PHUSICOS

According to nature

Deliverable 7.3

Web-based tool – module 3 (Design)

Work Package 7 – Product innovation to develop an evidence-base and data platform

Deliverable Work Package Leader:
BRGM

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Project information

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Web-site:	www.phusicos.eu
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Project partners:

Summary

PHUSICOS focus on demonstrating the effectiveness of nature-based solutions (NBSs) and the benefits to use them for small and frequent events in rural and mountainous areas which have an anxiety-provoking nature on exposed populations.

To do so, WP7 “Product Innovation” establishes a comprehensive state-of-research evidence-base and platform. Implemented NBSs related to extreme hydro-meteorological events in rural and mountainous landscapes are accessible though this open-source database management system, where multi-component, multi-thematic and multi-criteria information are stored.

The present deliverable presents the design and architecture of this interactive web-platform, including the module dedicated to the living-labs. Once fully operational, this module will gather all available information on the sites and will permit to make the demonstration of the differences between NBS scenarios and especially the reduction of risk for each case study site.

Contents

1 Introduction

The EU project PHUSICOS focuses on demonstrating the effectiveness of nature-based solutions (NBSs) and the benefits to use them for small and frequent events in rural and mountainous areas. Work Package 7 (WP7 "Product Innovation") is tasked with developing a system for documenting the relevant NBSs and results. To do so, WP7 developed an open-source database management system listing NBSs related to extreme hydro-meteorological events in rural and mountainous landscapes and describing semantic, documentary, photographic and cartographic related information. This is the PHUSICOS platform, which has been populated with data from appropriate NBSs from the PHUSICOS project as well as what could be identified in literature.

The PHUSICOS platform is composed of different components/modules. In addition to cataloging information about NBSs, it also provides functionality to analyze the NBS implementations registered in the database and presents adapted methodology for their evaluation from the literature.

The PHUSICOS platform is currently hosted on the BRGM IT infrastructure during the project period. At the contractual end of PHUSICOS it will be necessary to find an appropriate way to continue the legacy of this tool.

This document presents the design concepts for platform presented as a functional description and IT specifications. The design process included co-development with stakeholders, and considerations of user needs in the development of the interactive user interface. The document also presents considerations for the legacy of the platform to ensure that the technical developments and the collected data are preserved beyond the end of the PHUSICOS project.

2 Co-development process

Stakeholder involvement (in cooperation with WP3) has been incorporated in the design process. Focus has primarily been on the PHUSICOS partners responsible for the PHUSICOS demonstration sites to identify the needs proper to each study sites. Due to constraints under the COVID pandemic, most of the interaction with the stakeholders have been via email. However, a virtual workshop has been organized with stakeholders from the Serchio river site in June 2021 to collect their input.

During the workshop, a presentation of the existing PHUSICOS platform and of the Site index to develop has been done. Another presentation of the work and data created under WP4 has also be done and followed by discussion with the 16 participants.

Everyone agreed that it would be a good idea to integrate a technical module for technical users and a summary including maps and graphs for wider use. The farmers from the Serchio are really interested in following monitoring data for the Serchio river site (Level, pH, turbidity, salinity, nitrite, ammonium, etc.). For them, it was decided it

would be better to have a kind of report available in Italian with maps and graphs than GIS. But GIS also appears essential to share technical data. Indeed, the Serchio river site is “unique” in the way many scientists are involved as stakeholders and thus more data is needed on this site than on others. It was also suggested that this site, and the associated platform module, could be a suitable for student trainings, as several stakeholders are coming from the university.

3 Functional description of the platform

This section provides a basic introduction to the user experience and the interactive function of the platform. The database is implemented based on Bailles et al. (2020) in an open-source CMS (Content Management System) website. The CMS implementation supports file storage for documents and a map server to provide geo-referenced access to the cases in the CMS database. Refer to Section 4 for the technical (IT) details of the implementation.

3.1 The user experience

The PHUSICOS platform is an online tool. It can be accessible directly through the web portal (http://phusicos.brgm.fr/en) or linked from other web sites (for example, a link is provided in the project website (https://phusicos.eu/). The portal is available in English. The database is provided with 2 access levels:

- open access, providing any interested user with 'read only' access to the data; and
- limited access, providing registered users the ability to contribute information to the database.

User accounts can be created through self-registration. Due to security issues, an administrator validation of the account is necessary just after its creation.

3.2 System views/interfaces

The user interacts with the database via graphical user interface (GUI) providing several different views/interfaces, selected by choosing the appropriate button on the common header (Figure 1):

- **The Database view:** The searchable database of all registered NBS implementations
- **The Heatmap view:** An interactive tool allowing the searching and identifying of specific NBSs based on a combination of parameters
- **The Map view interface:** All registered NBSs are shown in their geographic locations
- **The Site index view:** Information and documents on the PHUSICOS sites are available through 3 sub-menu items

- **The Informations NBS tool:** A searchable library of information and resource materials

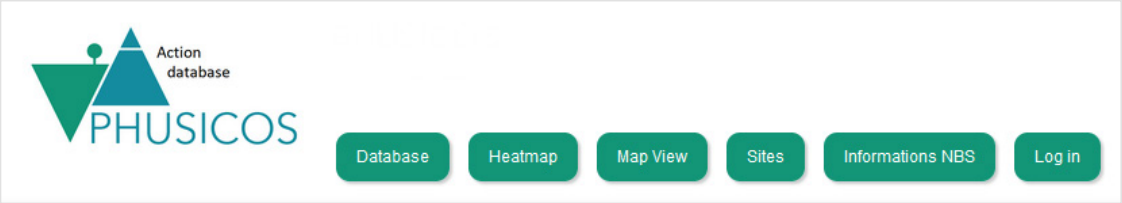

Figure 1. Common header for all views: Interface selection and user information

3.2.1 The Database View

This interface allows the user to search and filter the database of NBS cases stored in the database. The graphic window presents three main sections (Figure 2)

- The common header section
- The filtering criteria (left hand viewing pane)
- Search results (right hand viewing pane)

Filter criteria may be applied to limit the search results to specific types of cases, limiting the number of results returned from the database. As default, the full listing from the database is presented (no filters applied).

Note that the top of the search results viewing pane also contains an additional button, 'Add a solution', which can be used by the viewer to submit a new case to the database. This is the only view where this option exists. See section 'Adding data to the database' given below.

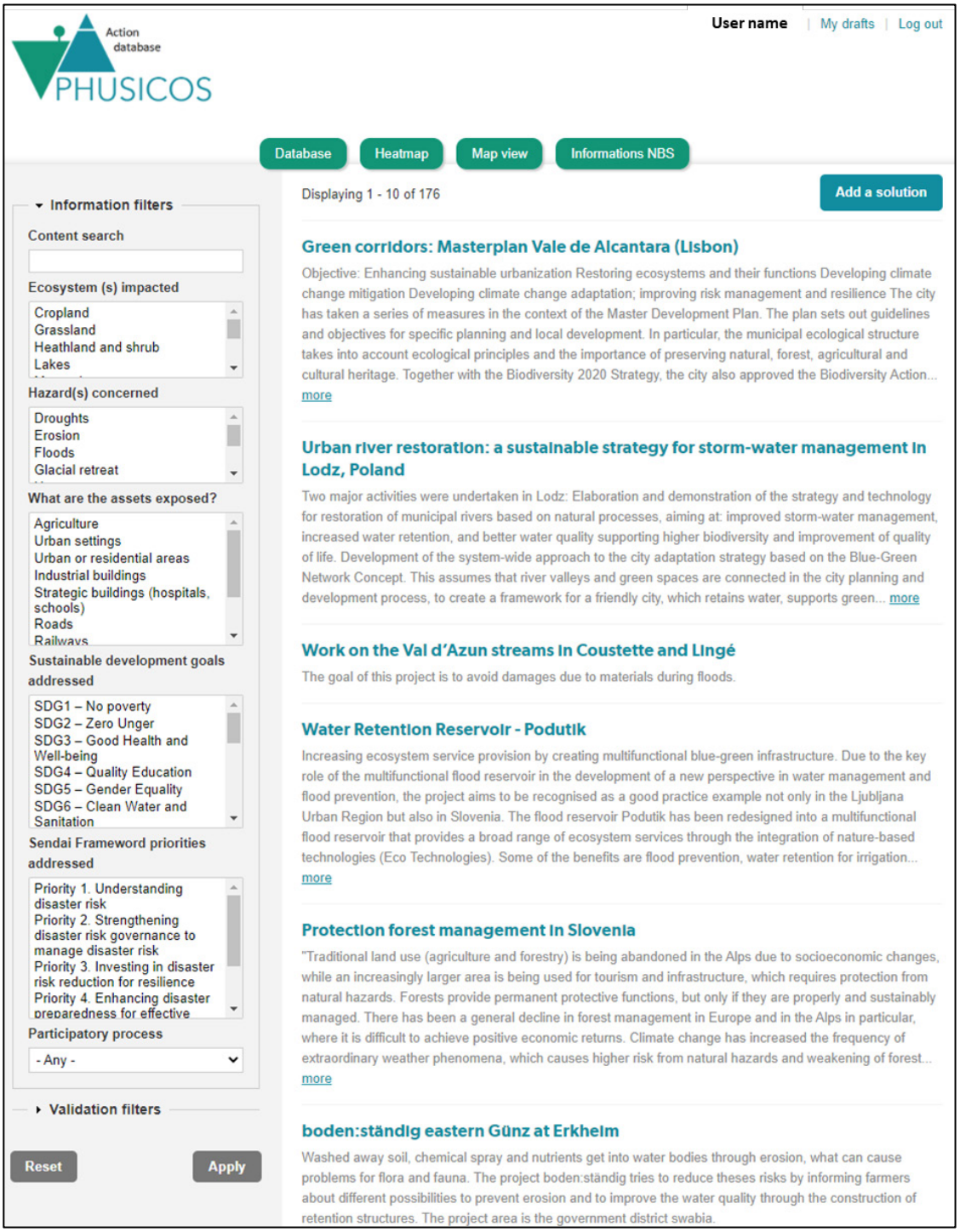

Figure 2. Database interface

Cases in the database are recorded with factual information as well as quantitative and qualitative assessment criteria. An example of a case is shown in Figure 3. Additional cases may be added by a user, see section 'Contributing to the database'.

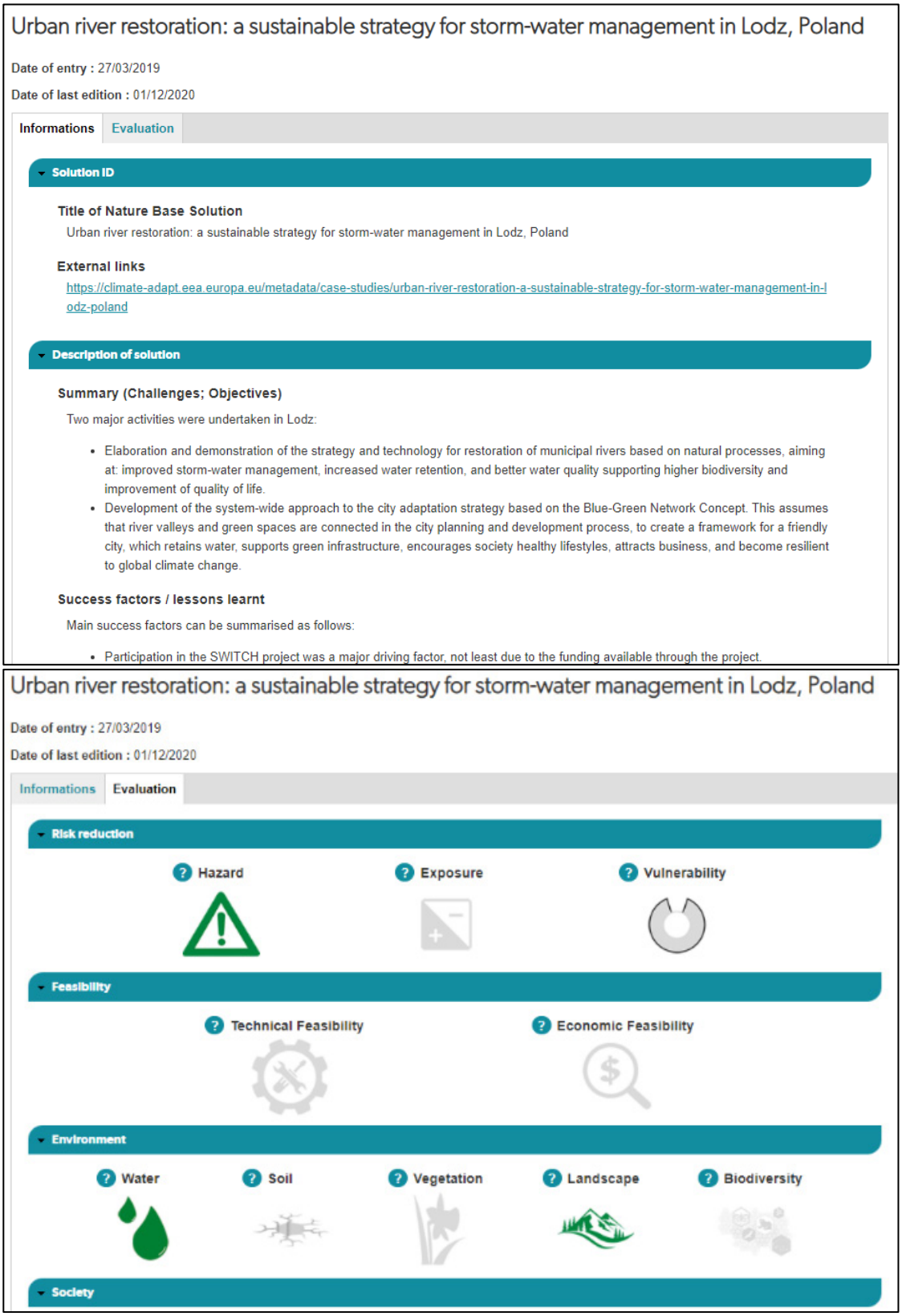

Figure 3. Example NBS case in the database. Top: Information tab, Bottom: Evaluation tab

3.2.2 The Heatmap View

The Heatmap view provides a tool for filtering and selecting NBS examples in the database. The user can cross-compare using 2 categories of parameters.

Each database entry has been assessed, and the NBS has been assigned parameter labels from a common set of categories and parameters. These categories include:

- Hazard(s) concerned
- Ecosystem(s) impacted
- Exposed assets
- Other challenges
- Sustainable development goals addressed
- Assessment hazard criteria.

Each of these categories has an associated list of potential parameters, for example for Ecosystems impacted the relevant parameters include *Rivers, Mountains, Wetlands* and several other types of ecosystems.

Once the user has selected two categories, the parameters assigned to each category create a matrix of potential combinations. The database search then uses each set of parameters in a query and returns the number of individual database entries (cases) for each combination. For example, in Figure 4 we see that the database contains 48 cases associated with flooding in rivers, and 19 cases concerning flooding in urban areas.

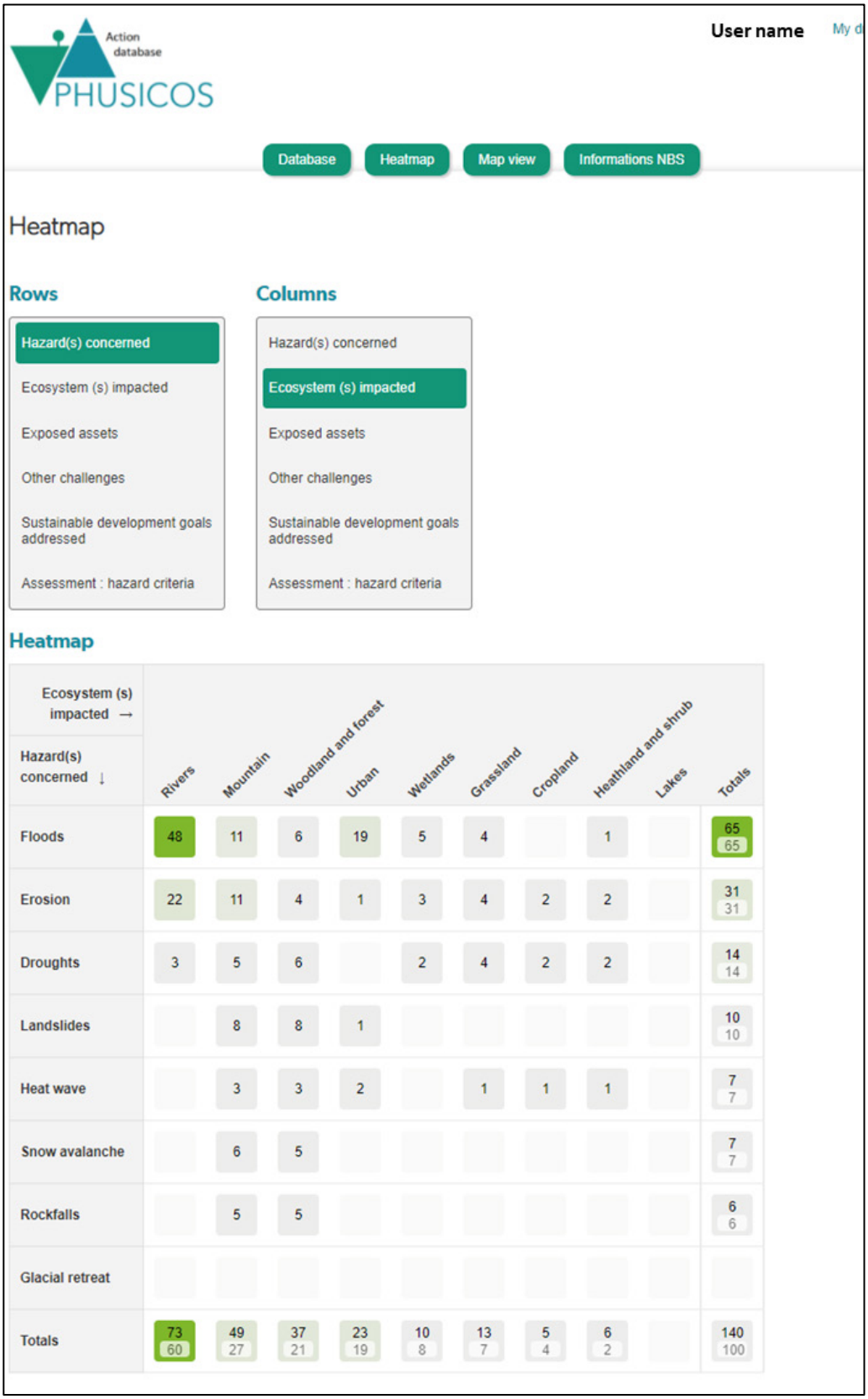

Figure 4. Heat map interface

Note that each button represents the total number of NBS cases satisfying the intersection of the two criteria. The summation buttons indicate the total number of cases identified by row and column, as well as the total number of *unique* cases identified (Figure 5). Individual cases may contain several parameters, and thus be counted multiple times.

Figure 5. Total buttons, heat map

Selecting one of the buttons on the heat map generates an additional information pane (below the heat map) providing a listing of the relevant NBS cases meeting the criteria associated with that button (*Figure* 6). Selecting an individual case description in this window brings the user into the description of the case in the database.

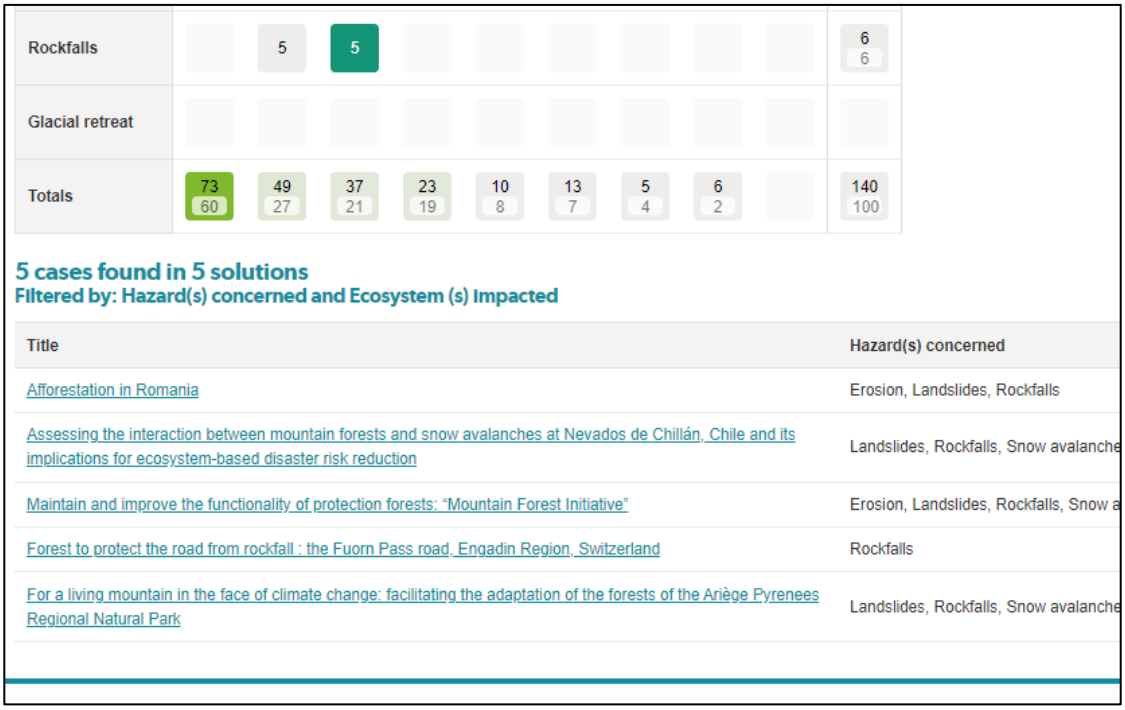

Figure 6. Pop-up pane indicating relevant NBS cases

3.2.3 The Map View interface

This view provides the user with an overview of the cases in the database by geographical location (Figure 7).

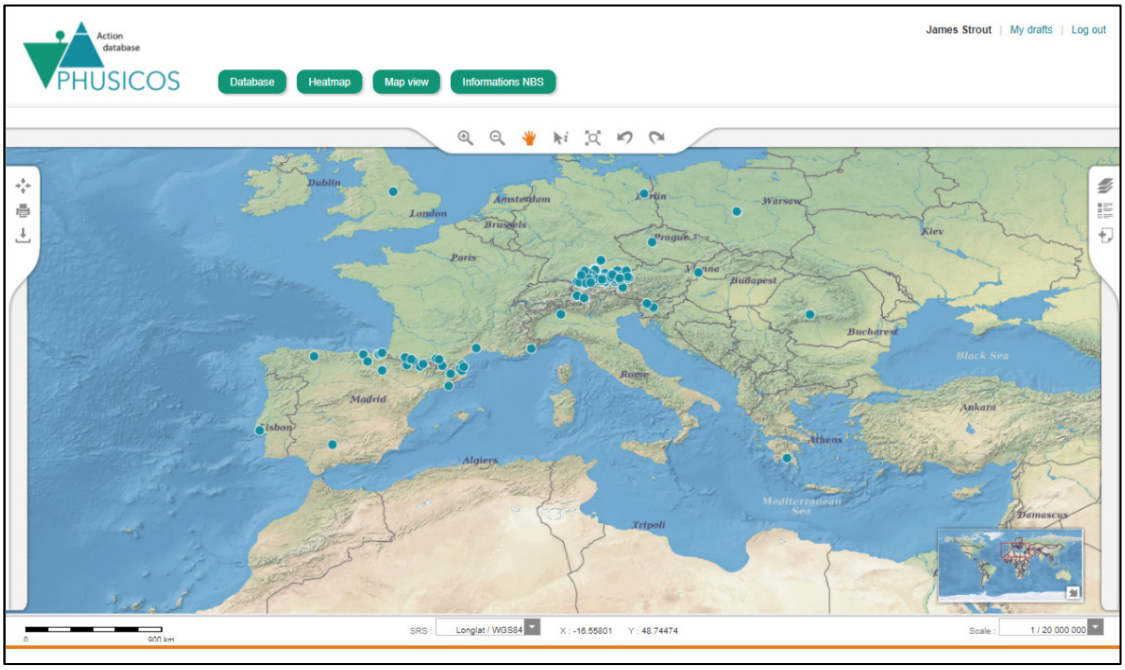

Figure 7. Map view interface

The user is offered several tool sets to interact with the map (Figure 8). The selection tool allows the user to pick individual NBS cases from the map, opening an information dialog box (Figure 9). The 'Read More' button in this dialog box brings the user to the case site description in the database.

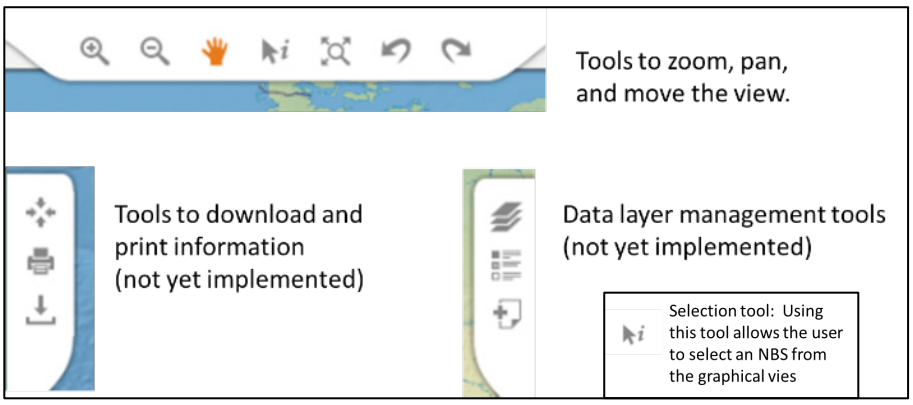

Figure 8. Map tools

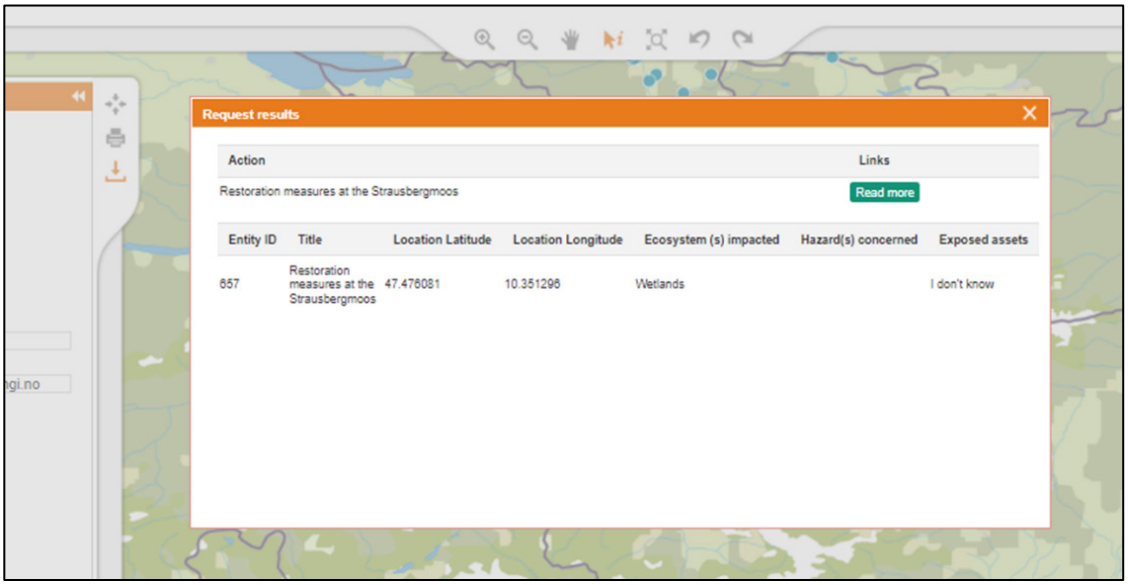

Figure 9. NBS information dialog window after using the selection tool to choose an NBS case on the map

3.2.4 The Site index view

This view is still under technical development. When fully implemented, this tool will provide the user with an access to all available data and documentation stored in the CMS for each PHUSICOS demonstrator case study.

The Button « Sites » permits to select the case study: « Serchio river », « Gudbrandsdalen », or « Pyrenees » (Figure 10).

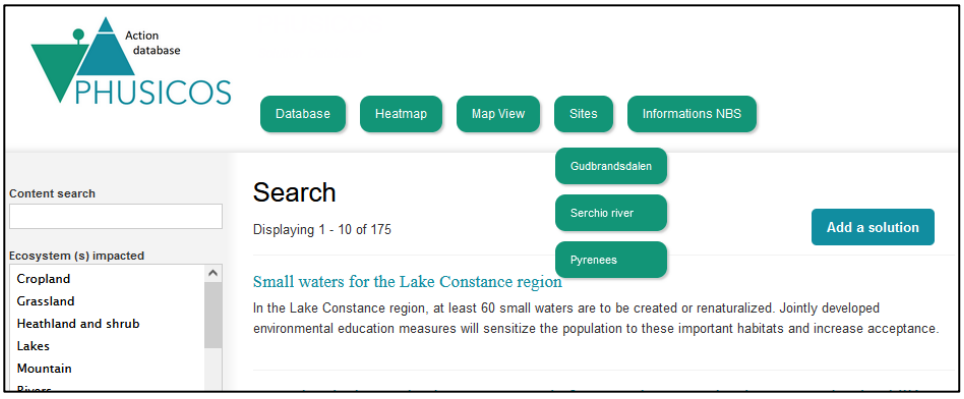

Figure 10. Submenus of the Sites button

Then in each case study, the content is composed of three parts:

The "summary" page (Figure 11) provides the description of the site and the NBS; it is dedicated to scientific and non-specialist people, and thus is written in English and in local language. In this part we can also find some link to external PHUSICOS platforms or link to download some additional information coming from other websites.

This section contains texts with graphics and maps (images), some technical information on the NBS implemented, technical inputs concerning the hazard and risk…

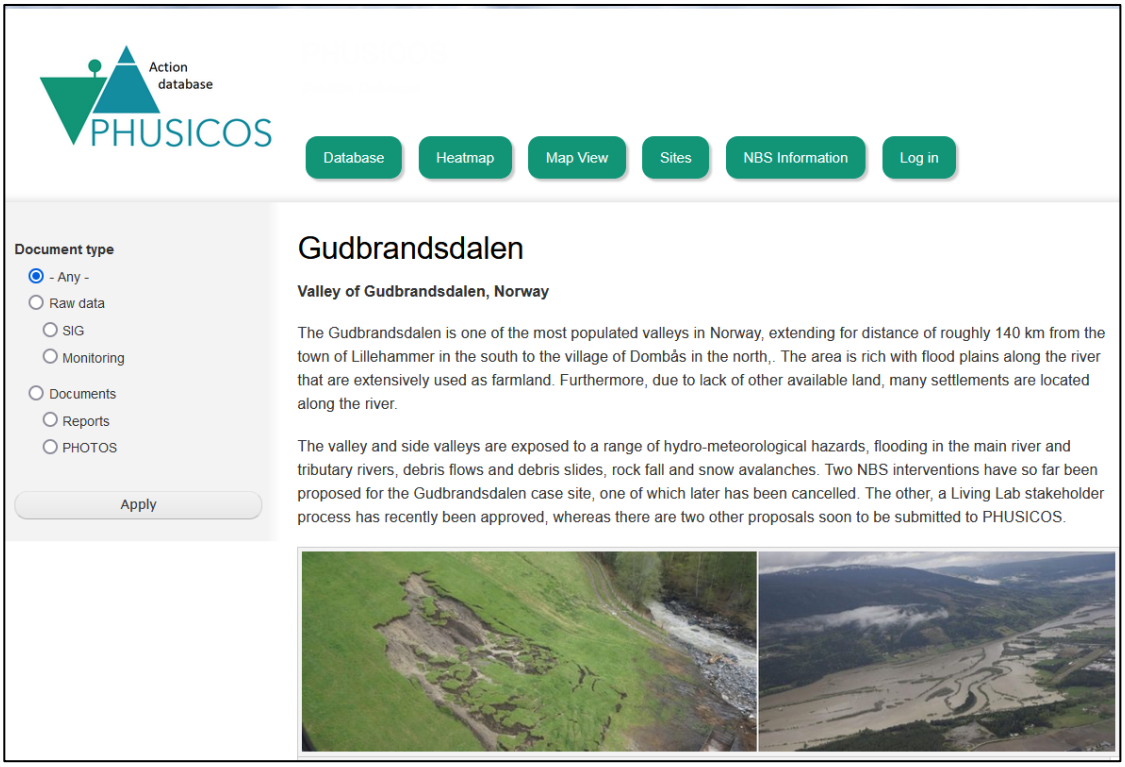

Figure 11. General presentation of Gudbrandsdalen case study Summary page.

a) A repository, which permits to store and share data. The access is limited to PHUSICOS partners and stakeholders of each case study. A classification of the available data can also be done, as seen on the left of the summary page (Figure 11). Searching the repository returns data files (Figure 12).
b) a GIS module, which permits to show all GIS data, mostly coming from WP4. It is based on CartoCMS technology already used in the Mapview (paragraph 3.2.3). An automatic zoom on the site will be done, with including pre-loaded layers (ex. Orthophotos). Data shall be made accessible in WMS.

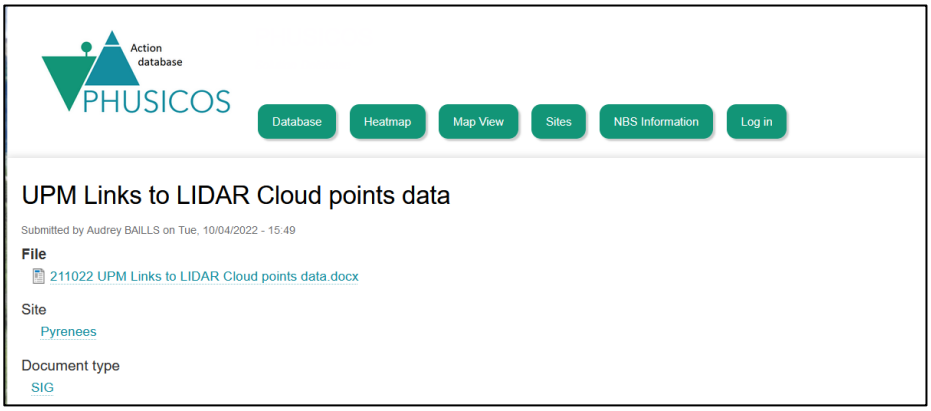

Figure 12. Example of data file for the Pyrenees case study.

3.2.5 The Informations NBS tool

This view/tool provides the user with a simple means to search through the database of cases and find available information and resources.

3.3 Contributing to the database

The database is read-only for open access users. However, once the user is logged in, they may add additional cases to the database. This can only be done via the 'Database interface', and the process is initiated by selecting the *'Add a solution'* button (Figure 13).

Figure 13. Adding cases to the database

The user is presented with a standard form for inputting the necessary case data (Figure 14). In general, this form covers nine topic areas including Solution ID, Description of the solution, Exposition, Activity, International classification, Actors, Temporal aspects, Financial aspects, and Other (participatory approaches, possibility to transpose the action …). Most data are entered by selecting one or several parameters from a standard set of choices. In some cases, the user will enter free text, links to external resources etc. (An example is shown in Figure 14.)

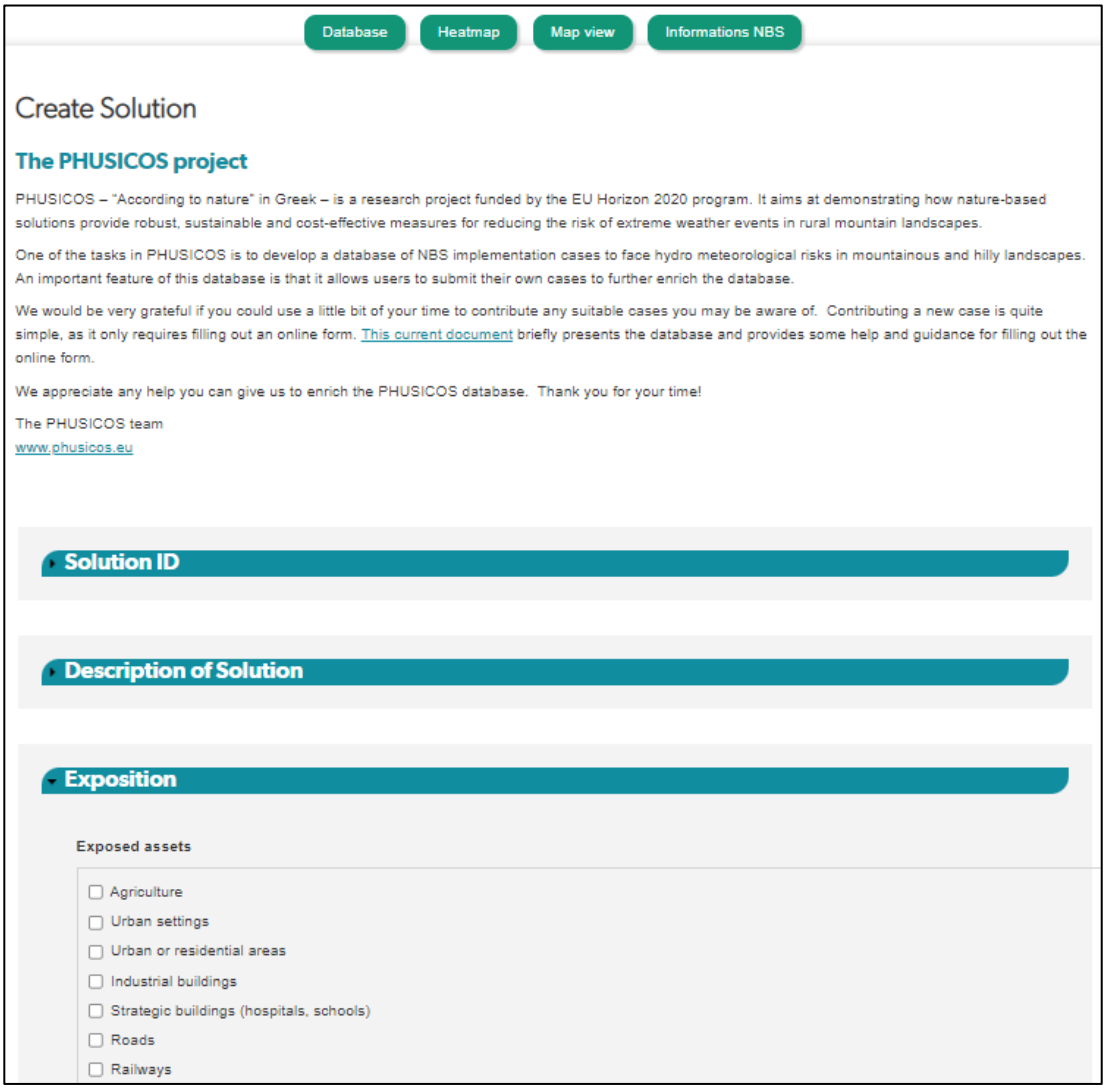

Figure 14. Creating a new case in the database

When completed, the user can select either to save a draft (for later editing) or submit the case for review by the system administrator (who approves publishing the case) (Figure 15).

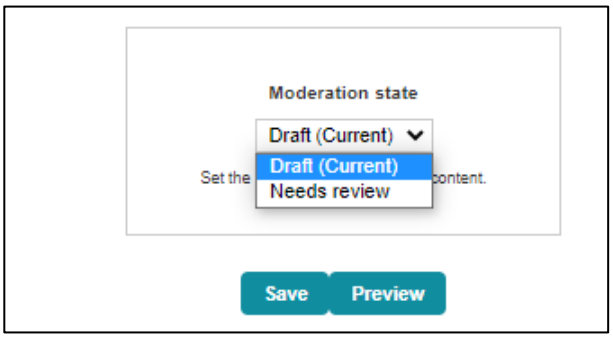

Figure 15. Saving/submitting a new case

3.4 Simplified framework for comparative assessment

WP4 of PHUSICOS developed a comprehensive framework for assessment of NBSs in context of natural hazard risk mitigation and ecosystem services monitoring (Autuori et al., 2019). The identification of NBSs Performance Indicators (PI) in this framework is based on a hierarchical structure, consisting of ambits, criterion, and sub-criterion. While the comprehensive framework approach offers the possibility to accurately (quantitively) evaluate and compare different scenarios for a same NBS site and in theory to compare different NBS sites, the framework is too complex to implement as a generalized comparative tool in the context of hundreds of NBSs being compared and considered across a wide swath of criteria and applications.

A simplified approach is therefore implemented in the PHUSICOS platform for that purpose (see PHUSICOS Deliverable 7.2), based on a qualitative evaluation of a reduced set of PIs. This qualitative assessment can often be made based on the information presented in case reports and literature and is not intended to be an expert evaluation but rather a practical, subjective evaluation based on the actual implementation of the NBS.

The criteria level is sufficiently general to be relevant over most NBS cases and at any scale. The scale is simple and is implemented as follows, with one answer per criterion (Figure 16):

+	if the NBS have a positive impact (on the criterion)
-	if the NBS have a negative impact,
+/-	if the NBS has an ambiguous impact,
0	if the NBS has no impact,
?	if the impact is unknown,
NA	when the criterion is not applicable or irrelevant.

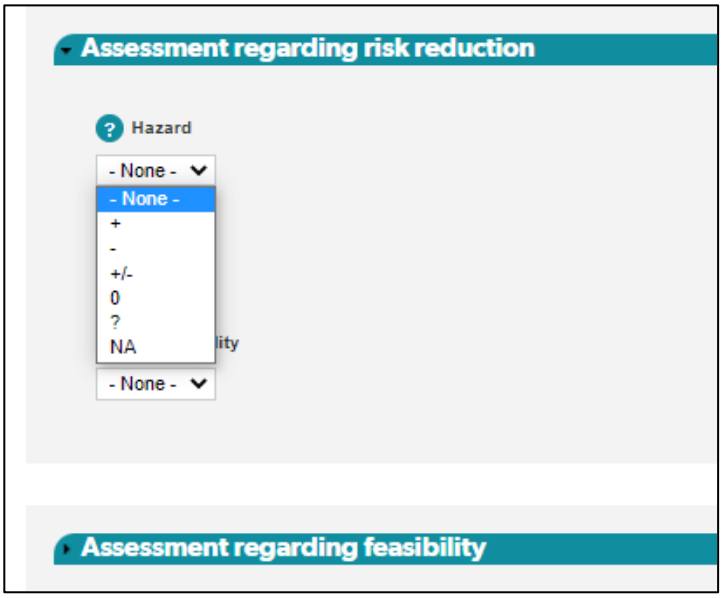

Figure 16. Example of the qualitative assessment using the simplified framework

4 IT specifications of the system

4.1 The global architecture

The implementation of the PHUSICOS platform is currently residing within the BRGM IT infrastructure. The system architecture is split into two parts (for data security) and hosted on virtual machines (VMs) running CentOS. The VMs communicate via TCP/IP port 5432 (Figure 17).

- The web service including the GUI and graphical functionality VM. This service is built on the Drupal web content management system (CMS) in PHP. (GNU General Public License), using also a CARTO service and custom plug-ins.
- The data service VM. This is a PostgreSQL (free and open-source relational database management system) and the PHUSICOS data set.

This specific arrangement was chosen due to BRGM security policy but may be implemented differently depending on the final partner hosting the solution.

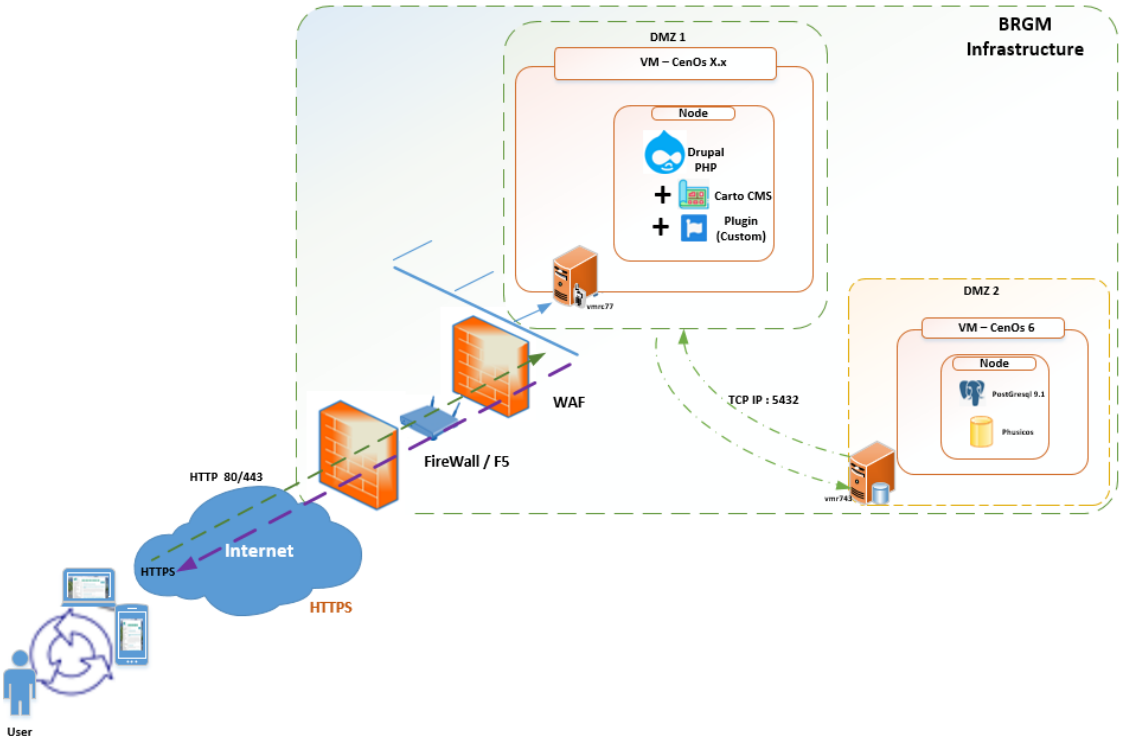

Figure 17. Overall diagram of the technical components of the IT PHUSICOS system

4.2 Hardware

The implementation is made using virtual machines, therefore the hardware specifications describe the VM instances hosting the implementation. Note that these

VMs are shared with other services, and thus the specifications are ample for the PHUSICOS platform service.

- Web service: 20Gb storage, 4Gb RAM, 4 CPU
- Data service: 50Gb storage, 2Gb RAM, 1 CPU

The file part weighs about 100M compressed and database (20Mb, not compressed and cache included...) for the whole.

4.3 Software

The following table specifies the software in use for this deployment.

Table 1 Software used

Components	Version	License	Comments
CentOS Linux	7.9.2009 (Core)	Open source.	Installed on web VM.
CentOS Linux	6.5 (Core)	Open source	Installed on database VM.
Docker Compose	1.23.0	Docker subscription service agreement	For Import tools and web
Drupal	9	GNU GPL	
PHP	7.4	PHP License v3.01	PHP
Apache	2.4.7	Apache Software Foundation	Apache
CartoCMS	12.2+	BRGM intellectual property, provided to PHUSICOS project for free	BRGM Internal module
PostgreSQL	9.1	Open source	
Plugin custom		BRGM intellectual property, provided to PHUSICOS project for free	BRGM Internal module

5 Legacy options for the PHUSICOS platform

The PHUSICOS platform will be maintained on the BRGM infrastructure until the end of the project. Following completion of the project it will be necessary to secure the legacy of this work and to decide an appropriate way forward to preserve the results produced in WP7. Whatever solution is chosen will involve effort and some cost needed to realize the transfer.

Several potential solutions have been identified:

BRGM as host

In this scenario, BRGM continue to manage, upgrade and maintain the hardware and software parts of the platform so that it remains available for use by stakeholders for browsing, sorting, and evaluating NBSs as well as adding new data in the database. This

solution is technically the simplest to implement (continuation of the current operations), but would incur costs after the end of the contract.

Moreover, a new French research program **IRIMA** (Integrated RIsks MAnagement for more resilient societies at the global changes era) will begin in 2023. This important project (Budget of 52 M€) will permit to fund during 8 years researches on risks sciences (PhD, Calls for proposal, equipment…). Notably, IRIMA includes a WP on numerical platforms that could include PHUSICOS one.

3rd Party as host

The technical components of the platform and all of NBS data collected are transferred to another organization, who implement the service and operate it in a similar way as the BRGM hosting. This is a technically complicated solution, as it may require re-developing parts of the underlying implementation to support the system in different environment. Note though that the underlying technical implementation should not alter the look and feel of the service. Implementing a 3rd party host requires identifying an appropriate organization to take charge of the entire system. To accomplish this we will need to identify possible organizations, and propose (negotiate) and agreement to put this into effect.

Potential organizations for 3rd party hosting or distribution of components:

- DRMKC: Disaster Risk Management Knowledge Center.
- H2020 projects: OPERANDUM, RECONNECT or other ongoing projects
- NetworkNature/Oppla

Distribute components

The PHUSICOS platform is split into functional components or elements that could be inserted in other existing IT tools developed in other H2020 projects. While a technical analysis would be necessary to identify which functional components can be identified, some examples include:

- The database and all technical content
- Simplified framework for comparative assessment
- Graphical designs and functionality of Heatmap tool
- Scripts/codes used to develop the graphical views and to filter the data

Once potential components are identified, then a negotiation would be necessary to determine which other organizations or platforms may be relevant for these components. This work will also have a certain cost that must be evaluated.

6 Remaining technical work under WP7

The site interface (Section 3.2.4) is still under development and should be finalised as soon as possible so the partners responsible for the sites can upload data related to their sites.

The last point remaining is the development of the map interface (Section 3.2.3) is order to integrate raster files or other geographical data relevant for enlightening the impacts of NBS on sites.

7 Cost / economic impacts

The PHUCOS platform is mostly built on open-source tools and software, thus license costs are mostly irrelevant. The BRGM implementation has some toolboxes that will be provided for free to the PHUSICOS project under a hybrid license.

Porting of the entire platform, or alternately components of the platform, will incur additional costs that fall outside of the PHUSICOS contract. These technical porting costs should thus be evaluated and an assessment made as to where they can be covered.

For the phase of maintenance by BRGM, hosting and operations costs should be budgeted.

8 Conclusion

The PHUSICOS platform provides a solution to collect and work with information about all NBSs related to DRR associated with extreme hydro-meteorological events in mountain landscape. These events impact the local economy of the affected regions and cause anxiety for the affected populations, in interface with the human and social sciences.

The WP7 has mapped existing data platforms and analysis of NBSs. It has co-develop with the stakeholders, an interactive and interoperable web-platform tool for demonstrating and maintaining data for NBSs by crossing multi-component, multi-thematic and multi-criteria information.

In the future, the on-line “PHUSICOS sites” interface must be finalized and enrich with rich content collected on the PHUSICOS living-labs.

9 References

Autuori, S., Caroppi, G., De Paola, F., Giugni, M., Pugliese, F., Stanganelli, M., and Urciuoli, G. (2019). PHUSICOS Deliverable D4.1: Comprehensive Framework for NBS Assessment. Available at: https://phusicos.eu/wp-content/uploads/2019/05/D4.1_Task4.1_UNINA_14052019_Final_withAppendicies.pdf

Baills, A., Grandjean, G., Maspataud, A., Ettinger, S., Abad, J., Dias, N., Albris, K., Hemmers, J., Clegg, G., Martucci, C. (2020b) The ESPREssO Action Database: Collecting and assessing measures for disaster risk reduction and climate change adaptation, International Journal of Disaster Risk Reduction, doi: https://doi.org/10.1016/j.ijdrr.2020.101599.

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