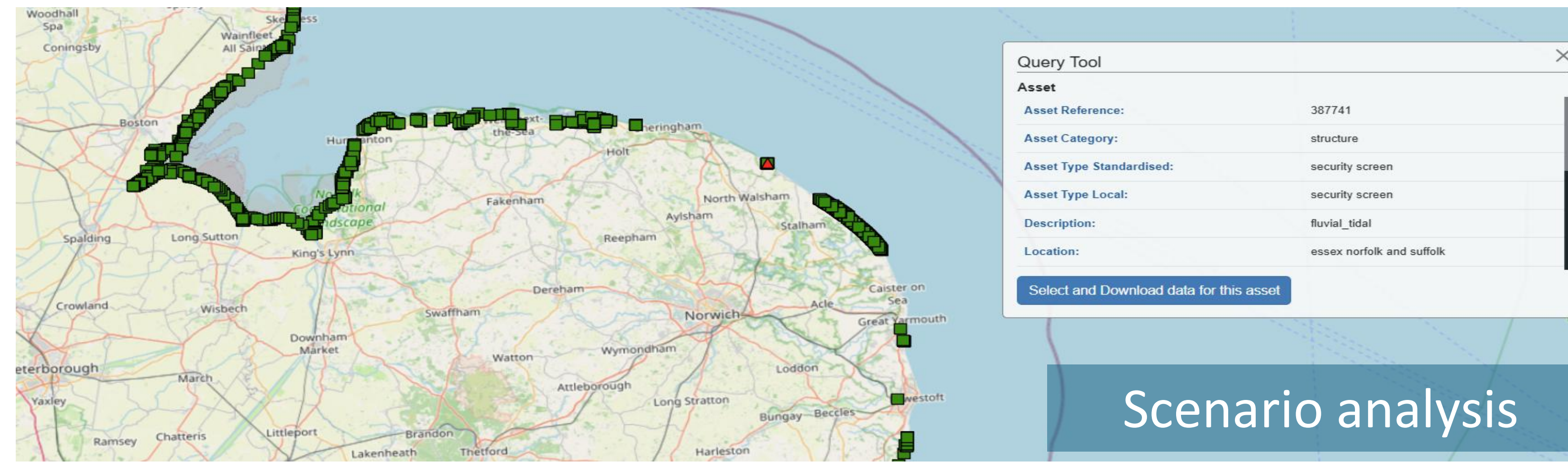
Timescale and budget

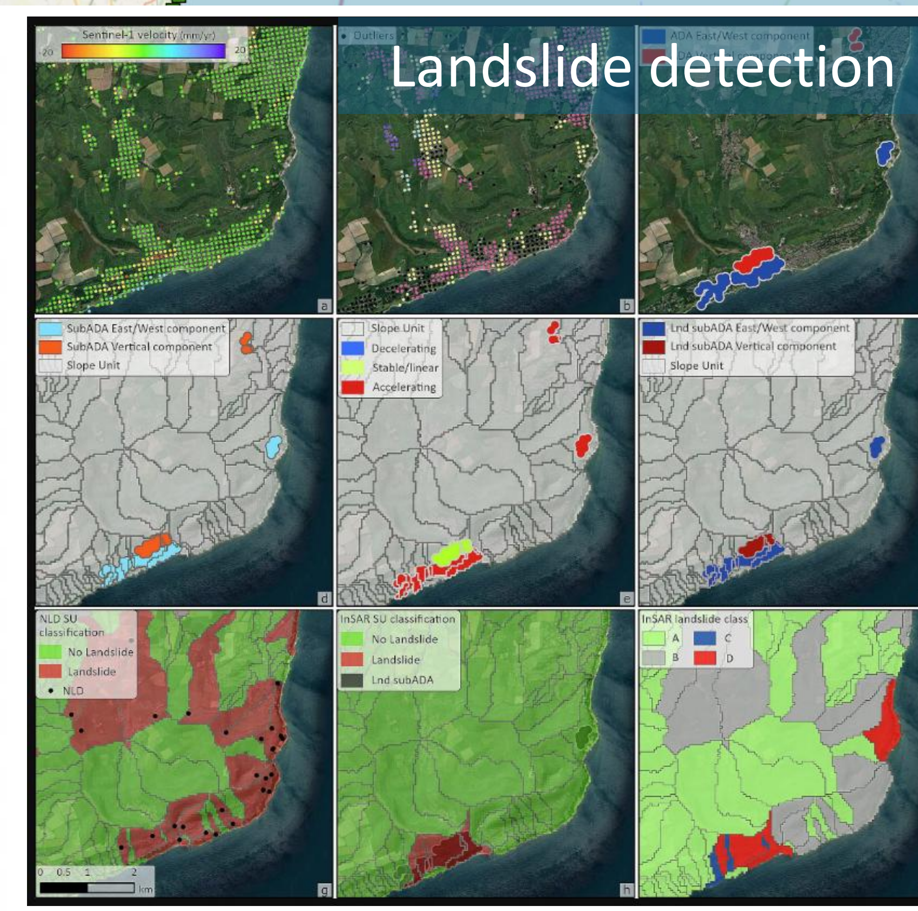


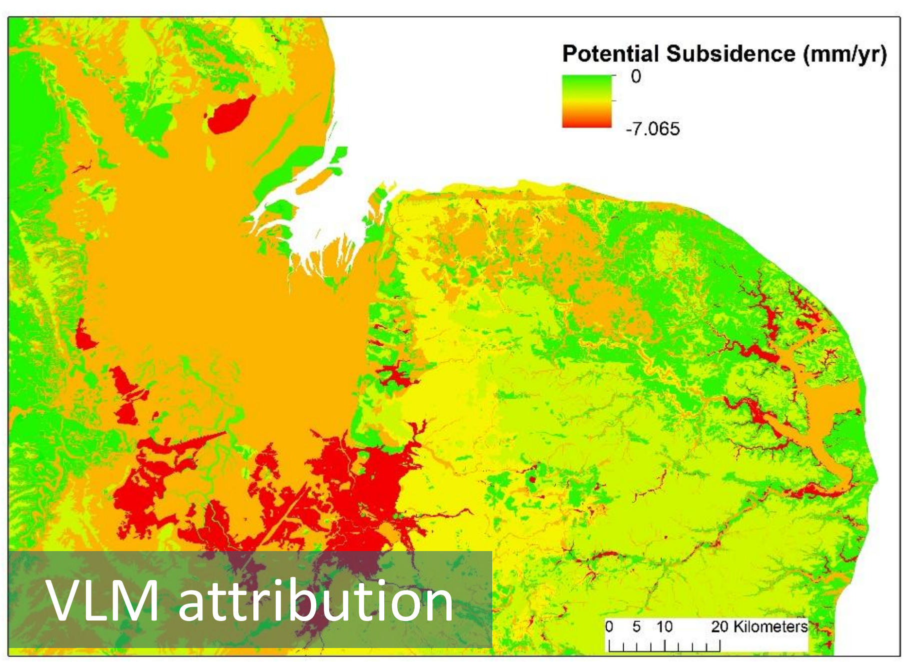
Total budget 1,5M

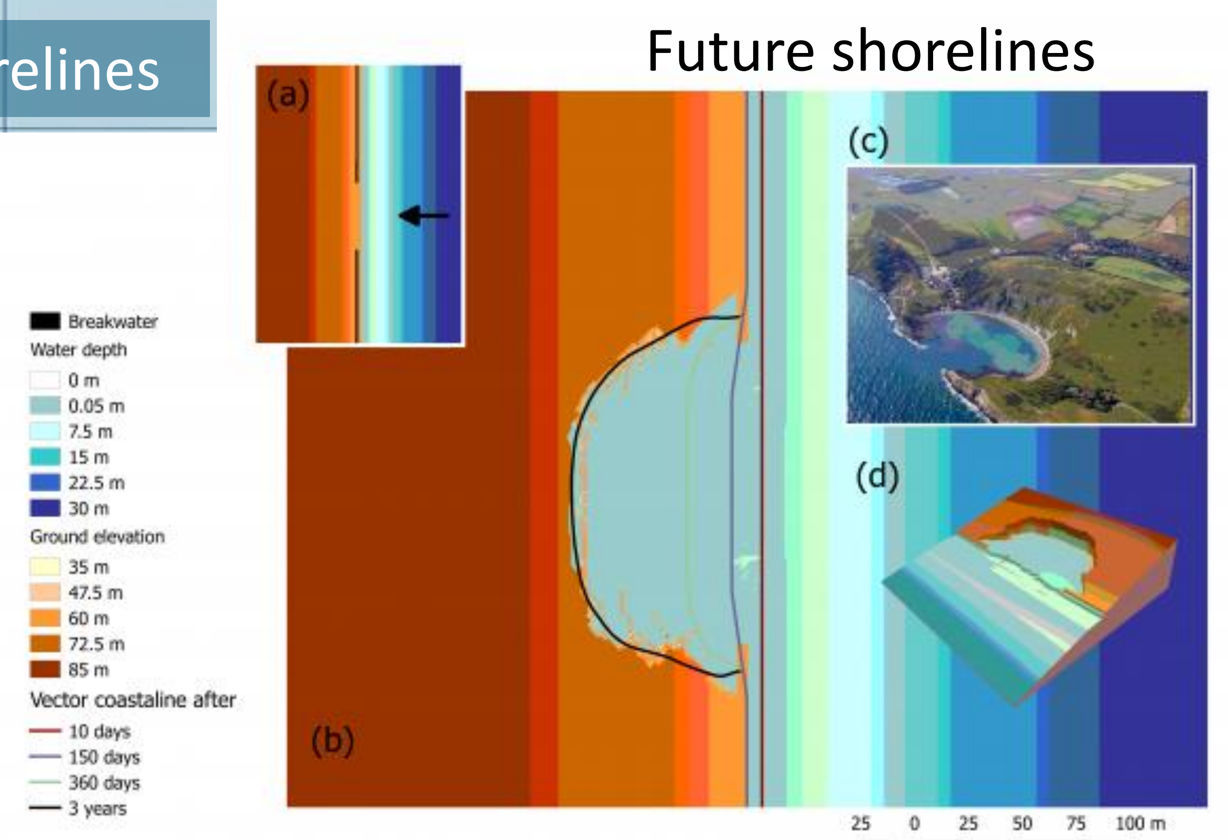
France : 47,5%
UK : 28%
Lux : 18,5%
Norvège : 2,5%
Espagne: 3,5%

Coastal change components





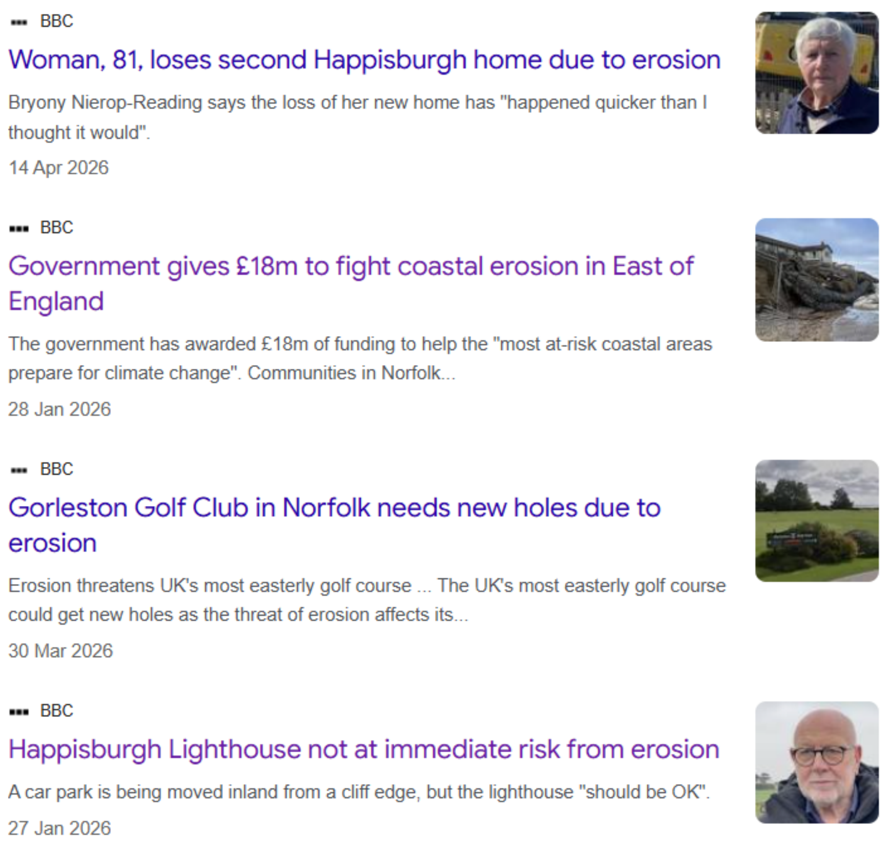




Coastal change – Happisburgh, Norfolk

Since the removal of a coastal defence section in 1999, 34 homes have crumbled into the water in Happisburgh because of coastal erosion.

https://coastal-environments.weebly.com/happisburgh.html


BBC
Woman, 81, loses second Happisburgh home due to erosion
Bryony Nierop-Reading says the loss of her new home has "happened quicker than I thought it would".
14 Apr 2026

BBC
Government gives £18m to fight coastal erosion in East of England
The government has awarded £18m of funding to help the "most at-risk coastal areas prepare for climate change". Communities in Norfolk...
28 Jan 2026

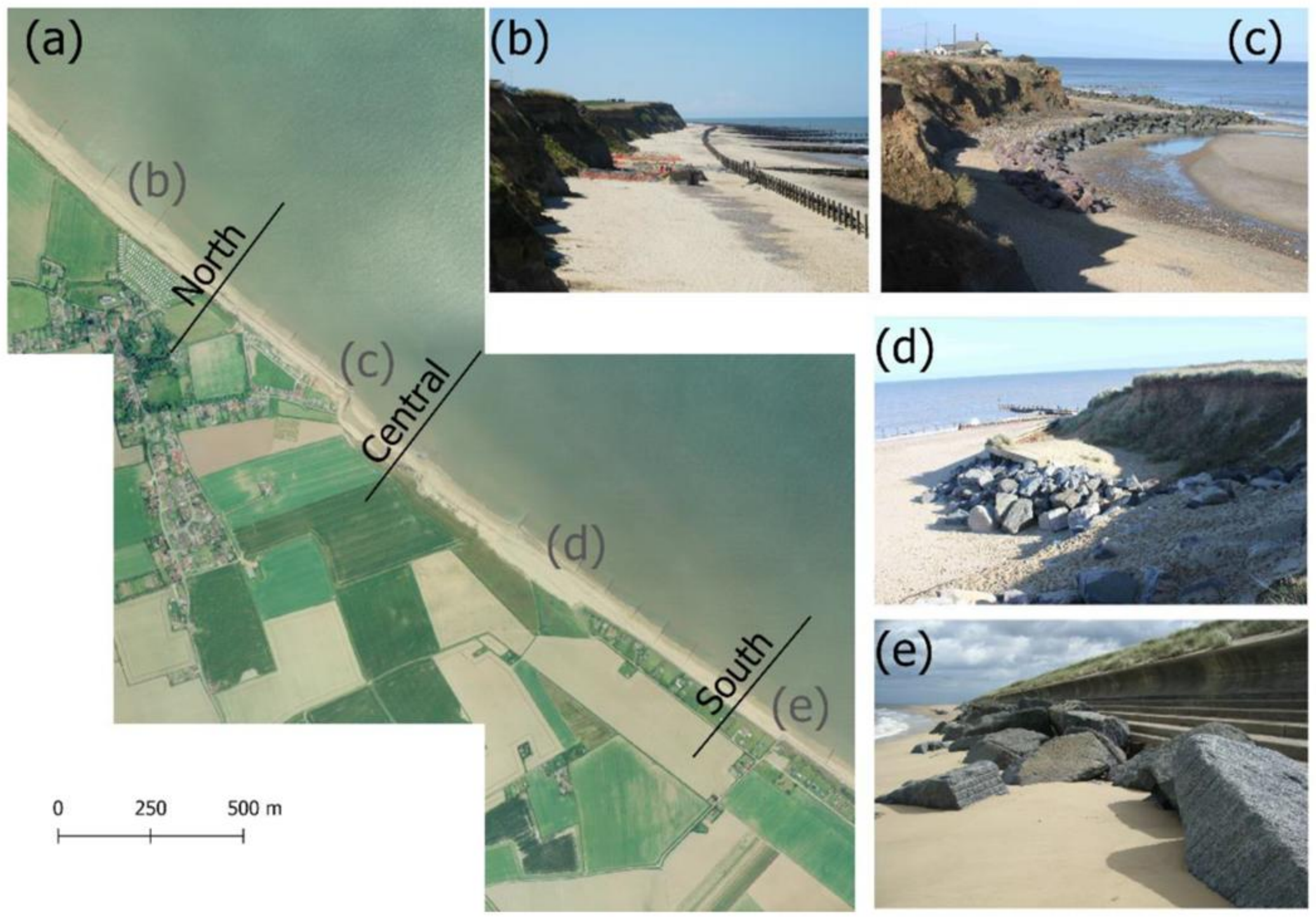
BBC
Gorleston Golf Club in Norfolk needs new holes due to erosion
Erosion threatens UK's most easterly golf course ... The UK's most easterly golf course could get new holes as the threat of erosion affects its...
30 Mar 2026

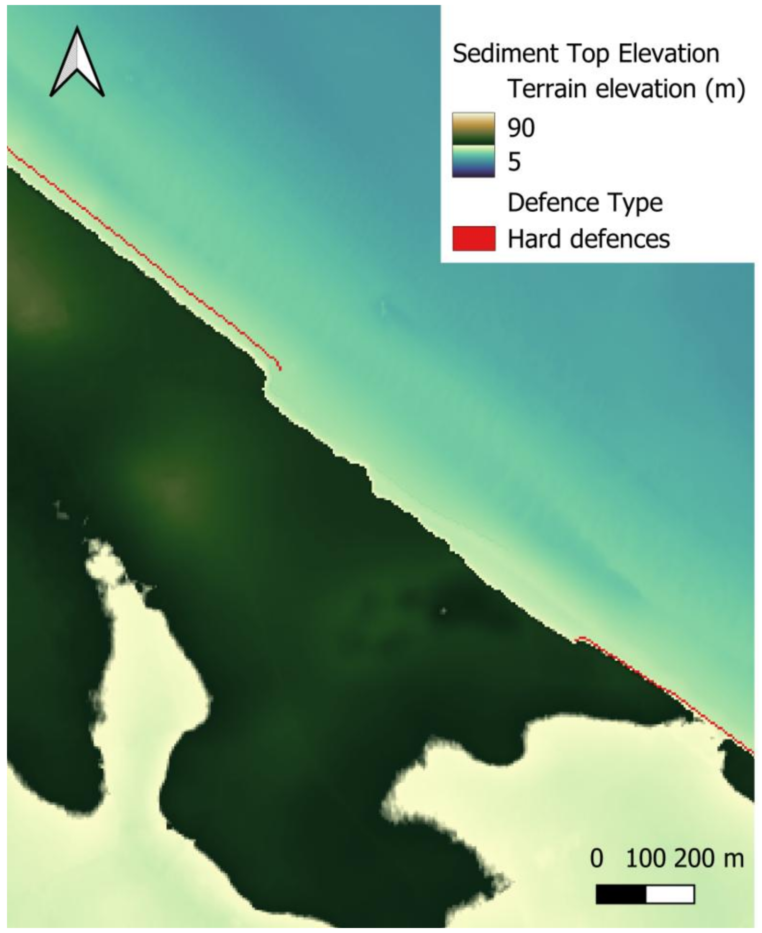
BBC
Happisburgh Lighthouse not at immediate risk from erosion
A car park is being moved inland from a cliff edge, but the lighthouse "should be OK".
27 Jan 2026

Left: Erosion of Happisburgh coastline between 1999 and 2024 after removal of sheet pile defences.

Centre: Original coastal defences (1996). Right: Recent headlines.

Coastal change – users requirements





Type	Environment
Goal	Decision support, risk management & communication
Interventions	System operation (e.g. beach nourishment, hard defences) & policymaking
Cost reduction	Disaster risk reduction, climate adaptation & biodiversity protection
System representation	Many systems (objects and large systems)
Timespan	Decades

Coastal flooding

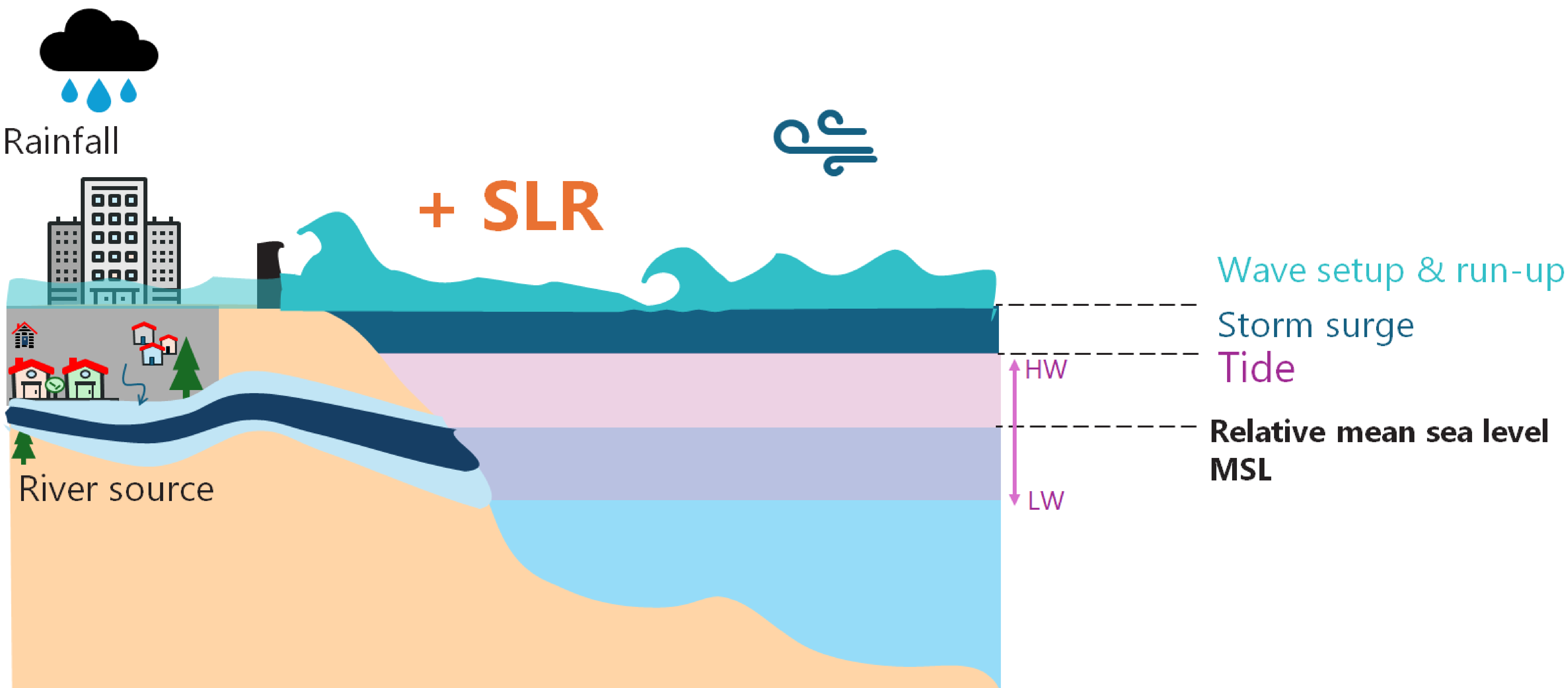
Coastal flooding is one of the **most destructive natural hazards** with social, economic and environmental consequences.

Coastal flooding will become more challenging:

- Relative sea-level rise and changes in storms & precipitation
- **Population growth and urban development** in floodplains
- **Degradation of natural habitats** that ac as a buffer to flooding;
- **Ageing flood defence assets**

Impact of Storm Ciara (Feb., 2020) on Saint Malo, France (Credit: EasyRideVideos)

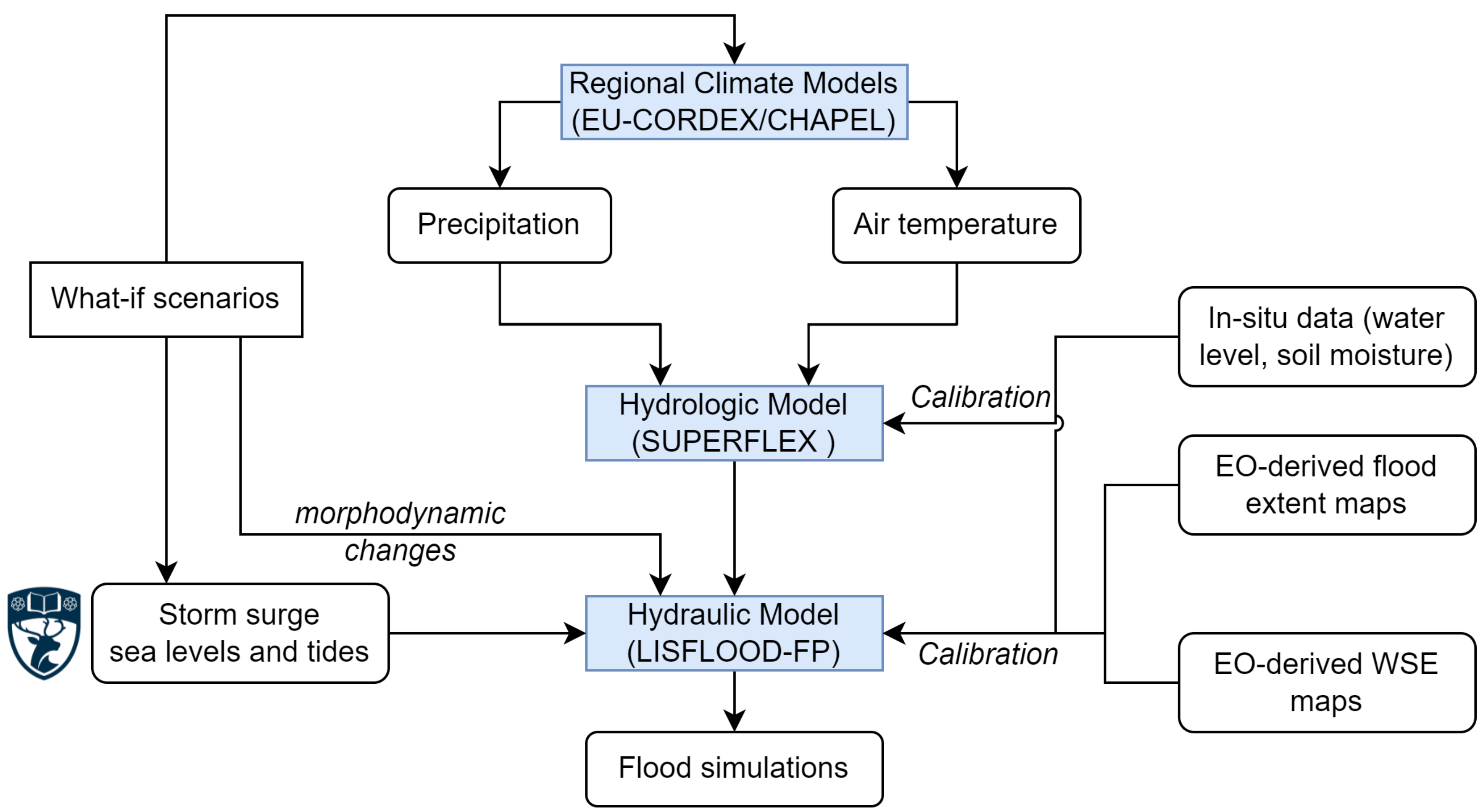
Drivers of Coastal & Compound Flooding

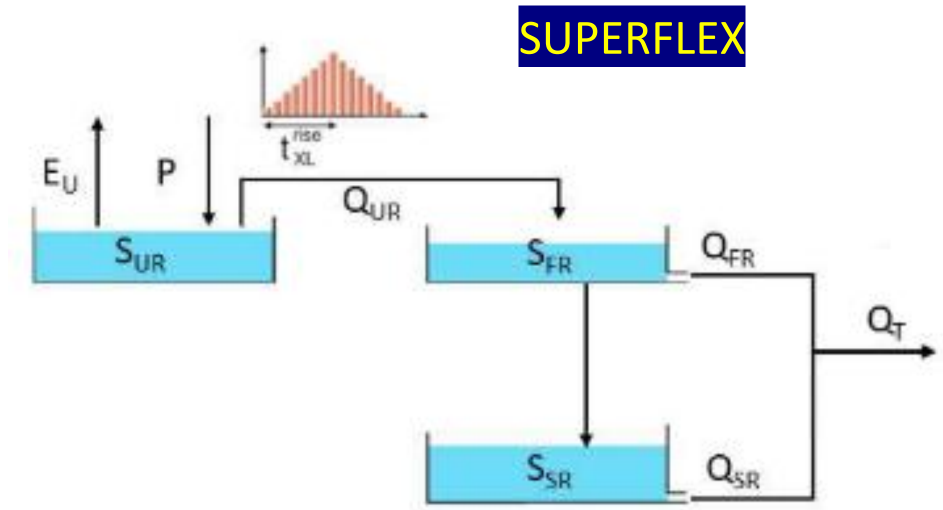


Total Water Level = MSL + tide + storm surge + wave setup + river input + rainfall/runoff [+ SLR]

Methodology

- Chained modelling approach: Climate-Hydrologic-Hydraulic model
- Calibration & validation using in-situ data & multiple EO datasets
- What-if scenarios related to boundary conditions (from RCMs and storm surges) and/or river/floodplain geometry changes





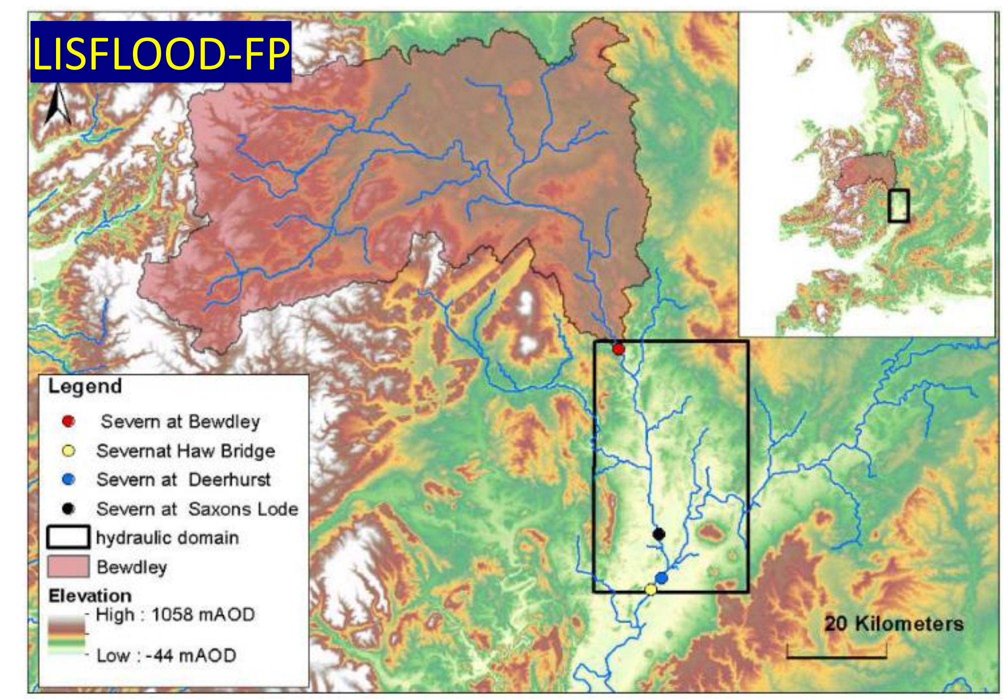
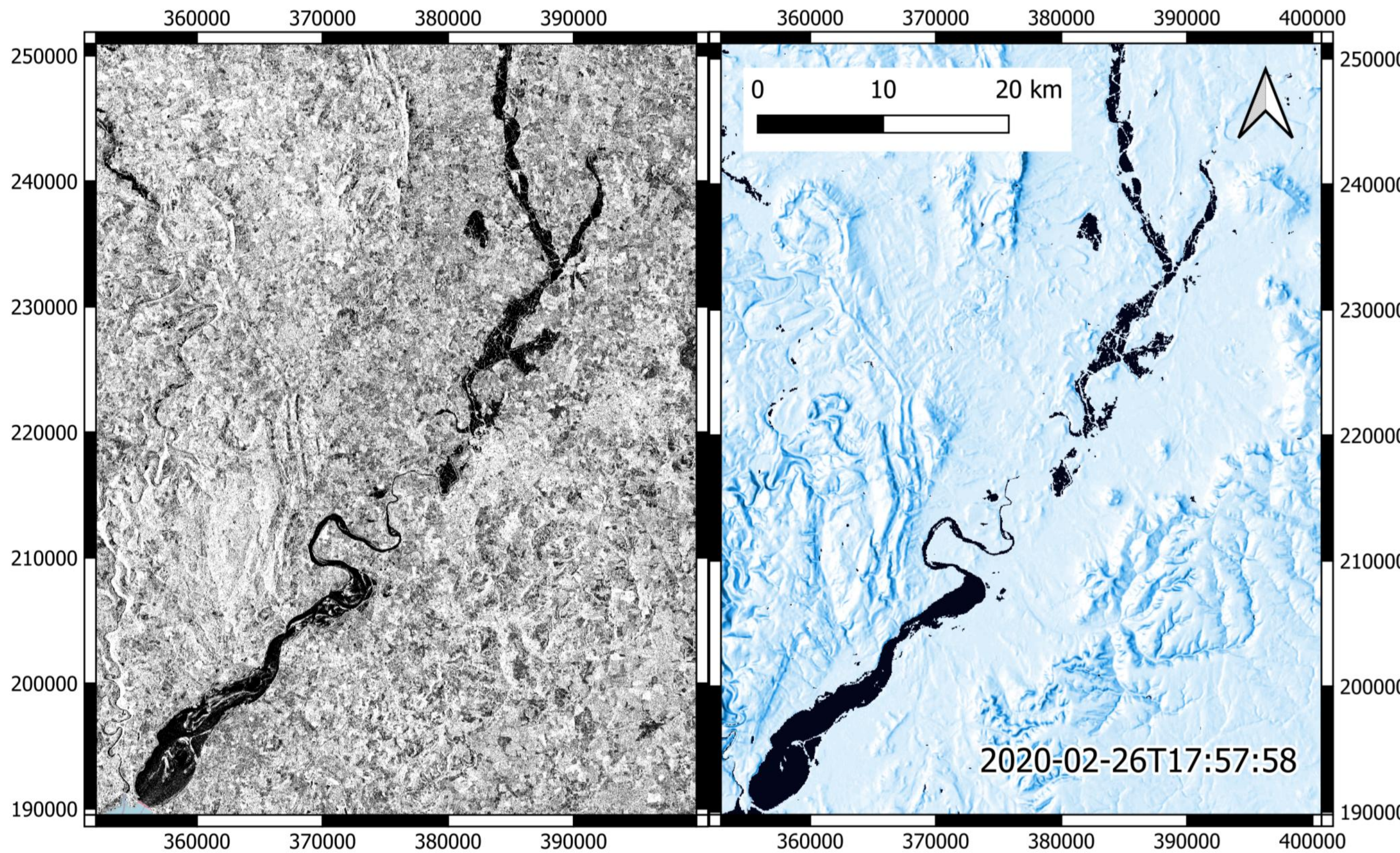


Figure 2.2: Study area: River Severn (UK). Only the boundary condition in Bewdley is taken into accoun Within the sub-catchment upstream of Bewdley (area of 4325 km^2) a lumped hydrologic model is used t determine the input of the hydraulic model along the river Severn downstream. The dots represent the existin gauging stations where the performances of the DA framework are evaluated. The black square is the hydrauli domain where LISFLOOD-FP runs.

Leverage EO data

Flood extent map derived from Sentinel-1 by Global Flood Monitoring (GFM)



https://extwiki.eodc.eu/GFM/PDD/GFM_algorithms/LIST_algorithm

Coastal flooding

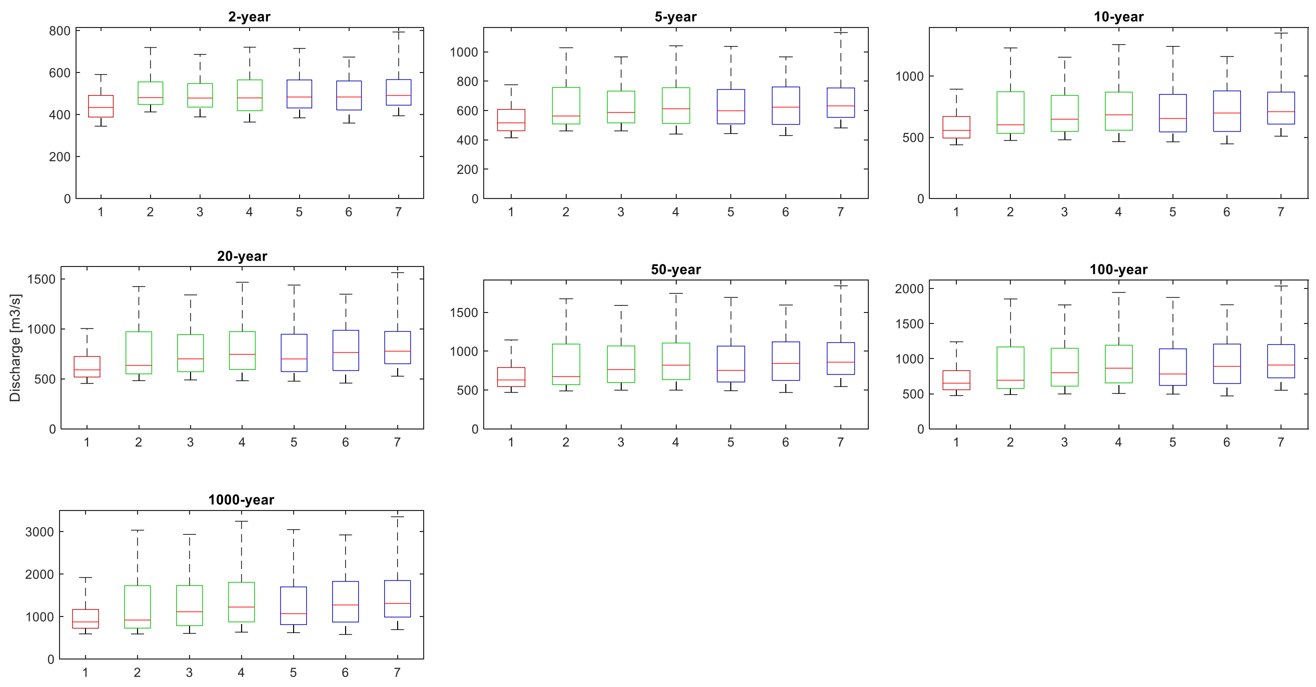
Climate Models and “What-if” Scenarios

Regional climate models: EURO-CORDEX archive (11 km, Europe) provide **precipitation** and **air temperature** projections, covering three Representative Concentration Pathways—RCP2.6 (stringent mitigation), RCP4.5 (moderate change), and RCP8.5 (severe change).

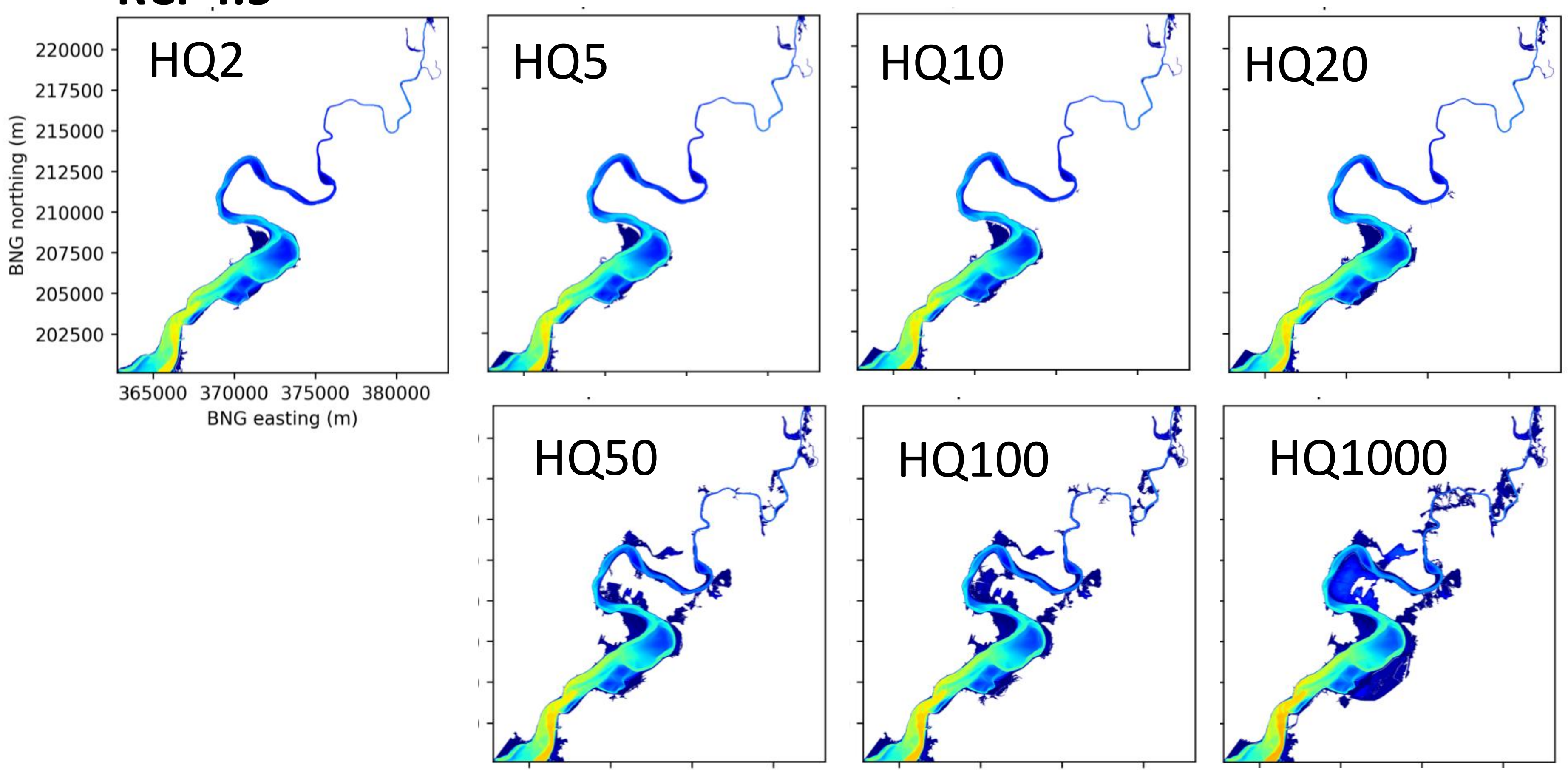
What-if scenarios:

- Users can **select climate scenario** with **storm surges** to generate corresponding flood hazard and risk maps
- Users can **select mitigation scenario** to assess its impact on flood hazard and risk at site level

Upstream boundary condition:



RCP4.5



In progress : Link with HPC allowing user to launch its own scenario

ARGANS ACRI ST adwäisEO BGS CLS COVARTEC BIOSFERA LIST University of Southampton

Sargassum use case

Voir presentation CLS

Mangroves

User Requirements

The platform should be designed to address the specific requirements of different user groups (policymakers, researchers, environmental managers), ensuring ease of access, usability, and the ability to make data-driven decisions

Data Visualization and Analysis Tools

- Graphical tools
- Data download
- Modelling

Real-Time Data Access

- Live data feeds
- Automatic data updates
- Integrate additional/other satellite and sensor data

Support Tools for Policymakers and Managers

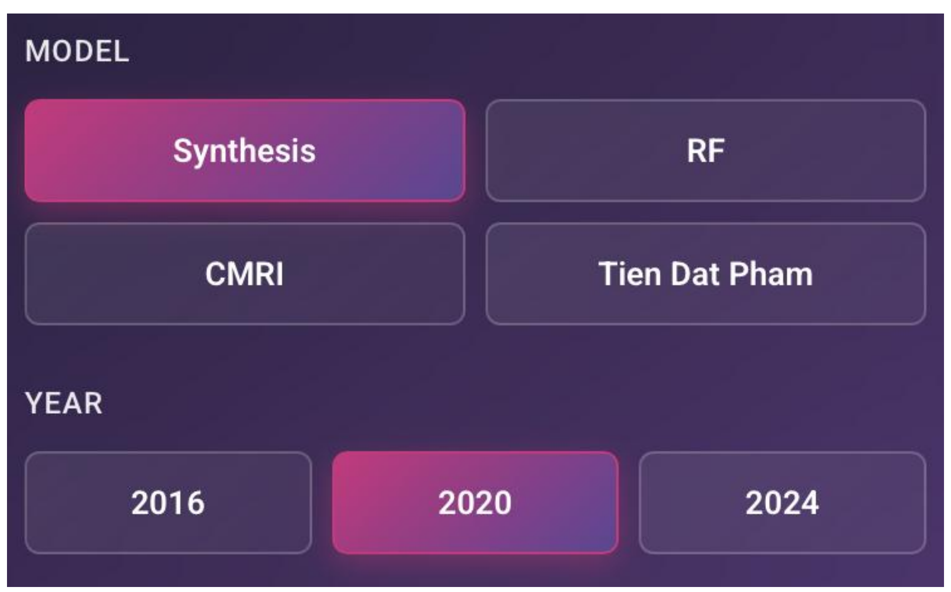
- Risk assessments
- Sustainability indicators
- Scenario planning tools

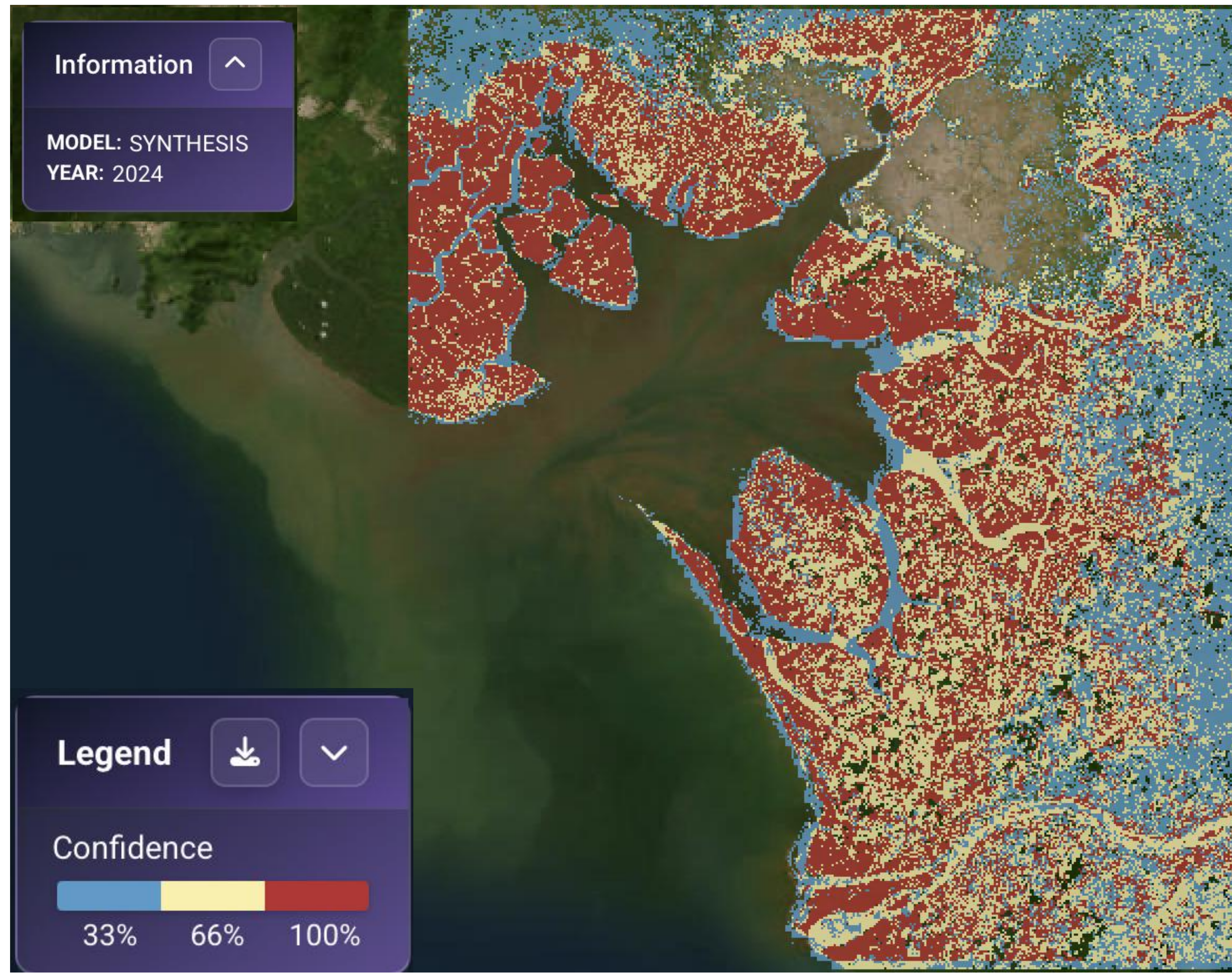
Integration with External Data Sources

- Data sharing
- Support integration with GIS software

Mangroves

Digital Twin: DETECTION (mapping habitat extent)





Mangroves

Digital Twin: Habitat suitability

Information

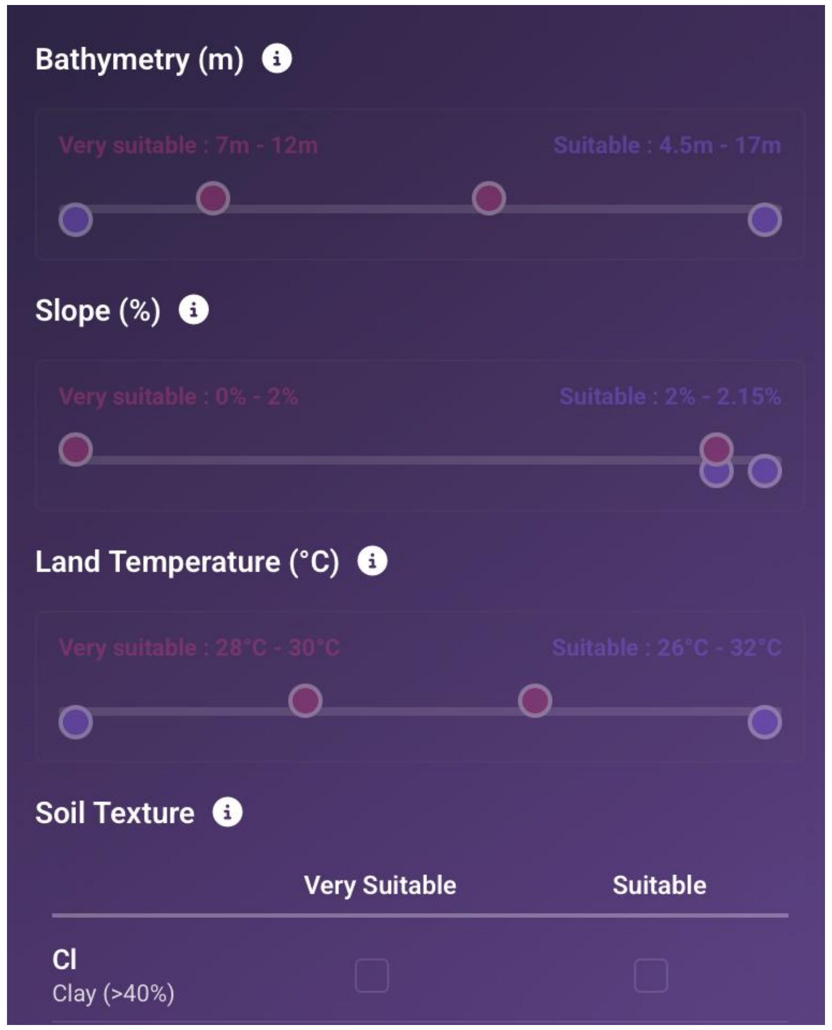
POPULATION: Included

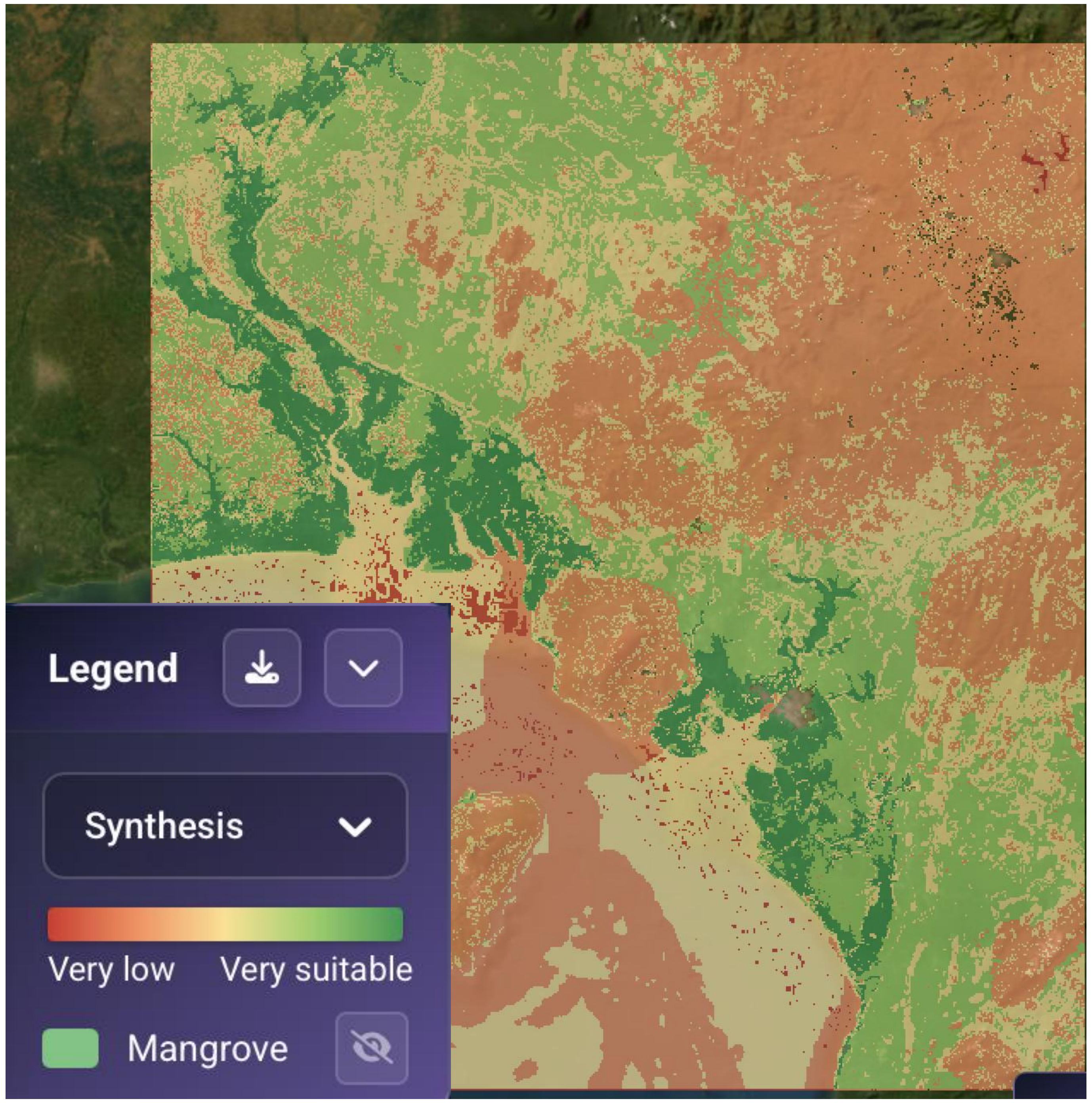
BATHYMETRY (m)
Very Suitable: 7-12 m
Suitable: 4.5-17 m

SLOPE (%)
Very Suitable: 0-2%
Suitable: 2-2.15%

LAND TEMPERATURE (°C)
Very Suitable: 28-30 °C
Suitable: 26-32 °C

SOIL TEXTURE
Very Suitable: SaClLo, SaLo, LoSa
Suitable: SaCl

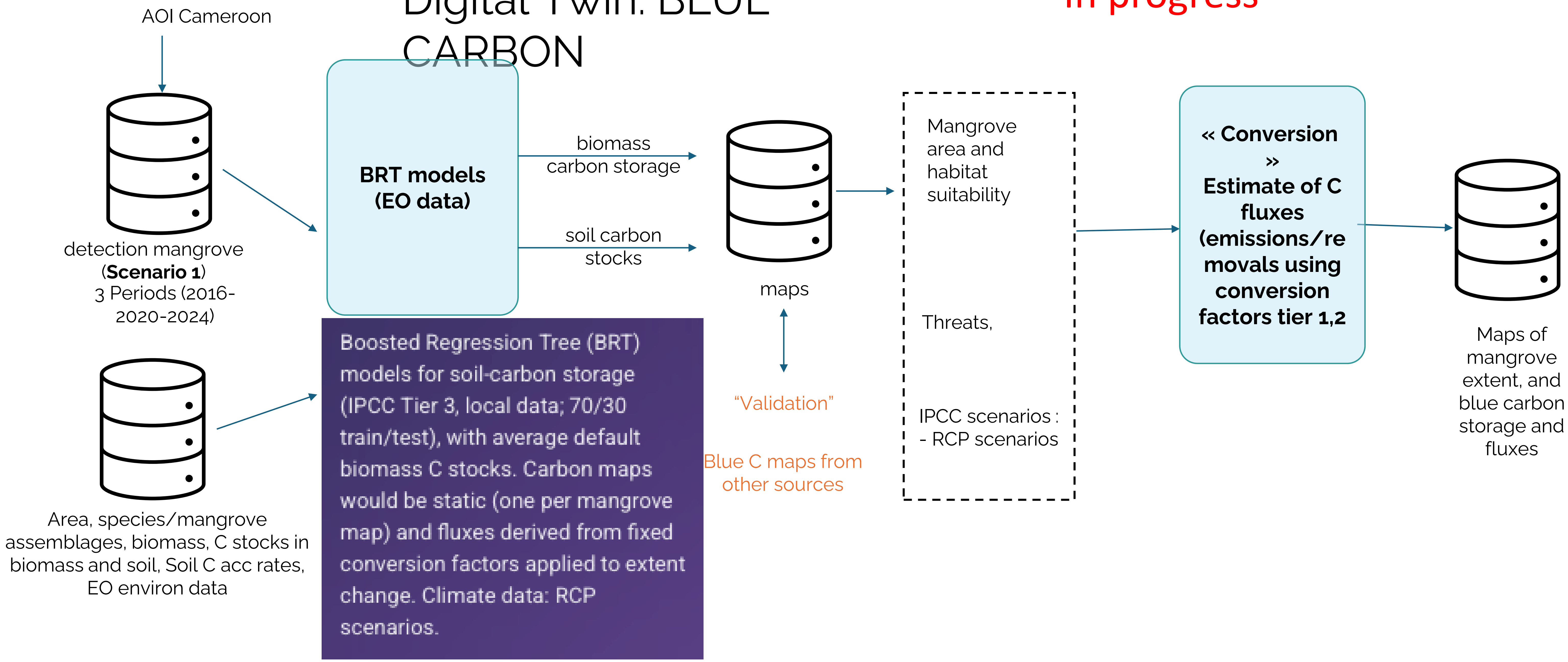




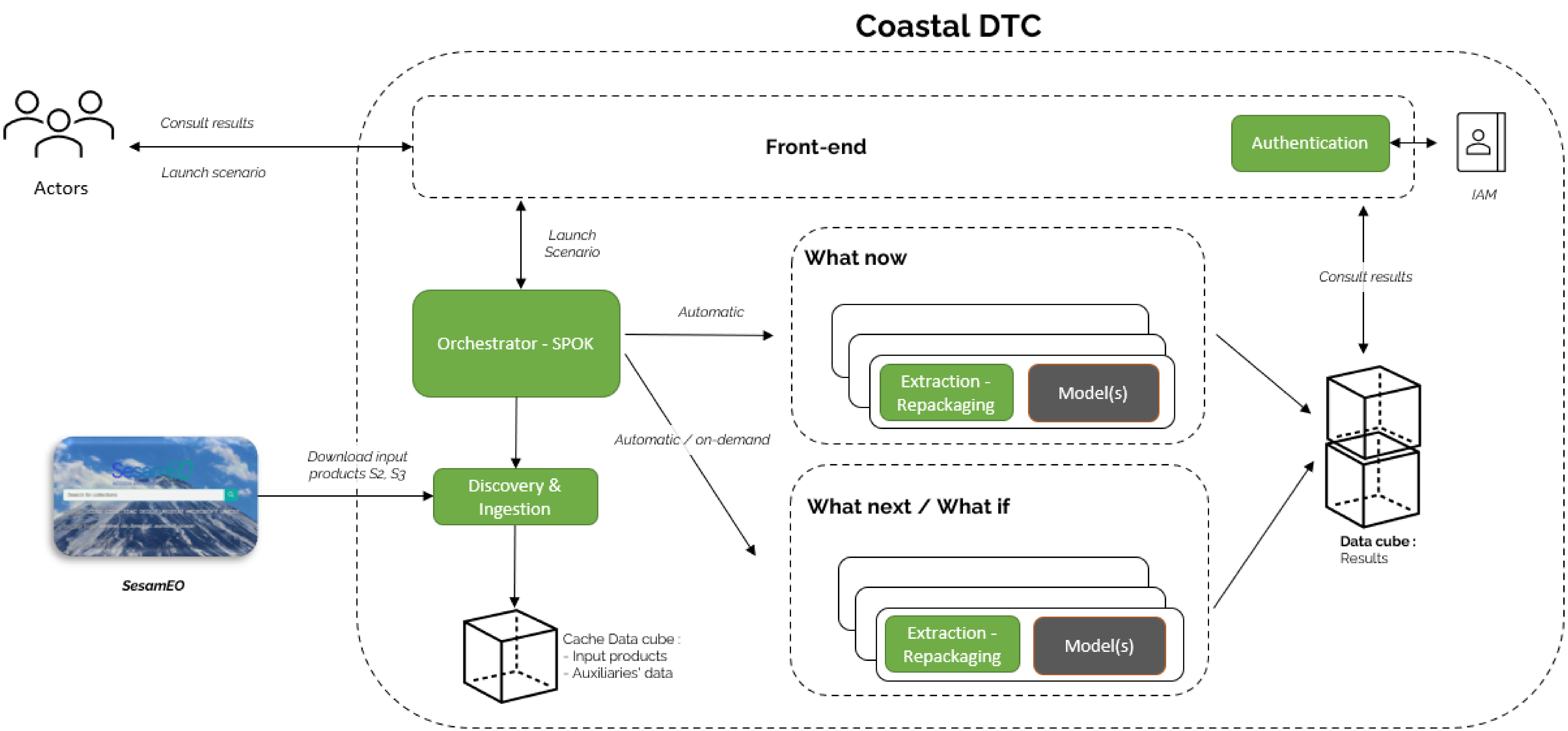
Mangroves

Digital Twin: BLUE CARBON

In progress



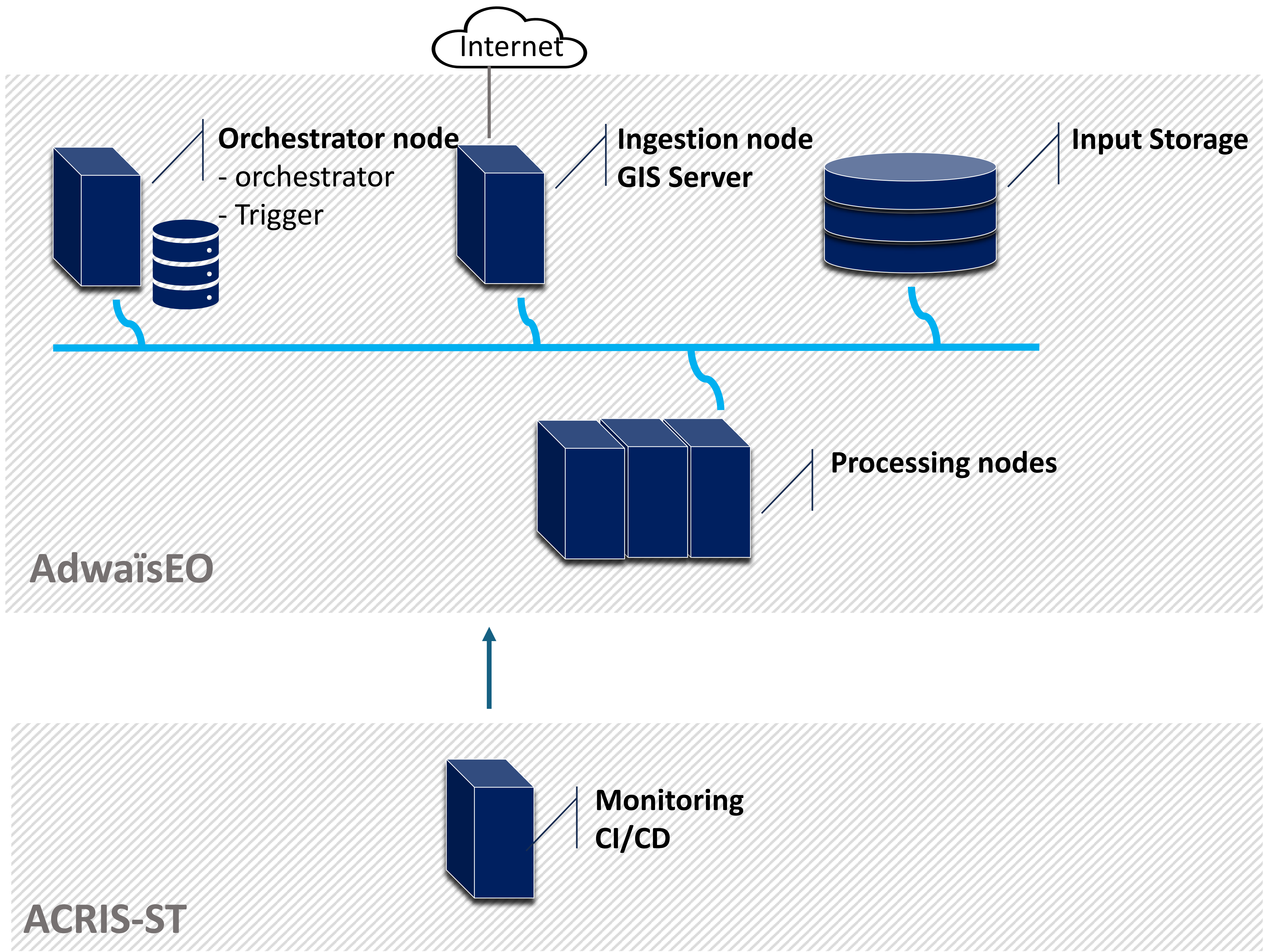
Architecture



Architecture/Infrastructure

Some figures :

- 3 Processing nodes
- 2 Management nodes
- 1 GIS server
- 2 Database
- 1 S3 Storage (1To)
- 1 NFS fast Storage (300GB)

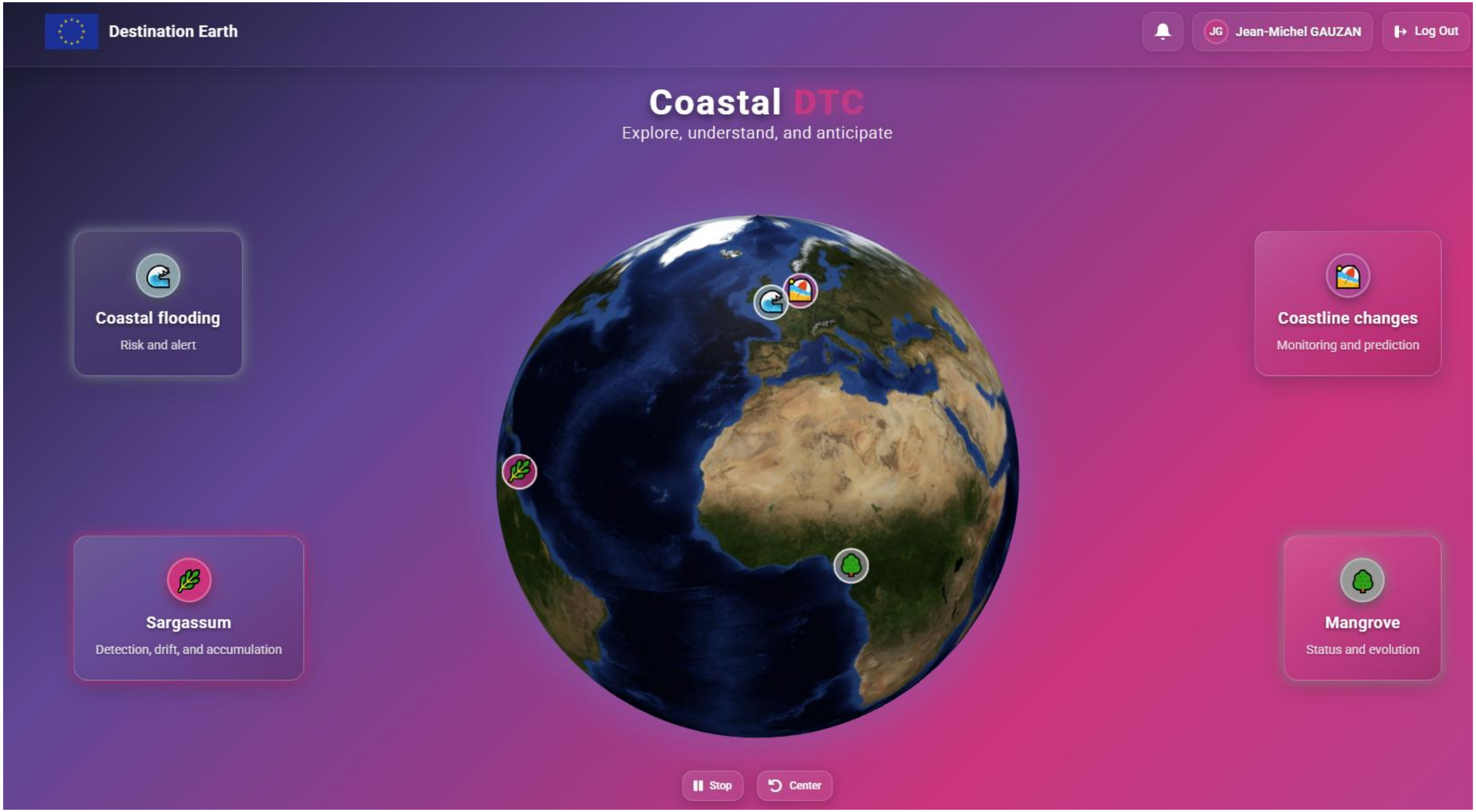


Syngergies with other DTs

- DTC Hydro
- DTC Ice Sheets
- SCOAST
- EDITO…

Website

17th December 2025
12:30 – 16:30 GMT
Harwell Campus



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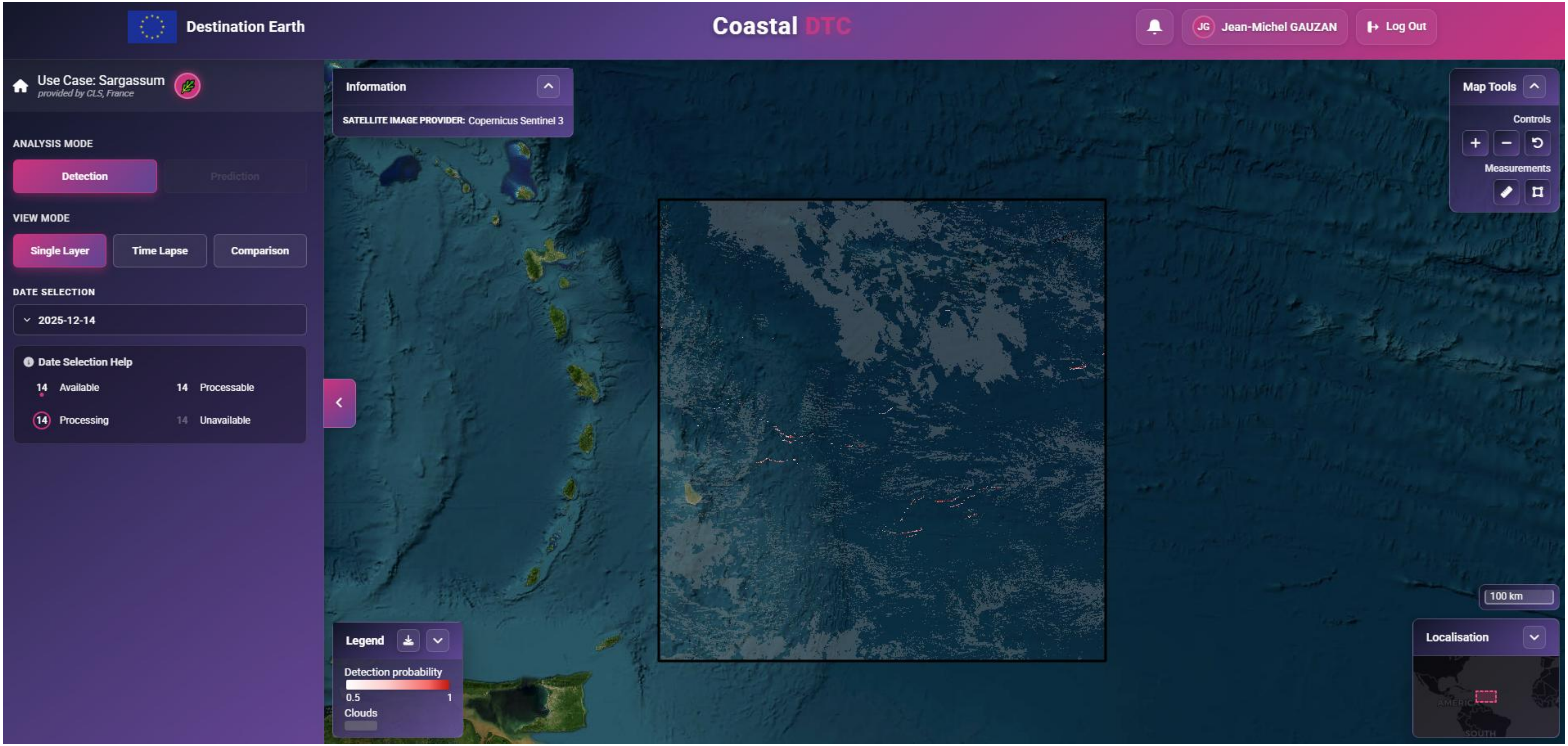

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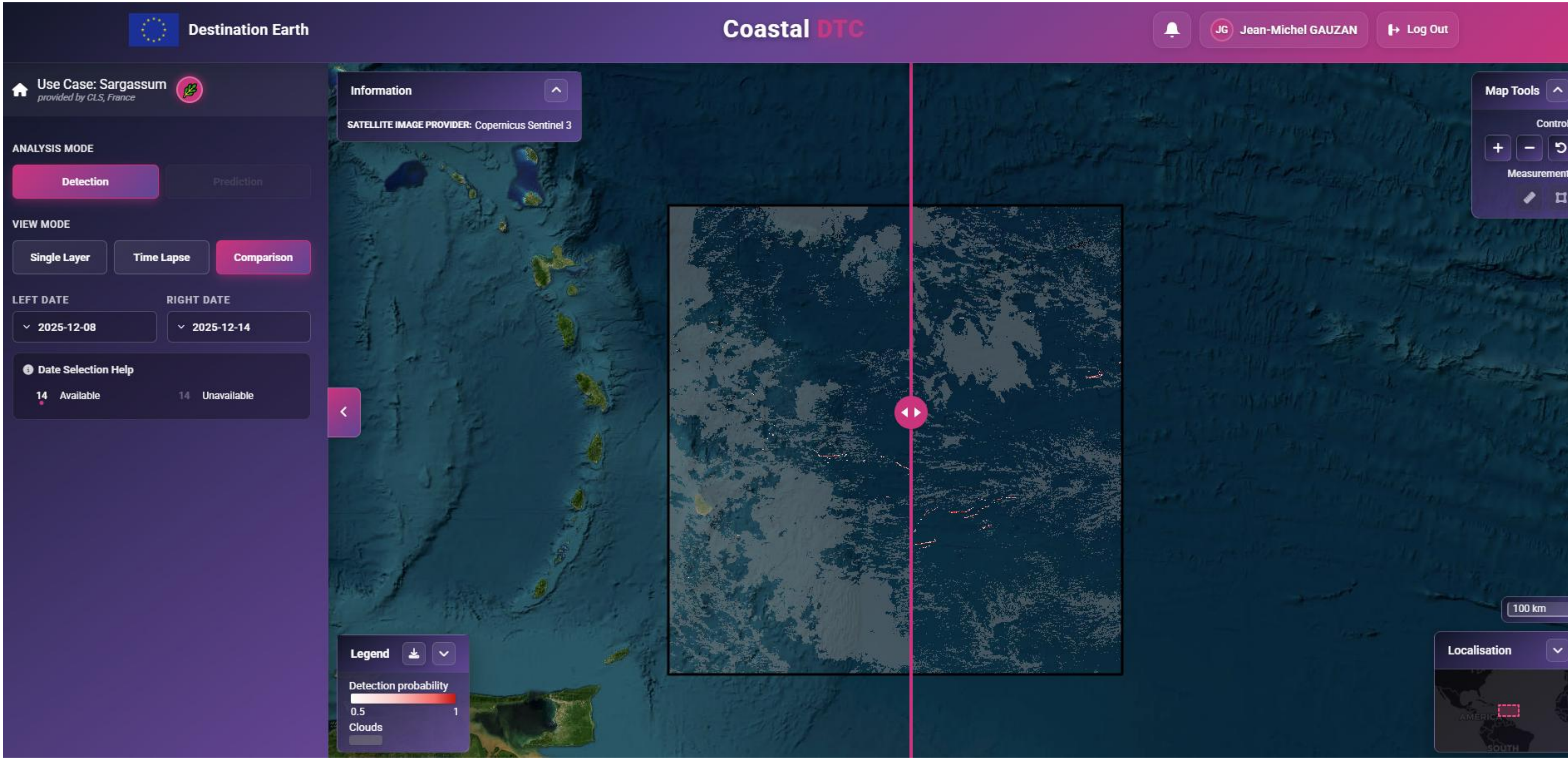

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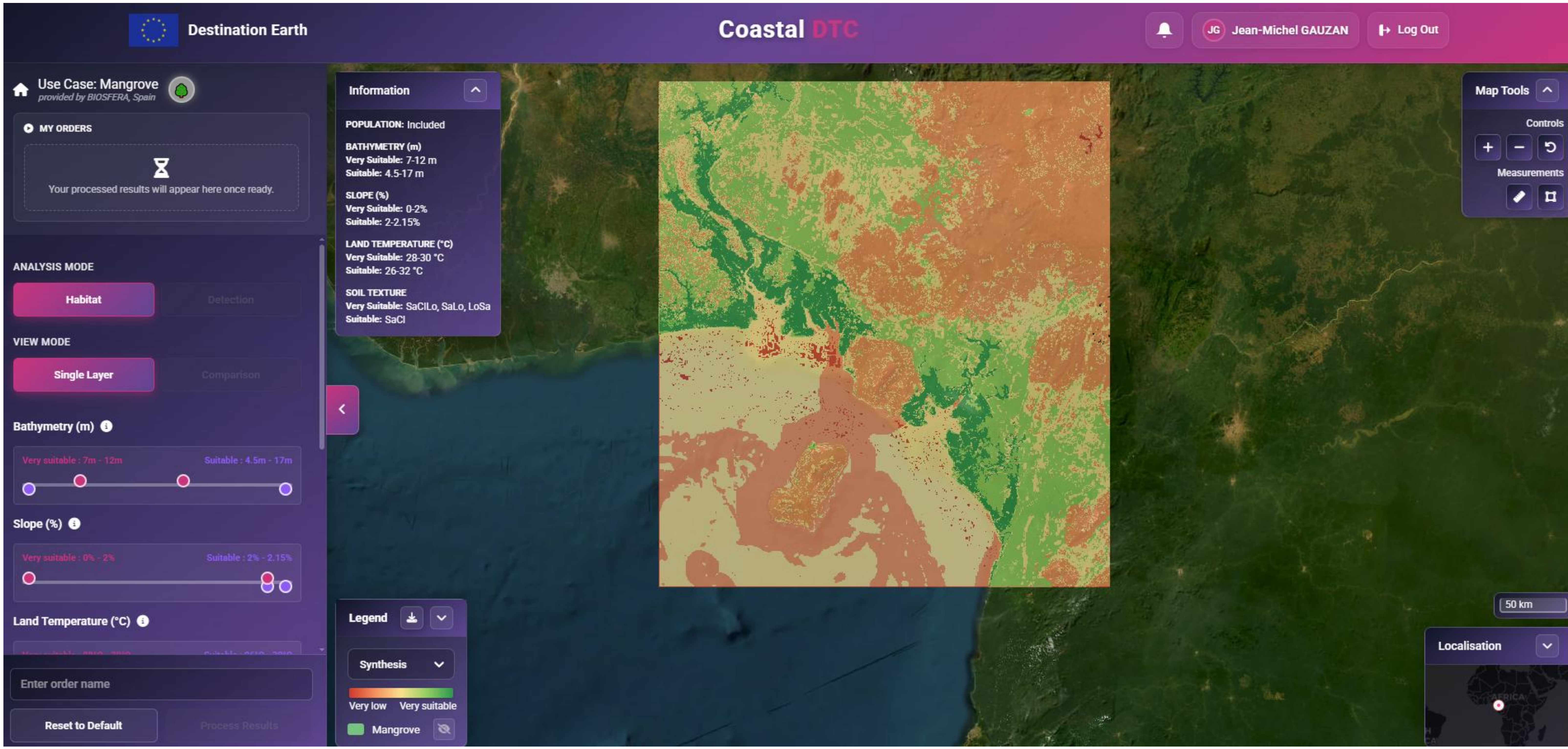

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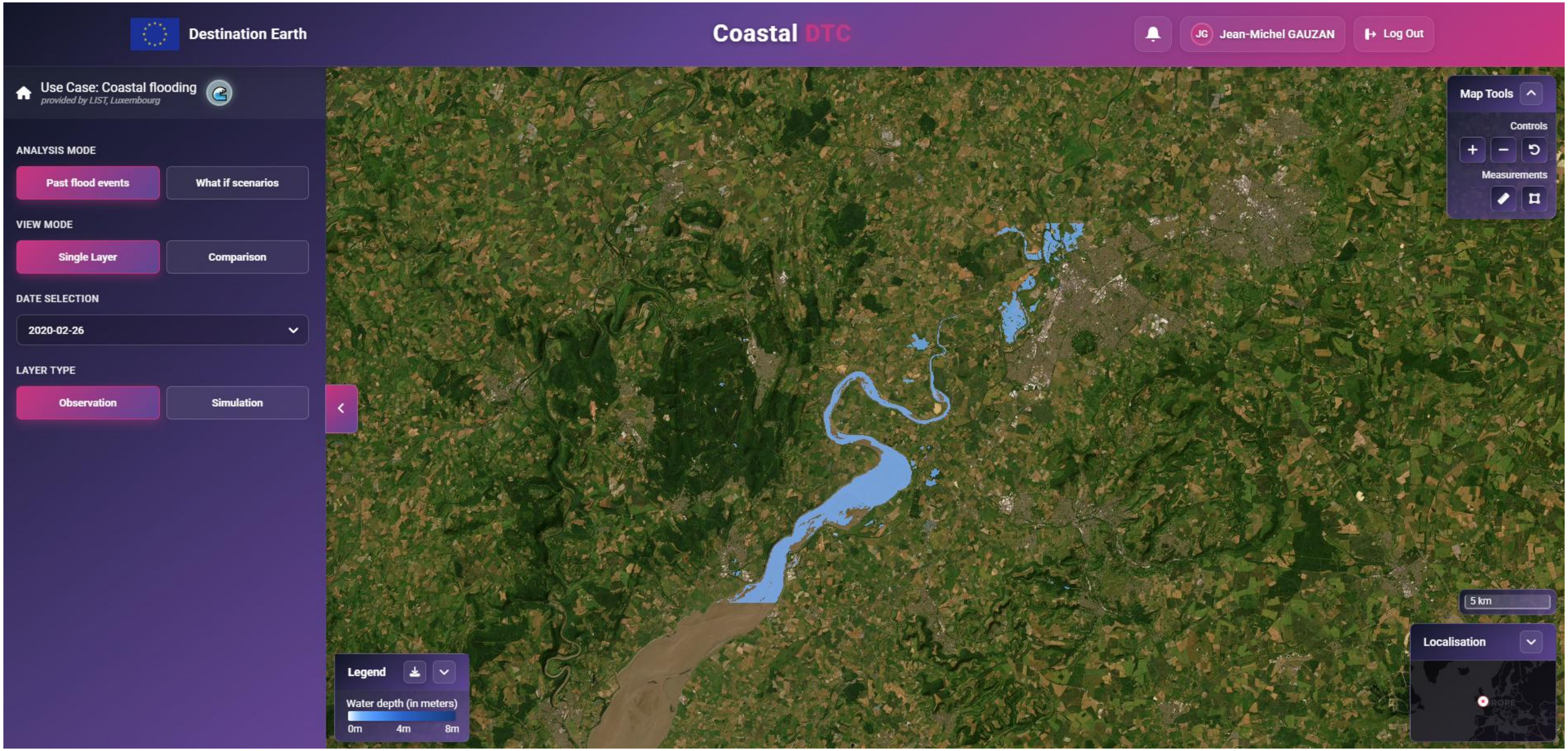

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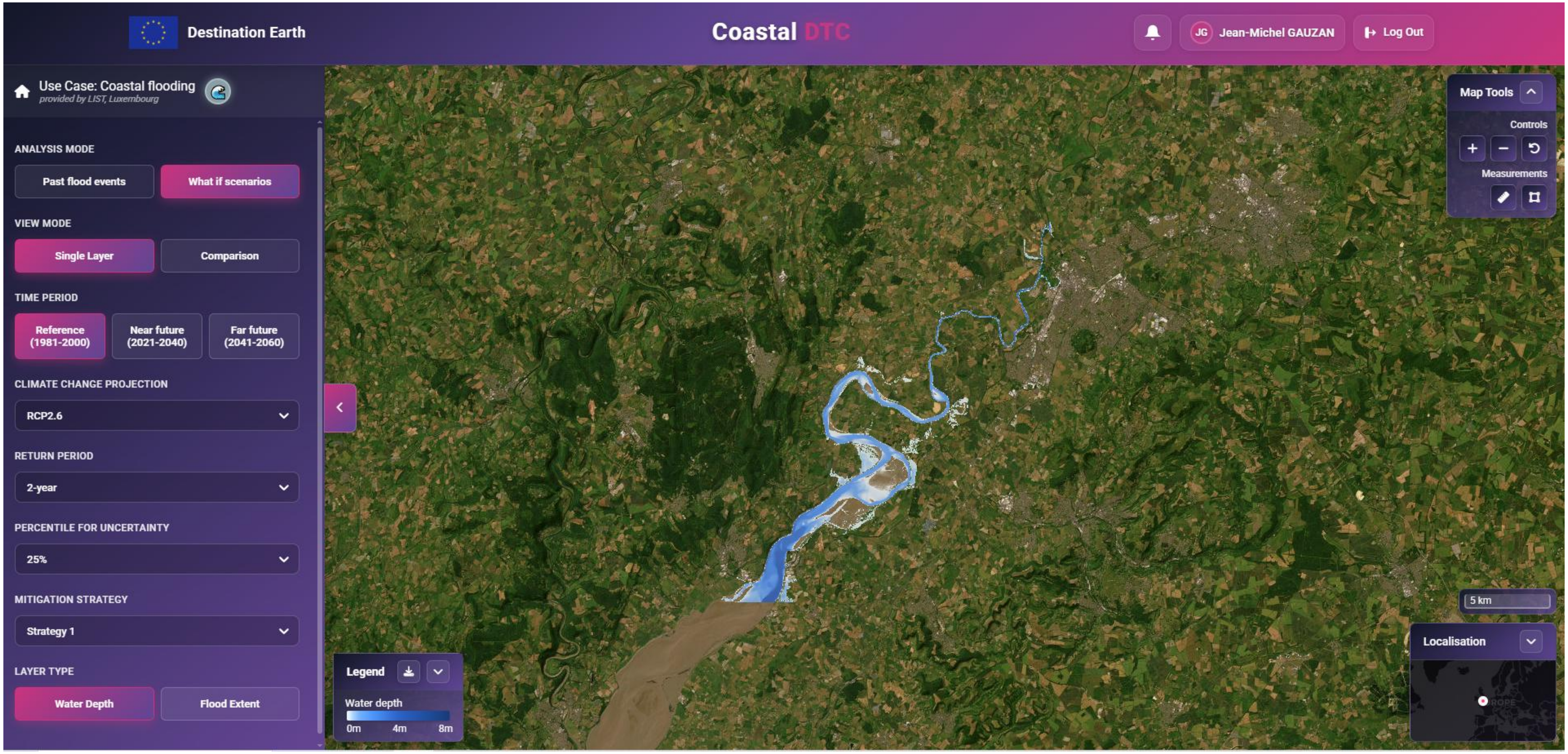

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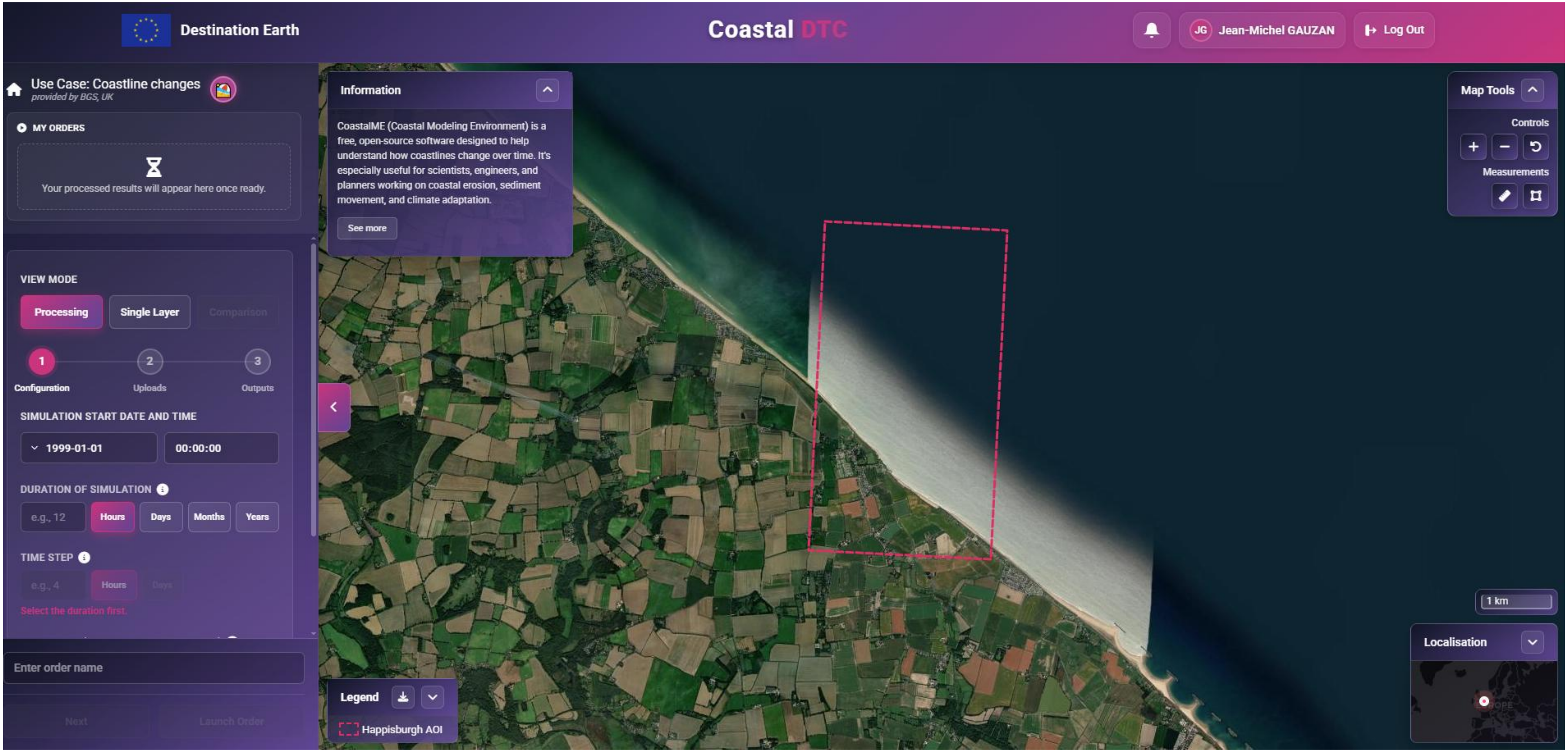

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