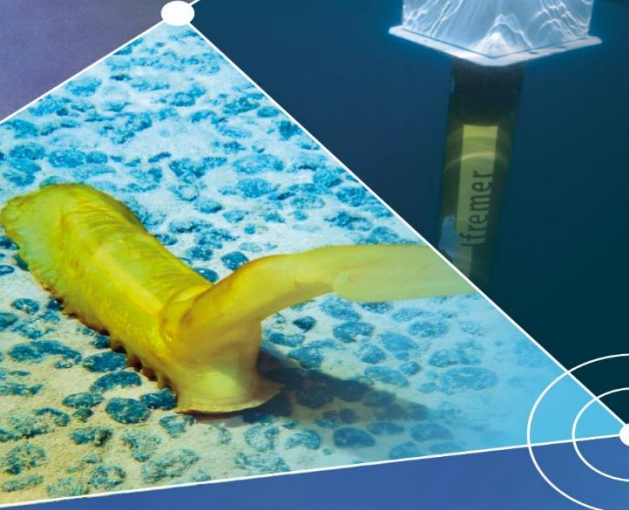
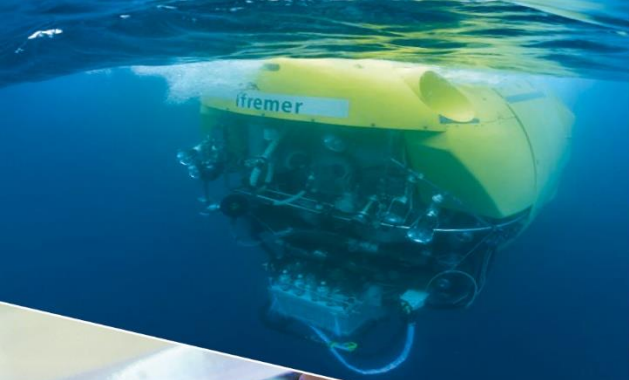




The EMSO-Azores deep sea observatory – 10 years of operation

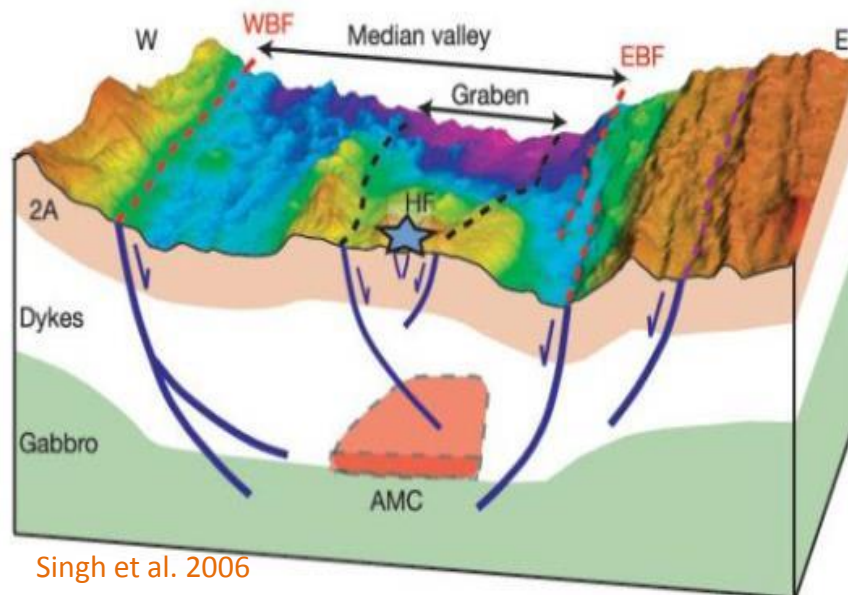
Julien LEGRAND, Pierre-Marie SARRADIN

Workshop on Sea Operation for Ocean Observatories
25 – 26 Septembre 2019, Toulon (FRANCE)



EMSO Azores Deep-sea Observatory 10 years of operations

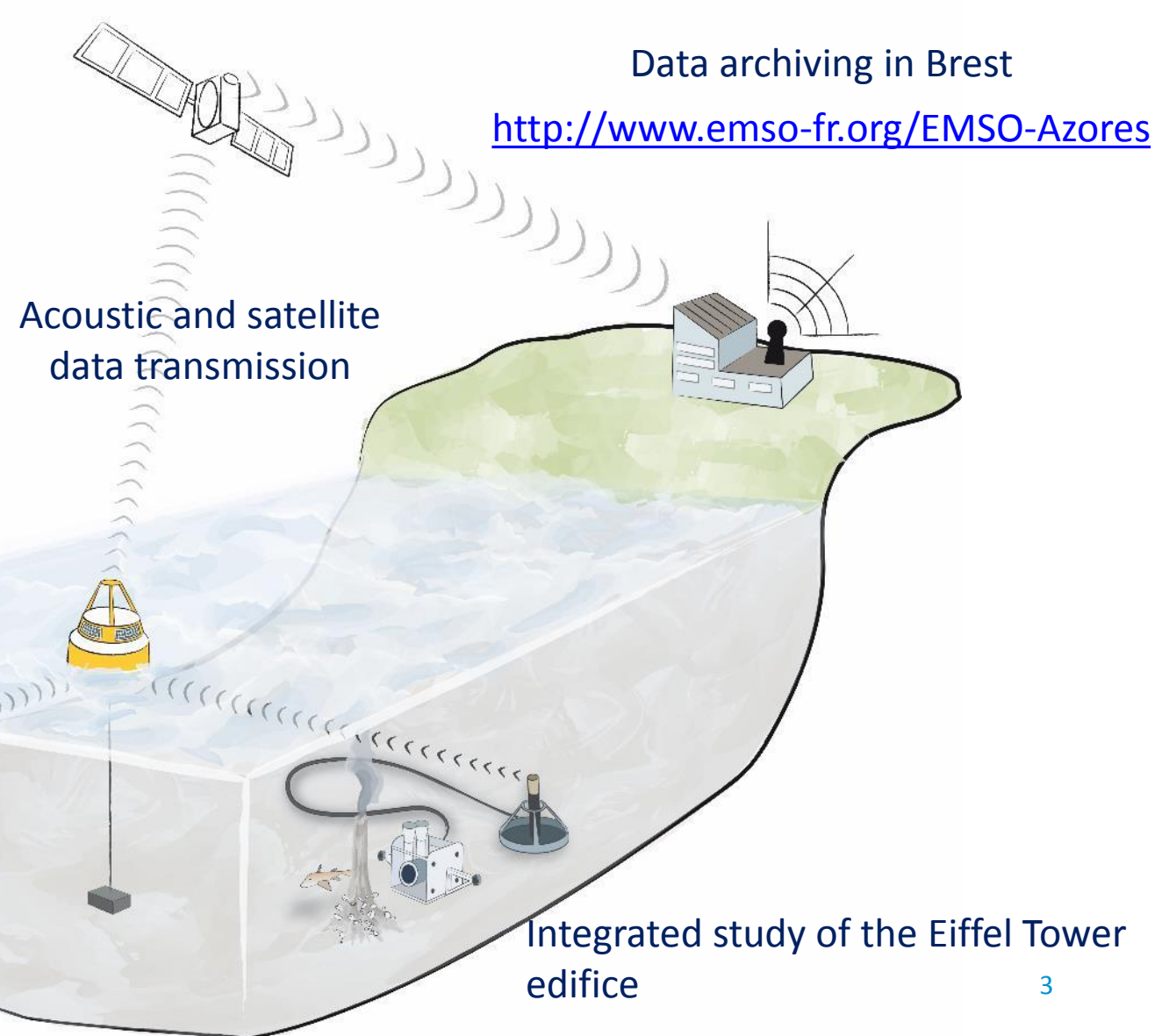
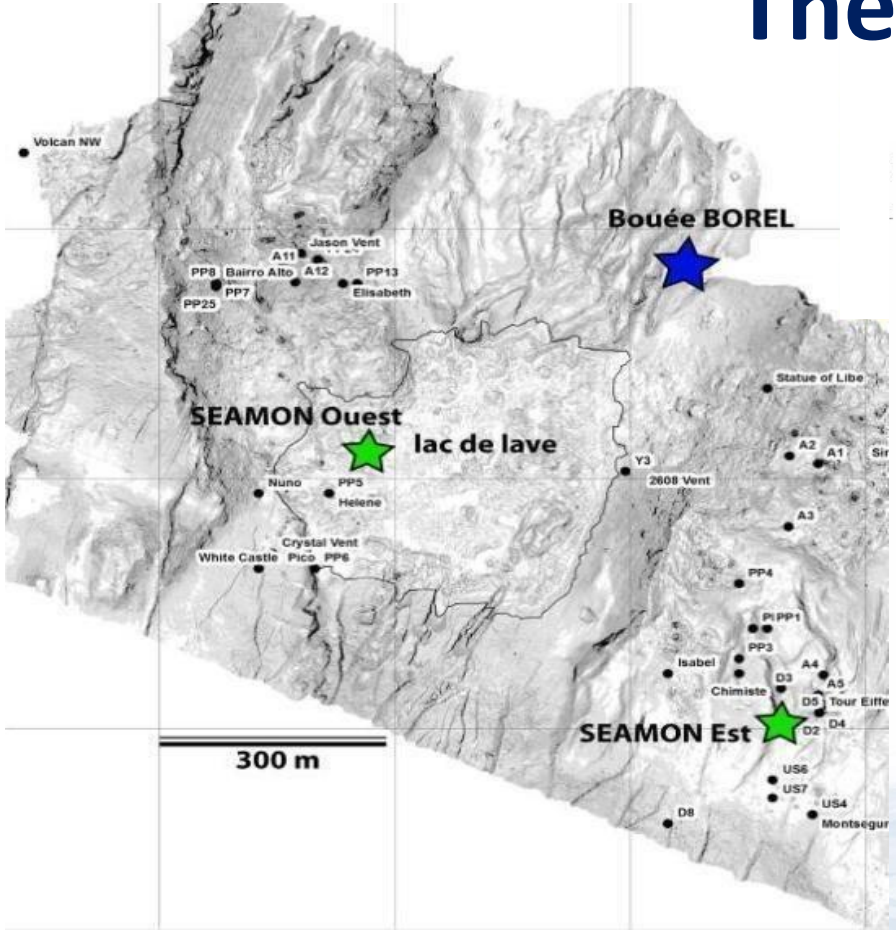
Understand the links between geological, physical and chemical processes and their effects on the dynamics of the hydrothermal fauna at different spatial and temporal scales at the Lucky Strike vent field



Singh et al. 2006



The infrastructure



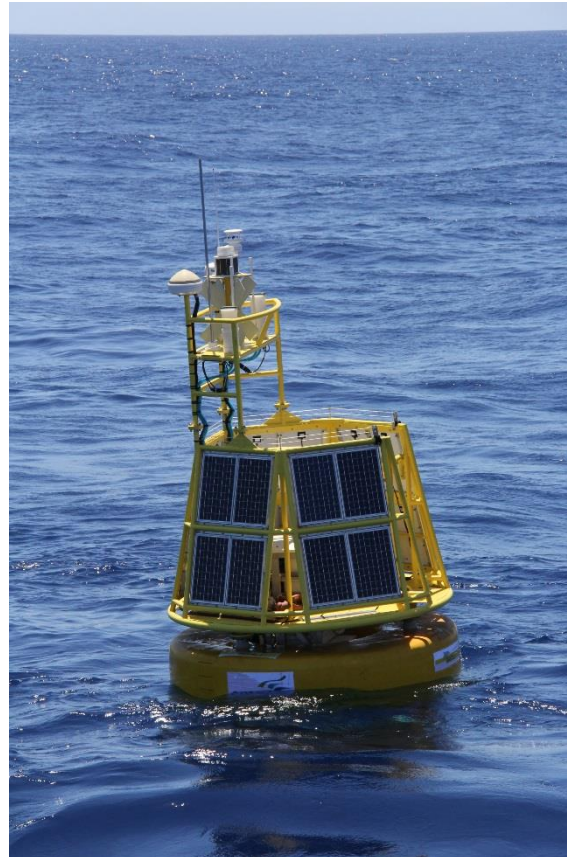
Seismic activity and vertical deformation of the seafloor

Integrated study of the Eiffel Tower edifice

The BOREL buoy

Relay buoy

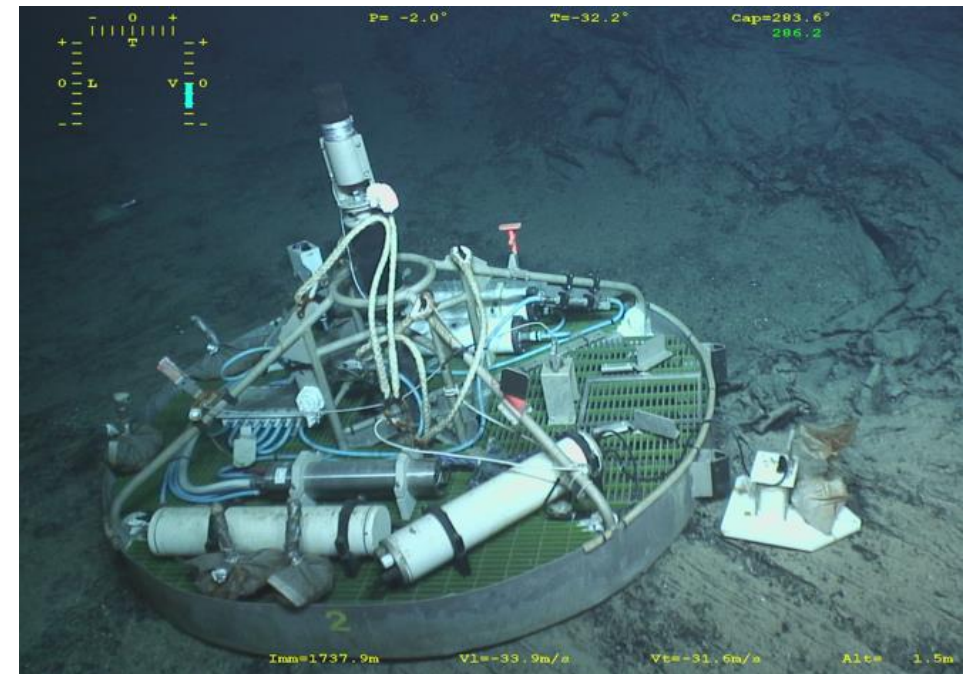
- COSTOF 2
- Iridium / Acoustic / WIFI connectivity
- 20 solar panels + lead batteries
- 2 redundant channels
- Weather station
- AIS
- Geodetic GPS
- Seaphox sensor (pH, CTD, O2)



The West Node

Seismic activity and vertical deformation of the seafloor

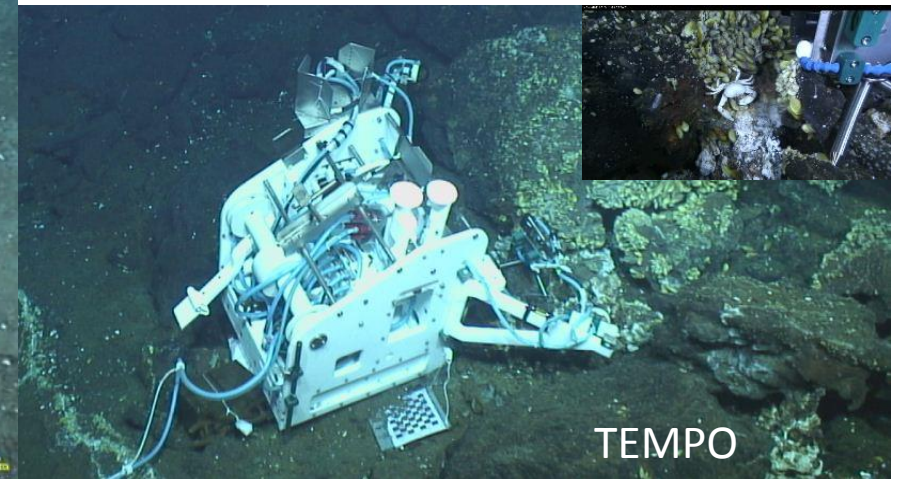
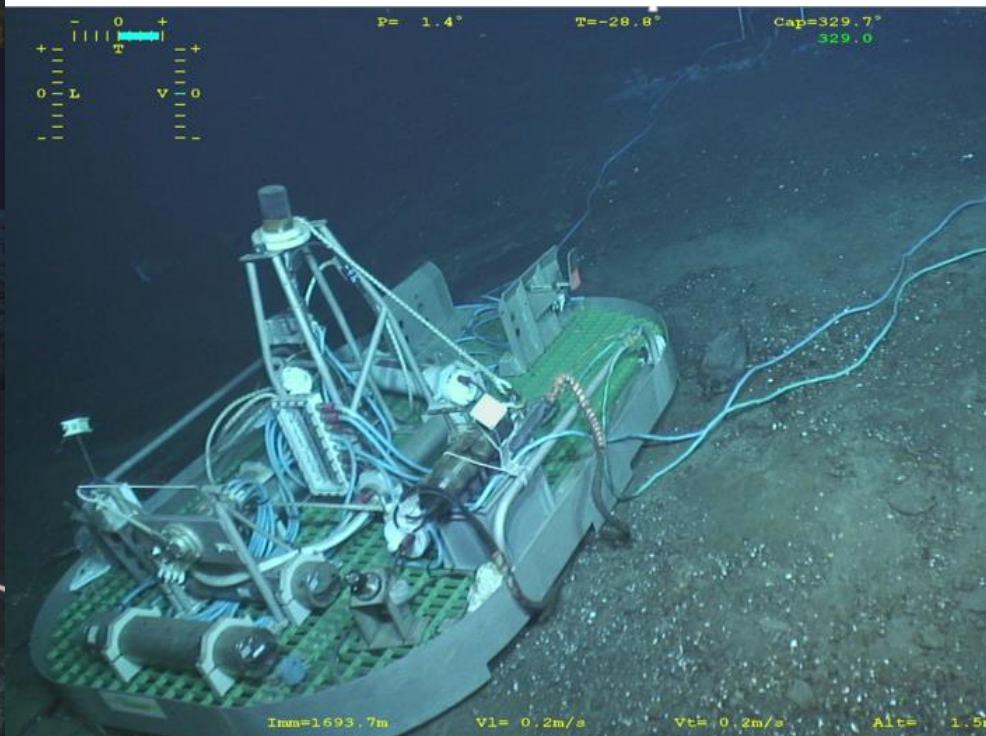
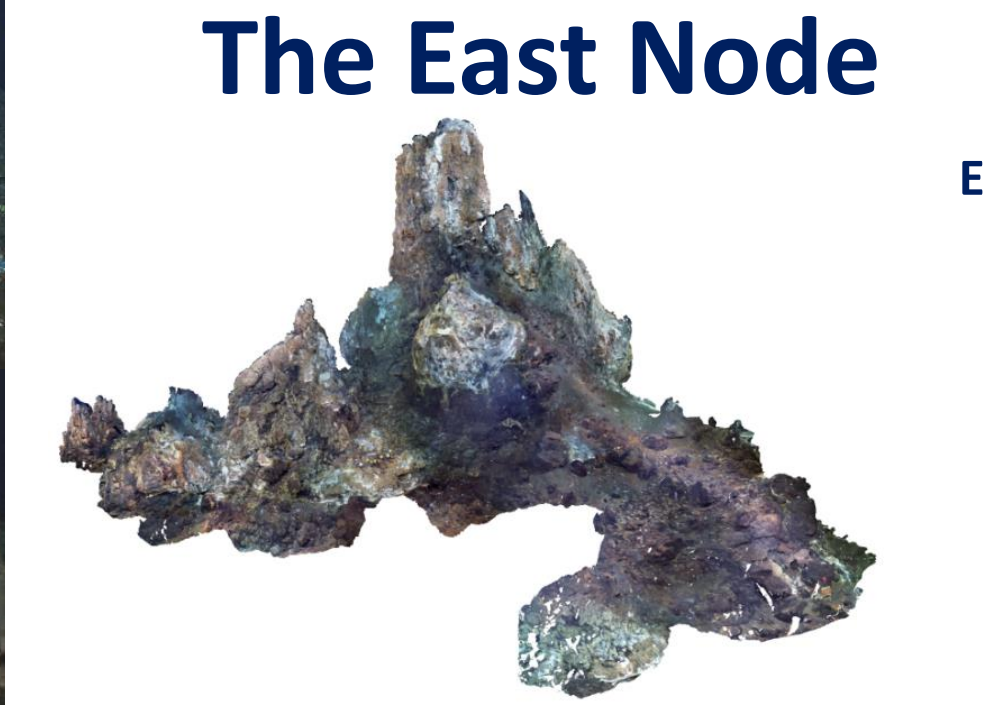
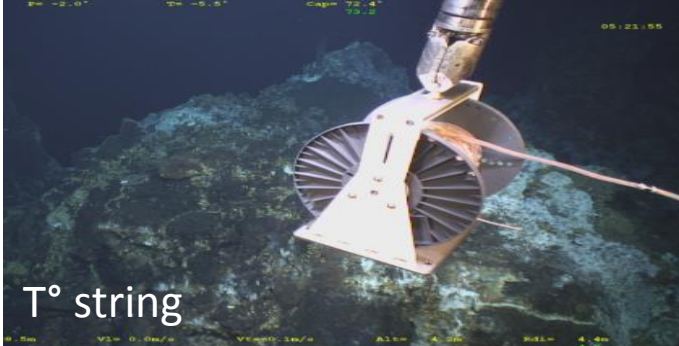
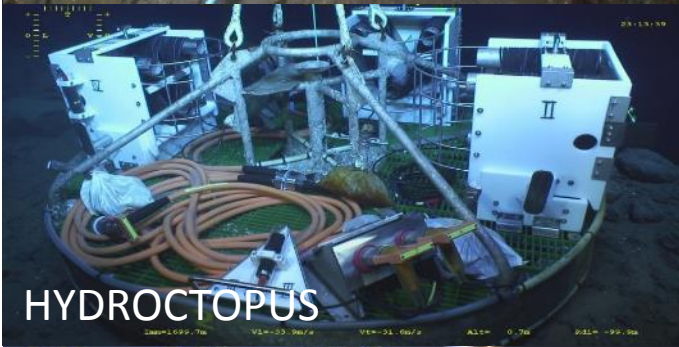
- COSTOF2
- Acoustic / WIFI connectivity
- Lithium Batteries (4KWh)
- 1 connected OBS
- 1 pressure gauge



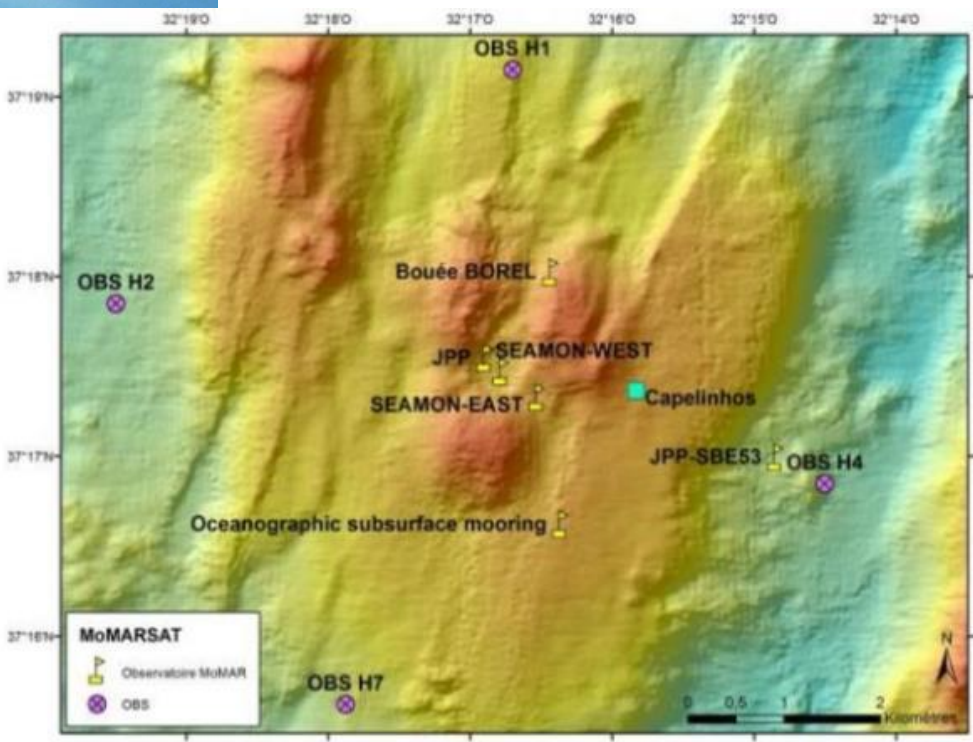
The East Node

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



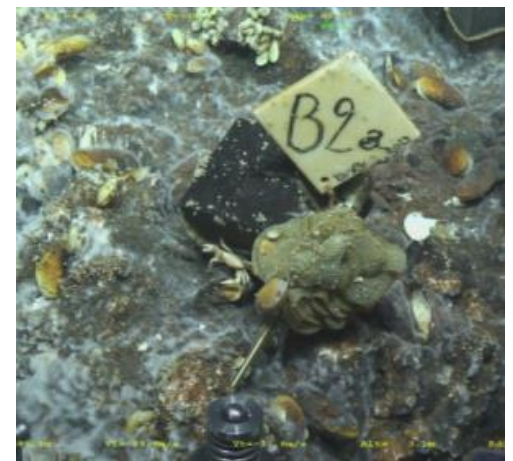
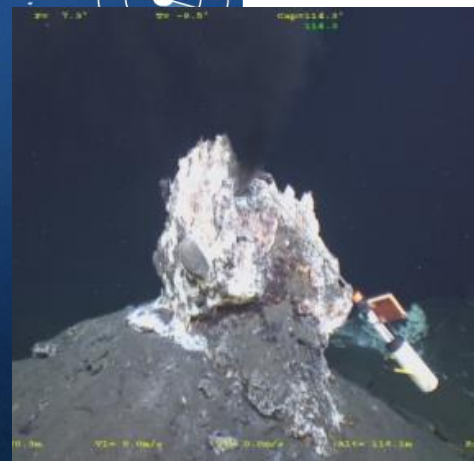
The unconnected components



- 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...**)



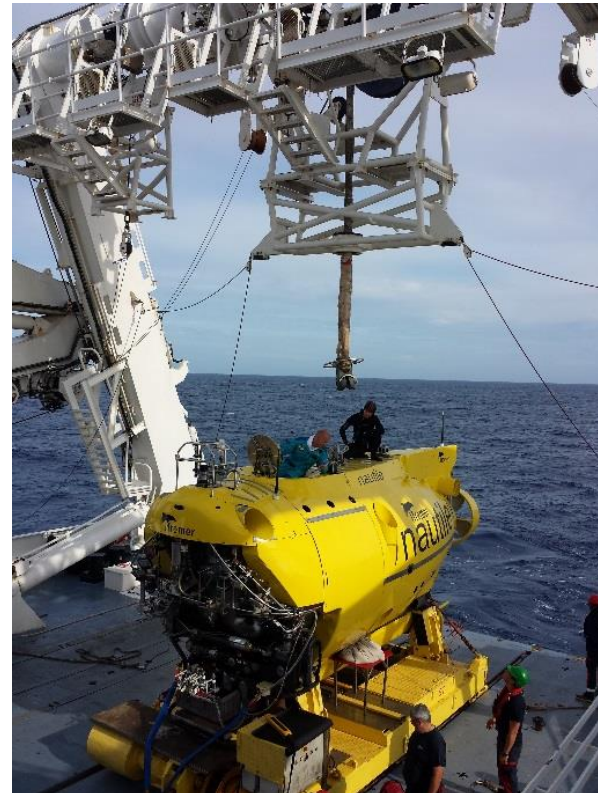
Maintenance cruises

10 years of operations

3 vessels

2 submersibles

20 days at sea / year (including 2 days of transit)



MoMARSAT cruises

Date	N/O	Submersible
Oct 2010	Pourquoi Pas?	Victor
Juil 2011	Pourquoi Pas?	Victor
Aout 2012	Thalassa	Victor
Aout-sept 2013	Pourquoi Pas?	Victor
Juil 2014	Pourquoi Pas?	Victor
Aout 2015	Pourquoi Pas?	Victor
Aout-sept 2016	Atalante	Victor
Juil 2017	Pourquoi Pas?	Victor
Aout 2018	Atalante	Victor
Juin 2019	Pourquoi Pas?	Nautile

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 – Nautilie (2019)

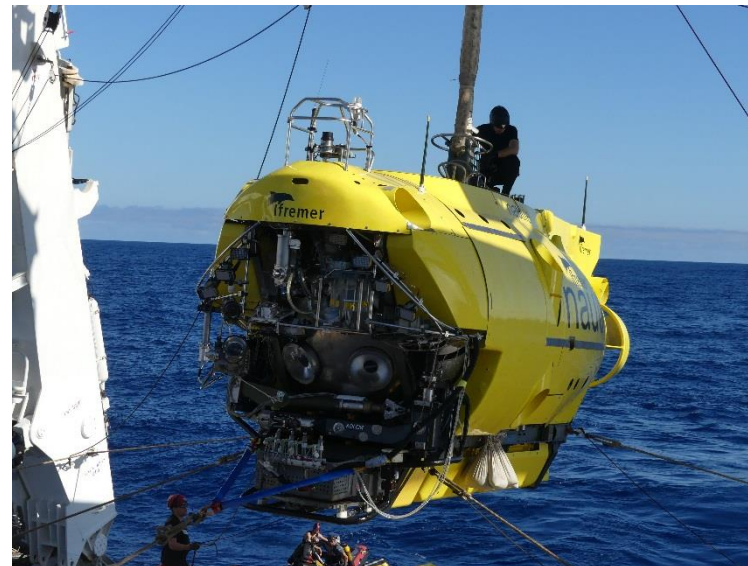
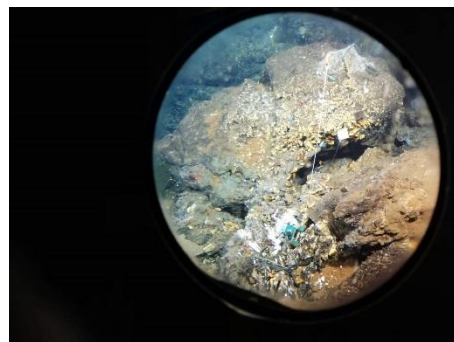
2 different claws with different dimensions

2 different Arms : Victor right handed / Nautilie left handed

Different payload

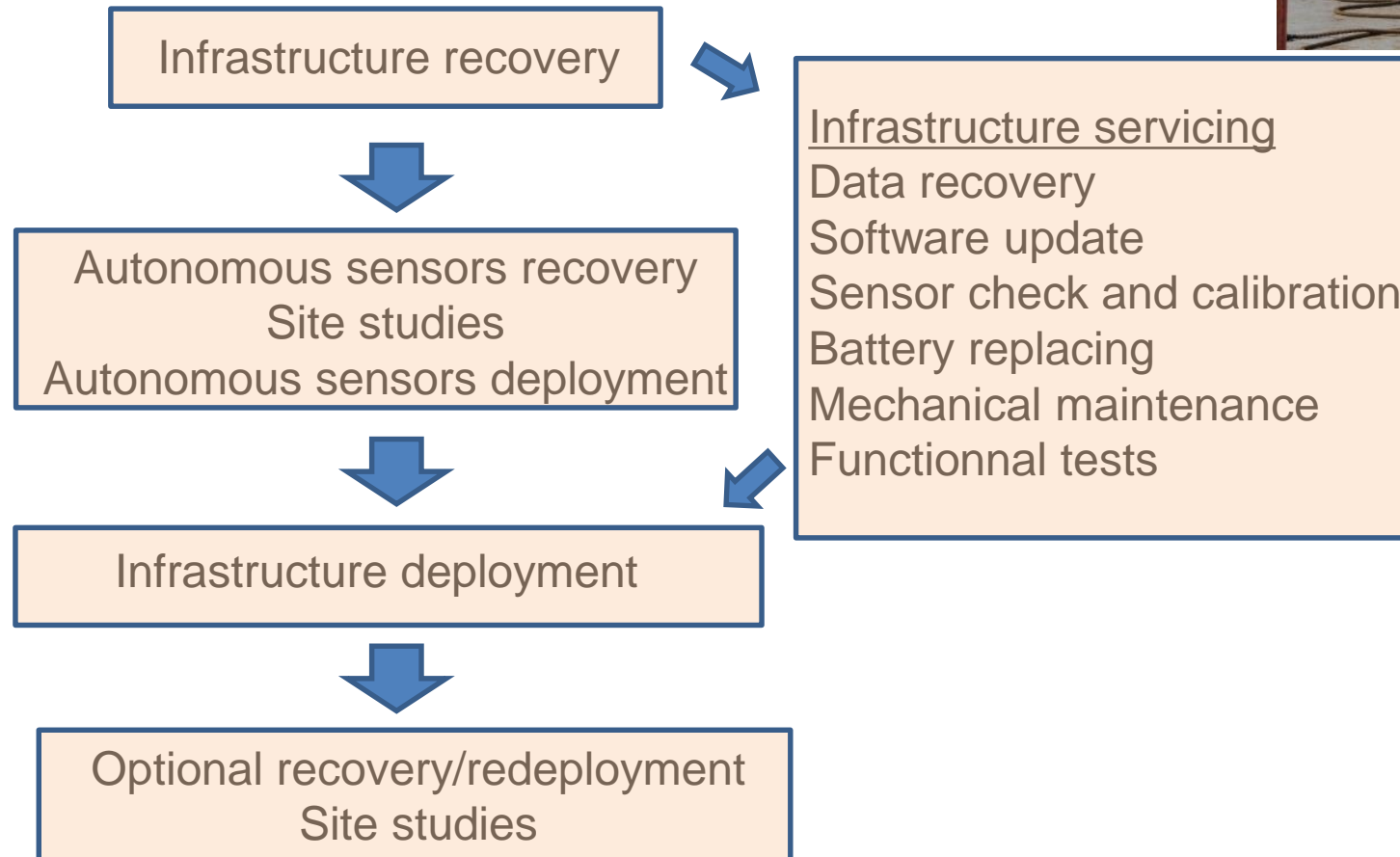
Different dive duration

Specific procedures for each submersibles



Maintenance cruises schedule

Cruise proposals to have access to the French Fleet Research Infrastructure



Operations

Multidisciplinary operations (technical, scientific)

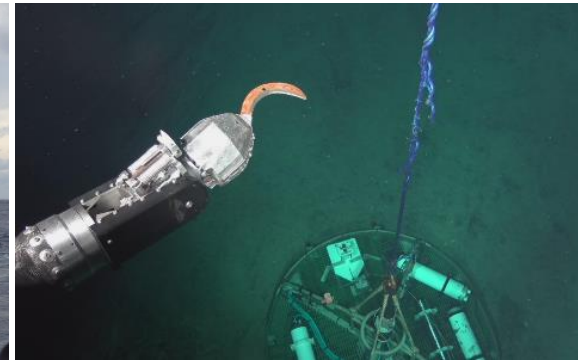
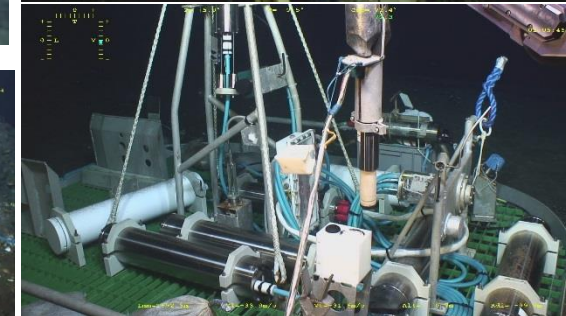
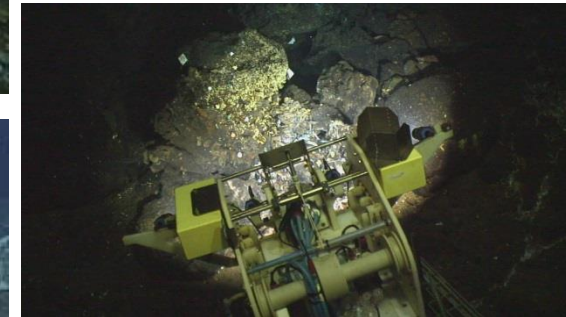
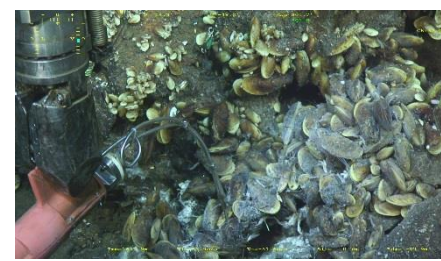
Sampling program associated systematically to the infrastructure maintenance

Deck operations

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

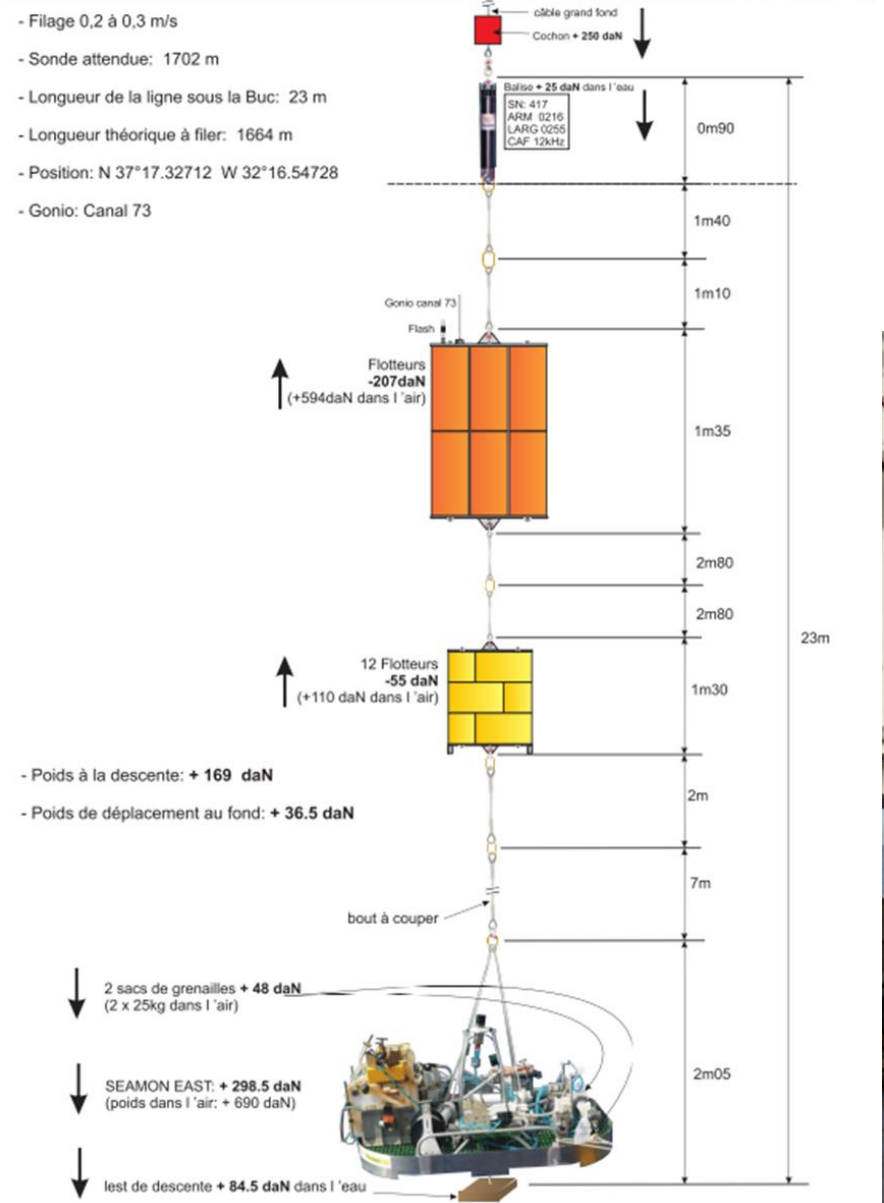
Submersible operations

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

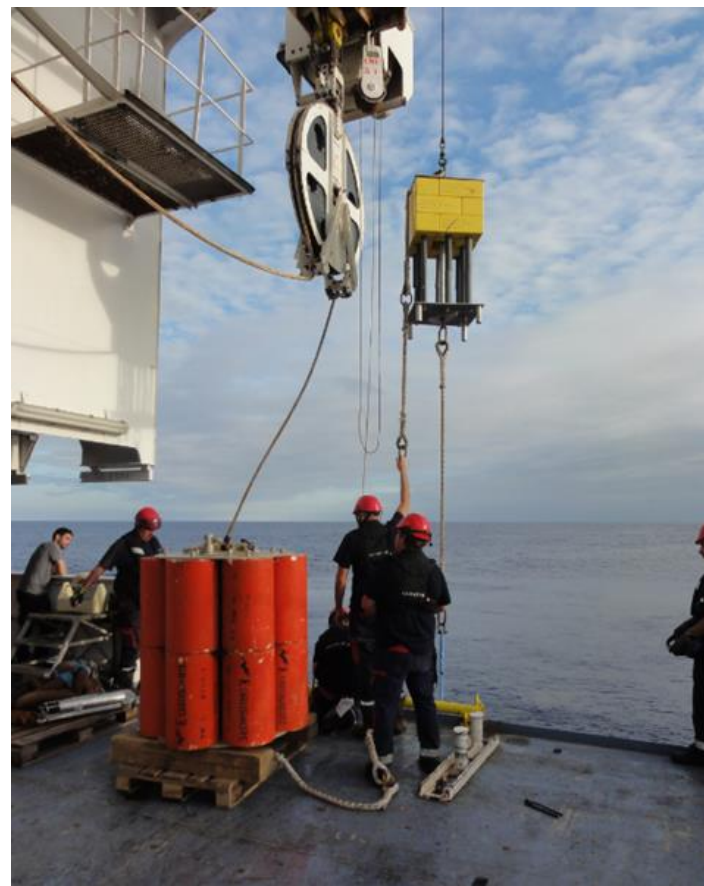


Deployment / Recovery

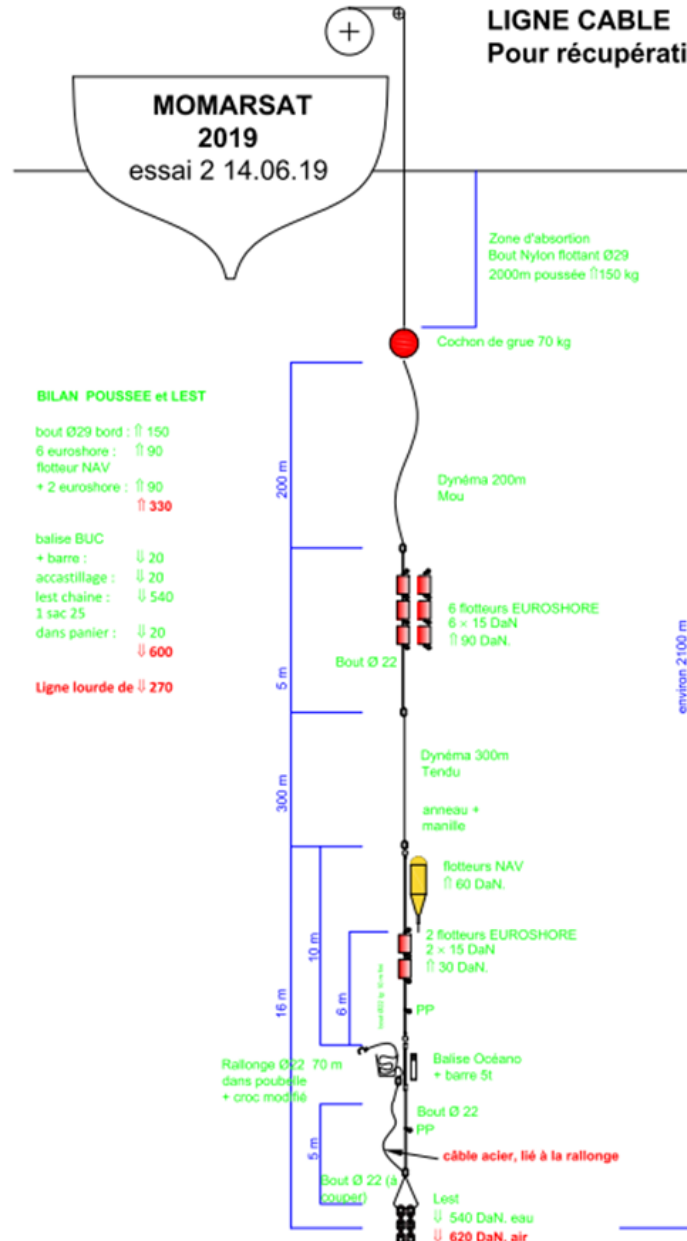
MOMARSAT 2019: Déploiement de SEAMON EAST mise à jour: 24 Juin 2019



- 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 positioning)
- Grabbing of the hook in the bucket
- Hooking of the station
- Submersible in security position
- Line recovery
- Station recovery on board



Heure	Nom Action
2019-06-15T11:20:26	Filage de la ligne
2019-06-15T14:18:12	Virage de la ligne
2019-06-15T15:36:42	Câble GF à bord

The shuttle

Benefits

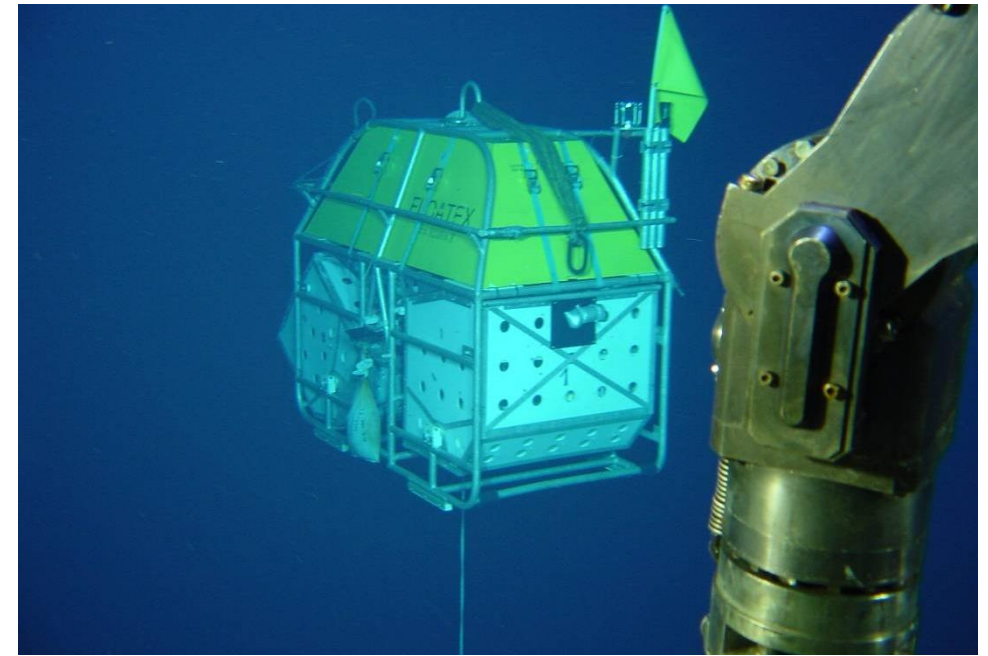
- Complementarity with the submersible
- Increase the dive duration (ROV)
- Essential for autonomous sensors deployment/recovery
- Essential to recover fresh biological samples

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



P=-13.8°

T= -9.0°

Cap= 21.9°

23.1

02:09:44

Thank you !

Segonzacia mesatlantica / Capelinhos

Imm=1658.3m

1698.2

Vl= 0.0m/s

Vt= 0.0m/s

Alt= 10.7m

Rdi= 12.8m