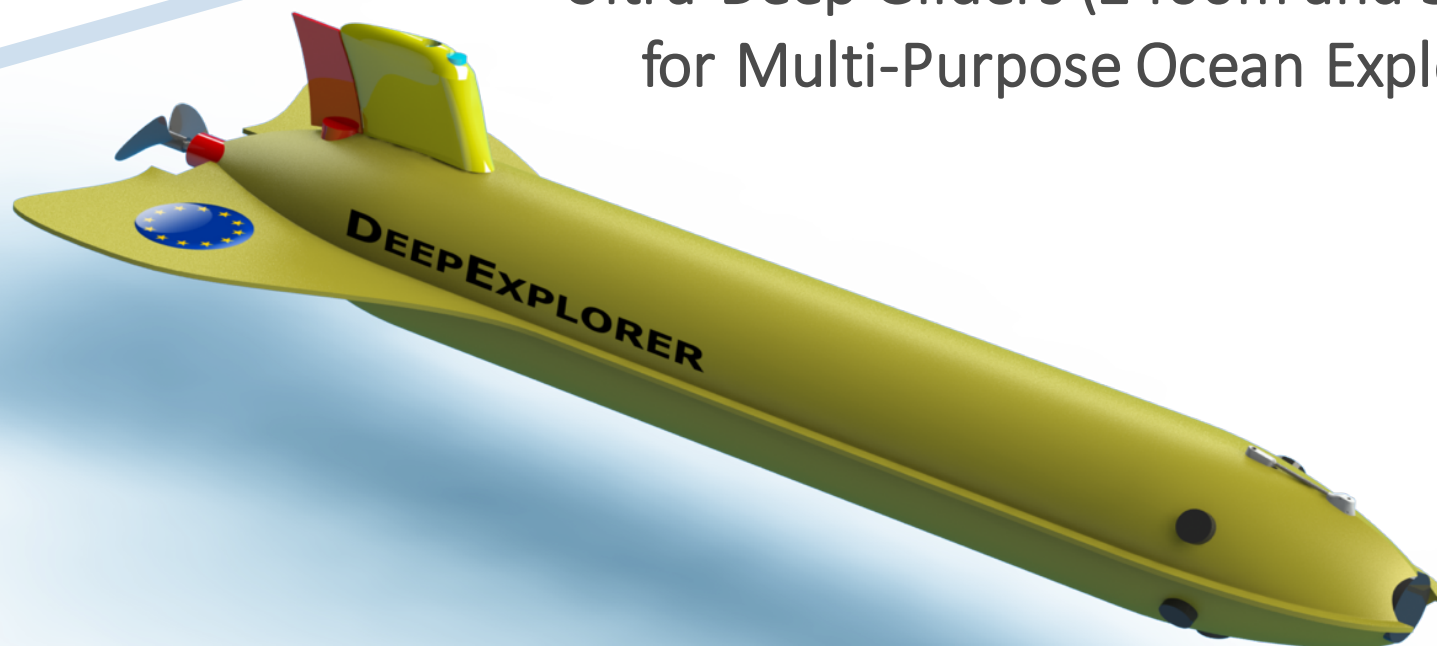


Challenging Development of Ultra-Deep Gliders (2400m and 5000m) for Multi-Purpose Ocean Exploration



Vianney Rochet (ALSEAMAR), Michael Field (ARMINES)

VROCHET@alseamar-alcen.com, michael.field@locean-ipsl.upmc.fr

Oceanology International, London, 17/03/16



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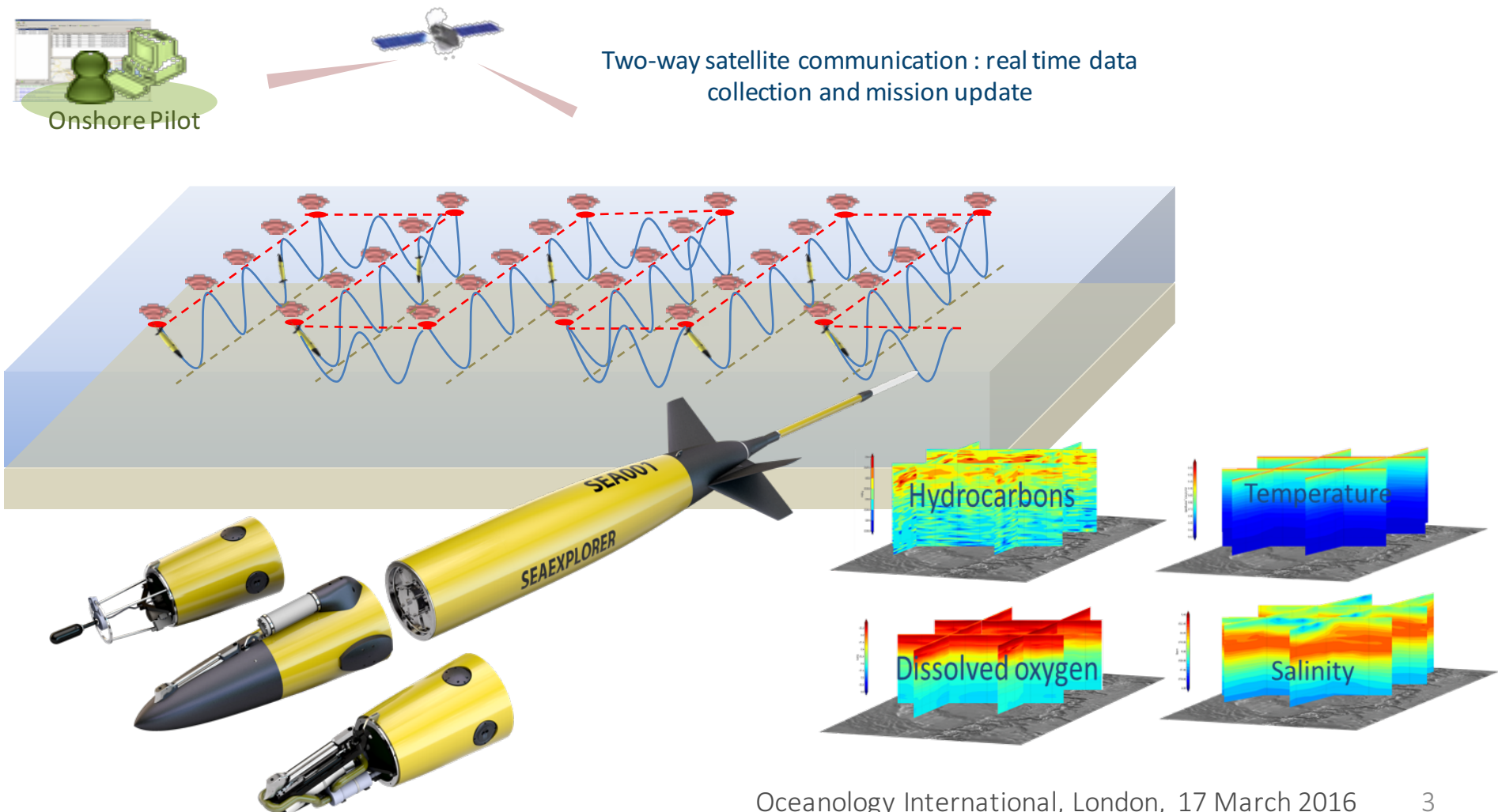
Ultra-Deep Gliders for Multi-Purpose Ocean Exploration

1. Underwater glider
2. Use cases
3. Future Market Applications
4. What is BRIDGES?
5. The Ultra-Deep Glider Platforms
6. Novel Sensors for Deep-Sea Exploration
7. Intelligent Behavior and Management

Ultra-Deep Gliders for Multi-Purpose Exploration

Underwater glider

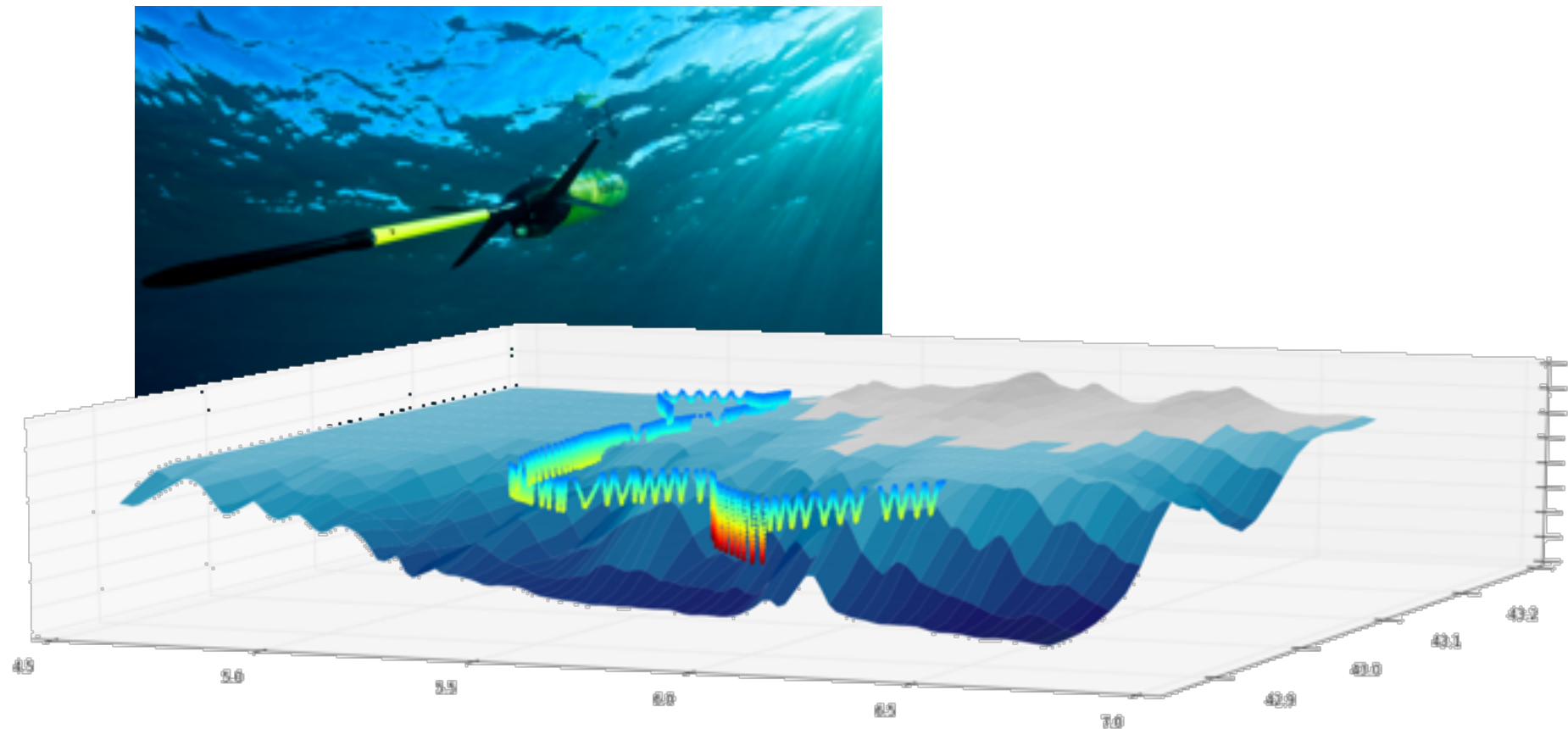
General principle :



Ultra-Deep Gliders for Multi-Purpose Exploration

Use cases

Glider mission :



Ultra-Deep Gliders for Multi-Purpose Exploration

Underwater glider

Operations :



Ultra-Deep Gliders for Multi-Purpose Exploration

What is BRIDGES?



ALSEAMAR
ALCEN



- Horizon 2020 – Research & Innovation Action – Blue Growth
- 7.8M€, 48-month project (2015-2019)
- 19 project partners from 9 countries, including 6 European SMEs



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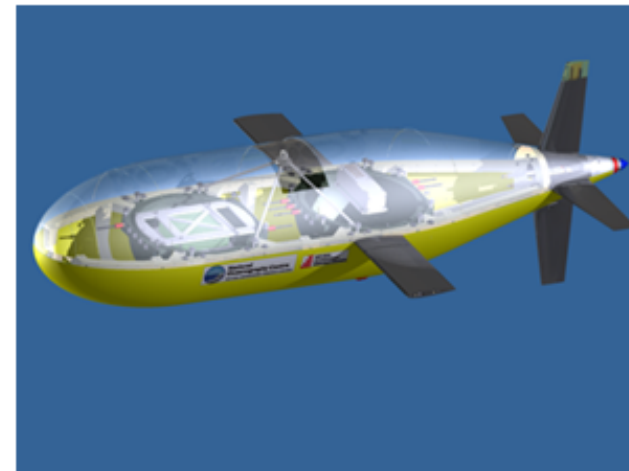
The Ultra-Deep Glider Platforms

Building on proven technology:

- SEAEXPLORER glider from ALSEAMAR



- Deep AUTOSUB-LR from NERC



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Ultra-Deep Gliders for Multi-Purpose Exploration

The Ultra-Deep Glider Platforms

Introducing the DEEP and ULTRA-DEEP EXPLORERS:

- DEEP EXPLORER for services down to 2400m
- ULTRA-DEEP EXPLORER for services down to 5000m



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Ultra-Deep Gliders for Multi-Purpose Exploration

The Ultra-Deep Glider Platforms

Main Features :

- Rechargeable battery, with primary cell capability (endurance x 2)
- Large payload bay
- Hybrid capability for horizontal flight (propeller and rudder)
- High modularity for battery and payload change



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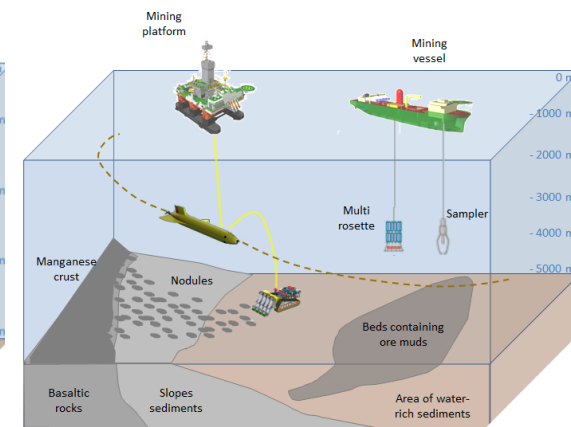
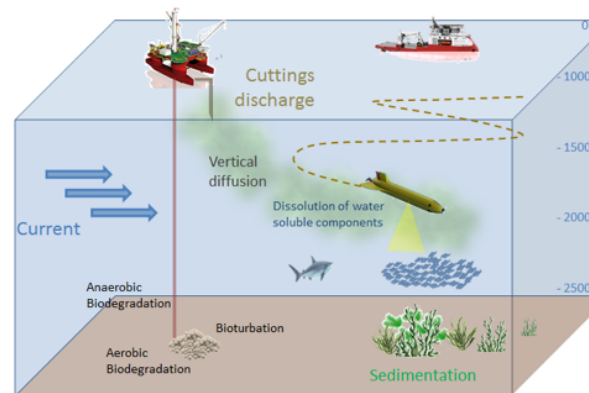
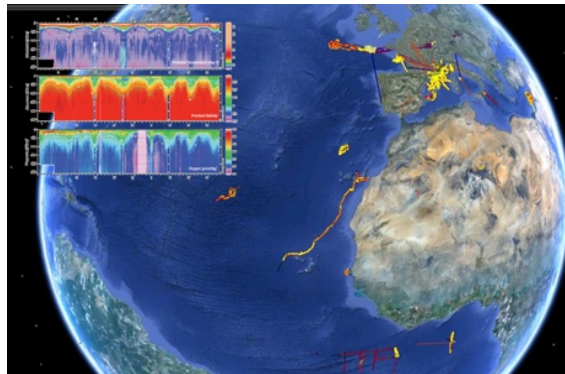
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Ultra-Deep Gliders for Multi-Purpose Exploration

The Ultra-Deep Glider Platforms

Providing Services to Key Markets

- Target key markets
 - Marine Science Research
 - Environmental Monitoring (MSFD)
 - Offshore Industry (Oil & Gas, Renewable Energy)
 - Sea Mining



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10

Ultra-Deep Gliders for Multi-Purpose Exploration

Novel Sensors for Deep-Sea Exploration

Development and Qualification of Multi-Purpose Glider Payloads:

- Development, testing and validation of four novel sensor packages:

NOC
Lab-On- Chip

OCTOPUS
Imaging

Mini Water
Sampler

Sea-Bed
Acoustics

- Testing and validation of glider-ready sensors for deep-sea operations:

Pumped
CTD

Temperature
Depth
Salinity

Optode

Oxygen

Optical
Sensors

Biology
Turbulence
Hydrocarbons
Methane

Hydro-
phone

Acoustics

ADCP

Current



Ultra-Deep Gliders for Multi-Purpose Exploration

Novel Sensors for Deep-Sea Exploration

Development and Qualification of Multi-Purpose Glider Payloads:

- Development, testing and validation of four novel sensor packages:

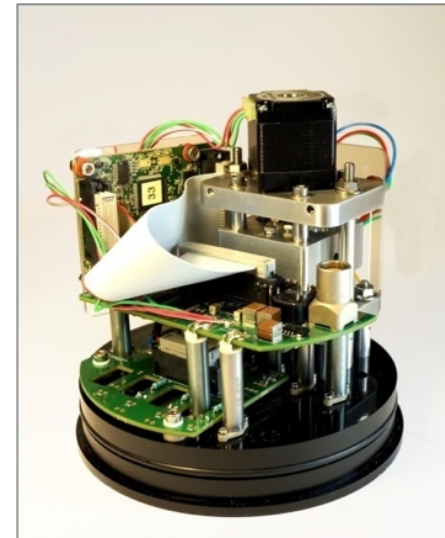
NOC
Lab-On- Chip

OCTOPUS
Imaging

Mini Water
Sampler

Sea-Bed
Acoustics

- Lab-On-Chip system developed by NOC
- In-situ sensing and analysis of:
 - Nitrate
 - Phosphate
 - Ammonia
 - Silicate
- Operation to 5000m depth



Ultra-Deep Gliders for Multi-Purpose Exploration

Novel Sensors for Deep-Sea Exploration

Development and Qualification of Multi-Purpose Glider Payloads:

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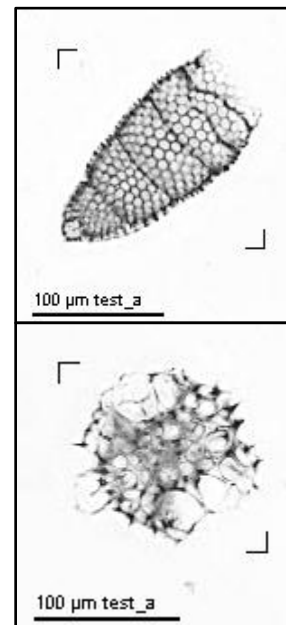
NOC
Lab-On- Chip

OCTOPUS
Imaging

Mini Water
Sampler

Sea-Bed
Acoustics

- OCTOPUS Imaging by Hydroptic/UPMC
- Image capture of micro organisms and micro particle/bubbles
- Onboard analysis and recognition of images



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13

Ultra-Deep Gliders for Multi-Purpose Exploration

Novel Sensors for Deep-Sea Exploration

Development and Qualification of Multi-Purpose Glider Payloads:

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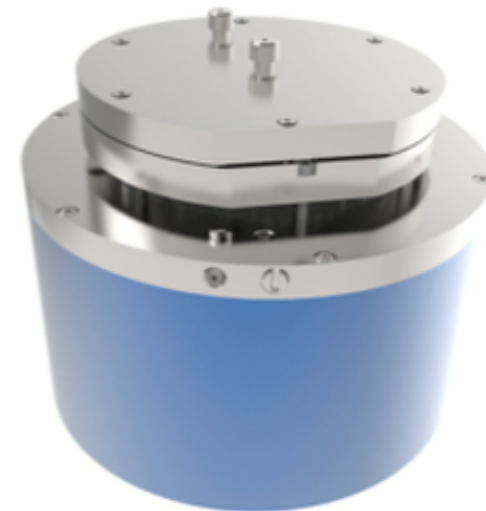
NOC
Lab-On- Chip

OCTOPUS
Imaging

Mini Water
Sampler

Sea-Bed
Acoustics

- Miniaturized water sampler for deep-sea glider operations
- Samples of 100ml each
- Activation at pre-programmed depth or triggered by local environment measurements
- Used to validate on-board sensor measurements



Ultra-Deep Gliders for Multi-Purpose Exploration

Novel Sensors for Deep-Sea Exploration

Development and Qualification of Multi-Purpose Glider Payloads:

- Development, testing and validation of four novel sensor packages:

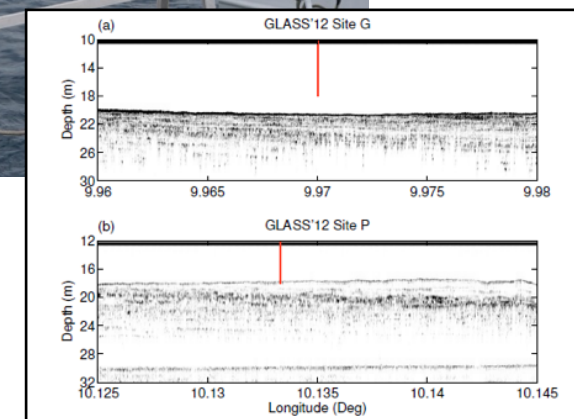
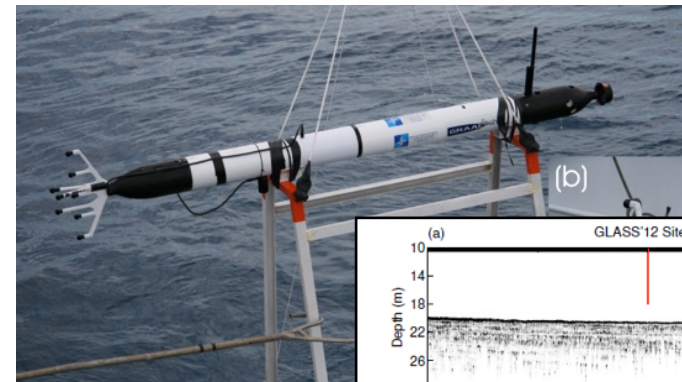
NOC
Lab-On- Chip

OCTOPUS
Imaging

Mini Water
Sampler

Sea-Bed
Acoustics

- Sea-bed penetrating acoustic system
- Active source for 10m penetration
- Provide sound characteristics of sediment layers



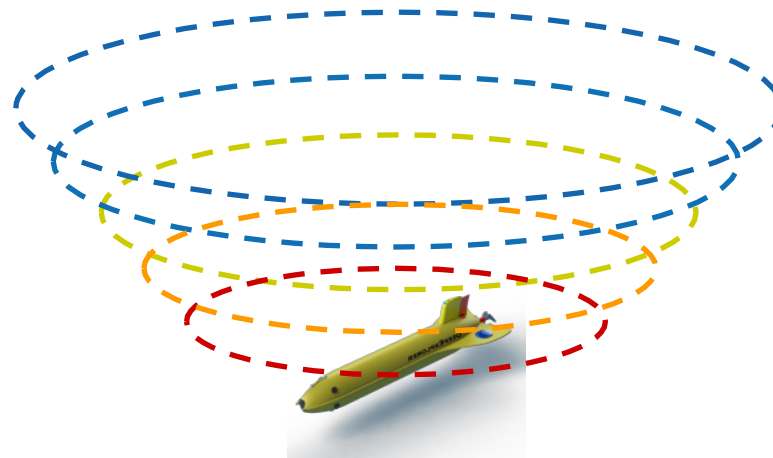
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Ultra-Deep Gliders for Multi-Purpose Exploration

Intelligent Behavior and Management

Glider Autonomy and Adaptive Behaviour :

- One ULTRA-DEEP EXPLORER dive/ascent to 5000m = ~24hours
- BRIDGES is developing intelligence for platform autonomy and sensor management
- Activation and sampling rate of sensors depending on glider state, depth, onboard sensing
- Adapting glider behaviour and flight depending on sensed environment
 - Changing to hybrid horizontal surveying (fixed-depth, sea-bed)
 - Homing in on detection of interest



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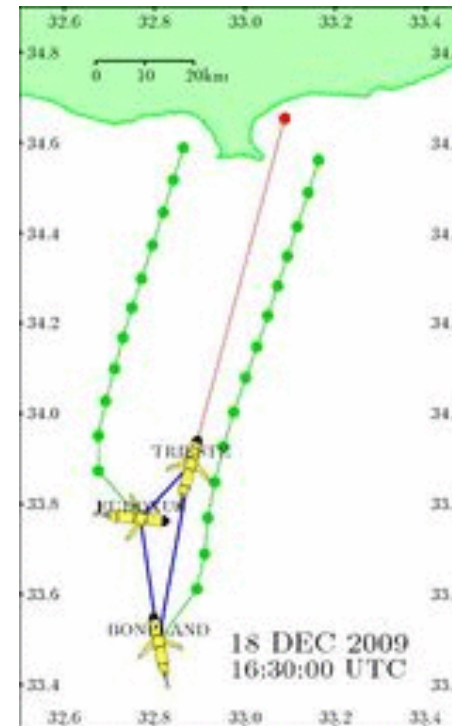
16

Ultra-Deep Gliders for Multi-Purpose Exploration

Intelligent Behavior and Management

Glider Autonomy and Adaptive Behavior :

- BRIDGES is also building upon work of GROOM, EGO to develop intelligent on-shore management of glider operations and fleets
- Taking into account local observations and forecast models (weather, current, shipping activity) for safe and efficient glider tracks
- Maintaining fleet formations and automated flight paths
 - Tracking a front, eddy survey
 - Holding a fleet pattern
 - Completing an alternating grid

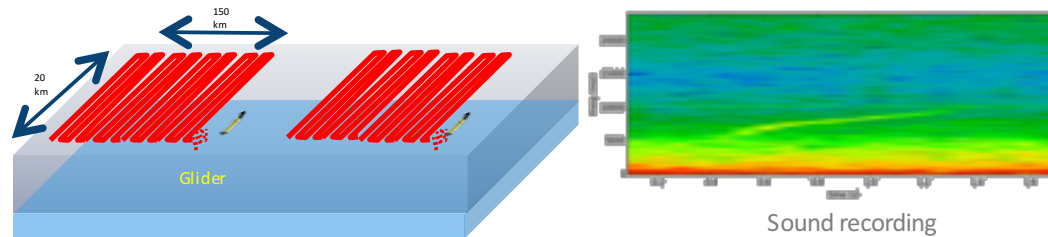


Ultra-Deep Gliders for Multi-Purpose Exploration

Market Applications

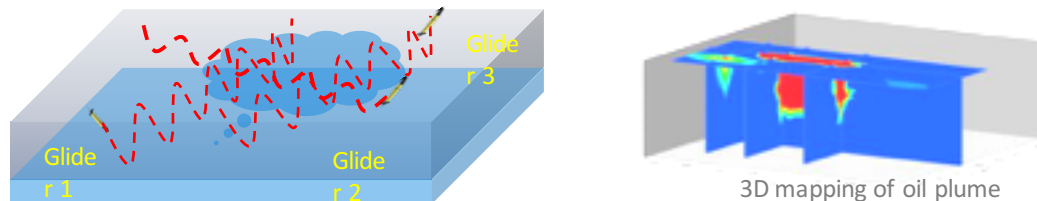
ENVIRONMENTAL BASELINE STUDIES (EBS)

- For mapping and tracking environmental parameters



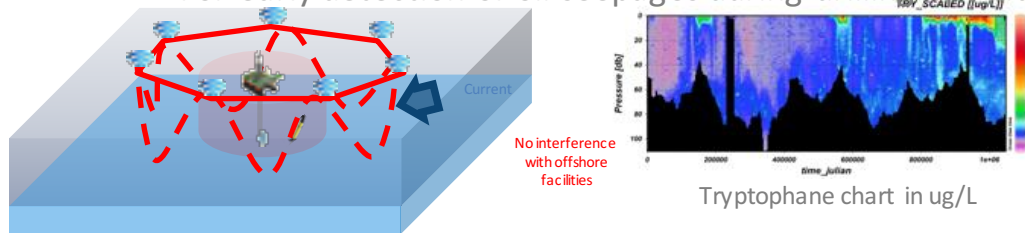
EMERGENCY PLAN

- For tracking Oil plume with 3D modeling



ENVIRONMENTAL MONITORING

- For early detection of oil seepages during drilling operations



No interference
with offshore
facilities

- Design of the offshore structure
 - Assistance during installation and marine operation
- Typical metocean data**
- Wave and Current

Traditional Monitoring means:

- Buoys, Current mooring

Advantage of the Glider compared to traditional means

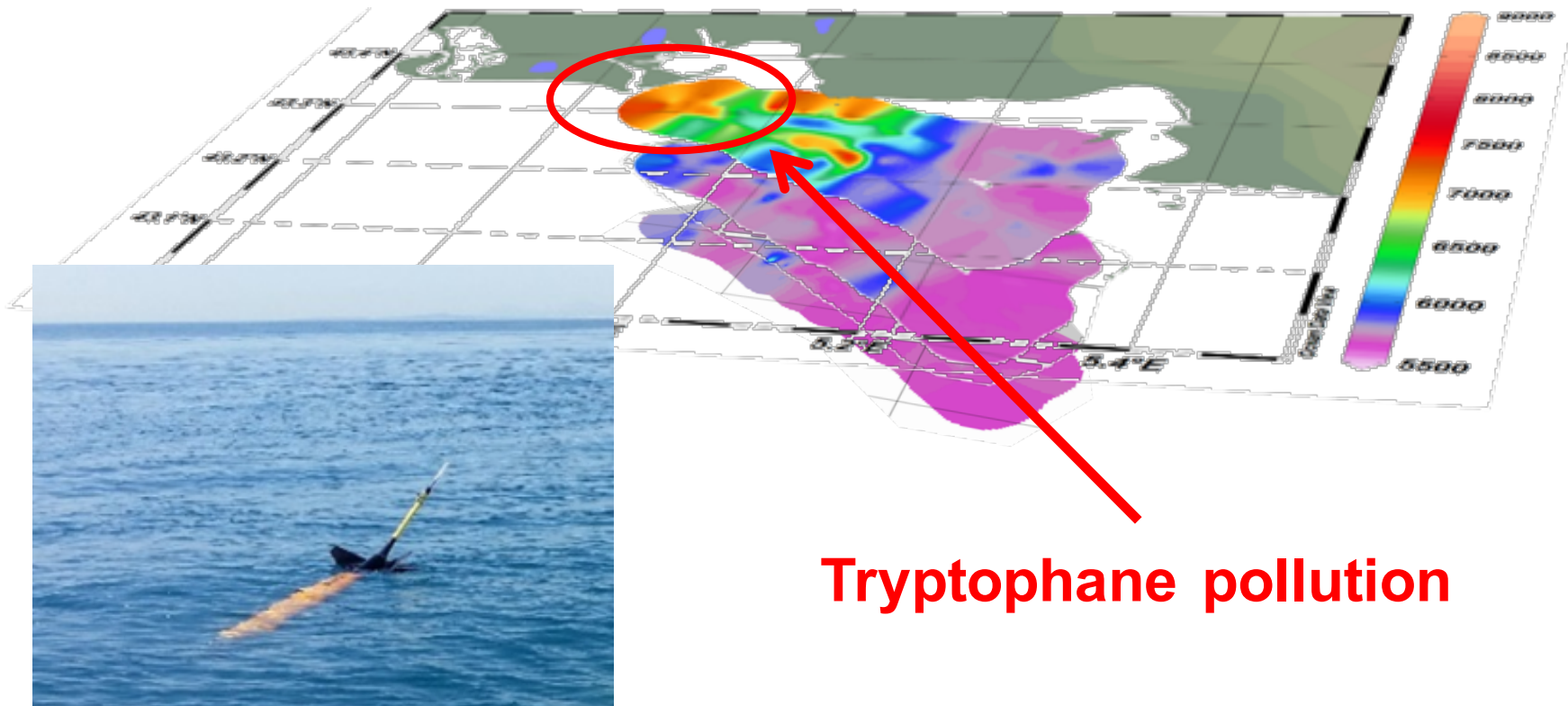
- Acquire data in Real Time
- Mapping of a large area.
- Require LOW logistic operations
- Low costs for deployment and maintenance



Ultra-Deep Gliders for Multi-Purpose Exploration

Market Applications

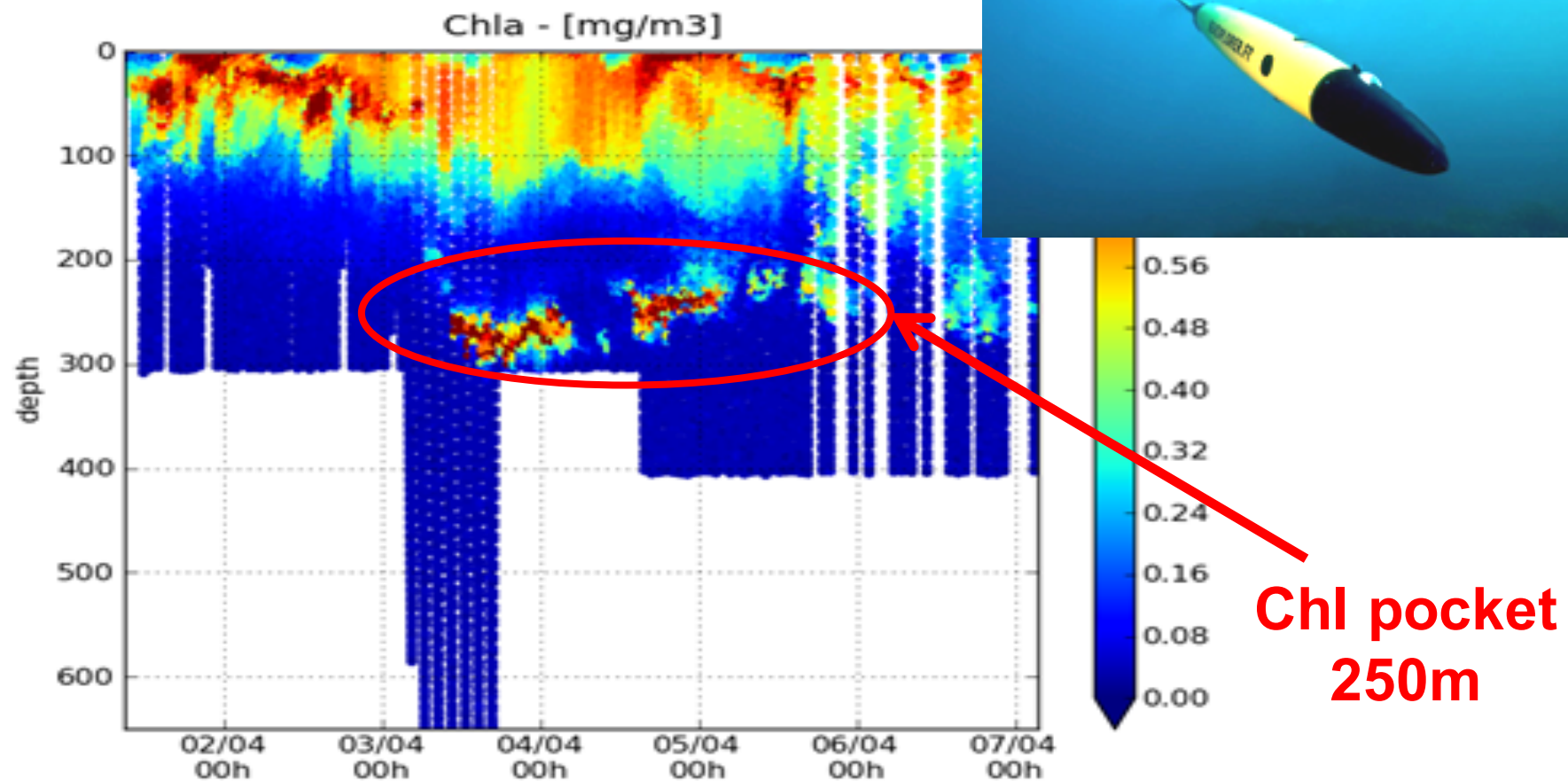
Pollution detection – Bay of Marseille :



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Market Applications

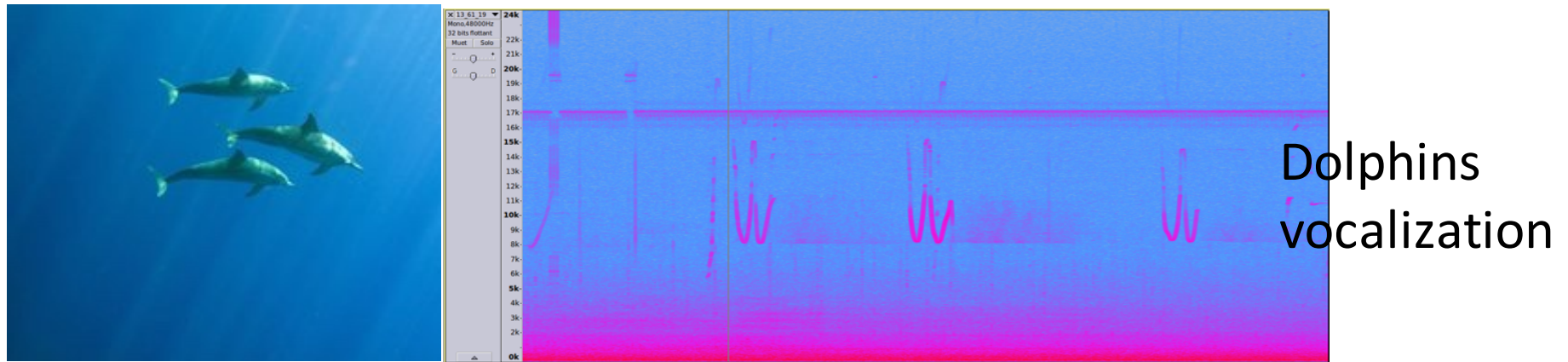
Pollution detection – Bay of Angels (Nice) :



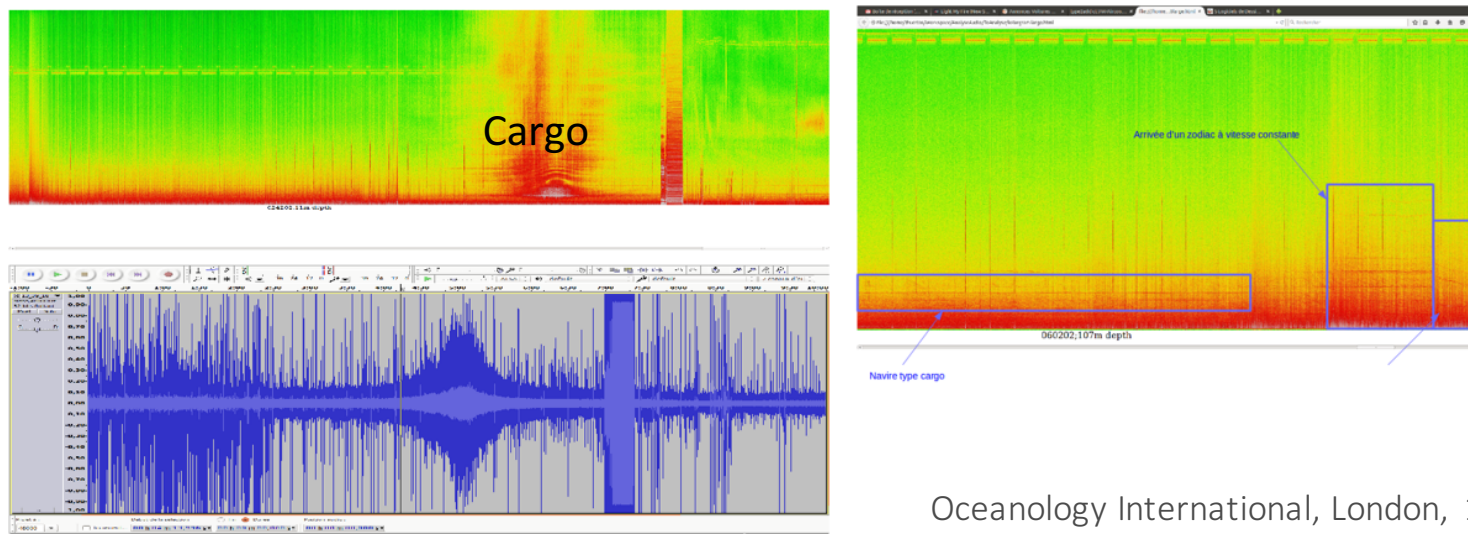
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Market Applications

Acoustic recording : Marine mammal's observation – acoustic noise base line ...



Marine Traffic: Detection/Recording ranging from huge cargo to small boats



Ultra-Deep Gliders for Multi-Purpose Exploration

Market Applications

Example Service 1 – Water Column Habitat payload

Applications :

- MSFD descriptors
 - 1-Biodiversity
 - 4-Food Webs
 - 5-Eutrophication
- Monitoring programs
 - Biodiversity: water column habitats
 - Biodiversity: fish
 - Eutrophication
- Copernicus
 - CMEMS, Biodiversity and Environ. Protection

SENSOR	PARAMETER
CTD	Depth, Temperature, Salinity
Optode	Oxygen
Micro-fluidic Cells	Nitrates, Phosphates
Fluorometer	Chlorophyll-a
Optical sensor	Turbidity
Imaging System	Plankton biomasses

Endurance: up to 2 months



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Ultra-Deep Gliders for Multi-Purpose Exploration

Market Applications

Example Service 2 – Oil and Gas service payload

Applications :

- Support for exploration and extraction of hydrocarbons
- Leak monitoring
- MSFD descriptors
 - 8-Contaminants
- Monitoring programs
 - Contaminants
- Copernicus
 - CMEMS, Biodiversity and Environ. Protection

SENSOR	PARAMETER
CTD	Depth, Temperature, Salinity
Optode	Oxygen
Fluorometers (2)	Crude Oil, Refined Oil
Optical sensor	Turbidity
Imaging System	Emulsified/Suspended Oil

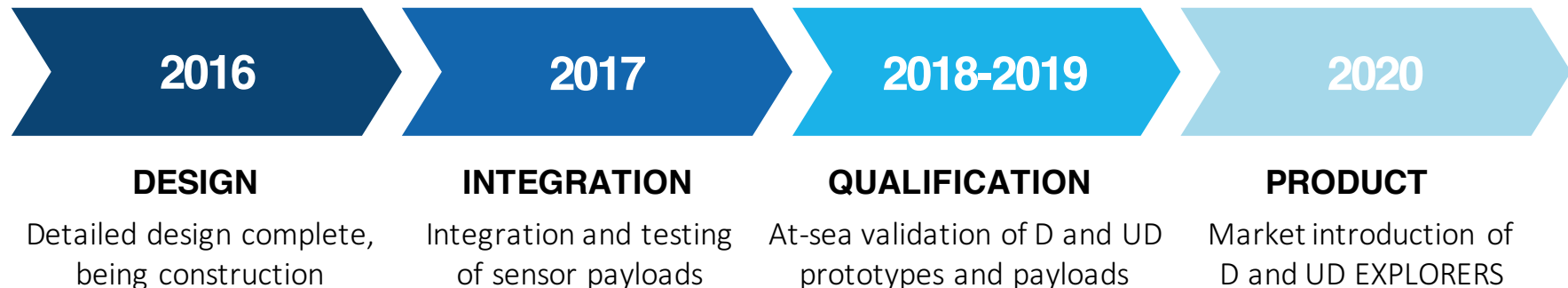
Endurance: up to 2 months



Ultra-Deep Gliders for Multi-Purpose Exploration

What's Next?

Coming soon...



- Keep up to date with BRIDGES!
 - www.bridges-h2020.eu
 - Sign-up for our regular newsletter
 - Follow BRIDGES on twitter [@BRIDGESh2020](https://twitter.com/BRIDGESh2020)
 - Organise a meeting/workshop with BRIDGES – contact@bridges-h2020.eu



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Oceanology International, London, 17 March 2016

24

Thank you for your attention!

Meet us at :

- SUT booth : S300
- ALSEAMAR booth : H300

