DELIVERABLE D.T1.2.2

Development of map creator online tool

Version 1
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CONTENTS

1. INTRODUCTION

Deliverable D.T1.2.2 "Development of map creator online tool" illustrates the methodology followed and implemented for the realization of the Web GIS tool aiming at assessing risk prone areas and "hot spots" where multiple concurrent hazards lead to potential impacts on CH in Central Europe. It also gives information and instructions for its use and consultation also by non speacialist users, representing therefore also a tutorial (see Subchapter 2.2 and related sections).

This deliverable has been realized within the Activity A.T1.2 "Mapping the exposure of cultural heritage to extreme events (floods, heavy rain) in changing climate".

The ProteCHt2save Web GIS Tool for Risk Mapping has been designed to support policy and decision makers in the identification of risk areas and vulnerabilities for cultural heritage in Central Europe exposed to extreme events linked to climate change, particularly heavy rains, flood and fire due to drought periods.

The ProteCHt2save Web GIS tool is one of the major outputs of the WPT1 (Tab. 1) and of the project in general. It merges outputs and results from WPT1 and WPT2 activities regarding the identification of the critical elements and vulnerability in the resilience and risk management of cultural heritage, comprising climate risk maps elaborated for the Deliverable D.T1.2.2 that represent the core of this tool.

Table 1. WPT1 Outputs

O.T1.1	Inventory of existing archives, maps, databases, model outputs for risk evaluation (state of art).	Data harmonization and management. Information from existing CC simulations/scenarios/NatCatSERVICE database on loss events due to natural hazards/existing national emergency plans for natural disaster response.
O.T1.2	Development of local maps for risk management and protection of cultural heritage.	Production of a map creator ICT tool aiming at assessing risk prone areas and "hot spots" where multiple concurrent hazards lead to potential impacts on CH.
O.T1.3	Compilation of a comprehensive set of Manual for mitigation and adaptation.	The Manual will offer adaptation strategies for CH management in the face of climate change, with the main aim of assisting heritage stakeholders, policy and decision makers.

2. THE PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING

The online tool visualizes in an interactive way risk maps of Central Europe, with high spatial resolution.

It shows the changes of specific climate parameters and climate extreme indices for three "thirty year" periods with respect to a reference period: past, near future and far future (see D.T1.2.3).

We have considered two scenarios employed in the latest IPCC (The Intergovernmental Panel on Climate Change) assessment report: RCP 4.5 (stabilizing that means that in the future the climate situation is not going to change) and RCP 8.5 (pessimistic).

It is possible visualize the ProteCHt2save Web GIS Tool starting from the official web site of the Project clicking on the Web GIS Tool button.
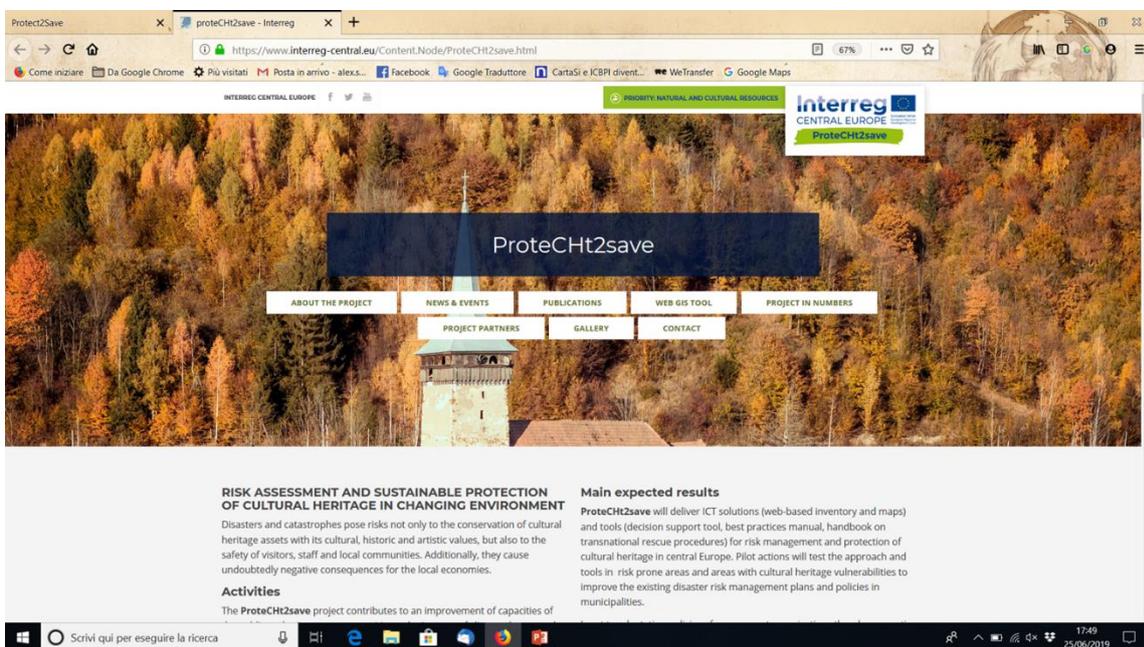
Figure 1. ProteCHt2save official webpage with a specific link to the Web GIS Tool

2.1. WGT design - technical information

The need to be able to view geocoded cartographic data online has led us to create a tool that can publish and make information available on the web. A Web GIS was therefore designed and open source applications and cartographic bases were chosen for its implementation.

In particular:

- Leaflet (https://leafletjs.com/index.html);
- OpenStreetMap (https://www.openstreetmap.org/);
- Mapbox (free Up to 25,000 Monthly active users, https://www.mapbox.com/).

Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. Weighing just about 38 KB of JS, it has all the mapping features most developers ever need.

Leaflet is designed with simplicity, performance and usability in mind. It works efficiently across all major desktop and mobile platforms, can be extended with lots of plugins, has a beautiful, easy to use and well-documented API and a simple, readable source code that is a joy to contribute to.

OpenStreetMap® is open data, licensed under the Open Data Commons Open Database License (ODbL) by the OpenStreetMap Foundation (OSMF).

OpenStreetMap is a world map, created by people like you and free to use under an open license.

OpenStreetMap is built by a community of mappers who contribute and maintain data on roads, trails, cafes, railway stations and much more, all over the world.

Mapbox is a developer platform used across industries to create custom applications that solve problems with maps, data, and spatial analysis. Mapbox's tools are building blocks that support every part of the web and mobile map-making process.

2.2. Web GIS Tool (WGT) – Contents and instructions for use

The web page of Web GIS Tool (WGT) for Risk Mapping is composed of 6 pages and only the Home Page is immediately available for all users, while a registration is required for the access at the further contents and pages.

2.2.1. Home Page

On the Home page we can find in brief, general information of the project and the introduction to the Web GIS Tool for risk mapping. Furthermore, a first overview of the project pilot sites is also available. Clicking on each of these frames we can obtain more detailed information on the partner responsible for the pilot site. Registration is required for consulting the overall contents.

Registration

Self-registration can be performed by clicking on the 'Register icon' in the ProteCHt2save Web GIS Tool home page end and subsequently filling the form in all its parts and clicking on 'Register' (Fig.2).
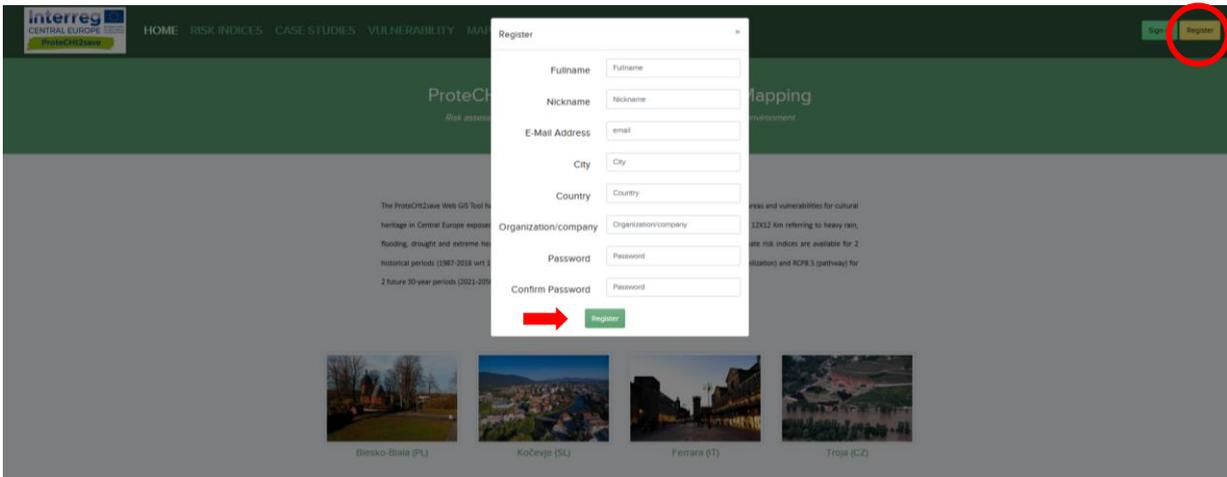
Figure 2. ProteCHt2save WGT Home page: registration form.

At this stage, the web page administration service will send an automatic notification to the provided e-mail address. Registration e-mails are usually received within few minutes after the registration procedure and it is necessary to click on the link provided in the e-mail to validate the registration.

Once the registration is confirmed, the new account will be automatically validated and enabled to the navigation on the ProteCHt2save WGT.

Login

Once registered, users can access the ProteCHt2save WGT home page by entering the username and password they have set up during the registration procedure and they proceed by clicking on the 'Sign in Icon' and inserting the username and password in the relevant fields. Finally click on the 'Login' button is required.
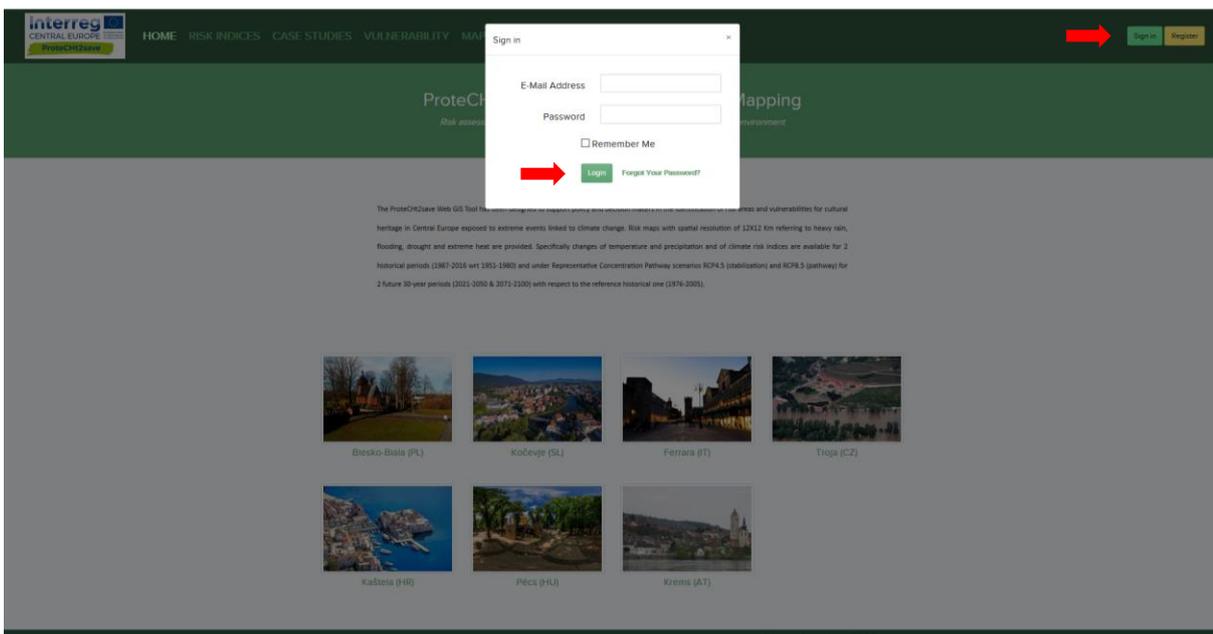
Figure 3. ProteCHt2save WGT homepage: login

2.2.2. Risk indices

Climate Risk Indices page is important to have deeper information about the climate extreme indices selected for the project. As mentioned in the Deliverable D.T1.2.3 these indices are internationally accepted by the scientific community for representing change in climate extreme, such dry spell or intense precipitation.

Clicking on each short name of the indices it is possible to reach the original web page of expert team on Climate Change Detection Indices ECDDI where the selected index is described. In this way, it is possible to obtain deeper information about each climate risk index to better understand its meaning. In the same page we can also visualize the climate variables (Fig. 4).

Figure 4. ProteCHt2save WGT - Risk indices page. Here it is possible visualize two sections: one for the climate extreme indices selected and one for the principal climate variables.

2.2.3. Case studies

In the page of the Pilot sites we find 7 boxes, one for each pilot site, with indication of their specific role in the project and a link to a description card with more technical information such as position, role in the project as pilot site, past events, measure adopted, time series, etc (Figs. 5 and 6).
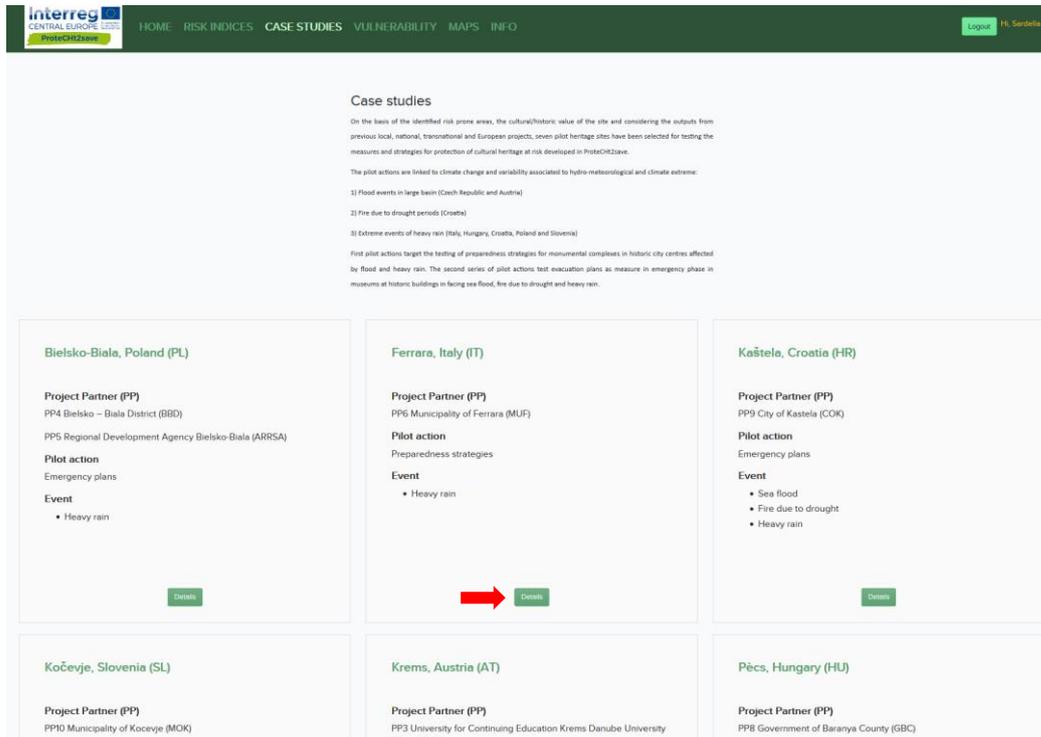
Figure 5. ProteCHt2save WGT - Case studies page. Figure shows the 7 boxes referring to the case studies of the project The 'Details Icon' allow to obtains more information about the single case study of the project.
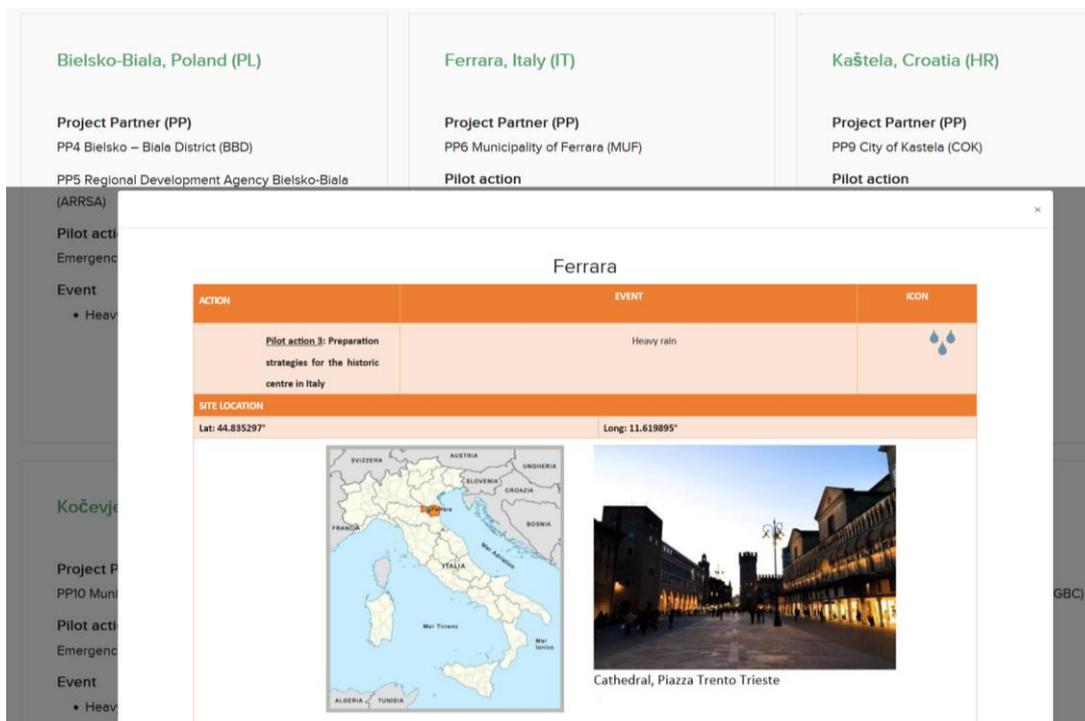
Figure 6. ProteCHt2save WGT – Case studies page. The figure shows an example of the datasheet that appears when each of 'Detail icon' in the Case studies boxes is clicked.

2.2.4. Vulnerabilty

On the vulnerability page (Fig. 7) the critical elements in the resilience both physical and managerial for local vulnerably of cultural heritage are reported. The information in this section are from the results obtained in the Deliverable D.T2.1.3 "Decision Support Tool" (Figs. 8 and 9).

Figure 7. ProteCHt2save WGT - Vulnerability page: 2 boxes and specific link to the different criticalities fully described in the Deliverable D.T2.1.3.

Figure 8. ProteCHt2save WGT - Vulnerability page. The figure shows an example of the datasheet that appears when each of 'Managerial criticalities' listed in the left box is clicked.

Figure 9. ProteCHt2save WGT - Vulnerability page. The figure shows an example of the datasheet that appears when each of 'Physical criticalities' listed in the right box are clicked.

2.2.5. Maps

The WGT allows to load climate risk maps through a suitably designed filter.

On the Maps page we can create different climate risk maps selecting a specific climate extreme index in the menu located at the left of the page. The cartographic bases are represented by Street map and Terrain map made available by OpenStreetMap

An "Introduction" button have the purpose to give more information about the process of mapping referring to the methodology implemented in the Deliverable D.T1.2.3 for the maps production.

The first action required to start in order to visualize one climate risk map is related to the selection of the specific climate risk index or climate variable among the 5 risk indices and 3 variables listed (Figs.10, 11 and 12).
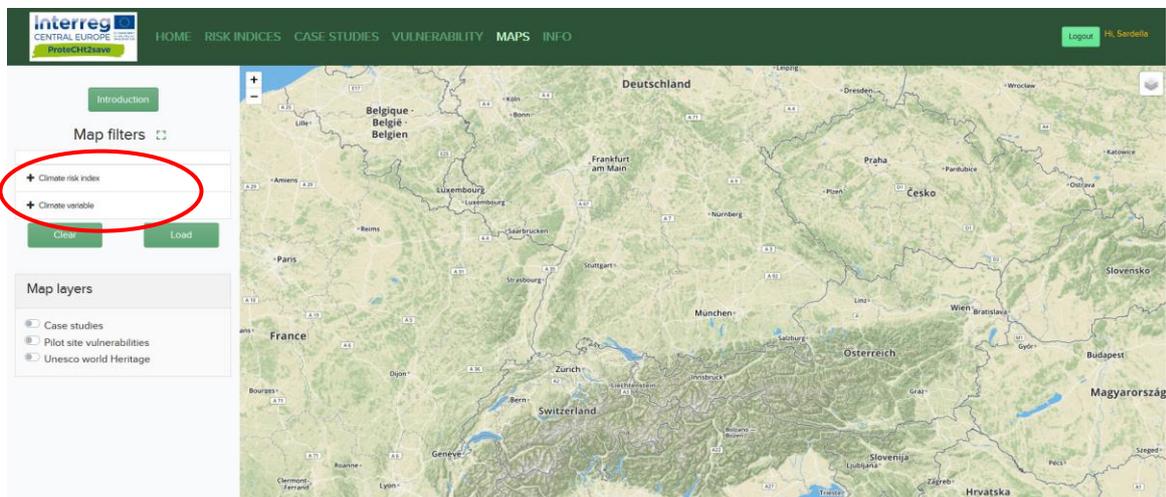

Figure 10. ProteCHt2save WGT - Maps page without any filter selection.

Figure 11. ProteCHt2save WGT - Maps page. List of Climate risk indices.

Figure 12. ProteCHt2save WGT - Maps page. List of Climate variables.

Once select the climate index/variable, the second step is the choice of the "Time coverage" of our interest between "Future projections" or "Historical observation" (Fig. 13).
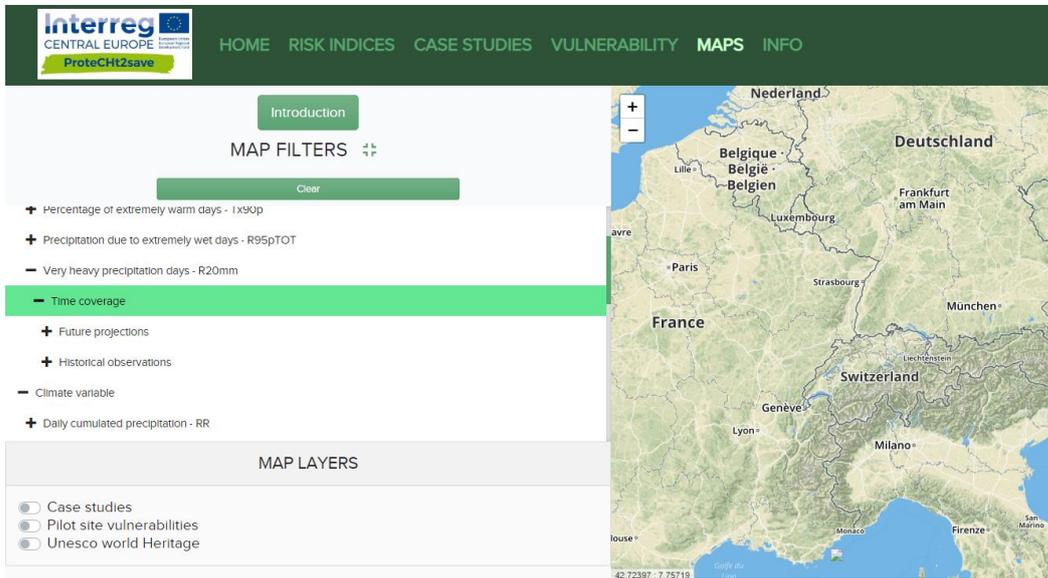
Figure 13. ProteCHt2save WGT - Maps page. Time coverage of the maps. It is possible to chose between Future projection and Historical observation.

Regarding the "Future projection", by selecting "Individual models" it is possible to visualize projections from each of the 12 models used (Fig. 14). These models are described in detail in D.T1.2.3.
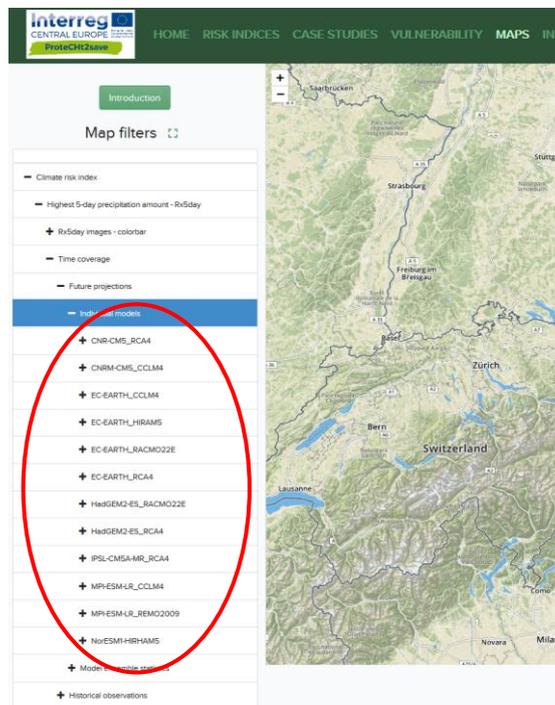

Figure 14. ProteCHt2save WGT – Maps page: selection among the 12 different individual climate models.

Whereas, selecting "Model ensemble statistics" (Fig. 15) it is possible to visualize the models ensemble that comprise elaboration of "Maximum", "Middle" and "Minimum" values for all the mathematical models used for data processing.
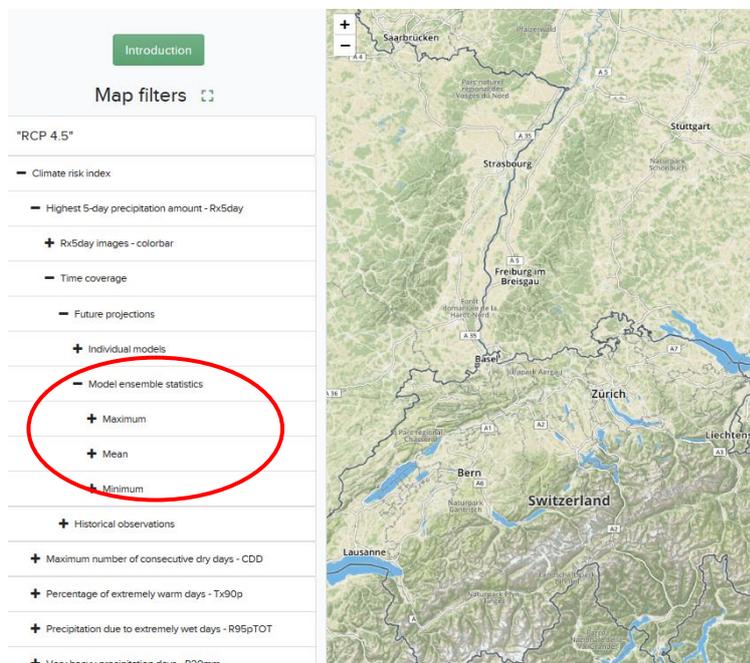

Figure 15. ProteCHt2save WGT – Maps page: selection among the 3 different model ensemble statistics

Furthermore, for both Individuals models and Model ensemble statistics, it is possible to select time coverage of the projections between "Near future" and "Far future" and the type of scenario in order to visualize maps under two different RCPs scenarios: "RCP 4.5" and "RCP 8.5".

Finally, the obtained map (Fig. 16 and 17) describes how and where the possible changes related to the specific climate risk index or climate variable selected will affect the area of Central Europe and its heritage in the specific time period.

Figure 16. The image shows the final map loaded after completing the selection of the different maps filters. In this case the map represents how and where the climate extreme index r20mm will change and affect the area of Central Europe and its heritage in the far future (2071-2100) considering the RCP 8.5 (pessimistic). In this case the Invidual model EC-EARTH-RCA4 has been selected.
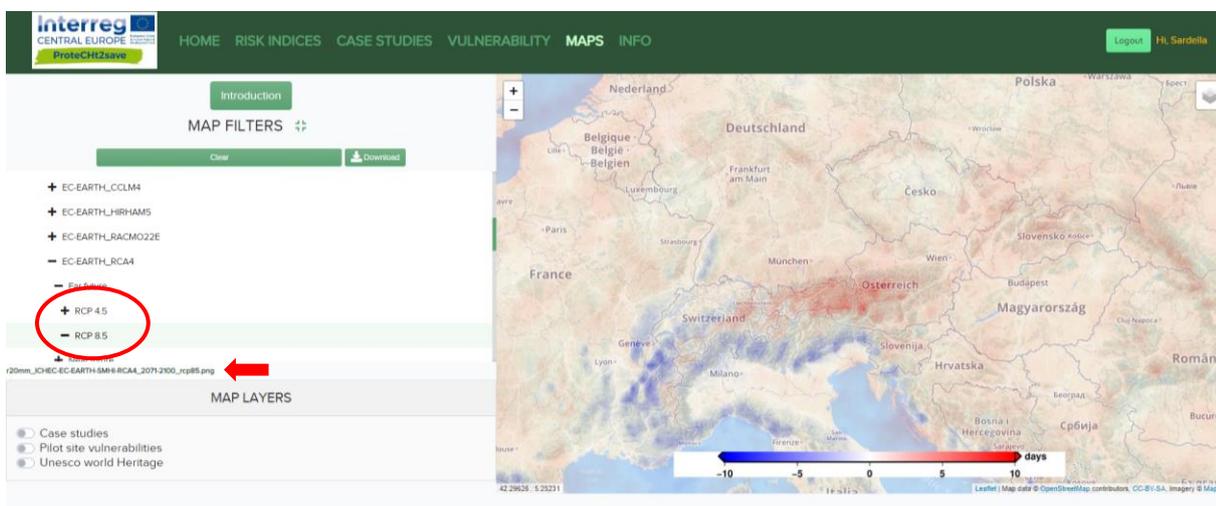
Figure 17. The image shows the final map loaded after completing the selection of the different maps filters. In this case the map represents how and where the climate extreme index r20mm will change and affect the area of Central Europe and its heritage in the far future (2071-2100) considering the RCP 8.5 (pessimistic). In this case a maximum of Model ensemble statistics has been selected.

Regarding the "Historical observations", for each climate index/variable only one map will be visualized, showing how and where the changes related one of them affected the area of interest (Fig. 18).
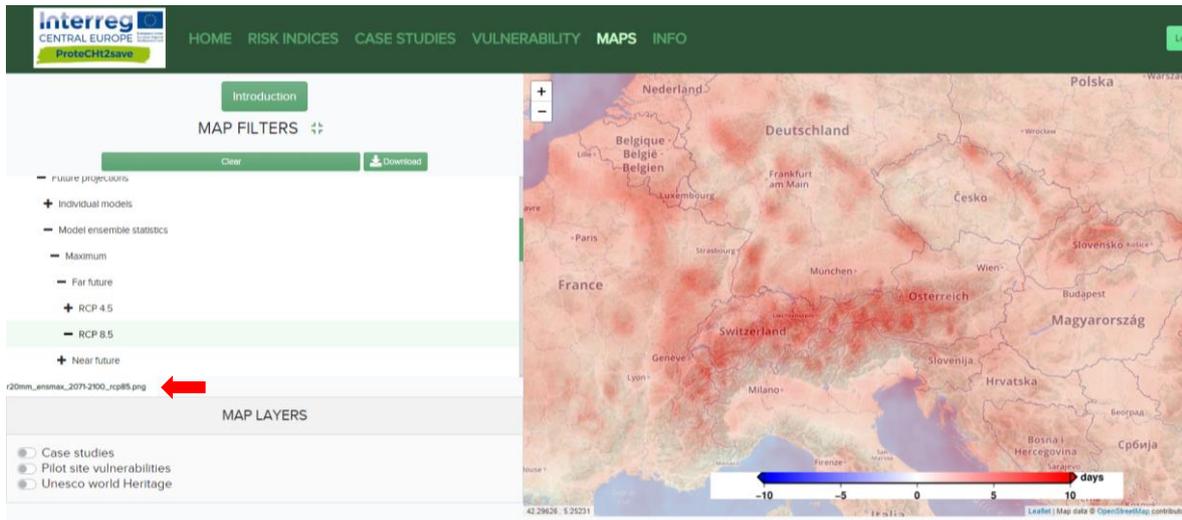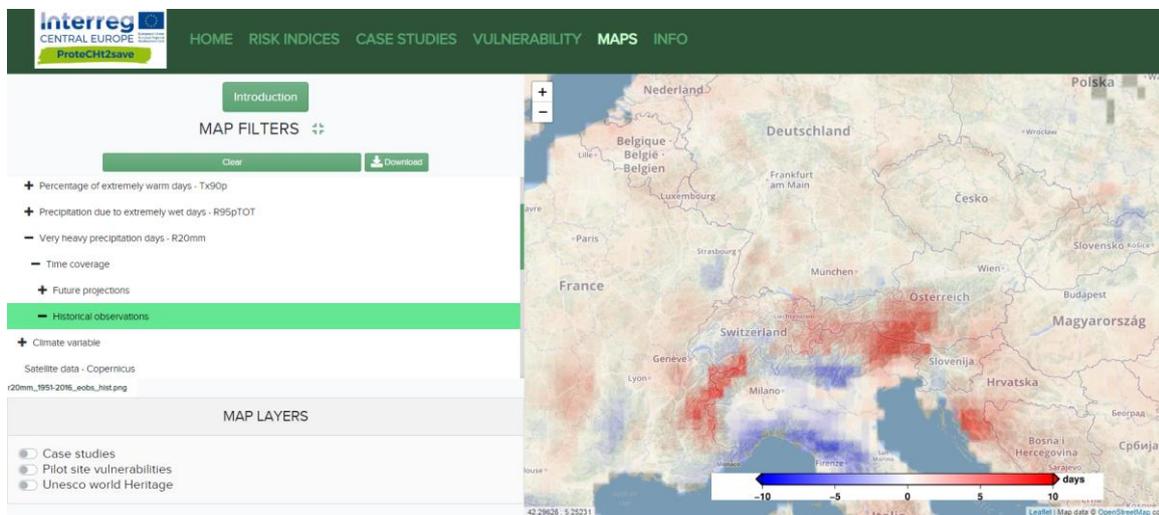

Figure 18. The image shows the final map loaded after completing the selection of the different maps filters. In this case the map represents how and where the climate extreme index r20mm changed and affected the area of Central Europe and its heritage in the past.

In addition to the map filters a "Clear icon" allows to reset the visualized map and applied other filters. Furthermore, clicking on the "Download icon" it is possible to download a printable version of the map created.

In the Map page it is also present an additional information box, named "Map layers" where it is possible to choose a specific layer in order to display the information associated with it on the map. In particular, it is possible to plot the position of the points that represent both the "Case studies" (Fig. 19) and the "Pilot site vulnerabilities" (Fig. 20) and query the associated database by opening different tabs (Figs 21 and 22).

In addition, thanks to the collaboration with the JPI-CH PROTHEGO Project, the UNESCO world Heritage's layer permits to superimpose the UNESCO World Heritage sites in Central Europe on the same maps and obtain information about them.
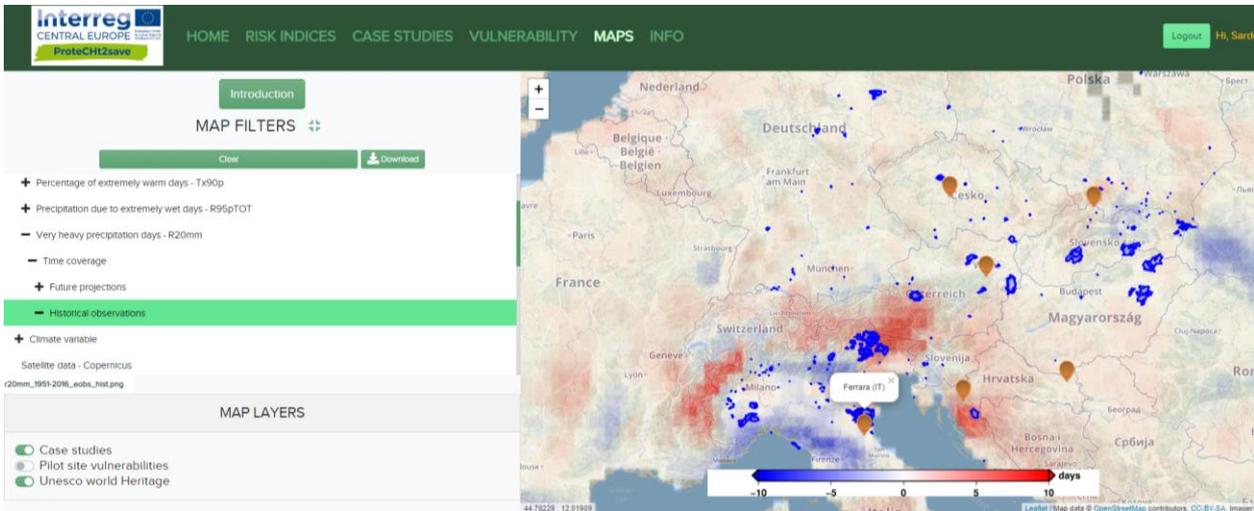

Figure 19. The same maps illustrated in Figure 18 where layers "Case studies" and "UNESCO world Heritage" are turn on. Orange points represent the positioning of ProteCHt2save case studies. Blue areas represent the UNESCO Sites.
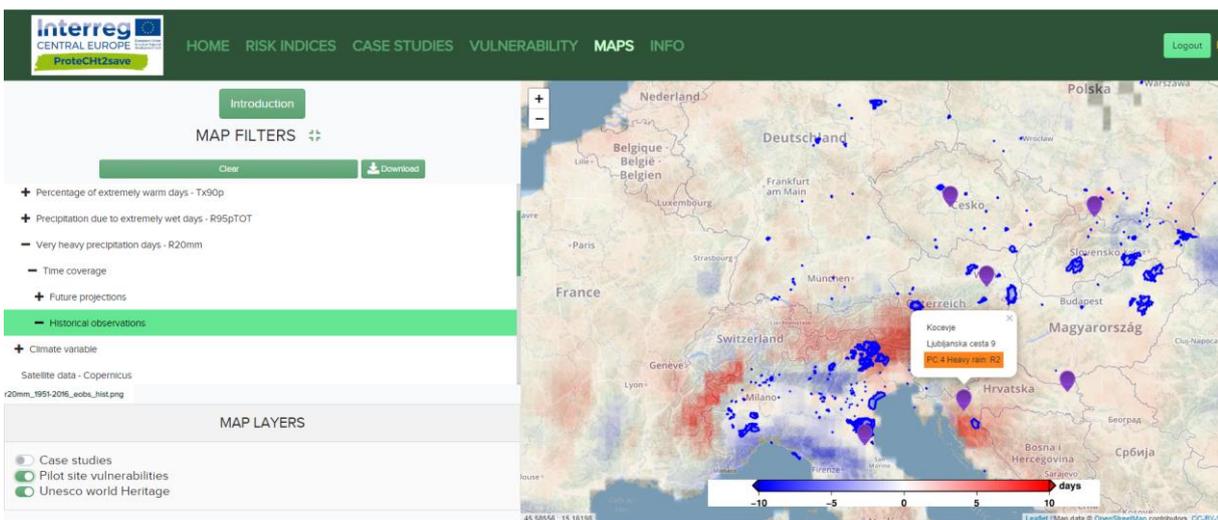

Figure 20. In this frame the Pilot site vulnerability layer is turn on. The first information we can obtain by positioning the cursor on each purple point is the vulnerability ranking of the site.
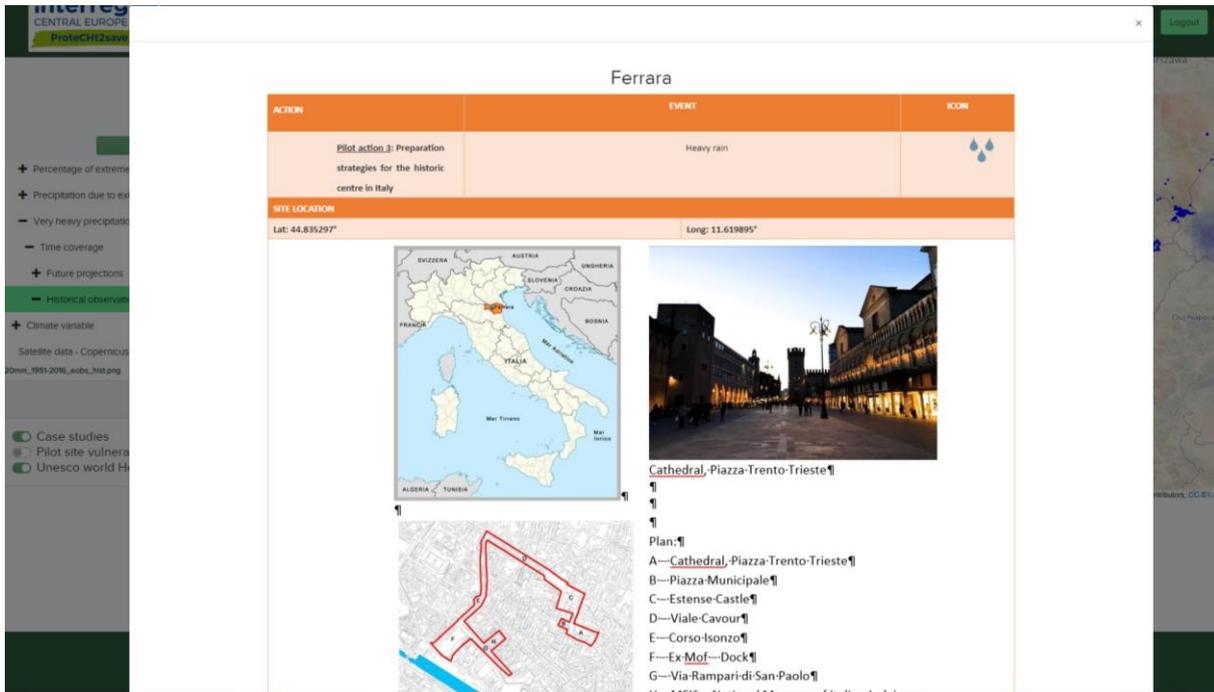
Figure 21. Image shows the Datasheets available when each orange point representing case studies is questioned. The information included in these Datasheets regarding are: position, role in the project as pilot site, past events, measure adopted, time series, etc.
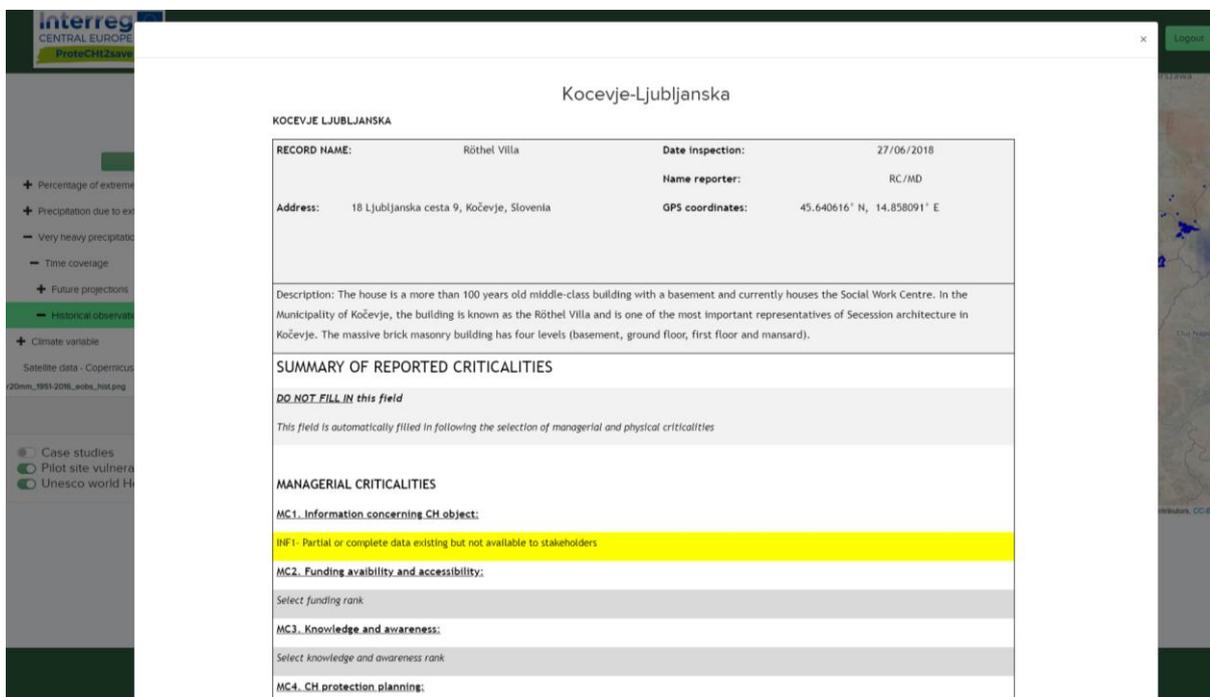

Figure 22. Image shows the Datasheets available when each purple point representing case studies is questioned. The information included in these Datasheets regards the criticalities, both managerial and Physical highlighting for each site.

2.2.6. Info

Information on the project and partnership is also available (Fig. 23)

Figure 23. ProteCHt2save WGT – Info page