



EU-CIRCLE

A pan-European framework
for strengthening Critical
Infrastructure resilience to
climate change

D5.3 Integrated CIRP environment first release

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Statement

This document accompanies the first software release of the CIRP platform and presents the adopted system architecture and application capabilities from the user point of view. CIRP is a multi-user collaborative modelling environment where multiple scientific disciplines can work together to understand interdependencies, validate results, and present findings in a unified manner.

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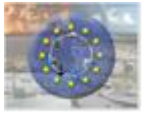
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**Abbreviations List**

Term	Description
CEF	Chameleon Enterprise Foundation
CIRP	Critical Infrastructure Resilience Platform
CI	Critical Infrastructure
CORDEX	Coordinated Regional Climate Downscaling Experiment
DEM	Digital Elevation Model
DoA	Description of Action
ECMWF	European Center for Medium range Weather Forecasting
ESGF	Earth System Grid Federation
GUI	Graphical User Interface
JEE	Java Enterprise Edition
OSGi	Open Services Gateway Initiative
PC	GEF Personal Computer
PCA	Principal Component Analysis
RCM	Reginal Climate Models
RCP	Rich Client Platform
RMI	Remote Method Invocation
SDK	Software Development Kit
UI	User Interface
UML	Unified Modeling Language
WebDAV	Web Distributed Authoring and Versioning
XML	Extensible Markup Language



Executive Summary

EU-CIRCLE's scope is to derive an innovative framework supporting resilience of the interconnected European Critical Infrastructure to climate pressures as the increasingly dependent, interdependent and interconnected nature of CI networks exposes previously unseen risks, new vulnerabilities, and opportunities for disruption of those networks.

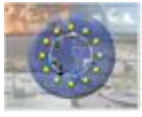
This document accompanies the first release of the Integrated CIRP environment that constitutes an innovative modular and expandable software platform that will assess potential impacts due to climate hazards. CIRP offers as an end-to-end collaborative modelling environment where new analyses can be added anywhere along the analysis workflow and where multiple scientific disciplines can work together to understand interdependencies, validate results, and present findings in a unified manner providing an efficient solution that integrates existing modelling tools and data into a holistic resilience model in a standardised fashion.

CIRP has it been engineered as a pluggable and extensible platform that will enable the Risk Management community to bring new data and modelling capabilities into practice. From the CIRP policy and decision maker perspective, the platform capabilities is offered as a toolbox that consists of a collection of diverse analyses of Risk and Resilience of Critical Infrastructures that are exposed to the direct and indirect effects of climate change.



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1 Introduction

This document accompanies D5.3, a deliverable of type “OTHER”, in this case the first software release of Critical Infrastructure Resilience. CIRP’s primary goal is to provide a multi-user web based software that will be able to analyse the CI’s vulnerabilities and impacts due to climate change in the form not only of physical damages but also service impacts, interdependencies, societal costs, environmental effects, and economic costs due to suspended activities.

The CIRP is intended to be a user-friendly environment that will provide its users with the ability to analyse what-if scenarios: leveraging model selection, climate data repositories and CI inventories in order to calculate impact for any kind of climate hazard and CI. In this way, users will be able to understand the impact of various adaptation strategies or quantify the potential impact of a catastrophic event on society.

The work package structure of EU-CIRCLE and especially the separation of Tasks in WP3, 4, 5 and 6 was based on the idea that risk model development and software development are two distinct activities and that the right approach for EU-CIRCLE is the one in which scientists and engineers develop the risk model (inputs, outputs, calibration, validation) and software developers work closely with this team to build efficient and user-friendly tools that are easily extended and adapted to suit a wide range of applications. In this respect the CIRP has been developed as an extensible platform that is able to accommodate different types of datasets (e.g. hazard, assets, interconnections, fragilities), file formats, and risk analysis algorithms and provide suitable user interface elements for scenario and data repository management, analysis workflows setup, and intuitive results visualisation and reporting.

The rest of the document is structured as follows: the methodological approach followed in order to build, test and validate CIRP is described in the following Section. Section 3 presents the CIRP System Overview and Section 4 the CIRP architecture. In Section 5, the Graphical User interface is presented and Section 6 describes in more detail the functionalities offered by the platform. Finally the future work is presented in Section 7.



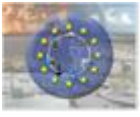
2 Methodology

The development of the CIRP platform (first release) was based on the requirements, design specifications and design strategies that are described in D5.1. The work has been conducted in the frame of Tasks 5.4, 5.6 and factors the outcomes of the various project meetings to date and DoA descriptions. CIRP during its development stages has been presented and interacted with EU-CIRCLE partners during the project meetings where comments and suggestions have been elaborated.

The development process was based on the Agile Software Methodology [1] as the work has been divided in iterations. Each iteration included the tasks necessary to release the mini-increment of new functionality: planning, requirements analysis, design, coding, testing, and documentation.

The CIRP integrated environment first release is based on the Consequence – based Risk Management (CRM) generic approach which has been selected and extensively described in D3.4 “D3.4 Holistic CI Climate Hazard Risk Assessment Framework”, Section 3.4. CRM has been used in climate/disaster risk reduction assessments allowing for the identification of uncertainty of climate risk modeling and quantify the risk to societal systems and functions. It also enables relevant stakeholders to develop risk reduction and adaptation strategies and implement mitigation actions.

.



3 System Overview

The Climate Infrastructure Resilience Platform (CIRP) is a multi-user simulation environment that offers a Climate Change Risk assessment analysis toolbox to CI policy-makers, decision makers, and scientists which allows them to utilise different and diverse modelling and risk assessment solutions, in a standardised and homogenised environment, to develop risk reduction strategies and implement mitigation actions that help minimise the impact of climate change on CIs.

Various risk assessment tools and platforms exist today that lack the flexibility to easily be extended with new analysis tools [2]. This is typically due to a combination of architectural approach and closed-source licensing policies. Such software does not allow the community to actively contribute new algorithms and capabilities and, therefore, allow the software to evolve with the advancements of science. Furthermore, software-licensing fees from proprietary vendors can make such packages unaffordable for many members of the community.

CIRP aims to cover this gap by offering an extensible platform assuring that the science and engineering principles behind the forecasting of damage probability of Critical Infrastructures (buildings, bridges, networks, pipelines, and other inventory items) from anticipated events is both pragmatic and state-of-the-art and therefore critical to minimising the impact of climate change events, reducing losses to economic resources, and the development of more stable communities.



4 Architecture

This section provides an updated (compared to D5.1) architectural overview of the developed CIRP platform (first release). CIRP has been developed as a fully modular, extensible, multi-user geospatial N-tier software system according to the design considerations and strategies presented in D5.1. It is an enterprise application compliant with the JEE specification that is based on a set of tools and components capable of providing the underlying building blocks for impact analysis arising from a dynamic climate risk approach to critical infrastructure.

The CIRP is accessible to end users either as a Client-Server installation or as a Web start-able rich client application. The first type of installation addresses the EU-CIRCLE scientific partners that will develop in the frame of Task 5.3 and in close collaboration with the software engineering partners, new dataset types and analysis plugins and thus need to have direct access to the client part SDK (set of plugins) of CIRP.

The second type of installation addresses the policy and decision makers and CI owners that need to access the system from a browser, operate in diverse locations, and receive automatic software updates as these become available from the consortium.

The CIRP server is based on the JEE specification while the CIRP client architecture is based on the Eclipse RCP technology and two related frameworks:

- The Satways Chameleon Enterprise Foundation
- The ERGO-Core [3] from the ERGO consortium

Each of the two core frameworks provides a set of discrete functionalities that may be exploited independently or in a collaborative manner. The ERGO-Core OSGi bundles provides the functionality related to inventory, data and metadata management, and the ability to wrap new analysis types and execute them on a workflow engine. The CEF framework provides the User Management & Roles and Access Rights modules, and the 3D GIS viewer and editor modules. Both frameworks are described in detail in D5.1.

The overall aim of CIRP is to provide a multi-user geospatial application that will:

- Support new types of infrastructures and links to societal functions;
- Support risk and resilience assessment models for multiple hazards;
- Support analysis and modeling of inter-dependent physical systems and non-technical systems that are essential for the recovery of a regional area (e.g. financial, social, healthcare, public safety, education etc.);
- Link to external software for climate hazards (e.g. flood, forest fire simulators) and infrastructure operation models, and
- Support the collaborative and interactive exchange of risk analysis information and related scenarios

The following UML Deployment Diagram (updated diagram compared to D5.1) shows the physical layout of the various hardware components (nodes) of the CIRP system as well as the distribution of executable environments and software components on that hardware. The diagram depicts the actual devices (workstations, servers), along with the inter-connections, and provides an effective system topology. In that topology, as illustrated below, the location of executable components and objects illustrates where the software units are deployed and executed.

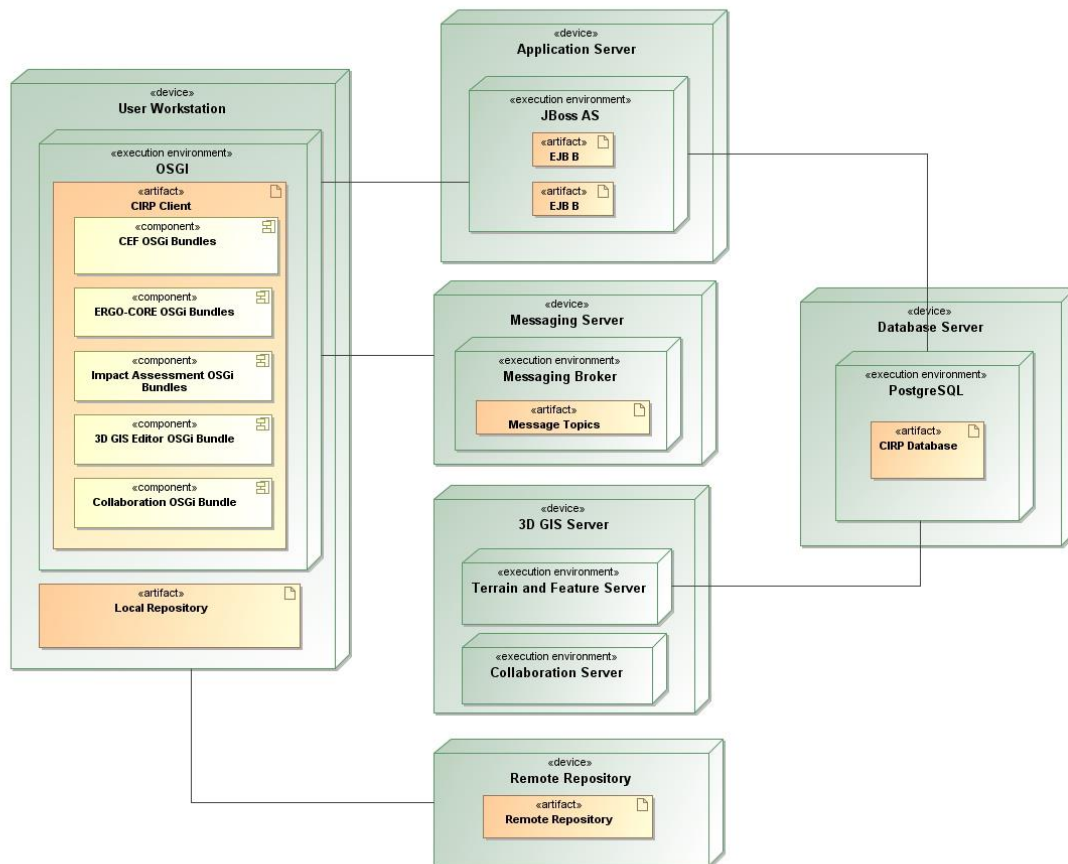


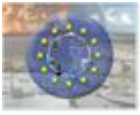
Figure 1: UML deployment diagram of the CIRP software system

The deployment diagram illustrates:

- The Application Server:
 - The core of the system running all server side Business Logic. The JBoss Application Server is the chosen execution environment. It stands between workstations and the Database, handling requests and storing and retrieving data and performing all necessary validations and actions. Communication with the Operator Workstations uses Enterprise Java Beans remote method invocations (RMI) technology.
- The Messaging Server:
 - Hosts the Message Broker that enables Event Driven based object exchanges.
- The Database Server:
 - Stores all configuration and runtime data for the system. PostgreSQL is the chosen Relational Database System. This is extended with PostGIS to support geographical data structures and spatial queries.
- The 3D GIS Server: It consists of three different services:
 - The terrain service streams 3D terrain databases
 - The feature service streams vector datasets
 - The Collaboration service allows multi-user collaborative sessions.



- The User Workstation:
 - The host device for the CIRP software. The latter will be a multi-screen Rich Internet Application. The currently supported workstation operating system is Microsoft Windows (XP, Vista, 7, 8, 10) while the RIA runs on top of the Java and OSGi [4] framework, which allows the application to be fast, efficient, extensible, scalable and adaptable to the user needs.



5 The CIRP Graphical User Interface

One of the main design goals was to have a user interface for both the CIRP operator and system administrator as friendly and customizable as possible. CIRP's UI consists of one or more (in the case of using multiple workstation monitors) main application windows. Each window includes a menu, toolbars (top, left, right and below), the perspective area and the main toolbar where the users will be able to navigate between the different perspectives. A perspective groups a number of views and supporting widgets and menus as well as shortcuts to relevant content creation wizards, other related views, and other related perspectives.

The graphical interface is quite rich using tables, lists, drop-down lists, links, buttons, features drag-n-drop capabilities, etc. The GUI has been designed to ease the required user actions and options for processing an operation. This is accomplished by:

- Auto-save functions when entering data or changing scenario contents
- Drag-n-drop features (e.g. raster and vector data to a Map)
- Appropriate design of forms and wizards

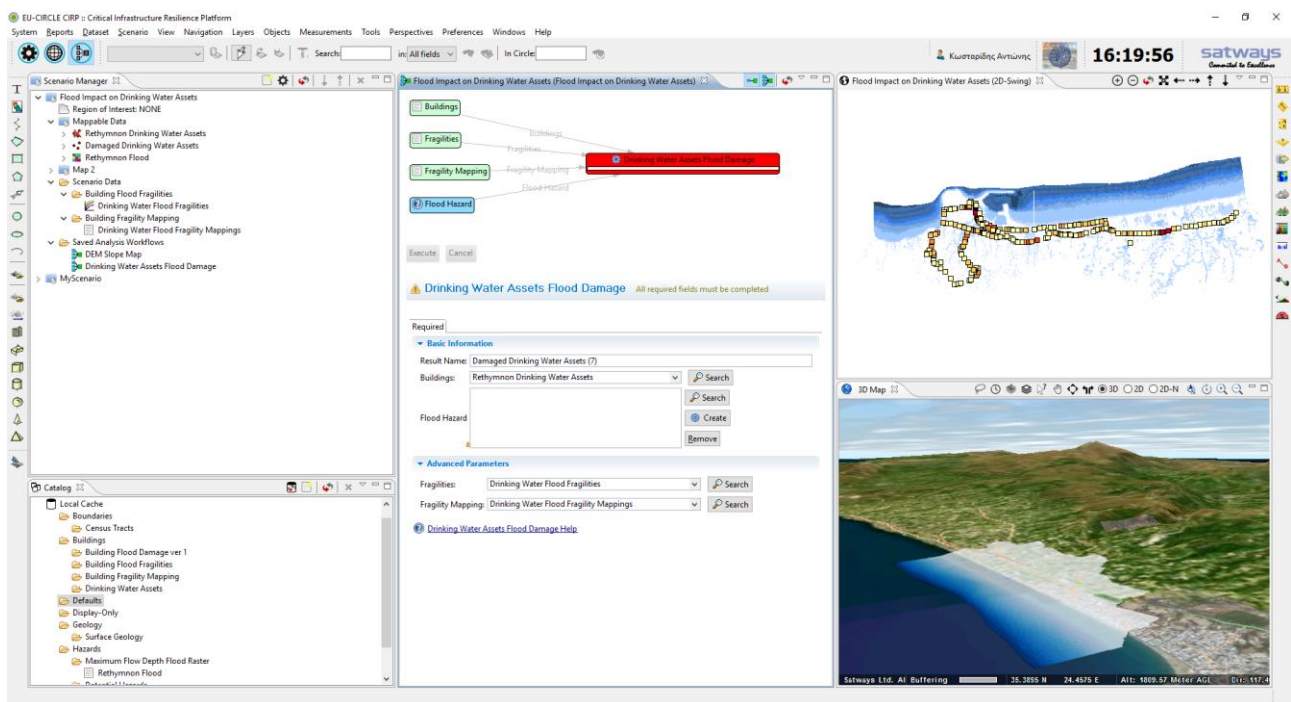


Figure 2: The CIRP Workbench System

The application defines the following window areas:

- Main menu: includes all application menus depending on the modules/plugins that are loaded
- Main toolbars area: includes window selection toolbar and toolbars contributed by other plugins
- Left toolbars area: includes toolbars that contributed by plugins and any minimized Views
- Right toolbars area: includes toolbars contributed by plugins and any minimized Views

- Status area: information and alerts (Status Region). Includes toolbars contributed by plugins and any minimized Views
- Perspective Area: includes the perspective views according to the perspective layout

User preferences are stored in the CIRP database and the GUI has been built to support multiple languages.

5.1 Perspectives and Views

CIRP software's environment provides the ability to switch between the groups of views of the Graphical User Interface (GUI) via the different perspectives. Switching is accomplished in the following two ways:

- Via the main toolbar of the application. Each user depending on their role will have access to one or more perspectives from which they access the application's functionalities.



Figure 3: Toolbar for perspective selection

- By pressing the Control-Tab the quick launcher popup window appears that allows the selection of a particular window



Figure 4: Quick launcher popup

A perspective comprises of one or more views. A view can be maximized occupying all available space of the perspective area, can be completely closed, can be minimized or detached from the perspective window as an independent view (the user has to drag the view outside of the window area).

In case of minimization of a view, it becomes a button in one of the sidebar tools or even in toolbars in the bottom of each window (status region) as shown in the following Figure.



Figure 5: Buttons of Minimized Views

A perspective when activated may contribute controls (buttons, combo boxes, check boxes) to main toolbar or to the left and right sidebar areas. As an example the 3D Map Editor perspective of CIRP provides a set of controls for editing shapefiles in the main toolbar.



Figure 6: 3D Map Editor toolbar

A View may also provide a number of functions through the view toolbar. The View toolbar is located at the top right part of the View area. This provides easier access to functions and provides users with a better understanding of the use of tools after the allocation is done on each View individually.

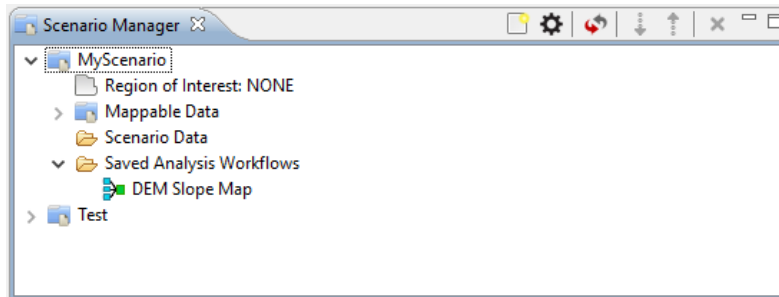


Figure 7: Additional controls on a View

5.2 Common UI elements

Some general GUI elements will be discussed in the following sections that appear often in various views.

5.2.1 Tooltips

Tooltips are evident in most fields providing the user the extra help in understanding the data displayed or providing a tip as to the nature of data input required.

5.2.2 Table Views




The most common way of presenting a list of data in the system is via tables. The tables used generally follow similar logic, but differ greatly in content.

MultiLineString	ID	ID2	USERID	FNODE	TNODE	LENGTH	WIDTH	LANES...	LANES_TF	LAT
	1153086	87802	28951	776709	788946	444	0	1.50	1.50	0
	1153085	540472	28950	788946	788945	72	0	1.50	1.50	0
	1153084	615722	28949	788945	788942	66	0	1.50	1.50	0
	1153083	713561	28948	788942	788936	458	0	1.50	1.50	0
	1153082	164525	28947	788936	788934	138	0	1.50	1.50	0
	1153081	903698	28946	788934	788929	229	0	1.50	1.50	0
	1153080	704038	28945	788929	706805	505	0	1.50	1.50	0
	1151347	1316422	27212	432321	782330	44	0	1.50	1.50	0
	1151346	1316421	27211	782330	782329	111	0	1.50	1.50	0
	1151345	10945	27210	782329	109490	214	0	1.50	1.50	0
	1151344	1316420	27209	782327	782328	1219	0	1.50	1.50	0
	1151343	23090	27208	782328	392401	2677	0	1.50	1.50	0
	1151342	1316419	27207	333929	782327	251	0	1.50	1.50	0
	1151341	1316418	27206	782326	333929	169	0	1.50	1.50	0
	1151340	782387	27205	775843	782326	178	0	1.50	1.50	0

Figure 8: Example table depicting the attributes of a shapefile dataset

The following are common features found in a tables View:

- **Sorting:** user can sort the list based on which column values they wish. This is done by clicking the title (header) of the corresponding column. In each table the corresponding column will be sorted alphabetically (if it contains numbers based on their values) in ascending order and the sorting criterion, it will reorganize the entire table. From this point, onwards every click on the name of the column will change the order of the sort from ascending to descending and vice versa
- **Resizing columns:** Through a rolling bar, users determine the size of table columns. The result of this action appears directly in the panel.

- **Export or Publish selected rows** : The user is able to select multiple rows of a table and export the dataset filtered with only these rows.
- **Select row by filter** : displays a wizard that enables the filtering of table rows based on user selected statements that include a table attribute (columns) and a list of predefined operators (e.g. equals, greater, than etc.).
- **Configure Table View** : display a wizard from which columns can be removed and re-ordered.
- **Statistics** Σ : displays a dialog that provides statistics for any selected attribute (column) in terms of maximum, mean, minimum, standard deviation values and a bar chart with the frequencies.

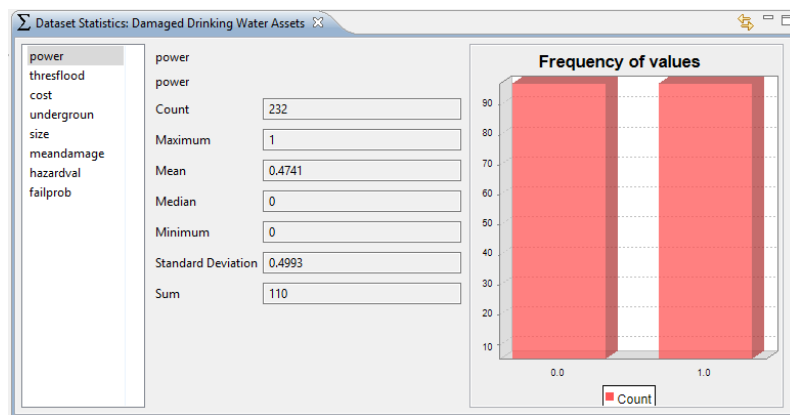

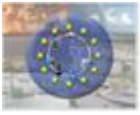


Figure 9: Statistics window of a Drinking water assets dataset

- **Copy selected cells** : copies the selected cells to the clipboard



6 CIRP Functionalities

6.1 Launching CIRP

CIRP can be launched via the executable (when deployed as client server) or a link to a Web Browser (in Web Start mode). After some seconds the following splash screen appears that requests from the user to provide the login credentials.



Figure 10: CIRP Splash screen

Upon providing the credentials and pressing the “Connect” button the user authentication and authorization takes place. The authorization refers to the Perspectives and Views that the user is able to access and any actions that is able to perform according to the appointed user role as defined by the System administrator.

The following sections presents the main Views and functionalities of the CIRP platform (first release).






6.2 The Impact Analysis Perspective


6.2.1 The Scenario Manager View

The Scenarios View shows each scenario a user is working with. A scenario is a user defined case that consists of one or more selected analysis tools from the toolbox and the associated datasets (input and output). Each scenario can be expanded to show its contents (see Figure 11).

The user defined Scenarios within CIRP provide the software basis for the baseline scenarios defined within D3.4, being the software) that will estimate the damages (and impacts) from climate hazards and their impacts on the CI operation. CIRP scenarios can be defined and implemented in sequential and/or in parallel way so that when defined together meaningful output are obtained from CIRP supporting policy questions and climate base scenarios.

Right-clicking the entries within the Scenario view the user can perform the following actions on them:

-  Creates a new scenario
-  Runs an analysis on your scenario
-  Refreshes the view
-  Moves the selected map layer down
-  Moves the selected map layer up

-  Removes the selected item. If the selected item is a dataset, removes it from the scenario. If the selected item is a scenario, deletes the scenario

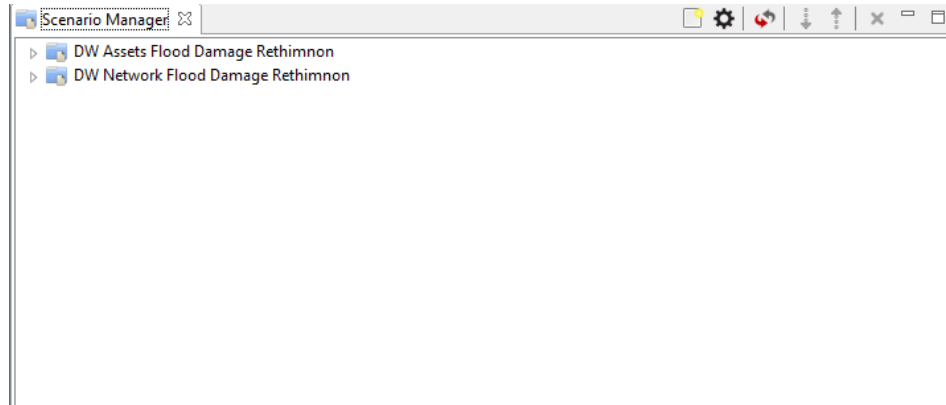







Figure 11: The Scenario Manager View with two loaded scenarios

By unfolding a scenario the following items are exposed:

- **Region of interest item:** depicts an optionally defined geographical region for the scenario
- **Mappable Data folder:** contains a list with the loaded raster and vector datasets. The following icons denote the dataset type:
 -  point vector layer
 -  polyline layer
 -  polygon layer
 -  raster or grid layer
- **Scenario Data folder:** contains non mappable data like fragilities and fragility mapping XML documents. Fragility datasets [5-7] appear with the  icon.
- **Saved Analysis Workflows:** contains a list of the analysis loaded into the scenario.

The following Figure depicts an example Scenario contents.

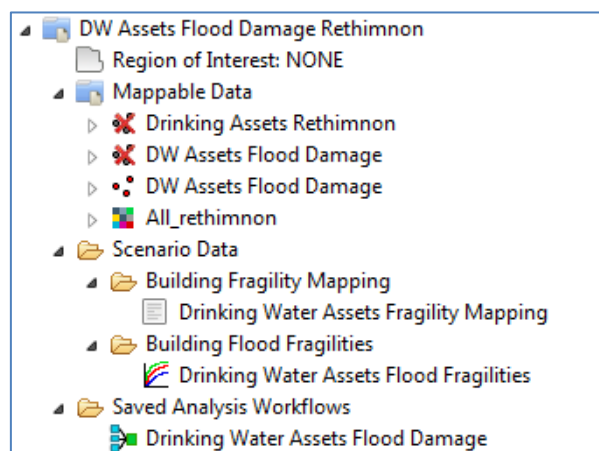


Figure 12: Sample Impact analysis scenario

Depending on the nature of a scenario item different options are provided via a mouse right click popup menu.

6.2.2 Actions on a Dataset

Right clicking a dataset item depicts the popup menu of Figure 17. It provides the following actions:

- **Compare with:** can compare the dataset with another selected from the popup wizard.

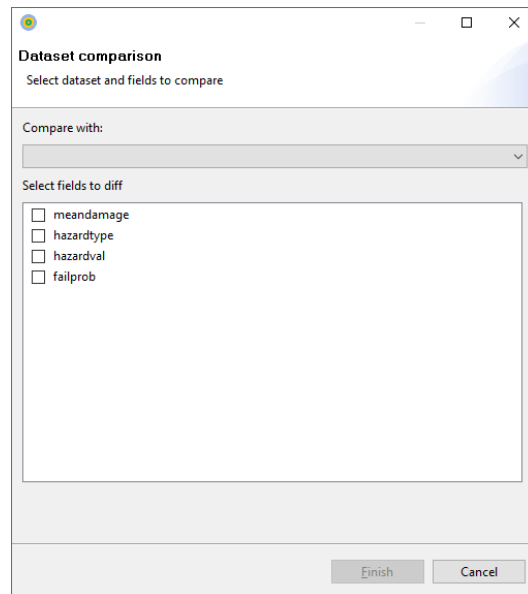


Figure 13: Dataset comparison wizard

- **Show Attribute Table:** depicts a Table View with the dataset attributes. The actions described in Section 5.2.2 are applicable in this View.
- **Properties:** depicts the Dataset properties View enlisting the repository, data type, data provenance and metadata (see Figure below):

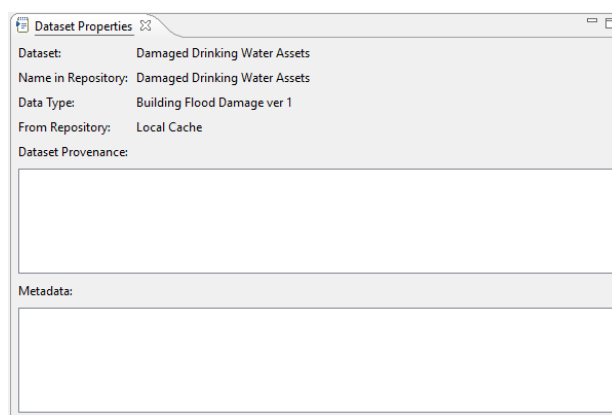


Figure 14: The Dataset Properties View for a sample dataset

- **Show Chart [8]:** depicts a wizard in order to select the fields to plot a chart for different aggregation types (mean, sum and count). This action is only valid for Feature datasets (not raster ones)

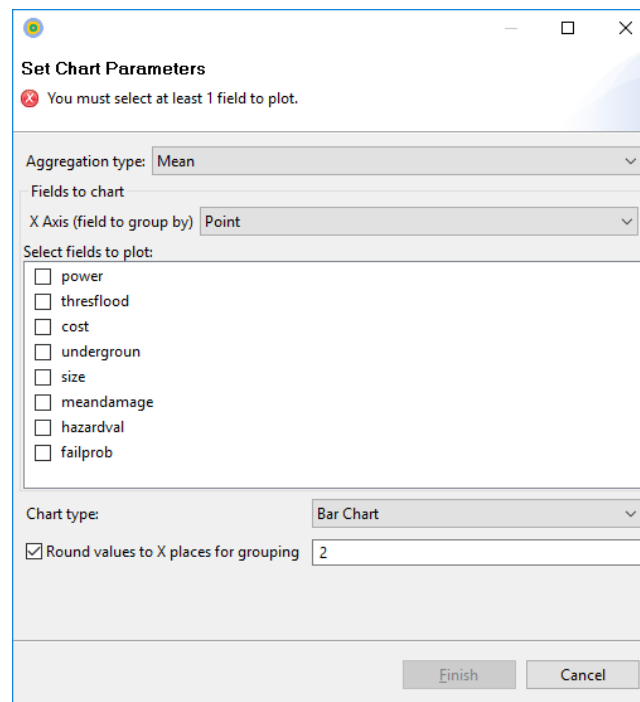


Figure 15: The Chart definition wizard for a selected dataset

- **Reports** – reserved for future release
- **Zoom to Layer:** zoom the map to the bounding box / envelope of the dataset
- **Toggle Visibility:** hides and shows the layer from the map
- **Import Style:** allows the selection of a style from the file system
- **Change Layer Style:** shows the Style Editor View (see section 6.2.7) which allows the modification of the layer appearance on the map.
- **Rename:** allows inline editing of the dataset name in the scenario tree
- **Copy & Paste:** allows copy and paste functionality
- **Delete:** deletes the dataset from the scenario tree
- **Export Dataset:** allows dataset export (as a copy) to a user selected location
- **Publish Dataset:** allows ingesting a dataset to a cache (local or remote). See section 6.2.5.
- **Filter by Region:** if a region of interest has been selected during scenario setup the this action allows geographic filtering of the dataset contents according to the ROI.
- **Clear Filter:** clears an applied filter
- **Filter:** shows a dialog where Boolean algebra filters can be applied on the dataset.

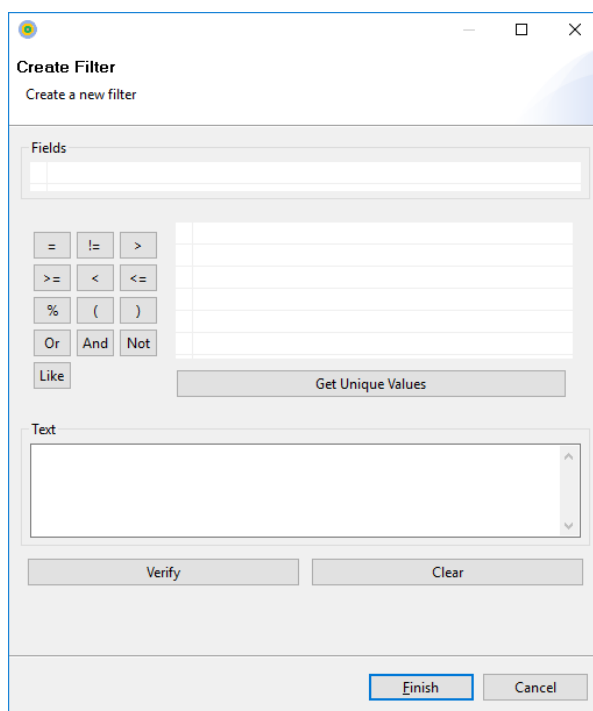


Figure 16: Boolean algebra filter dialog

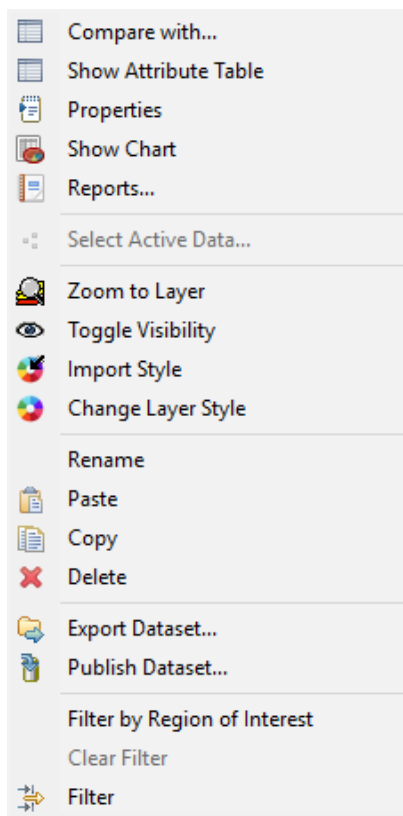



Figure 17: The available actions in the popup menu for a selected dataset

6.2.3 Executing an Analysis

A primary objective for the CIRP is that it be engineered as a pluggable and extensible platform that will enable the Risk Management community to bring new data and modelling capabilities into practice. From the CIRP policy and decision maker perspective, the platform capabilities will be offered as a toolbox that consists of a collection of diverse analyses of Risk and Resilience of Critical Infrastructures that are exposed to the direct and indirect effects of climate change.

In order to run an analysis the user should press the “Execute Analysis” button . Then a wizard is displayed that requests the selection of the scenario from a combo box (if a scenario is not yet selected in the Scenario Manager View).

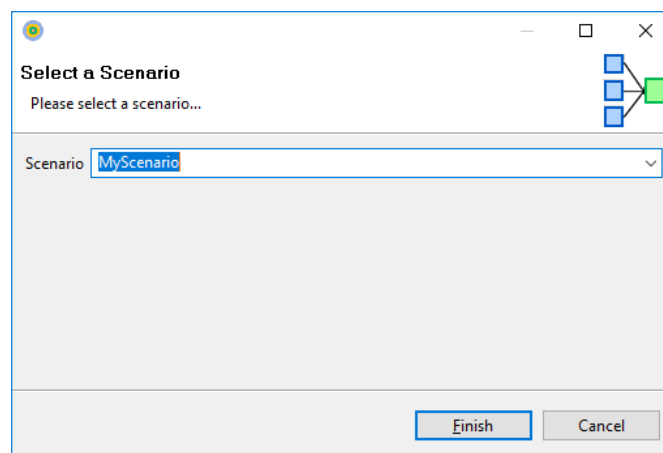


Figure 18: New scenario wizard

Upon pressing “Finish” button the analysis selection wizard appears enlisting the different analysis loaded into the system (as separated OSGi plugins) in a hierarchical manner according the category that each analysis belongs to. The following analysis categories are currently supported:

- **Building**
 - Drinking Water Assets Flood Damage Analysis
- **Climate Data:** Placeholder category for future climate data analyses
- **CI Networks**
 - Drinking Water Network Flood impact analysis
- **Decision Support:** Placeholder category for future decision support analyses.
- **GIS**
 - Aggregate features to regions
 - Append Feature Datasets
 - DEM Slope Map
 - Feature comparison
 - Join Datasets
 - Overlay Intersection
- **Hazard:** Placeholder category for future hazard analyses

- **CI Networks**
 - Drinking water network flood damage analysis
- **Socioeconomic:** Placeholder category for future hazard analyses
- **Validation**
 - Fragility mapping test analysis

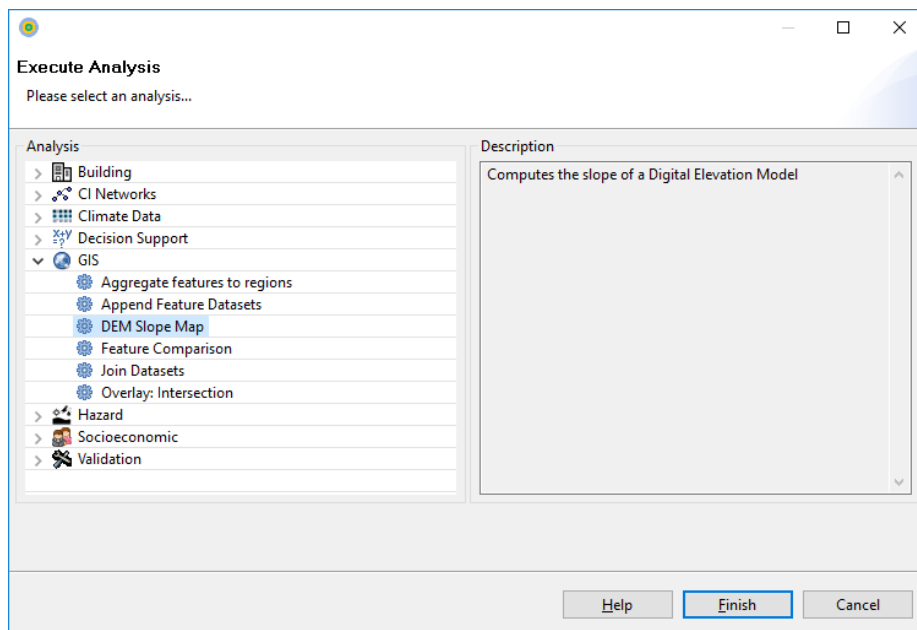


Figure 19: The available analyses categories

6.2.4 The Analysis View

An analysis View is launched upon double clicking a Saved Analysis workflow from the Scenario Manager or upon selection of an analysis from the “Execute Analysis” wizard. The view contains two parts:

- On the top the graphical part of the analysis workflow is presented
 - Light blue or green boxes denote an input node
 - Red or Green boxes denote an analysis node
- The node details part on the bottom which upon selection of a node (input or analysis) depicts widget controls that:
 - Enable the selection of a dataset (in the case of input nodes)
 - Enable the selection of all the required and optional inputs (in the case of an analysis node).

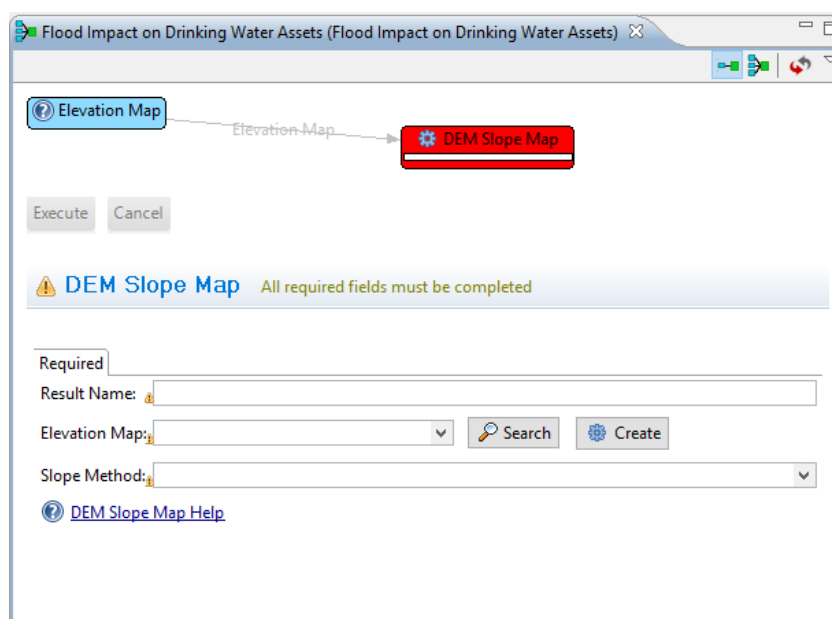


Figure 20: Example of an analysis View with only basic input fields

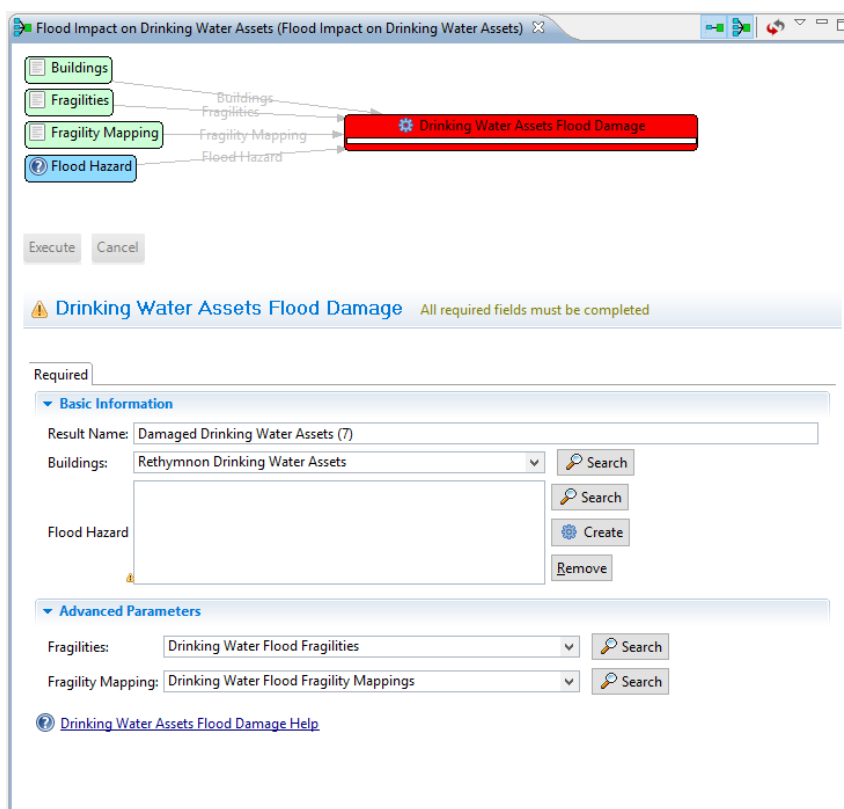


Figure 21: An analysis View with basic and advanced input parameters

In order to execute an analysis all the required fields must be filled by the user. A field may require the typing of a name (e.g. result name) or the selection of a dataset from the local or remote cache (see next section). Upon input completion the workflow nodes changes color as following:

- The light blue input node become light green
- The red analysis node becomes green.

In this state the “Execute” button is enabled.

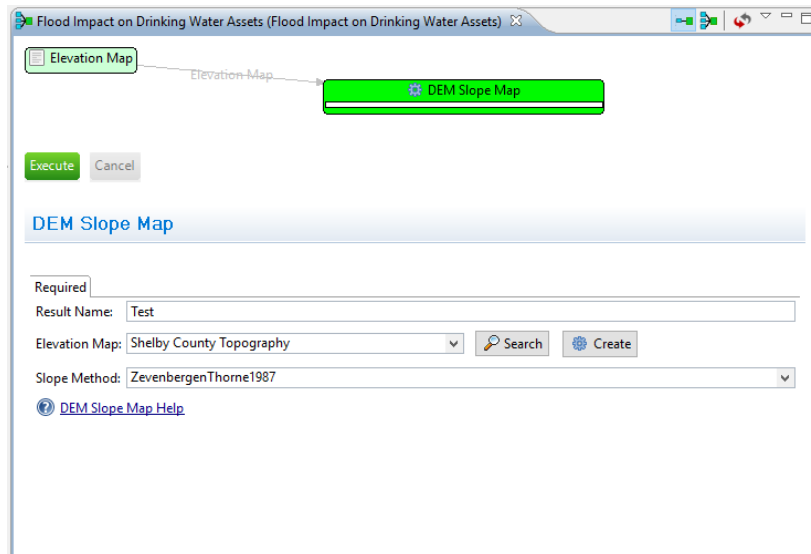


Figure 22: Analysis ready to be executed

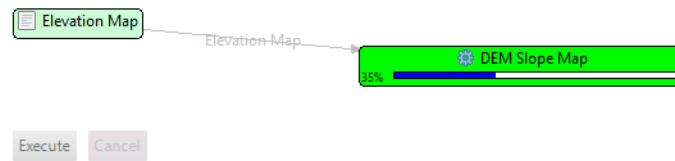


Figure 23: Progress indicator during analysis execution

6.2.5 The Catalog View

The Catalog View provides access to the local and remote file caches. A cache is a location where CIRP looks for and stores all of the data that it uses and produces.

A cache can be located locally, as a file on the local machine drive, or be remote. By default, CIRP creates a local cache on the user's system, where any remote data that is accessed is cached for local use.







Figure 24: The Catalog View

The local cache consists of folders on the local machine's drive, which are formatted in a specific format so that CIRP recognizes and knows how to read/write them. A user can create a new local cache by using the File -> New -> Repository menu and respective wizard.

To share or publish data to other CIRP users, a Remote cache is used. The remote cache is actually a WebDAV server.

The Catalog View provides a toolbar with the following options:

- **Synchronize** : synchronizes a cache with a remote cache
- **Create new repository** : shows the cache wizard dialog
- **Refresh** : refreshes a cache
- **Delete** : deletes a selected cache

When selecting a dataset of a cache (local or remote) the following options via right mouse click:

- **Load Dataset:** loads a dataset into a selected scenario
- **Delete from Repository** (only available for local repositories): deletes the dataset from the local cache
- **Export Dataset:** shows a wizard that allows copying the dataset to a local file path
- **Publish Dataset:** copies the dataset to another cache
- **View Dataset Location:** show the absolute file path of the dataset

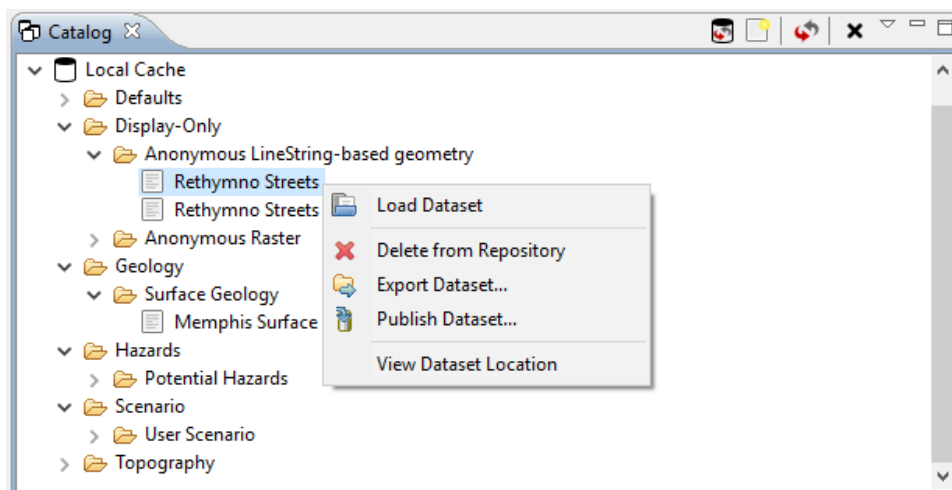


Figure 25: Available options for cache datasets

It must be noted that if the dataset belongs to a remote cache, then the Load Dataset option first downloads the dataset it into the local cache and then it loads it into the selected scenario.

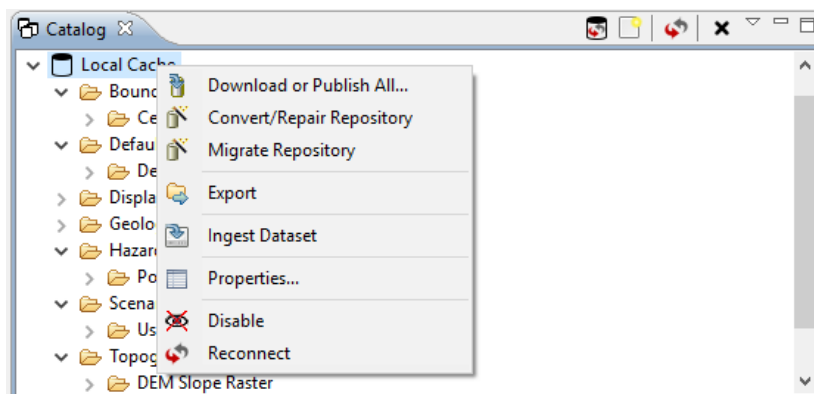


Figure 26: The popup menu of a cache / repository



In order to load a dataset into the local or remote cache the user must select the “Ingest Dataset” of the right click popup menu of a given selected cache. The user must select the appropriate file type from the list of predefined types. The following types are supported in the release:

- Fragility
- Animated Raster
- Network
- Table
- Shapefile [9]
- Raster
- Hazard
- Mapping
- CollectionShapefile
- Text Files

6.2.6 The 2D Map View

The 2D Map View of CIRP allows the visualization of raster and vector datasets in a layered approach and according to the defined styles [10] applied via the Style Editor View. The underlying map engine is based on the Geotools [11], [12] open source library. The 2D Map View provides the following actions on its toolbar:

- Zoom in
- Zoom out
- Refresh
- Zoom Extent
- Pan left, right, top, down

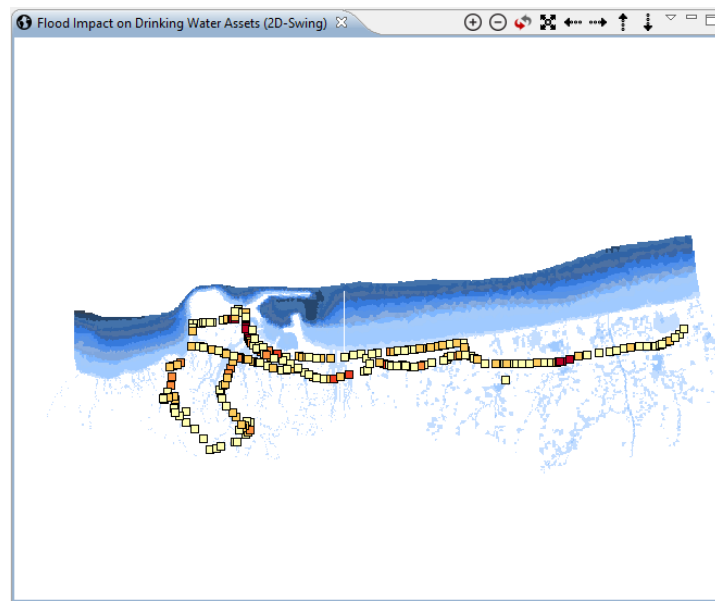


Figure 27: The 2D Map View with sample layers from a flood scenario

It must be noted that a 2D Map View can be opened multiple times in the same perspective window.

6.2.7 The Style Editor View

The Style Editor View provides the tools that allow the definition and application for Vector and raster datasets. The following styles are currently supported:

- Simple Style
- Ranged Style
- Unique Style
- Raster Style (applicable only on Raster Datasets)

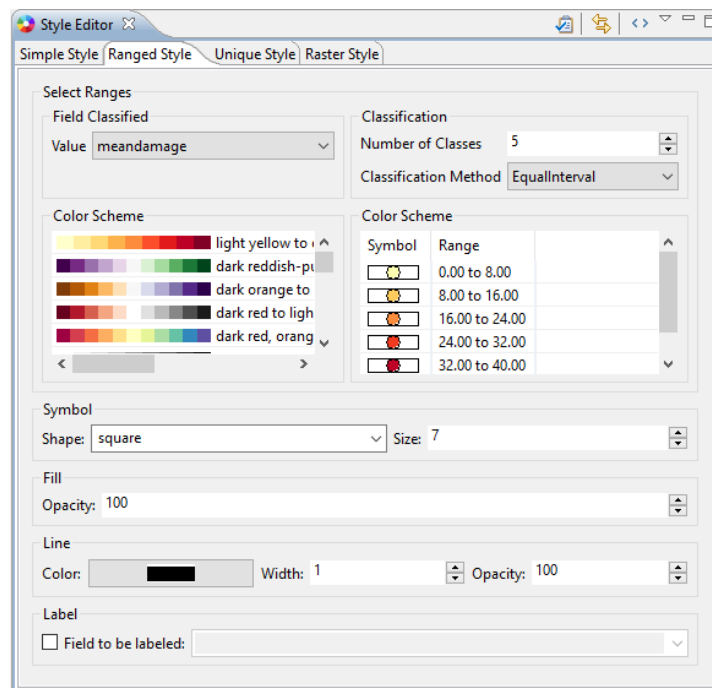


Figure 28: The Style Editor View

6.3 The 3D Map Perspective

The 3D Map Editor Perspective contains the following Views and toolbars:

- The 3D Map View
- The 3D Information Tree View
- The 3D Map Editor toolbar (in the main toolbar area)
- The Collaboration View
- The measurement and object toolbars

The following sections present the functionalities offered by each of the Views and toolbar associated actions.

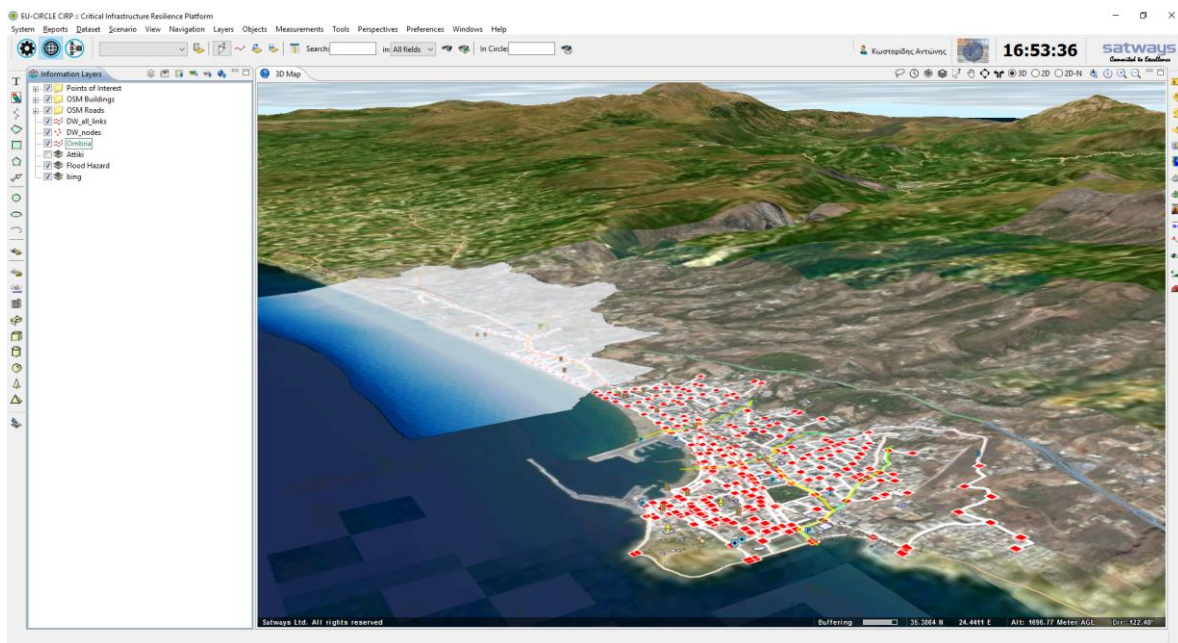


Figure 29: The 3D GIS perspective

6.3.1 The 3D MapView

The 3D view is created by fusing aerial and satellite photography, terrain elevation data and other 3D and 2D information sources including geospatial dataset layers.

It provides a set of advanced tools for processing, analysis and annotation of photo-realistic, interactive and three-dimensional landscapes. The user can import vector layers, images and elevation data from a variety of sources, add information on various landmarks such as image or text labels, buildings, cloud-point models, two-dimensional and three-dimensional entities and default routes from GIS files and databases.

A basic difference from the 2D Map is the fact that feature and imagery layers can be streamed from the 3D GIS servers and that the underlying map engine (TerraExplorer [13]) is using Graphics Card acceleration (DirectX) providing maximum performance. In addition feature layers (e.g. shapefiles) can also be streamed from the local cache repository (loading only features of the 3D viewport).

The 3D GIS module can process different coordinate systems as well as a wide variety of vector formats. This makes it easy for any user to display different kind of data from disparate sources. There are various tools available within the environment such as horizontal and vertical measuring, 2D/3D object creation, line of sight analysis etc.

6.3.2 The 3D Information Tree View





The 3D Information Tree View provides the tools that control the appearance of information in the 3D Map View. The information elements can be arranged in groups, according to function, type of information, or location. The appearance and styling of each object or layer can be changed via the Properties dialog (available as option from the right click pop-up menu). The View toolbar provides the following capabilities:

- Load a Feature Layer
- Load an Imagery Layer
- Load an Elevation layer
- Load a KML file

6.3.3 Editing Feature Layers

CIRP users will frequently want to assess the climate risk and related hazards to the critical infrastructure assets and networks. In this sense and in order to assess the risk for different asset and network configurations the Editing Feature toolbar provides a set of tools for editing (or creating new) vector datasets (e.g. shapefiles) that reside in the local cache.

The feature editing toolbar is enabled when a shapefile layer is selected from the 3D Information tree View. The toolbar provides the following widgets:

- A combo box for feature layer selection
- A properties button 
- The select feature toggle button 
- The add feature button (icons depending on the type of selected dataset e.g. point, polyline or polygon)
- The refresh layer button 
- The save layer button 

In order to edit an existing dataset feature the user must click on the “select feature” button and select via mouse left click a feature on the 3D map. Upon click the Feature Attributes window appears that contains a toolbar (similar to the editing toolbar), the geometry details and the attribute values of the selected feature. The position and layer attribute tables are editable (inline). If the user changes any of the values then the layer becomes dirty and is marked with an asterisk in the 3D Information tree. By pressing the Save Layer button the change is persisted in the original layer dataset.

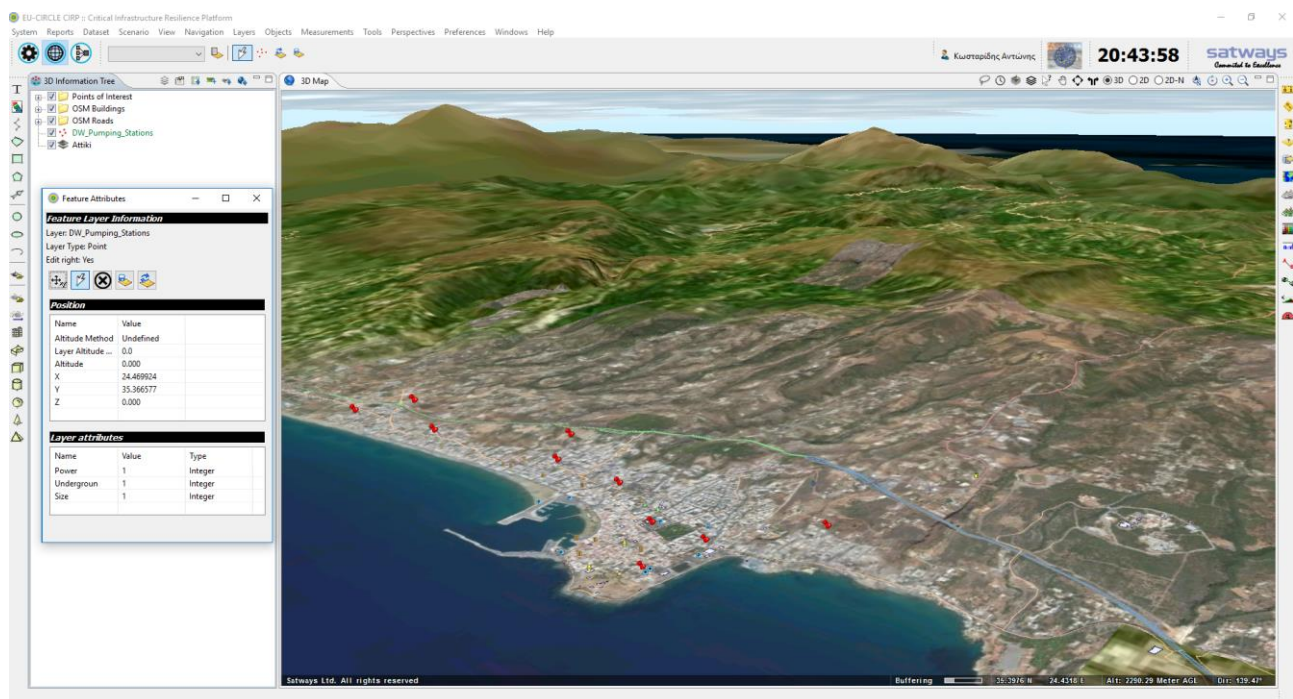
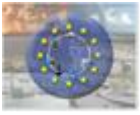


Figure 30: Editing a feature dataset



6.3.4 The Collaboration View

The Collaboration View connects CIRP users on one collaborative sessions. In these sessions users can chat, annotate the 3D terrain with text labels and freehand drawing, point using a virtual cursor and synchronize their flight. One user serves as the manager of the session, while the rest connect to the session as clients.

To join or open a Collaboration session: On the Tools menu, click Collaboration. The Collaboration View opens.

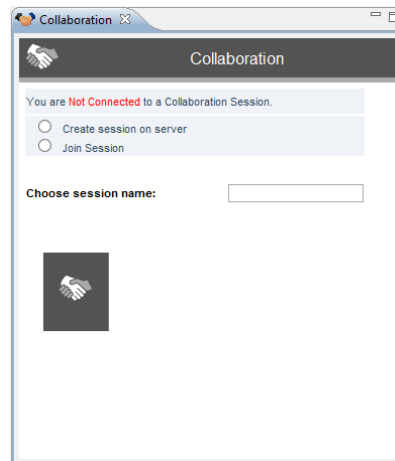


Figure 31: The Collaboration View initial contents

The Manager of the session is the only participant that has permission to give the leadership of the session to another user. The Leader of the session is the user that sets the location of the camera by navigating freely in the 3D Map and all other users can attach to this point of view. The Participants list displays all connected users to the session. If the session manager wants to appoint another participant leader, select the required name in the list, and click Set as Leader.

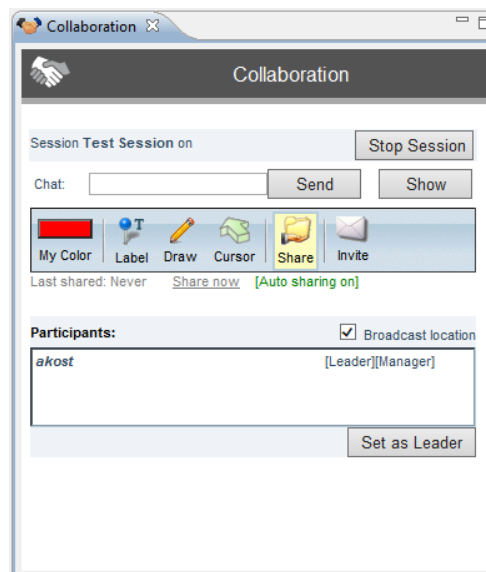
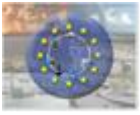


Figure 32: The collaboration session toolbox

To type a chat message:

- In the Collaboration dialog box, in the Chat field, type the message text.



- Click Send to send this chat message to all other participants in the session. The text appears in the Chat box preceded by the name of the sender.
- If the message box is not displayed, click the Show button to display it.

User may use a virtual cursor to point to an area on the 3D Window. The cursor, which is available in different colors, is visible to all the participants in the session.

To use the virtual cursor:

- In the Collaboration tool box, click the Virtual Cursor button.
- Click the Color button to set the virtual cursor's color and select a color from the color palette.
- Click and hold the mouse button to display the Virtual Cursor.
- Right-click to finish the operation.

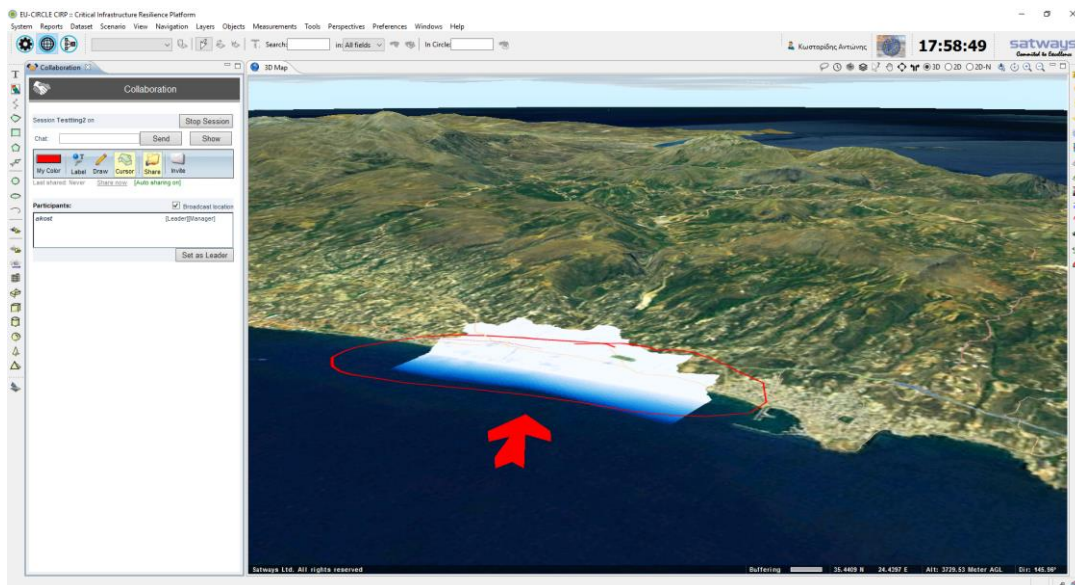


Figure 33: Collaboration session user defined map annotation symbols

User can draw freehand in the 3D Window. User drawings are visible to all participants in the session.

To draw freehand:

- In the Collaboration tool box, click the Draw button.
- Click the Color button to set the drawing tool's color and select a color from the color palette.
- Click and hold the mouse button to draw.
- Right-click to finish the operation.

To add a text label:

- In the Collaboration tool box, click the Add Text Label button. The Text Label field is displayed in the lower half of the dialog box.
- In the Text Label field, type a text string.
- Click the My Color button to set the color of the text, and select a color from the color palette.
- In the 3D Window, click the terrain location where you want to insert the text label. The label is displayed in the 3D Window at the same location, for all other participants of the session.

6.4 The Administrator Perspective

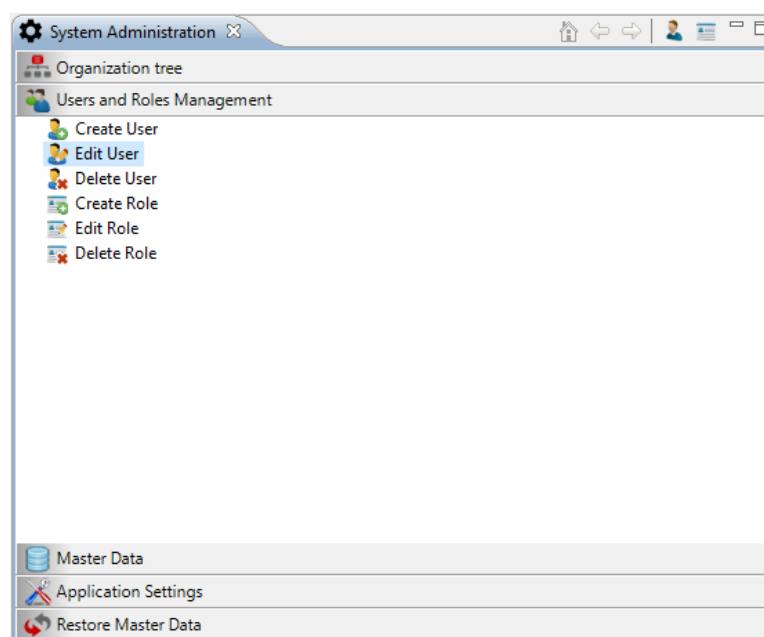
The administrator view provides the CIRP administration tools for User, Role and Access Rights management. Users are organized into organizations. Access in the administrator perspective is provided only to the system administrators.

It consists of three main Views:

- System administration View
- Users View

6.4.1 The System Administration View

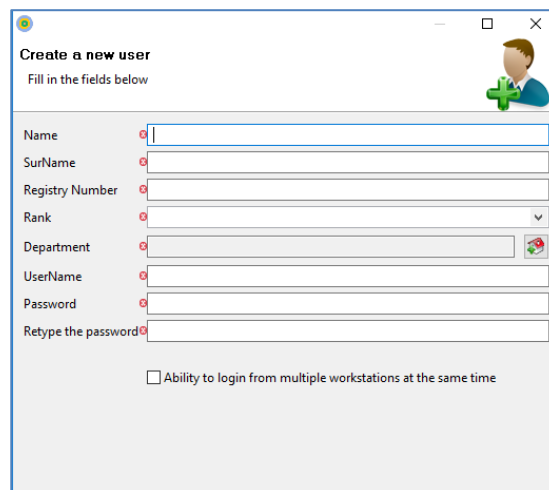
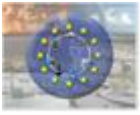
Using the options under the User and Roles Management section, the administrator is able to create edit and delete users and user roles.



For a new user, the administrator must fill in the following information:

- Name
- Surname
- Username:
- Password
- Department
- Etc.

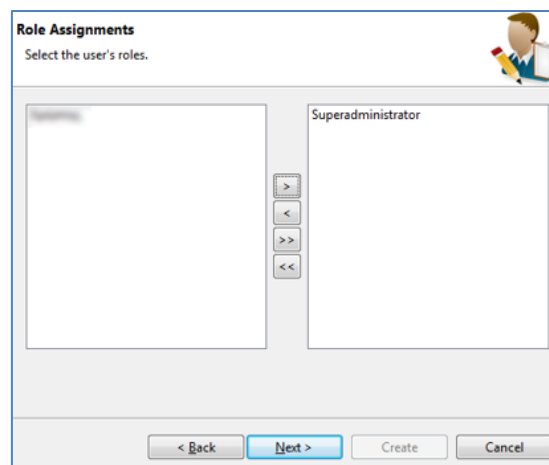
The "Create" button creates the new user. All the compulsory fields are marked with a special icon to help the administrator recognize what information is missing in order to be allowed to continue to the next page of the wizard.



The 'Create a new user' dialog box contains the following fields and options:

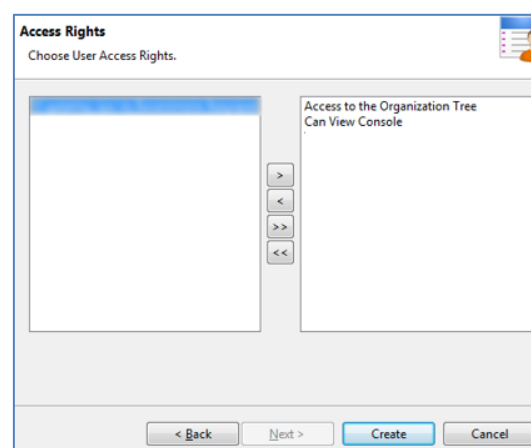
- Name
- SurName
- Registry Number
- Rank (dropdown menu)
- Department (dropdown menu with a plus icon)
- UserName
- Password
- Retype the password
- ☐ Ability to login from multiple workstations at the same time

Figure 34: Create New User



The 'Role Assignments' dialog box shows a list of roles on the right, including 'Superadministrator'. Navigation buttons between two lists are located in the center. At the bottom are buttons for '< Back', 'Next >', 'Create', and 'Cancel'.

Figure 35: Assign User Roles



The 'Access Rights' dialog box shows a list of access rights on the right, including 'Access to the Organization Tree' and 'Can View Console'. Navigation buttons between two lists are located in the center. At the bottom are buttons for '< Back', 'Next >', 'Create', and 'Cancel'.

Figure 36: Assign Access Rights

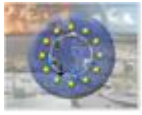
Regarding User Roles the system gives the ability to manage any number of Roles by providing access to the system Perspective, Views and toolbars. A user can be assigned more than one Role.

A user who has the predefined role of Administrator can perform the following functions:



- Create or Delete an Organization's Departments
- Create or Delete Users
- Create or Delete Roles
- Parametrize the System (Application Settings)

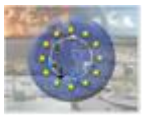
The Administrator can perform organizational management and tune the system according to the requirements of the users and the organization. Each of these functions listed above have been discussed previously.



7 Future Work

CIRP supports a well-defined extension mechanism in the form of plugins that can extend the platform capabilities by defining new datasets and analysis tools. Apart from the various data and analysis plugins that will be developed in the frame of Task 5.3 and Task 5.6 (climate direct and indirect impact to CIs) the following additional development tasks have been identified that will enhance the capabilities of the CIRP platform. These are summarized in the following table.

Planned Task	Description
Support for the NetCDF file format	The NetCDF [14] is the commonly self-describing, machine-independent data format for large-sized climate data (as those from ESGF, ECMWF and CORDEX and output from RCM/weather prediction models)
Implementation of Climate data statistical Analysis plugins	<p>Develop CIRP plugins that perform advanced statistical analysis on climate variables in order to make necessary statistical calculations needed within the EU-CIRCLE framework. These include:</p> <ul style="list-style-type: none">a) Estimation of return periods of climate variables based on Extreme Value theoryb) Estimate climate thresholds of CI assets, based on their design thresholdsc) Spatially aggregate climate parameters using factor analysis (PCA, non-negative PCA, etc) <p>Additionally, implement empirical statistical downscaling algorithms for specific estimation of point-based climate data and their statistical properties and distributions.</p>
Design and implement new climate and resilience indices	<p>Create a suitable interface that will allow the user to design and implement new indicators for</p> <ul style="list-style-type: none">➤ Climate indicators specific to the operation of the CI / CI assets, and are important for characterizing their risk and exposure to climate and secondary hazards➤ Describe and quantify resilience capabilities of the CI such as those that will be described in D4.3
Support for execution of analysis written in Python or R languages	The CIRP user will have the opportunity to introduce new customised scripts that will support specific analyses needed within the risk and resilience framework.
Execute secondary hazards	Introduce secondary hazard models (as executable files or scripts) based on user introduced inputs for selected scenarios
Multi-hazard maps	Develop multi-hazard maps based on selected hazards (and related data needed to execute each analysis) for a specific location and rank them according to likelihood, return periods exceeding design thresholds, damages for specific hazard levels, etc.

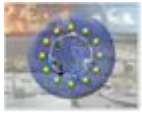


8 Conclusions

The document accompanies the Integrated CIRP environment first software release and describes the architecture and functionalities from the end user perspective. CIRP has been developed as a collaborative modelling environment where new scenarios with risk assessment and geospatial analyses are chained in workflow and where multiple scientific disciplines can work together to understand interdependencies, validate results, and present findings in a unified manner. CIRP's purpose is to provide an efficient, pragmatic, and effective solution that integrates existing modelling tools and data into a holistic resilience model in a standardised fashion.

CIRP offers an analysis toolbox environment for what-if scenario analyses with the selection of model chains, climate data, and CI inventories in order to calculate damages and assess the resulting risk. The CIRP platform provides a user friendly environment to enable the intuitive design and analysis of modelling scenarios created for any combination of climate hazard and CI assets. In this way, users are able to understand the impact of various adaptation strategies or to quantify the potential impact of a catastrophic event on society.

The CIRP extensible modular architecture can be shared across multiple communities to enable CI policy maker, owners, and scientists to leverage existing software analysis types and algorithms, inventory types, and fragilities while not binding the underlying platform to a particular scientific domain. This pluggable, open architecture is what will allow CIRP to support a wide variety of domain specific functionality isolated in plugins; to repackage different functionalities as a starting point for new applications, and to be extended to add new analytical capabilities in the future.



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