Mapping of flood risk in Emilia-Romagna coastal areas

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Flood risk in Emilia-Romagna coastal areas

The north-western Adriatic coast is exposed to a high - risk of flooding mainly due to exceptional sea level caused by storm surge.

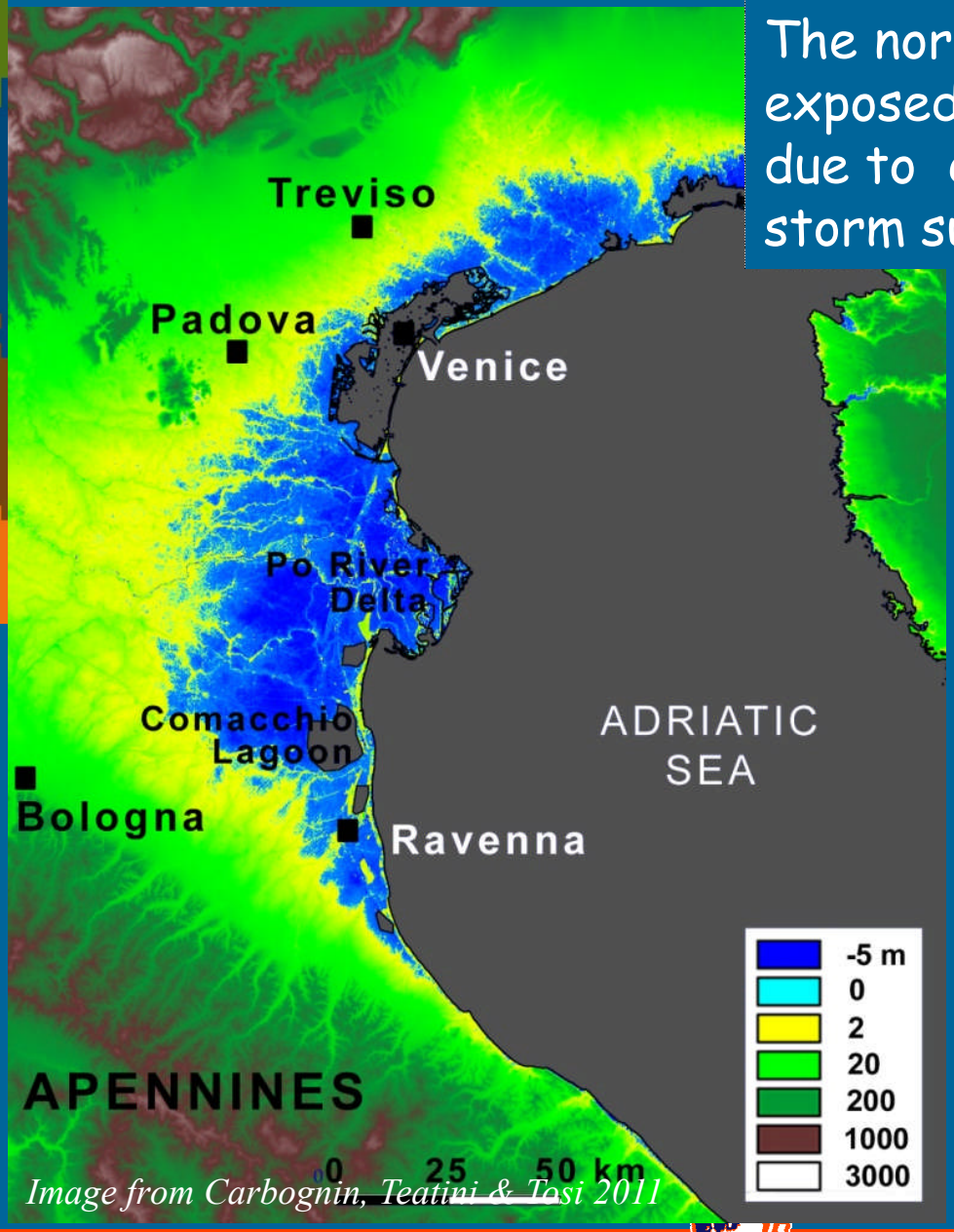


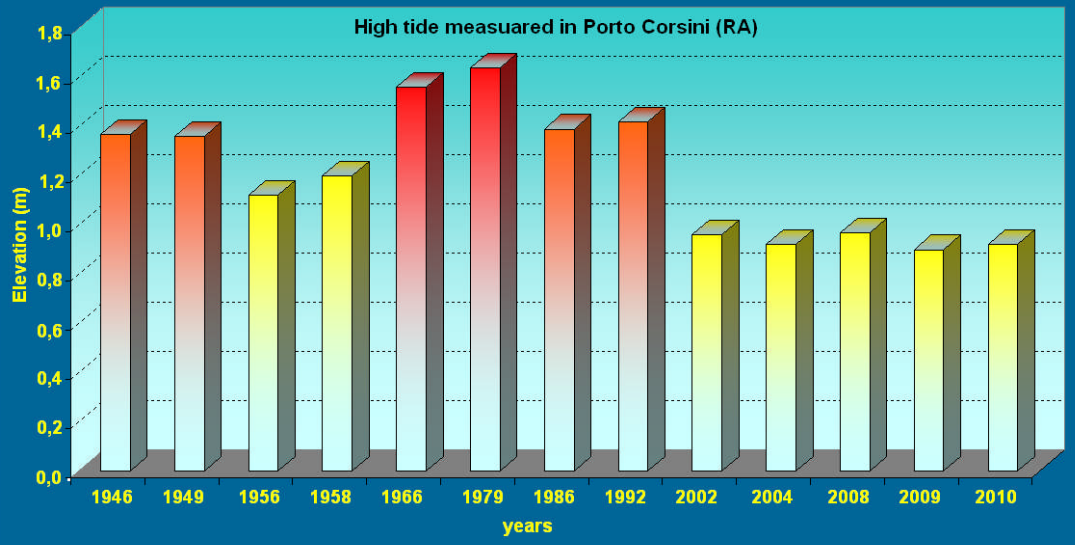
Image from Carbognin, Teatini & Tosi 2011

the risk is due to the extent of low-lying areas and to the high economic value of the coastal system

Physical factors

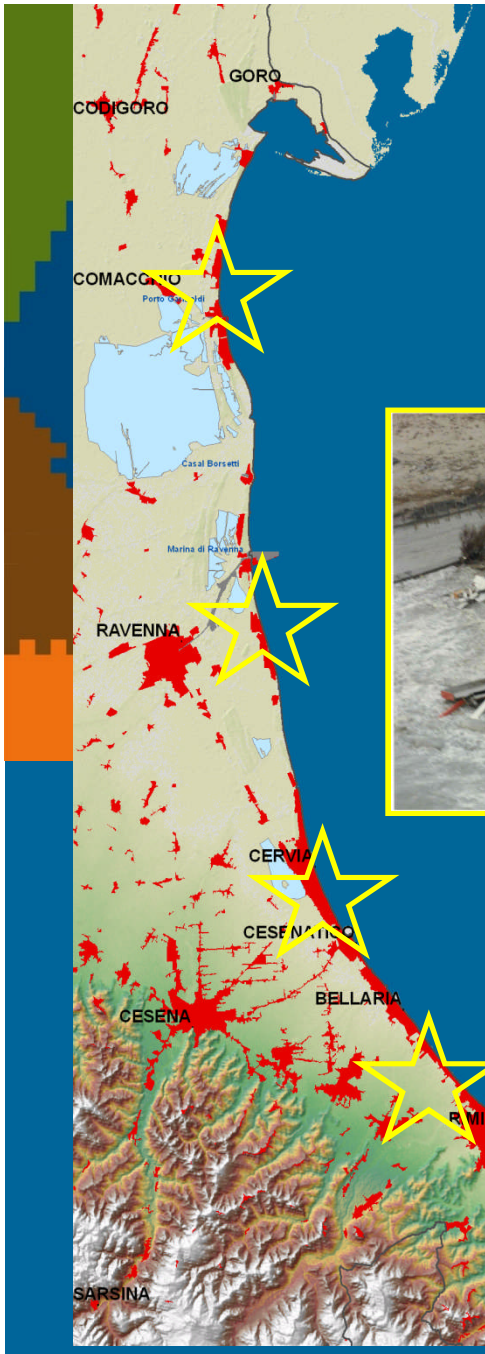
Storm surges are frequent in the Adriatic sea particularly during Autumn and Winter time; often associated to waves coming from south-east (Scirocco)

A detailed analysis of the maximum sea water levels and of the residual tide (surge component) was carried out by Masina & Ciavola within Micore project.

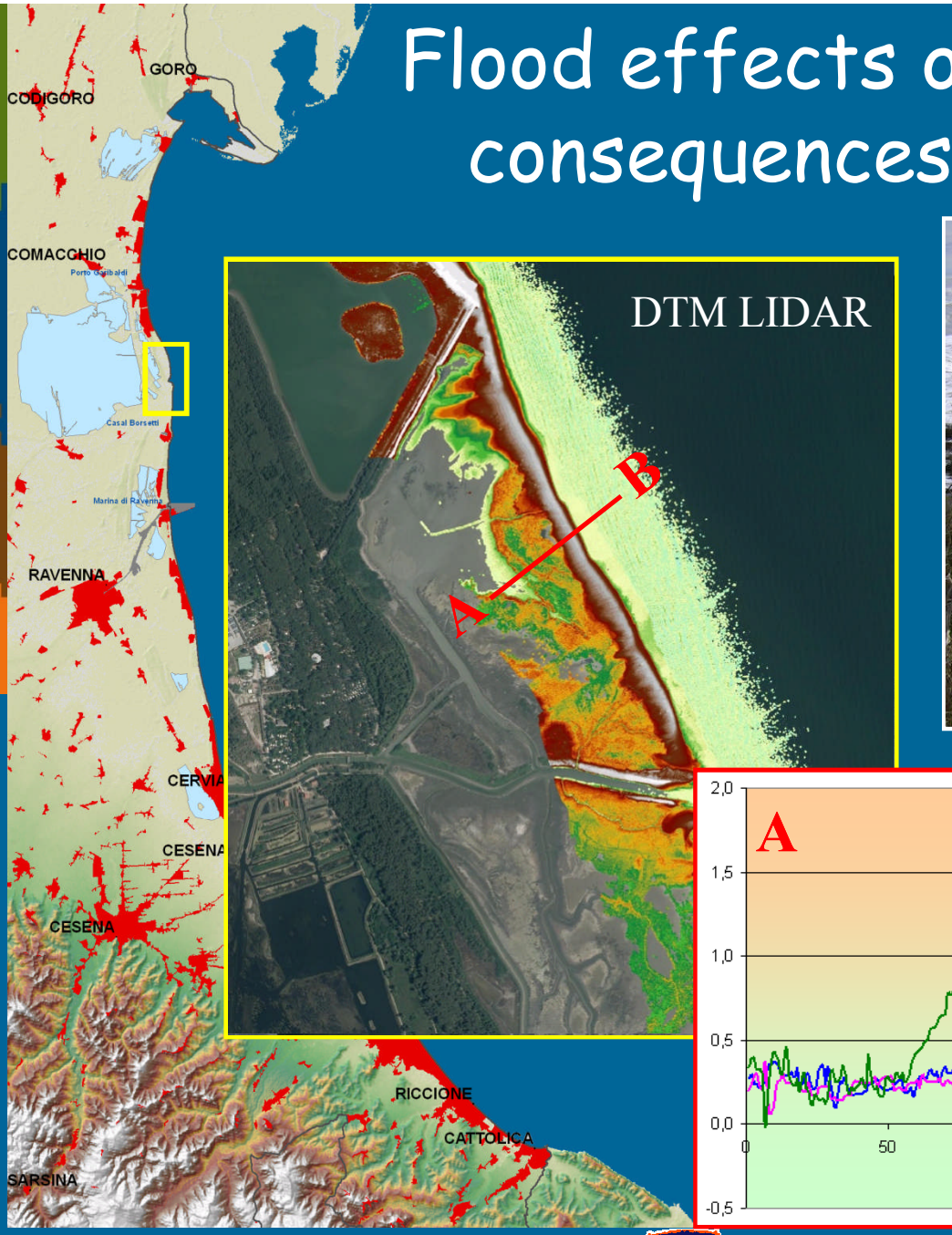


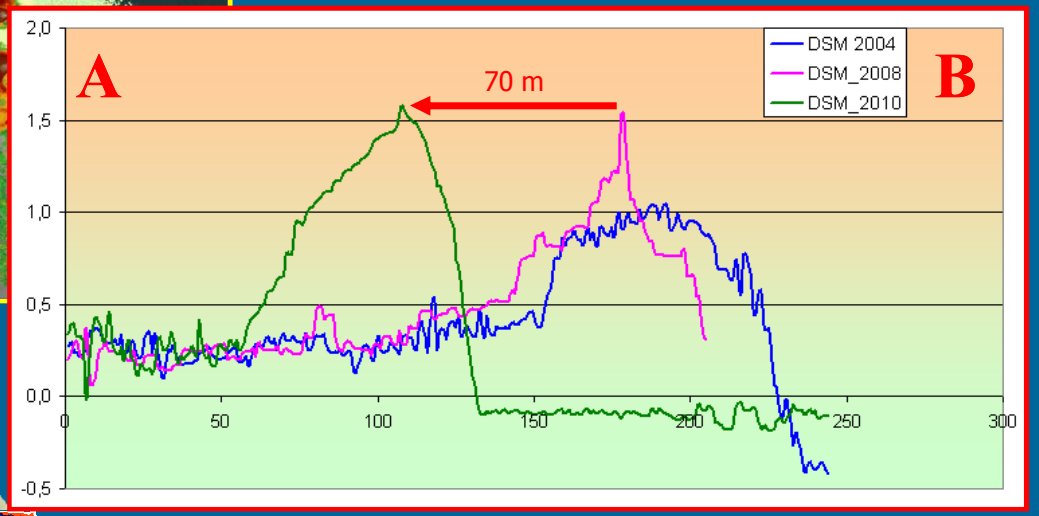
Return periods	Total water level	Residual tide
T2	0.85 m	0.61 m
T10	1.05 m	0.79 m
T100	1.28 m	1.02 m

flooding of urban areas and tourism infrastructures

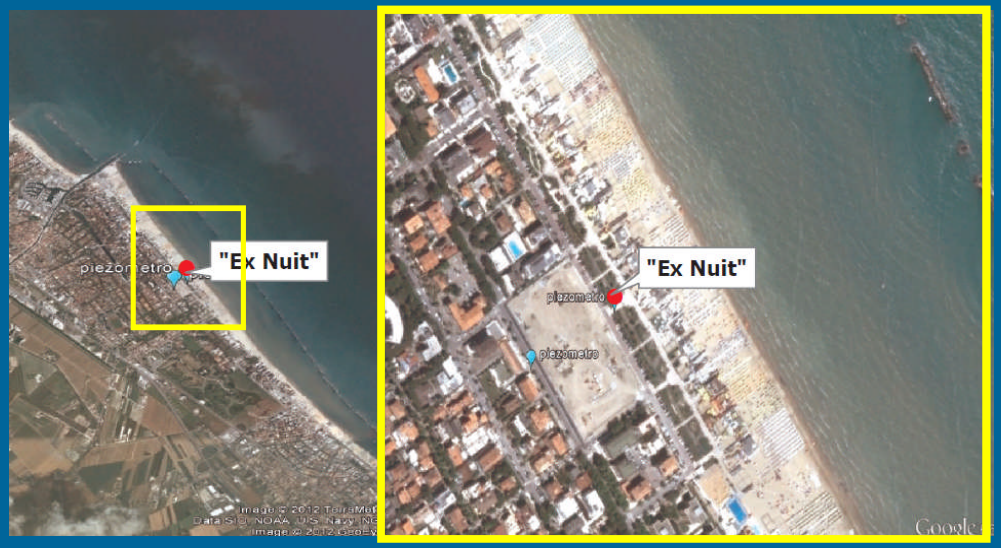


Flood effects on natural areas and consequences on the ecosystem

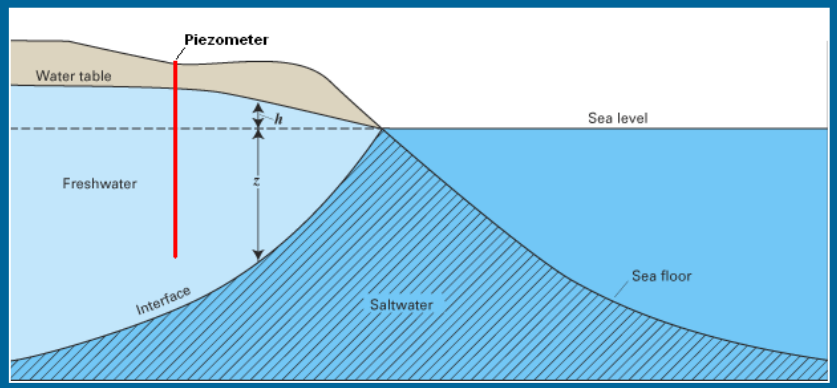


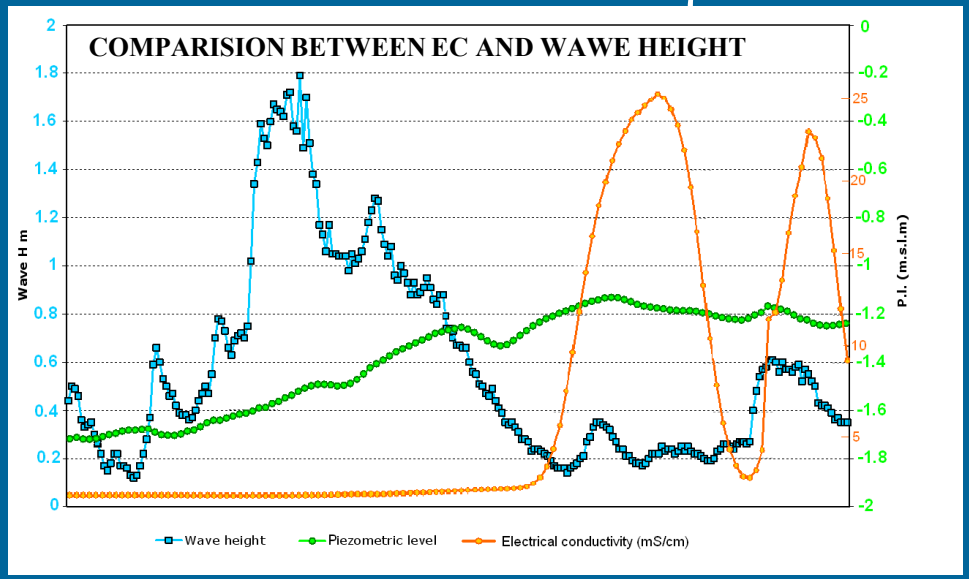


effects on the unconfined coastal aquifer



Measures of piezometric level and electrical conductivity (EC) reveal a strong connection between sea level and coastal aquifer parameters

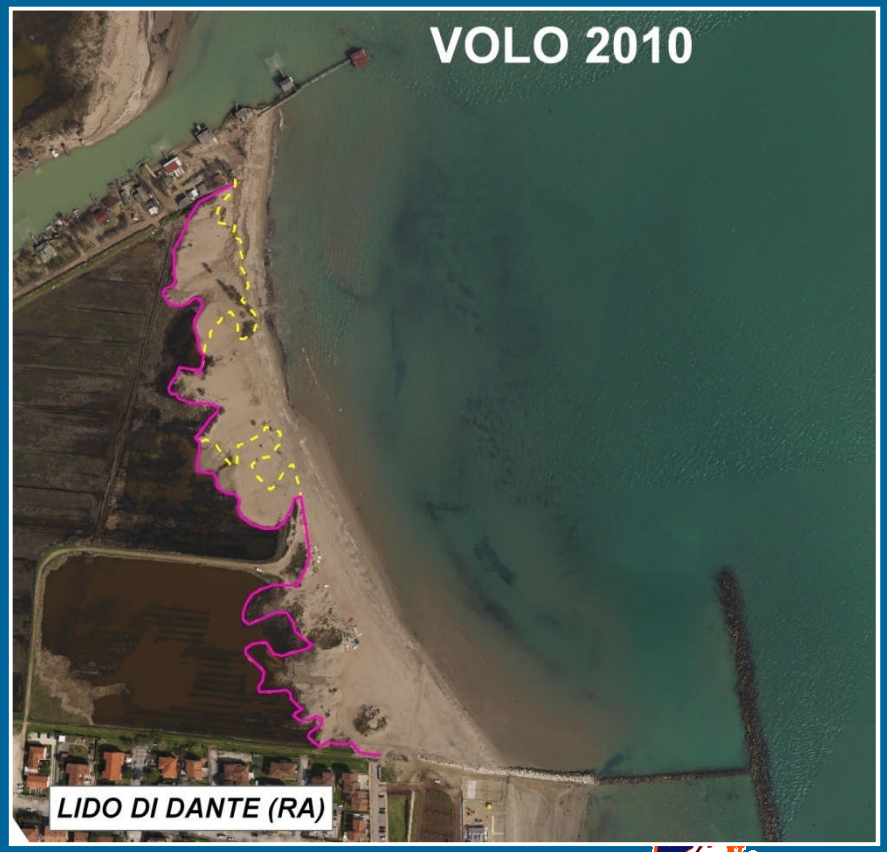




Studies and monitoring

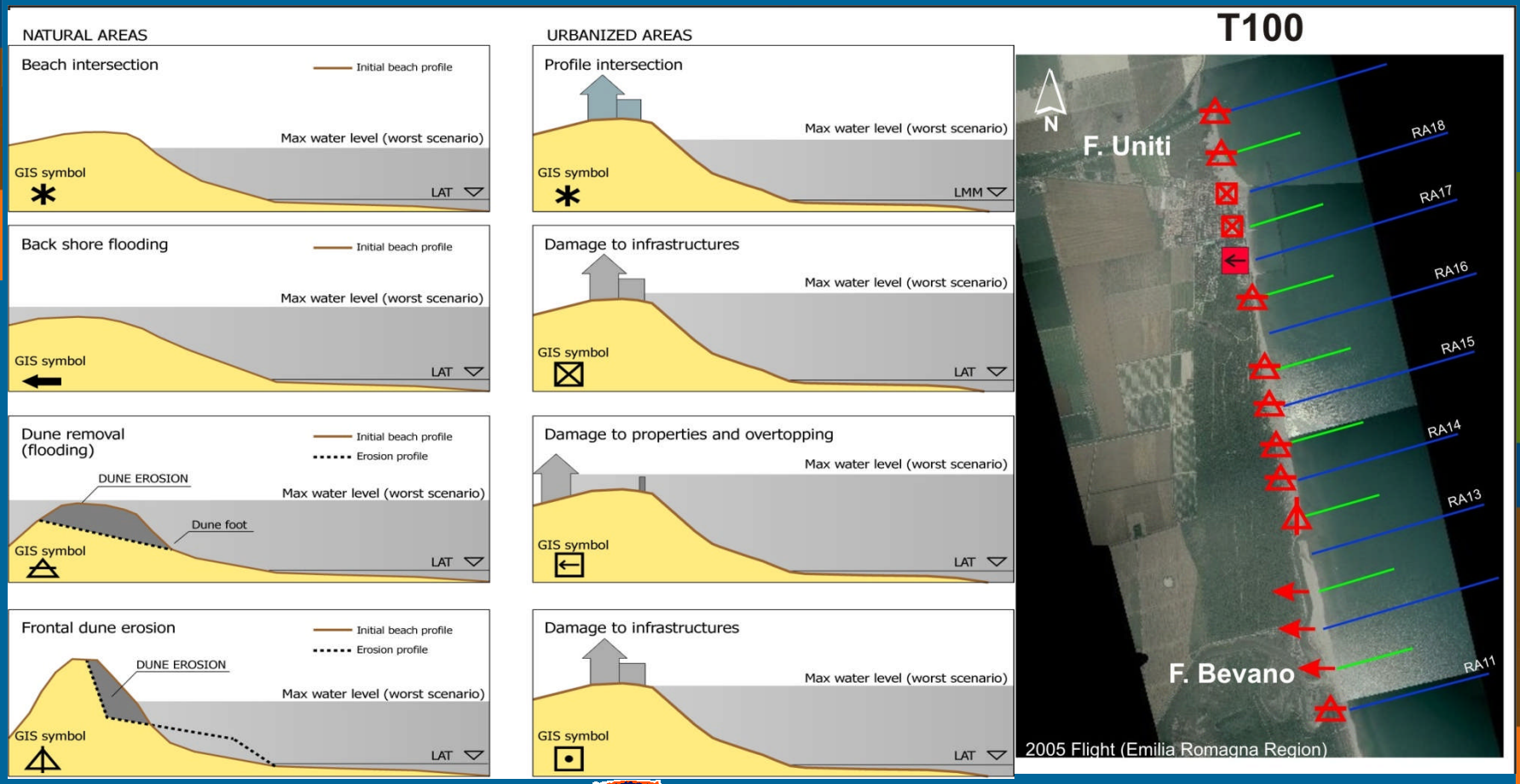
Classification of the most critical zones is based on:

- Morphological features
- Monitoring of post-event impacts



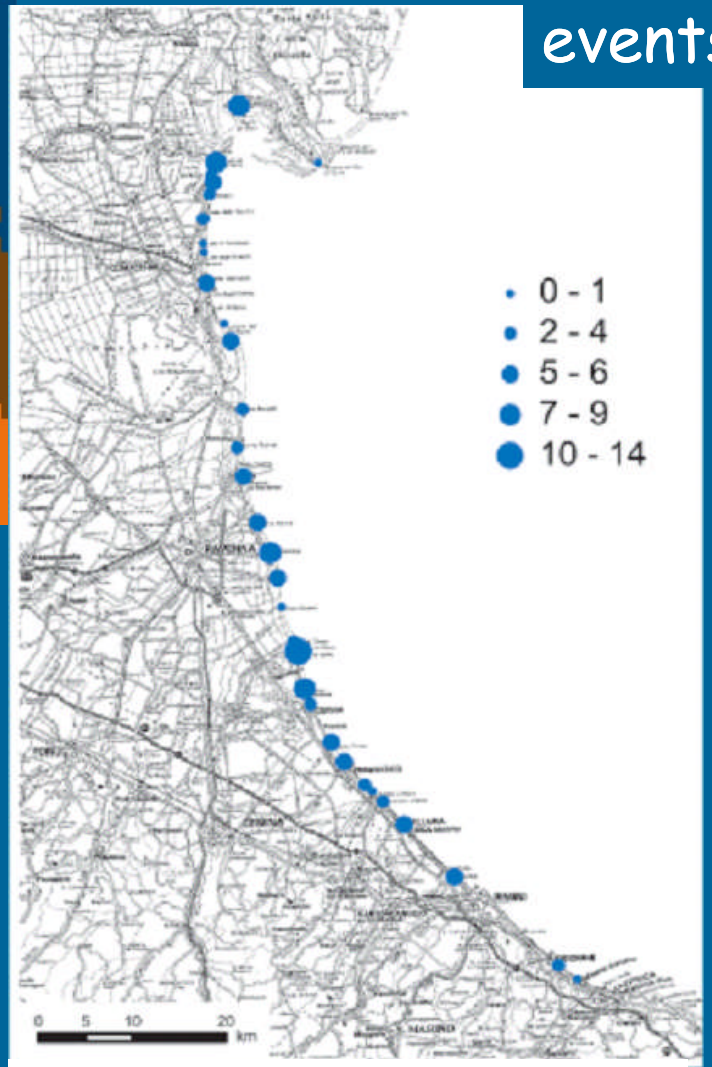
Run-up evaluation

for T1 – T10 – T100 return periods.
Analysis carried out along transects spaced 500 m - in collaboration with Unife (Armaroli C., Ciavola P., Masina M.)

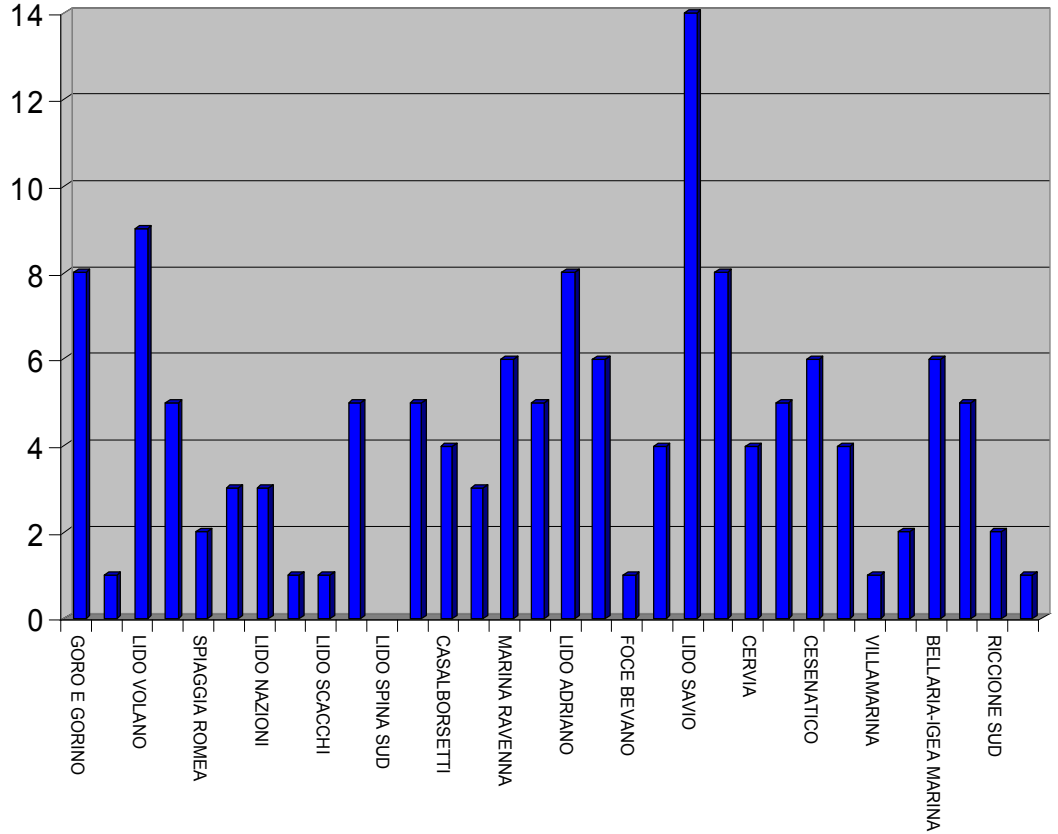


Historical storm database

31 localities recorded flooding events in the period 1946-2010



Sea flooding



A new method to produce hazard maps

The new target is the risk maps as expected by Directive 2007/60/EC (EFD) -Dlgs 49/2010

The first step, by June 2013, flood hazard maps

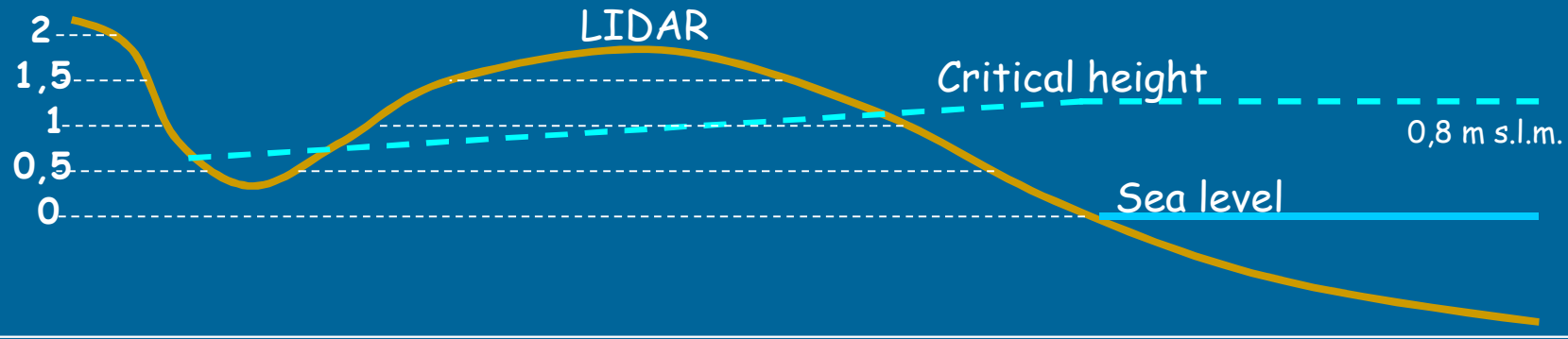
No standard protocol at national &/or european level

No specific funds dedicated at present

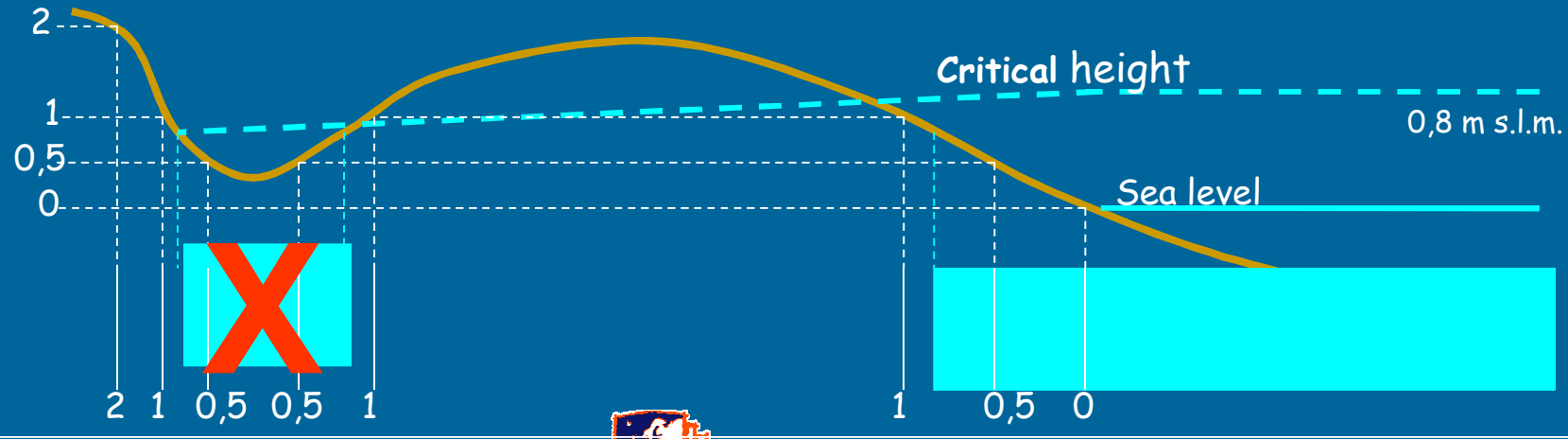
Conceptual method based on GIS

It's a first step of a complex procedure that requires availability of Lidar data and of the historical sea storm parameters to provide the scenarios

Comparison between topographic surface and sea level for a given hazard scenario



Identification of the pathway & exclusion of "isolated" depressed areas

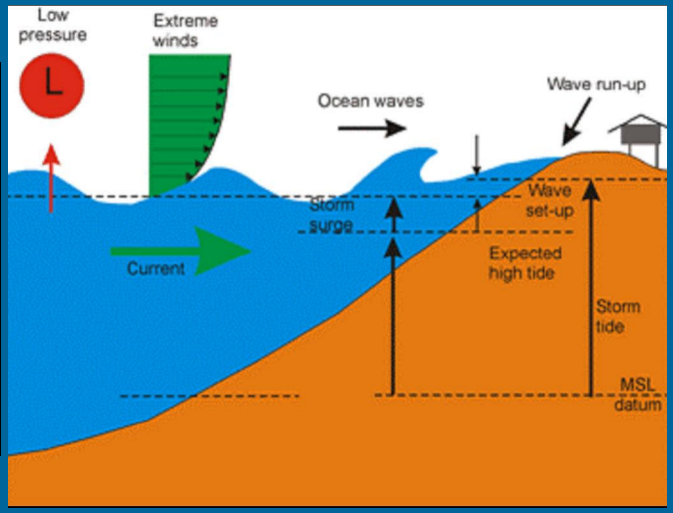


Hazard scenarios

The considered scenarios combine:

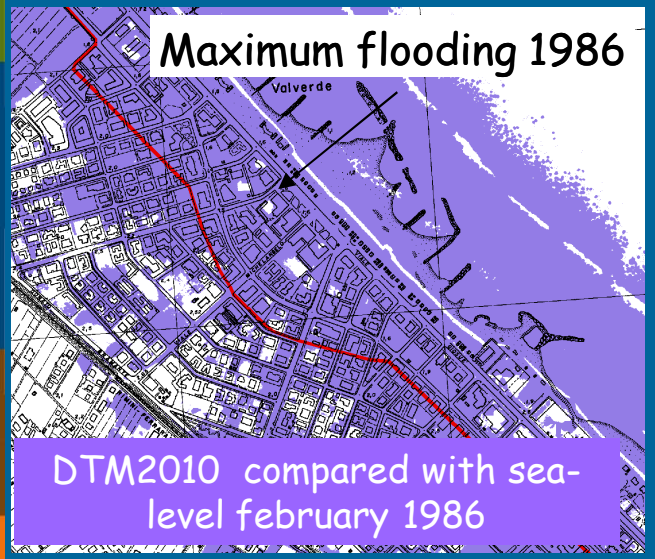
storm surge + astronomical tide + wave set up

Tr (Years)	Surge	Mean high tide	Set-up	Total elevation sea surface
Tr 1	H critic = 0,61	0,4	0,22	1,22 m
Tr 10	H critic = 0,79	0,4	0,3	1,49 m
Tr100	H critic = 1,02	0,4	0,39	1,81 m

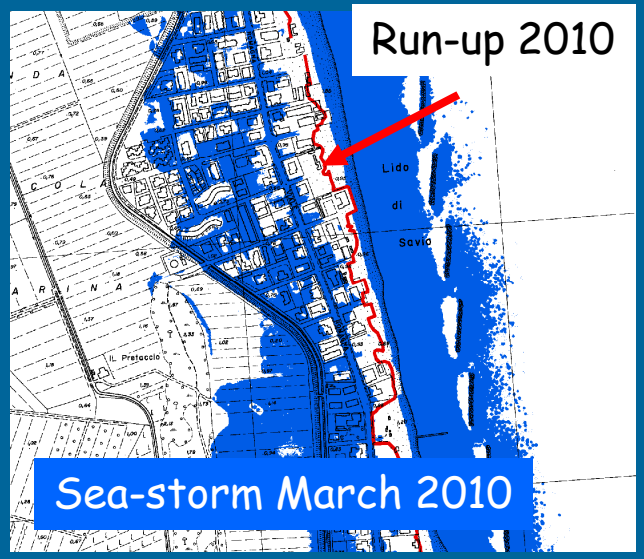


Values are derived from literature and compared to historical data from sea-storm catalogue

The damping component

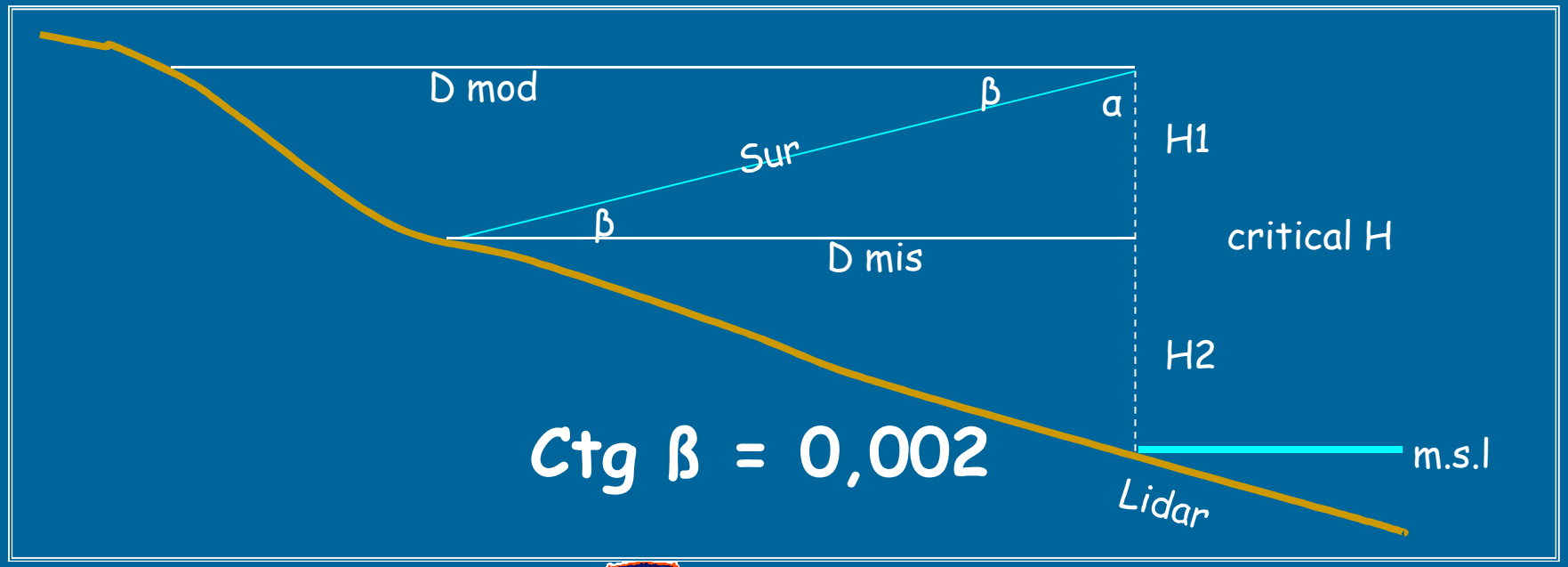


DTM2010 compared with sea-level february 1986



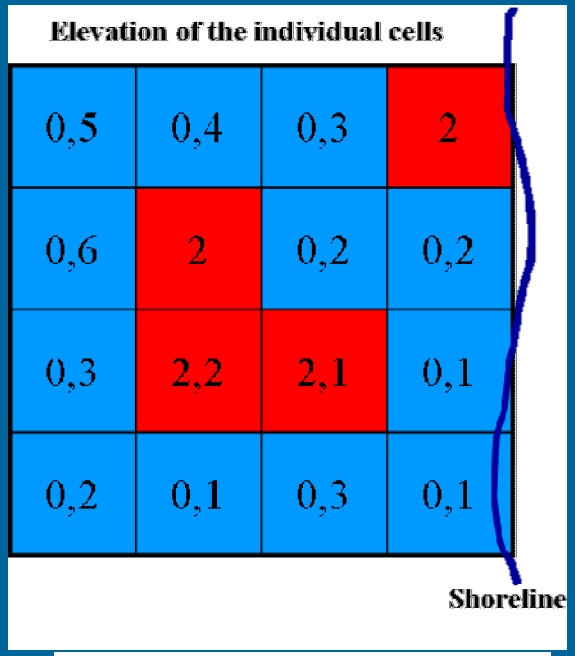
Sea-storm March 2010

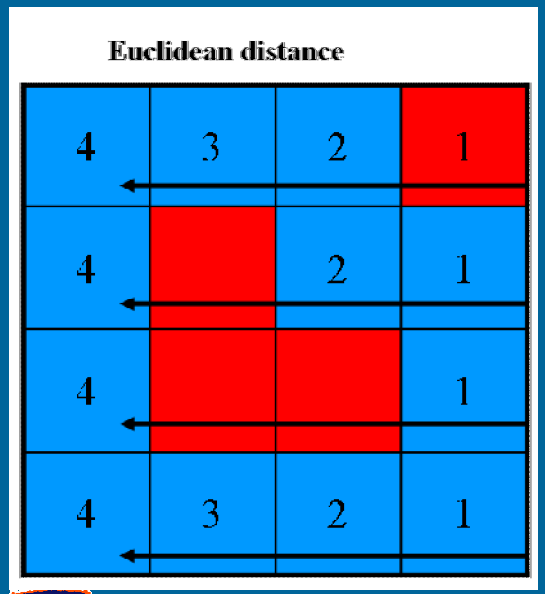
defined comparing the maximum run-up and flooding lines corresponding to real past events

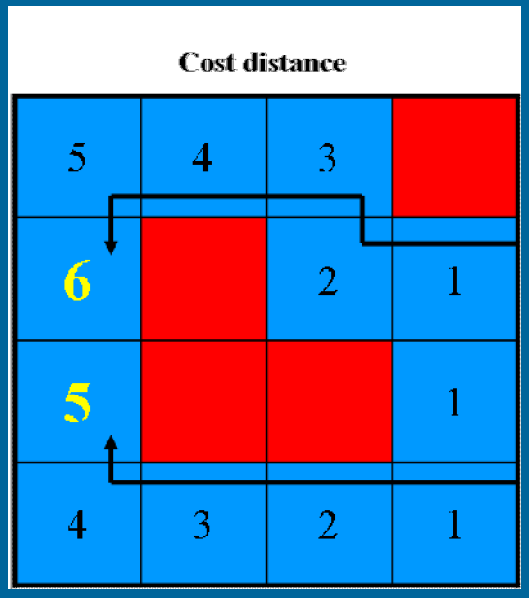


The GIS matrix

Defined the shortest paths for the water to reach the different areas - analysis by ArcGIS tool **Cost Distance Spatial Analyst**.



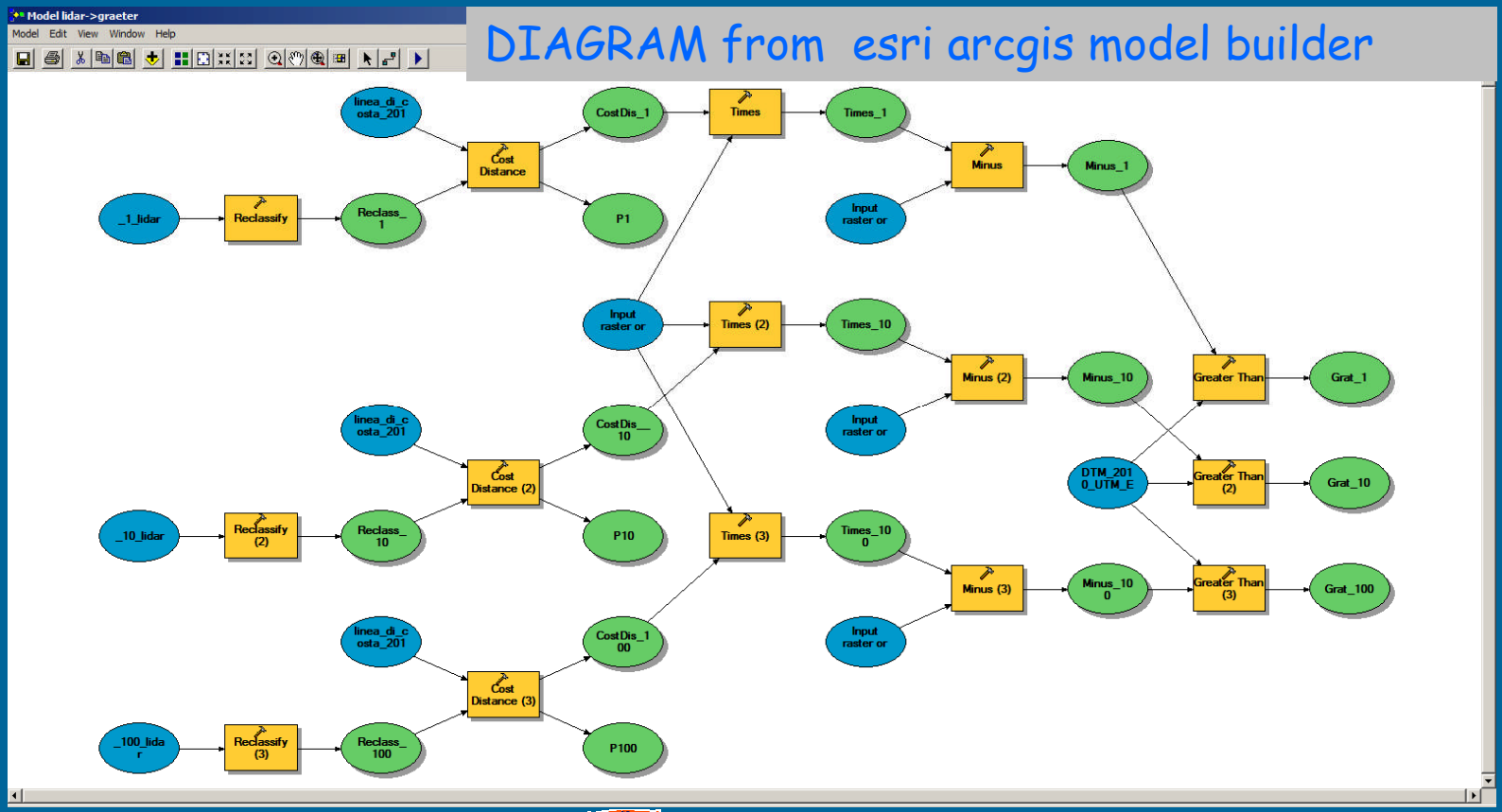




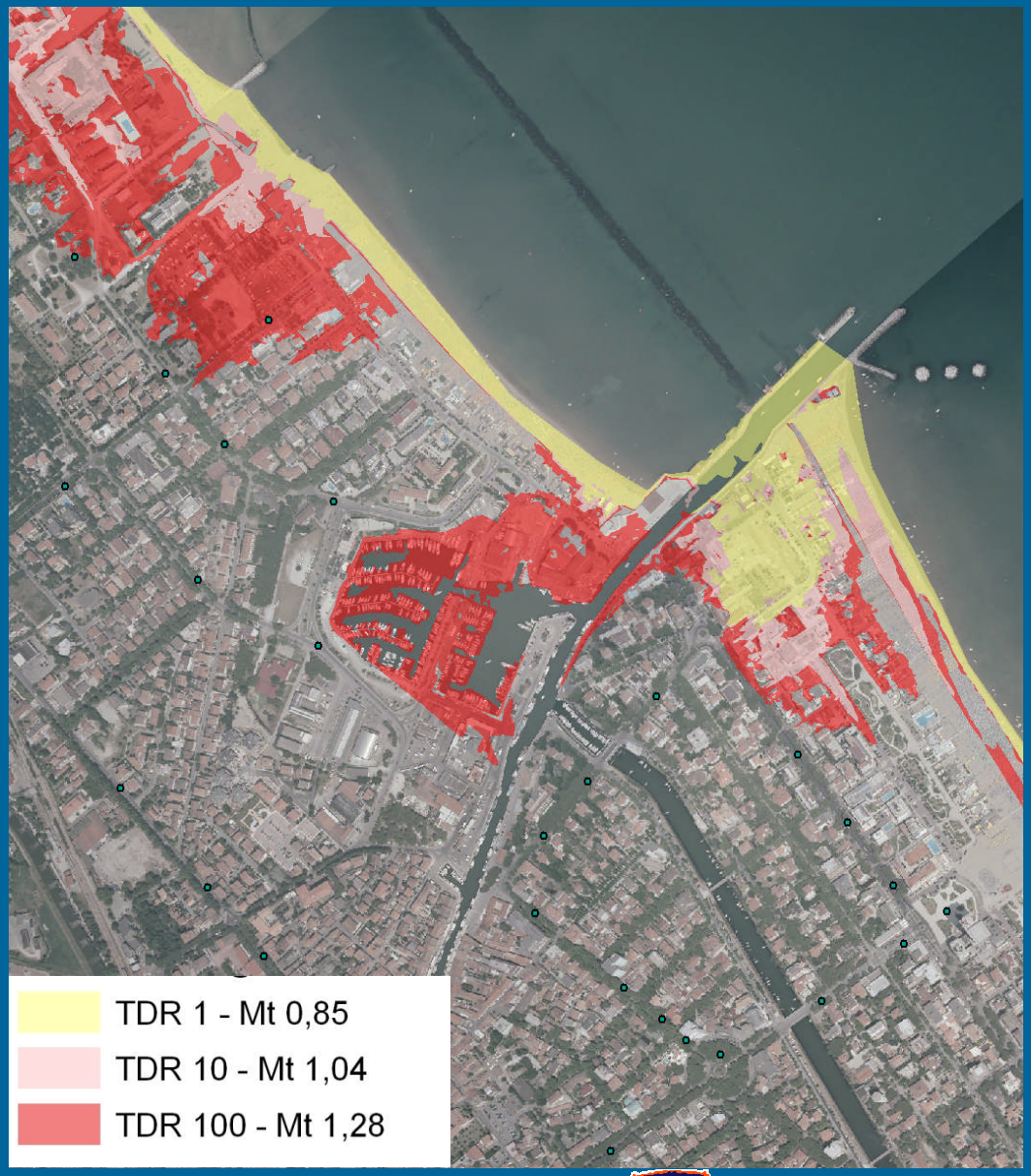
The GIS model

for a quick re-run of the model considering different DTM, scenarios, damping factor, etc.. a diagram from esri arcgis model builder was created

DIAGRAM from esri arcgis model builder



Example of hazard map



Example of hazard map for Cesenatico

Ongoing and Next steps

comparison of the sea-flood hazard map with:

Run-up evaluation along 500 m spaced beach profiles

Flood maps of Cesenatico and Lido di Savio obtained using the Mike Model (Zanuttigh et al)

Validation of the results with all flooding data from sea-storm catalogue

in situ GPS measurements of evidences of future significant sea-storms

Final considerations

- ✓ the proposed method is is a fast, symple and economic system to produce flood hazard maps
- ✓indicative water depth can be computed
- ✓ it's quite *replicable* and *exportable* to other regions if lidar data and sea-storm scenarios are available

- ✓ The GIS analysis doesn't consider run-up because it needs a dedicated formula
- ✓ it doesn't take into account morphological evolution of the beach
- ✓ No information regarding flow velocity

Thank you for attention