A sustainable platform for glider observations

Dr Pierre Testor shares insights into how rationalising and supporting efforts to foster a network of gliding observatories has resulted in opportunities to expand beyond European boundaries

Could you explain how the consortium has grown and what some of the key challenges are you have faced as a result of this expansion?

After the first European glider experiment I carried out in the framework of the Sixth Framework Programme (FP6) EU project MFSTEP in 2004-05, I was contacted by several teams in Europe that were interested in this technology. I tried to help them to step in. I thought it was very important to help develop this activity. The initial consortium formed naturally from these informal collaborations. A relatively small group then expanded as increasing numbers of institutions began investing in this technology.

In 2006, we started to organise yearly European Gliding Observatories (EGO) Workshops and Glider schools which attracted teams from outside Europe, whilst also becoming the international forum for glider activities. This new technology does face scientific, technological and logistical issues in oceanography. In particular, it approaches the difficult control of many steerable probes in a variable environment for a better sampling. It also needs the development of new formats and procedures in order to build glider observations at the global level.

Wonderful results already arise from the glider activity and oceanographers do generally agree this is a wonderful tool, maybe like Galileo's telescope for astronomers, and that the development of ocean observations with gliders is necessary to better understand the ocean. The group discussions turned into a Community White Paper presenting the glider activity of the last 10 years and some prospects for the next 10 years for the observation of the global ocean, which was presented at the last OceanObs'09 Conference in Venice.

This scientific/technological coordination activity is now supported by the ESF and a COST Action which started in July 2010. Some key challenges that have emerged from this expansion; the coordination of the global glider activity, setting up a sustainable glider system and network at a global scale and also ensuring a flux of glider data to the Global Ocean Observing System (GOOS).

How does EGO's work specifically feed into to GOOS?

All glider teams can now send the raw glider data in real-time to a Global Data Assembly Center, like Coriolis in France, which will process, undergo quality control, and disseminate the temperature, salinity, oxygen and fluorescence data into a classical format. This was a major output from the FP6/FP7 EU projects MFSTEP and MERSEA and many EGO partners already do so in a routine way. These glider observations within the oceans are then public and available in real-time and so, qualify into the GOOS just like the other components, such as satellites, Argo profiling floats, moorings.

How crucial is communication of the outcomes from EGO?

Dissemination of the project's results is very important and the hope is that this communication will bring additional partners into the international consortium. At the moment, the COST Action ES0904/EGO is a unique and official way for us to communicate with other stakeholders, and in particular SMEs.

To what extent do you think the project's work will help inform policy makers and ultimately citizens?

The COST Action ES0904 aims at the coordination and development of the glider activity. The project work of EGO will certainly define standards and efficient ways of operating gliders from different 'glider ports' all around the world and help collect the data we need to better understand and monitor the oceans at global, regional and coastal scale. That concerns a lot of societal applications. Gliders collecting a lot of data, our understanding and estimates of the global ocean state and evolution will, without doubt, increase both qualitatively and quantitatively with a coordinated deployment of the world fleet of gliders. Noteworthy, gliders are perfectly suited for monitoring the extended coastal environment (EEZ) which is not that well covered nowadays but one of the main issues of the EU Marine Strategy Framework Directive (MSFD).

Through data assimilation in numerical, coastal and forecasting models, glider data could constrain these models in such a way that the analyses and forecasts of the ocean could turn to much more accurate information on the currents, transports, heat and salt contents and biogeochemical parameters being readily available. The number of societal applications related to maritime activity (such as fisheries, security, impact of pollutants, search and rescue, maritime traffic and coastal management) will certainly develop as the accuracy and realism of these numerical analyses and forecasts increase. In addition, gliders are a very good support method for public outreach. They can be wonderful tools for increasing awareness about the necessity of monitoring our oceans because they are small fish-like robots with amazing performance capability, intelligent and smart.

Could you comment on the impact you hope the EGO project will have in the long term?

I hope EGO will help to set up a sustained glider network filling the gaps left by the other components of the GOOS in an optimal way. Sustained observations of the ocean are mandatory on a variety of space and time scales and gliders can address this, if deployed in combination with the other existing observing system according to science-driven objectives.

Casting the net wider with gliders

By utilising oceanic glider technology, researchers from the EGO COST Action are exploring the new observational capabilities for studying and monitoring the physics and biogeochemistry of the world's oceans

A SIGNIFICANT NUMBER of marine activities around the world have come to rely heavily on both academic oceanographic research and operational oceanography systems to provide relevant and up-to-date information. As a result, there is an increasing emphasis by the Marine European Policy on the importance of availability and easy access to the wide range of natural and human activity data on the oceans to support strategic decision making. Existing in situ observation networks based on marine platforms struggle to deliver sufficient real-time data in terms of spatial and temporal coverage. Underwater ocean gliders are intelligent and affordable tools that have proved useful for long-term multi-parameter marine observations and have the potential to fill the gap in knowledge left by existing technologies. Deployed in swarms, underwater gliders are able to provide high spatial and temporal resolution data from remote areas of the ocean. These pieces of oceanic research equipment are playing an increasingly important role in both present and planned marine observation networks. However, for marine managers and policy makers to be able to benefit effectively from the data gathered by gliders, a sophisticated level of cooperation between highly-skilled operators is required. A COST Office-funded project known as Everyone's Gliding Observatories (EGO) – COST Action ES0904, is hoping to deliver this.

The glider is a relatively new platform in oceanography, but one which has great potential thanks to its smart design and relatively cost-effective deployment. Gliders are platforms designed to deliver information about the vertical structure of the oceans by carrying out vertical profiles of physical (temperature, salinity) and biogeochemical parameters (ChlA, CDOM, Turbidity through optical properties). They have enhanced capabilities, when compared with profiling floats, by providing some level of manoeuvrability and hence position control. The gliders perform saw-tooth trajectories from the surface to depths of 1000-1500 m, along reprogrammable routes (using two-way communication via satellite). They achieve forward speeds of up to 40 km/day thanks to wings and rudders, and can be operated for several months before they have to be recovered. The objective of the EGO network is to build on this by supporting cooperation at the technological, scientific and organisational levels to help gliders deliver convenient and sustained observations of the world's oceans. The Chair of the Action, Dr Pierre Testor, explains that the EGO initiative is a gathering of several teams of oceanographers who are interested in developing the use of gliders for ocean observations: "Our goal is to share the efforts needed by glider data collection as a group and support the dissemination of glider data in global databases in real-time and delayed mode for a wider community". Initially composed of scientific teams from France, Germany, Italy, Norway, Spain and the UK, EGO now has representatives from outside of Europe, including from Australia, Canada and the U.S. This global collaboration means that scientific experiments with international fleets of gliders can be carried out and the project has a wider reach and applicability: indeed, it was this fact which led to the change of project name from 'European Gliding Observatories' to 'Everyone's Gliding Observatories'.

MFSTEP GLIDER BEFORE DEPLOYMENT IN THE IONIAN SEA

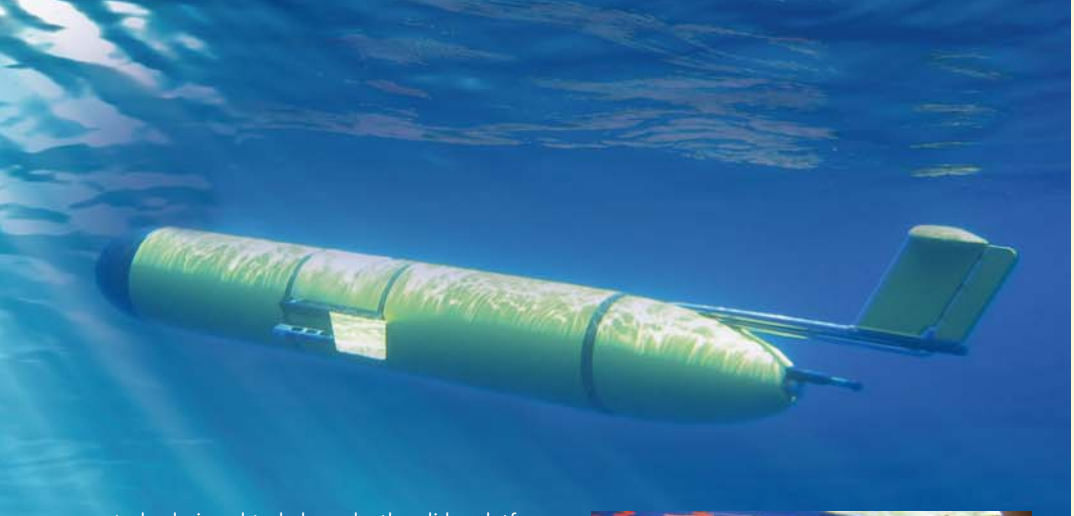
> One is generally amazed by the oceanic features the gliders and onboard sensors reveal

THE 'ATALANTA' GLIDER (OCEANOGRAPHIC CENTRE, UNIVERSITY OF CYPRUS)

OBJECTIVES

Testor says that whilst gliders – as active platforms which are remotely steerable – can readily fill the gaps left by the other components of the Global Ocean Observing System (GOOS), the glider community needs to be structured enough to be part of both the GMES and GEOSS system. With this in mind, the EGO project is coordinating international efforts on gliders at scientific, technological and organisational levels. The EGO consortium is also keen to develop innovative approaches in regards to supporting ambitious sampling strategies and measured parameters by developing tools and procedures for the cost-efficient use of gliders. Favouring scientific experiments through international collaboration means that the collaboration can help glider teams to develop and contribute to the worldwide efforts made for the global ocean observation, both physical and biogeochemical.

The EGO Action consists of five Working Groups (WG), each dealing with different aspects of the development of glider activity for marine research and operational oceanography. WG1 is dedicated to providing support for glider deployment and data dissemination by undertaking general



tasks designed to help make the glider platform suitable for being networked. For instance, as the legislation regarding gliders has not yet been developed nor standardised among different countries, an initial task of WG1 is to assess the legal conditions needed for flying gliders in the national waters or Exclusive Economic Zone waters of both participant countries and non-participant countries. The focus of WG2 is to investigate the technical developments possible for the existing platforms (engines, hulls, embedded energy, other hardware and onboard software) as well as fully new gliding vehicles, and to develop the ground-segment infrastructure. WG3 is tasked with coordinating efforts to develop easy and ergonomic access to piloting facilities, auto-pilot systems, flight control systems, automated fault diagnosis and environmental information systems helping the glider pilots to determine the best routes (such as maps of bathymetry, sea surface temperature, ocean colour and currents, numerical model outputs). WG4 is trying to find an answer to how gliders can optimally be combined with other observing systems by using Observing System Simulation Experiments (OSSEs) and 'network design' methodologies to assess the feasibility and optimality of the possible configurations. The final group, WG5, is looking into ways to conduct fields operations with fleets of gliders to gather detailed and accurate 4D oceanic datasets related to different specific research requirements. Of particular interest to Testor is the work WG5 are doing around the large trans-oceanic sections or boundary current sections for large scale or regional budgets as well as the investigation of mesoscale and submesoscale phenomena in specific areas.

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THE 'SPRAY006' GLIDER (SCRIPPS INSTITUTION OF OCEANOGRAPHY, CA, USA)

A NEW ERA IN OCEANOGRAPHY

An important component of this project is the fleet experiments. So far in Europe, the most notable successes of the fleet experiments were the simultaneous deployments of nine gliders in the Mediterranean Sea in winters 2007 and 2008 by teams from France, Germany, Spain and UK. Then, an eddy-focused experiment was carried out in 2009 south of Cyprus by teams from Belgium, Cyprus, France, and Italy. More recently, a fleet experiment was started in May 2011 where 10 German and French gliders were deployed in the Tropical Atlantic. All collected data is shared in near real-time on the ftp server set up by the Coriolis Center and are processed by the German and French teams: "This is a unique opportunity to harmonise procedures and define how such exercises could be carried out even more efficiently in an international framework in the future" says Testor. He also believes that flying gliders provide the opportunity to resolve a wide range of spatial and temporal scales and that glider datasets help us to better understand and characterise the oceanic variability by looking at many physical and biogeochemical processes on a range of scales: "One is generally amazed by the oceanic features the gliders and onboard sensors reveal". In addition, the assimilation of glider data into global or regional and coastal numerical models can significantly reduce the uncertainties of our ocean state estimates and there is now general agreement that gliders are an important part of the future of oceanography.

The EGO COST Action started with a 1st Symposium of the Action, some Short Term Scientific Missions and a fleet experiment in 2011. In addition, based on the Action consortium and proposal they have been able to elaborate on the EU project GROOM (Gliders for Research, Ocean Observation and Management) in the framework of the FP7 'Infrastructures – Design Studies' Call. This project was selected and started in October 2011 in order to demonstrate the benefits of a Research Infrastructure for gliders. This study is certainly very important while several glider facilities are being set up in Europe. Testor considers that there are a lot of synergies between all the different projects underway and the EGO COST Action and he will be looking at opportunities to leverage off these synergies during the coming year: "Since gliders offer really new capabilities in terms of sampling and have a tremendous potential with the scientific payload, we expect this project will lead to frontier-science studies and help us to enter in a new era in oceanography".

INTELLIGENCE

EGO

EVERYONE'S GLIDING OBSERVATORIES

OBJECTIVES

To promote glider technology and support scientific experiments by fostering large-scale international collaboration.

PARTNERS

Participating countries

Belgium
Cyprus
Finland
France
Germany
Greece
Iceland
Ireland
Israel
Italy
Norway
Portugal
Spain
Sweden
UK

Countries with intentions to participate

Poland

Non-COST Institutions

CSIR, South Africa

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