Multiple pressures on the Göta River and the city of Gothenburg, Sweden – management by stakeholder involvement

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Introduction:
Many urban areas face a number of future potential problems e.g. environmental, social and economic together with the, often not fully, defined effects of climate change and urban densification. Some of these issues are assumed to sometimes interact and sometimes counteract with each other. In northern Europe the effect of climate change is mostly identified as winters with more precipitation and dryer summers. For Sweden, both rain intensity during extreme rain events and the total annual precipitation, is estimated to increase 10-20% in 2100 [1]. However, Haeger-Eugensson [2] have, based on measurements, shown that for the Swedish west coast the predicted future precipitation levels are almost already reached. This is visible in more frequent flooding and also the ground water levels which have augmented constantly from 1990. Higher ground- and surface water tables increase the leakage from soil contaminants but may also dilute the pollutants and/or increase river bed-/bank erosion [3]. Thus, the future risk from a changing climate for the area is manly flooding and high water pollution concentration levels, which may influencing the city fresh water inlet. Simultaneously, Gothenburg, the second largest city in Sweden, is growing why, like for many other cities, optimized city planning is required.

Methods: The plans for the Great Gothenburg area is growth through urban densification, both within the city centre itself, but also in surrounding suburbs and towns, linked with expanded transportation (e.g. high speed trains). When planning this expansion, a multiple pressure analysis in needed including environmental, social, economic and other important aspects, in order to assure a future sustainable development of the region. In managing complex matters or systems (e.g. sustainable urban development), where the outcome is based on both actual metrics and on diffuse values (such as societal values), it is essential to have a methodology to objectively evaluate all aspects in a holistic way, e.g. how different variables interact and which are the drivers/buffering etc. To examine how the effect of climate change on the urban and coastal waters for the Gothenburg area (Swedish west coast) could be handled together with some of the positive and negative effects of urban densification, a sensitivity model was used [4] and applied on the Gothenburg urban area. The model includes an interactive process between experts, city officials, stakeholders and citizens at a number of meetings and further analysed within a core group.

Results: In the sensitivity model the connection and driving forces between different processes and variables were defined, valued and visualized into a more understandable system. At first the system of today for the area was determine. The result showed that the system was rather inert and thus difficult to modify, due to that only a few and less dominant parameters could be easily modified. One parameter that influenced both environment and most of the other variables was population growth, but not solely in a negative way. Further, old water rights up-stream is blocking new developments of e.g. housing and flood prevention. Other defied risks are numerous old contaminated industrial grounds that may start to (or is already) leaks due to increased ground water levels. According to the modeling, most of these measures give long feed-back cycles and have to be analysed further before used for recommending future measures and suggestions for optimization of the future management and planning of the area. It will also be used in the on-going stakeholder process for the ARCH project.

Discussion: Since both the effect of climate change and urban densification is very complex, it is thus also essential to incorporate in them into the urban planning process. The results from the exercise with the stakeholder process together with the sensitivity modeling a rather understandable pattern was visualized which could be further used into the planning process of the municipality. The group was somewhat overrepresented by experts why the result may become to some extent bias.

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