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Sea Level Change and Spatial Planning in the Baltic Sea Region: findings of the SEAREG project

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Abstract

The SEAREG project (Sea Level Change Affecting the Spatial Development of the Baltic Sea Region) is financed by Baltic Sea Region Interreg III B programme and is focusing on socio-economic and environmental assessment of the effects of climate change on the sea level in the Baltic Sea region (BSR). A rise of the sea level can lead to major flooding events, having severe impacts on the spatial development of cities and regions as well as sustainable development of the entire BSR. The project has benefited from an intensive discussion with several local and regional authorities from the case study cities and regions of Helsinki, Stockholm, Gdansk, Pärnu and Greifswald. The main result of the project will be a Decision Support Frame (DSF) that addresses local and regional planning authorities in the case study areas and the BSR area. The DSF shows ways how spatial planning can take the impacts of modelled future environmental changes into account. The DSF consists of modelling and GIS applications, impact and vulnerability assessments, a knowledge base and a discussion platform. The cooperation and learning processes around the DSF shall help involved parties in understanding each others' points of views and motivations for taking action. The appropriate dissemination of the results shall consequently lead to adequate implementations of appropriate actions, such as ICZM in the case of sea level rise.

1 Introduction

One of the basic ideas of the SEAREG project is to improve the communication between planners, social and natural scientists. The development of a Decision Support Frame (DSF) enables decision making with a firm scientific background and supports finding appropriate measurements in case of sea level rise in the Baltic Sea Region (BSR). The DSF (Fig. 1) consists of four major parts amending each other: Modeling and GIS applications, Impact and Vulnerability Assessments, Knowledge Base and Discussion Platform (Schmidt-Thomé 2003).

1.1 Modelling and GIS Application

Sea level 100 years after present (2071 to 2100) is estimated based on a high-resolution regional ocean model taking into account local land uplift or subsidence rates. The sea level rise is projected referred to the NH60 equipotential surface. Two general circulation models (GCM) provide the boundary conditions for the regional ocean model accomplished by using two emission scenarios (A2 and B2) by IPCC. The modeling is further described in “Modeling a future sea level change scenario affecting the spatial development in the Baltic Sea Region -Findings of the SEAREG project”(Staudt et al., this report). In the case study areas of the project the gained data will be processed in a GIS environment and the areas of inundation and flood prone areas are outlined for each case study area (Schmidt-Thomé 2004).

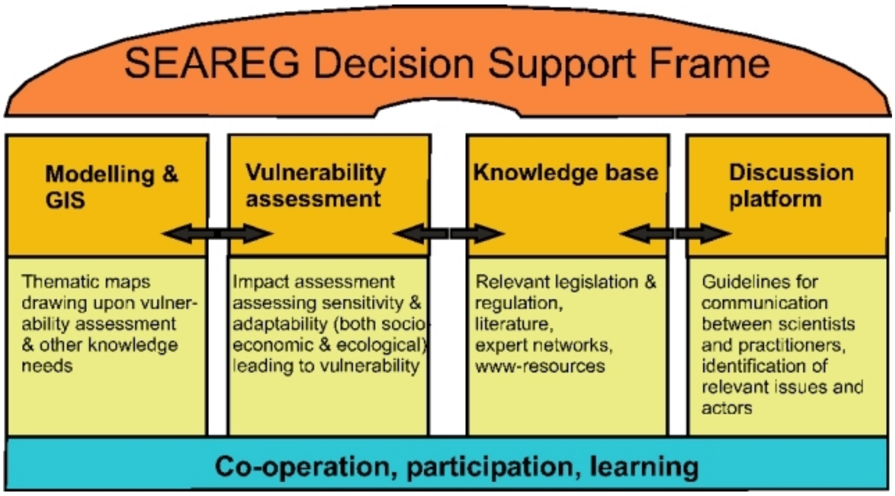

Figure 1: Basic structure of the Decision Support Frame

1.2 Impact and Vulnerability Assessment

The aim of the Vulnerability Assessment (VA) is to highlight endangerments due to future sea level change. It is carried out under the responsibility of local authorities and planners. To gain most significant results VA uses all sources offered by the DSF.

The GIS application provides a set of sea level rise maps, displaying the effects of sea level rise on an area. These maps are based on a digital elevation model (DEM) of the case study areas and a range of regional sea levels.

The first step of the VA is a screening assessment based on a screening matrix. The screening matrix gives a first overview on the possible impacts of sea level rise, clearly distinguishing the two main effects of general inundation by a risen sea level and resulting new flood prone areas. The screening matrix does not assess the impacts but serves as a checklist for the latter vulnerability matrixes.

The second step is the impact assessment that estimates the impact of the two main effects, inundation and flooding, to the socio-economic and ecological system. Whereas inundation and flooding depends mainly on the topography of a case study area, the impact considers the strong dependency on the properties of the affected entity. The socio-economic and ecological impacts are assessed jointly taking into account the strong interdependency of the two systems. The Knowledge Base and Discussion Platform contribute to enhance the results' reliability and acceptance among planners, stakeholders and decision makers.

The final step assesses the vulnerability. The vulnerability results from the possible impact and the capacity of an actor or organization related to the impacted entity, to withstand or to cope with it.

1.3 Knowledge Base

As Nicholls (1998) outlines a mismatch between available data, the level of effort and the sophistication of the assessment model lead in some cases to results that don't fulfill the expectations to the VA. The Knowledge Base as well as the Discussion Platform helps to balance the data availability, effort and expectations to the VA.

The VA requires best-available and possibly best-needed data and expertise. The knowledge base offers information about legislation and regulations and simplifies the access to expert networks, literature and www-resources.

1.4 Discussion Platform

The idea of the Discussion Platform is to analyze and enhance the communication process between planners and scientist and activate an exchange of information. Based on this analysis guidelines for communication are developed and relevant issues and actors identified. Instruments to analyze the communication process are round table discussions, e-mail questionnaires and interviews. So far three round table events were conducted. The participants of the first two round table discussions were either planners or scientists. In the third discussion scientist, planners and politicians took part (Schmidt-Thomé 2004).

2 Results

As the development of the Decision Support Frame and its implementation in the case study areas takes place at the same time, the results for the case study areas are in an unsettled status and will improve continuously.

2.1 Case Study Area Pärnu – Estonia

Figure 2 shows as an example of a sea level rise map. This map visualizes the upper edge of sea level rise modeled by the regional ocean model taking into account the local land uplift.

The screening assessment reveals further impacts besides the obvious land loss in Pärnu. Strong impacts are expected to the third sector, because Pärnu will lose major parts of the beach as a major tourist attraction. The current flood prone area during storm surges will move landwards according to the changed coastline. This will cause socio-economic impacts, affecting the infrastructure, industrial development and housing. Taking into account the present groundwater salinity a rising sea level will increase the problems of drinking water supply. Ecological impacts are caused by the loss of coastal habitat.

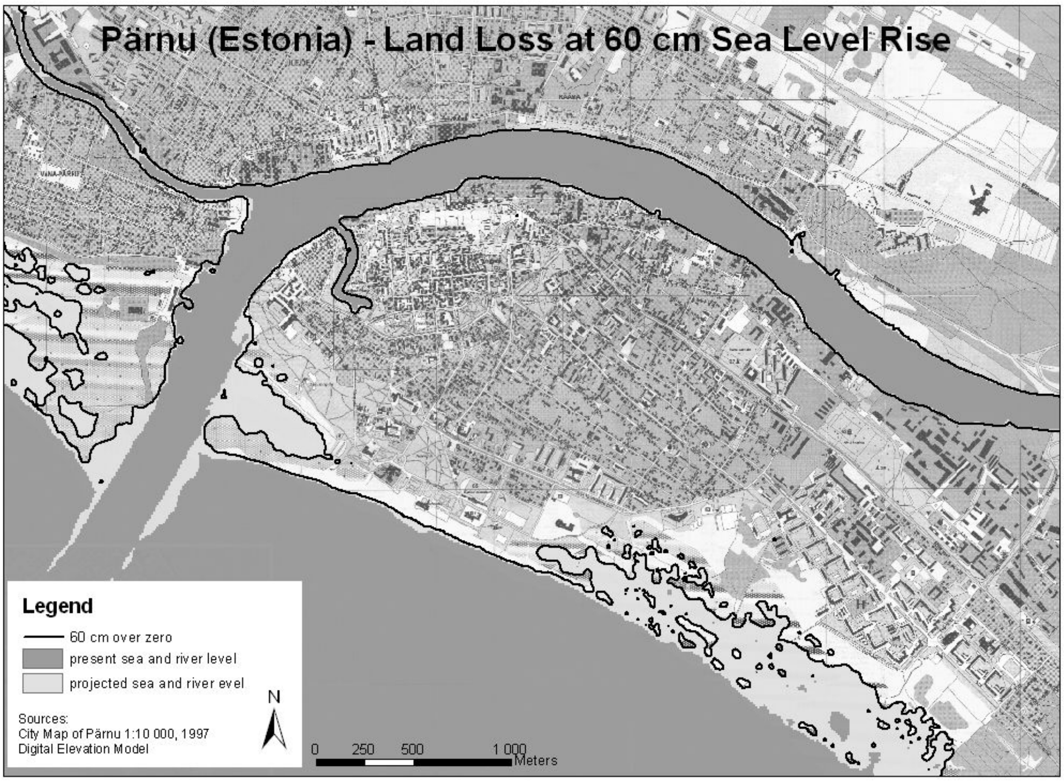

Figure 2: Preliminary map of Pärnu displaying land loss due to 60 cm sea level rise. This is according to the worst-case scenario provided by the regional ocean model and land uplift data.

3 Discussion

A main challenge of the DSF is the connection of climate modelling and spatial planning. The differences in scale are considerable. Although the regional ocean model down scales the information give by the GCM to a regional level, a remarkable gap in the exactness of spatial planning scales and climate modeling precision remains. Compared to the area of the City of Pärnu (about 50 km2) the climate model scales are very rough.

The VA is designed to cope with different quality and availability of data. However, the data availability may influence the outcomes of the VA for the case study areas. Whereas in Germany the ATKIS database (Amtliches Topographisch-Kartographisches Informationssystem) offers a consistent and extensive source of geo-data (see also "Impacts of sea level changes on coastal regions – a local study for SEAREG" Röber and Rudolphi, this report), the data for the Pärnu case study area derive from miscellaneous and partly unspecified sources.

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