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D4.6 Implementation of the DSS services for the CIPRNet web portal

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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
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1 Introduction – Rationale of this document

The CIPCast Decision Support System (DSS) is one of the main technological results that will be delivered by the planned Virtual Centre of Competence and Expertise in Critical Infrastructure (CI) Protection (VCCC) and one of the outcomes of the CIPRNet project. CIPCast has been designed and implemented to allow the prediction and rapid assessment of the consequences of a crisis scenario in an "operational" mode of operation on a 24/7 basis. CIPCast, however, can also be used in an "off-line" mode for producing risk analysis starting from synthetically produced events (rather than truly occurring ones) or from synthetically produced damages (rather than by damages produced by true or synthetic events). In the former case, we will talk of an "event simulator", in the latter case of a "damage simulator".

One of the main components of CIPCast (when acting in the "operational" mode) is a continuous process (running on a 24/7 basis) realising the Risk Assessment Loop (RAL) as has been described earlier in [D7.1]. Starting from the prediction of the occurrence of natural hazards and of their strengths, RAL first estimates the expected damages, then, it assess how these damages affect the services delivered by CI (in general, the damages will cause loss in service quality, or even complete loss of one or more services) and, subsequently, it estimates the consequences that the loss (or reduction) of services would have on relevant areas of societal life. The tool can also be used to "weigh" the efficacy of proposed mitigation and healing actions. Therefore, CIPCast may be a valuable tool for supporting emergency managers, like e.g., CI operators, Civil Protection coordination organisations, and rescue and fire brigades.
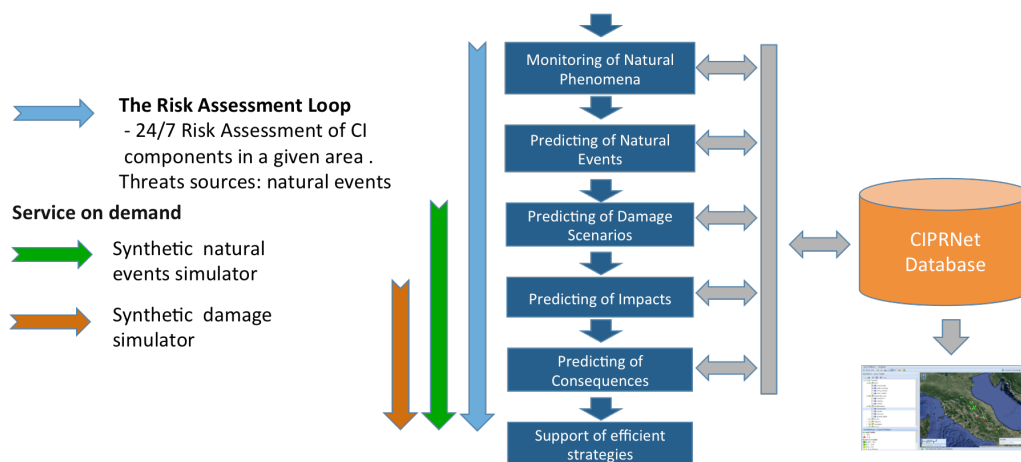
Figure 1: The CIPCast workflow and the different functionalities

In addition to the RAL, the DSS platform provides services on demand as shown in Figure 1 when used as "event simulator" and "damage simulator". The event simulator allows the user to simulate natural events in a specific area (e.g. an earthquake) and to analyse the related consequences. The damage simulator can be used to analyse the consequences of CI component failures and the resulting disruptions of services that are not caused by natural events (i.e. man-related causes, as attacks, spontaneous common-cause failures etc.).

The present deliverable is a technical report on the design and implementation of the CIPCast service. In particular, the document describes how the implemented services are available for web-based demonstration services for the VCCC. Section 2 recalls the overall design of the CIPCast DSS platform and, in particular, it describes the architecture of the web GIS (Geographic Information System) graphical interface of the platform. Section 3 describes how the

web GIS interface is used to provide the CIPCast web based demonstration services for the VCCC (*core demonstration services* in the following) and *the auxiliary demonstration services* designed to improve the end user experience (tutorial, feedback mechanisms, contact form). Section 4 describes a specific instance of the DSS CIPCast related to the Italian demonstration case (CIPCast-IT in the following) and the already implemented core services available for the demonstration. Section 5 includes a brief discussion about the long-term integration of the CIPCast services with the CIPRNet (or VCCC in the future) web portal. A summary of the implemented web demonstration services and future development plan concludes the document. The demonstration services tutorial is included as an appendix in Section 8 of this document.

2 CIPCast design

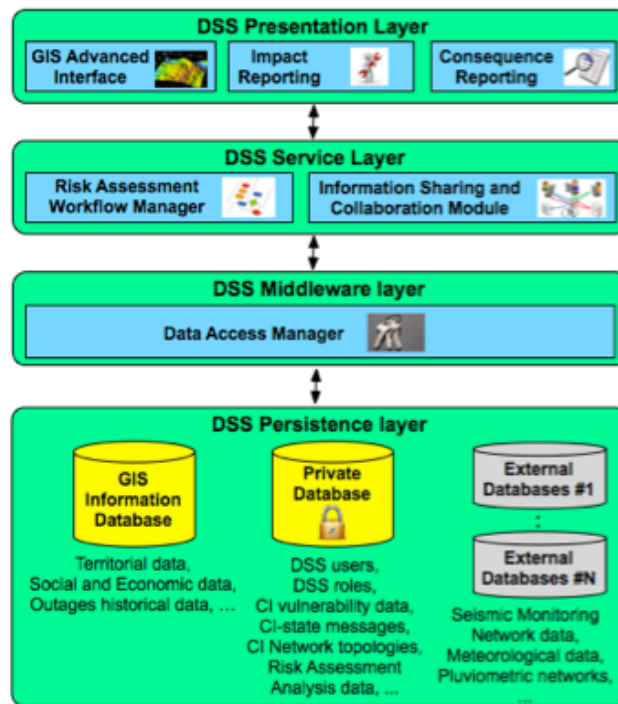The CIPCast platform architecture is composed of different layers as shown in Figure 2.

Figure 2: The CIPCast DSS architecture

The Presentation Layer contains the different components used to visualise the CIPCast risk forecast results in a friendly Graphical User Interface (GUI). In particular, the Geographic Information System (GIS) advanced interface allows CIPCast end users to visualise risk maps for CI elements and overlay this information with other kind of information as for example impact and consequence analysis results.

The Service Layer contains the different modules that realise the CIPCast business logic. In particular, this layer contains the aforementioned RAL and the future Information Sharing and Collaborative (ISC) platform. Other services are for example CIPCast System Admin services to manage the platform, CIPCAST Analysis services to manage analysis tasks on the available data/simulations, and the CIPCAST simulation service to manage and control simulation tasks.

The Middleware Layer implements procedures to gather, on a 24/7 basis, data coming from external sources, as from example meteorological data, in order to gather information to feed models and simulations to predict as soon as possible future extreme natural events (e.g. flooding). The details about the implemented data acquisition procedures are described in D7.6.

The CIPCAST Persistence Layer that is composed of different components:

- CIPCast data. Data sets are stored and managed using CIPCast systems and applications. In turn, CIPCast data will be further categorised as either Public (i.e. data that can be accessed by generic end users using the web applications and/or web services) that will be stored within the Public CIPCast Database, or Private. Examples of private data are: user management data (identities and roles), CI vulnerability data, Information Sharing and Collaborative (ISC) data, CI network topology data and CIPCast analysis result data. Private data will be stored within the Private CIPCast database.

- External data. In general, external data is stored in external databases. CIPCast relies on external data in different phases of the RAL. For example, the DSS continuously collects data form different sources: seismic monitoring networks (e.g., in Italy these data are stored and managed by the Italian Geophysics and Volcanology Institute) and meteorological stations (e.g., in Italy the stations are controlled by the Italian Air Force Met Office;
- Data and information shared with CIPCast end users (e.g. CI operators, Crisis Management, Local Authorities). For example, the CIPCast RAL requires that CI operators exchange with CIPCast experts data and information regarding the possible reduction in the Quality of Service (QoS) of their CI related to an expected harm scenario. For instance, in case CIPCast is used to build an expected harm scenario related to a future flooding event in a specific city area as part of a training or what-if discussion, CIPCast experts will use such data within the impact assessment phase in order to update the expected harm scenario considering possible cascading and dependency phenomena.

2.1 CIPCast presentation layer

The CIPCast GUI has been realised using Geo-Platform which is an Open Source Framework developed by the GeoSDI research group. Geo-Platform is used to create rich web GIS applications based on open source geospatial web-based software. The main characteristics of Geo-Platform are:

- Many open source projects dealing with geo-spatial data for maps display are based on JavaScript, which is a source for software stability problems like maintenance. For this reason, this framework uses GWT (Google Web Toolkit), to: (i) transform / compile Java code; (ii) generate Javascript code for any browser.
- Geo-Platform is a Java open source framework to develop rich web GIS applications, able to extend and enhance webGIS applications adding widgets (e.g. map feature, layer tree, layer properties) that perform functional needs of the end user. For example, there is a particular widget that can refresh automatically the geographical layer or map displayed on the current view every x seconds/minutes etc. A number of widgets has been developed within the CIPCast GUI as for example the widgets to simulate extreme natural events as earthquakes and heavy rain fall in a specific area, and to analyse the possible consequences of these events. Another example of a widget is the widget that has been developed to send emails to CI operators whenever specific events happen. These widgets realise the services on demand shown in Figure 1.
- Geo-Platform can be installed locally (e.g. at Linux installation using a downloadable ISO DVD). A local installation allows to set up different user/role combinations and every user can have one or more associated projects. CIPCast relies heavily on this feature. For example, the Italian CIPCast implementation (CIPCast-IT), implements the different services using data (territorial, technological networks) related to the Lazio region. The CIPCast-IT has a number of different end users as ACEA that is the main operator of the electric distribution network of the Rome metropolitan area or the Rome Civil Protection department. These two different end-users have different projects associated. Each project can be customised to show only data that are of interest for the end user.
- Data can reside locally or on different remote servers (via Open Geospatial Consortium (OGC)-compliant services).

Figure 3 shows the architecture of Geo-Platform and the data flows implemented within CIP-Cast. The figure also shows the different data security levels, which have been defined within the platform.
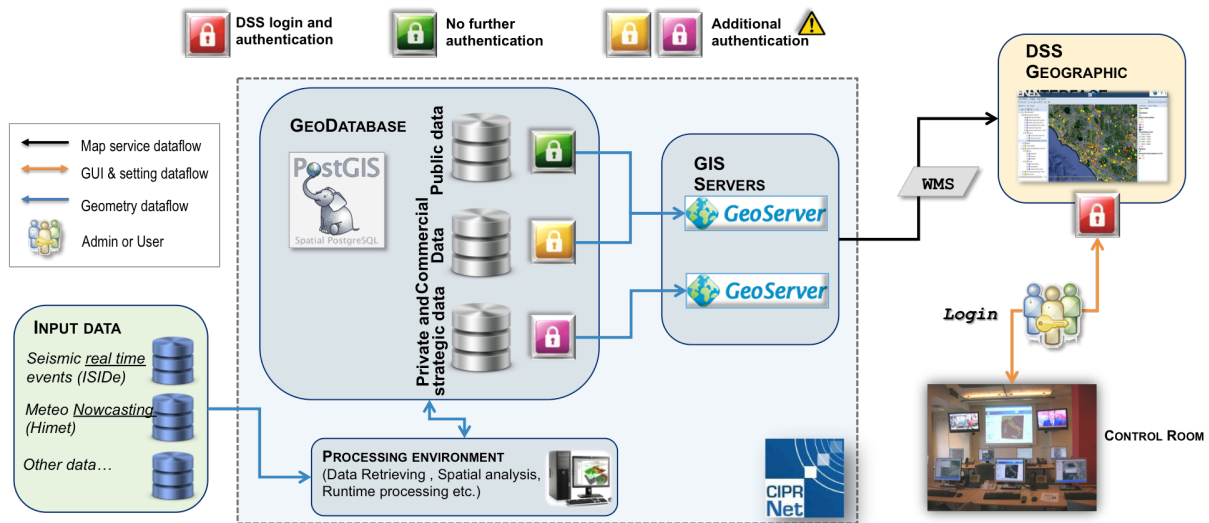

Figure 3: Geo-Platform architecture and data flow

Data continuously acquired from external data sources (e.g. meteo and nowcasting data) as well as data that have been acquired (commercial or not) for the RAL and simulations (e.g. CI technological networks, risk maps) are stored in a PostGIS database. The Geo-Platform uses the GeoServer (an open source server for sharing geospatial data) to public geospatial data using OGC open standards as Web Map Service (WMS). Data stored within PostGIS database can be visualised in the Geo-Platform application end user interface (the user browser) once transformed in a proper way by the GeoServer tool.

Figure 4 gives a summary of the data ontology of Geo-Platform highlighting the different access levels for different kinds of data.
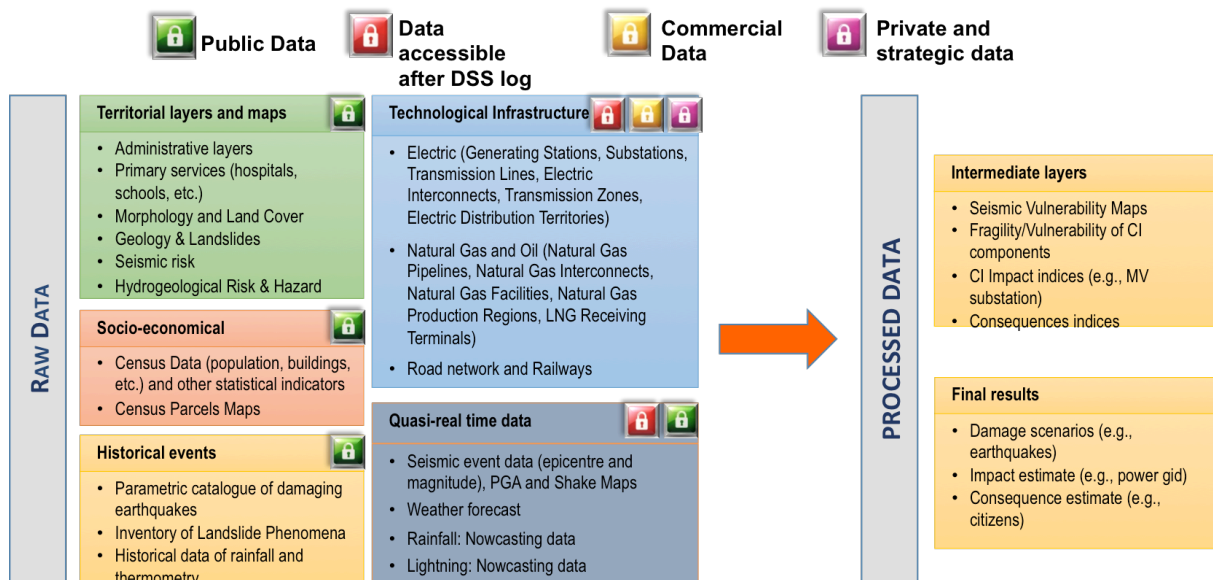

Figure 4: Geo-Platform data ontology

In general there are:

- Public data. CIPCast collects public open data. The end users, using the platform web GIS interface, can display a number of public information layers (e.g. administrative layers, census data, seismic risk maps, hydrogeological risk maps and so on). Hence, the web GIS interface constitutes an information hub to perform GIS analysis allowing end users to overlay in the same environment a number of information layers.
- Private and strategic data. CIPCast stores private data related to technological infrastructure networks. In general only the infrastructure owner can access these data. Ad-hoc access roles to grant the access to other users (e.g. other infrastructure network owners, Civil Protection organisations) need to be agreed with the owner of the data. CIPCast implements ad-hoc procedures in order to avoid information leakage and unauthorized access.
- Commercial data. ENEA acquired PLATTS [PLATTS] commercial data related to the transmission infrastructure networks of Italy, Germany and The Netherlands. In particular, ENEA acquired data related to the electrical, gas and railway domains. The end users cannot access these data. They are used by CIPCast to perform risk assessment analysis. The end users can have access only to the results of these analyses.

So, in general, CIPCast does not have a general access role scheme. Different users will have ad-hoc access schema that will be guarantee by CIPCast security policies and procedures.

ENEA owns the IPR related to the specific procedures implemented for the RAL workflow and to customise the Geo-Platform interface (i.e. the ENEA foreground). Anyway, the ENEA foreground can be used by the partners of the CIPRNet consortium for joint demonstrations and cross borders scenario risk assessment. The ownership of ENEA foreground will be transferred to EISAC in the next future.

3   CIPCast Demonstration services

Figure 5 shows the web portal of the platform (http://ciprnet.casaccia.enea.it/dss/). The web portal contains the description of the different functionalities that have been implemented with CIPCast-IT, how it is possible to use the services and it contains the links to the different Geo-Platform projects (that are related to different users as explained in section 2.1).

Figure 5: CIPCast GUI landing page

The web portal, as shown in Figure 6 contains an ad-hoc web page for the demonstration services.
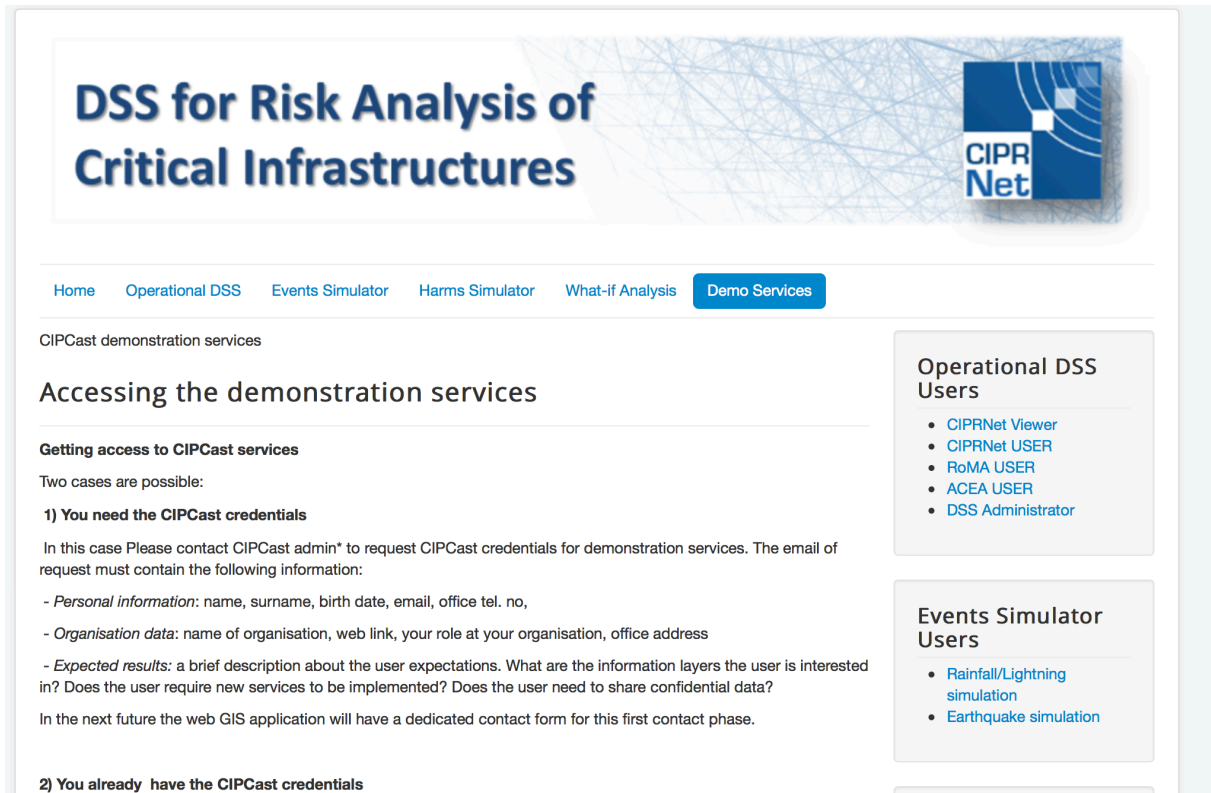
Figure 6: The Demonstration services page of the CIPCast web portal

Using one of the DSS links in the Operational DSS Users or Event Simulation Users menus of the web portal, the users will be faced with a Geo-Platform login page as shown in Figure 7.
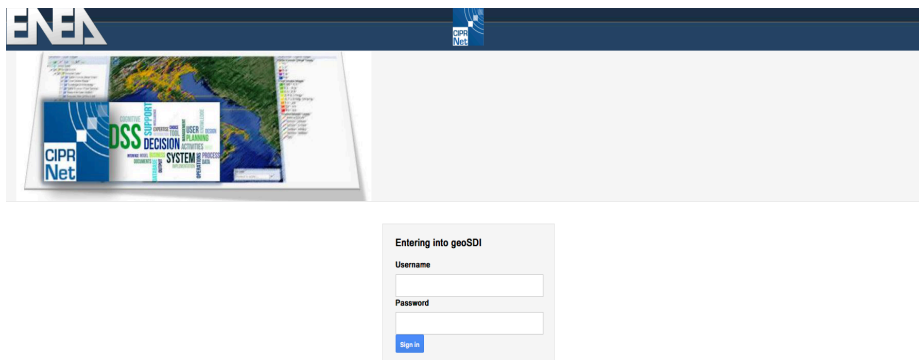
Figure 7: Geo-Platform login page

Then, the user using his/her credentials will enter the Geo-Platform application as shown in Figure 8.

Figure 8: The Geo-Platform application user interface

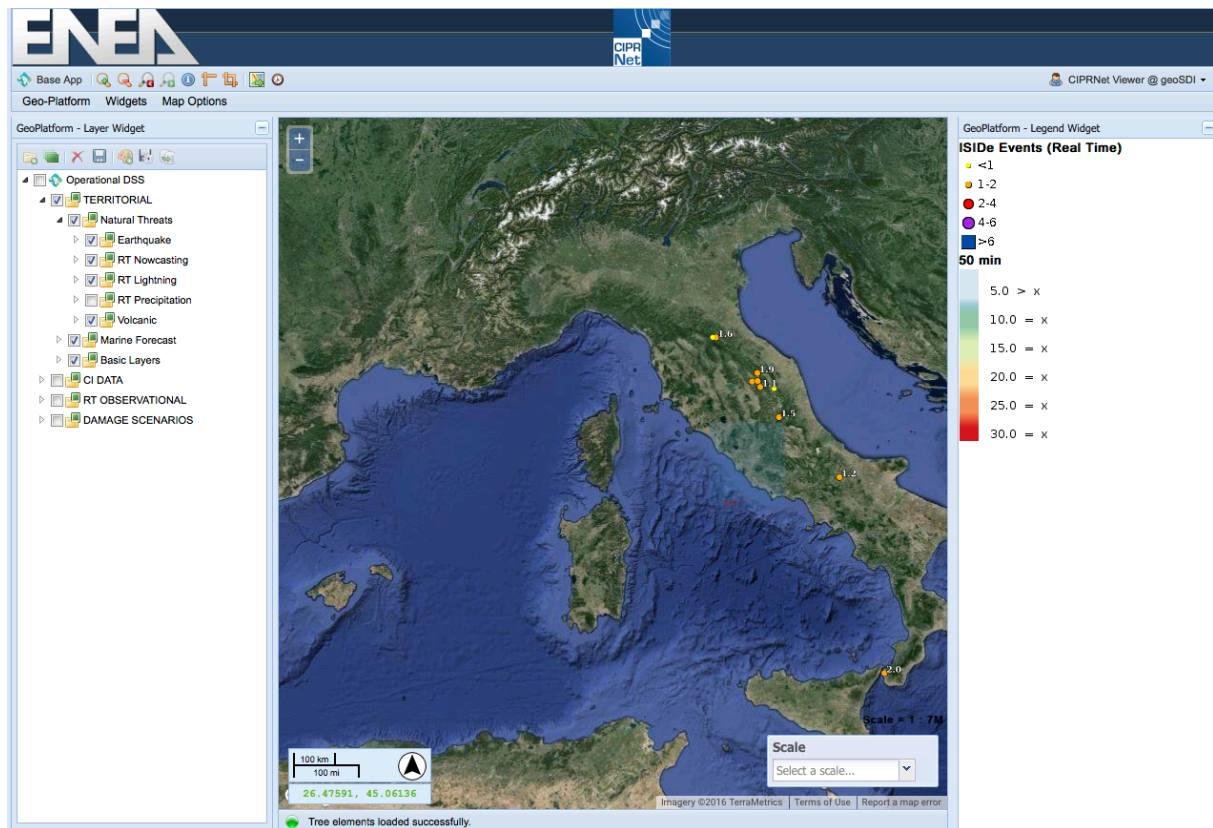It is worth stressing that the different projects are customised following end-user requirements. In particular, each end user will see only the information layer he/she requested to see and/or only the information layers he/she can have access to (i.e. some information layer are strictly confidential and only specific users can have access to these data). Moreover the user can visualise the results of specific RAL workflows that have been implemented for the infrastructure networks, services he/she is responsible for. The Figure 4 shows the data security levels to avoid information leakage.

A number of projects have been implemented in the Geo-Platform forming the so-called *core demonstration services*. In order to improve the end user experience, auxiliary demonstration services have been planned and partially implemented. These auxiliary services will be available on specific demonstration web pages tabs of the CIPCast web application. In particular, the following auxiliary services will be available:

- Tutorial. The demo web page will contain a link to the tutorial (described in Section 8) and a video explaining the different information layers available and how to use the demo widgets. The user, using these widgets, will experiment the on demand services that have been implemented for the CIPCast-IT instance;

- Contact Form. CIPCast demonstration service will not foresee a registration procedure. It will include a contact form used by the users to inform the CIPCast-IT board about their interest in the platform. The CIPCast-IT board will use the information provided by the user for a first screening and to understand if the user request can be fulfilled or not and if the contact request comes from a trustable organization. After this screening phase, a number of possible scenarios are possible:

  o the end user shows interest for a demonstration service already implemented in CIPCast and the service can be accessed by a wide CIP community (in the

document these services are referred as multi-users services). In this case the CIPCast board needs to verify if the end user can access the specific service of interest. In general, these services are provided using open data (i.e. no access restriction defined); in some cases, an ad-hoc access role will be implemented in order to display only the information the end user can have access to.

- o The end user requires a new service (that will be available for the demonstration as all other services). In this case, the CIPCast experts need to understand the end user services requirements and they need to understand how to customize the RAL workflow to be compliant with these requirements. Then, there is the implementation phase. In general, the process of providing a new demonstration service to an end user could last days/months.

- Feedback form. A feedback mechanism will be implemented to gather user information about the provided services and suggestions about possible improvements.

The current core demonstration services have been developed through direct contacts with the current end users (see Section 4).

4 CIPCast-IT demonstration services

The CIPCast service layer of Figure 2 implements the different services that are provided to the end users. As already highlighted in the introduction of the present document, CIPCast has different modes of operation:

- Operational mode to allow, on a 24/7 base, the prediction and a rapid assessment of the expected consequences of a crisis scenario;
- Off-line mode: for producing risk analysis starting from synthetically produced natural events (Event Simulator) or from synthetically-produced damages (Damage Simulator).

Depending on the end user requirements some of these services are available as web based demonstration services. In order to understand how the demonstration services are available to the end users it is worthwhile to recall that:

- The CIPCast GUI is a web GIS application (the Geo-Platform) allowing the visualisation of the DSS service results.
- The Geo-Platform has its own user management and in general there is not a registration procedure. The engagement of new users is composed of two distinct phases: 1) contact phase (i.e. through the contact form) and RAL customization phase where RAL workflow is customized to be compliant with the user requirements;
- CIPCast implements different workflows for different users as continuous processes. In other word the CIPCast is not an interactive web application. For instance, CIPCast-IT implements a workflow for ACEA. The workflow automatically gets data from and sends data to ACEA. Anyway, within the Geo-Platform a project named ACEA has been created and configured following ACEA requirements. Then, the ACEA user can visualise the CIPCast workflow results (e.g. rain precipitation maps, damage scenario) together with other information layer (e.g. risk flooding maps). The CIPCast sys administrators have configured the ACEA "project" to show only the information required/accessible by this specific user.
- Currently, different demo projects have been realised for different category of users (infrastructure network owners, Civil Protection, local government authorities).

In general, the CIPCast service layer implements services belonging to two different categories:

- *Multi-user services.* These services give a common framework for different users in different domains (e.g. weather forecast service);
- *Specific user services.* These services are domain-specific and allow a specific operator to make a thorough analysis about its own domain (e.g. services for electrical distribution network operators, services for local civil protection organizations).

In general, the services may be specific for a given area or territory (e.g. the metropolitan area of a city) or national/European wide.

As it has been described above, each phase of the RAL workflow may expose a demonstration service for the end users (e.g. weather data acquisition is exposed as a multi-user service using the GeoPlatform GUI). Other services are the result of a complete (in some cases partial) execution of the RAL workflow. Table 1 summarises the services currently implemented within the CIPCast-IT instance.

Table 1: The CIPCast-IT services. ACEA and ATO2 are the main utilities responsible of the electrical and distribution grid of Rome.

Service Name	Mode of operation	Service category	Stakeholders	Area of interest
Weather forecast	Operational	Multi users		Lazio region
Nowcasting	Operational	Multi users	ACEA, ATO2, Civil Protection of Rome	Metropolitan area of Rome, Lazio region
Lightning forecast	Operational	Multi users	ACEA	Lazio region
Seismic activity map	Operational	Multi users		Italy
EDN Risk Forecast	Operational/Off-line	Specific users	ACEA	Metropolitan area of Rome
WDN Risk Assessment	Operational/Off-line	Specific users	ATO2	Metropolitan area of Rome
Seismic Risk Assessment	Operational/Off-line	Specific users	Florence Municipal Administration	Florence city
Jubilee event management	Off-line	Specific users	ACEA	Metropolitan area of Rome

In general, operational specific user services are implemented through 24/7 processes running on CIPRNet servers. These processes exchange data, analyse results (risk assessment results) with the specific user through dedicated interfaces. The services listed in Table 1 have been developed in the framework of the Italian project RoMA (Resilience Enhancement of Metropolitan Areas)[RoMA]. The service Seismic Risk Assessment service has been developed in cooperation with the research foundation Prato Ricerche [PR]. It follows a brief description of each service (that are available for the demonstration web based services) (please refers to D7.6 for details):

- *Weather forecast.* ENEA has agreed with the company HIMET Srl [HIMET] (co-partner of the project RoMA) the free use of their forecast data (weather forecast, now-casting and lightning probability) for research purposes. In particular, HIMET provides Local Area Model to the CIPCast-IT derived from ECMWF (European Centre for Medium-Range Weather Forecasts[1]) data related to a large fraction of the centre area of Italy, comprising the Regione Lazio. A user can access Geo-Platform to visualise map reporting the spatial distribution (approximately, 5 km x 5 km) of the precipitation rate of rainfall forecasts (mm·hr-1).

- *Nowcasting.* Nowcasting is operated by the use of Meteorological Radars. *T*he company HIMET has a meteorological radar station (X-band) at Mount Midia (in the Apennine region, nearby the city of L'Aquila) whose data covering a large fraction of centre Italy fully comprising the Regione Lazio, are constantly acquired and treated to extract. From the reflectivity signals the rain abundance is estimated. The data are subsequently post processed in order to get the rain abundance prediction, in a grid of 800 Mt of resolution, for the subsequent 90 minutes from the current time.

- *Lightning forecast.* Each 15 minutes, the CIPCast-IT acquires the lightning probability data related to the next 45 minutes and visualises these data on the Geo-Platform.

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[1] http://www.ecmwf.int/

- *Seismic activity map*. CIPCast-IT constantly polls a national public website (the ISIDe website), which provides the recorded information of the last earthquake occurred in Italy with a very short time delay from the shock (usually within less than a minute).
- The *EDN (Electrical Distribution Network) Risk Forecast* service that has been developed for ACEA S.p.a (the main utility for the electrical distribution grid for the city of Rome) acquires data (network topology, configuration data, and vulnerability data) from the utility each hour. In case of a prediction (by the CIPCast weather models) of an extreme natural event affecting the city of Rome, the service performs a risk forecast assessment for the components of the electrical network. Indeed, the natural event can affect some components of the network and other critical components of other infrastructures. The service performs a simulation of the operator restoration procedures to analyse the impact of these failures on the network itself and on other domains (telecommunication, urban mobility, health) that depend in some way from the electrical distribution network.
- *WDN Risk Assessment*. The service performs a risk assessment for the Water Distribution Grid of Rome with respect natural hazards.
- *Seismic Risk Assessment.* CIPCast-IT from ISIDE data creates Peak Ground Acceleration (PGA) map. These maps represent the PGA distribution for each spatial point of a given area. In particular, CIPCast-IT is able to use empirical prediction of PGA propagation without local site seismic effects and with local site effects. For instance the Seismic Risk Assessment service developed for the Florence municipality uses the latter approach.
- *Jubilee event management service.* This service has been implemented for the ACEA stakeholder requiring a specific electrical distribution network risk assessment considering the various events during the Jubilee. The main objective is to analyse which are the most critical EDN components w.r.t. the various Jubilee events.

The results of the described services can be provided using different protocol/interfaces:

- Email messages of alert that are sent to the operators in case of prediction of an extreme natural event;
- RAL report files (XML, CSV files) sent to the operators. Each operator may implement ad-hoc procedures to analyse these reports;
- Geo-Platform GIS interface. The operator can use the Geo-Platform GIS interface to visualise layers related to the predicted natural event (e.g. the rain precipitation expected in the next two hours). CIPRNet GIS experts, sys admins have customized the Geo-Platform interface to the specific needs of the specific user.

5 CIPCast services long term integration

The previous discussion about the current demonstration services implemented within the CIPCast-IT instance is useful to understand the possible integration of these services in the CIPRNet web portal (or the VCCC web portal). As it was already pointed out, each CIPCast instance has a proper landing page that will redirect the users to the Geo-Platform web GIS application that is the GUI to display CIPCast results and data to the users. In the future, there will be a number of CIPCast instances, at least one instance for each EU member state. Each CIPCast instance will be related to a specific area and it will provide multi users and specific services. The landing page of each CIPCast instance will represent an information hub to display information and links to the various common framework services (the multi-user services) and to visualise specific service reports (e.g. RAL reports). Moreover, the users can use the web portal to properly conFigure the subscription to the different services (e.g. email alert service for extreme natural events), to conFigure the subscripted services (e.g. to conFigure the RAL report visualisation) and to access the other VCCC services as for example the Ask the Expert service [D5.3].

6 Conclusion

The document describes the CIPCast architecture and its graphical user interface (i.e. the web GIS application Geo-Platform) that is used to visualise the results of the various CIPCast services. Moreover, the document describes the different service categories and the different service interfaces and how these services are available as demonstration services. In general, a CIPCast service is a composition of different RAL phases. Each phase, in general, may generate information that can be displayed in the GUI. In particular this document describes the services implemented in the CIPCast Italian (CIPCast-IT) instance and how these services are integrated within the CIPRNet web portal. The CIPRNet web portal contains a general description and a link to the landing page of CIPCast-IT instance. This landing page contains the links to redirect the user to the web core demonstration services. Moreover, the landing page includes also as a so-called auxiliary service a tutorial to guide the user during the demonstration. In the next future other auxiliary services will be implemented as a contact form to easy the engagement of new users in the demonstration and a feedback mechanisms to gather information about possible improvements. Currently, the core demonstration services are available for different categories of end users: infrastructure networks operators (e.g. ACEA, ATO2 for the electrical distribution and the water distribution network in Rome), Civil Protection organization (e.g. the Municipal Civil Protection of Rome), research centres (e.g. foundation Prato Ricerche). Other users have shown a real interest about the platform services, and then a number of core demonstration services are under development for these users (e.g. Mantova municipality).

The document includes also a discussion about the possible long-term integration of the CIPCast DSS in the VCCC web portal.

7 References

[D5.3]   EU FP7 CIPRNet, ENEA, Deliverable D5.3 – Realisation of "Ask The Expert" function (2014)

[D7.1]   EU FP7 CIPRNet, ENEA, Deliverable D7.1 – Design of the DSS with consequence analysis (2014)

[D7.6]   EU FP7 CIPRNet, ENEA, Deliverable D7.5+D7.6 – Integration of meteo-climatological simulators, flood forecasts, earthquakes data and analysis tool and Interface to the technical demonstrator for federated CIP MS&A (2015)

[DOW]   Annex I – Description of Work (Annex to the Grant Agreement FP7-312450-CIPRNet)

[ECN]   Tofani, Alberto, De Nicola, Antonio, Di Pietro, Antonio, Pollino, Maurizio and La Porta, Luigi - *Data management and Information sharing in CIPRNet DSS* - European CIIP Newsletter, Issue 18, 8(2):19-22

[HIMET]   http://cetemps.aquila.infn.it

[PLATTS]   http://www.platts.com/maps-geospatial

[PR]   http://www.pratoricerche.it

[RoMA]   http://www.progetto-roma.org

[TLS]   PostgreSQL 9.3 manual

8 CIPCast WebGIS interface tutorial

CIPCast has been designed and implemented to allow the prediction and rapid assessment of the consequences of a crisis scenario in an "operational" mode of operation on a 24/7 basis.

CIPCast, however, can also be used in an "off-line" mode for producing risk analysis starting from synthetically produced events (rather than truly occurring ones) or from synthetically produced damages (rather than by damages produced by true or synthetic events). In the former case, we will talk of an "event simulator", in the latter case of a "damage simulator".

One of the main components of CIPCast (when acting in the "operational" mode) is a continuous process (running on a 24/7 basis) realizing the Risk Assessment Loop (RAL) as shown in Figure 9. Starting from the prediction of the occurrence of natural hazards and of their strength/magnitude, RAL first estimates the expected damages, then, it assess how these damages can affect the services delivered by CI (in general, the damages will cause loss in service quality, or even complete loss of one or more services) and, subsequently, it estimates the consequences that the loss (or reduction) of services would have on relevant areas of societal life. The tool can also be used to "weigh" the efficacy of proposed mitigation and healing actions. Therefore, CIPCast may be a valuable tool for supporting emergency managers, like e.g., CI operators, Civil Protection coordination organizations, and rescue and fire brigades.

The Figure 9 shows the main components of the CIPCast platform.
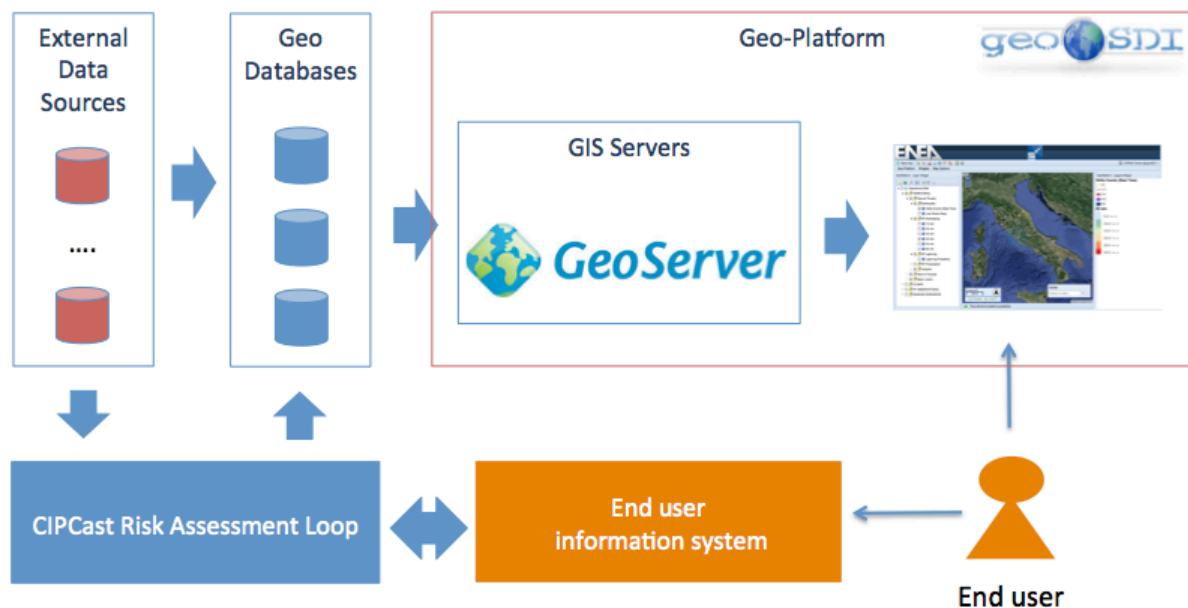
Figure 9: CIPCast platform

In short:

- The CIPCast GUI is a WebGIS application developed using the Geo-Platform technology[2] allowing GIS analysis (geoprocessing) and the geographical visualisation of the CIPCast service outcomes.
- CIPCast implements different workflows for different users as continuous processes. These processes continuously and automatically exchange data with end end-user information systems (Figure 9). Users, by means of the CIPCast GUI, are allowed to visualise the CIPCast workflow results (e.g. rainfall precipitation maps, damage sce-

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[2] http://www.geosdi.org/index.php/en/about

narios, etc.) together with other information layer (e.g. flood hazard and risk maps) using the WebGIS application.

- Currently, different custom projects have been set-up for different category of users (infrastructure network owners, Civil Protection, local government authorities).

A number of projects have been implemented in the Geo-Platform forming the so-called *core demonstration services*. The main objective of this tutorial is to support the users while interacting with the CIPCast WebGIS interface to use CIPCast demonstration services and analyse their outcome.

8.1   Getting access to CIPCast services

If you need credentials

Please contact CIPCast admin to request CIPCast credentials for demonstration services. The email of request must contain the following information:

Personal information: Name, Surname, birth date, email, office tel. no;

Organisation data: name of organisation, web link, your role at your organisation, office address;

Expected results: a brief description about expected results, basic requirements and main constrains.

In the next future CIPCast GUI will have a dedicated contact form to help the interested user to specify the detail of her/his request.

You have the credentials

CIPCast staff has examined your request and they created a GeoPlatform project for you. Using your credential you can have access to the WebGIS application to perform the analysis/simulation you have permissions to execute.

Regarding the CIPCast demonstration services (in this case, no RAL customization phase required) CIPCast admins after the contact phase need to understand and verify end-user requirements and data nondisclosure policies and data confidential agreements of CIPCast data, in order to correctly conFigure the visualization of data services for the end user.

8.2 CIPCast services

CIPCast implements different services for to the end users that can be classified as follows:

- *Multi-user services.* These services give a common framework for different users in different domains (e.g. weather forecast service);
- *Specific user services.* These services are domain-specific and allow a specific operator to make a thorough analysis of its own domain (e.g. services for electrical distribution network operators, services for local civil protection organizations).

In general, the services may be specific for a given area or territory (e.g. the metropolitan area of a city) or National/European wide.

In general, each phase of the RAL workflow may produce a service exposed to the end users (e.g. weather data acquisition is exposed as a multi-user service using the GeoPlatform GUI). Other services are the result of a complete (in some cases partial) execution of the RAL workflow.

8.3 CIPCast Geo-Platform GUI

In the following the main web page of the CIPCast WebGIS application (Geo-Platform GUI) that is shown after the user logs in to the application (Figure 10).
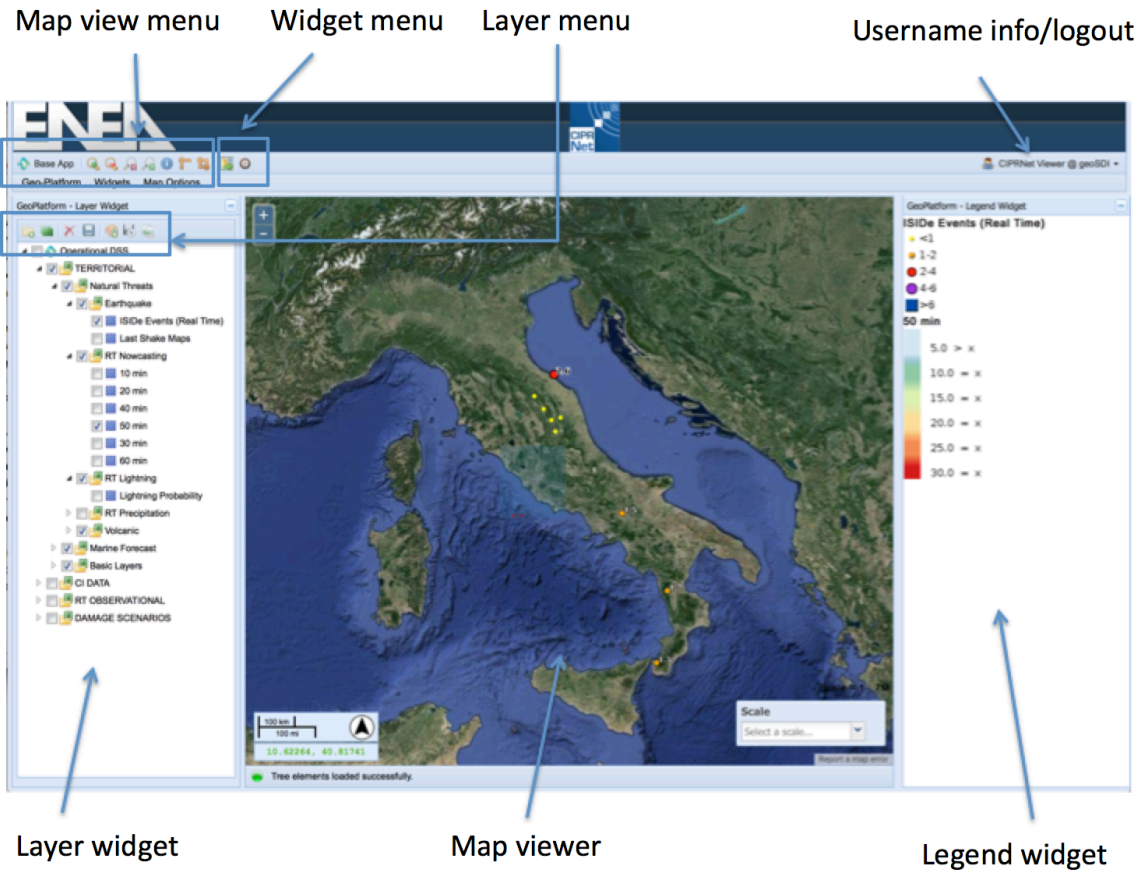
Figure 10: The Geo-Platform GUI

The *map viewer* shows as background the basic layer map (it is possible to conFigure the basic layer map using the Base Layer widget in the *widget menu*). Moreover, the user can add information layers using the *layer widget*. CIPCast admin conFigures the layer widget following the user requirement and considering the data nondisclosure policies. Then, the user will have a number of ordered folders in the layer widget. Each folder can contain a number of ordered information layers.

The default layer widget configuration comprises the following folders and information layers:

Static data

- Geographical data
- Technological assets
- Socio-Economic data

Dynamic data

- Weather stations
- Seismic sensors

- Hydrographic stations
- Remote sensing data

Forecast
- Weather forecast
- Weather now-cast
- Lightning forecast
- Marine Waves forecast

Damage Scenario
- Short term
- Medium term

Impact Scenario
- Short term
- Medium term

Consequences Analysis
- Short term
- Medium term

Specific folder ontology and layer widget configuration can be defined to be compliant with specific users requirements. Figure 11 shows an example of default layer widget configuration.

The *map viewer menu* contains the basic commands to manage the visualisation of the maps as zoom in, zoom out. The Get Feature Info command allows the visualisation of detailed information (i.e. attributes) stored in the GIS database related to a GIS entity (e.g. electrical secondary substation name, voltage, operator and so on). The other commands are the classical GIS commands such as Measure and Measure Area.

The *Widget menu* will contains two default widgets
- Select Base Layer allowing the choice of the base map layer (clicking this button the Base Layer Selection window of Figure 12 will be displayed)
- Timeline widget showing the time line (Figure 13) of the last extreme natural events in Italy (the demonstration services will display only earthquake events as gathered from the Italian National Institute for Geology and Volcanology seismic network). In the future this widget will be enriched with information related to other events (flooding, flash flood, heavy rain etc.)
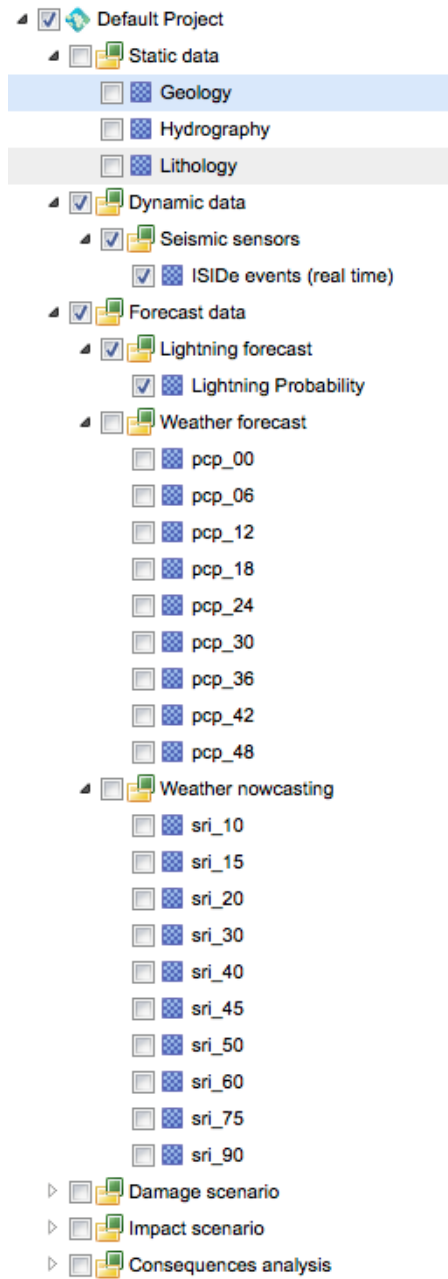
Figure 11: The default layer widget configuration
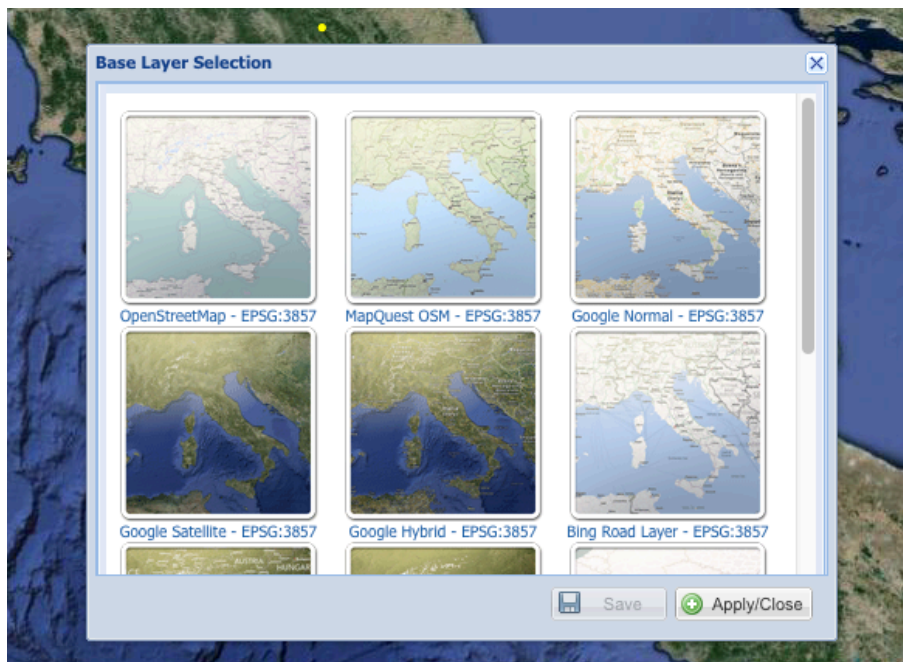
Figure 12: Base Layer Selection window
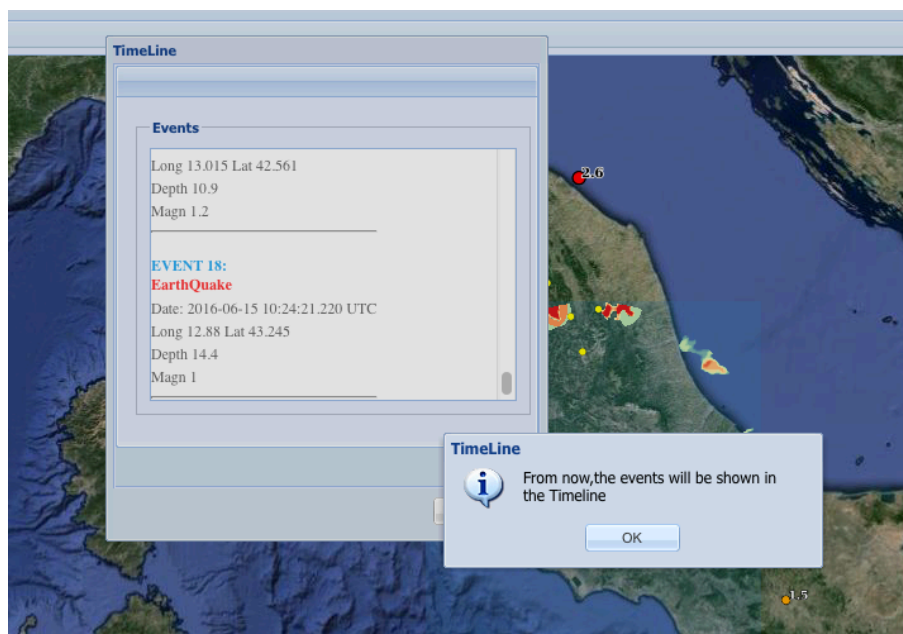
Figure 13: Timeline window

Specific users enabled to perform Event/Damage simulations will be allowed to see other widgets buttons in the *Widget Menu*. Figure 14 shows an example of a user widget menu with a number of simulations widgets enabled. In particular, the widget menu comprises two earthquake simulators, the Earthquake simulator and the Florence Earthquake simulator. Indeed, CIPCast, starting from the user provided features of the earthquake (magnitude and epicentre), produces an expected damage scenario on the bases of structure/infrastructure vulnerability, empirical propagation models of seismic waves in the ground and of the specific

ground seismic properties (geo-lithological characteristic). Two different approaches have been implemented:

1) Empirical prediction of Macroseismic Intensity/PGA propagation without local site seismic effects. This approach has been used for the Earthquake simulator allowing the impacts and consequences assessment of earthquake events on buildings in the La-zio and Tuscany regions;

2) Empirical prediction of Macroseismic Intensity/PGA propagation taking into account local site seismic effects. This approach has been used for the Prato Ricerche[3] (or Florence) Earthquake simulator allowing the impacts and damages assessment of earthquake events on buildings in the Florence city area.

In general, the choice of the empirical approach depends on data availability.
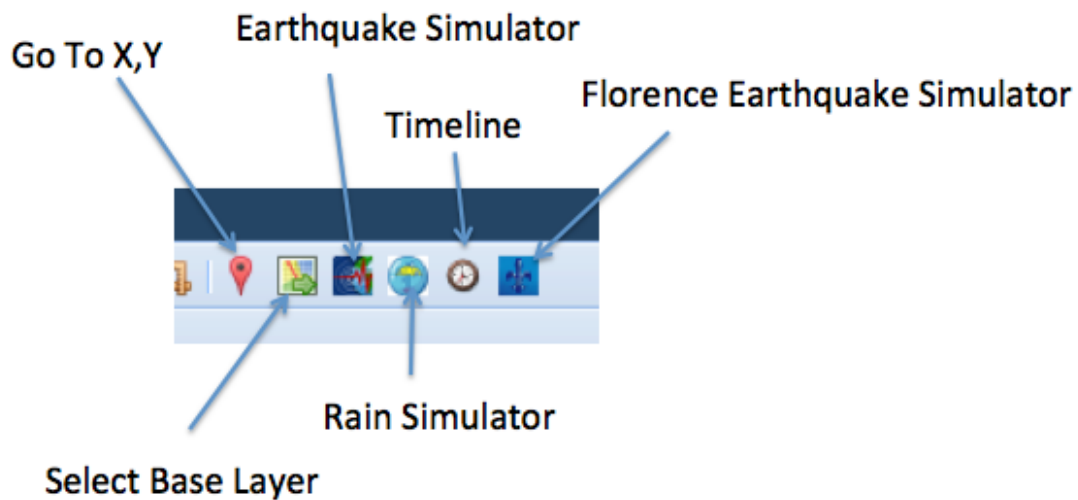
Figure 14: example of an extended widget menu
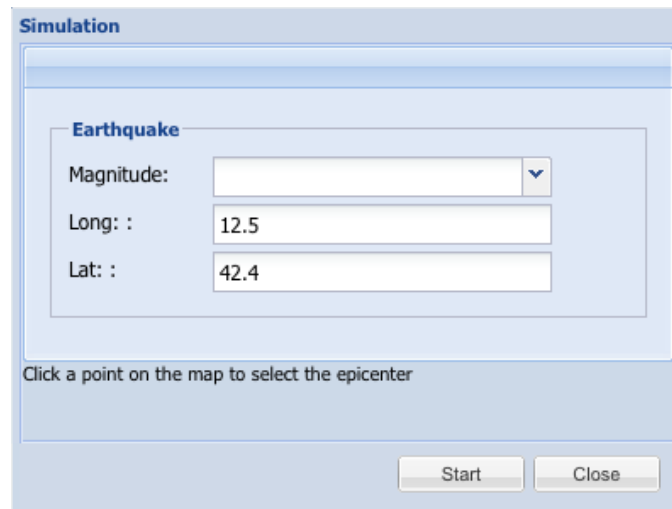
The Rainfall simulator has been developed to simulate heavy rainfall events in the metropoli-tan area of Rome and for their related impacts and consequences assessment.

The following section will illustrate how the enabled users can use the Earthquake simulator and the Rainfall simulator widgets

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[3] http://www.pratoricerche.it

8.4 The Earthquake Simulator

This section shows the steps needed to simulate an earthquake event using the CIPCast GUI.
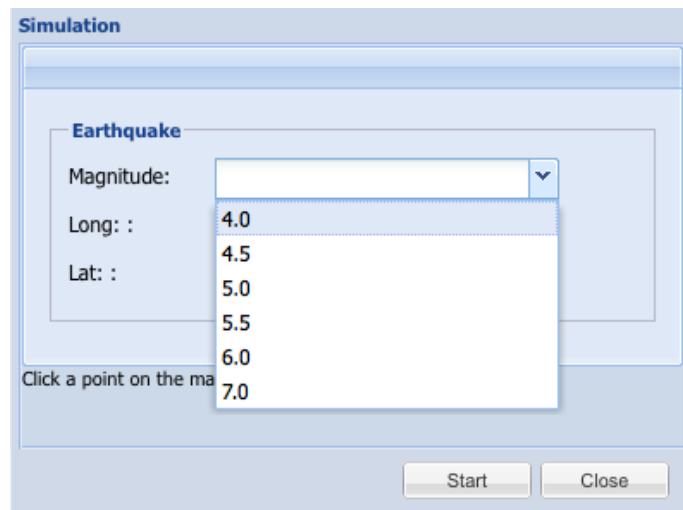
Figure 15: The Earthquake input pop-up window

After pressing the Earthquake Simulator button of the Widget menu, CIPCast GUI shows a pop up window allowing the user to input the basic earthquake features: magnitude and epi-centre location (latitude and longitude) (Figure 15).

The user can select the magnitude of the earthquake event using the drop down menu that is displayed pressing the arrow near the Magnitude input box (Figure 16)

Figure 16: The earthquake magnitude input drop menu

Using the Long and Lat input fields the user input the epicentre geo-localization data. Alternatively the user can input the epicentre Lat and Long by pointing and clicking a specific point in the map (Figure 17)
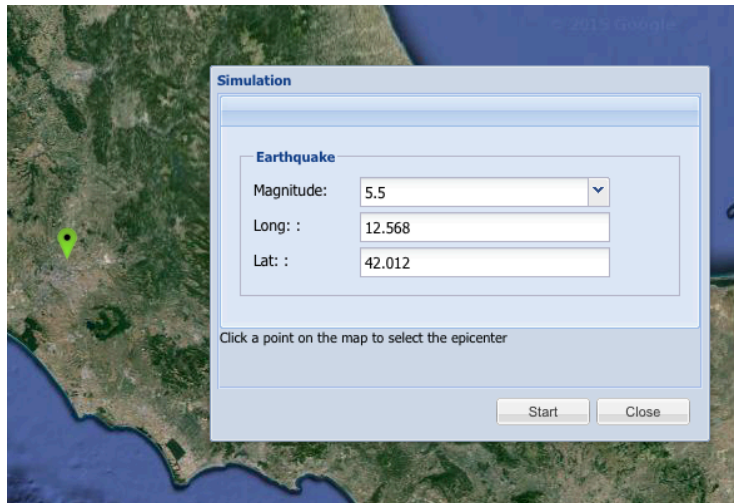
Figure 17: Epicentre selection

Then, the user can start the simulation by clicking on the "Start" button of the Simulation pop-up window. After the "Start" button is pressed the CIPCast GUI shows the Simulation Progress Bar of Figure 18
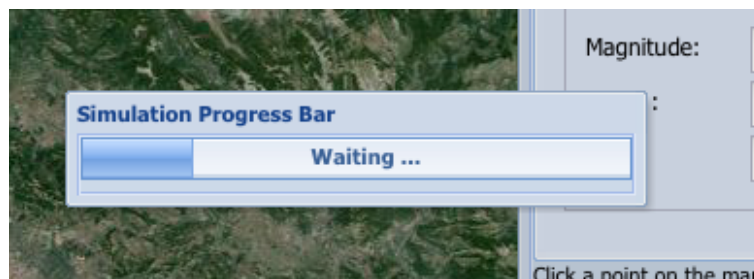
Figure 18: The Simulation Progress Bar

When the Earthquake Simulator terminates the simulation the CIPCast GUI will show the information pop-up window as shown in Figure 19
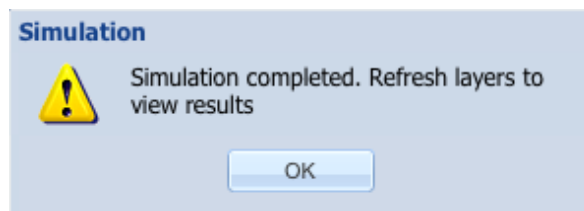

Figure 19: Simulation completed information window

The user can display the results of the simulation using ad-hoc information layers contained in the Damage Scenario folder of the Layer Widget.
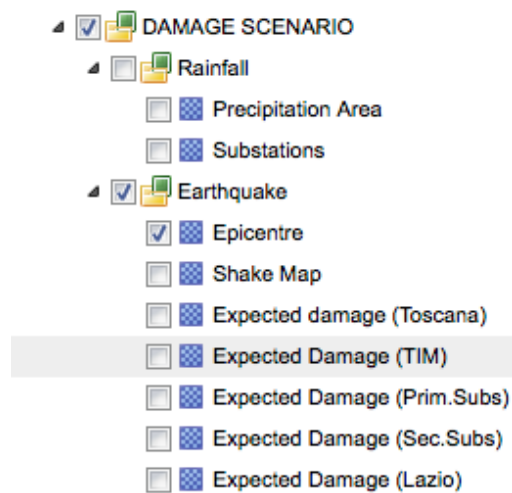
Figure 20: The earthquake damage scenario information layer

Then, the user can add to the map different information layers as for example the computed shake map (Figure 21), the expected damage on buildings in Tuscany and Lazio region (Figure 22). As it is shown in Figure 20 the user can visualize also data related to possible damages of infrastructure assets of the telecommunication and electrical distribution network of the city of Rome. These information layers will be available only for the operators that own the data.
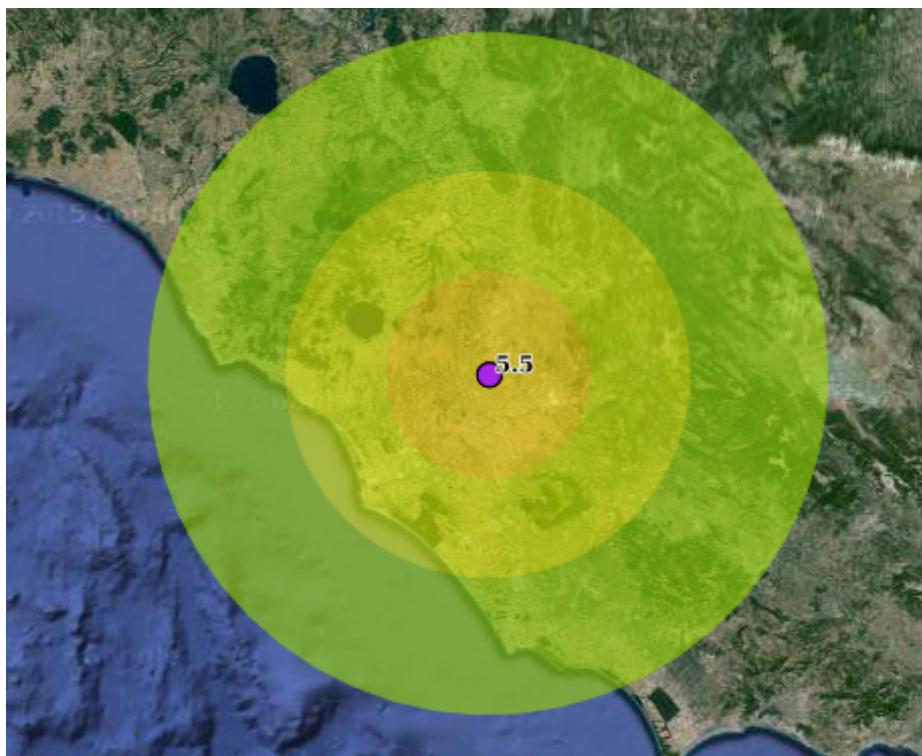
Figure 21: The earthquake shake map and epicentre
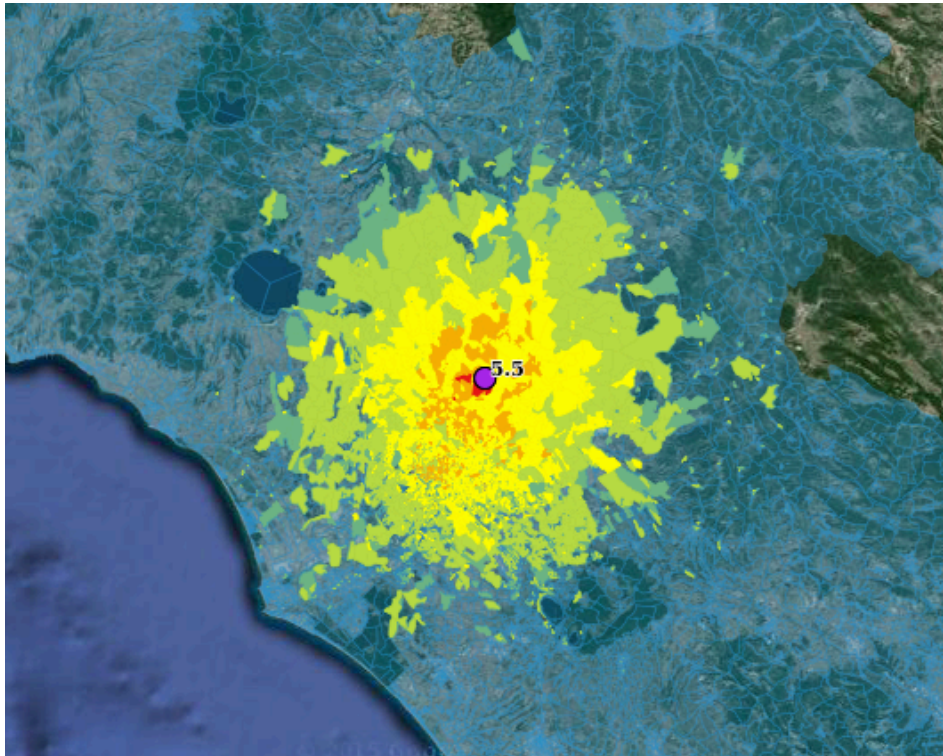
Figure 22: Expected damages on Lazio buildings

The *Legend widget* shows the meaning of the forms and colours of the objects showed in the map viewer. In the example of Figure 21 the expected damage colours help the user to understand the region areas mostly impacted by the simulated earthquake event.
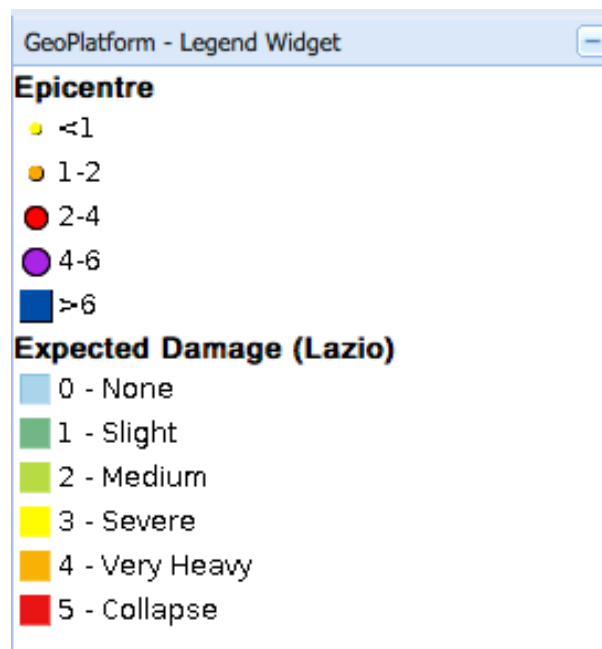

Figure 23: Legend widget
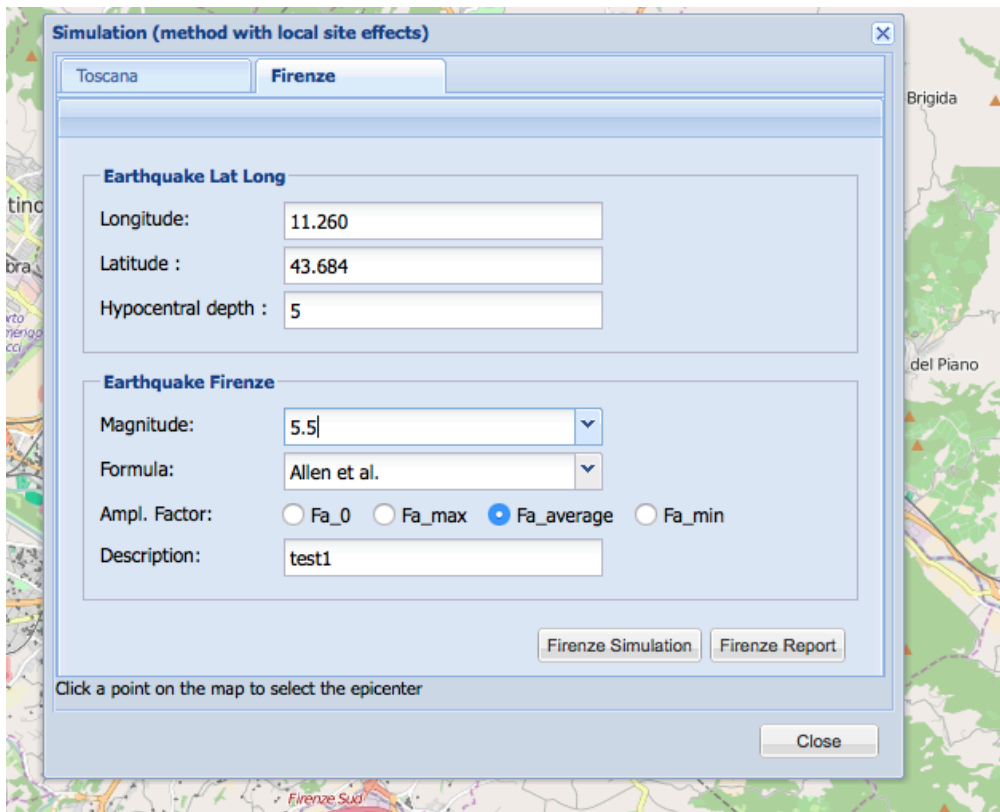
8.5 The Prato Ricerche Earthquake Simulator

This section is mainly devoted for the Prato Ricerche users. Anyway, it can be useful for the generic reader to understand the level of flexibility allowed by Geo-Platform in customizing the interface for specific users. In collaboration with Prato Ricerche foundation a specific Earthquake Simulator has been developed for the Tuscany region and in particular for the city of Florence. In general, the simulation allows a detailed seismic risk assessment considering local site effects and inventory of buildings data (characteristics, vulnerability, people resident, etc.) aggregated at level of single building (surveyed information, source: Municipality of Florence). By contrast, the earthquake simulator described in the previous section uses buildings data (characteristics, vulnerability, people resident, etc.) aggregated at level of Census block (statistical information, source: ISTAT).
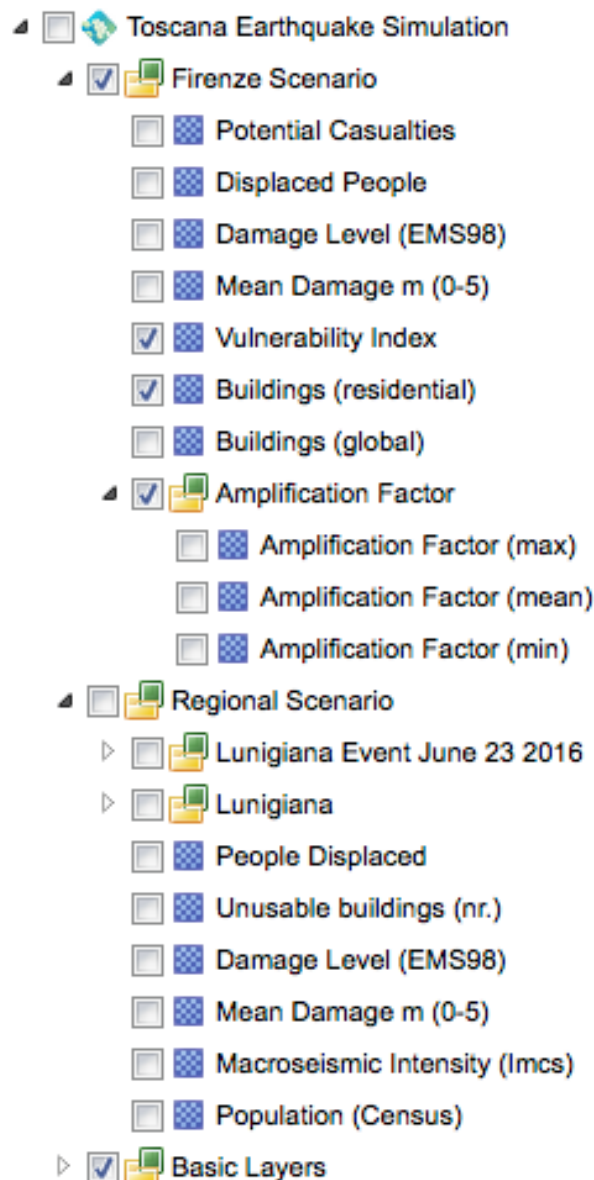
Figure 24: The Prato Ricerche Earthquake Simulator layer widget configuration

Figure 24 shows the customized Prato Ricerche Earthquake (PRE in the following) Simulator layer widget. Figure 25 shows the input pop-up window of the simulator. As it can be see

two type of simulations can be performed: a) Regional simulation (the "Toscana" tab of Figure 25) and b) Florence simulation (the "Firenze" tab of Figure 25).

Figure 25: PRE Simulator input pop-up window

The specific features of the Florence simulator can be summarized as follows:
- The end-user has to specify the hypocentral depth (km) in addition to the epicentre location;
- Different seismic attenuation laws (to estimate the macroseismic intensity) and amplification factors can be chosen (Figure 26).
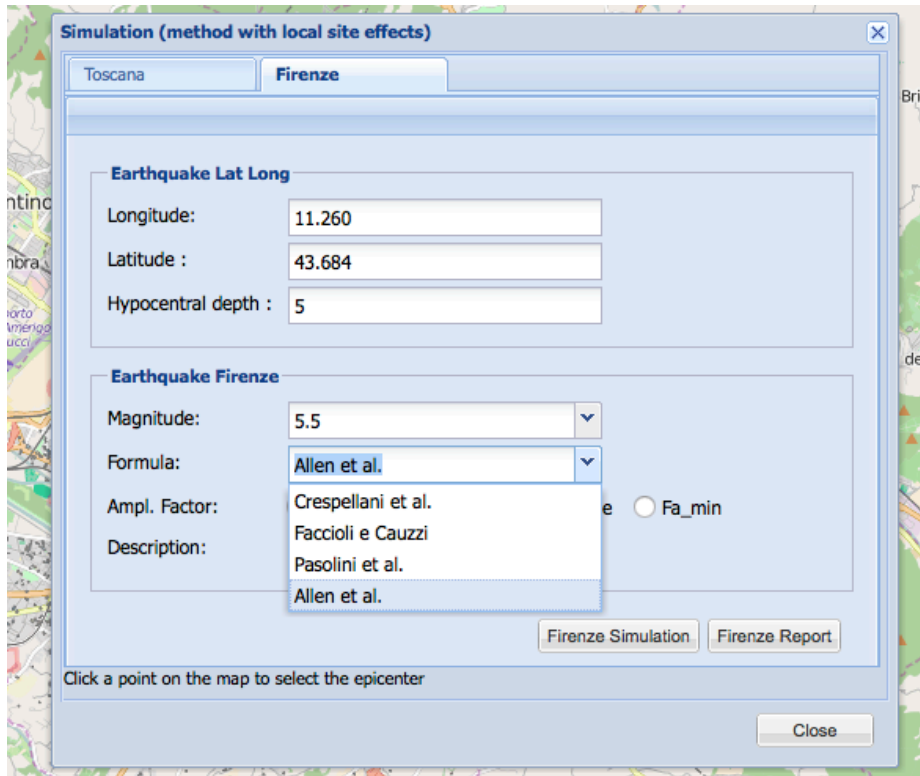
Figure 26: Specific features of the PRE input pop-up window

Then, the end-user presses the *Firenze Simulation* button of Figure 26 to start the simulation. The PRE Simulator, analogously to the previous Earthquake Simulator, shows a pop-up window informing the end-user that the computation is terminated. When, the simulation in completed the end-user can display the simulation report (pressing the *Firenze Report* button of Figure 26) as shown in
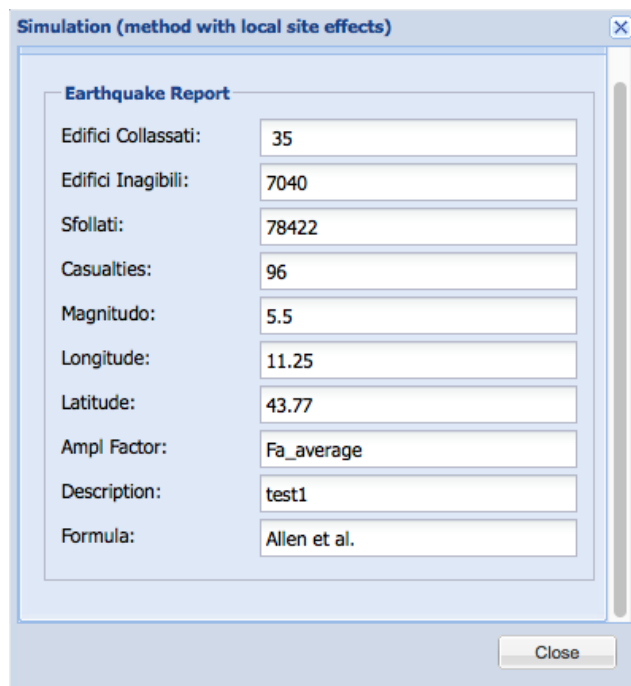

Figure 27: The PRE Simulator Report

Using this report the end-user can see information regarding the number of: collapsed buildings, condemned buildings, displaced persons and casualties.

Moreover, the end-user can display in the map viewer the outcomes of the simulation as shown in Figure 28 and Figure 29.

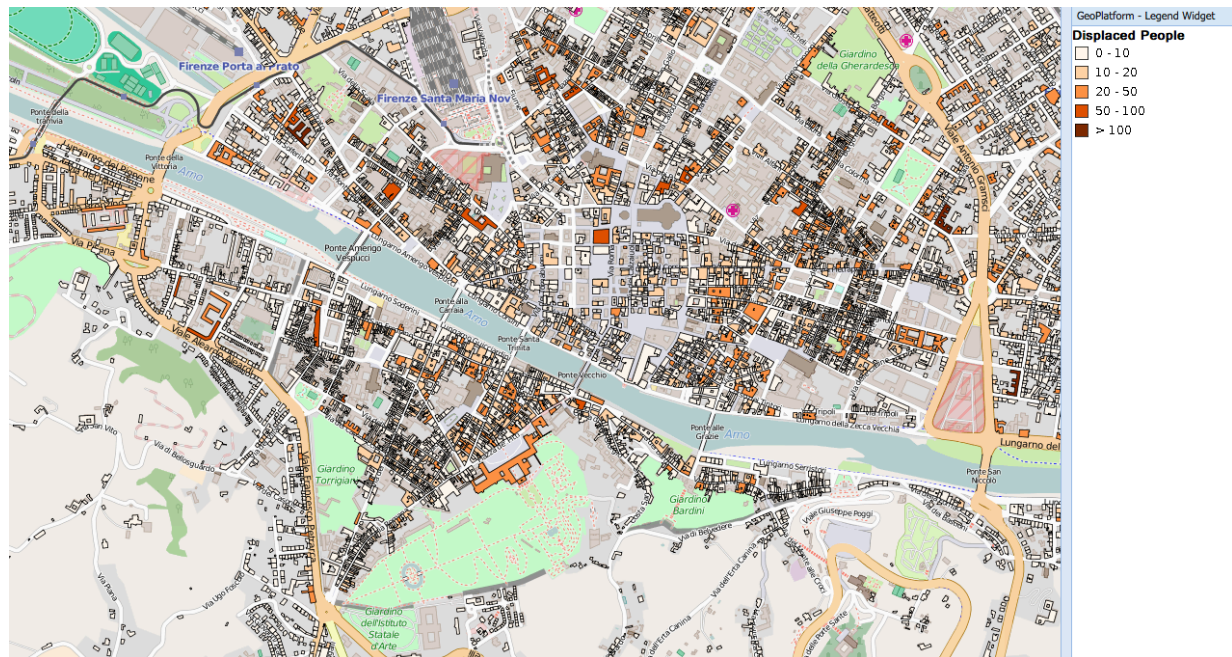**Figure 28: PRE damaged buildings map (The image has been manipulated for security reason)**

Figure 29: PRE displaced people map

8.6 The Rainfall Simulator

After pressing the Rainfall Simulator button of the Widget menu, CIPCast GUI shows a pop-up window similar to the window showed in Figure 15 (for the Earthquake Simulator case). In this case the user needs to insert the basic features of the rainfall event: intensity (mm/h) and the area interested by the precipitation event. The simulator allows the specification of the precipitation area through a circle. Then, the user needs to specify the location of the circle centre (the user can click on a point on the map to set the circle centre Lat and Long) and the circle radius (km). Figure 30 shows an example of input setting for a simulation using the Rainfall Simulator.
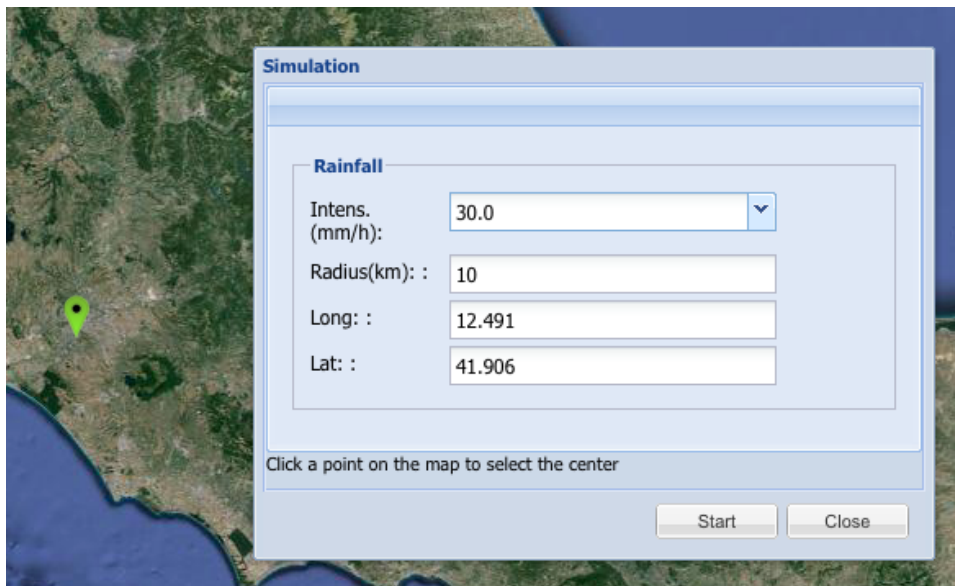

**Figure 30: Rainfall Simulator input pop-up window**

Selecting the Precipitation Area layer the end-user can see the selected precipitation area as shown in Figure 31.

Figure 31: The Precipitation Area

The Rainfall Simulator, using the vulnerability data related to the Electrical Distribution Network (EDN) of Rome metropolitan area (owned by ACEA[4] S.p.a), allows the visualization of the expected damage components.
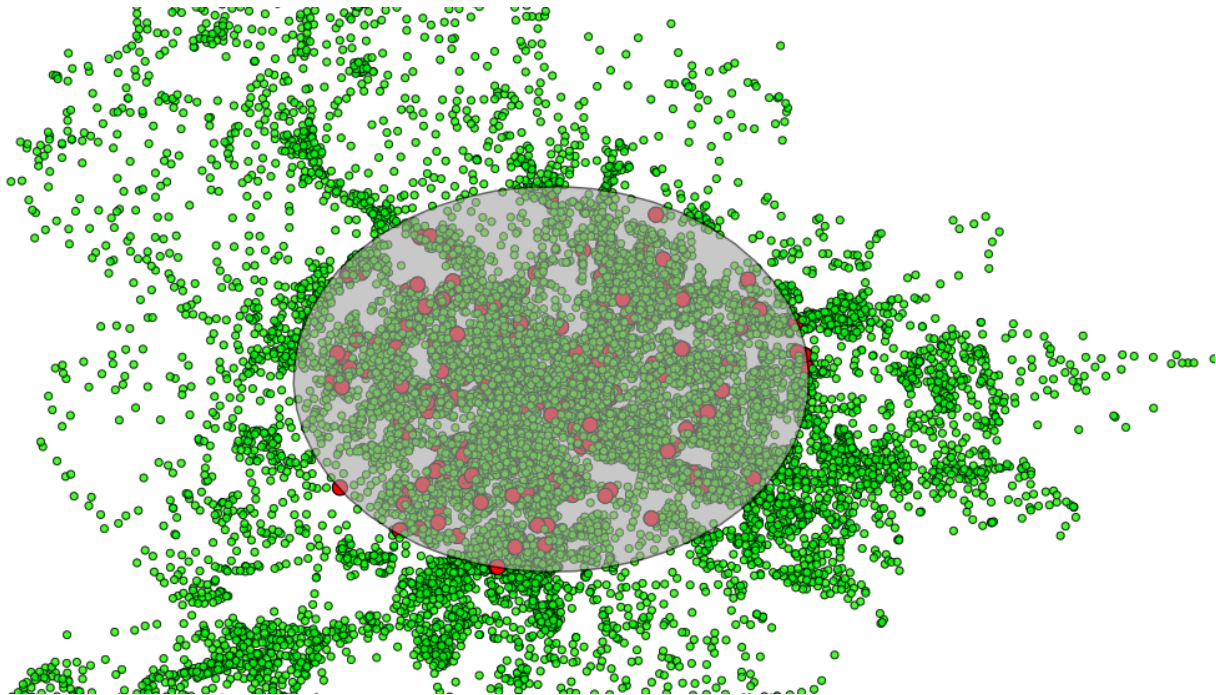
Figure 32: The Rainfall Simulator expected damage scenario

The Rainfall Simulator has been developed in collaboration with ACEA S.p.a in the framework of the Italian project RoMA (Resilience Enhancement of Metropolitan Areas)[5]. The Figure 32 shows an example of the computed damage scenario. The basic layer has been removed for security reasons. Currently, the described simulator widget is available only for ACEA users.

8.7 Conclusion

This tutorial described the main features of the Geo-Platform WebGIS interface. In general, the services are implemented for specific users and, following nondisclosure and data confidentiality agreements, these services will be available only upon requirement. The Geo-Platform/Geoserver technologies allow the management of users and roles. In particular, every user can have one or more associated projects. CIPCast relies heavily on this feature. For example, the Italian CIPCast implementation (CIPCast-IT), implements the different services using data (territorial, technological networks) related to the Lazio region. The CIPCast-IT has a number of different end users as ACEA that is the main operator of the electric distribution network of the Rome metropolitan area, the Rome Civil Protection department and the Prato Ricerche foundation. These three different end-users have different projects associated. Each project can be customized to show only data that are of interest for the end-users.

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[4] http://www.acea.it/Home2.aspx?lang=en

[5] http://www.progetto-roma.org