Legionnaires' disease GIS Tool

User Manual

The main objective of this toolbox is to provide a series of practical tools that Member States, Iceland, Liechtenstein and Norway and ECDC can use to facilitate a co-ordinated investigation and response to clusters and outbreaks of Legionnaires' Disease with an EU dimension.

The tools concern the following:

- ✓ Developing understanding
- ✓ Data collection
- ✓ Data management
- ✓ Data analysis
- ✓ Decision support
- ✓ Developing communications

Legionnaires' disease GIS Tool v2.0

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1. Basics applications utilities

1.1. Standard GIS tools

Zoom in/out

This tool is located directly in the map viewer as a + and – symbol for the zoom in and zoom out level. The max allowed will be 1:1 for zoom in and world scale for zoom out. User will click on the symbol to perform zoom operation.

Home

The user can click on the Home button to return to the initial default view.

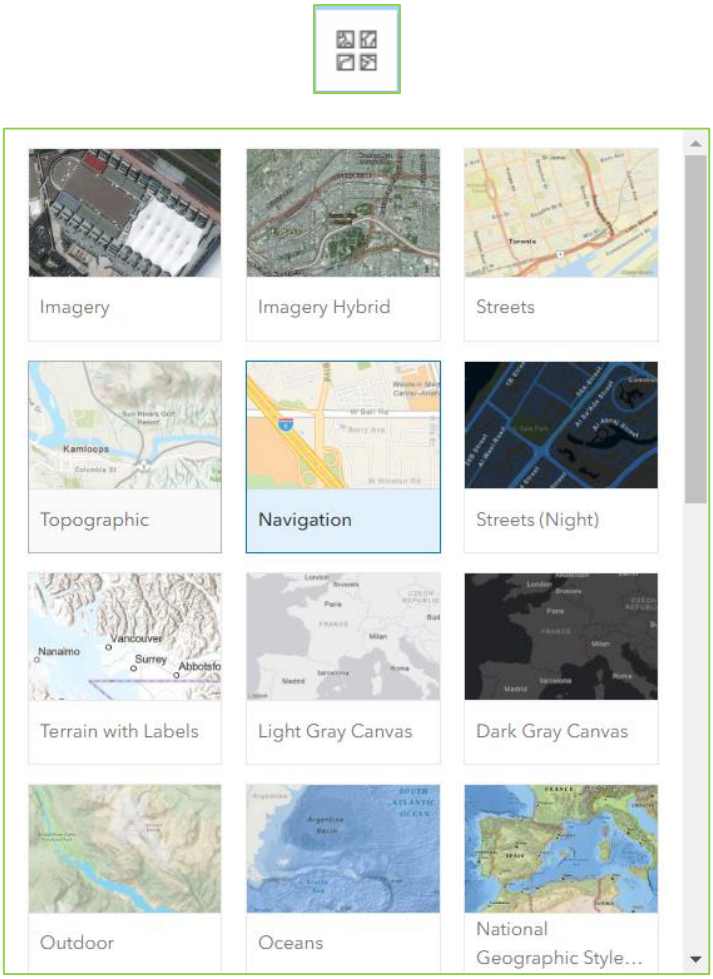
Pan

User can pan among the map by mouse left clicking and dragging.

1.2. Base maps

The application provides a tool for changing the base map. Tool is available directly in the map viewer as a button. By clicking in this tool, a pop-up window appears and displays a selection of available base maps published through ArcGIS Online

- Imagery
- Imagery hybrid
- Streets
- Topographic
- Navigation
- Streets (Night)
- Terrain with Labels
- Light Gray Canvas
- Dark Gray Canvas
- Outdoor
- Oceans
- National Geographic Style
- Others



1.3. Basic geographical measurements

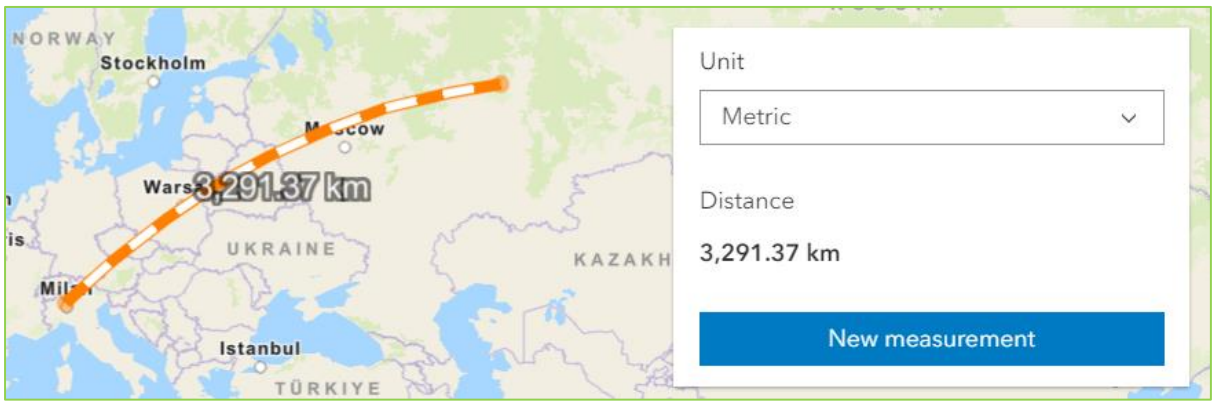
The measure tool is available as several buttons grouped with the GIS standard tools in the map viewer. The three buttons that allow measurements are as follows:

- Distance measure
- Area measure
- Remove measure

Distance

This tool measures distances between two or more locations in the map. Once the tool is selected, the cursor colour will change to orange, and the user can left click anywhere in the map viewer to define a vertex for the start location. At the same time, the user can drag the cursor to move the map view. When the user left clicks on a second location a second line will be created and distance between the two will be displayed. User can click in sequence on more points, to build more vertex and fit a polyline. To complete the operation, the user needs to double click on the last vertex. The total distance will be

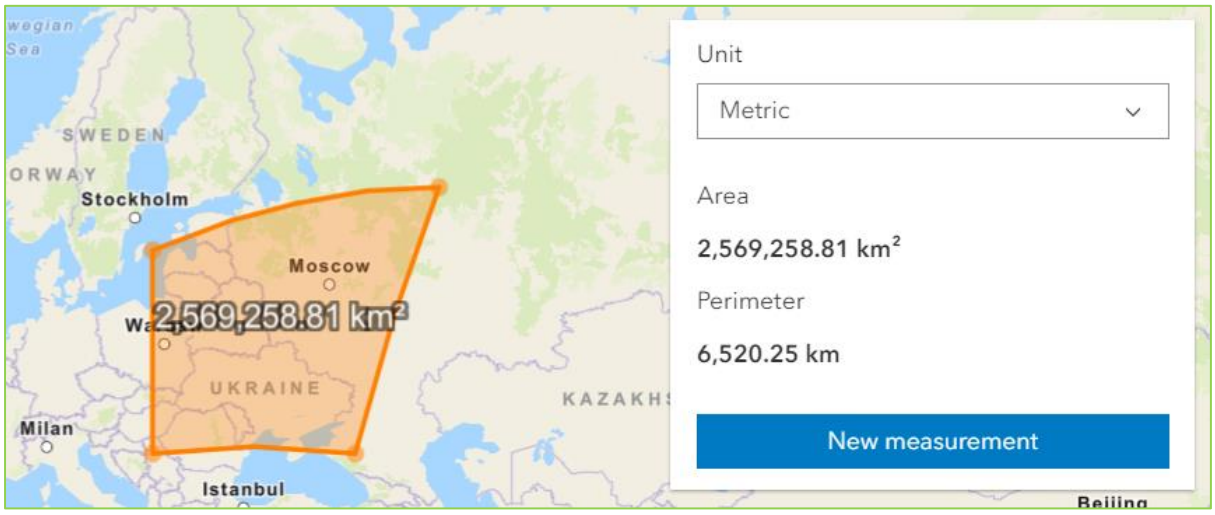
measured. In the same frame (bottom-right) where the measured distance is displayed, the user can select the desired units (kilometers, meters, miles, feets, etc.).



Area

This tool measures areas between three or more locations in the map. The mouse cursor will change color to orange, and the user can left click anywhere in the map viewer to define a start location. Then the user can drag the mouse cursor to another location and click to define a second vertex, etc. As user vertexes are created a polygon surface will be fitted between these and the relative area of the polygon will be dynamically displayed in the measure results panel. When user double clicks on a vertex the operation will be concluded, a final polygon will be displayed in orange and a final measure (area and perimeter) will be displayed in the measure results display.

Once the polygon is completed, the user can select the desired units (square kilometers, square meters, square feets, etc.). In the same frame (bottom-right) where the measured distance is displayed.

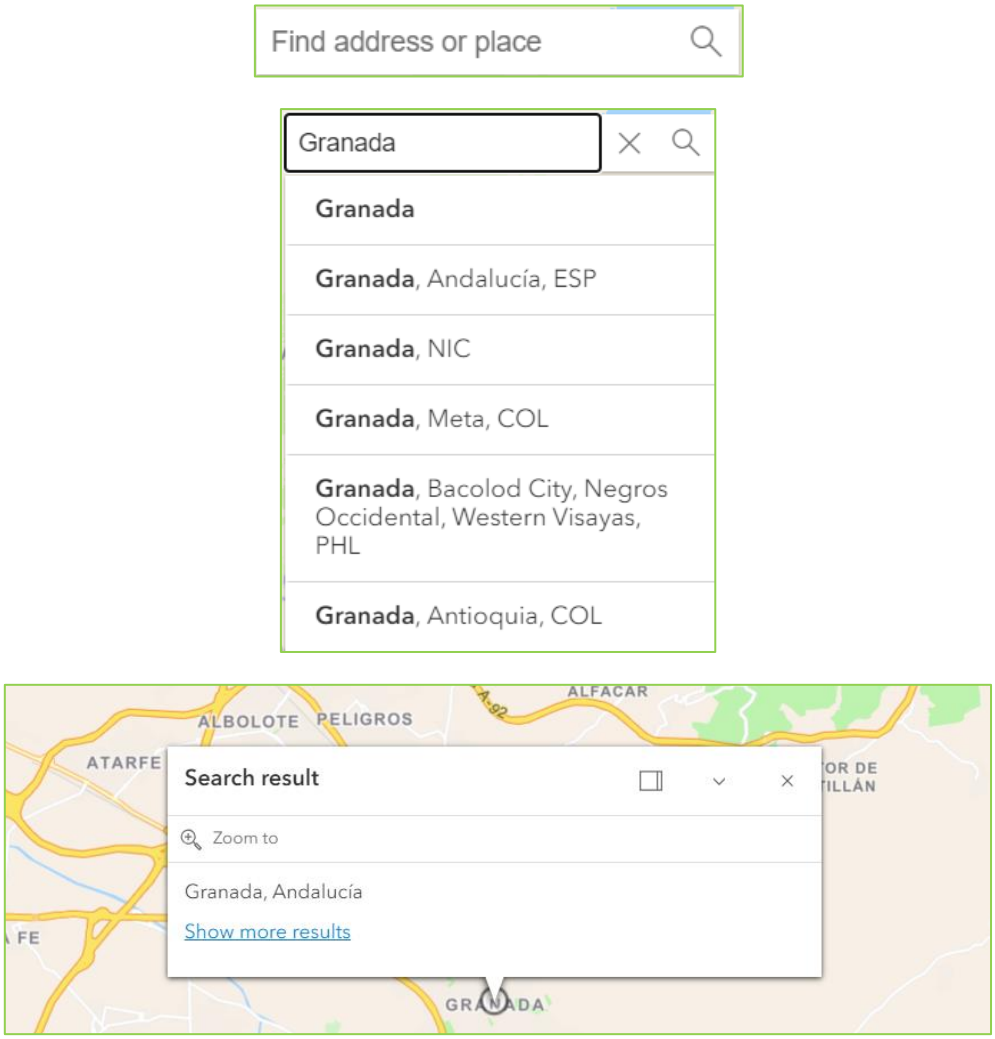


Remove

Once a measure operation is carried out (distance or area) the graphic results (line, polyline or polygon) and numeric results (results in the measure panel) can be deleted by the user clicking on the Remove measure button on the top right corner (trash icon).

1.4. Locations with text search

The search location tool will be available as a top right text window in the map viewer. The user can write the name of a location, and dynamically a menu of possible matching names will appear with a hint on nation and subnational reference. When the user clicks on any of the available records, the map view will automatically zoom on the requested locality and a graphic blue point will be displayed.

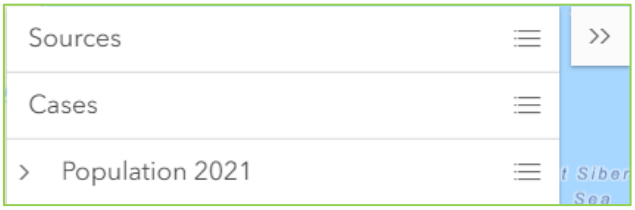


The search location tool will retrieve location based on the freely available geocoding service from ArcGis Online (ESRI).

1.5. Layer list and legend

The expand/collapse layer list tool is available as a button grouped with the GIS standard tools in the map viewer. By default, the layer list is not visible. Once the user hits the expand/collapse button for the first time the layer list will appear directly in the map view.

Only layers that have been activated or loaded on the map view will be visible in the layer list. The user can close this by clicking again on the expand/collapse button.



The legend will display the symbolization for each layer displayed in the map, including population, belonging to the categories of data uploaded and data outputs produced by the model. The legend will display the symbology and name of the layers shown in the map viewer. These layers typically represent the data uploaded by the user and the model output. The legend is dynamically linked to the contents in the map viewer, hence if the user adds a layer to the map viewer (e.g. upload potential sources), the map legend will update its content and add this item.

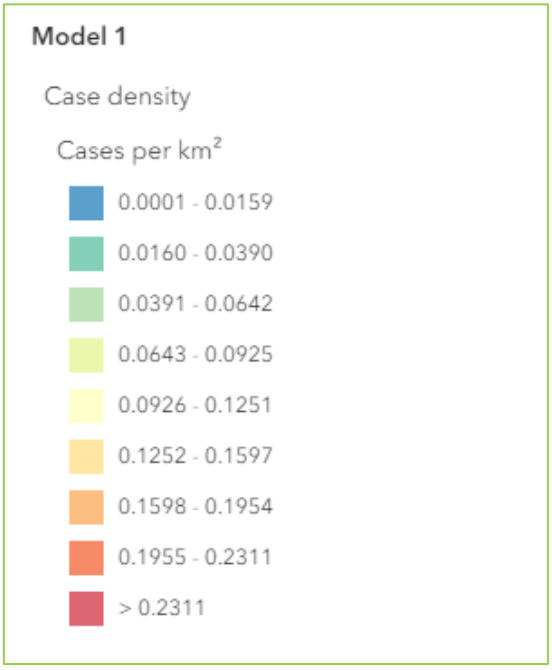
To display the legend the user has to click on the button to the left of the layer name in the layer list. This action will display the legend. To hide it, click on the same button again.

The following layers may appear in this list:

- Cases
- Sources
- Population
- Model 1 output – Case density

- Model 2 output – Disease Risk
- Model 3 output – Buffer density
- Model 4 output – Buffer risk

Additionally, to facilitate the visualisation of the legend of the spatial model outputs, a legend has been added at the bottom left of the map. This legend will be displayed on the map if you want to export it as an image.



In this map location only the legend of the run models will be displayed, and the legend of other layers (cases, sources or population) will not be displayed. To change the legend of the model to be represented, it is necessary to change it in the drop-down menu located in the side navigation bar, in **Step 6. Export results** > **Legend to show**. This legend can be hidden by selecting the None option in the drop-down menu.

2. Advanced applications utilities

2.1. Upload, draw and edit data

The application allows user to upload / delete / edit datasets of cases, and potential sources. Information about the format that is required for data upload and instructions how to do are provided here.

The input layers are the layers required by the models to run the analysis and produce output layers. Each layer has a specific symbology and data structure. The input layers

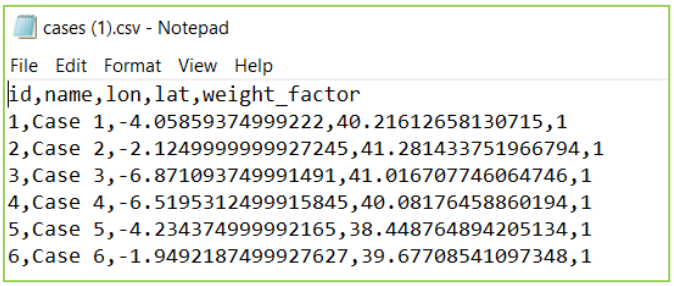
for cases and potential sources are “empty” by default and need to be populated with data by the end users.

Beside each item in the **Add data** panel, these functions are available through buttons:

- **Activate / deactivate layer**. Activating the checkbox allows the user to draw cases or potential sources, delete one by one, delete all, import data from a csv file, or export to a csv file the drawn features. In addition, this option will show or hide the layer on the map.
- **Add feature**. Once the checkbox is activated, the Add cases / sources button will be enabled. If the user clicks on the button, the cursor will display the symbology of the corresponding feature (case or source). By left clicking again on the map view, a new feature will be added.
- **Remove selected feature**. Once the checkbox is activated, the Remove selected cases / sources button will be enabled. To remove a feature, the user should left-click on the target feature on the map view. It will be marked with a light blue border. Once selected, if the user clicks on Remove selected feature, it will be deleted.
- **Remove all features**. Once the checkbox is activated, the Remove all cases / sources button will be enabled. If the user clicks on the button, all features (cases or sources) visible on the map shall be removed.
- **Import CSV**. Once the checkbox is activated, the Import CSV button will be enabled. This function allows the user to upload a csv file containing data on case or potential source locations. To import the file correctly, it must have a specific structure visible in the table below.

id	**name**	**lon**	**lat**	**weight_factor**
Identifier	*Description*	*Longitude (EPSG 4326)*	*Latitude (EPSG 4326)*	*Weight factor (0.0-1.0)*

- **Export CSV**. Once the checkbox is activated, the Export CSV button will be enabled. This function allows the user to download a csv file containing cases / sources data.

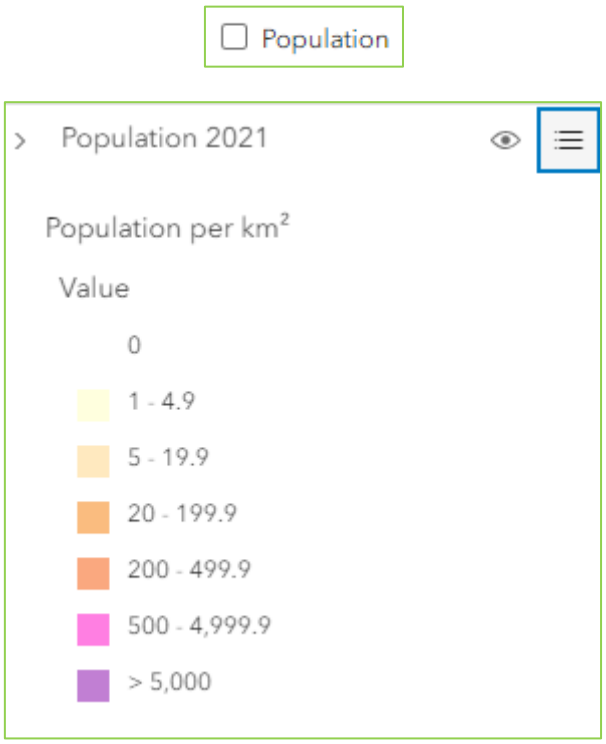


Symbology: the case data layer is a circle simple-marker, fill color RGB [255, 0, 0], size between 4 pt – 12 pt (depending on weigh_factor attribute), outline color RGB [0, 0, 0] and outline width 1 pt.

Symbology: the source data layer is a diamond simple-marker, fill color RGB [255, 255, 0], size between 4 pt – 12 pt (depending on weigh_factor attribute), outline color RGB [0, 0, 0] and outline width 1 pt.

2.2. Visualize population density

The user can visualize and inspect population density from EUROSTAT-GEOSTAT 2021 Grid dataset. Here a layer named “Population 2021” will be available. Next to the caption “Population” the user will find a checkbox. By clicking in this checkbox, the population layer will become visible.

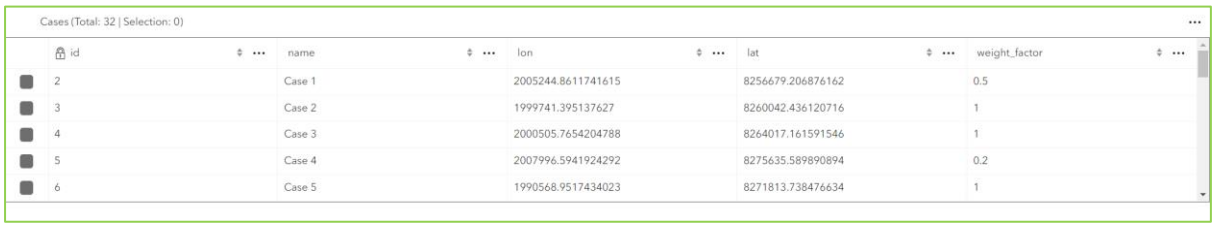


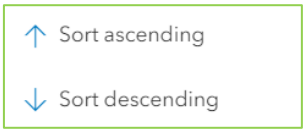
Symbology: Population density is displayed as a continuous surface, using yellow to purple scale, and 40 % transparency.

2.3. Visualize and edit attribute table of the input data

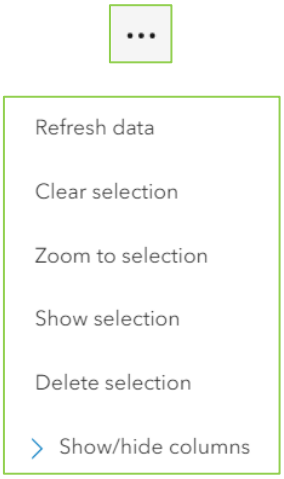
The **View data** option allows to examine the table of attributes of the cases and potential sources. By activating the checkbox, a table will appear at the bottom of the map. The drop-down menu allows you to switch between both layers to be displayed in the attribute table.

The user can also edit the cases and potential sources imported via csv file or drawn on the map by clicking on the corresponding cell and typing in a new value. Automatically the map will update the edited features. Additionally, the table presents a checkbox on the left for each entity. Activated entities will be highlighted on the map with a light blue border.





Each field in the table has a button to the right of the attribute name that allows you to sort the column in ascending or descending order. Additionally, by clicking on a button located at the top right of the table, new functions will appear to handle the selection made.



2.4. Analysis models

The second step allow the user to **Select a model**. A radio button will allow the user to toggle between the selected model they want to run.

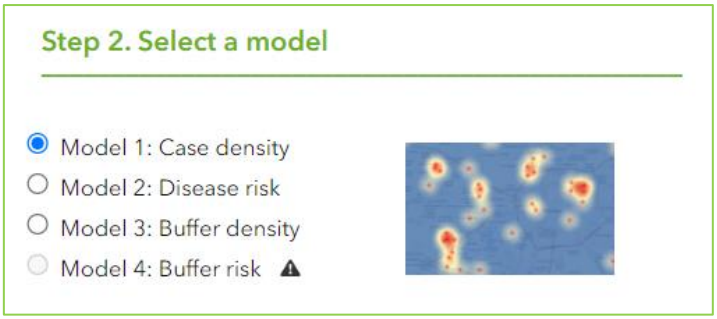
A total of 4 models are available. Thus, depending on the type of information required, the following are distinguished:

Analysis without potential cases data:

- **Model 1: Case density** (based on case data alone)
- **Model 2: Disease risk** (based on case and population data)

Analysis with potential source data: comparative analysis of potential risk sources:

- **Model 3: Buffer density** (case density in buffers around the potential sources)
- **Model 4: Buffer risk** (disease risk in buffers around the potential sources and relative risks between buffers)



2.4.1. Case density model

The **Case density model** is available in the “Select a model” section.

Action flow to run the model

The user has uploaded case data; the user selects the model, then can configure parameters or accept default values, then hits the "Run Model" button. The model will run in the background, and when completed it will provide outputs: as a result, a new layer will be added to the map and to the legend. The layer will be called Case density.

The model will apply a kernel density estimation. The available default model parameters will be:

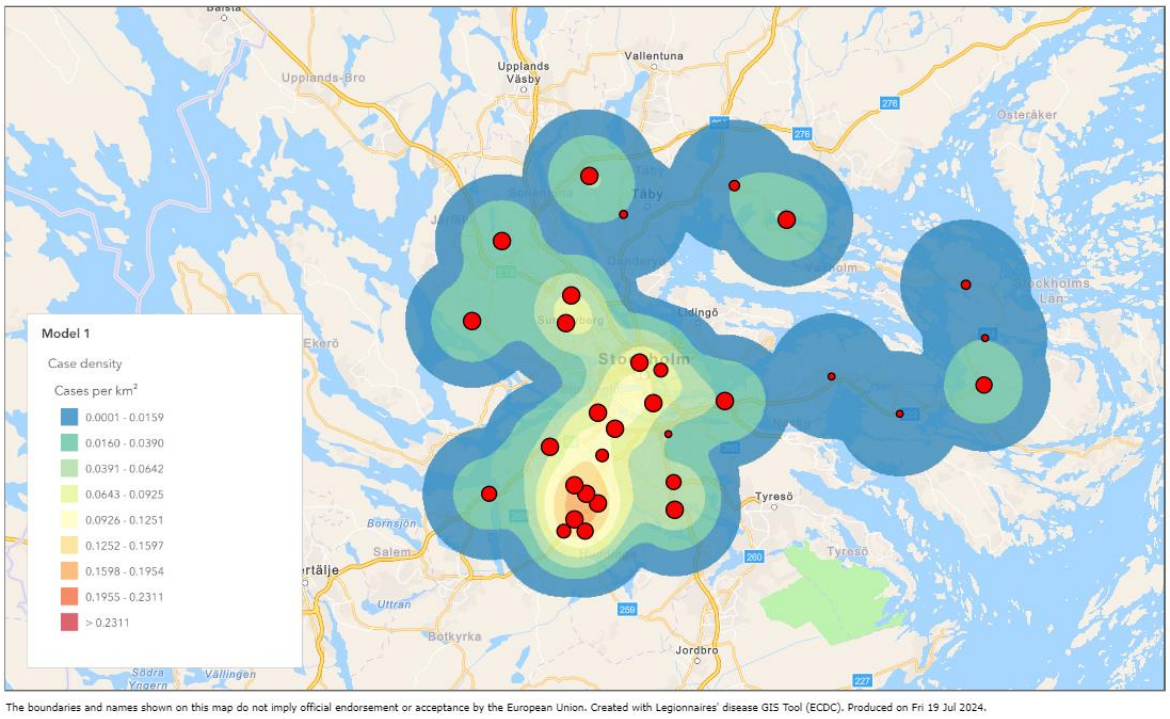
- **Search radius**: 5000 meters (200, 500, 1000, 2000, 5000, 10000)
- **Output cell size**: 100 meters (50, 100, 250, 500, 1000)
- **Weight factor**: No (Yes, No)

Model output settings:

- **File type**: Raster

- **Legend type**: Cold to Hot Diverging
- **Classification**: Natural breaks
- **Classes**: 9
- **Values**: decimal
- **Extent**: The analysis extent and output extent will be equal to the extent of the extent of the case data plus the search radius

Case density model



2.4.2. Disease risk model

The **Disease risk model** is available in the **Step 2. Select a model**.

Action flow to run the model

The user has uploaded case data; the user selects model, defines parameters then hits the “Run Model” button. The model will run in the background, and when completed it will provide outputs: as a result, a new layer will be added to the map and to the legend. The layer will be called Disease risk. The model will apply 2 processes:

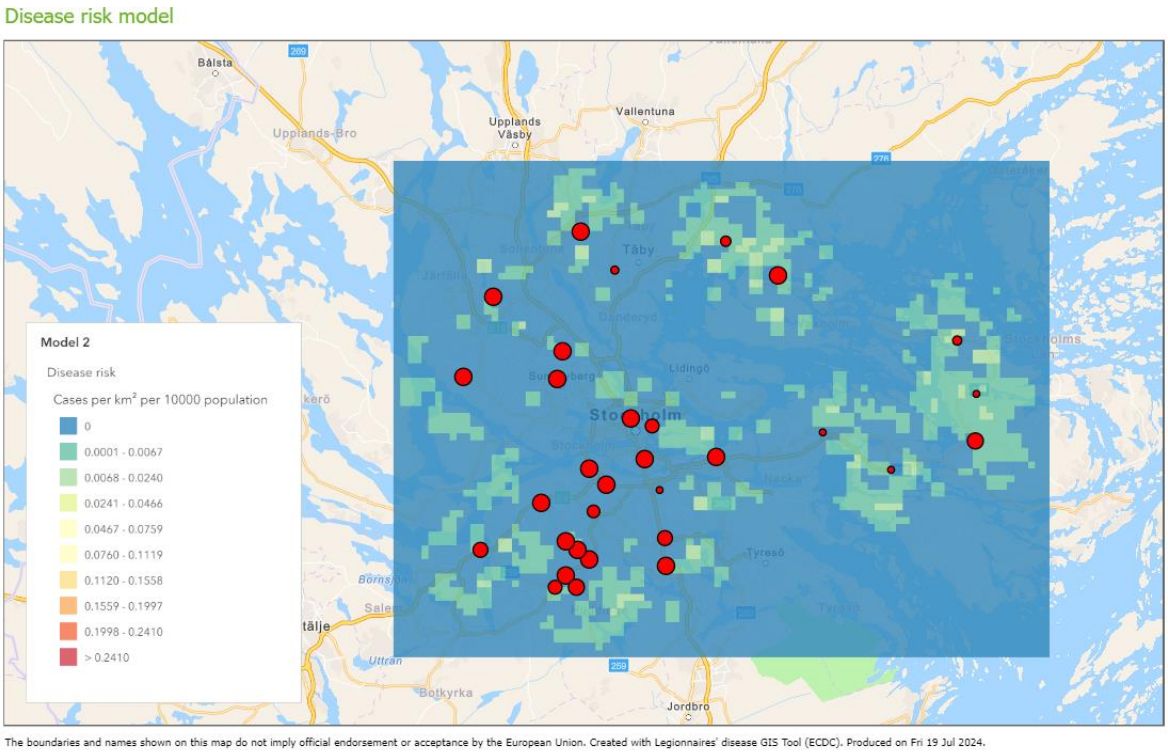
- **Process 1**: A kernel density estimation is applied from the case data.
- **Process 2**: A relative risk function is then calculated by dividing the case density layer by the underlying population density based on Eurostat GEOSTAT 2021.

The available default model parameters will be:

- **Search radius**: 5000 meters (200, 500, 1000, 2000, 5000, 10000)
- **Output cell size**: 1000 meters (it depends on the Population layer cell size)
- **Weight factor**: None

Model output settings:

- **File type**: Raster
- **Legend type**: Cold to Hot Diverging
- **Classification**: Natural breaks
- **Classes**: 9
- **Values**: decimal
- **Extent**: The analysis extent and output extent will be equal to the extent of the extent of the case data plus the search radius



2.4.3. Buffer density model

The **Buffer density model** is available in the "Select a model" section. It is similar to the Case density model but are calculated in concentric circles around potential sources.

Action flow to run the model

The user has uploaded case data and source data; defines the parameters or accepts default, then hits the "Run Model" button. The model will run in the background, and when process completed, will provide outputs. As a result, a new layer will be added to the map and to the legend. The layer will be called Buffer density.

By default, the model will apply the following processes:

- **Process 1**: create 4 concentric buffers around each potential source
- **Process 2**: for each buffer, calculate number of cases falling within it

- **Process 3**: for each buffer calculate the density of cases by buffer
- **Process 4**: display buffer layer in map

The available default model parameters will be:

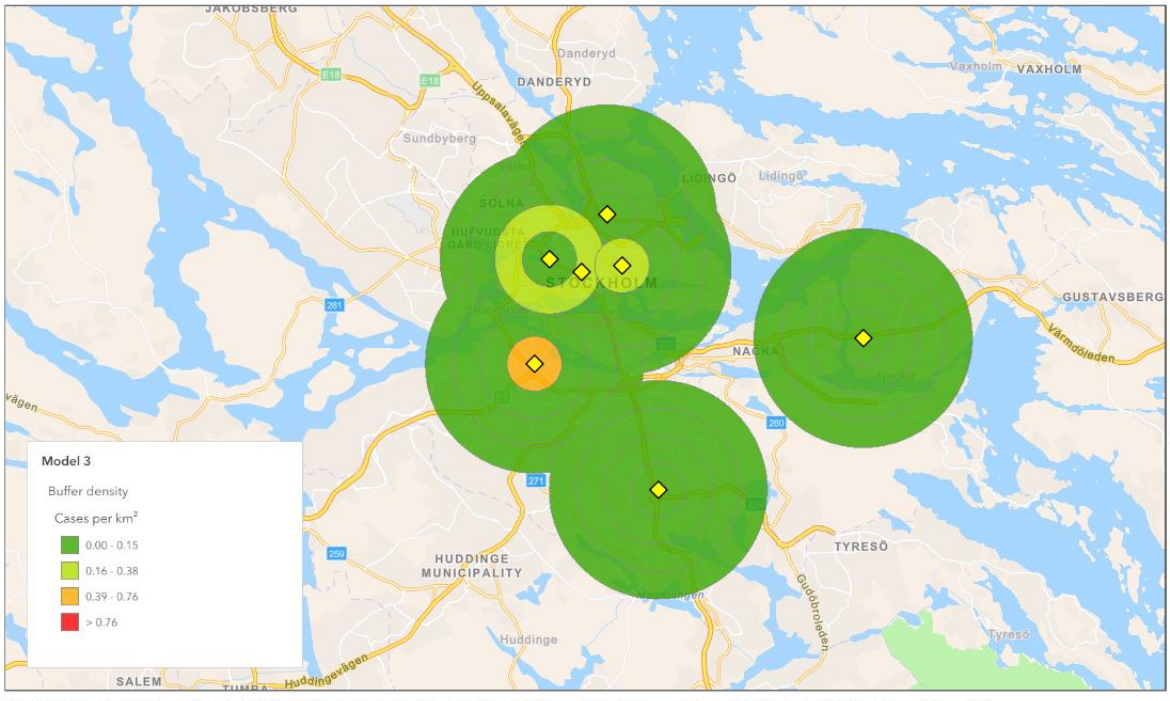
- **Weight factor**: No (Yes, No)
- **Buffer rings**: 0.1 km, 0.2 km, 0.5 km, 1 km. Four options available:
  - ✓ 0.1 km, 0.2 km, 0.5 km, 1 km
  - ✓ 1 km, 2 km, 3 km, 4 km
  - ✓ 4 km, 6 km, 8 km, 10 km
  - ✓ 5 km, 10 km, 15 km, 20 km

Model output settings:

- **File type**: Vector
- **Legend type**: Green to red
- **Classification**: Natural breaks
- **Classes**: 4
- **Values**: decimal, two digits after comma

Extent: The analysis extent and output extent will be equal to the extent of the extent of the case data plus the search radius

Buffer density model



The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. Created with Legionnaires' disease GIS Tool (ECDC). Produced on Mon 22 Jul 2024.

2.4.4. Buffer risk model

The **Buffer risk model** is available in the "Select a model" section. It is similar to the Case density model but are calculated in concentric circles around potential sources.

Action flow to run the model

The user has uploaded case data and source data; defines the parameters or accepts default, then hits the "Run Model" button. The model will run in the background, and when process completed, will provide outputs. As a result, a new layer will be added to the map and to the legend. The layer will be called Buffer risk.

By default, the model will apply the following processes:

- **Process 1**: create 4 concentric buffers around each potential source
- **Process 2**: for each buffer, calculate total population from underlying population service
- **Process 3**: for each buffer, calculate number of cases falling within it
- **Process 4**: for each buffer calculate the ratio between total cases and total population and multiply result by 10000
- **Process 5**: display buffer layer in map

The available default model parameters will be:

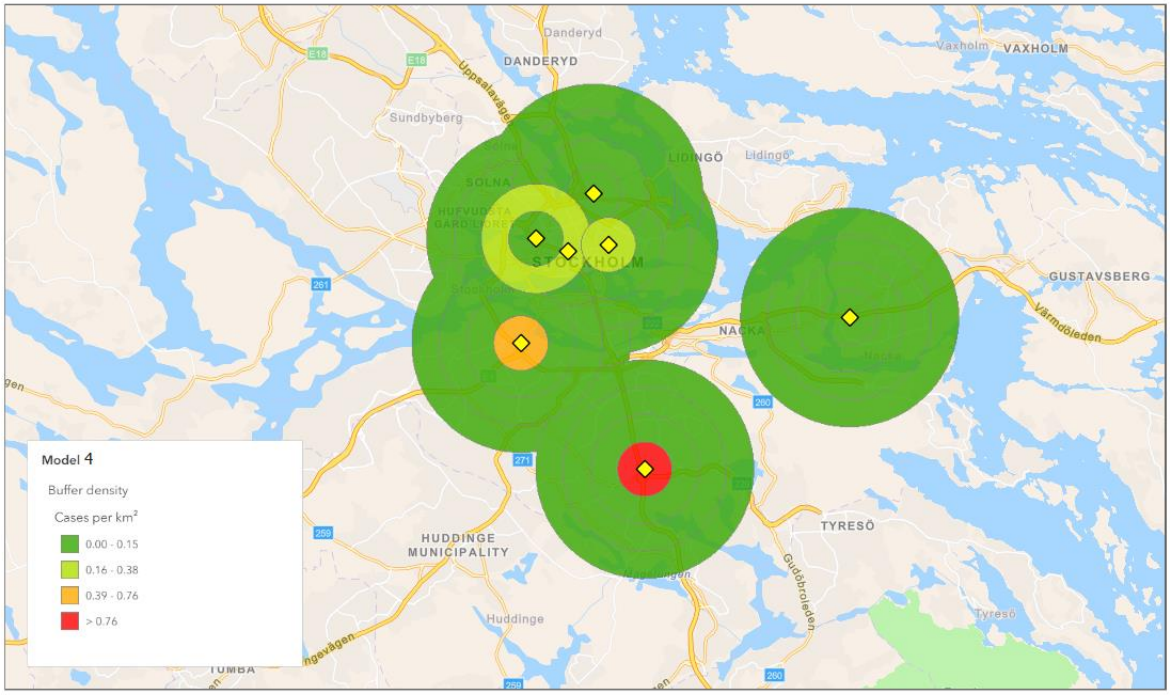
- **Weight factor**: No (Yes, No)
- **Buffer rings**: 0.1 km, 0.2 km, 0.5 km, 1 km. Four options available:
  - ✓ 0.1 km, 0.2 km, 0.5 km, 1 km
  - ✓ 1 km, 2 km, 3 km, 4 km
  - ✓ 4 km, 6 km, 8 km, 10 km
  - ✓ 5 km, 10 km, 15 km, 20 km

Model output settings:

- **File type**: Vector
- **Legend type**: Green to red
- **Value**: case per 10000
- **Classification**: Natural breaks
- **Classes**: 4
- **Values**: decimal, two digits after comma

Extent: The analysis extent and output extent will be equal to the extent of the extent of the case data plus the search radius

Buffer risk model



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2.5. Configure model parameters

The model options are available in the **Step 3. Configure the parameters**. The options are:

Cell size (M1)

Select the cell size in meters to be used in the output raster:

- 20 m
- 50 m
- 100 m
- 200 m
- 500 m
- 1000 m

It is only available for Model 1. Model 2 uses the same cell size as the population raster dataset. Model 3 and 4 return vector outputs, so no cell size adjustment is required. The smaller the cell size, the longer the execution time.

Search Radius (M1, M2)

It is only available for Model 1 and Model 2. The search radius within which to calculate density. Select the search radius in kilometres to be used by the kernel function:

- 0.2 km
- 0.5 km

- 1 km
- 2 km
- 5 km
- 10 km

Weight factor (M1, M2, M3, M4)

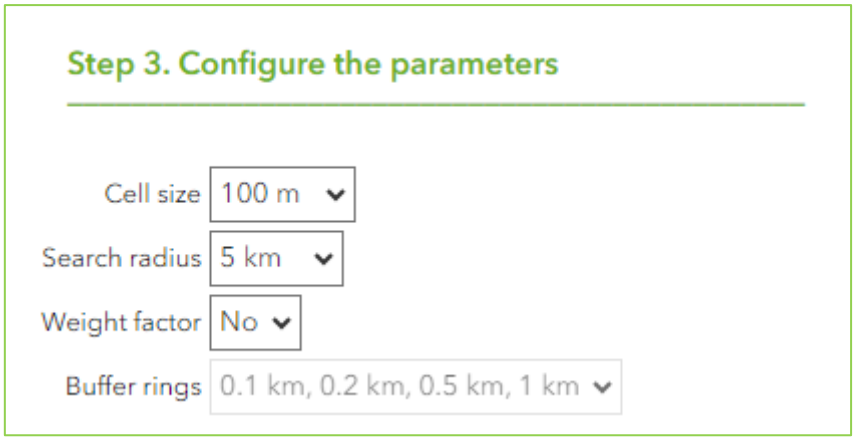
Field denoting weight values for each feature. The weight factor value is the count or quantity to be spread across the landscape to create a continuous surface. It is used to determine how the weight factor for each case location is applied in the kernel function algorithm. Two options:

- Yes. If user selects this option, then the system will use as weight factor for each case location the information contained in the field “weight_factor”. E.g. if more than one location entered by case, then the different locations should receive a proportion of the total weight of the case. If a case spent more time at one location or a location is a higher risk, it could receive a proportionally higher weight. The weight needs to be assigned by the user in the data input and the manual needs to describe what conditions there are for it to make sense (per case, the sum of weights given to different locations should be one).
- No. Same weight (1.0) is given to all case locations by the kernel function.

Buffer size (M3, M4)

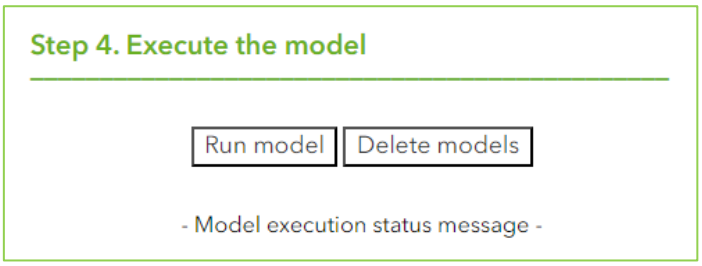
This parameter is only available for Model 3 and Model 4. It determines the size of the concentric rings that will be generated around the potential sources.

- 0.1 km, 0.2 km, 0.5 km, 1 km
- 1 km, 2 km, 3 km, 4 km
- 4 km, 6 km, 8 km, 10 km
- 5 km, 10 km, 15 km, 20 km



2.6. Run selected model

The application allows for **Run model** and **Delete model**. The models can be run by clicking on the Run model button or can be deleted from the map view clicking on Delete model in the **Step 4. Execute the model**.



Once the required data has been added, the model has been selected and the parameters have been set, the user can run the model. In case the data required by the selected model have not been added, a window will appear indicating the data to be added so that the model can run correctly. Once started, a loading bar will appear, indicating that the model is running in the background. The user may continue to use the application in parallel. In addition, a message will appear indicating the status of the process.

Model execution status message (**run progress**):

- Analysing ... model parameters
- Job status: Job executing
- Job status: job-succeeded
- Adding MapImageLayer to the map...

Model execution status message (**error handling**):

- Failed to add the MapImageLayer geoprocessing service output: {error}
- Failed to fetch the MapImageLayer geoprocessing service output: {error}
- Failed to successfully submitJob: {error}

If any of these errors appear, please read the problem description carefully. If you are unable to solve the problem, please contact GISTeam@ecdc.europa.eu.

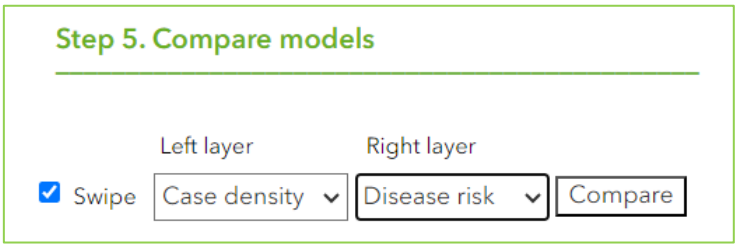
If a model has been run successfully and the same or a different model is run, the previous result shall be deleted. On the other hand, the user can click on the Delete model button and the result displayed on the map view will be deleted. The uploaded data are kept (cases, potential sources, population data), and the model settings are also kept during session.

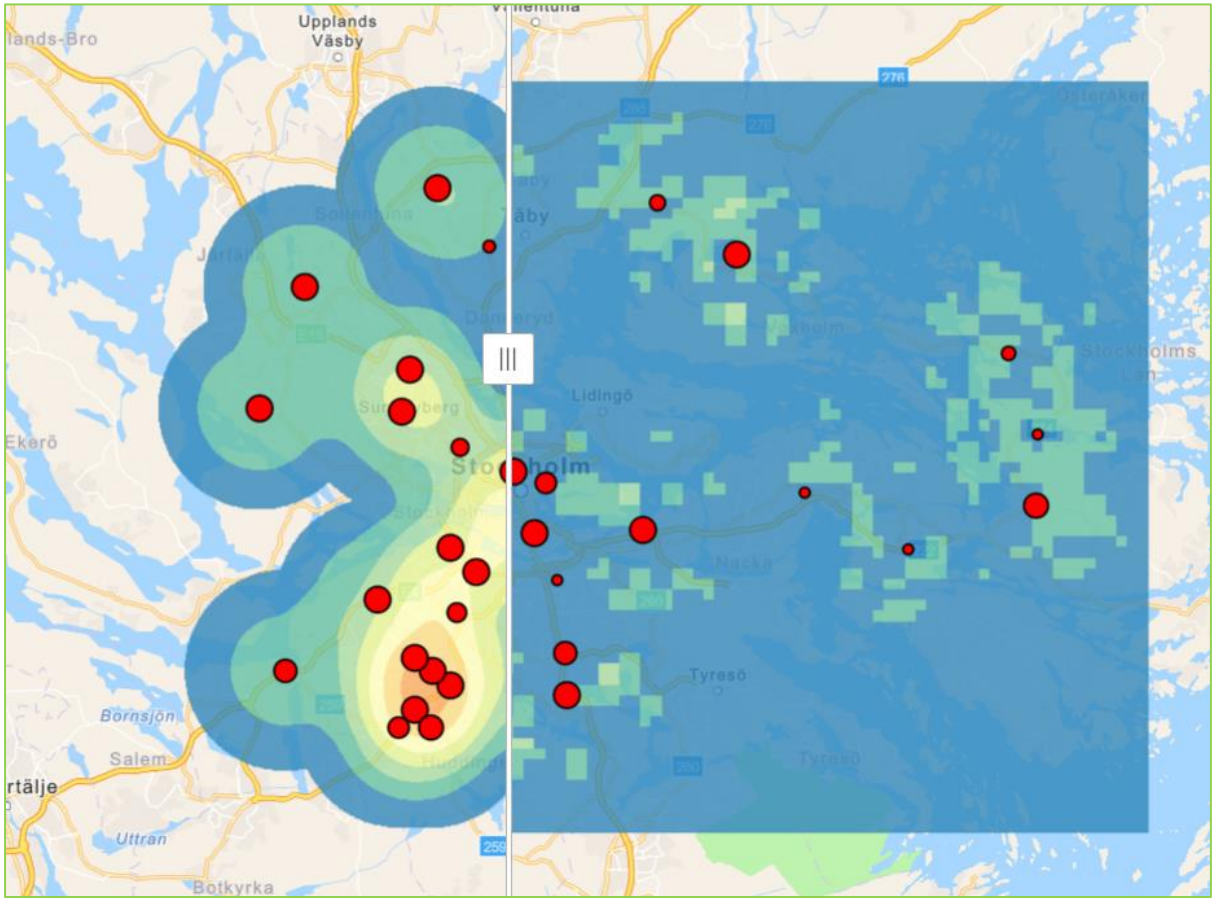
2.7. Compare spatial outputs

The user can compare the generated models with each other or simply slide the tool to look at the base map underneath the model output. When the user checks in the **Swipe** option, the swipe tool is activated. A handle is placed in the middle of the map viewer.

The user can choose on which side to display the different model output. If None is chosen, it will only be compared to the base map and no model output will be displayed on that side.

Once selected what is to be displayed on each side of the map, the user can click on the handle and drag to the right and left side, and this will display progressively the model outputs results. By deactivating the swipe option, the handle will disappear and the map view will return to default.



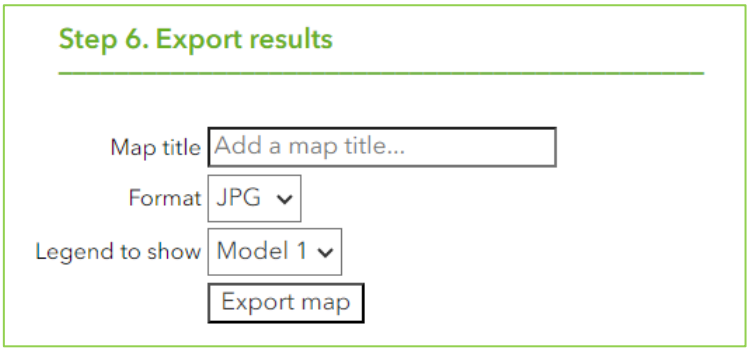


2.8. Export map outputs

The user will be able to export the model output using the function implemented in **Step 6. Export results**. This option produces a map in image format where all the layers visible on the map view will be displayed. Please note that only the legend of one of the models will be displayed, so it is recommended to export a map for each of the models generated.

The user will be able to:

- Add a map title
- Select the export file format (*.png or *.jpg)
- Select the legend to show on the map



Once the parameters have been set, the user can click on the **Export map** button and the corresponding map will be downloaded. Please note: the resolution and dimensions of the map may differ depending on the resolution and size of the screen.

3. Other

3.1. Browser compatibility

The application is compatible with the following browsers

- Internet explorer 8 and above
- Google Chrome
- Firefox
- Safari

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