Seventh Framework Programme

Call FP7-ICT-2009-6

Project: 247708 - SUDPLAN

Project full title:

Sustainable Urban Development Planner for Climate Change Adaptation

Companion Report - for Project Deliverable D3.3.3

Integrated Scenario Management System V3

Due date of deliverable: 31/08/2012
Actual submission date: 13/07/2012

Document Control Page	
Title	Integrated Scenario Management System V3 – Companion Report
Creator	CIS
Editor	Pascal Dihé
Description	Brief report to accompany the software (Integrated Scenario Management System V3).
Publisher	SUDPLAN Consortium
Contributors	All partners
Type	Text
Format	MS Word
Language	EN-GB
Creation date	05/06/2012
Version number	1.0
Version date	30/07/2012
Last modified by	CIS (Dihé)
Rights	Copyright "SUDPLAN Consortium". During the drafting process, access is generally limited to the Consortium.
Audience	☐ internal ☒ public ☐ restricted, access granted to:
Review status	☐ Draft ☒ WP Manager accepted ☒ Co-ordinator accepted Where applicable: ☐ Accepted by the GA ☐ Accepted by the GA as public document
Action requested	☐ to be revised by Partners involved in the preparation of the Project Deliverable ☐ to be revised by all SUDPLAN Partners ☐ for approval of the WP Manager ☐ for approval of the Quality Manager ☐ for approval of the Project Co-ordinator ☐ for approval of the General Assembly
Requested deadline	31/08/2012

Revision history			
Version	**Date**	**Modified by**	**Comments**
0.1	05/06/2012	SSc	New TOC for V3
0.2	12/06/2012	PDi	Figures and Description updated for V3
0.3	25/06/2012	DSt	+ DFKI Contributions
0.4	26/06/2012	MSc	+ frequency adjustment
0.5	28/06/2012	JWt	+ EDB Upload
0.6	05/07/2012	MSc	+ Hydrology DS
0.7	09/07/2012	MSc	+ PE Updates
0.8	10/07/2012	PDi	Documents merged
0.9	12/07/2012	PDi	Diagrams updated
1.0	13/07/2012	PDi	Final Version for Review
1.0	13/07/2012	LGi	Co-ordinator approval

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1. Management Summary

This document has been produced by the consortium of the European Project FP7-247708 Sustainable Urban Development Planner for Climate Change Adaptation (SUDPLAN). It is the companion report to the third deliverable of *T3.4 Integration, Testing and Software Validation* which represents the third software release of the integrated Scenario Management System that is composed of the distinct software components developed in *T3.3 - Product Implementation*. The software described in this report which is the actual deliverable D3.3.3 is the basis of the current pilot implementation work.

Due to the fact that the deliverable *D3.3.3 Integrated Scenario Management System V3* heavily depends on the results of the *D3.2.3 - Product Implementation V3*, this report repeats several parts of the companion report to the deliverable *D3.2.3 - Product Implementation V3.* Thus it is possible to gain a complete overview on the integrated SMS as well as on each individual building block without the need to read both reports. As described in section *2.1 Tasks and Documents involved* a final consolidated report will be provided with *D.3.3.4 Integrated Scenario Management System Description* due in m36.

1.1. Purpose of this Document

This document is a brief report to accompany the software developed in WP3 (Scenario Management System) of the SUDPLAN project bundled into *D3.3.3 Integrated Scenario Management System V3*.

In contrast to the companion report to the deliverable *D3.2.3- Product Implementation V3,* which gives an overview of the distinct building blocks, explains their architecture and reports on the developments performed during the three product implementation phases, this report intends to present the Scenario Management System as integrated solution and to report on the integration, testing and validation activities performed during the second product integration phase.

1.2. Intended Audience

This document targets all SUDPLAN partners.

1.3. Summary and Structure of the Document

This document is divided into three main parts.

The first part consists of an introductory chapter that explains the role of the partners involved in the work performed and explains the basic purpose of the Scenario Management System. Furthermore, it highlights the relationship of the software deliverable to other tasks and deliverables and explains the relations between the companion reports of D3.2.x and D3.3.x.

The second part of the report presents the overall architecture of the integrated SMS and provides information on the individual Building Blocks of the Scenario Management System, consisting of the SMS Framework, the Model as a Service Component and the Advanced Visualisation Component.

The third part reports on the actual integration, testing and validation activities performed. Thereby it presents the integration and testing environment as well as the seven use cases that were implemented until now in order to validate the integrated SMS and its functionalities against the needs and expectations of the users for V3.

The validation use cases considered in the Integrated Scenario Management System V1 were:

- UC #01: Visualise Climate Scenario Information on the European Scale (interaction with Common Services)
- UC #02: Execute Rainfall Downscaling (interaction with Common Services)
- UC #03: Execute Air Quality Downscaling (interaction with Common Services)
- UC #04: 3-D Visualisation of Local Air Quality and Traffic Data (part of Stockholm pilot local application)

The validation use cases considered in the Integrated Scenario Management System **V2** were:

- Execute IDF Rainfall Downscaling (interaction with Common Services)
- Local Data Upload
- Local Model Integration (interaction with Model as Service Integration)
- Time series Visualisation & Comparison
- 3-D Visualisation Wizard

The validation use cases considered in the Integrated Scenario Management System V3 are:

- Visualization of 3-D air quality data
- 3-D Animation of "Water-runoff"
- Hydrology Downscaling
- Emission Database Upload

In addition to the V3 uses cases listed above, several V1 use cases were updated with new V3 features like for example frequency adjustment.

The document closes with conclusions that can be used to gain an overview without reading the entire document.

Furthermore, the documents provides an annex (*Annex 2: Validation Use Case Screenshots and Diagrams*), which contains detailed interaction diagrams of the validation use cases as well as the complete set of screenshots related to the actions the user has to perform in a specific use case.

1.4. Abbreviations and Acronyms

Acronym	Description
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
CLI	Command-Line Interface
CS	Common Services
CSO	Combined Server Overflow
DEM	Digital Elevation Model
DoW	SUDPLAN Description of Work
DSS	Decision Support Systems
GIS	Geographic Information System
GUI	Graphical User Interface
HYPE	Hydrological Predictions for the Environment (Model)
ICT	Information and Communication Technologies
IO	Input & Output
ISO	International Standardization Organisation
IST	Information Society Technology
JWS	Java Web Start
O&M	Observation and Measurements (OGC specification of draft)
OGC	Open Geospatial Consortium
ORCHESTRA	Open Architecture and Spatial Data Infrastructure for Risk Management (FP6 integrated project)
SANY	SANY Sensors Anywhere (FP6 integrated project)
SDK	Software Development Kit
SOS	Sensor Observation Service (OGC specification of draft)
SPS	Sensor Planning Service (OGC specification of draft)
WFS	Web Feature Service
WMS	Web Map Service

2. Introduction

The main objective of WP3 work 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*' (DoW).

The development work performed to provide the software was divided according to the WP3 partner's field of development expertise.

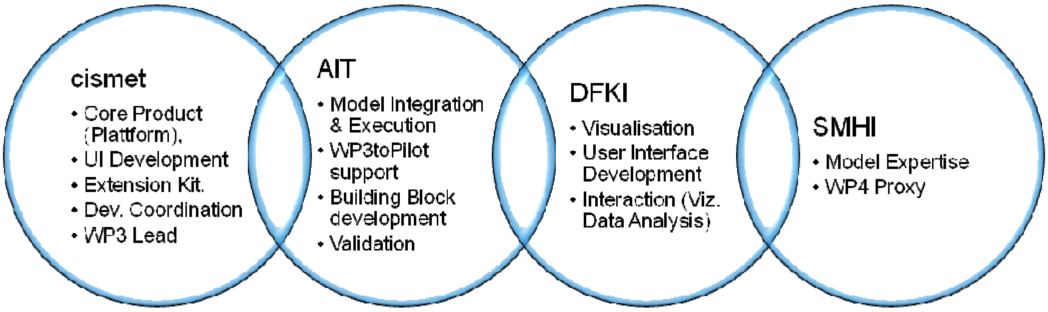


Figure 1: WP3 Partner Roles

The current implementation results which were integrated into the Scenario Management System V3 are categorized as basic scenario management core functionality, model integration, and visualisation. With respect to the WP3 partner's responsibilities, the Scenario Management System can be divided into the three distinct Building Blocks **SMS Framework**, **Model as a Service Integration,** and **Advanced Visualisation.** These Building Blocks are briefly presented in Chapter *3 Scenario Management System Overview*, a more detailed description of the Building Blocks can be found in the companion report to the deliverable *D3.2.3 - Product Implementation V3*.

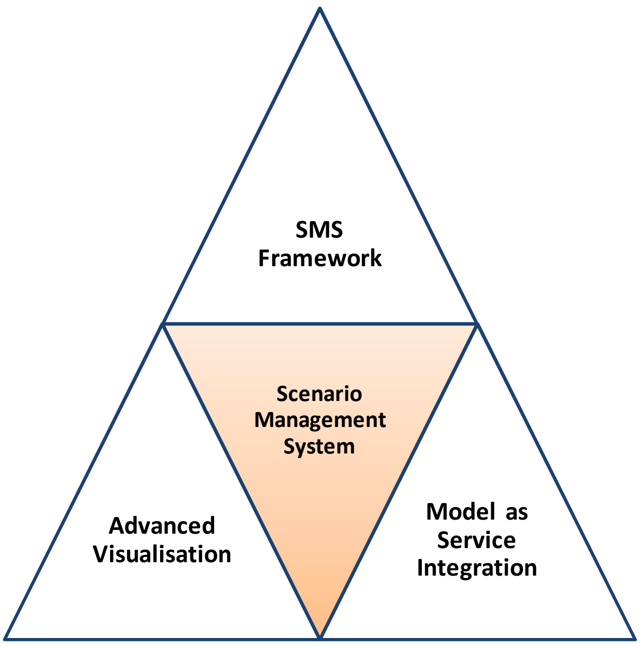


Figure 2: SMS Building Blocks

The general software development process in SUDPLAN follows a three iteration spiral development approach, in which we have now have reached the end of the third and final cycle.

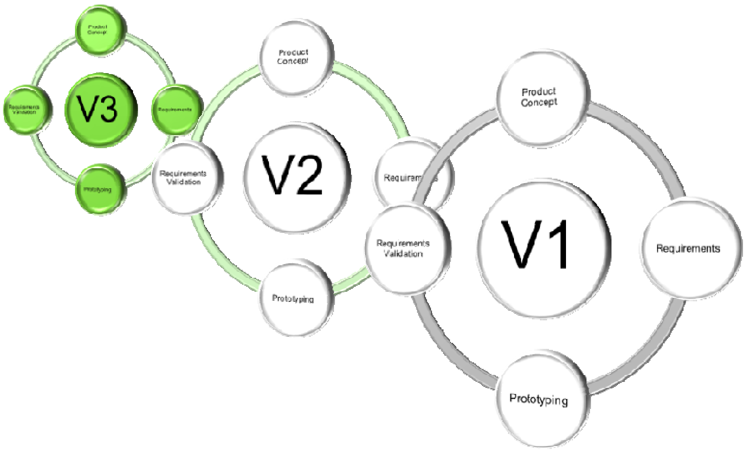


Figure 3: SUDPLAN Spiral Approach

The results of the three cycles are given in the companion report to the deliverable *D3.2.3 - Product Implementation V3*.

2.1. Tasks and Documents involved

Figure 4: Relations between Companion Reports shows the general content and overlap of the companion reports of the software deliverables D3.2.x and D3.3.x (x < 4) which will eventually be combined into the consolidated deliverable *D.3.3.4 Integrated Scenario Management System Description*.

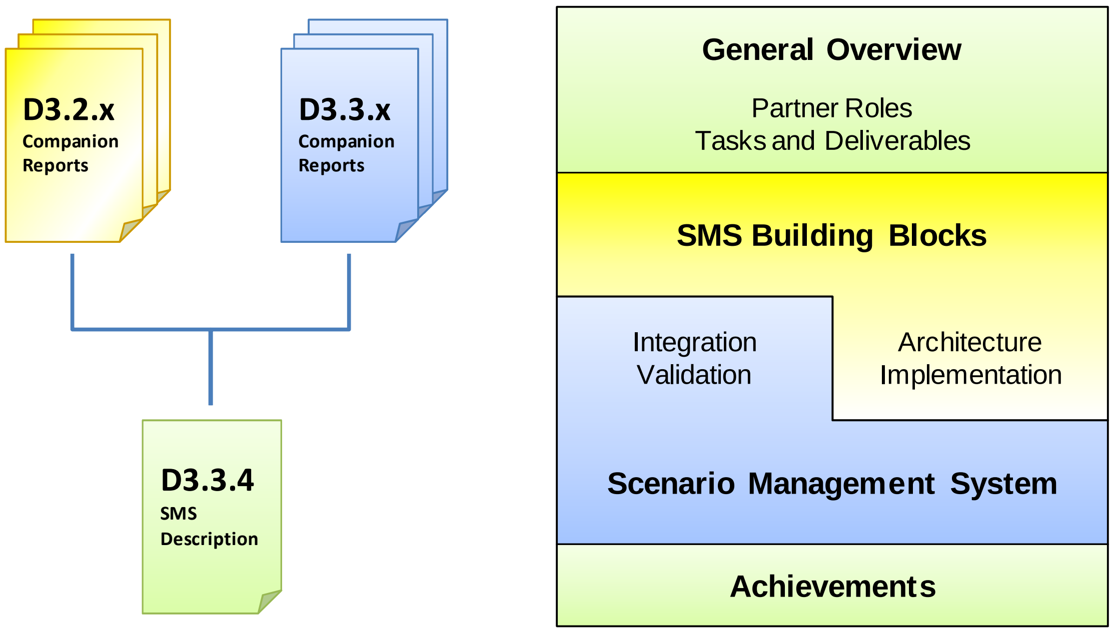


Figure 4: Relations between Companion Reports

Several parts of the D3.2.x and D3.3.x companion reports are common to both deliverables in order to be able to gain a complete overview on the SUDPLAN SMS without the need to read both documents. The main difference between the two types of documents is that the D3.2.x reports focus on architectural and implementation aspects of the individual SMS Building Blocks, while the D3.3.x (x < 4) reports focus on the integrated solution as well as testing and validation aspects.

As can be seen in *Figure 5: Dependencies in the Development* Process, the implementation of the SMS Building Blocks and their integration into the SMS is influenced by several activities in the overall project.

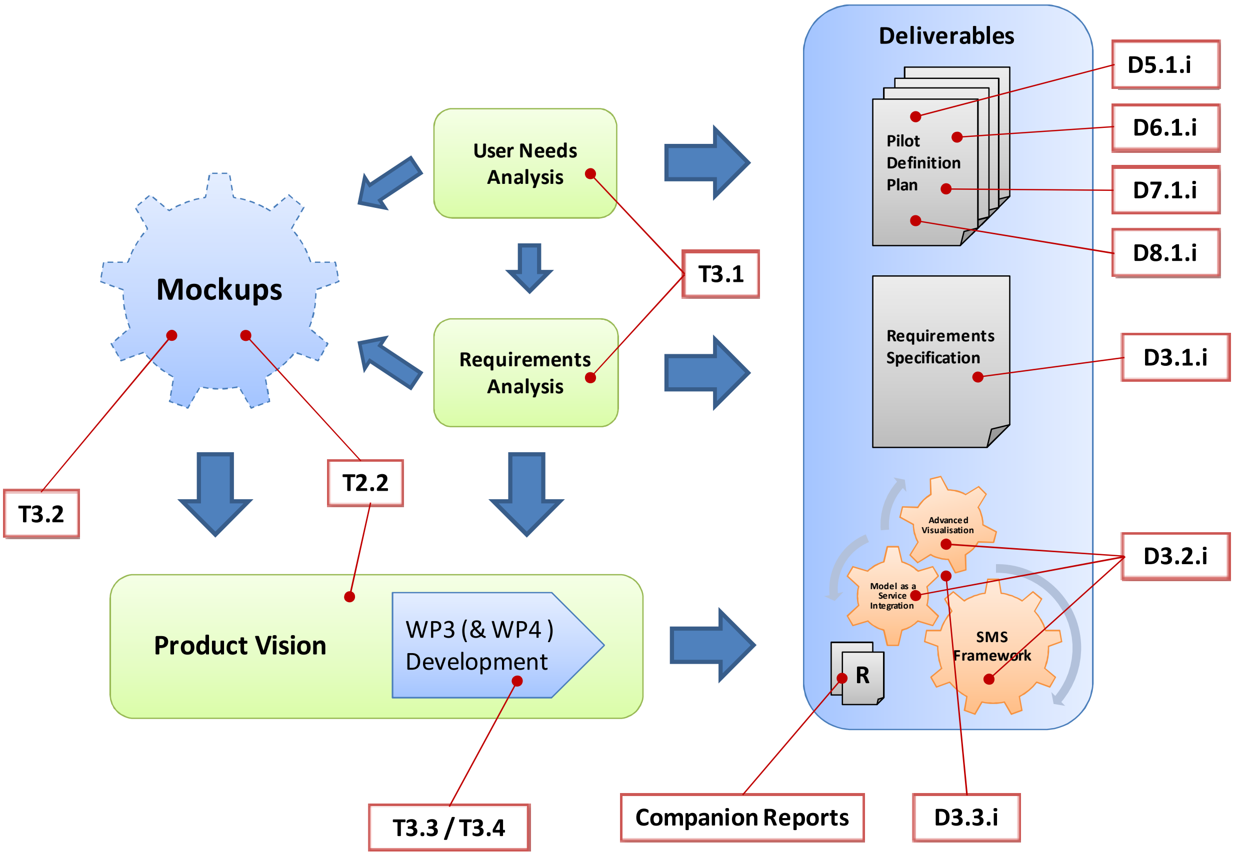


Figure 5: Dependencies in the Development Process

The developments of the SMS Building Blocks were performed in the *Product Implementation* (T3.3) Tasks while embedding the individual components in the integrated SMS took place in the *Integration, Testing and Software Validation* (T3.4) Task.

In the **first year** of SUDPLAN the developments were mainly driven by the *Product Conceptualisation* (T2.2), the *Product Prototyping* (T3.2), and the *Requirements Specification* (T3.1) tasks.

In the **second year** of SUDPLAN, the developments have not been influenced solely by refined requirements (D3.1.2) and ongoing mockup activities but also the implemented features of V2 have been selected on basis of the Pilot Application requirements laid out in the Pilot Definition Plans V2 (D[5-8].1.2). In addition Y2 implementation and integration work could already use the outcome of the *Product Validation and Evaluation* Task (T2.3) as shown in

Figure 6: Second Year Development. Thus, the findings of the first Validation and Evaluation Report (D2.2.1) have been taken into account during the development and integration activities.

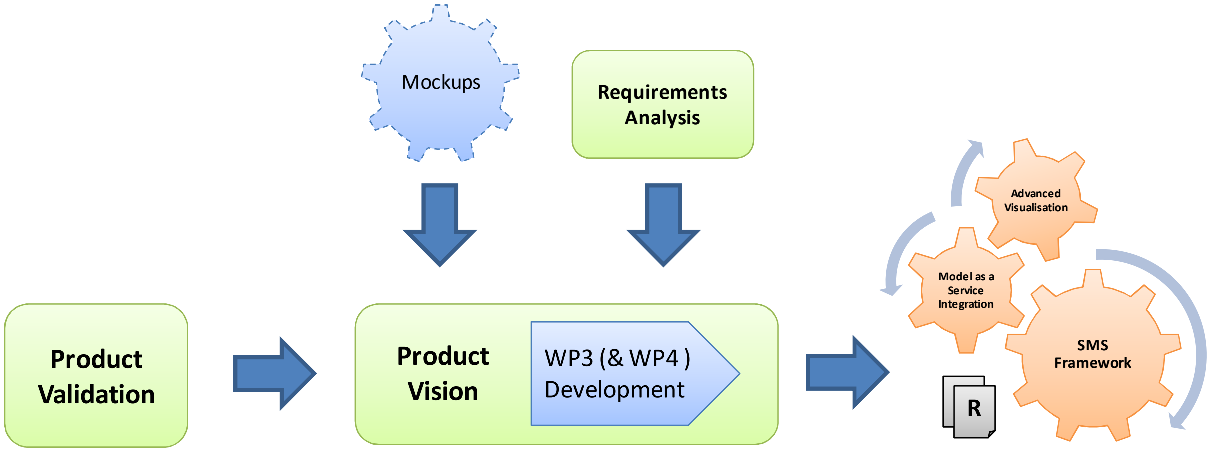


Figure 6: Second Year Development

In the **third year** of SUDPLAN, the developments were mainly driven by the outcome of the second Product Validation and Evaluation (D2.2.2) as well as the Pilot Definition Plans V3 (D[5-8].1.3).

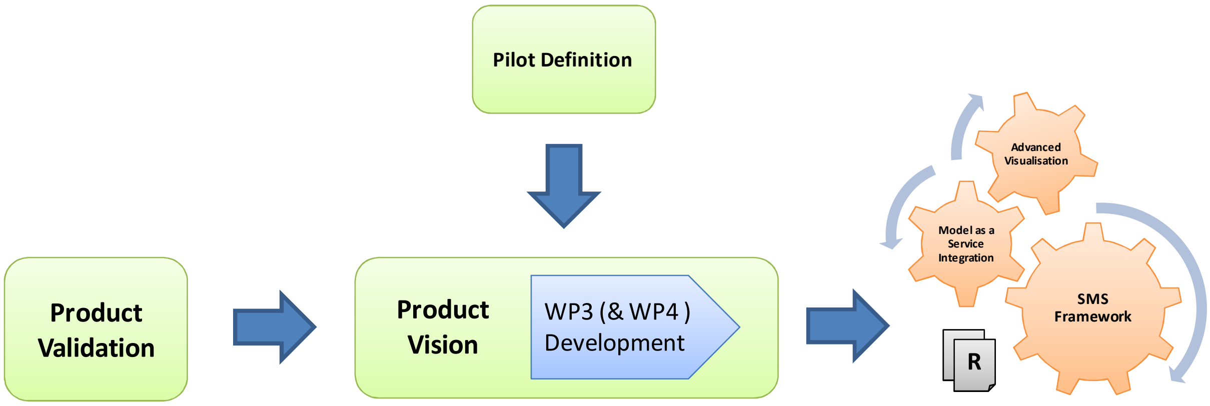


Figure 7: Third Year Development

The requirements and user needs analysis, as performed in the course of T3.1, are further explained in the *D3.1.2 - Requirement Specification V2*.

The immediate results of the WP3 development process (T3.3 and T3.4) are a set of distinct components, presented as SMS Building Blocks in detail in *D3.2.3 - Product Implementation V3*, and the integrated SMS itself, presented in this document.

3. Scenario Management System Overview

The Scenario Management System is the platform on which any SUDPLAN Application (or SUDPLAN System) is built. It consists of the three distinct Building Blocks described briefly in the subsequent sections of this chapter. For a more detailed description of these Building Blocks and a report on implementation activities please refer to the companion report to the deliverable *D3.2.3 - Product Implementation V3*.

The SMS and can be seen as a generic integration platform that will be able to facilitate climate change induced urban development planning in any city in Europe. The goal to provide a universal, flexible and adaptable planning tool is supported by the separation of the SUDPLAN System into several architectural layers as shown in *Figure 8: SUDPLAN Layered* Architecture.

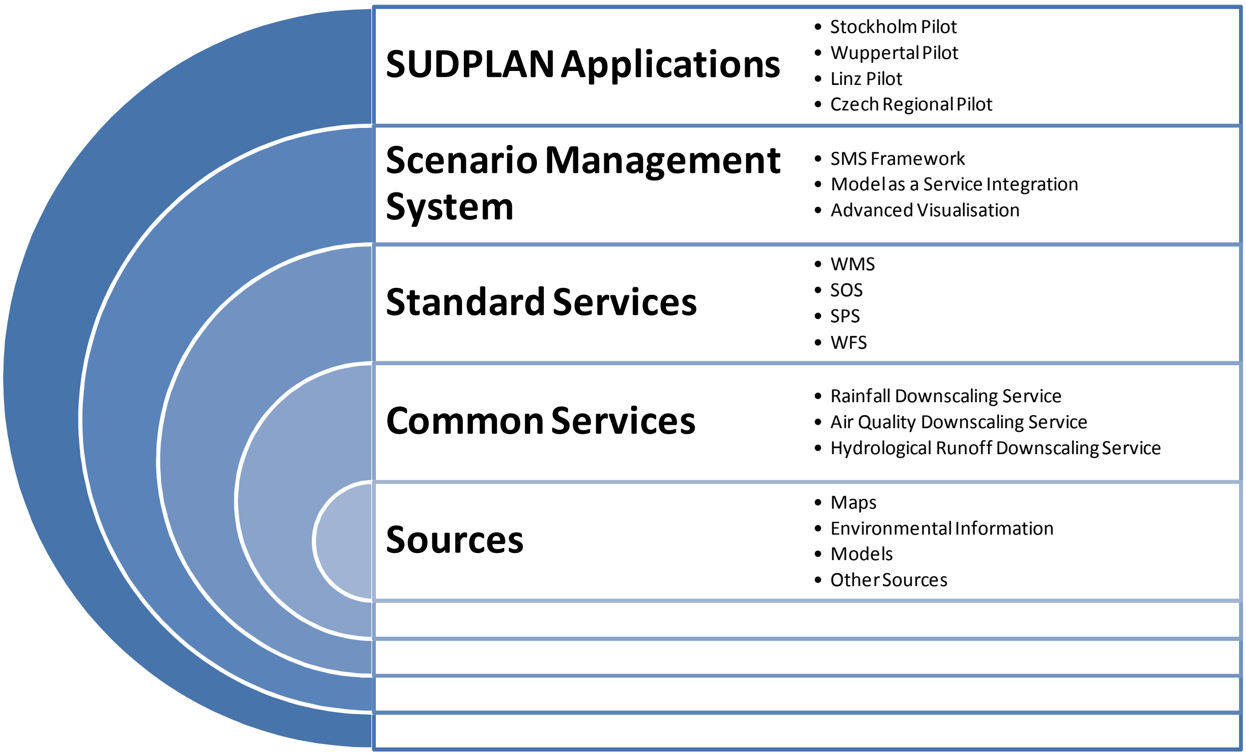


Figure 8: SUDPLAN Layered Architecture

The top-level layer, the SUDPLAN Application itself, is the result of an extension, customisation and configuration of the underlying SMS. The SMS comes with everything necessary to provide common scenario management tasks including data integration, model management and execution, basic and advanced visualisation, and comparison of various temporal and spatial data sets, etc. It therefore relies upon standard services for data access and model management and thus greatly facilitates the task of integrating new models and data sources. Consequently, the same mechanisms used for interfacing the SUDPLAN Common Services with the SMS can be used for local model and data source integration.

As shown in *Figure 9: OGC Services* Integration, several services specified by the Open Geospatial Consortium (OGC) are supported by the SMS: Sensor Planning Service (SPS), Sensor Observation Service (SOS), Web Map Service (WMS) and Web Feature Service (WFS).

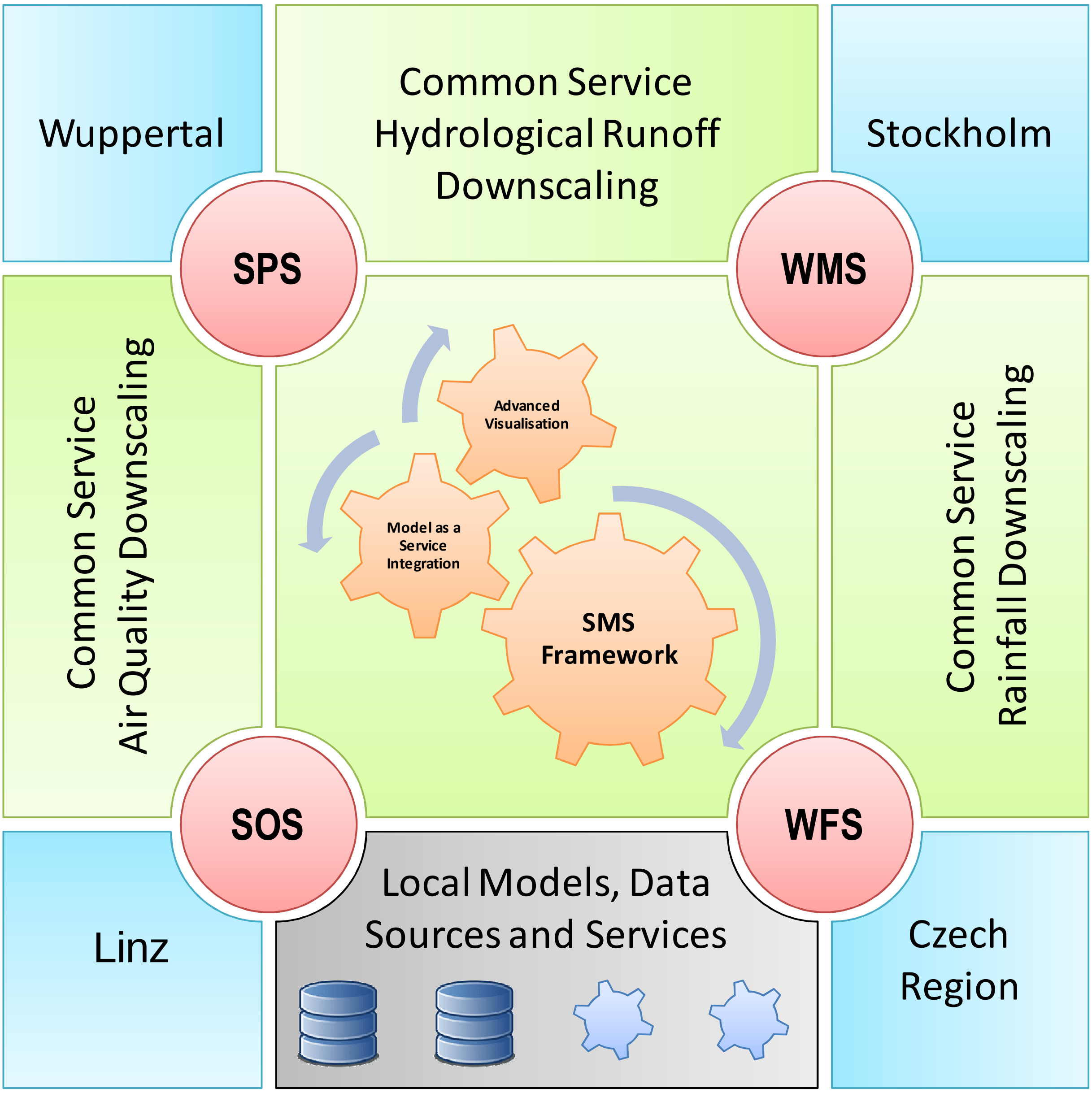


Figure 9: OGC Services Integration

It is nevertheless possible to develop a custom model integration solution with respect to particular user requirements. The SMS Framework allows both standard and custom integration without the need to change the SMS itself. For this purpose, the SMS Framework exposes an API that enables the developers of a SUDPLAN Application to extend the SMS with their specific functionalities. The four pilot applications of the SUDPLAN project therefore validate not only the general approach of the SMS but also its adaptability/transferability and thus its applicability to any city in Europe.

3.1. Scenario Management System Framework

The Scenario Management System Framework (GUI shown in *Figure 10: SUDPLAN SMS GUI*) is the central component providing common SMS and integration functionality. Together with the Building Blocks for the integration of models through standardized service interfaces and for advanced visualisation capabilities it provides the basis for pilot specific implementations and the necessary workflows to support the use of models as a basis for decision making.

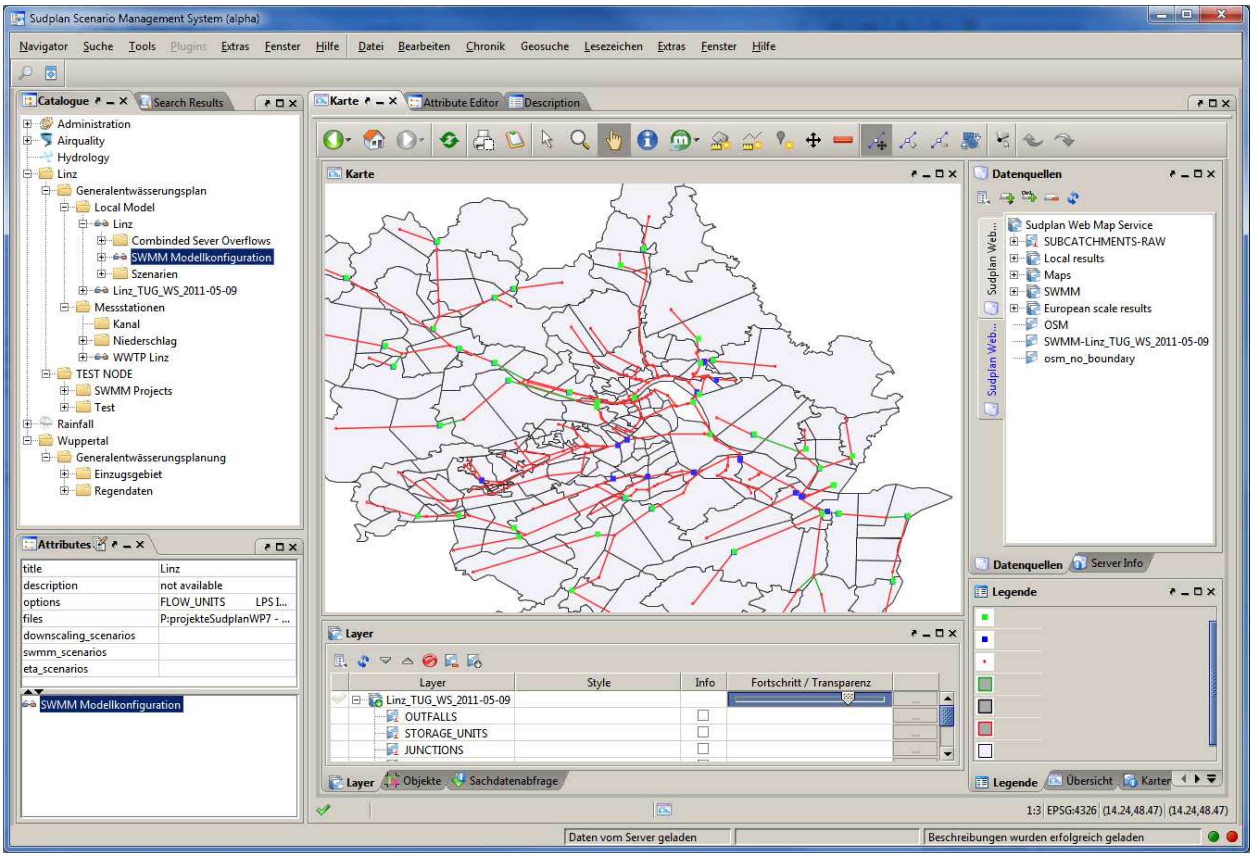


Figure 10: SUDPLAN SMS GUI

The core functionalities provided by the SMS Framework include, for example, navigation, search, visualisation and manipulation of arbitrary (geospatial) data. For the SUDPLAN project, extensions for the management of models, i.e. asynchronous model execution, result storage, parameterisation and basic model result visualisation (such as 1D time series, and 2D maps), were developed.

SMS development efforts are based on the open source cids[1] geo-integration platform. Cids is based on a 15 year research project and was developed by the Environmental Informatics Group (EIG). It was used in several projects including FP4 and FP5 projects. In 2001, it was turned over to cismet GmbH. All cids components are written in Java and thus are platform independent and web-enabled.

[1] http://www.cismet.de/en/products.html

The cids product suite consists of a set of services, applications, software components, management tools, development tools, and application programming interfaces (APIs) for the management, integration, and development of heterogeneous information systems with a special focus on interactive geo-spatial systems. It provides a distributed integration platform, which is particularly useful for workflows that need a combination of information and processes from different source systems such as GIS systems, relational databases, simulation models and so forth. In this way it already provides and supports a number of functionalities of the anticipated SUDPLAN SMS, including user management and access control, search and discovery of relevant information and advanced interactive 2D visualisation (OGC WMS and WFS clients). The architecture and the core components of cids and the SMS Framework are presented in the following.

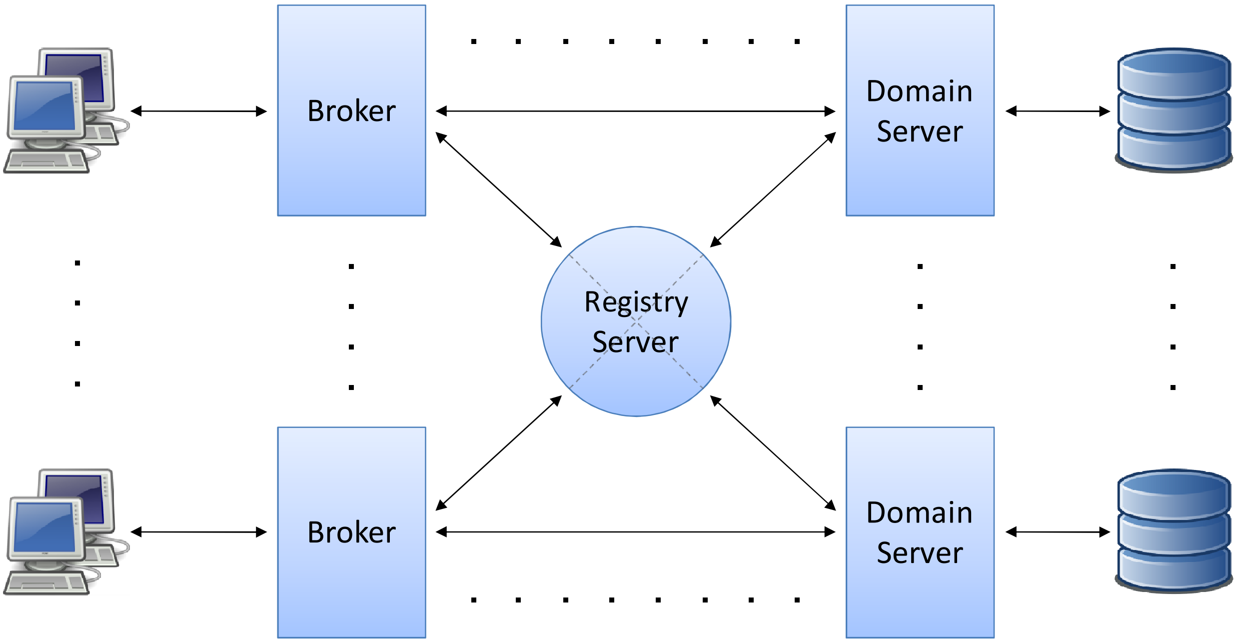


Figure 11: SMS Framework client-server Architecture

Figure 11: SMS Framework client-server Architecture shows that the SMS Framework is based on a client-server architecture in which an arbitrary number of client instances and server components co-exist in a service network, thus ensuring scalability and reliability. The components shown in *Figure 11* are explained in detail in the following sections.

The main building blocks of the SMS Framework are the Navigator (client), the Kernel, and a set of system management tools. The building blocks and the components are shown in *Figure 12 Building Blocks of the SMS Framework.*

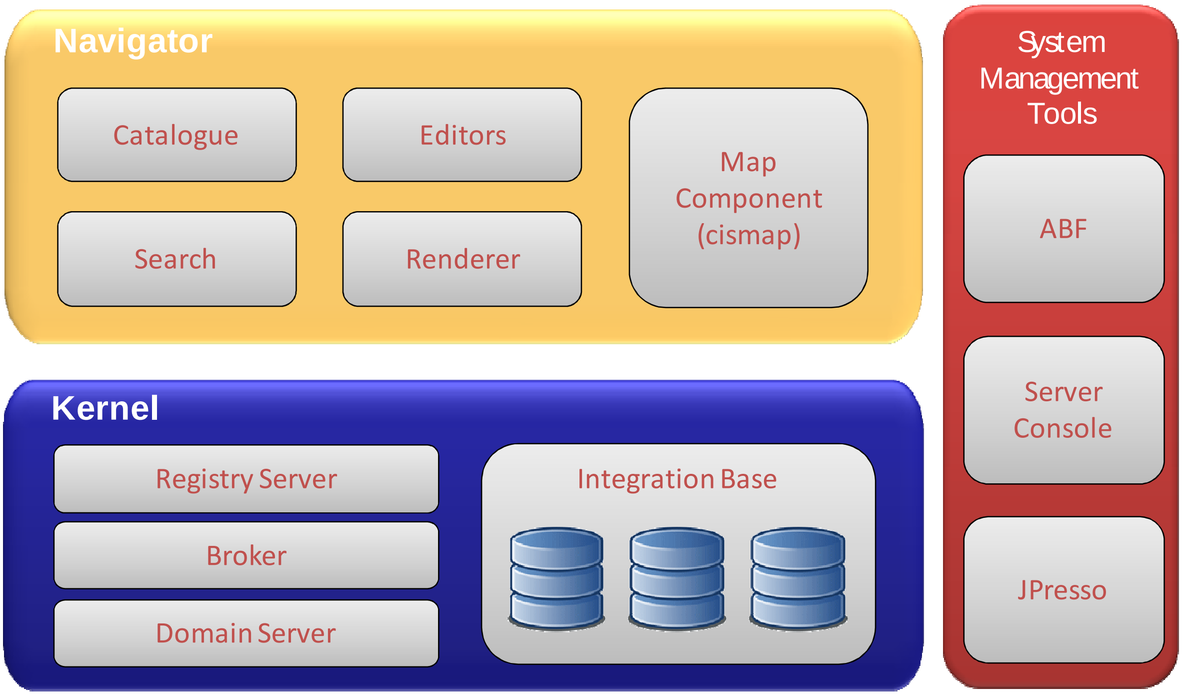


Figure 12 Building Blocks of the SMS Framework

The **Kernel** represents a network of distributed services and consists of the following four components:

- **Integration Base**
  The Integration Base is a distributed meta database which consists of a generic meta data model placed in a relational DBMS (Data Base Management System).

- **Domain Server**
  The Domain Server is the interface to an Integration Base and is responsible for the translation of the generic meta data structure into concrete meta objects and classes, thereby also supporting the creation and updating of meta data. It is also responsible for the construction of the dynamic catalogue structure at runtime.

- **Registry Server**
  The Registry Server is responsible for the resolution of distributed user privileges needed for the enforcement of access rights, the resolution of the distributed catalogue structure needed for the navigation, and the coordination of the distributed search. It also provides service infrastructure related functionalities like server name resolution, network monitoring, status information, etc.

- **Broker**
  The Broker is the interface to the clients and hides the distribution aspects of the system. It acts like a proxy and delegates client request to the appropriate Domain Servers.

For more information on the SMS Framework please refer to refer to the companion report to the deliverable *D3.2.3 - Product Implementation V3.* The SMS Framework is validated in all four validation use cases.

3.2. Model as Service Integration

The main objective of the Model as Service Integration is to provide the means to control model implementations and access model results, including both SUDPLAN Common Services and local pilot specific models, via standardised web services. The selected standards are members of the OGC SWE [SWE, 2007] family, specifically SOS (Sensor Observation Service) and SPS (Sensor Planning Service), which are used for model result access and model control. This part of the SMS can be used to access the corresponding common service (*see D4.1.2 – Concerted Approach Report V2*) as well as to encapsulate local models as in some of the four pilot applications of SUDPLAN.

Within SUDPLAN we concentrated on the use of the OGC service interfaces, since the OGC service interfaces are an accepted standard in the GIS community, and cover a large number of use-cases relevant to environmental applications. Additionally, the use of these established standards enables the integration of SUDPLAN services and the SMS with already existing as well as emerging data and model services.

The implementation of SOS and SPS related software is based on the Time Series Toolbox (TS-Toolbox) API from AIT. The TS-Toolbox API provides the means to conveniently deal with arbitrary time series. The TS-Toolbox represents a good starting point to implement dedicated services to wrap the various existing models needed in SUDPLAN and to establish the basis for the integration of new local models through standardised service interfaces. Many other parts of the TS-ToolBox, especially on the client side, can also be used or adapted to suit SUDPLAN needs.

In the following a short introduction on the TS-Toolbox architecture and the related APIs is given. More information on the TS-Toolbox can be found in the companion report to the deliverable *D3.2.3 - Product Implementation V3* and on the TS-Toolbox website at http://ts-toolbox.ait.ac.at.

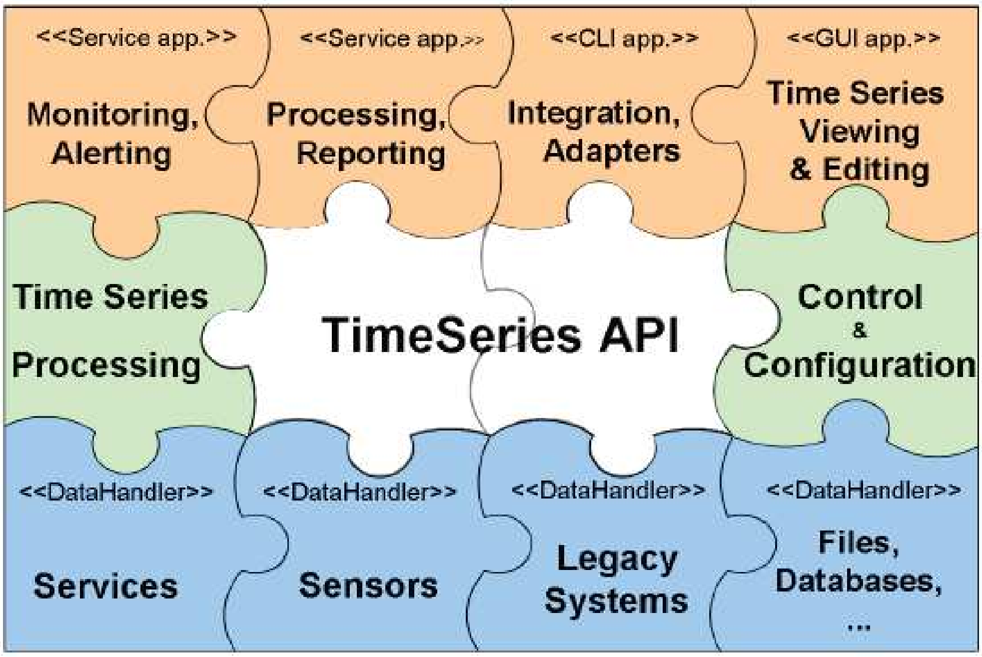


Figure 13: Elements of the TimeSeries ToolBox

TS-Toolbox is a high level programming framework that allows efficient access to, processing, archiving and presentation of semantically enriched time series. It consists of three layers (*Figure 13: Elements of the TimeSeries ToolBox*): the "applications" layer provides examples of complete TS-Toolbox applications with CLI, GUI and web-service interfaces; the "components" layer provides the functional building blocks for commonly used functions; and the "TS-API" layer provides the basic interfaces and methods for presentation and manipulation of semantically enriched time series.

The functionalities implemented by the TS Toolbox components provide application developers with higher level building blocks than typical general purpose libraries, and allow rapid development of full-fledged service, GUI, and CLI applications. Moreover, the TS-Toolbox based applications are highly modular, network-aware, and easily re-configurable, and the use of TS-API interfaces simplifies the task of extending and adapting the TS-Toolbox applications to new environments. The main advantages of the TS-API are:

- Data from different legacy systems, including local models and related environmental, geographical or background data, can be easily integrated, processed, visualized, and made available to a larger audience by means of standardized service interfaces.

- Its pipe-oriented architectural design greatly simplifies the task of component and data flow configuration within an application, e.g. using the output of a certain model (SUDPLAN Common Service) as the input to another model (pilot-specific local model).

- The components can be easily chained, e.g. in order to provide more sophisticated processing capabilities, and used in parallel (e.g. asynchronous model execution), in order to provide alternative means for accessing, storing and presenting the data.

- Components can be easily extended or replaced with alternatives, e.g. in order to access new types of data, integrate new models, or improve the processing or storage performance.

The TS-Toolbox "components" provide the functional building blocks for commonly used functions, such as:

- Sensor configuration and access to sensor data. For example, the AnySenDataHandler provides a mean to access various sensors accessible over serial and network interfaces.

- Read- and/or write- access to time series stored in services, files and databases. For example, the SOSDataHandler provides access to standardised Sensor Observation Service, the CSVSimpleDataHandler to ASCII files and the GenericDBDataHandler to relational databases.

- Service interfaces. For example, the Remote DataHandler allows exchange of time series between two TSToolbox applications over the network.

- Processing and annotation of the time series. In particular, the F3 Processor component provides a generic functional language for manipulation of the time series.

- Control components provide a convenient way to dynamically control the data flow and the behaviour of the DataHandler and Processing components.

The TS Toolbox is designed with extensibility in mind, and more components, such as model integration and management components developed in SUDPLAN, will be added in the future.

The Model as A Service Component is validated in the downscaling use cases (e.g. rainfall) as well as in the local model execution use cases (e.g. Linz Pilot).

3.3. Advanced Visualisation Component

The SUDPLAN SMS functionality will include "*an advanced 3-D/4D visualisation component for the visualisation and animation of 3-D results and predictions, in particular using the 3-D landscape.*" *(DoW)* This component will help the planners, modellers and decision makers to gain deeper insights into the correlations of phenomena related to their particular workflow. The goal of the first development cycle was to create a running system which visualises pilot data related to the Stockholm pilot. Here, the data was opened and processed directly. However, in the second development cycle this approach has been enhanced by a service-oriented concept.

The overall goal of SUDPLAN's 3-D visualisation component is to produce a flexible and modular tool which can be used in any application which has a need for geospatial visualisation in 3-D. Special emphasis is placed on the reuse of available APIs and software. Through the course of the project we will use suitable and stable open source software as much as possible. Additionally, we will use publicly available proven geospatial standards such as WMS, WFS etc. in order to facilitate the easy integration of new and existing content for visualisation.

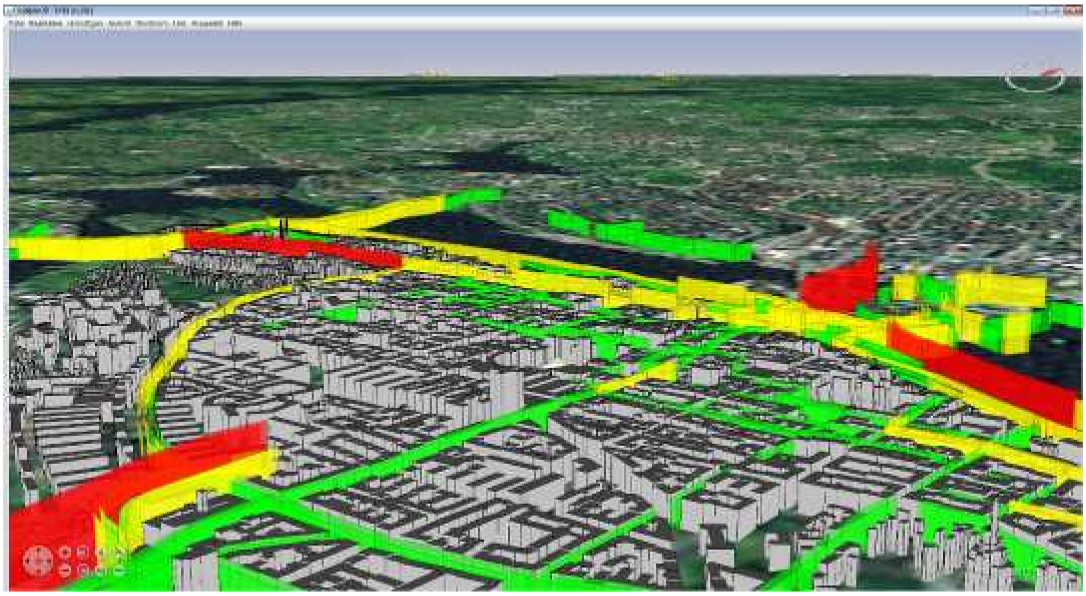


Figure 14: 3-D Visualisation of Air Quality and Traffic Density in Stockholm

Since the World Wind SDK already provides many standard GIS features (e.g. elevation model, compass, the possibility to increase the digital elevation model etc.) the 3-D visualization is able to focus on suitable visualization techniques.

Reviewing the possibilities and demands of the first year as well as future tasks it became evident that it will not be possible to accommodate all user requirements in a Java3-D based application within the runtime of the project. Thus, it was decided to use the freely available World Wind Java SDK[1] component as basis for the further development of the Advanced Visualisation Component. The World Wind Java SDK has been the best match for further development of the Advanced Visualisation Component, as it already provides a Virtual Globe metaphor, improved navigation capabilities compared to the year one prototype and support for basic geospatial services.

Because of many features already provided by World Wind's virtual globe we were able to come up with a more general concept in order to cope with pilots' visualisation needs. After the integration of the World Wind SDK and the synchronization with the SMS we developed a new visualisation wizard called VisWiz (see *Figure 15: An example of the visualisation Wizard (VisWiz)*). This visualisation wizard component is explained in detail on a technical level in the companion report to the deliverable *D3.2.3 - Product Implementation V3*. Therefore only a short overview is given in this document.

The idea of VisWiz is to provide a means to support the user in selecting a suitable and state-of-the-art 3-D visualisation technique both in the sense of scientific visualisation and information visualisation. Here, we focus on the independence of the provided GIS data from the visualisation. At a later stage the VisWiz will take advantage of the metadata from the input source in order to propose suitable visualisation techniques.

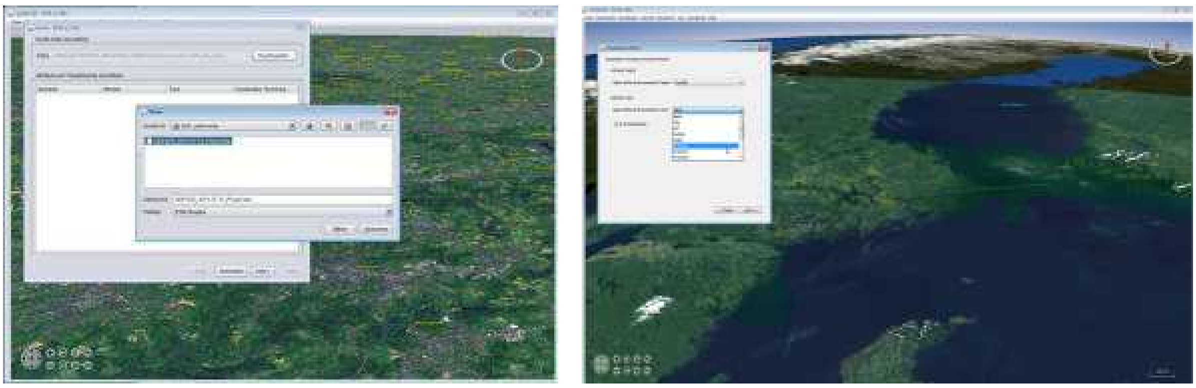


Figure 15: An example of the visualisation Wizard (VisWiz)

Using VisWiz the user is able to select between different visualisation techniques for one or multiple attributes provided as input source. The first version of the VisWiz was designed to support all user types for selecting a suitable visualisation technique for the selected data. This is even more important if the user is not familiar with visualisation in general or the content of the data source. In order to be usable for a wide variety of data sources and by a broad user group, great emphasis was put on the following points for the design of the VisWiz: independence from data source, extendable visualisation collection, intelligent proposal, and simple user interaction. Since the integration of visualisation techniques was set up as a plug-in architecture the extension of further visualisation techniques can be reached quite easily.

A standalone version of the SUDPLAN's 3-D visualisation component can be downloaded from http://sudplan.kl.dfki.de/. Since the SUDPLAN SMS uses Java™ Web Start (JWS) technology the 3-D visualization component has to take care of this fact as well and can be started directly from the browser.

[1] See http://www.goworldwind.org

4. SMS Integration, Testing and Software Validation

The goal of *T3.4 Integration, testing, software validation* and its corresponding deliverable D3.3.3 was to integrate the three SMS Building Blocks into one combined application including the testing and validation of the individual building blocks. *Figure 16: Integrated SMS Prototype* shows a screenshot of the prototype of the integrated SUDPLAN SMS including the advanced visualisation component (3-D Map on the right).

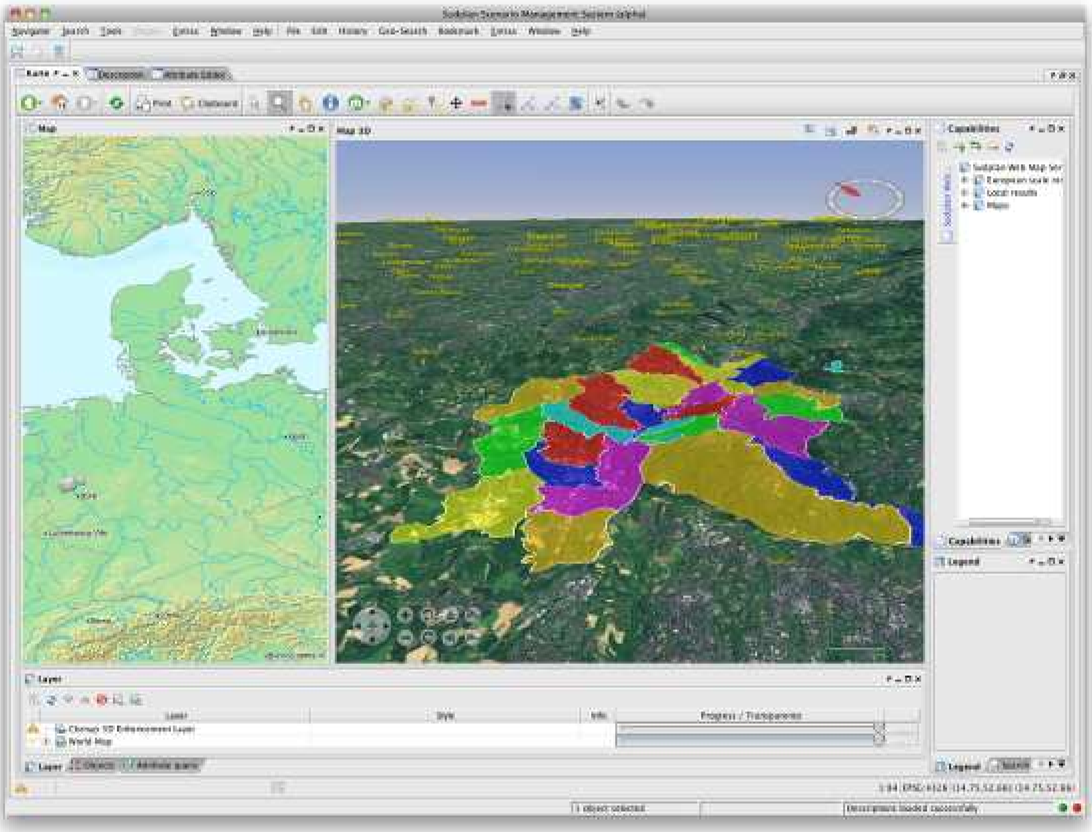


Figure 16: Integrated SMS Prototype with new 3-D Visualisation Component

The source code as well as the compiled libraries of the complete application can be downloaded from http://sudplanwp3.cismet.de/sms/. Since the SMS is web-enabled, it is also possibly to start it directly from the browser without the need to install the application locally (*Figure 17: Run the SMS from the Web*). Java™ Web Start (JWS), which can be downloaded from http://www.java.com/download/, is required for this kind of online invocation.

Figure 17: Run the SMS from the Web

The Web Start URL of the SMS Prototype is http://sudplanwp3.cismet.de/sms/run.html[1].

Figure 18: SMS Login Dialog

There is also a SMS Video Tutorial in six parts available, which explains the basic controls of the SMS application. It can be watched on the SUDPLAN WP3 Blog at http://sudplanwp3.cismet.de/?p=523[2].

4.1. Integration and Testing Environment

The first step towards the integration of the SMS application was the establishment of an integrated development and testing environment. This integration environment consists of tools and procedures for source code revision control, build management, issue tracking, automated unit tests and software artifacts management (SUDPLAN components and external libraries). This infrastructure was provided by cismet and is also used in other projects for state-of-the-art software development. It consists of the following components:

- **Apache Maven** [MAVEN]
  is used for is used for the management of software projects and provides a so called build lifecycle. The build lifecycle encompasses for example to process resources, compile sources, package results and retrieve project dependencies (e.g. external libraries).

- **Jfrog Artifactory** [ARTIFACTORY]
  is as maven artifact repository and is used to manages maven software artifacts and provides also caching capabilities for external repositories

- **Oracle Hudson Server** [HUDSON]
  is used for continuous integration, which means it continuously integrates changes in the source code, performs the specified automated test runs and deploys changes to the software repository (artifactory) and other relevant targets (e.g. the Web Start page of the SMS prototype)

[1] user: sudplan password: fjwe0ijfls or contact martin.scholl@cismet.de to obtain login information
[2] user: commission password: 9f4rJASG3rfd or contact martin.scholl@cismet.de to obtain login information

- **Apache Subversion** [SVN]
  is used for source code revision control and keeps track of source code changes.

- **MantisBT** [MANTIS]
  is used for issue tracking and management and provides change logs.

Figure 19: Software Development Infrastructure Interaction shows the interaction of these components. During the development process maven is responsible to retrieve all the project source's dependencies that are needed to compile the project. To do so maven uses the artifactory repository. Artifactory serves as an artifact repository for all the SMS related software developed in the SUDPLAN project but also retrieves and caches third party artifacts.

When new code is checked in by the developer Hudson will be notified about the change thus starting a build of the project and all its relationships. After a successful build the project artifact will be automatically deployed to the artifactory repository.

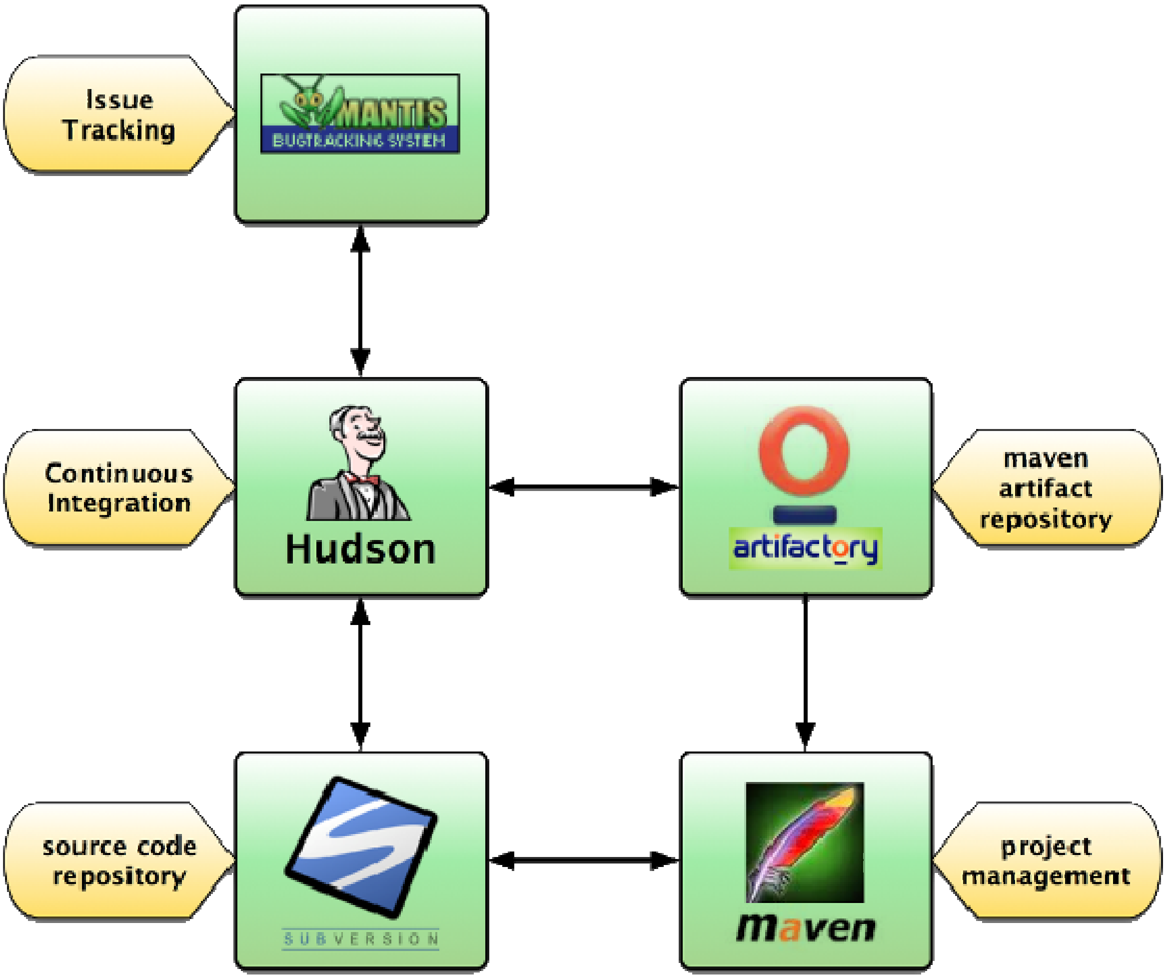


Figure 19: Software Development Infrastructure Interaction

Project builds and automated tests can be managed and monitored via the Hudson web interface as shown in *Figure 20: Hudson Continuous Integration*.

Figure 20: Hudson Continuous Integration Web Interface

The integration environment does not only ease development significantly, it also provides means for testing the software. Therefore automated unit tests are specified which ensure the developed software does what it is intended to do from the perspective of the developer. It does however not ensure that the software behaves as expected by the users which were involved in the specification of the requirements and thus the functionalities of the software. For this purpose, special validation uses cases that were specified together with the users were implemented. These validation use cases are documented in the next section *4.2 Micro-scale Validation of the integrated* SMS. The results of the automated unit test are documented as part of the build history of the software projects and can be accessed through the Hudson web interface (*Figure 20: Hudson Continuous Integration).*

4.2. Micro-scale Validation of the integrated SMS

In addition to the project wide validation and evaluation activity (T2.3) and in correspondence to validation aspects of *T3.4 Integration, testing, software validation*, the prototype of the integrated SMS developed in the first year of SUDPLAN was validated on a micro-scale with help of four representative use cases. These uses cases were defined by users and developers during the product prototyping phase (T2.2 and T3.2) as part of the mockup process presented in *2.1 Tasks and Documents involved*.

The uses cases supported by the first SMS prototype are:

- Use Case #01: Climate Scenario Information on the European Scale
- Use Case #02: Execute Rainfall Downscaling
- Use Case #03: Execute Air Quality Downscaling
- Use Case #04: 3-D Visualisation of Local Air Quality and Traffic Data

The uses cases of the first year validated primarily the integration of the Common Services and the proof-of-concept integration of the 3-D Visualisation Component. In year two, more emphasis was laid on the support for pilot applications, that is, the import of local data (time series, IDF curves, etc.) and the execution of local pilot specific models. Furthermore, the Common Services integration was improved, support for IDF Rainfall Downscaling was added and time series comparison features and the new 3-D Visualisation Component were integrated.

The five uses cases that were implemented and validated for V2 are

- Use Case #05: Execute IDF Rainfall Downscaling
- Use Case #06: Local Data Upload
- Use Case #07: Local Model Integration
- Use Case #08: Time Series Visualisation & Comparison
- Use Case #09: Execute the 3-D Visualisation Wizard (DFKI)

In the third year more emphasis was laid on the improvement of the 3-D visualisation capabilities of the SMS, the integration of Hydrology Downscaling and the improvement of the Rainfall and Airquality Downscaling integration (support for rainfall frequency adjustment and local emission database upload). The validation of the new features was performed with help of the updated use cases #01, #02, and #03 and the following new uses cases:

- Use Case #10: Visualization of 3-D air quality data using iso-surfaces
- Use Case #11: 3-D Animation of "Water-run off" simulation results
- Use Case #12: Execute Hydrology Downscaling
  Use Case #13: Emission Database Upload

The micro-scale validation cycle is shown in *Figure 21: SMS Micro-Scale Validation* Cycle. The individual SMS Building Blocks were implemented (T3.3) by the developers taking into account the requirements specified in *D3.1.2 Requirement Specification V2* (T3.1) and integrated into one application.

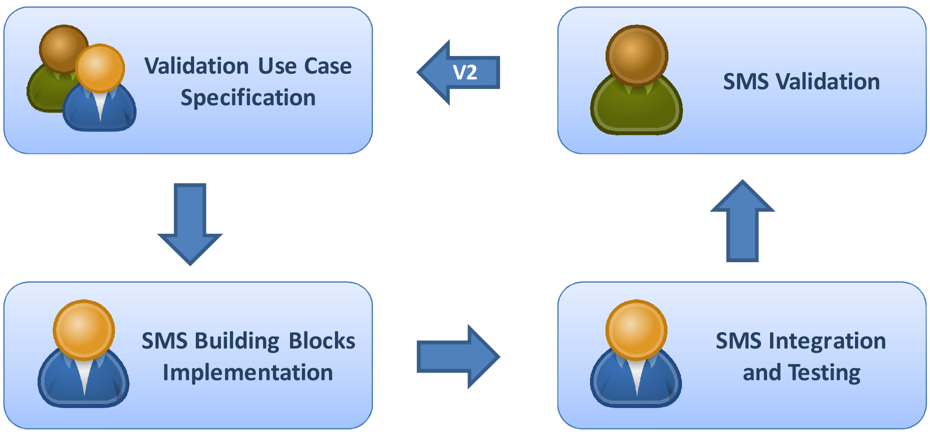


Figure 21: SMS Micro-Scale Validation Cycle

The integrated SMS has been configured by the developers to support the previously specified uses cases. The configuration of the SMS involved the creation of the respective meta objects that represent the connection to the common services, the input and output data, etc. as well as the configuration of the 2D and 3-D map components and related services (WMS, WFS, SPS, SOS).

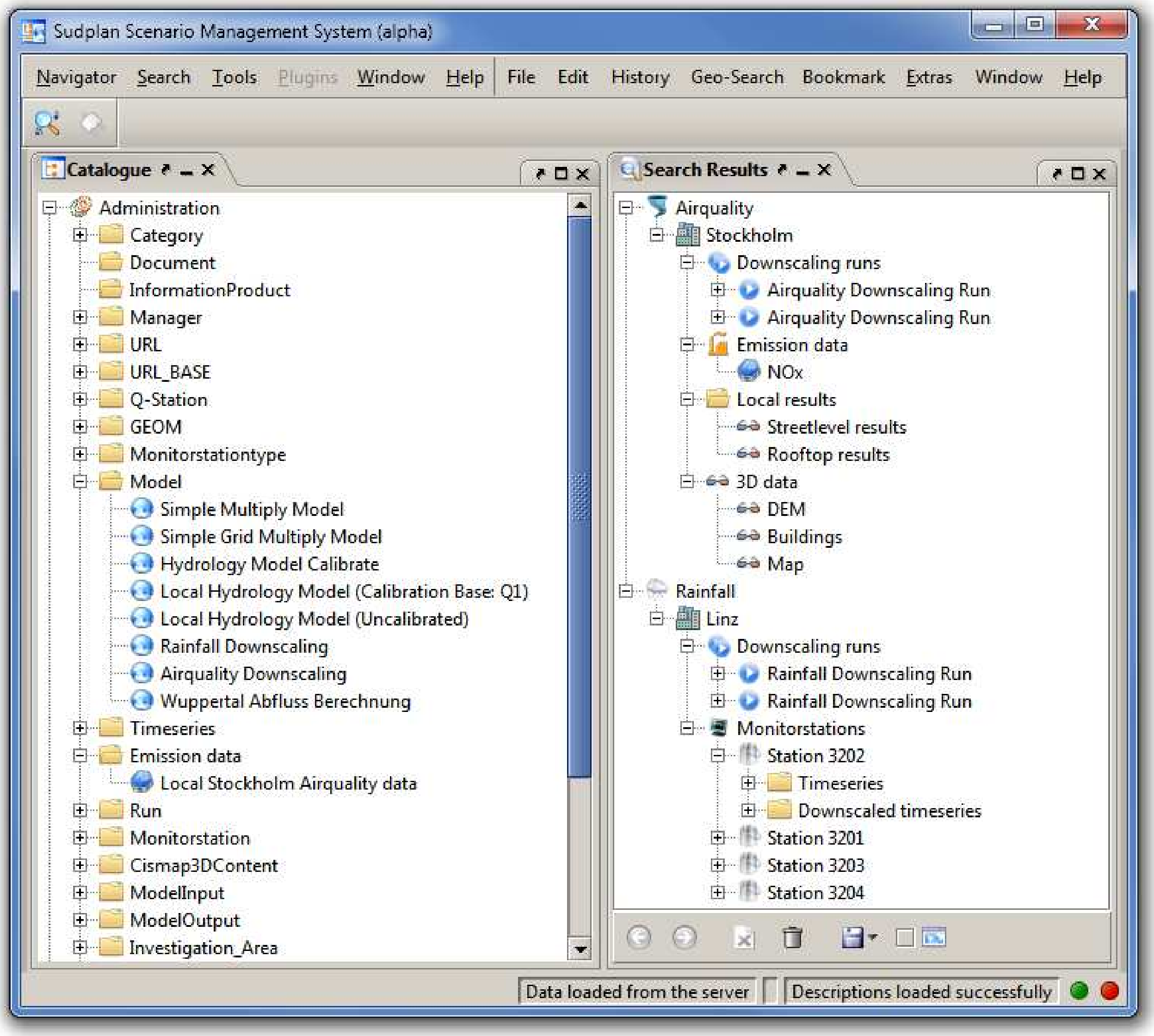


Figure 22: SMS Configuration for Validation Use Cases

Figure 22: SMS Configuration for Validation Use Cases shows the administrator's (left) and the users (right) view on the current configuration of the SMS. Additional configurations were created for the pilot specific applications as shown in *Figure 23: Local SMS Configuration for Pilot Applications* which are for example needed for the validation of the local model integration.

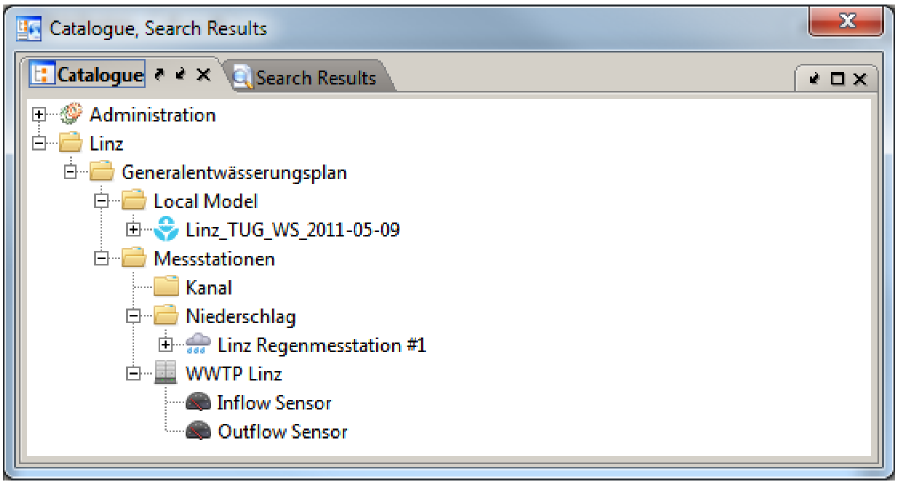


Figure 23: Local SMS Configuration for Pilot Applications (Linz Pilot)

The use cases were performed by the users of the SMS in order to validate the actual functionality of SMS compared to the expected functionality previously specified as part of the validation uses cases. *Table 1: SMS Validation Matrix* shows which part of the overall SMS was validated by which use case. It should be noted that of course only functionality that was available after the second implementation and integration phases could be validated.

	Scenario Management System					Pilot Applications		
	SMS Framework		Advanced Visualisation	Model as a Service		Local Data	Local Model	Common Services
	Wizards	Renderer		SPS	SOS			
Use Case #01		x						x
Use Case #02	x	x		x	x	x		x
Use Case #03	x	x		x	x	x		x
Use Case #04			x					
Use Case #05	x	x		x	x	x		x
Use Case #06	x	x				x		
Use Case #07	x	x		x	x	x	x	
Use Case #08	x	x			x			
Use Case #09			x					x
Use Case #10			x					x
Use Case #11			x					x
Use Case #12	x	x		x	x	x	x	x
Use Case #13	x	x		x		x		

Table 1: SMS Validation Matrix

The validation uses cases are furthermore explained briefly in the following sections of this document. Additional screenshots of the SMS and more detailed interaction diagrams can be found in *Annex 2: Validation Use Case Screenshots and Diagrams*.

4.2.1. Climate Scenario Information on the European Scale

This use case validates the interaction of the SMS between the Common Service for Climate Scenario Information on the European Scale. Currently, these Common Services provide time series of various variables, resolutions and climate scenarios through SOS and WMS interfaces.

	Variable	Scenario	Temporal Resolution				
			30-yearly	10-yearly	yearly	monthly	daily
Climate	Precipitation	CSSM3 A1B		WMS/SOS	SOS	SOS	SOS
		ECHAM5 A1B 3		WMS/SOS	SOS	SOS	SOS
		ECHAM5 A2 1		WMS/SOS	SOS	SOS	SOS
		HADLEY A1B		WMS/SOS	SOS	SOS	SOS
	Temperature	CSSM3 A1B		WMS/SOS	SOS	SOS	SOS
		ECHAM5 A1B 3		WMS/SOS	SOS	SOS	SOS
		ECHAM5 A2 1		WMS/SOS	SOS	SOS	SOS
		HADLEY A1B		WMS/SOS	SOS	SOS	SOS
Air Quality	Ozone	ECHAM5 A1B 3 RCP4.5		WMS/SOS	SOS	SOS	SOS
		HADLEY A1B RCP4.5		WMS/SOS	SOS	SOS	SOS
	NO_2	ECHAM5 A1B 3 RCP4.5		WMS/SOS	SOS	SOS	SOS
		HADLEY A1B RCP4.5		WMS/SOS	SOS	SOS	SOS
	Particles	ECHAM5 A1B 3 RCP4.5		WMS/SOS	SOS	SOS	SOS
		HADLEY A1B RCP4.5		WMS/SOS	SOS	SOS	SOS
	SO_2	ECHAM5 A1B 3 RCP4.5		WMS/SOS	SOS	SOS	SOS
		HADLEY A1B RCP4.5		WMS/SOS	SOS	SOS	SOS
Hydrology	Mean relative soil moisture	ECHAM A1B3		WMS/SOS			
		HADLEY A1B		WMS/SOS			
	DBS-corrected precipitation	ECHAM A1B3		WMS/SOS			
		HADLEY A1B		WMS/SOS			
	Mean Q	ECHAM A1B3		WMS/SOS			
		HADLEY A1B		WMS/SOS			
	Mean specific runoff	ECHAM A1B3		WMS/SOS			
		HADLEY A1B		WMS/SOS			
	Groundwater	ECHAM A1B3		WMS/SOS			
		HADLEY A1B		WMS/SOS			
	DBS-corrected temperature	ECHAM A1B3		WMS/SOS			
		HADLEY A1B		WMS/SOS			
	Agricultural drought, intensity	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Agricultural drought, number of days	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Mean High Flow	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Mean High Flow T10	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Mean High Flow T50	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Snow max	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Snow days	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Hydrological drought, intensity	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				
	Hydrological drought, number of days	ECHAM A1B3	WMS				
		HADLEY A1B	WMS				

Table 2: Available European Scale Data

Table 2: Available European Scale Data shows the currently available Pan-European climate data. Hydrology data for all temporal resolutions will eventually be made available through the SOS interface.

The time series data can not only be visualised in the SMS as graph but also in the map. For this purpose, the interactive TimeseriesFeatureRenderer as shown in *Figure 24: Validation Use Case 1* and described in detail in *D3.2.3 - Product Implementation V3* is used. In short, this SUDPLAN specific extension of the cismap map viewer is able to visualise changes over time in the map.

Figure 24: Validation Use Case 1

The interaction between the mapping component and Common Service providing the time series data and the WMS providing the rendered map layer of gridded time series data respectively is shown in *Diagram 1: Climate Scenario Information on the European Scale* above.

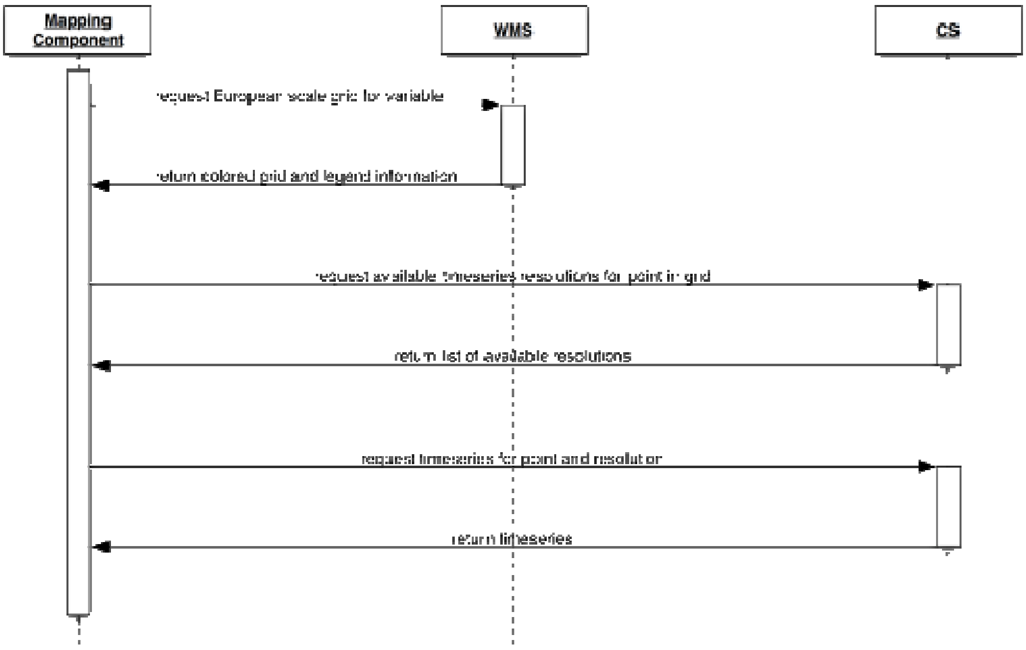


Diagram 1: Climate Scenario Information on the European Scale

Each service request is triggered by a specific user action. The actions performed by the user in this scenario are:

1. Drag and drop desired climate scenario information layer to the map
   Triggers the request on the WMS to return the respective map layer.

2. Choose layer transparency
   Does not trigger any service request, this functionality is supported directly by the mapping client.

3. Choose point in time
   Triggers the request on the CS to return the list of available resolutions at the selected point.

4. Hit the Info button
   Triggers the request on the CS to return the respective time series data.

5. View time-series information
   Shows the time-series information in the Interactive TimeseriesFeatureRenderer.

4.2.2. Execute Rainfall Downscaling

The second use case validates the interaction of the integrated SMS with the Common Service for Rainfall Downscaling. More specifically, it validates the generic model management concept of SMS, the Model as a Service Integration Building Blocks as well as the Interactive FeatureRenderer and the Rainfall Downscaling Wizard (*Figure 25: Validation Use Case 2*) components of the SMS. More information on these components can be found in *D3.2.3 - Product Implementation V3.*

Figure 25: Validation Use Case 2

The invocation of the Common Service for Rainfall Downscaling and the retrieval of the downscaled results are transparently performed by the Model as a Service Integration Building Block. For this purpose, it offers standardised service interfaces, the SPS and SOS interface.

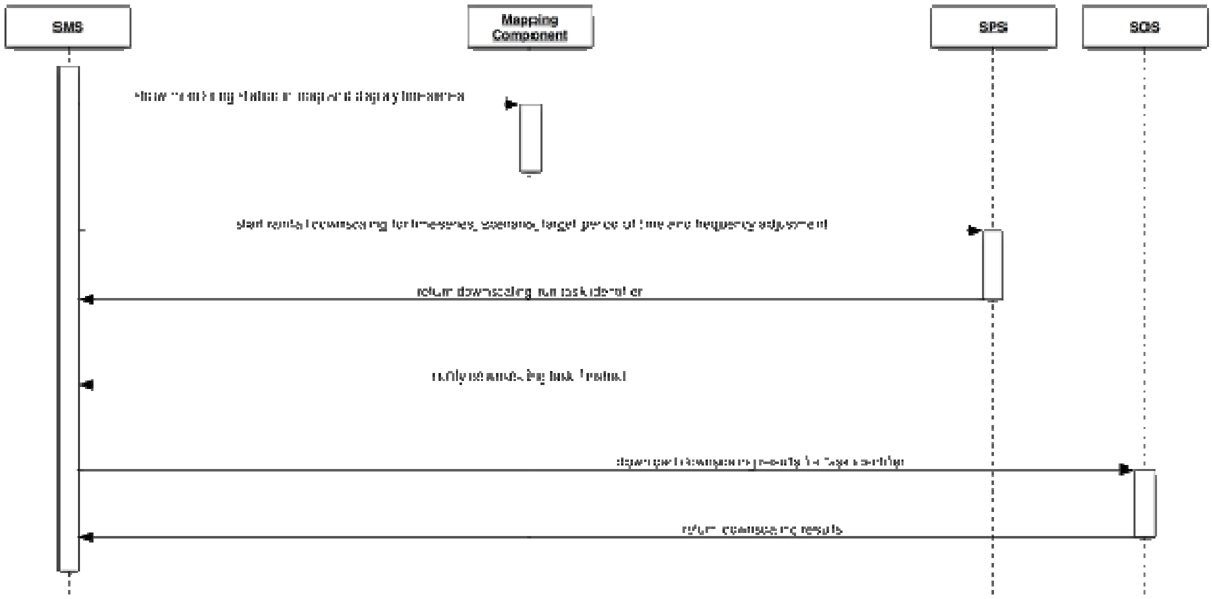


Diagram 2: Execute Rainfall Downscaling

For reasons of readability only the basic communication with the SPS and the SOS is shown in *Diagram 2: Execute Rainfall Downscaling*. Please refer to *Annex 2: Validation Use Case Screenshots and Diagrams* for a more detailed interaction diagram of this use case that also includes the interaction with SMS internal components.

The user actions and the corresponding interactions between the components and services are described in the following.

1. Drag and drop time series to the map
   Triggers the mapping component (cismap) to show the monitoring station in the map.

2. Choose Start Downscaling form the contextual menu
   Opens a Rainfall downscaling Wizard.

3. Choose scenario
   Requests the available scenarios from the Common Service for Rainfall Downscaling (through the SPS interface), together with each scenario's temporal boundaries (start/stop dates). The available scenarios are listed in the wizard, one to be selected by the user.

4. Choose target date and frequency adjustment
   Triggers a request to the SPS to return the temporal boundaries of the selected scenario and lets the user choose a start and an end date consistent (within) these temporal boundaries. Additionally the user can choose whether this downscaling should do a frequency adjustment.

5. Add metadata
   The user can add a description to the downscaling run.

6. Perform downscaling
   Initiates the downscaling. The SPS returns a task id and is periodically checked by the SMS if the downscaling is finished. The status of the model execution can be monitored as shown in *Figure 26: Monitor Model Execution Status*.

7. View the downscaling results
   Once the downscaling is finished, the SMS request the downscaled results from the SOS and displays it.

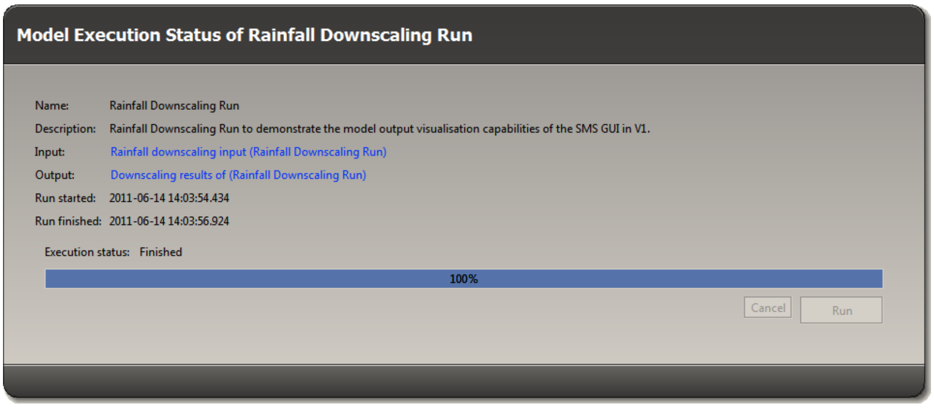


Figure 26: Monitor Model Execution Status

4.2.3. Execute Air Quality Downscaling

The third use case is similar to the second one described in the previous section. It validates the interaction of the SMS and its respective components with the Common Service for Air Quality Downscaling.

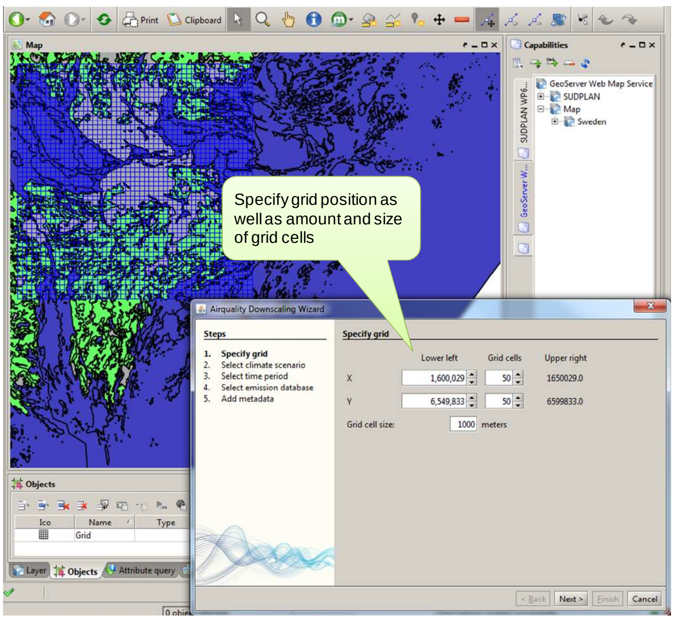


Figure 27: Validation Use Case 3

The main difference compared to the Execute Rainfall Downscaling Use Case is, that the Air Quality Downscaling model expects more parameters than the Rainfall Downscaling model and that the results consist of grids rather than time series. This results in more service requests and a Wizard user interface providing more options (*Figure 27: Validation Use Case 3*).

The interaction between the involved components is shown in *Diagram 3: Execute Air Quality Downscaling*. Please note, that this is again a simplified diagram and the complete version can be found in *Annex 2: Validation Use Case Screenshots and Diagrams.*

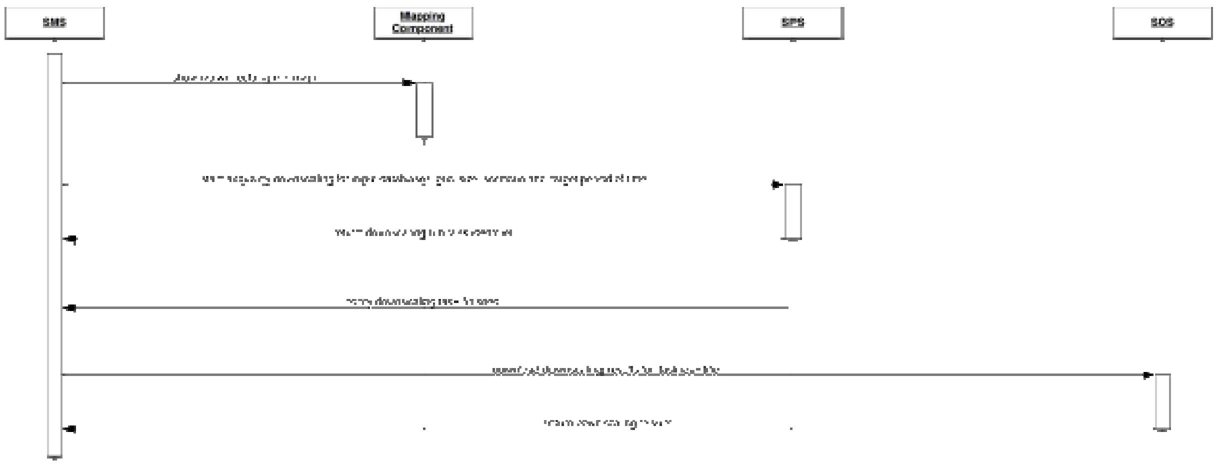


Diagram 3: Execute Air Quality Downscaling

The actions performed by the user in the validation use case are:

1. Select the area of interest in the map
   The user draws a new rectangle in the map. Its boundaries are used to select the area of interest for the downscaling run.

2. Choose Perform airquality downscaling form the contextual menu
   This displays a wizard which guides the user through several dialogs. These dialogs ask the user for the necessary input parameters for the air quality downscaling.

3. Choose grid cell size
   Lets the user choose the size and position of the downscaled air quality grid.

4. Choose scenario
   Requests the available scenarios from the Common Service for Air Quality Downscaling (through the SPS interface). The available scenarios are listed in the wizard, one to be selected by the user.

5. Choose target time period
   Lets the user choose a start and an end date for Air Quality Downscaling.

6. Choose emission database
   Requests the available emission databases (generated from uploaded gridded emissions, part of another use case) from the Common Services and lets the user select one of those local urban emission databases as input data to improve the downscaling process.

7. Add metadata
   The user can add a name and a description to the downscaling run.

8. Start the downscaling
   Initiates the downscaling. The SPS returns a task id and is periodically checked by the SMS if the downscaling is finished. See also *Figure 26: Monitor Model Execution Status*.

9. View results in the map or write them to CSV file
   Once the downscaling is finished, the SMS offers the user the possibility to request the downscaled results from the SOS. These results can be written to a CSV file or displayed in the map.

10. Choose time of interest
    The user can select a specific point in time to view.

4.2.4. 3-D Visualisation of Local Air Quality and Traffic Data

This use case constitutes a specific validation use case for the Stockholm pilot.

Its purpose is to demonstrate the integration status of the first version of the Advanced Visualisation Component (3-D Map). Therefore it validates mainly the synchronisation between the 2D (cismap) and the 3-D (Advanced Visualisation Component) map and the Advanced Visualisation Component's capabilities to visualise gridded data.

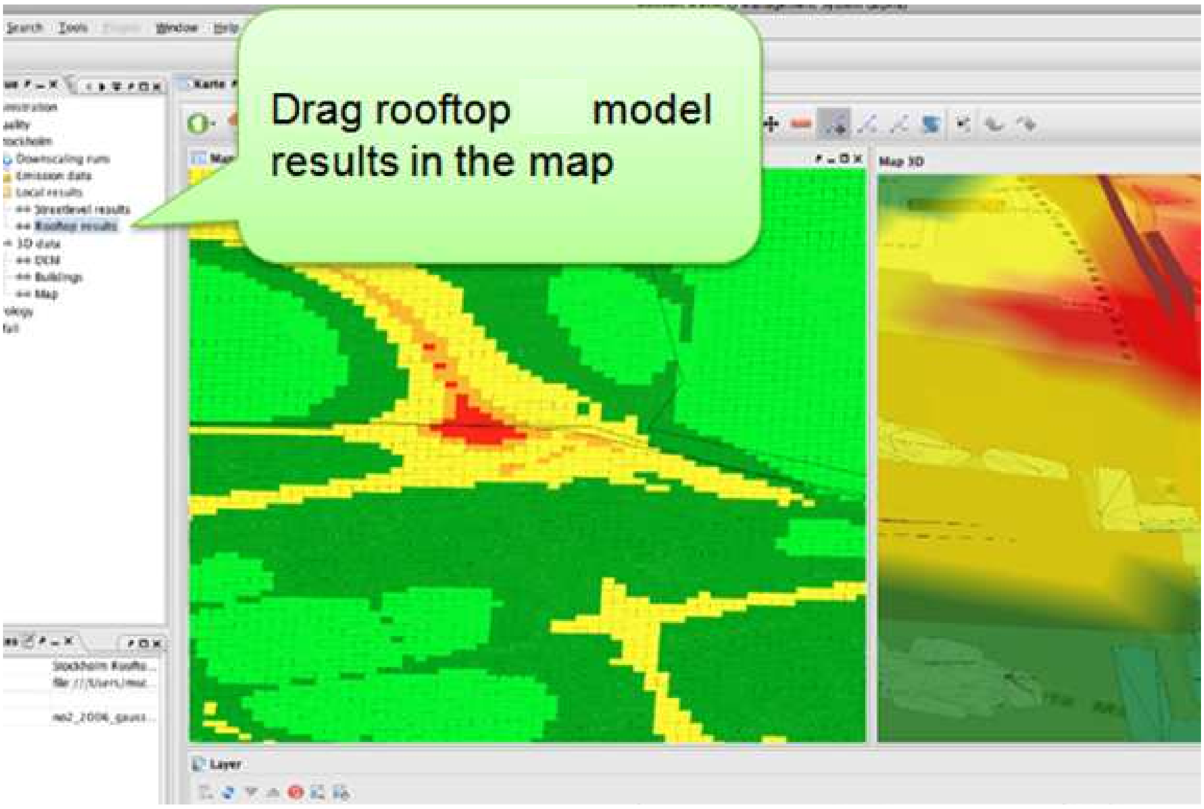


Figure 28: Validation Use Case 4

The actions performed in this use case are:

1. Drag digital elevation model (DEM) and 3-D Buildings Layer in the Map
   This shows the selected layers in both the 2D map and the 3-D map.

2. Activate the camera
   Allows the user to see the camera position in the 2D map and synchronises the 2D view with the 3-D view.

3. Drag street level model results in the map
   Shows results of a local model (pollution caused by traffic at street level) in the maps, both pollution levels and traffic volume are visualised.

4. Synchronise 2D/3-D View
   The user can draw a bounding box in the 2D map and can jump to the corresponding position the 3-D map.

5. Drag rooftop model results in the map
   Shows additional results of a local model (pollution caused by traffic over rooftops) in the maps.

4.2.5. Execute IDF Rainfall Downscaling

This validation use case is very similar to the rainfall downscaling use case presented in section *4.2.2 - Execute Rainfall Downscaling*. It shows how the user can downscale an IDF curve and how he can view the results. Please refer to *Annex 2: Validation Use Case Screenshots and Diagrams* for a detailed interaction diagram of this use case and the complete set of screenshots.

Figure 29: Validation Use Case 5

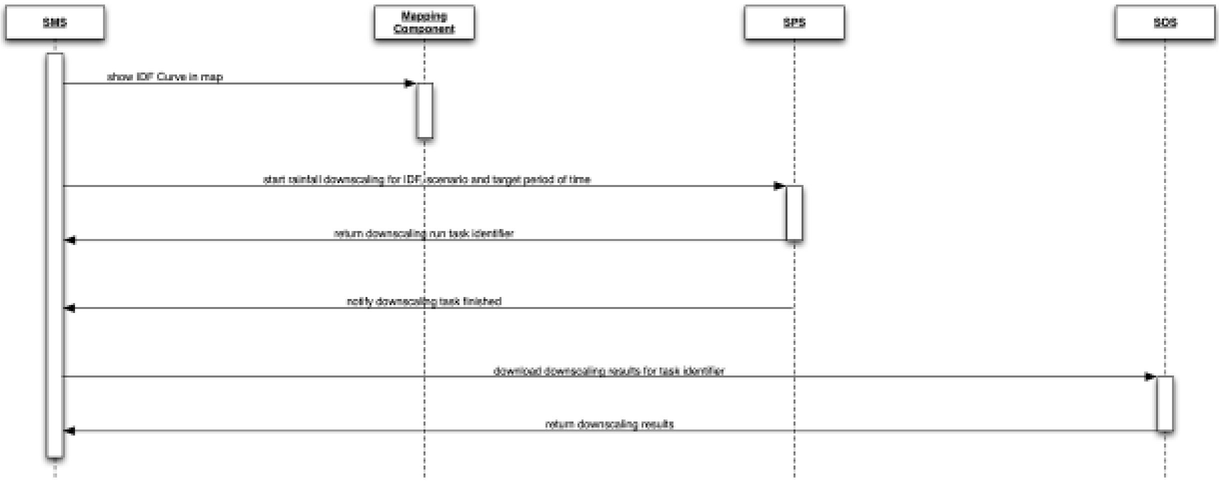


Diagram 4: Execute IDF Rainfall Downscaling

The actions performed in this use case are:

1. View the IDF curve
   This shows the input IDF curve in tabular format.

2. View the IDF curve’s extend on the map
   Adds a new IDF Curve Feature object to the cismap and shows the extent (spatial coverage) of the IDF curve, e.g. as bounding box.

3. Choose the rainfall downscaling action from the contextual menu
   Triggers a Feature Action that opens the IDF Downscaling Wizard.

4. Select a scenario
   Requests the available scenarios from the Common Service for Rainfall Downscaling, together with each scenario’s temporal boundaries.

5. Select a target year
   Triggers a request to the SPS to return the temporal boundaries of the selected scenario and lets the user choose a start and an end date consistent (within) these temporal boundaries.

6. Add metadata
   The user can add a description to the IDF downscaling run.

7. Wait for the execution to finish
   Initiates the downscaling. The SPS returns a task id and is periodically checked by the SMS if the downscaling is finished.

8. View the downscaled results
   Once the downscaling is finished, the SMS request the downscaled results from the SOS and displays it in a table.

4.2.6. Local Data Upload

This validation use case refers to requirements related to input data management and import. It shows how users can upload their own time series data to the system.

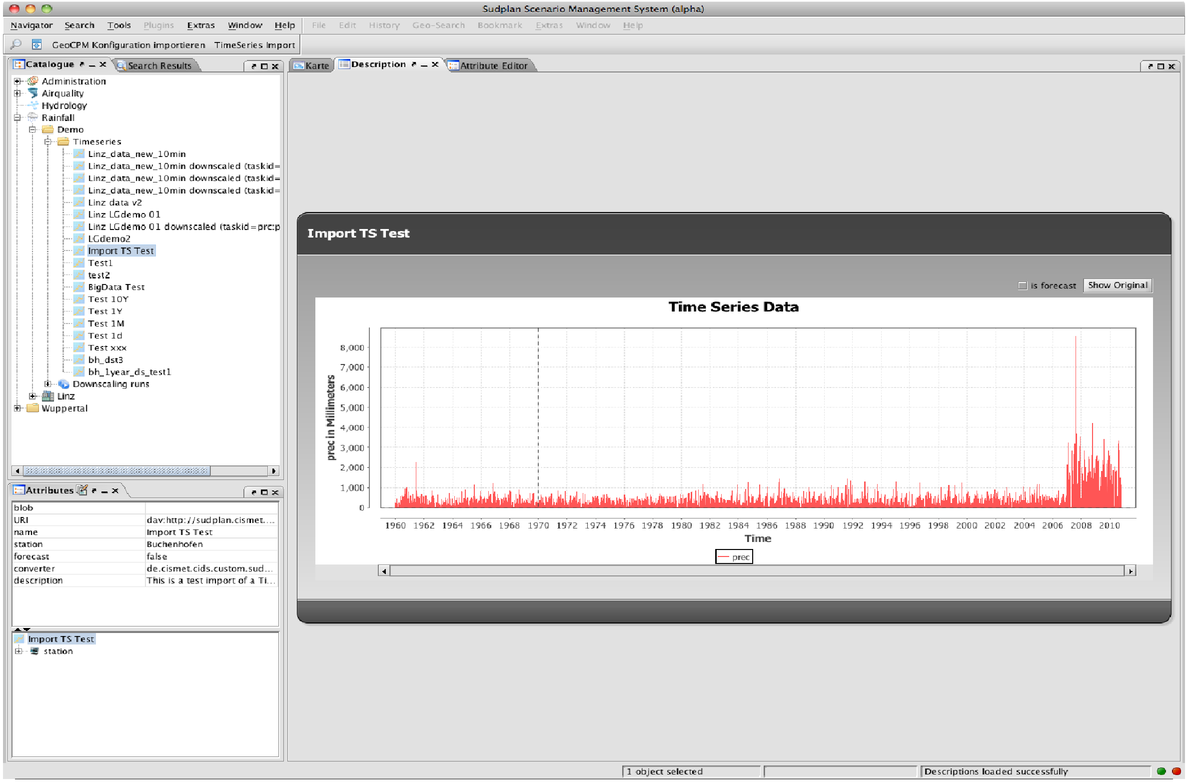


Figure 30: Validation Use Case 6

The actions performed in this use case are:

1. Choose the time series import action
2. Select a source file
   The user can select a local source file to be imported.
3. Select a source file converter
   The user has to select a converter, that converts the local file format into a suitable format for upload to the SOS.
4. Wait for the conversion to finish
   Depending on the size of the file, the conversion which is performed locally may take some time.
5. Add metadata
   The user can add some descriptive meta information.
6. Wait for the import to finish
   The converted file is uploaded to the data repository (e.g. to a SOS).

7. View the imported time series
   The data is now available in a well defined format and thus all operations on time series supported by the SMS can be used.

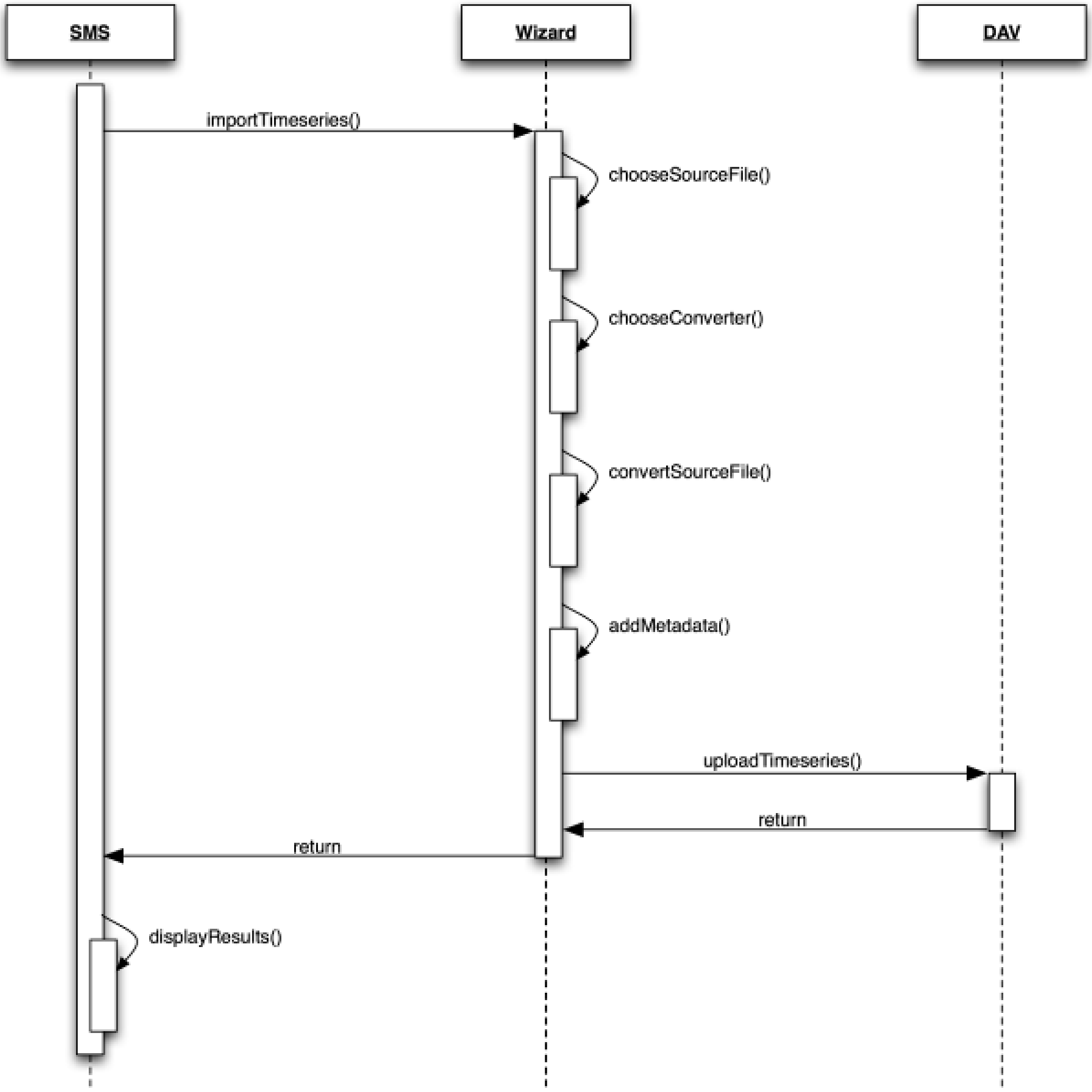


Diagram 5: Local Data Upload

4.2.7. Local Model Integration

The local model integration is validated as part of the pilot use cases implemented for V2. As an example, the integration of the Linz Pilot is shortly reported in this document. For a complete overview on the use cases supported by the Pilot Applications please refer to the Pilot Reports V2 (Deliverables *D4.2.2 – D8.2.2)*.

The Linz Pilot application validates nearly all of the SMS functionality available for V3. The relevant pilot use cases and their corresponding validation use cases are

- Pilot use *case UC-711 "Upload pilot specific data"* corresponds to *validation use case #6 "Local Data Upload"*: The user wants to upload pilot specific data in preparation for a scenario execution.
- Pilot use cases *UC-712 "Start Downscaling"* and *UC-713 "Download downscaling results"* correspond to *validation use case #2 "Execute Rainfall Downscaling"*: The user wants to start a downscaling scenario execution and to download some of the downscaling results.
- Pilot use cases *UC-714 "run local model"* and *UC-715 "calculate CSO efficiency rates"* correspond to *validation use case #7 "Local Model Integration"*: The user wants to start a local model execution (SWMM) and to calculate the required and the actual CSO efficiency rates based on results of a local model execution.

The Linz Pilot requires at least two independent model runs. The output of the SWMM model (*UC-714*) is input of the CSO efficiency calculation (*UC-715*), whereby also the SWMM model may use the output of a preceding rainfall downscaling (*UC-711* and *UC-712*).

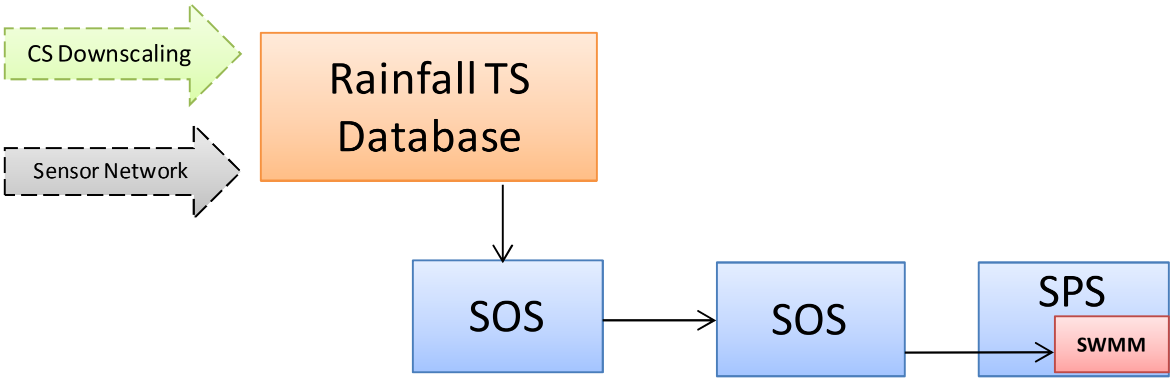


Figure 31: Linz Local Model Integration

As shown in *Figure 31: Linz Local Model Integration* the Linz pilot uses several OGC SOS and SPS which provide access to data and models. Access to rainfall data (historical and downscaled) is realised by a SOS. The SWMM model itself is encapsulated behind a SOS / SPS pair. The model SOS is used to transport model input data (e.g. rainfall time series received from the downscaling SOS) and model results (e.g. CSO efficiency rates), the SPS is used to control model execution.

The steps performed by the SMS and the SOS/SPS during a Linz model run with historical time series data are:

1. Get historical rain time series
   Ask the data SOS for the list of available historic rain data and get one time series.

2. Get model tasking description
   Ask for available models and get the tasking description of the model. The description can be used to inform a user about the model.

3. Upload model input data
   Upload the rain time series from step 1 as model input.

4. Run model
Get a list of required model parameters with their data types and valid value ranges. Start he model run, which continues in the background even if the SMS is closed (run times of some hours depending of the length of time processed can be expected). When the model run is finished, the SMS retrieves the information on the result location. The results are available through a SOS.

5. Download model results
The SMS uses the information from the model run to locate the results on the models SOS interface and download them.

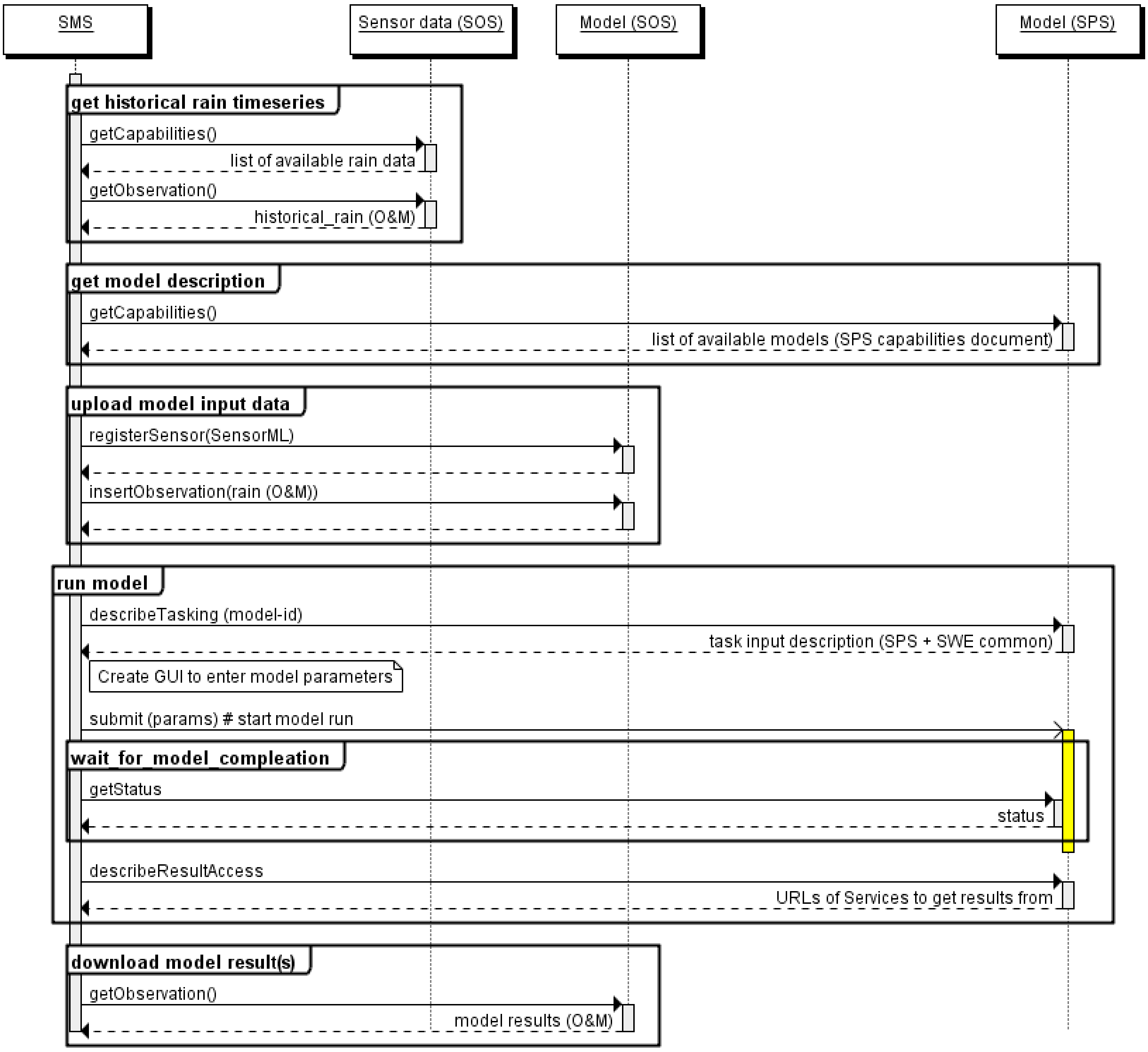


Diagram 6: Linz Local Model Integration

More information on the integration as well as a complete user workflow can be found in deliverable *D7.2.2 - Linz Pilot Report Version 2.*

Figure 32: Validation Use Case 7 shows an example of an SMS extension for the Linz Pilot. The user can select a specific model configuration. The description of the model configuration consist of a geospatial preview of the model as it is displayed in the map component, some meta-information about the model configuration and a list of model runs that have been performed with this configuration. The user has furthermore the possibility to initiate a new model run.

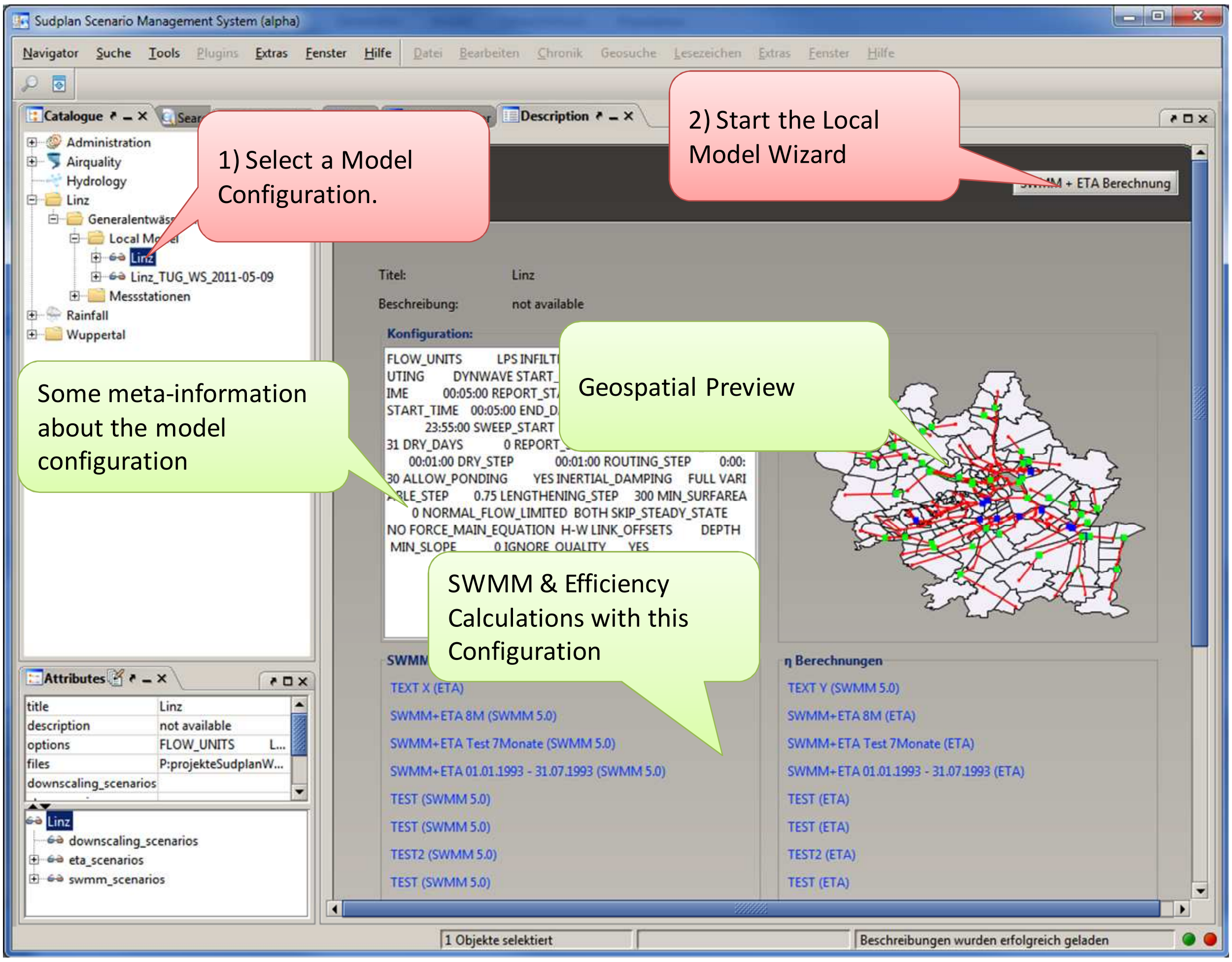


Figure 32: Validation Use Case 7

4.2.8. Time Series Visualisation & Comparison

This use case is similar to use case 4.2.1 “Information on the European Scale”. Instead of retrieving a single time series, this use case demonstrates how to retrieve multiple time series. It validates the time series visualisation framework and its comparison features as well as the interaction of the SMS and the WMS and SOS interfaces providing climate time series data. *Diagram 7: Time Series Visualisation & Comparison* gives an overview how the components interact with each other. A more detailed version of this use case can be found in *Annex 2: Validation Use Case Screenshots and Diagrams*.

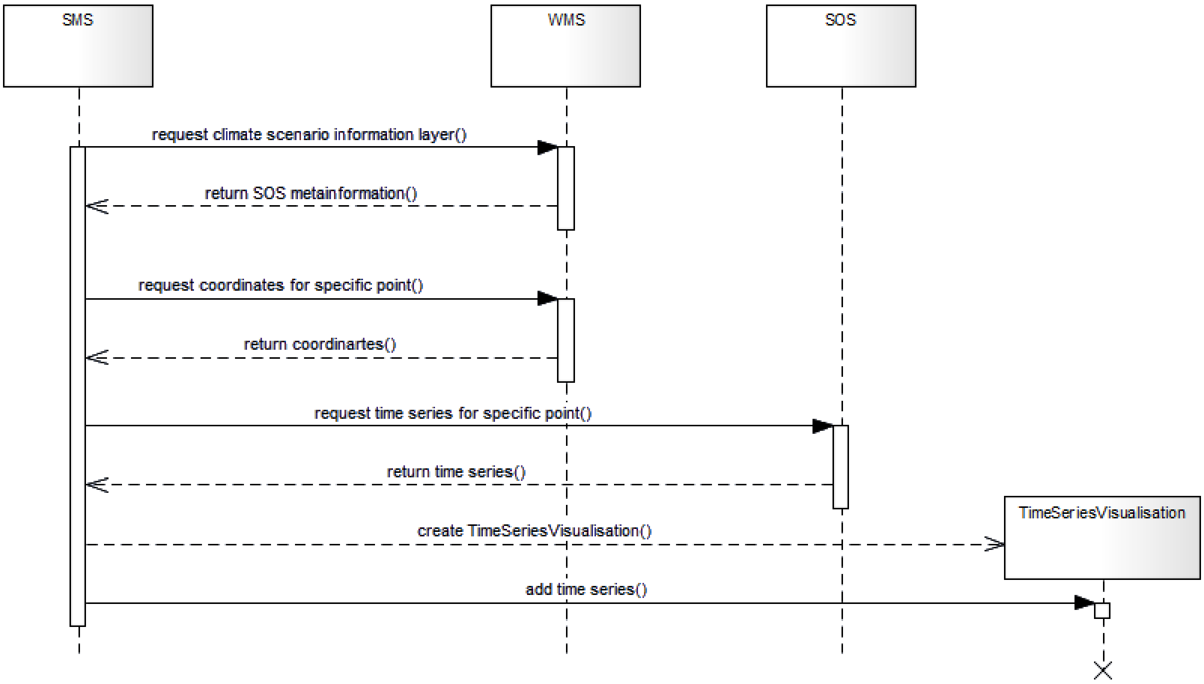


Diagram 7: Time Series Visualisation & Comparison

The time series visualisation framework is highly interactive and allows the visual exploration and comparison of multiple time series. The comparison and exploration abilities are extended by providing various operations that can be executed on time series. *Figure 33: Validation Use Case 8* shows the graphical user interface of the time series visualisation framework.

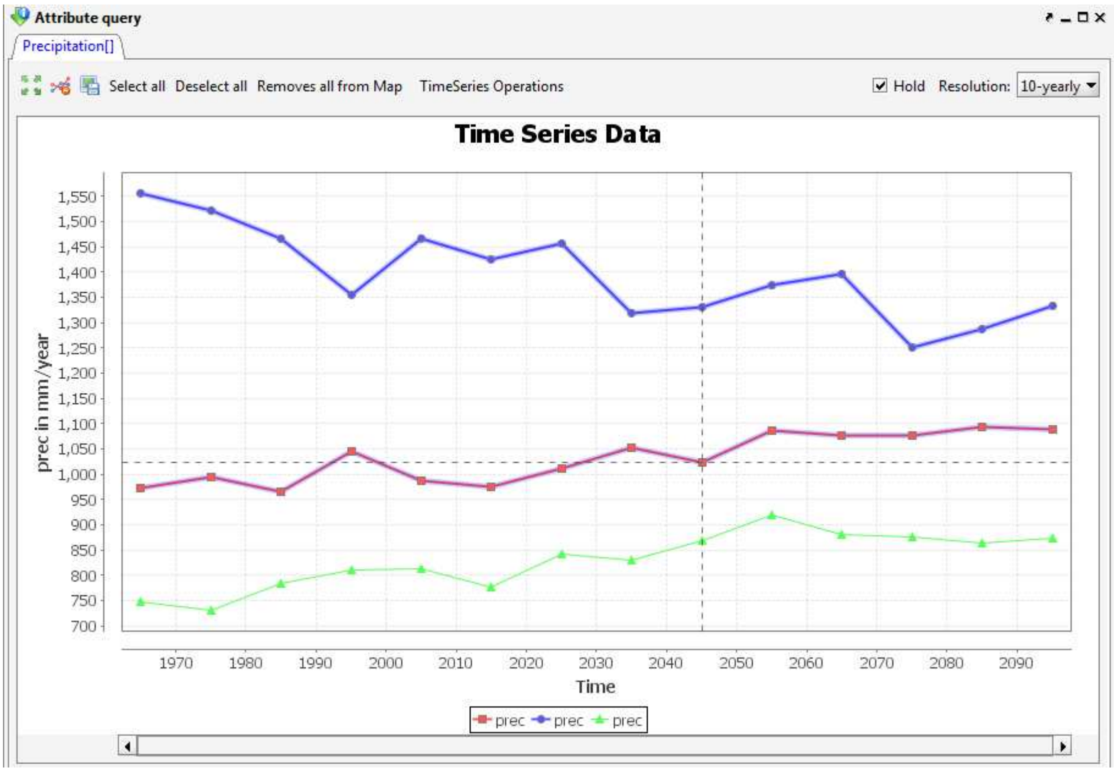


Figure 33: Validation Use Case 8

The actions performed by the user in this validation use case are:

1. Drag and drop desired climate scenario information layer to the map
Triggers the request on the WMS to return the respective map layer.

2. Select the Info-Checkbox in the Layer tab.
Activates the layer for attribute queries. This is necessary to retrieve time series data.

3. Select the Hold-Checkbox in the attribute query tab.
Allows visualising and comparison of multiple time series at once.

4. Hit the Attribute Query Button

5. Click on the map to perform an attribute query.
Triggers a request to the SOS and retrieves the requested time series data for the respective point. Time series data is visualised with the new TimeSeriesVisualisation Framework.

6. Hit the Select-All-Button or select time series by clicking on them.
The spatial context of the selected time series is reflected to the map. This step is necessary to determine the time series that can be used as parameter for time series operations.

7. Hit the TimeSeries Operations Button and select an operation.
Pop ups a dialog giving more detailed information to the requested operation and allows configuration of the parameters.

8. Define the parameters for the operation.

9. Hit the OK-Button.
Executes the selected operation. The newly calculated time series is added to the already existing chart.

4.2.9. Execute the 3-D Visualisation Wizard

The 3-D visualisation wizard use case as presented in this document constitutes a general approach to validate the use case for the 3-D visualisation wizard. Its purpose is to demonstrate the integration status of the Advanced Visualisation Component (3-D Map). Therefore, it validates mainly the Advanced Visualisation Component's capabilities to visualise arbitrary GIS data from different pilots in combination with suitable visualisation techniques.

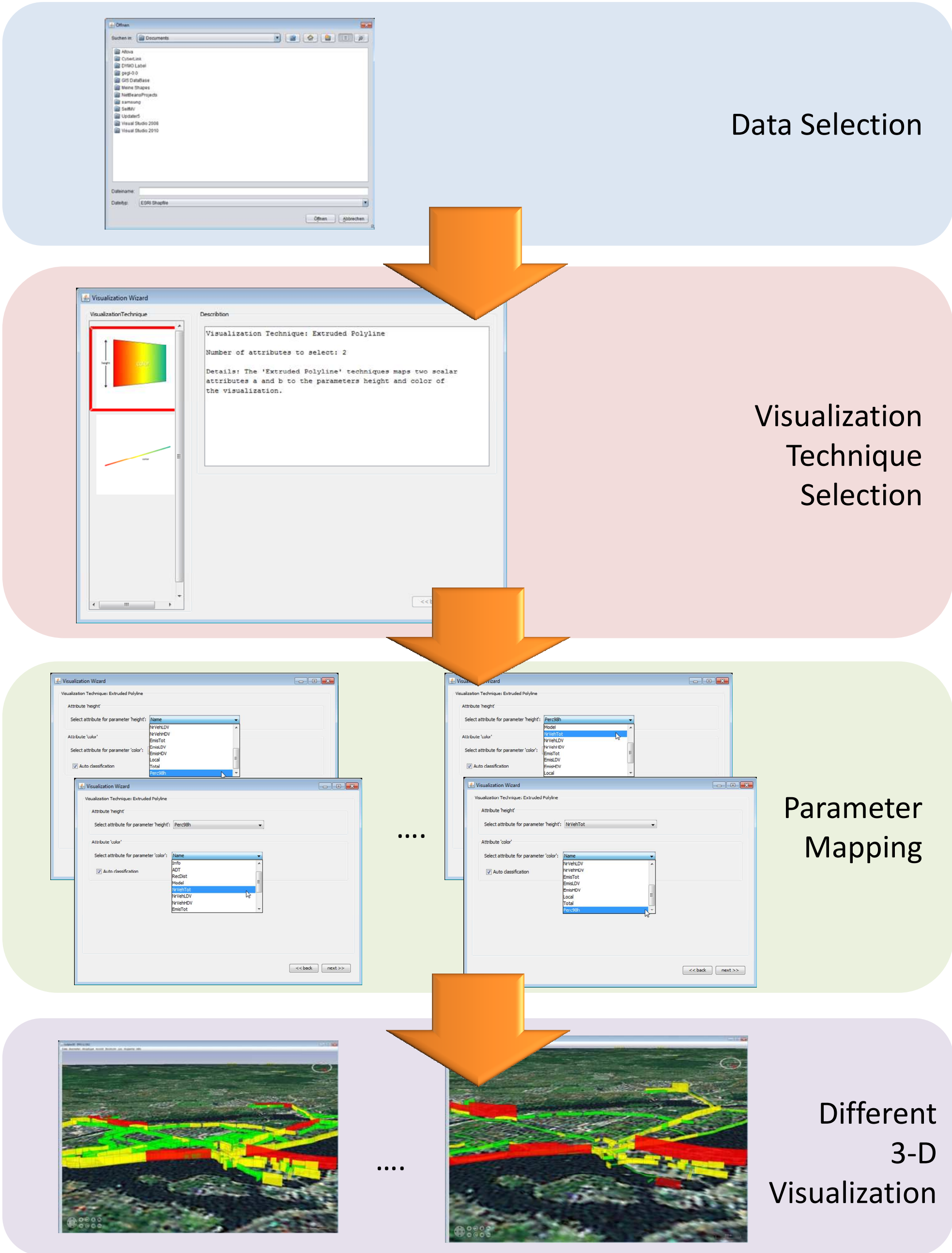


Figure 34: An exemplary VisWiz workflow.

After the selection of the data source the user selects a visualization technique. Depending on his selection and the input parameters the user is able to map the attributes of the data source to available visualisation parameters. According to the mapping of attributes to visualisation parameters different presentations will be computed.

The actions performed in this use case are:

1. Data Selection:
   The user selects the data to be visualized in the 3-D map from a local storage or a web service.

2. Visualisation Technique Selection:
   Allows the user to choose from a set of visualisation techniques for the selected data source.

3. Parameter Mapping:
   Depending on the visualisation technique as well as its parameters the user maps the data attributes to the visualisation parameters (i.e. NO_x attribute to height).

4. Attribute Classification:
   Depending on the mapping of the parameters and the selected visualisation technique the data attribute can be classified.

5. Visualisation:
   Depending on the mapping of "data-attribute to visualisation parameter" a 3-D visualisation is produced and presented within the virtual globe.

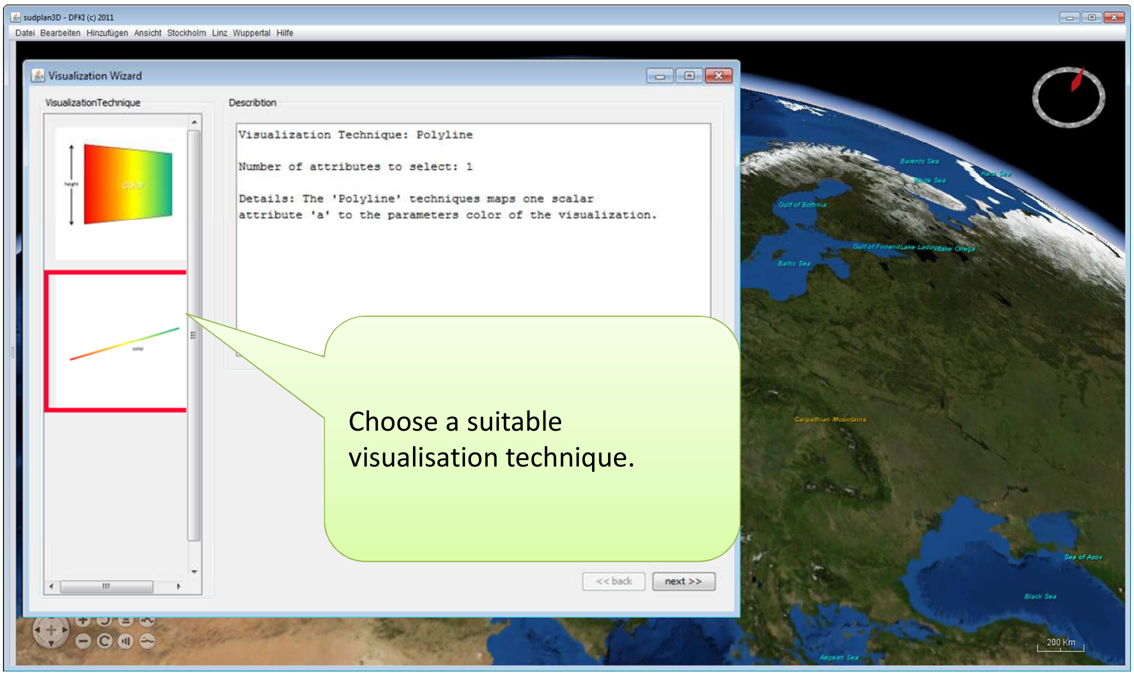


Figure 35: Validation Use Case 9

4.2.10. Visualization of 3-D air quality data using iso-surfaces

This use case is based on use case *4.2.8 - Execute the 3-D Visualisation Wizard*. It demonstrates how to interact with a produced set of iso-surfaces and how to control the animation. For this scenario we used NOx air quality measurements. The data was measured at different time steps and different heights in the city of Stockholm. This use case validates the new Marching Cubes visualisation as well as its animation and interaction features. A more detailed version of this use case can be found in *Annex 2: Validation Use Case Screenshots and Diagrams*.

The Marching Cubes visualisation allows an interactive, visual exploration and comparison of multiple iso-values for different time steps as well as different iso-values. An animation can be executed on both scenarios. *Figure 36: Validation Use Case 10*Figure 36: illustrates the results of the Marching Cubes visualization for the iso-values 1, 2, and 3 to 5.

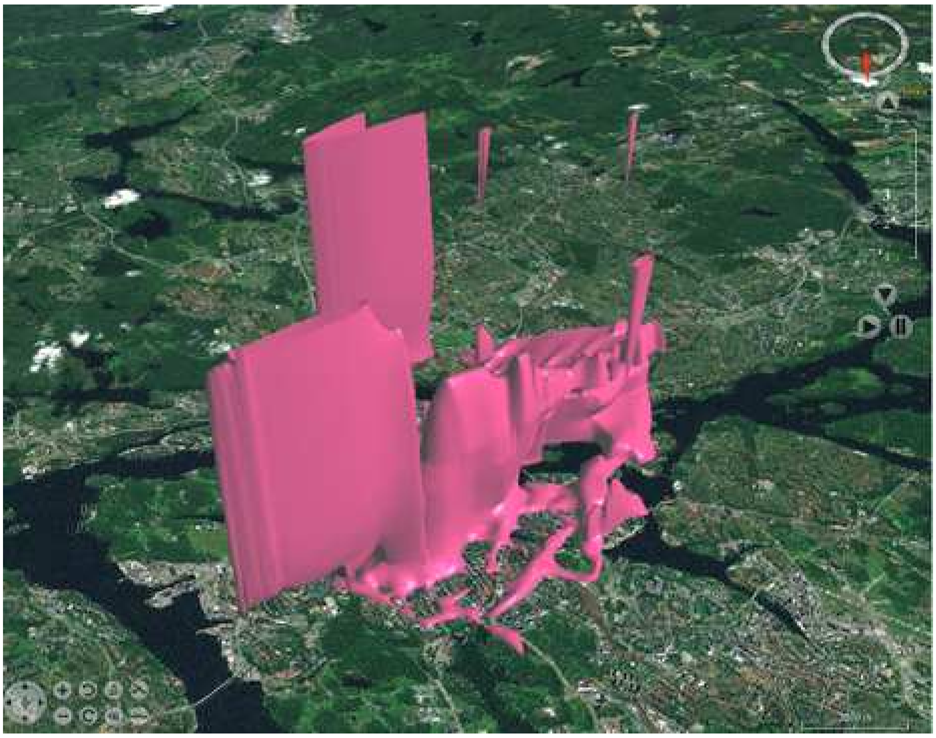


Figure 36: Validation Use Case 10

Using the VisWiz, as mentioned in use case 4.2.8 - Execute the 3-D Visualisation Wizard, the user is able to choose a transfer function and enter the iso-value/s as well as different time steps. Thus, the user can get a quick and easy understanding of a 3-D data set (e.g. certain air quality measurement, NOx) in relation to a geospatial position by viewing surfaces. Moreover, using the animation feature, the user can get a quick impression of how the iso-surface grows and shrinks, rather than reading some values and numbers. The actions that can be performed by the user in this use case are:

1. Play / Pause animation of iso-surface
2. Select iso-surface for a defined value

4.2.11. 3-D Animation of "Water-run off" simulation results

This use case is based on use case *4.2.8 - Execute the 3-D Visualisation Wizard* as well. It demonstrates how to interact with the customized visualization for the Wuppertal pilot. The input data is a terrain triangulation of the Lüntenbeck neighbourhood. For each triangle a series of water level results at different time steps have been simulated. The simulation assumed an event of one hour heavy rainfall. This use case validates a customized visualization technique and its interaction tools. A more detailed version of this use case can be found in *Annex 2: Validation Use Case Screenshots and Diagrams*.

Like the 3-D Marching Cubes visualization it is highly interactive and allows the visual exploration of the simulation results.

The exploration abilities are extended by providing three different modes: (a) visualizing the simulation results above terrain as a surface, (b) visualizing the results with an offset above the terrain and (c) lifting the visualization to a common reference plane to be able to compare the water level results. *Figure 37: Validation Use Case 11*Figure 37: illustrates the visualization results.

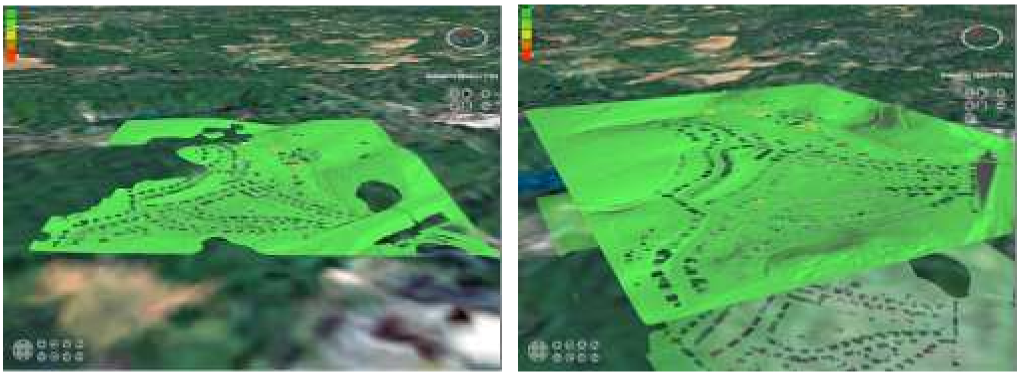


Figure 37: Validation Use Case 11

The action that can be performed by the user in this use case is to Play / Pause the animation of the rainfall simulation results.

4.2.12. Execute Hydrology Downscaling

This use case validates the whole Hydrology workflow that can be divided into three different parts:

1. Creation of a location-specific local model
   A local model constitutes a workspace that focuses on the specific catchment area chosen by the user. Within this workspace the user may adjust the HYPE European model to local conditions using a process called calibration with the result of being able to perform more region specific hydrological simulations using the calibrated local model.

2. Calibration of a local model
   Local models can be calibrated to fit local conditions. The process of calibration depends on local data in form of mean daily flow time series. Thus the local model has to be provided with local data so that calibration will result in a calibrated local model that is as accurate as possible for the specific region and local conditions.

3. Climate scenario simulation
   On basis of a calibrated local model the user may perform various simulations using different climate scenarios. The more accurate the calibration has taken place the more accurate the simulation results will be.

Moreover, this use case also showcases the SMS' ability to not only being able to integrate standard conformant "Model as a Service Integration Building Blocks" but to easily adapt to proprietary APIs, the HYPE Java API in this case, on basis of the generic model management concept (see *D3.2.3 Product Implementation V3*).

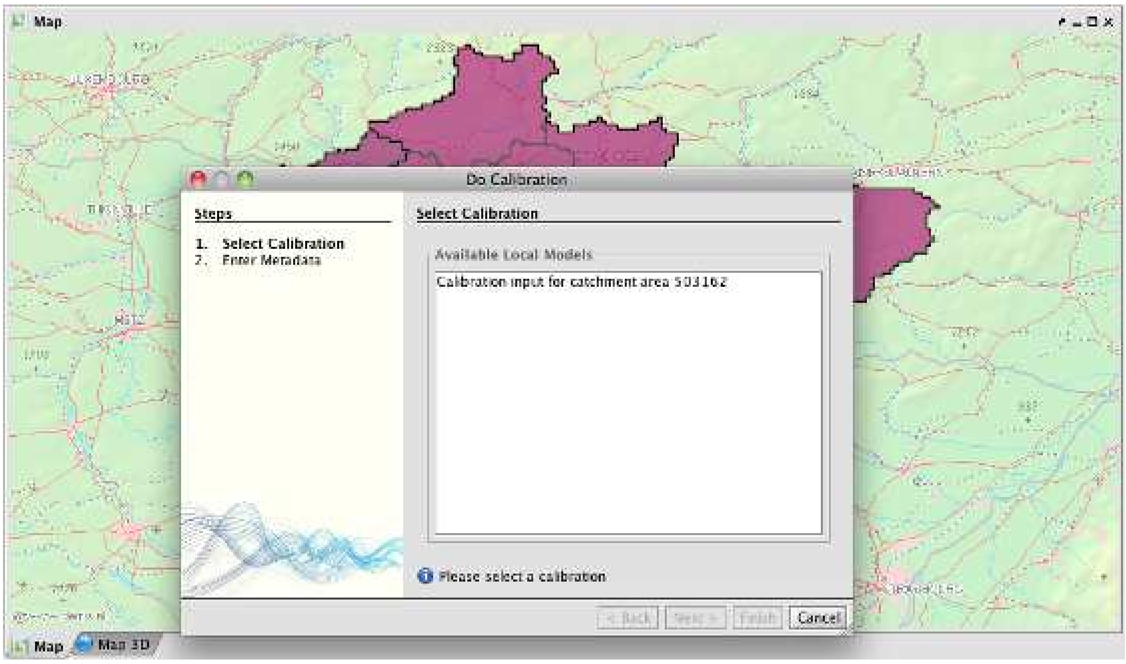


Figure 38: Validation Use Case 12

The interaction between involved components is shown in *Diagram 8: Execute Hydrology Downscaling*. This is only a very simplified display of the whole sequence. In *Annex 2: Validation Use Case Screenshots and Diagrams* a version with greater detail can be found.

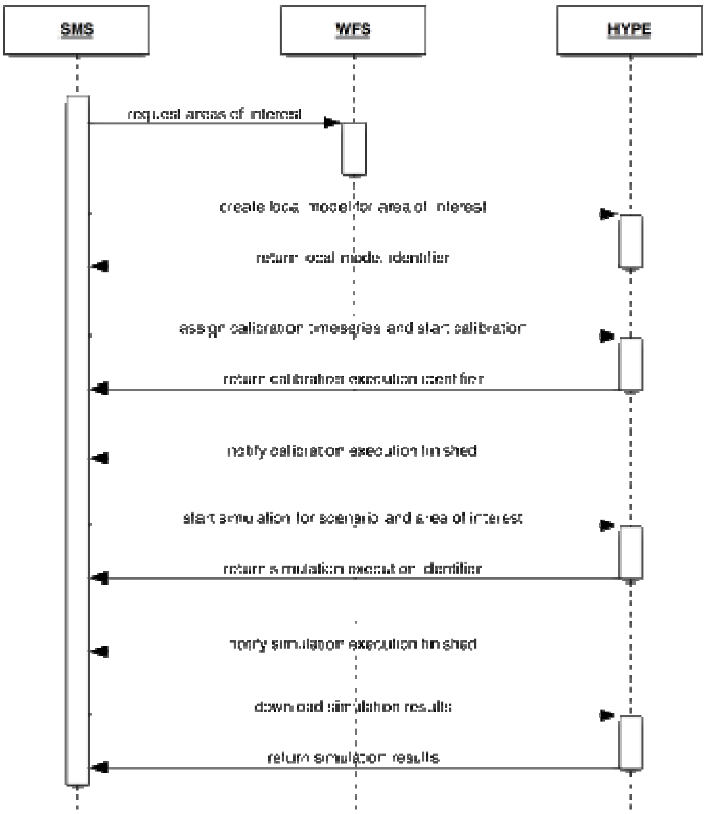


Diagram 8: Execute Hydrology Downscaling

In the validation use case the user shall take the following actions:

1. Goto area of interest
   The user may freely navigate to the area of interest or can alternatively visualise an object that lies within the area of interest (e.g. a monitoring station).

2. Select Show Catchment area from the contextual menu
   At the point of interest the user performs a right click to trigger the contextual menu. This offers an action that retrieves the Catchment area for the specific point of interest and visualises it on the map.

3. Select Show upstream areas from the contextual menu
   The user has the possibility to request all upstream catchment areas for the specific catchment area of interest by choosing the corresponding action from the contextual menu of the catchment area.

4. Select Create Local Model from the contextual menu of the catchment area of interest
   In order to perform the downscaling the user as to create a Local Model instance for his catchment area of interest. This can be done with this action.

5. Enter Local Model metadata
   To further describe and to be able to relocate the specific Local Model the user may enter some metadata.

6. Select Assign time series from the contextual menu for every relevant area
   The user should assign time series from its local database to every relevant catchment areas (the catchment area of interest and every upstream catchment area) to allow the calibration process to adapt to local conditions.

7. Choose Calibration
   The Assign time series wizard lets the user choose a Calibration that shall be updated with the new time series for the specific catchment area (the catchment area where the right-click has been performed). The SMS remembers the current context and thus the Calibration will be pre-selected here.

8. Choose time series
   The user has to choose a time series for the specific catchment area.

9. Select Do Calibration from the contextual menu of the area of interest
   When the user has assigned time series for every relevant catchment area he will choose Do Calibration from the contextual menu to initiate the Calibration process of the Local Model.

10. Choose Local Model
    The user has to choose a Local Model from the available Local Models for this catchment area of interest that have not already been calibrated. The SMS remembers the current context and thus the Local Model will be pre-selected here.

11. Enter Calibration metadata
    To further describe and to be able to relocate the specific Calibration the user may enter some metadata.

12. Start Calibration
    If the user finishes the wizard the calibration will be started with the given parameters. The HYPE API will issue an execution id which will then be used by the SMS Model Execution Monitor to check for the current state of the calibration.

13. View Calibration results
    As soon as the SMS detects that the Calibration is finished it downloads the Calibration results and visualises them to the user.

14. Select Do Simulation from the contextual menu of the catchment area of interest
    If a Calibration has been done for the catchment area of interest the user will perform a Simulation with a specific scenario. The contextual menu of the catchment area of interest offers this action.

15. Choose Local Model
    The user has to choose a Local Model form the available Local Models for this catchment area of interest that has already been calibrated. The SMS remembers the current context and thus the Local Model will be pre-selected here.

16. Choose Scenario
    The user has to choose the desired Climate Scenario from the list of Scenarios made available by the HYPE API.

17. Choose Time range
    Most likely the user will run a Simulation over the whole time range the Scenario offers. He has also the possibility to narrow it down here to decrease Simulation execution time.

18. Enter Simulation metadata
    To further describe and to be able to relocate the specific Simulation the user may enter some metadata.

19. Start Simulation
    If the user finishes the wizard the Simulation will be started with the given parameters. The HYPE API will issue an execution id which will then be used by the SMS Model Execution Monitor to check for the current state of the Simulation.

20. View Simulation results
    As soon as the SMS detects that the Simulation is finished it downloads the Simulation results and visualises them to the user.

4.2.13. Emission Database Upload

This use case validates the upload of custom emission databases to the Air Quality Common Service. It shows how the user can upload custom emission databases which are then available for Air Quality Downscaling. Additionally the metadata of an uploaded emission database is saved in the SMS. This allows the user to list, view and edit (if not yet uploaded) all available emission databases independently from the Execute Air Quality Downscaling use case.

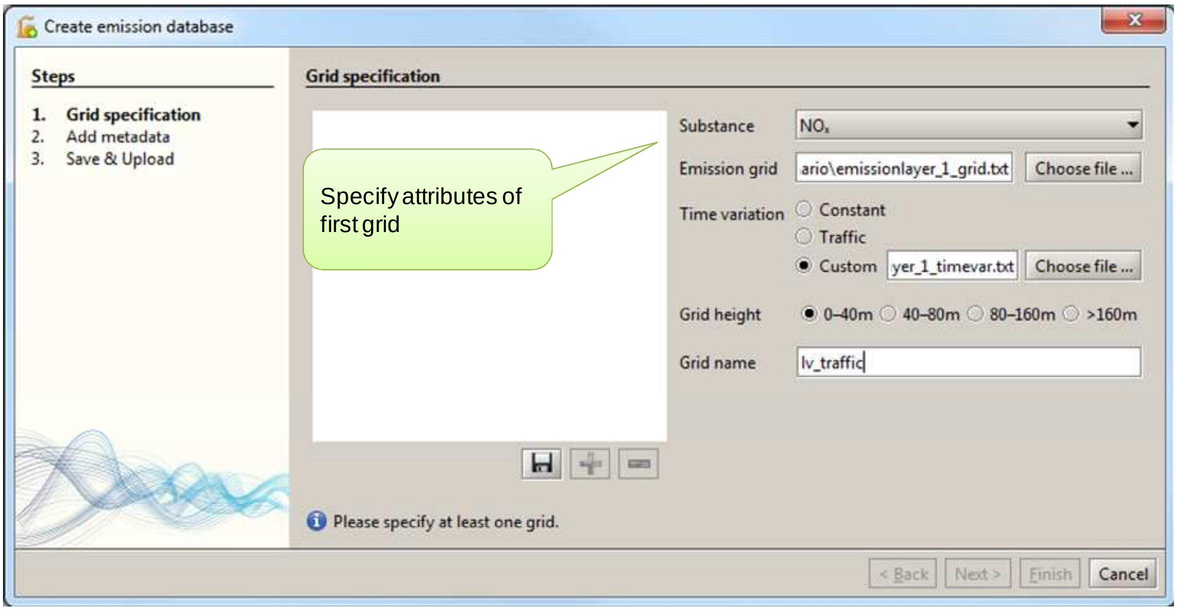


Figure 39: Validation Use Case 13

The interaction between the involved components is shown in *Diagram 9: Upload custom emission database*

Please note, that this is again a simplified diagram and the complete version can be found in *Annex 2: Validation Use Case Screenshots and Diagrams.*

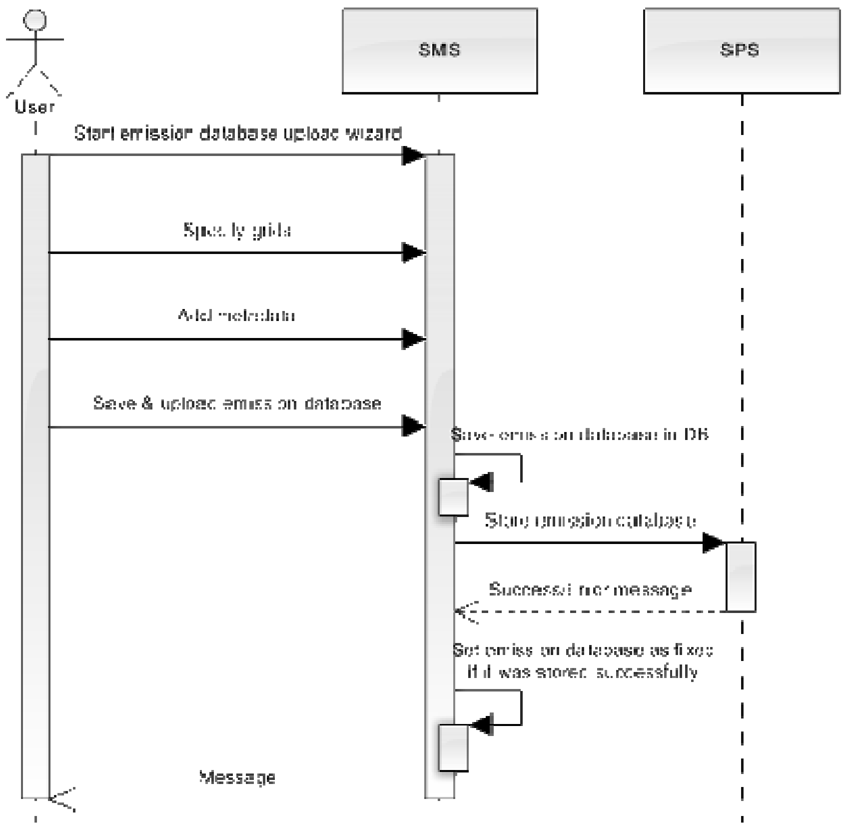


Diagram 9: Upload custom emission database

The actions performed by the user in the validation use case are:

1. Start the emission database upload wizard via the toolbar
   The toolbar of the SUDPLAN SMS provides an action to start the emission database upload wizard.

2. Define emission grids
   This displays a wizard which guides the user through several dialogs. These dialogs ask the user for the necessary input parameters for the air quality downscaling.

3. Add metadata
   Lets the user choose a name, a description and a spatial reference system (SRS).

4. Choose whether to upload or save the emission database
   Saves the emission database in the data store of SUDPLAN SMS and optionally uploads it to the SPS. If it was uploaded successfully, the emission database is marked as fixed, so that the user can't make further changes.

5. List emission databases and display their attributes
   After defining an emission database via the wizard, its metadata is saved in the SUDPLAN SMS. The user can thus list all uploaded emission databases in the SMS Catalogue and view their attributes. If an emission database wasn't successfully uploaded yet, he can edit the emission database and finally upload it.

6. Download emission databases
   The user can let the SMS write an exact copy of what is to be sent to the SPS to his file system.

7. Copy emission database
   If the user wants to create an emission database with slight changes to an existing one, he can copy the existing emission database and adjust it.

5. Conclusions

This document accompanies the third and final version of the integrated software labelled ‘Scenario Management System’’ which is deliverable *D3.3.3 Integrated Scenario Management System V3*. It is closely related to the deliverable *D3.2.3 - Product Implementation V3* and its companion report in the sense that it focuses on the integration and integration test use cases incorporating the results of D3.2.3.

As the main goal of *Task 3.4 integration, testing and validation* (reported in this document) was to integrate the implementation results provided after the final period *(D3.2.3 Product Implementation V3)* namely the individual Building Blocks of the Scenario Management System, into one application, the report focuses on describing the integrated functionality provided by the SMS V3.

The focus of V3 was mainly on the improvement of the 3-D visualisation capabilities of the SMS, the integration of Hydrology Downscaling and the improvement of the Rainfall and Air Quality Downscaling integration. Thereby also the newly added support for rainfall frequency adjustment and local emission database upload were validated.

From the large list of requirements (D3.1.2) the implemented features of V3 have been selected on basis of the Pilot Application requirements laid out in the Pilot Definition Plans V3 (D[5-8].1.3) to better support the pilot application development.

In addition, the report describes the integration environment used to perform the software integration and testing and how the integrated SMS software was validated on a micro-scale by the consortium to ensure that the implemented functionality is in line with the implementation plan and user’s expectations.

The micro-scale validation was performed with the help of thirteen representative use cases, which were collaboratively defined. Those use cases reflect the main functionalities of the SMS after the third year of developments.

The four uses cases that were implemented and validated for **V1** are:

1. To retrieve Climate Scenario Information on the European Scale from a Common Service through the SOS service interfaces provided by the Model as a Service Component and to visualise it in the map as interactive geographic layer and time series graph.

2. To perform a Time Series Rainfall Downscaling with help of the SOS and SPS services provided by the Models as a Service Component, to visualise the results in the map and to configure the downscaling model through a graphical user interface including the possibility to use the rainfall frequency adjustment of the CS.

3. To perform an Air Quality Downscaling similar to Rainfall Downscaling, additionally supporting further model configuration options and the ability to upload local air quality data to a SOS so that it can be used to improve the downscaling results.

4. To demonstrate the 3-D visualisation capabilities of the Advanced Visualisation Component by visualising local air quality and traffic data and to validate the interaction of 2D and 3-D map.

The five uses cases that were implemented and validated for **V2** are:

5. To perform an IDF Rainfall Downscaling with help of the SOS and SPS services provided by the Models as a Service Component, to visualise the results in a table and to configure the downscaling model through a graphical user interface.

6. To support the import (conversion and integration) of local time series data to be used as Common Service or Local Model input.

7. To support Local Model Integration (control, parameterise, run, visualise results) to connect Common Service results to the local planning process.

8. To support scenario comparison (for time series data) by the provision of a Time Series Visualisation and Comparison Framework.

9. To provide highly flexible visualisation support through a 3-D Visualisation Wizard

The four uses cases that were implemented and validated for **V3** are:

10. To demonstrate advanced visualisation and animation techniques for a set of iso-surfaces (Marching Cubes visualisation) which use NO_x air quality measurements in the city of Stockholm.

11. To provide a visualisation technique that shows simulation results above terrain as a surface which allows amongst others the comparison of different water levels.

12. To perform the entire Hydrology workflow, which consists of the creation of a location-specific local model, the calibration of the newly created local model and the climate scenario simulation on basis of the calibrated model.

13. To provide the possibility to upload custom emission databases to the Air Quality Common Service.

The result of this activity, which is recorded in both in the SUDPLAN WP3 Blog as screen cast and in *Annex 2: Validation Use Case Screenshots and Diagrams*, can be summarized as:

- V3 of the integrated SMS supports model management and visualisation capabilities; time series integration, visualisation and comparison; highly flexible 3-D visualisation; local model integration as well as the complete integration of V3 Common Service functionality (e.g. Rainfall, Air Quality, and Hydrology Downscaling, IDF curve support, local model calibration and upload).

- V3 of the three SMS Building Blocks (described in D3.2.3) have been successfully integrated and tested.

6. References

MAVEN	Apache Software Foundation. Apache Maven Project. Retrieved from http://maven.apache.org/
SVN	Apache Software Foundation. Apache Subversion. Retrieved from http://subversion.apache.org/
ARTIFACTORY	JFrog. Artifactory. Retrieved from http://www.jfrog.org/products.php
MANTIS	MantisBT. Mantis Bug Tracker. Retrieved from http://www.mantisbt.org/
HUDSON	Oracle. Hudson CI. Retrieved from http://hudson-ci.org/
NETBEANS	Oracle. NetBeans. Retrieved from http://netbeans.org/
SWE, 2007	Botts, M., Percivall, G., Reed, C., Davidson, J.: OGC sensor web enablement: Overview and high level architecture (July 2007), http://portal.opengeospatial.org/files/?artifact_id=25562

7. Annex 1: Glossary

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* are 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)
Emission scenario	European cities will also handle different local *emission scenarios* (to the atmosphere) that to a large extent influence future air quality, but with little influence on global climate.
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.
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.
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.
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.

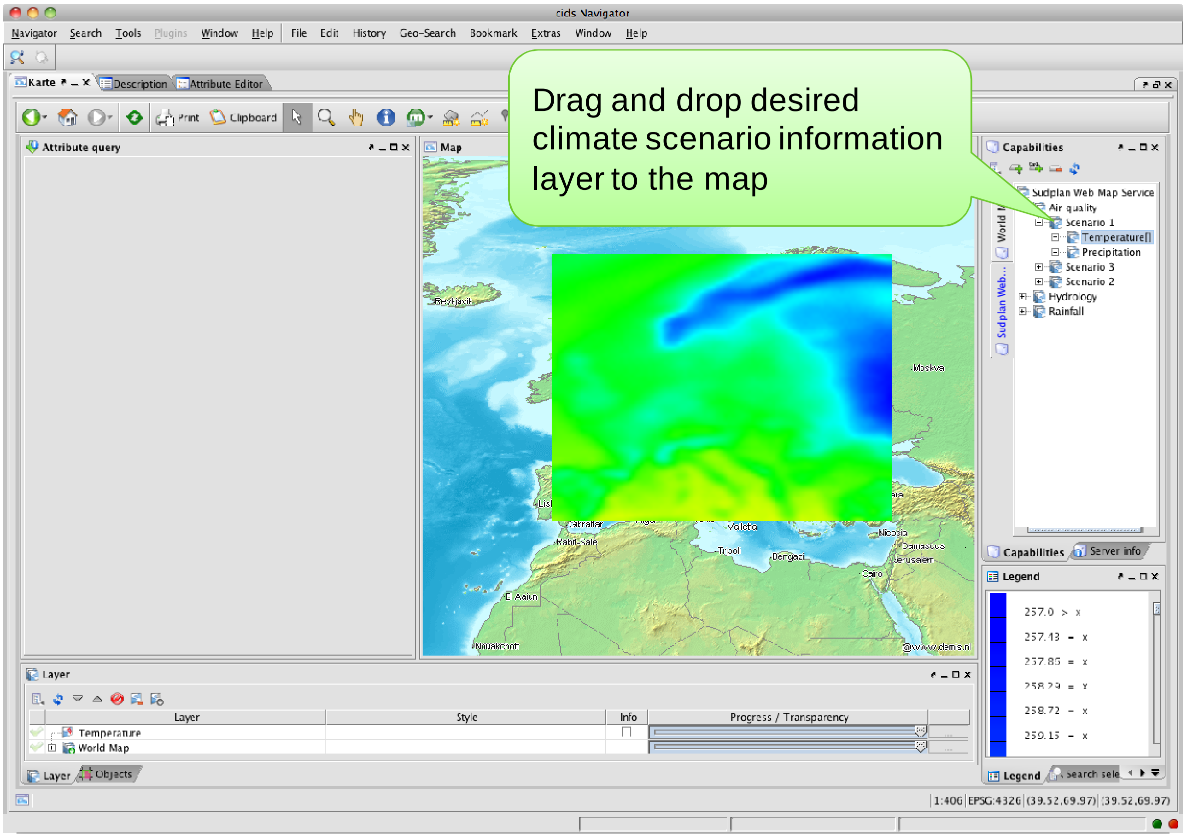
Scenario Management System	*Scenario Management System* (SMS) is synonymous with SUDPLAN platform
Scenario Management System Framework	The *Scenario Management System Framework* is the main Building Block of the Scenario Management System. It provides the Scenario Management System core functionalities 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.
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
User	The term *user* refers to people who have a more or less direct involvement with a system. Primary users are directly and frequently involved, while secondary users may interact with the system only occasionally or through an intermediary. Tertiary users may not interact with the system but have a direct interest in the performance of the system.
Web-based	Computer applications are said to be *web-based* if they rely on or take advantage of data and/or services which are accessible via the World Wide Web using the Internet.

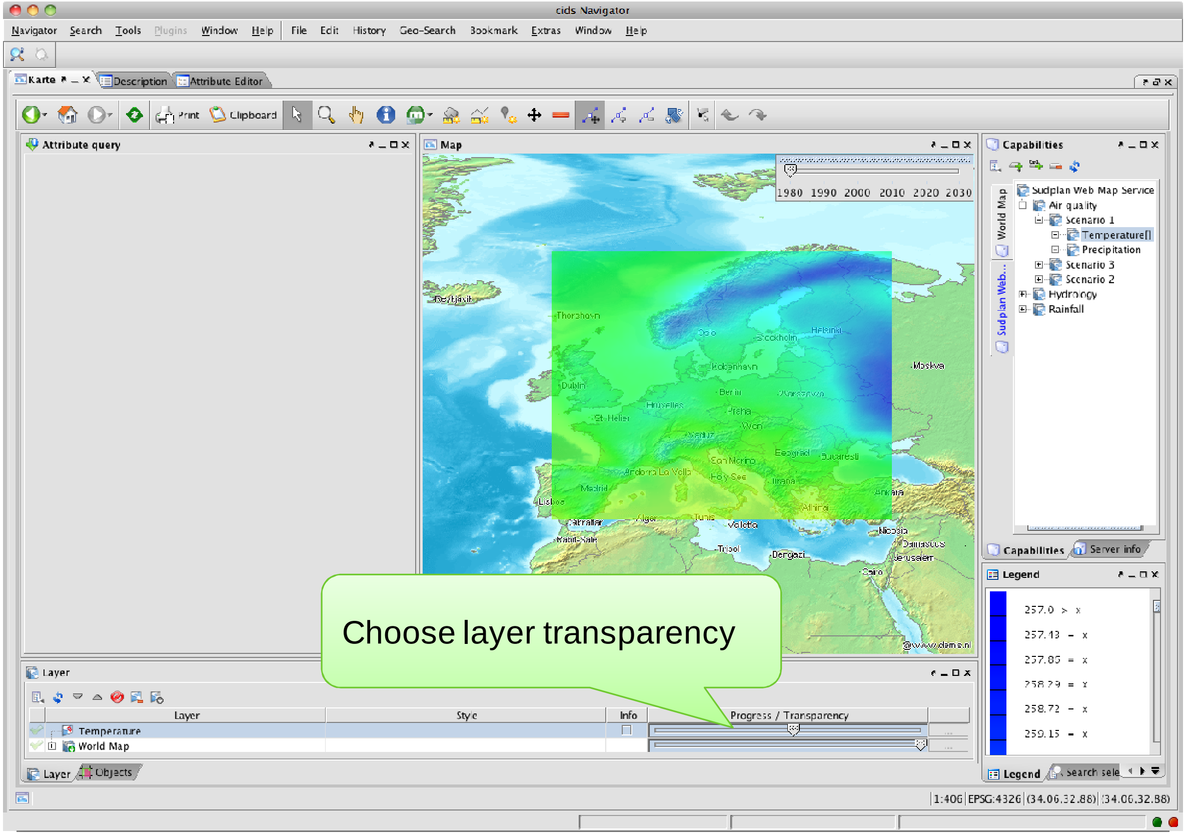
8. Annex 2: Validation Use Case Screenshots and Diagrams

This annex contains the detailed interaction diagrams of the validation use cases as well as the complete set of screenshots related to the actions the user has to perform in a specific validation use cases. The interaction diagrams as well as the user actions are explained in the respective use cases sections of section *4.2 Micro-scale Validation of the integrated* SMS.

8.1. Climate Scenario Information on the European Scale

For a description of this validation scenario please refer to *4.2.1 Climate Scenario Information on the European Scale*.

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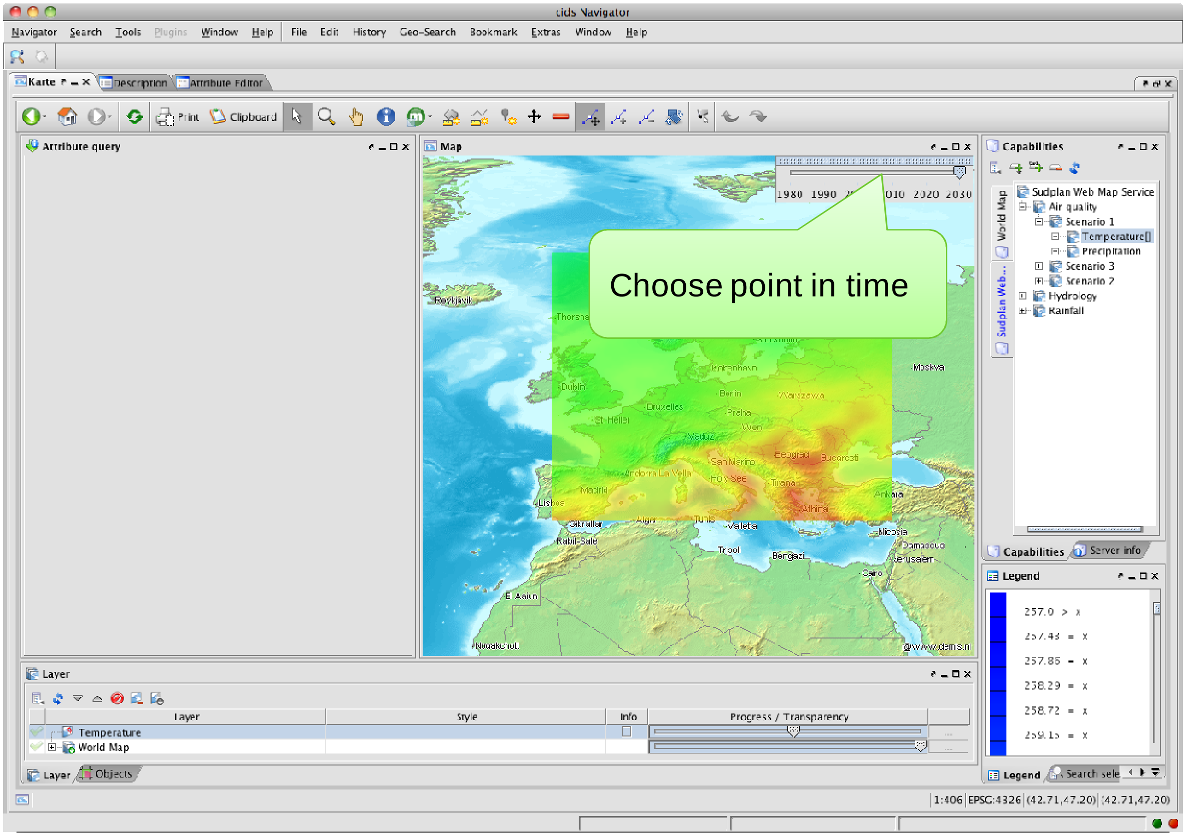
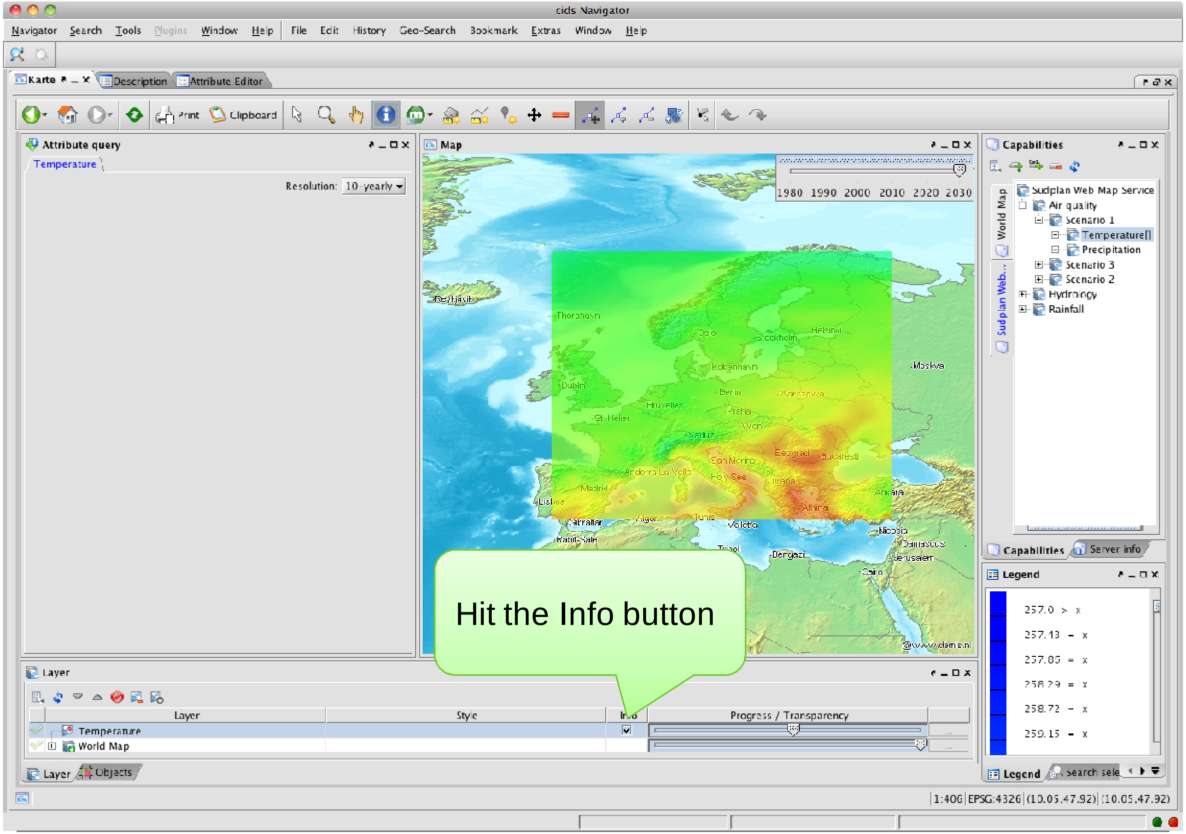
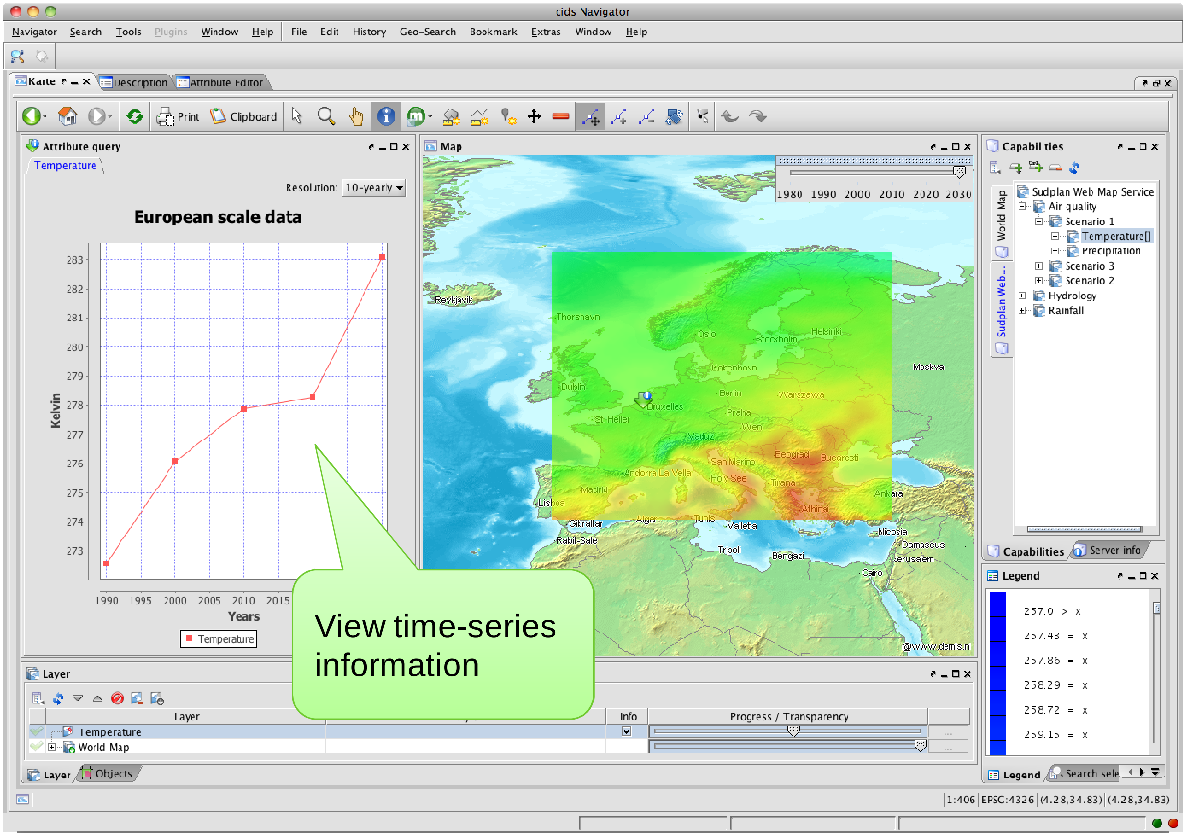
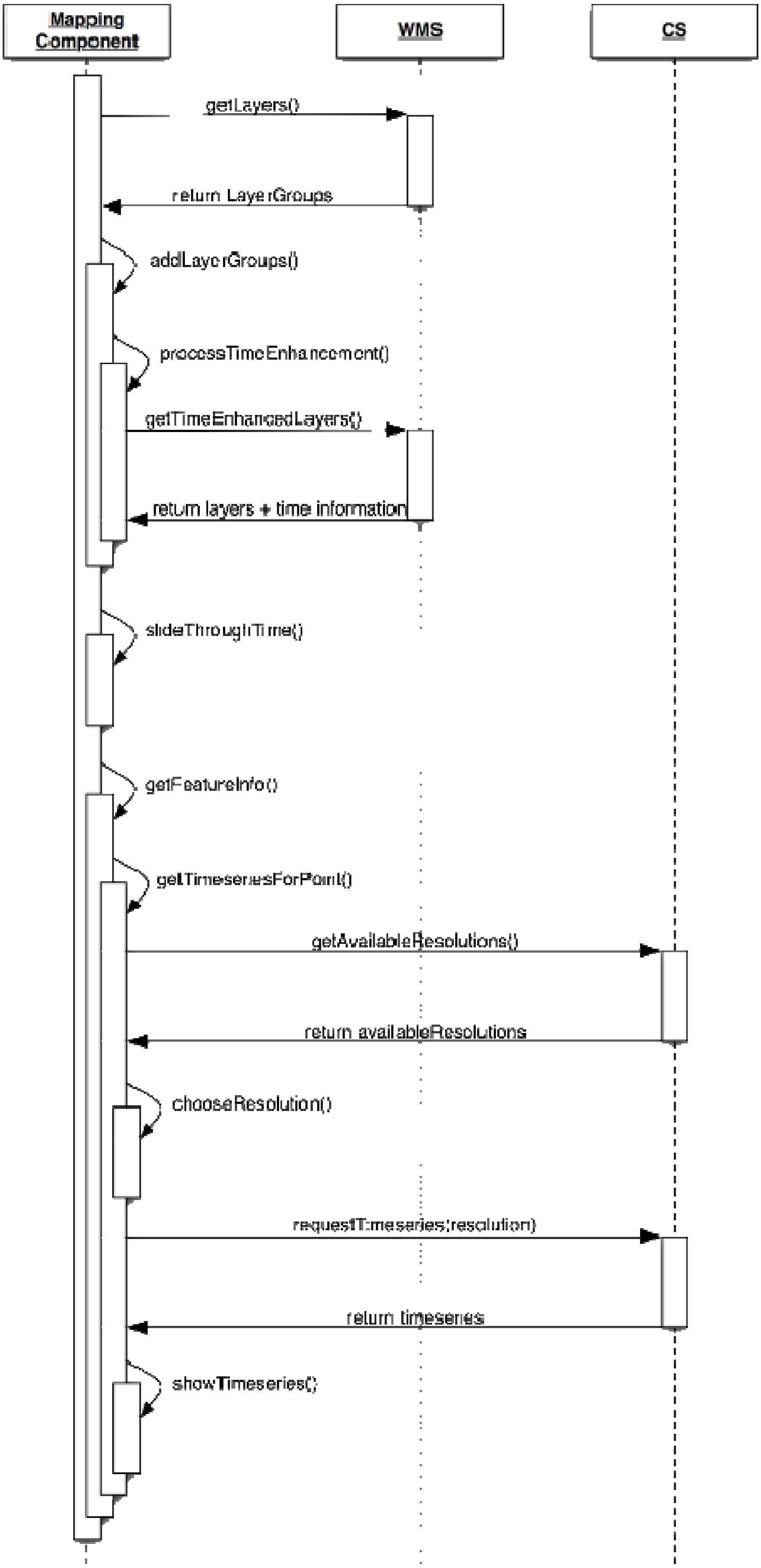

Choose point in time

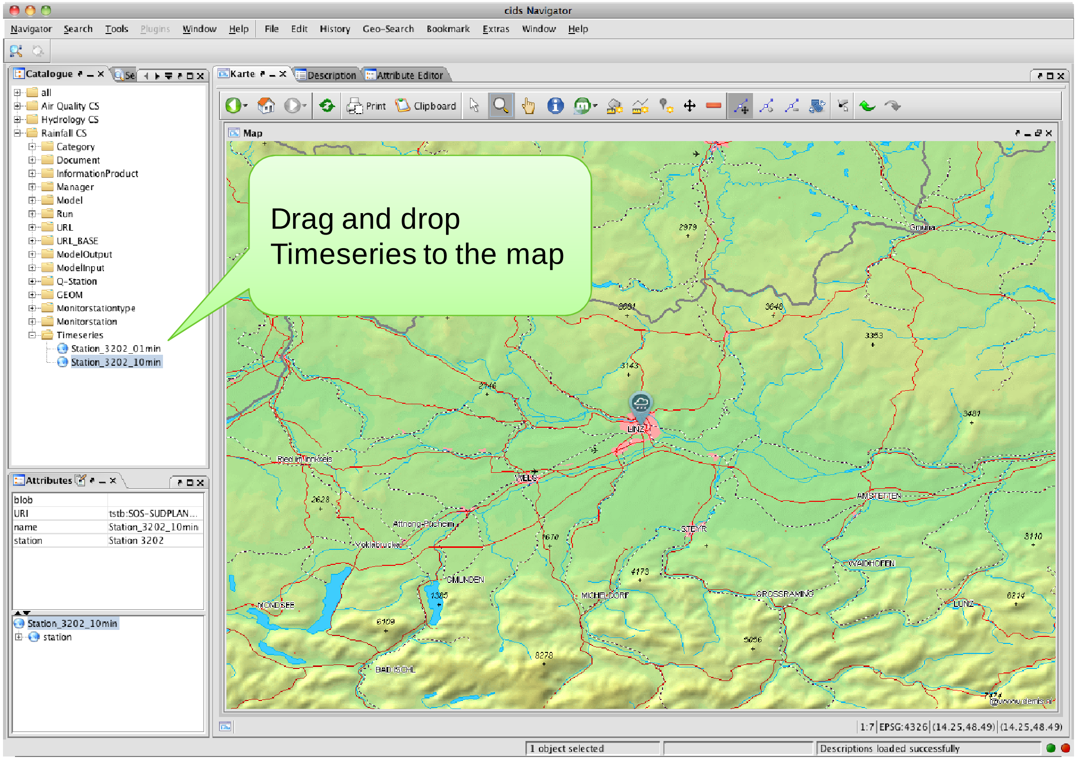

cids Navigator
Hit the Info button

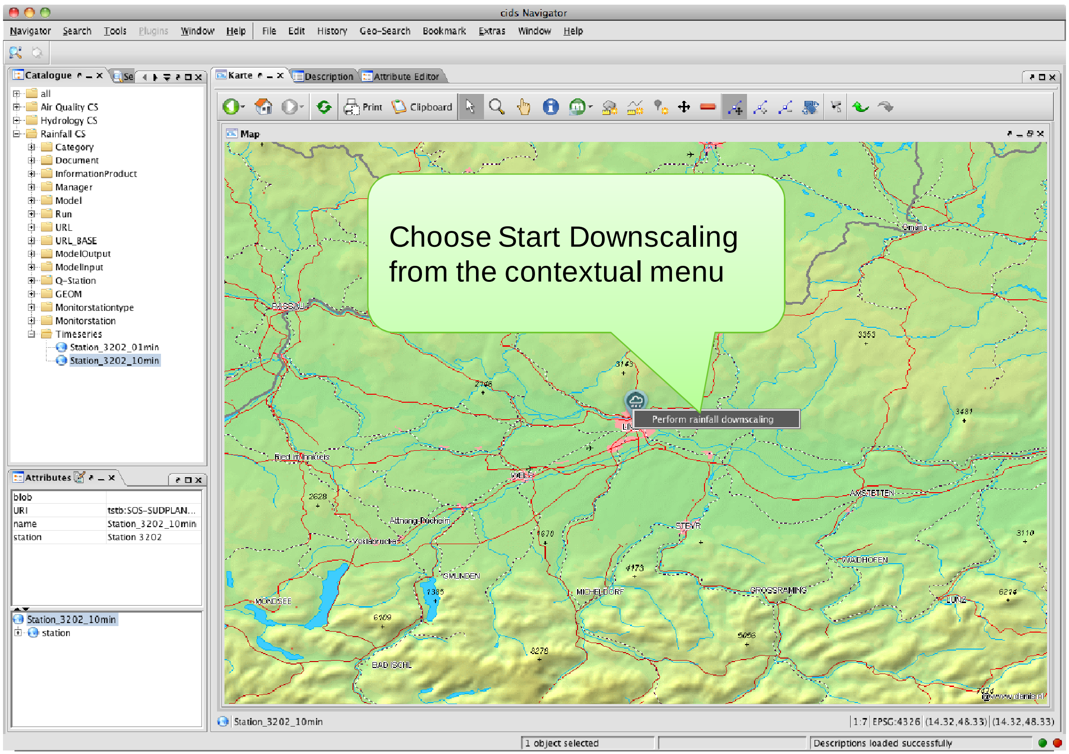

cids Navigator
European scale data
Kelvin
Years
View time-series information

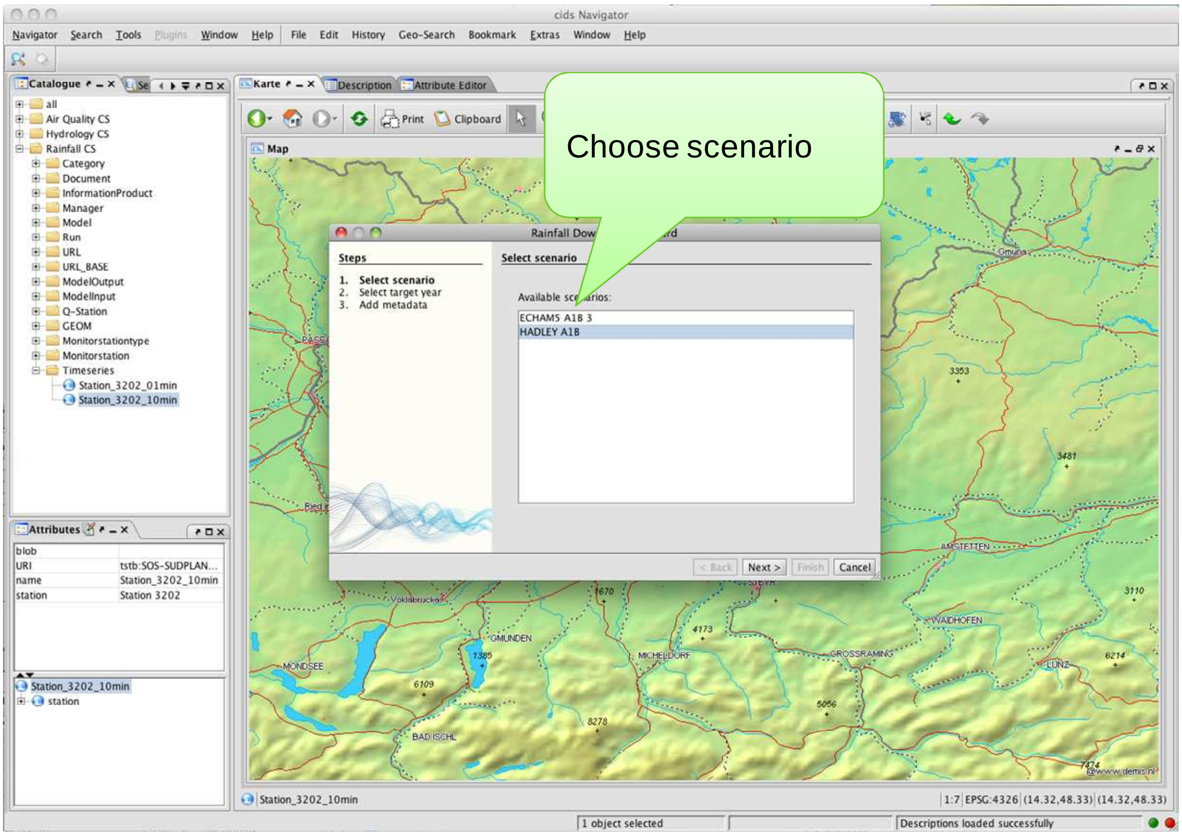

Mapping Component
WMS
CS
getLayers()
return LayerGroups
addLayerGroups()
processTimeEnhancement()
getTimeEnhancedLayers()
return layers + time information
slideThroughTime()
getFeatureInfo()
getTimeseriesForPoint()
getAvailableResolutions()
return availableResolutions
chooseResolution()
requestTimeseries(resolution)
return timeseries
showTimeseries()

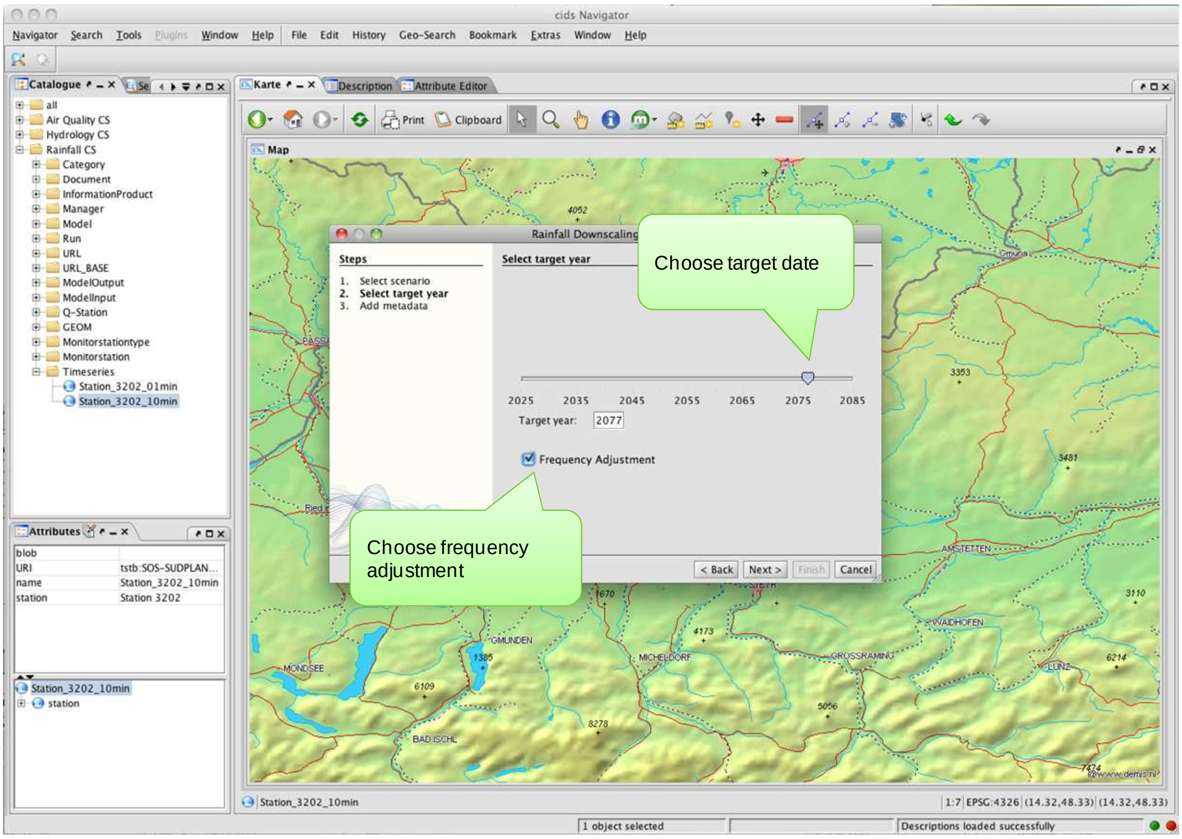
8.2. Execute Time Series Rainfall Downscaling

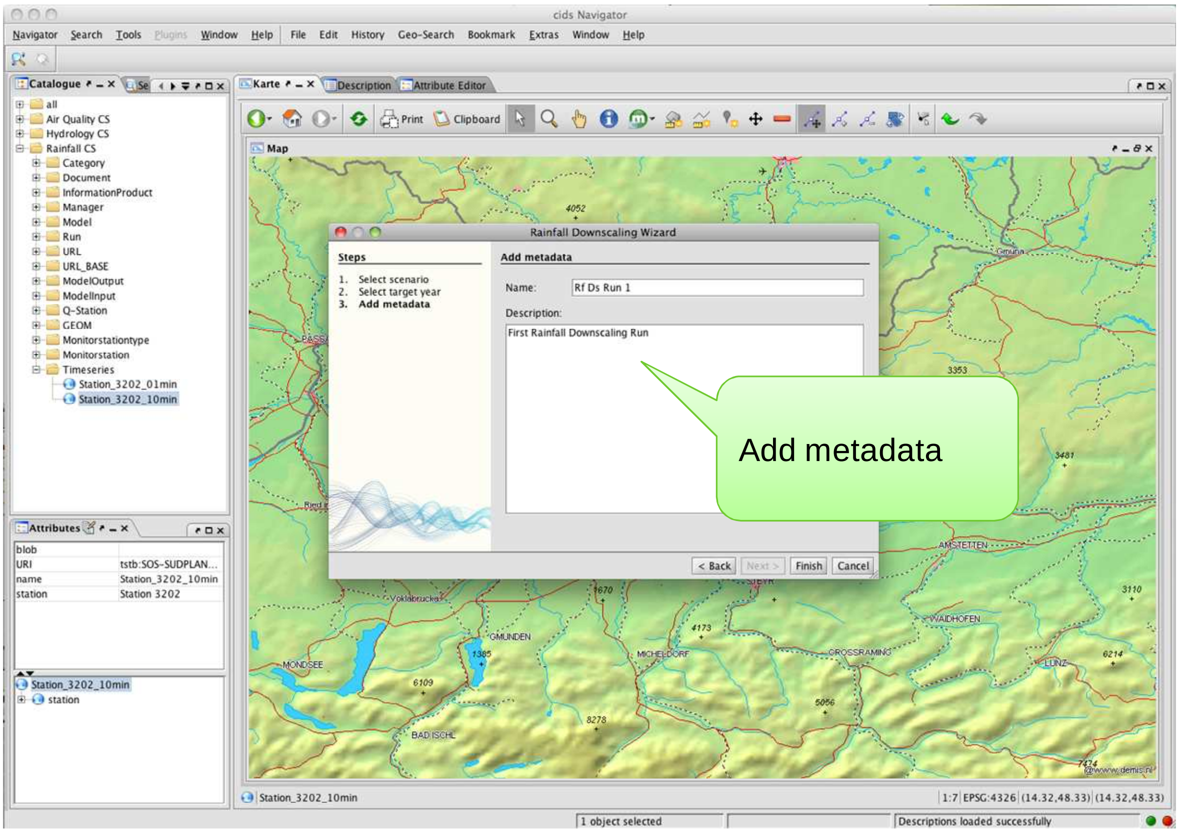
For a description of this validation scenario please refer to *4.2.2 Execute Rainfall Downscaling*.

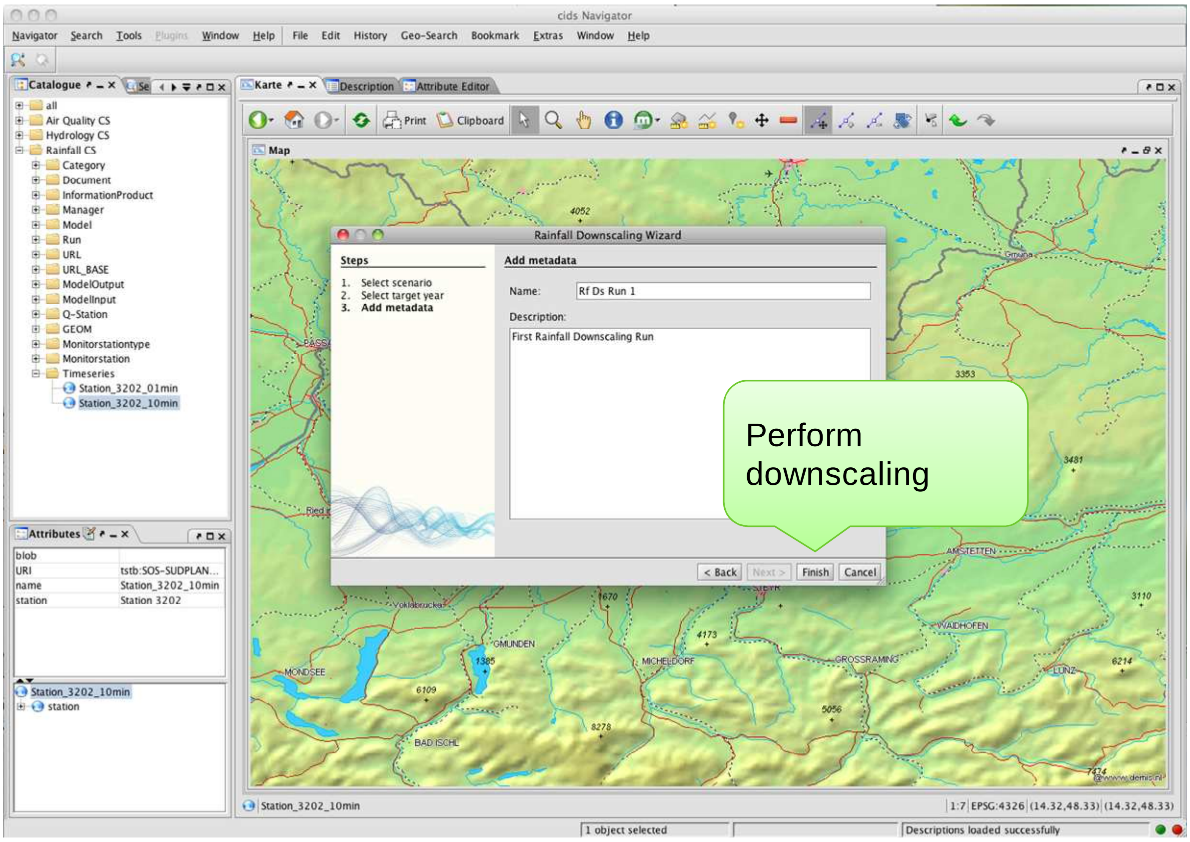


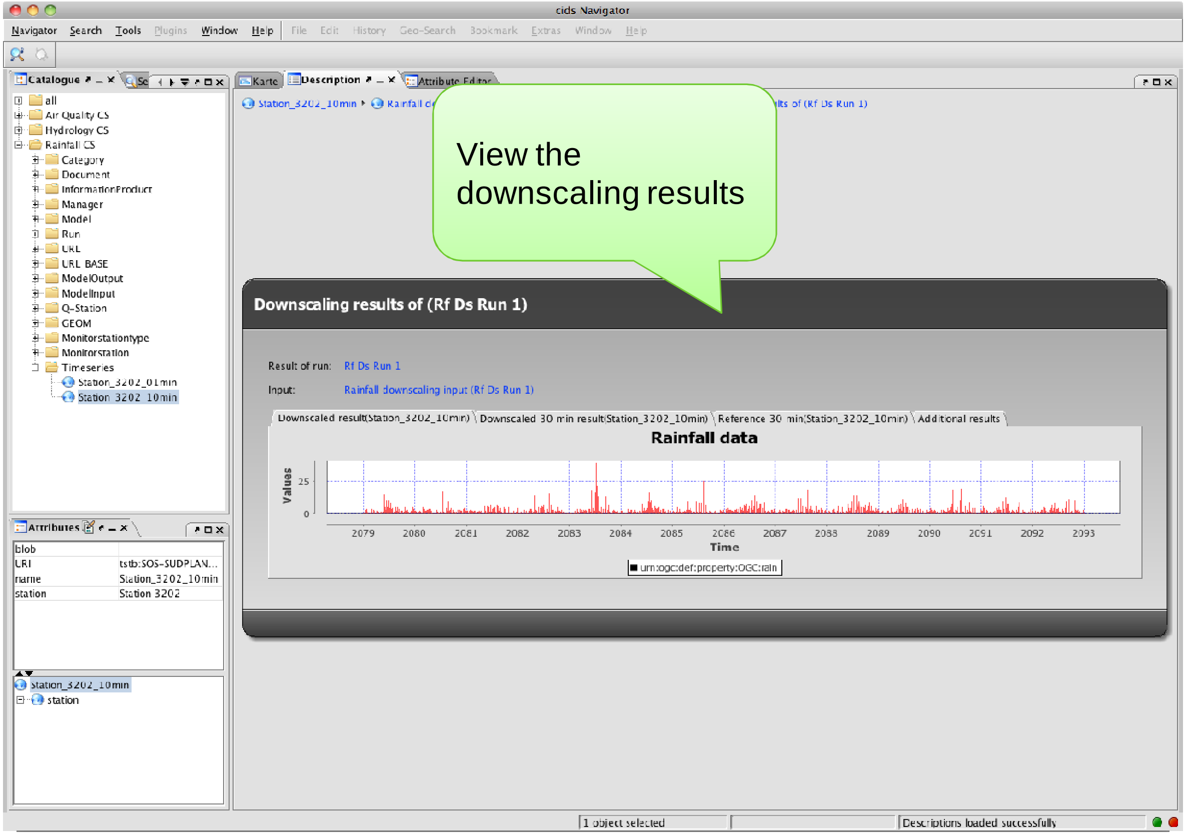


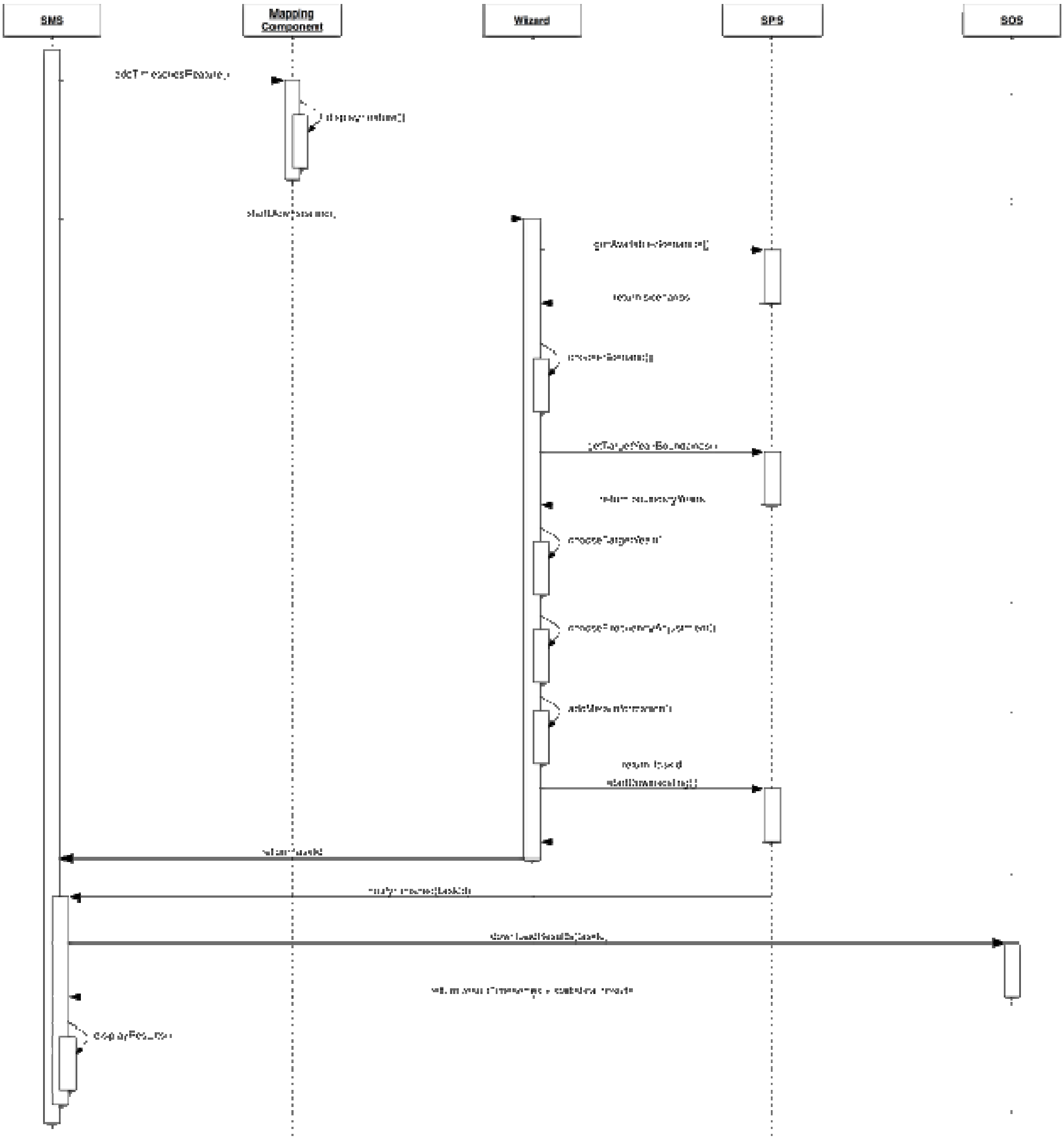

cids Navigator
Choose scenario
Rainfall Dow
Steps
1. Select scenario
2. Select target year
3. Add metadata
Select scenario
ECHAM5 A1B 3
HADLEY A1B
< Back
Next >
Finish
Cancel


cids Navigator
Rainfall Downscaling
Steps
1. Select scenario
2. Select target year
3. Add metadata
Select target year
Choose target date
2025
2035
2045
2055
2065
2075
2085
Target year: 2077
Frequency Adjustment
Choose frequency adjustment
< Back
Next >
Finish
Cancel


cids Navigator
Rainfall Downscaling Wizard
Steps
1. Select scenario
2. Select target year
3. Add metadata
Add metadata
Name:
Rf Ds Run 1
Description:
First Rainfall Downscaling Run
Add metadata
< Back
Next >
Finish
Cancel

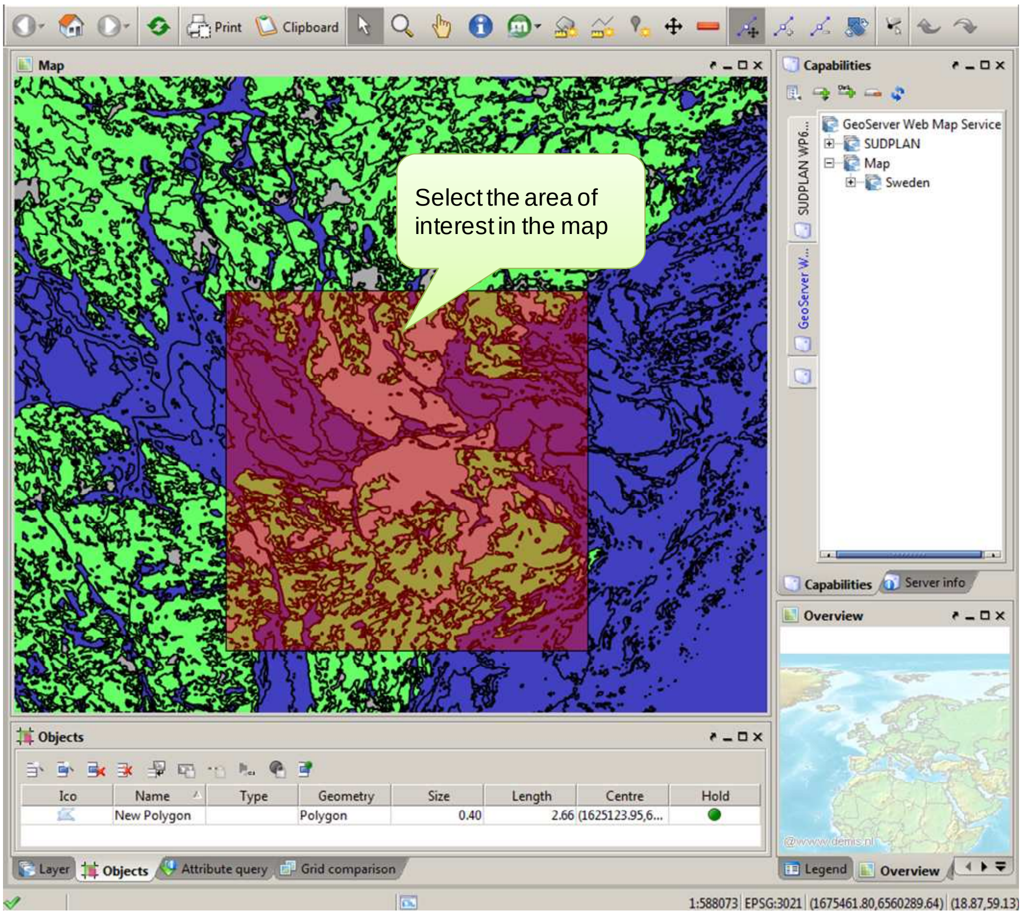

cids Navigator
Rainfall Downscaling Wizard
Steps
1. Select scenario
2. Select target year
3. Add metadata
Add metadata
Name:
Rf Ds Run 1
Description:
First Rainfall Downscaling Run
Perform downscaling
< Back
Next >
Finish
Cancel

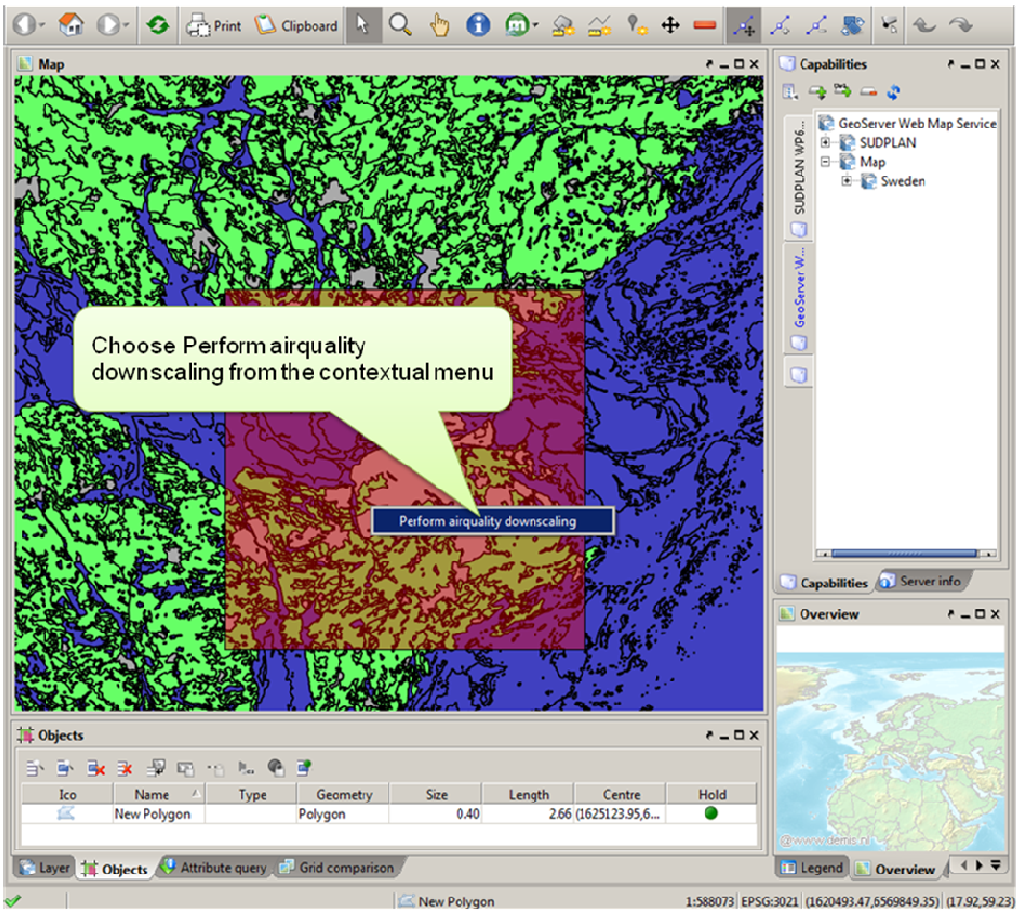

View the downscaling results
Downscaling results of (Rf Ds Run 1)
Result of run: Rf Ds Run 1
Input: Rainfall downscaling input (Rf Ds Run 1)
Rainfall data
Values
Time
Descriptions loaded successfully
1 object selected

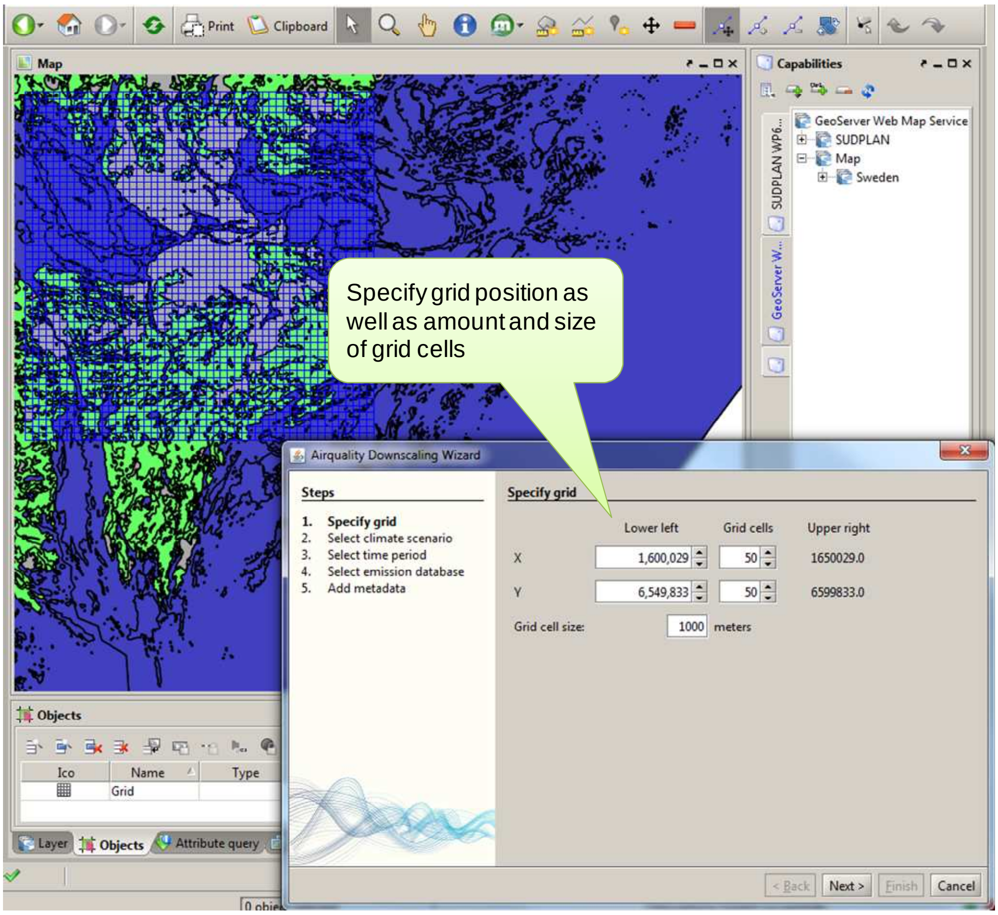


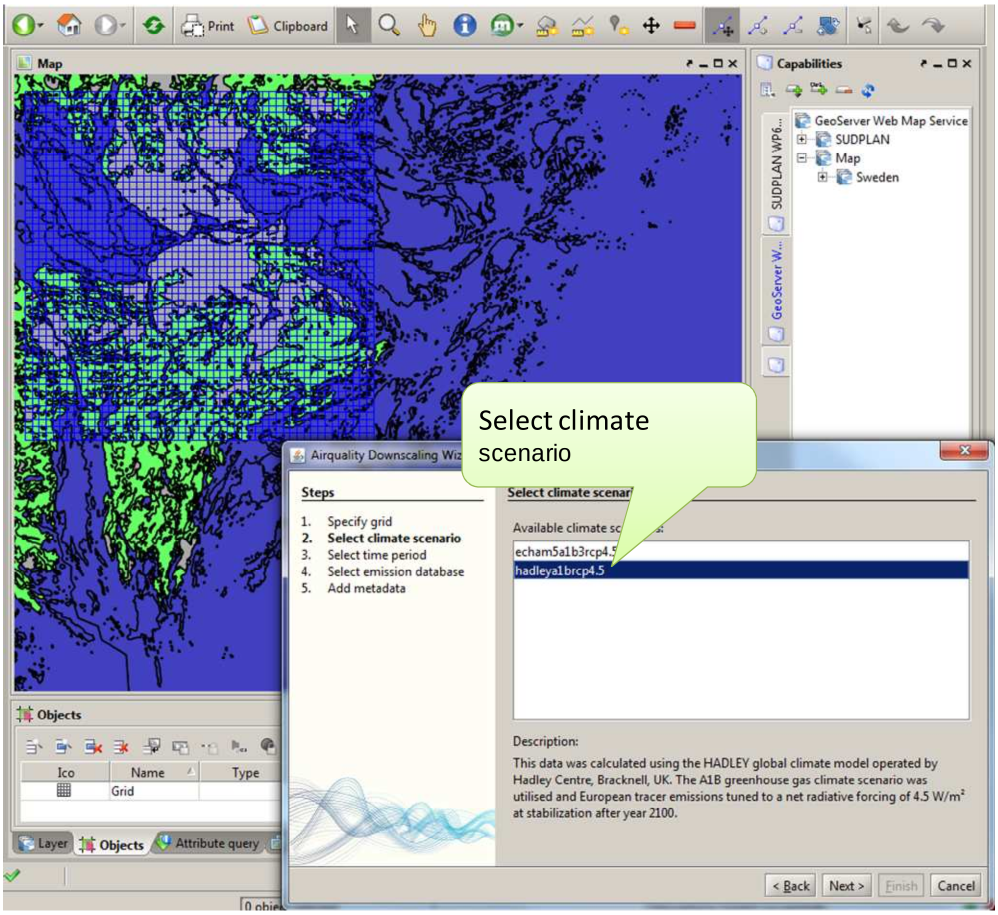
8.3. Execute Air Quality Downscaling

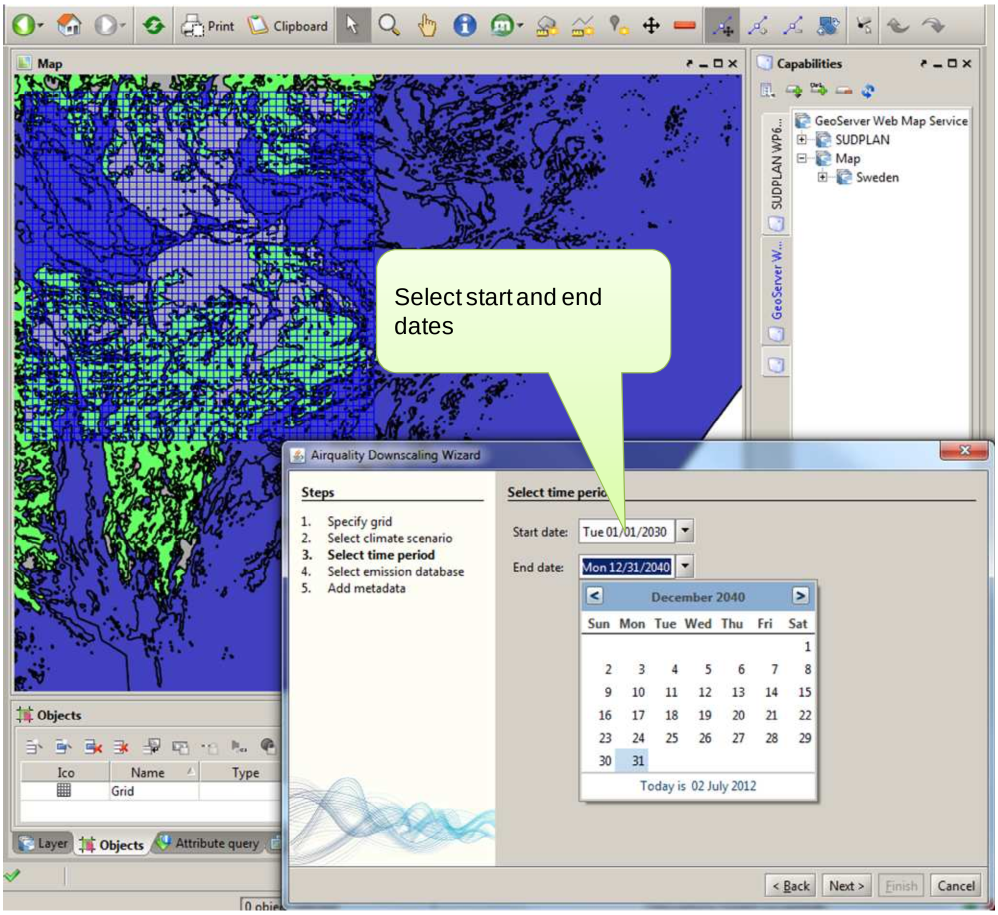
For a description of this validation scenario please refer to *4.2.3 Execute Air Quality Downscaling*.

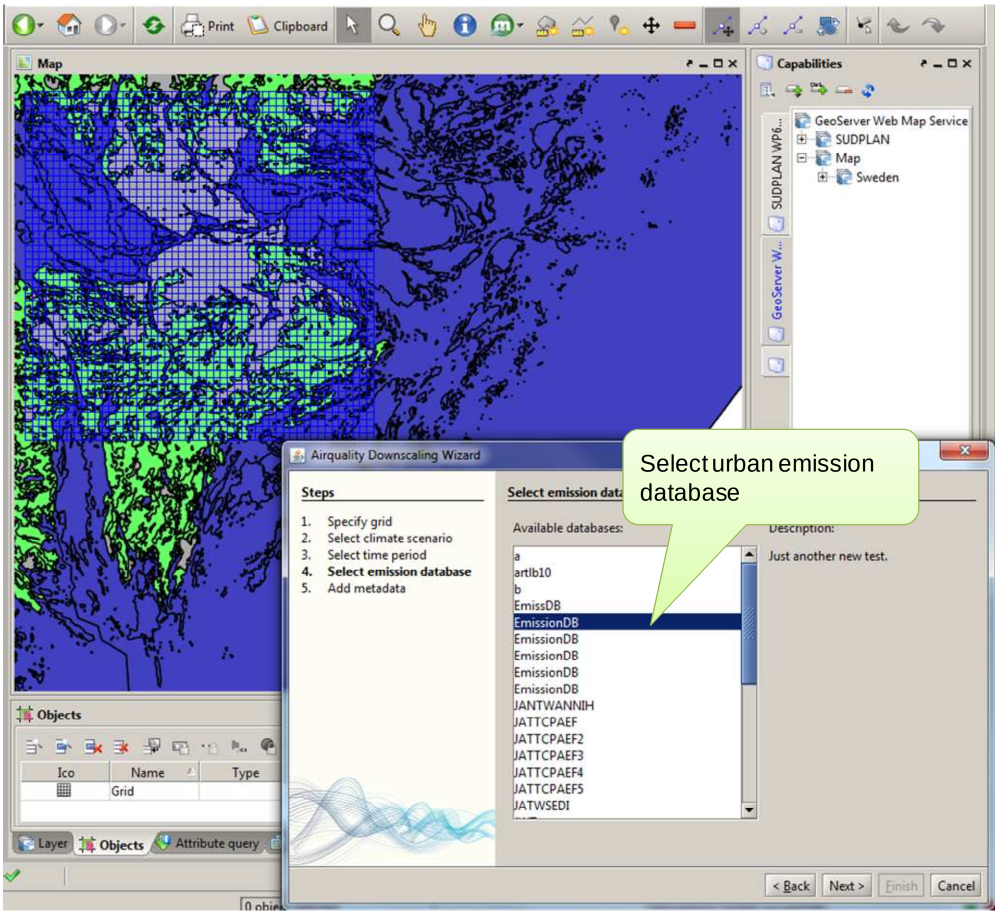

Select the area of interest in the map

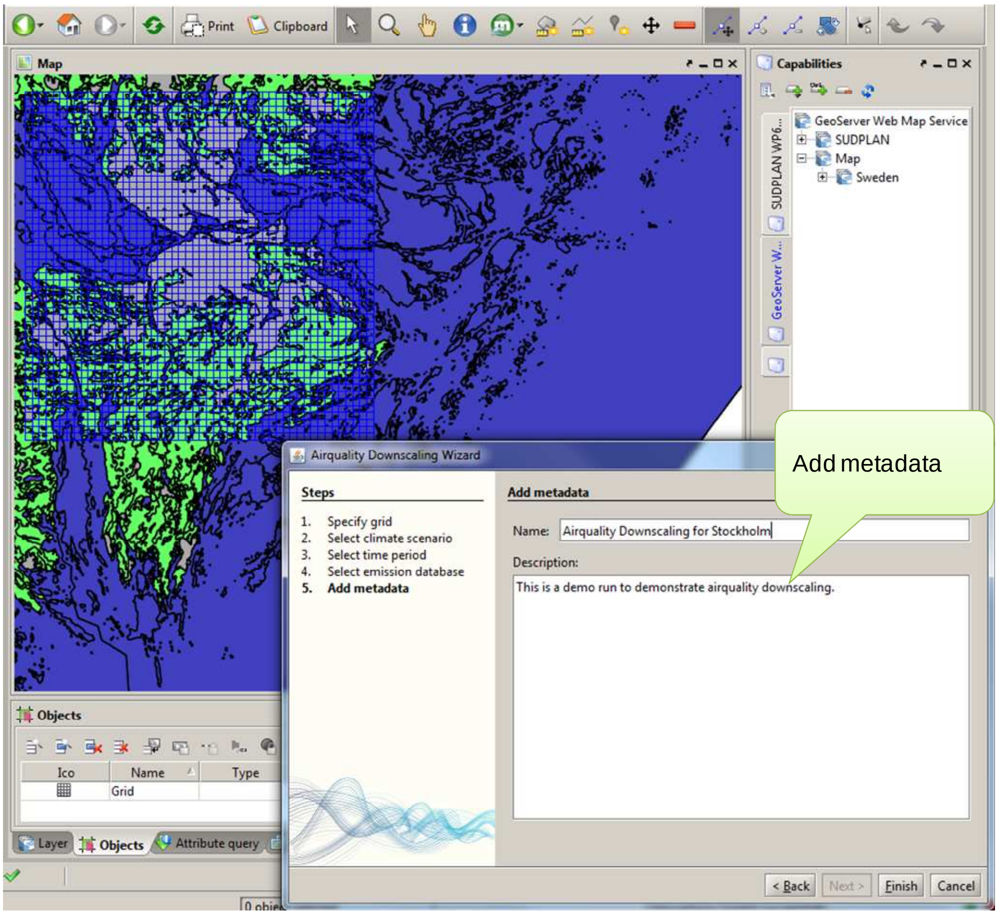

Choose Perform airquality downscaling from the contextual menu
Perform airquality downscaling

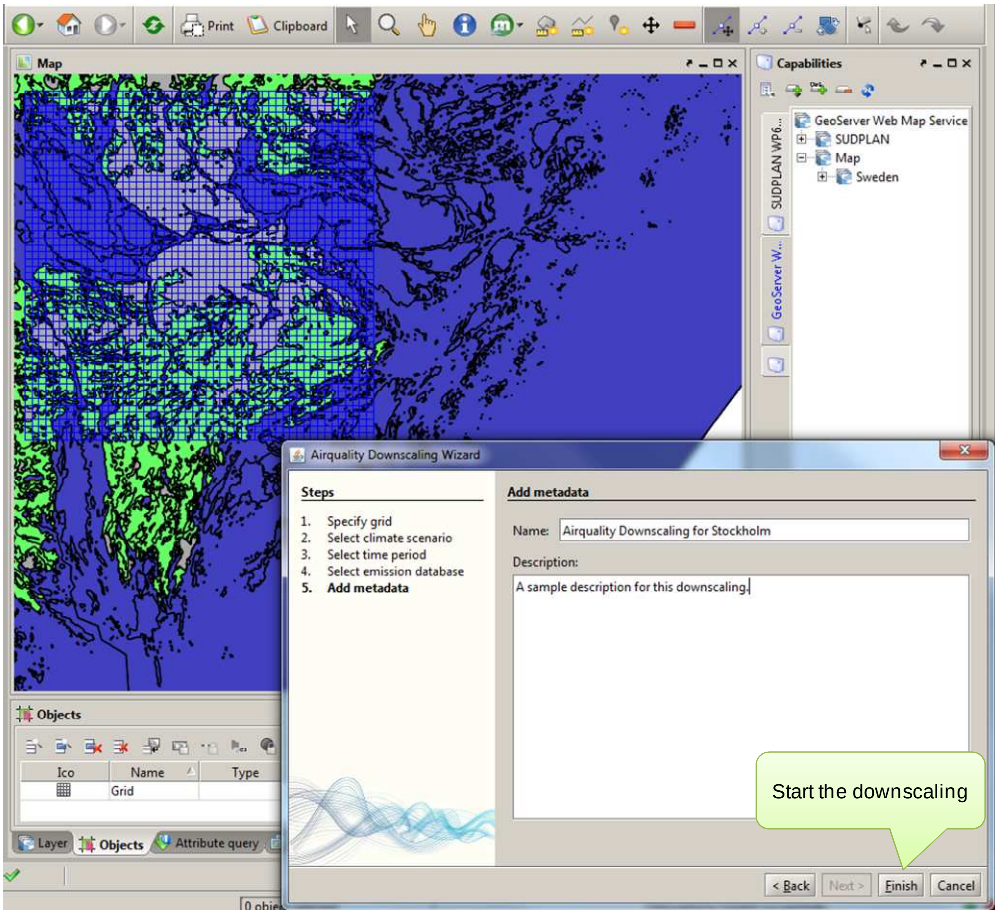

Specify grid position as well as amount and size of grid cells
Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Specify grid
Lower left
Grid cells
Upper right
X
1,600,029
50
1650029.0
Y
6,549,833
50
6599833.0
Grid cell size:
1000
meters
< Back
Next >
Finish
Cancel

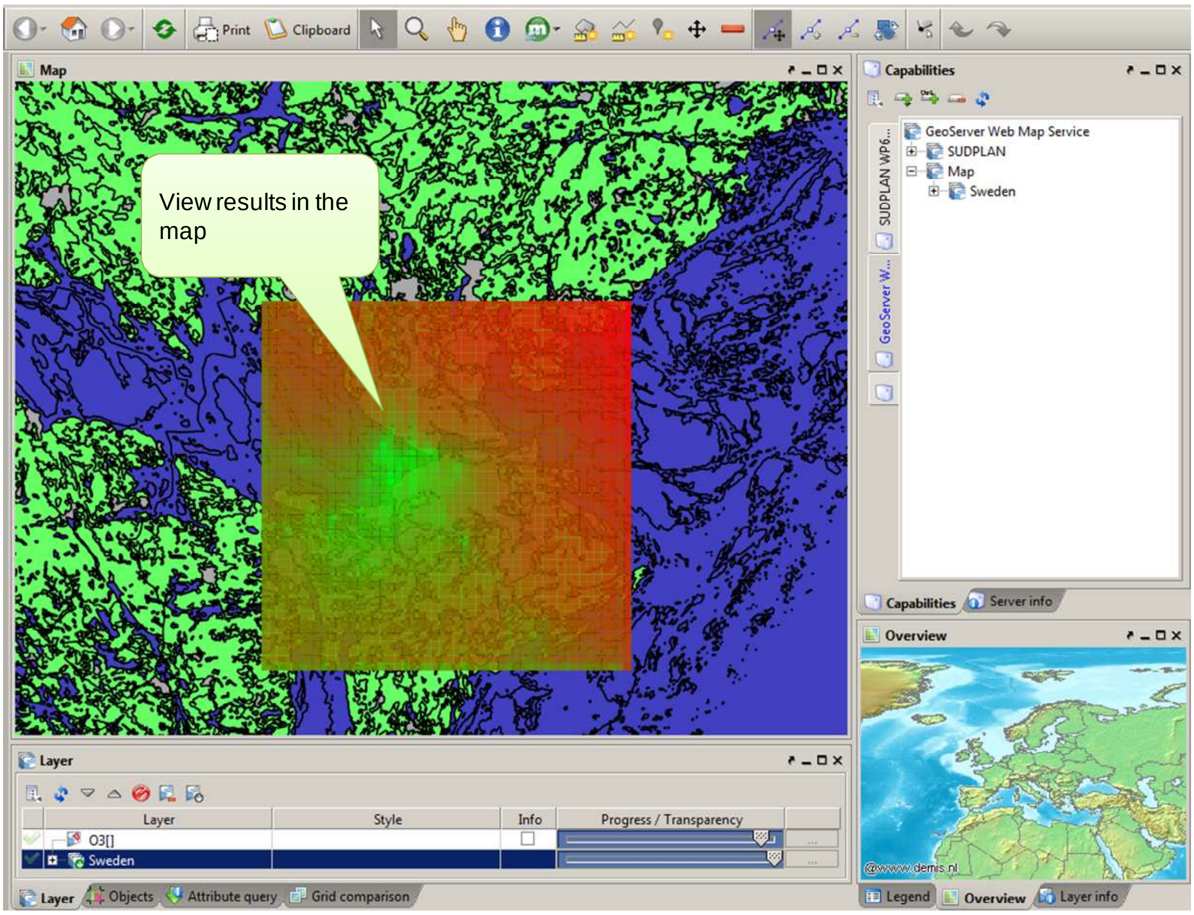

Select climate scenario
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
hadleya1brcp4.5
Description:
This data was calculated using the HADLEY global climate model operated by Hadley Centre, Bracknell, UK. The A1B greenhouse gas climate scenario was utilised and European tracer emissions tuned to a net radiative forcing of 4.5 W/m² at stabilization after year 2100.
< Back
Next >
Finish
Cancel

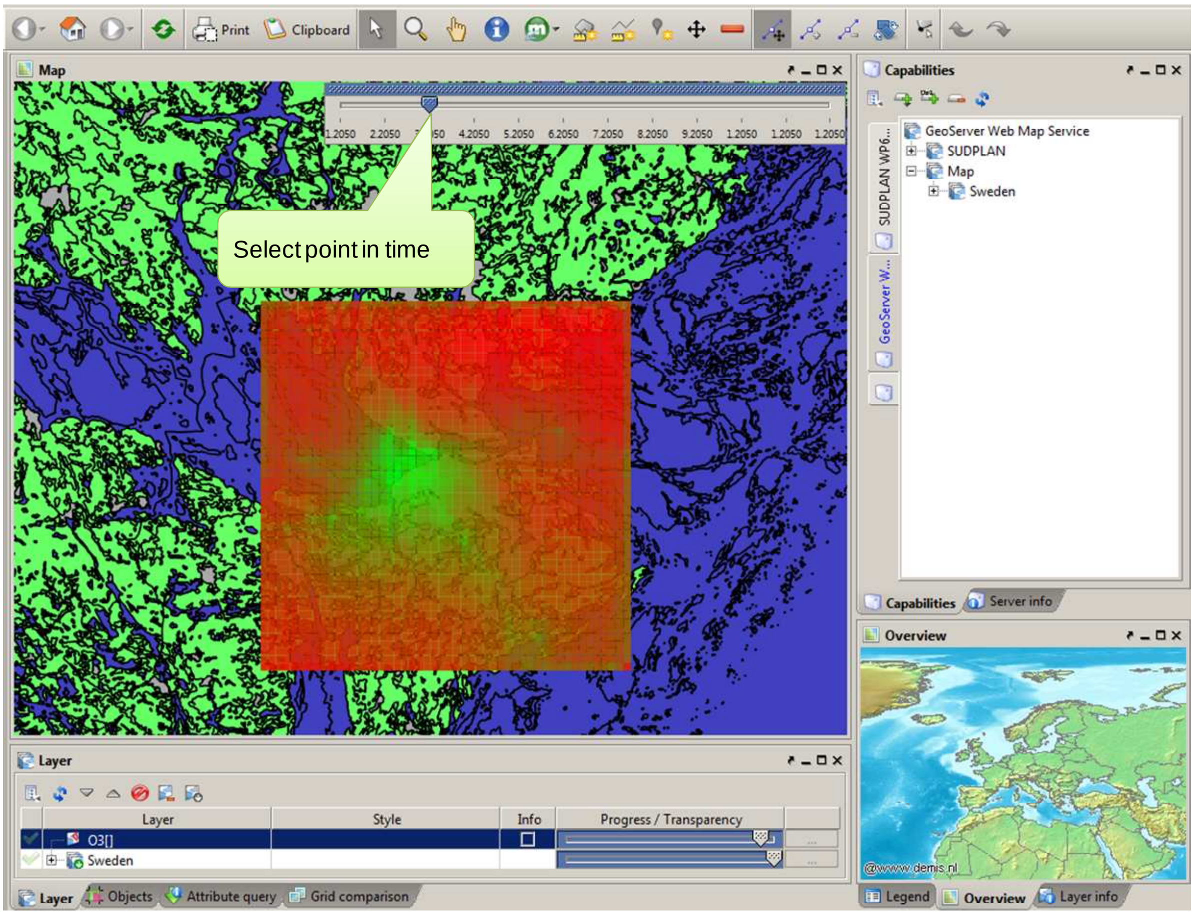

Print
Clipboard
Map
Capabilities
GeoServer Web Map Service
SUDPLAN
Map
Sweden
Select start and end dates
Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Select time period
Start date: Tue 01/01/2030
End date: Mon 12/31/2040
December 2040
Sun Mon Tue Wed Thu Fri Sat
Today is 02 July 2012
Objects
Ico Name Type
Grid
Layer Objects Attribute query
< Back Next > Finish Cancel

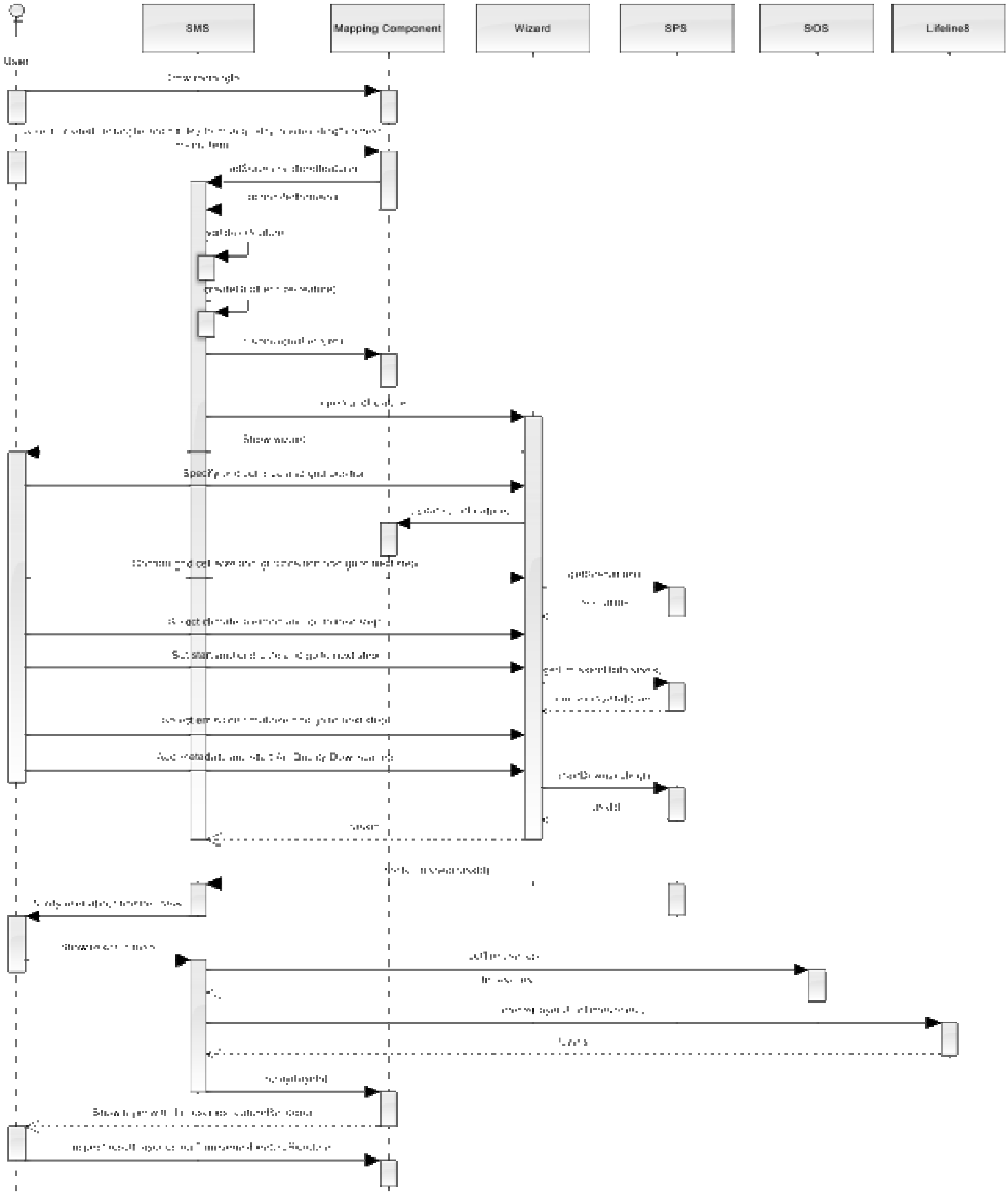

Print
Clipboard
Map
Capabilities
GeoServer Web Map Service
SUDPLAN
Map
Sweden
Select urban emission database
Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Available databases:
Description:
Just another new test.
a
artlb10
b
EmissDB
EmissionDB
EmissionDB
EmissionDB
EmissionDB
EmissionDB
JANTWANNIH
JATTCPAEF
JATTCPAEF2
JATTCPAEF3
JATTCPAEF4
JATTCPAEF5
JATWSEDI
Objects
Ico Name Type
Grid
Layer Objects Attribute query
< Back Next > Finish Cancel


Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Add metadata
Name: Airquality Downscaling for Stockholm
Description:
This is a demo run to demonstrate airquality downscaling.
Add metadata
< Back
Next >
Finish
Cancel


Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Add metadata
Name: Airquality Downscaling for Stockholm
Description:
A sample description for this downscaling.
Start the downscaling
< Back
Next >
Finish
Cancel


Print
Clipboard
Map
View results in the map
Capabilities
GeoServer Web Map Service
SUDPLAN
Map
Sweden
SUDPLAN WP6...
GeoServer W...
Capabilities
Server info
Overview
@www.demis.nl
Layer
Layer
Style
Info
Progress / Transparency
O3[]
Sweden
Layer
Objects
Attribute query
Grid comparison
Legend
Overview
Layer info

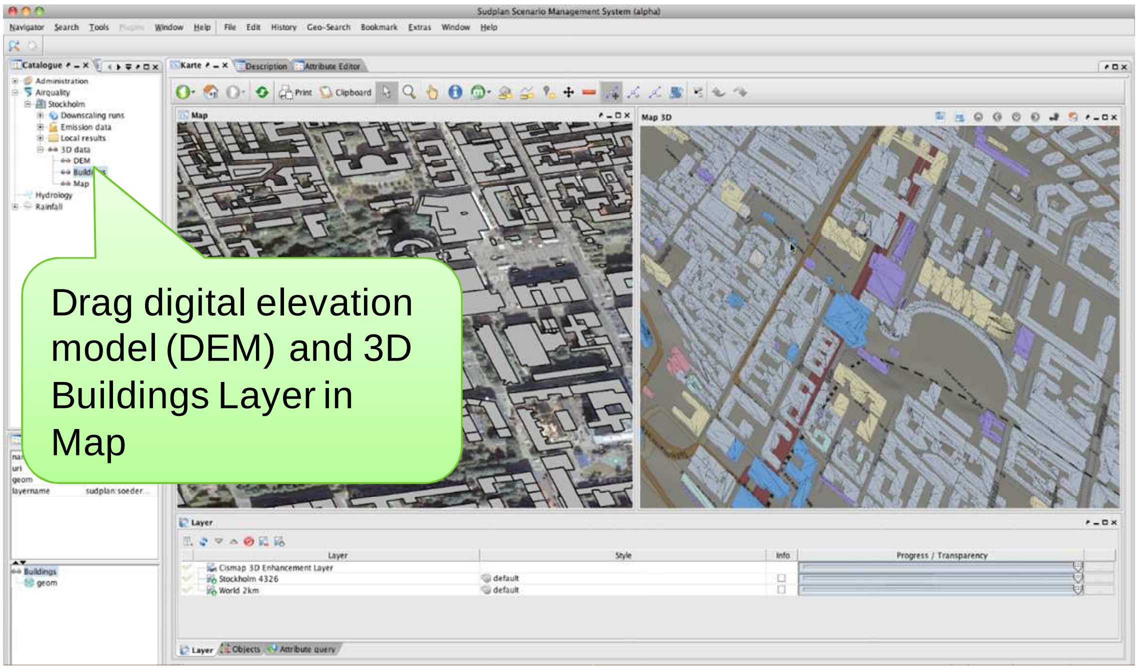

Print
Clipboard
Map
Select point in time
Capabilities
GeoServer Web Map Service
SUDPLAN
Map
Sweden
SUDPLAN WP6...
GeoServer W...
Capabilities
Server info
Overview
@www.demis.nl
Layer
Layer
Style
Info
Progress / Transparency
O3[]
Sweden
Layer
Objects
Attribute query
Grid comparison
Legend
Overview
Layer info

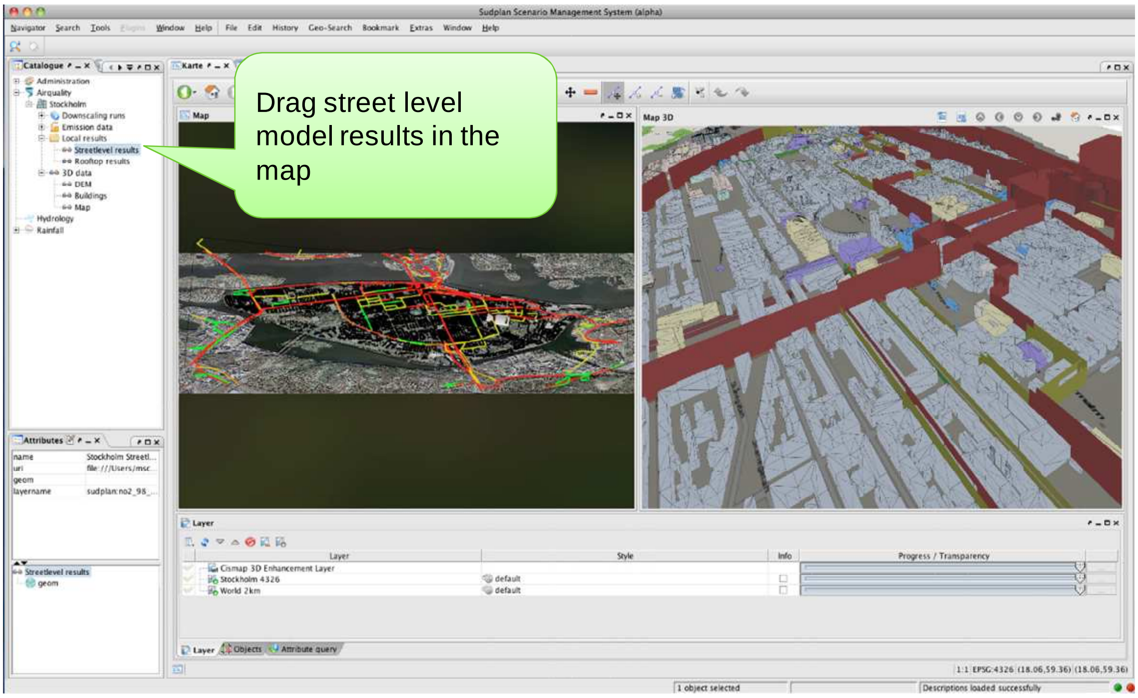

User
SMS
Mapping Component
Wizard
SPS
SOS
Lifeline8
Show wizard

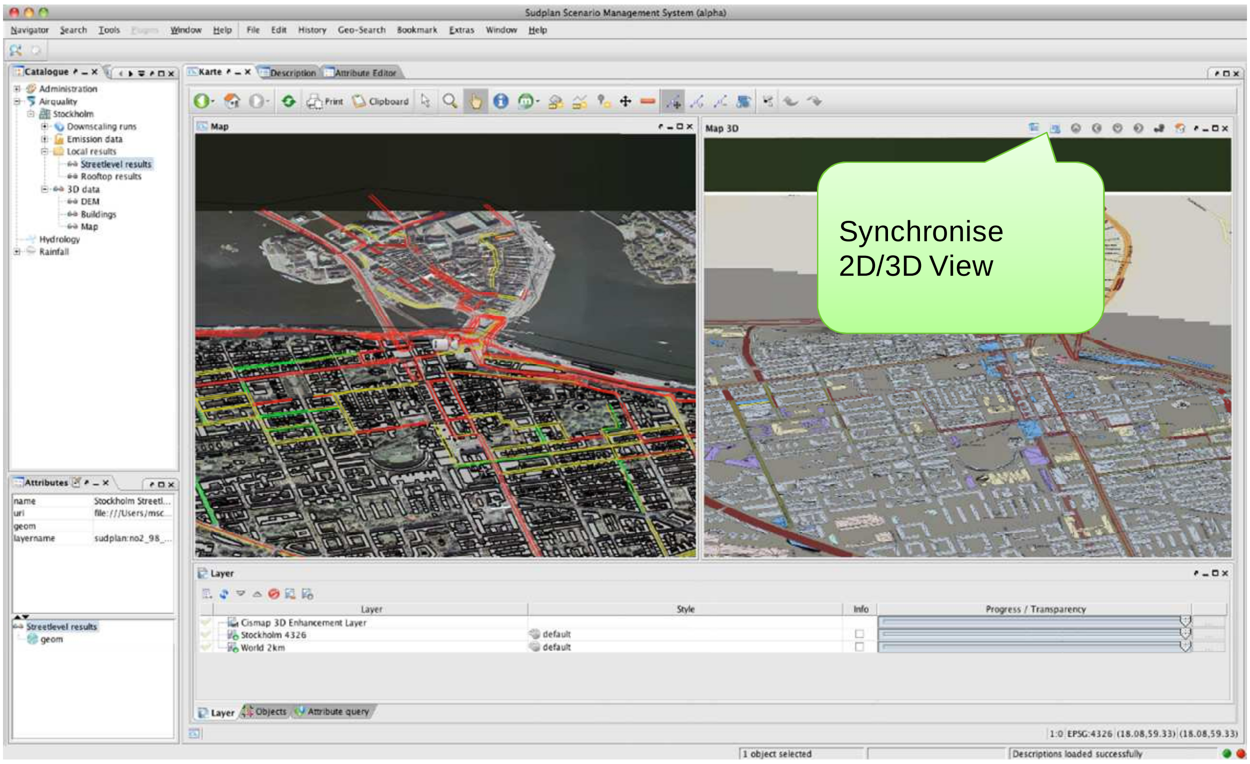
8.4. 3-D Visualisation of Local Air Quality and Traffic Data

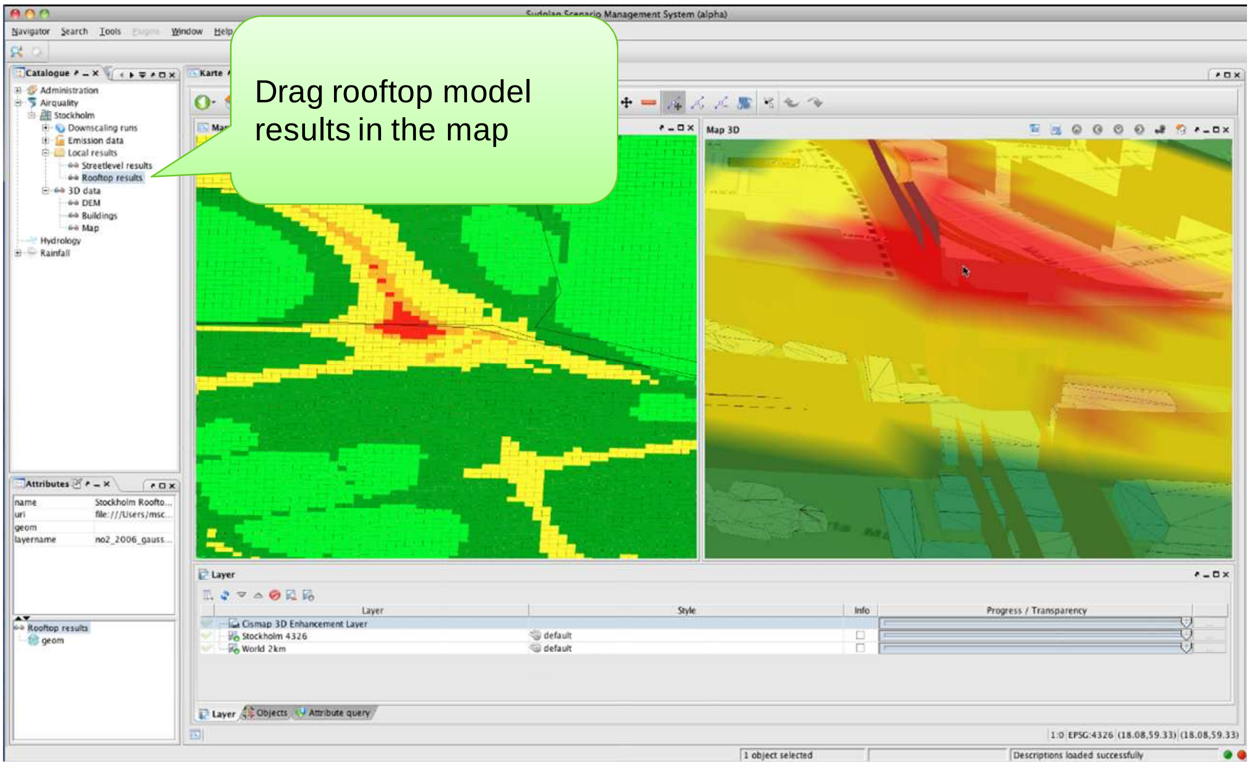
Note: This use case is based on the V1 of the Advanced 3-D Visualisation Component and is due to the change from the Java3-D to the WorldWind SDK obsolete. However, this section is left in the document for completeness.

For a description of this validation scenario please refer to *4.2.4 - 3-D Visualisation of Local Air Quality and Traffic Data*.



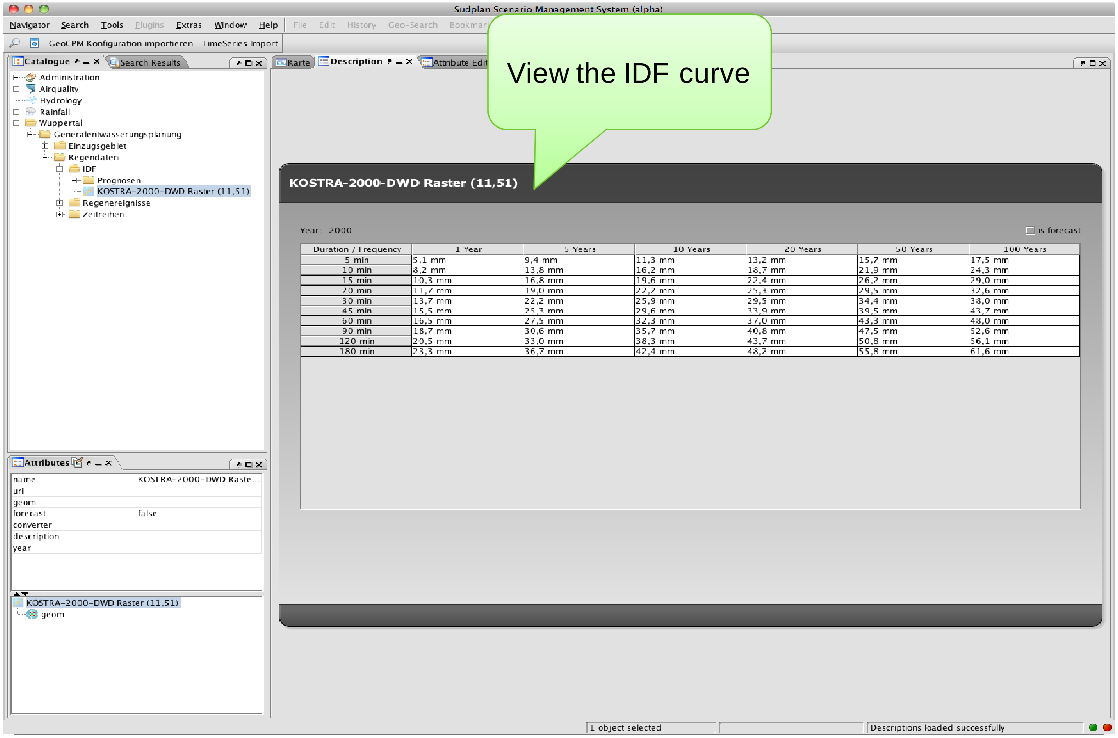


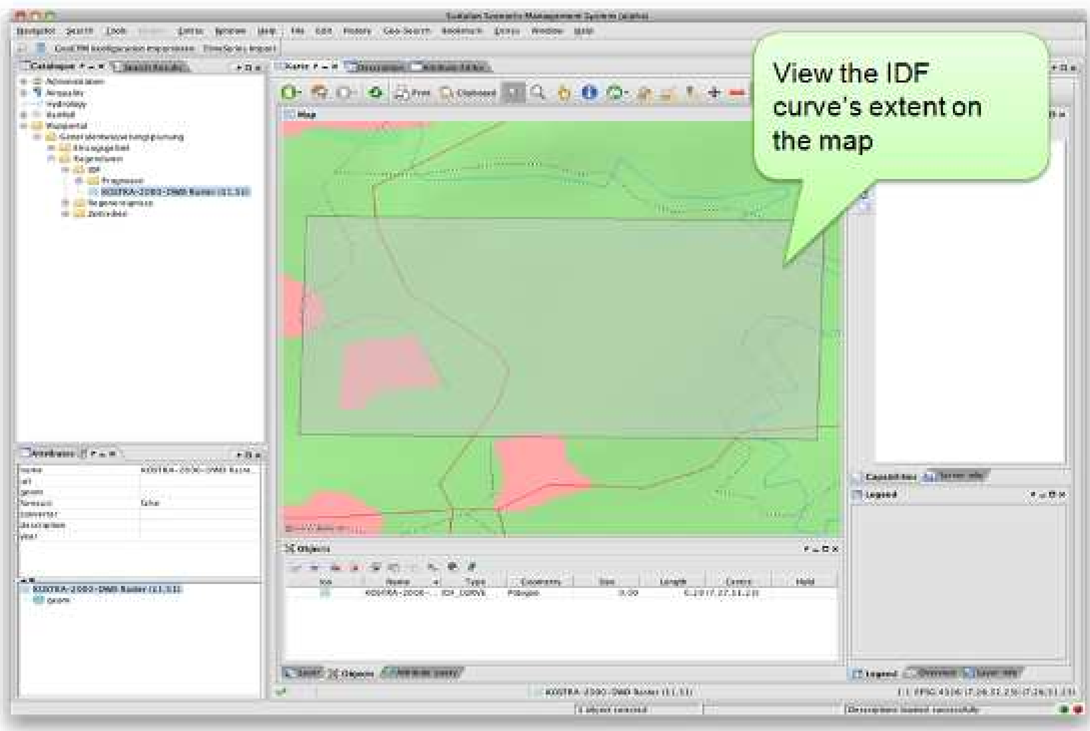

Sudplan Scenario Management System (alpha)
Synchronise
2D/3D View

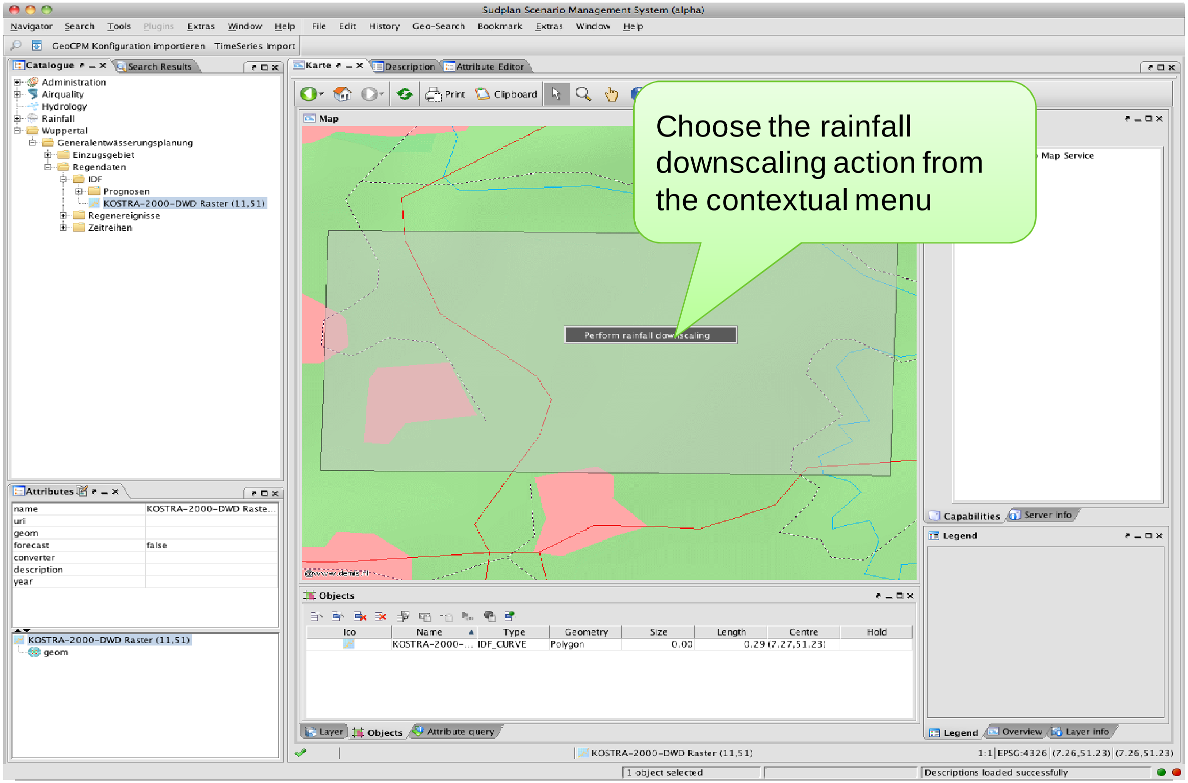

Drag rooftop model
results in the map

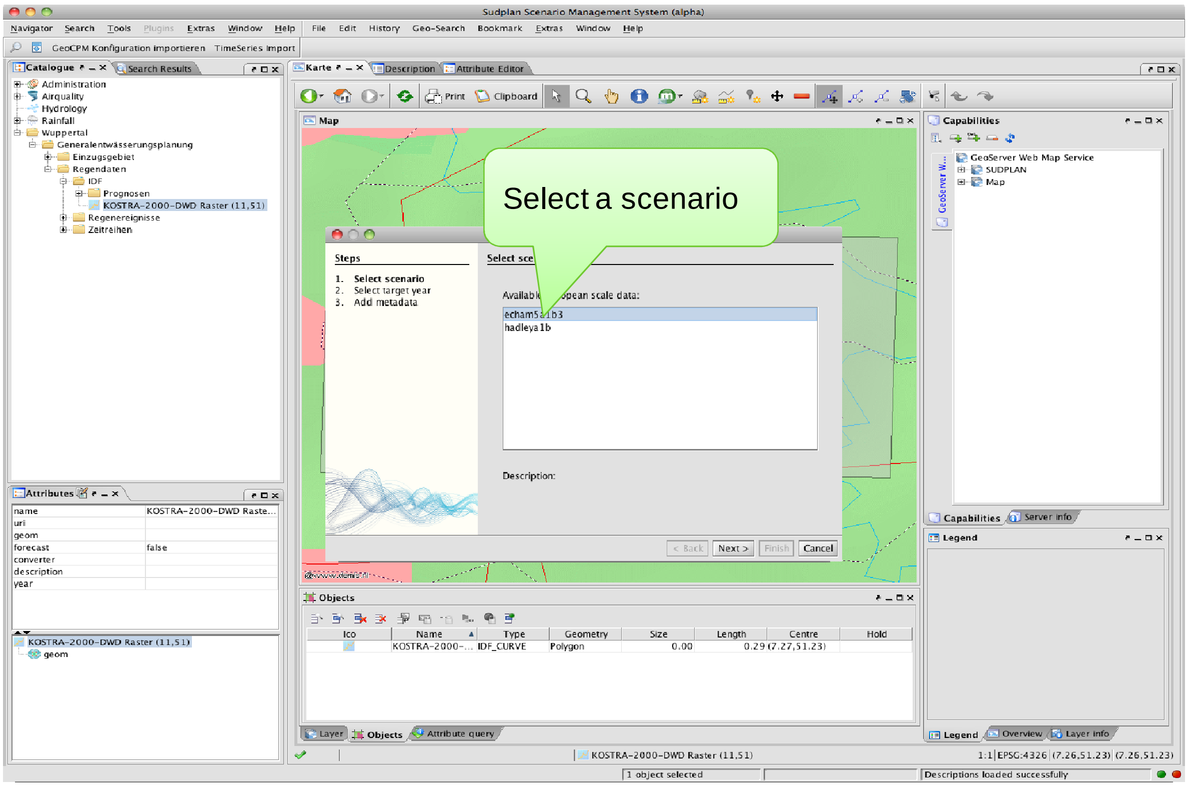
8.5. Execute IDF Rainfall Downscaling

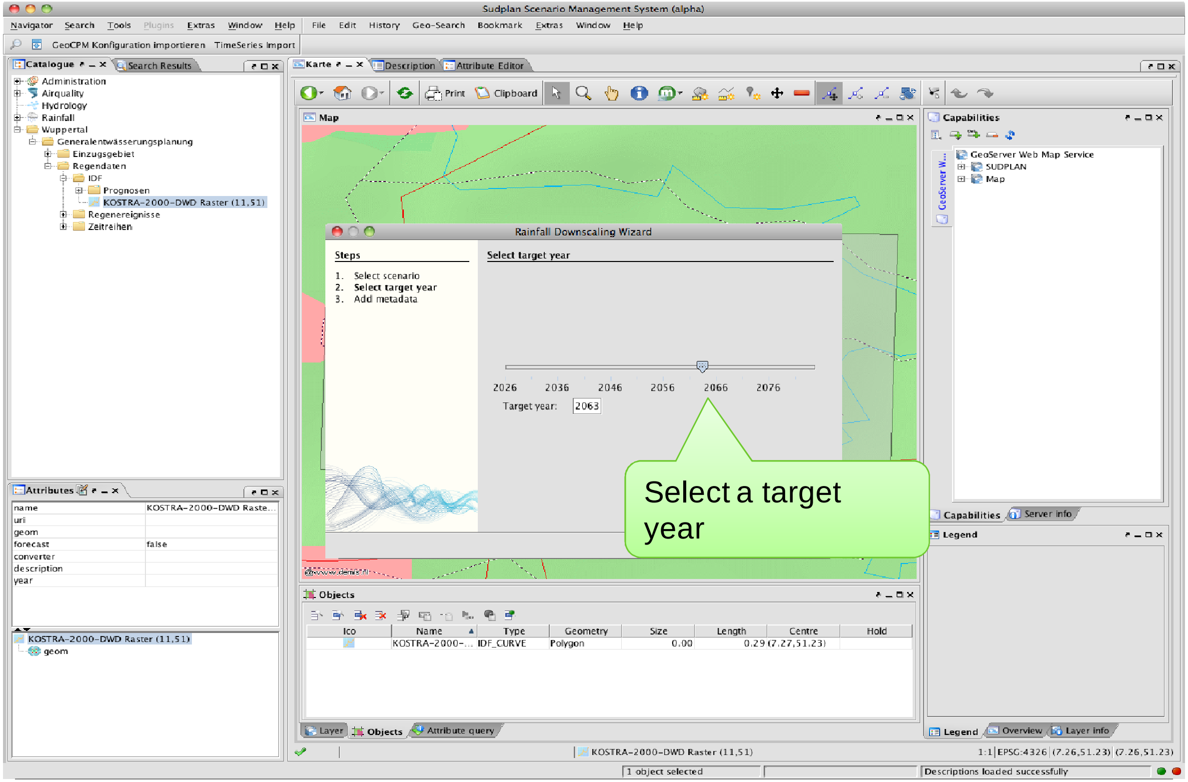
For a description of this validation scenario please refer to *4.2.5 - Execute IDF Rainfall Downscaling* .

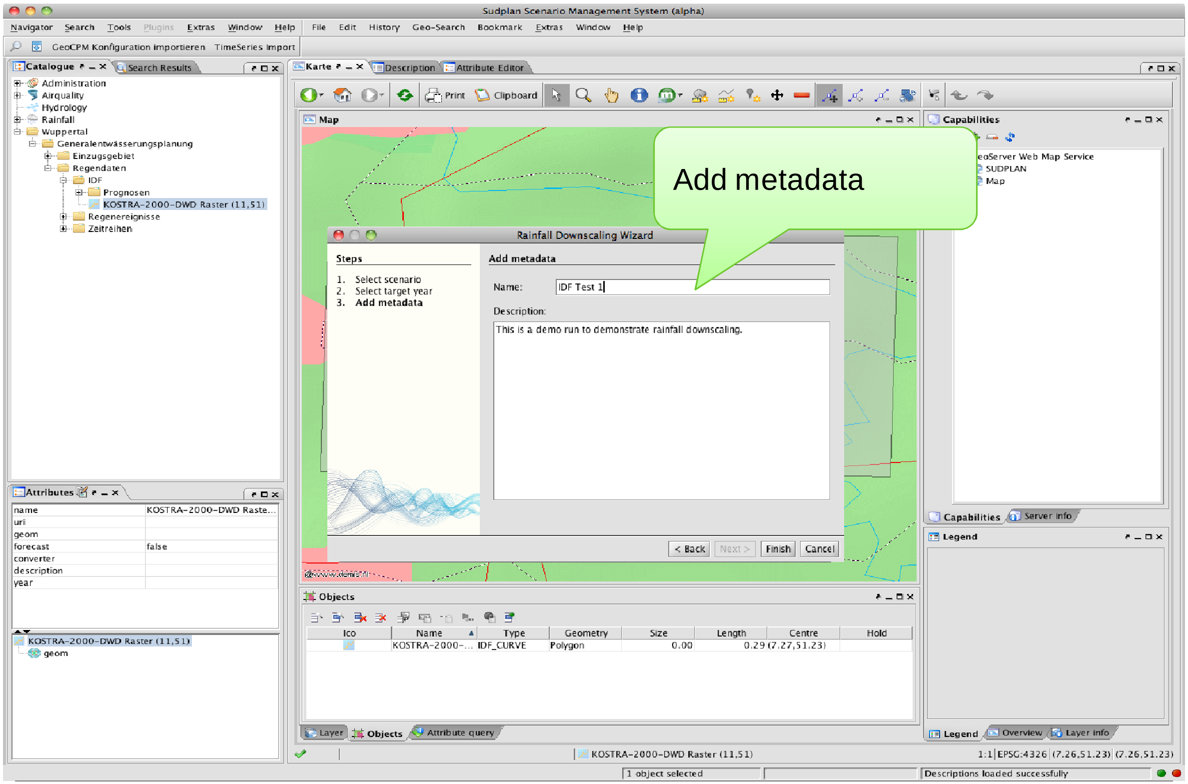


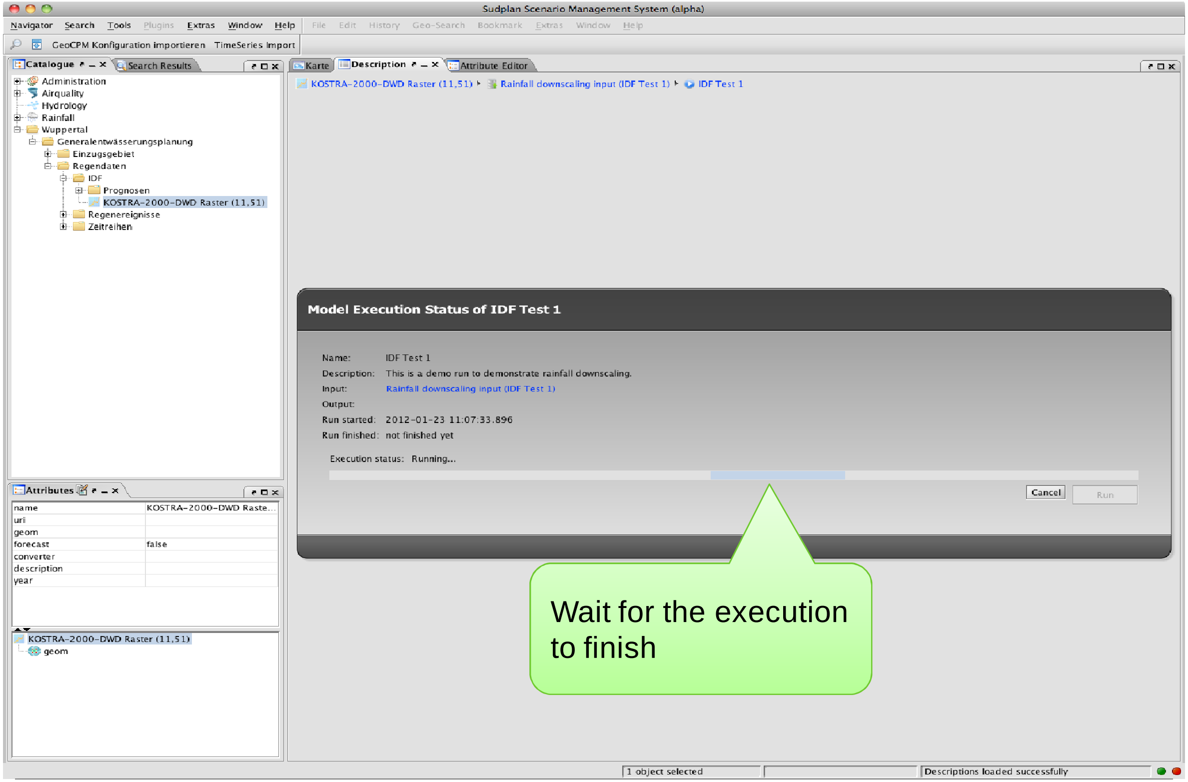


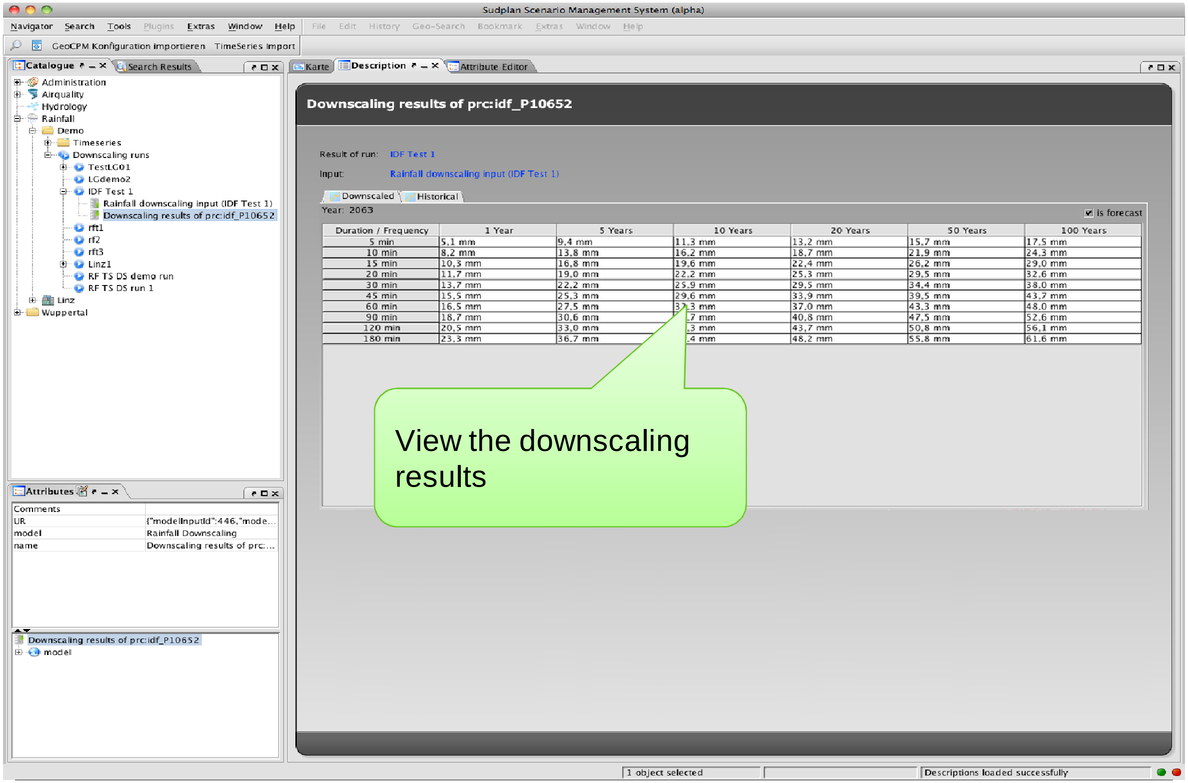

Choose the rainfall downscaling action from the contextual menu
Perform rainfall downscaling

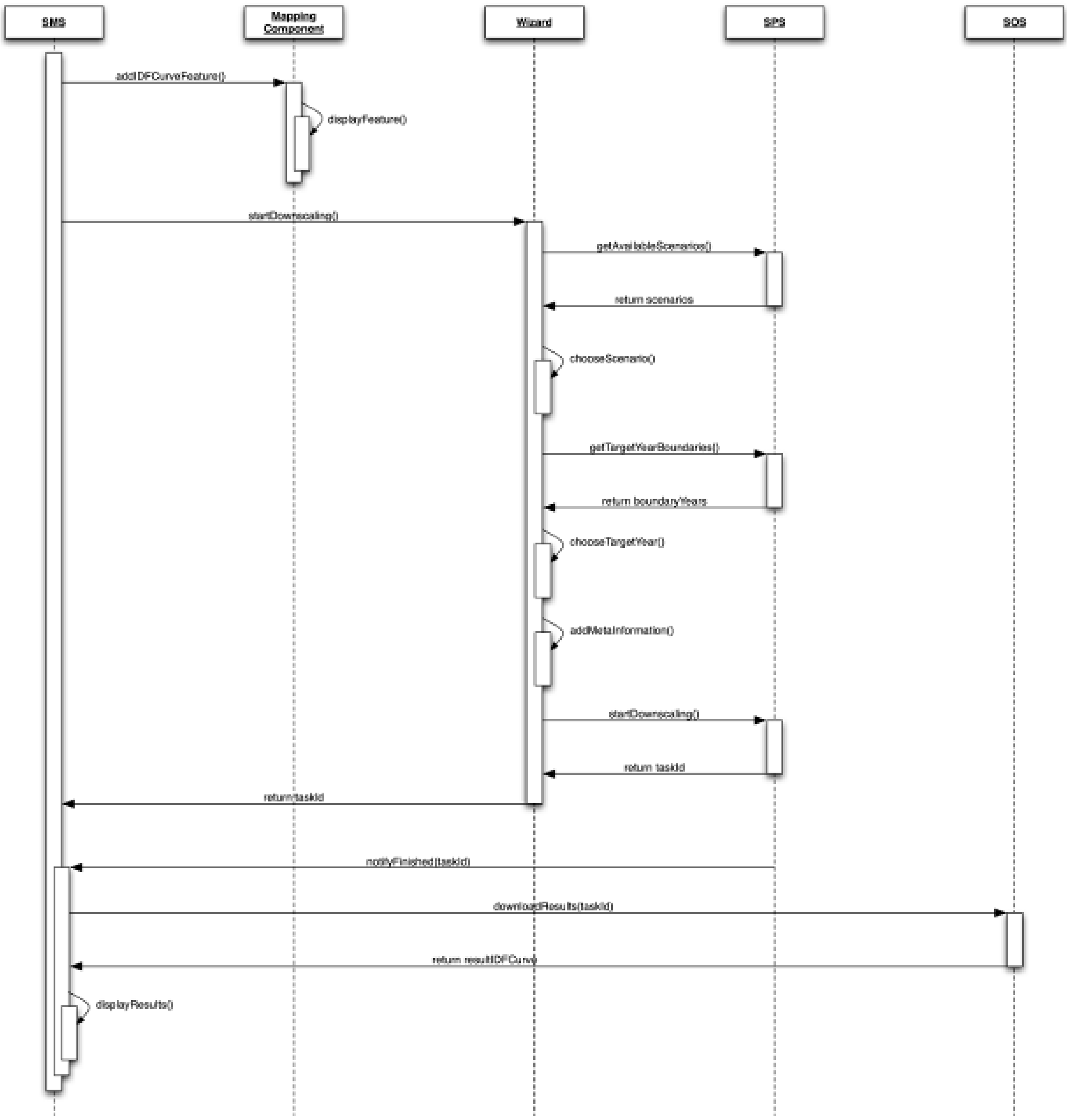

Select a scenario
Steps
1. Select scenario
2. Select target year
3. Add metadata
echam5r1b3
hadleya1b
Description:


Sudplan Scenario Management System (alpha)
Rainfall Downscaling Wizard
Steps
1. Select scenario
2. Select target year
3. Add metadata
Select target year
2026 2036 2046 2056 2066 2076
Target year: 2063
Select a target year


Sudplan Scenario Management System (alpha)
Rainfall Downscaling Wizard
Steps
1. Select scenario
2. Select target year
3. Add metadata
Add metadata
Name: IDF Test 1
Description:
This is a demo run to demonstrate rainfall downscaling.
< Back
Next >
Finish
Cancel
Add metadata

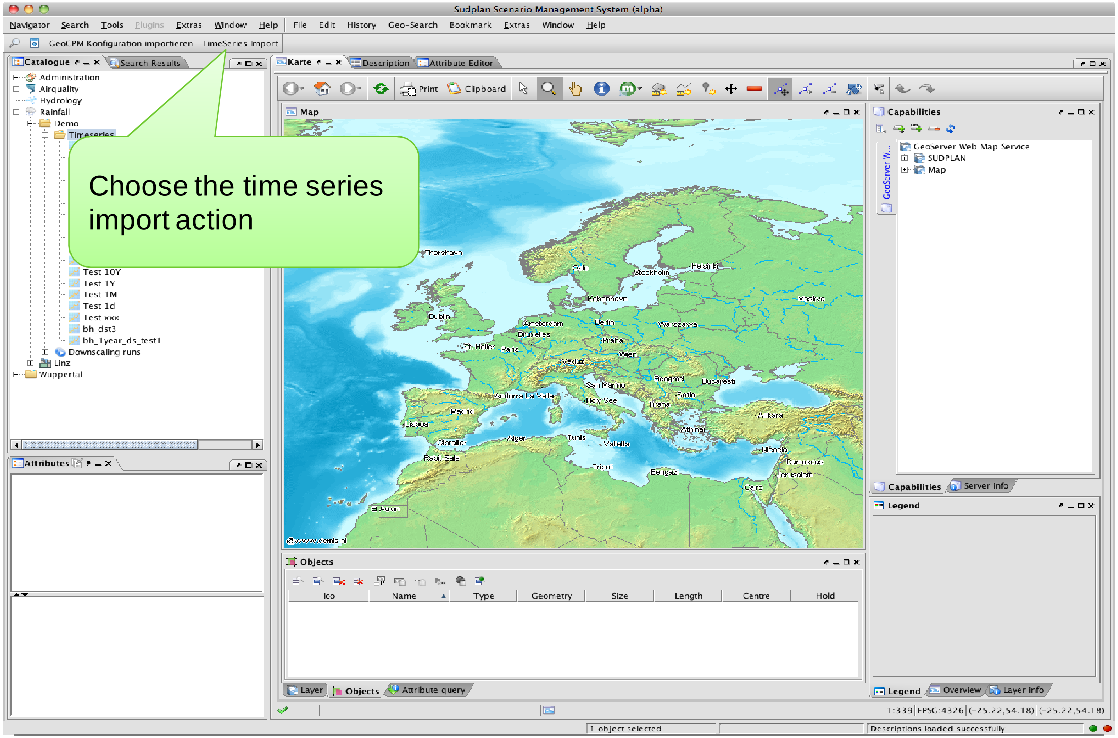

Sudplan Scenario Management System (alpha)
Model Execution Status of IDF Test 1
Name: IDF Test 1
Description: This is a demo run to demonstrate rainfall downscaling.
Input: Rainfall downscaling input (IDF Test 1)
Run started: 2012-01-23 11:07:33.896
Run finished: not finished yet
Execution status: Running...
Cancel
Run
Wait for the execution to finish

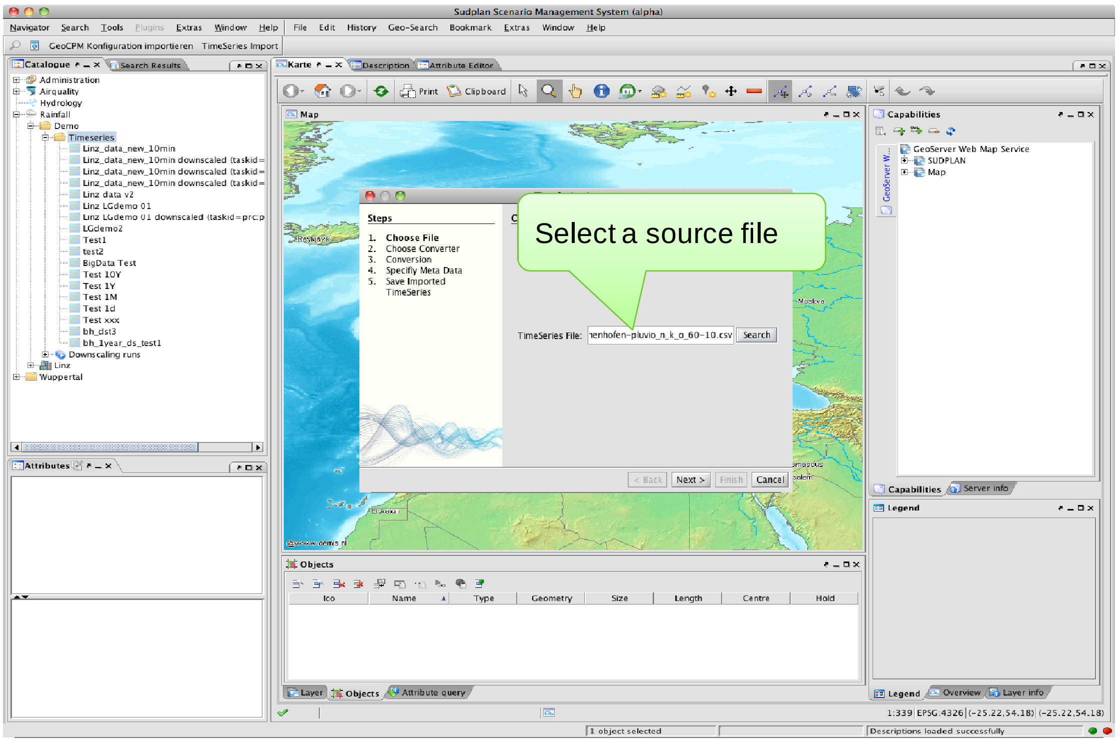

Sudplan Scenario Management System (alpha)
Downscaling results of prc:idf_P10652
Result of run: IDF Test 1
Input: Rainfall downscaling input (IDF Test 1)
Downscaled
Historical
Year: 2063
View the downscaling results

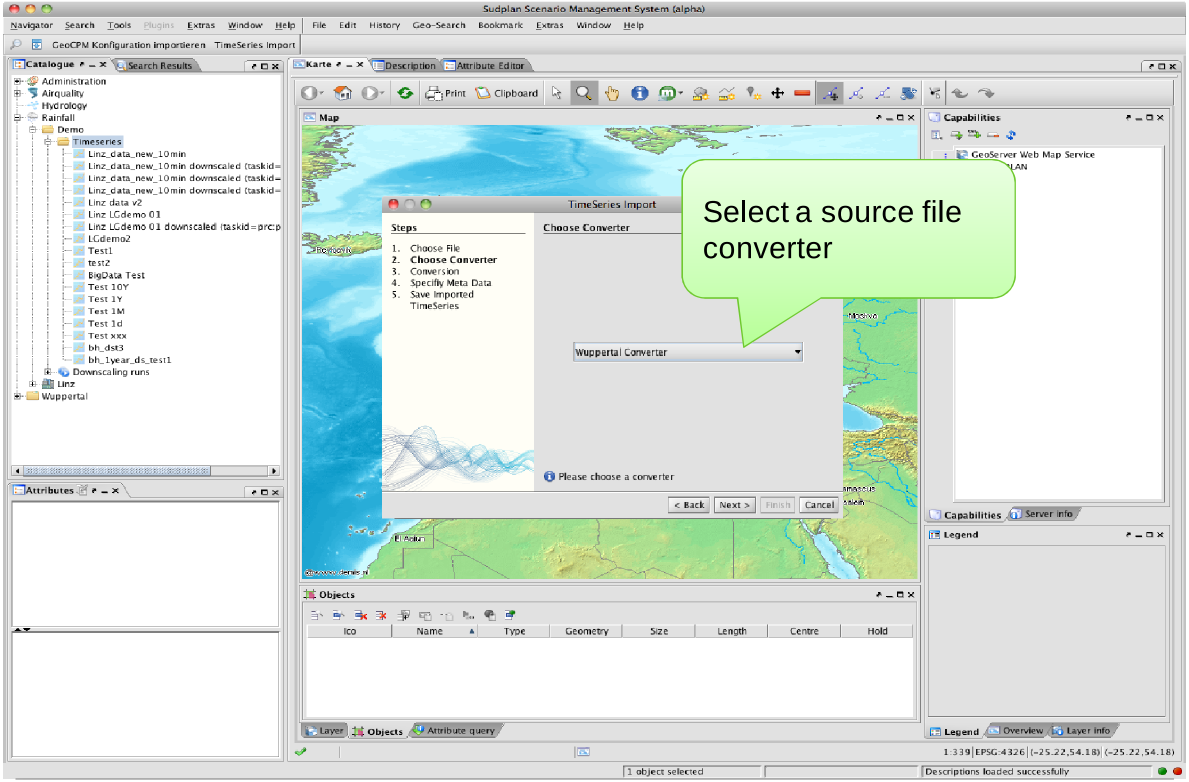

SMS
Mapping Component
Wizard
SPS
SOS
addIDFCurveFeature()
displayFeature()
startDownscaling()
getAvailableScenarios()
return scenarios
chooseScenario()
getTargetYearBoundaries()
return boundaryYears
chooseTargetYear()
addMetaInformation()
startDownscaling()
return taskId
return taskId
notifyFinished(taskId)
downloadResults(taskId)
return resultIDFCurve
displayResults()

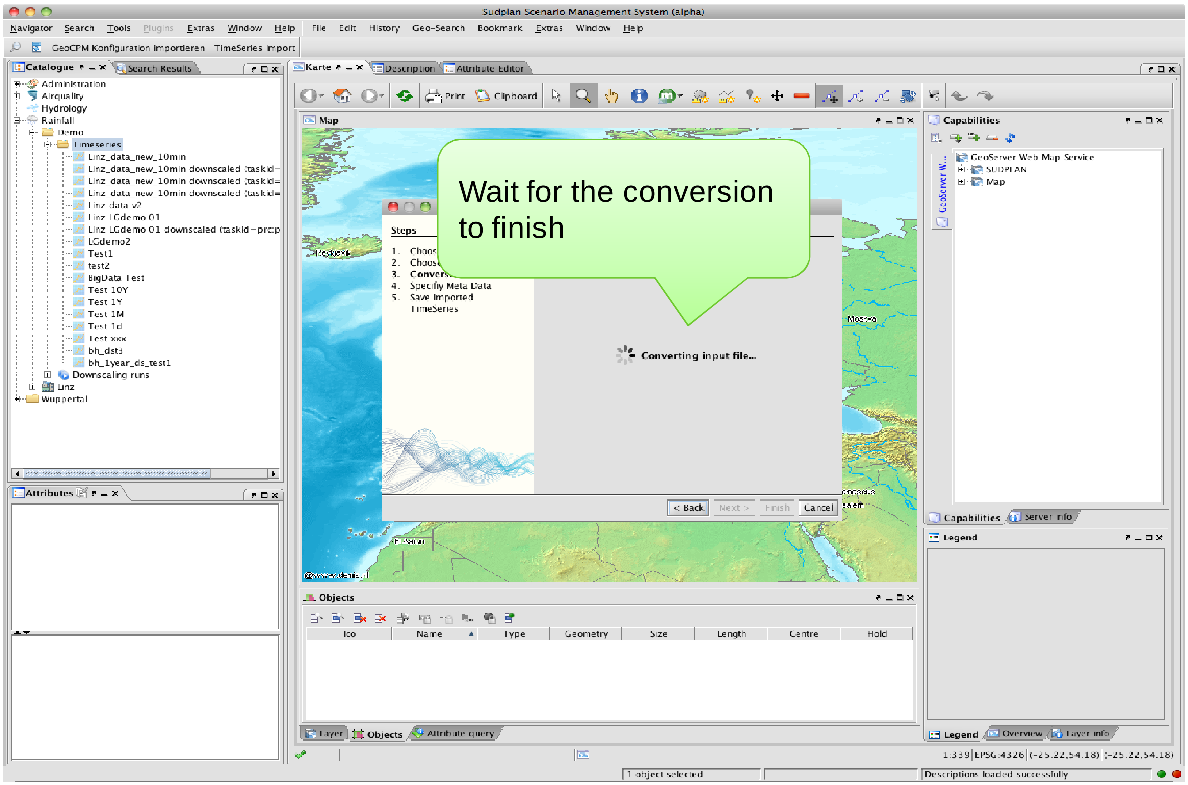
8.6. Local Data Upload

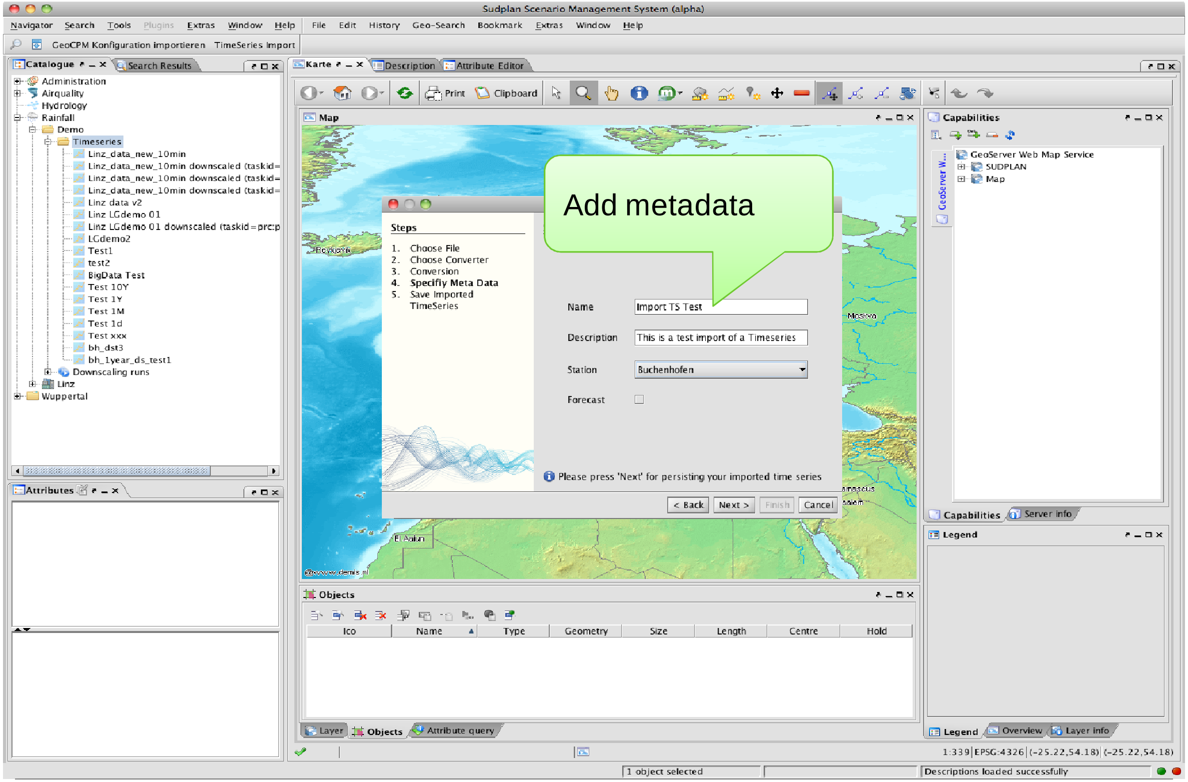
For a description of this validation use case please refer to section *4.2.6 - Local Data Upload*.

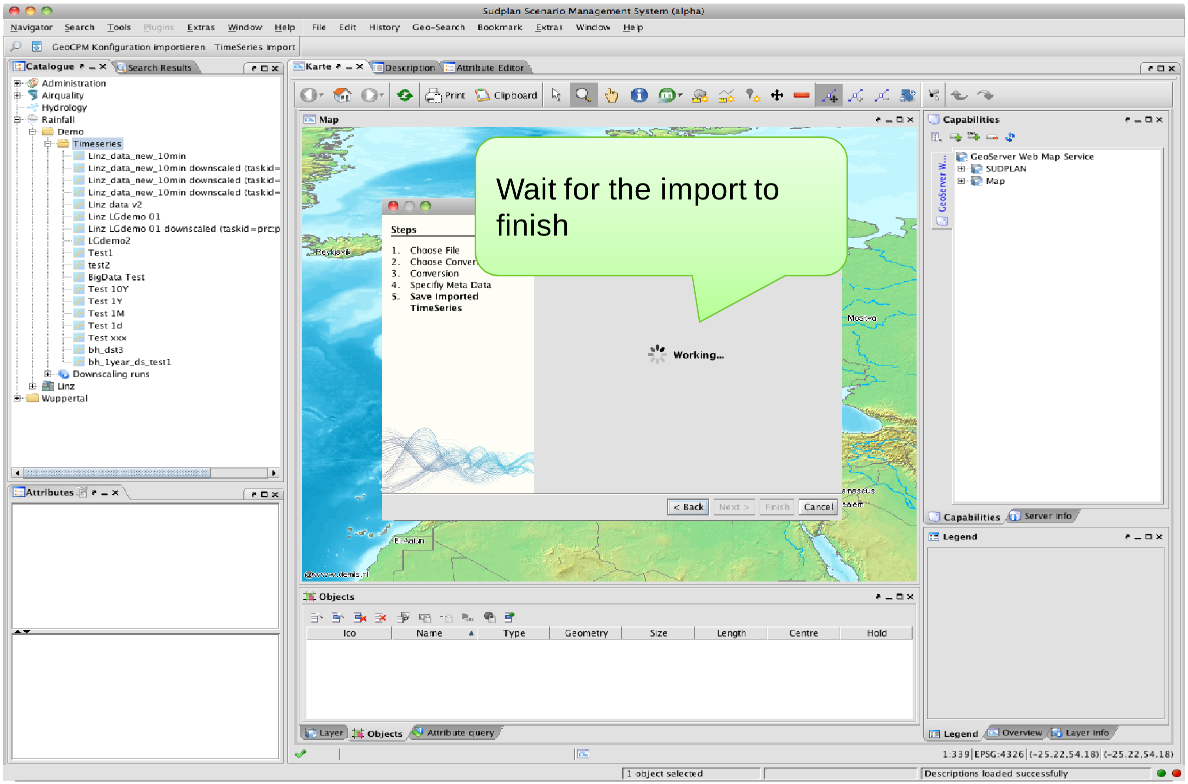


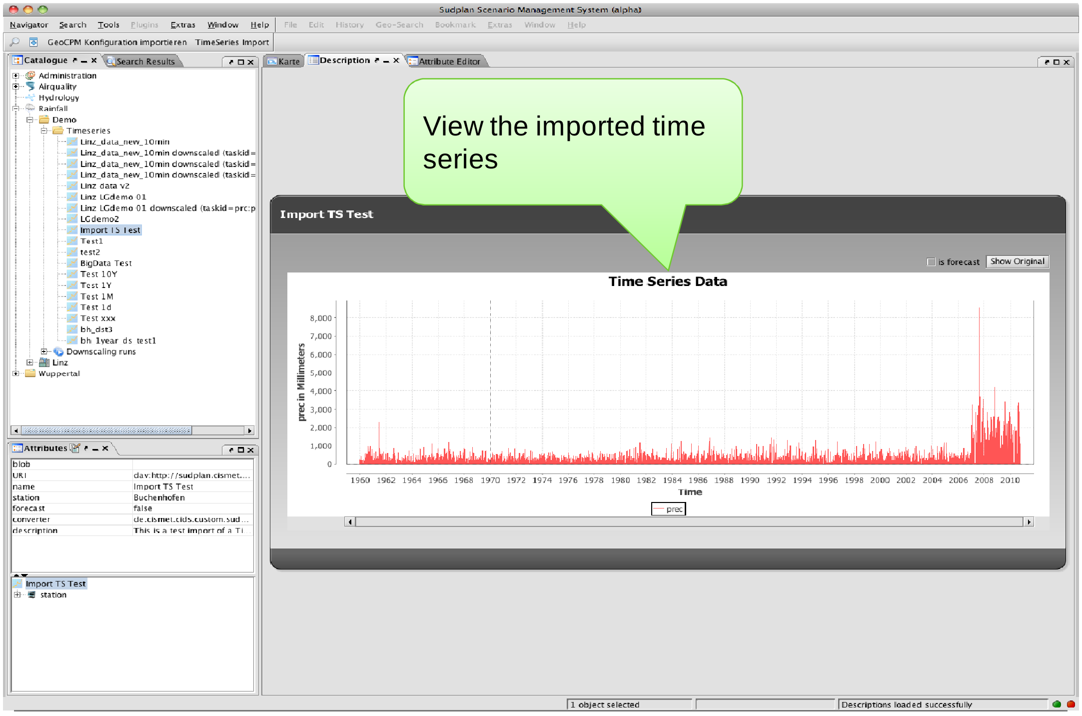


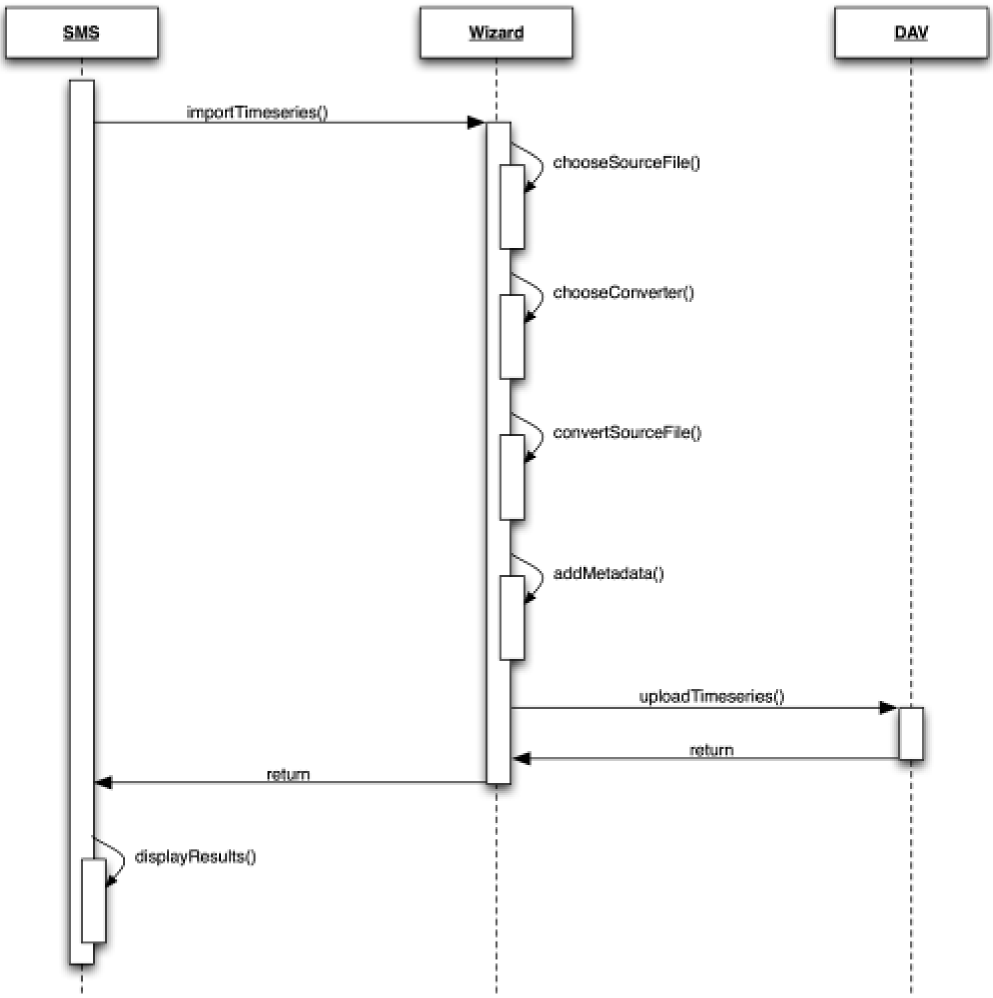

Sudplan Scenario Management System (alpha)
TimeSeries Import
Steps
1. Choose File
2. Choose Converter
3. Conversion
4. Specify Meta Data
5. Save Imported TimeSeries
Choose Converter
Wuppertal Converter
Please choose a converter
< Back
Next >
Finish
Cancel
Select a source file converter


Sudplan Scenario Management System (alpha)
Wait for the conversion to finish
Converting input file...
< Back
Next >
Finish
Cancel


Sudplan Scenario Management System (alpha)
Add metadata
Steps
1. Choose File
2. Choose Converter
3. Conversion
4. Specifiy Meta Data
5. Save Imported TimeSeries
Name
Import TS Test
Description
This is a test import of a Timeseries
Station
Buchenhofen
Forecast
Please press 'Next' for persisting your imported time series
< Back
Next >
Finish
Cancel

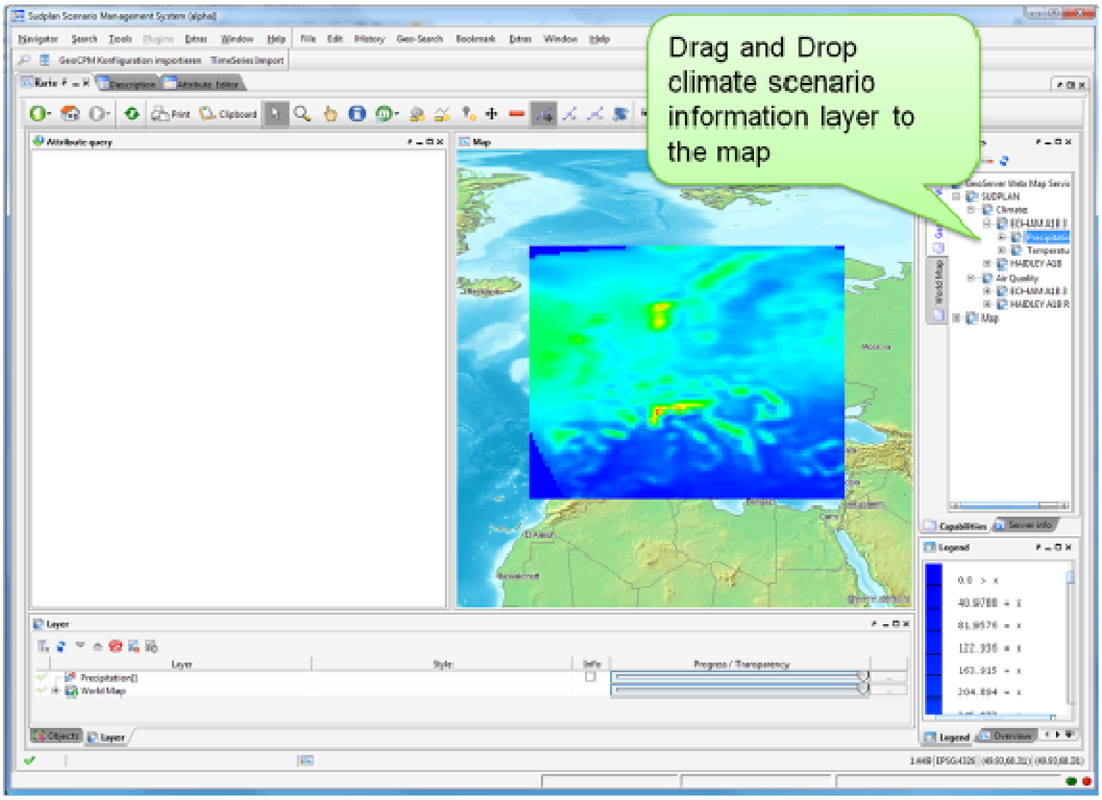

Sudplan Scenario Management System (alpha)
Wait for the import to finish
Steps
1. Choose File
2. Choose Conver
3. Conversion
4. Specifiy Meta Data
5. Save Imported TimeSeries
Working...
< Back
Next >
Finish
Cancel

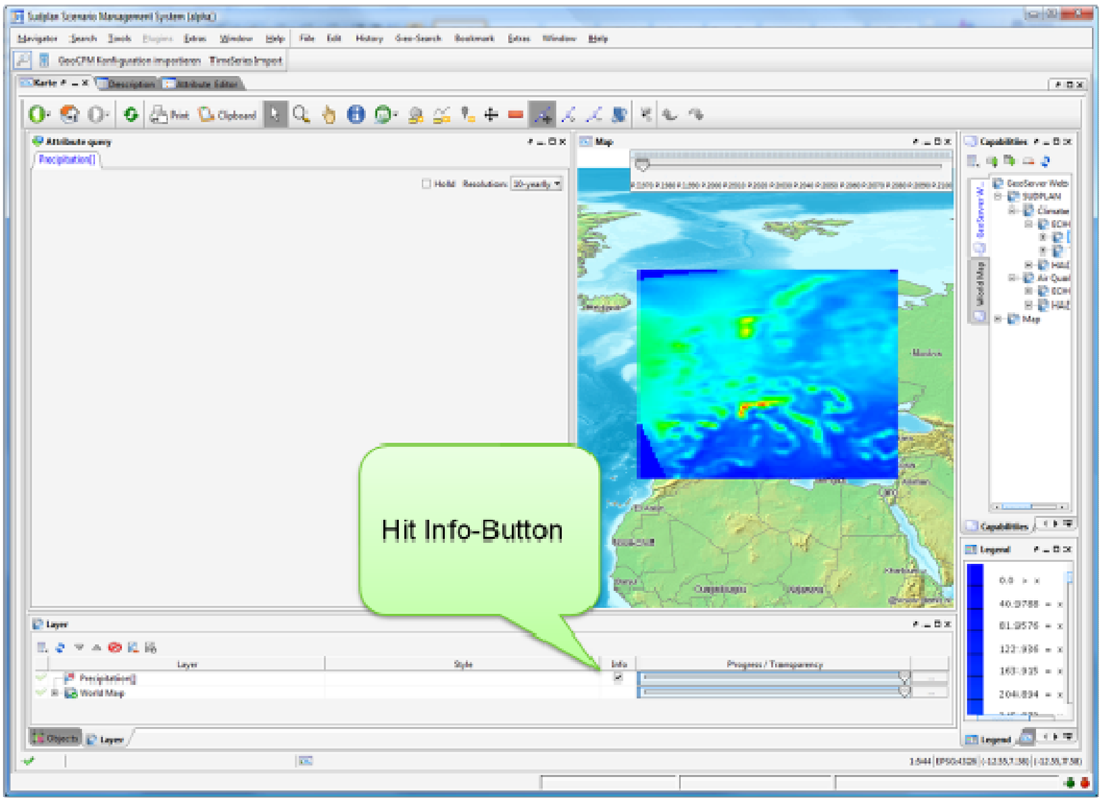

Sudplan Scenario Management System (alpha)
View the imported time series
Import TS Test
Time Series Data
prec in Millimeters
Time
prec

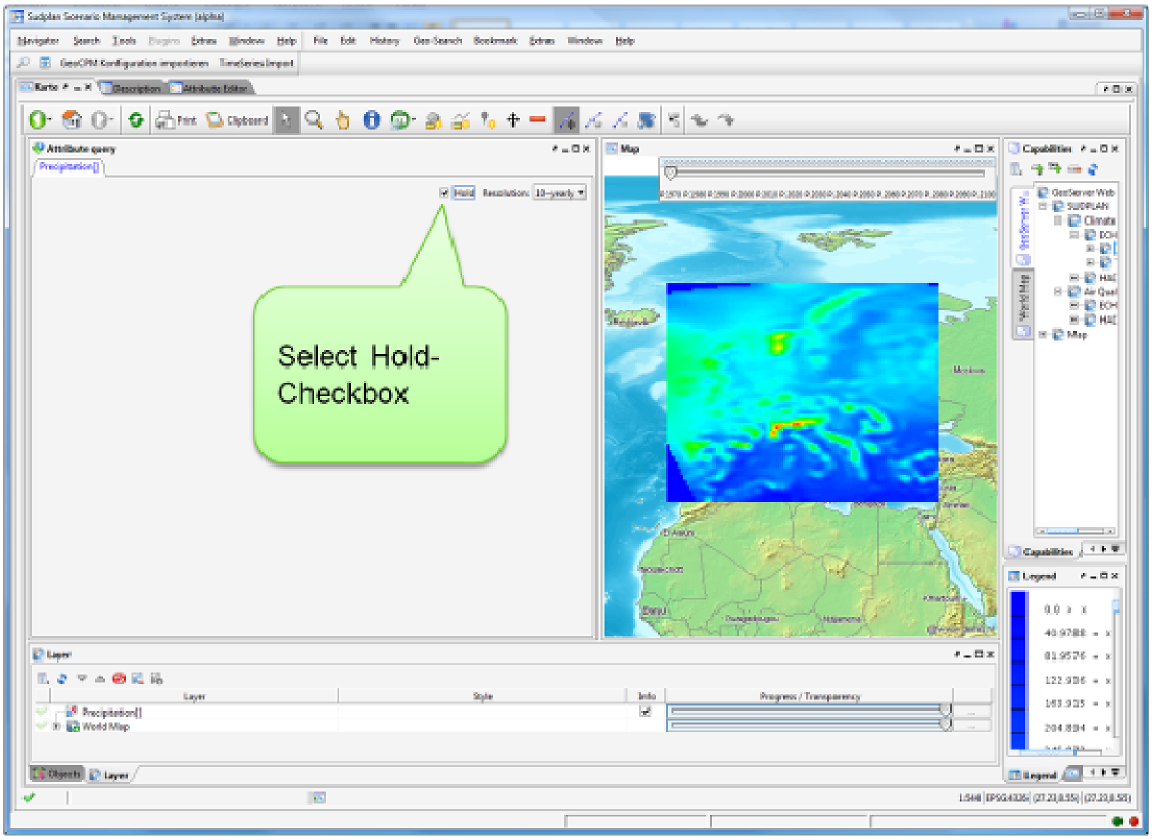

SMS
Wizard
DAV
importTimeseries()
chooseSourceFile()
chooseConverter()
convertSourceFile()
addMetadata()
uploadTimeseries()
return
return
displayResults()

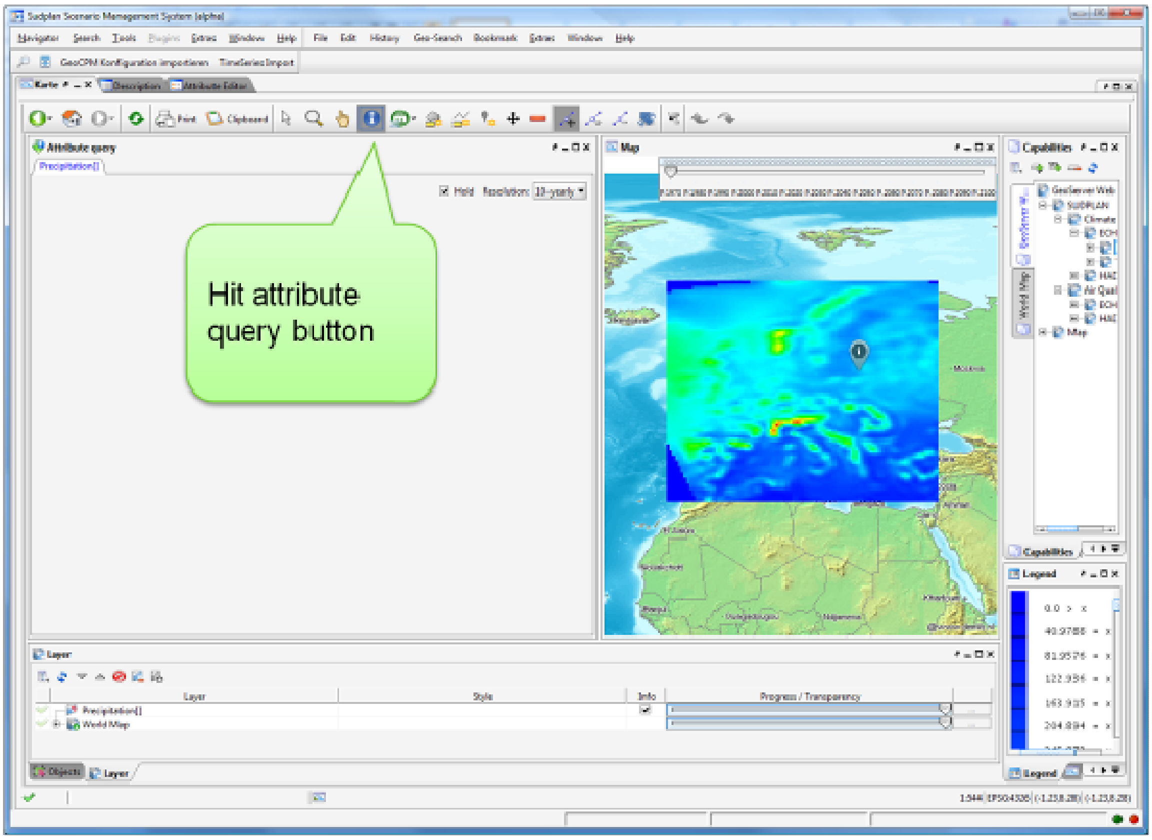
8.7. Time Series Visualisation & Comparison

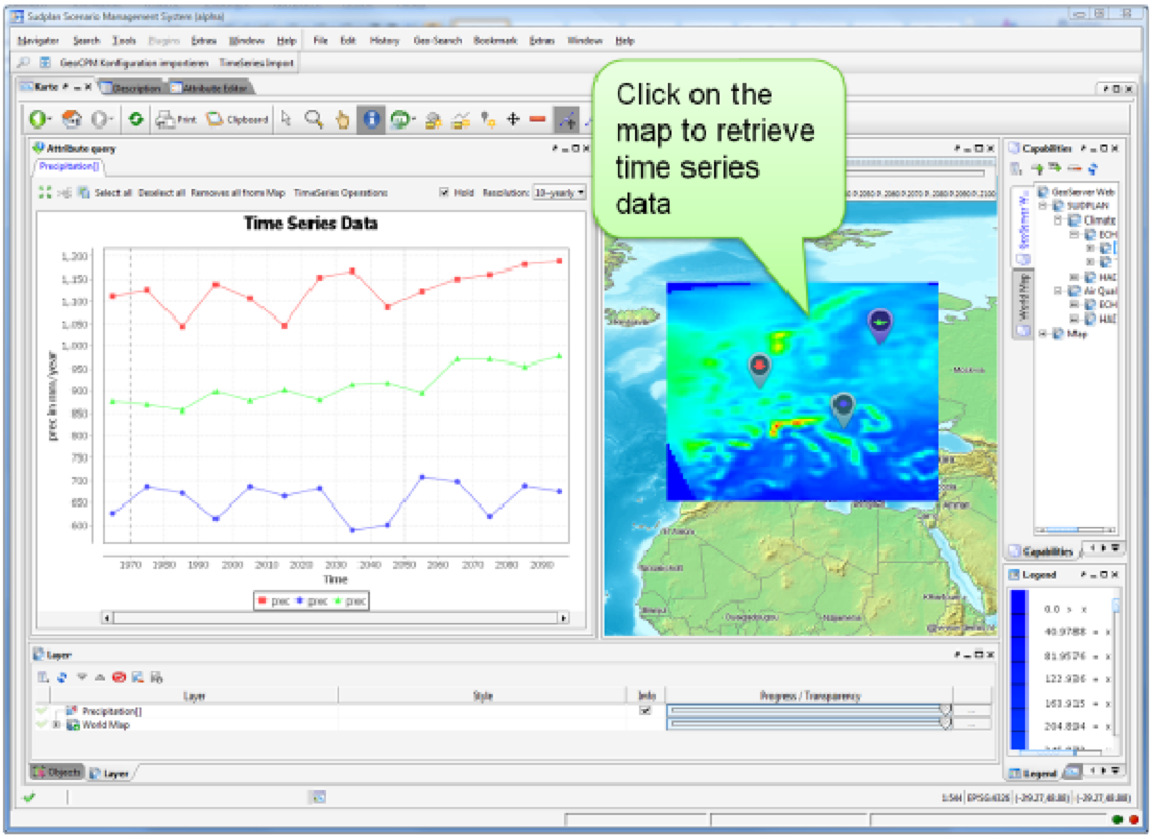
For a description of this validation use case please refer to *4.2.8- Time Series Visualisation & Comparison)*

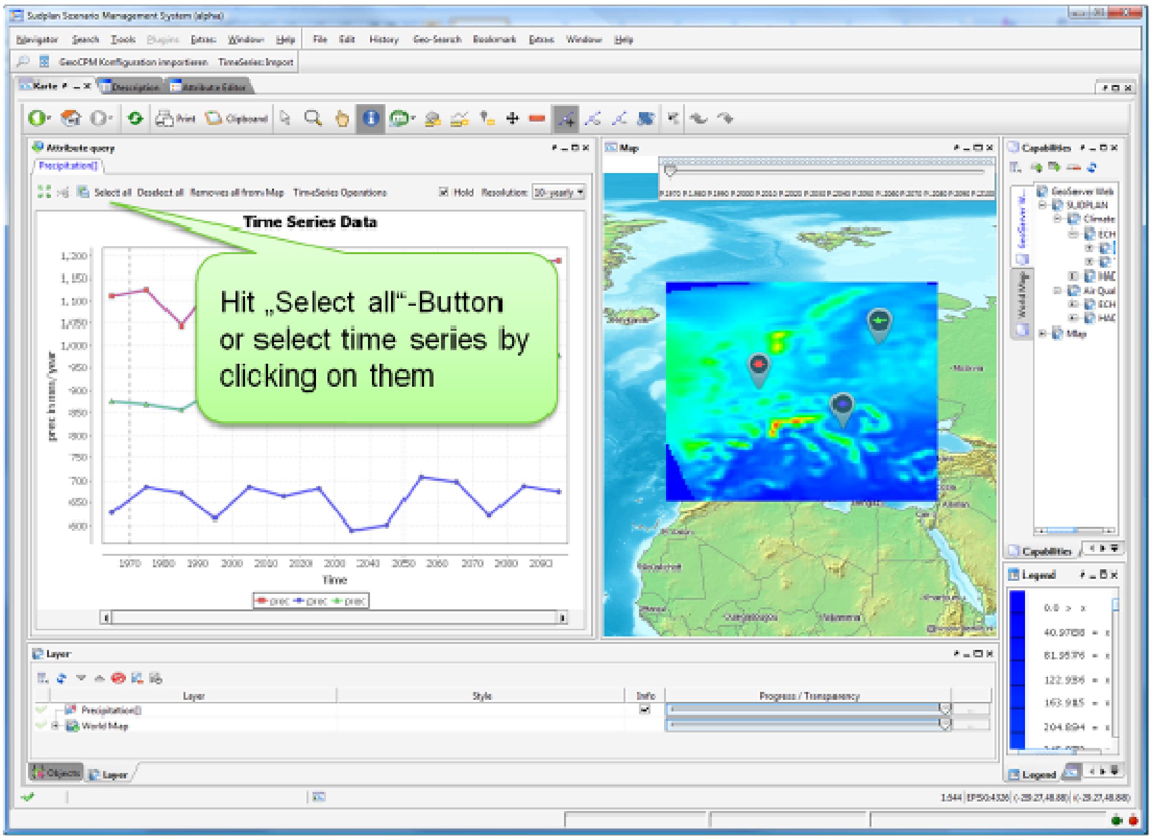


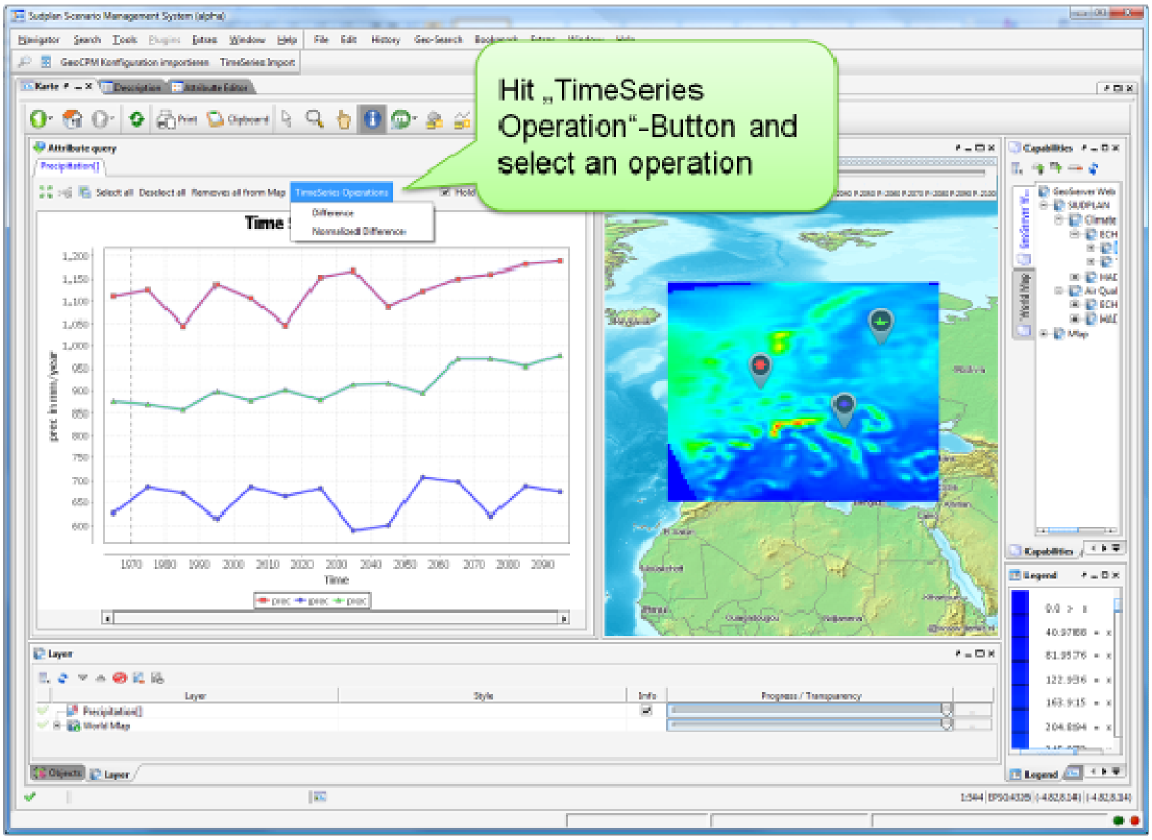


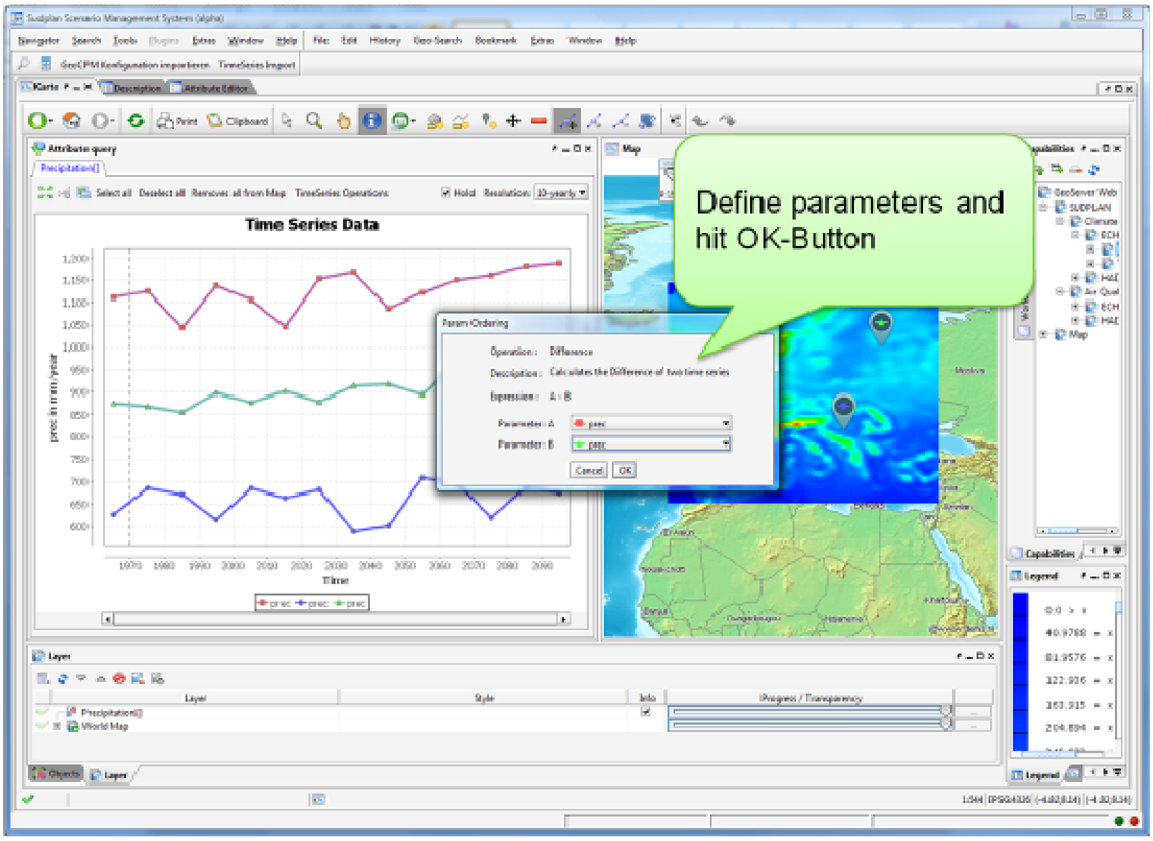

Select Hold-Checkbox

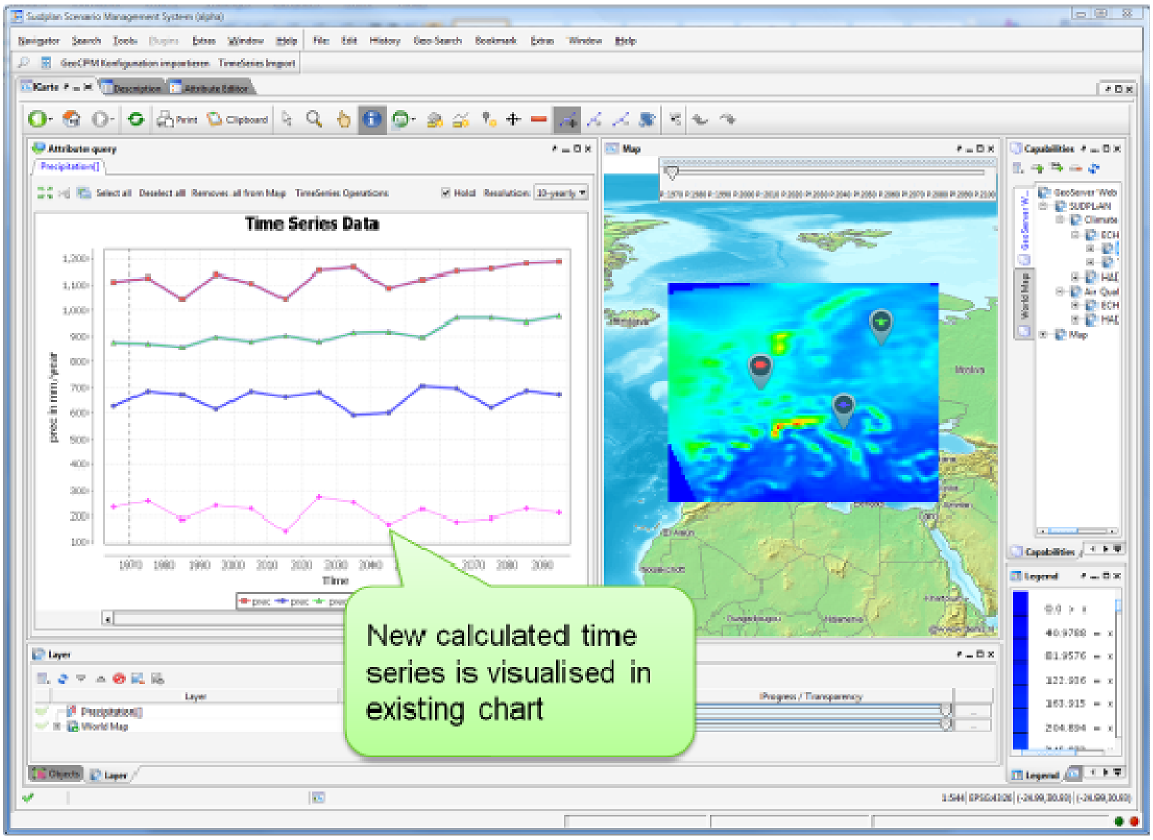

Hit attribute query button

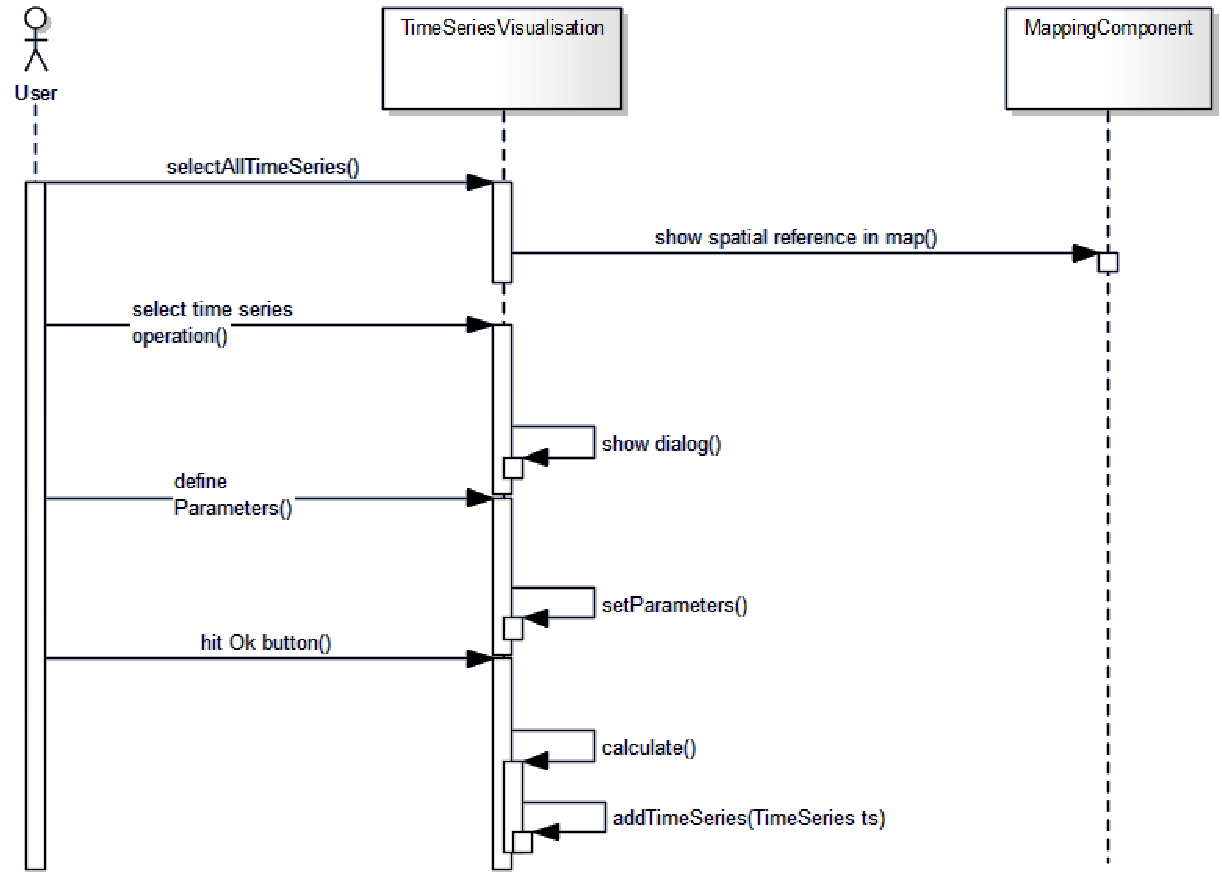

Click on the map to retrieve time series data
Time Series Data

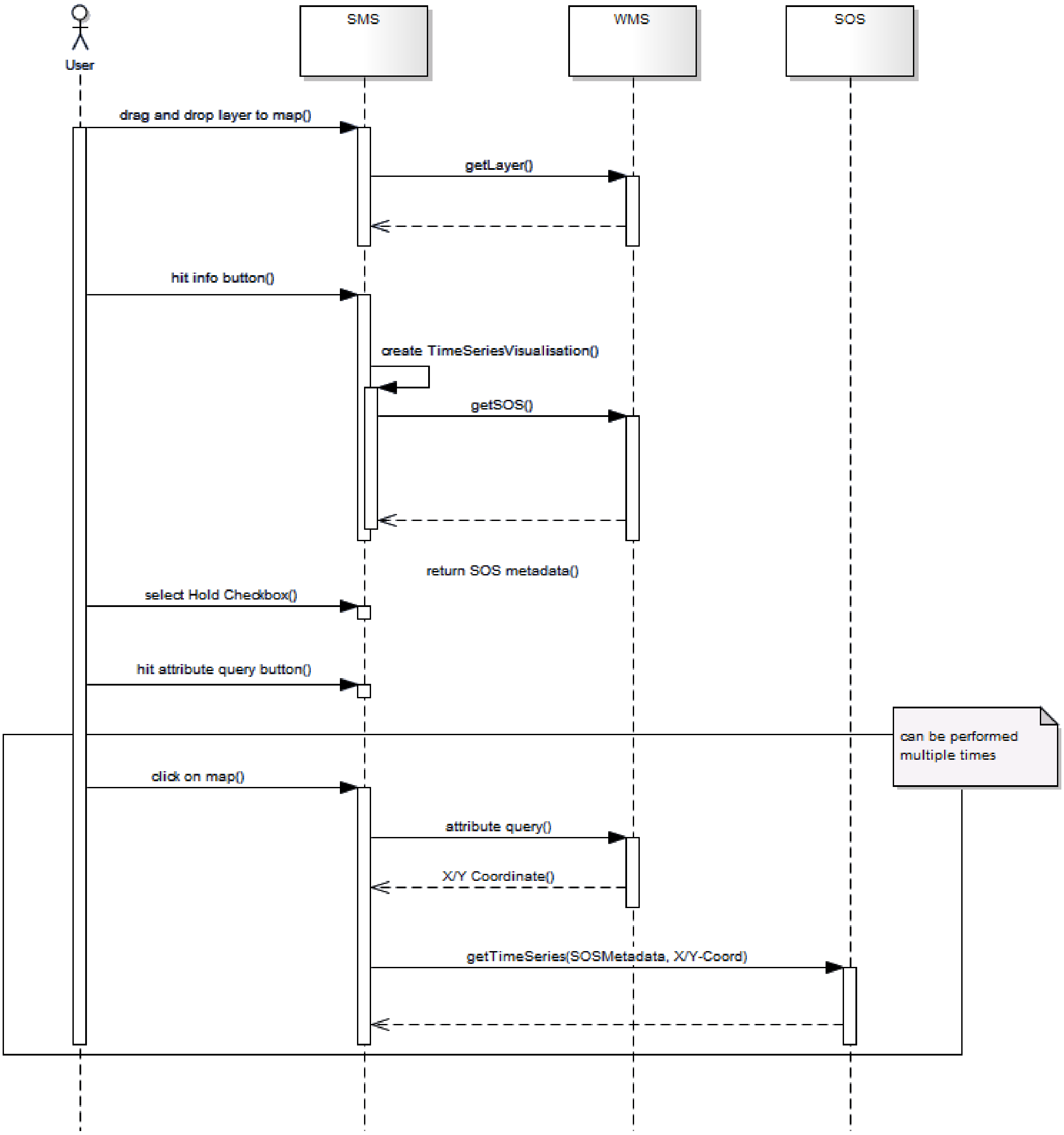

Hit „Select all"-Button or select time series by clicking on them
Time Series Data


Hit „TimeSeries Operation"-Button and select an operation


Define parameters and hit OK-Button

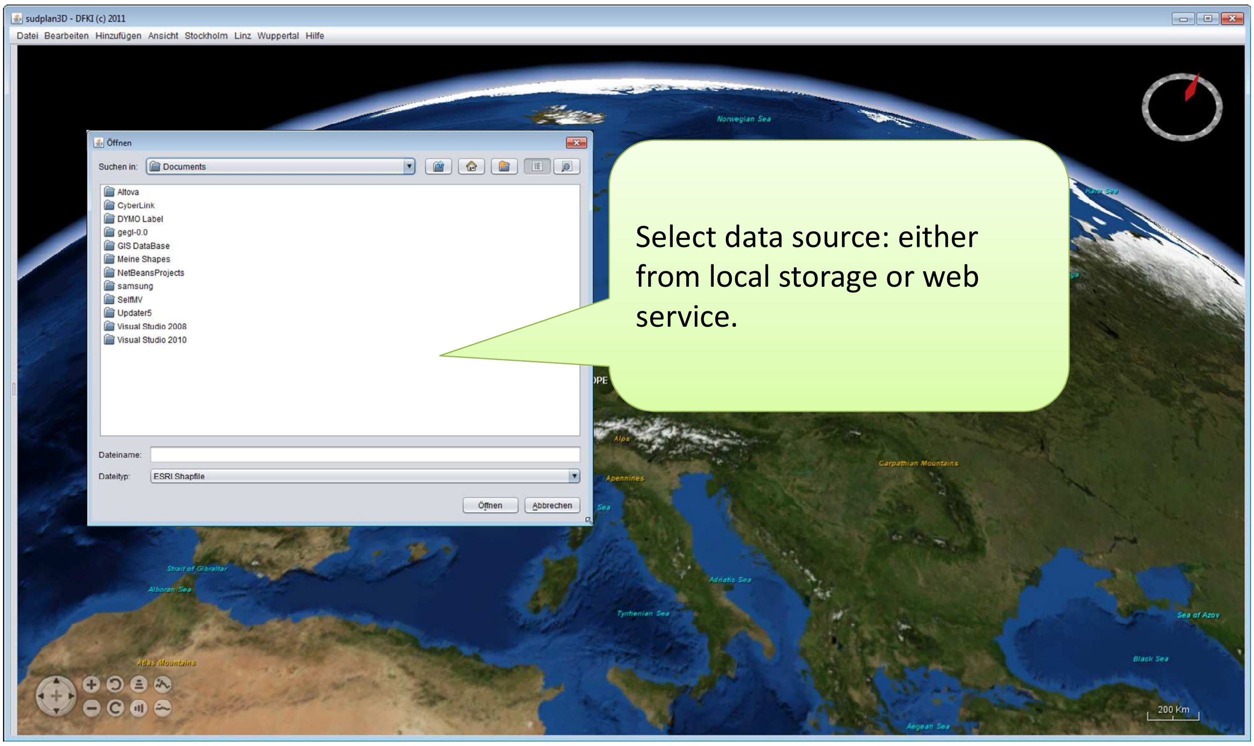

Time Series Data
New calculated time series is visualised in existing chart

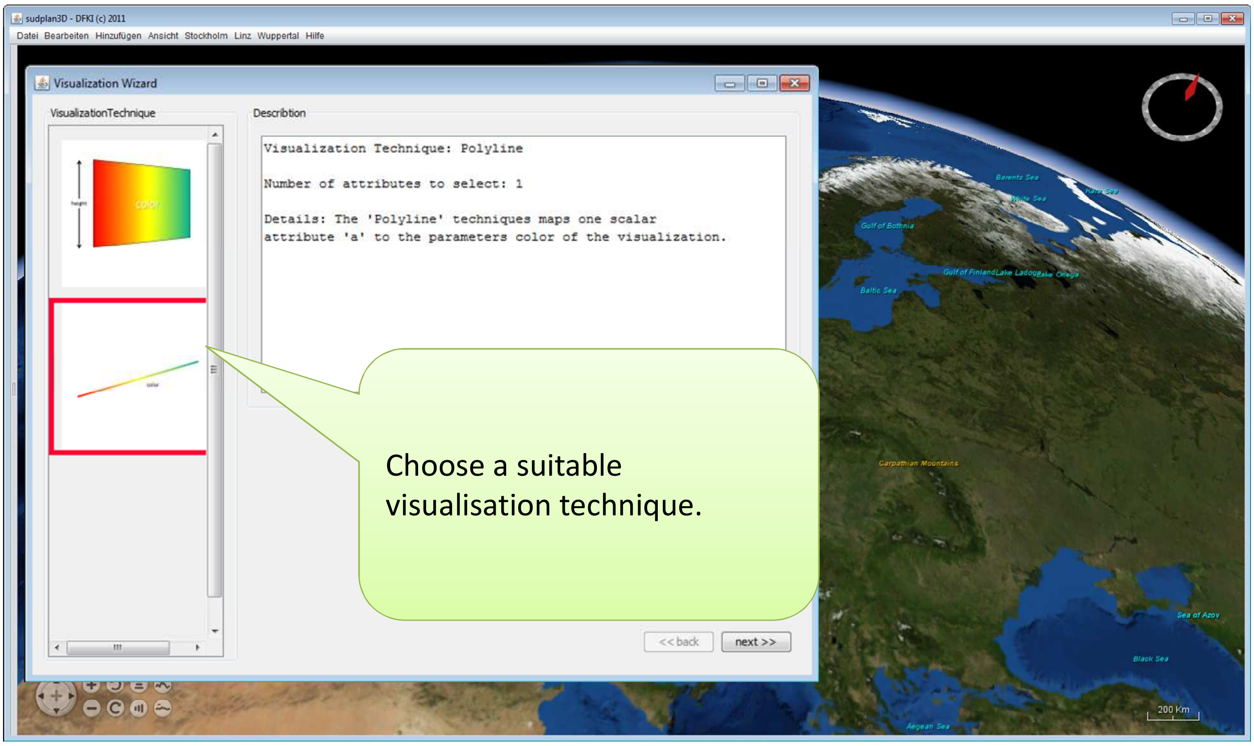

User
TimeSeriesVisualisation
MappingComponent
selectAllTimeSeries()
show spatial reference in map()
select time series operation()
show dialog()
define Parameters()
setParameters()
hit Ok button()
calculate()
addTimeSeries(TimeSeries ts)

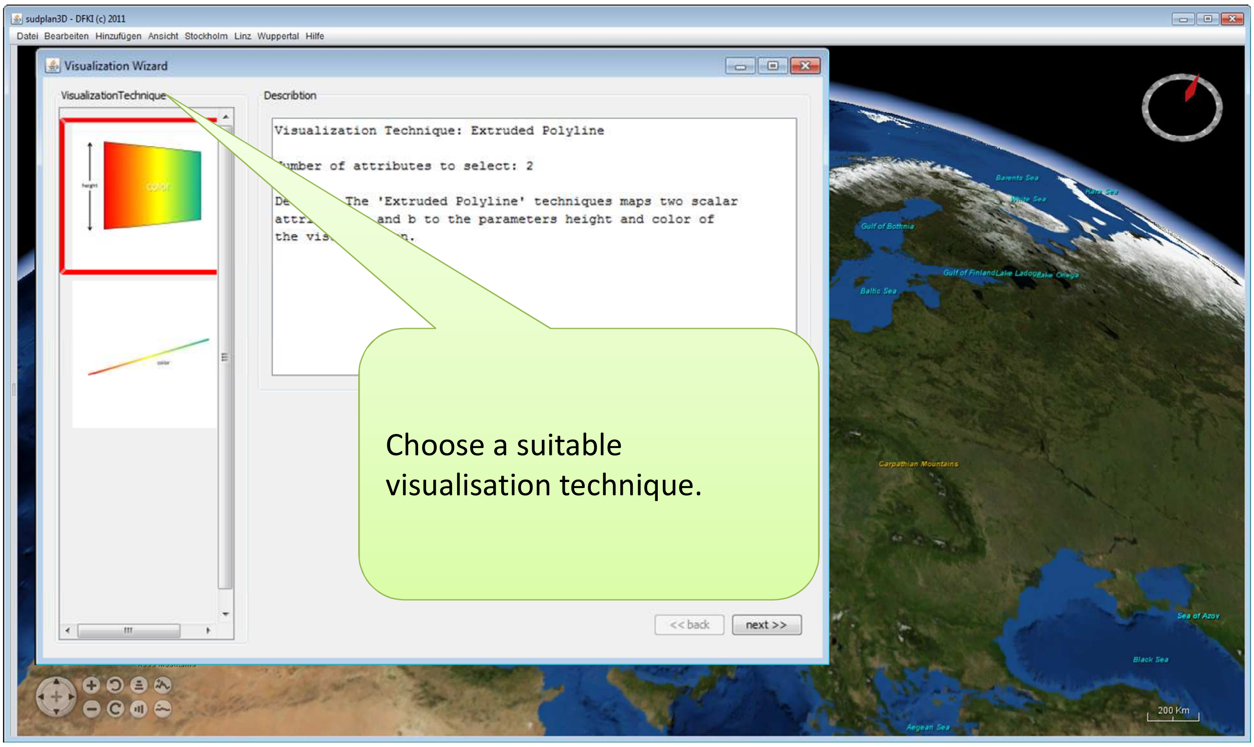

User
SMS
WMS
SOS
drag and drop layer to map()
getLayer()
hit info button()
create TimeSeriesVisualisation()
getSOS()
return SOS metadata()
select Hold Checkbox()
hit attribute query button()
can be performed multiple times
click on map()
attribute query()
X/Y Coordinate()
getTimeSeries(SOSMetadata, X/Y-Coord)

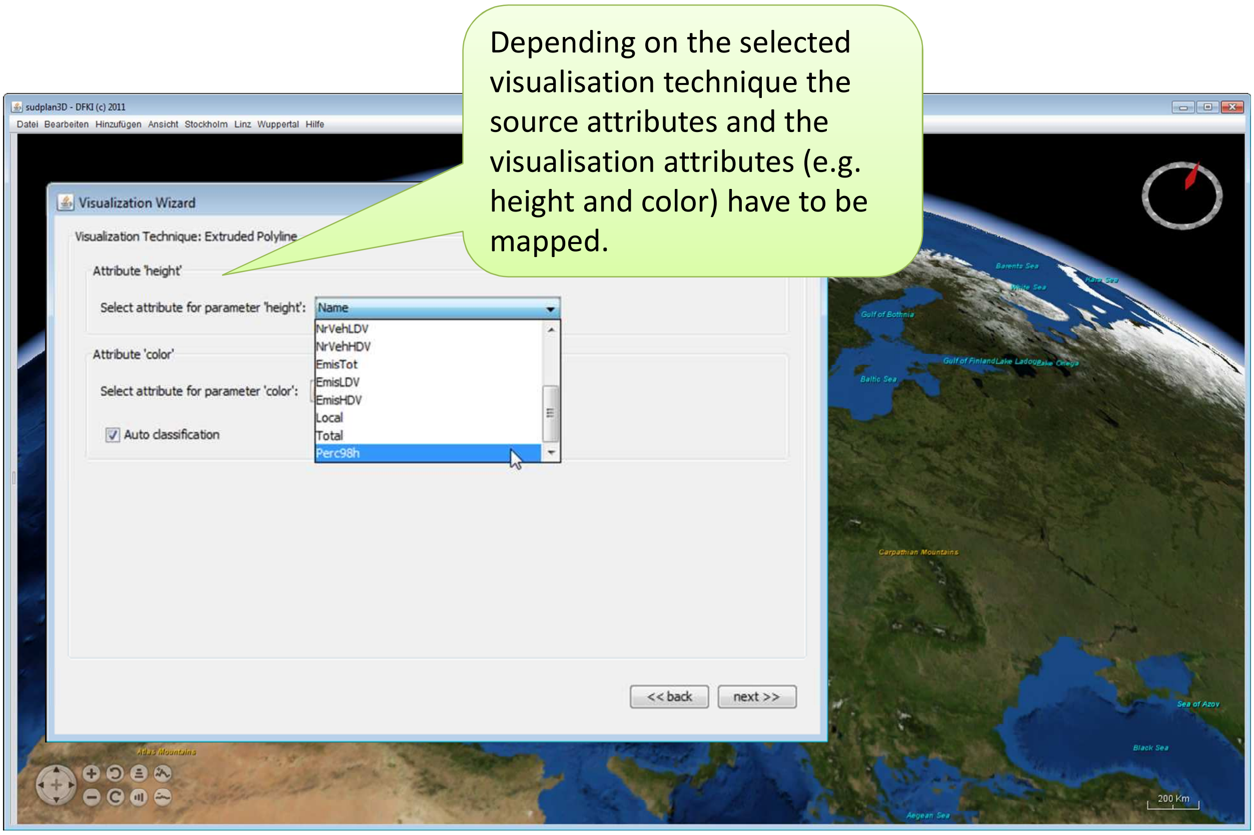
8.8. 3-D Visualisation Wizard

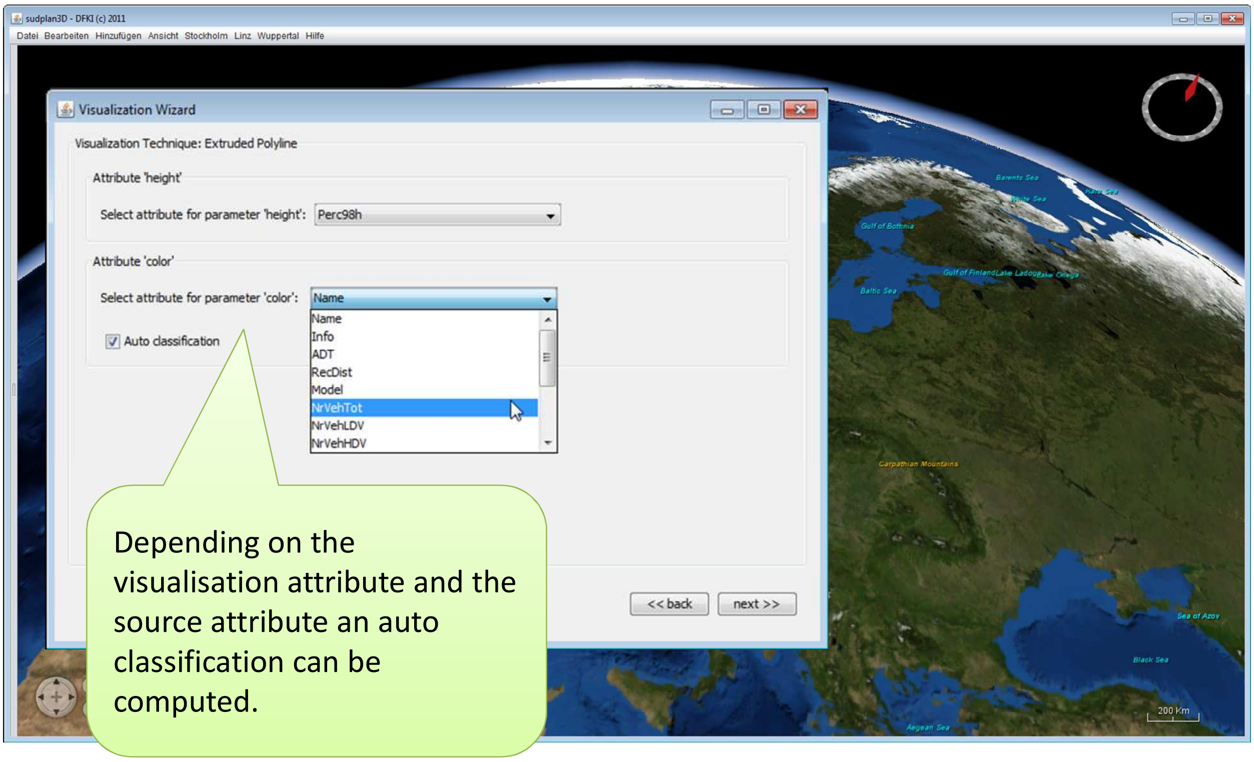
For a description of this use case please refer to *4.2.9 - Execute the 3-D Visualisation Wizard*.

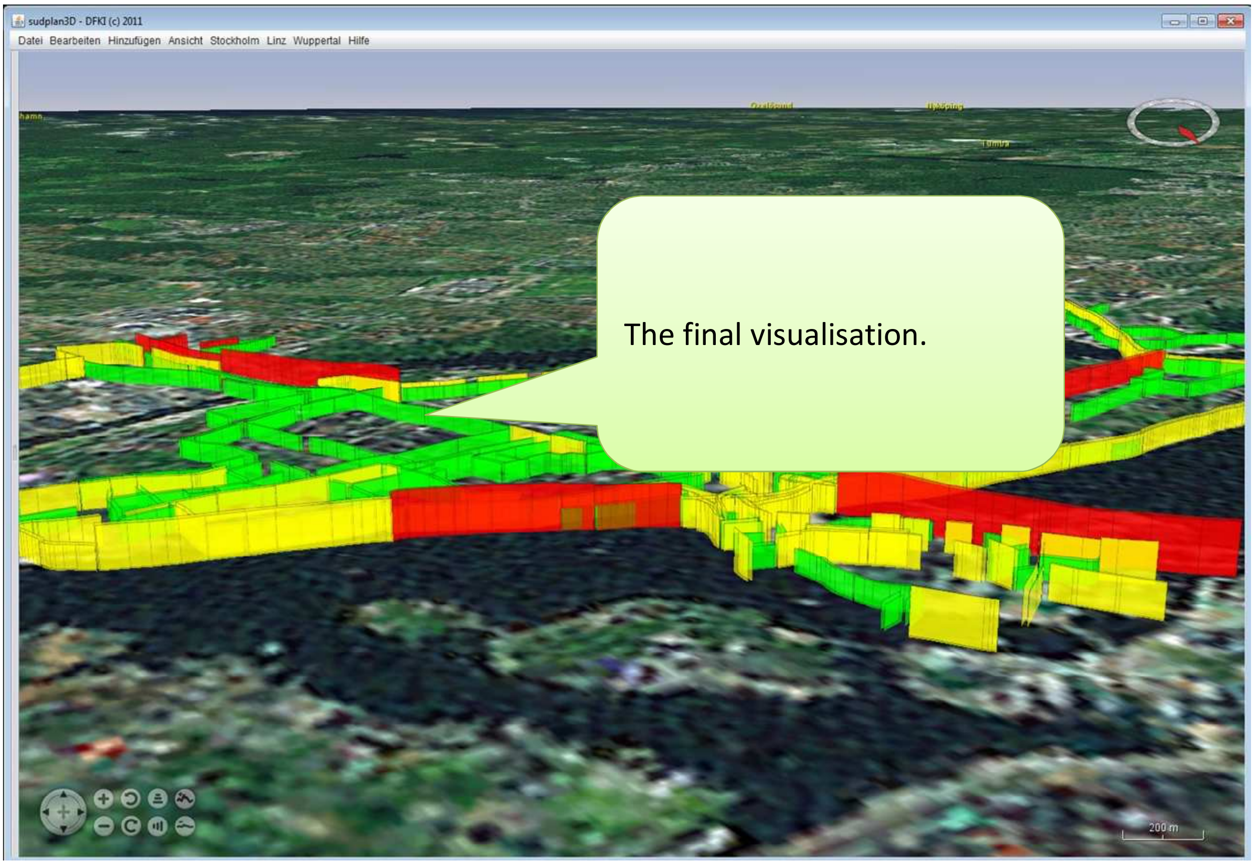





sudplan3D - DFKI (c) 2011
Datei Bearbeiten Hinzufügen Ansicht Stockholm Linz Wuppertal Hilfe
Visualization Wizard
VisualizationTechnique
Description
Visualization Technique: Extruded Polyline
Choose a suitable visualisation technique.
<< back
next >>
200 Km

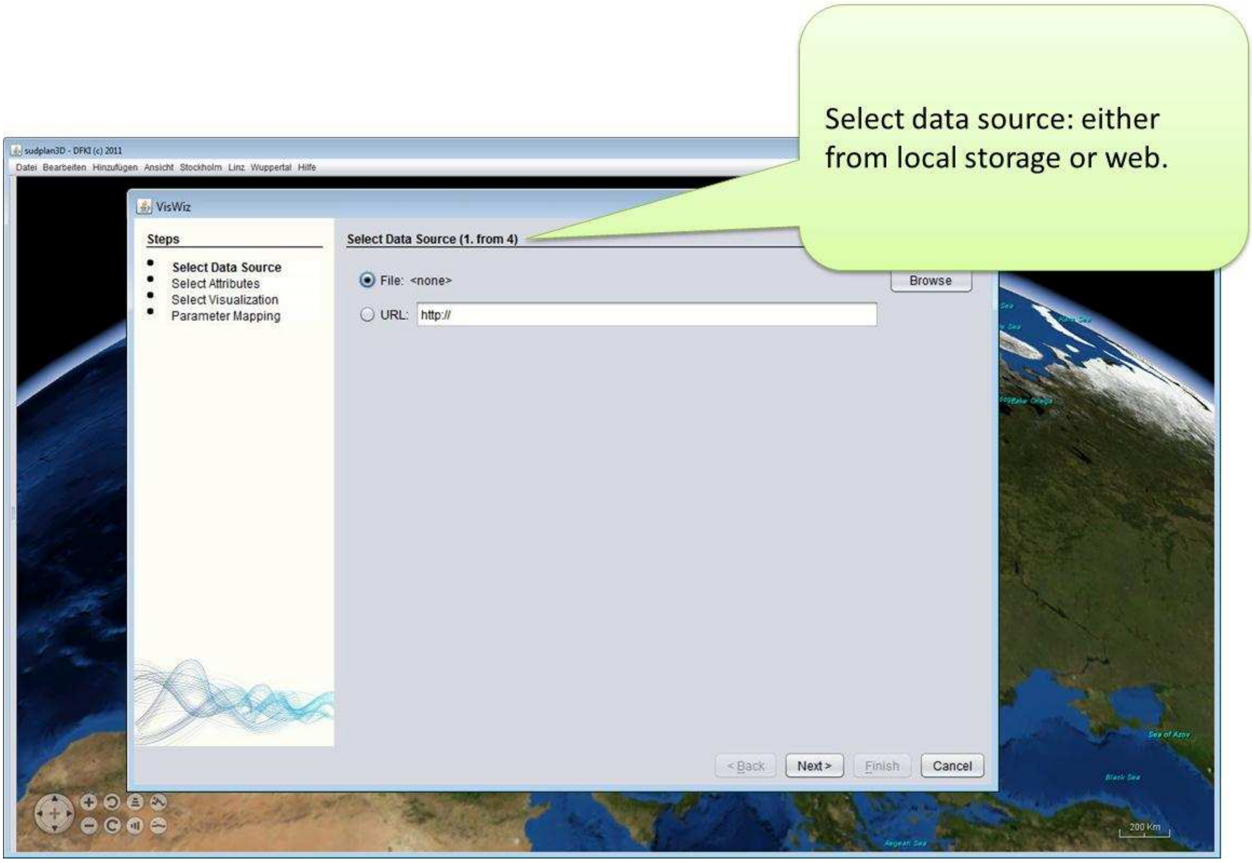

Depending on the selected visualisation technique the source attributes and the visualisation attributes (e.g. height and color) have to be mapped.
sudplan3D - DFKI (c) 2011
Datei Bearbeiten Hinzufügen Ansicht Stockholm Linz Wuppertal Hilfe
Visualization Wizard
Visualization Technique: Extruded Polyline
Attribute 'height'
Select attribute for parameter 'height':
Name
NrVehLDV
NrVehHDV
EmisTot
EmisLDV
EmisHDV
Local
Total
Perc98h
Attribute 'color'
Select attribute for parameter 'color':
Auto classification
<< back
next >>
200 Km

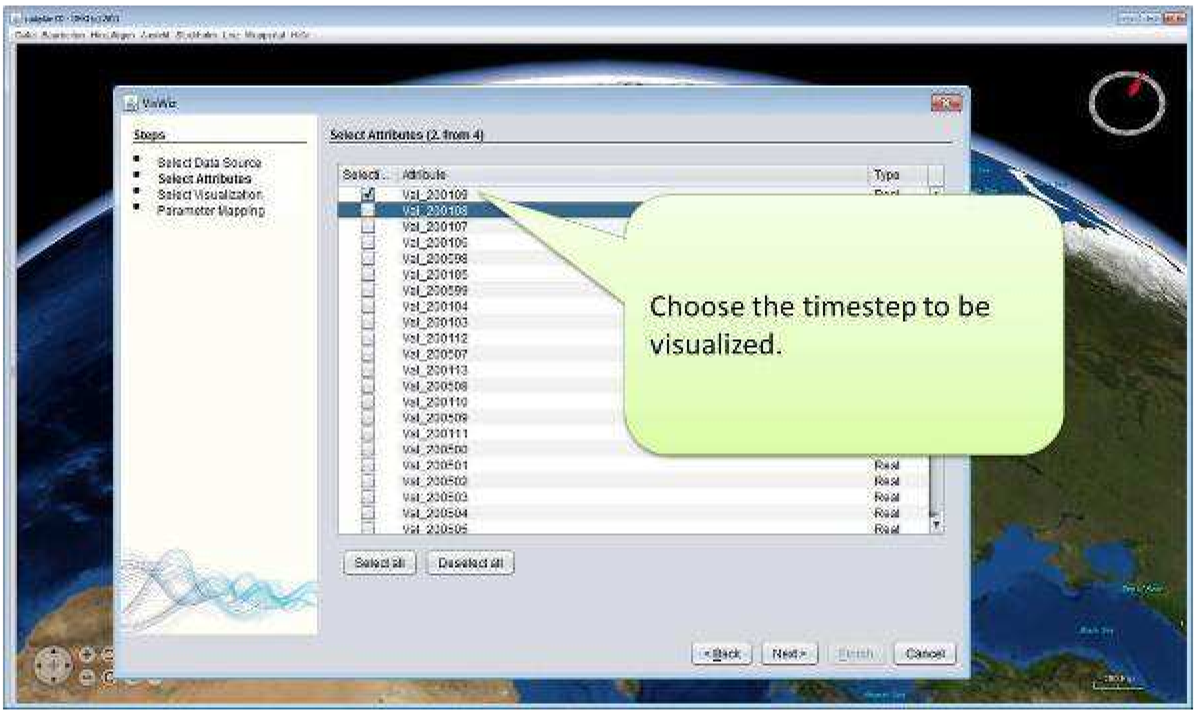

sudplan3D - DFKI (c) 2011
Datei Bearbeiten Hinzufügen Ansicht Stockholm Linz Wuppertal Hilfe
Visualization Wizard
Visualization Technique: Extruded Polyline
Attribute 'height'
Select attribute for parameter 'height': Perc98h
Attribute 'color'
Select attribute for parameter 'color': Name
Name
Info
ADT
RecDist
Model
NrVehTot
NrVehLDV
NrVehHDV
Auto classification
<< back
next >>
Depending on the visualisation attribute and the source attribute an auto classification can be computed.

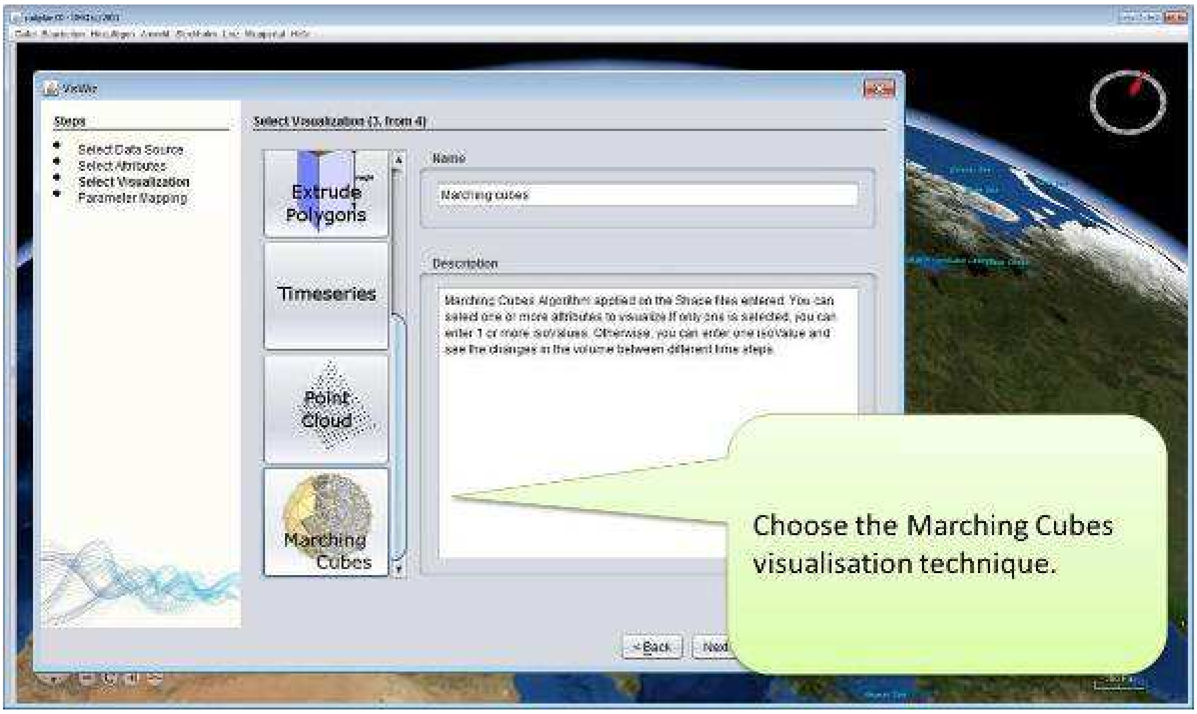

sudplan3D - DFKI (c) 2011
Datei Bearbeiten Hinzufügen Ansicht Stockholm Linz Wuppertal Hilfe
The final visualisation.

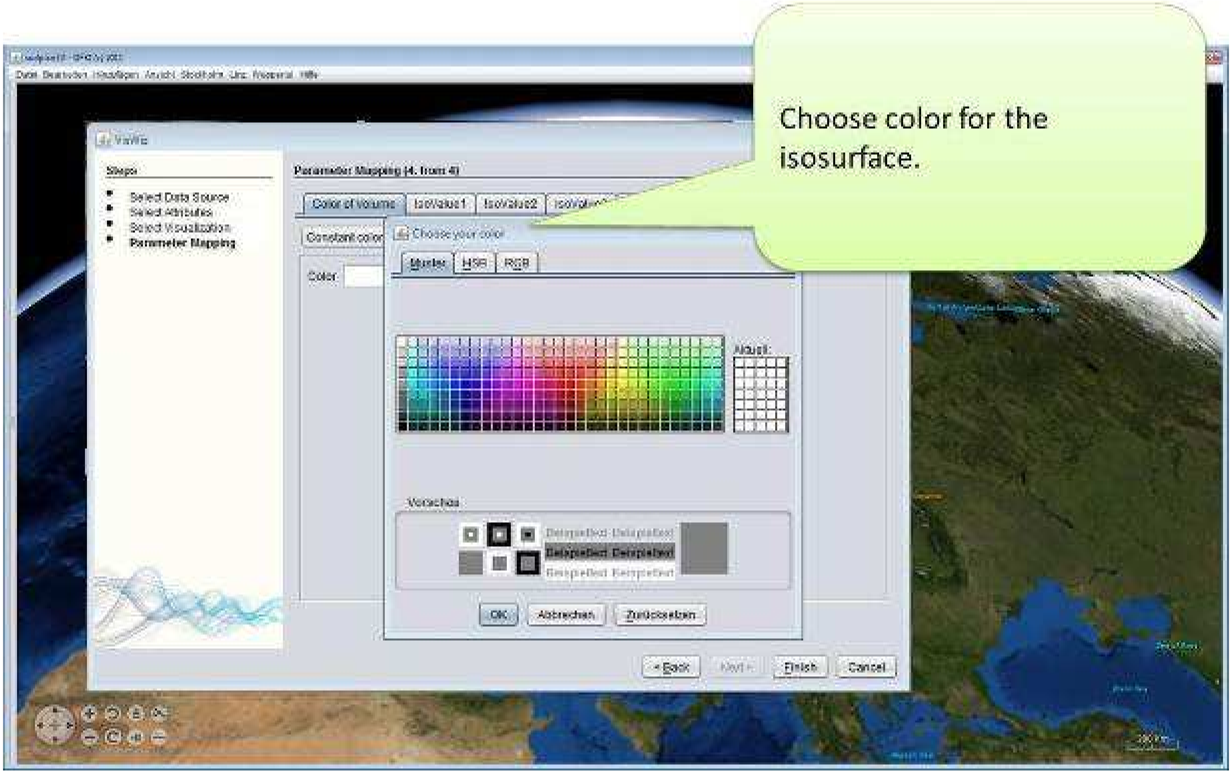
8.9. Visualization of 3-D air quality data using iso-surfaces

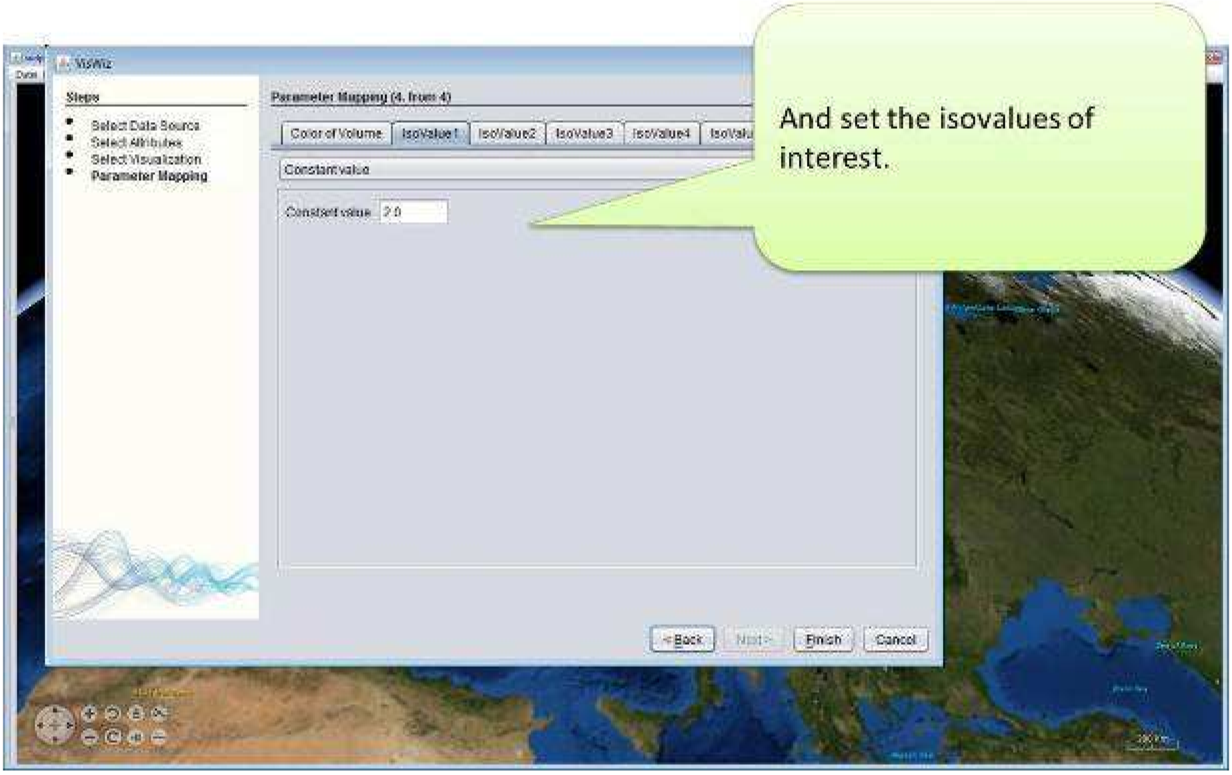
For a description of this use case please refer to *4.2.10 – Visualization of 3-D air quality data using iso-surfaces*.

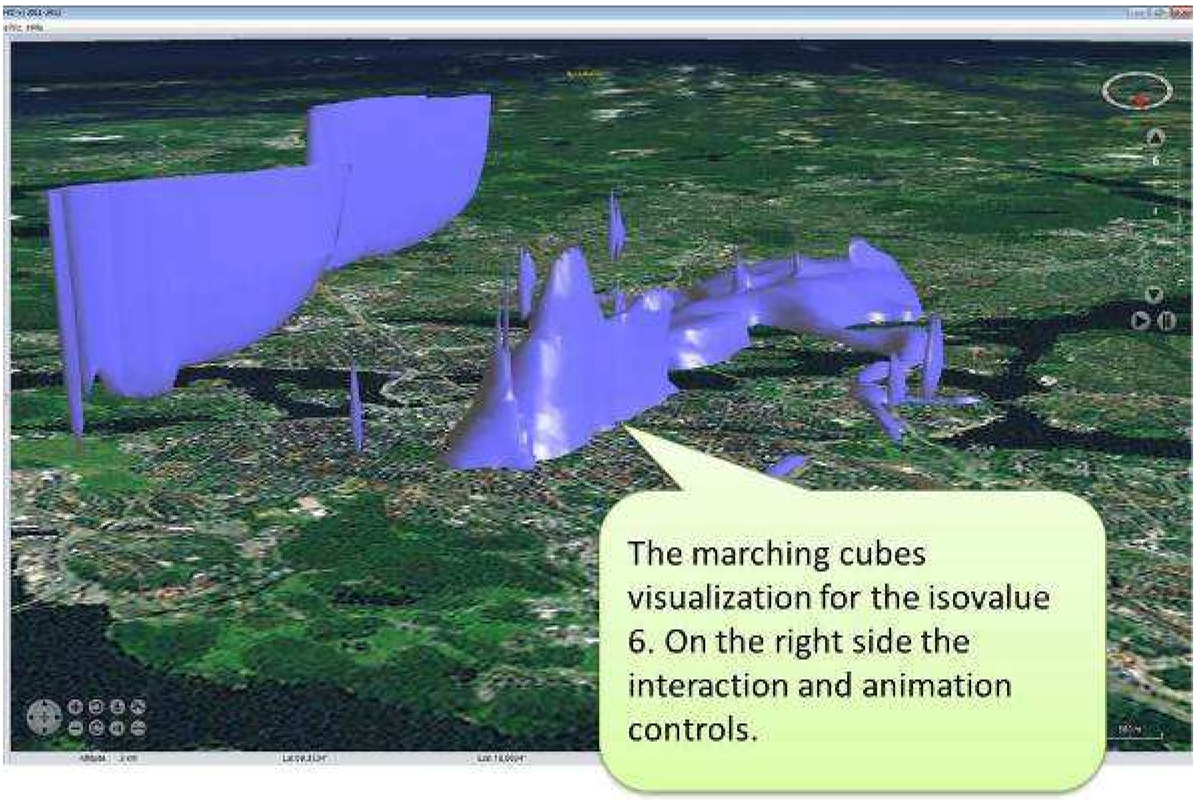


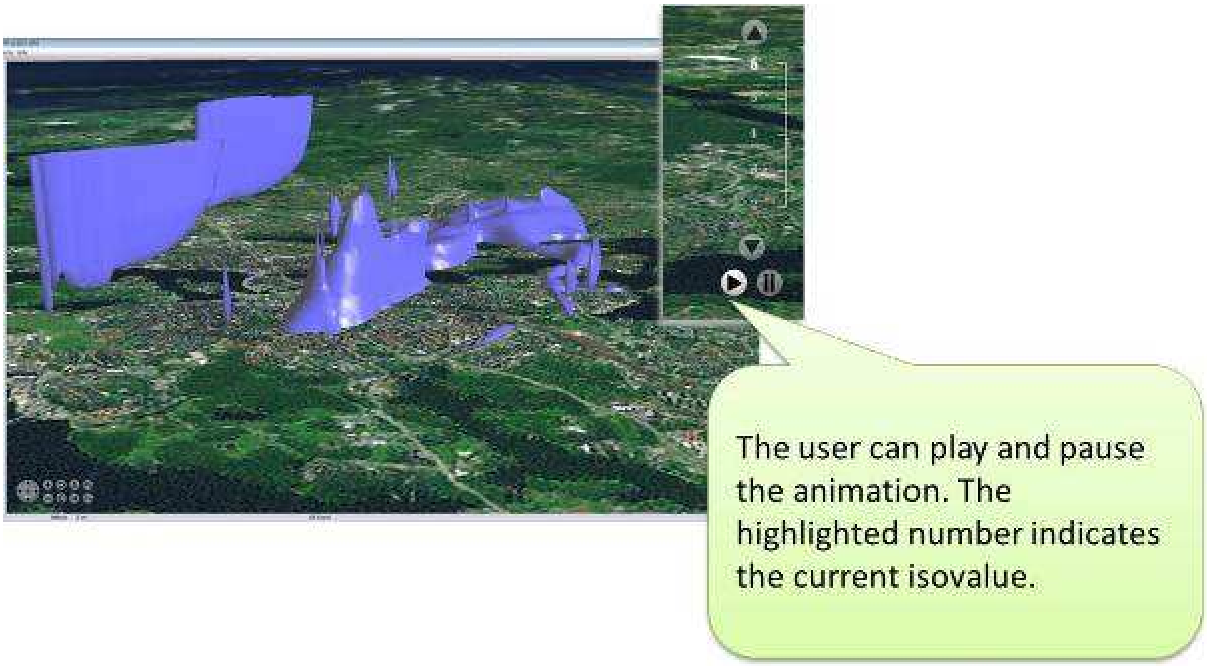



Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Select Visualization (3. from 4)
Extrude Polygons
Timeseries
Point Cloud
Marching Cubes
Name
Marching cubes
Description
Choose the Marching Cubes visualisation technique.


Choose color for the isosurface.
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Parameter Mapping (4. from 4)
Color of Volume
IsoValue1
IsoValue2
Choose your color
OK
Abbrechen
Zurücksetzen
< Back
Finish
Cancel

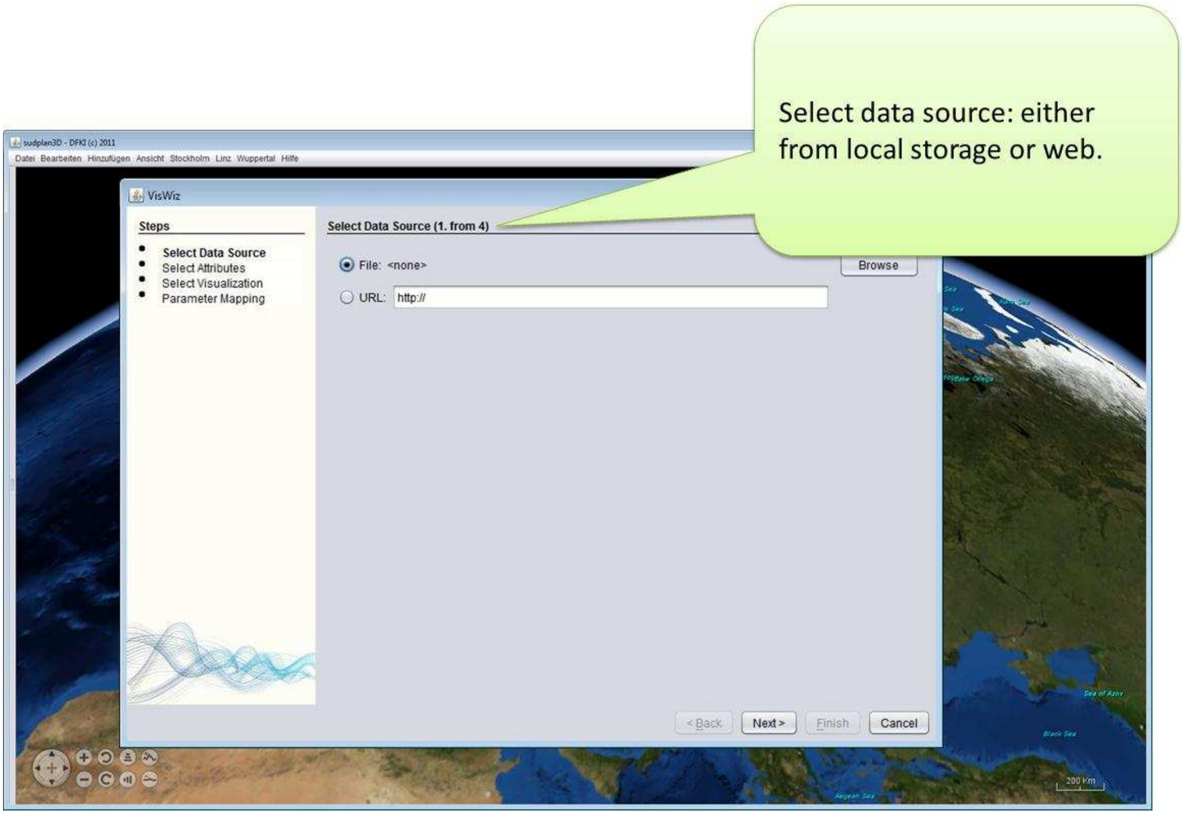

Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Parameter Mapping (4. from 4)
Color of Volume
IsoValue1
IsoValue2
IsoValue3
IsoValue4
Constant value
Constant value 2.0
< Back
Next >
Finish
Cancel
And set the isovalues of interest.


The marching cubes visualization for the isovalue 6. On the right side the interaction and animation controls.

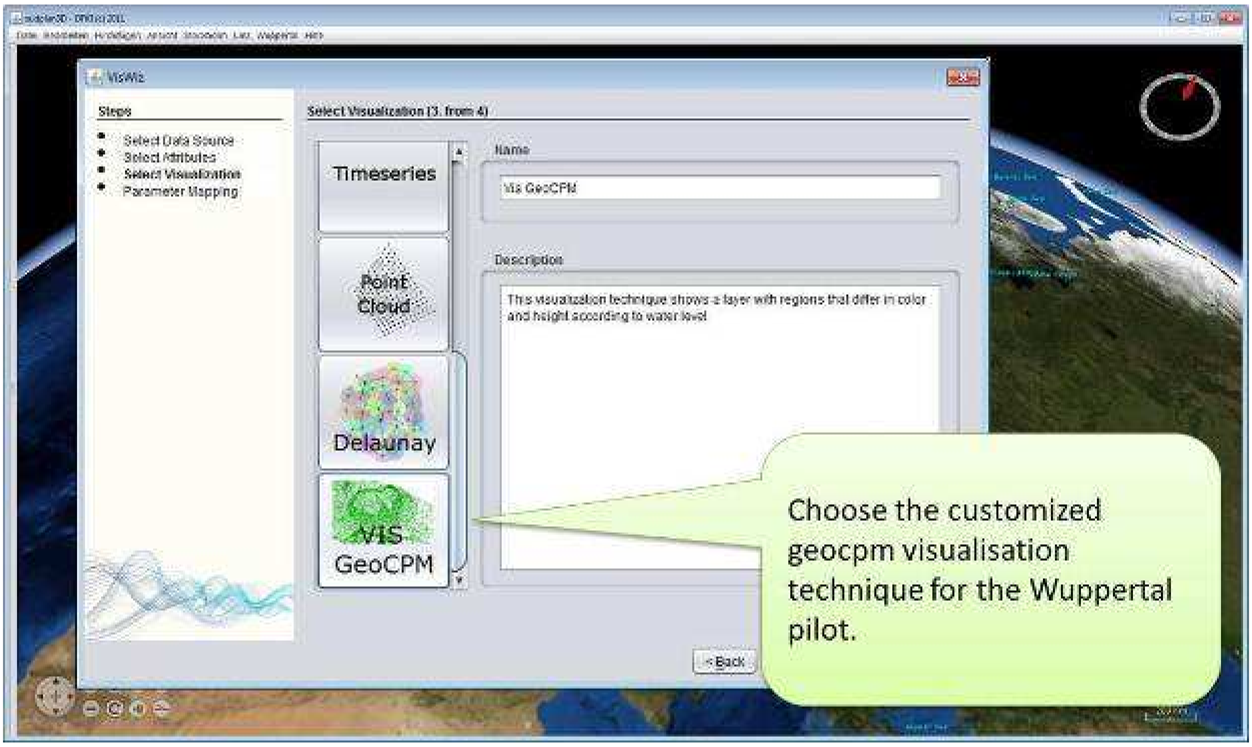


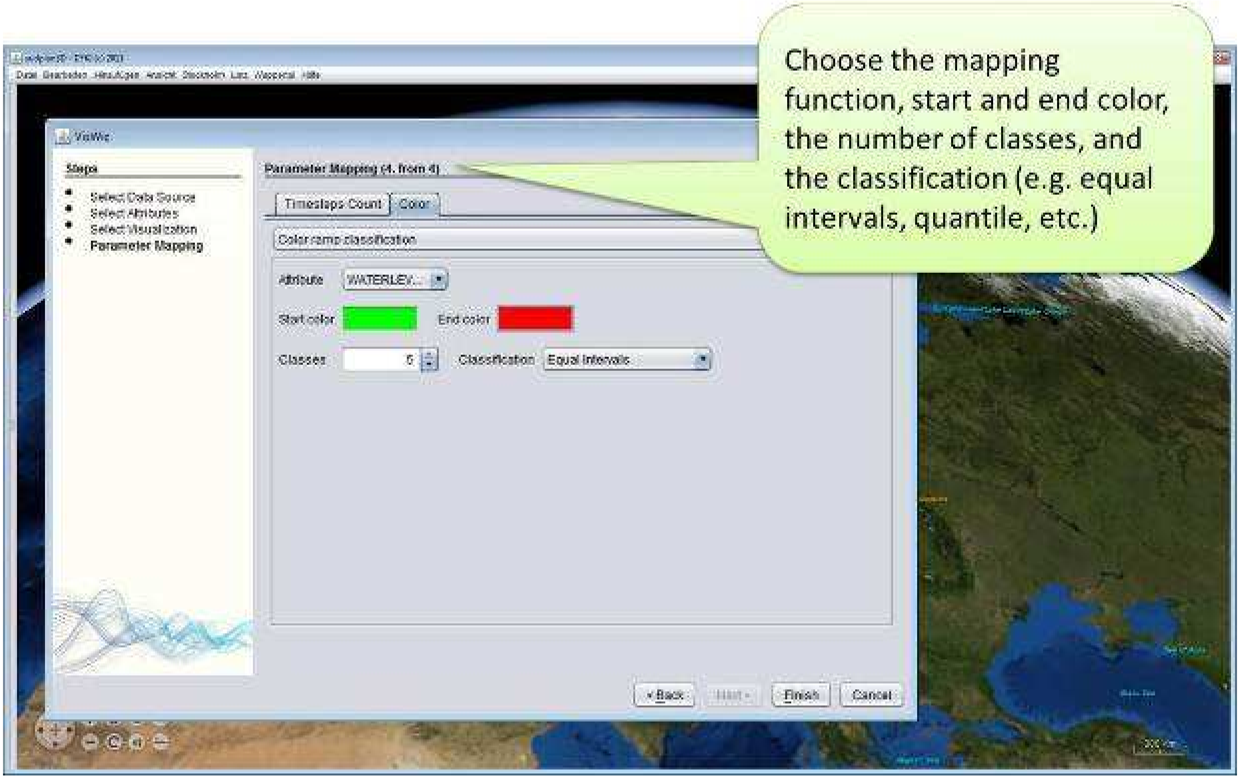
8.10. 3-D Animation of "Water-run off" simulation results

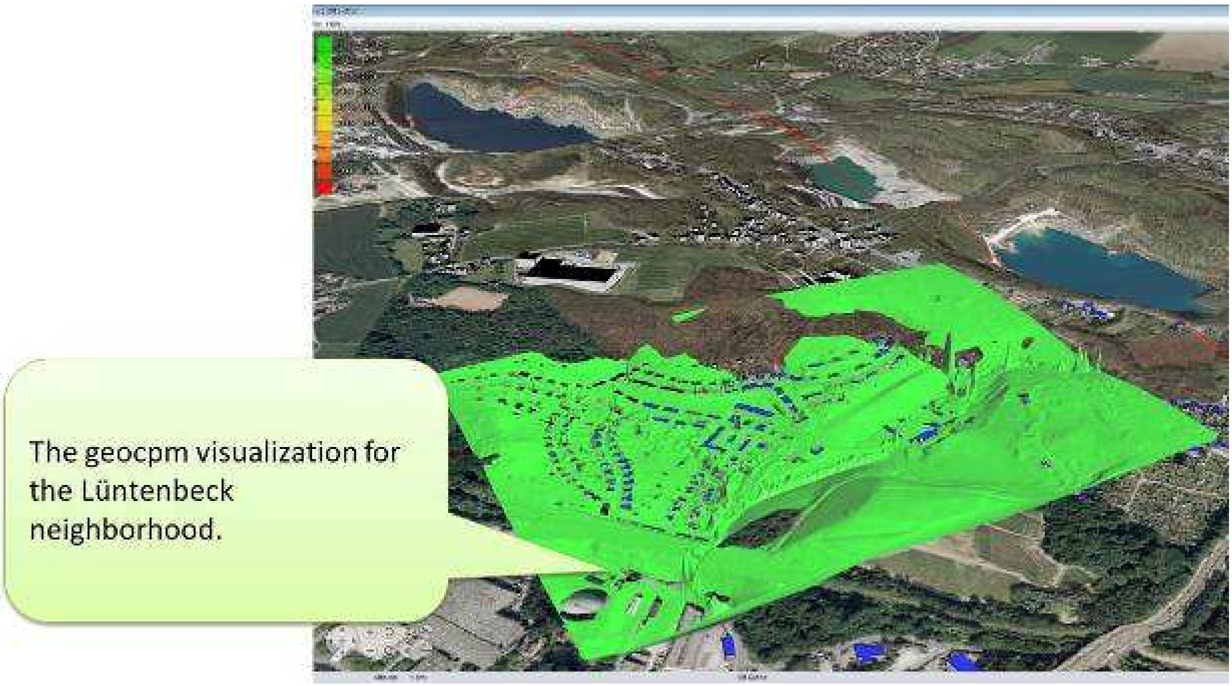
For a description of this use case please refer to 4.2.11 – 3-D Animation of "Water-run off" simulation results.

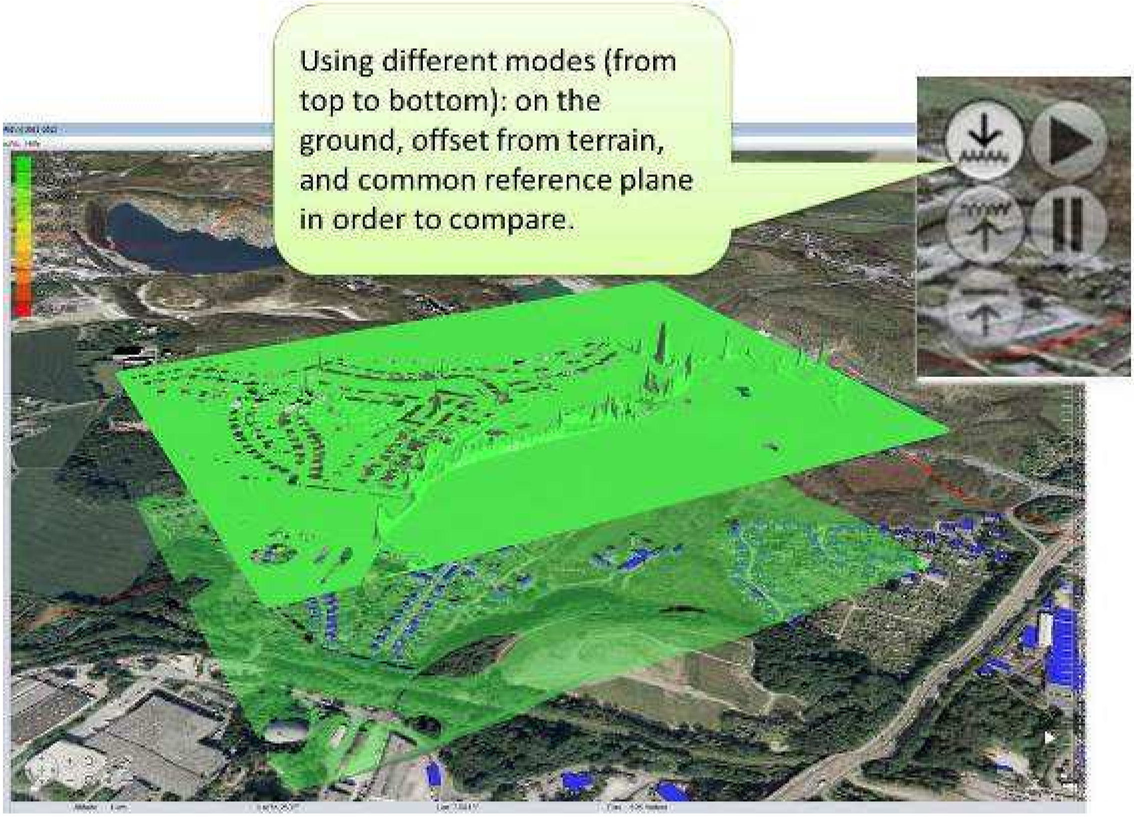



Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Choose the waterlevel attribute.


Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Timeseries
Point Cloud
Delaunay
VIS GeoCPM
Name
Description
This visualization technique shows a layer with regions that differ in color and height according to water level
Choose the customized geocpm visualisation technique for the Wuppertal pilot.


Choose the mapping function, start and end color, the number of classes, and the classification (e.g. equal intervals, quantile, etc.)
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Parameter Mapping (4. from 4)
Timesteps Count
Color
Color ramp classification
Attribute
WATERLEV...
Start color
End color
Classes
5
Classification
Equal intervals
< Back
Next >
Finish
Cancel

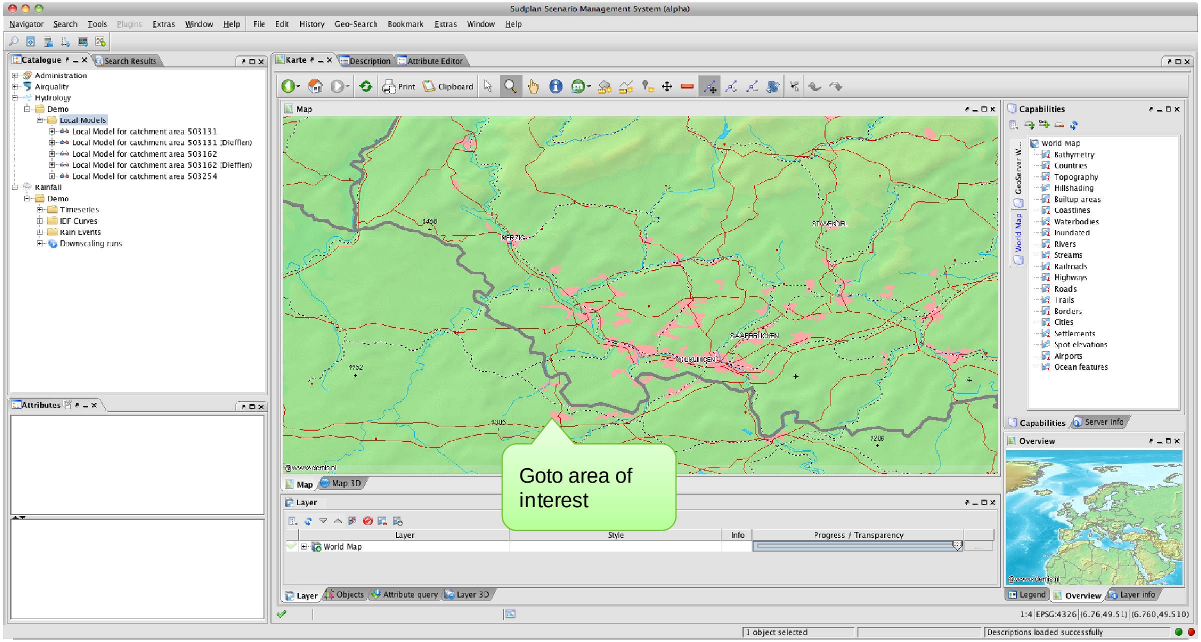

The geocpm visualization for the Lüntenbeck neighborhood.

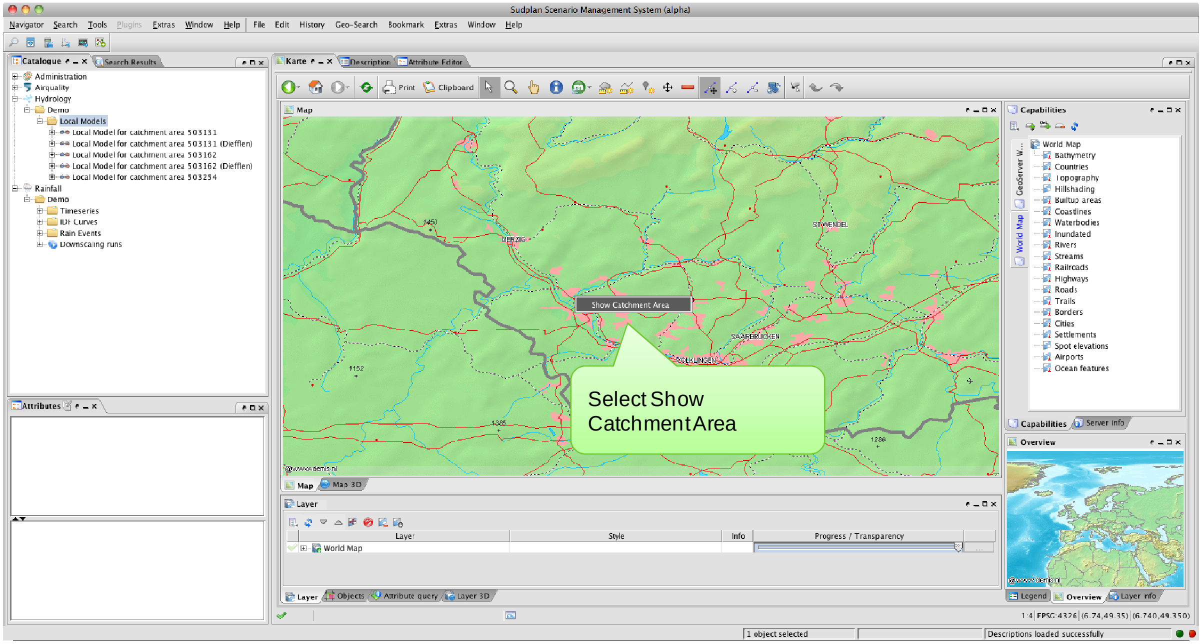

Using different modes (from top to bottom): on the ground, offset from terrain, and common reference plane in order to compare.

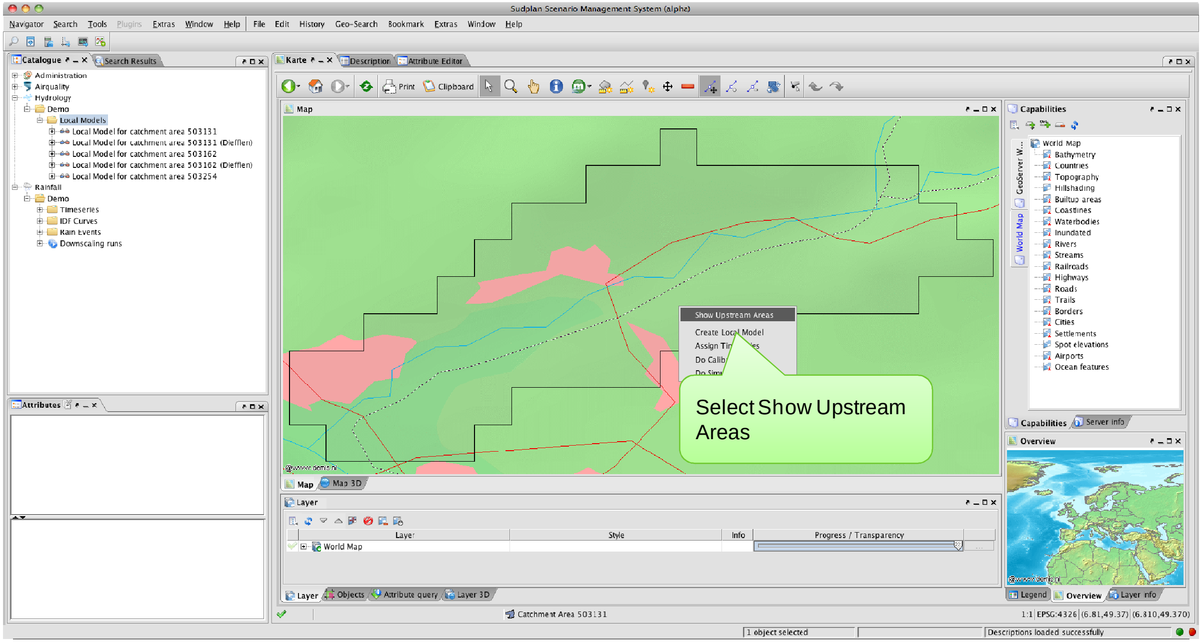

Using those controls the user can start, stop, and pause the animation.

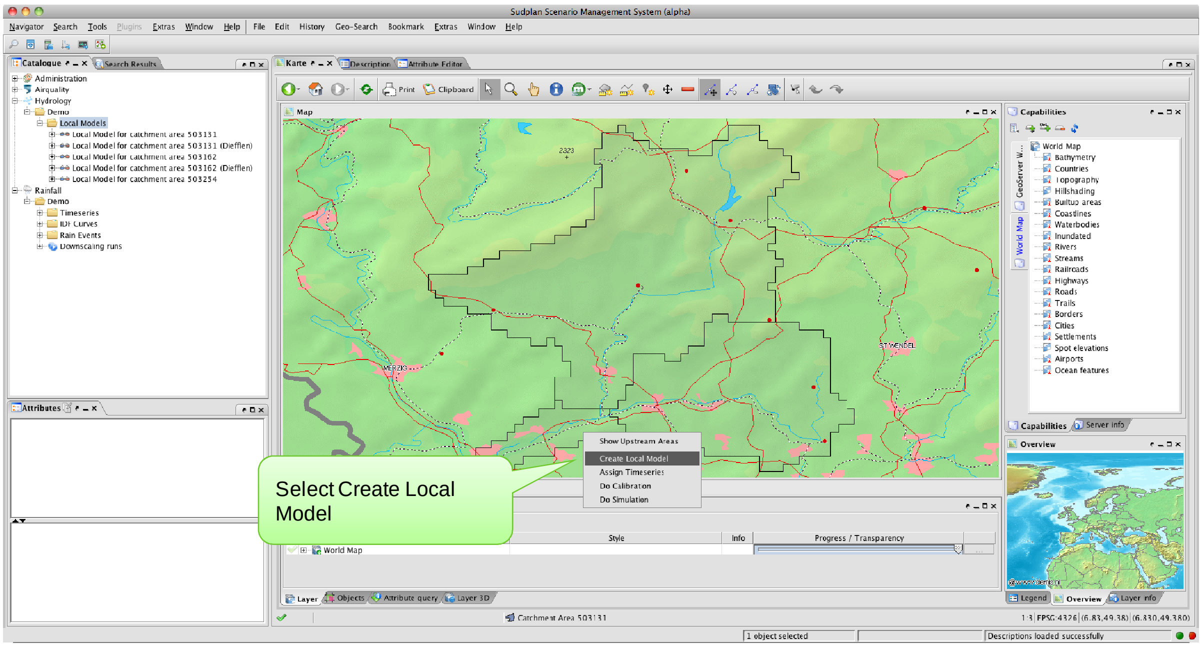
8.11. Execute Hydrology Downscaling

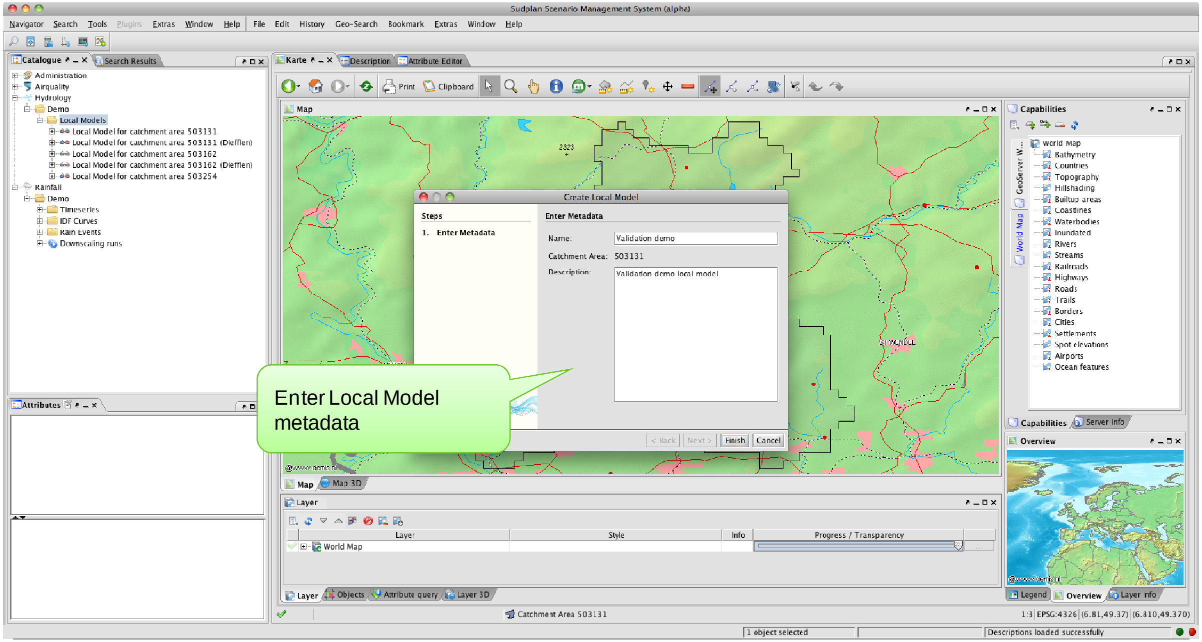
For a description of this validation scenario please refer to *4.2.12 - Execute Hydrology Downscaling*.

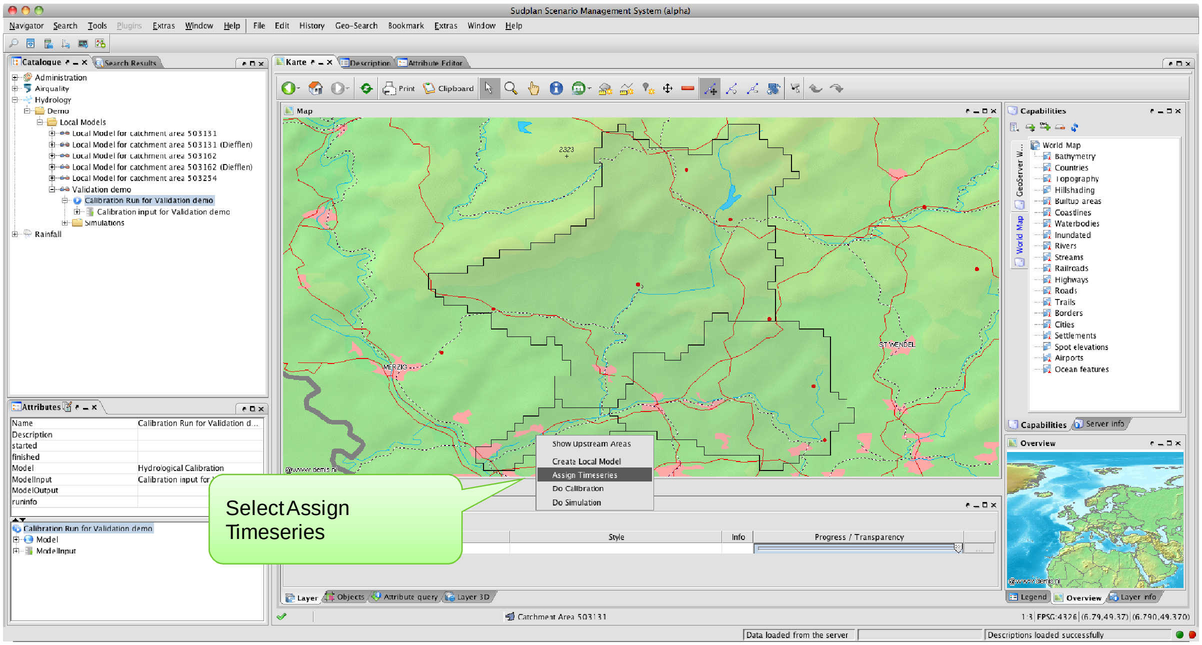


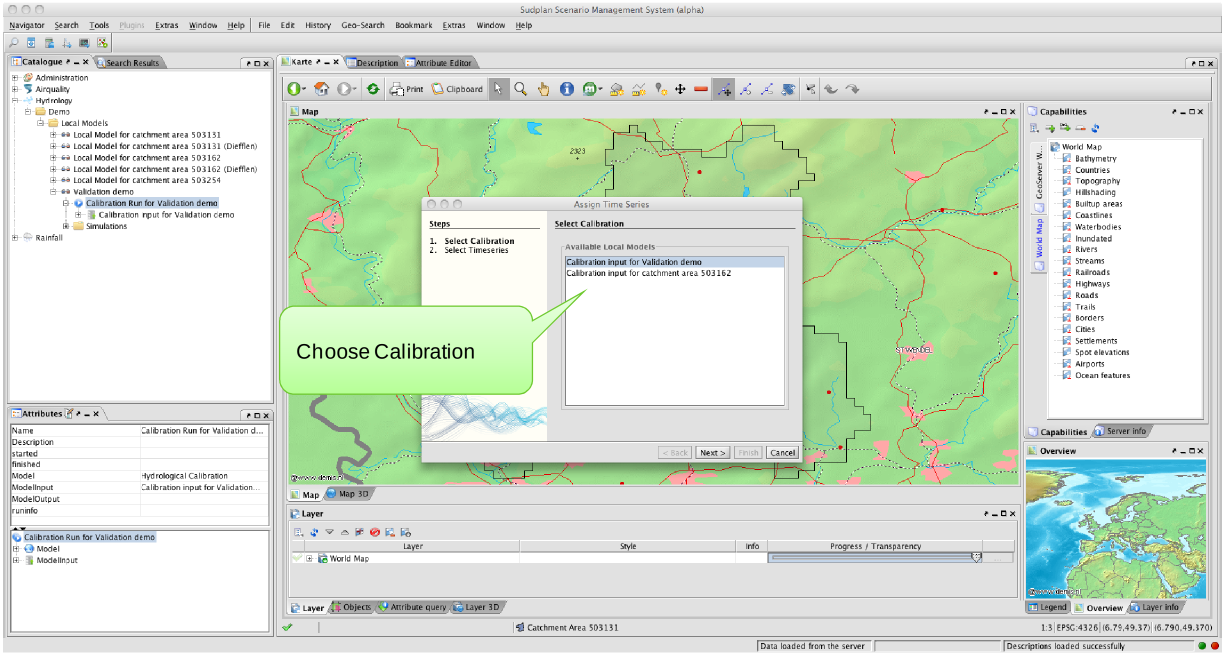


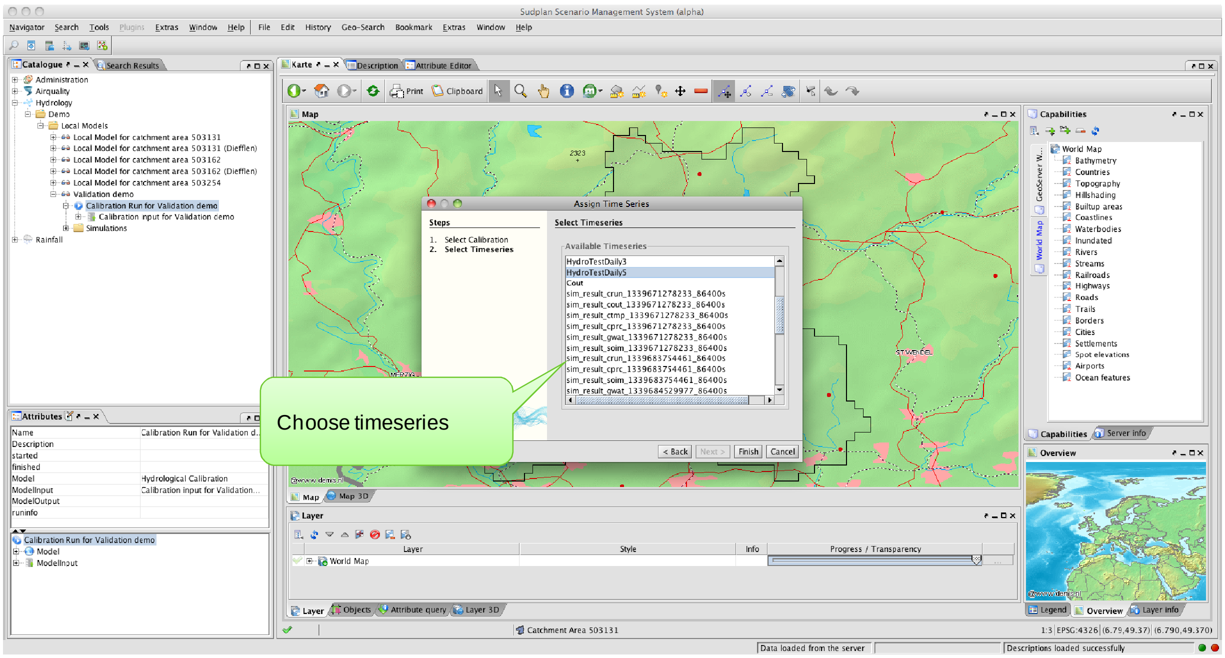

Sudplan Scenario Management System (alpha)
Show Upstream Areas
Create Local Model
Select Show Upstream Areas
Catchment Area 503131

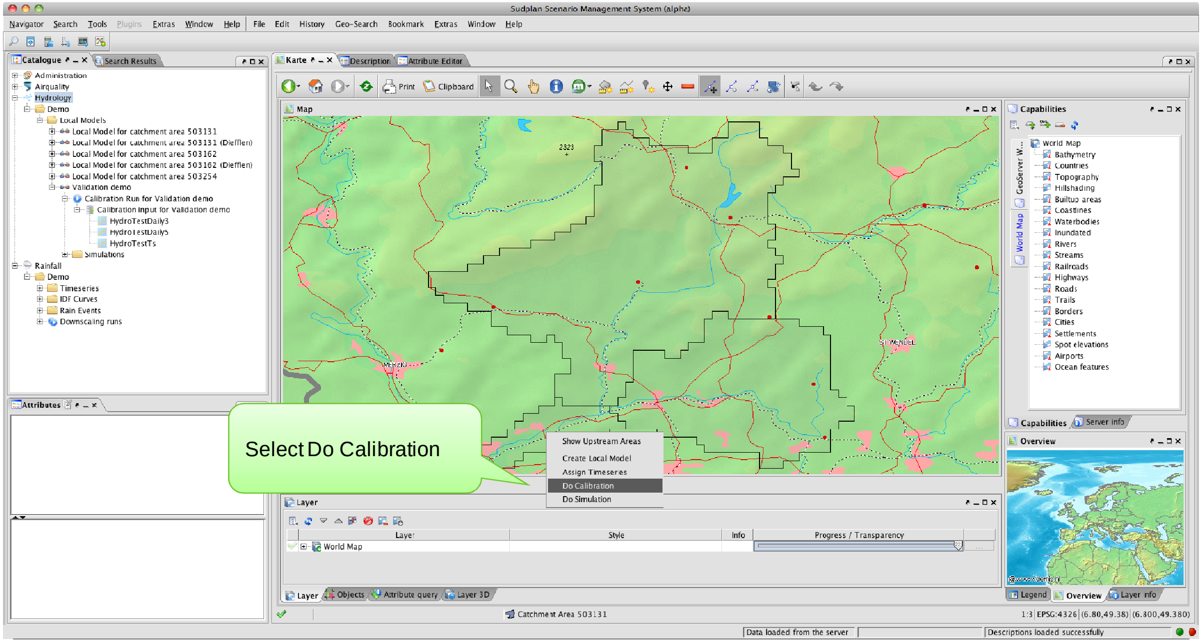

Sudplan Scenario Management System (alpha)
Show Upstream Areas
Create Local Model
Assign Timeseries
Do Calibration
Do Simulation
Select Create Local Model
Catchment Area 503131

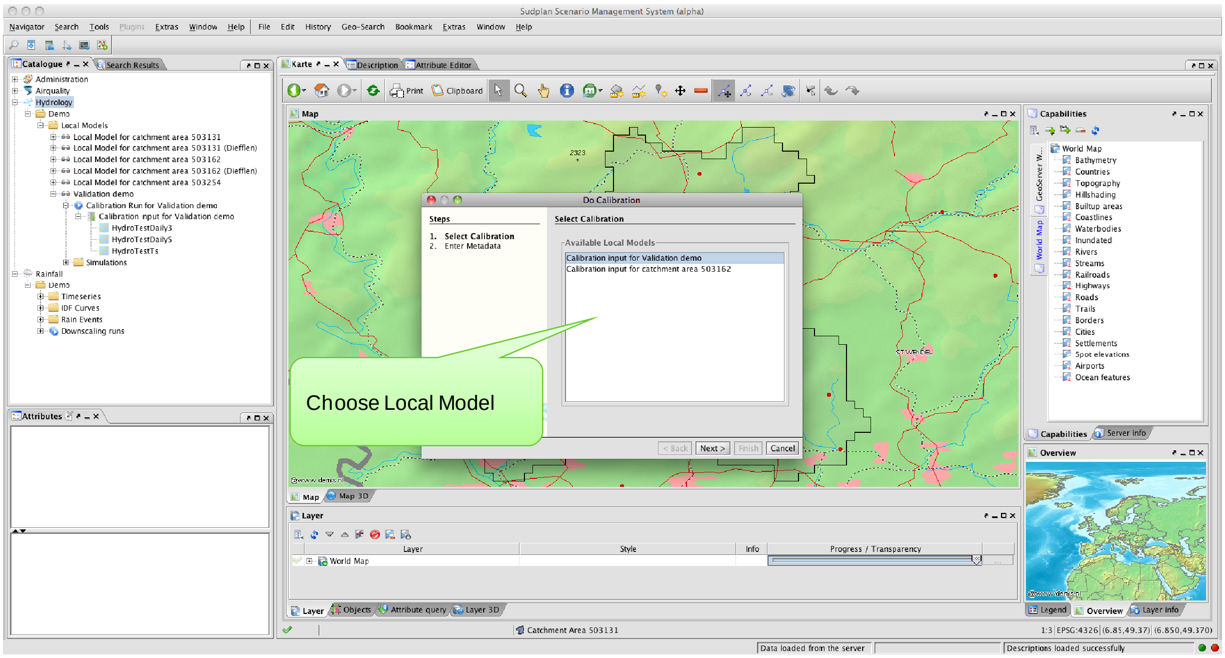

Sudplan Scenario Management System (alpha)
Create Local Model
Enter Local Model metadata

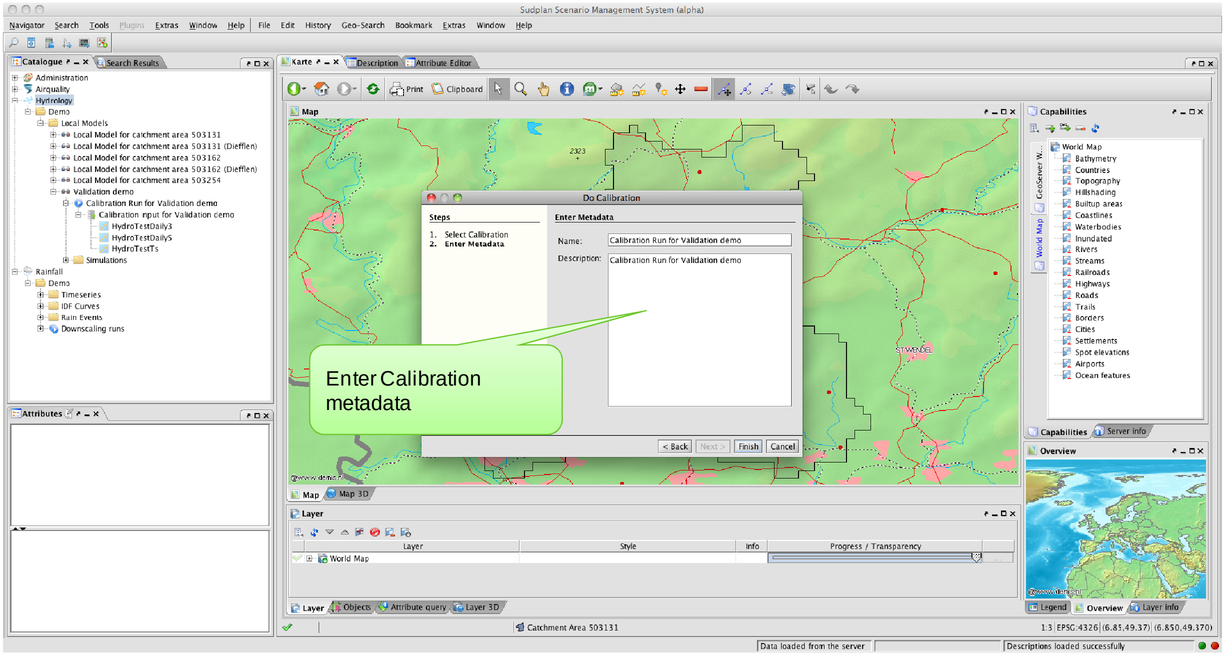

Sudplan Scenario Management System (alpha)
Select Assign Timeseries

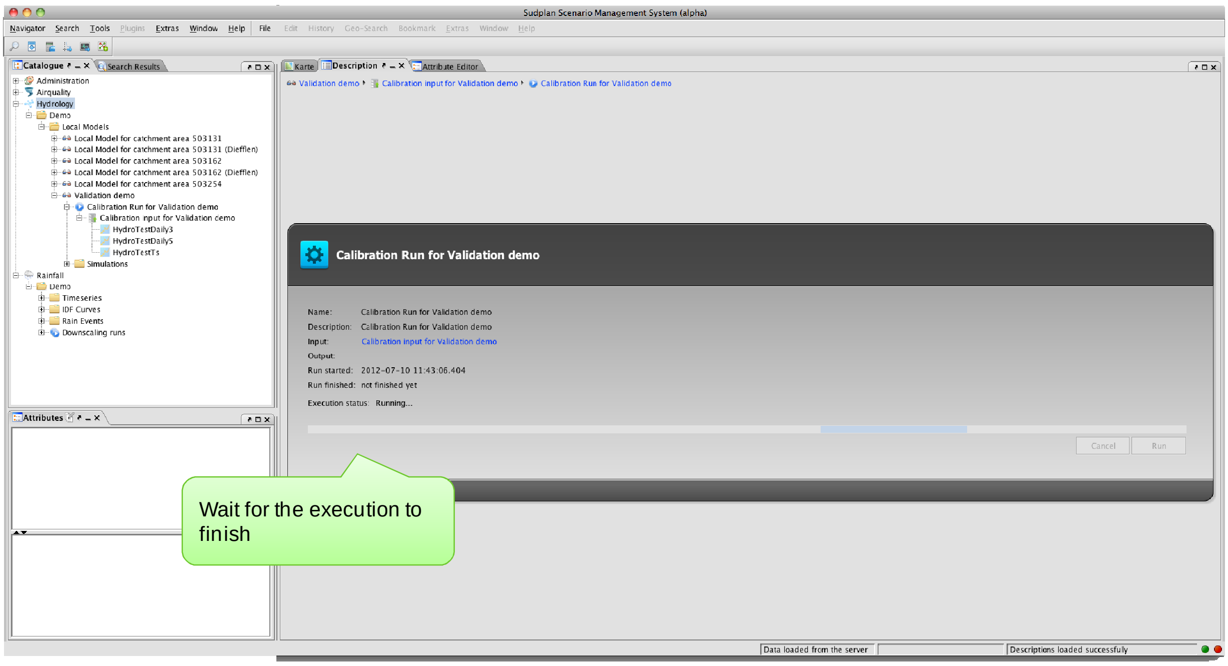

Sudplan Scenario Management System (alpha)
Assign Time Series
Steps
1. Select Calibration
2. Select Timeseries
Select Calibration
Available Local Models
Calibration input for Validation demo
Calibration input for catchment area 503162
Choose Calibration

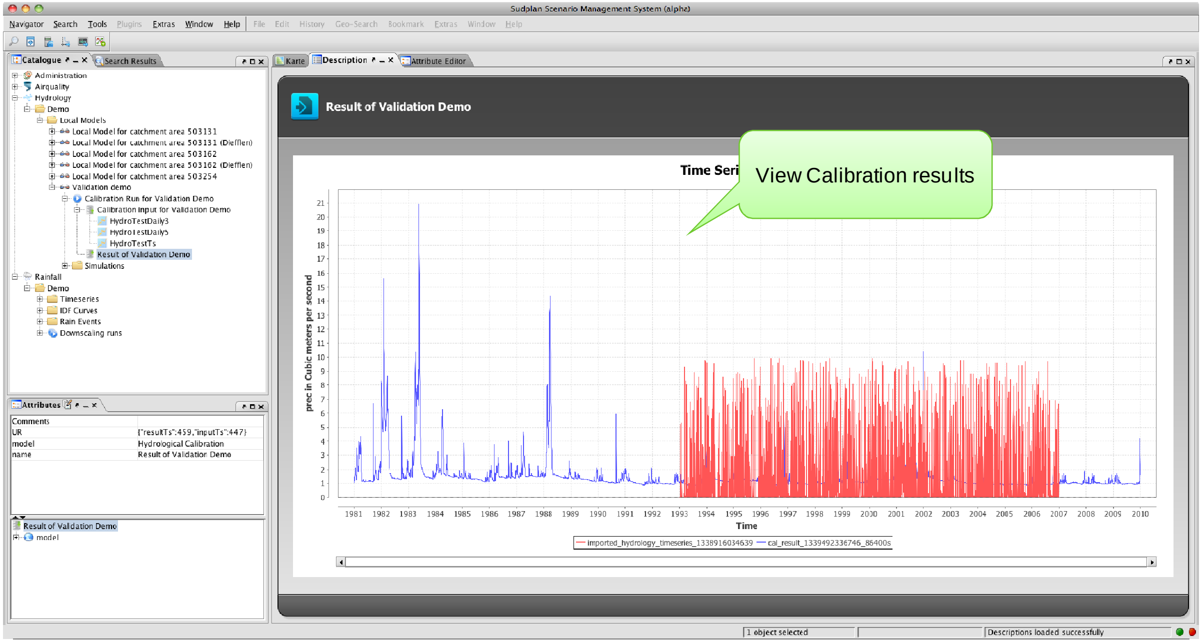

Sudplan Scenario Management System (alpha)
Assign Time Series
Steps
1. Select Calibration
2. Select Timeseries
Select Timeseries
Available Timeseries
Choose timeseries

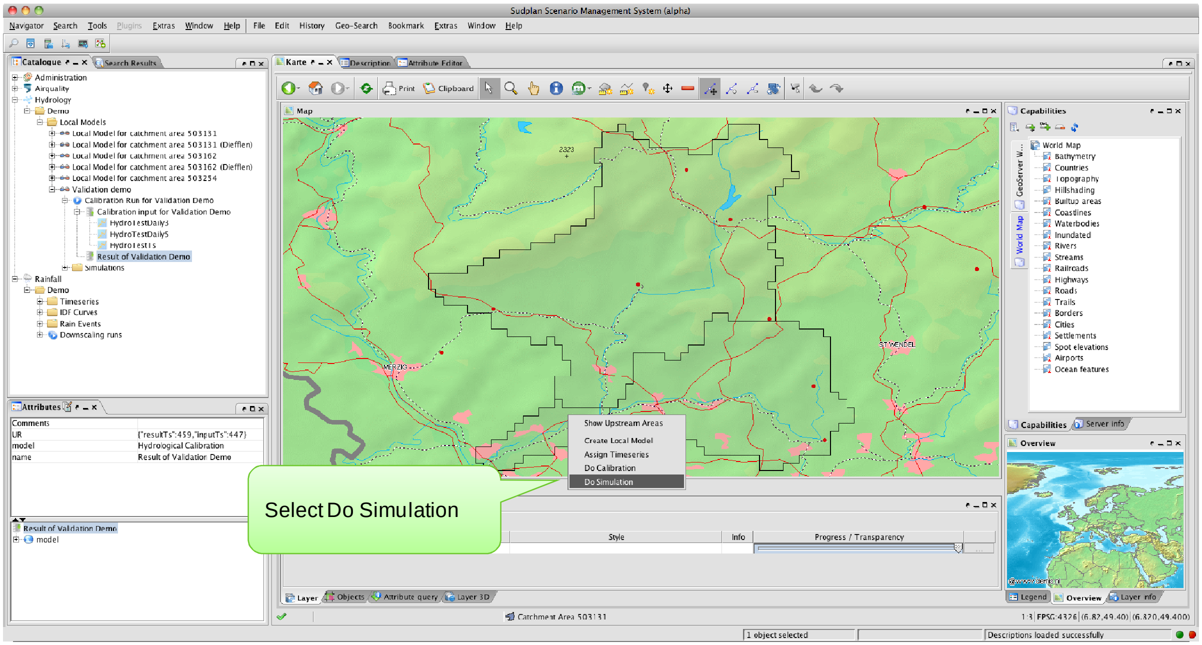

Sudplan Scenario Management System (alpha)
Select Do Calibration
Show Upstream Areas
Create Local Model
Assign Timeseries
Do Calibration
Do Simulation

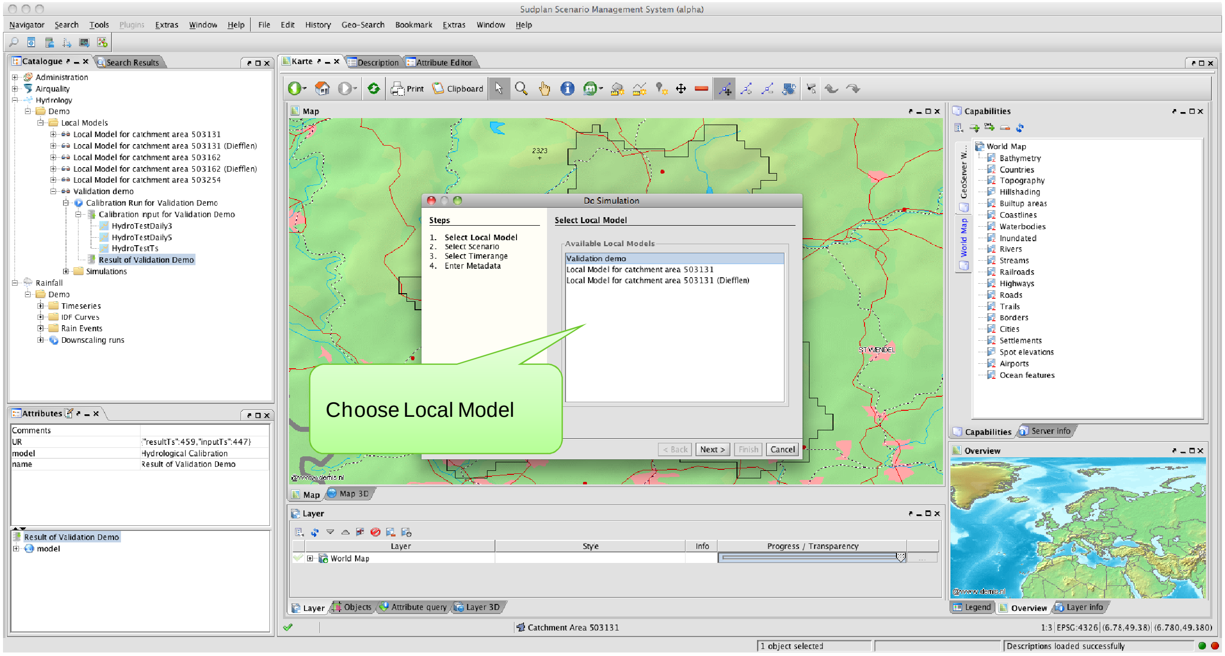

Sudplan Scenario Management System (alpha)
Do Calibration
Choose Local Model

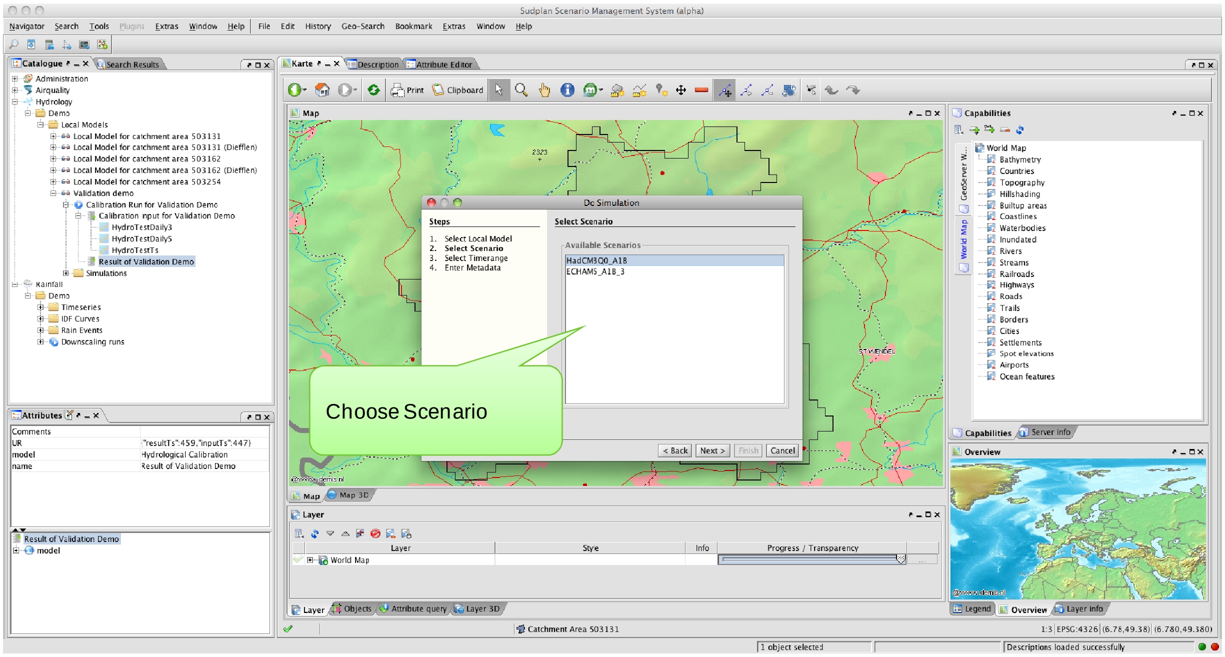

Sudplan Scenario Management System (alpha)
Do Calibration
Steps
1. Select Calibration
2. Enter Metadata
Enter Metadata
Name: Calibration Run for Validation demo
Description: Calibration Run for Validation demo
Enter Calibration metadata

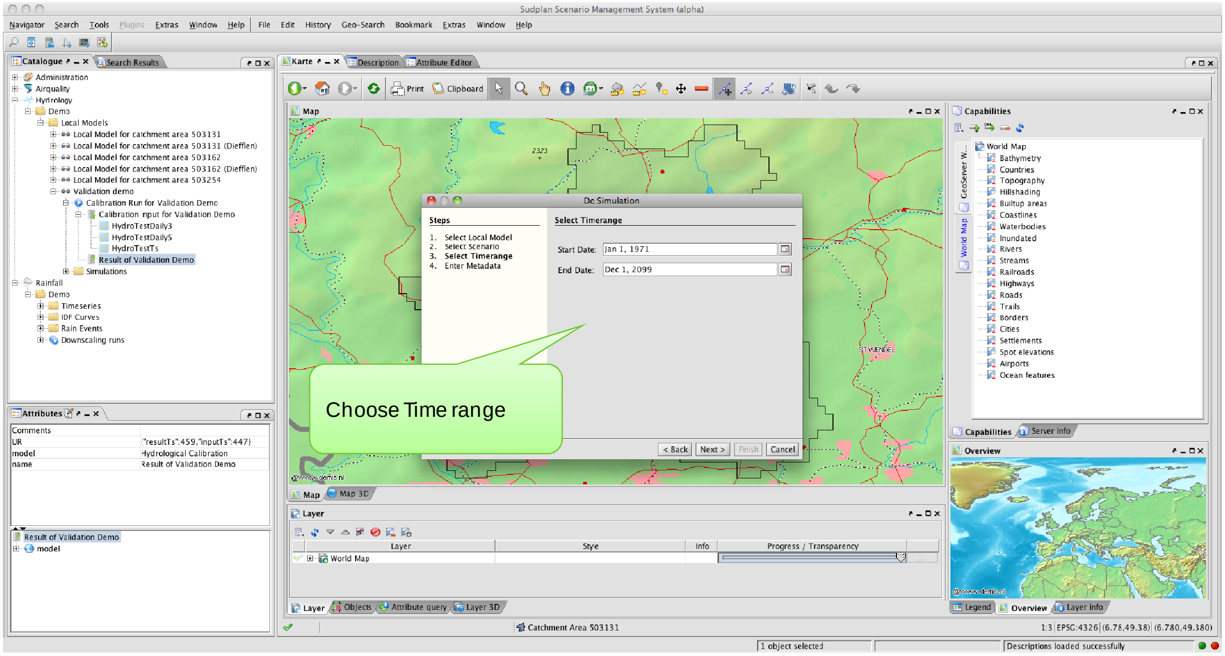

Sudplan Scenario Management System (alpha)
Calibration Run for Validation demo
Name: Calibration Run for Validation demo
Description: Calibration Run for Validation demo
Input: Calibration input for Validation demo
Output:
Run started: 2012-07-10 11:43:06.404
Run finished: not finished yet
Execution status: Running...
Wait for the execution to finish

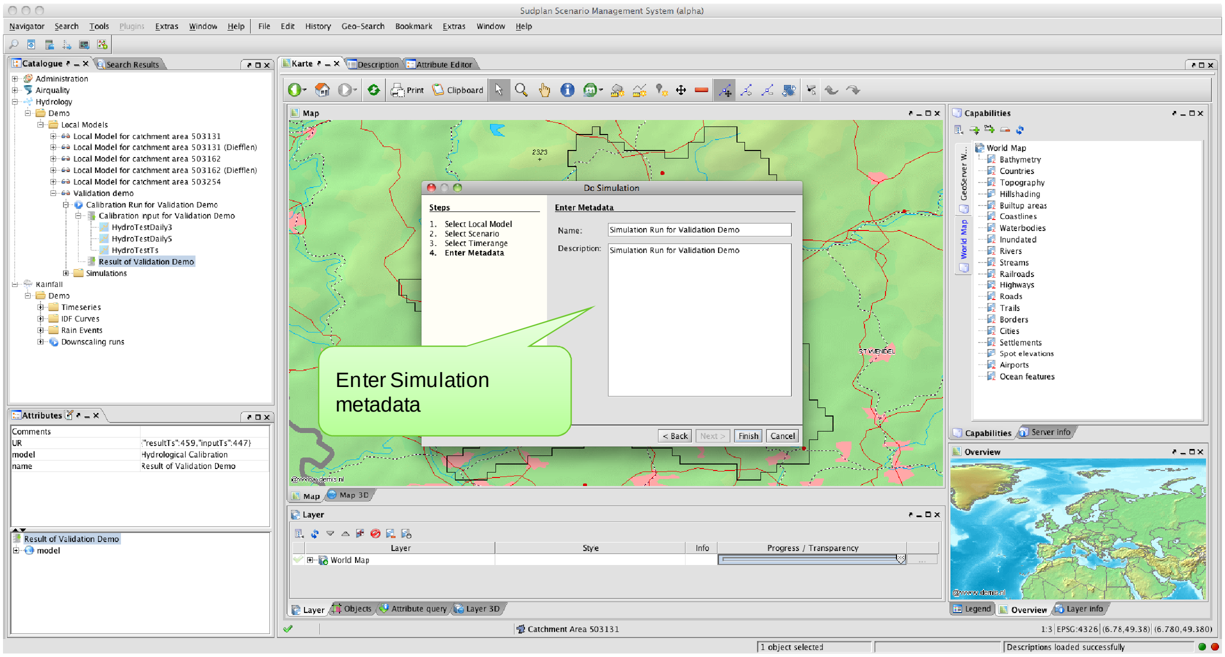

Sudplan Scenario Management System (alpha)
Result of Validation Demo
View Calibration results
Time
prec in Cubic meters per second

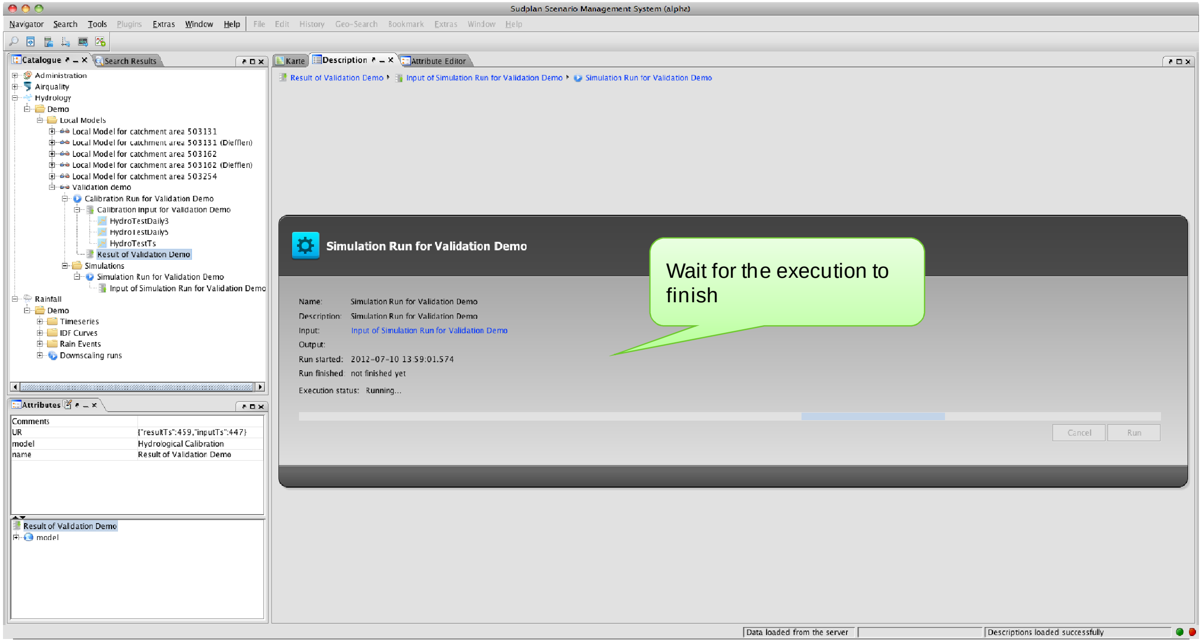

Sudplan Scenario Management System (alpha)
Show Upstream Areas
Create Local Model
Assign Timeseries
Do Calibration
Do Simulation
Select Do Simulation


Sudplan Scenario Management System (alpha)
Dc Simulation
Steps
1. Select Local Model
2. Select Scenario
3. Select Timerange
4. Enter Metadata
Select Local Model
Available Local Models
Validation demo
Local Model for catchment area 503131
Local Model for catchment area 503131 (Dieflen)
Choose Local Model

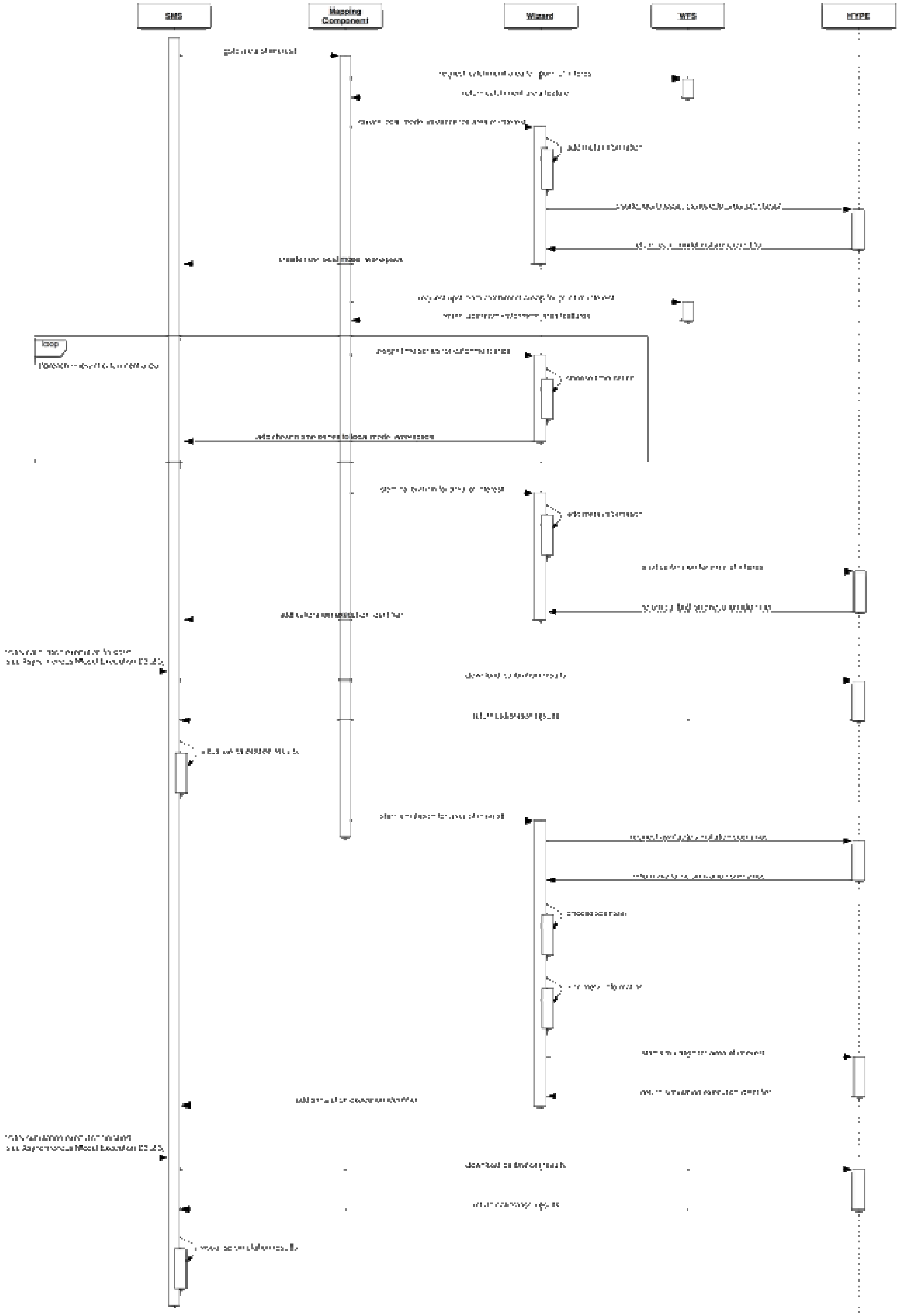

Sudplan Scenario Management System (alpha)
Dc Simulation
Steps
1. Select Local Model
2. Select Scenario
3. Select Timerange
4. Enter Metadata
Select Scenario
Available Scenarios
HadCM3Q0_A1B
ECHAM5_A1B_3
Choose Scenario


Sudplan Scenario Management System (alpha)
Dc Simulation
Steps
1. Select Local Model
2. Select Scenario
3. Select Timerange
4. Enter Metadata
Select Timerange
Start Date: Jan 1, 1971
End Date: Dec 1, 2099
Choose Time range


Sudplan Scenario Management System (alpha)
Dc Simulation
Steps
1. Select Local Model
2. Select Scenario
3. Select Timerange
4. Enter Metadata
Enter Metadata
Name: Simulation Run for Validation Demo
Description: Simulation Run for Validation Demo
Enter Simulation metadata

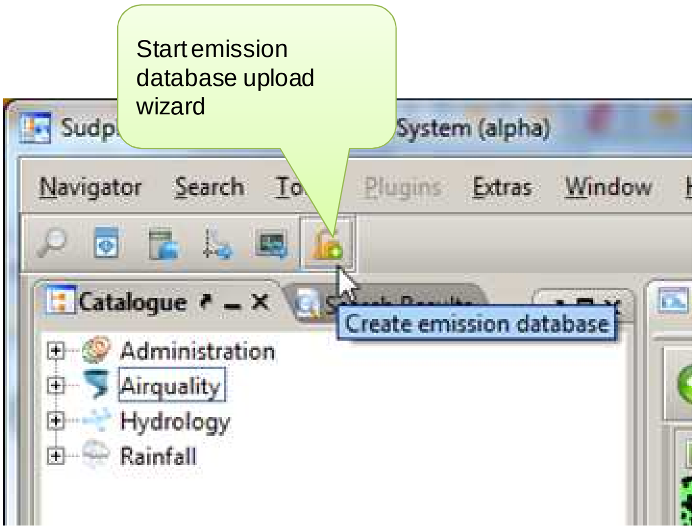

Simulation Run for Validation Demo
Wait for the execution to finish

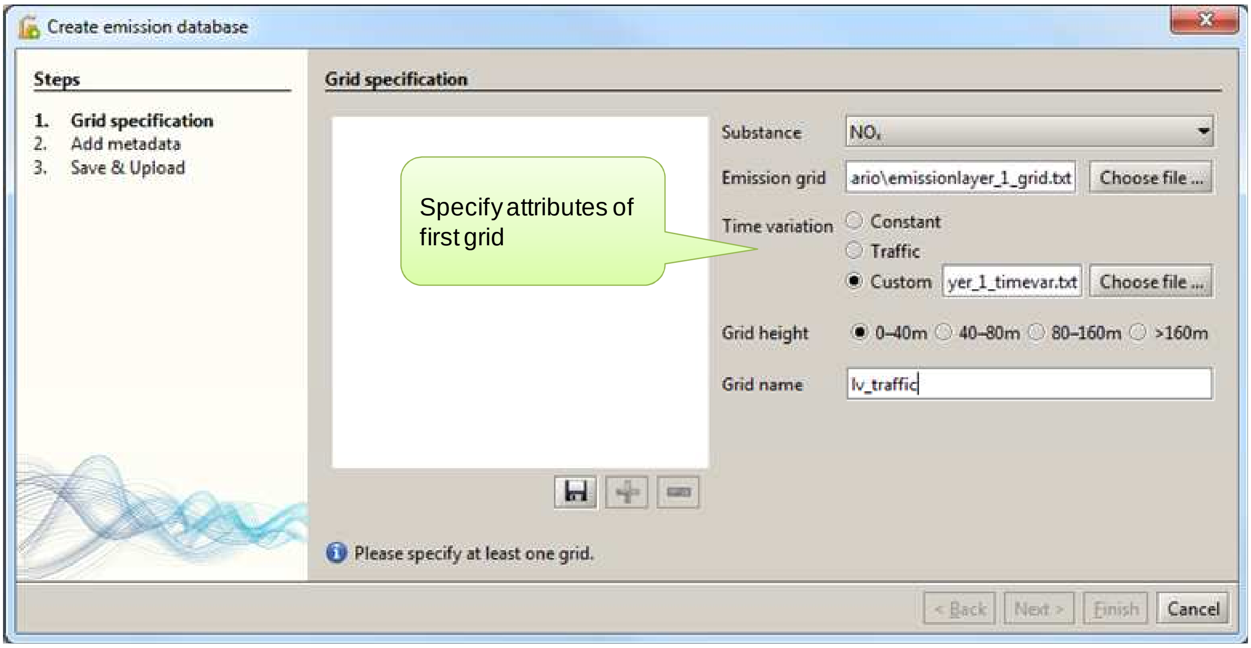

Result of Validation Demo Simulation
Time Series Data
View Simulation results

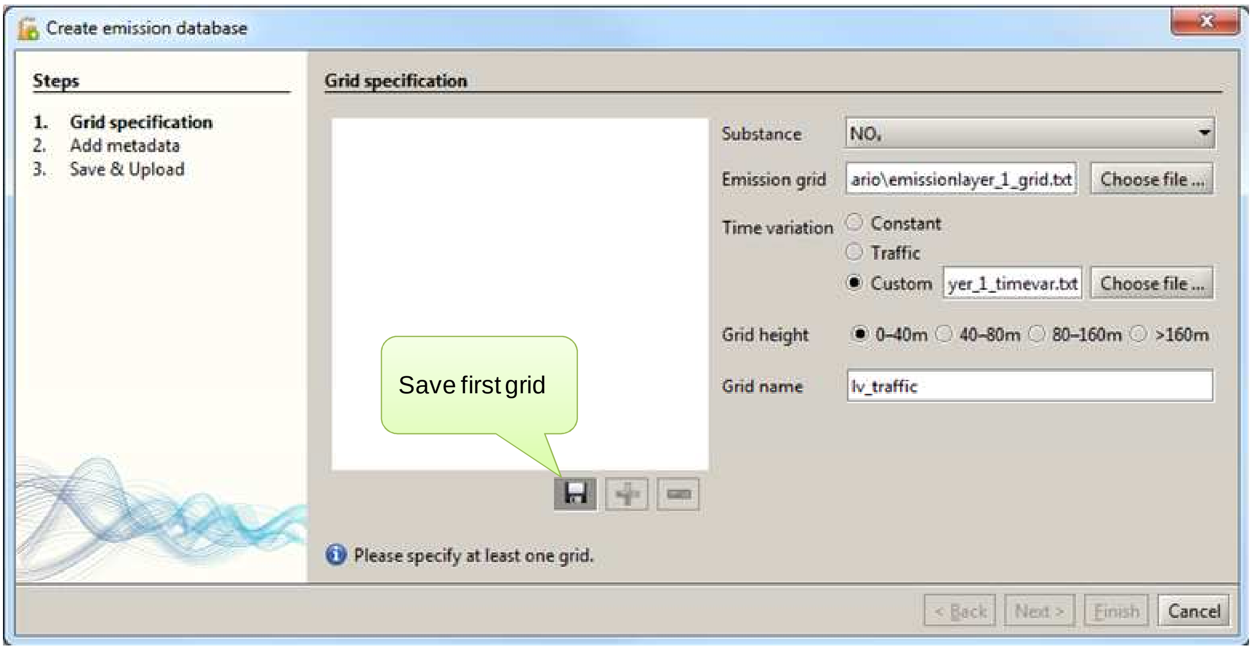


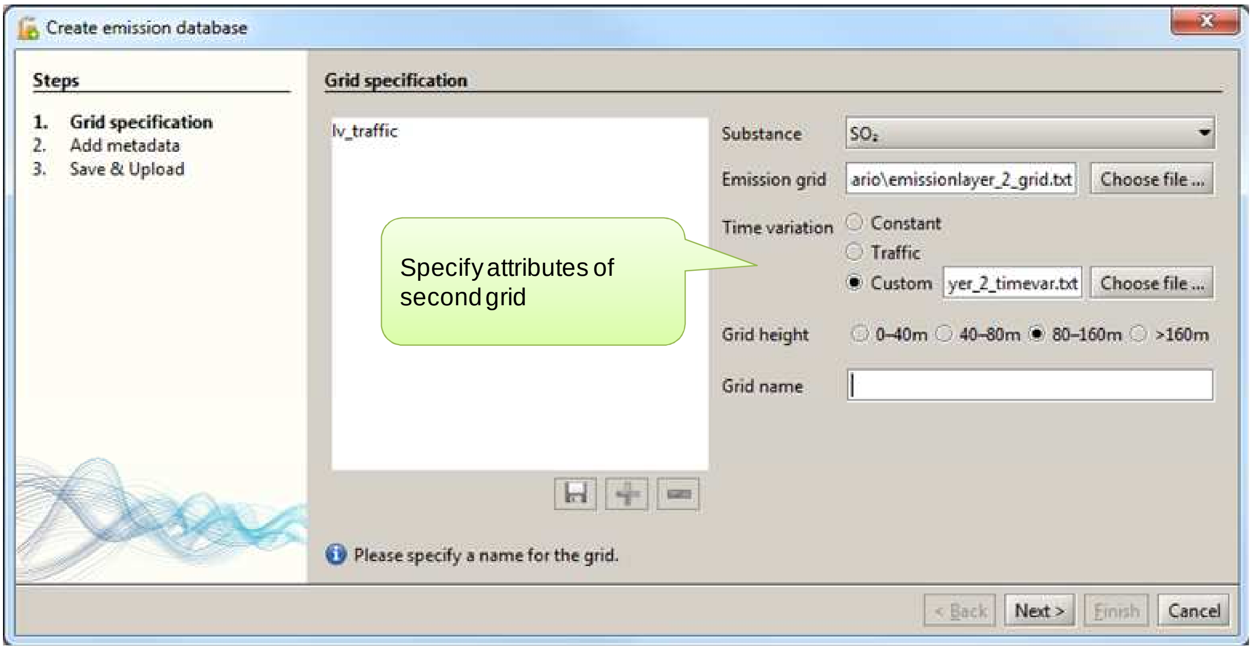
8.12. Emission database upload

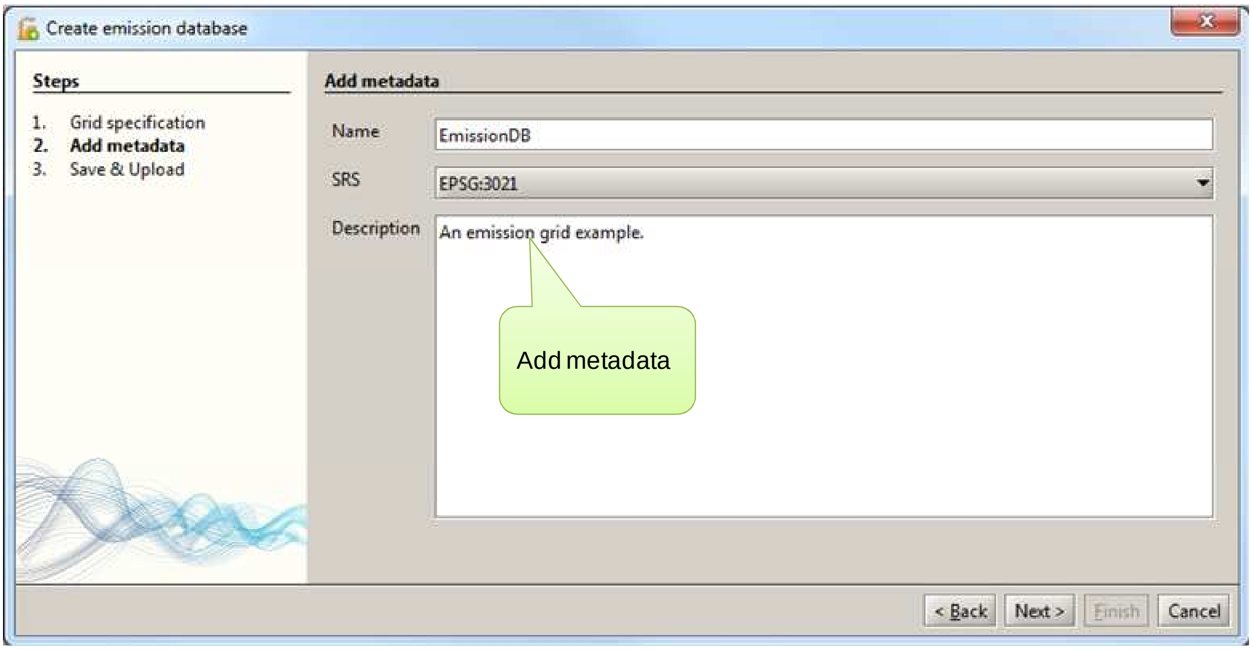
For a description of this validation scenario please refer to *4.2.13 Emission Database Upload*.

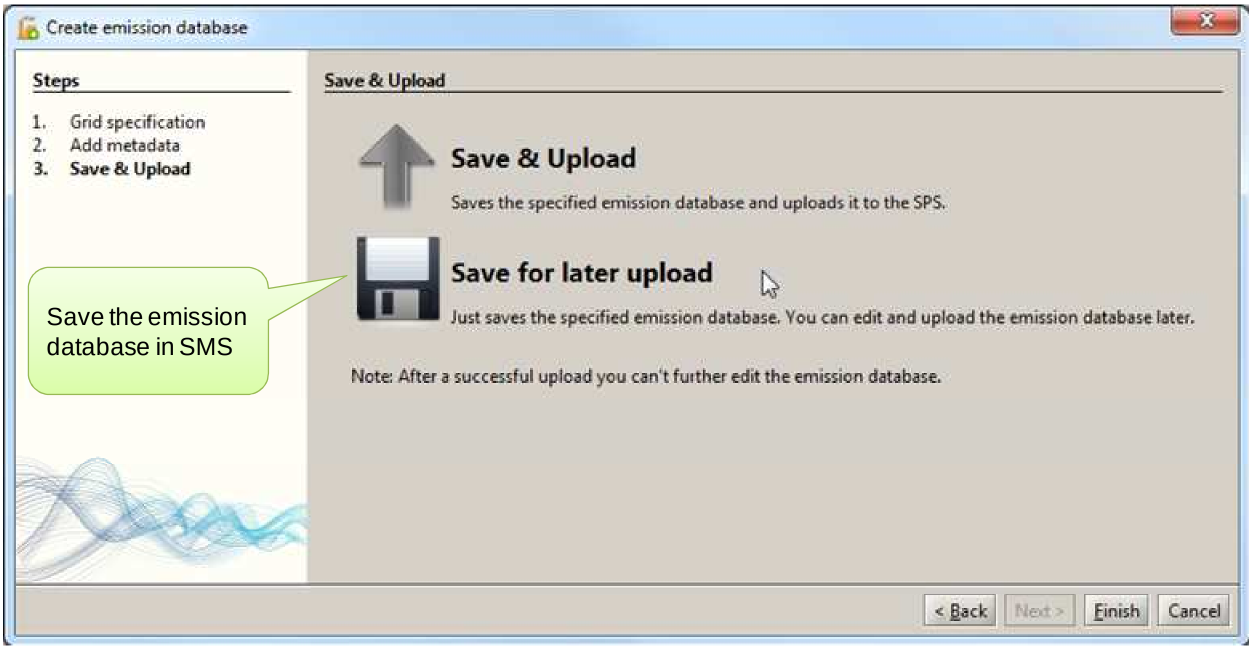


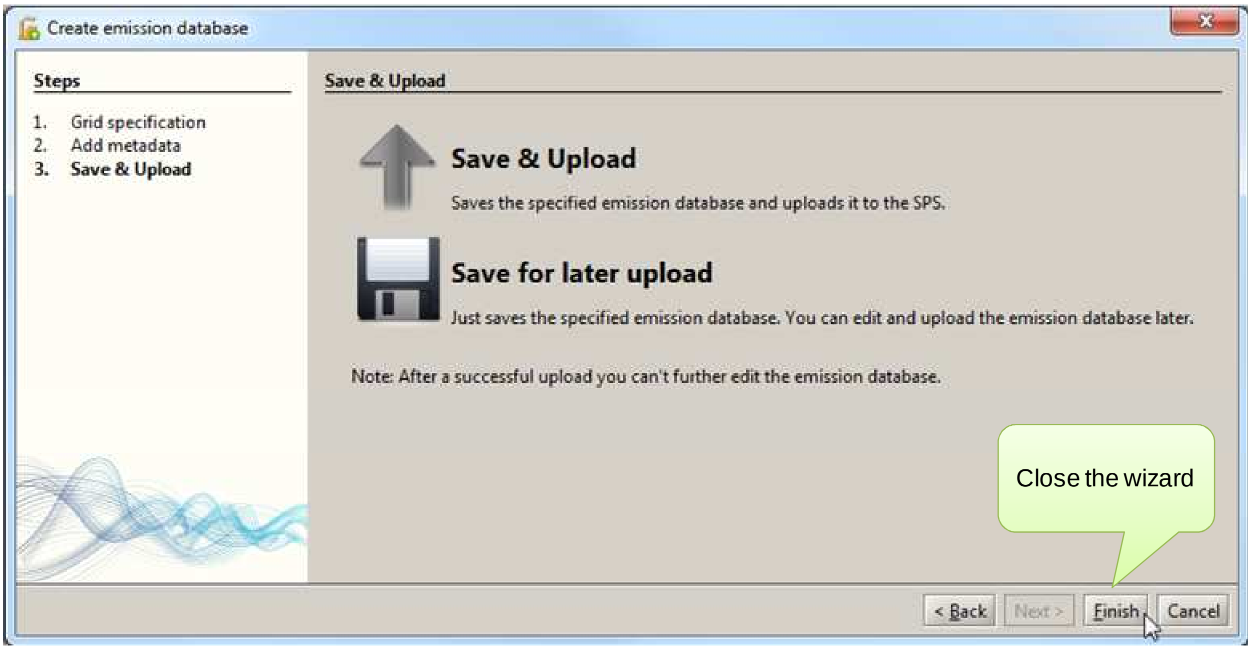


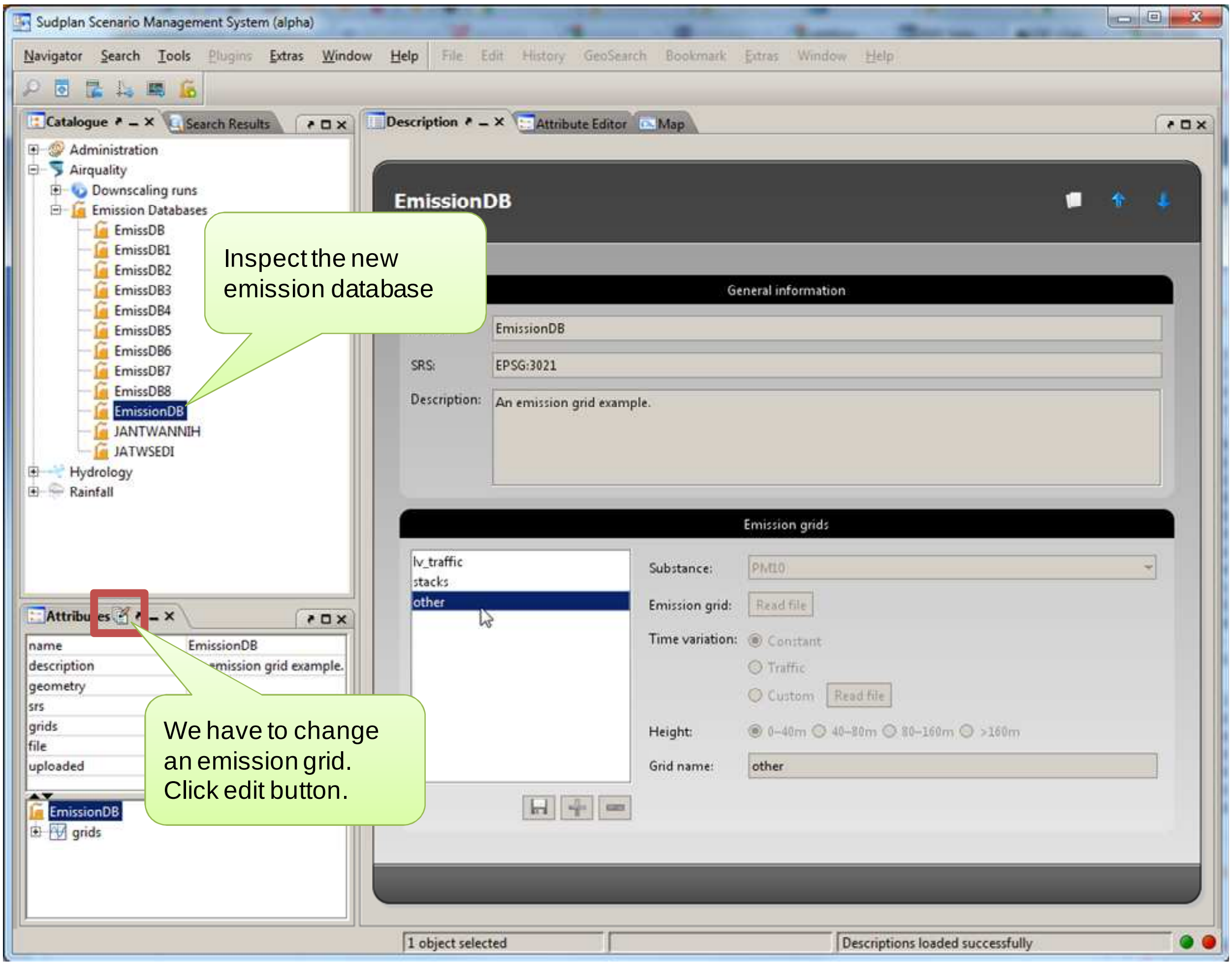

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Grid specification
Substance
NO₂
Emission grid
ario\emissionlayer_1_grid.txt
Choose file ...
Time variation
Constant
Traffic
Custom
yer_1_timevar.txt
Choose file ...
Grid height
0–40m
40–80m
80–160m
>160m
Grid name
lv_traffic
Save first grid
Please specify at least one grid.
< Back
Next >
Finish
Cancel

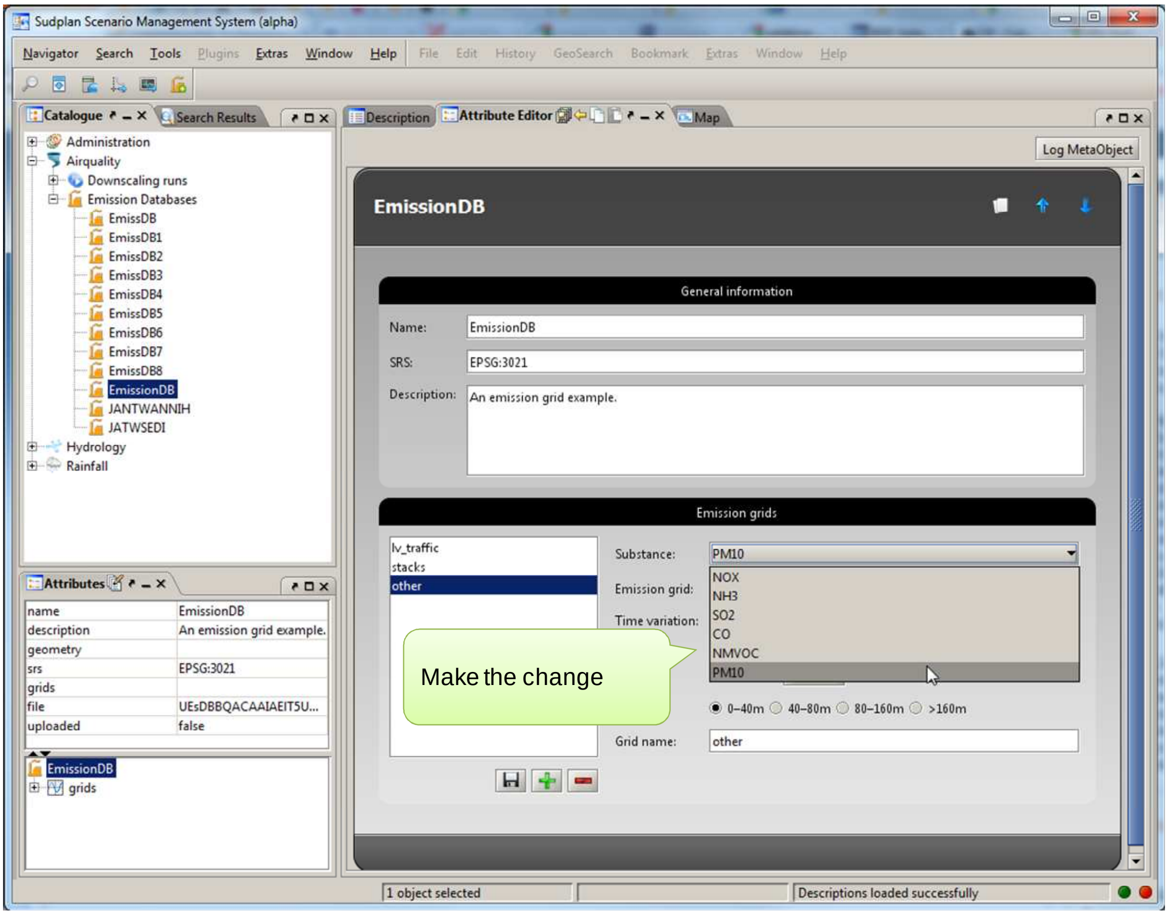

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Grid specification
lv_traffic
Substance
SO₂
Emission grid
ario\emissionlayer_2_grid.txt
Choose file ...
Time variation
Constant
Traffic
Custom
yer_2_timevar.txt
Choose file ...
Grid height
0–40m
40–80m
80–160m
>160m
Grid name
Specify attributes of second grid
Please specify a name for the grid.
< Back
Next >
Finish
Cancel

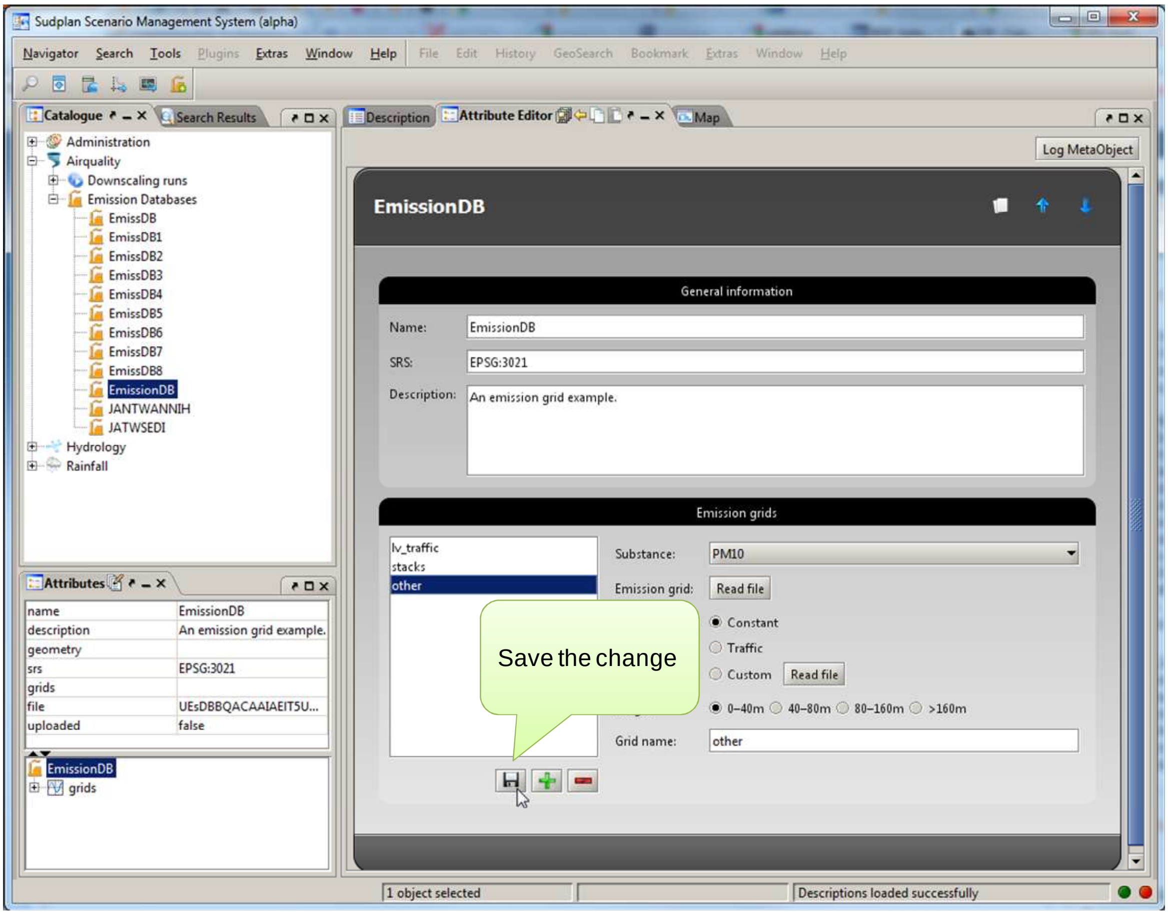

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Add metadata
Name
EmissionDB
SRS
EPSG:3021
Description
An emission grid example.
Add metadata
< Back
Next >
Finish
Cancel

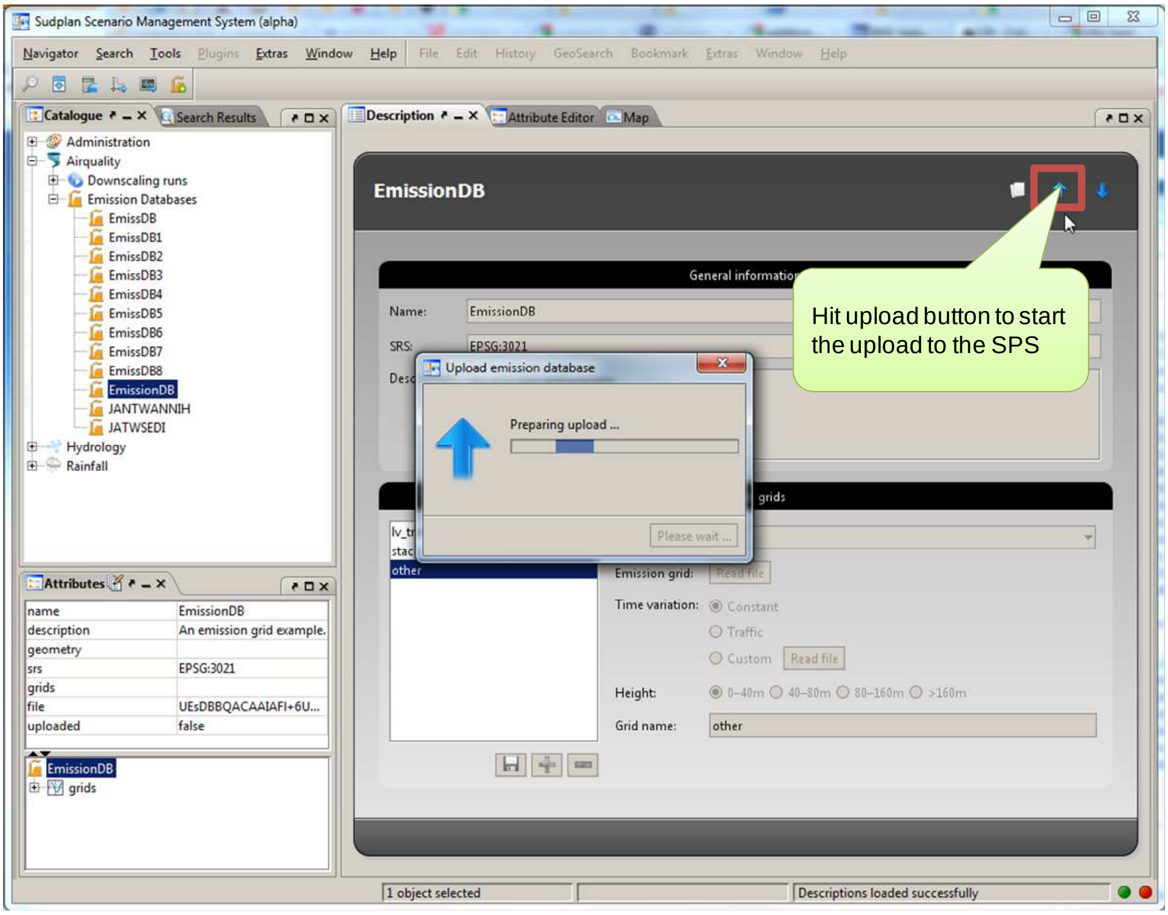

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Save & Upload
Save & Upload
Saves the specified emission database and uploads it to the SPS.
Save for later upload
Just saves the specified emission database. You can edit and upload the emission database later.
Note: After a successful upload you can't further edit the emission database.
Save the emission database in SMS
< Back
Next >
Finish
Cancel

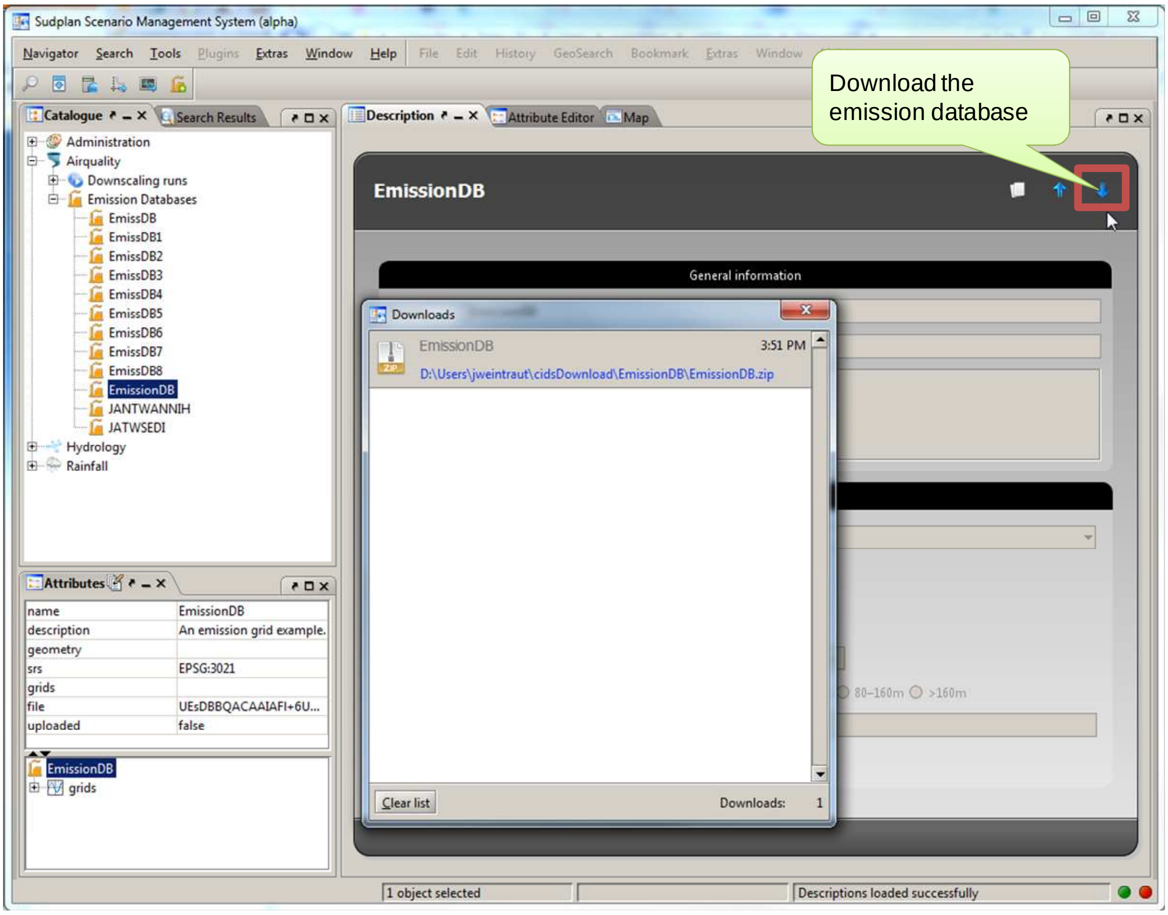

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Save & Upload
Save & Upload
Saves the specified emission database and uploads it to the SPS.
Save for later upload
Just saves the specified emission database. You can edit and upload the emission database later.
Note: After a successful upload you can't further edit the emission database.
Close the wizard
< Back
Next >
Finish
Cancel

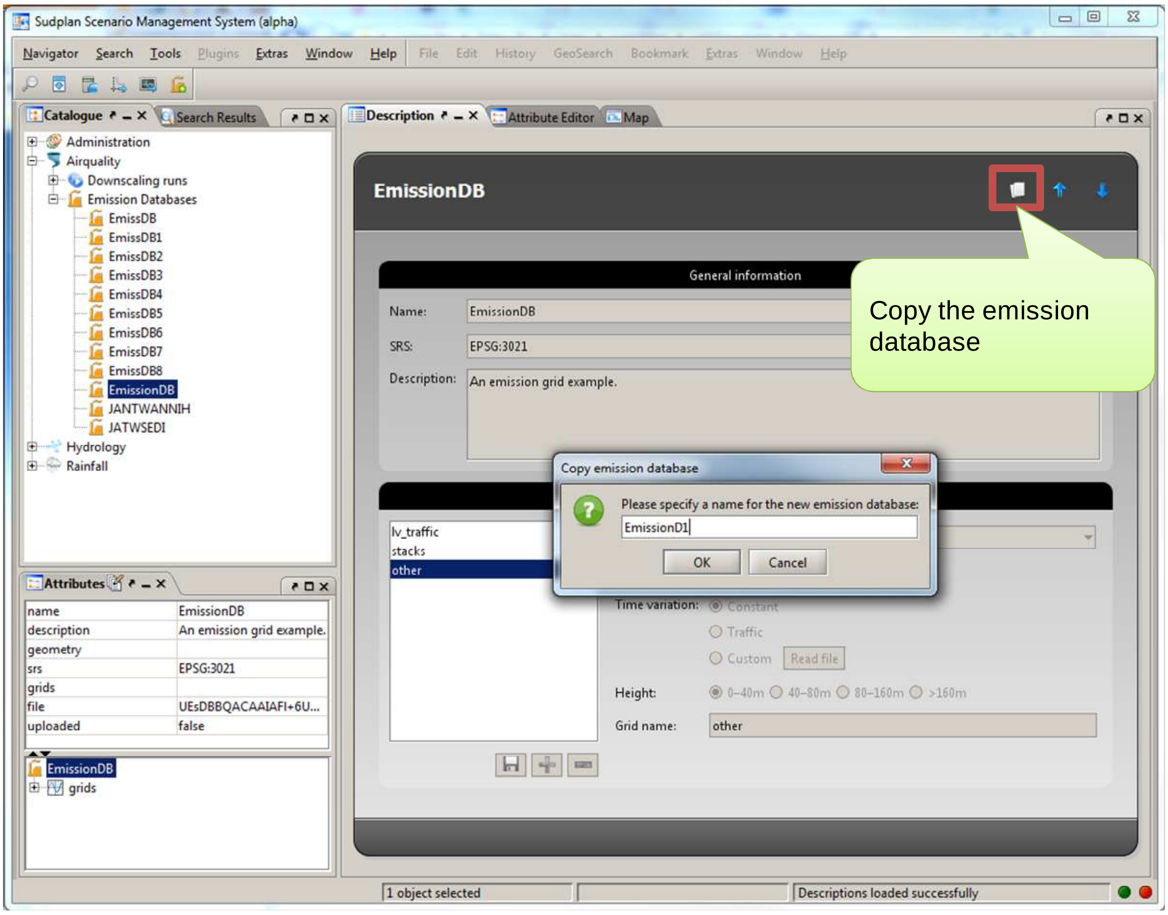

Sudplan Scenario Management System (alpha)
Inspect the new emission database
We have to change an emission grid. Click edit button.
EmissionDB
General information
SRS:
EPSG:3021
Description:
An emission grid example.
Emission grids
lv_traffic
stacks
other
Substance:
Emission grid:
Time variation:
Height:
Grid name:
1 object selected
Descriptions loaded successfully

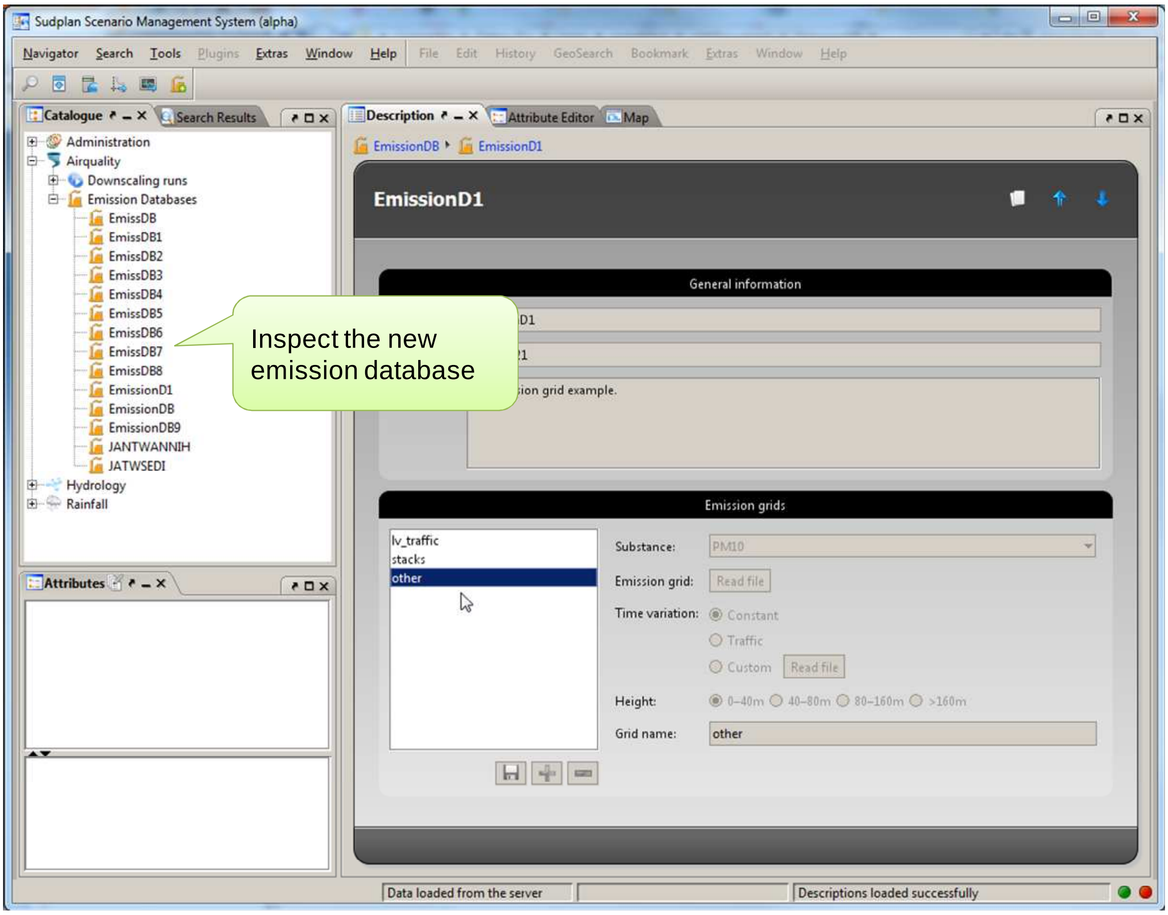

Sudplan Scenario Management System (alpha)
EmissionDB
General information
Name: EmissionDB
SRS: EPSG:3021
Description: An emission grid example.
Emission grids
Substance: PM10
NOX
NH3
SO2
CO
NMVOC
PM10
Make the change
Grid name: other
1 object selected
Descriptions loaded successfully

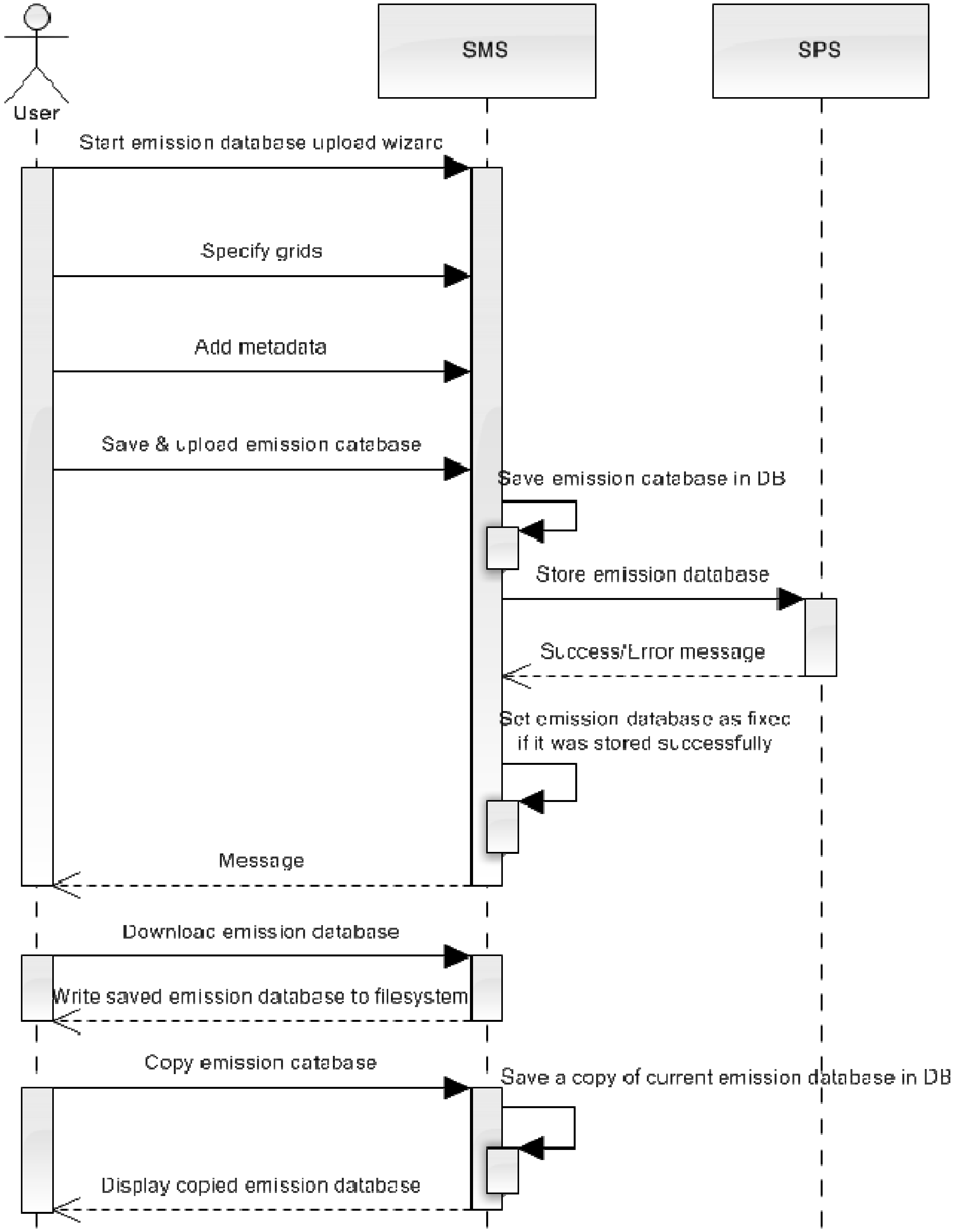

Sudplan Scenario Management System (alpha)
EmissionDB
General information
Name: EmissionDB
SRS: EPSG:3021
Description: An emission grid example.
Emission grids
Substance: PM10
Emission grid: Read file
Constant
Traffic
Custom Read file
Save the change
Grid name: other
1 object selected
Descriptions loaded successfully

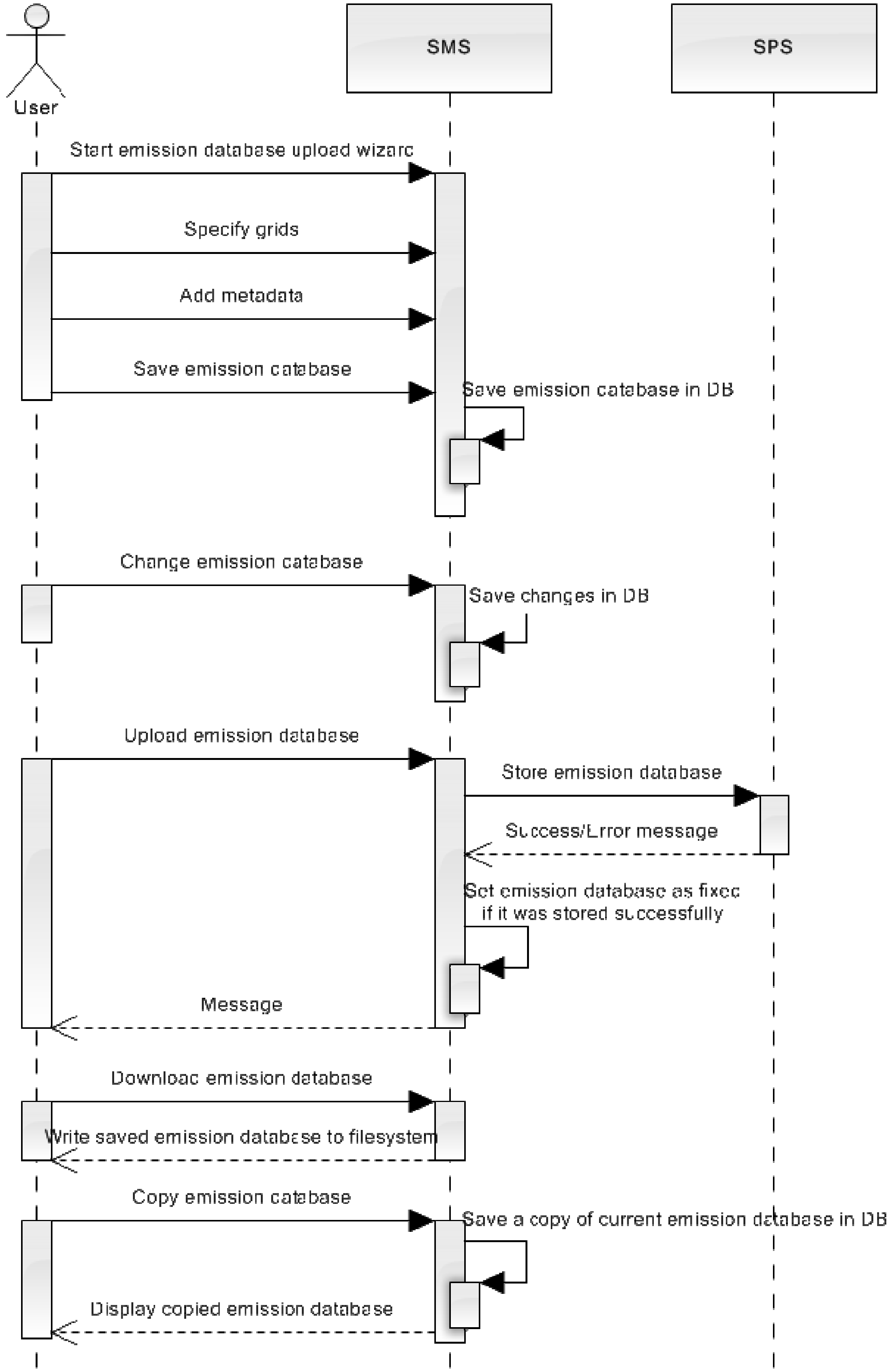

Hit upload button to start the upload to the SPS


Download the emission database


Sudplan Scenario Management System (alpha)
EmissionDB
Copy the emission database
General information
Name: EmissionDB
SRS: EPSG:3021
Description: An emission grid example.
Copy emission database
Please specify a name for the new emission database:
EmissionD1
OK
Cancel
1 object selected
Descriptions loaded successfully


Sudplan Scenario Management System (alpha)
EmissionD1
Inspect the new emission database
General information
Emission grids
Substance: PM10
Grid name: other
Data loaded from the server
Descriptions loaded successfully


User
SMS
SPS
Start emission database upload wizarc
Specify grids
Add metadata
Save & upload emission catabase
Save emission catabase in DB
Store emission database
Success/Error message
Set emission database as fixec
if it was stored successfully
Message
Downloac emission database
Write saved emission database to filesystem
Copy emission catabase
Save a copy of current emission database in DB
Display copied emission database


User
SMS
SPS
Start emission database upload wizard
Specify grids
Add metadata
Save emission database
Save emission database in DB
Change emission database
Save changes in DB
Upload emission database
Store emission database
Success/Error message
Set emission database as fixed if it was stored successfully
Message
Download emission database
Write saved emission database to filesystem
Copy emission database
Save a copy of current emission database in DB
Display copied emission database