RISK ASSESSMENTS FOR THE CASPIAN AND NORTH SEA COASTS UNDER SEA-LEVEL RISE

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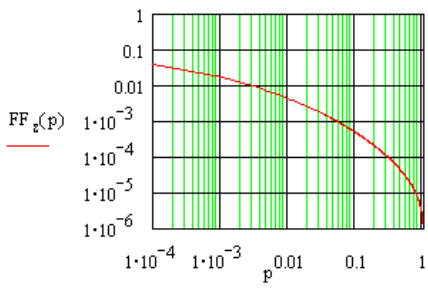
Keywords: Caspian Sea, North Sea, Wind Climate, Frequency Analysis

1. Introduction

An integrated methodology for risk assessment and estimation of possible environmental and economic losses on sea coasts under the possible accelerated sea-level rise in the nearest future is presented. In particular, the Caspian Sea coast (Yanin, 2003), the North Sea coast (Vrijling, 2001) and the coasts of the Sea of Azov will be investigated with respect to shoreline retreat consequences of global sea level rise. During storm surges dunes will be eroded over some distance and property located in this zone will be undermined. At the location of sea side resort towns, the dunes are covered with restaurants, hotels, appartment buildings and the related roads and walkways. The question is to what degree the property should be protected against the erosive forces of the sea that increase in strength overtime due to sea level rise. Starting with the distribution of the invested value as a function of the distance from the high water line and using the probability of exceedance of a certain distance by erosion, the risk can be calculated as a function of the distance. After some mathematical manipulation the risk can also be depicted in a frequency-damage curve, a FD-curve. Finally it is attempted to find an economic optimal strategy by equating the cost of regular beach nourishment with the reduction of the property risk due to an increasing probability of dune erosion.

2. Results

The risk at position x is described by the product of the probability that the erosion during a storm exceeds x at t and the value of the investment at x: $Risk(x,t) = (1-F_\varepsilon(x,t))\, I_{tot}\, f_I(x)$
If the distance x is expressed as a function of the percentage p of the total investement using the inverse distribution of the investment the FD-curve can be found. Elimination of x from the probability distribution of the erosion by x(p) gives this result. The question to which return period the development of property should be allowed and how frequently the dunes should be strengthened to cope with sea level rise, can be answered by looking to the cost of protection.



FD Curve (frequency damage)

3. Conclusions

Historically most attention went to the protection of the low lying areas, recently attention has shifted to the risk in the coastal zone. Because no casualties have te be feared only the probability of economic damage to the sea side developments is studied. The risk is represented in new ways, that are thought to be helpful in the public discussion. Firstly contour lines paralel to the coast are given for certain specified probabilities of damage to the property. Secondly the risk is represented in a graph as a function of the distance from the coastline. Thirdly the damage is given as a function of the probability in a FD-curve. All are functions of time due to sea level rise. The question to which contour development has to be allowed and at which interval the dune should be nourished to combat sea level rise will be answered by economic reasoning.

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