

Marine Technology developed at IMEDEA - TMOOS

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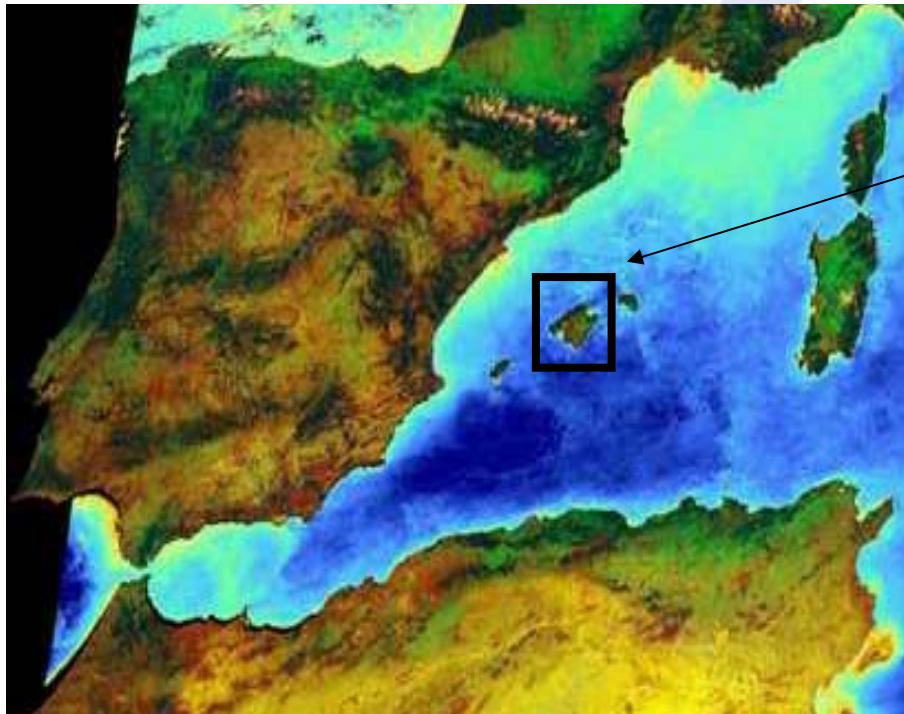
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IMEDEA - TMOOS

Marine Technologies, Operational Oceanography and Sustainability

Mediterranean Institute for
Advanced Studies - IMEDEA



Balearic Islands
Western Mediterranean



CSIC-UIB



Marine Technologies, Operational Oceanography and
Sustainability – **TMOOS department**

Head of department: Dr. Joaquín Tintoré

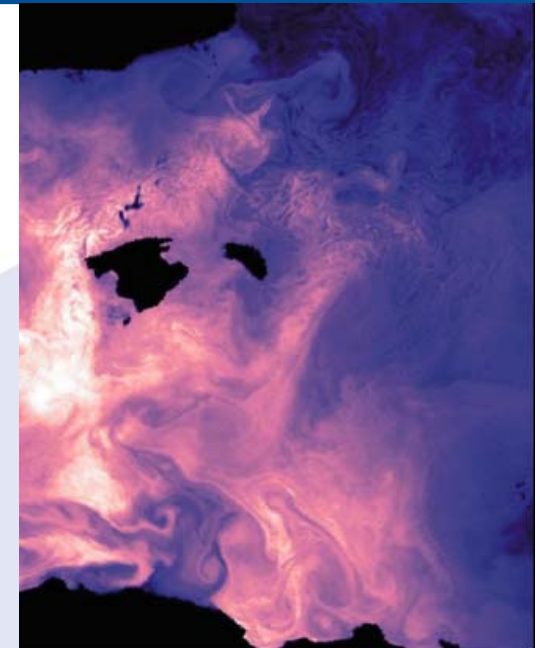
<http://www.imedea.uib-csic.es/tmoos/>

Research Line

Physics and technology of the coastal ocean system:
Observations, forecasting and interactions

Specific objectives:

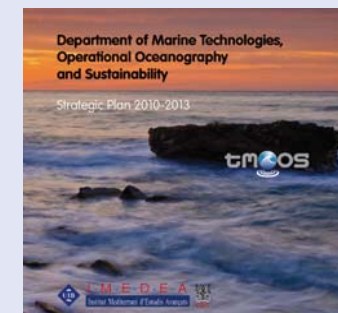
1. A better understanding of global change in the coastal zone therefore specifically including the modifications in climate, oceans, coasts and ecosystems.
2. The development of operational oceanography and related strategic services to society.
3. The development of new technological tools for coastal Ocean studies.



Observations

Numerical
models

Theory



Transfer of knowledge

Technology transfer

The TMOOS team develops new technologies such as for example (AUV's, coastal ROVs, buoys, remote sensing beach monitoring system, etc) which are transferred to end user's through the spin off company (participated by CSIC and UIB from June 2008), Albatros Marine Technologies (AMT).



Know how transfer, innovation

- Beach safety: development of a Hazard Alert System (HAS) in the Balearic Islands.
- Rip Current forecasting system.
- Oil Spill Operational modelling
- Coastal Zone characterization and Environmental Sensitivity Index for Oil spill
- ...

Technology Development Facilities

- Marine Electronic Laboratory
 - Oscilloscopes, function generators, power supplies, etc.
 - Circuit board plotter machine
 - Through-hole plating machine
 - Pick and place machine
 - Reflow soldering machine



- Mechanic Laboratory
 - Lathe
 - Milling machine
 - Mig welding machine
 - Vertical bandsaw
 - CNC vertical milling center
 - Rapid prototyping 3D printer machine
 - Vaccum casting machine
 - 10bar pressure chamber



Technology Development during 2003-2010

- **Underwater Autonomous Vehicles (AUV)**
 - Folaga
 - Cormoran
 - Vacca
- **Remotely Operated Vehicles (ROV)**
 - Pocket ROV
 - Mini ROV (AMT)
- **Drifters**
 - Surface Drifter SD01
 - Surface Drifter SD02
 - MiniDrifter MD01
 - MiniDrifter MD02 (AMT)
 - Iridium Drifter
- **Other Projects**
 - Radio Networked Bouys
 - Automatic Fish Tracking
 - Underwater Bottom Visualizer
 - Bed Shear Stress
 - Glider Mobile Controller

Underwater Autonomous Vehicles - AUV

Underwater Autonomous Vehicles - AUV

- Development of the Autonomous Hybrid Vehicle (AHV) technology:
 - Surface movement to desired Waypoints
 - Diving to measure the water column characteristics (Temperature, Conductivity and Depth – CTD)
 - Satellite based positioning (GPS)
 - Low cost communications in coastal marine environments (GSM, Radio)
 - Minimization of costs

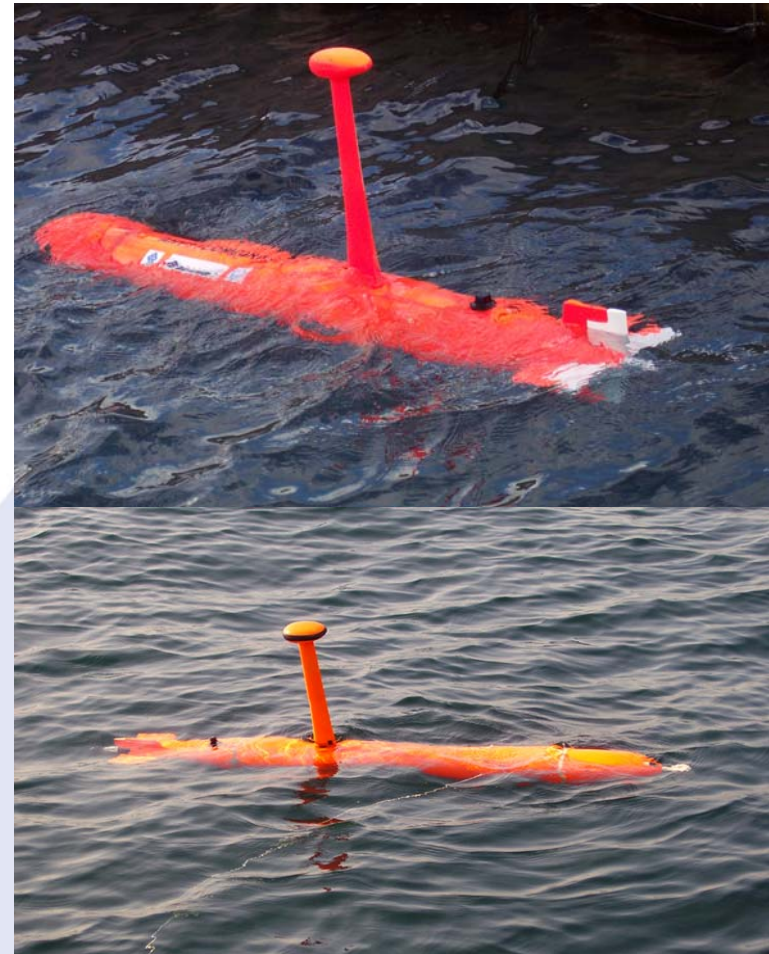
AHV1-2 FOLAGA

- AHV1 - Collaboration between a CSIC scientist (A. Alvarez Diaz), Pisa University and Saclant Undersea Research Center (NATO)
- AHV2 - Collaboration between Pisa University and Saclant Undersea Research Center (NATO), bought by TMOOS at 2005
- For the purpose of his scientific studies TMOOS modified the vehicle AHV2 by reducing its length (from 3 meters to 1.35 meters) and by adding a second fiberglass fairing to improve its hydrodynamic efficiency.



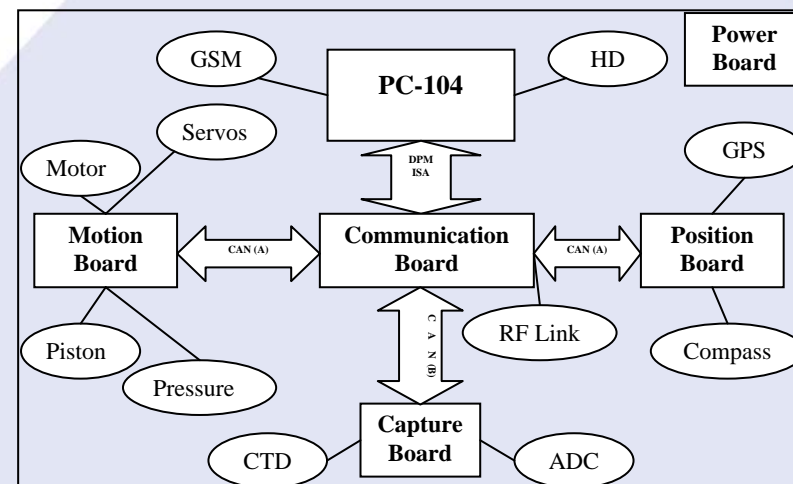
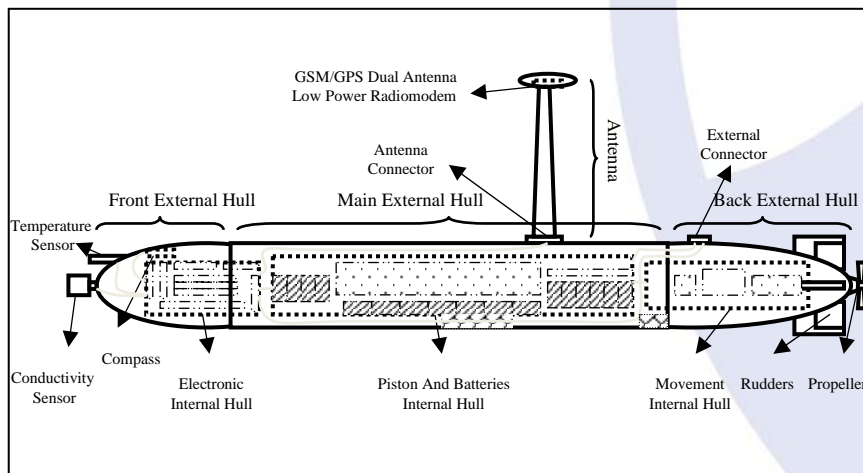
AHV3 - CORMORAN

- REN2003-07787-C02-01/MAR.
(2003-2006).
PI: A. Álvarez Díaz
- New design entirely developed at TMOOS
- Improvements vs. AHV1-2:
 - Hydrodynamic characteristics
 - Propulsion and orientation system (propeller and rudders)
 - Lowering the total vehicle size
 - Internal double hull for security
 - External antenna for communication and positioning
 - 100 meter depth tested
 - Depth control using static immersion controlled by a piston



AHV3 - CORMORAN

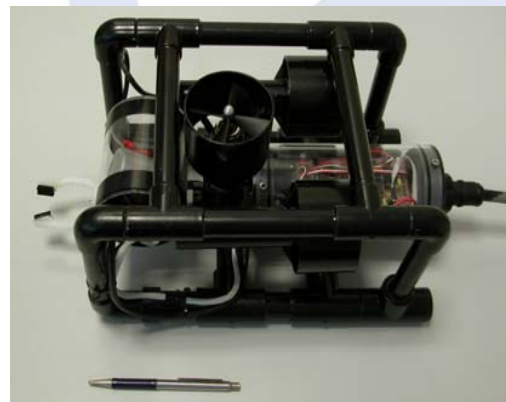
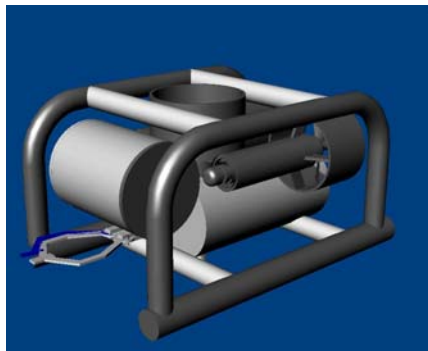
- Evolution:
 - First: Remotely controlled using a radiolink to test the mechanical characteristics
 - Second: Autonomous control using an internal PC and self made electronic boards



Remotely Operated Vehicles - ROV

Pocket ROV

- A ROV prototype was developed for underwater visual inspection at TMOOS (2006).
 - Small size and cost
 - 40 meter depth tested
 - 3 axis movement using 3 propellers
 - 2 axis compass and pressure sensing
 - Controlled by a PC software



Micro ROV

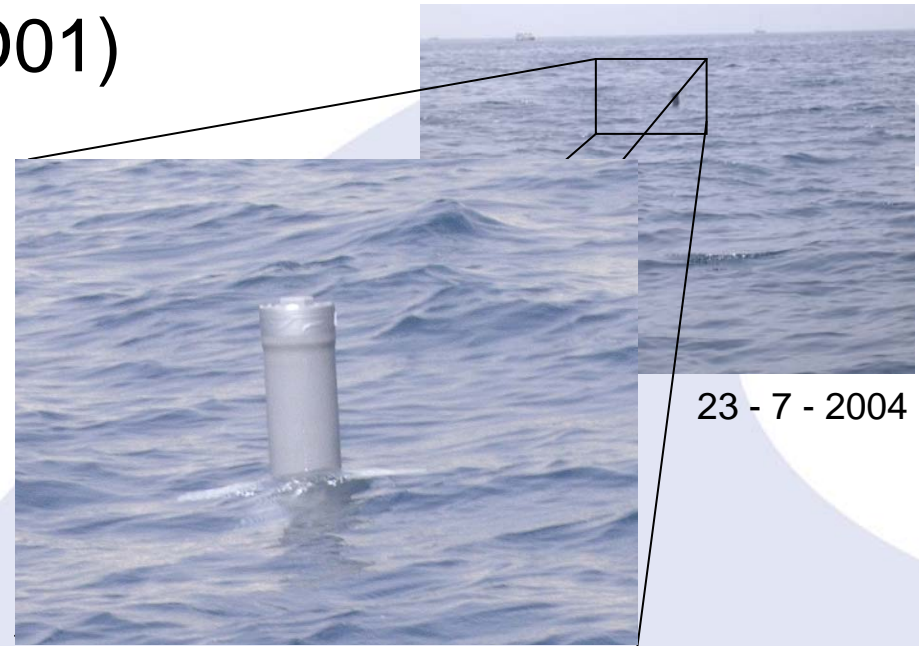
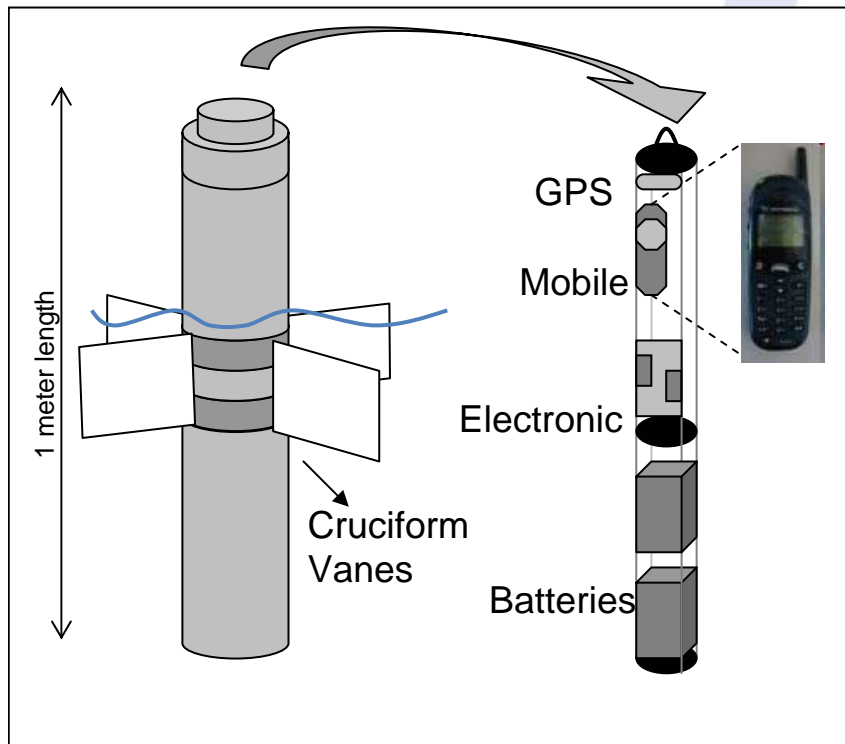
- Evolution of technology (2008):
 - Self-controlled and self-powered
 - Minimized and esthetical
 - Propellers optimized
 - Production design
 - User oriented
 - Different configurations
 - Consumption minimized



Coastal Drifters

DRIFTERS

- First Drifter Design (2004)
 - Surface Drifter 01 (SD01)



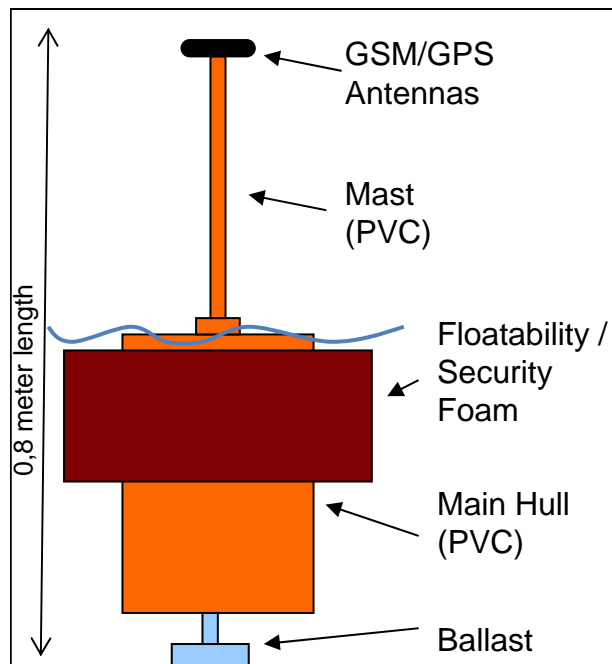
Developed to follow surface currents and **maximize the stability of the buoy.**

Uses GSM modem to send **SMS messages** with the position measured.

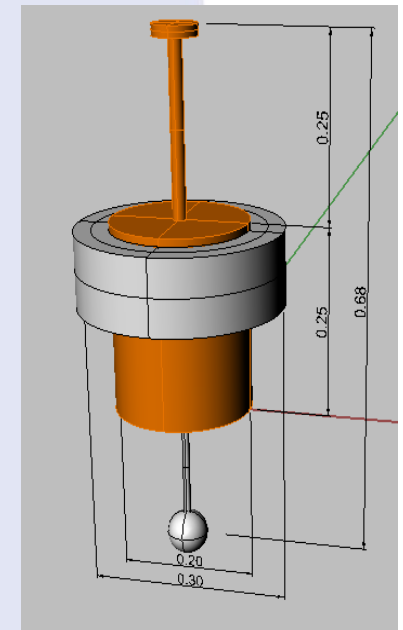
DRIFTERS

- Second Drifter Design (2005)
 - Surface Drifter 02 (SD02)

Designed to follow surface currents **minimizing the overall effect of wind on the chassis**, but maintaining the stability.

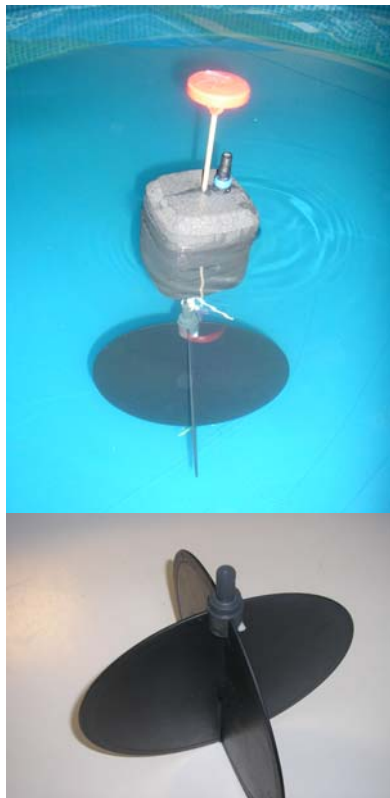


3 - 2 - 2005



Mini DRIFTER

- Third Drifter Design (2007)
 - Mini Drifter 01 (MD01)

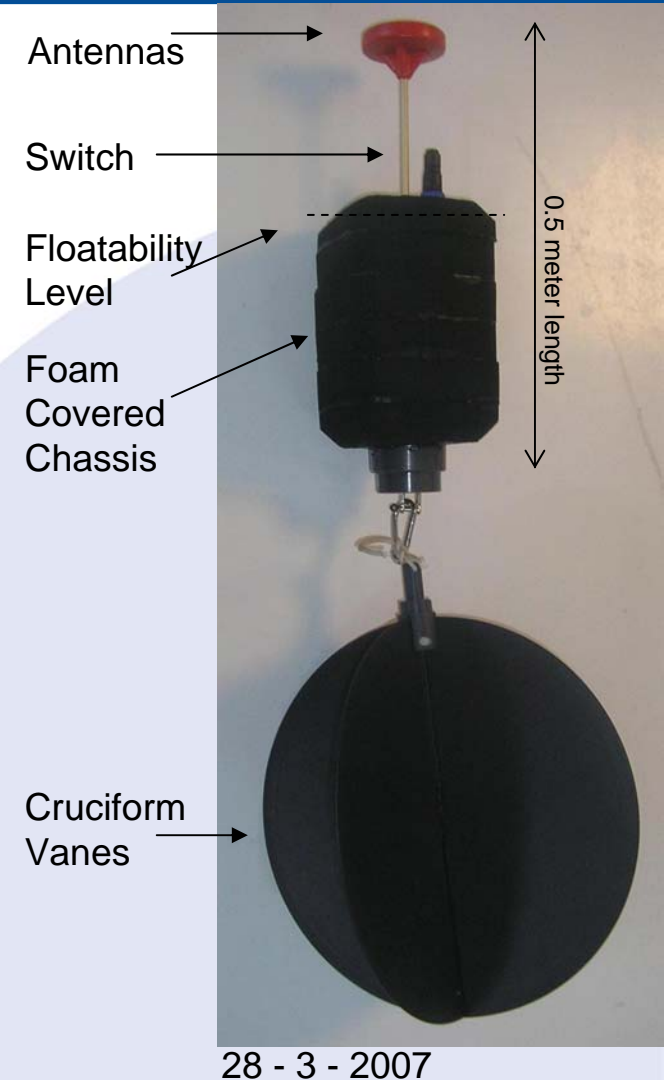


Designed in order to minimize the overall height and size to **avoid damages on possible traffic collisions**. Also a foam covering was used to add floatability and security.

The second design electronic was used, minimizing the quantity of batteries (12 to 3 Kg.).

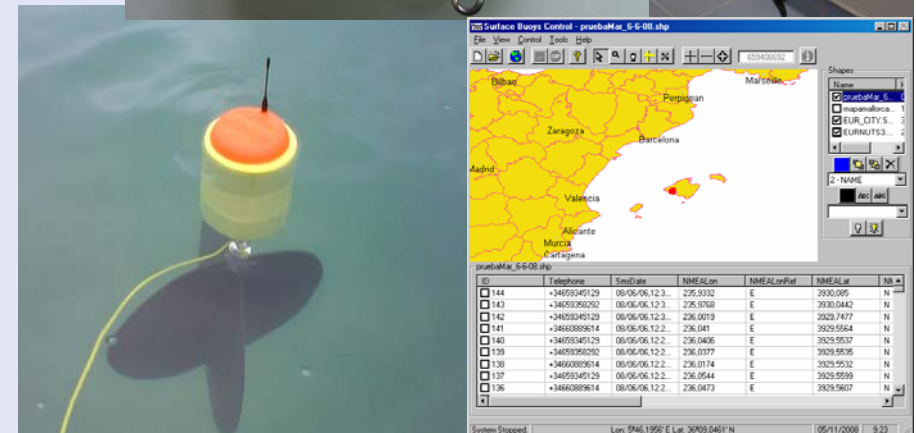
A cruciform vanes were used in order to follow better the desired surface currents.

Autonomy: 2 days



Mini DRIFTERS

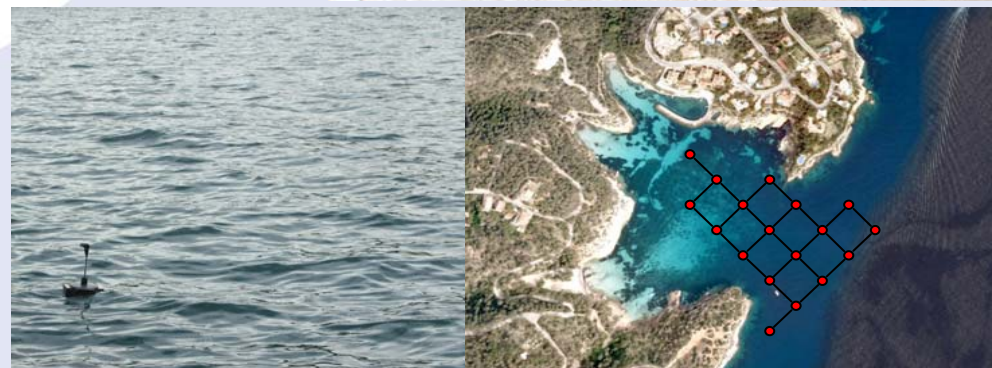
- Fourth Drifter Design (2008)
 - Mini Drifter 02 (MD02)
- RRNN. CTM2006-12072/MAR. (2007-2010)
IP: J. Tintoré.
- Drifters to measure currents in coastal marine environments
- Using Mobile Telephony Protocol GSM (**low cost communications**)
- Low size and weight to minimize collision effects (risk for maritime traffic)
- External foam to add floatability and security
- Temperature sensing
- **Minimization of consumption** (up to 40 days using 3 NiMH batteries).



Other Projects

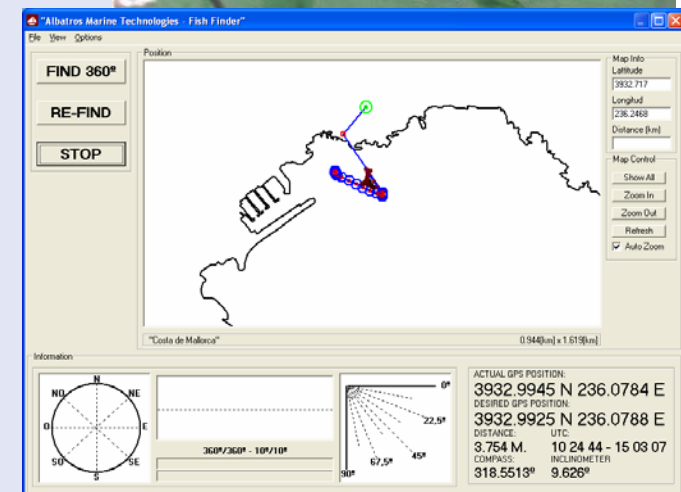
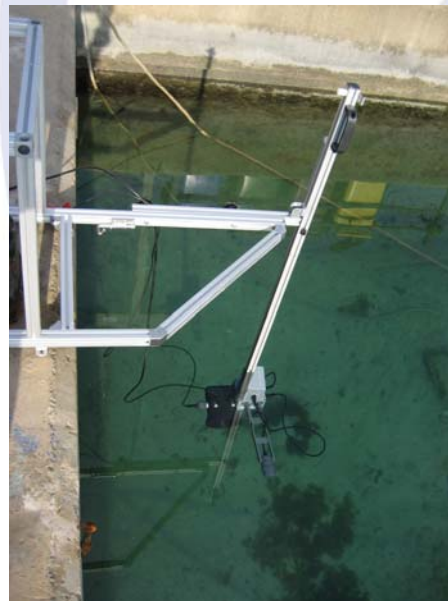
Radio Networked Buoys (WSN)

- Continuous measurement of large maritime areas in a robust manner
- **Low cost devices** (allows maximizing the number of measurement nodes)
- Wireless Radio Network communications (**minimization of transmission costs**)
- Multiple path and dynamic routing network (**minimizes importance of nodes losses**)
- Robust (fault detection) communication protocol
- Allows **real-time measurements** and user defined area and measurement period



Acoustical Fish Tracking

- Insertion of an acoustic emitter on fishes
- Use of a directional hydrophone
- GPS + Dynamic heading and pitch control of hydrophone
- Developed a position detection algorithm



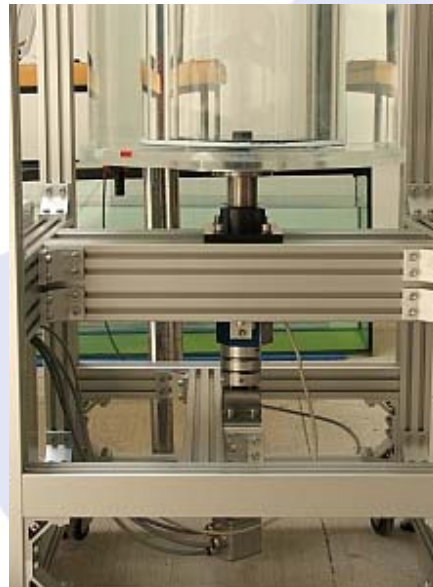
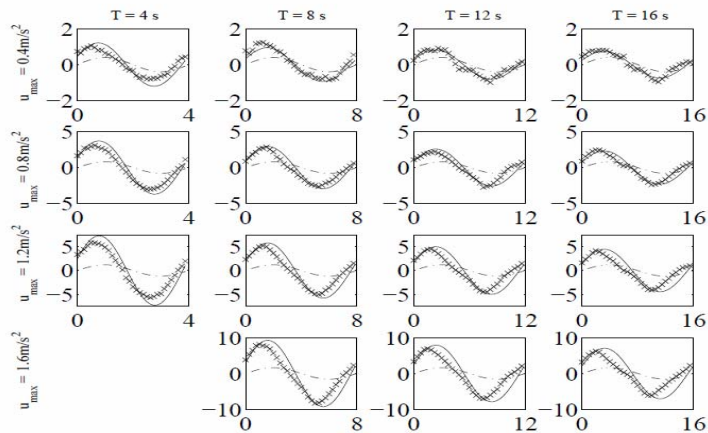
Underwater Bottom Visualizer

- Bottom type detection visualizer
- Underwater georeferenced image recorder
- GPS + Camera recorder software developed
- Optional video recorder

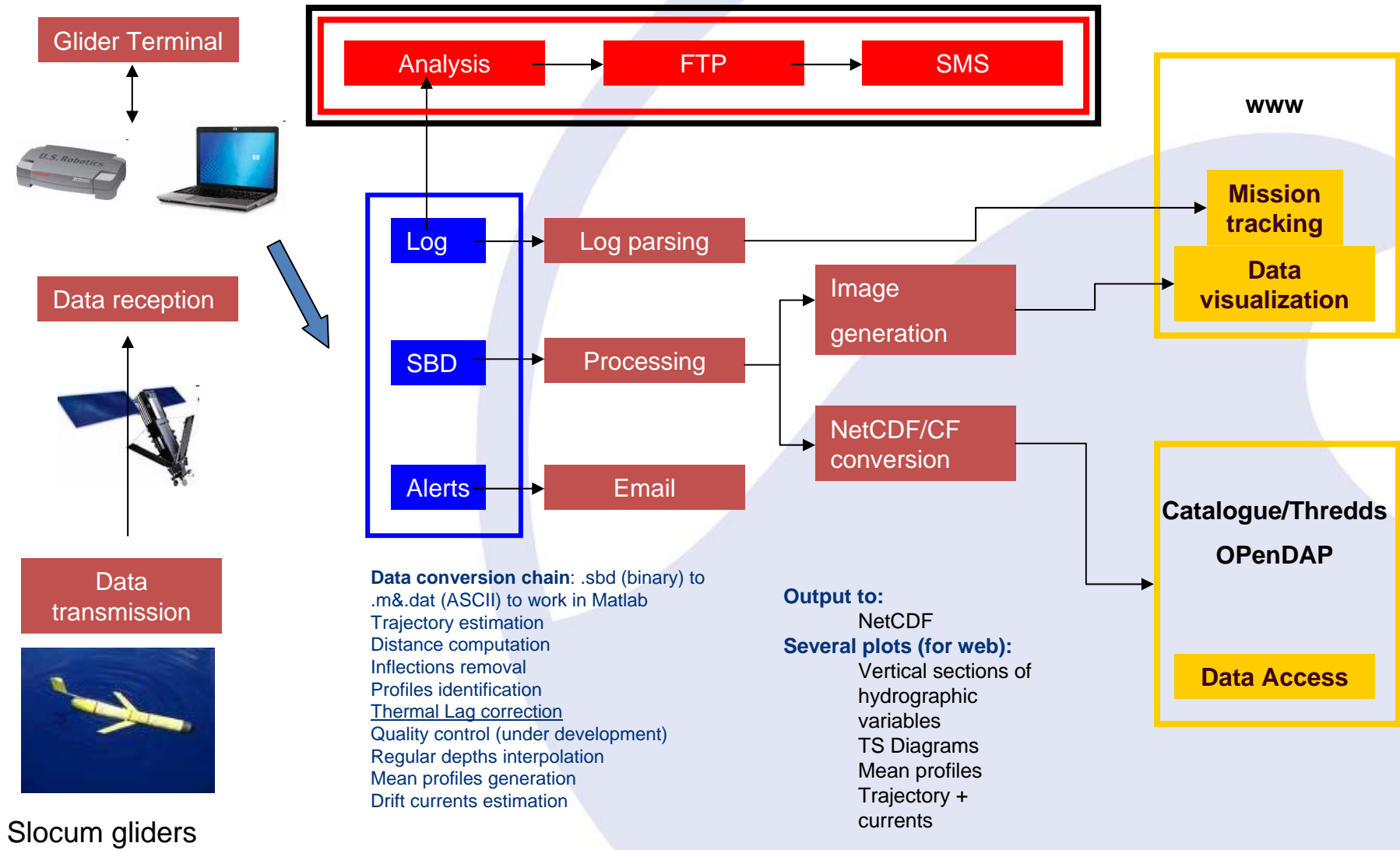


BED SHEAR STRESS

A new instrument built to measure directly the bottom shear stress under different conditions of periodic waves



Glider Mobile Controller



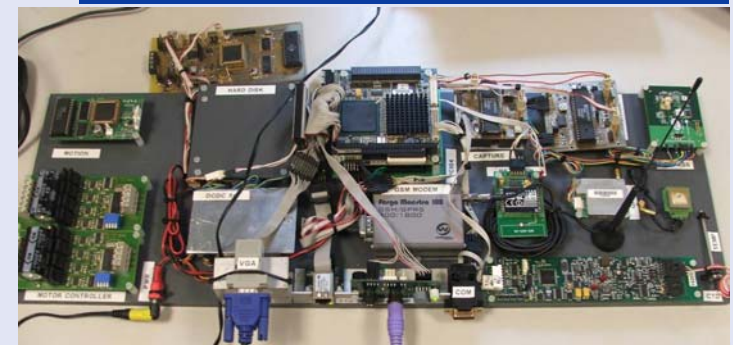
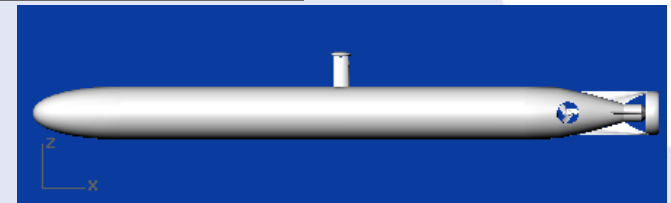
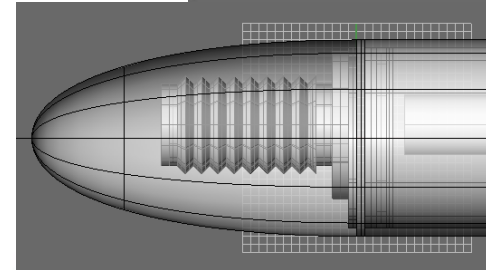
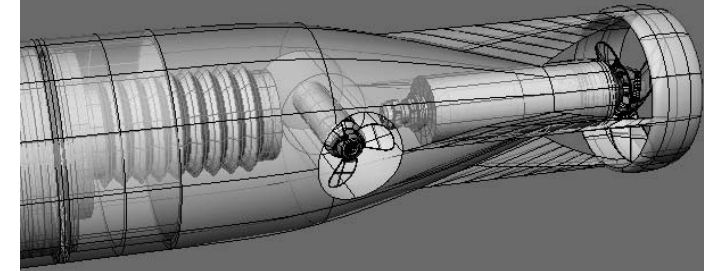
Slocum gliders

Current developments at IMEDEA - TMOOS

AUV - VACCA

Autonomous Vehicle for Water
Quality and Control (2010-Now):

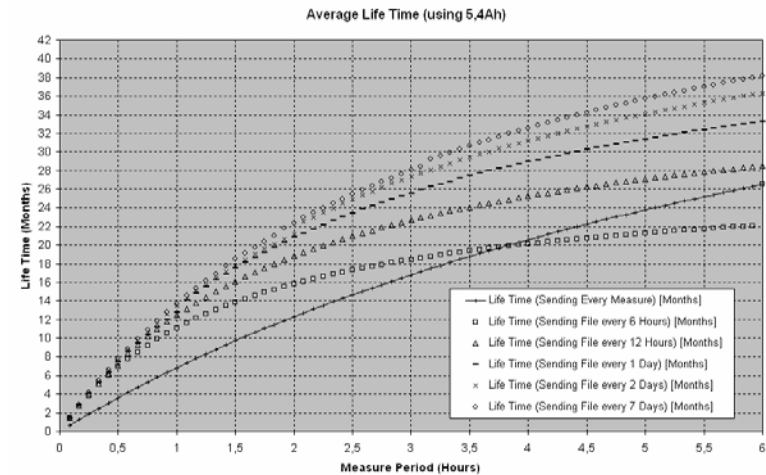
- Development of a new prototype based on AHV3-CORMORAN for testing purposes
- Use the same electronic design
- Complete mechanical redesign
- Minimization of weight and size
- Used as test-bed platform for a new multipurpose AUV



DRIFTERS - IRIDIUM

Low cost satellite-based drifter
(2007-Now):

- Iridium Short Burst Data messaging on a 9601 modem
- Optional GPS receiver
- Antenna suitable for mounting internal to the buoy hull or on top of the barometer port
- A Real Time Clock synchronized to GPS or Iridium system time and capable of generating timed wakeup/polling requests for external equipment
- Serial and/or analogue inputs for external sensor data input, on demand



Thank you!