

Towards the improvement of the Emilia-Romagna coastal EWS: bridging scientific knowledge with stakeholder's needs and perspectives



*Ravenna coastline
February 2015*

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Topics of the talk

- General information about coastal flood risks in Emilia-Romagna
- Methods for quick regional assessments
- The role of warning systems
- Lessons learned from previous events



Strategic importance of coastal zone & conflicts



parks



agriculture



tourism



energy



PO PLAIN

ADRIATIC
SEA

EMILIA- ROMAGNA
REGION

LIGURIAN
SEA

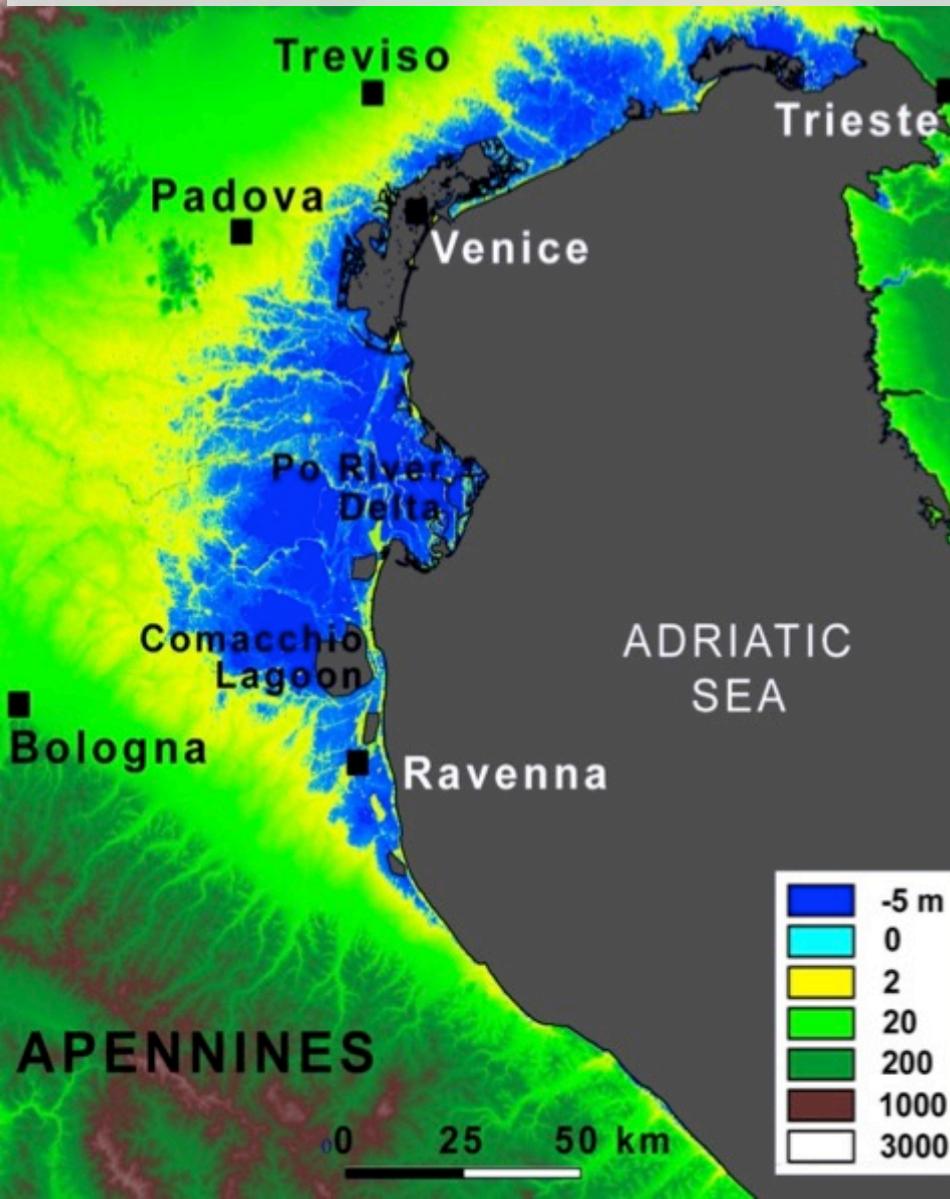


aquaculture



fishery

Large areas below mean sea level

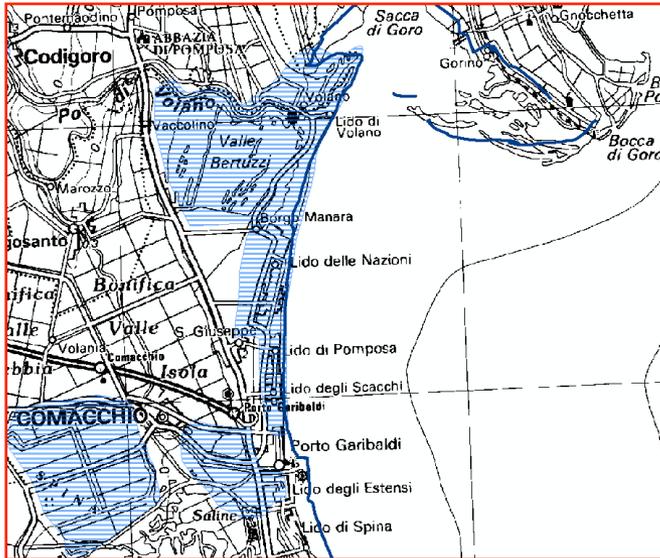


Coastal Risk

- Absence and/or discontinuity of coastal dunes, less than 30% of the entire coastline
- 65% of the shoreline in erosion, value reduced to 30% thanks to nourishment
- Urbanisation increases the level of risk

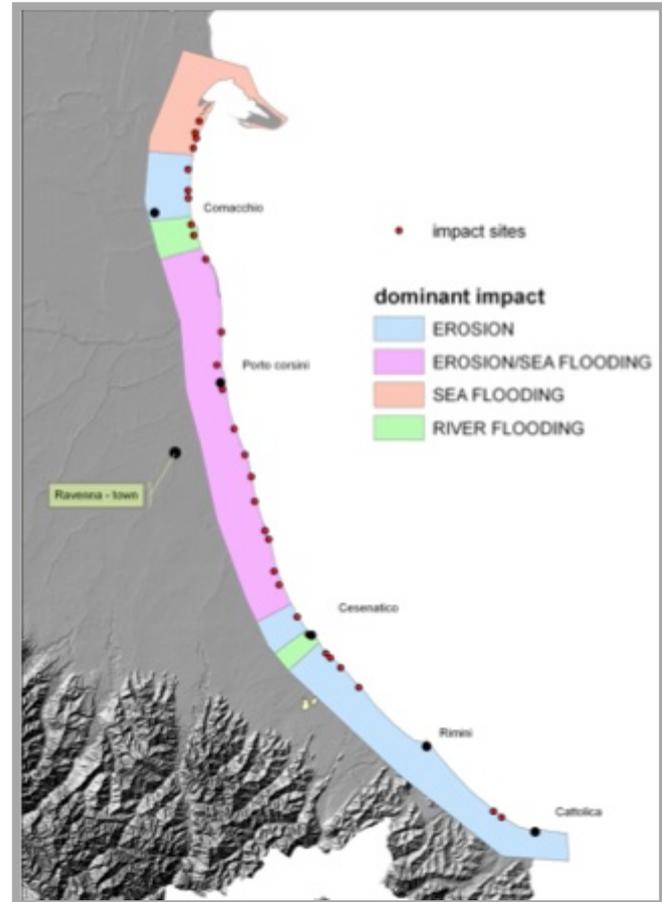


Historical record of storm impacts in Emilia-Romagna



Event 4 November 1966

Max wave height = 6.0 m (SE)
in Venice the highest level ever observed was recorded at 1.94 m
A total of 8600 hectares of land were flooded in Emilia-Romagna



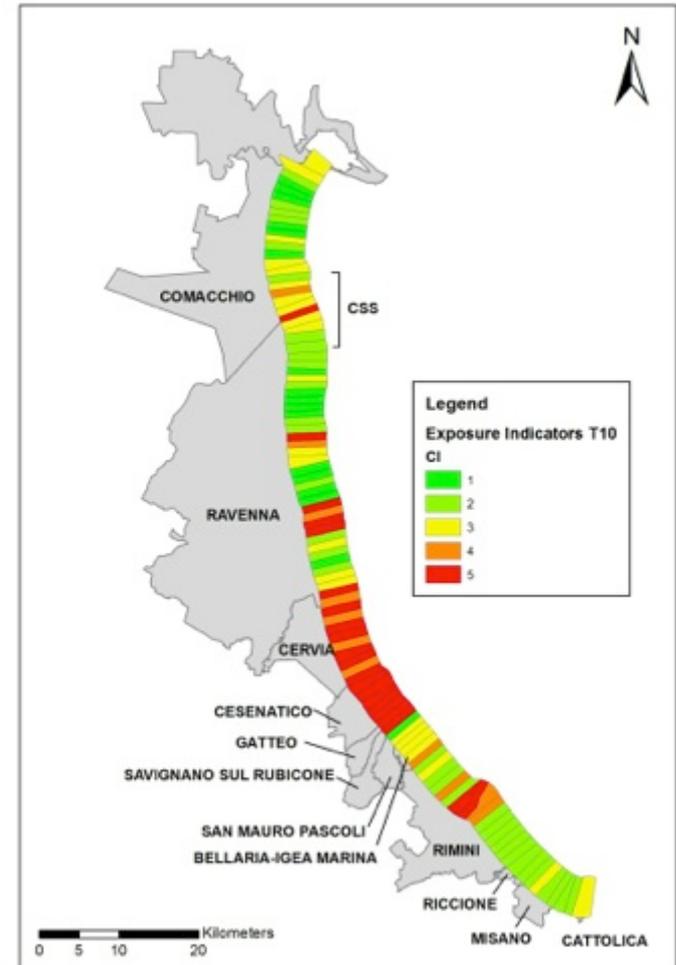
Event 31 October-2 November 2012

The costs to restore the beach was estimated at around 500,000 Euros

Armaroli C., Ciavola P., Perini L., Calabrese L., Lorito S., Valentini A., Masina M. (2012). Critical storm thresholds for significant morphological changes and damage along the Emilia-Romagna coastline, Italy. *GEOMORPHOLOGY* (ISSN:0169-555X) pp. 34- 51 Vol.143-144.

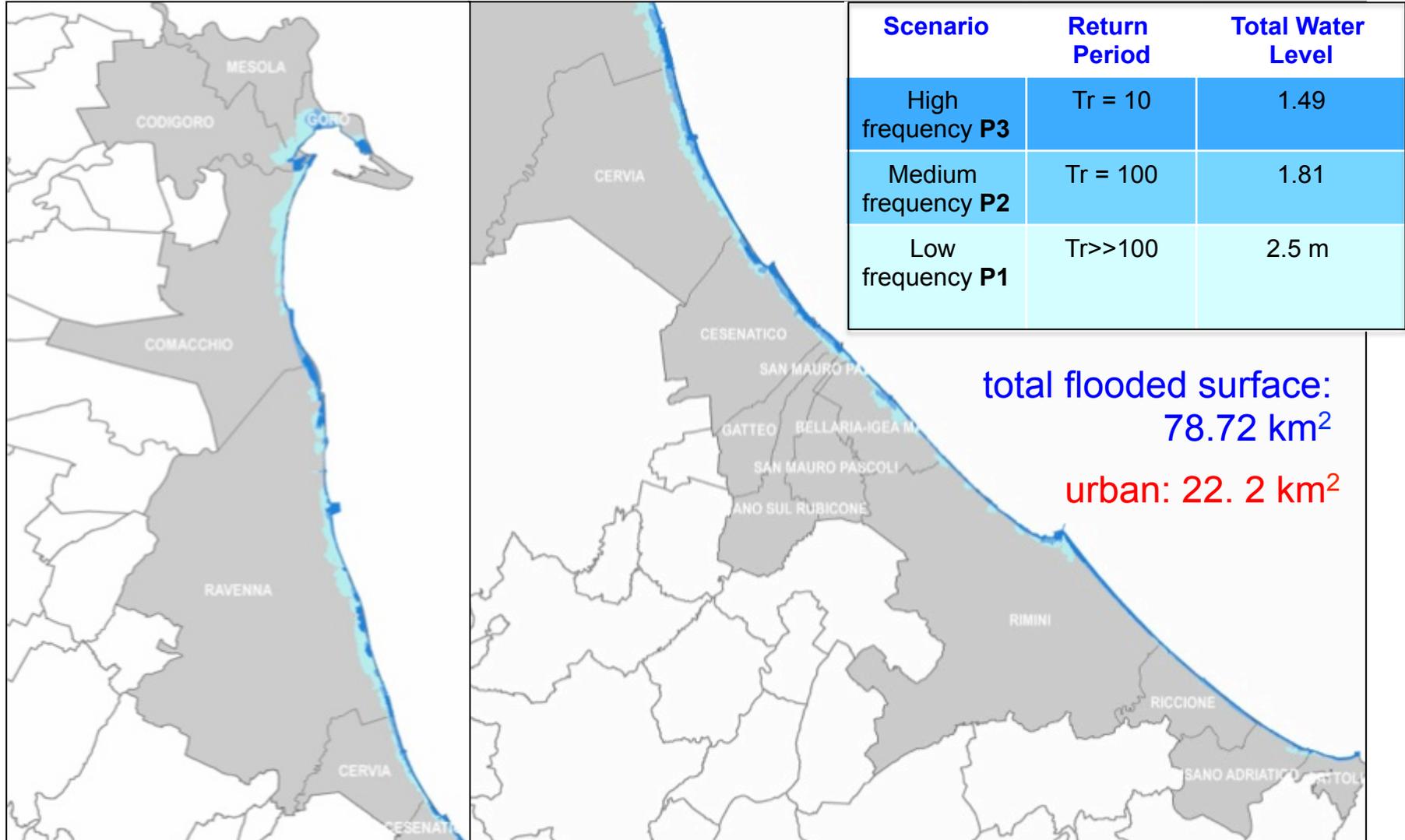
Output RISC-KIT Coastal Risk Assessment Framework (CRAF)

- At the regional scale (100's km) - can quickly assess present and future hot spot areas of coastal risk
- Three hazards: Coastal Flooding, Erosion, Overwash





Official Hazard Maps by RER (according to the EU Flood Directive 2007/60)



REGIONAL EARLY WARNING SYSTEM



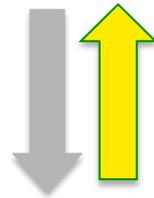
IMPACTS EVALUATION

- EWS system
- beach state (in_Storm)



WEATHER FORECAST

- sea state models
- morphodynamic model



DATA MANAGEMENT

- data collection
- in_STORM updating
- cartography
- damage evaluation



CIVIL PROTECTION ALERTS & ACTIONS

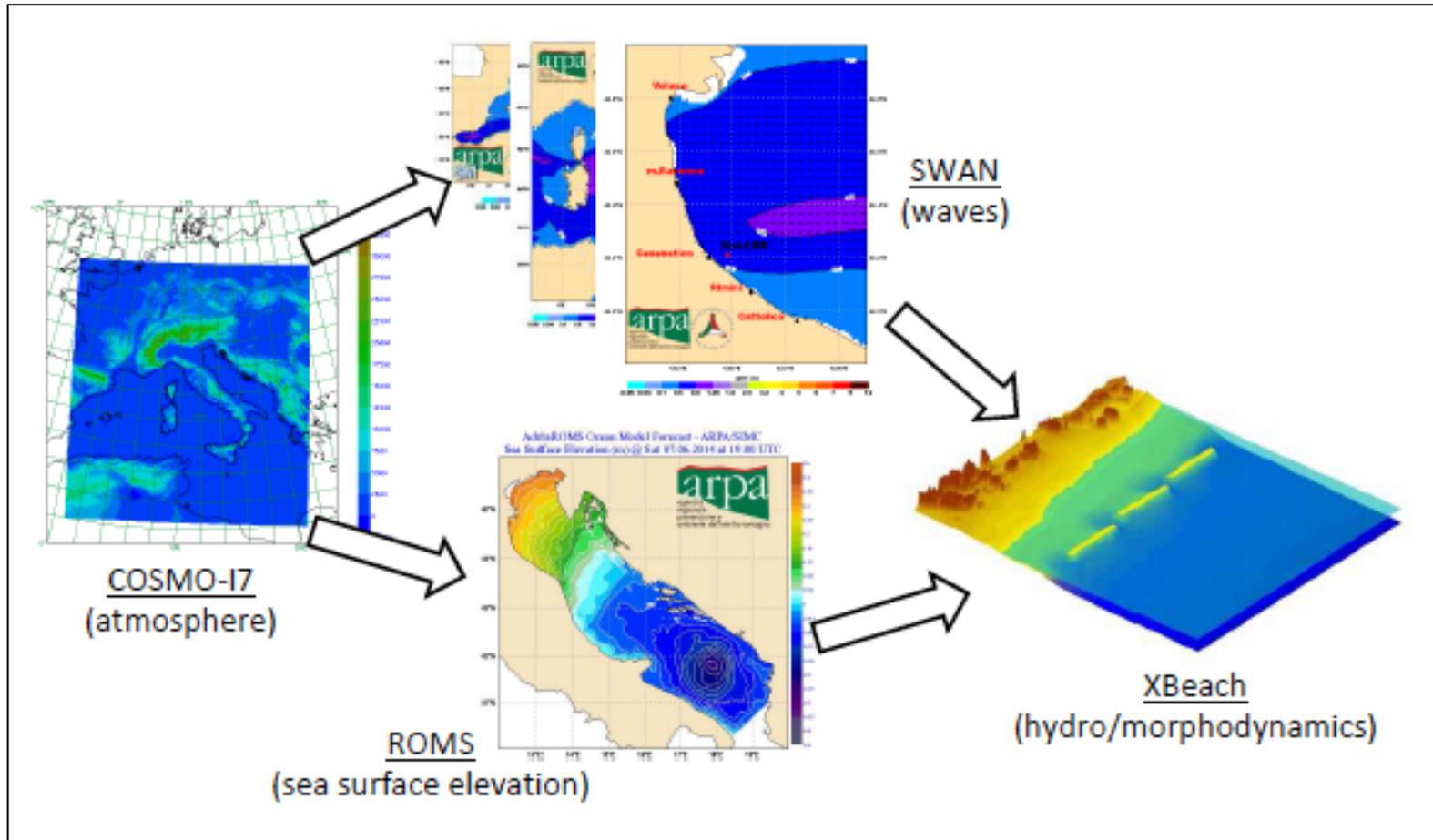


MONITORING

- webcams
- tide and wave gauges
- post event surveys

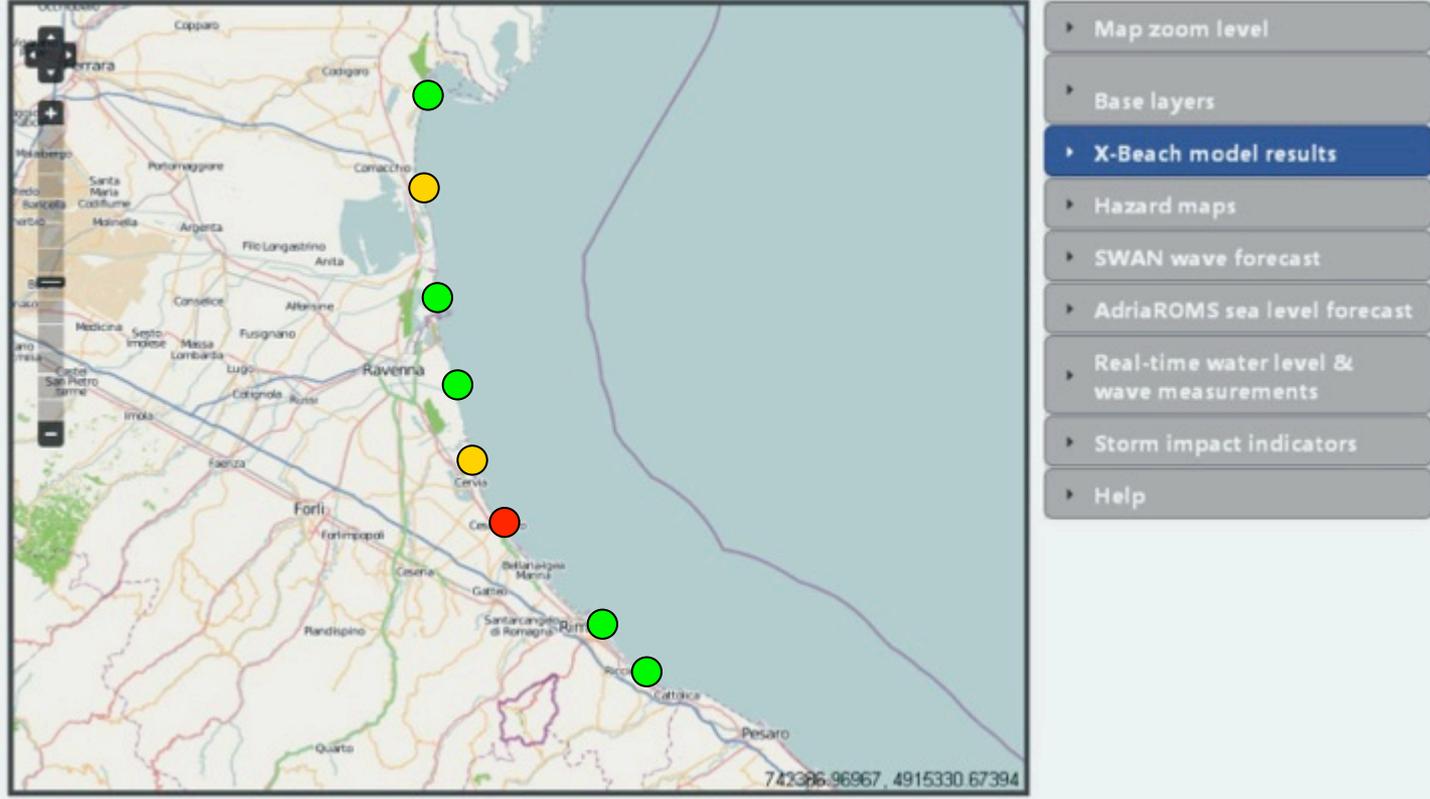


Numerical Warning System Model Chain



Interface visible to the operators

Emilia Romagna Early Warning System



- Map zoom level
- Base layers
- X-Beach model results**
- Hazard maps
- SWAN wave forecast
- AdriaROMS sea level forecast
- Real-time water level & wave measurements
- Storm impact indicators
- Help

A total of 22 1D profile lines running operationally



Impact of the storm of 5-6 February 2015 at Porto Garibaldi

Data, impacts observed and lessons
learned

Porto Garibaldi–Site location

PORTO
GARIBALDI –
BELLOCCHIO
(ITALY)



ESW highlighted high risk level starting from 4 February

safe corridor width SCW

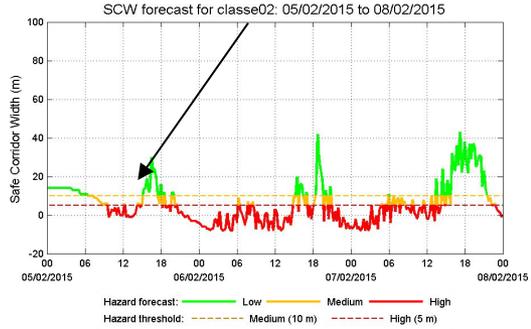
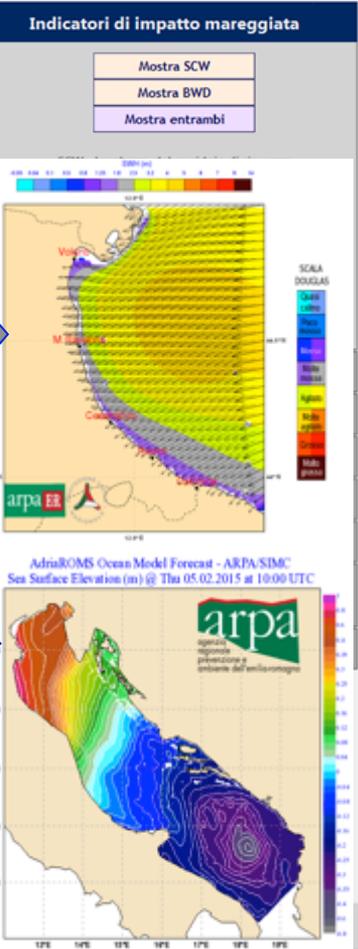
Early Warning System for the Emilia-Romagna coastline

Ita | Eng

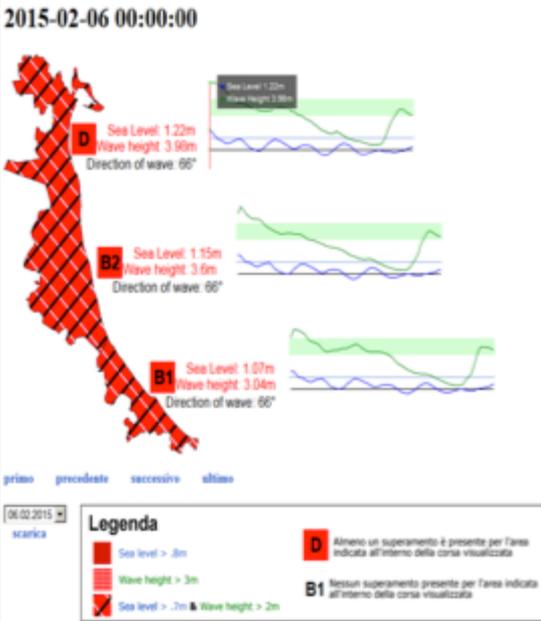


waves

sea level



Alert Level



Sea State

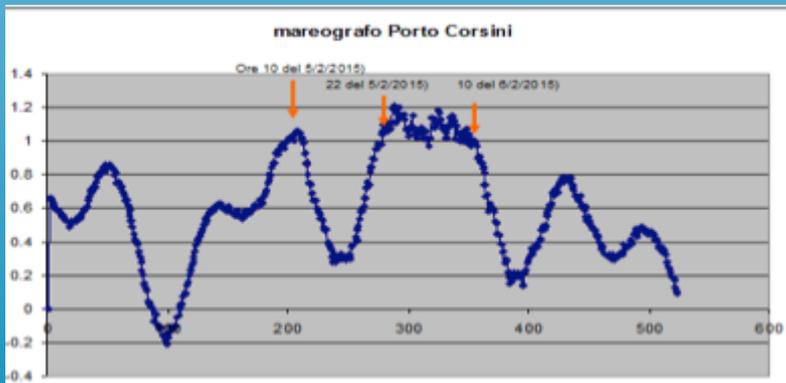
Wave buoys

Boa	Posizione		Hs ore 6 del 6/2/2015	Hs picco	Data e ora picco
	Distanza da costa fondale	prof.			
Nausica	8 km	10 m	4.66 m	4.66 m	6 febbraio ore 6
Garibaldi A	19 km	25 m	4.16 m	4.16 m	6 febbraio ore 6
Angelina	2 km	8.5 m	4.31 m	4.31 m	6 febbraio ore 6
Amelia	27 km	32 m	3.68 m	4.23 m	6 febbraio ore 4
Barbara	58 km	70 m	3.06 m	3.82 m	6 febbraio ore 3

Tide Gauges

Mareografo (proprietà)	Massima marea registrata	Data e ora
Porto Corsini (ISPRA)	1.21 m s.l.m	5/2 alle ore 23.40
Porto Garibaldi (Prov.Fe)	1.30 m s.l.m	6/2 alle ore 0.0
Volano (Prov.Fe)	1.47 m s.l.m	6/2 alle ore 1.10
Porto Rimini (Hera)	1.13 m s.l.m	6/2 alle ore 1 e alle 3

exceeded tide and wave thresholds for more than 1 day estimated a TR = 100 y



Beach and coast survey

several webcams installed over the beach tourism infrastructure are used to record the sea flooding and beach evolution



- aerial photos



- images and movie published on web

The challenge for responders



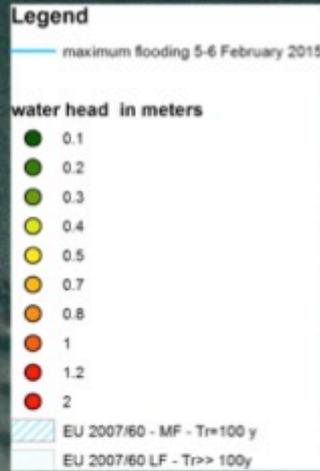
Flooded areas	18.5 km ² (Lido degli Estensi, Porto Garibaldi, Lido di Savio, Lido Adriano, Milano Marittima, Cesenatico, Gatteo Mare)	anthropogenic system
Overflowing of channel outflows	9 sites	
Damage to coastal defences	7 hotspots	
Damage to touristic infrastructure	27 sites	



Beach erosion	700 000 m ³ estimated sand loss 33 hotspots	natural system
Dune erosion	10 dune strips	
Overwash	40 points	
Outflow channels	19 points	

Total amount of damages, including private houses: 21 milion €

Map of water head

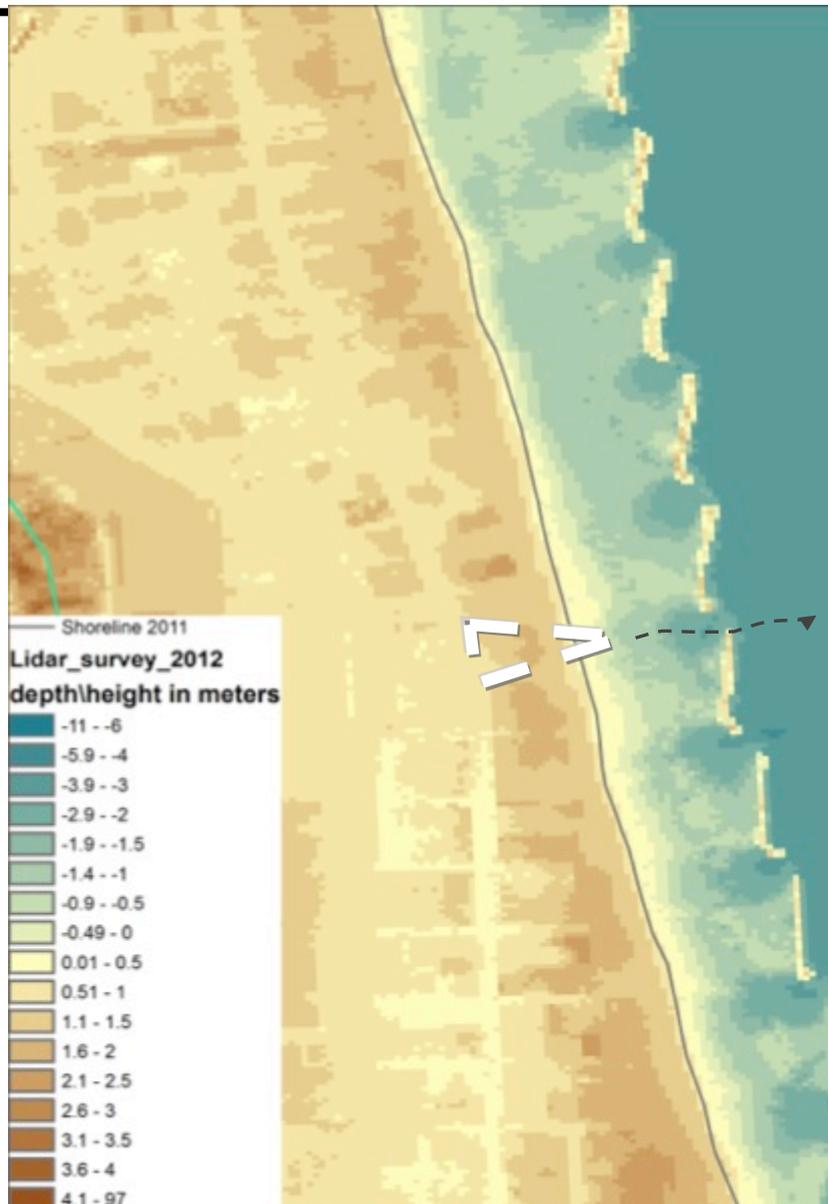


Example of flooded areas at Lido di Savio

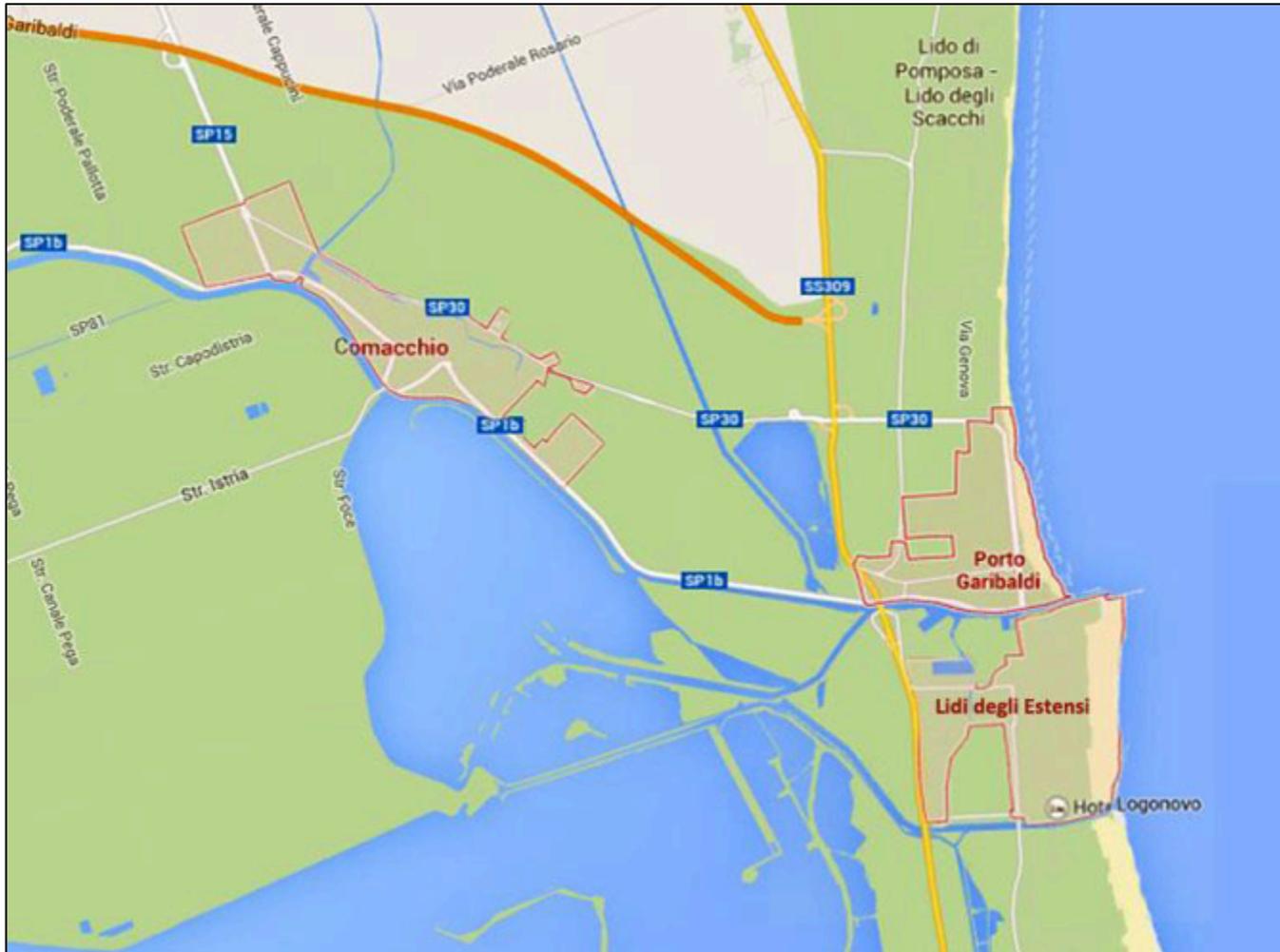


OUTFLOW CHANNELS

Outflow channels on the beach are points where the floodwater returns at sea as normal storm water systems (if present) cannot deal with the water in excess



The problem of combined land drainage and storm surge





PORTO GARIBALDI



LESSONS LEARNED

The storm that occurred on the 6 February 2015 was used to check the current procedure for alerting and to improve the alert chain



EWS prediction of the storm was correct

Civil Protection procedure timely activated

The real-time monitoring and post event monitoring procedure

Calibrated the Flood directive maps for scenarios Tr 100 years



Management of the alert; under construction a new procedure that includes during control of the event and emergency intervention for coastal flooding considering freshwater and saltwater input

Improve the monitoring of the damages establishing protocols



UNIVERSITÀ
DEGLI STUDI
DI FERRARA
- EX LABORE FRUCTUS -



RISC-KIT

Regione Emilia Romagna



servizio geologico
sismico e dei suoli



Porto Garibaldi: 5 February
2015



Thanks