Risk mapping for informed decision-making

Abstract: Ramboll has developed a risk mapping tool to facilitate informed decision-making in climate change adaptation planning. The tool combines and overlays statistical and geographical data with experience-based costs of damages and a spatial representation of the probability of climate risks. The output is a risk map for visual planning and a total sum of damages for a cost-benefit analysis. The tool has been effectively applied in several European cities and urban areas and is soon to be applied in Australia.

Keywords: Climate adaptation, risk mapping, cost-benefit analysis.

Introduction

In the face of climate change and urbanization, decision-making is increasingly made in unfamiliar and uncertain territory. Ramboll has developed a tool to estimate climate risks and associated damage costs for climate variables in different scenarios. The model produces a risk map in the form of a spatial grid of damage costs relative to climate hazard probability, and sums up the total cost of damages for each scenario.

The tool can be used to compare the consequences of different climate scenarios as well as the effectiveness of potential adaptation measures. Subsequently, the tool can be used to perform a cost-benefit analysis thereby revealing the most cost-effective solution.

Material and Methods

The risk mapping tool is developed using the program Feature Manipulator Engine (FME) by Safe. The tool combines statistical data on demography and geographical data on critical infrastructure with experience-based costs of damages, and overlays this information with a geographical data representation of the probability of climate risks, e.g. urban floods, coastal flooding, bushfires, etc. (see Figure 1 for a flow diagram of the model process).

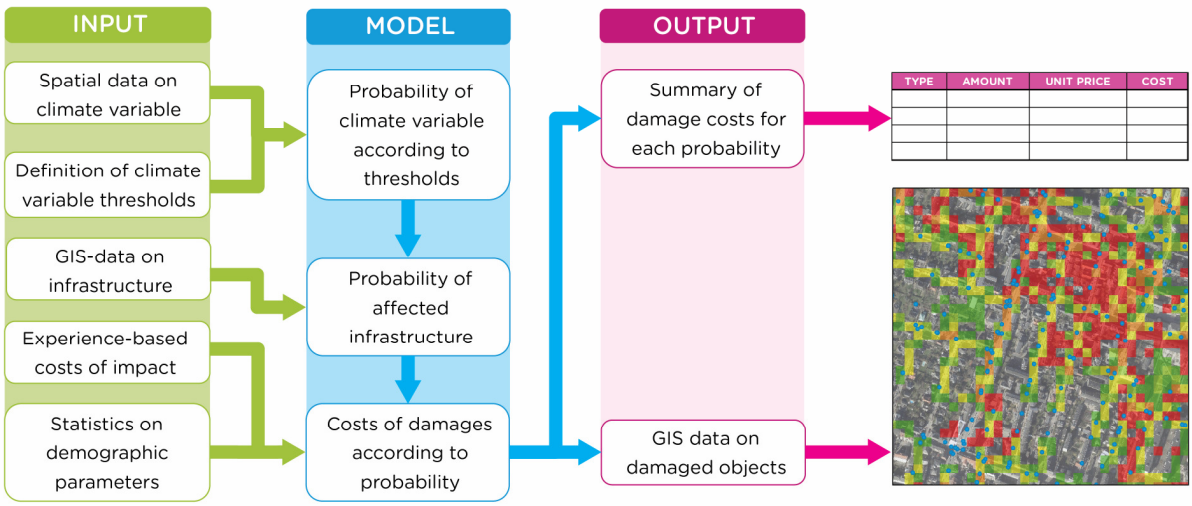

Figure 1: Flow diagram of the risk mapping tool

The tool can evaluate the effect of potential adaptation measures by including their impact on the spatial probability of climate risks for a given scenario. By comparing the damage costs with and without proposed adaptation measures, the potential economic benefits of adaptation can be estimated.

The same results serve as input to a cost-benefit analysis along with the construction costs associated with the proposed adaptation measures. The overall economic relation between adaptation and no-adaptation can thereby be concluded.

The model requires a set of well-defined thresholds and assumptions for climate variables, damage costs and other model parameters. The thresholds are context and climate variable dependent and are to be developed in close cooperation between the stakeholders and Ramboll.

Results and Conclusions

The risk mapping tool provides a visual planning facilitator for prioritizing measures and communicating spatial distribution of risk and damage costs to politicians and professionals for each scenario and proposed solution, as illustrated in figure 2 below.

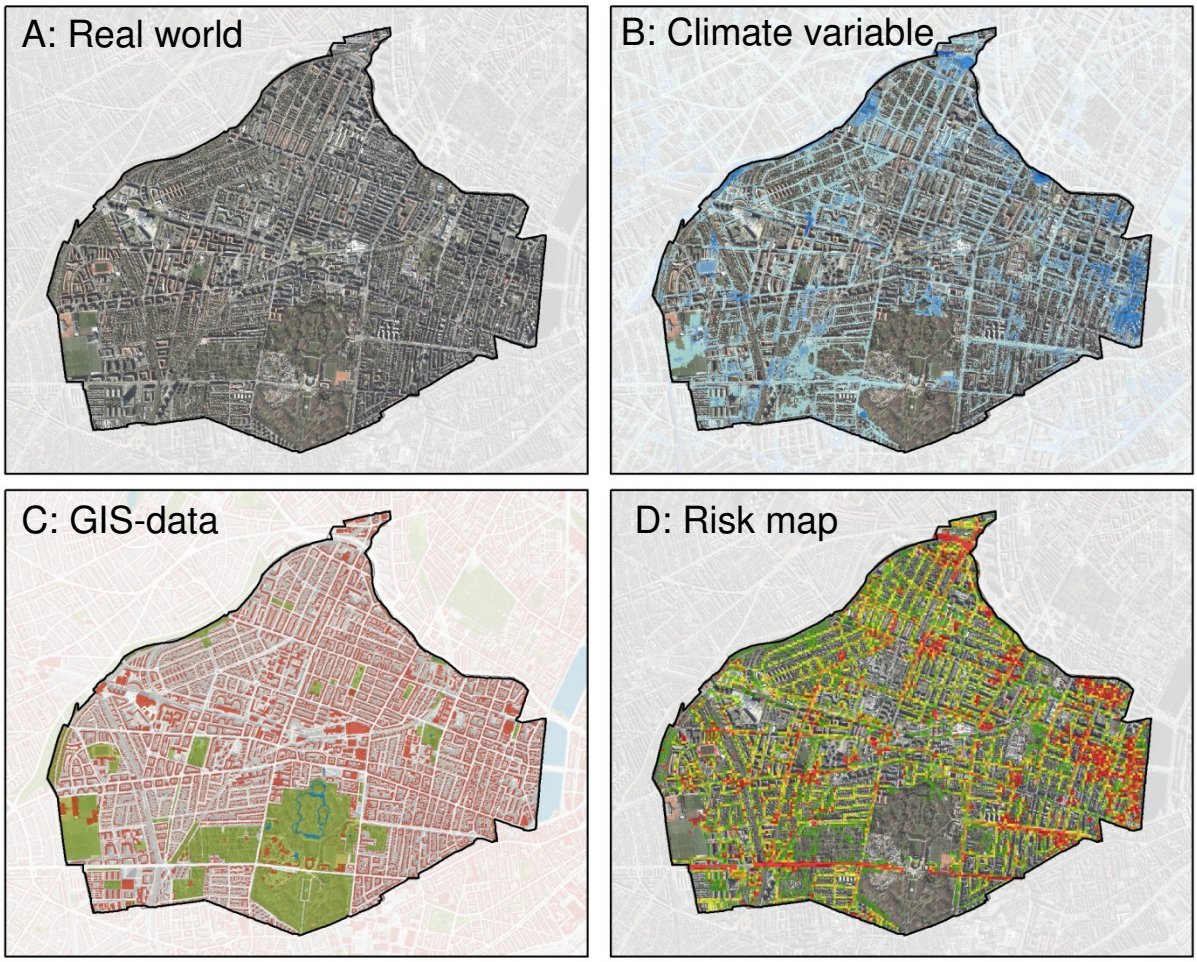

Figure 2: Examples of input (A-C) and output (D) to the risk mapping applied for the municipality of Frederiksberg, Denmark

The tool also provides a complete sum of damage estimates, which can feed into a cost-benefit analysis, in order to choose the most cost-effective climate adaptation measure when combined with the total construction sum and maintenance costs related to the adaptation measures in question. An example of a cost-benefit analysis over time is illustrated in figure 3 below.

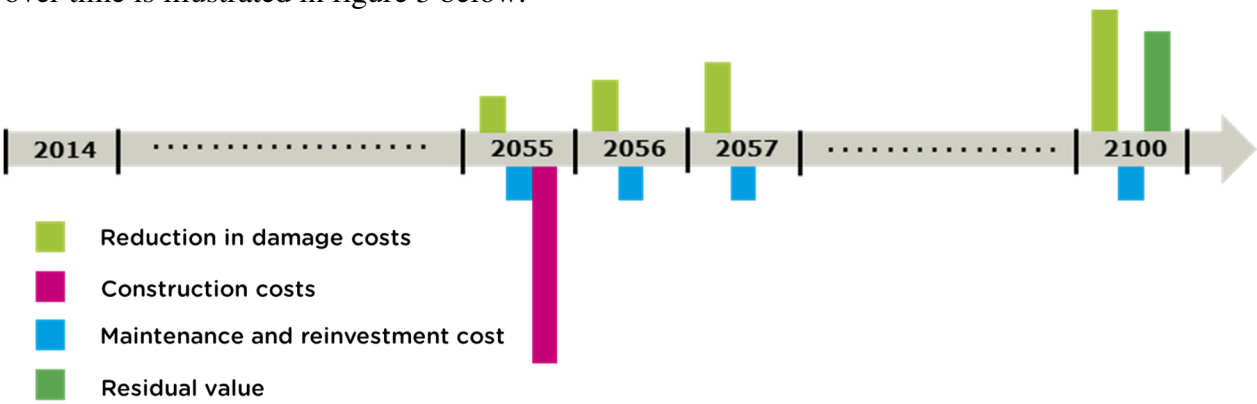

Figure 3 Example of the flow of costs in relation to the total construction and maintenance costs relative to a chosen adaptation solution, the reduction in damage costs and the resulting residual value.

The risk tool has been applied in multiple cities and areas across Denmark and Sweden and is about to be applied for the first time by Australian councils. Until now, the model has mainly been utilized for urban and coastal flooding, but is under continued development to include more demographic and infrastructural details and adapted to further climate variables. The ability of the tool to adjust to changing contexts makes it eligible for becoming a standard tool in the climate change adaptation processes across the world.