Smart Water and Wastewater Networks
Water 4.0
Fluid System Dynamics
Fluid System Dynamics

Laboratory 620 m², 5t, 200 kW
• Centrifugal pumps (DN 20 ... DN350)
• Submersible pumps (DN 200)
• Model experiments (4 X 6 X 1,4m)
• Measuring technology (HSPIV, PIV, LDV)
• etc.
Fluid System Dynamics

Teaching

- Fluid mechanics
- Fluid dynamics
- Fluid-flow machines
- Wind turbines
- Measurement and sensor technologies

Professional Training:

Der Pumpenfachingenieur

www.pumpenfachingenieur.com
info@pumpenfachingenieur.com
Nordic Water Network

• Nordic Water Network
  • Interdisciplinary cooperation platform
  • Scientists and students
  • Water related topics

• Partners

Technische Universität Berlin
Fachgebiet Fluidsystemdynamik
Industrial Revolutions – Water Revolutions

1. Mechanization

2. Electrification

3. Automation

4. Cyber Physical Systems

- Optimised flexible operation
- Real-time control and operation
- Machine to Machine communication
- Intelligent pump control
- Resource efficiency and sustainability
- Optimised data acquisition and analysis
- Cyber security
- Early warning systems
Smart Water and Wastewater Networks

- Real-time control and operation
- Machine 2 Machine communication
- Intelligent pump control
- Ressource efficiency and sustainability
- Optimised data acquisition and analysis
- Cyber security
- Early warning systems
IMEBA
Innovative mechatronic influence systems for the operational optimization of complex wastewater systems

Teststands in laboratory and in wastewater pumping station
Berlin-Lichtenberg
IMEBA
Intelligent pumping station – elimination of clogging
**ZIM Herzberg**

Pump to Pump Communication: Design of a decentralised intelligent network for 5 wet pit pumping stations

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**Technische Universität Berlin**

Fachgebiet Fluidsystemdynamik

08.02.2017

Wasser / Abwasser 4.0

10
KURAS – Concepts for urban stormwater management and wastewater systems

Development and comparison of integrated adaptation strategies for urban wastewater systems
KURAS – Concepts for urban stormwater management and wastewater systems

Building level

District level

Catchment level
Focal point: Storm Water Management
Analysis of individual measures
Evaluation of Measures

Benefit for the **residents**
1. on building level
2. Quality of open space
3. Urban climate / bio-climate

Benefit for the **environment**
4. Bio diversity
5. Groundwater
6. Surface water

**Economic Effects**
7. Direct costs
8. Use of resources
## Result of Selected Instrument

### Evaluation of Adaptation Measures

<table>
<thead>
<tr>
<th>Measure type</th>
<th>Benefits at building level</th>
<th>Landscape quality</th>
<th>City climate</th>
<th>Biodiversity</th>
<th>Groundwater</th>
<th>Surface water bodies</th>
<th>Resource use</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>scale of 0-5</td>
<td>change in energy consumption</td>
<td>support to the natural water cycle</td>
<td>average of absolute values of 4 indicators</td>
<td>change in annual heat stress (UTC)</td>
<td>o-biodiversity from floristic surveys</td>
<td>o-biodiversity from floristic surveys</td>
<td>increase in groundwater recharge</td>
</tr>
<tr>
<td>Green façade (north)</td>
<td>0-25</td>
<td>35</td>
<td>2.0</td>
<td>-2.0</td>
<td>11.0 (n=0)</td>
<td>not eval.</td>
<td>not eval.</td>
<td>not eval.</td>
</tr>
<tr>
<td>Green façade (south)</td>
<td>0-25</td>
<td>35</td>
<td>2.0</td>
<td>-2.0</td>
<td>11.0 (n=0)</td>
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<td>not eval.</td>
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<tr>
<td>Rainwater harvesting (for green roofs)</td>
<td>-30</td>
<td>not eval.</td>
<td>75</td>
<td>no effect</td>
<td>-100</td>
<td>2.6 (n=0)</td>
<td>3.44 (n=0)</td>
<td>0.09 (n=0)</td>
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<tr>
<td>Rainwater harvesting (for green roofs)</td>
<td>-100</td>
<td>no effect</td>
<td>-100</td>
<td>2.6 (n=0)</td>
<td>3.44 (n=0)</td>
<td>0.09 (n=0)</td>
<td>2.00 (n=0)</td>
<td>3.97 (n=0)</td>
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<tr>
<td>Rainwater harvesting (for green roofs)</td>
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<td>-30</td>
<td>75</td>
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<td>no effect</td>
<td>no effect</td>
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<td>no effect</td>
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<td>no effect</td>
<td>no effect</td>
<td>no effect</td>
</tr>
<tr>
<td>Stormwater harvesting</td>
<td>-300</td>
<td>0</td>
<td>2.0</td>
<td>-80.0</td>
<td>3.1 (n=27)</td>
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<td>not eval.</td>
<td>not eval.</td>
</tr>
<tr>
<td>Stormwater harvesting</td>
<td>-300</td>
<td>0</td>
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<td>not eval.</td>
<td>not eval.</td>
</tr>
</tbody>
</table>

### Individual Measures

- **Green Roofs:** 
  - Increase in stormwater retention: 50% (n = 100) 
  - Reduction in peak runoff: 0% (n = 100)

- **Green façade (north/south):** 
  - Increase in stormwater retention: 35% (n = 50) 
  - Reduction in peak runoff: 0% (n = 50)

- **Rainwater harvesting (for green roofs):** 
  - Increase in stormwater retention: 25% (n = 50) 
  - Reduction in peak runoff: 0% (n = 50)

- **Stormwater harvesting:** 
  - Increase in stormwater retention: 0% (n = 100) 
  - Reduction in peak runoff: 0% (n = 100)

### Conclusion

The evaluation of the selected instrument shows promising results for the increase in stormwater retention and reduction in peak runoff. However, further research is needed to optimize the implementation and assess the long-term effects on the environment and urban infrastructure.
### Potential: Best Measure per Category and Effect

<table>
<thead>
<tr>
<th></th>
<th>Bewohner</th>
<th>Umwelt</th>
<th>Ökonomie</th>
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<td>Nutzen auf Gebäudeebene</td>
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<td><img src="image2" alt="Symbol" /></td>
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<td><img src="image5" alt="Symbol" /></td>
<td><img src="image6" alt="Symbol" /></td>
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<tr>
<td>Stadtklima / Bioklima</td>
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<td><img src="image8" alt="Symbol" /></td>
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<td>Ressourcenutzung</td>
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<td><img src="image26" alt="Symbol" /></td>
<td><img src="image27" alt="Symbol" /></td>
</tr>
</tbody>
</table>

Legend:
- **gut geeignet**
- **mittelmäßig geeignet**
- **keine Wirkung (= gut geeignet)**
- **keine Wirkung (= schlecht geeignet)**
- **Wirkung unbekannt**
Focal point Storm Water Management
Creating combinations of measures

Local problems + goals in city districts

Selected instrument

Effective measure combination for a city district

A B C
Results of the Measure Planning

Combination of Measures
KURAS – Concepts for urban stormwater management and wastewater systems

Wastewater system: Investigation / evaluation of about 40 measures in four clusters
Focal point Waste Water Systems
Definition of challenges: 6 priority spheres of activity

- Combined sewer overflow
- Flooding
- Overflow
- Sediments in sewers
- Operational reliability of pumping systems
- WWTP effluent

Time scale: 2050
Problem analysis
Usage of weak point maps
Analysis of Individual Adaptation Measures

Sub systems

1. Simulation of measures with Infoworks CS → surface and sewer system

2. Simulation of measures with SIMBA# → treatment plant

3. Experimental investigation Commercial/industrial experiments in the waste water system
Analysis of Individual Adaptation Measures
List of measures

Available at www.kuras-projekt.de
KURAS – Concepts for urban stormwater management and wastewater systems

Investigation of single measures

Evaluation of single measures

Integrated evaluation of total system

Combination of measures to adaptation strategies
Recommendations for Action

1. Definition of challenges
   - Combined sewer overflow
   - Overflow
   - Flooding
   - Sediments in sewers
   - Operational reliability of pumping systems

2. Definition of goals
   - Scenarios

3. Definition of performance indicators
   - Over 40 performance indicators

4. Use of vulnerability maps for problem analysis
   - Analysis of the challenges

5. Analysis of adaptation measures
   - Surface
   - Pumping system
   - Sewer system
   - WWTP

6. Combination of adaptation strategies
   - Adaptation strategies for subsystems and the total system

7. Evaluation of the adaptation strategies
   - Potential effect
   - Strengths/weaknesses
   - Cost

8. Recommendations for action
   - Formulation of recommendations
KURAS Outcomes

- **Measure portfolio** with key figures / evaluation / etc.
- **Selected instrument** for planning and evaluation of measures
- **Catalogue** for the planning and of the **measure combinations**
- **Guideline** for the implementation of the method
- **Ecological city map** (published by SenStadtUm)

Soon available on www.kuras-projekt.de
Conclusions

- Great potential to adapt the waste water infrastructure to future challenges through **measure combinations**

- Measure combinations mean increased benefits: *synergies in the system can be used*

- „**KURAS-Method“** for the integrated planning of adaptation measures for urban waste water systems was tested in Berlin and **works!**

- **Unique data set for Berlin** (analysis of individual measures and measure combinations) as well as **extensive guideline** for the application of the method is available in October on [www.kuras-projekt.de](http://www.kuras-projekt.de)!
Outlook – Water 4.0

- Einstein Center Digital Systems – Chair Water 4.0

- Innovative Infrastructure for the Challenges of the future

- New projects: IoT / Big Data / Tele Control / etc.
  - Near real time control and operation
  - Early warning systems
  - Decision support systems
  - Optimised data handling
  - Intelligent asset management
  - Cyber security
THANK YOU FOR YOUR ATTENTION