

Desing and development of a large and high-resolution beach-monitoring program at Balearic Islands Coastal Observing and Forecasting Sytem

Lluís Gómez-Pujol, Amaya Álvarez-Ellacuría & Joaquin Tintoré

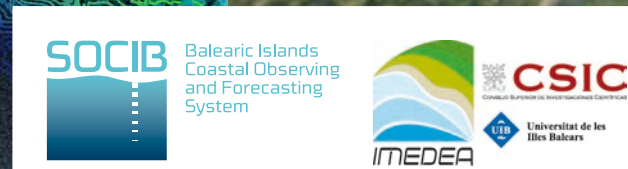
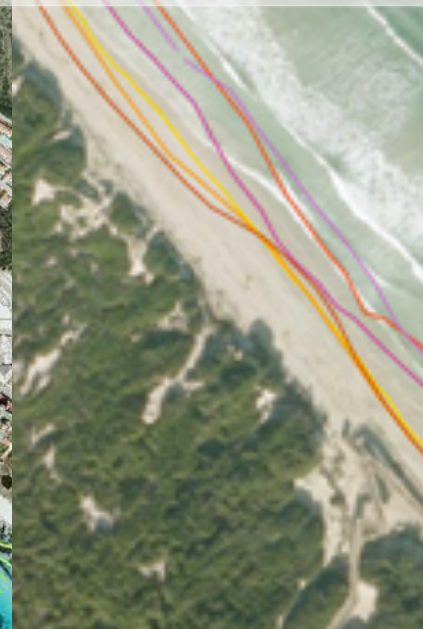
SOCIB, Balearic Islands Coastal Observing and Forecasting System, Palma, lgomez-pujol@uib.cat

Alejandro Orfila

IMEDEA, Mediterranean Institute for Advanced Studies (CSIC-UIB)

C08.05-08 COASTAL
Coastal Monitoring 3

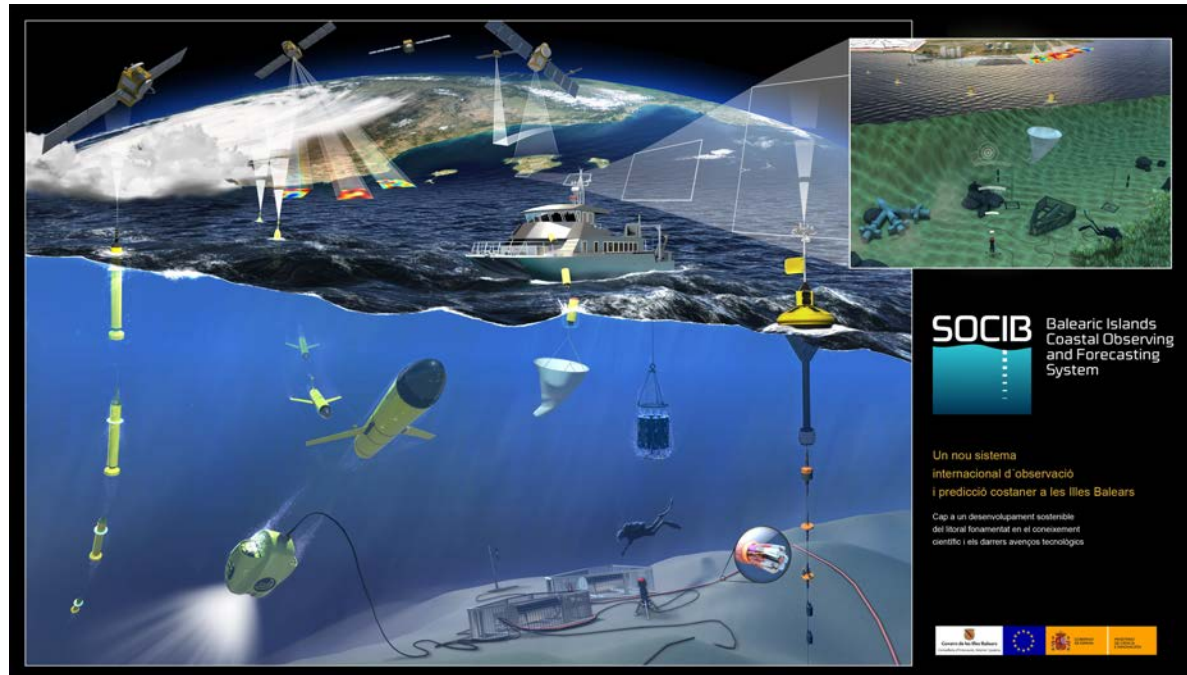
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INTRODUCTION

- This communication pretends to introduce the Balearic Islands Coastal Observing and Forecasting System, **SOCIB**, focusing on one of their infrastructures: the **BEACH MONITORING FACILITY**.
- 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.

Part of the Spanish System of Scientific and Technological Infrastructures (ICTS)



Operational Oceanography is here understood as general, including traditional operational services to society but also including the sustained supply of multidisciplinary data to cover the needs of a wide range of scientific research priorities.

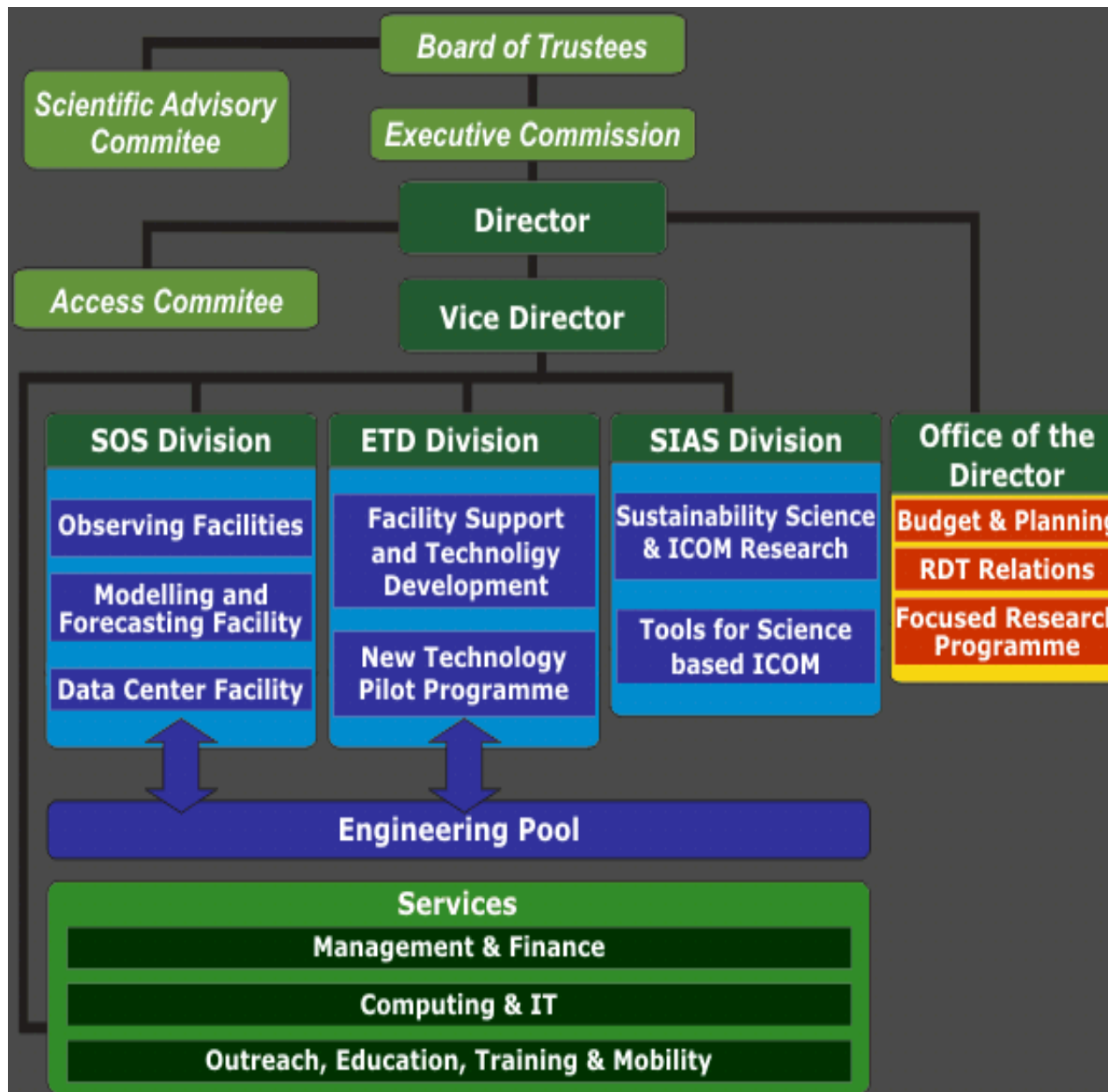


SOCIB'S MISSION

- The mission of SOCIB consists on developing a **scientific and technological infrastructure** which **will provide free, open, quality controlled and timely streams of data** mostly focused in the Western Mediterranean, focus in Balearic Islands and adjacent basins, and **covering from open ocean to nearshore**.
- 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.

GENERAL OBJECTIVES

- Support research and technology development:
 - The role of the Mediterranean Sea in the climate system at inter-annual scale,
 - The interaction between currents and eddies at mesoscale and submesoscale, vertical exchanges and physical and ecosystems variability
 - The **variability in nearshore morpho-dynamics** and the sea level variability in response to climate change.
- Support (on a longer term) **strategic needs from society in the context of global change** (providing a **continuous multidisciplinary and integrated monitoring of the coastal variability** or promoting the development of **new tools and technologies for decision support and risk assessment**).



OBSERVATIONAL FACILITIES (major elements)

- Coastal Research Vessel
- HR Radar
- Gliders and AUV's
- Moorings and tide gages
- ARGO and surface drifters
- Beach monitoring systems

FORECASTING SYSTEM

- Ocean currents (ROOMS) and waves (SWAN) forced by Atmospheric models (WRF) and ecosystem coupling (NPZ).

DATA CENTRE

- Quality control and Web access in open source
- Effective data archiving, internationally accepted protocols, delivery and communication.



BEACH MONITORING FOCUS

- A continuous, **large and high-resolution dataset on coastline evolution, nearshore waves and currents, sediments and beach bathymetry** is a key issue in order to characterize and manage coastal systems properly (IPCC, Nicholls et al., 2007). But, there are very few multi-decadal, high-resolution coastal monitoring programs currently in operation worldwide.

| SITE | SURVEYS UNDERTAKEN | PUBLICATIONS |
|-----------------------------------|---|-----------------------|
| Duck (USA) | 1981 – present, biweekly beach profiles 1986 – present, ARGUS intertidal bathymetries | Kroon et al., 2008 |
| Rhode Island (USA) | 1962 – present, monthly beach profiles | Lacey and Peck, 1998 |
| Noordwijck (The Netherlands) | 1964 – present, annual beach profiles 1995 – to present, ARGUS intertidal bathymetries 2001 – 2004 monthly 3D dGPS | Kroon et al., 2008 |
| Lubiatowo (Poland) | 1983 – present, monthly beach profiles | Rozynski, 2005 |
| Collaroy-Narrabeen (Australia) | 1976 – present, monthly beach profiles 2004 – to present, ARGUS intertidal bathymetries 2005 – to present, monthly 3D RTK-GPS | Harley et al., 2011 |
| Moruya (Australia) | 1972 – present, monthly beach profiles | McLean and Shen 2006 |
| Hasaki (Japan) | 1987 – present, daily beach profiles | Kuriyama et al., 2008 |

- 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 to develop at 4 beaches of the Balearic Islands.



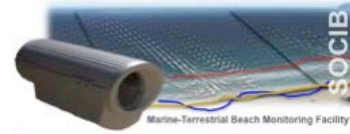
VIDEOMONITORING
(SIRENA)



RTK SURVEY



ECHOSOUNDING
BATHYMETRY



NEARSHORE WAVE
& CURRENT MEASURING



SEDIMENT ANALYSIS



WEATHER
STATION

MODULAR BEACH INTEGRAL MONITORING SYSTEM (MOBIMS)

| | Platja de Palma | Cala Millor | Son Bou | Santa Eulària |
|-----------|-----------------|-------------|----------|---------------|
| Length | 5 km | 2 km | 2.5 km | 0.5 km |
| Operating | Set 2011 | May 2011 | Oct 2011 | n.a. |
| Type | Urban | Urban | Natural | Inlet |



BEACH MONITORING GENERAL AIMS

The objectives of the Beach Monitoring Facility deals with different types of scopes, from scientific and technological development to education or services to society.

○ Scientific objectives

- In the large temporal scale, to build up a continuous and coherent time series related to beach morphology, waves and currents and sediment budgets in order to address effects and processes related with climate variability.
- In the short temporal scale, to provide data and physical variables that allow the study of coastal processes and the development of new models and scientific theories that improve the understanding of coastal and nearshore systems.

○ Technological objectives

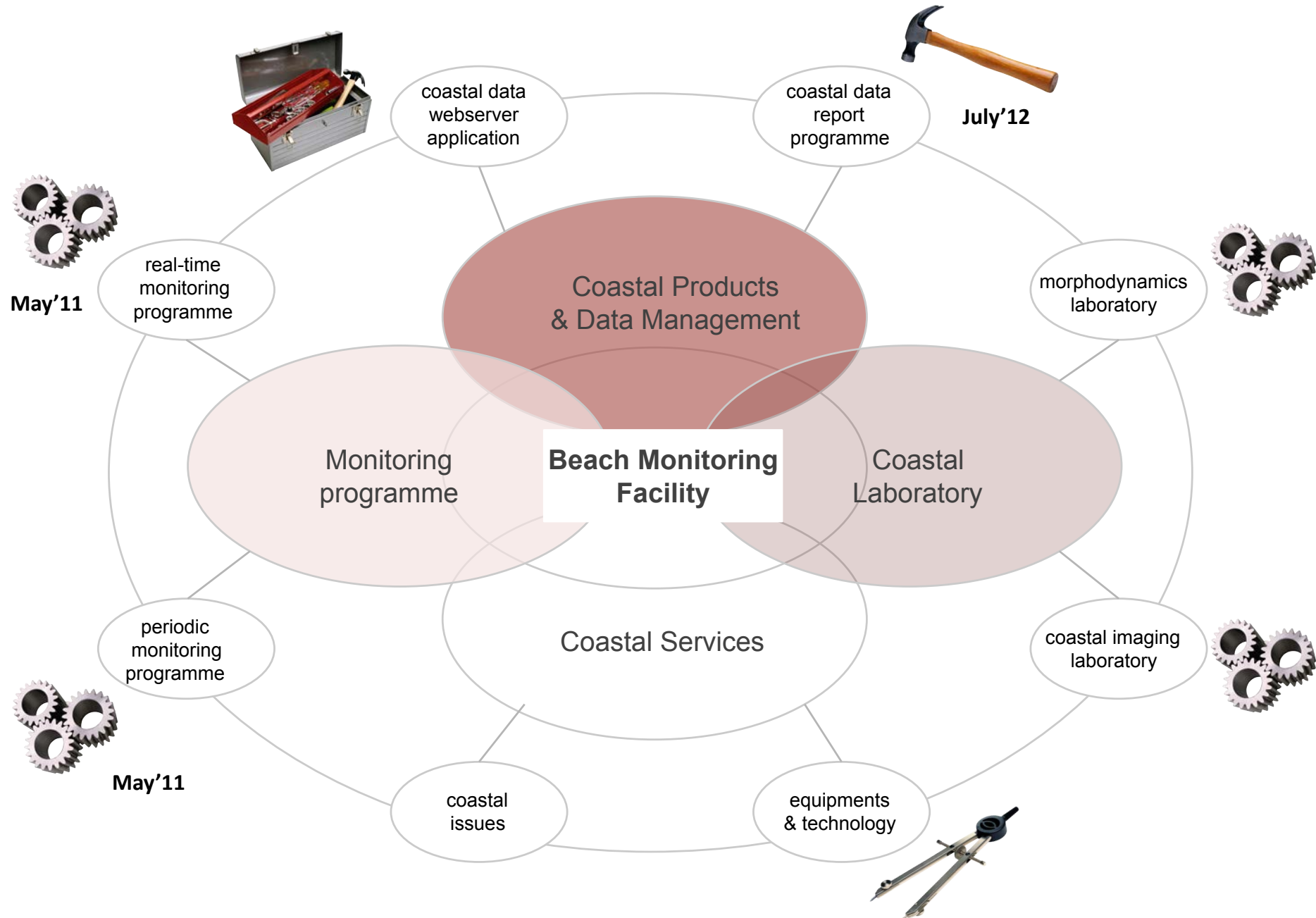
- Development and improving of coastal videomonitoring technology in terms of software and analytical tools for coastal issues.

○ Services to Society

- To offer products and services that contribute to safety and coastal management based on technological development and scientific knowledge.

○ Outreach and education

- To offer datasets, products and reports to the public in order to improve they coastal knowledge.
- To contribute to the formation of MSc and PhD students dealing with beach dynamics and coastal issues.





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

M. A. Nieto,¹ B. Garau,¹ S. Ballo,¹ G. A. Zarruk,² A. Ortiz,³ J. Tintoré,³ A. Álvarez-Ellacuría,¹ L. Gómez-Pujol^{1*} and A. Orfila¹

¹ IMEDEA (CSIC-UIB), Mediterranean Institute for Advanced Studies, Esporles (Illes Balears), Spain

² Department of Hydraulic Engineering, Universidad de Castilla La Mancha, Ciudad Real, Spain

³ Institute for Energy Technology, Kjeller, Norway

⁴ Department of Mathematics and Computer Science, Universitat de les Illes Balears, Palma (Illes Balears), Spain

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*Correspondence to: L. Gómez-Pujol, IMEDEA CSIC-UIB, Mediterranean Institute for Advanced Studies, 21 Miquel Marqués, 07190 Esporles (Illes Balears), Spain.
E-mail: lgomez-pujol@uib.es



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. The 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 the user to implement new routines and modules appropriate to fit specific needs as well as to adapt the system to study other dynamical processes where continuous observation is required. The software and image data base can be obtained as freeware. Copyright © 2010 John Wiley & Sons, Ltd.

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 equipment. These have a broad capacity to produce spatial and temporal measurements of physical and environmental variables being the only way to measure processes responsible for sediment transport. Unfortunately, these facilities require a large time and money investment and have relatively long installation and set-up times before producing useful data-sets. Classical examples of this kind of installations are the Field Research Facility operated since 1980 by the US Army Coastal Engineering Research Center at Duck (Lanson and Kraus, 1994; Miller and Dean, 2007), the US Geological Survey station at the Columbia River Littoral Cell in the Pacific coast (Ruggiero and Voigt, 2000) or the JARLUS data set in the Dutch coast (Wijnberg and Torwindt, 1995). Other recent development that must be considered are the Gold Coast shoreline and wave record obtained by the Northern Gold Coasts Beach Protection Strategy in southeast Australia (Boak et al., 2000) or the POL Liverpool Bay Coastal Observatory (Proctor et al., 2004).

Another alternative to measuring coastal processes is based on remote sensors. In this way, information is acquired automatically, continuously and periodically from high resolution 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, fixed digital video cameras have proven to be an attractive alternative for coastal monitoring because it provides the possibility to study a range of spatial and temporal scales, from specific cross-shore profiles to several kilometres of coast, with sampling intervals depending on the required measurement. Therefore, a broad number of coastal forms and near-shore processes can be monitored using remote techniques. For instance, researchers have used video images to extract beach and nearshore bathymetry (Stockdon and Holman, 2000; Aamirikhof et al., 2003), the nearshore hydrodynamics (Chickadel et al., 2003), as well as to unravel the formation and displacement of sand bars (Lippman and Holman, 1989; Ojeda, 2008; Russink et al., 2000) or the beachface morphodynamics (Almar et al., 2008; Ortega-Sánchez et al., 2007). The capabilities and functionality of video-based coastal monitoring systems are evolving rapidly; more so with the CoastView project (Davidson et al., 2007) that highlighted and standardized the possibilities and future trends of these systems for coastal zone or navigational channels management (Medina et al., 2007; Turner and Anderson, 2007; Koningvold et al., 2007).

Since the commercialization of ARGUS – a video-based coastal monitoring system developed by the Coastal Imaging Laboratory at Oregon State University (Holman and Sanley, 2007) – and because many potential applications to unravel nearshore issues based on video monitoring systems have

○ Real time monitoring consists on the automated collection of coastal videomonitoring images, weather data and waves data.

○ The SOCIB Beach Monitoring Facility is using **SIRENA, the open source, low cost video-based videomonitoring system developed at IMEDEA (CSIC-UIB)**. It captures 1500 images of the coast at 4Hz during the first 10 minutes of each hour resulting in a set of different types of images: snapshot, timex, variance and timestack.

○ SOCIB videomonitoring real time data is a web based system and images are hourly available from each one of the monitoring sites.



Snapshot



Timex




Variance






Time stack

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





SOCIB
Balearic Islands
Coastal Observing
and Forecasting
System

BEACH MONITORING FACILITY

Location list

Name ▲

Platja de Palma

Cala Millor

Son Bou

Overview **Location: Son Bou**

Filter options

☐ Camera name ▲

☒ Camera 01
☐ Camera 02
☐ Camera 03
☐ Camera 04
☐ Camera 05

☐ Product name
☐ Timex
☐ Variance
☒ Snapshot
☐ Timestack

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)




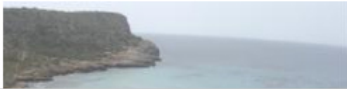


Camera 01 at 06:00 (UTC)



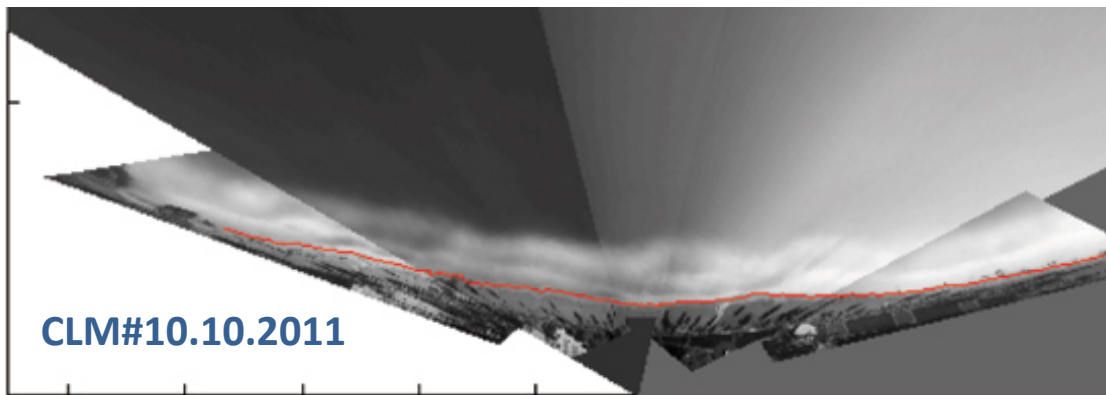
Camera 01 at 07:00 (UTC)



Camera 01 at 08:00 (UTC)

- Every hour the web site is updated with the latest snap-shot, timex and variance images. These can be viewed to provide and immediate qualitative assessment. A zoom and calendar tool enables more detailed examination and image comparison.



- Each week images (timex) are processed automatically to generate plan-view images of the beaches.

- A weekly plan-view image corresponding with the most favourable sea conditions and quality of images is processed in a automatically-manually batch mode to map the present shoreline position along a pre-defined region.

- This information is then automatically analysed against previous shoreline data to generate a dry beach width analysis.

| | 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 |



Palma beach
s'Arenal (Ma)

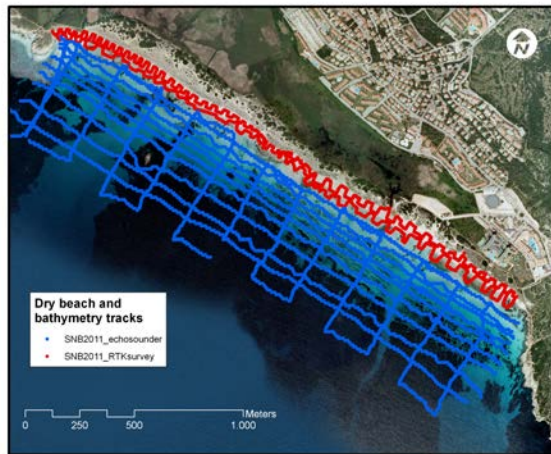


Cala Millor
Beach (Ma)

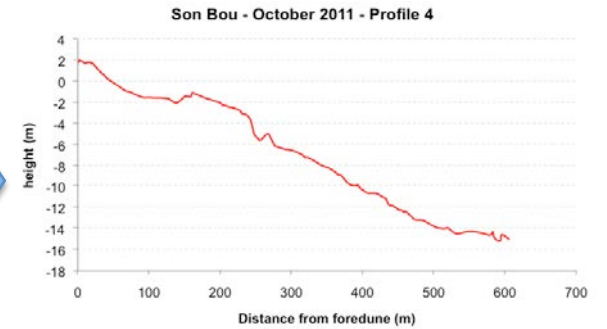


Son Bou
Beach (Me)

| | 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 |
| Bathymetric survey | 12 months | 12 months | 12 months | 12 months |
| Profile survey | 6 months | 6 months | 6 months | 12 months |
| Sediment survey | 12 months | 12 months | 12 months | 12 months |
| Awac download | 4 months | 4 months | 4 months | 6 months |
| Operation | 02.2012 – to present | 06.2011 to present | 10.201 to present | In mind 2013 |



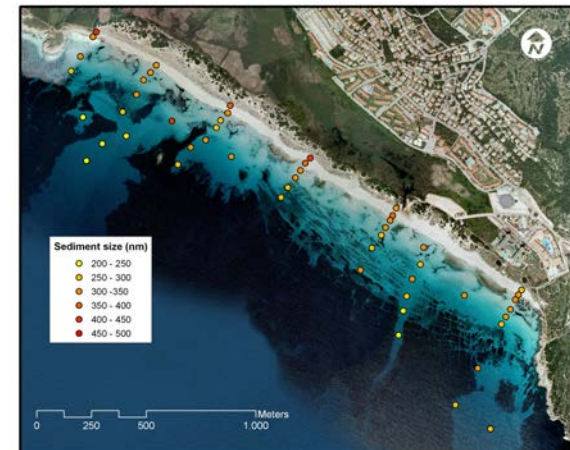
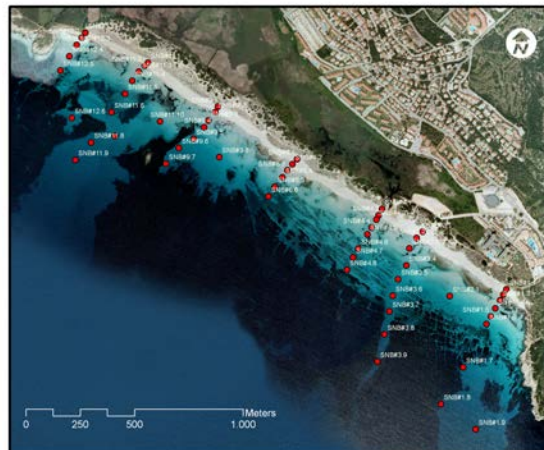
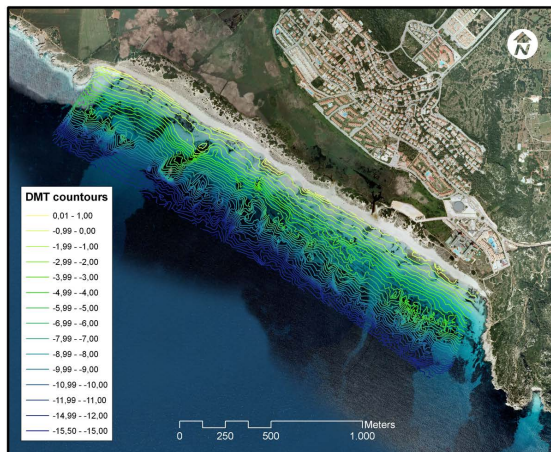
DEM (GIS)



BEACH PROFILES

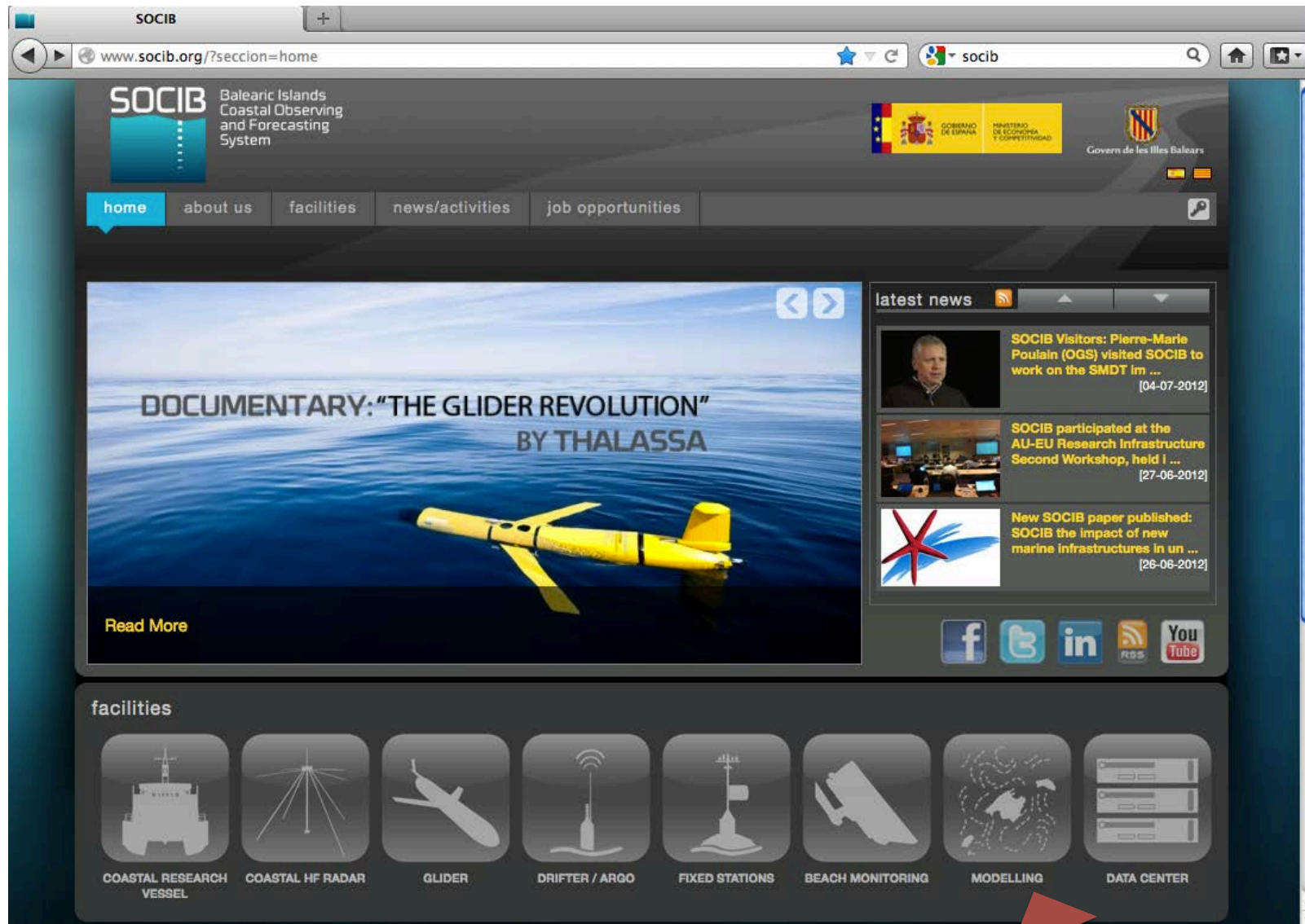


DEM (GIS)



SEDIMENT SIZE CHARACTERIZATION

Information on sediment budgets and sediment properties



A web based products dissemination (www.socib.org)

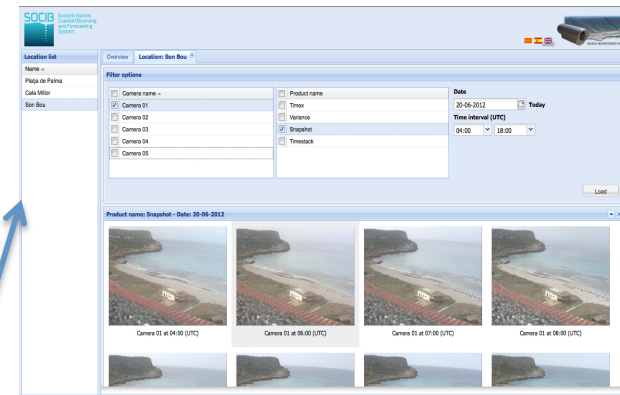
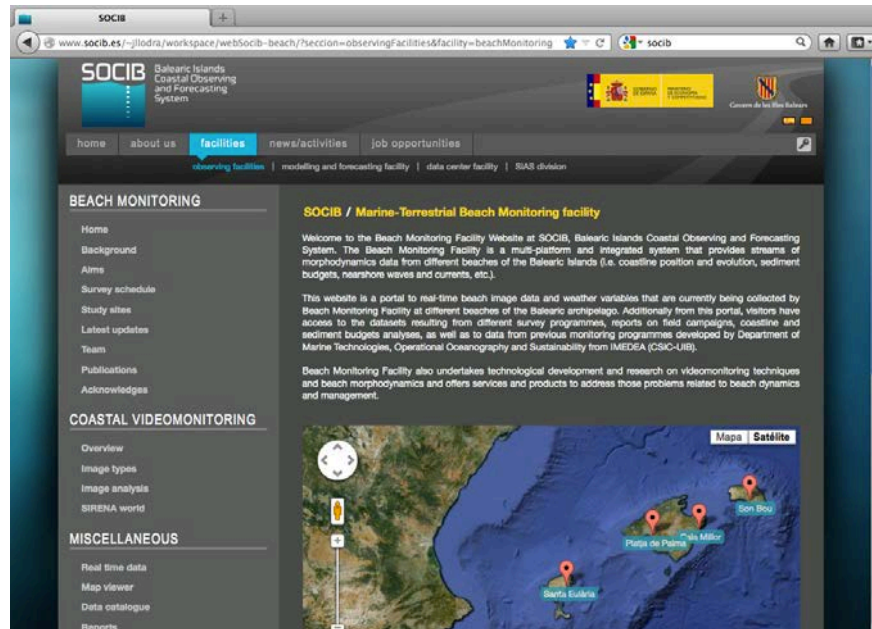
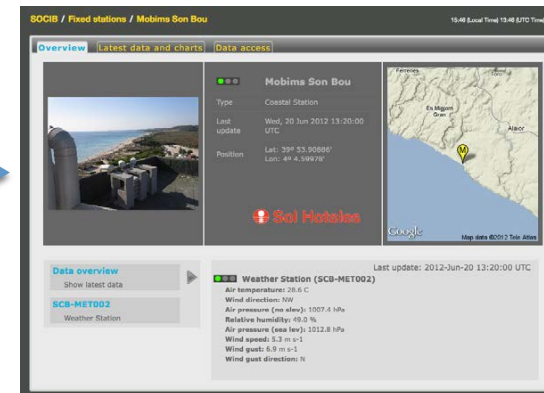
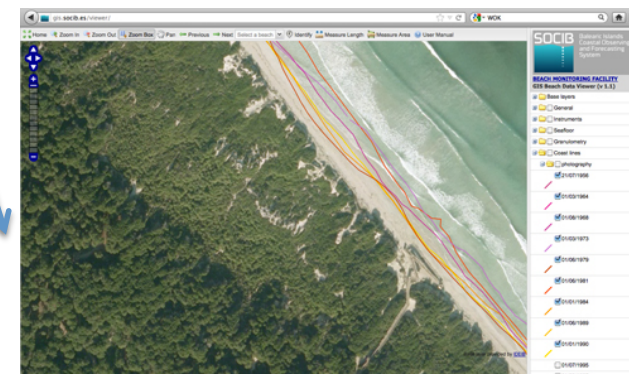


image
application



Weather
& wave
application



GIS beach
maps and
data
application

Location list

Name ▲

Platja de Palma

Cala Millor

Son Bou

Overview

Location: Son Bou

Filter options

☐ Camera name ▲

☒ Camera 01

☐ Camera 02

☐ Camera 03

☐ Camera 04

☐ Camera 05

☐ Product name

☐ Timex

☐ Variance

☒ Snapshot

☐ Timestack

Date

20-06-2012

Today

Time interval (UTC)

04:00

18:00

Load

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



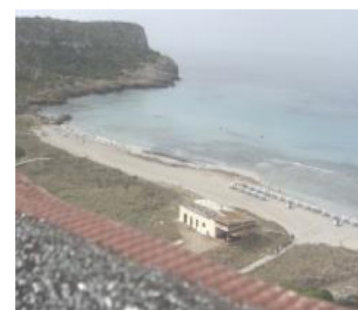
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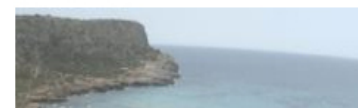
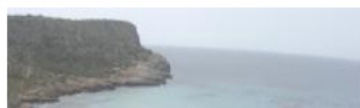
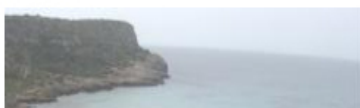
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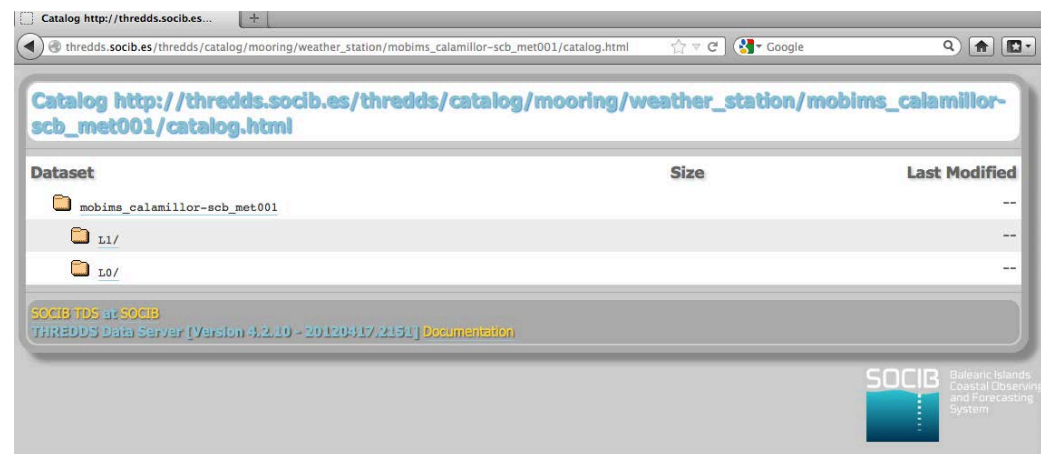
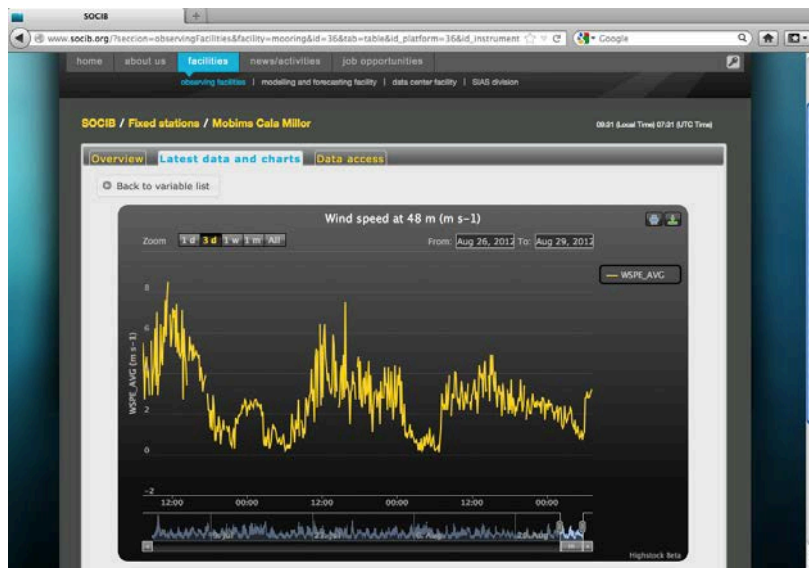
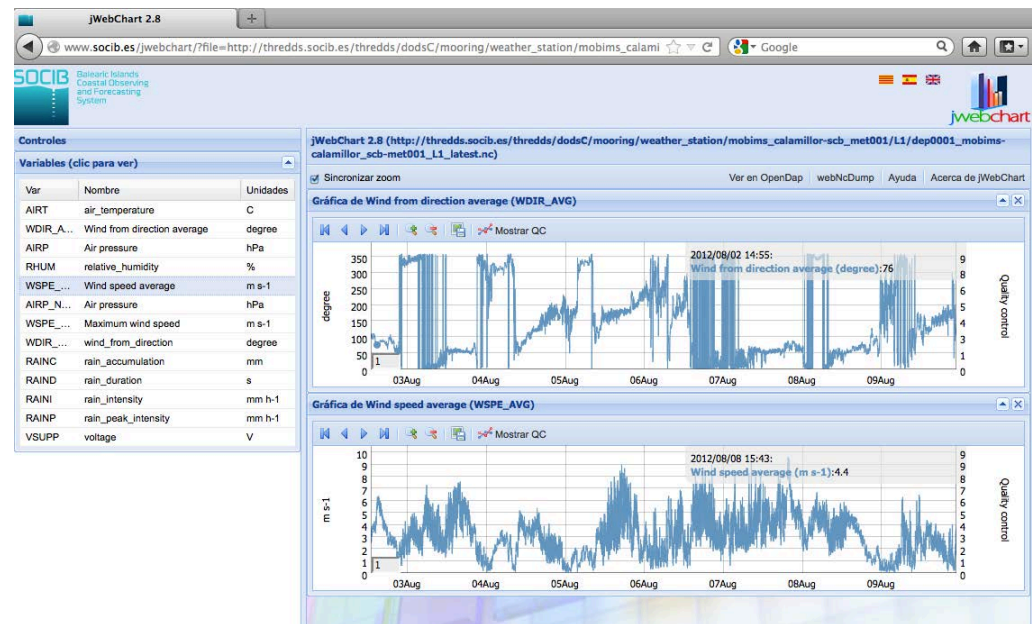
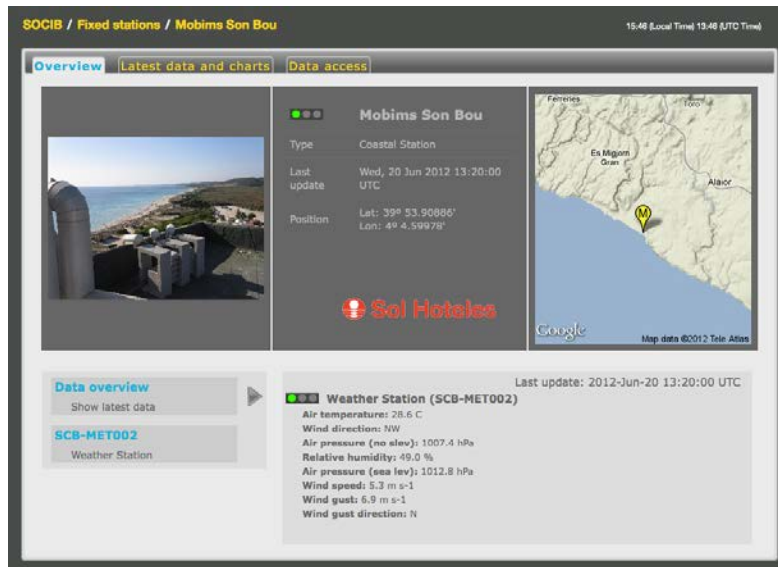


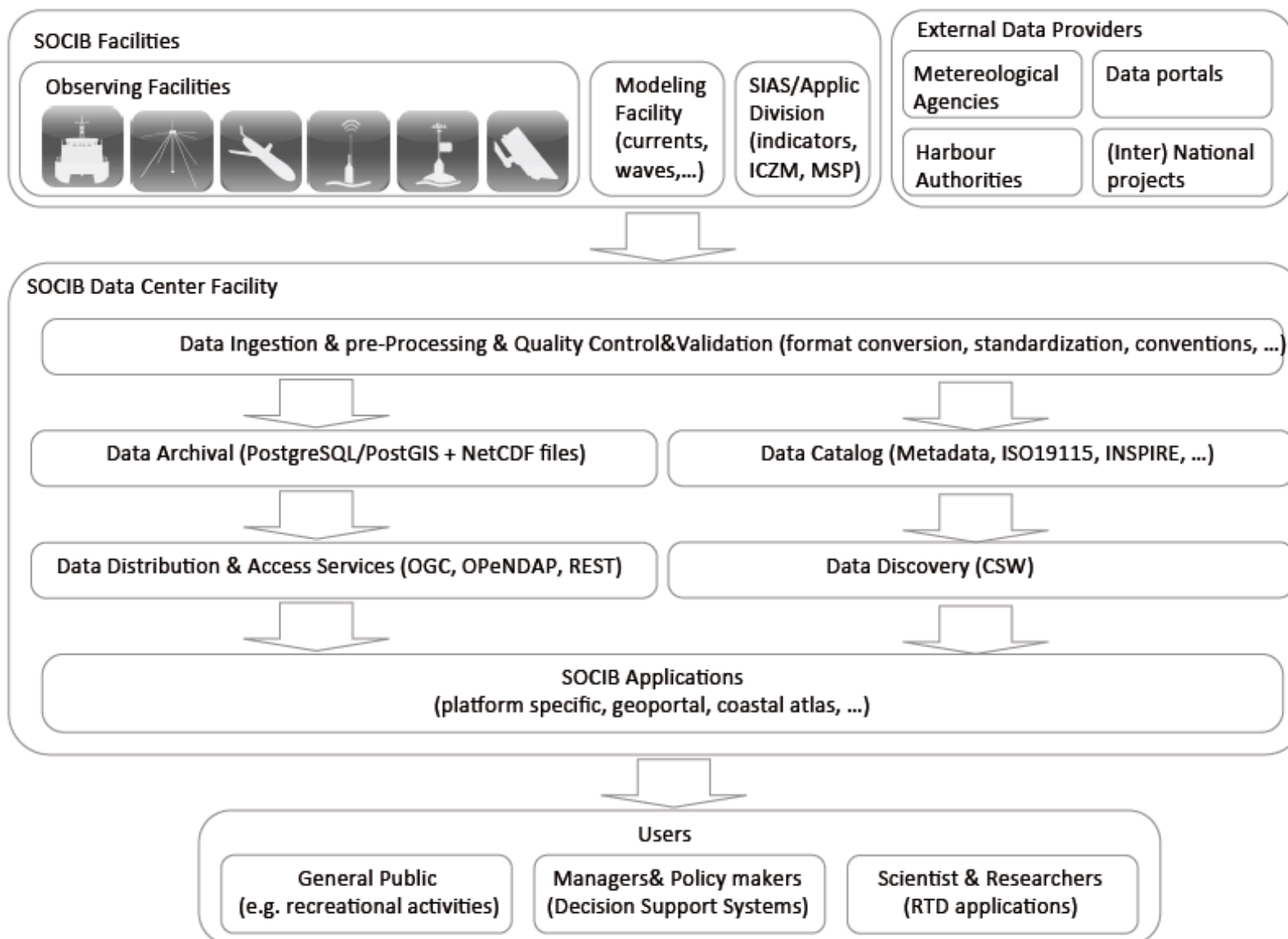
Camera 01 at 07:00 (UTC)



Camera 01 at 08:00 (UTC)







mobims@portal.socib.es - FileZilla

Amfitrió: Nom d'usuari: Contrasenya: Port: Connexió ràpida

Ordre: PWD
Resposta: 257 "/FCDATA/mobimsSNB/FCproducts/Reports"
Ordre: PASV
Resposta: 227 Entering Passive Mode (130,206,32,68,243,224).
Ordre: LIST
Resposta: 150 Here comes the directory listing.
Resposta: 226 Directory send OK.
Estat: Llistat dels directoris amb èxit

Lloc local: Lloc remot: /FCDATA/mobimsSNB/FCproducts/DTM/snb20111002/snb20111002surveypoints

Nom de fitxer

- mobimsSNB
 - AWACSB
 - FCdatafiles
 - FCproducts
 - BeachProfiles
 - BeachSediments
 - DTM
 - snb20111002
 - snb20111002contour
 - snb20111002surveypoints
 - Reports

| Nom de fitxer | Mida del fitxer | Tipus de fitxer | Darrera modificació |
|---------------------------|-----------------|-----------------|---------------------|
| SNB20111004survey.dbf | 2820183 | DBase Do... | 15/02/2012 |
| SNB20111004survey.prj | 400 | prj-fitxer | 15/02/2012 |
| SNB20111004survey.sbn | 94716 | sbn-fitxer | 15/02/2012 |
| SNB20111004survey.sbx | 5636 | sbx-fitxer | 15/02/2012 |
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| SNB20111004survey.shx | 74556 | shx-fitxer | 15/02/2012 |

23 fitxers i 8 c 7 fitxers. Mida total: 3414679 bytes

Servidor/Fitxer local Direcció Fitxer remot Mida Prioritat Estat

Fitxers a la cua Transferències fallides Transferències exitoses

Cua: buida

Beach Monitoring Facility SOCIB

Beach Monitoring Program

Bathymetric, beach and sediment survey at Son Bou (Menorca, Balearic Islands)

October 2011 Field Campaign Report



May 2012
SOCIB, Balearic Islands Coastal Observing and Forecasting System
PerceB, Ed. Neorfe, Ctra. Valldemossa km 7.4
E07121 Palma (Balearic Islands, Spain)

A future debate for coastal geomorphologists: How to define protocols for comparing and disseminating data...

Thanks !

