PHUSICOS

According to nature

Deliverable 7.4

Web-based tool – module 4 (Long-term support)

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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Summary

PHUSICOS focuses on demonstrating the effectiveness of nature-based solutions (NBSs) and the benefits of using them to mitigate small and frequent weather induced hazards 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 information management 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 latest structure and content of the PHUSICOS platform, and describes the long-term strategy for support and maintenance of the platform to ensure sustainability…

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 NBSs developed within the PHUSICOS project as well as what could be identified in literature.

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

The PHUSICOS platform was hosted on the BRGM IT development infrastructure during the project period. At the contractual end of PHUSICOS it will be moved to an operational IT environment and maintained by BRGM for 5 years. Necessary actions will be adopted to ensure the durability of the tool.

This document presents two topics: the design concepts and latest developments for platform presented; and the engagements taken to ensure the legacy of the platform and the collected data beyond the end of the PHUSICOS project.

2 Latest updates to the platform

This section provides a basic introduction and last updates on the user experience and the interactive function of the platform. The database is implemented based on Baills 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.

The latest platform was developed on the internal development environment https://phusicos-d9.brgm-rec.fr and will be moved before the end of the project to the operative environment hosted at https://phusicos.brgm.fr.During the last months of the project, the update of the CMS version has generated many bugs in term of both format and functionalities, and this has required a lot of work to fix each dysfunction.

2.1 The user experience

The PHUSICOS platform is an online tool hosted at the domain phusicos.brgm.fr. It can be accessed directly or by linking from other websites. The portal is available in English. The platform 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 after its creation.

During the development phase some issues and problems were experienced for the registration of users and consequently updating of the database. These issues have been solved for the operative version.

2.2 User Interface

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):

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

Most sections were already developed previously and are described below to offer a complete view of the final platform. Since D7.3, developments have been concentrated on the Map view interface and the Sites interface.

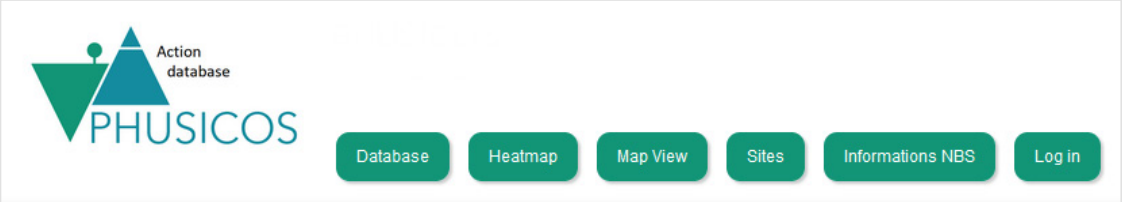

Figure 1. Common header for all views: Interface selection and user information

2.2.1 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 'Contributing to the database' given below.

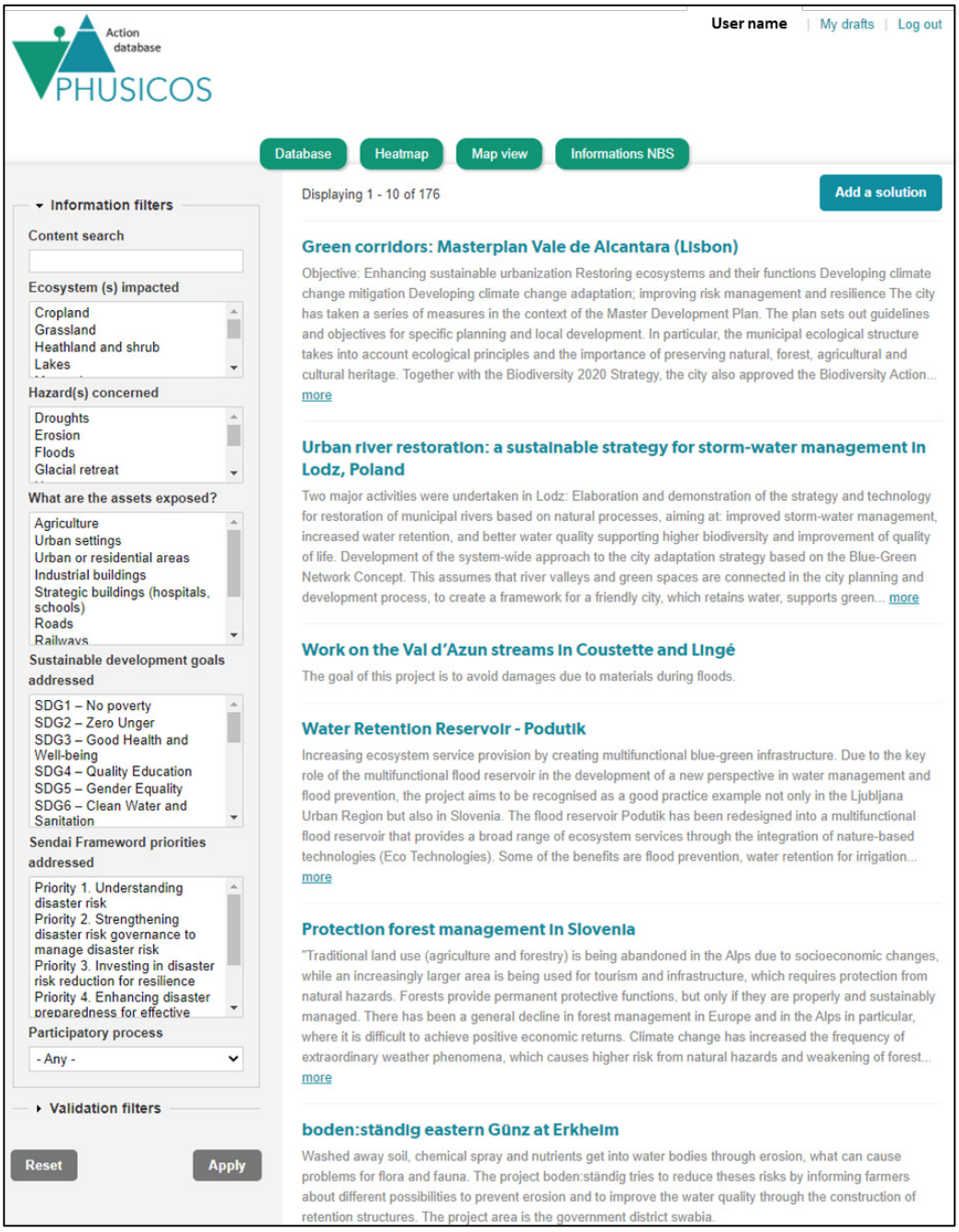

Figure 2. Database interface

Cases in the database are archived with quantitative data 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'.

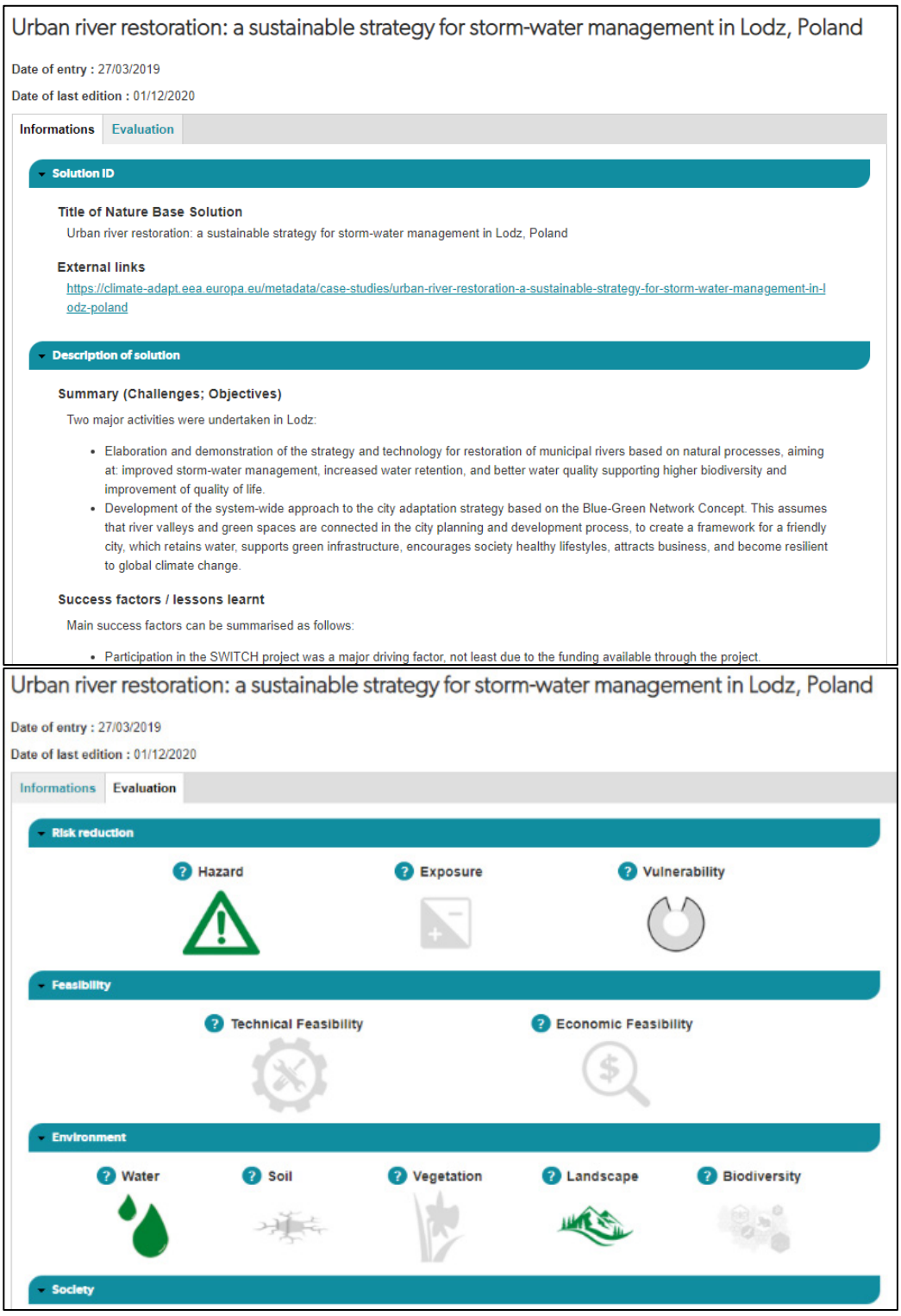

Figure 3. Example NBS case in the database. Top: Information tab, Bottom: Evaluation tab

2.2.2 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 is search using each set of parameters in the matrix and returns the number of individual database entries (cases) for each parameter 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.

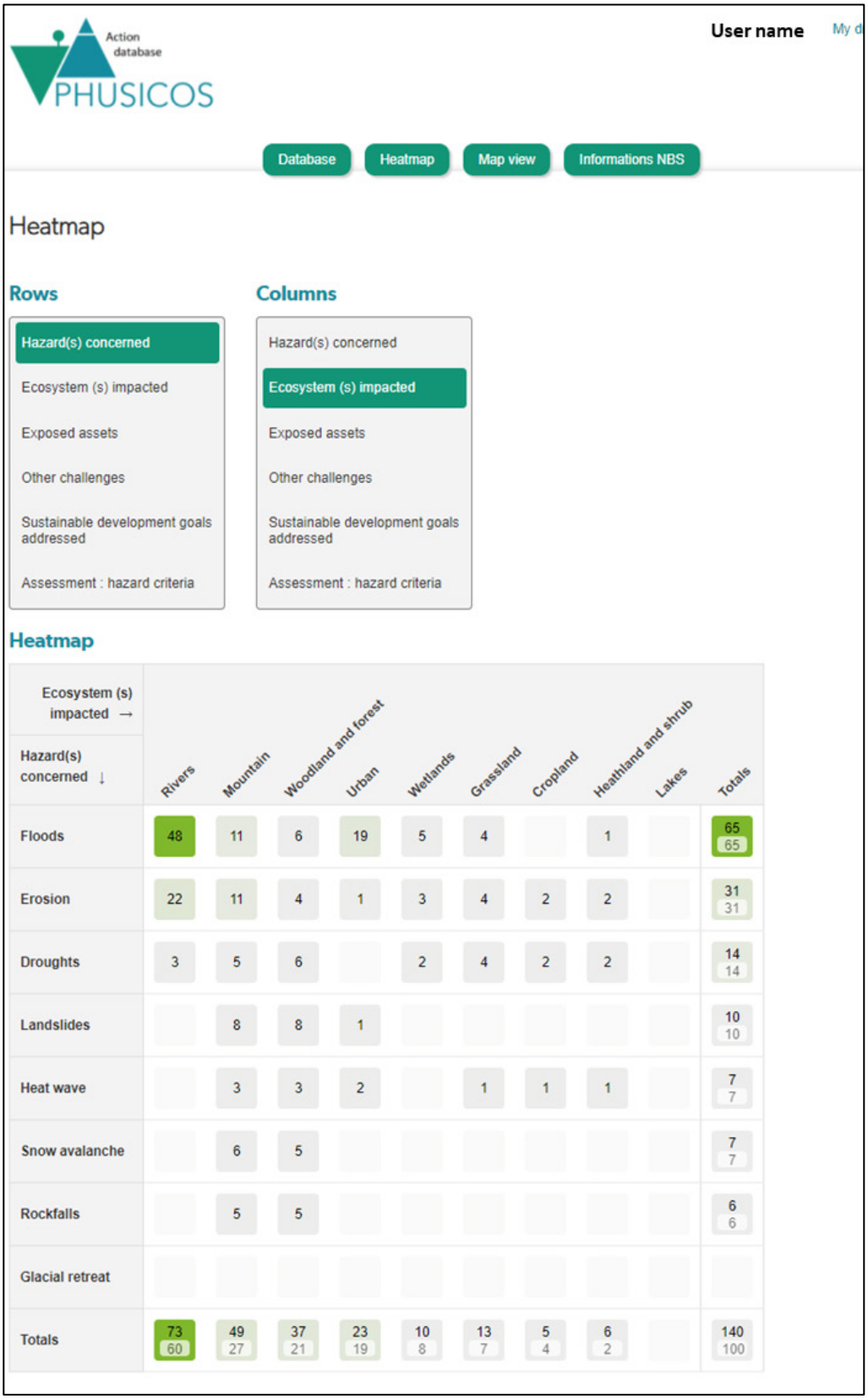

Figure 4. Heat map interface

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.

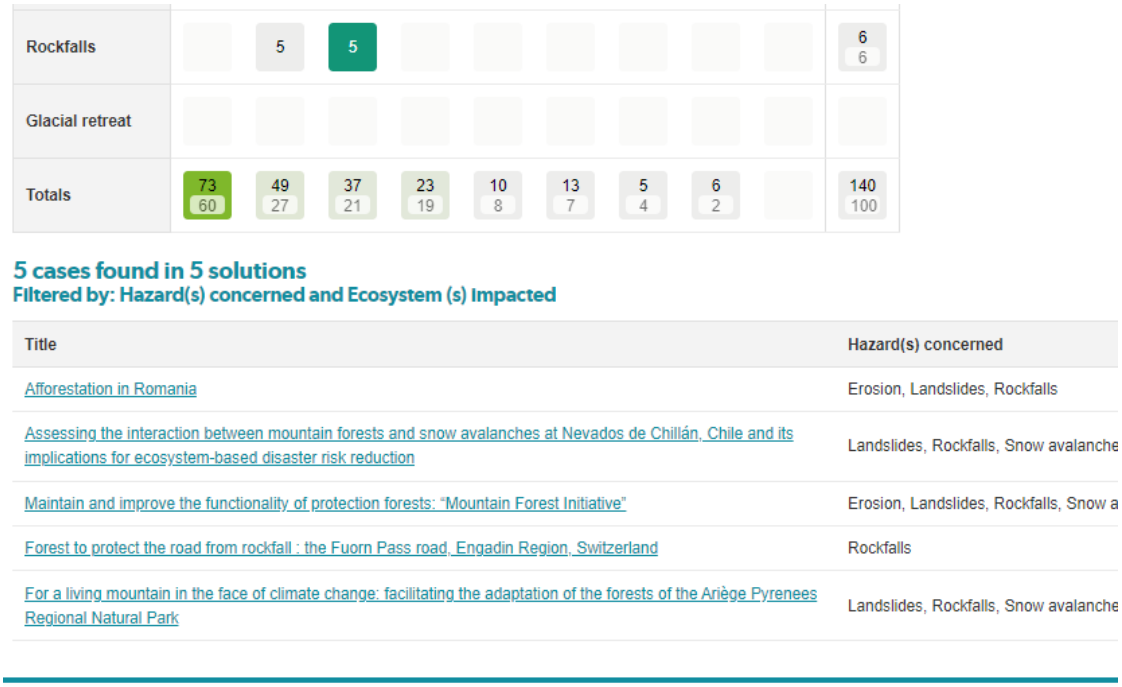

Figure 6. Pop-up pane indicating relevant NBS cases

2.2.3 The Map View interface

As mentioned previously, the map view interface has been updated.
This view provides the user with an overview of the cases in the database by geographical location (Figure 7).

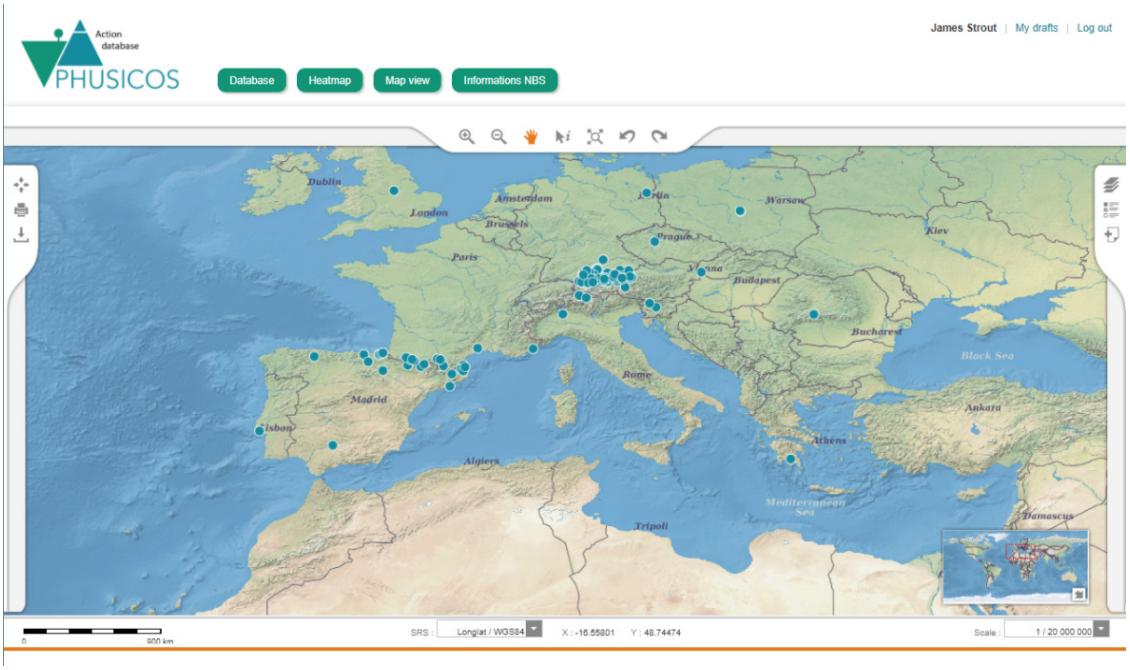

Figure 7. Map view interface

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.

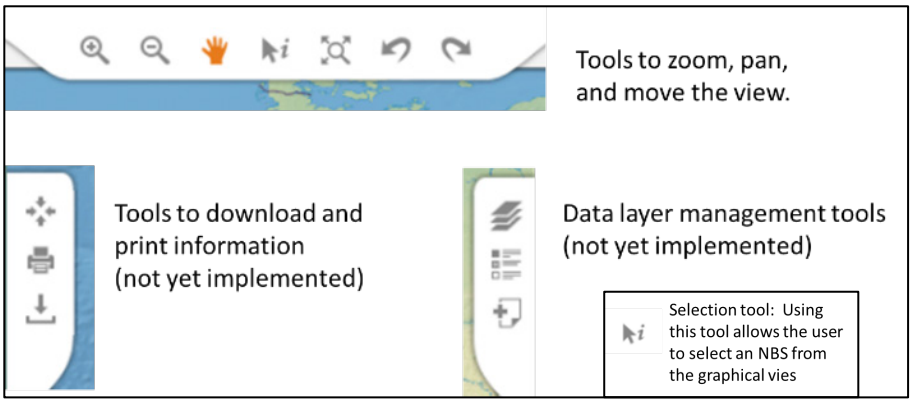

Figure 8. Map tools

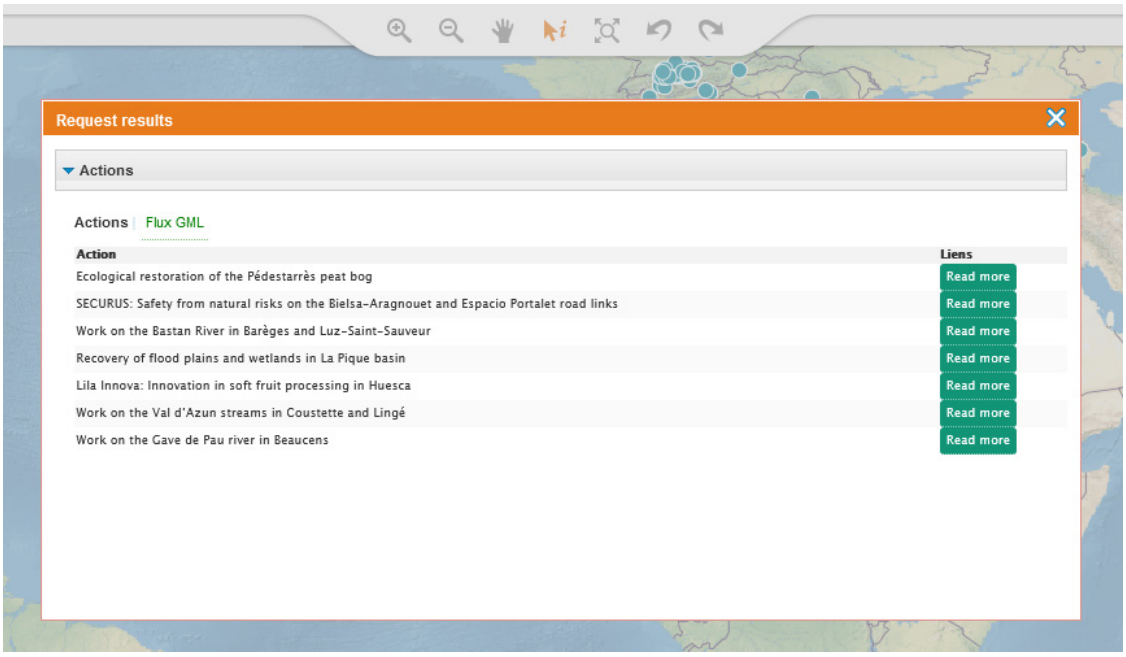

Figure 9. NBS information dialog window after using the selection tool to choose an NBS case on the map

Now, GIS data can be visualised on the map view interface. To propose GIS data permanently for all the users, web map services (WMS) should be provided to the administrator of the site together with the description of the data. Nevertheless, all users can visualise available WMS on their own interface. To do so, users should in the Map view interface, “couches externe”, enter the wms link in the search field and use the “interroger” button. Available layers appear below (Figure 10).

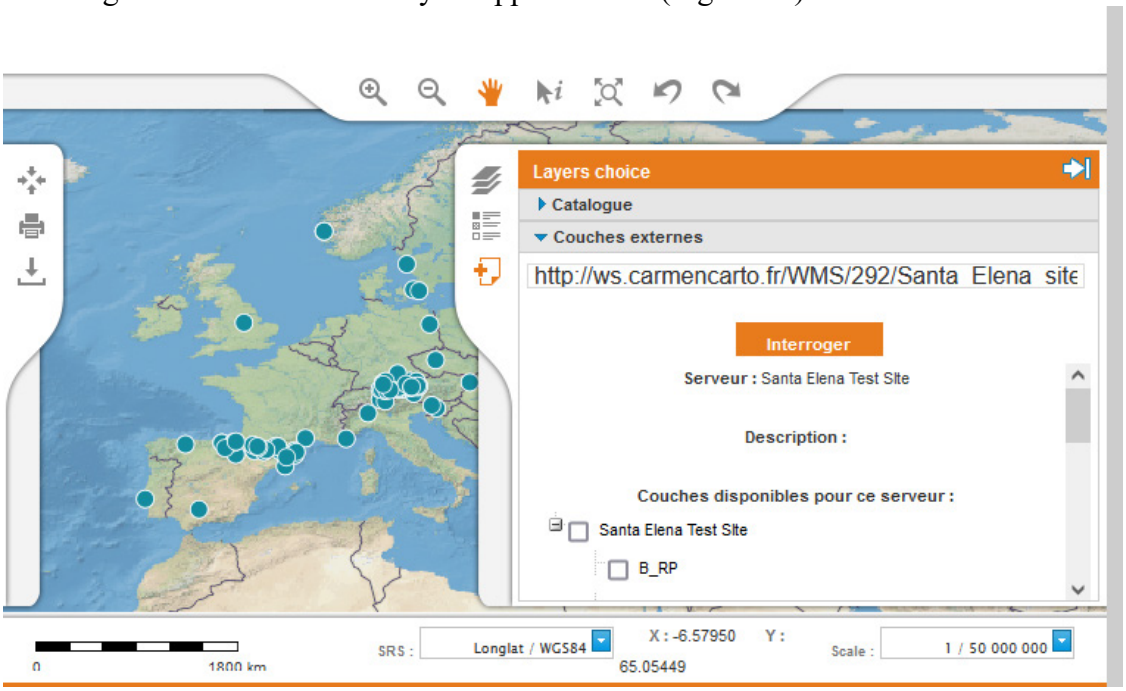

Figure 10: Consulting wms data

PHUSICOS team has added data from PHUSICOS sites that are available to all users of the PHUSICOS platform, especially data demonstrating the differences between different NBS scenarios. Thus, hazard maps can be displayed based on return periods, and the presence of (or lack of) NBS scenarios.

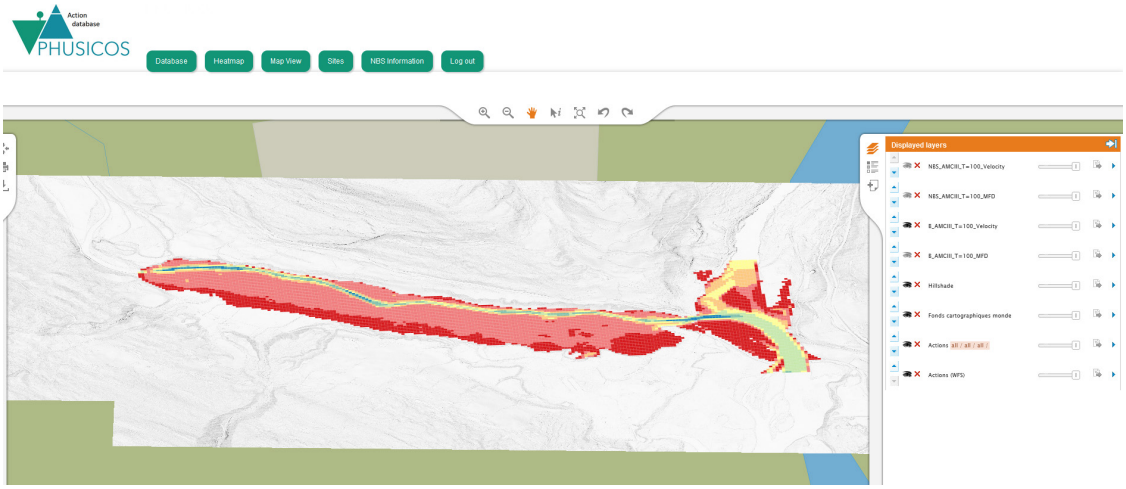

Figure 11: GIS elements on the Map view interface

Data from the cases at Gudbrandsdalen (Jorekstad and Øyer), Serchio river (Gioia and Studiati), and the Pyrenees (Artouste and Santa Elena) have been added. The layers can be selected in the "catalogue" tab (Figure 12) and then organized and managed in the "Displayed layers" tab (Figure 13).

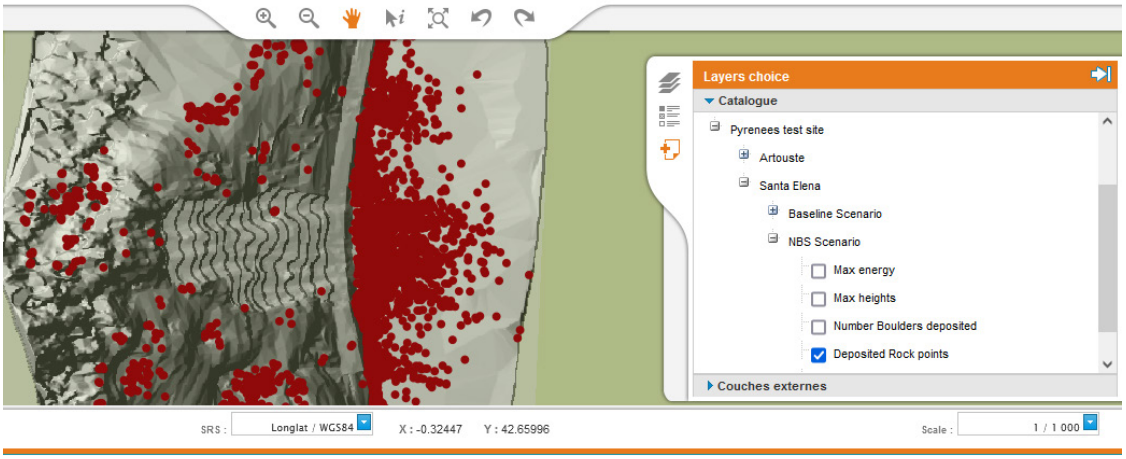

Figure 12: Selection of the layers to be displayed in the "Catalogue" tab

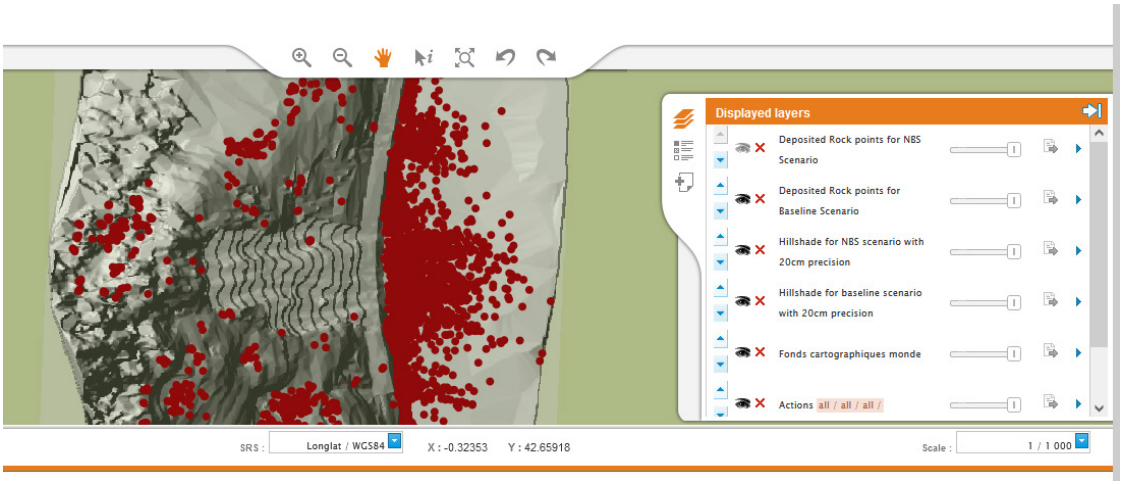

Figure 13: Displayed layers can be managed in the "Displayed layers" tab

2.2.4 The Site index view

This tool – which has also been updated -provides the user with access to available data and documentation stored in the CMS for each selected demonstrator site.

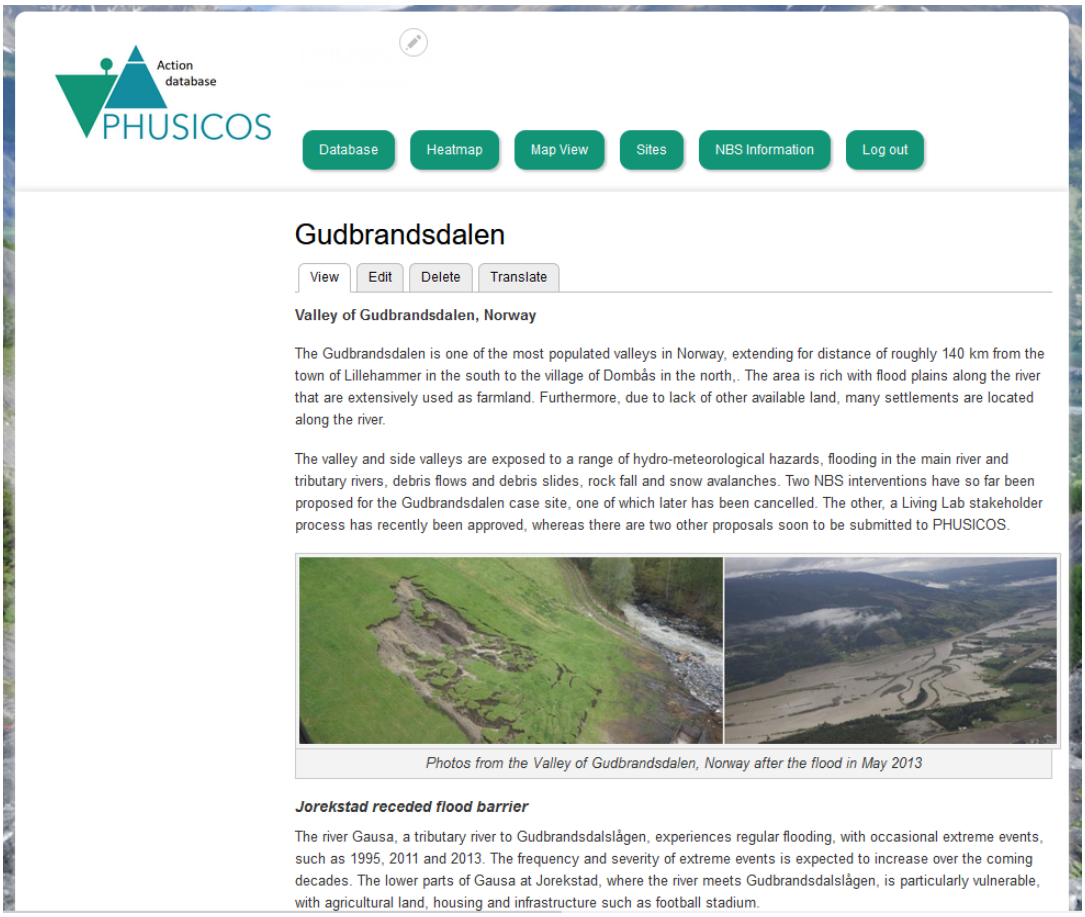

Figure 14: General information on the Gudbrandsdalen site, Norway

This interface is composed of:

- A summary part, which provides the general description of each site and the NBS implemented. Links can be provided in this part to external platforms or locations to download data.
- A repository, which permits gathering and sharing of information for each case study. The main window presents a typology of the, such as: Data (csv), Documents (pdf), Photos (jpg), GIS data (shp)… as well as a button to download them.

2.2.5 The Information's 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.

2.3 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 this approach offers the possibility to accurately (quantitatively) 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 (relevant for that criterion):

+	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.

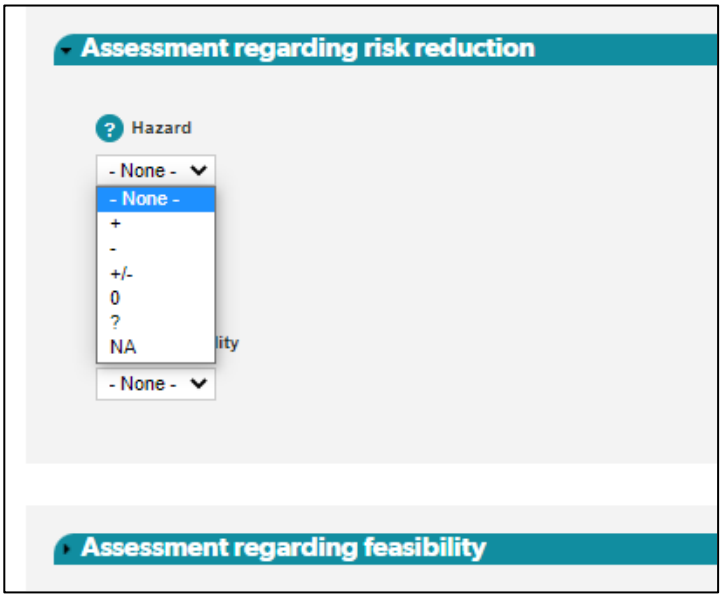

Figure 15. Example of the qualitative assessment using the simplified framework

2.4 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.

2.4.1 Adding new solutions

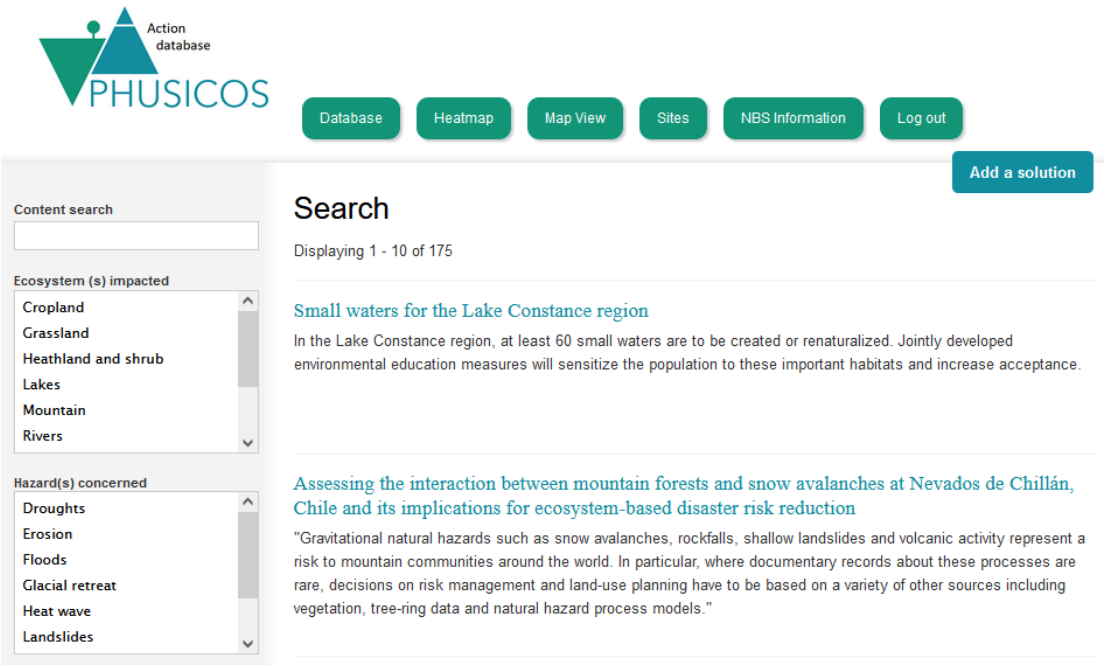

Figure 16. Adding cases to the database

The user is presented with a standard form for inputting the necessary case data. 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 17.

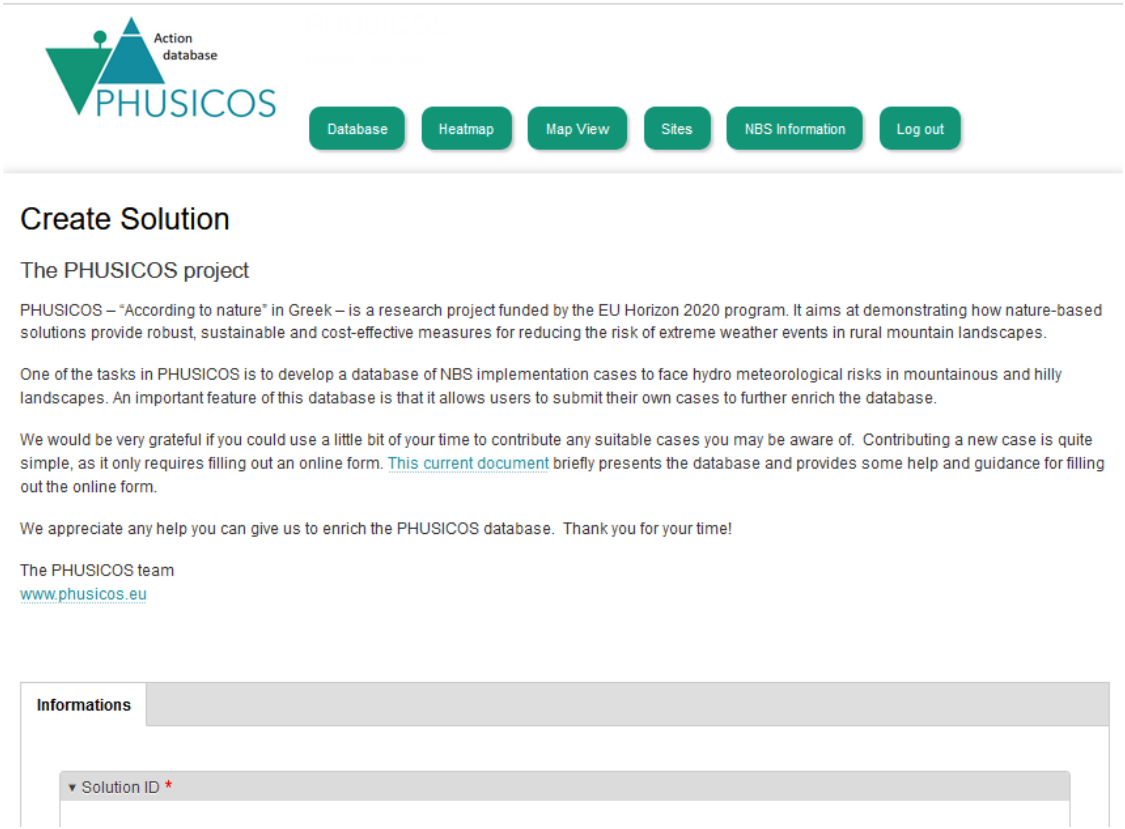

Figure 17. Creating a new case in the database

After the data of the case, the user should complete the assessment questionnaire (Figure 1Figure 18). Finally, the solution can be previewed or submitted directly.

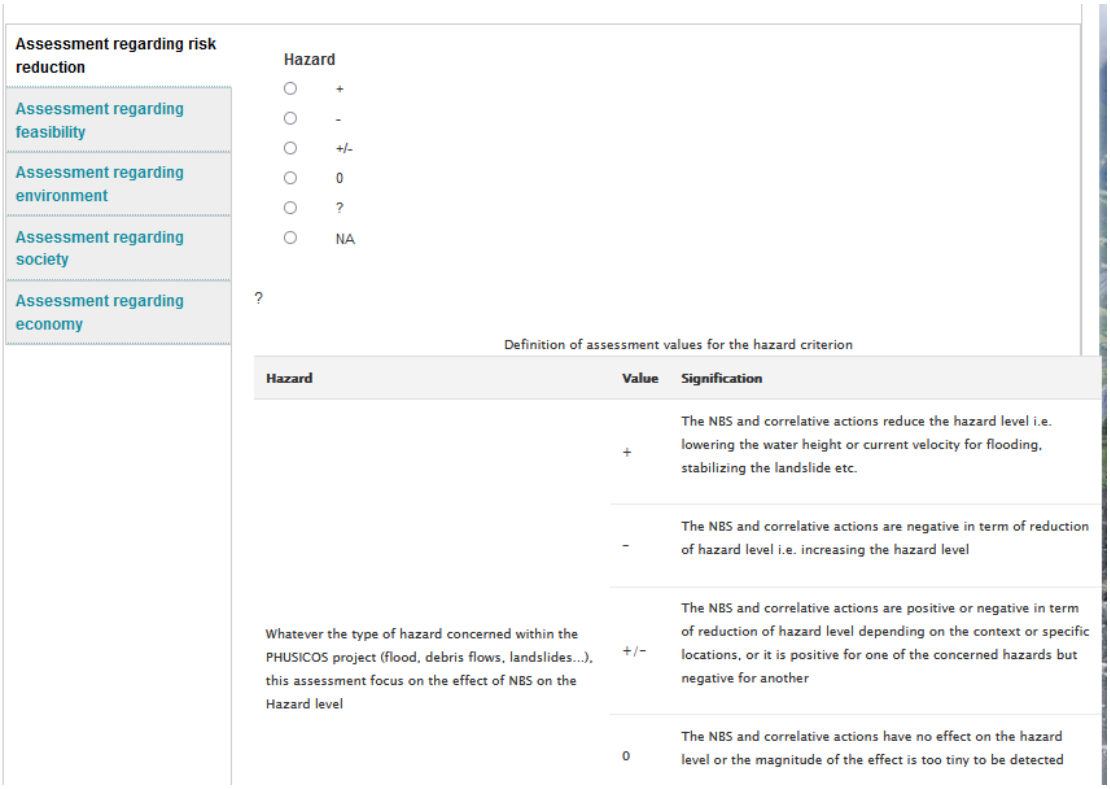

Figure 18: Assessment part of the data entry questionnaire

2.4.2 Editing/revising an existing solution

The user can only edit his own solutions. To do so, he should go to the action page and select the "Edit" tab (Figure 19). The user can thus modify all fields as described in section 2.4.1. The solution can also be deleted from the "delete" tab (Figure 20).

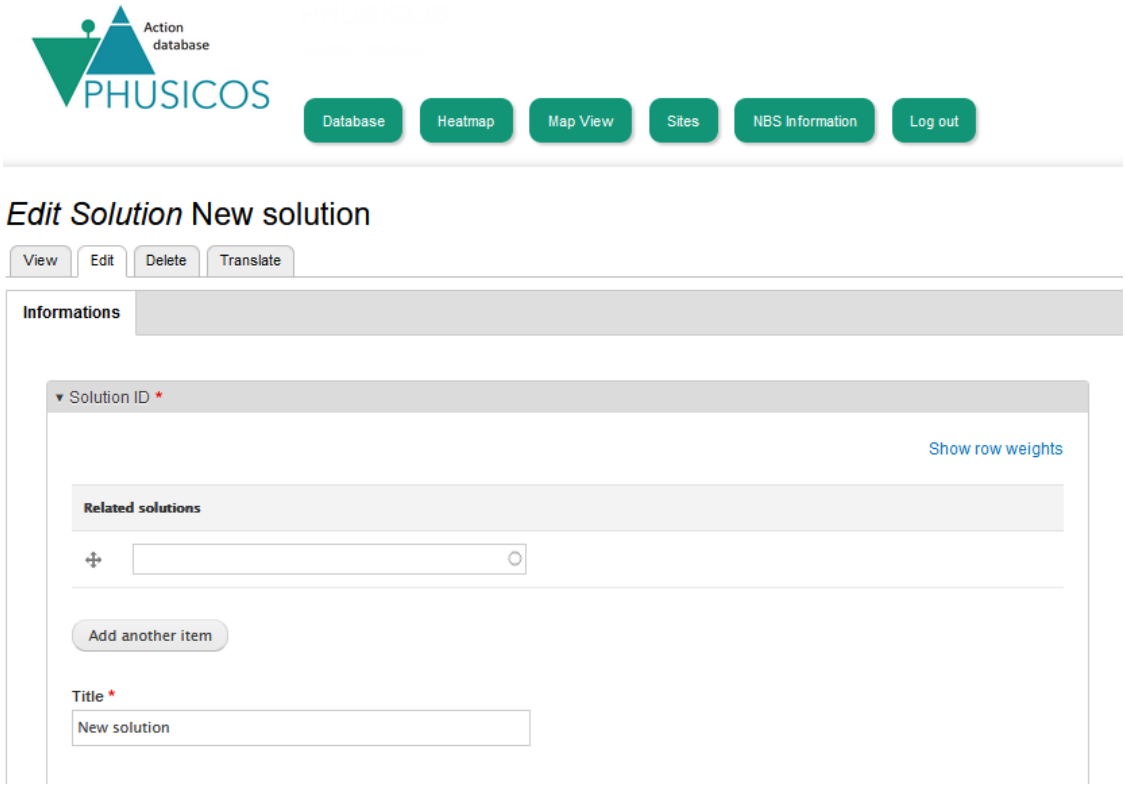

Figure 19: Option available on the actions authored by the user and the "edit" tab

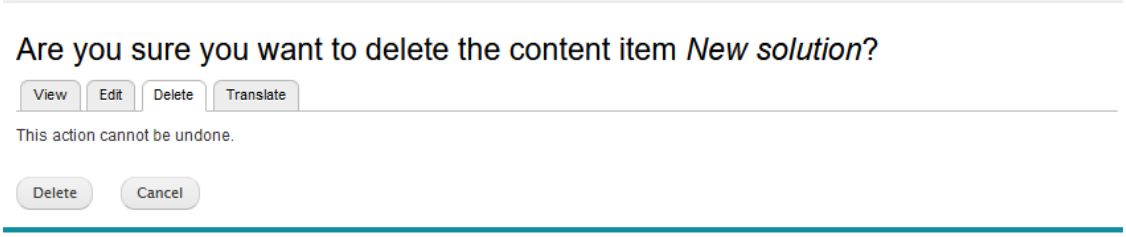

Figure 20: Option available on the actions authored by the user and the "delete" tab

2.4.3 Uploading documents / data

The logged in user can also contribute the NBS information tool. Once on the NBS information tool, the user should choose the nature of the document he wants to add (Figure 21). Then he is redirected to the corresponding data entry questionnaire (Figure 22).

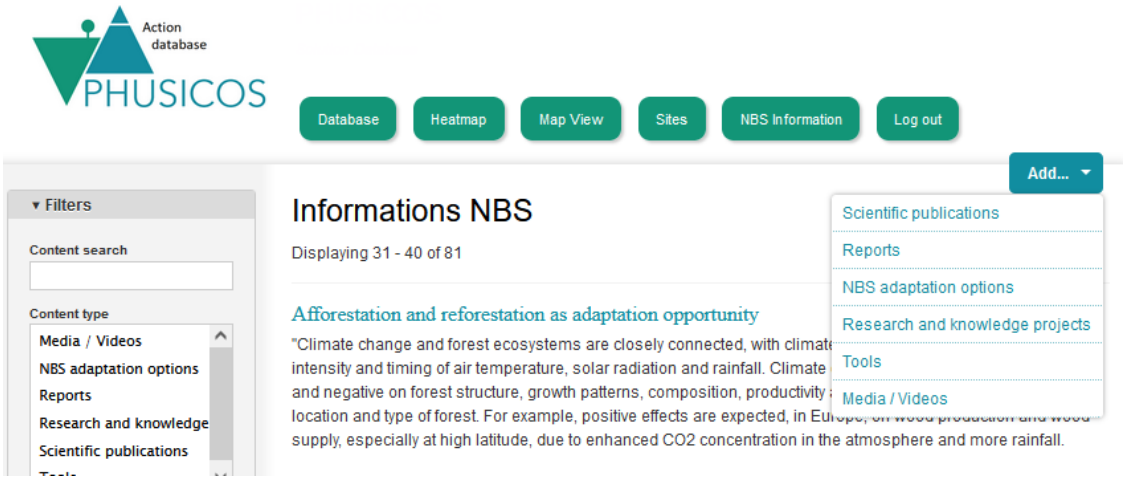

Figure 21: Contribution to the information NBS tool

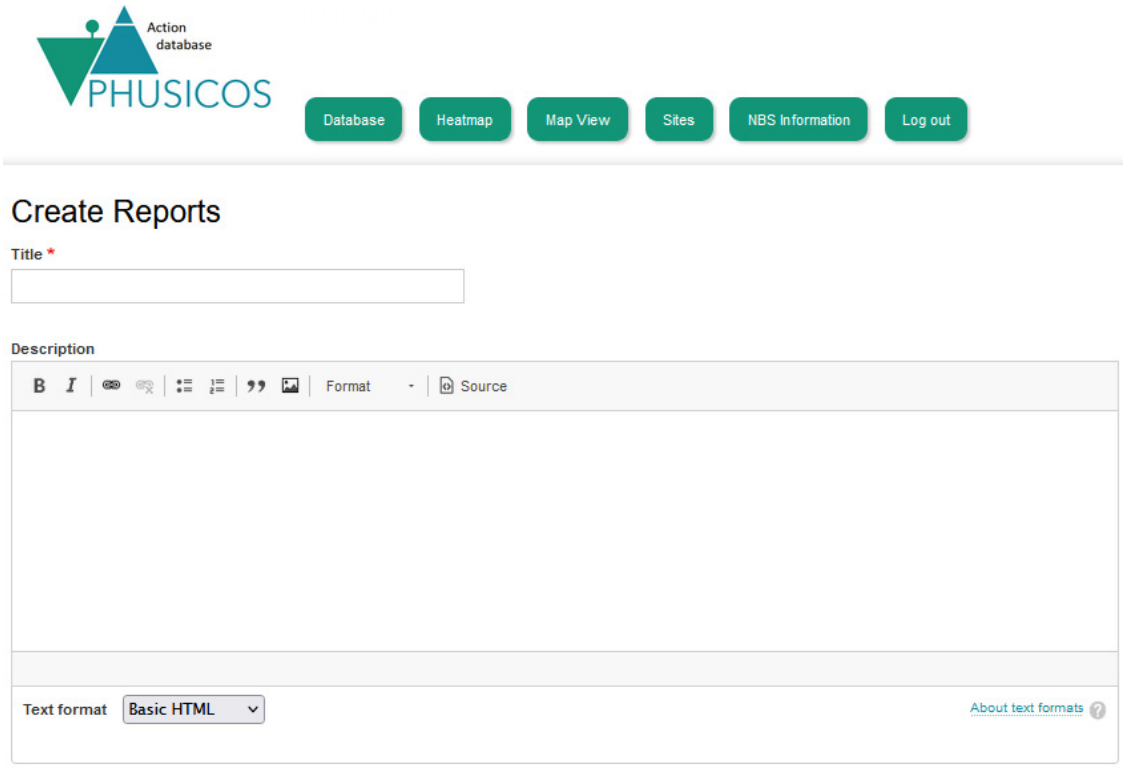

Figure 22: Example of the interface to submit a new report entry

3 Co-development experiences

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.

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.

- 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 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.

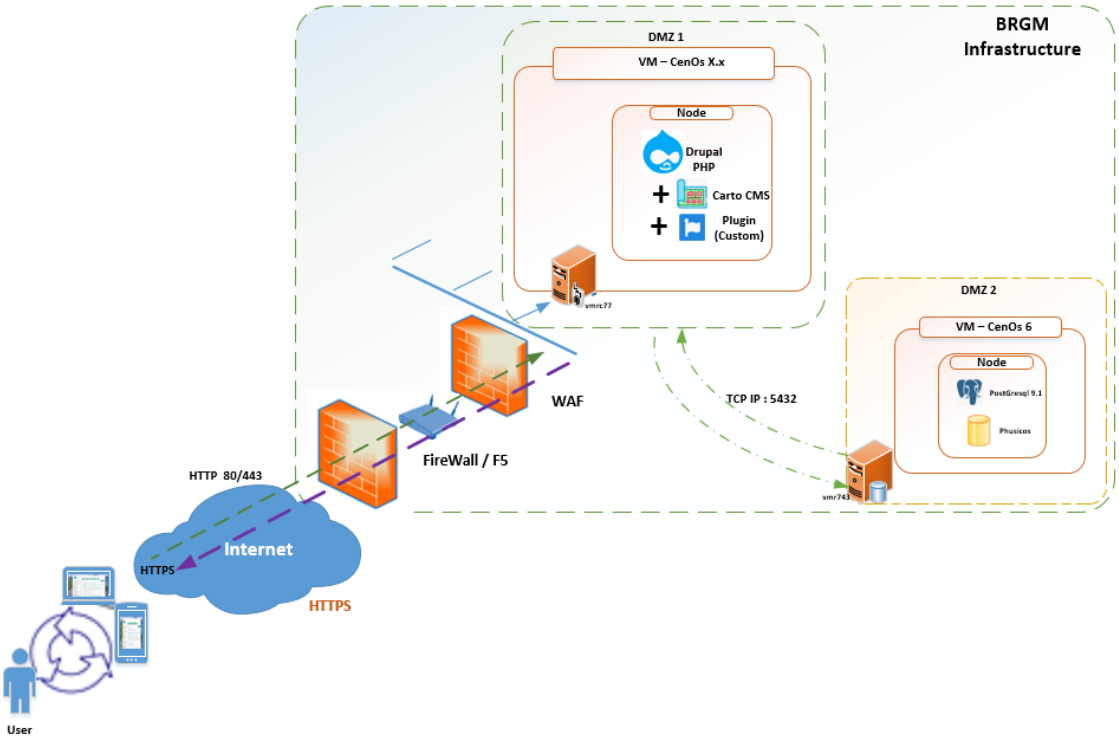

Figure 3: Overall diagram of the technical components of the IT PHUSICOS system.

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 (Open source)	Installed in a container in Web VM
Apache	2.4.7	Apache Software Foundation (Open source)	
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 Long term strategy for the PHUSICOS platform

5.1 Operational continuity

The PHUSICOS platform has been transitioned from an IT development environment (https://phusicos-d9.brgm-rec.fr) to an Operations environment with a dedicated web domain (https://phusicos.brgm.fr). This implementation will be maintained by BRGM for 5 additional years. At the end of this 5-year period, BRGM will make a new evaluation and choose the appropriate strategy at that time for the legacy of the data and the platform.

During the 5-year period BRGM will 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.

In addition, the Phusicos platform will be proposed within IRIMA French research program (Next Generation EU), that will last 8 years for a budget of 52 M€. IRIMA will gather the French organizations working on risks. One of the IRIMA WP is dedicated to numerical platforms and could thus include Phusicos platform.

5.2 Database content sharing/accessibility/Reuse

In addition, data from the platform is going to be transferred to public data repository so other organizations, who implement the same kind of services can integrate these data, and anyone can consult it. The Zenodo data repository (https://zenodo.org) was chosen for the deposit of the data and obtaining a doi number (10.5281/zenodo.7561629). The deposit of the data on Zenodo, will be done just before the end of the project to ensure the deposed data is as complete as possible.

5.3 Technology sharing

As long as the platform is maintained by BRGM, there will be no technology sharing to avoid duplication of the platform. After the end of maintenance by BRGM, the possibility will be considered for some elements of the platform (not including the map view which is not developed with an open-access module).

5.4 Cooperation with Network Nature

The team following maintaining the PHUSICOS platform after the end of the PHUSICOS project will follow the Network Nature Task force 1: "Data and Knowledge sharing". This task force is dedicated to defining and implementing an effective approach to share, search and reuse data and knowledge related to nature-based solutions and it is thus appropriate to register the Phusicos platform as an NBS resource in the Network Nature resource database.

6 Lessons learned

6.1 IT development process

There were a couple of fundamental challenges faced during the IT development process. The first was a mismatch in typical IT development projects as compared to the tempo and nature of scientific projects, and the second was the continuity and availability of IT resources. The third was adhering to the philosophy of open source and freely available tools.

IT development within a professional IT community typically follows a specification-based approach, with well-defined expectations of functionality and performance. The most common approach would be a complete specification followed by a development phase. The development phase results in a prototype (alpha or beta version), which following verification and testing is sent back to the development team for modification or updating as needed to satisfy the design specification. In contrast, a research project often initiates with clear hypothesis or goals, but the concise details of how this will be done are not necessarily in place. Defining these details as well as producing results underway are a natural part of the research process. Consequently, the need for an IT system to support this is also developing underway as the project progresses, e.g., the specifications for the IT system mature over time.

The challenge arises from the fact that the phasing and progression of the project (and consequently the IT system needs) are quite different from the natural phases of an IT system development project. The IT team works best according to set specifications, whereas the project research team is following a path of maturing needs over time. This creates a certain amount of inefficiency and complications in the collaboration between the scientific team and the IT developers. This manifests in terms of the availability and

continuity of IT resources for development works, which is the second fundamental challenge.

The development of such an IT tool requires an interdisciplinarity in the IT development team with a good integration to the scientific team. Ideally this would be a running relationship over time. However, in this case the IT team was overloaded with tasks, and their preference to manage this was to work in short, intensive development phases. In between these development phases, IT personnel may change with the consequence of losing the experience and specific insight into the system details they would have gained, making subsequent development phases even more challenging.

A third aspect of this was the focus on applying open-source codes and solutions where practical to maintain a free and publicly accessible data platform. This data platform must also answer realistic needs from the intended users. While this did not affect the overall results, it did add complications as the free resources used may not have been as ideal as licensed (commercial) source codes, requiring additional work to implement.

Finally, developing the platform and populating it with data was dependent on the overall progress of the project. Logically the PHUSICOS platform and its data is more of a product of the PHUSICOS project, and less of a project tool for data management and supporting research during the full duration of the project. This is quite simply due to the maturation and development times required, and the fact that data from the demonstration sites arrived late in the overall project.

6.2 Co-creation and collaboration

The development of the platform needed information from collaboration and co-creation with stakeholders to ensure that the platform services developed were addressing the real needs of the users. However, gathering this feedback proved to be difficult. In general, stakeholders were unresponsive to email requests for information and feedback, and collecting information and data to feed into the platform required a fair amount of follow-up. Even with close follow-up, information received was sparse.

As development of the platform required time, case sites had a natural tendency to continue managing information and data in accordance with their existing procedures, and there was little incentive to use time and resources to lift data sets over to a new platform. Monitoring needs and opportunities, while identified early in the project (e.g., the Framework Assessment tool), implementation of monitoring came quite late in the project. This also limited the implementation of these data in the PHUSICOS platform.

Finally, it would be beneficial if long-term financial support could be secured, e.g., from ministries or agencies, to ensure long-lasting operation and promote the impact of the work.

7 Exploitation opportunities

Exploitation potential can be considered in several aspects:

- The data sets stored in the PHUSICOS platform
- The technical solutions implemented to construct the PHUSICOS platform (coding as well as lessons-learned regarding design and functionality)
- The PHUSICOS platform as an operational service

The content of PHUSICOS platform (data and architecture) is public/open access and has been deposited to the Zenodo repository. All components of the platform can be re-used or integrated into products of any other research projects. For example, BRGM is in discussions with AXA Climate (https://climate.axa/fr/) to continue developing and enriching the PHUSICOS tool. The tool would stay open source and could be disseminated through the AXA Climate network. A topic the AXA climate Team is interested in are the PHUSICOS experiences of "what not to do", e.g., maladaptation, and how future systems can be improved by avoiding mistakes.

As a legacy to PHUSICOS, BRGM will integrate the platform into the French research program IRIMA (*https://www.brgm.fr/en/programme/irima-programme-structuring-reinforcing-science-risk-prevention-management-france*). IRIMA will run several projects on disaster risks management, including one on numerical platforms and data dissemination. This new research activity will welcome the PHUSICOS tool for the purpose of maintaining data from NBS cases and disseminating information at the European level. IRIMA will maintain the PHUSICOS platform's main functionalities and enrich the NBS cases.

BRGM is also discussing financing and maintenance of a French version of the platform with the *Direction Générale de la Prévention des Risques (DGPR)*, within *Ministère de la Transition écologique et de la Cohésion des territoires.*

Finally, BRGM is open to the idea of directly interfacing/interacting with the NetworkNature/Oppla databases, and with the Operandum GeoIKP platform.

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. The platform will be maintained for 5 extra years after the end of the project to ensure and components will be saved in the Zenodo repository to ensure long lasting use of this work.

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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