Linz Pilot

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Linz Pilot

Introduction and Goals – Pilot Definition

- Effects of climate change scenarios on combined sewer overflows (CSO)
- Assessment according to an Austrian Guideline: Estimation of CSO efficiency rates for hydraulics and particulate pollutants
Problem Description: Combined Sewer System

Precipitation

CSO = Funct.: Rain (!) and Land Use

Combined Sewer Overflows

W. Sprung (2005)

Hydraulic Capacity of WWTPs < 2 \times Q_{dwf}

Max $Q_{wwf} \approx \frac{100}{200} Q_{dwf}$
Urban Wastewater Management – Prevention of water pollution

Issues ...

... and the tools to manage them.

- Rainfall: Urban downscaling
- SWMM (U.S. EPA)
- Common Services
- Local model

- Historical rainfall data
- Sensor network
- Input data sets for local model

- Requirements fulfilled?
- Where are critical spots?
- Selection of mitigation strategies?
- Cost-efficient measures?

„What if?“
Introduction – Linz Catchment

- Total area ~ 900 km²
- Wastewater treatment plant (WWTP): Downtown Linz and 39 neighbour communes
- 950 000 PE, high industrial contribution
- Receiving Waters: Danube, Traun, Enns
Introduction – Linz Catchment

- Combined & separate system
- Partly real time controlled (since 2005)
- Several CSO tanks
- Total estimated storage volume 115,000 m³
- Primary clarifiers on WWTP work as CSO tanks during combined sewer flow

Photos: Wendner
Method – Austrian Regelblatt 19 Guideline

- **CSO efficiency rate** $\eta$:
  - Percentage of stormwater runoff routed to WWTP on average

- **Required CSO efficiency rates** $\eta_{req}$:
  - For dissolved ($\eta_d$) and particulate pollutants ($\eta_p$)
  - Based on $r_{720,1}$, PE and ratio combined/separate system

- **Actual efficiency rate** $\eta_{act}$:
  - Calculated by simulation model (long term simulations)
  - Sedimentation efficiency $\eta_{sed}$ for particulate pollutants
Actual efficiency rate > Required efficiency rate

Efficiency ratio $\nu = \frac{\eta_{act}}{\eta_{req}}$

- $\eta_{act}$ … Actual efficiency rate from simulation
- $\eta_{req}$ … Required efficiency rate

$\nu > 1,0 \quad \Rightarrow \quad \text{Requirements met}$
Method – Sewer System Model

- Aggregated model in SWMM5
- All relevant structures included
- 43 combined sewer overflows
- Estimated $\eta_{sed}$ for tanks: 20%
- Global sensitivity analysis and automated model calibration

Gamerith et al. (2011)
Linz Pilot

Method – Scenario Management System (SMS)

SUDPLAN

CS Rainfall Integration

Local Model Integration

Import Local Model Input Data Sets

Local Model Execution

Result Visualization and Comparison

CSO Eta Calculation

historic
CCSM3A1B
ECHAM5A1B3
ECHAM5A21
HADLEYA1B

SUDPLAN SMS
LINZ PILOT
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Results – Hotspot Detection of CSO Volumes

SUDPLAN
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Results – Requirements fulfilled?
## Results: Annual Means and CSO Efficiencies

<table>
<thead>
<tr>
<th>Time Series</th>
<th>Period</th>
<th>Annual Mean</th>
<th>$r_{720,1}$</th>
<th>CSO Efficiencies Rates and Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>mm/a</td>
<td>mm</td>
<td>η_{d,req} η_{d,act} ν_{d} η_{p,req} η_{p,act} ν_{p}</td>
</tr>
<tr>
<td>Historical</td>
<td>1993 – 2006</td>
<td>849.7</td>
<td>35.1</td>
<td>57.4 67.3 1.17 72.4 73.6 1.02</td>
</tr>
<tr>
<td>ECHAM5 (E)</td>
<td>2079 – 2092</td>
<td>941.2</td>
<td>39.2</td>
<td>55.4 63.9 1.15 70.4 70.8 1.01</td>
</tr>
<tr>
<td>ECHAM5-FA (E-FA)</td>
<td>2079 – 2092</td>
<td>941.6</td>
<td>40.8</td>
<td>54.6 64.2 1.18 69.6 71.1 1.02</td>
</tr>
<tr>
<td>HADLEY (H)</td>
<td>2079 – 2092</td>
<td>933.8</td>
<td>38.7</td>
<td>55.7 64.5 1.16 70.7 71.3 1.01</td>
</tr>
<tr>
<td>HADLEY-FA (H-FA)</td>
<td>2079 – 2092</td>
<td>932.8</td>
<td>40.9</td>
<td>54.6 64.1 1.17 69.6 70.9 1.02</td>
</tr>
<tr>
<td>Trend</td>
<td>2079 – 2092</td>
<td>↑</td>
<td>↑</td>
<td>↓    ↓    ←   ↓    ↓    ←</td>
</tr>
</tbody>
</table>

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*IWA WWC-2012 (Busan): Gruber et al. (2012)*
Results: Comparison historical and predictive rain
Results: Total Overflow Volume for 14 CSO

- 14 CSO from 43 => 95% of overflow volume
- At CSO 1 (Primary Clarifiers of WWTP) approx. 55% of the total overflow volume was spilled
- All 4 predicted scenarios lead to a total overflow volume increase of 21 – 23%
Sensor Network – Estimation of $\eta_{sed}$ of WWTP’s PC

Primary Clarifiers
Inflow

Outflow

TSSeq 323,4 mg/l
NO3-Neq 0,8 mg/l
CODeq 847,9 mg/l
CODf eq 329,4 mg/l

TSSeq 281,5 mg/l
NO3-Neq 2,0 mg/l
CODeq 687,4 mg/l
CODf eq 257,6 mg/l
Conclusions

- Linz Pilot estimates the impact of climate change scenarios on combined sewer overflows (CSOs)
- Comparison of different scenarios based on long term simulations using the Common Services for rainfall prediction
- For the future of Linz: Increase of rain intensities during winter/autumn period, decrease of rain intensities during summer period but general increase of peak intensities
- Increase in total overflow volume of approx. 20%
- Hotspot detection, comparison of proper mitigation strategies and portability is possible for each combined sewer system
Acknowledgements

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7-ICT-2009-6) under grant agreement no. 247708.

→ www.sudplan.eu

Sewer and WWTP operator of Linz

… and for your kind attention!

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