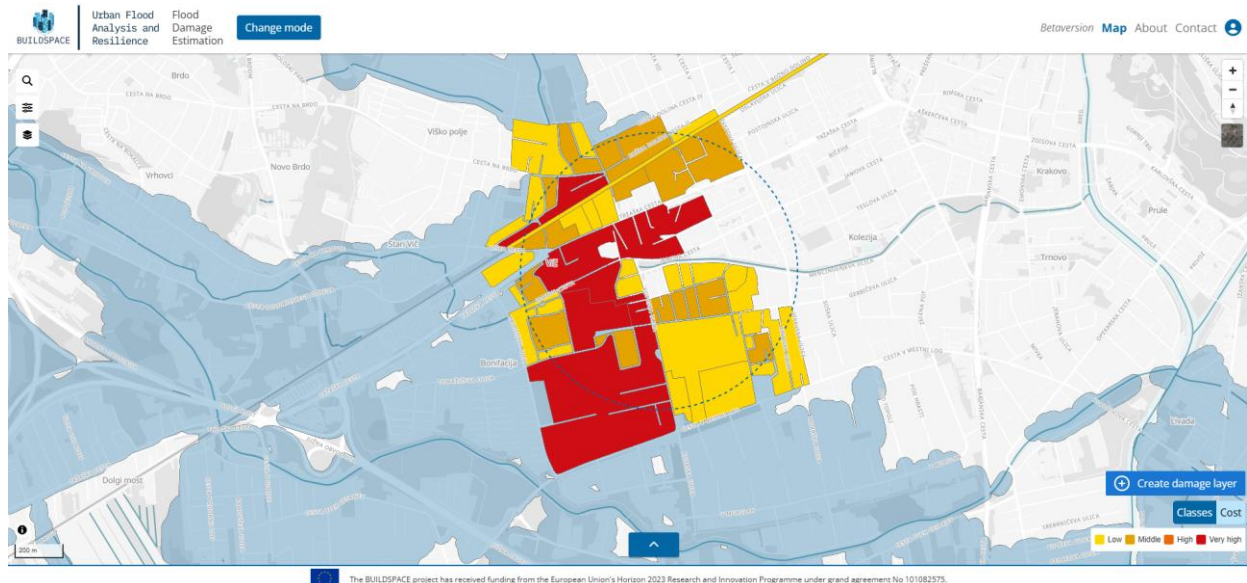




BUILDSPACE

**Enabling Innovative Space-driven Services for Energy
Efficient Buildings and Climate Resilient Cities**

BUILDSPACE Service: Urban flood analysis and resilience – Step-by-step user guide



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BUILDSPACE offers a set of interactive, city-scale services that help urban planners, municipalities, and decision-makers understand how climate change affects buildings and neighbourhoods. These services



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combine satellite data (Copernicus, EGNSS), local information and advanced modelling to visualise risks and opportunities for energy, heat and floods. Through intuitive map-based tools, cities can explore their current situation, test future scenarios, and assess strategies for resilience and sustainability. Each service focuses on a different aspect of urban resilience, but together they provide a common decision-support framework for climate-smart planning.

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1. Introduction

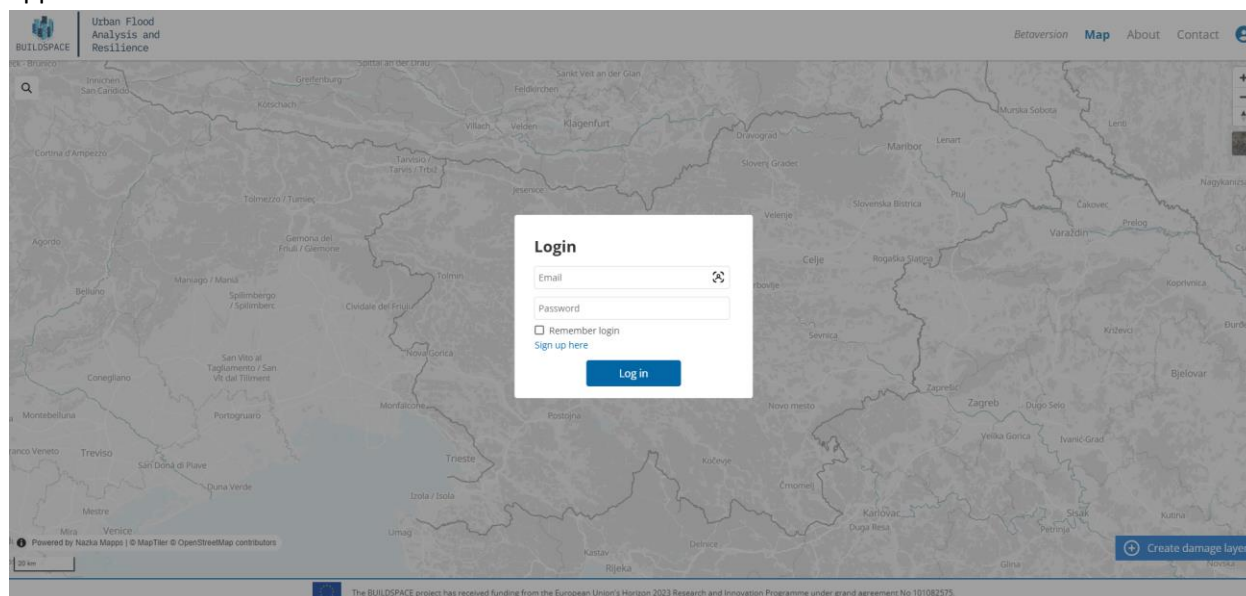


This step-by-step guide provides clear instructions for navigating and using service 5 of the Buildspace project. Each section outlines a specific part of the workflow to ensure accuracy and efficiency. The guide is intended to support users in performing tasks consistently and in accordance with best practices. This guide is divided into three parts. Firstly, there is part about general structures and functionalities. Then, the guide will continue with the explanations on creating a result layer for both the river flood damage estimation mode as the flash flood hotspot simulation mode. Finally, the management of the created result layers will be explained.

2. Getting started

2.1. Login

To access the application, a user needs to log in to get identified and access. The login screen pops up automatically and all other buttons and functions are disabled. The user needs to provide his email address as a username and a correct password. If the user does not want to enter his credentials every time he opens the application, he can check the 'Remember login' checkbox. When the credentials are filled in and correct, you need to click the 'Login' button. If the credentials are not valid, a warning message will appear.



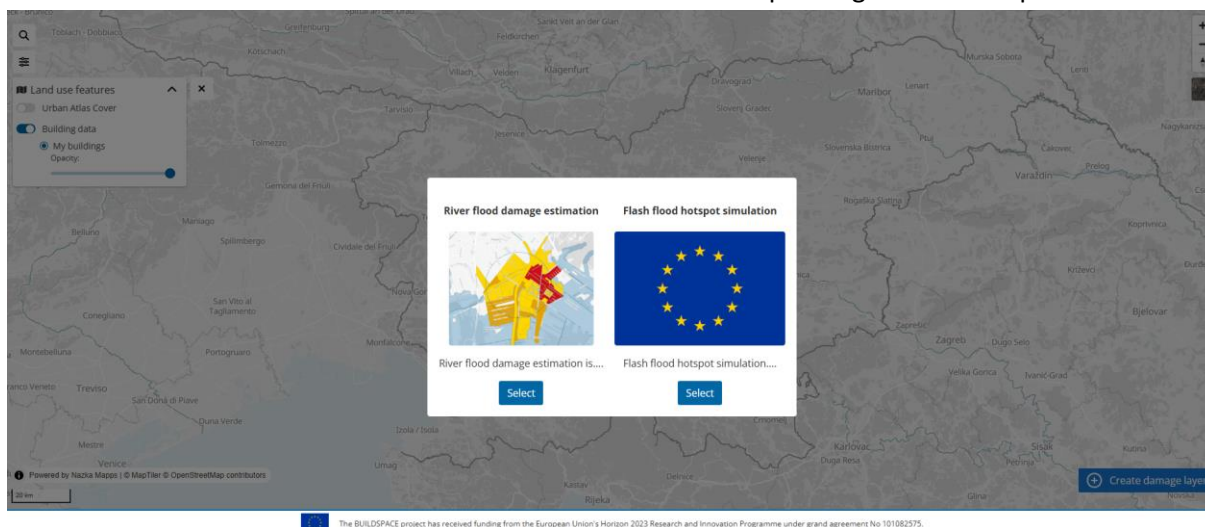
2.2. Mode selector

After you have logged in, another window opens over the map. This popup obliges you to choose the mode you would like to access. There are two options:

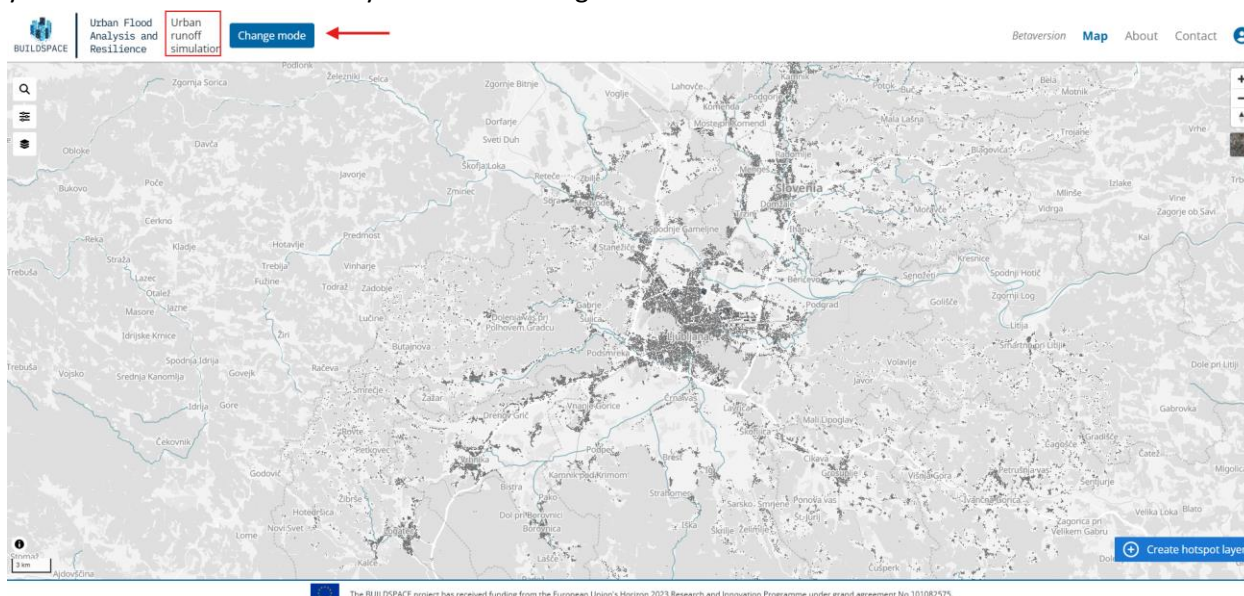
1. the river flood damage mode
2. the flash flood hotspot simulation.



You need to click the blue 'Select' button underneath the corresponding mode description.



When you have chosen your mode, the name of the mode is shown on top in the navigation bar as can be seen on the screenshot below. Next to the mode name, there is blue button that when clicked, will bring you to the other mode for easy intra-mode navigation.



3. Navigating the interface

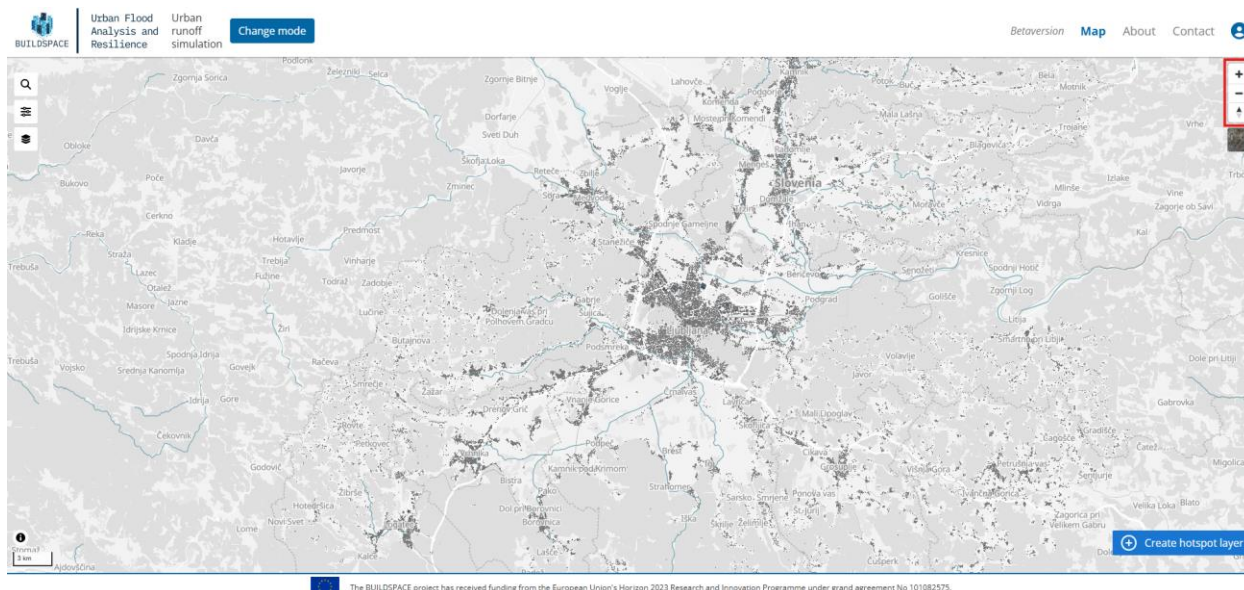
3.1. Map controls

When you are logged in and have chosen a mode, the application will appear. As you can see, the map is the most important component. The map has some basic controls that the user can use. For zooming, the user can use the mouse wheel to scroll or use the + and – buttons at the top right corner. The pan and move the map around, you can hold the left button on the mouse to drag the map in the direction you



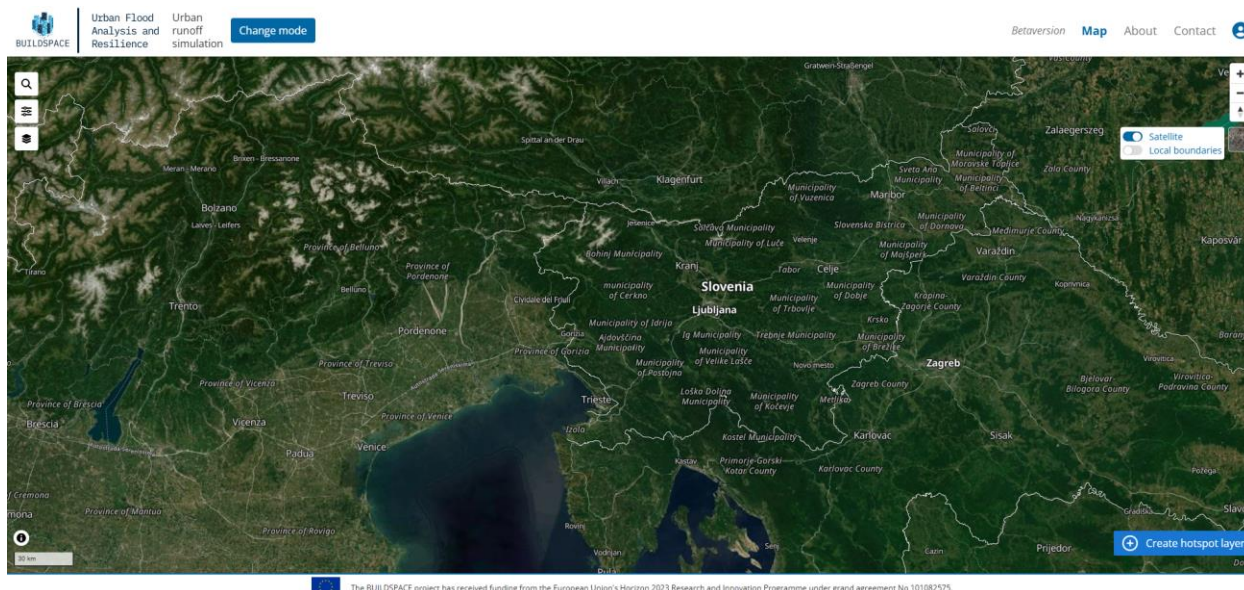
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want. If you hold the right button of the mouse, you can tilt the map vertically or turn it around its axis. The north arrow at the top right will change direction depending on the movements you make with the map. If you click the north arrow, the map will reorient itself back to the north.



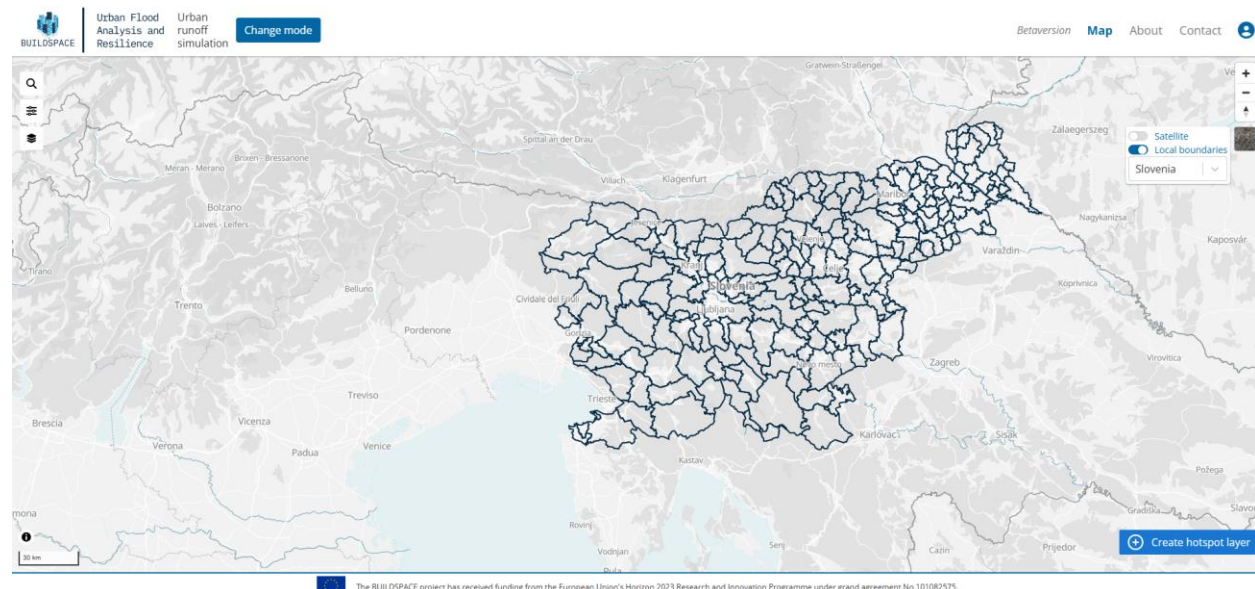
3.2. Background selector

Below the map controls there is a background selector. The background selector gives you the option to activate a background layer that can assist you with navigating the map. When you click on it, a small menu opens with two options. The first option is the satellite view. When you click the toggle next to it, a global satellite view will be activated.



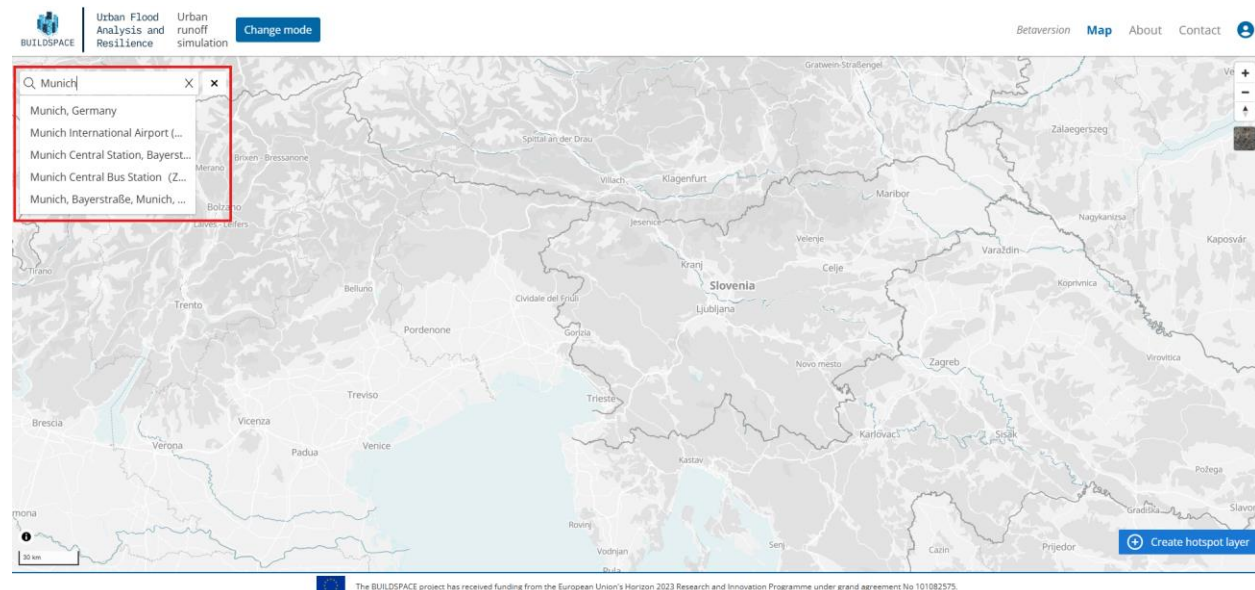
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The second layer are 'Local boundaries'. This allows you to visualise the boundaries of local divisions. When you click the toggle, a dropdown appears that lists all the countries for which local boundaries are available. If you select the country, the dropdown will close and the boundaries would appear.



3.3. Search functionality

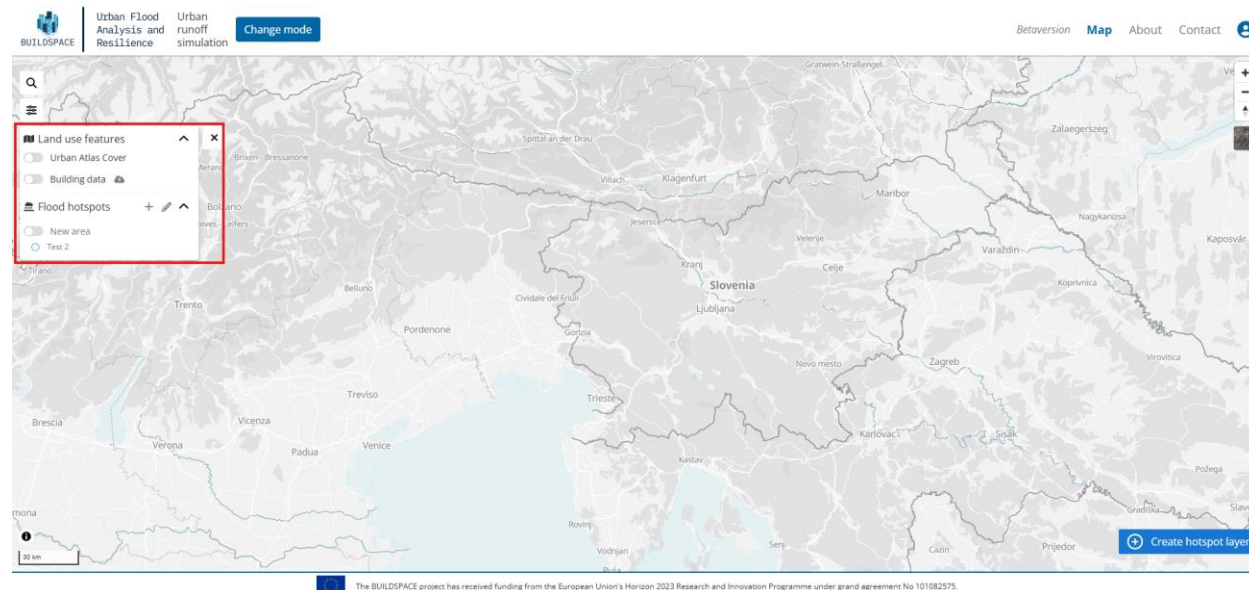
On the top left, there is a search functionality. When you click the white button with the magnifying glass sign, the search bar will open. You can click in the search bar and type to search any location in the world. The first 5 options are listed in the result box. When you have found the option you want, you can click it and the map will zoom and pan to the location. The search functionality allows for searching for both cities as points of interest. To close the search bar, you can click the X-icon.



3.4. Layer panel

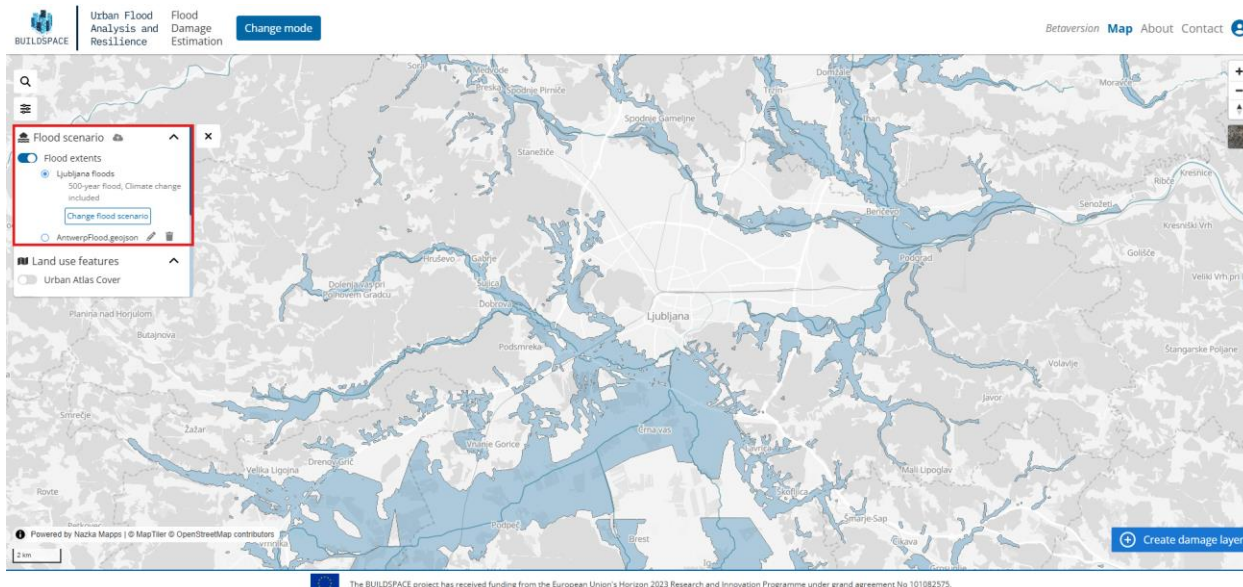
3.4.1 General layer panel structure

The layer panel is structured slightly differently between the two modes. Generally, the layer panel can be opened by clicking on the white layer button at the top left. To close the layer panel, you can click the X-icon. The panel is structured in different parts that can be opened or closed using the upwards and downwards-facing arrows.



3.4.2 Flood scenario

In the river flood damage estimation mode, the top part is to visualise flood extents of different climate scenarios. This part does not exist for the flash flood mode. The toggle allows the user to visualise the flood extent on the map. The label will show you which flood has been visualised. At the bottom of this part, there is a button to change the visualised flood extent.



When you click this button, a panel opens over the map that allows you to choose one of the pre-defined flood extents. There are two dropdowns that allow you to pick a flood extent. In the first dropdown, you have to choose a flood return period. There are three options: 10-year, 100-year and 500-year. The second dropdown allows you to change the extent depending on certain scenarios. Either you select 'No scenario' which will give you the original flood extent. Further you can select the option 'Anti-flood measures' which simulates taking precautions to limit the amount of flooding. For this option, the flood extent will be diminished by 50m. The last scenario is simulating climate change by extending the flood extents by 30m. The inset map will show the option you have selected. When you click confirm, the selected flood extent will be loaded into the main map and the pop-up will close.

3.4.3 Land use features

Both modes have in the layer panel a section about land use features that can be visualized and are used in the calculations. There are two options: the Urban Atlas Cover and the building data. The Urban Atlas Cover is a Copernicus land use classification map. If you hover over the small info button, a legend will open on the side that shows all the categories visible on the map. In the layer panel, an opacity slider will appear which allows you to increase or decrease the opacity of the layer visible on the map. When you activate the building layer, the buildings will appear on the map. Here there is also a opacity slider provided.



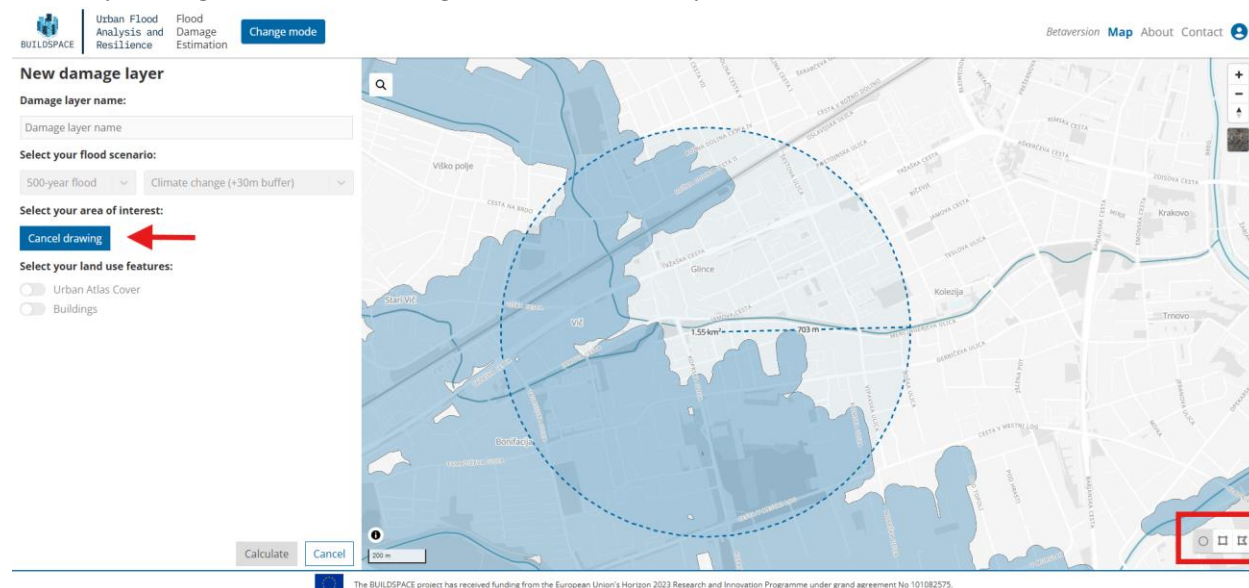
Betaversion **Map** About Contact



4.1. Drawing an area of interest

When you are in the view of creating a new result layer in both modes, you will be asked to draw an area of interest. This is a necessary step in both modes. When you click the 'Draw new area' button in the side panel, the map will go into drawing mode. At the bottom right, a new set of controls will appear in the bottom right. This will allow you to draw either a circle, a rectangle or a free shape. The circle will be standard selected. To draw the circle, you first click on the map, which will set the middle point. Then when moving your mouse across the screen, the circle will appear. When you click again, the circle will be set. For rectangles, the handling is very similar. The first click sets the bottom left corner point of the rectangle, and the next click will set the top right corner point, which results in a rectangle. Finally, the free shape allows you to draw any shape you want. Each click will draw an extra node. You need at least three nodes to be able to finalize your drawing. To complete the drawing, either use the ESC-button on your keyboard or double click on the last node.

Be warned that the size of the area of interest is limited to 10 km². The application will not allow you to save a larger one. When you have completed your drawing, a small pop-up will appear that allows you to give it a name and then save it or delete it again. You can also cancel the drawing and exit the drawing mode by clicking the 'Cancel drawing' button on the side panel.



4.2. Creating a river flood damage layer

When you are in the river flood damage estimation mode, your screen will look like the image below when you are creating a new result layer.

Firstly, you need to give the damage layer you are creating a name. This name will be used to save your layer to your profile so that you can identify it later again. Below the name, the flood scenario needs to

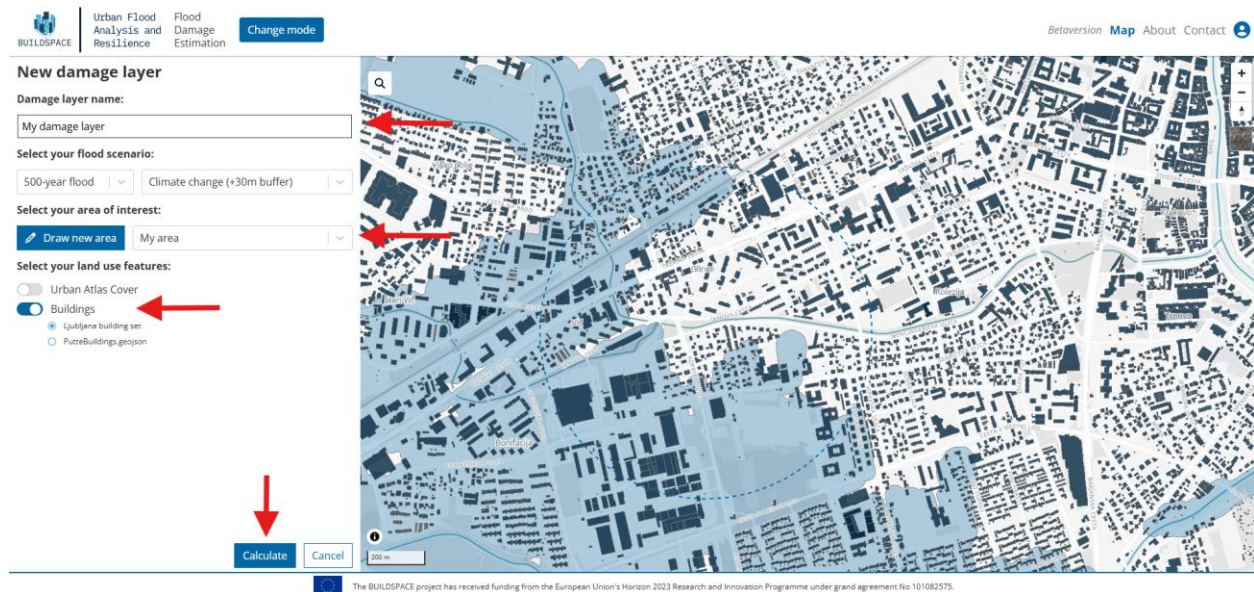


be selected. The flood scenario you have currently active on the map will be filled in here, but you can still pick another one by using the two dropdowns.

Next, there is the area of interest. Here you can choose to draw a new area, as explained in the previous step, or you can select an area that has already been saved from the dropdown next to the button. If the dropdown is not present, that means no area has been saved to your profile yet.

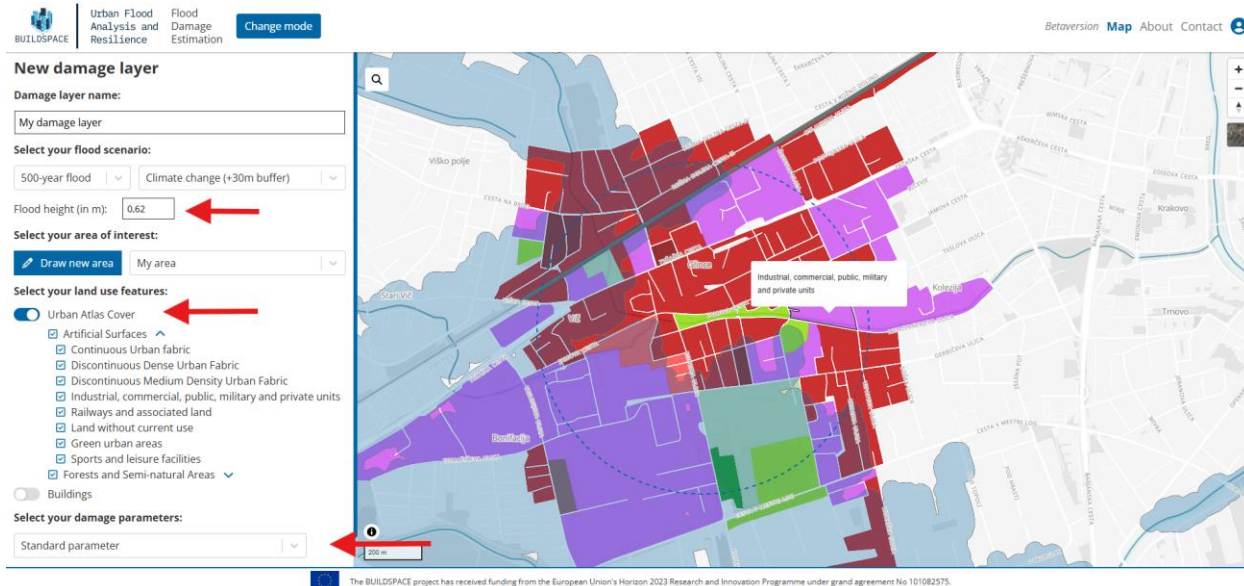
Finally, you need to select your land use features.

On the example below, the buildings have been selected. They are visualised on the map, and this means that the calculations will be done on the individual buildings. If all the requirements are entered correctly, the blue 'Calculate' button at the bottom will activate. If the button is not active, it means one of the parameters is missing. When you click the calculate button, the calculation will start, and the resulting layer will be created and saved to your profile. Clicking the 'Cancel' button will take you out of this mode back to the main map without conducting any calculations.



If in the panel, in the land use features section, you select 'Urban Atlas Cover', the content of the panel will change slightly as can be seen on the next image. In the land use feature section, all classes of the UAC that are present within your selected area of interest will be listed. There you can choose to click the checkboxes at each category to decide if you want to include that category into the damage estimations. The options that are selected, will be visible on the map. If you hover with the mouse over an area, the class will appear in a pop-up. Above the land use features, the flood scenario section will have an extra input field: flood height. Here the user can enter the flood height he would like to simulate in meters. You can enter any height between 0.1 meters and 10 meters. Lastly, at the bottom of the panel, you can also select your parameter set that will be used to do the calculations. In this mode, the parameter set will determine the damages in Euros per square meter for each UAC-class. You can choose to either use the standard parameter set provided, or create a new parameter set by clicking on the last option of the dropdown. For instructions on how to create new parameter sets, we refer you to the 'Replication guide'.

When all inputs have been given, you can calculate the result which will return a damage estimation for your selected flood for each Urban Atlas Class.



The screenshot shows the BUILDSPACE web application interface. At the top, there are navigation links: BUILDSPACE, Urban Flood Analysis and Resilience, Flood Damage Estimation, and a 'Change mode' button. Below the navigation bar, the 'New damage layer' form is displayed. The form includes a 'Damage layer name' field with the value 'My damage layer'. The 'Select your flood scenario' section has two options: '500-year flood' and 'Climate change (+30m buffer)'. The 'Flood height (in m):' field is set to '0.62'. The 'Select your area of interest' section has two options: 'Draw new area' and 'My area'. The 'Select your land use features' section has a toggle for 'Urban Atlas Cover' which is turned on. Below this, there is a list of land use features with checkboxes: 'Artificial Surfaces', 'Continuous Urban fabric', 'Discontinuous Dense Urban Fabric', 'Discontinuous Medium Density Urban Fabric', 'Industrial, commercial, public, military and private units', 'Railways and associated land', 'Land without current use', 'Green urban areas', 'Sports and leisure facilities', and 'Forests and Semi-natural Areas'. The 'Buildings' toggle is turned off. The 'Select your damage parameters' section has a dropdown menu set to 'Standard parameter'. To the right of the form is a map of a city area with various land use zones. A red arrow points to the 'Flood height' field, another red arrow points to the 'Urban Atlas Cover' toggle, and a third red arrow points to the 'Standard parameter' dropdown. A tooltip is visible over the map, showing 'Industrial, commercial, public, military and private units'. At the bottom of the map, there is a scale bar indicating '200 m'. Below the map, there is a small text box stating: 'The BUILDSPACE project has received funding from the European Union's Horizon 2023 Research and Innovation Programme under grant agreement No 101082575.'

4.3. Creating a flash flood hotspot layer

The flow for creating a flash flood hotspot layer is relatively like the river flood damage estimations. Here, you will also need to provide a name in the first box and select or draw an area of interest on the second line. There is no need to choose between the UAC and your building file in this mode, as both will be taken into account automatically, but you can choose to use a specific uploaded building file. For navigation purposes, a simplified layer panel is active on the map to visualize either of those layers.

Furthermore, there are three new parameters that need to be defined.

Firstly, you have to decide on a rainfall event. This can be done by entering the number of millimetres of rain you want to use in the calculations. If you are not sure, we've included a handy calculation method that can be accessed by clicking the 'Simulate rain event'-button. This will reveal three extra dropdown where you can select a climate **RCP scenario**, a **return period** and a **year**. Based on this input, the tool will provide you with an expected rainfall that can be used in the hotspot generation.


Urban Flood Analysis and Resilience
Urban runoff simulation
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New hotspot layer

Hotspot layer name:

Select your area of interest:

[Draw new area](#) New area

Select your rainfall scenario:

Rain (mm) [Simulate rain event](#)

Select your infiltration parameter set:

Soil category C (low infiltration)

Select a BGI scenario:

No BGI scenario

Select a building file:

Ljubljana building set

[Calculate](#) [Cancel](#)



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Urban runoff simulation
Change mode

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New hotspot layer

Hotspot layer name:

Select your area of interest:

[Draw new area](#) New area

Select your rainfall scenario:

Rain (mm) [Simulate rain event](#)

Select the following parameters to simulate a rainfall event.

RCP scenario

Return period

Year

[Simulate](#) [Cancel](#)

Select your infiltration parameter set:

Soil category C (low infiltration)

Select a BGI scenario:

No BGI scenario

Select a building file:

Ljubljana building set



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5. Viewing and managing results

5.1. Layer selector update

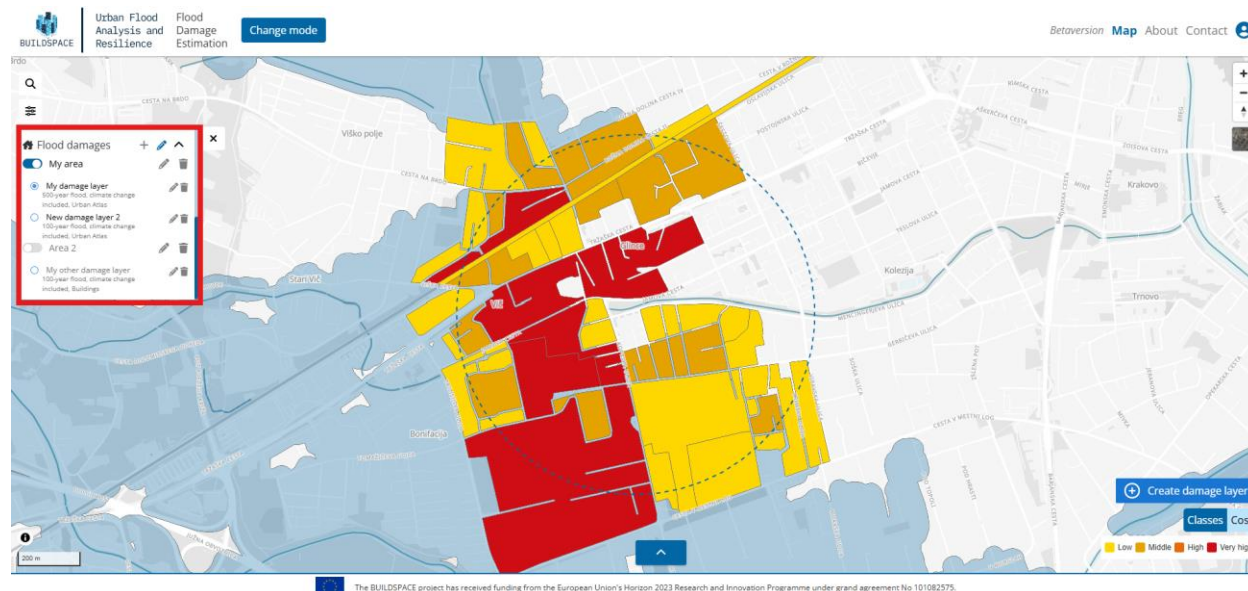
When a result layer is created successfully, you will be redirected to the main page where your results will be automatically showcased on the map. At the layer panel on the left side, the section about the results will now be filled with your created layers. This section is called 'Flood damages' for the river flood damage estimation mode and 'Flood hotspots' in flash flood mode.

Here the result layers are organised and structured by area. Each area can have one or more result layers, but only one layer can be visualised at the time. If a user clicks on the pencil icon in the title, each area



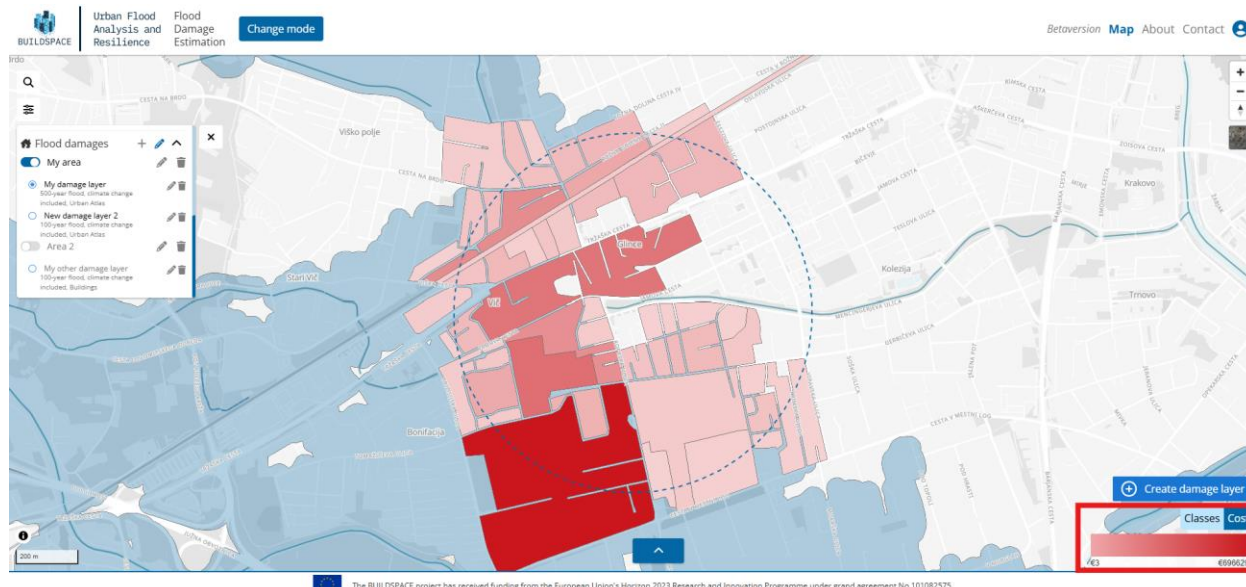
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and layer will receive some action icons. Firstly, there is a pencil, that allow you to change the name of an area or a result layer. Secondly, there is a trash can. When you click this next to a result layer, the layer will be deleted. If you delete an area, the area itself as well as all result layers in that area will be deleted.



5.2. Legend

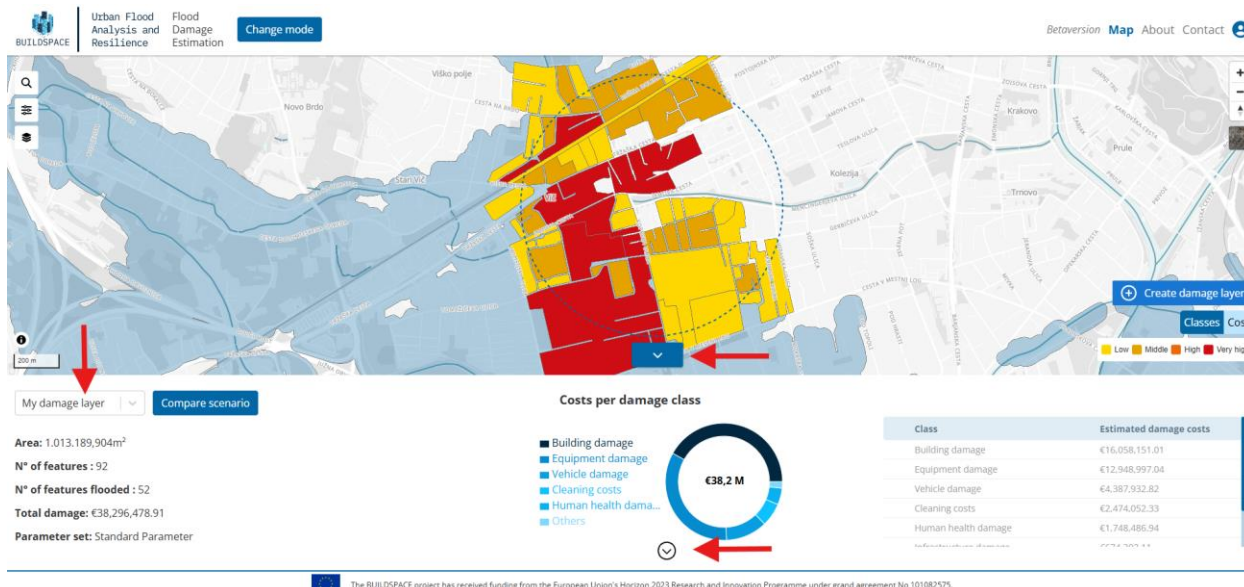
At the bottom left corner of the screen, a legend will be present when you have a result layer active. Above the legend, there is a switcher which allows you to change the way of visualisation. You choose to visualise as classes. This way, the classes have fixed boundaries and do not change depending on the results. This allows for easy cross-layer comparisons. If you want to have a more detailed look within you created layer, you can choose this option 'Continuous', which will create a continuous colour scale depending on the values within your result layer, ranging from the lowest to the highest value. This allows for easy intra-comparison.



5.3. Data panel

When you have created a result layer, a data panel with extra information and analysis will be provided. The data panel is hidden below the screen and can be opened by clicking the white arrow in the blue button. The same button can be used to close the panel again. At the top left of the panel, there will be a dropdown that holds all your result layers, grouped per area of interest. You can choose to select another result layer from this dropdown to load the data of that layer in, or you can select it in the layer selector. Next to the dropdown, there is a 'Compare scenario' button, that will start a comparison. We'll discuss this in the next section.

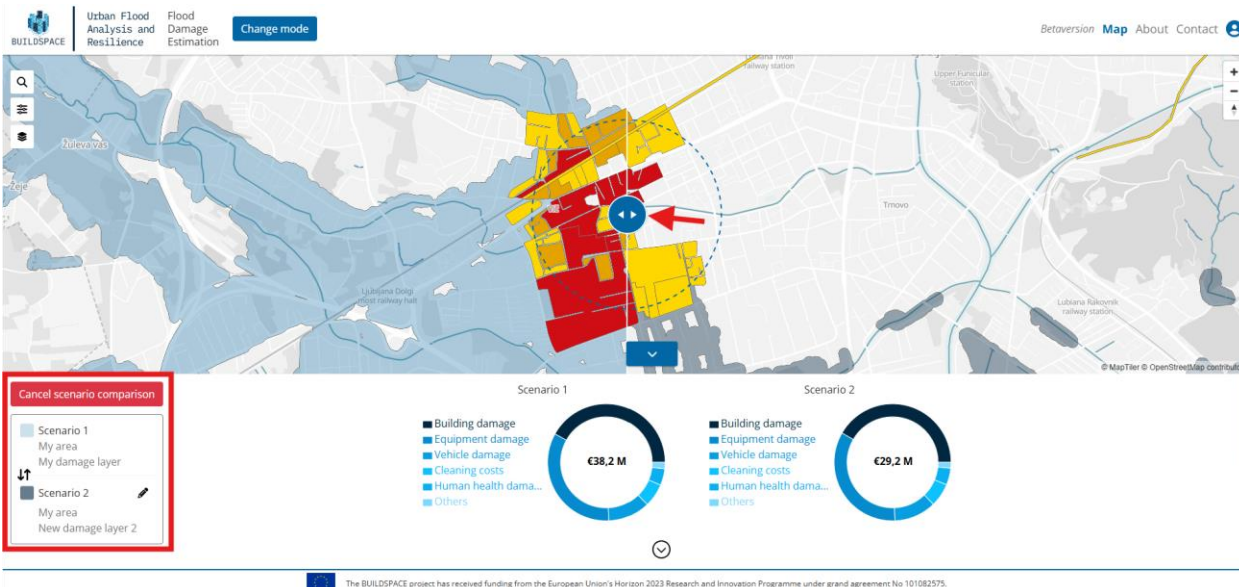
The content of the data panel itself, depends on the mode you are in, but the structure is the same. On the left there are some attributes in text form of the selected result layer. On the right, there are graphs and tables showcasing your results with more detail. At the bottom of the screen, there is a little arrow that allows you to navigate to the next screen of visualisations, if any are available. You can also just scroll in the data panel to navigate downwards.



5.4. Comparison

To add the comparison mode, you need to first open the data panel of one of the layers you would like to compare. If it is possible to compare that layer with another layer, the 'Compare scenario' button will be active and can be clicked. If it is not possible to compare, the button will be greyed out. For a comparison to be possible, you need to have two result layers within the same mode and within the same area of interest. When you have successfully started a comparison, your screen should look like the image below.

When the comparison is started, the result layer you started from will be considered 'Scenario 1' and will be already loaded in. Scenario 2 you still need to select in the little box on the left of the panel, using the dropdown menu. This menu will show all available layers. Scenario 1 will be shown on the left on the map and in the data panel, scenario 2 on the right. By using the switch icon (two arrows) in the box, you can switch Scenario 1 and 2 from position. The data panel will show you the comparison graphs and tables for both result layers. On the map, a slider appears that can be used to move left or right over the map, showing scenario 1 on the left and scenario 2 on the right. You can exit the comparison mode by clicking the red button saying, 'Cancel scenario comparison'.





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