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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/
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)
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)
PE	Pan European: One of the SUDPLAN Common Services
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/m2.
RNB	Airviro Field database
SANY	Sensors Anywhere (FP6 IST-033654)
SDI	Spatial Data Infrastructure
SISE	Single Information Space in Europe for the Environment

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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

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 *IPCC emission scenarios*	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.
European tracer gas emissions (air pollutants)	*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.
Local emission scenarios	*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 (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.
Planning scenario	A planning scenario describes one hypothetical decision met by a decision maker
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
SUDPLAN Product	*The SUDPLAN Product* is the combination of the Scenario Management System (SMS) software, the Climate Scenario data and the Common Services providing downscaling models. Integrated local models are part of customized versions of the SUDPLAN Product
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.

1. Management Summary

SUDPLAN project has developed an advanced modelling system which enables planners to include the effects of climate change into complex urban and regional planning. The most visible results of this work are the tools delivering projections on environmental variables such as rainfall characteristics, hydrological conditions and air pollution episodes. This document, D2.2.3 Validation and Evaluation Report V3, summarises the outcome of the extensive validation activities of the project at the end of the third and final development cycle.

Particular attention is given to: 1) the evaluation of usability by end users and scientific soundness as well as (2) the detailed evaluation of the technical achievements by internal experts. The Validation methodology is explained in chapter 2. The complete results of the validation as well as an initial analysis of these results are presented in Annex A, B and C of this document.

On the whole, the surveyors were very satisfied with the SUDPLAN software. Indeed, the results where commended as “a unique innovative tool which significantly supports decision making process on city development, mainly in terms of city infrastructure”. SUDPLAN offers a flexible and extensible framework which allows end-users with no expertise in climate change modelling to exercise sustainable planning with respect to climate change. Its strength is recognised in integration of local model runs with future climate scenarios consisting of both Europe- wide and urban/regional specific information.

Considerable progress has been made in the final development cycle in the course of the 3rd project year, especially with respect to 3D visualisation, additional climate scenarios, and the functionality offered by common services. This progress is best understood through comparison of the recommendations issued in V2 validation with results achieved at the end of the project, which is presented in section 3.2.

No conceptual weaknesses have been discovered during the validation process. The internal technical survey performed by the SUDPLAN developers indicates an excellent progress since V2 validation and high level of requirements fulfilment at the end of the project. The results of the end-user surveys (section 3.4) are consistent with those of the internal survey and indicate high level of satisfaction with the SUDPLAN results.

Chapter 4 concentrates on the surveyors’ suggestions for further improving and extending the functionality of the product in post-project commercialization. These recommendations mainly concentrate on further improvements and extensions of the already established functionality such as: “introducing additional scenarios”, “exporting in additional formats”, improving the visualisation and improving the documentation for the occasional users. However, some recommendations also indicate the interest of using the SUDPLAN tool for contexts not covered by the project pilots, requiring minor or larger post-project development.

A synthesis of the conclusions from the V3 validation results is presented in chapter 5.

2. Methodology

The aim of this document (D2.2.3) is to validate the final project results at the end of the third and final development cycle (V3). During validation, particular attention was given to:

1. the usability of the SUDPLAN product from the point of view of the users interested in using model results and developing their own applications based on SUDPLAN (external validators) and
2. the fulfilment of the requirements from the point of view of the experts involved in the development of the product (internal validators).

The information required for the validation has been gathered through two online surveys:

1. The “internal technical” survey, which has been used in the V2 validation as well as in the V3 validation by SUDPLAN ICT and climate change experts involved in the product development, contains 135 questions. Mapping of these questions to user- and DoW-requirements is shown in Annex A.
2. A simplified “end-user” version of the survey, which has been used in V3 validation by end users, contains 40 questions focusing on usability of the product (Annex B).

The end-user survey has been filled in by SUDPLAN workshop participants in October 2012 as well as by the current and potential users of the SUDPLAN pilot applications in preparation of the D[5-8].3.3 Product Validation Report(s). This allowed us to re-use the information from the pilot validation and congregate it together with information that was explicitly collected for this document.

Update of the SUDPLAN’s DoW which came into effect in 2012 made obsolete some of the original DoW requirements and made irrelevant some of V2 questions dealing with e.g. automation tasks (SMS), urban heat island temperature simulations (CS air quality) and land use configuration (CS hydrology). The results of these questions have been eliminated in the analysis of the V3 internal validation and they are marked correspondingly in the Annex A documentation of the full survey.

2.1. Relation to other SUDPLAN Documents

All documents and software deliverables that have been used as input for this document are listed in the Table 3 on page 38. The relation of these documents to D2.2.3 is described hereafter:

- This document validates the SUDPLAN product in the sense that it takes into account the validation of the Pilot Applications D[5-8].3.3 Product Validation Report(s), Integrated Scenario Management System V3 D3.3.3 as well as Common Services V3 D4.[1-4].3).
- The SUDPLAN validation methodology has been described in the revised D2.1 Product Validation Plan and foresees the use of surveys and the comparison with the V2 validation results (D2.2.2 Validation and Evaluation Report V2).
- SUDPLAN surveys are based on a large set of requirements from D3.1.2 Requirement Specifications document which have been translated into a web questionnaire

(LimeSurvey[1]). Parts of these requirements are directly based on the SUDPLAN DoW, whereas others ("system requirements") have been defined during the project execution. The correlation between particular requirement(s) and question(s) in the questionnaire is presented in the Annex A of the present document.

- The D[5-8].3.3 Product Validation Reports document the validation results regarding the usability of the Pilot Application at the end of project development.

2.2. Validator's Professional Profiles

The criteria for identifying the persons that should fill in the questionnaire are:

- The type of expertise (and thus the feedback they can provide); and
- The level of involvement in the SUDPLAN project.

D2.1 validation plan and the LimeSurvey questionnaire recognise the following types of surveyors:

- By provenance: members of the team or external experts
- By background: analysts, modellers, system managers, IT experts, climate change experts.
- By level of involvement: "seen presentations", "used model results", "worked with the system" or "participated on the workshop".

The information on the surveyors' profiles is collected as "self-assessment" in question 7 of the internal technical survey or question 6 in the end-user version of the survey. Surveyors' profiles are taken into account in the detailed analysis of the results in B.1 of this document.

2.3. Rating and Survey Evaluation

The two SUDPLAN surveys feature several types of questions, including:

1. Rating, starting with 1 for lowest (not fulfilled at all) to 7 for highest rating (fulfilled beyond expectations)
2. Multiple choice questions, where a single question can have only a limited number of answers (with or without NA).
3. Yes|No|NA type of questions.
4. Free text fields

[1] LimeSurvey allows customisation on surveyor's profile, efficient analysis of the answers and harmonized evaluation process

Most of Yes/No answers indicate whether a particular component or aspect will be validated. This provides us information about the number of performed validations for each component or aspect.

The “Rating” and “Multiple choice” answers provide the numerical indicators to perform a ‘statistical’ analysis. The average value is an indicator for the level of the validators’ satisfaction with the component or aspect in question. A (significant) dispersion of results indicates disagreement and a need for clarification. In this context it is important to take into account the total number of the collected answers on particular area of the analysis and discuss the statistical significance of the results in the conclusions. This type of detailed discussion is provided in B.1 of this document.

The free text answers provide specific information which cannot be analysed automatically. The outcome of this analyse is presented as recommendation(s) in the conclusion of each evaluated component or aspect.

3. SUDPLAN product validation

3.1. Status and Main Achievements of the V3 Development cycle

This document reports on the validation results of the SUDPLAN product at the end of the third and final development cycle. It is thus a logical follow-up of the V1 and V2 validations and addresses not only the final achievements but also the improvements achieved in the V3 development cycle. The status of the development and related validation results at the end of each cycle can be summarized as:

- **V1**: **validation of specifications, mock-ups and early parts of the product**. Some pilots also had local models available and ready for integration. Since no integrated SUDPLAN product existed at the end of V1 development cycle, the validation was performed by SUDPLAN team members only, mainly in order to double-check the soundness of the specifications
- **V2**: **validation of the early working SUDPLAN software, models and data.** The V2 validation was available / integrated in February 2012. Main focus at this stage was the usability of already implemented features, and prioritising the work of the final development phase in line with the surveyors' recommendations.
- **V3**: **validation of the final SUDPLAN product** against requirements and establishing a list of recommendations for extensions and improvements which should be implemented in the (post-project) exploitation phase.

The more relevant elements of the SUDPLAN product that were already (at least partially) developed and validated in V2 were:

- **The Common Services (CS)** featuring: Pan European information, Rainfall Timeseries downscaling , Rainfall IDF downscaling, Air Quality downscaling (results available), and Hydrology downscaling (partially integrated)
- The first version of the **Scenario Management System (SMS)**
- The data for **two climate scenarios** (ECHAM, HADLEY), already integrated in the SUDPLAN product and usable in the context of Pan-European information as well as in the context of all downscaling services
- The V2 software also allowed use of **integrated local models**.

Major developments in V3 cycle include:

- The integration of more climate scenarios
- The completion of Hydrology services implementation
- To extend the capabilities of Rain Time-series downscaling (Frequency adjustment)
- To create a wizard for easy upload of gridded urban emissions, input to Common Services Air Quality downscaling.

- To extend the data visualization features of the product

Section 3.2 below clarify the most important outcomes of V3 validation: (1) "how did we address the recommendations of the V2 cycle?" and (2) "how much progress did we really achieve in V3?".

3.2. Fulfilment of SUDPLAN Requirements

According to the SUDPLAN validation methodology, the complete set of SUDPLAN system requirements has been validated by 9 selected representatives of the SUDPLAN team using the "internal technical survey".

The internal technical survey asks questions about the following components: Graphical User Interfaces; advanced 3D/4D visualization; pan European climate change scenarios; three common services – rainfall, air quality and hydrology; possibility to integrate local models; usage of external standard-based services by SUDPLAN; questions related to SUDPLAN interface specifications; availability of SUDPLAN services in line with interface specifications; use of standard data encodings and interfaces; use of open source software and open source software provided by SUDPLAN; remaining questions tackling the completeness of the SUDPLAN functionality. This survey was also used in V2 validation.

The table below shows the number of participants that validated each of the components in V2 survey, in the internal technical V3 survey and in the V3 end-user surveys.

Components and aspects evaluated	**V2**	**V3**	**Stockholm pilot**	**Wuppertal pilot**	**Linz pilot**	**Czech reg. pilot**	**Workshop**	**Hydrology**
Graphical User Interfaces	17	7	11	6	7	11	9	3
3D/4D Visualisation	4	4	2	6	3	11	7	
Common Services: Pan-European visualisation	22	8	8	5	7	10	8	3
Common Services: Rainfall	14	7	4	6	7	8	7	
Common Services: Air Quality	12	4	4	2	1	11	5	
Common Services: Hydrology	6	4	4	1	1	9	1	3
Local models	16	6	1	6	7	9	6	
External services	6	4						
SOA interfaces	2	2						
SOA services	3	2						
Usage of standards	6	4						
Open source software	6	2						
Completeness of functionality	10	2	2	6	7	10	4	
Conclusions	31	8	10	6	7	11	9	

Total participants:	33	9	12	6	7	11	9	3

Table 1: Number of surveyor per validated component and aspect for V2 survey, for V3 internal technical survey and for V3 end user surveys.

A majority of questions in SUDPLAN surveys are of the "1 to 7 rating" type (where 7 is used only to indicate the extraordinary achievements far beyond expectations). Rating of four or more indicates that the surveyors are satisfied with the results.

The Figure 1 and Figure 2 below show the distribution of average ratings for all "rating" type questions in the V2 survey and in the V3 internal technical survey.

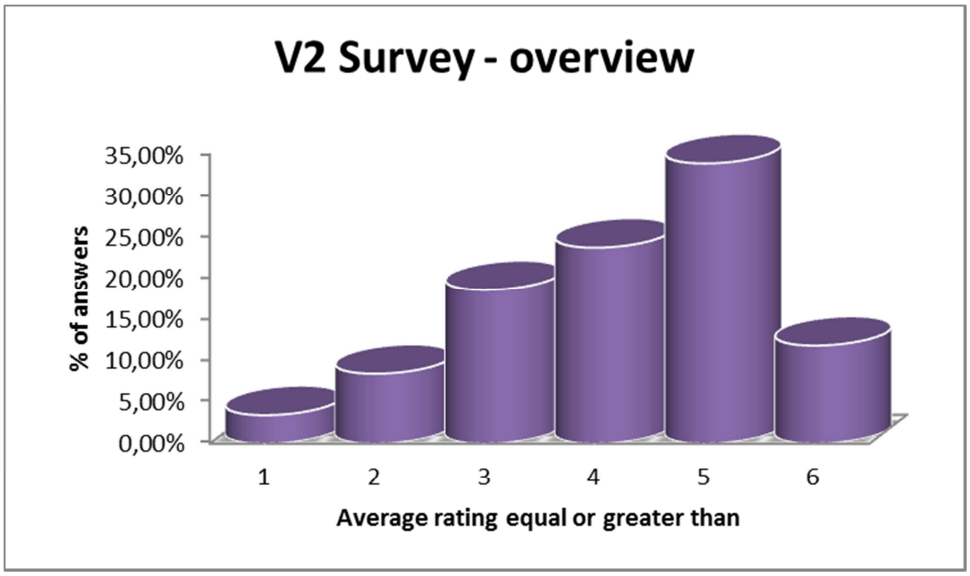

Figure 1: Distribution of average ratings in V2 internal technical survey

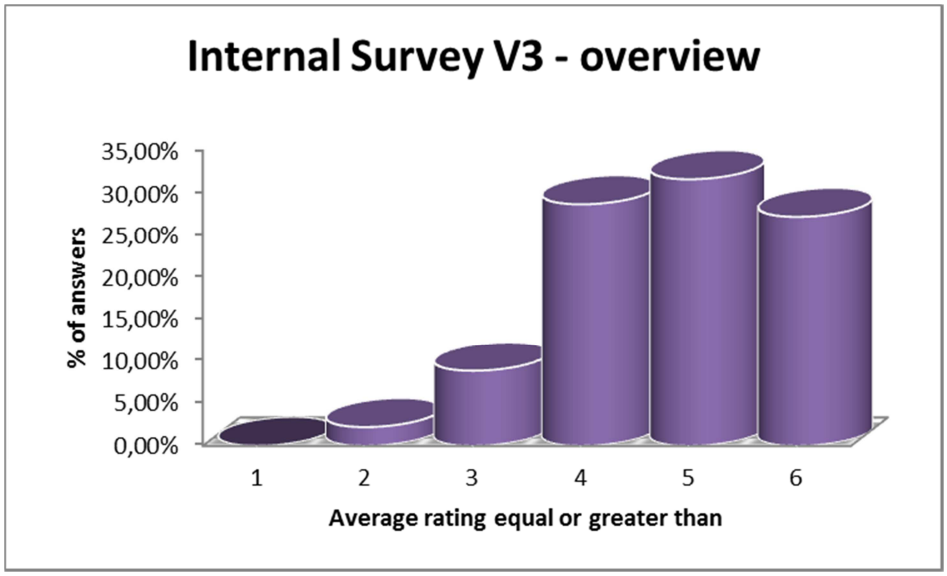

Figure 2: Distribution of average ratings in V3 internal technical survey

The most outstanding difference between the two figures is a huge increase of average ratings of six or more (8% in V2, 27% in V3). On the whole, the number of questions with an average rating of four or more advanced from 67% to 88% and the average rating across all questions increased from 4.3 to 4.9. This indicates both excellent progress in the final project year and a high level of requirement fulfilment at the project end.

The comparison of the average scores per tested component in V2 and V3 validation is shown in Figure 3.

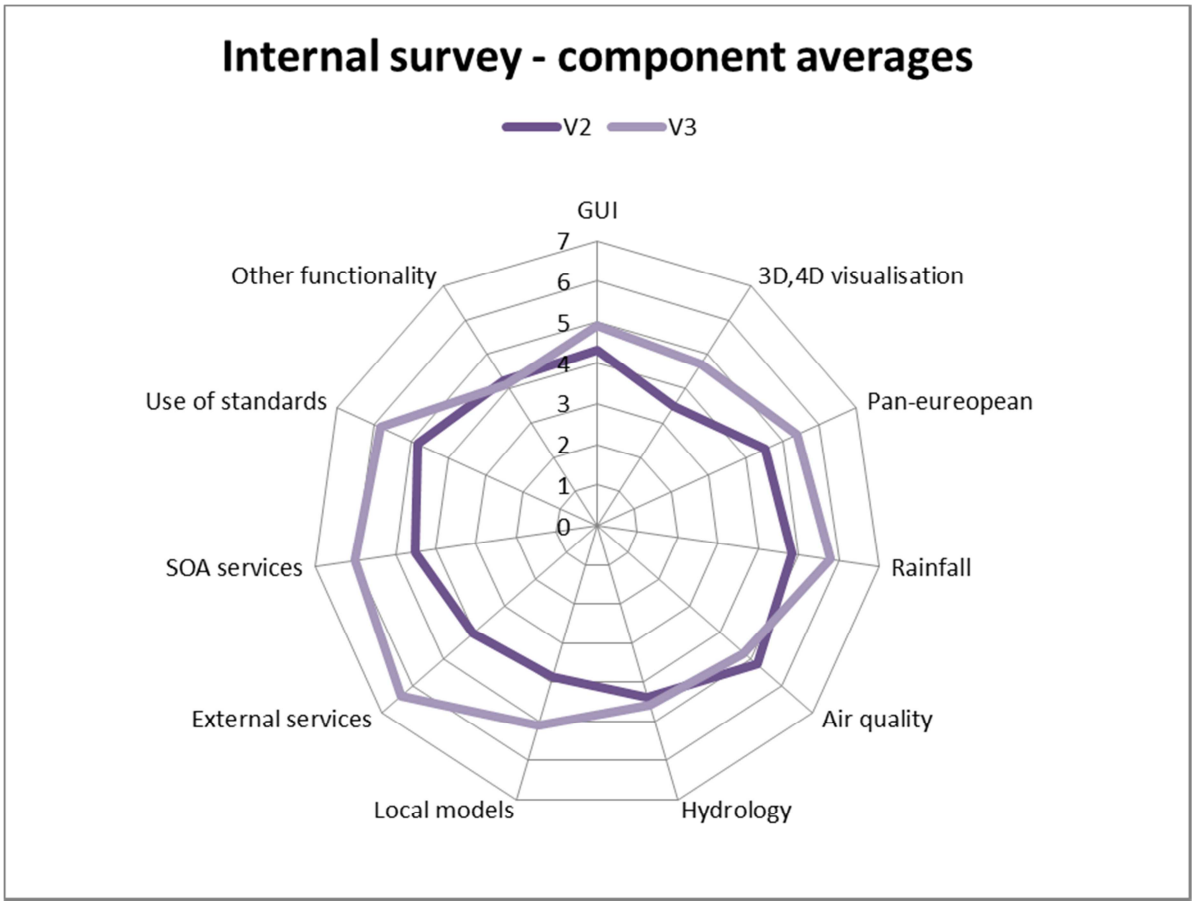

Figure 3: Average score per component and aspect in internal technical survey

The Figure 3 indicates significant progress in most categories since V2 validation. V3 SUDPLAN product is technically very sound, implements relevant standards and interacts with external services.

It should be noted that the "SOA interfaces" and "open source software" components of the survey have no "rating 1-7" type of questions and consequently do not appear in this figure. A separate analysis of the answers related to these two components reveals a similar high level of satisfaction as for the "SOA" or "External Services".

On the whole, the results indicate that: (1) significant progress has been achieved since the V2 validation; and (2) most of the SUDPLAN requirements have been fulfilled.

A detailed analysis of the internal survey results is provided in B.1.

3.3. Fulfilment of V2 Recommendations

The realisation that the fulfilment of formal software requirements does not necessarily guarantee user satisfaction is rapidly changing the software development process. While SUDPLAN did not go as far as to adopt the AGILE methodology, the V2 validation results were used as a way to introduce additional layer of informal requirements in form of "recommendations" for V3 developments.

The issues and recommendations identified in V2 validation cycle thus served as direct input to the individual development plans of WP3-WP8. In order to maximize the uptake of the final SUDPLAN results, the highest priority has been given to issues related to usability and integration of the SUDPLAN product in existing ICT environments.

Key recommendations, additional context information as well as the actions taken in response to these recommendations during V3 development cycle are shown in Table 2 below.

ID	Recommendation	Comment	Source	Action taken 2012
VR2_RC1 	**Enhanced Import and Export options for different formats.**	Most requested are text files (csv), followed by NetCDF	All Pilots	The requested formats have been implemented by WP3, as well as a file format suitable to feed directly into the SWMM model. There is now even an import wizard allowing selection from different csv file formats.
VR2_RC2 	**Make more climate scenarios available**	This is requested by end users who are not climate change experts to get a better feeling of the bandwidth of results depending on the climate change influence. This was also requested by climate change experts.	All	Implemented by WP4. Current combinations of climate models and emission scenarios available are: ECHAM5_A1B_3 ECHAM5_A2_1 HADCM3_A1B CCSM3_A1B CNRM_A1B There are plans to continuously extend this list in the future as new results from the climate change research community emerge.
VR2_RC3 	**More result comparison possibilities.**	Not only between different future results but also between historical and future data. Integration in the map component was also asked for.	WP6, WP7	This has been Implemented by WP3.
VR2_RC4	**Visualization of the differences as uncertainties**	Related to different predictions of future emissions.	WP7	Not implemented. The differences originate from different assumptions about future emissions and model details. Visualization of the differences as

				uncertainties would therefore convey a wrong message to the user.
VR2_RC5 	**Additional visualization methods for some result types**		WP7	Implemented.
VR2_RC6 	**Some online tutorials**	Tutorials specialized for different tasks	WP7	A number of tutorial videos where produced. This includes tutorials for the general functionality as well as pilot and common service specific tutorials.
VR2_RC7	**Context-sensitive help**		WP6, WP7	Not implemented. This feature is considered important for the commercialisation, but of little to no interest in terms of R&D.
VR2_RC8	**Reporting functionalities**	Export of diagrams where additional information should be amended both in the title and in the legend	WP6, WP7	Partially implemented. Reporting facilities are part of the underlying platform and can be easily integrated on the basis of concrete end user requirements.
VR2_RC9 	**GUI enhancements**	Some validators request to make the GUI easier to use. But there are also requests to make the GUI more flexible.	WP5, WP7	As part of a usability initiative by WP3 the usability and stability of the GUI components has been considerably enhanced. A highly flexible docking framework allows for individual customization (per user, per application) and thus provides both the possibility to provide a very simple GUI where little functionality is required and the necessary flexibility to adapt the application to individual needs.
VR2_RC10	**Enhance OGC service interfaces**	There were some requests regarding the access of the Common Services using the provided interfaces.	Discussions about usage of SUDPLAN results	Out of the scope of the SUDPLAN project but thinkable for a commercial version.

		This includes requests for more data encoding styles (not only OGC O&M) and interface versions.	beyond the projects lifetime.	
VR2_RC11 	**Frequency adjustment in the Rainfall Time series Downscaling**	At the moment (in V2) only delta-changes are applied in the Rainfall Time series Downscaling model. This should be extended to apply also frequency changes.	Climate Change experts as well as WP7 as user of this common service	Implemented by WP4.
VR2_RC12	**Temperature Downscaling**		Discussions about usage of SUDPLAN results beyond the projects lifetime.	Temperature projections from regionally downscaled scenarios exist, but no urban downscaling model for temperature has been implemented. Additional Common Services, including temperature downscaling could be developed in the product commercialisation phase.
VR2_RC13	**Hydrological service extensions**	There were ideas about a) editing the sub-basin parameters and b) upload of local catchment divisions	Discussions about usage of SUDPLAN results beyond the projects lifetime.	Not implemented. Work on hydrology services in 2012 concentrated on the use of local data for calibration. Further extensions could be developed in an exploitation phase after the project.
VC2_R14 	**Identification of events in Rain-Timeseries**	Identify an extreme storm water event in a time series and to extract and store it as a rainfall event	WP6	Instead of taking a rain event from a timeseries we decided to use the IDF data, which provides a sound statistical base about the occurrence frequency of events. From this IDF data synthetic rain events are generated.

Table 2: Actions taken in last cycle as respond on V2 recommendations for enhancement

The green tick symbol indicates that eight out of 14 V2 recommendations were satisfactorily resolved in V3 development cycle. One recommendation was partially implemented, one was rejected by the SUDPLAN team, two were considered out of the project scope (see comments in last column).

Finally, the recommendations 12 and 13 were considered to be highly interesting. As clarified in an amendment of the DoW, these requirements could not be met within the limitations posed by available budget. However, the recommendations form a basis for further development of the air quality and hydrological downscaling in Common Services.

On the whole, the SUDPLAN team is highly satisfied with the achieved results and also with the quality of the recommendations received in V2 and in V3 validation. The V3 recommendations are discussed in chapter 4.

3.4. Fulfilment of Users Expectations

According to SUDPLAN validation methodology, the "end user survey" is used to validate the fulfilment of users' expectations. This survey is similar to the "internal technical survey", but refers only to components and aspects which can be validated by end users. The number of surveyors and validated components and aspects is shown in Table 1 on pages 20-21.

The end-user survey has been filled out by both SUDPLAN-internal and external end users, separately in the context of each of the four SUDPLAN pilots. In addition, the participants of the SUDPLAN final event also validated the results using this survey. Average scores per component for all end-user surveys are shown in Figure 4.

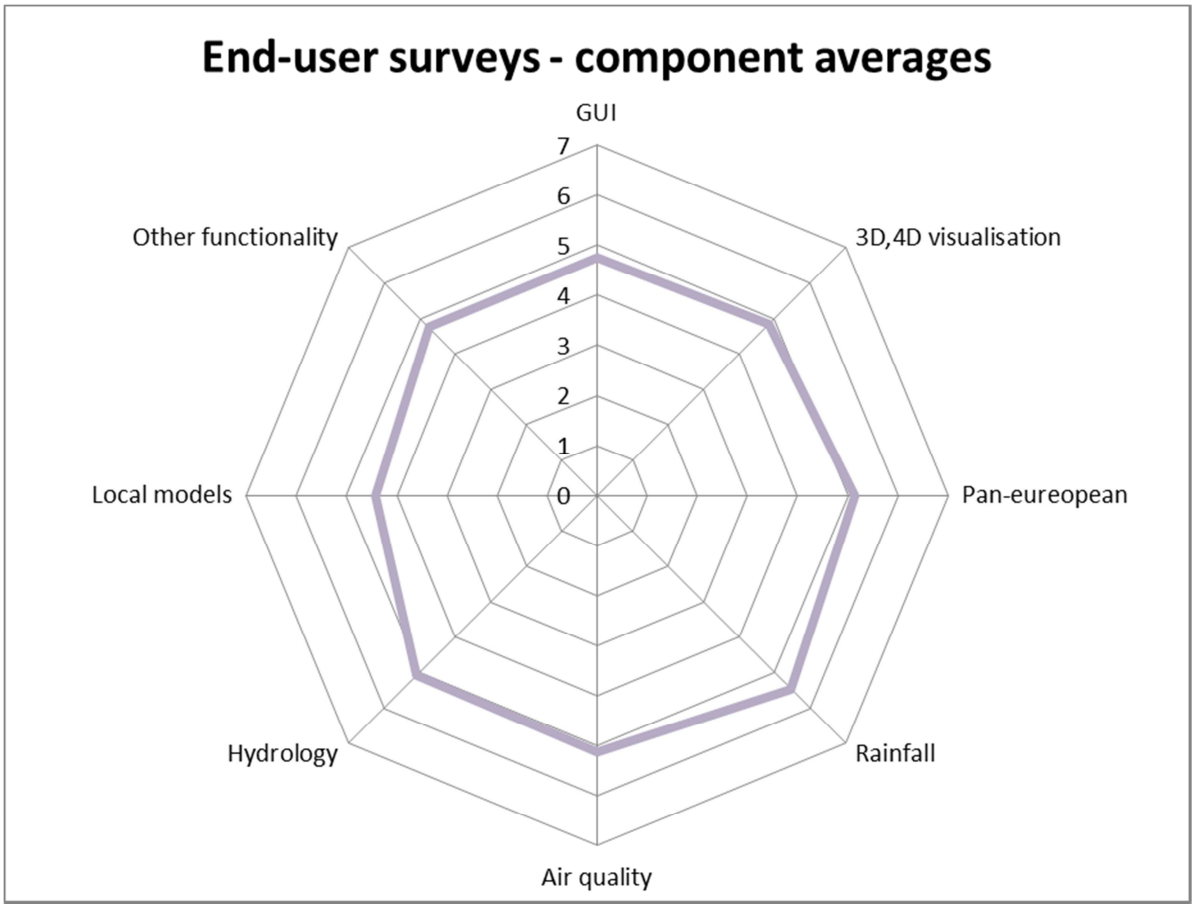

Figure 4: Average score per components and aspects for end-user surveys

The results of the end-user surveys are consistent with those of the internal technical survey and significantly above state-of-the-art rating (4). This is also illustrated in the Figure 5.

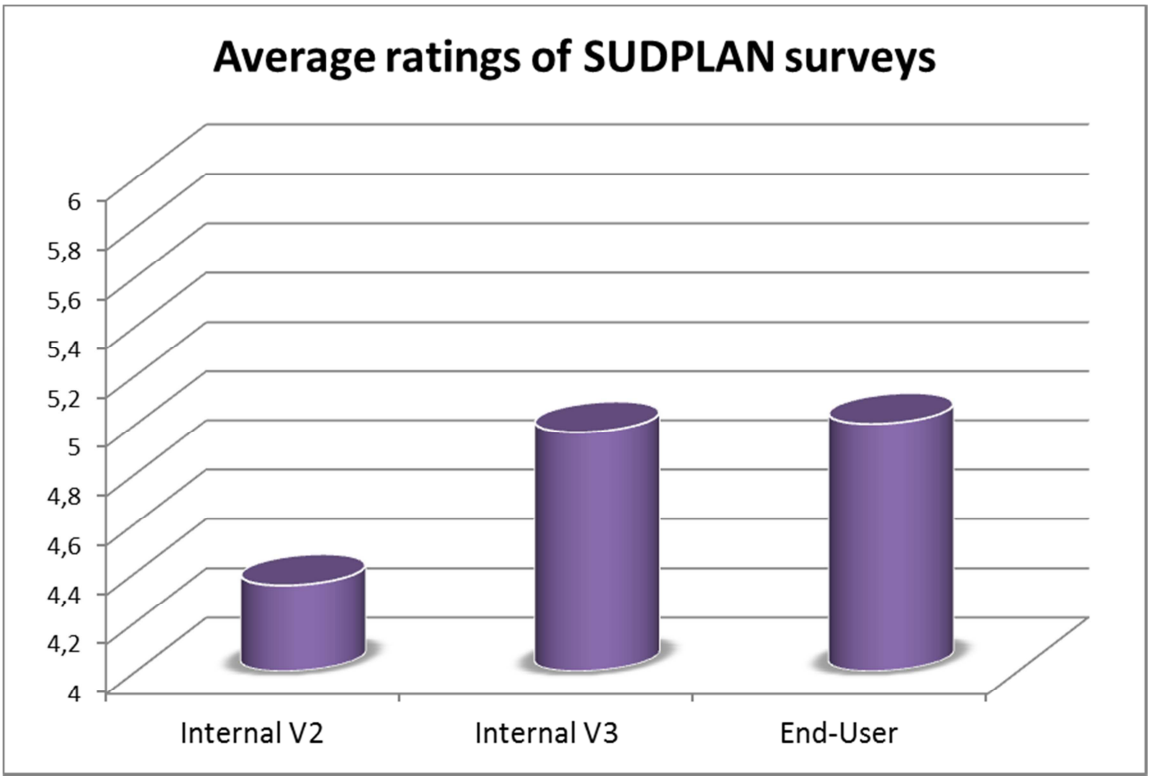

Figure 5: Average rating across all questions achieved at V2 survey, V3 internal technical survey and at end-user surveys.

Per-survey analysis shows significantly lower score for "integration of local models" in Wuppertal pilot survey. The deviation is a consequence of the use of proprietary models in Wuppertal. A somewhat lower score (however with a rating 4.6 still well above par) was also given to the Air Quality application at the Wuppertal workshop. A possible interpretation is that some of the workshop participants missed a local air quality model implementation, similar to those for rainfall in Wuppertal and Linz. Other important per-pilot findings include:

Wuppertal Pilot: After the project the Wuppertal pilot needs to be integrated into Wuppertal's IT infrastructure. Some features should be amended to enable seamless workflow for and among the primary users. Surveyors requested the display of maximum water levels and cell specific time variation curves of a local model. The Wuppertal pilot could be integrated into the General Drainage Planning process.

Linz Pilot: The Linz pilot has fully implemented the definition, execution and analyses of scenarios. Surveyors requested improved visualisation and reporting related to combined sewer overflows.

Czech Regional Pilot: The long-term air quality projections up to the year of 2100 are highly appreciated and viewed as unique. Requested improvements relate to a more complete integration of SUDPLAN to the Czech national modelling system (the Czech pilot found this integration more complex than they anticipated). They also asked for an easier way of feeding the downscaling model with local emissions. The latter comment is likely due to the fact that the

SMS wizard for gridded emission upload – completed mid 2012 - was not used by the end-users of the Czech pilot themselves, while preparing the different Czech scenarios.

Detailed analysis of the end-user survey results is provided in Annex C.2 (page 118) of this document.

3.5. Summary of SUDPLAN Status and Progress Achieved in V3

At the end of V3, the SUDPLAN product has reached the expected level of maturity and functionality which is close to a commercial product. The product is well accepted by end users and fulfils most of the requirements.

Main progress (as compared to V2 status) has been achieved in the following fields:

- Five combinations of climate models and global emission scenarios are available in V3 vs. two in V2 of the product.
- The full integration of the CS hydrological downscaling in the SMS GUI with possibility to include local data and perform an autocalibration will drastically increases the accuracy of the Hydrology service.
- Rainfall Time-series downscaling can now as an option adjust changes in the rain frequencies in addition to rain intensities which were already available in V2.
- A wizard provides easy upload of gridded emissions for a city, preparing for air quality downscaling.
- The V3 product features integrated 3D visualisation with extremely flexible data representation on a 3D globe.
- A manager concept that greatly simplifies the task of integrating the local models.
- Greatly improved and extended data import and data export functions
- Possibility to generate reports and presentation material.

Detailed analysis of the survey results is provided in the Annex C and the recommendations for further improvements are discussed in the chapter 4 hereafter.

4. Summary of Proposed Enhancements and Identified Deficits

SUDPLAN provides "a unique innovative tool which significantly supports decision making process on city development, mainly in terms of city infrastructure". The software developed in the course of the project can be considered very close to a commercial product but of course needs to be enhanced and extended towards the market needs.

As expected, the V3 surveys revealed some deficits in the software and downscaling model components developed and provided recommendations for enhancements that can help to successfully commercialize the project results. The aim of this chapter is to summarize this information in a form of ideas for the future development beyond the end of the project.

The following sections provide a condensed view on the major issues and recommendations identified by the validators. Many of them concentrate on usability and user friendliness – key targets for improvements in the exploitation phase. Requests for additional functionality are generally more difficult to fulfil. The prioritisation of the future developments will depend on the actual needs of customers and the possibilities to establish SUDPLAN as widely used tool in Europe. As a consequence, and in contrast to the V2 validation, the identified issues will not be translated to concrete recommendations and actions to the developer teams in WP3 and WP4. Instead they constitute the basis for a priority listing of actions to be performed during the commercialisation phase, after the formal end of the SUDPLAN EU FP7 project.

4.1. GUI enhancements, including maps and 3D

Issue / Recommendation	Comment	Priority for Commercialisation
Contextual help missing	Contextual help would improve the commercial appeal of the product.	Should have
Supporting help in English	A multilingual documentation and help system would improve the commercial appeal of the product.	Should have, also for other languages when needed.
Laptop / small displays use: problem to display both map and time series in visualisation	Not really a problem - the application is optimized for high resolution screens. Workaround: arrange the tabs for fast switching between map and time series – can be done by the users today.	Low priority – to be tackled with hardware recommendations
Visualization functionalities: comparing two result sets	Partially implemented, could be improved in commercial product.	Should have
Visualize 3D volumes	Can be easily integrated (Visualisation Wizard) in the 3D component	Should have

Spatial and temporal visualisation was found unintuitive and too complex	Navigation in 4 Dimensions is complex. Improved concepts for 4D visualization and navigation may emerge in the future.	Low priority – require more investigation of user needs
Linkage between Geo CPM results and 3D map missing	Functionality specific for one local model, could be implemented if there is enough commercial interest. The missing link is synchronization of 2D and 3D views.	Irrelevant for the overall product
Draw resulting CSO overflow volumes in a proportional scale in the geo-referenced map	Functionality specific for one local model. Consider to optimize result visualization on map.	Irrelevant for the overall product. Needs to be considered at customizing level.
Visualize historic and downscaled rain time series with identical y-axis scales	Valuable Feedback	Should have
Introduce a possibility to make layers transparent	This request is unclear and needs more investigation as this was always possible. Maybe this was meant on a per basin basis.	Already available
Introduce a view for single local basin and the upstream area for this basin	Would enhance usability of hydrology common service and therefore to be considered for the commercial product.	Should have, relevant only for hydrology
Simplify the upload of historical data required for model calibration	Needed for rainfall and hydrological applications in common services. Consider adding more file formats and the possibility to include simple value adjustment in the wizard. This considered for the commercial product.	Should have, will be continuously improved as needed.
Simplify the way future time periods are defined	In the moment the middle year of a time period has to be given. Can be extended allow to specify any of first, centre or last year. To be considered for the commercial product.	Should have

Maximum water levels and cell specific time variation curves should be available as alphanumeric or graphic information both in the 2D map and in the 3D map	This refers to pilot specific functionality. Investigate usability of showing small tables or curves within the 2D and 3D map.	Irrelevant for the overall product. Needs to be considered at customizing level.
Simplify the use of downscaling services in combination with local models.	Investigate usage simplification when downscaling and local models are run within one wizard.	Should have

4.2. Available scenarios, scenario and model documentation, model enhancement

Issue / Recommendation	Comment	Priority for Commercialisation
Extend the list of available climate scenarios	There are already plans to continuously extend this list.	For a commercial product the most updated scenarios will be continuously extended as they become available.
Provide information about flows with return times of 100 years (hydrology)	Can easily be added to the list of available variables.	Should have
Provide the number of days with ice coverage	Under development and will be available in future versions of HYPE.	Should have
Provide data and statistics comparing with the reference period 1961-1991 (hydrology)	Can be made available. Requires reprocessing of results available today.	Should have
Provide calculation of the long-term (annual or seasonal) volumes from a downscaled time series	At present only future relative changes (%) on seasonal volumes are given but it would be very easy to give also absolute numbers as they are calculated anyway. This is a useful extension of the RF downscaling “statistics table”, simple to	Should have

	implement.	
Allow calculation/extraction of a rainfall event from a (downscaled) time series.	Allowing the users to save only selected parts of time series is not difficult. Helping to users to choose the "right" part of the time series would be much more interesting, but it's unclear how to do this. Needs more investigation.	To be investigated
Improve CS air quality downscaling regarding spatial resolution (finer than 1x1 km)	Higher resolution can be achieved by direct coupling of local models to use SUDPLAN climate scenario forcing and boundary conditions from urban downscaled results (with local models integrated in SUDPLAN or executed externally).	Can be performed for a future city application, but require some development efforts.
Underlying EHYPE model should be free for use	Data and Model Source Code from E-Hype is available via hypeweb.smhi.se and can be ordered from SMHI. The E-HYPE model is just one application of the HYPE model.	Underlying model code HYPE already free for use.
Provide more information about the calibration method used	Enhance model documentation. More for scientific than for planning tasks. Available in WP4 deliverables.	Should have
Improve emission inventory upload	The upload of gridded emissions is quite simple as it is. However, line and point sources are not accepted. If this is required, the commercial product Airviro GUI (see Glossary) could be used as a workaround for now.	Low priority - possible already today by using commercial software
Change local land use in hydrological scenario	Land use influences hydrological conditions and river runoff. And land use may change much faster than climate conditions, so the requested functionality would definitely enhance SUDPLAN. But this functionality was not part of the SUDPLAN functionality outlined in DoW.	To be investigated
Upload new and locally refined catchment areas (Hydrology)	Hydrological downscaling is based on Europe-wide basin data. Enhancing this data with local, more precise data would be an enhancement. Catchments might also be changed by human influence (e.g. a dam), so this	To be investigated

	would also be a possibility to assess planning decisions.	

4.3. Functional enhancements

Issue / Recommendation	Comment	Priority for Commercialisation
Allow production of videos directly from SMS	No concrete plans. Can be done by export of single maps and processing using existing video software.	Nice to have
Simplify the usability in local dispersion models	If variables required for executing local models (principally wind speed and direction) they could be exported from the Pan-European climate scenarios. This would make it possible to run external (local) models for future conditions.	Should have – easy to fix by extending the variables available on the Pan-European scale. But more interesting is to be able to export those variable from CS urban model output (see Section 4.2)
Provide support for service chaining	In the course of SUDPLAN implementation, it became clear that service chaining is not needed in our pilots. Could be implemented if there is sufficient commercial interest after the project end.	Nice to have
Configuration of models, model validation and model calibration	This is a highly model specific task and most models provide their own tools for this. So no generic implementation is planned for this functionality.	Out of scope
Improve support for reporting.	SUDPLAN foresees the ability to export material usable in reports, but development of general-purpose reporting tool is out of scope. Reporting facilities are part of the underlying cids platform [2]and can be easily extended if required.	Already available
Implement specific visu-	The uncertainty is very difficult to	To be investigated

[2] http://www.cismet.de/cidsDeveloperFAQ.html

alization of the uncertainties for several scenarios	quantify in a statistical sense, but the "robustness" of future scenarios can be described by statements like e.g: • all scenarios indicate the same trend (increase/decrease) • the scenarios indicate an interval for certain variable in the future	

4.4. Other aspects

Issue / Recommendation	Comment	Priority for Commercialisation
Allow integration of new local models by non-programmers	Model Integration is a complex task and in most cases needs the support of an IT person. A wizard concept for integration of models, and implementation for some models with standard service interfaces already exists. The cost for this better usability is the need to create a new wizard for each local model.	To be investigated
Allow integration of SUDPLAN in existing systems and workflows	Integration in the sense of sharing the data over standardised service interfaces like (WMS, SOS) is already possible. Integration in an existing system in the sense of integration in an existing user interface was never a goal of this project.	To be investigated
Extend data import / export functionality	All formats requested in V2 validation are implemented. New requests for shape files and excel files prove the interest in SUDPLAN results. But this functionality is not only a question of data formats but also of data semantics and sometimes even of the question of the data availability. Support for additional data formats will depend on commercial interest.	Should have - will be continuously extended according to requirements from future end-users

Sometimes the tool freezes and sometimes time series and legends are not shown / missing error message	Since SUDPLAN is a distributed system it depends on a reliable network connection. The GUI should monitor the network traffic and display proper error messages in the commercialized product.	Must have
Problems with incorrect map data	The background maps are loaded from different web map services and SUDPLAN depends on the correctness of this data. A SUDPLAN user can provide its own maps for this purpose if a better quality or resolution is needed.	Irrelevant

5. Conclusion

The validation V3 confirms that SUDPLAN has produced scientifically sound and technologically mature results that can be used to integrate the effects of climate change into urban planning:

- On the one hand, ICT experts are very satisfied with the underlying technology and flexibility of the resulting system (see section 3.2 and B.1).
- On the other hand, the end users (city and regional planners) are impressed with the possibility to take into account the effects of climate change in their work (see section 3.4 and B.1).

The SUDPLAN product was described as close to being operational by the team members and end users alike.

The key strength of SUDPLAN product is recognized in its potential to support the interdisciplinary urban/regional planning process and to contribute to climate change adaptation. The unique ability to simulate future development, which includes many different aspects (climate change, air pollution, hydrology, urban sewerage, etc.) is found to be new and very often beyond the current state-of-the-art.

Nevertheless, the results of the SUDPLAN should not be considered “final”, for two reasons. First, we are aware of various opportunities for improving the functionality of existing pilots. Some of them are already listed in chapter 4 and may be implemented after the project. The key weaknesses highlighted by surveyors were “complexity”, as well as lack of “user friendliness” and “ease of use”.

Second, the SUDPLAN product consists of a number of fairly independent components which can be re-used in contexts which aren’t covered by the existing SUDPLAN pilots, including for instance disaster management.

As a result, the implementation of new applications related to “climate change” on top of the existing SUDPLAN toolbox would be certainly be far more cost-efficient than developing such applications from scratch. The key recommendations of this validation are therefore:

- To use the current results as a marketing tool to attract attention and wherever possible achieve immediate commercialization of the product “as is” of with minor improvements of the look and feel.
- To actively seek the users interested in taking the effects of climate change into account in contexts that aren’t fully covered with the current SUDPLAN pilots, searching funding for developing minor or larger extensions of SUDPLAN functionality.

6. References

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

Document	Version
DoW (new)	2012-06-20
D2.1 Validation Plan (revised after 1st ATR)	2011-06-15
D2.2.1 Validation and Evaluation Report V2	2012-03-06
D3.1.2 Requirement Specification V2	2011-11-28
D3.3.3 Scenario Management System V3	2012-07-13
D4.1.3 Common Services Concerted Approach V3	2012-09-30
D4.2.3 Rainfall Downscaling Service V3	2012-05-18
D4.3.3 Hydrological Downscaling Service V3	2012-09-06
D4.4.3 AQ Downscaling Service V3	2012-04-30
D5.3.3 Stockholm Product Validation Report V3	2012-11-30
D6.3.3 Wuppertal Product Validation Report V3	2012-12-07
D7.3.3 Linz Product Validation Report V3	2012-11-29
D8.3.3 Czech Product Validation Report V3	2012-11-29

Table 3: List of documents and software deliverables that has been referenced or used for this document

Annex A - LimeSurvey internal technical validation

A.1. 0 – Personal Information

Name	1: David Steffelbauer 2: David Camhy 3: Lars Gidhagen 4: Lena Strömbäck 5: Martin Scholl 6: Daniel Steffen 7: Peter Kutschera 8: Mihai Bartha 9: Jonas Olsson
Organization	1: TU Graz 2 TU Graz 3: SMHI 4: SMHI 5: cismet GmbH 6: German Research Center for Artificial Intelligence (DFKI) 7: AIT 8: AIT 9: SMHI

4 [0/typeOfRisk]: 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	1	1	2	1
Dimensioning of sewage water systems			1	1
Risks of flooding of rivers	2	2	2	1
Hydrological conditions	2	1	1	1
Air pollution	1	1	1	1
Other				

5 [0/timeOfInteresr]: 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	3	
Long term planning (>10 years) planning	8	1	

6 [0/validation scope]: Please indicate what part of SUDPLAN the validation is made (Y= Yes, N = No). Only one answer per user possible.

Application	
Stockholm pilot	0
Wuppertal pilot	1
Linz pilot	2
Czech pilot	0
Overall application	6

7 [0/knowledge profile]: Please describe the user's knowledge with respect to the SUDPLAN product

Type of user	
SUDPLAN team member	9
Analyst	3
Modeler	2
System manager	1
IT expert	6
Climate change expert	2
Have seen presentations and documentations	9
User of the SUDPLAN / model results	3
Working with the actual system	2

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.

A.2. 1 – Graphical User Interface

A.2.1. 1a – GUI specific

SUDPLAN shall provide user-friendliness of services and interfaces, in particular ergonomics of the graphical user interface (GUI) and the visualization components
Enable usage by untrained users, not only "SUDPLAN" experts.
REQ-DOW-2.10: Offer user-friendly interfaces

9 1a/Q1a: Please indicate the key concepts used in SUDPLAN to assure the GUI ergonomics (Y = concept used, N = concept not used, NA = concept not applicable). Please give the number of answers for each alternative.

Key concepts	Y	Uncertain	N	NA
Task-Oriented Menu structure	6	0	0	0
Multi-lingual user interface	2	4	1	0
Smart scaling for small screens	1	1	5	0
Workflows for common tasks	6	0	0	0
Colour-coding for colour-blind	0	4	2	0
Contextual help system	1	2	3	0
Alerts when processing finished	5	2	0	0
Panning/browsing through results (in time)	5	2	0	0
Panning/browsing through results (in space)	5	2	0	0
Highlighting recently changed data	1	5	0	0
Comparing two result sets	7	0	0	0

10 1a/Q1c: Please give a short textual explanation on the user friendliness of the SUDPLAN application and suggestions for improvement.

1: No contextual help.

2: Problems using the system on smaller screens. Better help system would be great.

3: The GUI is rather complicated and not very self-explaining. After some practice it works well.

4: The system is easy to use. However, it is comlicated and sometimes it is hard to getting started with the system. Would like more features for comparing maps visually. (Show them side bu side)

8: good

SUDPLAN shall provide easy-to-use planning, prediction, decision-support and training tool.
The main idea of the SUDPLAN project is to develop an easy-to-use web-based planning, prediction, decision support and training tool, for the use in an urban context, based on a what-if scenario execution environment, which will help to assure population's health, comfort, safety and life quality as well as sustainability of investments in utilities and infrastructures within a changing climate.
REQ-DOW-1.1: Build an easy-to-use system

SUDPLAN shall employ user-centred design principles in the design of the user interface. SUDPLAN shall provide user-friendly services and interfaces, graphical user interfaces (GUI), and data visualization components.
Systematic user-centred design helps ensure that the intended users are successful and improves overall productivity. Furthermore it enables the use of the SUDPLAN product by untrained users, not only SUDPLAN experts.

REQ-USR-1.1.1: User-centred design

11 1a/Q1d: Please assess the ease of use of the SUDPLAN application (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Define a scenario				*1*	*2*	*3*		
Excute existing scenario "as is"				*1*	*1*	*1*	*1*	
Execute existing scenario with changed parameters				*1*	*2*	*1*		
Save results			*1*	*1*	*1*	*2*	*1*	
Share results with others				*2*	*1*	*1*		
Visualize results				*2*	*2*	*2*		
Visualize uncertainties[3]		*1*	*1*	*1*	*2*			
Compare the results of various scenarios			*2*		*4*			
Export results in different formats				*3*	*1*	*2*		

12 1a/Q1e: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

1: There should be a better way for scenario storage, so that there is no risk of deleting old scenarios.

2: Export options could be improved.

3: Only CS has been evaluated. Visalisation of PE time series very nice (score 6). Visualisation of PE maps OK (score 4), but the sliding in time does not show up smoothly. Visualisation o DS RF OK, but wrong graph type (does interpolation between data). Visualisation of DS HYD OK. Should be good to be able to open two map windows to be able to compare two scenarios. Visualisation of DS AQ poor (WMS), difficult to change colours and does not allow more than 7-8 time steps. Visualisation of DS AQ time series not implemented, this is very poor result.

4: Now answer for features not tested. Again, would be nice to compare maps side by side.

7: Because of the many functions available it needs some time to get familiar with all of them. So SUDPLAN is a tool for everyday use by experts.

SUDPLAN shall allow automation of recurring tasks wherever possible.

In SUDPLAN application analysis and management there will be tasks which must be performed repeatedly. Allowing the users to automate such tasks will greatly enhance ultimate productivity.

REQ-USR-1.2.1: Recurring task automation

SUDPLAN shall allow users to configure tasks which are to be executed on a recurring basis.

Recurring tasks will generally require configuration of input data, parameters, and other variables.

[3] This question and all other questions with orange background in Annex A aren't in the SUDPLAN scope according to new DoW.

REQ-USR-1.2.2: Recurring task configuration

SUDPLAN shall support the development and maintenance of user interface profiles for different users.

User interfaces generally allow configuration by users to suit their needs or preferences. Keeping these configurations in a profile prevents any given user from having to reconfigure the application each time they use it.

REQ-USR-1.3.1: Profiling of the user interface

SUDPLAN shall support establishment of user groups with shared profiles.

Some aspects of the user interface configuration may be associated with categories of users rather than individual users.

REQ-USR-1.3.2: Establishement of user groups

SUDPLAN shall support the development and maintenance of automation task profiles.

Automatically recurring task configurations should be stored in a profile to allow users to re-establish similar task executions without having to completely re-enter configuration information.

REQ-USR-1.3.3: Profiling of automation tasks

SUDPLAN shall support profiling of business processes for different users and user groups.

SUDPLAN applications will often require combinations of information and services requested from diverse sources, and these request transactions will need to be configured. Saving of request transaction profiles will help users and user groups to streamline their analyses by avoiding extensive reconfiguration.

REQ-USR-1.3.4: Profiling of business processes

13 1a/Q1f: Please assess the ease of use of the profiling and automation capacities of SUDPLAN (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Recurring task automation	*1*		*2*	*2*		*1*		
Recurring task configuration	*1*		*1*	*1*		*1*		
Profiling of the user interface	*1*			*2*				
Establishment of user groups	*1*				*1*	*1*		
Profiling of automation tasks	*1*			*1*				
Profiling of business processes	*1*							

14 1a/Q1g: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

4: Not available in the parts of the system I have tested.

SUDPLAN shall enhance the current state of the art in interactive visualization by the support of different types of output devices (the system can be adapted to a wide variety of hardware from single-user desktop to immersive multi-user environments)

Depending on the systems available to the user proper visualization techniques have to be used.

REQ-DOW-10.4: Provide support of different output devices

15 1a/Q2a: Please assess the usability with various output devices used (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall						*2*	*1*	
High resolution PC monitor (22-26 Inch, 1080p)					*2*	*2*	*1*	
Laptop (15-17 Inch, 1280x800 pixel or better)				*2*	*1*	*2*		
Small Laptops (12-14 inch, 1024x800 pixel)			*1*	*1*	*1*	*1*		
Netbooks (about 10 inches, below 1024x800 pixel, low processing power)		*1*	*1*	*1*		*1*		
Small 3D Displays (Desktop monitors)						*1*		
Large 3D displays (for presentation to a large audience)						*1*		

16 1a/Q2c: Please give a short textual explanation of the special features allowing the use of the SUDPLAN's GUI elements across the large range of screen sizes, key advantages of SUDPLAN wrt. to state of the art (if any), and suggestions for improvement.

1: Working on small laptops and netbooks is not recommended because the number of windows in the sudplan GUI is very high.

2: Too many GUI elements for use on small display sizes.

4: No answer means not tested.

Certain general elements of the user interface design enhance system usability.
REQ-USR-1.1: Usability

SUDPLAN shall employ user-centred design principles in the design of the user interface. SUDPLAN shall provide user-friendly services and interfaces, graphical user interfaces (GUI), and data visualization components.
Systematic user-centred design helps ensure that the intended users are successful and improves overall productivity. Furthermore it enables the use of the SUDPLAN product by untrained users, not only SUDPLAN experts.
REQ-USR-1.1.1: User-centred design

SUDPLAN shall employ user interface design features that help prevent users from making errors when possible, allow users to reverse an error if one is made, or minimize the consequences of user errors if neither of these is possible.
Preventing or successfully mitigating user errors is necessary to ensure a productive outcome of the users' use of the system.
REQ-USR-1.1.2: User errors

SUDPLAN shall employ design features which allow the software to carry the burden of remembering information needed from one part of an application by another.
Avoiding a reliance on the users' short-term memory significantly increases productivity, reduces error rates, and increases user satisfaction.
REQ-USR-1.1.3: Short-term memory

SUDPLAN shall provide contextual help to users.
When users are expected to provide input to an application they may need clarification or explanation of the input that is expected of them.
REQ-USR-1.1.4: Contextual Help

SUDPLAN shall be easy to understand and to learn.
SUDPLAN users should be able to learn how to use the user interface easily and to readily understand its functionality.
REQ-USR-1.1.5: Ease of learning

SUDPLAN's user interface shall be easy to remember.
SUDPLAN users should be able to readily remember how to use the user interface.
REQ-USR-1.1.6: Memorability

SUDPLAN shall present a transparent user interface.
SUDPLAN users should not need to have technical knowledge outside of their domain.
REQ-USR-1.1.7: Transparency

17 1a/Q3a: Please assess the usability of SUDPLAN (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
User-centred design			*1*		*2*	*1*		
User errors			*1*	*4*				
Short-term memory				*1*	*2*	*1*		
Contextual Help			*1*	*3*		*1*		
Ease of learning			*1*	*1*	*3*	*1*		
Memorability				*2*	*2*			
Transparency			*1*		*3*			

18 1a/Q3c: Please give a short textual explanation on the (dis)advantages of the usability in SUDPLAN, and suggestions for improvement.

2: No contextual help system

4: Hard to remember how to access functionalities.

SUDPLAN shall support visualization based on geo-spatial paradigms.

Environmental data are very often spatial in nature, and therefore require geo-spatial visualization techniques.

REQ-USR-2.5.2 Spatial visualization

SUDPLAN shall support visualization of time-based phenomena.

Environmental phenomena are dynamic in nature, and therefore often require the use of visualization techniques representation variation of one or more variables as a function of time.

REQ-USR-2.5.3 Temporal visualization

SUDPLAN shall support visualization of phenomena varying in both time and space.

More complex environmental data sets vary in both time and space.

REQ-USR-2.5.4 Spatio-temporal visualization

SUDPLAN shall support the visualization of an individual model run.

Many SUDPLAN modelling runs will generate spatial and/or temporal data which need to be visualized to be interpreted by the analyst.

REQ-USR-2.5.5 Visualization of a model run result

SUDPLAN shall support the visual comparison of multiple model runs.

Analysis of the results from multiple comparable model runs (such as under different scenarios) requires the ability to simultaneously represent model results visually.

REQ-USR-2.5.6 Comparison of model run results

19 1a/Q4a: Please assess the usability of SUDPLAN for visualization (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Spatial visualization				*1*	*1*	*3*	*1*	
Temporal visualization					*3*	*3*		
Spatio-temporal visualization					*2*	*3*		
Visualization of a model run result				*1*	*2*	*2*	*1*	
Comparison of model run results			*1*	*2*	*2*	*1*		

20 1a/Q4c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

3: see earlier comments on differences in visualisaton between different applications.

A.2.2. 1b – 3D GUI

SUDPLAN shall extend the state-of-the-art in the field of environmental decision support systems by offering to users highly integrated and interactive 3D / 4D
Rationale: Proper visualization is needed to understand large data sets, especially if they are georeferenced. The visualization will not only be used by experts for themselves but also to inform other persons.
REQ-DOW-3.2

22 1b/Q1a: *Please indicate the usability of the SUDPLAN 3D/4D visualization as compared to state of the art applications (1 to 7 or NA, with 4=on par, 1=way below, and 7=way above. NA can be used to indicate that the comparison is impossible, useless or beyond your knowledge).* Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Large data sets			*1*					
Geo-referenced data			*1*					
3D data			*1*					
3D data, georeferenced, on a map			*1*					
1D Time-series						*1*		
2D Time-series			*1*					
3D Time-series		*1*						
Multi-dimensional data			*1*					

23 1b/Q1c: Please give a short textual explanation for the above marks, key advantages and suggestions for improvements. Please indicate also the "state of the art" applications used in the comparison above.

3: Has only evaluated AQ visualisations. In general the results are below the expected as for the 3D presentations. Animation of true 3D time series not possible. The World Wind is a good starting point, but there are too few visualisation options. It also seems that the use require a lot of local memory and PC capacity.

SUDPLAN shall enhance the current state of the art in interactive visualization by a highly interactive, extendable 3D / 4D visualization framework combining geometric, volumetric and information visualization algorithms as well as interaction techniques for analyzing, comparing and presenting of simulated what-if scenarios (in the area of sustainable urban development).

A proper visualization is required to understand and compare complex or large data sets. This is needed to understand the implications of different scenarios.

REQ-DOW-10.1: Provide 3D / 4D visualisation framework

24 1b/Q3a: Please assess the capabilities of the SUDPLAN 3D/4D visualization framework (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall impression						*2*	*1*	
Interactive applications						*1*	*1*	
Geometric visualisation algorithms					*1*	*1*	*1*	
Volumetric visualisation algorithms					*1*		*1*	
Other information visualisation algorihms					*1*		*1*	
Presenting of simulated what-if scenarios							*1*	
Comparing of simulated what-if scenarios								

Analyzing of simulated what-if scenatios							*1*	

25 1b/Q3b: Please give a short textual explanation for the above marks, key advantages of SUDPLAN wrt. to state of the art (if any), and suggestions for improvement.

8: although not a important issue, I would reccomend using a horizontal timeline slider to the 3D visualization of water level timeseries

SUDPLAN shall enhance the current state of the art in interactive visualization by an extendable framework; regarding visualization as well as interaction metaphors (the system can be adapted to a wide variety of data)

The 3D/4D visualization shall also be usable for direct interaction with the SUDPLAN system to allow an intuitive use.

REQ-DOW-10.2: Provide interaction framework

26 1b/Q4a: Please describe the key enhancements of the "state of the art" in interactive visualization developed by SUDPLAN.

A.3. – Common Services

A.3.1. 2a – Climate Scenario Information

All forecast models depend on the selected climate scenario. So information about the available scenarios is needed by the user.

28 2a/Q1a: Please indicate the usability of the provided climate scenario information (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Available number of different climate scenarios			*2*	*1*	*3*	*1*	*1*	
Available area over europe					*1*	*6*	*1*	
Available time range						*6*	*2*	
Available scenario documentation		*1*		*3*	*1*	*1*	*1*	

A.3.2. 2b – Common Services Rainfall

SUDPLAN shall provide the possibility to assess maximum rain intensity

Maximum rain intensity to be expected over sealed surfaces is needed to know how water run-off systems must be dimensioned.

REQ-DOW-1.3: Assess maximum rain intensity

SUDPLAN shall extend the state-of-the-art in the field of extreme precipitation by providing statistical measures (IDF curves) for future intense rainfalls, based on climate model results

This data is needed (at least in WP7) to plan efficient strategies to prevent damage, as input to a local model of the waste water infrastructure caused by future storm water events.

REQ-DOW-5.1: Provide IDF curves

SUDPLAN shall extend the state-of-the-art in the field of extreme precipitation by enabling the user to improve the quality of the simulated precipitation results by adding local historical precipitation data.

REQ-DOW-5.2 Improved precipitation simulation results

SUDPLAN shall extend the state-of-the-art in the field of extreme precipitation by identifying future periods – typically 1-2 months – with extreme precipitation events, for which SUDPLAN provides precipitation grids with high temporal (30 min) resolution
This data is needed to plan efficient strategies to prevent damage caused by future accumulations of heavy rain events.

REQ-DOW-5.3:Identify extreme precipitation events

30 2b/Q1a: *Please assess the quality of the SUDPLAN precipitation prediction with respect to the state of the art (1 to 7 or NA, with 4=on par, 1=way below, and 7=way above. NA can be used to indicate that the comparison is impossible, useless or beyond your knowledge).*
Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Maximum rain intensity						*1*		
IDF cuves						*1*		
High temporal resolution rain data						*1*		
Identification extreme precipitation events								
Upload of historical data to improve the results						*1*		

31 2b/Q1c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

SUDPLAN shall provide the possibility to assess maximum rain intensity

Maximum rain intensity to be expected over sealed surfaces is needed to know how water run-off systems must be dimensioned.

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This data is needed to plan efficient strategies to prevent damage caused by future accumulations of heavy rain events.

REQ-DOW-5.3: Identify extreme precipitation events

32 2b/Q2a: Please assess the ease of use of the SUDPLAN precipitation prediction results. So this question is not about the GUI but the provided results, which might be used for visualisation or as input to other models (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Maximum rain intensity					*2*	*2*		
IDF cuves					*3*	*3*	*1*	
High temporal resolution rain data					*2*	*3*	*1*	
Identification extreme precipitation events				*1*	*1*	*2*		
Upload of historical data to calibrate the results				*2*	*2*	*3*		

33 2b/Q2c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

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A.3.3. 2c – Common Services – Air Quality

SUDPLAN shall provide possibility to assess the risk from air pollution and extreme temperature

Spatial distribution of air pollution, risk for extreme events and high ambient temperature in built-up residential and work areas.

REQ-DOW-1.4: Assess risk from air pollution and extreme temperatures

SUDPLAN shall extend the state-of-the-art in the field of air pollution by offering the possibility for countries or groups of countries to assess future exposure and health risks caused by air pollutants and high ambient temperature

Air quality has a huge impact on human health, so assessing the air quality means also to assess human health risks. For example a visualization of air quality together with population density will help to make proper decisions.

REQ-DOW-7.4: Assess future health risks

35 2c/Q1a: Please assess the capability of SUDPLAN to assess the risk of pollution and extreme temperature (1 = below, 4 = on par, 7 = far above). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*

Air pollution: Compared to the state of the art					*1*			
High ambient temperature: Compared to the state of the art	*1*							
High ambient temperature: Compared to SUDPLAN objectives	*1*							
Air pollution: Compared to SUDPLAN objectives	*5*							

36 2c/Q1b: Please assess the usability of the SUDPLAN tool as the basis for assessment of the air pollution and extreme temperature risks (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall				*1*				
Scenario Management System (SMS)				*1*				
Common Services (CS)				*1*				

37 2c/Q1c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN, and suggestions for improvement.

3: The AQ DS works OK. The lack of possibilities for visualisation of maps and time series results lower the usability. The temperture DS was never implemented, but is an important variable in CC assessment of urban environments.

SUDPLAN shall extend the state-of-the-art in the field of air pollution by delivering long term (10 year) air quality and temperature simulations over the entire Europe, for different climate scenario windows (e.g. 2006-2015, 2026-2035, 2046-2055 etc), enabling the end user to identify trends in poor air quality and heat wave incidents.

REQ-DOW-7.1: Provide long term air quality simulation

38 2c/Q2a: Please indicate the level of support for following functionality (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Long term (10 year) air quality and temperature simulations over entire Europe						*1*		
Choice of climate scenario windows (e.g. 2006-2015, 2026-2035, 2046-2055 etc)	*1*							
Identify trends in poor air quality			*1*					
Identify trends in heat wave incidents	*1*							

39 2c/Q2c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN, and suggestions for improvement.

3: Only possible to run DS AQ for one year at a time.

SUDPLAN shall extend the state-of-the-art in the field of air pollution by performing year long downscaling air quality and temperature simulations that allow the assessment of how local sources, activities and land use impact future air quality in particular European cities

REQ-DOW-7.2: Assess local influence to air quality

40 2c/Q3a: Please indicate the level of support for following functionality (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Perform year long downscaling air quality simulations					*1*			
Perform year long downscaling temperature simulations	*1*							
Assess how local sources, activities and land use impact future air quality in particular European cities					*1*			

41 2c/Q3c: Please give a short textual explanation on your experience with assessing the impact of local sources, activities and land use on future air quality in European cities (in SUDPLAN), and suggestions for improvement.

SUDPLAN shall extend the state-of-the-art in the field of air pollution by allowing local emission scenarios and dispersion models to be nested to the downscaled air quality grids, demonstrating the relative importance of local sources within individual industrial, urban and residential environments

REQ-DOW-7.3: Connect local emission models

42 2c/Q4a: Please indicate the level of support for following functionality (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Use of the downscaled air quality grids in local emission scenarios and dispersion models				*1*				
Allow users to estimate the relative importance of local sources within individual industrial, urban and residential environments				*1*				

43 2c/Q4c: Please give a short textual explanation on your experience with assessing the importance of local sources to future air quality (in SUDPLAN), and suggestions for improvement.

SUDPLAN shall extend the state-of-the-art in the field of air pollution by offering the possibility for countries or groups of countries to assess their possibilities to fulfill national air quality standards and environmental objectives, also in a climate change perspective

Assess the implications of decisions met now to the fulfillment of actual and future air quality standards (Strictly spoken this would also require a model of future air quality standards).

REQ-DOW-7.5: Assess future fulfilment of air quality standards

44 2c/Q5a: Please indicate the usability of SUDPLANs air quality results (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

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

45 2c/Q5c: Please give a short textual explanation on your experience with the usability of SUDPLANs air quality results, and suggestions for improvement.

A.3.4. 2d – Common Services – Hydrology

SUDPLAN shall provide the possibility to assess river flooding scenarios

Risk for river flooding and inundations of built-up areas and other developed areas have to be assessed based on future climate scenarios

REQ-DOW-1.2: Assess risk for river flooding and inundations

47 2d/Q1a: Please assess the capability of the application to assess the river-flooding scenarios (1 = below, 4 = on par, 7 = far above). Please give the number of answers for each alternative.

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

48 2d/Q1b: Please assess the usability of the SUDPLAN tool as the basis for river-flooding assessment applications (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall				*1*	*1*			
Scenario Management System (SMS)				*1*	*1*			
Common Services (CS)				*1*	*1*			

49 2d/Q1c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN wrt. to state of the art (if any), and suggestions for improvement. Please state also which state-of-the art product was used for comparison.

SUDPLAN shall extend the state-of-the-art in the field of flood and draughts by leaving local end users the possibility to improve SUDPLAN model results by adding local precipitation, river runoff and land use data.

To get more accurate results some fine grain local data can be used by the downscaling services.

REQ-DOW-6.2: Provide better downscaling results by using local data

50 2d/Q4a: Please assess the usability of SUDPLAN to improve the model results by adding local and historical data (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
River runoff					*2*			
Land use	*1*							

51 2d/Q4b: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

SUDPLAN shall extend the state-of-the-art in the field of flood and draughts by forming a tool which evaluates how different local land use and urbanization scenarios respond hydrologically to climate changes

Land use, and to a somewhat lesser extent the urbanisation (e.g. building architecture, requirements on infrastructure, sustainable population density) are very sensitive to climate changes.

REQ-DOW-6.3: Assess future land use scenarios

52 2d/Q5a: Can the end user evaluate the impact of different scenarios? (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Climate change scenarios					*1*	*1*		
Land use scenarios	*1*							
Urbanisation scenarios	*1*							

53 2d/Q5b: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

SUDPLAN shall extend the state-of-the-art in the field of flood and draughts by delivering time series output of future river runoff suitable to feed local hydraulic flooding models

To protect existing and plan future infrastructures the risk of flooding has to be assessed.

REQ-DOW-6.4: Provide future runoff time series

54 2d/Q6a: Please assess the quality of the future runoff time series (1 = below state of the art, 4 = on par with state of the art, 7 = above state of the art). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Ease of use				*1*				
Data quality				*2*				
Suitable to feed into local hydraulic flooding model				*1*				

55 2d/Q6c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement. Please state also which state-of-the art product was used for comparison.

56 2d/Q7a: Please indicate the usability of SUDPLANs result in the hydrological domain (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
As information about expected future environmental conditions					*1*	*3*		
Comparing the results of future city development plans	*1*		*1*					

57 2d/Q7c: Please give a short textual explanation on your experience with the usability of SUDPLANs results in the hydrological domain, and suggestions for improvement.

3: No possibility to change local land use.

A.4. 3 – Local Models

SUDPLAN shall extend the state-of-the-art in the field of extreme precipitation by enabling the user to improve the quality of the simulated precipitation results by adding local historical precipitation data

Local historical data can be used to calibrate the results according the local conditions

REQ-DOW-5.2: Provide input for local models

SUDPLAN shall support modellers in integrating their models into a SUDPLAN application.

Integrating models into a SUDPLAN application, possibly with other models, means that the modeller needs to be able to specify the role of the model(s) within the application and to make the necessary connections between the model(s) and other components of the application.

REQ-USR-3.1.1: Model Integration

SUDPLAN shall support modellers in the configuration of models for analysts.

Modellers need to be able to configure models by specifying those data which are necessary for the model but which will not be under the control of the analyst.

REQ-USR-3.1.2: Model configuration

SUDPLAN shall support modellers in calibrating their models within a SUDPLAN application.

If a SUDPLAN application provides access to sufficient measurement data, it may be desirable to calibrate the model(s) used within the application to those data.

REQ-USR-3.2.1 Model calibration

SUDPLAN shall support modellers in validating their models within a SUDPLAN application.

If a SUDPLAN application has access to sufficient measurement data, using these data to validate the model(s) can increase confidence in the results of the model(s) within the context of the application.

REQ-USR-3.2.2: Model validation

59 3/Q1a: Please assess the ability of SUDPLAN in the field of model integration (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

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

60 3/Q1b: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

1: Model validation and calibration does not really run in sudplan.

2: Model calibration and validation is not handled by the SMS. Different model version handling could be improved

8: easy integration / interfacing of models and data sources through standardized interfaces.

A.5. 4 – Usage of External Services

SUDPLAN shall extend the state-of-the-art in the field of environmental decision support systems by offering ubiquitous integration with information sources and services in SOA-based infrastructures Needed for easy integration of existing and future services.

REQ-DOW-3.4:Provide integration with SOA-based infrastructures

62 4/Q3a: Please indicate the level of support offered by the SUDPLAN product (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Service and resource discovery								
Service and resource integration						*2*	*1*	
Access standardised SOA services						*1*	*1*	
Interpret underlying data model						*1*	*1*	
Transform data to different models						*1*	*1*	
Data interpolation / extrapolation								
Fusion of data from heterogenous sources						*1*		

SUDPLAN shall extend the state-of-the-art in the field of environmental decision support systems by offering ubiquitous integration with information sources and services in SOA-based infrastructures

Needed for easy integration of existing and future services.

REQ-DOW-3.4: Provide integration with SOA-based infrastructures

SUDPLAN shall support the integration of spatial layers through standardized services.

Spatial data will play a crucial role in SUDPLAN applications, and integration of these data using standard tools is essential.

REQ-DEV-1.2.1: Web map services

SUDPLAN shall support the integration of models through standardized web services.

Integration of distributed models through standardized web services is essential to support the development of SUDPLAN applications.

REQ-DEV-1.2.2: Model service integration

SUDPLAN shall support information product modelling.

Elements of SUDPLAN application information products can also be structured using information modelling methods.

REQ-DEV-1.2.3: Sensor Service integration

63 4/Q3b: Please indicate which external service types can be used by SUDPLAN. Please give the number of answers for each alternative.

	Yes without any configuration	Yes with some configuration by the user	Yes with configu-ration by the administrator / developer	No	NA
OGC WMS (Web Map Service)	2	1			
OGC WFS (Web Feature Service)	3	1			
OGC WCS (Web Coverage Ser-vice)	1				
OGC SOS (Sensor Observation Service)	1	1	1		
OGC SPS (Sensor Planning Ser-vices)	1	1			
OGC WPS (Web Processing Ser-vice)					

64 4/Q3c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN (if any), and suggestions for improvement.

A.6. 5 – SOA

A.6.1. 5a – Provide a SOA interface

SUDPLAN shall define and publish interfaces to access SUDPLAN (in order to access results or to invoke services), which are based on open standards

This will allow other systems to use data and services provided by SUDPLAN.

REQ-DOW-2.2: Publish interfaces

SUDPLAN shall extend the state-of-the-art in the field of service-oriented infrastructures by adding to SOAs new types of services (both specifications and implementations)

If there are no proper service specifications SUDPLAN will provide new specifications and implementations.

REQ-DOW-9.3: Provide new SOA specifications

66 5a/Q1a: Please name the SUDPLAN service interface specifications. This includes standard interfaces, extended or new interfaces as well as propritary interfaces.

1: OGC SOS; 2: OGC SPS; 3: OGC WMS; 4: OGC WFS 5: 6: 7: 8: 9:
1: Sensor Observation Service SOS 2: Sensor Planning Service SPS 3: Web Feature Service WFS 4: 5: 6: 7: 8: 9:

67 5a/Q1b: Please describe the SUDPLAN service interface specifications from the previous question. Please give the number of answers for each alternative.

	pre-existing service specification	extension	new SUDPLAN development	open source specification	proprietary
OGC SOS;		1			
OGC SPS;		1			
OGC WMS		1			
OGC WFS	1				

	pre-existing service specification	extension	new SUDPLAN development	open source specification	proprietary
Sensor Observation Service SOS	1	1			
Sensor Planning Service SPS	1				
Web Feature Service WFS	1				

68 5a/Q1c: Please indicate the level of completion (at least of the new or extended) service interface specifications. Please give the number of answers for each alternative.

	No specification	Functional description	Complete formal description	Considered "best practice" by relevant community	De-facto industry standard	De-facto standard e.g. OGC/ISO/CEN standard	No answer
OGC SOS;						1	
OGC SPS;						1	
OGC WMS						1	
OGC WFS						1	

69 5a/Q1d: Please give pointers to publicly available service documentations / specifications (at least for new or extended specifications). Please give the number of answers for each alternative.

	N/A
Sensor Observation Service SOS	http://portal.opengeospatial.org/files/?artifact_id=26667
Sensor Planning Service SPS	http://portal.opengeospatial.org/files/?artifact_id=23180
Web Feature Service WFS	http://portal.opengeospatial.org/files/?artifact_id=8339

70 5a/Q1e: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

7: Some adaptation / profiling of the standard services where needed, but they are implemented in a way compatible with existing specification.

A.6.2. 5b – Provide SOA service

SUDPLAN shall define and publish interfaces to access SUDPLAN (in order to access results or to invoke services), which are based on open standards

REQ-DOW-2.2: Publish interfaces

72 5b/Q1a: Please name the service instances and data sets used in SUDPLAN. This includes new as well as pre existing services, models and data sets. Examples: Model of Linz sewerage system, Rain time series.

1: Pan european information (SOS, WMS, WFS) 2: Rainfall downscaling (SOS, SPS) 3: Air quality downscaling (SOS, SPS) 4: Hydrological downscaling 5: Local Linz model (SOS, SPS) 6: 7:
1: PanEuropean SOS 2: Rainfall SOS 3: - 4: AirQuality SOS 5: - 6: Hydrology SOS 7:

73 5b/Q1b: Possible usage of the service instances and data sets named in the previous question. Please give the number of answers for each alternative.

	Free of charge	Commercial	SUDPLAN internal only	NA
Pan european information (SOS, WMS, WFS)				
Rainfall downscaling (SOS, SPS)				
Air quality downscaling (SOS, SPS)				
Hydrological downscaling				
Local Linz model (SOS, SPS)				

	Free of charge	Commercial	SUDPLAN internal only	NA
PanEuropean SOS			1	
Rainfall SOS			1	
-				

AirQuality SOS			1	
-				
Hydrology SOS			1	

SUDPLAN shall provide user-friendliness of services and interfaces, in particular ergonomics of the graphical user interface (GUI) and the visualization components

REQ-DOW-2.10: Offer uses-friendly interfaces

74 5b/Q3a: Please indicate the key concepts used in SUDPLAN to assure the usability of the service interfaces. Please give the number of answers for each alternative.

	Yes	Uncertain	No	NA
Self-describing service interfaces	1			
Self-describing data models	1			
Service ontology			1	
Data ontology			1	
Response time estimate			1	
Response size estimate			1	
User-requested limits for response time			1	
User-requested limits for response size			1	
Subscribe / alert mechanism			1	
Panning / browsing through results (in time)	1			
Panning / browsing through results (in space)	1			
Fetching the recently changed data only			1	

75 5b/Q3c: Please give a short textual explanation on the user friendliness of the SUDPLAN service interfaces and suggestions for improvement.

8: standardized user interfaces which fulfilled the SUDPLAn requirements.

SUDPLAN shall extend the state-of-the-art in the field of service-oriented infrastructures by complementing SOAs in the field of modelling services

The models used within SUDPLAN will be provided as services

REQ-DOW-9.4: Provide new SOA modelling services

76 5b/Q4a: Please list the "model as a service" services developed in SUDPLAN. This includes common services as well as local models integrated as services.

	Service name	Type (e.g. OGC SOS)	URL to access the service
7:	PE SOS	SOS	http://aniara.smhi.se:8083/
	RF SOS	SOS	http://aniara.smhi.se:8084/
	RF SPS	SPS	http://aniara.smhi.se:8085/
	AQ SOS	SOS	http://aniara.smhi.se:8086/
	AQ SPS	SPS	http://aniara.smhi.se:8087/
	HYD SOS	SOS	http://aniara.smhi.se:8088/
8:	Rainfall SPS	OGC SPS	
	AirQuality SPS	OGC SPS	

SUDPLAN shall contribute to the extension of the state-of-the-art in the area of model integration and expose the models used in SUDPLAN applications as services in loosely coupled SOA

The models used within SUDPLAN shall be offered as services to allow re-using them in multiple contexts without repeated model development efforts.

REQ-DOW-8.1.: Provide models using SOA

SUDPLAN shall support the integration of models through standardized web services.

Integration of distributed models through standardized web services is essential to support the development of SUDPLAN applications.

REQ-DEV-1.2.2: Model Service Integration

77 5b/Q4b: Please assess the ease of use of “models as services” (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
using already configured model services						*1*	*1*	
integrating a new model service					*1*	*1*		

78 5b/Q4c: Please give a short textual explanation on your experience with integrating and using the models as services (in SUDPLAN), and suggestions for improvement.

7: OGC SPS offers a sound basis for model integration, but to offer a user friendly interface some programming work is needed.

8: easy integration based on standards and open frameworks

SUDPLAN shall contribute to the extension of the state-of-the-art in the area of model integration as models become more available to administrative end users
Models available as services should be offered to SUDPLAN users.
REQ-DOW-8.2: Provide models for the end user

SUDPLAN shall support modellers in integrating their models into a SUDPLAN application. Integrating models into a SUDPLAN application, possibly with other models, means that the modeller needs to be able to specify the role of the model(s) within the application and to make the necessary connections between the model(s) and other components of the application.

REQ-USR-3.1.1: Model integration

79 5b/Q5a: Please assess the capability of SUDPLAN "model as a service" concept (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Dynamic linking the models with data sources						*1*		
Configuration of the models						*1*	*1*	
Running of the models continuously	*1*							
Running of the models on request						*2*		
Informing the users about the model run progress					*1*	*1*		
Propagation of the data and model uncertainties								
Providing rich self-describing data models for model results						*1*		
Handling large data sets						*2*		

80 5b/Q5c: Please give a short textual explanation on your experience with the SUDPLAN's "model as a service" concept, and suggestions for improvement.

7: OGC SPS need an extension to allow easy implementation of user friendly interfaces is an plug&play style. OGC SOS should optimized for large data sets.

8: it works as expected. Mapping SPS on top of models was a success.

SUDPLAN shall contribute to the extension of the state-of-the-art in the area of model integration as emerging SOA development is fostered

Techniques and tools used for model integration in SUDPLAN shall also be available outside of SUDPLAN.

REQ-DOW-8.3: Foster SOA development in the area of model integration

81 5b/Q6a: Please name the extensions of the state of the art in the area of "model as a service" achieved by SUDPLAN (if any).

7: OGC SOS profile regarding offering-list. OGC SOS extension to handle large data sets.

SUDPLAN shall extend the state-of-the-art in the field of service-oriented infrastructures by supporting the spreading of SOA-type service networks

Since SUDPLAN will allow the access to and from SOA based service networks users will have an interest to use SOA networks

REQ-DOS-9.2: Spread SOA-type service networks

82 5b/Q7a: Please list the projects and products using (parts of) the SUDPLAN service infrastructure (if any).

	Project /product name	URL where to find more information
7:	Future IDF curves for regional planning in Europe (demo)	http://meetingorganizer.copernicus.org/EGU2012/EGU2012-9483.pdf
8:	ENVIROFI	http://www.envirofi.eu

83 5b/Q7b: Please give a short textual report on the achievements wrt. spreading of the SOA infrastructures by SUDPLAN, and suggestions for improvement.

7: SUDPLAN is a step in the direction if Future Internet (FI), making information easy available to anyone.

A.7. 6 – Usage of Standards

The SUDPLAN product service interfaces, data and meta-information models shall be entirely based on open standards

The usage of open standards is needed to enable connections to other (existing and future) systems. For example, we need to access already existing city-local data and services which are not based on open standards. This should be done by providing standard based interfaces to this data storages and services.

REQ-DOW-2.1: Use open standards

SUDPLAN shall contribute to the extension of the state-of-the-art in the area of model integration as existing standards (e.g. OGC Web Processing Service) are tested and validated in terms of their usability

SUDPLAN will collect experience in using existing SOA standards.

REQ-DOW-8.4: Validate existing standards

SUDPLAN shall extend the state-of-the-art in the field of service-oriented infrastructures by taking up existing developments, validating and improving them

Rationale: SUDPLAN will use and where necessary improve existing standards

REQ-DOW-9.1: Improve existing SOA standards

85 6/Q7a: Please name the standards that were tested / extended / validated for their usability / actually used in the SOA context by SUDPLAN). This includes service interfaces, data coding standards and more.

		Yes	No	Comment
OGC WMS		3	1	
OGC WFS		4	0	
OGC WCS		1	3	
OGC SOS		4	0	8: extension SamplingGrid
OGC SPS		4	0	
OGC WPS		0	4	
Other 1	O&M	1		
Other 2	GML	1		
Other 3	SA Sampling	1		
Other 4	OWS	1		
Other 5				

SUDPLAN shall contribute to the extension of the state-of-the-art in the area of model integration as existing standards (e.g. OGC Web Processing Service) are tested and validated in terms of their usability

SUDPLAN will collect experience in using existing SOA standards.

REQ-DOW-8.4: Validate existing standards

SUDPLAN shall extend the state-of-the-art in the field of service-oriented infrastructures by taking up existing developments, validating and improving them

Rationale: SUDPLAN will use and where necessary improve existing standards

REQ-DOW-9.1: Improve existing SOA standards

86 6/Q7b: Please assess the usability of the standards named in the previous question (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

		1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
OGC WMS							*3*		
OGC WFS							*4*		
OGC WCS							*1*		
OGC SOS					*1*		*1*		
OGC SPS						*1*	*1*		
OGC WPS									
Other 1	O&M						*1*		
Other 2	GML						*1*		

Other 3	SA Sampling						*1*		
Other 4	OWS						*1*		
Other 5									

SUDPLAN shall contribute to the extension of the state-of-the-art in the area of model integration as existing standards (e.g. OGC Web Processing Service) are tested and validated in terms of their usability

SUDPLAN will collect experience in using existing SOA standards.

REQ-DOW-8.4: Validate existing standards

SUDPLAN shall extend the state-of-the-art in the field of service-oriented infrastructures by taking up existing developments, validating and improving them

Rationale: SUDPLAN will use and where necessary improve existing standards

REQ-DOW-9.1: Improve existing SOA standards

87 6/Q7c: Please describe the key shortcomings of the above mentioned standards that were discovered in the pilot, and give suggestions for improvement.

8: SA Sampling was missing Support for Continuous Coverages. SUDPLAN developed a SA Sampling extension.

The SUDPLAN product service interfaces, data and meta-information models shall be entirely based on open standards

The usage of open standards is needed to enable connections to other (existing and future) systems. For example, we need to access already existing city-local data and services which are not based on open standards. This should be done by providing standard based interfaces to this data storages and services.

REQ-DOW-2.1: Use open standards

88 6/Q2a: Please indicate the proprietary solutions used in this pilot (if any) and explain why no open standard has been used (e.g. “existing system, replacing too costly”, “no open standard exists”).

	Solution	**Reason**
1	7: Wuppertal local model 8: TS-API	7: Existinc commercial system 8: no comparable implementation existing, available in house experts
2	7: Hydrological model configuration	7: Existing webservice
3		

4		
5		
6		
7		
8		
9		
10		
11		

The SUDPLAN product service interfaces, data and meta-information models shall be entirely based on open standards

The usage of open standards is needed to enable connections to other (existing and future) systems. For example, we need to access already existing city-local data and services which are not based on open standards. This should be done by providing standard based interfaces to this data storages and services.

REQ-DOW-2.1: Use open standards

89 6/Q2b: Please give a short textual explanation for the above marks, and suggestions for improvement.

A.8. 7 – Open Source Software

SUDPLAN shall be based on open source products, and will itself be an open source product

Should enable simple extensibility, reuse and make the product easily available to all interested parties at minimal cost

REQ-DOW-2.3: Use and provide open source

91 7/Q1a: Please name the software elements of SUDPLAN. This might include libraries, service implementations, GUI elements and so on.

	Solution
1	SUDPLAN SOS service impl
2	SUDPLAN SOS client impl
3	SUDPLAN SPS service impl
4	SUDPLAN SPS client impl
5	TS-API
6	SOSServer (AIT)
7	SOSClient (AIT)
8	SPSServer (AIT)

9	SPSClient (AIT)
10	
11	

SUDPLAN shall be based on open source products, and will itself be an open source product

Should enable simple extensibility, reuse and make the product easily available to all interested parties at minimal cost

REQ-DOW-2.3: Use and provide open source

92 7/Q1b: Possible usage of the service instances and data sets named in the previous question. Please give the number of answers for each alternative.

	Pre-existing software	**SUDPLAN extension**	**New software**	**Availible as open source**
1		0	1	1
2		1		1
3		0	1	1
4		1		1
5 (1)	1			1
6 (2)		0	1	
7 (3)		0	1	
8 (4)		0	1	
9 (5)		**0**	**1**	
10				
11				
12				

93 7/Q1c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement. Especially if some new developed software is not open source: please state why!

A.9. 8 – Completeness of Functionality

Decisions based on the SUDPLAN applications may have great impact (e.g. financial impact on city planning). It is therefore important to adequately store all the facts and results leading to the decision, e.g. to allow a-posterior reconstruction of the decision making process and audits. Every piece of data within the internal repositories therefore has to be assessed with descriptions about the origin and processing of these data.

REQ-DOW-2.7

95 8/Q2a: Please list quality controlled data repositories used within SUDPLAN.

	Name
1	
2	
3	
4	
5	
6	
7…	

96 8/Q2b: Please indicate which aspects of the repository QA are covered.

	uncertainties of input/output data known and visualized	Data snapshot (input data, model results) used for decision making saved with scenario instance	Decision & reasoning/comments saved with scenario instance)
1			
2			
3			
4			
5			
6…			

97 8/Q2c: Please give a short textual explanation on the (dis)advantages of "quality controlled repositories" in SUDPLAN, and suggestions for improvement.

98 8/Q3a: Please describe at least one "worst case" scenario illustrating the need for "security" when using SUDPLAN.

99 8/Q3b: Please indicate the worst case scenario consequences, in terms of the human or monetary losses, legal liabilities, etc (example: 100M€ on productivity loss in case of false alert).

100 8/Q3c: Please give a short textual explanation on the (dis)advantages of "security" in SUDPLAN, and suggestions for improvement.

Web publishing is becoming a main information source for large parts of the population. SUDPLAN does not intend to implement a full Content Management System functionality, but it should allow the export of results in proper formats to publish them in the WWW to inform the public.

REQ-DOW-2.9

101 8/Q4a: Please assess the usability of the "result publication" on the web as offered by SUDPLAN (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Tables						*1*		
Graphic representations					*1*	*1*		
Animations		*1*						
Videos					*1*			
3D Material			*1*					
Complete reports				*1*				

102 8/Q4c: Please give a short textual explanation on the (dis)advantages of "web publication" in SUDPLAN, and suggestions for improvement.

3: I assume that this refer to the content of the web portal and the web blog used for developing of GUI.

SUDPLAN shall extend the state-of-the-art in the field of environmental decision support systems by offering to users the dynamic composition of scientific work flows

Allow users to define their own workflows as needed

REQ-DOW-3.1:Provide dynamic composition of work flows

103 8/Q5b: Please indicate the level of usability of the "dynamic workflow composition" offered by SUDPLAN as compared to the state of the art workflow solutions (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*

Dynamic workflow composition								

104 8/Q5c: Please indicate the "state of the art" applications used to compare SUDPLAN with.

105 8/Q5d: Please give a short textual explanation for the above marks, key advantages of SUDPLAN wrt. to state of the art (if any), and suggestions for improvement.

SUDPLAN shall extend the state-of-the-art in the field of environmental decision support systems by offering automation of model runs, analysis and reporting

Simplify the use of modelling, analysis and reporting tools for end users

REQ-DOW-3.3

106 8/Q6a: Please indicate the level of support for following functionality offered by SUDPLAN product (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Automated model runs						*1*		
Automated analysis		*1*						
Automated reporting								

107 8/Q6c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN (if any), and suggestions for improvement.

SUDPLAN shall offer a powerful tool for assessing environmental factors and their interaction with urban subsystems such as infrastructure, waste water and transport systems, in a climate change perspective to be used for city management.

Model based decision support applications are used to better understand the effects of city management decisions in a complex system.

REQ-DOW-4.1: Support city management

108 8/Q7a: Please assess the usability of SUDPLAN in the city management scenario (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

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

1

109 8/Q7b: Please assess the usability of the SUDPLAN tool as the basis for city management applications product (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall				*1*				
SMS (Scenario Management System)				*1*				
CS (Common Services)				*1*				

110 8/Q7c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN (if any), and suggestions for improvement.

3: Part of the functionality is very good, but also a lot missing.

SUDPLAN shall enhance the current state of the art in interactive visualization by allowing easy customization of the visualization and interaction by the user/planer, which can produce presentations tailored for different recipient groups

This is needed to present facts and document the reasons of decisions outside the interactive SUDPLAN environment.

REQ-DOW-10.3: Provide tools to create customizable presentation material

SUDPLAN shall support the users' efforts to produce accessible information products from the results of their analyses.

The value of an analysis can be greatly enhanced by producing information products which contain or reflect the results but which are also accessible to other stakeholders. Analysts will require system support to help them generate such information products.

REQ-USR-2.71: Creation of information products

SUDPLAN shall support the generation of reports.

Basic reports making the results of scenario execution accessible to non-analysts are necessary in order to communicate the results to the other stakeholders of the SUDPLAN application.

REQ-USR-2.7.2: Report generation

SUDPLAN shall support the publishing of its artefacts for use of other services.

SUDPLAN analysts may wish to make their data and other information available to other web-based services, and therefore need a mechanism for publishing this information to the Internet.

REQ-USR-2.9.1: Information publishing

111 8/Q8a: Please assess the level of SUDPLAN's achievement while creating presentation material in the following categories (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Interactive visualization								
Customization for different recipient groups								
Exporting the results for further dissemination								

112 8/Q8c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN wrt. to the state of the art (if any), and suggestions for improvement.

REQ-USR-2.1: Information management (specific to analysts)

SUDPLAN shall allow users to manage their information sources easily.

An information-intensive application must facilitate the finding, storing, and utilization of information within the application in order to support user success and satisfaction.

REQ-USR-2.1.1: Information source management

SUDPLAN shall support users in the management of information related to their activities.

Besides actual input data, there may be other information valuable to the analyst, and this information needs to be readily accessible to the users.

REQ-USR-2.1.2: Management of related knowledge

SUDPLAN shall allow users to find and utilize information sources distributed globally via the Internet.

SUDPLAN applications will often rely on data from multiple external sources.

REQ-USR-2.1.3: Distributed information sources

SUDPLAN shall allow users to manage the results of analysis easily.

SUDPLAN applications will produce results in a wide variety of forms. These data need to be easily accessible to and manipulated by the analysts.

REQ-USR-2.1.4: Output data management

SUDPLAN shall support processing of the results of users' analyses.

Given the complexity of SUDPLAN applications, output data resulting from primary analytical techniques may need to be post-processed by the user, and system support for these activities is necessary.

REQ-USR-2.1.5: Result processing management

SUDPLAN shall support the management of information products.

Information products produced by analysts must be stored and managed in an organized and accessible fashion.

REQ-USR-2.1.6: Information product management

SUDPLAN shall support spatial reference system conversion.

Information products produced throughout the platform must be easily convertible to other spatial reference systems.

REQ-USR-2.1.7: Coordinate conversion

SUDPLAN shall support tracing of user actions.

SUDPLAN shall provide support the tracing of user and system component interactions

REQ-USR-2.1.8: Tracing

113 8/Q9a: Please assess the usability of SUDPLAN with respect to the information management requirements of analysts (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Information source management				*1*				
Management of related knowledge								
Distributed information sources					*1*			
Output data management				*1*				
Result processing management				*1*				
Information product management								
Coordinate conversion				*1*				
Tracing								

114 8/Q9c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

REQ-USR-2.2 Interactivity (Special to analysts)

The SUDPLAN user interface shall be highly interactive.

SUDPLAN needs to support and encourage analysts who want to interact with the system by including design features which facilitate manipulation of elements of the modelled system (e.g. parameters, variables, and input data).

REQ-USR-2.2.1: General interactivity requirements

Where feasible, the SUDPLAN user interface shall respond immediately to changes in parameters.

When the analyst has manipulated an input to the modelling system, the system needs to provide an immediate response to this change in situations where that makes sense and is possible.

REQ-USR-2.2.2: Responsiveness

Where feasible, the SUDPLAN system shall pre-fetch and cache data.

Pre-fetching and caching data locally (on users' computers or on a fast LAN) can greatly improve the users' experience of interactive exploration of the data.

REQ-USR-2.2.3: Local data copy

Where feasible, the SUDPLAN system shall download only the part of the data that actually changed since the last request.

Repeated fetching of data over a network is slow and inefficient.

REQ-USR-2.2.4: Differential data download

115 8/Q10a: Please assess the usability of SUDPLAN with respect to the interactivity requirements of analysts (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
General interactivity requirements				*1*				
Responsiveness				*1*				
Local data copy								
Differential data download								

116 8/Q10c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

REQ-USR-2.3: Model management (specific to analysts)

SUDPLAN shall support users in choosing initial and boundary conditions.

Mathematical models generally require parameters describing initial and boundary conditions as constraints for internal variables in the model. It is essential that users be permitted, and assisted where possible, in choosing and establishing those conditions.

REQ-USR-2.3.1: Initial and boundary conditions

SUDPLAN shall support users in storing, managing and re-using sets of conditions.

Particular combinations of initial and boundary condition parameters can be stored as a set, and then reused in subsequent model runs.

REQ-USR-2.3.2: Condition sets

SUDPLAN shall support end users executing models synchronously.

Models which generally run to completion quickly can be run by users who choose to wait for completion.

REQ-USR-2.3.3: Synchronous model execution

SUDPLAN shall support users executing models asynchronously.

Since some models will take considerable time to complete, users may choose to run these models asynchronously.

REQ-USR-2.3.4: Asynchronous model execution

SUDPLAN shall permit users to instantiate repeated executions of models with a variation of conditions.

Extending the concept of asynchronous model execution, users can run multiple instances of the same model combination with varying sets of parameters, producing a "family" of results.

REQ-USR-2.3.5: Model set execution

SUDPLAN shall support users performing and/or using pre-calculated model executions.

For computationally intensive models limiting the number of times the model has to be executed, and using stored results from previous runs, can help model combinations which use these results to execute in a timely fashion, and can also reduce redundant use of computational resources.

REQ-USR-2.3.6: Pre-calculated model execution

SUDPLAN shall allow users to monitor model execution progress and shall notify users of changes in model status.

Computationally intensive models can take considerable time to execute, and during their execution analysts will need to be able to check their status and learn if a run has completed, failed, etc.

REQ-USR-2.3.7: Model run status

REQ-USR-2.6 Result documentation/annotation

SUDPLAN shall support the documentation of an individual model run.

The results of each model run need to be annotated before being stored in order to facilitate search and recovery.

REQ-USR-2.6.1 Documentation of a model run

SUDPLAN shall support the documentation of a scenario set execution

In addition to storing annotations about individual model runs, analysts will need to annotate scenario sets as well.

REQ-USR-2.6.2 Documentation of scenario set execution

117 8/Q11a: Please assess the usability of SUDPLAN with respect to the model management and result documentation requirements of analysts (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Initial and boundary conditions				*1*				
Condition sets				*1*				
Synchronous model execution								
Asynchronous model execution								
Model set execution								
Pre-calculated model execution								
Model run status				*1*				
Documentation of a model run				*1*				
Documentation of scenario set execution				*1*				

118 8/Q11c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

REQ-USR-2.7: Information products

SUDPLAN shall support the users' efforts to produce accessible information products from the results of their analyses.

The value of an analysis can be greatly enhanced by producing information products which contain or reflect the results but which are also accessible to other stakeholders. Analysts will require system support to help them generate such information products.

REQ-USR-2.7.1: Creation of information products

SUDPLAN shall support the generation of reports.

Basic reports making the results of scenario execution accessible to non-analysts are necessary in order to communicate the results to the other stakeholders of the SUDPLAN application.

REQ-USR-2.7.2: Report generation

SUDPLAN shall support the export of its artefacts to external formats.

In order to support the generation of information products beyond basic reports, the analyst will need to be able to export artefacts (such as model execution results or visualized data) to other formats so that they can use tools outside of SUDPLAN to develop more information products.

REQ-USR-2.7.3: Export

REQ-USR-2.8: Sharing

SUDPLAN shall support the sharing of information among different users.

Information regarding a SUDPLAN application, including but not limited to input data, should be readily shared between consenting analysts to facilitate collaboration and efficiency.

REQ-USR-2.8.1: Information sharing

SUDPLAN shall support the sharing of results among different users.

The results of model and scenario set execution can be useful for analysts working on the same or related applications, and should be readily shared along with their documentation annotations.

REQ-USR-2.8.2: Result sharing

SUDPLAN shall support the sharing of information products among different users.

Multiple analysts might be producing similar information products to communicate their results. Sharing of these products encourages efficiency and consistency.

REQ-USR-2.8.3: Information product sharing

SUDPLAN shall support the sharing of automation tasks among different users.

The configuration of automation tasks can become complex for some complicated modelling systems. Sharing these configurations for re-use brings increased efficiency and quality control.

REQ-USR-2.8.4: Automation sharing

SUDPLAN shall support the sharing of annotations among users.

Sharing of annotations among analysts working on the same data sets can increase their efficiency and support additional quality control.

REQ-USR-2.8.5: Annotation sharing

REQ-USR-2.9: Publishing

SUDPLAN shall support the publishing of its artefacts for use of other services.

SUDPLAN analysts may wish to make their data and other information available to other web-based services, and therefore need a mechanism for publishing this information to the Internet.

REQ-USR-2.9.1: Information publishing

SUDPLAN shall support the publishing of its artefacts as web content.

Other SUDPLAN application information, such as visualizations and information products, may also be shared with others as web content in order to enhance the value added by the application analyses.

REQ-USR-2.9.2: Web publishing

SUDPLAN shall use standards for the publishing of information content.

Adherence to standards will increase the availability of SUDPLAN application information to the wider community.

REQ-USR-2.9.3: Web publishing standards

119 8/Q12a: Please assess the usability of SUDPLAN for the creation of reports, publications and data export with respect to the requirements of analysts (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Creation of information products					*1*			
Report generation		*1*						
Export					*1*			
Information sharing					*1*			
Result sharing					*1*			
Information product sharing								
Automation sharing								
Annotation sharing								
Information publishing								
Web publishing								
Web publishing standards								

120 8/Q12c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

REQ-USR-4.1: Platform management

SUDPLAN shall support system managers in managing users.

In order to manage access to a SUDPLAN application the system manager needs to be able to specify users and groups of users to the system.

REQ-USR-4.1.1: User management

SUDPLAN shall support system managers in managing system security and access rights.

System managers need to be able to specify which users are authorized to have what level of access to which parts of the application.

REQ-USR-4.1.2: Security and rights management

REQ-USR-4.2:

Integration SUDPLAN shall support system managers in integrating data sources.

A SUDPLAN application may use data from a variety of sources. The system manager needs to be able to integrate these data sources into the application for the system analyst.

REQ-USR-4.2.1: Data source integration

SUDPLAN shall support system managers in integrating sensor services.

SUDPLAN applications may use sensor services that are either local to the application or that are distributed and accessible via the web.

REQ-USR-4.2.2: Sensor service integration

SUDPLAN shall support system managers in integrating arbitrary services.

SUDPLAN applications may use other non-modelling services that are either local to the application or that are distributed and accessible via the web.

REQ-USR-4.2.3: Service integration

121 8/Q13a: Please assess the usability of SUDPLAN with respect to the requirements of system managers (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

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

122 8/Q13c: Please give a short textual explanation for the above marks, key advantages of SUDPLAN and suggestions for improvement.

A.10. 9 – Conclusions

Information about climate scenarios, downscaling of rain, air quaity and hydrogogical conditions.

123 9/Q4a: Have you had access to similar information as available from SUDPLAN before?

	Y	**N**	**NA**
	2	6	1

124 9/Q4b: Compared to the earlier information SUDPLAN results are: (1 = not fulfilled at all, 4 = on par, 7 = fulfilled beyond expectations). Please give the number of answers for each alternative.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Quality				*2*				
Usefullness						*2*		

125 9/Q4c: Which information sources where used for comparison? Please describe the reasons for your judgement.

9: Publically available climate model information. Data of same quality are available but the easy access in SUDPLAN should be very useful.

126 9/Q4d: What is your impression of the SUDPLAN output?

	Not scientifically sound nor credible	**Not possible to judge on quality**	**Scientifically sound and credible**
		2	4

127 9/Q5a: Do you find the SUDPLAN output to be useful as a base for your planning? Choose one of the following answers.

	Not at all	**To certain extent**	**Highly useful**
1		6	2

Please enter your comments here.

2: Better information about the used climate model would be important

3: It becomes highly useful is CS ouput is combined with local model runs of user-defined scenarios. Only CS is useful to certain extent.

8/: I'm not a planner

128 9/Q6a: Did SUDPLAN provide you with the data output expected? Choose one of the following answers.

	A lot of information missing	**Most information given**	**All aspects covered**
		5	3

Please enter your comments here.

129 9/Q7a: 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
		3	5

Please enter your comments here.

2: Large data handling could be improved
3: PE time series is excellent, map presentaton ordinary.

130 9/Q8a: What is in your opinion the strength of SUDPLAN output?

2: - Integration of local model runs with climate scenario information
- Integration of external data services like sensor data
3: Access both to European wide and urban specific information. The possibility to produce multiple climate scenarios as well as multiple local scenarios.
4: Easy to browse and zoom in on interesting details-
6: Offering a all-in-one toolkit for sustainable planning with respect to climate change.
8: good and usefull system that chains diferent data sources and models in a single tool.

131 9/Q9a: What is in your opinion the weakness of SUDPLAN output?

2: - Hard to integrate new local models
3: Part of the CSvisualisation is poor or lacking. No support in interpretation of uncertainties (or very general).
4: Mor analysis capabilities needed.

132 9/Q10a: Would you recommend the SUDPLAN tool to colleagues in other European cities? Choose one of the following answers.

	No	Maybe for a few specific cases	Yes, would be useful for most cities
		1	7

Please enter your comments here.

3: Because no similar product exists.

133 9/Q1a: Please give a short summary of your impression of the SUDPLAN product.

2: Great product that helps in understanding consequences of future climate problems. User Interface could be improved.
3: A highly interesting concept which should be further developed.
6: SUDPLAN offers a flexible and extensible framework for any data source being of interest in the context of sustainable planing with repect to climate change.
8: Very nice thought through concept and realisation.
9: Useful and innovative tool for combining climate scenarios with local data and models.

134 9/Q2a: Please give some proposals for improvement of the SUDPLAN product.

2: - Easier integration of local models
- Slow User Interface
- Better handling on smaller displays
- Web based GUI

3: DS AQ: Improved visualisation (with differences).
DS RF: Statistical and graphical visualisation of output from different climate scenarios.
DS HYD: Should allow editing of land use in local model.

9: It is rather difficult to use, requires a lot of learning and detailed knowledge of all functions and buttons available, maybe a little less flexibility and more focus on facilitating common tasks would help.

135 9/Q3a: Please give some proposals for the optimization of this survey.

Annex B - LimeSurvey end-users validation

B.1. A – Personal Information

Name	1: Lars Örtegren 2: Chantal Donnelly 3: Magnuz Engardt 4: anonymous 5: anonymous 6: anonymous 7: anonymous 8: Joakim Pramsten 9: Lena Strömbäck 10: anonymous 11: Jenny Enberg 12: Christer Johansson
E-mail address	1: leo@apertum.se 2: chantal.donnelly@gmail.com 3: magnuz.engardt@smhi.se 4: - 5: - 6: - 7: - 8: joakim.pramsten@stockholmvatten.se 9: lena.stromback@smhi.se 10: - 11: jenny.enberg@lansstyrelsen.se 12: christer@slb.nu
Organization affiliation, position and principal responsibilities.	1: Manager and software developer at Apertum IT AB. 2: Senior researcher, research project leader 3: SMHI 601 76 Norrköping SWEDEN 4: SMHI, Sweden, researcher 5: SMHI, Sweden, researcher 6: Stockholm municipality, Environmental and Health administration, ITexpert 7: Stockholm municipality, Environmental and Health administration, GIS expert8: Stockholm Vatten Water and Sewage Network, Investigations 9: SMHI, research coordinator 10: Stockholm Water and Sewage Company, planning sewage network 11: Coordinator, Water Framework Directive and Floods Directive for Bothnian Sea Water District Authority. 12: SULVF
Where did you learn about SUDPLAN and become familiar with it?	1: Partner of SUDPLAN project 2: via SMHI 3: through participation in the project 4: Through SMHI 5: at SMHI

	6: I learned about it in Stockholm but I did not get familiar with it 7: involved in the project 8: Presentation by SMHI 9: By working with the SUDPLAN project 10: At a presentation held at the municipality 11: through SMHI - partner in the project 12: Part of SUDPLAN

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

Name	1: Werner Sprung 2: Friedrich Hochegger

	3: Thilo Lehmann 4: David Steffelbauer 5: David Camhy 6: Valentin Gamerith 7: Guenter Gruber
E-mail address	1: Werner.Sprung@holding-graz.at 2: f.hochegger@linzag.at2: david.steffelbauer@tugraz.at 3: thilo.lehmann@wien.gv.at 4: steffelbauer@sww.tugraz.at 5: camhy@sww.tugraz.at 6: gamerith@sww.tugraz.at 7: gruber@sww.tugraz.at
Organization	1: Holding Graz Services 2: LINZ AG 3: Wien Kanal 4: TU Graz 5: TU Graz 6: TU Graz 7: TU Graz

Name	1: Jan Mertl 2: Vladislav Bízek 3: Mária Kazmuková 4: Katerina Sukdolova 5: Jiri Kvapil 6: Jan Pokorny 7: Rut Bizkova 8: Pavlina Slavikova 9: Miluse Rollerova 10: Jana Benesova 11: Ludek Pasek
E-mail address	1: jan.mertl@cenia.cz 2: vladislav.bizek@gmail.com 3: kazmukova@urm.mapnet.cz 4: katerina.sukdolova@mzp.cz 5: jiri.kvapil@cenia.cz 6: jan.pokorny@cenia.cz 7: bizkova@tacr.cz 8: pavlina.slavikova@cenia.cz 9: miluse.rollerova@cenia.cz 10: jana.benesova@cenia.cz 11: pasek@ekosystem.cz
Organization	1: CENIA 2: Environ. consultant 3: ÚRM 4: MŽP 5: CENIA

	6: CENIA 7: TAČR 8: CENIA 9: CENIA 10: CENIA 11: Ekysystem
Country	1: Czech Republic 2: Czech Republic 3: Czech Republic 4: Czech Republic 5: Czech Republic 6: Czech Republic 7: Czech Republic 8: Czech Republic 9: Czech Republic 10: Czech Republic 11: Czech Republic
Organization	1: Team member 2: Team member 3: Urban planner 4: Head of AQ unit 5: Team member 6: Deputy Head of EA Unit 7: Chairperson 8: Head of EA Unit 9: EA expert 10: EA expert 11: Project manager

Name	1: Eckhard Kohlhas 2: Uwe Schlink 3: anonymous 4: Fred Weber 5: Hinnesk Ries 6: Ronny Klaeboe 7: anonymous 8: Felix van den Meijden 9: Inka Kaufmann 10: Anders Rimne 11: Jenny Enberg 12: Malin Bruhn (survey submitted in paper form)
E-mail address	1: eckhard.kohlhas@lung.mv-regierung.de 2: uwe.schlink@ufz.de 3: - 4: fred.weber@stadt-hagen.de 5: hinnesk.ries@hzg.de 6: rk@toi.no 7: -

	8: felix.vandermeyden@denhaag.nl 9: inka.kaufmann_alves@bauing.uni-kl.de 10: Anders.rimne@lansstyrelsen.se 11: Jenny.enberg@lansstyrelsen.se 12: Malin.bruhn@lansstyrelsen.se
Organization affiliation, position and principal responsibilities	**1:** Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg- Vorpommern Abteilung Wasser Dezernatsleiter EG-Wasserrahmenrichtlinie **2:** Helmholtz Centre for Environmental research UFZ Permoserstr.15, 04318 Leipzig, Germany Senior scientist Urban climate, urban air quality, health effects **3:** hydro & meteo GmbH & Co. KG env. engineer quality control of rainfall data GIS **4:** Municipality (stadtverwaltung) of Hagen; Head of environmental planning, air quality, climate protection, GIS **5:** Climate service Center Germany science offices climate data analysis, consulting for city-adaption to CC **6:** TOI Chief research officer www.toi.no **7:** SHMI Marketing **8:** Department of City Management, The Hague **9**: - **10:** Water authority – South Baltic Sea; Climate impact hydrology **11:** Water authority – Bothnian Sea; Coordinator climate impact hydrology 12: Water authority – North Baltic Sea; Climate impact hydrology
Country	1: Germany 2: Germany 3: Germany 4: Germany 5: Germany 6: Norwey 7: Sweden 8: The Netherlands 9: Germany 10: Sweden 11: Sweden 12: Sweden
Where did you learn about SUDPLAN and become familiar with it?	1: Wuppertal_workshop 2: from colleagues 3: Wuppertal_workshop 4: SUDPLAN workshop 5: google 6: Wuppertal_workshop 7: Participating in the project regarding marketing 8: Wuppertal_workshop 9: Aqua Urbanica 2012, Munich 10: Through SMHI, project member from Sweden. 11: SMHI 12: -

6 [A_6]: Please describe your knowledge with respect to the SUDPLAN product. Check any that apply:

Type of user	Y	N
SUDPLAN team member	15	21
Urban / regional planner	11	34
Modeller	14	31
System manager	1	44
IT expert	9	36
Climate change expert	8	37
Have seen presentations and documentations	30	15
User of the SUDPLAN / model results	10	35
Working with the actual system	15	30
Participating in a SUDPLAN workshop	28	17

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.

7 [A_7]: Please indicate in which context did you test the SUDPLAN output Check any that apply:

Type of environmental risk		
Urban stormwater flooding during intense rainfall		13
Management of sewage water systems		10
Risks of flooding of rivers		5
Hydrological conditions		10
Air pollution		15
Other	none	5
	not yet tested, just saw demo during the WS	
	no testing	

	brief presentation	
	climate change	

8 [A_8]: Which temporal horizon is relevant for your planning? Check any that apply:

Temporal planning interest	Y	N	NA
Present conditions and short term (<10 years) planning	26	19	
Long-term planning (>10 years)	39	6	

B.2. B – Graphical User Interface

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

9 [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	*21*	*20*		*4*
Contextual help system	*18*	*19*	*3*	*5*
Alerts when processing finished	*11*	*29*		*5*
Panning/browsing through results (in time)	*24*	*18*		*3*
Panning/browsing through results (in space)	*22*	*20*		*3*
Highlighting recently changed data	*10*	*23*	*4*	*8*
Comparing two result sets	*24*	*18*		*3*

10 [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			*6*	*8*	*9*	*9*	*2*	*11*
Define a scenario			*3*	*7*	*14*	*9*	*3*	*9*
Execute scenario with parameters			*3*	*7*	*6*	*10*	*8*	*11*
Save results			*1*	*10*	*4*	*13*	*5*	*12*
Share results with others		*2*	*4*	*8*	*9*	*5*	*1*	*16*
Visualize results		*1*	*1*	*7*	*12*	*15*	*4*	*5*
Visualize uncertainties	*8*	*5*	*3*	*9*	*4*	*3*	*1*	*12*
Compare the results of various scenarios		*1*	*5*	*8*	*15*	*7*	*3*	*6*
Export results in different formats			*6*	*11*	*6*	*7*	*1*	*14*

11 [B_3] Please assess the usability of SUDPLAN

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
With various output devices		*1*	*4*	*8*	*8*	*3*		*21*
Spatial visualization		*1*	*1*	*4*	*10*	*17*	*3*	*9*

Temporal visualization	*1*	*1*	*1*	*4*	*13*	*12*	*3*	*10*
Spatio-temporal visualization		*1*	*1*	*5*	*11*	*13*	*1*	*13*
Contextual help	*6*	*2*	*5*	*8*	*6*	*2*		*16*
Ease of learning		*5*	*6*	*8*	*8*	*7*		*11*
Memorability			*2*	*8*	*11*	*5*	*2*	*17*
Geo-referenced data		*1*		*9*	*11*	*4*	*5*	*15*
Transparency	*1*	*1*	*1*	*5*	*11*	*10*	*1*	*15*
3D data, geo-referenced, on a map		*1*	*2*	*5*	*11*	*9*	*2*	*15*

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

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall impression			*1*	*4*	*7*	*15*	*2*	*16*
3D GUI interaction			*2*	*8*	*5*	*10*	*1*	*19*
Information visualization			*3*	*7*	*9*	*8*	*2*	*16*
Presenting of the scenarios			*1*	*10*	*7*	*9*	*2*	*16*
Comparing of the scenarios		*2*	*5*	*7*	*9*	*3*	*2*	*17*
Analysing of the scenarios		*4*	*2*	*11*	*7*	*3*	*1*	*17*

13 [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.

A little difficult to remember where everything is. The left menu isn't always intuitive

Overall fine. Two points to improve: - It is hard to use on a small screen. - It does not visualize uncertainty well.

I have not tried it myself so I think it is difficult to judge what is easy and logical and what is not.

- 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

- Visual analysation 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 a useful feature for offline presentation (politicians and general public)

- 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 wizzards should be enhanced (individual operation names)

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

Too many buttons.

Absolute useful tool in the context of sewage planning. Some improvements regarding visualization.

GUI is well thought out. Display of spatial information and model results is very good. Better help system would be great.

The GUI is clearly structured and easy to navigate. Spatial data and measurement data is accessible and the result visualization as well as result comparison works well. The overall speed of time series visualization of could be improved.

The capability is nearly fulfilled beyond the expectation. Contextual help is missing. Tutorials are missing in written form at all but are at least available as small video clips. Usability need some improvements. Reporting functionality is missing.

the user experience is comparable to other similar systems

Really hard to work with for inexperienced user who is not familiar with the product. Fantastic 3D visualization as well as the visualization of temporal development of climate and air quality.

Attractive and potentially very useful application but it is hard to learn how to work with it. Some manual or contextual help would be very helpful.

too little experience, maybe more demo on website

3D-visualization should be improved

(not having worked with the GUI/SUDPLAN myself) I'm impressed by the visualization you've created. Everything looks very good + easy to use + well-arranged. I also had the impression it responds quickly (combining data, changing zoom etc.)

I have accessed the system, but have no password. I have seen the functionality, that is nicely put together. I in particular liked the prospects of being able to postprocess outputs from submodels before visualisation. I thought using open source solutions reduces barriers to wide spread use.

I have no personal experience. My impressions are based on the second day of the Wuppertal workshop (presentations by the SUDPLAN partners and the Q&A. Some information previous to the workshop would have helped to understand the models better. The SUDPLAN site provides links to relevant modles but ik took some time to get all the pieces of the puzzle. The product at this stage is not completed. The manual has still to be drafted. It would also help to better define the target group.

The GUI looks appealing and the open source solution is good. Nevertheless, the advantages over "normal" GIS-application is not clear for me. The visualisation tecniques seemed not so much "advanced". The only advantage I could see is, that you can start applications out of the GUI. The handling and built-up of scenarios seems labourious (clicking many drop-down menues).

B.3. C - Common Services

B.3.1. C1 – 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.

14 [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		2	2	7	11	16	3	4
Within area of your interest over Europe			1	4	13	14	8	5
Available time range			1	5	6	18	10	5
Available scenario documentation			10	10	8	6	1	10
Possibility for changing temporal resolution for data export	1		2	5	8	9		20

B.3.2. C2 – Common Services – Rainfall

The rainfall services provide prediction of

- *rain time series*
- *IDF curves*

15 [C2_1] Please assess the usability of the SUDPLAN short-term rainfall downscaling.

	1	2	3	4	5	6	7	NA
Overall				2	9	13	5	16
Upload of historical/local data to improve the results				5	7	11	4	18
Downscaling				5	7	13	4	16
Visualisation of the results		1		2	7	15	4	16

16 [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			3	4	7	10	6	15
Downscaling procedure				3	6	17	5	14
Results visualisation and download				3	7	16	5	14

17 [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				5	7	4	4	25
Downscaling procedure				4	3	10	4	24
Results visualisation and download			1	2	3	10	4	25

18 [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				3	8	11	1	22
Downscaled continuous rainfall time series: Long-term (annual, seasonal) volumes	2			2	5	12	3	21
Downscaled continuous rainfall time series: High and low intensities				4	6	8	2	25
Downscaled IDF-curves: General performance				5	2	6	1	31
Downscaled IDF-curves: Dependency on duration				3	4	4	1	33
Downscaled IDF-curves: Dependency on return period				4	3	4	1	33

19 [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				2	5	6		32
Dependency on duration				1	6	5		33
Dependency on return period				3	4	5		33

20 [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.

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.
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 stormwater event). This has to be done outside of the SUDPLAN SMS.
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.
Didn't have enough insight to form an opinion.
Great feature to have the possibility to downscale historic rain timeseries to future predicted ones based on different climate change approaches.
I have not been able to assess this directly, only through the presentations at the workshop. I need to look into the quality of own data sources, before being able to

judge the performance of the downscaling software. The integration with E-hype seemed very promising.
I am not in a position to assess the scientific soundness of IDF-curves.
IDF-curves not relevant for Linz Pilot
Was not part of testing of rainfall application.
I did not check the IDF-curve functionality in detail so I gave no answer to the related questions. Overall the procedure for uploading rainfall data and performing the downscaling is easy to carry out and the results can be put directly to use in following model runs.
Better information about climate scenarios would be helpful in assessing the scientific soundness and credibility of rainfall downscaling
Linz Pilot is only dealing with long term rain time series. Therefore I have no experience and no need with applying the IDF curve SUDPLAN functionality so far.
The downscaling procedure for predicted rain time series need some improvement in the context of the definition of future time periods. The already implemented rainfall downscaling functionality is unique and no comparable tool is known at the moment for this functionality. It allows the estimation of climate change in the context of combined sewer overflows (CSO). Regarding the usability there is still some place for improvements especially concerning the background information and the contextual help regarding the already implemented climate scenarios, but also for the visualization and the report functionality.
not evaluated
-
No tool available for comparison, therefore no answers to questions 19 and 20.

B.3.3. C3 – Common Services – Air Quality

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

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

	1	*2*	*3*	*4*	*5*	*6*	*7*	*NA*
Overall					*7*	*7*	*3*	*23*
Upload local emission data			*5*	*4*	*6*	*3*	*2*	*25*
Downscaling			*3*	*2*	*9*	*6*	*2*	*23*
Visualisation of the results			*4*	*1*	*3*	*9*	*5*	*23*

22 [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*	*2*	*8*	*7*	*2*	*25*
Trends in air quality			*2*	*1*	*5*	*11*	*1*	*25*
Year-long downscaling air quality simulations			*2*	*2*	*7*	*8*	*1*	*25*
Impact of local sources, activities and land use	*1*		*2*	*4*	*6*	*5*	*2*	*25*

on future air quality in particular European cities								
Use of the downscaled air quality grids in local planning scenarios			*2*	*4*	*7*	*5*	*2*	*25*
Use of SUDPLAN air quality results as input to local dispersion models			*3*	*5*	*7*	*2*	*1*	*27*
Estimate the importance of local sources of pollutants vs. long-range pollution transport for the local air quality			*2*	*3*	*7*	*3*	*3*	*27*

23 [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*	*2*	*8*	*6*	*4*	*24*
Comparing the results of future city development plans			*3*	*3*	*5*	*8*	*1*	*25*
Assess the feasibility of fulfilling national air quality standards and environmental objectives, in a climate change perspective			*1*	*4*	*8*	*2*	*3*	

24 [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.

Common Service Air Quality is not used in the Wuppertal pilot, hence no validation.
The common Service ""Air Quality"" is not used within the WUP pilot, hence it is not validated here.
The common Service ""Air Quality"" is not used within the WUP pilot, hence it is not validated here.
Didn't have enough insight to form an opinion.
The spatial resolution might be improved becouse the concentration fields of air pollutants are very heterogeneus in urban areas. Enhanced spatial resolution will help identify hot spots.
See previous remarks. Air quality is a very dynamic field. At the local level predictions will be difficult to make.
Not relevant for Linz Pilot
was not part of testing the air pollution tool.
I did not use the SUDPLAN platform for air pollution assessment
I am not involved in air pollution and I am therefore not familiar with this topic.
the results are satisfactory and sufficient
New tool which has not been available in the Czech Republic before.
Results could be used on regional or local scale for urban planning. I find possible improvement in minimization of projection uncertaintes and improvement of emission inventories.
I compared Sudplan results with my personal knowledge of situation and scenarios currently available for Prague.
Sudplan tool is able to provide decision makers with the insight to the future state and development of air quality in urban areas in the climate change perspective. Moreover, it is able to predict what will happen with air quality if some infrastructural and socio-economic changes take place. This is the main added value of the

product which can contribute to adaptation of cities to climate change.
The results are very useful and can effectively support decision making processes on regional level. What I particularly appreciate is the incorporation of climate change factors into the future development of air quality. However, I think that the integration of national air quality modeling systems with the Sudplan tool would be very complicated, moreover,it seems to be hard to upload national and regional emission and activity data into Sudplan system. Unfortunately, unless having this issue fixed, the usability of the system in real urban developoment projects is limited.
-
Not part of the Wuppertal pilot, therefore no validation.

B.3.4. C4 – Common Services – Hydrology

Questions about prediction of river runoff

25 [C4_1] Please assess the usability of the SUDPLAN tool as the basis for river flooding assessment applications

	1	2	3	4	5	6	7	NA
Overall				2	8	7		28
Upload of local river discharge time series			1	4	6	6	1	27
Local calibration			1	8	3	5	1	27
Presentation of the results from local calibration				7	5	5	1	27
Presentation of the results from simulation			1	2	6	9	0	27

26 [C4_2] Please assess the usability of SUDPLAN hydrological application

	1	2	3	4	5	6	7	NA
Preparation and staring a local calibration				10	3	6		26
Starting a local climate simulation				7	5	7		26
Download and further exploration and use of the results				6	5	7		27

27 [C4_3] Please indicate the usability of SUDPLAN hydrological results for assessing

	1	2	3	4	5	6	7	NA
Changes in river discharge				3	5	9	1	27
Changes in soil moisture				5	6	6	1	27
Changes in available ground water levels		1		7	2	6	2	27

28 [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.

Good tool. The models shoud be free for use
Common Service Hydrology is not used in the Wuppertal pilot, hence no validation.
The common Service ""Air Quality"" is not used within the WUP pilot, hence it is

not validated here.
The common Service ""Air Quality"" is not used within the WUP pilot, hence it is not validated here.
Didn't have enough insight to form an opinion.
I thought the integration of precipitation E-hype and domain specific models (Wuppertal/Linz) very interesting. However, I have only experienced this from the workshops, and am not comfertable with judging before actually having tried the system out in an application context.
Dis not attend this presenttaion.
Not relevant for Linz Pilot
was not part of the testing of the application.
I did not use the hydrology services
I was not involved in these topics and therefore I have not tested the implemented functionality.
not evaluated
-
Not part of the Wuppertal pilot, therefore no validation.

B.4. 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. These models are typically not usable outside the context of this specific city.

29 [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	2	3	6	6	7	2	17
Running models directly from the SUDPLAN GUI			1	7	7	6	8	16
Specifying parameters for model runs			3	3	11	8	2	18
Using model results as input for another model (Service chaining)	4		3	3	8	7	2	18
Configuration of models	4	1	3	9	5	4		19
Model validation	5	1	1	5	11	2		20
Model calibration	5	1	1	6	11	1		20

B.5. E – Completeness of Functionality

30 [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	3	7	6	10	1	17
Report generation		2	4	4	10	5	1	19
Coordinate conversion		1	2	5	9	4	1	23
Export			2	5	10	8	1	19
Information/result sharing			6	5	8	4	2	20

31 [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	3	10	4	1	23
Security and rights management	1	1		5	9	3	2	24
Data source integration			1	6	7	8	1	22
Sensor service integration			2	5	7	6		25
Model integration	1	1	6	2	7	6		22

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

the toolset is easy to use also for other questions
- 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)
- 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
unfortunatelly, I cannot assess, I have only a little experience with the product
- 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
Common services, build an run scenarios
- the GUI - the fact that it allows to easily assess the range of future climate impacts for an own area of interest
The joint application of different common services can helpsplving trade-offs in urban planning when different end points (air quality, risk of inundation, ...) are considered.
Downscaling of rain data and possibility of georeferenced mapping of sensors, wastewater-treatment-plants, etc... with datas of the sensors and meta information.
Chaining/postprocessing/integration
The ability to select a time frame (for example 2020-2050) and being able to show effects of climate change using a sliding scale.
The connection to common services is a great advantage of the tool.
Integration and visualization of data time series
Access of clmate and emission scenarios
Downscaling of temp and percip. River discharge, soil moisture. Possibility or local calibration.
Possibility to upload own datasets, zooming in mapp, mapview of all Europe.
visualisation local calibration hydrology
Spatiotemporal visualisation Integration of local data with other SUDPLAN models
For hydrological modelling: adding your own discharge and calibrate a model for a smaller area.
The integration of data and models for different scenarios in one platform The ease

of use in the process involving different services (upload - downscaling - model run - result visualisation)
Integration of measurement data, climate scenario information and local model runs.
The model and on-line data integration was done nearly beyond our expectations.
Air quality modeling in the long-term perspective.
Production of time series of temperature/precipitation/air quality for the particular place. Visualization of temporal development of climate and air quality over the whole Europe and zoom in to the area to be dealt with.
Generation of time series for the particular place. Possibility to visualize develpment of climate and air quality in time over long time period. 3D visualization.
Embedding your own models with a set of changeable parameters.
- Rainfall Downscaling - Easy manipulation of the DEM (TIN)without licence for local model required - Enhanced interactive visualization compared to the local model)

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

none
- No GUI avaiable for export of GIS data via OGC Services (mainly WFS would be useful)
- 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 unfortunatelly, I cannot assess, I have only a little experience with the produc
- 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
A kind of data assimilation (ombination of predictive models will measuremnts made at selcted points and time periods) might increase the pecision of projections to the future. The aspect of model uncertanity might be better considered.
See previous question. It would be nice if the effects over a time period could be shown in the form of an animation. This would be particularly useful for presentations to policymakers and local politicians.
The comparison of scenarios could be done with transparant layers (eventually this is possible, I haven't seen it in the Workshop)
Better reporting possibilities No context help
Time series and spatial visualization of climate scenarios
Help functionalities. Information on diffrent layers and parameters.
Better background map
- Include add-ons (e.g. like in Firefox browser) where developers can add their own modules to enhance SUDPLAN
A 'how to start' guide might help the users not familiar with SUDPLAN to find faster into the full system functionality
Help system, better information about the climate scenarios.
Report functionality for other end user categories is missing.

Using of real climate data instead of model results for current year´s simulations.
Low resolution of climate change data, downscaled regional climate model data are not incorporated into the system. It´s hard to display delta of emissions between two time slices or two scenarios. In particular, it is hard to display negative values (decrease of emissions). Ease of downloading national emission data - the system is not flexible and user friendly.
Upload and display local activity and emission data on the map. Better export possibilities of data (shapefiles, xls files).
-
- 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 analysation capabilities (e. g. display of max. waterlevels and time variation curves for a selected cell of the TIN)

34 [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.

Easy to use, delivers answers to key questions according climate change. The models shout be free for use in other context.
Validator is not involved in any planning process, therefore no statement is given.
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.
unfortunatelly, I cannot assess, I have only a little experience with the produc
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 possibilty 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.
SUDPLAN is easy to use in different urban planning tasks
low-threshold for non-experts
It is an useful tool to make climate scenarios understandable to people and help to make decisions (concerning the future planning of e.g. sewer water system) easier.
For my opinion, the sudplsn-system is not adrssed for the local level, particulary for urban planning issues. For example, air quality measurements like enviromental zone, immision depending steering system or planning road by passes cannot evaluated. For urban developing and town planning it is extrem important to asses the influence of different measures to make the required decisions.
The visualisation is very appealing. Predefined analyses are vry easy to perform. Colomns bars were often missing.
It is essential that the SUDPLAN application can be used by non-scientists. At city

level there are hardly any researchers employed. Day to day work in the field of environment and city planning envolves applied science. This is an important consideration in the development of SUDPLAN. Special considerations is needed for the limitations. The manual should therefore also include backgroud information about the limitations of downscaling.
For ""non expert"" users, e.g. city planners, the the tool should be slimmed down.
All in one szenario management system Possibilities to use future aspects for sewage design (climate change, land use, ...)
Consider urban heat island effects and higher geographic resolution. Include future population density and make population weighetd concetrations.
See conclusion from project member SMHI where we stated all comments on the tool.
- The ease of use of the system and the comparability of results from different scenarios can help the planner to compare and decide - The visualisation allows to easily present the results to stakeholders that are not involved in detail in the planning process
I think the main advantage of using SUDPLAN in city management scenarios and urban planning is the integration of climate scenario information in local models.
The possibility to compare different scenarios regarding the CSO behavior in the context of possible climate change or a changed land use in one platform is unique, well done and facilitates the development of proper mitigation strategies by responsible urban drainage managers in time. For a regular application some improvements should be done concerning the visualization and reporting functionality.
Better resolution of data used for modeling.
Air quality modeling takes into account climate change, which is crucial in the long-term perspective. Complexity of the product for urban planning, taking into account either air quality or hydrology issues including flooding and soil moisture.
The biggest benefit of the Sudplan tool I see in evaluation of the impacts of city development projects on air quality carried out either before or after project implementation.
-
SUDPLAN offers the possibilty 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 avaiable 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.

B.6. F – Conclusions

Please, give your final impression on SUDPLAN!

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

	Y	N	Cannot assess	NA
New	25		2	
Better quality	20		7	
More useful	23		4	

36 [F_2] Would you use the SUDPLAN output as a base for your future city planning? Check any that apply:

	Yes	Comments
Yes, I would	19	-
Yes, it is useful for most cities	13	- especially for bigger cities - mainly for large cities with appropriate IT infrastructure - mainly for large cities with appropriate IT infrastructure
Yes, to certain extent	15	- If I need to concern climate changes in air quality model-ling - See above mentioned. It is an innovative product. I would use it if a good support (mannual, contextual help) were provided and if the upload of national data was easier.
Yes, but I still miss some information	10	- climate indees, robustness measures, statistics - uncertainties - there are still big uncertainties in this kind of projection
Maybe for a few specific cases	7	-
I would recom-mend to my col-leagues in other European cities	14	-
No, I would not use it at all.	2	For city planning as I'm no city planner. But for other things maybe.

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

Excellent and con-tributing to a better understanding	Ordinary	Not useful	NA
37	8	-	-

Please enter your comments here:

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.
very nice and comprehensive presentation
Though there is still room for improvements, e.g. visualization of volumes could be amended.
Based on presentations and understanding. I am an environmental scientist - not a planner !!
.. but not in all fields
Hard to use, to many boxes, background map needs further developing.
I like the 3D visualization and its possible use to visualize more variables at the same time, which could be used for the interpretation of results.
Results are great, however, it is a bit more difficult to work with the system.

38 [F_4] What is in your opinion the strength of SUDPLAN product?

delevoped toolset which can be used for any desired questions
- 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
- 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 path, land use plans etc. to enable interdisciplinary planning processes
comprehensive and understandable presentation of results
- Flexible visualization of different scenarios in 2D, 3D and 4D - SUDPLAN lowers the threshold to introduce climate change in urban planning
Good tool to integrate other models
the GUI
- The combination of planning measures and climate change aspects into one tool for the ssessment of future potential risks - Th graphical presentation of all results in a common framework
Understandable graphical representation of future changes concerning climate change.
To take into account climate change in the planning of sewerage systems.
Global overview about climate change.
no answer
The integration approach means that future impovements in modelling and resolution will carry over into all submodels without having to do a lot of manual integration.
Translating the complexity of climate change into a practical application that can be used as an eye-opener for people not familiar with climate change. Useful tool in the upcoming field of climate adaptation.
The connection to the common services
To take climate aspects into account for sewage design
Localized estimation on climate change and the ability to show estimated trends based on different scenarios. The capability to downscale short-term rainfall and the estimation of seasonal variations in rain patterns.

Easy accessibility to future climate data originating from different estimates.
Easy to use. Nice visualisations of climate scenarios.
Visualize regional climate change predictions.
Making climate change scenarios available. Improving the climate change information by adding local data.
Makes recent research methods readily available to planners
Graphics, Interaction with users (i.e. users can enhance the product through their own work).
Bringing together different areas (climate change, hydrology, air pollution, etc) to one system.
The integration of data sources, services and models in one platform combined with the ease of use and the result & scenario comparison possibilities
The presentation of scientific results for end users.
The integration of different services in one unique platform which is running on nearly each IT platform.
Visualization, combination of air quality and climate change modeling/projections
Visualization, combination of climate, air quality and hydrology modeling.
Integration of climate change, air quality and hydrology modeling. Long time scale of results up to 2100. Assessment of what-if scenarios. Advanced visualization techniques used.
Already mentioned in previous answers.
Giving a wider audience access to originally complex models

- See above (Q 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.

39 [F_5] What is in your opinion the weakness of SUDPLAN product? What should be improved?

The product would have a larger distribution if there where free for use models
- 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)
- 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)
little information about input
Insufficient contextual help of application and limited possibilities of integration with national modelling systems.
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)
no comments
I don´t know how to upload national data into the Sudplan modeling system (emission, transportation etc.).

I have no comments
The models used in SUDPLAN are not accessible for everybody
Being able to be adopted by many people from many fields of interest in many regions means to be unable to go fully into details.
no answer
Consideration of uncertanities of different origins. data, models, ... and their visualisation.
Downscaling of rain data takes a lot of time.
Reporting and help functionality.
Not useful for urban developing and town planning.
no answer
The software is free to download. However, the usability lies in the integration with SMHI downscaling, and E-hype etc. It isnot very clear whether it is possible to access these services, or whether this requires some sort of agreement/fee. There were suggestions that usage of the program could drain smhi for computing power.
Could be much more user-friendly tas-oriented menu structure. There is a need for another vocabulary.
See previous remarks.
The GUI seems too overloaded, a less detailed UI would eventually be more useful.
NO opinion
In long term sense: actuality of input data, climate model approaches, ...
I do not know.
I would like to have functionality to compare maps side by side.
No specific weaknesses
Not so easy to use without learning. User interface could be improved.
Background information on data and methodes used. Assesment of uncertaninty.
See conclusion sent from project member SMHI (in evaluation form)
Better user handling.
More scenariso required to define uncertainty
It's always a weakness with manual uploading of data into the system. I think the graphics (presentation of results) is the weakest point of SUDPLAN.
Modular add-ons so that one can more easily etend the product. Open-access to source code throughout.
I don't know.
Some minor points as a more detailed documentation or help system could be added
Better information about the climate scenarios
All implemented services must be alive and full internet connection is necessary to apply the whole functionality of the SMS SUDPLAN system.
not evaluated
No idea.
Uncertainties of projections
It is only the first step and some follow up is necessary.
User friendliness of the product for someone who has not been involved in its development. Complicated upload of local data - it should be easier as the product is aimed at supporting regional development. Better mannual and application support system after the project end is essential.
Already mentioned in previous answers.
-
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:

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
- 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. desaster management). Most usful are the 3D map component and the temporal navigation through WMS layers.
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)
very advanced product, needs more publicity
I think that the temporal range of modeling up to 2100 is too long and that the capabilities of model are exaggerated. I would recommend to focus on modeling by decades, which is, from my point of view, more accurate and valuable for end-users.
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.
no comments
The project results can support infrastructure development projects and the Environmental Impact Assessment processes. However, better integration with national information system and tools is needed.
I have no comments
versatile, easy to use, transferable
When combined with a solid specialized model for the specific field of interest, SUDPLAN adds a fantastic GUI and interesting CS data.
no answer
An excellent interdisciplinary product integrating recent scientific developments (JCT, environmental) with practical urban planning.
Overall it is a nice tool to visualize climate change influencing different points of interest (Hydrology, waste water treatment, air pollution) and therefor to help people to make decisions concerning future tasks.
Very useful tool for the planning process of sewerage systems if you want to take into account climate change.
Interesting details for the pan-european scale, but not useful for local scale
no answer
I thought the conceptual framework a very promising avenue to pursue further. I would have liked to look into how to integrate the Regional model/E-hype output with a domain specific model for transportation networks (problems due to snow/ice)
Useful as a platform in projects with many participants.

Nice product. Needs some evolution regarding the intended user (non-scientist).
The product as a whole is really a great advantage. In the workshop in Wuppertal, the scenario management was not clear to me. This point could be improved.
NO opinion
Useful tool in the context of climate change aspects for sewage planning
It seems like a good and usable product.
It is an interesting syste. I like the possibility to easily explore details in results.
Though interested and impressed I think that most municipal planners has the need for specific recommendations for the adaptation to a future climate at a specific place and maybe not what will the weather be like in Löddeköpinge year 2063 or the Gdansk forecasts. This is perhaps more useful att a national/europeean level. So (of course, depending on price) I think my organization might not by this product.
Easy access of future climate and emission scenarios for long term urban planning.
Nice way to present different climate scenarios.
Good intentions but need further technical and user-development.
A powerful tool for urban planners.
Nice
Impressing collection of results and achievments from a number of different disciplines.
Good but would be good to link better with other developments going on in this direction
Impressive, user interface, integration.
The SUDPLAN product is overall very well presented and impressed both users and stakeholders. The results combining historic measurement data, climate change scenarios and local models and their comparison allow a sound assessment of possible future changes within one platform. The outputs are useful also for presentation to stakeholders not involved directly in the planning process.
I think SUDPLAN is a well thought out product, which is useful for end-users to get a deeper understanding of scientific results. The integration of climate scenario information in local models helps to get a better understanding of future challanges.
A great tool to take into account climate changes and other future aspects (land use, population, ...) for future city planning.
not evaluated
Excellent tool applicable to improve air quality assessment and management in the Czech Republic
As my occupation is air quality I focused mainly on air quality part of the project. I appreciate the tool developed within the project, in particular the visualization. Results of pilots could be used for regional and local urban planning.
Good idea, well done, quite a lot of work in front of authors.
Please see the assessment above.
Very innovative tool which significantly contributes to air quality protection on urban level. It can support decision making processes on city development projects, mainly in terms of city infrastructure. The main limitation of the system I see in a difficult adjustment of the tool to national conditions, namely I mean upload of local data into the system and its integration with already existing models.
A helpful tool for all kinds of long term (!) analysis.
SUDPLAN implements a forward-looking concept. In principle it is possible to integrate the Wuppertal pilot into the planning process Generalentwässerungsplanung (Urban drainage planning)

Annex C – Analysis of the Validation Surveys

This annex provides the detailed analysis of the surveyors' responses to internal technical survey (C.1) as well as to end user surveys (C.2). The information provided hereafter does not include judgment on surveys validity or importance for the project.

All information related to surveys provided in the main document, is based on this annex. This in particular includes summary statistics presented in chapter 3 and the recommendations in chapter 4. Complete validation results are available in Annex A and Annex B.

C.1. Analysis of Internal Technical Validation

Table 1 on the pages 20-21 indicates which components and aspects have been validated during the V2 and V3 period, based on the detailed validation methodology, as well as how many individuals have validated each of the components.

The internal technical survey in V3 is the same as the survey used in V2, so we can compare them easily. But since in V3 there was a special end user version the number of answers in this internal technical survey is much lower (first and second column). The surveyors which provided at least one answer relevant to the evaluated component or aspect of the SUDPLAN product are counted. In all validation cycles, most surveyors answered the questions related to "common services" and "conclusions". Far less feedback was received on the questions requiring in-depth technical knowledge of the system. These differences will be taken into account when performing the analysis of the results later in this section.

The following Table 4 analyses the results according to the scope of the validation and experience of the person performing a validation. A total of 9 persons filled out parts of the LimeSurvey questionnaire.

Application	Surveyors
Pilot independent view	6
Stockholm pilot – WP 5	0
Wuppertal pilot – WP 6	1
Linz pilot – WP 7	2
Czech regional pilot – WP 8	0

Table 4: Number of surveyors by scope of validation in the internal technical validation

As explained in section 2.2, the surveyors self-assessed their professional knowledge and level of involvement with respect to project (question 7). The results are summarized below.

Type of user	WP5	WP6	WP7	WP8	overall	Total
SUDPLAN team member		1	2		6	9
Analyst		1			2	3
Modeller		1			1	2
System manager					1	1
IT expert			2		4	6
Climate change expert		1			1	2

Have seen presentations and documentations		1	2		4	7
User of the SUDPLAN / model results		1	2		3	6
Working with the actual system		1	2		3	7

Table 5: Professional knowledge and level of involvement of surveyors in the internal technical validation

More information on surveyors, their names, current organisation affiliation as well as their professional profile, is presented later in Table 8.

Cross-correlation of the users' self-assessment (question 7) with "particular interests" as stated in question 4 of the survey is shown in the Table 6 below. This table shows that we had no analysts for the dimension of sewage water system in the team. Instead we had a close cooperation with the end users in the city of Linz, they used the external expert validation and are therefore not shown here.

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

Table 6: Surveyor's interests vs. professional profile – internal technical validation

D2.1 also differentiates between primary and secondary users, independent of their role as analyst or modeller. Therefore the "Analyst" column is split. Analyst primary users are end users of SUDPLAN working directly with the system. More practically, this surveyor self-assessed he is analyst and was working with actual system, in the question 7 of the survey. Analyst secondary users are end users of SUDPLAN output, using results without working directly with the system. The surveyor self-assessed he is analyst and was using SUDPLAN model results.

SUDPLAN deals with both long term and short term planning. The surveyor's interests are in-line with these goals, with 67% of the surveyors interested in short-term planning, and 89% in long-term planning.

Temporal planning interest	Y	N	NA
Present conditions and short term (<10 years) planning	6	3	
Long term planning (>10 years) planning	8	1	

Table 7: Surveyor's interests in short-term and long-term planning – internal technical validation

Here is a list of team members who filled in SUDPLAN V3 validation survey. They were selected to have at least one expert for each aspect of the implementation.

1	David Steffelbauer	david.steffelbauer@tugraz.at	Institute of Urban Water Management and Landscape Water Engineering – TUGraz	Austria	Team member
2	David Camhy	camhy@sww.tugraz.at	Institute of Urban Water Management and Landscape Water Engineering – TUGraz	Austria	Team member
3	Lars Gidhagen	lars.gidhagen@smhi.se	SMHI, Sweden's Meteorological and Hydrological Institute	Sweden	Project coordinator, Head Air Quality research
4	Lena Strömbäck	lena.stromback@smhi.se	SMHI, Sweden's Meteorological and Hydrological Institute	Sweden	Coordinator hydrological research
5	Martin Scholl	martin.scholl@cismet.de	cismet GmbH, Software Development	Germany	Software developer
6	Daniel Steffen	daniel.steffen@dfki.de	DFKI, German Research Cente for Artificial Intelligence	Germany	Computer visualisation, software developer
7	Peter Kutschera	Peter.Kutschera@ait.ac.at	AIT, Austrian Institute of Technology	Austria	SUDPLAN software architect
8	Mihai Bartha	mihai.bartha@ait.ac.at	AIT, Austrian Institute of Technology	Austria	Software developer
9	Jonas Olsson	jonas.olsson@smhi.se	SMHI, Sweden's Meteorological and Hydrological Institute	Sweden	Hydrometorological research

Table 8: List of all surveyors who participated in the internal technical validation process

Analysis of the responses for each of the surveys components and aspects is provided in sections C.1.1 to C.1.14.

C.1.1. Graphical User Interfaces

Seven surveyors validated this aspect.
Task-oriented menu, workflow for common task and comparing two set result are defined as most important concepts to assure GUI ergonomics.
The system got generally very good rating (between 4 and 6) for the ease of use. In a context of pan-European climate scenario information, visualisation of time series works well, for both individual as well as comparison of time series from multiple scenarios. For visualisation of maps there were suggestions to improve the possibility of comparison, e.g. by being able to open two map windows side by side.
Although basically all functionality of the requirement specification has been achieved, there is a wish for further functionality. The surveyors point out the following issues as especially im-

portant for the GUI, to make it easier to use:

- More conceptual help
- Quantitative estimates of uncertainties in scenario simulations
- Improved export options

There were also some specific observations of technical details/bugs to be solved:

- Problems of visualising large number of downscaled AQ simulations
- Problems while visualising time series from AQ downscaled grids (while time series from PE grids are visualized very nicely)

Increase the smoothness in visualisation while sliding map presentations in time

C.1.2. 3D / 4D Visualisation

Four surveyors validated parts of this aspect.
The capability of SUDPLAN visualisation framework was evaluated by three persons who confirmed that the tool fulfilled their expectations. One person evaluated the usability of Air Quality 3D visualisation and found it to be below the expected.
The World Wind is a good framework, but more visualisation options are asked for. It is presumed that the use of the component requires a lot of local memory and PC capacity.
A recommendation, not considered to be an important issue by the surveyor, was to use a horizontal timeline slider for shifting the 3D visualization of water levels.

C.1.3. Common Services: Pan-European Visualisation

Eight surveyors validated this aspect.
The temporal and spatial coverage fulfilled all expectations. However, the number of scenarios, as well as the scenario documentation, were rated both high and low. The climate experts found the number of scenarios to be too low (lowest rating 3), while IT experts found it to be beyond the expectations. Thus this difference can be explained by the surveyor's profile and earlier experiences of working with climate scenarios and uncertainties.
As for the different ratings of the available scenario documentation, we could not connect it to any surveyors' profile. We interpret it as another recommendation to extend the on-line documentation support in general, including the issue of climate scenarios and uncertainties.

C.1.4. Common Services: Rainfall

Seven surveyors validated this aspect.
The downscaling procedure with Rainfall time series got high ratings by all surveyors. One person evaluated the quality of precipitation prediction, giving high rating (6). The upload of historical data got slightly lower ratings, but still was above the state-of-art.

C.1.5. Common Services: Air Quality

Four surveyors validated parts of this aspect.
The Air Quality downscaling is functional and the usability of results for the prediction of future environmental conditions are rated as well fulfilling expectations.
The same recommendation of a detail problem as already given in 3.2.1 Graphical User Interfaces was given here, to fix so that time series can be visualised for downscaled AQ grids exactly in the same way as for Pan-European AQ grids (did not work during validation). There was also a recommendation to allow user defined colour settings in the visualisation of comparisons of two AQ different scenarios, in the same way as for the visualisation of individual AQ results. A better visualisation of differences between two scenarios is necessary to allow users to estimate the relative importance of local sources within individual industrial, urban and residential environments.
The internal technical V3 questionnaire, same as for V2, included the temperature downscaling, which was eliminated as a requirement in the amended DoW of June 20, 2012. There was a comment that the ambient temperature is an important variable in climate change assessment of urban environments.

C.1.6. Common Services: Hydrology

Four surveyors validated parts of this aspect.
The capability of the application to assess the river-flooding scenarios, its usability as a basis for assessments and allowing the calculation of future run-off are considered to be state-of-the-art.
One surveyor lacks the possibility to compare time series output from various different climate scenario projections (same variable, same location). In fact this functionality exists, however the procedure it is not intuitive. This calls for improved on-line help functionality.
One surveyor requested the possibility to change local land use in hydrological scenario. In addition, the possibility to upload new and locally refined catchment areas has been identified as important improvements for a next generation of the SUDPLAN tool. However, the possibility to change land use through the SMS GUI was not part of the functionality outlined in DoW.

C.1.7. Local Models

Six IT experts validated this aspect.
In general, model integration is well rated. As the local model integration differs between pilots, the recommendations are specific for each pilot.

C.1.8. External Services

Four IT experts validated this aspect.
Support for use of external services is fulfilled beyond expectations.

C.1.9. SOA Interfaces

Two IT experts validated this component.
Two pre-existing service interface specifications are used for the implementation of service interfaces: Sensor Observation Services (SOS) and Sensor Planning Services (SPS).
OGC Web Map Service (WMS) and Web Feature Service (WFS) interfaces are used to access external services.
All of these services are OGC/ISO/CEN standards.

C.1.10. SOA Services

Two IT experts provided the list of SOA services implemented.
The SOA services to access the common services are:

- Pan-European use case: 2 SOS, 1 WMS, 1 WFS
- Rainfall downscaling: 1 SOS, 1 SPS
- Air Quality downscaling: 1 SOS, 1 SPS
- Hydrology downscaling: 1 SOS, 1 WMS (The same as in the Pan-European use case)
- Local Linz services: 2 SOS, 1 SPS

It turned out that the usage of SOS and SPS can fulfil the requirements of data transfer and model invocation.
The SOS standard is not optimized for large data transfers and for the usage in an interactive environment (GUI) the possibility to measure data transfer progress is missing.
Both, using already configured model services and integration of a new model services fulfilled the expectations.
Automatic or continuous model runs are not implemented.
The capability of “model as service” concept is also well rated.

C.1.11. Usage of Standards

Four surveyors validated this aspect.
The following open standards were used in the project: OGC Open GIS Web Services, WMS, WFS, WCS, SOS, SPS, GML, O&M in general and especially O&M-Sampling-Features.
All of them fulfilled expectations with the exception of:

- SOS, which proved to have problems with large data sets
- O&M-Sampling-Features, which was missing support for continuous coverage.

Consequently, an extension was developed in SUDPLAN.
The following proprietary solutions are used: the local model integration in the Wuppertal pilot (existing closed source product) and the hydrological model configuration (Existing web service).

C.1.12. Open Source Software

Two surveyors validated this aspect.
Open source software was used, extended and even new projects where created, e.g. the whole scenario management system and OGC SOS and SPS implementations (Client and Server) are available as open source.

C.1.13. Completeness of Functionality

Two surveyors validated part of this aspect.
Result publication on the web is identified as poor, especially for animations and 3D material.
Environmental decision support by offering automation of model runs is rated well, but support of analysis is rated very low, with 2.
The usability of SUDPLAN tool as a basis for city management application is identified as average (rating 4 for SMS and CS). The support of city management is rated low because of a lot of missing functionalities.
The usability with respect to the information management requirements is little bit better rated (4 and above).
Model management (specific to analyst), in particular run status and related documentation are rated well.
Generation of complete reports is not available, but export of material for information and result sharing is very satisfying.

C.1.14. Conclusions

All 8 surveyors provided input to the overall conclusive evaluation of the tool.
The surveyors consider the product very useful. Data of same quality is available, but the easy access in SUDPLAN contributes to its usefulness. Their impression is that the output is scientifically sound and credible and can be used as a base for planning. However the documentation of the climate scenario data used in the product should be improved.
CS output becomes highly useful when combined with local model runs of user-defined scenarios.
SUDPLAN provides most of the anticipated output data. The graphical presentation is excellent and contributes to a better understanding. Strengths of the SUDPLAN product include:

- Integration of local model runs with climate scenario information
- Integration of external data services like sensor data
- Access both to European wide and urban specific information
- The possibility to produce multiple climate scenarios as well as multiple local scenarios
- Easy to browse and zoom in on interesting details
- Offering an all-in-one toolkit for sustainable planning with respect to climate change

Surveyors indicated a need for further improvements in the integration of new local models, in

part of the CS visualisations and in the interpretation of uncertainties.
In terms of common services downscaling, the proposals are:

- Air quality: Improved visualisation of differences between scenarios.
- Rainfall: Extended statistical and graphical visualisation of output from different climate scenarios.
- Hydrology: To allow editing of land use in local model.

One surveyor stated: 'It (SUDPLAN product) is rather difficult to use, requires a lot of learning and detailed knowledge of all functions and buttons available, maybe a little less flexibility and more focus on facilitating common tasks would help'. Other surveyors suggested further extension of functionality.

C.2. Analysis of End User Validations

Following the feedback on the V2 validation process itself and resulting recommendations for the third validation cycle, the survey was reduced from 135 to only 40 questions. The question have been slightly changed with the aim to reach a wide range of potential end-users and be understandable for anyone interested in SUDPLAN product after participation in a seminar and/or demonstration of the SUDPLAN tool.

The list of components and aspects validated by end users, as well as number of surveyors per surveys used for the validation is listed in Table 1, on the pages 20-21.

The project pilots provided a final validation based on simplified surveys only. Their responses and recommendations are summarised in this chapter. In the beginning of the last project year (2012) of SUDPLAN, it was decided to move the experimentation and validation of the hydrological downscaling services from the Czech regional pilot to Sweden. A group of end users from the Swedish Water authorities, with special interest and responsibility for climate change, validate the SUDPLAN functionality of running and visualizing hydrological simulations for future years, based on climate scenarios. The outcome of this activity is a part of "workshop" validation.

Further, the surveyors self-assessed their professional knowledge and level of involvement with respect to project (question 6 in the simplified survey). The statement given by Wuppertal workshop participants and by participant from Swedish water authority ("hydrology group") is collected in the "overall" column, below.

Type of user	WP5	WP6	WP7	WP8	Overall	Total
SUDPLAN team member	6	2	4	3	0	15
Analyst	2	3	3	1	2	11
Modeller	6	2	3	0	3	14
System manager	0	1	0	0	0	1
IT expert	3	3	1	1	1	9
Climate change expert	3	1	0	1	4	9
Have seen presentations and documentations	6	6	0	7	5	24
User of the SUDPLAN / model results	2	0	3	3	1	9
Working with the actual system	3	3	4	4	1	15

Table 9: Professional knowledge and level of involvement of surveyors – end users' validation

Cross-correlation of the users' self-assessment (question 7) with "particular interests" as stated in question 4 of the survey is shown in the Table 10 below:

Type of environmental risk	Analyst primary	Analyst secondary	Modeller	System Manager
Urban stormwater flooding during intense rainfall	3	6	6	2
Dimensioning of sewage water systems		5	5	1
Risks of flooding of rivers	3	2	2	1
Hydrological conditions	3	2	4	1
Air pollution	4	6	2	
Other	1	2	3	

Table 10: Surveyor's interests vs. professional profile – end users' validation

The statement on temporal planning interests is shown in the Table 11 below. The trend is similar with the internal technical validation. More interest is given to long-term planning with 78% than to short-term planning which came up on 56%.

Temporal planning interest	Y	N	NA
Present conditions and short term (<10 years) planning	5	4	
Long term planning (>10 years) planning	7	2	

Table 11: Surveyor's interests in short-term and long-term planning – end users' validation

The following Table 12 summarises the professional profiles of the persons that completed the LimeSurvey simplified questionnaire. Persons that have indicated that they do not want to appear with names in the SUDPLAN public deliverables are indicated as "anonymous".

1	Lars Örtegren	leo@apertum.se	Apertum IT AB.	Sweden	Manager and software developer
2	Chantal Donnelly	chantal.donnelly@gmail.com	SMHI	Sweden	Senior researcher, research project leader
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Table 12: List of all surveyors who participated in end-user validation process

A total of 48 persons worked out end users LimeSurvey questionnaire, representing SUDPLAN staff (15 persons) and external end-users (33 persons). It is important to note that some of the project team insiders are also potential end-users of the SUDPLAN product. Surveyors not directly involved in the project have been either invited to seminars with demos of the software, presentations of output results and performed the tools on his own, or participated in second dissemination event in Wuppertal in October 2012.

Average scores per evaluated component or aspect for each of the pilots and for the final workshop are shown in Figure 6 (Stockholm pilot), Figure 7 (Wuppertal pilot), Figure 8 (Linz pilot), Figure 9 (Czech regional pilot) and in Figure 10 (final workshop) below.

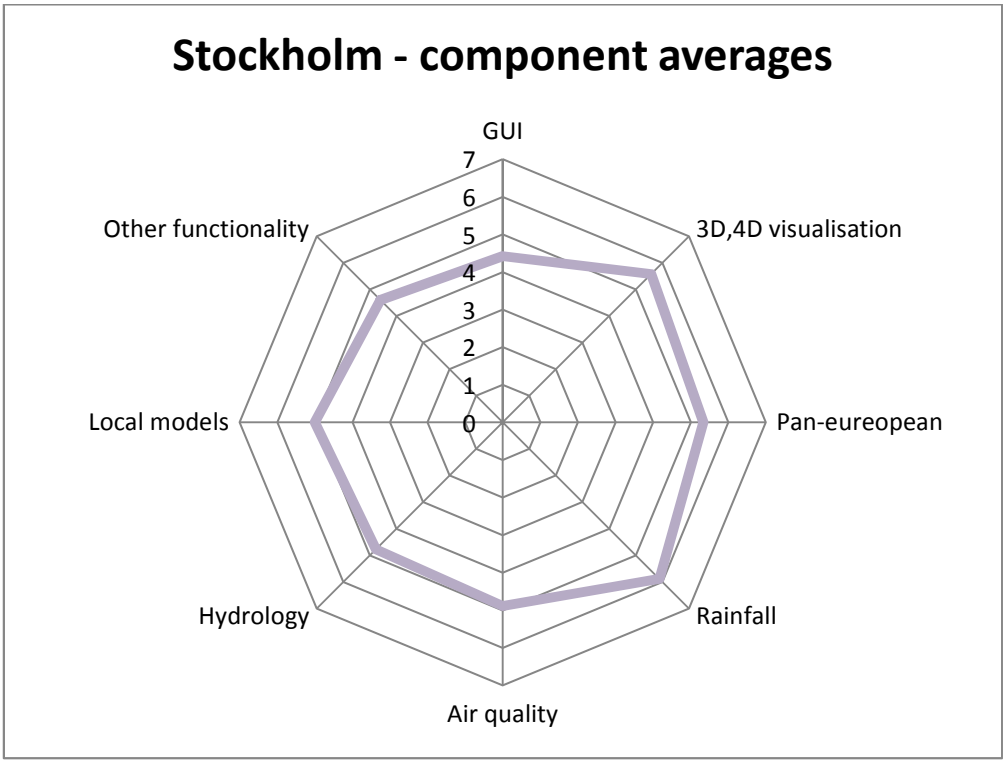

Figure 6: Average score per components and aspects in WP5 (Stockholm pilot)

[4] Survey only submitted in paper form.

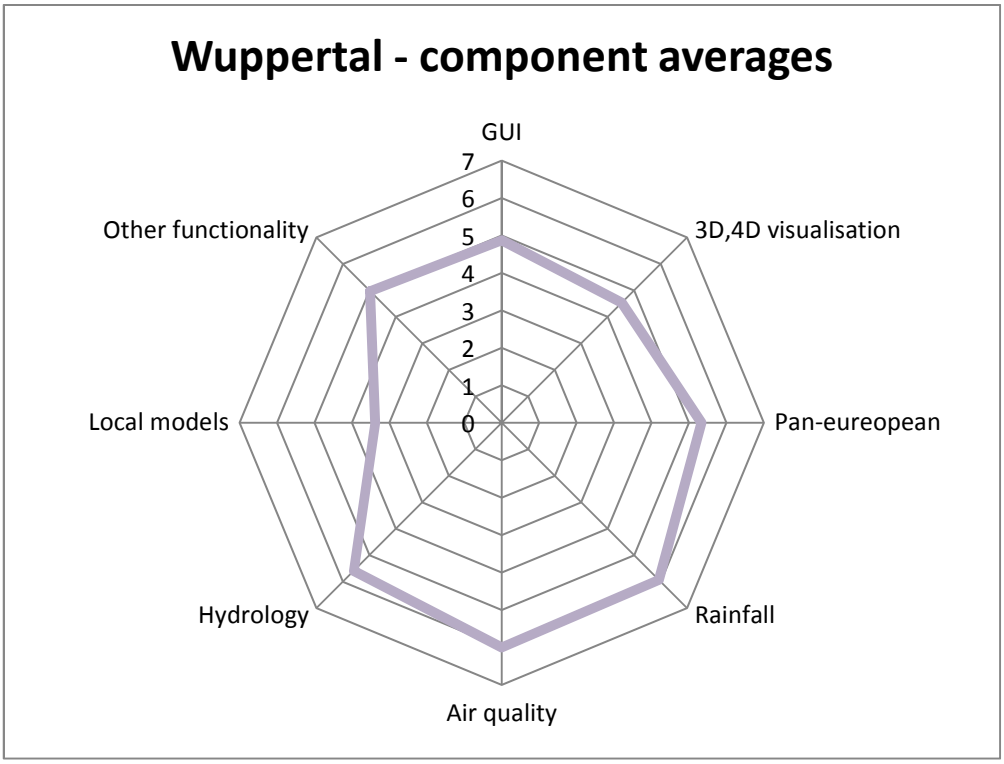

Figure 7: Average score per components and aspects in WP6 (Wuppertal pilot)

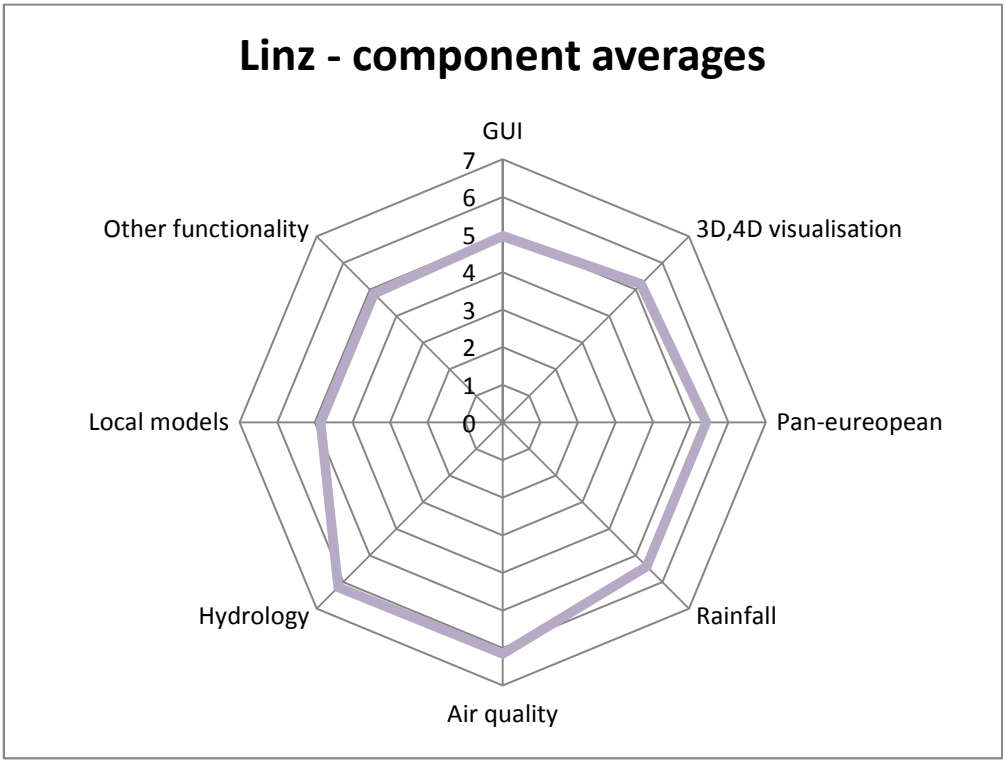

Figure 8: Average score per components and aspects in WP7 (Linz pilot)

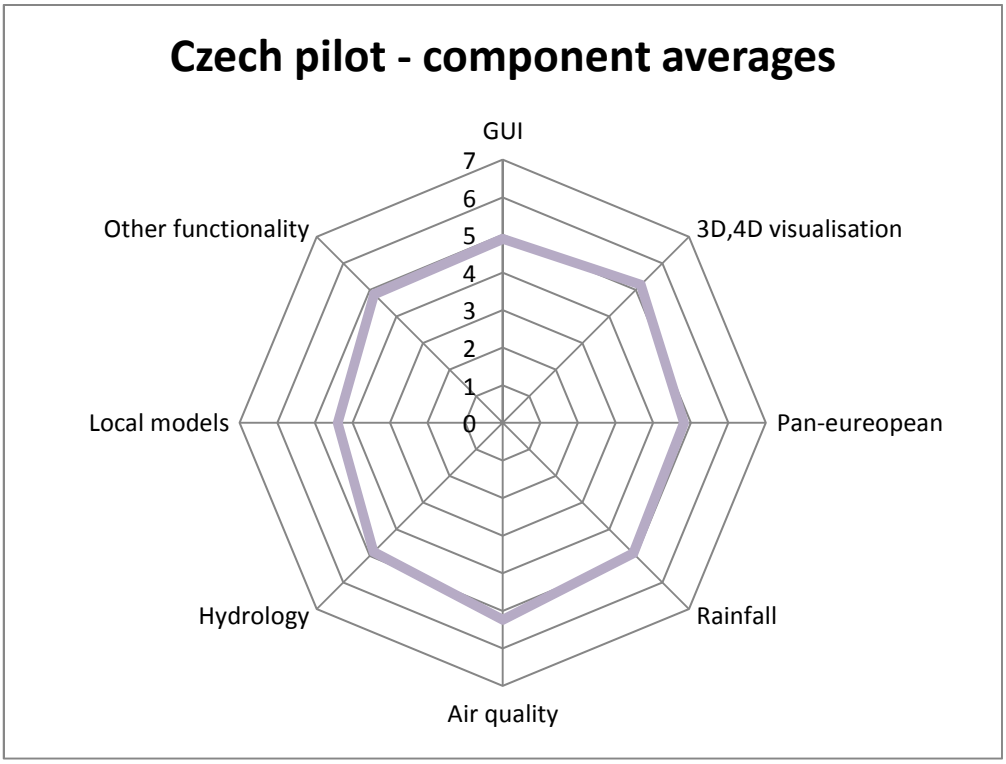

Figure 9: Average score per components and aspects in WP8 (Czech regional pilot)

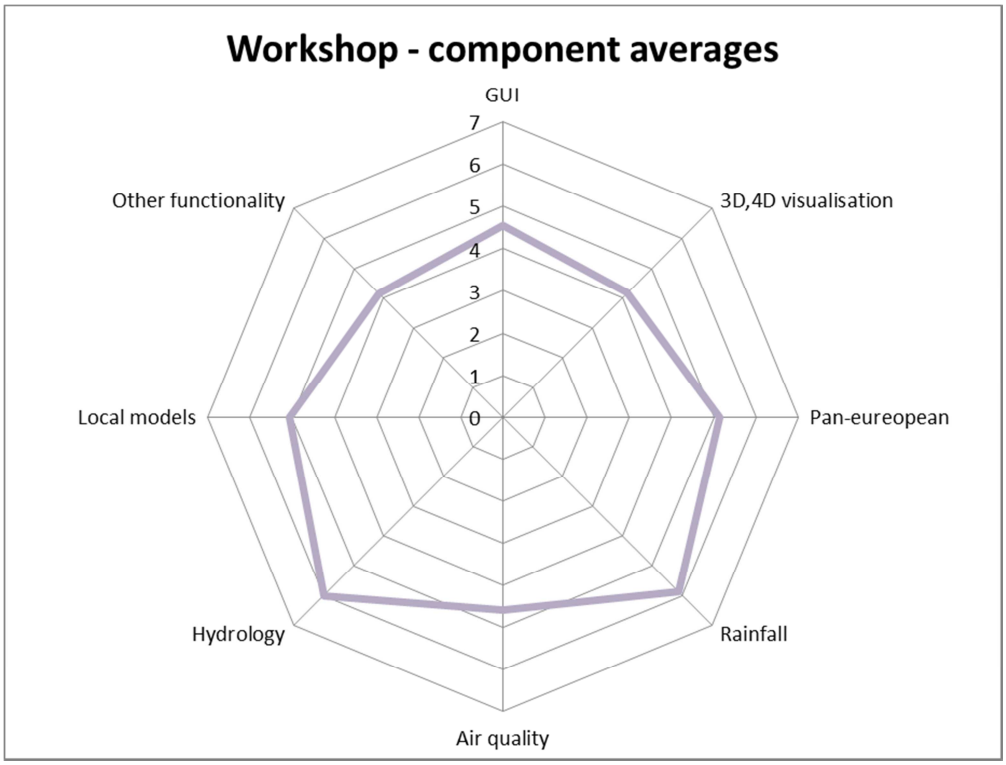

Figure 10: Average score per components and aspects from final workshop held in Wuppertal, October 2012

Significantly lower averages for "integration of local models" in Wuppertal pilot survey and for the Air Quality in final workshop survey may be a consequence of the use of proprietary models in Wuppertal and expectations of the workshop participants to see a local air quality model implementation similar to those for rainfall in Wuppertal and Linz.

Following sections summarise validation outcome for all components and aspects in end user surveys. The information is compiled from pilot specific reports from the final workshop. The professional profile of persons who performed validation is taken in account.

The section also presents the collected recommendations of the surveyors.

C.2.1. Graphical User Interfaces

Almost all surveyors (47) validated this aspect.
The assessment on the importance of concepts which assure GUI ergonomics is correlated with profile of surveyor. Also the previous knowledge and experience of similar tools will affect the experience of the SUDPLAN tool and how easy it is to learn and use.
Generally, the possibility to browse through the results in space as well as in time was considered to be the most important concept of SUDPLAN, which is not surprising for a geographic information system.
On the other hand, visualization functionalities, such as comparing two result sets, were higher rating from end-users than from IT experts. Even more, lack of contextual help was notified in overall, but this was important for the ease of use, in particular for the secondary end–users and should be considered for the commercial product. In addition, sometimes the tool freeze and sometimes time series and legends are not shown. Therefore, the better error messages would be helpful for cases where was not clear whether the problems were caused by slow network connections, the system waiting on some results or if a software problem occurred.
Also other visualisation aspects need improvement. Currently, uncertainties can be estimated by scenario comparison only, a specific visualization of the uncertainties from several scenarios would be appreciated. For scientific data based work uncertainty analysis is a must have and thus should be considered a major enhancement for the commercialized product. Spatial and temporal visualisation was found not intuitive and too complex for use. Due to the complexity of the system, better user support is highly recommended. Resulting CSO overflow volumes could be drawn in a proportional scale in the geo-referenced map or historic and downscaled rain time series could be visualized with identical y-axis scales which would make the comparison easier.
A benefit of the system in hydrology aspect is the possibility to adjust the tool to a person's individual ways of working by varying the layout and looks of the windows in the SMS client. The possibility to make layers transparent and the functionality to view a single local basing and the upstream area for this basin can be useful when prioritizing actions, for instance actions for prevention of flooding, in the physical planning, or in analyses of risk and vulnerability.
The GUI was given high usability while using high resolution monitors, but much lower rating for low resolution displays e.g. laptop use (problem to display both map and time series in visualisation). Further, the number of control elements and usability of any modelling environment is much better on larger displays.
The GUI is clearly structured and easy to navigate. Spatial data and measurement data are accessible and the result visualization as well as result comparison works well. The interaction of the interface with other national information systems (uploads and downloads of data) and the possibility to integrate SUDPLAN to the national modelling systems is limited.
The overall impression is that is SUDPLAN tool very useful application which almost fulfilled objectives. For the commercialization, some refinement in the visualization and well supporting help in English should be considered.

C.2.2. 3D / 4D Visualisation

26 surveyors validated this aspect.
Their overall impression and their rating of the interaction with the 3D GUI, the visualization of scenarios and other information were quite positive.
The 3D / 4D capabilities to compare and analyse scenarios received low ratings, but one comment indicates that a purely visual analysis of scenarios is sufficient for practical use. Possible reason for lower rating lies in fact that this tool is considered complex and difficult to get familiar with for non-experts.
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.
In air quality domain, the users highlighted the added value of the tool in identifying large point sources of air pollution.

C.2.3. Common Services: Pan-European Visualisation

41 surveyors validated this aspect.
Most of them are satisfied with the number of available climate scenarios and the related spatial and temporal coverage. However, four surveyors considered the available number of different climate scenarios insufficient (below the stat-of-art) to be able to assess uncertainties in results.
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. Export of results is missing and would be very beneficial for an analytic work.
The main added value of SUDPLAN results was attributed to the long term assessment while for the evaluation of current conditions other systems may have more extensive functionality.
The user-group (see Table 1 on page 21) who validated PE visualisation in hydrology aspect provided very detailed validation report, shown below.
The statistical information about climate change in Europe shows mean values for the period 1981-2000. It would have been interesting to also show data from the reference period 1961-1991 as many of the regional climate analyses for Sweden use this reference period to compare with future climate for 2050 or 2100.
Harmonizing the reference periods would have been pedagogical as it supports comparative studies and communications with other actors within the area of climate adaptation.
Currently the following statistical variables are available in the SUDPLAN tool:

- The mean annual high water in a river or stream
- The mean annual low water in a river or stream
- The 1 in 10 year flood level
- The 1 in 50 year flood level
- The number of days (per year) with hydrological drought
- The intensity of days with hydrological drought
- The number of days (per year) with agricultural drought

- The intensity of days with agricultural drought
- Snow storage potential
- Maximum snow depth

In the southern parts of Sweden, there is already competition about surface and groundwater. Examples of this is the competition that occurs between the agricultural landscape in the summer between the farmers that wants to irrigate their crops to get a good harvest and nature interests that want to maintain a reasonable flow in the surface water streams to enable a rich bio diversity.
Moreover, agricultural interests in some areas compete with the interests of water supply from ground water but also surface water required by the municipalities. In this context it is interesting to study several of the variables available in the SUDPLAN tool. From the tool it is possible to get a viewpoint on whether these problems are going to increase or decrease in the future by studying the future flows in the streams, the periods of drought in the agricultural land, soil moisture and groundwater levels.
These variables are very important to consider by the water authorities when planning actions for future water supply since many courses implies that the competition of access to water is going to increase in the future. This will suggest that actions that delay the water paths in the landscape, for instance wetlands, irrigation pounds, rashness beds, and changed drainage will be prioritized in the future.
In the eastern part of South Baltic Seas Water district there is a lack of natural glaciofluvial deposits suitable for supply of drinking water. This means that this part of the country is dependent on surface water and water from the bedrock. In this case the SUDPLAN tool gives an overview the expected access of water resources in a changed climate.
The quality of the water is affected by extreme flows when nutrients, humic, and other substances get the possibility to be washed out during a short period. This makes the information in SUDPLAN about extreme flows interesting. When planning new infrastructure in the society we would prefer information about flows with return times of 100 years. Flows with shorter return time are still interesting when discussing transports of substances, so these variables need to be kept in the system.
Information about snow depth is interesting from a biological perspective since snow- and ice coverage affects the blending of chemical and biological conditions in lakes and rivers. From the water authorities perspective the number of days with ice coverage is, though, more interesting than the number of days with snow coverage.
Consequently, the suggested improvements are:

- Data and statistics comparing with the reference period 1961-1991 as this is the reference period used for many available Swedish climate reports.
- Flows with return times of 100 years as this information is used in projects for dimensioning of new infrastructure.
- Information about ice coverage, as this is important for the biological conditions in water.

C.2.4. Common Services: Rainfall

Rainfall component was validated by four surveyors in case of the Stockholm pilot and by 6-8 surveyors in other pilots.They rated the usability and the ease of use of the rainfall downscaling service as “impressive”, with average scores above 4 in Czech pilot (worst case) and above 6 in every single category in Wuppertal pilot (best case).
In all pilots, the downscaling procedure with rainfall time series is rated slightly lower than the one with IDF-curves. This may be a consequence of the fact that handling of time series is much more time consuming then handling of the IDF curves. In addition, the IDF downscaling is not used in the Linz pilot. Nevertheless, the procedure for uploading rainfall data and performing the downscaling has been commented as “easy to carry out” and “the results can be put directly to use in subsequent model runs” in Linz pilot. Furthermore, the general performance of the downscaled continuous rainfall time series got a positive rating in all four pilots.
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 compared to other products.
Main suggestions are to improve the information about the available climate scenarios, to simplify the upload of historical data required for results calibration as well as the way future time periods are defined. Once again, “background information” and “contextual help” regarding the already implemented climate scenarios, visualisation and report functionality are asked for.
Finally, the surveyors expressed interest in calculation of the long-term (annual or seasonal) volumes from a downscaled time series as well as in the calculation/extraction of a rainfall event from a (downscaled) time series. The main added value of the system is seen in its ability to predict long term precipitation volumes as well as to identify the risk of extreme precipitation events for the selected place.

C.2.5. Common Services: Air Quality

Most inputs came from Czech pilot (11 surveyors) and the rest from the workshop participants.
The presentations left well impression on usability and ease of use. As consequence, the workshop participants rated this service slightly higher than those who run the tool.
However, Air Quality downscaling is identified as a new and potentially very useful tool. Czech pilot surveyors have claimed that similar tool has not been available in the Czech Republic before. The main advantage they saw in its ability to predict air quality on local level while taking into account climate change forcing. Therefore, the SUDPLAN system and the Czech Pilot results in particular can support regional development projects and decisions upon these projects both in the phase of preparation and implementation. Having such a tool available is highly relevant for Prague, as the concentrations of pollutants, which are emitted mainly from transportation and small point sources, are higher compared to the average in other European cities.
The usability of the SUDPLAN tool as the basis for assessment of the future air pollution was given high ratings (5-7) especially as regards downscaling and visualization of results while the complicated upload of local emission data is considered as the weakness of the application.
Looking at the level of support which individual functionalities of AQ downscaling can provide to regional development processes the highest ratings acquired the prediction of long-term air quality and temperature trends as well as the functionality to assess the impact of local sources, activities and land uses changes on air quality in future. On the other hand, the usability of

SUDPLAN results in local dispersion models is regarded as quite complicated and needs further support from the SUDPLAN developers. Surprisingly, usability of SUDPLAN in evaluating the achievement of air quality objectives received just average ratings which confirm the local focus of the project instead of the wider national scope.
Possible improvements of the tool have been identified in description and minimization of projection uncertainties and in the improvement of emission inventories. Furthermore, the integration of national air quality modelling systems with SUDPLAN was identified as quite complicated. The limitations of CS air quality downscaling regarding spatial resolution (up to 1x1 km) have been pointed out, as the concentration fields of air pollutant are very heterogeneous in urban are, so the identification of hot spots in cities is limited. Nevertheless, external local models can help overcome this problem.

C.2.6. Common Services: Hydrology

The major input came from Czech (9 surveyors) and Stockholm (5 surveyors) pilots, as well as from the user-group (see Table 1 on page 21) that validated PE visualisation and common services in hydrology aspect.
The surveyors from Linz and Wuppertal pilots in most cases awarded ratings between 5 and 7 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 river flooding assessment. One of the respondents expressed his opinion that the underlying EHYPE model should be free for use.
The possibility of adding local observation and recalibrate the E-Hype model is useful. It is also very useful to save the result of these calibrations and the climate simulations based on them. Due to a lack of information about the calibration method used, this was lower rated. This information is important to increase the transparency in the calculations.
The functionality to visualise and export time series of, for instance, temperature, precipitation and runoff, is useful. These time series can be used as input for other external models.
As a whole the tool provides very good functionality to show the expected outcome of important hydrological parameters at different climate scenarios. Expected change in the coming hundred years is efficiently visualised by using the slide bar functionality on the time axis in the tool. It is also useful that external WMS services can be integrated into the system.
The Swedish water authorities have a national project with the purpose of modelling environmental toxins in a sub-basin. These models are driven by S-Hype with data about current flows. It would be interesting to connect this model for environmental toxins with climate predictions by using SUDPLAN. The possibility to model transport of environmental toxins with stream flows affected by a future climate can give a good support in prioritizing actions. The mobility of environmental toxins is affected not only by the flow. In addition the temperature has a big impact on the substances volatility and transport. This makes it extremely interesting to add more climate sensitive parameters to the model for environmental toxins.
Another task for the Swedish water authorities is modelling of the nutrients nitrogen and phosphorous. By using the S-Hype model, that is able to model transports of nutrient and phosphorous, the tool would be able to signal how a changed climate, with changed hydrological patterns, affects the transport of nitrogen and phosphorous. Here, it is important to remember, that future transport of nitrogen and phosphorous to a large extent will be dependent on changes in crop usage and agricultural methods. It is not unlikely that this has a larger impact on the total transport of nutrients to the sea than changed patterns in precipitation and runoff.
For future development it is interesting to extend the data with more climate scenarios than the one existing today in the system. In extent to available parameters it would be interesting to

show changes in sea level from several perspectives, such as physical planning, erosion, water quality and planning of drinking water.
Geographical layers should be corrected as some mistakes and inaccuracies occurred. In order to enhance the usability of the tool for water management planning a new functionality was suggested which displays the information about area of the basin.

C.2.7. Local Models

Most of surveyors from each pilot gave input on this aspect. The exception is Stockholm pilot with only one input.
Running a local model that has already been integrated in a SUDPLAN application from the GUI is considered to be well. Likewise is the specification of parameters for a model run. The integration of SUDPLAN downscaling services with local models is quite complicated and requires programming skills, so is no task for an end user. As consequence, this led to quite different ratings, possibly because the programming framework provides some guidance for this task.
The local WP7 model (U.S. EPA SWMM) is made accessible through the SMS. The SUDPLAN SMS allows the execution and comparison of different model input files using different climate scenarios.
Specification of parameters for the model runs was improved since V2. Configuration of the model is only partly handled by SUDPLAN, many settings are directly linked to the input (=scenario) configuration. Model validation and calibration is (for the Linz pilot SWMM model) not carried out directly in the SUPDLAN platform because tools for these tasks already existed at the start of the project.
In the Wuppertal pilot, service chaining, configuration of models, model validation and model calibration are not implemented. To some extent, these features are available with the Common Service “Hydrology” and its rating is accordingly heterogeneous: 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.
The workshop participants found the integration of models and its running directly from GUI almost beyond the expectation, but in terms of configuration they perceived some deficiency.

C.2.8. Completeness of Functionality

All components requested from planners (capabilities to support the creation of information products, reports and publications, to share results and to export data) received a rating of four or higher.
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. Consequently the user needs special technical knowledge and / or external tools (example: the production of a movie showing the course of a run-off simulation) to perform these tasks.
Regarding requirements of system managers, the questions related to user management, security and rights management received higher rating whereas data source integration and model integration were rated below average.
The following functionalities were mentioned most frequently as particularly useful:

- The integration of data and models for different scenarios in one platform

- Integration of local data with other SUDPLAN models
- Spatio-temporal visualisation
- 3D and 4D visualization methods on virtual globe
- Zooming in map, view of all Europe
- information about the calibration method used, to increase the transparency in the calculations
- The ease of use in the process involving different services (upload - downscaling - model run - result visualisation)
- Common Service “Rainfall Downscaling” for easy introduction of climate change effect on the rainfall pattern
- Manipulation of breaklines representing local or extensive measures directly in the map
- The integration and visualization of rainfall time series, measurement data, climate scenarios and local model runs
- Air quality downscaling and visualization with higher resolution in cities
- Generation of time series of temperature/precipitation/air quality for the selected place
- Visualization of temporal development of climate and air quality over long time period in the whole Europe
- For hydrology modelling: adding your own discharge and calibrate a model for a smaller area
- Considering map functionality, the possibility to make layers transparent and the functionality to view a single local basing and the upstream area for this basin. This functionality can be useful when prioritizing actions, for instance actions for prevention of flooding, in the physical planning, or in analyses of risk and vulnerability
- The functionality to visualise and export time series of, for instance, temperature, precipitation and runoff, as input for other external models

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 vast 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).
The surveyors have contributed with the following recommendations for improvement:

- Some missing functionalities or possible improvements of the existing ones have been pointed out in the survey, for example the possibility for developers to add their own modules to enhance SUDPLAN functionality.
- Timeseries and spatial visualisation of climate scenarios
- Better background maps
- Higher geographic resolution, include future population density to estimate population weighted concentrations.
- 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 se-

lected cell of the TIN

- 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
- Better reporting possibilities, context help, help system missing
- Better information about the climate scenarios
- 'How to Start' guide might help the users not familiar with SUDPLAN to find faster into the full system functionality
- Possibility of using real climate data when dealing with current conditions
- Better resolution (e.g. from regional climate models) of climate data entering into the AQ downscaling.
- More flexible visualization of emission changes between two time slices or two scenarios including the possibility to display decrease of emissions
- Information about the calibration method used, to increase the transparency in the calculations

Furthermore one participant expressed the expectation that a GUI should be amended to support the export of GIS data via OGC Services.
SUDPLAN is a sophisticated approach for an all in one scenario management system. It provides an easy way to introduce future aspect of climate change effects in urban planning processes, both mid- and long-term, without expert knowledge on climate change matters. The visualisation allows to easily presenting the results to stakeholders that are not involved in detail in the planning process. However, for a commercial application some improvements should be done concerning the visualization and reporting functionality.

C.2.9. Conclusions

All surveyors with one exceptions provided input related to general impression on SUDPLAN tool and possibilities for succeeding on the market. SUDPLAN's team is very thankful for their support in our validation process and for their fruitful recommendations and suggestions.
Compared with previously available information, SUDPLAN results were judged to be new by 35 persons, of better quality by 28 and more useful by 43 persons. Only one surveyor assessed the result as "not new" and four of them found it "not of better quality". Other surveyors could not assess this question.
Likewise many of the respondents (17 and 13) would use SUDPLAN product for future urban planning and considered it useful for most cities, in particular for the large ones with appropriate IT infrastructure.
The tool is found useful to certain extent. It has integrated Common Services and local models and offers the possibility to compare different scenarios.
Usefulness would be even higher if the tool would provide a manual, or if taking into account the climate change in planning wold be required by law. Accordingly, 14 respondents would recommend SUDPLAN to their colleagues in other European cities. We can therefore conclude that the SUDPLAN tool fulfils its primary role to support planners through provision of infor-

mation on local climate change effects.
Most surveyors found the graphical presentation of the SUDPLAN results excellent and contributing to a better understanding, although some room for improvements was identified. More detailed analysis of this aspect is provided in section C.2.1.
Stated strengths of SUDPLAN output include:

- It gives a broader audience access to complex environmental models. This was up to now restricted to a small group of experts.
- Provide an impressive collection of results and achievements from a number of different disciplines
- The integration of data sources, services and models in one platform combined with the ease of use and the result & scenario comparison possibilities.
- Nice user interface and integration with possibilities to easily explore details in results.
- SUDPLAN is open for the implementation of applications similar to the existing pilots, what would be more cost-efficient than 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 did not discover any real conceptual weaknesses of the SUDPLAN. However they identified some desirable improvements and amendments.
Suggested improvements include:

- Provide more climate scenarios,
- Improve 3D- and 4D visualization of the surface run-off simulation results,
- Allow provision of modular add-ons so that one can more easily extend the product (open-access to source code throughout),
- Provide a functionality to compare maps side by side and improve the user interface.

The user friendliness for those who are not IT experts and who have not been involved in the product development has received below-average ratings. The second weak point identified by surveyors is the poor documentation. In addition to a handbook that addresses the end users, a guideline for installing the cids framework would be needed for organizations that are not already operating this software.
All surveyors commended the graphical presentation of the SUDPLAN results, although some room for improvements was identified. For example it would be useful to present the deviation of the water levels from “normal” rather than, or in addition to absolute values for a specific spot on the 2D and 3D maps. It was proposed to implement this as a tooltip appearing in the 2D or 3D map.
Finally, the product provided no reporting functionality for secondary end-users. This was not required in the pilot definition plans but should be considered for the commercial product.