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Final Event of the European Project TRITON

The establishment of a pilot erosion observatory in the gulf of Patras

N. Depountis, N. Sabatakakis

Project co-funded by European Union, European Regional Development Funds (E.R.D.F.) and by National Funds of Greece and Italy

AIM AND OBJECTIVES OF A PILOT EROSION OBSERVATORY

The establishment of a pilot erosion observatory in areas that suffer significant erosion problems aims to collect real-time data, with the monitoring of several parameters that negatively affect shorelines. The collected data can be used with the appropriate interpretation in the design of long-term protection measures of the suffered shorelines.

In order to achieve this goal, it is necessary to create from the early beginning a detailed geomorphological and coastal plan of the study area and install the necessary equipment for real-time monitoring.

Project co-funded by European Union, European Regional Development Funds (E.R.D.F.) and by National Funds of Greece and Italy

THE EROSION OBSERVATORY OF THE GULF OF PATRAS

The gulf of Patras was selected as the study area for the establishment of the pilot erosion observatory because of:

- the existence of a main port connecting Greece-Italy
- the increased urban and touristic development that is gradually expanding along its shoreline
- the existence of rich biodiversity

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ENGAGED ACTIVITIES

Equipment installation performed by the Region of Western Greece

- one wave data buoy system for wave intensity measurements
- two tide gauges (marigraphs) for sea rise level and tidal measurements
- two weather stations for real time atmospheric measurements

Surveys and studies performed by the University of Patras

- Geotechnical surveys and engineering geological plans
- Satellite, aerial photo imaging, UAV and USV surveys
- Marine surveys and digital bathymetric plans
- Environmental monitoring in the protected areas
- Numerical study of waves, currents and sediment transport

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EQUIPMENT INSTALLATION

The installation of the equipment aims to facilitate the collection of useful data and enable the development and adoption of the necessary measures in order to address the erosion phenomenon.

- A weather station, a tide gauge (marigraph) and a wave buoy system were installed in the wider area of the new port of Patras.
- A weather station and a tide gauge (marigraph) were installed in the port of Killini

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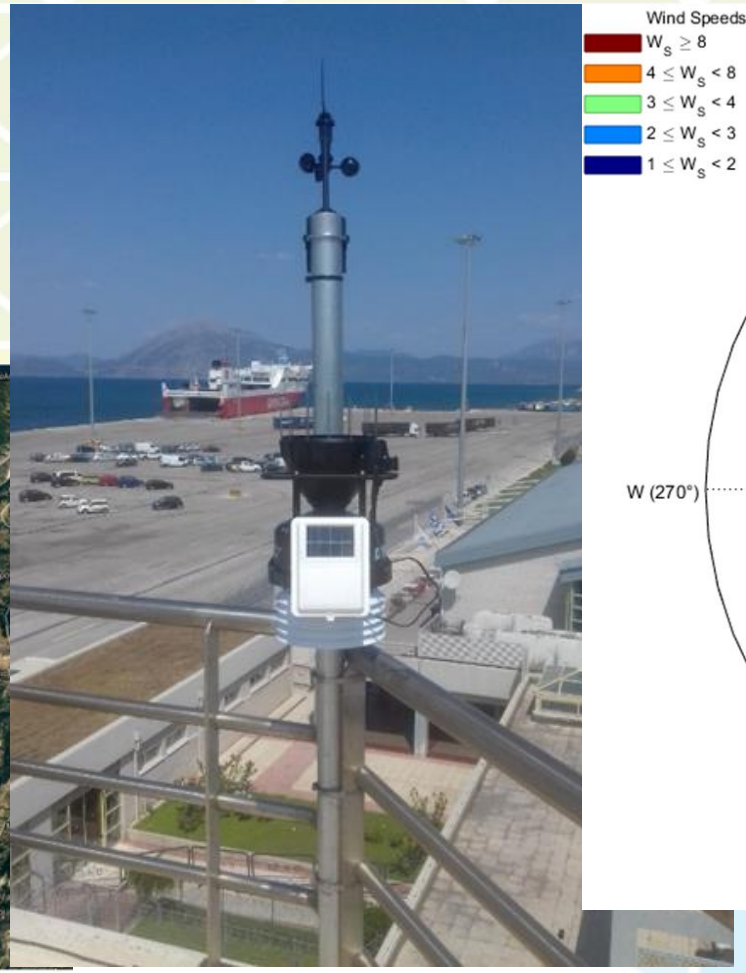
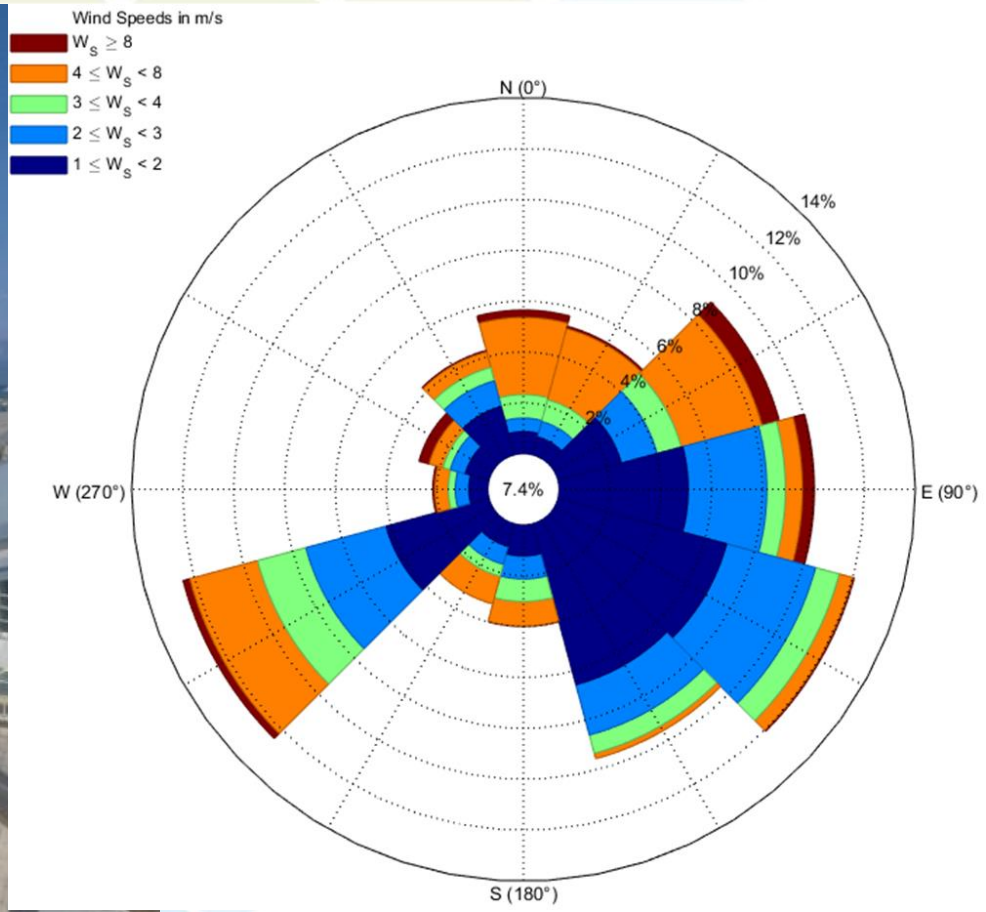
WEATHER STATION IN THE NEW PORT OF PATRAS

The weather station installed on 16/10/2019 and provides real time atmospheric measurements (temperature, humidity, wind speed/direction and rain height)



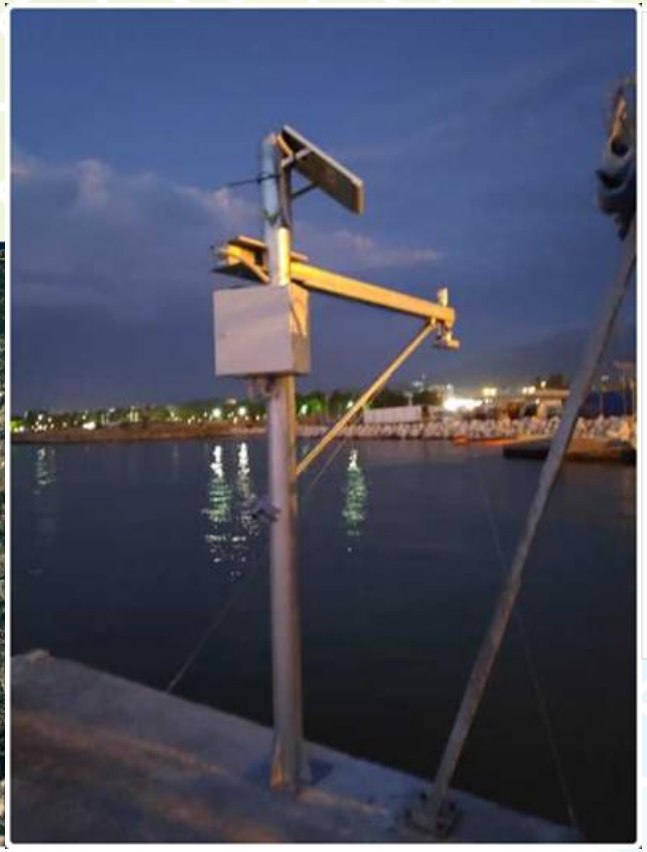


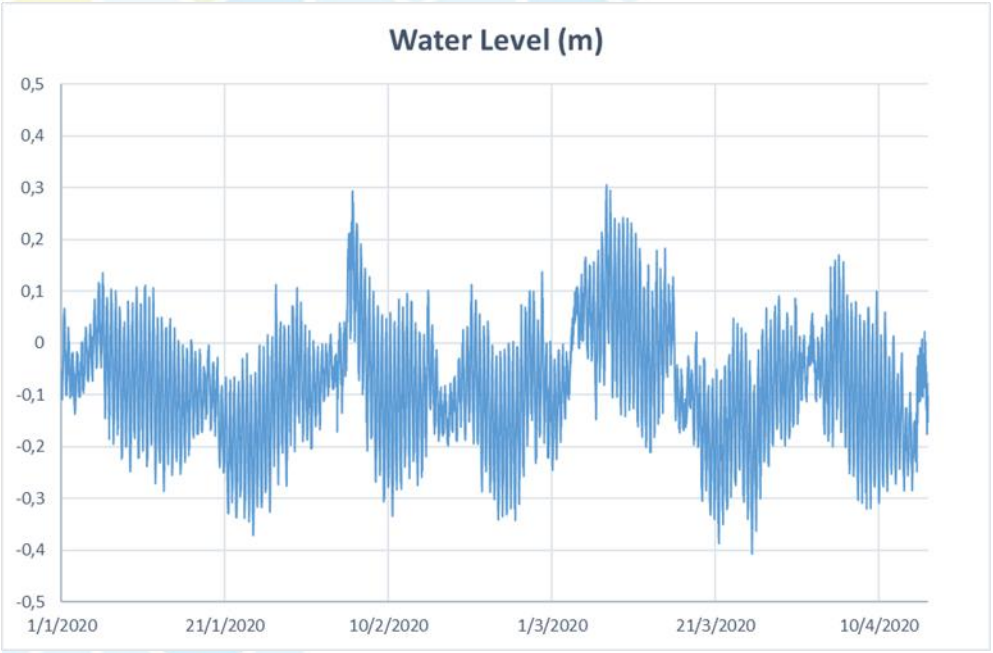
Wind rose diagram for the period 01/01/2020-15/04/2020

Project co-funded by European Union, European Regional Development Funds (E.R.D.F.) and by National Funds of Greece and Italy

TIDE GAUGE IN THE NEW PORT OF PATRAS

The Patras tide gauge (marigraph) installed on 16/10/2019 and provides real-time sea-level and tidal measurements every 10 minutes



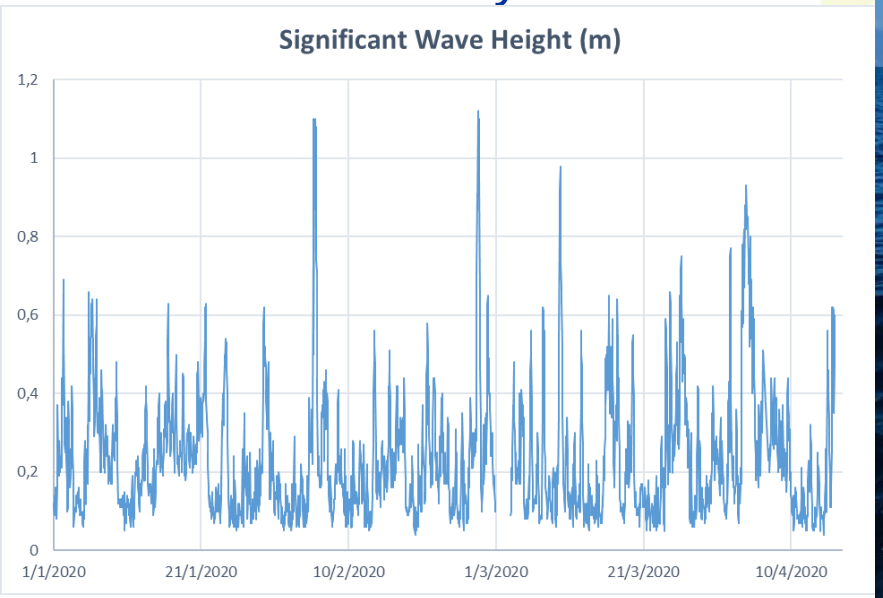


Sea level measurements for the period 01/01/2020-15/04/2020

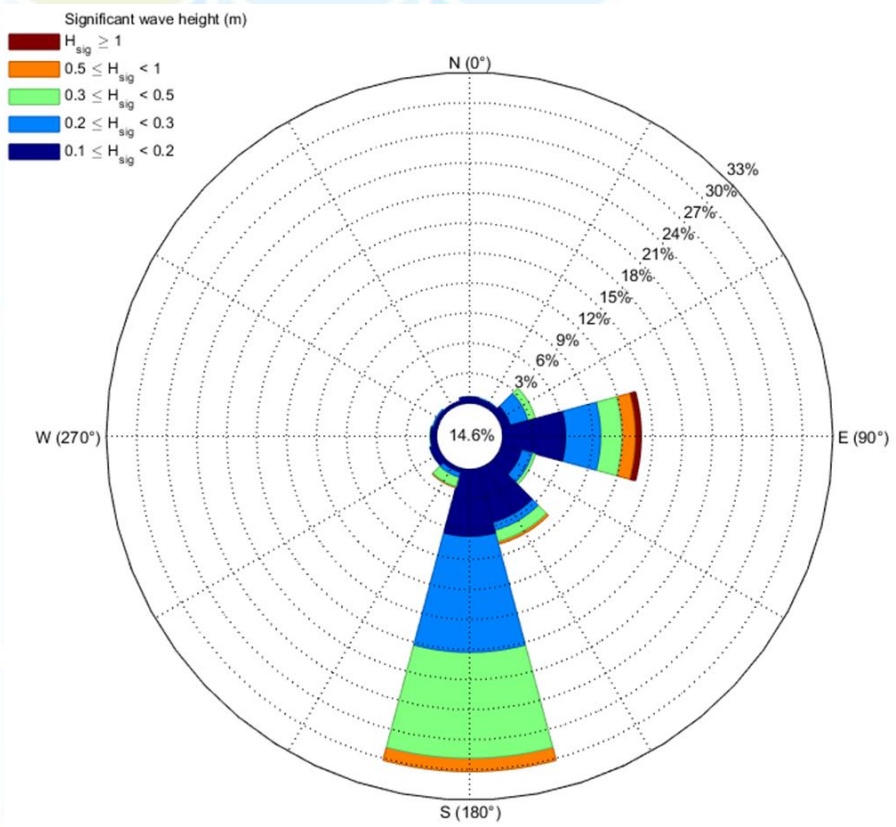
Project co-funded by European Union, European Regional Development Funds (E.R.D.F.) and by National Funds of Greece and Italy

WAVE DATA BUOY SYSTEM IN THE GULF OF PATRAS

The Wave data buoy system installed on 16/10/2019 south of the new port of Patras and provides real time wave measurements every 30 minutes



Significant wave height for the period 01/01/2020-15/04/2020



Wave rose diagram for the period 01/01/2020-15/04/2020

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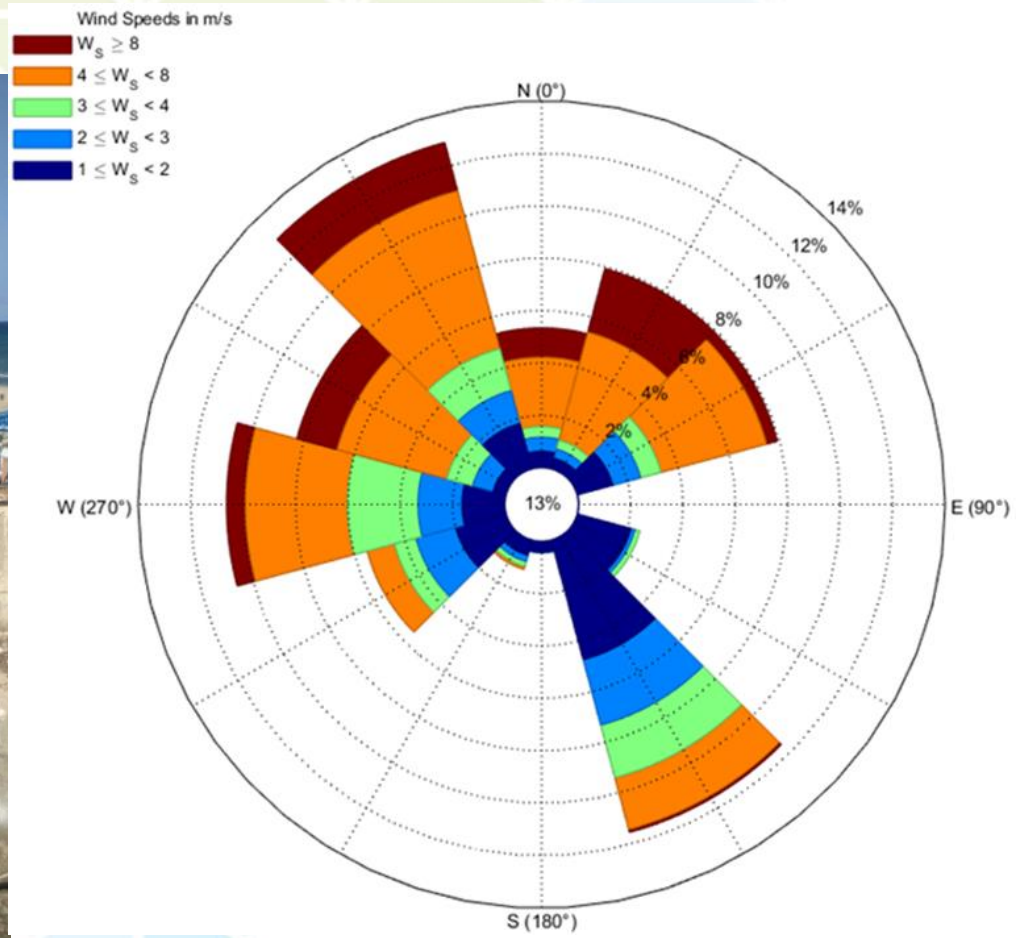
WEATHER STATION IN THE PORT OF KILLINI

The weather station installed on 22/09/2019 and provides real time atmospheric measurements (temperature, humidity, wind speed/direction and rain height)



Wind rose diagram for the period 01/01/2020-15/04/2020

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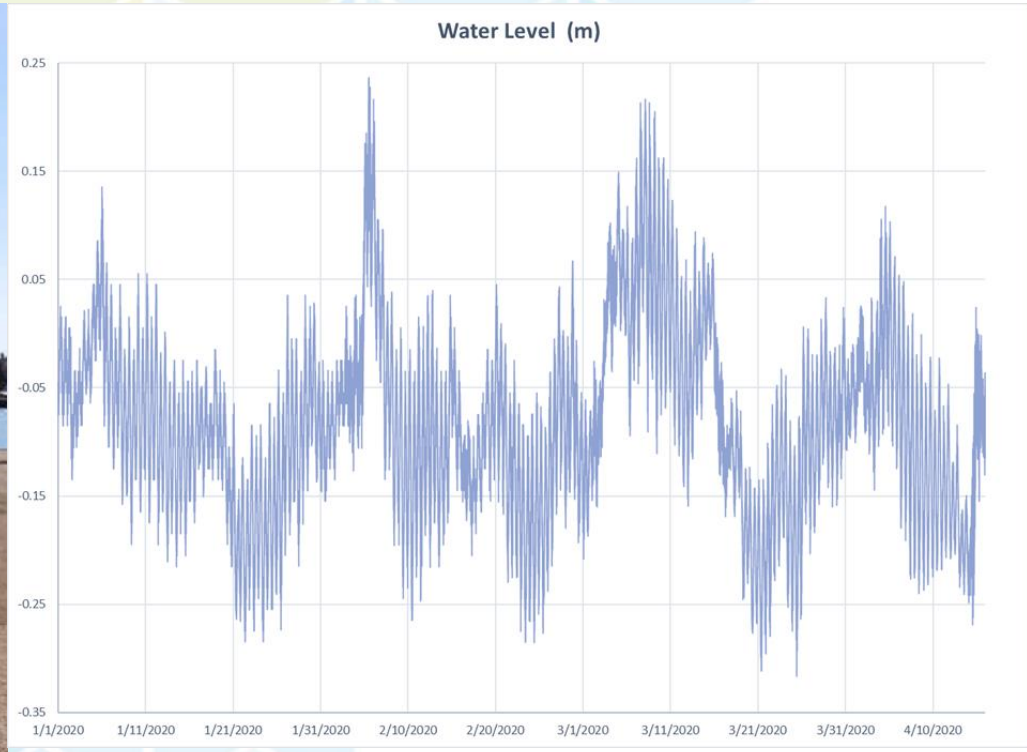
TIDE GAUGE IN THE PORT OF KILLINI

The Killini tide gauge (marigraph) installed on 13/09/2019 and provides real-time sea-level and tidal measurements every 10 minutes



Sea level measurements for the period 01/01/2020-15/04/2020

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SURVEYS AND STUDIES IN THE GULF OF PATRAS

- Geotechnical surveys and engineering geological plans
- Satellite, aerial photo imaging, UAV and USV surveys
- Marine surveys and digital bathymetric plans
- Environmental monitoring and management
- Numerical study of waves, currents and sediment transport

Project co-funded by European Union, European Regional Development Funds (E.R.D.F.) and by National Funds of Greece and Italy

UoP TRITON RESEARCH TEAM

- Nikolaos Sabatakakis, Project Manager, Engineering Geology
- Nikolaos Depountis, Deputy project Manager, Engineering Geology
- Konstantinos Nikolakopoulos, Member of the Technical Committee, Remote Sensing and GIS
- George Papatheodorou, Member of the Advisory Board, Marine Geology and Oceanography
- Athanasios Dimas, Member of the Advisory Board, Coastal Engineering
- <u>External expertees and researchers</u>

  Dimitris Christodoulou, Elias Fakiris, George Leftheriotis, Aikaterini Kavoura
- <u>PhD Candidates</u>

  Vasileios Bouboulis, Dionisios Apostolopoulos

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GEOTECHNICAL SURVEYS

In the frame of the TRITON project an extensive geotechnical investigation program was performed along the shoreline of the gulf of Patras, comprising of:
(a) Borehole drilling and core sampling
(b) in-situ and lab tests
(c) sediment analysis

The purpose of this program was to identify the soil's stratigraphy and its geotechnical properties for specific coastal applications

Google-Earth map representing the geotechnical operations performed along the shoreline of the gulf of Patras (borehole drilling: ΓΝ, CPT tests and sampling points for sediment analysis: S)

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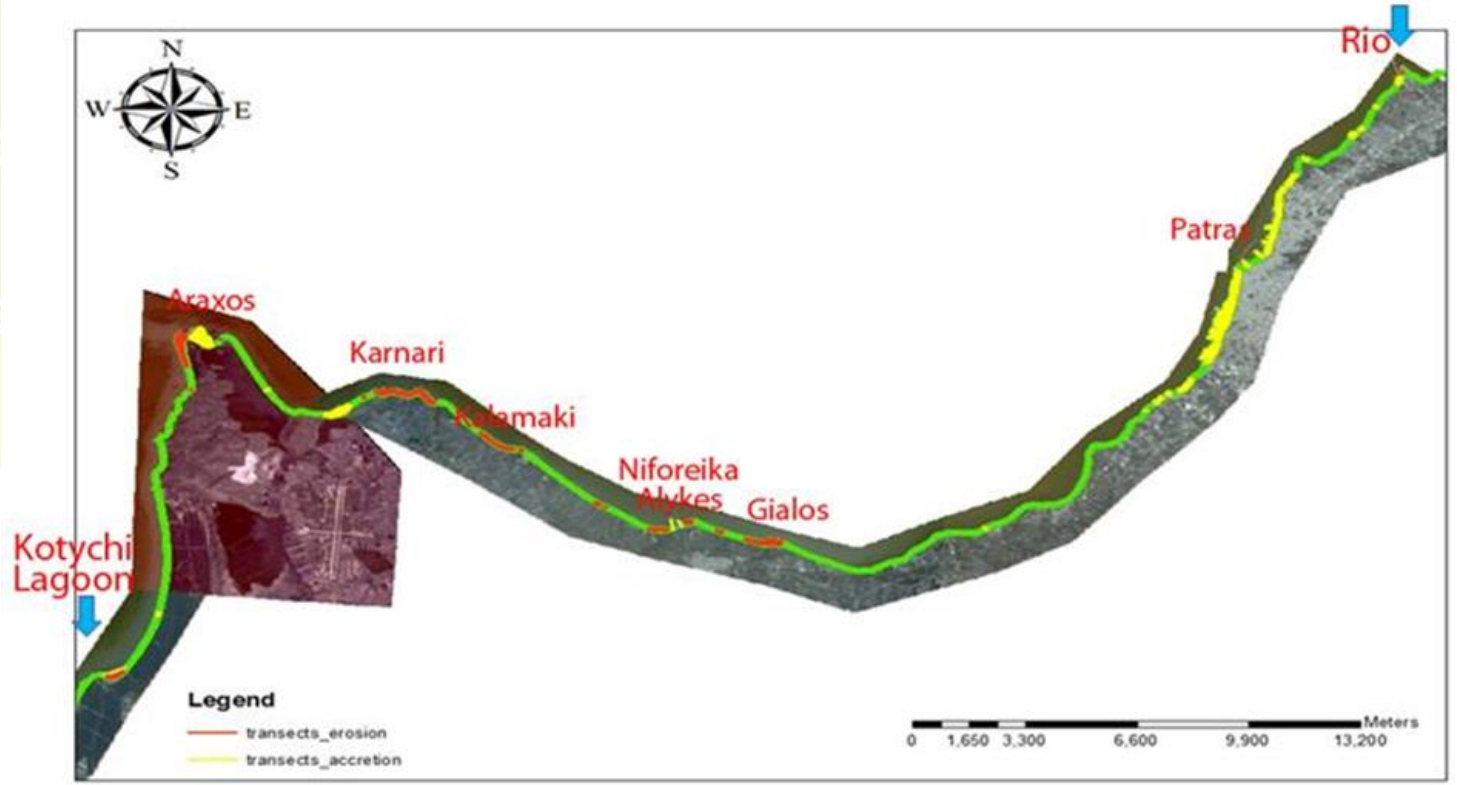
SATELITE, AERIAL PHOTO IMAGING, UAV AND USV SURVEYS

Digital processing of diverse remote sensing data has been performed along the shoreline of the gulf of Patras.

Medium to Very High Resolution (VHR) satellite data have been processed to map the recent coastline and classical analogue air photos (1945-2008) are used to detect the shoreline changes.

Unmanned Aerial Vehicles and Unmanned Surface vehicles are used for up-to-day data collection in specific areas.



Map of the shoreline displacement from 1945 to 2018 in the area of study. Red color represents areas where the erosion is higher than 30m, yellow color represents areas where the accretion is higher that 30m and green color represents areas where the shoreline displacement is lower than 30m.

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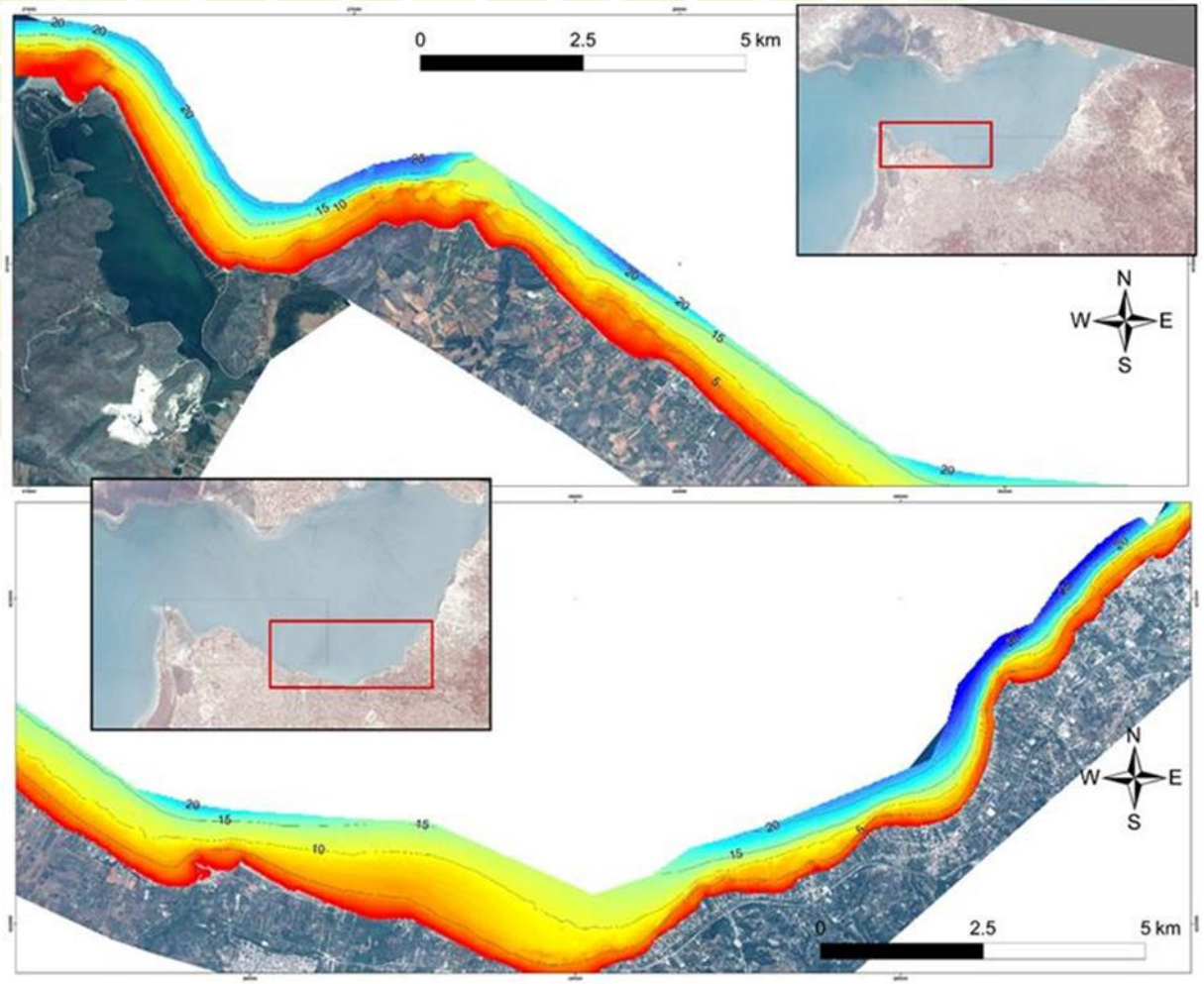
MARINE SURVEYS AND DIGITAL BATHYMETRIC PLANS

An extensive marine survey was conducted comprising of:
(a) marine research and data acquisition methods for mapping the bathymetry of the southern part of the gulf of Patras,
(b) processing and analysis of the collected data
(c) bathymetric plans of the research area.



Bathymetric map of the coastal area of the Southern part of the gulf of Patras

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ENVIRONMENTAL MONITORING AND MANAGEMENT

Processing of the data derived by the installed equipment (environmental) stations in the areas of intervention

- Region of Western Greece in the gulf of Patras and the Killini port
- Management Body of Kotyhi Strofylia Wetlands & Kyparissia Gulf in the Papas, Prokopos and Kotychi lagoons

[1-2: weather station and marigraph in the new port of Patras; 3: wave buoy system in the gulf of Patras; 4-5: weather and water quality stations in the Papas lagoon; 6: water quality station in the Prokopos lagoon; 7-8: water quality stations in the Kotychi lagoon; 9-10: weather station and marigraph in the Killini port]

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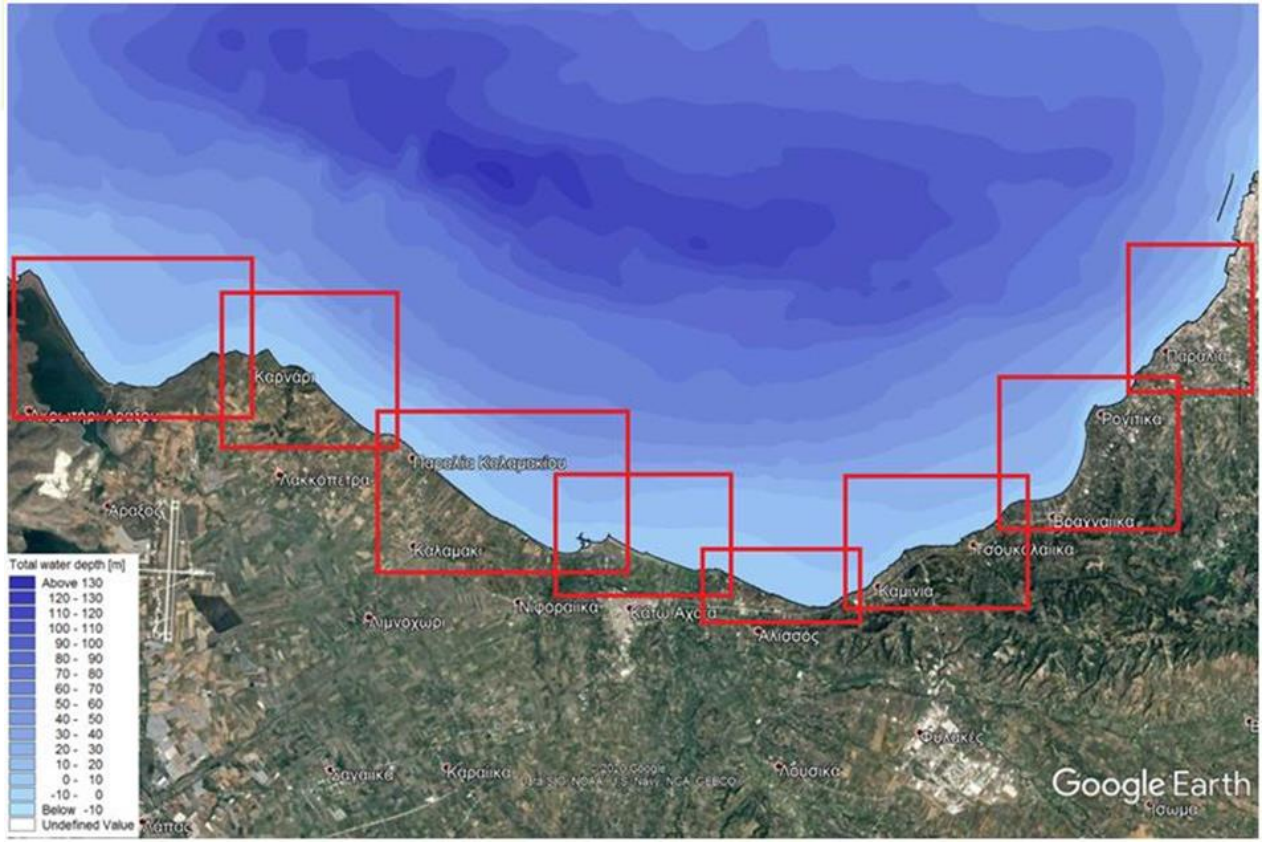
NUMERICAL SIMULATION OF WAVES, CURRENTS AND SEDIMENT TRANSPORT

For clarity of the presentation of the results and better understanding of the coastal processes, the pilot area was divided into 8 coastal independent sub regions as it will be discussed later

The numerical simulations included 4 stages:

1. Determination of the wave climate in the deep waters of the Gulf of Patras due to NE winds east of the gulf and NW, W and SW winds west of the gulf.
2. Numerical simulation of wave propagation in the gulf of Patras for wind speed of 1 year return period for each wind direction.
3. Numerical simulation of the magnitude and the direction of the wave-generated currents in the coastal zone of the gulf for each one of the wind cases of Stage 2.
4. Numerical simulation of the magnitude and the direction of sediment transport in the coastal zone of the Gulf of Patras for each one of the wind cases of Stage 2.



Satellite image (Google Earth) of the pilot area of the Gulf of Patras showing the 8 coastal independent subregions

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