Ocean Sensing Comes of Age: European Consortium Advances Interoperability in Science

Published on Monday, 24 August 2015 14:37 Lori Keesey 0 Comments

Different stressors are affecting ocean health and productivity. The European NeXOS project is developing a sys distributing data seamlessly.

Associate Professor Joaquín del Rio Fernandez, an expert in the development of "smart" electronic interfaces at the Universitat Politécnica de Catalunya in Barcelona, asks a question: "If you're able to connect a USB device to any computer without problems, why can't you connect an instrument to any type of platform?"

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According to him, the answer is simple: While a number of industries and disciplines have embraced interoperability — most notably the telephone industry where a call is placed and received regardless of the device or means of transmission — the marine sciences community has yet to create an approach for developing an in-situ, end-to-end monitoring system capable of exchanging and making use of information seamlessly, with little human intervention.

That is, until now. Under the auspices of the European Commission's (EC) 7th Framework Programme, the Ocean of Tomorrow 2013, del Rio and a consortium of interdisciplinary experts have begun the challenging task of designing multifunctional "plug-and-play" sensor systems that scientists could deploy on virtually any fixed or mobile platform to monitor the health and productivity of ocean waters surrounding the European continent and beyond.

Called NeXOS — short for next generation multifunctional web-enabled ocean sensors for a changing ocean — the project also is developing standards and technologies that would allow users to share data and operate the sensors via the Web, creating a complete, end-to-end system that would dramatically reduce the complexity and cost of gathering and disseminating ocean observations — a daunting task given the fact that the seas cover 70 percent of the Earth's surface.'

Since it began in 2013, "NeXOS has made good progress implementing an integrated strategy," said Jay Pearlma

leading community outreach for the wide-ranging project. NeXOS builds on other initiatives, like the European S (ESONET), and is supporting the EC in leveraging synergies in Oceans of Tomorrow 2013 projects, he said.

"For sure, this effort will not be a success in the future if no one uses it," said del Rio, who is addressing interope and platform level. "For this reason, the project consortium includes instrument and platform manufacturers."

Now involving 21 partners in academia and private industry, the project has established the overreaching NeXOS begin testing different prototype optical and acoustic sensors later this year. These technology designs will be m licensing and open sources by 2017.

Although other projects are addressing many of the same objectives, "NeXOS, with 21 partners, has the capabil systems for ocean observations," said Eric Delory, who works with the Oceanic Platform of the Canary Islands (P NeXOS. "This raises complexity in terms of coordination, but it has the advantage of representing a broad comm expertise."

Once completed in a couple years, NeXOS is expected to fulfill European policymakers' goal of developing a sust capability to monitor the oceans, which regulate the climate and play an integral to all known sources of life.

"NeXOS will significantly facilitate the sharing of oceanographic measurement data," said Simon Jirka, a project German-based organization that fosters innovation in the field of geoinformatics and is responsible for developir architecture and corresponding software tools. "While several projects have addressed this issue more narrowly, cover the whole path, from the sensor to the user of the resulting data for in-situ ocean observation," Jirka said. much easier for data consumers, such as scientists, to access data from very heterogeneous sensors that are op organizations and countries."

Much-Needed Capability

The advent of such a system, which would monitor the European seas from near-coastal areas to the open ocea the sea floor, can't come too soon, NeXOS participants say. "There is a growing concern about the health of the different stressors," Pearlman said.

Oliver Zielinski, a professor of marine sensor systems at the University Oldenburg in Germany and lead develop sensors, agrees.

"Oil contaminations are a threat to the marine environment," Zielinski said. "Algae types, including potentially ha to both environmental-monitoring stakeholders and scientists alike. The same holds true for the carbon system, changes need to be evaluated."

Different environmental stressors, such as pollution, climate change, and overfishing, are affecting life. Image Credit: Jay Pearlman/IEEE

Environmentalists also have been sounding the alarm about declining fish stocks. In recent years, supplies of co anchovy, and sea bass have sunk to their lowest levels in decades, prompting concerned citizens and organizatic on catches. In 2014, the European Union implemented changes in its Common Fisheries Policy, which was estab rules for managing European fishing fleets. Among other things, the new policy limits fishing to "maximum susta no more fish can be caught than the existing stock can reproduce.

"Reproduction and the sustainability of the fish stock also are affected by other environmental factors, such as c activities, and pollution," Pearlman said. "These factors also must be understood to fully address the overall heal Europe's open waters."

Stove-Piped and Disparate

With so much at stake, creating a comprehensive monitoring system has proven elusive and challenging. Unlike marine-sciences community has yet to adopt end-to-end interoperable sensor systems that would improve effici and ultimately drive down costs. A significant roadblock, Pearlman said, is the community's relatively small size.

As a consequence, the community has made due with a variety of sensor and instrument types, each with its ow communication protocols, and data formats. Connecting these disparate devices into a network requires speciali translate command and data protocols between the individual instruments and the platforms on which they resi require extensive manual configuration to match the driver software of each network port to a specific instrume large number of instruments and platforms that need configuring, the task quickly becomes Herculean.

Given the expense of technology development, the scope of the challenge, and the relatively small number of er needed "something big, a large program or project" that could fund, design, and promote the architecture for pl technologies to distribute the resulting data to users around the globe, Pearlman said.

The EC's 7th Framework, coupled with other agreements, provided the critical mass, Pearlman added.

NeXOS Innovations in a Nutshell

An important piece of the NeXOS architecture, of course, is the sensor. Two types are in development under this that aims to improve interoperability and slash the costs of sensor systems. Though they will perform different j

low-cost, and consume less power.

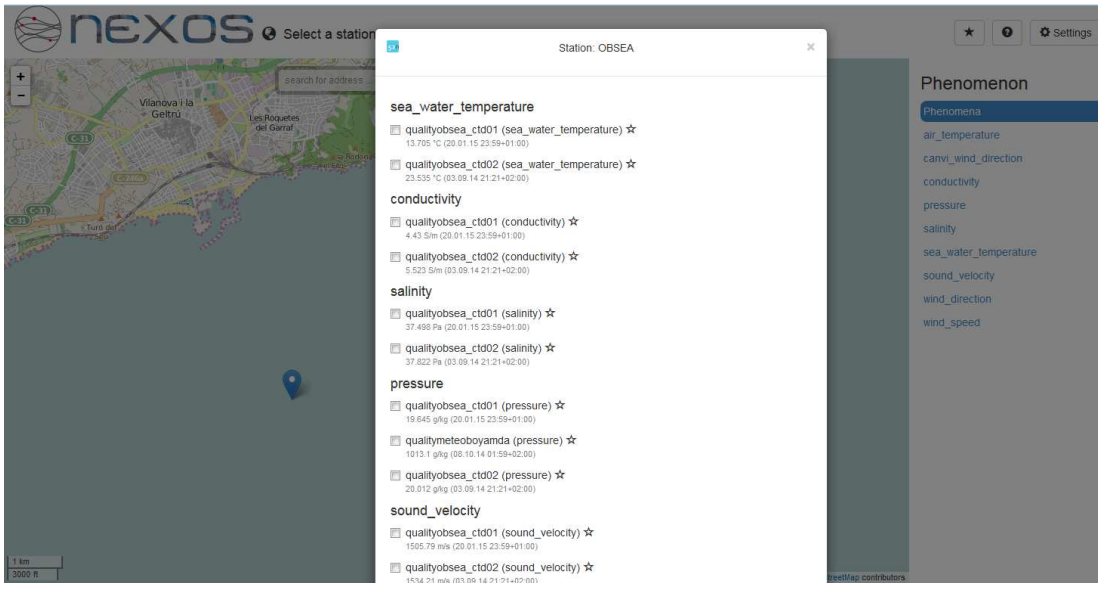
This image shows the PLOCAN offshore platform, which currently is under construction. It will be installed in 2016 east of Gran Canaria. The platform will ease the operations of fixed and mobile ocean observing systems and accelerate tests of new technologies. Compact NeXOS sensors will be deployed on gliders from the platform. Image Credit: PLOCAN

Optical sensors will measure chemical compounds, such as nutrients, dissolved gases, acidity, and organic matte measurement techniques. "Fluorescence sensors will detect oil and other contaminates, absorbance sensors will chemo-optical sensors will assess key parameters of the carbon system," Zielinski said. "That's quite a range. Ar measuring with a high repetition rate and designed for long-term applications."

Just as important, he said, is their flexibility. "Modern marine observatories need to be flexible in their objectives same time. Marine hazards, for example, are difficult to forecast, and if they do occur, it is important to engage assess the situation with as much flexibility as possible," Zielinski added. "Therefore, NeXOS optical sensors hav they are multispectral."

Also under development are passive-acoustic systems — smart hydrophones — to measure underwater noise, cr human activities. By listening in, these sensors can alert scientists and other users to fish-reproduction areas, se levels, and low-frequency seismic events. Despite their obvious value to researchers, acoustic sensors remain ex the consortium believes it will hurdle by standardizing designs.

"This is the reason we're making sure that all acoustic data and features follow international standard formats a standard Web services," Delory said.



This screenshot shows the data-visualization tool that the NeXOS project is developing as part of i to make ocean-monitoring data more accessible to users. Image Credit: Simon Jirka

In addition, all sensors designed under the NeXOS umbrella call for common interfaces that make it easier to int and future platforms. As a result, "a tool for visualizing sensor measurements will be able to load sensor data fr Web and display the data on any computer screen," Jirka explained. "I'm very optimistic that we will achieve thi covers the whole range, from the sensor device to the end user. This is quite unique, as many other projects on limited parts of this chain."

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Topic: Oceans, Technology

Tags: NeXOS ocean sensors

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