Climate risk and adaptation service: Venice, 23/12/2013

Evaluation of sea-level rise in coastal areas under future climate change scenarios

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Keywords: sea level rise, risk assessment, coastal areas

Target groups

- **Local/Regional Authorities**
- **Private Stakeholders**
- **Civil protection authorities**

Relevance to the case-study requirements

Sea level changes have important impacts on coastal regions, contributing to beach erosion, damages associated with floods and storms and intrusion of salt in fresh water streams. These impacts, in turn, heavily affect Mediterranean countries, whose coastal economies strongly rely on shore activities.

More specifically, sea-level rise is a prominent issue for the North Adriatic case study area both considering the vulnerability of fragile ecosystems such as coastal lagoons, and the concentration of cultural and socio-economic values.

The approach

A Regional Risk Assessment (RRA) methodology was developed and applied to the North Adriatic coastal areas (Italy) in order to produce climate risk and adaptation services for local stakeholders and decision-makers. The RRA methodology is based on 4 main phases (figure 1) and was performed with the support of the GIS based DSS 'DESYCO' providing maps and statistics which allows the identification and ranking of areas and targets that are likely to be affected by sea-level rise inundation in future climate change scenario.

1. Hazard assessment:

- allows to identify areas that could be affected by potential sea-level rise inundation;
- sea-level rise future scenarios (2041-2050) were provided by the coupled model PROTHEUS/ENSAMBLES forced by the A1B emission scenario (*Dell'Aquila A. et. al., 2013);*
- topographic information comes from the Digital Elevation Model (DEM) with a spatial resolution of 5m for the case study area.

2. Exposure assessment:

aimed to identify, select and localize receptors (i.e. elements at risk) that could potentially be inundated by the sea-level rise and exposed to losses.

3. Vulnerability assessment:

- aimed to evaluate the degree to which the receptors could be affected by sea-level rise hazard based on site-specific territorial information;
- it was assumed that sea-level rise inundation affects all the receptors in the same way, causing a permanent loss of receptors;
- homogeneous vulnerability score equal to 1 was assigned to all the investigated area.

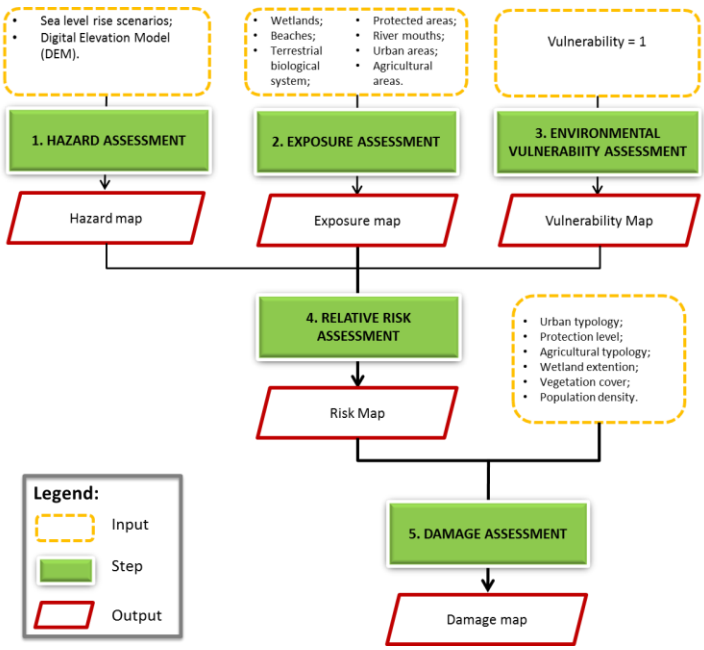

Figure 1: Main steps of the RRA applied for the evaluation of sea-level rise inundation in coastal zones.

4. Risk assessment:

integrates information about the sea-level rise hazard with the territorial exposure and vulnerability in order to identify areas at risk of inundation for the selected future scenario.

5. Damage assessment:

provides a relative estimation of the potential social, economic and environmental losses associated to targets and areas at risk of sea-level rise inundation in the case study area.

References:

Torresan S., 2012. Development of a Regional Risk Assessment methodology for climate change impact assessment and management in coastal zones. PhD Thesis, University Ca' Foscari Venice, Italy.

Dell'Aquila A., Calmanti S., Ruti P., Struglia M., Pisacane G., Carillo A., Sannino G., 2012. Effects of seasonal cycle fluctuations in an A1B scenario over the Euro-Mediterranean region. CLIMATE RESEARCH Clim Res, Vol. 52: 135–157, 2012.

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The products

Which coastal areas could be more affected by a sea-level rise inundation?

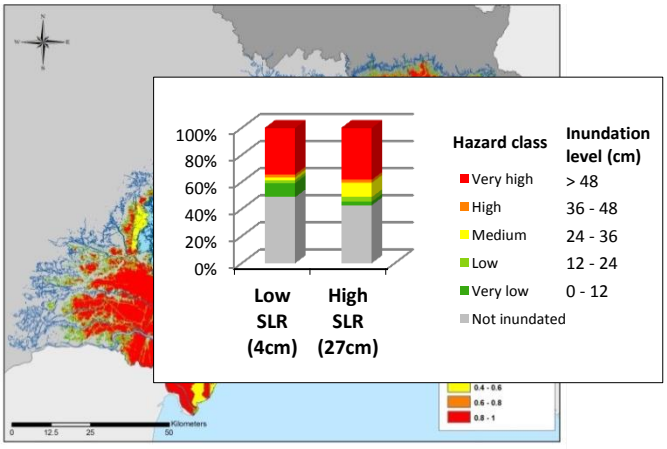


Fig.1 Hazard map for the sea-level rise inundation impact (projected water level of 27cm) for the North Adriatic coast and related statistics showing the distribution of the percentage of surface associated to each hazard class.

Where are localized targets exposed to potential sea-level rise inundations?

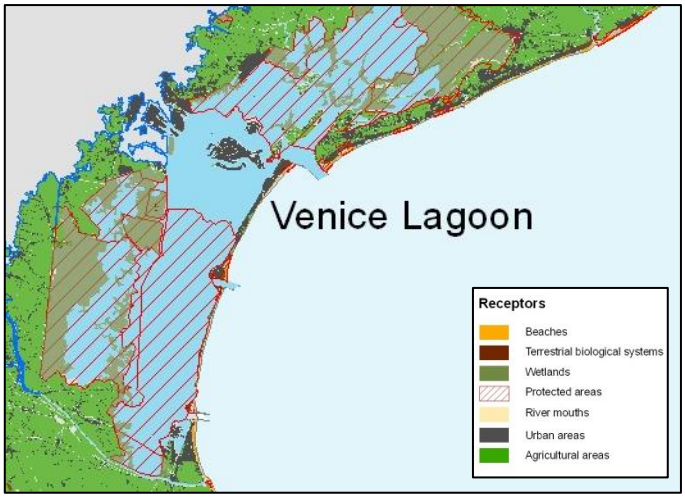
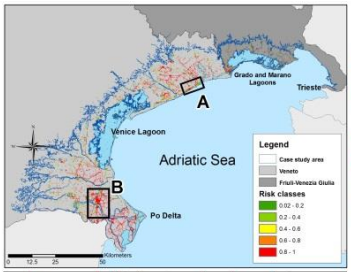


Fig.2 Exposure map for the receptor beaches, terrestrial biological systems, wetlands, protected areas, river mouths, agricultural areas and urban areas.

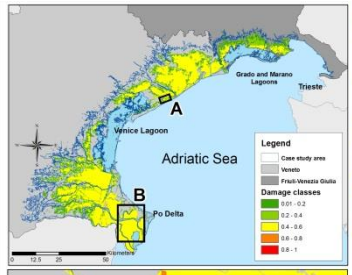
Where are localized higher risk areas due to sea-level rise inundation?



Risk class	Urban areas (Kmq)	
	Kmq	%
Very low	8.23	9.00
Low	8.30	9.08
Medium	8.65	9.46
High	5.53	6.05
Very high	60.74	66.42
Tot	91.45	100.00

Fig. 3 Risk map of urban areas for the sea-level rise scenario (27cm) and related statistics showing the distribution of the percentage of surface associated to each risk class.

Which areas will be affected by the highest socio-economic losses?



Value factors
Protection level
Population density
Agricultural typology
Vegetation cover
Urban typology
Wetland extension

Fig. 4 3 Damage map of agricultural areas for the sea-level rise scenario (27cm) and table of the value factors selected for the estimation of the social, economic and environmental value associated to each target.

Making the product usable

The evaluation of sea-level rise inundation in coastal areas was performed applying a simplified approach that projects the water height, related to the future sea-level rise scenario, inland and inundates all land areas at an elevation below this level using the topographic information comes from the Digital Elevation Model (DEM) with a spatial resolution of 5m for the North Adriatic coastal areas.

Therefore the developed product should be considered as screening tool useful to evaluate critical vulnerabilities associated to sea level rise events. Cooperation with local stakeholders is required in order to improve this product with a more detailed analysis taking into account high resolution territorial data (i.e. LIDAR, land use map) and data related to artificial protections placed along the coastline and in correspondence to depressed areas able to attenuate inundation events.

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Further information: www.climrun.eu

This information sheet was developed in the framework of the CLIM-RUN FP7 EU project. The product it describes should not be used without acknowledging the project and, particularly for any operational use, interaction with the authors is welcome and strongly encouraged.