

An International Coastal Ocean Scientific and Technological Observing and Forecasting System in the Balearic Islands

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Research and technology development presently ongoing and future activities at IMEDEA, a joint research center between the Spanish research Council (CSIC) and the University of the Balearic Islands (UIB) located in Mallorca will be presented. These activities are specifically focused towards (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 and (3) the development of new technological tools for coastal ocean studies. A particularity of IMEDEA activities since 1985 has been the integration of process studies with observational field work, numerical modeling and data management from the open ocean to the coast. Recently, technology development and implementation and near-shore dynamics have been also included in this integral perspective. These studies are mostly (but not only) centered in the Mediterranean Sea, considered a reduced scale ocean laboratory where oceanic processes can be studied at smaller scales than in other oceanic regions (Internal Rossby Radius of order 10 km). Physical mechanisms are thus better monitored and understood in this ocean basin, contributing to the knowledge of physical interactions at local, sub-basin and global scales.

Ocean research in Mallorca has significantly contributed to understand different oceanographic problems related to mesoscale dynamics, fronts, eddies and filaments induced vertical motions, shelf/slope exchanges through canyons, interactions between basin and sub-basin scale (Alborán, Balearic) circulation and topography, interactions between mesoscale dynamics, blocking effects and interactions with large basin scale flows, new forecasting systems successfully applied to different oceanic areas, coastal morpho-dynamics, wave current interactions, beach erosion and sediment transport, and also technology implementation and development (including gliders, new coastal AUV's, and buoys). Results from this research, carried out in the frame of competitive projects mostly funded by EU, Spanish National R&D Plan and also Balearic Islands R&D&I Plan, were published in peer reviewed international journals.

Under this research frame, and through intensive international collaborations which are gratefully acknowledged, a research group with permanent scientists, technicians and postgraduate and graduate students has been progressively established. This scientific team has implemented a **Pilot Forecasting and Observational System** in the Balearic Islands. The system¹ has three distinct interacting elements, Observations, Numerical Predictions and Data Management and GIS coastal zone characterization and services. On the Observational side this presently includes two gliders, two real time coastal buoys, drifting buoys, ARGO floats and satellite data that may be obtained by simple Web Access browsing through the file hierarchy², together with access to different coastal

¹ <http://www.imedeaiuib.es/goifis/OPERACIONAL/EN/>

² clicking on any of the files will prompt user to download the netcdf file

research vessels and instrumentation. Different types of high resolution forecasting systems have been implemented on the modeling side, from beach to sub-basin scale. Work is being addressed presently on three operational systems, one for coastal ocean currents and forecasting oil spill trajectories and impacts in the Balearic coast, one for rip currents forecasting and safety for swimmers in Balearic beaches and one being just started for prediction of large sea level oscillations in harbors (such as Ciutadella in Menorca) associated with atmospheric pressure perturbations. Concerning the data base and GIS part, a detailed characterization of the coastline of the islands is available online for decision making and support, following NOAA Restoration and Response Division categories.

This system is a first step towards establishing an **International Coastal Ocean Scientific and Technological Observing and Forecasting System** in the Balearic Islands, an R&D facility open to international peer reviewed scientific cooperation. This project was first proposed in November 2005 in the frame of the Integrated Coastal Zone Management Balearic Islands Project³, a joint research initiative between IMEDEA and the Balearic Islands Government. The initiative was finally agreed in the Conference of Presidents of January 2007, the Balearic Government and more recently, in September 2007, adopted by the Spanish Council of Ministers. This initiative is a specific contribution to MOON⁴ and is also in line with OOI initiative⁵ and several other observational and forecasting systems (EGO⁶, Liverpool Bay Coastal Observatory⁷) and will be also linked to future European operational initiatives such as the MyOcean and other GMES actions.

The **Balearic Islands System** is a multidisciplinary and integrated **research system** for the observation and forecasting of the coastal ocean variability. The system will be composed of three major components: (1) an observing sub-system, (2) a forecasting and data assimilation sub-system and (3) a data management, visualization and dissemination sub-system. It will allow real time monitoring and forecasting of the space-time variability of the coastal area. The development of new technology that can contribute to science-based sustainable management of the coastal region will also be considered as part of this initiative.

The **general objective** of the Balearic Islands System is twofold: (1) to address and respond to international scientific, technological and strategic grand challenges in the coastal ocean and (2) to vertebrate the coastal ocean operational oceanography research being carried out in the Balearic Islands, contributing to the consolidation of a well structured center of excellence. The **general scientific objective** of the Balearic Islands System is to advance on the understanding of physical and multidisciplinary processes and their non linear interactions, to detect and quantify changes in coastal systems, to understand the mechanism that regulate them and to forecast their evolution and or adaptation under, for example, different IPCC scenarios. The system will specifically

³ http://www.imedeaiuib.es/goifis/GIZCBalears/index_en.html

⁴ <http://www.moon-oceanforecasting.eu/>

⁵ http://www.joiscience.org/ocean_observing, The Ocean Observatories Initiative is a program that focuses the science, technology, education and outreach of an emerging network of science driven ocean observing systems. Building on the heritage of the ship-based expeditionary era of the last century, oceanography is commencing a new phase in which research scientists increasingly seek continuous interaction with the ocean environment to adaptively observe the earth-ocean-atmosphere system. Such approaches are crucial to resolving the full range of episodicity and temporal change central to so many ocean processes that directly impact human society, our climate and the incredible range of natural phenomena found in the largest ecosystem of the planet.

⁶ <https://www.locean-ipsl.upmc.fr/gliders/EGO/>

⁷ <http://cobs.pol.ac.uk/>

address the preservation and restoration of the coastal zone and its biodiversity, the analysis of its vulnerability under global change and consider new approaches to a more sustainable management of the coastal area based on sound indicators, ranges of variability and thresholds.

Five **specific objectives** have been also identified: Scientific, Technological, Strategic (response to society needs), Transfer of Knowledge and Training. They will be reviewed in detail in this presentation together with the expected contribution beyond state of the art, the expected products and benefits, etc. Attention will be also given to address the specific questions raised by organizers: ‘Can we identify how the coastal zone is affected by climatic and anthropogenic factors?’ and ‘Can we forecast, to sufficient accuracy for marine management purposes, the physical and ecosystem response in the coastal zone?’. It is evident that these questions are fully in line with IMEDEA actions and objectives in this topic, areas, objectives and actions that constitute the presently approved Strategic Plan for 2006-2009.

The Balearic Islands International Coastal Ocean Scientific and Technological Observing and Forecasting System will be part of the **Spanish Large Scale Infrastructure Facilities** and will be **open to international** research groups. An international scientific advisory committee will be responsible for the implementation of a peer review evaluation process following the highest quality standards. We will also present initial preliminary ideas on the internal scientific and management structure. The Balearic Islands System should also become an integral and key element of the future Marine Core Service in the Mediterranean.

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