MERMAID opens prospect of cleaner seas with pollution early warning system

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MERMAID helped European beaches to become cleaner. Credit: EUREKA

Marine Environmental Remote-controlled Measuring And Integrated Detection - an international team of scientists and engineers developed automatic sensors and analyzers, mounted on a network of radio-controlled stations, to sample, measure and record chemical and biological changes to water. The project later became one of the cornerstones of the intergovernmental GOOS, Global Ocean Observing System.

Initially, three prototype stations were sited in the North Sea around

Germany's Elbe River estuary. Yet the project's real achievement was to lay the foundations for reliable, widespread monitoring systems that provide accurate early warning of pollution, allowing marine authorities to take timely counter-measures.

Before MERMAID, most marine monitoring was hit-and-miss, dependant on infrequent ship water-sampling voyages, and laboratory analyses performed weeks, even months later - far too late for effective actions. Some automated systems in the North Sea measured parameters such as salinity and temperature, but they were incapable of recording the all-revealing chemical and biological profile of water.

MERMAID harnessed the latest computer and communications technology to provide near real-time assessment of water quality and conditions for potentially the entire North Sea and other large bodies of water.

The team developed automated equipment to detect and analyze key parameters for oxygen balance, pH (alkali/acid levels), nutrients (usually nitrates and phosphates from fertilizers in farmland run-off water), chlorophyll (indication of algae), and toxic substances (including industrial effluents, organic micro-pollutants, and oil).

For the first time, it was possible to detect in real-time such "events" as algal blooms with associated heavy metal enrichment or the sudden release of nutrients from swollen rivers.

MERMAID was an initiative of the GKSS Institute for Coastal Research, a government-funded centre based in Germany. "MERMAID was a great success from every point of view," says Dr Friedhelm Schroeder, who had a central role in coordinating the project and is now project manager of the advanced programme that MERMAID spawned: COSYNA - Coastal Observing System for Northern and Arctic Seas.

The project's commercial partners went on to market MERMAID modules around the world, with South American and South East Asian countries being some of the first to adopt this new technology outside Europe. Meanwhile, GKSS has continued to develop the system as the core of COSYNA, pushing ever further the technological limits of sensors and finding cheaper and innovative ways to gather data on the composition and quality of water.

One new module that is lowering operating costs is the FerryBox, an automated measuring and sampling station carried on board a ferry or other ship plying a regular route. The box, can observe a far wider area than is possible with fixed stations on buoys. Moreover, the instruments, which receive water through the vessel's pumping system, are protected against heavy fouling (biological growth) and harsh exterior conditions. Sample collection and maintenance are carried out when the ship is in harbour. Another new development is a sensor that uses a genetic probe to detect toxic algae.

COSYNA is now two-thirds completed, and already operates with several fixed stations, some FerryBoxes, radar detection of water movement, and satellite remote sensing. However, the project still has some way to go before there is a sufficient supply of high quality data for accurate "modelling" - providing computerized views of conditions, both existing and possible future scenarios.

COSYNA is still identifying additional areas to monitor: two stations are located at either end of a major current that flows the length of the North Sea, yet there is a lack of data from along its path.

The solution for this and other open sea areas may be the USA-made glider, a 1.8 metre long, self-guided submarine-like vehicle, packed with instruments. It spends most of the time gliding underwater: when it surfaces, data is transmitted via satellite link to the base station, and new

instructions for sampling and navigation are downloaded. "We anticipate that gliders, on trips of up to two weeks, will be able to complete many of our information gaps."

In coastal waters, offshore wind-turbines are a relatively new support for autonomous fixed stations.

Dr Schroeder says, "We are attempting to link the COSYNA network with systems operated by other North Sea countries. Eventually, we would like all countries surrounding the sea to link their monitoring stations with COSYNA, contributing to a joint North Sea observatory.

In the 20 years since MERMAID began, there have been some improvements in North Sea water quality. Tourist beaches during the past 10 years have not been blighted by the unpleasant foam that results from the degradation of huge algal blooms. "However," Dr Schroeder points out, "levels of nitrates have dropped only slightly, despite the intention of European governments to achieve a 50% reduction. The danger is that high concentrations, usually from fertilizer flushed by rain from farmland, can encourage massive algal blooms, resulting in oxygen starvation and disaster for marine life."

Global climate change is having a major effect; warming water is provoking fish migrations, while a rising level of CO_2 makes the water more acidic, inhibiting the growth of organisms and threatening the food chain. And oil spills remain a constant threat.

"If we are going to meet these threats effectively, it is essential to have a better understanding of what is happening in the North Sea. And that is only possible if we continue to improve and expand the monitoring system that began with MERMAID."

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