Strategie innovative, Monitoraggio ed Analisi del rischio di Erosione costiera: il progetto STIMARE

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COAST

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RemTech Expo 2019 (18, 19, 20 Settembre) FerraraFiere

www.remtechexpo.com

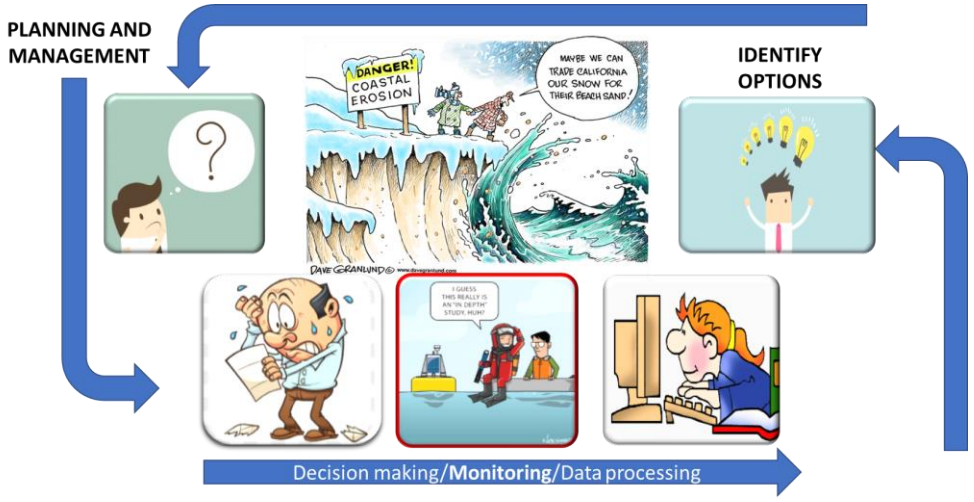
RISK MANAGEMENT

AIM → **MINIMIZE POTENTIAL HARM, LOSS AND DAMAGE DUE TO COASTAL HAZARD**

Risk management

- Risk assessment
- Implementation of strategies and actions

COASTAL ZONES MANAGEMENT



Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

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https://site.unibo.it/stimare/it

Innovative Strategies, Monitoring and Analysis of the Coastal Erosion Risk

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

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UNIVERSITÀ DI BOLOGNA

Politecnico di Bari

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UNIVERSITÀ DI BOLOGNA

Politecnico di Bari

RESEARCH GROUP

The Project has a strong interdisciplinary approach, involving **coastal engineers, urban planners, geologists, ecologists and mechanical engineers.**

Renata Archetti, Augusto Bianchini, Claudia Romagnoli, Marco Abbiati, Fabio Addona, Laura Airoldi, Luigi Cantelli, M. Gabriella Gaeta, Massimo Guerrero, Marco Pellegrini, Cesare Saccani, Leonardo Damiani, Angela Barbanente, Alessandra Saponieri, Vincenzo Simeone, Eufemia Tarantino, Mirko Saponaro, Maria Francesca Bruno, Angelo Doglioni, Giulia Motta Zanin, Luigi Pratola, Matteo Gianluca Molfetta

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OBJECTIVES

MAIN AIM: to define strategies for coastal management, based on a strong involvement of the stakeholders, in order to:

- protect coasts and increasing their value
- create synergies between research and territory and develop shared and innovative strategies for coastal management defense

Methodology based on

- Field monitoring
- Ecological monitoring
- Risk analysis/risk perception
- Laboratory physical modelling
- Numerical modelling

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OBJECTIVES

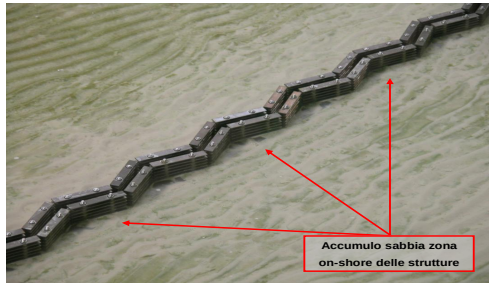
Risk analysis (review of existing indicators and models, analysis of new indicators, CVI, CEI, RI calculations)

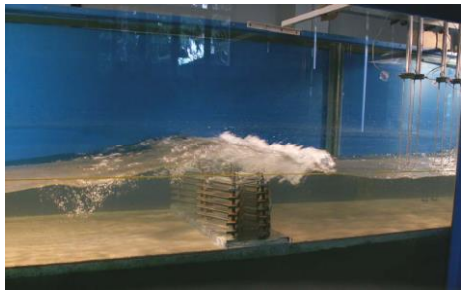
Deepining of **alternative and low-environmental impact strategies** for coastal defense against erosion (BDS, geo tubes, Ejectors, WMESH

Development of **low-cost monitoring methodologies** and instruments in order to encourage a Coastal Observatory (e.g. slow-cost video stations, UAVs, thermo/infrared cameras for low visibility conditions)

Optimization of defense systems in order to **minimize the effects on coastal ecosystems** and preserve coastal environment quality, according to the Marine Strategy Directive

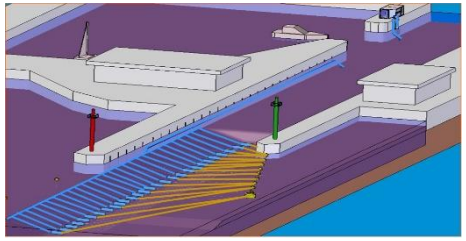
Numerical modelling of both hydrodynamic and morphodynamic processes by assimilating the aquired data





WMESH

VIDEO STATIONS



EJECTORS

BDS

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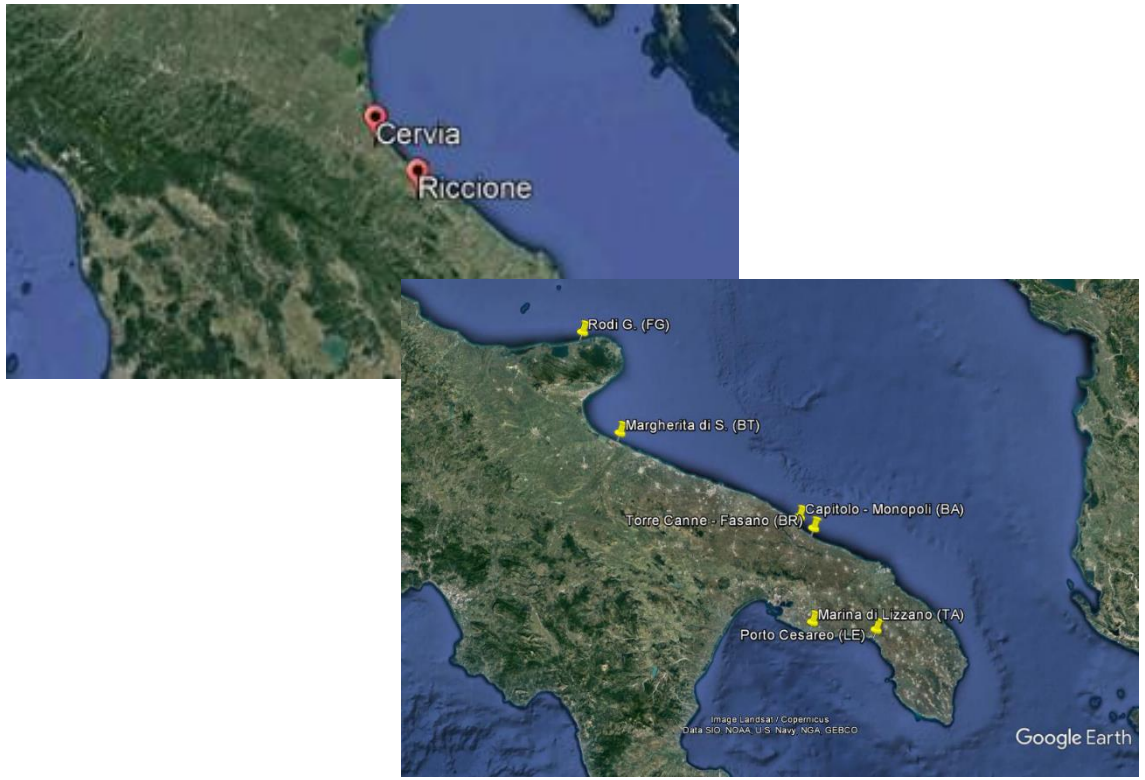
AREAS OF STUDY



The case study sites are chosen on the coast facing Adriatic Sea, in the Mediterranean Sea in Italy.

Two of the study cases are in the **Emilia Romagna** region, **Cervia** and **Riccione** (North Italy), and the third, **Margherita di Savoia**, in the **Apulia** region (South Italy).

The selection was driven by the occurrence of **unconventional solutions** in place and/or by the **strong interest** that the coastal management plays for the local economy.

- **Riccione:** littoral system affected by strong sediment transport and erosive processes. Net sediment transport S to N. Coastline protected by sandbags, reef-balls and WMESH.
- **Cervia:** Net sediment transport N to S. Harbor siltation and southern beach erosion. Innovative plant for sediment undersea transport (“ejectors”).
- **Margherita di Savoia:** shoreline regression downdrift of the harbor breakwaters and flooding hazard affecting inlands areas.
- **Monopoli:** strong sediment transport due to wave action

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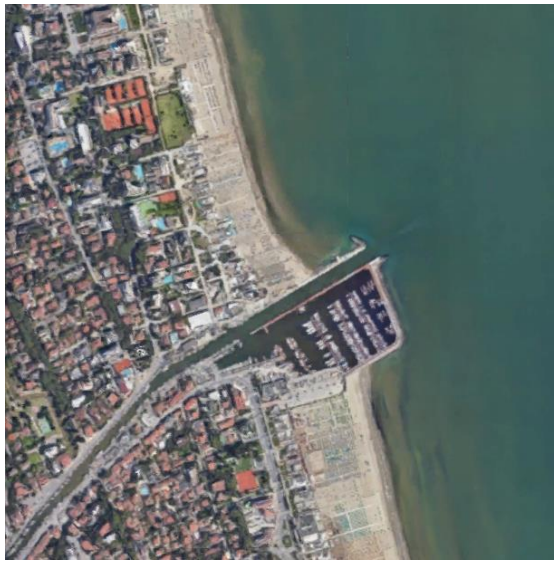
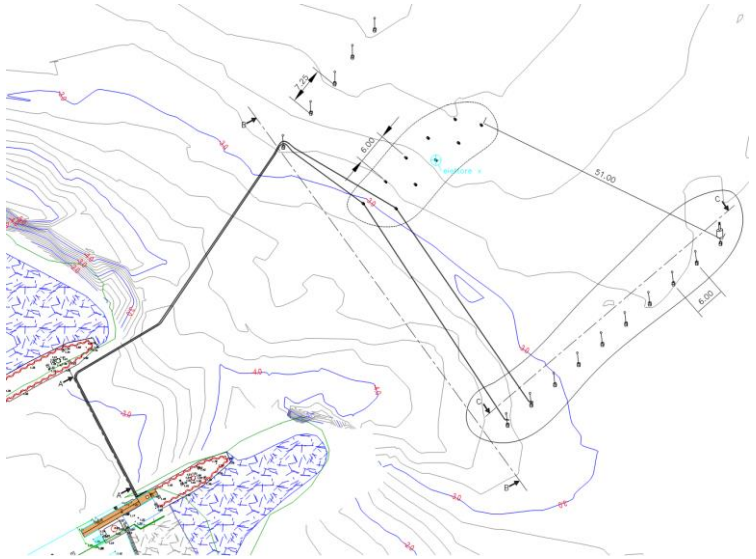
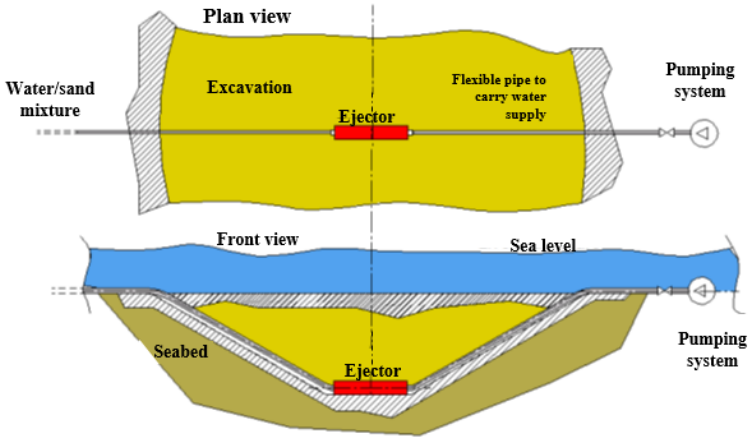
Cervia

FIELD INTERVENTIONS

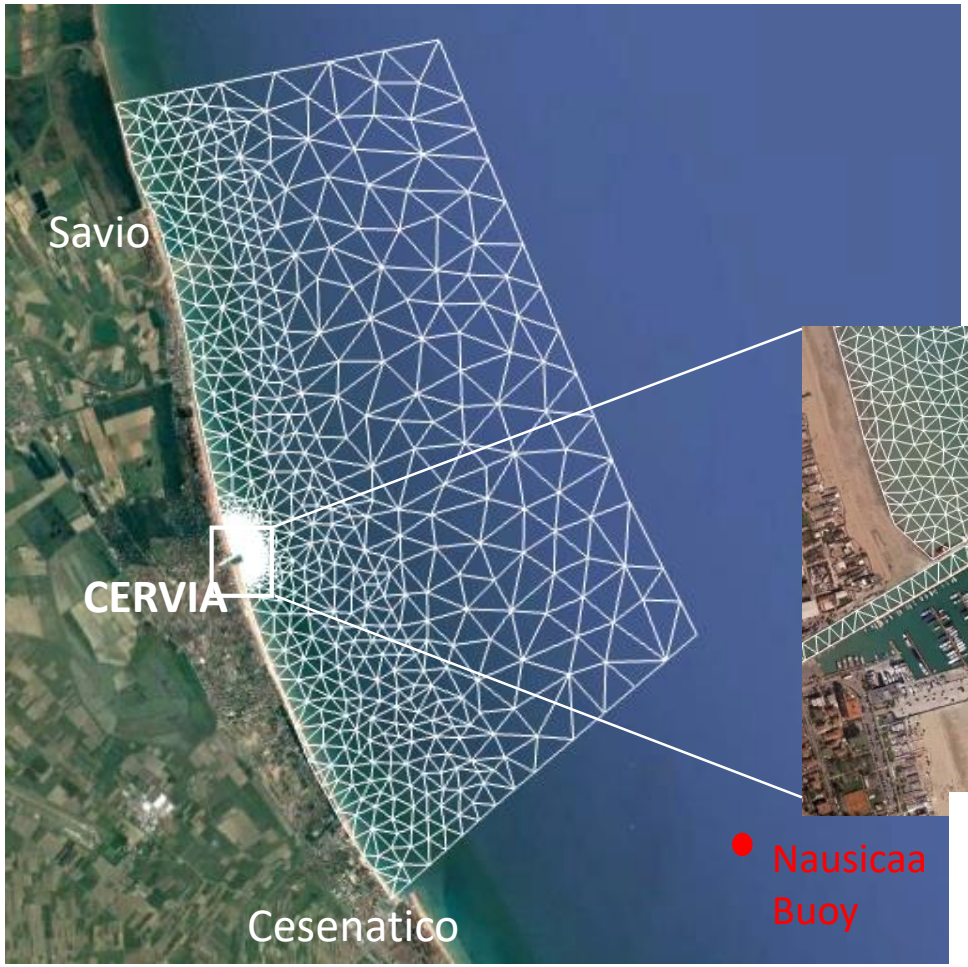
Cervia: installation of a plant for **seabed re-modelling** consisting of a set of devices, called *ejectors* to reduce the sediment accumulation at the entrance of the channel harbor of Cervia



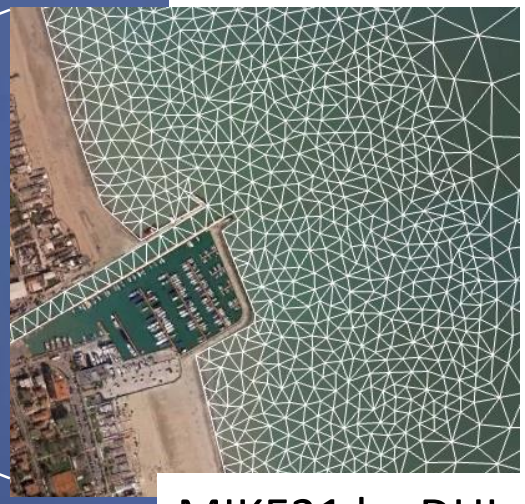


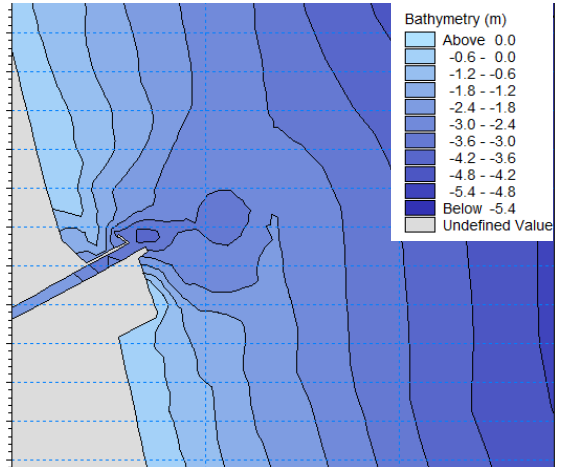


Set-up of the numerical model



Detailed bathymetry of the Cervia port and navigation channel on April, 2019. Two different densities for the resolution of the unstructured mesh: from 5 m (close to the port) up to 200 m (offshore)





MIKE21 by DHI was used to implement the approach and investigate its operational use for the management of the ejectors system.

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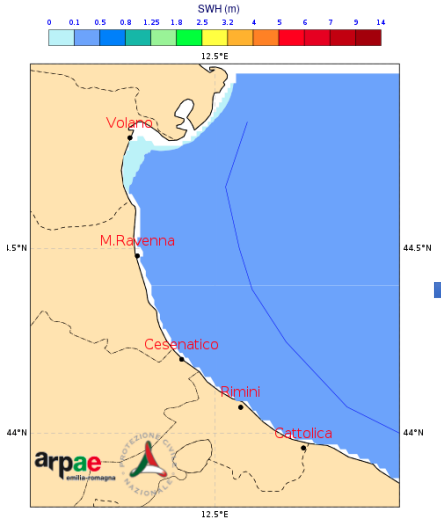
Cervia

FIELD INTERVENTIONS

Cervia: Query algorithm implementation, by means of a Scenarios' based approach for rapid assessment of sea conditions at Cervia port



...
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Hs_Tp_Dirm_WL_Q
...
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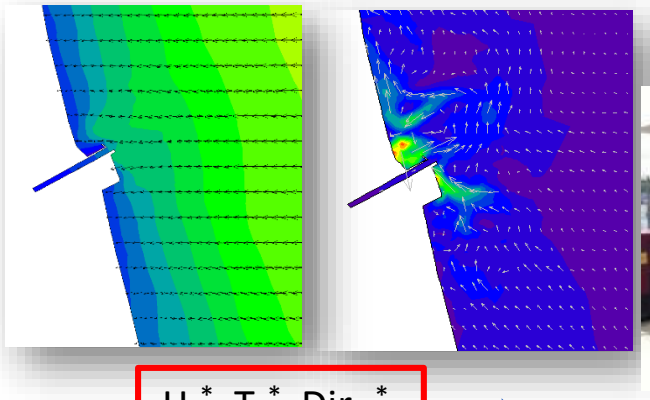
At the port entrance*



H_s^*, T_p^*, Dir_m^*, U^*, dir^*, Q_{ls}^*

Control room of the ejectors

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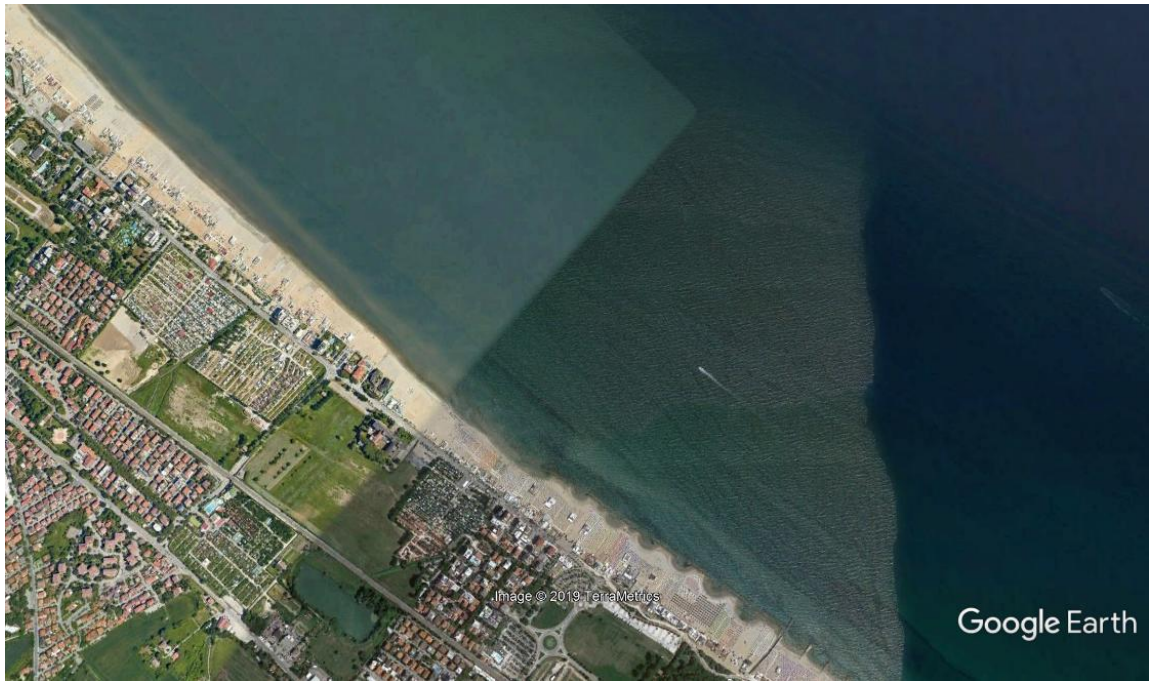
Riccione



Il comune di Riccione ha un fronte mare di 6.200 m diviso in due dal porto di Riccione.
Il tratto a sud del porto, a partire dal confine con Misano, è difeso per 2.800 m da una barriera sommersa in sacchi di sabbia posta a circa 150-180 m dalla battigia, mentre, nei primi 600 m di spiaggia a sud del porto e sulla spiaggia a nord del porto, non sono presenti opere di difesa dal mare.

- trasporto lungocosta S-N
- spiaggia a granulometria sabbiosa fine
- diminuzione apporti sedimento
- litorale privo di opere rigide ma posto sottoflutto rispetto ad altre opere di difesa (2.8 km barriera in sacchi,1983-1998)
- in erosione dagli anni ’70
- area sottoposta a diversi interventi di ripascimento (1983, 2002, 2007, 2016) e monitorata da Arpae.

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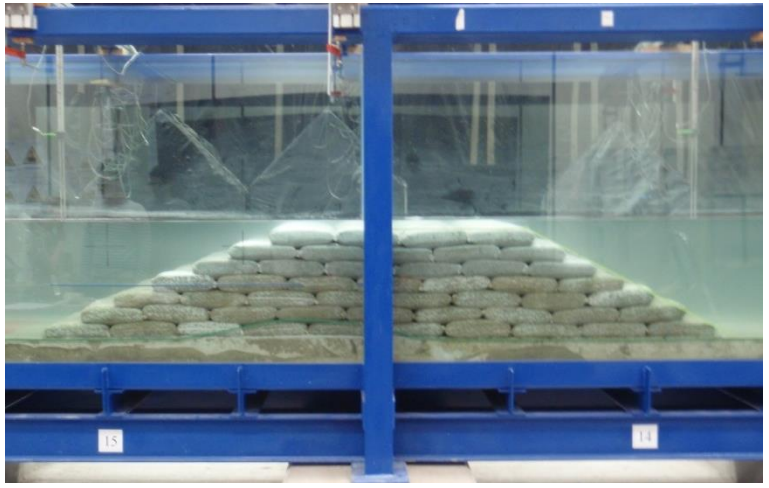
L'INCONTRO CON BLENNIUS E CON IL COMUNE DI RICCIONE

BLENNIUS



Sacchi in sabbia

Reef Ball

WMesh

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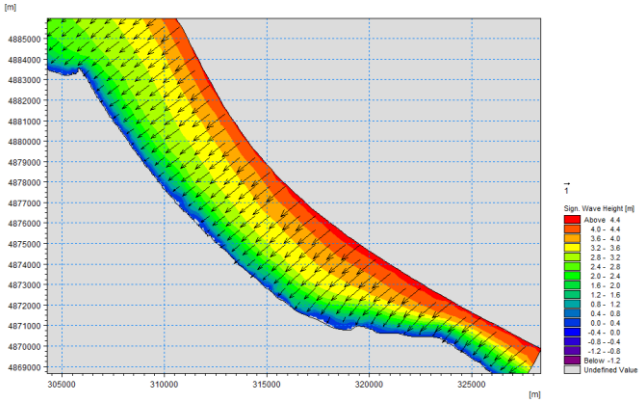
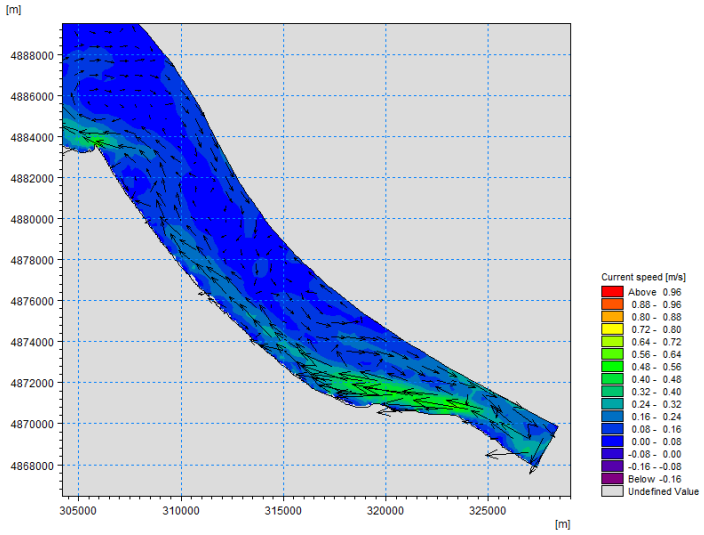
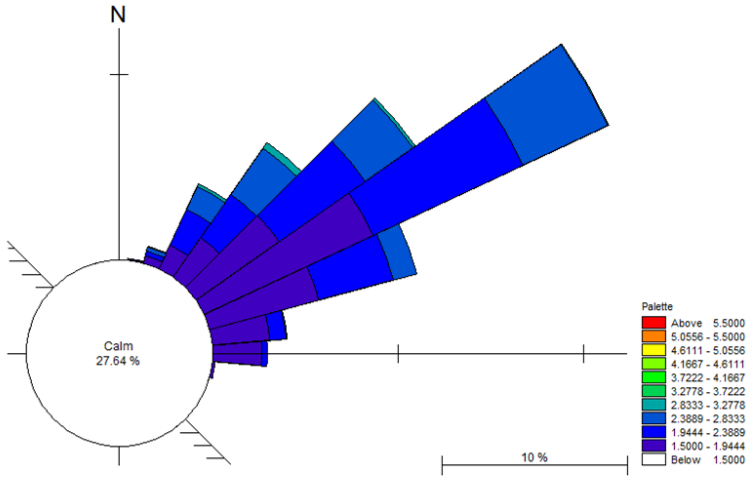
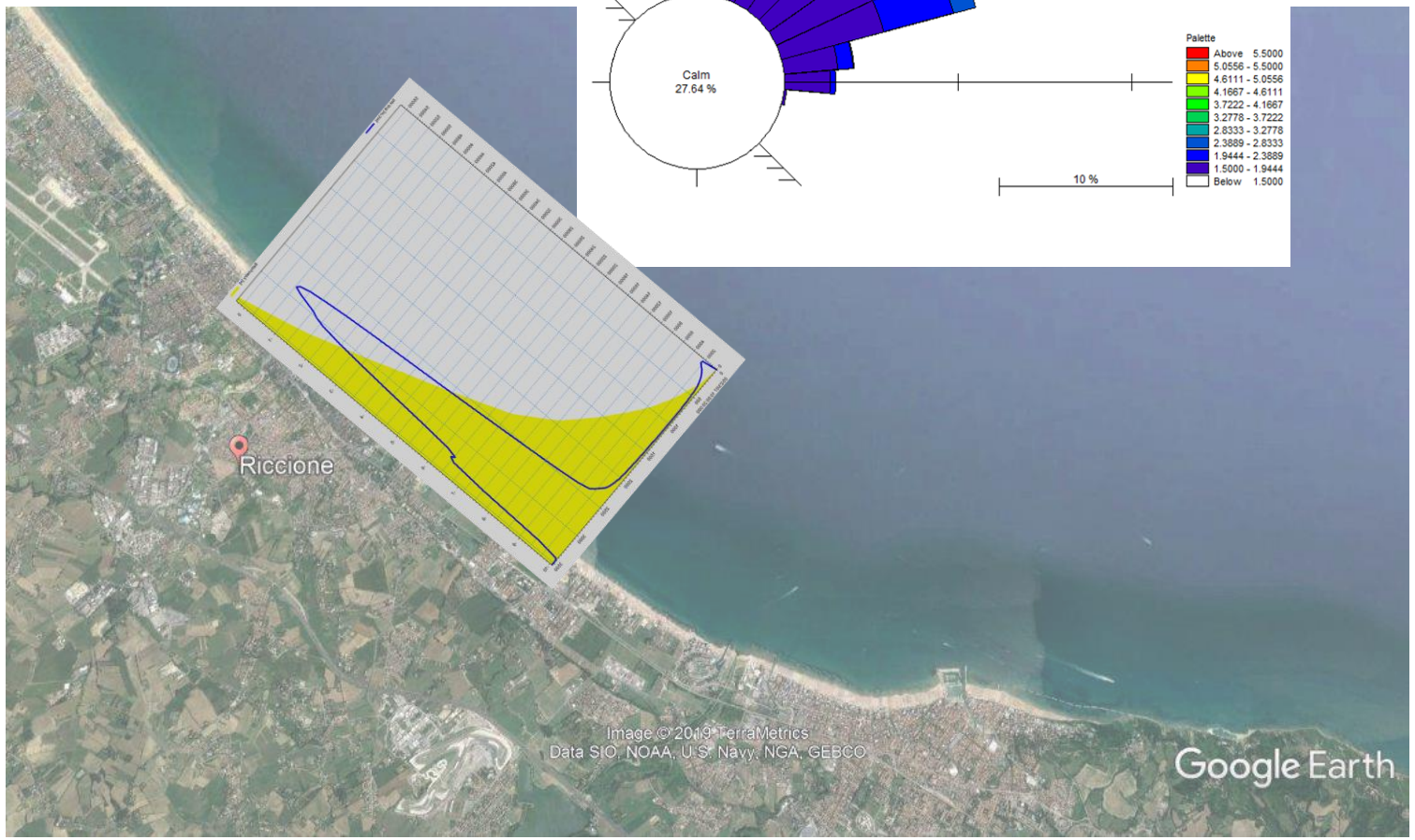
Riccione









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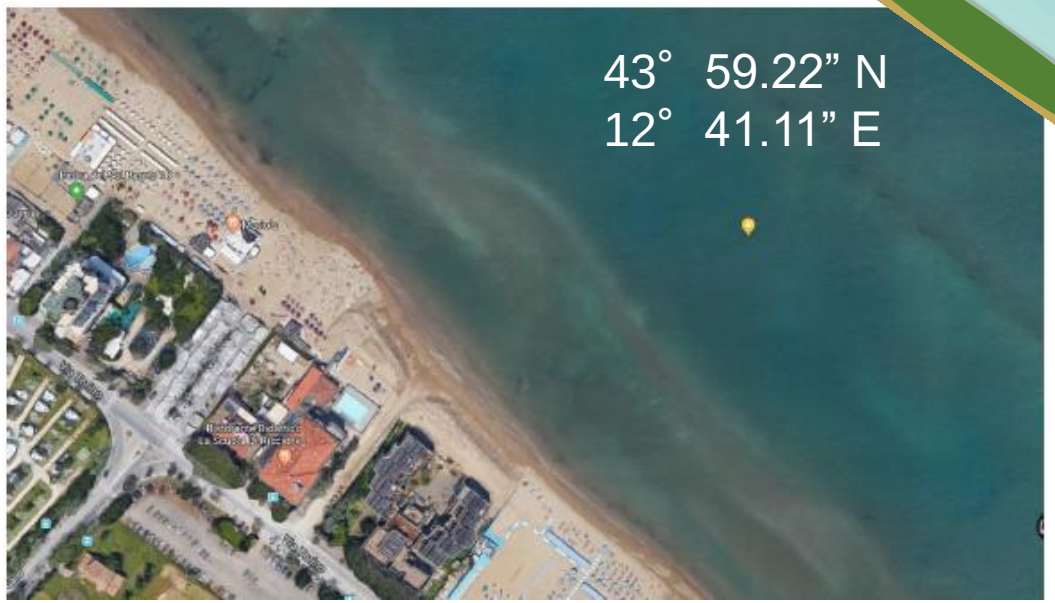
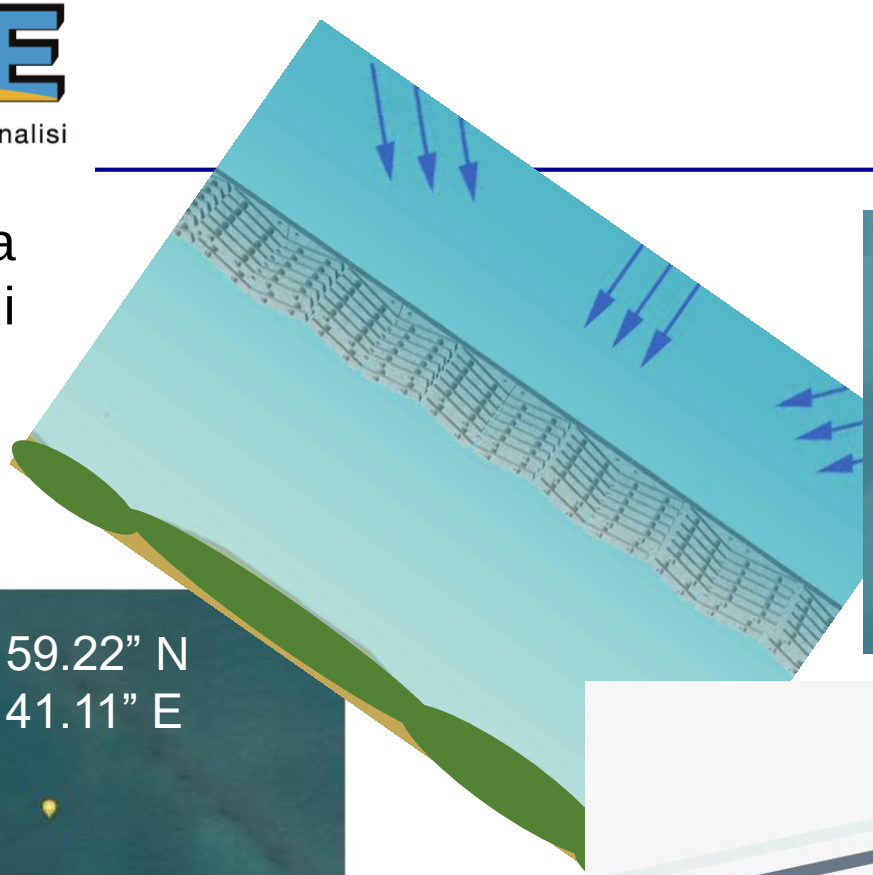
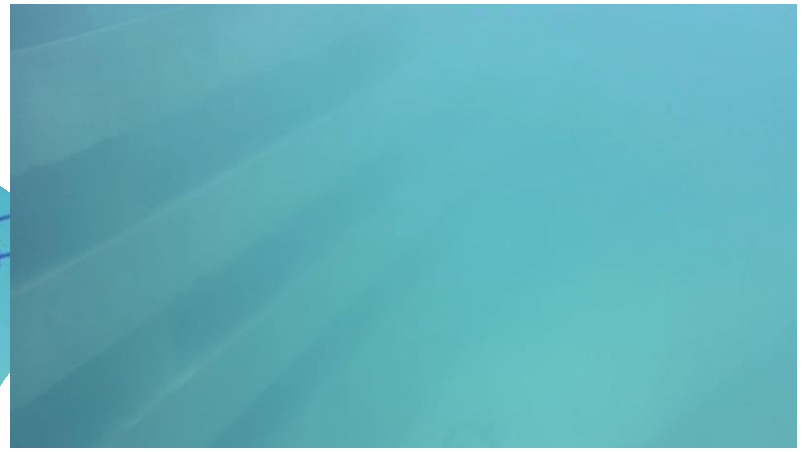
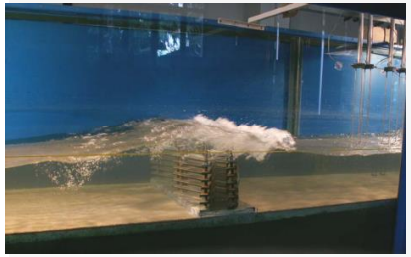
Riccione

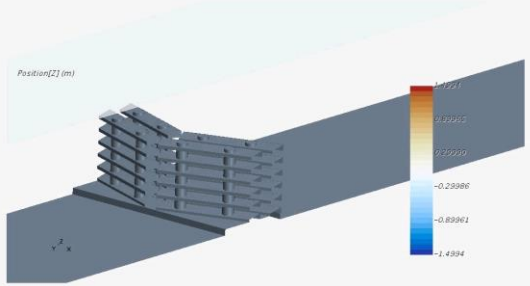
Installazione sperimentale a Riccione di 3 moduli di WMESH
in Maggio 2017
In Aprile 2018









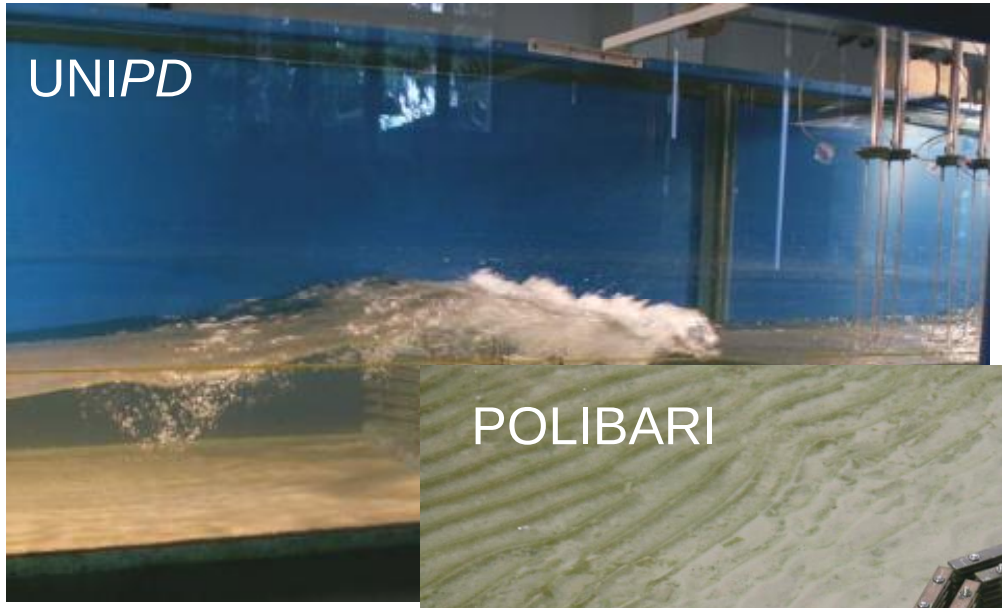


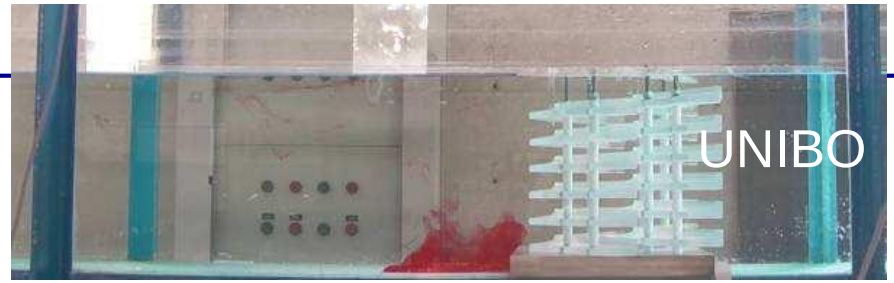
PROGETTAZIONE

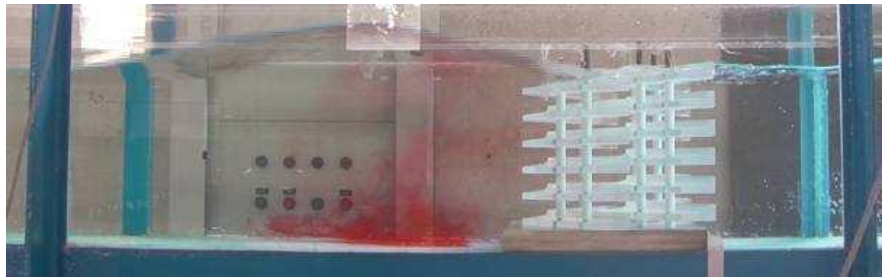
- Coefficiente di trasmissione
- Overtopping
- Permeabilità della struttura (nuova e in esercizio?)
- Effetti sul fontale nearfiled e farfield
- Effetti sulla costa

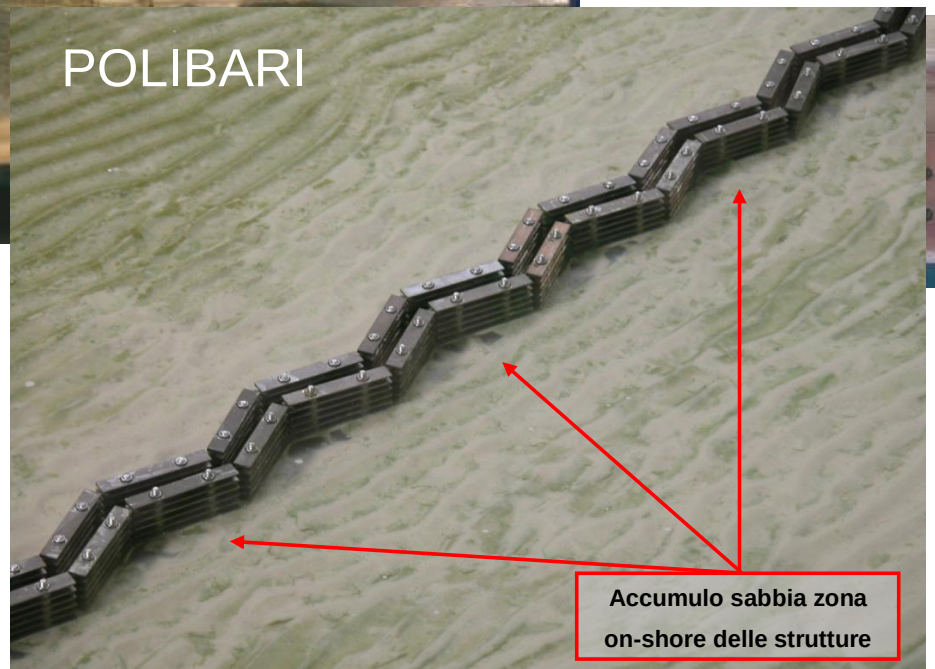
Opere innovative di difesa costiera

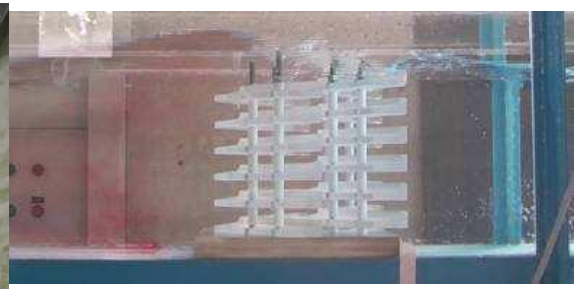
WMesh











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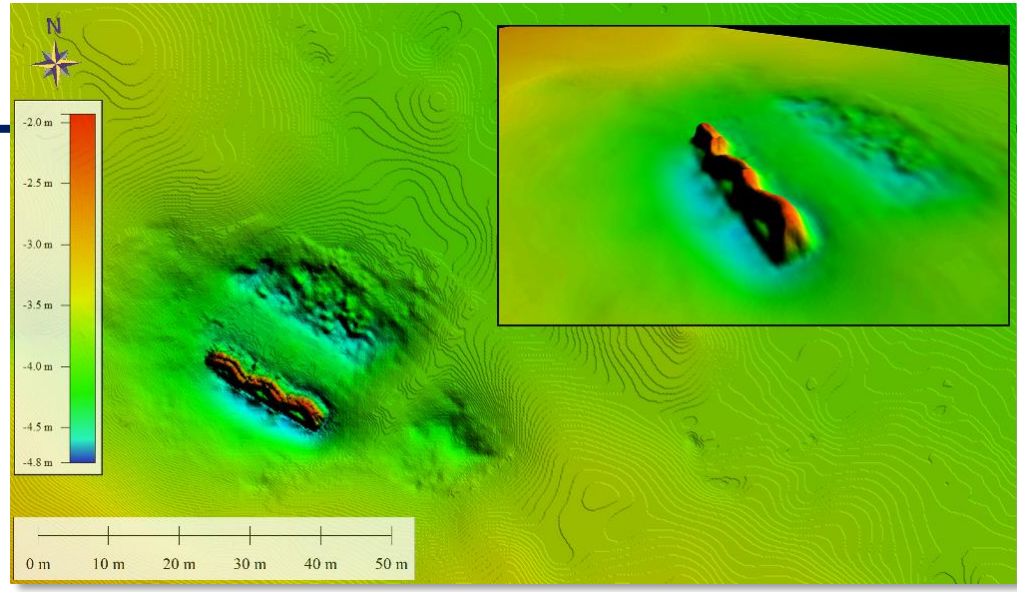
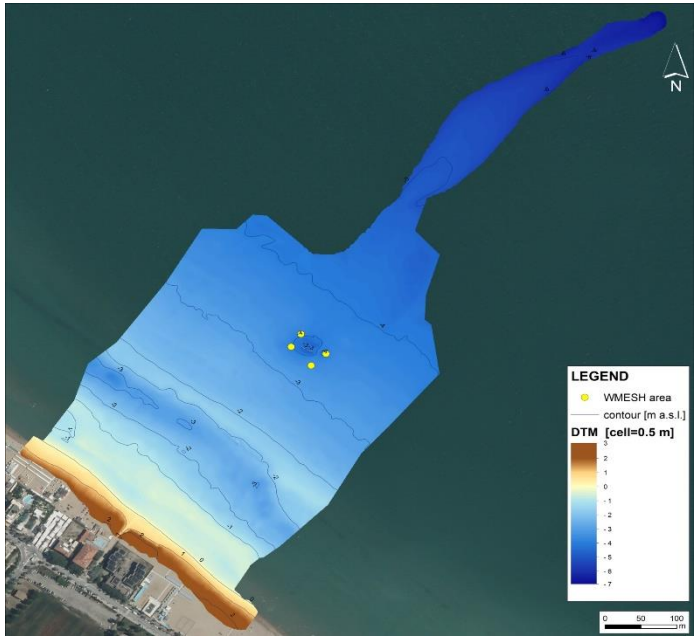
FIELD INTERVENTIONS

Riccione: multi-technique survey for monitoring the short-term beach evolution



- Topographic survey of the emerged beach by means of TLS
- Bathymetric survey by means of multibeam
- Field sampling of sediments, fish fauna and sessile fauna



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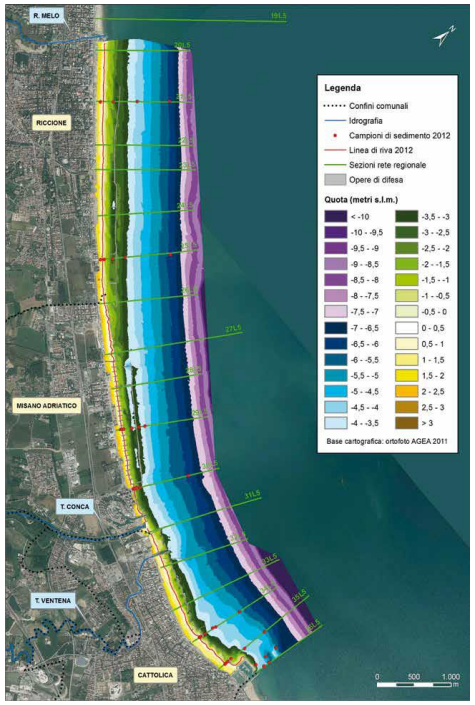
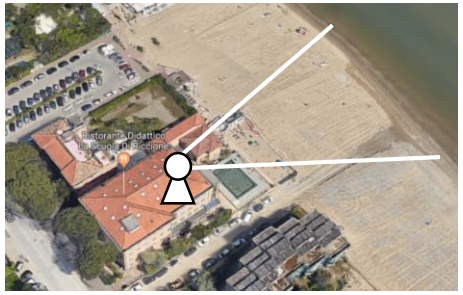
Riccione

FIELD INTERVENTIONS

Riccione: Deployment of a low-cost videomonitoring system July 2019





Raspberry Pi + camera
Resolution : 2 Mpixels (1640 x 1232)
Data rate : 2 Hz.

Shoreline and **transects** acquired with GPS to be compared with image processing

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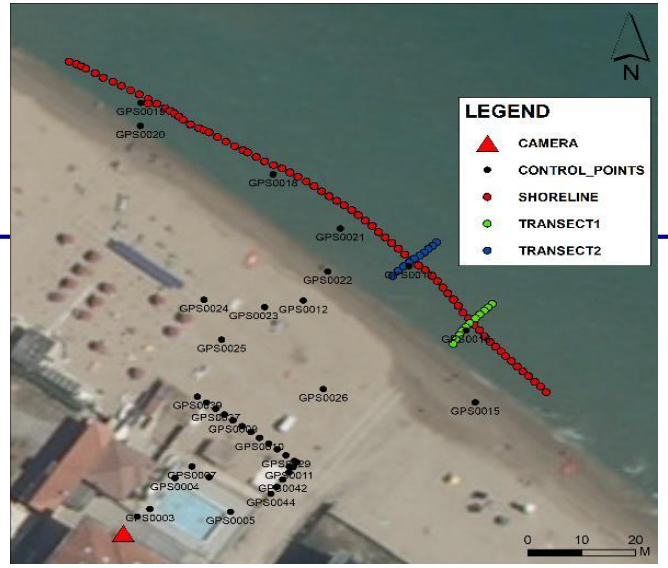
Riccione



Methods

Deployment of a **low-cost videomonitoring system**

Raspberry Pi + camera

Resolution : 2 Mpixels (1640 x 1232)

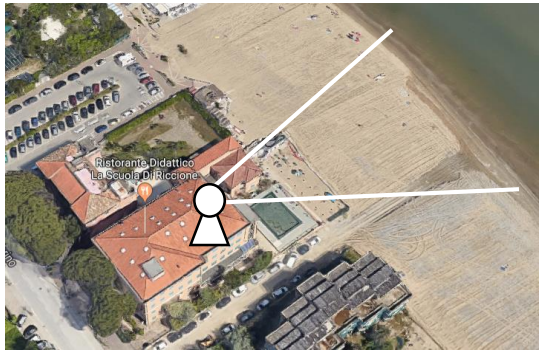
Data rate : 2 Hz.

Real-time image processing (in situ)

Open source software (Python) for timex images (average of the acquired images over 10 mins)

Offline-processing (remote)

- Georeferencing and image rectification (through Ground Control Points)
- Shoreline automatically detected from timex



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Riccione

Results

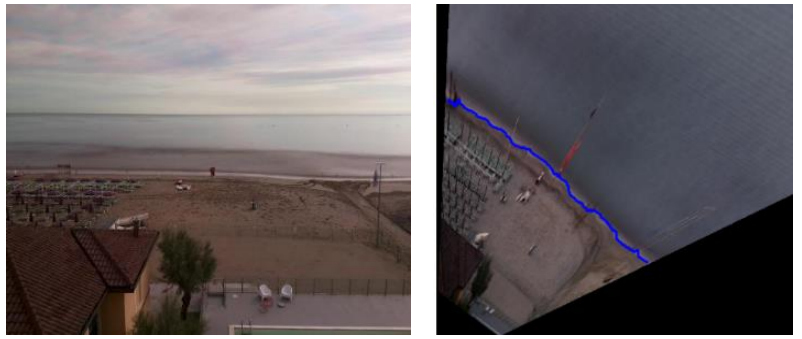
Video-monitoring station installed in July 2019.

Contamination by **tourists**

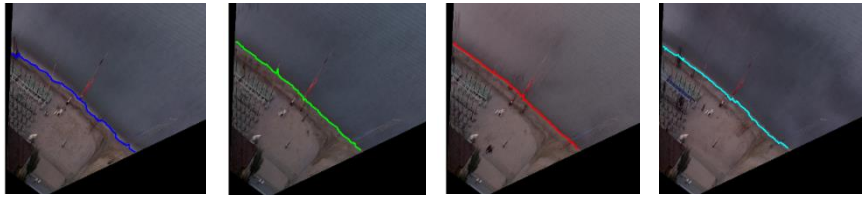
Image rectification and **shoreline**

Time evolution of the shoreline (effects of a storm surge)

Image rectification and shoreline



29/07 30/07 31/07 01/08



02/08
STORM SURGE

02/08 03/08 04/08

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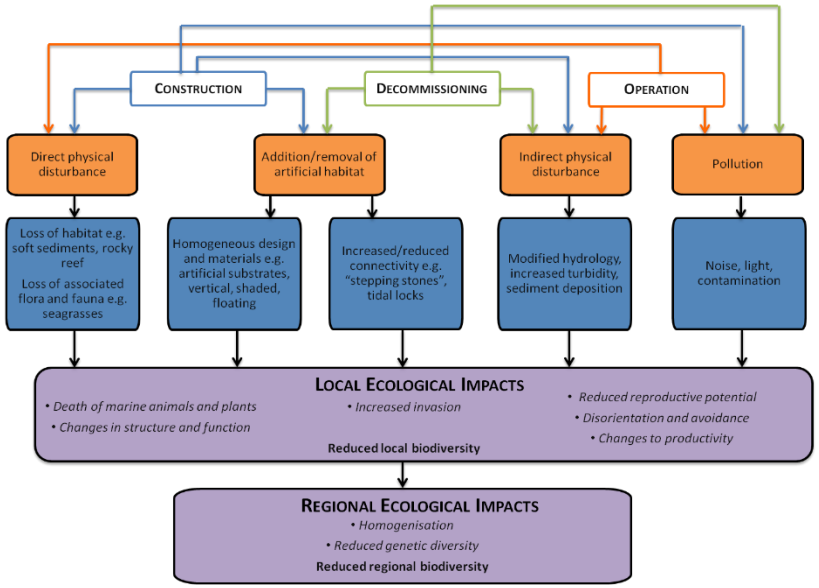
ECOLOGICAL MODELLING

Analysis of the potential ecological impacts related to:

1) Changes in structures and compositions in native bentonics on the sand

2) Structures and compositions and biomass of the new populations on the artificial structures



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FIELD INTERVENTIONS

Margherita di Savoia: sandy beach nourishment by using sediments dredged from the harbor entrance

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Monopoli

FIELD INTERVENTIONS

Monopoli: small nourishment (about 40 mc) for seasonal managements of the pocket beach from submerged sandy bars

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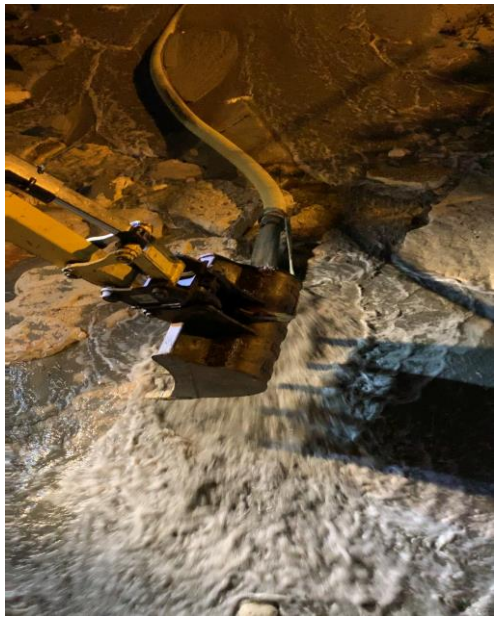
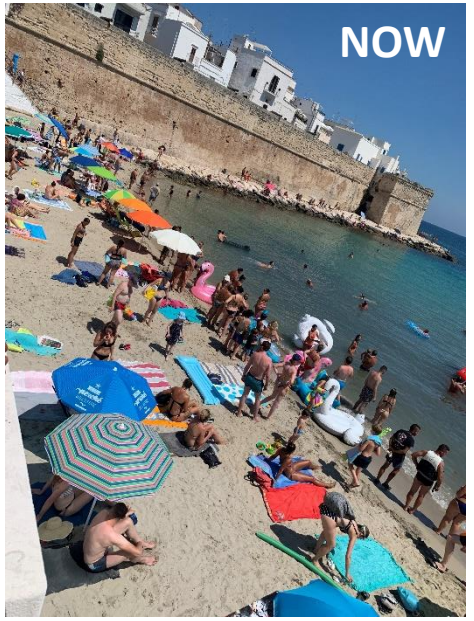
FIELD INTERVENTIONS

Monopoli: small nourishment (about 40 mc) for seasonal managements of the pocket beach from submerged sandy bars





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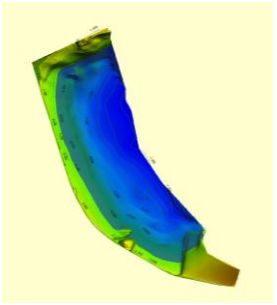
RISK ASSESSMENT
FIELD MONITORING

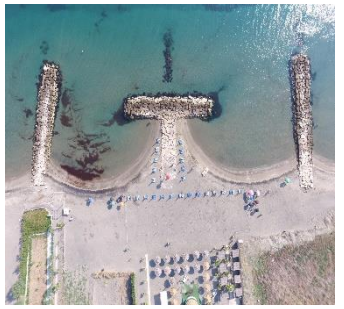
Physical indicators

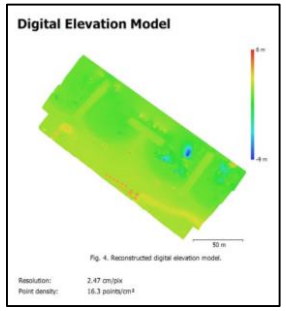
Experiential knowledge

GPS surveys

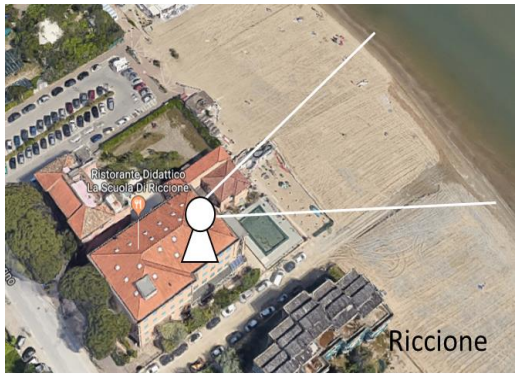


UAV





Video



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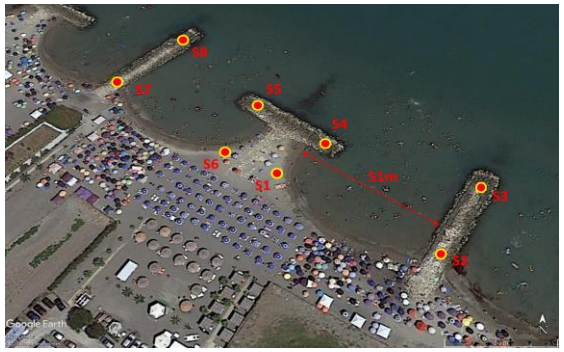

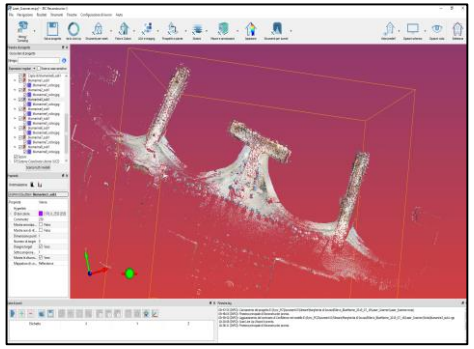

STIMARE

Strategie Innovative per il Monitoraggio ed Analisi del Rischio Erosione

RISK ASSESSMENT/FIELD MONITORING

Physical indicators

Experiential knowledge

Activities performed

- Scenario Workshop
- **Questionnaires**

Period: from June 2019 - still ongoing

Surveyors:

- 14 volunteer students involved in the administration of the questionnaires
- Troisi Ricerche Srl

Respondents:

a) Residents
b) Tourists
c) Beach managers

1116 Questionnaires submitted to **tourists** and **residents**

30 Questionnaires submitted to **beach managers**

STRUCTURE OF THE QUESTIONNAIRE
SECTION 1: BEACH ATTENDANCE
SECTION 2: OPINIONS ON THE BEACH FREQUENTED
SECTION 3: KNOWLEDGE ABOUT COASTAL EROSION
SECTION 4: RESPONDENT SOCIO-DEMOGRAPHIC PROFILE
SECTION 5: NOTES AND/OR COMMENTS

STIMARE

Strategie Innovative per il Monitoraggio ed Analisi del Rischio Erosione

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