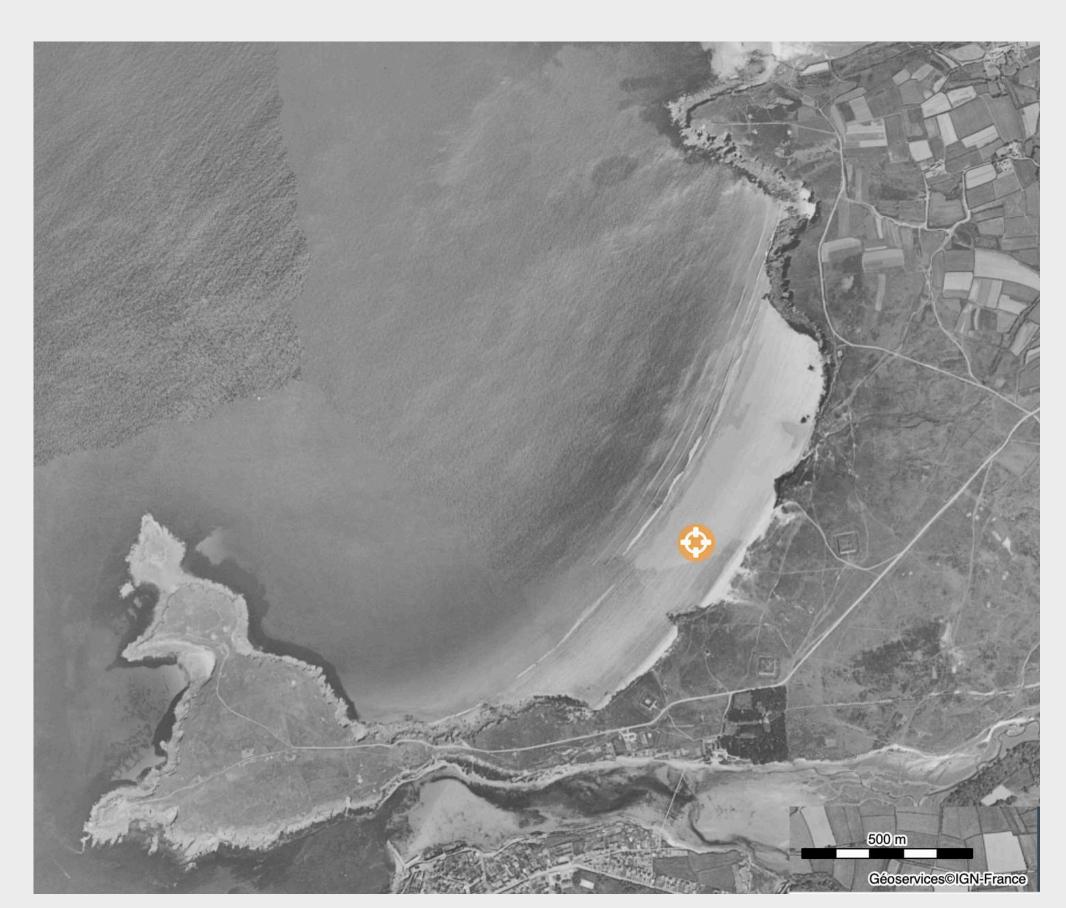
Les Blancs Sablons

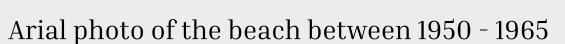


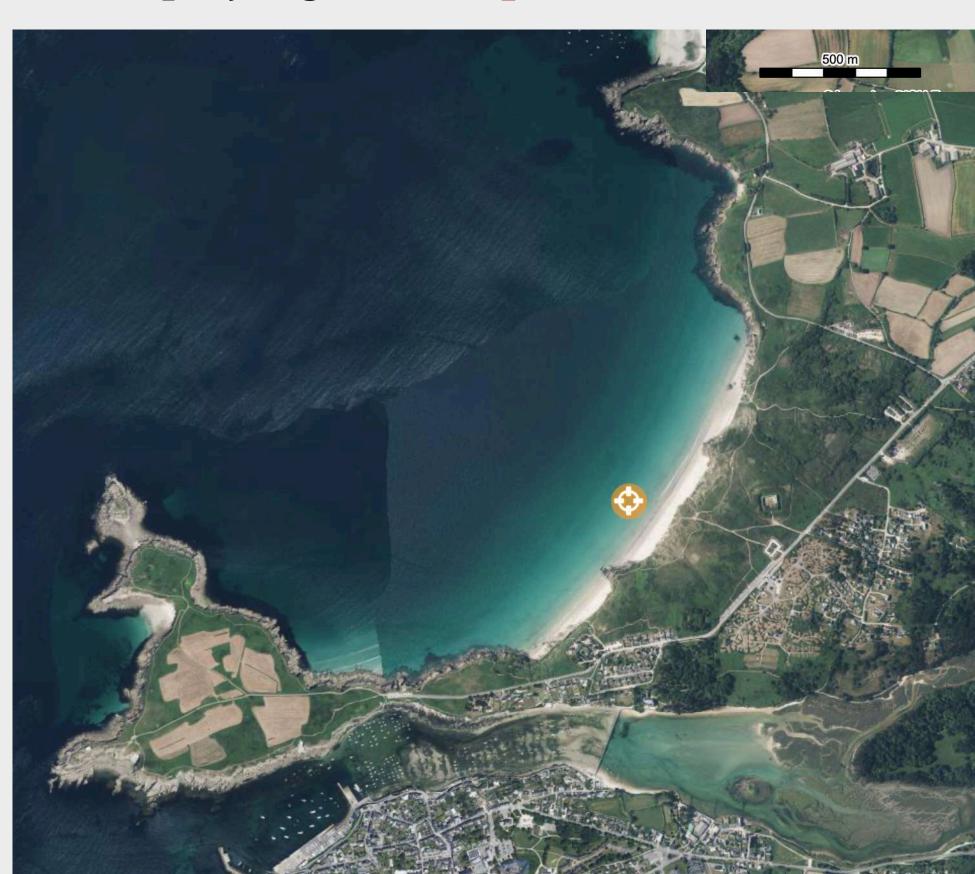
A Living Shoreline Between Past and Future

Les Blancs Sablons, a white-sand bay on the west coast of Brittany, has been shaped over millennia by tides, winds, and glaciers. Behind its beauty lies a fragile ecosystem now threatened by sediment loss and erosion. More than just a beach, it is a living laboratory for studying the resilience of nature and the impact of human activity on biodiversity. The morphology of the beach is dissipative, and the coastline is shaped by rocky claves and massive dunes herited from an ancient history.

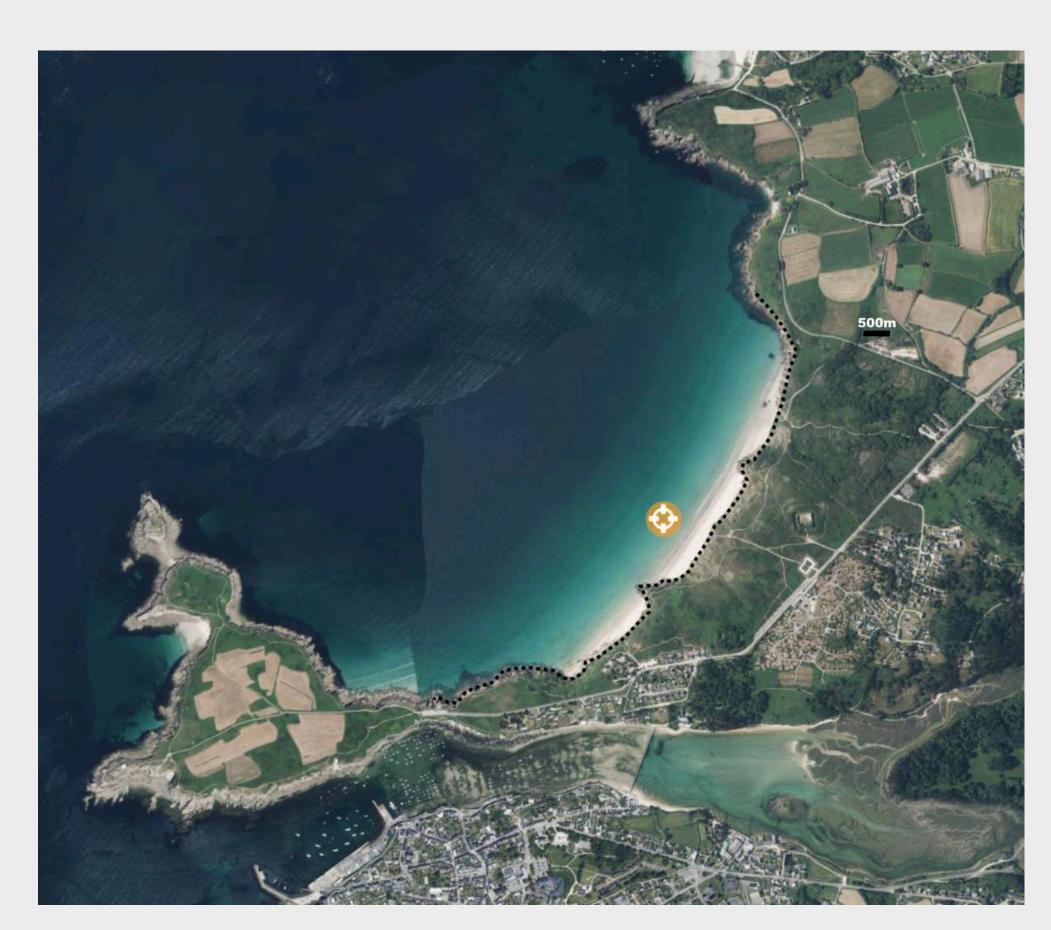
Let's play a game of spot the differences!







Arial photo of the beach in 2025



A prediction of the coastline with sealevel rise of 1 m

Elevation profile (1)

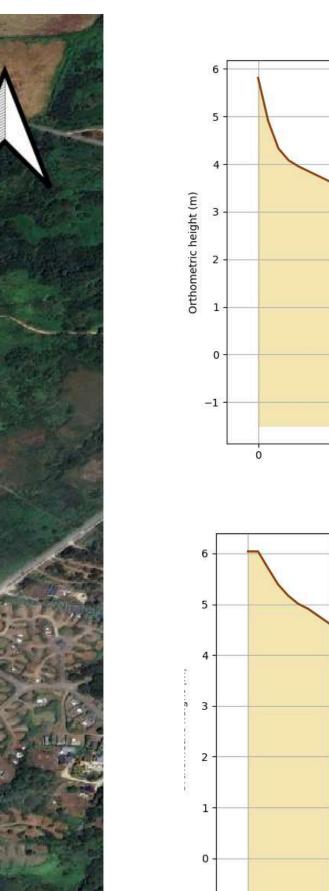
Elevation profile (2)

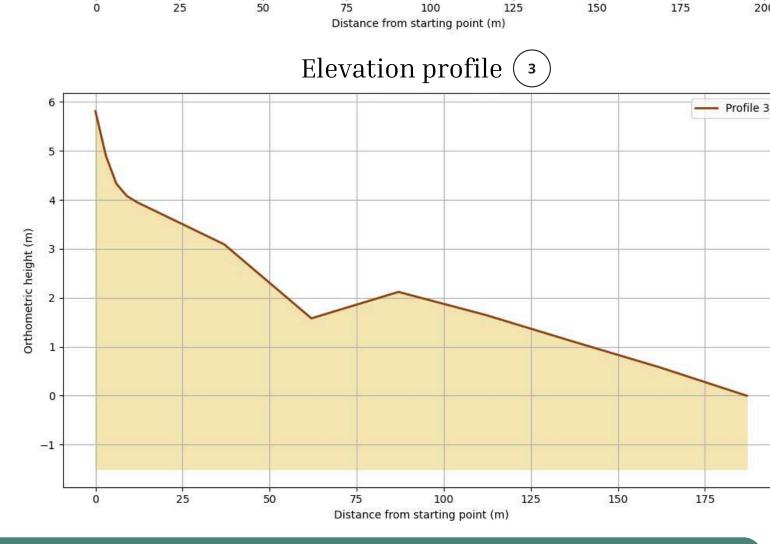


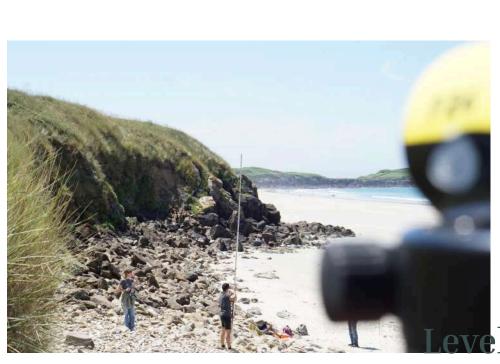
Dune profile (2 S-SW N-NE



Site surveyed using leveling profiles to capture beach topography.

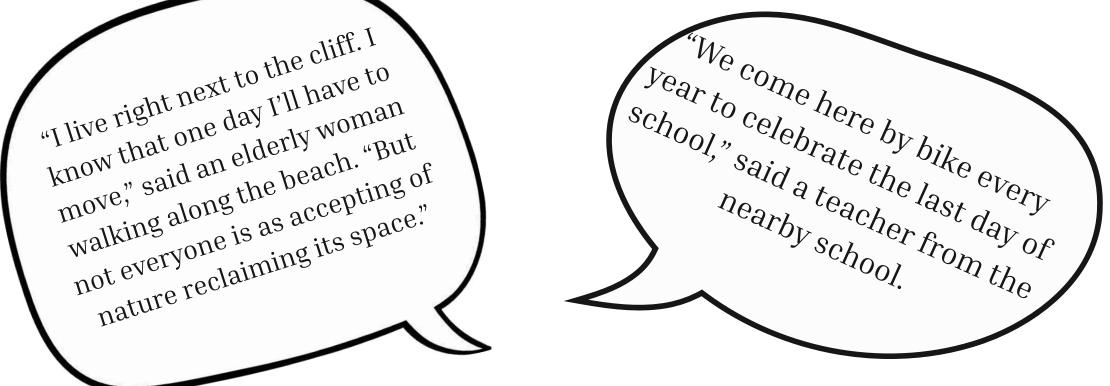


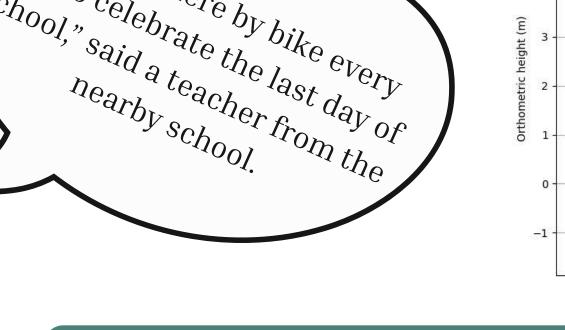






A leveler is a tool to assess beach slope. This is done by moving along a straight line with a giant ruler, while another person is looking through a telescope at a fixed angle of 0 degrees. Relative to the position of the telescope, the height is then measured along the line.





The sediment on this beach is homogeneous, consisting of very fine sand. Near the shoreline, the sand is medium well-sorted, becoming increasingly well-sorted toward the dunes. The sediment is composed of quartz, feldspars, shell fragments (notably mussel pieces), and mica. Black mica particles are selectively sorted by wave action, accumulating at the crests of ripple formations. Profiles 1 and 3 terminate in a gravel berm, while Profile 2 ends in a dune. The gravel in Profile 1 is coarser, with sizes reaching up to meters, whereas the gravel in Profile 3 is finer, generally ranging within decimeters.

The averaged slope on this beach is 0.23°. According to the Bruun Rule (Per Bruun, 1962), a sea level rise of 1 m could result in a coastal retreat of approximately 42 meters.

coastal retreat = Sealevel rise / tan (beach slope)

This retreat would likely impact the coastal path behind the cliff and could potentially lead to a breakthrough to the harbour located to the south. Groundwater extrusion in the third pocket can affect the quality of sea water while storm periods, in the beach have been closed for pollution problems at the middle of the summer.

In the present day, Les Blancs Sablons is part of a protected Natura 2000 site, recognized for its biological richness and ecological importance. Here, biology and geology intertwine in a constant dance. A retreat of 40 m seems like a lot but no critical infrastructure is affected, the coastal path can be readjusted. This beach can be used to feed models of coastline prediction with the "natural state". The erosion of the cliff will add sediment to the system in the long run. The Blancs sablons beach its a perfect example of a self entertained beach.

Morgat Beach



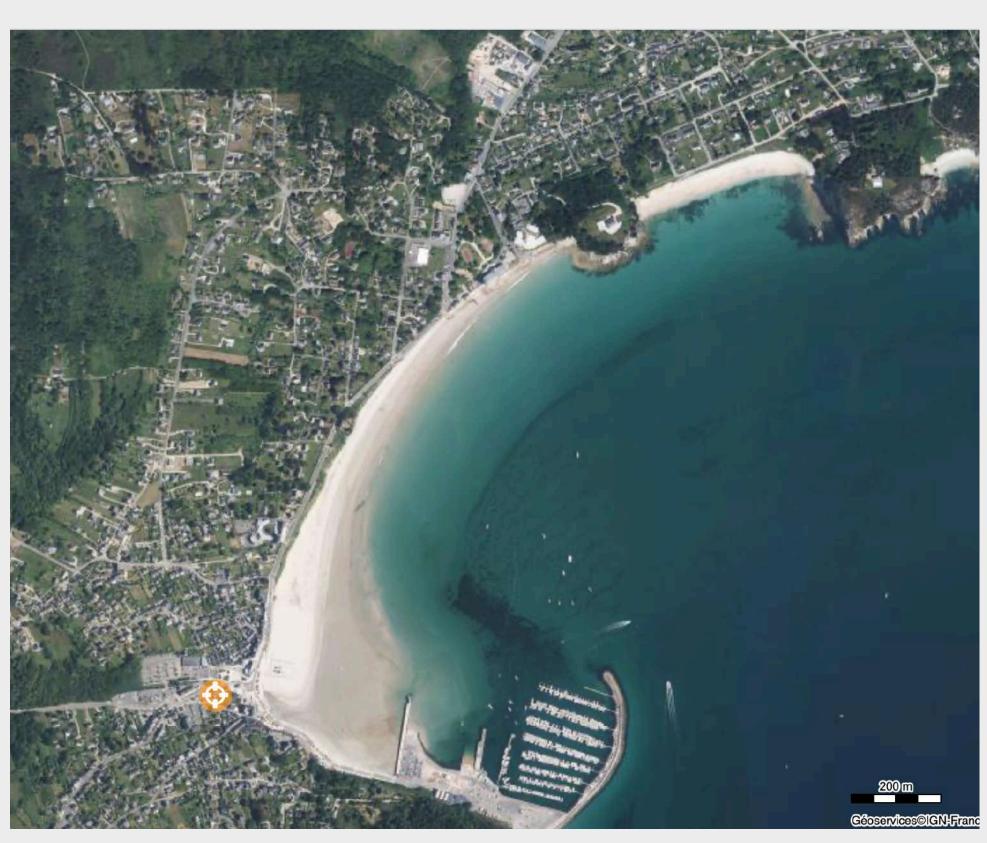
Between Natural Beauty and Human Impact

Morgat beach, located on the picturesque Crozon peninsula in Brittany, has long been a symbol of natural beauty. However, the construction of the harbour in 1970 marked a turning point in the landscape and daily life of the community: it altered the sea currents, caused sand to accumulate in undesirable areas and aggravated erosion, especially on the left side of the beach. This intervention also seriously affected the marine ecosystem and fishing activity, which has practically disappeared due to the decline of fish.

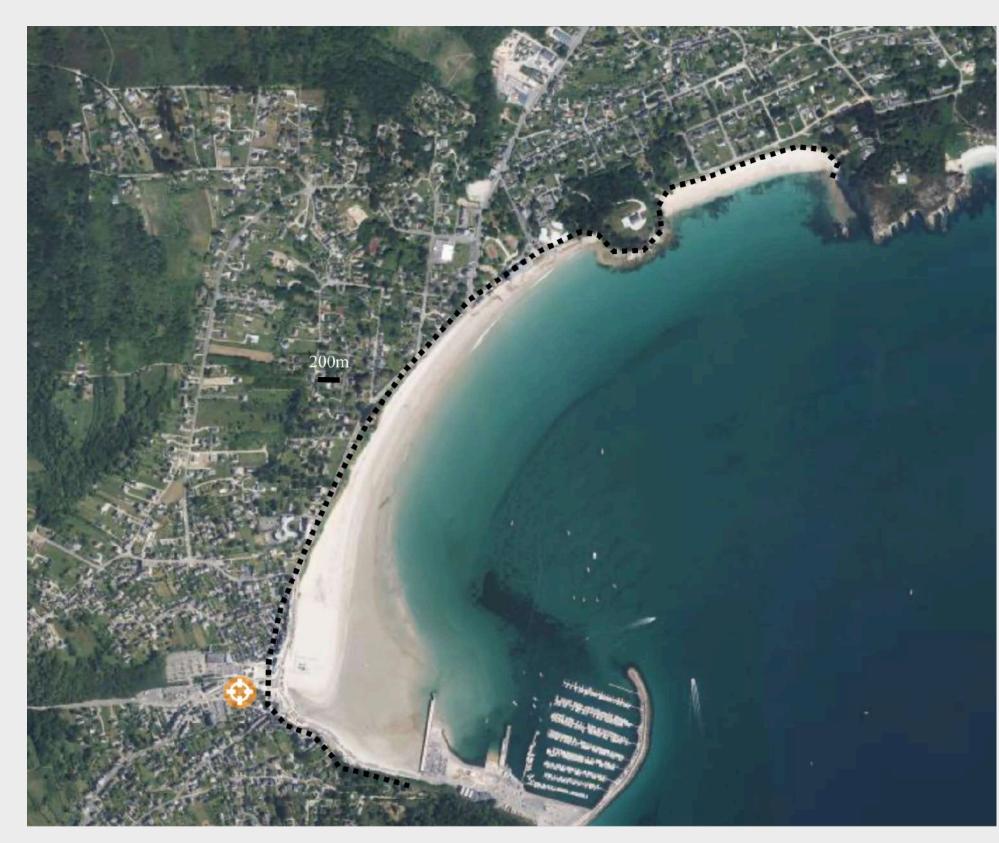
Let's play a game of spot the differences!



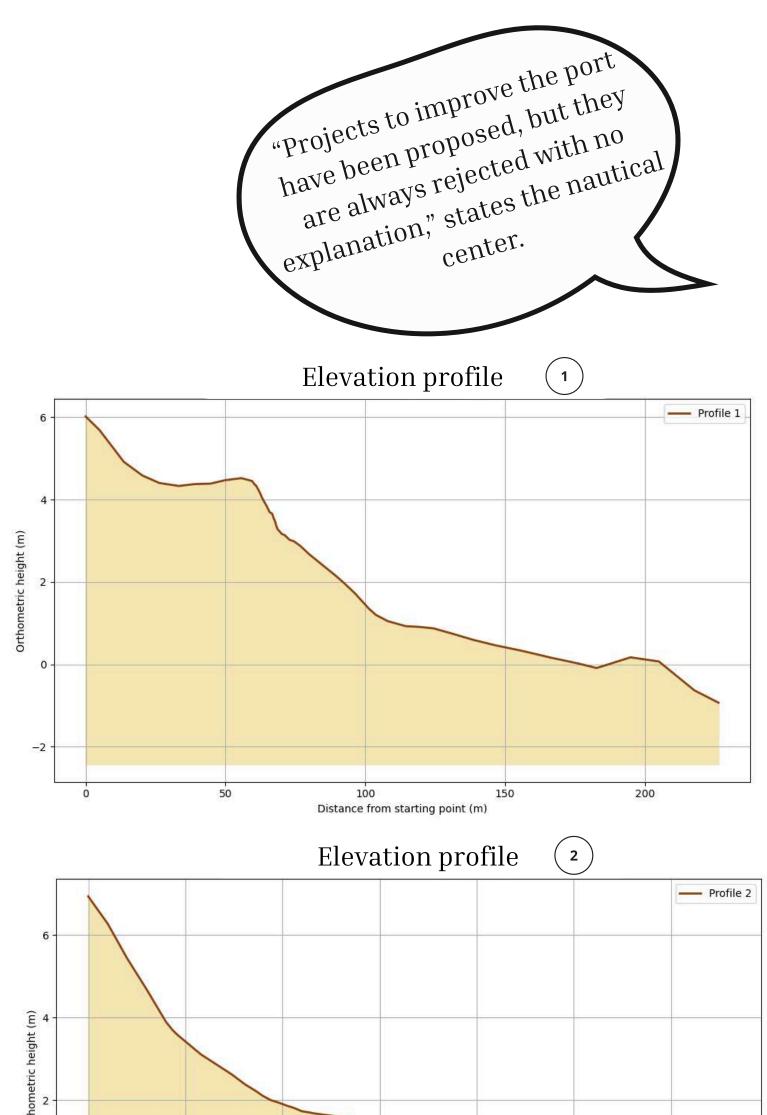
Arial photo of the beach between 1950 - 1965



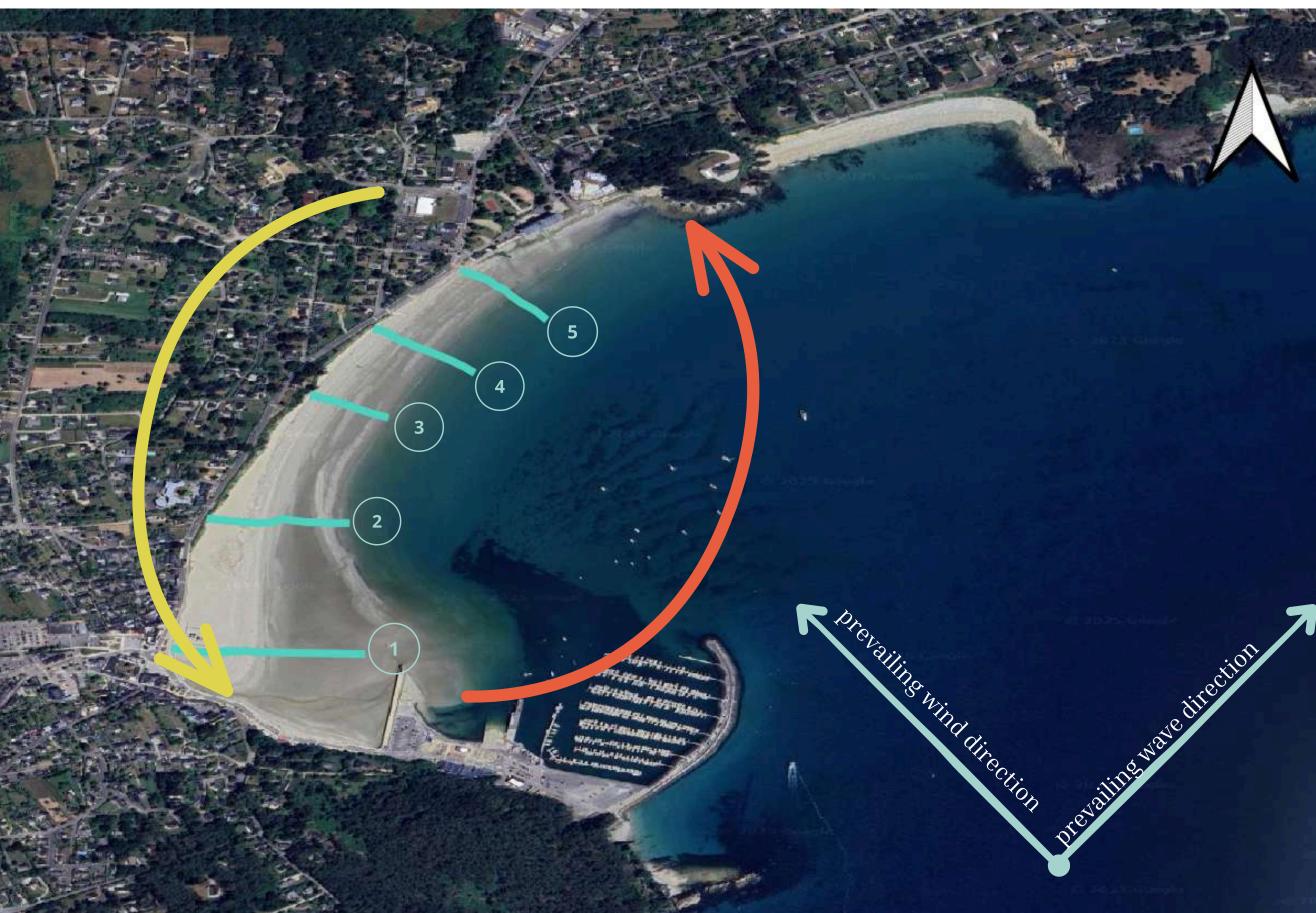
Arial photo of the beach in 2025



A prediction of the coastline with sealevel rise of 1 m

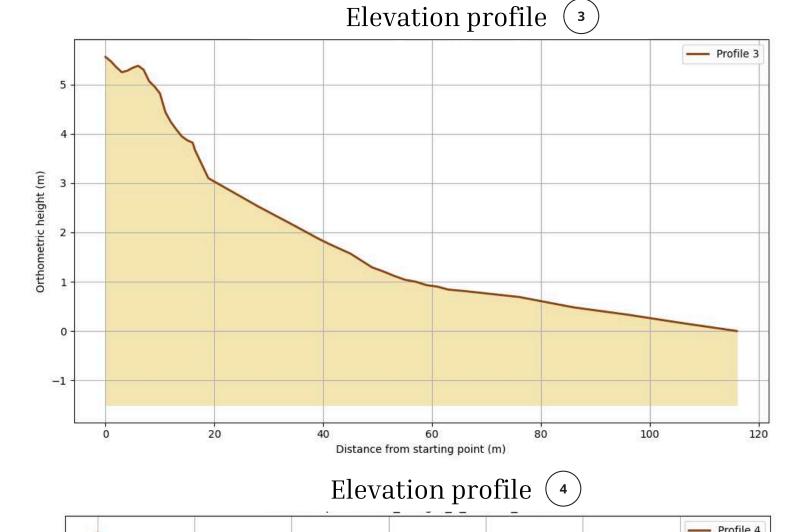


Profile 2



Site surveyed using leveling profiles to capture beach topography.
The yellow arrows indicate sand movement.
The red arrwo indicates, where the sand naturally would move.

"Before the harbor construction [in 1970], there was plenty of sand, and erosion wasn't an issue," recalls a local resident.



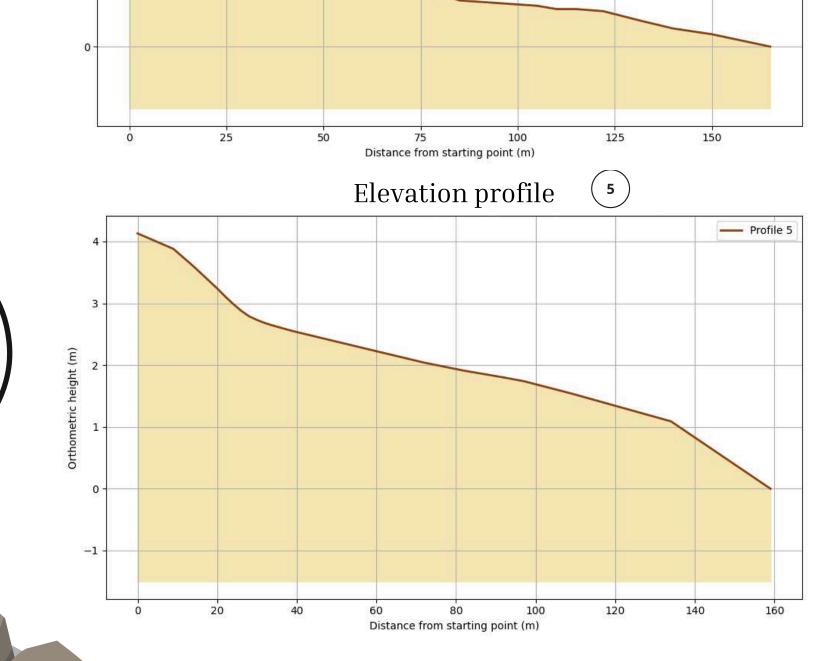


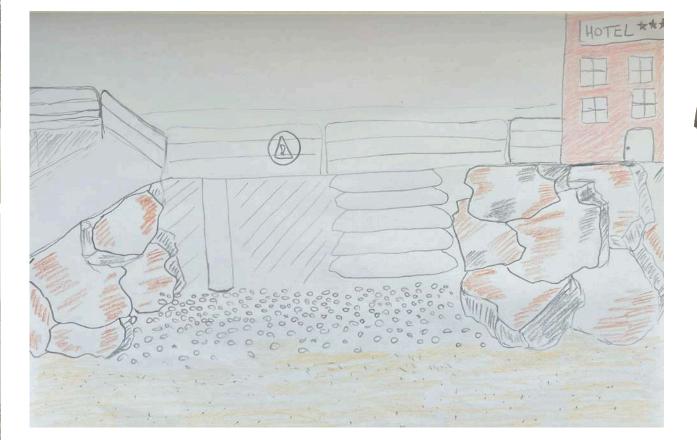


Photo of a poster explaining the project to be carried out to reinforce the area with erosion problems.





Photo sequence (A–C): Excavator and truck relocating sand due to sediment deficit. After just one tidal cycle, the gravel berm re-emerges, indicating rapid erosion. This operation is repeated every four days.



Sketch of the beach right next to the hotel. The sediment erosin is clearly visible.

The sediment on this beach consists of fine sand mixed with pebbles. The surface alternates between smooth sandy areas, ripple patterns, and patches of gravel. At the back of the beach, a steep gravel berm with distinct cusps marks the transition to a zone stabilized by large, anthropogetically-placed rocks and a concrete wall protecting the road near the hotel. In an enclosed section of the beach, a small dune is beginning to form.

The accumulation of the sand next to the harbour results from the disrupted circulation of sediments. The averaged slope is 0,04° on this site. According to the Bruun Rule (Per Bruun, 1962), a sea level rise of 1 meter would result in a coastal retreat of approximately 26.5 meters.

coastal retreat = Sealevel rise / tan(beach slope)

Today, Morgat is still dealing with the consequences of decisions made in the 1970s. As sea levels rise, the beach will attempt to return to its natural state, reclaiming land in a way that could be devastating for the local population. While a retreat of 26 meters may not sound extreme, it would threaten and potentially destroy critical infrastructure, like the main road and the 5-star hotel. One proposed solution is the construction of a large offshore barrier or sea wall. However, nature-based approaches, such as establishing a kelp forest to reduce wave energy and erosion, are not only more visually appealing but also far better for the surrounding ecosystem.

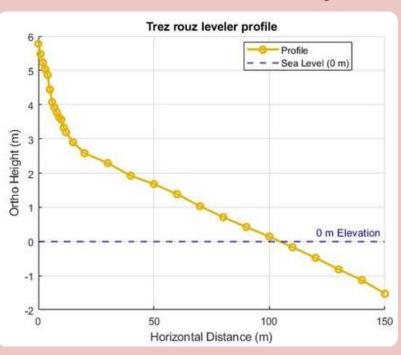
TREZ ROUZ: BETWEEN BEACH CUSPS AND CLIFFS, AN EXAMPLE OF A NATURAL DISSIPATION PROCESS







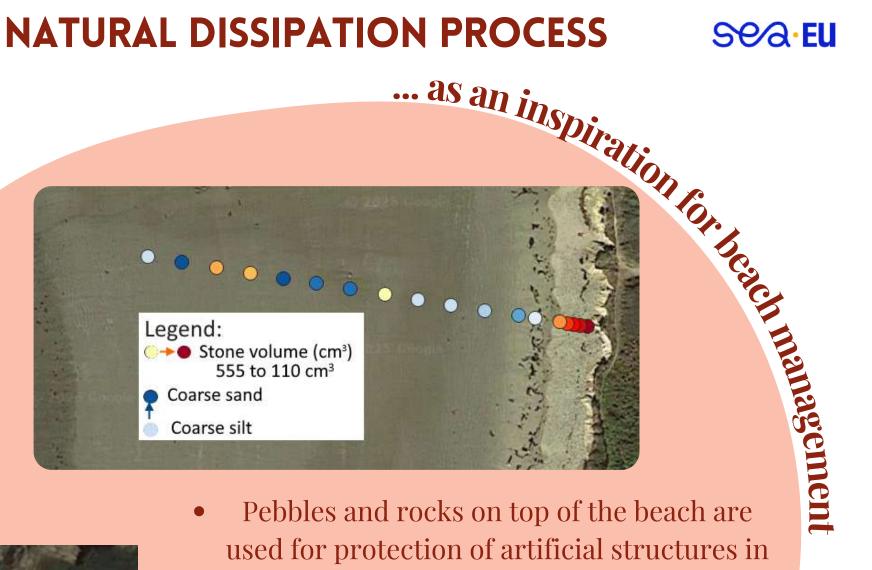
Leveller & beach cusps





• Rocks protect the north-east part





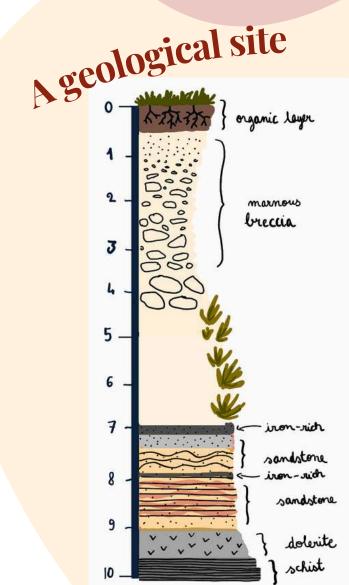
Pebbles and rocks on top of the beach are used for protection of artificial structures in other beaches in Bretagne:



Morgat beach







NE

SW

- Eroded cliffs show various layers
- Information on the past geological periods and the history of the region

Recreational, Tourism

Land Use: ZNIEF Type I Protected Natural Area









Stakeholders Interests

	Companies	The camping "Trez reuz";	
	NGOs	Bretagne Vivante (Regional nature protection); Association for the protection of Cro	
	Policy Assistance	Municipality of Crozon; DREAL Bretagne (Regional Directorate for the Environment Planning and Housing); French Ministry of Ecological Transition; French Maritime Affairs Directorate (DIRM); EU Commission (Maritime Affairs), EU Environment Agency.	
	Scientists	IUEM; IFREMER (French Research Institute for Exploitation of the Sea); CNRS (National Center for Scientific Research of France)	
	Recreationals users and tourists	Presqu'ile de Crozon Tourist Office; Finistère Departmental Tourism Committee; Regional Bretagne Tourism Board); Camping and Leisure Association of Finistère; Hiking Federation of Bretagne; Surfing and Sailing Clubs	

There is low accessibility

Use of the beach

The beach will stay at equilibrium if no infrastructure is built

With rising sea level, it might go back, threatening the camping behind



TROIS MOUTONS: THE STORY OF A NATURALLY RETREATING DUNE

Tombolo

- A narrow area of rocks that joins an island to the coast
- Protecting the beach behind
- Hard substrate for algae, molluscs & snails

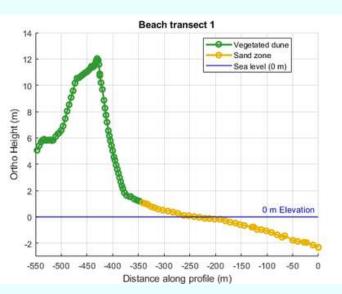


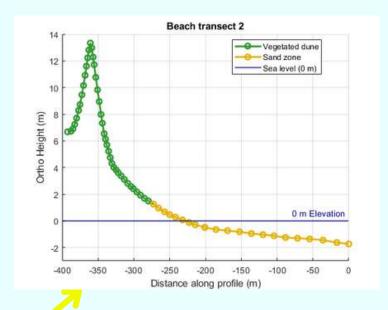
Ecological measures



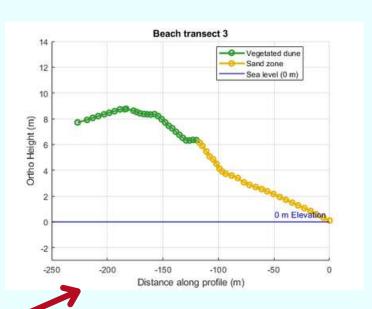
• Dune has a restricted access to protect the vegetation which roots hold the dune in place as a nature based solution

Beach slope transects





France







On the lowest profiles, danger of submersion



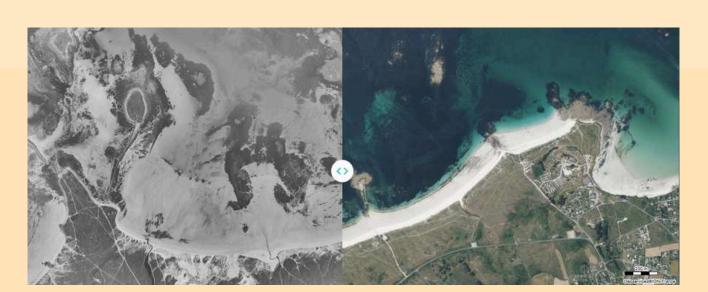
Stakeholders Interests

Dune retreat: 1950 vs 2025

Beach transect 2

Beach transect 3

500 m





Land Use: ZNIEF Type I + agriculture

Companies	The camping "The dunes"; local business regarding surf (Equipment rental and surf school Reve o Kite)
NGOs	Bretagne Vivante (Regional nature protection)
Policy Assistance	Municipality of Lampaul-Ploudalmézeau; DREAL Bretagne (Regional Directorate for the Environment Planning and Housing);French Ministry of Ecological Transition; French Maritime Affairs Directorate (DIRM); EU Commission (Maritime Affairs), EU Environment Agency.
Scientists	IUEM; IFREMER (French Research Institute for Exploitation of the Sea); CNRS (National Center for Scientific Research of France)
Farmers	Local farmers cooperatives →Pays d'Iroise Agricultural Cooperative; CUMA (Cooperative for the use of agricultural equipment in Finistere); Eureden (Mayor agricultural cooperative in Bretagne);
Recreationals users and tourists	Pays d'Iroise Tourist Office; Finistère Departmental Tourism Committee; Regional Bretagne Tourism Board); Camping and Leisure Association of Finistère; Hiking Federation of Bretagne; Surfing and Sailing Clubs

What do people think? Google review





Coastal dynamics within the Bay de Bertheaume

Annika Block, Clémence Lescop, Valentin Ferelloc, Barbara Pizarro, (Ivo Martic)





Kiel University Christian-Albrechts-Universität zu Kiel

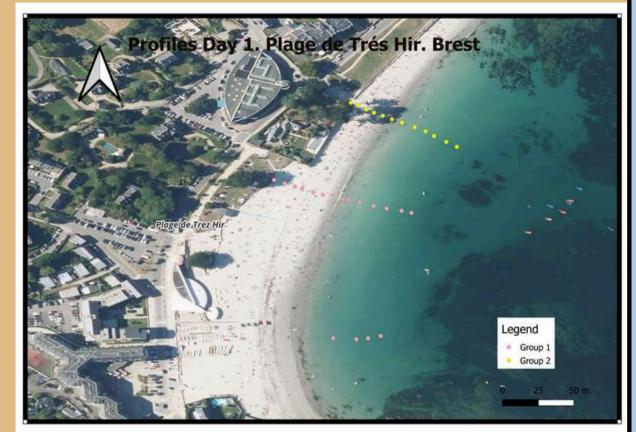
Plougonvelin TREZ HIR

(48.346832, -4.703564)



Site presentation: South-Est orientation Substrat: sand of different grain size/outlying bedrocks

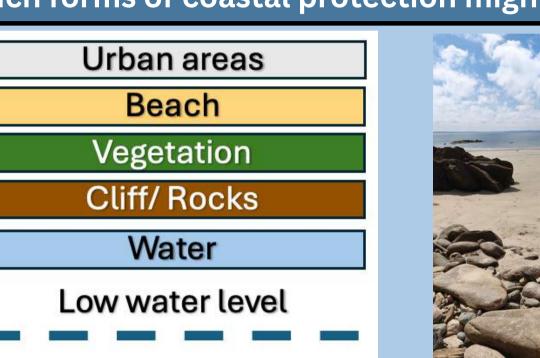
Biology: Shells (*Litorina*, Patella), Algae (Fucus, ulva), marine worms (Arenicola) Lots of human activities





Why is it important?

- Tidal current system within the Bay of Brest leading to complex sediment transport patterns
- Balance between sediment supply and erosion needs to be in equilibrium in order to keep beaches stable
- Beach slope as influencing factor on wave breaking mechanisms and thus erosional force
- Climate change and sea-level rise will lead to changes in the existing forcing and thus change the equilibrium
- → How will the beaches in the Bay of Bertheaume develop assuming sea-level rise? Which forms of coastal protection might be useful?



Do our observations match the current and wave dynamics of the bay?

YES!

- A decrease in sediment size from East to West: Trez-Hir < Porsmilin < Trégana
- The waves travel westward from the Iroise Sea, then are refracted by the Bertheaume point to create a current circulation affecting sand distribution.



Map showing the waves directions (cyan arrows) in the Bay of Bertheaume, and the logshore sediment transport (green arrows)

PORSMILIN

Locmaria-Plouzané

(48.355726, -4.679232)

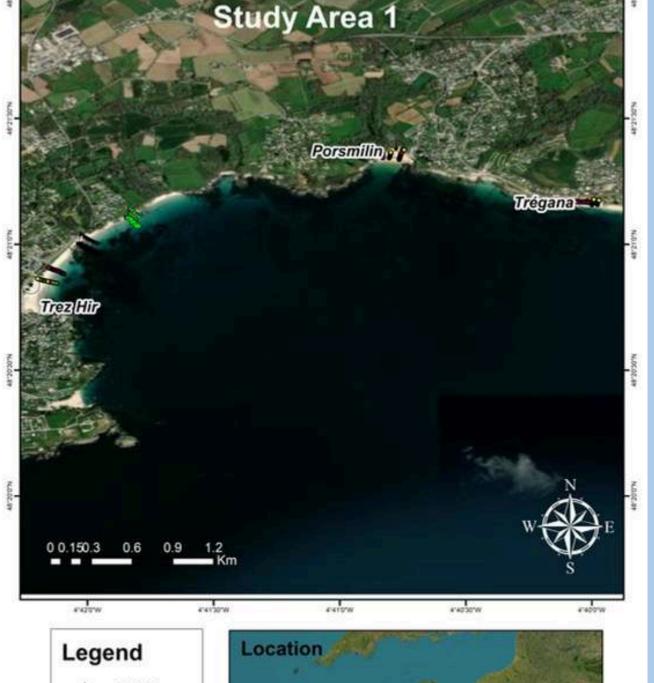
Site presentation:

South-Est orientation Substrat: coarser sand, fewer changes in grain size, some accumulations of pebbles

Biology: Shells (Litorina, Patella), Algae (Fucus) Mostly surfing activity

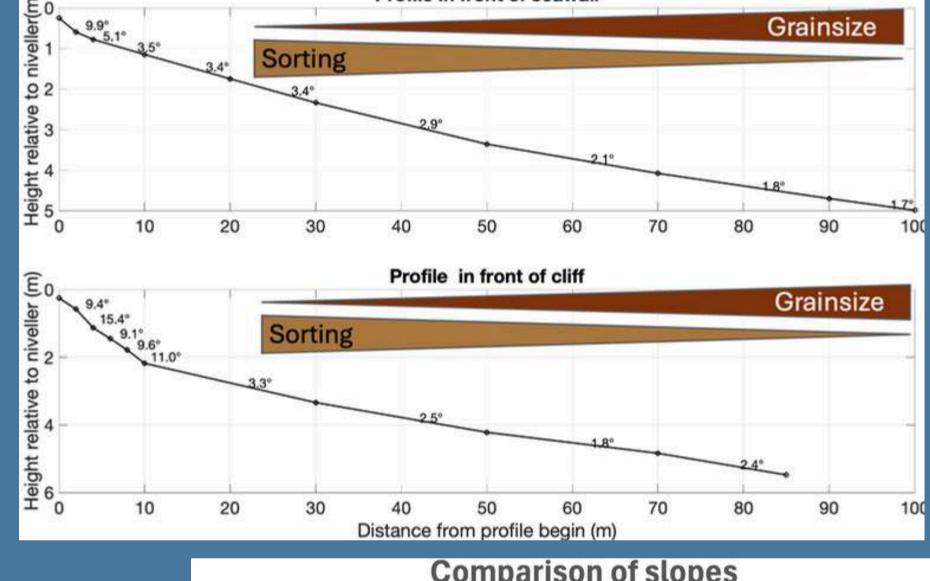


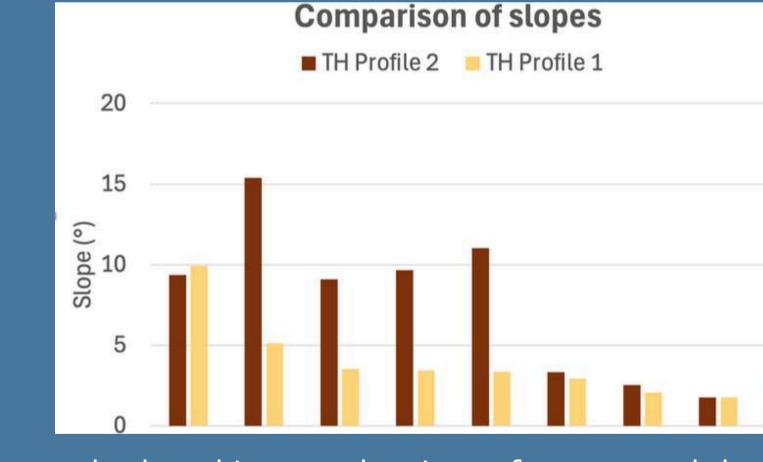






Beach profiles

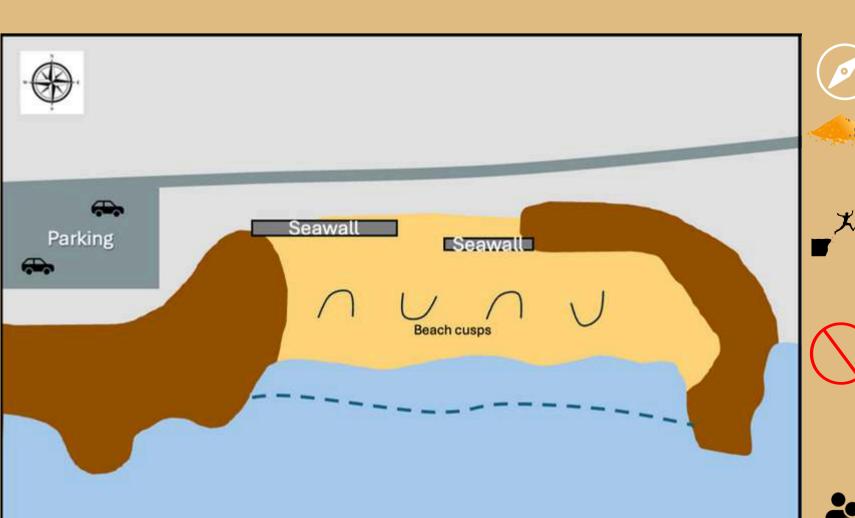




TRÉGANA

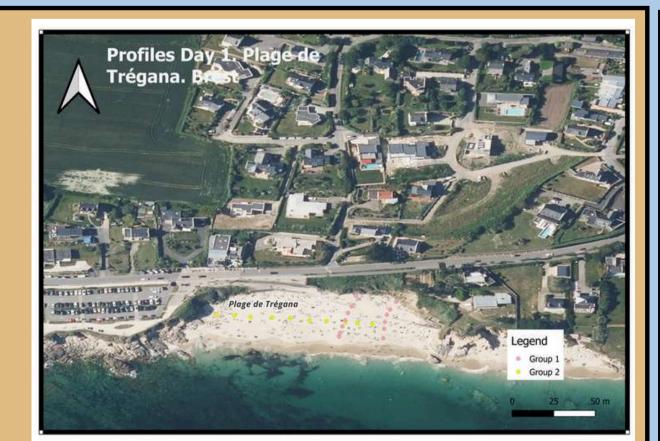
Locmaria-Plouzané

(48.352780, -4.666676)



Site presentation:

- South-Est orientation Substrat: Coarse sand, few changes in grain size
- Cliff: Loss of vegetation on the cliff
- Eastern side of the beach closed to the public, risk of falling rocks
- Lots of human activities/ sunbathers





How will these 3 beaches develop?

- Under climate change, coastal dynamics will change with sea-level rise and changes in storm patterns (more frequent and/ or stronger) as
- Conflicts between coastal protection, recreational purposes, and infrastructure might increase, especially at highly anthropogenic
- Porsmilin
 - little infrastructure in the hinterland and dunes, so beach can retreat
- Trégana and-Trez Hir
- already hard structures build and cliffs surrounding the beach, so beach retreat not possible
- Theoretically other coastal protection measures are installed in other places (like artificial reefs to reduce wave energy)
- onot applicable here, as the dynamics in the Bay are not fully understood yet
- changing the system could lead to other unexpected changes in coastal dynamics at other parts of the Bay

Beach slope influences the breaking mechanism of waves and thus the erosional force

- Seawalls are upright structures that reflect waves and superimpose them with incoming waves, which increases the erosional force
- Natural systems adapt to changes in forcing by changing beach slope and thus lead to accretion or erosional states
 - low slope: accretion
 - high slope: erosion
- Based on observations we would expect higher erosion after high energy events in front of the seawall
- reflective conditions at seawall will increase erosional force
- less reflective in front of the cliff





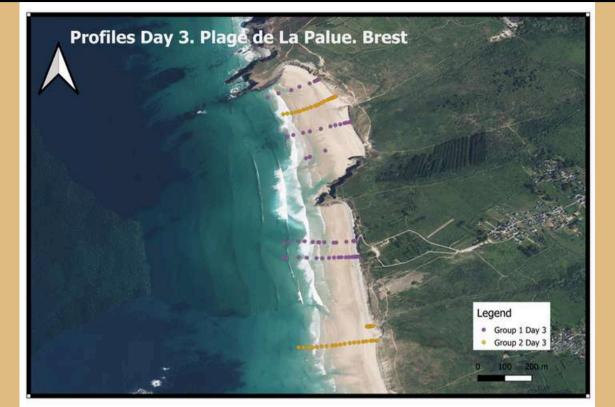
Coastal dynamics at the beach of La Palue

Annika Block, Clémence Lescop, Valentin Ferelloc, Barbara Pizarro, (Ivo Martic)

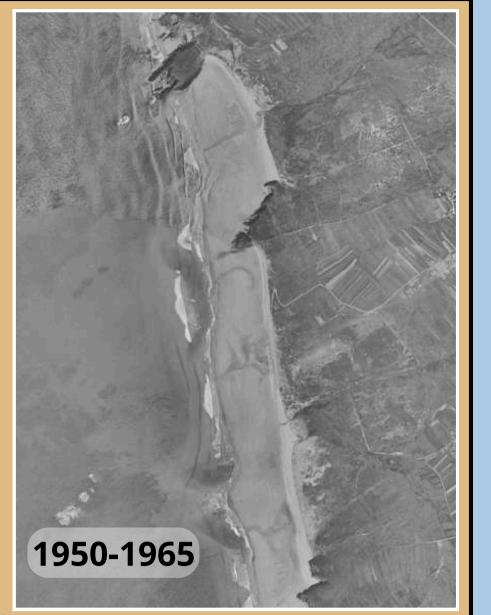








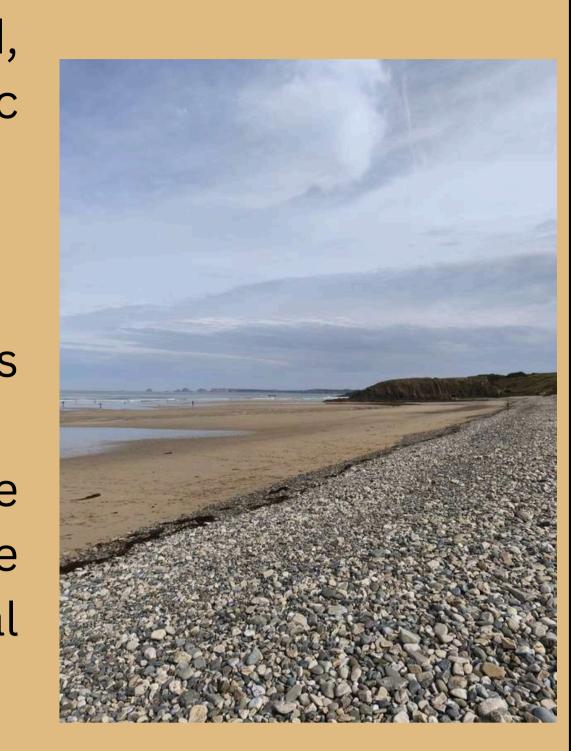
- Site presentation:
 West orientation
- Substrat: sand of different grain sizes/ mud and pebbles
- Biology: Shells (*Patella*, *Mussels*), Algae (*Fucus*, *Pelvetia*, *Halydris*)
- Mostly surfing activities

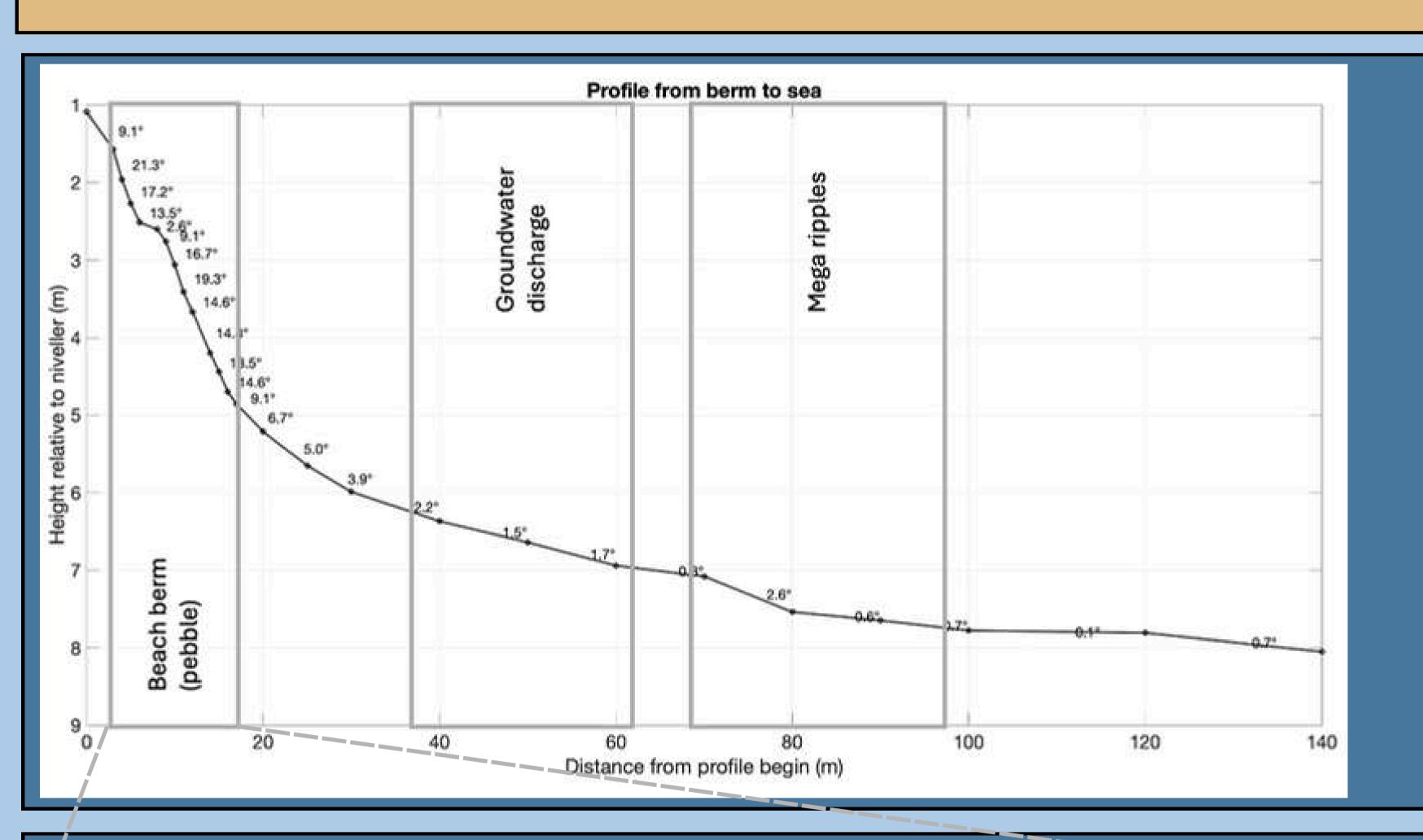


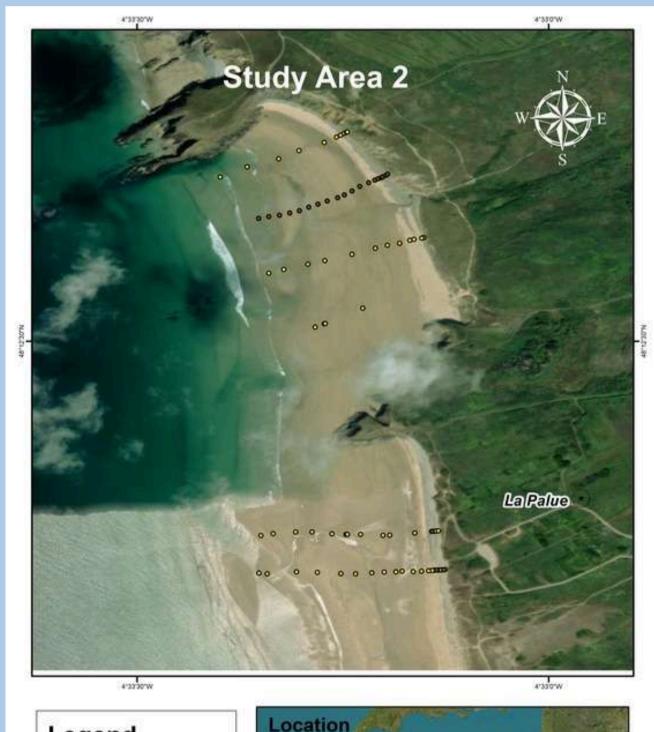
remonterletemps.ign.fr

Why is this beach interesting?

- La Palue is a dynamic beach at equilibrium, showing several interesting features to be studied, and at the same time only a little anthropogenic influence
 - beach berm
 - o mega ripples
 - groundwater discharge and fluvial systems establishing
- A dominant beach berm has settled and can be used to study its dynamics, which is useful because berms are discussed to be used for natural coastal protection









Geological Settings

- Basalt flows with pillow lavas, breccias with volcanic elements from Upper Ordovician (-445My ago)
- Fault network responsible for tectonic repetitions
- Stratigraphy: section in the Rozan Tuffs, Limestones and Cosquer shales

ean Grain Size: MGS Rounding: R R: Sub-angular MGS: 5*2.5*3cm R: Sub-angular Pebble MGS: 6*4.5*2.5cm slope Terrace R: Sub-rounded (Pebbles) MGS : 6.5*5*2.5cm Pebble R: Sub-rounded MGS: 5*4*2cm slope R: Rounded Terrace (Pebbles) Pebble slope White pebbles (Quartzite, sandstone, granite) Black pebbles (Dolerite, pillow lava of Lostmarc'h)

Characterization of the berm

- The beach berm was studied regarding structures like the slope and terraces and pebble properties
 - The uppermost slope is characterized by the least sorted and largest pebbles
- Bands of different colours and thus mineral compositions were observed, which might be linked to density differences, but that fore further studies are needed
- From the top to the bottom, the rounding increased
- Within the berm, beach cusps were observed
- A Pürckhauer was used to determine whether sand is underlying the berm
 - At a distance of 12 m from the profile begin, sand was found in a depth of 45cm

How will this beach develop?

- Under climate change, coastal dynamics will change with sea-level rise and changes in storm patterns (more frequent and/ or stronger) as dominant drivers
- Conflicts between coastal protection, recreational purposes, and infrastructure might increase, especially at highly anthropogenic places
- La Palue is a natural beach without any nearby human structures, so it will have space to retreat and find another equilibrium state or evolve without human interference
- There will be some erosion on the parts of the beach enclosed by the cliff.
- The dunes, especially those of **Lostmarc'h**, have plenty of space to retreat thanks to the very flat terrain behind the dune (an ancient river).
- There is **no need** for **coastal protection** because the beach is already in equilibrium; we should allow **natural processes** to continue

