Connecting **European coasts**

Patrick Farcy and **Ingrid Puillat** outline work to create a consolidated network of coastal observation systems and services to support research into climate change and improve on current monitoring facilities

Can you begin by explaining the main objectives of your current research?

One of the main challenges of environmental research is to evaluate how the climate is changing and what are the consequences for mankind. Of course, the global changes have a huge impact on the marine ecosystem health and thereby on human health. Coastal oceanography enables forecasting the evolutions of the coastal seas and assessing the consequences of global change on biodiversity, phytoplankton, fish and marine mammals.

Why is there a need for a central networked infrastructure of coastal observatories?

There is a need for a more coordinated infrastructure network, ie., infrastructures which are acquiring fundamental coastal parameters through harmonised methodology, from sensors to data quality assessment. This will guarantee that best quality datasets are produced from coastal monitoring (mainly through digital models) by scientists and users across Europe. There is also a need to optimise the network; to measure parameters in more sensitive areas. The more data we have, the more precise the results.

What do existing observatories measure and what technologies are currently deployed to procure this knowledge?

The Joint European Research Infrastructure Network for Coastal Observatories (JERICO) priority parameters include standard temperature and salinity, and also dissolved oxygen, carbon dioxide, pH, turbidity and chlorophyll-a. A complementary set of important environmental parameters includes nutrients (nitrate, phosphate, and silicate), sea level and plankton species information.

Existing coastal observatories in European waters are composed of platforms such as moored buoys, piles, profiling systems, gliders, shore-based High Frequency radars, 'ferryboxes' and automated systems on board fishing boats. The sensors themselves are commercial products, such as physical sensors of temperature and currents and chemical sensors; and, in some cases, optical sensors.

How will data be translated for modelling the coastal regions around Europe?

The first step is to choose reliable sensors and calibrate them following approved methodology. It is important to assess how and when bio-fouling will impact sensor measurements. The datasets are transmitted to a data centre, for quality control and validation. Following this step, the data become available for assimilation into oceanographic models or validation.

Will an integrated approach help in our understanding of existing coastal resources and emerging trends in marine stocks?

Naturally, JERICO is only one link in the chain. For modelling fish stocks, Ifremer has developed the RECOPESCA system (this will be integrated in JERICO) which measures the fishing effort, and physical parameters in the water column, on volunteer fishing ships. All the information – depth of the net, weight of the fish and physical parameters – is concatenated with the GPS position and sent to the data centre. These datasets are used in national databases and also in the European databases for the Common Fishing Policy.

Sensing coastal changes

A programme integrating and updating observation data, technologies and sites for a **Joint European Research Infrastructure Network for Coastal Observatories** will provide coherent high quality Europe-wide coastal monitoring data and enable transnational research

How will JERICO contribute to Global Monitoring for Environment and Security (GMES)?

GMES is an EU programme that promotes the use of satellite and *in situ* data to monitor the ocean environment on a global scale. In situ data can and will feed GMES databases by contributing to the MyOcean Marine Core Service. In addition, validation of satellites continuously requires new in situ data – although it is not trivial to validate satellites near the coasts. In that way, the JERICO network will provide data to GMES downstream services.

Can you explain your contribution to the European Global Ocean Observing System (EuroGOOS)?

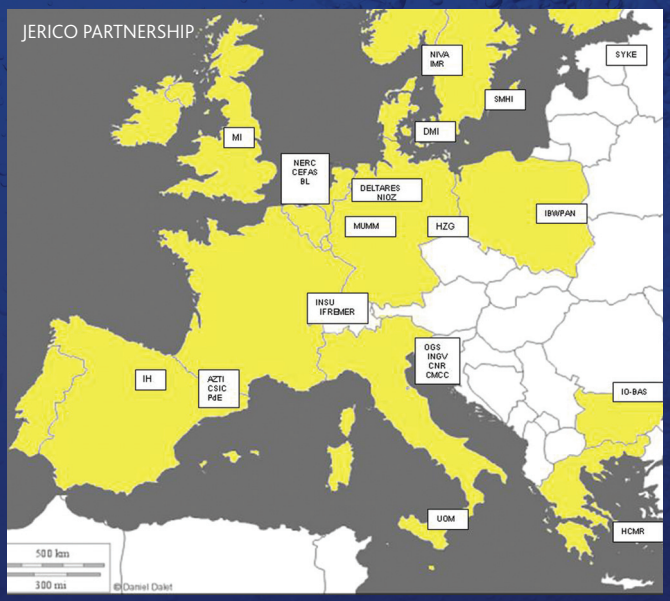
The six Regional Ocean Observing Systems in EuroGOOS are part of the JERICO network. Their involvement is managed in a dedicated work package on trans-regional exchanges. Effectively, the JERICO network is the coastal part of the EuroGOOS programme.

What framework is required in order to guarantee the project's future sustainability?

The maintenance of a coastal observatories network induces high costs because regular site visits are required to maintain the observing systems.

In JERICO, we shall consider the development of some cheaper, more compact, autonomous systems. One future trend is to integrate the citizen science into the network by developing small systems which can be housed in professional fishing boats or private sailing boats; with comparatively low investment and lower operating costs, we could then have a really significant and interesting set of information.

SINCE THE INCEPTION of the Global Environment Observing System of Systems (GEOSS), worldwide efforts to integrate, consolidate and make information about conditions in the Earth's atmosphere, oceans and land universally available have been energetically undertaken. These activities have been directed towards global sustainability and coordinated responses to threats to human health and safety. In parallel, a number of international programmes now contribute to decision support. The European component of GEOSS is the Global Monitoring for Environment and Security (GMES) programme, which seeks to standardise observations of land, oceans and atmosphere, to harmonise emergency responses and to inform policies on global security and climate change.



In terms of the European marine environment, the programme that supports GEOSS is the European Global Ocean Observing System (EuroGOOS). EuroGOOS comprises a number of Regional Ocean Observing Systems (ROOS) and a new programme, Joint European Research Infrastructure Network for Coastal Observatories (JERICO), has been conceived to integrate all regional coastline observing elements into a network of European operational coastal observatories (OCO).

JERICO is being funded within the European Union's Seventh Framework Programme (FP7) and supports the European Strategy Forum on Research Infrastructures; in this capacity, JERICO is a strategic move towards strengthening and integrating European scientific research on evolution of the marine environment and climate change. The Programme's main objectives aim to ensure that a wide variety of datasets, collected from increasing sources of observations and information systems, are standardised and made easily available in order to meet the ever-increasing demands of coastal oceanographic management and research. The work is also expected to contribute to climate research and marine ecosystem planning.

JERICO is being developed by a consortium of 27 partners from 17 European countries under the management of the Institut français de recherche pour l'exploitation de la mer (Ifremer), the French national research centre in charge of sustainable management of the sea. The programme started on the 1 May 2011 and is due for completion by the end of April 2015. Patrick Farcy, the coordinator of JERICO, is a Senior Engineer responsible for oceanographic research management at Ifremer and is also leading the Service Access work package.

Within the programme, coastal observing methodologies are being harmonised according to common technical standards and coastal sensor calibration will be standardised. The work offers a significant opportunity to modernise obsolete technologies and methods, improve the range of information collected and explore the implementation of emerging technologies.

COASTAL OBSERVATIONS

Coastal monitoring systems have links to meteorological services and environmental

JERICO

JOINT EUROPEAN RESEARCH INFRASTRUCTURE NETWORK FOR COASTAL OBSERVATORIES

OBJECTIVES

JERICO proposes a Pan European approach for a European coastal marine observatory network, integrating infrastructure and technologies To increase the coherence and the sustainability of these dispersed infrastructures.

PARTNERS

Ifremer, France • **SYKE**, Finland • **IBWPAN**, Poland • **DMI**, Denmark • **NIVA**, Norway • **IMR**, Norway • **DELTARES**, The Netherlands • **OGS**, Italy • **CNR**, Italy • **UOM**, Malta • **HCMR**, Greece • **NERC**, UK • **INGV**, Italy • **HZG**, Germany • **MUMM**, Belgium • **CEFAS**, UK • **SMHI**, Sweden • **CSIC**, Spain • **NIOZ**, The Netherlands • **MI**, Ireland • **BL**, UK •**TECNALIA-AZTI**, Spain • **INSU/CNRS**, France • **IH**, Portugal • **Institute of Oceanology/Bulgarian Academy of Sciences**, Bulgaria • **Puertos del Estado**, Spain • **The Euro-Mediterranean Center on Climate Change**, Italy

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agencies, providing data for climate research weather forecasting and oceanic modelling. It is also required for assisting with responses to disasters such as hazardous material spills. Coastal and shelf sea observations in particular, are important for predicting coastal flooding, managing shipping safety and marine resources, and monitoring potential threats from river discharges and agricultural runoffs that may degrade water quality or lead to excessive algal blooms.

Coastal observatories measure a wide range of parameters collected from sensors that are housed on fixed platforms (such as buoys, platforms, piles, gliders and fishing boats), 'ferryboxes' on ocean liners and cargo ships, and from devices carried by 'ships of opportunity' (commercial and private boats, and yachts that volunteer to participate in collecting measurements). High Frequency radars on shore measure the speed and direction of ocean surface currents – they can measure large marine areas, many kilometres off shore. All of these measurements, methods and technologies will be joined up in the new network, as Farcy explains: "We need to combine high-resolution models and precise observations of both physical, chemical and biological parameters".

DEVELOPING JERICO SERVICES

JERICO is producing a networked infrastructure based on the end-to-end coastal monitoring process from data acquisition to dissemination. The work is structured in 10 Work Packages (WPs), the first two taking the initial baseline of current technology and methods and setting a common vision and strategy for the future. Given the goals of the project, a key consideration is to ensure terminology is being standardised. A technical harmonisation WP1 addresses the various observing systems – an example of such a system is RECOPESCA, which is installed on volunteer fishing vessels and collects information about catches and environmental factors to inform coastal management and research activities on fish stocks. "There is also a need to optimise the network, to measure parameters in more sensitive areas. The more data we have, the more precise the results will be," Farcy highlights. This optimisation process is the focus of another work stream.

Ultimately, the programme is developing a strong cluster of services. Best practice guidelines and quality-control standards are being produced and means of improving OCO service components through technological upgrades and innovation.

The researchers are assessing management of distributed data, which is currently held in systems such as MyOcean and SeaDataNet (see pages 9 and 27 respectively), including data requirements for ocean modelling systems. Interfaces between the different ROOS are being developed through a dissemination web portal, OceanBoard. This will provide information about the programme and its progress, to professional and academic users and policy makers. It will also support raising public awareness about the programme. As a key requirement is for the OCO to be cost-effective, operational and maintenance methods and costs will be addressed – this includes sensor fouling, calibration and quality control.

One important component of JERICO is trans-national access (TNA) to infrastructure. TNA is designed to share research infrastructures beyond national boundaries and promote knowledge by providing access to data and resources to researchers from countries lacking the necessary infrastructure. Examples of products include databases, prototypes, instruments, algorithms, protocols and standards. A major objective of TNA is fostering joint research initiatives across national boundaries. This aspect of TNA is piloted in a number of twinning experiments: "The expectation is that this will strengthen collaboration between twinned partners around common inter-calibration procedures hence providing better quality data for better quality results," explains Farcy.

FUTURE PROOFING

"One of the main challenges for environmental research is to evaluate climate change and its present and longer term consequences for human beings. We need to gather the longest possible time-series for understanding and predicting global change and to sustain scientific activities. Therefore it is crucial to guarantee a long lifetime for the JERICO network," Farcy reflects. The latter requirement, together with the cost and time that would be necessary to develop and implement new technology, led JERICO to seek technological sustainability of the OCO. The consortium therefore endeavours to incorporate emerging profiling technologies for coastal seas, to develop new technologies such as new biochemical and DNA/RNA physico-chemical sensors and to enhance interoperability between existing sensors and systems; the intention is to harness mobile technology and software for monitoring key biological compartments and processes; and to increase coastal oceanographic measurement.

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