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Table of Contents

Index of Figures

1. Management summary

The most important accomplishments in the first year of the SUDPLAN Wuppertal pilot development refer to preparatory work that is connected with the model component, i.e. the software that is used to run simulations of surface run-off in the course of heavy stormwater events.

Wuppertal has decided to use the software GeoCPM by tandler.com GmbH / Pecher AG as the model component for the Wuppertal pilot. An arrangement has been made with the software manufacturer whereby all SUDPLAN partners taking an active part in the development of the Scenario Management System (SMS) are allowed to work with GeoCPM during the project. In order to run simulations with GeoCPM you need a sophisticated high-resolution digital elevation model for the area that your simulation covers. Until now two such models have been set up for the catchment areas of the two streams ‘Varresbeck’ and ‘Lüntenbeck’.

After the Pilot Definition Plan (PDP) for version 1 (D6.1.1), submitted in July 2010, the definition of the pilot’s graphical user interface (GUI) has been pursued. This was done in the so called “mockup-process”. Since the model component was not on hand at that time both the PDP and the subsequent mockup-process concentrated on the use cases that do not affect the communication between the SMS and the model component. Until now four mockups of these use cases have been compiled.

Meanwhile the software and the relevant data are available to start with the integration of the model component and the visualisation of the results. Because of this, the planned order of implementation of use cases was changed and instead of the “prioritisation” use case forseen in D6.1.1 the implementation of the more important process of the integration of the model component and the visualisation of the results will be conducted before the prioritisation use case of the Wuppertal pilot.

Since the release of the first version of the integrated SMS is not planned before M16 (April 2011) there are no fully implemented use cases using the results of WP3 (Scenario Management System) and WP4 (Common Services) available yet. However, they will be described in the forthcoming versions V2 and V3 of this document.

2. Preparatory Work

To put it in a nutshell, the Wuppertal pilot is based upon two guiding ideas. The first is the development of a tool that enables the responsible planners to define and run simulations of surface run-off in the course of heavy stormwater events and to visualise the results of these 'modelling experiments'. The second idea is to consider the effect of climate change on the future rainfall patterns by requesting the rainfall data that is input to the simulations from the SUDPLAN Common Services.

All SUDPLAN pilots use external model components for the execution of modelling experiments, hence it is evident that one kind of preparatory work deals with the availability of the model component and its interface (cf. 2.1). A second kind of preparatory work targets the availability of local rainfall data – the Common Services require this as input for the calculation of downscaled future precipitation data (cf. 2.2). The last kind of preparatory work is concerned with the availability of other data that is needed as input for the modelling experiments (cf. 2.3).

2.1. Model Component

It is an individual problem of the Wuppertal pilot development that the City was not running an appropriate model component for the simulation of surface run-off when the project started. Even though the procurement of this software component is neither part of the SUDPLAN project nor funded via SUDPLAN there is a strong dependency: the implementation of the most important use cases of the Wuppertal pilot depends completely on the availability of the model component. Therefore it was crucial to have an appropriate software product available as soon as possible.

2.1.1 Software Selection

In the third quarter 2010 the City of Wuppertal has decided to use the software GeoCPM by tandler.com GmbH / Pecher AG as the model component for the Wuppertal pilot. It is a component for ++SYSTEMS, a geographical information system (GIS) with subject-specific modules for all aspects of the sewerage domain. Hence it can easily be combined with the module DYNA, that is already in use in Wuppertal for the weak-point analysis of the sewage system (cf. Fig. 1). Since the software manufacturer is interested in the SUDPLAN project, it was easy to make an agreement whereupon all SUDPLAN partners who take an active part in the development of the SMS are permitted to use GeoCPM during the project.

Fig. 1 gives an impression of the workflow in a combined simulation of surface run-off using both GeoCPM and the DYNA.

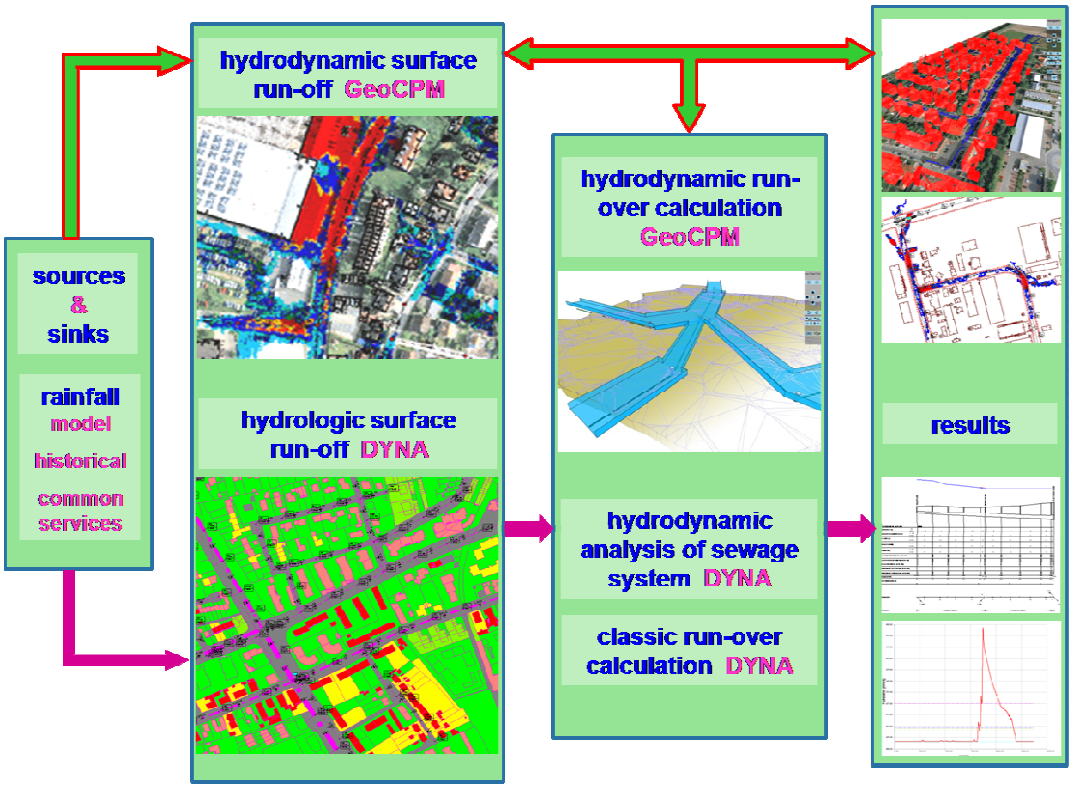

Fig. 1: combined application of GeoCPM and DYNA for surface run-off simulation (© tandler.com GmbH / Pecher AG)

2.1.2 Interface

Now that Wuppertal has come to a decision concerning the model component (cp. 2.1.1) the next major activity in the Wuppertal pilot development will be a workshop that brings together the SUDPLAN partners who are in charge of the implementation of the SMS (mainly CISMET and DFKI) and the model component experts from tandler.com GmbH / Pecher AG.

The main goal of this event will be the development of a clear specification of the communication between the SUDPLAN SMS and GeoCPM. The workshop is currently in planning stage. It will be scheduled for January / February 2011.

2.2. Local Climate Data

The Wuppertal pilot will use the two Common Services concerning precipitation that will be established by SMHI to simulate intense short-term rainfall under the predicted future climatic conditions: 'Urban downscaling' and 'Stormwater generator' [SUDPLAN D4.1.1]. To use the urban downscaling service it is necessary to provide historical high resolution precipitation data for the area that your simulation covers.

2.2.1 Data Acquisition

The required rainfall data is available for two gauging stations in Wuppertal:

- Wastewater treatment plant 'Buchenhofen' in the western part of Wuppertal, keeping records since January 1st 1960, operated by Wupperverband
- Wastewater treatment plant 'Schwelm' close to the eastern boundary of Wuppertal, keeping records since November 2nd 1970, operated by Wupperverband

There are various other gauging stations in Wuppertal, but they were put into operation much later. Therefore the two stations with long-term records are considered to be the most valuable input for the urban downscaling service.

Though the gauges are operated by the Wupperverband it is possible to access them via an information system that belongs to the Wuppertaler Stadtwerke (WSW), the municipal utility that runs the sewage system on behalf of the City of Wuppertal. This information system is based upon the software AquaZIS by the company aqua_plan GmbH, a tool for the management and evaluation of time series data. Both Wupperverband and WSW have agreed to provide the required precipitation data for use in the SUDPLAN project.

2.2.2 Data Structure and Exchange Formats

AquaZIS (cp. 2.2.1) allows the export of precipitation data as both time series and IDF curves. It supports a large variety of interchange formats, e.g. DVWK, ED-format, MD-format, SM-format, LF-format, AQZ-ASCII, NASIM-format and UV-format. Furthermore it is possible to export the data in dBASE data base files (DBF-format).

In 2010 the emphasis in the Wuppertal pilot development was not on the use of the Common Services. Hence the detailed specification of the data structure that has to be provided for uploading precipitation data to the Common Services has to be elaborated in 2011.

2.3. Other Relevant Input Data

In the SUDPLAN Wuppertal pilot GeoCPM will be used to calculate the stormwater surface run-off in model runs defined with the SMS. The most complex input parameter for such a model run - besides the simulated precipitation data - is an optimised high-resolution digital elevation model (DEM), the so-called 'calculation model'. GeoCPM expects this in the form of a triangulated irregular network (TIN). The labour-intensive step in creating a calculation model is to define all the relevant man-made break lines like the exterior walls of buildings ('building break lines') and road kerbs or similar vertical structures ('road kerb break lines').

Meanwhile the modelling of the surface run-off during heavy stormwater events has been introduced into the continuous planning process of Wuppertal's sewer system, called 'Generalentwässerungsplanung' (General Drainage Strategy). This is an important achievement, because it implements the workflow the SUDPLAN SMS will be used in the future! At the

moment the modelling work is carried out directly with GeoCPM, without consideration of climate change effects.

So far two calculation models have been set up in this context:

- for the catchment area of the stream ’Varresbeck’ and ’Lüntenbeck’,
- for the catchment area of the stream ’Lüntenbeck’ (cp. Fig. 2).

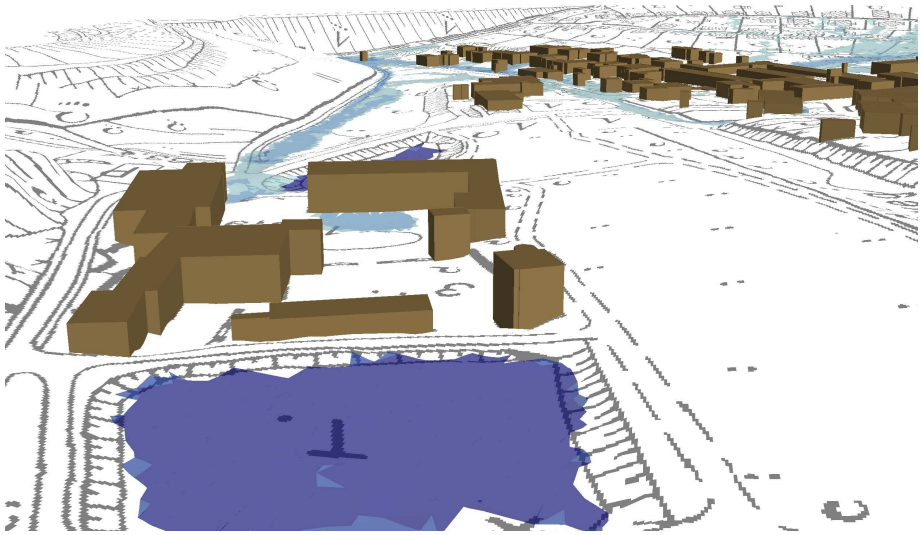

Fig. 2: flooded areas for the stream ’Lüntenbeck’
(© Pecher AG)

3. Pilot Design

The GUI specification for the use cases described in the PDP was approached in its own so called “mockup-process” that uses a blog to allow a stepwise refinement of the user interface. Until now the main input for this process was compiled in a session in Wuppertal in May with participants both from cismet and the City of Wuppertal. The results of this process are documented in subsection 3.1.

Since the required preconditions are fulfilled meanwhile (cf. chapter 2) is was decided to incorporate a first implementation of the model component integration and the visualisation of the results in Version 1 of the Wuppertal pilot, although this has not been covered by the mockup-process so far. Subsection 3.2 discusses the reasons for this change of plan.

3.1. Graphical User Interface

The PDP for Version 1 of the SUDPLAN Wuppertal pilot specifies the following use cases:

- **UC-611** Show Basin Information
- **UC-612** Show Catchment Information
- **UC-613** Visualise Objects in Map
- **UC-614** Assess Basin Risk Level
- **UC-615** Search Catchment/Basin
- **UC-616** Prioritise Catchment Areas
- **UC-617** Trace Prioritisation Changes
- **UC-618** Print Information
- **UC-619** Browse 3D Map
- **UC-6110** Show Historic Precipitation
- **UC-6111** Show Simulated Precipitation
- **UC-6112** Generate Rain Fall Pattern
- **UC-6113** Compare Precipitation data
- **UC-6114** Model Surface Run-Off

At that time – submission date of the PDP was July 9th 2010 – the software component for the simulation of surface run-off was not available yet (cf. 2.1.1). Hence both the PDP and the subsequent mockup-process focused on the use cases UC-611 up to UC-617 that do not affect the communication between the SMS and the model component.

So far four mockups have been prepared:

- **MD-WP6-1** Assess Basin Risk, referring to UC-611 and UC-614 ➔ This mockup illustrates the selection of a natural topographical basin (a ‘hot spot’ that is likely to be flooded during a

storm water event) in the 2D Map or in the Object Catalogue and the process of editing the risk levels of that basin (cf. Fig. 3 and 4). This information is essential for the subsequent prioritisation process.

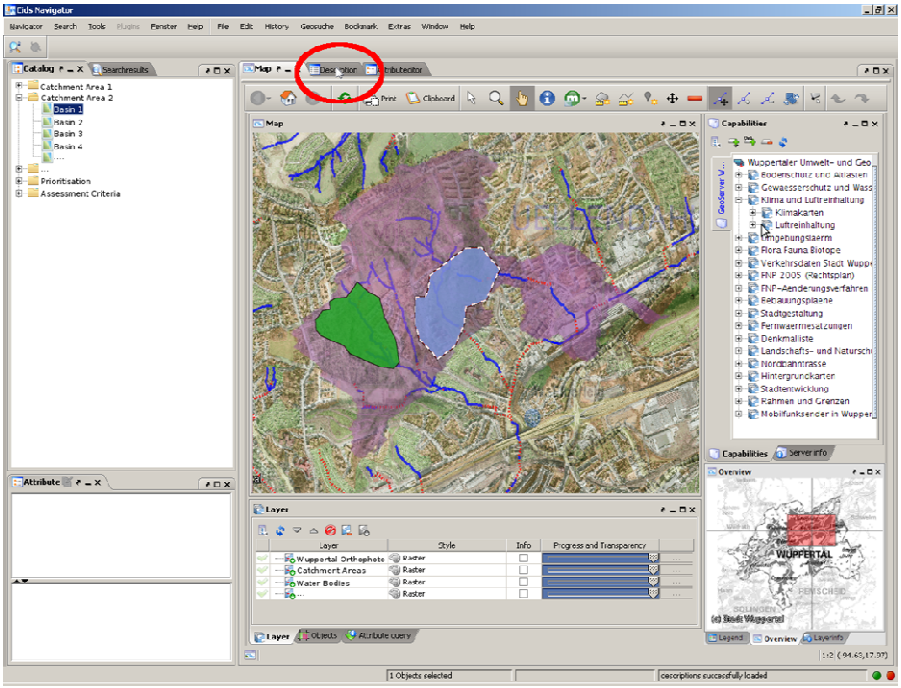

Fig. 3: mockup for selection of a natural topographical basin

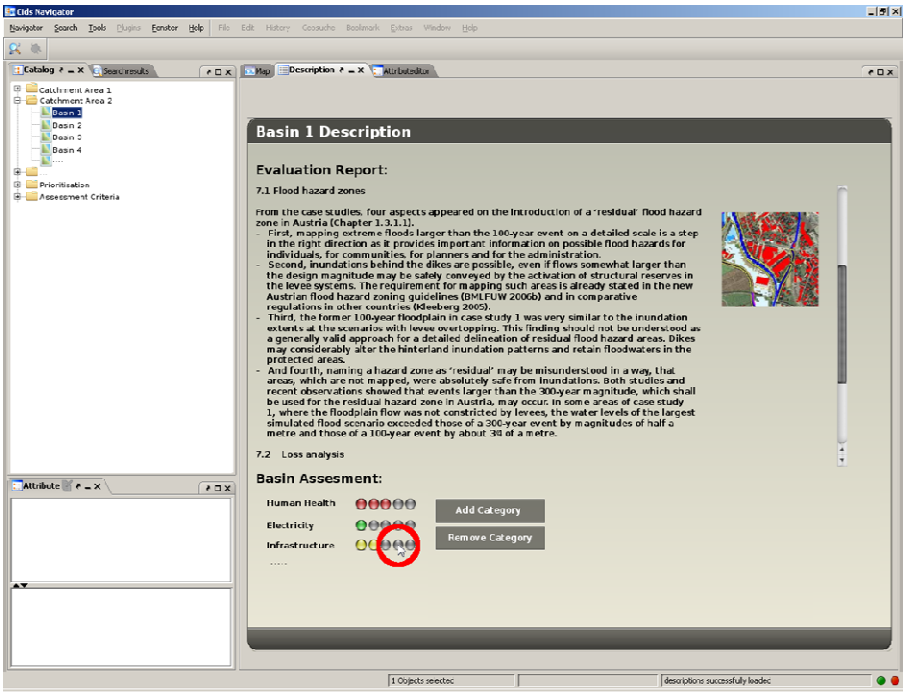

Fig. 4: mockup for editing the risk levels of a basin

- **MD-WP6-2** Visualise Objects in the map, referring to UC-613 ➔ This mockup shows drag and drop operations of basins and catchment areas from the Object Catalogue to the 2D Map component and the display of basin-related information in the map (cf. Fig. 5).

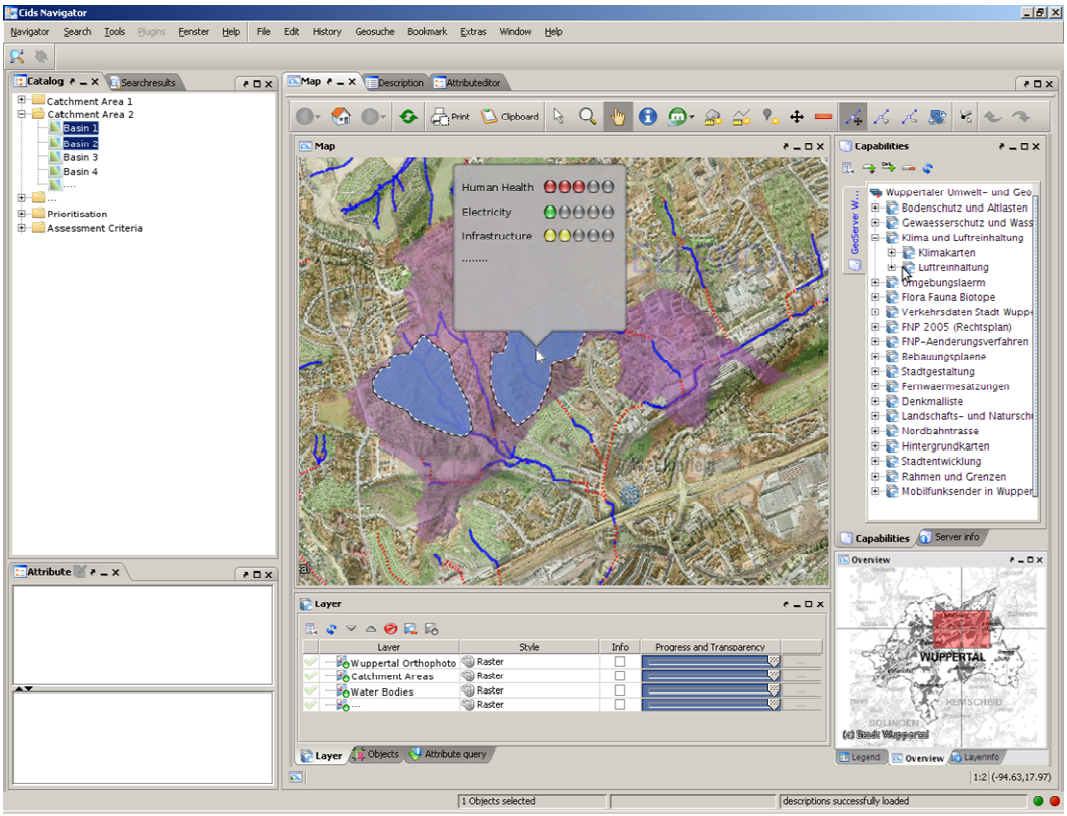

Fig. 5: mockup for the visualisation of catchment areas and basins in the map

- **MD-WP6-3** Prioritise Catchment Areas, referring to UC-612, UC-616 and UC-617 ➔ This mockup (cf. Fig. 6) shows how the user views the desired catchments and changes the catchment prioritisation (the order in which they are dealt with in the planning process).

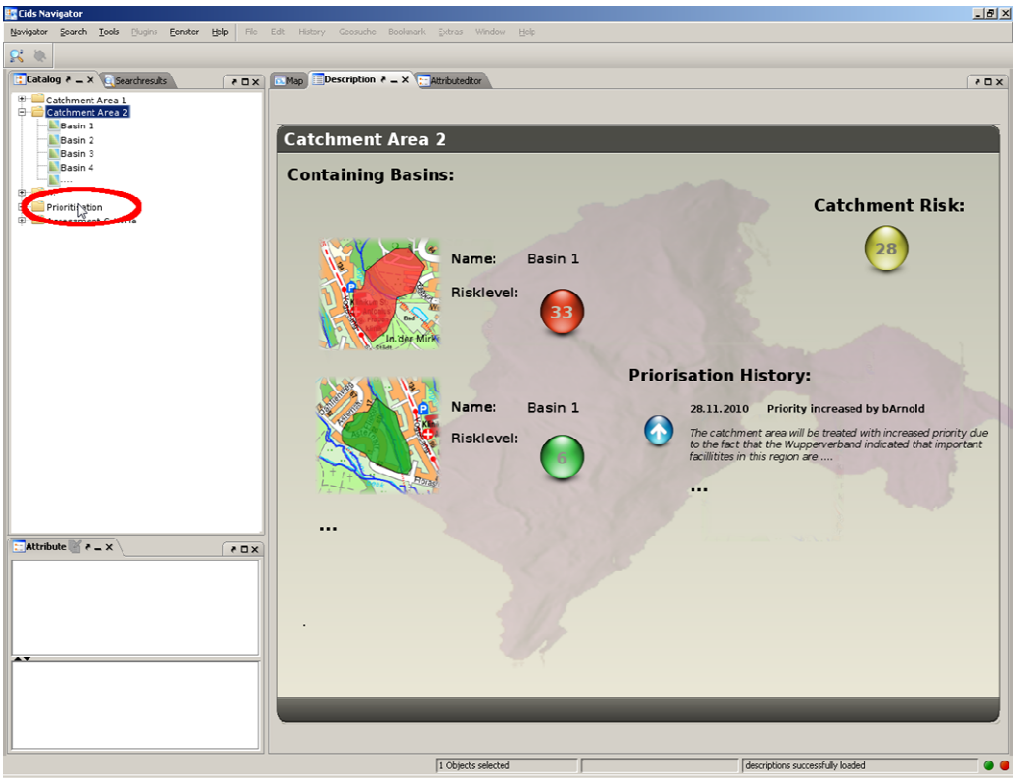

Fig. 6: mockup that shows the results of the catchment prioritisation

- **MD-VP-2** Basin and Catchment Visualisation, referring to UC-611, UC-612 and UC-6114 ➔ This mockup shows first ideas for the visualisation of basin and catchment information and the results of surface run-off simulations in the context of a DEM and a city model.

3.2. Modification of Use Cases

The use cases that are covered by the mockup-process in third and fourth quarter of 2010 (cf. 0) have their business value, but they are not exactly the core of the Wuppertal pilot, since they work on a quite low level of interaction. Both the *Basin Risk Assessment* and the *Catchment Area Prioritisation* are likely to happen only a few times in the process of the 'Generalentwässerungsplanung', maybe even only one-time for a certain basin or catchment area.

Fortunately, the preconditions to start with the integration of the model component and the visualisation of the results have been fulfilled since that time (cf. 2.1.1 and 2.3). Using the SMS

to run simulations of surface run-off in the course of heavy stormwater events is undoubtedly a highly interactive process that will be carried out several times for each catchment area.

Therefore it was decided at the Norrköping PMC meeting (October 7-8, 2010) to implement a first raw version of this use case as part of Version 1 of the Wuppertal pilot.

4. Implemented Use Cases

Since the release of the first integrated version of the SUDPLAN SMS is planned for M16 (April 2011) there are no fully implemented use cases using the results of WP3 (Scenario Management System) and WP4 (Common Services) available yet. However the description of the implemented use cases will be the main content of the forthcoming versions V2 and V3 of this document.

5. Conclusions

During this phase of the project mainly preparatory work concerning the software component for the simulation of surface run-off and the required input data has been carried out. The software GeoCPM has been selected as local model component, however this was an activity outside of the project that was consequently not funded via SUDPLAN. Since two calculation models for catchment areas of streams in Wuppertal have been set up in 2010 – an activity outside of the project as well – a first implementation of the model component integration and the visualisation of the results will be introduced in the second year of the project.

The main work within the limits of the SUDPLAN project was the definition of 14 use cases for the Wuppertal pilot, described in detail in the PDP document, and the subsequent mockup-process that uses a blog for a stepwise definition of the user interface. Until now four mockups have been prepared, referring to seven of the above-mentioned use cases. The local model component integration has not been tackled in the mockup-process so far, because the model component was not available when the main part of this work was done.

6. References

SUDPLAN D4.1.1 D4.1.1 Common Services concerted approach V1.pdf, SUDPLAN Consortium, 09.08.2010

7. Glossary

technical term	*Explanation*
AquaZIS	software tool for the management and evaluation of time series data, produced by the German company aqua_plan GmbH
AQZ-ASCII	proprietary data format for precipitation data in the form of equidistant or variable time series, defined by aqua_plan GmbH
Calculation Model	a high-resolution digital elevation model in the form of a triangulated irregular network (TIN) that is optimised for the calculation of hydrodynamic surface run-off, therefore it comprises a detailed model of all relevant man-made break lines like the exterior walls of buildings and road kerbs
DYNA	software component for ++SYSTEMS, used for the simulation of hydrologic surface run-off and hydrodynamic analysis of sewage systems (manufacturer: tandler.com GmbH / Pecher AG)
ED-format	proprietary data format for precipitation data in the form of time variation curves, used by software products of German company itwh GmbH
ES-format	standardised interchange data format for precipitation data ('Einheitliche Schnittstelle für die Weitergabe von Regendaten') defined by 'Deutscher Verband für Wasserwirtschaft und Kulturbau e.V. (DVWK)'
GeoCPM	software component for ++SYSTEMS, used for the simulation of hydrodynamic surface run-off (manufacturer: tandler.com GmbH / Pecher AG)
IDF curve	Intensity-Duration-Frequency curve for rainfall data – an IDF curve indicates the rainfall intensity that will occur for a given duration and return period
LF-format	proprietary but widely-used data (interchange) format for precipitation data in the form of equidistant time series, used by the software 'LWAFLUT' (manufacturer: Hydrotec GmbH)
MD-format	proprietary data format for precipitation data in the form of equidistant time series, used by software products of German company itwh GmbH
NASIM-format	proprietary data format for precipitation data in the form of time series with 6 minutes equidistance, used by the software 'NASIM' (manufacturer: Hydrotec GmbH)
SM-format	proprietary but widely-used data (interchange) format for precipitation data in the form of equidistant time series, used by the software 'Schmutzfracht-simulationsmodell SMUSI' (manufacturer: Hessisches Landesamt für Umwelt und Geologie)

technical term	*Explanation*
++SYSTEMS	geographical information system with subject-specific modules for all aspects of the sewerage domain (manufacturer: tandler.com GmbH / Pecher AG)
UV-format	proprietary but widely-used data (interchange) format for precipitation data in the form of equidistant or variable time series, defined by German company Hydrotec GmbH

8. Acronyms and Abbreviations

acronym / abbreviation	*Definition*
DBF	dBASE Data Base File
DEM	Digital Elevation Model
GIS	Geographical Information System
GUI	Graphical User Interface
PDP	Pilot Definition Plan
SMS	Scenario Management System
TIN	Triangulated Irregular Network
WSW	Wuppertaler Stadtwerke (municipal utility)

