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Ronan Ysebaert, Christine Zanin, Nicolas Lambert, Jacques Michelet, Erik  
Gløersen, Sebastian Hans

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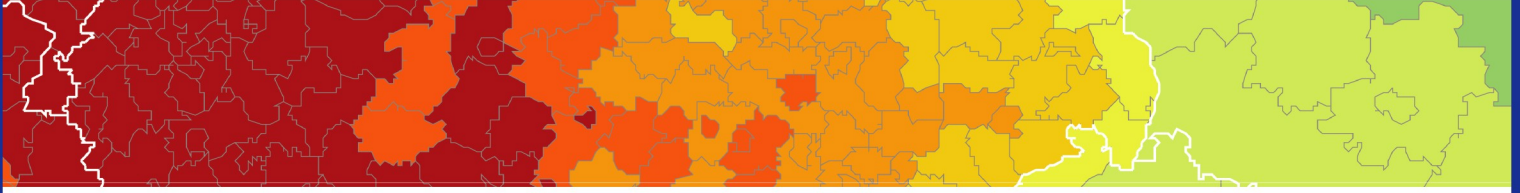
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**Inspire policy making by territorial evidence**



# ESPON 2020 MapKits

## Global Strategy for ESPON MapKits

### **Final Report**

Version 11/05/2017

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This delivery does not necessarily reflect the opinion of the members of the ESPON 2020 Monitoring Committee.

**Authors**

Ysebaert Ronan, UMS RIATE – University Paris Diderot (France)

Zanin Christine, UMS RIAT

Lambert Nicolas, UMS RIA

Michelet Jacques, Universi

Gloersen Erik, Spatial Fore

Hans Sebastian, Spatial Foresight (Luxembourg)

**Advisory Group**

ESPON EGTC: Martin Gauk, Marjan Van Herwijnen, Ilona Raugze (Director)

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Contact: [info@espon.eu](mailto:info@espon.eu)

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# ESPON 2020 MapKits

## Global Strategy for ESPON MapKits

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## Abbreviations

EBM	EuroBoundaryMap
EC	European Commission
ECL	ESPON Cartographic Language
EFTA	European Free Trade Association
ESPON	European Territorial Observatory Network
EU	European Union
FUA	Functional Urban Areas
FYROM	Former Yugoslav Republic of Macedonia
GADM	Global Administrative Areas
GDB	GeoDataBase
GEOSPECS	Geographical Specificities and Development Potential in Europe
GIS	Geographical Information System
GISCO	Geographical Information System for the Commission
GREAT	Generalised Representation for European Areas and Territories
ITAN	Integrated Territorial Analysis of the Neighbourhood
LAU	Local Administrative Units
LUZ	Large Urban Zone
NUTS	Nomenclature of Territorial Units for Statistics
M4D	Multi Dimensional Database Design and Development
NMCA	National Mapping Cadastral Agencies
OGC	Open Geospatial Consortium
OSGEO	Open Source Geospatial Consortium
PUSH	Potential Urban Strategic Horizons
SNUTS	Similar to NUTS
TeDi	Territorial Diversity
QGIS	Quantum Geographical Information System
UMZ	Urban Morphological Zone
WUTS	World Units Territorial System





## **Executive summary**

This guidance document aims at summarizing the global strategy followed by the ESPON 2020 MapKits project for creating the ESPON MapKits : (1) Enlarging mapping possibilities and support the growing availability of data in a European perspective. (2) Focus on uses and quality. (3) Promote the dissemination of open source information.

The last part (4) describes the data sources used to create the layers included in ESPON MapKits.

# 1 Enlarging mapping possibilities and support the growing availability of data in a European perspective

The ESPON Cartographic Language project (2013) analysed the map production in the previous ESPON Programme. It revealed that most of the maps produced by ESPON Projects displayed data at the NUTS2 or NUTS3 levels. This can be explained by the thematic scope of these projects, but also by lack of available data at more detailed levels (e.g. LAU2 units, cities, grid cells).

However, the European statistical landscape is changing. An increasing number of European datasets at the level of LAU2 units and cities are currently being produced. Previously, one mainly had the SIRE database 2008 (with census data for EU15 and EFTA countries from around 2000) and the DG REGIO mountain study database extended to non-mountainous countries as part of a dedicated ESPON 2006 project (covering EU27, Norway and Switzerland, with LAU2 from 1991 and 2001 associated to the 1997 SABE delineation)<sup>1</sup>. In recent years, a file with historical population figures 1961-2011 has been compiled by Spatial Foresight for DG REGIO<sup>2</sup> and Eurostat offers a 'census hub' which allows users to query national census data directly<sup>3</sup>. The number indicators available for cities under the Urban Audit has increased. A European survey on geocoding practices among National Statistical Institutes has been carried out<sup>4</sup> and the GEOSTAT 2011 population grid has been released<sup>5</sup>.

Consequently, the ESPON 2020 MapKits project has focused its activities to produce around 30 MapKits covering emerging needs of cartography in a European perspective. Firstly, by proposing a large set of geographical objects (NUTS, LAU, grids, neighbouring countries). Secondly, by developing, for several geographical contexts in a multiscalar perspective (Zooms, transnational cooperation areas, Europe, World).

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1 <http://database.espon.eu/db2/resource.jsessionid=c56c5d85707c77d06d71ad37c92d?idCat=42>

2 <http://ec.europa.eu/eurostat/web/nuts/local-administrative-units>

3 <https://ec.europa.eu/CensusHub2/query.do?step=selectHyperCube&qhc=false>

4 <http://www.efgs.info/wp-content/uploads/geostat/2/GEOSTAT2-Spatializing-statistics-in-the-ESS-2015-002.pdf>

5 [http://ec.europa.eu/eurostat/statistics-explained/index.php/Population\\_grids](http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_grids)

## 2 Focus on uses and quality

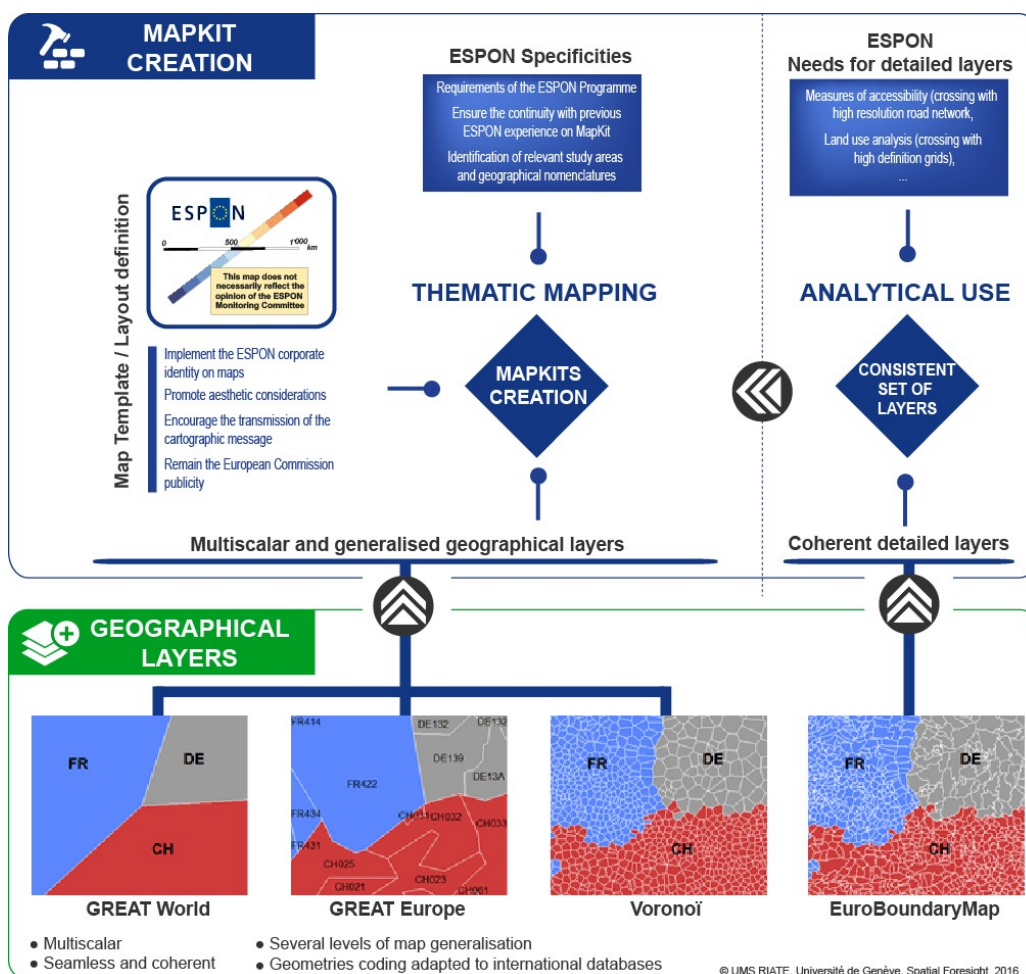
In the ESPON context, geographical layers are used for two purposes: mapping and analysis (Figure 2 -1 Erreur : source de la référence non trouvée). Criteria of quality and suitability (i.e. 'fit for purpose') of individual geographical layers may be different depending on considered uses:

- For analyses, the key criterion is **precision**. It is important to consider whether files that are combined in an 'analytical MapKit' are consistent, so that analyses based on their overlay produce reliable results;
- For mapping, the key criterion is **informational value**. The objective is to make it possible to convey the cartographic message to the recipients of each map in an efficient way. This implies that 'noise' (e.g. unnecessarily detailed boundaries) must be eliminated. The focus should be on generating geographical shapes that are easily recognisable. For this purpose, you need to consider the spatial extent of each map (e.g. Europe, a transnational cooperation area), the size of geographical units to be represented (e.g. NUTS 3 regions, LAU units) and the format of the final product (e.g. A4 paper, Powerpoint presentation, computer screen).

Whatever the purpose of the geographical layers, some additional criteria must be considered to ensure an operational use of these layers within the ESPON 2020 Programme:

- Geographical layers must be **correct**: whatever the degree of map generalisation followed, the geographical position of territorial units (points, lines or polygons) displayed on maps should be carefully checked.
- Whatever the geographical area, geographical layers included in ESPON 2020 MapKits should be **complete**: it must include all the statistical units included in the main database of reference at European and international levels (Eurostat, United Nation), in a multiscalar perspective (from LAU2 to World level).
- The **coding systems** of geographical layers must **be consistent with official nomenclatures** to ensure a perfect match with statistical information provided by European and international data providers.
- The **topology must be carefully checked** to avoid geometric inconsistencies when aggregating territorial units, for instance (e.g. NUTS3 into NUTS2 units).
- Efficient solutions must be found to manage **multi-part objects**, such as territorial units that include islands and exclaves.

Figure 2-1: The inputs material used in ESPON MapKits



This ESPON 2020 MapKits project aims to **provide the ESPON Community with structured and coherent sets of geographical layers for thematic mapping and analytical use**. Depending on the purpose of the cartographic need, the ESPON Mapkits are based on four different sets of geographical layers:

**[1] GREAT World:** a world-wide layer of countries and territories with a high degree of generalisation, produced by UMS RIATE.

**[2] GREAT Europe:** pan-European layers of regions, countries and territories produced by UMS RIATE, which provides suited and seamless layers for thematic mapping from NUTS3 to NUTS0 levels and referencing all the NUTS version required by the tender (2006, 2010, 2013).

**[3] Voronoi Map:** pan-European (41 (32 only at LAU2 level...) countries + micro States) layers of LAU units, regional and national units produced by the University of Geneva.

**[4] The ESPON LAU2 Census 2011 Map** is a pan-European (32 countries) collection of layers representing LAU units, regional and national units compiled and processed by ESPON 2020

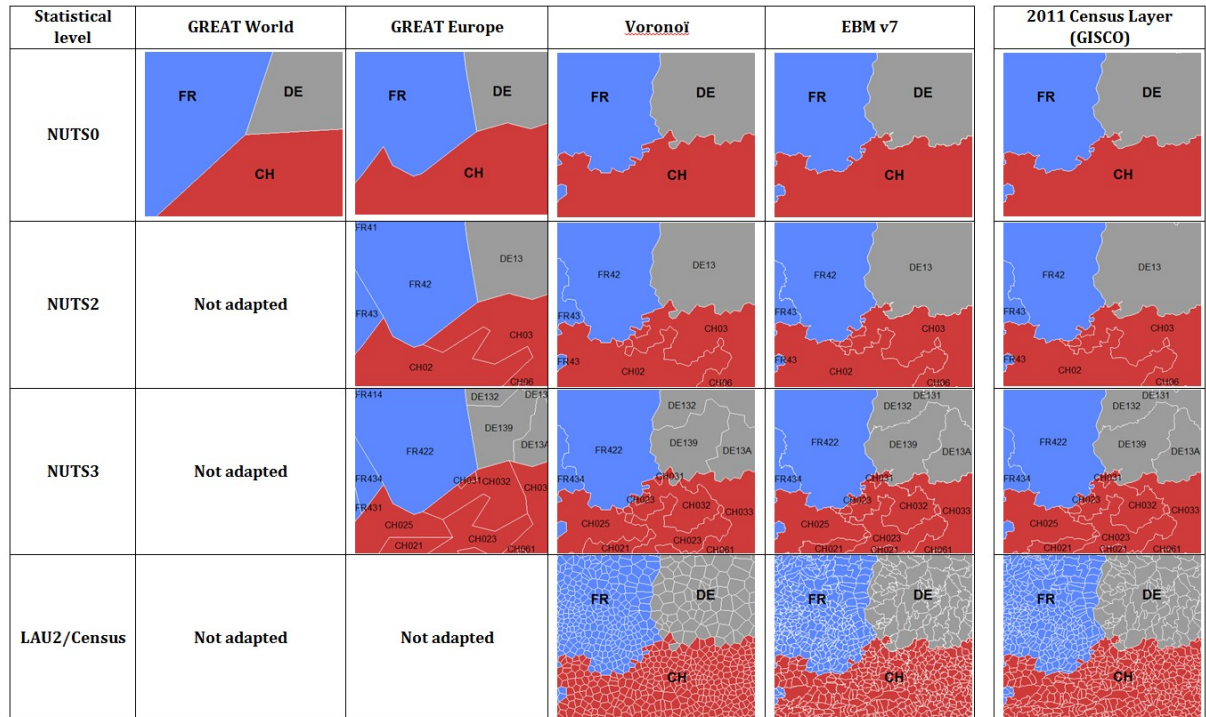
EuroGeographics based on inputs from National Mapping and Cadastral Agencies (NMCAs), with a resolution corresponding to a scale of 1:100 000 and that include the codes used in 2011 census data in the attribute data. Eurogeographics points out that these layers “have been compiled from official source data provided by Europe's NMCAs with the best available semantic quality and positional accuracy”. These data are disseminated under a commercial license; however, files from Eurogeographics will be available to ESPON 2020 project groups and to the ESPON EGTC. Users having gained access to these maps as part of their involvement in the ESPON programme may therefore not use them for other purposes.

**[5] The 2001 LAU Census Map:** a pan-European layer of LAU Units making it possible to map 2001 census data, to be provided by the ESPON EGTC.

Figure 2 -2 compares geographical layers [1], [2], [3] and [4], as well as the 1:1,000,000 map of 2011 census units available for download from the Eurostat website. Mapping different administrative units (LAU2, NUTS3, NUTS2 and NUTS0) with these different layers in the border area between Germany, France and Switzerland makes it possible to identify possible uses for each of them:

- First, one can observe that the 1:1,000,000 map of 2011 census units is only marginally more generalised than EBM v.7 of which the resolution corresponds to a scale of 1:100,000. This implies that while the ESPON LAU2 Census 2011 Map is best suited for analytical purposes, being “*as detailed as possible*”, the 1:1,000,000 map of 2011 census units is not a good option for representation. By comparison, the Voronoï map offers a much clearer and easy to read representation of LAU2 units.
- Second, for representations of NUTS3 and NUTS2 regions, the Voronoï and GREAT Europe are complementary: the former would be suited for narrow scale MapKits (e.g. transnational and macro-regional areas), while the latter would function well for European MapKits. Third, the GREAT Europe map is adapted for European regional maps (NUTS0-1-2-3) for wider geographical extents (all ESPON Area); while, the GREAT World map functions for global maps of countries and territories. It is obvious that high generalised geographical layers (such as GREAT World) are not suitable to display regional and territorial units on maps.

Figure 2-2: Comparison of the four set of geographical layers according to the geographical level of analysis in the cross-border area Switzerland-Germany-France

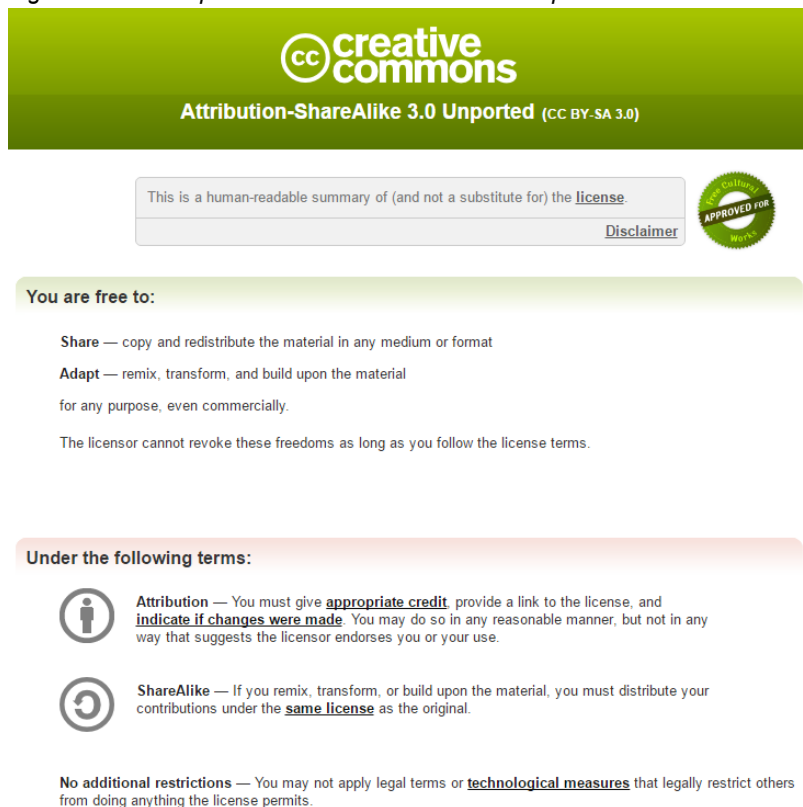


### 3 Promote the dissemination of open source information

Open data is a World level movement to meet growing needs for data among economic, academic and cultural players. Within this framework, open access to public data is part of the digital agenda of the European Commission. In 2011, the Commission invited European Institutions to “*create the right framework conditions for the re-use of public sector information across the European Union, and to support the projects and infrastructures that can turn Europe’s public data into a motor for innovation, growth and transparency*”. Following these recommendations, ESPON supports Open Data creation, namely in the context of the ESPON MapKits.

In concrete terms, it means that the **GREAT and the Voronoï layers [1], [2] and [3] are available under Creative Commons license BY-SA**. These layers can be freely downloaded from UMS RIATE and ESPON Websites and can be disseminated and reused for research, teaching or commercial activities following a limited number of conditions.

Figure 3-3: The inputs material used in ESPON MapKits



source: <https://creativecommons.org/licenses/by-sa/3.0/>

Nevertheless, it’s important to distinguish between geometries and the ESPON layout: the **ESPON layout remains the exclusive property of the ESPON EGTC. It must only be used in the context of the ESPON programme.**

## 4 Data sources of ESPON layers

This part summarizes the generation process of the geographical layers included in the ESPON MapKits. All the input layers used in ESPON MapKits are located in the input folder of the ESPON 2020 MapKit delivery. An important attention has been paid to the quality of these layers (validity with the official territorial nomenclatures, topology).

### 4.1 Central layers used for display statistical phenomenon on maps

#### World level [GREAT World]

GREAT World layer, developed by UMS RIATE. 209 Territorial objects covering all the UN Member States (193 territorial units). This layer is available under Creative Commons license on UMS RIATE Website.

As regard to the country 2014 layer available on Eurostat Website<sup>6</sup> (256 territorial units), 47 territorial units are excluded of the layer made available in the country layer. These territorial units are excluded of considering their respective area and/or population, which is considered too small to be displayed in a Global Mapkit. As a reminder, the WUTS hierarchical classification developed by the ESPON 3.4.1 project (2006) *is constituted by 168 countries, which represent a minimum of 1/10 000 of the population, GDP or area of the World* (ESPON 3.4.1).

Taking also into account the availability of socio-economic data on World databases and cartographic issues (this layer is adapted for cartographic purposes, not adapted to too much detailed territories). Below are listed the territories excluded from the layer by category (FAO listing). These territories represent less than 0,2 % of the World in term of population and/or land area.

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<sup>6</sup><http://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/countries#countries14>  
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Figure 4-4: World territories out of the nomenclature included in the Global MapKit and their respective weight in term of area and population

ISO2	Name	Area (sq.km)	Pop (thousands inh.)	Comment	Type (FAO)
CC	Territory of Cocos (Keeling) Islands	14	0,628		AU Territory
CX	Christmas Island Territory	135	2,071		AU Territory
HM	Territory of Heard Island and McDonald Islands	372	0		AU Territory
NF	Territory of Norfolk Island	34,6	2,302		AU Territory
BL	Collectivity of Saint Barthélemy	24	9,131		FR Territory
CP	Clipperton Island	1,7	0		FR Territory
PF	Territory of French Polynesia	4 167	274	67 populated islands	FR Territory
PM	Territorial Collectivity of Saint Pierre and Miquelon	24	6,279		FR Territory
				Crozet, Kerguelen, Saint Paul and Nouvelle-Amsterdam	
TF	French Southern and Antarctic Lands	7633	0,14		FR Territory
WF	Territory of the Wallis and Futuna Islands	140	12,197	2 islands	FR Territory
XO	Fr Territory (Juan De Nova, Glorioso, Europa, Tromelin, Bassas Da India)	40,6	0		FR Territory
AW	Aruba	18	103,441		NL Self-Governing Territory
AN	Netherlands Antilles	960	193,459		NL Territory
BV	Bouvet Island	49	0		NO Territory
TK	Tokelau	10,2	1,223		NZ Non-Self-Governing Territory
CK	Cook Islands	24	20,725		NZ Territory
NU	Republic of Niue	26	1,61		NZ Territory
AI	Anguilla	9	14,46		UK Non-Self-Governing Territory
BM	Bermuda	5	62,376		UK Non-Self-Governing Territory
GI	Gibraltar	1	31,997		UK Non-Self-Governing Territory
KY	Cayman Islands	26,4	59,172		UK Non-Self-Governing Territory
MS	Montserrat	10	5,094		UK Non-Self-Governing Territory
PN	Pitcairn Islands	5	0,067		UK Non-Self-Governing Territory
SH	Saint Helena, Ascension and Tristan da Cunha	39	3,987		UK Non-Self-Governing Territory
TC	Turks and Caicos Islands	95	33,74		UK Non-Self-Governing Territory
VG	British Virgin Islands	15	29,585		UK Non-Self-Governing Territory
GS	South Georgia and the South Sandwich Islands	3 903	0,026		UK Territory
IO	British Indian Ocean Territory	60	4		UK Territory
AS	Territory of American Samoa	20	55,434		US Non-Self-Governing Territory
GU	Territory of Guam	54	167,543		US Non-Self-Governing Territory
VI	Virgin Islands of the United States	35	106,208		US Non-Self-Governing Territory
MP	Commonwealth of the Northern Mariana Islands	46	54,541		US Territory
UM	United States Minor Outlying Islands				US Territory
XL	Navassa Island (Disputed Territory)	5,2	0		US Territory
	<b>Total world</b>	<b>13 206 554</b>	<b>7 230 046</b>		
	<b>Share of these territories in the World, %</b>	<b>0,14</b>	<b>0,02</b>		

## European regional level [GREAT]

GREAT layers, developed by UMS RIATE. These layers have been generated manually for cartographic purpose for the ESPON Area.

In the mapkits, these layers are available for the 2006, 2010 and 2013 versions (levels 0-1-2-3). UMS RIATE proposes also these layers in the NUTS versions 1980, 1988, 1995, 1999 and 2003). The cartographic process to create these layers starts from official layers provided by the European Commission (<http://ec.europa.eu/eurostat/fr/web/gisco/geodata/reference-data/administrative-units-statistical-units>)

These layers fit with several reference document (official NUTS nomenclatures provided by the European Commission, nomenclatures for Candidate Countries and EFTA countries). The data sources used for the codification of the layers are available in the folder metadata of the ESPON 2020 MapKits delivery (nuts2006\_names.xls ; nuts2010\_names.xls and nuts2013\_names.xls) This layer is available under Creative Commons license on UMS RIATE Website.

## **European local level [Voronoi]**

Voronoi layer is developed by the University of Geneva. Inner centroids have been generated from the analytical layers polygons (ESPON LAU2 Census 2011), conserving their attributes (Unit code, shape area). Source : <http://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/census#censuscentroids11>

Voronoi polygons have been generated afterwards. Resulting layer has been clipped with the coastline. The coastline has been initially extracted from the GADM [<http://gadm.org/>] and then simplified so as to shape the contour of the continent and islands. Some LAU2 islands not available in the GADM have been manually added. The Voronoi is clipped again with the lake layer from EEA. Only lakes of >250km<sup>2</sup> are represented. The lakes have been simplified from the EEA layer. (<http://www.eea.europa.eu/data-and-maps/data/wise-large-rivers-and-large-lakes>)

NUTS0 borders originate from the NaturalEarth 50m (<http://www.naturalearthdata.com/>). They have been manually adjusted so that they allow both: following the LAU centroid structure of countries, while preserving the original degree of generalization.

In order to ensure best geographical coherence for coasts and national borders (= contiguity to an object that is easily identifiable), manual adjustment has been carried on so far as possible.

For regions with large, oblong or oddly shaped municipalities (Iceland, French Guyana), manual adjustment was made so as to ensure minimum congruence between the Voronoi layer and the original geometry in order not to confuse the cartographic message

Finally, LAU are aggregated into NUTS so as to check whether the Voronoi processing has not artificially created enclaves/exclaves. This layer fits with the EU 2011 Census data.

This layer is licensed under Creative Commons license. It can be downloaded from the UMSRIATE Website or requested by sending a message to the following address: [lau2-europe@unige.ch](mailto:lau2-europe@unige.ch)

## ***ESPON LAU2 Census 2011***

This mapping file is an adapted version of the 1:100,000 version of the Eurostat map of LAU2 units that is supposed to use the same nomenclature and codes as in the 2011 census data. This shapefile was first adapted from EuroBoundaryMap versions 6.0 and 6.2 by GISCO<sup>7</sup>. In order to make this modified file fully compatible with census data, the ESPON MapKit project

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<sup>7</sup> For further information, see: <http://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/census#censusunits11>  
ESPON 2020

then made some manual adjustments to this map when this was possible (e.g. merging units in BG, splitting parishes that crossed NUTS borders in the UK), and used elements from EuroBoundaryMap v6 and v10 in other cases (e.g. Danish municipalities). This implies that the LAU layer for analytical purposes does not match for all countries covered a particular version of the EBM.

Users accessing this mapping file as part of their involvement in the ESPON programme may not use it for any other purpose.

### **Similar to NUTS layers (SNUTS)**

This layer has been created by UMS RIATE and GIS-CIST within the framework of the ESPON M4D and ESPON ITAN projects. Starting for several sources (national sources, Wikipedia), a similar to NUTS layer has been developed for cartographic purpose in a way to be comparable as much as possible with the European NUTS nomenclature, following the principles of the NUTS classification.

(<http://ec.europa.eu/eurostat/web/nuts/principles-and-characteristics>)

The layer has been double-checked within the ITAN project by national experts. This layer is available under Creative Commons license on UMS RIATE Website.

### **Zoom-Out layer (US, Canada, Mexico)**

The Zoom-out layer has been developed by UMS RIATE. The input data source used is Natural Earth (<http://www.naturalearthdata.com/downloads/10m-cultural-vectors/>), Admin 1 layer. It has been afterwards generalised and clipped with physical layer (lakes). The codification system used is based on the OECD territorial nomenclature (<http://stats.oecd.org/Index.aspx>).

This layer is available under Creative Commons license.

### **Seas**

The Sea layer has been produced within the ESPON EsaTDOR project ([https://www.espon.eu/main/Menu\\_Projects/Menu\\_ESPON2013Projects/Menu\\_AppliedResearch/ESaTDOR.html](https://www.espon.eu/main/Menu_Projects/Menu_ESPON2013Projects/Menu_AppliedResearch/ESaTDOR.html)). This layer is the property of the ESPON Programme.

**UMZ (point location)** layer corresponds to Urban Morphological Zones. It has been created within the ESPON M4D Project and Géographie-cités starting from Corine Land Cover data and provides the geographical location of urban objects populated by more than

10 000 inhabitants over Europe. The technical report "UMZ: a database now operational for urban studies" describes the methodology followed for developing this urban nomenclature (<http://database.espon.eu/db2/resource?idCat=31>)

This layer is the property of Géographie-cités and the ESPON Programme.

**CITIES NEIGHB (point location)** layer corresponds to urban objects location in the European neighbourhood. It has been developed within the ESPON M4D Project and Géographie cités starting from national definitions. The technical report "European Neighbouring Cities" describes the methodology followed for developing this layer (<http://database.espon.eu/db2/resource?idCat=31>)

This layer is the property of Géographie-cités and the ESPON Programme.

## 4.2 Additional layers available in the MapKits calculated from the central layers

**Layers "Frames"** are generated by a R program taking into entry the bounding box parameters and the map projection used in the template.

**Layers "Scales"** are generated by a R program in order to be adjusted to the ESPON Map template (bottom right).

**Layer FUA (LUZ) (polygons)** is aggregated from the Voronoï layer (LAU2 attributes), following the DG REGIO Classification (<https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp>)

**FUA (LUZ) (point location)** corresponds to the barycentres of the FUAs polygons created above. The location of some points has been adjusted manually to fit with the coastlines. Two additional fields have been added to this layer, corresponding to the urban nomenclatures used within the ESPON SGPTD project ([https://www.espon.eu/main/Menu\\_Projects/Menu\\_ESPON2013Projects/Menu\\_AppliedResearch/SGPTD.html](https://www.espon.eu/main/Menu_Projects/Menu_ESPON2013Projects/Menu_AppliedResearch/SGPTD.html)) and ESPON City Bench Tool ([https://www.espon.eu/main/Menu\\_ToolsandMaps/CityBench/](https://www.espon.eu/main/Menu_ToolsandMaps/CityBench/)). By default, this layer is not displayed in ESPON MapKits.

**NUTS (regional layer)** NUTS layers (Voronoi layer) are aggregated using LAU2 attributes.

**Coastlines layers** are generated by an R program starting from GREAT and Voronoï layers.

**Country layers** are generated by a R program starting from the GREAT World precise layer.

**Capital layer** has been created following United Nations resource (<http://unstats.un.org/unsd/geoinfo/geonames/>). It has been adjusted manually to be coherent with the GREAT regional layer (meaning no points located in the sea).