SUDPLAN: Developing a Decision Support System to Cope with Climate Change – Urban Drainage Pilot Linz

ICT-2009-6.4, Project No. 247708

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INTRODUCTION

IPCC
http://www.ipcc.ch/news_and_events/docs/srex/SREX_slide_deck.pdf

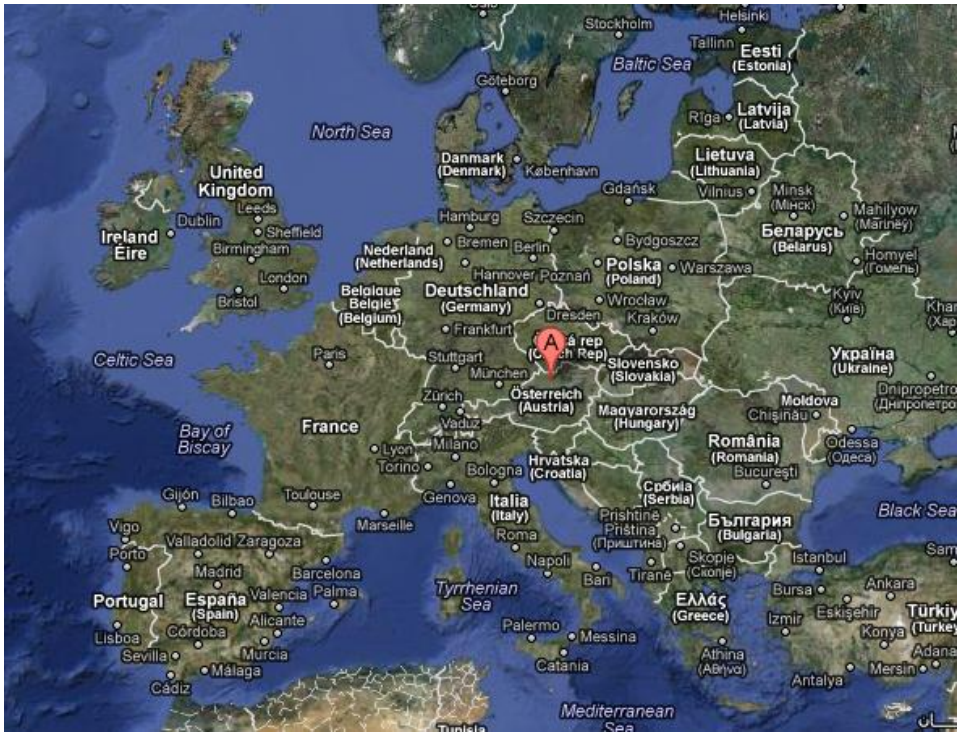



How to deal with these challenges?
How to facilitate decision making?

Project SUDPLAN

- **EU FP7 project SUDPLAN**
  Sustainable Urban Development Planner for Climate Change Adaptation
- **Web-based scenario management system and decision support platform**
- **Supports planning and decisions in urban infrastructure for extreme events due to climate change effects**
- **4 pilot studies (air quality, flooding and combined sewer overflows)**

INTRODUCTION – Pilot Study Linz



Google Maps

- **Effects of climate change scenarios on combined sewer overflow (CSO) loads**
- **Assessment according to Austrian guidelines**
  - **Estimation of efficiency rates for hydraulics and particulate pollutants**

INTRODUCTION – Linz Catchment

Linz AG

- **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

METHODS – Austrian RB19 Guideline

- **CSO efficiency rate η:**
  - Percentage of stormwater runoff routed to WWTP on average
- **Required CSO efficiency rates η_{req} :**
  - For dissolved (η_d) and particulate pollutants (η_p)
  - Based on $r_{720,1}$, PE and ratio combined/separate system
- **Actual efficiency rate η_{act}:**
  - Calculated by simulation model (long term simulations)
  - Sedimentation efficiency η_{sed} for particulate pollutants

METHODS – Austrian RB19 Guideline

Actual efficiency rate > Required efficiency rate

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

η_{act} … Actual efficiency rate from simulation

η_{req} … Required efficiency rate

$\nu > 1{,}0$ ➔ Requirements met ✓

METHODS – Sewer System Model

- Aggregated model in SWMM 5
- All relevant structures included
- 43 combined sewer overflows
- Estimated η_{sed} for tanks: 20%
- Global sensitivity analysis and automated model calibration
- 1 year simulation: 20 minutes simulation time

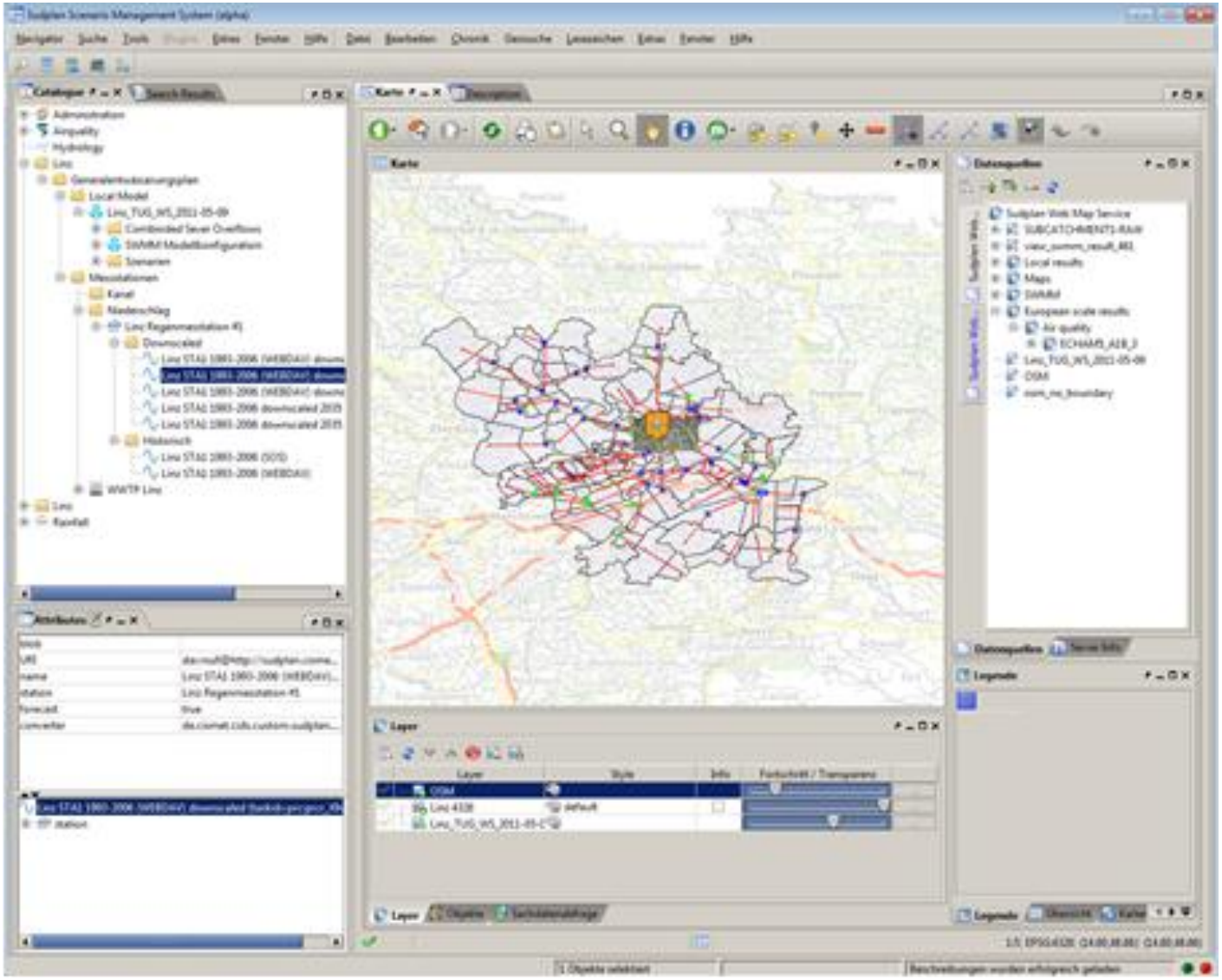
Gamerith et al. (2011)

METHODS – Rainfall

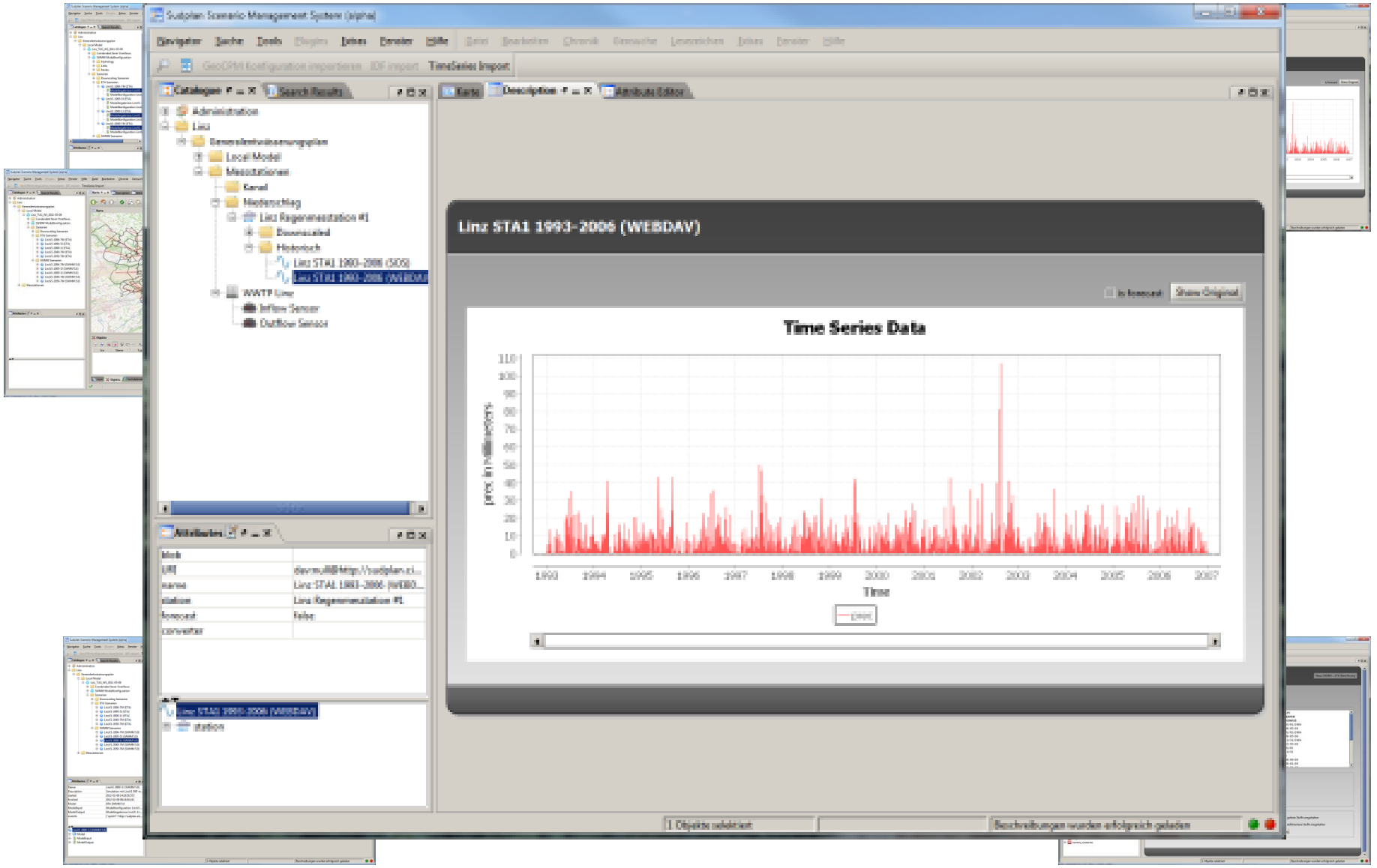
- **Five rainfall time series, 14 years**
  - **One historical time series from downtown Linz (1993 – 2006)**
  - **Four predicted time series (2079 – 2092)**

    Downscaling of historical time series with two climate model **ECHAM5 (E)** and **HADLEY (H)** emission scenario with and without **Frequency Adjustment (FA)** provided by Common Services (SMHI)

METHODS – Scenario Management System



METHODS – Scenario Management System



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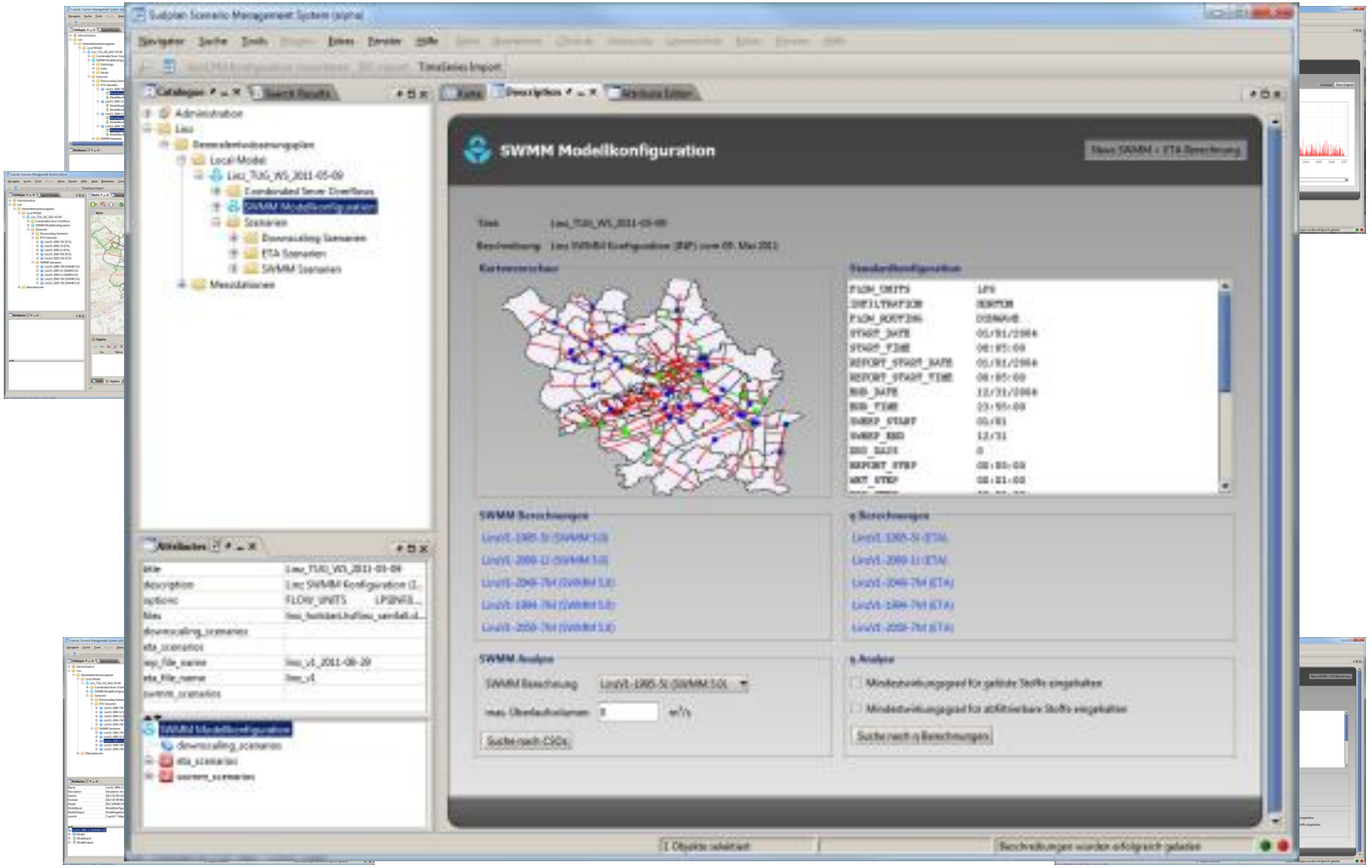

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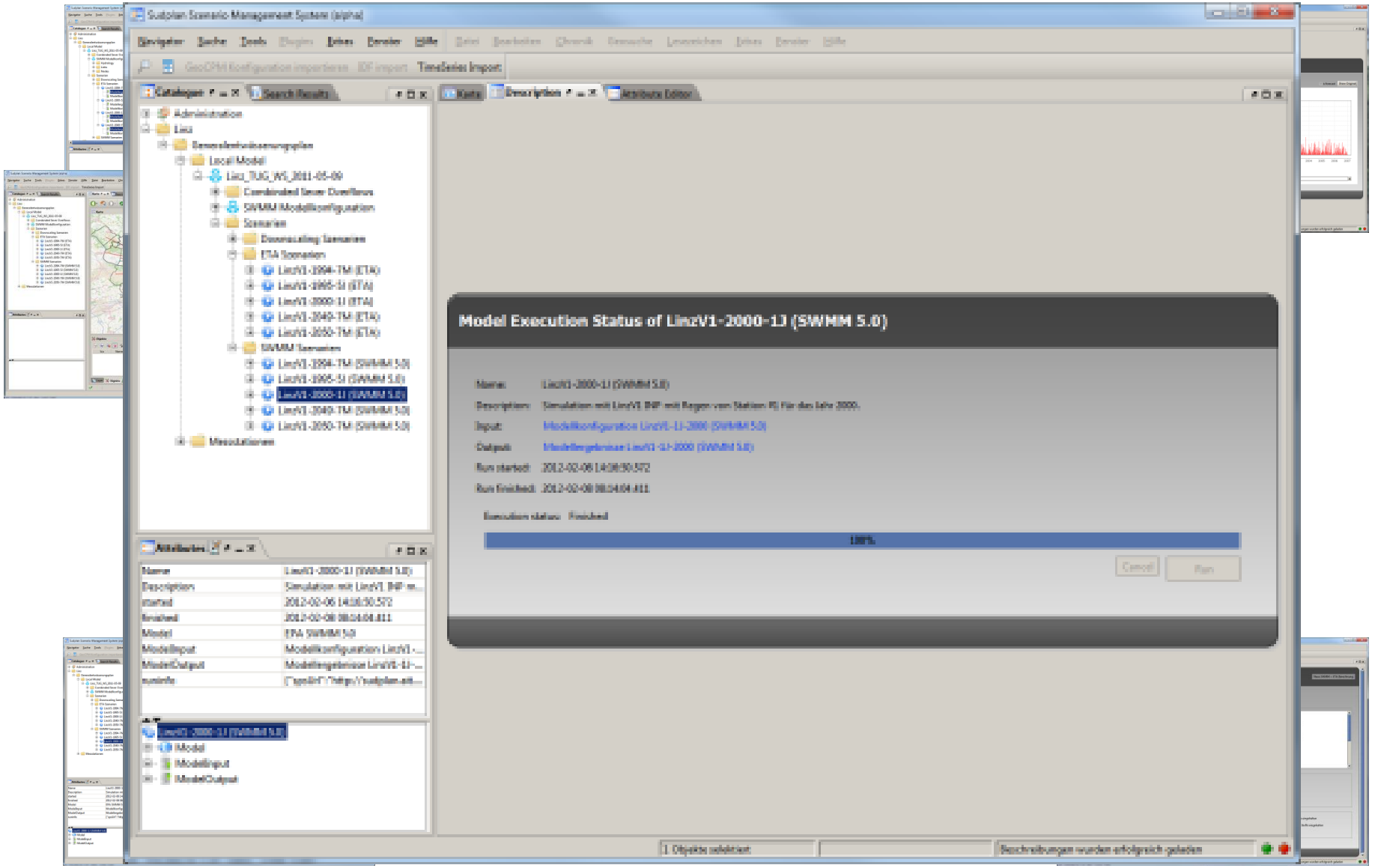

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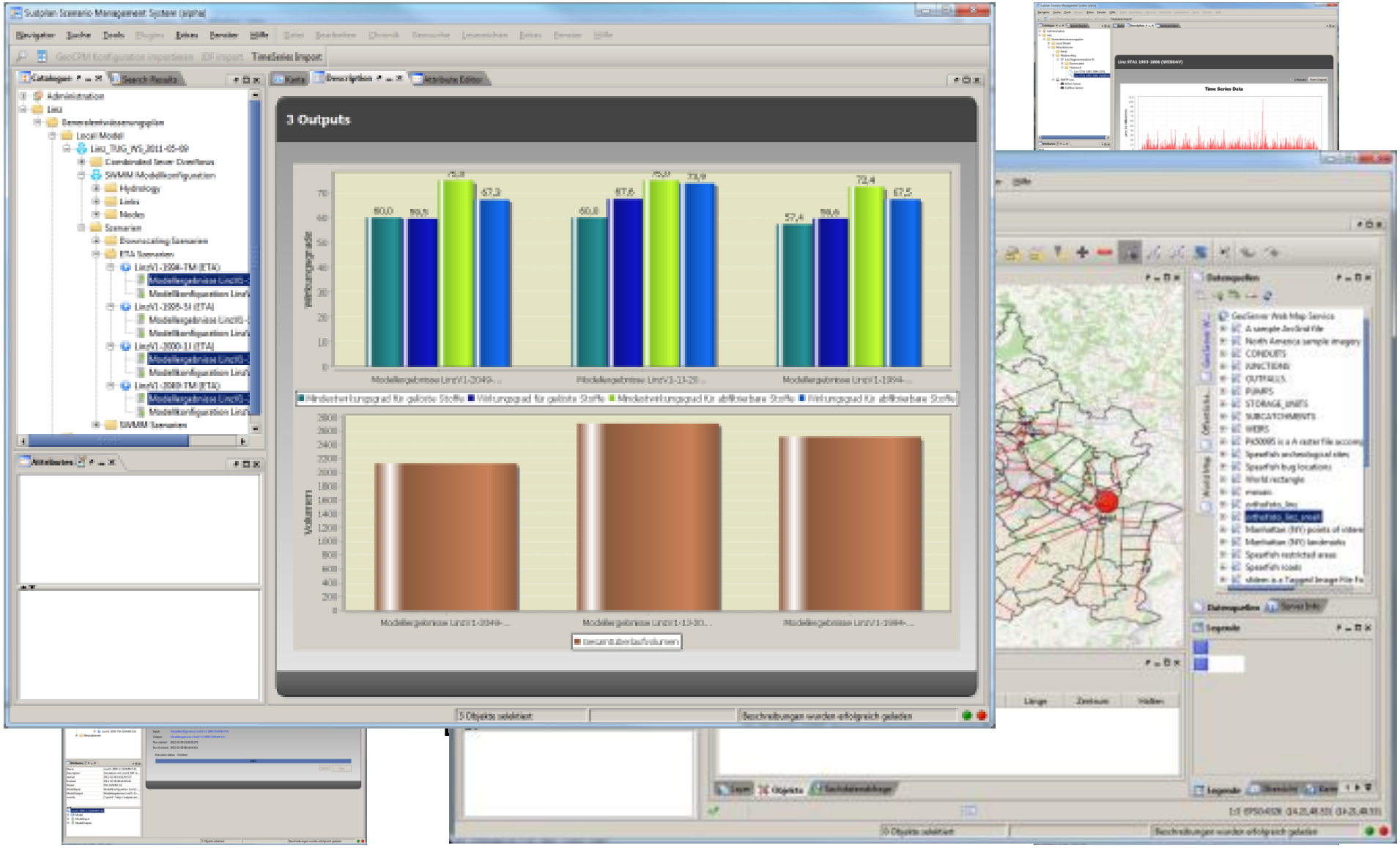

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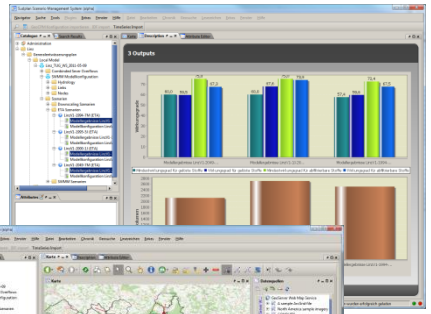
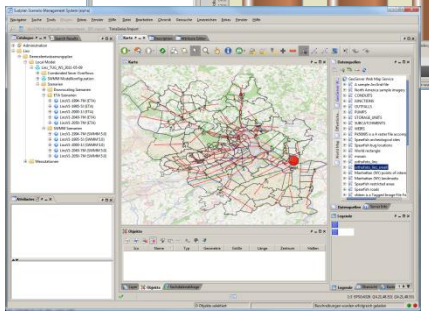
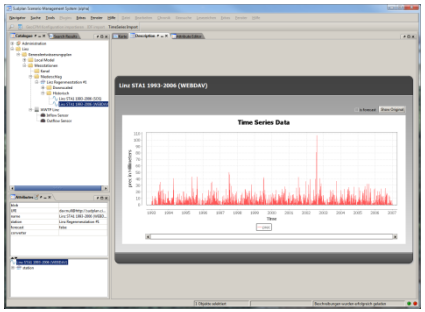




Result Visualization and Comparison

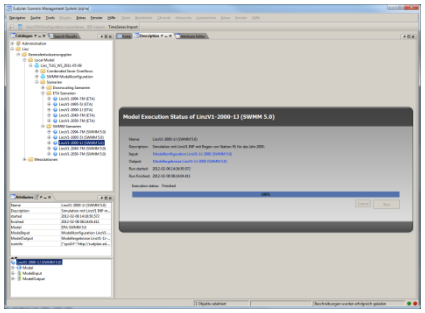
CS Rainfall Integration



CSO Eta Calculation

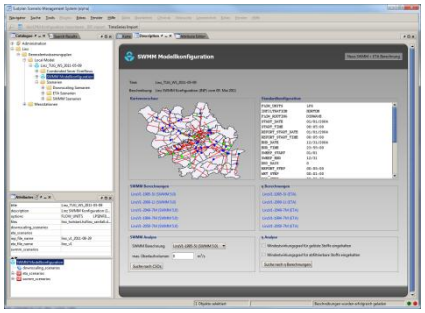
SUDPLAN SMS LINZ PILOT

Local Model Integration



Local Model Execution

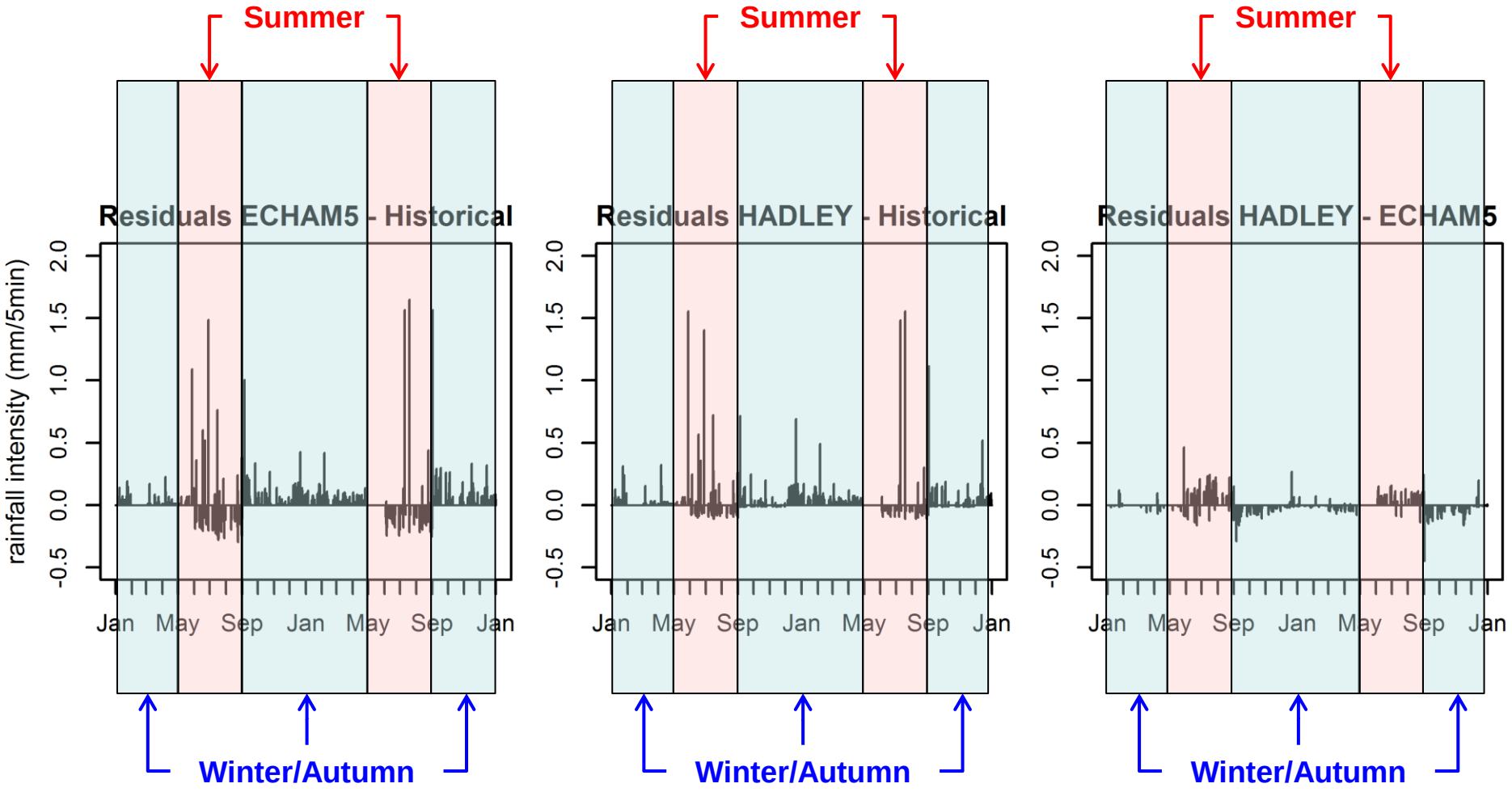
Import Local Model Input Data Sets



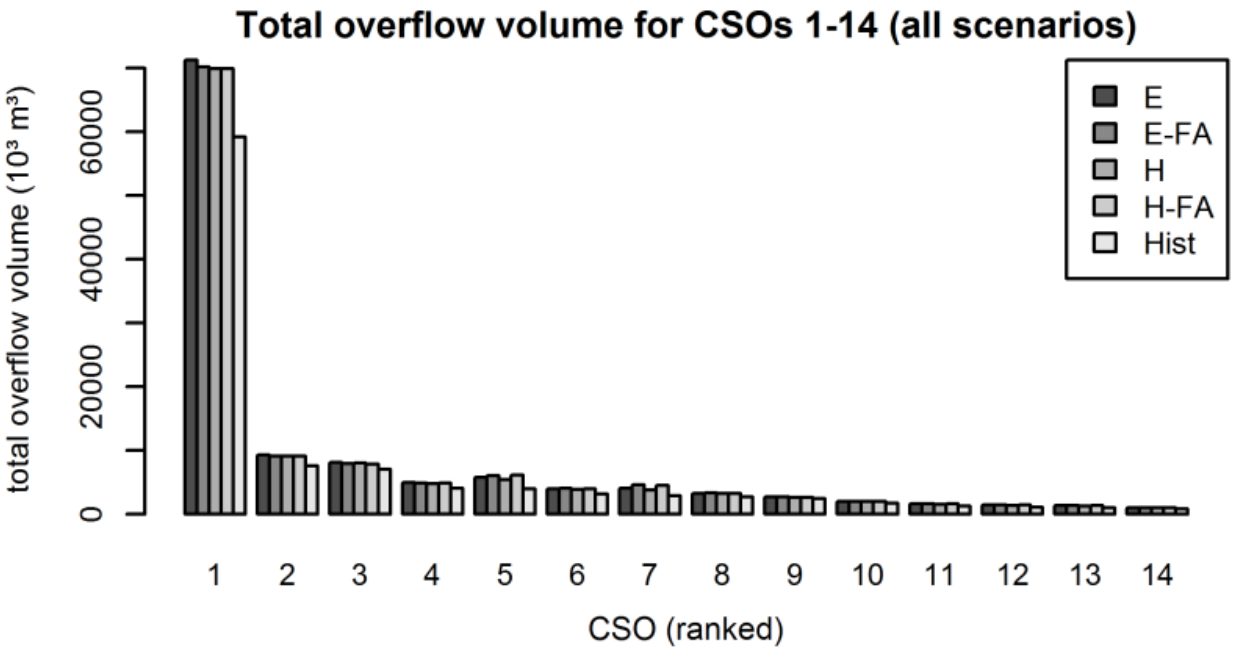
RESULTS: Annual Means and CSO Efficiencies

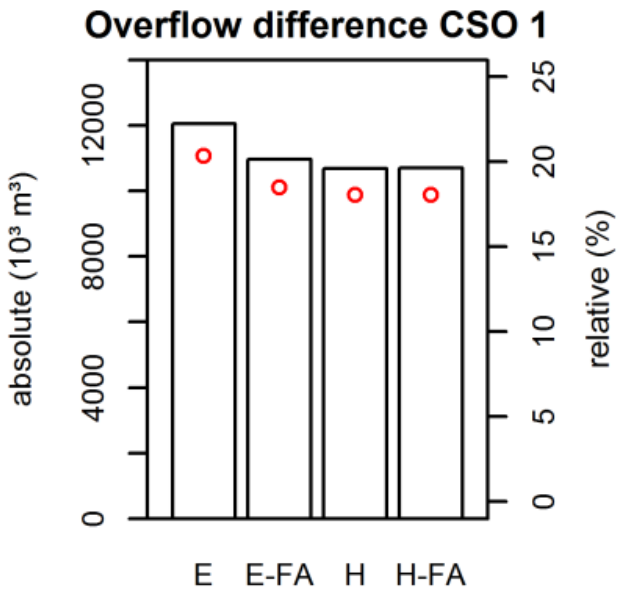
Time Series	Period	Annual Mean	$r_{720,1}$	CSO Efficiencies Rates and Ratios					
				$\eta_{d,req}$	$\eta_{d,act}$	ν_d	$\eta_{p,req}$	$\eta_{p,act}$	ν_p
		mm/a	mm	%	%	-	%	%	-
Historical	**1993 – 2006**	**849,7**	**35,1**	**57,4**	**67,3**	**1,17** ✓	**72,4**	**73,6**	**1,02** ✓
ECHAM5 (E)	2079 – 2092	941,2	39,2	55,4	63,9	**1,15** ✓	70,4	70,8	**1,01** ✓
ECHAM5-FA (E-FA)	2079 – 2092	941,6	40,8	54,6	64,2	**1.18** ✓	69,6	71,1	**1,02** ✓
HADLEY (H)	2079 – 2092	933,8	38,7	55,7	64,5	**1,16** ✓	70,7	71,3	**1,01** ✓
HADLEY-FA (H-FA)	2079 – 2092	932.8	40,9	54,6	64,1	**1,17** ✓	69,6	70,9	**1,02** ✓
Trend	2079 – 2092	↑	↑	↓	↓	→	↓	↓	→

RESULTS: Comparison historical and predictive rain



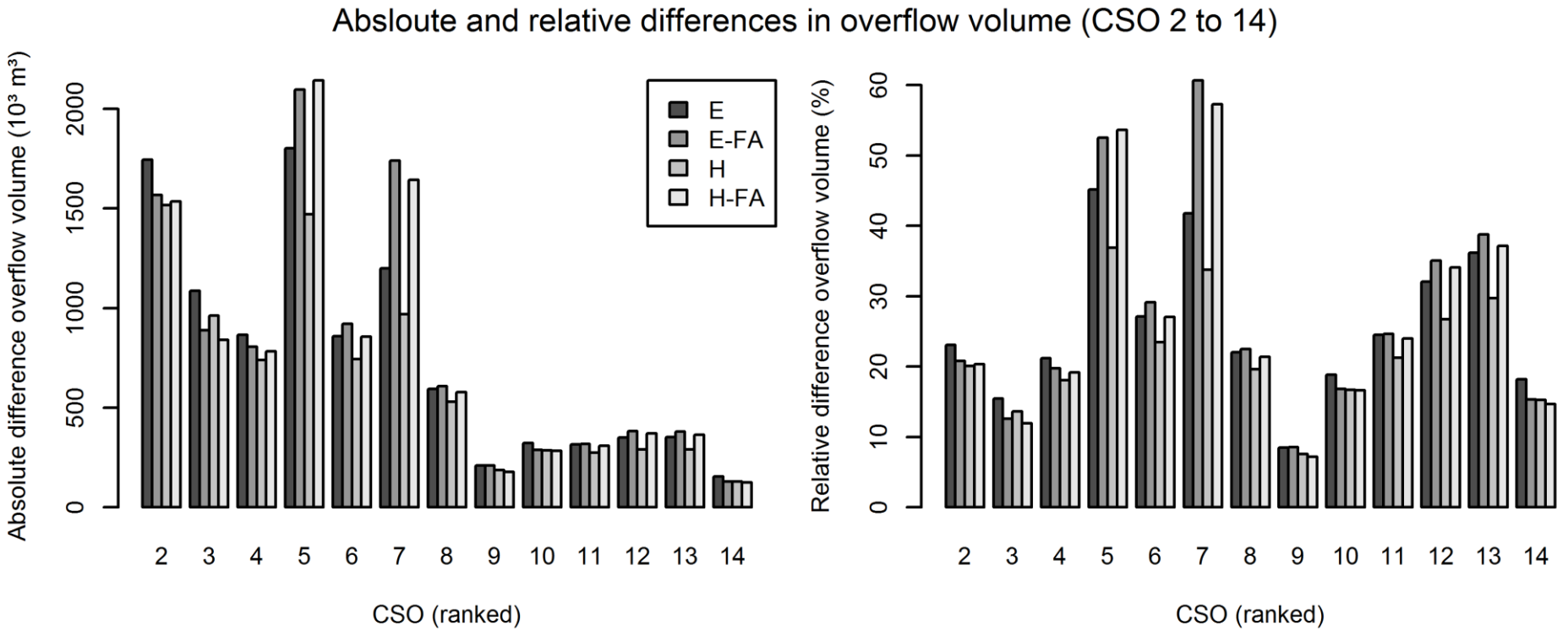
RESULTS: Total Overflow Volume for 14 CSO





- 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%

RESULTS: Comparison Total Overflow Volume for CSO 2 – 14



- General increase of overflow volume for all 4 future scenarios
- Very irregular increase between 10 to 60%
- This could have a severe influence for water quality

CONCLUSIONS (1/2)

- **Pilot Study Linz in SUDPLAN project:**
  SMS to estimate the impact of climate change scenarios on combined sewer overflows
- **Comparison of 4 scenarios in long term simulations:**
  Two climate model ECHAM5 (E) and HADLEY (H) in the variation with or without Frequency Adjustment (FA)
- **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 ranges between 21% and 23%**

CONCLUSIONS (2/2)

- 14 of 43 CSO significant contribution (95% of overflow volume)
- CSO 1 (primary clarifiers at WWTP) highest impact with approx. 55% of total overflow volume
- Increase of overflow volume is very irregular at CSO's and ranges between 10% and 60%
- This could have severe impact on the water quality of receiving waters in future
- All requirements of Austrian CSO guideline regarding the CSO efficiency rates are met

ACKNOWLEDGEMENTS

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➔ www.sudplan.eu

Sewer and WWTP operator of Linz

… and for your kind attention!