



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

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# INTRODUCTION

IPCC

[http://www.ipcc.ch/news\\_and\\_events/docs/srex/SREX\\_slide\\_deck.pdf](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)

**SMHI**

**AIT** AUSTRIAN INSTITUTE  
OF TECHNOLOGY

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 **cenia**

 **DFK** Deutsches  
Forschungszentrum  
für Künstliche  
Intelligenz GmbH

 **LF** STOCKHOLMS OCH UPPSALA  
LÄNS LUFTVÄRDSFÖRBUND

 **Wuppertal**

 TU  
Graz

# 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



- ✚ **Total area ~ 900 km<sup>2</sup>**
- ✚ **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 m<sup>3</sup>
- ✚ Primary clarifiers on WWTP work as CSO tanks during combined sewer flow



Photos: Wendner

# METHODS – Austrian RB19 Guideline

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

# METHODS – Austrian RB19 Guideline

**Actual efficiency rate > Required efficiency rate**

**Efficiency ratio  $v = \eta_{\text{act}} / \eta_{\text{req}}$**

$\eta_{\text{act}}$  ... Actual efficiency rate from simulation

$\eta_{\text{req}}$  ... Required efficiency rate

**$v > 1,0 \quad \rightarrow \quad \text{Requirements met } \checkmark$**

# METHODS – Sewer System Model

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



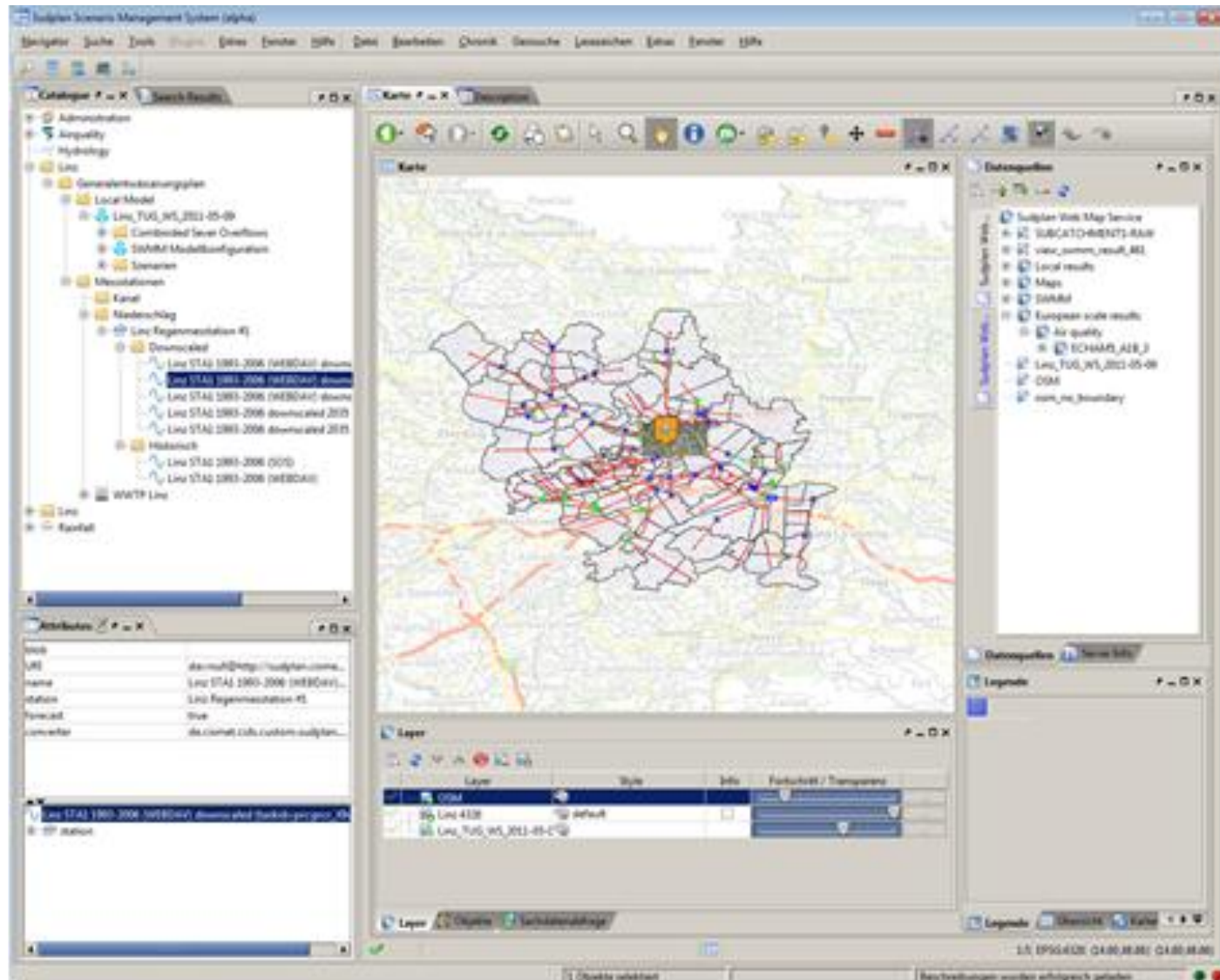
Gamerith et al. (2011)

## METHODS – Rainfall

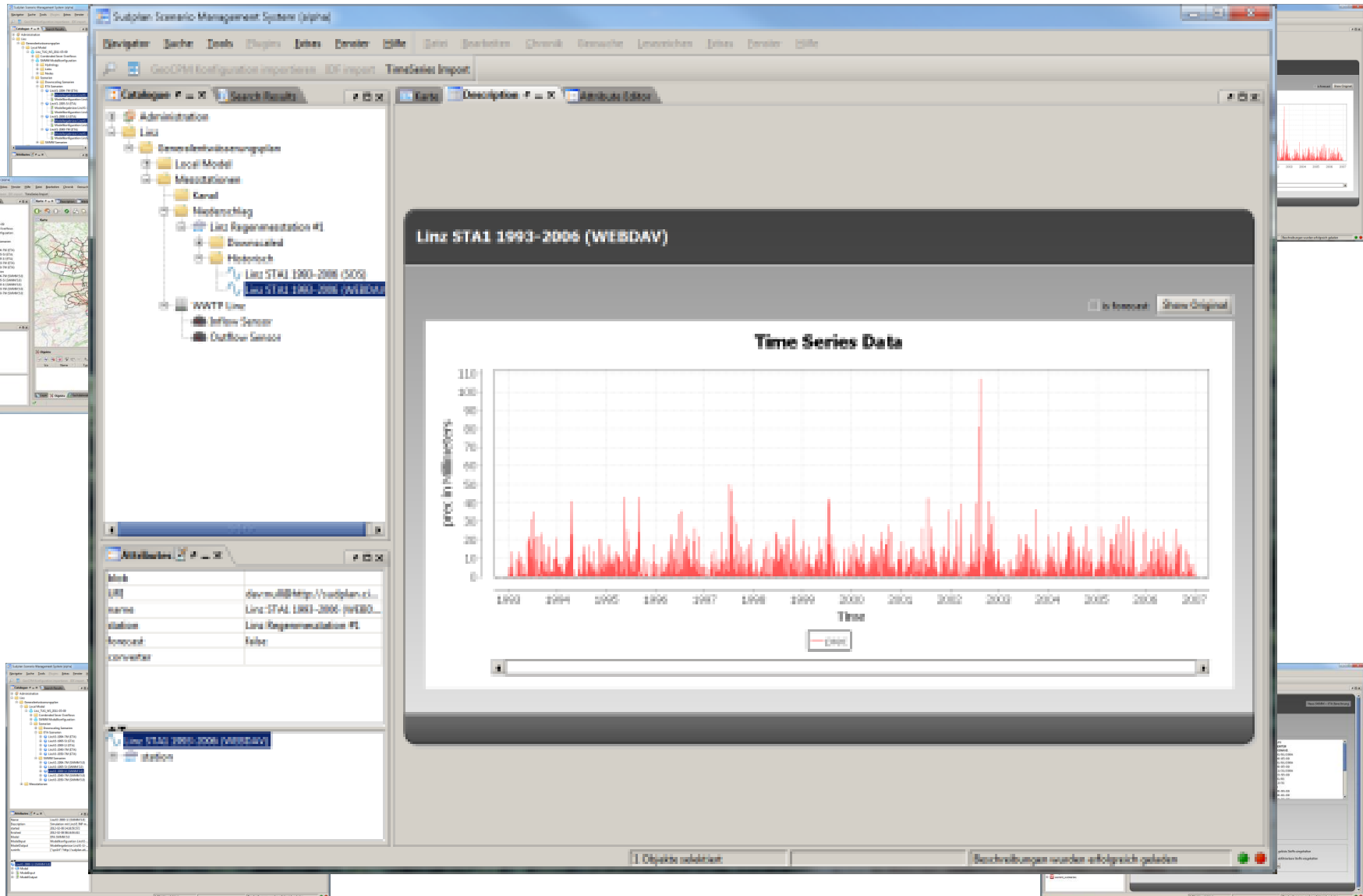
- ✚ **Five rainfall time series, 14 years**
  - ✚ **One historical time series from downtown Linz (1993 – 2006)**
  - ✚ **Four predicted time series (2079 – 2092)**

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)

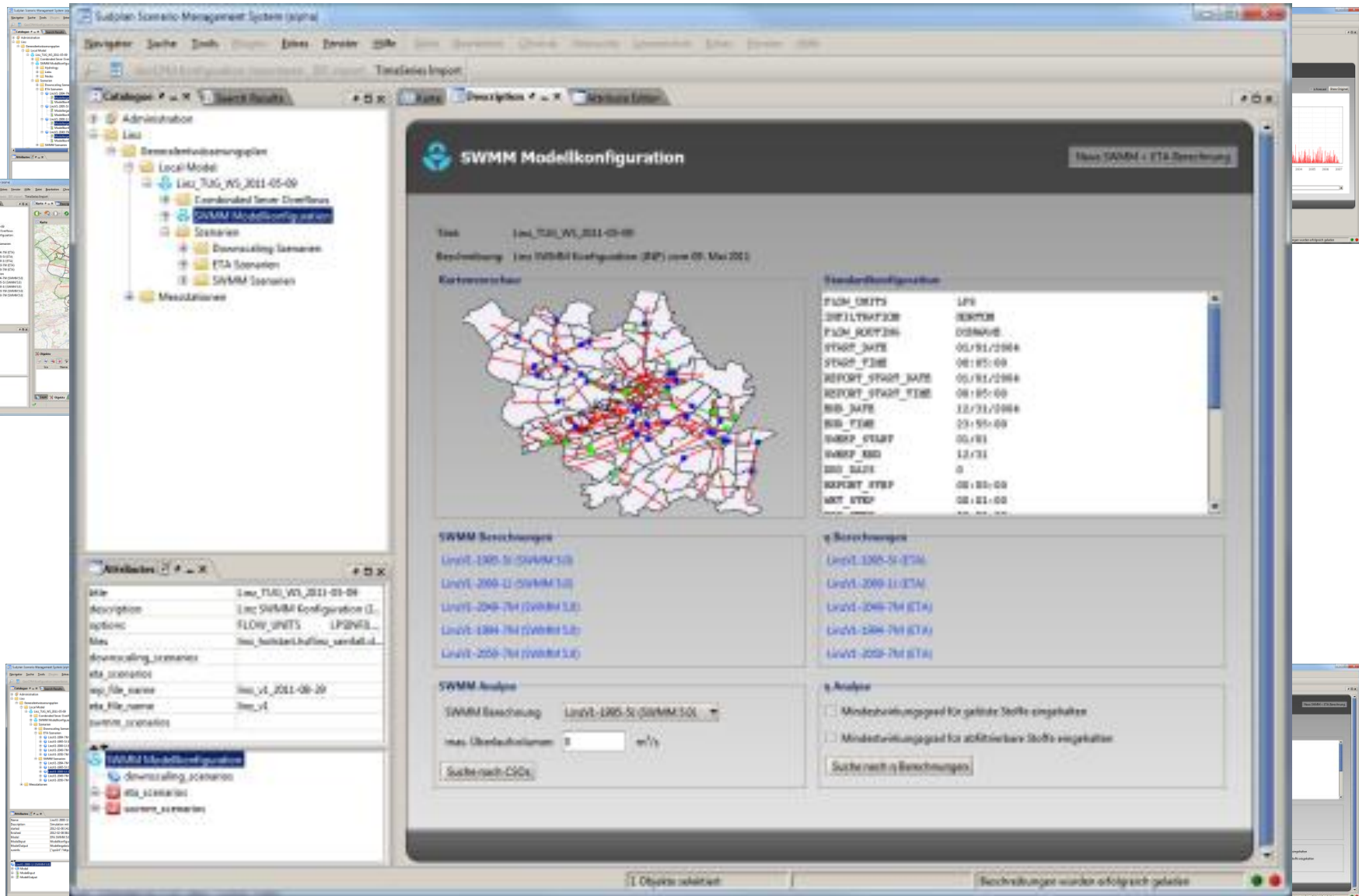
# METHODS – Scenario Management System



# METHODS – Scenario Management System



# METHODS – Scenario Management System



The screenshot displays the SUDPLAN Scenario Management System (sigplan) interface. The main window is titled "SWMM Modellkonfiguration" and shows a map of a city area with a network of pipes and nodes. The interface is divided into several panels:

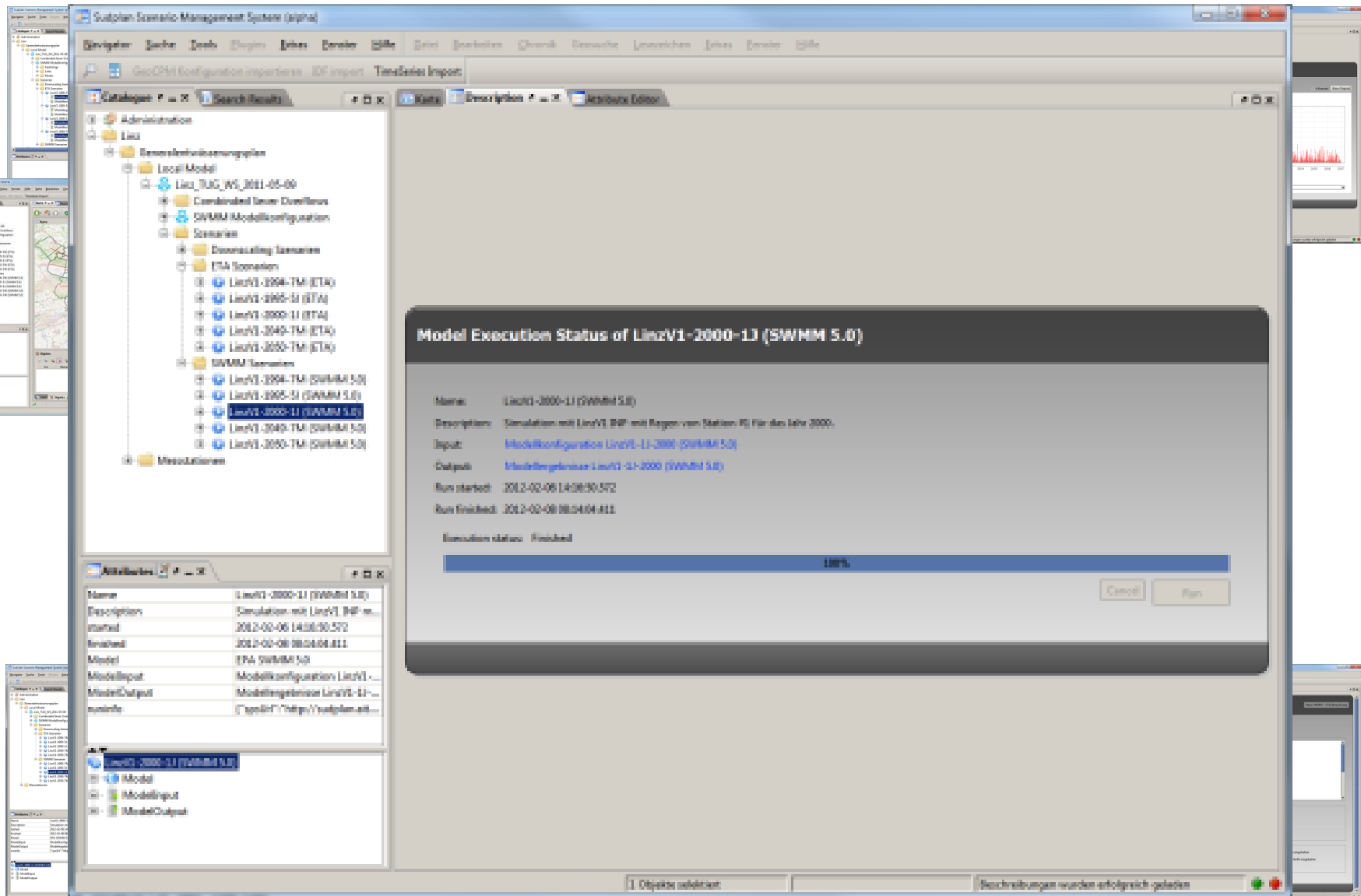
- Left Panel (Catalogue):** A tree view showing the project structure, including "Administration", "Local Model", "Downloaded Scenario Directories", "SWMM Modellkonfiguration", "Scenarios", "Downloaded Scenarios", "ETA Scenarios", "SWMM Scenarios", and "Measurements".
- Top Panel (Search Results):** A table showing search results for "SWMM Modellkonfiguration".
- Right Panel (Standardkonfiguration):** A table of standard configuration parameters for SWMM, including:
 

Parameter	Value
FLOW_UNITS	LPS
INFILTRATION	KESTON
FLOW_ROOTING	ORNBAND
START_DATE	01/01/2004
START_TIME	00:00:00
REPORT_START_DATE	01/01/2004
REPORT_START_TIME	00:00:00
END_DATE	12/31/2004
END_TIME	23:59:59
SWEEP_START	01/01
SWEEP_END	12/31
END_DATE	0
REPORT_STEP	00:00:00
WRT_STEP	00:01:00
- Bottom Panel (Attributes):** A table showing attributes for the selected scenario, including:
 

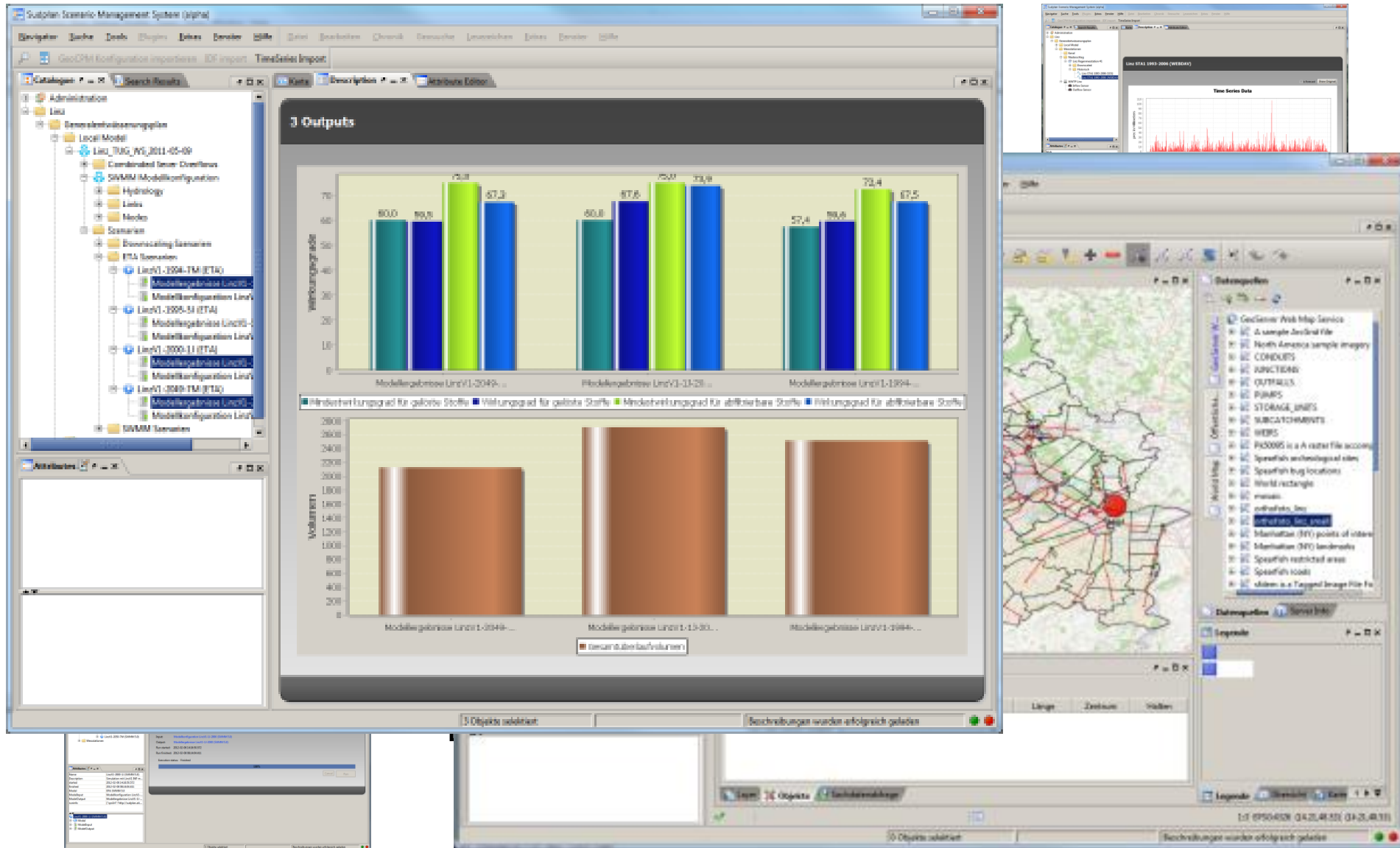
Attribute	Value
file	lms_TUG_WS_2011-05-09
description	lms SWMM Configuration (1)
options	FLOW_UNITS LPSWFS...
file	lms_standard.inflow_sambal...
downloaded_scenarios	
eta_scenario	
eta_file_name	lms_vt_2011-05-29
eta_file_name	lms_vt
swmm_scenario	

The interface also includes a "SWMM Analyse" section with a dropdown menu for "SWMM Berechnung" and a "Suche nach q-Berechnungen" button.

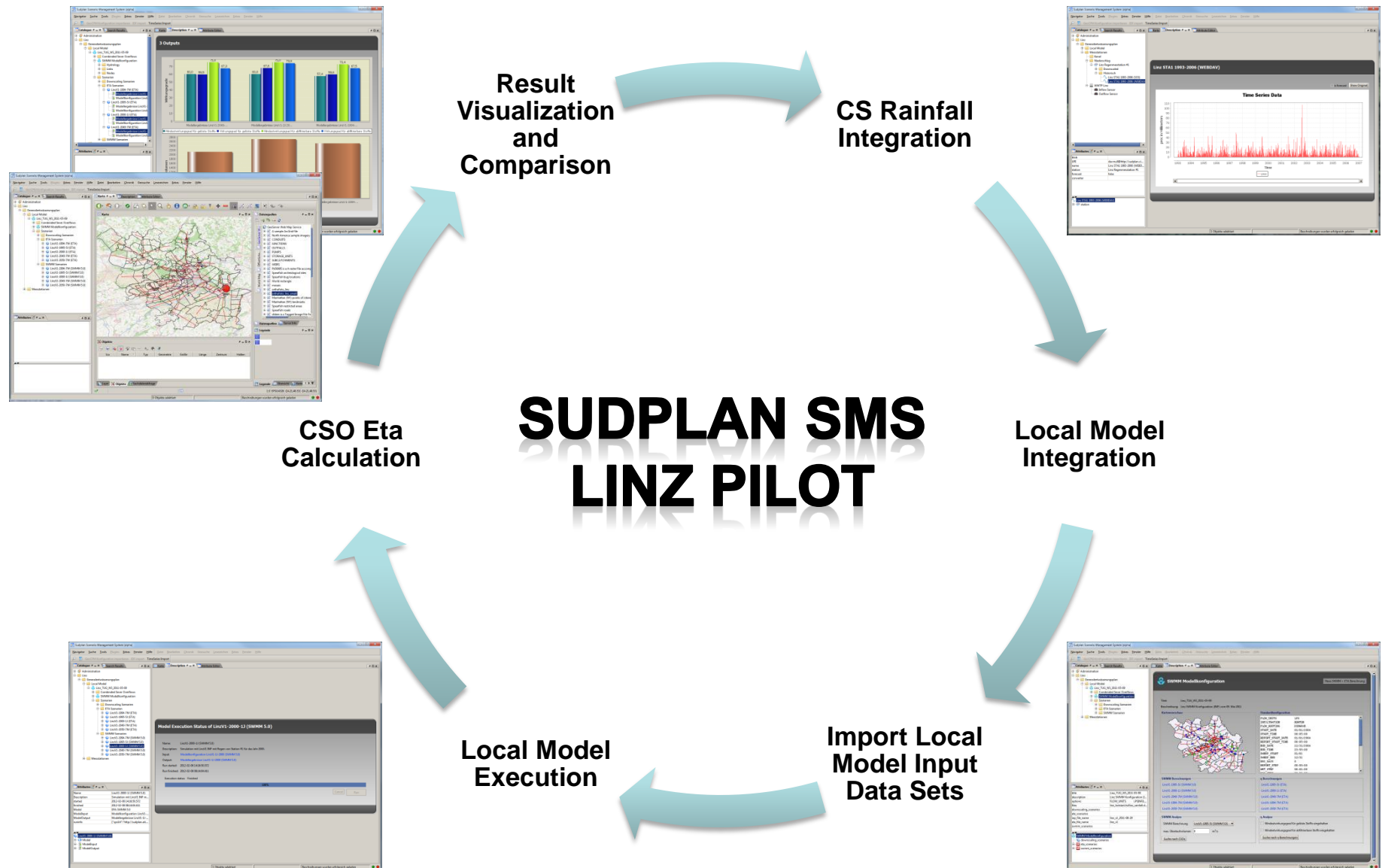
# METHODS – Scenario Management System



## METHODS – Scenario Management System



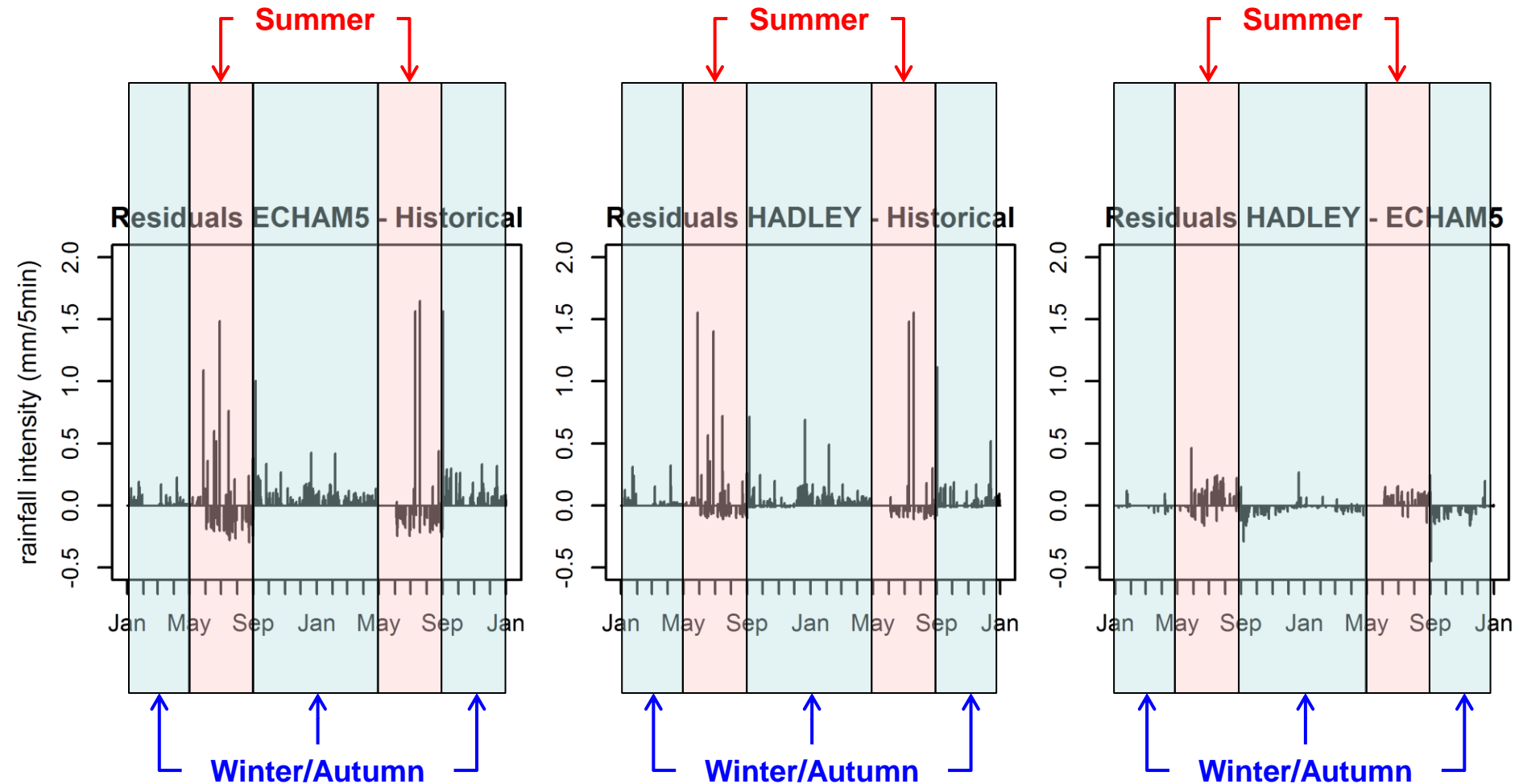
# METHODS – Scenario Management System



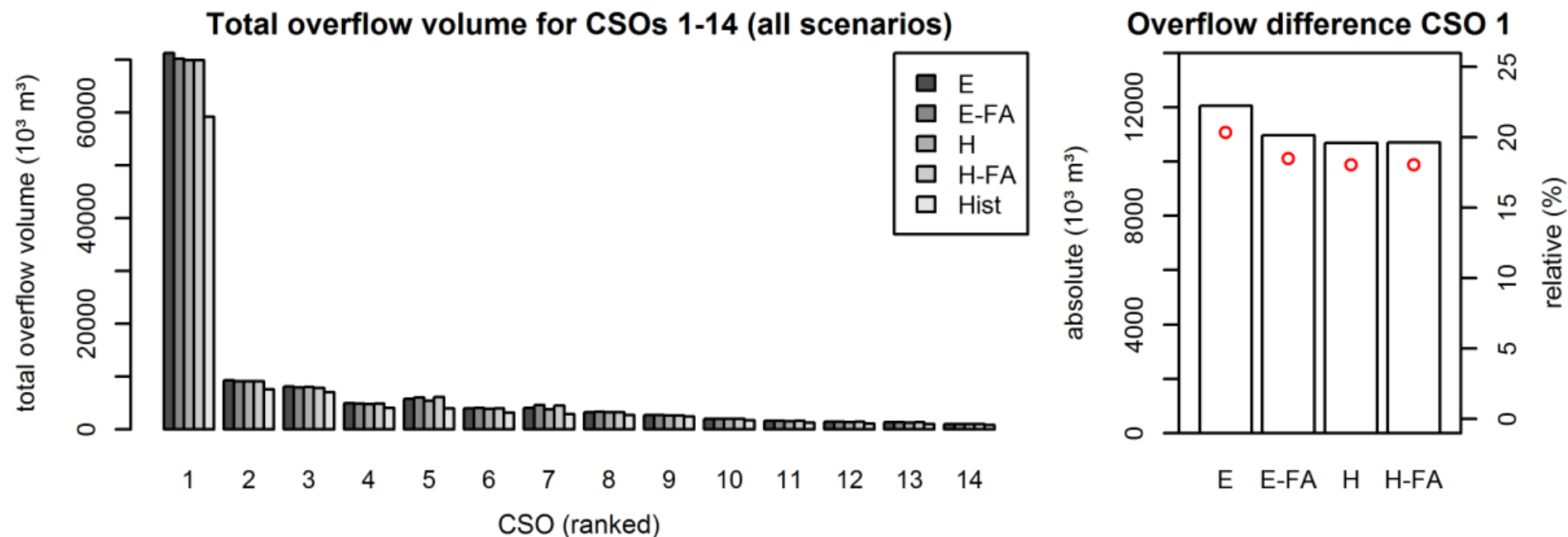
# RESULTS: Annual Means and CSO Efficiencies

Time Series	Period	Annual Mean	$r_{720,1}$	CSO Efficiencies Rates and Ratios					
				$\eta_{d,req}$	$\eta_{d,act}$	$v_d$	$\eta_{p,req}$	$\eta_{p,act}$	$v_p$
		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



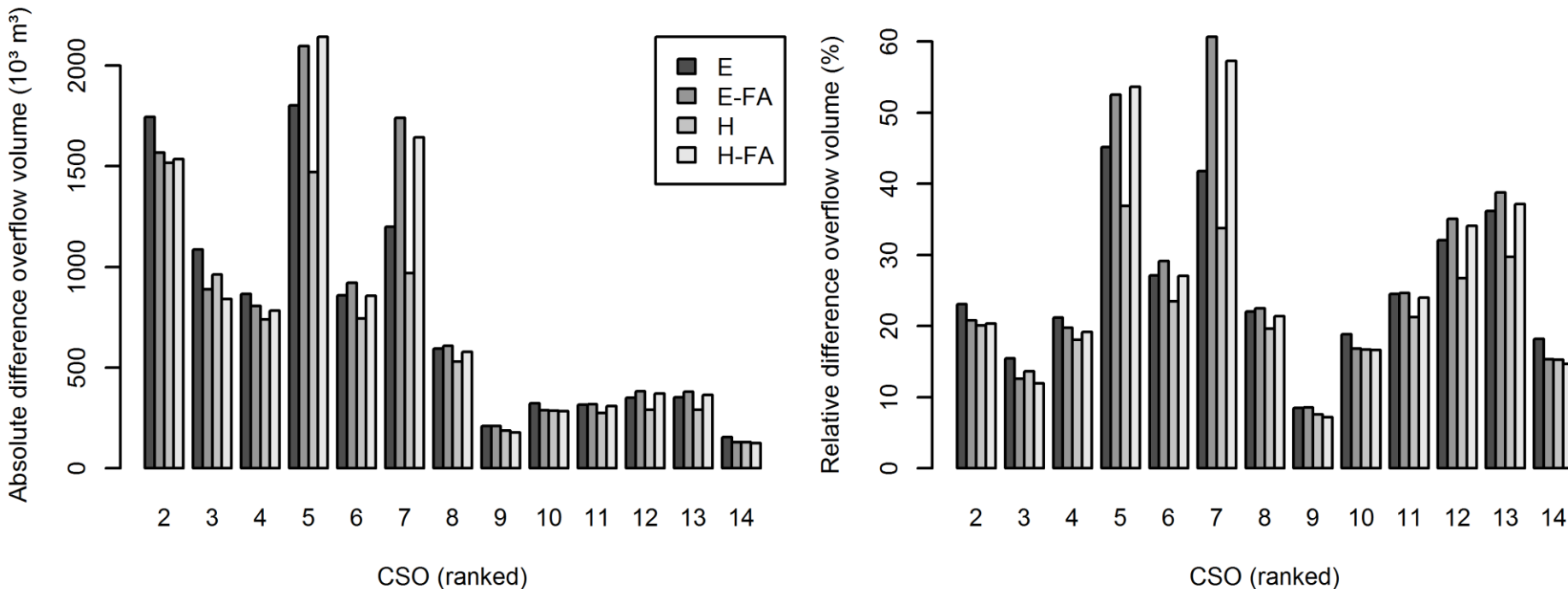
# RESULTS: Total Overflow Volume for 14 CSO



- 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

Absolute and relative differences in overflow volume (CSO 2 to 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](http://www.sudplan.eu)



Sewer and WWTP operator of Linz

## ... and for your kind attention!