A risk-based evaluation tool for feasible urban drainage design under influence of climate change

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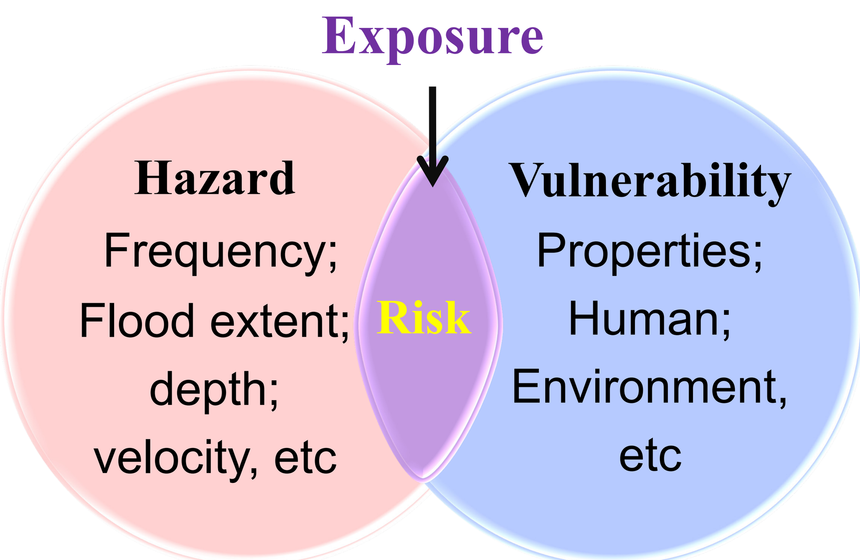
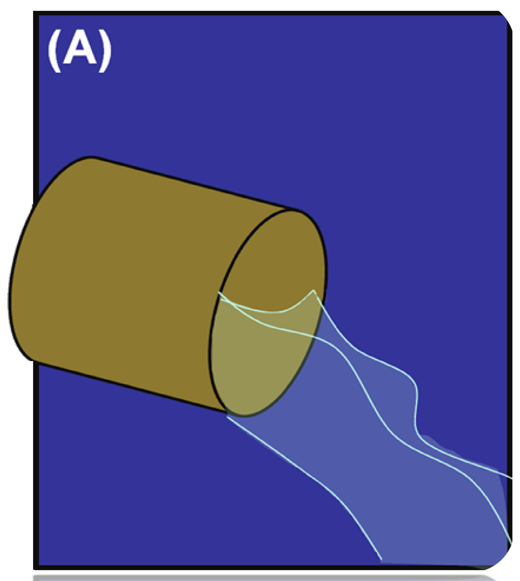
Introduction

Climate change is affecting precipitation extremes. The concepts of traditional urban drainage design are being questioned and there is a growing trend towards managing urban water in a more sustainable and resilient way.

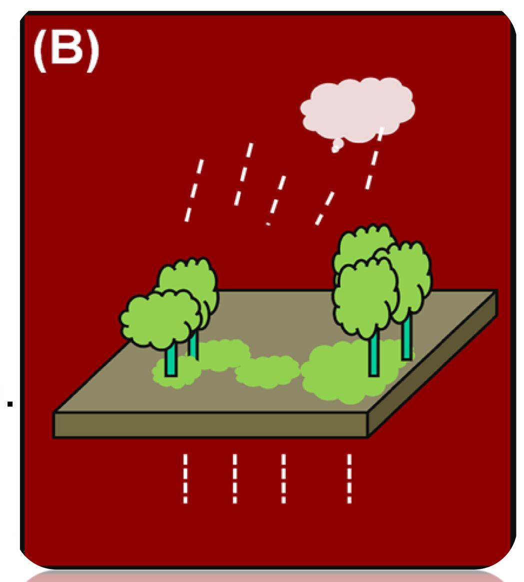
Flood risk can be reduced through appropriate activities that reduce the hazards and/or vulnerabilities. A better understanding of the individual performance of each type of measure is needed.



Approach

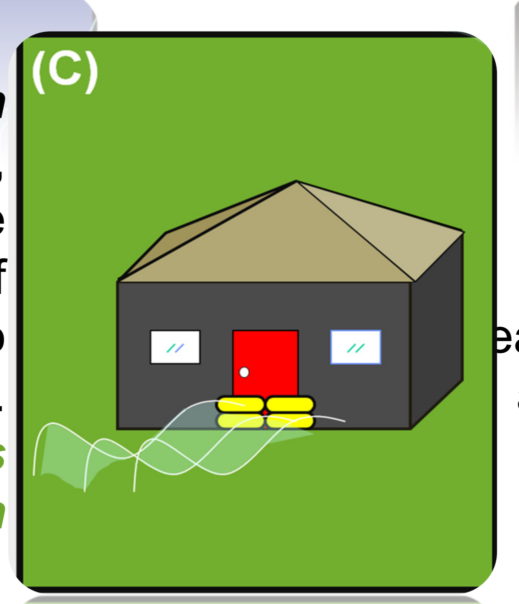


Flood conveyance, to enhance the conveyance capacity of excess flows, e.g. ***pipe enlargement***

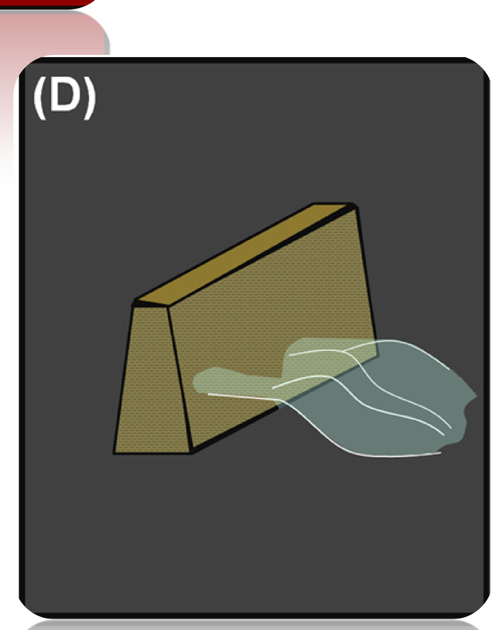


Flood attenuation, to slow down and reduce water runoffs, e.g. ***infiltration***

Flood regulation & preparedness, to reduce the exposure of vulnerabilities to flood hazards, i.e. ***individual assets protection***



Flood defense, using structural measures to prevent floods reaching vulnerably areas, e.g. dams, flood walls



Results

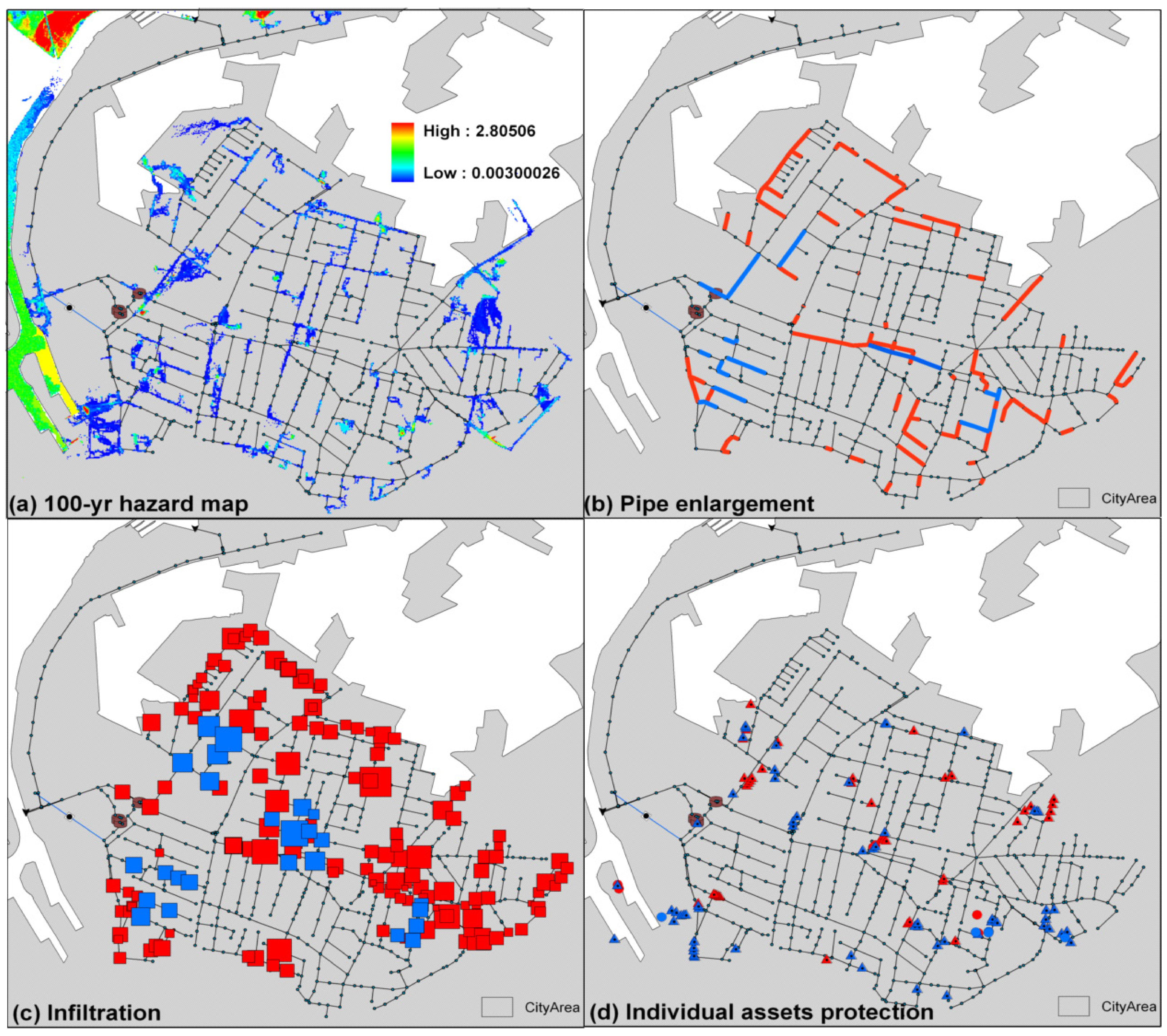


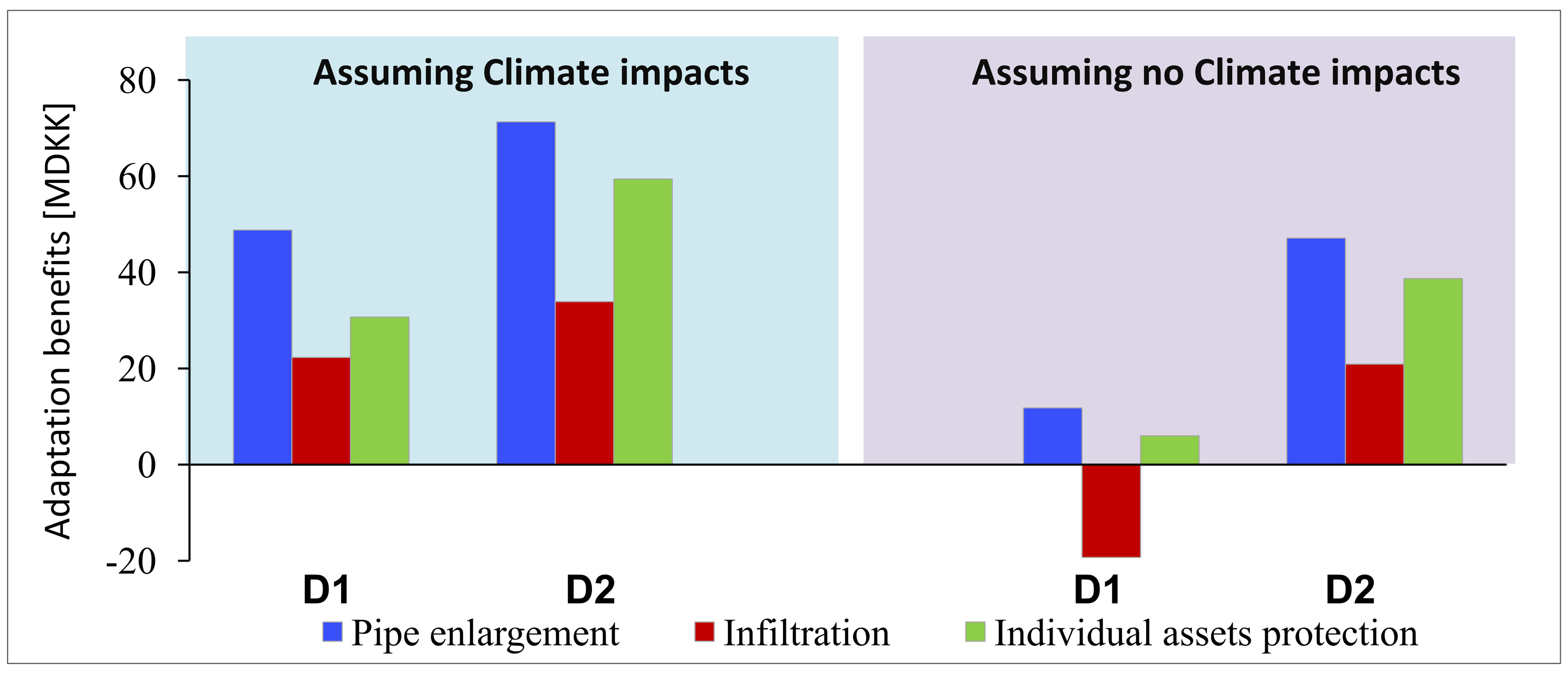
Illustration of hazards and tested adaptation options. The top left figure shows the inundated areas of a 100 year storm. The other three figures show where measures are needed to comply with the two decision criteria respectively. The modification in blue indicates the measures invested under both criteria, while the ones in red are the supplementary measures only needed under decision criterion 1.

Three options were tested: pipe enlargement, infiltration and individual assets protection. Each option was used under two adaptation schemes:

D1) ***Overall adaptation***, aiming at a fixed minimum service level of any type of damage of 5 years, based on equity principle.

D2) ***Economically optimal adaptation***, considers adapting to the return period that is most economically profitable.

We also tested that if the suggested adaptation will be paid off even in the absence of climate change impacts.



Estimated adaptation benefits (Net Present Value (NPV)) by means of three adaptation measures under current and future climate conditions assuming discount rate of 3%

Discussion and Conclusion

	Pipe enlargement	Infiltration	Individual assets protection
☺	Efficient, in terms of both technical and economic aspects.	Infiltration has effects on water discharge and peak flow	Cost-effective in reducing the flood risk
☹	A series of pipes need to be enlarged, due to its chain actions	Not efficient in preventing downstream floods for extreme events	The efficiency is highly dependent on local participation, which is still very limited

- The three measures analyzed are complementary to each other; a *sustainable* adaptation should promote their cooperation in order to maximize the effectiveness.
- More robust and beneficial strategy could be designed under the second scheme. This corresponds to a gradual extension of the system. This approach may be more economically feasible.