Interreg
Ελλάδα-Κύπρος
Ευρωπαϊκό Ταμείο Περιφερειακής Ανάπτυξης
ΕΥΡΩΠΑΪΚΗ ΕΝΩΣΗ
ΑνΔιΚαΤ

Promoting diving tourism through the new technologies an overview of the BLUEMED, MAGNA and MeDryDive projects

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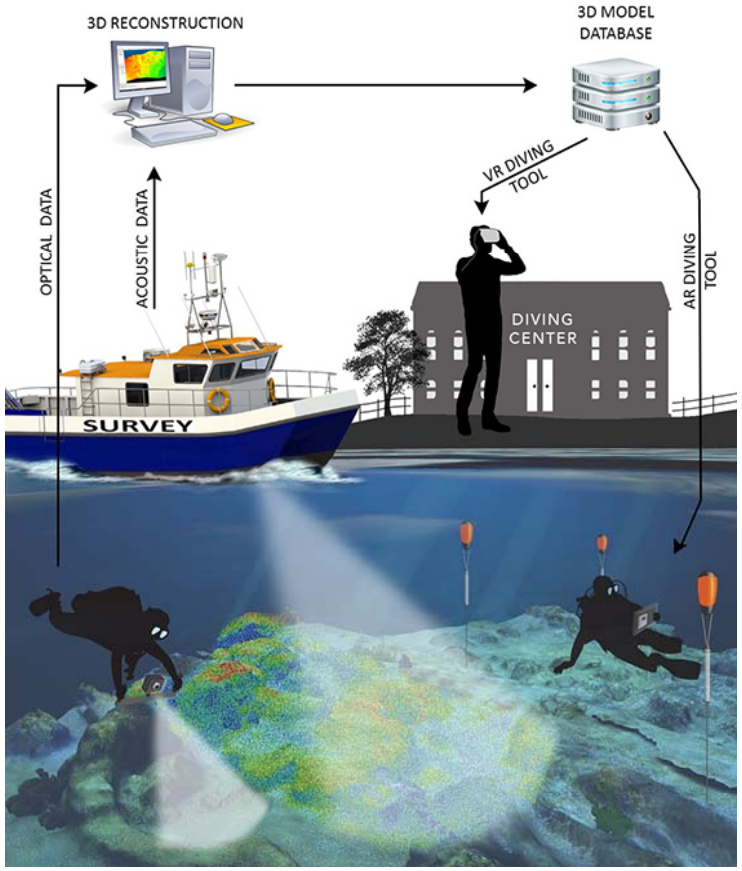
DIPARTIMENTO DI
INGEGNERIA MECCANICA,
ENERGETICA E GESTIONALE
DIMEG

3D
RESEARCH

Agenda

- Presentation
- Bluemed & iMARECulture
- Diving in cultural sites
- Create underwater 3D contents
- Dry Visit in Virtual Reality
- Underwater Augmented Reality



Presentation

UNIVERSITÀ DELLA CALABRIA

- 13 Departments
- 900 Professors and Researchers
- 750 technical and administrative staff
- 30.000 students

Presentation

SPINOFF › UNIVERSITÀ DELLA CALABRIA

AppliCon

Underwater communication and localization

3D RESEARCH EXPERIENCE TECHNOLOGY

Underwater 3D and Augmented Reality

tech4sea underwater technologies

Underwater mechatronics

Preservation and dissemination of Underwater Cultural and Natural Heritage

BLUEMED

- Plan/test/coordinate Underwater Museums, Diving Parks and Knowledge Awareness Centers in order to support sustainable & responsible tourism development and promote **Blue** growth in coastal areas and islands of the **Med**iterranean

Programme Cofinancé par le Fonds de Développement Régional
Programme cofinanced by the European Regional Development Fund

Consortium

1. Regional Development Fund - **Region of Thessaly** (RDFT) *(Lead Partner / WP1 Leader)*
2. **Atlantis Consulting** S.A. (ATL) *(WP3 Leader)*
3. **Dubrovnik** Neretva Regional Development Agency DUNEA *(WP2 Leader)*
4. Foundation University Enterprise of the **Region of Murcia** (FUERM)
5. Ministry of Cultural Heritage and Activities and Tourism of Italy (**MIBACT**)
6. **Ministry of Culture and Sports of Greece** - Ephorate of Underwater Antiquities (MCSG)
7. **University of Calabria** (UNICAL) *(WP4 Leader)*
8. **University of Patras** (UPatras) *(WP5 Leader)*
9. **University of Cyprus** (UCY)
10. **University of Zagreb** Faculty of Electrical Engineering and Computing (UNIZG-FER)
11. **Marine Protected Area "CAPO RIZZUTO“** (associate partner)
12. Municipality of **Pylos-Nestor** (associate partner)
13. National **Museum of Underwater Archaeology** Cartaghena(associate partner)
14. **Parco Archeologico dei Campi Flegrei** (associate partner)

Programme Cofinancé par le Fonds de Développement Régional
Programme cofinanced by the European Regional Development Fund

General Objectives

- **Study the natural, cultural, and legislative conditions** of selected locations in the Mediterranean region with the aim to plan, test, and coordinate Underwater Museums and Diving Parks in a unified approach

- **Preserve and protect** underwater cultural resources, while making them **publicly accessible** with the promotion of the concept of Underwater Museums and organized underwater archaeological sites

- **Protect the marine ecosystem** of the Mediterranean

- **Promote a sustainable & responsible model of tourism development** for the selected coastal and island regions of the Mediterranean

Scope

- **Plan, Test and Coordinate** a combination of Underwater Museums, Diving Parks & Knowledge Awareness Centres
- **Promote best practices** in protecting natural and cultural resources of the Mediterranean Sea
- Enhance their attractiveness as **poles of economic growth** for local societies
- Make Underwater Museums and Diving Parks **accessible to non-divers** with the use of **3D reconstruction** and digital visualization techniques
- Plan, establish & best manage **Knowledge Awareness Centers (KACs)**
- Study and test the possibility of **establishing Underwater Museums and Diving Parks** by running **pilot actions** in 4 selected locations

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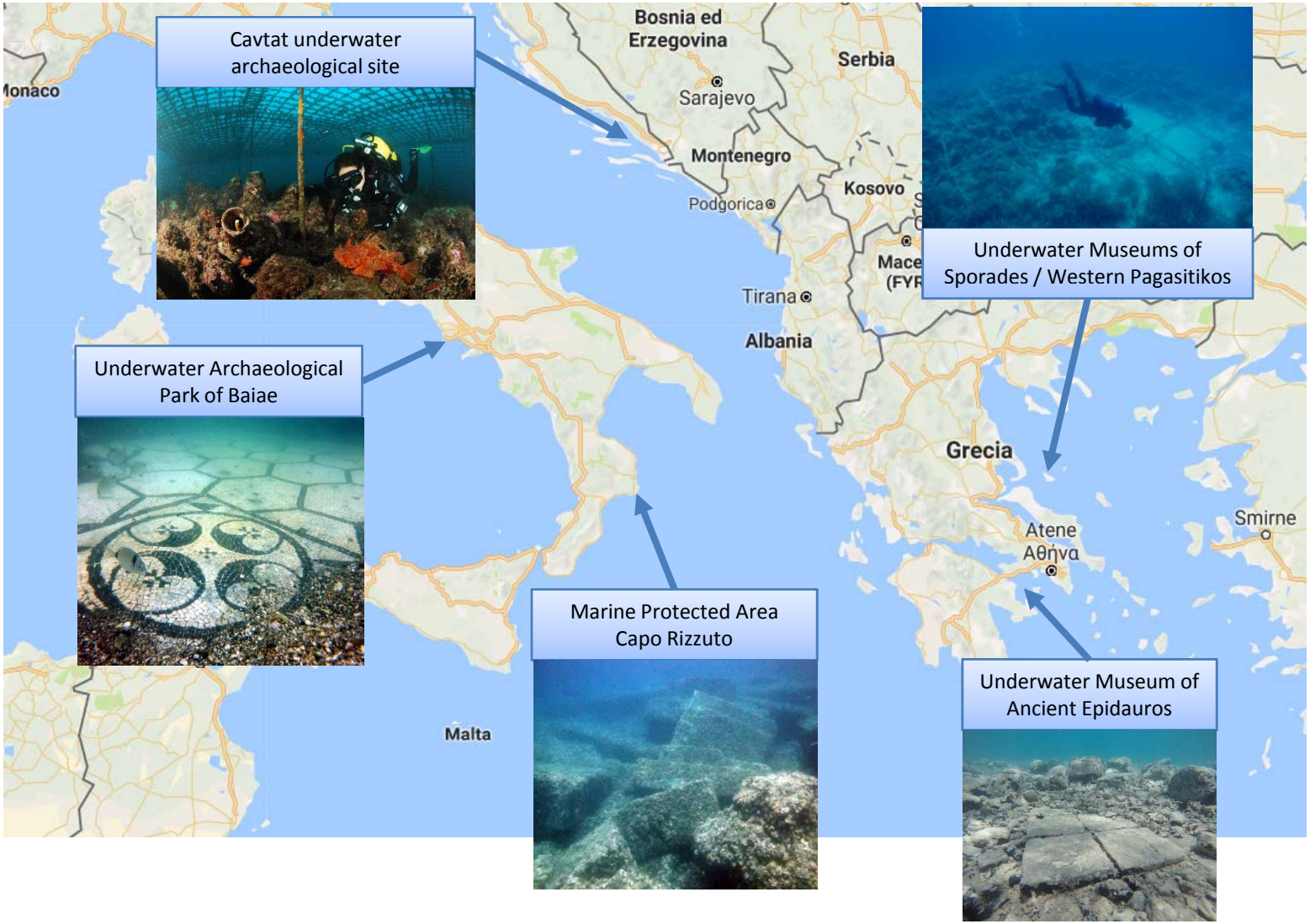
BLUEMED PILOT SITES



H2020 – iMAREculture

iMmersive serious games and Augmented REality as tools to raise awareness and access to European underwater CULTURal heritagE

Capofila: Cyprus University of Technology

Call: H2020-SC6-CULT-COOP-2016-2017

Durata: 01/11/2016 – 31/10/2019

Budget complessivo: 2.370.275 €

H2020 - iMAREculture

iMARE CULTURE

Ministero dei beni e delle attività culturali e del turismo
ISTITUTO SUPERIORE PER LA CONSERVAZIONE ED IL RESTAURO

Cyprus University of Technology

3D RESEARCH EXPERIENCE TECHNOLOGY

University of Cyprus

PIERIDES FOUNDATION
ΙΔΡΥΜΑ ΠΙΕΡΙΔΗ

Aix*Marseille université

UNIVERSIDADE NOVA DE LISBOA

UNIVERSITAS MASARYKIANA BRUNENSIS

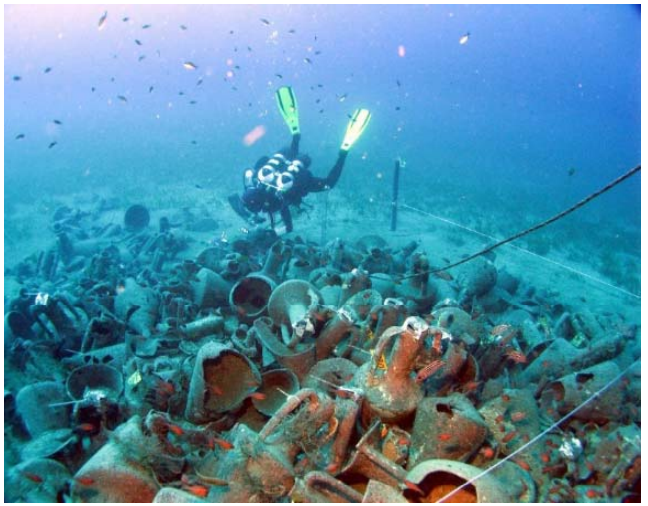
UNIVERSITAS STUDIORUM SARAJEVOENSIS

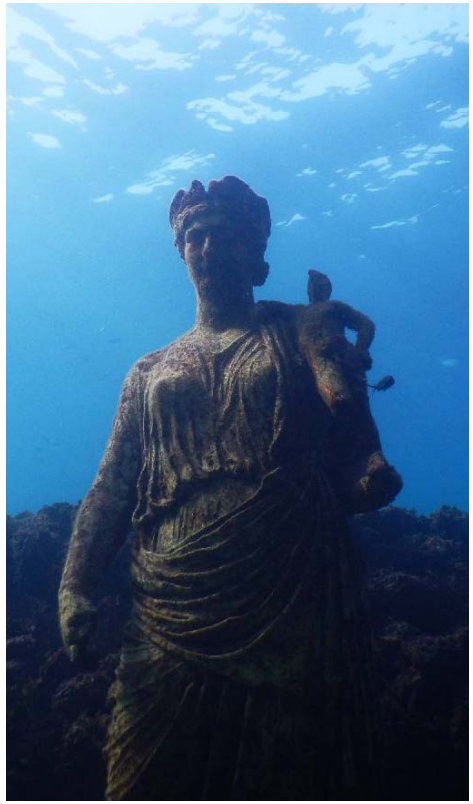
HOLOGRAFIKA

UNIVERSITÉ Concordia UNIVERSITY

iMARECulture Pilot Sites

- Underwater Archaeological Park of Baiae (Italy)
- Mazotos shipwreck (Cyprus)
- Xlendi shipwreck (Malta)





Diving in Cultural Sites

The 2001 UNESCO Convention

- 2001 UNESCO Convention on the Protection of Underwater Cultural Heritage:
  - "The **preservation in situ** of underwater cultural heritage shall be considered as the first option before allowing or engaging in any activities directed at this heritage."
  - **Responsible** non-intrusive **access** to observe or document in situ underwater cultural heritage shall be encouraged to create **public awareness**, **appreciation**, and protection of the heritage except where such access is incompatible with its protection and management.

Tourism and Underwater Cultural Heritage

- Underwater Archaeological Parks represent a unique opportunity for the development of coastal area because:
  - Diving in the Med is possible almost 9 months/year
  - Diving tourism is sustainable also by minor destinations
  - 24 million certified divers in the world
  - 800.000 Europeans divers each year make one trip with 10 night-outs spending more than 1,4 billion Euros annually

Cultural Diving Tourism… why?

- Improve protection and accessibility of UCH
- Create high quality added value thematic tourism
- Promote the available local natural & cultural resources
- Achieve a competitive unique advantages in a Glocal level
- Develop a weekly based diving/tourism destination

Archaeological Underwater Itineraries

How to choose the site

- Relevant archaeological importance;
- Great appeal for scuba divers (e.g. richness of flora and fauna) and/or snorkelers;
- Good presence of diving centers and touristic services.

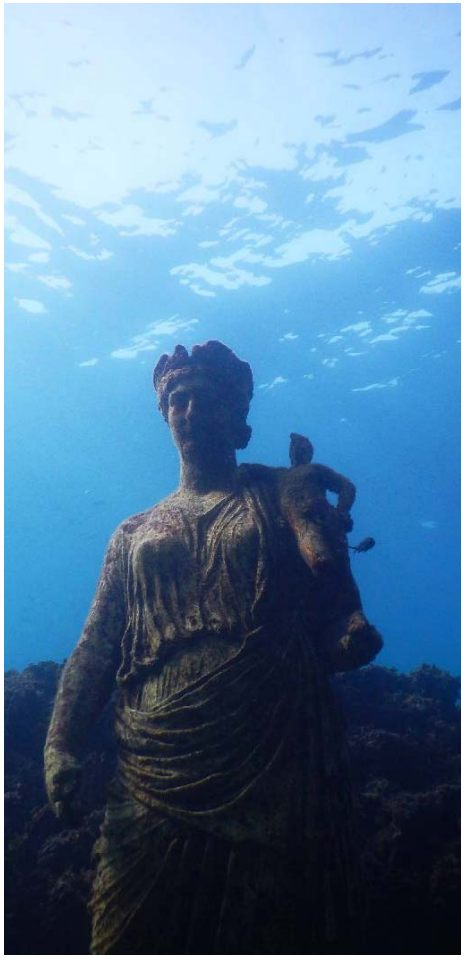
Requirements

- Size: 10.000-50.000 sqm;
- Depth ≤ 30 m;
- Interdiction to navigation;
- Surveillance;
- Buoy Mooring.

Some experiences in Italy: a wide variety of UW cultural assets

San Pietro in Bevagna - Puglia

MPA Isole Egadi - Sicily



Underwater Aracheological Park of Baia

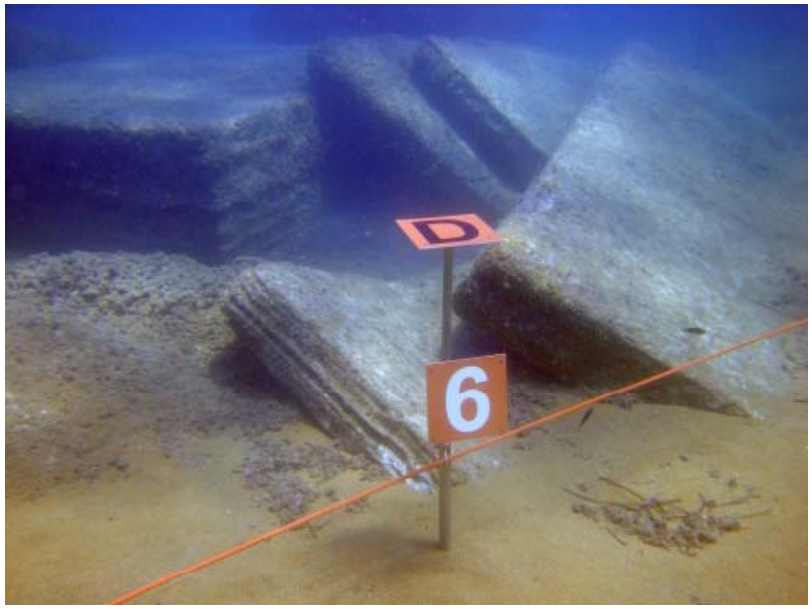
MPA «Capo Rizzuto» - Calabria

The Italian legislative framework

- Underwater Cultural Sites are always restricted access areas;
- Diving, snorkeling and other sport activities are allowed in selected sites but only with tourists accompained by authorized guides or diving centers;
- Usually diving centers renew their authorization yearly;
- In Baia and few other sites, divers and snorkelers pay a fee (to the Park) to access the site.

Traditional underwater itinerary

Area Marina Protetta
CAPO RIZZUTO

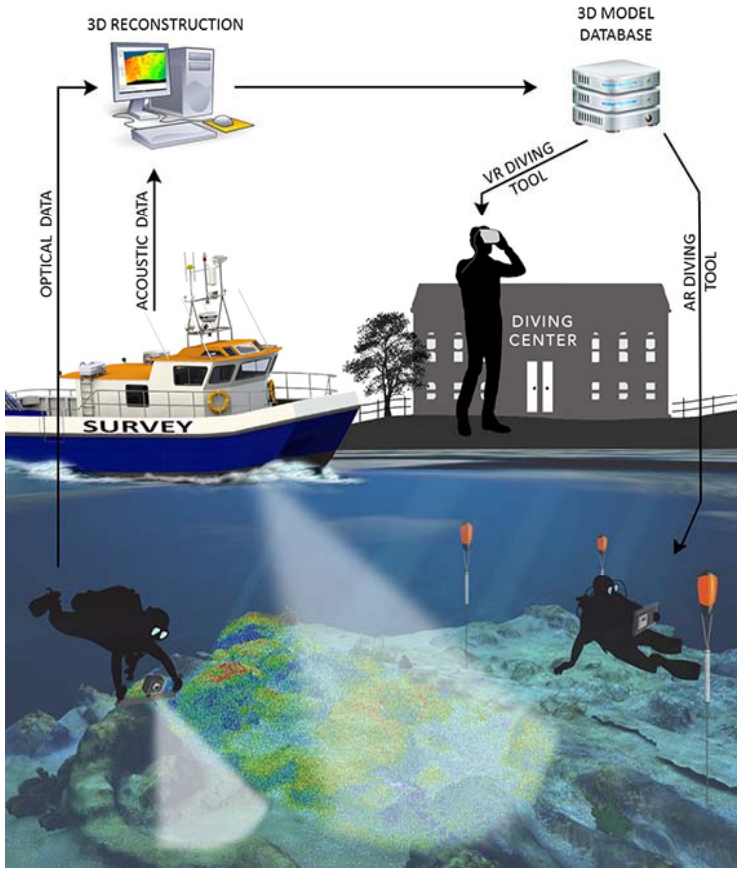


Underwater itinerary

soprintendenza del mare

Motivations: some open questions

- How to **generate value** from a responsible and sustainable exploitation of underwater archaeological sites?
- How to make accessible the underwater site to **non diver tourists**?
- How to **improve the divers experience** in the submerged archaeological site going beyond the traditional approach of underwater itineraries?

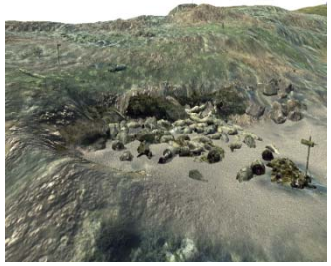
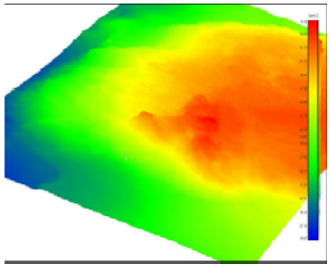
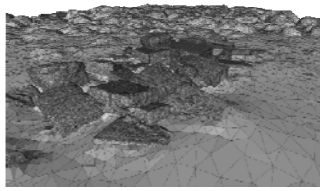


3D Recording of Underwater CH for VR&AR

- Methodology



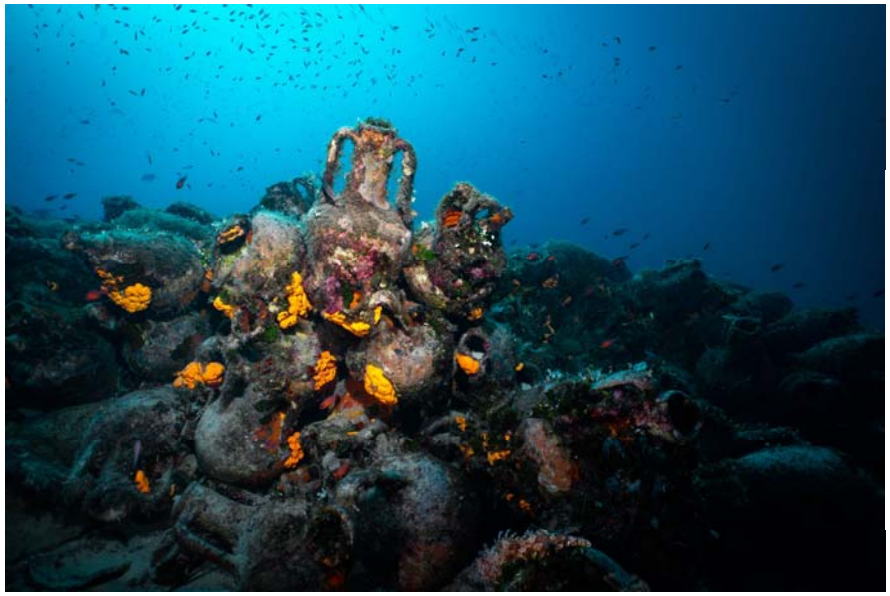



Site preparation → Opto-acoustic data acquisition → 3D Reconstruction → Data fusion and 3D modelling → VR&AR

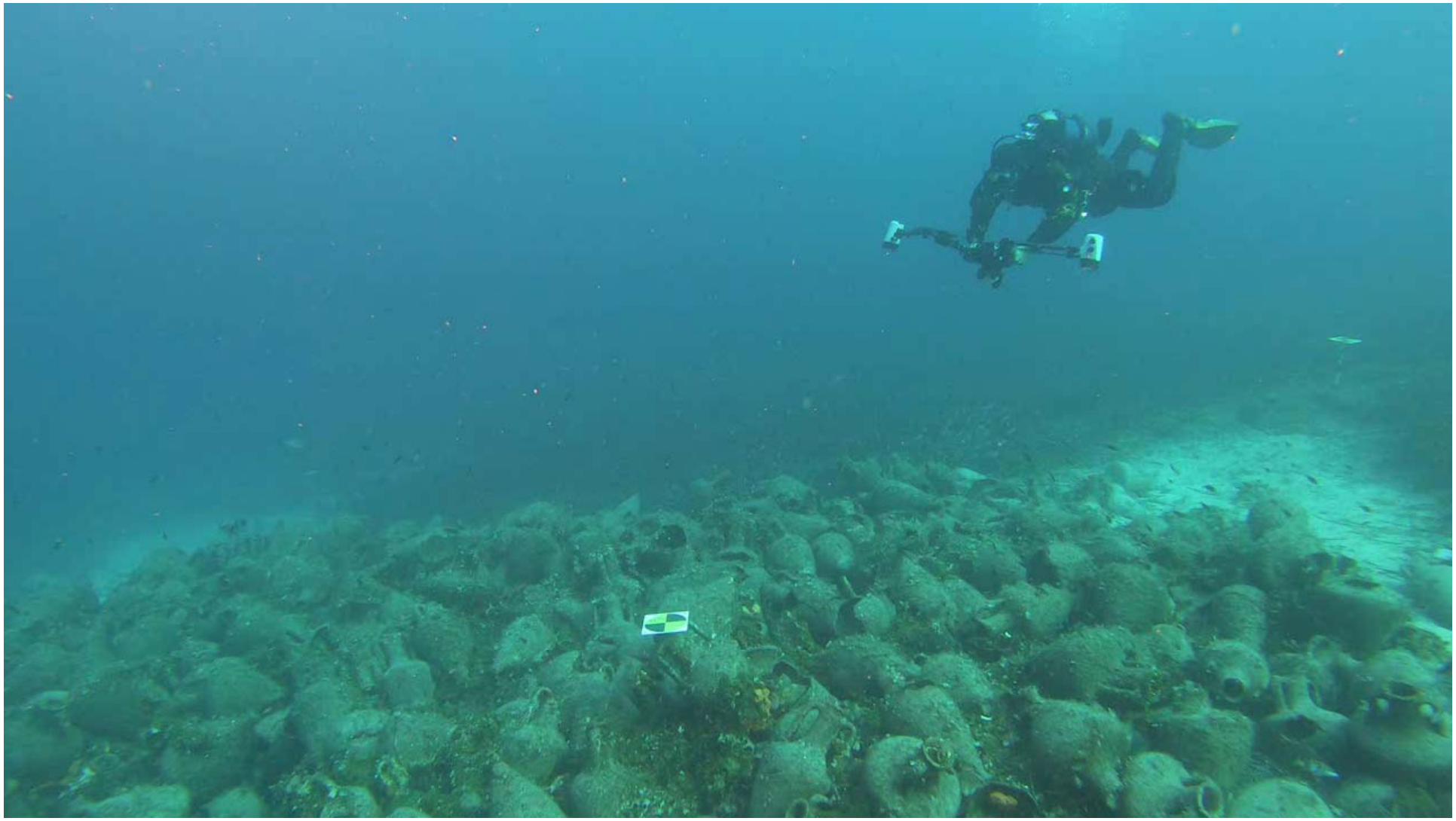
A case study: The Peristera Shipwreck

- The wreck lies just off the coast of Peristera, an uninhabited island located at about half nautical mile from Alonissos (Northern Sporades) at a depth of about 22-28 meters.
- Include thousands of amphorae distributed on the seabed in an area of about 25 x 12 meters
- The amphorae, which carried wine, are of two types, Mende (Chalkidiki) and Peparethos (Skopelos island)
- It can be dated between 420 and 400 BC



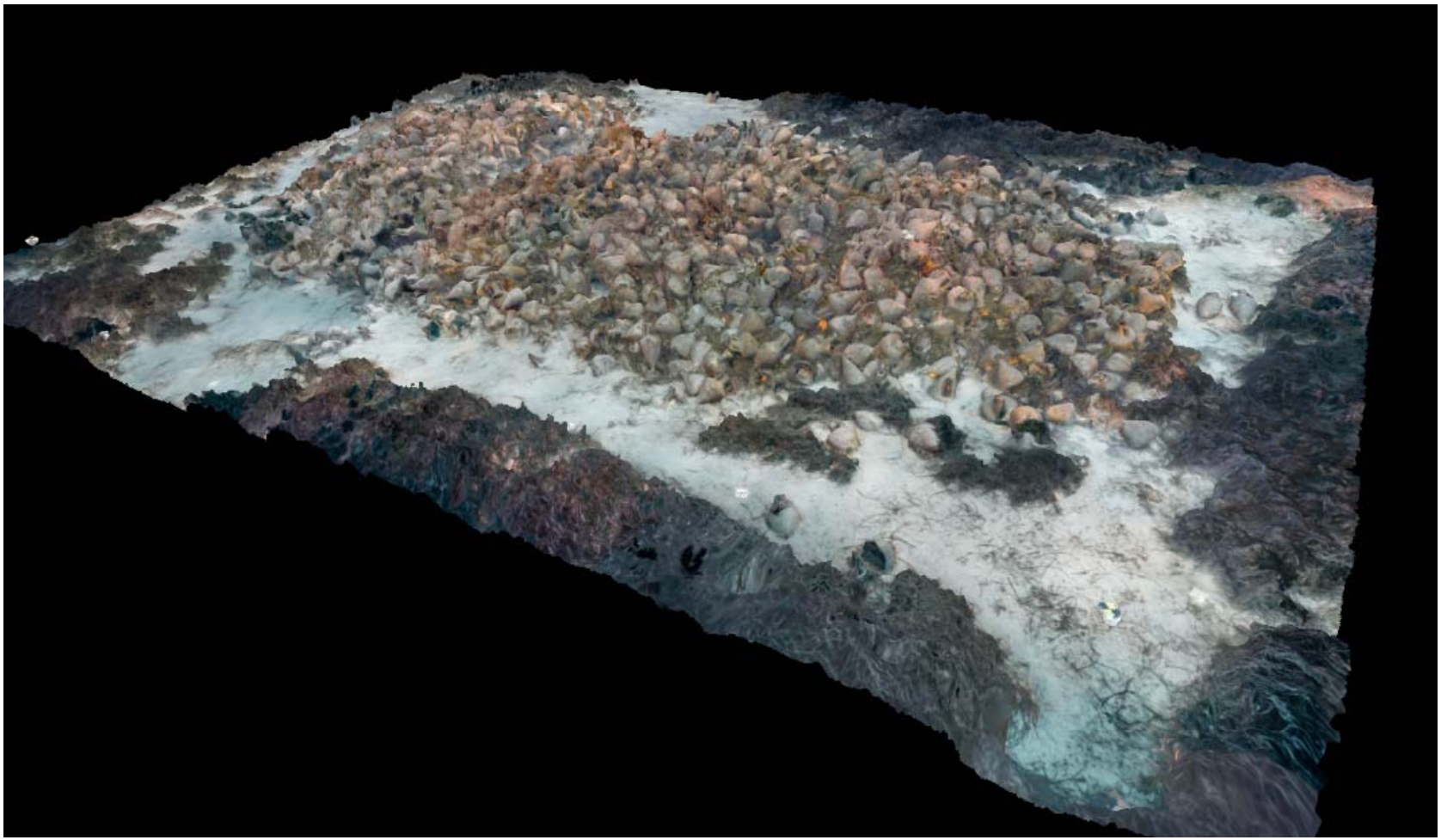
Site Preparation

Images acquisition



Video recorded for the BLUEMED Project – courtesy of Greek Minister of Culture and Sport, Ephorate of Underwater Antiquities

3D model generation



1044 images used - 366.673.704 dense point cloud

20.000.000 of polygons

RMSE 0.022m

Aerial Survey

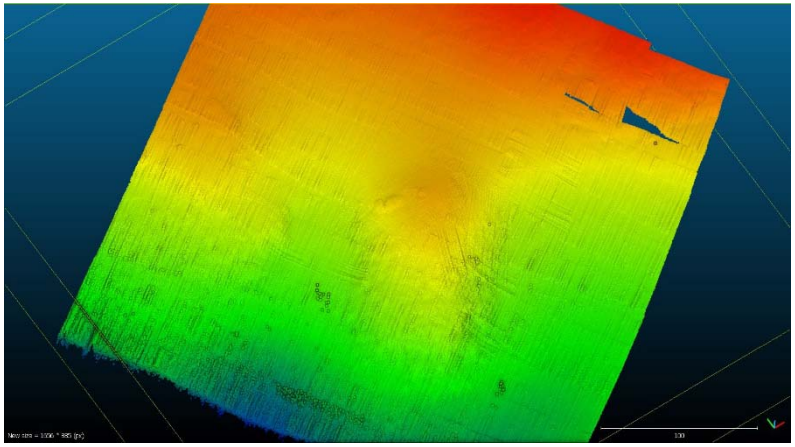
- DJI Phantom 4
- Altitude of 40m
- Oblique session
- 381 photos

Peristera Shipwreck - Acoustic Survey

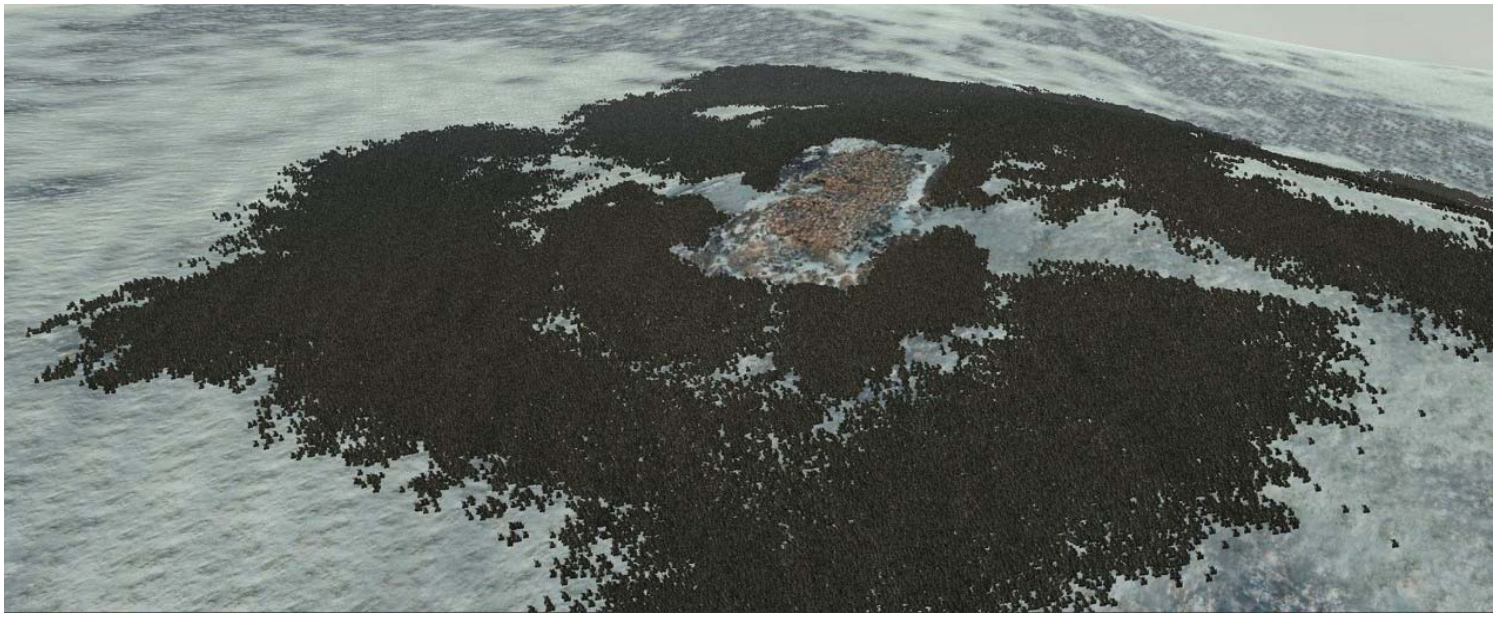
A lightweight autonomous underwater vehicle (LAUV) Lupis with Klein UUV-3500 side-scan sonar has been used in order to recover precise GPS coordinates

An autonomous surface vehicle (ASV) equipped with a Norbit WBMS 400/700KHz multibeam sonar and the accompanying Applanix navigation system together with a high-precision Trimble GPS antenna was used to collect acoustic data

- In total an area of approx. 300x300m in front of the Peristera island was covered
- 2.548.382 points

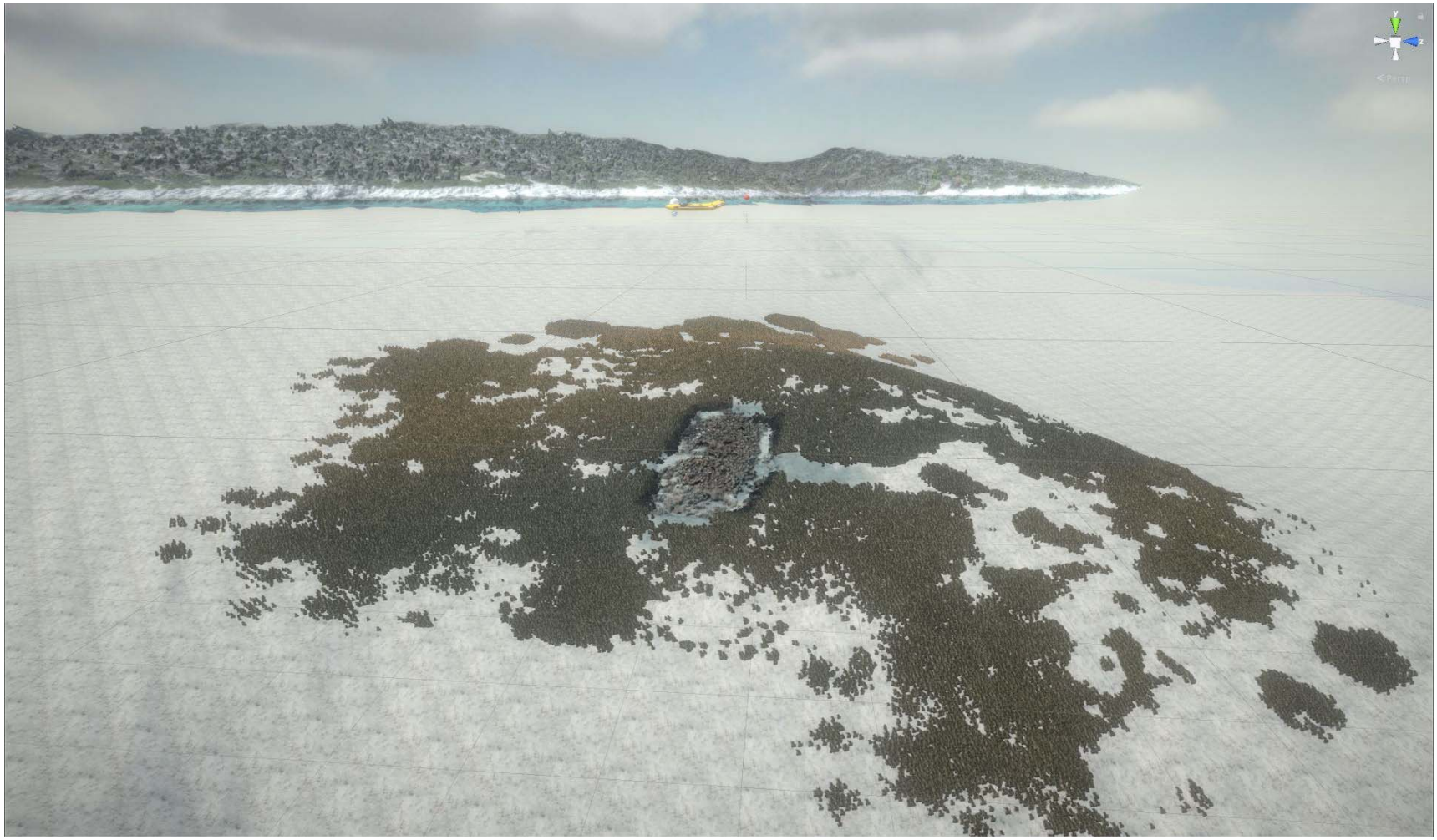


Peristera Shipwreck – Multiresolution model

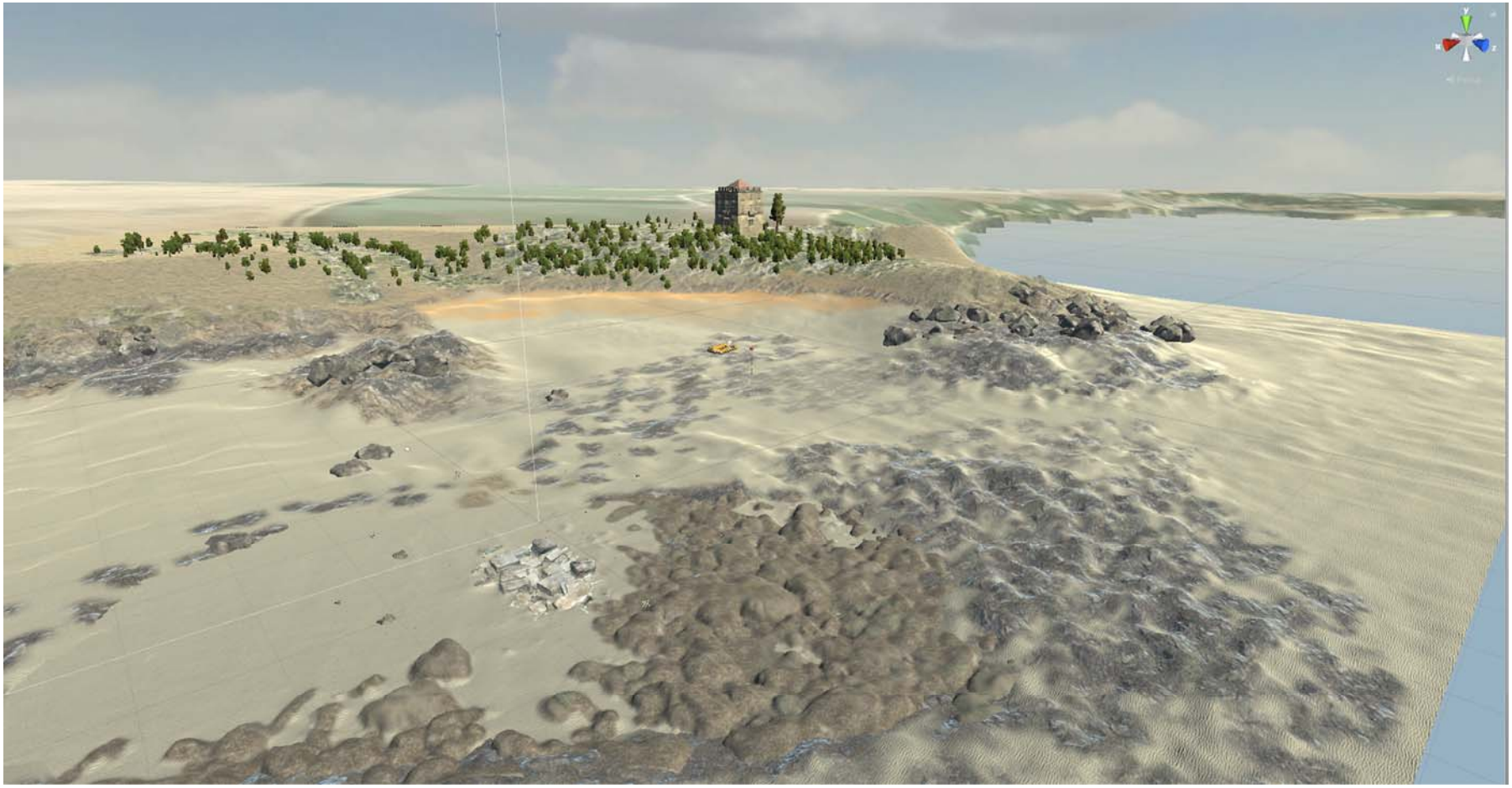


- Optical and acoustic data merged by means of a target-based registration approach based on the detection of homologous geometrical entities.
- 12 GCP have been used. For each, 11 measurements were taking and a median have been perfomed.
- Average error of 15cm has been obtained

Peristera Shipwreck – Multiresolution model



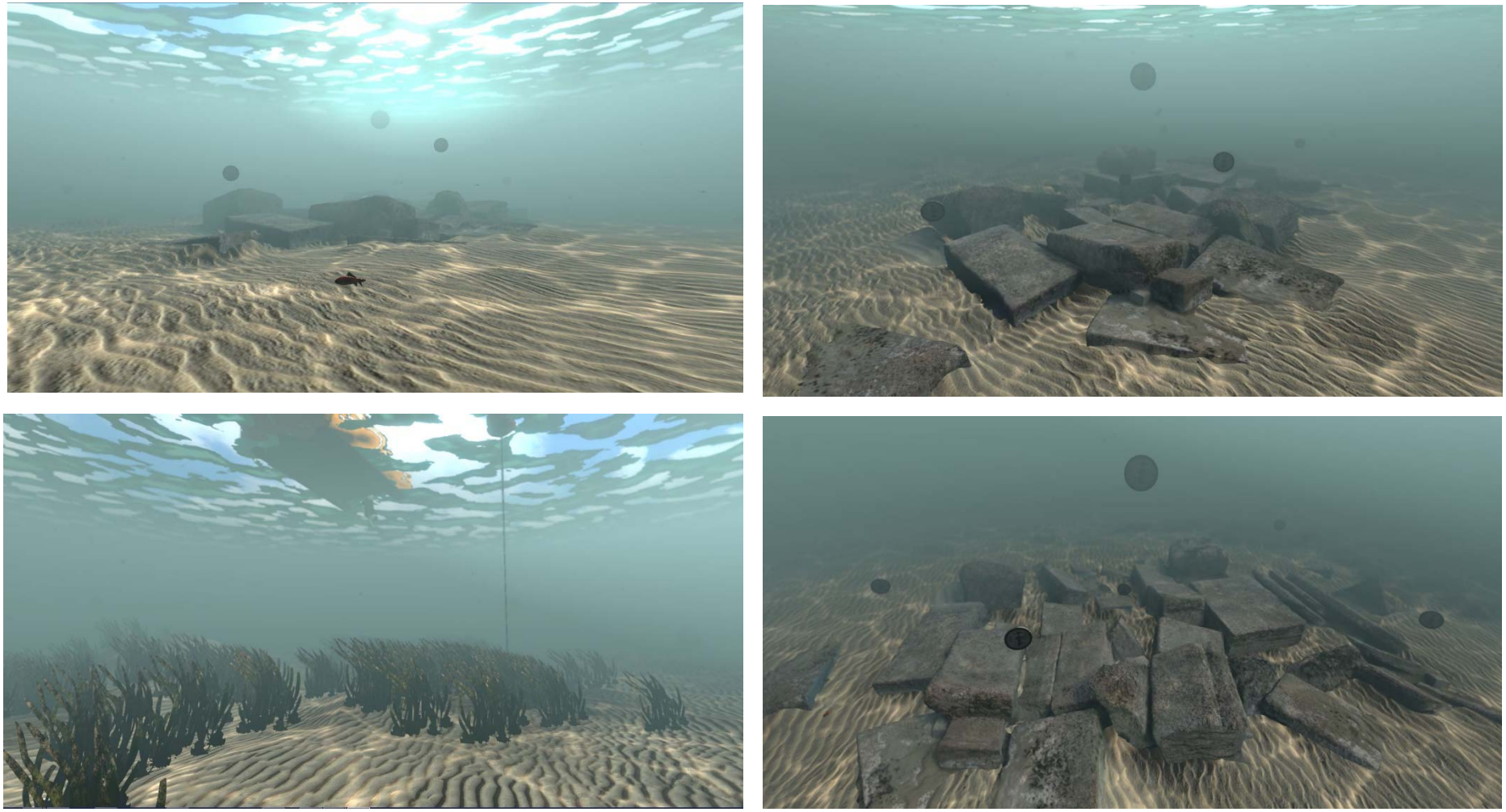
From 3D model to Virtual Reality



From 3D Model to Virtual Reality

Surface of the sea, visible coast-line, sky, additional elements (buoys, boats, etc.)

From 3D Model to Virtual Reality



Underwater flora e fauna , Point of Interests (POIs), graphical effects (turbidity, refractions, fog, caustics)

Providing contents… and fun

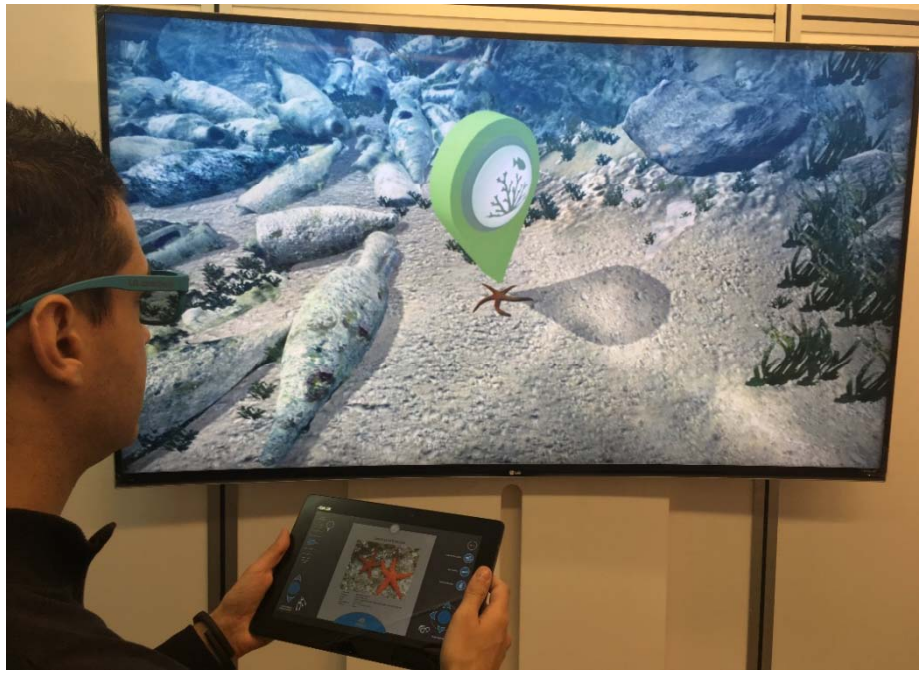
Diving buddy

Interaction with POIs (text/audio/etc.)

360° video storytelling

Switch from present to past

VR systems



VR semi-immersive visualization

- HD monitor based on passive 3D technology.
- Controller based on a multi-touch screen tablet.

VR immersive visualization

- HMD (head mounted display) technology.
- Wireless handheld controller.

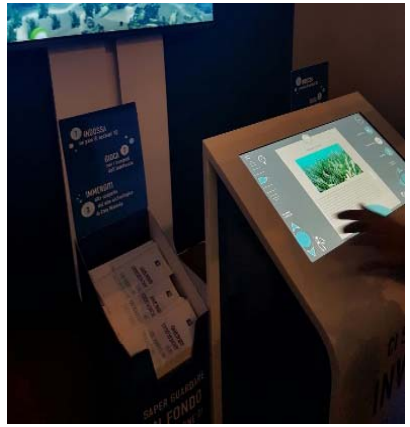
Semi-Immersive Virtual Reality

3D Visualization System configuration: 1 console + 1 monitor

- Console with 23’’ touchscreen;
- Display 55’’ 4K resolution;
- Software for Real Time Rendering;
- 3D underwater virtual realty scene.

Specifications:

- Size: 160 x 200 x 60 cm;
- Structure: iron;
- Console: Intel i7, 16 GB RAM, SSD 256 GB, nVidia GeForce 960 4GB, Capacitive touchscreen 23”;
- Monitor: Display 55’’;
- Stereoscopy (optional);

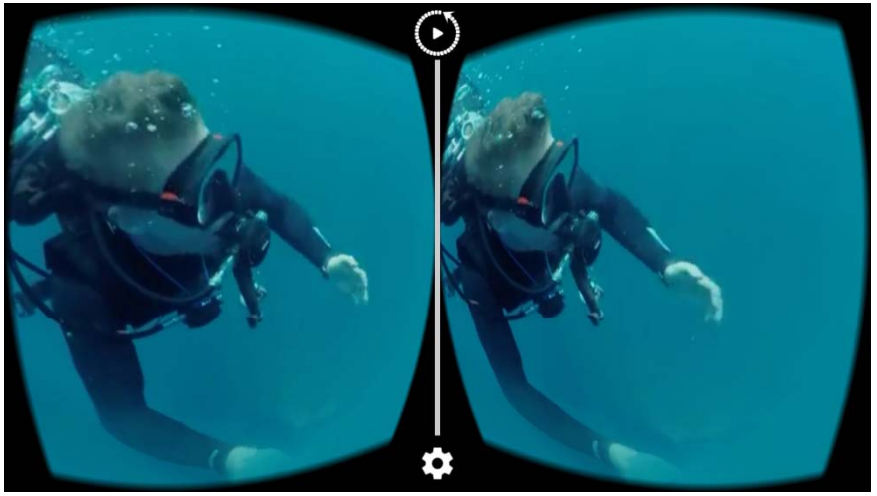


Immersive Virtual Reality

Google Cardboard

Google Daydream View

Immersive Virtual Reality



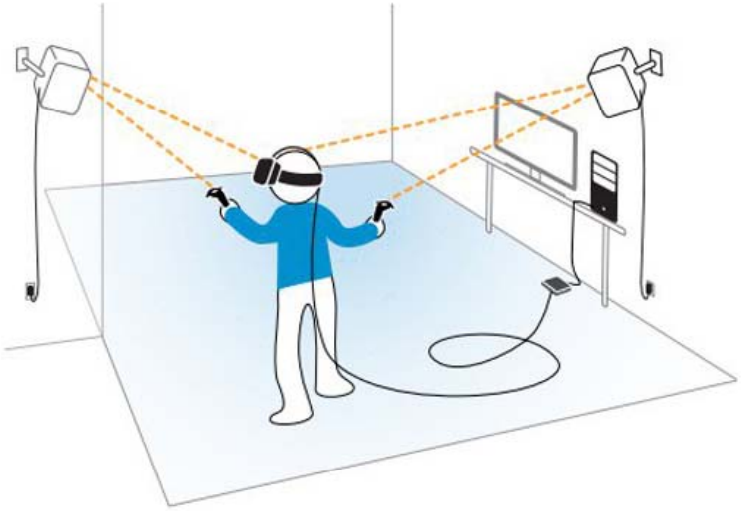
Immersive Virtual Reality

System configuration:

- HMD;
- Sensor for head tracking;
- Two controllers for interaction;

Specifications:

- Workspace area: 4 x 3 m;
- Device: HTC Vive with 2 controllers;
- PC: Intel i7, 16 GB RAM, SSD 256 GB, nVidia GeForce 960 4GB;
- Monitor: Display 55'' 4K;



Immersive Virtual Reality

Applications of Dry Visit in Virtual Reality

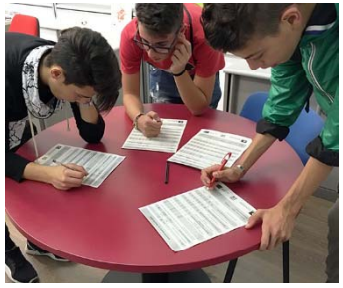
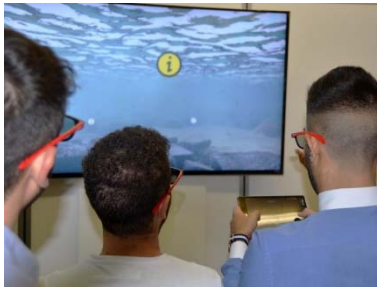
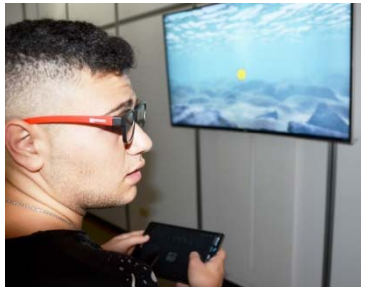
Virtually recreate the diving experience to:

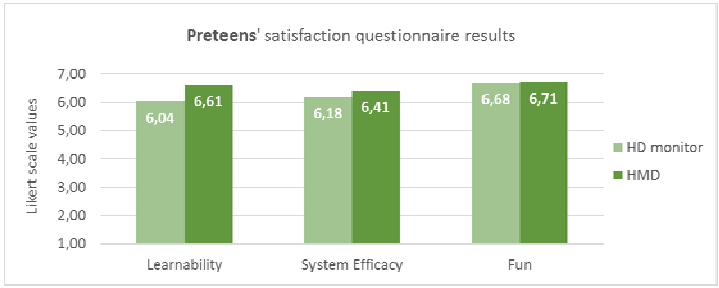
- **Raise the awareness** of local people and tourisout UCH
- **Promote** the most exciting dives in fairs, exhibitions or even on the web
- Plan and **prepare the dive** and explain what you will see in the water
- Allow **accompainig persons** to experience the dive while waiting

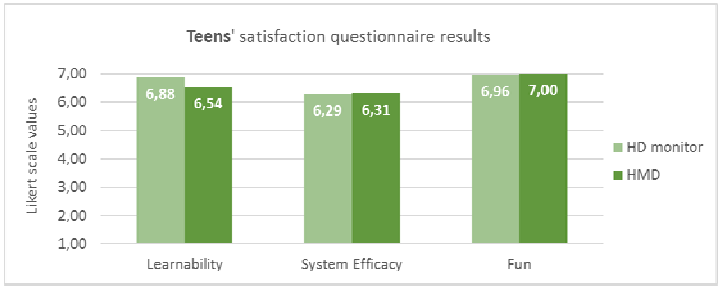
Knowledge Awareness Center in Amaliapolis

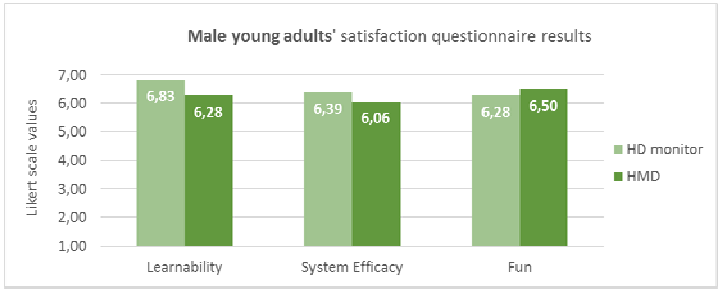
User Testing

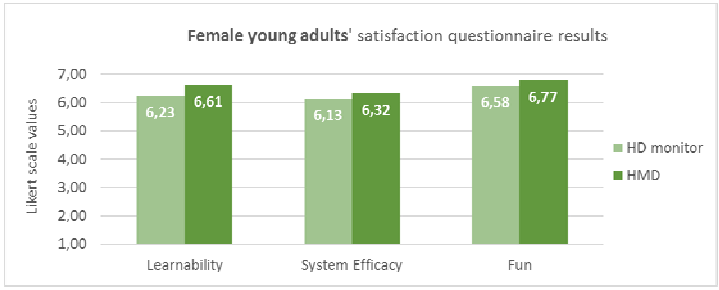


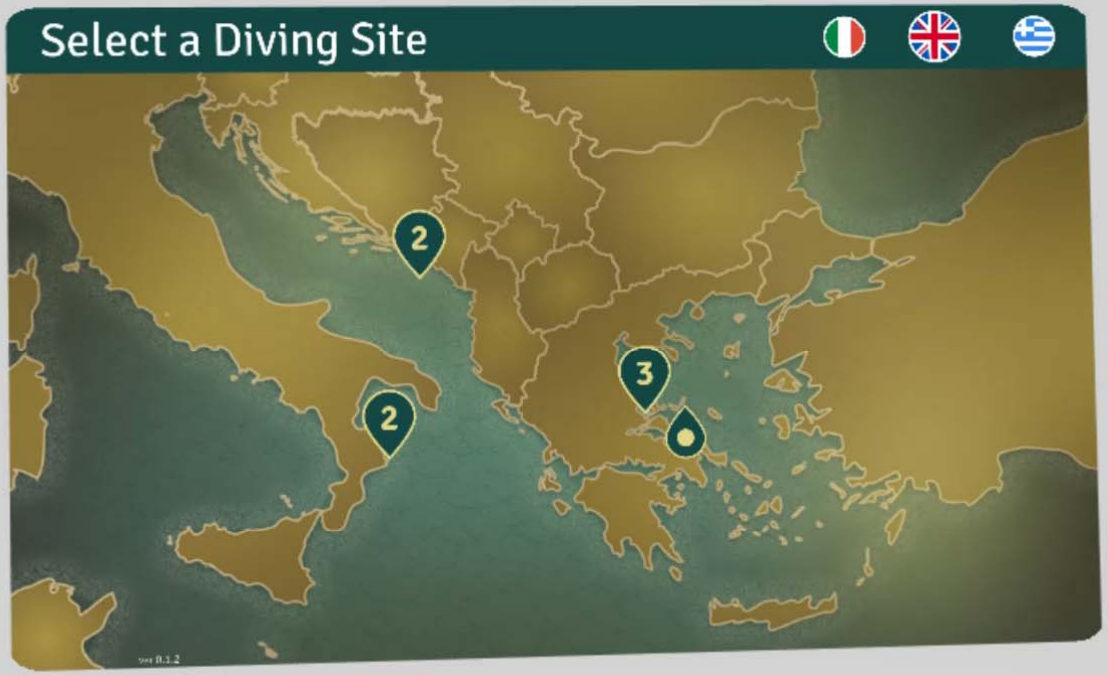






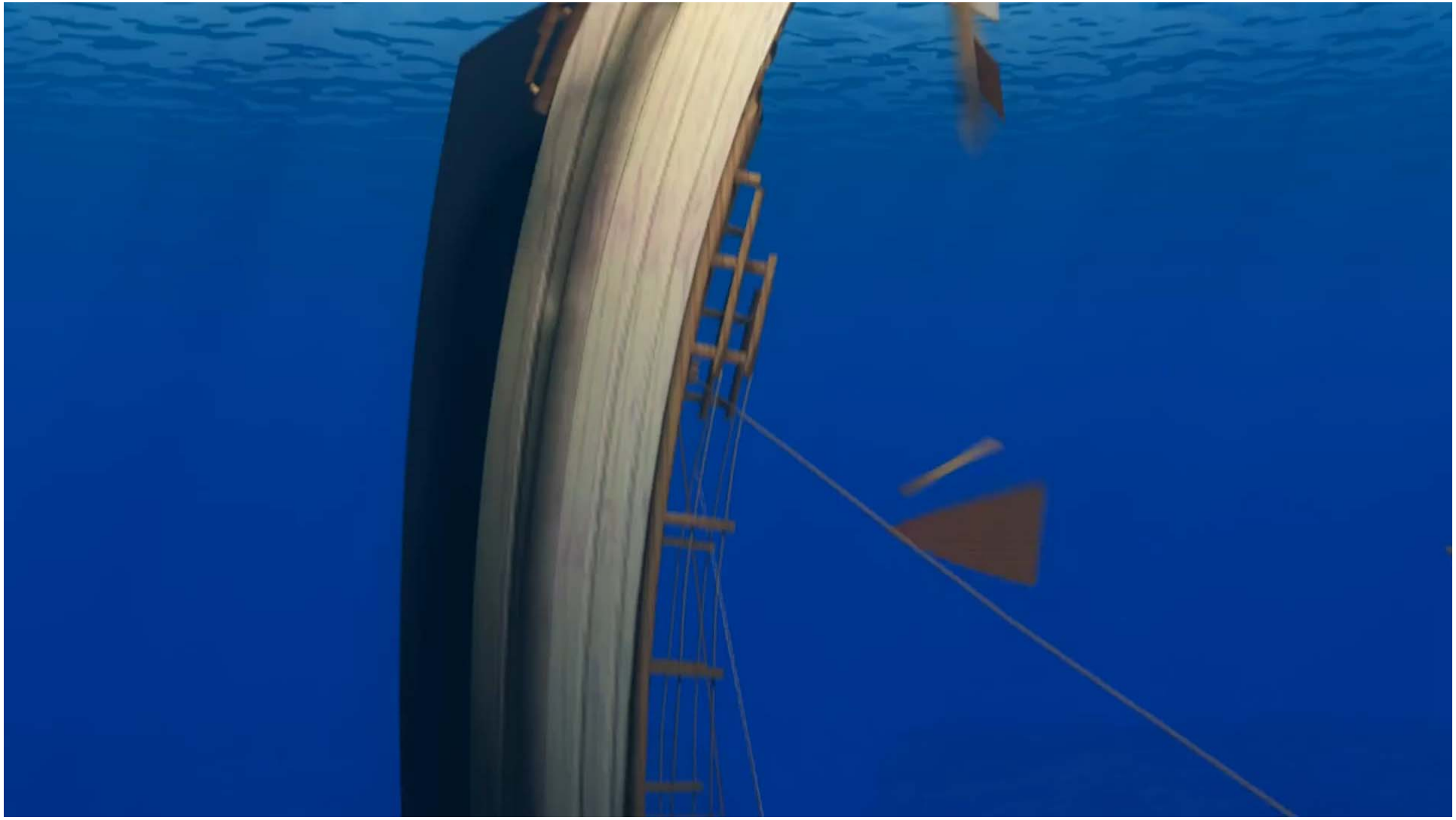


Virtual Diving at the Peristera Shipwreck (Sporades, Greece)



Interreg Mediterranean BLUEMED

Virtual Diving in the iMARECulture pilot sites



iMARE CULTURE

IMARECulture received funding from the EU-H2020 programme. GA No. 727153.

Dry Visit - conclusions and open challenges

- **Conclusions**
  - VR is an excellent tool to disseminate UCH
  - Engage people with funny and educative apps
  - Opportunities for connection with creative industries

- **Open Challenges**
  - Provide a lot of different contents (audio, video, 3D, etc.) in a seamless way
  - Assign goals and task to do in order to motivate people to play and learn
  - Teach to be responsible tourists and divers

Underwater Augmented Reality

Image courtesy of MIBACT-ISCR and Parco Archeologico dei Campi Flegrei

Underwater tablets and smartphones

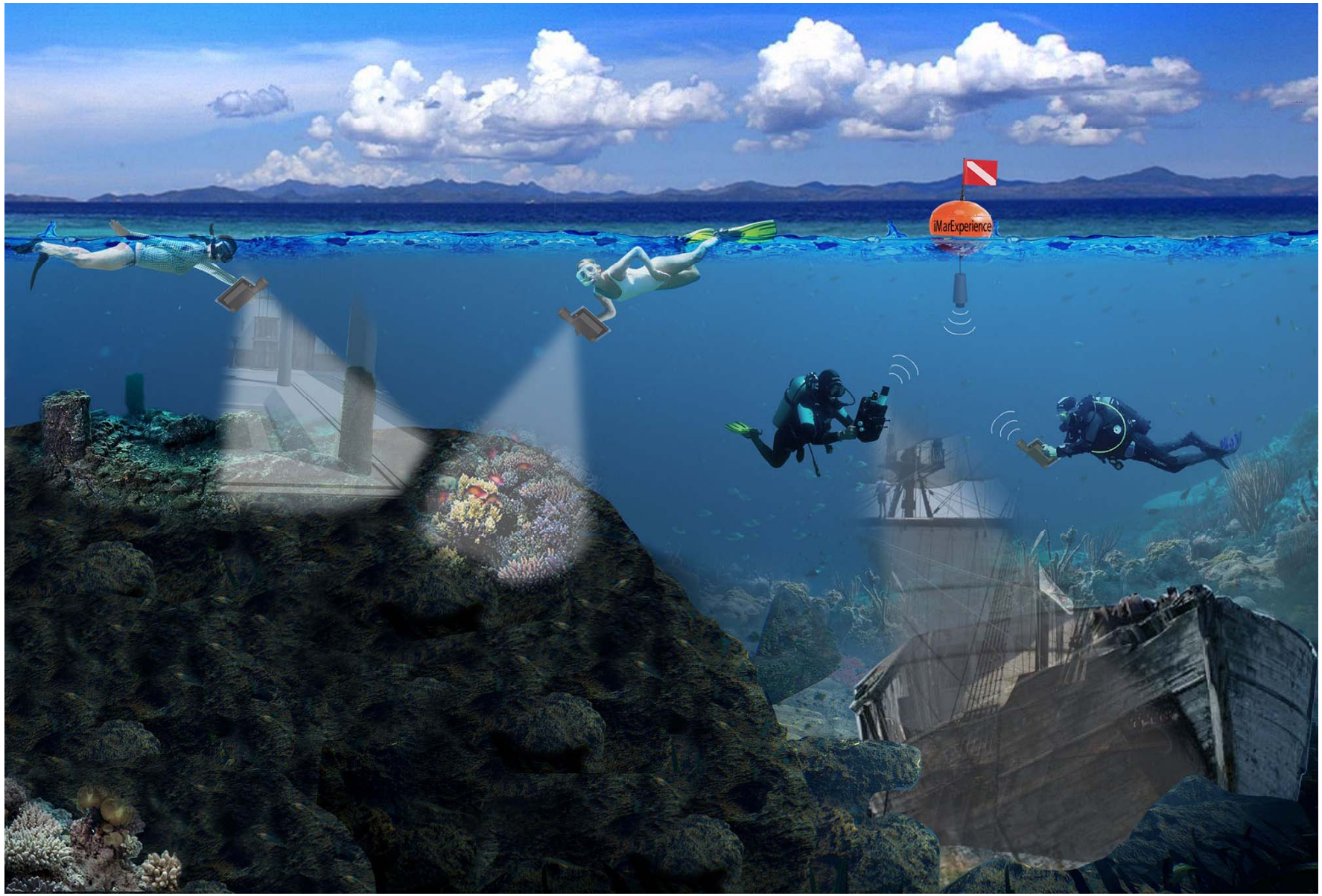
- Easydive

- iDive

- ValsTech

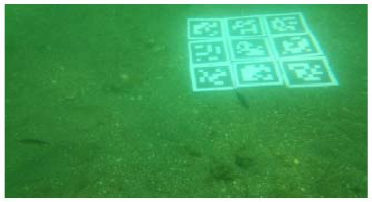
- Divevolk

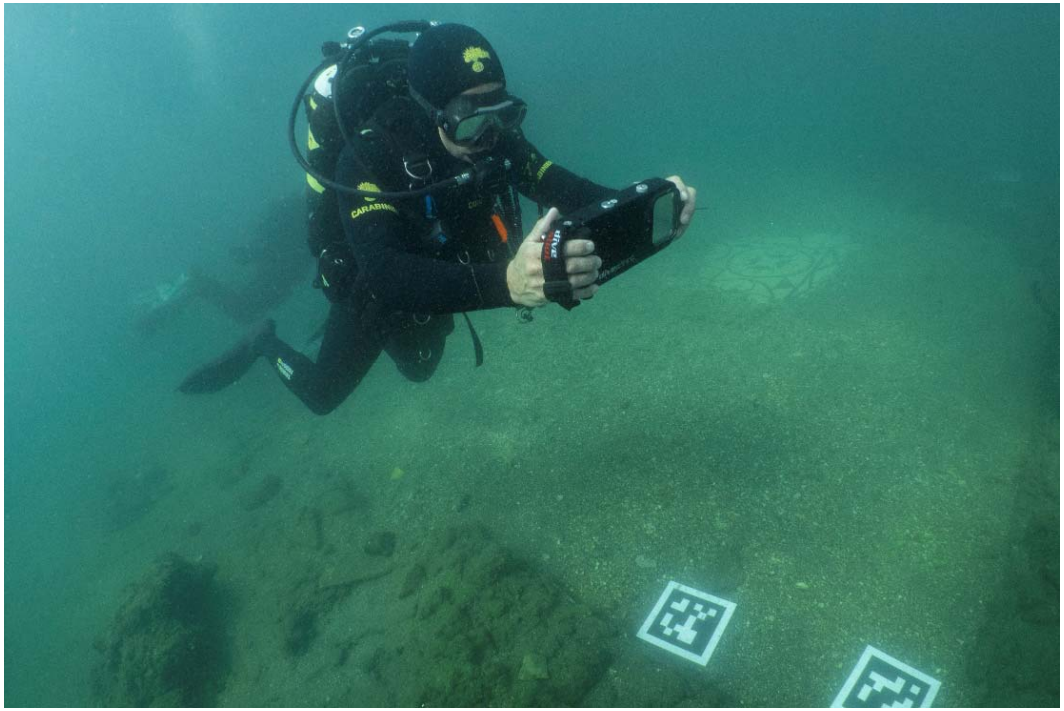
UWAR: different scenarios… different solutions



Marker-based AR

- Cost-effective (no acoustic tracking)
- Requires to prepare the environment by placing fixed visual markers
- Introduced a new method to improve the detection of markers

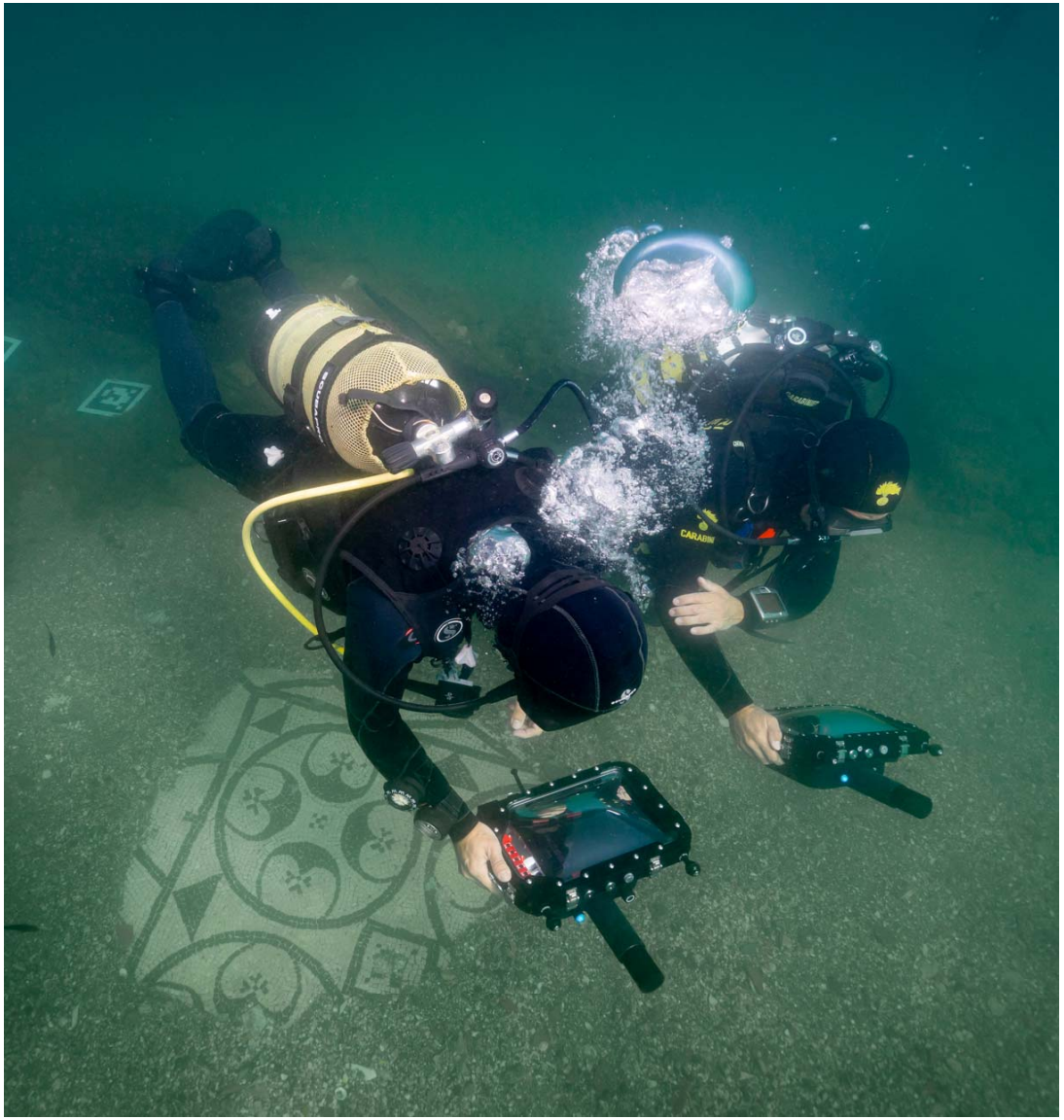




Marker-less AR

- Requires an acoustic positioning system
- Assisted navigation + UW AR
- Introduced a new hybrid tracking system that merges positioning data generated by the acoustic positioning system with data coming from a VIO framework.

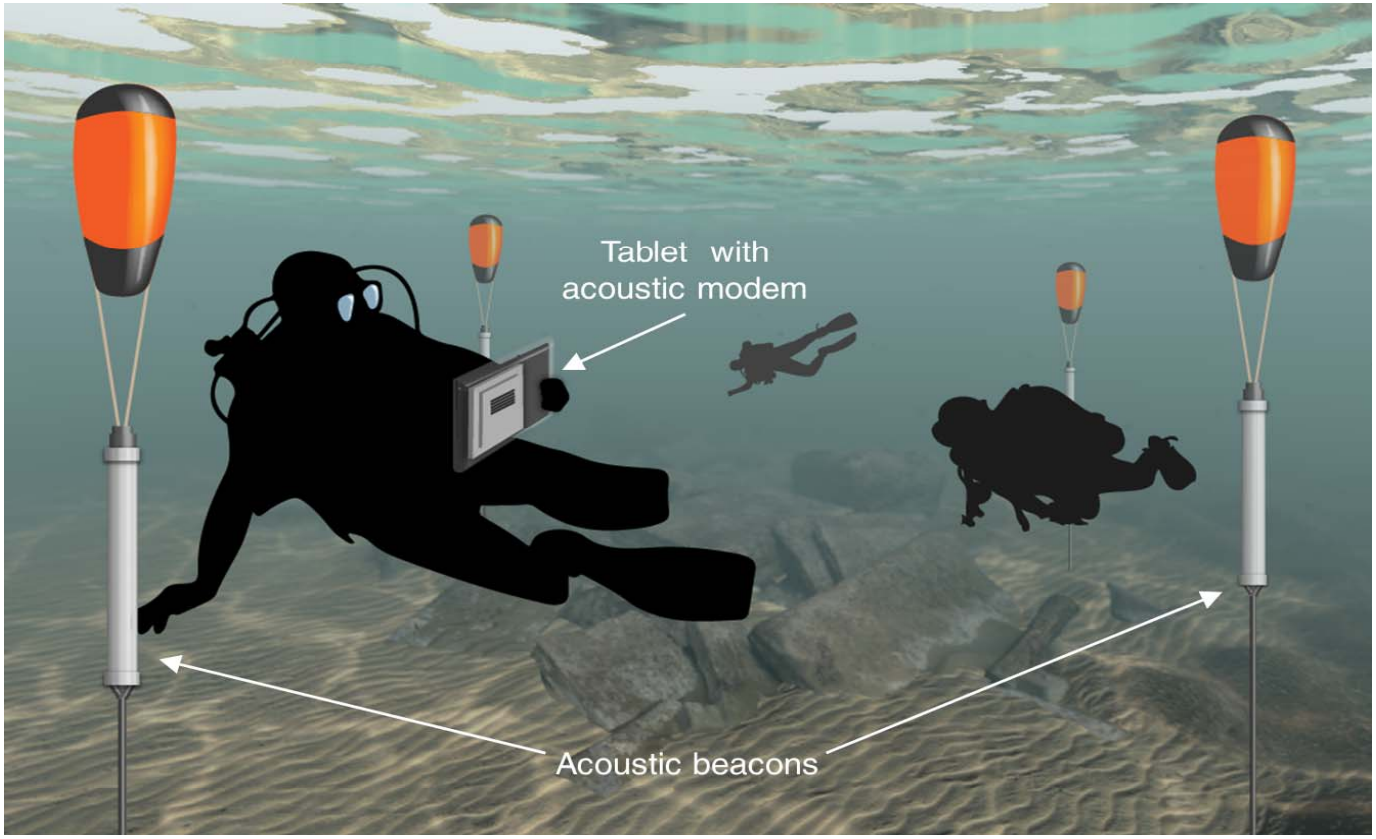
Underwater tablet with acoustic localization



The tablet in a waterproof case is equipped with an acoustic localization system

Underwater acoustic localization

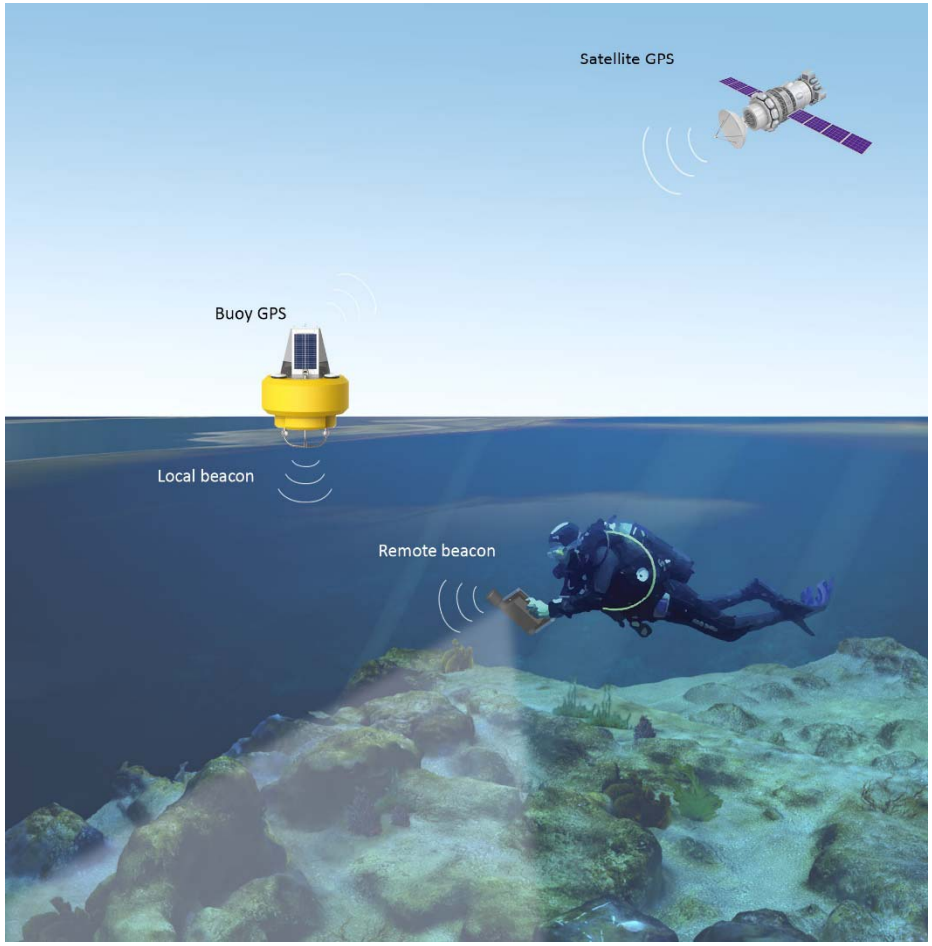
Setup 1: 4 fixed beacons (LBL)



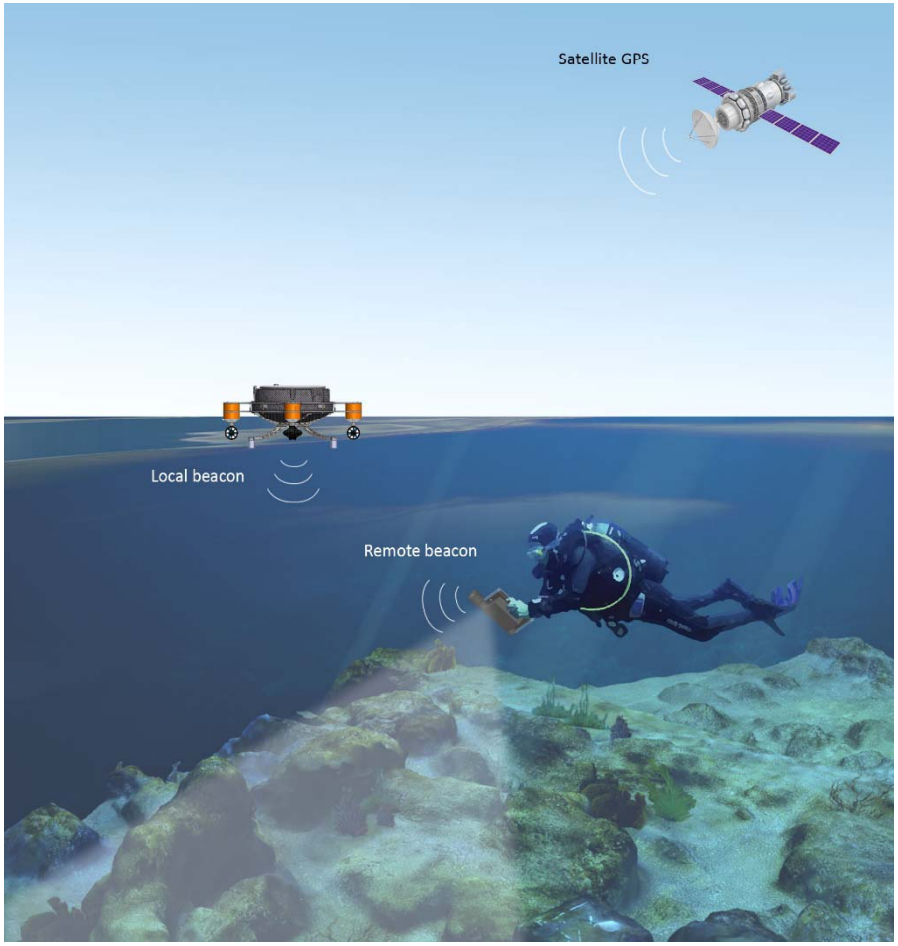
- Long baseline = good accuracy
- Two-way ranging = slow update

Underwater acoustic localization

Setup 2: Surface buoy + USBL



Setup 3: ASV + USBL

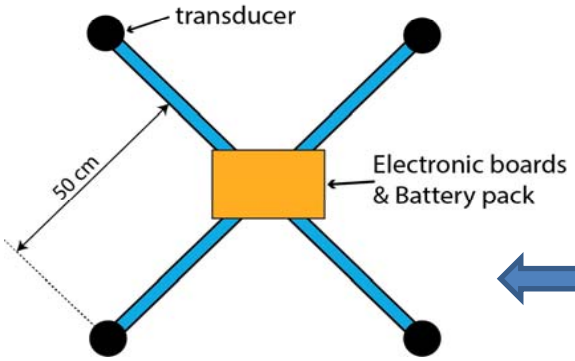


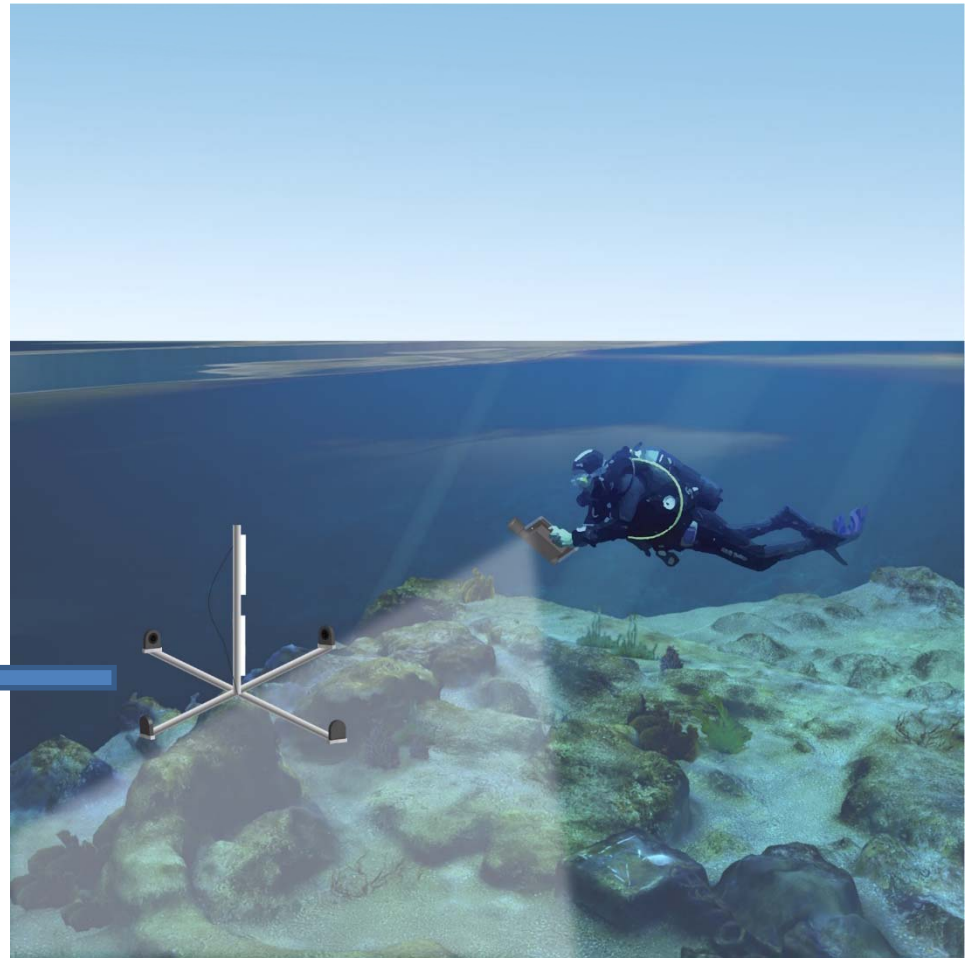
- Ultra-short baseline = bad accuracy
- Accuracy depends on GPS and IMU

Underwater acoustic localization

Setup: 4 fixed transducers with one control electronics (SBL)

- Four acoustic transducers are placed on a pole fixed to the sea bottom on a known GPS position

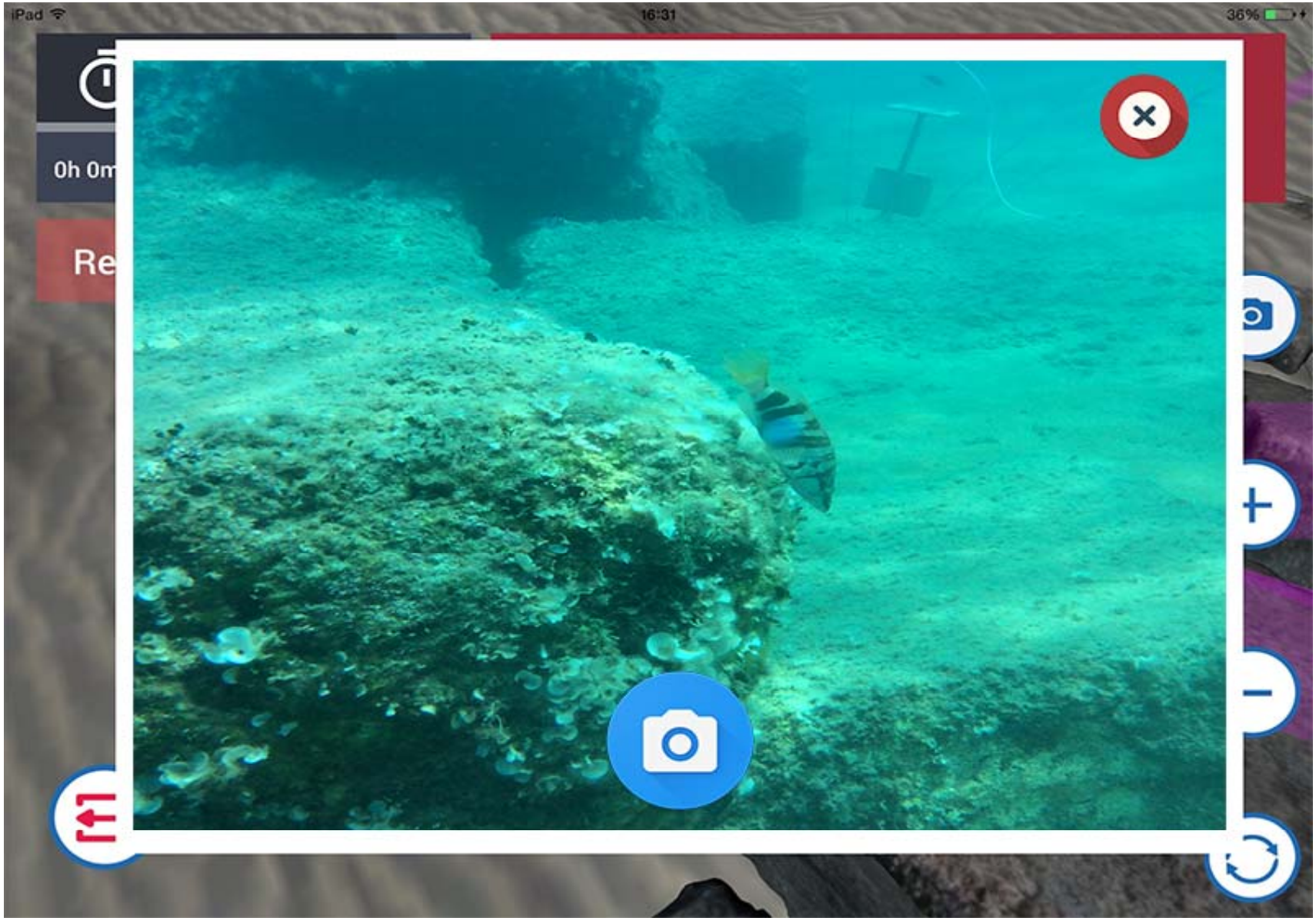




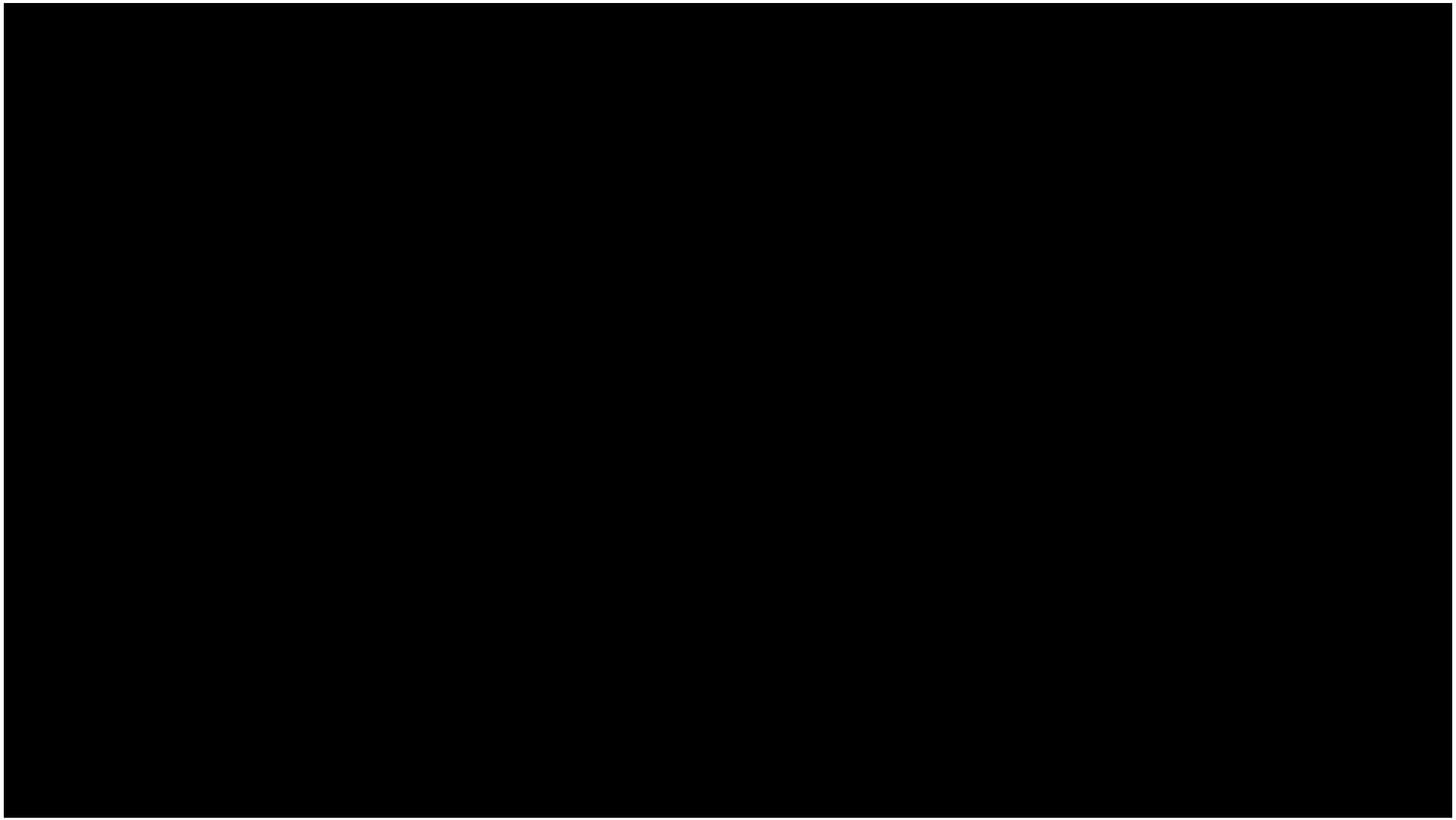
- Short-baseline = acceptable accuracy
- One-way ranging = No delay for multiple tablets

Underwater Augmented Reality in Baiae

User Interface App: «Georeferenced photos»



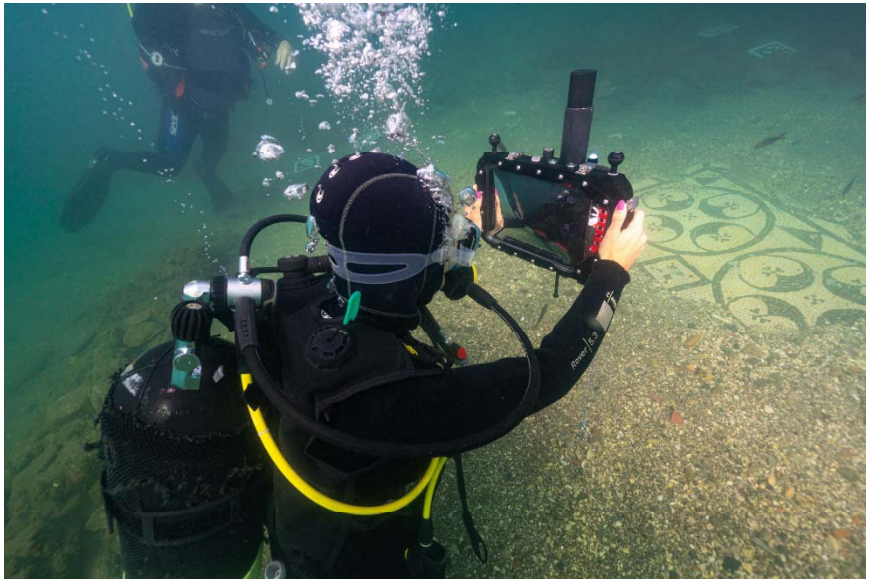
Tests in Baiae – June 2018

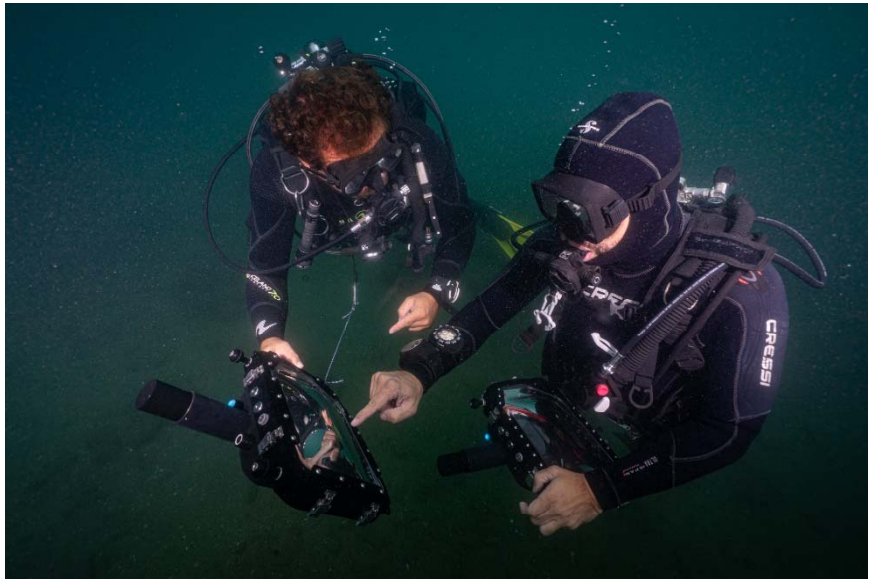


IMARECulture received funding from the EU-H2020 programme. GA No. 727153.

Tests in Baiae – September 2019

IMARECulture received funding from the EU-H2020 programme. GA No. 727153.

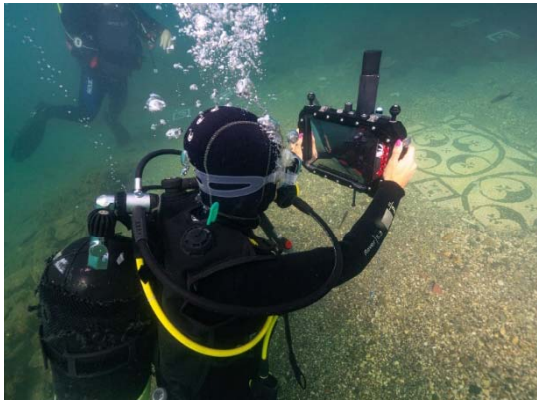




UWAR - Conclusions and open challenges

- **Conclusions**
  - On-map localization is useful in large sites or when turbidity complicates orientation and navigation
  - Tablet provides contents related to the diver position
  - AR is exciting for submerged ruins
  - It is a touristic service that creates value for stakeholders

- **Open Challenges**
  - Need for faster, cheaper and more accurate acoustic localization
  - Improve ergonomics (reduce size, increase screen contrast, etc.)



Ongoing projects

MeDryDive

Co-funded by the COSME programme of the European Union

Consortium

1. MAZI TRAVEL (Greece)
2. ATLANTIS CONSULTING SA (Greece)
3. 3D RESEARCH SRL (Italy)
4. CAMPI FLEGREI DIVING CENTER (Italy)
5. NOVENA D.O.O (Croatia)
6. BUDVA DIVING CENTRE (Montenegro)
7. MUNICIPALITY OF KAVAJE (Albania)

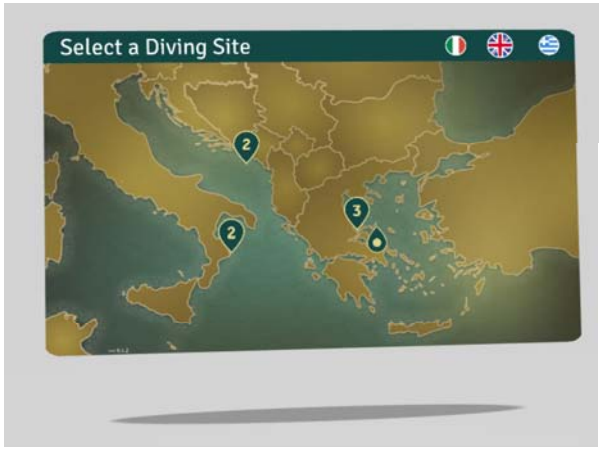
MeDryDive goals

a. **To define, design and develop** the 'Dive in the Past' as a new tourism product with selected UCH locations in Italy, Greece, Croatia, Montenegro;
b. **To design value-adding services** to be offered to our target groups;
c. **To develop** marketing and product sustainability strategies for the proposed product concept;
d. **To raise awareness** with respect to the social value, the competitive advantage, and the particularities of underwater cultural heritage;
e. **To support and promote** networking of stakeholders of UCH sites, and foster the transfer of good practices and the cross-fertilization of knowledge;
f. **To develop** a roadmap for up taking project results by other EU UCH sites

MeDryDive goals

A dryDive serious game based on the reuse of 3D models already available. The game will allow the player to dive in some of the most appealing underwater cultural sites of the Mediterranean enjoying the experience to swim among the remains of ancient civilizations.

The gaming elements will include storytelling, puzzles and quests in order to stimulate the players to accomplish the various missions in order to pass to the next site. The game will be available for the main mobile platforms such as Android and iOS



MAGNA Project

Sail in History

ON THE ROUTE FROM GREECE TO MAGNA GRAECIA

Co-funded by the European Maritime and Fisheries Fund

Consortium

1. MAZI Travel (Greece)
2. Atlantis Consulting SA (Greece)
3. University of Calabria (Italy)
4. Italian Minister of Cultural Heritage (Italy)

GOAL: Develop a **transnational thematic touristic route** between Greece and the Ionian coast of Calabria (Southern Italy) an ancient Magna Graecia colony on the basis of cultural and historical connections between these two Mediterranean areas

MAGNA Activities

- **Assessment of pilot sites** in Italy and Greece
- Design of **value-adding services** to be offered to the target groups
- Development of **marketing and sustainability strategies**
- Raise awareness to stakeholders with respect to the **social value**, the **competitive advantage**, of ancient nautical Cultural Heritage
- Development of a roadmap for **uptaking** of project results by other EU sites
- Support and promote **networking** of stakeholders and synergies building

The Italian Pilot sites

The Greek Pilot sites

Thanks for your attention

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