EU FLOODS DIRECTIVE IN DENMARK

SCREENING FLOOD RISKS ON THE 8000-KM-LONG DANISH COAST

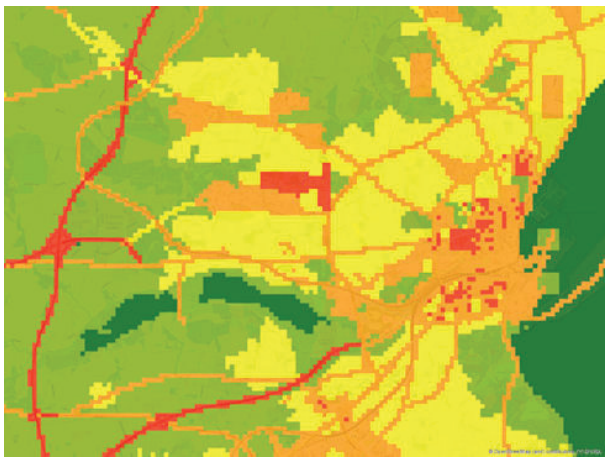
The Danish Coastal Authority (DCA) is preparing for the second cycle of the implementation of the EU Floods Directive. As a first step, the DCA plans to use a new approach to designating areas where the coastal flood risk is high. A risk-index-based method was developed to determine the risk level on the basis of the available flood hazard and exposure datasets. The *risk index* is calculated using the square root of the geometric mean of the 'hazard indicator' and the overall exposure indicator.

The hazard indicator considers coastal flooding only as a potential coastal risk. Depending upon the hazard levels obtained from flood-depth datasets provided by DCA for various occurrence probabilities, the hazard indicator is ranked from 0 to 5 (None, Very Low, Low, Medium, High and Very High). The overall exposure indicator is calculated as the maximum index for all exposure categories, with the significance of each category being rated from negligible (1) to very high (5).

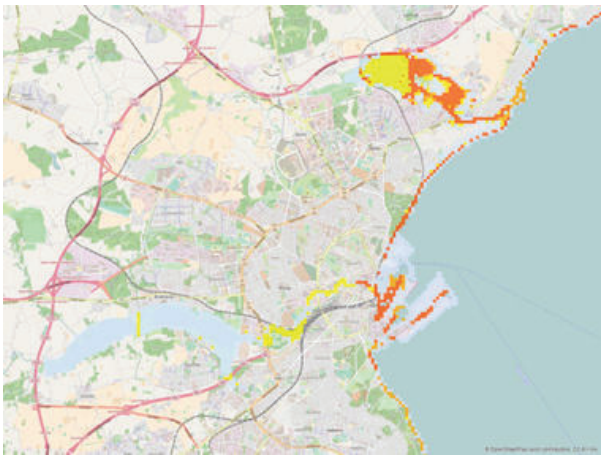
Possible exposure categories include: assets and land, people, ecosystems and cultural heritage, critical infrastructures (transport, utilities, emergency services) and the economy.The land-use exposure indicator, for example, compares the relative value of assets and land on the coast. The indirect effects on transport, utilities and economic activities are assessed to take higher-order losses into consideration (such as traffic disruption, loss of services such as water or electricity supplies, or the failure or disruption of a supply chain).

The next step is to investigate several risk integration methodologies for multiple return periods with the aim of identifying the areas where the flood risk is significant. Two methods were identified as the most appropriate for the development of integrated risk indices for the Danish coast. The 'Marking hotspots and return periods' method is based on the identification of risk hotspots defined as cells with high or very high risk indices. The assessment is carried out for all return periods, and the minimum return period at which a cell becomes a hotspot is recorded. The 'Thresholds of risk approach' method was designed to implicitly account for equivalence between more frequent, but lower-impact, flood events, and less frequent, higher-impact, flood events. In the analysis of a schematic coastal strip, these two methods produce similar results but the magnitude of the predicted risks varies because of the threshold definitions applied. Further study of these methods is therefore required to determine the effect of changes in the threshold definitions and to identify values that describe risk appropriately in the Danish setting.

Finally, a Risk Screening Toolbox has been developed in ArcGIS for the application of the risk screening methodology. Aarhus bay was selected as a pilot area for testing purposes. The Risk Screening Toolbox was applied to the pilot area to test the different approaches, to illustrate the effect of different modelling choices and to support recommendations about the methodology to be applied. The Risk Screening Toolbox helps DCA to define the management areas where the risk of coastal flooding is high and where there will be more detailed hazard and impact assessments for the purposes of the Floods Directive.



Overall exposure index for Aarhus, Denmark.



Integrated Risk using 'Marking hotspots and return periods' for Aarhus, Denmark

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Further reading:
Briere et al., EU Floods Directive in Denmark - Risk index-based method application (2017)