# Dashboard design prototype

# Deliverable D2.3

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**BESTMAP**

**Behavioural, Ecological and Socio-economic Tools for Modelling Agricultural Policy**

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## Preface

Dashboards for data visualisation and decision-making are information management tools that visually display, analyse and provide metrics of data, for better decisions and understanding improvement.
Dashboards provide critical reporting of spatialised data and associated metrics information and are essential for displaying model results, guiding decisions and better navigating the landscape. The main aim of the dashboards is to quickly gain insights into the most relevant results of the data displayed. The main added value for users is that information is transformed into knowledge which is useful for decisions on policy making.

## Summary

This deliverable presents a detailed description of the BESTMAP dashboard prototype functionalities, designed to facilitate end-users such as stakeholders, scientists and regular citizens, to access analysis and reporting of BESTMAP model results that simulate future scenarios. The deliverable aims to explain the dashboard architecture, interface design and analytical functionalities that have already been implemented. This prototype has also been presented to potential end-users and their feedback has been collected in a list of future implementations.

## 1. BESTMAP Dashboard design

BESTMAP has adopted an application development, the dashboard, where end-users such stakeholders, scientists or regular citizens are able to use, analyse and report the results of models that simulate future scenarios. The first version of this decision-support tool was designed by the consortium members and subsequently co-designed with end-users. The codesign development of the dashboard has been focused on functional requirements that have been transformed into functional characteristics. As a remarkable feature, the dashboard is not designed as a presentation of statistical numbers and graphs, but it is map-oriented, allowing easy interaction and comparison of policy alternatives by visualising geospatial distributions of the positive and negative impacts on each case study at a glance. The first version of the dashboard is available at https://www.ogc.grumets.cat/bestmap/.

At technical level, the dashboard is a configurable system designed to allow simple replacement of content as soon as the project generates new models or pre-computed results. The visualisation includes maps to easily identify spatial distribution of impacts, graphs or tabular data. It allows on-the-fly computation of several statistics; it will show data quality indicators (e.g. uncertainty) and is provided with user-friendly controls that allow the selection of different narratives or scenarios.

The data architecture that includes the project dashboard is composed of 4 components (Figure 1). First, the GeoNetwork provides a Metadata Catalogue and also stores the data. Models run in a virtual environment using GeoNetwork data as inputs and its output results are data sources for the GeoServer (WMS / WFS). All possible scenarios are precomputed as possible results. Complex indicators are also precomputed and stored in the GeoNetwork. The GeoServer provides responses to the dashboard queries that are presented to the users as graphical or numerical values. Simple indicators such as statistical summaries are computed directly on the dashboard.

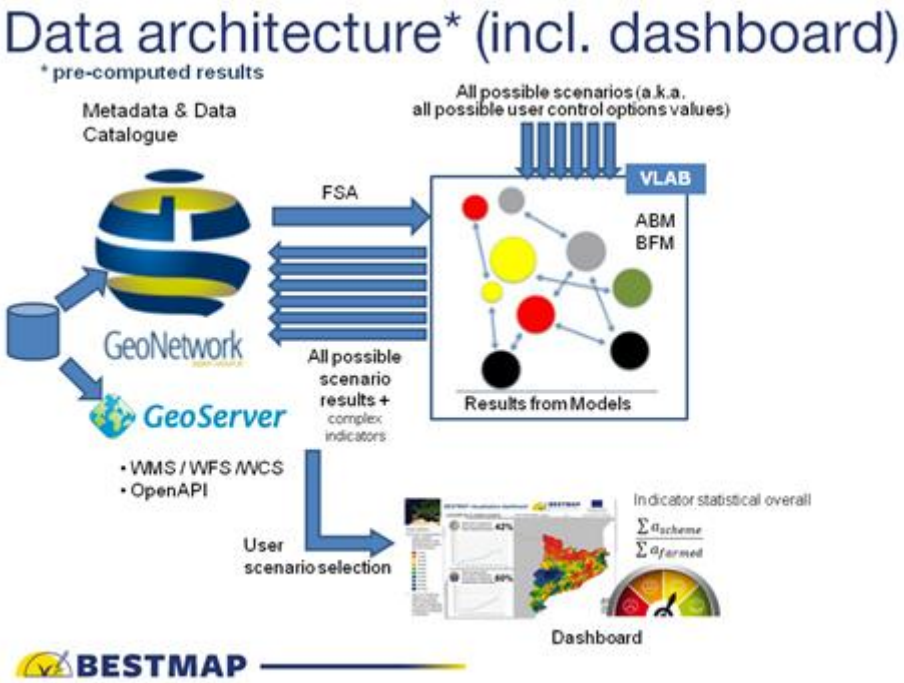


**Figure 1: Data architecture including dashboard**

## 2. Dashboard Architecture

In a regular WMS, layers are prepared and symbolised in the server, and thus a static portrait is transferred to the client. In BESTMAP, the dashboard server uses Cloud Optimised GeoTIFF (COG) directly in the browser, which transmits fragments on a GeoTIFF. Instead of responding coloured images (png, jpeg, etc), it delivers binary arrays. The client creates on-the-fly symbolisations, statistics, etc.
In addition to COG, the dashboard also supports direct access to GeoJSON, which provides a similar solution for vector data. GeoServer can expose COGs using WMS.

## 3. General Functions

The Dashboard interface consist of the following frames (Figure 2):

1. General location
2. Legend and layers (available and visible)
3. Current position
4. Navigation buttons
5. Viewer buttons
6. Viewer
7. Go to specific case study

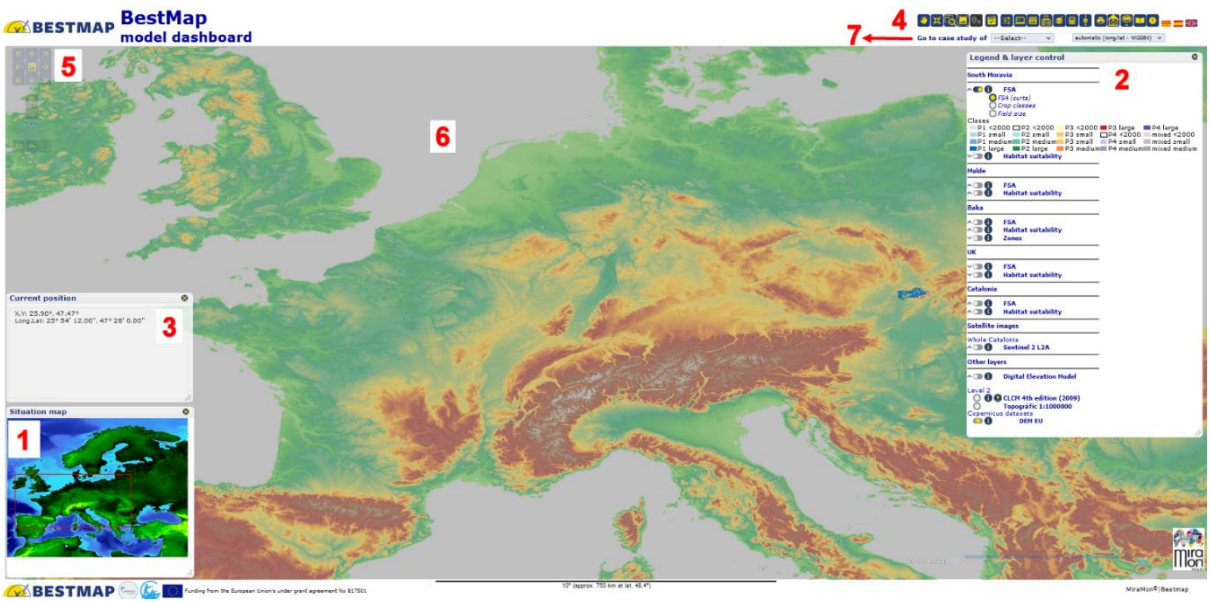


**Figure 2: General view of BESTMAP model dashboard**

## 3.1. Spatial component functions

### 3.1.1. General location

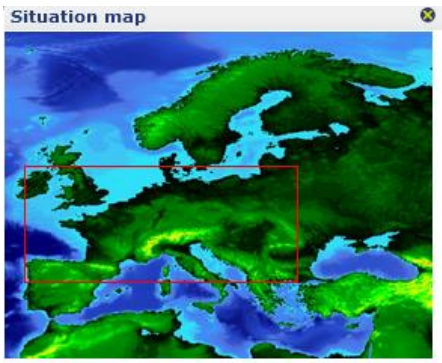


**Figure 3: General location map**

The location frame (Figure 3) shows the whole area over which it is possible to navigate (location map). The area and position of the viewer on the location map is indicated by a red-coloured box. By clicking on the location map (outside the box), the viewer is relocated and centred on the point that was clicked on.
This floating window can be closed using the top right cross to maximise the general view window and displayed again by pressing the “Show situation map”, located at the top right corner of the general view (Figure 4).

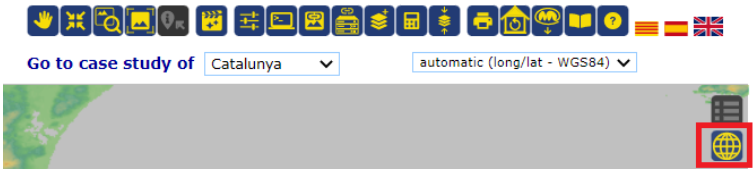


**Figure 4: Show situation map button**

### 3.1.2. Current position

This frame (Figure 5) shows the coordinates of the position of the cursor over the viewer or over the location map in two reference systems. The first one is the pan-European coordinate system, defined as the default in the context of the project (Lambert Azimuthal Equal Area LAEA ETRS89, EPSG: 3035) and second one is the geographic coordinates (Longitude/Latitude WGS84, EPSG:4326). Coordinates change according to the cursor movements over the view. The user can also carefully copy this information to the clipboard.

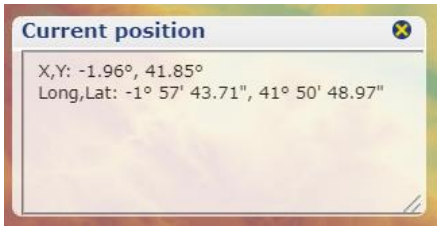


**Figure 5: Current position window**

This floating window can be closed using the top right cross to maximise the general view window and displayed again by pressing the “Show information about current position“ located at the top right corner of the general view (Figure 6).

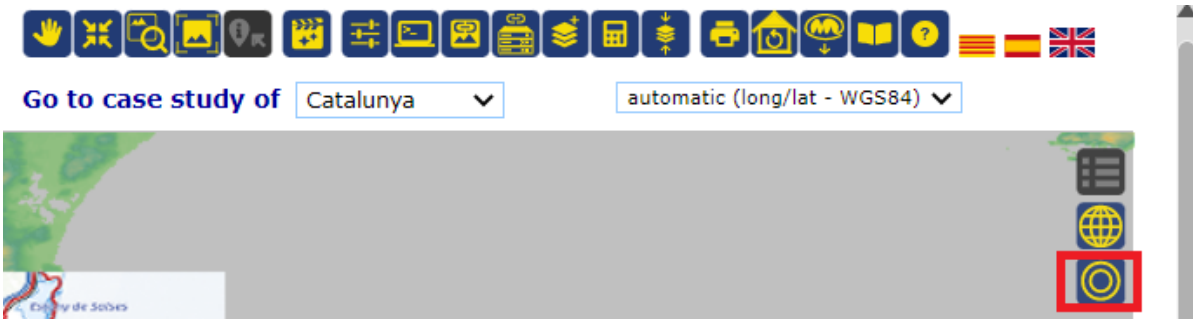


**Figure 6: Show current position button**

This window also shows the values of the data active in the browser in real time, by only hovering over it (Figure 7).

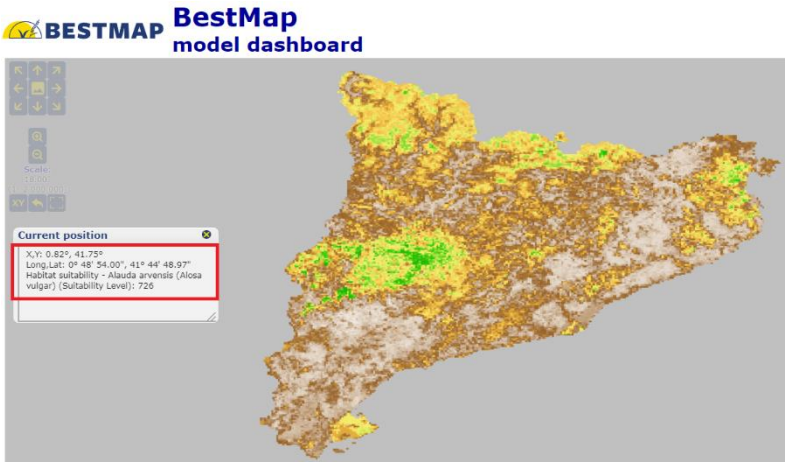


**Figure 7: Current position window content also display the values of the active layers in the view**

### 3.1.3. Navigation buttons

Figure 8, shows the navigation buttons, which function is, from left to right:

**Figure 8: Navigation buttons**

| | |
|---|---|
| 1. Pan view | 2. Centre where click |
| 3. Window zoom | 4. New View /Screenshot |
| 5. Query by location | 6. Time series and animations |
| 7. Options | 8. Console |
| 9. Link to map | 10. Links to the servers |
| 11. Add layers | 12. Layer calculator |
| 13. Analytical combination of layers | 14. Print |
| 15. Restart from server | 16. Install MiraMon Universal Map Reader |
| 17. Story maps | 18. Interactive help |

The user can also pass the cursor over the button and the description of each function will appear.

### 3.1.4. Viewer buttons and Viewer

The main viewer displays the different layers activated from the legend. By moving the cursor over the viewer, the projection and geographic coordinates appear in the "Current position" box. It is also possible to execute the commands for centre view, window zoom and query by location, by selecting the corresponding button from the navigation menu and clicking on the viewer.

**Figure 9: Viewer buttons**

The arrow buttons at the top left corner of the viewer permit horizontal, vertical or diagonal movement over the layers (Figure 9). The magnitude of jump can be adjusted using the magnifier buttons to reduce or increase 1 zoom level.
Bottom buttons are used (from left to right) to go to a specific coordinate, to jump to previous view or to display the viewer in full screen mode.

### 3.1.5. Selection of case study area

This drop-down list allows users to select the preferred case study relocating the viewer over the given area (Figure 10). The zoom is automatically adjusted to bring it into focus. After zooming into a case study, the user will get the impression that the browser is specialised in that case study.

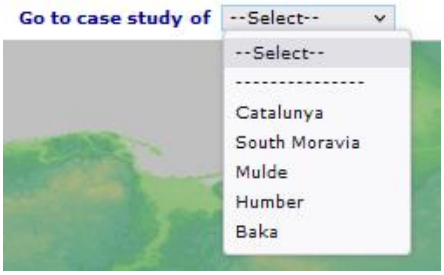


**Figure 10: Go to case study function**

Additionally, it is possible to move the viewer position over a desired area in any one on the following ways:

- By clicking on the location map and adjusting the zoom (with the buttons on the magnifying glass).
- By panning using the arrow buttons on the edges of the image and adjusting the zoom.
- By pressing the Centre View button and clicking on the desired point of the view.

- By pressing the Window Zoom button and then positioning the window over the view.

As the browser window is of fixed proportions, it is not always possible to obtain the exact area desired. In this case, it is possible to fall back by manually resizing the browser window.

### 3.1.6. Query by location

By clicking on the viewer, a new browser window emerges showing detailed information about the position and information on queryable layers in the legend (Figure 11). The information shown here is similar to the one shown in the current position window, but it has the following differences:

- The user can select which layers are queryable (only the ones visible are shown in the "current position" window).
- External layers that are provided in a classical WMS server that are declared queryable are shown here (the current position only shows the layers that are requested as binary arrays).

By clicking at the top-right corner blue arrow (see Figure 11 red square), the pop-up window will be transformed into a floating window, part of the main map browser viewer.

**Figure 11: Query by location result of a point in the screen**

## 3.2. Thematic component functions

### 3.2.1. Legend and layers

The legend and layers control frame shows the list of layers available and a description of the categories of each layer (see Figure 12). The legend allows the user to control the status of the layer viewing and query options. There is no specific map browser for each case study area but a single and global browser for all case studies. In summary, when using the zooming tools to approach a case study, only the layers available for this selected case study will be shown. However, the browser has the capability to switch layers on and off if they are not considered relevant because they do not cover the current bounding box or will be represented too coarsely (limitation by scale). Layers which are switched off are only listed in the layer frame, but are not displayed in the view, nor their categories shown in the legend.
Visualisation of layers is controlled with the toggle button: full visualisation , semi-transparency , and hidden . When the layer arrow shows the symbol on the left, this

indicates that the layer categories are hidden and can be displayed in the legend by clicking on it. When the categories are displayed, the ⌄ symbol appears.
From the legend, these are the main functionalities available:

- Define a layer, on semi-transparent or off
- Select which datasets are queryable by location
- Modify the name of the layer or style
- Add layers to the map (from the server, from the local drive or from an URL)
- Move layers up and down
- Show the histogram and statistics of the layer
- Reclassify layer values
- Edit the visualisation of a style
- Get information about the symbolisation palette code

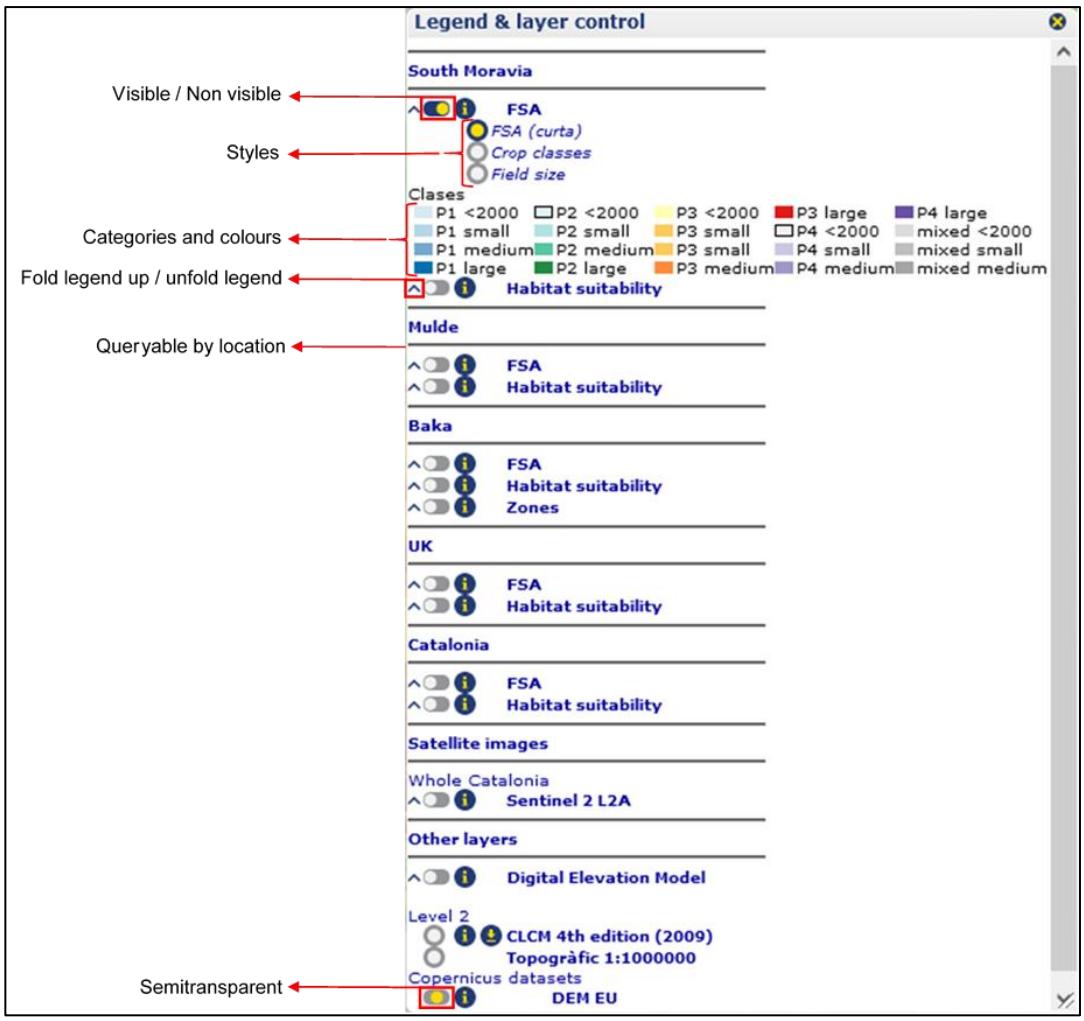


**Figure 12: Legend and layer control frame**

### 3.2.2. RGB compositions

For those CS where Sentinel data is available, personalised RGB compositions can be created. Users can create 3 band composites to represent the response of three such bands in a single image (Figure 13). The most useful RGB combination of bands for Sentinel 2 are[1]-:

| | |
|---|---|
| Natural Colours/ True colour: 4 3 2 | Healthy vegetation: 8 11 2 |
| False colour Infrared: 8 4 3 | Land/Water: 8 11 4 |
| False colour Urban: 12 11 4 | Natural Colours with Atmospheric Removal: 12 8 3 |
| Agriculture: 11 8 2 | Shortwave Infrared: 12 8 4 |
| Atmospheric penetration: 12 11 8a | Vegetation Analysis: 11 8 4 |

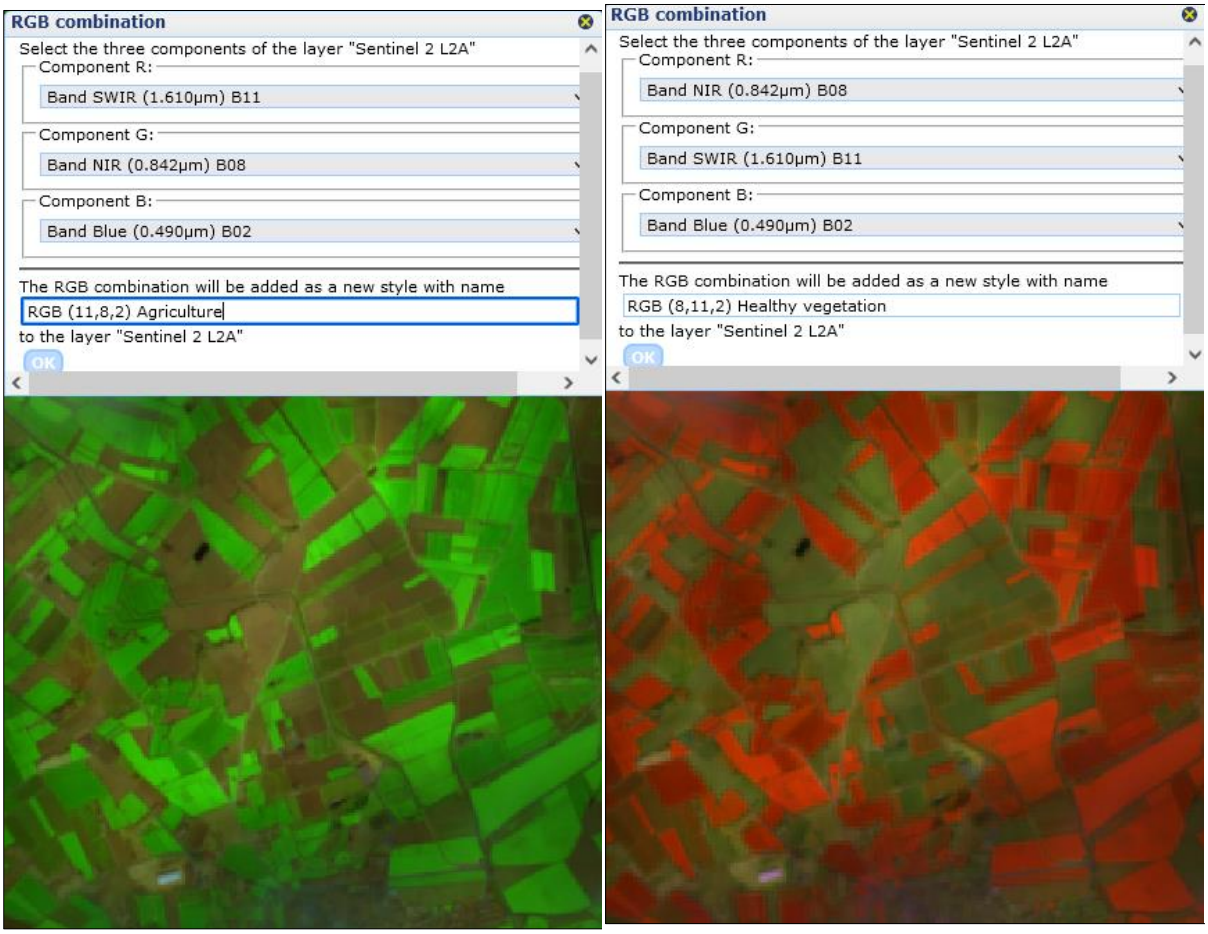


**Figure 13: Examples of RGB combinations**

### 3.2.3. Screenshots

It possible to freeze a fragment of the view by using the camera button ( Figure 8, button 4) on the toolbar at any time. After drawing the rectangle representing the area to be converted into a new view, a new window with the same view will appear (indicated as View 1, View 2, etc.) (Figure 14). Its content is not changed and it can be moved around. Users can keep as many screenshots open as they like. This is useful if users want to compare different layers, scenarios, areas or times.

[1] http://forum.step.esa.int/t/list-of-band-combinations-for-sentinel-2/1156. Note that RGB combination are specific for each satellite.

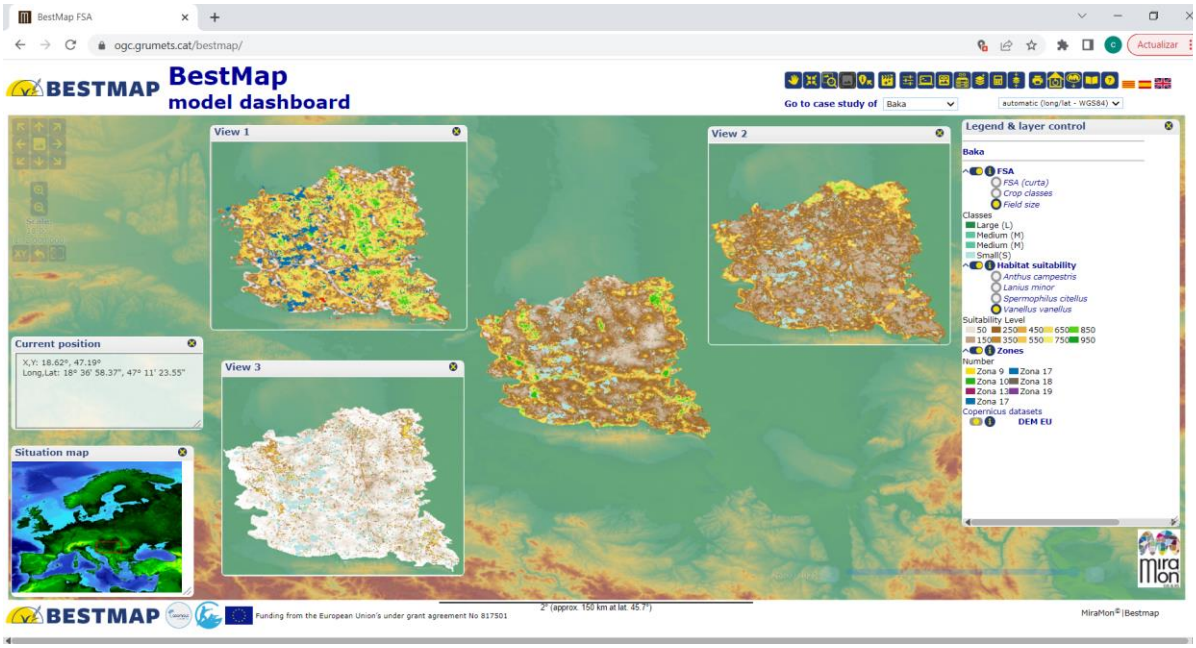


**Figure 14: Screenshots can be used to compare different scenarios**

## 3.3. Temporal component functions

If time series of data is available, users can create a time animation. Time-slider of data is implemented as a time drop-box with the list of available dates. Be aware that there is no time synchronisation among layers and changing the date in one layer has no effect in the other time dependent layers.

By pressing the “Show animation” button, the animation window is opened. It allows you to see the images, which comprise the same temporal sequence in order, as if you were watching a video (Figure 15). The area loaded in the view is the one used in the animation. In the pop-up menus in the top part of the window, you can choose the temporal series that you wish to see and its style.
Using the buttons in the bottom half of the window, you can control the animation (start, stop, pause, etc).
The images that make up the animation are shown in a horizontal strip in the bottom part of the panel. By selecting or clearing a check box you can enable or disable each image to include or exclude it from the animation, (this is useful in series of satellite images in which some of the images may contain clouds).

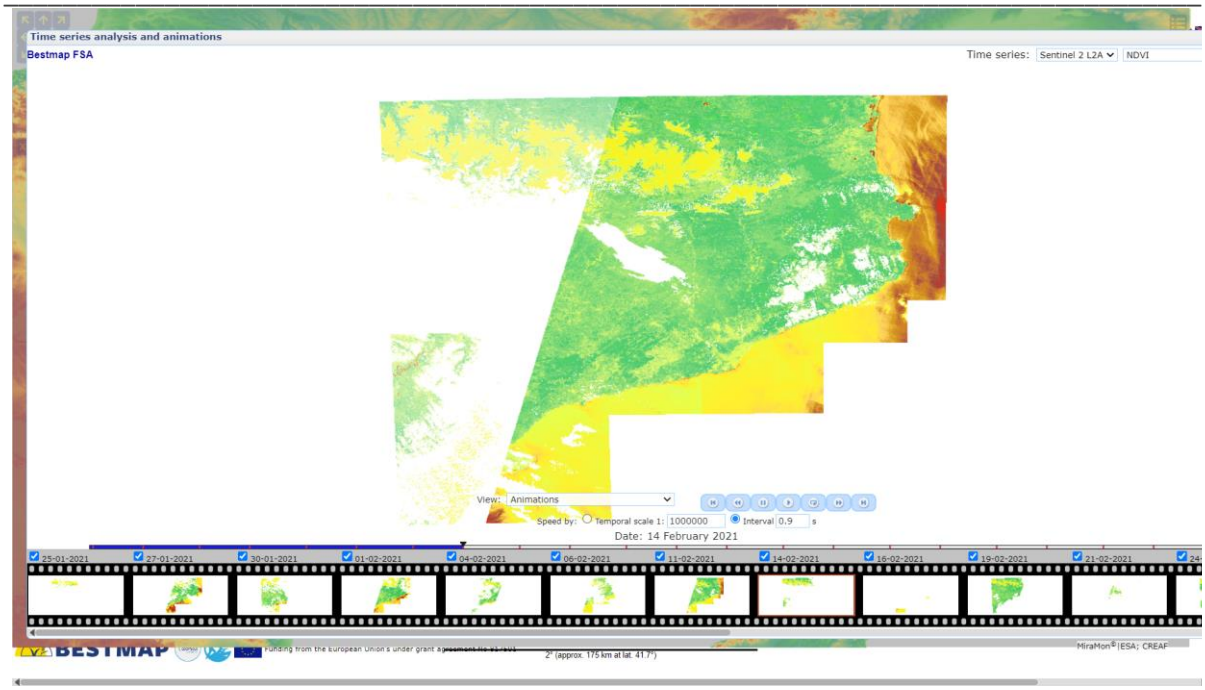


**Figure 15: Time series animation of a CS NDVI**

# 4. Analytical functions

The browser incorporates the capability to create new layers, (or new styles for an existing layer), that are the results of an analytical expression.

IMPORTANT: please be aware that these calculations are performed at screen resolution. Layers and styles that result from a calculation are evaluated on the fly each time that the view changes by effect of a zoom or a pan. The results of these calculations (including statistics) are done at the screen resolution and might change because of a zoom. Analytical functions provide a fast way to try your ideas and get immediate results. Even if the results can be a reasonable approximation, when you are ready to take conclusions we highly recommend that you download the datasets and repeat the calculations at full resolutions with a GIS application to increase accuracy and reduce uncertainty.

## 4.1. Statistics, histograms and pie charts

When a layer is active (indicated as visualised in the layer control panel), the user can right click on the layer name to open the “context menu” with several options available. One of these options is the “Histogram/Pie Chart” (Figure 16). By selecting this, a graphical representation of the distribution of values or categories seen in the current view will be displayed. According to the type of layer, the graph displayed will be a histogram or a pie chart, for discrete or categorical data respectively (Figure 18).
The dashboard allows the user to keep the histogram window open and frozen, and open additional histogram windows to be able to visually compare them. In addition, by placing the cursor on a histogram column, information displaying the count of each detected value in the column will appear (Figure 17).

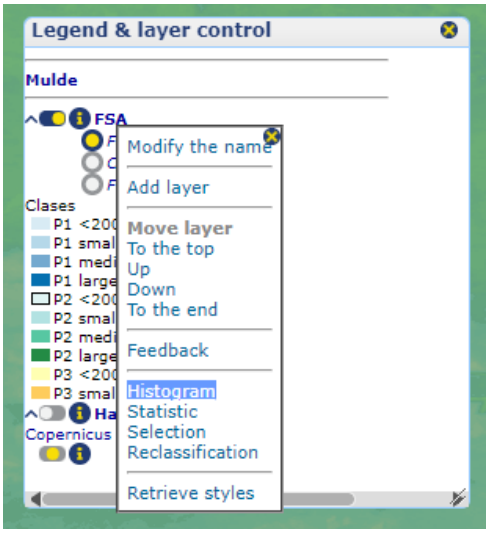


Figure 16: Histogram /Pie Chart option

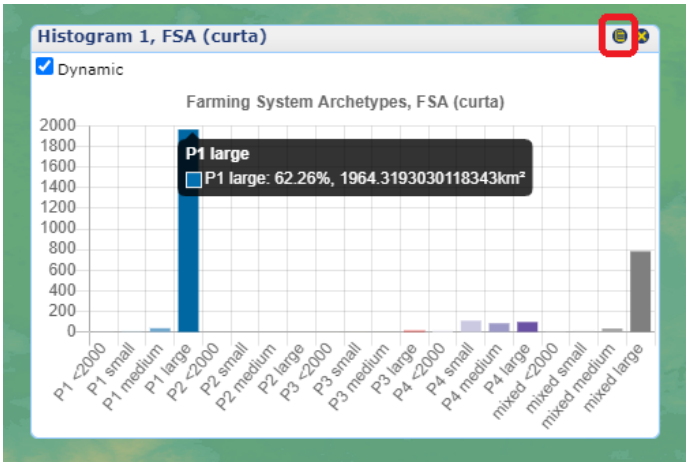


Figure 17: Example of histogram computed

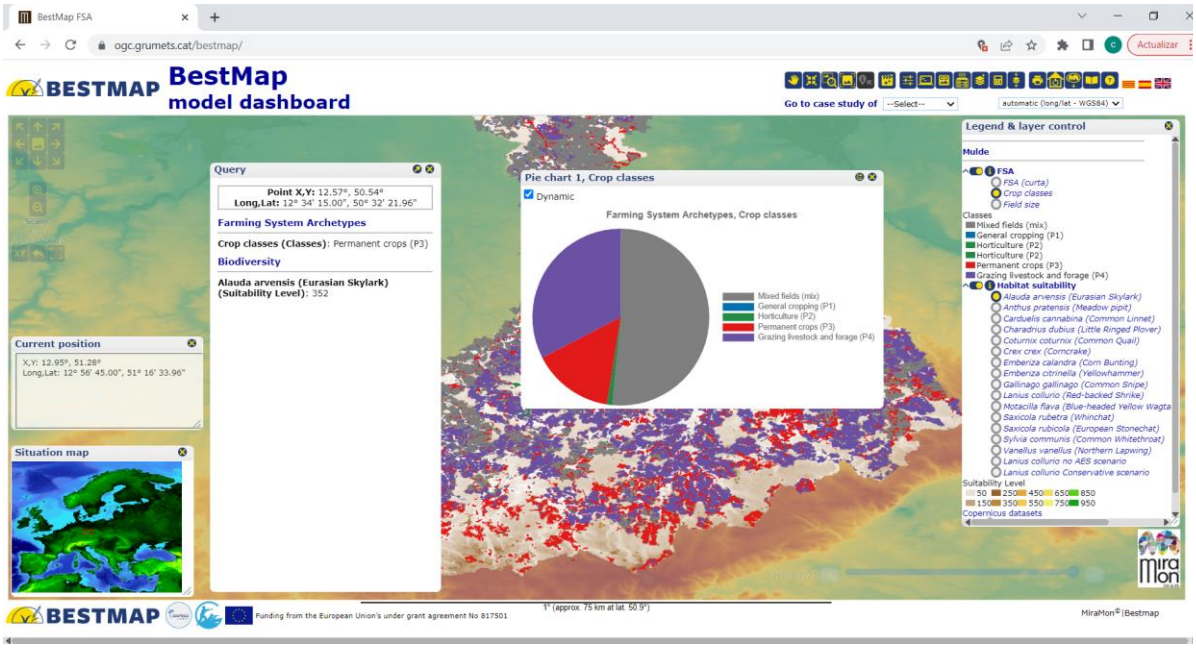


Figure 18: Example of the dashboard with pie chart and query by location window

By selecting a particular area of interest or moving the main window view, the histogram will be recalculated with the new values relative to current view.

The numerical values used to elaborate this graphic can be copied and pasted into a text file or spreadsheet (e.g. MS Excel) by using the small icon at the top-right corner of histogram window (see Figure 17, red square). The clipboard information will also contain derived statistics such as mean, standard deviation, range, etc.

## 4.2. Selection by condition

The dashboard allows the user to perform analyses, such as determining the distributions of variables in a given area. This can be made through the “Selection by condition” function (left click on a layer) (Figure 19). Users will be able to select one of the layers visible at the moment

and apply the conditions to be explored. The operators supported in the tool are 6 (=, =/=, >, <, >=, <=). The example corresponds to “Select only *Anthus campestris* habitat suitability higher than 500”.

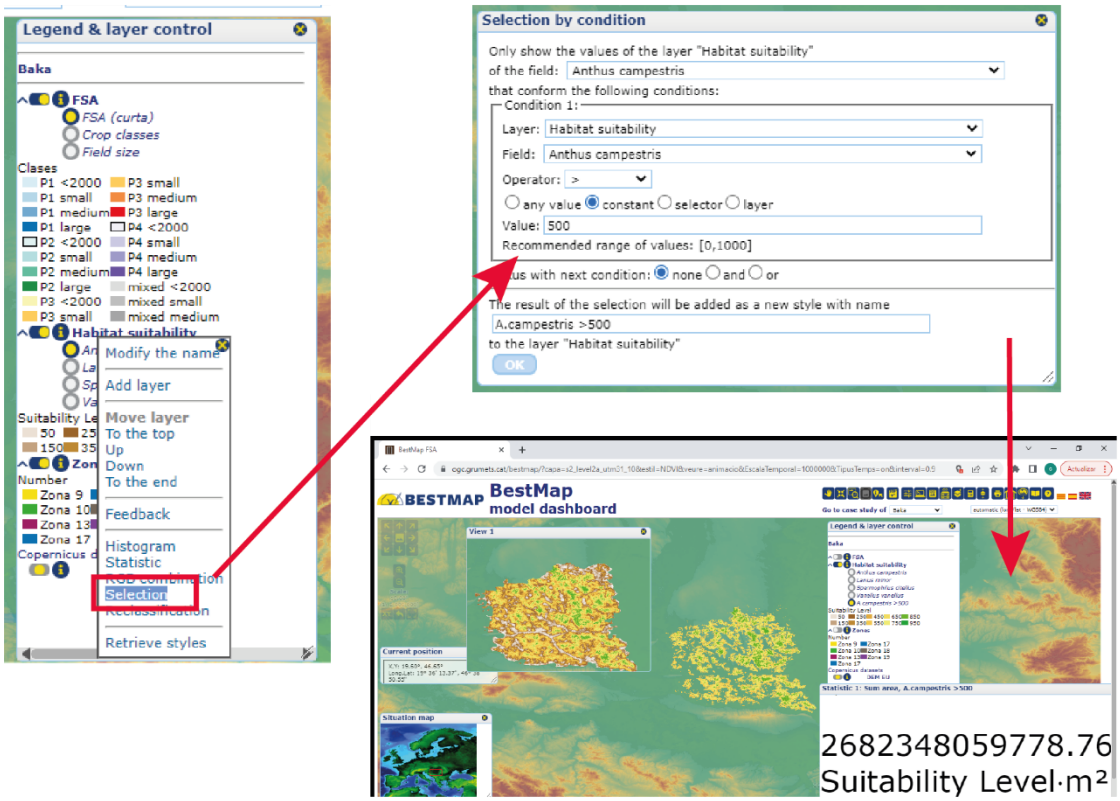


**Figure 19: Example of simple selection by condition**

Once the result is displayed as a new layer, data can be copied and pasted to a spreadsheet and saved. (Figure 20).

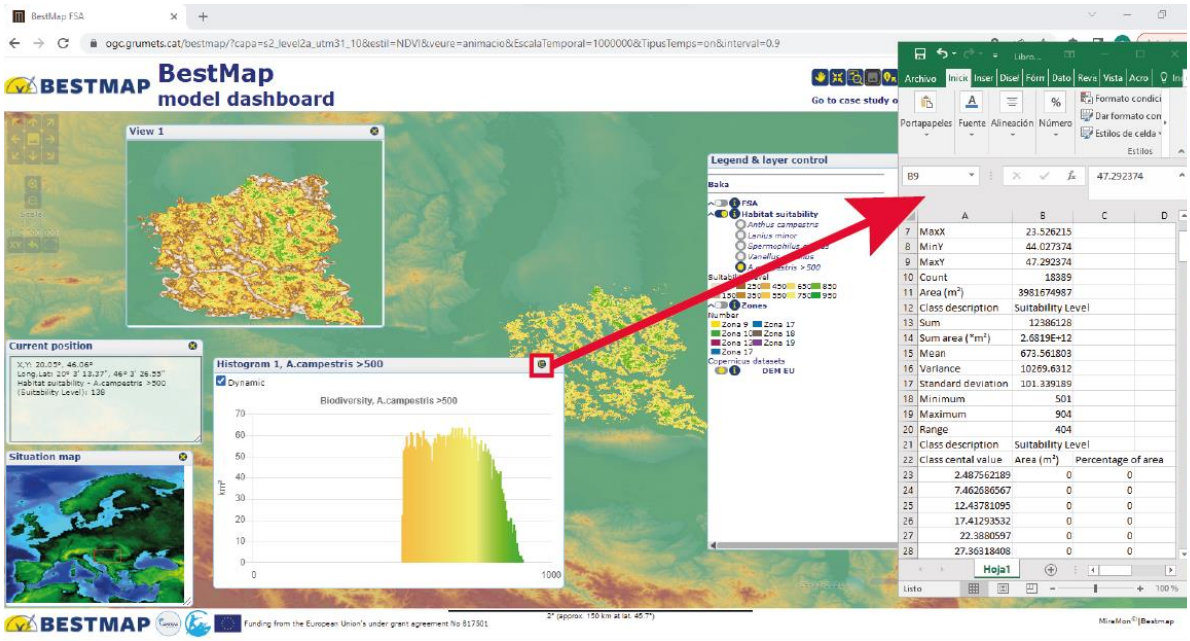


**Figure 20: Example on how selected data can be saved as spreadsheet file.**

More complex selections by conditions (Figure 21) can be performed involving more than one layer. For instance: “Compare *Vanellus* habitat suitability at Zone 9 and Zone 7”. Please note that since these new selections by condition generate a new layer, new selections by condition can be performed using the previous selection.

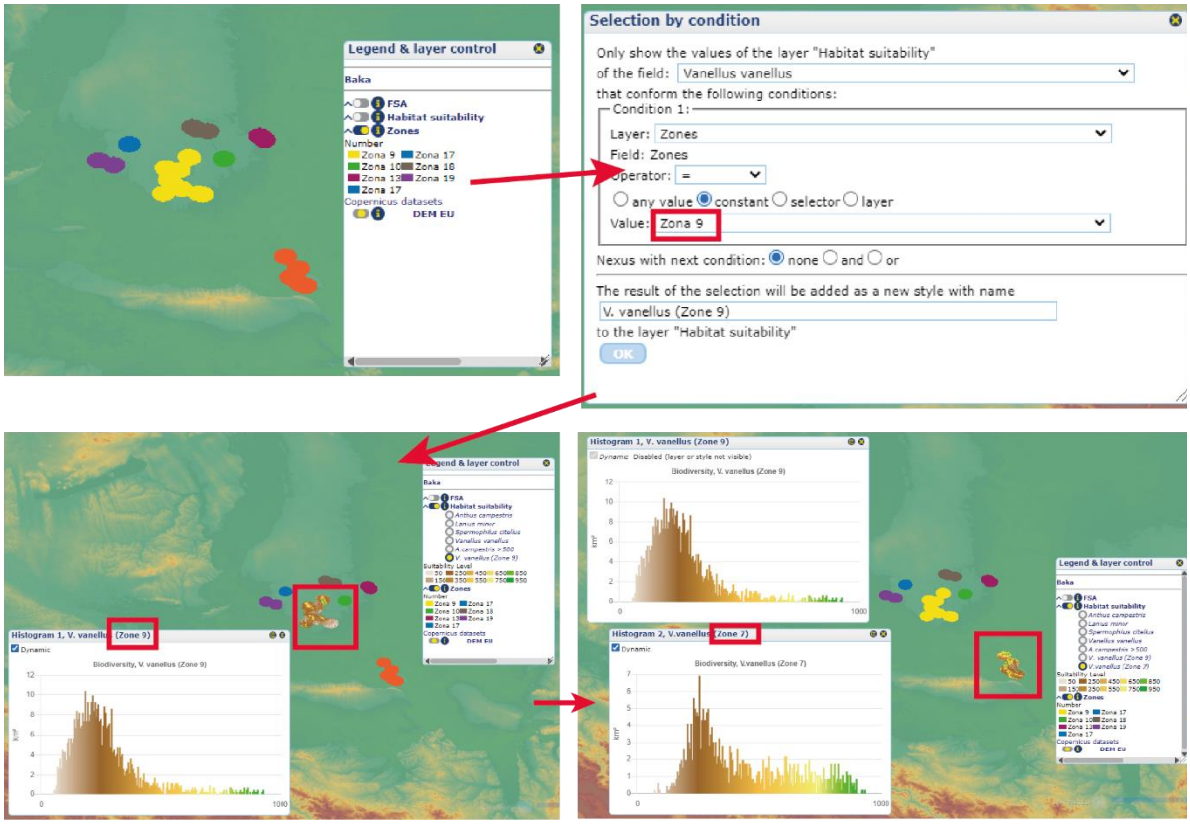


**Figure 21: Example of complex selection by condition**

## 4.3. Layer calculator

The dashboard also includes a layer calculator (see Figure 8, button 12). A layer calculator performs the same operation than a scientific calculator but some of the numbers in the expression can be substituted by layers (Figure 22). The result of such a calculation is a layer where each pixel is the result of the operational calculation of the original layer pixel values.

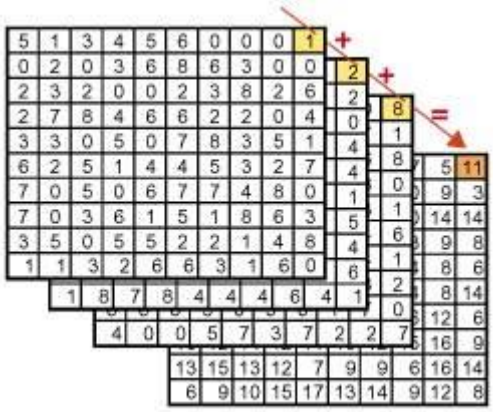

**Figure 22: Layer calculator concept**

A useful application of the layer calculator is the computation of differences between different scenarios to visualise the spatial distribution of the agri-environmental schemes effect. For instance, the user can compute the difference between “Current Habitat suitability vs Habitat suitability without AES of “*Lanius collurio*“ for a given region (Figure 23).

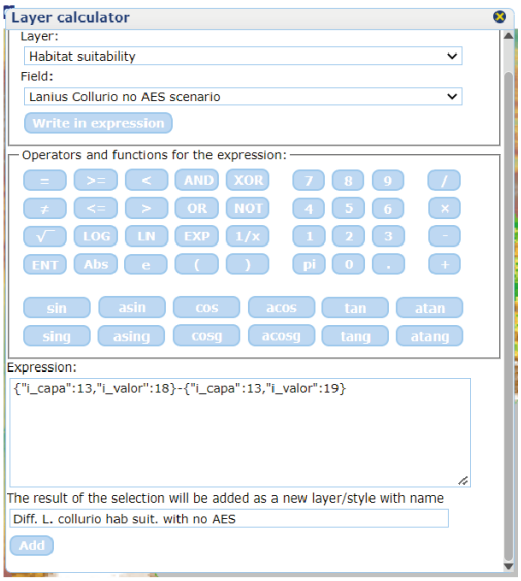


**Figure 23: Example of difference layer calculation between different Bird Habitat suitability scenarios**

The result returns a new layer showing the differences. The user can transfer the results to a spreadsheet file to analyse the statistics of such differences (min, max, st. dev…) and visualise where the maximum differences occur (Figure 24).

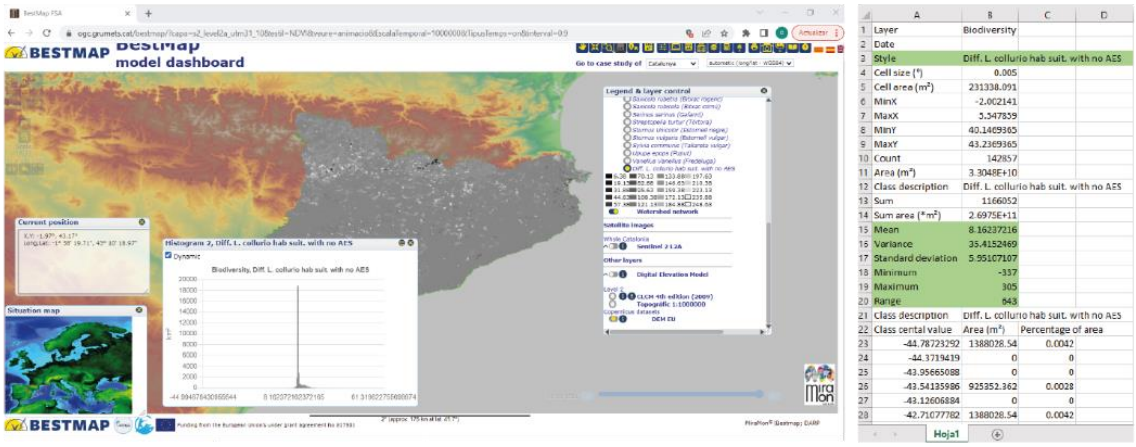


**Figure 24: Result of layer calculation of differences between 2 habitat suitability layers (current – no AES scenario) Higher values (in white, see legend) indicate areas where the application of AES is more effective.**

## 5. Story maps

To complement the data visualisation of the BESTMAP results, the dashboard includes a new functionality called story maps. Story maps enable end-users and stakeholders to explore and discover case study narratives based on dynamic maps and other multimedia content. The aim of story maps is to guide end-users and stakeholders through the relevant narratives of the project results, topics and policy briefs per case study, so the story facilitates the final users' interpretation and understanding of the results, in case they are not familiar with modelling results or policy briefs.

The storyline includes a narrative text in the local language of a topic associated with this specific area and supported or related to the interpretation of BESTMAP models resulting maps, together with graphs, statistics, or references to other types of documents, such as scientific journal publications or reports. As the narrative is progressing, the map is moving to focus on the specific area related to the text, so the user sees the results, changes etc.

The narratives are built around key questions such as "How sensitive is the result to payment level above income forgone?" or "How much does the Bird Habitat suitability change in different scenarios?".

The button to activate the "Story maps" is symbolised with a "book" icon (see Figure 25). Narratives are provided both in English and in the local language of the case study country/region aiming to be understandable for any type of local end-user.

**Figure 25: "Story maps" navigation button**

When the user goes to a specific case study (e.g. Mulde, DE) the main viewer window moves to centre on the selected case study and the legend displays all the available layers. Following this, the "Story map" button can be activated and a list of the story maps included for this case study will pop-up. The user can then select the desired narrative (Figure 26).

**Figure 26: Example of story maps for the "Mulde" case study**

Following a floating window with the story map will appear (Figure 27) so the user can start reading the narrative around the selected case study. The user has the option to resize and place the window as desired. By scrolling down, the user will have an interactive experience while reading the content of the story map, which is synchronised with dynamic maps and histograms. The main goal of this interactive component of the story is to engage the user with the narrative and to help him/her understand the results of the case study in a more comprehensive way.

If the narrative is supported by graphs, a second floating window showing a histogram/pie chart will pop up when text will reference the graph (Figure 27). Note that if the user zooms into another view, the graph will be recalculated with the values belonging to the new selected area (Figure 28).

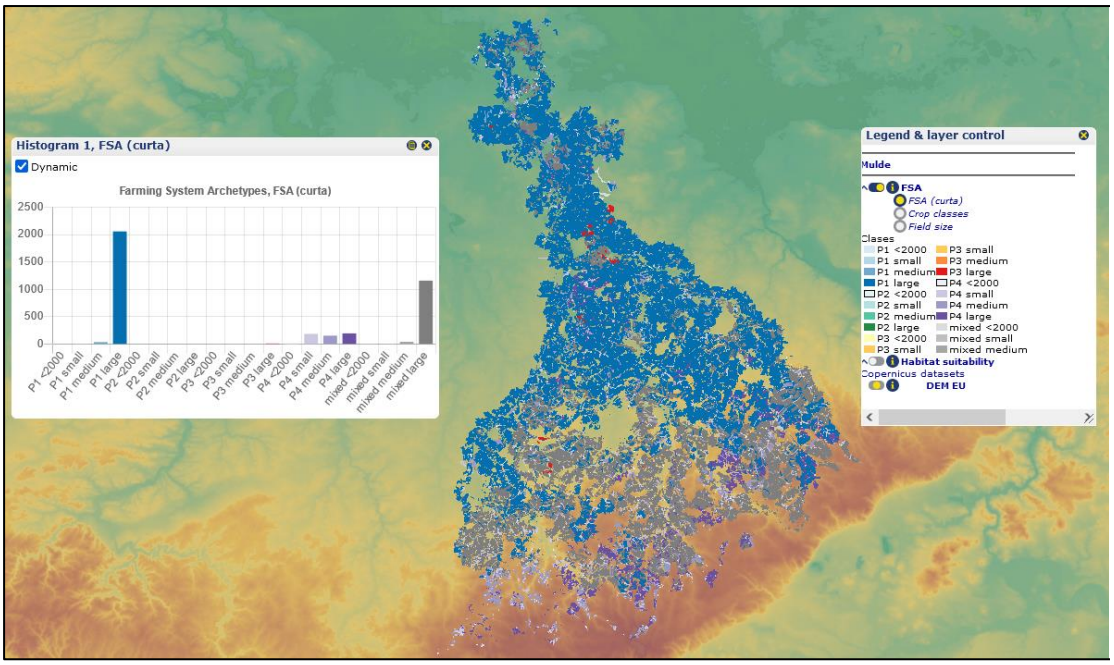


**Figure 27: Interactive histogram visualising the spatial distribution of the FSA categories in the whole area of the Mulde case study**

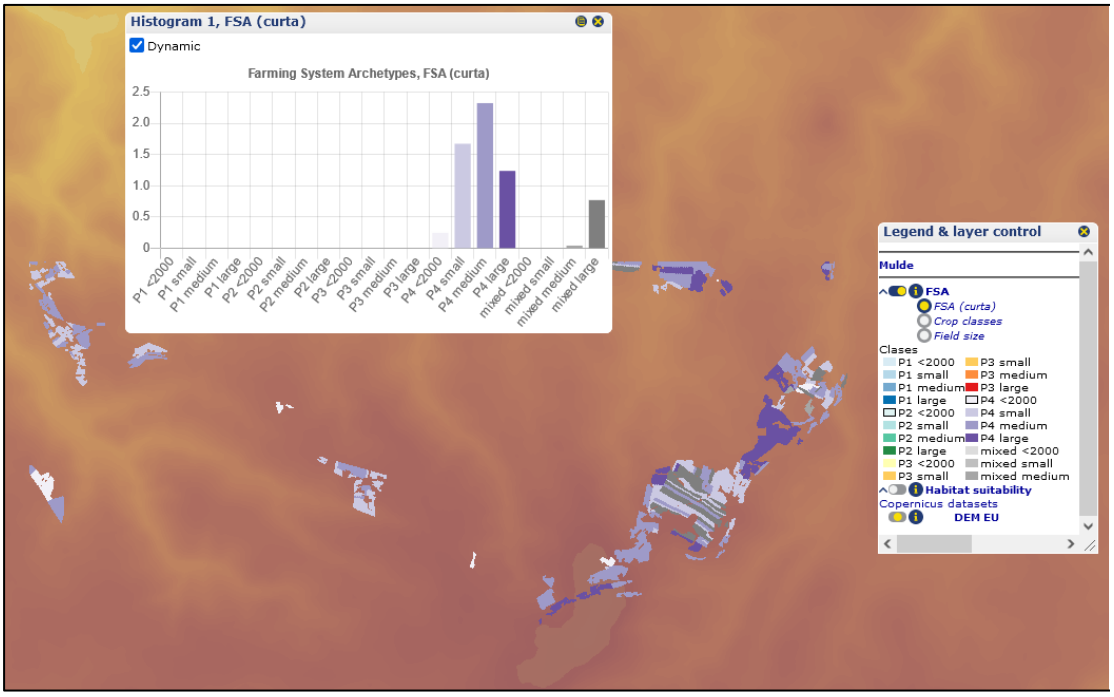


**Figure 28: Interactive histogram visualising the spatial distribution of the FSA categories in the higher regions of the Ore Mountains of the Mulde case study**

The user can continue scrolling down to read the rest of the story map that can be supported with photography (Figure 29).

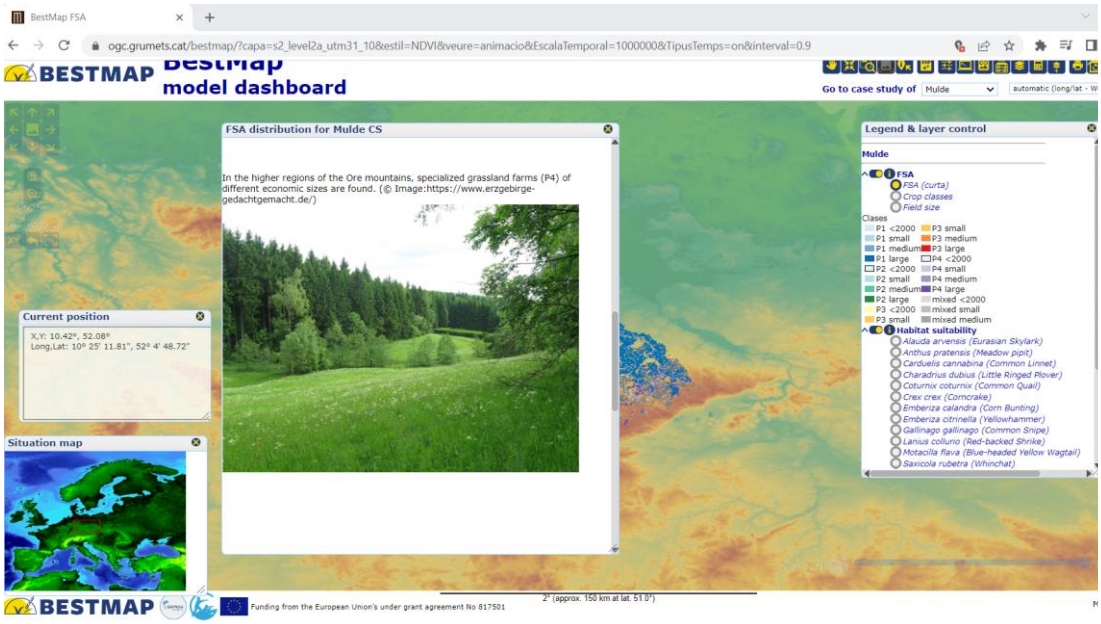


**Figure 29: Story map text supported with images.**

# 6. Current implemented layers and story maps

To this date, the following layers (Table 1) and story maps (Table 2) for the case studies and topics are implemented into the dashboard prototype:

**Table 1: Layers implemented in the prototype version**

| Layers | South Moravia | Mulde | Baka | Humber | Catalunya |
|---|---|---|---|---|---|
| **FARMING SYSTEM ARCHETYPES** | ● | ● | ● | ● | ● |
| **BIOPHYSICAL MODELLING** | | | | | |
| **Biodiversity** | ● | ● | ● | ● | ● |
| **Food & fodder** | | ● | | | |
| **Carbon sequestration** | | | | | |
| **Water nNutrient delivery** | | | | | |
| **Farm income model** | | | | | |
| **AGENT BASE MODELLING** | | ● | | | |
| **OTHER ANCILLARY DATA** | | | | | |
| **Zones** | | | ● | | |

● Implemented ● In progress

**Table 2: Story maps implemented in the prototype version**

| Story maps | South Moravia | Mulde | Baka | Humber | Catalunya |
|---|---|---|---|---|---|
| **FARMING SYSTEM ARCHETYPES** | ● | ● | ● | ● | ● |
| **BIOPHYSICAL MODELLING** | | | | | |
| **Biodiversity** | | ● | | | |
| **Food & fodder** | | | | | |
| **Carbon sequestration** | | | | | |
| **Water nutrient delivery** | | | | | |
| **Farm income model** | | | | | |
| **AGENT BASE MODELLING** | | | | | |
| **OTHER ANCILLARY DATA** | | | | | |
| **Zones** | | | | | |

● Implemented ● In progress

# 7. Configuration

By pressing the “Options” button, a dialog box (see Figure 30) emerges visualising georeferenced parameters and gives users the option to configure different parameters of the browser. Description of functions follows.

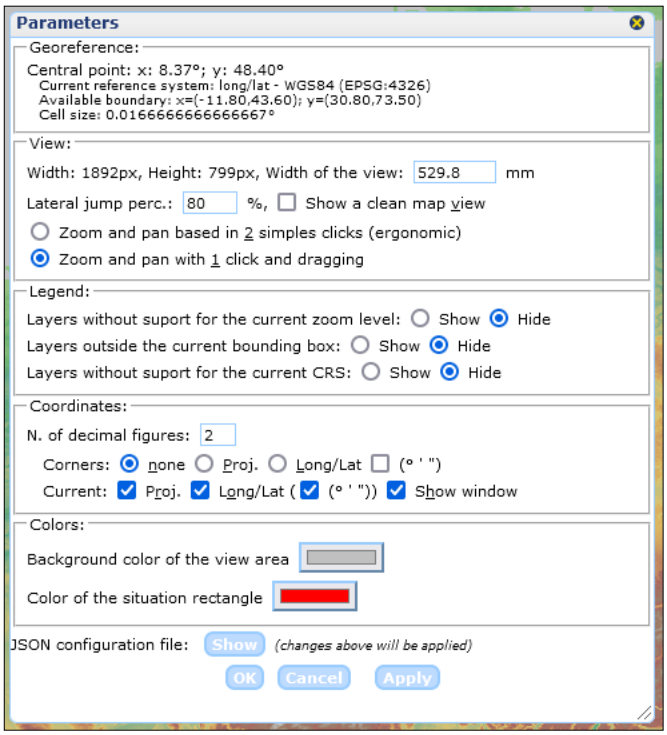


**Figure 30: Configuration parameters**

## 7.1. Georeference section

In this section, the user will find detailed information about georeferenced parameters such as the central point, the current reference system, the available boundary and the cell size.

## 7.2. View section

- Width and Height: this parameter allows the user to define the size of the viewer when the automatic mode (check box “Show a clean map view”) is deactivated. If this option is enabled, the width and height values are resized so that the view fills the area as large as possible.
- Lateral jump perc.: it indicates the percentage of the image that moves when clicking on the arrow buttons of the viewer.
- Zoom and pan based in 2 simples clicks (ergonomic): by checking/unchecking radio button.
- Zoom and pan with 1 click and dragging: by checking/unchecking radio button

## 7.3. Legend section

- Layers without support for the current zoom level: by checking/unchecking radio buttons “Show” and “Hide”
- Layers outside the current bounding box: by checking/unchecking radio buttons “Show” and “Hide”
- Layers without support for the current CRS: by checking/unchecking radio buttons “Show” and “Hide”

## 7.4. Coordinates section

This section allows for the configuration of different aspects of the coordinates that are displayed on the browser.

- N. of decimals figures: the user can display the desired number of decimal digits in the coordinates.

- Corners: allows the user to configure the viewing format of the coordinates that appear at the corners of the viewer. This may be: none, determined by the projection, or in longitude/latitude. In the last case, it is possible to choose between decimal degrees or sexagesimal degrees (degrees, minutes and seconds) degrees (º ' ").

- Current: refers to the coordinates of the position of the cursor over the view or over the location map. This parameter allows the user to configure the viewing format of the coordinate frame. In this case, the viewing formats may be determined by the projection, in longitude/latitude or in both. For longitude/latitude, it is possible to choose between decimal degrees or sexagesimal (degrees, minutes and seconds) degrees (º ' "). The check box “Show window” allows the user to activate or deactivate the “Current position” window.

### 7.5. Colours section

- Background colour of the view area: by clicking on the colour box, the user can choose the preferred background colour of the view area.

- Colour of the situation rectangle: by clicking on the colour box, the user can choose the preferred colour for the situation box

## 8. Dashboard co-design with end-users

The dashboard has been co-designed in a first meeting with stakeholders and project members to ensure its usefulness. The prototype was presented and users were able to interact with it, explore functionalities or display a specific combination of parameters in the map. Since the version used for the demo was the prototype, some operability difficulties appeared in screen display functionalities or operating the zoom options. Users suggested some transparencies when map displaying, the use of full text instead of acronyms, or a dashboard version with a simplified option button menu. Regarding the exploration of biophysical models, participants would find it interesting to have easier access to comparative results (between areas, between species, and so on) based on before and after AES scenarios. Users also mentioned their interest in uploading specific datasets of their interest as a useful functionality. Finally, the story maps concept was welcomed and users asked if they could build their own narratives directly in the tool. Key messages of this meeting were collected, analysed and some of their requests are being implemented.