

## **Documentation**

### **1) The Hypercarte project**

HyperCarte is a project that proposes an application for interactive cartography. The project focuses on the development of a methodology easily understood that allows the analysis and visualisation of spatial phenomena taking into account its multiple possible representations. Statistical observations of the territory are complex, and one representation, directly linked to a precise objective, is the result of a combination of different choices relative to the territories and geographical scales, and the statistical indicators. This is of interest for researchers as well as development policy decision-maker.

Thus, the principal innovative aspect of the HyperCarte project lies on this perspective based on the popularisation of methods coming from spatial analysis such as the fitting of territorial scales, gradients, discontinuities.... This supposes an effort of pluridisciplinary cooperation between geographers and computer scientists in order to create new maps in real time according to the different choices. An important effort has concerned ergonomics and time of calculus.

### **2) HyperAtlas**

HyperAtlas is a tool for **Multiscalar Territorial** and gives the opportunity to derive several indicators on the basis of the ratio of two initial geographical indexes according to different spatial contexts.

*Multiscalar Territorial Analysis* is based on the assumption that it is not possible to evaluate the situation of a given territorial unit without taking into account its relative situation and localisation. Regions belong to territorial and spatial systems. Indeed, from a policy point of view and in a social science perspective, contrasts and gradients are of much more interest than absolute values. Furthermore, aggregating and disaggregating territorial units make it possible to see how local values add up to form territorial contexts and regional positions.

**Whatever** the indexes used for political decisions, they have to be evaluated in relative terms. This may be done according to various territorial contexts. Thus one spatial organisation may be examined from **three** different viewpoints that are three territorial contexts. They are differentiated according to the scale of political intervention or action they are referring to and that have a sense for the questioning: a global one, a medium one and finally a local one. Thus what is represented is the deviations to the three reference values associated to these different levels.

Let us take the example of the European union (25), at the level of the region (NUTS2 for instance), and let the observed index be the wealth per resident in the regions (GDP/inh.). It is possible with HyperAtlas to consider the level of wealth of the

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<sup>1</sup> (c) Software realised by the Hypercarte Project in the framework of ESPON Project 3.1 coordinated by the BBR. The Hypercarte Project is the consortium of french research teams in computer science (LSR-IMAG, ID-IMAG), Geography (UMR 8504 Géographie-cités) and spatial planning (UMS 2414 RIATE).

regions relatively to three territorial contexts, and not only from an absolute point of view. The chosen contexts may be for instance respectively: (1) the whole European Union (2) the country (3) the neighbourhood defined by contiguous regions.

HyperAtlas proposes for such an indicator seven maps that will be described furthermore in sections 5 and 6.

- The three first ones described the two parent distributions (here, wealth and population) and their ratio, that is the chosen index's one.
- Then, three maps show the relative distributions to the three chosen contexts. For the above example they are first the deviation of a region to the European reference area, secondly the deviation of a region to its national reference area, and in the third place the deviation of a region to the local reference area.
- The seventh map proposes a synthesis of the different combination of the three previous relative maps.

**Some political justifications about the contextual and multilevel mapping**, based on the European example:

The first map where the referent context is the global one is the classical way of mapping an index when the chosen context is the studied area. The values of the indices are converted into a global index.

The second map, corresponding to the intermediate level, here the national one, is very important to combine with the previous one. Indeed, many contradictions can appear between the two levels, with important political consequences.

The third one is based on the local differential between one region and the neighbouring ones according to various criteria of proximity (contiguity, time-distance). According to recent research in the field of spatial economy and regional science, those local advantages/handicaps appear to be of crucial importance for the regional cohesion because they are strongly connected with the action of economic or social actors.

The multiscale approach proposed to evaluate the same index at various scales. In terms of territorial cohesion, it is indeed very important to evaluate the level of development of a region according to at least three levels.

### **3) The input data**

The data provided by geographers are priority serialized in a convenient format for HyperAtlas in a file named with an extension .HYP. This file can then be imported directly into HyperAtlas. No changes can be done on data using HyperAtlas.

Necessary input data from geographers are:

- The geometry associated to the *elementary zoning*\*
- The statistics associated to the *elementary units*\*
- The hierarchy of territorial units and zonings definition.
- The definition of some specific areas included in the whole observed area.

The design of these data is described in the documentation of HyperCarte project.

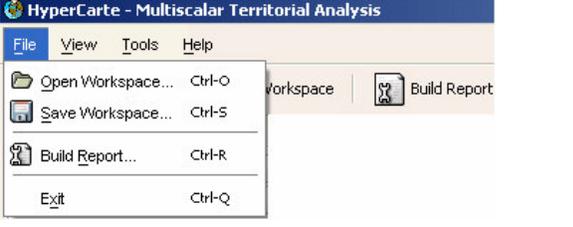
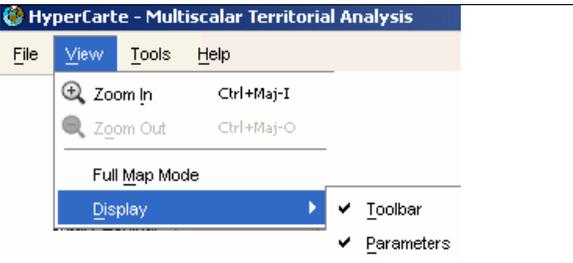
### **4) Working with HyperAtlas : the main window**

HyperAtlas is totally interactive. It works with three sets of parameters that are linked to one or more maps. At any time, the user can change the different input parameters, and the linked maps are immediately updated. The user has also the possibility to configure each map individually: number of equivalence classes,

statistical progression (arithmetic or geometric), the pallet of colours, etc. This gives the possibility to generate a very accurate collection of maps.

HyperAtlas works with only one window which is composed by: a menu bar, a tool bar, 3 boxes for the parameters, and a collection of the 7 calculated maps.

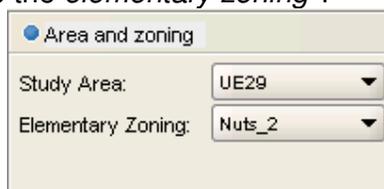
### The menu bar and the toolbar

<p>The menu “<b>File</b>” concerns exclusively</p> <ul style="list-style-type: none"> <li>- the files where the parameters entered in the three boxes and that define the “workspace”, may be stored in a XML file,</li> <li>- the report which is the edition of the different maps created in a HTML file.</li> </ul>	
<p>The user can find also these items as icons in the <b>Tool bar</b>.</p>	
<p>The menu “<b>view</b>” concerns the appearance of the map (zoom in, zoom out) as well as the display of different parts of the window (toolbar, parameters)</p>	
<p>The menu “<b>Tools</b>” has 2 options and allows to deal with the other functions of the cursor:</p> <ul style="list-style-type: none"> <li>-the “<b>pan</b>” allows to move the map inside the window.</li> <li>The “<b>histogram</b>” is only useful for the synthesis map, and display for each region the three contextual deviations (see section 6)</li> </ul>	

### 5) The MTA’s parameters

#### Definition of the Study area and Elementary zoning:

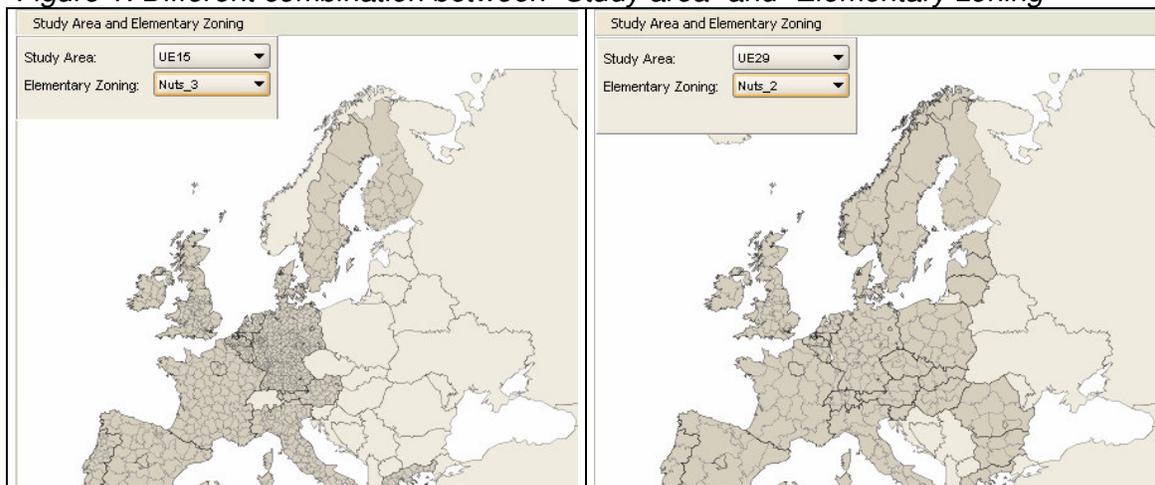
Obviously, this is the first step of the different choices to do. This allows the definition of the basis of the study: which spatial extension (area) and at which geographical level? Which division will be the *elementary zoning* ?



These two parameters have to be selected in the two respective pop up lists: The different propositions are internal and come from the a priori implementation.

- “Study Area” indicates the spatial extension that will be mapped.
- “Elementary zoning” indicates the set of elementary units that will be studied. The associated map (see the thumb index: “[Study area and elementary zoning](#)”) allows the user to follow his choices: the selected area is mapped when the chosen elementary zoning is drawn.

*Figure 1: Different combination between “Study area” and “Elementary zoning”*



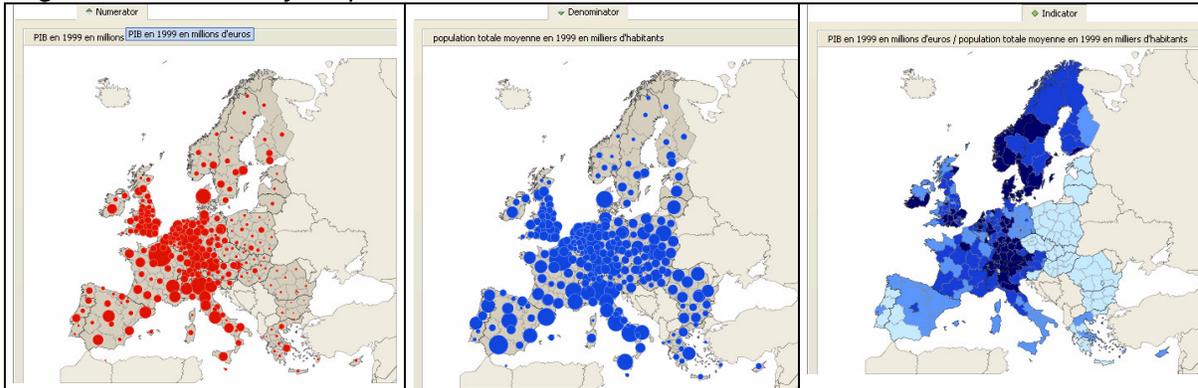
### ◆ the indexes

HyperAtlas only works with size variables (that is only variables that may be aggregate at upper level by sum) .and proposes a multiscalar cartography of the ratio of two size variables In order to define the studied ratio, the user may combine every couple of these types of variables, in the window “ratio”, by choosing each of them in the two popup list.



Three maps are linked respectively to these three choices. Two representations with proportional circles for the size variables, and the third one shows units colored according to the ratio value (see fig2). Precisely, the color is the one associated to the ratio class. Number of classes and associated color (pallet) can be configured in Option tab.

Figure 2 : Elementary maps : from size variables to the ratio



### □ The contexts for deviation mapping

As it has been already described in section 2, the user has to define here the three territorial contexts corresponding to three different levels of spatial observation: **global**, **medium** and **local**.

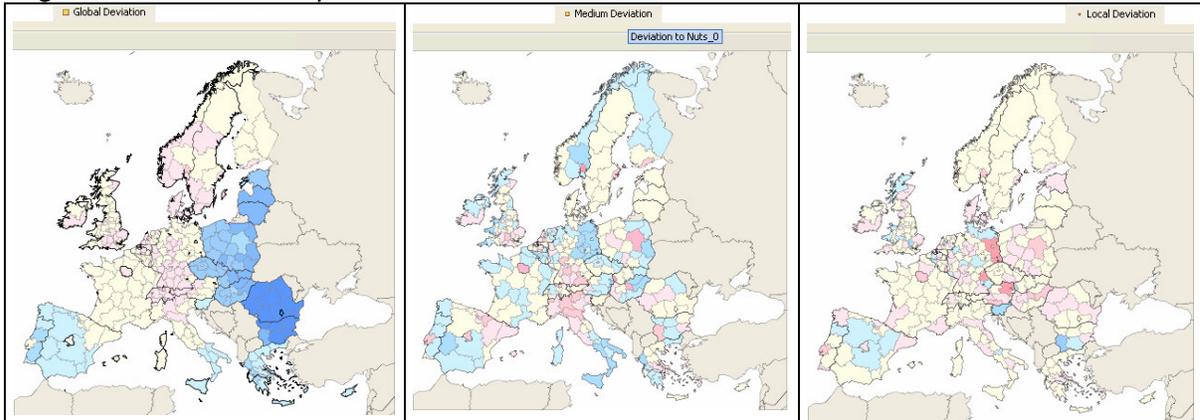
The screenshot shows a window titled 'Contexts for the deviations'. It contains three rows of controls:
 

- Global:** A dropdown menu set to 'UE15', a text input field containing '21,4', and an 'OK' button.
- Medium:** A dropdown menu set to 'Nuts\_0'.
- Local:** A dropdown menu set to 'Contiguity'.

- The **global context** may be the whole “study area” chosen. In this case the associated map will be the same as the map associated to the ratio itself. So the user may choose another global context or a reference value. For instance, in the example of the EU, even if the study area is the 29 potential countries, it may be of interest to observed the spatial differentiations according to an another global reference, for instance the global value associated to EU15. For this level, the user may also exogenously enter a value. At first this value is initialised with the global area’s value.
- The **medium context**, on the other hand, has to be a geographical zoning that is an aggregation of the “*elementary zoning*” previously chosen.
- The **local context** indicates which proximity relation will be the basis of the neighbourhood’s definition for each elementary unit. That is usually “contiguity”, but it may be also relation based on distances since they have been introduced in the HYP file (units that are at distance less than X km), or time-distances. Then, each elementary unit’s value will be compared to its neighbourhood’s value.

Another three maps are linked to these choices (figure 3). The values of the deviations are transformed into global indexes 100. Thus values may be interpreted in terms of percentage of the reference value. The maps are drawn with double progression frame, centred on 100, in order to highlight the regions that are under their reference value (100) and the ones that have upper values.

Figure 3: Multiscalar representation: deviations to three contexts



 **The synthesis map**

The three relative positions may be summarized in one synthetic map. The *elementary units* are classified in 8 classes according to their three relative positions. Close to the map, on the thumb index “options”, the user has to specify which point of view he wants to favour, in order to reduce the whole combinatory of possible cases. First one should indicate whether the point of view is to underline the regions whose ratio is greater than one or more contextual values, or less than them, according to the studied indicator (see the boxed text). Then, one can choose the value that will be the threshold.

Legend	Options	Explanation
<p>Threshold value must be higher than 100% when criterion is 'Higher than'. It must be lower than 100% when selecting 'Lower than'.</p>		
Criterion:	Higher than ▼	
Threshold Value:	100 %	
OK		

The map (figure 4) illustrates then 8 different configurations of relative position according to the three contexts and the chosen previous parameters. The legend gives for each class the description of these contextual positions. The last class (white) gathered all the regions that are not concerned by the chosen comparative criterion for any contexts.

When “Histogram” is on (see section 4), it is possible when clicking on one region, to edit a histogram (figure 5) representing the three contextual deviations.

Figure 4: a multiscalar synthesis.

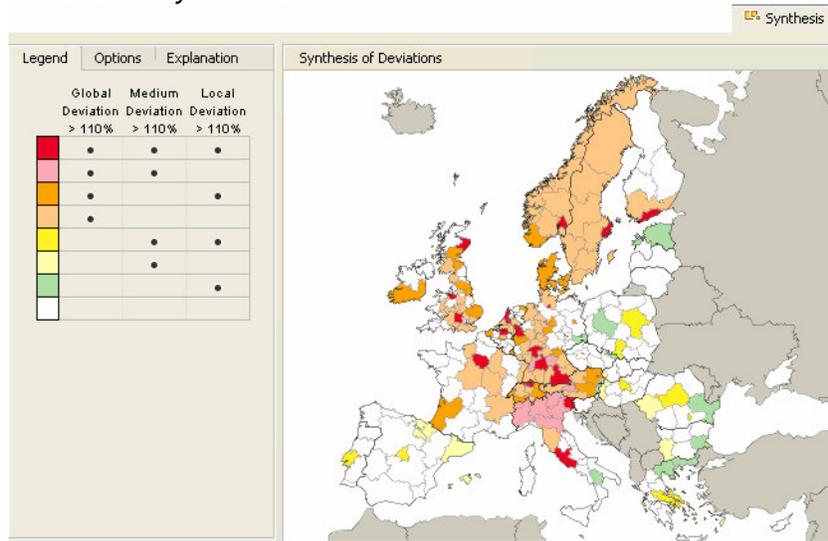
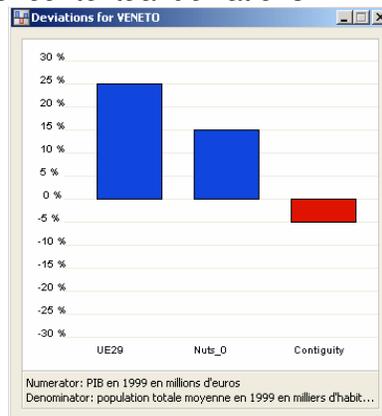


figure 5: another summary of contextual deviations:

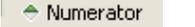
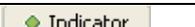
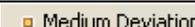


**Multiscalar typologies of regions for political decisions: the example of the European level**

When the policymakers want to build political scenarios or to evaluate propositions of structural funds, they need to have a synthetic view on the situations of regions according to the various territorial contexts which can modify the situation of a given region. The question of *perequation* (transfer from “advanced” to “lagging” region) is very sensible and it is important to propose a complete view of the scales where those *perequation* processes can take place, according to the principle of subsidiary. As an example, we analyse how the picture of “lagging” regions is modified when the previous criterion of Objective 1 (less than 75% of the mean value of GDP) is applied simultaneously at three scales (European, national, local). Simultaneously, it is possible to propose a typology of “advanced regions” based on the symmetric criteria of more than 133% of the mean value of GDP at those three scales. According to this methodology, it is possible to demonstrate that very few regions are “lagging at all scales” and “advanced at all scales”. Many are in more complex situations like certain regions of Switzerland or Norway which are “advanced” at European scale but “lagging” at their national or local scales. Reversely, the metropolitan regions of candidate countries are very often “lagging at European scale” but “advanced at national and local scales”.

## 6) Tools to work with the maps

### ➤ Summary of the different maps.

<b>Thumb index</b>	<b>Maps</b>
 Area and zoning	This map visualises the <a href="#">study area and elementary zoning</a> chosen.
 Numerator	This map shows for each unit of the elementary zoning, the value of the indicator chosen for the numerator.
 Denominator	This map shows for each unit of the elementary zoning, the value of the indicator chosen for the denominator.
 Indicator	This map shows the distribution of the ratio (numerator/denominator) over the units of the elementary zoning.
 Global Deviation	This map proposes a relative perspective of the distribution of the ratio (numerator/denominator) over the units of the elementary zoning: each absolute measure is put in relation with a reference value. Here the reference value is common for the whole area. The index value is 100 when an elementary unit has exactly the same value than the reference value or area. It is 200 when the elementary unit measure is twice the reference one, it is 50 when this is half the reference area.
 Medium Deviation	This map proposes a relative perspective of the distribution of the ratio (numerator/denominator) over the units of the elementary zoning: each absolute measure is put in relation with the value of its upper unit in the reference zoning. The index value is 100 when an elementary unit has exactly the same value than its reference unit. It is 200 when the elementary unit measure is twice the reference one's, it is 50 when this is half the reference unit.
 Local Deviation	This map proposes a relative perspective of the distribution of the ratio (numerator/denominator) over the units of the elementary zoning: each absolute measure is put in relation with the value of its neighbourhood, as defined by the local reference. The index value is 100 when an elementary unit has exactly the same value than its neighbourhood. It is 200 when the elementary unit measure is twice its neighbourhood, it is 50 when this is half its neighbourhood.
 Synthesis	This map proposes a synthesis of the different perspectives due to the three different contexts. The synthesis is based on a deviation threshold, either by upper values or by lower value. This is to be chosen by the user, because it depends of the meaning of the ratio. For instance high values of unemployment rates point out different types of regions than high values of an indicator of resources. According to which regions have to be differentiated (lagging ones or winning ones), one has first to chose the point of view of the synthesis. Then, a typology of the regions that verify the condition at least for one context is realised.

### ➤ The different appearances and functions of the mouse cursor.



At any time, the position of the mouse cursor on the map gives information about the elementary unit that it points. The content of this information window depends on the map. It gives first the name of the unit, and the values associated to the selected unit.

*The information window:*

Details	
Unit	BOURGOGNE
Numerator	33 100
Denominator	1 610
Indicator	20,6
Deviation(s)	90% (index: 100 = Nuts_0)



Except for the synthesis map, a left click everywhere on the map changes the function of the cursor, to “Pan” if this option is on. (see section 4).



On the synthesis map, when the mouse cursor is a “hand”, it indicates that the histogram function is on. A right click on a specific region opens its histogram window (see section 5, figure 5)

### ➤ Legend, classes and explanation

Close to each map are three thumb indexes containing tools and help to change and understand the cartography: The choices are valid for the current map.

Legend	Options	Explanation																		
<table border="1"> <tr><td>248,0</td><td>(N)</td></tr> <tr><td>208,0</td><td>(2)</td></tr> <tr><td>175,0</td><td>(3)</td></tr> <tr><td>147,0</td><td>(4)</td></tr> <tr><td>123,0</td><td>(20)</td></tr> <tr><td>103,0</td><td>(42)</td></tr> <tr><td>86,0</td><td>(101)</td></tr> <tr><td>72,0</td><td>(76)</td></tr> <tr><td>60,2</td><td>(24)</td></tr> </table>	248,0	(N)	208,0	(2)	175,0	(3)	147,0	(4)	123,0	(20)	103,0	(42)	86,0	(101)	72,0	(76)	60,2	(24)	Paletts Color: Classes Number: 4 Progression: <input checked="" type="checkbox"/> Geometric <input type="checkbox"/> Arithmetical	This map proposes a relative perspective of the distribution of the ratio (numerator/denominator) over the units of the elementary zoning: each absolute measure is put in relation with a reference value. Here the reference value is common for the whole area. The index value is 100 when an elementary unit has exactly the same value than the reference value or area. It is 200 when the elementary unit measure is twice the reference one, it is 50 when this is half the reference area.
248,0	(N)																			
208,0	(2)																			
175,0	(3)																			
147,0	(4)																			
123,0	(20)																			
103,0	(42)																			
86,0	(101)																			
72,0	(76)																			
60,2	(24)																			

**Legend** : displays the bounds of the classes (left) and the count of each (right) and the colour associated.

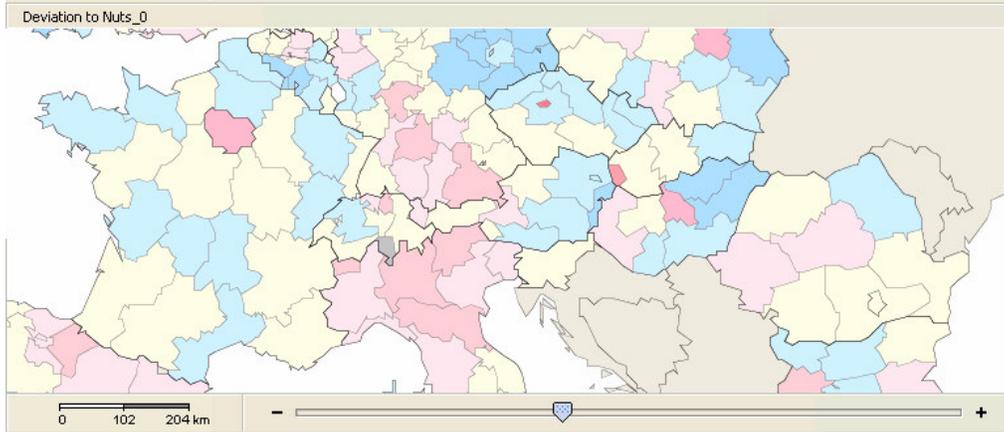
**Options**: gives three possibilities of changes appearance in the map. The choices are instantaneously taken into account.

- **palette colour**: allows first to choose between four defined pallet , and secondly to inverse the displayed progression.
- **Classes number**: allows the user to choose exactly the level of differentiation he wants, between 2 and 10 classes.
- **Type of progression**: the user can choose the progression of the successive bounds: either arithmetic (classes with equal amplitude) or geometric (classes with increasing amplitude); the default choice is geometric, because usually the distribution is not symmetric around the value 100. The first choice is appropriate when the distribution is symmetric around the value 100.

**Explanation:** gives some lines in order to help the reading of the chosen map.

➤ **Zoom**

It is possible at any time to zoom a map, either with the menu **view** or with the cursor at the bottom of the window. The scale bar follows the zoom in or out. Any change is applied to every maps.



**7) The report**

HyperAtlas proposes in the menu **File** to save the whole collection of maps for a given set of parameters and the table containing the rough data and the deviations. This report is stored as a set of web file in a directory that must already exist. The names of files are generic:

- "[index.html](#)", the file to be run to display the report. The maps in the report are saved at the current scale.
- "[map0.png](#)" to "[map7.png](#)" contains the seven maps.

The report reminds used parameters for analysis (see figure 6).

*Figure 6: Visualizing the results through the report.*

## Hypercarte Report

### Parameters

#### Space and Zoning

- Study Area: UE29
- Elementary Zoning: Nuts\_2

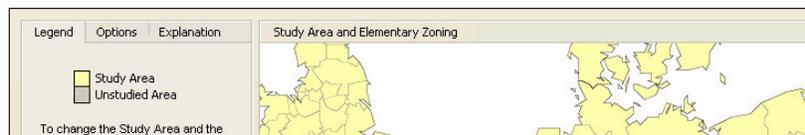
#### Indicator

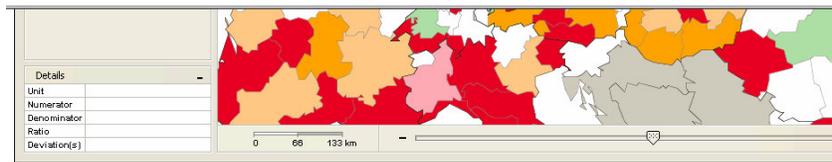
- Numerator: Average population of females in 1999 in thousands
- Denominator: Average population of males in 1999 in thousands

#### Contexts of Reference

- Global: UE25
- Medium: Nuts\_0
- Local: Contiguity

### Generated maps





**Table of generated results**

Code	Name	Numerator	Denominator	Indicator	Global Deviation	Medium Deviation	Lo Devi
		POPMP99E	POPMPH99E	POPMP99E/POPMPH99E	UE25	Nuts_0	Cont
UKL2	EAST WALES	542	527	1,03	98,0	99,8	
UKL1	WEST WALES AND THE VALLEYS	952	914	1,04	99,2	101,1	
SI	SLOVENIA	1017	970	1,05	99,8	100,0	
UKK4	DEVON	554	521	1,06	101,2	103,1	
UKK3	CORNWALL AND ISLES OF SCILLY	254	240	1,06	100,5	102,4	
UKK2	DORSET AND SOMERSET	610	575	1,06	100,9	102,8	
UKK1	GLOUCESTERSHIRE, WILTSHIRE AND NORTH SOMERSET	1100	1080	1,02	96,9	98,8	
DE73	KASSEL	650	619	1,05	100,0	100,3	
DE72	GIESSEN	540	521	1,04	98,7	98,9	
DE71	DARMSTADT	1892	1818	1,04	99,1	99,3	
FR26	BOURGOGNE	827	784	1,05	100,4	99,6	
FR25	BASSE-NORMANDIE	731	693	1,05	100,4	99,6	

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## Glossary

**Elementary unit** : the set of elementary units compose (cover) the whole area, and constitute the *elementary zoning*\*.

**Elementary zoning** : smallest division of the studied area. Each unit of this zoning is called elementary unit.

**Study Area** : territorial space on which we will base the analysis. It can be Europe, Cameroun, or France only by example. Just one study area can be loaded at once in the application.

**NUTS** : zoning nomenclature for Europe used to organize in a hierarchy with 5 levels all units.

NUTS\_0 groups administrative units at country level : France, Germany, Spain, Italy, etc.

NUTS\_1 groups administrative units at great region level : ILE DE FRANCE, BASSIN PARISIEN, EST, CENTRE-EST, etc.

NUTS\_2 groups administrative units at region level (*Région* in France - *Länder* in Germany - *Comunidades autonomas* in Spain, *regioni* in Italy) : ILE DE FRANCE, RHONE-ALPES, PACA, etc.

NUTS\_3 groups administrative units at departement level (*Département* in France - *Kreise* in Germany - *Provincias* in Spain, *Provincia* in Italy): Essone, Isère, Savoie, etc.

**Stock** : social-economic count, like number of deaths on 1999 year, number of births on 1999 year, total population in thousand on 1999 year. Stocks are normally valued on each elementary unit. There are also called indicator.

**Ratio** : ratio between two stocks defined on the same set of territorial units and selected among available stocks.

$$\text{ratio} = \text{stock1} / \text{stock2}$$

**Deviation** : is defined for each unit, relatively to a specified contex. It measures the deviation between the value of the unit and the average value of the contexte, expressed in % of the average value.

$$\text{deviation} = (\text{indicator})_{\text{unit}} / (\text{average})_{\text{context area}}$$

**Global deviation** : deviation when the context is the global area.

**Medium deviation** : deviation when the context is defined by a territorial unit belonging to a chosen higher zoning level containing the considered unit.

**Local deviation** : deviation when the context of an unit is defined by the set of units belonging to its neighbourhood (for instance adjacent units).

**Report** : XHTML document listing the set of parameters used for analysis (study area, zoning, context for deviation, indicators for numerator and denominator) and maps produced by the application.

**Workspace** : context of analysis, plus options selected in application when working on a study area : zoom level, map mode, etc. It can be exported in a XML sheet.