# *ECOMAP project*

# *"Good practices Report on Virtual and Subaqueous travels"*

*Biodiversity, Alien species impact and Virtual journey as diving offers in the Adriatic Sea*

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|---|---|
| Project Acronym | ECOMAP |
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# Table of contents

# Abstract/Executive Summary

The main aim of this report is exchanging best practices, competences and knowledge about the blue underwater heritage and its intersectionality brought by the ECOMAP project and related FORUMs, in which many interventions and explanations on EU objectives target applied at the territorial scales have been presented and discussed. This report covers in particular on the one hand the biodiversity and alien species topic, peculiarities and impacts, and the virtual and subaqueous tours, as cultural heritage conservation and diving offers. As it is reported in the UNESCO "Underwater Cultural Heritage" Convention (2001), the protecting action for underwater life and heritage, the operative scope as well as challenge is developing various awareness-raising and capacity-building activities aimed at all stakeholders and to the valorization of underwater cultural heritage. The oceans, seas, lakes and rivers hide from view and protect under the surface a priceless heritage, largely unknown and underestimated. The underwater vestiges are threatened by looting and commercial exploitation, industrial trawling, coastal development, exploitation of natural resources and the sea bed. These vestiges are also weakened by global warming, and water acidification and pollution. In order to protect, understand and make this heritage better known, UNESCO has developed and implemented for 20 years the 2001 Convention on the Protection of Underwater Cultural Heritage. The ECOMAP project has implemented a similar route on the awareness-raining and capacity-building actions in the WP5 dedicated to the enforcement of the port cities, especially in the management and containment measures of climate changes and arthropodization near the coastal areas. Around the underwater heritage preservation, many aspects are taken into account, but mainly and through the ECOMAP actions, two of them: natural marine and in-land biodiversity and underwater historical-cultural heritage. Many initiatives and documentaries targeted with the BLUE GROWTH concept have been implemented and to these, experts (such as professional divers), research centers, technology transfer center, agencies, sectoral managers (such as marinas) contributed with various cross-border ideas, best practices and examples from Friuli Venezia, Veneto, Marche regions and on the hand central Croatian coastal side.

# Chapter 1 – Biodiversity and Alien species' impact: insights and best practices from the Adriatic Sea

In regards of WP5.4 contribution to the "Virtual and subaqueous travels" and its set of actions, the ECOMAP project and its partnership has organized a specific training/technological transfer module in the REMTECH 2020 DIGITAL EDITION (September 2020) dedicated to the climate change effects, impacts to the biodiversity and recent invasion of alien species in the Adriatic Sea. Through these important good practices, the ECOMAP would put attention to the further challenging missions that regions, communities and coastal ports authorities have to know about their natural resources and how they are changing over the times.

As explained above, the climate changes topic has been discussed and two relators have contributed distinctly to it. Marina Cabrini from the National Institute of Oceanography and Geo-physics (OGS) aimed bio invasion of alien species, introduced by ballast waters in the Adriatic Sea, globally ranked as ten of the most unwanted things. The invasion of HAOP (Harmful Aquatic Organisms and Pathogens) into new marine environments through ships' ballast water and sediments is one of the greatest threats for the coastal and sea ecosystem. The relator summarized the argument by giving some inputs on that: 3-5 billion tons of BW are annually carried by ships in worldwide, in Adriatic ports about 10 million tons per year are discharged; 7000 species of different microorganisms, plant and animals are being transferred worldwide every year; economic activities, mainly fishery and tourisms sectors may be disturbed from HAOP invasions and the invasions of HAOP may cause illness or death to human populations. In 2013, the BALMAS project (17 partners and 7 associated partners) carried out activities in 10 different port between Italy and Croatia, that has contributed in creating solutions to the climate change issue. The partnership in FVG has installed a long-term research monitoring area with all needed parameters (sediments and water samplings) in Gulf of Trieste. The project has implemented field and lab activities. It is strategic to have a ballast water management system for the protection of the Adriatic Sea with standardized and inter calibrated protocols. Indeed, use of tools such as databases for the analysis of the time series necessary for comparison with the introduction of NIS is extremely important as well as sustainability of natural capital. Here below is presented the complete explanation of best practice:


# BIOINVASION OF ALIEN SPECIES INTRODUCED BY BALLAST WATERS IN THE ADRIATIC SEA

**Marina Cabrini**

*OGS - Istituto Nazionale di Oceanografia e di Geofisica Sperimentale*
*Sezione di Oceanografia*
*via Piccard 54, 34151 Trieste*

**REMTECH EXPO', Ferrara, 22 settembre 2020**

The invasion of HAOP (Harmful Aquatic Organisms and Pathogens) into new marine environments through ships' ballast water and sediments is one of the gratest threats for the coastal and sea ecosystyem.

3-5 billion tones of BW are annualy carried by ships in worldwide, in Adriatic ports about 10 million tonns per year are discharged

7000 species of different microorganisms, plant and animals are being transferred worlwide every year

Economic activities, mainly the sectors of fishery and tourisms may be disturbed from HAOP invasions

Invasions of HAOP may cause illness or death to human populations

From 1988 in USA
Invasion of *Dreissena polymorpha* (zebra mussel) indigenous from Black and Caspio Sea

EPA estimates a 100 billion $ loss

Invasion of *D. p* in Central Italy lakes



*Noctiluca scintillans* MACARTNEY in the Northern Adriatic Sea: long-term dynamics, relationships with temperature and eutrophication, and role in the food web

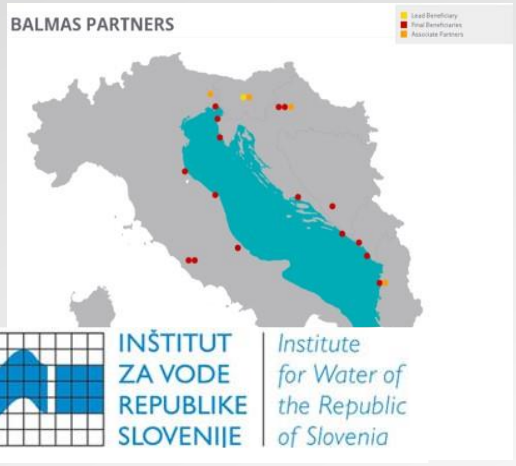
*Noctiluca scintillans*

## Ballast Water Managment System for Adriatic Sea Protection

**BALMAS**

**17 PARTNERS**

**7 Associated Partners**




2013-2016

**Study Area**


Ports represent the most important sites and are the first to be involved in the introduction of bioinvaders through the ships (ballast water, fouling, etc. etc.).

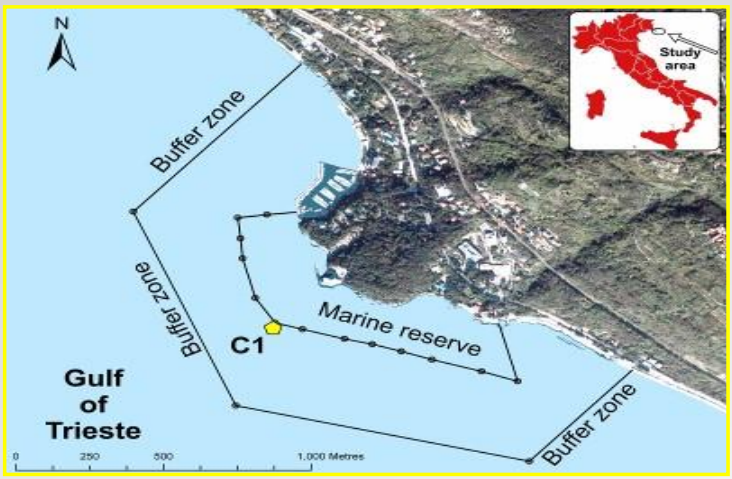
Ports are:

- DONOR
- RECEIVER

Monitoring program of water and sediments constitute in these two sites

**EARLY WARNING SYSTEM**

prevention of new introductions


N
Study area
Buffer zone
Buffer zone
Marine reserve
C1
Gulf of Trieste
Buffer zone
0
250
500
1,000 Metres


IL PORTO DI TRIESTE


18.
Terminal Prodotti Petroliferi

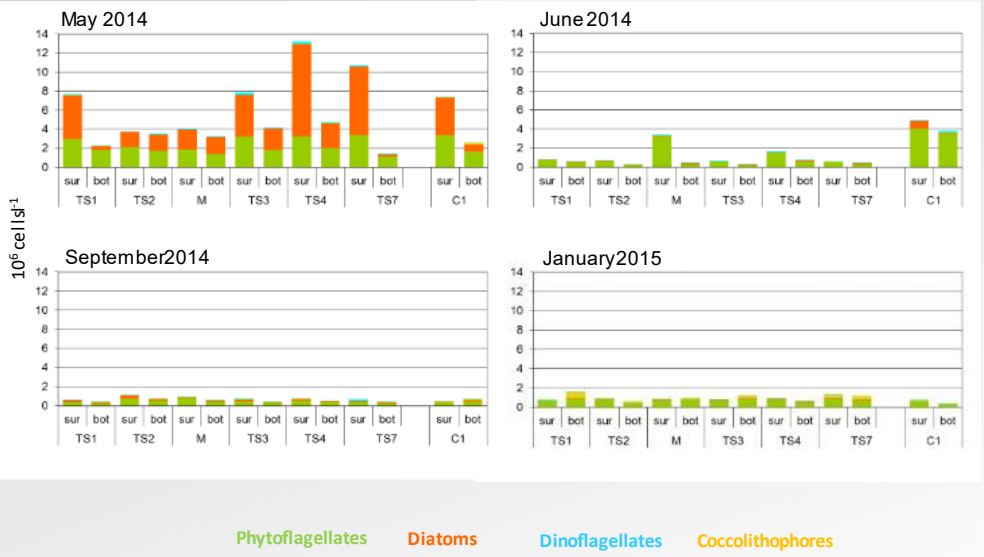

TRIESTE PORT: BALMAS sampling sites
18.5 m.
TS1
15 m.
TS2
15.5 m.
M
TS7
19.5 m.
13 m.
TS3
SEDIMENT (4 sites in the Port of Triest + C1) * 2 times /year
Sites TS1, TS2, TS3, TS4, C1
WATER (6 sites in the Port of Triest + C1) * 4 times/year
Sites TS1, TS2, M, TS3, TS4, TS7, C1
TS4
10.5 m.
Image © 2014 CNES / Astrium
Google earth
2004
Data di acquisizione delle immagini: 8/7/2013 45°37'18.55"N 13°46'20.39"E elev 1 m alt 4.53 km

## PARAMETERS

1) T, salinity, ph - CTD and transparency – Secchi disk
2) Grain size and TOC
3) Nutrients: nitrites, nitrates, phosphates, silicates
4) Oxygen and Chlorophyll *a*
5) Human Phatogens *E. coli, Enterococchi intestinali, Vibrio cholerae*, (serotypes O1, O139)
6) Phytoplankton
7) Mesozooplankton
8) Microbenthos
9) Macrozoobenthos
10) Meiobenthos
11) Mobile epifauna/fish
12) Macroalgae
13) Dinoflagellate cysts

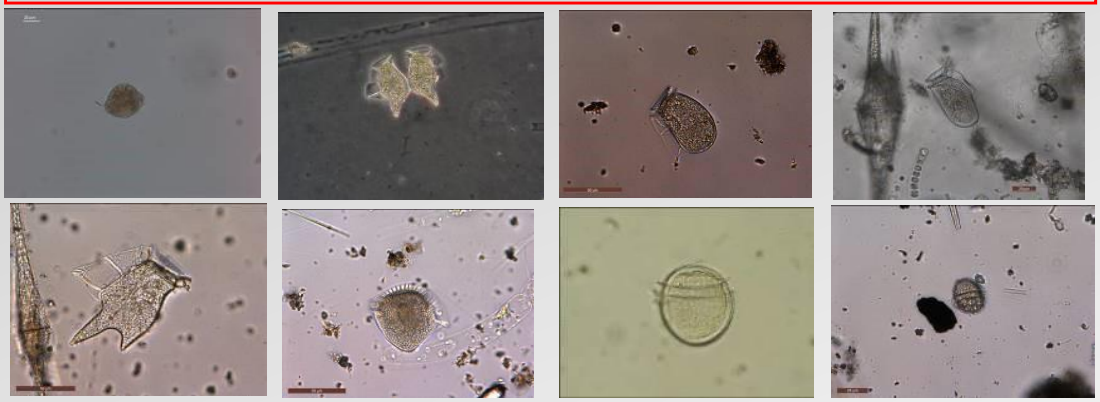
## Sampling by niskin bottles (surface and bottom)

Phytoplankton abundances

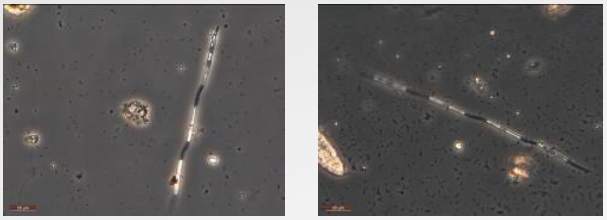


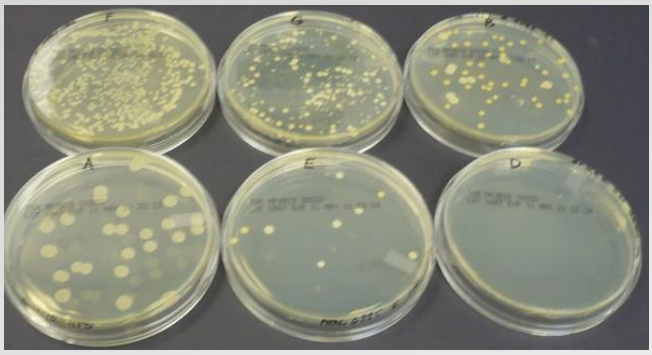
## Sampling by vertical net

**HAO species**: *Alexandrium pseudogonyaulax; Dinophysis caudata, D. fortii, D. sacculus, D. tripos; Lingulodinium polyedrum; Phalacroma mitra, P.rotundatum; Prorocentrum cordatum; Protoceratium reticulatum*



**NIS**: *Pseudo-nitzschia multistriata*

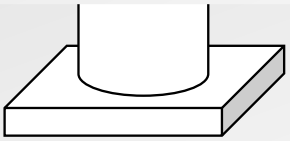


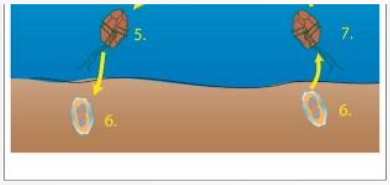


Direct plating methods are adopted to enumerate VIABLE BACTERIA CULTURABLE at 22° and 37° C (UNI EN ISO 6222:2001).

Abundances are expressed as Colony-forming units (CFU 100 mL $^{-1}$).

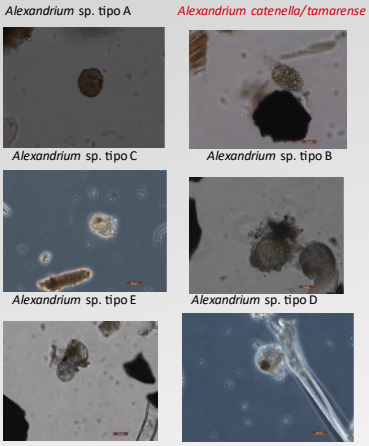
Cinzia Fabbro



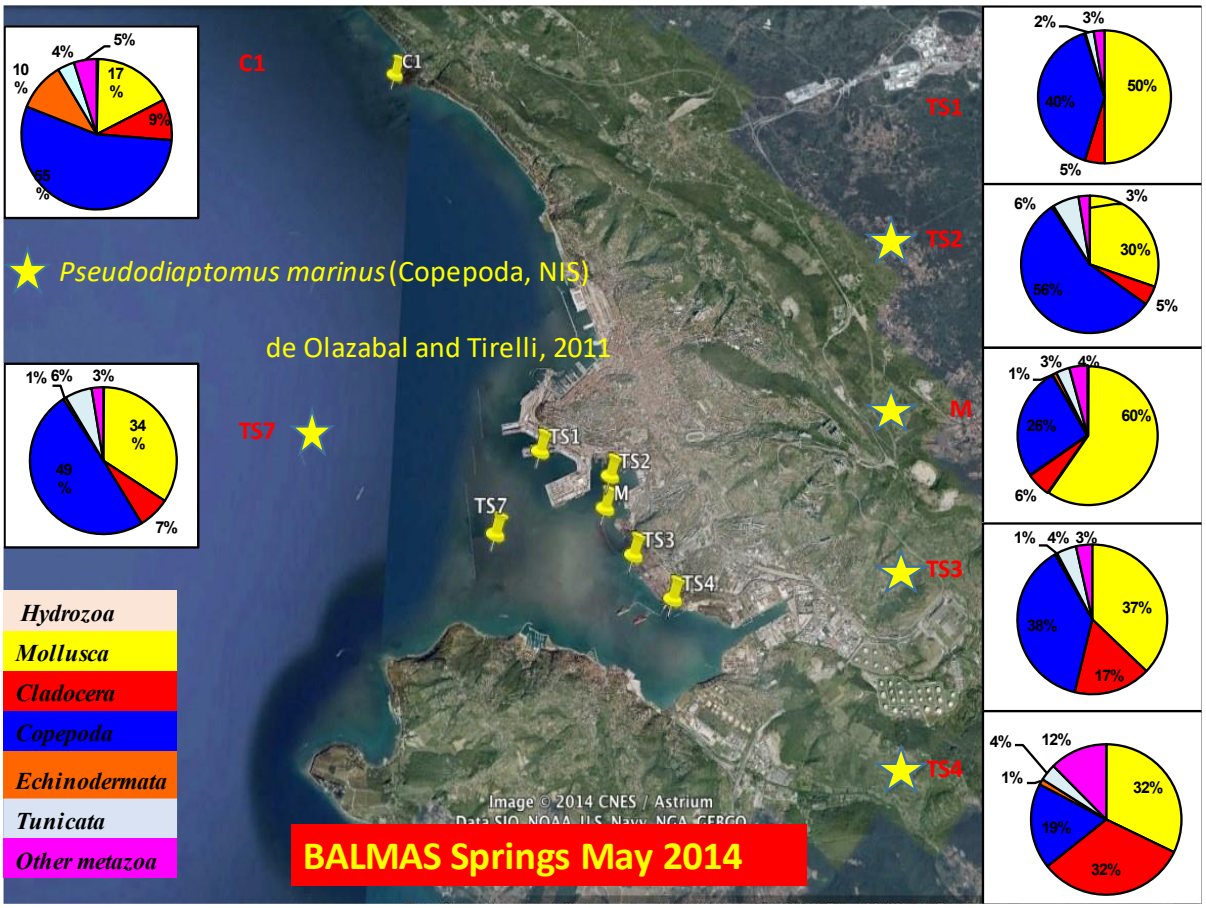


**Cysts of Gonyaulacales**

*Gonyaulax* sp.
*Gonyaulax scrippsae*
*Gonyaulax spinifera* group
*Gonyaulax* cf. *membranacea*
*Lingulodinium polyedrum* (DSP)
*Alexandrium* sp. tipo A,B,C,D,E,F,G,I,L,M
*Alexandrium catenella/tamarense* (PSP)
*Alexandrium* cf. *pseudogonyaulax* (PSP)
*Alexandrium* cf. *margalefi*
*Protoceratium reticulatum*






C1
TS1
TS2
M
TS3
TS4
TS7
Pseudodiaptomus marinus (Copepoda, NIS)
de Olazabal and Tirelli, 2011
Hydrozoa
Mollusca
Cladocera
Copepoda
Echinodermata
Tunicata
Other metazoa
BALMAS Springs May 2014
Image © 2014 CNES / Astrium


HARD BOTTOMS SAMPLING SITES
SOFT BOTTOMS SAMPLING SITES

**HARD BOTTOMS May, 2014**

**Dominant species:**

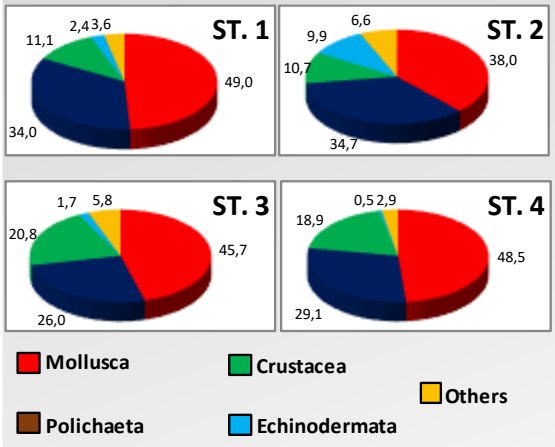
- **.POLICHAETA:** *Serpula vermicularis*
- **.MOLLUSCA:** *Rocellaria dubia*
- **.CRUSTACEA:** *Corophium acutum*
- **.ECHINODERMATA:** *Ophiotrix fragilis*

**SOFT BOTTOMS May, 2014 NO ALIEN SPECIES**

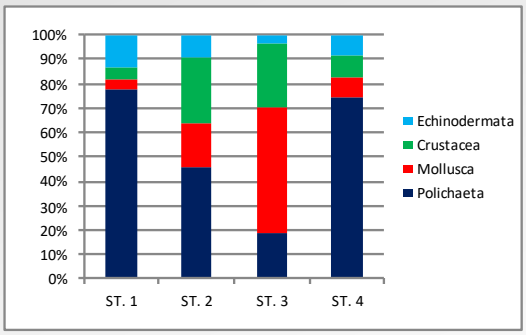
**Dominant species:**

- **.POLICHAETA:** *Scoletoma impatiens*
- **.MOLLUSCA:** *Tellina distorta*
- **.CRUSTACEA:** *Ampelisca diadema*
- **.ECHINODERMATA:** *Amphiura filiformis*

## HARD BOTTOMS




## SOFT BOTTOMS



# Mobile fauna - Trieste

(Trieste harbour, 3 stations)

Trammel net and traps confirmed to be highly species-selective (high percentage of exclusive taxa retained by each gear)

They are complementary and efficient fishing gears to draw a complete picture of resident mobile fauna

24 taxa, 0 NIS

PBS Spring and Fall 2014 - Number of individuals

| TAXA | trammel net | traps |
|---|---|---|
| **Fish** | | |
| *Chelidonichthys lucernus* | 2 | |
| *Chelon labrosus* | 7 | |
| *Diplodus annularis* | 4 | |
| *Gobius niger* | | 19 |
| *Pagellus acarne* | 1 | |
| *Pagellus erythrinus* | 6 | |
| *Sciaena umbra* | 2 | |
| *Scorpaena porcus* | 1 | |
| *Serranus hepatus* | 1 | 8 |
| *Sparus aurata* | 2 | |
| *Spicara maena* | 4 | |
| *Spondyliosoma cantharus* | 1 | |
| *Umbrina cirrosa* | 2 | |
| **Crustaceans** | | |
| *Liocarcinus vernalis* | | 1 |
| *Maja crispata* | 13 | |
| *Melicerthus kerathurus* | 6 | |
| *Macropodia rostrata* | | 8 |
| *Pagurus bernardus* | 1 | |
| *Pilumnus hirtellus* | 3 | |
| *Pagurus prideaux* | 3 | 26 |
| **Molluscs** | | |
| *Hexaplex trunculus* | 13 | |
| *Nassarius nitidus* | | 5 |
| *Nassarius reticulatus* | | 120 |
| *Sepia officinalis* | 5 | |



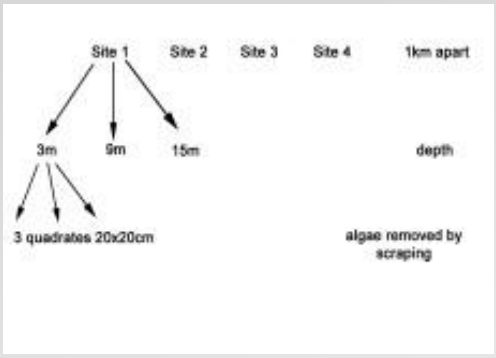
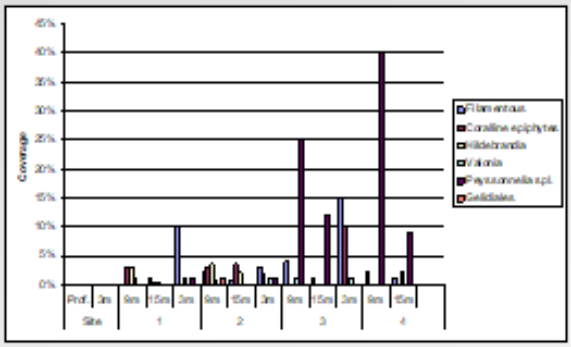



Table 1 Macroalgae abundances in the sampling sites

| Site | Dep. | Filamentous | | Coralline | | Hildebrandia | | Valonia | | Peyssonnelia spl. | | Gelidiales | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | May14 | Oct14 | May14 | Oct14 | May14 | Oct14 | May14 | Oct14 | May14 | Oct14 | May14 | Oct14 |
| | 3m | | | | | | | | | | | | |
| 1 | 9m | | 1 | 1 | 1 | 1 | 1 | + | + | | | | |
| | 15m | 1 | 1 | 1 | 1 | 1 | + | | | | | | |
| | 3m | 1 | 1 | + | + | + | + | | | + | + | | |
| 2 | 9m | 1 | + | + | + | + | + | + | + | | | + | |
| | 15m | + | | + | + | + | | | | | | | |
| | 3m | + | + | + | + | | + | + | + | + | + | | |
| 3 | 9m | 1 | 1 | | | | | + | + | 3 | 3 | | |
| | 15m | + | + | | | | | | | 1 | 2 | | |
| | 3m | + | 1 | 1 | + | | | + | + | | | | |
| 4 | 9m | + | 1 | | | | | | | 5 | 5 | | |
| | 15m | + | | | | + | | | | 1 | | | |




- Low coverage of macroalgae
- The majority of taxa were collected as single thallus and as epiphyte of filter feeders.
- A total of 33 algal taxa was collected, of which 20 Rhodophyta, 7 Chlorophyta and 6 Ochrophyta
- The coverage was very low (< 5%) and only *Peyssonnelia* spl. showed higher coverage at a depth of 9 m at site 3 and 4.
- No NIS was identified.

## Alien species

Photo R. Auriemma

Alien Species in the Port of Trieste

*Notomastus aberans* *Arcuatula senhousia*

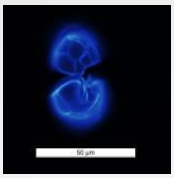
Photo A. de Olazabal

*Pseudodiaptomus marinus*

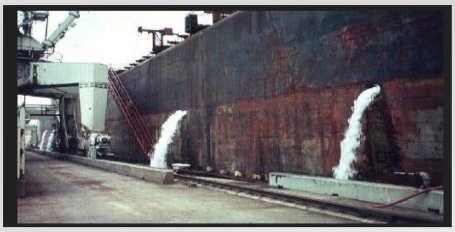
Photo: D. Fornasaro

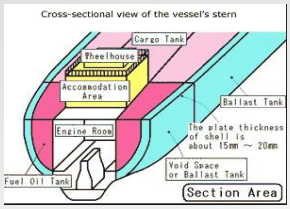
*Pseudo-nitzschia multistriata*

Photo: A. Beran



*Alexandrium margalefii*



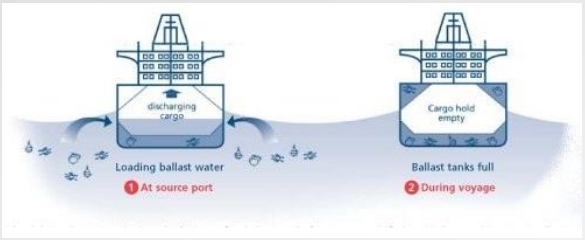


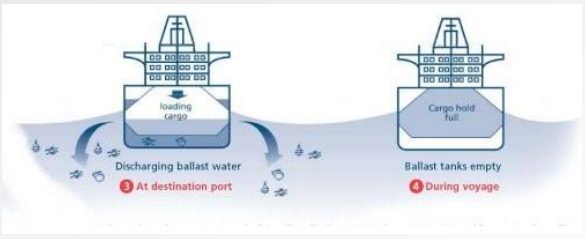
Ballast waters

Alien species introduction through ballast water

Toxic microalgae for human

Toxic microalgae for environment



# BALLAST WATER SAMPLING

10 tanks in the port of Trieste, Venice, Ancona and Bari were sampled to measure T, salinity and fluorescence to estimate and identify viable phytoplankton and zoolplankton and bacteria

**Looking for ballast water to sample….**

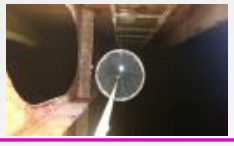
Water sampling via sounding pipe

**Temperature** and **Salinity**

**Fluorimeter portable:**

High risk *(*active Chl *a*), low risk *rischio (*Chl *a low*)

**Mesozooplankton** samplingthrough WP3 via manhole



# BALLAST WATER SAMPLING

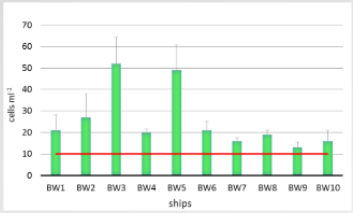
10 ship' ballast tanks, coming in the Port of Trieste, were sampled from April to June 2015

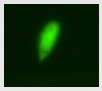
| N° | SHIPS | TYPE | ORIGIN OF BW | RESIDENCE DAYS | WATER LEVEL (m) | SAMPLING POINT |
|---|---|---|---|---|---|---|
| BW1 | GEMINI SUN - RUSSIA | OIL TANKER | BLACK SEA | ND | 4.3<br>ND | SOUNDING PIPE<br>MANHOLE |
| BW2 | UN TRIESTE - TURKEY | RO-RO CARGO | MIDDLE ADRIATIC | 1 | 5 | IN-TANK |
| BW3 | ULUSOY-15 -TURKEY | RO-RO CARGO | IONIAN SEA | 16 | 2.4 | VENT WATER BALLAST |
| BW4 | ULUSOY-14 -TURKEY | RO-RO CARGO | SOUTHERN ADRIATIC | 5 | 2.1 | IN-TANK |
| BW5 | ULUSOY-15 - TURKEY | RO-RO CARGO | IONIAN SEA | 1 | 2.25 | IN-TANK |
| BW6 | ULUSOY-14 -TURKEY | RO-RO CARGO | IONIAN SEA | 12 | 2.4 | MANHOLE |
| BW7 | ULUSOY-15 - TURKEY | RO-RO CARGO | IONIAN SEA | 28 | 2.4 | MANHOLE |
| BW8 | ULUSOY-14 - TURKEY | RO-RO CARGO | IONIAN SEA | 20 | 2.4 | MANHOLE |
| BW9 | ULUSOY-15 -TURKEY | RO-RO CARGO | IONIAN SEA | 1 | 2.5 | MANHOLE |
| BW10 | ULUSOY-14- TURKEY | RO-RO CARGO | IONIAN SEA | 26 | 2.4 | MANHOLE |

ND= Not Detected

Water was collected from the sounding pipe or manhole

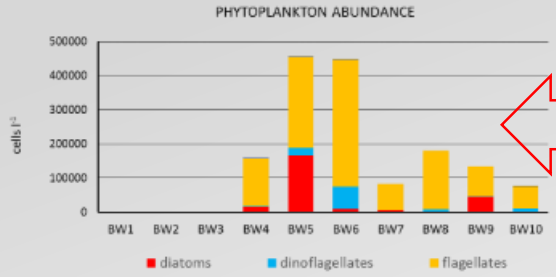
For the viable cell analysis, 500 ml of sea water (integrated sample) were sampled from every ballast tank.
1 ml was stained with Fluorescein Diacetate (FDA) as a selective viability indicator and processed using an epifluorescence microscope.
4 replicates were counted using a Sedgewick-Rafter Chamber
The viable cell analysis, in according to the *Balmas guidelines*, focuses on organisms less than 50 µm in minimum dimension and greater than or equal to 10 µm in minimum dimension



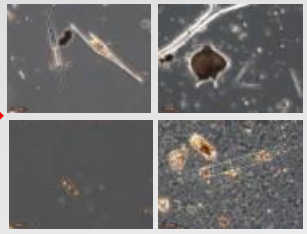



The number of viable cells exceeded the *Balmas guidelines* limits (**10 cells ml$^{-1}$**) in all samples !!

For phytoplankton quantitative and qualitative analyses, 500ml-water (integrated sample) were fixed with Lugol (1% final concentration). Cell counts were carried out according to the Utermöhl's method




Several phytoplankton organisms were found inside the ballast tanks



Also potentially toxic species were found

## Port of Trieste

| N° | SHIPS | TYPE | WB-TANK | ORIGIN OF BW | RESIDENCE DAYS | WATER LEVEL (m) | SAMPLING POINT |
|---|---|---|---|---|---|---|---|
| BW1 | GEMINI SUN - RUSSIA | OIL TANKER | 6P<br>6WB-P | BLACK SEA | ND | 4.3<br>4.3 | SOUNDING PIPE<br>MANHOLE |
| BW2 | UN TRIESTE - TURKEY | RO-RO | 12 | MIDDLE ADRIATIC | ND | 5 | IN-TANK |
| BW3 | ULUSOY-15-TURKEY | RO-RO | 14 | IONIAN SEA | ND | 2.4 | VENT WATER BALLAST |
| BW4 | ULUSOY-14-TURKEY | RO-RO | 13 | SOUTHERN ADRIATIC | ND | 2.1 | IN-TANK |
| BW5 | ULUSOY-15 - TURKEY | RO-RO | 19 | IONIAN SEA | ND | 2.25 | IN-TANK |
| BW6 | ULUSOY-14-TURKEY | RO-RO | 9 | IONIAN SEA | 14 | 2.4 | MANHOLE |
| BW7 | ULUSOY-15 - TURKEY | RO-RO | 9 | IONIAN SEA | ND | 2 | MANHOLE |
| BW8 | ULUSOY-14 - TURKEY | RO-RO | 13 | IONIAN SEA | ND | 2.4 | MANHOLE |
| BW9 | ULUSOY-15-TURKEY | RO-RO | 19 | IONIAN SEA | ND | 2.5 | MANHOLE |
| BW10 | ULUSOY-16- TURKEY | RO-RO | 12 | IONIAN SEA | ND | 2.4 | MANHOLE |

ND= Not Detected


| | D1-STANDARD | | | | | | D2- INDICATIVE TEST | | |
|---|---|---|---|---|---|---|---|---|---|
| | TEMPERATURE (°C) | | | SALINITY | | | FLUOROMETER | | |
| | sur. | middle | bot. | sur. | middle | bot. | sur. | middle | bot. |
| BW1 | 20.1 | 17.5<br>19.1 | 15.8 | 17.4 | 18.5<br>18.5 | 31.7 | LOW | LOW<br>LOW | HIGH |
| BW2 | 20.8 | 19.9 | 19.6 | 36.6 | 37.0 | 37.6 | HIGH | HIGH | HIGH |
| BW3 | 24.2 | - | - | 37.3 | - | - | HIGH | - | - |
| BW4 | 24.8 | - | 22.5 | 37.3 | - | 37.2 | LOW | - | LOW |
| BW5 | 25.6 | 25.1 | 24.5 | 35.6 | 36.4 | 37.1 | HIGH | HIGH | HIGH |
| BW6 | 24.2 | 23.9 | 23.8 | 36.8 | 36.9 | 37.0 | LOW | LOW | LOW |
| BW7 | 25 | 24.4 | 23.8 | 36.9 | 37.3 | 37.3 | LOW | LOW | LOW |
| BW8 | 24 | 23.2 | 21.7 | 38.0 | 37.9 | 37.6 | LOW | LOW | LOW |
| BW9 | 27.1 | 24.5 | 24.3 | 35.5 | 36.7 | 37.5 | HIGH | HIGH | LOW |
| BW10 | 24.4 | 23.8 | 23.7 | 37.3 | 37.4 | 37.5 | LOW | LOW | LOW |

ND = Non Disponibile
FIB = Fecal Indicator Bacteria

| | NAVI | ORIGINE delle BW | GIORNI di PERMANENZA | BALLAST WATER QUALITY STANDARD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | D1 STANDARD D2 INDICATIVE | | D-2 DETAILED | | | CONFORMITA' |
| | | | | SALINITA' | FLUORESCENZA | FIB* | FITO | ZOO | D2 STANDARD |
| TRIESTE | GEMINI SUN | MAR NERO | ND | X | V | V | X | X | X |
| | UN TRIESTE | MEDIO ADRIATICO | ND | V | X | V | X | X | X |
| | ULUSOY-15 | MAR IONIO | 16 | V | X | V | X | X | X |
| | ULUSOY-14 | SUD ADRIATICO | 5 | V | V | V | X | X | X |
| | ULUSOY-15 | MAR IONIO | 1 | V | X | V | X | X | X |
| | ULUSOY-14 | MAR IONIO | 12 | V | V | V | X | X | X |
| | ULUSOY-15 | MAR IONIO | 28 | V | V | V | X | X | X |
| | ULUSOY-14 | MAR IONIO | 20 | V | V | V | X | X | X |
| | ULUSOY-15 | MAR IONIO | 1 | V | X | V | X | X | X |
| | ULUSOY-14 | MAR IONIO | 26 | V | V | V | X | X | X |
| VENEZIA | M/V MARJA | CICLADI | ND | V | X | V | X | X | X |
| | OBELIX | MED. ORIENTALE | 14 | V | V | V | X | X | X |
| | M/V MARJA | VENEZIA | 1 | V | X | V | X | X | X |
| | M/V MARJA | VENEZIA | 1 | V | X | V | X | X | X |
| | OBELIX | PIREO | 2 | V | V | V | X | X | X |
| | KING BYRON | RIJEKA | ND | V | V | V | V | X | X |
| | M/V MARJA | TRIESTE | 2 | V | X | V | X | X | X |
| | UNI-PHOENIX | PIREO | 2 | V | V | V | V | X | X |
| | OBELIX | PIREO | 65 | V | V | V | X | X | X |
| | M/V MARJA | VENEZIA | 36 | V | X | V | X | X | X |
| ANCONA | M/V KRETA | MISURATA (LIBIA) | 6 | V | V | V | X | X | X |
| | CRUISE OLYMPIA | PATRASSO | 1 | V | V | V | X | X | X |
| | BF MELODY | TRIESTE | 15 | V | V | V | V | V | V |
| | M/V RICKMERS | ATLANTICO | 32 | X | V | X | V | V | X |
| | OLYMPIC CHAMPION | ANCONA | ND | V | X | X | X | X | X |
| | MARKO POLO | SPALATO | 1 | V | V | X | X | X | X |
| | REGINA DELLA PACE | ANCONA | ND | V | V | X | V | V | X |
| | ELLENIK SPIRIT | ANCONA OFFSHORE | ND | V | X | X | X | X | X |
| | MSC GABRIELLA | VENEZIA | ND | V | X | V | X | X | X |
| | SUPERFAST XI PIREUS | IONIO | ND | V | V | V | X | X | X |
| NON CONFORMITA' | | | | 6,6% | 40% | 16,6% | 83,3% | 90% | 96,6% |

*Vibrio choleraeis absent in all the samples*

MARTEDÌ 3 SETTEMBRE 2013 IL PICCOLO — Monfalcone cronaca | 21

# L'acqua ridiventa verde Canale come uno stagno

Denunciati disagi e cattivi odori nell'Est-Ovest ma nessun rischio sanitario
Proteste del Marina Lepanto. Il Consorzio industriale prepara una bonifica

di Giulio Garau

Sono tornate le alghe nel Canale Est-Ovest e, come è accaduto lo scorso anno (più in ritardo però visto il maltempo) il tratto terminale a fondo cieco che ospita un gran numero di marina e cantieri nautici si è ritrasformato in uno stagno verde e maleodorante. Brutto da vedere, ma quest'anno anche poco accogliente perché oltre al disagio per gli utenti che si vedono la barca imbrattata, si è fatto sentire un odore poco invitante dovuto alla putrefazione delle stesse alghe rimaste con grandi e oleo che alcune barche hanno rilasciato in mare nell'operazione proibita di rivestimento delle sentine.

E come lo scorso anno a partire nuovamente all'attacco è stato il Marina Lepanto che ha lo stesso delle maxime a Comune di Monfalcone, Consorzio per lo sviluppo industriale e quello di Bonifica per chiedere provvedimenti di fronte alla

GUARDA LA FOTOGALLERY sul nostro sito www.ilpiccolo.it

"problematica condizione delle acque del canale Est Ovest". Un problema sgradevole per la vista e a causa dell'odore, ma senza conseguenze igienico-sanitarie. Il fenomeno di fioritura infatti è stato analizzato, non si tratta di alghe tossiche e in più il canale non è balneabile. Ma stavolta il Consorzio industriale, per quanto di opportunità, ha deciso di intervenire per cercare di risolvere il problema.

«Vogliamo assieme al Consorzio di bonifica la possibilità di procedere con un intervento di pulizia del canale e in particolare del bacino sul quale stanno proliferando le alghe togliendole - spiega il direttore del Cisis, Gianpaolo Fontana - anche perché in certi punti sono cresciute molto e arrivano a toccare le chiglie delle imbarcazioni». Non si tratta di un intervento "donato", ma piuttosto esercizio visto che il fenomeno naturale è brutto da vedere e che comporterà costi non da poco. Alghe e fango del canale infatti sono considerati rifiuti speciali e dovranno essere smaltiti negli impianti ad hoc. «In realtà poi anche il problema dell'odore sgradevole - spiega lo stesso direttore - non è dato dalla putrefazione delle alghe che sono in acqua e non si sente. Quanto dal fatto che mescolate alle alghe c'è gasolio e olio delle sentine di alcune imbarcazioni, oltre a scarichi dei wc di qualche natante, e si tratta di una brutta abitudine che bisognerà eliminare». Come mai anche quest'anno è ripetersi di un fenomeno che non si vedeva da qualche tempo? Dalle analisi fatte la causa della fioritura algale sarebbe da attribuire a vari fattori da un lato all'innalzamento delle temperature e all'assenza di piogge durante l'estate. Dall'altro lato alla minore corrente che una volta provocavano gli scarichi di raffreddamento della centrale A2a che da quando non ci sono più i gruppi a olio rilascia nel canale oltre tre volte in meno di acqua.

L'acqua del canale Est-Ovest completamente verde a causa delle alghe (Foto di Katia Bonaventura)

Un altro scarico del canale verde (Foto di Katia Bonaventura)

**PONTILE OCEAN**

| | profondità (m) | T | S | nutrienti | C e N totali | pH | $O_2$ | chl | fito |
|---|---|---|---|---|---|---|---|---|---|
| st. A | 0 | x | x | x | | | | x | x |
| | 3 | x | x | x | | | | x | x |
| | | | | | | | | | |
| st. B | 0 | x | x | x | x | x | x | x | x |
| | 8 | x | x | x | | x | x | x | x |

**PONTILE LEPANTO**

| | profondità (m) | T | S | nutrienti | C e N totali | pH | $O_2$ | chl | fito |
|---|---|---|---|---|---|---|---|---|---|
| st. C | 0 | x | x | x | | | | x | x |
| | 5 | x | x | x | | | | x | x |
| | | | | | | | | | |
| st. D | 0 | x | x | x | x | x | x | x | x |
| | 5 | x | x | x | | x | x | x | x |

Weekly sampling from 24 July to 10 September 2012 in A and B station

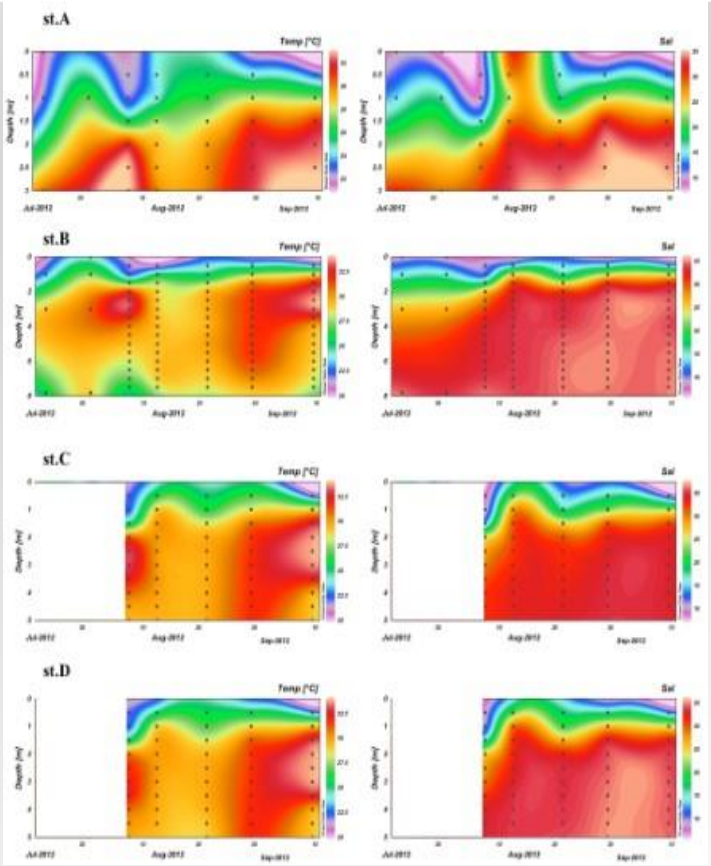
from 8 August to 10 September in C and D station

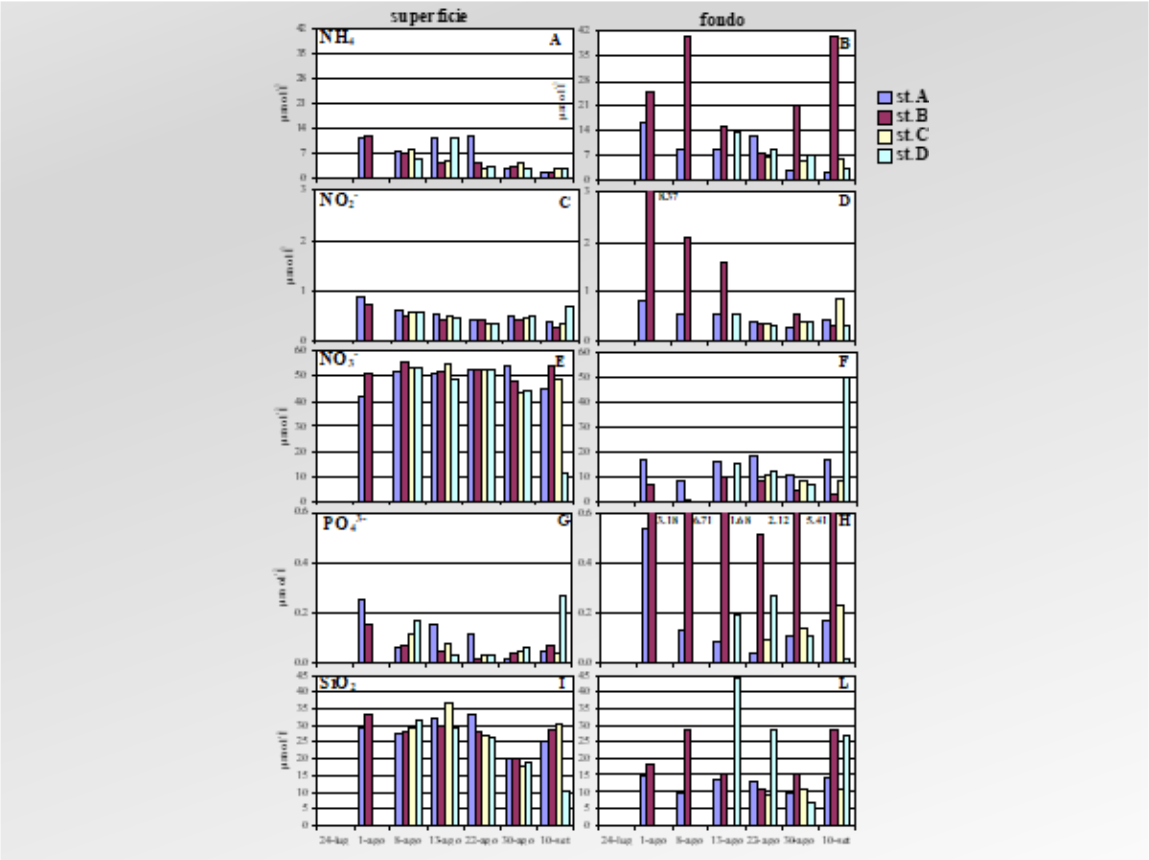

Aim of the work:

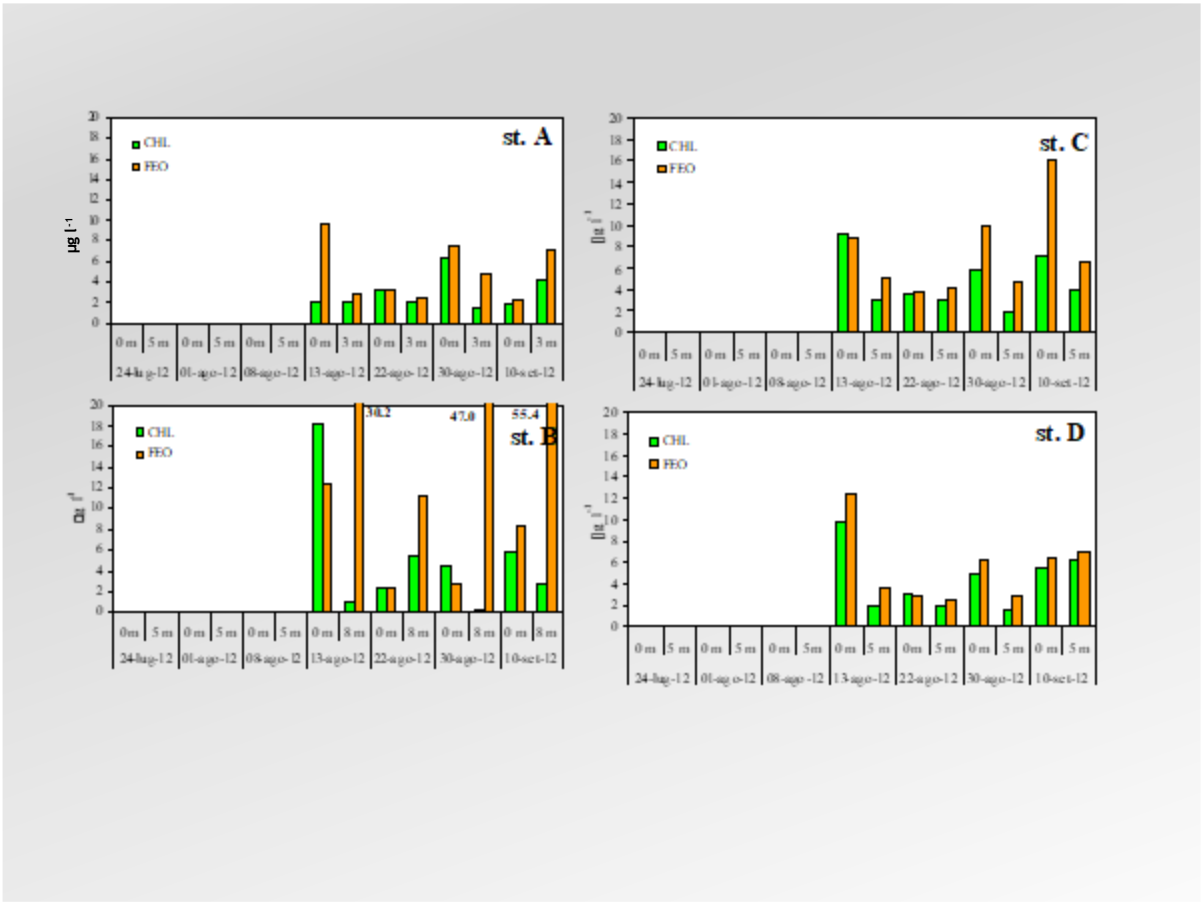
to identify the species responsible for the blooms

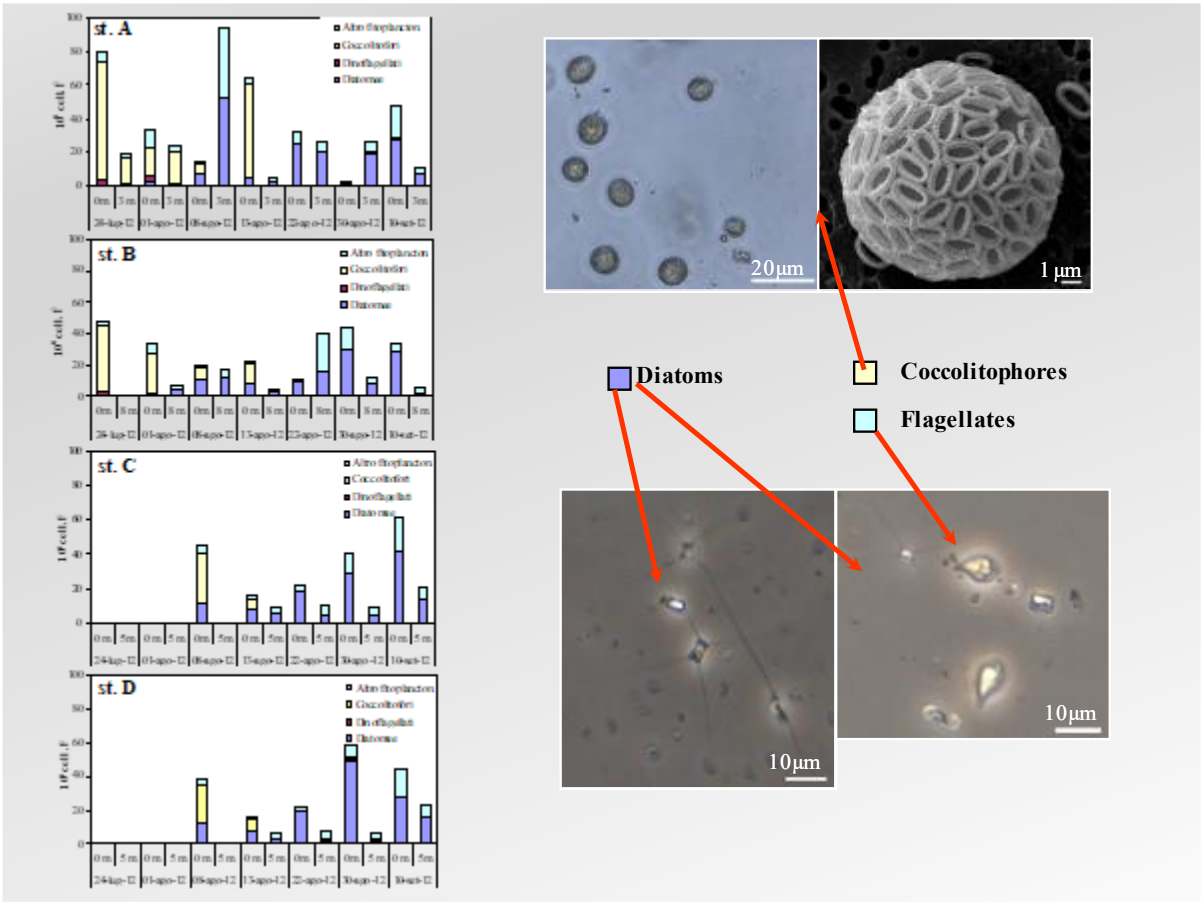
to evaluate the environmental conditions, physical and chemical factors

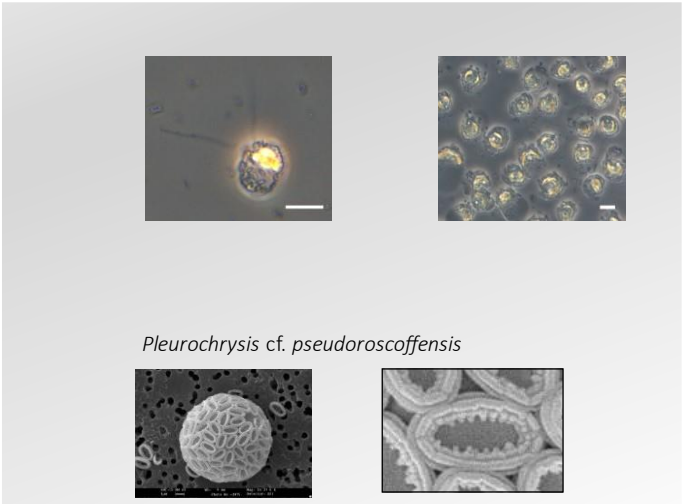
to indicate how to mitigate, reduce or eliminate the abnormal event



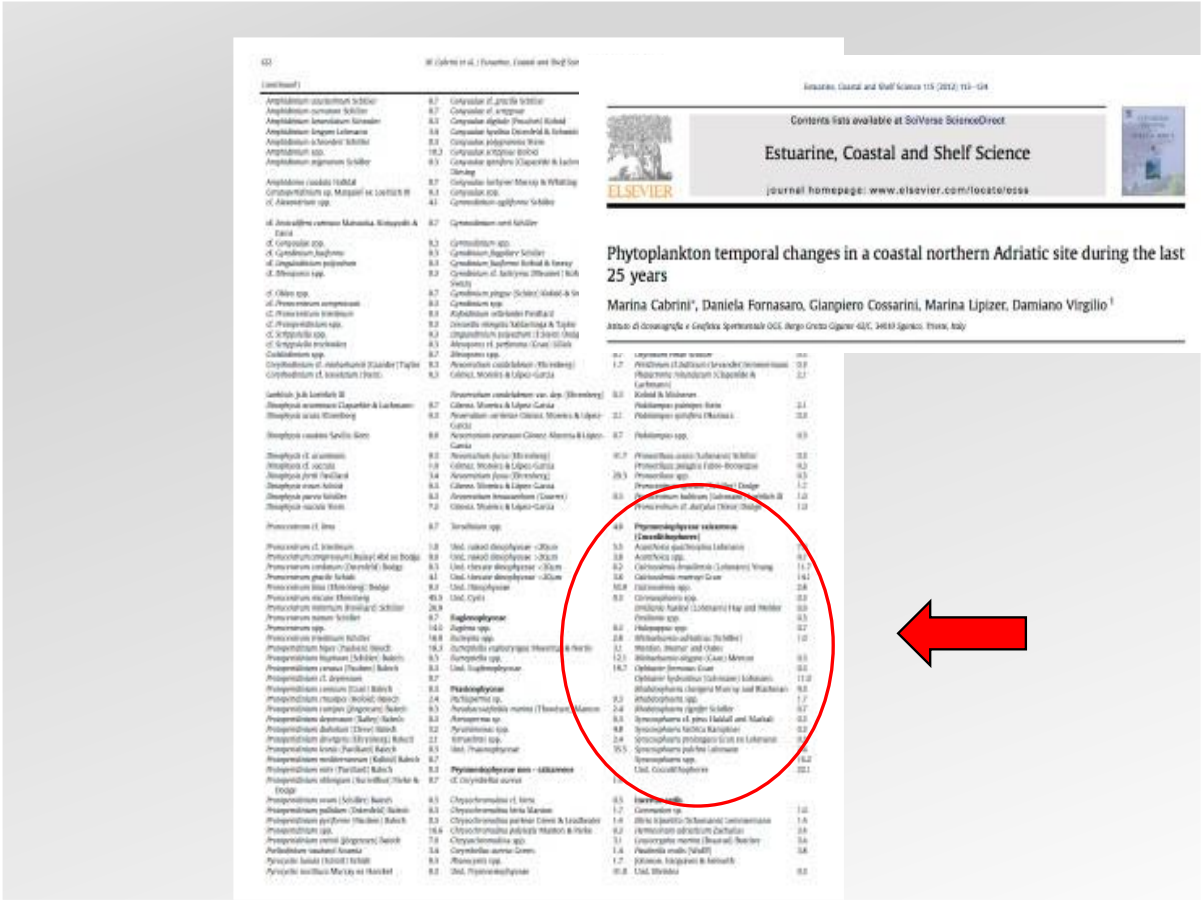

superficie
fondo
NH4
A
B
NO2-
C
D
NO3-
E
F
PO4 3-
G
H
SiO2
I
L
µmol l
st.A
st.B
st.C
st.D
24-lug
1-ago
8-ago
15-ago
22-ago
30-ago
10-set
23-ago


st. A
st. B
st. C
st. D
CHL
FEO
µg l-1
30.2
47.0
55.4



*Pleurochrysis* cf. *pseudoroscoffensis*



Contents lists available at SciVerse ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Phytoplankton temporal changes in a coastal northern Adriatic site during the last 25 years

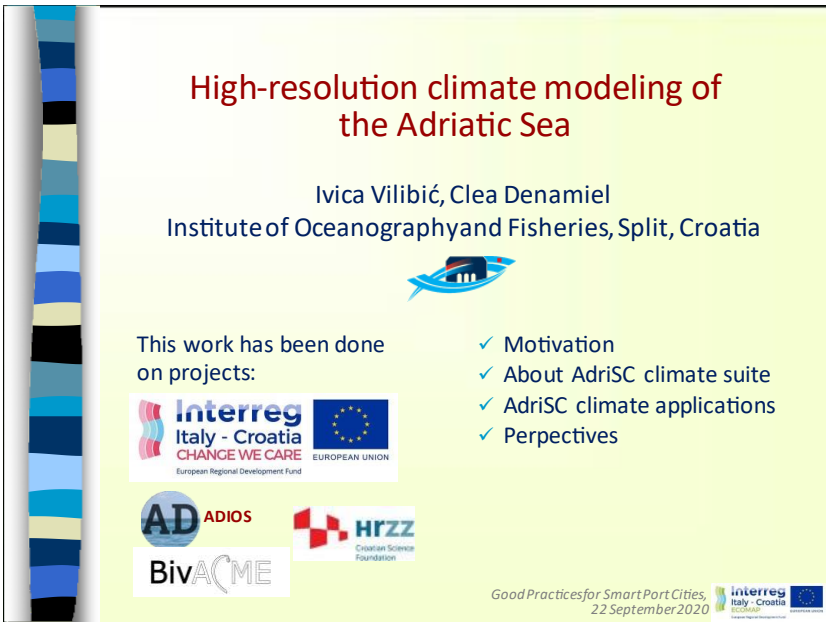
Marina Cabrini*, Daniela Fornasaro, Gianpiero Cossarini, Marina Lipizer, Damiano Virgilio

# Finalconclusions

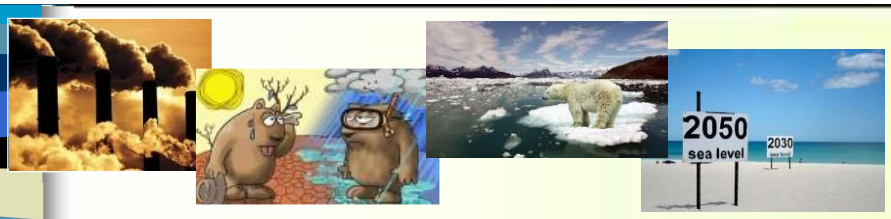
- ✓ The transport of HAOP through BW can induce changes in the state of ecosystems with negative repercussions on both human health and the economy
- ✓ It is strategic to have a ballast water management system for the protection of the Adriatic Sea with standardized and intercalibrated protocols.
- ✓ Bacteria, microalgae and copepods have been found viable in BW which can trigger new introductions and new toxicity phenomena in other seas
- ✓ Importance of a planned monitoring plan for coastal waters including port waters and for incoming ballast waters
- ✓ Use of tools such as databases for the analysis of the time series necessary for comparison with the introduction of NIS
- ✓ Globalization will lead to an increase in maritime traffic and consequently the BW problem will have to be managed to reduce the risk to both the environment and human health
- ✓ Sustainability of natural capital

**BALLAST WATER OGS STAFF**

Furthermore, Ivica Vilibic from the Institute of Oceanography and Fisheries of Croatia (IZOR) gave an example of high-resolution climate modelling of the Adriatic Sea, through CHANGE WE CARE project. First of all, an overview of climate changes meaning has been given. In fact, climate change is a global societal problem reflected in: (1) the appearance of more violent weather phenomena, drought, fires, (2) the death of animal and plant species, (3) flooding from rivers and lakes, (4) the creation of climate refugees, (5) destruction of the food chain and economic resources, especially in developing countries. To mitigate climate impacts firstly is necessary to quantify them, particularly since global climate (and even regional climate) models are not providing the details at the coastal scale. CHANGE WE CARE fosters concerted and coordinated climate adaptation actions at transboundary level. The project explores climate risks faced by coastal and transition areas contributing to a better understanding of the impact of climate variability and change on water regimes, salt intrusion, tourism, biodiversity and agro-ecosystems affecting the cooperation area. The main goal is to deliver integrated, ecosystem-based and shared planning options for different problems related to climate change (CC), together with adaptation measures for vulnerable areas to decision makers and coastal communities who may best benefit from it. Here below is presented the complete explanation of best practice:

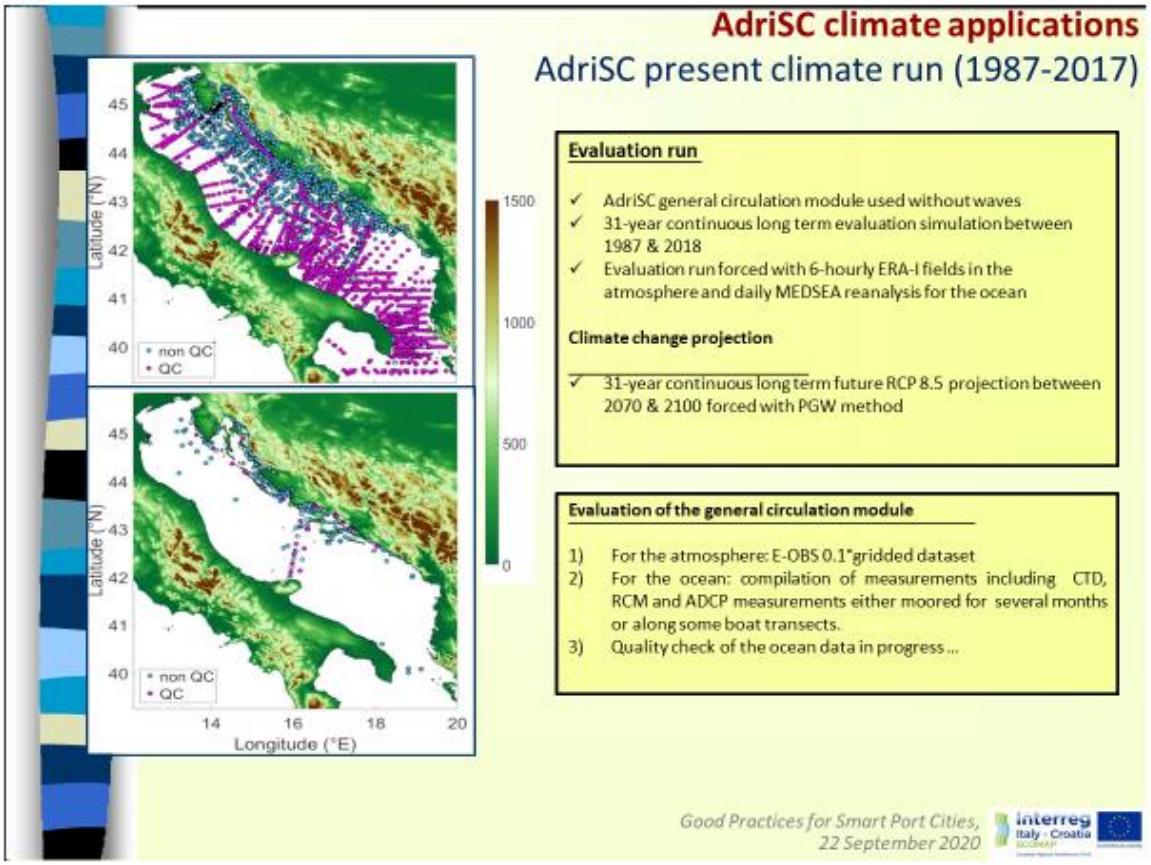


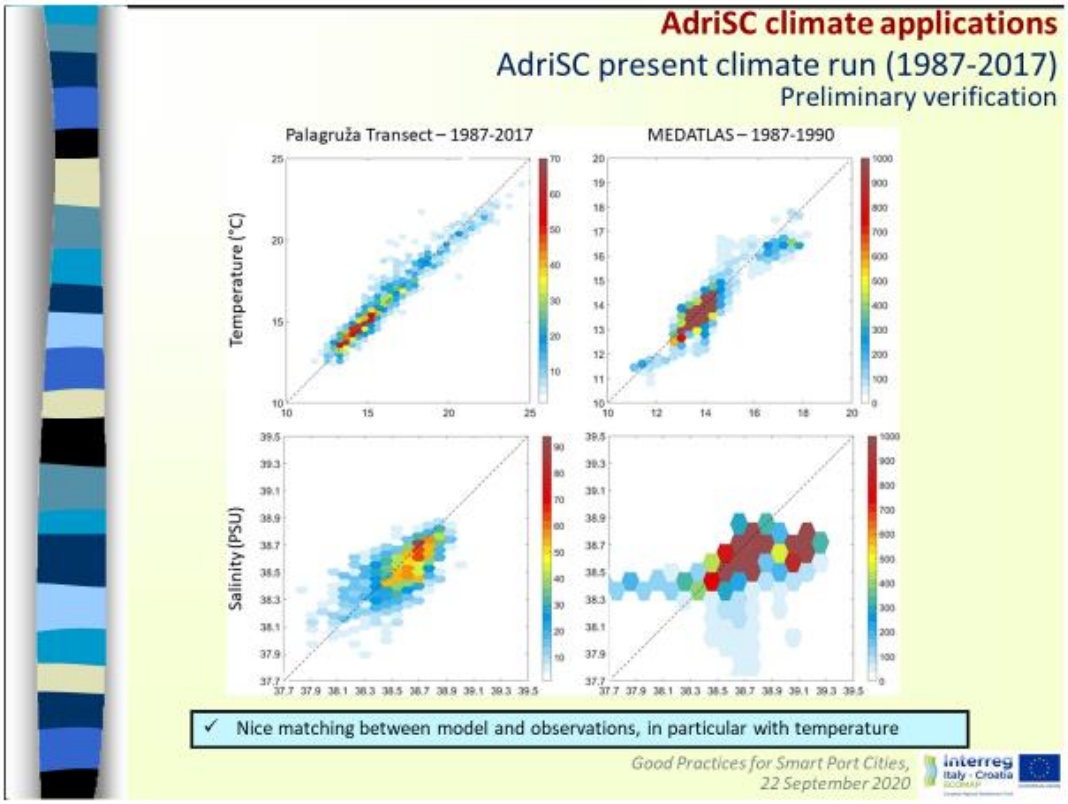
## Motivation

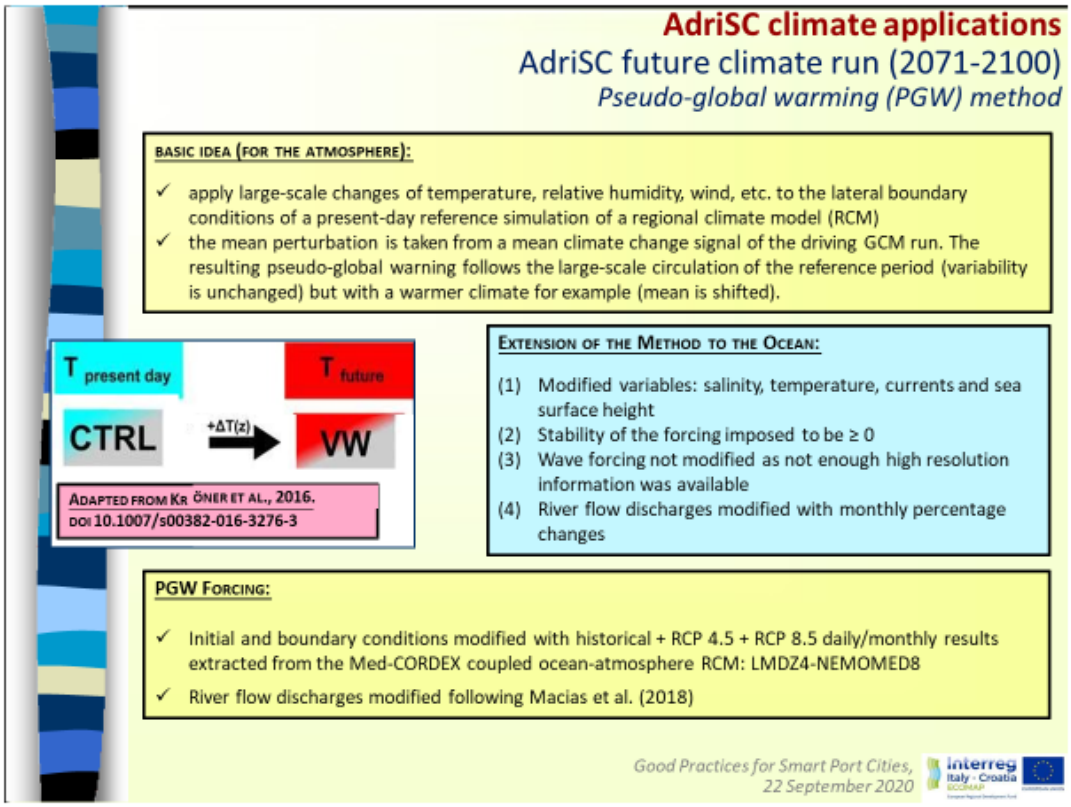



- ✓ Climate change is a global societal problem reflected in: (1) the appearance of more violent weather phenomena, drought, fires, (2) the death of animal and plant species, (3) flooding from rivers and lakes, (4) the creation of climate refugees, (5) destruction of the food chain and economic resources, especially in developing countries, (6) etc ...
- ✓ To mitigate climate impacts we need first to quantify them,
- ✓ Global climate (and even regional climate) models are not providing the details at the coastal scale,
- ✓ Therefore, a need for high-resolution atmosphere-ocean models is a must,
- ✓ The Adriatic might be a case study area for high-resolution climate modelling.

*Good Practices for Smart Port Cities, 22 September 2020*


AdriSC climate applications
AdriSC present climate run (1987-2017)
Evaluation run
✓ AdriSC general circulation module used without waves
✓ 31-year continuous long term evaluation simulation between 1987 & 2018
✓ Evaluation run forced with 6-hourly ERA-I fields in the atmosphere and daily MEDSEA reanalysis for the ocean
Climate change projection
✓ 31-year continuous long term future RCP 8.5 projection between 2070 & 2100 forced with PGW method
Evaluation of the general circulation module
1) For the atmosphere: E-OBS 0.1°gridded dataset
2) For the ocean: compilation of measurements including CTD, RCM and ADCP measurements either moored for several months or along some boat transects.
3) Quality check of the ocean data in progress...
Latitude (°N)
Longitude (°E)
non QC
QC
1500
1000
500
0
Good Practices for Smart Port Cities, 22 September 2020

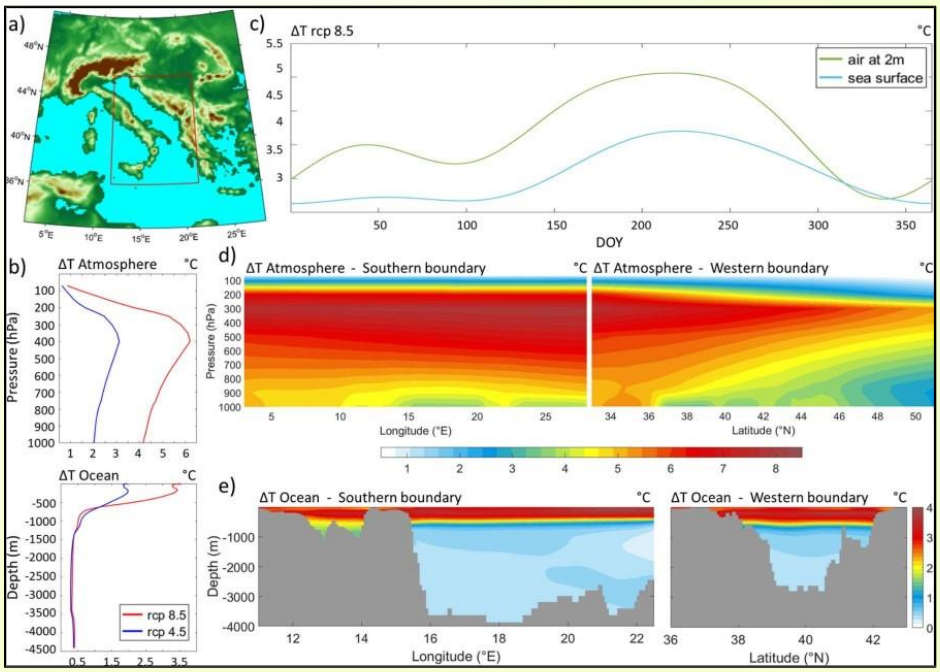

AdriSC climate applications
AdriSC present climate run (1987-2017)
Preliminary verification
Palagruža Transect – 1987-2017
MEDATLAS – 1987-1990
Temperature (°C)
Salinity (PSU)
✓ Nice matching between model and observations, in particular with temperature
Good Practices for Smart Port Cities,
22 September 2020


AdriSC climate applications
AdriSC future climate run (2071-2100)
Pseudo-global warming (PGW) method
BASIC IDEA (FOR THE ATMOSPHERE):
✓ apply large-scale changes of temperature, relative humidity, wind, etc. to the lateral boundary conditions of a present-day reference simulation of a regional climate model (RCM)
✓ the mean perturbation is taken from a mean climate change signal of the driving GCM run. The resulting pseudo-global warning follows the large-scale circulation of the reference period (variability is unchanged) but with a warmer climate for example (mean is shifted).
T present day
T future
CTRL
+ΔT(z)
VW
ADAPTED FROM KRÖNER ET AL., 2016.
DOI 10.1007/s00382-016-3276-3
EXTENSION OF THE METHOD TO THE OCEAN:
(1) Modified variables: salinity, temperature, currents and sea surface height
(2) Stability of the forcing imposed to be ≥ 0
(3) Wave forcing not modified as not enough high resolution information was available
(4) River flow discharges modified with monthly percentage changes
PGW FORCING:
✓ Initial and boundary conditions modified with historical + RCP 4.5 + RCP 8.5 daily/monthly results extracted from the Med-CORDEX coupled ocean-atmosphere RCM: LMDZ4-NEMOMED8
✓ River flow discharges modified following Macias et al. (2018)
Good Practices for Smart Port Cities, 22 September 2020

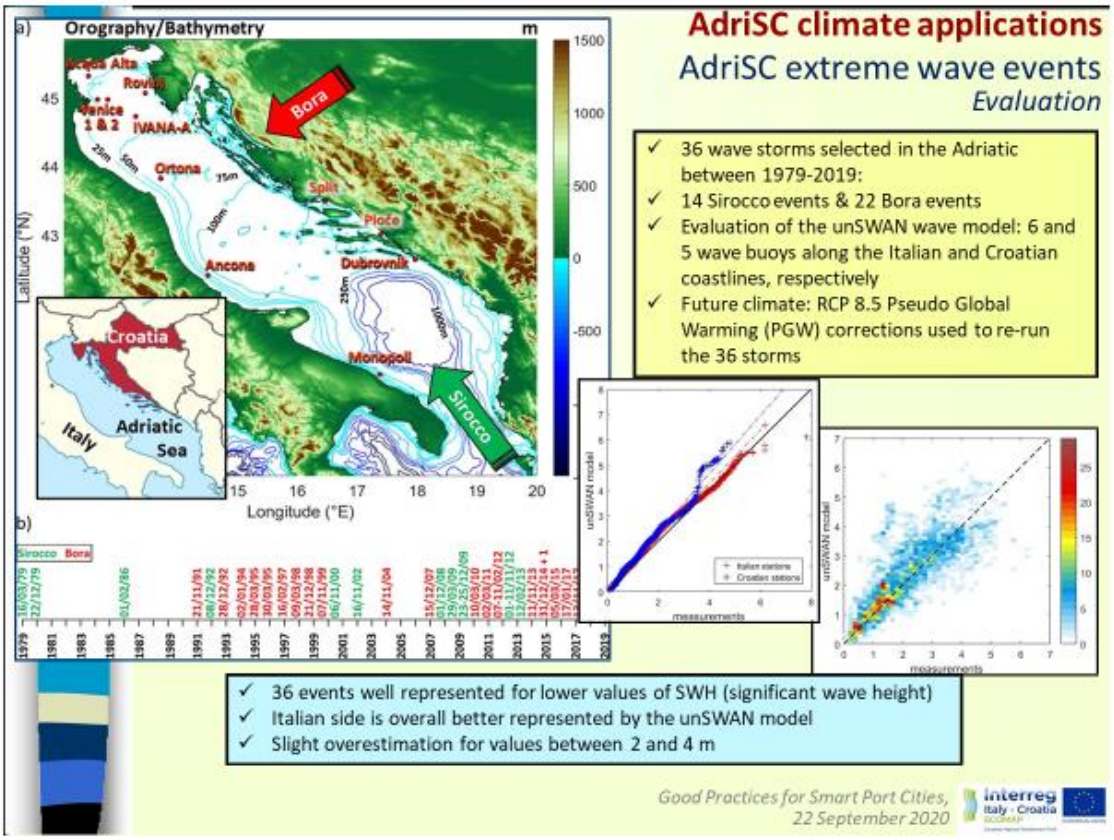
## AdriSC climate applications

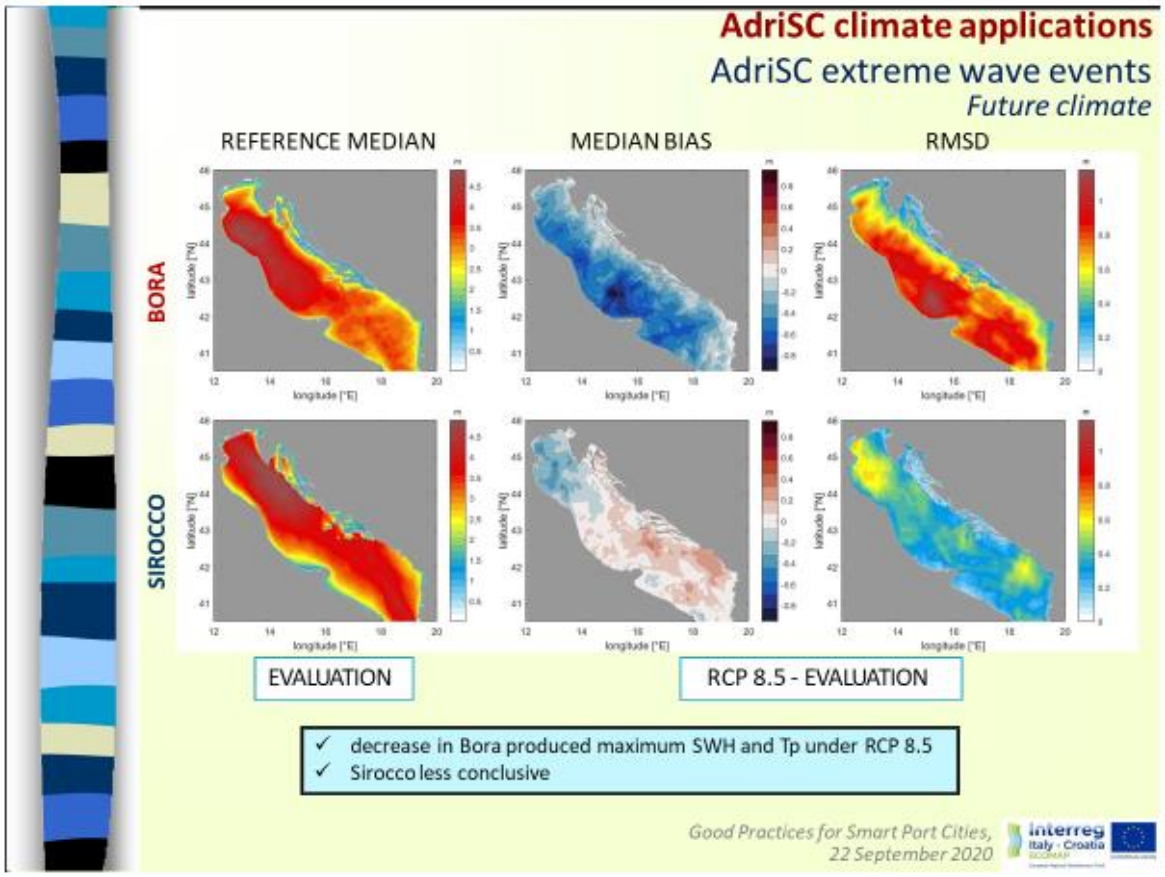
AdriSC future climaterun (2071-2100)

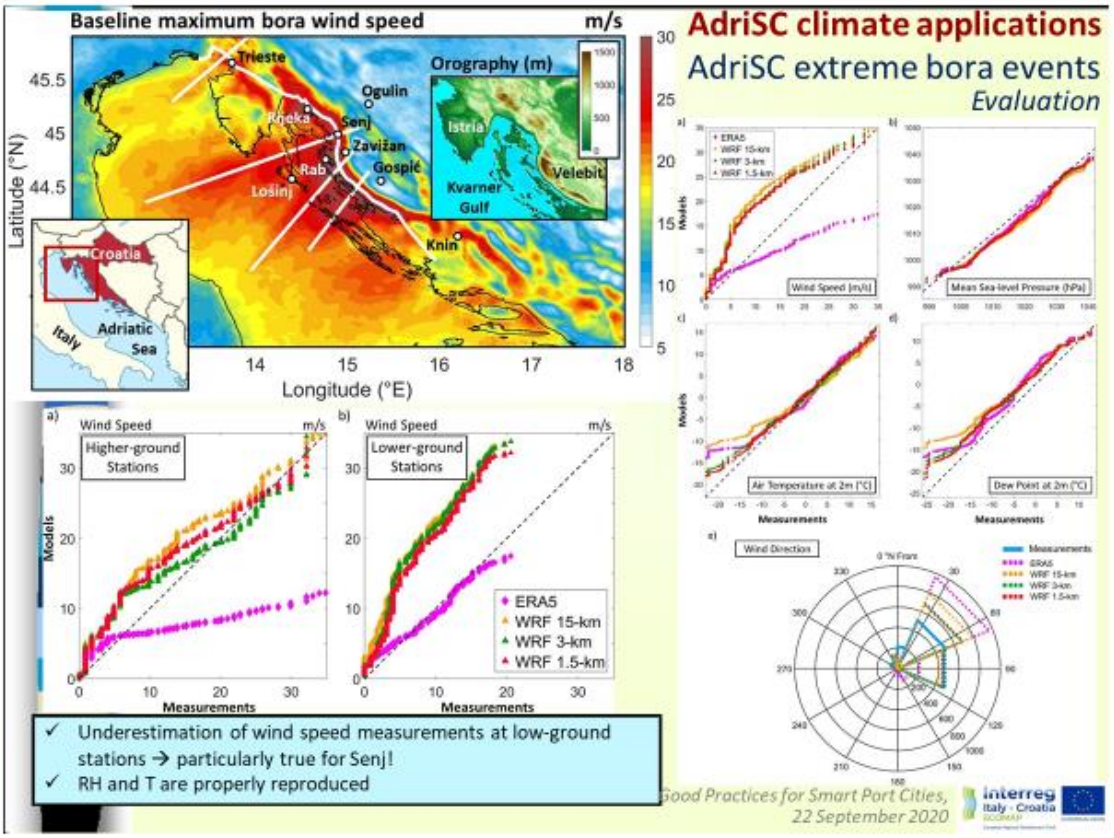
*Pseudo-global warming (PGW) method*

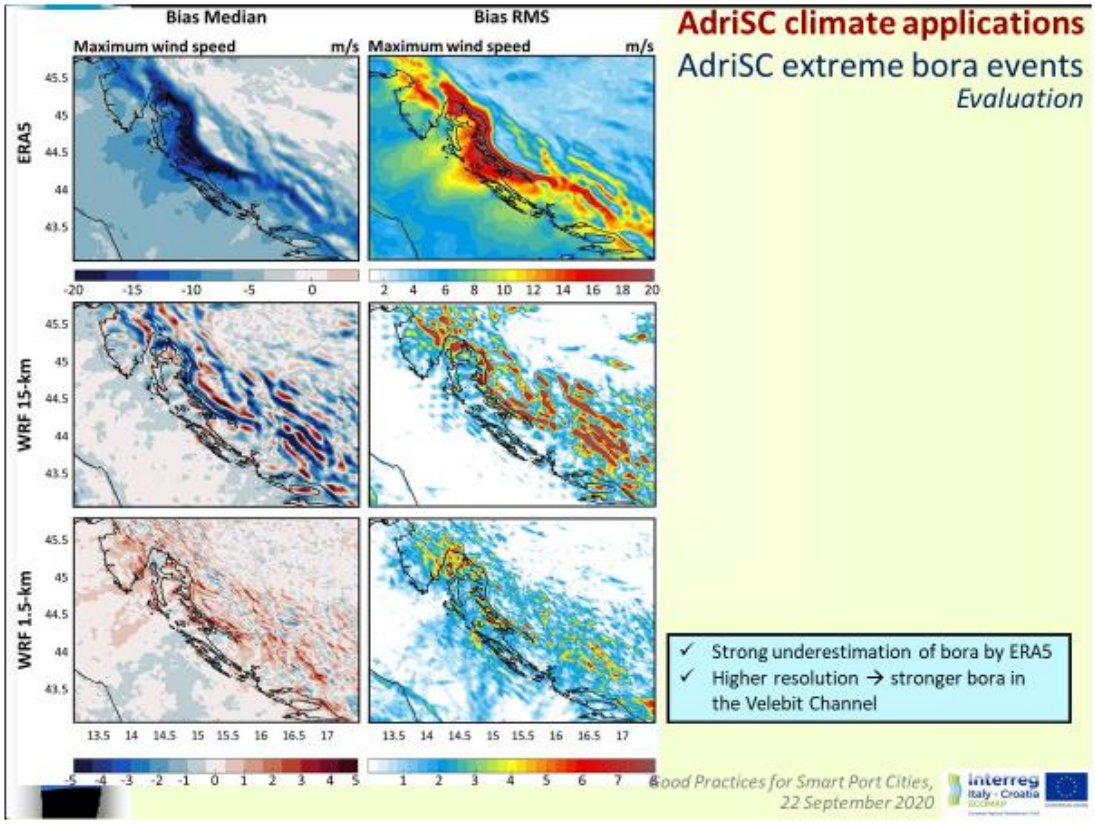


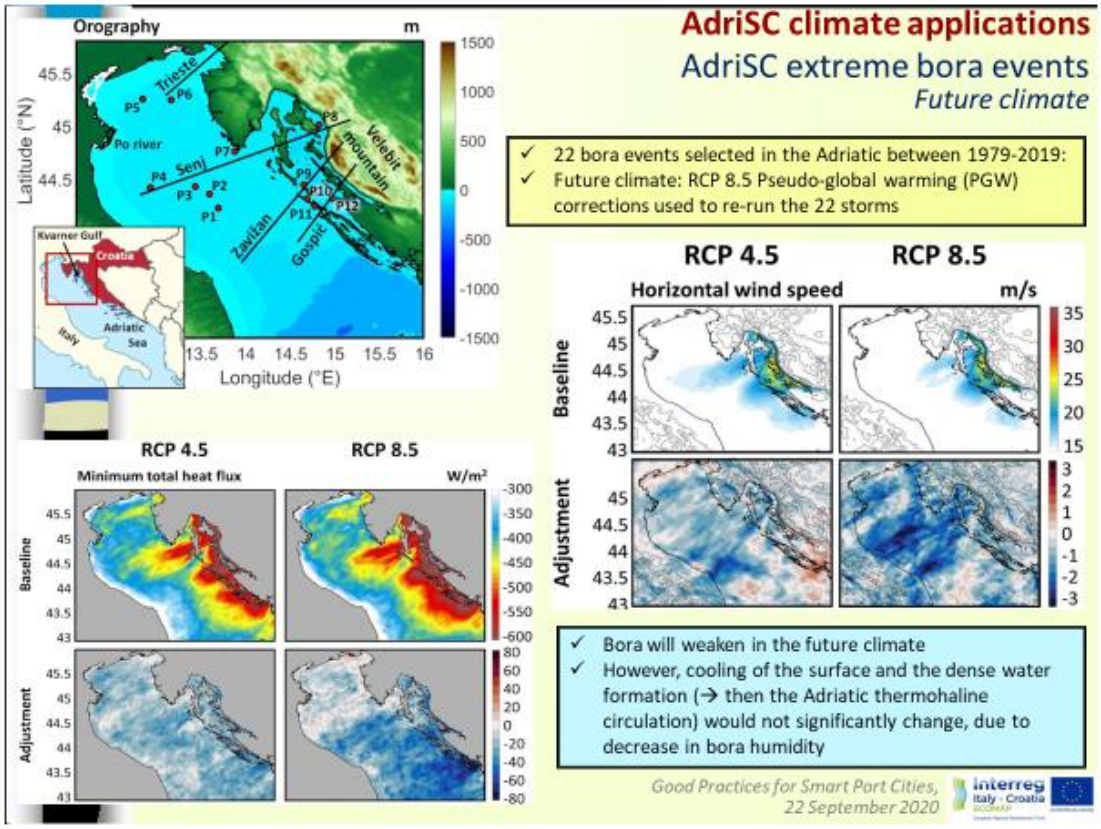

*Good Practices for Smart Port Cities, 22 September 2020*


AdriSC climate applications
AdriSC extreme wave events
Evaluation
a) Orography/Bathymetry
m
Bora
Sirocco
Split
Ploce
Ancona
Dubrovnik
Ortona
Venice
IVANA-A
Croatia
Italy
Adriatic Sea
Monopoli
Latitude (°N)
Longitude (°E)
b)
Sirocco
Bora
36 wave storms selected in the Adriatic between 1979-2019:
14 Sirocco events & 22 Bora events
Evaluation of the unSWAN wave model: 6 and 5 wave buoys along the Italian and Croatian coastlines, respectively
Future climate: RCP 8.5 Pseudo Global Warming (PGW) corrections used to re-run the 36 storms
unSWAN model
measurements
36 events well represented for lower values of SWH (significant wave height)
Italian side is overall better represented by the unSWAN model
Slight overestimation for values between 2 and 4 m
Good Practices for Smart Port Cities,
22 September 2020

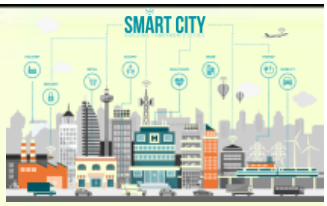

AdriSC climate applications
AdriSC extreme wave events
Future climate
REFERENCE MEDIAN
MEDIAN BIAS
RMSD
BORA
SIROCCO
EVALUATION
RCP 8.5 - EVALUATION
✓ decrease in Bora produced maximum SWH and Tp under RCP 8.5
✓ Sirocco less conclusive
Good Practices for Smart Port Cities,
22 September 2020


Baseline maximum bora wind speed
m/s
AdriSC climate applications
AdriSC extreme bora events
Evaluation
Orography (m)
Trieste
Ogulin
Rijeka
Senj
Zavižan
Gospić
Rab
Lošinj
Istria
Kvarner Gulf
Velebit
Knin
Croatia
Italy
Adriatic Sea
Latitude (°N)
Longitude (°E)
45.5
45
44.5
14
15
16
17
18
30
25
20
15
10
5
Wind Speed
Higher-ground Stations
Lower-ground Stations
Models
Measurements
ERA5
WRF 15-km
WRF 3-km
WRF 1.5-km
Wind Speed (m/s)
Mean Sea-level Pressure (hPa)
Air Temperature at 2m (°C)
Dew Point at 2m (°C)
Wind Direction
✓ Underestimation of wind speed measurements at low-ground stations → particularly true for Senj!
✓ RH and T are properly reproduced
Good Practices for Smart Port Cities, 22 September 2020

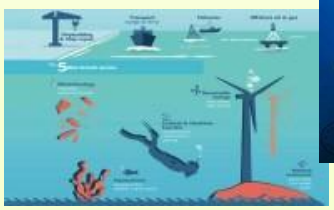

Bias Median
Bias RMS
Maximum wind speed
m/s
ERA5
WRF 15-km
WRF 1.5-km
AdriSC climate applications
AdriSC extreme bora events
Evaluation
✓ Strong underestimation of bora by ERA5
✓ Higher resolution → stronger bora in the Velebit Channel
Good Practices for Smart Port Cities,
22 September 2020


AdriSC climate applications
AdriSC extreme bora events
Future climate
Orography
m
Trieste
Po river
Senj
Velebit mountain
Zavižan
Gospić
Kvarner Gulf
Croatia
Adriatic Sea
Italy
Latitude (°N)
Longitude (°E)
✓ 22 bora events selected in the Adriatic between 1979-2019:
✓ Future climate: RCP 8.5 Pseudo-global warming (PGW) corrections used to re-run the 22 storms
RCP 4.5
RCP 8.5
Horizontal wind speed
m/s
Baseline
Adjustment
Minimum total heat flux
W/m²
✓ Bora will weaken in the future climate
✓ However, cooling of the surface and the dense water formation (→ then the Adriatic thermohaline circulation) would not significantly change, due to decrease in bora humidity
Good Practices for Smart Port Cities, 22 September 2020

## Perspectives



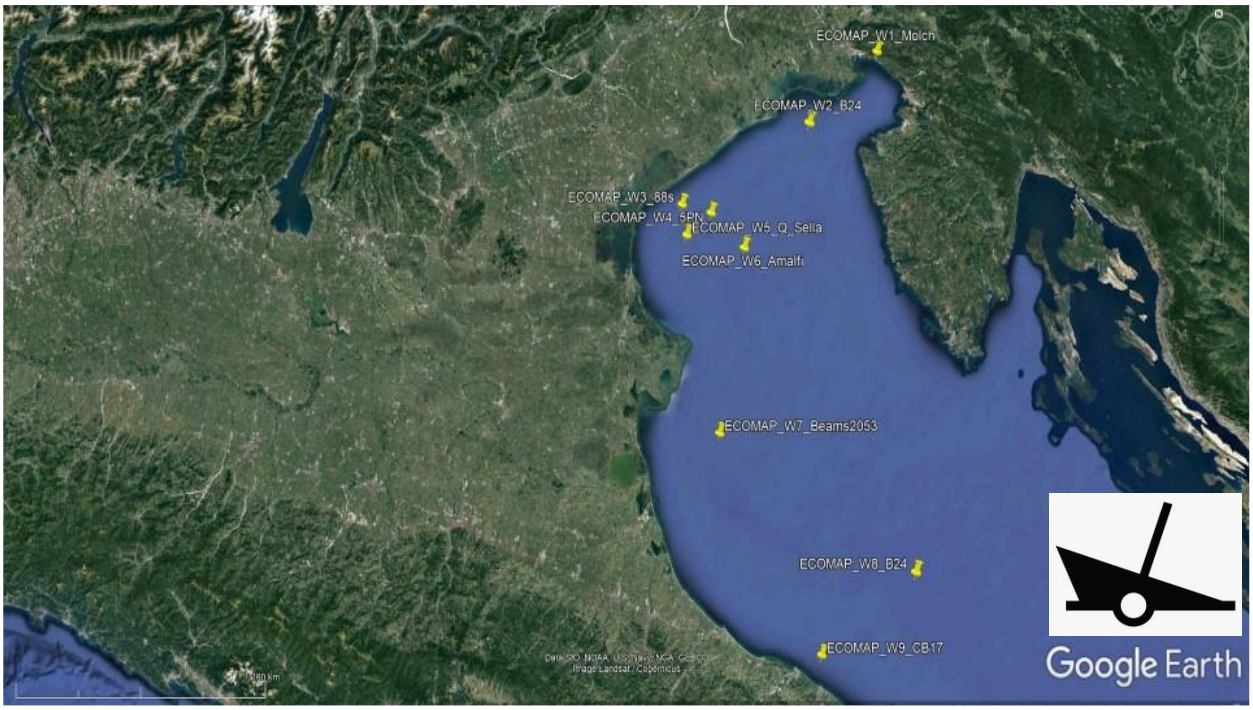

- ✓ A substantial progress in climate modelling of the Adriatic Sea, going down by an order of magnitude higher resolutions – 1 to 3 km vs. 10 to 20 km (in RegCMs)
- ✓ New methodology (pseudo-global warming, PGW) applied in assessment of future climate of extreme events
- ✓ Long-term high-resolution climate runs (present and future climate) still to be investigated, but first results are promissing ...
- ✓ Hopefully, climate modelling will be the tool used by decision-makers and policy-makers, in shaping the future of the Adriatic regions, coastal areas and sea resources
- ✓ Publications: Denamiel et al. (https://doi.org/10.1007/s00382-020-05397-x, https://doi.org/10.1007/s00382-020-05435-8).



*Good Practices for Smart Port Cities, 22 September 2020*

# Chapter 2 – Virtual journey in the Adriatic Sea: water resources as diving offers

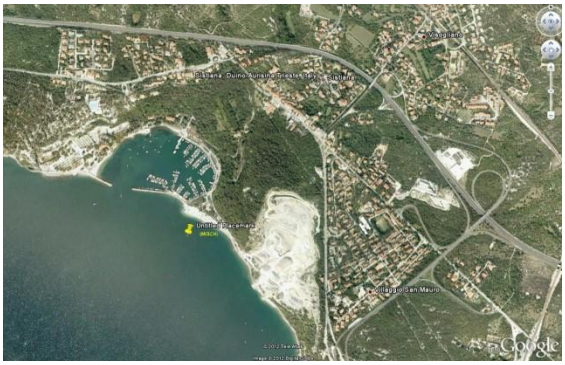
In regards of the WP5.4 contribution to the virtual journey in the Adriatic Sea, partners have collaborated intensively to the ideation, with the main stakeholders along all the Adriatic coasts, of different virtual journey as also diving offers. The partnership has presented the "Underwater cultural heritage Virtual Tour", at the Final Conference in Podstrana (7-8th June 2022) and in occasion of the FORUMs held in the various Blue Innovation Hubs, especially thanks to the strength cooperation of CFR (Center Future Research) and the National Scientific Responsible of the Federation Diving Center Italia, Professor Giovanna Bucci, in the ECOMAP project. The virtual tour is also enriched by a virtual documentary in the field of blue growth, underwater life and sustainable innovative solutions branded by the "BLUE WAY". To this is possible to get access to the animation of the virtual tour: https://drive.google.com/file/d/1zRaYNoAT_cna6Sj64XMYM159BaZV7dVq/view , whilst here below there is the representation of the best practice's virtual tour through slides:

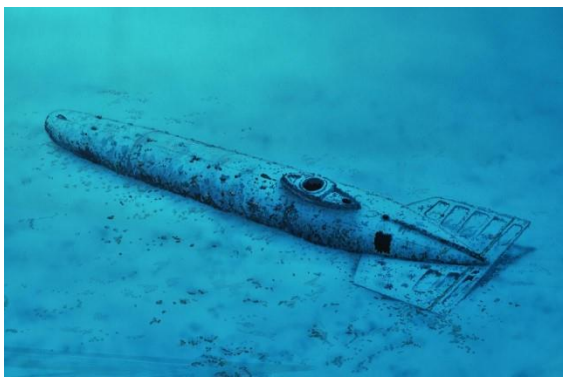



# NORTHERN ADRIATIC IRON WRECKS

ECOMAP **W 1**, Molch, singleseater mini-submarine – Friuli Venezia Giulia
ECOMAP **W 2**, B24, aicraft, heavy bomber - Friuli Venezia Giulia
ECOMAP **W 3**, 88S, torpedo boat - Veneto
ECOMAP **W 4**, 5PN, torpedo boat - Veneto
ECOMAP **W 5**, Quintino Sella , destroyer - Veneto
ECOMAP **W 6**, Amalfi, armored cruiser - Veneto
ECOMAP **W 7**, Beams 2053, mine sweeper – Emilia Romagna
ECOMAP **W 8**, B24, aircraft, heavy bomber – Emilia Romagna
ECOMAP **W 9**, CB 17, submarine - Marche


# Molch, Sistiana (TS)



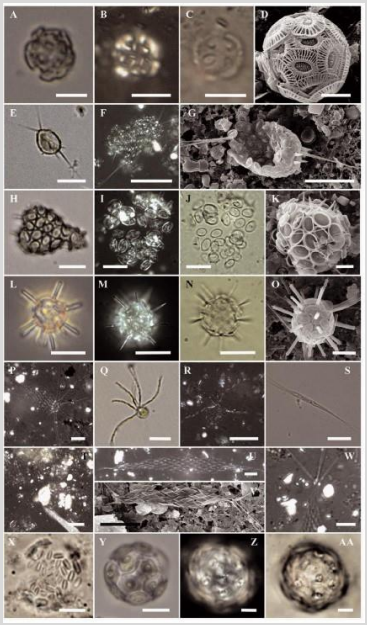


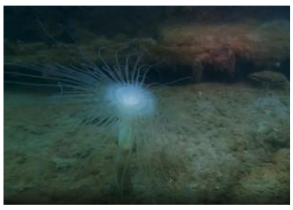

Interreg
Italy - Croatia
ECOMAP
EUROPEAN UNION

## Micrographs of some heterococcolithophores at microscope

- AeD: Emiliania huxleyi;
- EeG: Acanthoica quattrospina;
- HeK: Syracosphaera pulchra;
- LeO: Rhabdosphaera clavigera var.stylifera;
- P: Calciopappus rigidus;
- QeR: Ophiaster hydroideus;
- SeT: Calciosolenia brasiliensis;
- U: C. corsellii;
- Ve -W: C. murrayi;
- X: Algirosphaerarobusta;
- Y-AA: Calcidiscus leptoporus.

(Cerino *et alii* 2017)





## W1 – Molch (Sistiana – TS)


# W2 - B24 (Grado – TS)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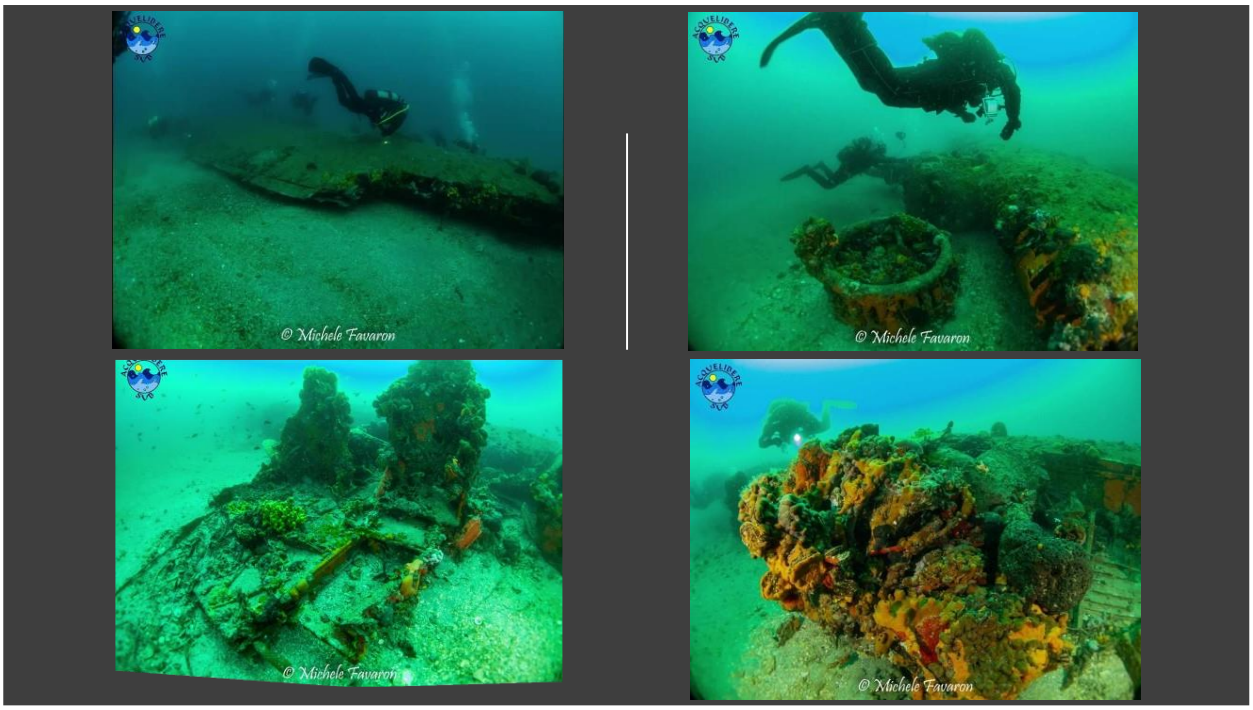
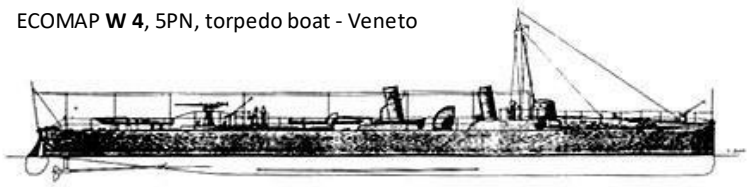
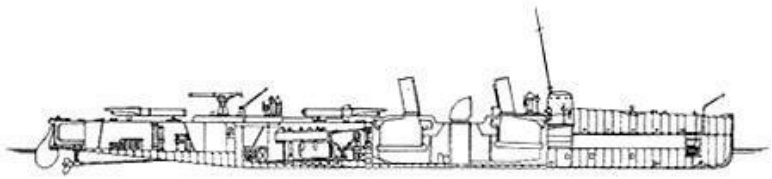
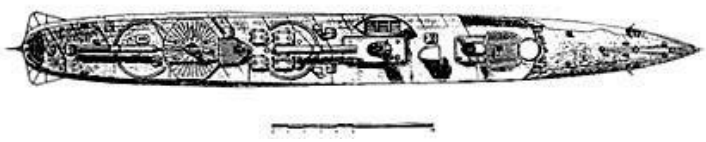

© Michele Favaron
© Michele Favaron
© Michele Favaron
© Michele Favaron

ECOMAP **W3** - torpedo boat 88-S of the Regia Marina

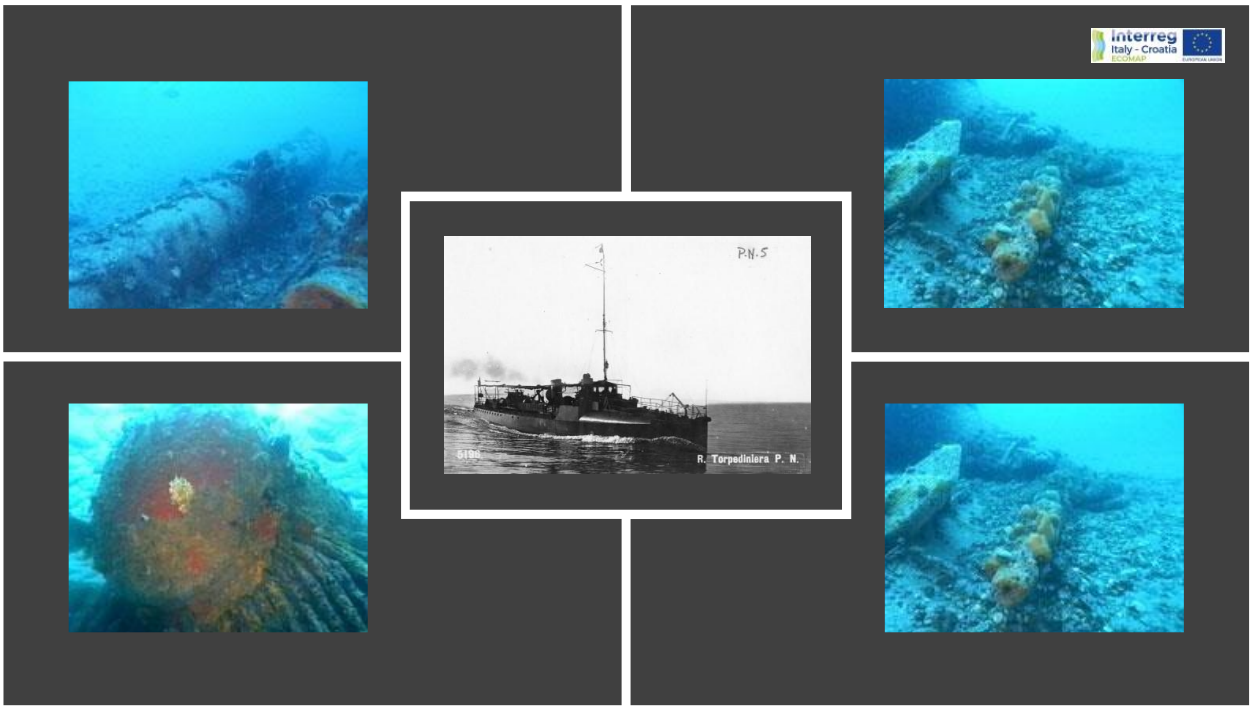
ECOMAP **W 4**, 5PN, torpedo boat - Veneto

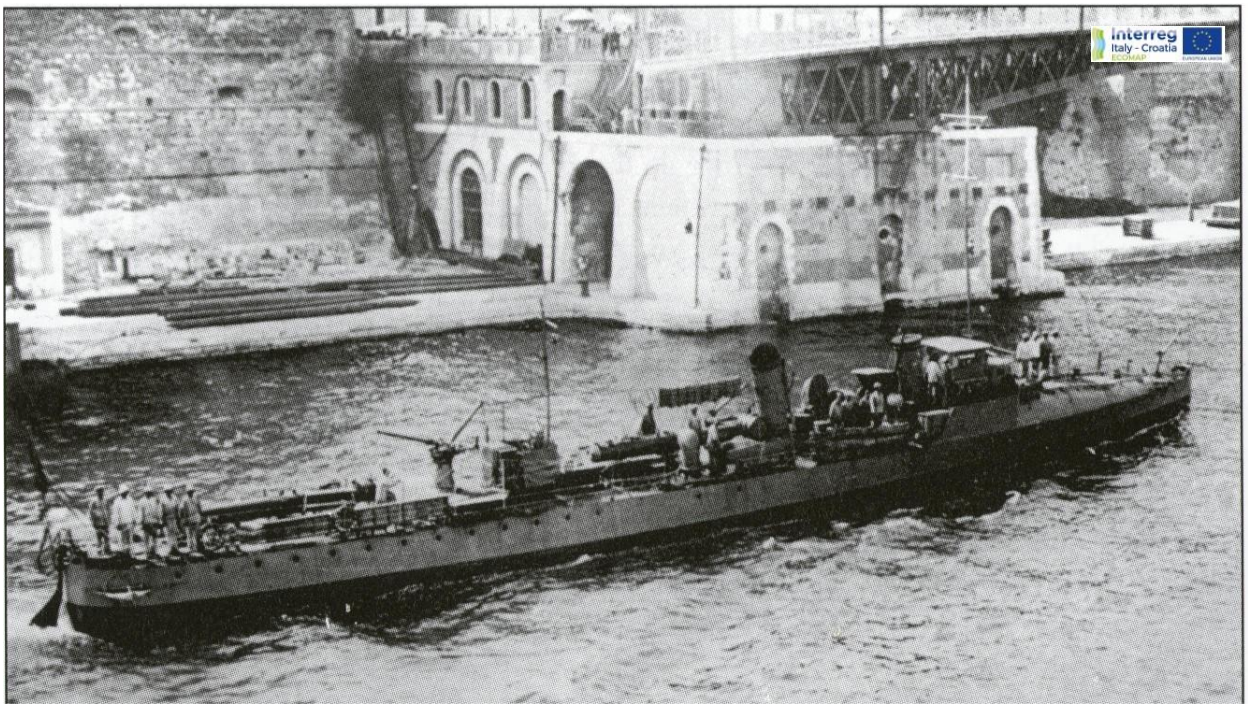




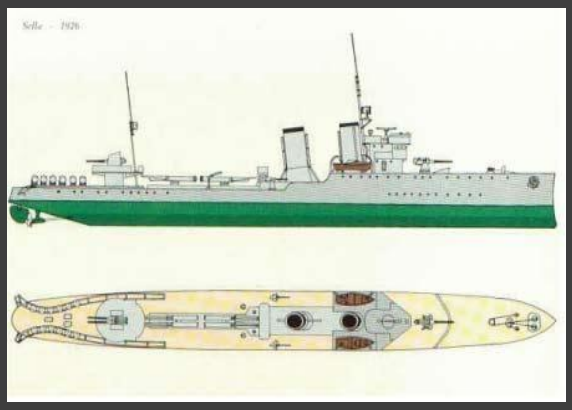


https://www.arpa.veneto.it/acqua/venetodamare/02_fruitori_02_sub_scheda_5pn.htm


P.N.5
R. Torpediniera P. N.

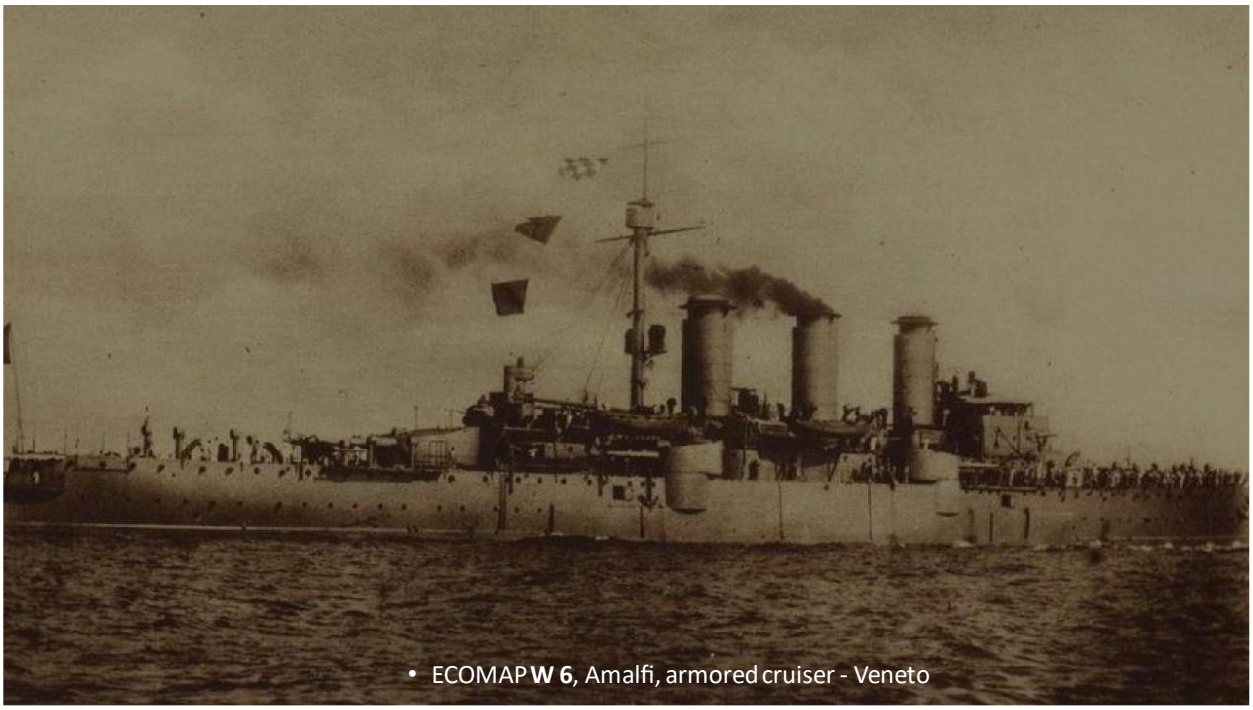


# QUINTINO SELLA




ECOMAP **W 5**, Quintino Sella , destroyer– Veneto - http://win.argovenezia.it/sella.html


MUSEO STORICO NAVALE
Quel portolano è un tesoro storico
Consegnato il libro che affondò con il "Quintino Sella"
Un momento della cerimonia di consegna del portolano
https://www.underwaterphotovenice.it/portolano-del-cacciatorpediniere-quintino-sella/



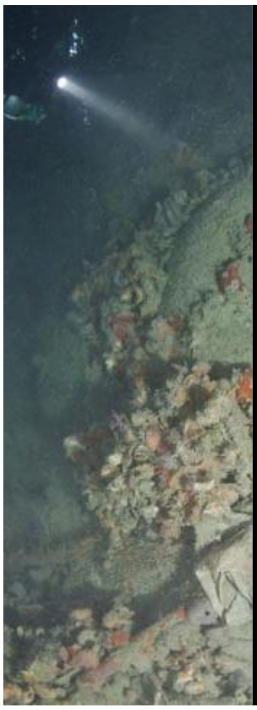
• ECOMAP **W 6**, Amalfi, armored cruiser - Veneto


https://geo.regione.emilia-romagna.it/cartografia_sgss/user/viewer.jsp?service=costa

# ECOMAP W8 - B24 Rimini (RN)

B24, Rimini – Dive Planet (S. Paganelli)

# B24, Rimini – Dive Planet (S. Paganelli)

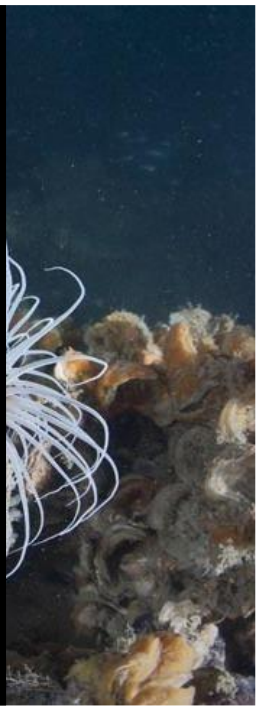


## B24, Rimini

- wheel

Dive Planet (S. Paganelli)

## B24, Rimini



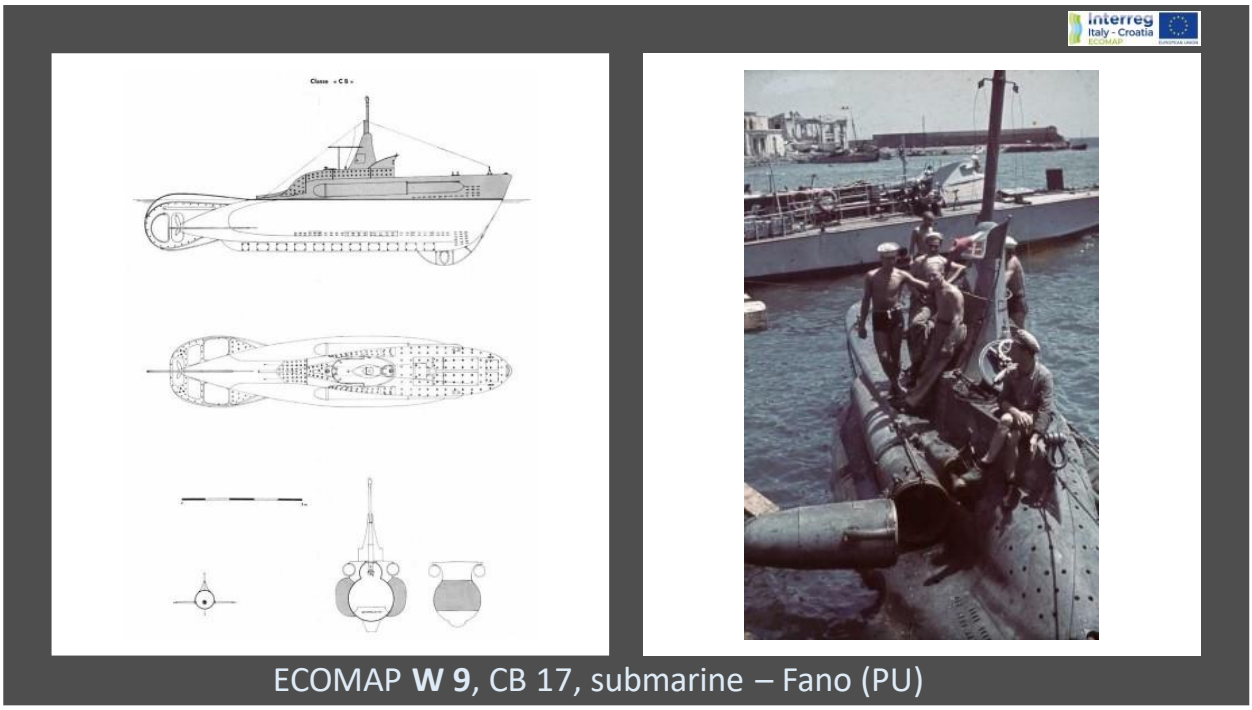
- Cerianthus membranceus

(S.Paganelli)

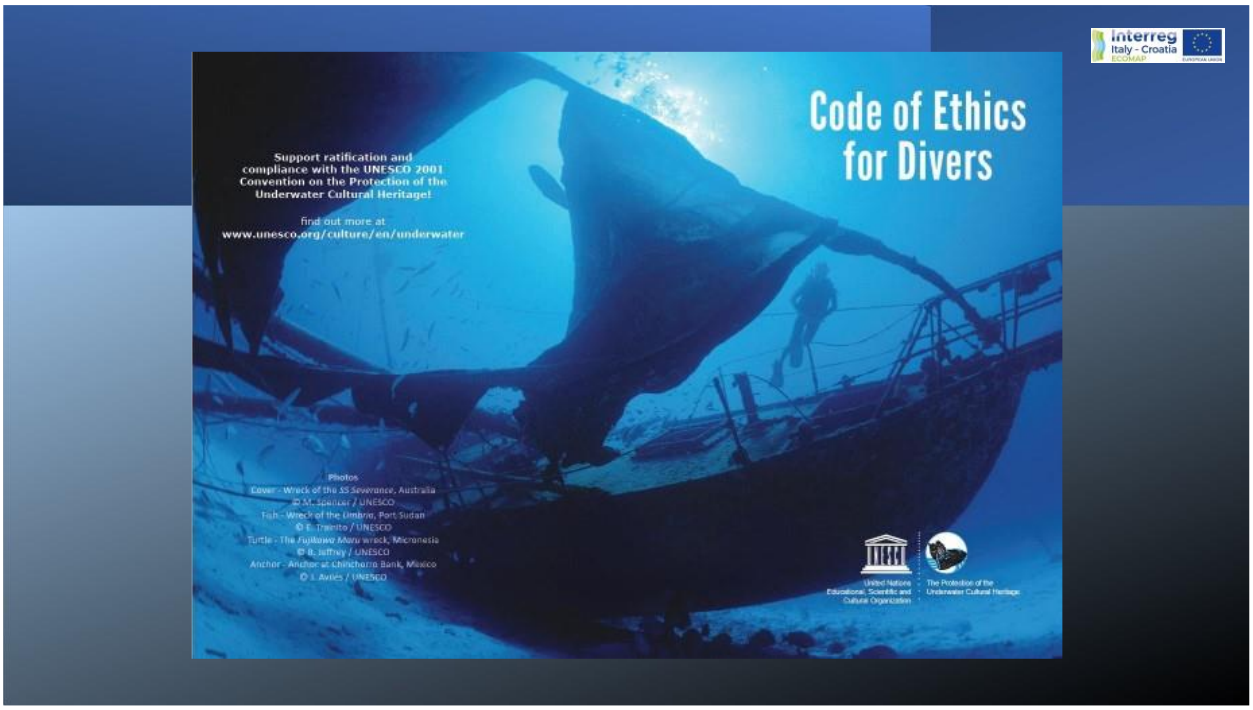

Stefano Paganelli


B24, Rimini
• Tek diving


Stefano Paganelli

ECOMAP **W 9**, CB 17, submarine – Fano (PU)




# Protection of the Underwater Cultural Heritage

The Underwater Cultural Heritage

is the witness of our common memory, for several millennia.

The oceans, seas, lakes and rivers hide from view and protect under the surface a priceless heritage, largely unknown and underestimated.

https://en.unesco.org/underwater -heritage

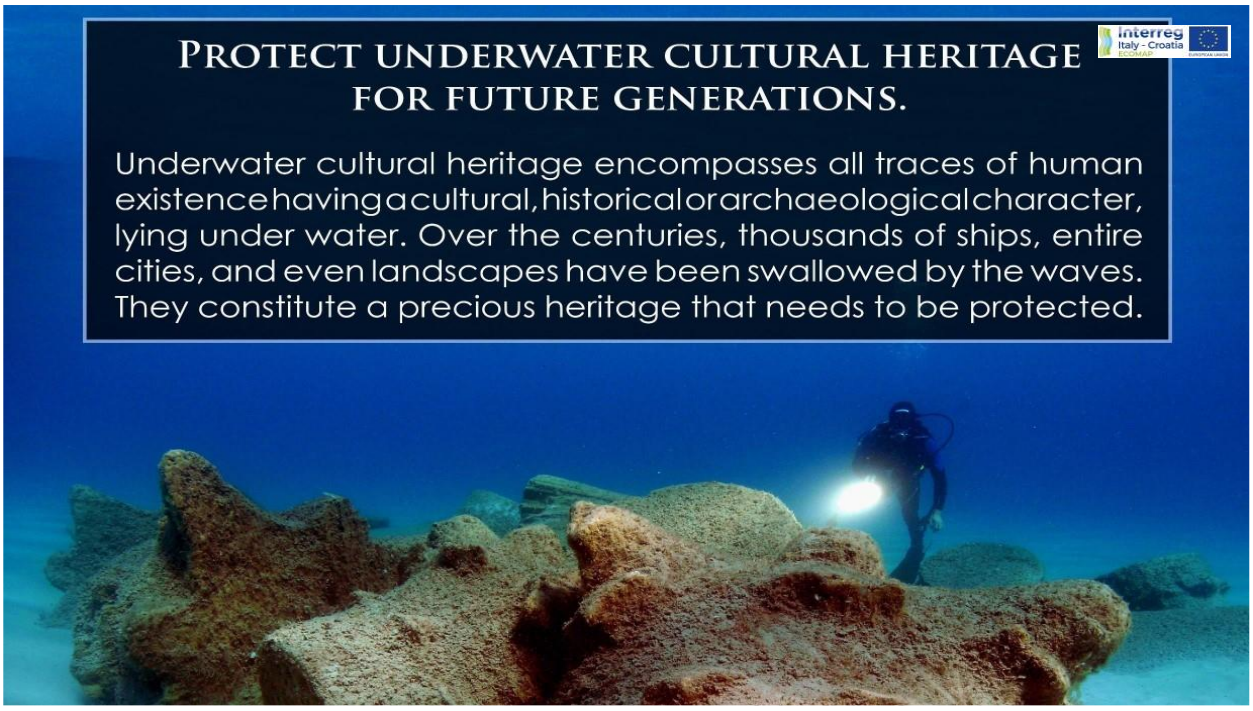
Interreg Italy - Croatia ECOMAP EUROPEAN UNION

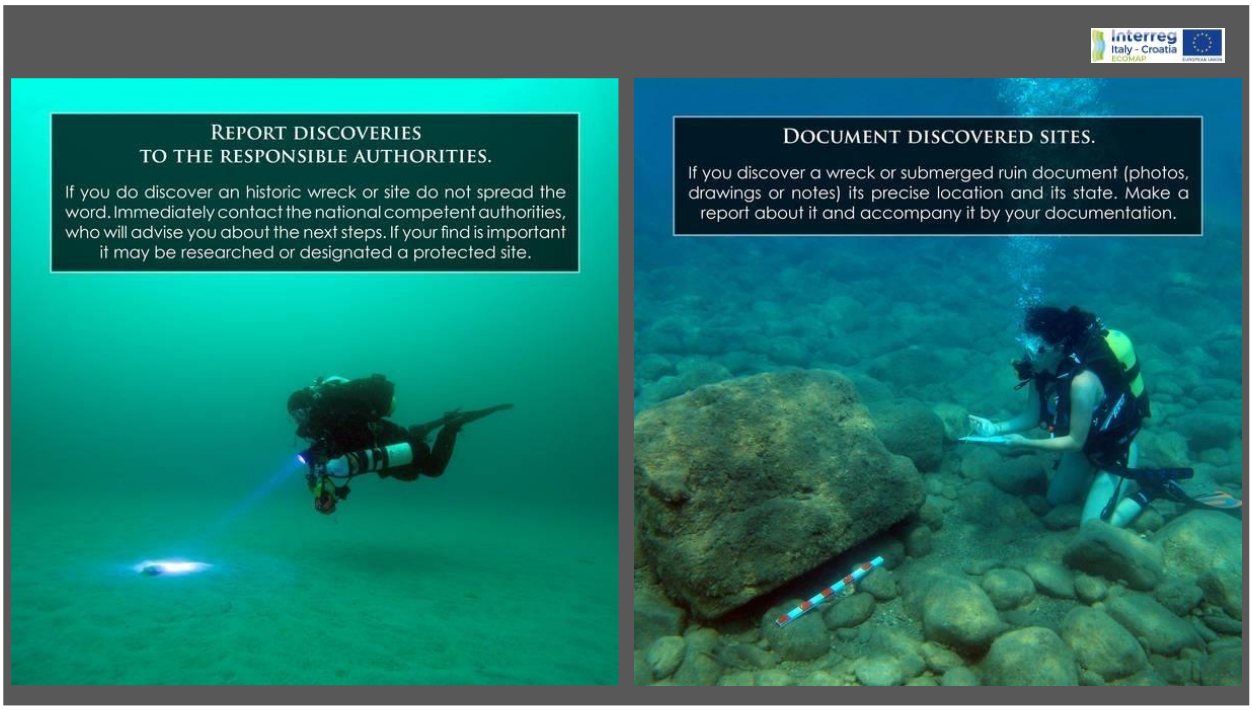
UNESCO and CMAS collaborate in the protection of the underwater cultural heritage

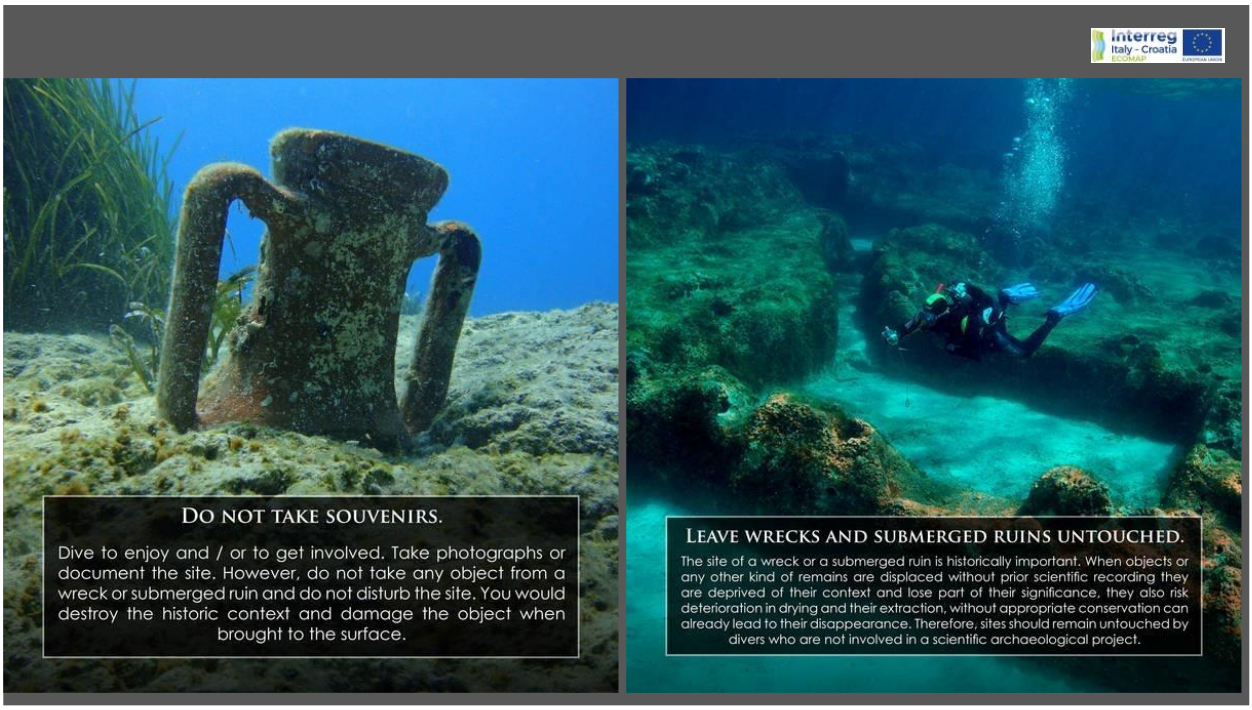
CMAS DIVERS COMMUNITY FEDERAZIONE ITAF07 CDC ITALIA CMAS

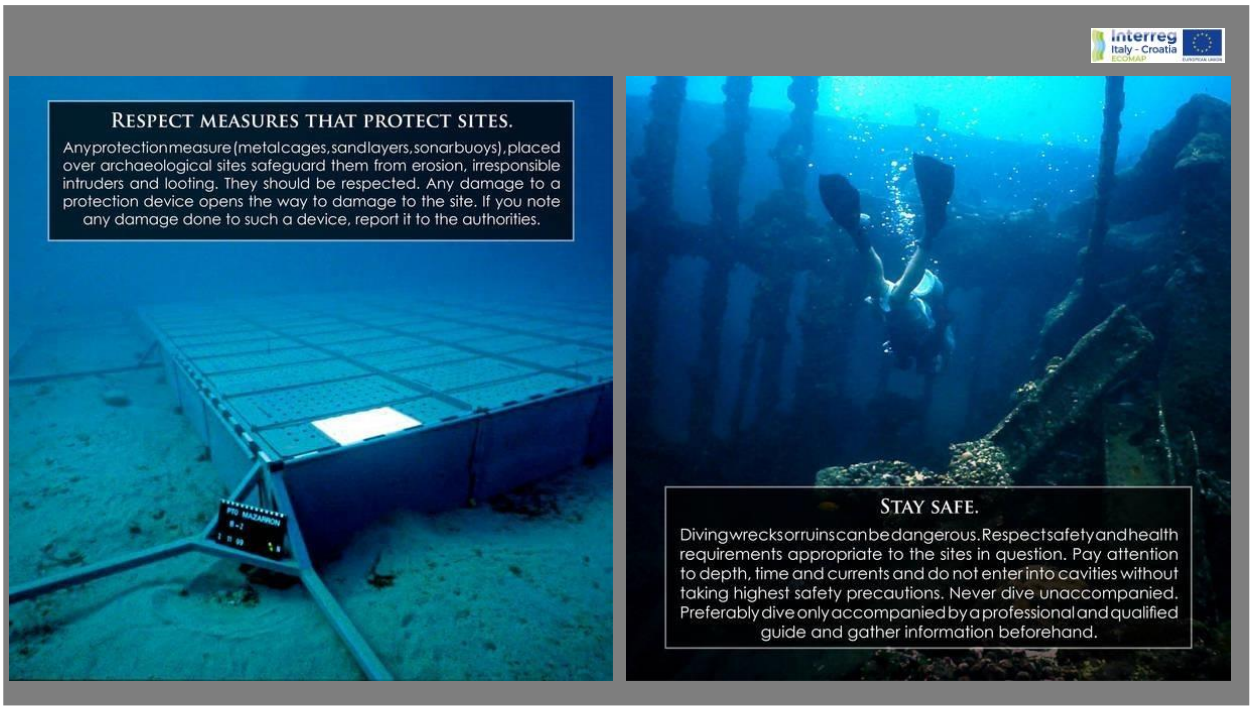
# CODE OF ETHICS

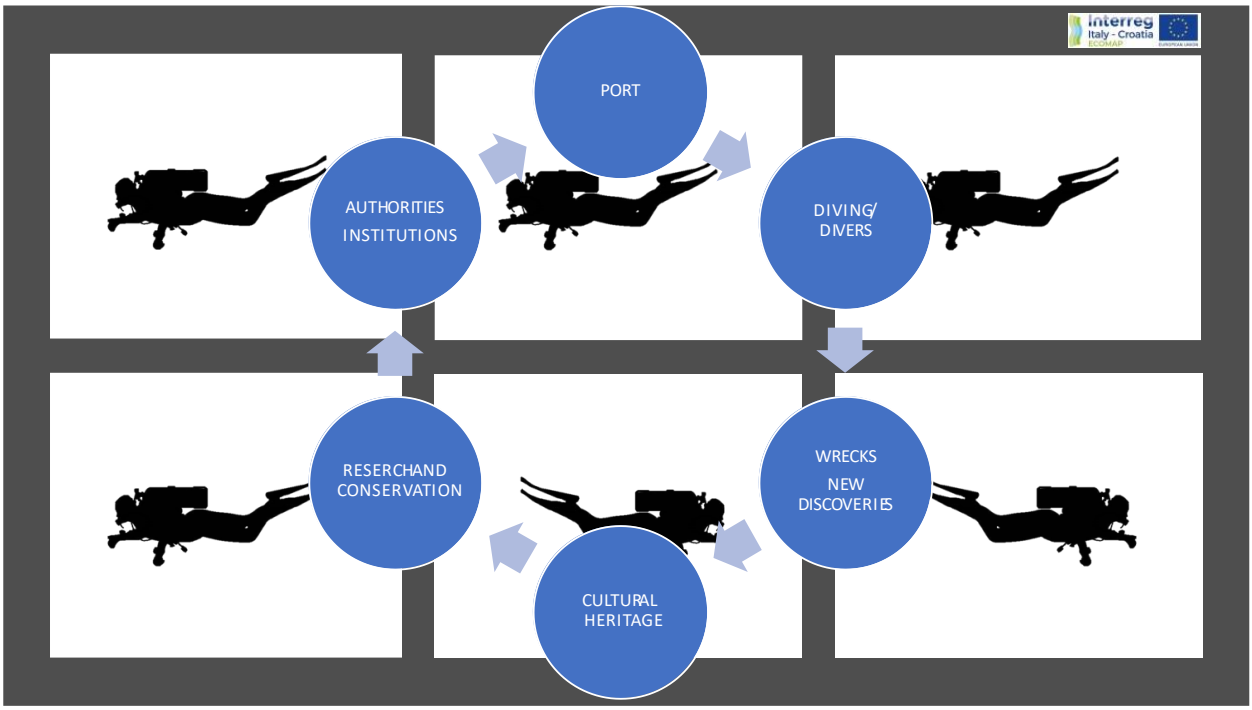
- **1.5 Environment**
- The CMAS is committed to raise environmental performance of underwater sports and activities and make them a vector of
- environmental protection and sustainable development.
- CMAS looks to youth to breed a future for sportsmanship and safety while nurturing a passion and respect for water and its environment.
- The CMAS will promote the optimal use of resources and materials, efficient logistics and transport, reduction of polluting
- discharges to water and emissions to air.




REPORT DISCOVERIES
TO THE RESPONSIBLE AUTHORITIES.
If you do discover an historic wreck or site do not spread the word. Immediately contact the national competent authorities, who will advise you about the next steps. If your find is important it may be researched or designated a protected site.
DOCUMENT DISCOVERED SITES.
If you discover a wreck or submerged ruin document (photos, drawings or notes) its precise location and its state. Make a report about it and accompany it by your documentation.


DO NOT TAKE SOUVENIRS.
Dive to enjoy and / or to get involved. Take photographs or document the site. However, do not take any object from a wreck or submerged ruin and do not disturb the site. You would destroy the historic context and damage the object when brought to the surface.
LEAVE WRECKS AND SUBMERGED RUINS UNTOUCHED.
The site of a wreck or a submerged ruin is historically important. When objects or any other kind of remains are displaced without prior scientific recording they are deprived of their context and lose part of their significance, they also risk deterioration in drying and their extraction, without appropriate conservation can already lead to their disappearance. Therefore, sites should remain untouched by divers who are not involved in a scientific archaeological project.


RESPECT MEASURES THAT PROTECT SITES.
Any protection measure (metal cages, sand layers, sonar buoys), placed over archaeological sites safeguard them from erosion, irresponsible intruders and looting. They should be respected. Any damage to a protection device opens the way to damage to the site. If you note any damage done to such a device, report it to the authorities.
STAY SAFE.
Diving wrecks or ruins can be dangerous. Respect safety and health requirements appropriate to the sites in question. Pay attention to depth, time and currents and do not enter into cavities without taking highest safety precautions. Never dive unaccompanied. Preferably dive only accompanied by a professional and qualified guide and gather information beforehand.


PORT
AUTHORITIES
INSTITUTIONS
DIVING/
DIVERS
RESERCHAND
CONSERVATION
WRECKS
NEW
DISCOVERIES
CULTURAL
HERITAGE

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Michele Favaron, Acquelibere Sub, Padova

Stefano Paganelli, Dive Planet, Rimini

Code of ethics: https://en.unesco.org/underwater-heritage

**Music**

audiohub_2015-00211-237_fantasy-world_creative-commons

**Video editing**

Giovanna Bucci

## Conclusions

As results of diverse interactions between interested "blue" stakeholders (any bodies that may have interest in the maritime sector) gathered at the FORUMs, regional working groups, partners and experts' intense cooperation have brought in the field of biodiversity research & innovation thematic, underwater heritage, relevant and potential subaqueous virtual tours that divers and divers-to-be may accomplish in the Adriatic Sea. At the same time, presenting and discussing these topics into well-known territorial forums that deal normally with blue growth topics has been enriching and valuably useful for all the stakeholders that have recently approach into the sustainability and blue growth ways of thinking their commercial and entrepreneurship realities. This brought also a great boast on the regional and local governance to improve and revise politics and territorial plans in a strategic perspective.