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Scenario Management System Description

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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 final report to describe the Integrated Scenario Management System. Due to the fact that the deliverable *D3.3.4 Integrated Scenario Management System Description* depends on the results of the *D3.2.x - Product Implementation* and *D3.3.x - Integrated Scenario Management System* this report repeats several parts of these reports. Thus it is possible to gain a complete overview on the integrated SMS. For detailed information we recommend to read the above mentioned reports.

1.1. Purpose of this Document

This document is a brief report describing the core elements of the software developed in WP3 (Scenario Management System) of the SUDPLAN project. In contrast to the companion reports of the deliverables *D3.2.3- Product Implementation V3* and *D3.3.3- Integrated Scenario Management System V3* this report summarizes the final results of the Scenario Management System as an integrated solution.

This document describes the features of the developed SMS software. However, it does not serve as a detailed handbook. For detailed information regarding features and usage of the SMS as well as the interaction, we recommend the prepared videos in the SUDPLAN video channel at YouTube. The videos can be accessed via the following link: http://www.youtube.com/user/Sudplan. Moreover, we provide a SMS Video Tutorial in six parts, 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[1]. Finally, we offer various feature videos available at the SUDPLAN web site (http://sudplan.eu/Results/Workshop/SUDPLAN-workshop).

1.2. Intended Audience

This document targets all SUDPLAN partners and users of the SMS.

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.

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

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.

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

- Visualise Climate Scenario Information on the European Scale (interaction with Common Services)
- Execute Rainfall Downscaling (interaction with Common Services)
- Execute Air Quality Downscaling (interaction with Common Services)
- 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
- Visualisation of 3-D air quality data
- 3-D Animation of "Water-runoff"
- Hydrology Downscaling
- Emission Database Upload
- Grid comparison
- Data export
- Rain event generation

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.

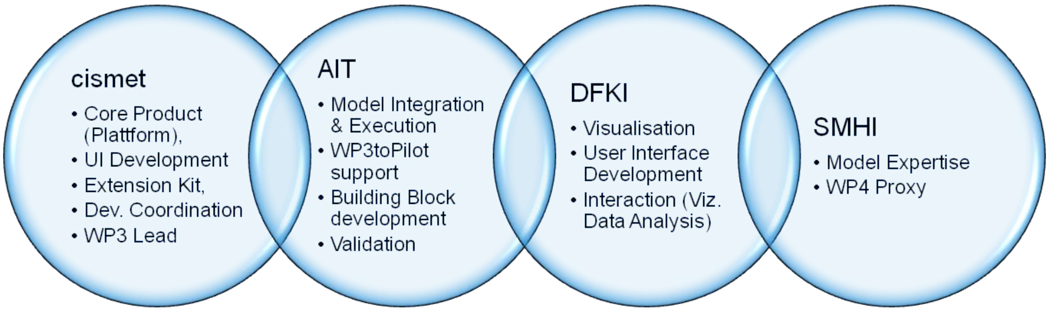


Figure 1: WP3 Partner Roles

The current implementation results which were integrated into the Scenario Management System 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*.

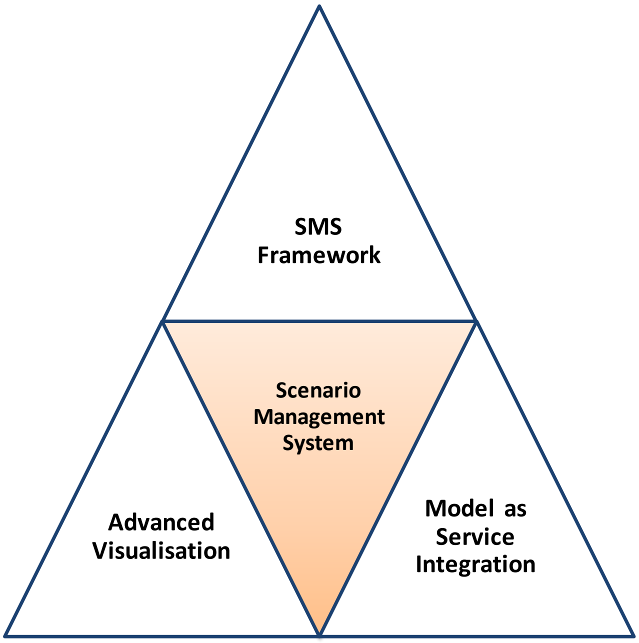


Figure 2: SMS Building Blocks

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.

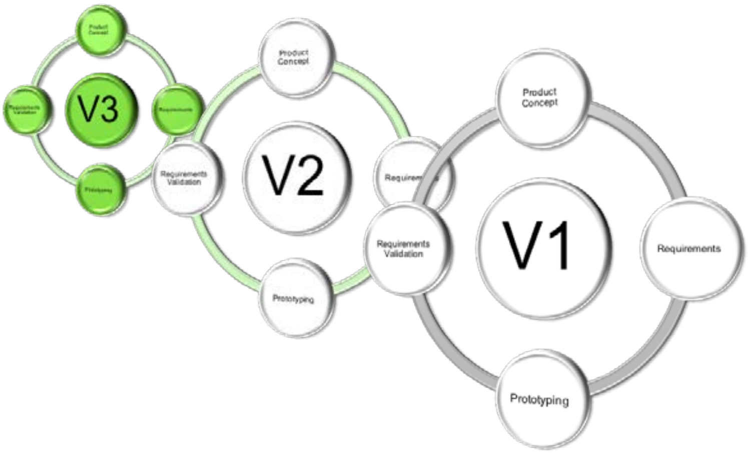


Figure 3: SUDPLAN Spiral Approach

The results of the three cycles are given in the companion reports to the deliverables *D3.2.x - Product Implementation*. *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 are combined into this consolidated deliverable *D.3.3.4 Integrated Scenario Management System Description*.

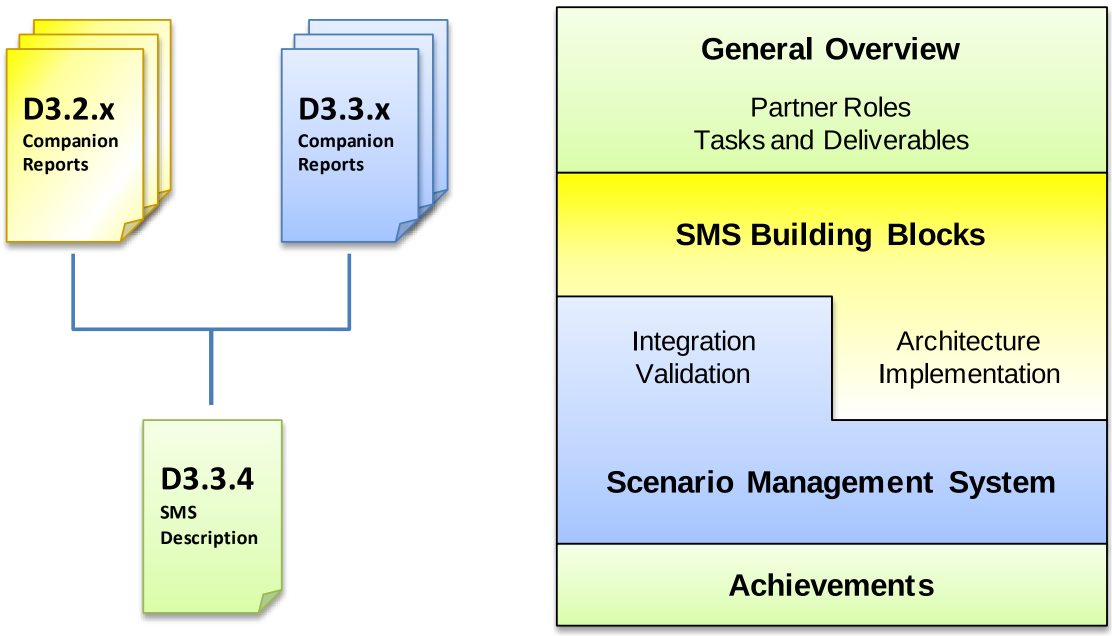


Figure 4: Relations between Companion Reports

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.

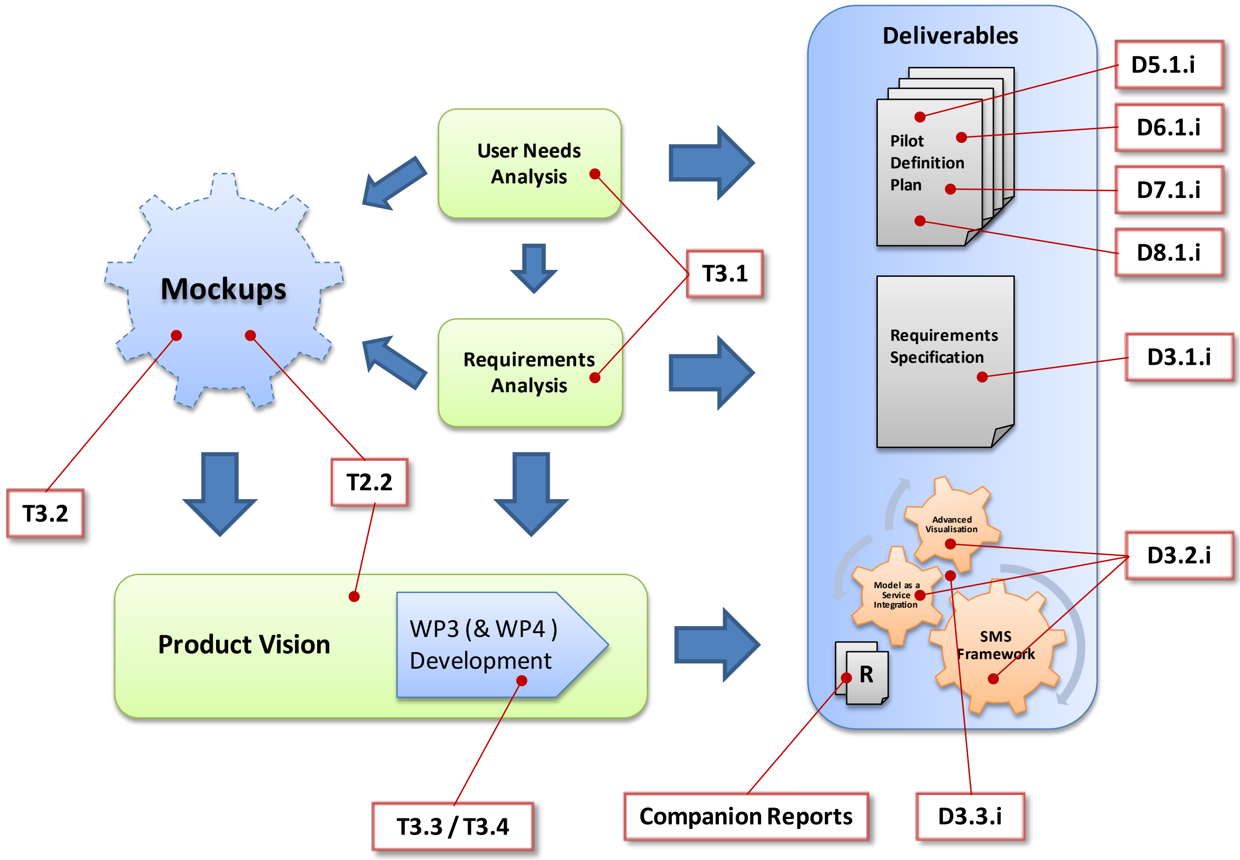


Figure 5: Dependencies in the Development Process

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 on-going mock-up 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.

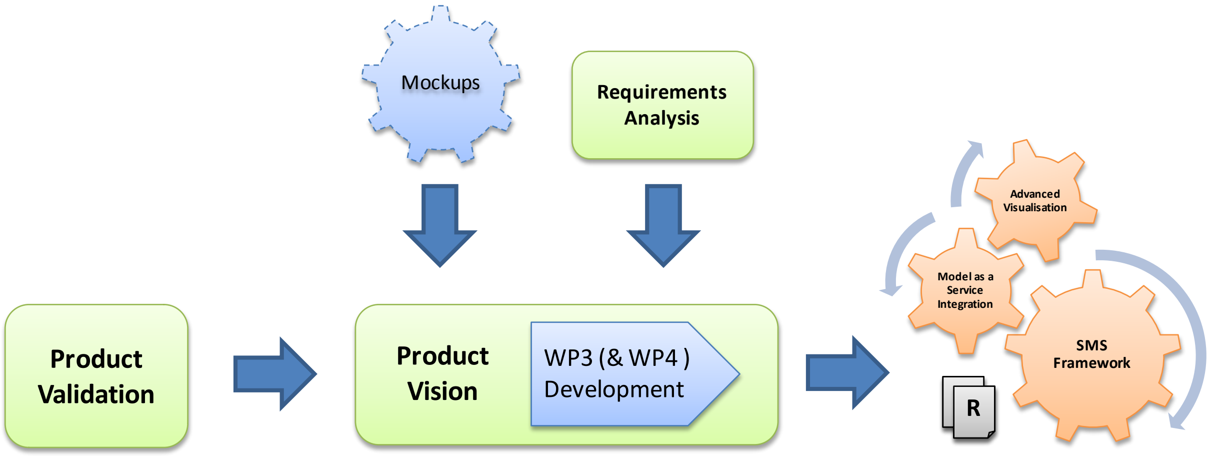


Figure 6: Second Year Development

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).

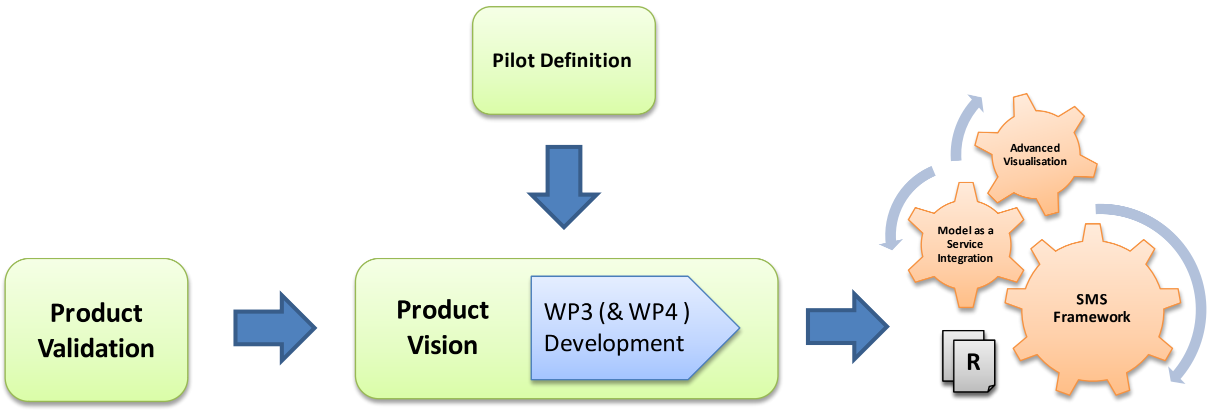


Figure 7: Third Year Development

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 sections 3.2 – 3.4 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.

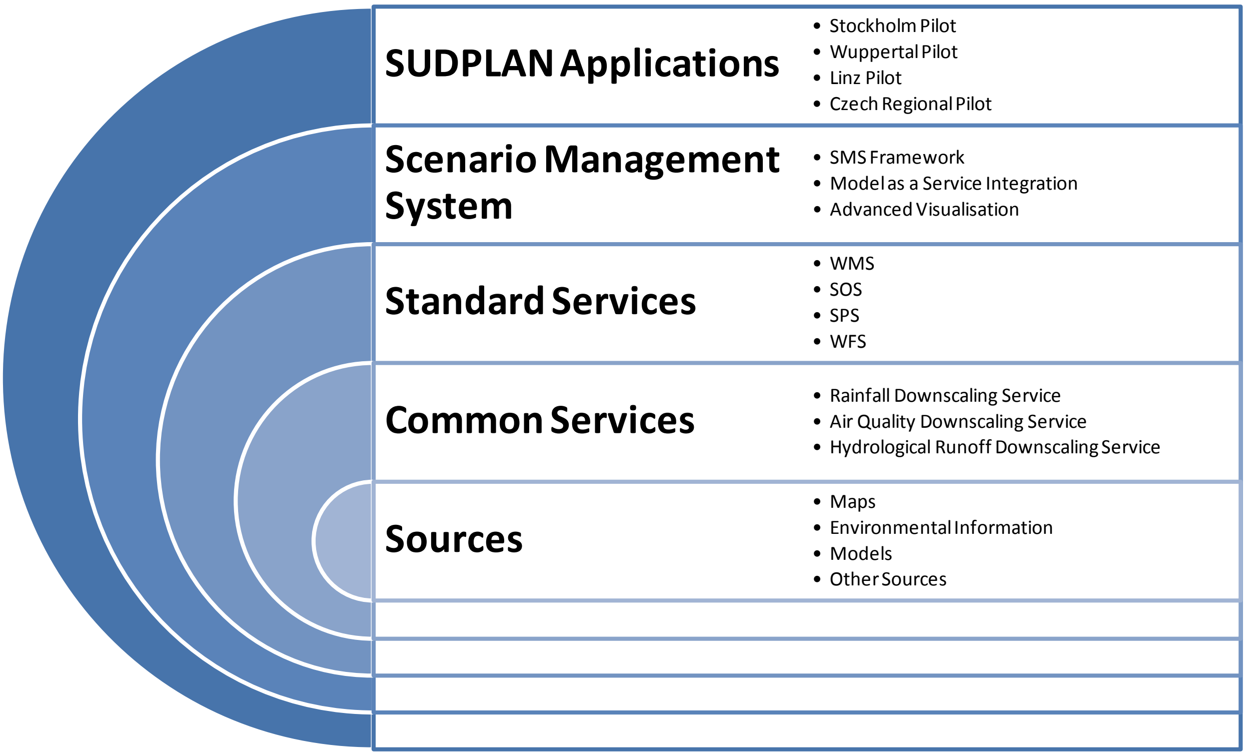


Figure 8: SUDPLAN Layered Architecture

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).

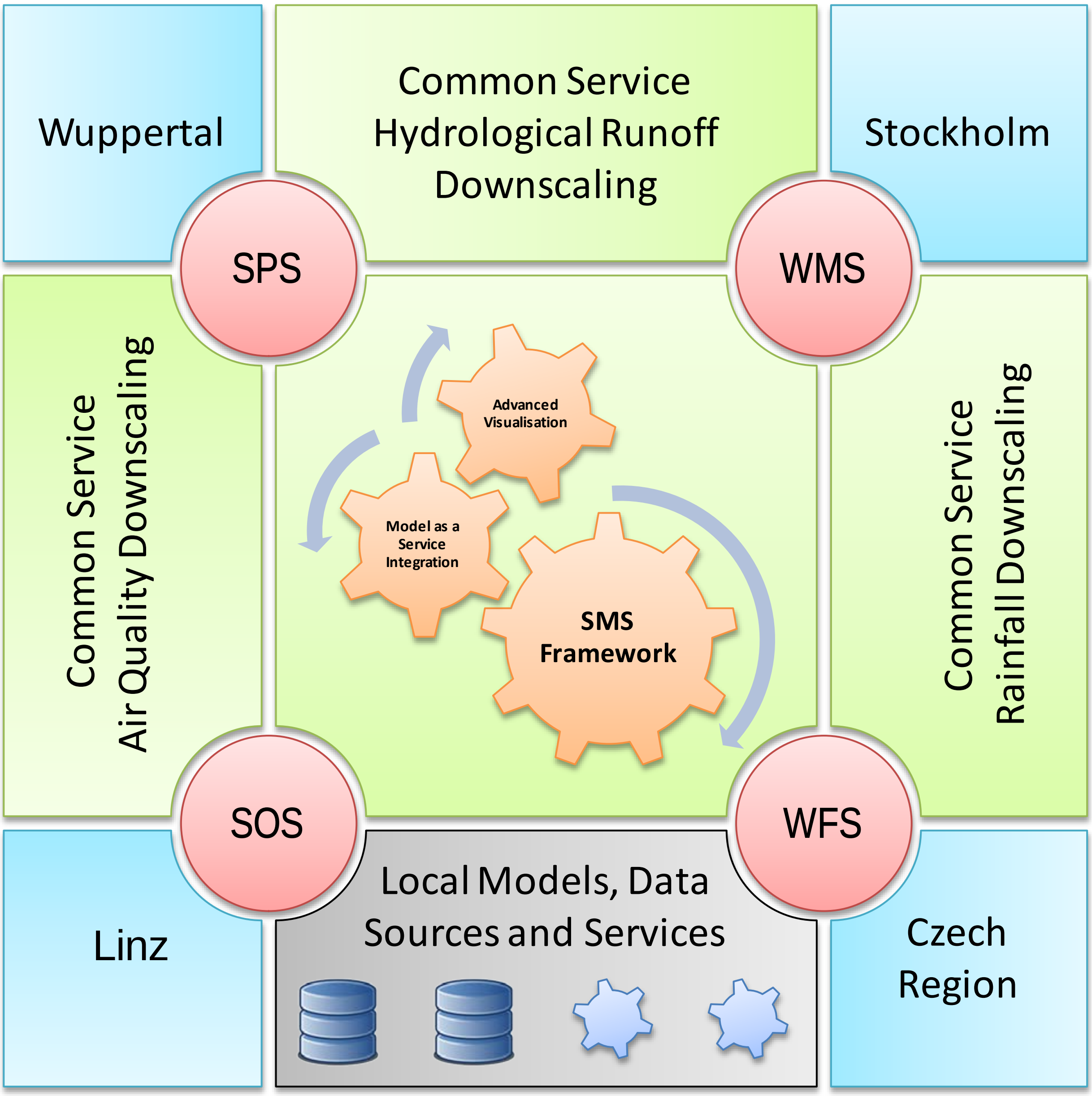


Figure 9: OGC Services Integration

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. Core Technologies

The choice of technologies, products and software components for the implementation of the SUDPLAN product was driven by the requirement to provide a sophisticated yet simple to use planning tool. The goal of the project was to develop a mature software solution that can be adapted to the needs of any European city with minimal effort. In order to reach this goal it was necessary to select software components that already provide the infrastructure and a certain set of core functionality. Furthermore, the SUDPLAN product had to adhere to certain fundamental expectations expressed in the DoW, which imposed certain technical requirements on the type of software components that have been selected for the implementation. Moreover, the SUDPLAN partners involved in the implementation of the SMS Building Blocks had to be able to extend, configure and adapt the selected software components in consideration of their personal expertise, the planned resources and the given time frame.

3.1.1. Scenario Management

The aforementioned considerations have already been taken into account during the preparation of the project, and have led to the plan to use the cids product of cismet as the basis for the SMS Framework. Cids (http://www.cismet.de/cidsDeveloperFAQ.html) is an open source toolkit for the management and integration of complex, heterogeneous, multi-domain, multi-use data of both a temporal and spatial nature. It has been used in the ICT context, including FP4 and FP5 projects. cismet, as developer of cids, has the necessary knowledge to adapt it to SUDPLAN needs, thus developing SUPDPLAN specific extensions and providing integration and training support for the rest of the consortium.

3.1.2. Model as a Service Integration

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.

We decided to use the TS-Toolbox because it 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. In the SANY project, we found that the use of existing SOS and SPS implementations, e.g. from 52° North Initiative [SOS52N, 2011] is not feasible as they are complete systems, and they are not built to act just as an interface implementation to wrap existing models or data bases. Many parts of the TS-ToolBox, especially on the client side, can be used or adapted to suit SUDPLAN needs.

3.1.3. Advanced Visualisation

It was decided to use the freely available World Wind Java SDK component as the basis for the development of the Advanced Visualisation Component. The integration of NASA's World Wind SDK allowed focusing only on the visualisation and animation of 3-D results and predictions, in particular using the 3-D landscape.

The World Wind SDK is a free and open source Java-API for a virtual globe released under the NASA Open Source Agreement (NOSA). The framework provides a powerful platform for giving the means to express, manipulate and analyse data of interest. World Wind provides many features for displaying as well as interacting with geographic data and representing a wide range of geometric objects. Moreover, extending the API is simple and easy to do. World Wind features include:

- Open-source, high-performance 3-D Virtual globe API and SDK
- Open-standard interfaces to GIS services and databases
- Display high-resolution imagery, terrain, and geographic information from any open-standard public or private source
- Huge collection of high-resolution imagery and terrain from NASA servers
- Supports Coordinate System: Lat/Lon, UTM, MGRS
- Supports of GeoTIFF, JPG, PNG, and JPEG2000
- Supports standard GIS formats: Shape file, KML, GML, GeoJSON
- Different Navigation Modes are being supported
- Supports visualisation for stereoscopic displays

Organizations across the world use and support the on-going development of World Wind to monitor weather patterns, and visualize cities and terrain. With World Wind taking care of the basic concepts of visualizing geographic data on a virtual globe, we are now able to focus on solving the domain specific problems and to focus mostly on the visualisation and animation of 3-D results and predictions, in particular using the 3-D landscape.

3.2. 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.

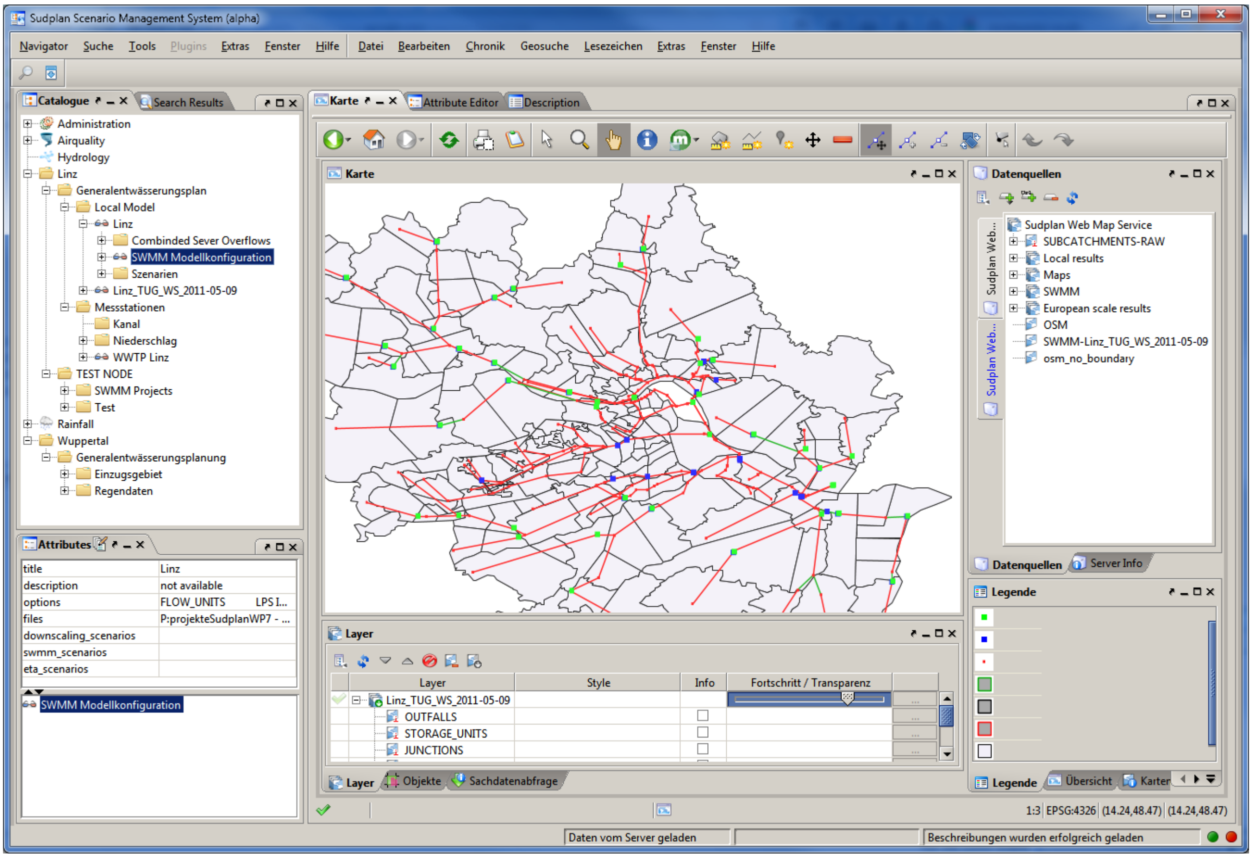


Figure 10: SUDPLAN SMS GUI

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 1-D time series, and 2-D 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.

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 2-D visualisation (OGC WMS and WFS clients). The architecture and the core components of cids and the SMS Framework are presented in the following.

[1] http://www.cismet.de/cidsWhitepaper.html

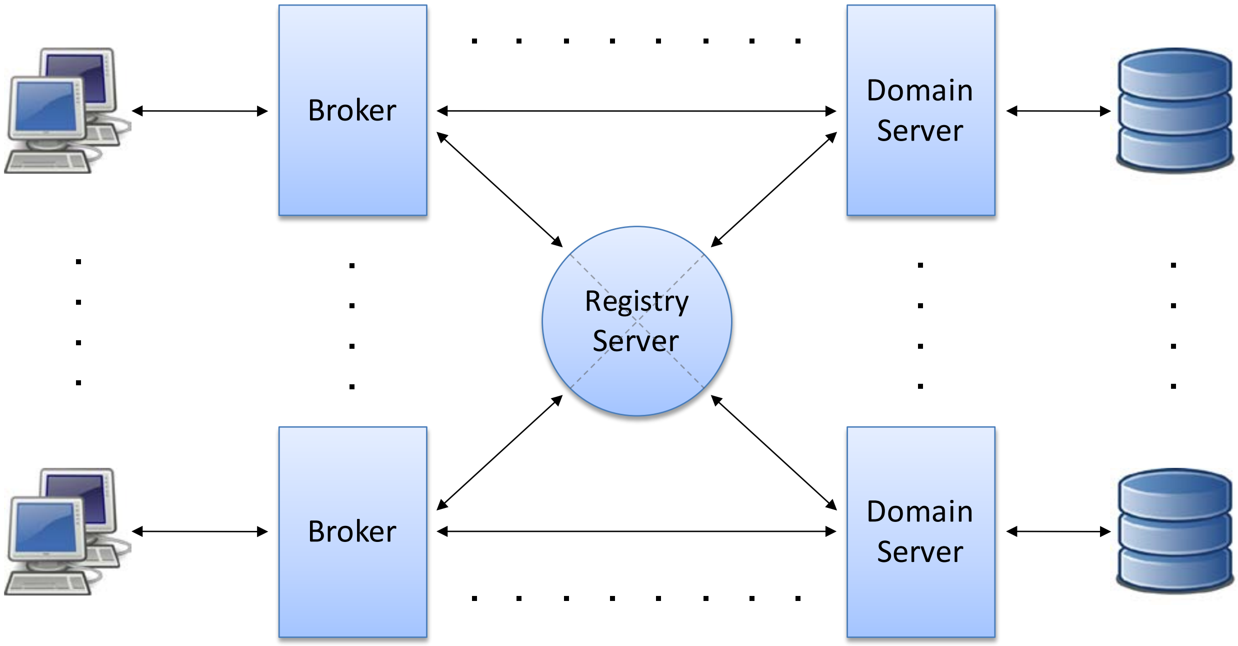


Figure 11: SMS Framework client-server Architecture

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.*

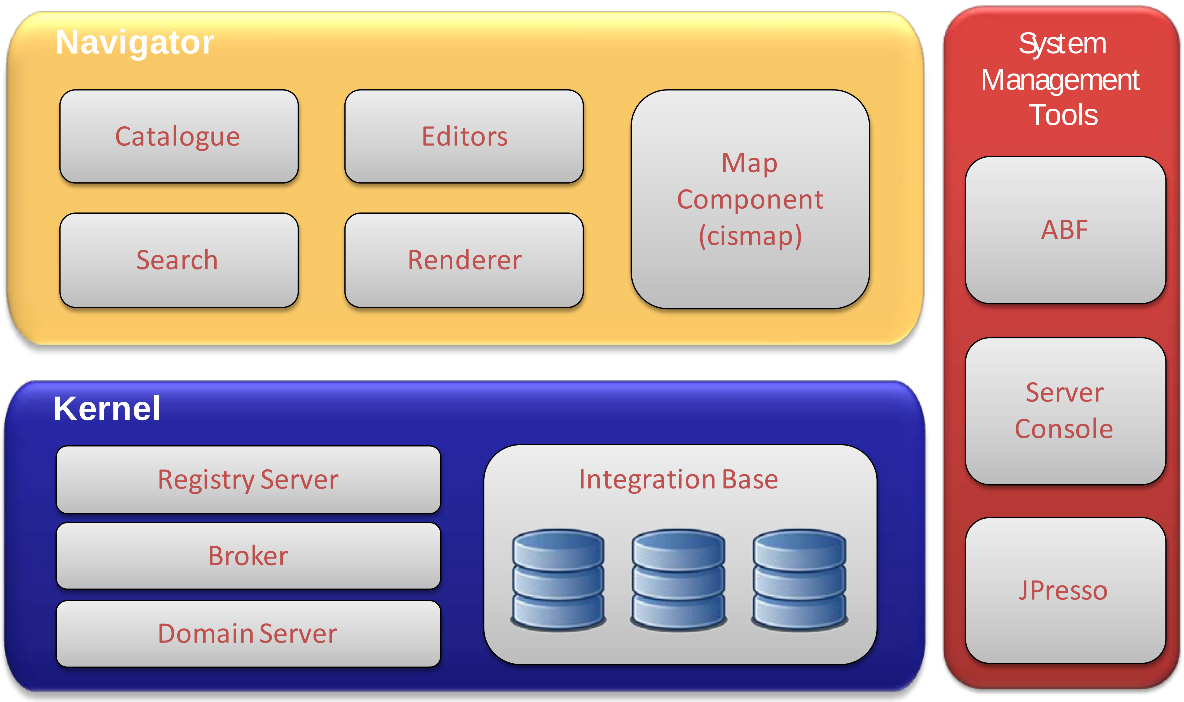


Figure 12 Building Blocks of the SMS Framework

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.

3.3. 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.

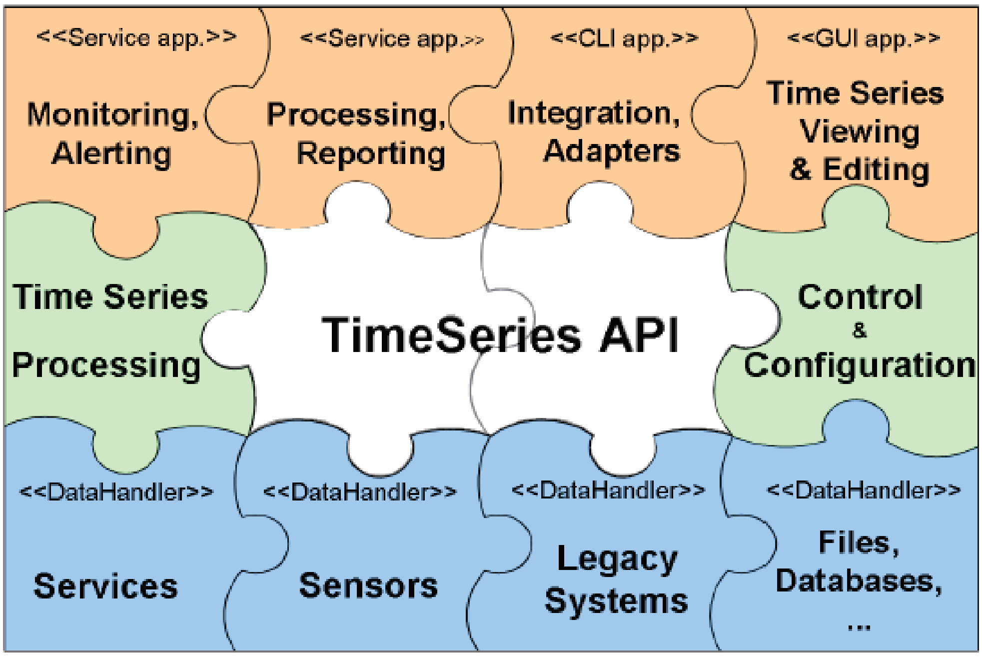


Figure 13: Elements of the TimeSeries ToolBox

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).

3.4. Advanced Visualisation Component

The SUDPLAN SMS functionality includes “*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 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 have used suitable and stable open source software as much as possible.

Additionally, we 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.

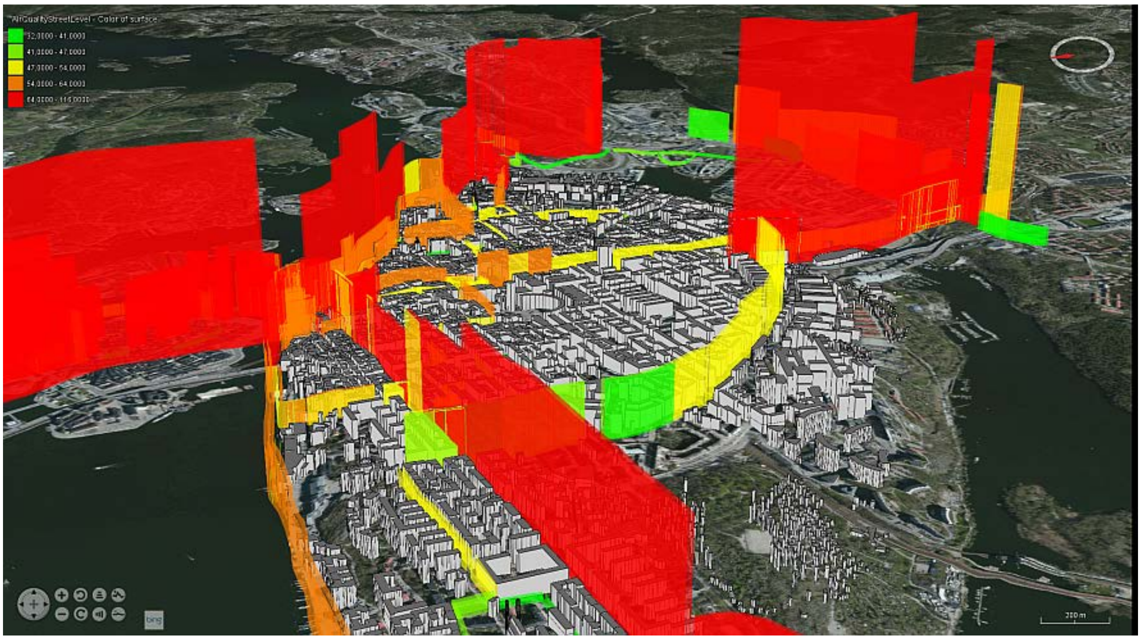


Figure 14: 3-D Visualisation of Air Quality and Traffic Density in Stockholm

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 visualisation is able to focus on suitable visualisation techniques.

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 visualisation component has to take care of this fact as well and can be started directly from the browser.

3.5. Feature Summary

This section summarizes the features of the SMS framework. The latest release supports a number of vital features that are used to access, visualise and compare Common Service results as well as local models results. In summary, the features included in the software are:

- Enhanced local and downscaled data (time series, IDF curves as well as custom pilot data) import and export facilities
- Support for Hydrology Common Service
- Euler 2 Rain Event generation
- Enhanced model result visualisation (2-D time series)
- Model Result (Scenario) Comparison (2-D time series) including visual comparison support, time series operations and 2-D map interaction
- Model management (information related to a model, i.e. meta information)
- Enhanced Asynchronous model execution (incl. model state persistence)
- Management of model runs, results and parameterization
- Basic model result visualisation (1-D time series, 2-D maps)
- Model Result (Scenario) Comparison (1-D time series) including visual comparison support, time series operations and 2-D map interaction.
- Integration of temporal aspects of 2-D map visualisations
- Search and discovery of objects of concern (e.g. results, scenarios)
- OGC SOS (TS-API based), SPS (TS-API based), WMS and WFS integration capabilities.

- Support for Rainfall (time series & IDF)
- Air Quality Common Services
- Pan-European Common Services (climate change parameters)
- Local model integration support
- Integration facilities for local data (time series)
- Access to downscaling functionality through a set of Common Services
- Dedicated SOS and SPS services to be accessed from the SMS framework
- Supporting access of Common Services implementing OGC service interfaces
- Access to local data and model results as well as upload model input through SOS
- Model execution through SPS
- Integrated virtual globe as advanced 3-D visualisation component
- Enhanced user interface for easily setting up visualisations using the wizard VisWiz
- Component to manage visualisation techniques and results
- Time series visualisation
- State-of-the-art classification algorithms to support visualisation techniques
- Enhanced IO-Module for customized geodata, e.g. GeoCPM data Wuppertal
- Visualisation of iso-surfaces using Marching Cubes algorithm
- Visualisation to present the simulation results from Wuppertal Pilot in 3-D
- Integration of Animation for visualisation techniques
- Integration of WMS layer at defined heights above sea level
- Ability to render the 3-D virtual globe on a back-projected stereoscopic large display

The current version of SMS related software can be found at: http://sudplanwp3.cismet.de/sms/.

4. SMS Integration, Testing and Software Validation

The goal of *T3.4 Integration, testing, software validation* 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 with 3-D Visualisation Component* shows a screenshot of the prototype of the integrated SUDPLAN SMS including the advanced visualisation component (3-D Map on the right).

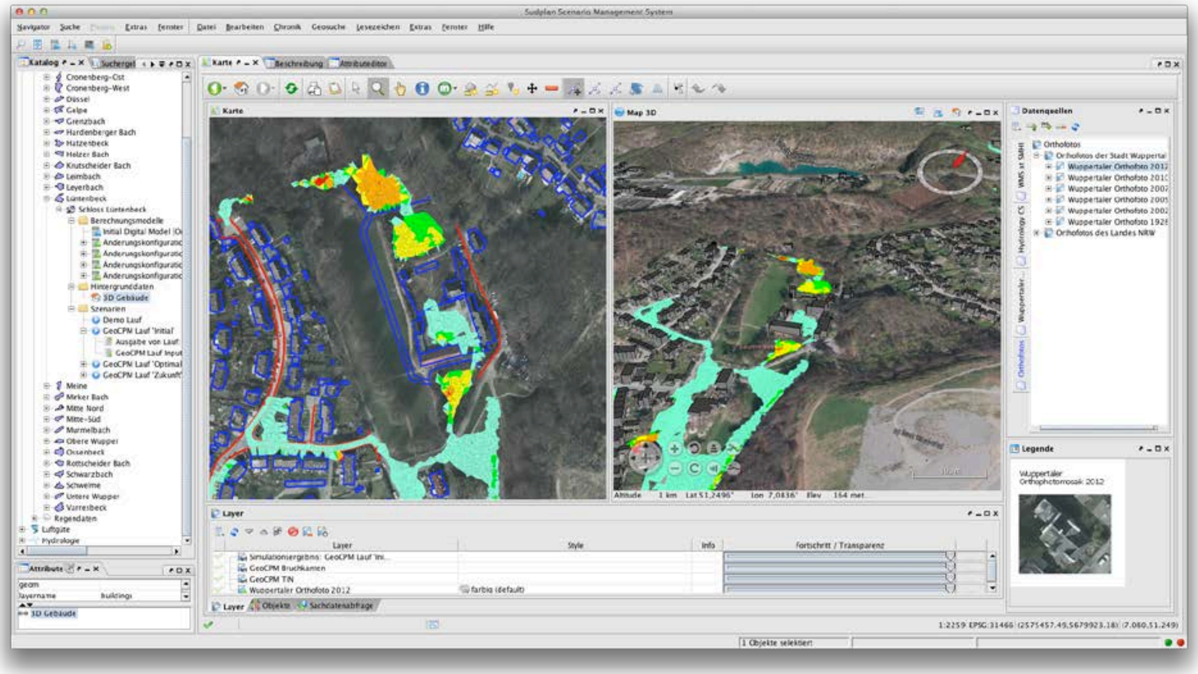


Figure 16: Integrated SMS with 3-D Visualisation Component

The source code as well as the compiled libraries of the complete application can be downloaded from http://repo.cismet.de as maven artefacts or alternatively the source code can be viewed and cloned from http://github.com/cismet. Since the SMS is web-enabled, it is also possible 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]

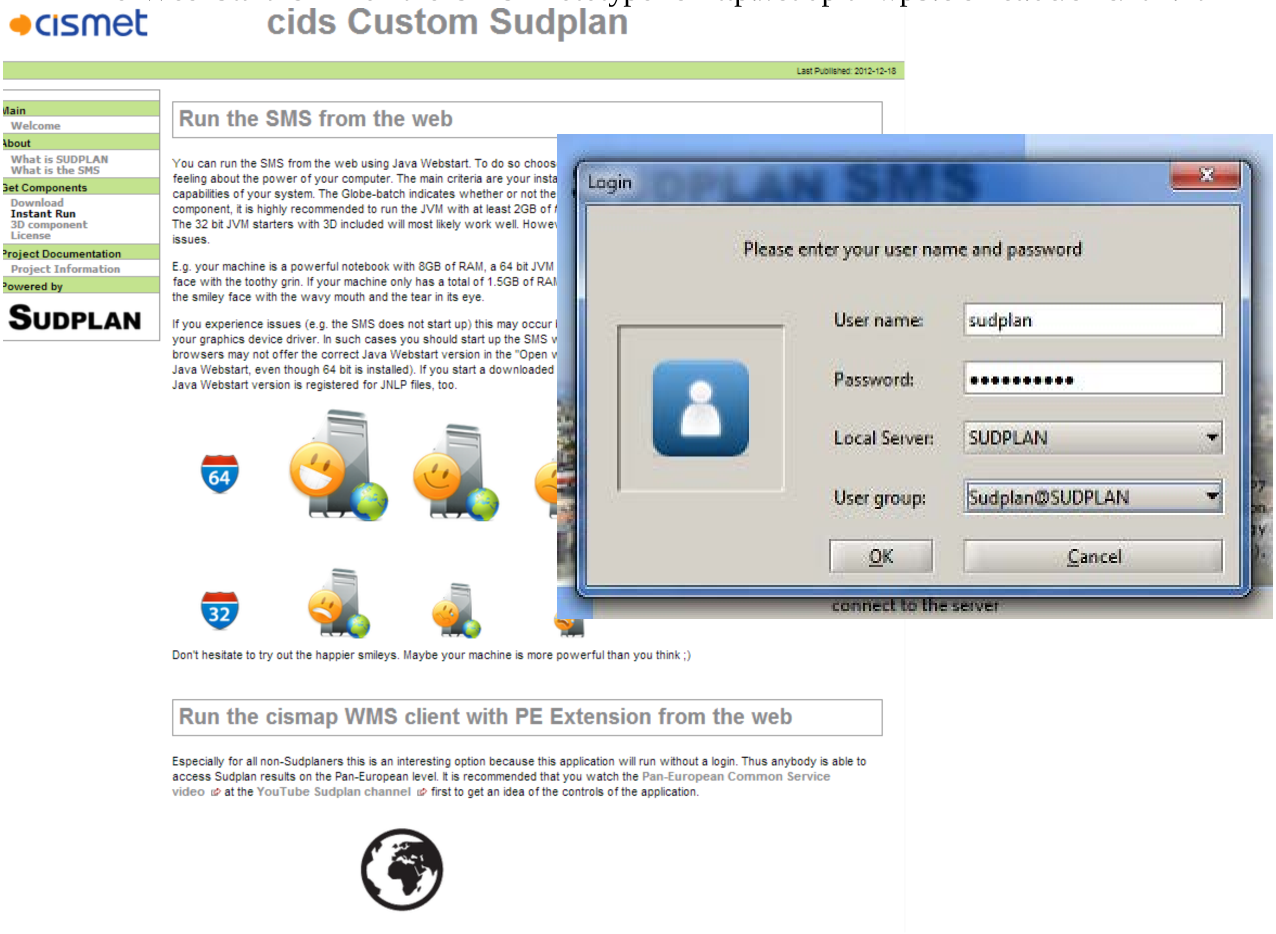


Figure 18: SMS Login Dialog

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]. Additionally there are feature videos available at the SUDPLAN web site (http://sudplan.eu/Results/Workshop/SUDPLAN-workshop) as well as at the SUDPLAN YouTube channel (http://www.youtube.com/user/Sudplan).

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:

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

- **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

- **Jenkins CI Server** [JENKINS]
  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)

- **git** [GIT]
  is used for source code revision control and keeps track of source code changes.

- **GitHub** [GITHUB]
  is used as a public online source code repository as well as 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 Jenkins 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.

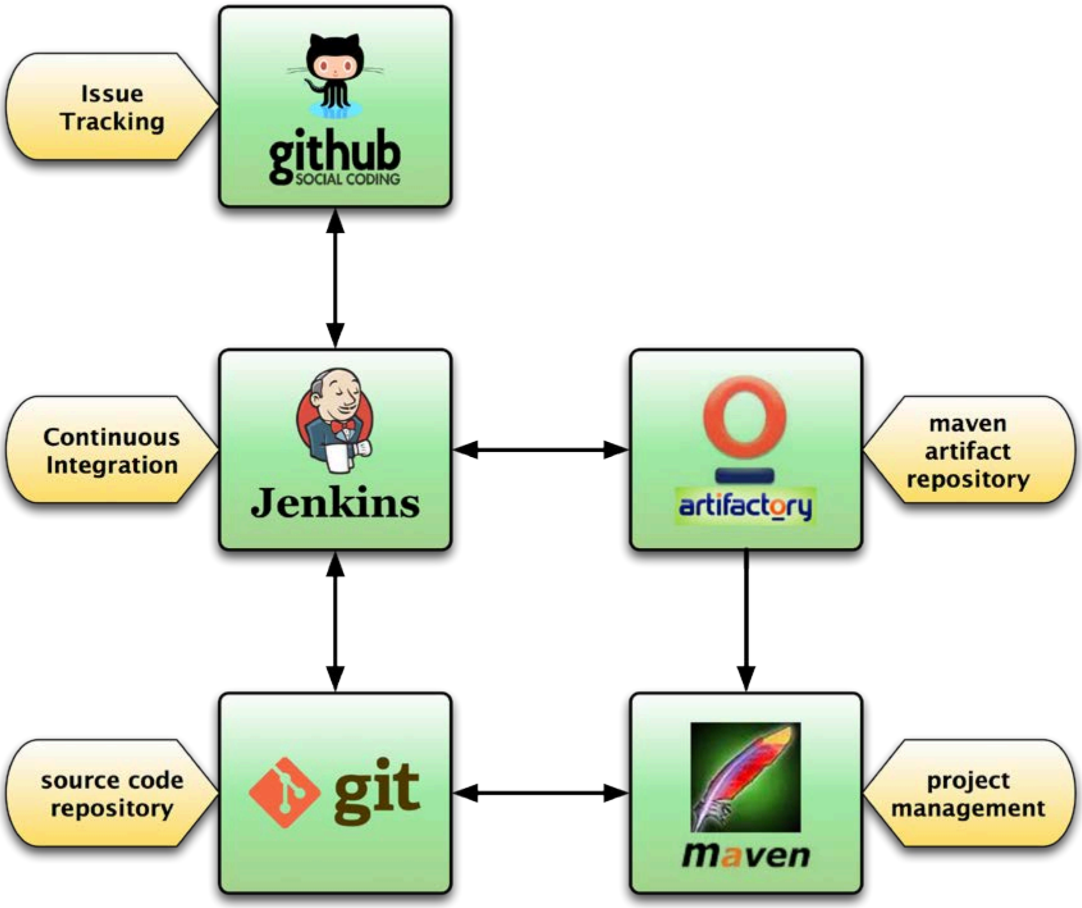


Figure 19: Software Development Infrastructure Interaction

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

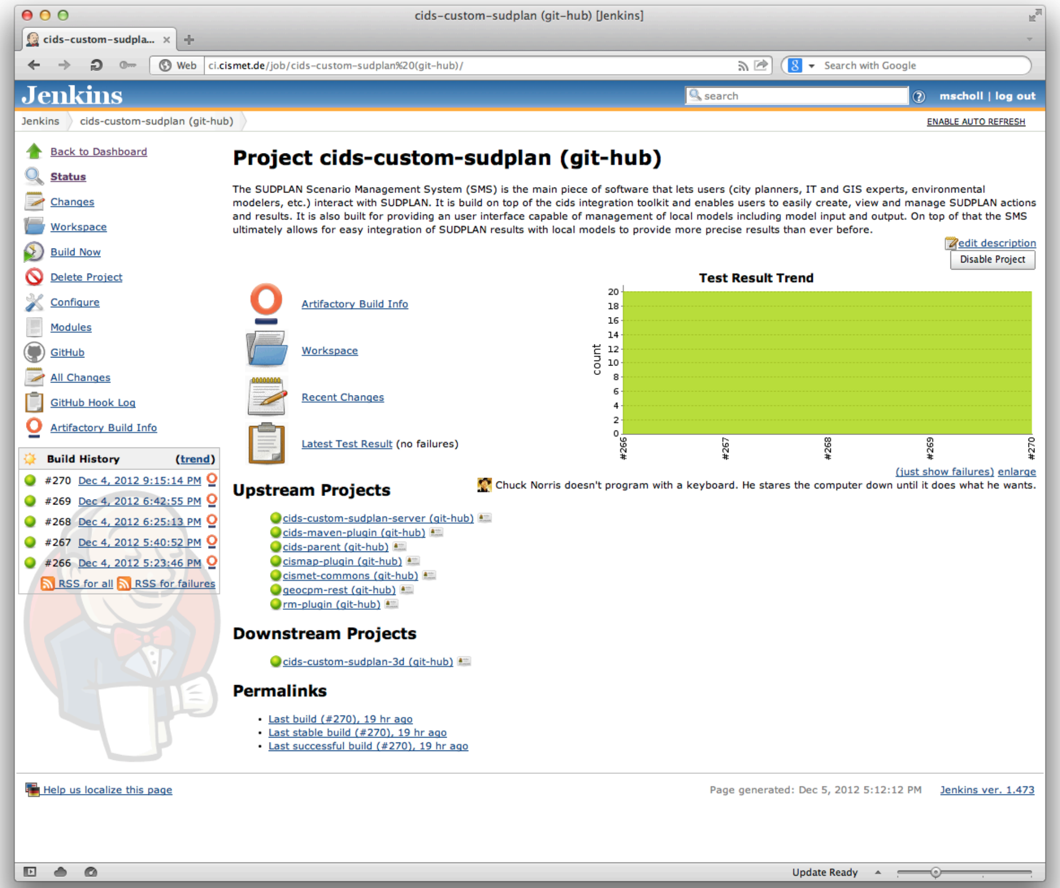


Figure 20: Jenkins Continuous Integration Web Interface

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 Jenkins web interface (*Figure 20: Jenkins Continuous Integration Web Interface*).

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 use cases supported by the final SMS release 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: Execute IDF Rainfall Downscaling
- Use Case #05: Local Data Upload
- Use Case #06: Local Model Integration
- Use Case #07: Time Series Visualisation & Comparison
- Use Case #08: Execute the 3-D Visualisation Wizard
- Use Case #09: Visualisation of 3-D air quality data using iso-surfaces
- Use Case #10: 3-D Animation of "Water-run off" simulation results
- Use Case #11: Execute Hydrology Downscaling
- Use Case #12: Emission Database Upload
- Use Case #13: Grid comparison
- Use Case #14: Data export
- Use Case #15: Rain event generation

These use cases depict the main SUDPLAN SMS functionality. They cover the integration of all four Common Services (Pan-European Scale, Rainfall, Air Quality and Hydrology), the integration of the 3-D Visualisation Component and the integration of Local Models. Additionally they demonstrate the more general SMS facilities that are not only useful but essential to really be able to apply the SMS core features to gain real benefit. They are mainly focussed on the possibility to include local data in the workflow and how to visualise and export result data.

As those use cases evolved during the single implementation, integration and validation phases they are also suited to demonstrate the usability improvements that were accomplished.

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 were integrated into one application.

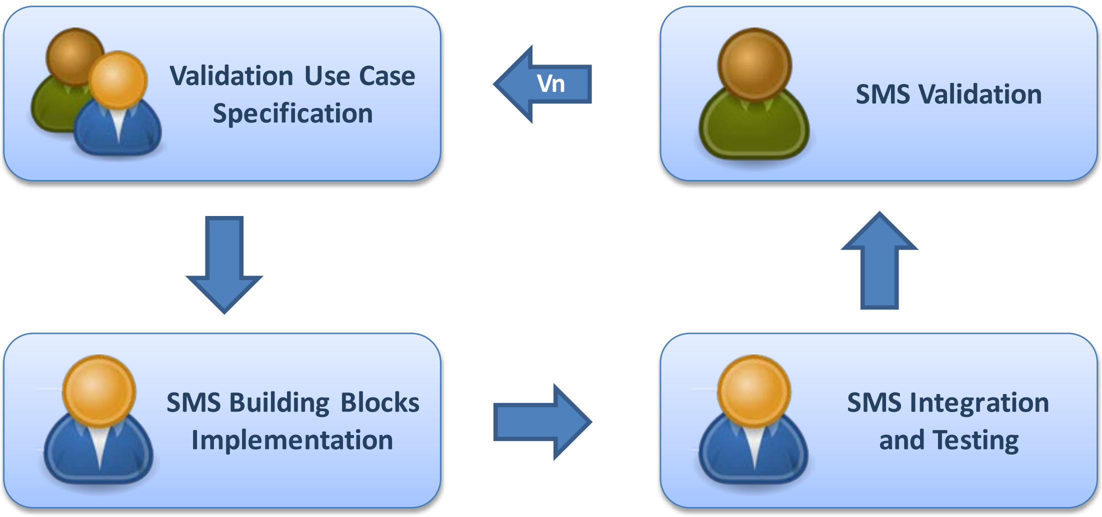


Figure 21: SMS Micro-Scale Validation Cycle

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).

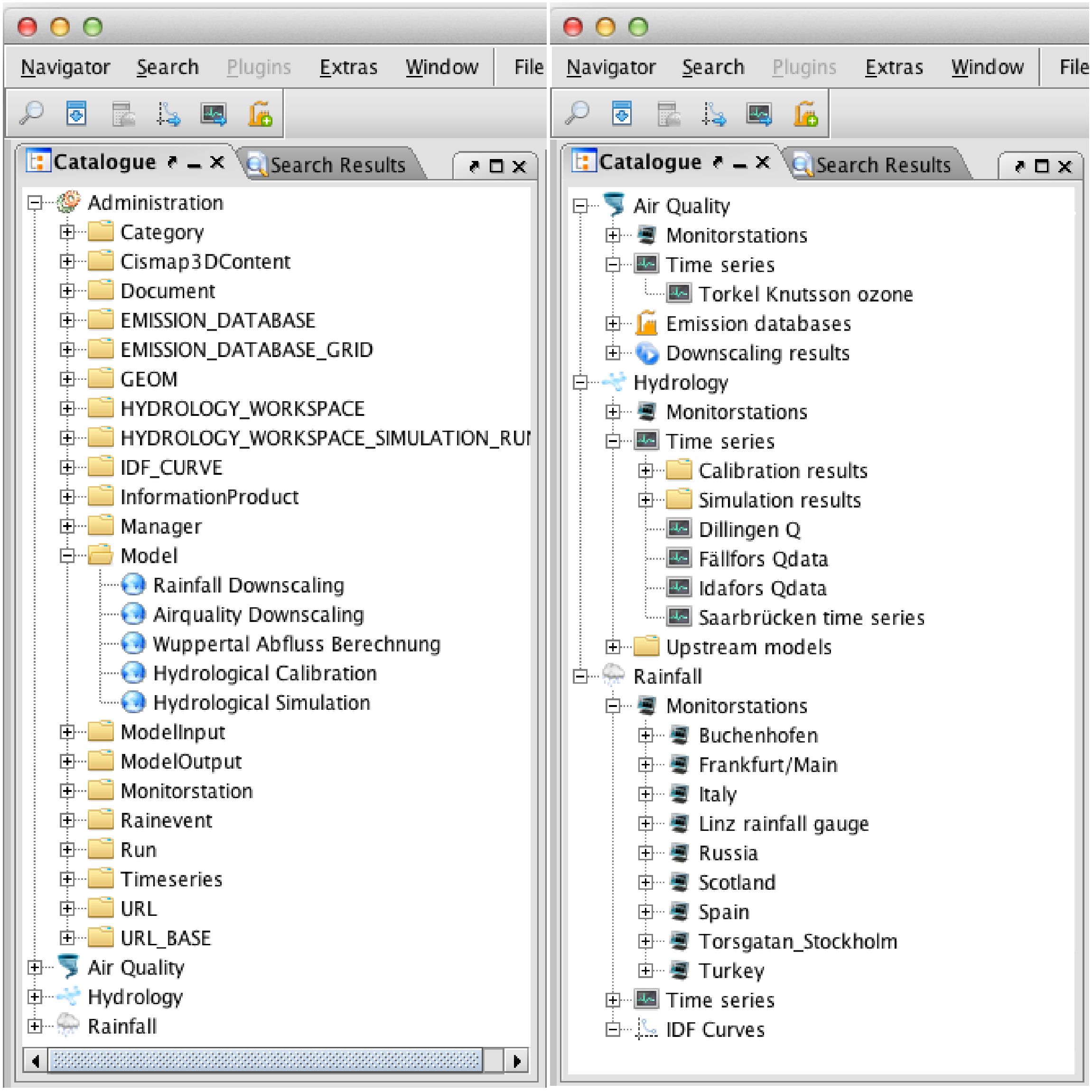


Figure 22: SMS Configuration for Validation Use Cases

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.

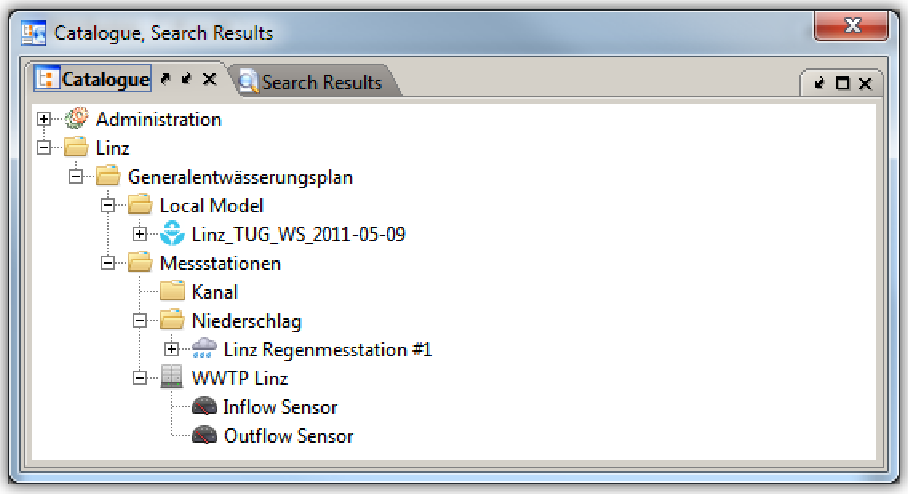


Figure 23: Local SMS Configuration for Pilot Applications (Linz Pilot)

The use cases were performed by the users of the SMS in order to validate the actual functionality of the 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.

	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	x		x	x	x		x
Use Case #05	x	x				x		
Use Case #06	x	x		x	x	x	x	
Use Case #07		x			x			
Use Case #08			x					x
Use Case #09			x					x
Use Case #10			x					x
Use Case #11	x	x		x	x	x	x	x
Use Case #12	x	x		x		x		
Use Case #13		x			x			x
Use Case #14	x				x	x		x
Use Case #15	x	x				x		

Table 1: SMS Validation Matrix

The validation uses cases are further 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
		CNRM 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
		CNRM 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
		CNRM A1B CLEO4.5 2		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
		CNRM A1B CLEO4.5 2		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
		CNRM A1B CLEO4.5 2		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
		CNRM A1B CLEO4.5 2		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, intensitry	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 can be made available through the SOS interface for a commercial product.

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

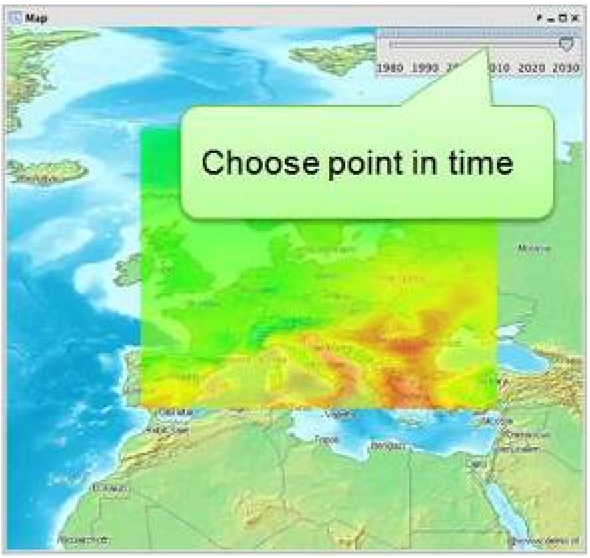


Figure 24: Validation Use Case 1

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.

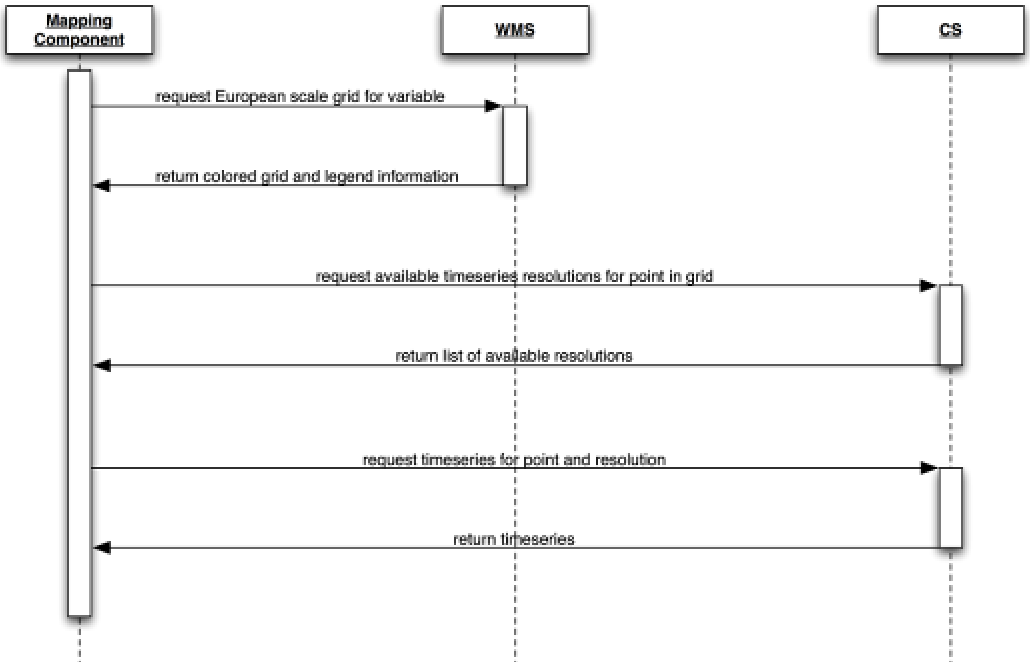


Diagram 1: Climate Scenario Information on the European Scale

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 time series visualisation component.

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.*

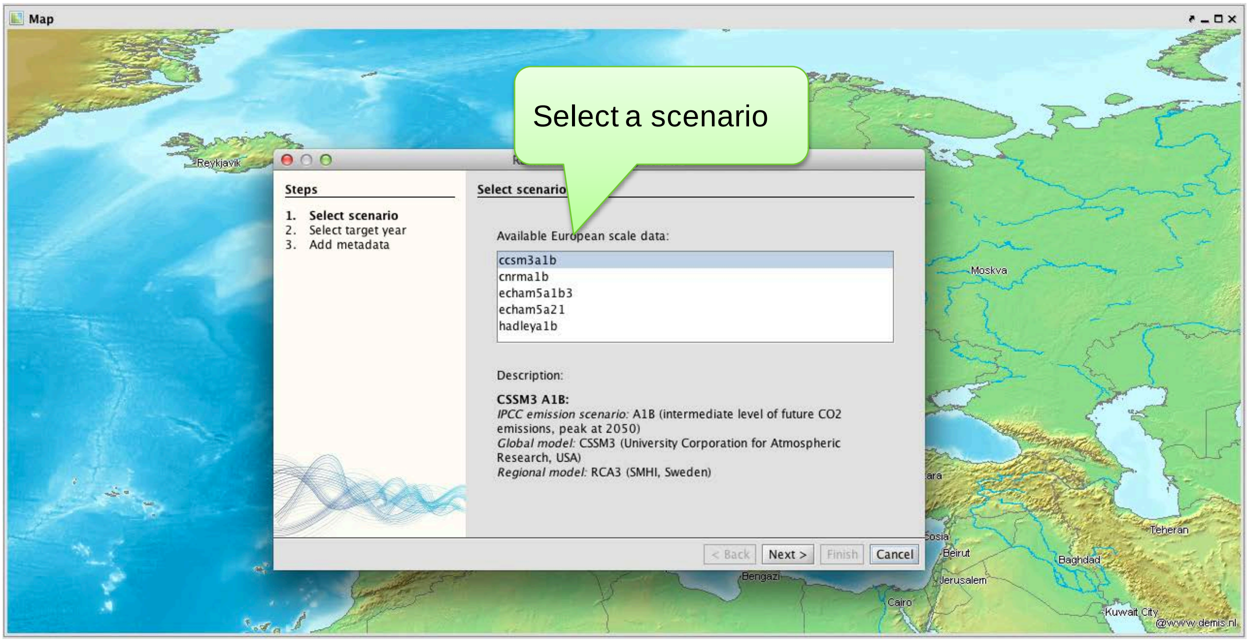


Figure 25: Validation Use Case 2

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.

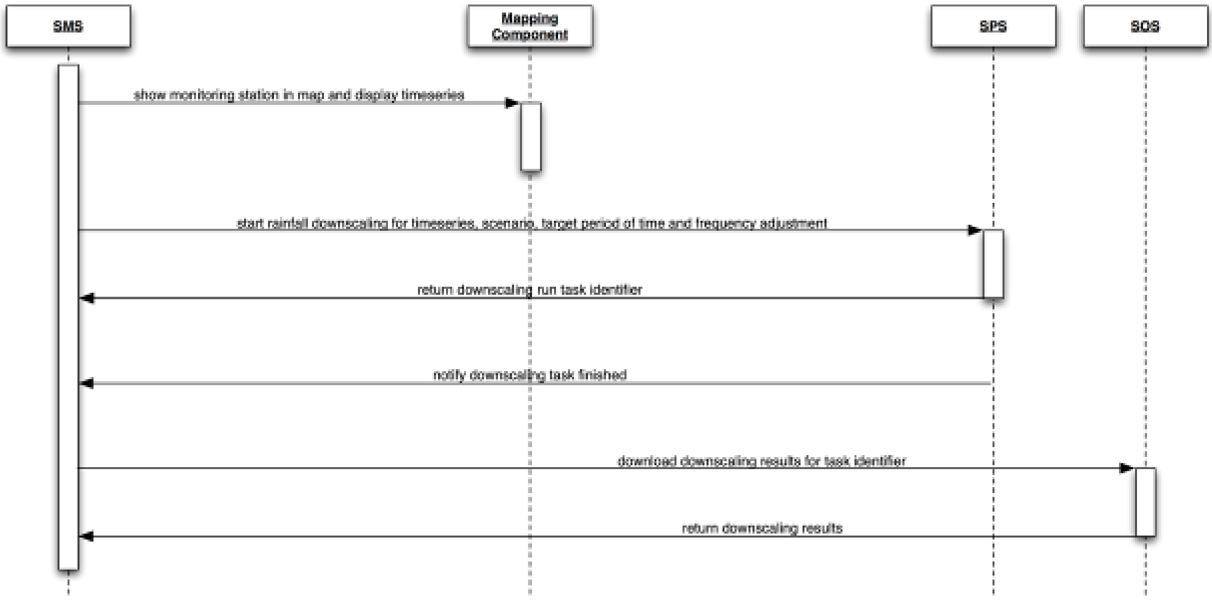


Diagram 2: Execute Rainfall Downscaling

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 of the time series object, either in the map or in the catalogue
   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 by finishing the wizard
   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 requests the downscaled results from the SOS and displays it.

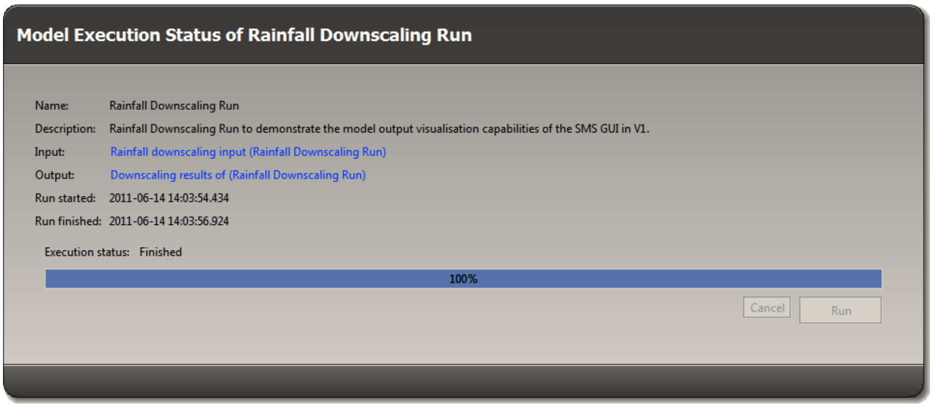


Figure 26: Monitor Model Execution Status

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.

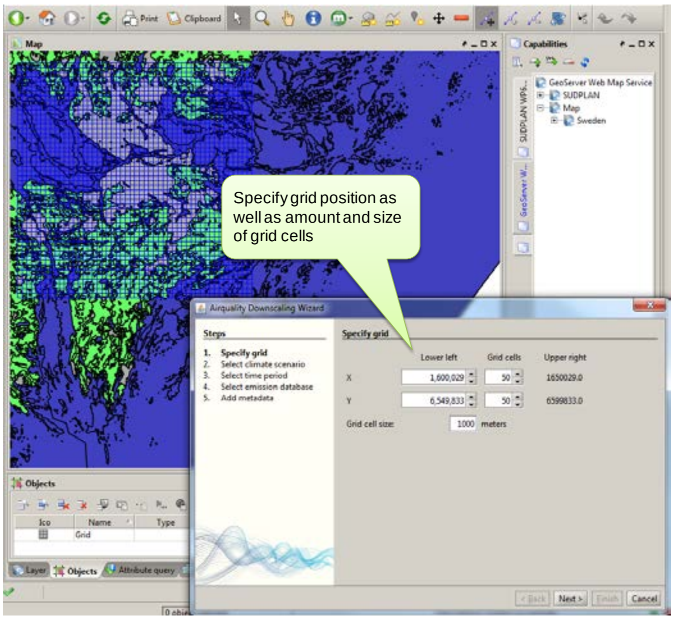


Figure 27: Validation Use Case 3

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.*

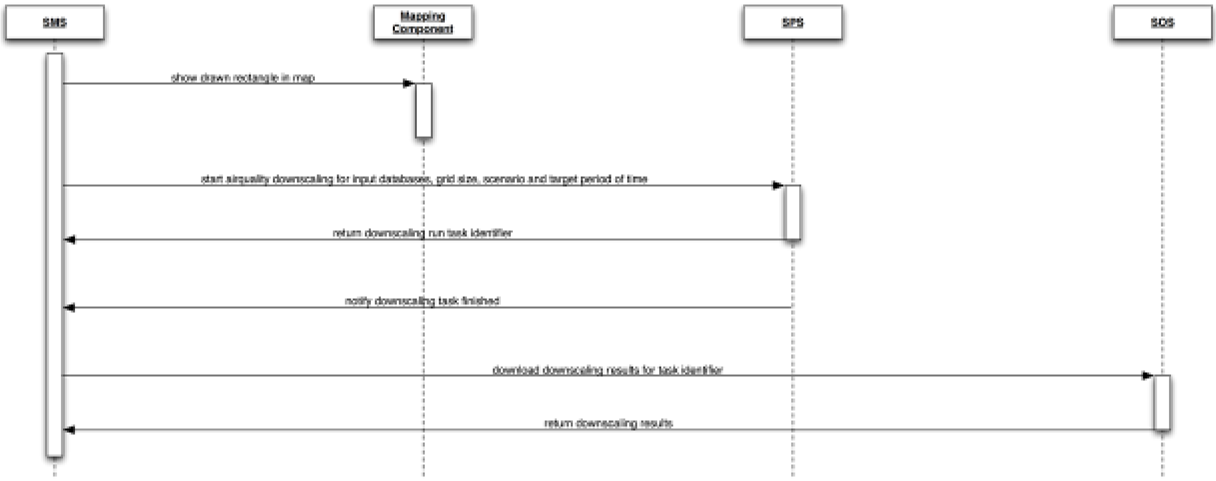


Diagram 3: Execute Air Quality Downscaling

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 Air Quality downscaling form the contextual menu of the rectangle
   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. 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.

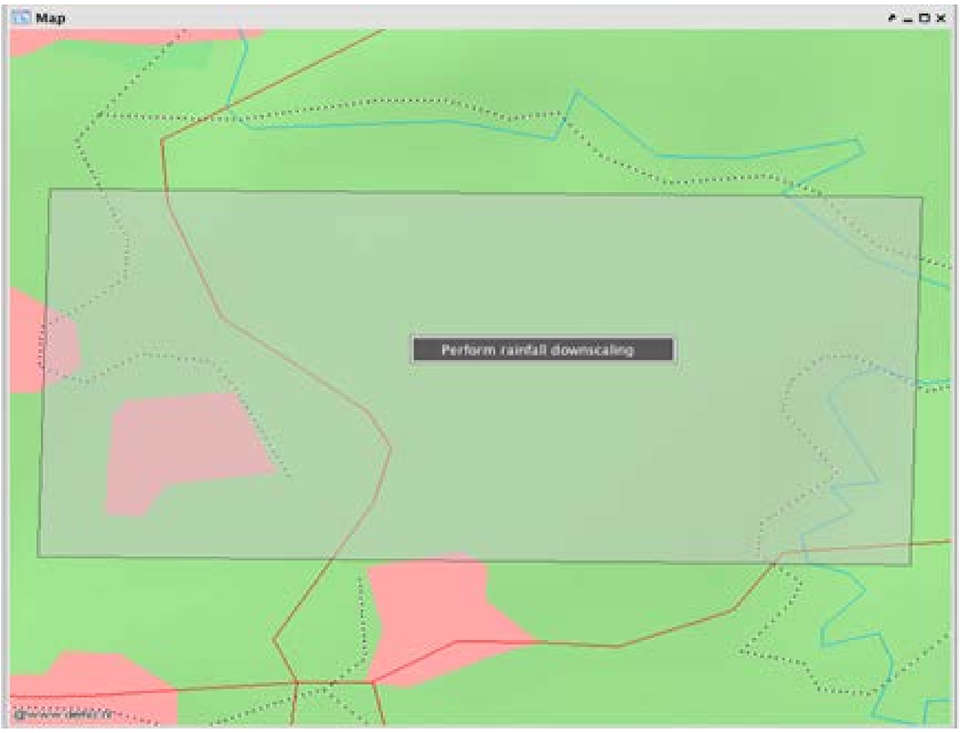


Figure 28: Validation Use Case 5

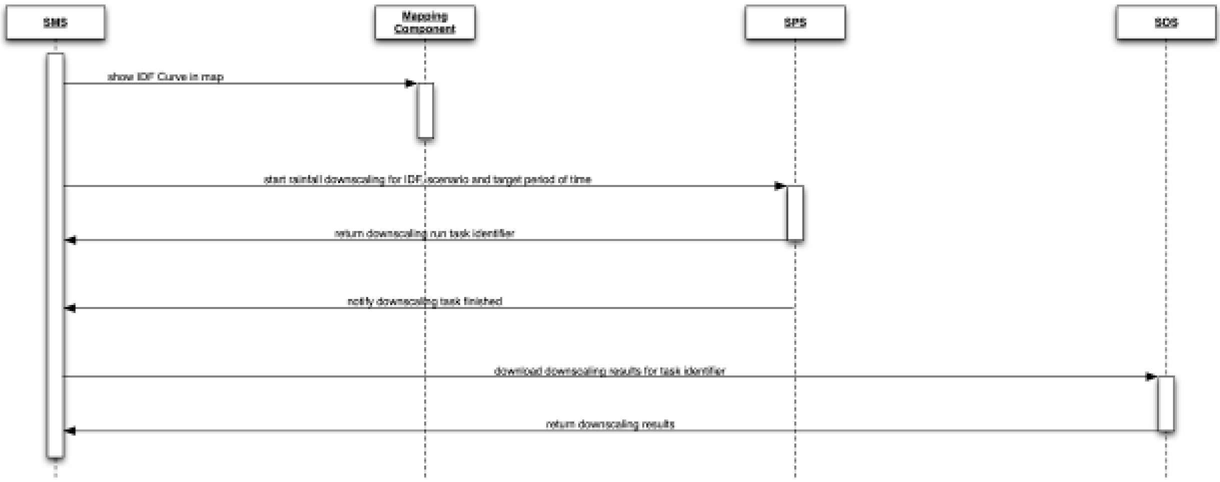


Diagram 4: Execute IDF Rainfall Downscaling

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 of the IDF object either on the map or from the catalogue
   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.

4.2.5. Local Data Upload

This validation use case refers to requirements related to rainfall input data management and import at the example of a time series import. It shows how users can upload their own time series data to the system. The procedure is the same for IDF data.

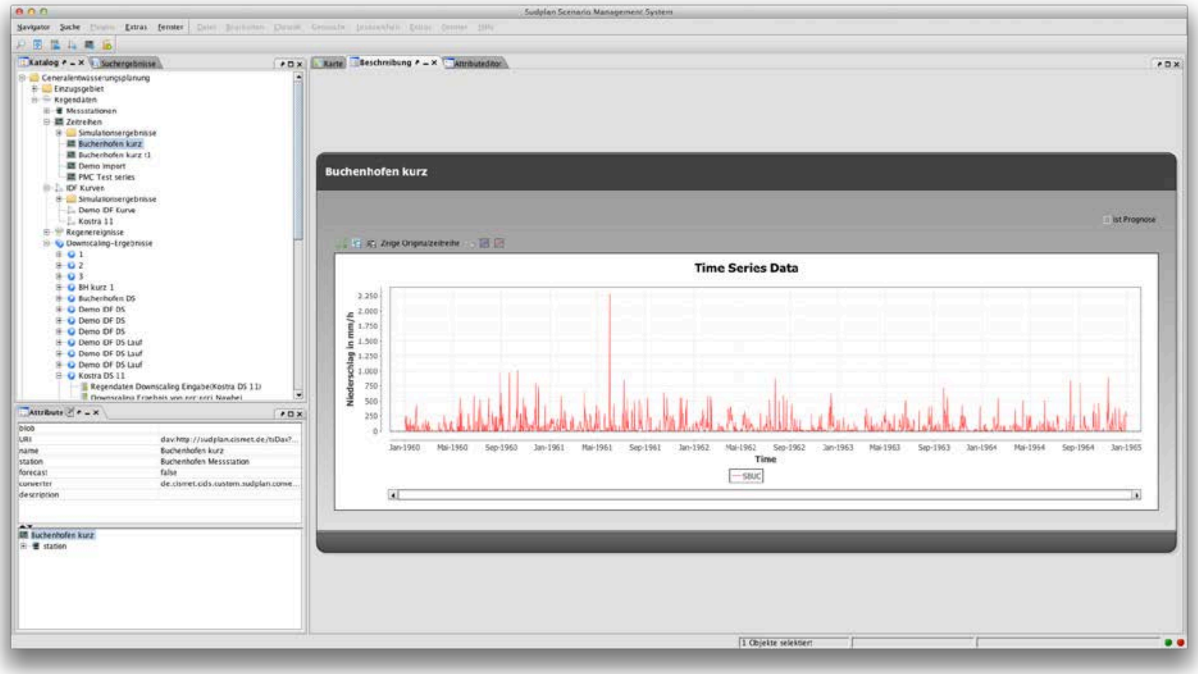


Figure 29: Validation Use Case 5

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 or WebDAV).
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.

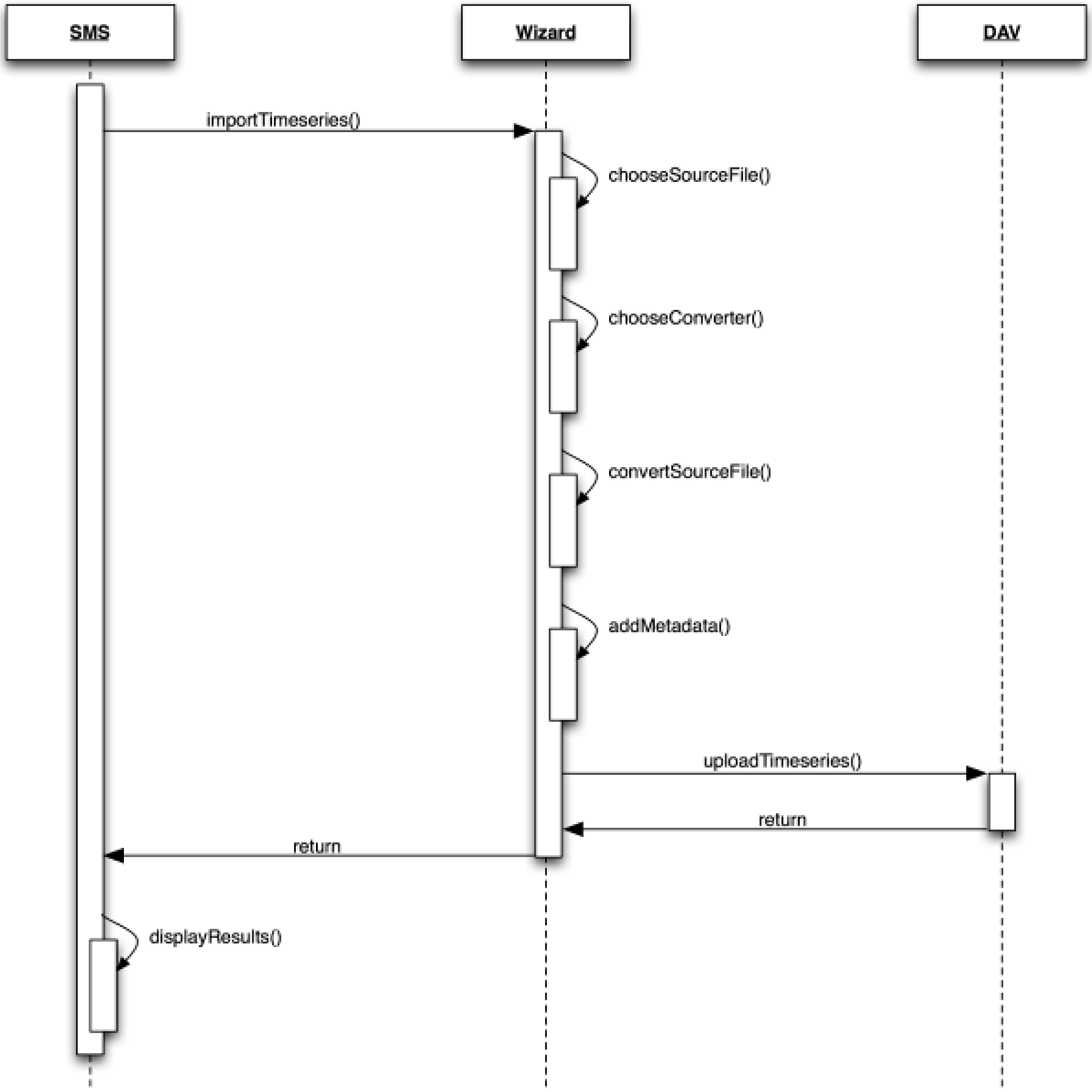


Diagram 5: Local Data Upload

4.2.6. Local Model Integration

The local model integration is validated as part of the pilot use cases implemented for V3. 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 V3 (Deliverables *D4.2.3 – D8.2.3).*

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 "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 #6 "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*).

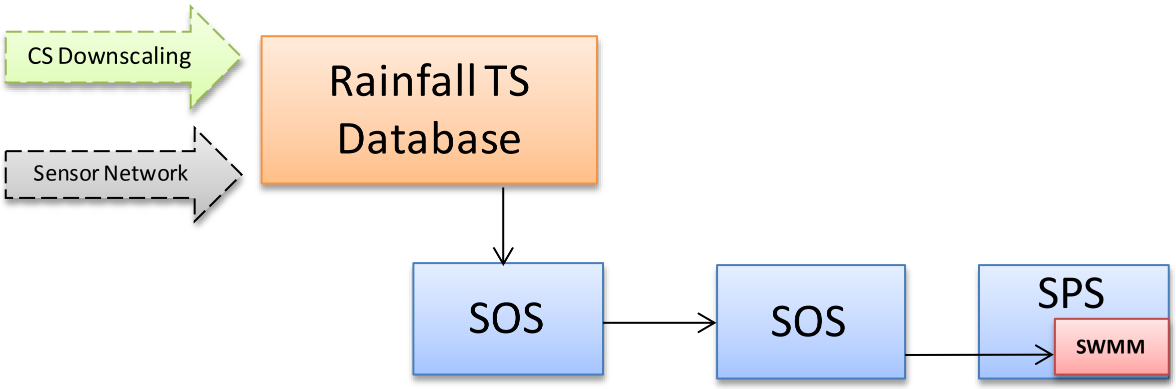


Figure 30: Linz Local Model Integration

As shown in *Figure 30: 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.

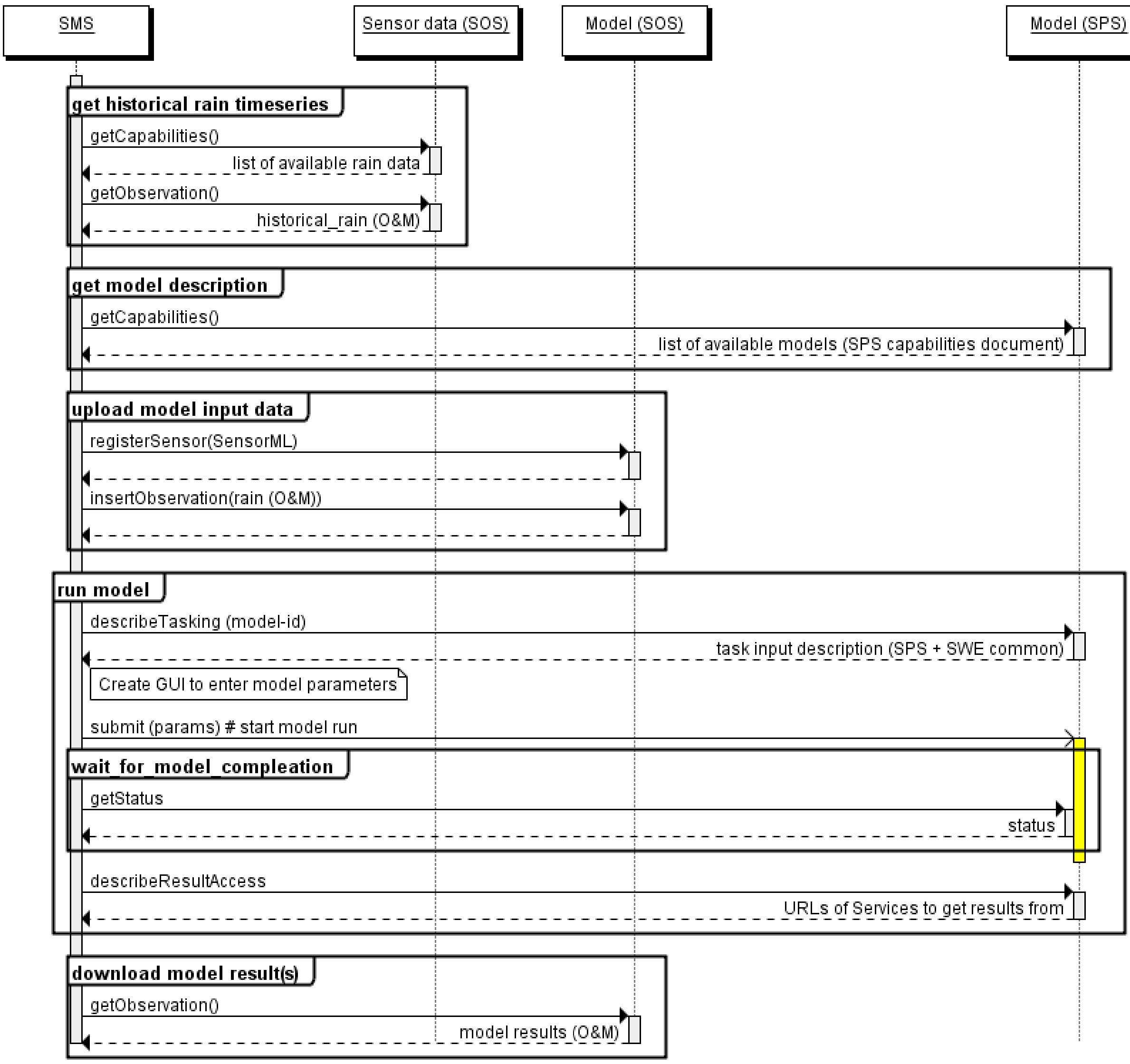


Diagram 6: Linz Local Model Integration

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 31: Validation Use Case 6 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.

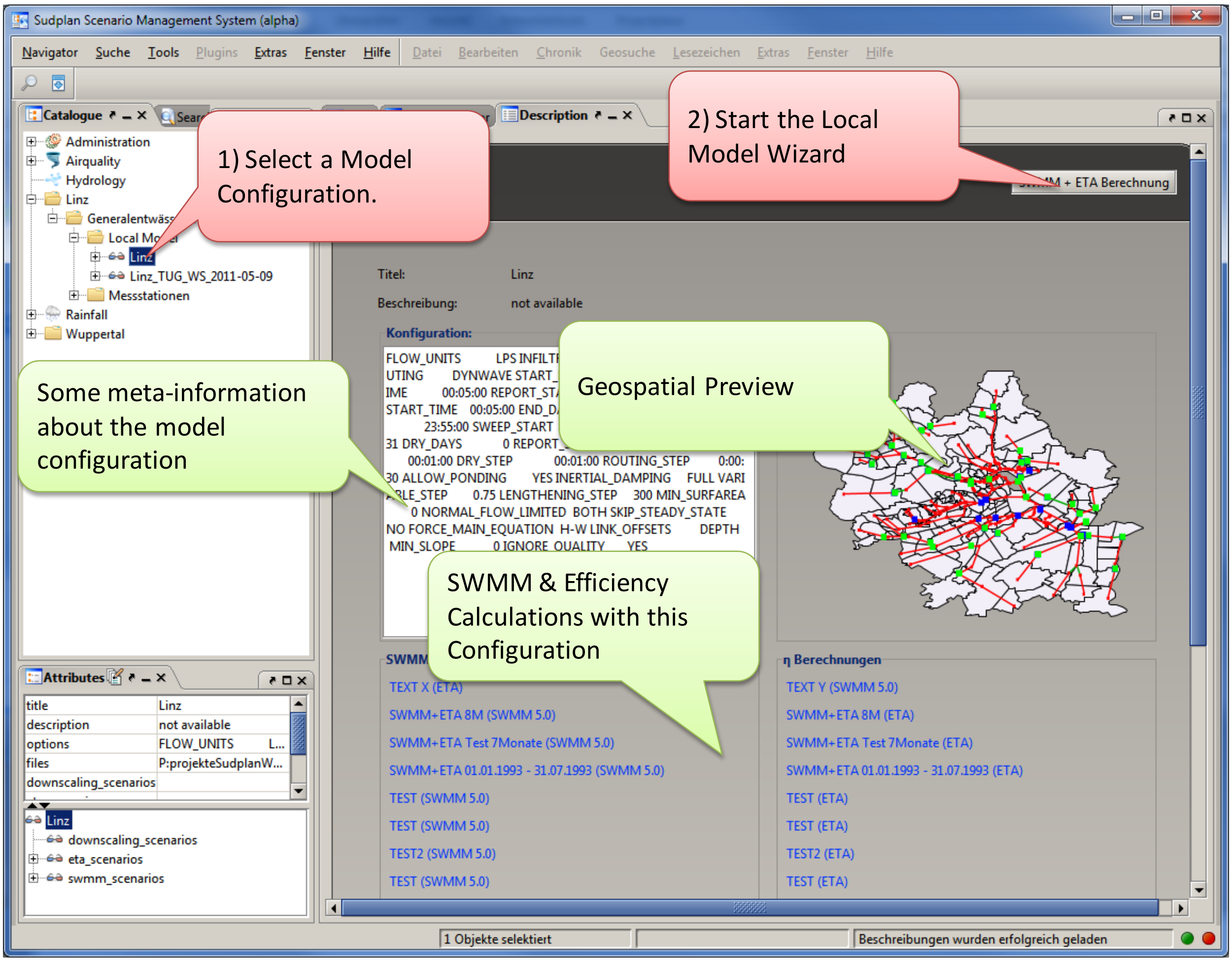


Figure 31: Validation Use Case 6

4.2.7. 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*.

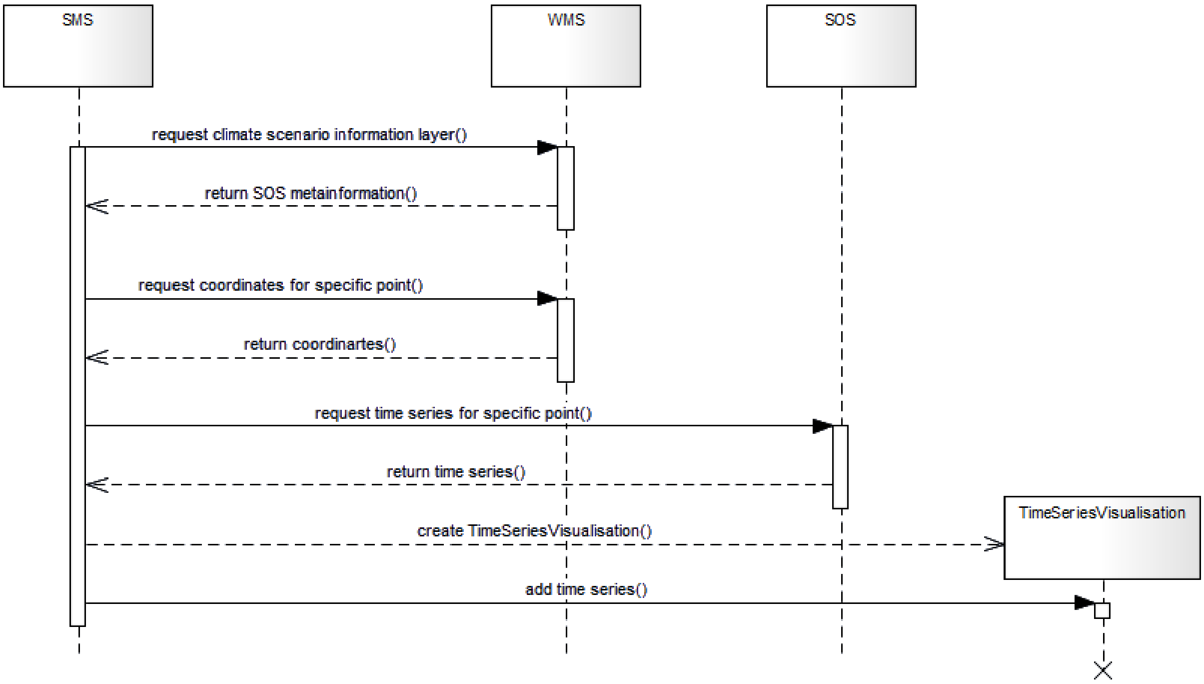


Diagram 7: Time Series Visualisation & Comparison

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 32: Validation Use Case 7 shows the graphical user interface of the time series visualisation framework.

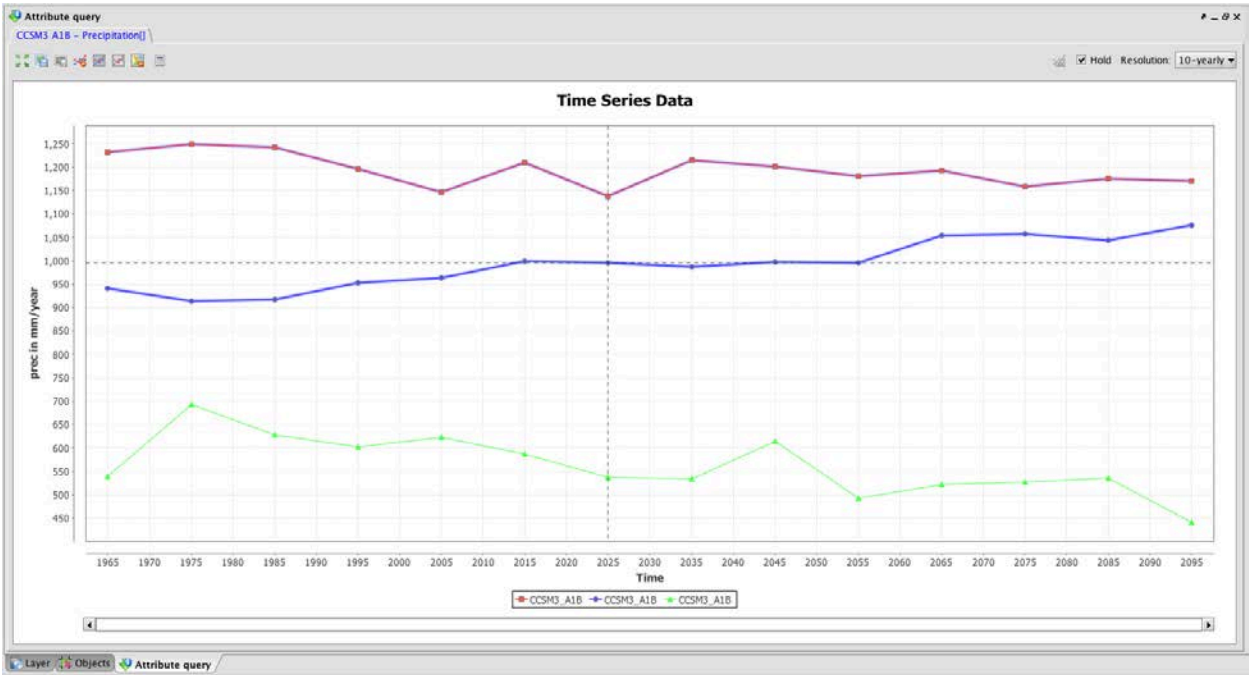


Figure 32: Validation Use Case 7

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.

   a. Alternative: Add another layer to the map and use combined comparison
      Using the Hold facilities it is possible to display multiple time series of the same scenario from different locations. Adding another Info-enabled scenario layer causes the SMS to request time series for points for both (or even more if more layers are added) scenarios. The resulting time series can be compared using the combined comparison button. The Hold feature and the combined comparison can be used altogether.

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.

4.2.8. 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 (see *Figure 33: An exemplary VisWiz workflow*). 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.

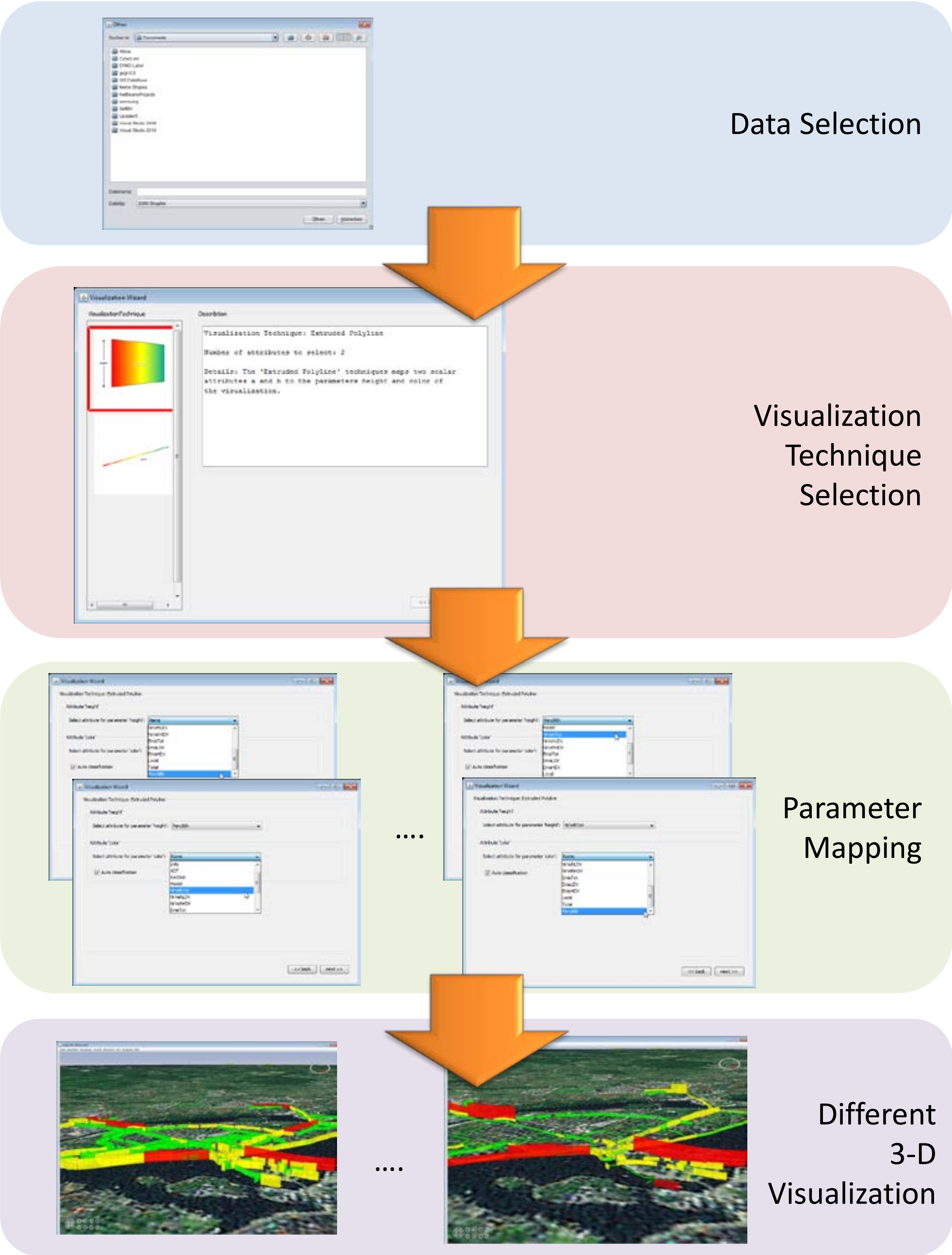


Figure 33: An exemplary VisWiz workflow

After the selection of the data source the user selects a visualisation 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.

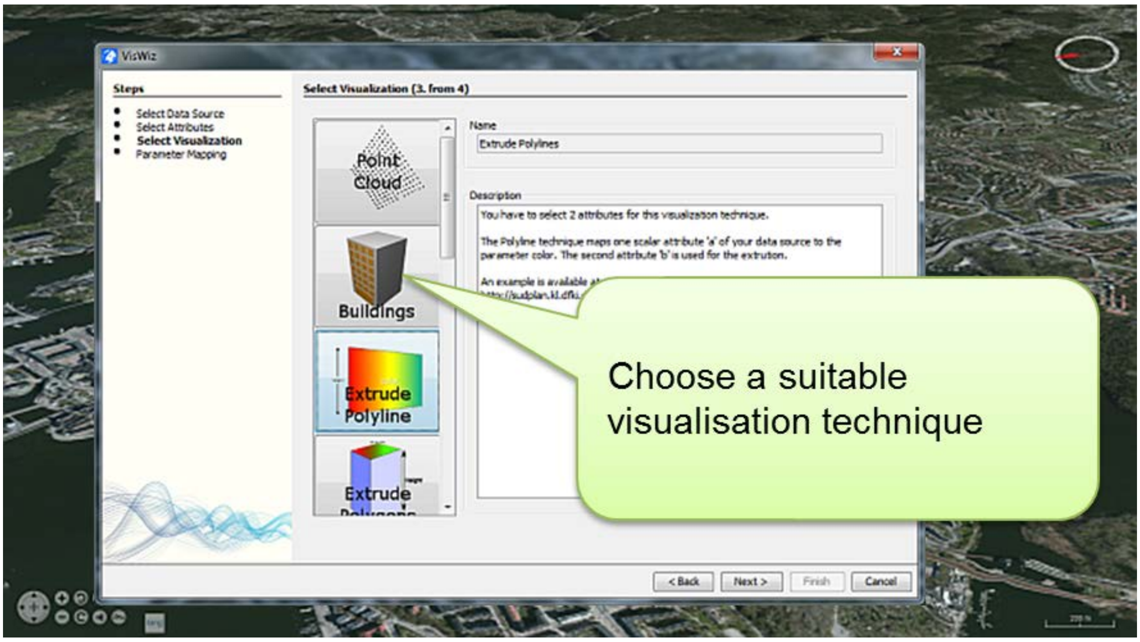


Figure 34: Validation Use Case 8

4.2.9. Visualisation 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 concentration levels simulated by a local 3D grid model. The model output data were stored at different time steps and at 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 illustrates the results of the Marching Cubes visualisation for different iso-values.

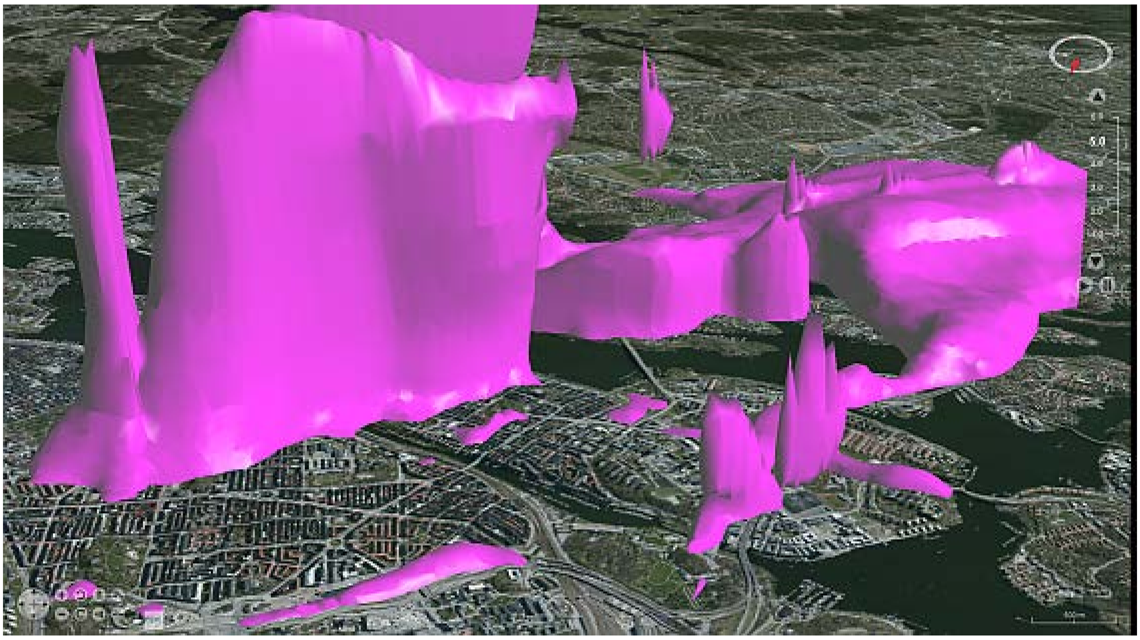


Figure 35: Marching Cubes visualization for the iso-surface

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 simulated air quality data, 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

4.2.10. 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 visualisation for the Wuppertal pilot. The input data is a terrain triangulation of a selected Pilot location (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 visualisation 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 visualisation 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 visualisation to a common reference plane to be able to compare the water level results. Figure 37 illustrates the visualisation results.

Figure 36: Different 3-D visualisations for the GeoCPM simulations for Lüntenbeck

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

4.2.11. 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*).

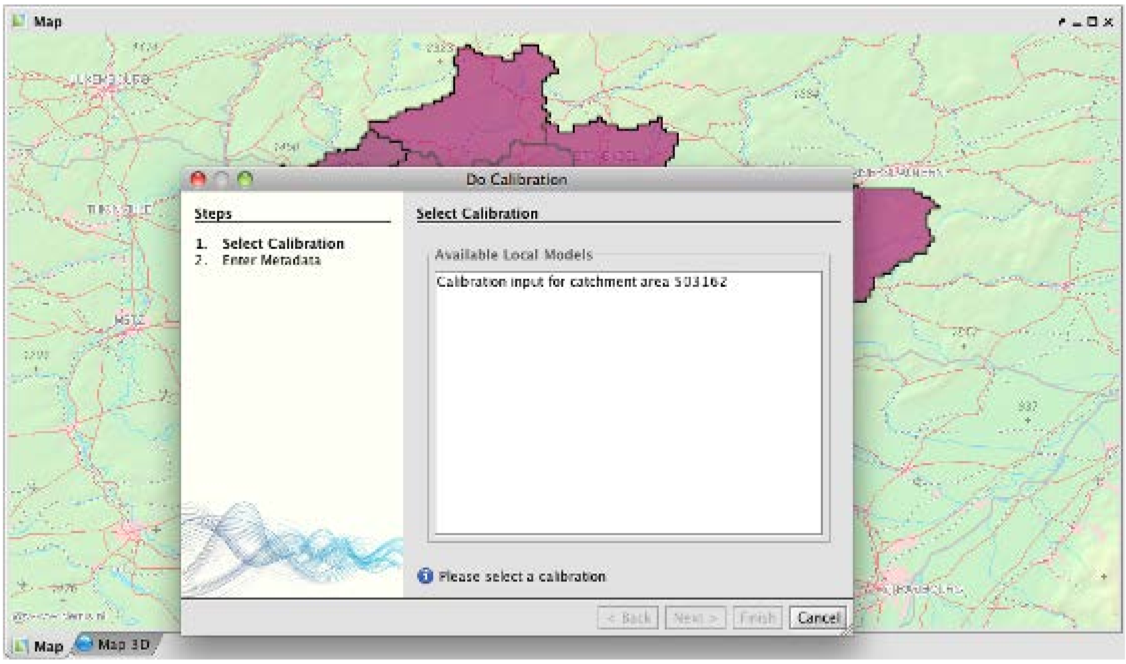


Figure 37: Validation Use Case 12

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.

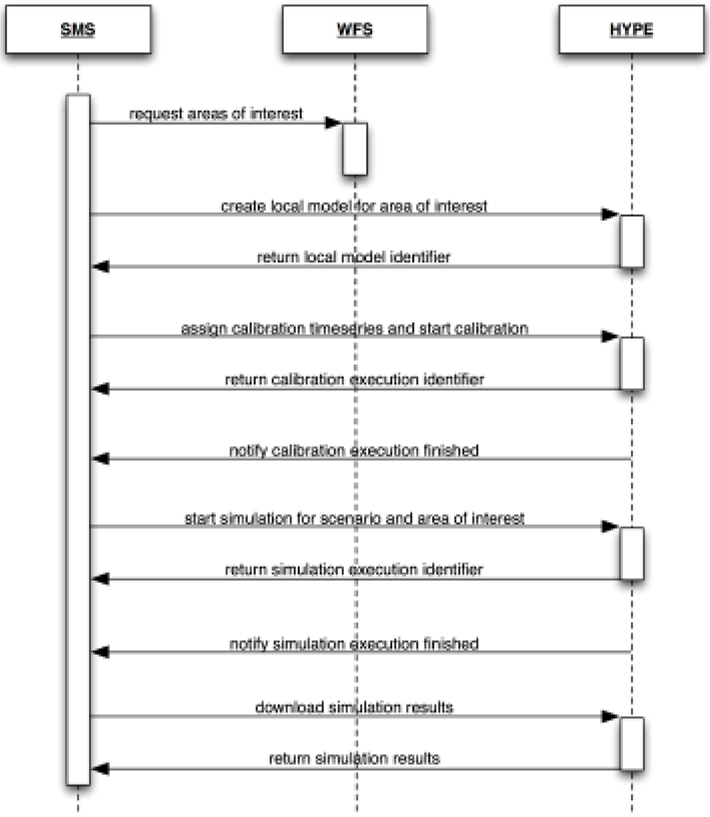


Diagram 8: Execute Hydrology Downscaling

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.

4.2.12. 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.

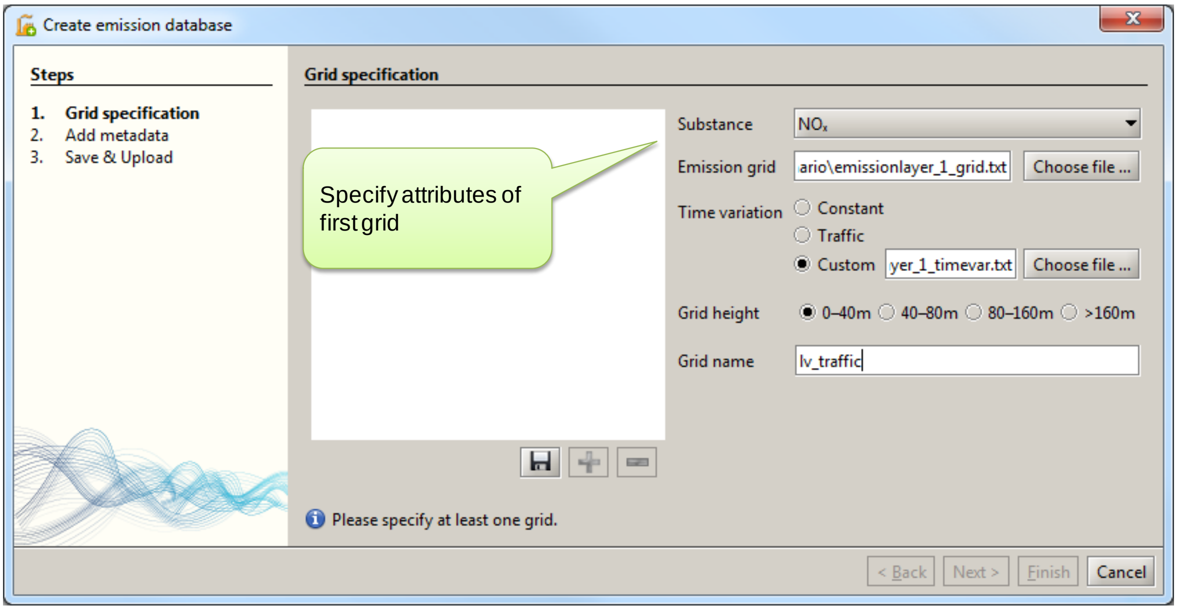


Figure 38: Validation Use Case 13

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.*

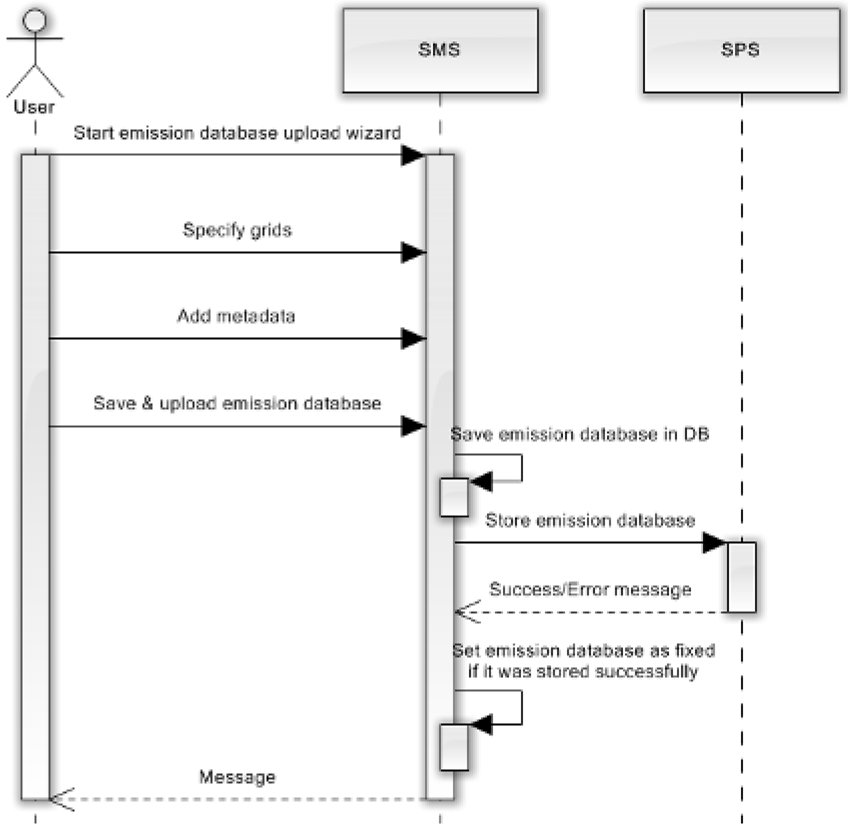


Diagram 9: Upload custom emission database

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.

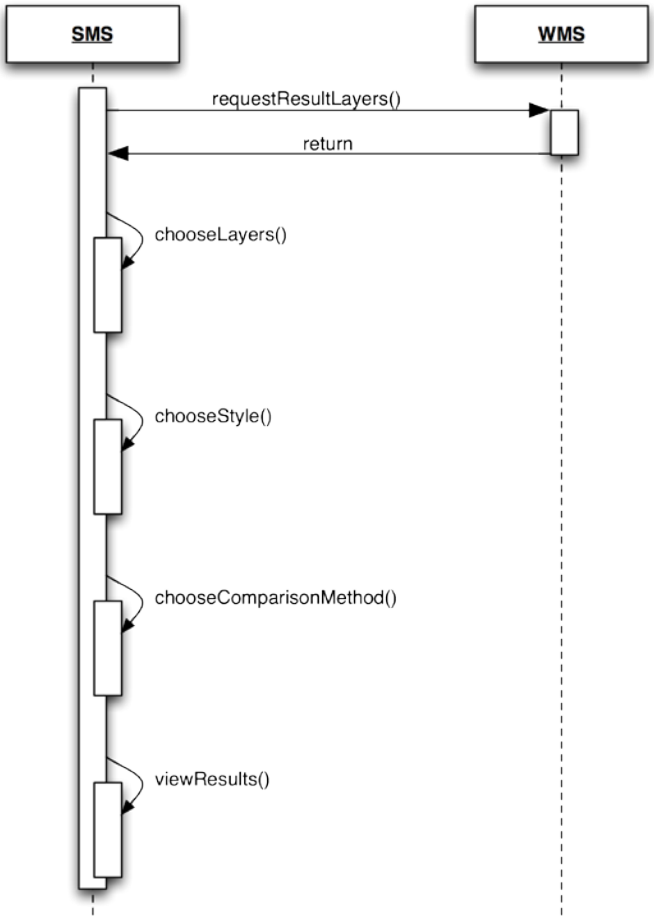
5. List emission databases and display their attributes
   After defining an emission database via the wizard, its metadata is saved in the SUDPLAN SMS. The user can thus list all uploaded emission databases in the SMS Catalogue and view their attributes. If an emission database wasn't successfully uploaded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

4.2.13. Grid comparison

This use case demonstrates the capabilities of the SMS to compare gridded data. The comparison features are implemented using image manipulation algorithms on WMS layers. Thus they can be used in a variety of different contexts, not only those that explicitly expressed such a requirement in the first place, such as Air Quality. However, this concrete use case is introduced to validate comparison capabilities of the SMS for Air Quality downscaling results.



The steps necessary to validate this feature are:

1. Visualise two Air Quality downscaling results
   Navigate to the Air Quality downscaling results WMS and choose the desired layers. Alternatively select the desired downscaling results from the catalogue and open the description pane where the renderer offers to visualise a certain variable with a certain resolution on the map.

2. Choose grids to compare
   Open the grid comparison widget and choose which layer to compare to which. As the comparison is done using certain algorithms the ordering is important so that one gets the desired results.

3. Create and select style for comparison
   The comparison is made on basis of image data and the result shall be an image as well. Thus the user has to create a style for comparison that maps the boundaries of the images to a desired scale as well as a color representation. If an appropriate style is available it can be selected.

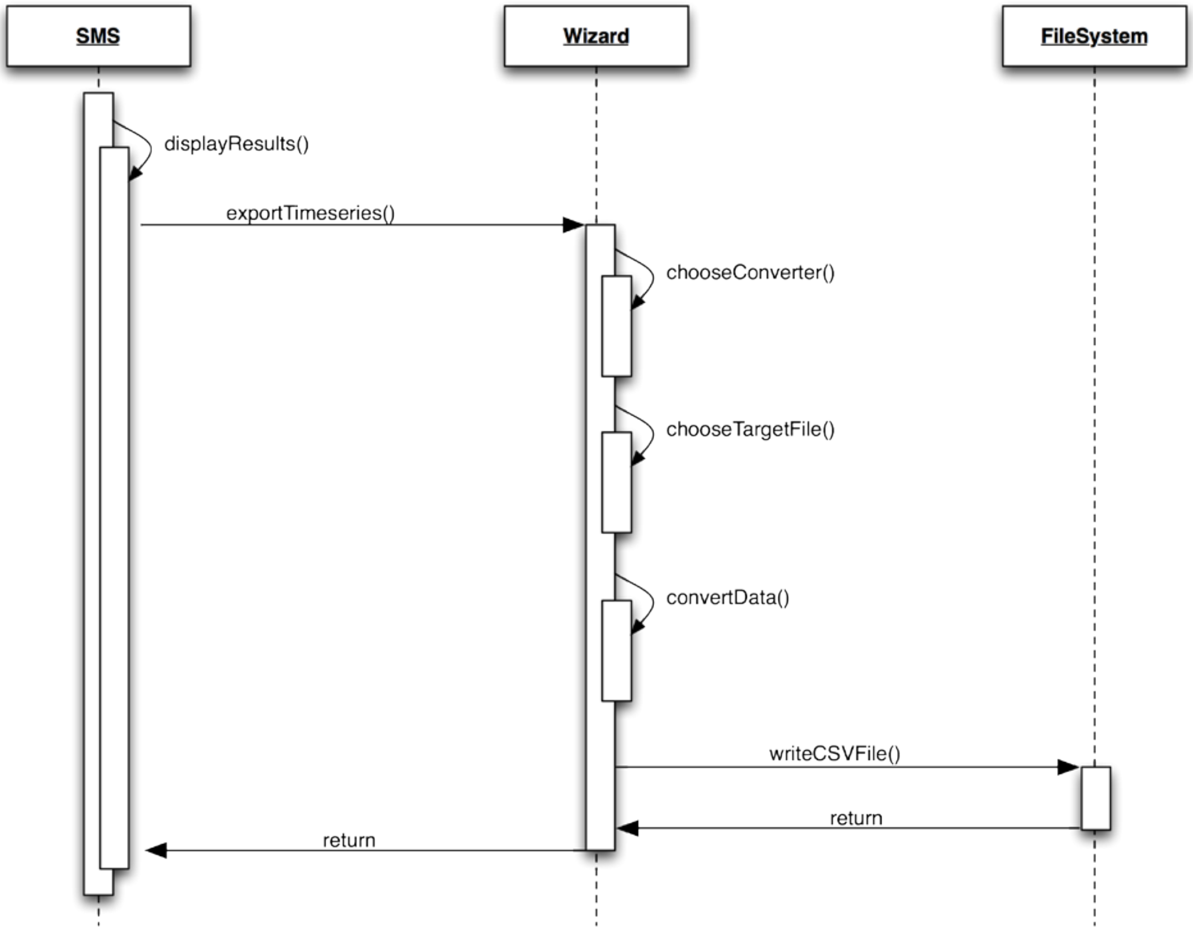
4. Choose comparison method
   As data can be compared in different ways a suitable comparison method has to be chosen

5. Slide through time and compare results
   After the comparison method was chosen a new object appears on the map that constitutes the comparison result. Use the lower slider to slide through the different time steps. Use the slider right next to the comparison method combo box to adjust the contrast of the result. However, this is not available for every comparison method.

For more information on the topic of grid comparison see D.3.2.3 Product Implementation V3.

4.2.14. Data export

In order to be able to benefit from data calculated in the SUDPLAN SMS in external tools the SMS provides export facilities. Thus this use case shows how it is possible to export time series data to CSV at the example of rainfall time series downscaling results. In fact, the export process is the inverse of the import and hence the steps to be done are very similar to those of the import.



The actions to be performed by the user are:

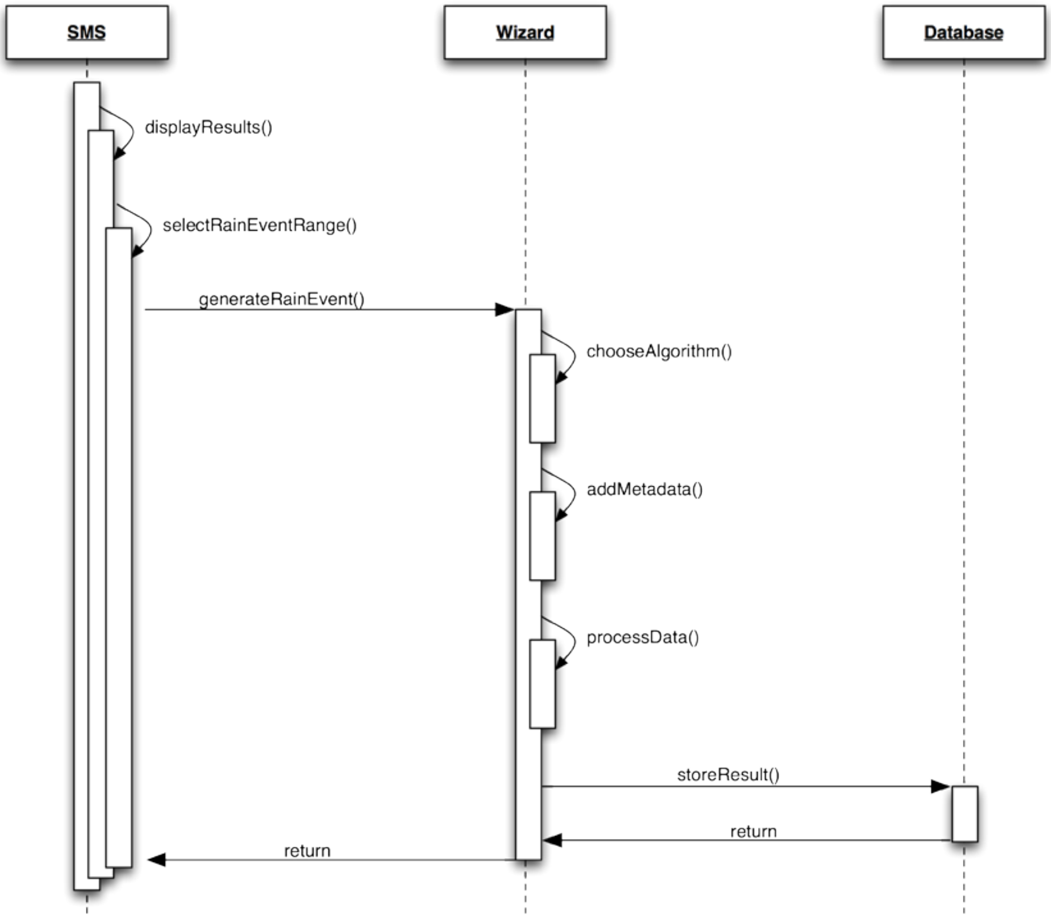
1. Visualise RF TS downscaling results
   Select the results of a time series downscaling and open the description pane. The RF TS downscaling results are visualised
2. Choose the export action from the time series visualisation toolbar
   As any time series that is visualised in the SMS its visualisation has the same

common toolbar that offers an export button. This button will cause the export wizard to be started using the selected time series as input.

3. Select a converter
   Similar to an import the user has to choose a converter to convert the time series data. However, in this case the converter obviously has to turn the data from the internal format of the SMS into the desired one.
4. Select a target file
   Choose a file where the data shall be exported to.
5. Wait for the export to finish
   Simple wait until the converter has finished processing the data and the target file is written
6. Locate and view the file on the disk
   Navigate to the target file and open it in an editor to see the raw values of the time series in the desired format.

4.2.15. Rain event generation

The generation of rain events is rather useful for users that intend to investigate the impact of (future) storm water events using their own data instead of data from catalogues. In SUDPLAN this functionality is of high importance in the Wuppertal pilot but can also come in handy on various other occasions. Thus this validation use case demonstrates how a rain event can be generated from an IDF downscaling result.



The actions to be performed by the user are:

1. Visualise RF IDF downscaling results
   Select the results of an IDF downscaling and open the description pane. The RF IDF downscaling results are visualised.

2. Select length and annual recurrence
   Select the values from which the rain event shall be generated. As the IDF table visualisation arranges the annual recurrence as columns and the duration as rows this simply means select the values of the desired column until the desired length for the rain event is reached.

3. Start the rain event generation wizard
   Do a right click on the selection, choose the Euler-Computation action from the contextual menu and the wizard appears.

4. Choose algorithm
   The Euler-Computation wizard offers two different algorithms to generate a rain event from the selected values. Select the desired one.

5. Add metadata
   In order to identify the rain event again later on and to describe what this it is best suited for enter a name and a description

6. Finish the wizard
   In the last step the wizard generates the actual rain event and stores it as soon as the user finishes the wizard.

7. View the new rain event
   After the wizard is finished successfully the new rain event will be visualised automatically and the user can view the results of the process.

4.3. Usability Enhancements

The development of the SUDPLAN SMS went through different phases and at the end of each a product validation report was generated for each SUDPLAN Pilot Application as well as the general SMS. These validation reports provide valuable information for the SMS development as they indicate where users feel that additional action should be undertaken. Additionally, there was intense information exchange regarding usability improvements with the SUDPLAN partners during the whole project lifetime.

SUDPLAN defines various user requirements regarding usability in D3.1.2 Requirement Specification V2 such as:

REQ-USR-1: Common user requirements

These requirements are common to all three categories of SUDPLAN users.

REQ-USR-1.1: Usability

Certain general elements of the user interface design enhance system usability.

REQ-USR-1.1.1: User-centred design

SUDPLAN shall employ user-centred design principles in the design of the user interface. SUDPLAN shall provide user-friendly services and interfaces, graphical user interfaces (GUI), and data visualisation components.

REQ-USR-1.1.2: User errors

SUDPLAN shall employ user interface design features that help prevent users from making errors when possible, allow users to reverse an error if one is made, or minimize the consequences of user errors if neither of these is possible.

REQ-USR-1.1.3: Short-term memory

SUDPLAN shall employ design features which allow the software to carry the burden of remembering information needed from one part of an application by another.

REQ-USR-1.1.4: Contextual Help

SUDPLAN shall provide contextual help to users.

REQ-USR-1.1.5: Ease of learning

SUDPLAN shall be easy to understand and to learn.

REQ-USR-1.1.6: Memorability

SUDPLAN's user interface shall be easy to remember.

REQ-USR-1.1.7: Transparency

SUDPLAN shall present a transparent user interface.

REQ-USR-1.2: Automation

REQ-USR-1.3: Profiling

Profiles are groups of option or setting values chosen by users to personalize their interaction.

REQ-USR-1.3.1: Profiling of the user interface

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

REQ-USR-1.3.2: Establishment of user groups

SUDPLAN shall support establishment of user groups with shared profiles.

REQ-USR-1.3.3: Information source management

SUDPLAN shall allow users to manage their information sources easily.

In accordance to those requirements and the user feedback collected through the overall Validation Report in general (D2.2.2 Validation and Evaluation Report) and the single Pilot Validation Reports (D5.3.3-D8.3.3) as well as continuously during the application development and release cycles various usability enhancements have been implemented.

Visual appearance	
Description	The visual appearance of the SUDPLAN SMS has been improved in various ways: • By default the SUDPLAN SMS provides an application layout that is suitable for many workflows by grouping the single widgets thematically. Additionally, any user of the SMS may create its very own layout by rearranging any of the available widgets. By default the SMS stores the user specific settings so that the application layout is restored when the user logs in again. Moreover, the single widgets also store their current state hence not only the layout is restored but the widget specific configuration as well. Thus the user may continue his work right where he left off. Furthermore the user has the possibility to store arbitrary layouts and configurations so that he may reconfigure the SMS to use them at any time. So it is possible to prepare layouts suited for small devices such as ultrabooks as well as multi-head desktop environments. • The punctuation and general text style has been improved and unified and the application is available with English as well as German localisation. • Data visualisation has been improved, e.g. IDF curves now not only provide a tabular data representation but also a chart with an array of

<table>
<tr><td></td><td>curves.
Longer running tasks, which are actions that may not finish within less than one second, provide visual feedback of their loading state so that the user can see if the task is still running.</td></tr>
<tr><td>Originates from</td><td>REQ-USR-1.1.1, REQ-USR-1.1.6, REQ-USR-1.3.1</td></tr>
<tr><td>Applies to</td><td>D2.2.2 – Annex A – Chapter 8.2.1</td></tr>
</table>

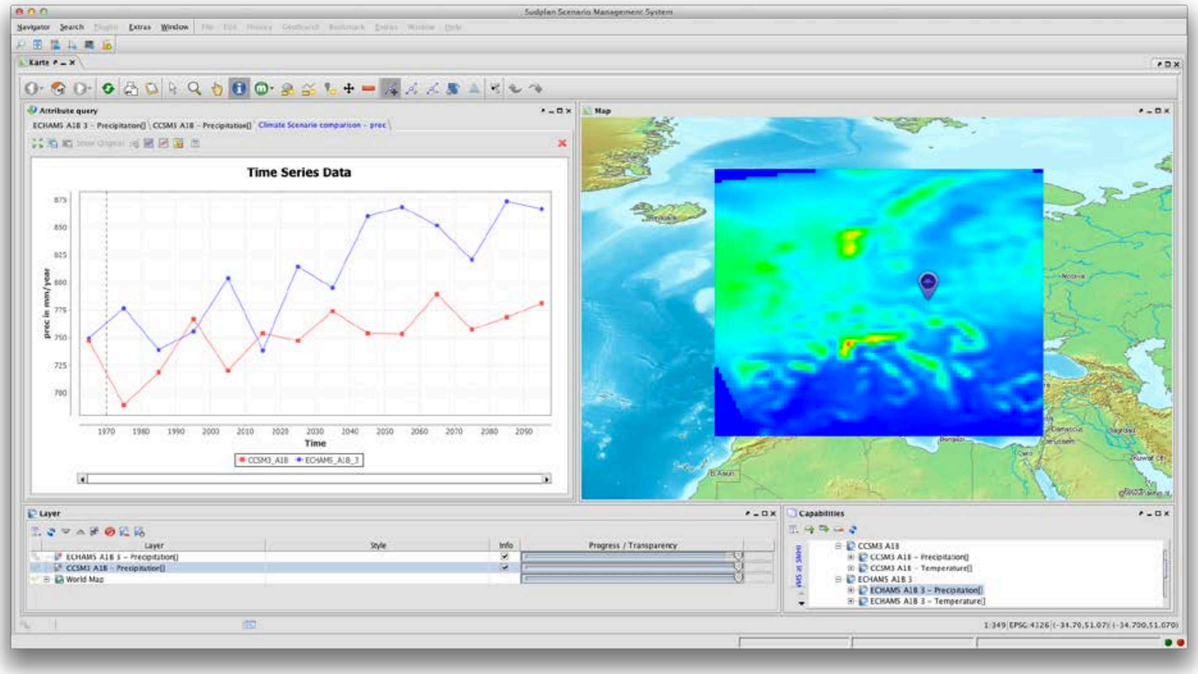


Figure 39: Example of a custom configuration best suited for the Pan-European Use Case

<table>
<tr><th colspan="2">Workflow</th></tr>
<tr><td>Description</td><td>The main workflows covered in SUDPLAN have been optimised in various ways:
Many data visualisations now provide the most important actions directly in an appropriate way, such as e.g. an additionally toolbar for time series visualisations so that the user may e.g. access the time series export functionality without the need to locate the appropriate menu item.
Many objects provide their available actions from various locations where they are visualised, e.g. the Rainfall Downscaling actions can be accessed from the contextual menu of the IDF curve object when it is visualised in the catalogue or in the map.
Many objects can be edited in various placed best suited for the current workflow and user preference, e.g. the emission databases can be edited</td></tr>
</table>

	using an appropriate wizard or the "normal" editor. • Many available actions highlight and visualise an appropriate visualisation of their results now. • Dialogs, such as notifications of long running tasks now popup in an appropriate location so that the user easily spots them. • On-the-fly search for capabilities making it easy to find a specific layer for visualisation.
Originates from	REQ-USR-1.1.1, REQ-USR-1.1.3, REQ-USR-1.1.5, REQ-USER-1.1.7
Applies to	D2.2.2 – Annex A – Chapter 8.2.1

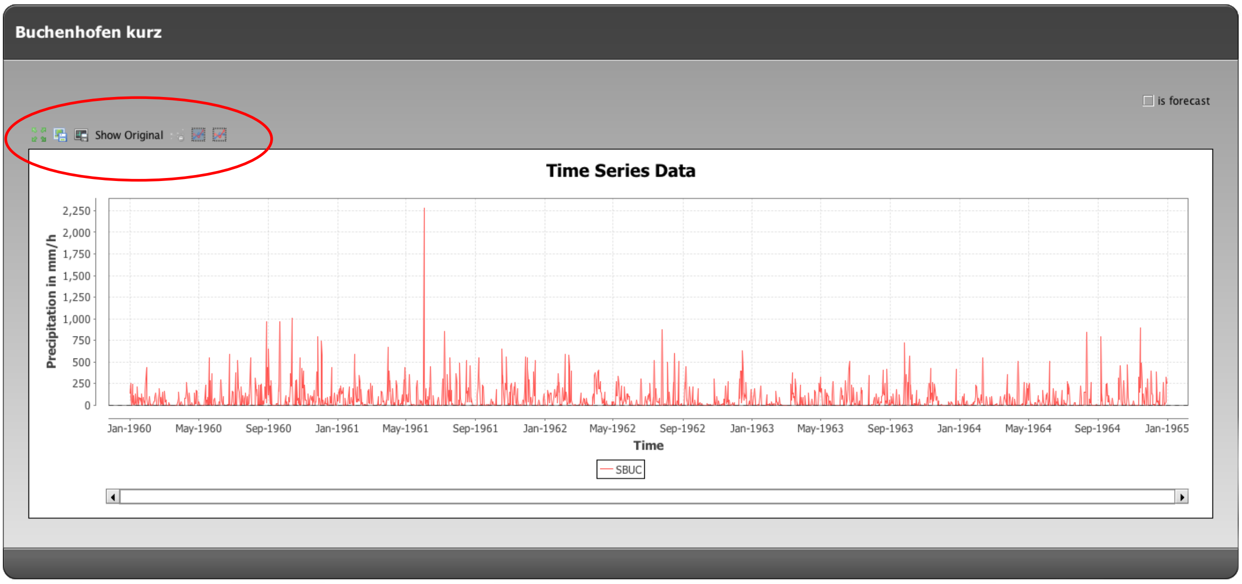


Figure 40: Time series visualisation with toolbar

Guidance and Help	
Description	The SUDPLAN application does not provide a "classical" help system but supports the user in a more appropriate way with the implementation of on-screen hints. This can be as simple as a tooltip text for components and as advanced as previews. These features on the one hand and the available feature and tutorial videos on the other hand provide a basic understanding of the SUDPLAN application as well as of the main workflows and guide the user so that he can successfully complete his task. Additionally, the available SUDPLAN information for various topics has been improved, such as scenario descriptions for downscaling or appropriate legend data

Originates from	REQ-USR-1.1.4, REQ-USR-1.1.5, REQ-USR-1.1.7
Applies to	D2.2.2 – Annex A – Chapter 8.2.1

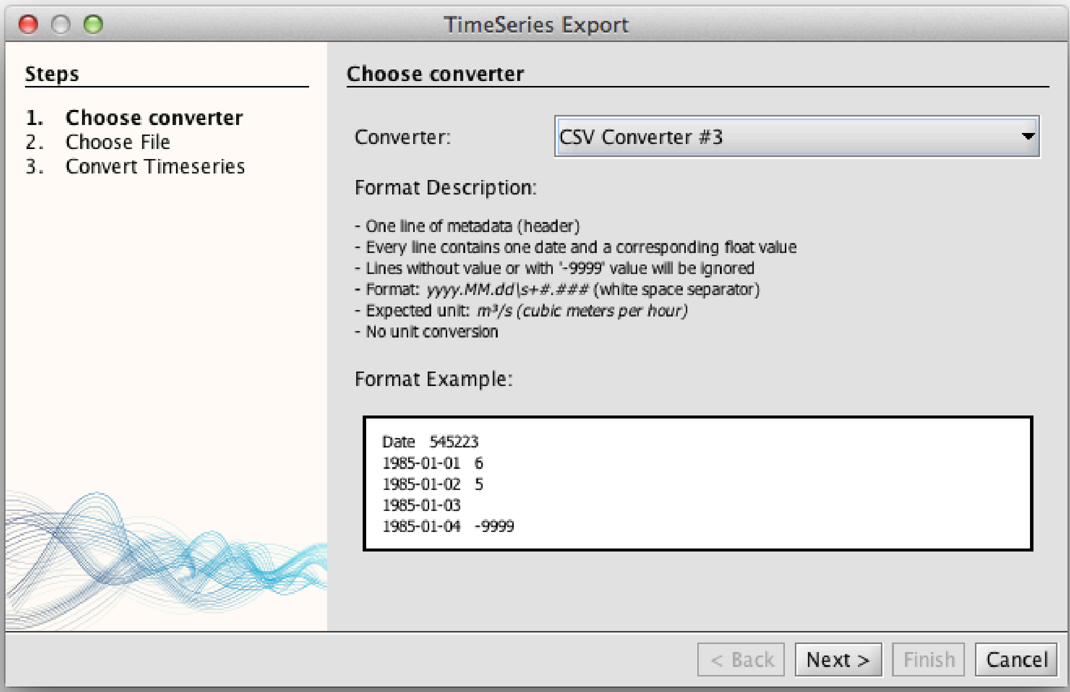


Figure 41: Time Series Export wizard showing a converter format preview

Error handling	
Description	Error handling in SUDPLAN have been optimised in various ways: • Users are not confronted with cryptic error messages anymore but are notified that an error occurred. Where appropriate they have the possibility to store the error details so that they can inform a responsible person. Additionally, in case of a renderer error, the user also has the option to view the desired data nonetheless but with the default auto-generated visualisation. • Recoverable errors can now be resolved easily with little user interactions and without the danger of producing inconsistencies in both data and views, e.g. if the connection to the backend server of the application is broken the user may easily reconnect with the possibility

	of alteration of the connection properties.
Originates from	REQ-USR-1.1.1, REQ-USR-1.1.2, REQ-USR-1.1.7
Applies to	D2.2.2 – Annex A – Chapter 8.2.1

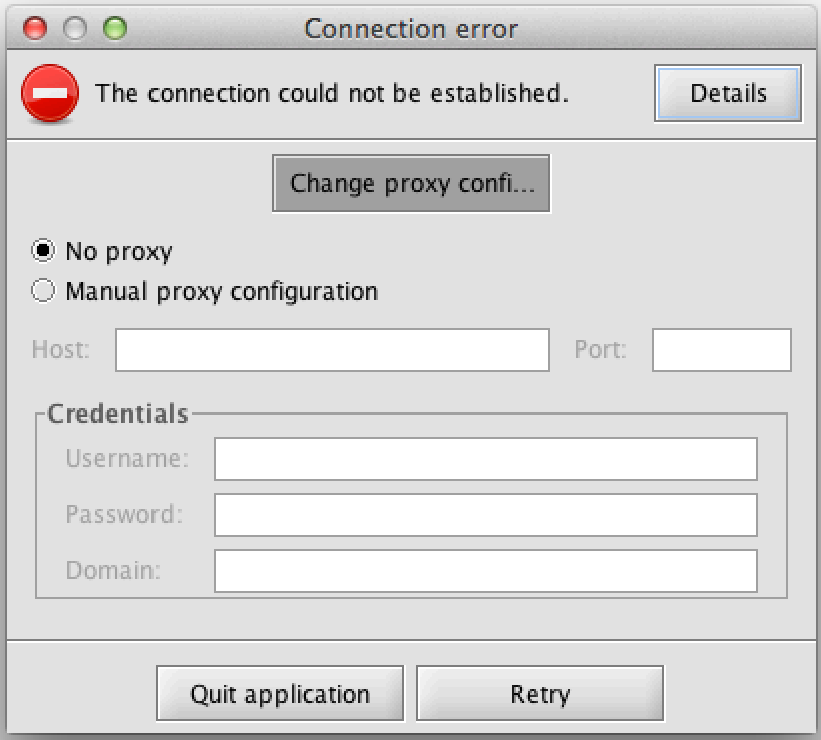


Figure 42: Reconnector dialog

5. Conclusions

This document describes the final version of the 'Scenario Management System' which is based on deliverable *D3.3.3 Integrated Scenario Management System V3* which is closely related to the deliverable *D3.2.3 - Product Implementation V3*.

This document is a brief description of the core elements of the software developed in WP3 of the SUDPLAN project. In contrast to the companion reports of the deliverables *D3.2.3-Product Implementation V3* and *D3.3.3- Integrated Scenario Management System V3* this report summarizes the final results of the Scenario Management System as an integrated solution.

This document illustrates the features of the developed SMS software. However, it does not serve as a detailed handbook. For detailed information regarding features and usage of the SMS as well as the interaction, we recommend the prepared videos in the SUDPLAN video channel at YouTube. The videos can be accessed via the following link: http://www.youtube.com/user/Sudplan. Moreover, we provide a SMS Video Tutorial in six parts, 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[1]. Finally, we offer various feature videos available at the SUDPLAN web site (http://sudplan.eu/Results/Workshop/SUDPLAN-workshop).

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 various representative use cases, which were collaboratively defined. Those use cases reflect the main functionalities of the SMS after the third year of developments a detailed use case walkthrough can be found in Annex 2.

The uses cases described and explained in this report 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.

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

4. 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.

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

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

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

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

9. 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.

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

11. 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.

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

13. To demonstrates the capabilities of the Scenario Management System to compare gridded data.

14. To support the export the data calculated in the SUDPLAN SMS in external tools.

15. To generate rain events in order to investigate the impact of (future) storm water events using own data instead of data from catalogues and to demonstrate how a rain event can be generated from an IDF downscaling result.

6. References

GIT	Distributed revision control and source code management (SCM) system http://git-scm.com/
GITHUB	Web-based hosting service for software development projects that use the Git revision control system https://github.com/
JENKINS	Open source continuous integration tool http://jenkins-ci.org/
MAVEN	Apache Software Foundation. Apache Maven Project. Retrieved from http://maven.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/
SOS52N, 2011	Sensor observation service (March 2011), http://52north.org/communities/sensorweb/sos/index.html
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.

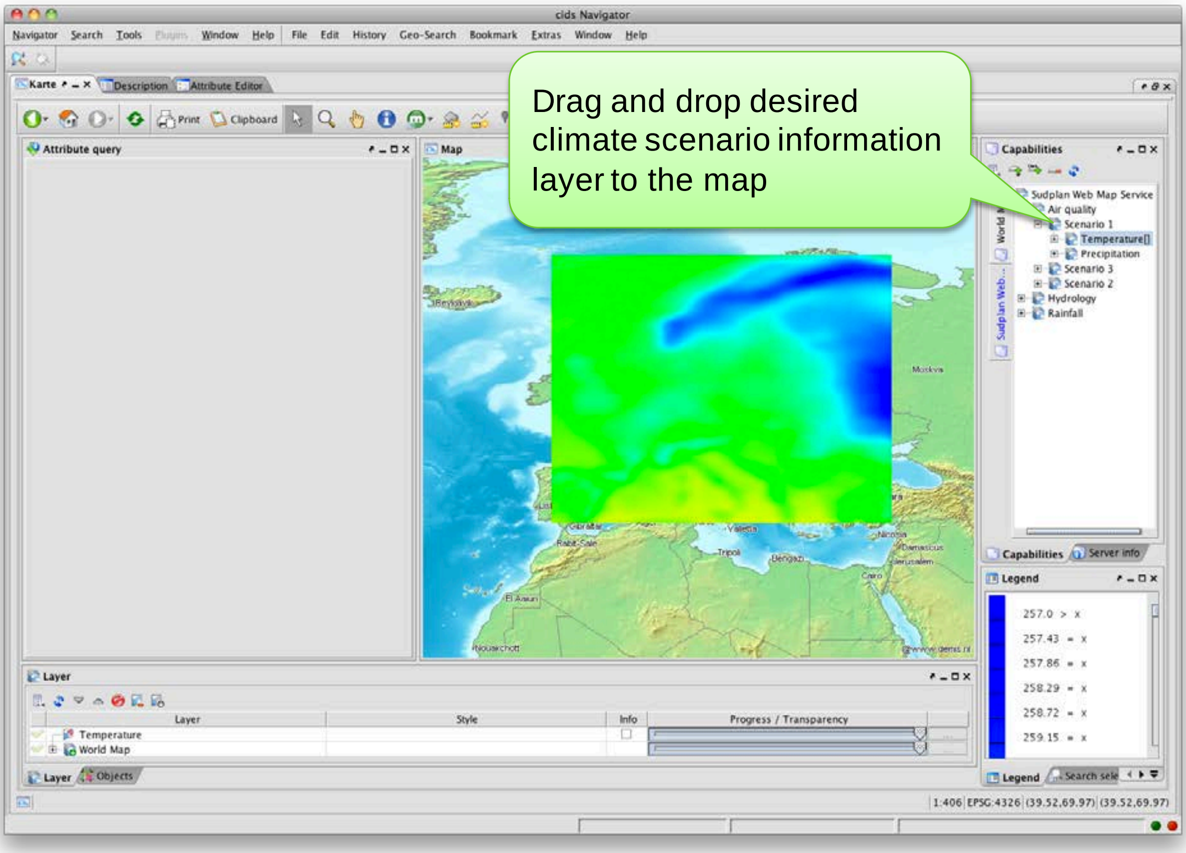
Scenario Management System	*Scenario Management System* (SMS) is synonymous with SUDPLAN platform
Scenario Management System Framework	The *Scenario Management System Framework* is the main Building Block of the Scenario Management System. It provides the Scenario Management System core functionalities 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.

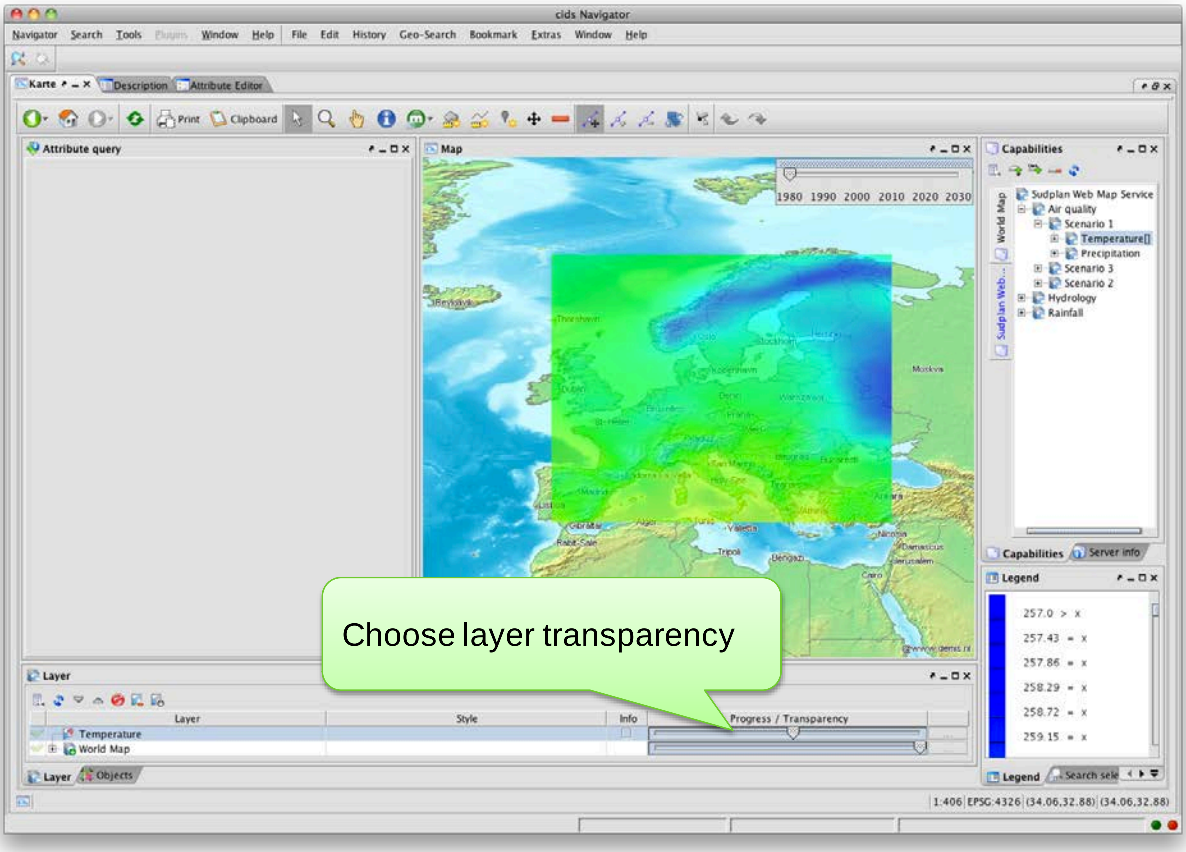
8. Annex 2: Validation Use Case Screenshots and Diagrams

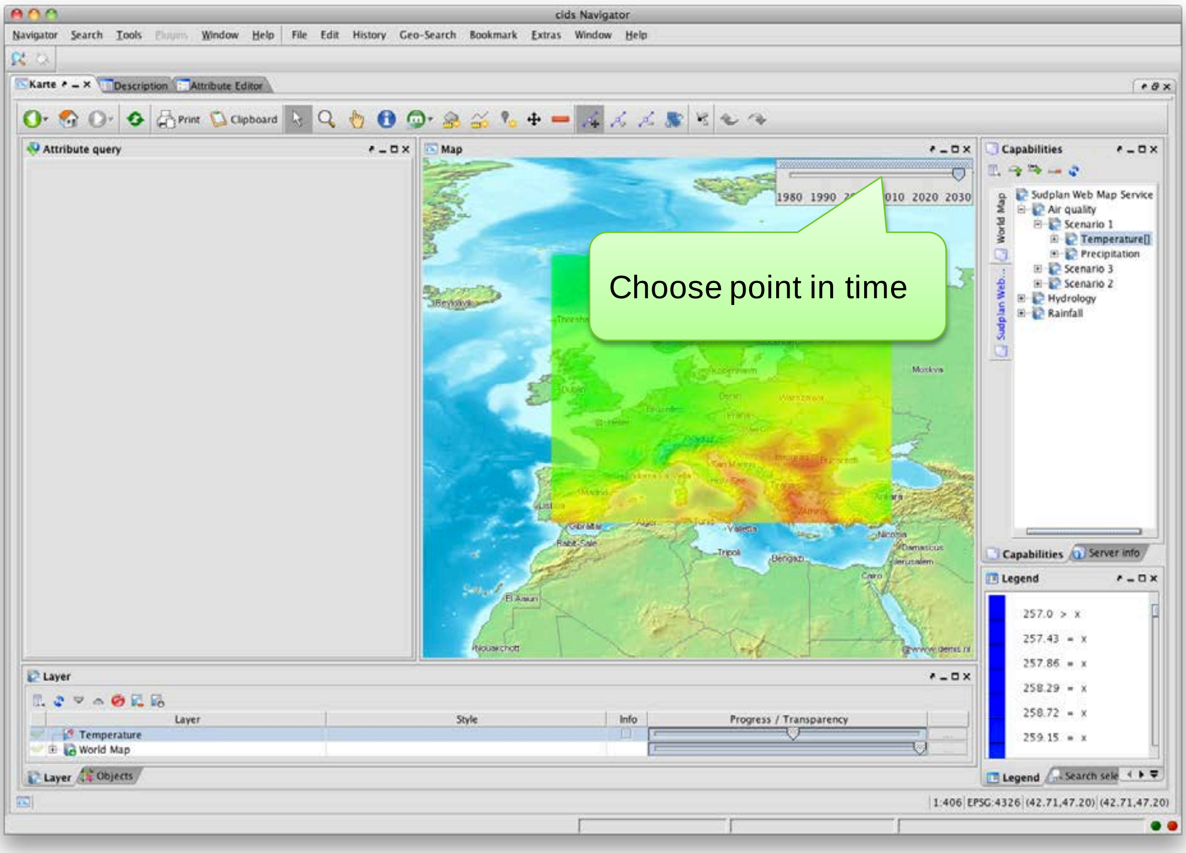
This annex contains the detailed interaction diagrams of the validation use cases as well as the complete set of screenshots related to the actions the user has to perform in a specific validation use cases. The interaction diagrams as well as the user actions are explained in the respective use cases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

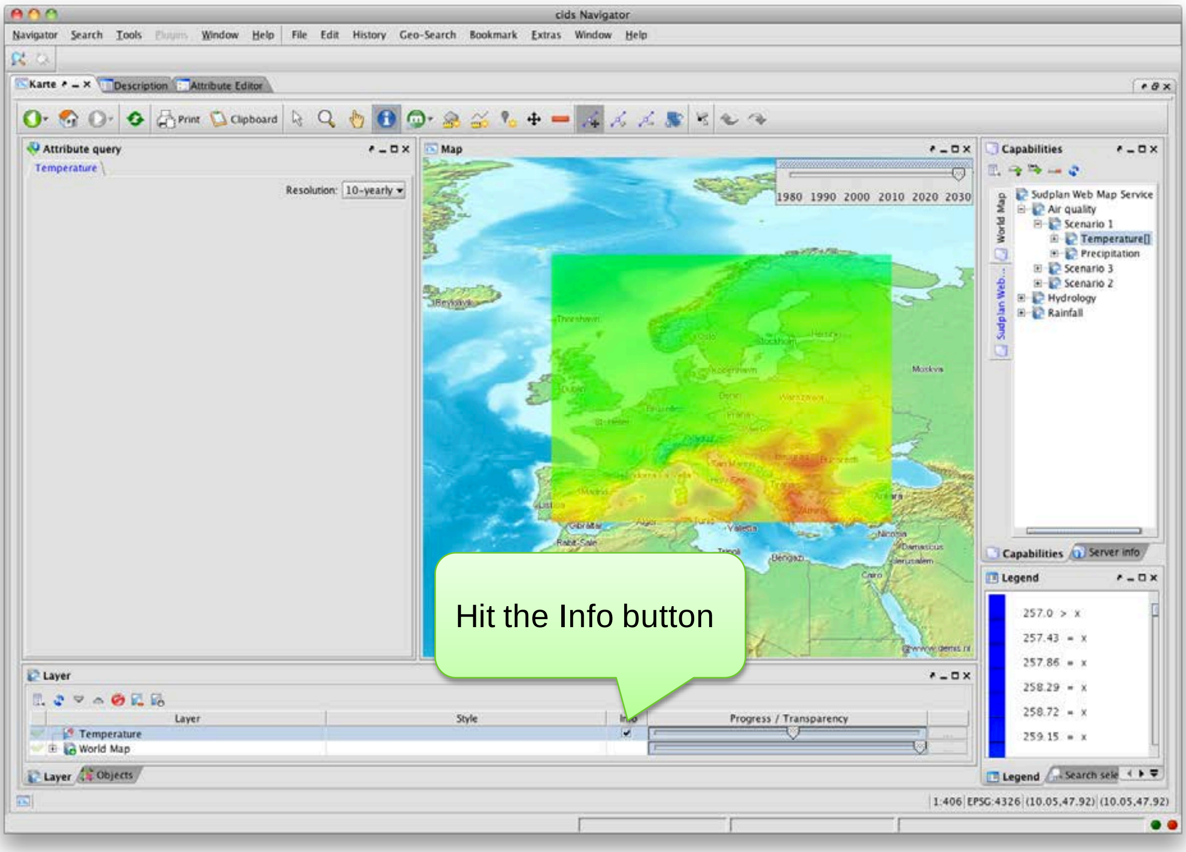
8.1. Climate Scenario Information on the European Scale

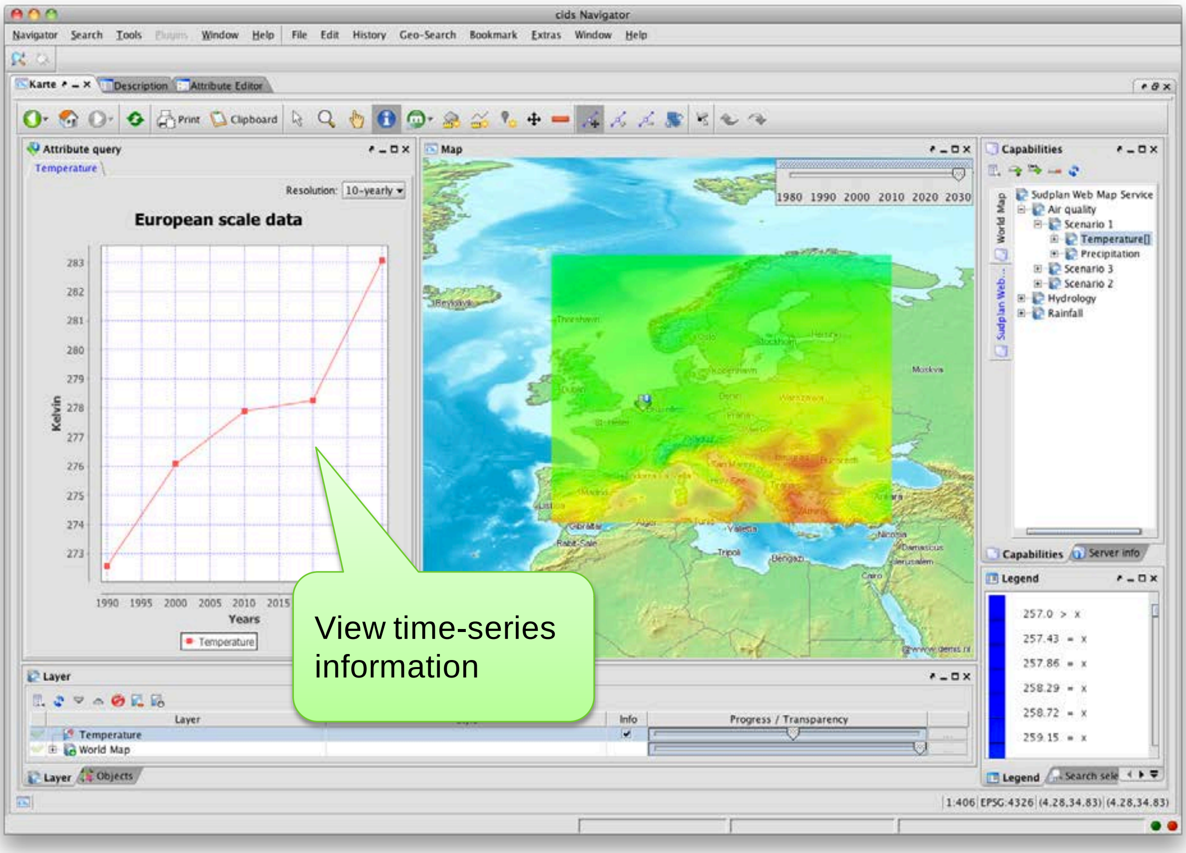
For a description of this validation scenario please refer to *4.2.1 Climate Scenario Information on the European Scale*.

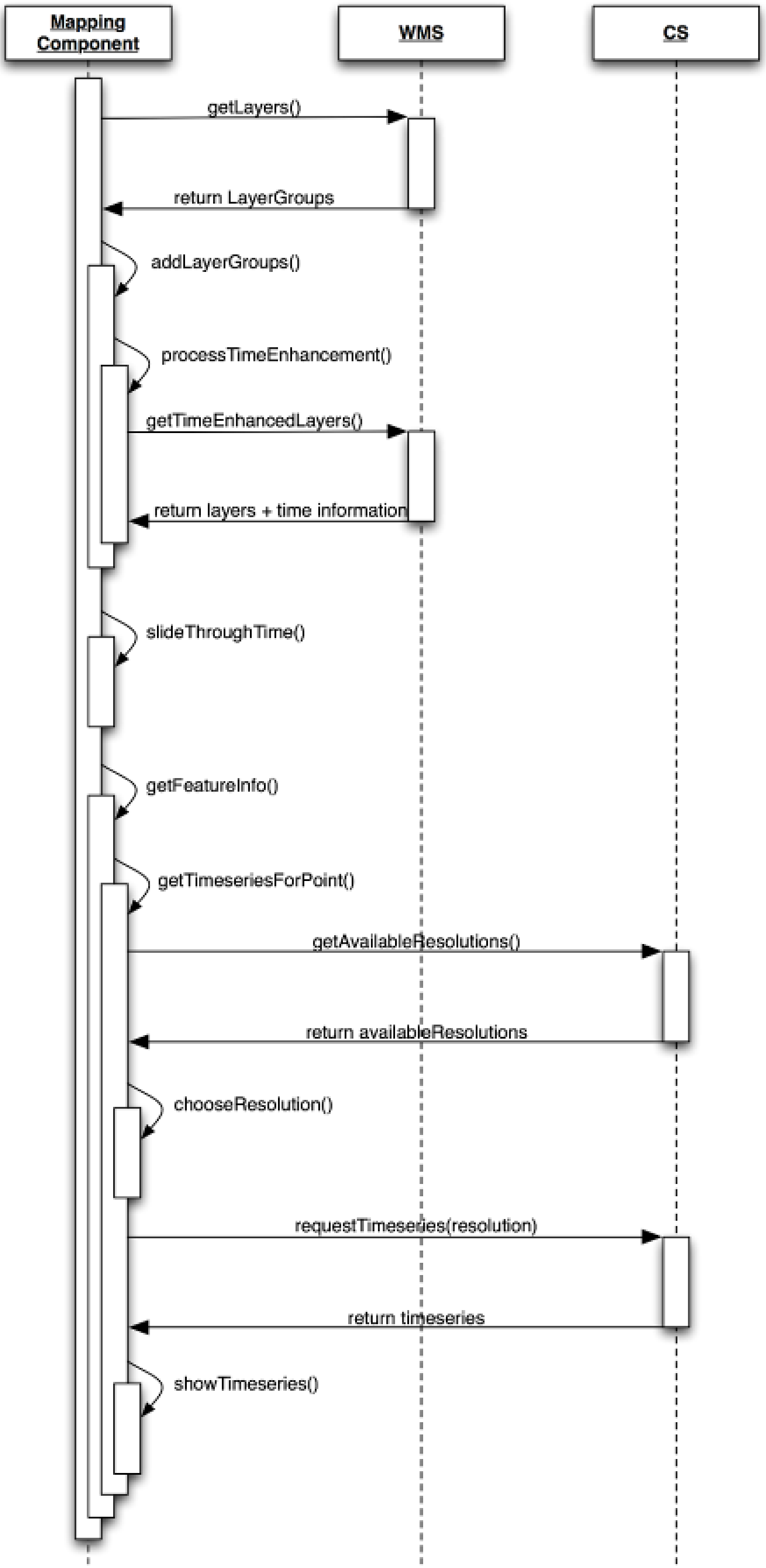



cids Navigator
Choose layer transparency


cids Navigator
Choose point in time

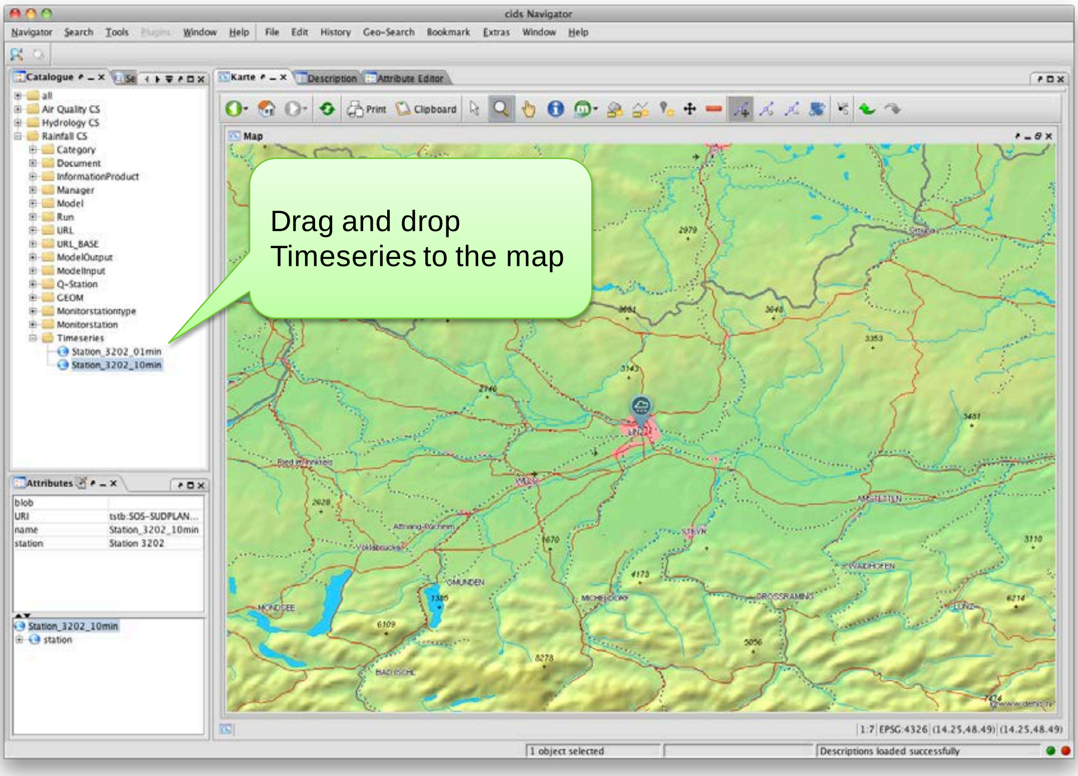

cids Navigator
Hit the Info button

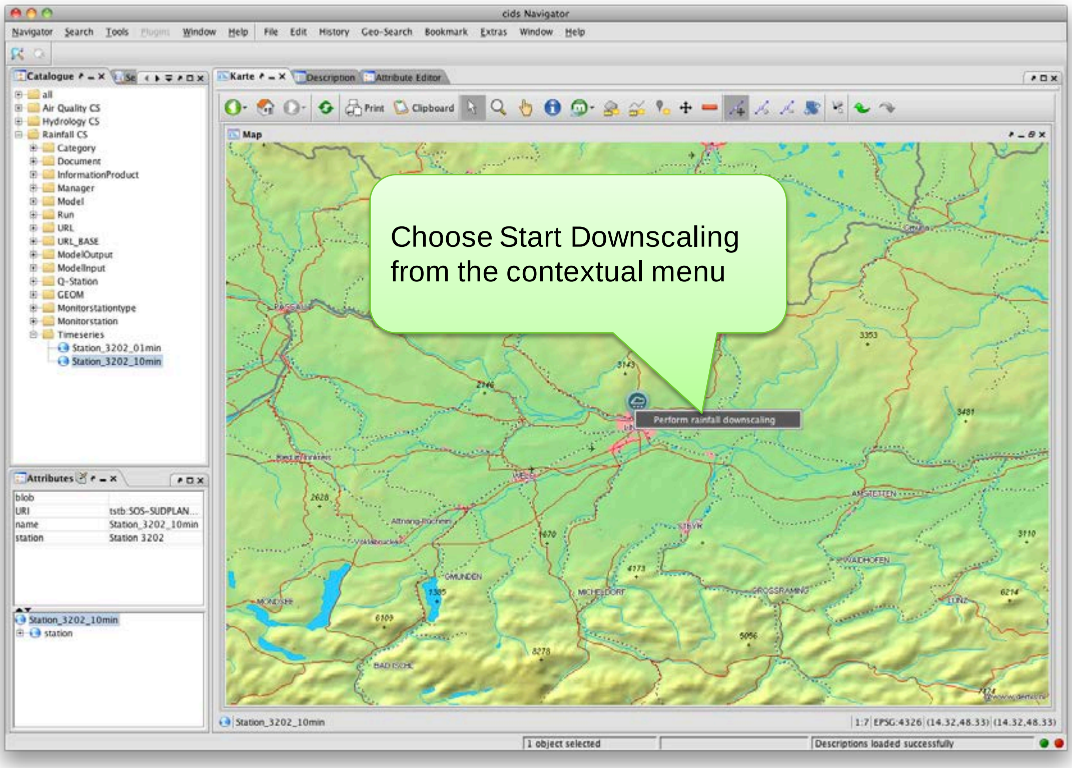

cids Navigator
European scale data
Kelvin
Years
Temperature
View time-series information

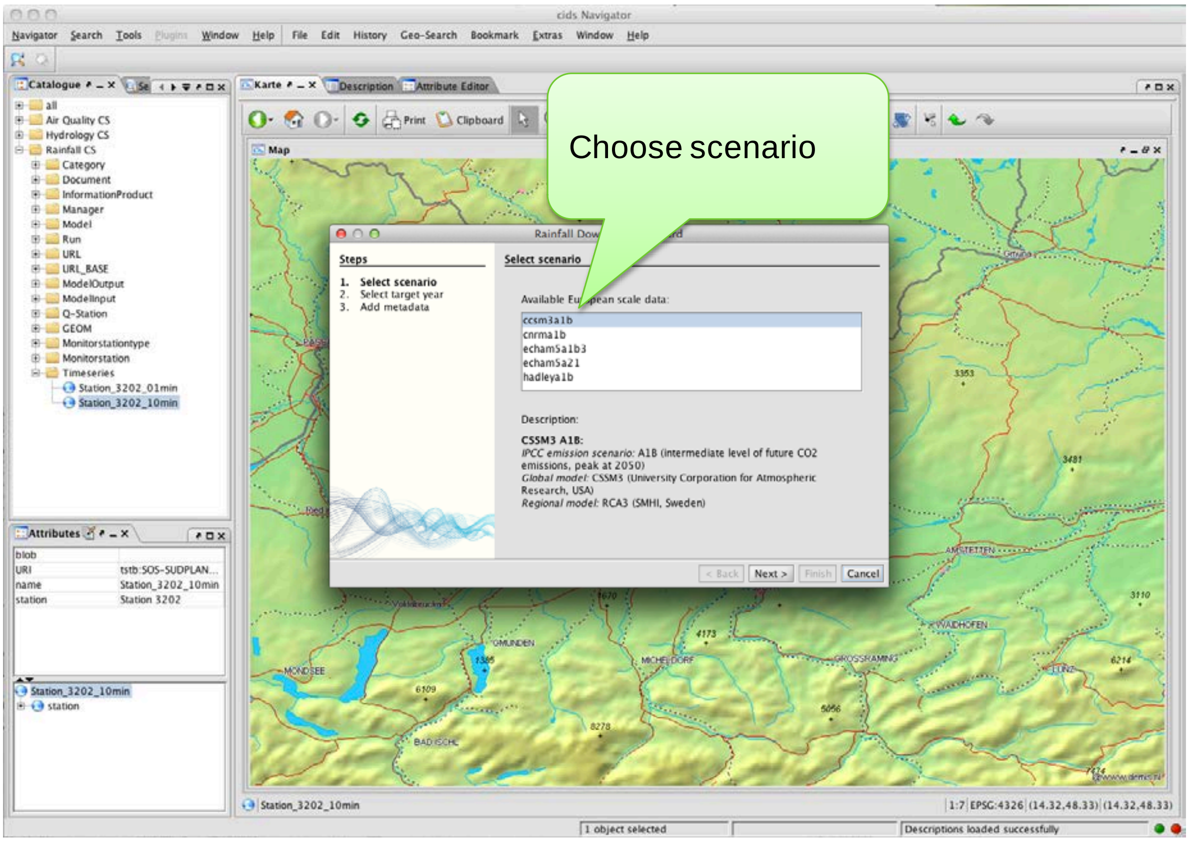

Mapping Component
WMS
CS
getLayers()
return LayerGroups
addLayerGroups()
processTimeEnhancement()
getTimeEnhancedLayers()
return layers + time information
slideThroughTime()
getFeatureInfo()
getTimeseriesForPoint()
getAvailableResolutions()
return availableResolutions
chooseResolution()
requestTimeseries(resolution)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

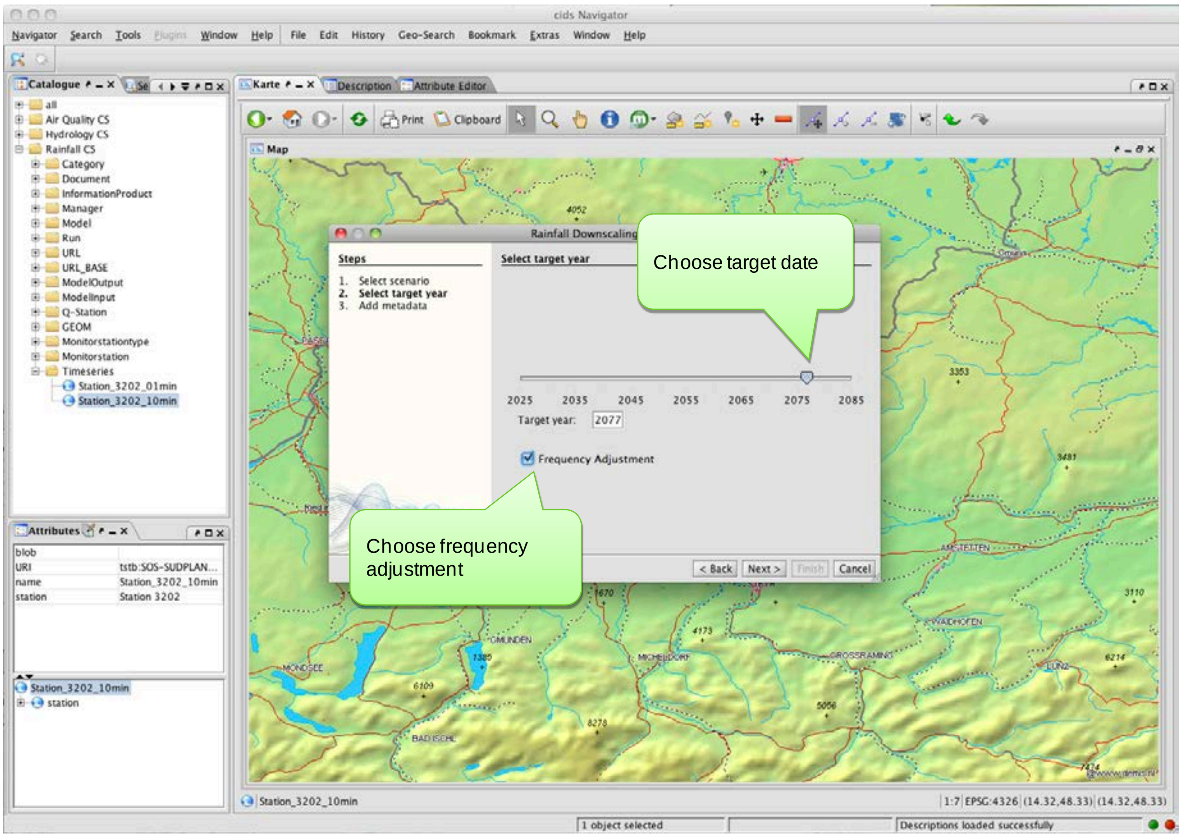
8.2. Execute Time Series Rainfall Downscaling

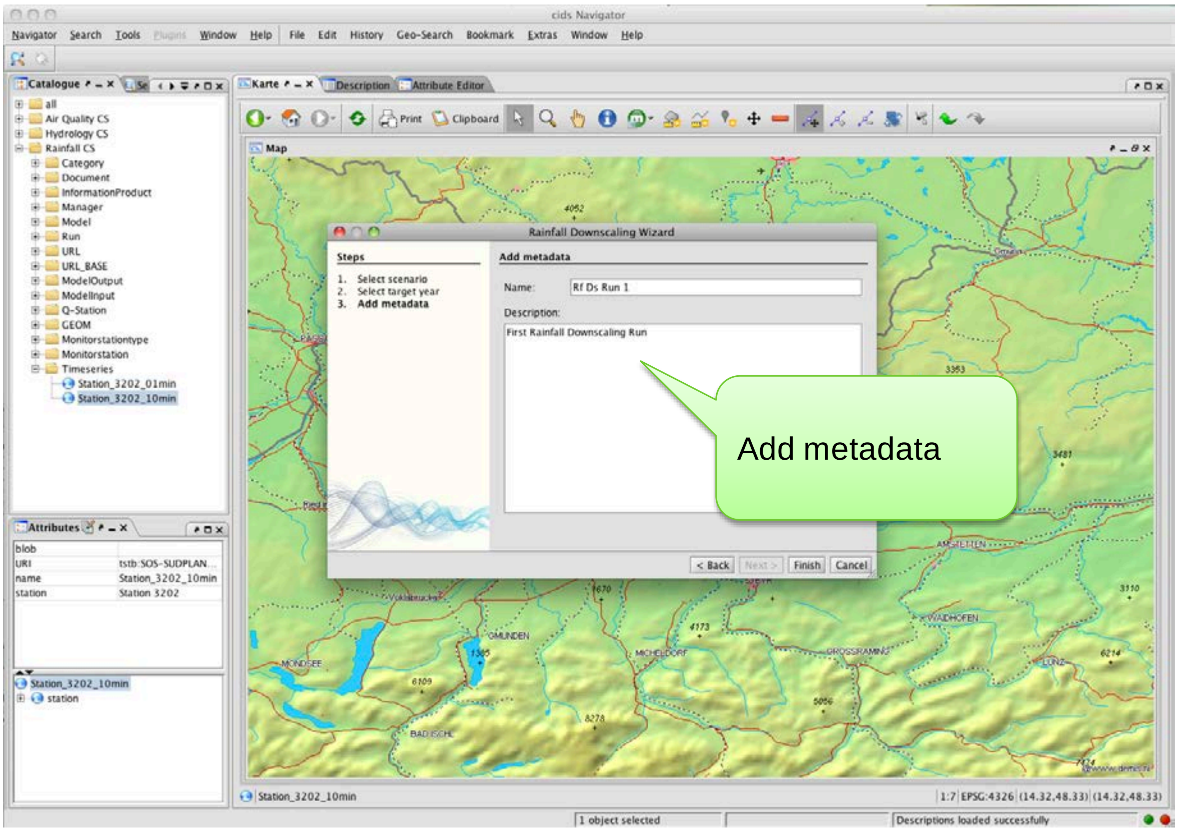
For a description of this validation scenario please refer to *4.2.2 Execute Rainfall Downscaling*.

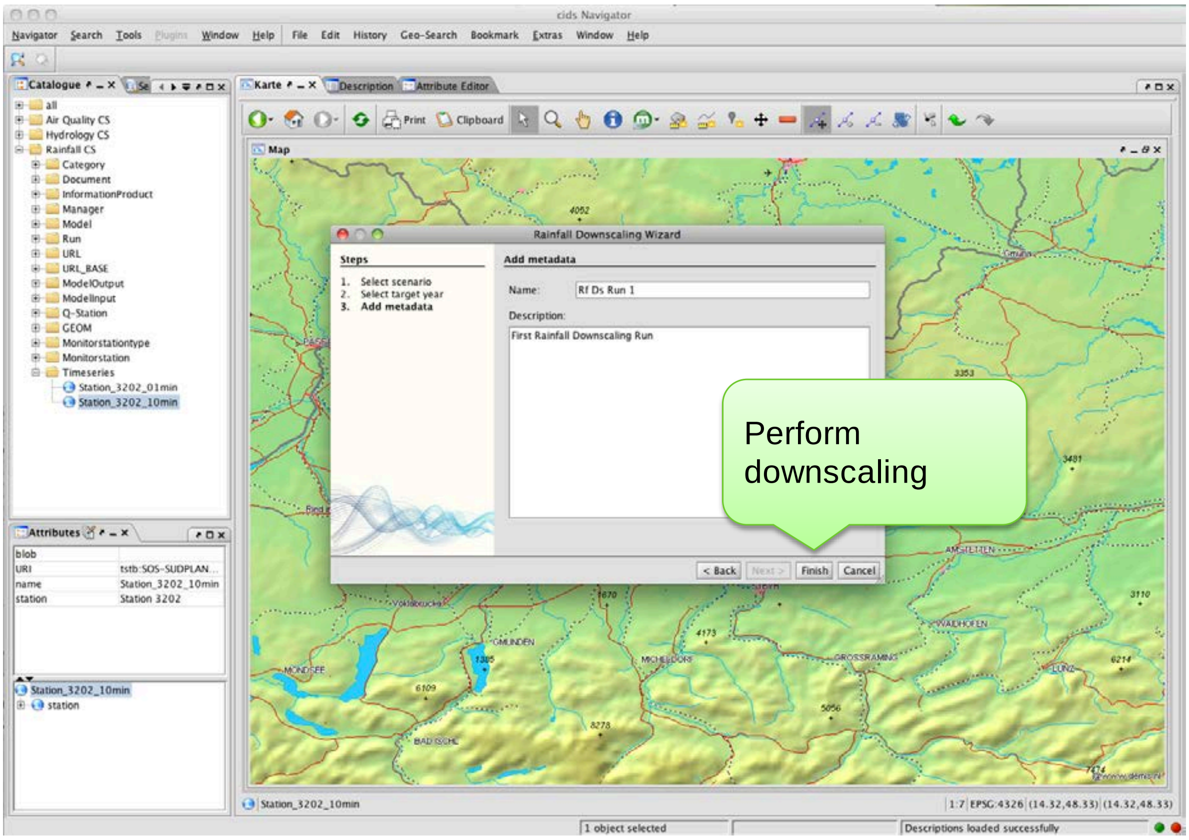




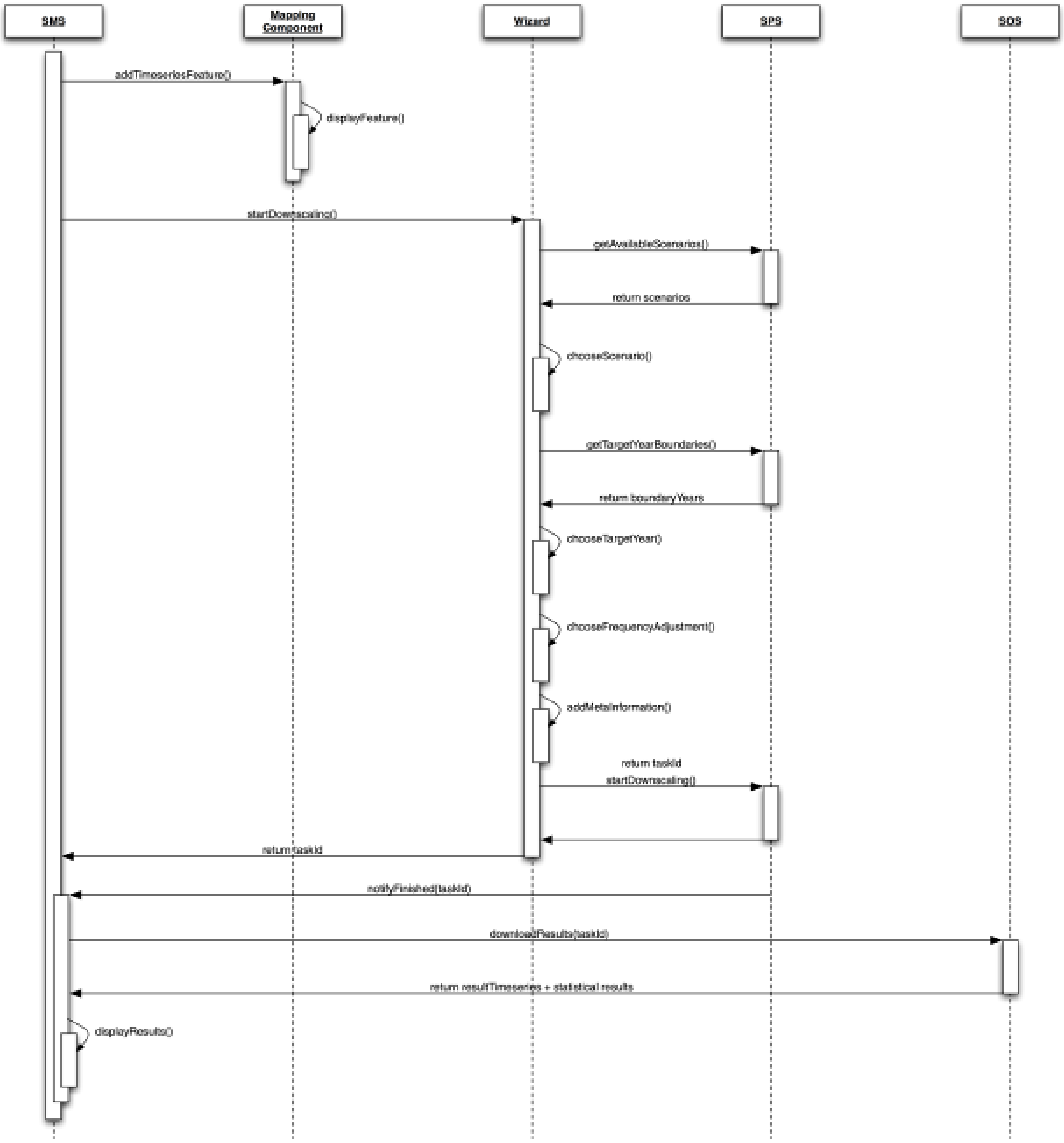

cids Navigator
Choose scenario
Rainfall Downscaling Wizard
Steps
1. Select scenario
2. Select target year
3. Add metadata
Select scenario
Available European scale data:
ccsm3a1b
cnrma1b
echam5a1b3
echam5a21
hadleya1b
Description:
CCSM3 A1B:
IPCC emission scenario: A1B (intermediate level of future CO2 emissions, peak at 2050)
Global model: CCSM3 (University Corporation for Atmospheric Research, USA)
Regional model: RCA3 (SMHI, Sweden)
< 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

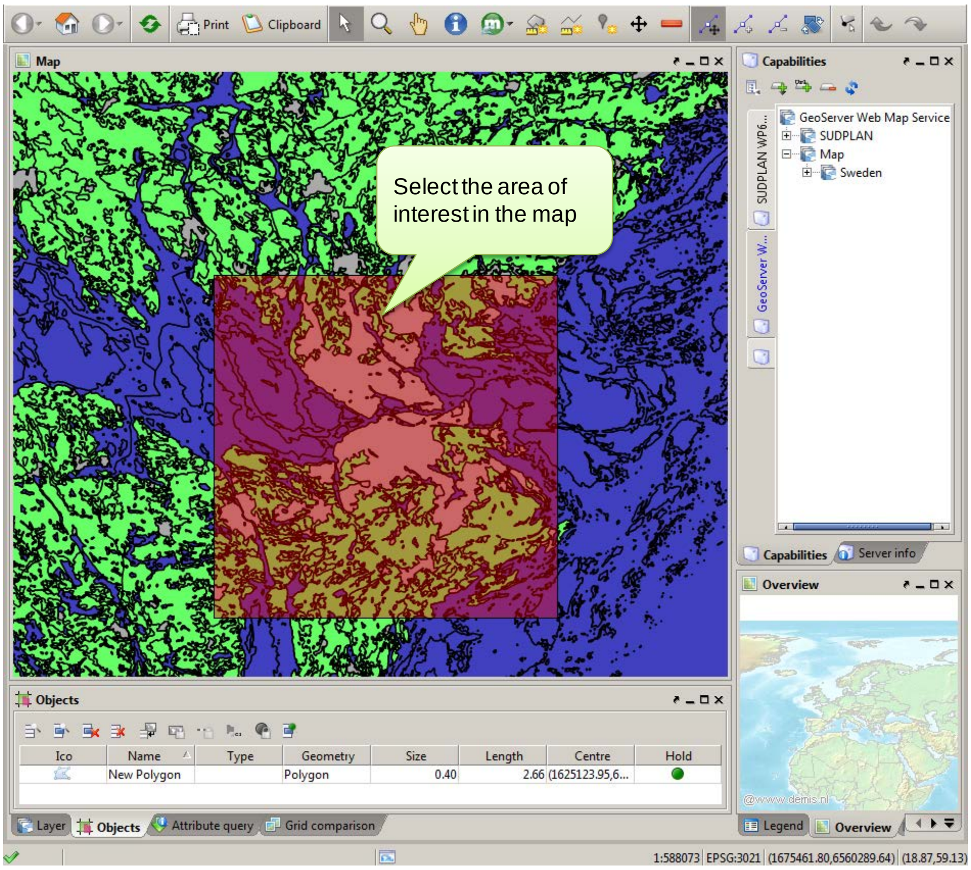

cids Navigator
Rainfall Downscaling Wizard
Steps
1. Select scenario
2. Select target year
3. Add metadata
Add metadata
Name:
Rf Ds Run 1
Description:
First Rainfall Downscaling Run
Perform downscaling
< Back
Next >
Finish
Cancel

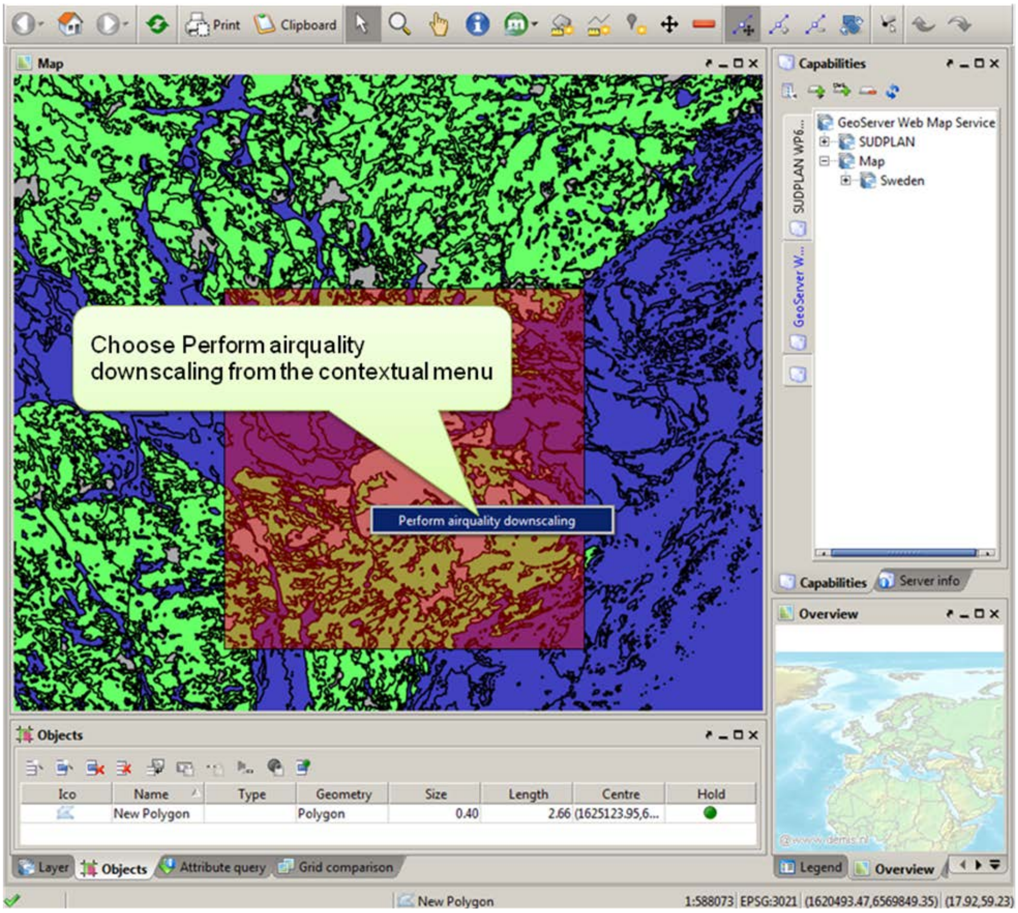

cids Navigator
View the
downscaling results
Time Series Data
Time
Statistische Ergebnisse
Total season accumulation
Maximum 30-min intensity
Frequency of occurrence
1 object selected
Descriptions loaded successfully

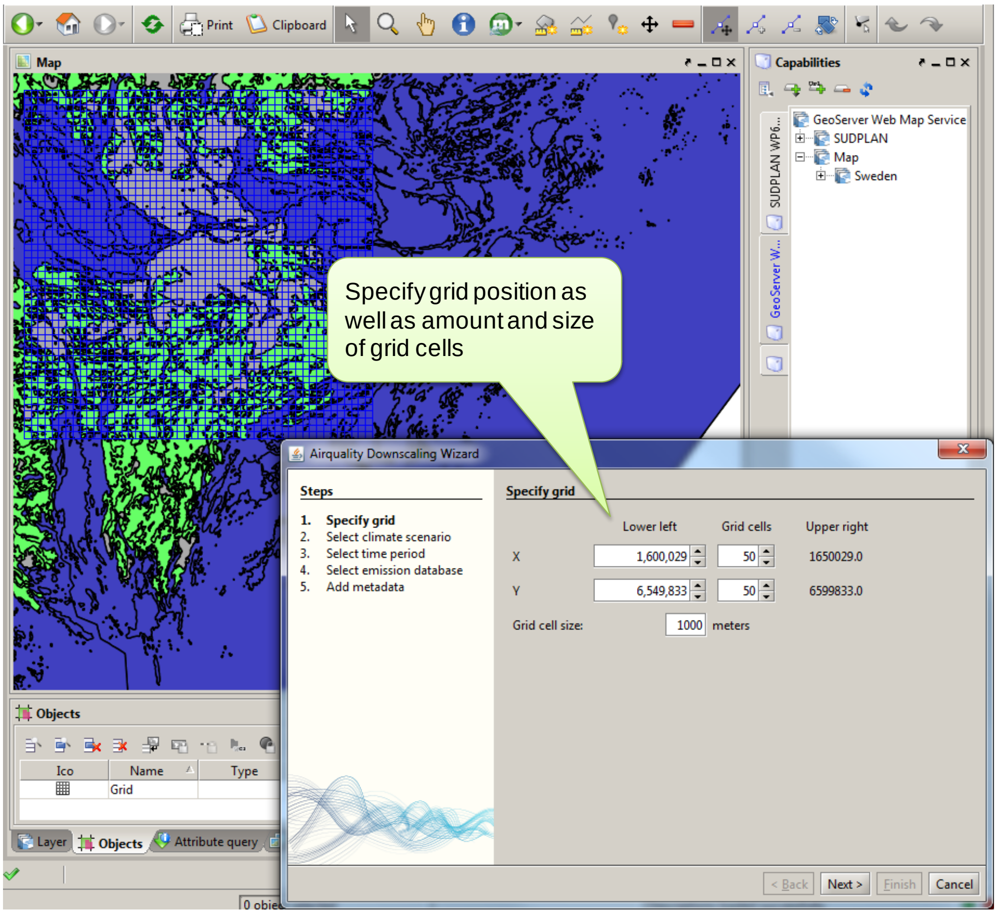

SMS
Mapping Component
Wizard
SPS
SOS
addTimeseriesFeature()
displayFeature()
startDownscaling()
getAvailableScenarios()
return scenarios
chooseScenario()
getTargetYearBoundaries()
return boundaryYears
chooseTargetYear()
chooseFrequencyAdjustment()
addMetaInformation()
return taskId
startDownscaling()
return taskId
notifyFinished(taskId)
downloadResults(taskId)
return resultTimeseries + statistical results
displayResults()

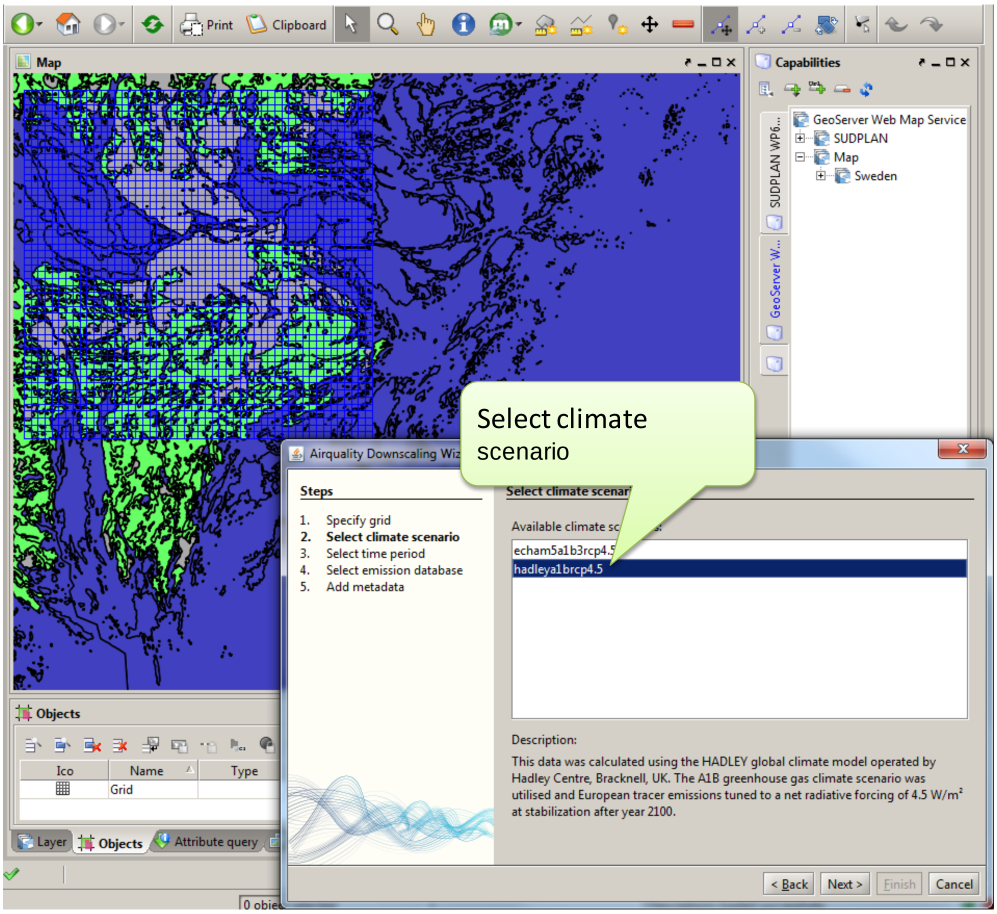
8.3. Execute Air Quality Downscaling

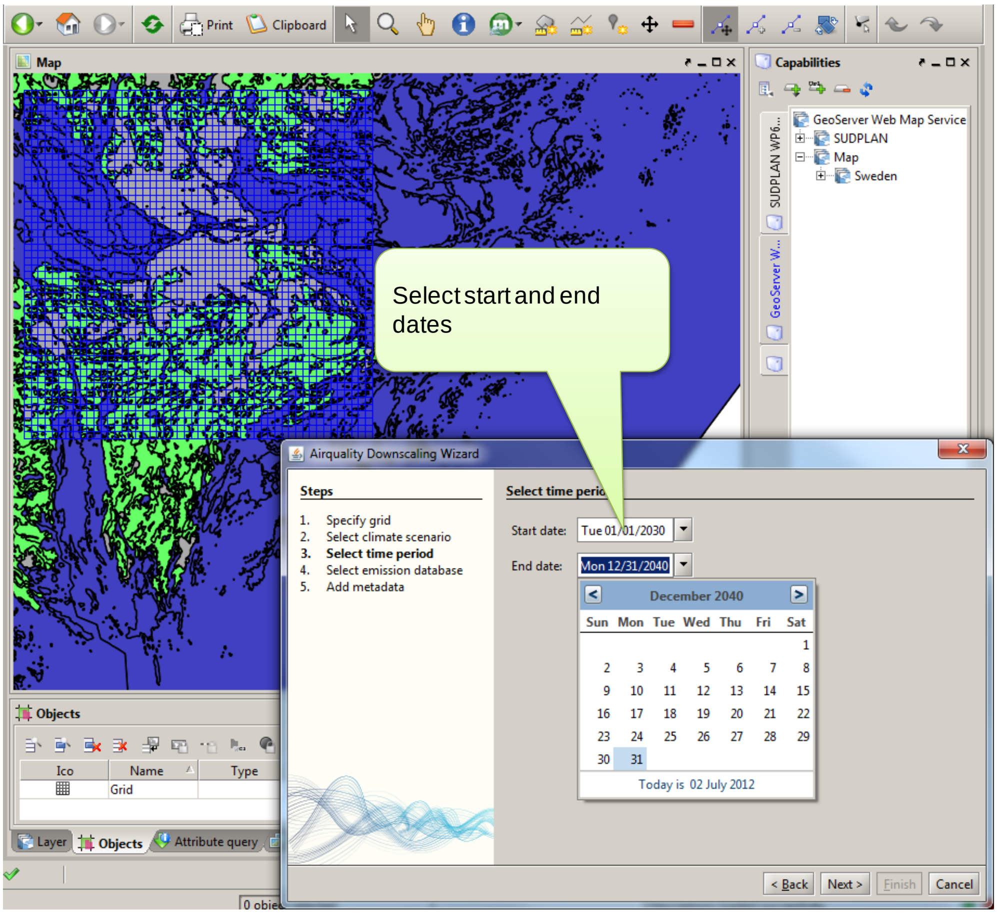
For a description of this validation scenario please refer to *4.2.3 Execute Air Quality Downscaling*.

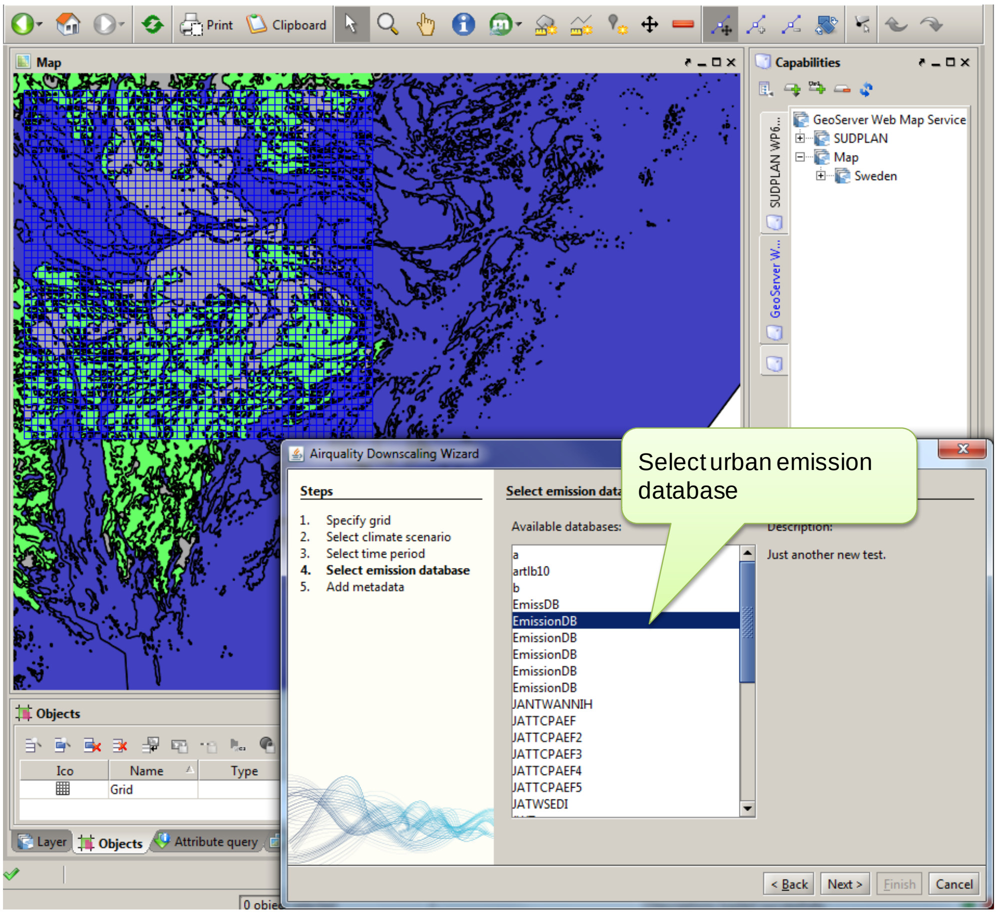


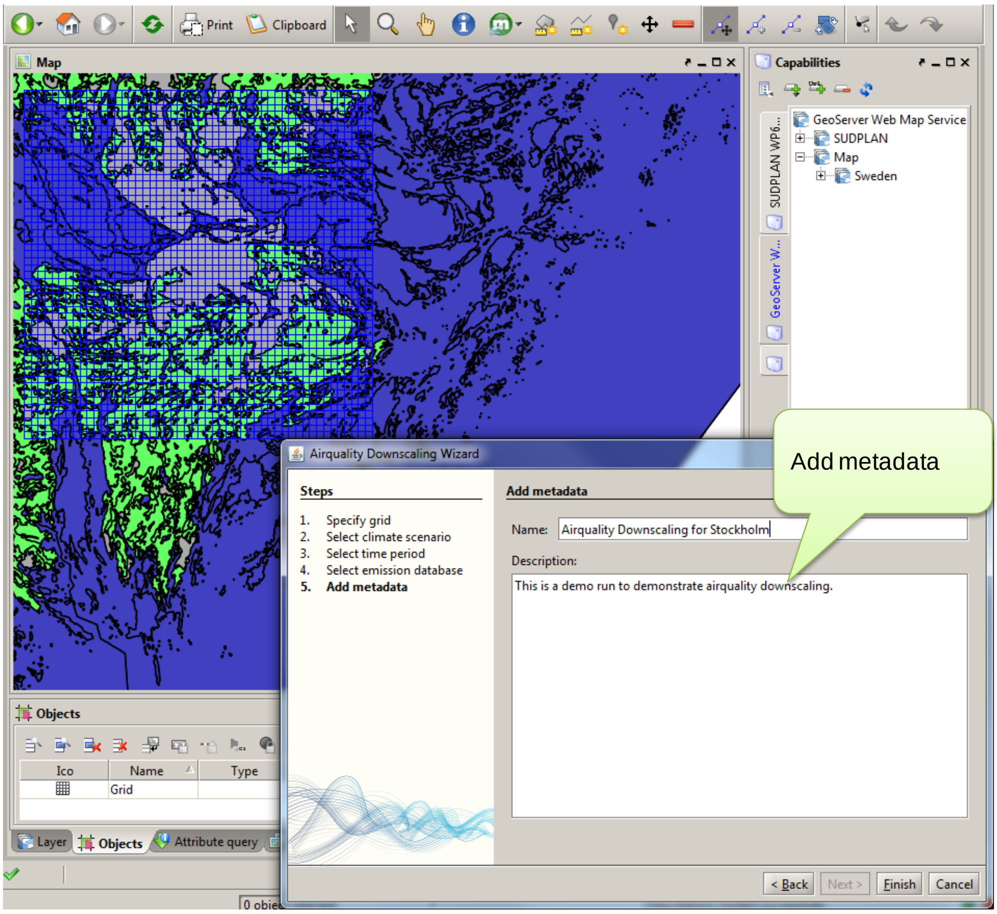

Choose Perform airquality downscaling from the contextual menu
Perform airquality downscaling

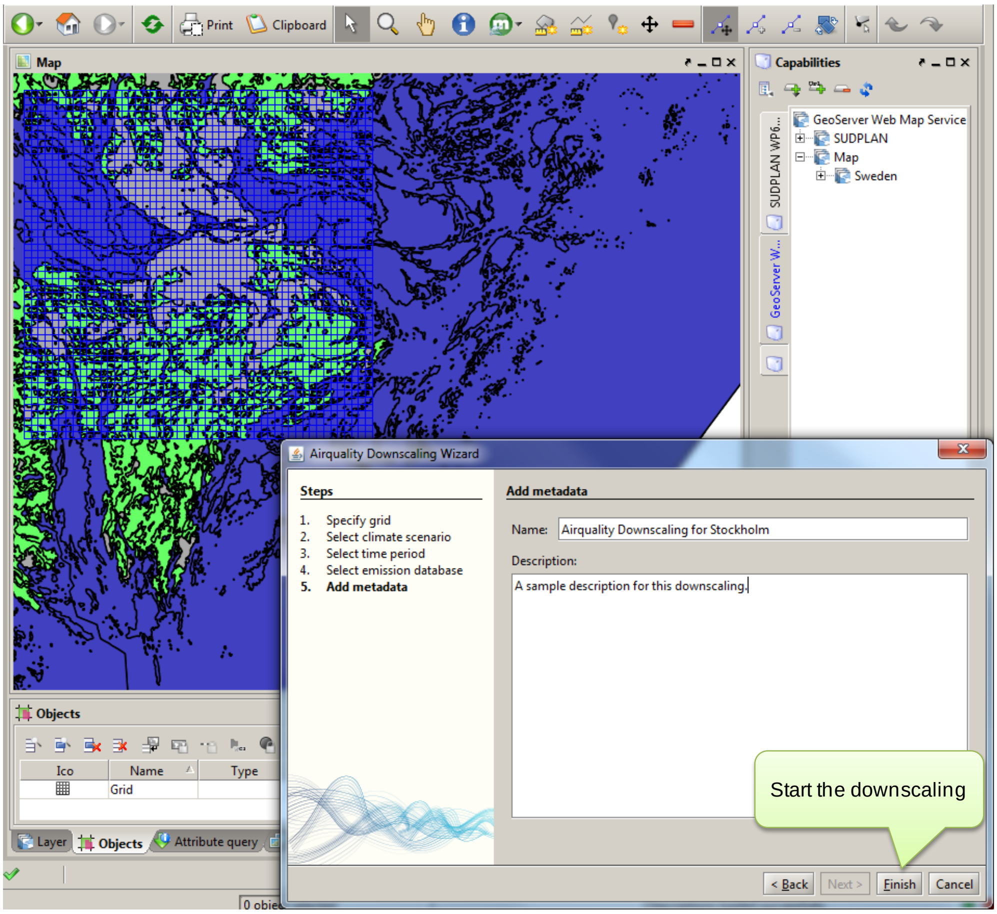

Specify grid position as well as amount and size of grid cells
Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Specify grid
Lower left
Grid cells
Upper right
X 1,600,029 50 1650029.0
Y 6,549,833 50 6599833.0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

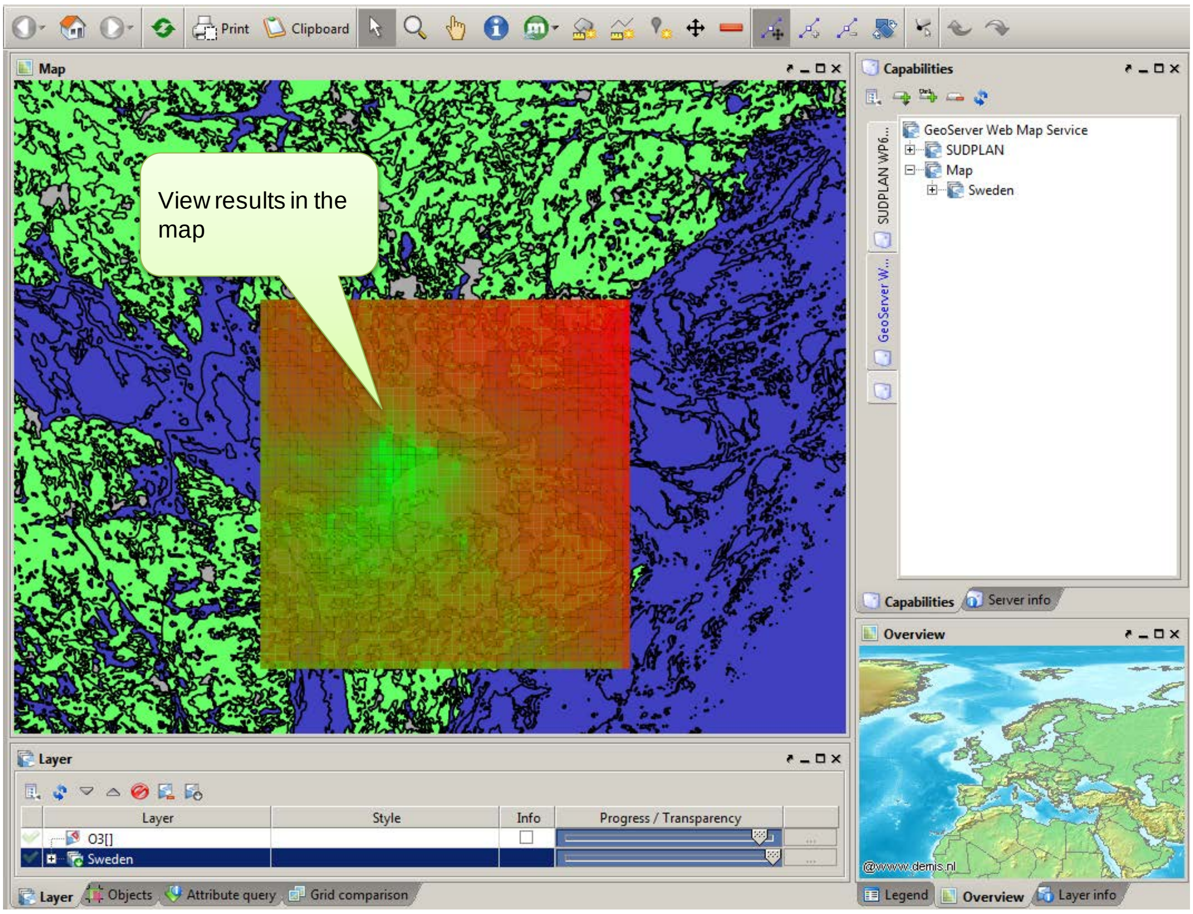

Select climate scenario
Airquality Downscaling Wiz
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Available climate sc
echam5a1b3rcp4.5
hadleya1brcp4.5
Description:
This data was calculated using the HADLEY global climate model operated 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

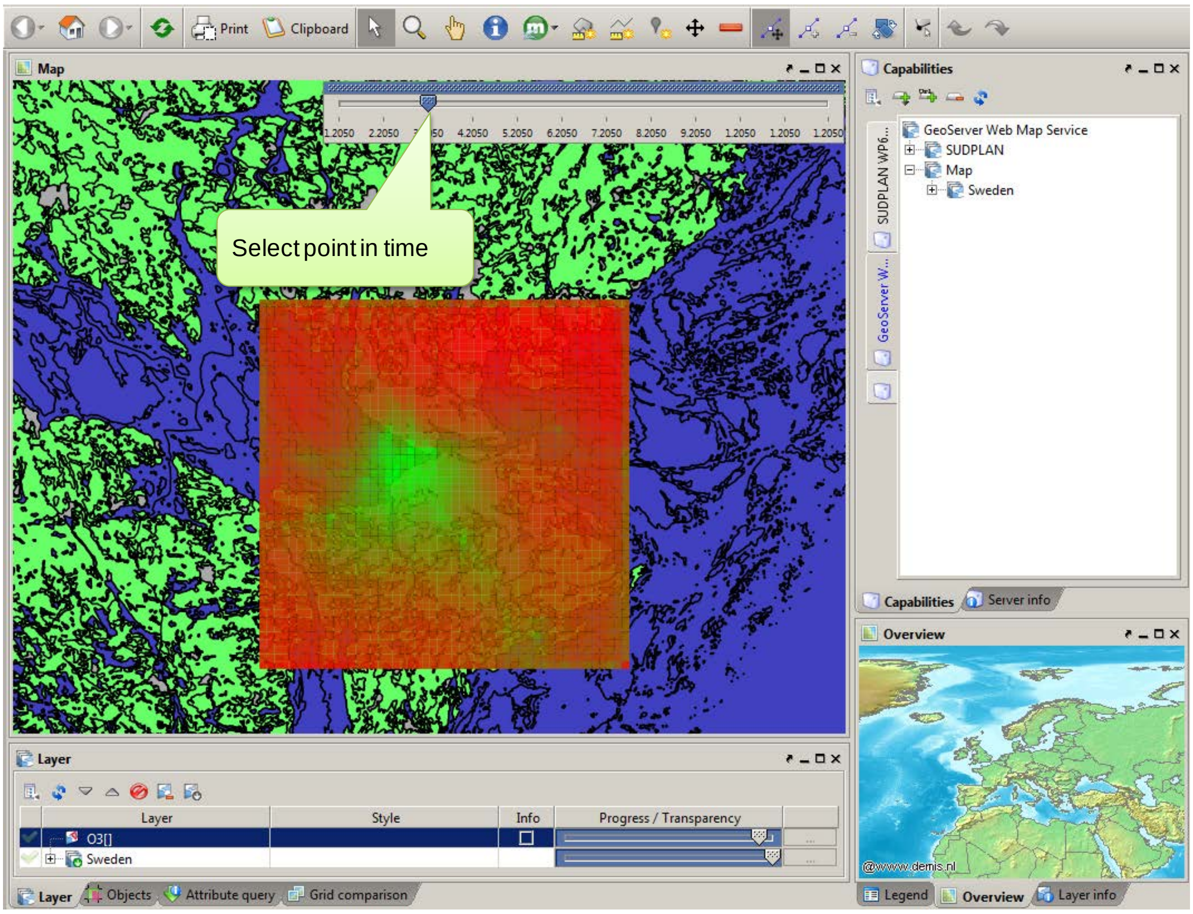

Select start and end dates
Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Start date: Tue 01/01/2030
End date: Mon 12/31/2040
December 2040
Today is 02 July 2012
< Back
Next >
Finish
Cancel

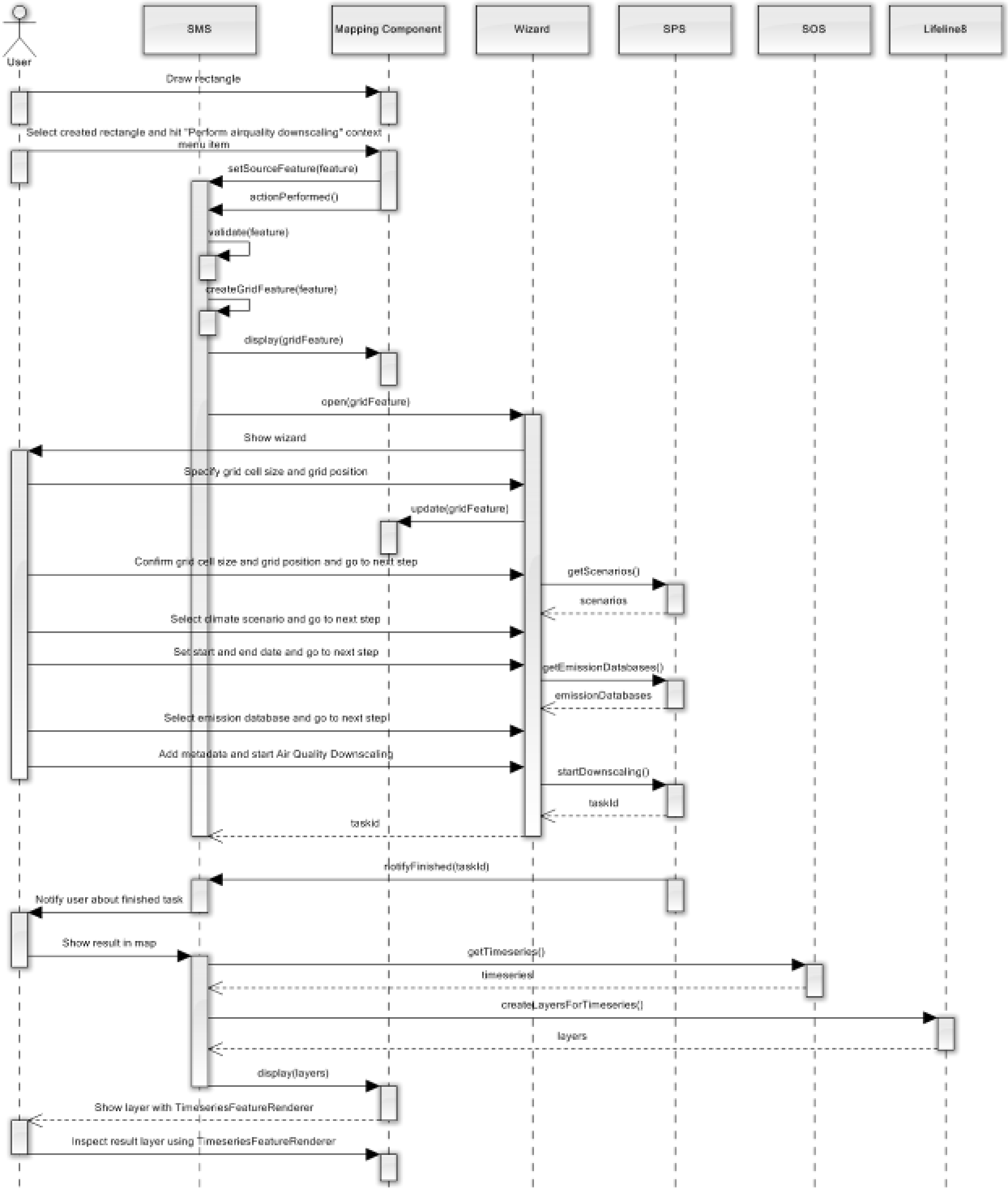

Select urban emission database
Airquality Downscaling Wizard
Steps
1. Specify grid
2. Select climate scenario
3. Select time period
4. Select emission database
5. Add metadata
Available databases:
Description:
Just another new test.
a
artlb10
b
EmissDB
EmissionDB
EmissionDB
EmissionDB
EmissionDB
EmissionDB
JANTWANNIH
JATTCPAEF
JATTCPAEF2
JATTCPAEF3
JATTCPAEF4
JATTCPAEF5
JATWSEDI
< Back
Next >
Finish
Cancel


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

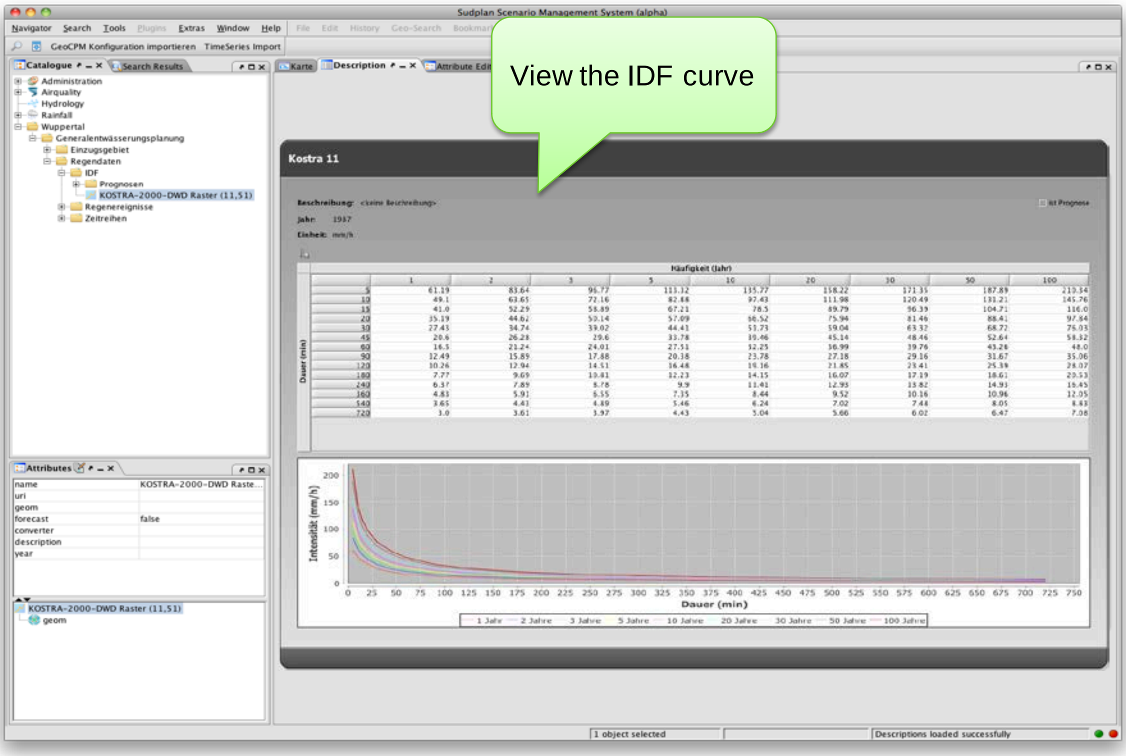

View results in the map
Capabilities
GeoServer Web Map Service
SUDPLAN
Map
Sweden
Overview
Layer
Style
Info
Progress / Transparency
O3[]
Sweden

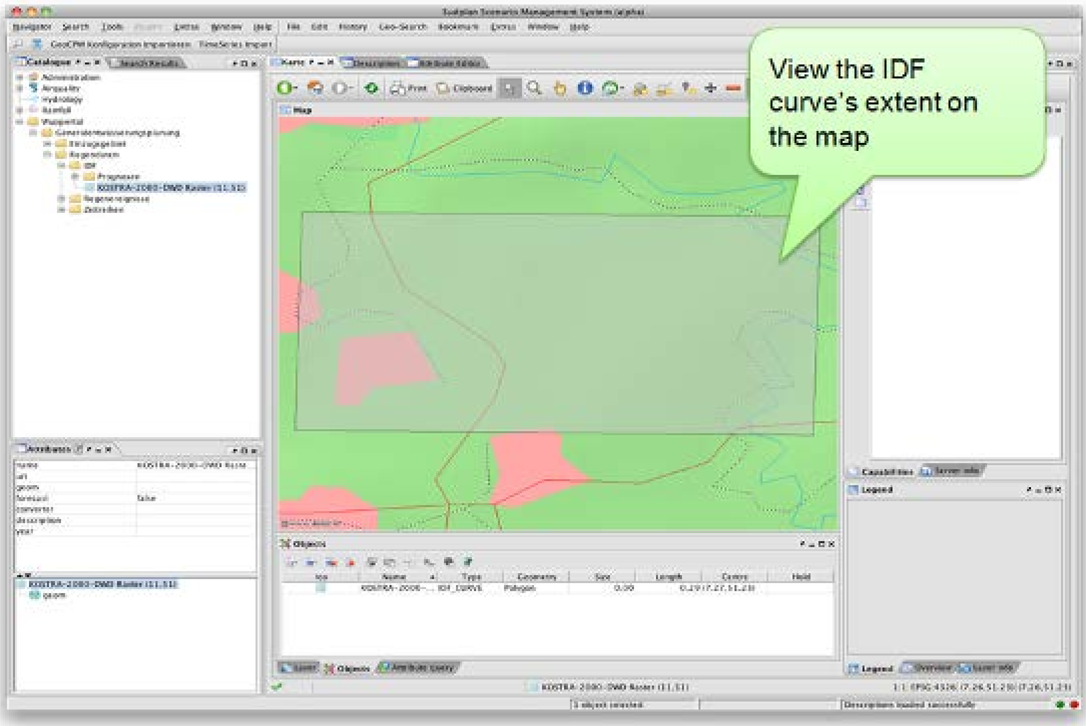

Print
Clipboard
Map
Select point in time
Capabilities
GeoServer Web Map Service
SUDPLAN
Map
Sweden
Server info
Overview
Layer
Style
Info
Progress / Transparency
O3[]
Sweden
Objects
Attribute query
Grid comparison
Legend
Layer info

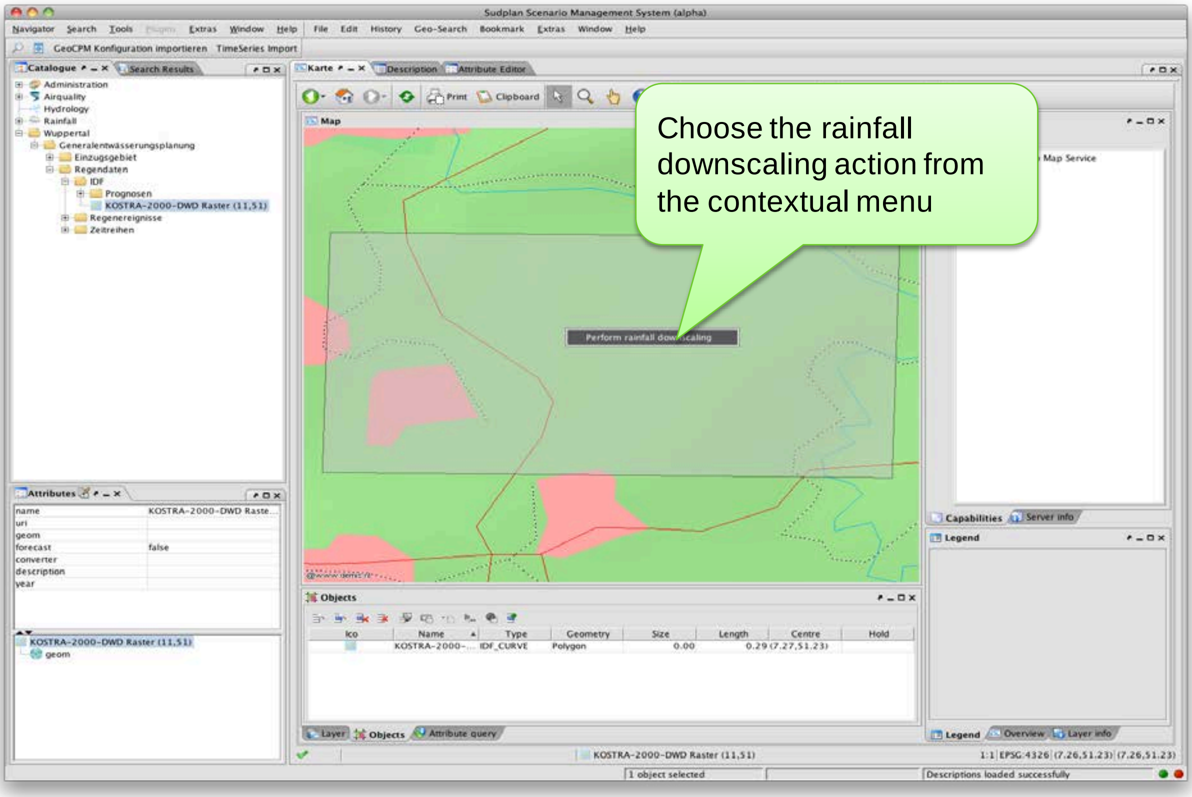

User
SMS
Mapping Component
Wizard
SPS
SOS
Lifeline8
Draw rectangle
Select created rectangle and hit "Perform airquality downscaling" context menu item
setSourceFeature(feature)
actionPerformed()
validate(feature)
createGridFeature(feature)
display(gridFeature)
open(gridFeature)
Show wizard
Specify grid cell size and grid position
update(gridFeature)
Confirm grid cell size and grid position and go to next step
getScenarios()
scenarios
Select climate scenario and go to next step
Set start and end date and go to next step
getEmissionDatabases()
emissionDatabases
Select emission database and go to next step
Add metadata and start Air Quality Downscaling
startDownscaling()
taskId
taskId
notifyFinished(taskId)
Notify user about finished task
Show result in map
getTimeseries()
timeseries
createLayersForTimeseries()
layers
display(layers)
Show layer with TimeseriesFeatureRenderer
Inspect result layer using TimeseriesFeatureRenderer

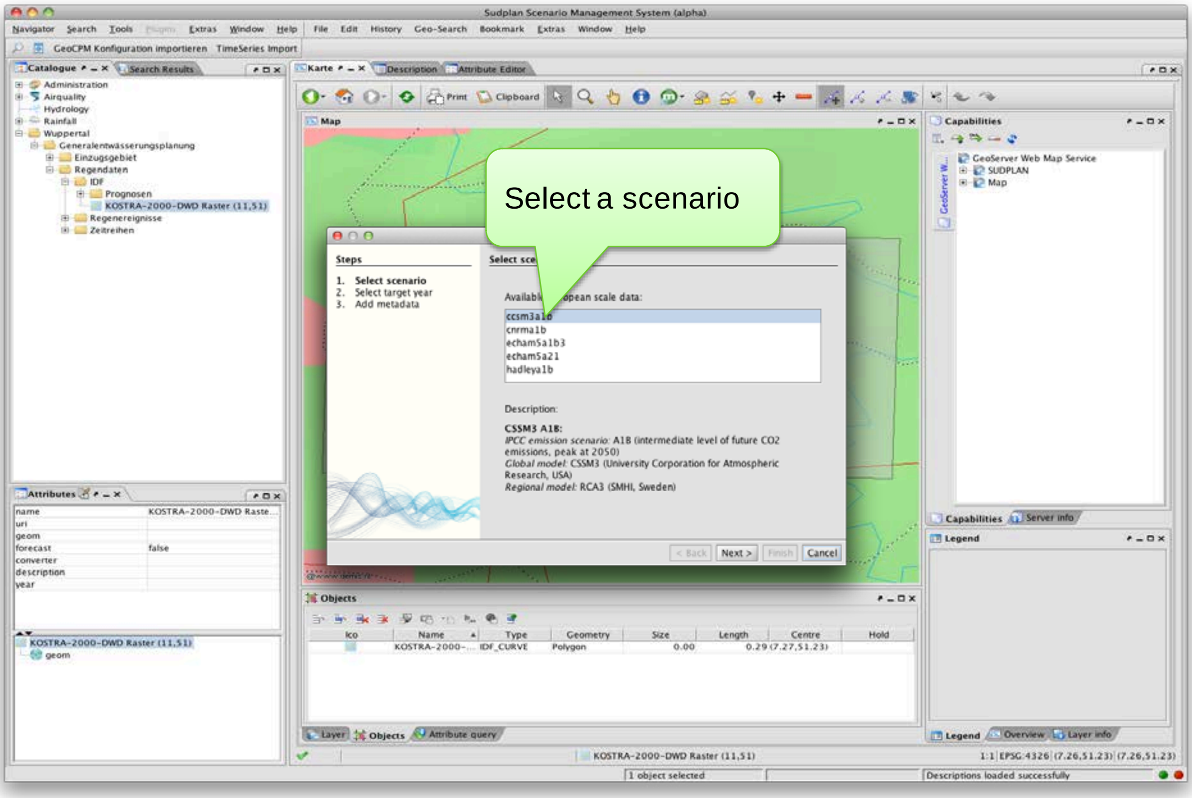
8.4. Execute IDF Rainfall Downscaling

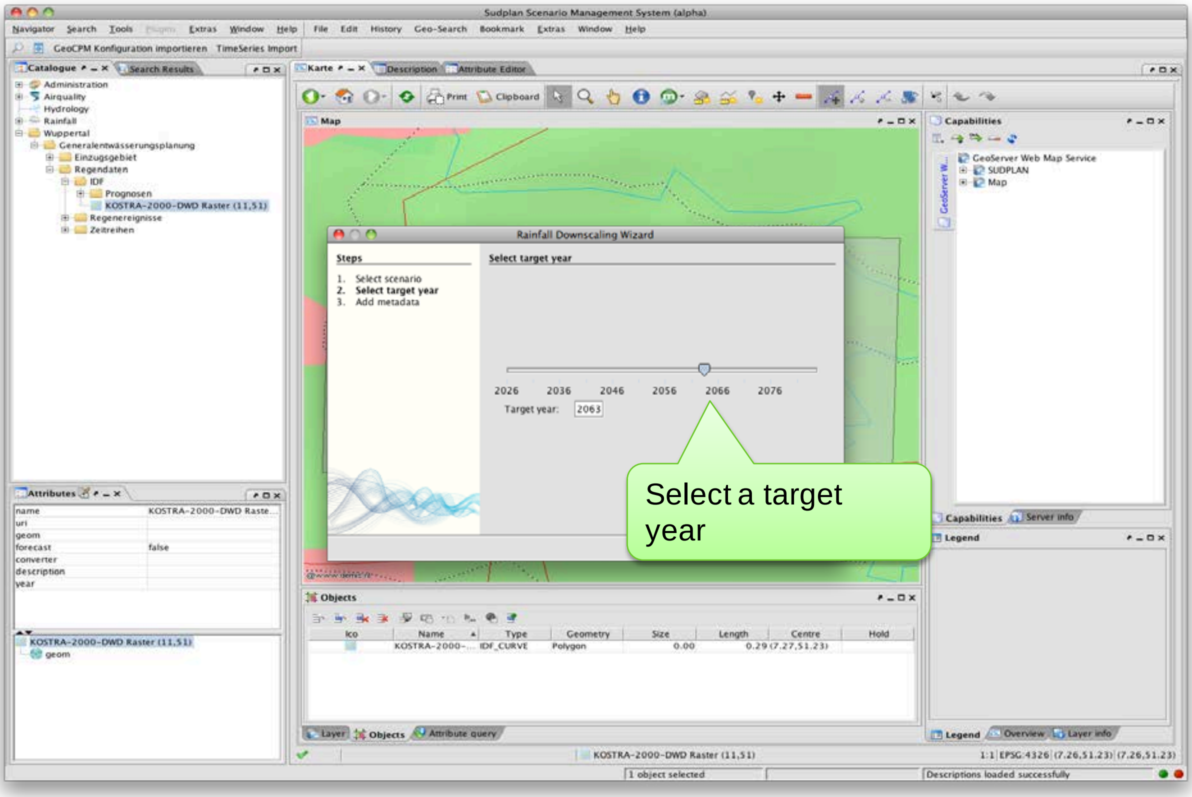
For a description of this validation scenario please refer to *4.2.4 – Execute IDF Rainfall Downscaling*.

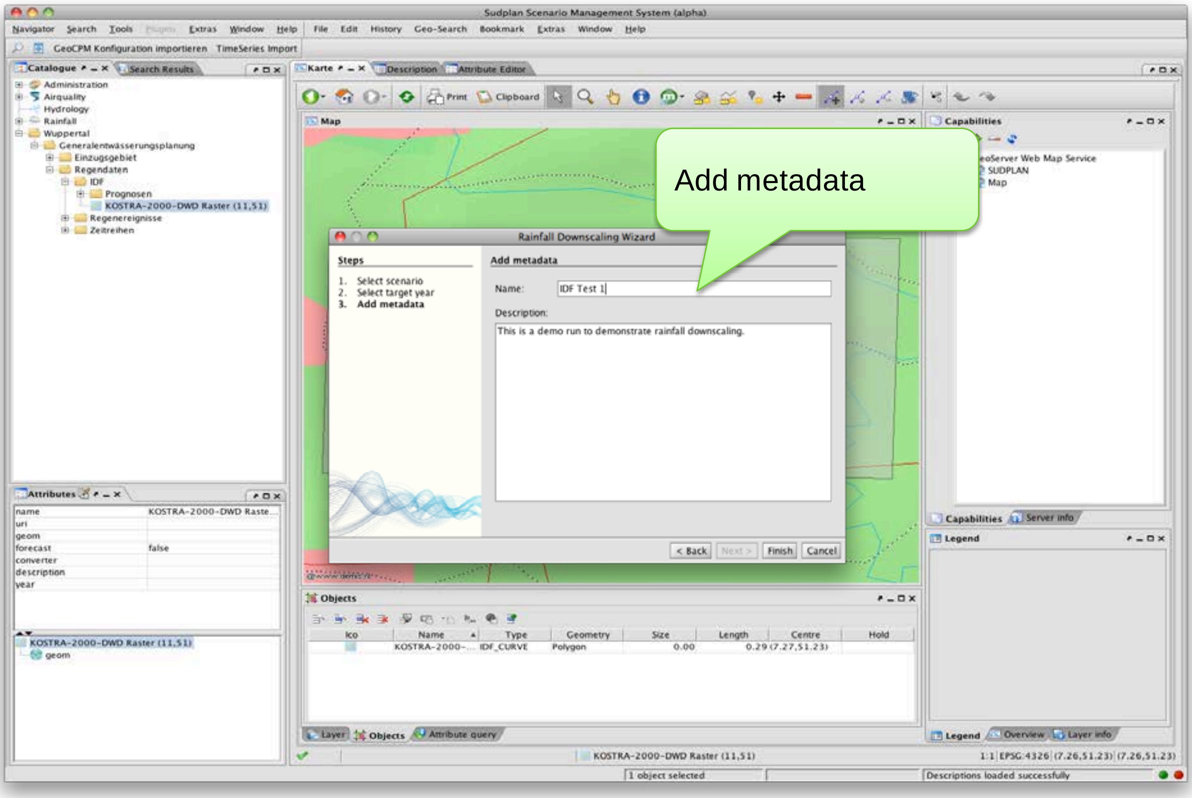


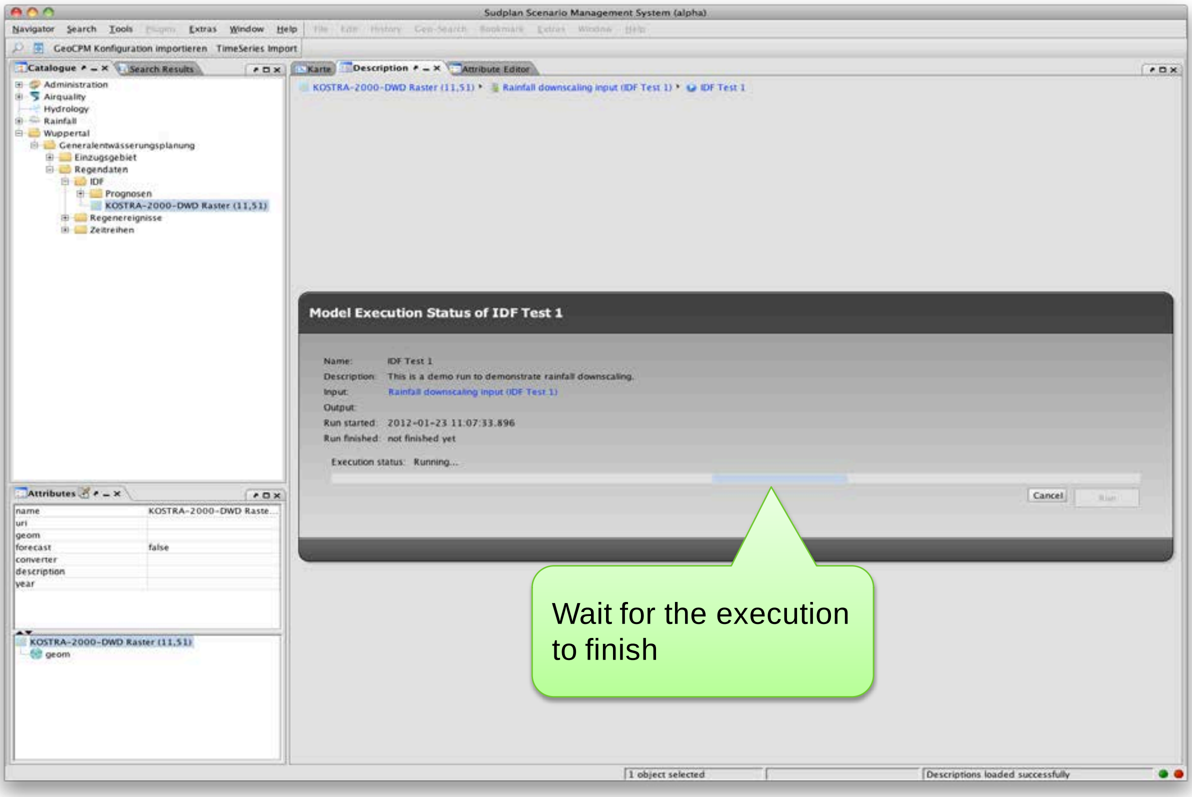


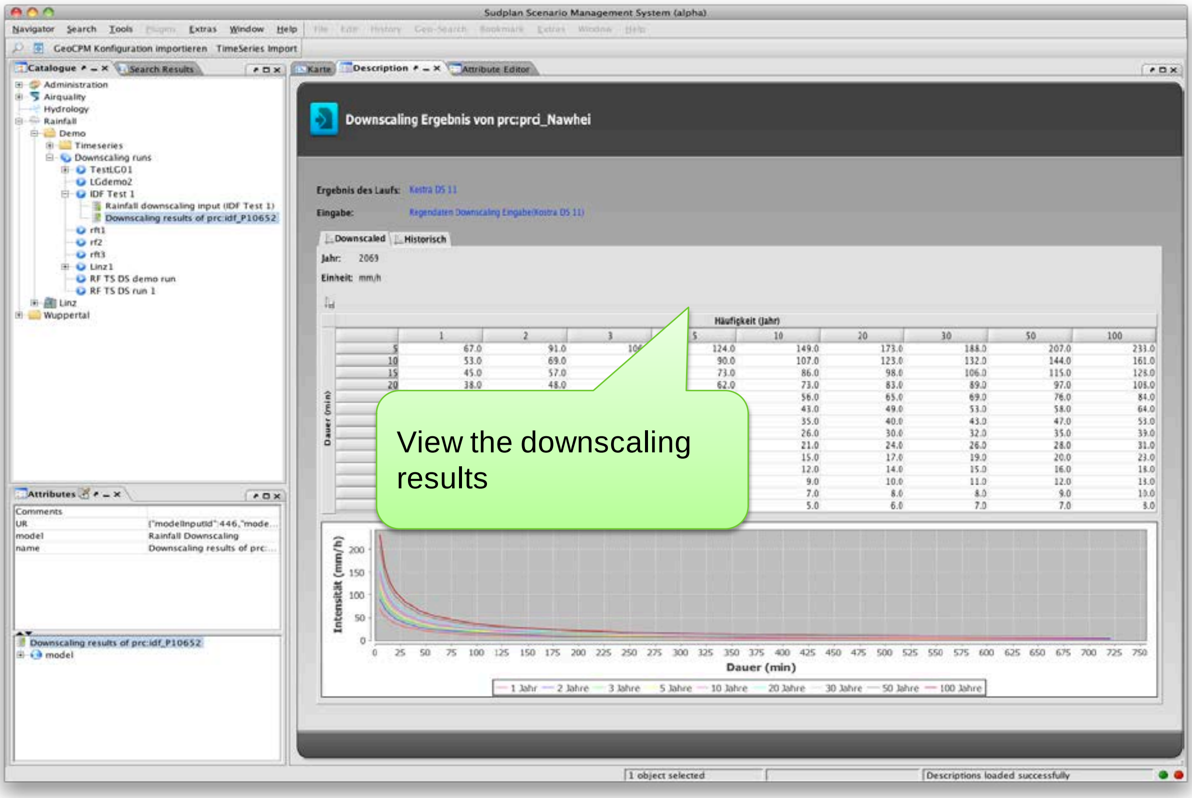

Sudplan Scenario Management System (alpha)
Choose the rainfall downscaling action from the contextual menu
Perform rainfall downscaling

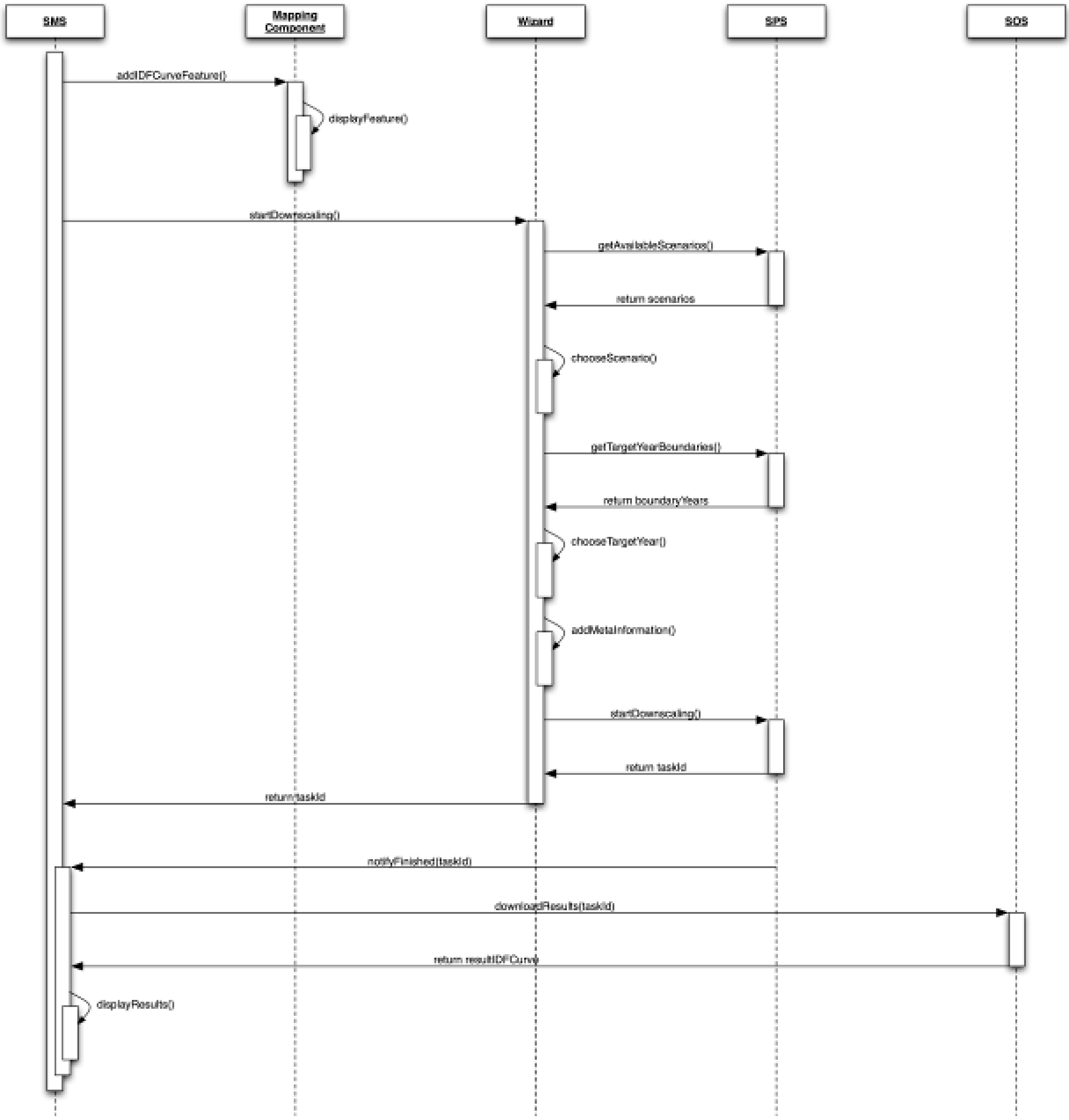

Sudplan Scenario Management System (alpha)
Select a scenario
Steps
1. Select scenario
2. Select target year
3. Add metadata
ccsm3a1b
cnrma1b
echam5a1b3
echam5a21
hadleya1b
Description:
CSSM3 A1B:
IPCC emission scenario: A1B (intermediate level of future CO2 emissions, peak at 2050)
Global model: CSSM3 (University Corporation for Atmospheric Research, USA)
Regional model: RCA3 (SMHI, Sweden)
Next >
Cancel


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)
Add metadata
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

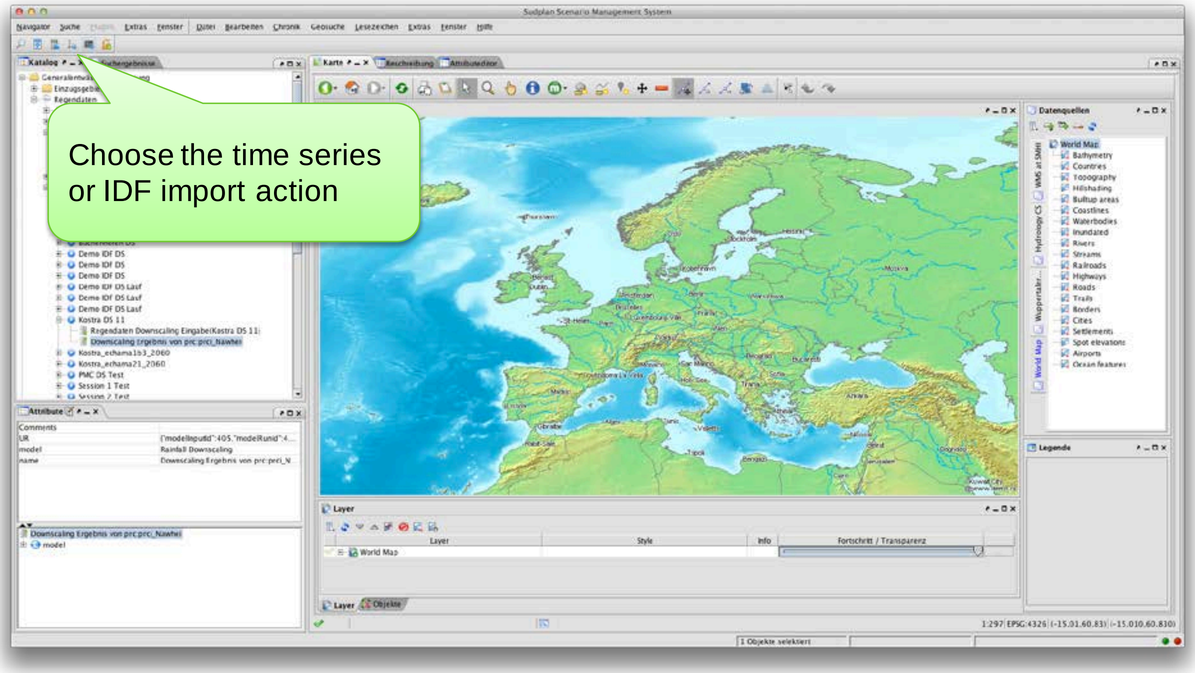

Sudplan Scenario Management System (alpha)
Model Execution Status of IDF Test 1
Wait for the execution to finish

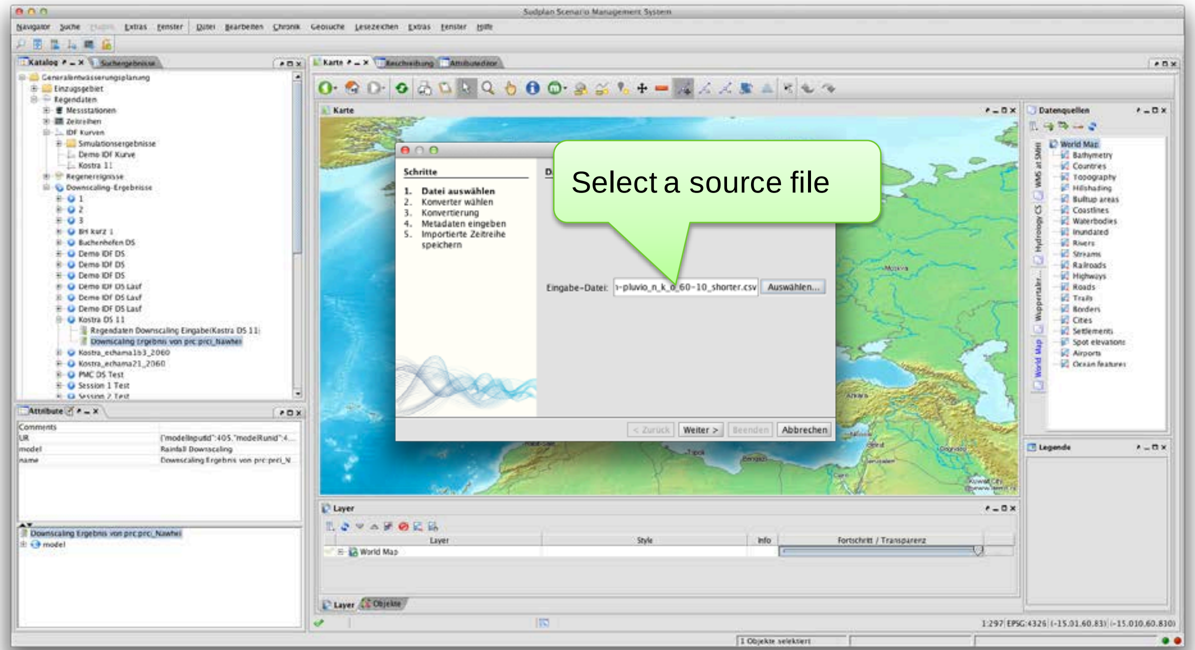

Sudplan Scenario Management System (alpha)
Downscaling Ergebnis von prc:prci_Nawhei
View the downscaling results

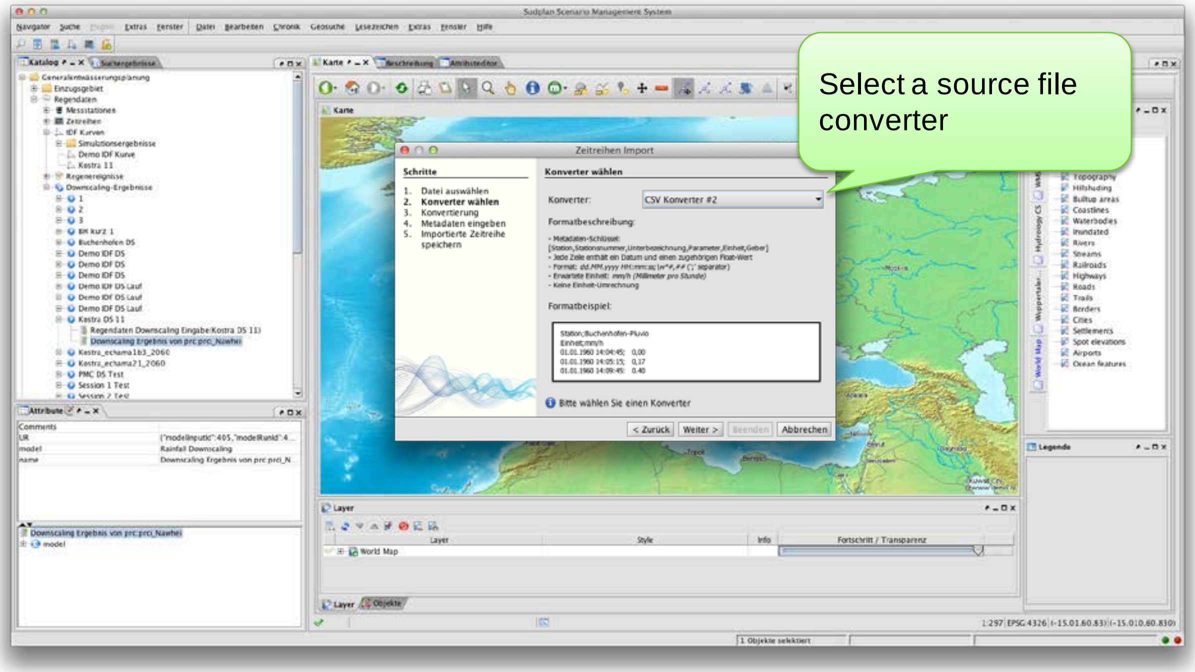

SMS
Mapping Component
Wizard
SPS
SOS
addIDFCurveFeature()
displayFeature()
startDownscaling()
getAvailableScenarios()
return scenarios
chooseScenario()
getTargetYearBoundaries()
return boundaryYears
chooseTargetYear()
addMetaInformation()
startDownscaling()
return taskId
return taskId
notifyFinished(taskId)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

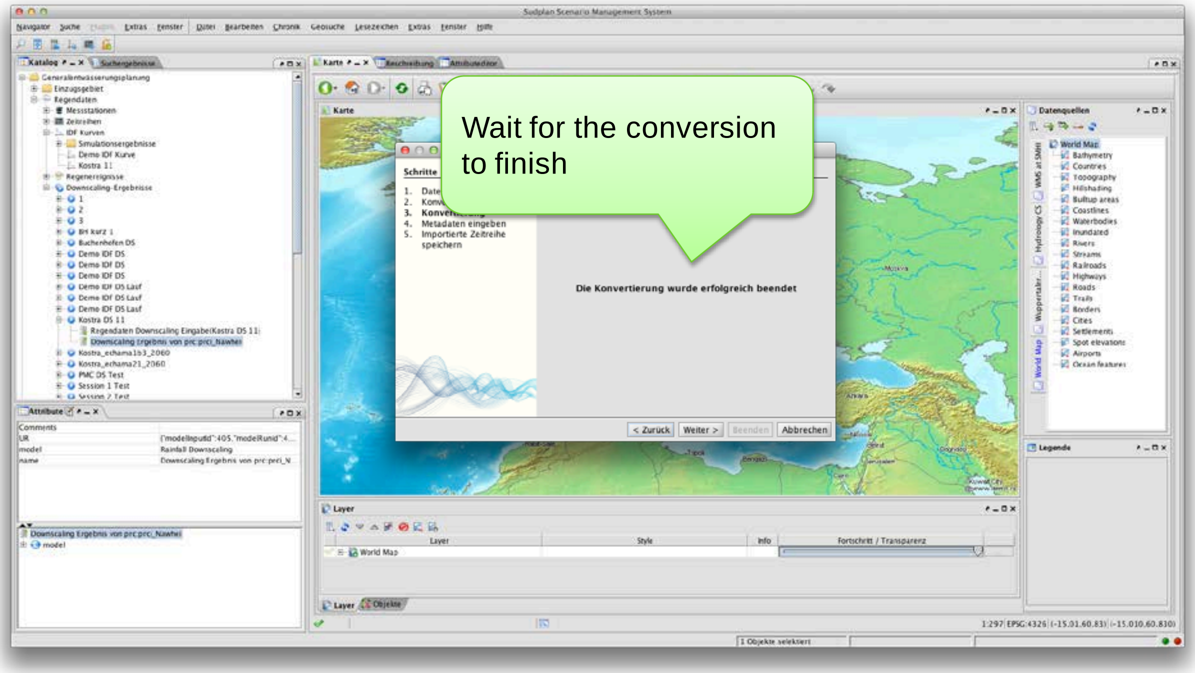
8.5. Local Data Upload

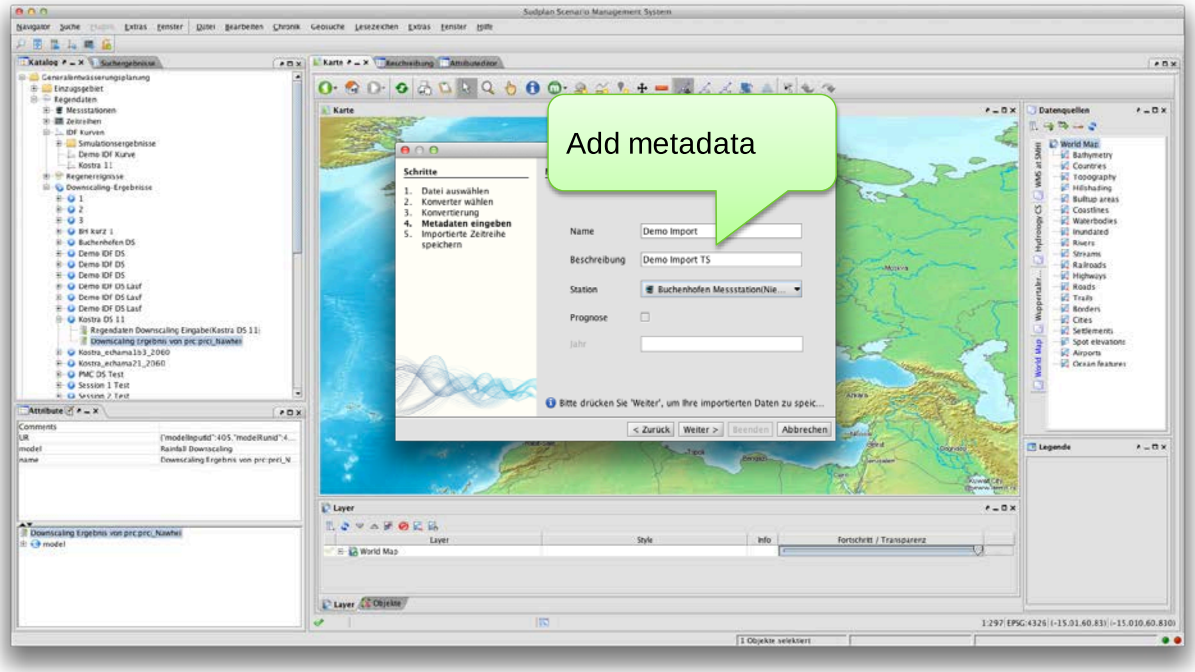
For a description of this validation use case please refer to section *4.2.5 - Local Data Upload.*

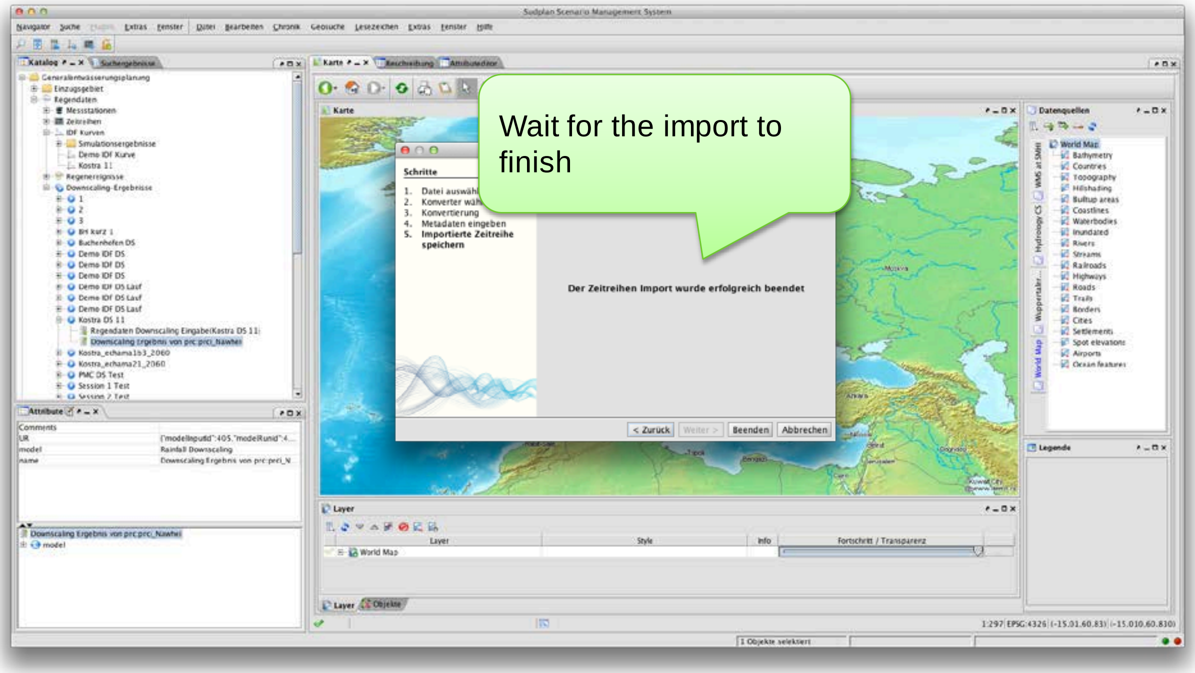


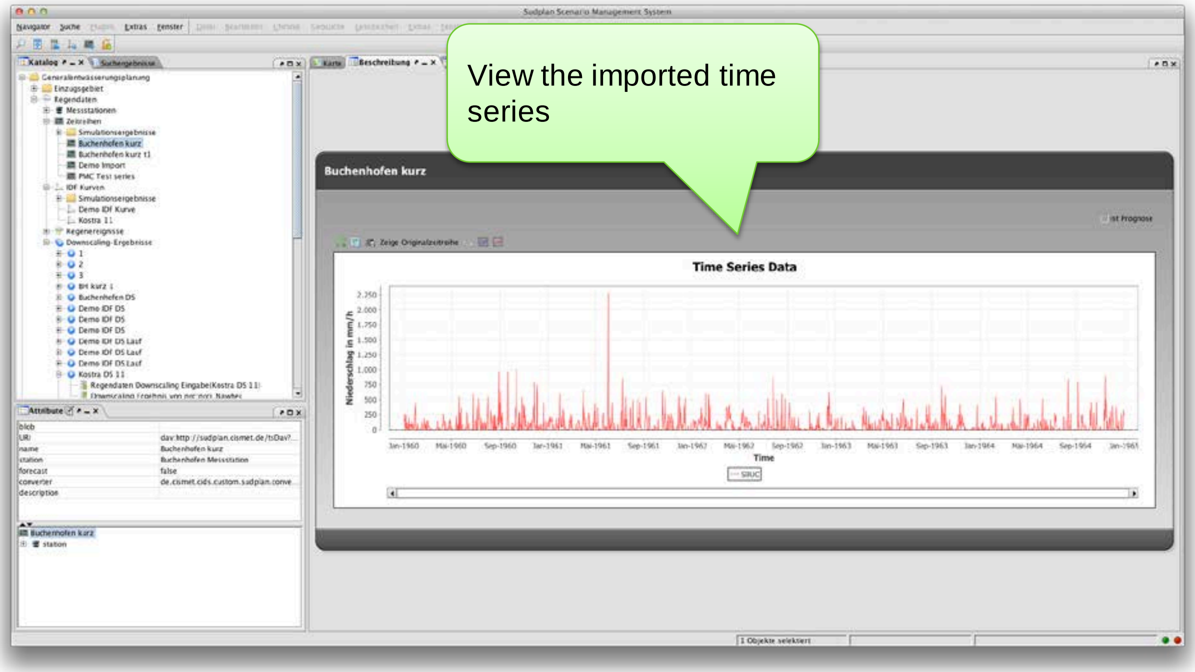


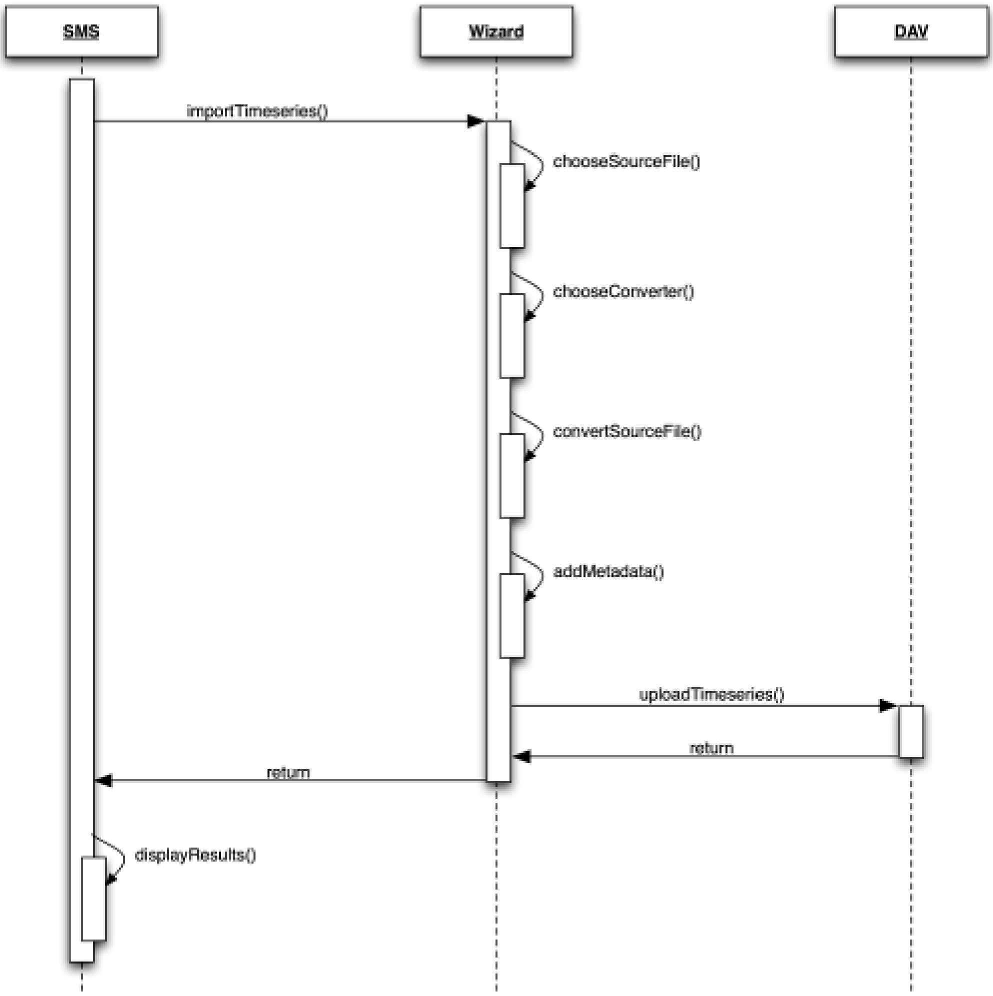

Select a source file converter
Zeitreihen Import
Schritte
1. Datei auswählen
2. Konverter wählen
3. Konvertierung
4. Metadaten eingeben
5. Importierte Zeitreihe speichern
Konverter wählen
Konverter:
CSV Konverter #2
Formatbeschreibung:
Formatbeispiel:
Bitte wählen Sie einen Konverter
< Zurück
Weiter >
Beenden
Abbrechen


Wait for the conversion to finish
Schritte
Die Konvertierung wurde erfolgreich beendet
< Zurück
Weiter >
Beenden
Abbrechen


Add metadata
Sudplan Scenario Management System
Schritte
1. Datei auswählen
2. Konverter wählen
3. Konvertierung
4. Metadaten eingeben
5. Importierte Zeitreihe speichern
Name
Demo Import
Beschreibung
Demo Import TS
Station
Prognose
Bitte drücken Sie 'Weiter', um Ihre importierten Daten zu speic...
< Zurück
Weiter >
Beenden
Abbrechen

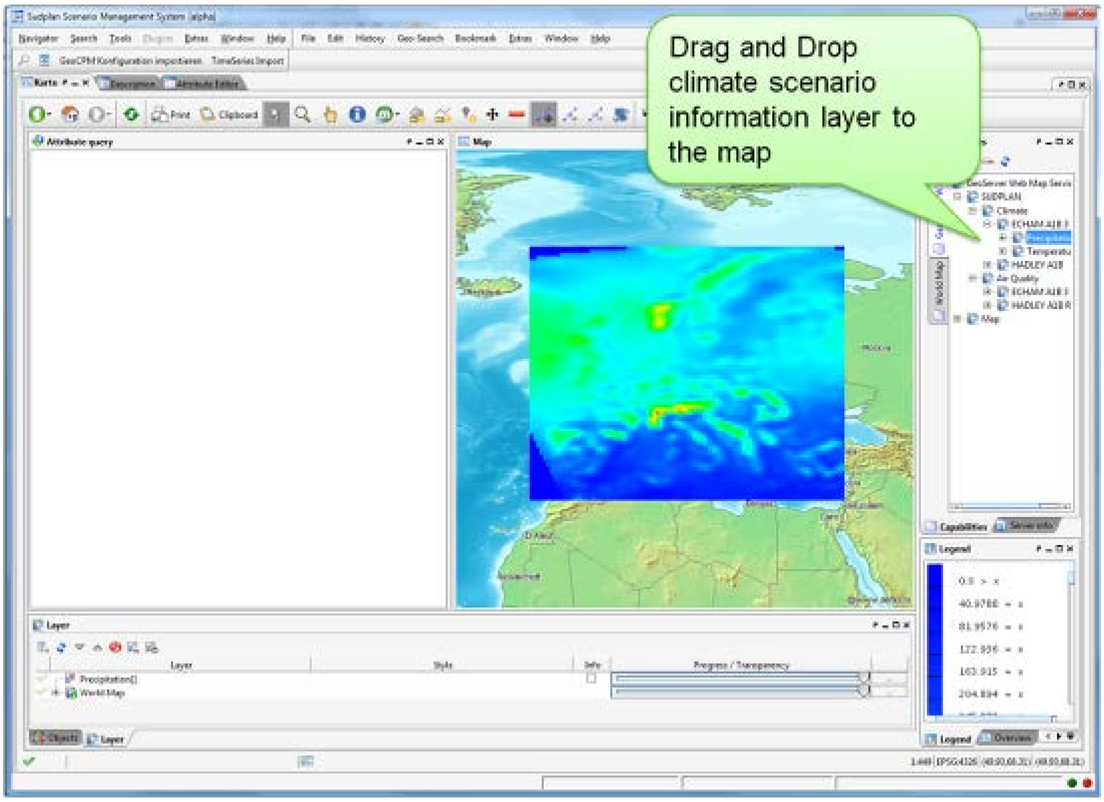

Wait for the import to finish
Sudplan Scenario Management System
Schritte
Der Zeitreihen Import wurde erfolgreich beendet
< Zurück
Weiter >
Beenden
Abbrechen

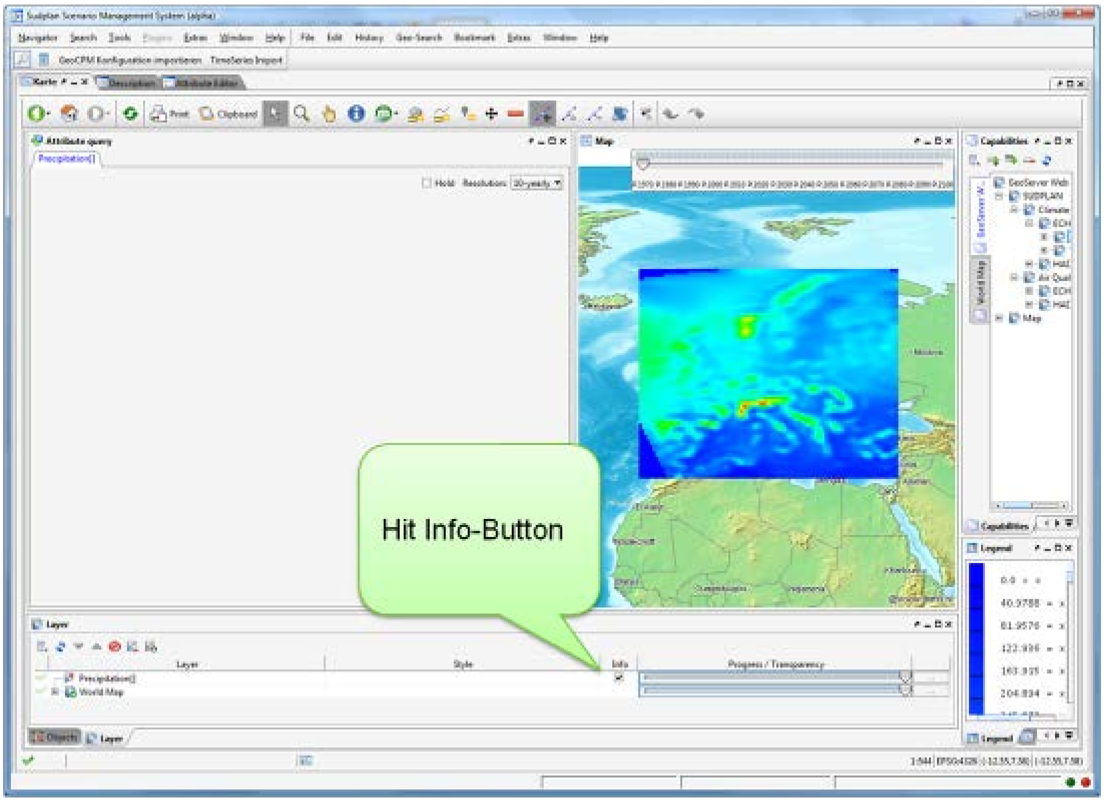

View the imported time series
Buchenhofen kurz
Time Series Data
Time

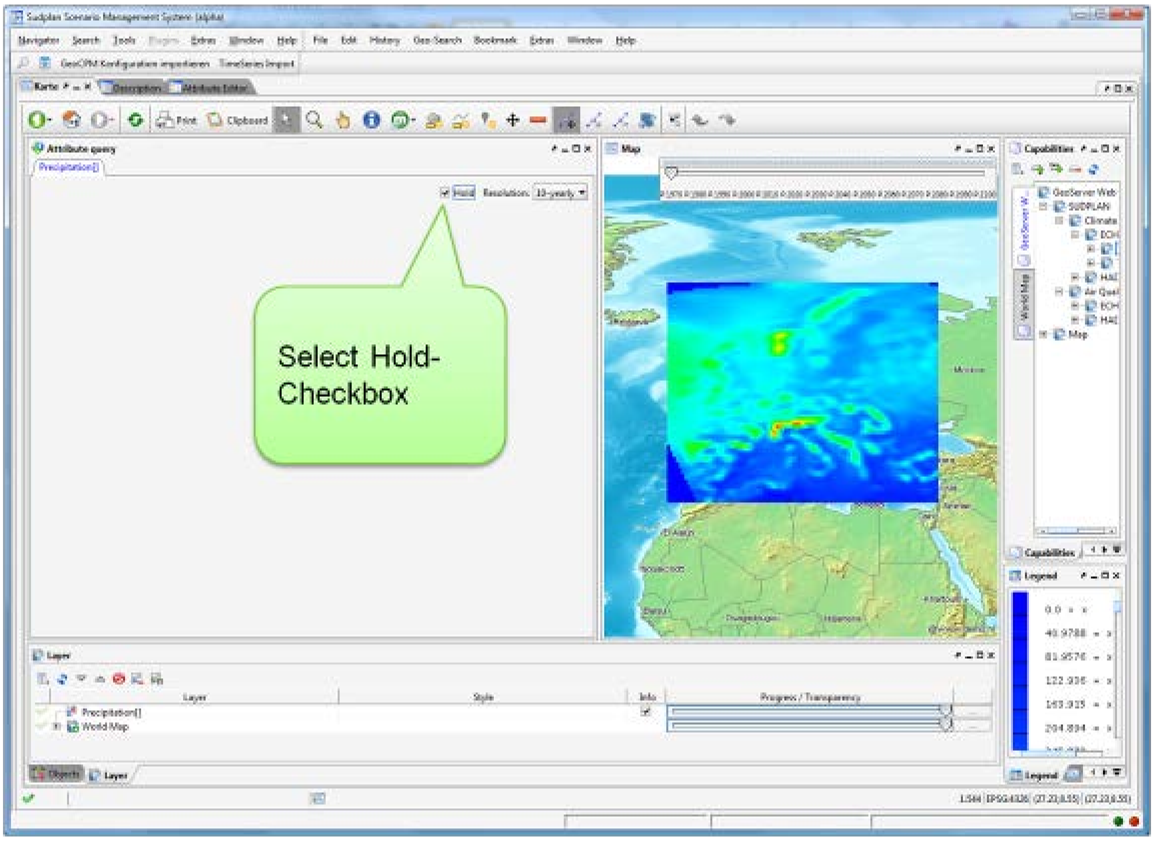

SMS
Wizard
DAV
importTimeseries()
chooseSourceFile()
chooseConverter()
convertSourceFile()
addMetadata()
uploadTimeseries()
return
return
displayResults()

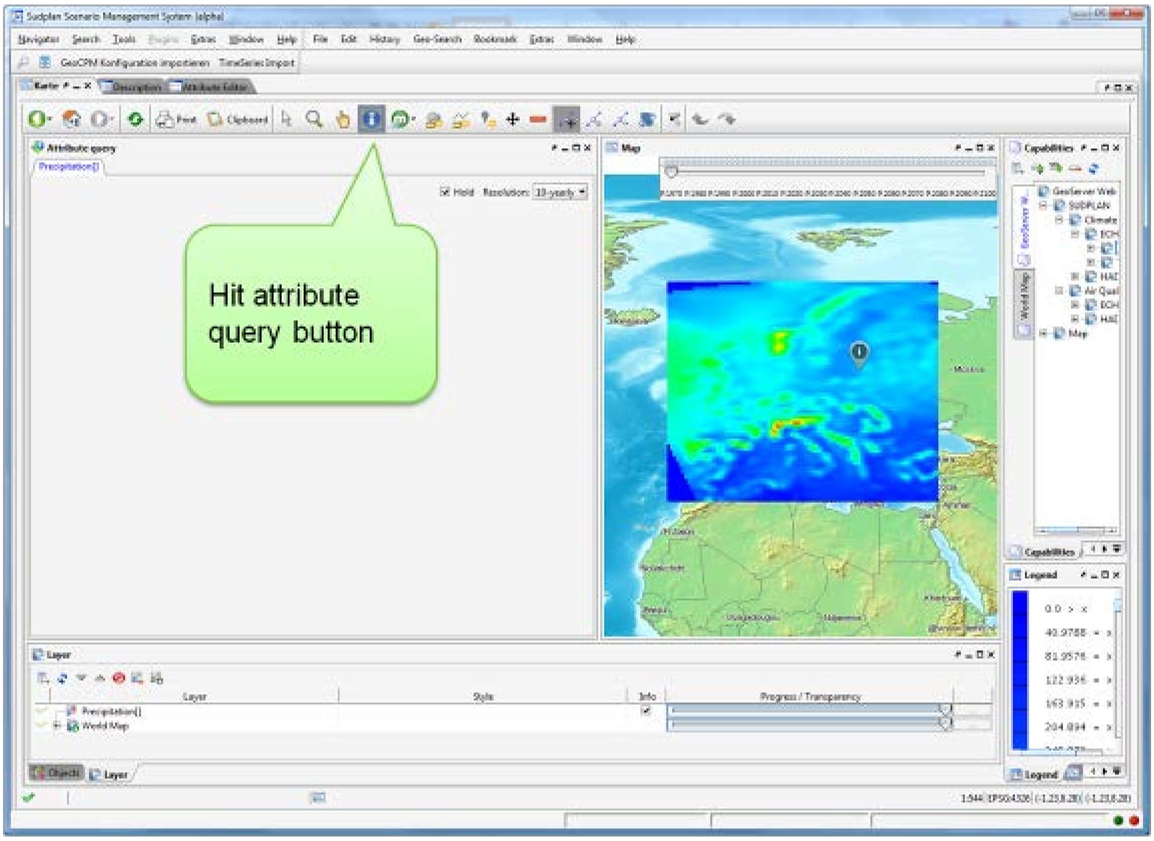
8.6. Time Series Visualisation & Comparison

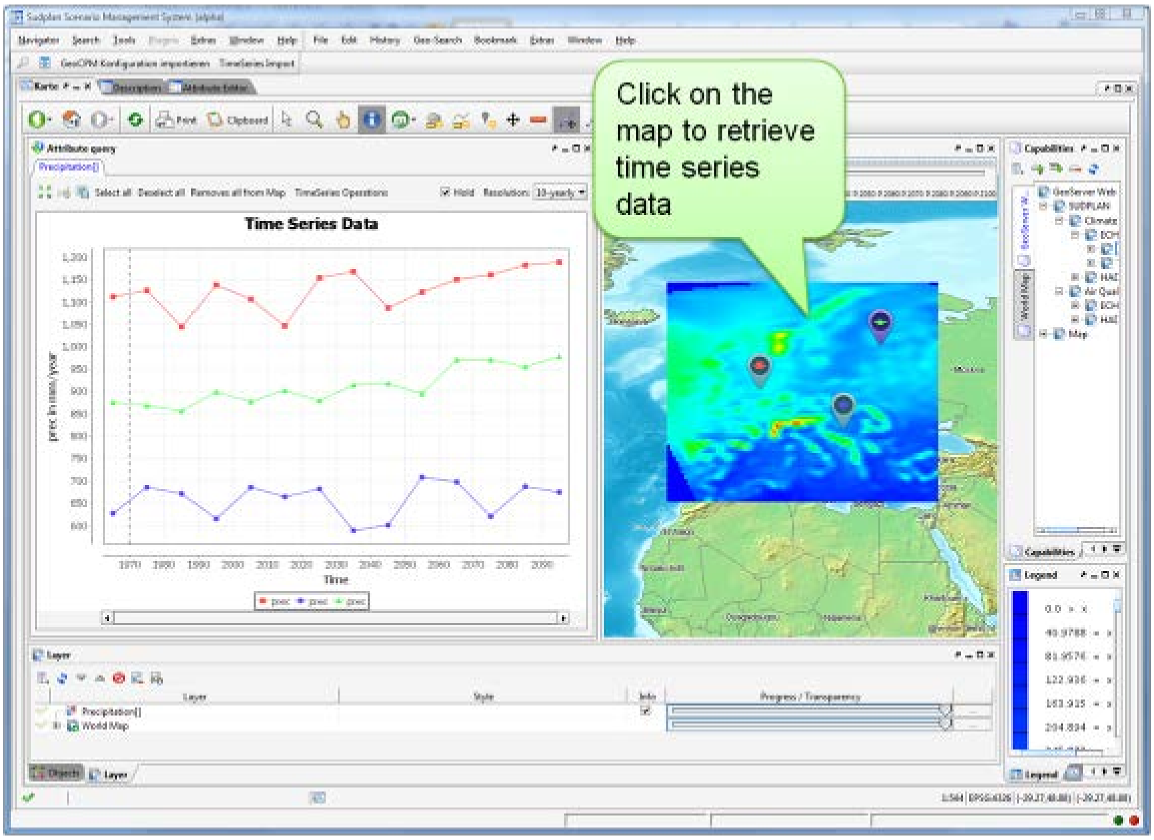
For a description of this validation use case please refer to *4.2.7 - Time Series Visualisation & Comparison.*

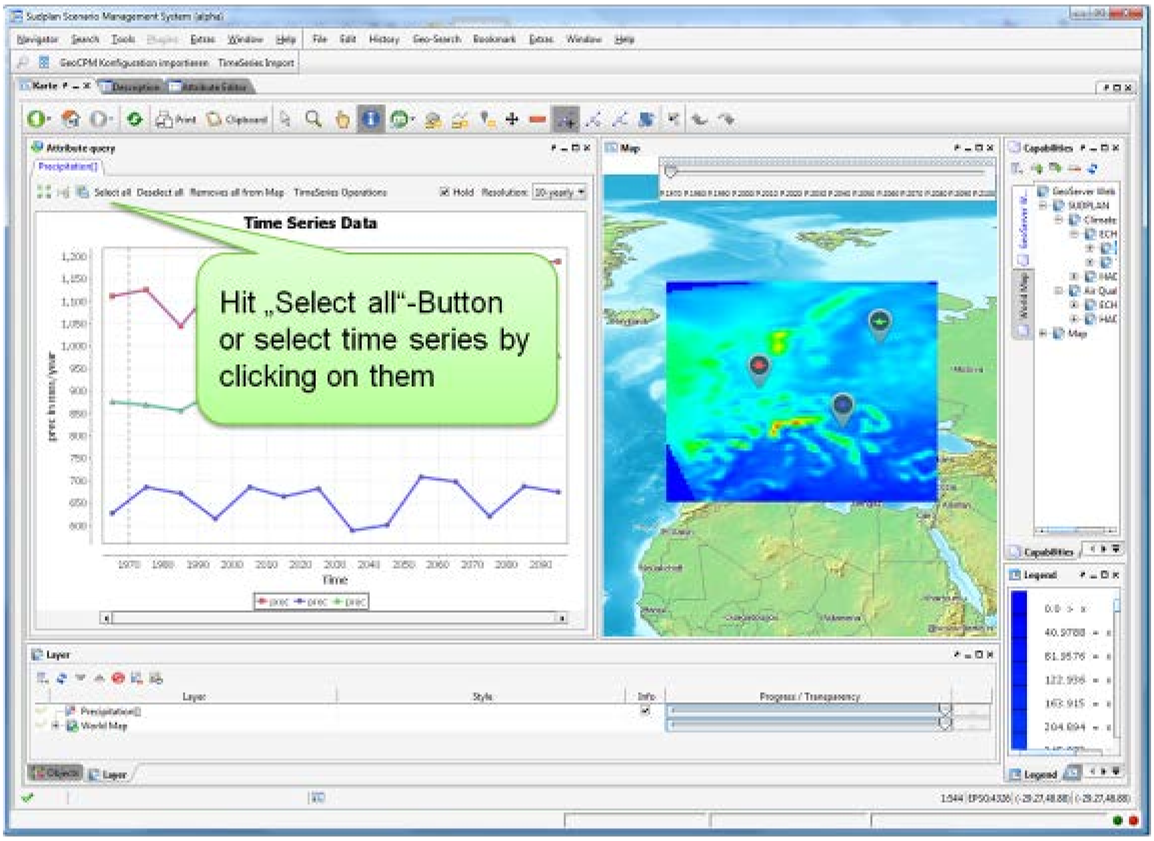


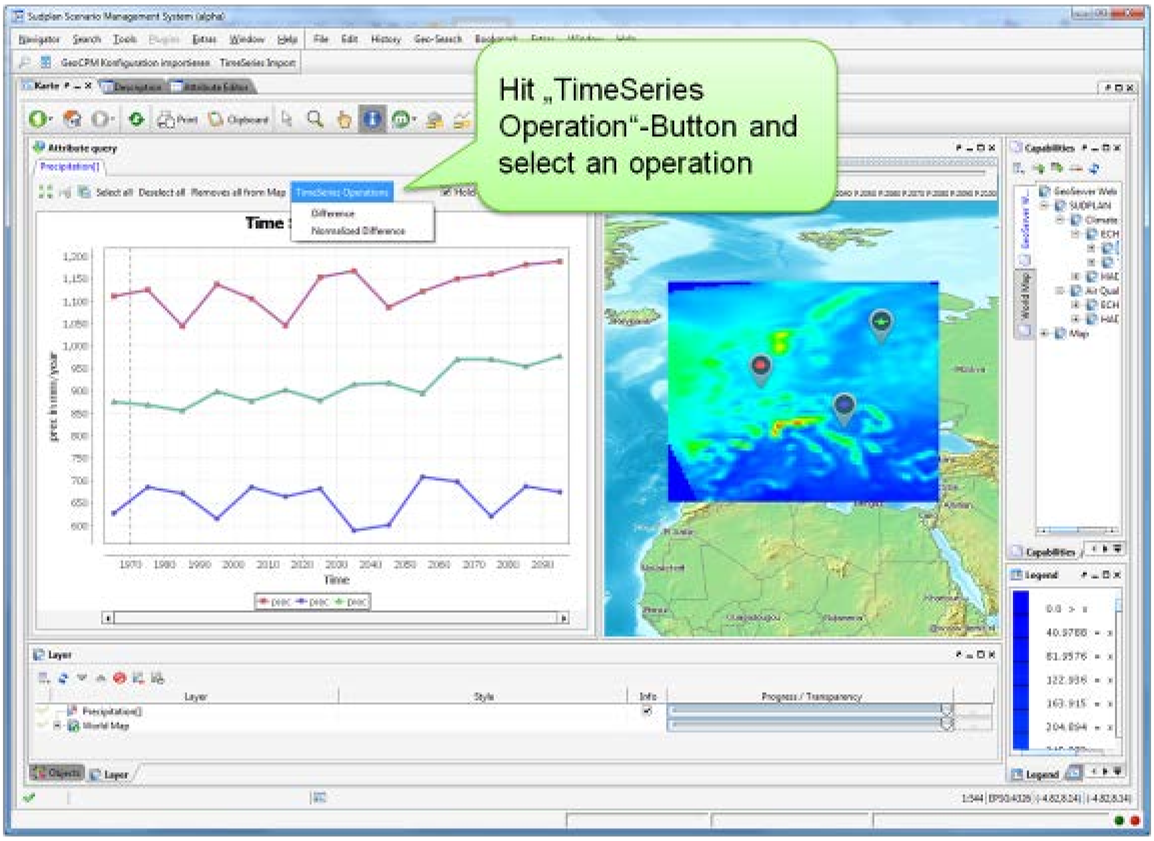


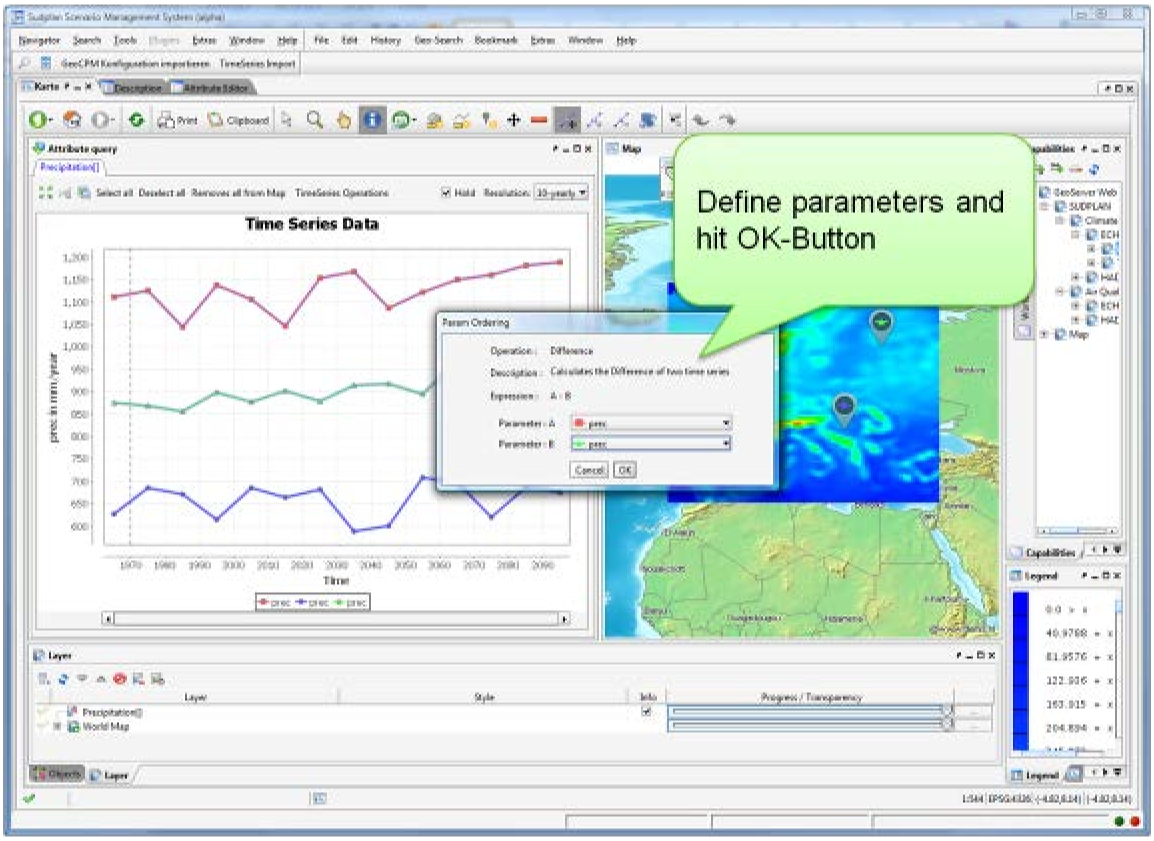

Select Hold-Checkbox

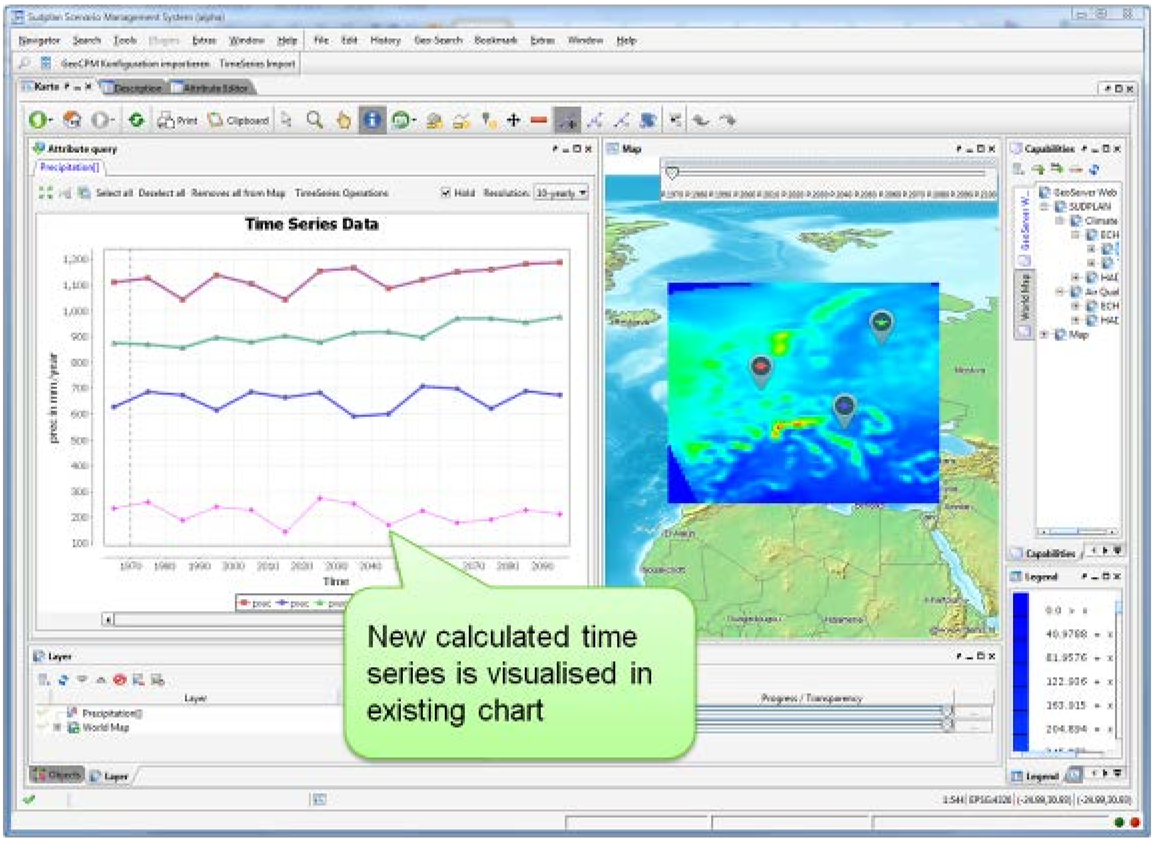

Hit attribute query button

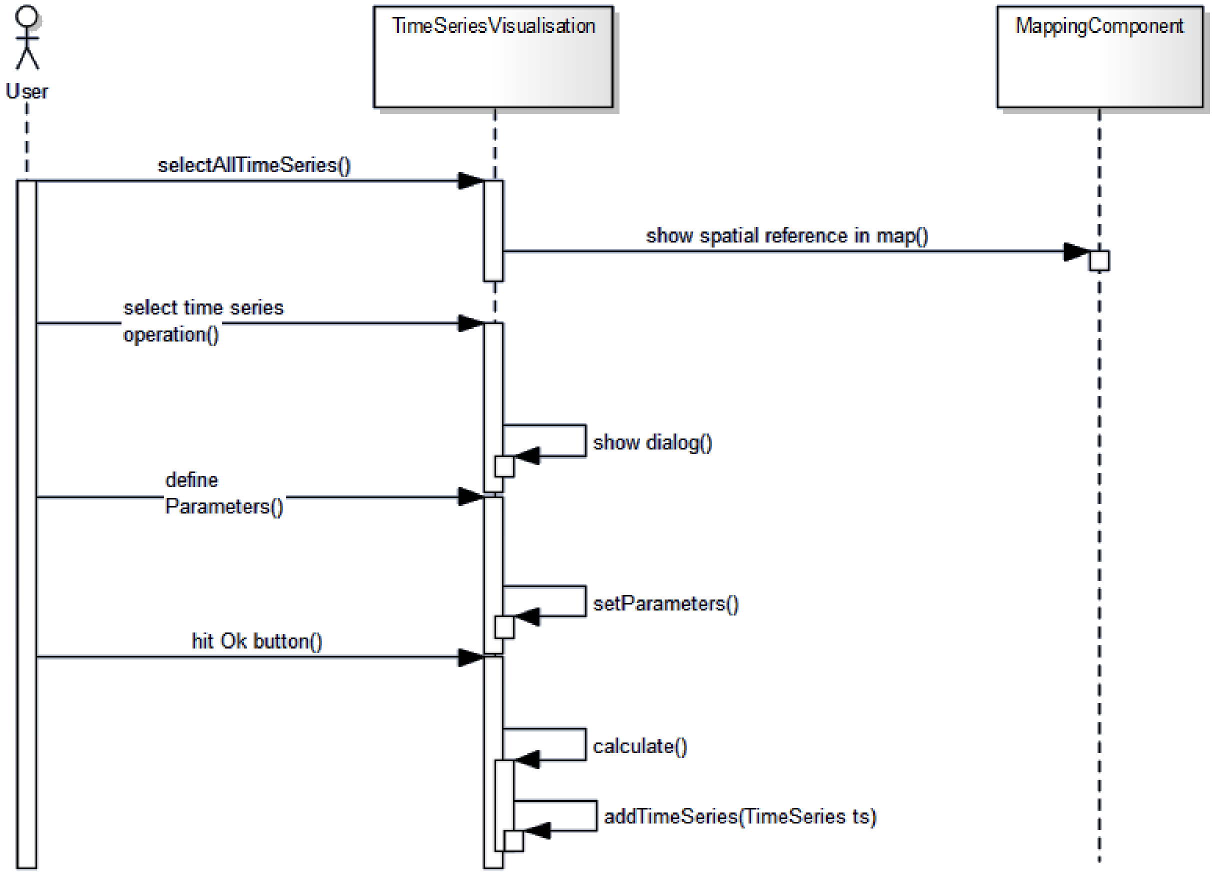

Click on the map to retrieve time series data
Time Series Data

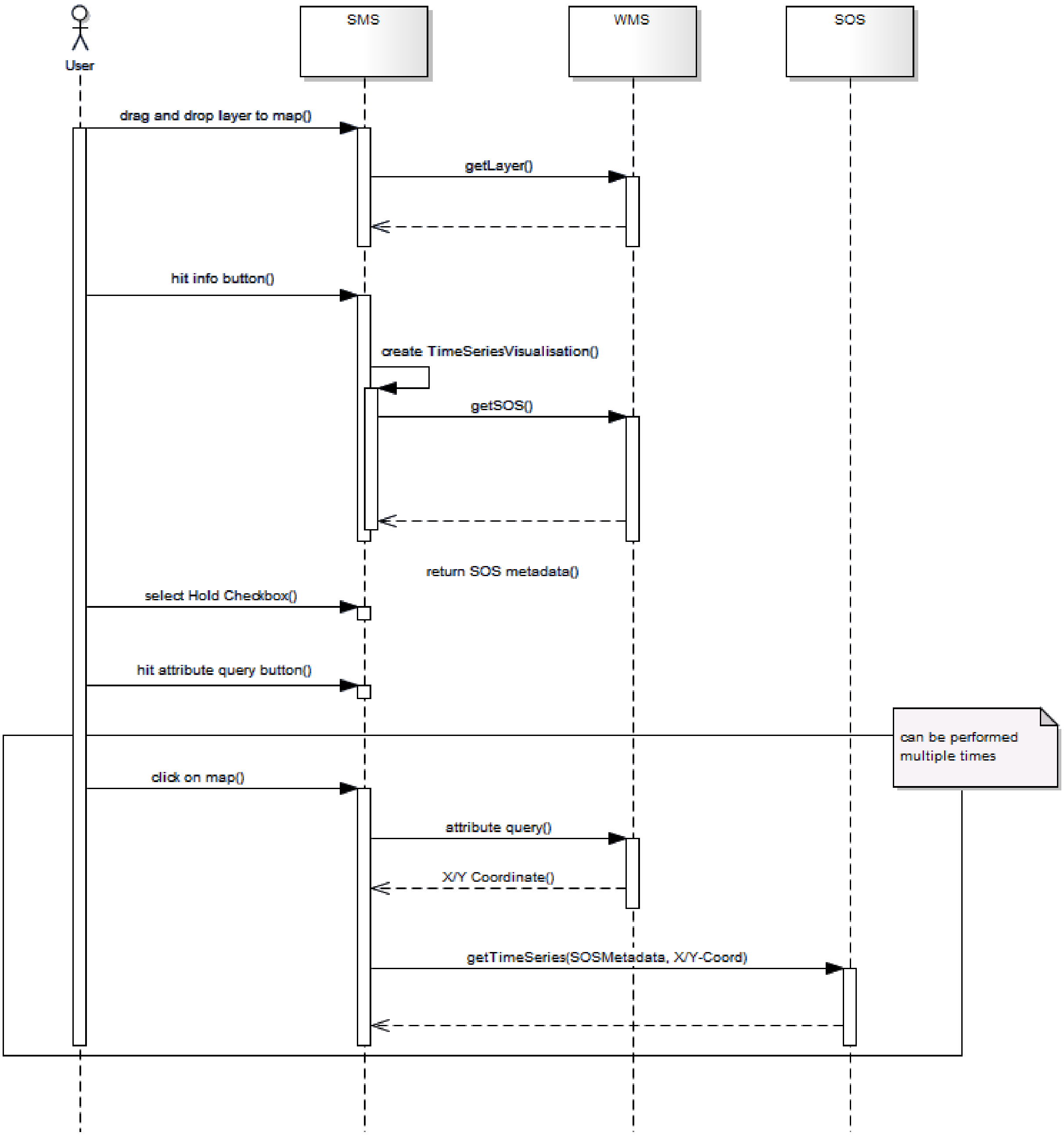

Hit „Select all"-Button or select time series by clicking on them
Time Series Data


Hit „TimeSeries Operation"-Button and select an operation


Define parameters and hit OK-Button
Time Series Data

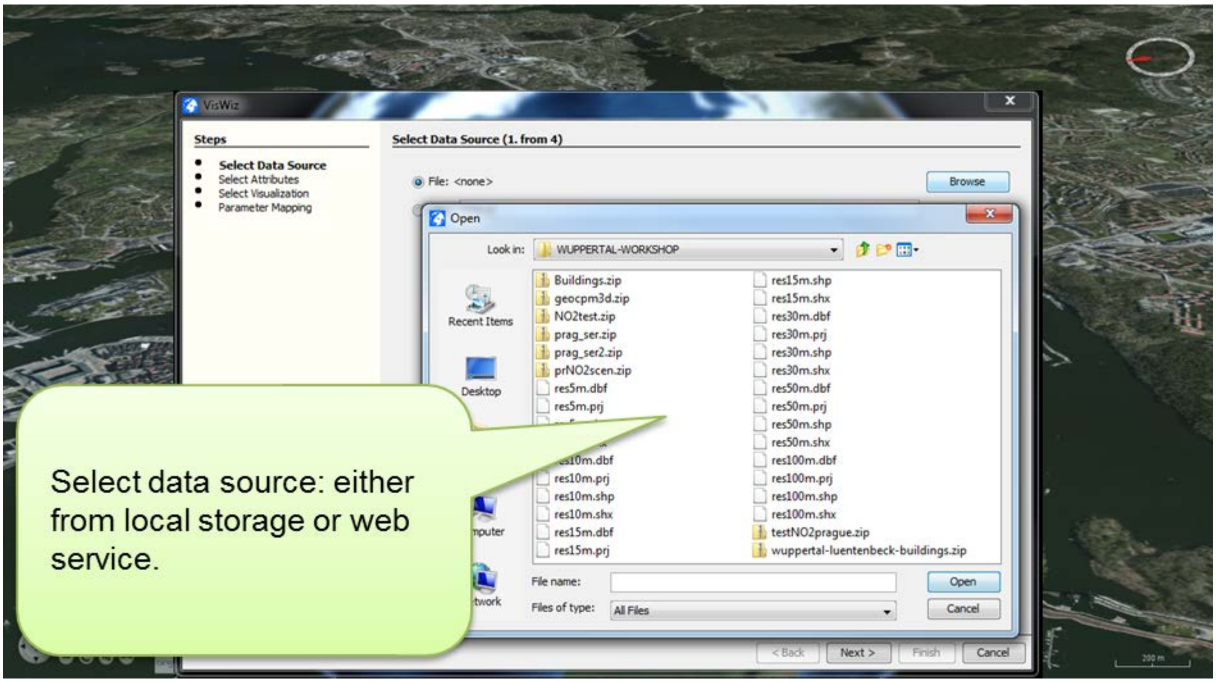

Time Series Data
New calculated time series is visualised in existing chart

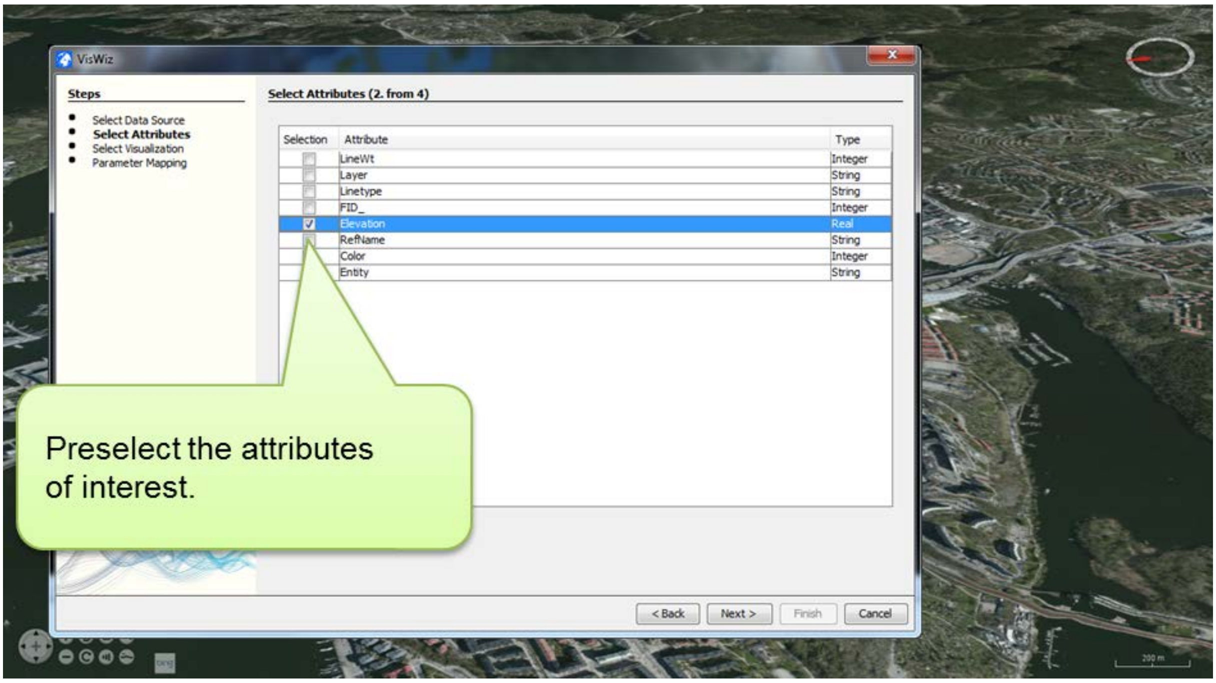

User
TimeSeriesVisualisation
MappingComponent
selectAllTimeSeries()
show spatial reference in map()
select time series operation()
show dialog()
define Parameters()
setParameters()
hit Ok button()
calculate()
addTimeSeries(TimeSeries ts)

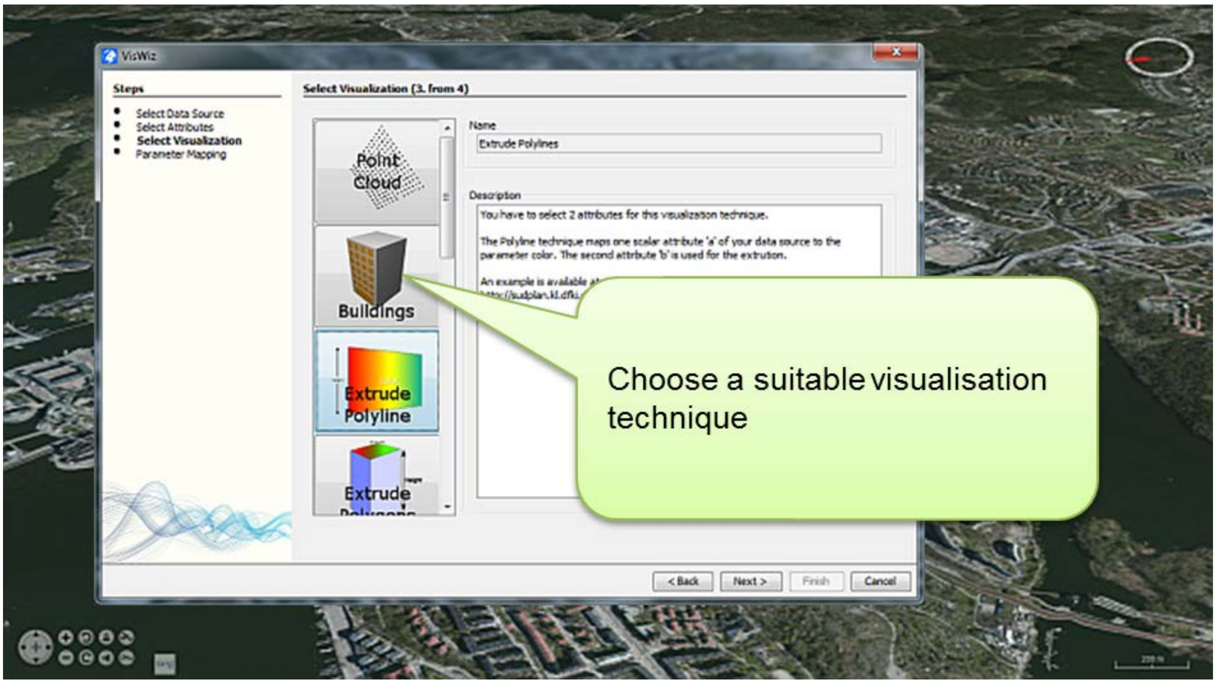

User
SMS
WMS
SOS
drag and drop layer to map()
getLayer()
hit info button()
create TimeSeriesVisualisation()
getSOS()
return SOS metadata()
select Hold Checkbox()
hit attribute query button()
can be performed multiple times
click on map()
attribute query()
X/Y Coordinate()
getTimeSeries(SOSMetadata, X/Y-Coord)

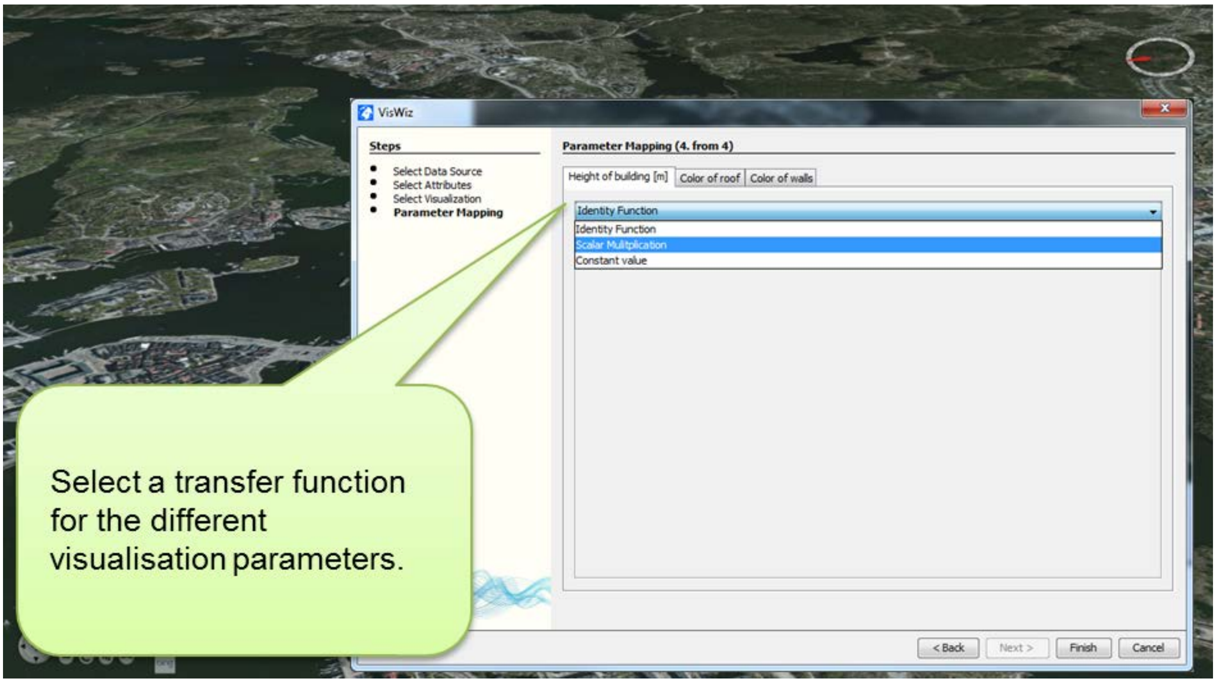
8.7. 3-D Visualisation Wizard

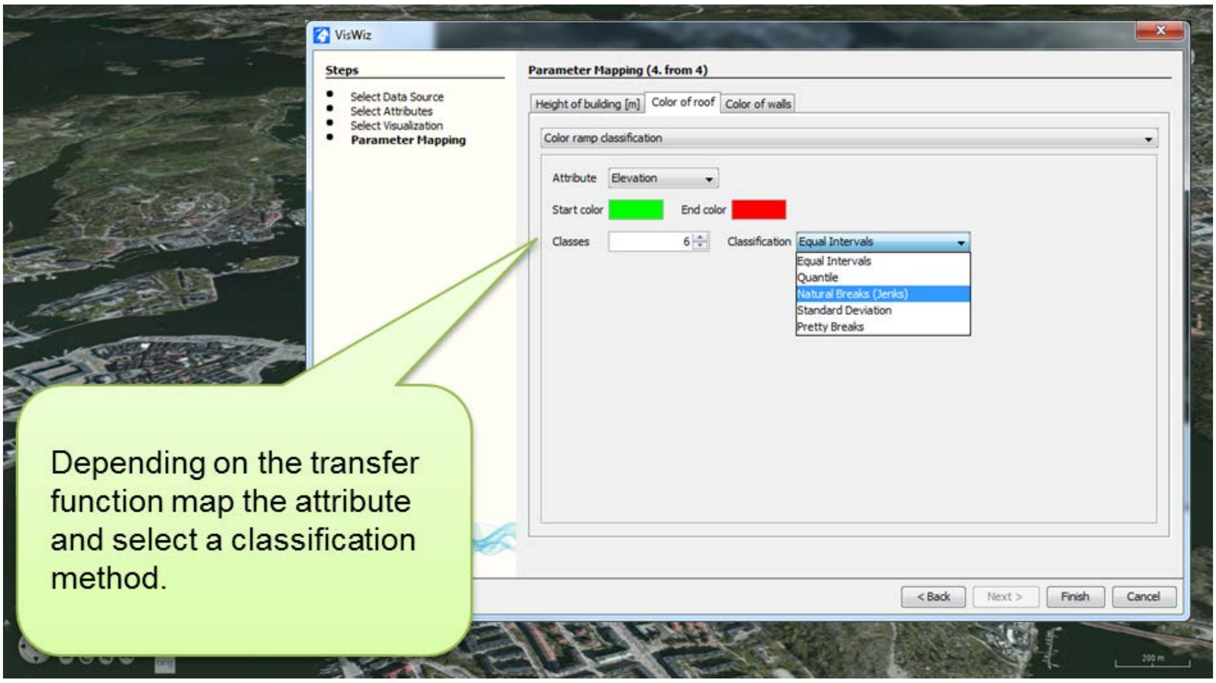
For a description of this use case please refer to *4.2.8 - Execute the 3-D Visualisation Wizard.*






VisWiz
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Select Visualization (3. from 4)
Point Cloud
Buildings
Extrude Polyline
Extrude
Name
Extrude Polylines
Description
You have to select 2 attributes for this visualization technique.
The Polyline technique maps one scalar attribute 'a' of your data source to the parameter color. The second attribute 'b' is used for the extrution.
< Back
Next >
Finish
Cancel
Choose a suitable visualisation technique

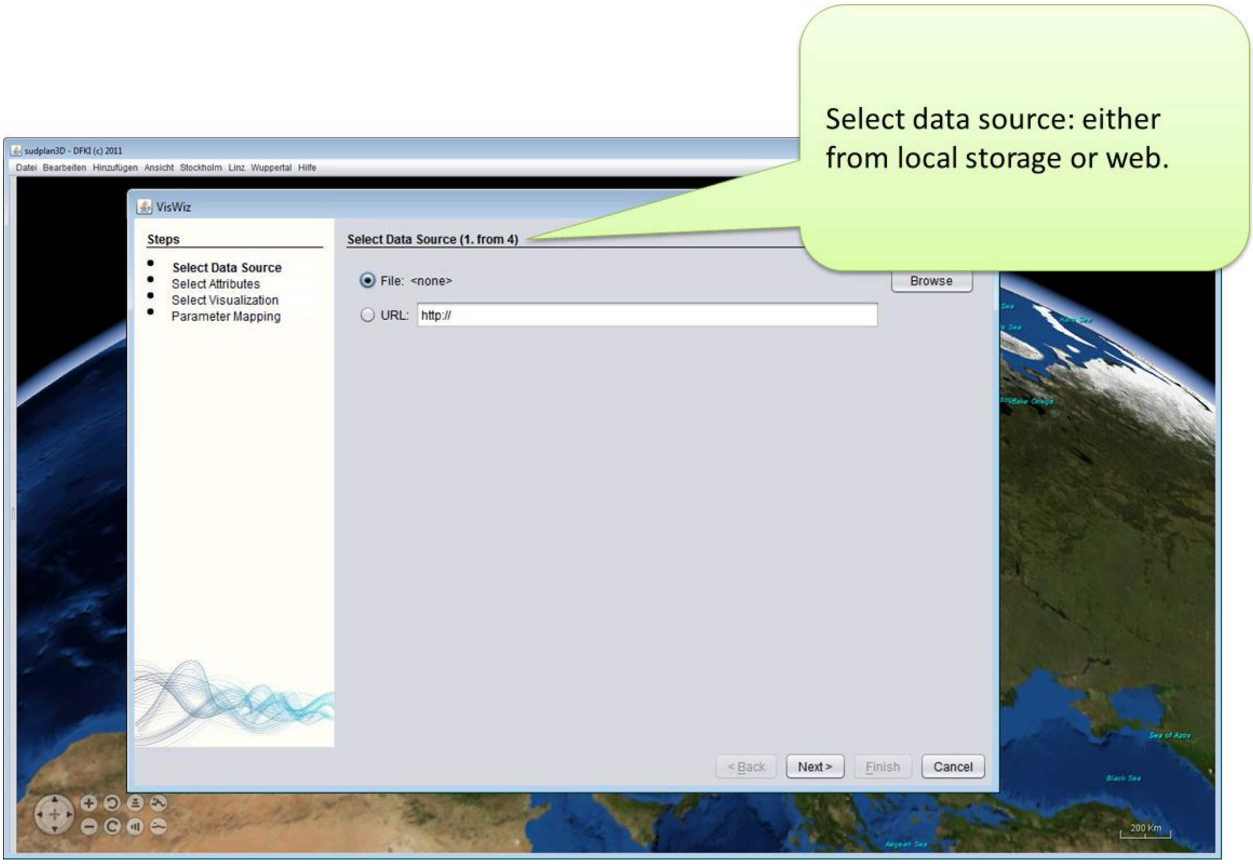

VisWiz
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Parameter Mapping (4. from 4)
Height of building [m]
Color of roof
Color of walls
Identity Function
Identity Function
Scalar Mulitplication
Constant value
< Back
Next >
Finish
Cancel
Select a transfer function for the different visualisation parameters.

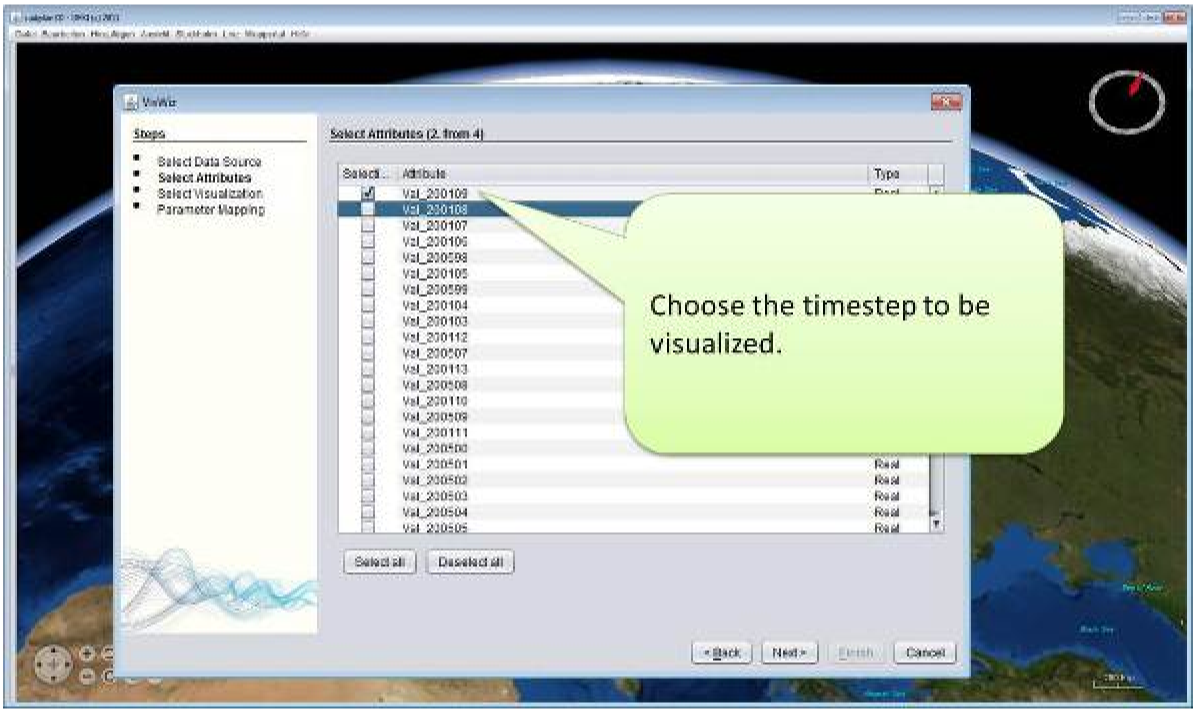

VisWiz
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Parameter Mapping (4. from 4)
Height of building [m]
Color of roof
Color of walls
Color ramp classification
Attribute
Elevation
Start color
End color
Classes
6
Classification
Equal Intervals
Equal Intervals
Quantile
Natural Breaks (Jenks)
Standard Deviation
Pretty Breaks
< Back
Next >
Finish
Cancel
Depending on the transfer function map the attribute and select a classification method.

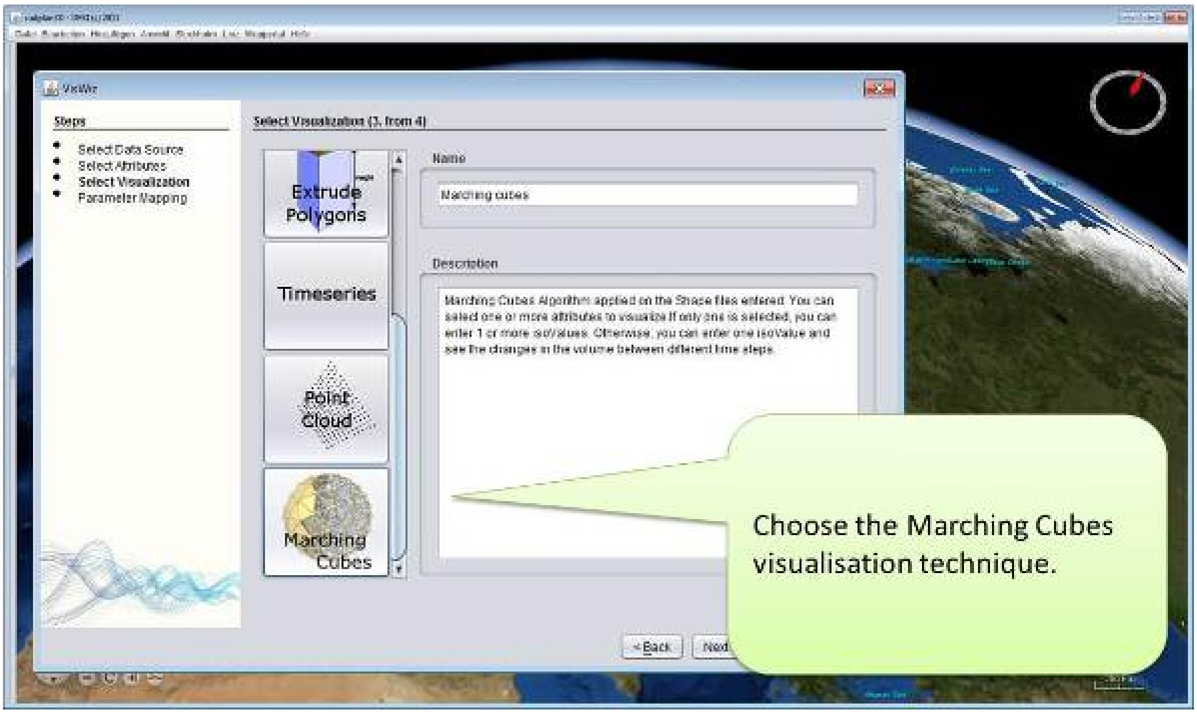

The final visualisation.

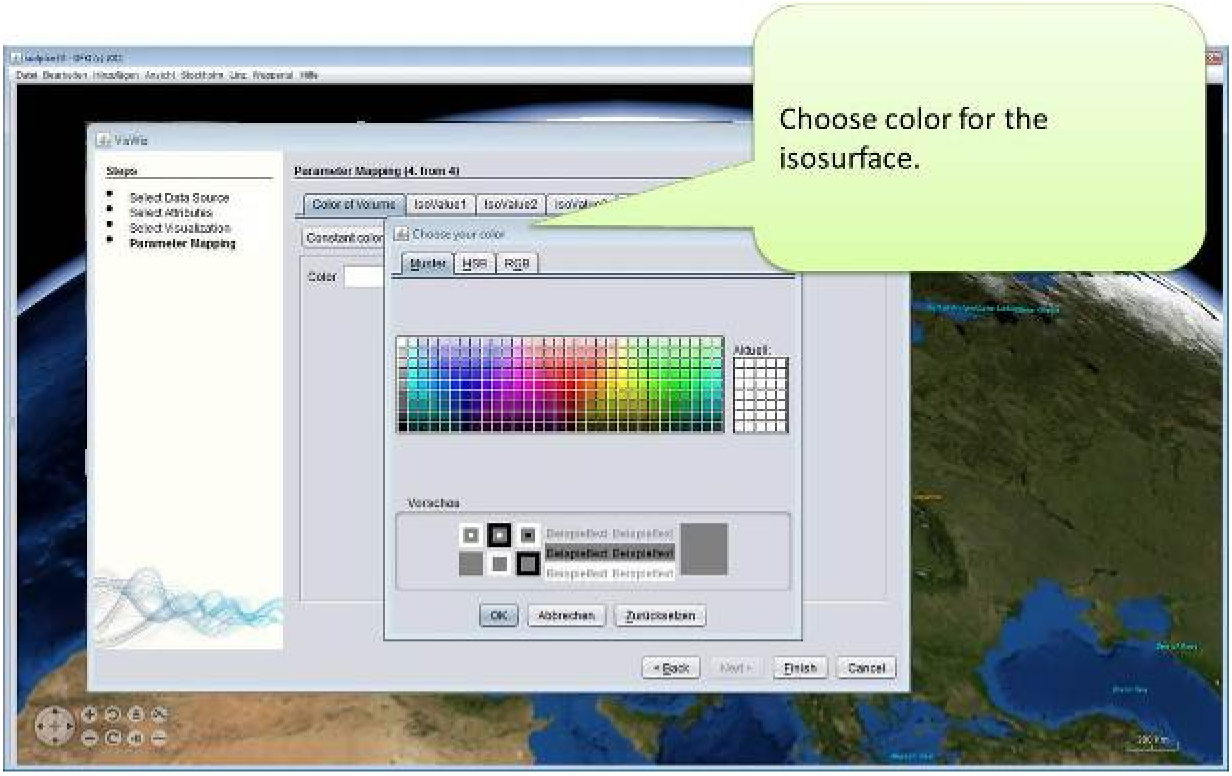
8.8. Visualisation of 3-D air quality data using iso-surfaces

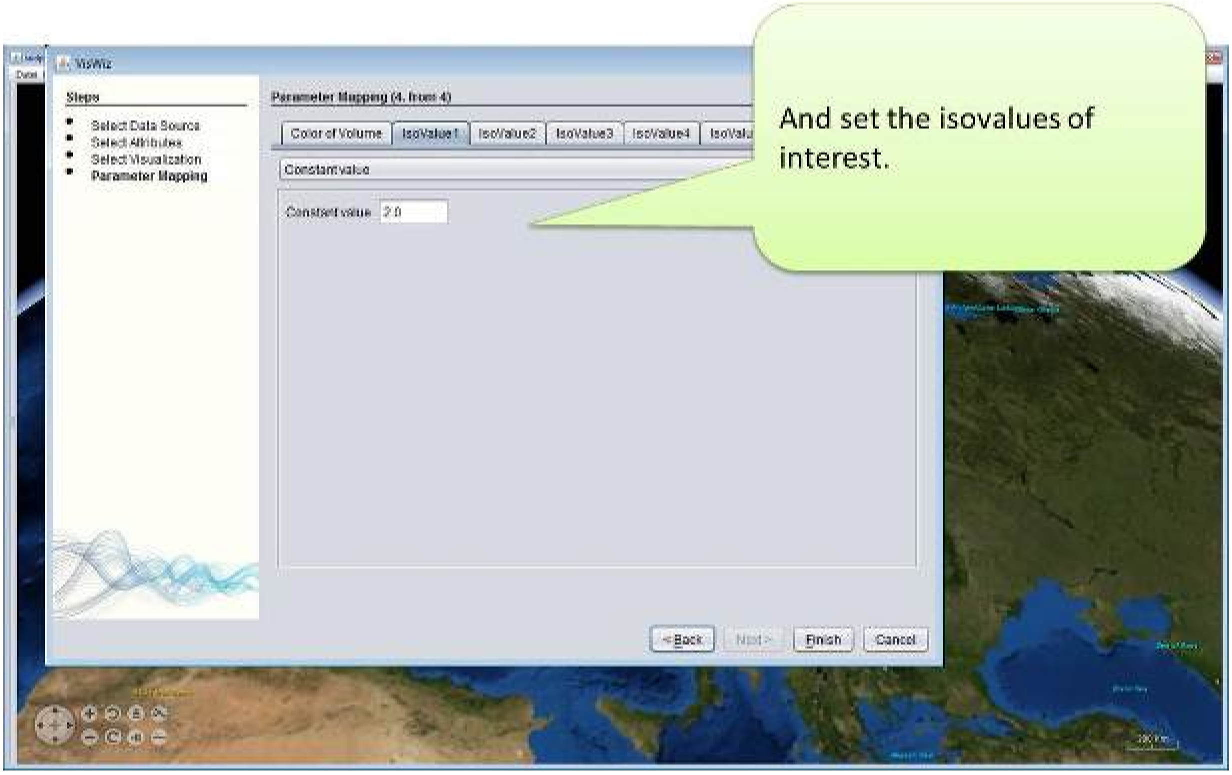
For a description of this use case please refer to *4.2.9 - Visualisation of 3-D air quality data using iso-surfaces*.

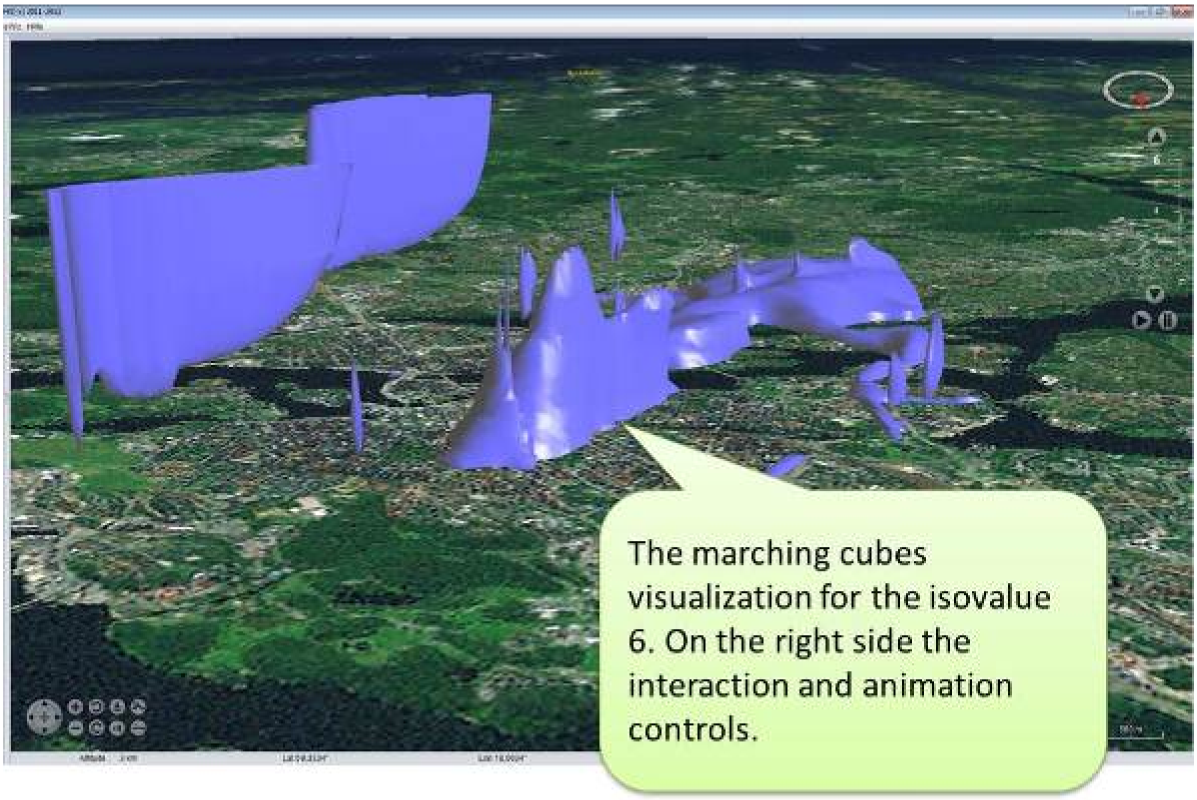


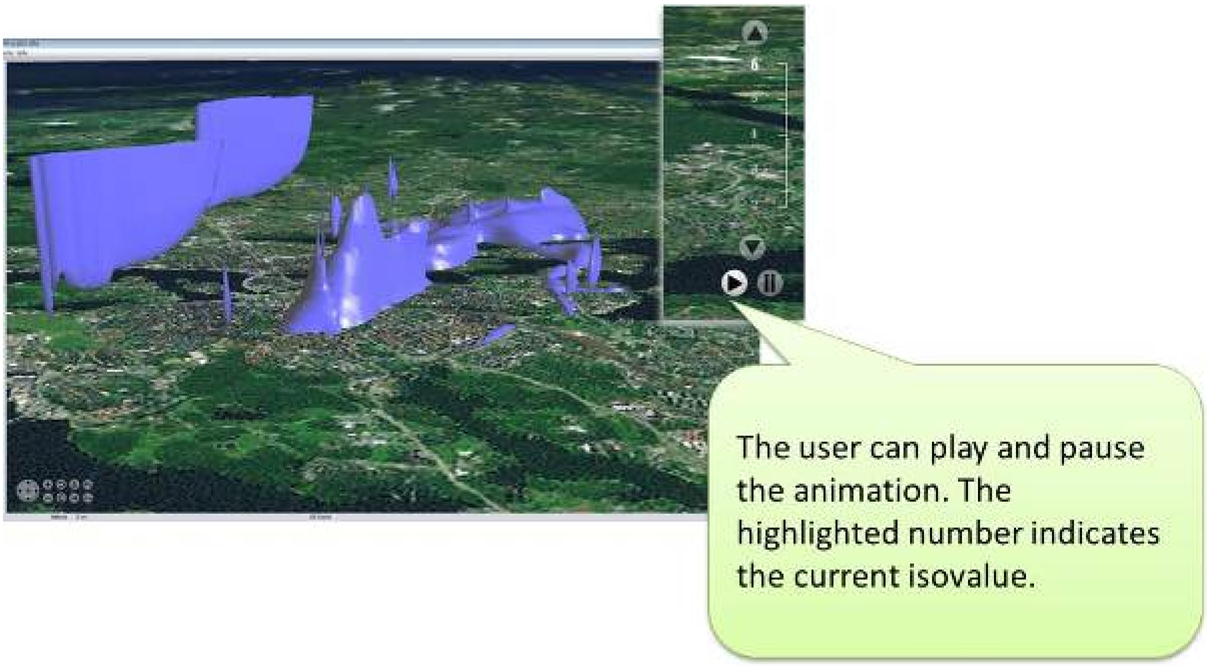



Select Visualization (3. from 4)
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Extrude Polygons
Timeseries
Point Cloud
Marching Cubes
Name
Marching cubes
Description
Marching Cubes Algorithm applied on the Shape files entered. You can select one or more attributes to visualize If only one is selected, you can enter 1 or more isoValues. Otherwise, you can enter one isoValue and see the changes in the volume between different time steps.
Choose the Marching Cubes visualisation technique.


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

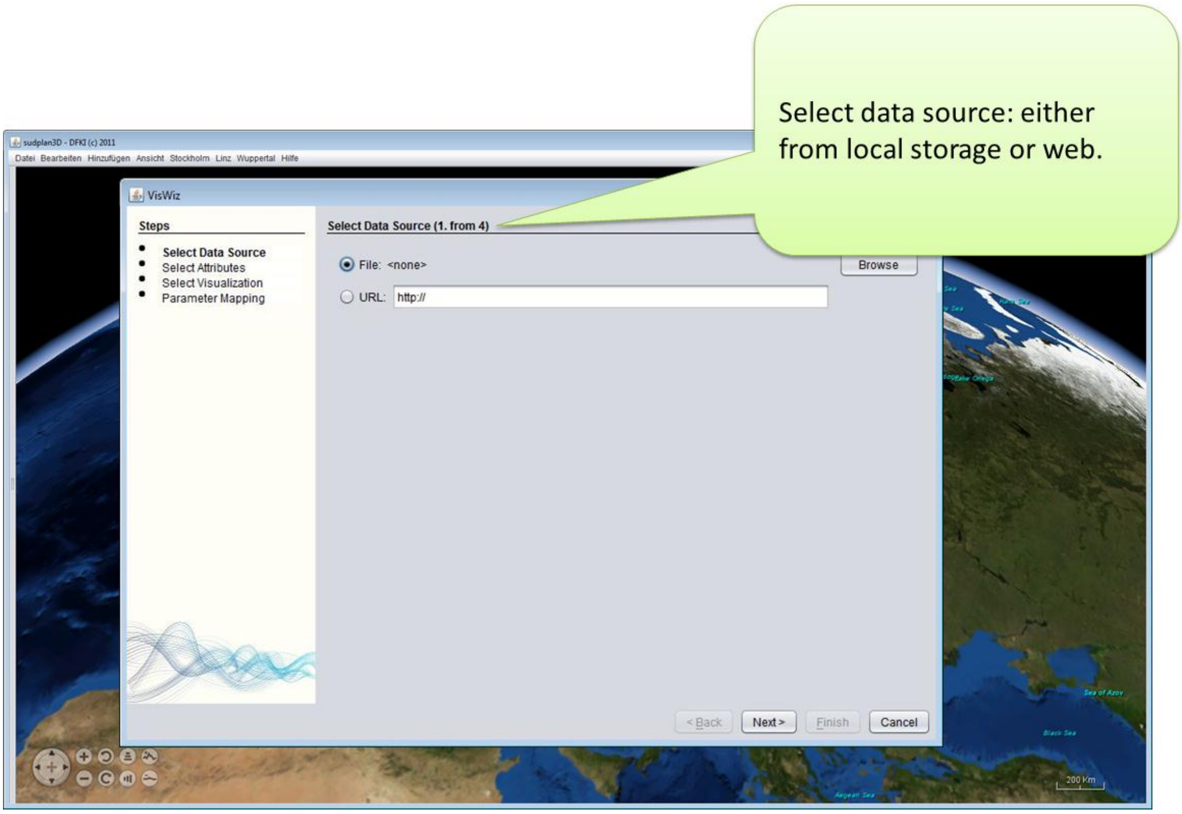

VisWiz
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Parameter Mapping (4. from 4)
Color of Volume
IsoValue1
IsoValue2
IsoValue3
IsoValue4
Constant value
Constant value 2.0
< Back
Next >
Finish
Cancel
And set the isovalues of interest.


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

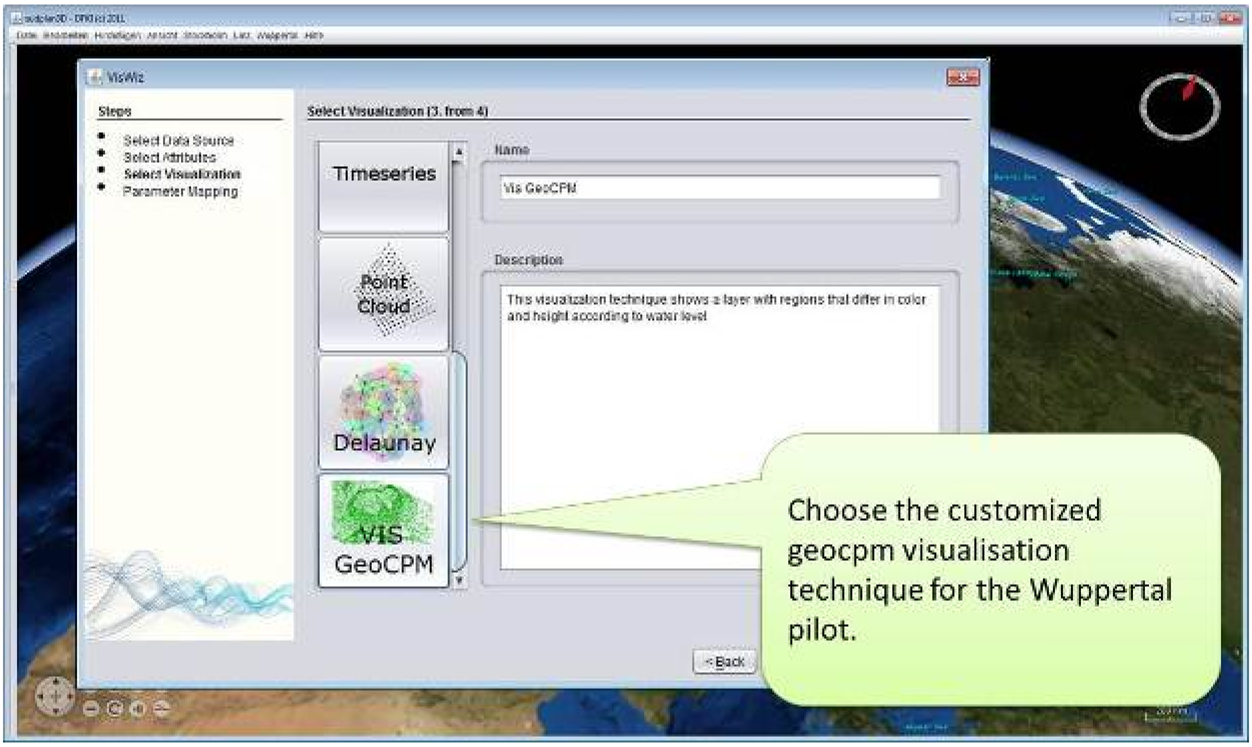


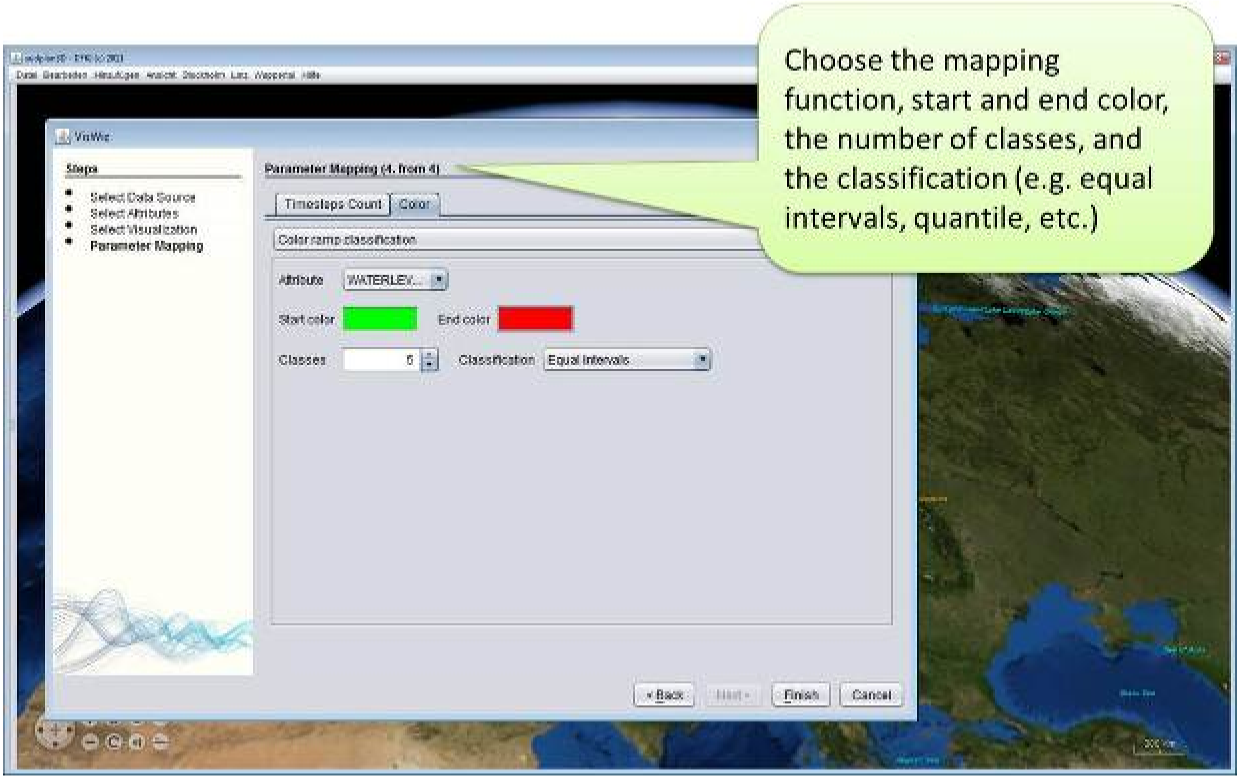
8.9. 3-D Animation of "Water-run off" simulation results

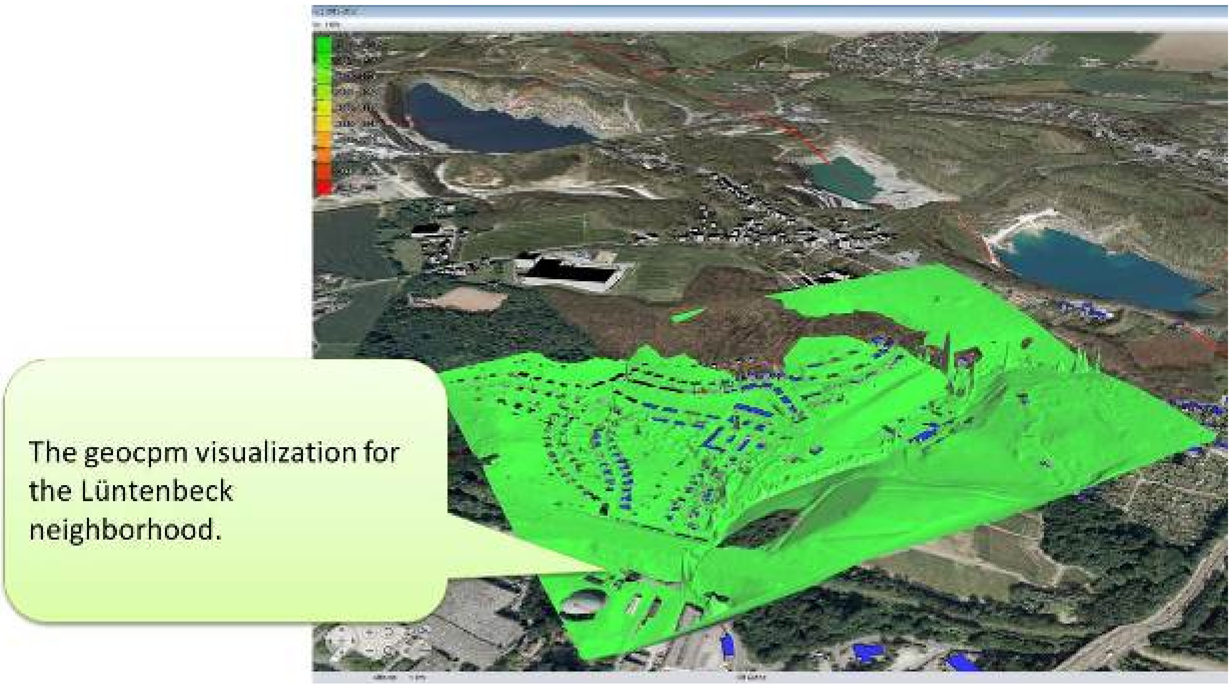
For a description of this use case please refer to *4.2.10 - 3-D Animation of "Water-run off" simulation results*.

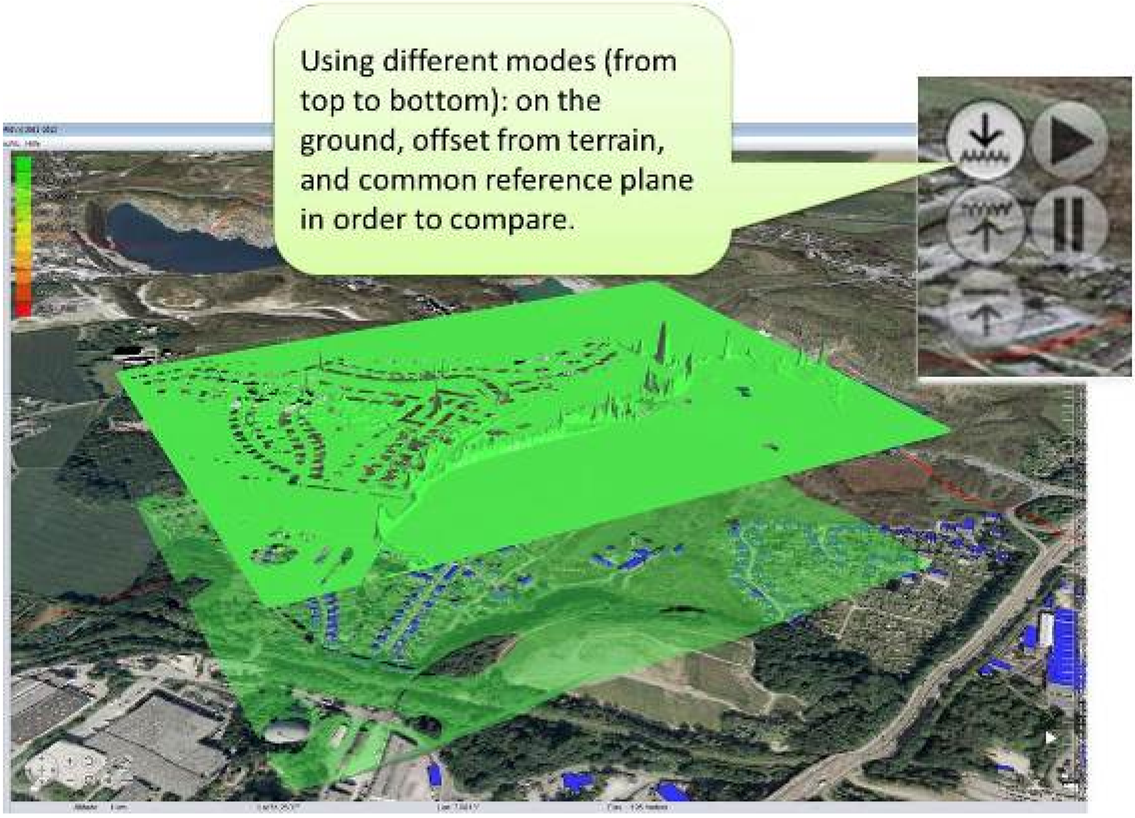



VisWiz
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Select Attributes (2. from 4)
Attribute
Type
WATERLEVEL
Real
Choose the waterlevel attribute.
Select all
Deselect all
< Back
Next >
Cancel


VisWiz
Steps
Select Data Source
Select Attributes
Select Visualization
Parameter Mapping
Select Visualization (3. from 4)
Timeseries
Point Cloud
Delaunay
VIS GeoCPM
Name
Vis GeoCPM
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.
< Back


Choose the mapping function, start and end color, the number of classes, and the classification (e.g. equal intervals, quantile, etc.)
VisWiz
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

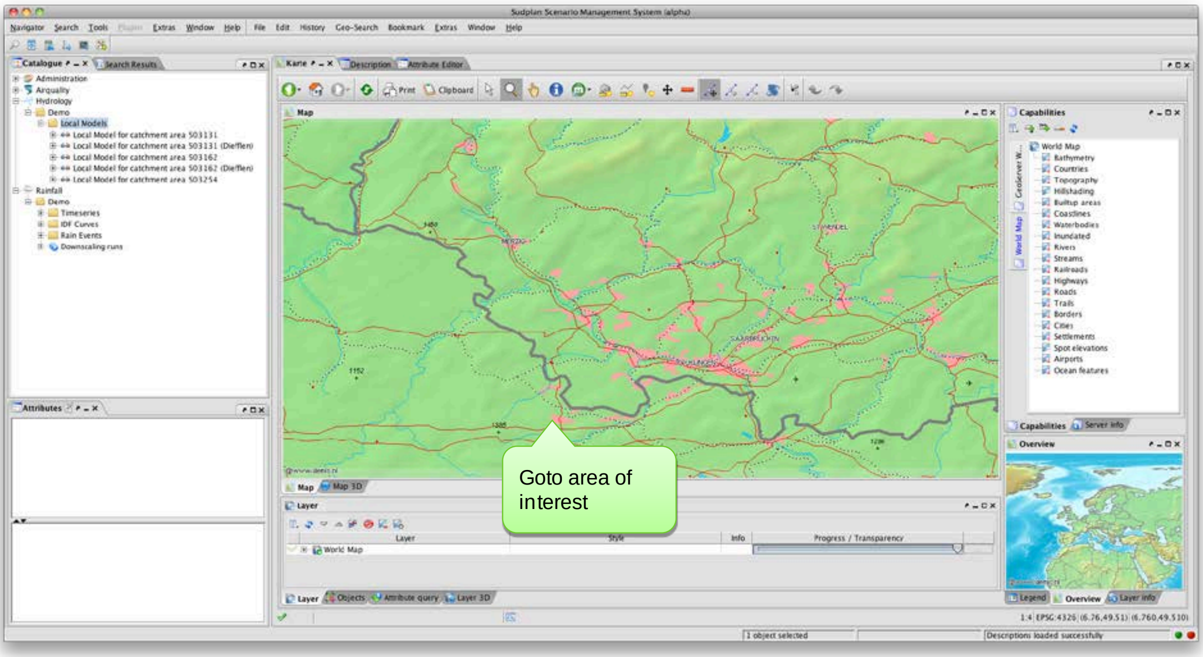

The geocpm visualization for the Lüntenbeck neighborhood.

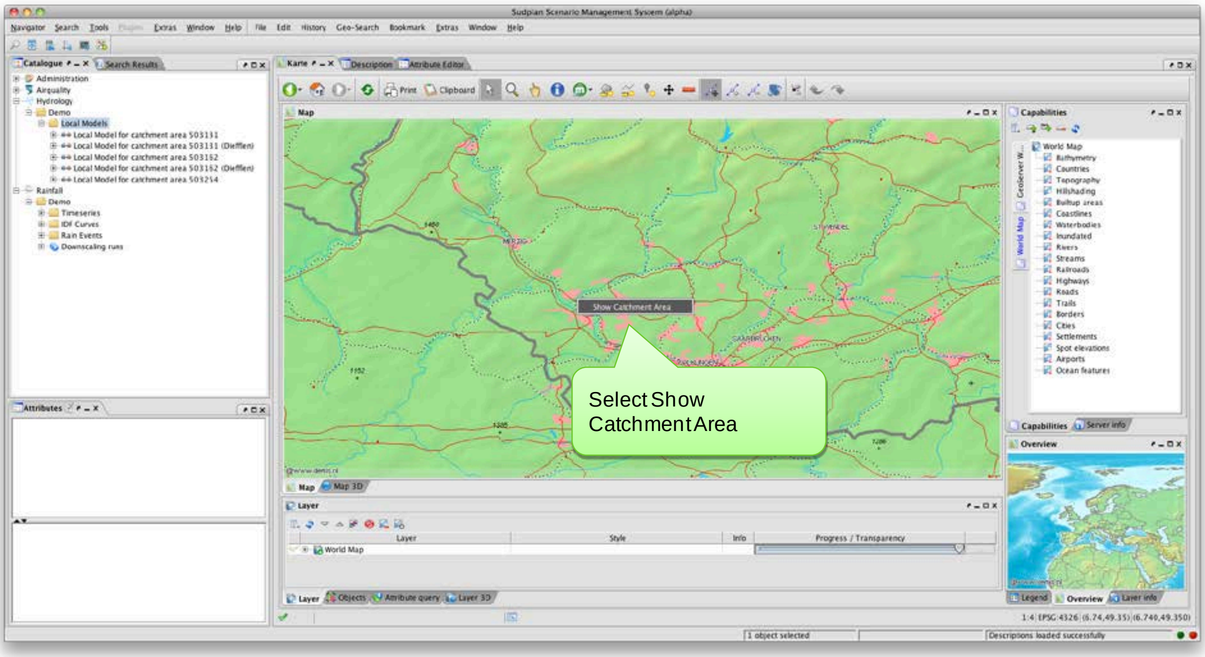

Using different modes (from top to bottom): on the ground, offset from terrain, and common reference plane in order to compare.

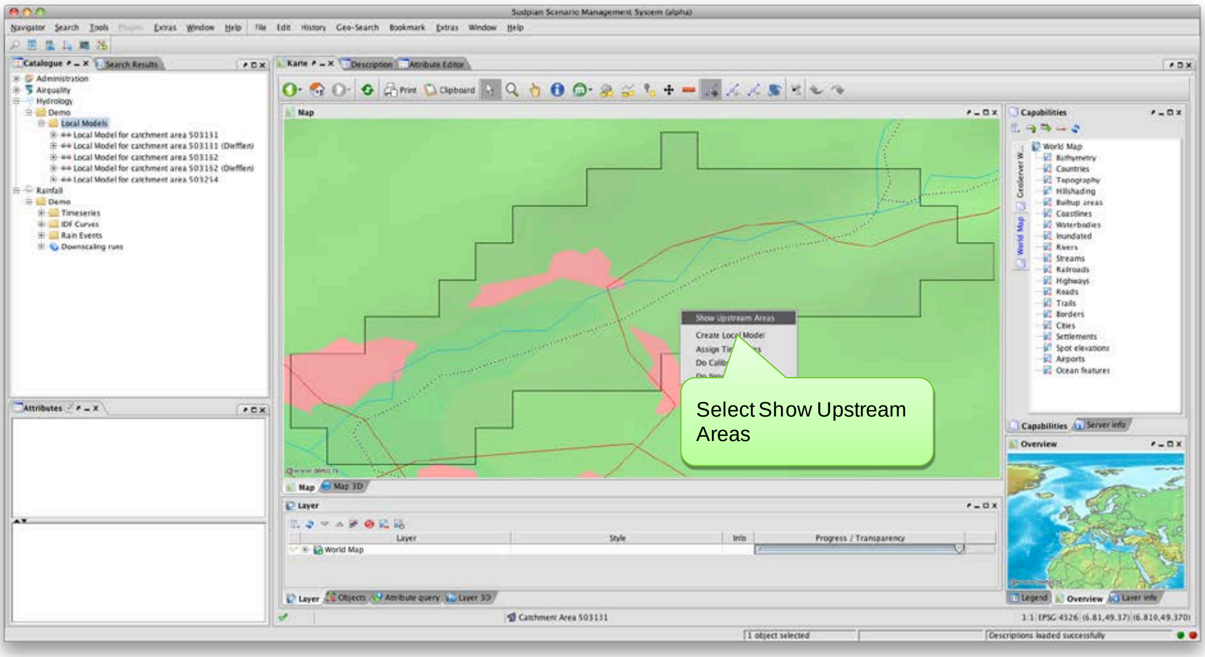

Using those controls the user can start, stop, and pause the animation.

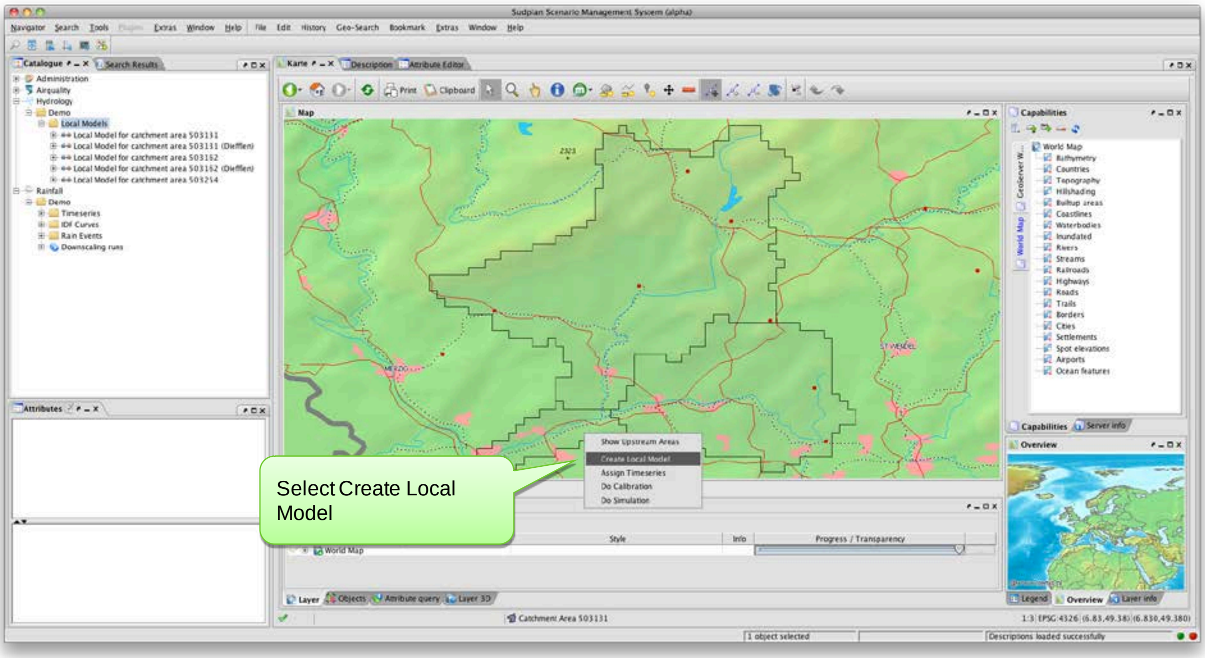
8.10. Execute Hydrology Downscaling

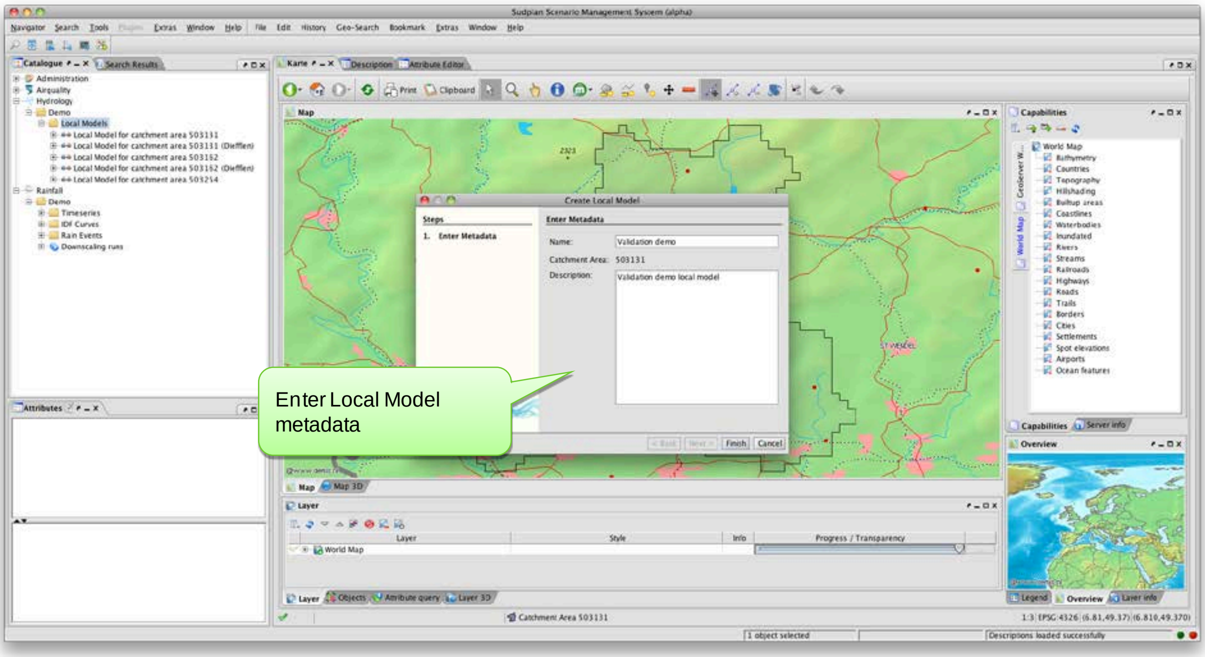
For a description of this validation scenario please refer to *4.2.11- Execute Hydrology Downscaling.*

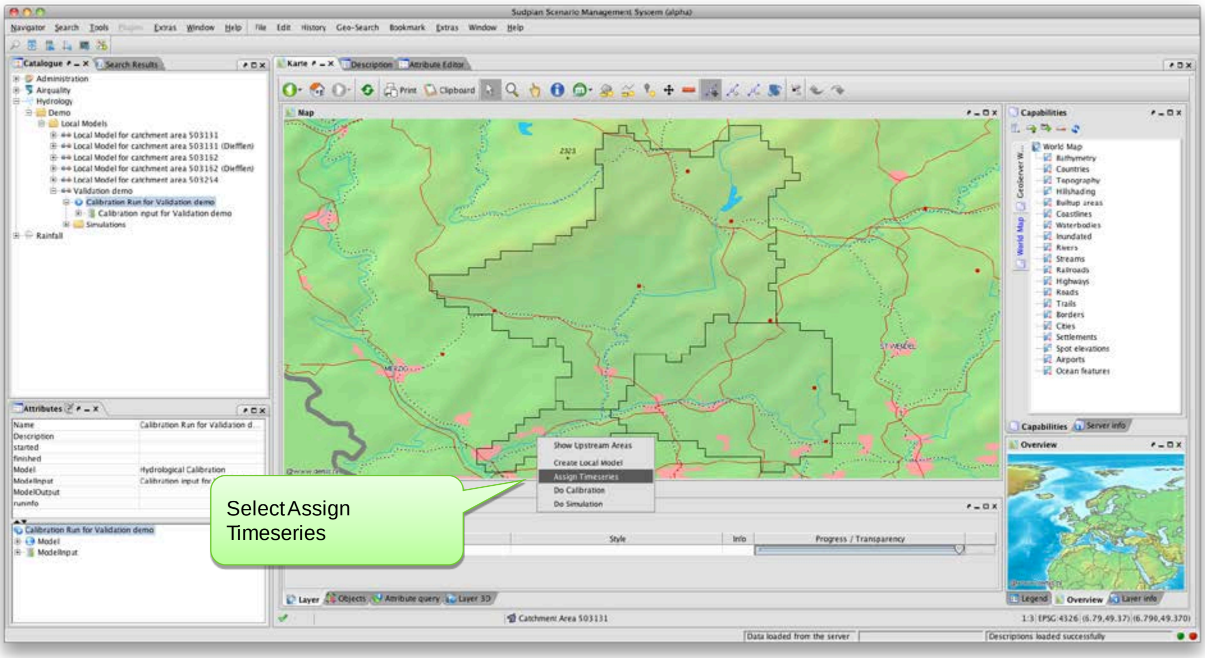


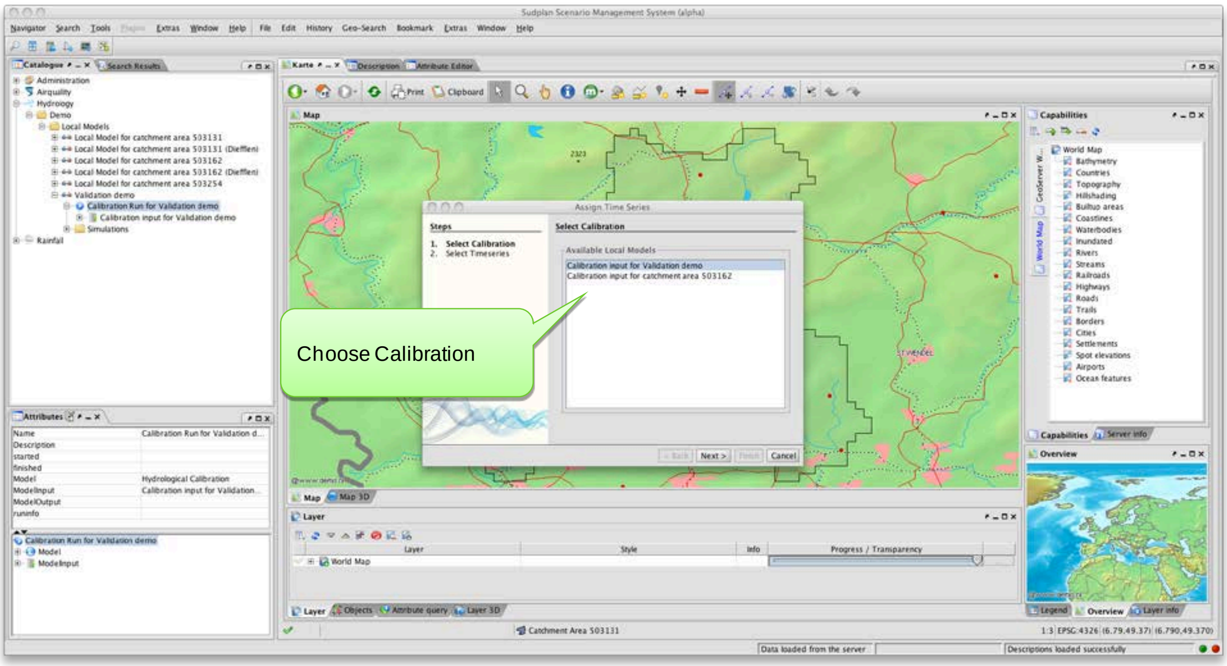


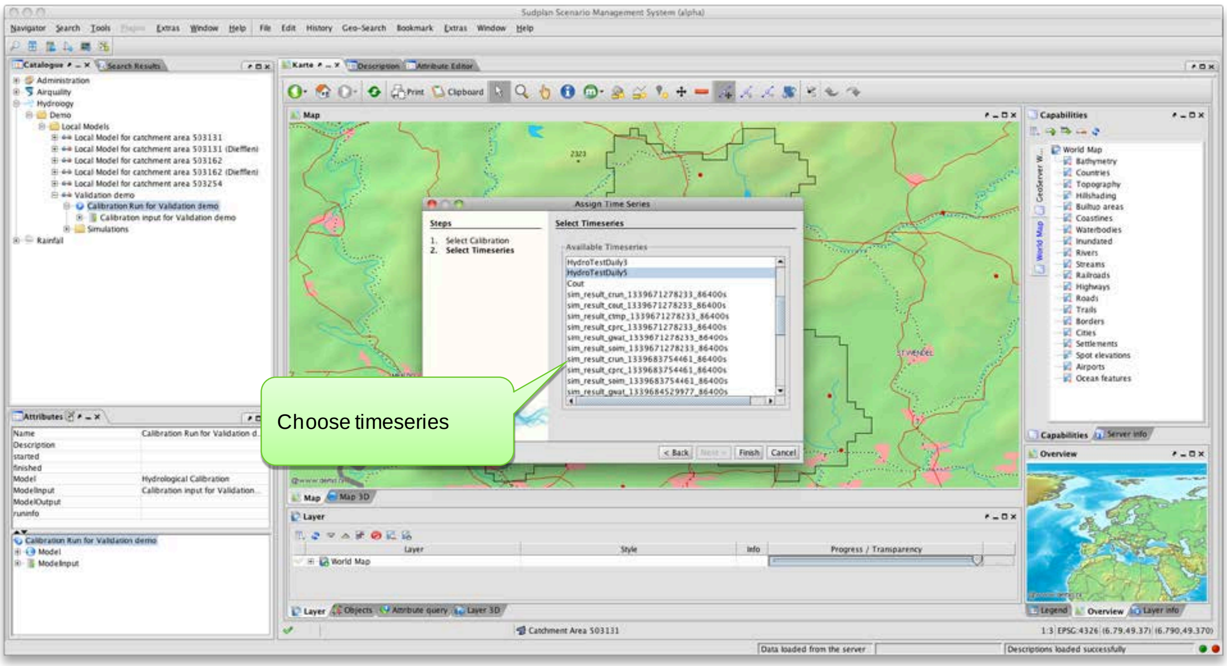

Sudplan Scenario Management System (alpha)
Show Upstream Areas
Create Local Model
Select Show Upstream Areas

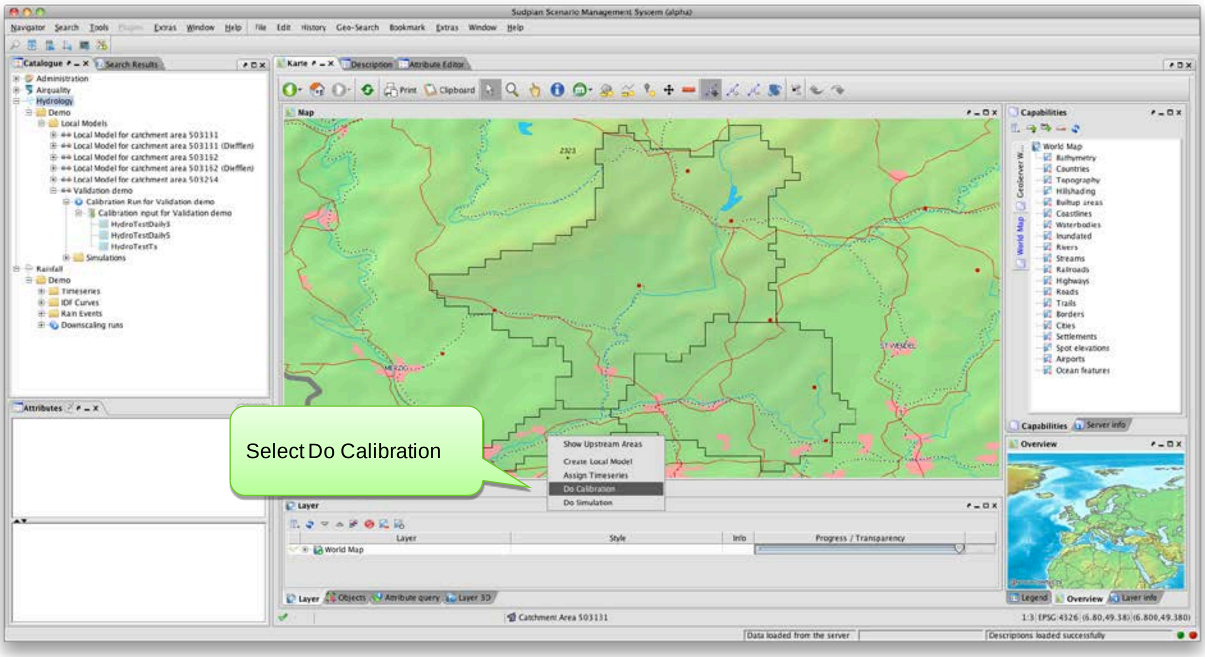

Sudplan Scenario Management System (alpha)
Show Upstream Areas
Create Local Model
Assign Timeseries
Do Calibration
Do Simulation
Select Create Local Model

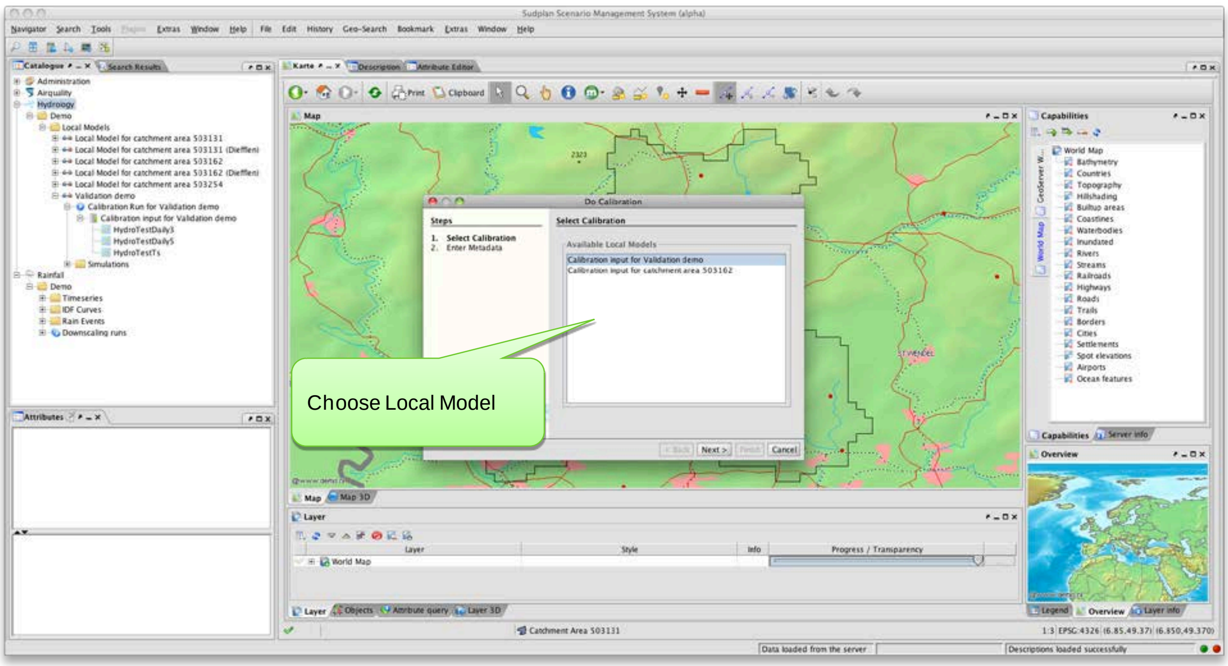

Enter Local Model metadata

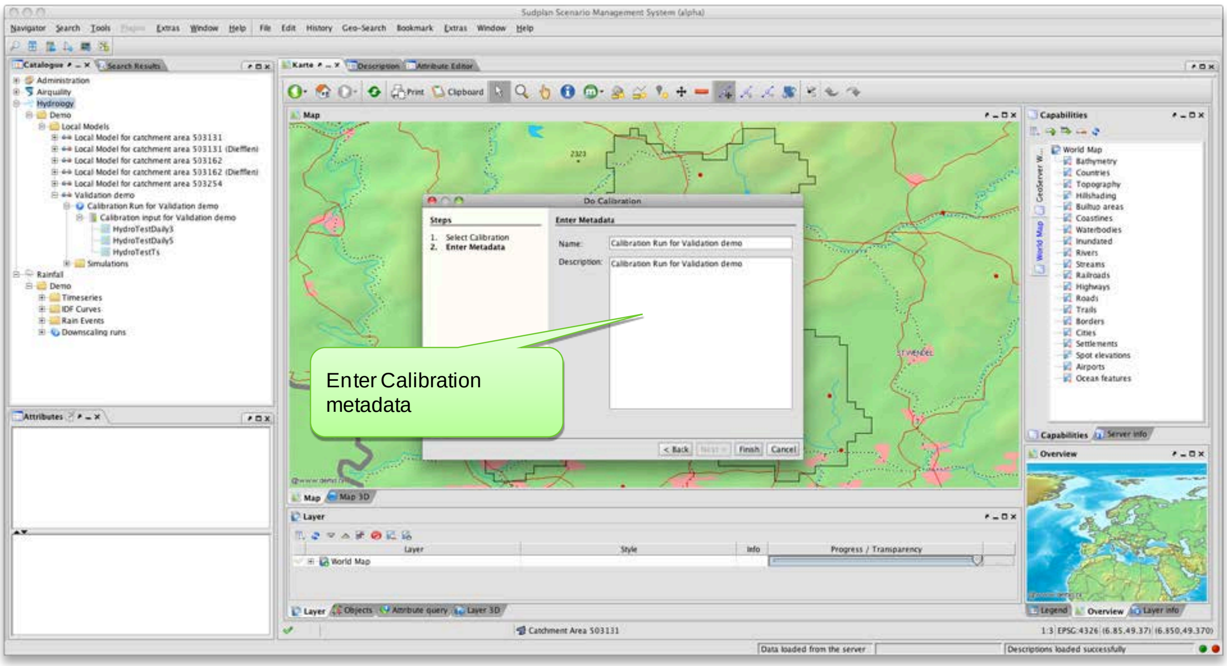

Select Assign Timeseries

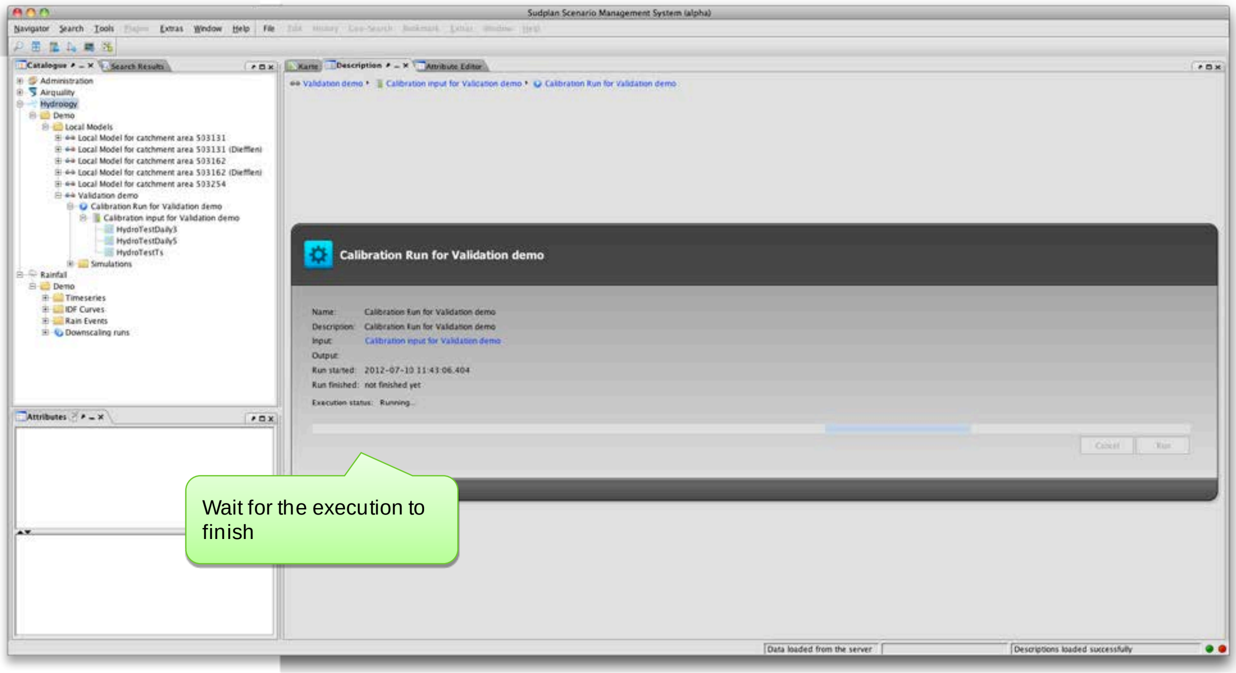

Sudplan Scenario Management System (alpha)
Assign Time Series
Steps
Select Calibration
Available Local Models
Calibration input for Validation demo
Calibration input for catchment area 503162
Choose Calibration


Sudplan Scenario Management System (alpha)
Assign Time Series
Steps
Select Timeseries
Available Timeseries
HydroTestDaily3
HydroTestDaily5
Choose timeseries

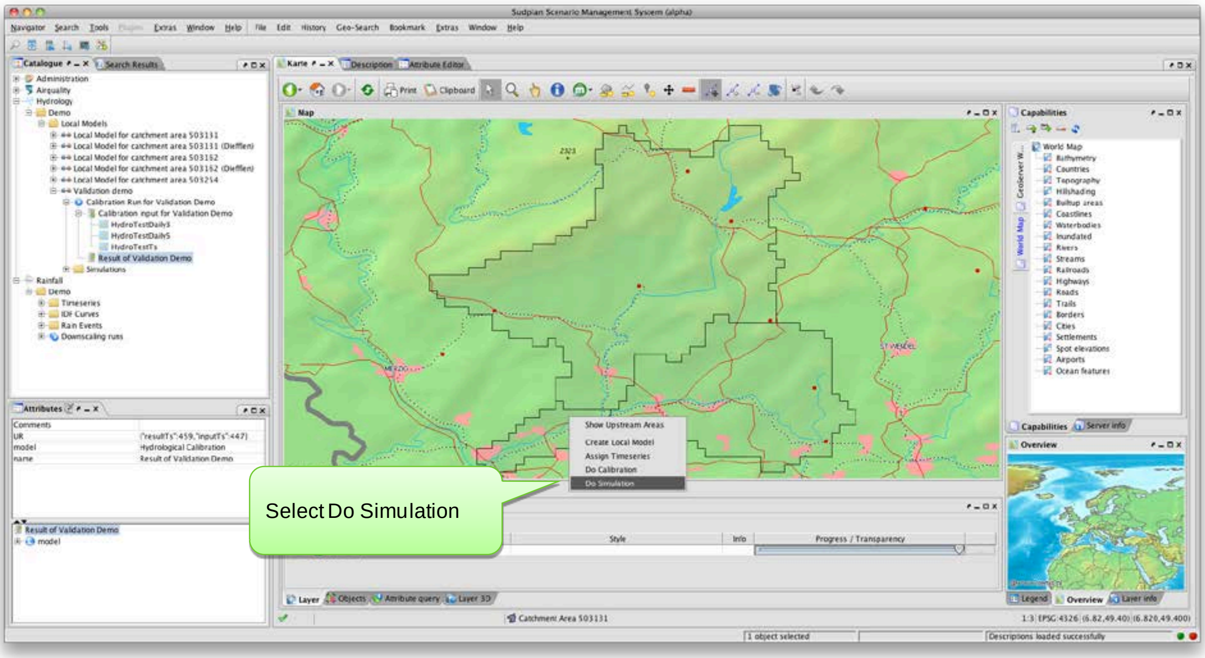

Select Do Calibration
Show Upstream Areas
Create Local Model
Assign Timeseries
Do Calibration
Do Simulation

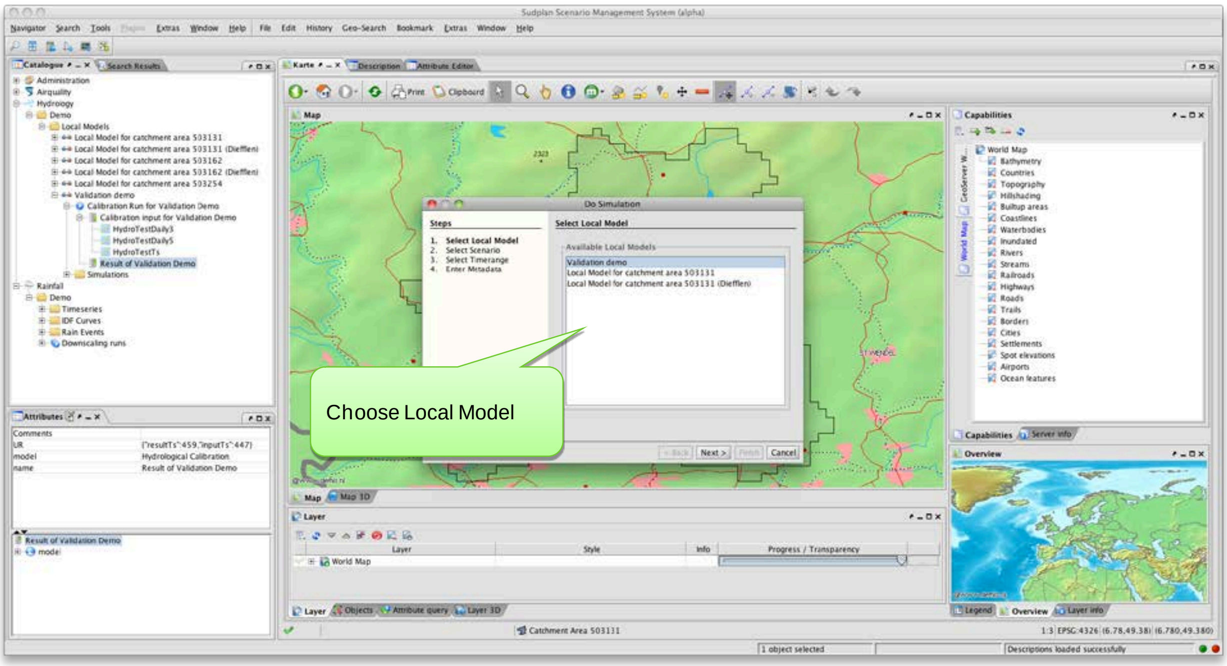

Do Calibration
Steps
1. Select Calibration
2. Enter Metadata
Select Calibration
Available Local Models
Calibration input for Validation demo
Calibration input for catchment area 503162
Choose Local Model

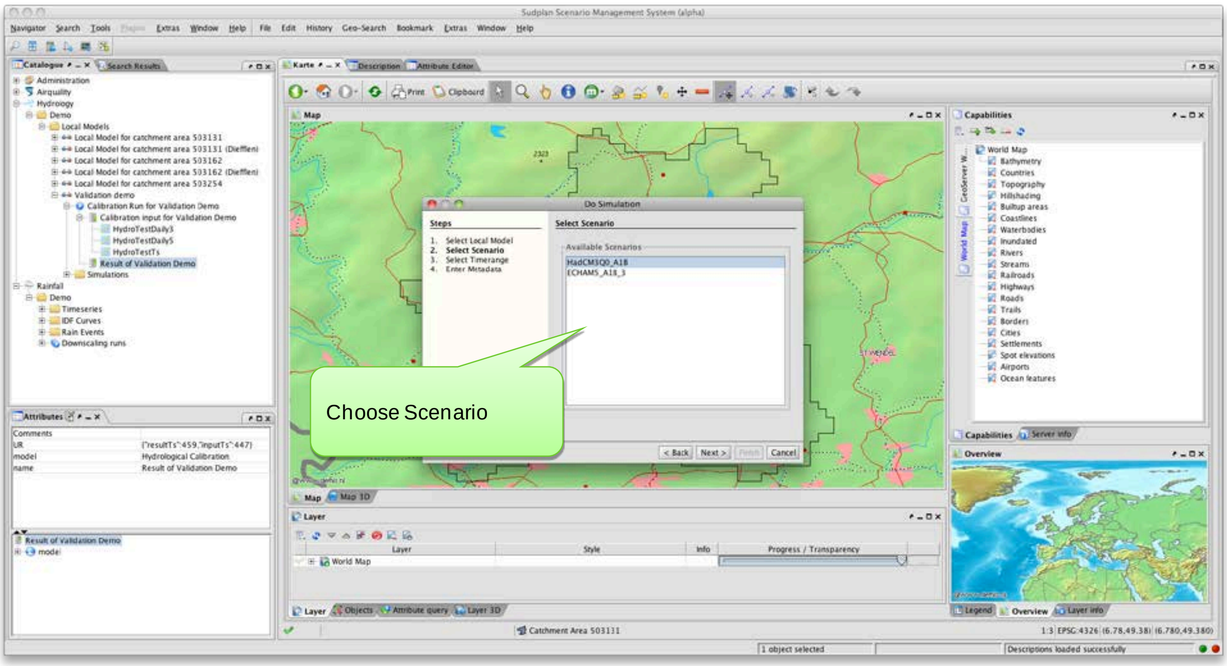

Enter Calibration metadata

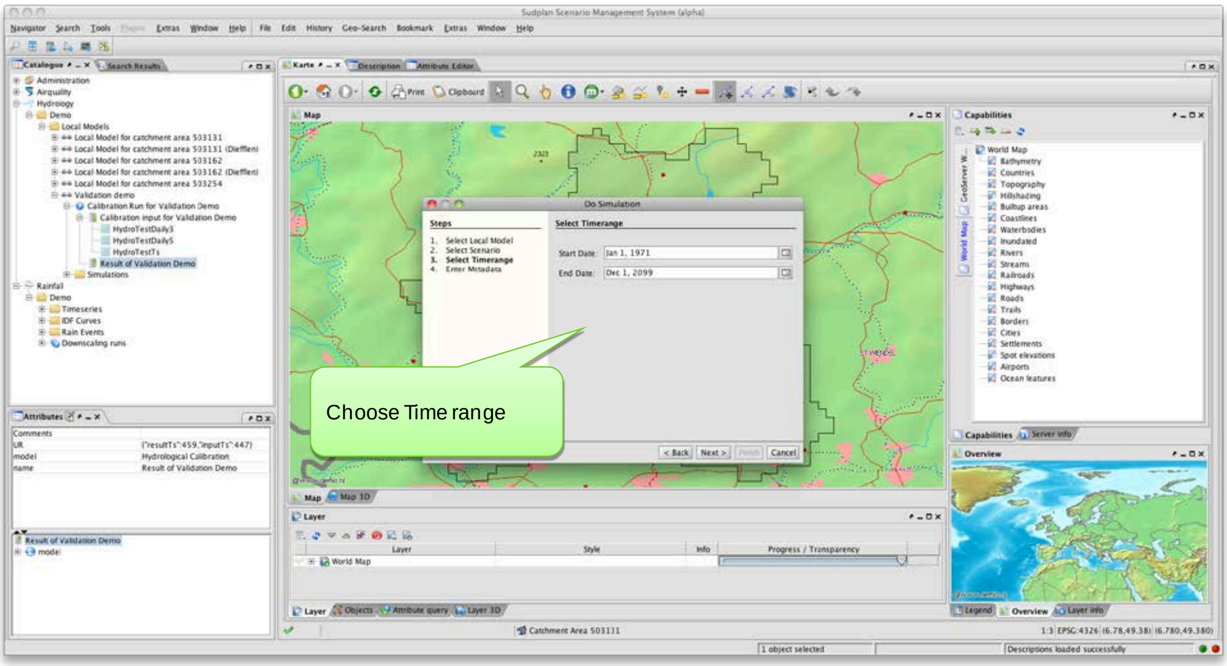

Wait for the execution to finish

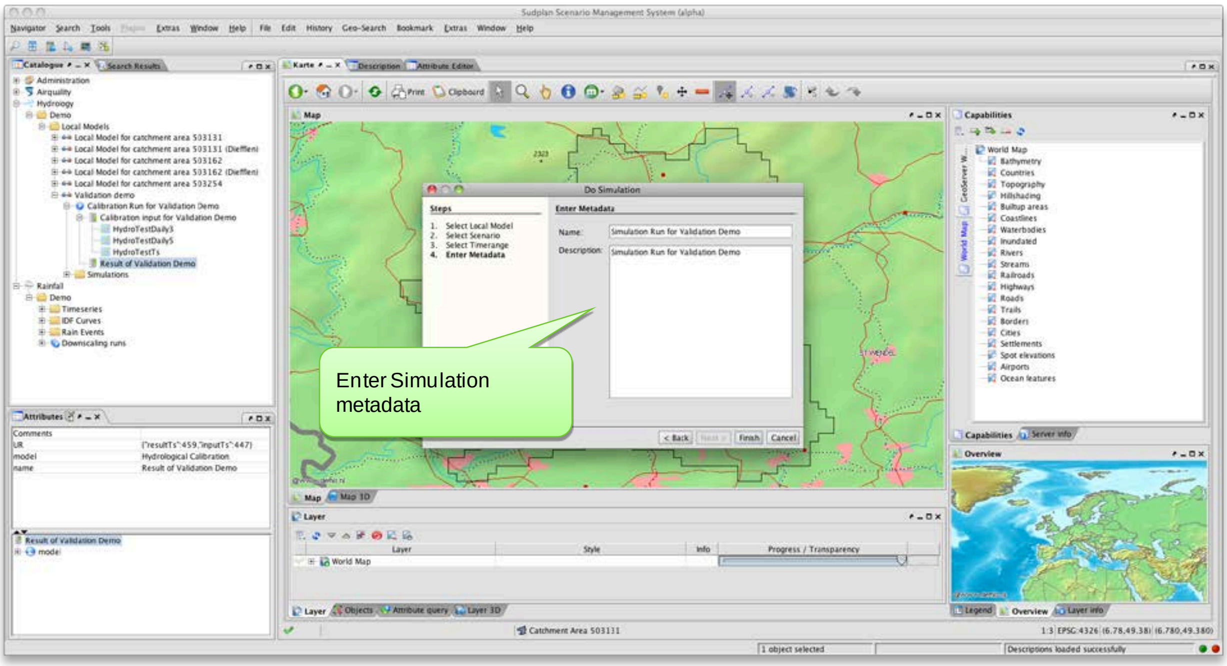

Sudplan Scenario Management System (alpha)
Result of Validation Demo
View Calibration results
Time
1 object selected
Descriptions loaded successfully

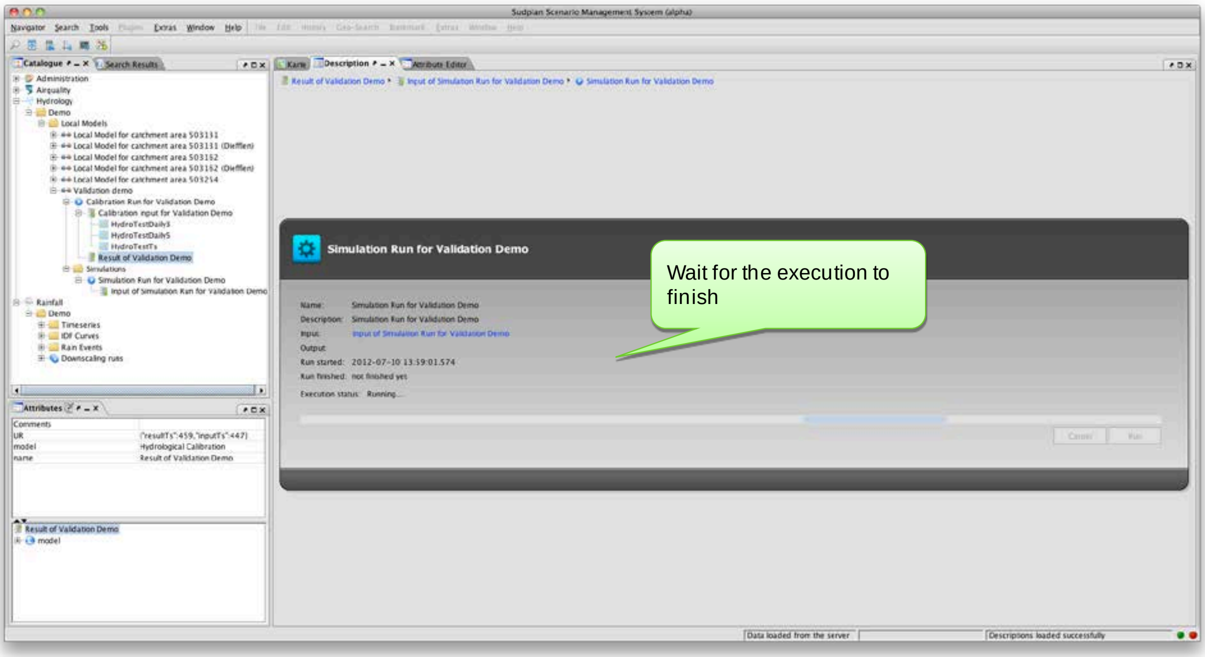

Sudplan Scenario Management System (alpha)
Show Upstream Areas
Create Local Model
Assign Timeseries
Do Calibration
Do Simulation
Select Do Simulation
Catchment Area 503131
1 object selected
Descriptions loaded successfully


Choose Local Model

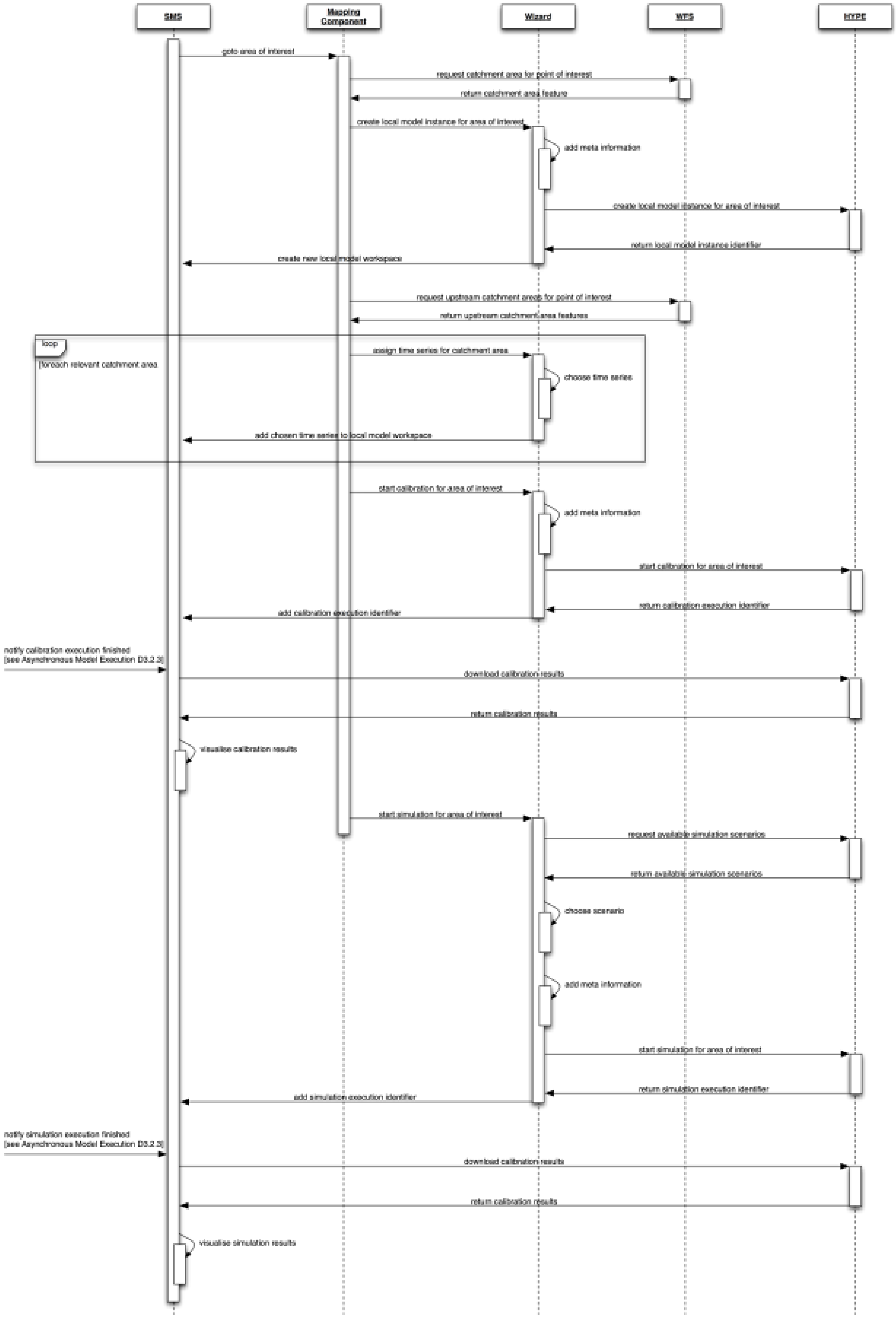

Choose Scenario


Do Simulation
Select Timerange
Start Date: Jan 1, 1971
End Date: Dec 1, 2099
Choose Time range


Do Simulation
Enter Metadata
Name: Simulation Run for Validation Demo
Description: Simulation Run for Validation Demo
Enter Simulation metadata

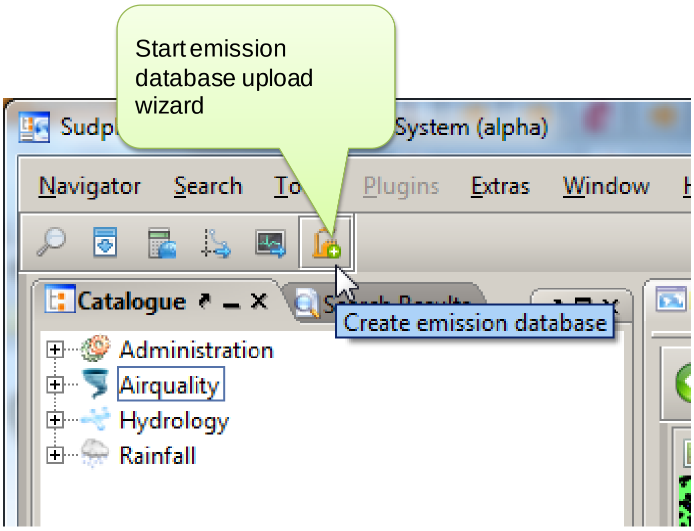

Simulation Run for Validation Demo
Wait for the execution to finish

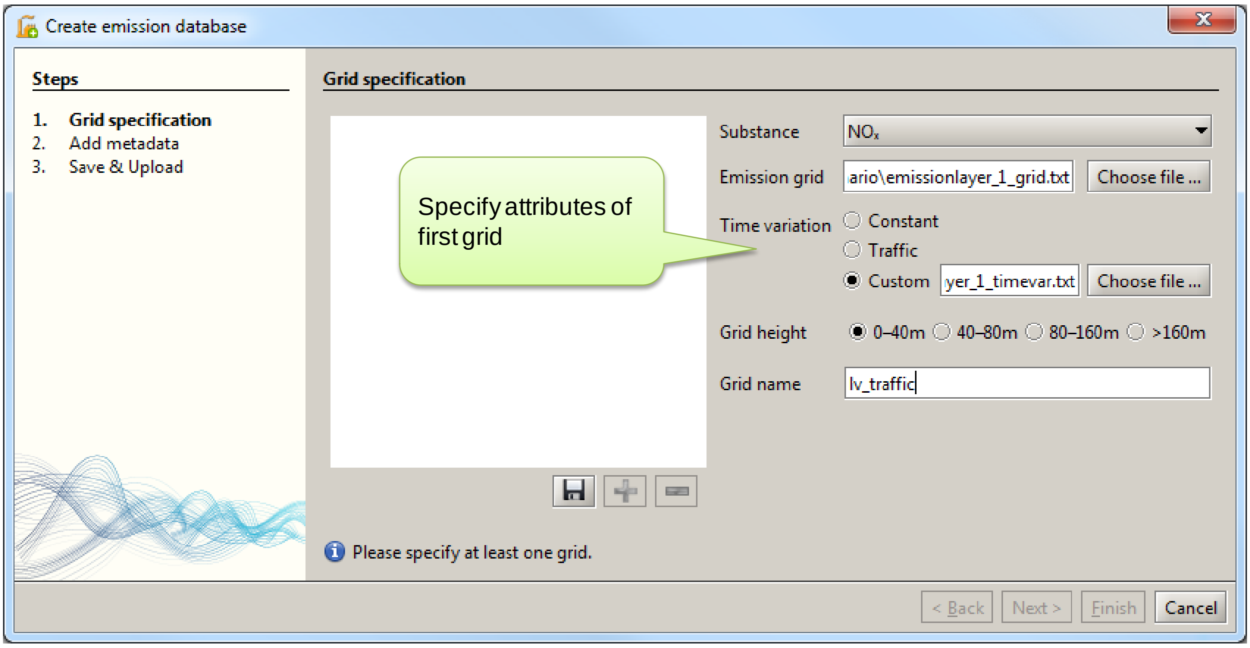

Result of Validation Demo Simulation
Time Series Data
View Simulation results
Time

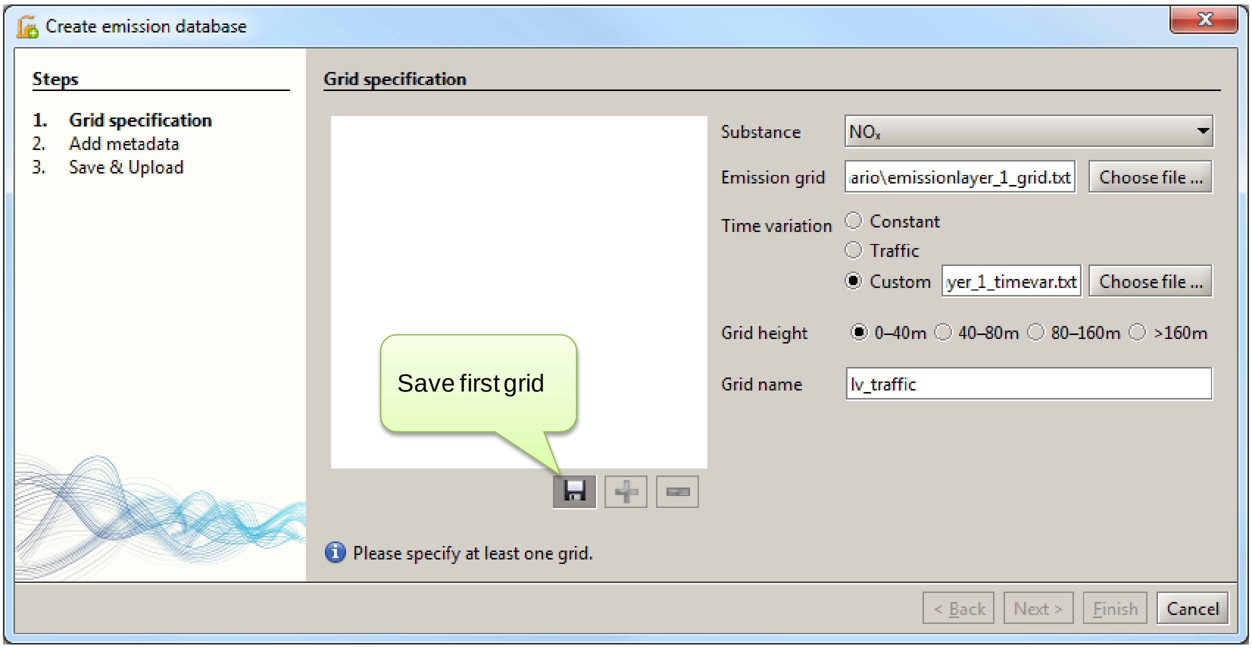

SMS
Mapping Component
Wizard
WPS
HYPE
goto area of interest
request catchment area for point of interest
return catchment area feature
create local model instance for area of interest
add meta information
create local model instance for area of interest
return local model instance identifier
create new local model workspace
request upstream catchment areas for point of interest
return upstream catchment area features
loop
[foreach relevant catchment area
assign time series for catchment area
choose time series
add chosen time series to local model workspace
start calibration for area of interest
add meta information
start calibration for area of interest
return calibration execution identifier
add calibration execution identifier
notify calibration execution finished
[see Asynchronous Model Execution D3.2.3]
download calibration results
return calibration results
visualise calibration results
start simulation for area of interest
request available simulation scenarios
return available simulation scenarios
choose scenario
add meta information
start simulation for area of interest
return simulation execution identifier
add simulation execution identifier
notify simulation execution finished
[see Asynchronous Model Execution D3.2.3]
download calibration results
return calibration results
visualise simulation results

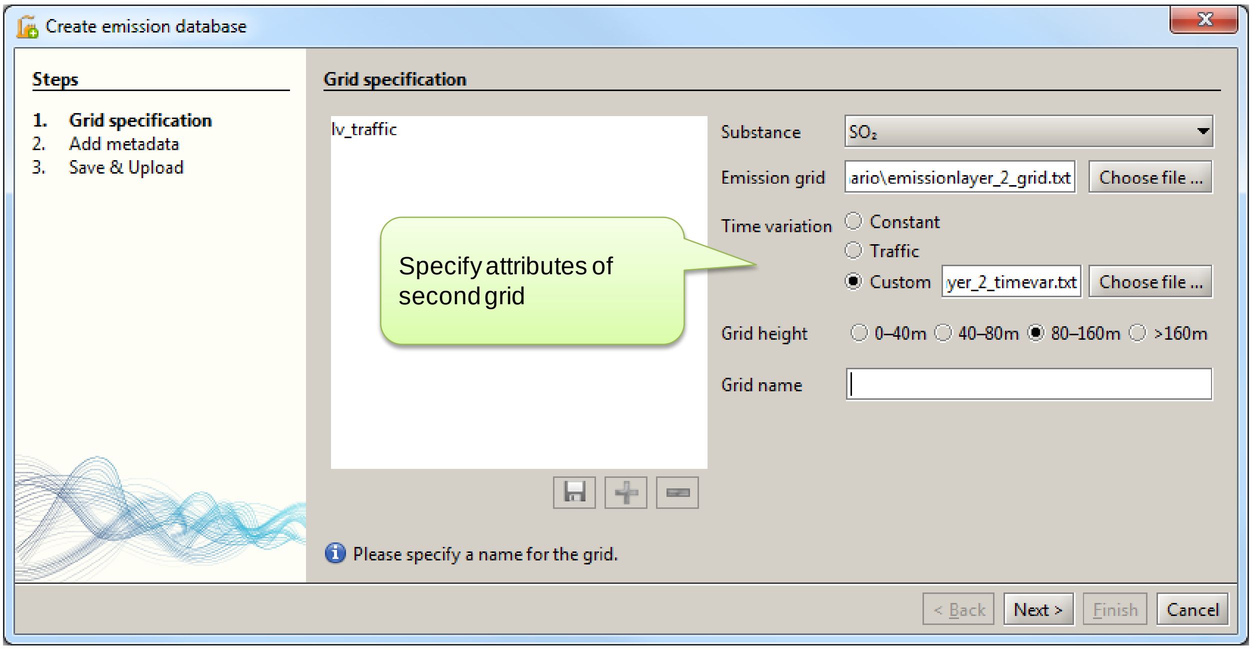
8.11. Emission database upload

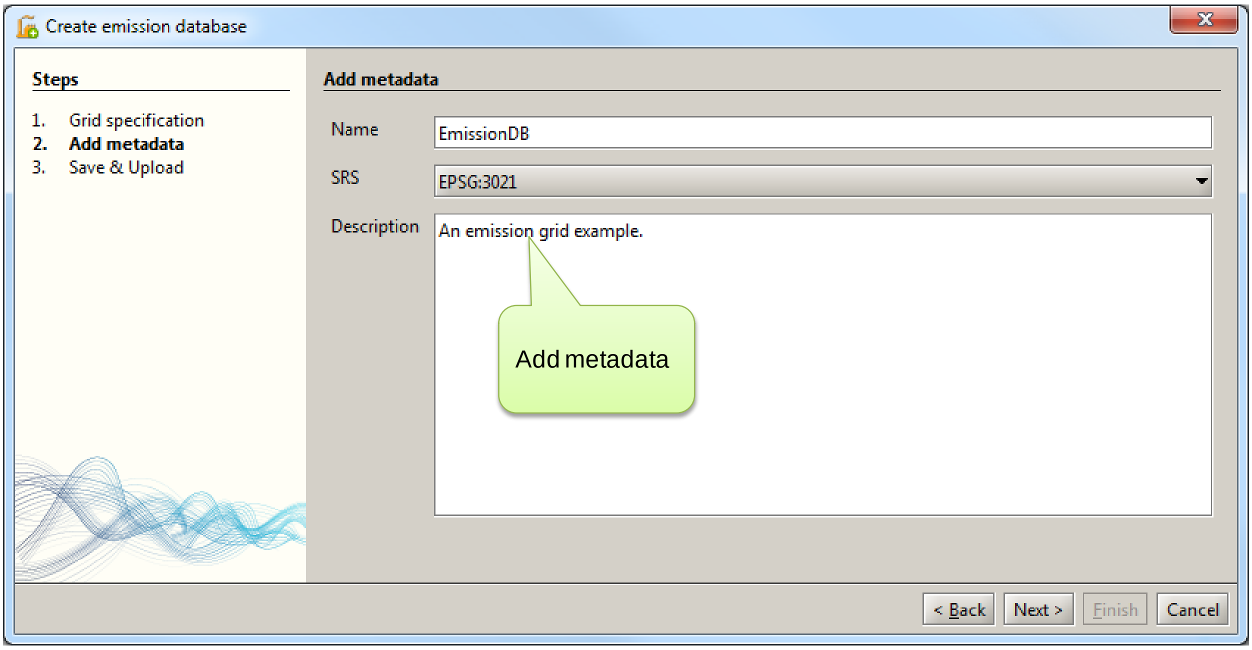
For a description of this validation scenario please refer to *4.2.12 - Emission Database Upload*.

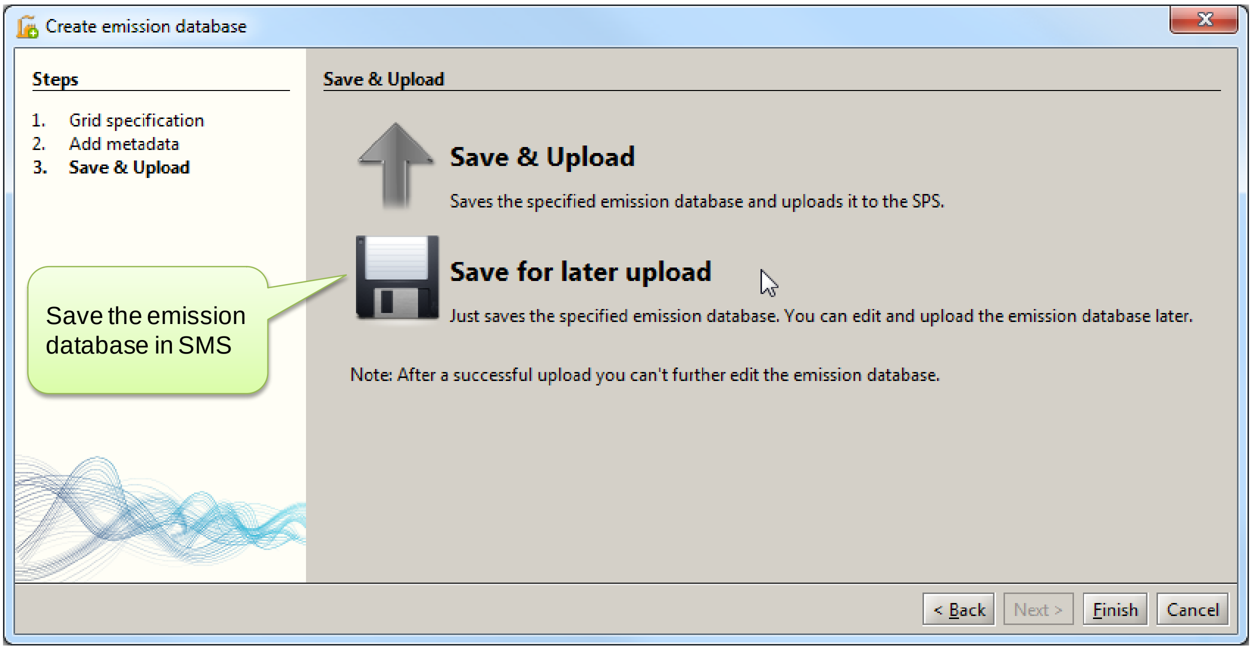


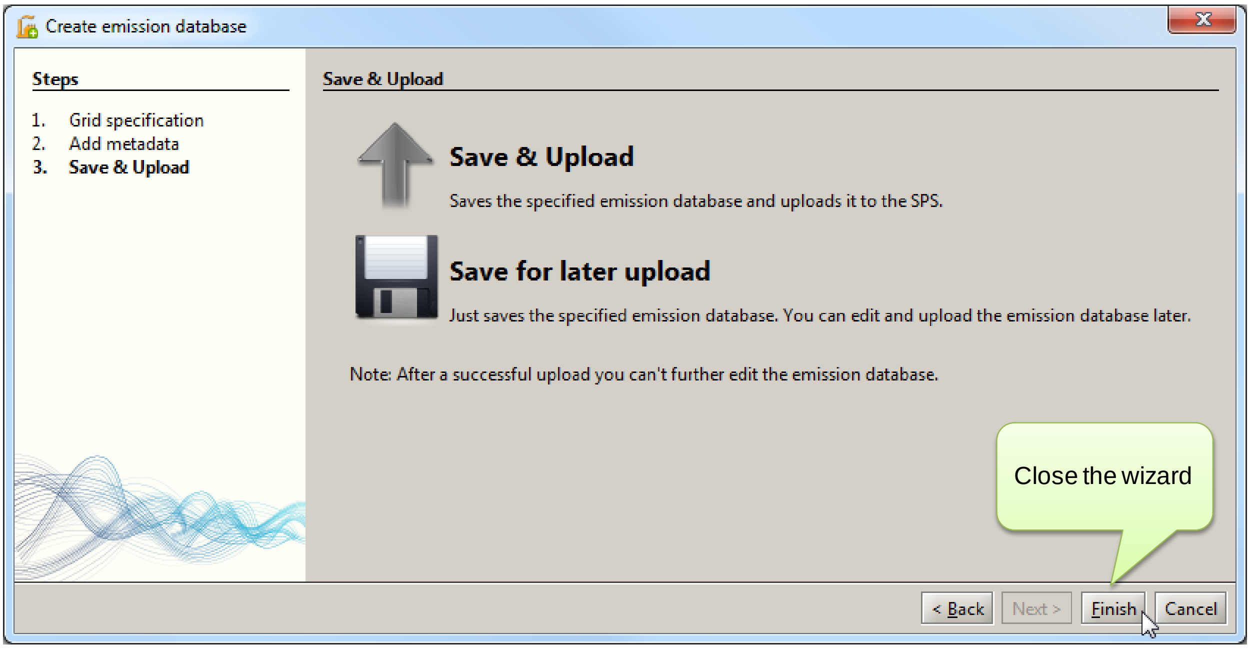


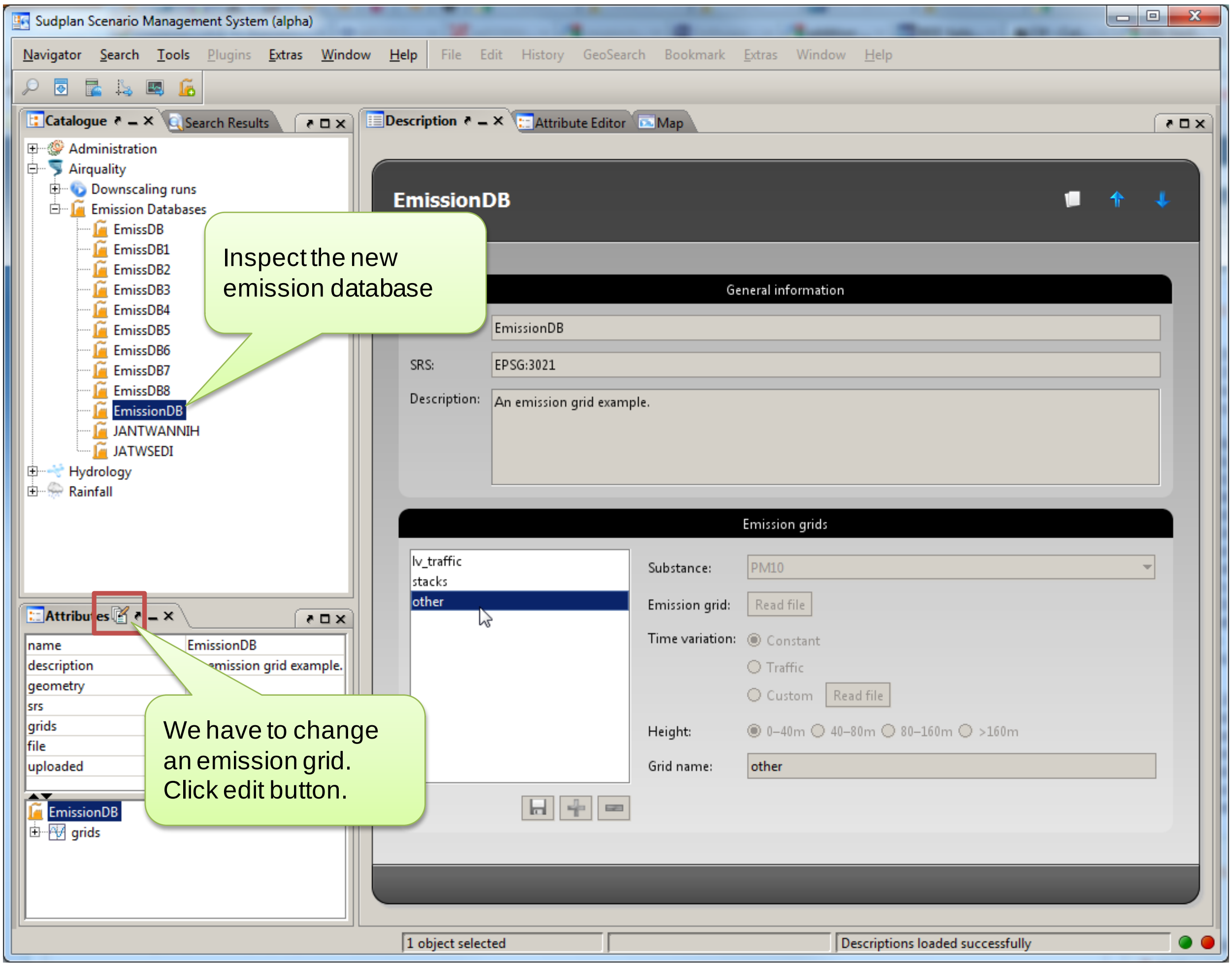

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Grid specification
Substance
NOx
Emission grid
ario\emissionlayer_1_grid.txt
Choose file ...
Time variation
Constant
Traffic
Custom
yer_1_timevar.txt
Choose file ...
Grid height
0–40m
40–80m
80–160m
>160m
Grid name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

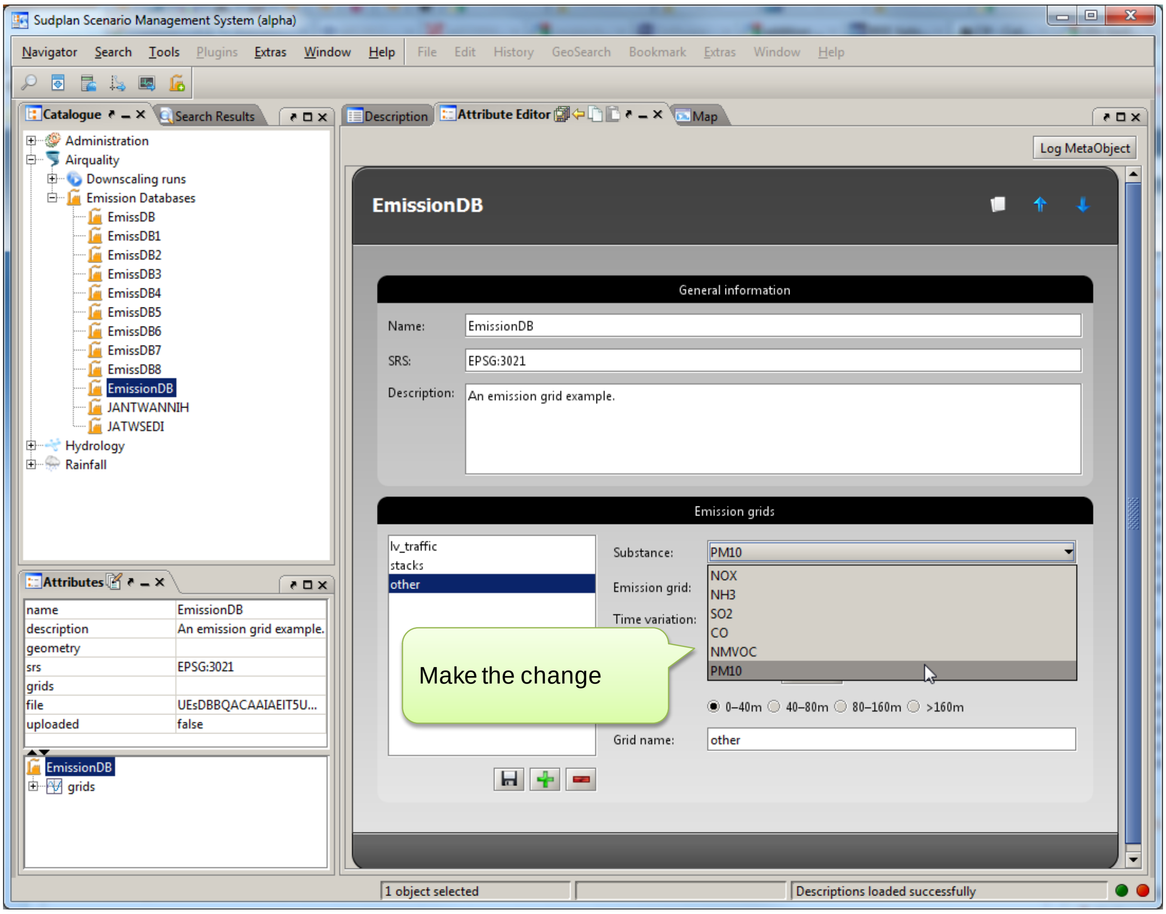

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Grid specification
lv_traffic
Substance
SO2
Emission grid
ario\emissionlayer_2_grid.txt
Choose file ...
Time variation
Constant
Traffic
Custom
yer_2_timevar.txt
Choose file ...
Specify attributes of second grid
Grid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

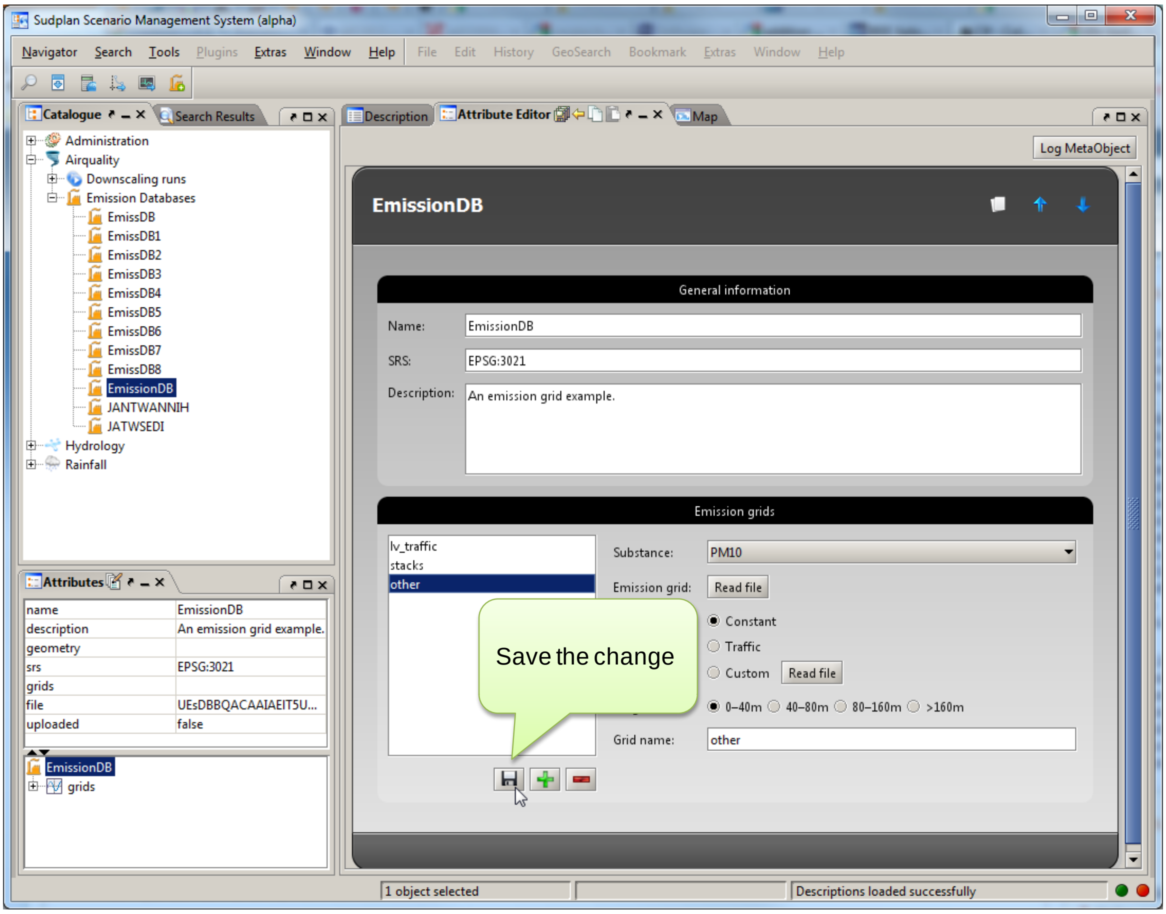

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Add metadata
Name
EmissionDB
SRS
EPSG:3021
Description
An emission grid example.
Add metadata
< Back
Next >
Finish
Cancel

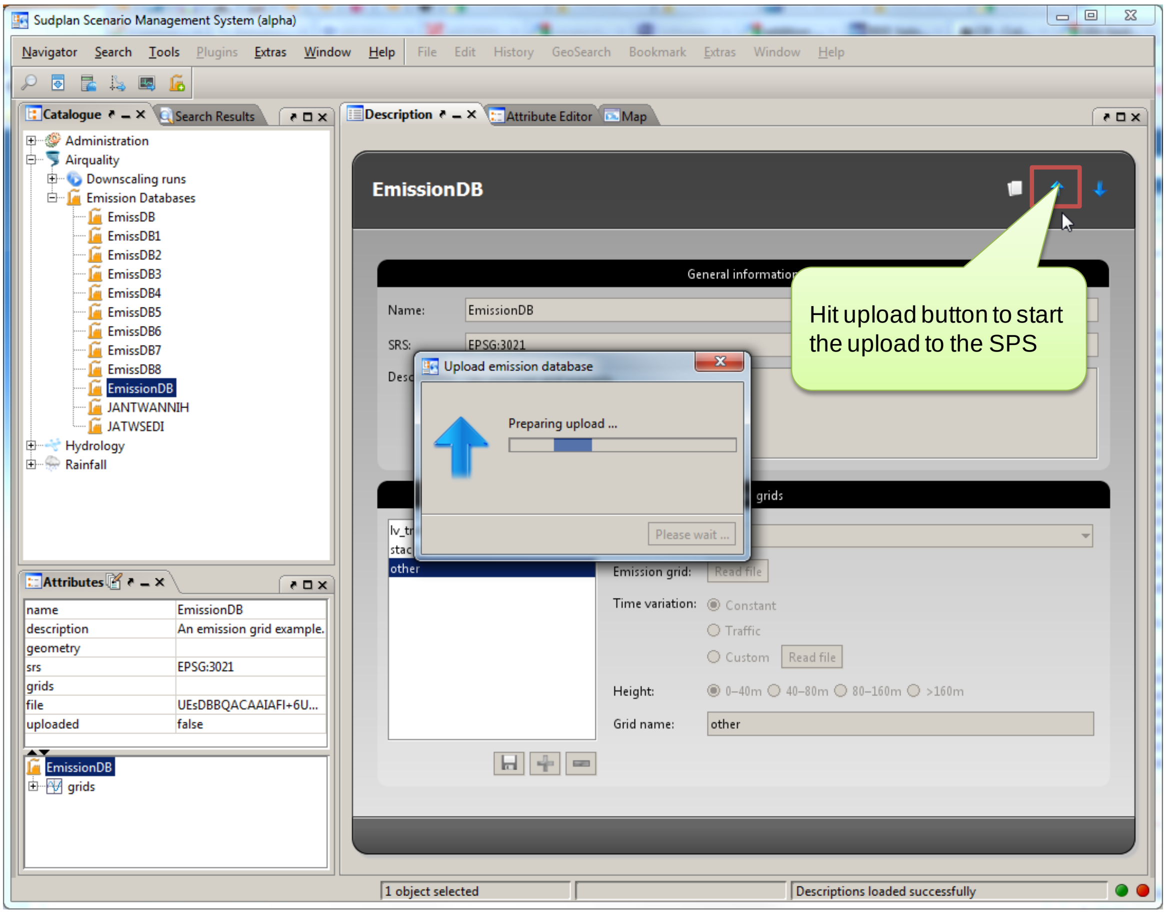

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Save & Upload
Save & Upload
Saves the specified emission database and uploads it to the SPS.
Save for later upload
Just saves the specified emission database. You can edit and upload the emission database later.
Note: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

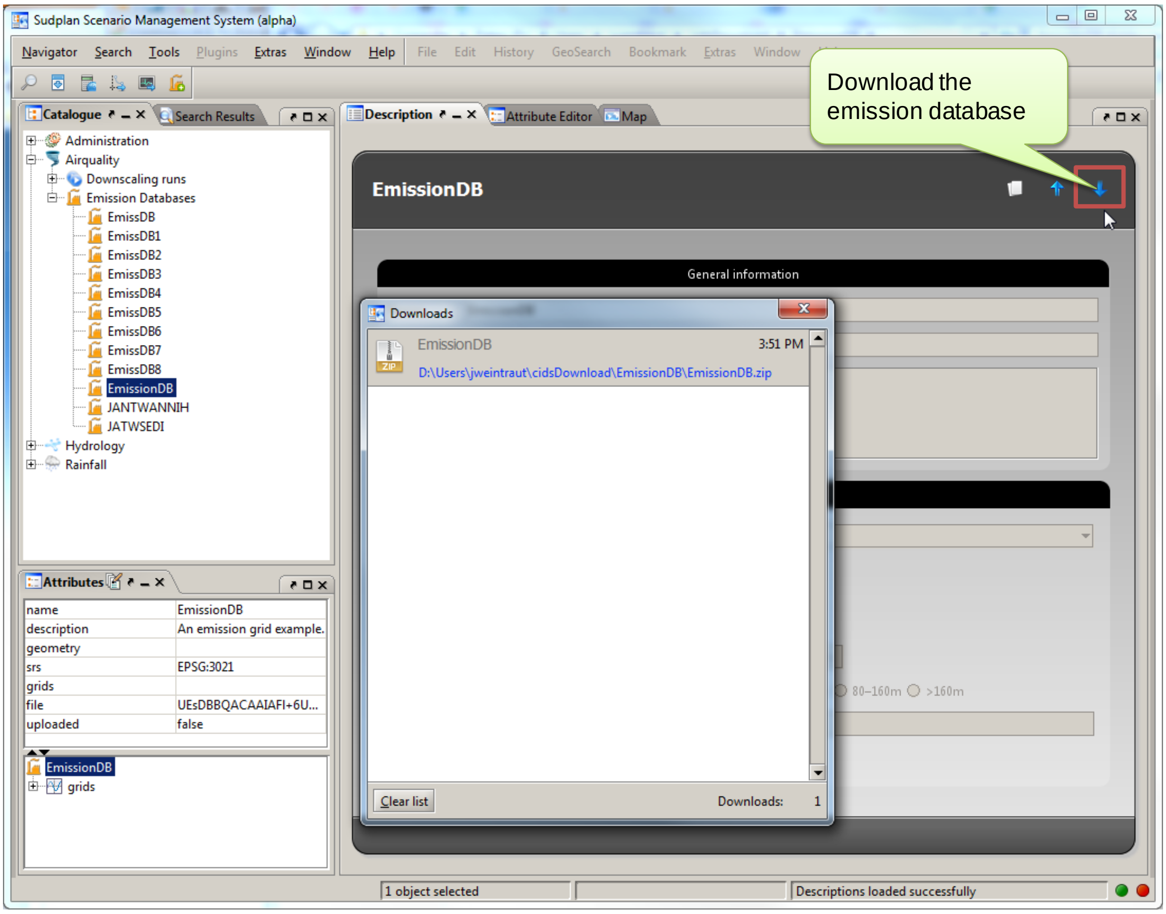

Create emission database
Steps
1. Grid specification
2. Add metadata
3. Save & Upload
Save & Upload
Save & Upload
Saves the specified emission database and uploads it to the SPS.
Save for later upload
Just saves the specified emission database. You can edit and upload the emission database later.
Note: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

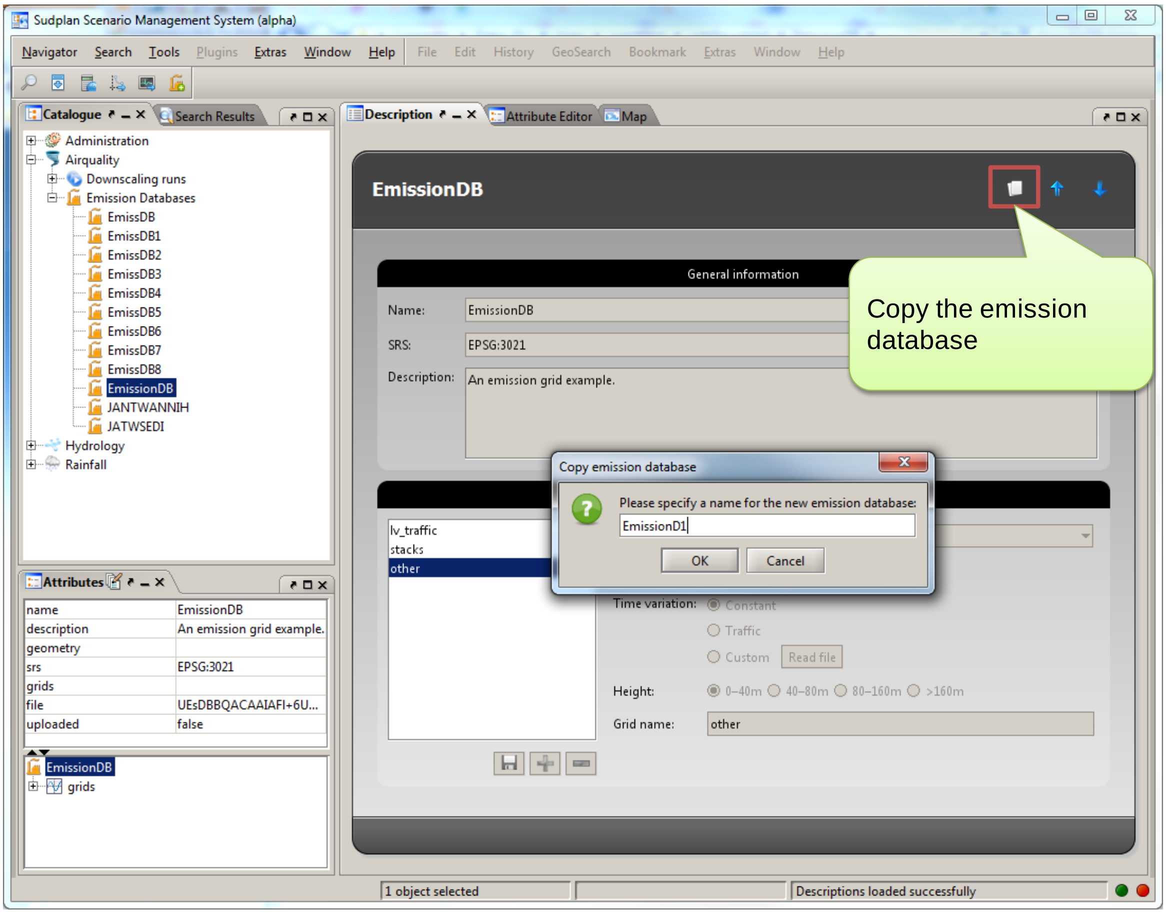

Sudplan Scenario Management System (alpha)
Inspect the new emission database
We have to change an emission grid. Click edit button.
EmissionDB
General information
SRS:
EPSG:3021
Description:
An emission grid example.
Emission grids
lv_traffic
stacks
other
Substance:
PM10
Emission grid:
Time variation:
Constant
Traffic
Custom
Height:
Grid name:
1 object selected
Descriptions loaded successfully

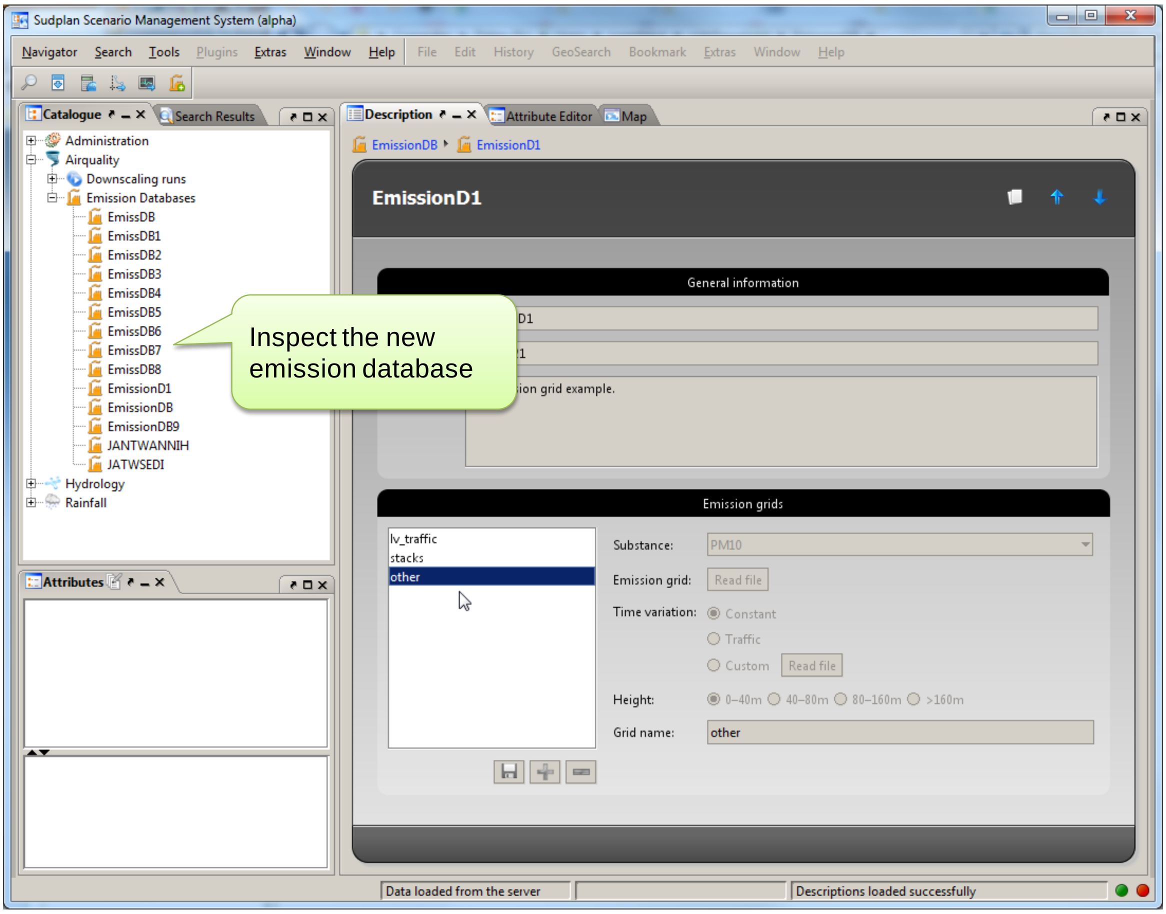

Sudplan Scenario Management System (alpha)
EmissionDB
General information
Name: EmissionDB
SRS: EPSG:3021
Description: An emission grid example.
Emission grids
lv_traffic
stacks
other
Substance: PM10
NOX
NH3
SO2
CO
NMVOC
PM10
Emission grid:
Time variation:
Make the change
0-40m 40-80m 80-160m >160m
Grid name: other
1 object selected
Descriptions loaded successfully

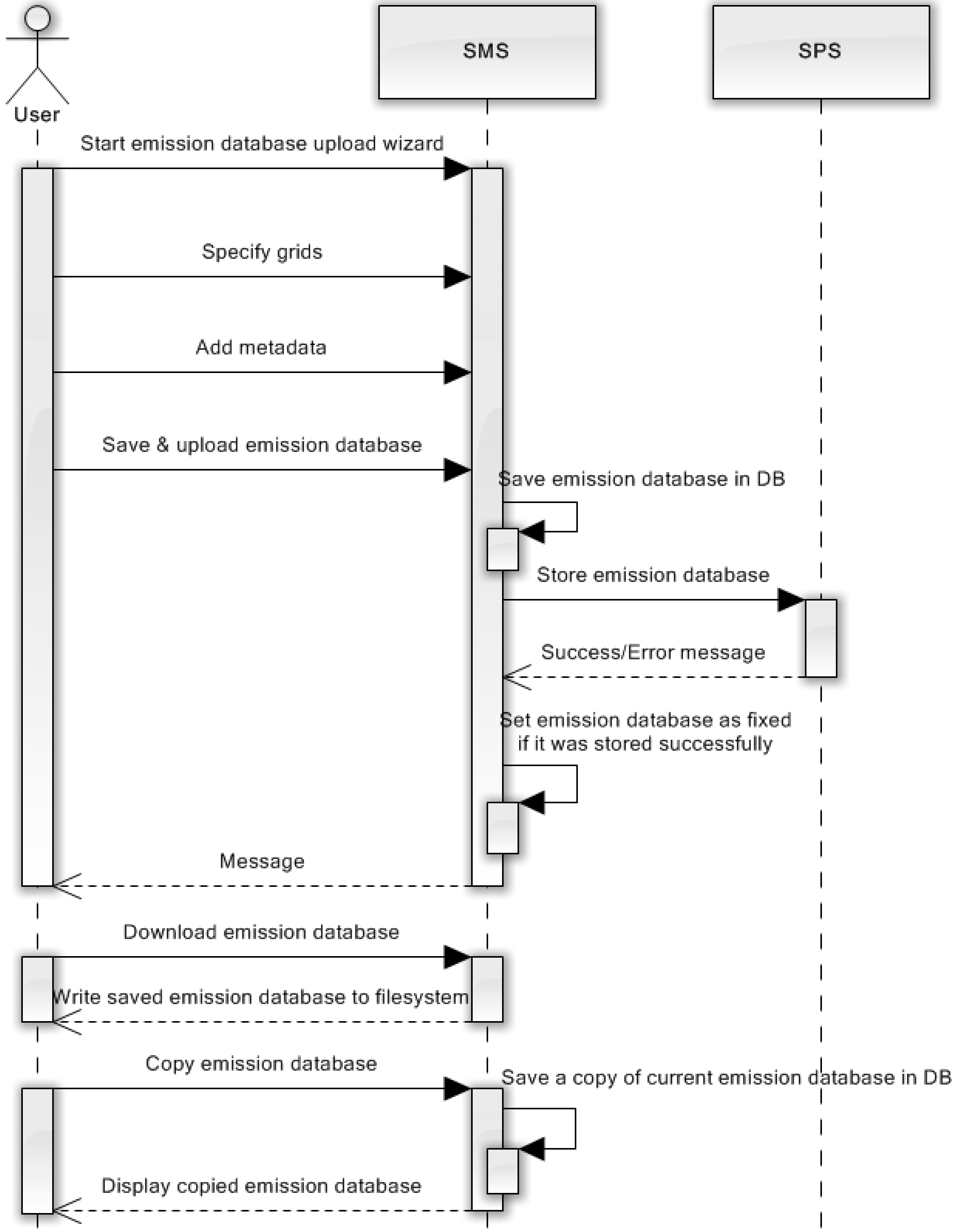

Sudplan Scenario Management System (alpha)
EmissionDB
General information
Name: EmissionDB
SRS: EPSG:3021
Description: An emission grid example.
Emission grids
lv_traffic
stacks
other
Substance: PM10
Emission grid: Read file
Constant
Traffic
Custom Read file
Save the change
0-40m 40-80m 80-160m >160m
Grid name: other
1 object selected
Descriptions loaded successfully

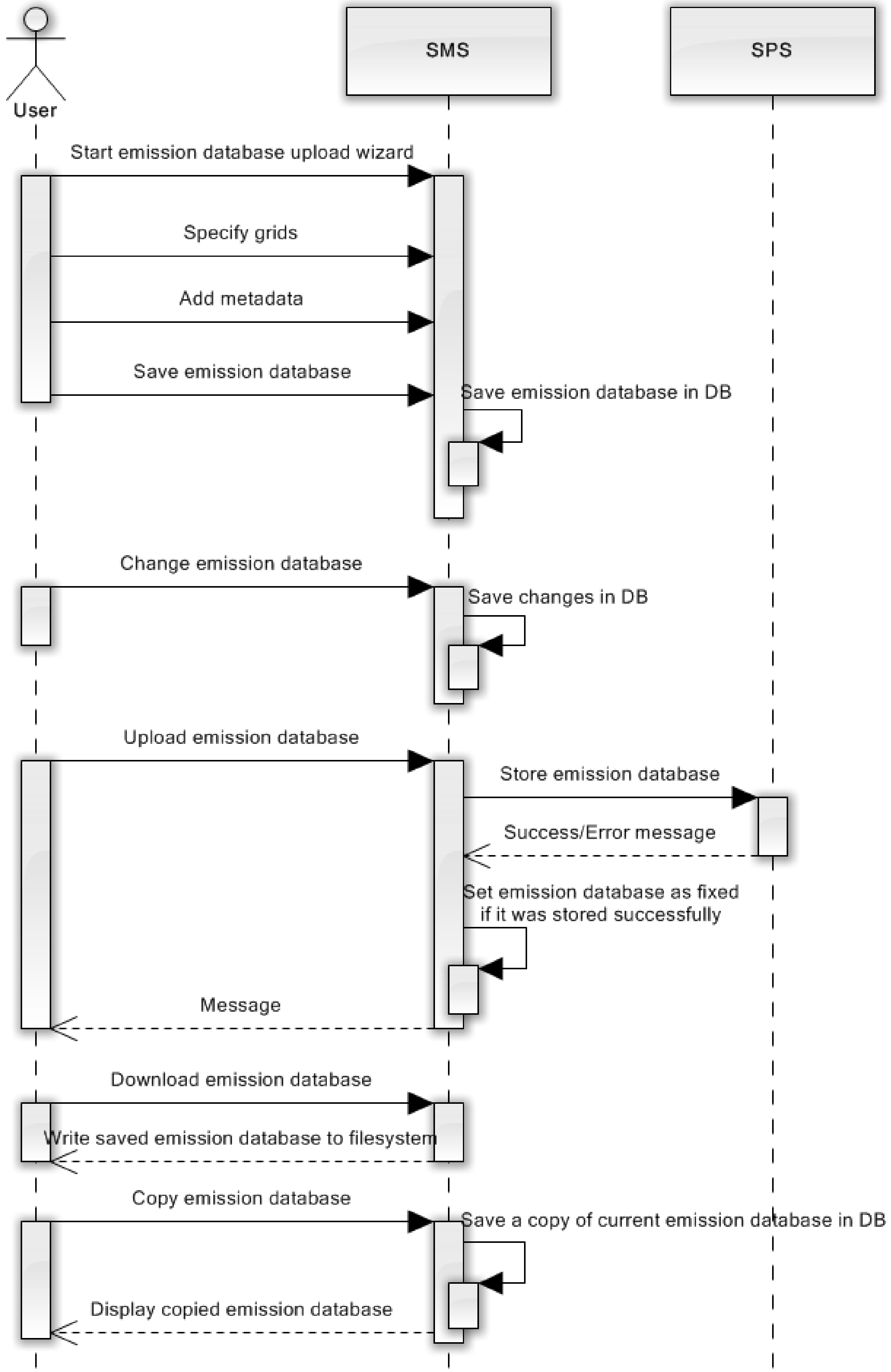

Hit upload button to start the upload to the SPS
Upload emission database
Preparing upload ...
Please wait ...


Download the emission database
Downloads
EmissionDB
3:51 PM
D:\Users\jweintraut\cidsDownload\EmissionDB\EmissionDB.zip
Clear list
Downloads: 1


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

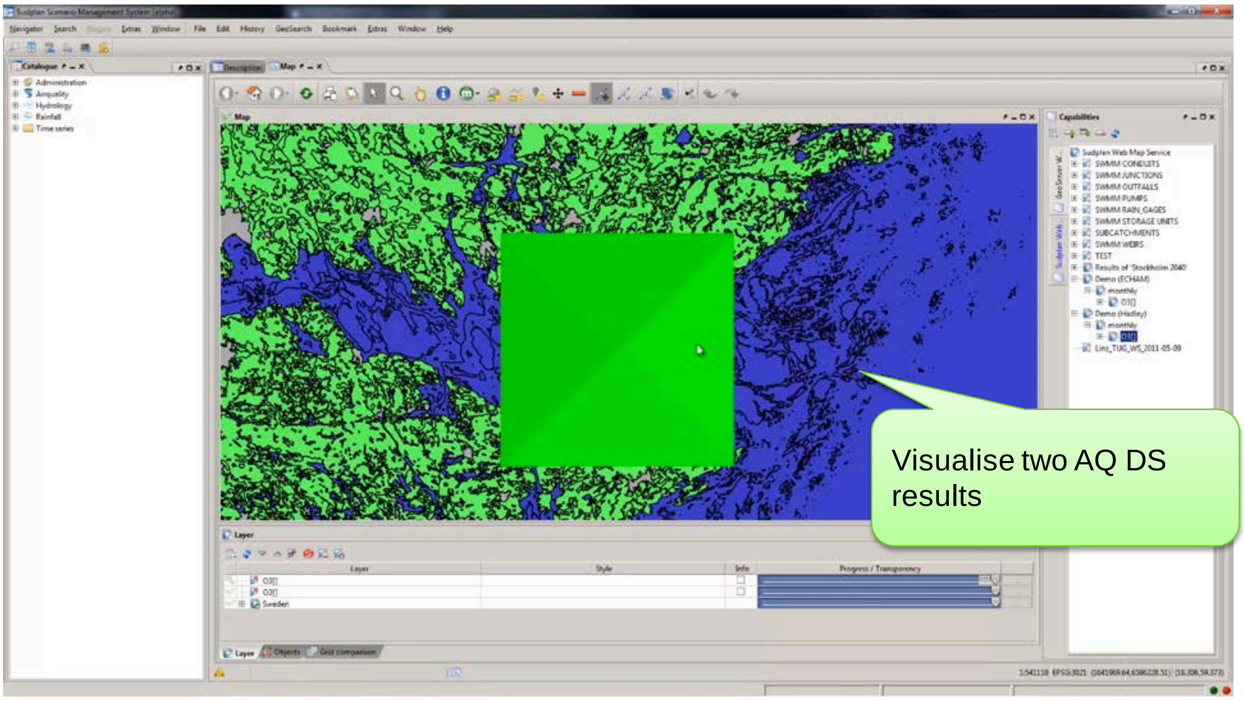

Sudplan Scenario Management System (alpha)
EmissionD1
General information
Inspect the new emission database
Emission grids
Substance: PM10
Time variation:
Height:
Grid name: other
Data loaded from the server
Descriptions loaded successfully

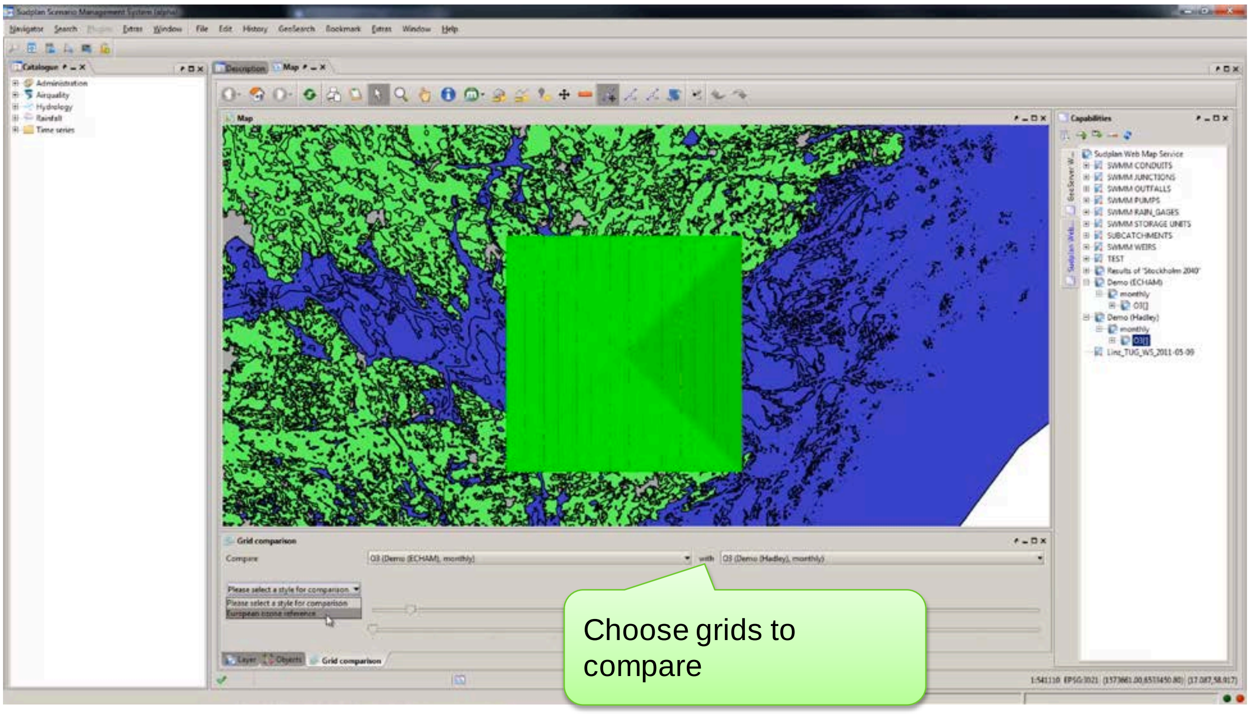

User
SMS
SPS
Start emission database upload wizard
Specify grids
Add metadata
Save & upload emission database
Save emission database in DB
Store emission database
Success/Error message
Set emission database as fixed if it was stored successfully
Message
Download emission database
Write saved emission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

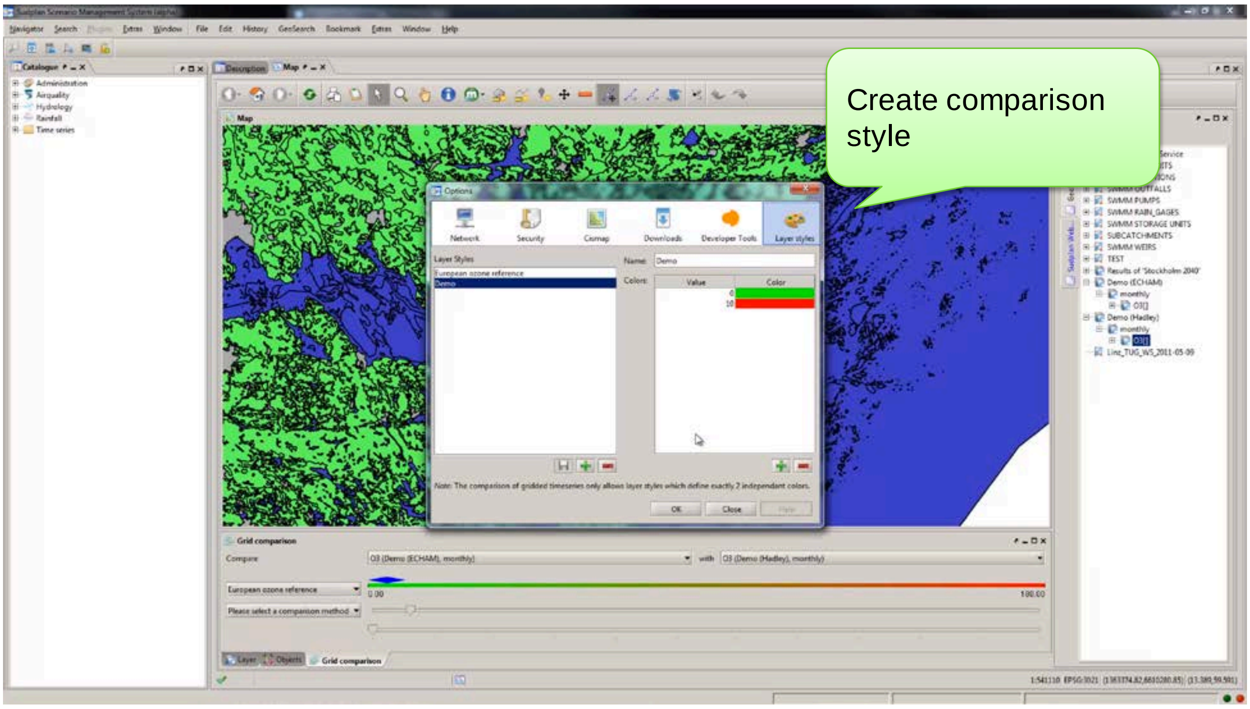

User
SMS
SPS
Start emission database upload wizard
Specify grids
Add metadata
Save emission database
Save emission database in DB
Change emission database
Save changes in DB
Upload emission database
Store emission database
Success/Error message
Set emission database as fixed
if it was stored successfully
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

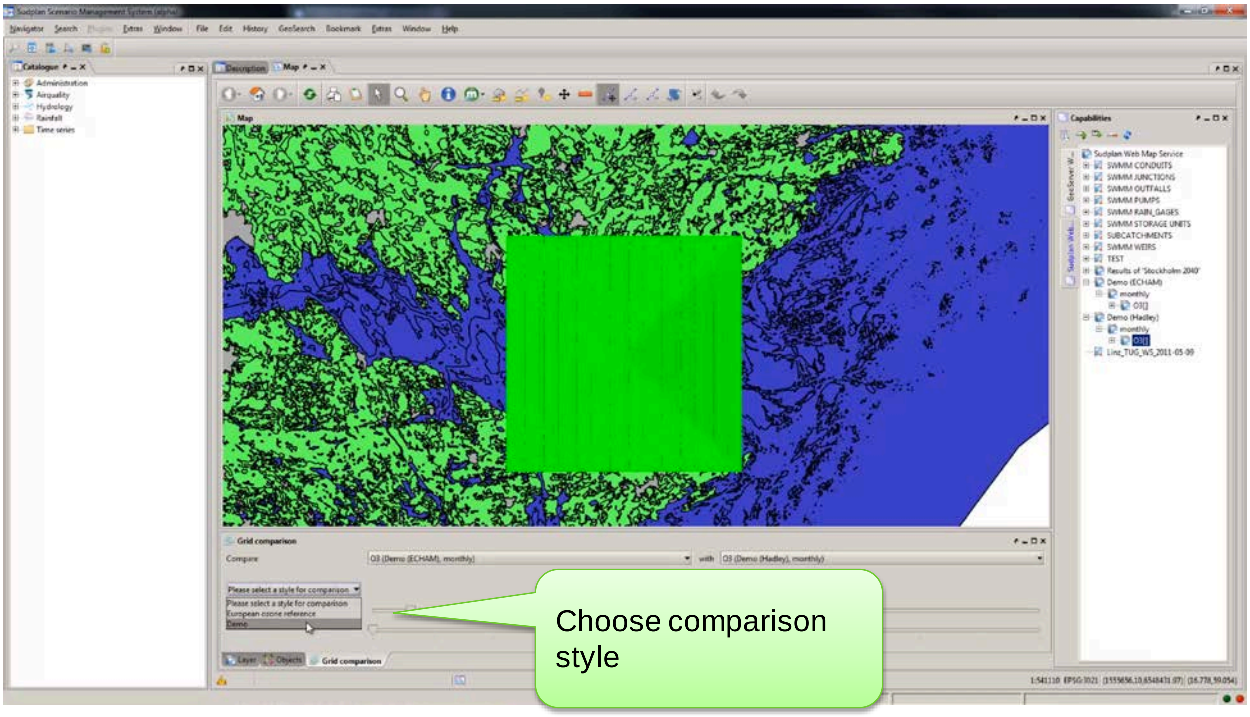
8.12. Grid comparison

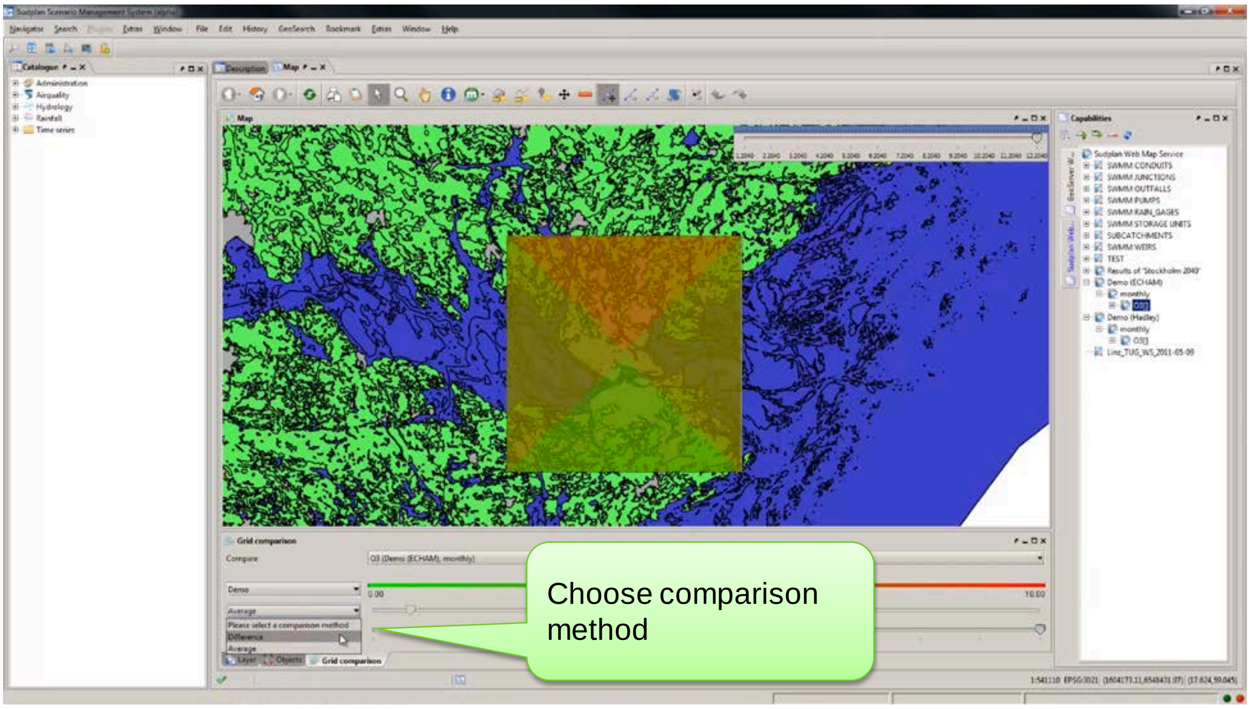
For a description of this validation scenario please refer to *4.2.13 - Grid comparison*.

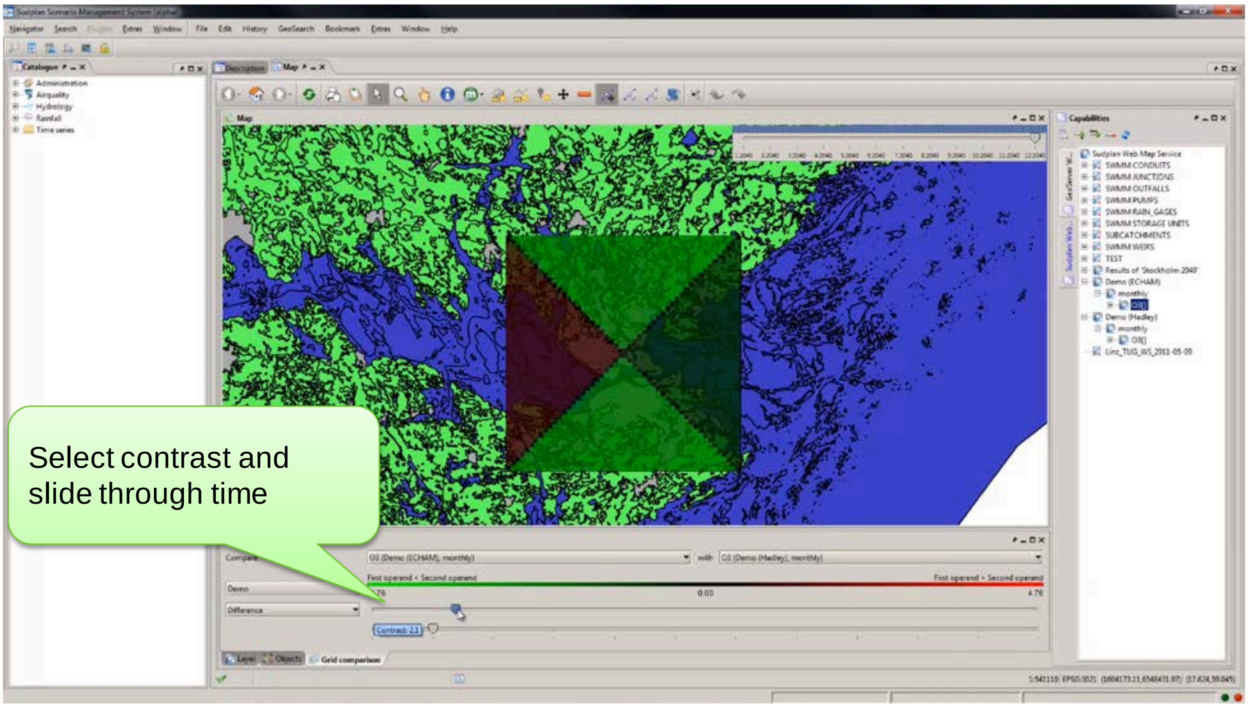


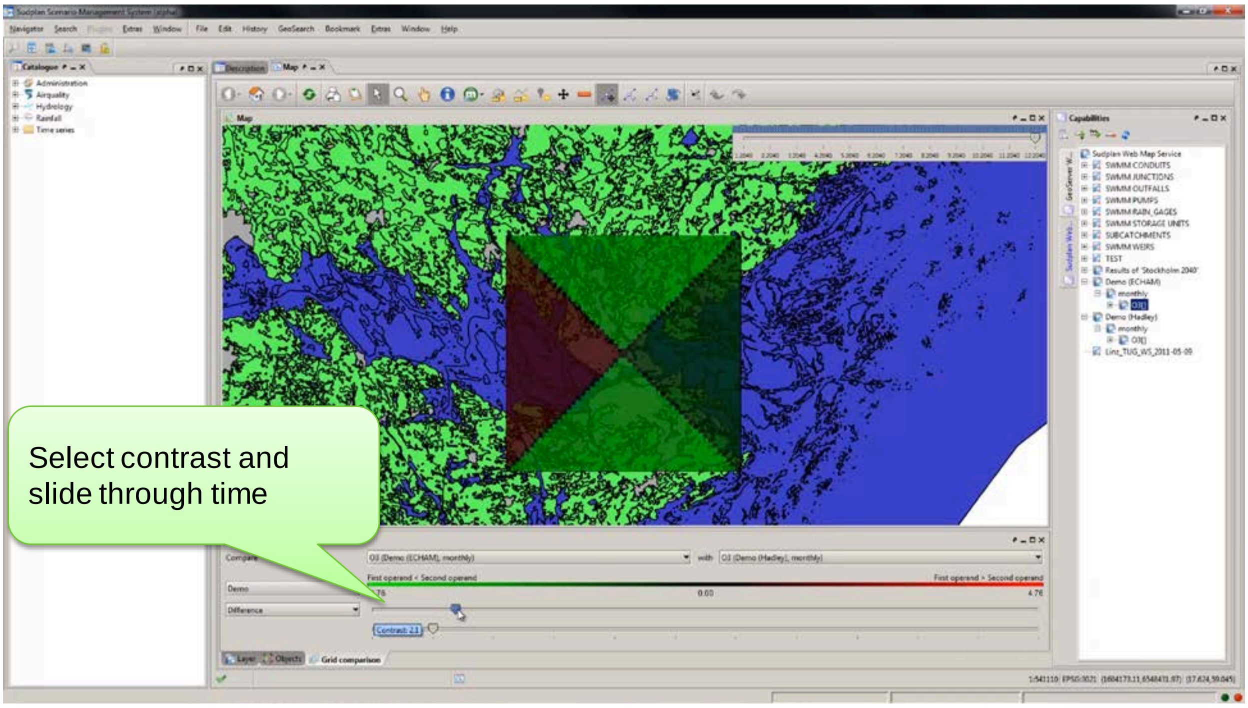



Create comparison style


Choose comparison style

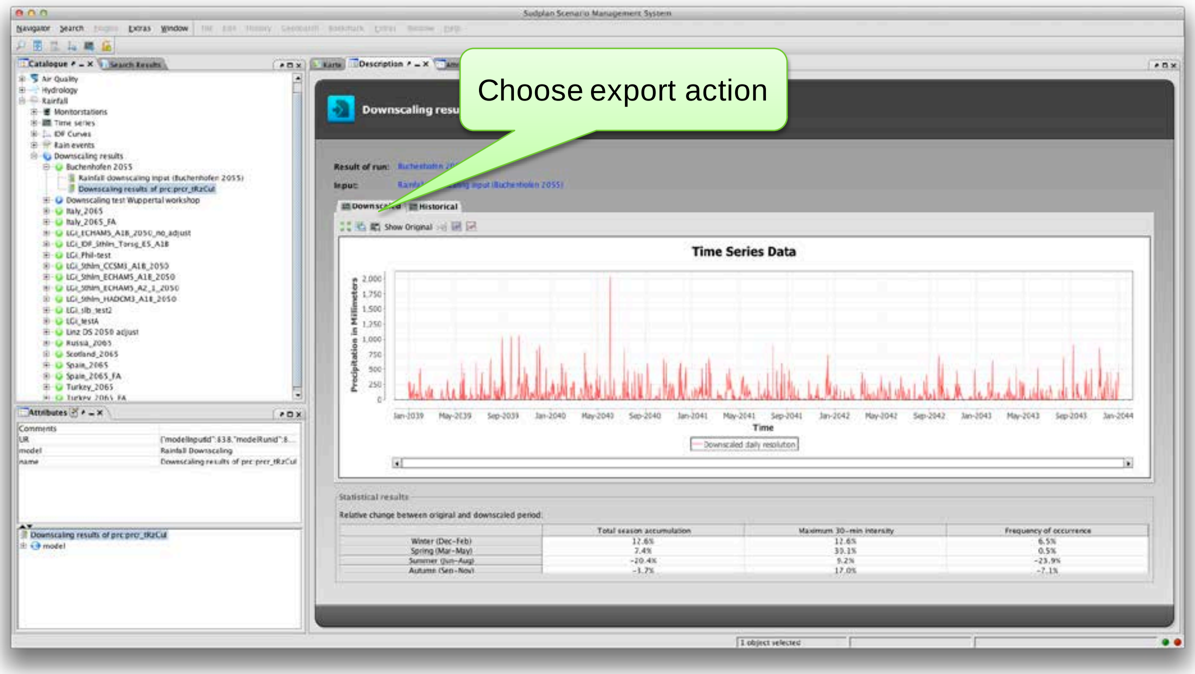

Choose comparison method

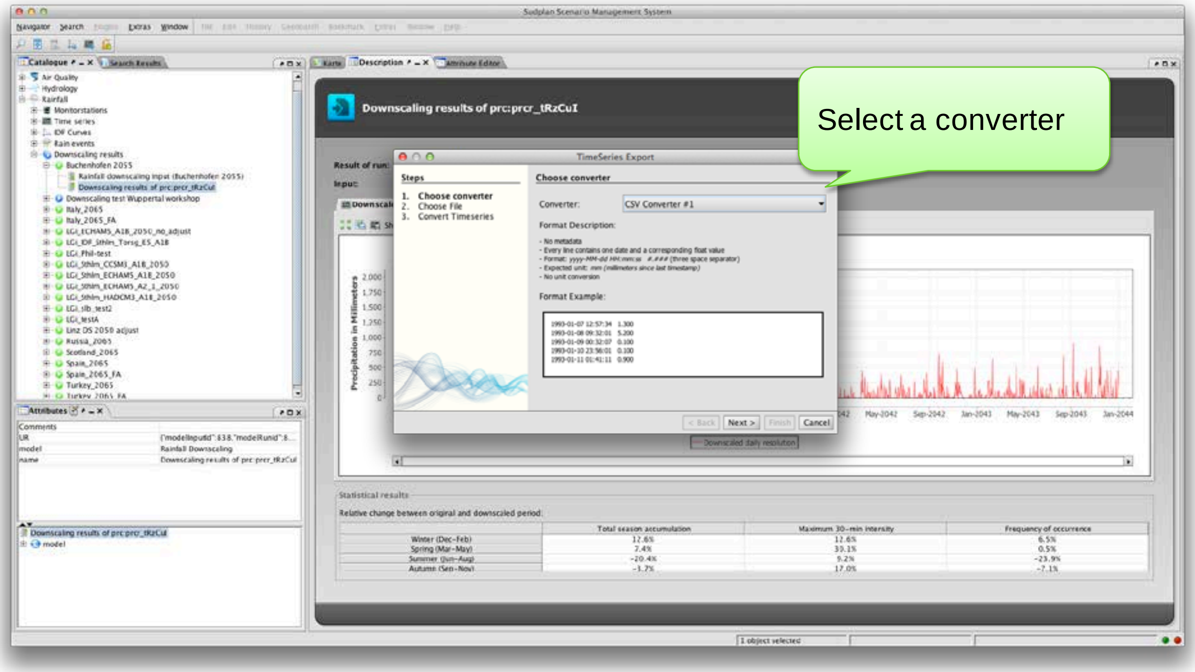

Select contrast and slide through time

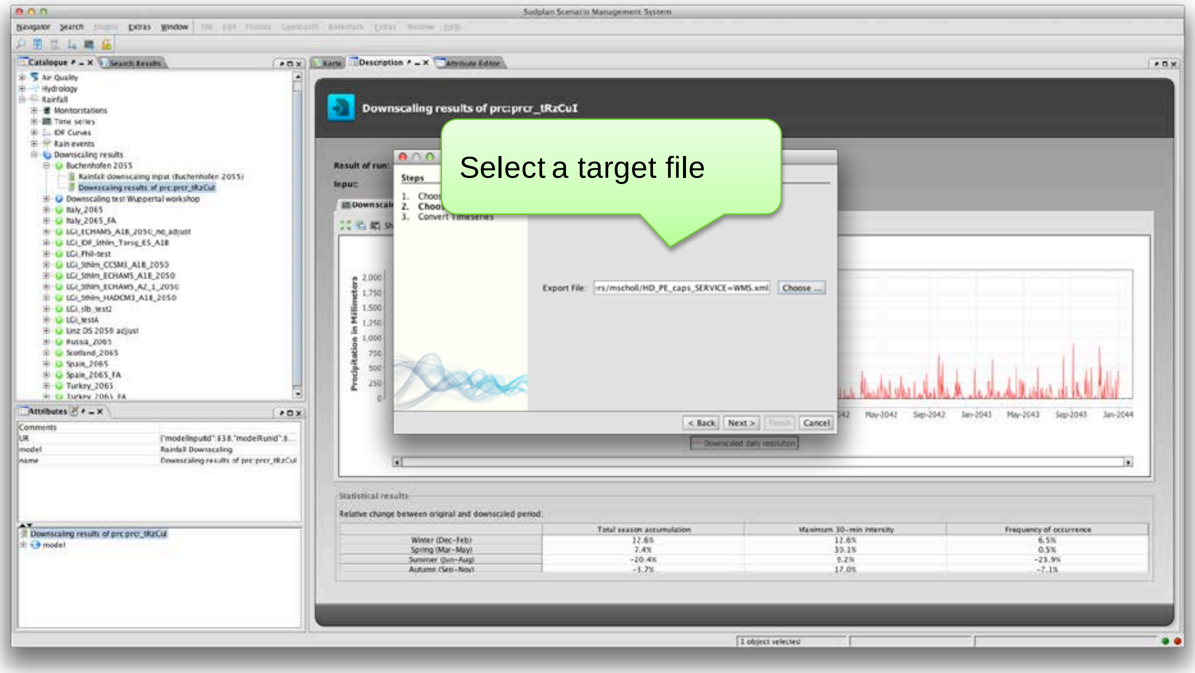

Select contrast and slide through time

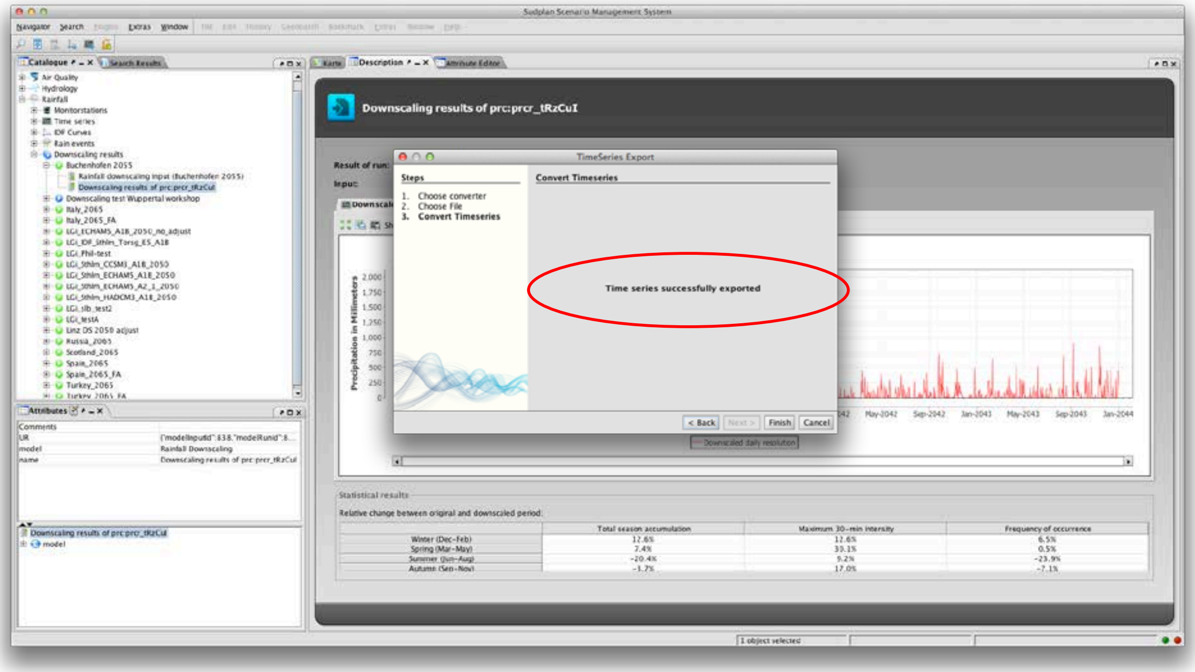
8.13. Data export

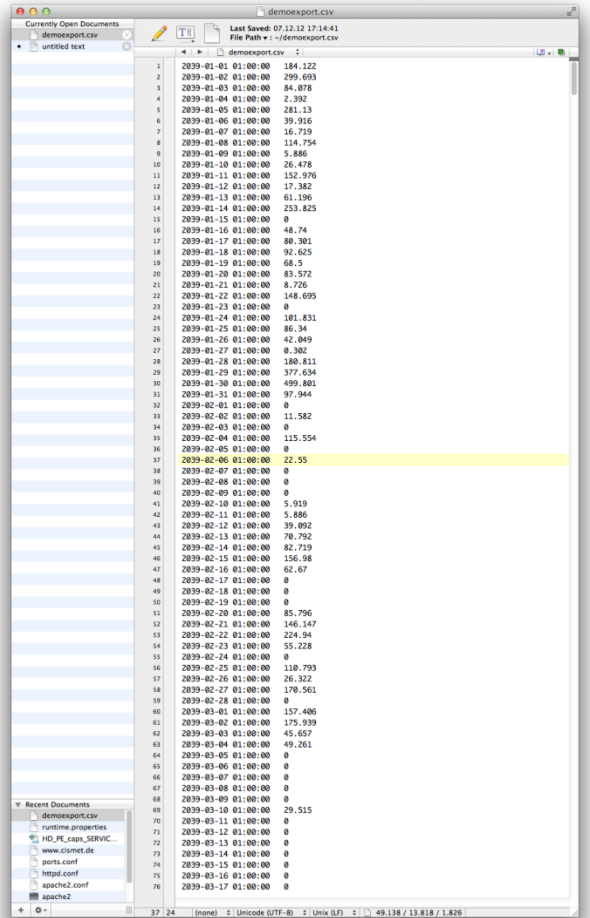
For a description of this validation scenario please refer to *4.2.14 - Data export*.




Select a converter

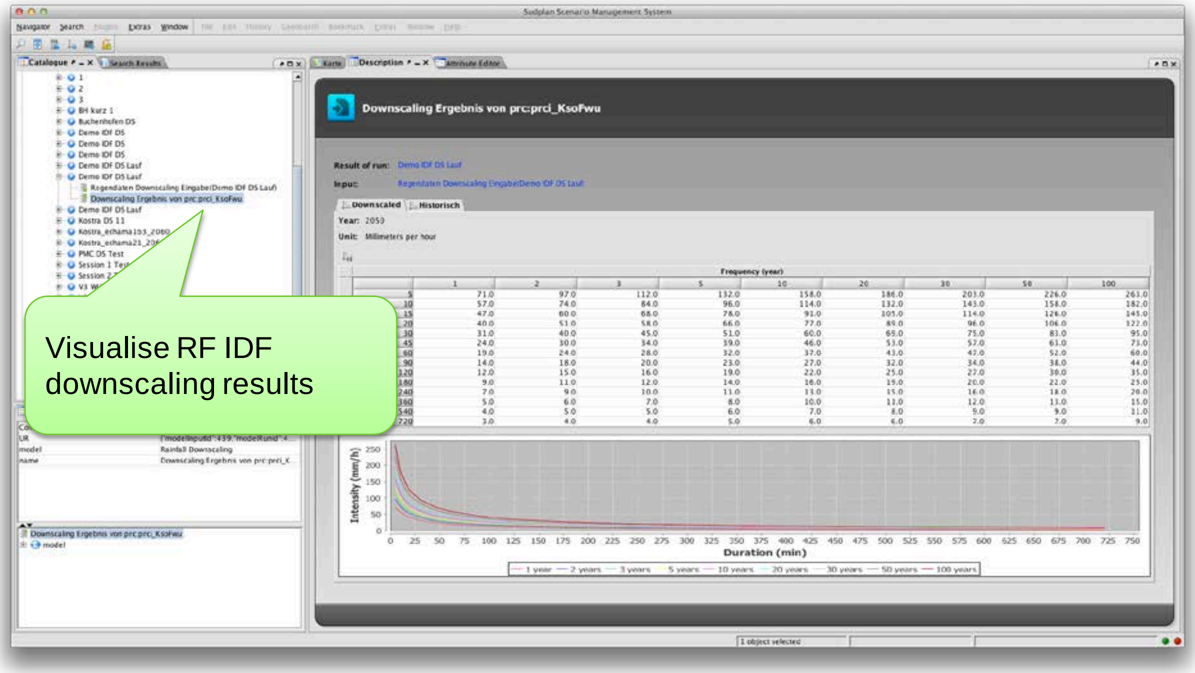

Select a target file

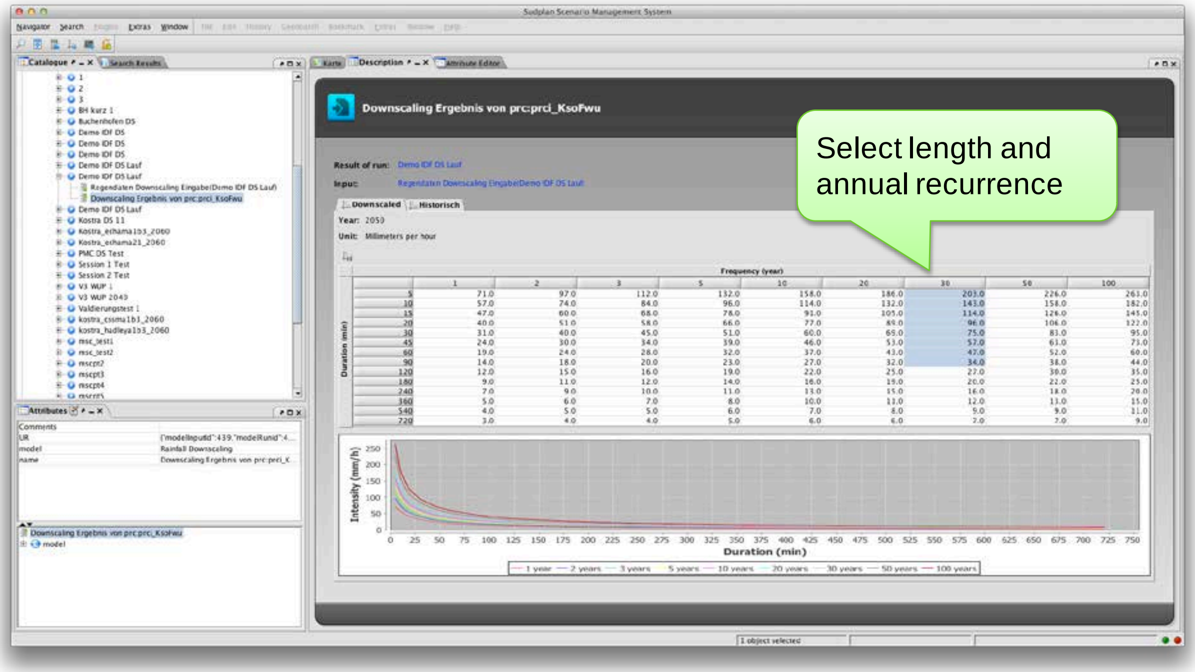

Sudplan Scenario Management System
Downscaling results of prc:prcr_tRzCuI
TimeSeries Export
Steps
1. Choose converter
2. Choose File
3. Convert Timeseries
Convert Timeseries
Time series successfully exported
< Back
Next >
Finish
Cancel
Statistical results
Relative change between original and downscaled period
Total season accumulation
Maximum 30-min intensity
Frequency of occurrence
Winter (Dec-Feb)
Spring (Mar-May)
Summer (Jun-Aug)
Autumn (Sep-Nov)

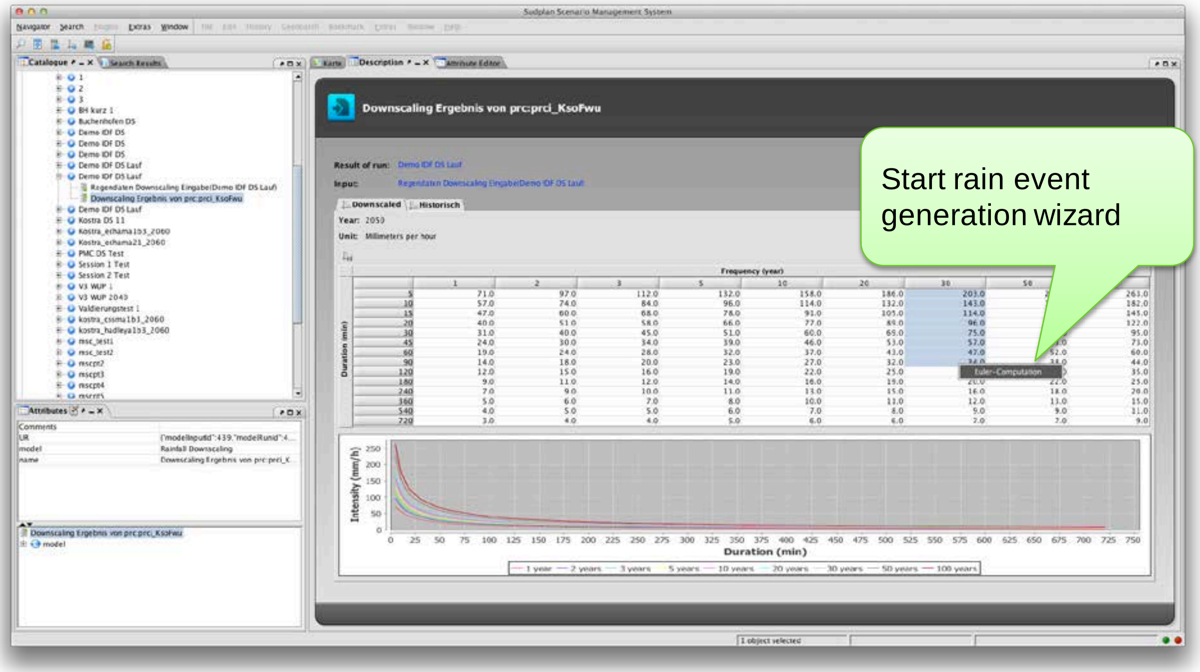

demoexport.csv
Currently Open Documents
Recent Documents

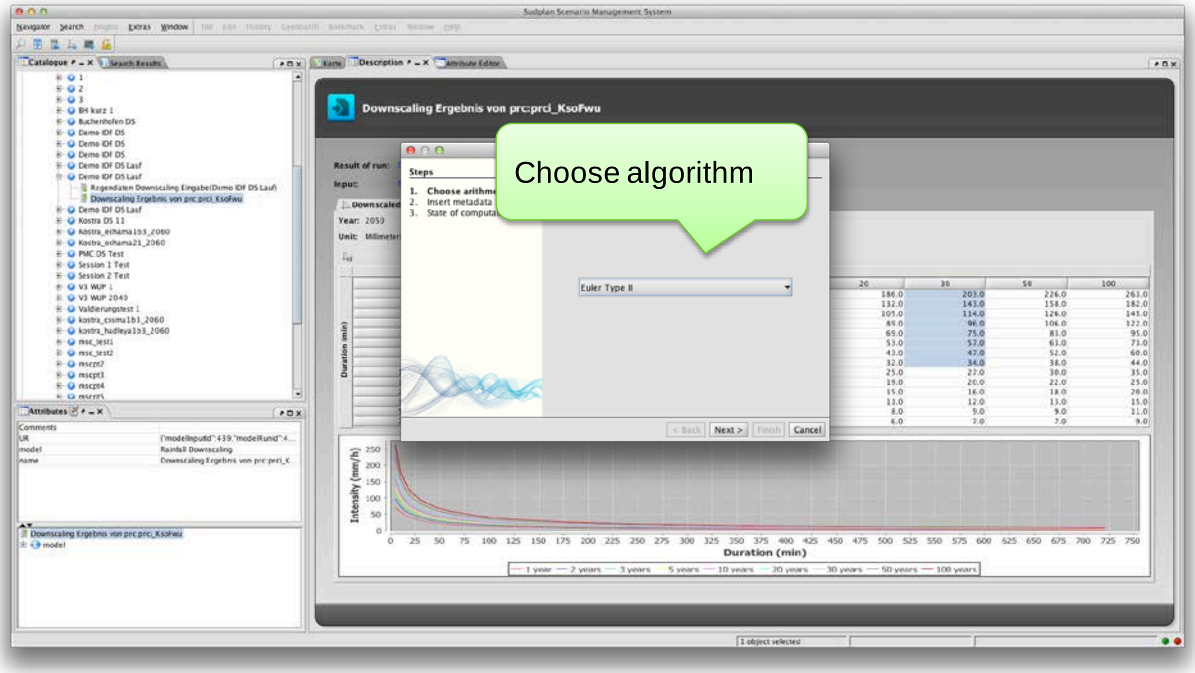
8.14. Rain event generation

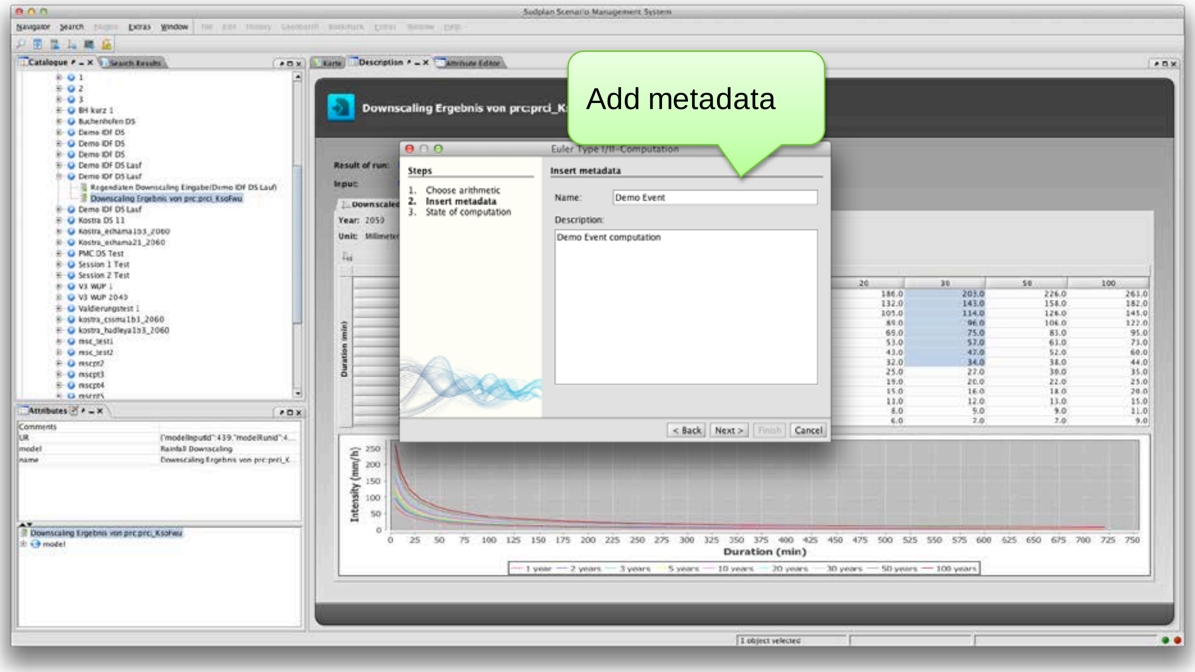
For a description of this validation scenario please refer to *4.2.15 - Rain event generation*.

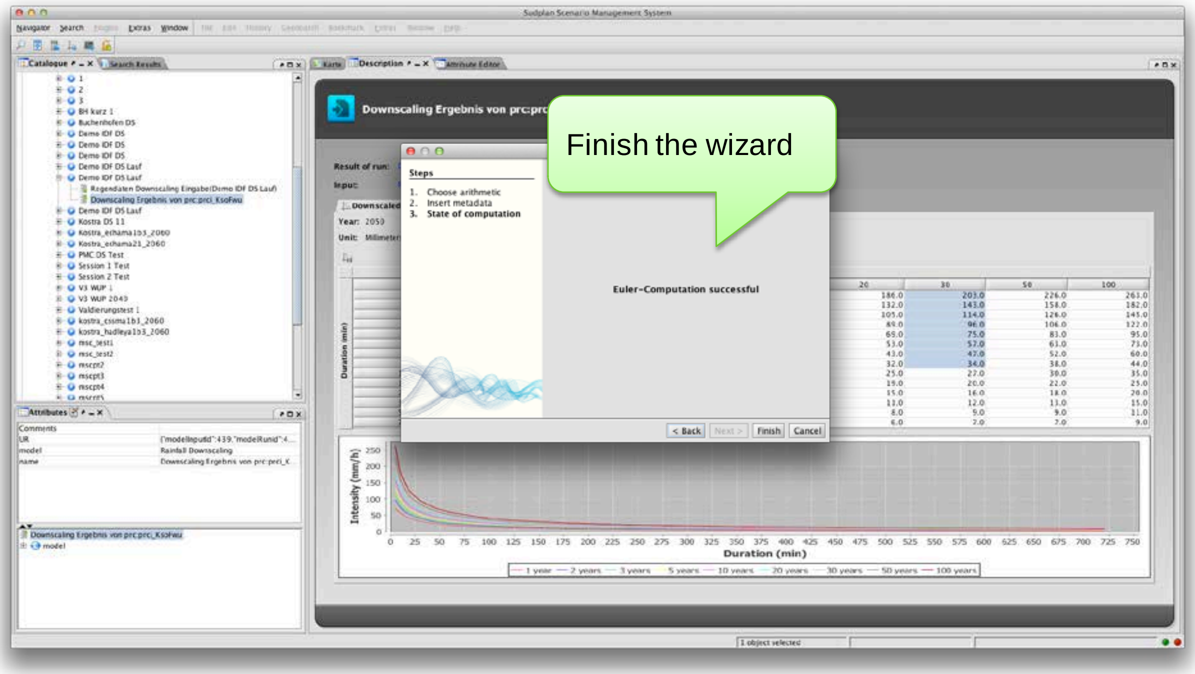


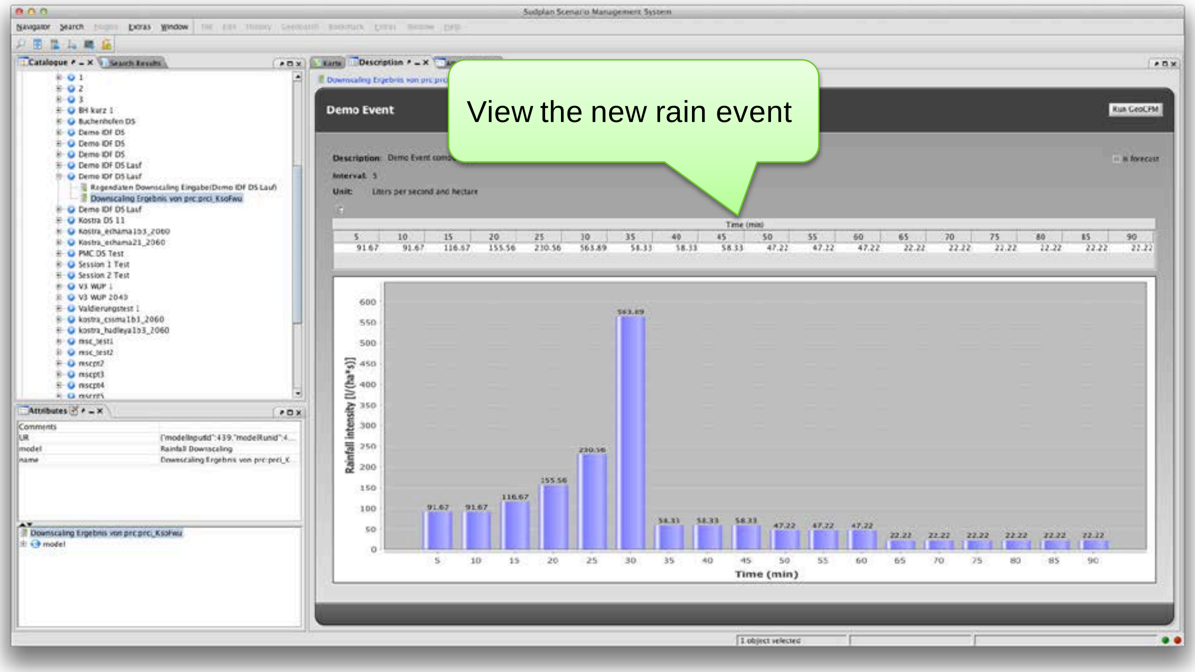



Sudplan Scenario Management System
Downscaling Ergebnis von prc:prci_KsoFwu
Start rain event generation wizard
Intensity (mm/h)
Duration (min)


Sudplan Scenario Management System
Downscaling Ergebnis von prc:prci_KsoFwu
Choose algorithm
Euler Type II
Intensity (mm/h)
Duration (min)


Add metadata
Insert metadata
Name:
Demo Event
Description:
Demo Event computation
Duration (min)


Finish the wizard
Euler-Computation successful
Duration (min)


View the new rain event
Demo Event
Time (min)