

Modern Port Development and Cultural Heritage Preservation within port infrastructures. Current and Future Challenges

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3 Port of Heraklion

- Maritime structures, such as piers and docks that have historic, social and cultural importance
- When within the infrastructures cultural heritage sites are present the problems are more complicated
- Increased vulnerability due to modernization of port infrastructures
- Climate change impacts are increasing risk related to existing problems
- Risks affecting coastal cultural heritage may stem from exposure to one or more hazards (structural damage, material degradations)
- Especially when within the infrastructures, monuments or landmarks are presents, mitigation measures and monitoring are required

Objectives

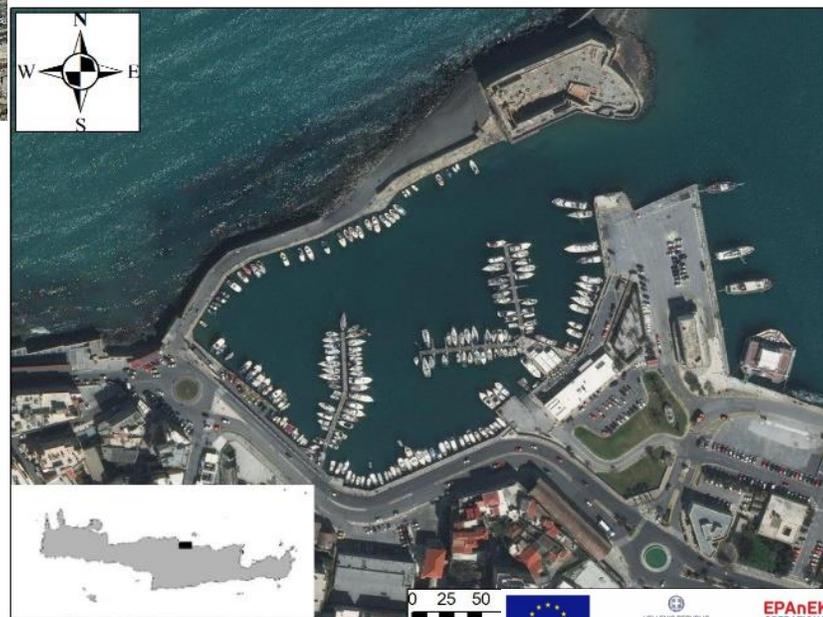
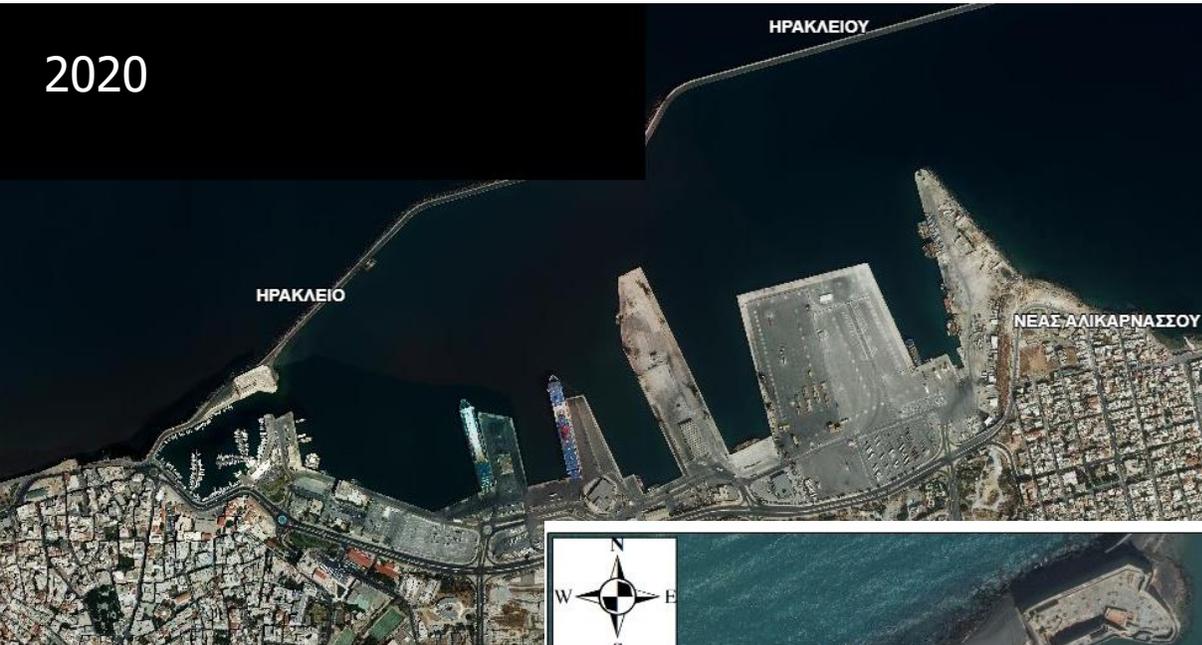
- Explore the impact of development plans and wave action in to 2 port facilities hosting cultural heritage monuments
- Identify the causes of degradation
- Propose interventions / actions for protection and regeneration

Scope

- Improve the resilience of infrastructure and cultural heritage
- Increase the accessibility and safety of users

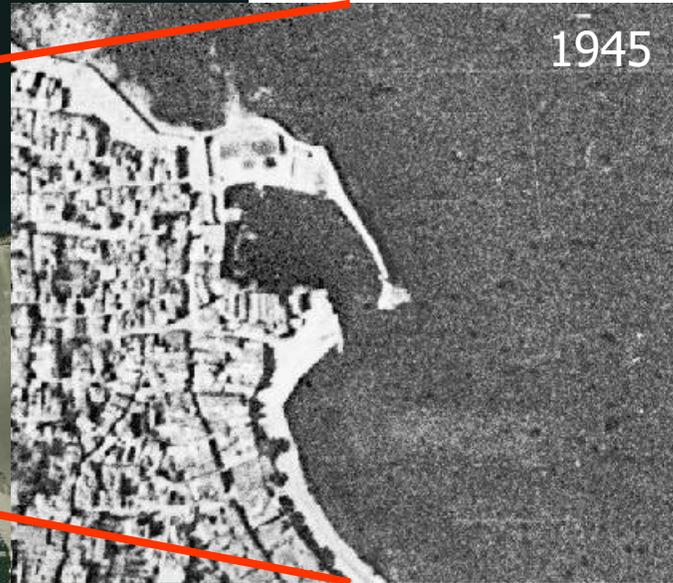
Study area

Heraklion Port



Study area

Rethymnon Port



Impact, Limitations and Actions



Impact

- Scouring on coastal walls
- Mechanical erosion of artificial surfaces
- Salt crusts
- Structural issues
- Rock displacements

Limitations

- Budget limitations
- Spatial limitations
- Landscape / CH preservation
- Structural issues
- Other...(WWII bombs)



2015



2017

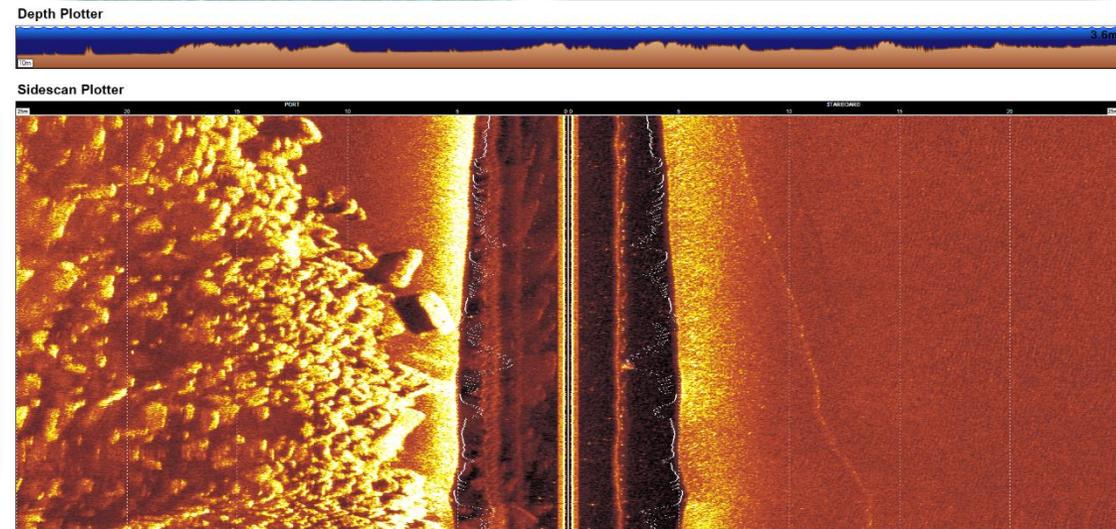


2017

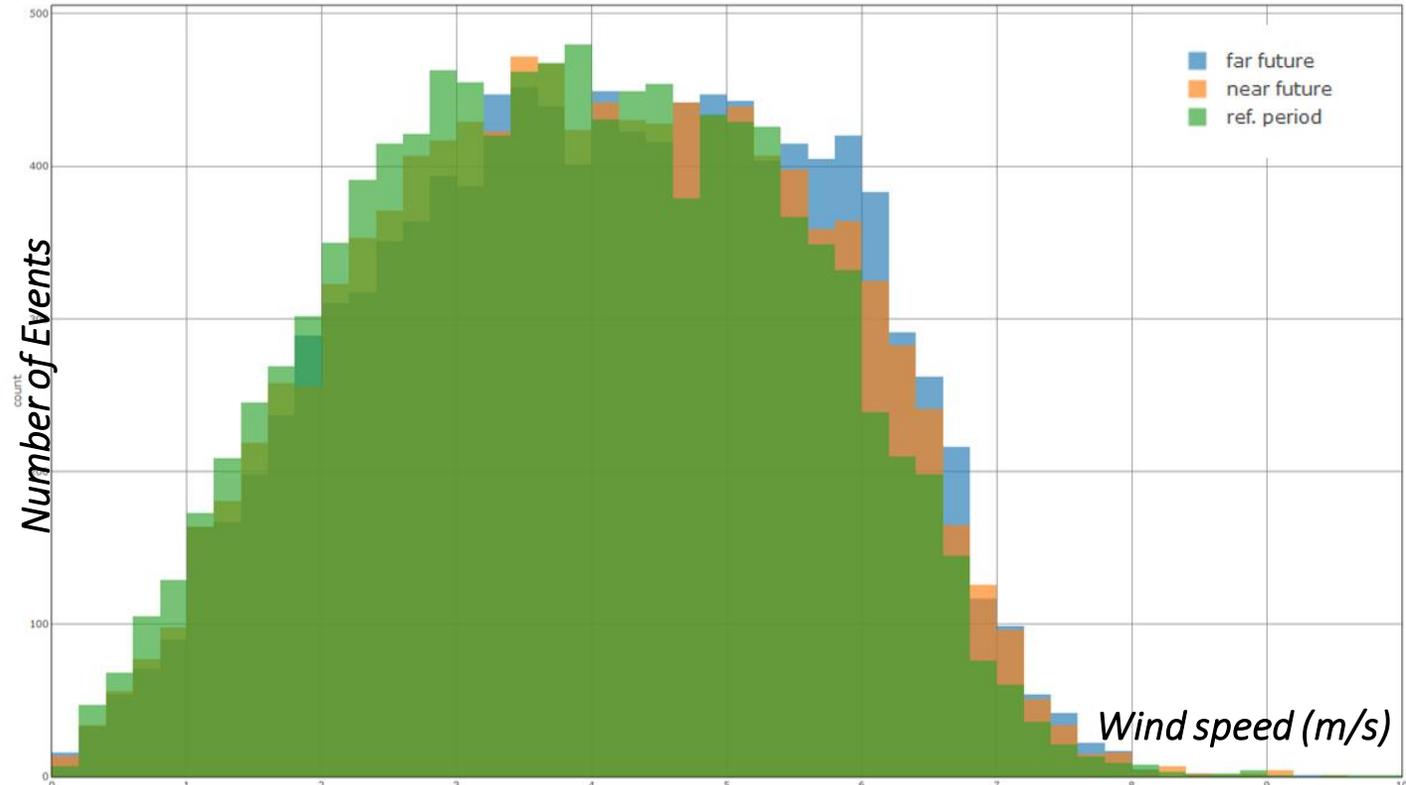
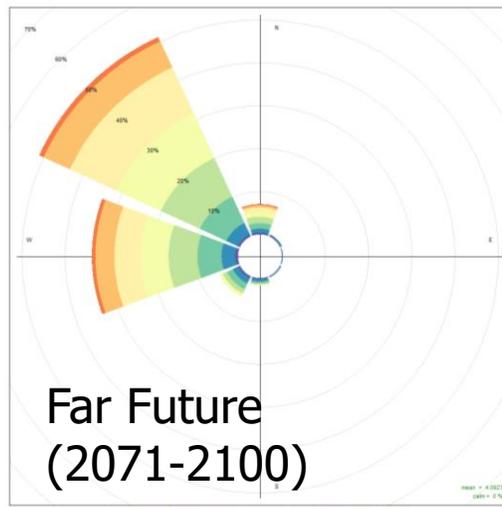
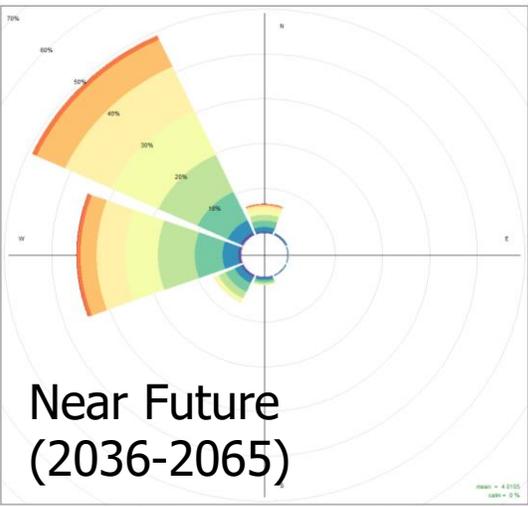
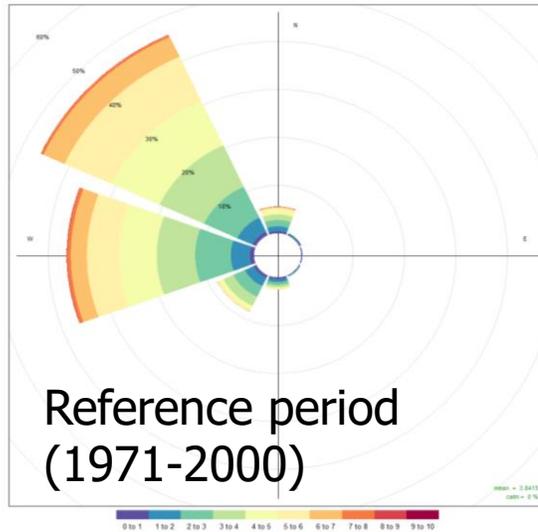


2/2019

- Climatic Modeling for wind climate (*data: HERACLES H2020 project*)
 - near future: 2036 – 2065
 - far future: 2071 – 2100
- Hydrodynamic modelling
 - Wave modeling
 - Wave overtopping
- Monitoring
- Sonar images
- Port authorities development plans



Climatic Modeling (wind)



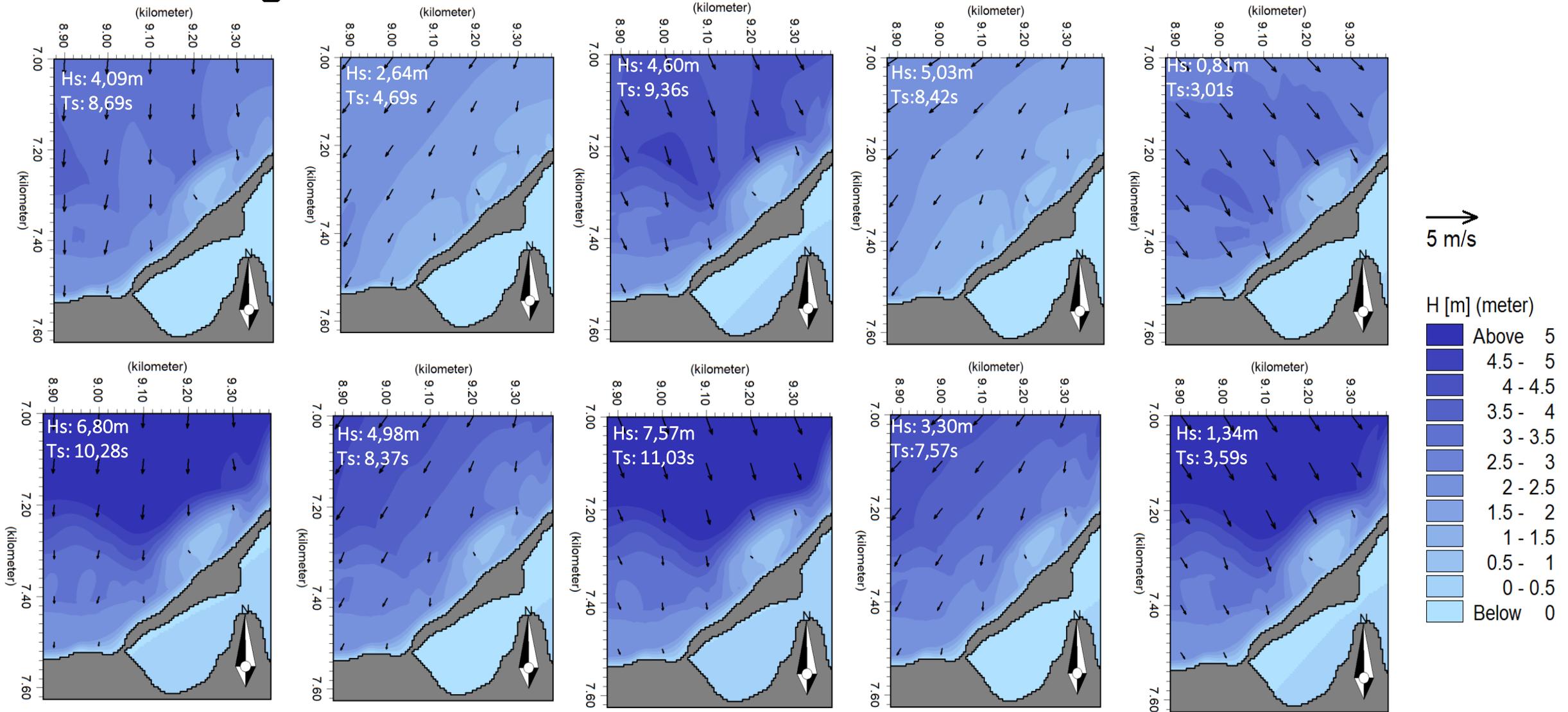
%	45°	90°	135°	180°	225°	270°	315°	360°
Ref.	0,49	0,24	0,37	2,53	8,33	36,39	46,10	5,55
Near	0,50	0,26	0,30	1,85	6,77	34,75	49,07	6,50
Far	0,54	0,26	0,38	1,68	5,18	33,77	51,16	7,03

HERACLES: "HERitage Resilience Against CLimate Events on Site" funded by EU Horizon 2020 research and innovation programme under grant agreement No 700395

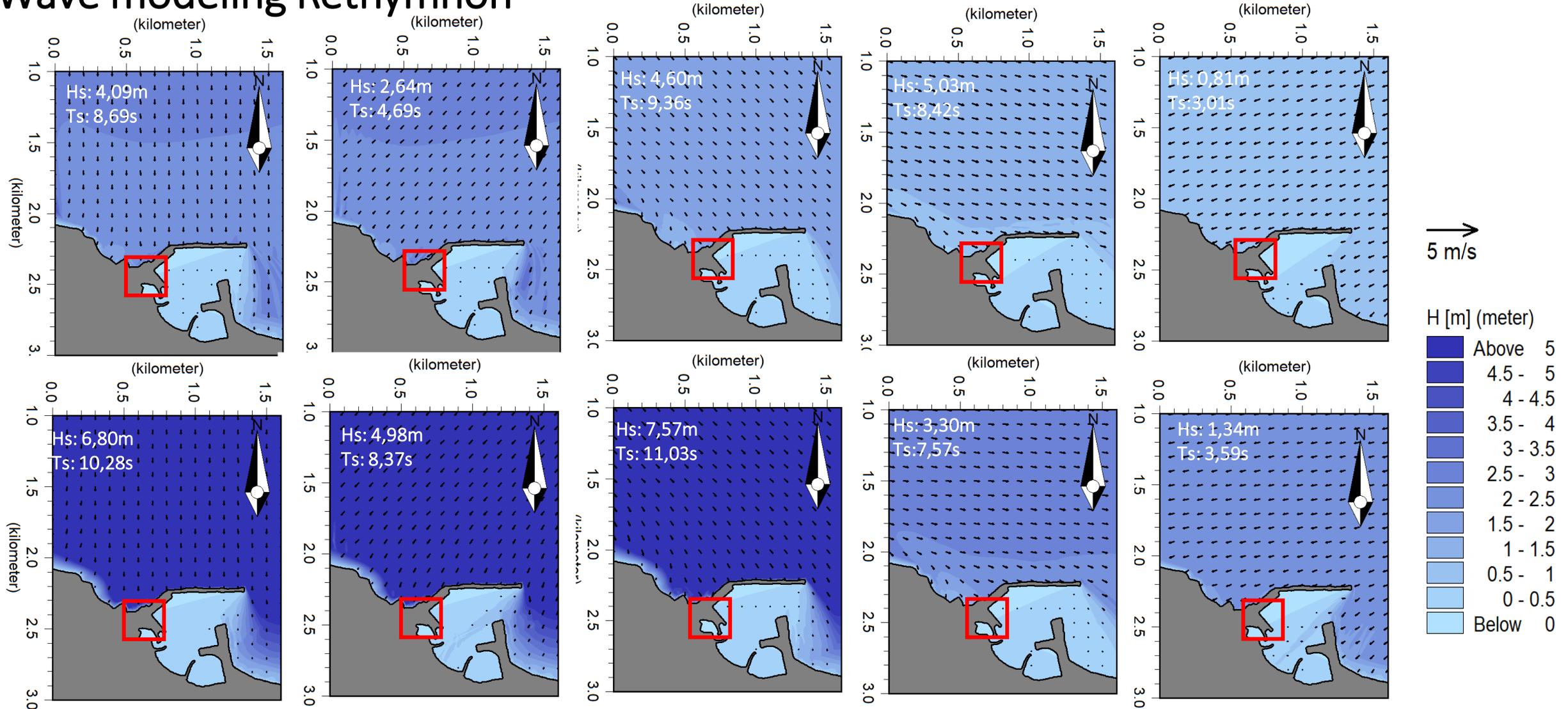


Changes in the Wave frequency, speed and direction result on the increase of extreme wave impact on the monument

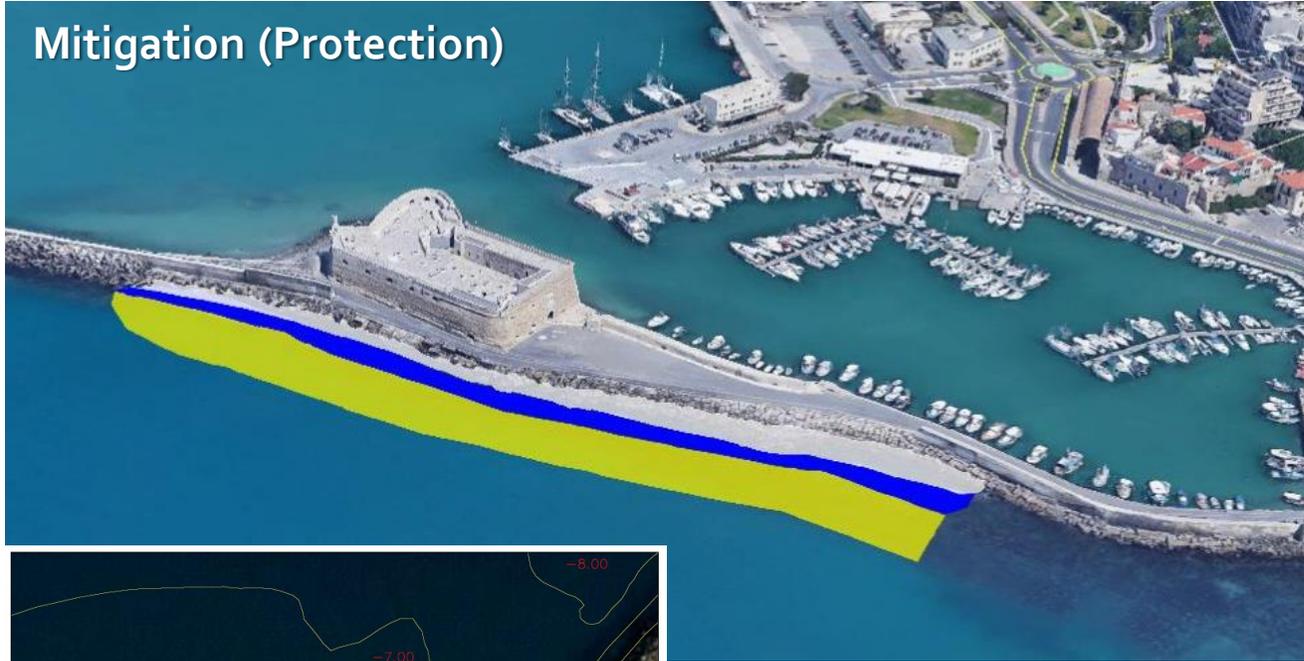
Wave modeling Heraklion



Wave modeling Rethymnon



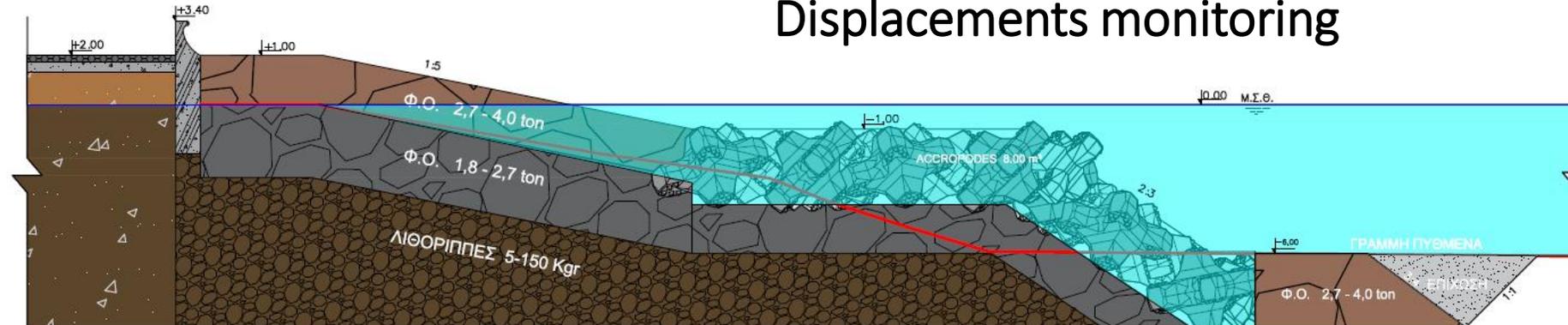
Mitigation (Protection)



Increasing underwater armouring of the monument
(estimated cost 900.000 Euros)

- No influence in visibility
- 80% reduce of wave spray
- 90% reduce of wave overtopping

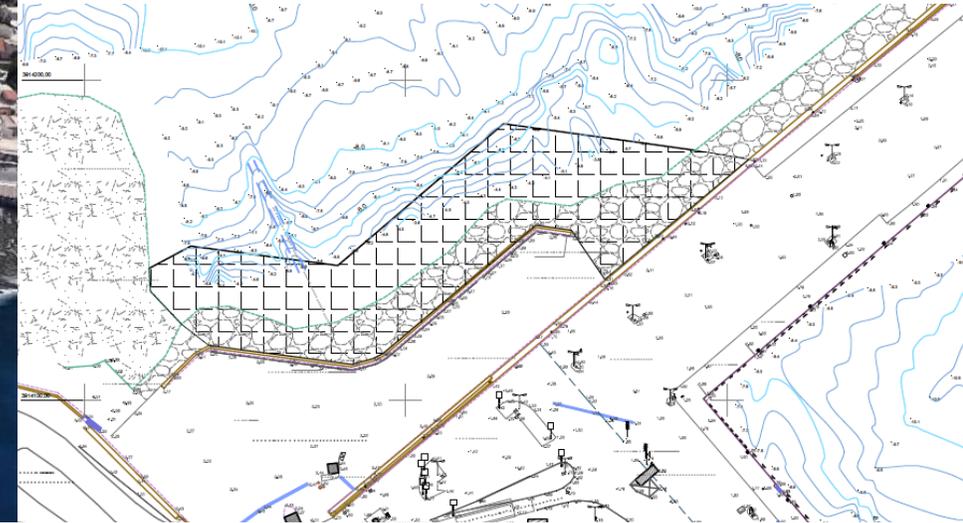
Monitoring program including
Continuous Climate & wave monitoring
Displacements monitoring



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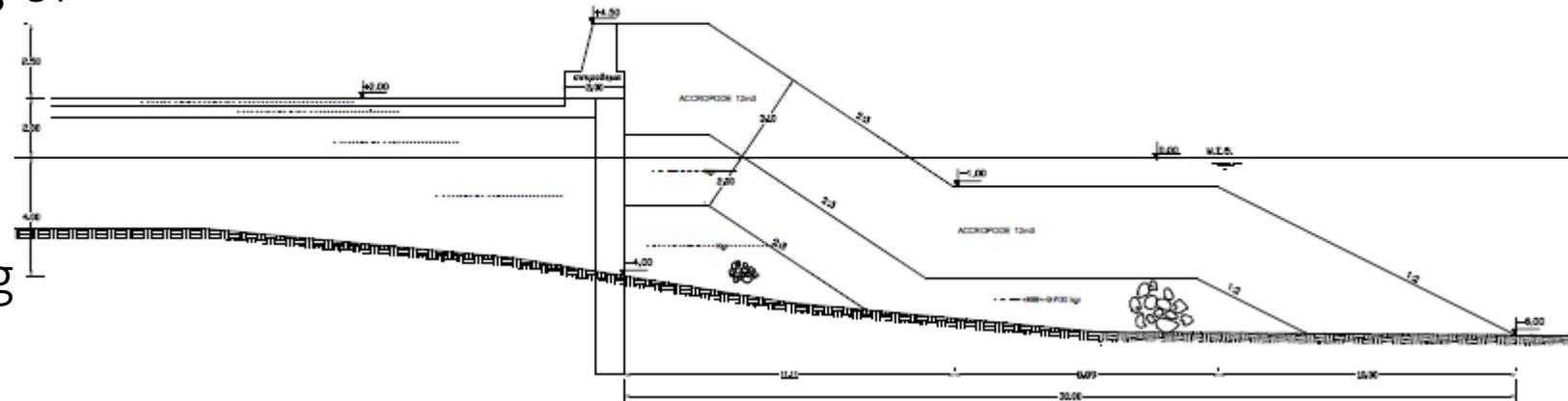


Mitigation (Protection)



Increasing underwater armouring of the monument

- No influence in visibility
- 60% reduce of wave spray
- 80% reduce of wave overtopping



- Besides the climate and environmental other factors can affect the heritage conservation
- The actual use and management as well as development plans can have negative impact on heritage, such as pathological decay and degradation.
- The first step of the protection strategies is the assessment of the historic values
- Moreover the identification of all the hazards that produce impacts and effects on the port heritage, in order to set up a methodology for risk calculation and evaluation is needed
- Defining a Risk Assessment framework can lead to guidelines and strategies of protection, directly related to the specific vulnerabilities

- Periodic monitoring of environmental pressures can provides better information for preventive conservations
- Maritime monuments have historical value and have social and cultural importance to be seen as elements of added value for development and not only as historical relics
- Recognizing a specific vulnerability, it would be more correct to define a socioeconomic value rather than a material one

A comprehensive understanding of environmental, CC and social effects will build a basis for taking proactive rather than reactive measures and reduce the anticipated risks in the future, in an innovative paradigm for conservation even with existing limitations in funds and means

THANK YOU



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For Heraklion Data from HERACLES: "HERitage Resilience Against CLimate Events on Site" funded by EU Horizon 2020 research and innovation programme under grant agreement No 700395 were used



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