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Product Validation Report V3

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1.0	2012-12-07	SSa	QA by SSc incorporated
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1. Management Summary

This document D6.3.3 Product Validation Report V3 reports on the usability of the SUDPLAN product from the Wuppertal pilot's point of view. Validation against technical detail requirements is not in the scope of the validation process; this is done as part of the state-of-the-art software development and documented in the respective deliverables of WP3.

A total of six persons worked out an online questionnaire (LimeSurvey, simplified version). Among them are 3 urban planners -potential primary users- representing the three organizations that are interested to use the SUDPLAN tools for their planning processes (Wuppertal municipality, the local public utility company and the regional water board). Moreover, 2 IT experts who will be in charge of running and maintaining the system in the future for all the organizations at the Wuppertal site participated in the survey. Moreover, an external potential primary user in the hydrology domain took part and provided a valuable assessment of the possible use of SUDPLAN beyond the focus of the Wuppertal pilot. All of the respondents of the survey had seen presentations and documentations of SUDPLAN before they filled in the survey, five of them visited the 2nd Dissemination Event in Wuppertal in October 2012. The assessments of three participants were based on working experience with the Wuppertal pilot application.

The complete results of the LimeSurvey questionnaire for the Wuppertal pilot after project's third year (2012) are collected in Annex A of this report. A summary and - in some cases - an interpretation of these outcomes is given in Chapter 4. The summary separates the aspects graphical user interfaces, 3D visualization, climate scenario information, Common Services (rainfall, hydrology and air quality), completeness of functionality and conclusions.

Chapter 5 provides a synopsis of the respondents' assessments and their individual conclusions. The essence of this can be outlined as follows:

- SUDPLAN offers the possibility to organize interdisciplinary planning processes in a municipality, providing an easy way to introduce climate change effects in urban planning without deep expertise on climate change matters.

- The SUDPLAN Wuppertal pilot is in its current status close to being operational. However, there is still some work to be done to integrate the prototype in Wuppertal's IT infrastructure. Moreover, some features of the Wuppertal pilot should be enhanced to enable seamless workflows for the primary users in Wuppertal.

- The majority of the individual assessments is affirmative indicating that the SUDPLAN Wuppertal pilot is a planning tool clearly beyond the state-of-the-art.

- SUDPLAN contains technical components like the 3D map and the temporal navigation through WMS layers that will be of great use in a lot of contexts not covered by the existing SUDPLAN pilots.

- SUDPLAN is open for the implementation of applications similar to the existing pilots, which is more cost-efficient than a complete development from scratch.

2. Methodology

The common methodology for all V3 Product Validation Reports is described in detail in D2.1 Validation Plan (revised after 1st ATR) document dated June 15, 2011; hereafter only referred to as D2.1 Validation Plan. The validation procedure is summarised below. All technical developing staff members participating in the pilot work have contributed to the validation by filling in a questionnaire.

With the purpose to increase the number of external end-users participating in the validation procedure, the third and final validation of the SUDPLAN project includes a simplified version of the full validation questionnaire. This simplified version contains only questions which can be responded by any interested person that has participated in a seminar and / or demonstration of the SUDPLAN tool. Also the pilot staff members characterized as end-users have used the simplified validation survey.

2.1. Documents involved

D2.1 Validation Plan describes the methodology used to produce the four pilots deliverables D[5-8].3.3 (Product Validation Reports V3) and the project overall validation of deliverable D2.2.3 (Validation and Evaluation Report V3).

The objective of the D6.3.3 Product Validation Report V3 is to validate the usability of the SUDPLAN product from the Wuppertal Pilot's point of view. It will also provide input to the D2.2.3 Validation and Evaluation Report, for which the main focus is on the potential usability of the SUDPLAN product beyond the project and for an arbitrary city in Europe. This means that the comments given by external end-users will be particularly important. In addition, the SUDPLAN results are assessed against the impacts expected by the call which are defined as objectives in the SUDPLAN Description of Work.

A table of all documents used or referenced in this document is given in Chapter 6 at the end of this document.

2.2. Validation aspects

2.2.1 Fulfilment of the pilot goals

Validating the level of fulfilment of the pilot goals as defined in D6.1.3 Pilot Definition Plan V3 is out of the scope of this document (instead given in deliverable D6.2.3 Wuppertal Pilot V3).

2.2.2 Professional profiles taking part in the pilot product validation

The pilot validations are performed in two steps. The first step is for WP leaders to assure that all pilot staff members fill in the full validation and to encourage as many external end-users as possible to fill in the simplified LimeSurvey web questionnaire. The second step is to merge all individual answers into this pilot product validation document.

There is a formal SUDPLAN classification, valid for both project staff and external end-users, in which they are defined as:

- Analysts – primary users: End users of SUDPLAN output, e. g. city planners or their technical staff, working directly with the system.
- Analysts – secondary users: End users of SUDPLAN output, e.g. city planners or their technical staff, using SUDPLAN results but without working directly with the system.
- Modellers: Developing, integrating and configuring the different models of the type used in SUDPLAN applications for a city. They are considered secondary end users, as they normally do not work directly with the system.
- System Managers: Installation, maintenance and system administration. They are considered secondary end users, as they normally do not work directly with the system.

The results of the validation LimeSurvey questionnaire should include impressions from all four professional profiles. However, one individual can belong to more than one professional profile.

2.2.3 Interaction between WP3 and WP4 and usability of the SUDPLAN Product

This deliverable assesses and documents the usability of the main results of WP3 Scenario Management System and WP4 Common Services for the SUDPLAN Wuppertal pilot application.

The summary and generalization of the pilot validations are compiled as a part of the WP2 work, and reported in D2.2.3 Validation and Evaluation report. That document also draws conclusions on the pilot validations to provide feedback to WP3 and WP4. It is essential for WP3-WP4 to know whether they are on track and where improvement or even changes have to be implemented to allow an after-project use and exploitation. Furthermore, this document also assesses the independence of the implementation of the SUDPLAN product from the specific pilots and the usability for an arbitrary European city.

2.2.4 Technical requirements of WP3 and WP4

The fulfilment of the technical requirements of WP3 (Scenario Management System) and WP4 (Common Services) is validated by unit- and integration tests done during the product development. This purely technical validation is out of the scope of the present document.

2.3. Rating

SUDPLAN product validation contains questions of the following types:

1. Rating starting with 1 for lowest (not fulfilled at all) to 7 for highest rating (fulfilled beyond expectations, which should be awarded only in exceptional cases and explained in the text), or NA (not applicable). ***Example where 5 persons related to this pilot have filled in the questionnaire:***

	1	2	3	4	5	6	7	NA
Define scenario:			2		1	2		
Execute scenario					1	3		1

2. Rating from 1 to 7 indicating the comparison with e. g. state of the art solution, with 4=on pair with the state of art, 1=way below state of the art, and 7=way above the state of the art. NA can be used to indicate that the comparison is impossible, useless or beyond the evaluator's knowledge.

   Example where 5 persons related to this pilot have filled in the questionnaire:

	1	2	3	4	5	6	7	NA
Compared to state of the art solutions					2	2	1	
Compared to SUDPLAN project objectives					1	4		

3. Yes|No|NA type of questions. ***Example:***

Dynamic workflow composition supported by	**Y**	**N**	**NA**
Pilot application:		5	
SUDPLAN product:	4		1

4. Multiple choice questions used to confirm that specific requirements are met. This type of question is normally responded by persons involved in SUDPLAN development. Each single question can have only a limited number of answers (with or without NA). For example, in Q 2.2.1 the users are asked to list the SUDPLAN service interfaces and indicate their type (OS = Existing Service Interfaces with open standard specifications, re-used in SUDPLAN; P = Existing proprietary Services with no open specifications, re-used in SUDPLAN (if any); (N) New service Interfaces defined in SUDPLAN (if any):

Service interface	**OS**	**P**	**N**
Dummy 1:			
Dummy 2:			
Dummy 3:			
Dummy 4:			

5. Free text fields are used to collect overall impressions and comments beyond the simple yes / no or rating level, giving the evaluator the the opportunity to explain the way a requirement has been fulfilled. In case of partial fulfilment or failure to fulfil the requirement, the description could also explain e. g.:

   - Which part of the requirement was not fulfilled?

- Why the requirement was dropped / not fulfilled?
- What are the consequences of not-fulfilling the requirement?
- Will the requirement be fulfilled later? (e. g. “planned for development beyond the project”)

3. Validated components and aspects of the pilot product

The following table indicates which components and aspects have been validated during the V3 period, as well as the number of individuals that have given their opinion. The Wuppertal pilot is, for the V3 validation, using the simplified version of the online questionnaire (in V2 the full version was used). The complete list of the simplified validation questions is given in Annex A (Simplified LimeSurvey).

The following table gives the number of persons that have participated in the different parts of the V3 validation.

Components and aspects evaluated in the simplified pilot validation:	**V3**
Graphical User Interfaces	6
Visualisation	6
Climate Scenario information	5
Common Services: Rainfall	6
Common Services: Air Quality	1
Common Services: Hydrology	2
Local models	6
Completeness of functionality	6
Conclusions	6

4. Summary

The group of people who volunteered to validate the Wuppertal pilot comprises 3 urban planners representing the 3 organizations that have shown interest to use this application in their planning processes. The first 2 are the Wuppertal municipality (participant No. 2) and the local public utility company "WSW Energie & Wasser AG" (participant No. 6) that both are involved in the mid- and long-term planning of the stormwater sewage system including flood precaution (General Drainage Planning). In addition, the regional water board "Wupperverband" (participant No. 5) is engaged in the prevention of flooding caused by the surface watercourses. The 3 urban planners involved can be regarded as potential primary users of the Wuppertal pilot. One of them has worked extensively with the actual system, the other 2 have seen presentations and taken part in the 2nd Dissemination Event in Wuppertal in October 2012.

As representatives of the System Manager Profile, 2 IT experts validated the Wuppertal pilot: one of them (participant No. 4) will very probably be in charge of operating the application for all 3 parties mentioned above in the future. The other one (participant No. 1) represents Wuppertal in the SUDPLAN project. He is responsible for the department of the Wuppertal municipality that will run the Wuppertal pilot application. Both of them have worked with the actual system before they filled in the LimeSurvey.

The last person (participant No. 3) to fill in the LimeSurvey used to work for the City of Wuppertal's Environmental Agency, therefore he has a thorough understanding of the General Drainage Planning process and the subsequent requirements towards SUDPLAN. He now works for a federal State Authority in another federal state in the field of the EC Water Framework Directive. Hence he is able to validate both the Wuppertal pilot and the potential use of the Common Service "Hydrology". He also had taken part in the above mentioned workshop in Wuppertal.

In this section the characteristics of the validation participants are given, followed by summaries of the most important conclusions concerning each of the validated components and aspects. A complete list of all questions and answers of the LimeSurvey validation is available in Annex A of this report. The results of the full validation including purely technical issues will be outlined in the D2.2.3 Validation and evaluation report V3.

The following table summarises the professional profiles of the persons that completed the LimeSurvey simplified questionnaire (Annex A).

1	Stefan Sander	stefan.sander @stadt.wuppertal.de	City of Wuppertal	Germany	Head of department "Information processing and cartography"
2	Bernard Arnold	bernard.arnold @stadt.wuppertal.de	City of Wuppertal	Germany	Project manager stormwater sewer system and supervisor of the sewer system operator

3	Eckhard Kohlhas	eckhard.kohlhas @lung.mv-regierung.de	Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg-Vorpommern (Federal State authority)	Germany	departmental head EC Water Framework Directive
4	Reinhard Verkennis	reinhard.verkennis @stadt.wuppertal.de	City of Wuppertal	Germany	System manager SDI
5	Daniel Heinenberg	dhg@wupperverband.de	Wupperverband (water board)	Germany	Consultant for flood precaution
6	Jens Ante	jens.ante@wsw-online.de	WSW Energie & Wasser AG (public utility company)	Germany	Urban drainage planner and manager for measured data

The particular interest and profile of the participants filling in the simplified questionnaire have been classified according to the following table (note that one person can be interested in more than one environmental risk):

Type of environmental risk	Analyst primary	Analyst secondary	Modeller	System Manager
Urban stormwater flooding during intense rainfall	3		2	1
Dimensioning of sewage water systems				
Risks of flooding of rivers	2			
Hydrological conditions	2			
Air pollution	1			
Other				

SUDPLAN deals with both long term and short term planning. Nearly all of the questionnaire participants are interested in short term as well as in long term planning where climate change is of importance.

Temporal planning interest	Y	N	NA
Present conditions and short term (<10 years) planning	6	0	
Long term planning (>10 years) planning	5	1	

The professional profiles have been classified according to the following table:

Type of user	Y	N
SUDPLAN team member	2	4
Analyst	3	3
Modeler	2	4
System manager	1	5
IT expert	3	3
Climate change expert	1	5
Have seen presentations and documentations	6	0
User of the SUDPLAN / model results	0	6
Working with the actual system	3	3
Participated in a SUDPLAN workshop	5	1

4.1. Summary for Graphical User Interfaces

All 6 participants gave input to this aspect. The possibility to browse through the results in space and time was considered to be the most important concept of SUDPLAN, which is not surprising for a geographic information system. Means to compare two result sets and the generation of alerts when a long data processing is finished were also regarded as crucial.

In contrast to this, the highlighting of recently changed data is perceived to be less important, most likely because this function is not applicable to the Wuppertal pilot.

Concerning the usability of SUDPLAN the main workflow (Scenario definition and execution, saving of the results) got a positive assessment whereas the visualization of the results was ranked slightly lower (but still positive in general).

A contextual help in the strict meaning was missed by 4 out of 6 participants. However, the importance of this concept is only ranked secondary. (Most of the explanatory information comes from the metadata rather than from a contextual help system.) In addition 3 out of 6 respondents missed the visualization of uncertainties by providing different scenario results, presumably because this has not been shown in the Wuppertal pilot.

The comments of the participants indicate that they know the differential WMS layer method implemented in the Stockholm pilot to support the comparison of simulation results. But since it is not included in the Wuppertal pilot the features for comparing scenarios only received a mean score.

Further comments underline the respondents' positive impression of the SUDPLAN GUI, for they demand only minor issues to be changed or amended (e. g. a fully German version of the interface, additional tooltips, an enhanced textual design of the wizards, the closing of some consistency and workflow gaps, the latter mainly when changing over from the 2D visualization of the local model results to the 3D / 4D visualization).

4.2. Summary for 3D visualisation

All 6 participants gave input to this aspect. Their overall impression was rather good, likewise was their rating of the interaction with the 3D GUI, the visualization of scenarios and other information.

The 3D / 4D capabilities to compare and analyse scenarios only got a low score (cf. 4.1 concerning the comparison features), but one comment indicates that a purely visual analysis of scenarios is sufficient for practical use.

The participants encourage further or refined 3D visualization methods, in particular one for the visualization of water volumes instead of symbolizing water levels by colours on the ground level. Moreover it would be appreciated to have a method that displays the maximum water levels and cell specific time variation curves of a local model result as alphanumeric or graphic information both in the 2D and in the 3D map.

4.3. Summary for Climate scenario information

A total of 5 persons gave input to this aspect. In general the participants of the survey are satisfied with the number of available climate scenarios and the related spatial and temporal coverage. Similarly the possibility for changing the temporal resolution for data export that comes with the getfeatureInfo response of the WMS layers (Pan European use case) got a positive rating.

The climate scenario information provided in this way is definitely considered to be beyond the state of the art.

The weak point in this context with a consequently lower rating is the comparatively poor documentation of the scenarios that comprises only a few catchwords in the explanatory block of the wizards.

4.4. Summary for Common Services: Rainfall

All 6 survey respondents contributed to this section. They regarded the usability and the ease of use of the rainfall downscaling service as impressive with average scores not lower than 6 in every single category. The downscaling procedure with rainfall time series is rated slightly lower than the one with IDF-curves, probably since it is much more time consuming.

The comments of the participants show that there was no alternative state-of-the-art product for the calculation of climate change effects available for any of them. Consequently there is only little response to the required assessment of the scientific soundness and credibility of the downscaling results. Only the general performance of the downscaled continuous rainfall time series got a positive rating of larger group (5 persons). However, the few given assessments are quite consenting with scores of 5 or 6. The only exception to this is the question concerning the calculation of long-term (annual or seasonal) volumes from a downscaled time series. This feature that was not explicitly required by the Wuppertal pilot is not implemented yet, hence 2 participants rated it with 1 point only. (Unfortunately, it is not possible to figure out what the other 2 participants who rated 6 points were referring to.)

In the comments 2 participants indicated that the calculation of a rainfall event from a (downscaled) time series is not implemented yet. This would also involve the interactive manipulation of rainfall series, e. g. cutting out a short part of the data that describes a heavy stormwater event. Currently this has to be done outside of the SUDPLAN SMS.

4.5. Summary for Common Services: Air Quality

One survey respondent answered the questions concerning the Common Service "Air Quality" based on his participation in the 2nd SUDPLAN dissemination event in Wuppertal. (This is not surprising since the Wuppertal pilot which is clearly in the focus of this validation document does not use this service.)

However, he appreciated the Air Quality Service and rated it with scores between 5 and 7 in every category that he dealt with.

4.6. Summary for Common Services: Hydrology

Only two survey respondents answered the questions concerning the Common Service "Hydrology" based on his participation in the 2nd SUDPLAN dissemination event in Wuppertal. (This is not surprising since the Wuppertal pilot which is clearly in the focus of this validation document does not use this service.)

Both respondents were satisfied with this SUDPLAN component and gave it in most cases a rating between 5 and 6 meaning "above the state of the art". The only exception with a somewhat lower rating is the usability of the local calibration in the context of riverflooding assessment.

One of the respondents expressed his wish that the underlying E-HYPE model should be free for use.

4.7. Summary for Local Models

A total of 6 persons gave input to this aspect. Running a local model that has already been integrated in a SUDPLAN application from the GUI is considered to be beyond the state of the art. Likewise is the specification of parameters for a model run.

The integration of a new model requires programming skills and is no task for an end user. Therefore 3 persons gave a low rating of 1 or 2 points in this category. Nevertheless, two respondents still consider the possibility to integrate new models to be above the state of the art, possibly because the programming framework provides some guidance for this task.

Service chaining, configuration of models, model validation and model calibration are not implemented in the Wuppertal pilot but to some extent these features are available with the Common Service "Hydrology". Accordingly heterogeneous is the rating of these features: respondents who concentrated on the Wuppertal pilot consider them to be not fulfilled at all, those who validated the Common Service "Hydrology" assess these features as slightly above the state of the art with scores between 4 and 5.

4.8. Summary for Completeness of functionality

All 6 survey respondents provided input to this section. There was a heterogeneous assessment ranging from 2 to 6 points of SUDPLAN's capabilities to support the creation of information products, reports and publications, to share results and to export data. Due to the open nature of the services SUDPLAN is based on, it is feasible to accomplish these tasks, but in most cases there is no specific GUI available, hence the user needs special technical knowledge and / or external tools (example: the production of a movie showing the course of a run-off simulation).

The assessment of the SUDPLAN usability from the system manager's point of view was also positive with an average rating of 5.9 (clearly above the state of the art). The only exception with a lower rating is the integration of new models. (The different possible expectations regarding model integration have already been discussed in section 4.7.)

The following functionalities were mentioned most frequently as particularly useful:

- Common Service "Rainfall Downscaling" for easy introduction of climate change effect on the rainfall pattern (mentioned 3 times)
- manipulation of breaklines representing local or extensive measures directly in the map (mentioned 3 times)
- 3D and 4D visualization methods on virtual globe (mentioned 3 times)

Moreover, some general features of the system architecture and the used programming framework were mentioned as particularly useful: the good transferability of the SUDPLAN approach (using the toolset with other models and for other questions), the consequent use of standards (makes SUDPLAN easy to integrate in an existing SDI) and the advantages of using Java as programming language (platform independence and easy deployment via Java Web Start).

On the other hand the respondents missed the following features:

- more detailed information in the 2D and 3D visualizations to improve capabilities for analysis, e. g. the display of maximum water levels and time variation curves for a selected cell of the TIN, mentioned 3 times
- the calculation of Euler II rainfall events from time series with the necessary statistical processing of the time series carried out in the background, mentioned 3 times (Remark: in the Pilot definition phase this functionality was considered optional only and therefore was not included in the tight implementation schedule.)
- an interactive mode to work with the imported time series, e. g. to derive a shorter one or to extract a single rainfall event from the original dataset, mentioned 2 times

Furthermore one participant expressed the expectation that a GUI should be added to support the export of GIS data via OGC Services (This was implemented only for Air Quality).

The key advantages of using SUDPLAN in urban planning are outlined as follows: SUDPLAN offers the possibility to organize interdisciplinary planning processes in a municipality, in particular the mid- and long-term planning process for the stormwater sewage system called "Generalentwässerungsplanung" (General Drainage Planning). SUDPLAN will be integrated in Wuppertal's SDI, so the data of all planning departments will be available in the same application. Different perspectives on a planning task can be shared. SUDPLAN provides an

easy way to introduce climate change effects in urban planning processes without deep expert knowledge on climate change matters.

4.9. Summary for the Conclusions part of the LimeSurvey

All 6 survey respondents provided input to this section. All persons who were able to assess this (4 or 5 of 6) regarded the SUDPLAN results as positive (new, better quality and more useful) than the previously available information. Likewise, most of the respondents (5 of 6) would use it for future urban planning and considered it as useful for most cities, at least for large cities with an appropriate IT infrastructure (4 of 6). Accordingly, 5 of 6 respondents would recommend SUDPLAN to their colleagues in other European cities.

All participants of the survey find the graphical presentation of the SUDPLAN results excellent and contributing to a better understanding, although some room for improvements was identified. For example, it would be useful to have a feature Info request on the 2D and 3D map that answers with the exact maximum height of water at a certain spot as long as the maximum water levels are displayed. It was proposed to implement this as a tooltip appearing in the 2D or 3D map.

With respect to the main strengths of SUDPLAN the participants of the survey recapitulated the particularly useful functionalities from section 4.8. Furthermore the following features of SUDPLAN were mentioned:

- The SUDPLAN Wuppertal pilot appears ready to use, although some features have to be refined.
- It gives a broader audience access to complex environmental models. This was up to now restricted to a small group of experts.
- SUDPLAN lowers the threshold to introduce climate change in urban planning (in the case of the Wuppertal pilot this process is the General Drainage Planning, cf. 4.8).
- SUDPLAN is open for the implementation of applications similar to the existing pilots, more cost-efficient than a development from scratch.
- The SUDPLAN Software is licence free (Open Source software), so there is no financial drawback if an organisation wants to establish further SUDPLAN applications.

The survey respondents didn't see any real conceptual weakness of the SUDPLAN Wuppertal pilot, however they identified some desirable improvements and amendments, mainly referring to the 3D- and 4D visualization of the surface run-off simulation results (e. g. a volume visualization method is missing) and the integration of the 3D / 4D visualization into the workflow (so far only the visualization of the maximum water levels is integrated in the

workflow, not the 4D visualization of the full result set). The second weak point the respondents identified is the poor documentation. Besides a handbook that addresses the end user a guideline for installing the cids framework appears necessary for organizations that are not already operating this software. However, this is no problem for the City of Wuppertal, because it already runs a couple of applications based on the cids framework.

In their summaries the respondents gave the following outline of the potential use in Wuppertal:

- The SUDPLAN Wuppertal pilot is in its current status close to being operational. However, some work has to be done to integrate the solution (= project result) into Wuppertal's SDI to set up a fully integrated planning environment. Moreover, some functional details have to be improved. On the basis of the information collected during the validation it will be possible to integrate the Wuppertal pilot into the General Drainage Planning process (cf. 4.8).

With a more general approach the respondents summarized the potential use of the SUDPLAN tools as follows:

- SUDPLAN implements a forward-looking concept that makes it a must have toolset for all kinds of long-term analysis not only for city planners. The downscaling processes and the hydrological models can be used also in rural areas. SUDPLAN contains technical components that will be of great use in a lot of contexts not covered by the existing SUDPLAN pilots yet, e. g. disaster management. Most useful are the 3D map component and the temporal navigation through WMS layers. SUDPLAN has the potential to set up new applications similar to the existing pilots in a cost efficient way.

5. Conclusion

The validation of V3 of the SUDPLAN Wuppertal pilot is based on the assessments of 6 persons. Among them are 3 potential primary users representing the 3 organizations that are interested to use the SUDPLAN output for their planning processes and two IT experts who will be in charge of managing the system in the future for all primary users at the Wuppertal site. Moreover, a potential external primary user in the hydrology domain took part in the validation and provided a valuable assessment of the possible use of SUDPLAN beyond the focus of the SUDPLAN pilots. The following conclusions can be drawn based on their assessments:

- SUDPLAN offers the possibility to organize interdisciplinary planning processes in a municipality, providing an easy way to introduce climate change effects in urban planning without expertise on climate change matters.

- The SUDPLAN Wuppertal pilot is in its current status close to being operational. Some refinement work has to be done to integrate the prototype into Wuppertal's SDI to set up a fully integrated planning environment.

- The majority of single assessments is affirmative indicating that the SUDPLAN Wuppertal pilot is a planning tool clearly beyond the state-of-the-art. Low ratings in most cases refer to SUDPLAN functionalities that are not featured in the Wuppertal pilot and are therefore unobjectionable.

- Some features of the Wuppertal pilot should be added or existing ones improved to enable seamless workflows for and among the primary user organisations: the Wuppertal municipality, Wuppertaler Stadtwerke (public utility company) and Wupperverband (water board):
    - further or refined 3D visualization methods, in particular one for the visualization of water volumes instead of symbolizing water levels by colours on the ground level
    - more detailed information in the 2D and 3D visualizations to improve capabilities for analysis of a scenario, e. g. the display of maximum water levels and time variation curves for a selected cell of the TIN
    - drag and drop for local model results to the 3D map should be fully supported (so far only implemented for maximum water heights)
    - calculation of an Euler II rainfall event from a time series with the necessary statistical processing of the time series carried out in the background
    - an interactive mode to crop a time series, e. g. to derive a shorter one or to extract a single rainfall event from the original dataset

- SUDPLAN contains technical components that will be of great use in a lot of contexts not covered by the existing SUDPLAN pilots yet, e. g. disaster management. Most useful are the 3D map component and the temporal navigation through WMS layers.
- SUDPLAN is open for the implementation of applications similar to the existing pilots, what would be more cost-efficient than development from scratch.

6. References

This is the list of documents and software deliverables that have been be used as input for this document.

Table 1: List of documents and software deliverables that has been referenced or used for this document

Document	Version
D2.1 Validation Plan (revised after 1st ATR)	2011-06-15
Grant agreement for: Collaborative project SUDPLAN, Annex I "Description of Work" (DoW)	2012-06-20
D6.1.3 Wuppertal Pilot Definition Plan V3	2011-12-21
D6.2.3 Wuppertal Pilot V3	2012-10-31

7. Glossary

2D	Two-dimensional, typically a field that varies in east-west and north-south direction. The field may also vary in time –this is typical for e.g. air pollution and population density. The former varies from one hour to another while the latter maybe varies from one year to another.
3D	Three-dimensional, typically a field that varies in east-west and north-south direction as well as vertically. The field may also vary in time.
4D	Four-dimensional. Most often 3D field that explicitly also varies in time. It could also be when a certain 3D parameter (e.g. a particular air pollutant) also varies according to another 3D parameter (e.g. temperature). It will then be possible to study the variation of the first 3D parameter as a function of space (x,y,z) and the second parameter.
Airviro	Air quality management system consisting of databases, dispersion models and utilities to facilitate data collection, emission inventories etc, see http://www.Airviro.smhi.se/
Climate scenario	*Climate scenarios* means the resulting climate evolution over time, as simulated by global (GCMs) and regional (RCMs) climate models. Climate scenarios are products of certain emission scenarios that reflect different economic growth and emission mitigation agreements.
Common Services	*Common Services* is the climate downscaling services for rainfall, river flooding and air quality, developed in the SUDPLAN project and accessed through the SUDPLAN platform (Scenario Management System)
Common Services server	*Common Services* models will be executed at a SMHI server, accessible through OGC communication.
Emission scenario	These are of three types, of which the first one is behind the climate scenarios used in all SUDPLAN Common Services. The two remaining emission scenario types are only relevant for air quality downscaling.

- *IPCC emission scenarios*	*IPCC emission scenarios* are estimates of future global greenhouse gas concentrations based on assumptions about global development (economic growth, technical development, mitigation agreements, etc). During the first two years of the SUDPLAN projects, the climates scenarios based on SRES (Special Report on Emission Scenarios) A1B scenario from the 4th assessment have been used. The SRES emission scenarios do not include emissions of the pollutants of interest for air quality. If available the climate scenarios based on the 5th assessment RCP (Representative Concentration Pathways) emissions scenarios will also be used within the SUDPLAN project. They include emissions of air pollutants.
- *European tracer gas emissions (air pollutants)*	*European tracer gas emissions (air pollutants)* thus may or may not be included in IPCC emission scenarios. For creating Pan-European air quality fields under climate scenarios driven by the SRES A1B emission scenario, SUDPLAN uses tracer gas emissions from the more recent RCP emission scenarios. This inconsistency will be solved when climate scenarios based on RCP emission scenarios are available.
- *Local emission scenarios*	*Local emission scenarios* (to the atmosphere) are those of a particular European city. These will to a large extent influence future air quality in the city, but have little influence on global climate, nor do they influence air pollution concentrations in incoming long-range transported air. SUDPLAN will typically need gridded emissions with 1x1 km or finer spatial resolution as input to its urban air quality downscaling model.
Hind cast	A simulation of a historical period. Often done to compare model simulations with data which is available during that period.
Hot spot	Point (or small area) which is very different from its surroundings. In the present context, most often high concentrations of air pollutants, or extreme meteorological conditions.

Information product	Raw data, such as the results of mathematical modelling, and the analysis thereof, will often need to be packaged in such a way as to be accessible to the various stakeholders of an analysis. The medium can be one of a wide variety, such as print, photo, video, slides, or web pages. The term *information product* refers to such an entity.
Mockup	A model of a design used for demonstrating the functionality of a system.
Model	A *model* is a simplified representation of a system, usually intended to facilitate analysis of the system through manipulation of the model. In the SUDPLAN context the term can be used to refer to mathematical models of processes or spatial models of geographical entities.
PM_{10}	'PM10' shall mean particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM10, EN 12341, with a 50 % efficiency cut-off at 10 μm aerodynamic diameter;
$PM_{2.5}$	'PM2,5' shall mean particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM2,5, EN 14907, with a 50 % efficiency cut-off at 2,5 μm aerodynamic diameter;
Profile	Within SUDPLAN a *profile* is a set of configuration parameters which are associated with an individual or group, and which are remembered in order to facilitate repeated use of the system.
Regional downscaling	A climate scenario may be downscaled to a higher spatial resolution, typically 25-50 km, by a Regional Climate Model (RCM). The regional downscaling in SUDPLAN will be performed by SMHI's RCM (RCA, see below) and will generate climate scenarios at 44 or 22 km resolution.
Report	A *report* is a particular type of information product which is usually static and might integrate still images, static data representations, mathematical expressions, and narrative to communicate an analytical result to others.

Scenario	A *scenario* is a set of parameters, variables and other conditions which represent a hypothetical situation, and which can be analysed through the use of models in order to produce hypothetical outcomes. In SUDPLAN a scenario is an individual model simulation outcome to be used in urban planning. The model simulation may or may not include Common Services downscaling (with specific input) and may or may not include a local model simulation (with specific input and parameters).
Scenario Management System	*Scenario Management System* is synonymous with SUDPLAN platform
Scenario Management System Framework	The *Scenario Management System Framework* is the main Building Block of the Scenario Management System. It provides the Scenario Management System core functionalities and integration support for the other Building Blocks.
Scenario Management System Building Block	Scenario Management System Framework is composed of three distinct *Building Blocks*: The Scenario Management System Framework, the Model as a Service Building Block and the Advanced Visualisation Building Block.
Street canyon	Volume between high buildings in cities. Due to poor circulation (and high emissions) prone to poor air quality. Street canyons have unexpected circulation patterns, thus dedicated models are needed to study air pollution here.
SUDPLAN application	A *SUDPLAN application* is a decision support system crafted by using the SUDPLAN platform and integrating models, data, sensors, and other services to meet the requirements of the particular application.
SUDPLAN platform	The *SUDPLAN platform* is an ensemble of software components which support the development of SUDPLAN applications.
SUDPLAN system	*SUDPLAN system* is synonymous with SUDPLAN application

Urban downscaling	This refers to further downscaling of the regional climate scenarios for Europe to the urban scale within SUDPLAN. This will be possible for a) *rainfall/precipitation* where the temporal resolution will be 30 minutes or less. The spatial resolution will be that of a precipitation gauge, i.e. representative for a point rather than a certain area. b) *hydrological variables (river runoff, soil moisture etc*) where the temporal resolution is daily and the spatial resolution linked to catchment areas which presently count approximately 35000 and with average size 240 km^2. *c) air quality (PM, NO2/NOx, SO2, O3, CO).* The temporal resolution will be hourly for gridded output fields and the spatial resolution typically 1x1 kilometres.
User	The term *user* refers to people who have a more or less direct involvement with a system. Primary users are directly and frequently involved, while secondary users may interact with the system only occasionally or through an intermediary. Tertiary users may not interact with the system but have a direct interest in the performance of the system.
Web-based	Computer applications are said to be *web-based* if they rely on or take advantage of data and/or services which are accessible via the World Wide Web using the Internet.

8. Acronyms and abbreviations

Acronym	Description
A1B	Emission scenario used for global climate modelling in IPCCs Fourth Assessment Report (AR4)
Airviro	Air quality management system to facilitate data collection, emission inventories etc, see http://www.airviro.smhi.se/
CS	Common Services
AVDB	Airviro Time Series database (used for storage in Common Services)
AR4, AR5	Fourth and Fifth Assessment Report of IPCC
AQ	Air Quality

C API	Application Programming Interface written in C
CMIP5	Coupled Model Intercomparison Project, phase 5 (coordinated model exercise in support to AR5)
CS	Common Services (SUDPLAN functionality)
CTM	Chemistry Transport Model
CTREE	FairCom CTREE database (Index database, core of AVDB)
DBS	Distribution-Based Scaling, a method to bias-correct (i.e. remove systematic errors in) the temperature and precipitation of the RCM output
DoW	SUDPLAN Description of Work
DSS	Decision Support Systems
ECHAM5	GCM developed at Max Planck Institute for Meteorology, DE
ECMWF	The European Centre for Medium-Range Weather Forecasts (also co-ordinating FP7-SPACE project MACC)
EDB	Airviro Emission database
EEA	European Economic Association
E-HYPE	HYdrological Predictions for the Environment (European set-up), hydrological rainfall-runoff model developed and used by SMHI
EM&S	Environmental Modelling and Software
ESA	European Space Agency
ESDI	European Spatial Data Infrastructure
EU	European Union
GCM	Global Climate Model or, equivalently, General Circulation Model. Physically based computer model that simulates the global climate on a 200-300 km resolution. Can be used both to reproduce historical climate and estimate future climate, e.g. in response to changes in greenhouse gas concentrations.
GHG	GreenHouse Gases
GTE	Georeferenced Time-series Editor
GIS	Geographic Information System
HadCM3	GCM developed at Met Office Hadley Centre, UK
HIRLAM	HIgh Resolution Limited Area Model, numerical weather prediction model developed and used operationally by SMHI
ICT	Information and Communication Technologies
ID	Identifier
IDF-curve	Intensity Duration Frequency-curve, a curve (or a table of values) showing the rainfall intensity associated with a certain duration (i.e. time period) and frequency (i.e. probability, generally expressed as a return period). Calculated from short-term rainfall observations and widely used in design of urban drainage systems.
iEMSs	International Environmental Modelling & Software Society
IFIP	International Federation for Information Processing
IPCC	The Intergovernmental Panel on Climate Change, the leading body for the assessment of climate change

IPR	Intellectual Property Rights
ISAM	Indexed Sequential Access Method, a method for indexing data for fast retrieval
ISO	International Standardization Organisation
ISESS	International Symposium on Environmental Software Systems
IST	Information Society Technology
MATCH	Multiple-scale Atmospheric Transport and Chemistry modelling system, a CTM developed and used by SMHI.
MODSIM	International Congress on Modelling and Simulation
OASIS	1) Organization for the Advancement of Structured Information Standards 2) Open Advanced System for Disaster and Emergency Management (FP6 project)
OGC	Open Geospatial Consortium
O&M	Observation and Measurements
ORCHESTRA	Open Architecture and Spatial Data Infrastructure in Europe (FP6 IST-511678)
OSGeo	Open Source Geospatial Foundation
OSIRIS	Open architecture for Smart and Interoperable networks in Risk management based on In-situ Sensors (FP6 IST-33799)
PMC	Project Management Committee
RC	Rossby Centre, climate research unit at SMHI
RCA	Rossby Centre Atmospheric model, RCM developed by SMHI and used in SUDPLAN
RCM	Regional Climate Model, commonly used to increase the spatial resolution of climate scenarios to 25-50 km in a specific region.
RCP4.5	Radiative Concentration Pathways: A set of four emission scenarios to be used for the AR5 simulations. The scenarios are named according to their radiative forcing at 2100, e.g. 4.5 W/m^2.
RNB	Airviro Field database
SANY	Sensors Anywhere (FP6 IST-033654)
SDI	Spatial Data Infrastructure
SISE	Single Information Space in Europe for the Environment
SISE	Single Information Space in Europe for the Environment
SMHI	Swedish Meteorological and Hydrological Institute
SMS	Scenario Management System
SOA	Service Oriented Architecture
SOS	Sensor Observation Service
SPS	Sensor Planning Service
SWE	Sensor Web Enablement
SUDPLAN	Sustainable Urban Development PLANner for climate change adaptation
SWE	Sensor Web Enablement
Tbd	To be determined

UWEDAT	AIT environmental data management and monitoring system
WCC	World Computer Congress
WCS	Web Coverage Service
WFS	Web Feature Service
WP	Work Package
WPS	Web Processing Service
WMS	Web Map Service

Annex A – Simplified LimeSurvey

1.1. A - Personal information

Name	1: Stefan Sander 2: Bernard Arnold 3: Eckhard Kohlhas 4: Reinhard Verkennis 5: Daniel Heinenberg 6: Jens Ante
E-mail address	1: stefan.sander@stadt.wuppertal.de 2: bernard.arnold@stadt.wuppertal.de 3: eckhard.kohlhas@lung.mv-regierung.de 4: reinhard.verkennis@stadt.wuppertal.de 5: dhg@wupperverband.de 6: jens.ante@wsw-online.de
Organization affiliation, position and principal responsibilities	1: **City of Wuppertal (municipality):** Land Registry Office, Head of Department "Information Processing and Cartography", responsible for setting up and running the city's Spatial Data Infrastructure and information system for land management 2: **City of Wuppertal (municipality**): Environmental Agency, Office for Coordination of urban drainage, Project manager responsible for technical aspects of the sewer system and for supervision of the sewer system operator 3: **Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg-Vorpommern (Federal State authority)**: Department "Water", departmental head 350 (EC Water Framework Directive) 4: **City of Wuppertal (municipality):** Land Registry Office, member of team "Spatial information processing" 5: **Wupperverband (water board):** consultant / case worker flood precaution and data communication 6: **WSW Energie & Wasser AG (public utility company)**: Urban Drainage Planning / Management of Measured Data
Where did you learn about SUDPLAN and become familiar with it?	1: From working in the SUDPLAN project as site leader Wuppertal pilot 2: From working in the SUDPLAN project (Wuppertal pilot) 3: Announcement, SUDPLAN Workshop 4: Internal peresentations of the Wuppertal pilot in Wuppertal municipality, 2nd Dissemination Event in Wuppertal 10/2012 5: Presentation of City Wuppertal 6: Contact with project team member in 2010, participation in 2nd Dissemination Event in Wuppertal 10/2012

Please describe the user's knowledge with respect to the SUDPLAN product (Y= Yes, N = No).

Type of user	Y	N
SUDPLAN team member	2	4
Urban / regional planner (analysts)	3	3
Modeler	2	4
System manager	1	5
IT expert	3	3
Climate change expert	1	5
Have seen presentations and documentations	6	0
User of the SUDPLAN / model results	0	6
Working with the actual system	3	3
I participated in a SUDPLAN workshop	5	1

SUDPLAN team member: You were developing SUDPLAN.

Analysts are those people who will be using the SUDPLAN applications on a regular basis to carry out analyses in order to arrive at an environmental management decision. In some cases they may be the decision makers, and in other cases they may be supporting the decision makers. This category of user would include expert planners and city planners, as defined in the DoW, and are likely to be primary users (i.e. they will use the SUDPLAN applications directly and regularly).

Modelers are those people who develop, integrate, and/or configure mathematical models to be used within SUDPLAN applications. While these users might be expert planners as well, this category is reserved for people performing specific model development tasks; if and when they work as planners, they revert to the Analyst category. Modellers may be seen as secondary users in that they will not generally, in this role, use the SUDPLAN application on a regular basis, and might not use it directly at all.

System Managers are those people who install and maintain SUDPLAN applications and carry out general system administration tasks. This would include the integration of components, such as models, into SUDPLAN applications. While this task might be performed by the same people who developed the models, when they are carrying out the integration into an application they have switched into a role as a System Manager. These users could be considered secondary users. While they will definitely use the SUDPLAN applications directly, it will only be occasionally (in this role).

IT-Experts are people working in the developement or administration of IT systems. If you have some GIS and SOA background please select this also.

Climatic Change experts are people with knowledge in the Climate Change domain. They may or may not act as any of the other roles within SUDPLAN.

Please indicate for what type of environmental risk SUDPLANS has been used (Y= SUDPLAN used, N = SUDPLAN not used, NA= concept not applicable). For other, please indicate what other risk.

Type of environmental risk	Analyst primary	Analyst secondary	Modeller	System Manager
Urban stormwater flooding during intense rainfall	3		2	1
Dimensioning of sewage water systems				
Risks of flooding of rivers	2			
Hydrological conditions	2			
Air pollution	1			
Other				

Please indicate what is the temporal planning interest (Y= of interest, N = not of interest, NA= not applicable).

Temporal planning interest	Y	N	NA
Present conditions and short term (<10 years) planning	6	0	
Long term planning (>10 years) planning	5	1	

1.2. B - Graphical user interface

This question group is about the usability and functionality of the graphical user interface.

10 [B_1]: Please indicate the importance of key concepts used in SUDPLAN to assure the GUI ergonomics

Key concepts	*Very important*	*Important*	*Not relevant*	*NA*
Task-Oriented Menu structure		*6*		
Contextual help system	*1*	*2*	*3*	
Alerts when processing finished	*3*	*3*		
Panning/browsing through results (in time)	*4*	*2*		
Panning/browsing through results (in space)	*4*	*2*		
Highlighting recently changed data		*3*	*2*	*1*
Comparing two result sets	*3*	*3*		

11 [B_2]: Please assess the ease of use and profiling of the SUDPLAN application

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Customization of the user interface					*3*	*1*	*1*	*1*
Define a scenario					*4*	*2*		
Execute scenario with parameters					*2*	*3*	*1*	
Save results					*1*	*2*	*3*	
Share results with others				*1*	*4*	*1*		
Visualize results				*1*	*3*	*2*		
Visualize uncertainties	*3*			*1*	*1*			*1*
Compare the results of various scenarios		*1*	*1*	*1*	*2*			*1*
Export results in different formats			*3*	*2*	*1*			

12 [B_3]: Please assess the usability of SUDPLAN

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
With various output devices				*1*				*5*
Spatial visualization					*2*	*4*		
Temporal visualization					*4*	*1*		*1*
Spatio-temporal visualization					*3*	*3*		
Contextual help	*4*				*1*			*1*
Ease of learning				*1*	*2*	*2*		*1*
Memorability			*1*	*1*	*3*			*1*
Geo-referenced data					*1*	*2*	*1*	*2*
Transparency					*2*	*1*	*1*	*2*
3D data, georeferenced, on a map				*1*		*1*	*2*	*2*

13 [B_4]: Please assess the capabilities of the SUDPLAN 3D/4D visualization framework

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall impression					*4*	*2*		
3D GUI interaction				*1*	*1*	*3*	*1*	
Information visualization					*5*	*1*		
Presenting of the scenarios				*2*	*3*	*1*		
Comparing of the scenarios		*1*	*2*	*2*				*1*
Analyzing of the scenarios		*3*		*3*				

14 [B_5]: Please give a short textual explanation on your experience with the capability, usability and ease of use of SUDPLAN GUI, and suggestions for improvement.

1:

- sharing of results is only well supported among the users of the Wuppertal pilot or with a tool that supports WMS
- comparison of scenarios is assumed to be possible via differential WMS layer (not proved)
- GUI is still a mixture of English and German
- some tooltips are missing (e. g. 3D map)
- 3D visualization method for 3D volumes is missing (would be a useful amendment)
- linkage between GeoCPM results and 3D map is still missing

2:

- visual analysis of scenarios is sufficient for practical use
- comparison of scenarios is assumed to be possible via differential WMS layer in 2D map and 3D map (not proved)
- production of videos directly from SMS would be would be a useful feature for offline presentation (politicians and general public)

4:

- some gaps with respect to consistency of the GUI should be closed (e. g. drag and drop operations for all objects in the catalogue)
- textual design of the wizards should be enhanced (individual operation names)

6:

- max. water levels and cell specific time variation curves should be available as alphanumeric or graphic information both in the 2D and in the 3D map

1.3. C – Climate Scenario information

Climate scenario information is provided only "as is" for information about existing climate scenarios. This information can also be used for training purposes.

15 [C1_1]: Please indicate the usability of the provided climate scenario information.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Available number of different climate scenarios				*1*	*1*	*2*	*1*	*1*
Within area of your interest over Europe				*1*	*1*	*1*	*2*	*1*
Available time range					*2*	*1*	*2*	*1*
Available scenario documentation			*2*	*1*	*2*			*1*
Possibility for changing temporal resolution for data export					*3*	*1*		*2*

1.4. C2 – Common Services – Rainfall

The rainfall services provide prediction of

- *rain time series*
- *IDF curves*

16 [C2_1]: Please indicate the usability of the SUDPLAN short-term rainfall downscaling.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall					*1*	*2*	*3*	
Upload of historical/local data to improve the results					*2*	*1*	*3*	
Downscaling					*2*	*1*	*3*	
Visualisation of the results					*1*	*2*	*3*	

17 [C2_2a]: Please assess the functionality and ease of use of the SUDPLAN downscaled continuous rainfall time series:

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Upload of historical data					*2*	*1*	*3*	
Downscaling procedure					*1*	*4*	*1*	
Results visualisation and download						*3*	*3*	

18 [C2_2b]: Please assess the functionality and ease of use of the SUDPLAN downscaled IDF-curves:

	1	2	3	4	5	6	7	NA
Upload of historical IDF curve					1	1	3	1
Downscaling procedure						2	3	1
Results visualisation and download						2	3	1

19 [C2_3a]: Please assess the scientific soundness and credibility of different aspects of the downscaled continuous rainfall time series from SUDPLAN:

	1	2	3	4	5	6	7	NA
Downscaled continuous rainfall time series: General performance						2	3	1
Downscaled continuous rainfall time series: Long-term (annual, seasonal) volumes	2					2		2
Downscaled continuous rainfall time series: High and low intensities						2		4
Downscaled IDF-curves: General performance						1		5
Downscaled IDF-curves: Dependency on duration						1		5
Downscaled IDF-curves: Dependency on return period						1		5

20 [C2_3b]: Please assess the scientific soundness and credibility of different aspects of the downscaled IDF-curves from SUDPLAN:

	1	2	3	4	5	6	7	NA
General performance						1		5
Dependency on duration					1			5
Dependency on return period					1			5

21 [C2_4]: Please give a short textual explanation on your experience with the usability of SUDPLANs results in the rainfall domain, and suggestions for improvement. Please state also which state-of-the art product was used for comparison.

1:

- The usability and the ease of use of the rainfall downscaling service is impressive. In Wuppertal there is no alternative state-of-the-art product for the calculation of climate change effects available, therefore it is impossible to assess the correctness of the calculations. However annual or seasonal volumes of precipitation can't be derived from a downscaled time series. The only missing option for the WUP pilot is the calculation of a rainfall event from a (downscaled) time series, this is not implemented yet.

2:

- The usability and the ease of use of the rainfall downscaling service is impressive. In Wuppertal there is no alternative state-of-the-art product for the calculation of climate change effects available, therefore it is impossible to assess the correctness of the calculations. However annual or seasonal volumes of precipitation can't be derived from a downscaled time series. The only missing option for the WUP pilot is the calculation of a rainfall event from a (downscaled) time series, this is not implemented yet. This also involves the interactive manipulation of rainfall series (cutting out a short part of the data that describes a heavy storm water event). This has to be done outside of the SUDPLAN SMS.

4:

- In Wuppertal there is not tool with high and known accuracy for climate modelling and downscaling available, therefore the credibility of the downscaling results is not validated.

6:

- No tool available for comparison, therefore no answers to questions 19 and 20.

1.5. C3 – Common Services – Air Quality

This includes projections of air pollution influenced by climate change and changees in Europe air pollutant emissions.

22 [C3_1]: Please assess the usability of the SUDPLAN tool as the basis for assessment of the future air pollution:5

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall							*1*	*5*
Upload local emission data						*1*		*5*
Downscaling						*1*		*5*
Visualisation of the results						*1*		*5*

23 [C3_2]: Please indicate the level of support for following functionality to assess the risk of air pollution:

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Prediction of long-term air quality and temperature simulations over entire Europe							*1*	*5*
Trends in air quality						*1*		*5*
Year-long downscaling air quality simulations					*1*			*5*
Impact of local sources, activities and land use on future air quality in particular European cities					*1*			*5*
Use of the downscaled air quality grids in local planning scenarios						*1*		*5*
Use of SUDPLAN air quality results as input to local dispersion models								*6*
Estimate the importance of local sources of pollutants vs. long-range pollution transport for the local air quality					*1*			

24 [C3_3]: Please indicate the usability of SUDPLANs air quality results

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
As information about expected future environmental conditions							*1*	*5*
Comparing the results of future city development plans						*1*		*5*
Assess the feasibility of fulfilling national air quality standards and environmental objectives, in a climate change perspective								*6*

25 [C3_4]: Please give a short textual explanation on your experience with the usability of SUDPLANs results in the air quality domain, and suggestions for improvement. Please state also which state-of-the art product was used for comparison.

1:
- The common Service "Air Quality" is not used within the WUP pilot, hence it is not validated here.

2:
- The common Service "Air Quality" is not used within the WUP pilot, hence it is not validated here.

4:
- Common Service Air Quality is not used in the Wuppertal pilot, hence no validation.

6:
- Not part of the Wuppertal pilot, therefore no validation.

1.6. C4 – Common Services - Hydrology

Questions about prediction of river runoff

26 [C4_1]: Please assess the usability of the SUDPLAN tool as the basis for riverflooding assessment applications

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall					*1*	*1*		*4*
Upload of local river discharge time series					*1*	*1*		*4*
Local calibration				*1*		*1*		*4*
Presentation of the results from local calibration					*1*	*1*		*4*
Presentation of the results from simulation						*2*		*4*

27 [C4_2]: Please assess the usability of SUDPLAN hydrological application

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Preparation and starting a local calibration						*2*		*4*
Starting a local climate simulation					*1*	*1*		*4*
Download and further exploration and use of the results					*1*	*1*		*4*

28 [C4_3]: Please indicate the usability of SUDPLAN hyrological results for assessing

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Changes in river discharge						*2*		*4*
Changes in soil moisture					*1*	*1*		*4*
Changes in available ground water levels					*1*	*1*		*4*

29 [C4_4]: Please give a short textual explanation on your experience with the usability of SUDPLANs results in the hydrological domain, and suggestions for improvement. Please state also which state-of-the art product was used for comparison.

1:
- The common Service " Hydrology" is not used within the WUP pilot, hence it is not validated here.

2:
- The common Service " Hydrology" is not used within the WUP pilot, hence it is not validated here.

3:
- Good tool. The models shoud be free for use.

4:
- Common Service Hydrology is not used in the Wuppertal pilot, hence no validation.

6:
- Not part of the Wuppertal pilot, therefore no validation.

1.7. D - Local models

Questions about the usage of local models. Local means the model is typically pre-existing and developed outside SUDPLAN. This model is now integrated to be used from within the SUDPLAN GUI. This models are typically not usable outside the context of this specific city.

30 [D_1]: Please assess the ability of SUDPLAN in the field of model integration

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Ease of integration of models as a service	*2*	*1*			*1*	*1*		*1*
Running models directly from the SUDPLAN GUI					*1*	*1*	*4*	
Specifying parameters for model runs					*5*	*1*		
Using model results as input for another model (Service chaining)	*4*				*2*			
Configuration of models	*4*			*1*	*1*			
Model validation	*4*				*2*			
Model calibration	*4*			*1*	*1*			

1.8. E - Completeness of functionality

31 [E_1]: Please assess the usability of SUDPLAN for the creation of reports, publications and data export with respect to the requirements of planners

	1	2	3	4	5	6	7	NA
Creation of information products		1	1	1	1	1		1
Report generation			2		1	1		2
Coordinate conversion			1	1	1	1		2
Export				1	2	2		1
Information/result sharing			1	1	1	2		1

32 [E_2]: Please assess the usability of SUDPLAN with respect to the requirements of system managers

	1	2	3	4	5	6	7	NA
User management					1	2	1	2
Security and rights management				1		1	2	2
Data source integration					1	2	1	2
Sensor service integration					1	1		4
Model integration	1	1			1	1		2

33 [E_3]: Please indicate the functionalities you find in SUDPLAN, that are particularly useful

1:
- Common Service Rainfall Downscaling for easy introduction of climate change effect on the rainfall pattern
- manipulation of breaklines directly in the map representing local or extensive measures
- 3D and 4D visualization methods on virtual globe

2:
- Common Service Rainfall Downscaling for easy introduction of climate change effect on the rainfall pattern
- manipulation of breaklines directly in the map representing local or extensive measures
- 3D and 4D visualization methods on virtual globe

3:
- the toolset is easy to use also for other questions

4:
- Java technology makes the application platform independent
- Java Web Start supports easy deployment of the application
- SUDPLAN is easy to integrate in Wuppertal's SDI
- existing standards for data access are used extensively (e. g. OGC standards)

5:
- embedding your own models with a set of changeable parameters.

6:
- Rainfall Downscaling
- easy manipulation of the DEM (TIN) without licence for local model required
- enhanced interactive visualization (compared to the local model)

34 [E_4]: Please indicate the functionalities you miss in SUDPLAN, that might be particularly useful

1:
- calculation of a Euler II rainfall event from a time series, either historical or downscaled (needs statistical processing)
- interactive mode to crop a time series to derive a shorter one or to extract a single rainfall event from the time series
- additional visualization of details like max. water levels as tooltip in the 3D and 4D map

2:
- calculation of an Euler II rainfall event from a time series, either historical or downscaled (needs statistical processing)
- interactive mode to crop a time series to derive a shorter one or to extract a single rainfall event from the time series
- additional visualization of details like max. water levels as tooltip in the 3D and 4D map

3:
- none

4:
- no GUI available for export of GIS data via OGC Services (mainly WFS would be useful)

6:
- calculation of a single rainfall event from a downscaled or historical time series
- amendment of more detailed information in the 2D and 3D visualizations to improve capabilities for analysis (e. g. display of max. water levels and time variation curves for a selected cell of the TIN)

35 [E_5]: Please give a short textual explanation about key advantages of SUDPLAN functionality, usability in the city management scenarios and urban planning, and give suggestions for improvement.

1:
- First key advantage is the flexible spatiotemporal visualization of simulation results together with all the other data available in Wuppertal's SDI (2D to 4D). This is not available when working directly with the local model. Second is the possibility to introduce climate change into the rainfall patterns without the necessity to become a climate change expert. The SUDPLAN Wuppertal pilot will be used in an urban planning process called "Generalentwässerungsplanung" (General Drainage planning), the mid- and longterm planning process for the stormwater sewage system.

2:
- First key advantage is the flexible spatiotemporal visualization of simulation results together with all the other data available in Wuppertal's SDI (2D to 4D). This is not available when working directly with the local model. Second is the possibility to modify the initial input parameter set of the local model (DEM and rainfall event) in an easy way. The SUDPLAN Wuppertal pilot will be used in an urban planning process called "Generalentwässerungsplanung" (General Drainage planning), the mid- and longterm planning process for the stormwater sewage system.

3:
- Easy to use, delivers answers to key questions according to climate change. The models shout be free for use in other context.

4:

- Participant is not involved in any planning process, therefore no statement is given.

6:

- SUDPLAN offers the possibility to organize interdisciplinary planning processes in a municipality. SUDPLAN will be integrated in Wuppertal's SDI, so the data of all planning departments will be available in the same application. Different perspectives on a planning task can be shared. SUDPLAN provides an easy way to introduce climate change effects in urban planning processes without expert knowledge on climate change matters.

1.9. F - Conclusions

Please, give your final impression on SUDPLAN!

36 [F_1]: Compared with the previous available information, SUDPLAN results are:

	Y	N	Can not assess	NA
New	5		1	
Better quality	4		2	
More useful	4		2	

37 [F_2]: Would you use the SUDPLAN output as a base for your future city planning? Please choose all that apply and provide a comment

	Y	N	Comments
Yes, I would	5	1	
Yes, it is useful for most cities	4	2	1: mainly for large cities with appropriate IT infra-structure 2: mainly for large cities with appropriate IT infra-structure
Yes, to certain extent	1	5	
Yes, but I still miss some information	0	6	
Maybe for a few specific cases	2	4	
I would recommend to my colleagues in other Europe-an cities	5	1	
No, I would not use it at all.	0	6	

38 [F_3]: How did you find the graphical presentation of the SUDPLAN results? Choose one of the following answers.

	Not useful	Ordinary	Excellent and contributing to a better understanding
			6

Please enter your comments here.

1:
- Though there is still room for improvements, e. g. visualization of volumes could be amended.

2:
- Though there is still room for improvements, e. g. it would be useful to have a feature Info request on the 2D and 3D map that answers with the exact max. height of water at this spot implemented as tooltip in the map.

39 [F_4]: What is in your opinion the strength of SUDPLAN output?

1:
- flexible visualization of different scenarios in 2D, 3D and 4D
- SUDPLAN lowers the threshold to introduce climate change in urban planning

2:
- flexible visualization of different scenarios in 2D, 3D and 4D
- integration of all the data of Wuppertal's SDI, e. g. results of accumulated flow paths, land use plans etc. to enable interdisciplinary planning processes

3:
- developed toolset which can be used for any desired questions

4:
- Wuppertal pilot appears ready to use (although some features have to be refined)
- Software is licence free (Open Source)
- Software is based on standards and it will be easy to integrate it into Wuppertal's SDI
- integration of all the data of Wuppertal's SDI, e. g. results of accumulated flow paths, land use plans etc. to enable interdisciplinary planning processes

5:
- giving a wider audience access to originally complex models

6:
- See above (Question 33 E_3)
- SUDPLAN is open for the implementation of applications similar to the Wuppertal pilot, what would be more cost-efficient than development from scratch.

40 [F_5]: What is in your opinion the weakness of SUDPLAN output? What should be improved?

1:
- There is no real conceptual weakness. However there is room for improvement in the 3D- and 4D visualization of the simulation results (e.g. a volume visualization method) and in the integration of 3D/4D visualization in the workflow (so far only the visualization of the max. water levels is integrated in the workflow, not the 4D visualization of the full result set).

2:
- There is no real conceptual weakness. However there is room for improvement in the 3D- and 4D visualization of the simulation results (e.g. a volume visualization method) and in the integration of 3D/4D visualization in the workflow and additional visualization of details (e. g. max water level as tooltip in the 2D and 3D map).

3:
- The product would have a larger distribution if there where free for use models.

4:
- documentation is not sufficient
- a guideline for installing the cids framework appears necessary for a user who is not already operating this software (no problem for the City of Wuppertal)

6:
- There is no evident conceptual weakness, though some details need improvement.

40 [F_6]: Please give a short summary of your impression of the SUDPLAN product:

1:
- The SUDPLAN Wuppertal pilot is in its current status close to being operational. However some work has to be done to integrate the prototype (= project result) into Wuppertal's SDI to set up a fully integrated planning environment. Moreover some functional details have to be improved. The SUDPLAN tool itself has the potential to set up applications similar to the WUP pilot (e.g. for air quality simulations) in a cost efficient way.

2:
- The SUDPLAN Wuppertal pilot is in its current status close to being operational. However some work has to be done to integrate the prototype (= project result) into Wuppertal's SDI to set up a fully integrated planning environment. Moreover some functional details have to be improved. The SUDPLAN tool will enable Wuppertal to establish the intended new process of the "Generalentwässerungsplanung" (General Drainage planning).

3:
- SUDPLAN is a must have toolset not only for city planners. The downscaling process and the hydrological Models can be used also in rural areas.

4:
- Besides the use for the urban stormwater planning SUDPLAN contains technical components that will be of great use in a lot of other contexts (e. g. disaster management). Most useful are the 3D map component and the temporal navigation through WMS layers.

5:
- A helpful tool for all kinds of long term (!) analysis.

6:
- SUDPLAN implements a forward-looking concept. In principle it is possible to integrate the Wuppertal pilot into the planning process "Generalentwässerungs-planung (Urban drainage planning)".

