SCENARIOS OF COMBINED RIVER AND SEA WATER INUNDATION ALONG THE ADRIATIC COAST

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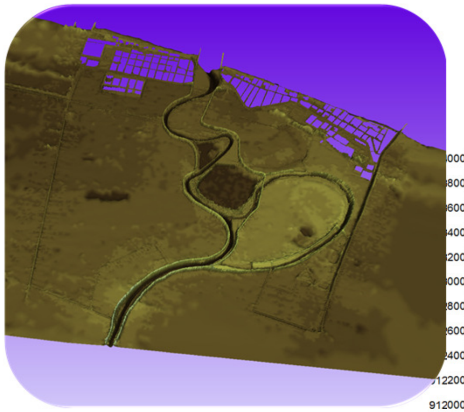
Lido di Savio – storm on March 9th, 2010



Rendering of the modelled area

Motivation

The coasts of the Emilia Romagna region, Italy, are located in low-lying areas of the Northern Adriatic Sea, are characterized by high anthropogenic subsidence due to extraction of water and methane and suffer from erosion due to low riverine sediment supply. In the recent past several municipalities have been damaged by coastal flooding.

Combined erosion and flooding processes are investigated within the recently launched THESEUS project (www.theseusproject.eu), to provide a general framework for risk assessment and mitigation in a long term sustainable perspective.

Data, tools and method

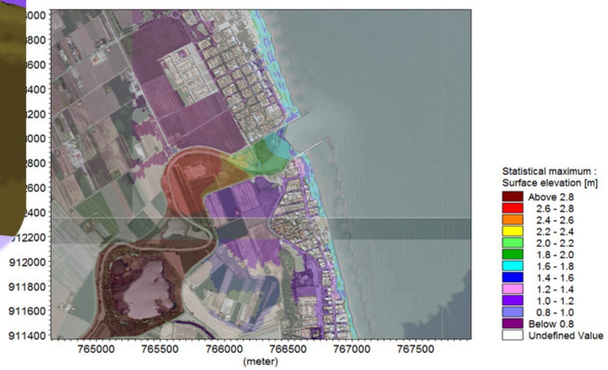
Flooding conditions are simulated with 2DH numerical models (in this poster, an example along the 7 km coastal stretch of Lido di Savio, close to Rimini, is shown).

- Lidar data of the area to derive high-resolution dtm.
- Selection of representative climate scenarios: sea scenarios characterized by a return period of 10, 25 and 100 years are combined with the frequent river scenario with 30 years discharge return period.
- Land use map to derive roughness maps.

In both areas to the North and to the South of the river outlet, the sea level rise during storms above 1.1 m produces an immediate (in less than 30 minutes) and intense flood (water depths between 2 and 1 m, from the shore to the houses and to the agricultural land behind).

The areas close to the river section are also inundated due to the wave propagating inland from the outlet and prevailing on the river discharge.

Maximum surface elevations (a.s.l) for the 100 years storm.



Numerical modelling and boundary conditions

Wave structure interaction and wave run-up on beaches and/or dunes require models capable to deal with steep slopes and emerged slopes. Traditional commercial 2DH numerical models, such Mike21 suite developed by DHI Water & Environment & Health can represent wave overtopping an transmission only when the slope is submerged.

It is therefore needed an appropriate original approach to overcome the model limitations (Martinelli, et al., 2010. Assessment of coastal flooding risk along the Emilia Romagna littoral, Italy. Coastal Eng. 57(11-12), 1042-1058):

- Waves are transferred from offshore till the shore, including wave reduction due to structures, by means of an analytical *ad hoc* Matlab procedure.
- The "off-shore" boundary of the modelling domain is moved to the shoreline and the "shoreline" boundary condition considers a varying level in time given by the sum of storm surge, wave set-up and wave run-up on the beach.
- Flooding propagation is simulated as a dam-break: the potential wave energy represented by wave run-up provides a reasonable velocity for the running-up wave.

The river discharge is imposed along the river section at the inland boundary. The river discharge –varying in time during the flood is obtained from 1 D simulations. The conditions at the river outlet are derived from a preliminary MIKE21 FM simulation on a coarse grid coupling SW and HD modules.

Lateral and inland boundaries are closed; the computational domain is enlarged to avoid spurious reflection effects.

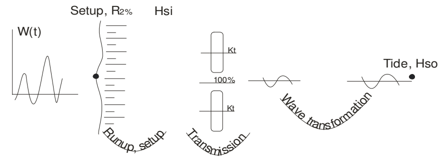
Scenarios simulated in Lido di Savio.

Each event is simulated for 24 hours: a combination of a 12-hours storms with a 20-hours river flood.

Meteomarine conditions are derived from CENAS (1997) - Study on the coastline evolution of the Eastern Po plain due to sea level change caused by climate variation and to natural and anthropogic subsidence, Kluver Academic

	Sea: T_r=10 y, River: T_r=100 y	Sea: T_r=25 y, River: T_r=100 y	Sea: T_r=100 y, River: T_r=30 y
Storm surge	1.04 m	1.14 m	1.28 m
Wave height	4.9 m	5.4 m	6.2 m
Wave period	9.6 s	10.1 s	10.7 s
Peak discharge	815 m^3/s	815 m^3/s	815 m^3/s

From off-shore to shoreline boundary condition.



Conclusions

Commercial 2DH tools, such as MIKE 21 FM, can be applied at local scale to obtain detailed flooding maps for combined sea-river flooding scenarios.

The key modelling issues are the limitations in reproducing

- wave run-up on steep slopes
- beach reshaping during storms (in this case, the bottom is fixed so that results are not cautious).

In Lido di Savio -as in most places along the Emilia Romagna region- the dominant flooding parameter is the storm surge level. Flooding is rapid so that evacuation plans may be not efficient. The maintenance of river banks and of beach width are essential for the safety of the urban areas.

Instantaneous flooding during the 100 years storm.