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# Modelling Climate Change and Urbanization Impacts on Urban Stormwater and Adaptation Capacity

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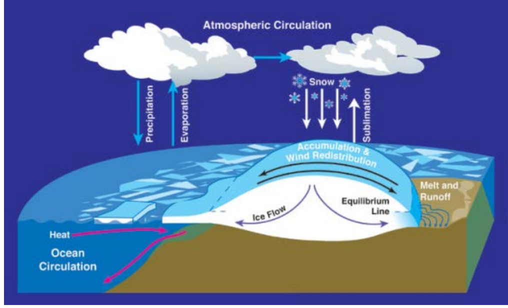
# Outline

- Drivers
- Methodology
- Case study
- Results and discussions
- Conclusions

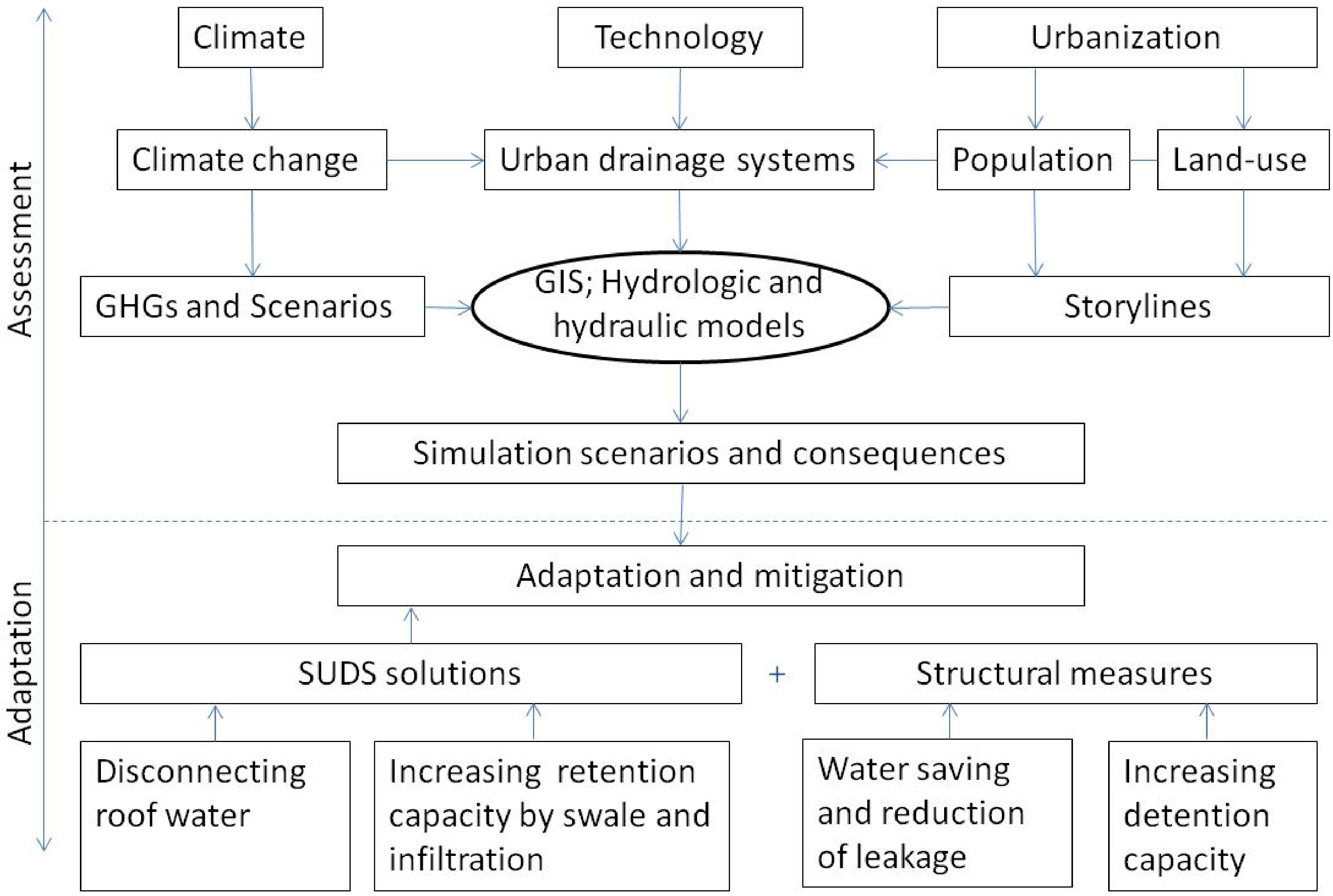
# Drivers

- Climate change: More frequent intense precipitation, increase temperature, and sea level rise
- Urbanization: growth population, increase of water demand and sewage discharge, and impervious areas
- Aging drainage networks and insufficient drainage capacity



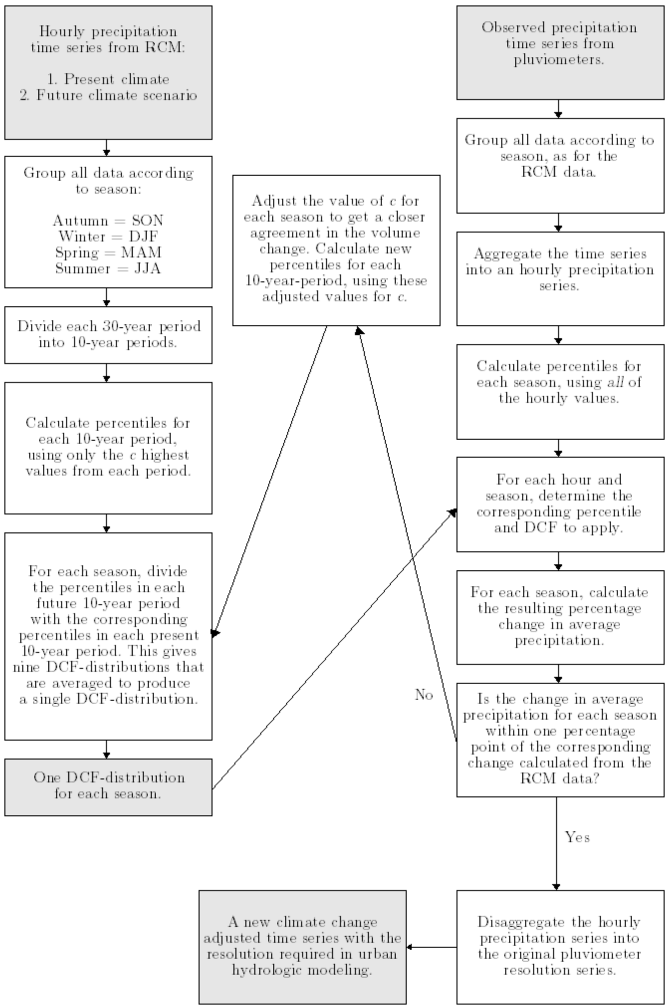


# Methodology

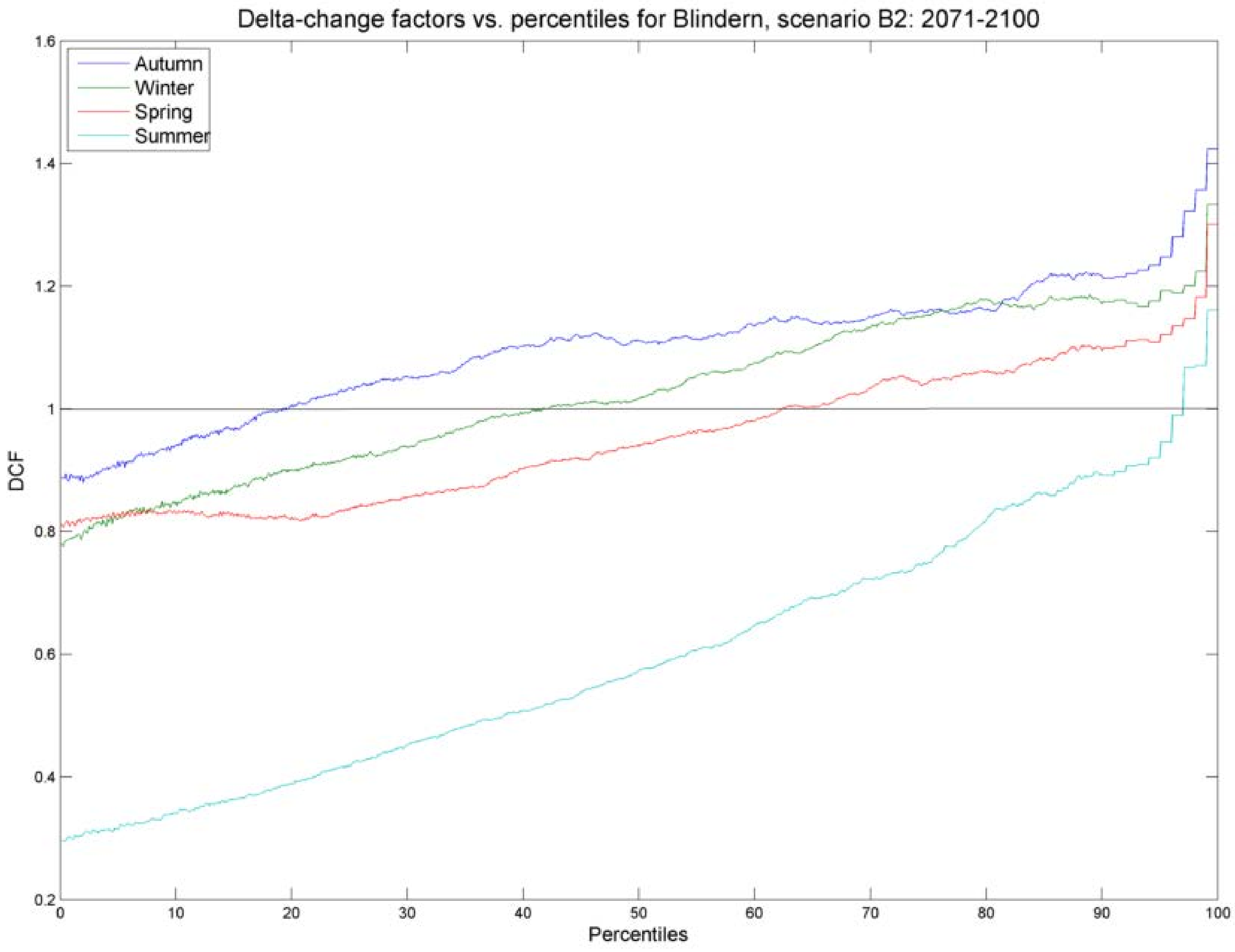


# Delta-Change Model (DCM) approach

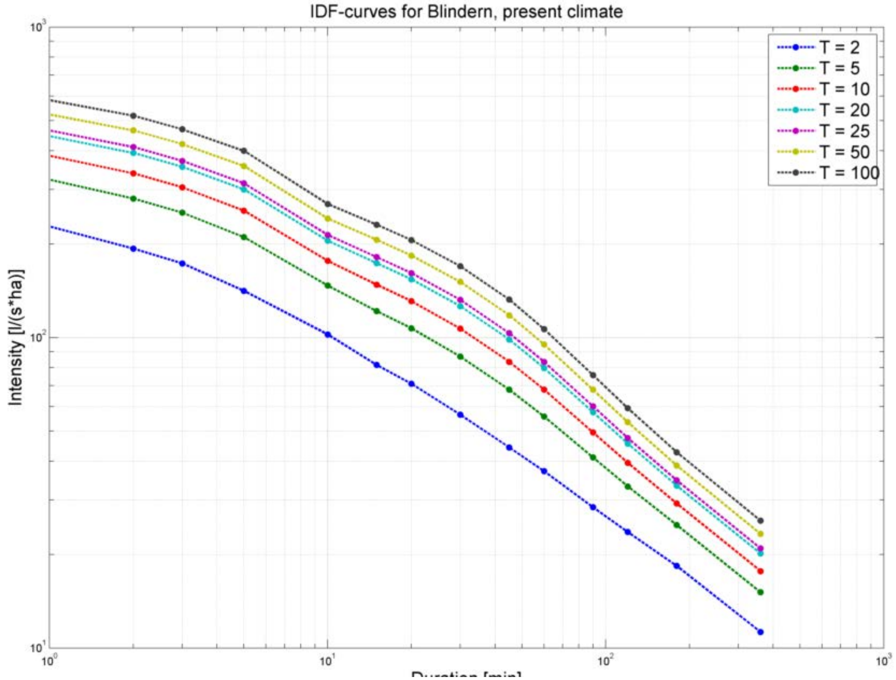
- It compares the regional climate model results to the observed precipitation values.
- Factors obtained to describe the relative change in precipitation are called Delta-Change Factors (DCFs).
- These factors are then applied to the observed high resolution precipitation time series to obtain projections of future precipitation time series with the same temporal and spatial resolutions and IDF curves.

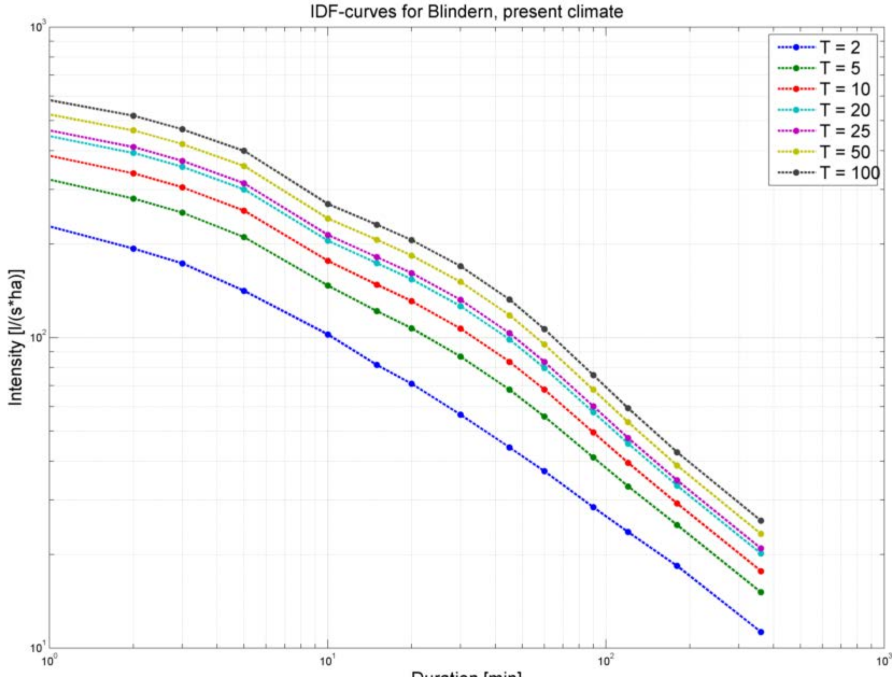


# Seasonal Delta-change factors



# IDF for the present (left) and future (right) climate

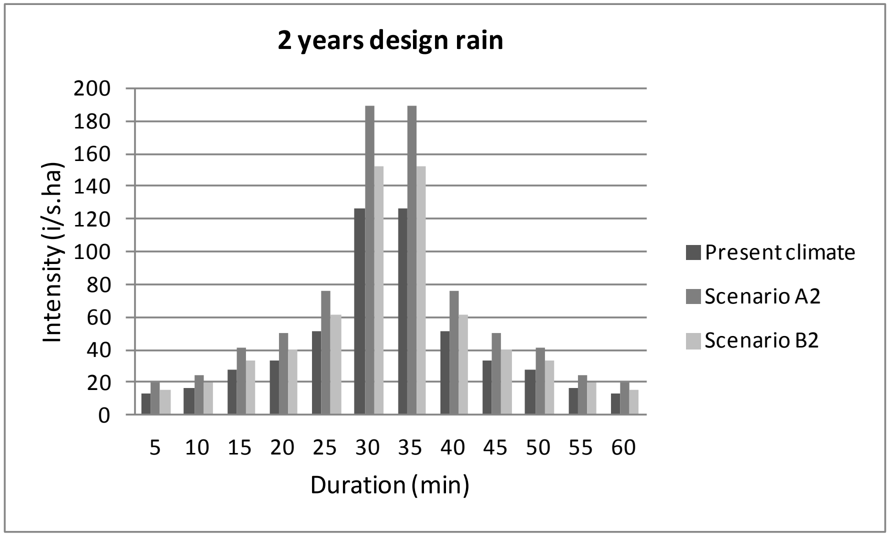



For scenario B. Precipitation intensities increase varying from 17%-23%

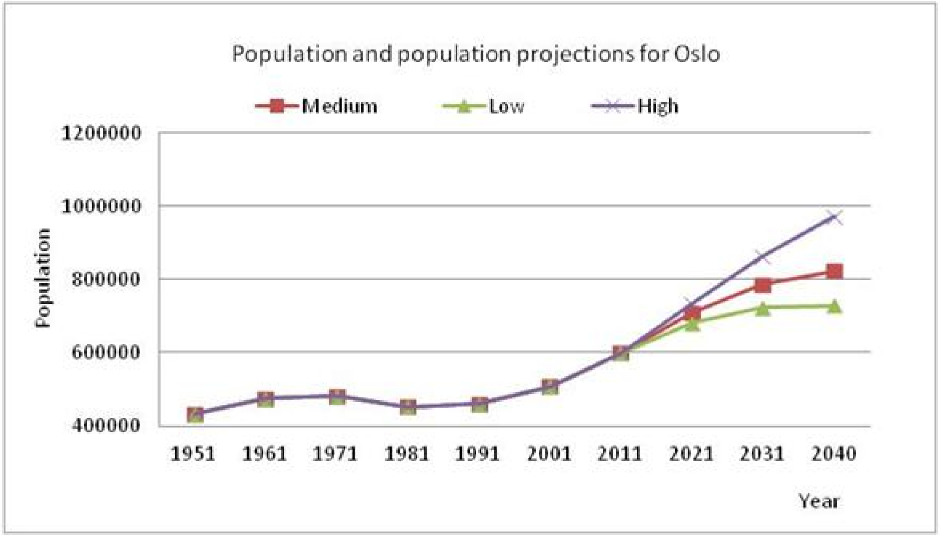
# Hyetograph for 1 in 2/20/100 years' rain

- Rain T= 1 in 2 years for CSO control
- Rain T= 1 in 20 years for flood control
- Rain T= 1 in 100 years for test consequences and adaptive capacity in extreme weather condition



# Urbanization

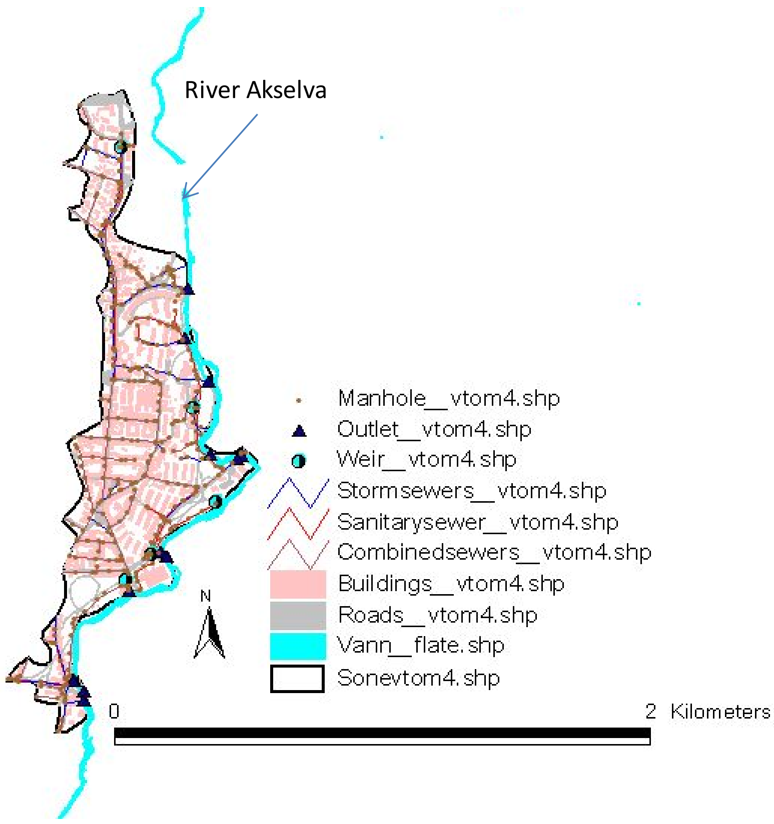
- Growth of population




- Water consumption in residential areas

| Specific water consumption (l/pe-day) | Present (control) | Scenario A2 | Scenario B2 |
|---|---|---|---|
| Household | 160 | 160 | 150 |
| Unregistered use | 15 | 15 | 15 |
| Leakage | 100 | 100 | 55* |
| Sum | 275 | 275 | 220 |

# Case study




- Residential area 112 ha
- DHI-MOUSE model:

  - Existing sewers: 15 km long sewers, 411 manholes, 2 overflow weirs (3 original ones have been closed) and 15 stormwater outlets.

  - 66% combined sewers

  - calibrated according to the measured precipitation, temperature, water level and sewer discharged during June-December 2009.

  - Problem: frequent CSOs

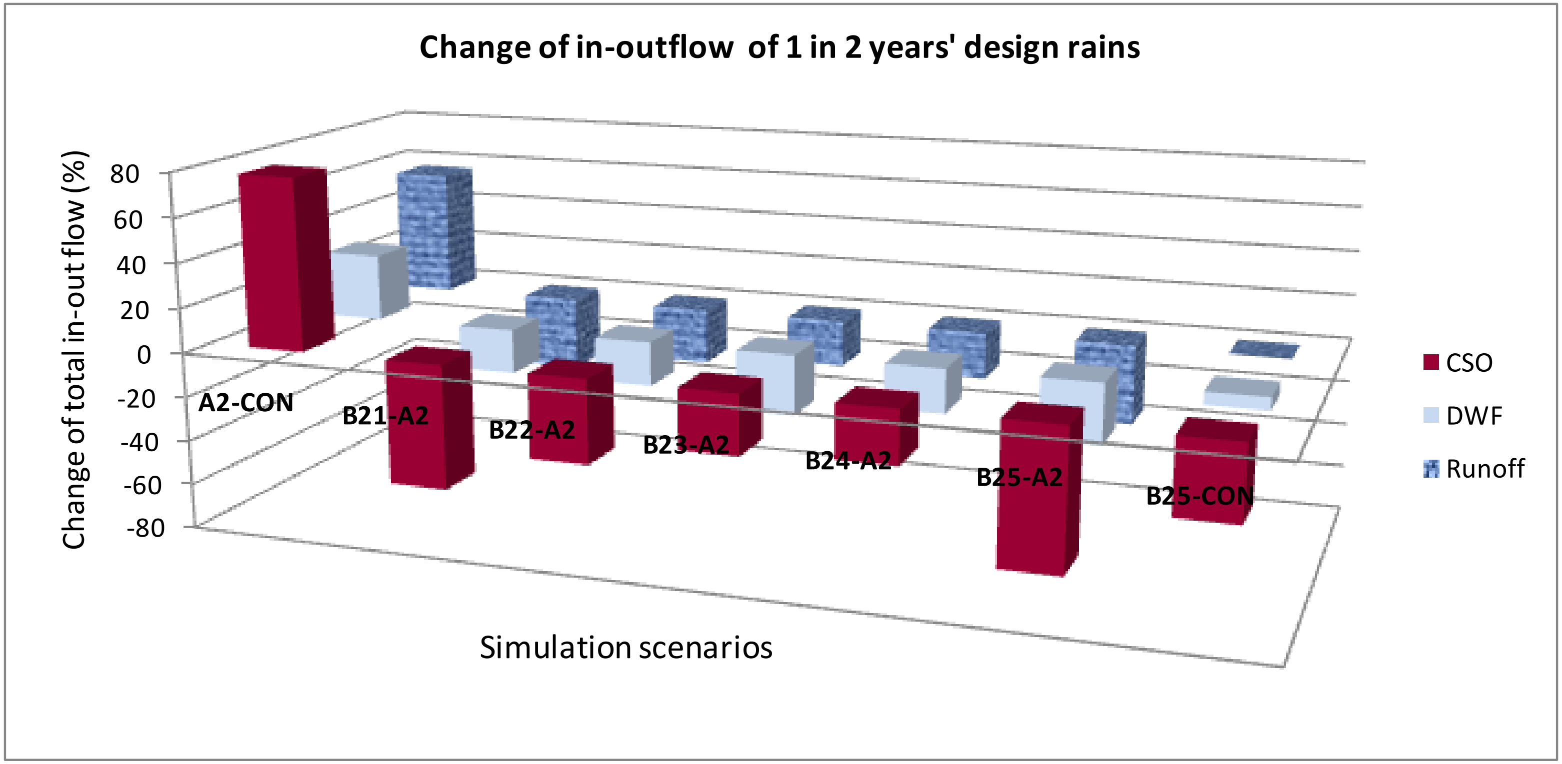
# Adaptation potentials

- B2.1 Disconnect water from building roofs
- B2.2 Increase retention capacity (swale & infiltration pond)
- B2.3 Water saving and leakage reduction
- B2.4 Structural measures, e.g. use large pipes and detention basins
- B2.5 All

# Simulation storylines and scenarios

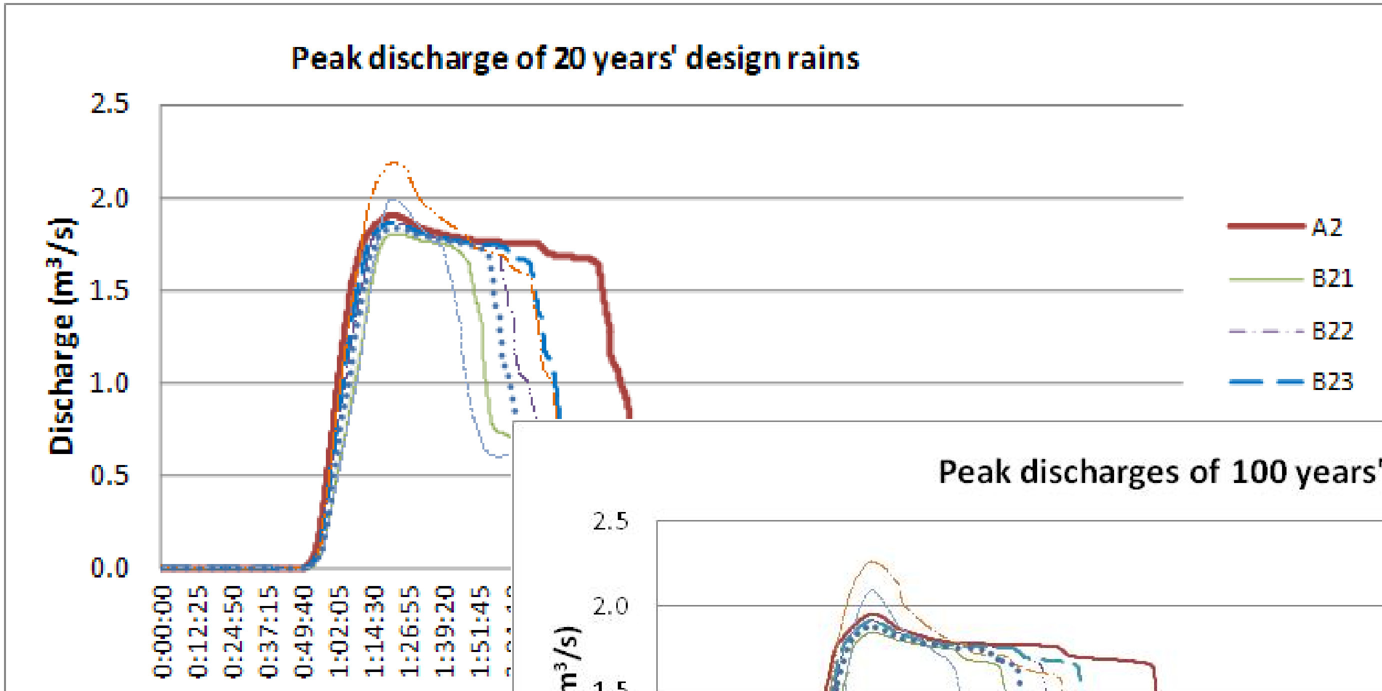
| Parameter | Storyline1 | Storyline 2 | | | Storyline 3 | | |
|---|---|---|---|---|---|---|---|
| | CONTROL | A2 | B2.1 | B2.2 | B2.3 | B2.4 | B2.5 |
| **Population** | 7692 | 9984 | | | 9984 | | |
| **Total catchment area[a] (ha)** | 112 | 112 | | | 112 | | |
| **Impervious surface area (ha)** | 28.07 | 31.1 | **23.9** | 31.1 | 31.1 | 31.1 | **23.9** |
| **Swale & Infiltration (mm)** | 0.6 | 0.6 | 0.6 | **350** | 0.6 | 0.6 | **350** |
| **Water consumption (l/pe-day)[b]** | 275 | 275 | 220 | 220 | **200** | 220 | **200** |
| **Detention (large pipe and basin)** | Existing sewers (CON, A2, B2.1-B2.3) | | | | | **Site-specific** (B2.4-B2.5) | |

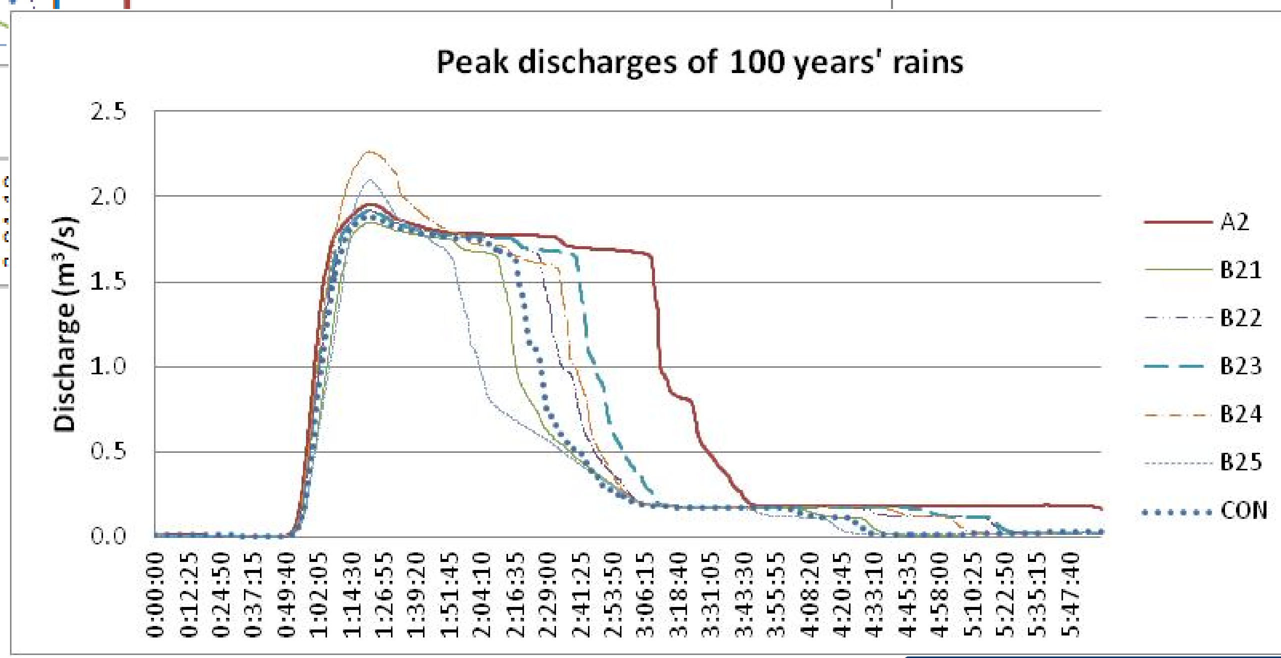
# Results and discussions (1) – Total in-outflow




For a 2-yr rain event minor adaptation is needed to achieve the goal for CSO control.

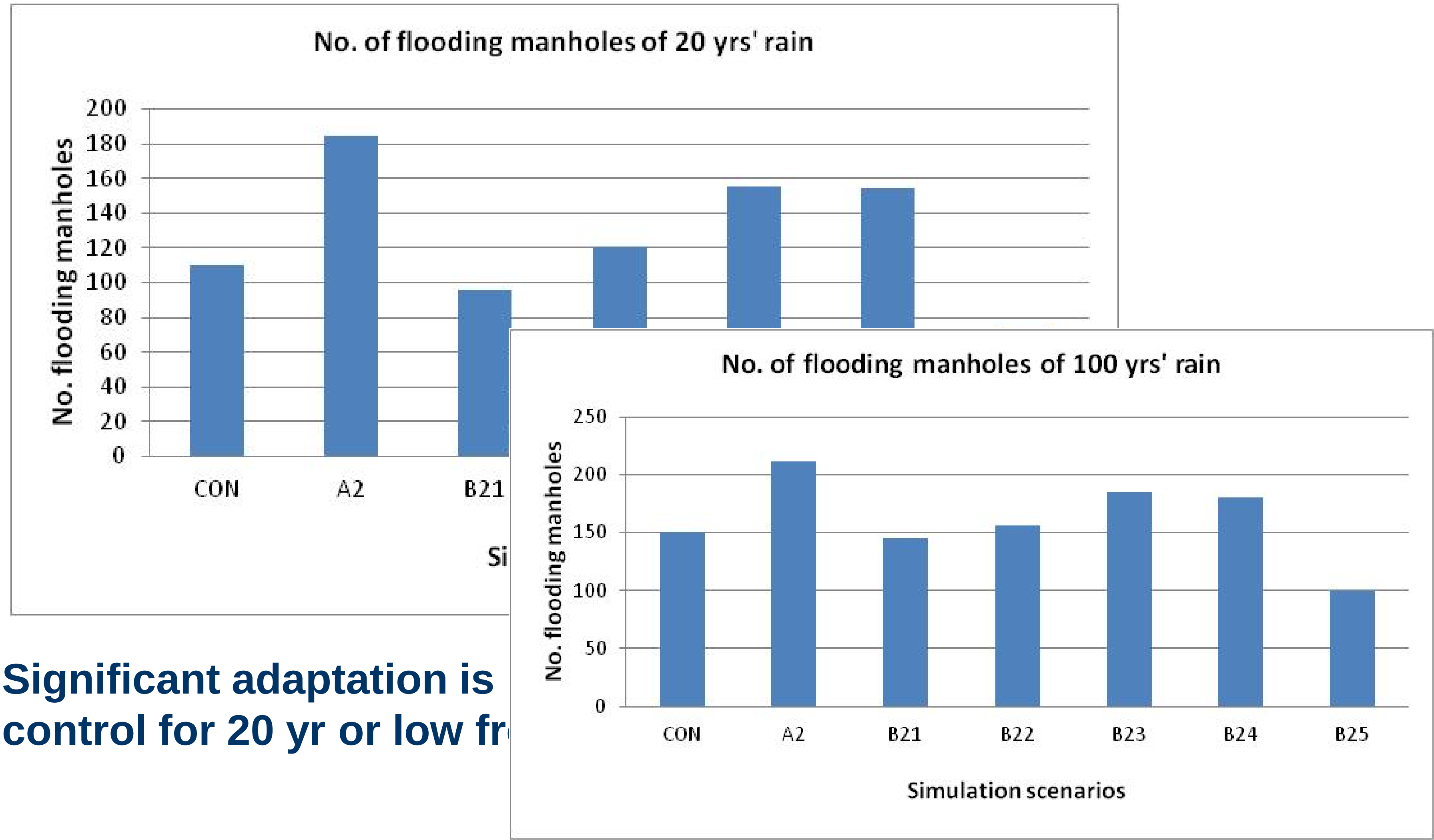
# Results and discussions (2) - discharge




B21-B23 reduced
volume; B24-B25
but increased the

# Results and discussions
# – no. of flooding manholes




**Significant adaptation is**
**control for 20 yr or low fr**

# Conclusions

- In addition to the changes in the climate, taking into account the changes the built environment and the physical systems
- A precise assessment requires for data and scenarios with fine temporal and spatial resolutions
- Uncertainties exist in projections of climate scenarios, growth of population and their settlement, and plan for land uses in a long term perspective
- Of the four selected adaptation measures, the simulation results indicate that disconnecting water from building roofs  is the most efficient measures to reduce sewer surcharge.
- The paper focus on the effects of technical solutions for adaptation, economic issues are not included. Demonstration projects in the real world are essential to validate the simulation methods and results – coming EU Calls.

# Thank you very much for your attention

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