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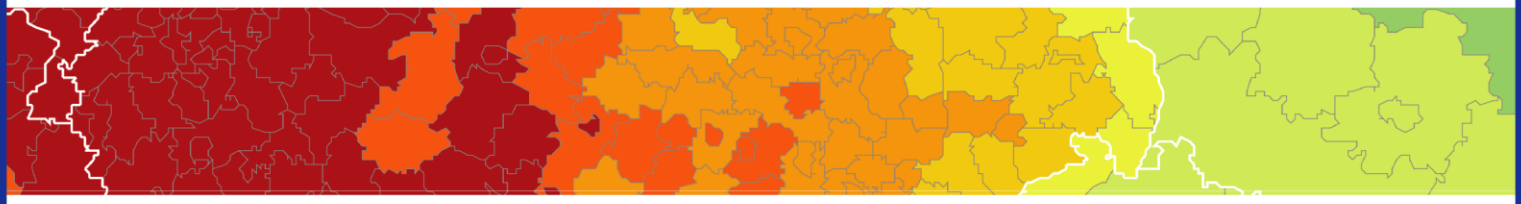

ESPON FUORE - Functional Urban Areas and Regions in Europe

Monitoring and Tools

User Guidance Manual

Version 10/07/2020

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ESPON FUORE - Functional Urban Areas and Regions in Europe

Disclaimer:

This document is a user guidance manual.

The information contained herein is subject to change and does not commit the ESPON EGTC and the countries participating in the ESPON 2020 Cooperation Programme.

The final version of the report will be published as soon as approved.

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Introduction

The purpose of this document is to provide detailed guidance for the users on how to best use the FUORE web tool and the Web Data Analysis Toolbox.

In section 1, the different functionalities of the FUORE web tool and how to use them are described, whereas section 2 is about the WDAT, i.e. how to use the Jupyter notebook to estimate an indicator from the ESPON DB or provided by the user.

1 The FUORE web tool

The webtool is running at: http://fuore.eu/.

So, the user can open the webtool everywhere where the internet connection is available. The web tool is optimized for the Google Chrome web browser and it also works properly in the Microsoft Firefox web browser. It is strongly recommended to use the most up-to-date version of the web browsers, to sure all features and functionalities of the tool work properly.

1.1 The landing page

The first interaction with the user is secured by the landing page. It provides a short intro of the tool and access to all the data and information contained in the tool. Nine interactive tiles are available on the landing page, allowing the user to select the functional region of his interest.

For each tile, an illustrative figure is provided, showing the delineation of that specific type of the functional region in a map view. Once the user clicks on the tile dedicated to that one particular type of functional region, he is re-directed to a page providing access to all indicators which are linked (and available) for that specific type of region (see Figure 1.1. Final version of the landing page of the Web Tool (available at fuore.eu).).

Figure 1.1. Final version of the landing page of the Web Tool (available at fuore.eu).

The landing page also provides the access to the:

- description of delineation methodology for each type of functional region
- methodology of the disaggregation process
- official project information (project web page on ESPON programme portal)
- GUI of the Web Data Analysis Toolbox ("advanced toolbox" or "Custom disaggregation tool" hyperlink), which allows the user to disaggregate their own indicators and visualise the results on the functional regions´ level in the web tool.
- YouTube channel with guidance videos on how to use the tool in praxis
- Final report of the project

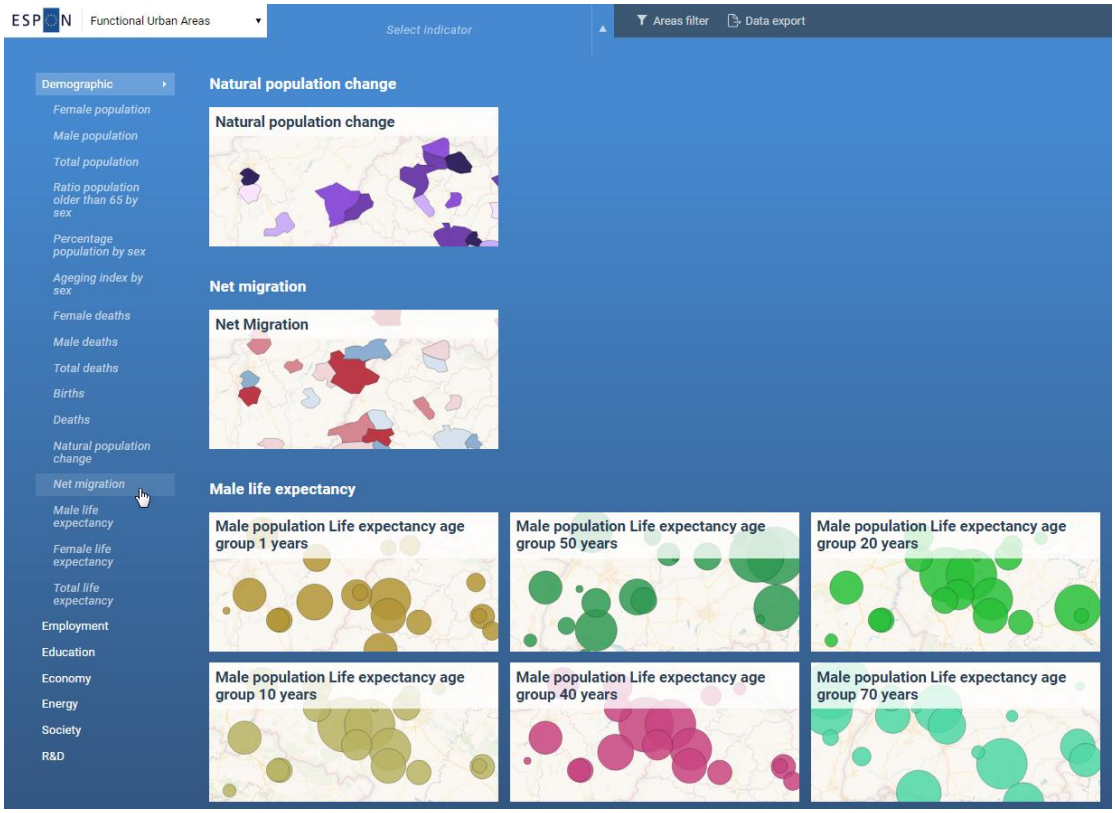
1.2 Selection of indicator of interest

Once the user selects the functional region of his interest on the landing page, a page to selection of indicator of interest opens. For each type of functional region, a specific **set of indicators** is integrated and presented in the web tool by illustrative tiles (

Figure 1.2). This complete set of indicators is divided into several meaningful thematic groups and sub-groups - **categories**, and **sub-categories.** So, the user starts with **selection of category**, then a **sub-category** of interest and, after that, he can select the **indicator**.

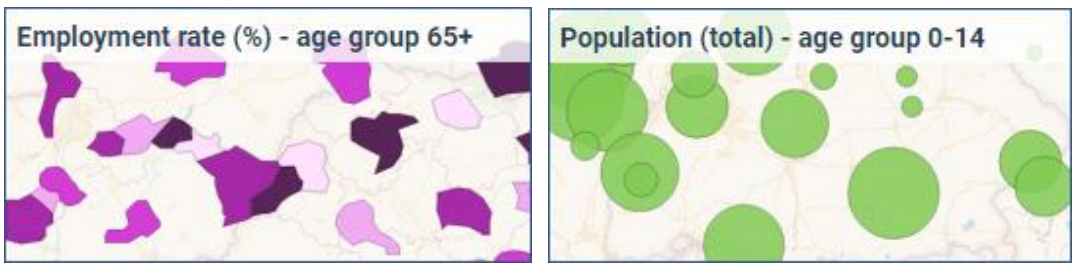
The interactive list of categories is presented on the left side of this page. When the user selects the category/sub-category of his interest, the page automatically navigates to appropriate group of indicators. The tiles representing particular indicators are presented in the main section (on the right side) of this page. The categories, sub-categories and indicators are sorted in alphabetical order so the user can easily find the indicator of his interest by its name.

Figure 1.2. Access to data and information presented in the Web Tool – for each type of functional region, a set of indicators is integrated and presented, divided into thematic categories and sub-categories.



Different types of indicators – stocks or ratios - are automatically reflected in figures on tiles corresponding to each indicator. Following the basic cartography rules, ratio figures are shown as choropleth maps, whereas, for stock values, a cartodiagram (proportional circles) is used (see Figure 1.3). For that specific case when the data series for an indicator contains both positive and negative values, diverging colour scheme is applied – with one representing positive values and another colour representing negative values. This type of cartographic visualisation and also the colour is automatically generated, based on specification in the input metadata. The same type of map visualisation and colour shown on the tiles is also used in the Map View of the tool.

Figure 1.3. Different types of figures on the tiles representing ratio and stock indicators.

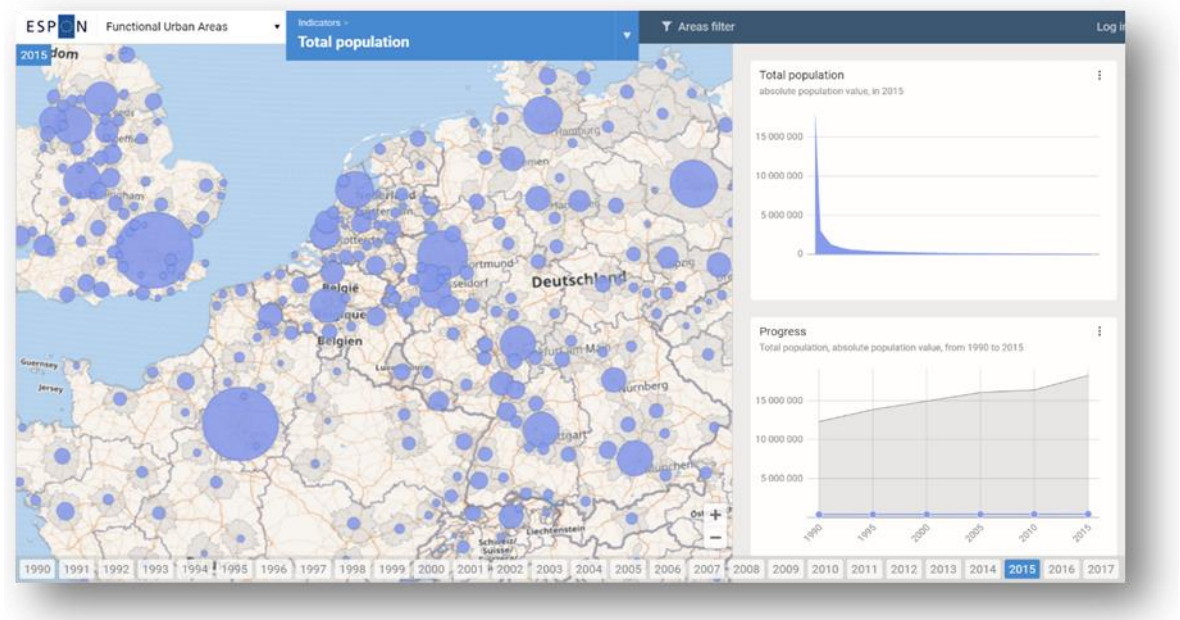


The user can select the indicator of interest simply by clicking on respective tile.

1.3 Analytical Map View

Once the indicator of interest is selected, the analytical Map View of the web tool opens, with a pre-defined visualisation dedicated to the selected indicator. This Map View contains the **interactive map window**, showing a **thematic map** and a **panel with interactive charts** presenting the values of selected indicator for the reporting units. At the bottom of this Map View, an **interactive time axis** is available, enabling the selection of the year or multiple years of interest, for which the values are displayed in the map and charts.

Figure 1.4. Typical Map View of the Web Tool – a pre-defined visualisation presenting the selected indicator for the selected type of functional regions, with interactive map, charts and time axis.



Each Map View is dedicated to one (selected) indicator and presents its values in: interactive map window; column chart (status values for selected year) and line chart (showing development of indicator values in the time-series). Once inside such Map View, dedicated to one selected indicator, the user can always **change the indicator**, thematic **category or sub-category** or even **type of functional region** of his interest, through the interactive menu at the top of the Map View.

1.4 Interactive components and functionalities of the web tool

The web tool provides few interactive components and functionalities which are crucial to enable the user effective analysis of the integrated data and information. The following types of interactive functionalities and components are included:

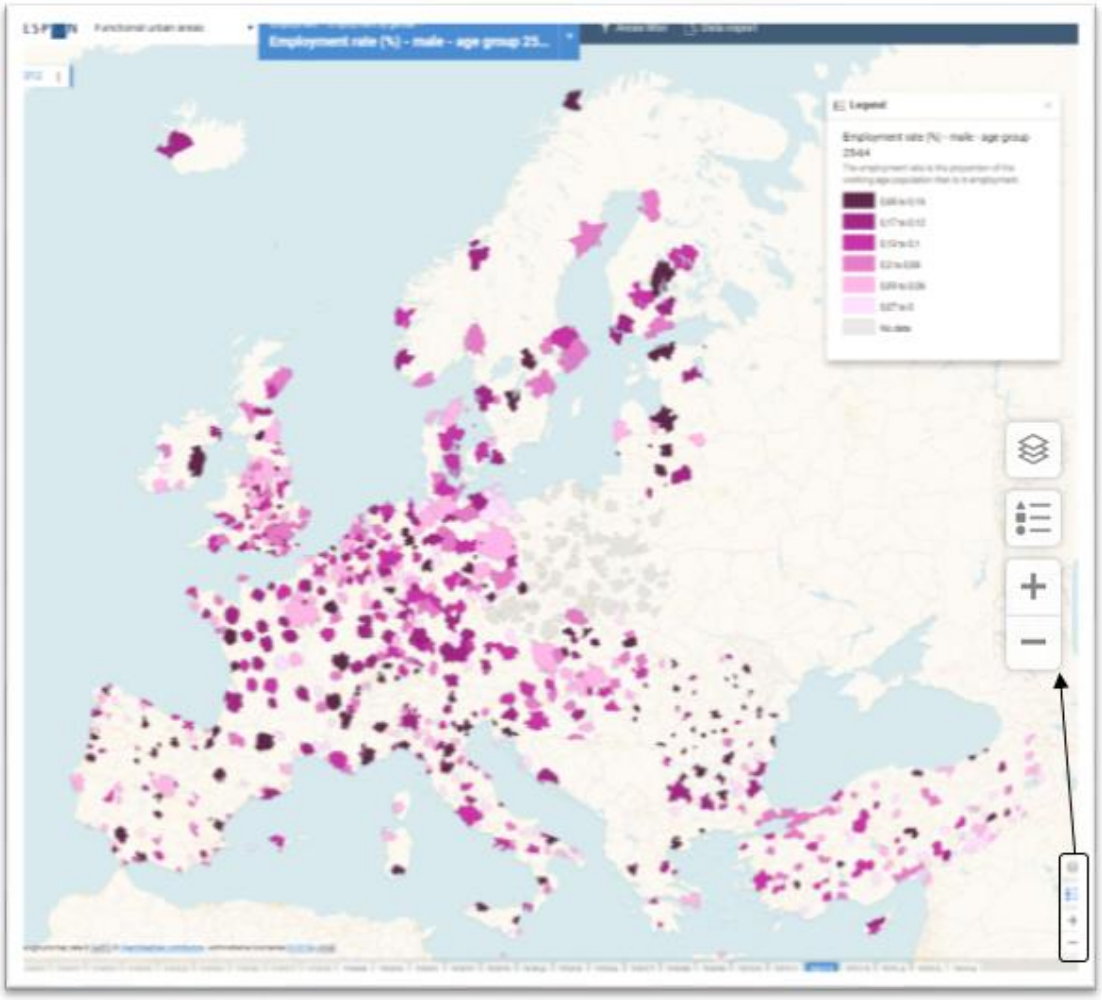
- Interactive map window
- Interactive benchmarking and filtering functionalities
- Switcher for levels of analytical units (regional/country level)
- Interactive charts
- Interactive time-axis
- Interactive exporting tools

Following chapters describe each of them in detail and explain, how the user can use them to analyse the data and information in the tool.

1.4.1 Interactive map window

Considering the spatial character of the data presented, the interactive map window is the crucial component of the web tool. In the interactive map window, a spatial distribution of the values of selected indicator over European regions is presented. In the lower right corner of the map window, you can find few basic control buttons for the map (setting background map, displaying legend, zooming in or out).

Figure 1.5. In the interactive map window of the Web Tool.



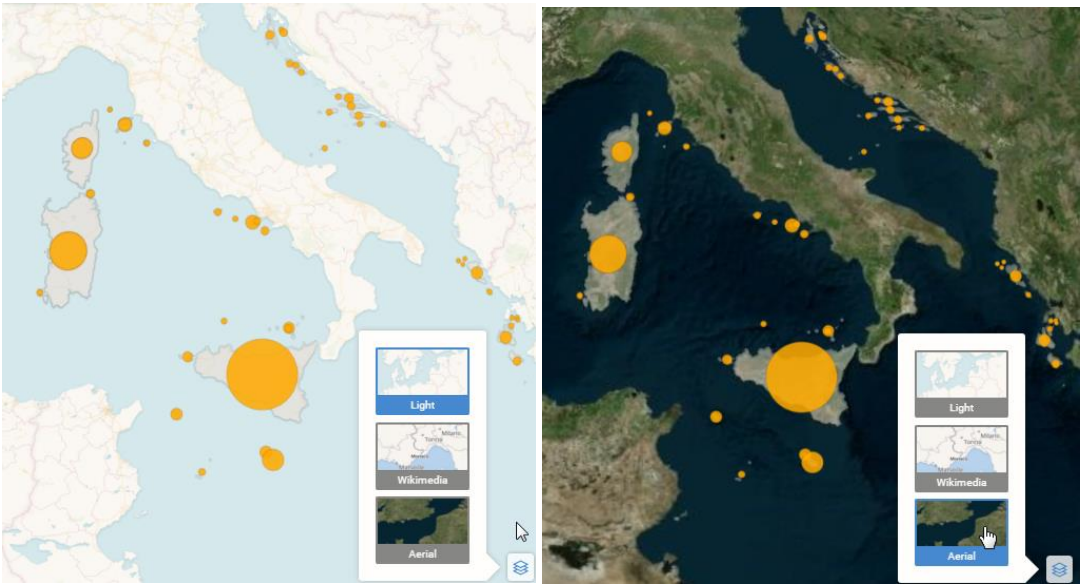
Navigating in the map

The user can interactively **zoom in** and **out** in the map (using the dedicated buttons available in the lower right corner of the map or with a help of the wheel of the mouse he uses) or **pan the map** in any direction via left-mouse-button clicking into the map window, holding the button and dragging the mouse in a direction he wants to pan the map).

Switching the map window background

For the background map in the Map Window, a switcher is available (a button in the lower right corner of the map window. This allows to switch between different types of background maps, including various open-source maps (like Wikimedia or CARTO) or aerial map (Bing).

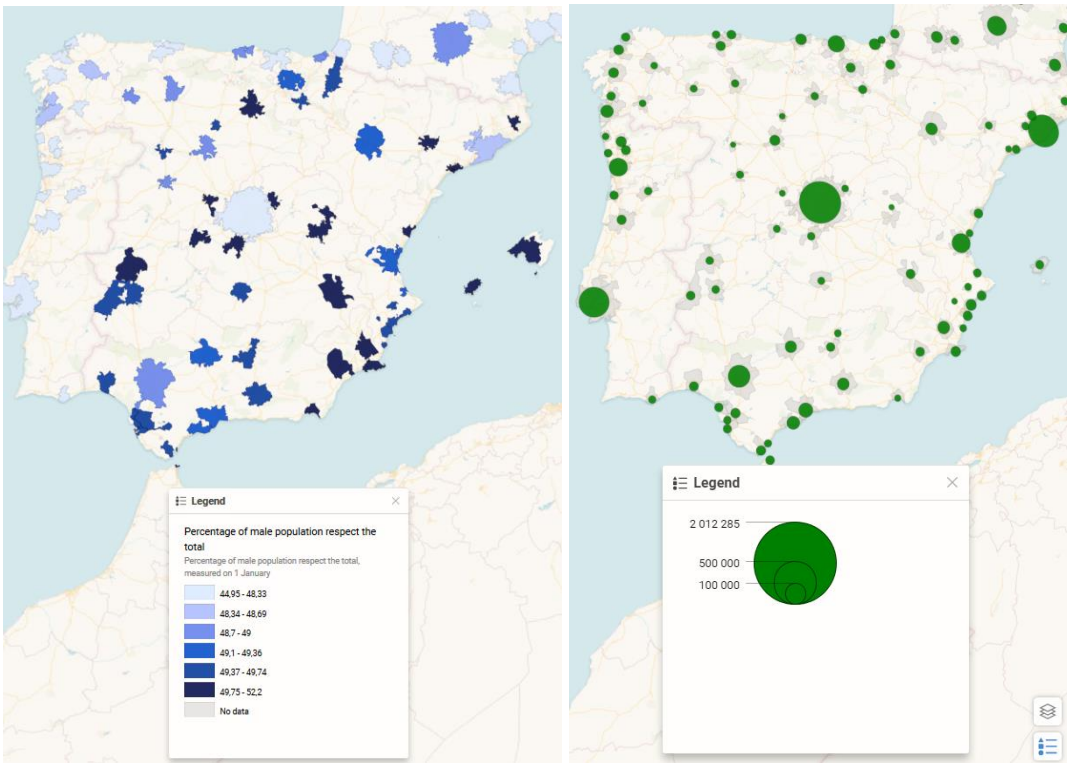
Figure 1.6. Various types of background map can be switched on in the map window

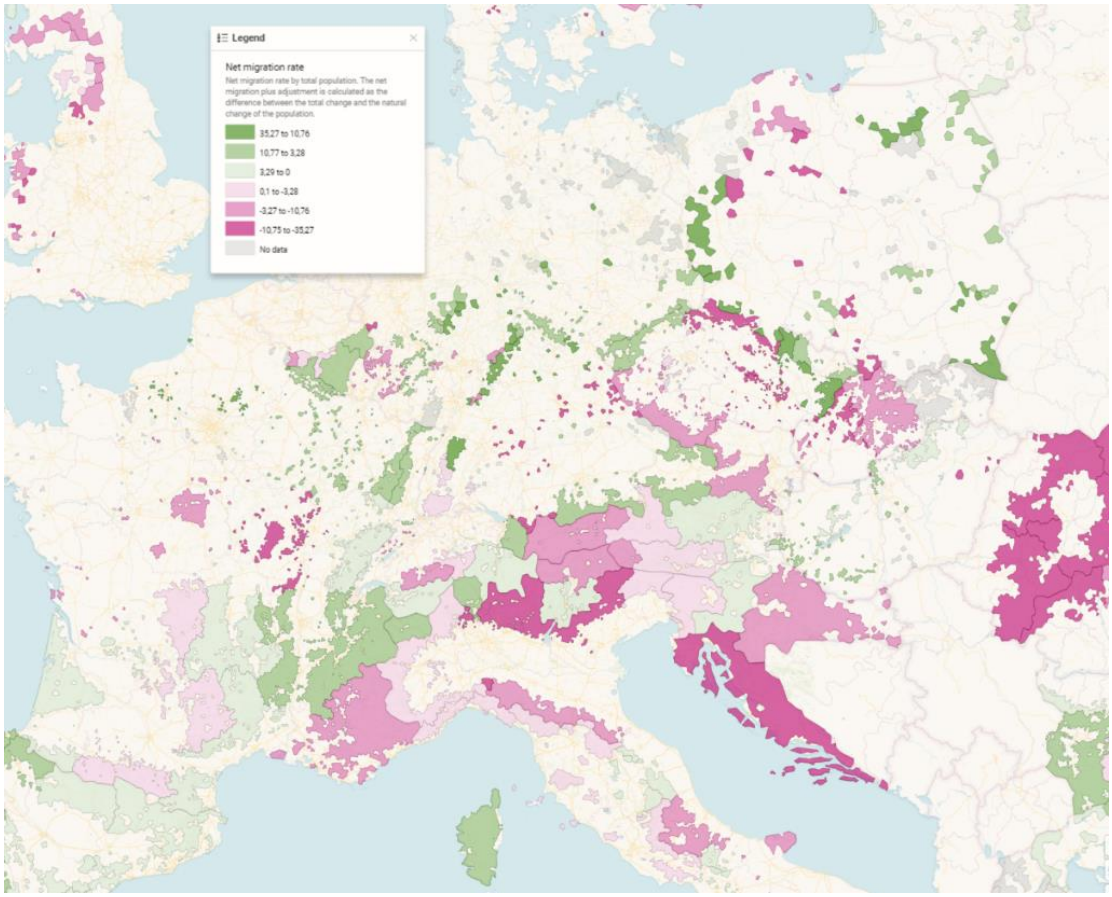


Visualisation of the values of indicators in the map

There are **two ways in which the indicators can be displayed in the map**, depending on the type of the indicator (see **Chyba! Nenalezen zdroj odkazů.**). For the indicators with absolute values (stocks), a **carthodiagram** is available. For the indicators with the relative values showing ratios (%), a **choropleth** map is used. **Diverging colour scheme** is applied in case an indicator shows both positive and negative values.

Figure 1.7. Two types of cartographic visualisation in the map – choropleth map for proportional values/ratios (left) and carthodiagram for absolute values/stocks (right), and diverging colour scheme for combination of positive and negative values (bottom), all with corresponding legends.

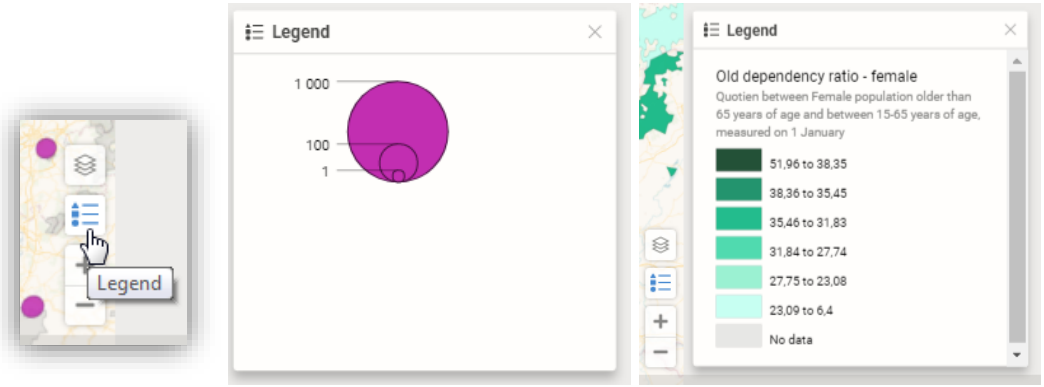




Displaying legend for the map

For any type of map visualisation, a legend is available, which can be opened using a “legend” button in the lower right corner of the map window. The user can open or close the legend in any time during the work with the application, or move the window with legend to any place of the Map View.

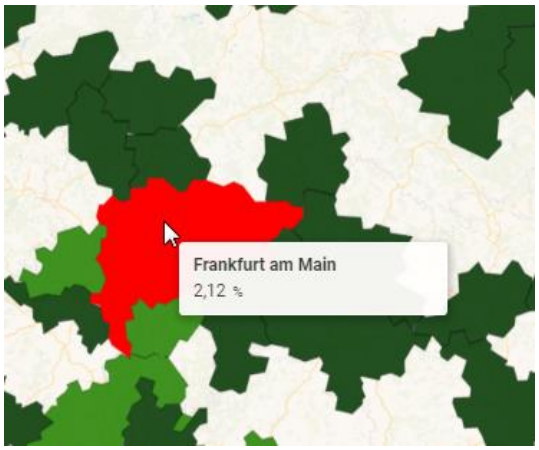
Figure 1.8. Legends for the map, for different types of cartographic visualisation (choropleth – left – showing graduated colours, proportional circles – right – showing size of the circle).

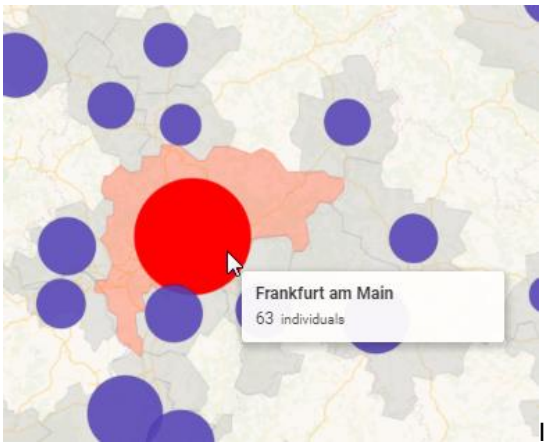


Displaying values of analytical units in the map

A functionality to interactively query data in the map is implemented (based on Web Feature Services). Once the user puts the cursor over an analytical unit in the map, the name of the unit is displayed, together with value of indicator, for this selected unit.

Figure 1.9. Querying the indicator value for analytical unit in the map.





In case the proportional circles are used for the visualisation of the indicator in map, the whole area of reporting unit is highlighted (not only the circle) so the user can see the real extent of the functional area.

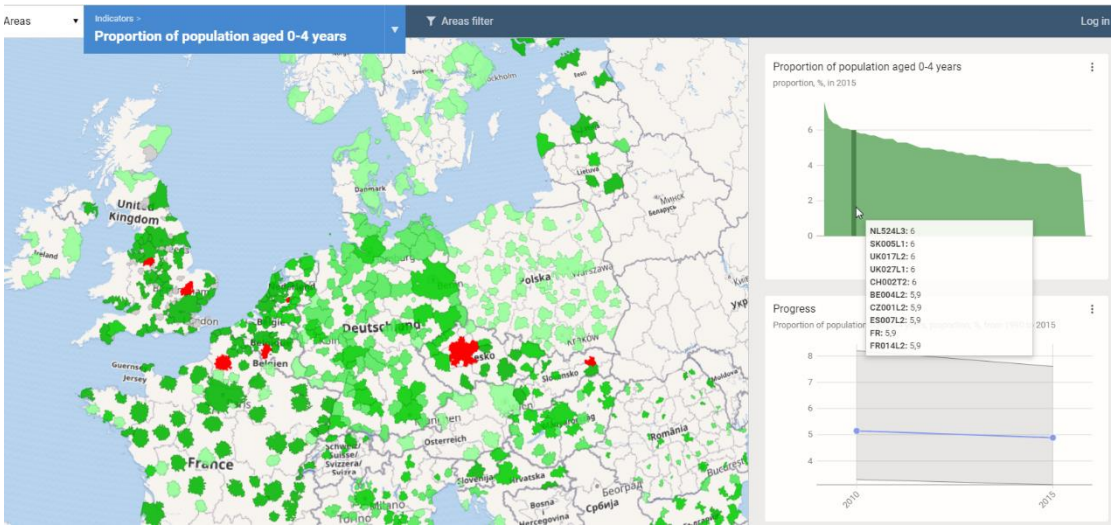
1.4.2 Interactive benchmarking and filtering

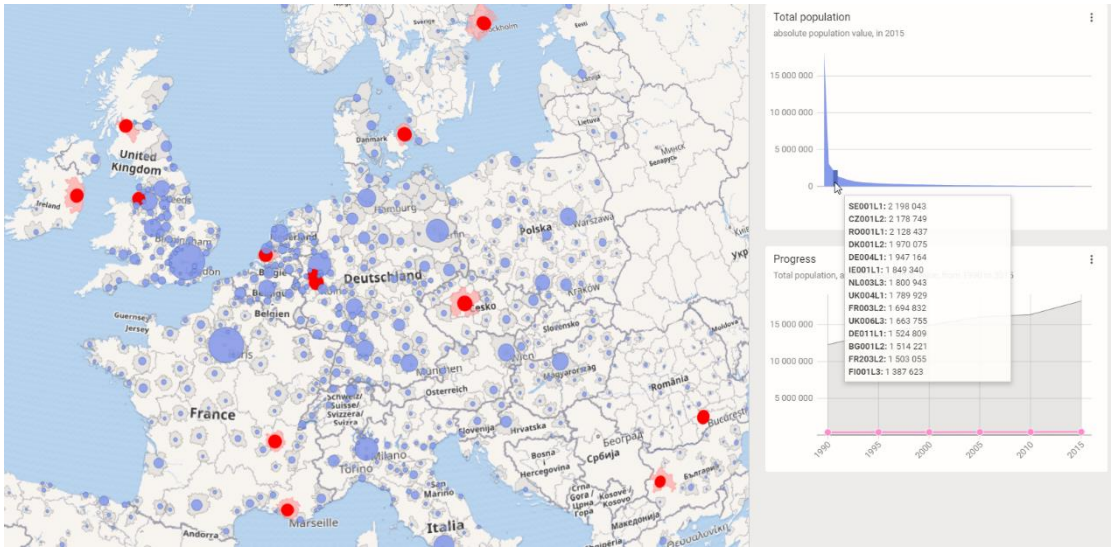
Interactive functionalities for filtering and benchmarking of reporting units (based on indicators´ values or other properties) are integrated into the web tool. Those functionalities provide the users the possibility to interactively select or filter the reporting units based on one or the combination of different attributes, and, through this, to create temporal selections of units of interest.

Hover selection of unit of interest

For the interactive data selection and benchmarking, there is a **hover functionality** integrated (Figure 1.10). It is an option to interactively select any unit (or group of units with similar indicator´s values) in a chart and such selection is immediately highlighted in the map window, so the user can check the geographical distribution of the selected reported units.

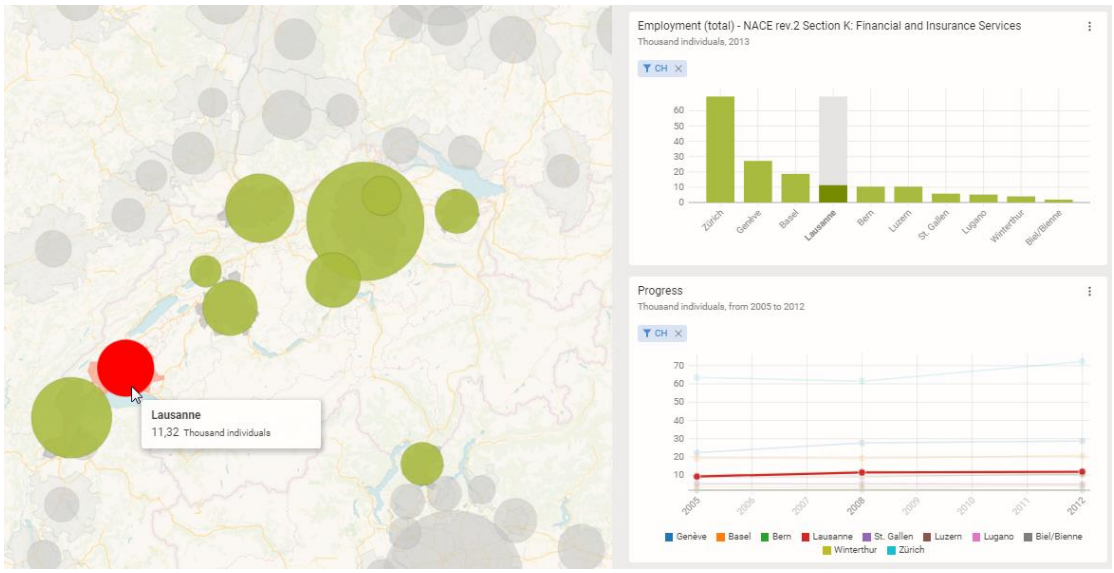
Figure 1.10. Hover functionality – units selected in column chart are highlighted in map.





The same hover functionality works also vice-versa – which means the user can start the selection of the reporting unit in the map window and this selection is reflected in the charts.

Figure 1.11. Hover functionality – unit selected in map is highlighted in charts.



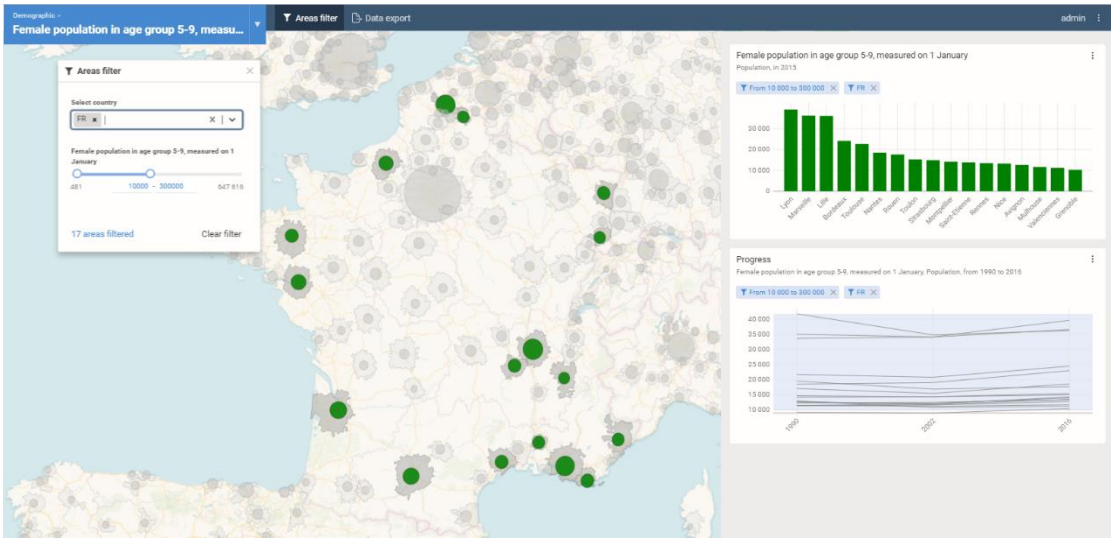
Filtering analytical units

The main filtering functionality is represented by the **Areas filter** (see Figure 1.12), which is the interactive filtering widget integrated into the tool. The button activating this filter is located in the header at the top of the user interface. It enables the user to filter the reporting units based on:

- Country
- Indicator values
- Combination of both

The user can select one or multiple countries of interest and combine the country filter with a filter of indicator´s values. Once the filter is applied, only the selected units are displayed in the map and charts. This selection can be quickly modified or deactivated by the user.

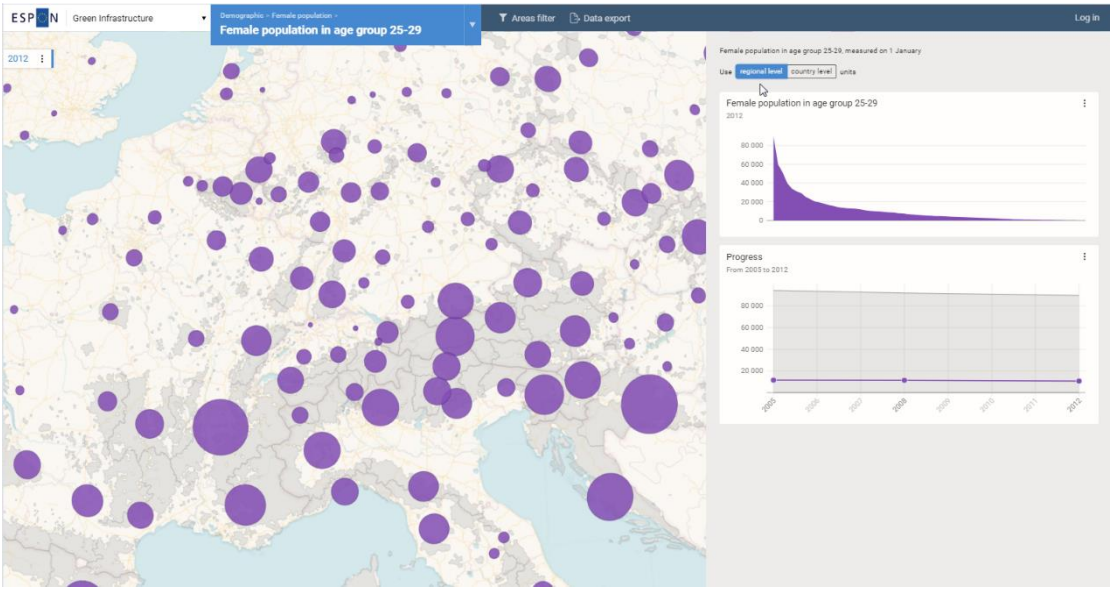
Figure 1.12. Filtering FUAs based on combination of country (FR) and indicator value – result in the map and charts.

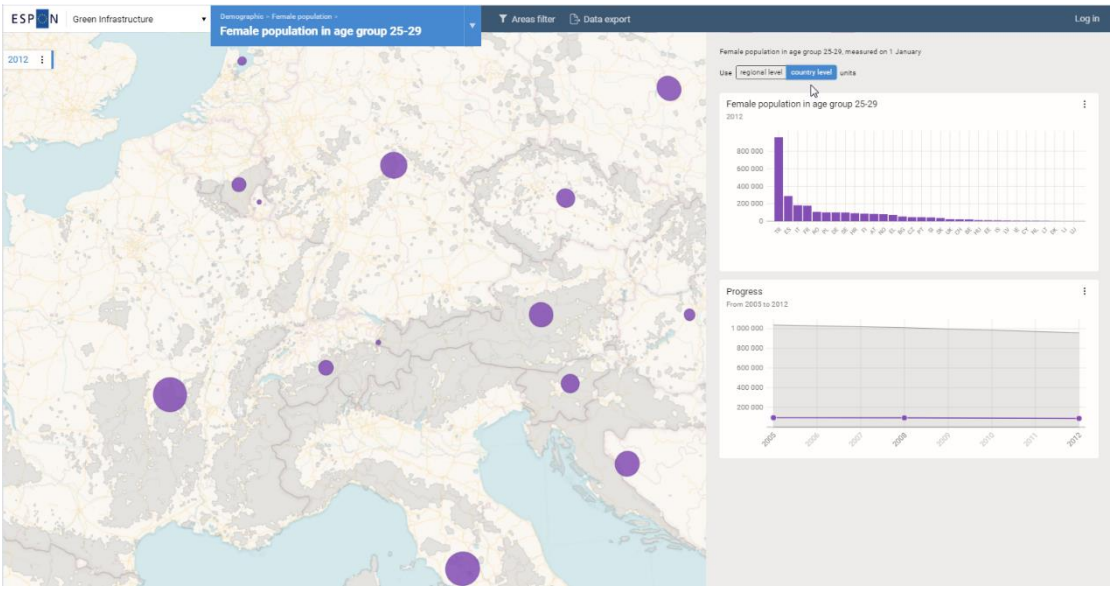


1.4.3 Hierarchical levels of analytical units

For each type of functional region, two hierarchical levels of analytical units are presented in the tool. By default, the “regional” level is switched on. In case the user wants to display values aggregated (for that particular type of functional region) to the country level, he just needs to switch to “country” level in the interactive switcher in the tool (the switcher is located above the charts, as demonstrated in Figure 1.13 below).

Figure 1.13. Switching between hierarchical levels of analytical units (regional level – top, country level – bottom).

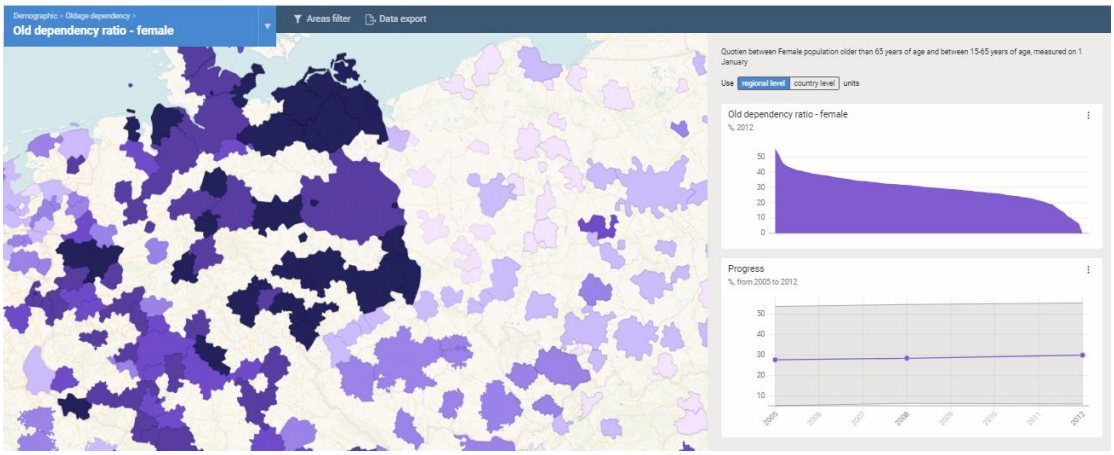




1.4.4 Interactive charts

Two types of interactive charts are available by default in each indicator-related Map View (see Figure 1.14). These charts are situated in the charts panel on the right side of the Map View.

Figure 1.14. Two types of charts – column bar and linear chart showing trends are available in the chart panel.



A column bar presents the status values of indicator for one (currently selected) year. By default, values for all the functional regions (analytical units) of selected type (e.g. all functional areas in Europe) are displayed in this chart. The reporting units are automatically sorted in a descending way, based on the indicator´s values. In case multiple years (more than one) are activated in the tool, the column bar is automatically changed to a linear chart, to be able to display values for more than one year.

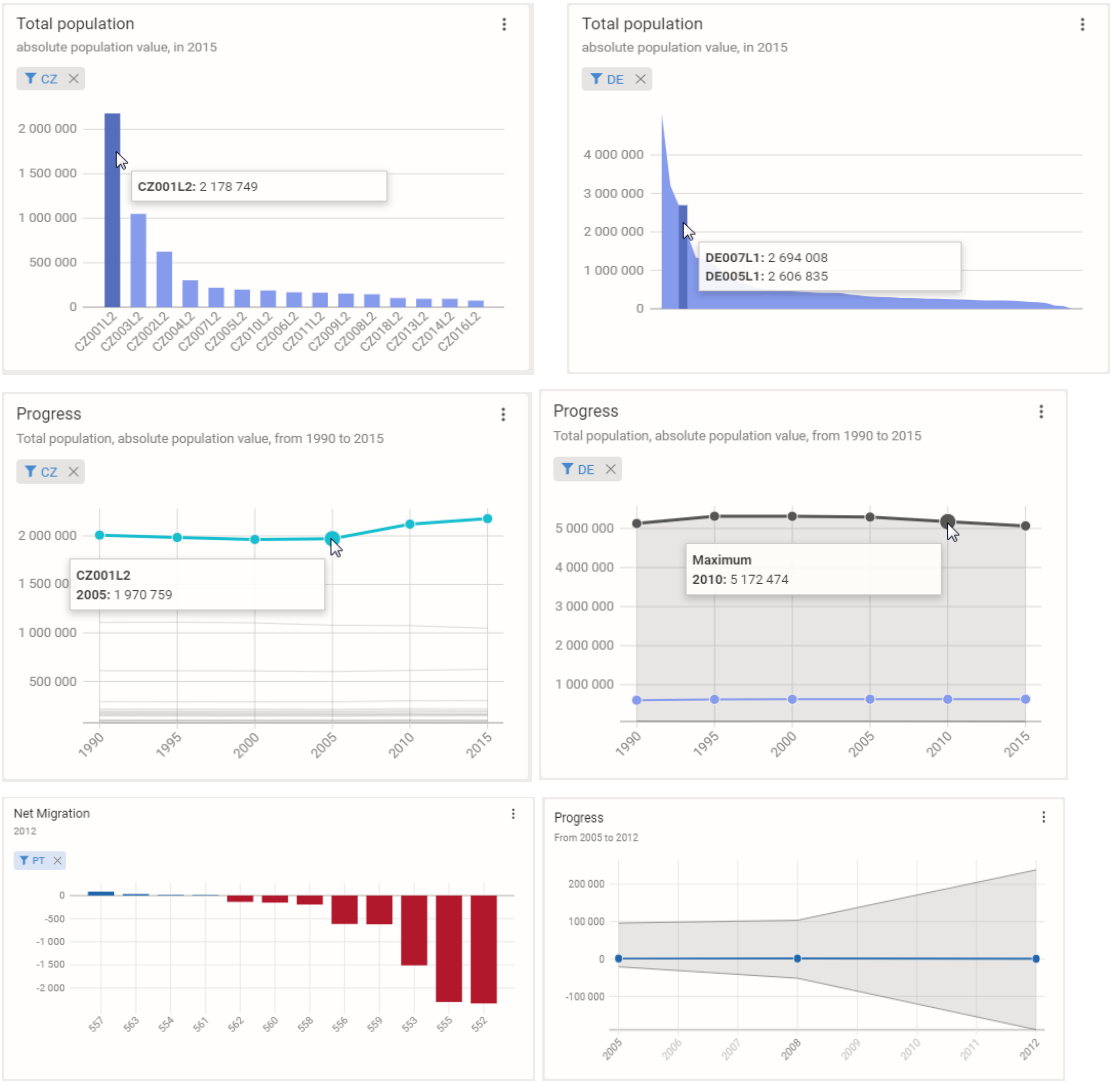
A linear chart displays the trends – i.e. the development of indicator values over time. In this linear chart, an early time-series for the years with highest (percentual) availability of the data/indicators in the frame of selected functional region is displayed. This approach secures that the chart will show valid values for most of available indicators for that particular type of

functional region for most of the years. For the final version of the tool, a period between 2005 and 2012 is displayed for all types of functional regions (this period was selected based on following rule: for each type of functional region, a proportion of indicators with available data was calculated for each year. The highest percentage of indicators was identified for all the years in the period 2005-2012, which was valid for all types of functional regions).

In case a large number of units is displayed in the charts, the units are automatically grouped into intervals in the column chart and only the maximum, minimum and average values of the whole set of (currently displayed) analytical units are presented in the linear chart.

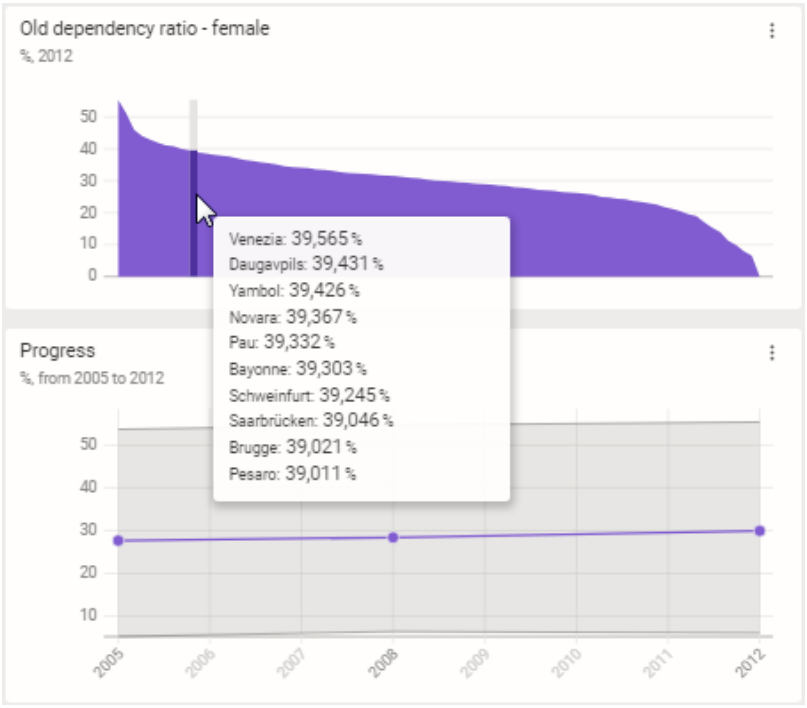
The figure below demonstrates these two different modes of two basic types of charts (column bar, linear chart), which are available in the web tool, depending on how many analytical units are currently selected and also on character of currently displayed indicator. The less analytical units selected, the better the user can see the details in differences between currently selected analytical units.

Figure 1.15. Grouping the values of indicators in case of large number of reporting units (left – low number of reporting units, right – high number of reporting units).



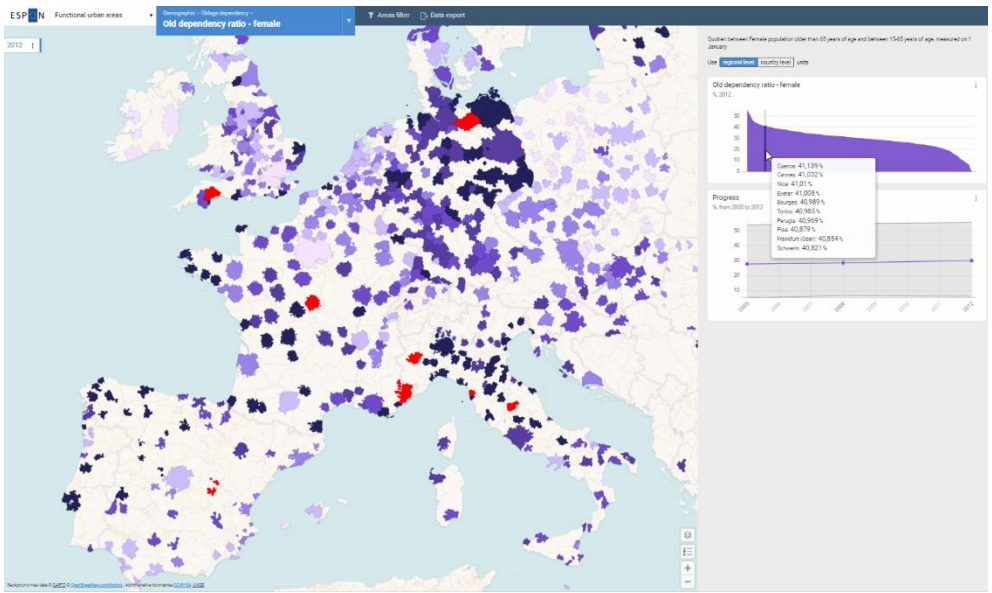
The hover functionality allows to interactively select any value/interval in the column chart (or in linear chart, in case it is in mode displaying lower number of reporting units) and to display the (full) names of regions presented in the chart as well as of values of indicators for those regions.

Figure 1.16. Two types of charts – column bar and linear chart showing trends available in the chart panel.



In addition, this interactive selection in synchronized with the map window, so in case some reporting unit (or interval of units) is selected in the chart, the same selection is automatically highlighted also in the map window. Combination of these functionalities allows for easy and highly interactive benchmarking of regions.

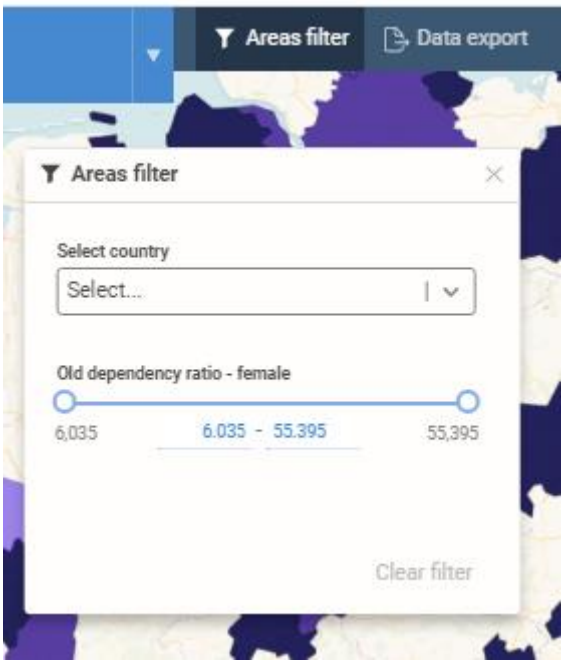
Figure 1.17. Synchronized behaviour of the selection in chart and in the map – in both of them, same units are highlighted.



“Zooming” into values in charts

In case the user wants to see better the differences between the values in charts, he can use the filter to limit the number of units which are displayed in charts and see better details in distribution of values and order of units. This can be done using the filter, which can be opened using the button in the top of the application window.

Figure 1.18. Interactive filtering of analytical units – by country, value, or combination of both.

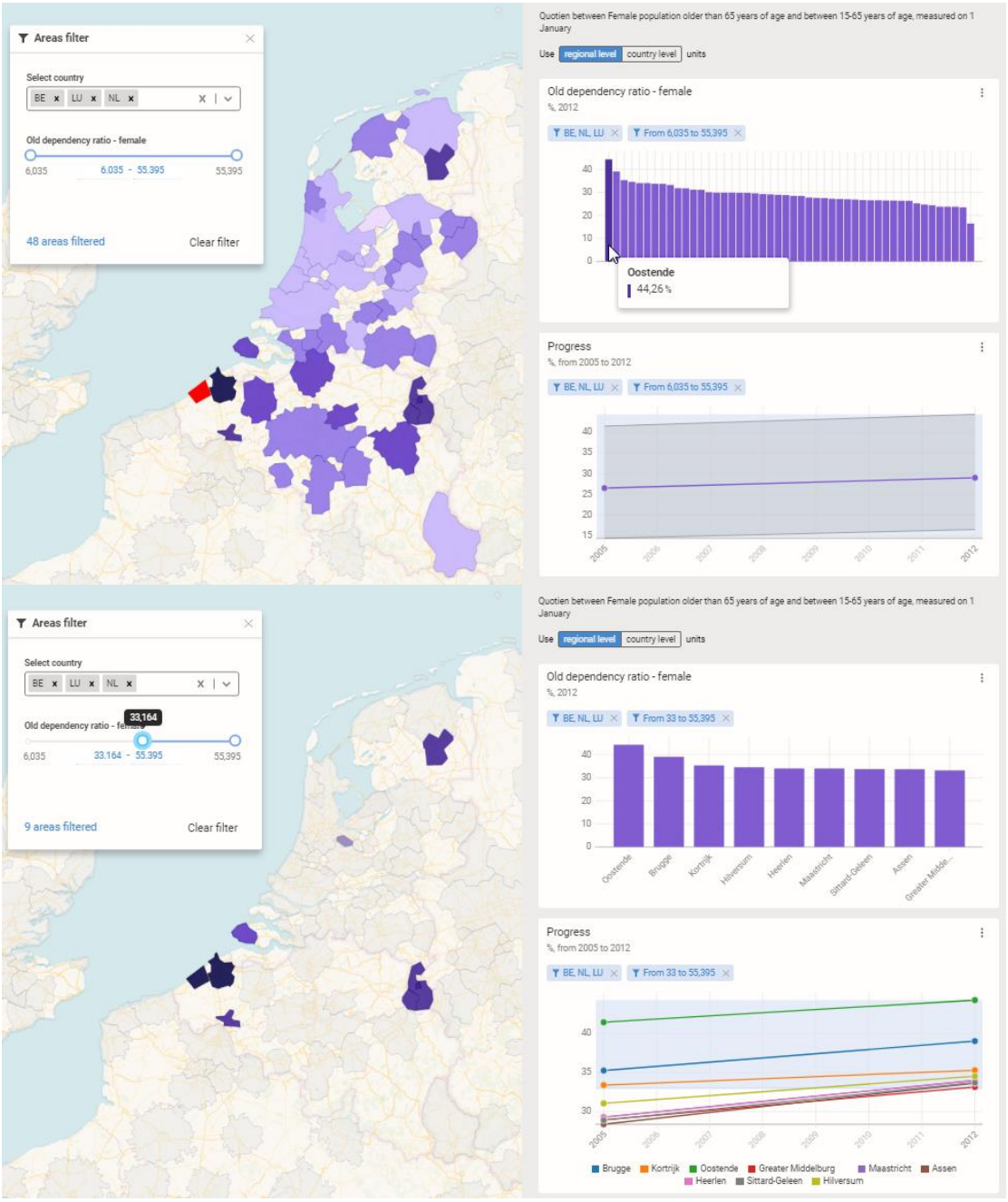


This filter allows to filter the units to be displayed in the charts (as well as in the map) by:

- Country
- Value of indicator
- Combination of both

Doing so, the user can e.g. select only the functional urban regions, which are belonging to specific country or multiple countries (the figure below demonstrates the FUAs of Benelux countries only selected by the filter – top). In the next step, the FUAs with highest values of indicator are selected (bottom). This allows the user to see the situation in detail also in the charts, which are interactively modified depending on how many analytical units are selected. This is particularly valid for the linear chart, which shows the average, maximum and minimum values of all analytical unit displayed in the tool, but in case less then 10 units are selected by the filter, you can see the trend for each of these units in the linear chart, each of them in different colour.

Figure 1.19. Limiting the number of units to be displayed in the chart (and in the map) by filtering.



The filter always shows the number of currently selected analytical units and it can be easily inactivated using the button “Clear filter” in the lower right bottom of the filtering widget.

1.4.5 Displaying data in time-series

To allow the user to follow the trends in development of values of indicators over time, the tool enables to display the data for **more different years** in the same time. This **multiple-year mode** is enabled through the interactive axis (

Figure 1.20), located at the bottom of the map application window.

Figure 1.20. Axis for selection of the year(s) of interest.

The user can display (through clicking on the respective button) the data for selected year (or multiple years at once) in both map and charts (Figure 1.21). In case there are no data available for some of the years from the time range, the buttons representing those years are automatically inactivated so those years cannot be selected by the user (they appear in light grey colour – and a warning appears in case the user tries to select one those years, that "selected indicators is not available" for that year). In case more than one year is selected on the axis, the column bar in the chart panel automatically changes the type to linear chart, to be able to present years for more than one year. While the original linear chart (the bottom one) always displays a period between 2005 and 2012, the upper, any time-series can be displayed in the upper linear chart. For each newly selected year, a new map window is added. In the map, the number of years to be displayed at once is limited to 9, to assure good readability of the information displayed in the map. In case all these nine years are selected, the possibility to select additional year on the axis is disactivated.

Figure 1.21. Multiple-year mode of the Web Tool, showing values for four different years in map and charts.

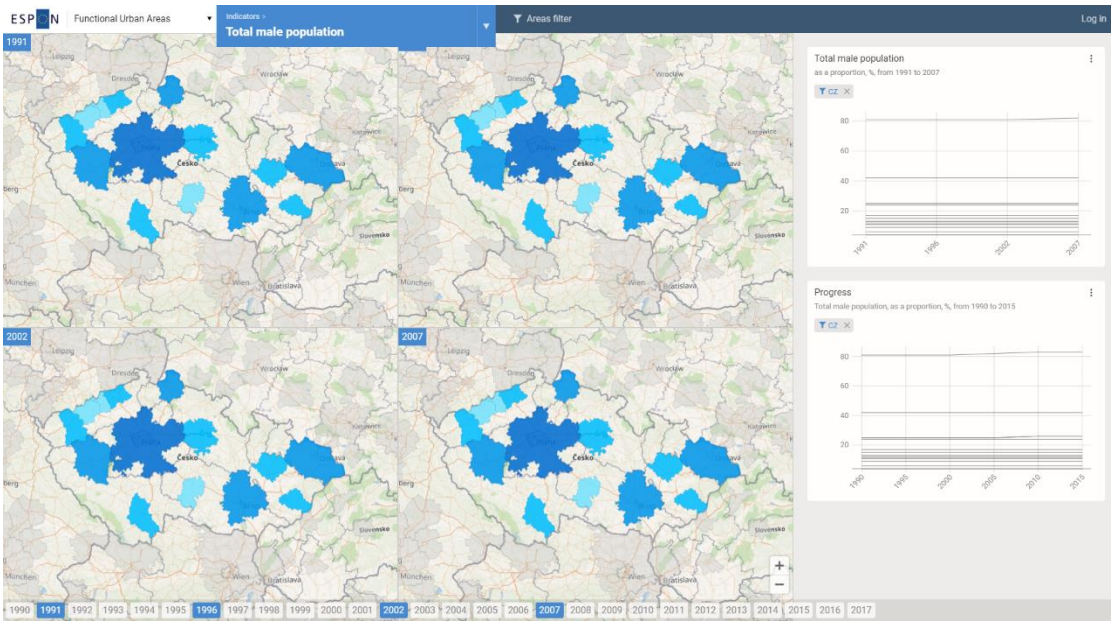
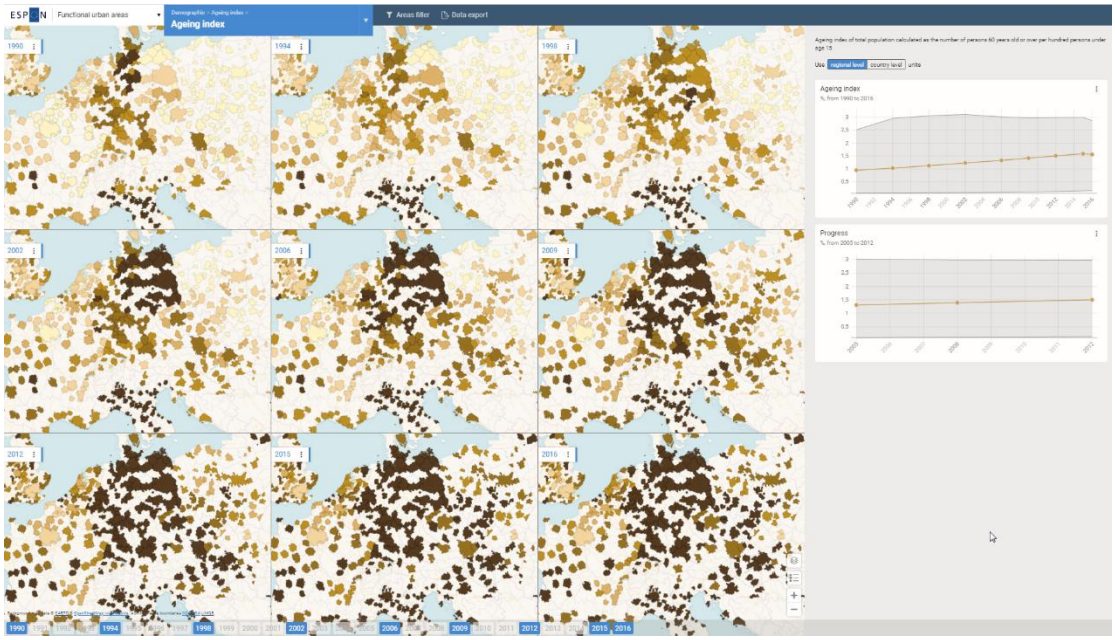


Figure 1.22. Multiple-year mode of the Web Tool, showing values for nine different years in map and charts.

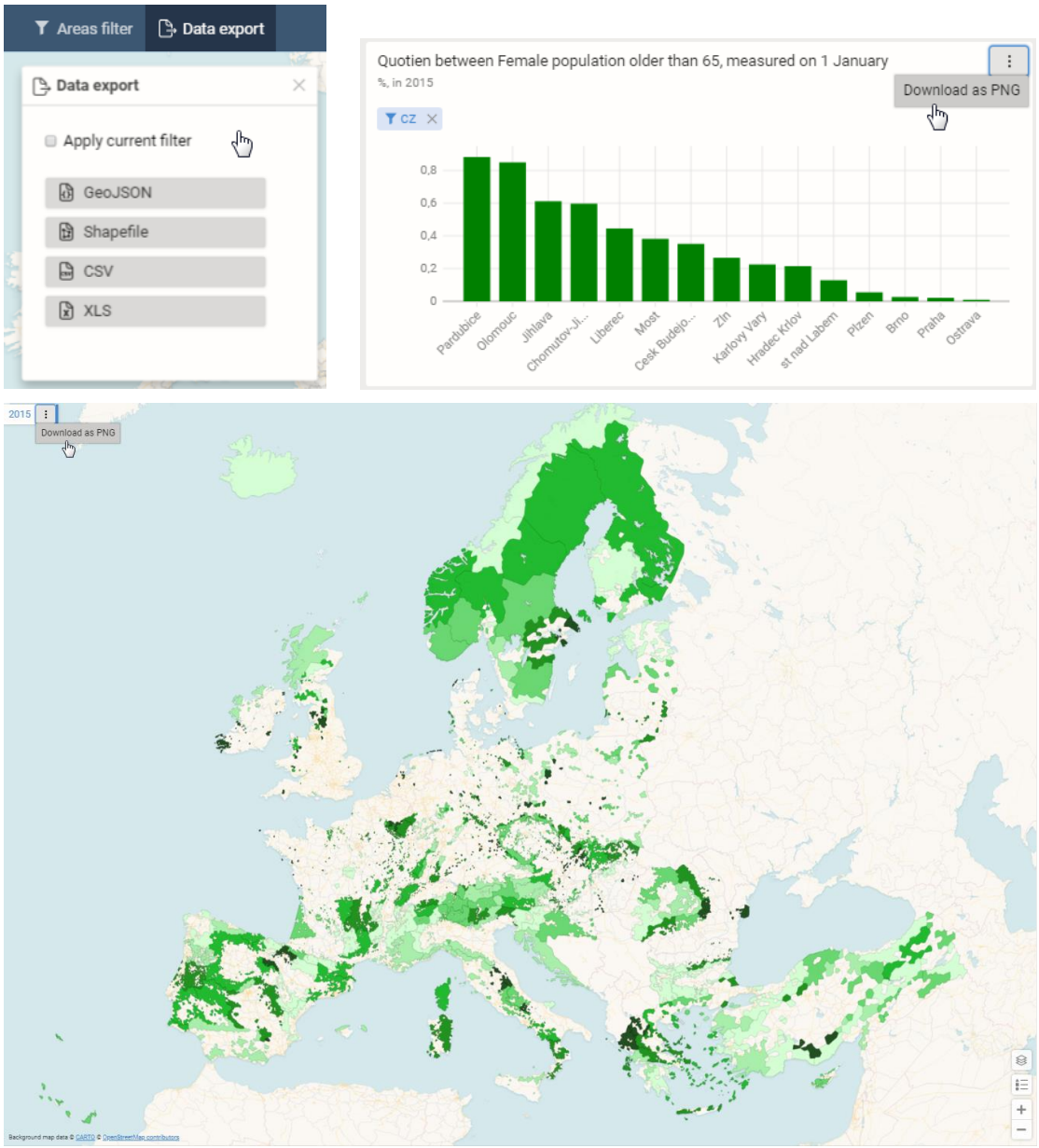


1.4.6 Exporting and sharing data

Various exporting functionalities are implemented in the beta version of the tool, in order to enhance interactivity of the tool and to support the user-driven analysis. These includes:

- Export map as PNG
- Export chart as PNG
- Data Export (a set of units selected in the Area filter or all units can be exported):
    - As GIS layer: GeoJSON or Shapefile
    - As table: CSV or XLS

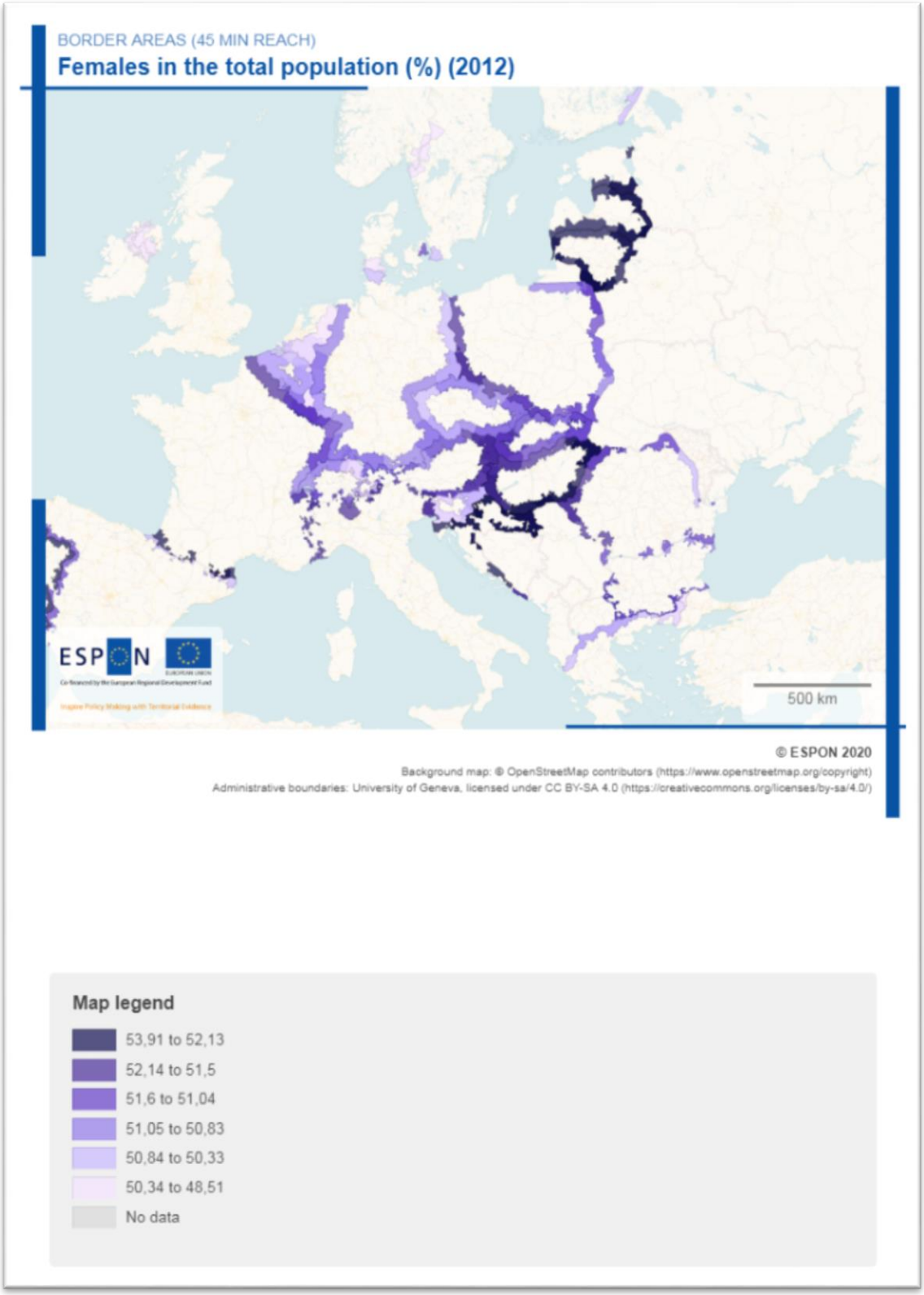
Figure 1.23. Exporting tools (data export, graphical elements export).



For the map export, a complete Map Layout is exported, containing the map window with all layers displayed in the map, accompanied with graphical scale and legend, title of the map and ESPON logo. A draft layout of such exported map is presented in

Figure 1.*24. Map Layout as PNG, including title, legend and ESPON logo, as a result of the Data Export functionality of the web tool.* below. This layout can be further adjusted, based on ESPON preferences.

Figure 1.24. Map Layout as PNG, including title, legend and ESPON logo, as a result of the Data Export functionality of the web tool.

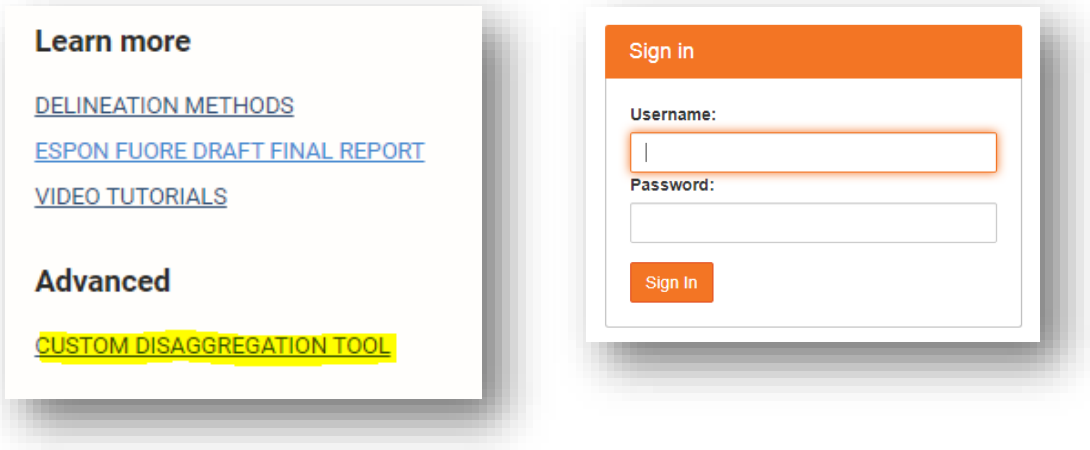


2 User-driven disaggregation and visualisation of a new indicator

For the advanced user, there is a specific functionality implemented enabling the upload of data for a new indicator (at NUTS2 or NUTS3 level), from which the figures can be disaggregated and reaggregated back to any of the functional areas available in the web tool.

A hyperlink is available on the landing page of the web tool, providing access to this functionality. This link re-directs the advanced user (who needs to log-in first) to the GUI of the Web Data Analysis Toolbox´s (WDAT) – see section 1.1.

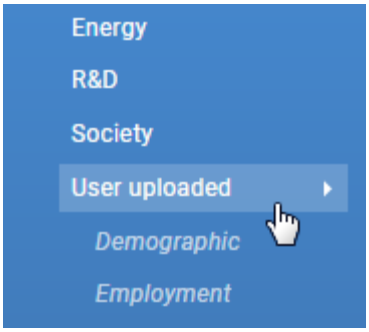
Figure 2.1. A link on the landing page leads the user to the access to the Web Analytical Toolbox. The user needs to log in dedicated dialogue window.



By means of the WDAT, the user is able to parametrize, run, and validate his own disaggregation process, as explained in this chapter. As a final step, the user can upload the results of the disaggregation process into the Web Tool and explore and analyse them interactively, in illustrative maps and charts, or export them as graphics, GIS data or tables.

The indicator estimated by means of the WDAT and then uploaded to the Web Tool is automatically included into a “User uploaded” category in the list of categories of indicators (Figure 2.2).

Figure 2.2. A link to the “User uploaded” category distinguishes the indicators which were disaggregated by the user and then uploaded to the Web Tool.



The next section describes how to use the WDAT on a step-by-step basis:

2.1 The Web Data Analysis Toolbox – User Manual

This section of the FUORE Guidance Manual is aimed at describing the way to use the advanced FUORE Web Data Analysis Toolbox (WDAT) on a step-by-step basis. The WDAT implements an innovative technical solution based on Jupyter Hub, a multiuser server for Jupyter notebooks (http://jupyter.org/hub) to be able to run the whole data processing in the cloud. The Jupyter Notebooks contain a user-friendly version of the scripts that have been used to carry out all the estimations of the FUORE indicators.

Although the WDAT works in most browsers, it is strongly recommended the usage of **Mozilla Firefox** for an optimal performance.

2.1.1 Step 1. Accessing the WDAT

The advanced toolbox can be accessed from the FUORE web tool, by clicking on the corresponding link, as specified in Figure 2.1:

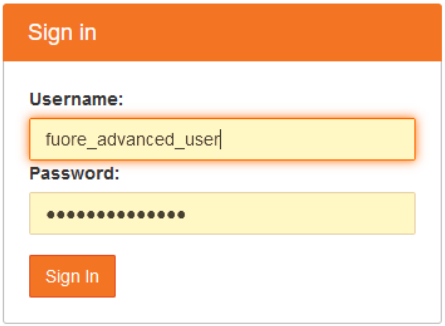
Alternatively, this is the link to directly access the WDAT:

https://212.24.101.53/user/fuore_advanced_user/notebooks/espon_analytical_webtool.ipynb

2.1.2 Step 2. Logging in

Once in the correct URL, the user needs to sign in to be able to execute the jupyter notebooks behind:

Figure 2.3. Sign-in window to log into the notebook.



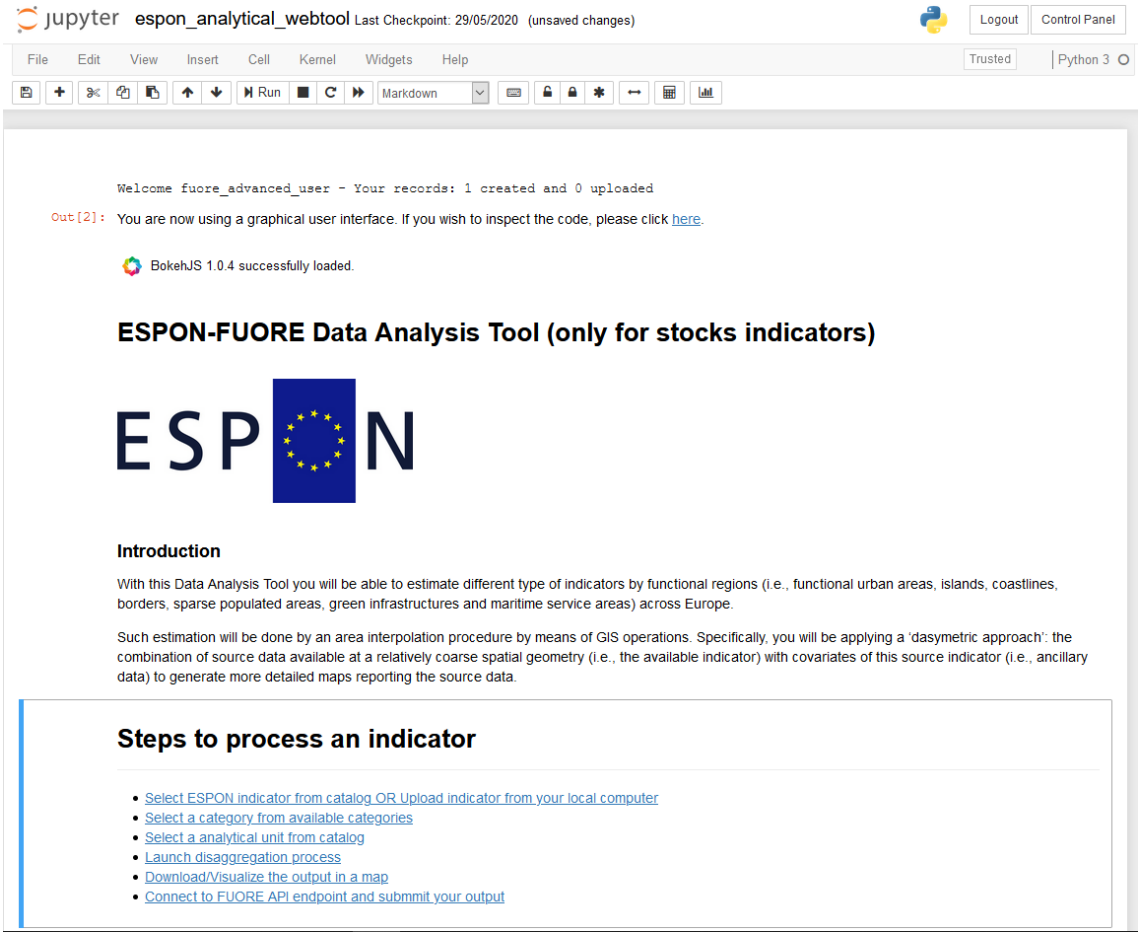
Although a user-friendly interface has been prepared, there is some required knowledge to use the tool (at least the one provided by this manual), so it is suggested to provide the credentials only to advanced/interested users that can be relied on, and provide this guidance materials too. The credentials to access the WDAT are the following ones:

Username: fuore_advanced_user

Password: fuore_$Esp1001

Once logged in, the user should see this layout:

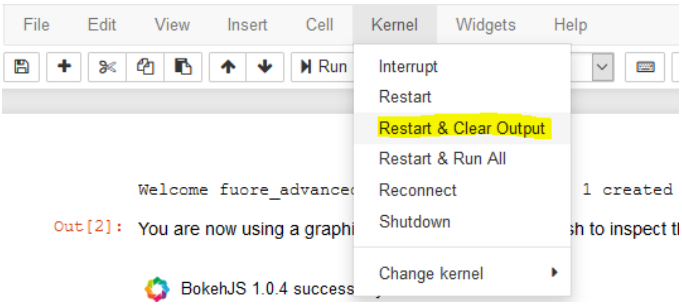
Figure 2.4. WDAT Jupyter notebook landing page.

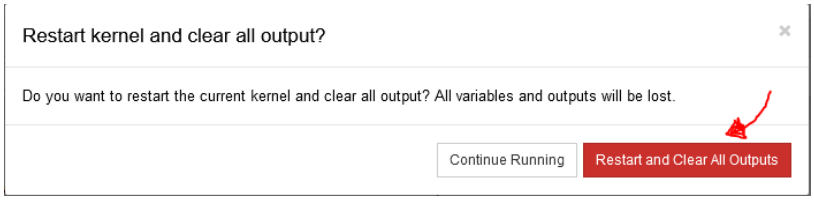


2.1.3 Step 3. General aspects

As the same credentials can be used by different users (in different times), it is recommended to restart the kernel and clear all previous outputs, to make sure previous processes have not been left unfinished. To do so, use the menu above to select “Kernel/Restart & Clear Output” and click on the confirmation button:

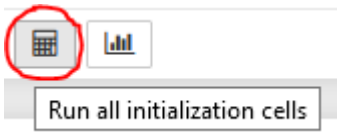
Figure 2.5. Menu option to restart the kernel and clear all output and confirmation button.





It is also recommended to run all initialization cells by clicking on the corresponding button:

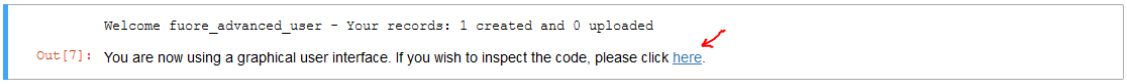
Figure 2.6. Button to run all initialization cells before starting the processing.



Now, everything is ready to start the processing. In case the notebook does not move from one step to the next one, the “Run” button above can be used (this should not occur, especially if using Mozilla Firefox).

For very advanced users, there is the option to inspect the code through a link provided at the top:

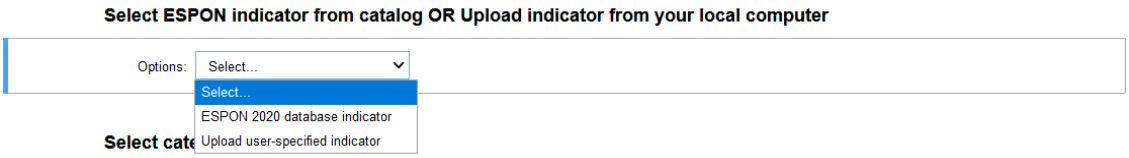
Figure 2.7. Link to inspect the code behind the user-friendly interface.



2.1.4 Step 4. Selecting the type of estimation

The first step in the processing chain is selecting whether the user wants to estimate data from one of the existing ESPON DB Base indicators, or upload an indicator from his/her own:

Figure 2.8. Selection box of the source of indicator for the estimation.

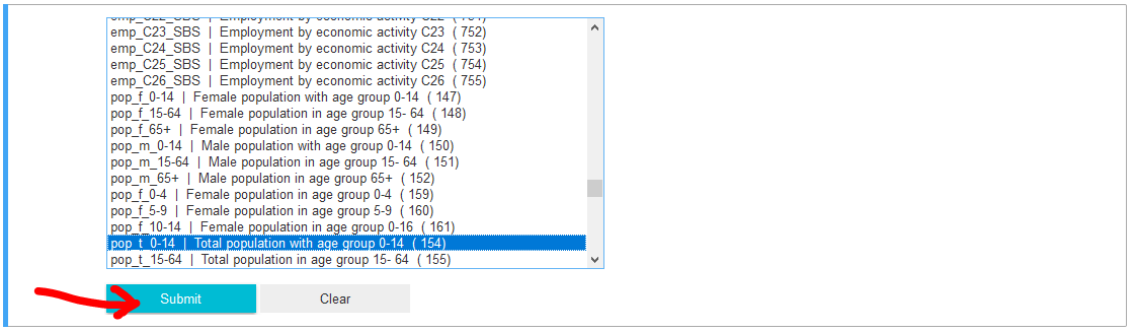


From now on this manual refers to option A, in the case of the ESPON DB indicator, and option B in the case of the uploaded indicator.

2.1.5 Step 5a. Selecting the ESPON DB indicator

After having selected the option of using an existing ESPON DB indicator, the user should select one of the listed indicators, by clicking on it and on the “Submit” button:

Figure 2.9. Selection box of the ESPON DB base indicator.



The script will automatically detect the Category (e.g. Demographic):

Figure 2.10. The category is automatically filled in in the case of ESPON base indicators.

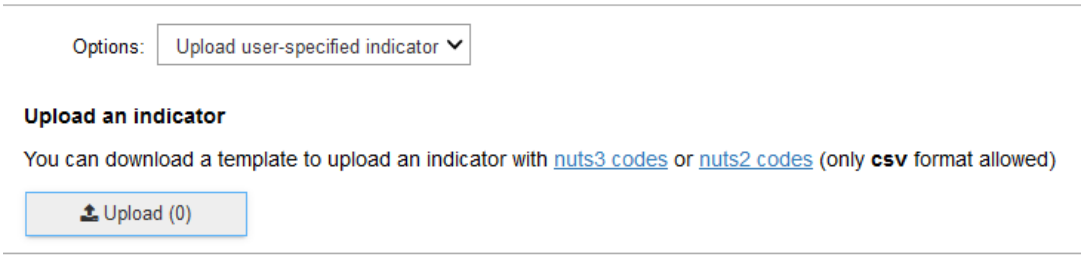
To continue with the processing, you can go to sub-section 2.1.7.

2.1.6 Step 5b. Uploading a user indicator and defining its category

In the case of selecting the option of uploading an indicator, the user can download two templates in CSV format, one for NUTS2 and another one for NUTS3, which should be used to provide the user-driven indicator. Please notice that the system is prepared for NUTS 2013 version and the methodology implemented by FUORE is meant to estimate indicators from stock values, so it will treat any figure provided as if it was a stock indicator. Each advanced user is responsible for the right usage of the toolbox and the results provided.

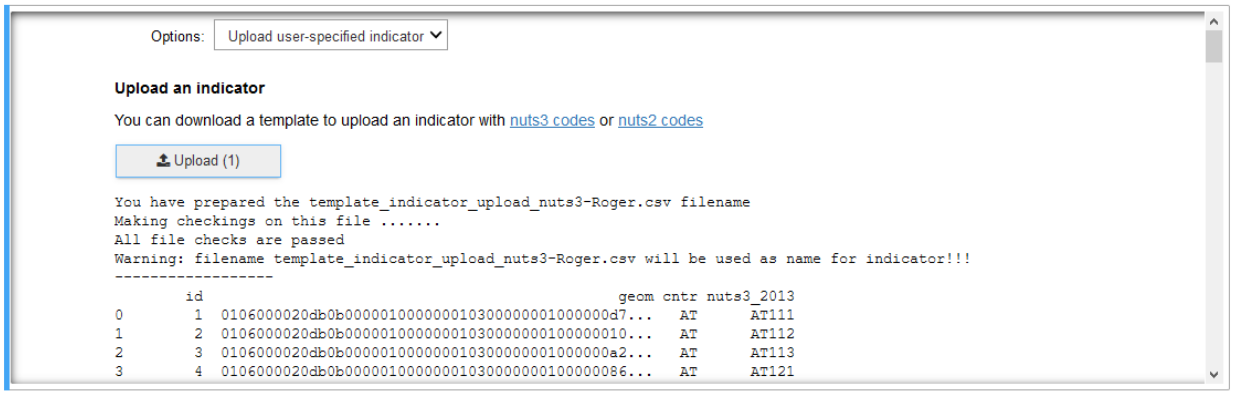
The templates can be obtained from the corresponding links:

Figure 2.11. NUTS3 and NUTS2 (version 2013) CSV templates are provided.



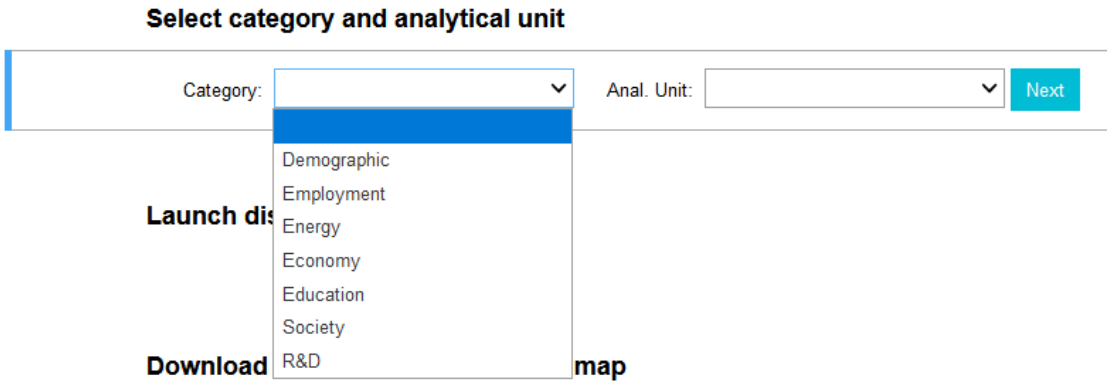
Once the user has prepared the data, the “Upload” button should be selected to browse for the file and, after selecting it, the button will change the number in brackets to 1, and the file is verified by the system:

Figure 2.12. Once uploaded the CSV file provided by the user is automatically verified.



Differently from the case when an ESPON indicator is used, in this case the user can select the category where the indicator belongs to. This selection will define the weighting matrix, which is eventually used in the disaggregation, so it is very important to select the right category according to the data provided:

Figure 2.13. Selection of the category in the case of providing a user-driven indicator.

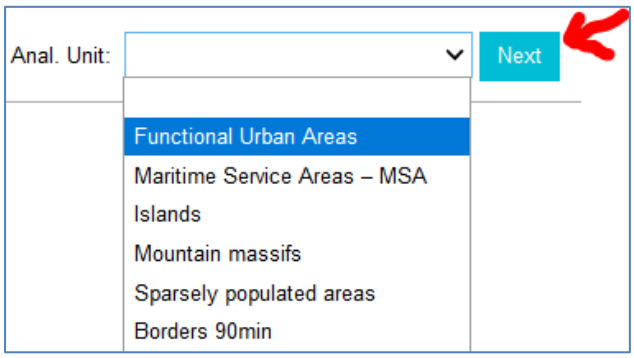


After this step, the procedure is the same as if we were using an ESPON DB indicator (see section 2.1.7).

2.1.7 Step 6. Selection of the functional region of interest

After having selected the indicator to be disaggregated, the user should select one of the functional region types from the combo box and click on the next button:

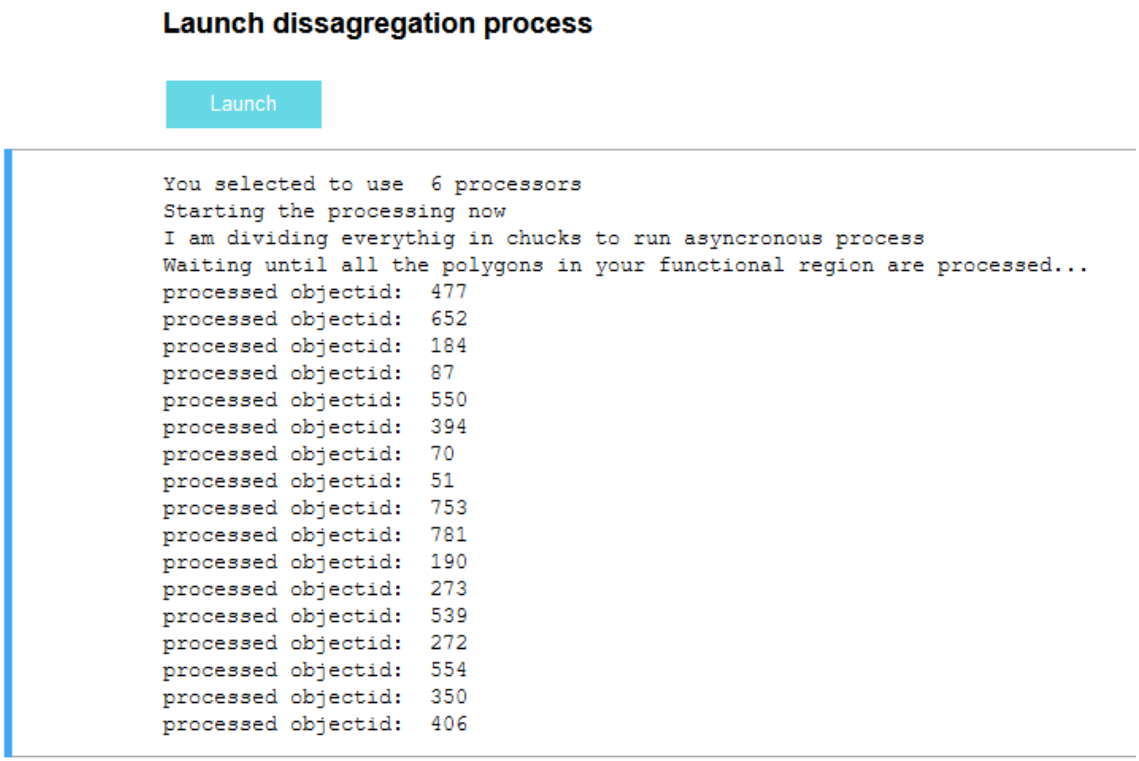
Figure 2.14. Selection of the functional area to which the indicator estimation will be made.



2.1.8 Step 7. Launch the disaggregation/aggregation process

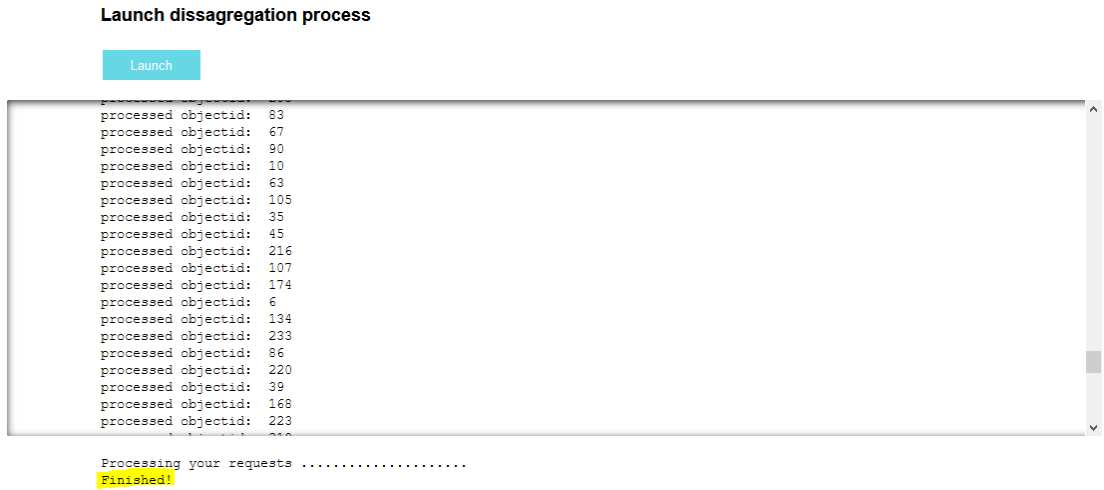
By clicking on the “Launch” button, the process of estimation of the indicator by the selected functional region starts:

Figure 2.15. Estimation process launch button and process development.



The process will run for a while (typically, few minutes). The user can check the progress by going down with the scroll bar and should wait until the processing is finished:

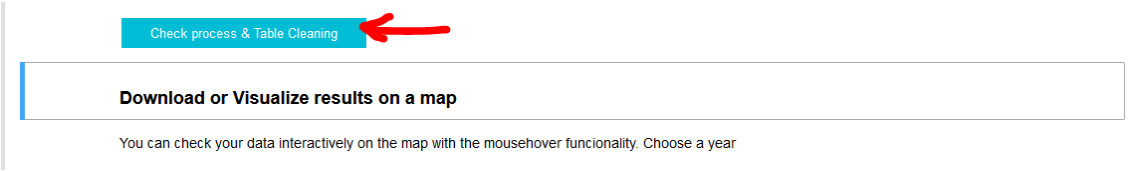
Figure 2.16. Message of processing finished.



2.1.9 Step 8. Checking the process and cleaning the table

This is a verification step, to confirm that the table has been created in the database and cleaning the unnecessary elements of the table. Click on the corresponding button to proceed:

Figure 2.17. Checking and output cleaning button.



A short message for confirmation will appear:

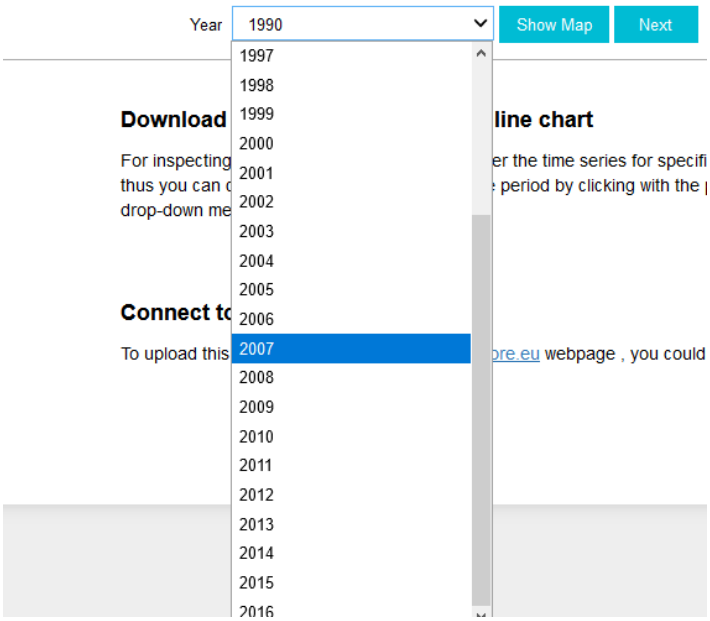
Figure 2.18. Confirmation message after checking and cleaning the output.

Note: if the button does not appear, use the “Run” button above until it appears (only when the processing is finished).

2.1.10 Step 9. Displaying the map

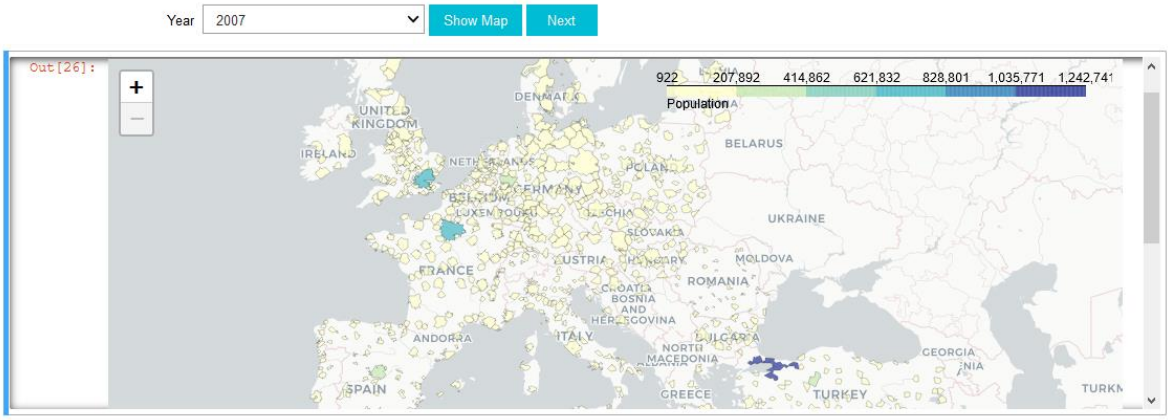
At this stage, a map showing the results of the estimation for any of the years included in the time series can be retrieved. To do so, just select a year in the combo box and click on the “Show Map” button:

Figure 2.19. Selection of year to display the map in the WDAT.



The map will be then displayed, and, by hovering on it, the resulting figures can be explored.

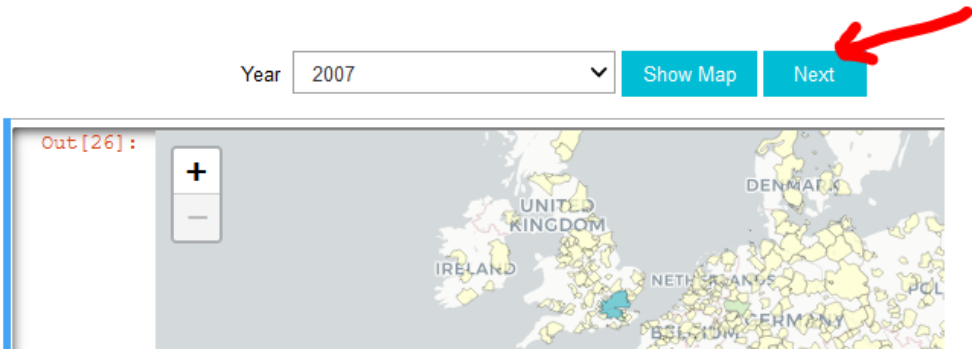
Figure 2.20. Overview of the map provided by the WDAT to preview the results of the estimation.



2.1.11 Step 10. Displaying the charts

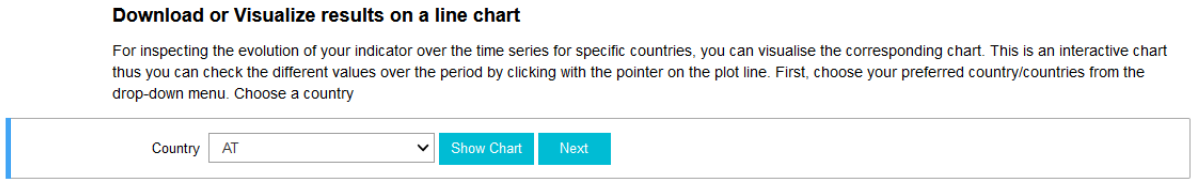
In order to go on, the user should click on the “Next” button as shown below:

Figure 2.21. Next button to leave the map visualization and move to the chart rendering option.



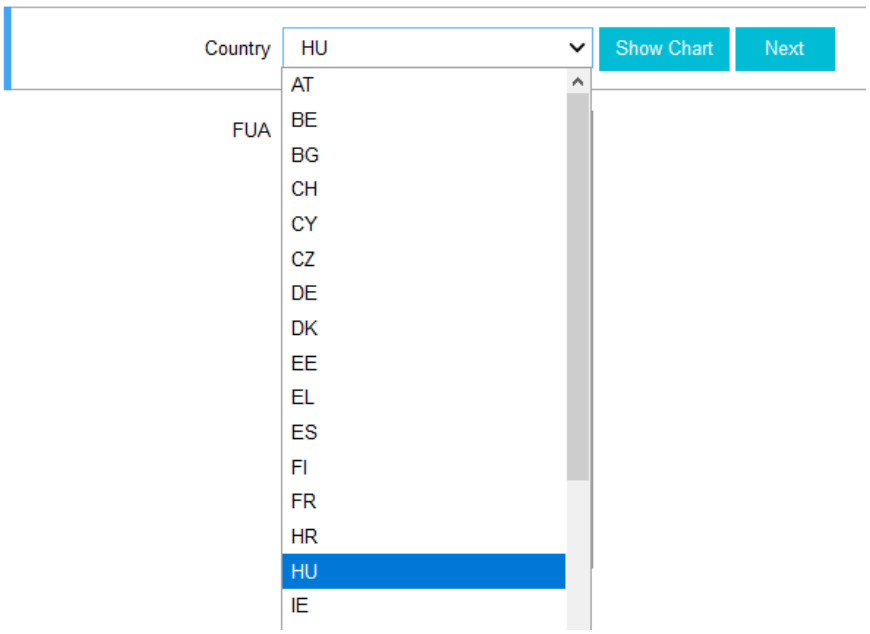
The possibility to check the results on a line chart is now enabled:

Figure 2.22. Combo box and buttons to visualize the estimated data as line charts.



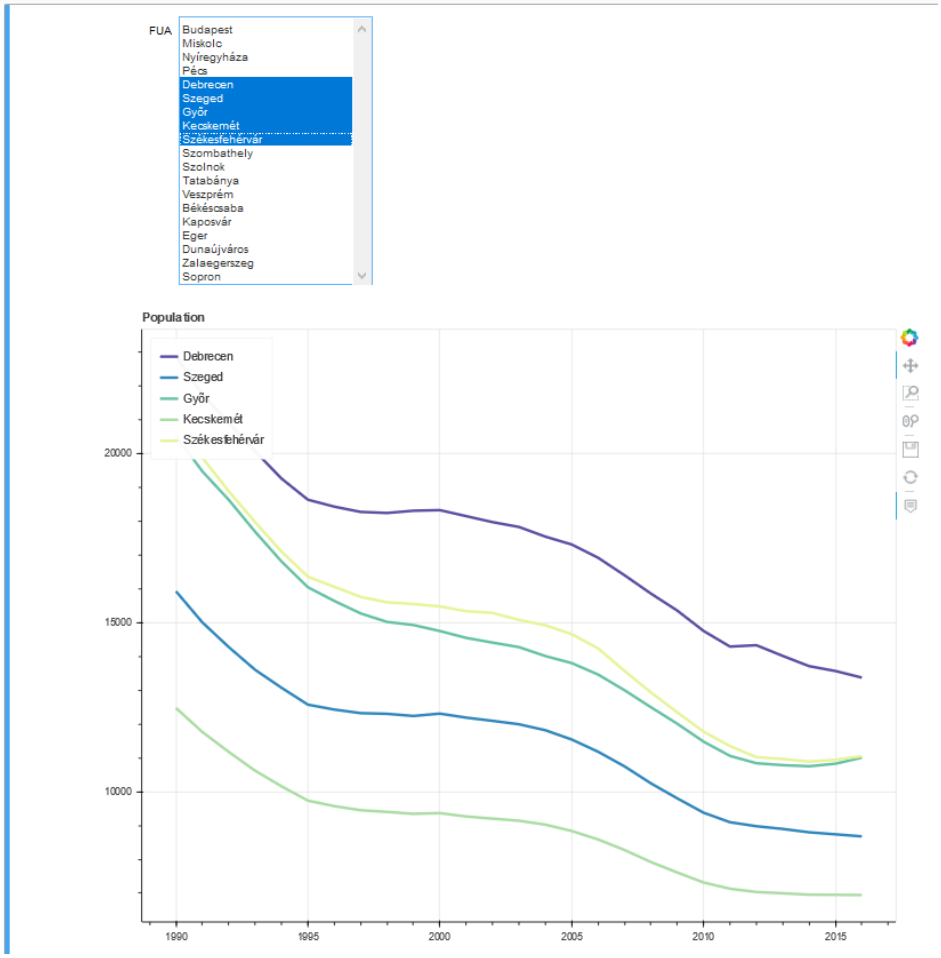
Select one of the countries in the combo box and click on the “Show chart” button:

Figure 2.23. Combo box to select a country from which the line chart will be drawn.



Once done, all the functional areas of the selected country will be listed, and the user can select one of them (or many, by clicking and dragging with the mouse). In the example below, many FUAs are selected, and the chart is displayed for them:

Figure 2.24. Selection of functional area(s) from the selected country to display the line chart.



2.1.12 Step 11. Checking/completing metadata and submitting the results

The last step of the process is checking or completing a few metadata fields and submitting the outcome to be eventually shown in the FUORE web tool.

When done with the chart visualisation, the user should click on the next button:

Figure 2.25. Next button to leave the chart visualization and proceed with the metadata.

After that, the different metadata to be completed will appear. In the case of an indicator from the ESPON DB, the metadata will be automatically filled in (Figure 2.26) and cannot be changed by the user in order to be consistent with the source data. If the indicator to estimate was provided by the user, then the metadata fields should be edited before submitting the results. The metadata introduced here will be eventually used by the FUORE web tool once the indicator is published.

In order to submit the indicator, click on the “Submit” button once the metadata is complete:

Figure 2.26. Metadata fields, automatically filled in in the case of an ESPON base indicator.

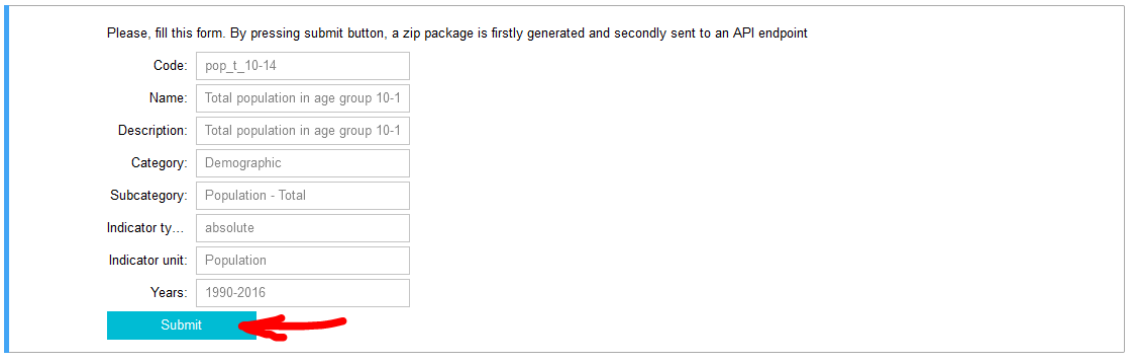
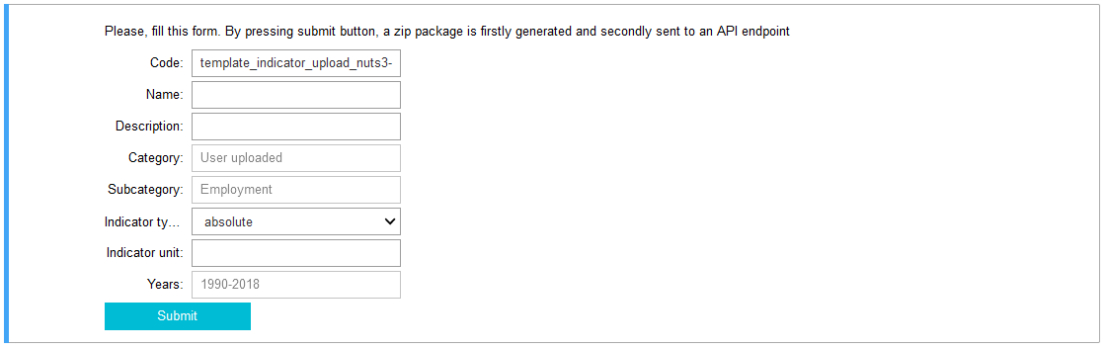
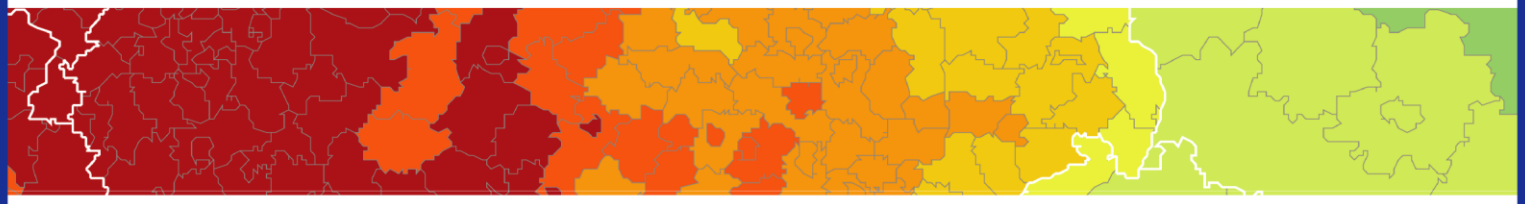


Figure 2.27. Metadata fields, to be filled in in the case of a user-supplied indicator.



Once the submit button is clicked, the indicator is sent to the FUORE web tool. It might take a while until the indicator is visible in the web tool (generally few minutes).



ESPON 2020 – More information

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