

H2020 BRIDGES Project – Month 18 Publishable Summary

Working towards implementation of the Europe 2020 strategy for sustainable growth in the marine and maritime sectors necessitates the development and application of advanced technology to enable smarter, reliable and more cost-effective methods of operating at-sea. Improved operational capabilities are required such as increased autonomy, working at extreme depths, more sophisticated sensing of the water column, the deep-sea environment and their resources. The expected increase in ocean industrialization generates an immediate need for smarter and safer technology to support long-term exploration and monitoring services of the coastal and deep ocean while controlling the potential impact of these activities on the marine environment.

The BRIDGES project (Bringing together Research and Industry for the Development of Glider Environmental Services) aims to address this demand by providing a necessary tool for further understanding, improved monitoring, and responsible exploitation of the marine environment while assuring its long-term preservation. This new tool – a robust, cost-effective, re-locatable, versatile and easily-deployed underwater glider – will support autonomous, long-term in-situ exploration of the deep ocean at large spatio-temporal scales and enable safe and sustainable offshore operations in extreme environments.

The main objectives of the BRIDGES project are to develop and demonstrate at-sea two new glider prototypes with improved sensing capabilities capable of operating in extreme depths and designed to provide cost-effective services to key marine markets. This is being achieved by:

- Further improving on existing European glider technology by development of two new glider prototypes, extending operating capabilities to depths of 2,400m (Deep Explorer) and 5,000m (Ultradeep Explorer), in order to deliver a range of industrialized, innovative gliders with a high TRL ready to quickly penetrate the targeted markets.
- Enhancing sensing capabilities with novel, sophisticated payloads to demonstrate exploration and monitoring service capabilities for a wide range of science and industry domains.
- Developing on-board and on-shore intelligent management systems to provide a high level of autonomy for gliders and glider fleets, and to act as an additional sensing component of monitoring systems for science and industry services.
- Standardization of glider data and hardware to facilitate the exploitation and commercialization of the platform and resulting data products, including integration into national, regional and global observing systems.

During the first 18 months of the project, BRIDGES has been working with academia and industry to define the market needs and target applications for the new deep-sea gliders, identifying 22 services across the key markets of marine science research, Marine Strategy Framework Directive (MSFD) implementation actions, living resources, offshore Oil & Gas, and Deep-Sea Mining. The design requirements to perform these services has been included in the vehicle and sensor payload development. Three different services and their respective payloads have been chosen to be fully developed and demonstrated at-sea during the BRIDGES project: (1) Biogeochemical Essential Ocean Variables service, (2) Water Column Habitats service, and (3) Exploration and Prospecting service.

The design phase of the project is nearly complete, and in the advanced stages for the glider platform, sensor packages and control systems, with subsystems in preparation for manufacture and testing. The deep gliders have been designed for large payload capabilities while maintaining the smallest size and lowest weight possible to ensure safe and easy deployment and recovery at-sea. A Glider Simulator has been manufactured, based on the actual glider control system architecture, replicating all functions of the glider navigation behaviour and communications for the development, integration and testing of sensors and autonomy software, while also intended to become part of the Deep and Ultradeep Explorer commercial range of products for training and mission planning purposes.

BRIDGES has developed a new framework for glider data and metadata standardization, building on work from and collaboration with other projects (FP7 GROOM, NexOS, COMMONSENSE) and programmes (EuroGOOS, EMDONET, H2020), as well as the international glider community (EGO: Everyone's Gliding Observatory), to produce a comprehensive solution that will be piloted by the

BRIDGES Deep and Ultradeep Explorers. The proposed framework has been presented to the international glider community and glider management teams for Observing Systems, with keen interest from both glider manufacturers and end-users. Adoption of the standard will result in common glider data products with high-quality, well-documented data and metadata that can be readily integrated into national, regional and global observing programmes, maximising the impact and exploitation potential of future glider activities.

The ground-breaking nature of BRIDGES is in providing a technology to enable long-term deep-sea monitoring on networked, unoccupied platforms. The long-term networking concept cannot be fully developed by current ROV, AUV and HOV technologies due to economic and/or endurance limitations. For this reason, BRIDGES is further developing underwater gliders to provide a cost-effective, long-term and easily networked capacity to monitor 98% of the world's oceans.

BRIDGES gliders go beyond the capabilities of current glider technology; being able to operate in extreme pressure environments, hybrid buoyancy and propeller propulsion navigation to facilitate seabed and ocean column exploration, and development of service-oriented smart sensing systems targeting industrial applications. The sensing systems are miniaturized, low-power systems suitable for integration into the Deep and Ultradeep Explorers, and include cutting-edge technology for the in-situ analysis of nutrients, acoustic characterization of the sea-bed, and small particle and organism imaging system, with planning in progress for patent applications and commercialization.

The BRIDGES technology will improve the scientific capacity to observe and understand the deep sea water column and seafloor by obtaining meaningful information on environmental descriptors and processes. With an estimated 5% of the seafloor surveyed, environmental characteristics and resources from abyssal regions have remained largely unknown until now. Uncontrolled exploitation of ocean resources can significantly jeopardize these environments with unpredictable consequences. For this reason, exploration and long-term monitoring of the water column and sea-floor are fundamental to enabling sustainable exploitation of resources with minimum impact.

The competitiveness of the European Blue Economy will be increased with the development of Deep and Ultradeep Explorers, which will offer a cost-effective capacity for exploration and monitoring to facilitate the sustained exploitation of deep ocean resources. BRIDGES will demonstrate solutions that can be applied to a cost-efficient ecosystem-based management of marine regions that increase industrial competitiveness and help achieve Good Environmental Status of the ecosystem.

Controversies regarding environmental policies may be left unresolved by the technological difficulties to monitor deep and vast ocean regions, and this lack of public awareness directly effects their social confidence. BRIDGES will provide a capability to support the evaluation of environmental protection procedures, to improve present performance metrics of environmental policies and to increase the social confidence about the correctness of such policies.

Finally, the establishment of a European marine deep glider infrastructure for research and industry will enable the sustainable and safe operations in deep-sea areas all over Europe and the globe. BRIDGES is contributing to this end by further developing the European glider industry through addition of the Deep and Ultradeep Explorers to their current SeaExplorer glider, the first and only commercially-available European glider, as well as further development of glider piloting and data dissemination software and web tools for promoting glider activities