The EMSO-Azores deep sea observatory – 10 years of operation

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Workshop on Sea Operation for Ocean Observatories
25 – 26 Septembre 2019, Toulon (FRANCE)
EMSO Azores Deep-sea Observatory
10 years of operations

Understand the links between geological, physical and chemical processes and their effects on the dynamics of the hydrothermal fauna at different spatial and temporal scales at the Lucky Strike vent field

Singh et al. 2006
The infrastructure

Data archiving in Brest
http://www.emso-fr.org/EMSO-Azores

Acoustic and satellite data transmission

Seismic activity and vertical deformation of the seafloor

Integrated study of the Eiffel Tower edifice
The BOREL buoy

Relay buoy
- COSTOF 2
- Iridium / Acoustic / WIFI connectivity
- 20 solar panels + lead batteries
- 2 redundant channels
- Weather station
- AIS
- Geodetic GPS
- Seaphox sensor (pH, CTD, O2)

The West Node

Seismic activity and vertical deformation of the seafloor
- COSTOF2
- Acoustic / WIFI connectivity
- Lithium Batteries (4KWh)
- 1 connected OBS
- 1 pressure gauge
The East Node

Ecology / Microbiology / Biochemistry / Seismicity

- COSTOF2
- Acoustic / WIFI connectivity
- Lithium Batteries (12KWh)
- Hydroctopus (hydrophones network)
- BARS (Chlorinity)
- CISICS (Bio-chemistry, fluid sampler)
- T° string (100 sensors)
- Tempo (Video, Chemini Fe, O2)
- Turbidity, O2
The unconnected components

- An array of 4 Autonomous OBS
- 2 Autonomous pressure gauge
- > 30 Temperature probes
- 1 Physical oceanography mooring
- Colonization substrata (ecology/microbiology)
- 3 Autonomous currentmeters

An Integrated Study Site

- Ecology (biodiversity, spatial distribution, food web, in situ experimentation – resilience and chronobiology...)
- Fluid chemistry (time series, spatial variability, mixing gradient) – 13 sites
- Exploration (Capelinhos discovery !, inactive areas, deep corals, Survey OTUS2...)

![Image of a map with various study sites and oceanographic features](image-url)
Maintenance cruises

10 years of operations
3 vessels
2 submersibles
20 days at sea / year (including 2 days of transit)

MoMARSAT cruises

<table>
<thead>
<tr>
<th>Date</th>
<th>N/O</th>
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<td>Oct 2010</td>
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<td>Victor</td>
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</table>
3 different vessels

- DP quality (very important for deployments / recoveries)
- Deck working surface
- Trawls capability
- Laboratory surface
- Cabins number

PourquoiPas?
Ideal for this type of multidisciplinary cruises.
Deployment of Victor by the starboard crane and the moorings with the A-frame (2h/day saved)

Atalante
Possible , less scientists onboard impacting the working rythme. Deck space OK with nodes storage on the containers. Some troubles with the DP.

Thalassa
Not enough deck space, Scientist number limited. No laboratory.
2 submersibles

Victor – Nautile (2019)
2 different claws with different dimensions
2 different Arms: Victor right handed / Nautile left handed
Different payload
Different dive duration
Specific procedures for each submersibles
Maintenance cruises schedule

Cruise proposals to have access to the French Fleet Research Infrastructure

- Infrastructure recovery
- Autonomous sensors recovery
  - Site studies
  - Autonomous sensors deployment

- Infrastructure deployment

- Optional recovery/redeployment
  - Site studies

- Infrastructure servicing
  - Data recovery
  - Software update
  - Sensor check and calibration
  - Battery replacing
  - Mechanical maintenance
  - Functionnal tests
Operations

Multidisciplinary operations (technical, scientific)
Sampling program associated systematically to the infrastructure maintenance

Deck operations
Mooring: BOREL, oceanographic mooring, OBS, CTD, ...

Submersible operations
- Monitoring nodes deployment/recovery
- Autonomous sensors deployment/recovery
- Sampling operations (water, fauna, microbes,...)
Deployment / Recovery

- DP quality and cable type important (+- time consuming)
- BUC positioning : 10m on the seafloor
- Mooring schemes upgraded by experience
- Deployments moorings to allow precise nodes positioning
Recovery with synthetic cable

- Validation during ESSNAUT 2019 (for PP?, max 2000m deep)
- Seamon West + East recovered during MOMARSAT19
- To validate with Victor during MOMARSAT20

- First trial: failure due to a bottom line weight too light / buoyancy too important
- Second trial OK

Operations sequencing
- Line mooring (BUC positionning)
- Grabbing of the hook in the bucket
- Hooking of the station
- Submersible in security position
- Line recovery
- Station recovery on board

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The shuttle

Benefits
- Complementarity with the submersible
- Increase the dive duration (ROV)
- Essential for autonomous sensors deployment/recovery
- Essential to recover fresh biological samples

Limitations
- Free falling (uncontrolled landing position)
- Can land on active vent or infrastructure parts (10 to 80m drift measured) – Necessity to moor 100m from the working area.
- Payload

Possible improvements
- Increase the payload
- Basket modularity with ROV
- Deployment with cable or autonomous deployment
Conclusion – perspectives

EMSO Azores maintenance cruises are more and more efficient

**Some improvements to be done**

- Decrease the maintenance frequency (in situ energy replacement, in-situ data download)  
  -> Technological developments included in the cruise proposal for period 2021-2024

- Decrease the environmental impact (Ballast system, mooring with 2 cables operations, ...)

- Increase the interoperability between submersibles (arms, claws, interfaces, ...)
- Shuttle improvements

  -> New ROV reflexion working group
Thank you!

Segonzacia mesatlantica / Capelinhos