Using Model Predictive Control to utilize green cloudburst solutions for smaller rain events

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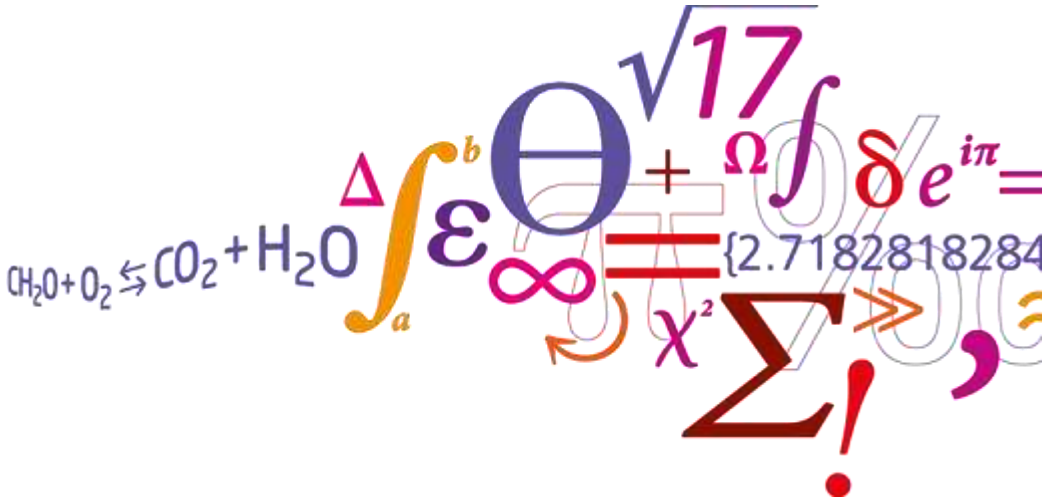


DTU Environment
Department of Environmental Engineering

Management of extreme rain events

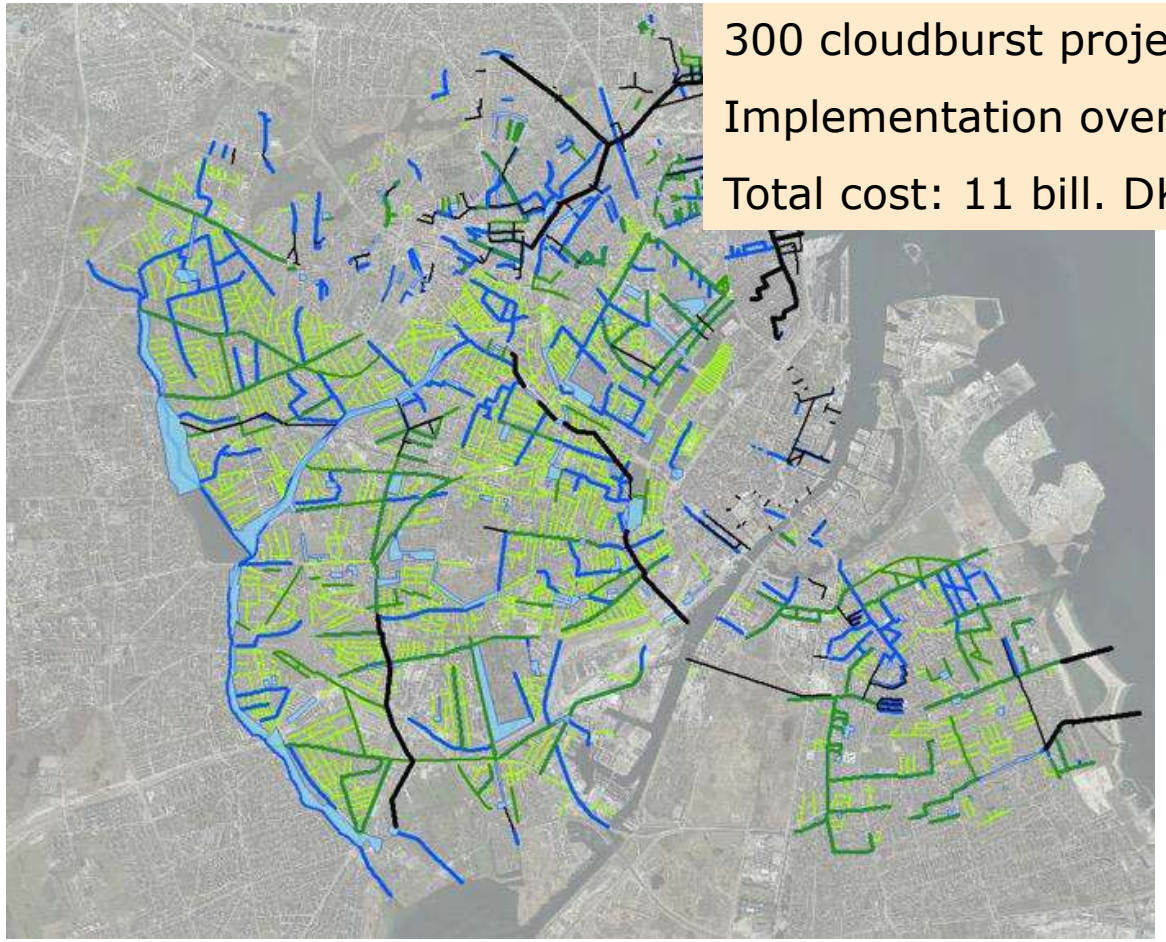
Copenhagen

Before 2010: No cloudbursts

From 2010 to 2016: 5 major cloudburst in 7 years, with damages of billions of Euros

http://www.bt.dk/danmark/store-oversvoemmelser-i-hele-kobenhavn

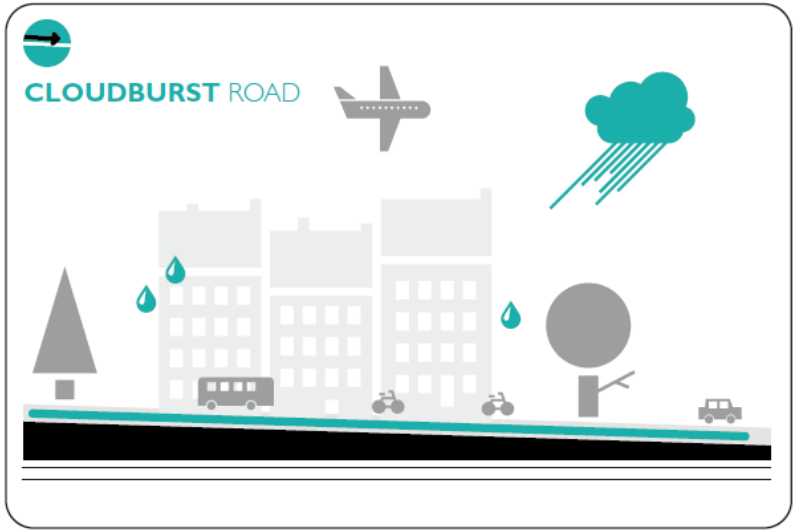
Climate adaption plan for extreme rain events

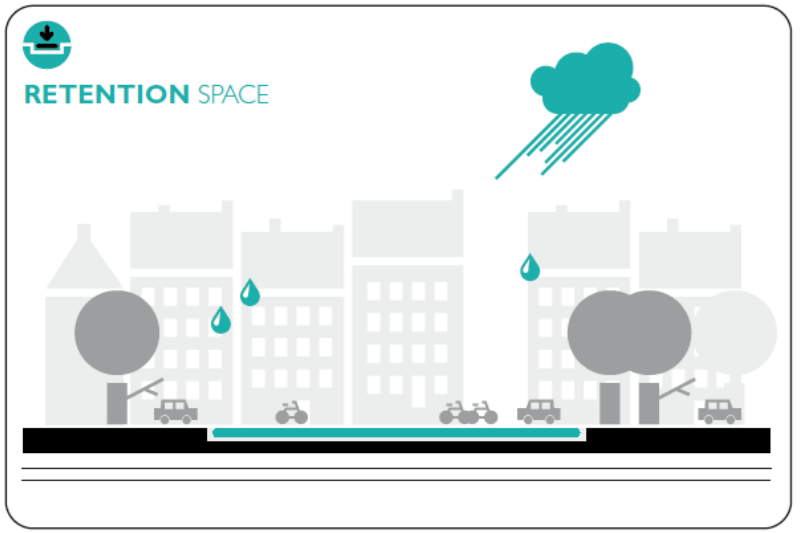


300 cloudburst projects

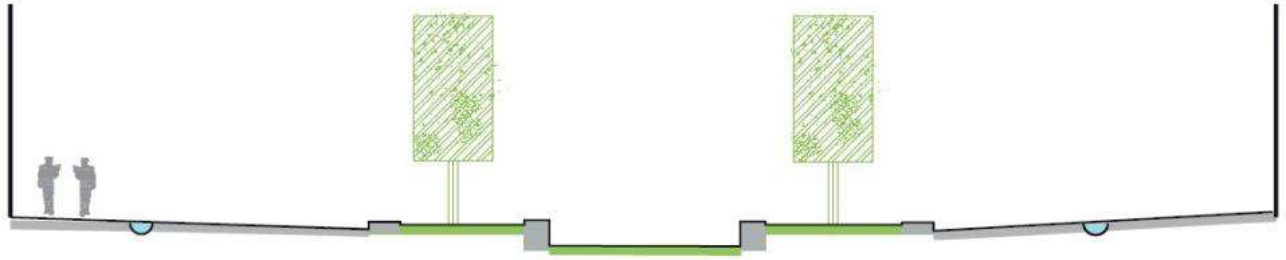
Implementation over 30 years

Total cost: 11 bill. DKK



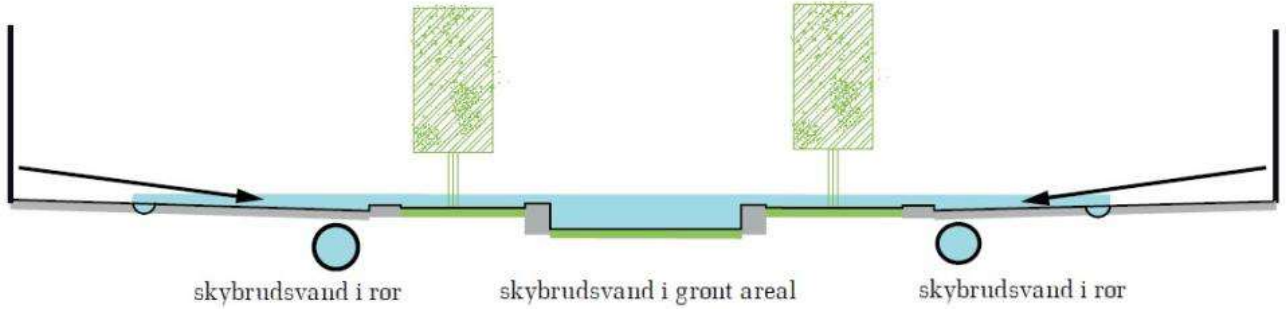


The design of a cloudburst road



Dry weather

Normal rain



Extreme rain

Example of retention space

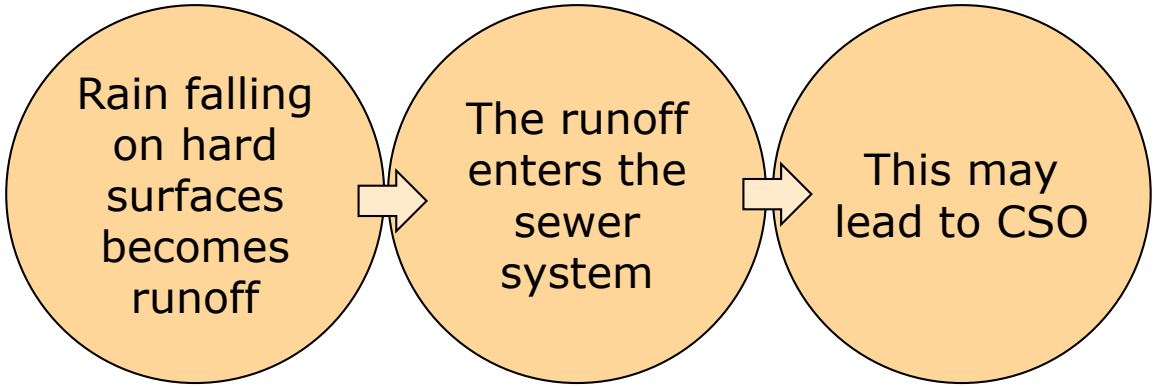
Management of minor to medium rain events

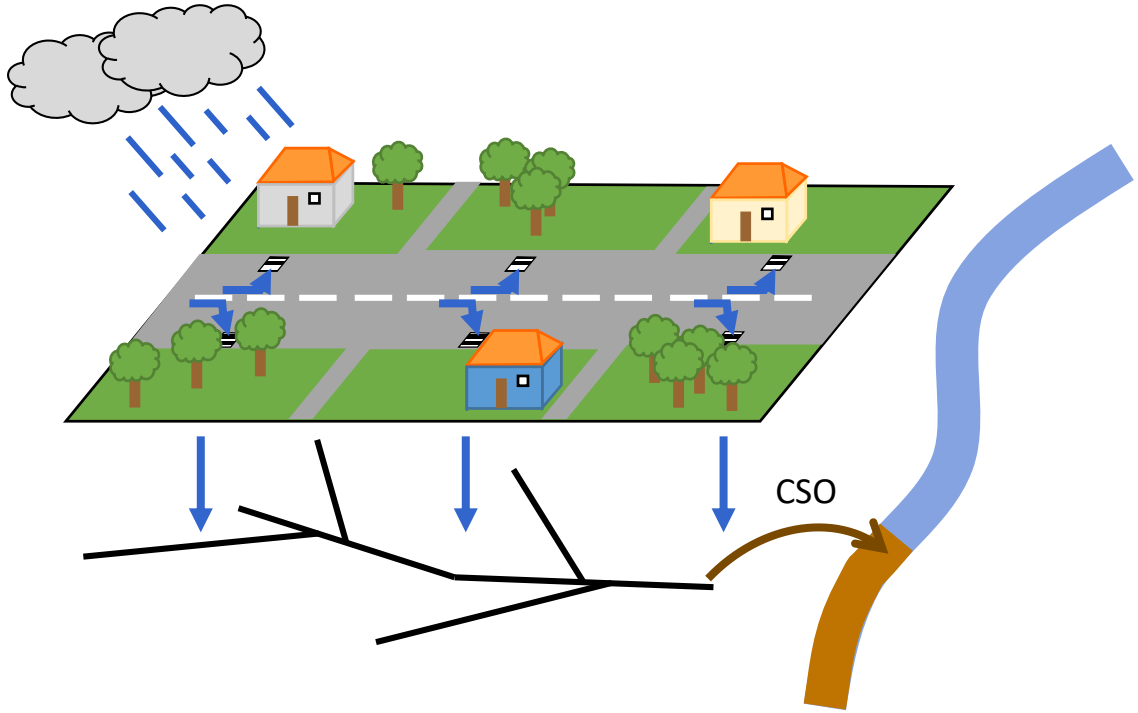
Combined sewer overflow (CSO)

Underlying idea

Can you combine 1) management of smaller rain events with 2) climate adaptation for extreme rain through above-ground control – and hereby minimize the total CSO volume?

Current situation: underground control





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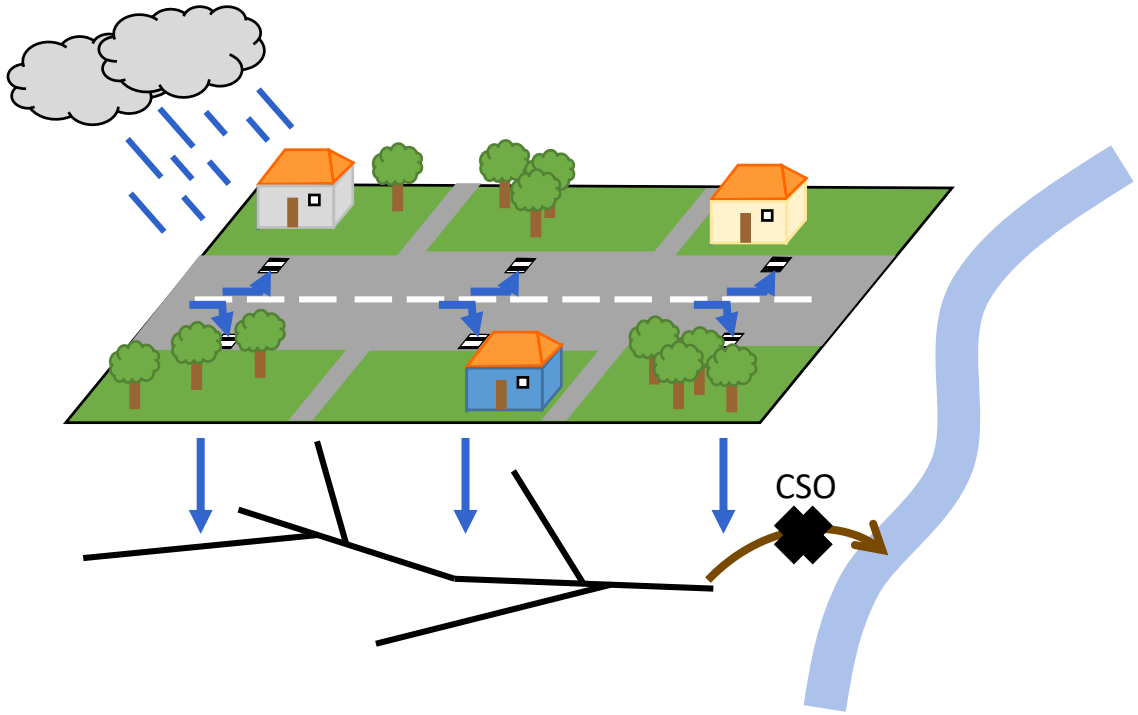

Control of water on terrain

Rain falling on hard surfaces becomes runoff → The sewer system capacity will not be exceeded → The runoff should enter the sewer system

The sewer system capacity will be exceeded → The runoff should not enter the sewer system and instead make use of the cloudburst projects

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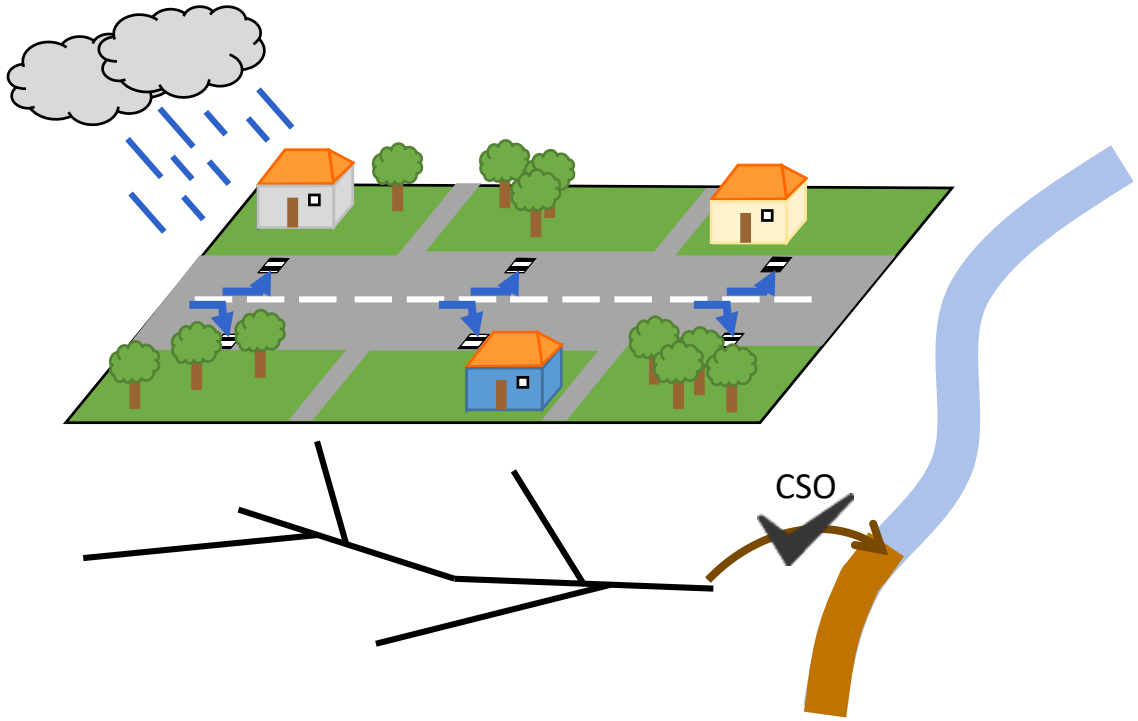

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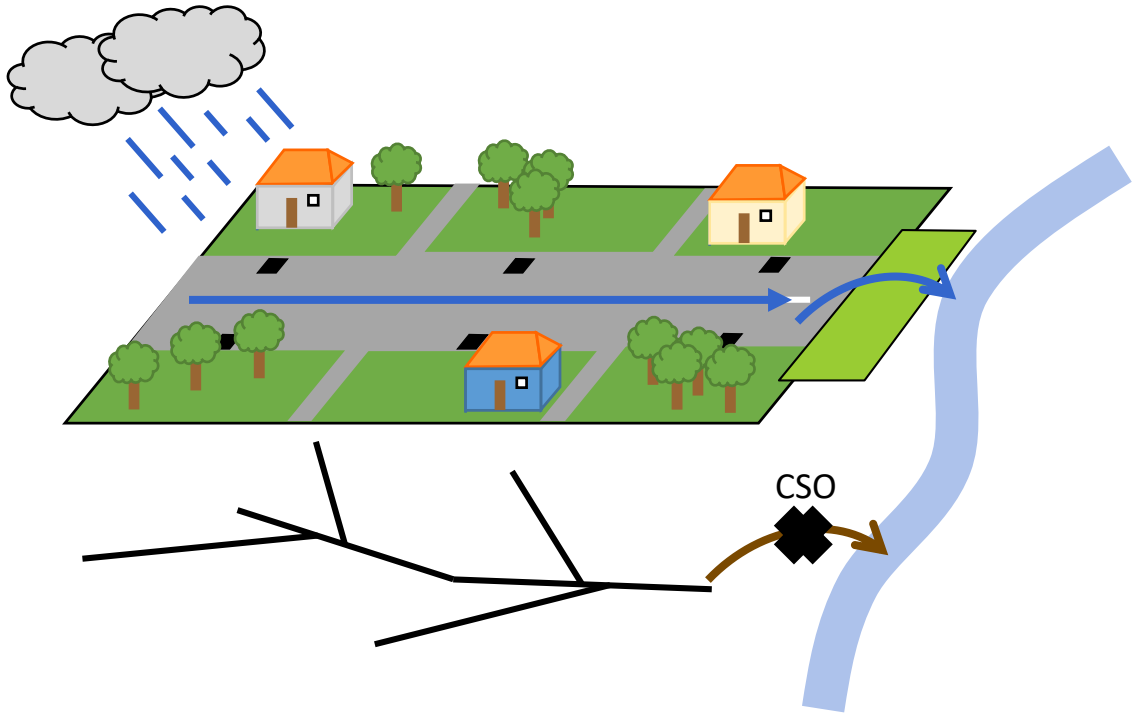

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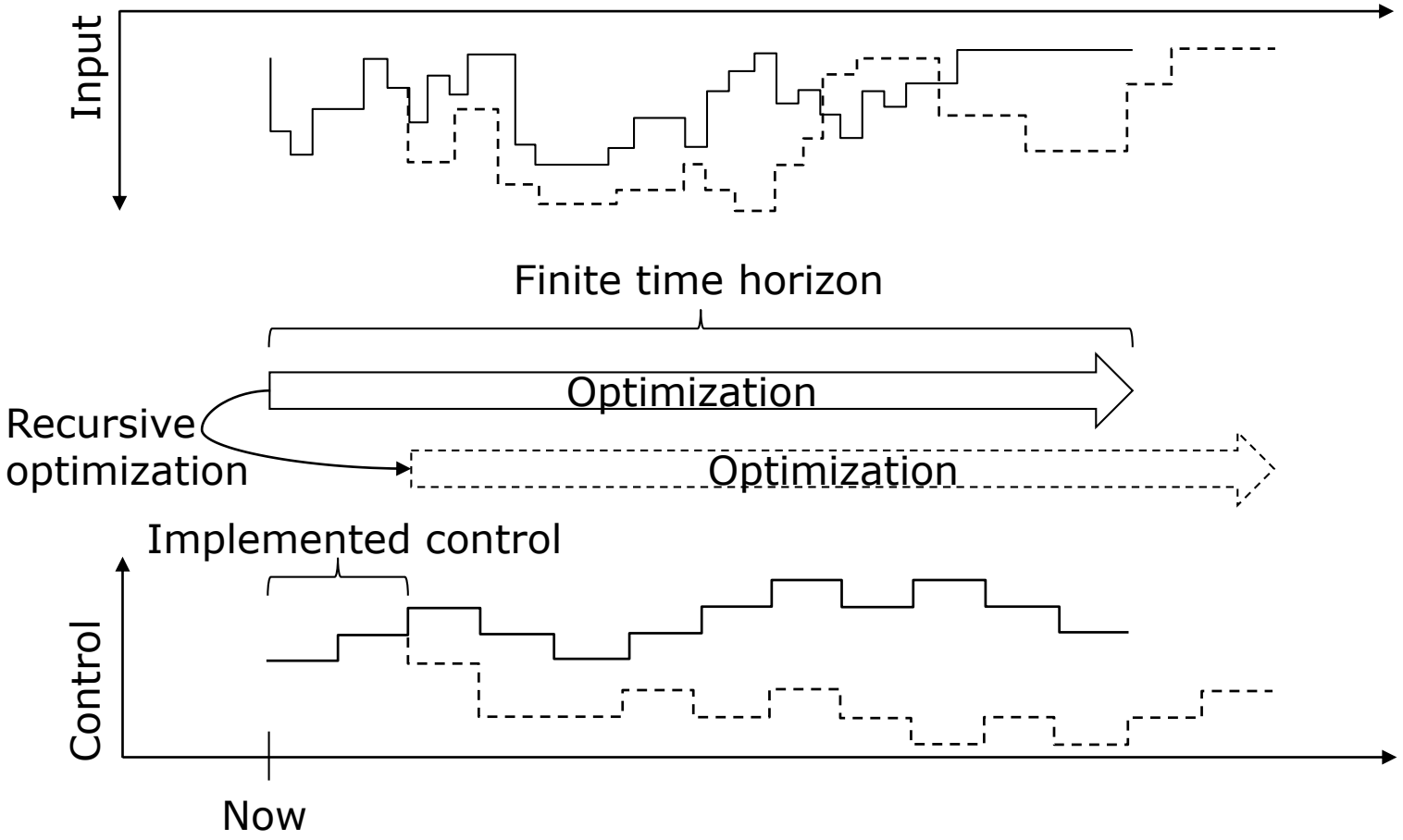
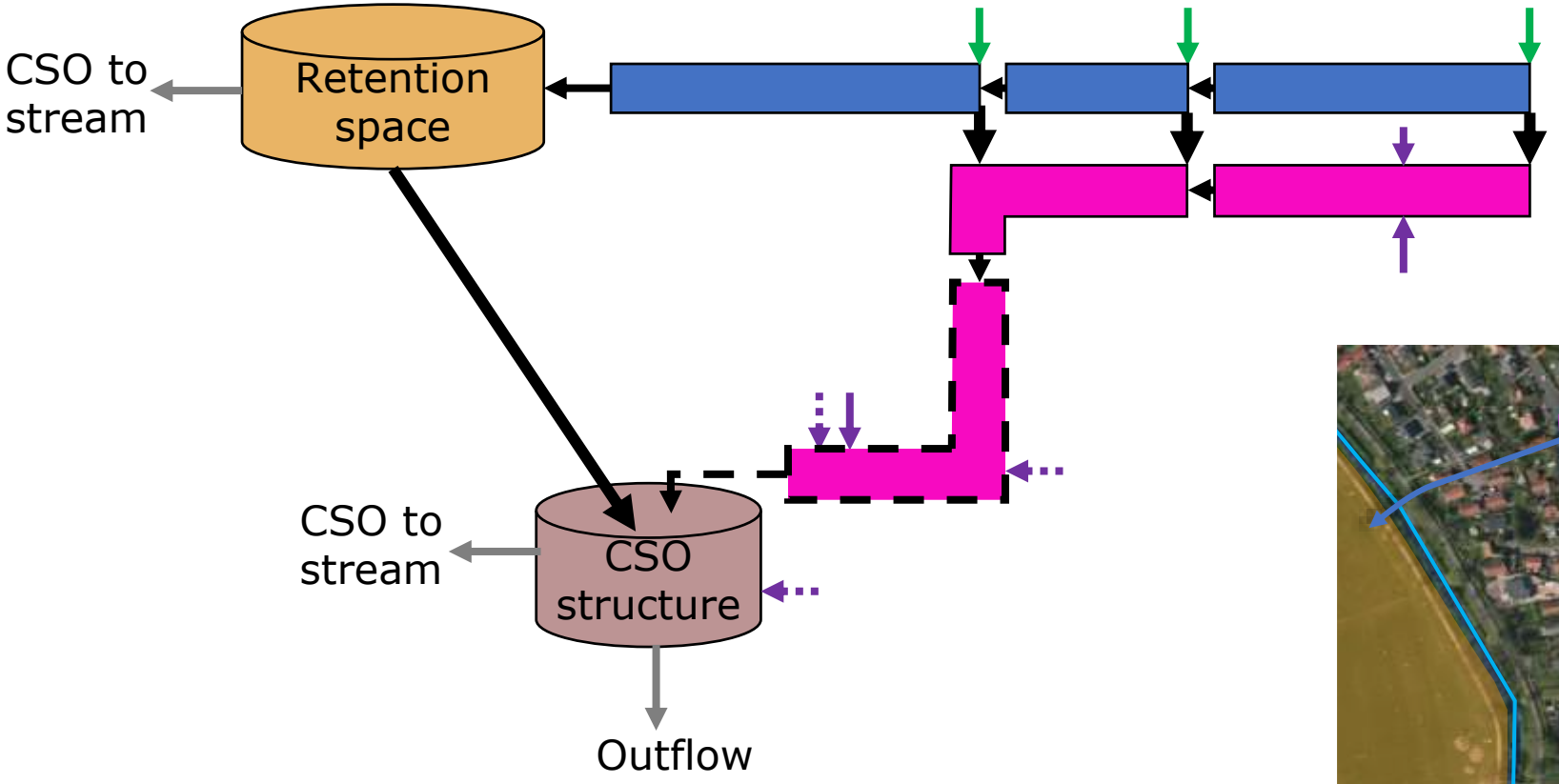
Model predictive control in general



Model predictive control – in this study

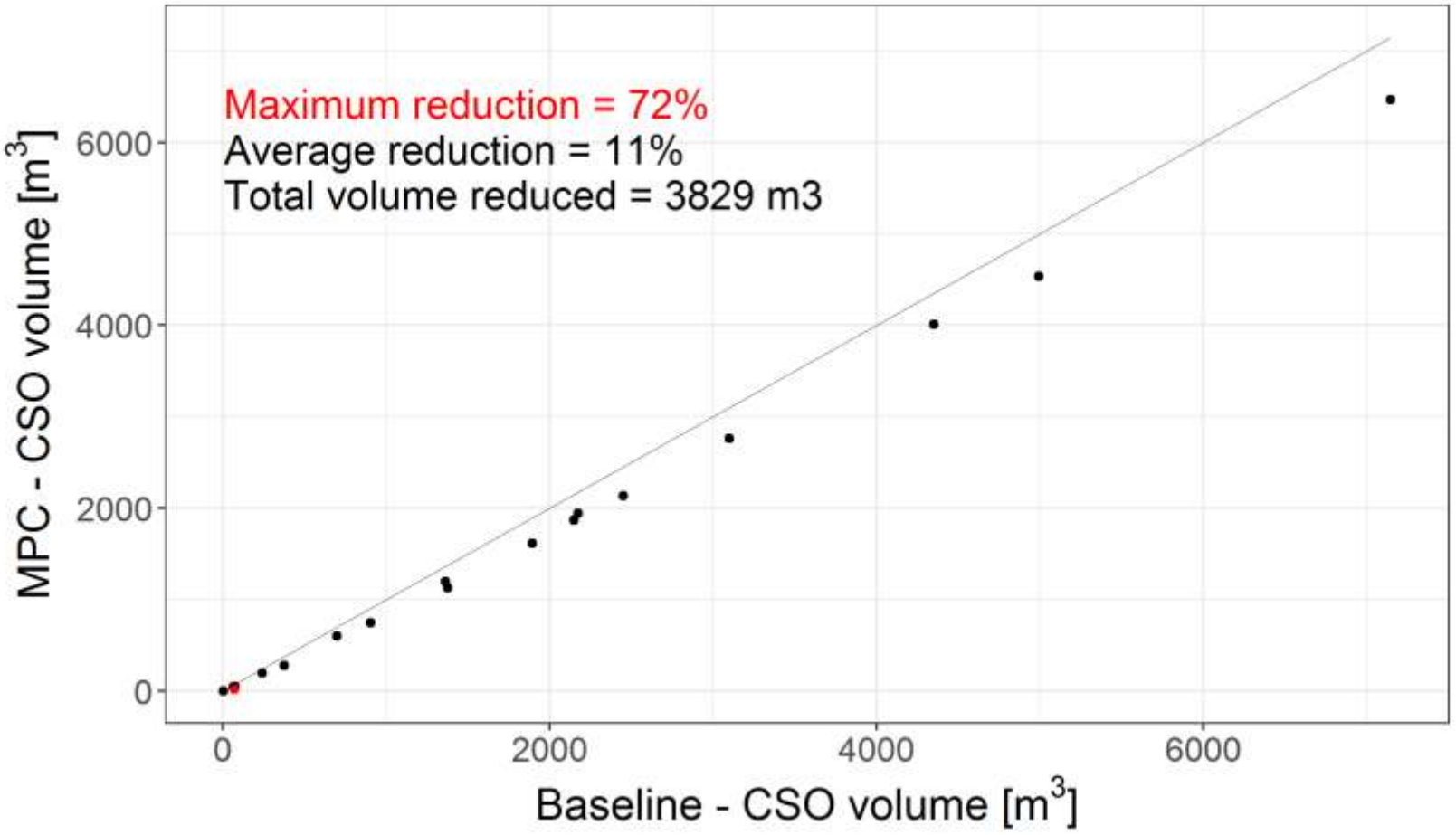
Internal MPC model



Controlling 7% of the upstream area to a CSO

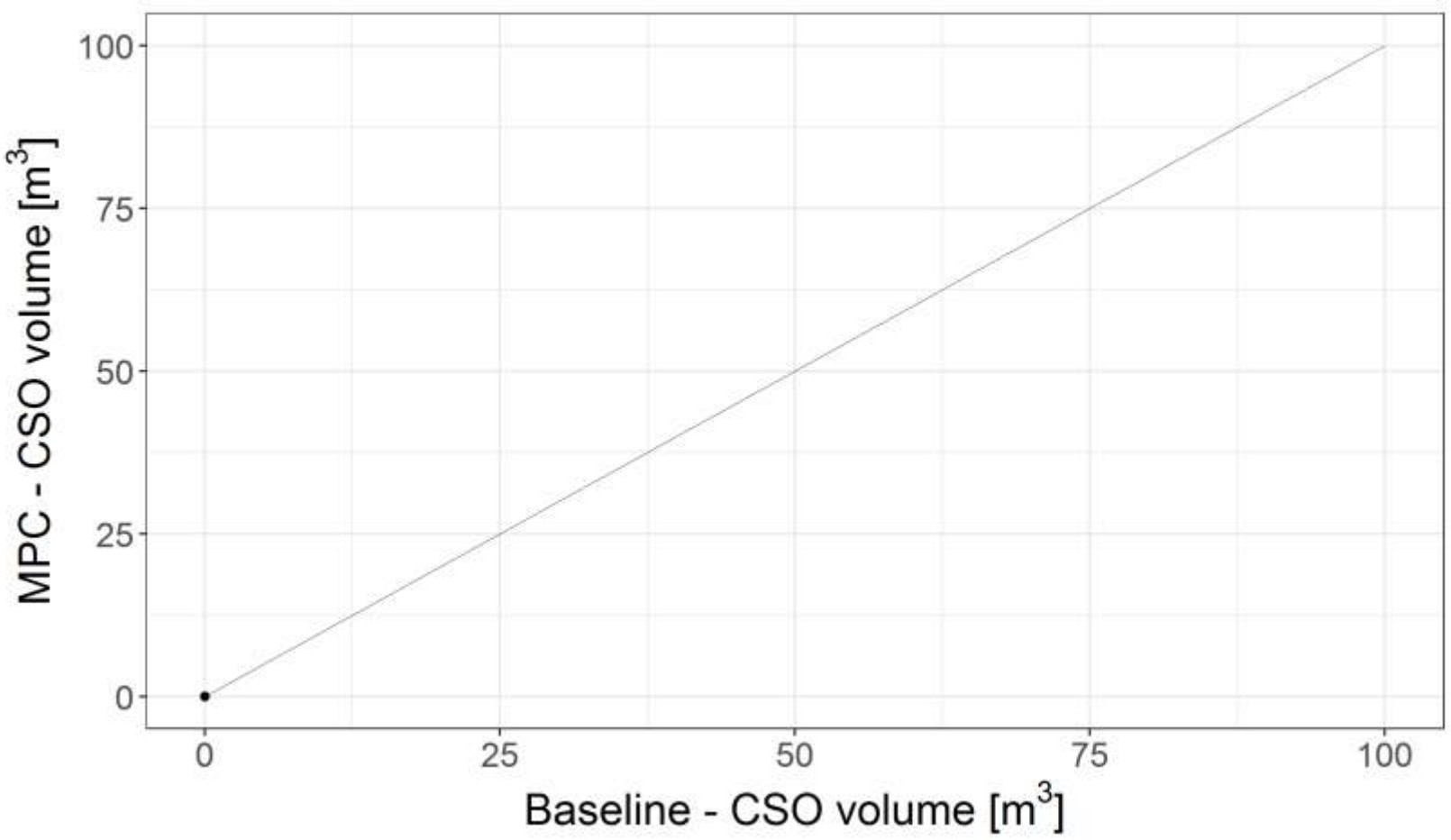
Results and discussion

18 events in 2016 resulting in CSO



Results and discussion

14 events in 2016 not resulting in CSO



Conclusions – is it worth the effort?

Can you combine 1) management of smaller rain events with 2) climate adaptation for extreme rain through above-ground control – and hereby minimize the total CSO volume?

YES

- Above-ground MPC may send water on terrain even though there would not be a CSO.
- Using 2 out of the 300 cloudburst projects in above-ground model predictive control reduced the amount of CSO with on average 11%, but at times up to 72%.
- Imagine what we could do if we expanded the concept to cover all 300 cloudburst projects?