

# *Posidonia oceanica* beach-cast litter in Mediterranean beaches: a coastal videomonitoring study

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ICS2013

WITH  
PLYMOUTH  
UNIVERSITY



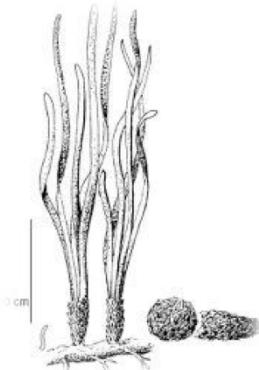
ICS2013





- *Posidonia oceanica* is an endemic reef-building seagrass widespread along Mediterranean nearshore sandy and rocky bottoms.

- It loses leaves in autumn and leaf litter can be found mainly along sandy coasts forming wedge structures of few to several meters in thick that 80's French authors denominated **banquettes**.

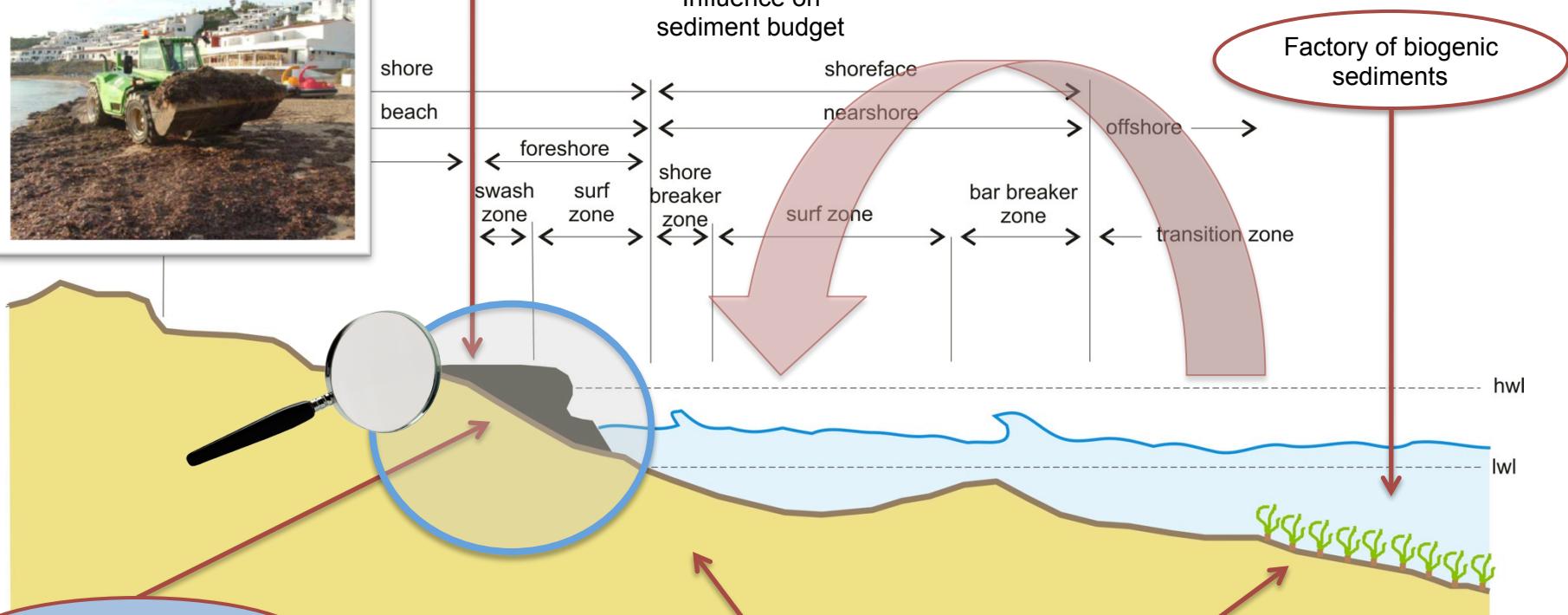




management policy  
and human erosion



Influence on  
sediment budget



Banquettes erosion  
protective role



*P. oceanica* play an important role  
in many coastal processes...

Factory of biogenic  
sediments



Influence on  
beach profiled  
adjustment and wave  
attenuation (reef effect)

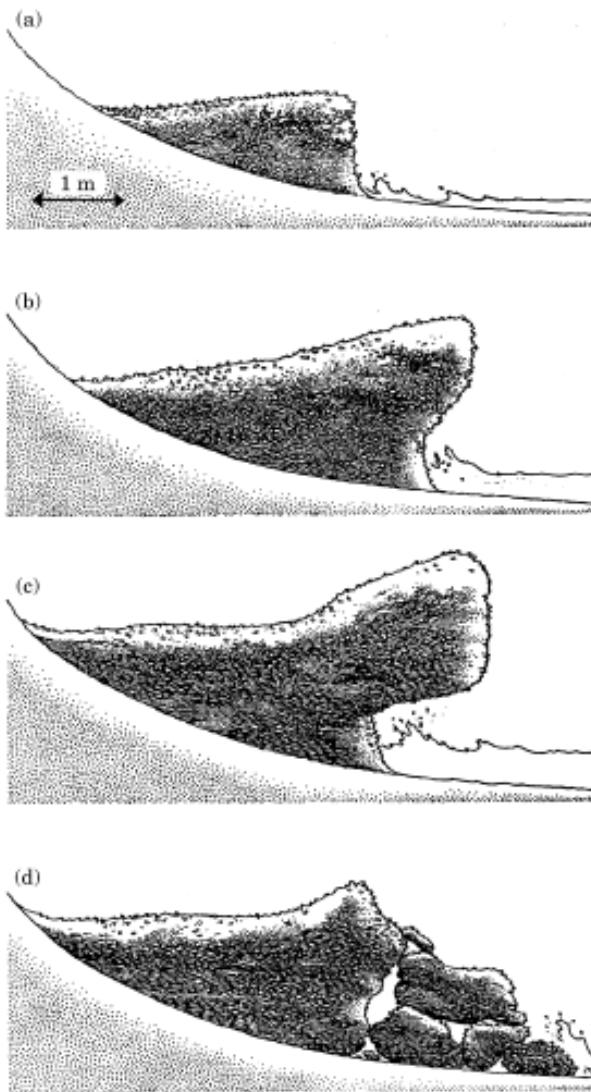


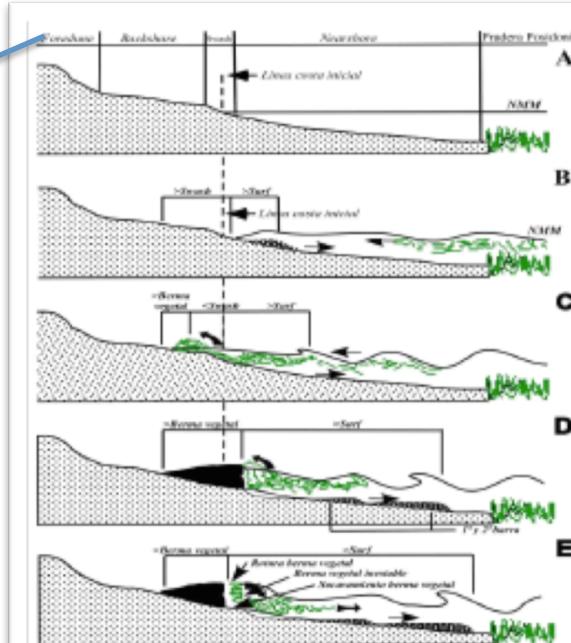
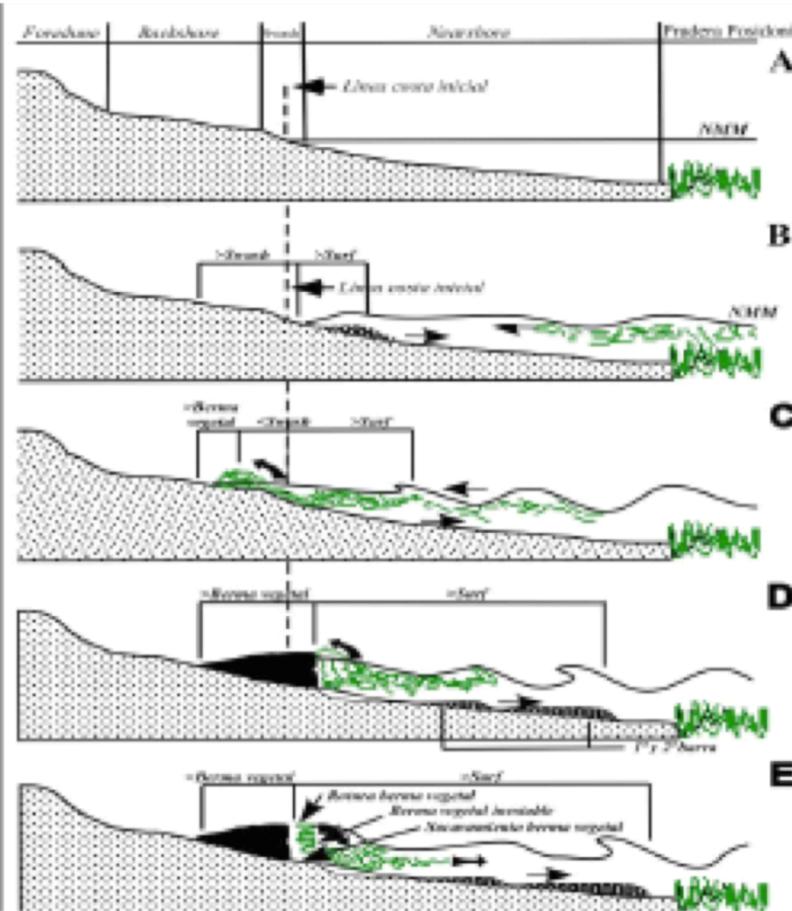
Fig. 3. Proposed sequence of formation-destruction of the banquette.  
(a) Initial stage, (b) gain in size, (c) maximum height is attained, (d) the banquette collapses due to erosion of its base by wave action.

○ Boudouresque and Jeudy de Grissac (1984) were the **first authors** stress the role of the **banquettes** in the **protection** of the **shorefront** under severe **storms**.

○ Different authors assume that **banquettes play an important role in the shore morphodynamics** and their removal could have a negative impact on shore stability (Chessa et al., 2000; Servera et al., 2002; de Falco et al., 2008; Roig-Munar, 2010).

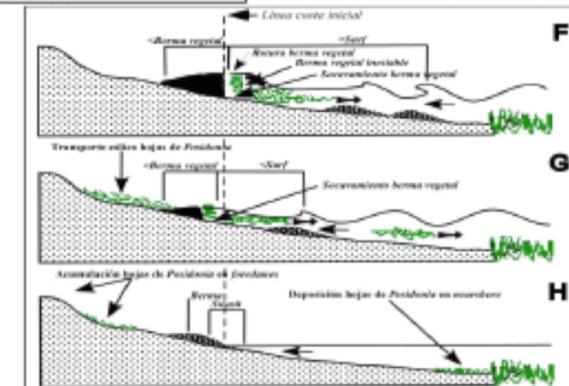
○ **Other** authors state that since leaves have less density than water **the effect of beach banquettes on beach protection is almost negligible** (Medina et al., 2001).

○ There is a large debate although the depositional dynamics of banquettes is not well known and few qualitative studies and **none quantitative work** have been published on this issue.



Hb  
↑  
↓

Hb



Sustento arenoso  
Sentido transporte sedimento  
Barra/berma  
Sentido transporte restos Posidonia

From Roig, F.X. 2010 and Servera et al., 2002

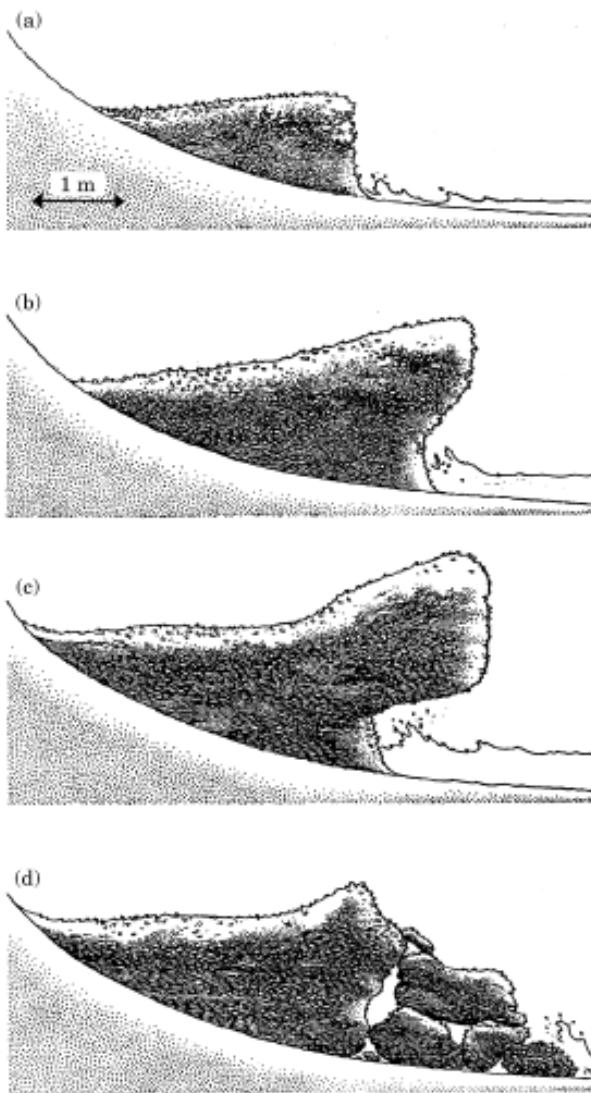


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- There is a large debate although the depositional dynamics of banquettes is not well known and few qualitative studies and **none quantitative work** have been published on this issue.



## Aims

- First, to unravel what type of sea states and wave energy promote the formation of *P. oceanica* banquettes.
- Second, evaluate their role in beach protection





Cala Millor Beach (NE Mallorca)

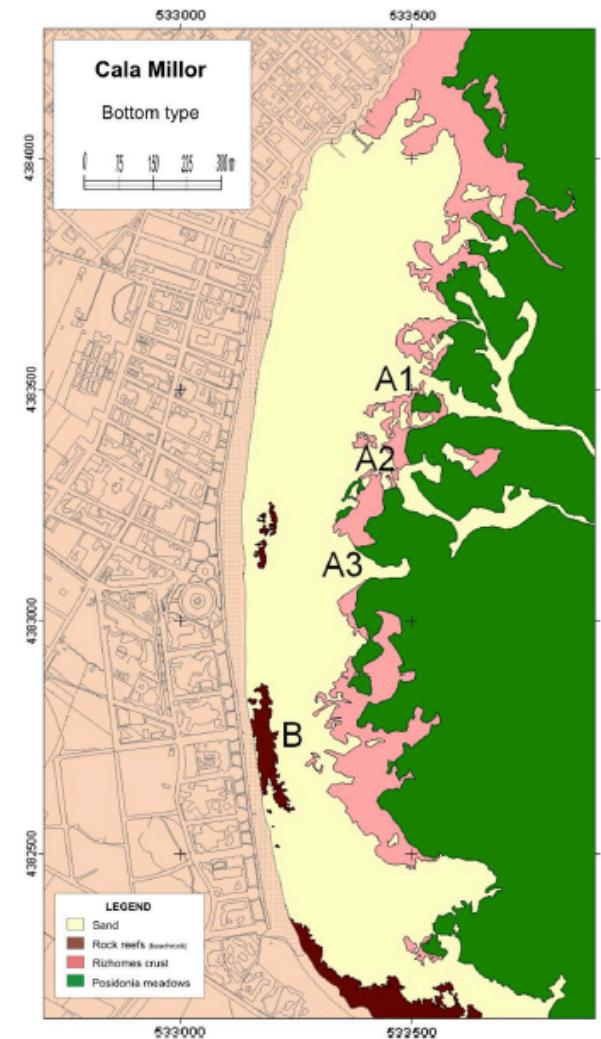
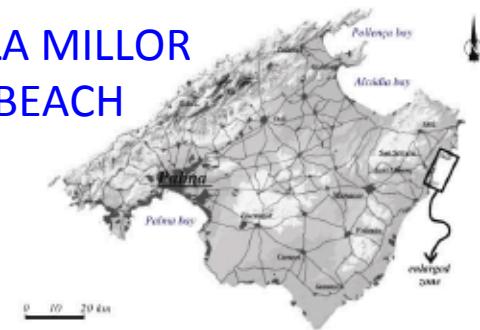


Son Bou Beach (S Menorca)

	Platja de Palma	Cala Millor	Son Bou	Santa Eulària
Length and location	5 km, SW Mallorca	2 km, NE Mallorca	2.5 km, SW Menorca	0.5 km, SE Eivissa
Beach type and main interest	Urban	Urban (rips)	Natural (reefs)	Urban, inlet
Equipment	3 SIRENA stations (15 cameras) 1 Weather station 1 AWAC	1 SIRENA stations (5 cameras) 1 Weather station 1 AWAC	1 SIRENA stations (5 cameras) 1 Weather station 1 AWAC	1 SIRENA stations (4 cameras) 1 Weather station 1 AWAC
Operation	09.2011 – to present	05.2011 – to present	10.2011 – to present	In mind 2013



## CALA MILLOR BEACH

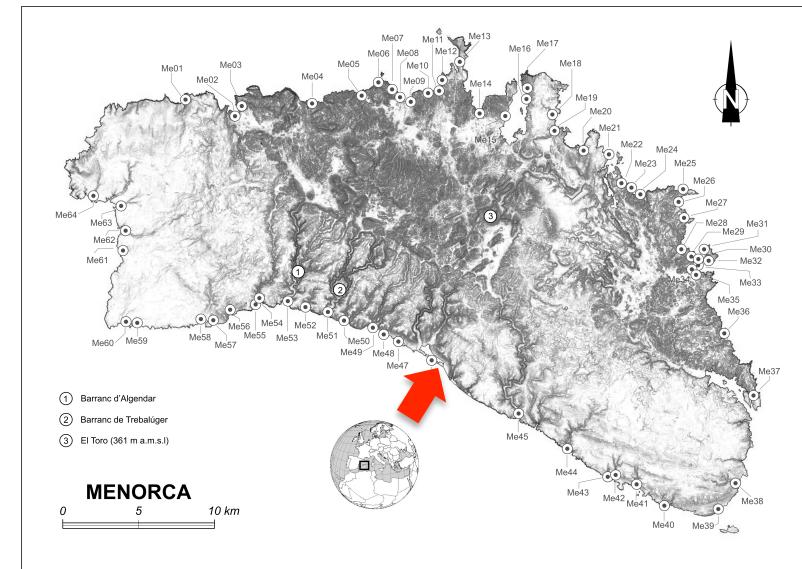


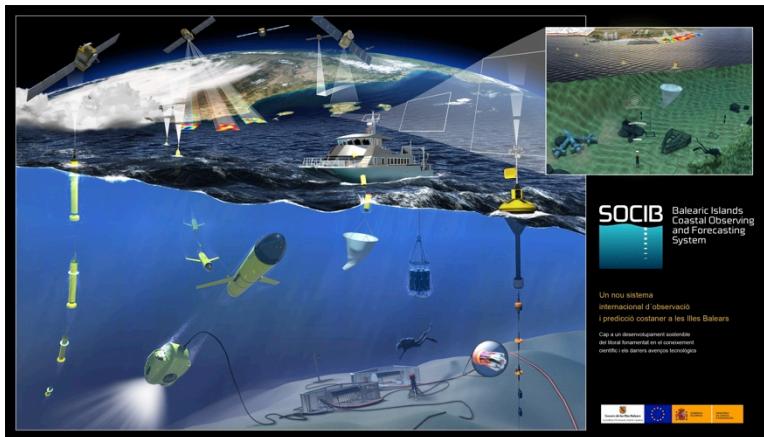
- Beach length 2000 m,  $H_s < 1$  m,  $H_{12}$  2.5 m, waves from NE and ESE; biogenic medium to fine sands, 2 phi.
- *Posidonia oceanica* seagrass from 6 to 35 m in depth.



## SON BOU BEACH

- Beach length 2000 m,  $H_s < 1$  m,  $H_{12}$  2.5 m, waves from E-SE and SW; biogenic coarse sand to medium sands, 1.8 phi
- *Posidonia oceanica* seagrass from 5 to 35 m in depth.





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VIDEOMONITORING  
(SIRENA)



RTK SURVEY



ECO-SOUNDING



ADCP



SEDIMENTS



WEATHER STATION

## MODULAR BEACH INTEGRAL MONITORING SYSTEM (MOBIMS)

- SOCIB is a **multi-platform distributed and integrated Scientific and Technological Facility**, a facility of facilities, **providing streams of oceanographic data and modelling services** in support to operational oceanography and **contributing to the needs of marine and coastal research** in a global change context.

- The aim of the SOCIB's Beach Monitoring Facility is to contribute to this issue by means of the **Modular Beach Integral Monitoring System (MOBIMS)**, which consists of a video-monitoring system, an Acoustic Doppler Current Profiler (ADCP) and a programme of bathymetric and sediment sampling.

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### An open source, low cost video-based coastal monitoring system

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*Earth Surface Processes and Landforms*

**ABSTRACT:** A low cost, automated, remote monitoring video system built on standard commercial off-the-shelf (COTS) components and implemented with open source software is presented. This system has been implemented in a coastal area to perform image acquisition and processing, generating statistical products and transferring the information from the field to a central node where post-processing and data visualization are made available to the general public. The open structure of the software allows dynamical processes where continuous observation is required. The software and image data base can be obtained as software.

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**KEYWORDS:** video monitoring; remote sensing; coastal zone

#### Introduction

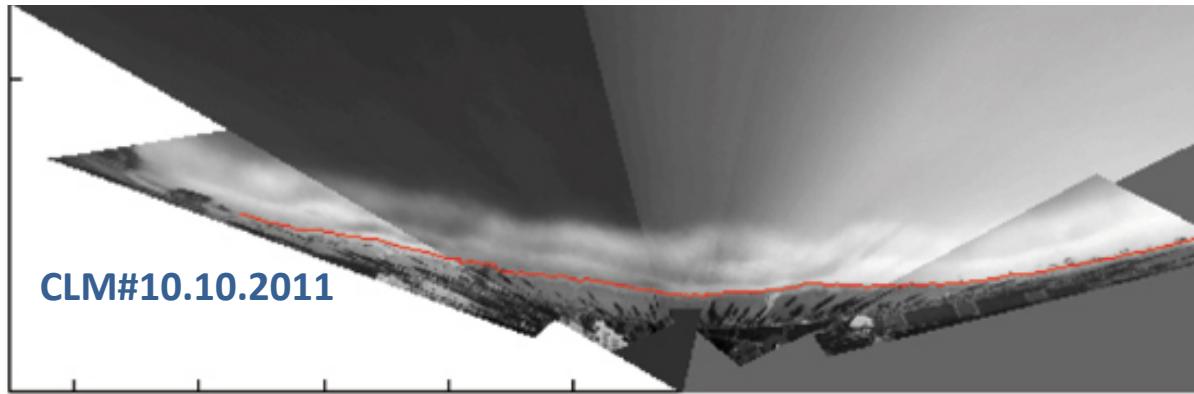
Several experiments and coastal monitoring facilities have been developed and carried out in the last decade. The most complex approaches are field-based and use coastal oceanographic instruments to measure a large number of physical and environmental variables being the only way to measure processes and parameters for coastal monitoring. These facilities require a large time and money investment and have relatively long installation and set-up times. Examples of this kind of installations are the Field Research Facility operated since 1980 by the US Army Corps of Engineers (Hanson and Hanson, 1980; Hanson and Kaus, 1994; Miller and Duan, 2007), the US Geological Survey station at the Columbia River Estuarine Cell in the Pacific Northwest (Miller et al., 2007), the coastal observatory in the Dutch coast (Wijmenga and Terwindt, 1995). Other recent development that must be considered are the Gold Coast Observatory (GCO) installed by the Queensland Government and Gold Coast Beach Protection Strategy in southeast Australia (Beak et al., 2000) or the POI (Liverpool Bay Coastal Observatory).

Another alternative to measuring coastal processes is based on remote sensors. In this way, information is acquired automatically and continuously through the analysis of digital images. This alternative to traditional field studies that utilizes a significantly lower amount of human, economic, and

computational resources, allows better continuity and frequency in data acquisition. Among optical remote sensors, video cameras are the most common and promising alternative for coastal monitoring because it provides the possibility to study a range of spatial and temporal scales, from the formation of a sandbar to the evolution of a coastal area, with sampling intervals depending on the required measurements. Therefore, a broad number of coastal forms and nearshore processes can be monitored with video cameras. For instance, researches have used video images to extract bathymetry (Kaneda and Hwang, 1996; Hwang and Kaneda, 2000; Almehiri et al., 2003), the nearshore bathymetry (Chikada et al., 2003), as well as to unravel the formation of sandbars (Kaneda and Hwang, 1996; Hwang and Kaneda, 2000; Ojeda, 2005; Russelius et al., 2005) or the beachface morphology (Almar et al., 2006; Oregua-Sánchez et al., 2007).

Video-based coastal monitoring systems and video monitoring systems are evolving rapidly; more so with the CoastView project (Davidson et al., 2007) that highlighted the potentialities of video monitoring systems for coastal zones or navigational channels management (Muñoz et al., 2007; Turner and Anderson, 2007; Koningsveld et al., 2008).

Since the commercialization of ARGUS – a video-based monitoring system developed by the University of Michigan (Ogden et al., 2000; Savenkov et al., 2004; Savenkov and Savenkov, 2007) – and because many potential applications to unravel nearshore issues based on video monitoring systems have



<http://imedea.uib-csic.es/tmoos/sirena/>

- Cala Millor, May 2011 to May 2012
- Son Bou, October 2011 to October 2012
- Daily hourly images from 04:00h to 18:00h UTC.
- One AWAC (Nortek) installed in each beach at ca. 17 m in depth. Wave data collected in bursts of 20 min each hour at 4 Hz.



Snapshot



Timex



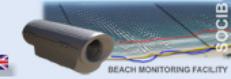
Variance





SOCIB Balearic Islands Coastal Observing and Forecasting System

 BEACH MONITORING FACILITY



**Location list**

Name
Platja de Palma
Cala Millor
<b>Son Bou</b>

**Overview** Location: Son Bou 

**Filter options**

<input type="checkbox"/> Camera name ▲	<input type="checkbox"/> Product name
<input checked="" type="checkbox"/> Camera 01	<input type="checkbox"/> Timex
<input type="checkbox"/> Camera 02	<input type="checkbox"/> Variance
<input type="checkbox"/> Camera 03	<input checked="" type="checkbox"/> Snapshot
<input type="checkbox"/> Camera 04	<input type="checkbox"/> Timestamp
<input type="checkbox"/> Camera 05	

**Date**  
20-06-2012  Today

**Time interval (UTC)**  
04:00  18:00 

**Load**

**Product name: Snapshot - Date: 20-06-2012**

  
Camera 01 at 04:00 (UTC)



Cam	Epsor	CAM1	CAM2	CAM3	CAM4	CAM5	Observacions
11/05/11	x	x	x	n	n		
12/05/11	x	x	s	n	n		desmonte diurn, la càmera 2 permet video de
13/05/11	x	x	x	s	s		idem anterior + pujada barres
14/05/11	x	x	x	x	x		
15/05/11	n	n	n	n	n		temporal que fa net
16/05/11	n	n	n	n	n		beach cups
17/05/11	n	n	n	n	x		se veu com puja des del fons però no surt
18/05/11	n	s	n	n	x		anclada a beach rock
19/05/11	n	n	n	n	n		temporal
20/05/11	n	n	n	n	n		temporal
21/05/11	n	n	n	n	n		temporal
22/05/11	n	n	n	n	n		temporal
23/05/11	x	s	n	n	n		Al sector nord tac
24/05/11	x	s	x	n	n		cam desplaçada
25/05/11	s	n	n	n	n		Al nord hi puja un
26/05/11	s	s	n	n	n		alga surant
27/05/11	n	n	n	n	n		tractor a primera hora fent net
28/05/11	s	x	s	s	x		sortida barra
29/05/11	x	x	x	x	x		construcció poten
30/05/11	s	s	s	s	s		bon dia de pujada desde mar
31/05/11	x	n	n	n	n		es veu sopa

## Variable:

- Absence / Presence of banques at some point of the beach



CLM: 92% of days with non-continuous banques

SNB: 71% of days with non-continuous banques



- Banques appeared at least during the 39% of the monitored days at both study sites.
- Banques presence were higher in winter than in summer.
- Banques showed preferential patchy or spatial skewed deposition.
- Different types of banques could be identified according volume and the spatial extent

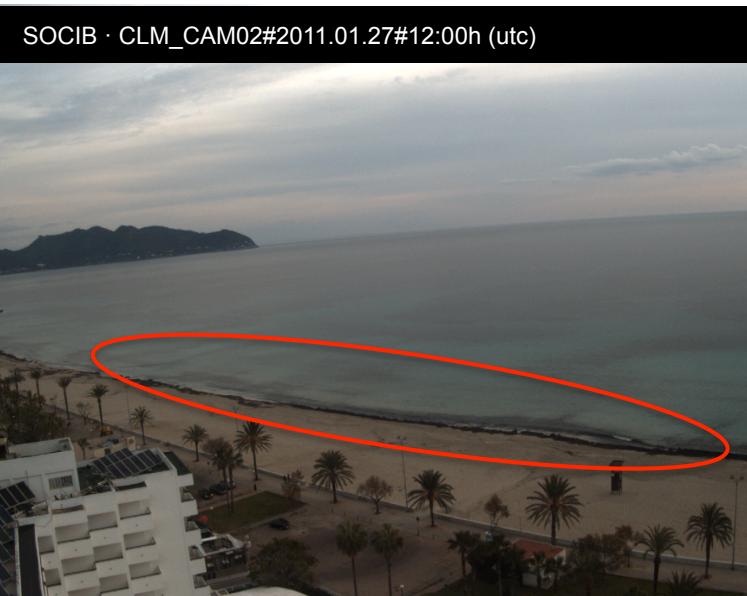
Site and season	Days Surveyed	<i>Presence of banques on the beach (days)</i>			
		N	Continuous	Patchy	Absent
CLM	377	149	12	137	228
winter	187	103	10	93	84
summer	190	46	2	44	144
SNB	385	153	44	109	232
winter	207	103	40	63	104
summer	178	50	4	46	128





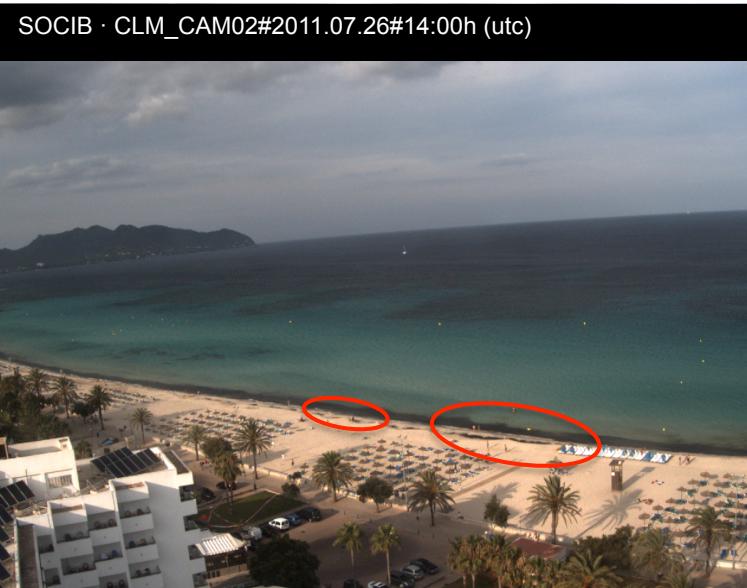
## Winter conditions

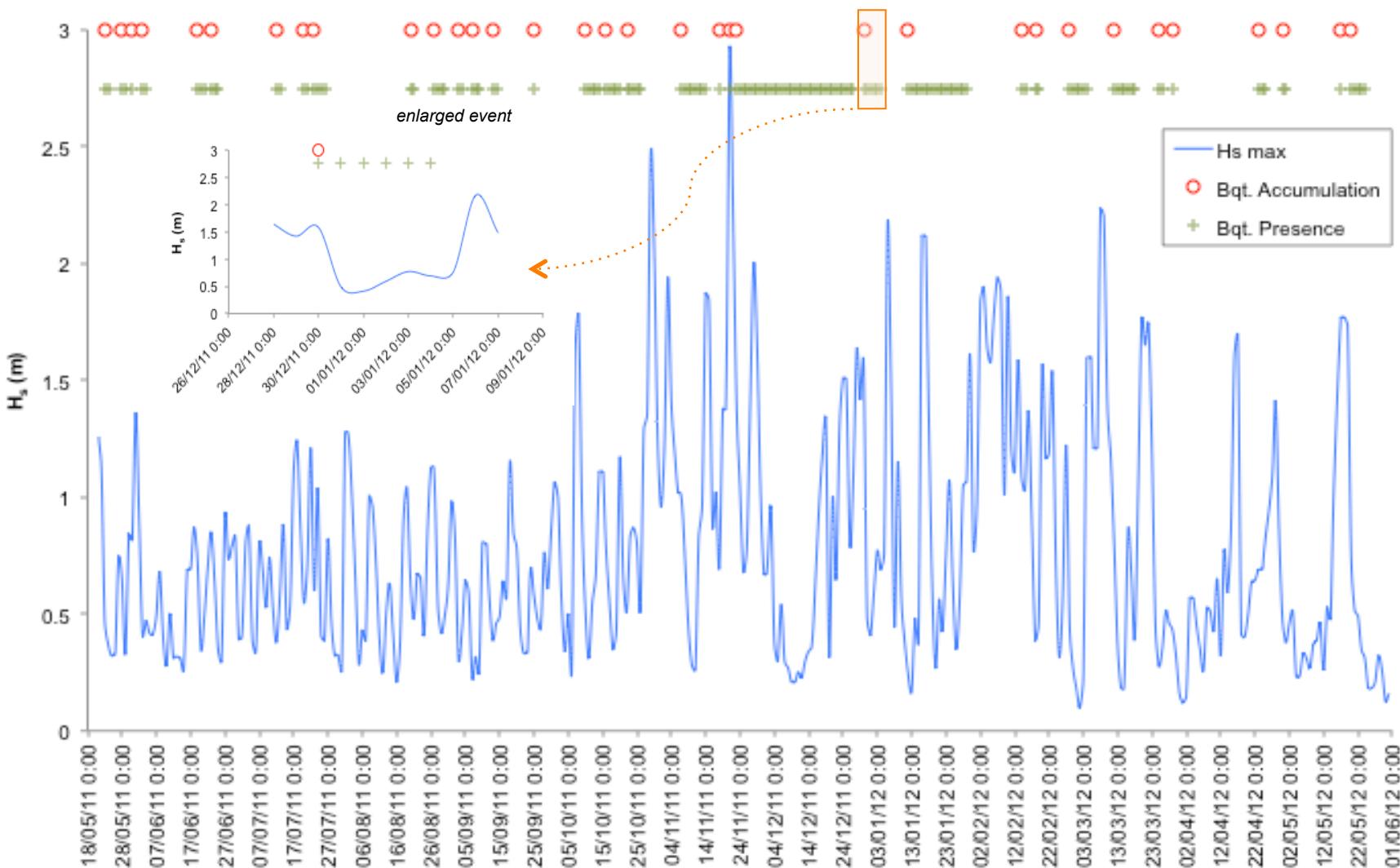
large and continuous banquets



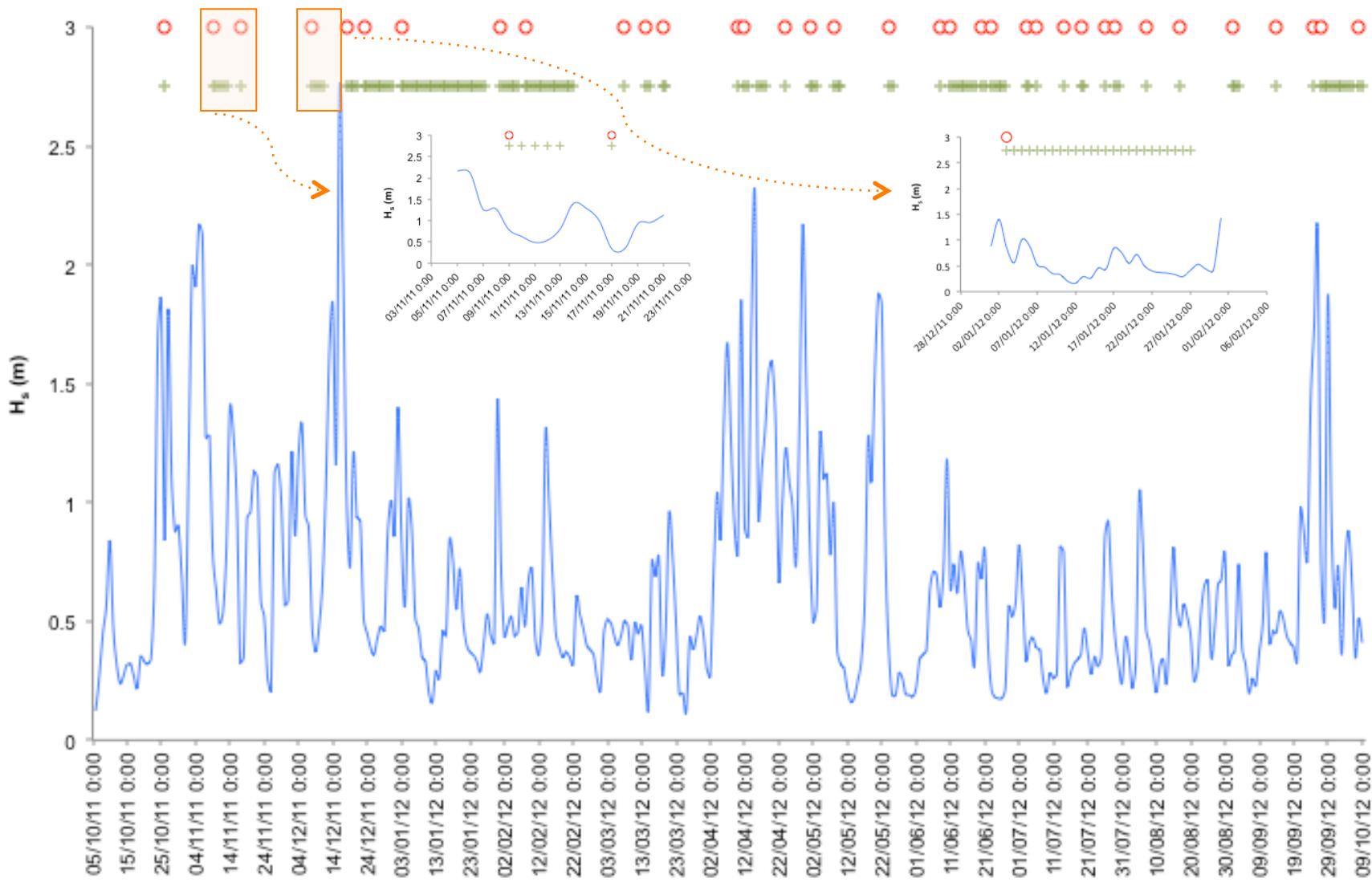
## Summer conditions

patchy and minor entity banquets



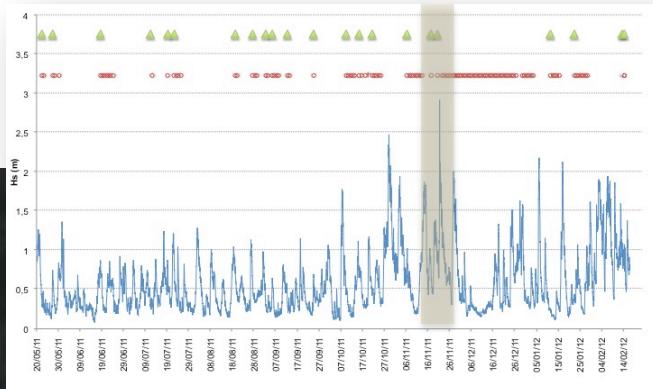


Cala Millor Beach (NE Mallorca)



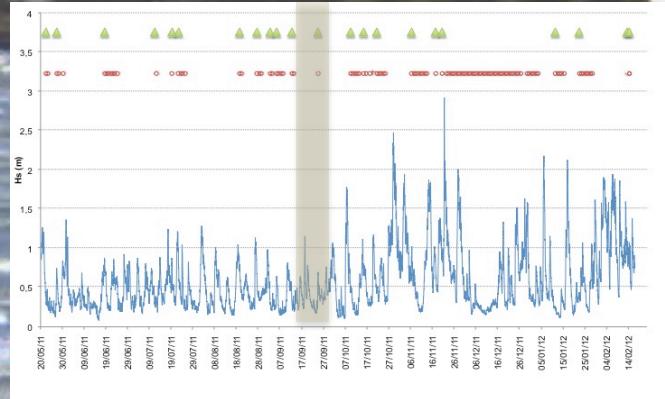


07.11.2011 to 15.11.2011; Hs ca 2m



20.11.2011 to 28.11.2011; Hs ca 3 m

27.08.2011 to 29.08.2011; Hs ca 1.5 m

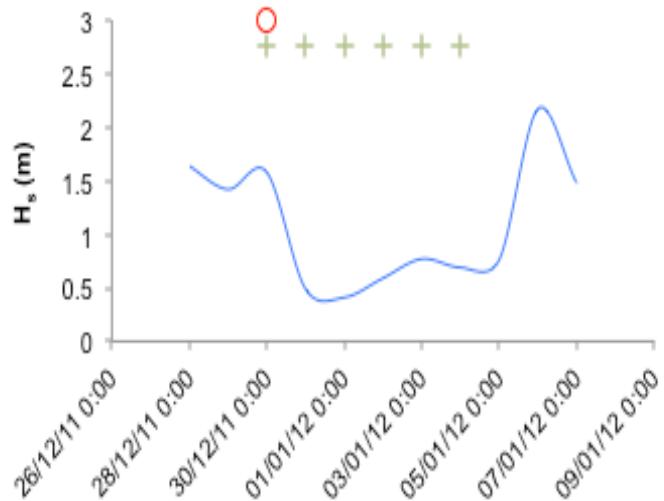




CLM: 52 % of banquettes rested on the beach less than 2 days

SNB: 57 % of banquettes rested on the beach less than 2 days

Site and season	Events	<i>Permanence of banquettes on the beach (%)</i>			
		1 – 2 days	2 – 4 days	4 – 8 days	> 8 days
CLM	33	51.5	18.2	24.2	6.1
winter	14	42.9	0	42.9	14.3
summer	19	57.9	31.6	10.5	0
SNB	37	56.8	24.3	8.1	10.8
winter	14	35.7	40	7.1	28.6
summer	23	69.6	21.7	8.7	0



- Hourly images showed that the permanence of banquettes on the beachface was variable, but more than 50% of the banquettes just remained as much as two days in the beachface.
- Larger permanence occurred in winter because the combination of calms and amount of leafs available.
- Banquettes rarely persisted before the arrival of a new sea storm.



WE HAVE IDENTIFIED **70** EVENTS OF *P. OCEANICA* BANQUETTES IN TWO SANDY MEDITERRANEAN SEMI-EXPOSED BEACHES:

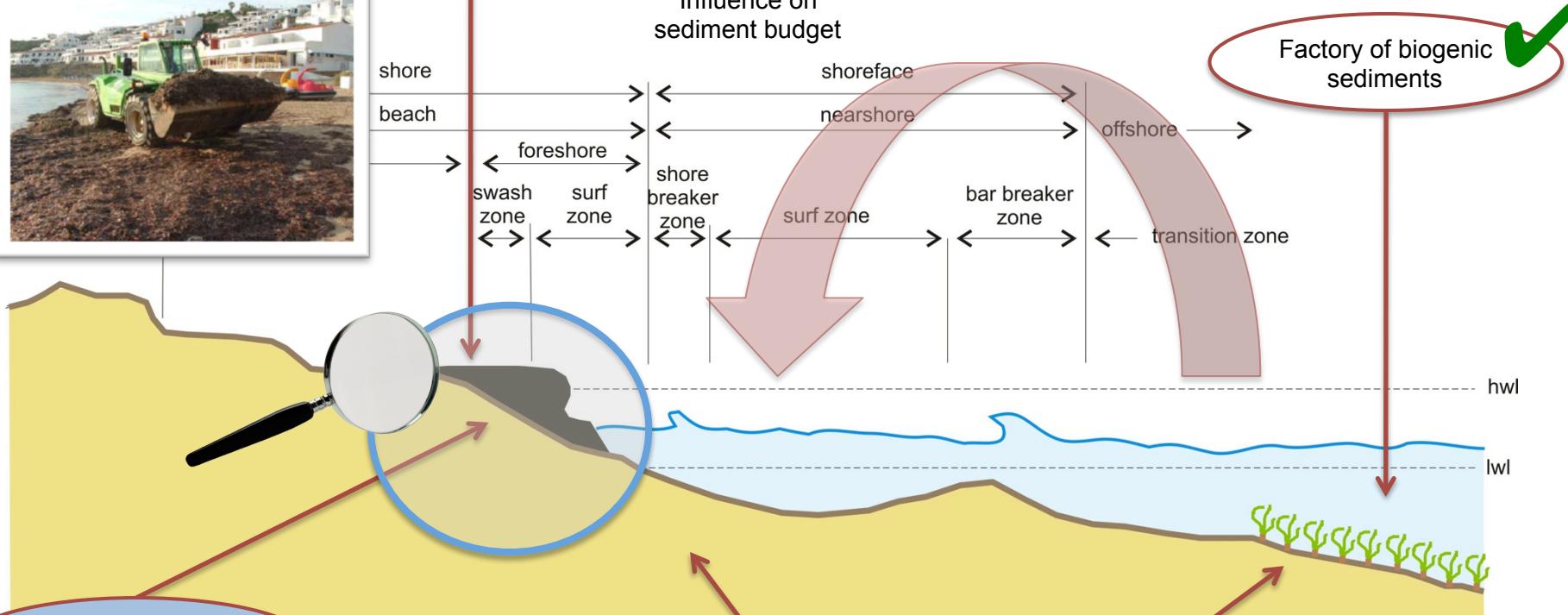
- Accumulation of banquettes relies to seagrass ecology and physical factors such as winds, currents and winds.
- Images show that banquettes deposits occur following storm waves ( $H_s > 1m$ ) and larger volumes appear early in waves winter season because there is a highest availability of leas litter.
- Banquettes use to be removed in low wave energy conditions\*\*\*
- When storms arrive to the beach they do not use to find an organic barrier that protect and the only mechanism for wave dissipation is the beach profile adjustment.



management policy  
and human erosion



Influence on  
sediment budget



*P. oceanica* play an important role  
in many coastal processes...

Factory of biogenic  
sediments

Banquettes erosion  
protective role

???

Influence on  
beach profiled  
adjustment and wave  
attenuation (reef effect)



# Thanks!



Balearic Islands  
Coastal Observing  
and Forecasting  
System



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