The wave network along the Venetian Coast and sea state forecasting systems

Marco Favaro – Tide Forecasting and Early Warning Centre - CPSM

STREAM| P14| City of Venice

Final conference – 23/24 May 2023

European Regional Development Fund

The meteomareographic network of Venice Tide Forecasting Centre (CPSM)

13 tide gauges

4 ondameters

12 meteorological stations (pressure, wind direction and velocity, …)

2 ondametric buoys → STREAM

The meteomareographic network of Venice Tide Forecasting Centre (CPSM)

- Real time monitoring of sea storm events
- Study of sea waves behavior near the coast to improve sea state and tide forecast
- Data can be assimilated by forecasting modellistic systems

Network of small buoys near the coast

The installation of two buoys at 4 km off the venetian coast has been completed on June 2022.

For our Centre these tools are important to improve the forecast of the state of the sea near the coast. The buoys provide new real time data on the waves.

Wave data are also crucial for making more accurate prediction of tidal level.

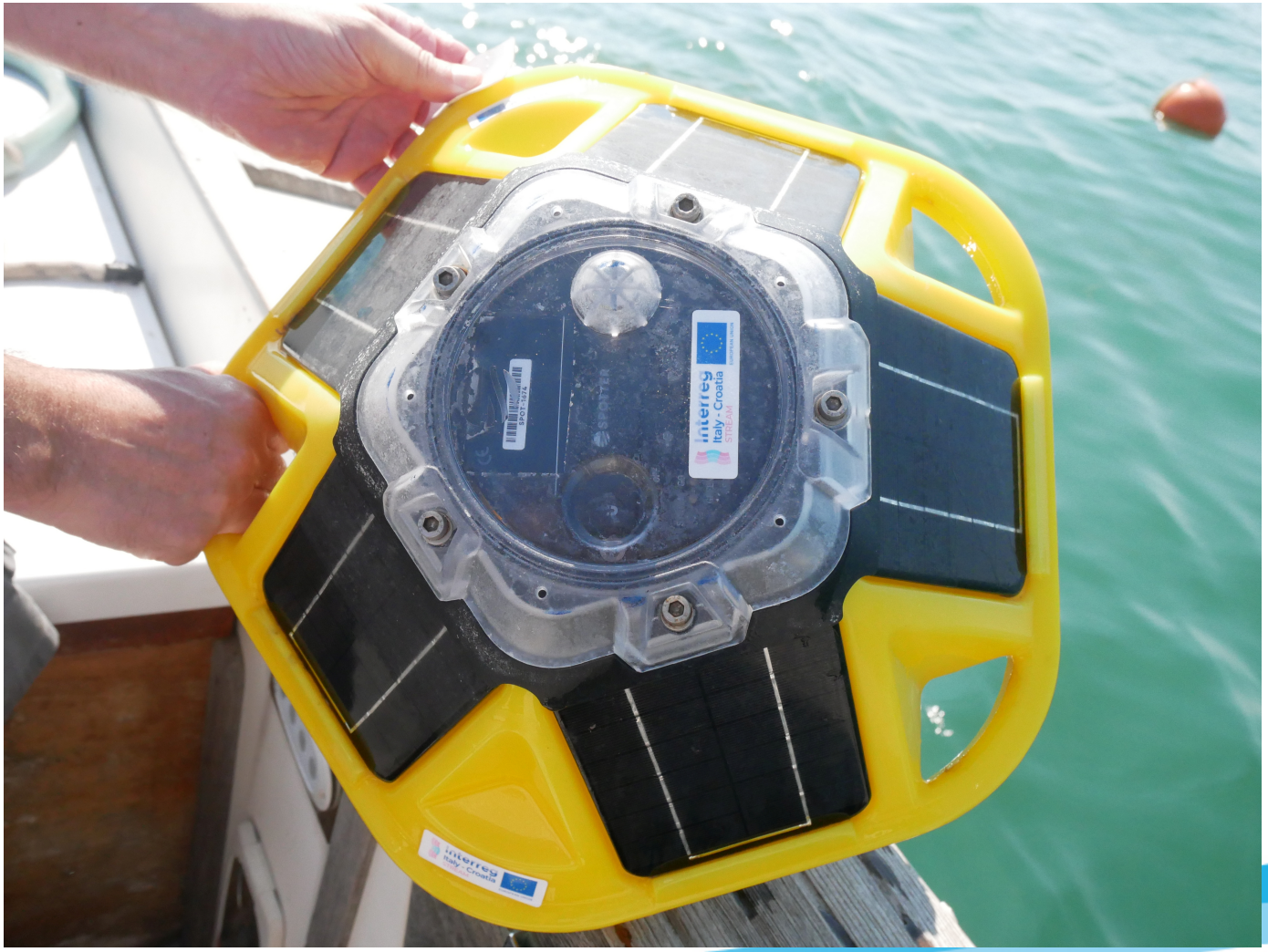
The buoys, together with other existing instruments, allow for more effective monitoring of extreme events.

The data from the instruments are published on open data site of City of Venice.

The network of the buoys is used also to validate the outputs of the sea storms early warning system that is being implemented with the STREAM project.

Network of small buoys near the coast

June 14, 2022



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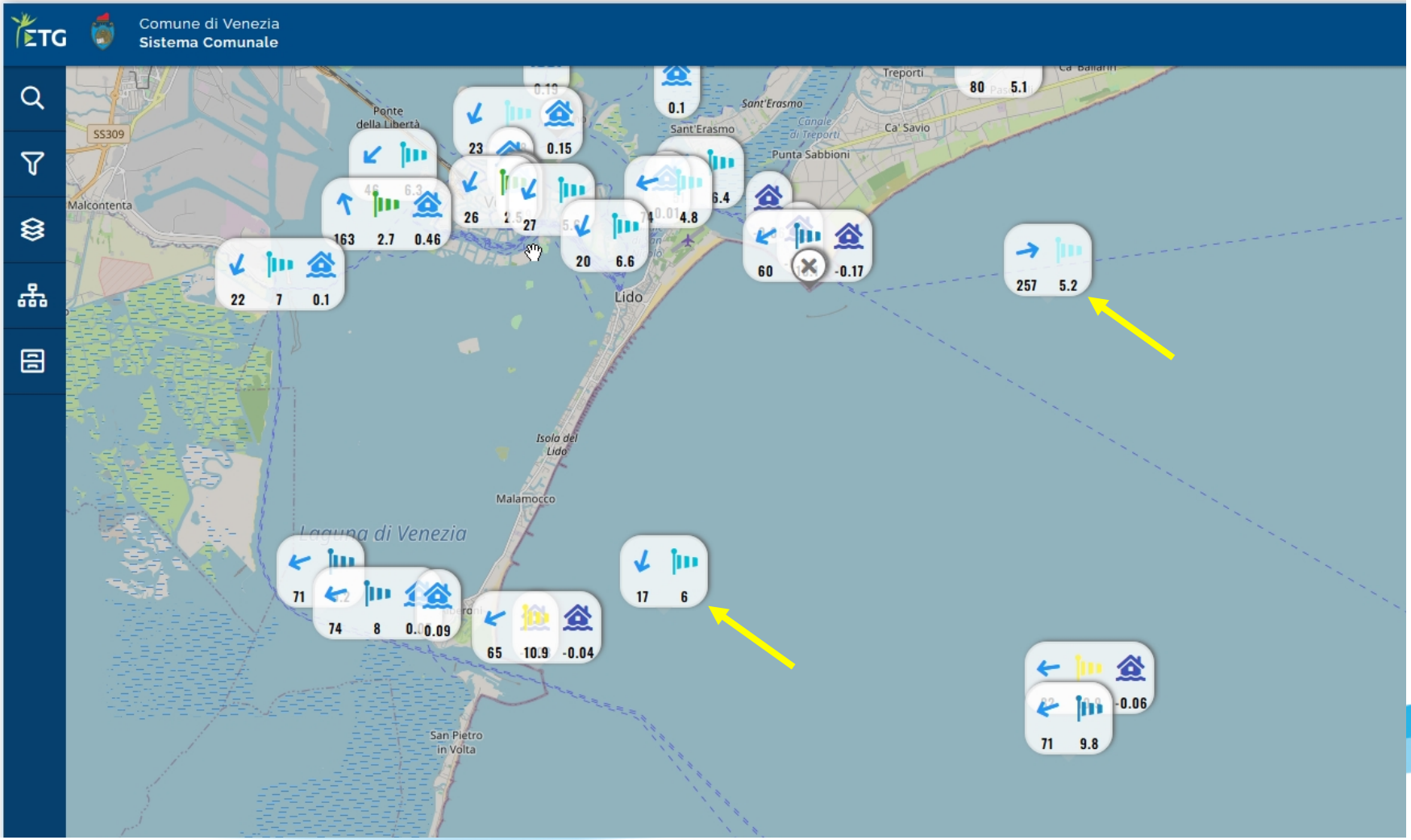
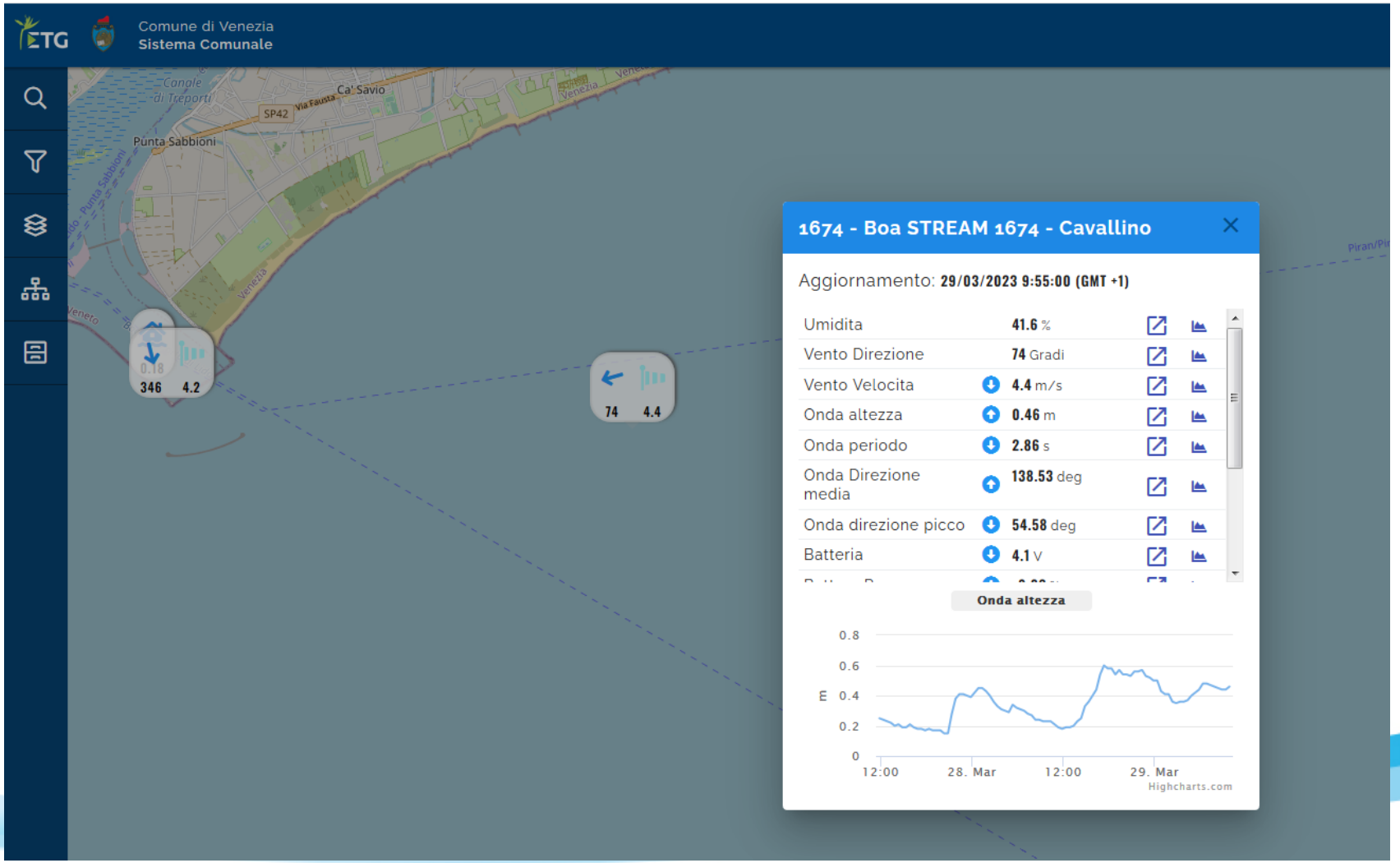


Network of small buoys near the coast



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The wave network along the Venetian coast and sea state forecasting systems

STREAM| CNR-ISMAR | Francesco Barbariol

Final conference| Venice | 24 May 2023

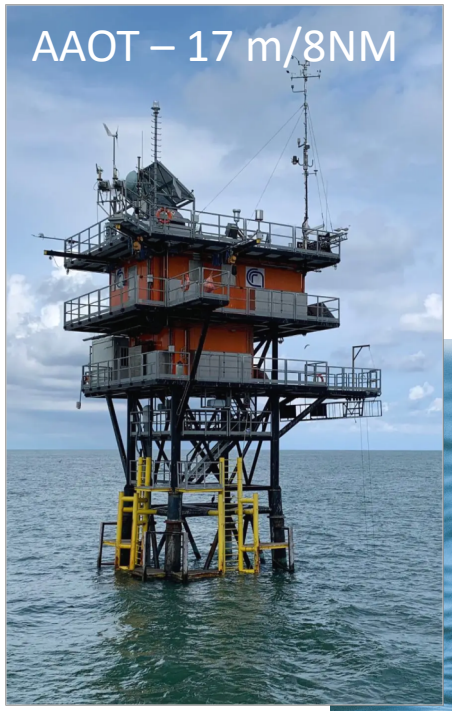
European Regional Development Fund

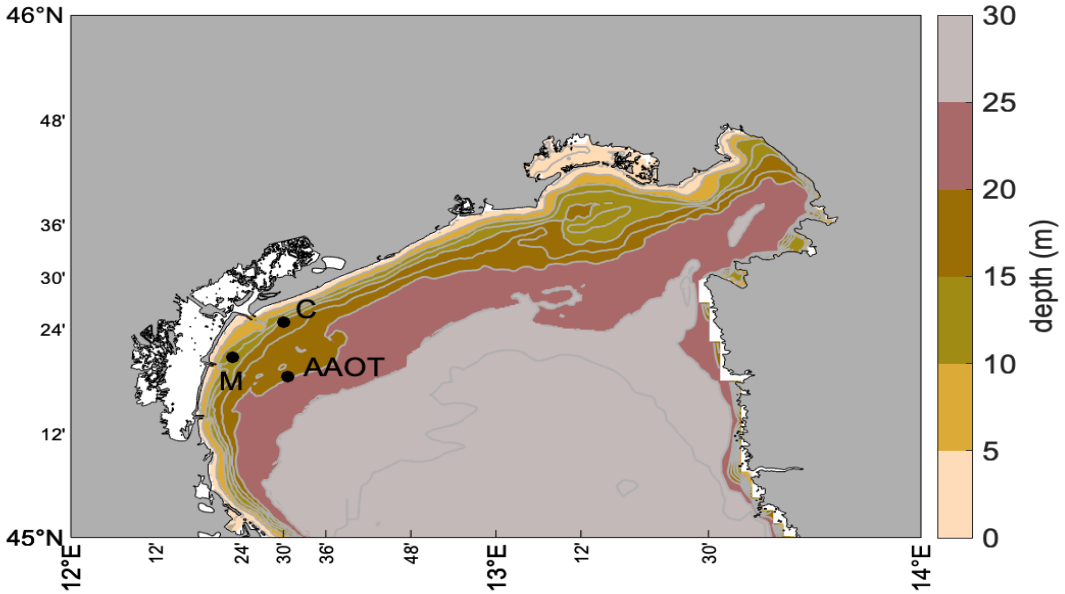
Overview

- STREAM coastal buoys data: getting closer to the Venice shoreline → flooding, erosion
- PELMO wave forecast system (AAOT)
- Future perspectives:
  - Model developments (thanks to coastal wave data)
  - Observational developments (new wave data)

STREAM coastal buoy data: getting closer to the shore

STREAM BUOYS deployed on 16/06/2022





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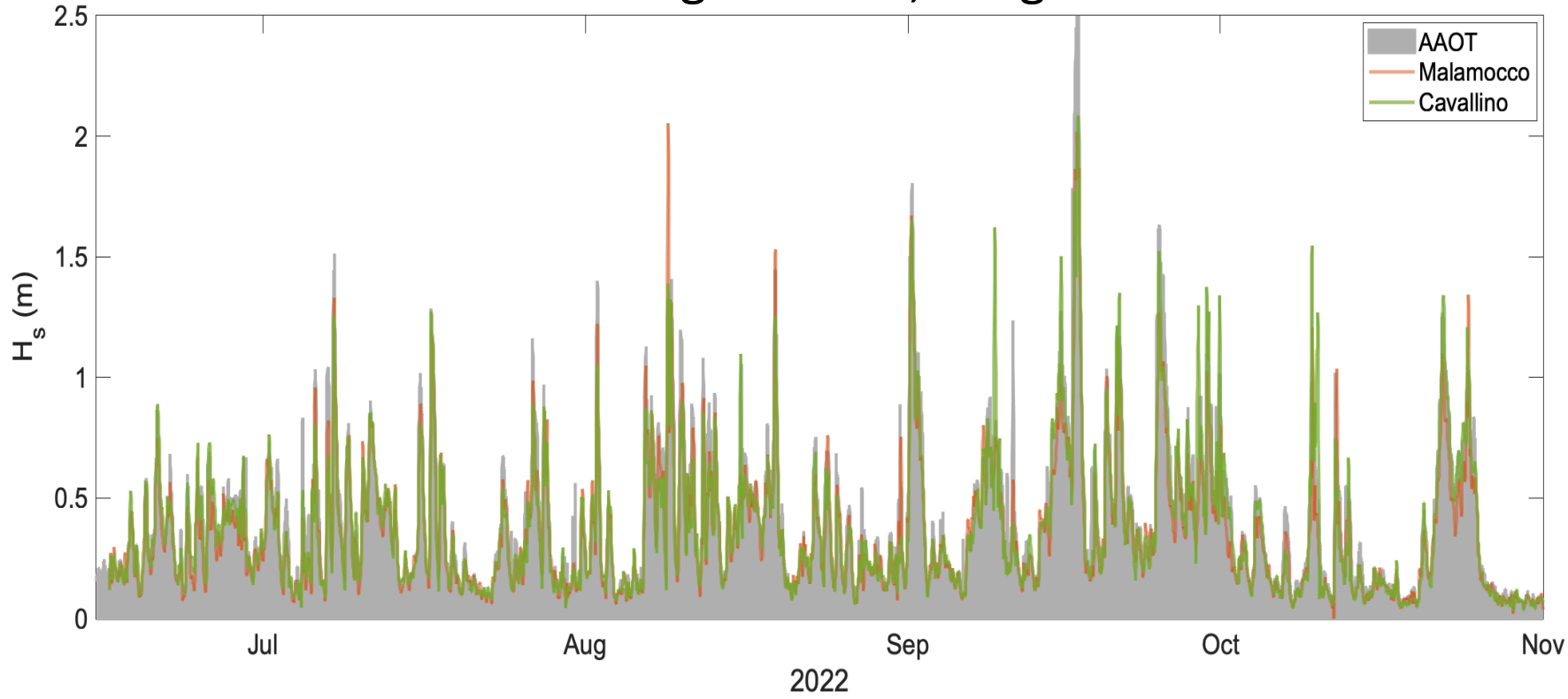
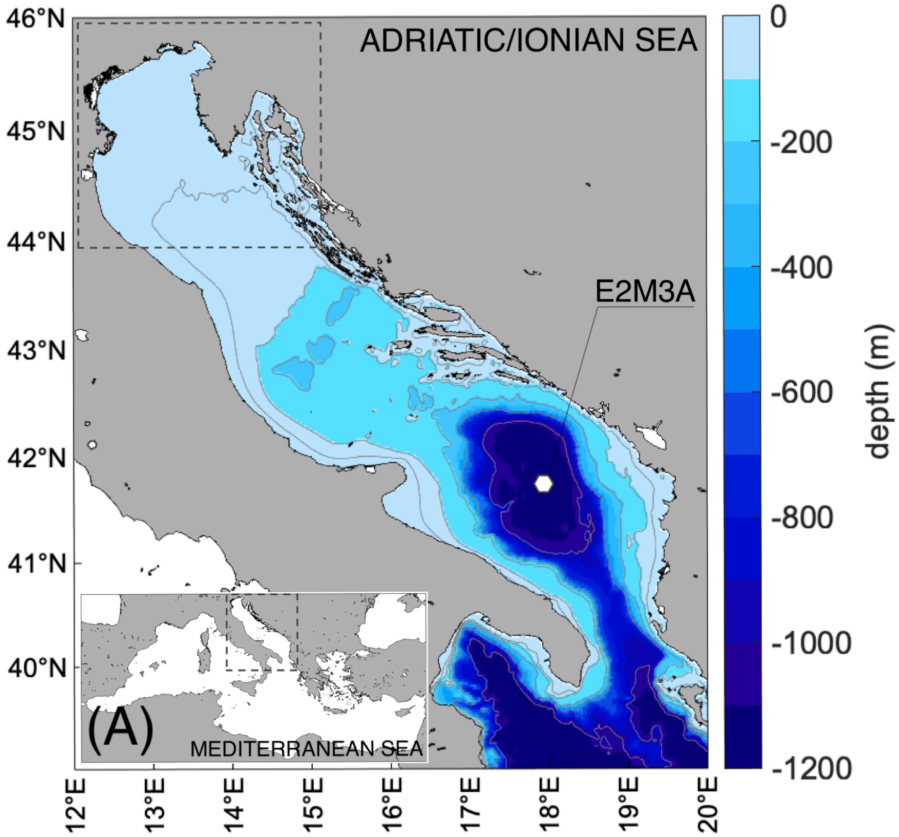
STREAM coastal buoy data: getting closer to the shore

First months of measurements: good data, in agreement with AAOT



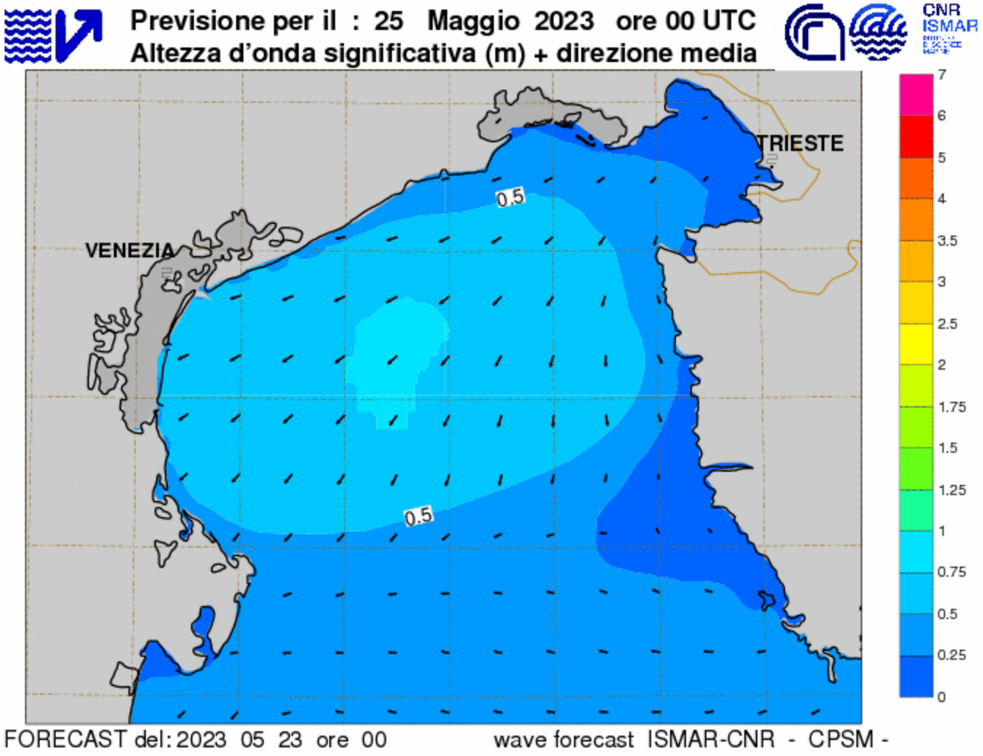
PELMO wave forecast system

- Adriatic Sea states forecast model
- Developed by CNR-ISMAR and CPSM (Venice municipality)
- Operational since 2021, forecast distributed since 2023 (twice day)
- Forced by ECMWF wind
- Based on state-of-the art WAVEWATCH III model



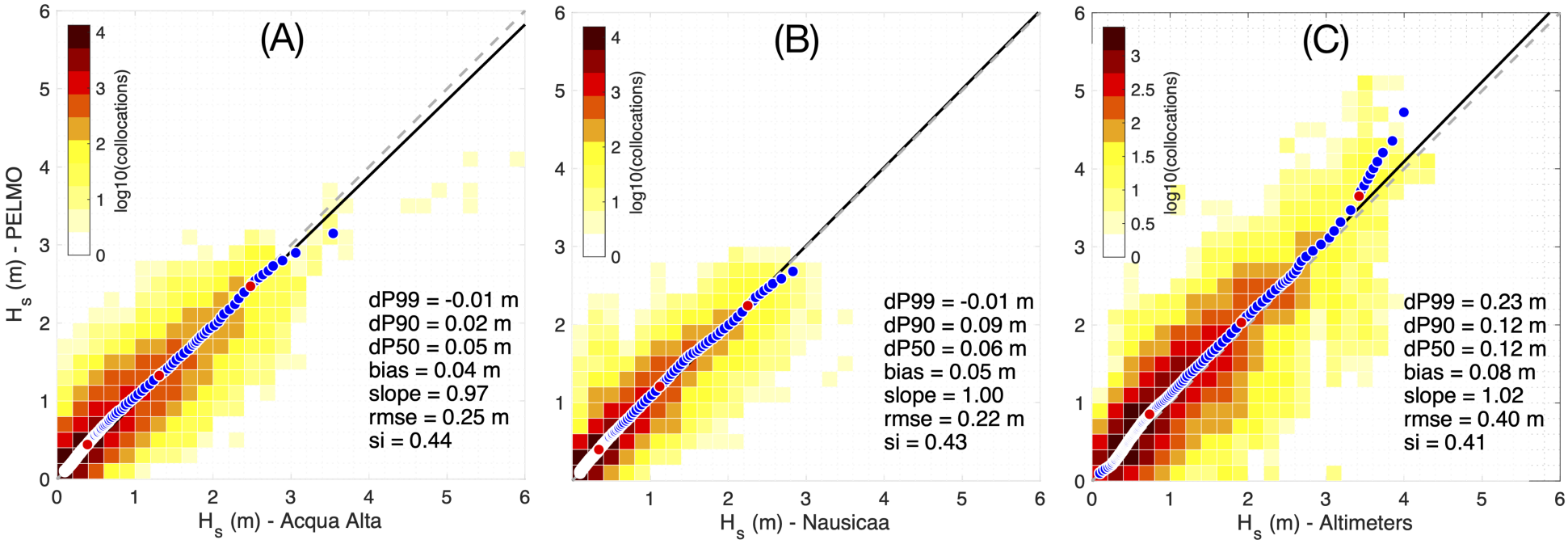
PELMO wave forecast system

- Targeted on the northern Adriatic Sea (Venice littoral) storms
- Wind correction to reduce the systematic error of ECMWF winds in the Adriatic enclosed basin (against scatterometers)
- Wave model calibration to further reduce the systematic error in wave forecast (against AAOT measurements)
- Target: 1 < Hs < 3 m (warnings)



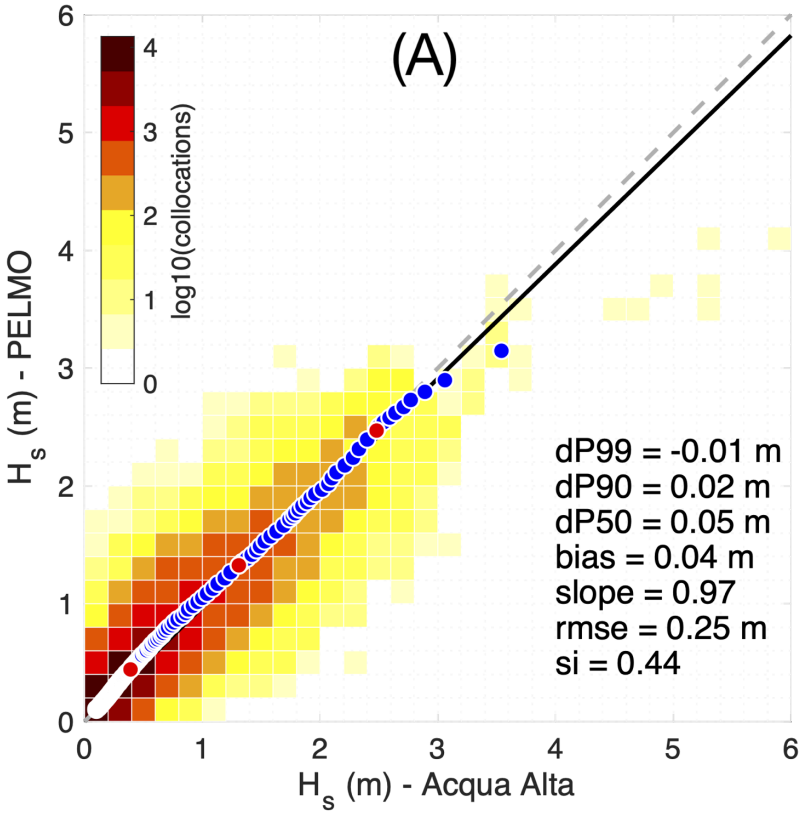
PELMO wave forecast system

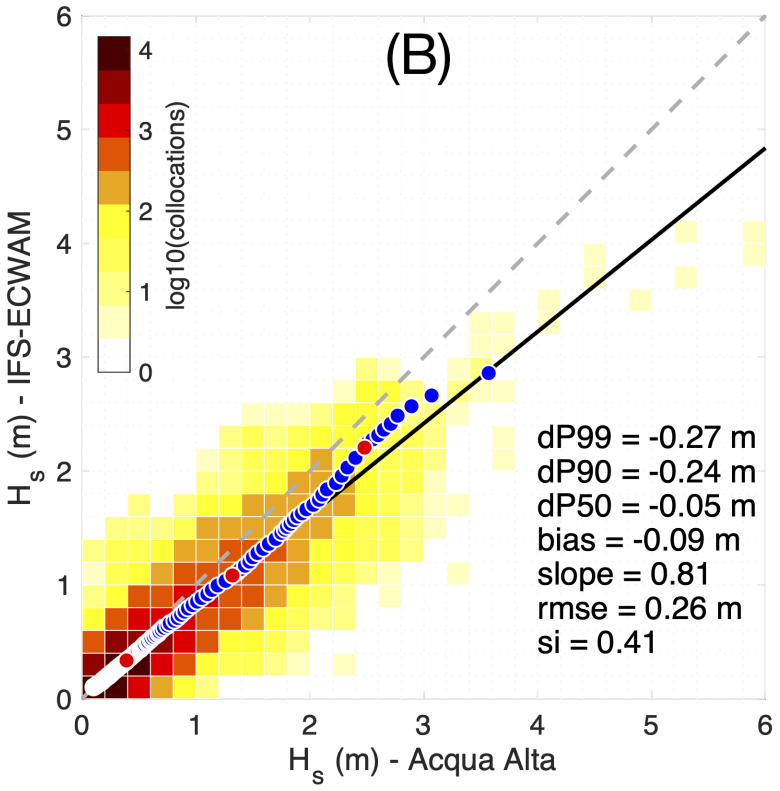
SKILLS at AAOT, Nausicaa buoy (Emilia Romagna shoreline) and altimeter tracks



PELMO wave forecast system

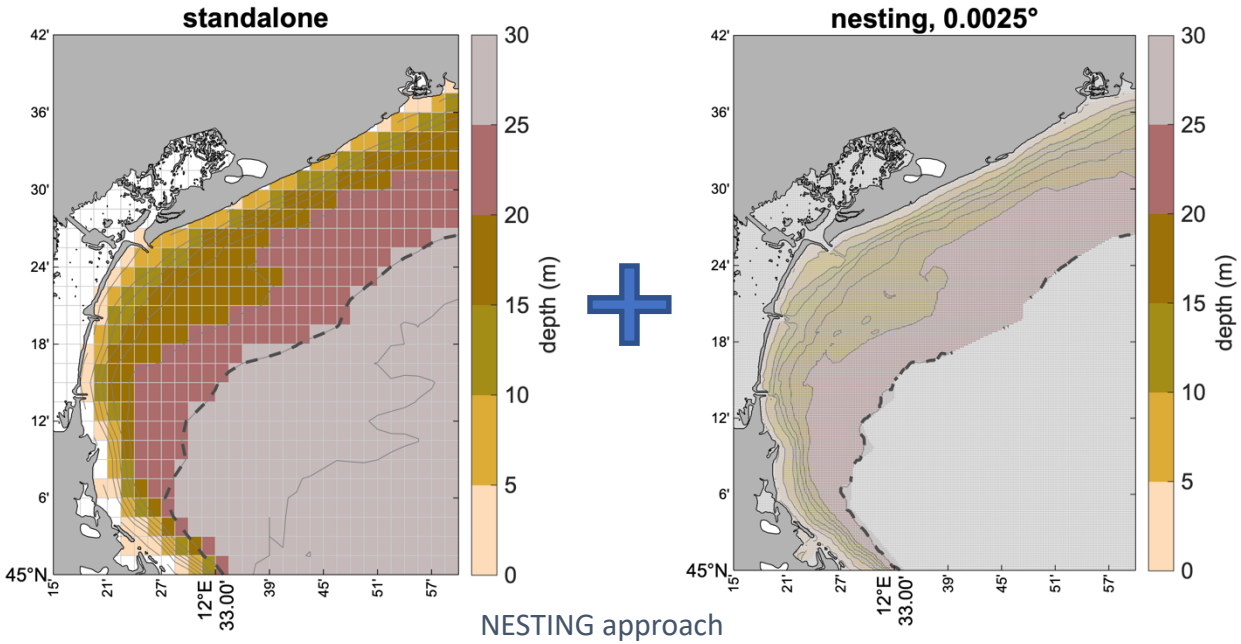
SKILLS compared to IFS-ECWAM model (no wind correction, no wave calibration)



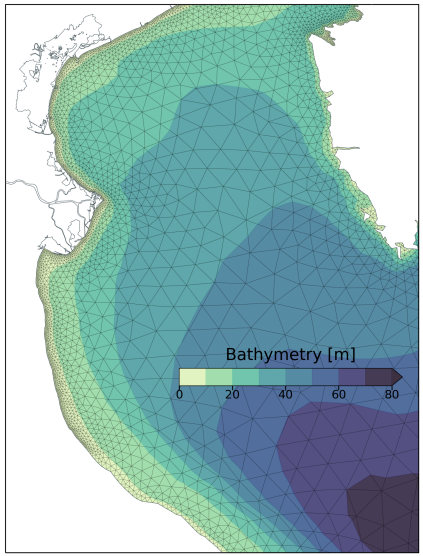


Future perspectives: model developments

1. Increasing the PELMO model resolution along the Veneto littoral (NESTING and UNSTRUCTURED modeling)
→ use of STREAM buoys data for validation of COASTAL FORECASTS



NESTING approach



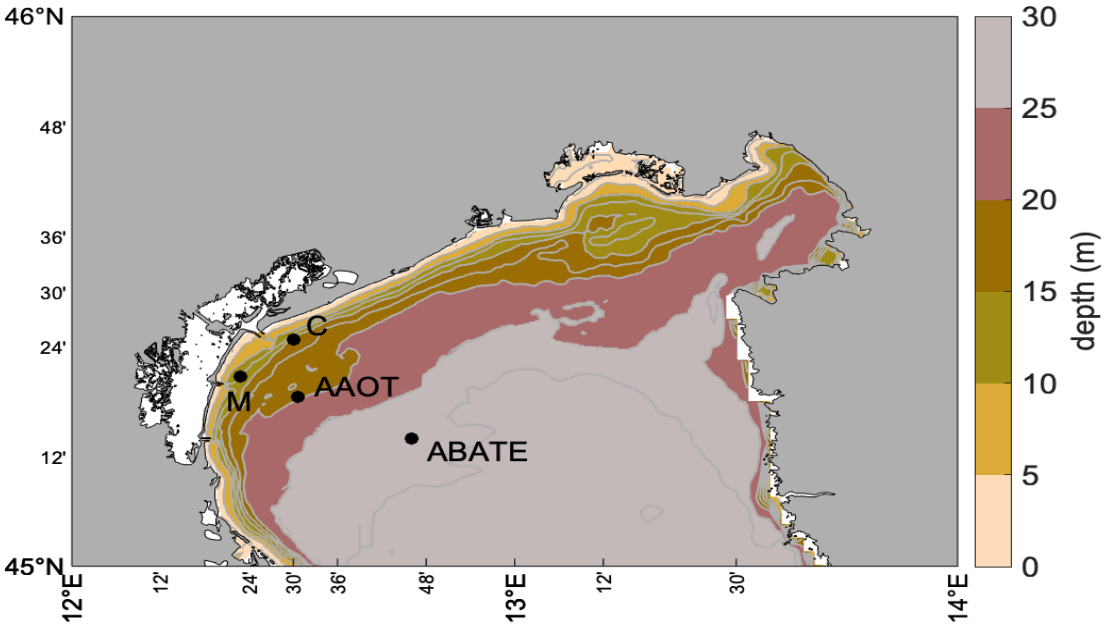
SHYFEM unstructured grid

2. COUPLED OCEAN-WAVE FORECASTING, to account for WCI effects on storm surge and waves (SHYFEM-WW3)

3. ENSEMBLE FORECASTING, to account for the uncertainty in the ECMWF wind forcings

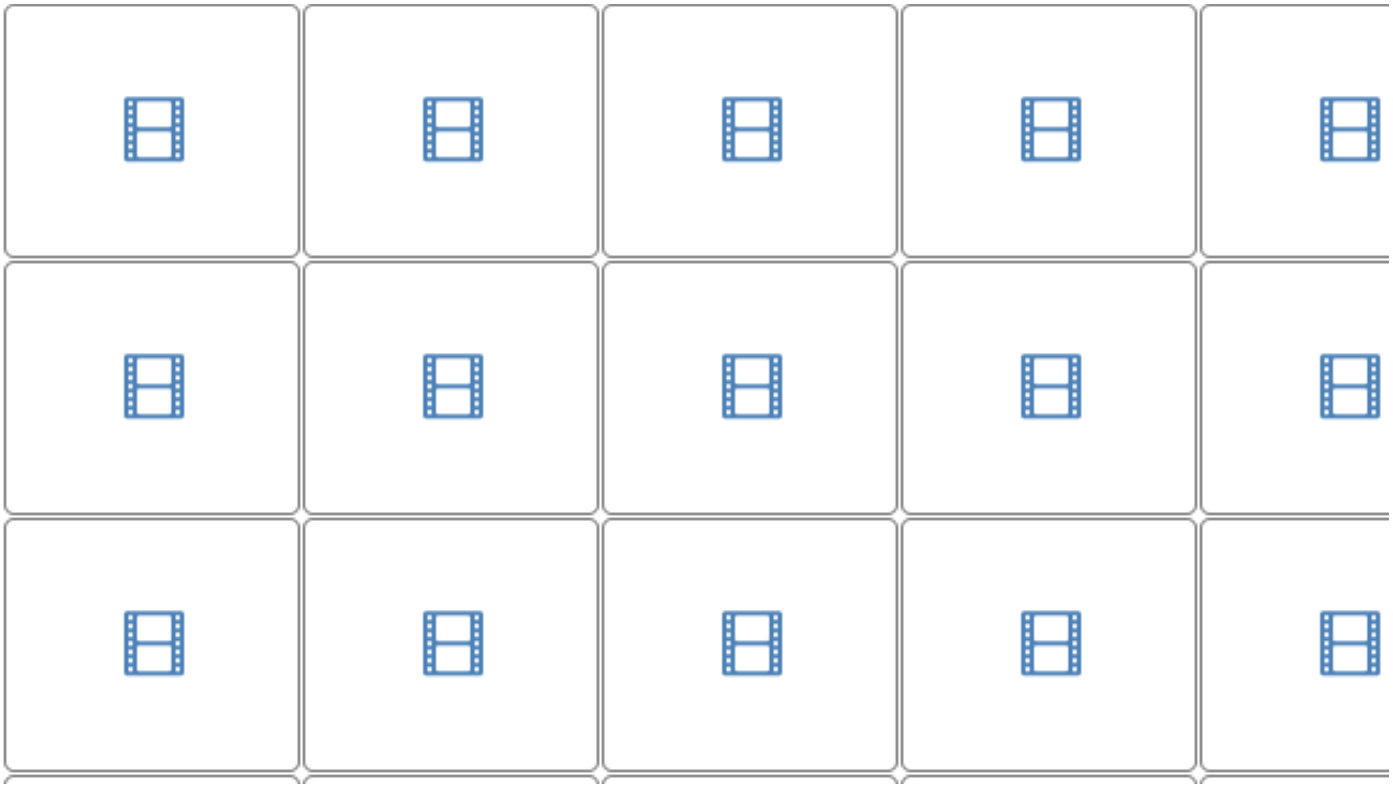
Future perspectives: observational developments

1. NEW wave data: SPOTTER buoy @ meda ABATE station (PNRR-ITINERIS project) – 20 NM



Future perspectives: observational developments

2. NEW wave data: ISPRA-RON buoy @ AAOT station (PNRR-MER project)



La rete ondametrica lungo la costa veneziana e i sistemi di previsione dello stato del mare

CNR-ISMAR

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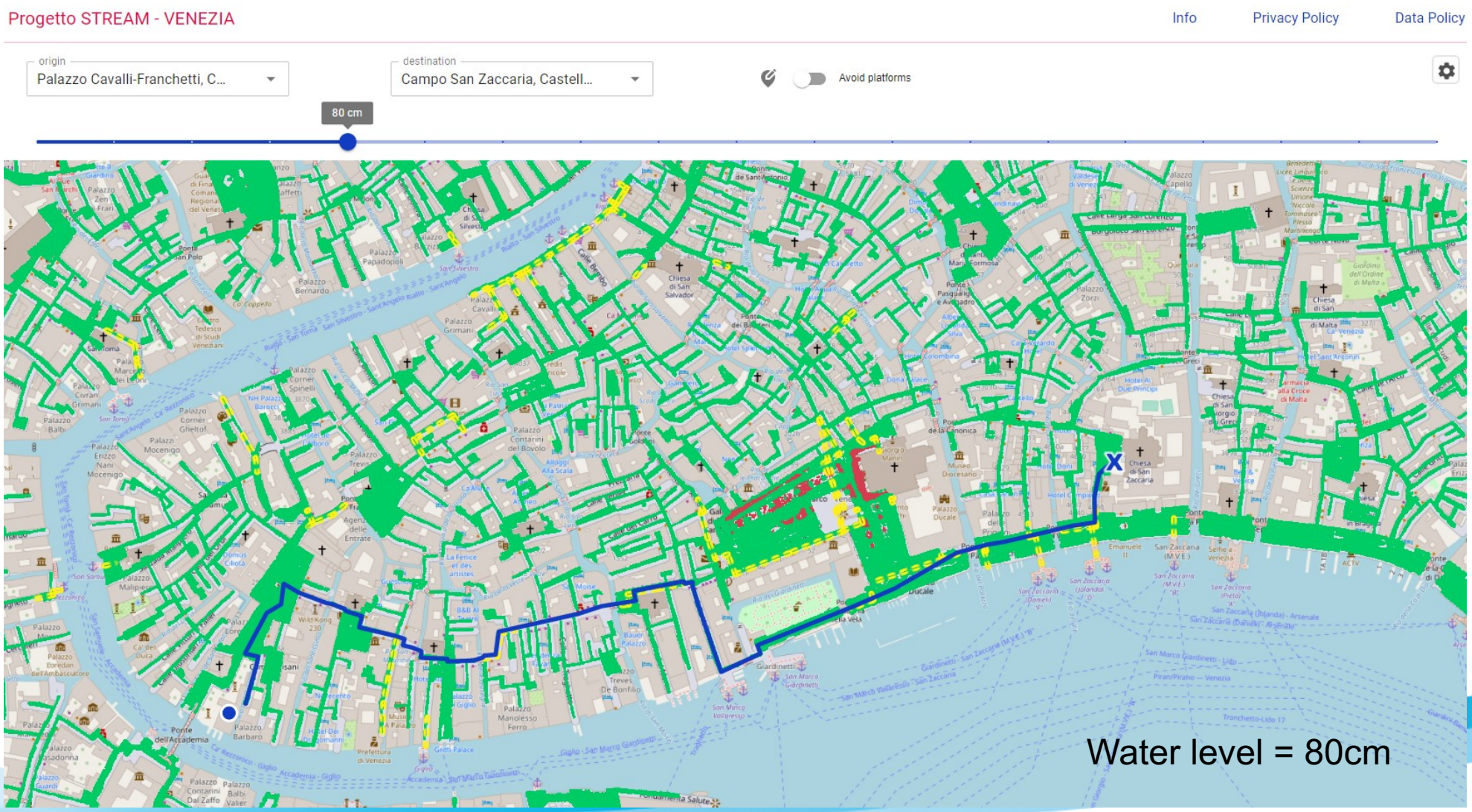
Dynamic flood map of Venice and dynamic sea storms map of Veneto region coast

STREAM| City of Venice | Amedeo Fadini

Final conference| Venice | 24 May 2023

European Regional Development Fund

Venice dynamic flood map with routing



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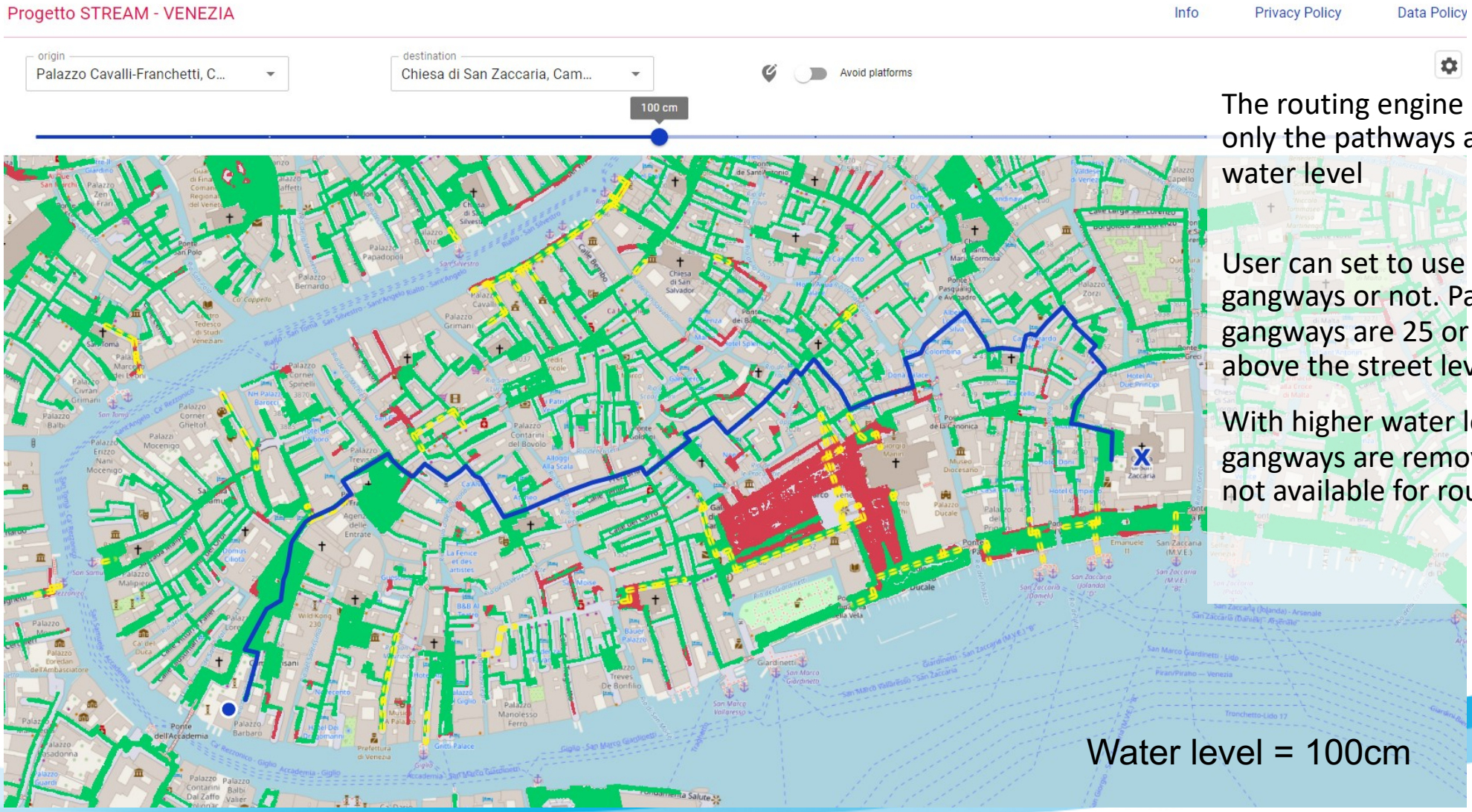
COMUNE DI VENEZIA

Centro Previsioni e Segnalazioni Maree

Venice dynamic flood map with routing



The routing engine consider only the pathways above the water level

User can set to use the gangways or not. Path with gangways are 25 or 50 cm above the street level.

With higher water level gangways are removed and not available for routing.

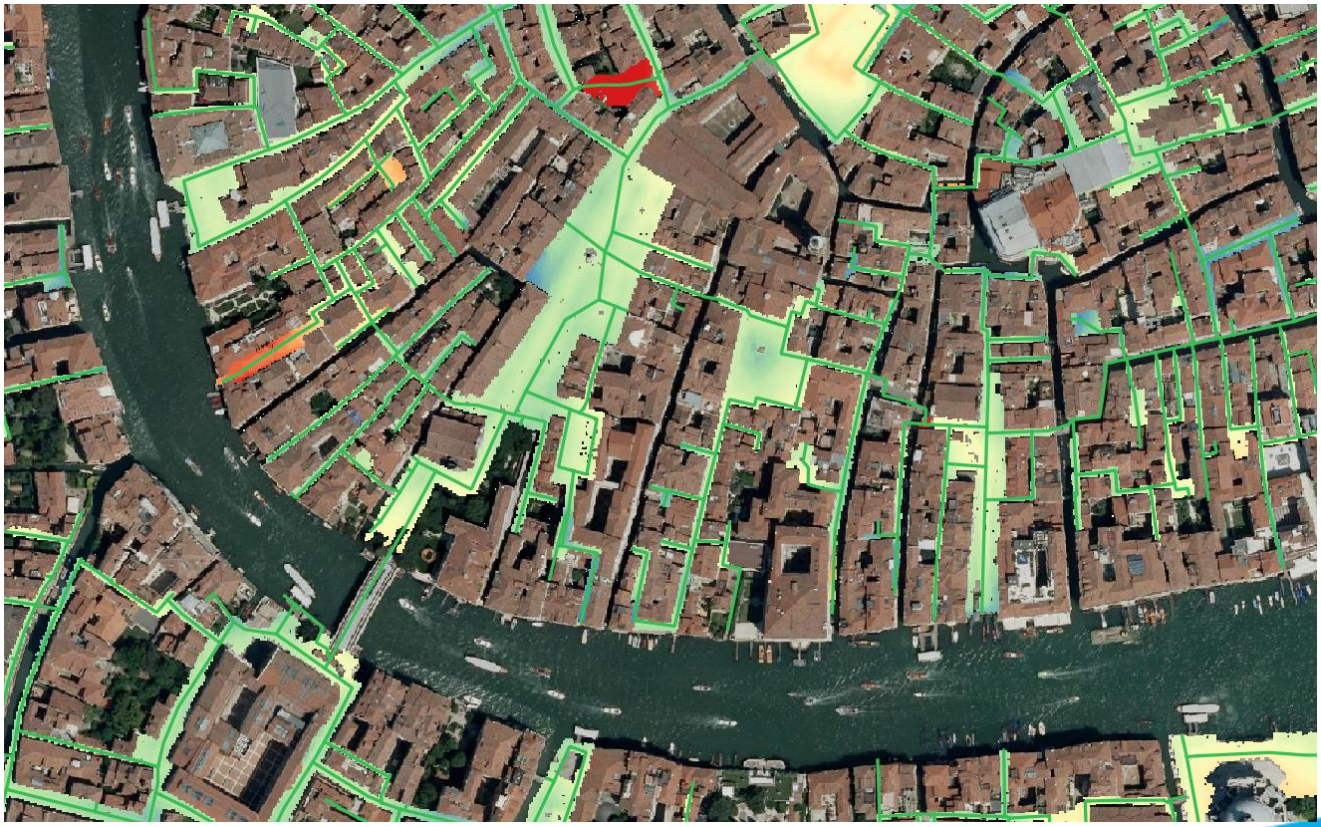
Input data

Accurate data about elevation of Venice streets are available from 2010 project RAMSES thet mapped all the city with LIDAR scan resulting in a contour map with 1cm steps. Quotes are referred to Punta della Salute

Some part of the city should be remapped.

The network of pedestrian street is quite complex and the available graphs still need to be improved for a good routing result

Indeed the arcs of the graph don’t lie on the more elevated part of the street, to verify if two nodes are connected at a given water level.

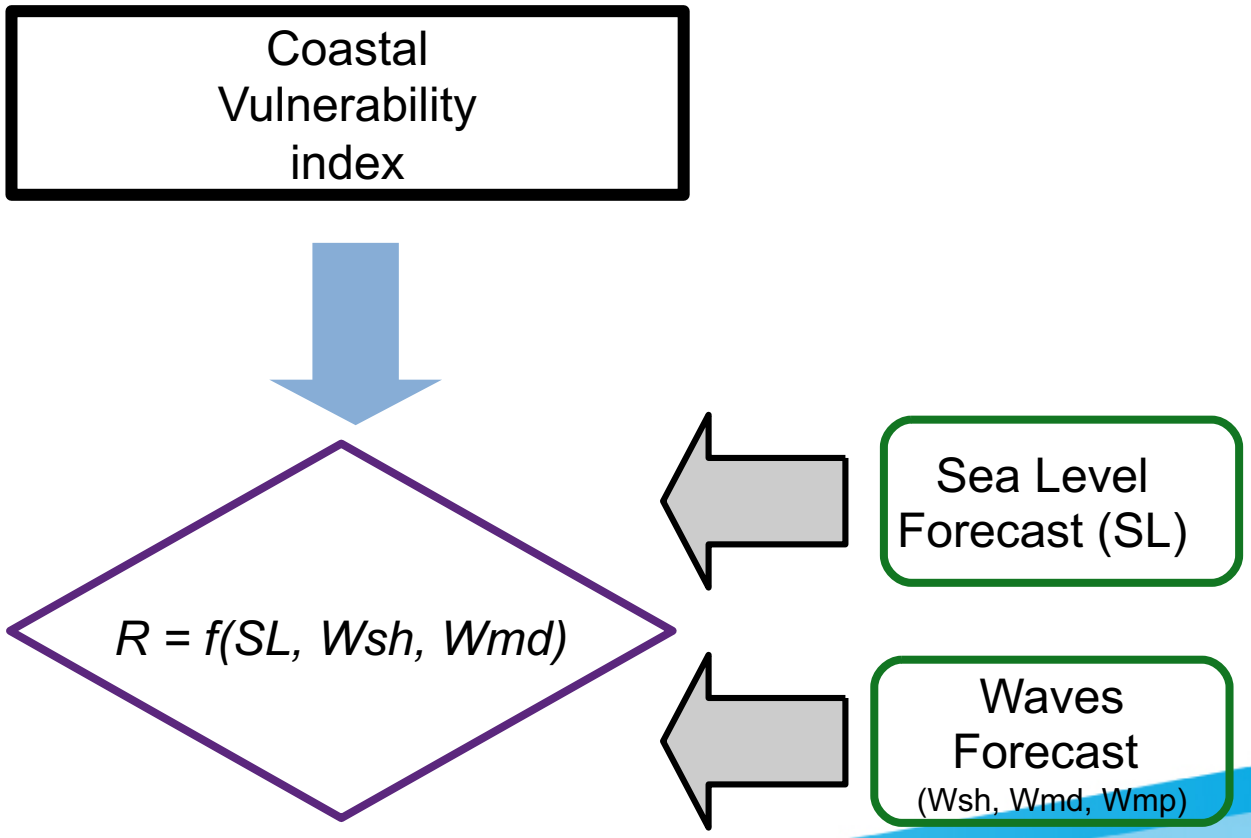


Dynamic coastal map

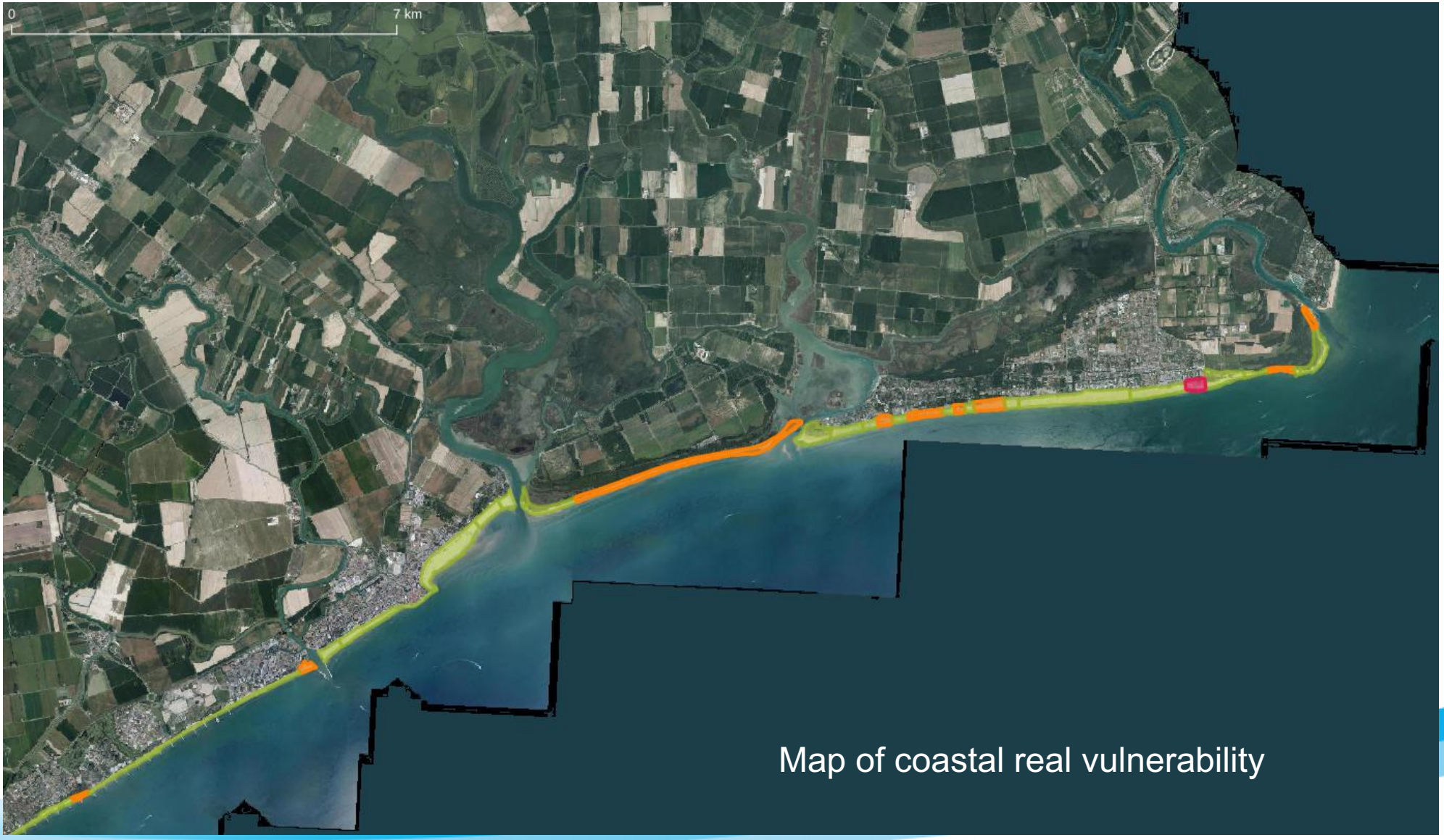
Starting rom vulnerability map of the coast of Veneto 7 coast sectors has been designated.

Every time that a new forecast model is available (daily) the software will get the time series of Sea Level and Waves.

For each sector a risk score is computed and showed in map



Dynamic coastal map



Map of coastal real vulnerability

Thank you for attention!