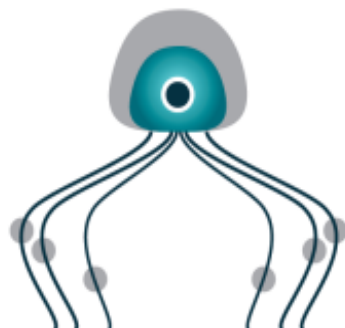


November 17<sup>th</sup> 2016

Tiago Rebelo



MEDUSA  
**DEEP SEA**

OPENING THE DEEP-SEA FRONTIER

[PT02\_Call4\_0013]

# Scope

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## Programme PT02 – "Integrated Marine and Coastal and Waters Management"

The main objective of this funding programme is to **achieve a Good Environmental Status (GES) of marine and coastal waters in Europe, according to the Marine Strategy Framework Directive (MSFD).**

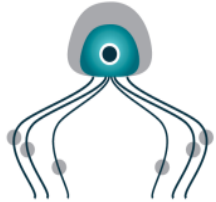
The expected outcomes of the Programme are:

- More integrated management of marine water resources;
- Improved monitoring of marine waters;
- Increased capacity for assessing and predicting environmental status in marine waters;
- Increased awareness of and education in integrated marine water management.

**MEDUSA\_DS** is funded within Call 4 – “R&D smart sensors and development of monitoring platforms and interoperability test cases”:

- Outcome 2: Improve monitoring of marine waters
- Output 3: Capacity on unmanned or mobile oceanic and coastal monitoring operations increased.

# Objectives



**MEDUSA  
DEEP SEA**

## MOTIVATION

**Reinforce the national capacity for mobile autonomous and extended range deep-sea exploration and monitoring, affording scientists and commercial operators means to open and explore the deep sea frontier and contribute for the Good Environmental Status in oceanic and coastal areas.**

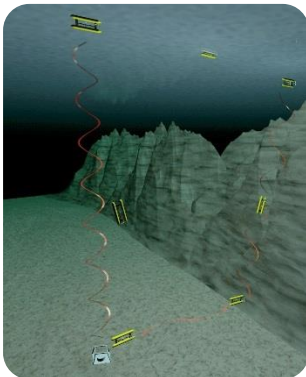
## MISSION

**Develop a system of multiple autonomous vehicles for ocean exploration and monitoring, capable of operating at water depths of up to 3000 meters, with light logistic requirements.**

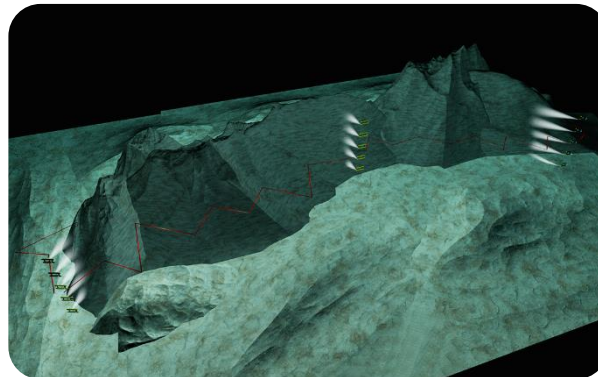
"It's remarkable that so much of the deep sea has never been seen by human eyes at a time when we are viewing the far reaches of the universe using modern technology."

# Requirements

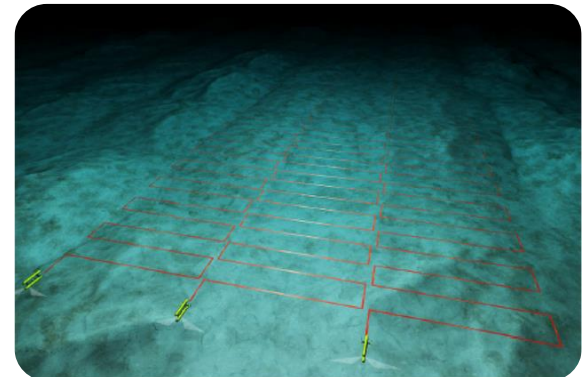
- Develop a **deep-sea AUV** to cover the deep-sea areas of the national remote oceanic areas, up to 3000 m depth.
- The MEDUSA<sub>DS</sub> system will be **designed to comply** with the **requirements** of three **typical scenario missions** (while leaving the flexibility for other future developments):
  1. data download and water column profiling,
  2. resource exploration and mapping, and
  3. high resolution habitat mapping.
- The **final demonstration** will cover at least **Scenario 1** at a **deep-sea location** (1000 m depth minimum).



Scenario 1



Scenario 2



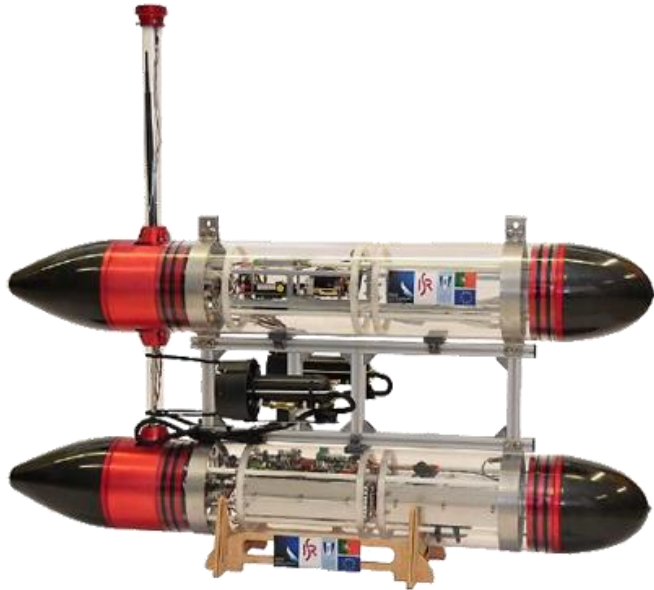
Scenario 3

# Overview

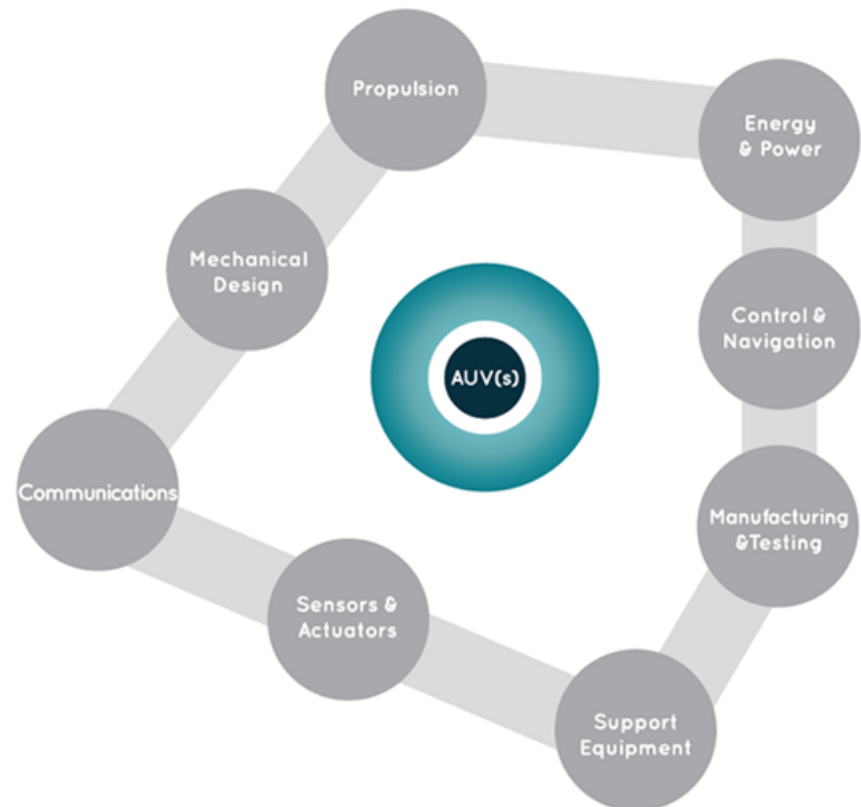
[www.medusadeepsea.com](http://www.medusadeepsea.com)

Sep. 2015 - Apr. 2017

## Multiple Cooperative Autonomous Vehicles



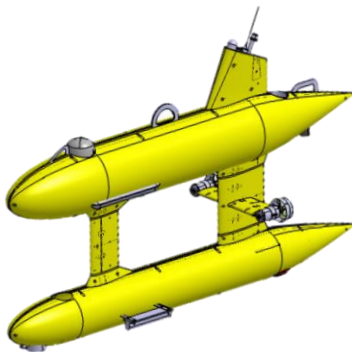
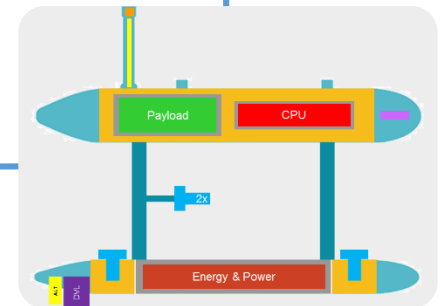
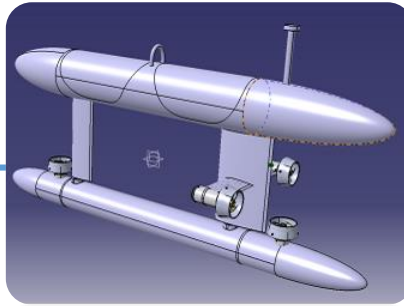
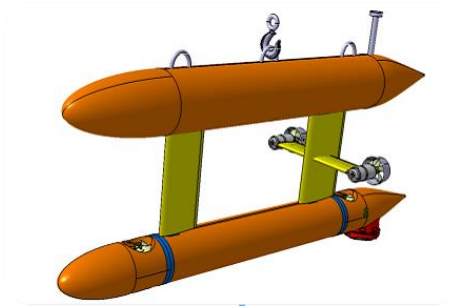
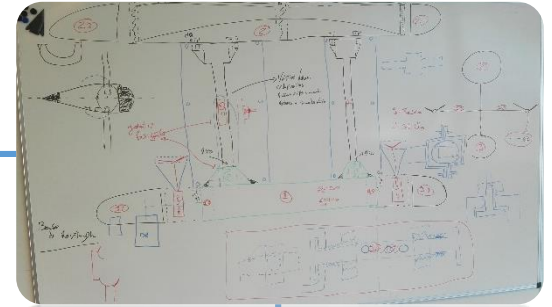
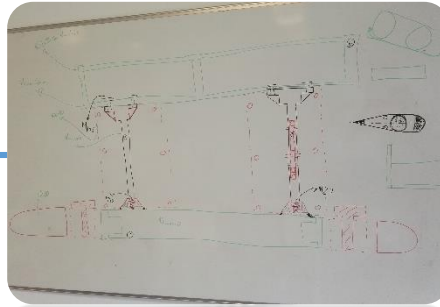
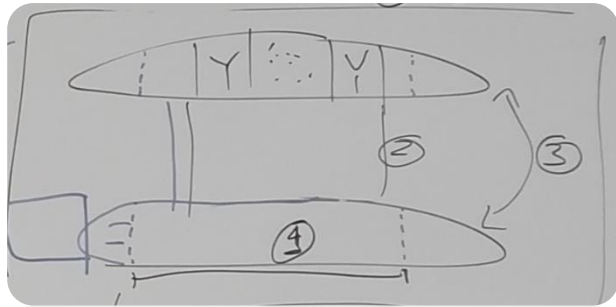
A small fleet of 5x MEDUSA (shallow water) vehicles have been built and have been extensively used by IST/ISR.



ASV - AUTONOMOUS SURFACE VEHICLE

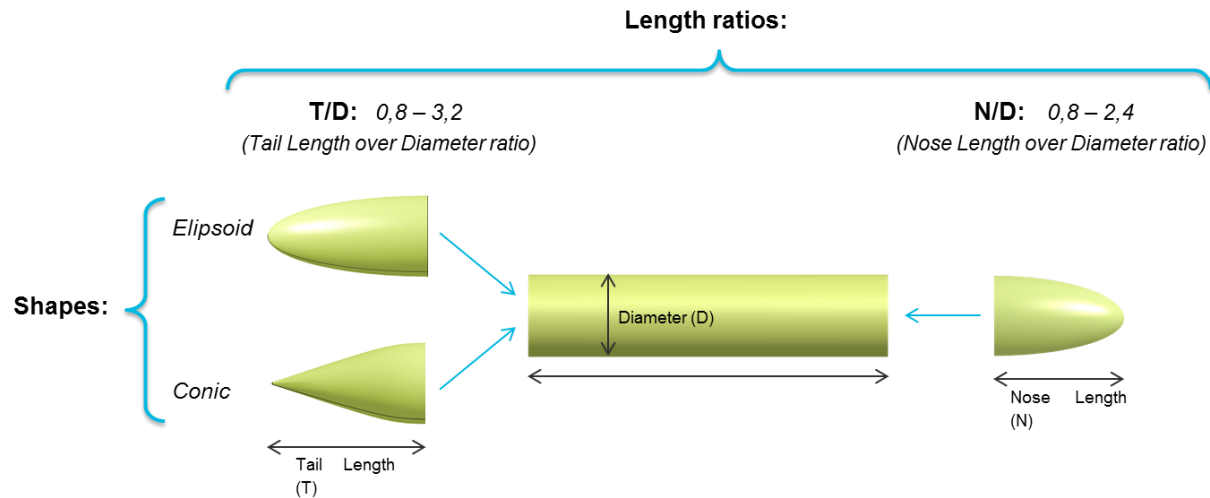
AUV - AUTONOMOUS UNDERWATER VEHICLE

# Development – Concept(s)

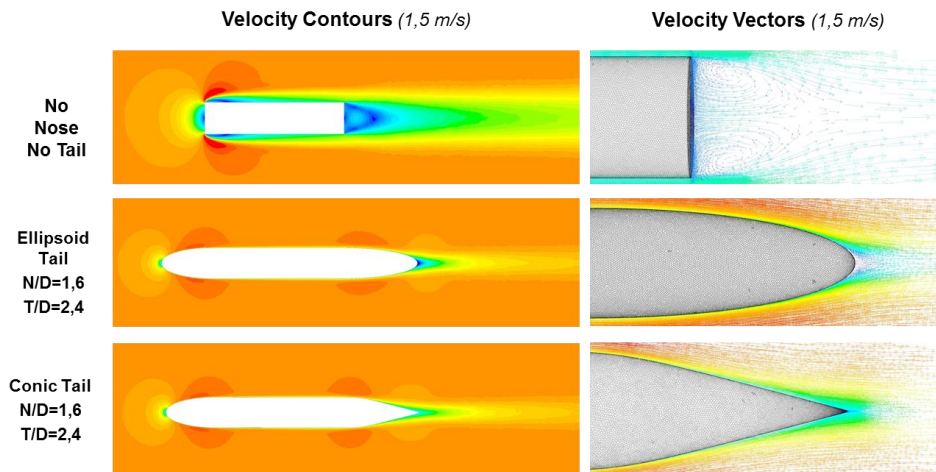




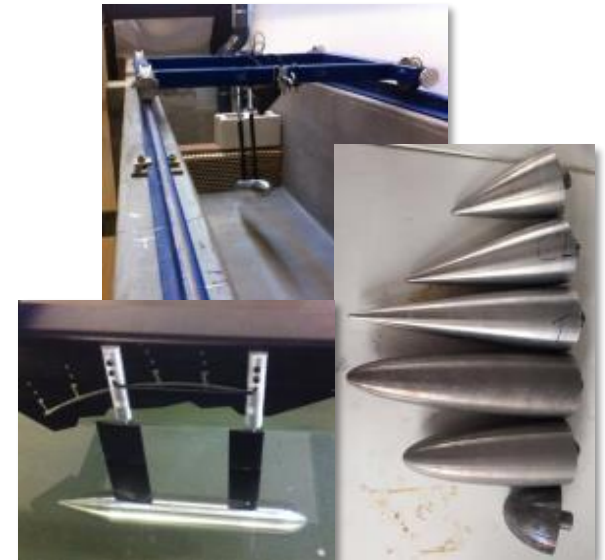
# Development – Hydrodynamics



## Numerical Evaluation

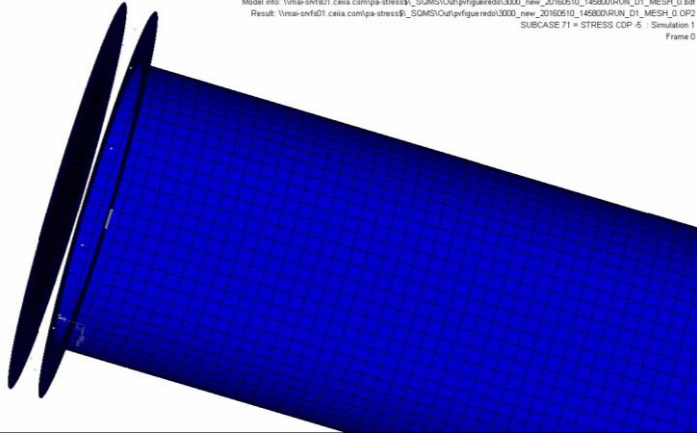


## Experimental Testing

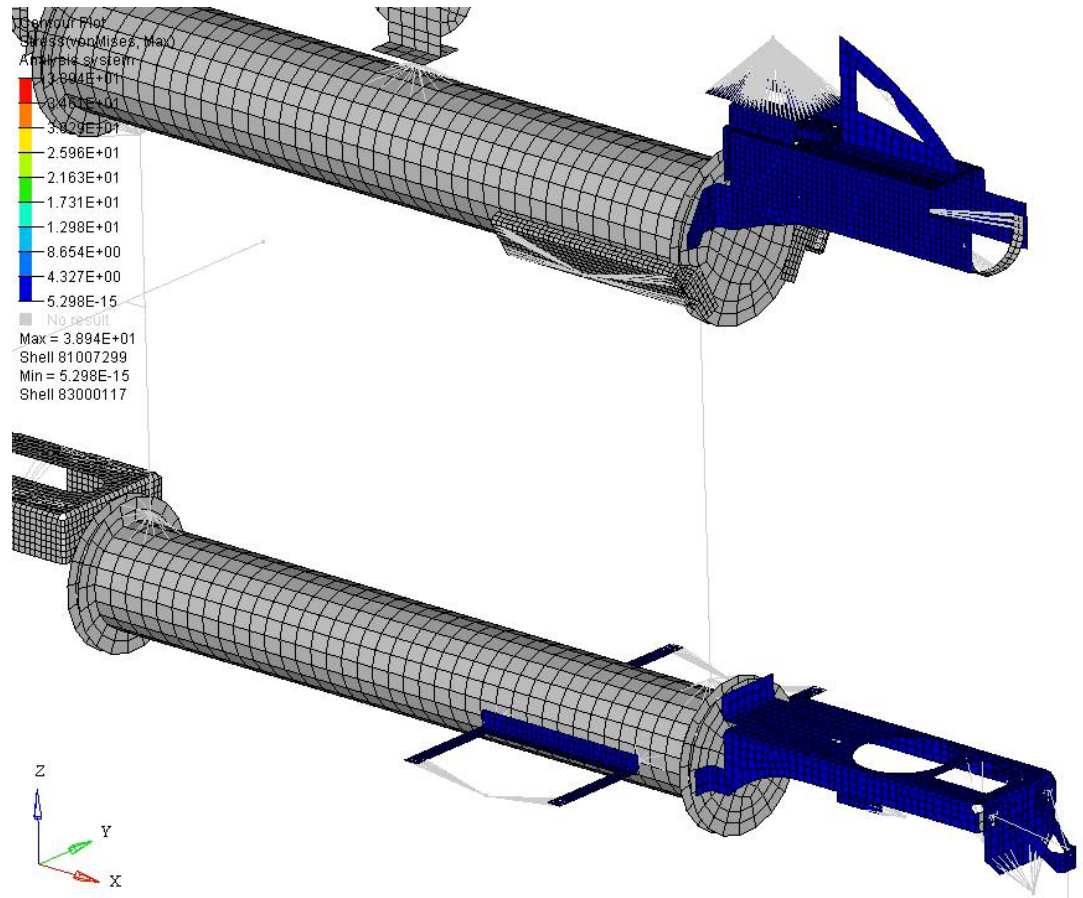
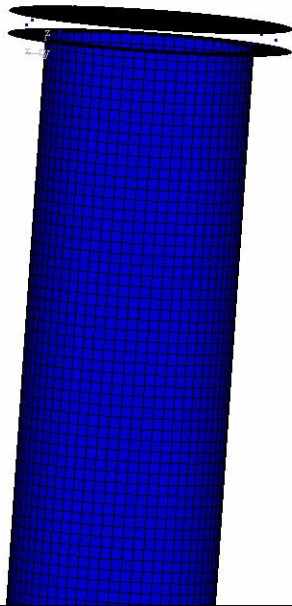


# Development – Structures

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SUBCASE 11 = STRESS COP-5 Simulation 1  
Frame 0



Model info: \\mai-srvfs01.ceiia.com\pa  
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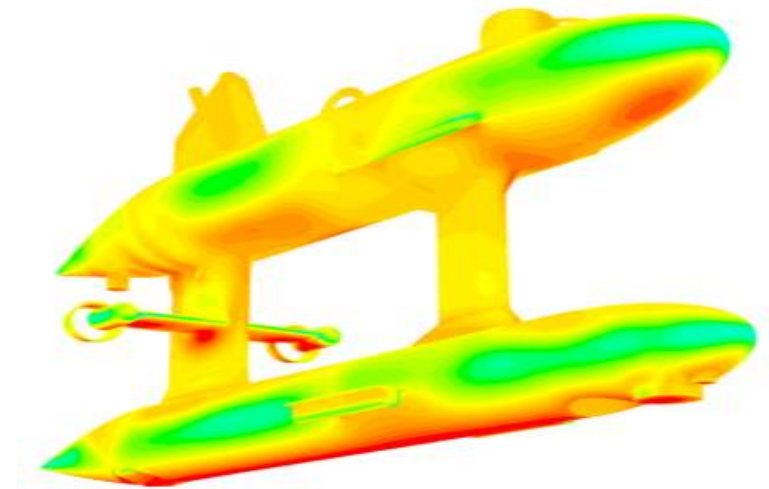
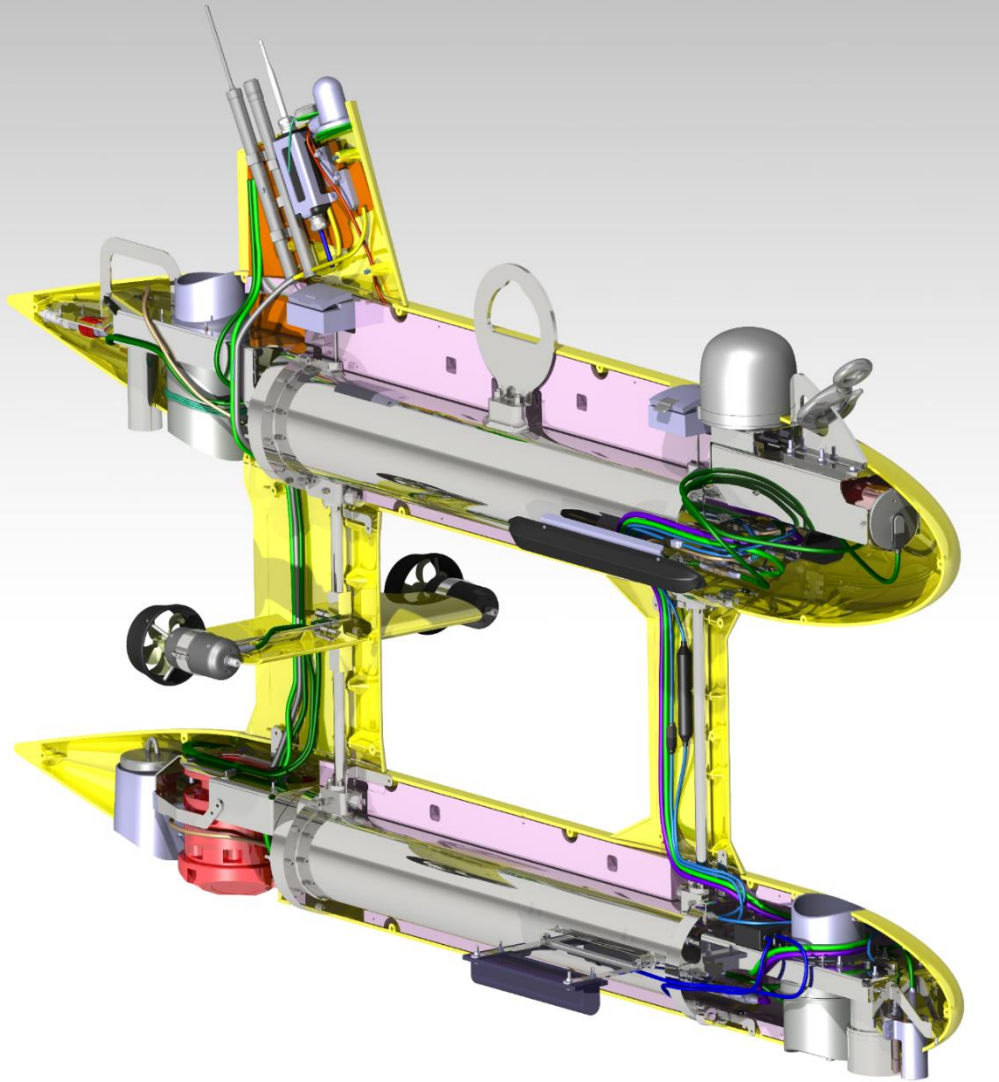




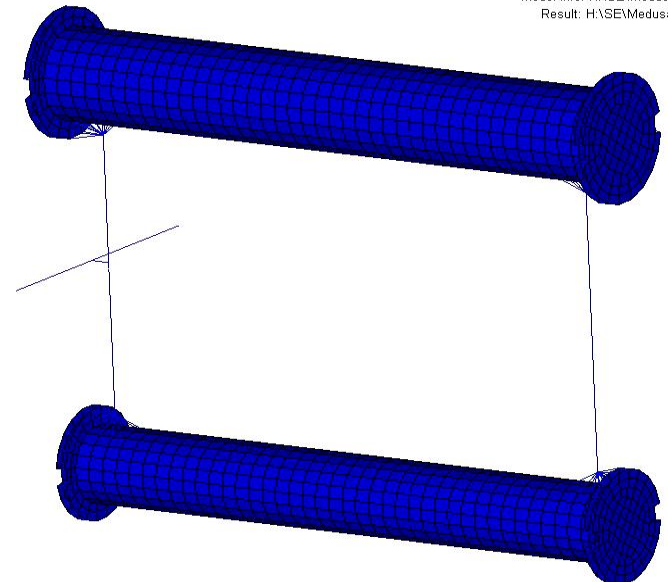
# Development – Manufacturing



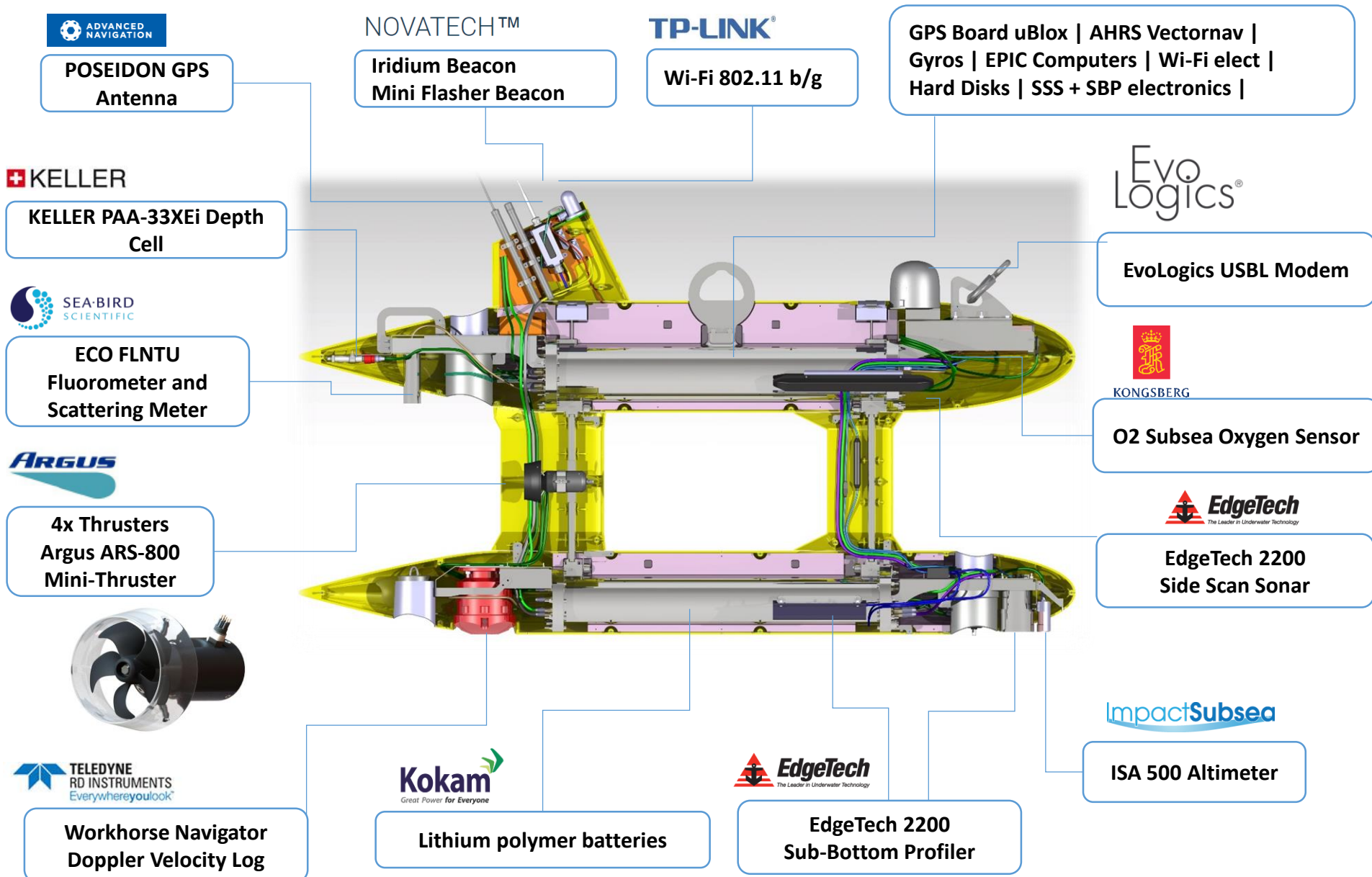
# Integrated Product



Model info: H:\SE\MedusaDS\2  
Result: H:\SE\MedusaDS\2\_



# Integrated Product – System Breakdown





# Results (Expected)

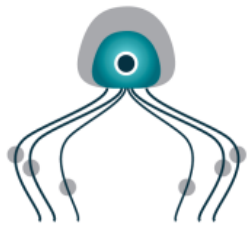


## MAIN CHARACTERISTICS

- Type: Double hull AUV
- Size: 2.8 m x 1.5 m x 0.7 m
- Weight: ~300 kg
- Endurance: ~10 hrs
- Range: ~50 km
- Maximum depth: 3000 meters
- Maximum speed: 3 m/s
- Nominal speed: 1,25 m/s
- DOF: 4
- Power system capacity: 2.4 kWh
- Launch and recovery: Crane

## MISSIONS

- Seabed Mapping
- Oil and Gas Survey
- Geophysical Survey
- Oceanographic survey
- Search and Recovery



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THANK YOU



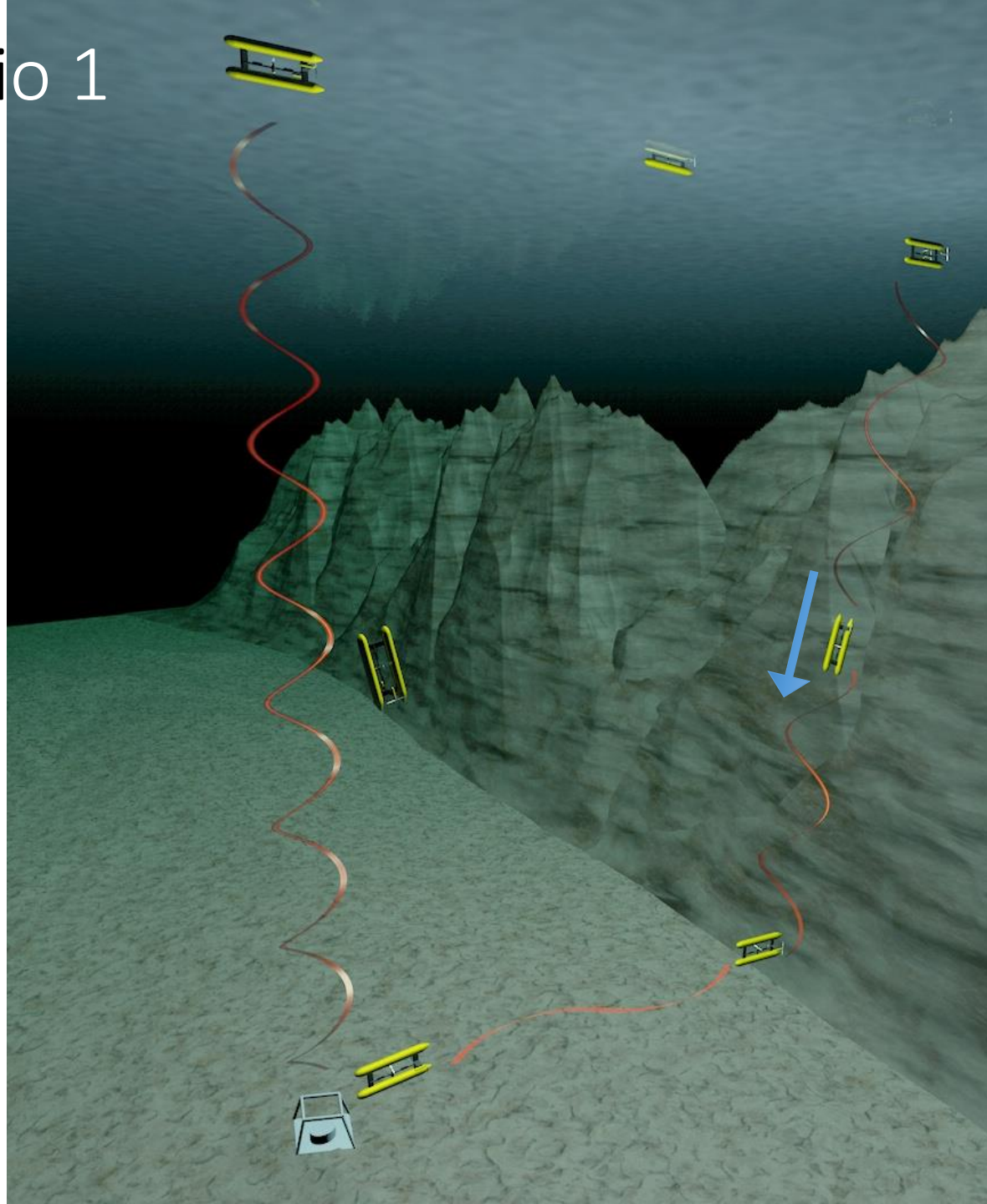


Extra Slides

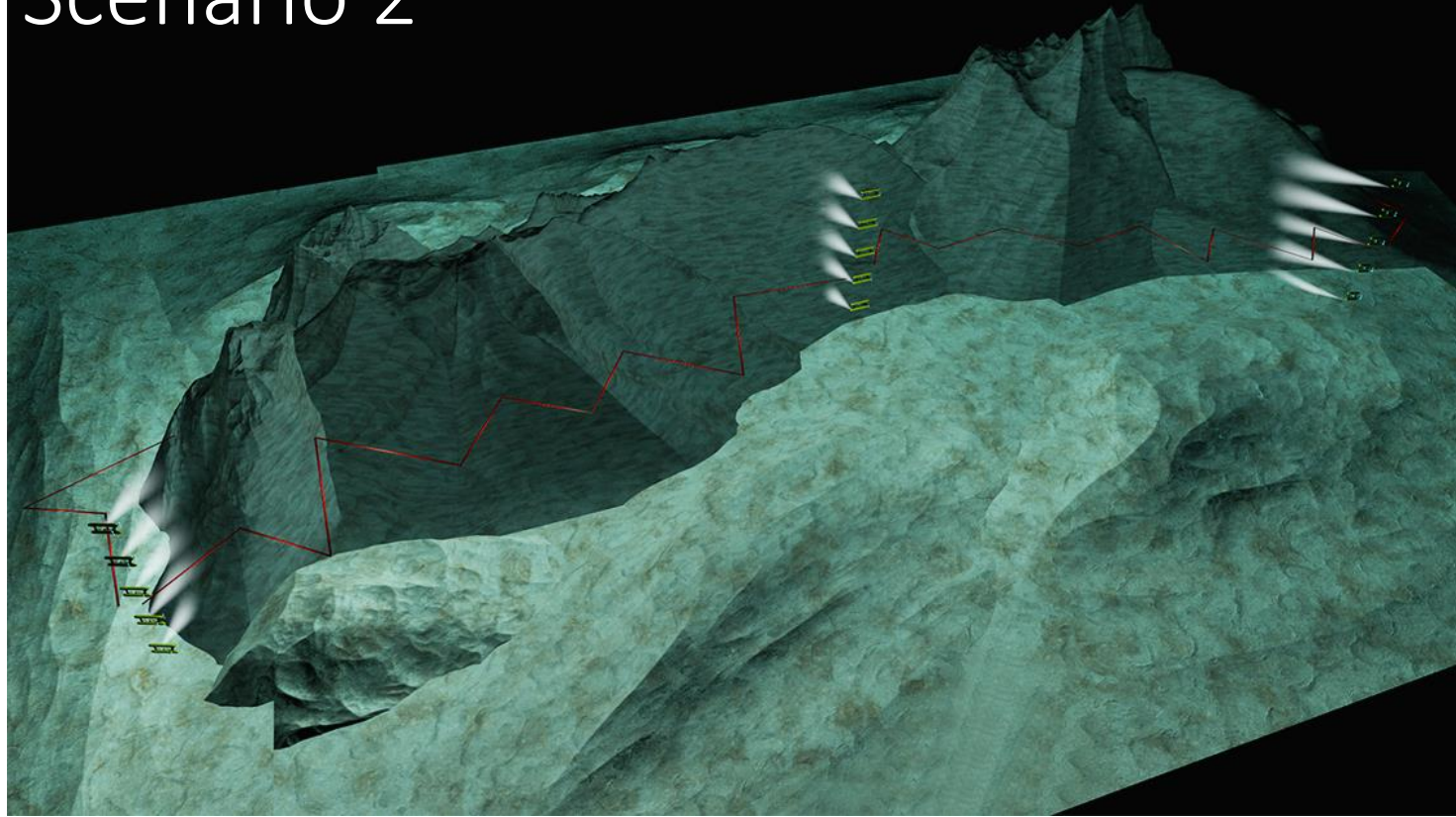
# Mission Scenario 1

## Data download and water column profiling

- Shuttle carrying data (data download or data mule) in collaboration with other platforms.
- To reach the seabed and homing on a fixed lander or oceanic observatory.
- In the descent the AUV will perform water column data acquisition in a well defined “spiral” with negative pitch.
- Finally the AUV changes to high positive pitch for the ascent and will spiral all the way up to the surface.



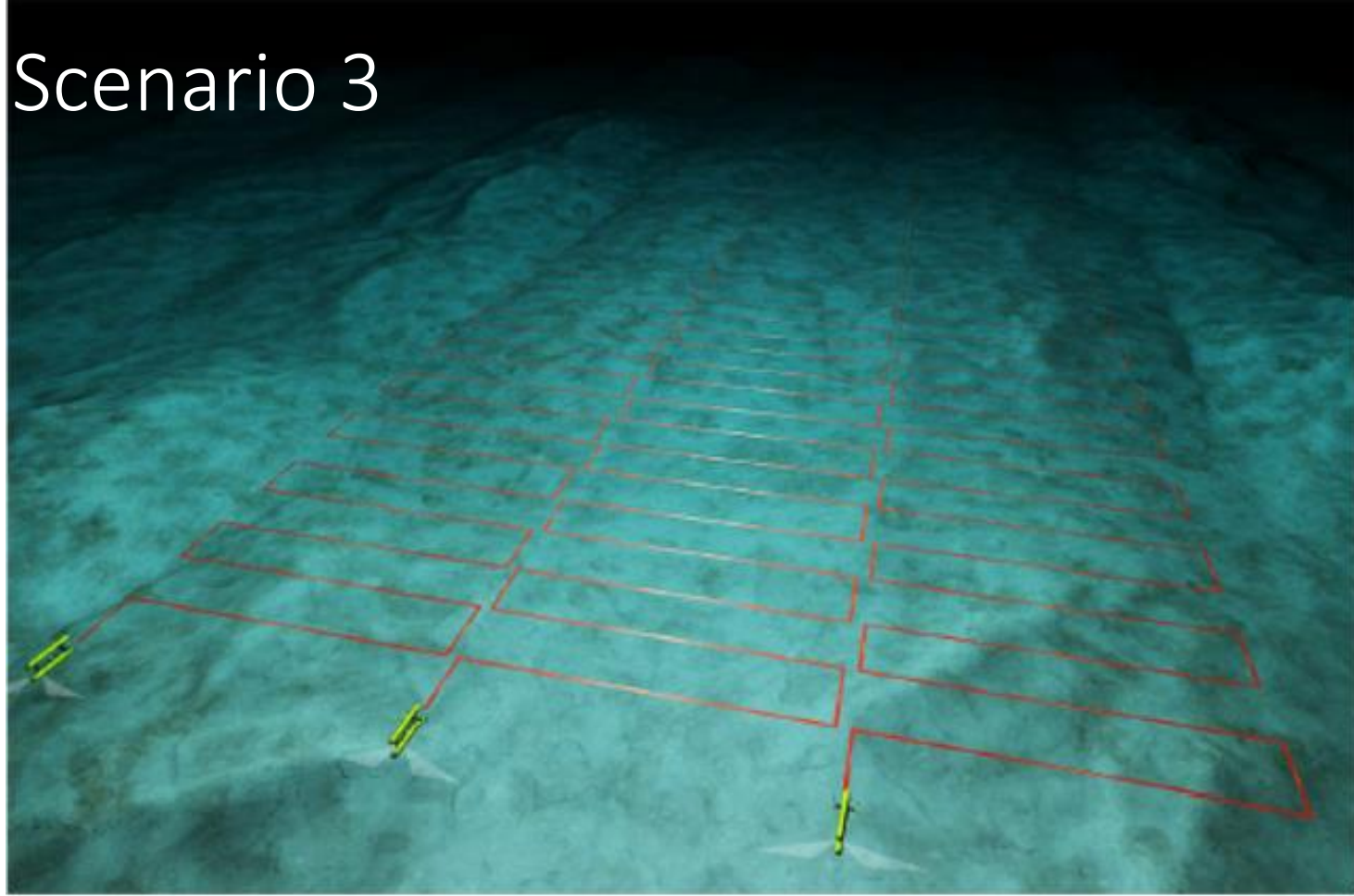
# Mission Scenario 2



## Resource exploration and mapping

- Exploring and mapping resources from the deep-sea (e.g. Mid-Atlantic Ridge).
- The AUV group will perform transects, measure water parameters near the seabed acquiring side scan sonar data in medium range.
- In this mission the MEDUSA<sub>DS</sub> system will have an ASV plus 3 to 5 collaborating AUVs.
- During transects the AUV system will search for hydrothermal sources.

# Mission Scenario 3



## High resolution habitat mapping

- high resolution habitat mapping with an ASV and 3 to 5 AUVs performing “lawn mower” trajectories, at 2-3 m altitude from the sea bottom
- carrying high resolution cameras and side scan sonar configured for the highest resolution
- to allow scientists to map and describe deep-sea ecosystems benthic communities and its functioning