The Alps 2050 Atlas ALPS 2050

Tobias Chilla, Anna Heugel, Thomas Streifeneder, Elisa Ravazzoli, Peter Laner, Ulrike Tappeiner, Francesca Teston, Lukas Egarter, Thomas Dax, Ingrid Machold, et al.

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The Alps 2050 Atlas ALPS 2050 COMMON SPATIAL PERSPECTIVES FOR THE ALPINE AREA. TOWARDS A COMMON VISION Inspire Policy Making by Territorial Evidence

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Inspire Policy Making by Territorial Evidence

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.

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Abbreviations

AC	Alpine Convention
ALCOTRA	Alpes Latines Coopération Transfrontalière
ARGE ALP	Arbeitsgemeinschaft Alpenländer (ital. Comunità di Lavoro delle Regioni Alpine)
ARPAF	Alpine Region Preparatory Action Fund
ASP	Alpine Space Programme
CGET	Commissariat général à l'égalité des territoires (engl. General Commissariat for Territorial Equality)
CNM	Mountain National Council
DEGURBA	Degree of Urbanisation
EEA	European Environment Agency
EGTC	European Grouping Of Territorial Cooperation
EPO	European Patent Office
ESPON	European Territorial Observatory Netwrk
EU	European Union
EUSALP	EU Strategy for the Alpine Region
GDP	Gross Domestic Product
JRC	Joint Research Centre
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LAU	Local Administrative Unit
LEADER	Liaison Entre Actions de Développement de l'Économie Rurale (engl. Links between actions for the development of the rural economy)
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (engl. Statistical Classification of Economic Activities in the European Community)
NGO	Non Governmental Organisation
NUTS	Nomenclature des unités territoriales statistiques (engl. Nomenclature of Territorial Units for Statistics)
OECD	Organisation for Economic Co-operation and Development
OSM	OpenStreetMap
PPS	Power Purchasing Standard
PROFECY	Processes, Features and Cycles of Inner Peripheries in Europe
SCI	Special Conservation Interest
SGI	Services of General Interest
SPA	Special Protection Area
SRES	Special Report on Emissions Scenarios
TCP	Territorial Cooperation Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

1 Introduction

1.1 The Alps 2050 Atlas

This atlas is part of the ESPON project Alps 2050 that develops spatial visions and perspectives for the Alpine region towards the year 2050. The spatial perimeter goes beyond the Alps in the morphological sense (which is mostly congruent with the Alpine Convention perimeter) but also considers the Territorial Cooperation Programme Alpine Space and the Macro-regional strategy EUSALP.

The Atlas brings together the relevant maps from the project that show structures, patterns and trends that contextualise the spatial development. Firstly, this atlas serves analytical purposes and gives background information for the Alps 2050 main report, and secondly, provides general visualisation, orientation and inspiration.

Obviously, the selected set of maps cannot cover all relevant themes in a perfectly balanced way. The availability of meaningful data that covers the transnational area adequately on selected territorial levels is clearly a limiting factor. But still, we think that visualising the existing data helps to fuel the debate on territorial development in the Alps.

The main impressions from the Atlas can be summarised in the following bullet points:

- Territorial development in the Alpine Region is characterised by **diversity and complexity**. Comparing the different thematic maps reveals very different pictures: Sometimes underlining the relevance of the morphological context, sometimes stressing the contrast between urban and rural areas, sometimes revealing differences between North and South or East and West.

- The complexity underlines the postulate of **contingency**: spatial development is not necessarily determined by mountains and morphology, but spatial development is a political process open for political struggles, societal debates and democratic decisions.

- Aiming at tailor made territorial strategies means to carefully consider this complexity on the ground, considering **parallels and differences**. From a transnational perspective, the parallels can be perceived as common challenges that stand in the heart of macro-regional strategy implementation. At the same time, regional and national differences can be a potential for diversity, best developed on political levels of the European multi-level system in subsidiarity.

- The Alpine region certainly is a very dynamic region offering multiple **opportunities** for future development without focussing solely on growth dynamic.

For those who like to refer to cartographic reflections on the Alps, we should mention here two other interesting works that are presenting indicators for the Alpine Convention perimeter, namely the 'Alpine convention Vademecum' (Alpine Convention 2010[1]) and 'The Alps in 25 maps' publication (Alpine Convention 2018[2]).

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1   http://www.alpconv.org/en/publications/alpine/Documents/Vademecum_web.pdf
2   http://www.alpconv.org/en/publications/alpine/Documents/25maps.pdf

1.2 Spatial focus: Perimeters and topography

Spatial Focus Alps 2050

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☐ INTERREG Alpine Space
▨ EUSALP
☐ Alpine Convention

Territorial level: NUTS0 (2013)
Source: FAU & Eurac Research, Alps 2050, 2018
Origin of Data: European Commission, Alpine Space Programme, Eurac Research
EuroGeographics for the cities
University of Geneva for administrative boundaries
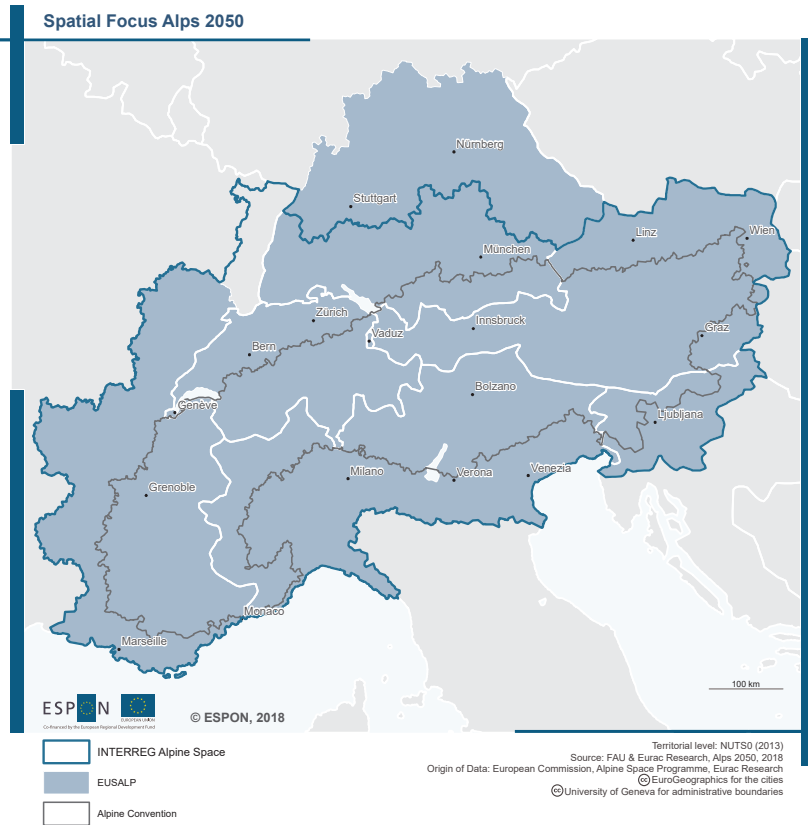
Map 1   Spatial focus and political perimeters of the Alps 2050 space

Altitude/Topography Index

© ESPON 2018

☐ INTERREG Alpine Space
☐ Alpine Convention
☐ EUSALP
■ high morphology following Altitude/Topography index by Swiss National Park

Territorial level: Grid / LAU 2 (2011) / NUTS 0
Source: FAU, Alps 2050, 2018
Origin of Data: Swiss National Park, 2018
EuroGeographics for the cities
University of Geneva for administrative boundaries
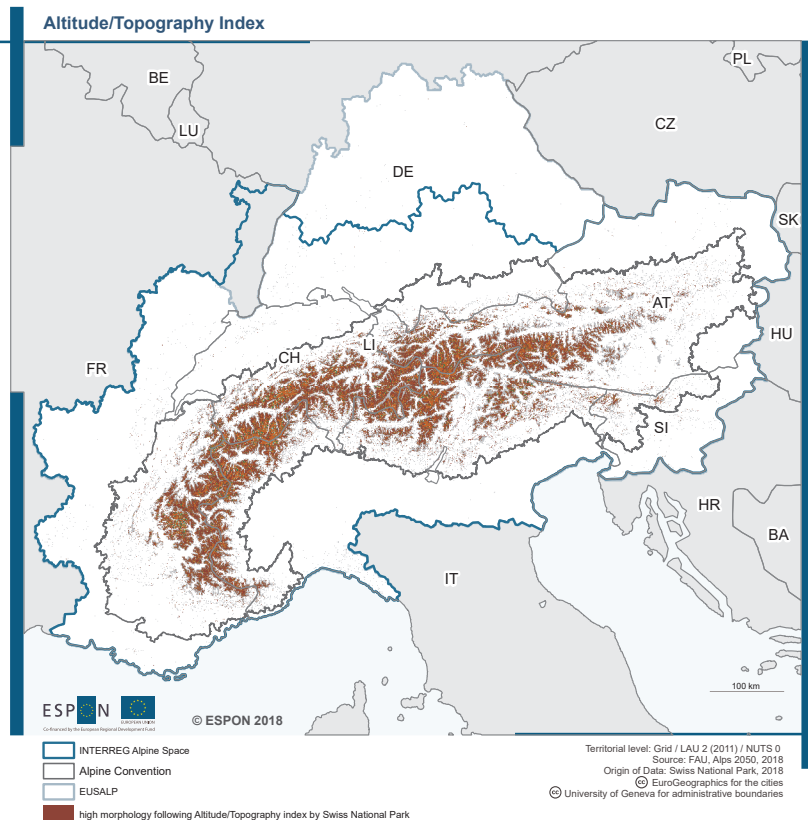
Map 2   The Alpine mountains in the Alps 2050 perimeter

The maps (Map 1 and Map 2) show the perimeters that are relevant for the Alps 2050 project, namely

- The **Alpine Convention** (AC, signed in 1991) whose perimeter has been aligned on municipal level based mainly on morphological arguments, i.e. that the perimeter marks the mountainous parts. In this report, this part will be named the inner-Alpine area.
- The **INTERREG Alpine Space** Programme started in 2000 and is now running in the fifth period 2014-20. Its perimeter goes far beyond the mountain area and also includes the surrounding metropoles and 'hinterland'.
- The **macro-region EUSALP** (launched only in 2016) is similar but not identical with the ASP space. The areas of the ASP and EUSALP perimeter that go beyond the Alpine Convention space will be named pre-Alpine areas in this report. Its delimitation is based on the regional level.

The perimeters are not trivial, in particular due to territorial reforms on the French side: Recent reforms have changed the political geography, and this will lead most probably to a larger territory in the Western EUSALP and Alpine Space. For the time being, the perimeter of the Alpine Space period 2014-20 (http://www.alpine-space.eu/about/the-programme/which-area-is-covered) and the EUSALP perimeter as defined in the official communication from the European Commission (COM 2015/366 final, p. 11) serve as the spatial focus of this ESPON project.

Moreover, Map 1 and Map 2 display the national borders of the states involved. The numerous national borders which can challenge a harmonious, cohesive and sustainable development.

2   Settlement system

Settlement system

Number of inhabitants per municipality (2010)

·	1 - 2.500	●	> 50.000 - 100.000
·	> 2.500 - 5.000	●	> 100.000 - 1.000.000
·	> 5.000 - 10.000	●	> 1.000.000 - 1.714.142
●	> 10.000 - 50.000		

Territorial level: LAU2 (2011)/NUTS0
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat & National Statistical Offices, 2013
ⓒ EuroGeographics for the cities
ⓒ University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
〜〜〜 Alpine Convention

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Map 3   Settlement system – Population size of municipalities

Indicator/Methodology: Map 3 shows the size of the municipalities in the year 2010. The number of inhabitants per community is assigned to one of the seven size categories, differentiated by size and colour of the symbols. – One has to stress that the administrative LAU area is not identical with physical settlement areas. The fact that municipality sizes are not harmonised has consequences for the interpretation of such maps: the larger the administrative municipality, the less exact is the impression of the settlement system: For example, the role of valleys is less visible and the impression of polycentricity can be misleading as dispersed settlements are part of just one formal municipality, as we can see in particular when comparing the French and Slovenian situation. In Slovenia the settlement pattern with around 6,000 settlements is much more dispersed than the map which shows municipalities illustrates. Moreover, the different mandates on the municipal level have to be considered – e.g. the "communauté de communes" in France or "Verwaltungsgemeinschaft" in Germany are very different forms of inter-municipal institutionalization.

Description: The settlement system of the Alps 2050 perimeter shows the following patterns and characteristics:

- Within the Alpine Convention perimeter, the size of municipalities tends to be much lower than beyond; and also the number of municipalities within a certain area tends to be lower in the mountainous area than in the pre-Alpine area.

- The map shows the importance of valleys for settlements, in particular the Inn valley (East of Innsbruck), the Rhine valley (North and South of Liechtenstein), the Isère valley (between Genève and Grenoble), the Sava and Soca valleys in Slovenia, the Po valley (from Milano eastwards) etc.

- The map illustrates the relevance of different political and administrative contexts: The average size of municipalities – for example – is clearly larger in Slovenia (96 km², 2018) than in France.

- The map clearly displays the importance of the Alpine morphology: the higher the mountains and narrower the valleys, the smaller the settlements.

Despite all the differences between national and regional contexts, there are obvious parallels in the settlement system – the relevance of the morphological structure in the inner Alpine area, and the agglomeration ring all around the mountainous area. As macro-regional strategies are about common challenges and opportunities, the settlement system could be an obvious issue. It might be meaningful to debate transnational instruments for the development of settlement systems that support synergies across borders.

Indicator/Methodology: Map 4 shows the typology of the Commission's Directorates-General for Regional and Urban Policy, Agriculture and Rural Development, Eurostat and the Joint Research Centre (JRC) together with the OECD (http://ec.europa.eu/eurostat/web/degree-of-urbanisation/methodology). The so called DEGURBA methodology classifies Local Administrative Units level (LAU or communes) based on a combination of criteria of geographical contiguity and minimum population threshold applied to 1 km² population grid cells that are aggregated on LAU-level. The classification is elaborated as follows:

- **Cities** (alternate name: densely populated areas): At least 50% of the population lives in urban centres (with a high population density).

- **Towns and suburbs** (alternate name: intermediate density areas): At least 50% of the population lives in urban clusters and less than 50% of the population lives in urban centres.

- **Rural areas** (alternate name: thinly populated areas): At least 50% of the population lives in rural grid cells.

Description: Also this map shows differences between the largely rural inner-Alpine areas and the much more urbanised pre-Alpine areas. However, the picture is less dichotomic than the settlement system in the map before. In particular, the rural character of many regions beyond the mountainous parts is very clearly visible (e.g. French and Bavarian parts). It gets also clear that the Alps 2050 perimeter comprises a ring of metropolises of European relevance, surrounding the mountainous area.

The map shows the importance of spatial reflections on a fine scale: It does make sense to argue on the LAU or NUTS 3 level and not to refer to NUTS 2 too often which is, however, often the case when debating European spatial patterns.

Urban and rural areas

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DEGURBA

- 🟥 cities
- 🟦 towns and suburbs
- 🟩 rural areas
- ⬜ no data

FUA

- ▒ FUA

Territorial level: LAU2 (2011)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat & National Statistical Offices, 2013
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
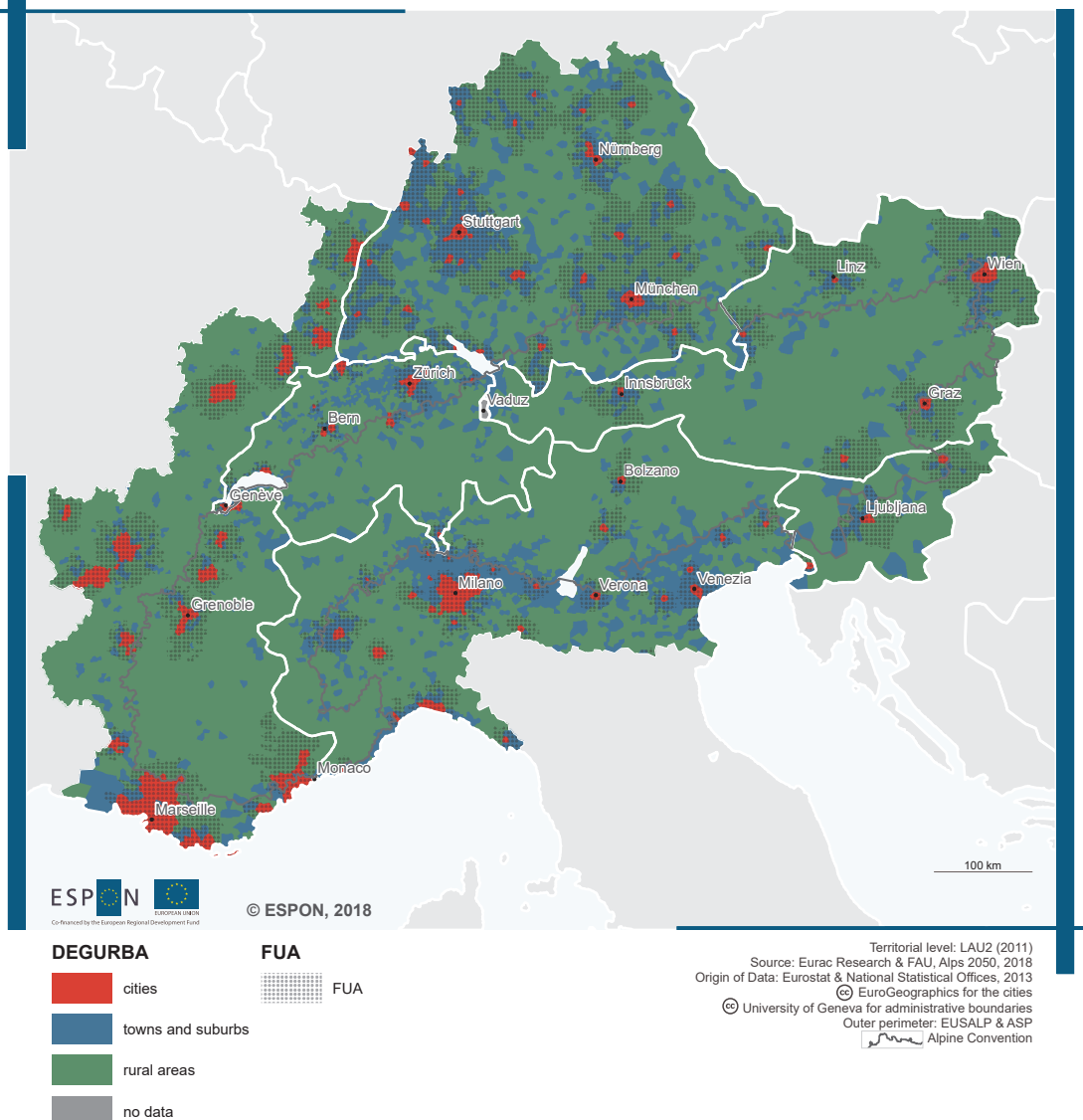
Map 4   Urban and rural areas following the DEGURBA approach

3 Services of General Interest

The analysis of the accessibility of Services of General Interest (SGI) were developed in the framework of the ESPON project PROFECY by TCP International and is described in detail in the PROFECY project report's annexes. PROFECY identified OpenStreetMap (OSM) as the major data source for locations of SGIs, partly amended by national data sources; the train stations were based on an internal project data base. The accessibility of SGIs was calculated as the car travel time from the centre of each grid cell (resolution 2.5 x 2.5 km) to the next facility, regardless if the grid area is inhabited or not. Depending on the SGI type, only facilities within the same country as the origin grid cell were considered as destinations (in case of public services such as schools and health care), or domestic facilities and facilities in the neighbouring country (in case of private services such as shops, cinemas and also for the train stations). Grid travel times were also aggregated to LAU level by averaging the travel times of all grid cells belonging to one LAU unit. The assignment of grid cells to LAU units was based upon the location of the centre of the grid cell.

In this methodology, the different size of municipalities matters. The larger the municipality, the more generalised is the cartographic picture that can hide small scale morphological contexts. The picture has to be relativised as very negative values often concern only few inhabitants. It makes sense to read this map in parallel to the population density map (Map 11) and the settlement system map (Map 3). Moreover, one might state that the Slovene situation might be better than indicated in the map, due to the relatively large size of the municipal territories.

Travel time to doctors by car
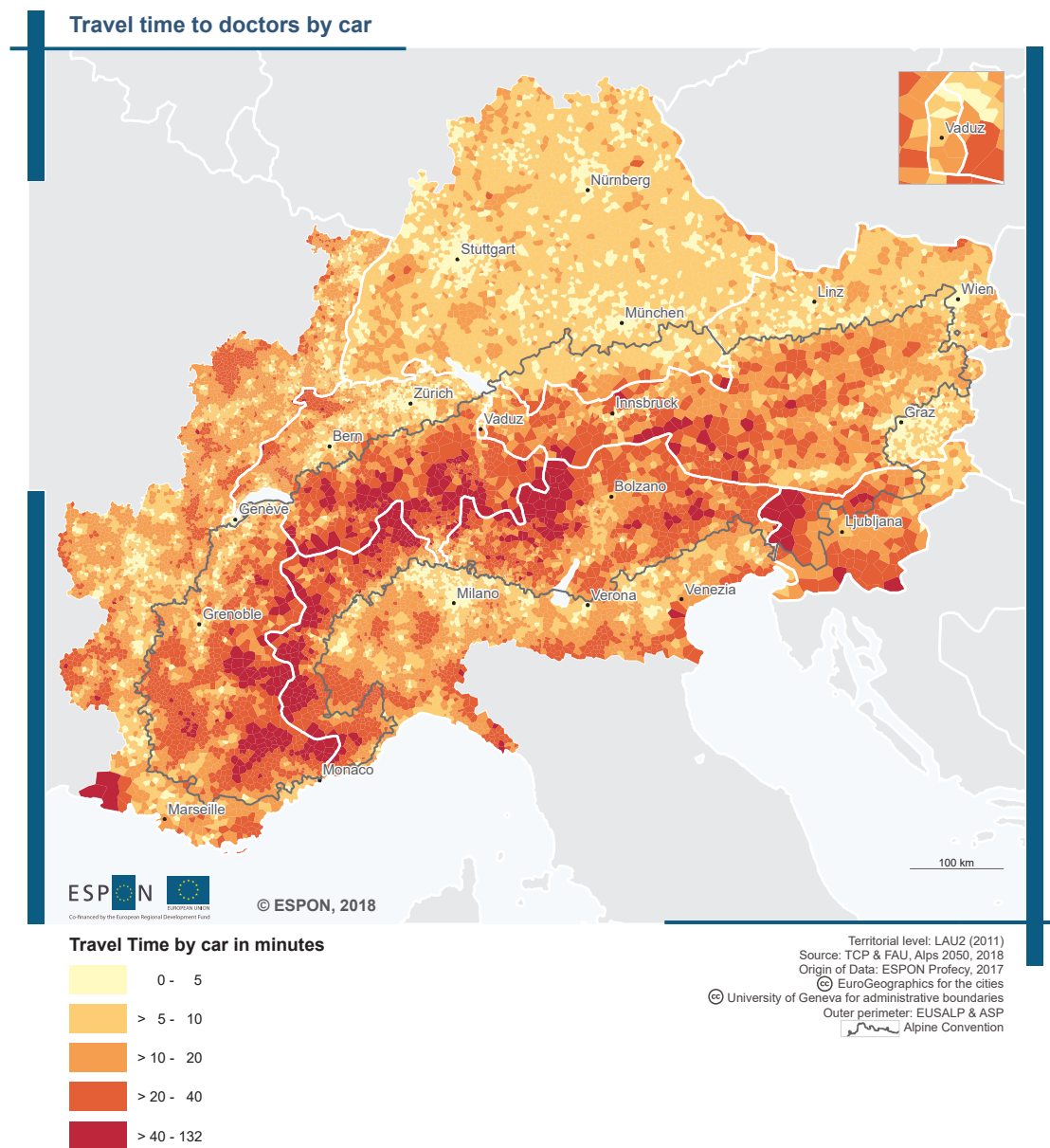
Map 5   Travel time to doctors by car

Indicator/Methodology: Map 5 is based on the calculation of travel time to general doctors by car. The darker the colour is, the more time it takes within the respective municipality to reach the next doctor. The calculation takes into account that the nearest doctor might be in a neighbouring municipality. The OSM data refer to the service facility "doctors" with the OSM type 2120.

Description: The overall picture very clearly shows the role of the morphology: The accessibility is much easier in pre-Alpine areas than in inner- Alpine areas. This can obviously be explained by a) the lower population density in mountainous areas that lead to a lower density of medical services and b) to the difficulties to ensure a good technical accessibility in mountainous areas, due to expensive and complex infrastructure issues (tunnels, natural risks etc.). This situation can be observed almost independent from national affiliation, with the exception of Slovenia where in consequence of the big municipality size the picture is not that differentiated. Longer distances caused by the bigger municipality size lead to higher values for the whole municipality.

Travel time to primary schools by car

Vaduz

Nürnberg

Stuttgart

Linz

Wien

München

Zürich

Vaduz

Innsbruck

Graz

Bern

Genève

Bolzano

Ljubljana

Grenoble

Milano

Verona

Venezia

Monaco

Marseille

100 km

© ESPON, 2018

Territorial level: LAU2 (2011)
Source: TCP & FAU, Alps 2050, 2018
Origin of Data: ESPON Profecy, 2017
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

Travel Time by car in minutes

	0 - 5
	> 5 - 10
	> 10 - 20
	> 20 - 40
	> 40 - 71

Map 6   Travel time to primary schools by car

Indicator/Methodology: Map 6 is based on the calculation of travel time to primary school by car. The map shows values for the municipality level (LAU) that are aggregated from grid data. The darker the colour is, the more time it takes within the respective municipality to reach the next primary school. The classification differentiating the five categories is the same as for doctors. The calculation takes into account that the nearest primary school might be in a neighbouring municipality. The OSM data refer to the service facility "primary schools" with the OSM type 2082.

Description: The explanation is parallel to the accessibility of doctors – the overall picture very clearly shows the role of the morphology also in this case: The accessibility is much easier in pre-Alpine areas than in the mountainous areas. However, the picture is slightly 'brighter' (more yellow/orange colours). This means that the density of primary schools is higher than the density of doctors.

Travel time to train stations by car

Travel time by car in minutes

	0 - 5
	> 5 - 10
	> 10 - 20
	> 20 - 40
	> 40 - 129

© ESPON, 2018

Territorial level: LAU2 (2011 updated)
Source: TCP & FAU, Alps 2050, 2018
Origin of Data: ESPON Profecy, 2017
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
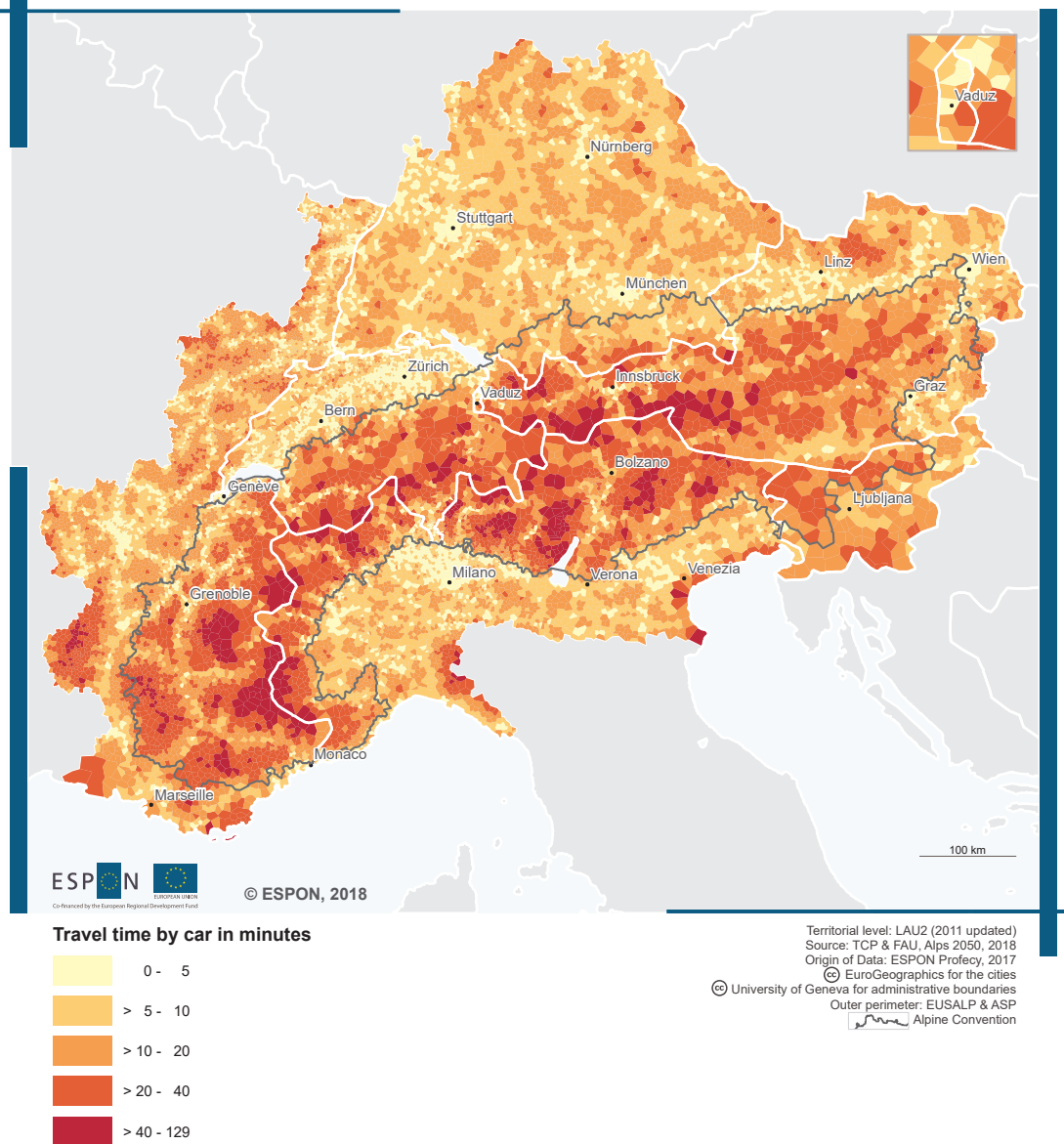
Map 7   Travel time to train stations by car

Indicator/Methodology: Also this data behind Map 7 were developed in the framework of the ESPON project PROFECY by TCP International – the same information apply as for the two maps above: The map is based on the calculation of travel time to train stations by car. The map shows values for the municipality level (LAU) that are aggregated from grid data. The darker the colour is, the more time it takes within the respective municipality to reach the next primary school. The calculation takes into account that the nearest train station might be in a neighbouring municipality. The classification of the data (legend) is the same in the two cases introduced above.

Description: In principle, most of the comments from the above introduced cases also apply in this case. However, there are two specific arguments:

- The spatial pattern shows more clearly the morphology, in particular the valleys that host the rail infrastructure.

- The large net structure of train railway stations is less densely organised than primary schools and doctors.

4 Demography

4.1 Population change

Population change 2010-2015

Population change in %

≤ -10	> 0 - 5	unincorporated area
> -10 - -5	> 5 - 10	no data
> -5 - 0	> 10 - 25	
	> 25	

© ESPON, 2018

Territorial level: LAU2 (2011 updated)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat & National Statistical Offices, 2013
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
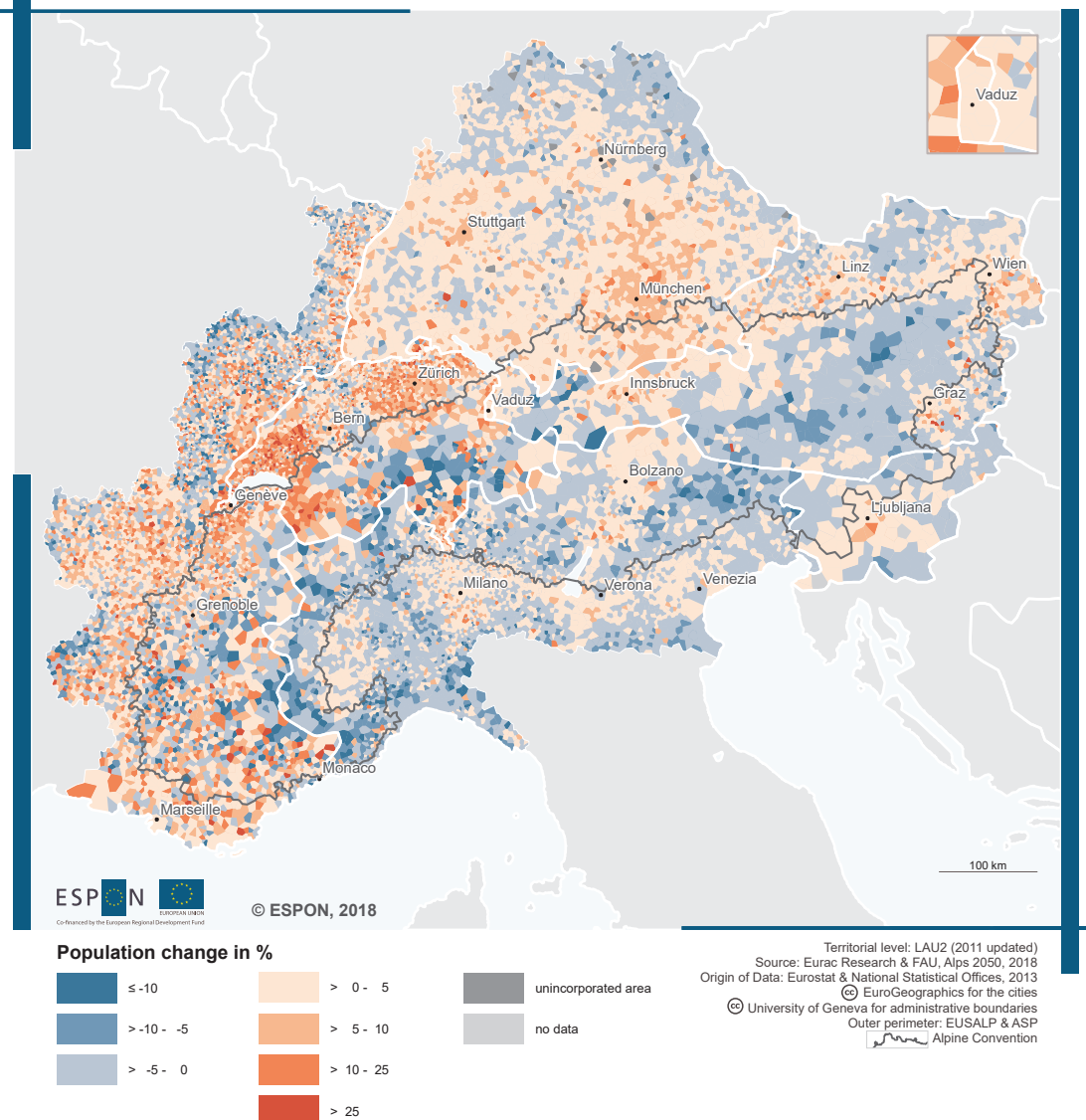
Map 8   Population change 2010-2015 on municipal level

Indicator/Methodology: Map 8 shows the demographic trend between 2010 and 2015 on municipality level (LAU): Summarising the different demographic components of in-/outmigration over municipality borders as well as childbirths and deaths, the overall demographic trend can be positive (considered as population growth) or negative (population loss): The darker the colour red is, the stronger is the overall positive trend; the darker the colour blue, the more negative is the trend. NB: The categories comprise different ranges of values (e.g. 0-5% and 25-100%), but they comprise a comparable number of cases.

Description: The overall picture clearly shows the important influence of the degree of urbanisation: In the observed period, metropolises and the larger cities are almost always the centre of population increase, whereas the patterns in the rural areas are much more diverse: For example, the Southern Tyrol area is demographically developing much more positive then the Belluno region. The difference

is large between the Alpine countries: The differences are obvious e.g. along the French-Italian and the German-Swiss side. Moreover, the particular development paths of corridors are obvious, in particular for the Inn Valley, the High Rhine Valley, Slovenian motorway cross and most of all the Brenner corridor.

Different to the settlement system map, the picture does not primarily reproduce the differences between mountainous and non-mountainous regions. Instead, the diversity of rural spaces and the large scale influence of metropolitan 'growth poles' leads to a much more complex picture.
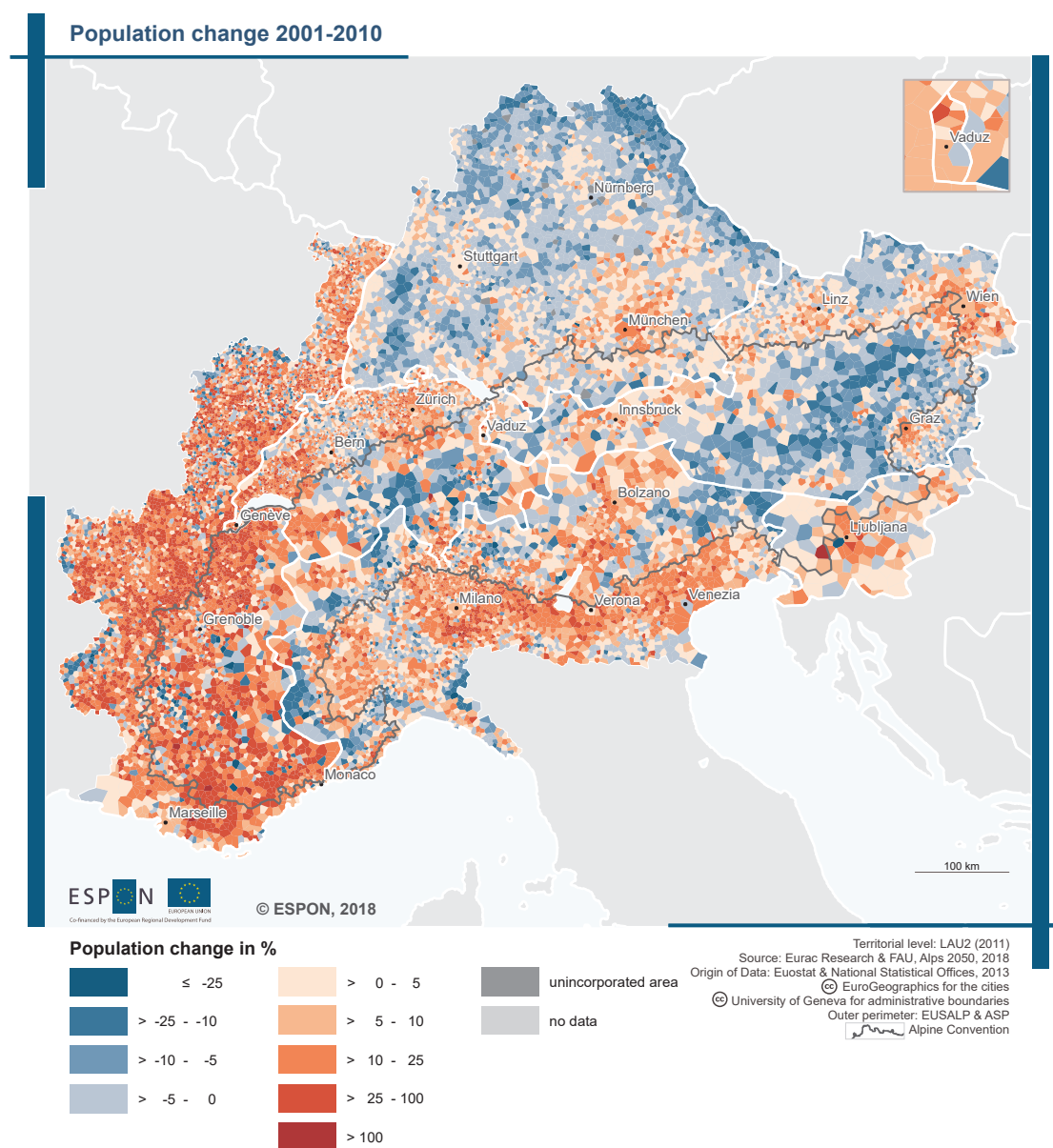
Population change 2001-2010

Population change in %

≤ -25	> 0 - 5	unincorporated area
> -25 - -10	> 5 - 10	no data
> -10 - -5	> 10 - 25	
> -5 - 0	> 25 - 100	
	> 100	

© ESPON, 2018

Territorial level: LAU2 (2011)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Euostat & National Statistical Offices, 2013
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

Map 9   Population change 2001-2010 on municipal level

Indicator/Methodology: The indicator in Map 9 is the same as in the map shown above, but refers to an earlier period of time, namely 2001-10.

Description: The general trends are similar to the more recent trends described above for the years 2010-2015. However, the overall development has recently been more positive in the German and

Swiss regions. In contrary, the Po Valley in Italy shows very different and much more negative values. The patterns on the French side are now much more diverse than before. In Slovenia, the positive trend of population growth can be identified in the urban and suburban areas and along the motorway, while the mountainous, border and remote areas are clearly loosing population.

Population Change 2001-2010

Population Change 2001-2010 (%)

■ < -25.0	
■ -25.0 - -10.1	
■ -10.0 - -5.1	
■ -5.0 - -0.1	
■ 0.0 - 4.9	
■ 5.0 - 9.9	
■ 10.0 - 24.9	
■ 25.0 - 99.9	
■ ≥ 100.0	

■ Data not available
■ Data not harmonized
■ Non-ESPON Space
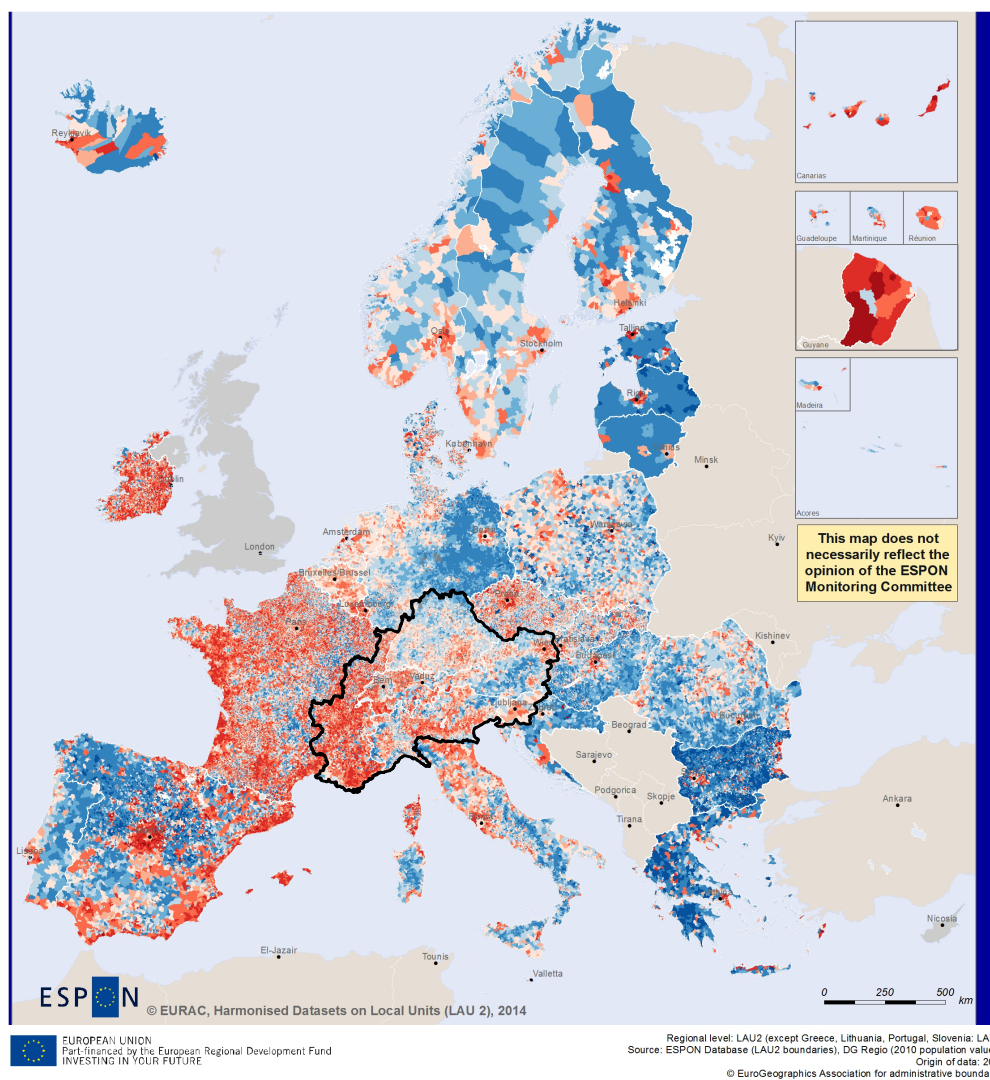
Map 10   Population change 2001-2010 on municipal level in Europe

Indicator/Methodology: see above, Map 9 (further information: http://regdev-blog.eurac.edu/wp-content/uploads/Demographic-change-Europe-Municipalities-map.jpg)

Description: Map 10 positions the demographic development of the Alpine regions on the European

scale. The overall picture underlines the diversity of developments and the comparable positive trend. When negative trends are visible they show more small scale patterns than in other parts of Europe (e.g. Iberian Peninsula, South-Eastern Europe). As already mentioned above, the positive trend in metropolitan regions and the diversity of rural development parts is visible – and can also be found in many other European regions. The demographic development in the Alps, thus, mirrors the demographic trends that can be found European wide.

Indicator/Methodology: Tab. 1 to Tab. 3 show the same indicator as Map 8 and Map 9 and refer to the period 2001-2015. The municipal data are summed up following different classifications:

- Tab. 1 differentiates between the inner-Alpine area (all municipalities that are part of the Alpine Convention area) and the pre-Alpine area (all municipalities that are part of the Alps 2050 perimeter and lie beyond the Alpine Convention perimeter) (cf. Map 1)
- Tab. 2 differentiates between urban areas, towns and suburbs, rural areas following the DEGURBA classification (cf. Map 4).
- Tab. 3 differentiates the municipalities that are part of the Alps 2050 space by national affiliation.

Tab. 1   Population change 2001-2015 comparing the inner- and pre-Alpine area

Population	Change 2001-2015	Change 2001-2010	Change 2010-2015
Alps 2050	+ 7,8%	+ 5,4%	+ 2,3%
Inner-Alpine	+ 7,8%	+ 6,1%	+ 1,6%
Pre-Alpine	+ 7,8%	+ 5,2%	+ 2,5%

Description: In the period 2001-2015, the population change is positive and the growth rate is the same in all three spatial categories (all +7,8%). Also when differentiating the decades, the overall trend is positive for all areas. Between 2001 and 2010, the growth rate of the inner-Alpine area is higher than in the Alps 2050 space and in the pre-Alpine area. This is different between 2010 and 2015 – in this period the growth rate of the pre-Alpine area is higher than in the inner-Alpine area.

Tab. 2   Population change 2001-2015 comparing urban areas, towns and suburbs and rural areas based on the DEGURBA classification

Population	Change 2001-2015	Change 2001-2010	Change 2010-2015
Alps 2050	+ 7,8%	+ 5,4%	+ 2,3%
urban	+ 8,1%	+ 5,1%	+ 2,9%
towns and suburbs	+ 8,2%	+ 5,7%	+ 2,4%
rural	+ 6,8%	+ 5,2%	+ 1,5%

Description: Differentiating the Alps 2050 area following the DEGURBA classification, the population growth in urban areas and towns and suburbs between 2001 and 2015 is nearly the same. The growth rate in rural areas is also highly positive but lies under the growth rate of the urban areas. The same applies in the temporal differentiation.

Tab. 3   Population change 2001-2015 differentiated by national affiliation

Population	Change 2001-2015	Change 2001-2010	Change 2010-2015
Alps 2050	+ 7,8%	+ 5,4%	+ 2,3%
AT	+ 6,1%	+ 4,2%	+ 1,8%
CH	+ 15,5%	+ 8,4%	+ 6,6%
DE*	+ 3,5%	+ 0,1%	+ 3,3%
FR*	+ 12,1%	+9,3%	+ 2,5%
IT*	+ 8,1%	+ 8,1%	+ 0,1%
LI	+ 12,2%	+ 7,8%	+ 4,1%
SI	+ 4,8%	+ 4,2%	+ 0,6%

*parts that belong to the Alps2050 perimeter

Description: Differentiating the population change by national affiliation (Tab. 3), there are obviously more differences than in Tab. 1 and Tab. 2. In the period 2001-2015, the German parts and Slovenia show growth rates under 5 %, whilst Switzerland, the French parts and Liechtenstein lie clearly over 10 percent. Whereas the trends in Switzerland and Liechtenstein show high growth rates over periods, the German parts had nearly no change between 2001 and 2010 and show a crucial increase of the growth rate after 2010. In contrast, the French and the Italian parts as well as Slovenia show rather high growth rates between 2001 and 2010 and a decline of the rates after 2010.

4.2 Population density

Population density

Area proportional map

Population proportional map

Population density 2015
(Inhabitants/km²)
≤ 100
> 100 - 150
> 150 - 200
> 200 - 250
> 250 - 500
> 500

100 km

© ESPON, 2018

Territorial level: NUTS 3 (2013)
Source: FAU & Eurac Research, Alps 2050, 2018
Origin of data: Eurostat & National Statistical Offices, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries

Map 11   Population density – in area proportional mapping (left hand side) and population proportional mapping (right hand side)

Indicator/Methodology: Map 11 shows the population density on NUTS 3 level – on the left hand side proportional to the surface area (classical cartographic representation), on the right hand side a cartogram using the Gastner-Newman method. In the latter map, the size of the territories is relative to the population (number of inhabitants) of the territories.

Description: This cartographic tool underlines the large differences in demographic patterns within the Alps 2050 perimeter. The mountainous areas almost 'disappear' due to their low population density, the urbanised and metropolitan territories of the pre-Alpine space literally 'blow up'. The right hand map is somehow the caricature of the 'metropolitan view on the Alps'.

4.3 Population change and the urban-rural differentiation

Indicator/Methodology: The visualisation of Fig. 1 and Fig. 2 are so-called box plots. This kind of visualisation differentiates the quartiles of the values of population change on municipality level for different spatial categorisations. For example, the blue box in Fig. 1 shows the second and third quartile of the population change values for the cities, and the line separating them shows the median value. The vertical line above shows the top quartile, the line below the quartile with the lowest values. The analyses are based on municipal level that are aggregated by different dimensions. The main idea is to confront urban and rural spaces and inner- and pre-Alpine spaces.

The graphic is based on the same data as Map 9 (population change 2001-2010).

Population change 2001-2010, LAU2 regions (DEGURBA-classification)

© FAU, Eurac Research Alps 2050

Origin of data: Eurostat & National Statistical Offices 2013
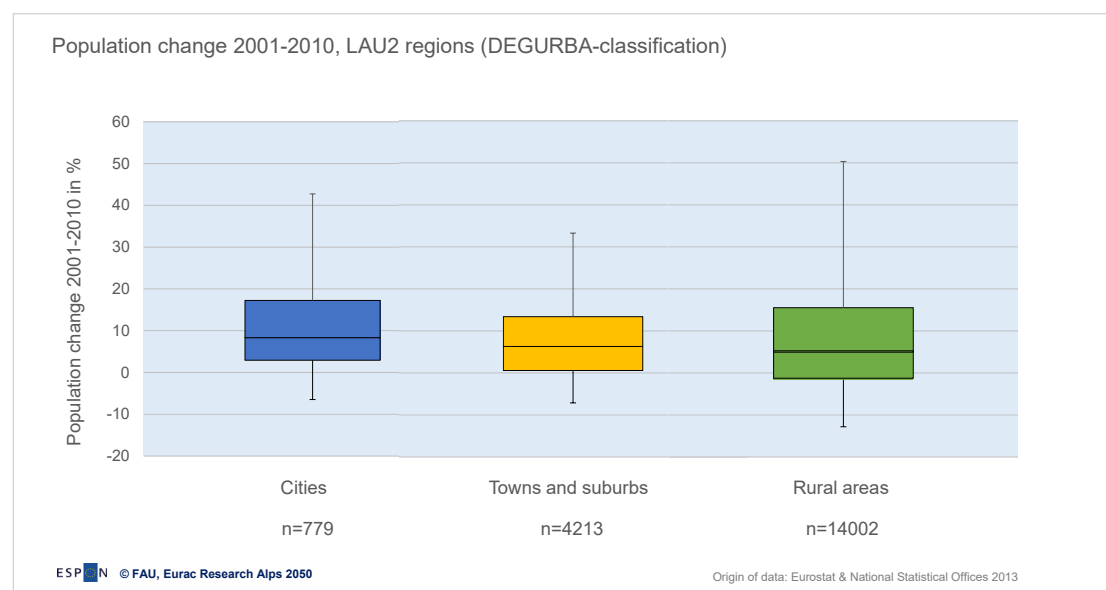
Fig. 1   Population change 2001-2010 based on the DEGURBA classification, LAU level

Description: Fig. 1 compares the population development in cities, towns/suburbs and rural areas (DEGURBA classification cf. Map 4). The population development is positive in (more than) three quartiles in the categories cities and towns/suburbs, a bit less in the rural municipalities. The range is much higher in rural areas than in the former two categories. The median shows the highest value for the city category (8,3%) and lower values for the suburban (6,3%) and rural (4,9%) communes.

Population change 2001-2010, LAU2 regions

Pre-Alpine areas (EUSALP areas beyond the Alpine Convention perimeter, DEGURBA-classification)

Inner-Alpine areas (Alpine Convention areas, DEGURBA-classification)
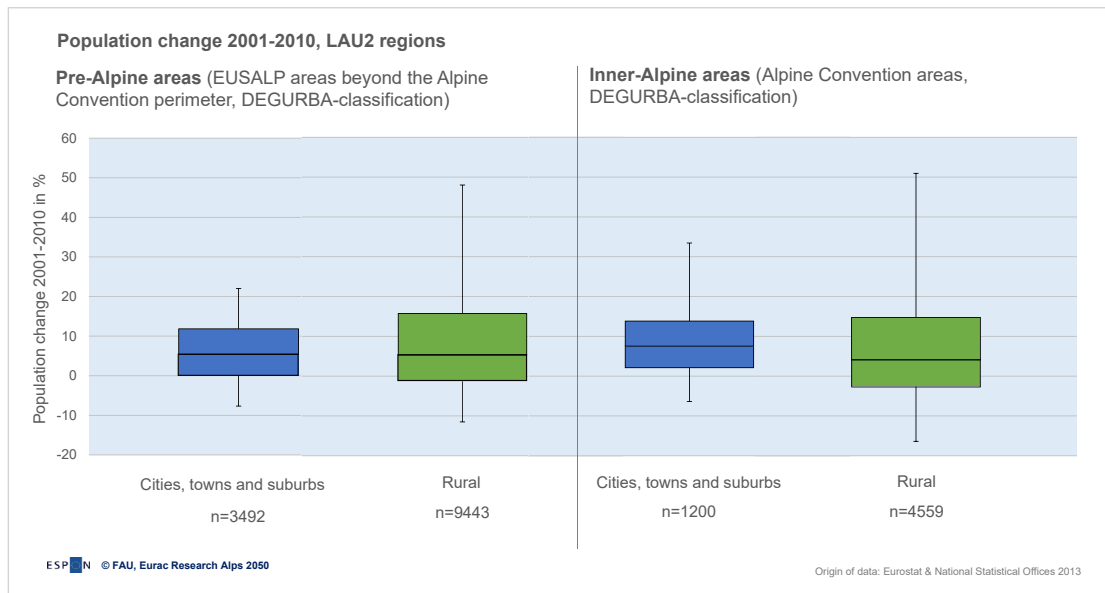
Fig. 2   Population change 2001-2010 comparing urban and rural spaces – on the left hand side for the pre-Alpine areas, on the right hand side for the inner-Alpine areas

Description: Fig. 2 is more complex: firstly, the categories 'cities' and 'towns and suburbs' are merged and confronted to the rural category. On the left hand side, we see the values for the inner-Alpine, mountainous areas; on the right hand side the values for the pre-Alpine areas of the project perimeter. On both sides, we see the higher diversity of development in the rural areas, and the overall more positive development in the urban category. The urban development tends to be stronger in the inner-Alpine areas than in the pre-Alpine areas. This shows a slightly stronger trend of urbanisation in this space. The rural spaces are developing slightly more diverse and less positive in the inner-Alpine than in the pre-Alpine space.

4.4 Ageing index

Ageing index 2015

Persons over 65 / Persons between 0-14 * 100

	0 - 50		> 200 - 5100
	> 50 - 100		no aging index
	> 100 - 150		unincorporated area
	> 150 - 200		no data

Territorial level: LAU2 (2011 updated)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: National Statistical Offices, 2018
cc EuroGeographics for the cities
cc University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

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Map 12   Ageing index 2015 on municipal level

Indicator/Methodology: Map 12 shows the relation between the number of persons over 65 years and the number of persons under 14 years old on municipality level.

Description: The overall pattern is similar to the other demographic indicators, and this is not by chance: Those areas that have a strong immigration tends to be the 'younger' as young people are more mobile (migration due to education or career development reasons) and they have a higher probability to already have or get children. Those regions with the highest ageing index are in particular mountainous parts in almost all countries of the Alps 2050 perimeter, showing those regions that are not target regions of migration; also large parts of the Italian lowlands show a high ageing index. Urbanised regions and corridors tend to be younger, due to immigration (universities, labour market). If one takes this picture as an indicator for future development options, many regions in Italy, Southern Switzerland, parts of France and Inner Austria can be regarded as under pressure.

4.5 Women between 25 and 35

Women between 25 and 35 in % of total population (2017)

- 4,3 - 5
- > 5 - 6
- > 6 - 7
- > 7 - 8
- > 8 - 10,4

Territorial level: NUTS3 (2013)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

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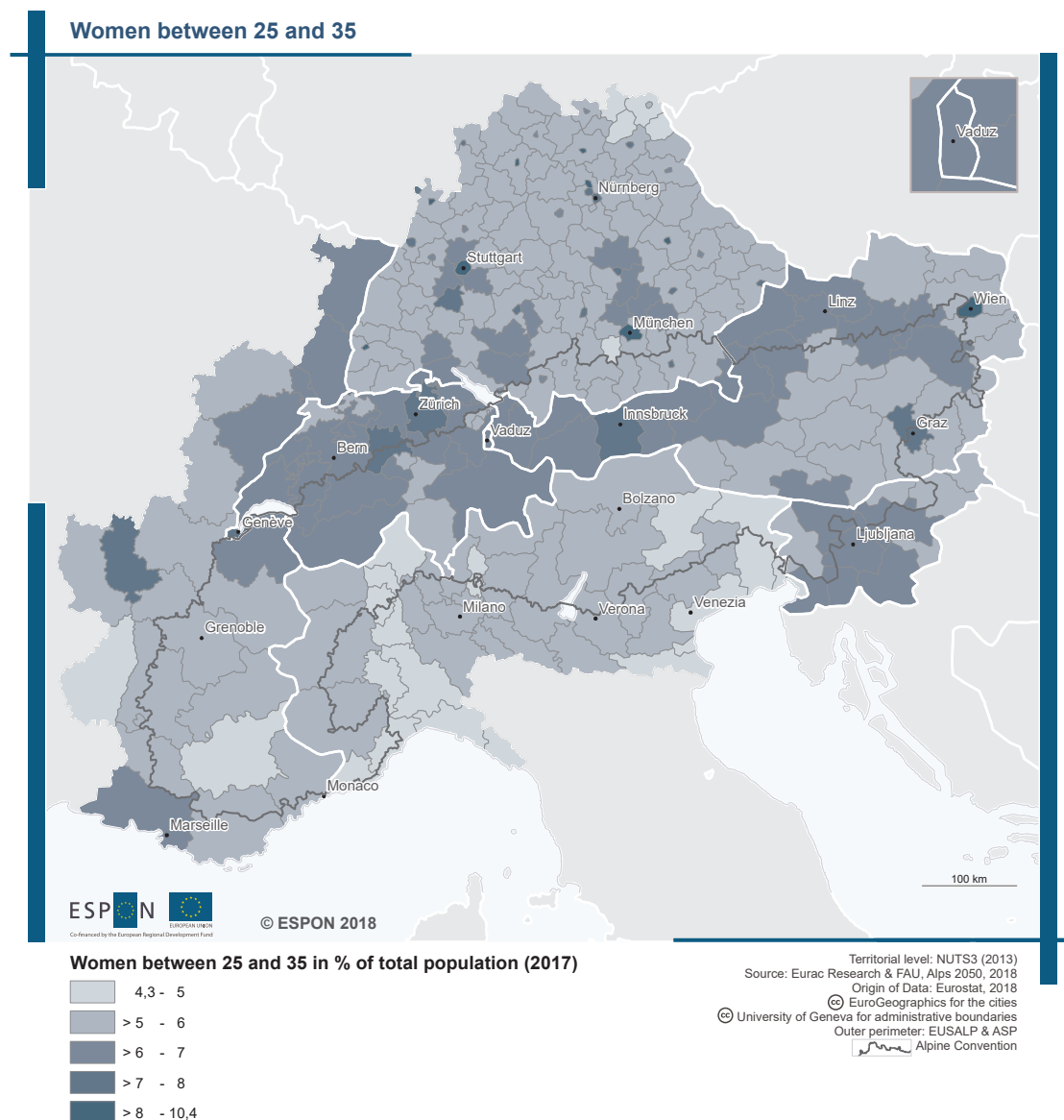
Map 13   Women between 25 and 35 2017

Indicator/Methodology: Map 13 shows the share of female inhabitants in the age group between 25 and 35 on the NUTS 3 level. This indicator can be understood as a hint for the further demographic development: The over average share of this population group can be seen as indication for a positive natural demographic development in the coming years (number of births). This indicator is closely related with the demographic dynamic – the more immigration, the more women in the age group 25-35 years can be expected.

Description: The map shows that the highest values can be found in urban areas and in Switzerland, Northern Austria and large parts of Slovenia. On this spatial scale (NUTS 3), the morphology seems not to play a dominant negative role. In most cases, the patterns reflect the degree of immigration in recent years.

4.6 Natural change and migratory dynamics

Net natural change

Natural change per 1.000 inhabitants (2011-2015)

■ -8,8 - -4		■ > 0 - 2	
■ > -4 - -2		■ > 2 - 4	
■ > -2 - 0		■ > 4 - 6	
		■ > 6 - 7,8	

Territorial level: NUTS3 (2013)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
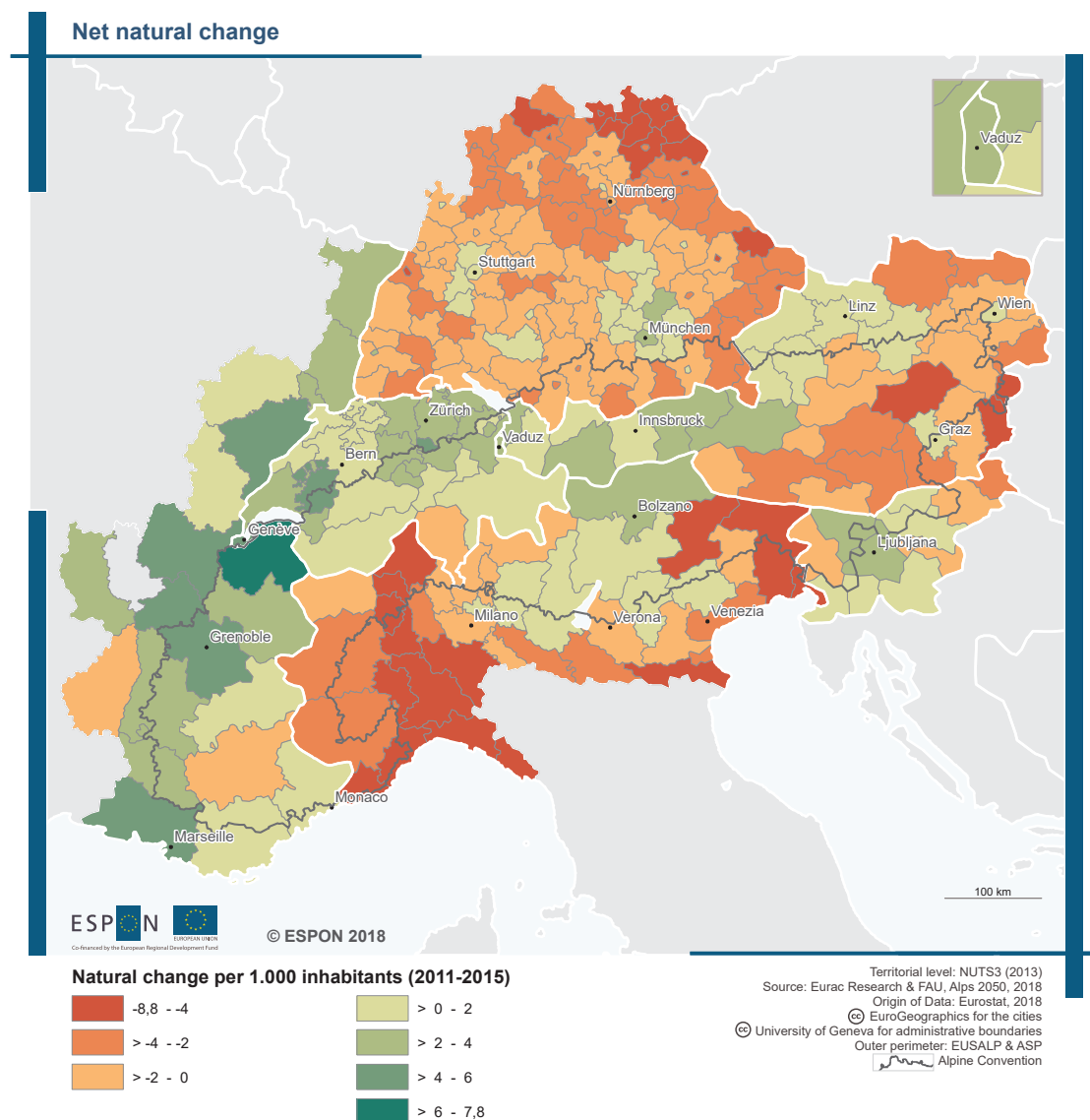
Map 14   Net natural change 2011-2015

Indicator/Methodology: Map 14 shows the dynamic of the natural demographic development, which means the number of births minus the number of deaths without considering in- and outmigration (on the NUTS 3 level for 2015).

Description: The map clearly shows that many parts of the Alps 2050 perimeter are characterised by a negative natural change value – in most regions, the number of deaths is higher than the number of births. Exceptions from this trend are many urbanised areas, Switzerland, large parts on the French side and Slovenia except some border regions. Germany, Italy and East/Southern Austria show rather negative values. Those areas that show negative natural values depend to a high extent on the migration dynamics. One should put this map into perspective with regard to the following aspects:

- In general terms, natural dynamics are less important in quantitative terms: on the NUTS 3 level, the number of migrating people is far higher than the number of births and deaths. This is true for Europe as a whole.

- As for all maps, also here the question of scale applies: The NUTS 3 level hides in many cases larger differences on municipality level.
- The patterns of this map are similar to those in the map women between 25 and 35, cf. Map 13.

Net migration

Net migration per 1.000 inhabitants (2011-2015)

-5,4 - -2	> 0 - 2	> 6 - 8
> -2 - 0	> 2 - 4	> 8 - 10
	> 4 - 6	> 10 - 20,5

Territorial level: NUTS3 (2013)
Source: Eurach Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
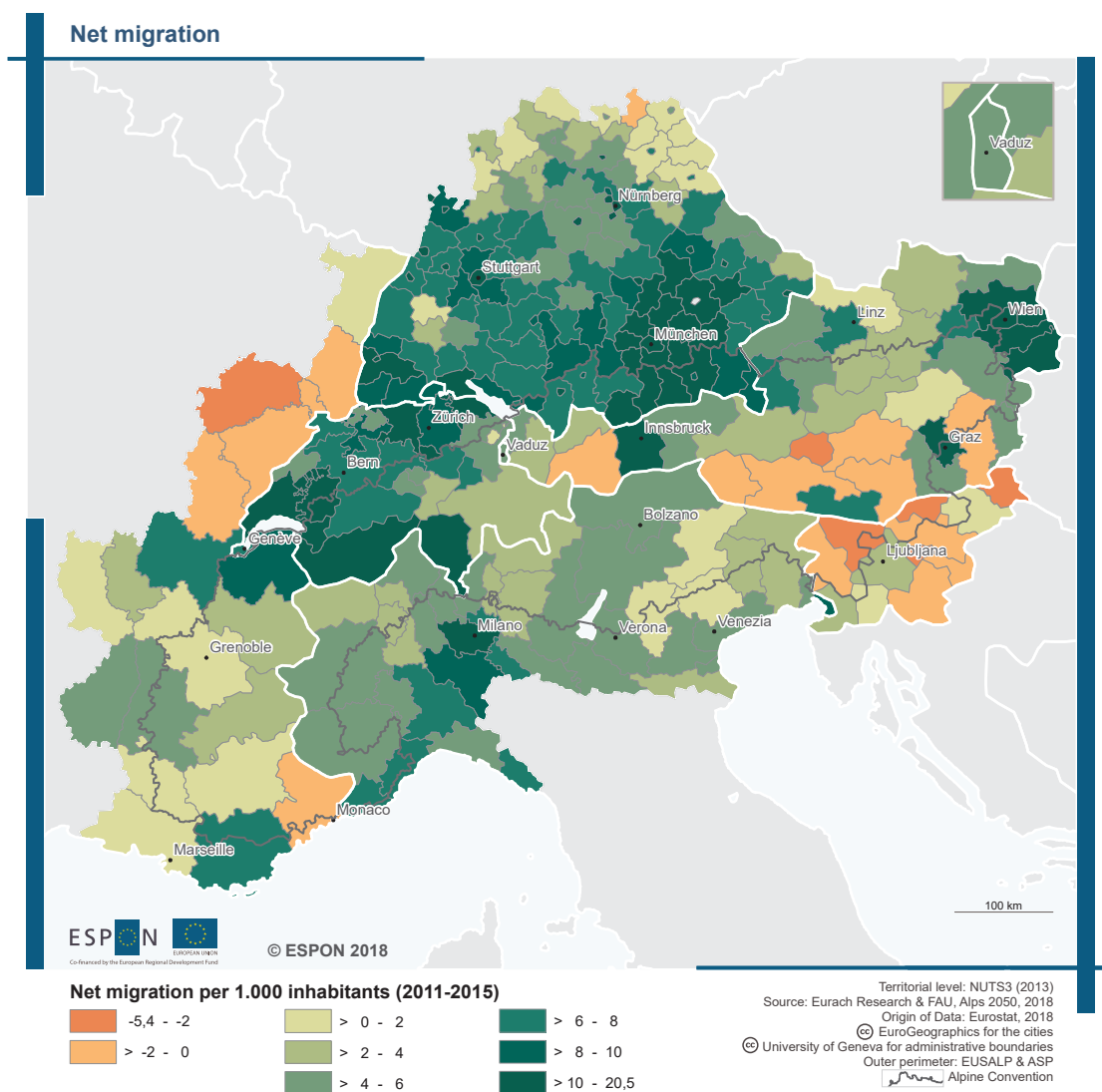
Map 15   Net migration 2011-2015

Indicator/Methodology: Map 15 shows the dynamic of the migration development, thus the number of people moving in and out crossing the 'borders' of NUTS 3 regions, i.e. leaving or entering the districts of the Alps 2050 regions without considering births and deaths (for 2015).

Description: This map underlines that the Alps 2050 region is – overall speaking – an attracting space as almost all NUTS 3 regions show a positive migration balance. The overall picture shows a certain North-South divide, but the role of metropolitan spaces is more dominant. The asylum seeking people are not included in a comprehensive manner (2015 was the year of the most important inmigration but only few of these persons were statistically registered).

Net population change 2011-2015

Positive change

■ Positive natural change, positive migration

■ Negative natural change, positive migration

■ Positive natural change, negative migration

Negative change

■ Positive natural change, negative migration

■ Negative natural change, positive migration

■ Negative natural change, negative migration

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Territorial level: NUTS3 (2013)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
ⓒ EuroGeographics for the cities
ⓒ University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
〰 Alpine Convention

Map 16   Population change and the role of migration and natural change 2011-2015

Indicator/Methodology: Map 16 shows the population net change over the period 2011-15 on the NUTS 3 level. The green colours indicate absolute growth, the red colours absolute loss. The colour intensity shows the different factors for the trend, i.e. if the growth/loss can be traced back to migration flows or to natural demographic development.

Description: The overall picture shows that the demographic development is very diverse over the Alps 2050 perimeter. Positive developments in both migration and natural development can be found in most metropolitan areas, along the Brenner corridor (Innsbruck-Verona) and in almost all NUTS 3 regions in Switzerland. In principle, this map brings together the two maps presented before, illustrating the natural net development and the migration net development, so the above formulated comments also apply here.

Share of foreign residents

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Foreign residents per total inhabitants 2015 (in %)

	1,8 - 7,5
	> 7,5 - 10,0
	> 10,0 - 12,5
	> 12,5 - 15,0
	> 15,0 - 17,5
	> 17,5 - 63,8
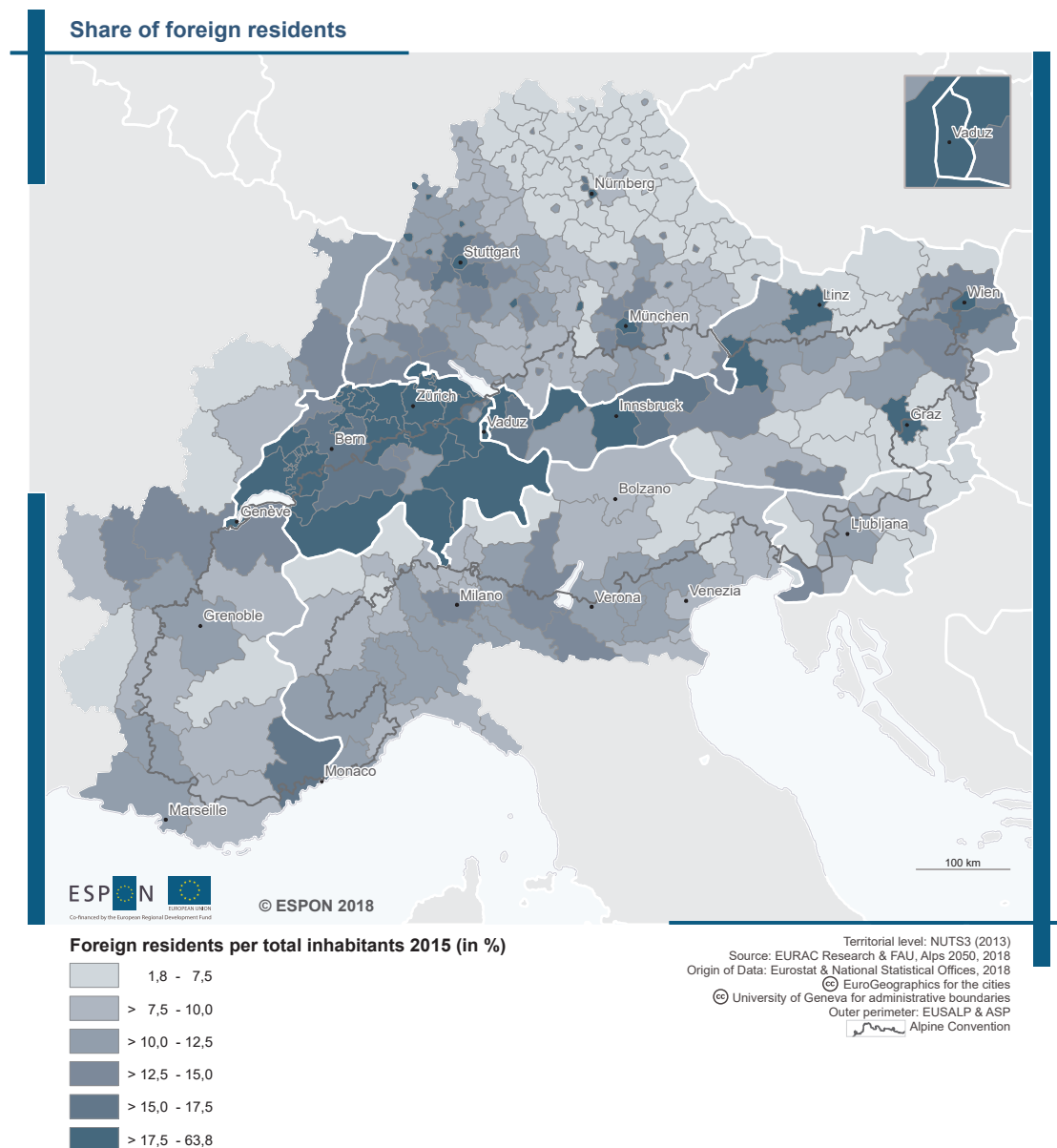
Map 17   Share of foreign residents 2015

Indicator/Methodology: Map 17 shows the share of foreign residents for 2015 on the NUTS 3 level (defined by having a different nationality than the country of residence). The indicator comprises migrants from neighbouring Alpine countries as well as from any other international migration.

Description: Switzerland with its over-average economic growth in recent years (and decades) shows the highest share of international inhabitants, followed by the economically successful parts of (mostly Northern) Austria. The rate of foreigners on the German side is linked to the presence of the (automotive) industry where migrant workers play traditionally an important role. In Slovenia, the higher percentage in the coastal region is due to the economic orientation of this area (port, logistics and tourism) strongly attracting foreign labour working.

One has to keep in mind that naturalisation conditions differ from one country to another (jus soli in France vs. more restrictive policies in Switzerland and Liechtenstein for instance), which partly influences the number of foreign residents.

5 Economy

5.1 Economic strength and disparities

GDP per capita

GDP per capita in PPS (2014)

	12.900 - 20.000
	> 20.000 - 30.000
	> 30.000 - 40.000
	> 40.000 - 50.000
	> 50.000 - 135.000

Territorial level: NUTS3 (2013)
Source: FAU Alps 2050, 2018
Origin of Data: Eurostat, 2018
cc EuroGeographics for the cities
cc University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
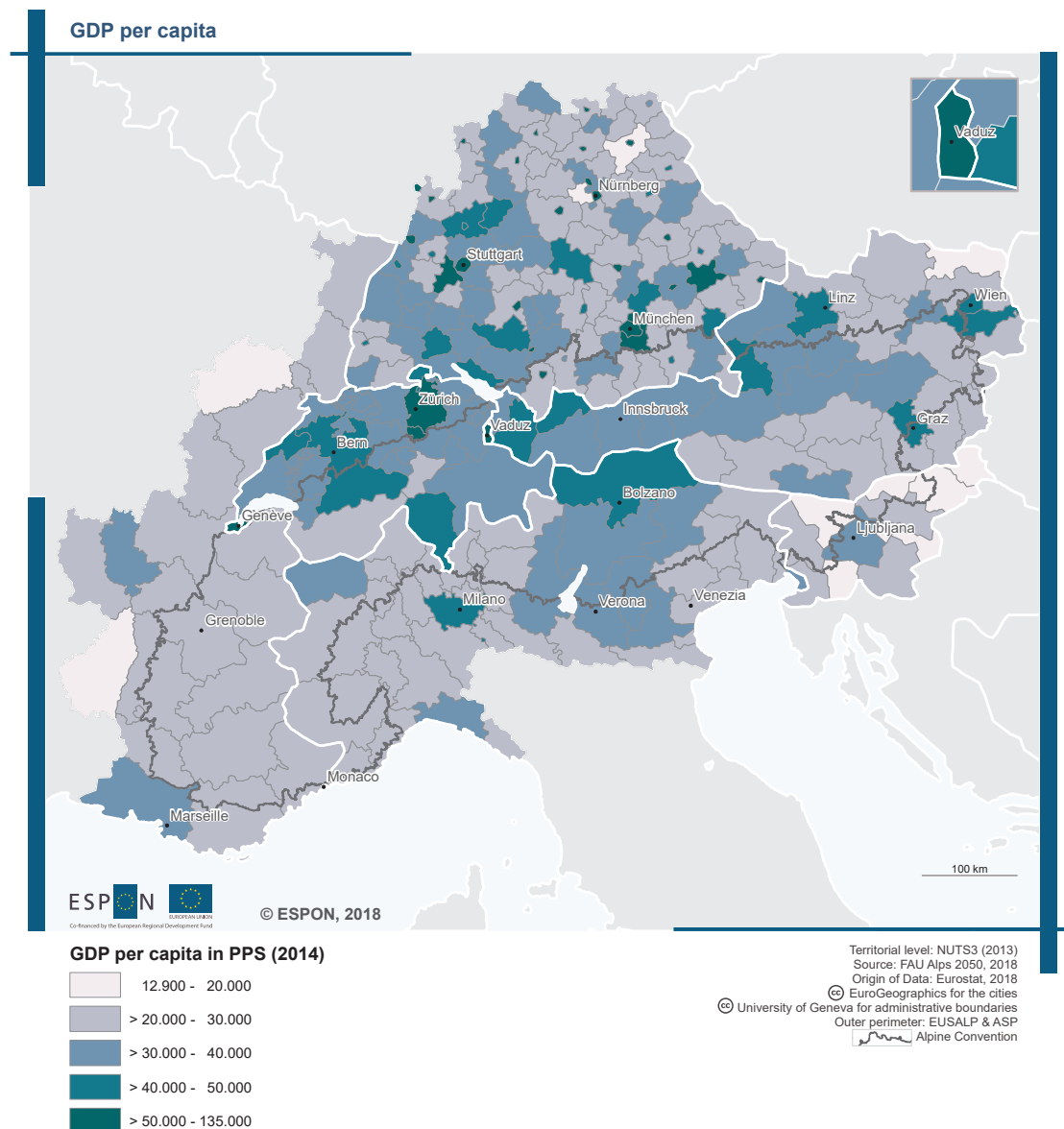
Map 18   GDP per capita 2014

Indicator/Methodology: Map 18 shows the Gross Domestic Product (GDP) that describes the economic strength. The expression in power purchase standards (PPS) considers that the same nominal value of monetary units means different things in 'rich' and 'poor' regions. Both maps show values for the spatial level of NUTS 3. The values are calculated per inhabitant, not per worker which means enhanced values in small NUTS 3 regions (especially for the German "Kreisfreie Städte") due to commuting flows.

Description: The values are most positive in urbanised and metropolitan regions. Moreover, we see a certain North-South divide as regions in Germany, Switzerland and Austria are on a higher GDP per capita level than many regions on the Italian and French side. Slovenia displays the important role of the Ljubljana region and the lag in the development of the Eastern Cohesion region.

GDP change

GDP change in % (2008-2014)

-14,4 - -7,5	> 0 - 7,5	> 22,5 - 30
> -7,5 - 0	> 7,5 - 15	> 30 - 93,3
	> 15 - 22,5	

Territorial level: NUTS 3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
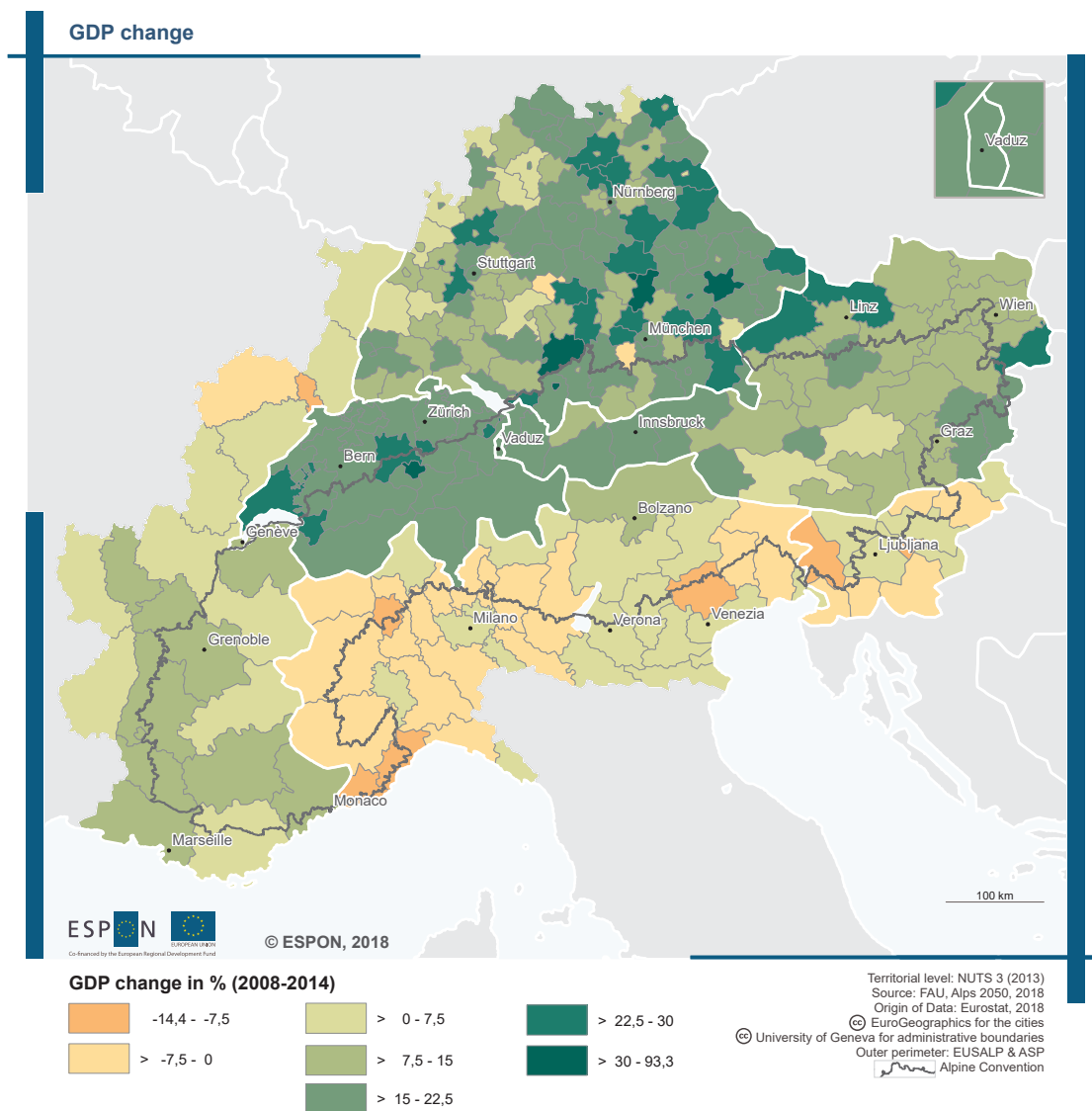
Map 19   GDP change 2008-2014

Indicator/Methodology: Map 19 shows the change of the Gross Domestic Product (GDP) between the years 2008-14 and, thus, indicates the overall economic performance on regional level.

Description: The overall picture is in some parts similar to the map of the GDP level, which means that – in the period 2008-14, thus following the start of the economic crisis – economic North-South divide has increased. The already strong regions in Switzerland, Southern Germany and Northern Austria have performed better than most other regions. The same applies on the intraregional scale: The anyway positive position of the Grenoble – Marseille corridor in France, of Southern Tyrol in Italia or of Ljubljana in Slovenia have even increased relative to their neighbouring regions.
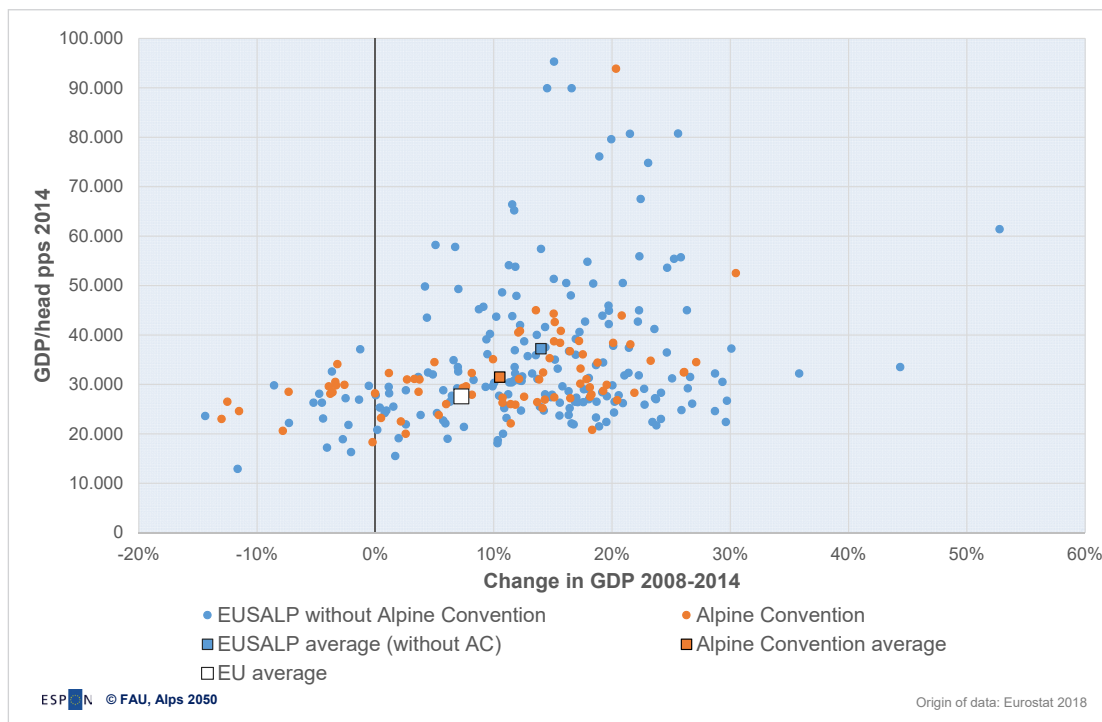
Fig. 3   GDP change on regional level – comparing pre- and inner-Alpine districts
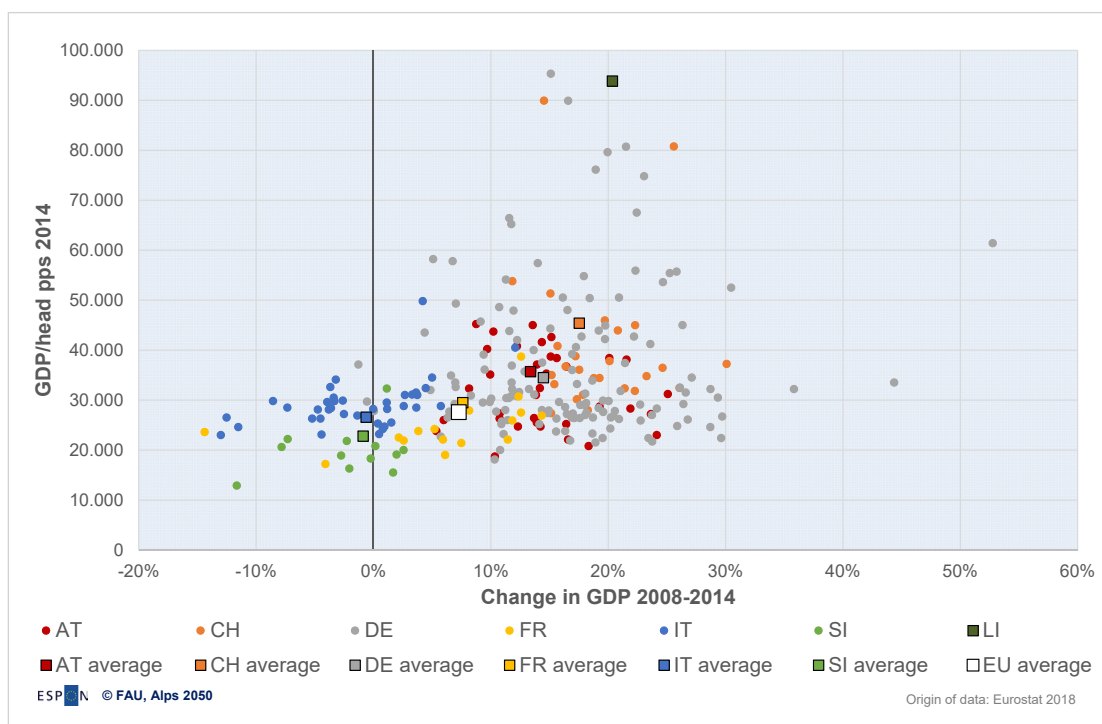
Fig. 4   GDP change on regional level – comparing districts of different national affiliation

Indicator/Methodology: The two scatter plots are based on the GDP indicator – on the y-axis the level of GDP per capita in pps and on the x-graph the change in GDP between 2008 and 2014.

The upper graph (Fig. 3) differentiates those NUTS 3 regions being part of both the Alpine Convention and the EUSALP areas (inner-Alpine) and those who are not part of the Alpine Convention but only of the EUSALP (pre-Alpine). The lower version of the graphic (Fig. 4) shows the performance of regions differentiated with regard to their national context.

Description: Fig. 3 shows that the EUSALP perimeter comprises many regions with a very strong economic performance, but also some pretty weak performing ones. Simplifying to a certain extent, the graph shows that economic diversity is larger within the EUSALP perimeter than it is within the AC perimeter. The AC regions are performing slightly weaker than the EUSALP ones. This can be explained via the lower presence of urban centres that lead to agglomeration effects. The major part of the cities is located outside of the Alpine Convention. One might interpret this as an argument for the 'hypsometric postulate' (inner-Alpine AC regions at "higher" altitudes develop slightly weaker than the 'lowland' EUSALP regions), but there are many exceptions. One has to admit that the picture would be different on a finer scale: Even within relatively prosperous (NUTS 3) regions, certain villages and areas can be hit very hard by demographic and structural change (c.f. results of ESPON project PROFECY on Inner Peripheries; Noguera et al. 2017). Both the GDP level and trend are above EU average, and the non-mountainous EUSALP regions are ahead of the Alpine Convention regions.

The picture is much clearer in the lower graphic (Fig. 4): The NUTS 3 regions of each country make up a kind of a 'cloud' that can immediately be differentiated from other countries. The high variability within the 'clouds' of Switzerland and Germany have to be seen relative to the small size of the NUTS 3 regions in these countries. However, the overall picture is clear: The fragmentation argument – postulating the high importance of national contexts – is very true, at least on the NUTS 3 level. In other words: The belonging to a certain nation-state determines the economic path to a high extent. The question, if a region is situated in the inner-Alpine or pre-Alpine area (i.e. AC or EUSALP), is less decisive.

5.2 Regional disparities

Tab. 4   Development of regional disparities 2008-14: variation coefficient of GDP per capita (pps) in % (NUTS 3)

	2008	2014	Change
EU 28	53,31	56,05	+ 5,14%
ALPS2050	33,80	35,52	+ 5,09 %

Indicator/Methodology: Tab. 4 presents the values for the coefficient of variation of GDP per capita in PPS (in %), weighted by the population numbers on NUTS 3 level. A decrease of the coefficient of variation is equivalent to a reduction of disparities and vice versa. It allows to describe disparities of spaces of different sizes, development level and of different points of time (2008-14).

Description: The disparities are much higher on the EU level than within the Alps 2050 space. This was to be expected as the area is much smaller and the economies involved are performing relatively smart (for more details see Map 18 and Map 19). It is interesting to note that the trend is similar: disparities increased in both spaces over the time 2008-2014 almost with the same changes, slightly different for the Alps 2050 perimeter.

5.3 Labour and employment

Employment change in % (2008-2014)

- -16,3 - -5,0
- > -5,0 - 0,0
- > 0,0 - 5,0
- > 5,0 - 10,0
- > 10,0 - 21,1

Territorial level: NUTS 3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: Eurostat & National Statistical Offices, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
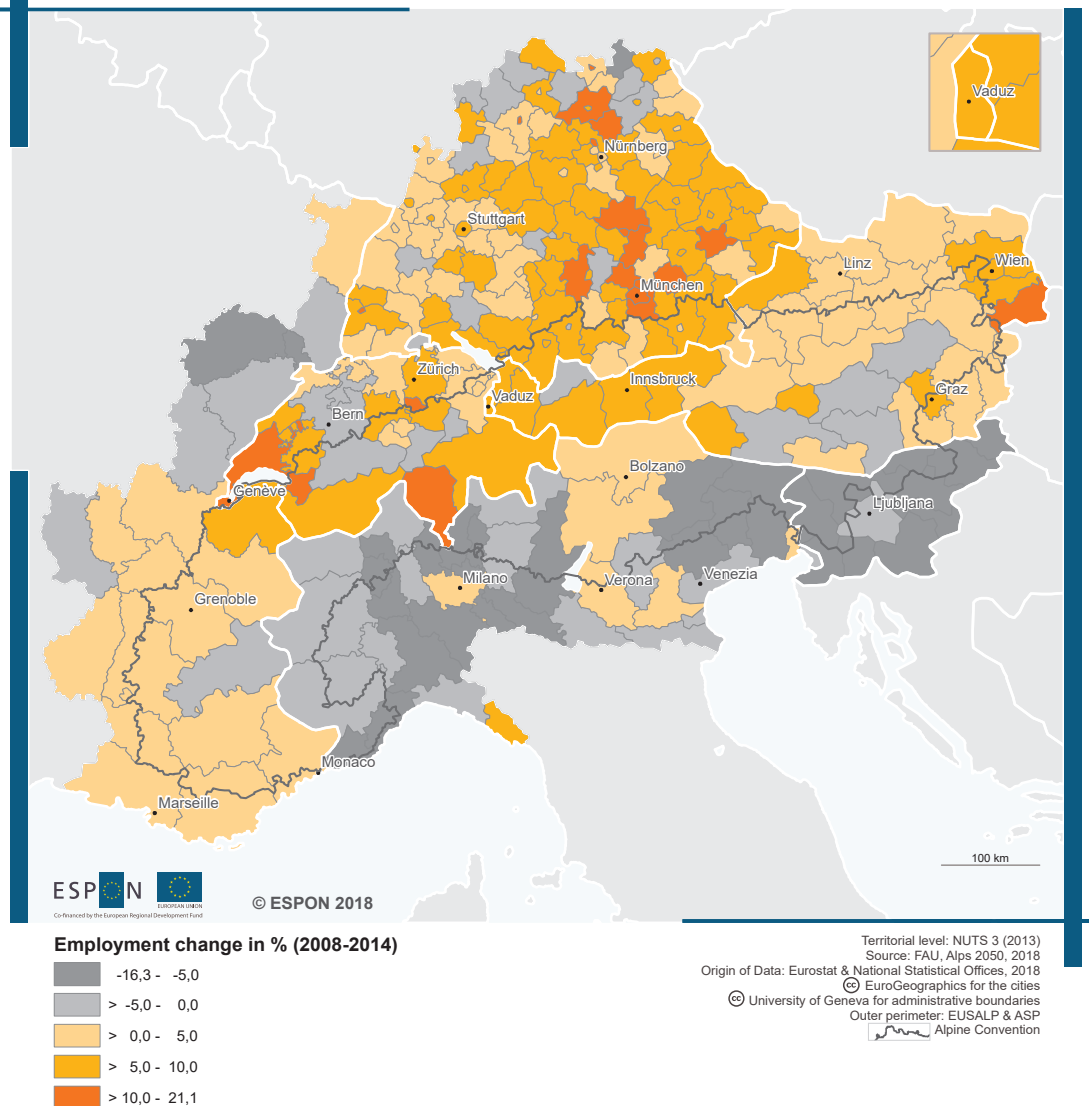
Map 20   Employment change 2008-2014

Indicator/Methodology: This indicator shows changes in employment for the period 2008-14 (Map 20). It illustrates to what extent the number of working places of all sectors and branches have developed. Grey colours indicate negative trends, yellow/red colours indicate a positive development.

Description: The spatial pattern shows a pretty clear North-South divide. This picture confirms the patterns we observe with regard to economic development (GDP trend), demographic development (in particular migratory patterns) and patents. This confirms the interrelatedness of socio-economic development in these dimensions.

Share of labour force in agricultural sector

Labour force in agricultural sector in % (2014)

- 0,1 - 3,0
- > 3,0 - 6,0
- > 6,0 - 9,0
- > 9,0 - 12,0
- > 12,0 - 19,3

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Territorial level: NUTS3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: Eurostat & National Statistical Offices, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
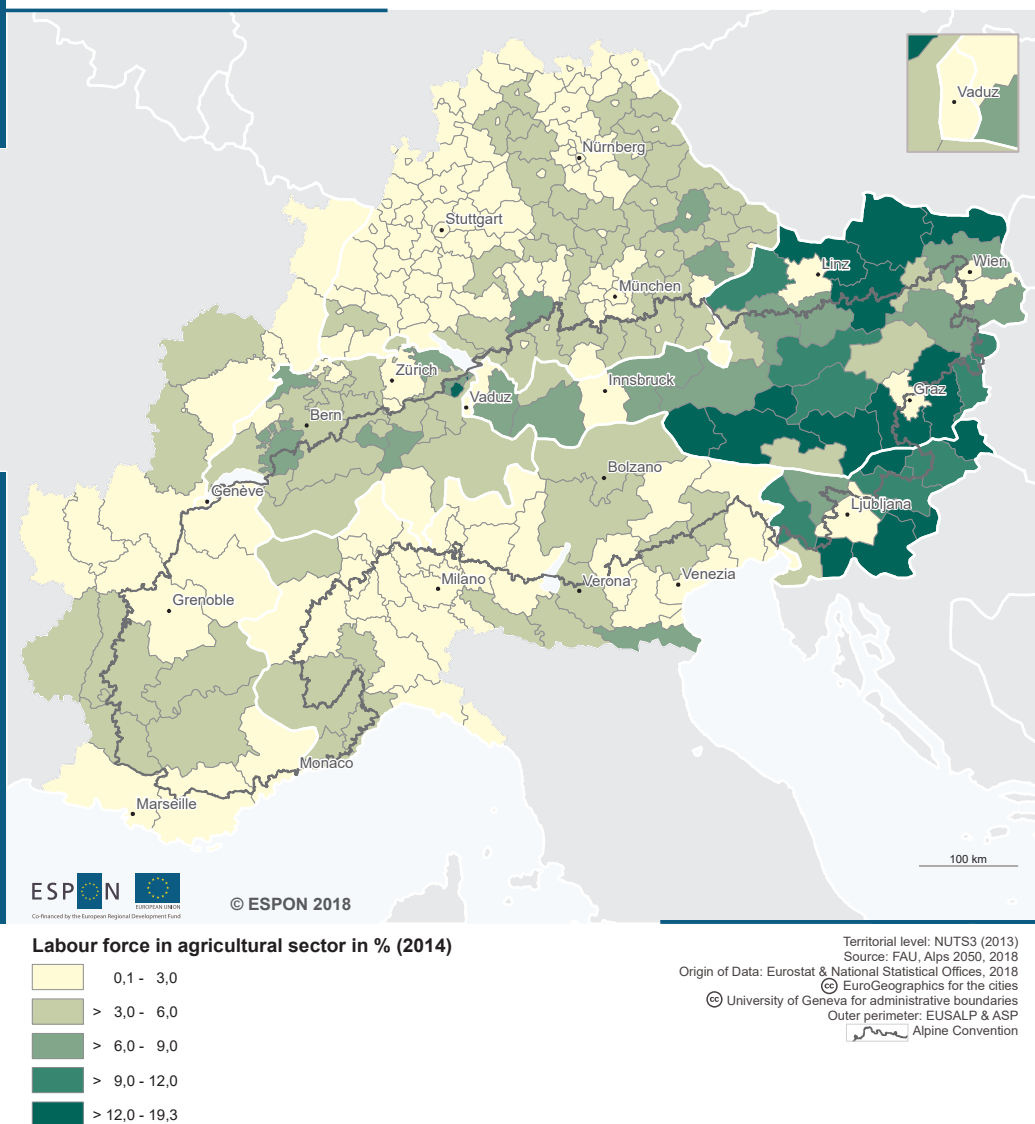
Map 21   Share of labour force in agricultural sector 2014

Indicator/Methodology: Map 21 shows the employees in the NACE sector A, comprising agriculture, forestry, and fishery relative to all employees on the NUTS 3 level (in %). The data is provided by Eurostat and, thus, is harmonised on the European level (with the exception of Switzerland and Liechtenstein). In some countries (in particular in Austria, some concerns also in Slovenia and Italy), the Eurostat data contradicts domestic data due to different definitions (e.g. part-time working) and methodologies. This visualisation shows the share of all persons (employees) and not full-time equivalents which would show far lower values.

Description: The spatial pattern shows values over average for large parts of Slovenia and (Eastern) Austria. This pattern is not easy to explain: beyond the statistical complexity, the enhanced values for Austria could be explained with a high priority policy for rural and mountainous areas.
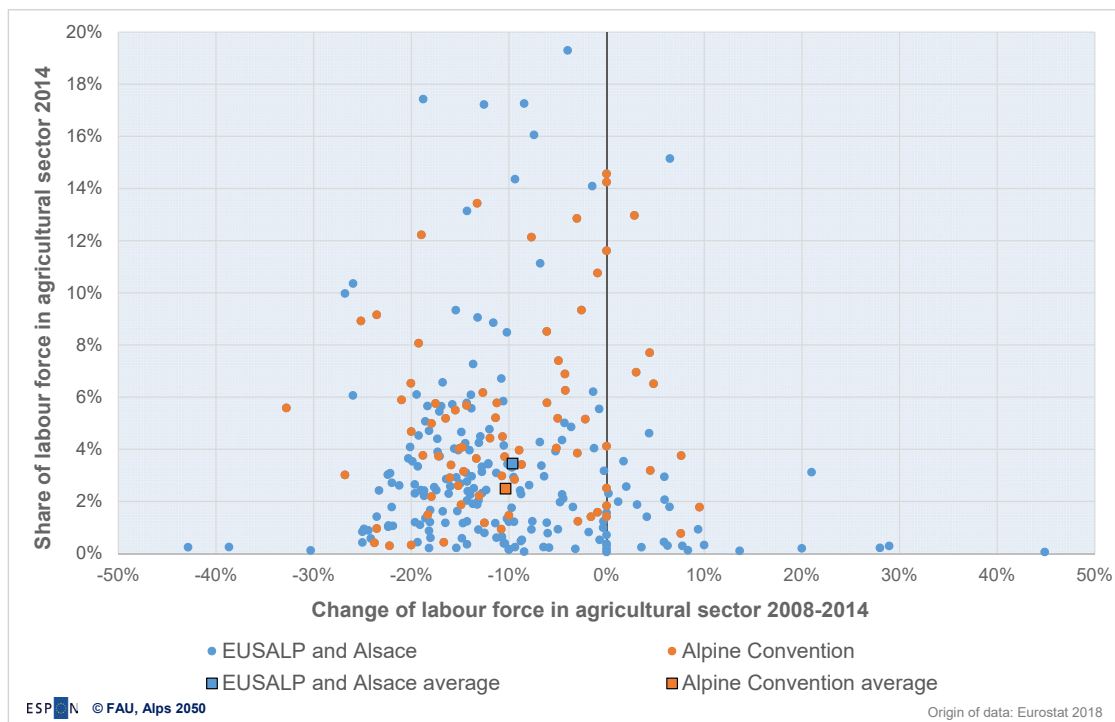
Fig. 5   Change of labour force in the agricultural sector on regional level – comparing pre- and inner-Alpine districts
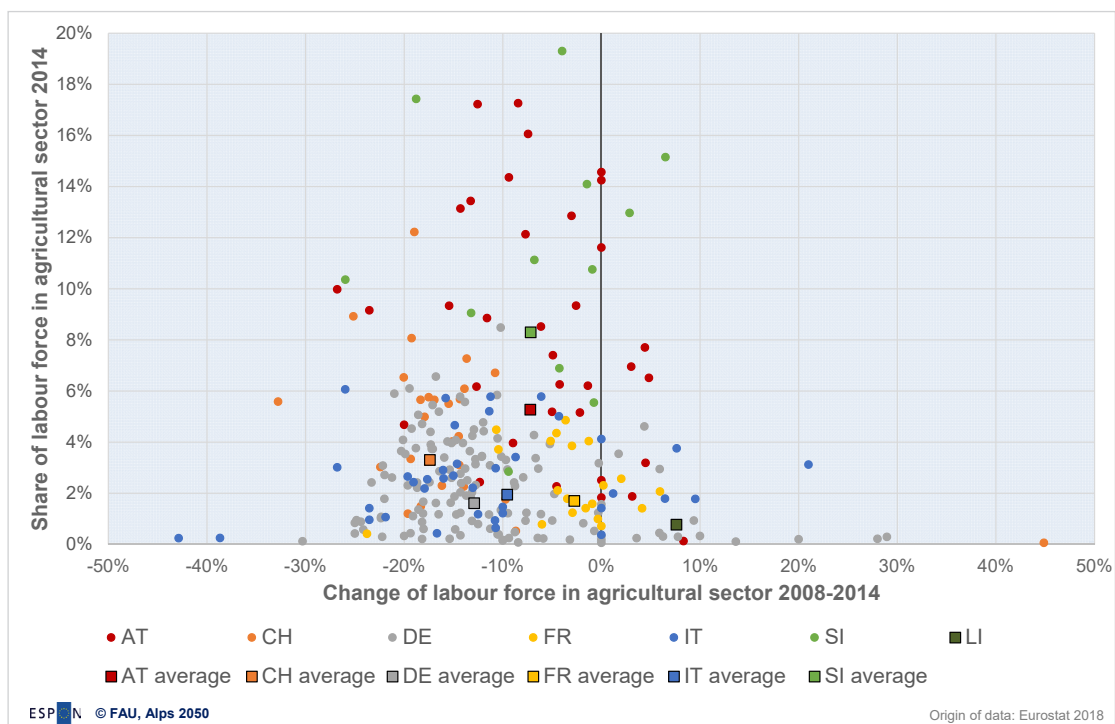
Fig. 6   Change of labour force in agricultural sector on regional level – comparing districts of different national affiliation

Indicator/Methodology: The scatter plots of Fig. 5 and Fig. 6 visualise the level of agricultural employment on the y-axis and the change of the labour force in the agricultural sector for 2008-14. Each dot represents one NUTS 3 region; in the upper graph, we differentiate the inner-Alpine regions ("Alpine Convention") and the pre-Alpine regions (EUSALP and Alsace without Alpine convention

areas). In the lower scatter plot we differentiate the national affiliation – each colour represents one country affiliation.

Description: All in all, we see a diverse development spatial pattern. The scatter plot confirms the impression from the cartographic representation of Map 21 that the differences between inner-Alpine and pre-Alpine areas are not significant, in other words: the average values are very close between the inner and pre-Alpine space. However, the national affiliation does matter – the average values of the national level are clearly different. This shows the relevance of political decision-making (funding programmes, subsidies etc.).

5.4 Innovation

Patent applications

Patent applications per mio. inhabitants (2012)

	9 - 150
	> 150 - 300
	> 300 - 450
	> 450 - 600
	> 600 - 1770
	no data

Territorial level: NUTS3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
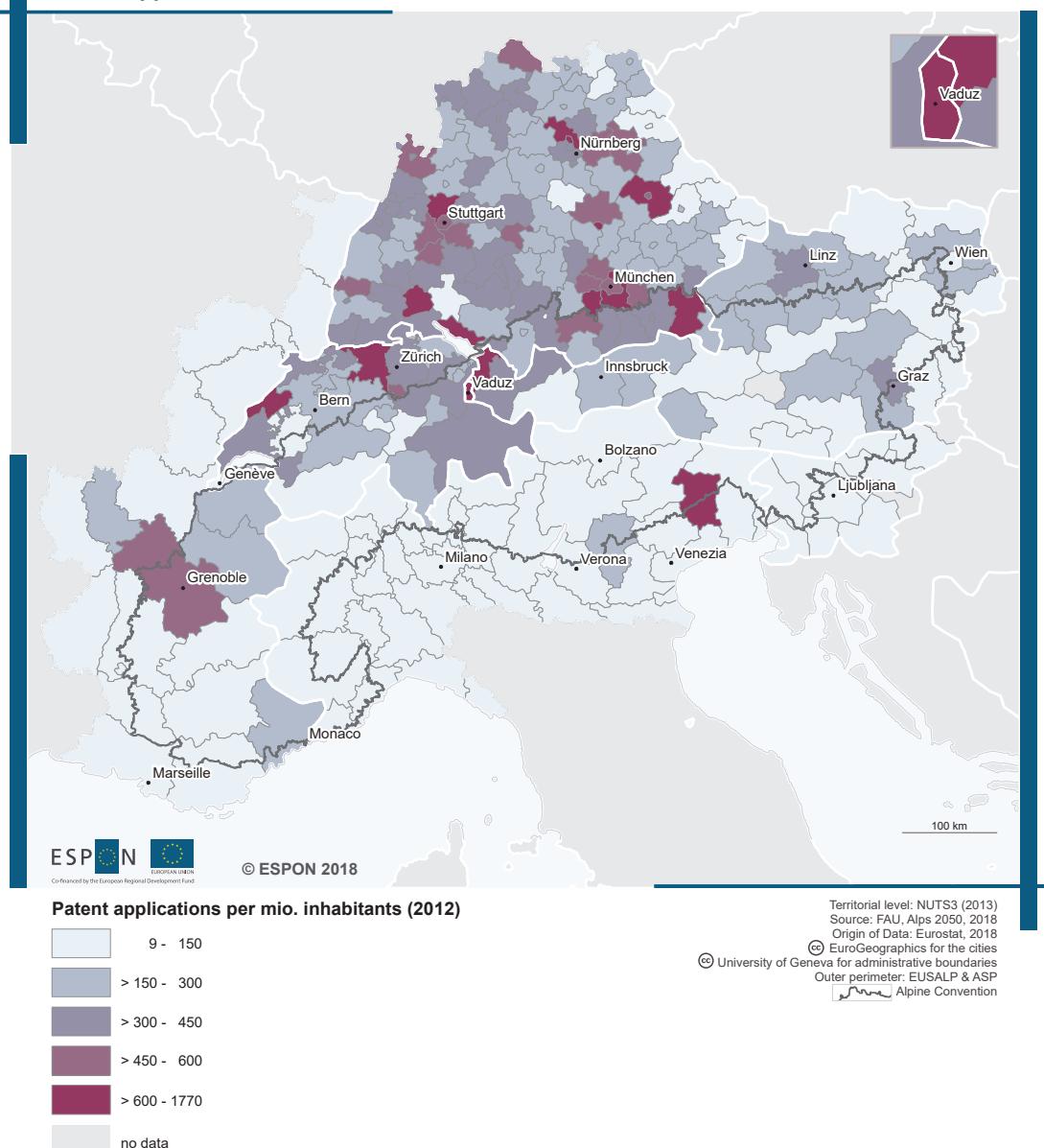
Map 22   Patent applications per mio. inhabitants 2012

Indicator/Methodology: Map 22 visualises the indicator patent application per million inhabitants at the European Patent Office (EPO). This map shows very different values on the NUTS 3 level. The methodological debate on this indicator is complex: One might criticise the focus on technological innovations and, thus, the underestimation of process innovation, social innovation, management innovation etc. – at the same time, the number of EPO patents correlates strongly with socio-economic development and, thus, is an important hint.

Description: This map shows a pretty sharp North-South contrast within the Alps 2050 perimeter comprising values below 150 and above 600. There is a certain focus on metropolitan regions, but the national affiliation to Northern Alpine or Southern Alpine countries is important. The Swiss and German economies tend to be over the average of patent applications, and so is Northern Austria and the Grenoble region; large parts of France, Italy and also Slovenia show low levels of patent application.

5.5 Tourism

Tourism intensity

Overnight stays * 100 per inhabitant (2015)

	7 - 250
	> 250 - 500
	> 500 - 750
	> 750 - 1000
	> 1000 - 1500
	> 1500 - 8379

Territorial level: NUTS3 (2013)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
EuroGeographics for the cities
University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention
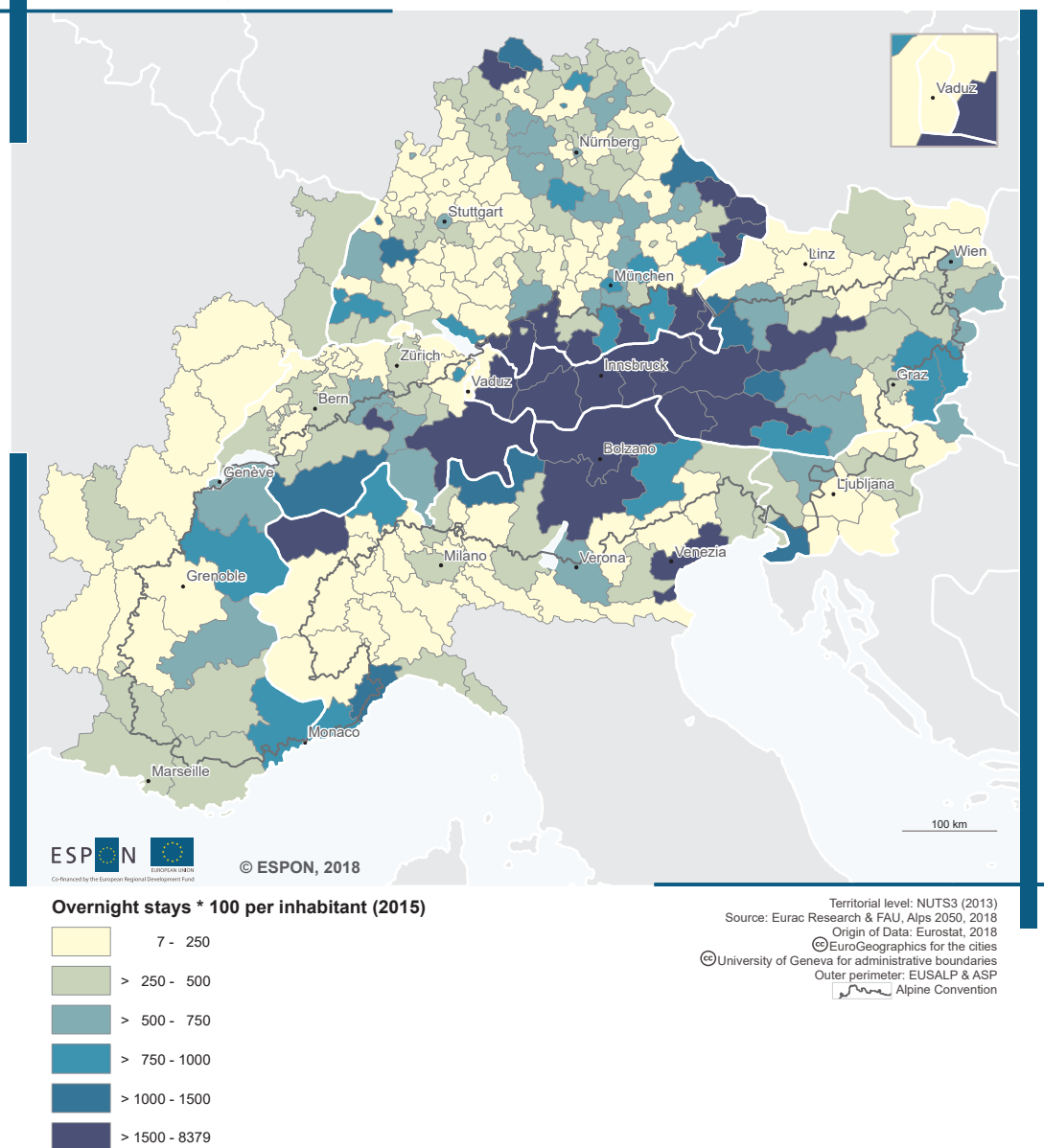
Map 23   Tourism intensity 2015 – overnight stays per 100 inhabitants

Indicator/Methodology: The indicator tourism intensity is calculated on the NUTS 3 level and is based on the formula "overnight stays per year x 100 / population 2015" (Map 23). It shows the actual demand (and not only the infrastructure quantity as shown in the next map).

Description: The values are the highest in the central and Eastern parts of the inner-Alpine area. This is due to the strong presence of the tourism sector and the relatively low population density. As a result, the relative economic importance is the highest in inner-Alpine areas.

Tourism capacity
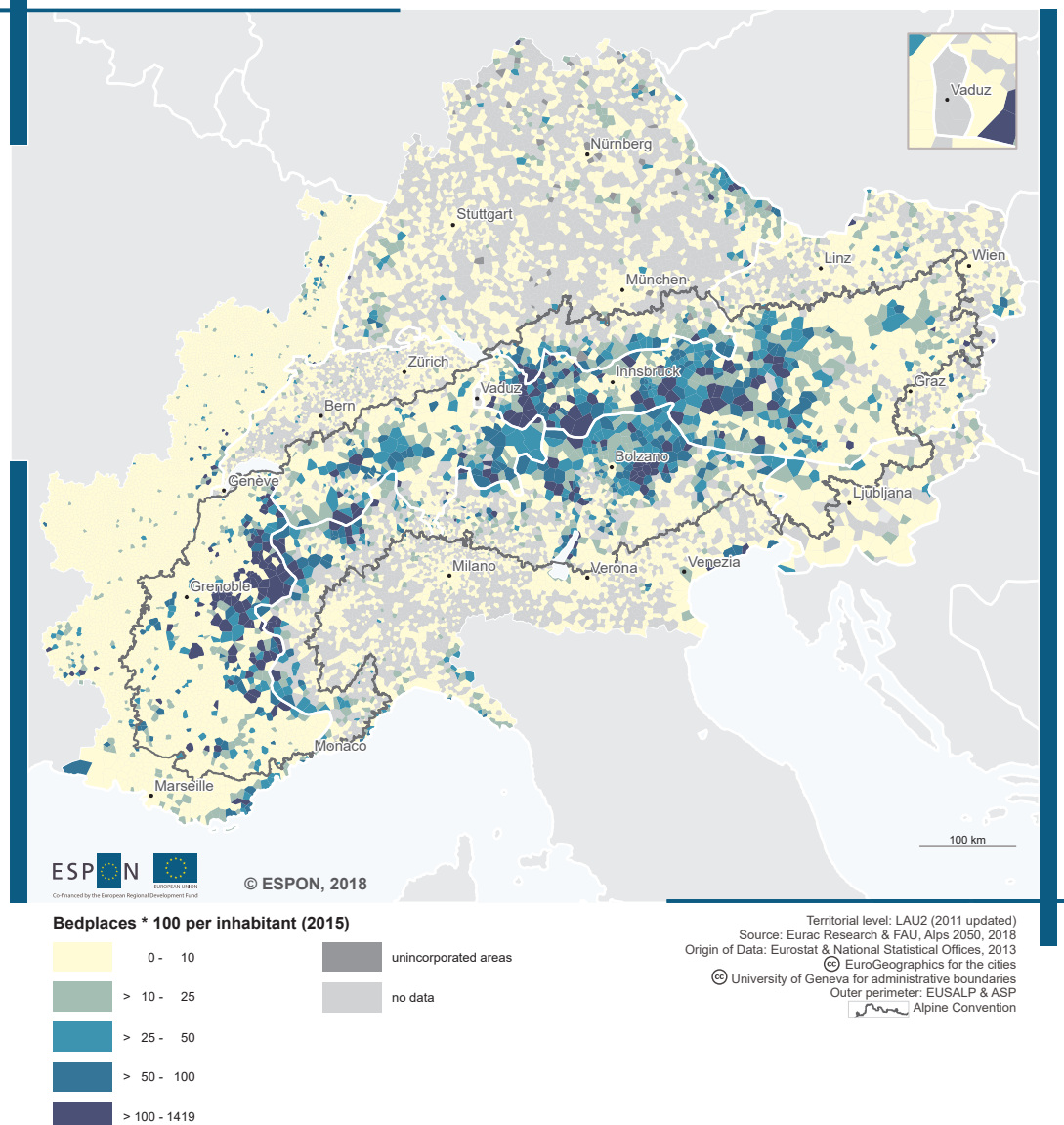
Map 24   Tourism capacity 2015 – bedplaces per 100 inhabitants

Indicator/Methodology: The indicator tourism capacity is calculated on LAU level and is based on the formula "bedplaces / inhabitants 2015" (Map 24). This indicator shows the actual tourism infrastructure. The methodology counting bedplaces differs in the nation states so that the maps shows bedplaces in hotels and similar establishments[3]. The large number of municipalities without data is due to data protection reasons.

Description: The overall patterns underline the findings described in Map 23. However, the finest spatial scale reveals large differences within one region – the skiing places on the French side or the Dolomites on the Italian side are very visible – and the local influence on tourism activities. In Slovenia apart from the tourism capacity in the Alpine part (Triglav national park area), the greener parts are mostly related to the spa centres based on the thermal water. The coastal towns have higher capacities in Slovenia, Italy and France.

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3   Data refer to "Hotels and similar establishments" without campsites. Slovenia and Austria: "permanent beds" (without extra beds or couches); Liechtenstein: Hotel industry ("Hotellerie") in Liechtenstein.; Switzerland: hotels and spa facilities; France: hostel beds, holiday residence, villages vacances (holiday village) and an estimated number of hotel beds (number of rooms x2); Austria: hotels and similar establishments, including commercial accommodations; Germany: Bavaria, bed places are excluding camping places; Baden-Württemberg: Hotels, Hotel garnis, guest houses and hostelry

Bedplaces change

Bedplaces change in % (2001*-2010)

■	-49 - -40	■	> 0 - 20	■	no data
■	> -40 - -20	■	> 20 - 40		
■	> -20 - 0	■	> 40 - 60		
		■	> 60 - 133		

* data for some Italian and German regions refer to 2003/04

Territorial level: NUTS3 (2013)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of Data: Eurostat, 2018
ⓒ EuroGeographics for the cities
ⓒ University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

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Map 25   Bedplaces change 2001-2010

Indicator/Methodology: Map 25 shows the changes of bedplaces between 2001 and 2003. Brown/ yellow colours indicate a loss, green colours indicate growth dynamics.

Description: In mountainous areas, the economic role of tourism tends to grow. The differences between the national contexts are striking: The values are largely positive for the Italian and Slovenian side and negative for the French side.

6 Ecology and ecosystem services

6.1 Protected areas

Protected areas
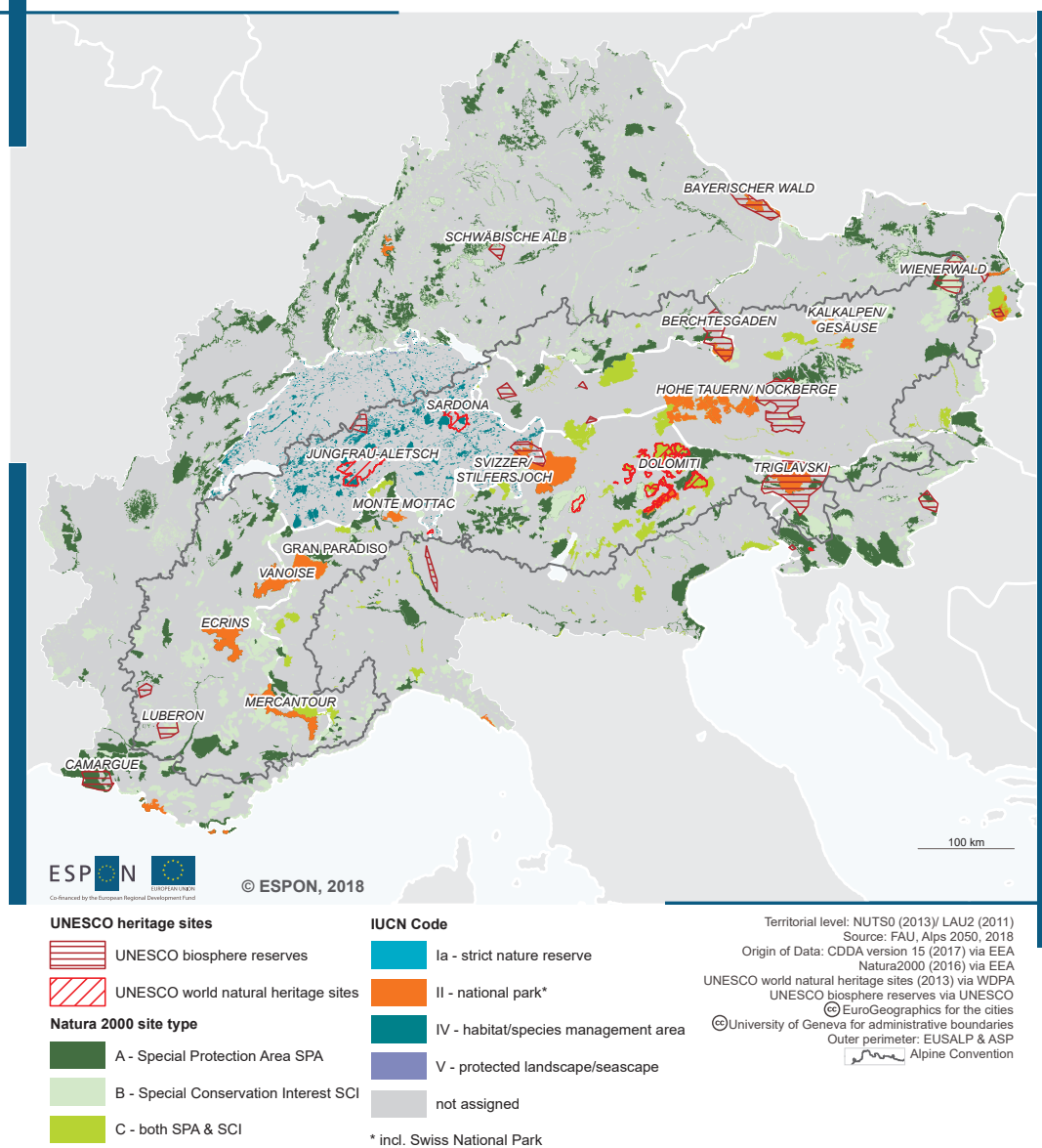
Map 26   Protected areas

Indicator/Methodology: Map 26 provides an overview on the state of the protected areas in the Alps 2050 perimeter. From a methodological point of view, this is a challenge as domestic protection regimes are not standardised or officially documented. But there are diverse helpful sources that are brought together in this map:

- Within the EU, the Natura 2000 network shows those sites that are protected due to the habitats directive (Special Conservation Interest SCI) and the directive on the conservation of wild birds (Special Protection Area SPA).

- On global level, the UNESCO offers the protection formats of natural heritage sites and biosphere reserves.

- In the case of Switzerland, which is (as non EU-member) not included in the Natura 2000 network, the map shows the IUCN codes Ia and IV which follow similar protection purposes as the Natura 2000 network. The IUCN (International Union for conservation of nature) is an NGO umbrella organization that also involves many governmental ministries. The IUCN code helps to make regional and national protection regimes comparable.

Description: Again, we see clear differences between the national protection regimes. For example, national parks are much more frequently enacted in AT, FR and IT, whereas DE and CH have fewer national parks which are mostly relatively small in size. Another example is the different implementation path of the EU protection directives that display very different average sizes of protection areas within the different countries, ranging up to 38% of protected area in Slovenia.

The inner-Alpine area is not necessarily more or less often object to protection measures. However, many famous mountain massifs are object to national park regimes and/or UNESCO protection (e.g. Dolomites in Italy, Triglav in Slovenia).

6.2 Soil sealing
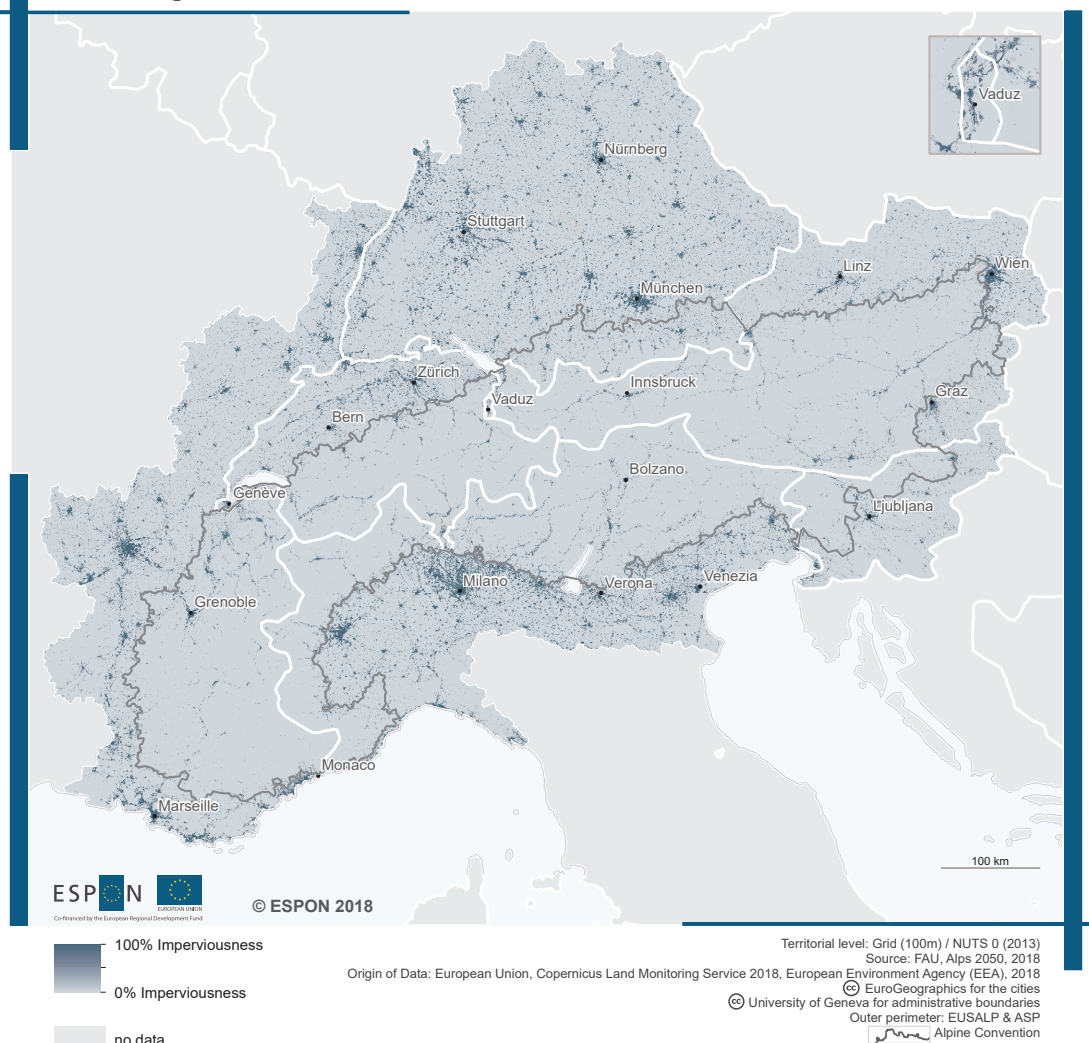
Map 27   Soil sealing 2012

Indicator/Methodology: Map 27 shows soil sealing in the year 2012. Soil sealing is measured as a degree of imperviousness based on grid data (100 m) differentiated by colour. The data is provided by the European Environmental Agency.

Description: Soil sealing of the Alps 2050 perimeter shows the following patterns and characteristics:

- Within the Alpine Convention perimeter, the extent of the impervious area is much lower than beyond.

- The map shows that the impervious degree is the highest outside the mountainous area, especially in the major urban areas of Lyon, Torino, Milano, Verona, Wien, Linz and Munich. In accordance to the settlement system, some inner Alpine valleys are displayed on the soil sealing map but on a much lower level of imperviousness, e.g. the Rhone valley (Valais), the Rhine valley (North and South of Liechtenstein), the Inn valley (around Innsbruck), and the Isère valley (between Geneva and Grenoble), the Po valley (from Milano Eastwards) etc.

This is one of the maps that clearly displays a morphological picture of the Alps. It highlights the mountainous area including the exceptions of the biggest Alpine cities of Innsbruck, Bolzano and Grenoble. The overall picture must not be misunderstood in the sense that soil sealing would not be a problem in mountainous areas: In these areas, the settlement pressure concentrates on the flat valleys that represent only a small share of the whole territory.

In accordance with the settlement system soil sealing also shows the relevance of the morphological structure of the Alpine valleys and the agglomeration ring all around the mountainous area. Soil sealing is not an issue limited to a national context and rather belongs to the common challenges of the Alps and should be part of future macro-regional studies and debated on a transnational level.

Soil sealing changes 2009-2012

Annual changes sealed area/land area

-0,40 - -0,10	> 0 - 0,05
> -0,10 - -0,01	> 0,05 - 0,10
0	> 0,10 - 0,15
	> 0,15 - 0,20
	> 0,20 - 1

Territorial level: Grid (10 km²) / NUTS0 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: European Environment Agency (EEA), 2017
cc EuroGeographics for the cities
cc University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

© ESPON 2018
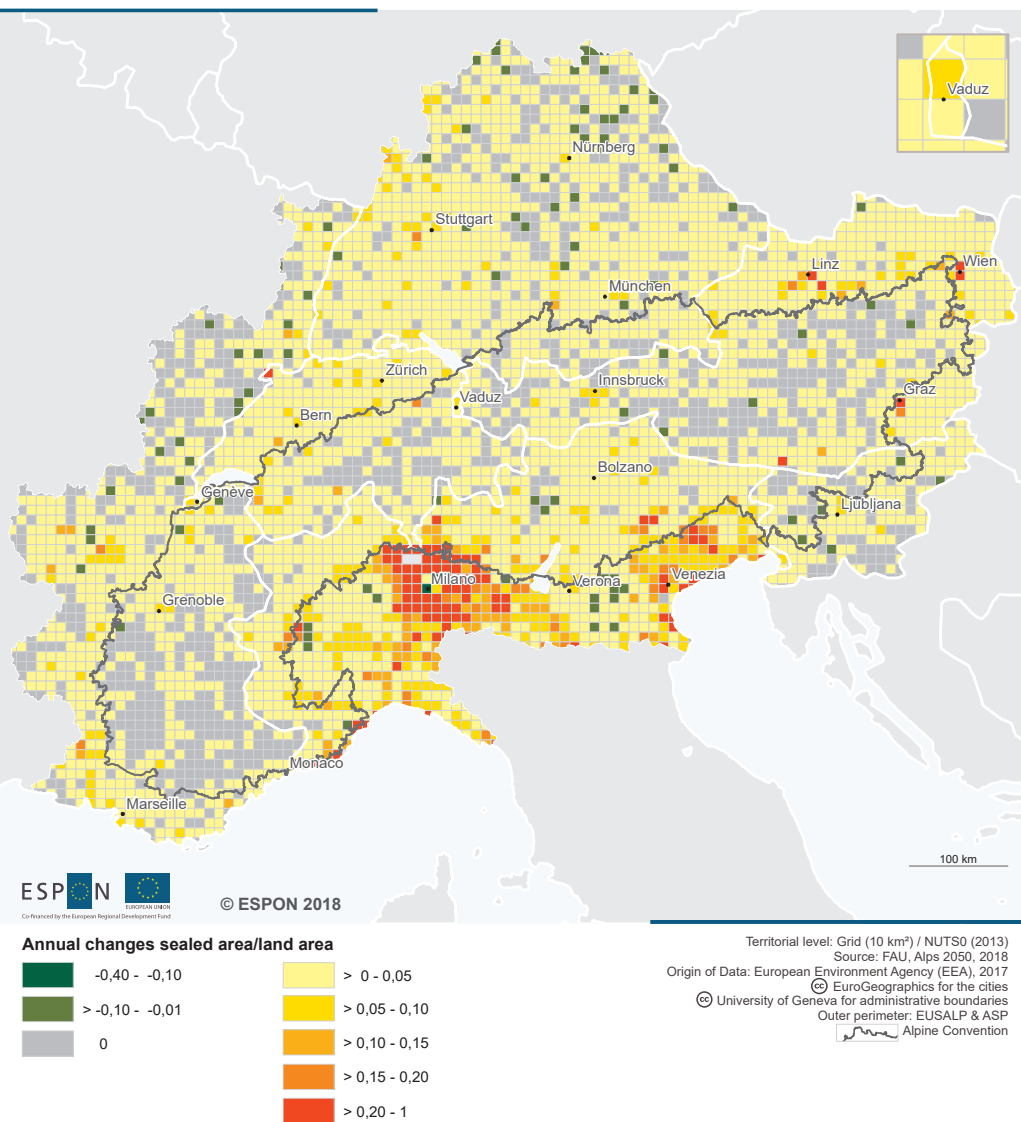
Map 28　　Soil sealing changes 2009-2012

Indicator/Methodology: Map 28 shows the trend in soil sealing between 2009 and 2012. This is a rather short time period and already some years old, but it is the only dataset displaying trends for the complete Alps 2050 perimeter. Soil sealing is measured as the relation of sealed area to land area based on grid data (10 km) differentiated by colour.

Description: Soil sealing is a trend that can be observed in almost all parts of the Alps 2050 perimeter. The map shows that soil sealing is a trend that is most probably to happen in urban areas, and it is most present in the area around Milano, but also Torino and Venice. It is less prominent in the very inner-Alpine areas where morphology largely prevents settlement activity. In general, we see that soil sealing is a slow, but steady process affecting almost all municipalities, as the light yellow colour in the map shows. More than the speed it is the omnipresence of the trend that makes it an important topic.

6.3 Eco-system services

Eco-system services - Leisure
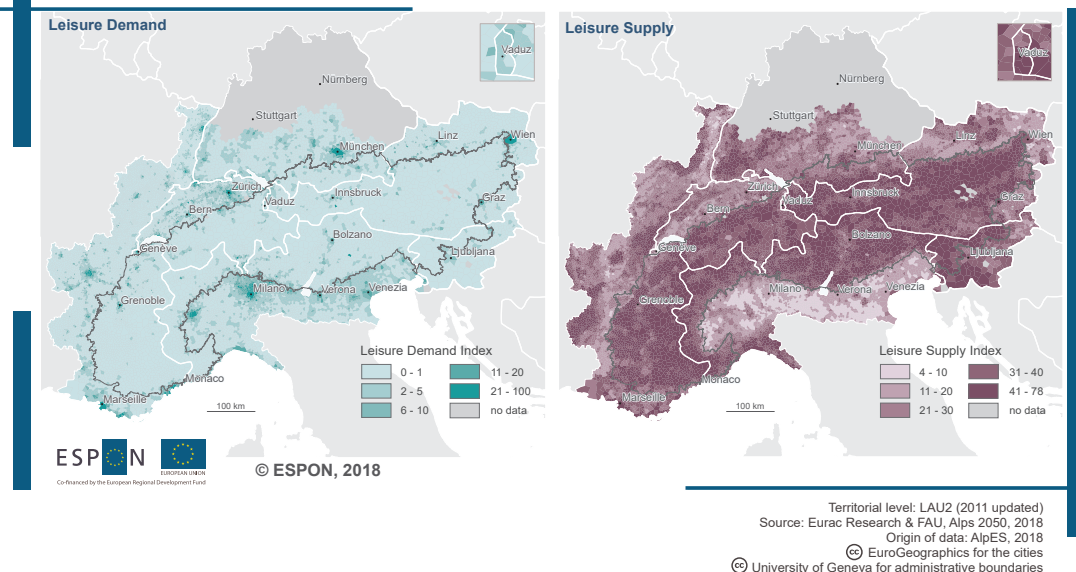
Map 29   Eco-system services – Leisure demand and supply

Indicator/Methodology: The data behind these representations (Map 29) is based on the outputs of the Alpine Space project "AlpES: Alpine Ecosystem Services – mapping, maintenance, manageme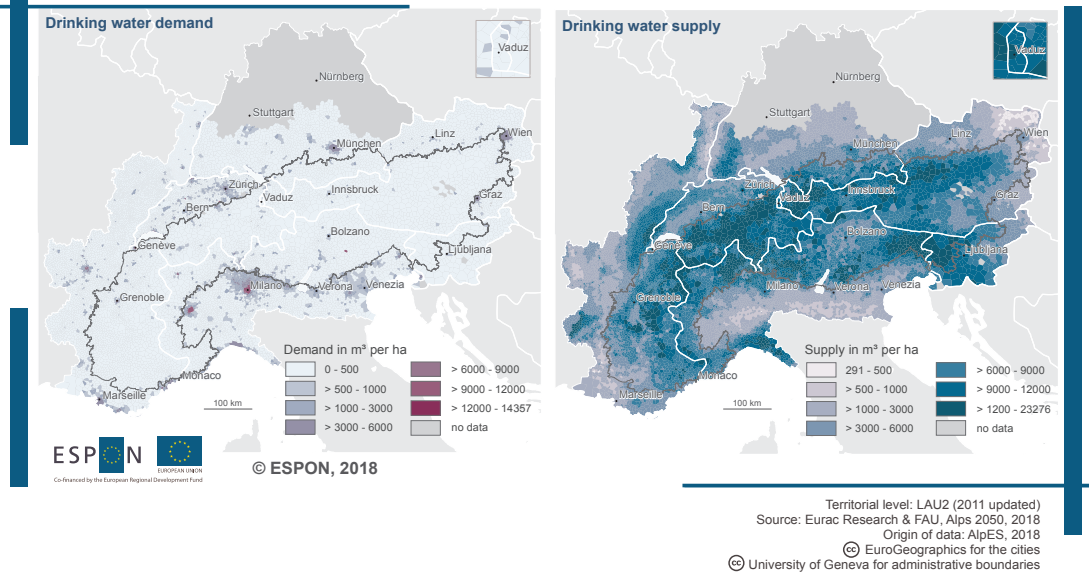nt" that aimed to reflect the spatial patterns and functions of Ecosystem Services in the Alpine Space cooperation area. Leisure supply and demand is one of the Ecosystem services addressed in this project which is described in more detail by Schirpke et al. (2017). Following this approach, the recreation ecosystem service includes both, the recreation potential provided by ecosystems (the supply side) and the possibility to benefit from it (the demand). Recreation supply is defined as the capacity of ecosystems to provide recreation opportunities due to the natural preconditions without human input and regardless of these being actually used. The service, however, is only provided if people can reach the supply areas to carry out recreational activities. Thus, the supply (right-hand side) is related to areas capable of providing recreation that are accessible by transport infrastructure. The demand for recreational opportunities (left-hand side) is here expressed by quantifying local beneficiaries (inhabitants and tourists) considering their general societal preferences.

Description: The two maps show clearly the difference between both patterns of the ecosystem service recreation (leisure). The demand is located at those places where the population density is very high; leisure supply is mostly concentrated in mountainous regions. What the map does not show (but the more detailed data behind), is that recreational landscapes around urban agglomerations are frequented all the year long, whereas visitation rates in remote mountain areas depend greatly on the season.
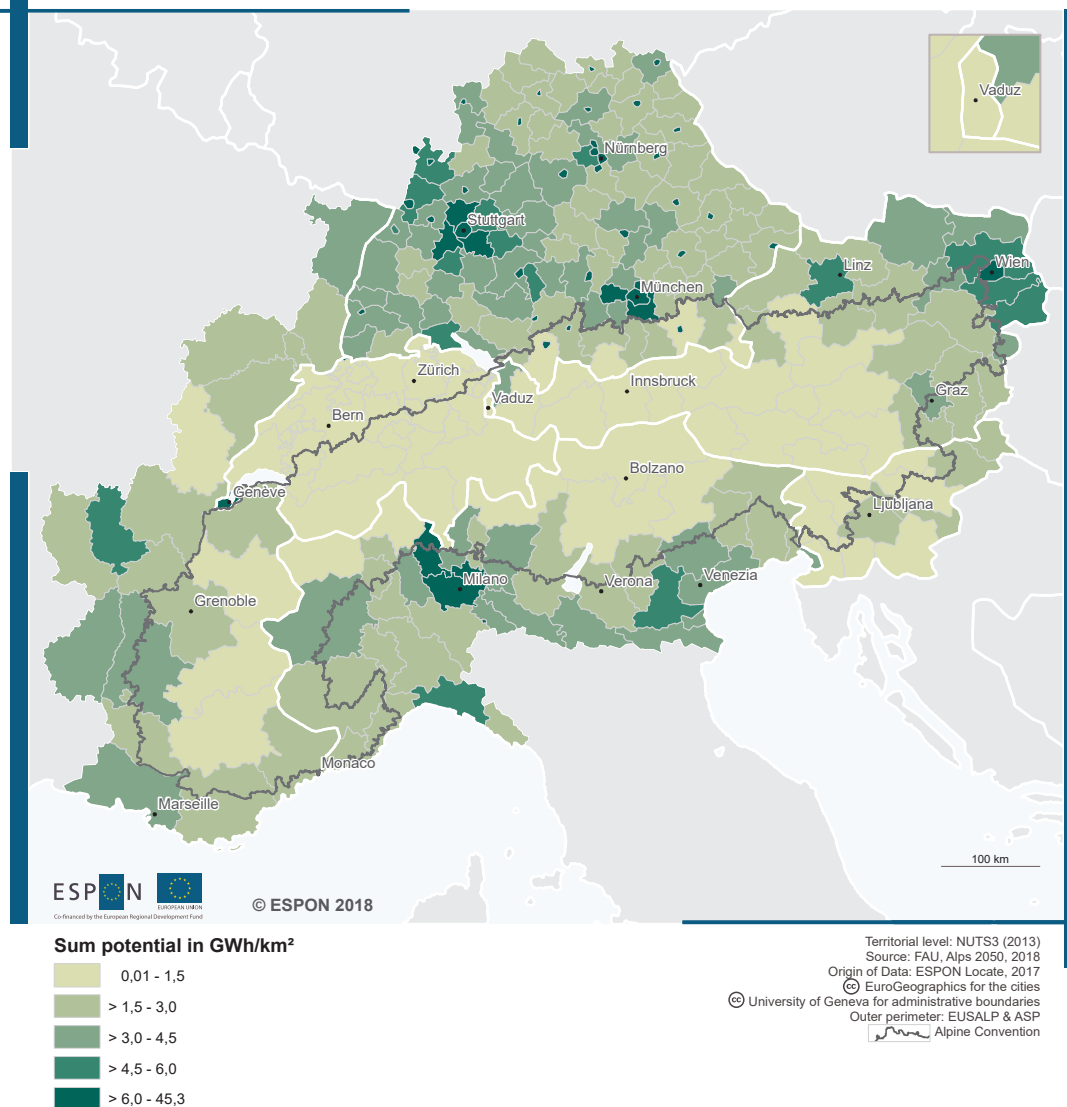
Eco-system services - Drinking water

Drinking water demand

Demand in m³ per ha

0 - 500	> 6000 - 9000
> 500 - 1000	> 9000 - 12000
> 1000 - 3000	> 12000 - 14357
> 3000 - 6000	no data

100 km

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Drinking water supply

Supply in m³ per ha

291 - 500	> 6000 - 9000
> 500 - 1000	> 9000 - 12000
> 1000 - 3000	> 1200 - 23276
> 3000 - 6000	no data

100 km

Territorial level: LAU2 (2011 updated)
Source: Eurac Research & FAU, Alps 2050, 2018
Origin of data: AlpES, 2018
cc EuroGeographics for the cities
cc University of Geneva for administrative boundaries

Map 30   Eco-system services – Demand and supply of surface water

Indicator/Methodology: The data behind these representations (Map 30) is also based on the outputs of the Alpine Space project "AlpES: Alpine Ecosystem Services – mapping, maintenance, management". They separately confront the surface water supply and the surface water demand. The supply indicator (right-hand side) quantifies the annual average available water runoff with drinking-water quality. The model estimates the water runoff from subcatchment areas based on gridded information on climatic, soil, topographic and land-cover characteristics. On the contrary, the demand indicator (left-hand side) quantifies the demand for drinking water as the total annual abstraction of water for the public supply system. Water abstraction is understood as water removed directly from its source.

Description: The contrast of both maps is striking: we see that the supply indicator map clearly delineates the Alpine mountain rage, whereas the peripheral zone, which are mainly lowlands, have much lower runoff. On the contrary, the water demand is very much linked to the urban and metropolitan nodes with elevated population densities or to the permanently irrigated areas within the Alpine space. Organising these spatial patterns with political and spatial development tools is a major challenge of the Alps 2050 perimeter.

7 Energy

Technical potential of all renewable energy sources

Sum potential in GWh/km²
- 0,01 - 1,5
- > 1,5 - 3,0
- > 3,0 - 4,5
- > 4,5 - 6,0
- > 6,0 - 45,3

Territorial level: NUTS3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: ESPON Locate, 2017
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
~~~ Alpine Convention

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Map 31   Technical potential of renewable energy resources

Indicator/Methodology: Map 31 shows the technical potential of renewable energy sources in the year 2017. The sum potential of different renewable energy sources is assigned to categories differentiated by colour. The potential of renewable energy has been calculated within the Enertile model (ESPON Locate 2017). This model takes into account spatial data, meteorological data and technology-specific calculations as well as current capacities of interconnectors and electricity storage. The calculations do not show the financial investment necessary to exploit the potential. However, economically or politically unfeasible areas and options are not included in the calculations.

Description: The map of the potential of renewable energy sources in the Alps 2050 perimeter shows the following patterns and characteristics:

- This is one of the maps that clearly displays the importance of national and regional contexts. France, Italy and regions in North-eastern Austria as well as Germany show the highest potential for renewable energy sources.

- On the one hand, different potentials of renewable energy sources illustrate different policies for renewable energies. On the other hand, the map shows differences because in some countries and regions the potentials of renewable energy sources have been used already. The latter seems to be true for hydropower in Switzerland and Western Austria as well as wind resources in Germany.

The differences of the potential of renewable energy sources might be related to different policies for renewable energies in the Alps 2050 perimeter. Therefore, developing common macro-regional policies is a real challenge.

Hydropower potential

Technical potential for hydropower in GWh/km²

Large hydropower
- 0 - 0,05
- > 0,05 - 0,1
- > 0,1 - 0,2
- > 0,2 - 0,4
- > 0,4 - 9,2

Small hydropower
- 0 - 0,03
- > 0,03 - 0,05
- > 0,05 - 0,1
- > 0,1 - 0,2
- > 0,2 - 0,7

Territorial level: NUTS3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: ESPON Locate, 2017
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

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Map 32   Hydropower potential

Indicator/Methodology: The Map 32 shows the technical potential for hydropower (in GWh) in the year 2017. The map distinguishes between large and small hydropower facilities. Large hydropower is assigned to one of five categories differentiated by colour, small hydropower is assigned to five categories differentiated by hatching lines. Hydropower potential is defined as the combination of existing power plants and the remaining economically and environmentally feasible options for new plants as well as technical upgrades to existing plants. Hydropower potential was allocated to different regions according to long-term data on mean monthly discharges of flow rate stations. The economically and environmentally feasible hydropower potential does not take into account land ownership, legal status of land, planning regulation, political will to support hydropower developments, or other site-specific issues. These issues might further reduce the technical hydropower potential.

Description: The map of the technical potential for hydropower in the Alps 2050 perimeter shows the following patterns: Technical potentials for larger hydropower developments show up in France, along the Danube and Po River and in some Slovenian regions (rivers Sava and Mura). A technical potential for smaller hydropower developments displays in several Alpine regions, e.g. the Upper Rhine Valley including Vosges and Black Forest, Eastern Austrian regions or Southern Tyrol.

The tremendous regional differences of the technical potential for hydropower calls for regionally specific, place-based policies.
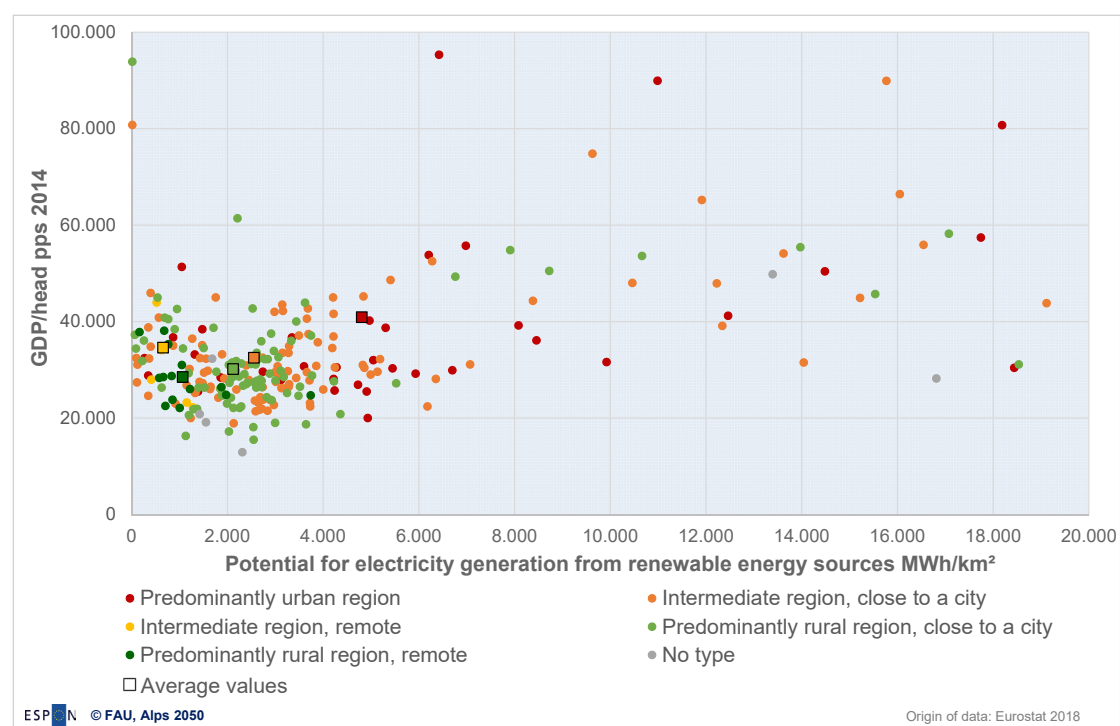

Fig. 7   Economic strength and potential for renewable energy on regional level – differentiating urban and rural territories
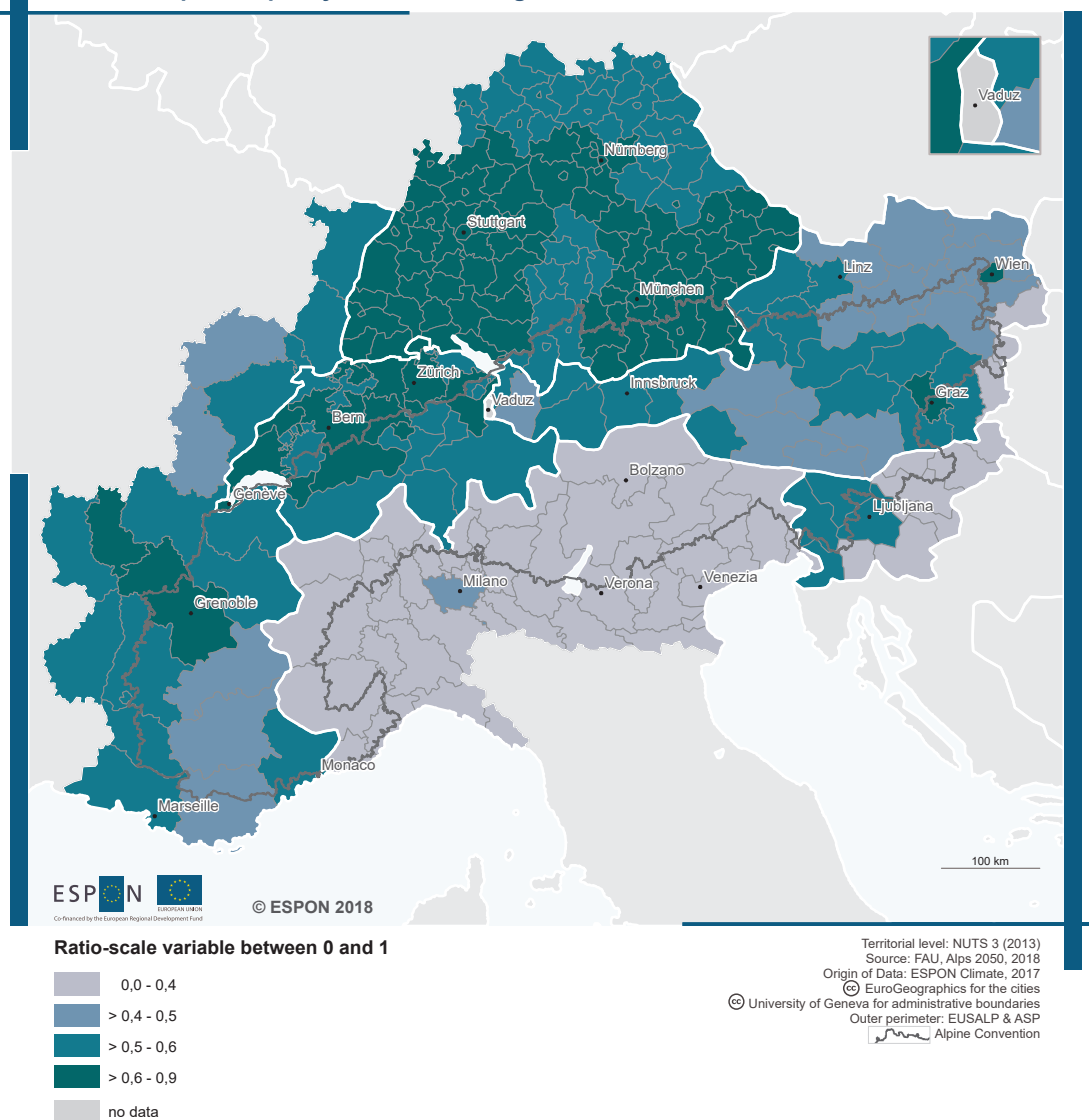
Indicator/Methodology: The map brings together the renewable energy potential as described above (Map 31), and the urban-rural differentiation as introduced above (DEGURBA typology, cp. Map 4). On the y-axis, the GDP per head values are shown (for details see Map 18 etc.).

Description: The question behind this map is if renewable energy could be a future potential for the more rural and economically less strong performing regions. The Fig. 7 shows that urban territories tend to perform stronger in the economic sense – which is true for most economies in Europe and beyond. However, it is interesting to note that urban regions also tend to have a higher potential

for electricity generation from renewable energy resources than rural spaces. As a result, energy questions are a cross-cutting question that has to be addressed in all kinds of territories.

8 Climate Change

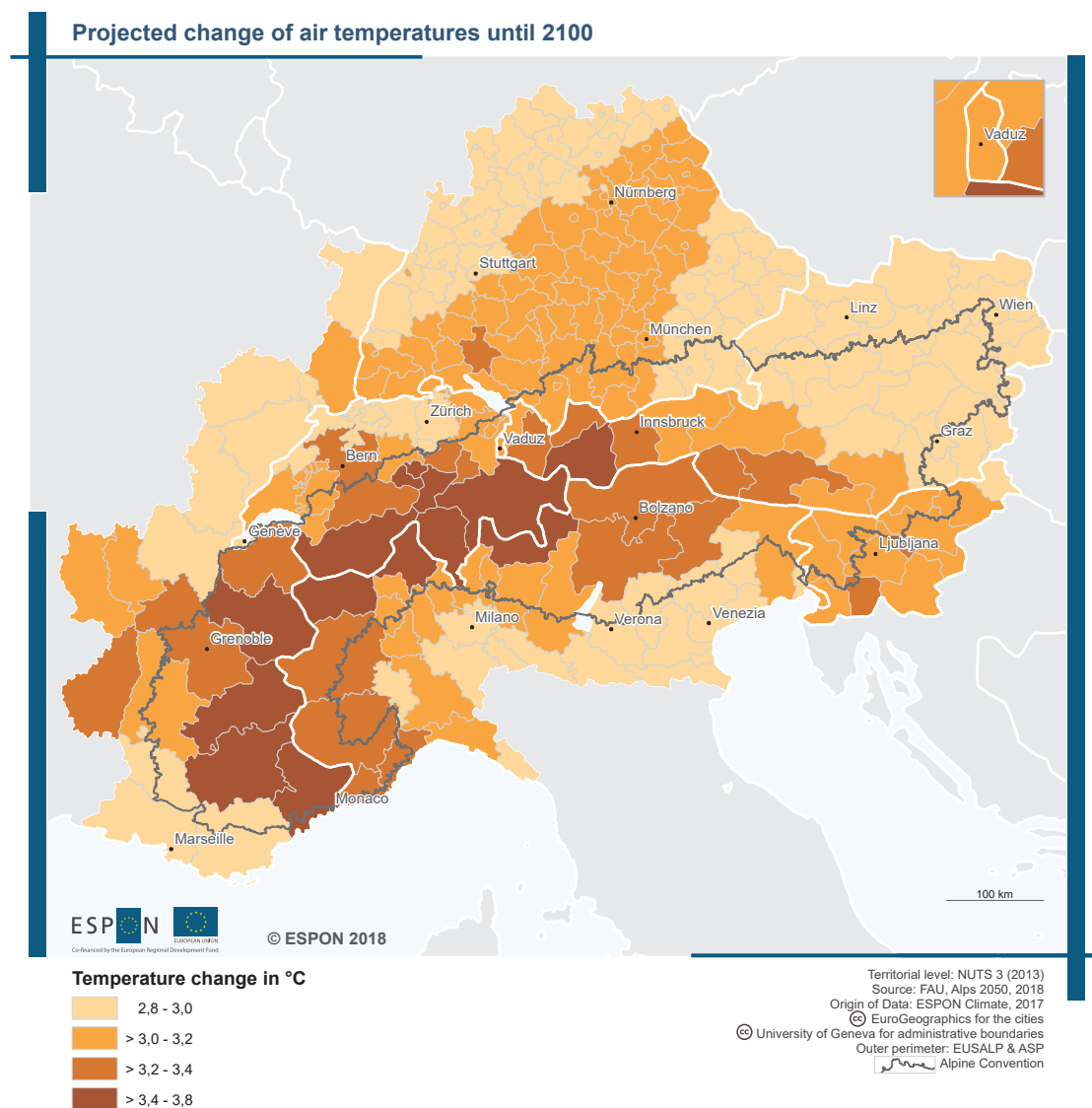**Overall adaptive capacity to climate change**

Map 33   Overall adaptive capacity to climate change

Indicator/Methodology: Map 33 shows the overall adaptive capacity to climate change in the year 2017. The adaptive capacity to climate change is measured on a ratio-scale variable between 0 and 1 and is assigned to one of four categories differentiated by colour. The overall adaptive capacity is an aggregate indicator composed of eleven indicators measured in the ESPON Climate project. The overall adaptive capacity was calculated as weighted combination of economic capacity (weight 0.21), infrastructural capacity (0.16), technological capacity (0.23), knowledge and awareness (0.23), and institutional capacity (0.17). Weights are based on a Delphi survey of the ESPON Monitoring Committee. It should be clearly stated that exposure to increasing natural hazards is not directly calculated.

Description: The differences of the adaptive capacity to climate change in the Alps 2050 perimeter show the following patterns and characteristics:

- The map shows lower adaptive capacities in Italy as well as in the Eastern parts of Austria and Slovenia. Correspondingly, higher adaptive capacities to climate change characterise the Western and Northern Alpine regions.

- The map also shows that the adaptive capacity to climate change tends to be higher in urban regions. This observation is true for all Alpine regions. Urban agglomerations such as Grenoble, Milano, Ljubljana, Graz, Vienna, Bern, Zurich, Stuttgart, Nuremberg and Munich show higher adaptive capacities than their surroundings.

- The map does neither display a morphological picture of the Alps nor distinctions between different Alpine perimeters.

It is striking that the adaptive capacities to climate change are lower in Italy than in all the other Alpine countries. The differences between urban and rural areas might be a barrier for comprehensive solutions at the regional level. This context represents a governance challenge when it comes to developing transnational strategies to adapt to climate change.

Projected change of air temperatures until 2100

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Territorial level: NUTS 3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: ESPON Climate, 2017
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

Temperature change in °C

- 2,8 - 3,0
- > 3,0 - 3,2
- > 3,2 - 3,4
- > 3,4 - 3,8

Map 34   Projected change of air temperatures until 2100

Indicator/Methodology: Map 34 shows the climatic changes calculated on the basis of the IPCC SRES A1B scenario as the 15th percentile of the changes between 1961-1990 and 2071-2100 of 12 ENSEMLBES climate models. The methodology is part of the ESPON Climate project (2017). The change in annual mean temperature is assigned to one of four categories differentiated by colour.

Description: The changes of the (air) temperature in the Alps 2050 perimeter show the following patterns and characteristics:

• The map shows higher changes in annual mean temperature within the Alpine Convention perimeter than beyond.

• Accordingly, this is one of the maps that clearly displays a morphological picture of the Alps. This map clearly represents the mountains in the Alpine region.

• In particular, the Southern side of the Alpine mountain range is characterized by the highest changes in annual mean temperature. This observation illustrates that the French-Italian, Swiss-Italian and Austrian-Italian border regions are the Alpine regions which are most severely affected by climate change.

The relevance of rising temperatures and climate change impacts in general is not bounded to a political system or national contexts. Obviously, the change of annual mean temperature is representing a common challenge of mountain areas and especially of Alpine regions on the Southern side of the mountain range. Consequently, dealing with climate change impacts such as rising temperatures calls for transnational policies and measures.

Indicator/Methodology: The figures (Fig. 8 and Fig. 9) bring the adaptive capacity to climate change and the economic strength, measured as GDP per head, together. For more details see the descriptions in the sectoral analyses above. Fig. 8 differentiates following the urban-rural typology, the Fig. 9 differentiates the national affiliations.

Description: The spatial pattern in Fig. 8 is not very clear and certainly not showing clusters ('clouds'). However, the average values might be discussed as an argument that economic strength and adaptive capacity might have a link – though a statistical correlation cannot be shown. The picture is much clearer with regard to the national affiliation (Fig. 9) which seems to be an explanatory factor with regard to adaptive capacity. This mirrors well the role of political decisions.
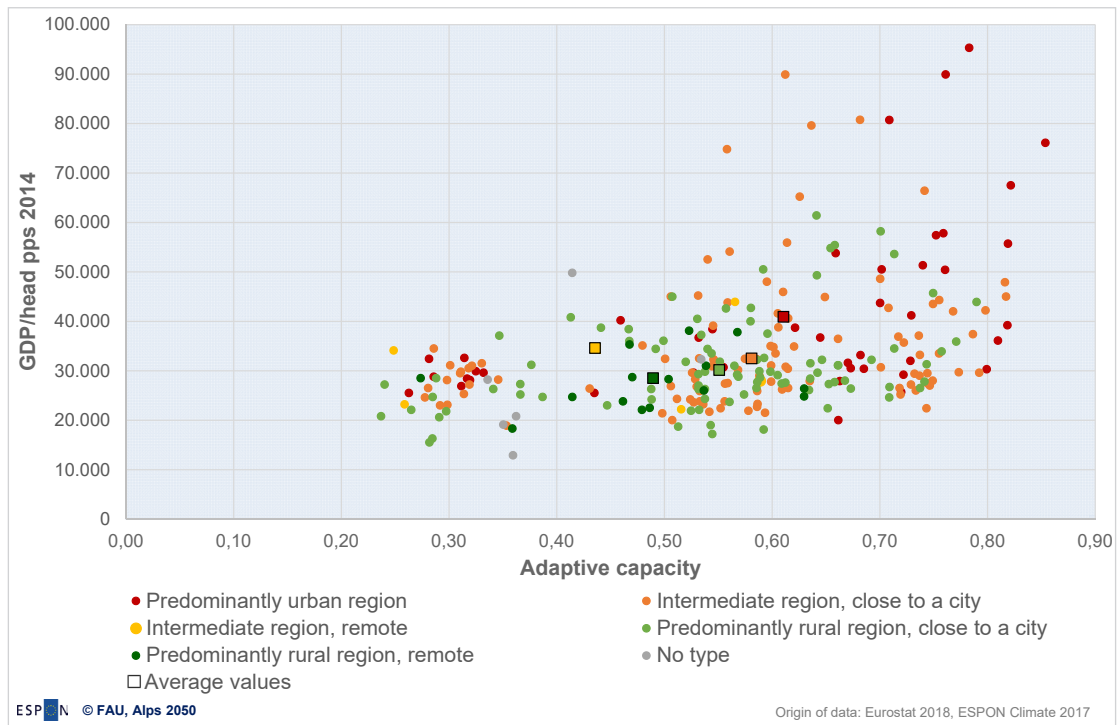
Fig. 8   Adaptive capacity to climate change and economic strength on regional level –
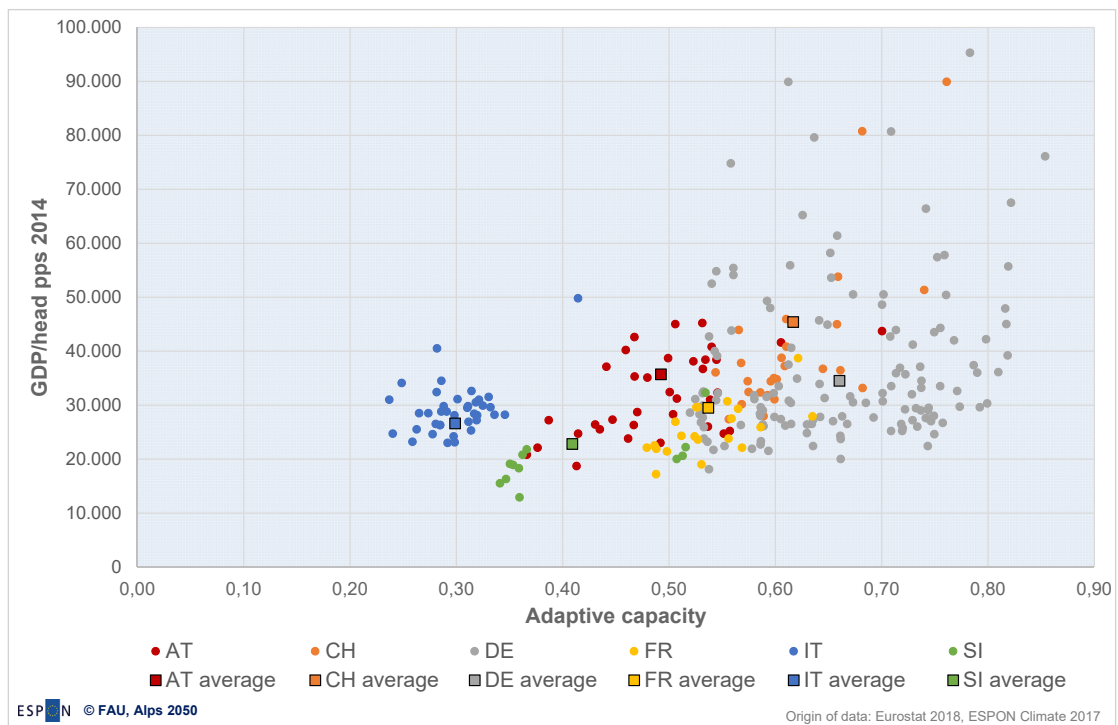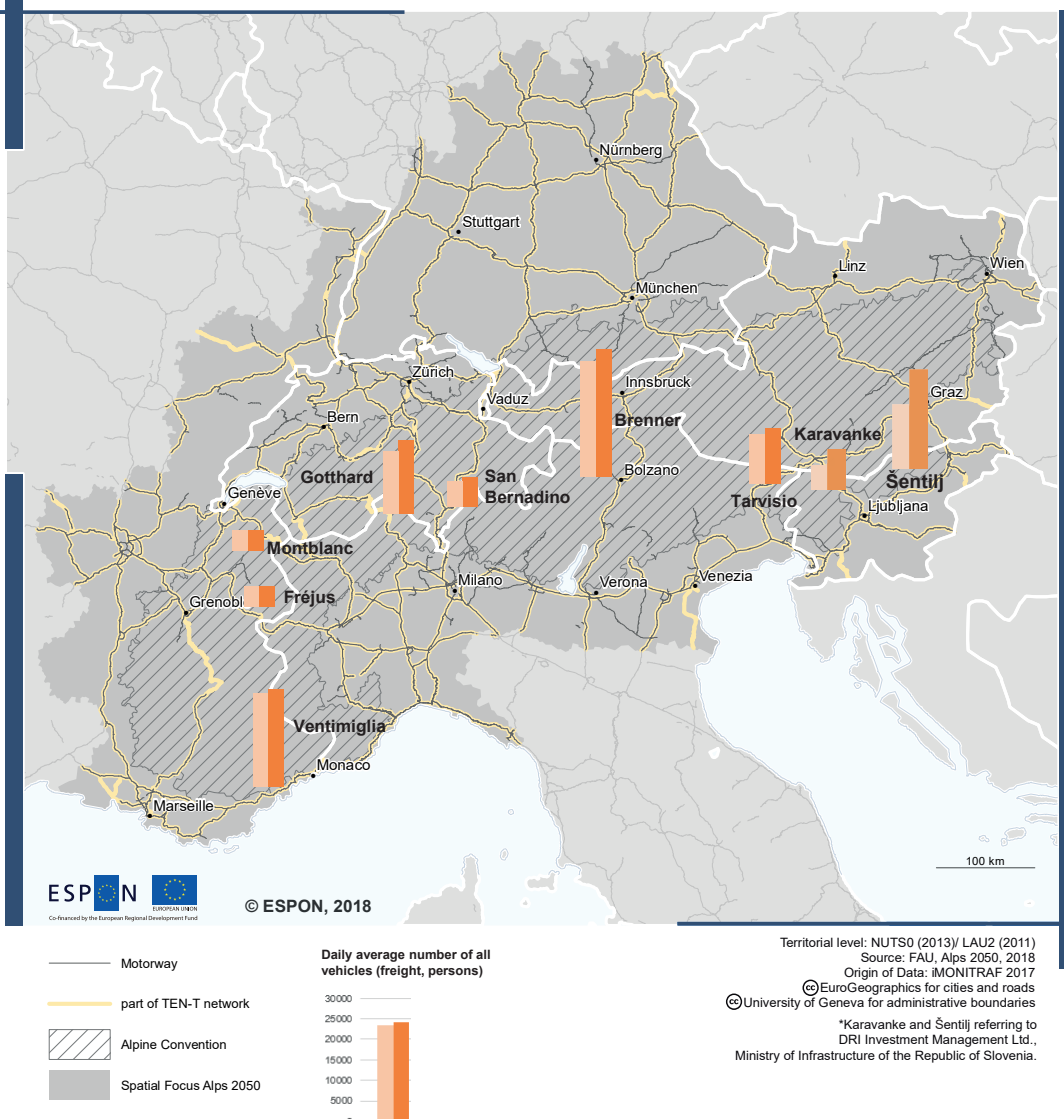differentiating urban and rural territories

Fig. 9   Adaptive capacity to climate change and economic strength on regional level –
differentiating national affiliations

9 Transport

Development of transalpine traffic flows 2006-2016

Map 35   Development of transalpine traffic flows 2006-2016

Indicator/Methodology: Map 35 shows the transalpine traffic flows for the years 2006 and 2016. The numbers comprise freight and persons and all vehicles via road for selected mountain passes.

Description: The map provides the visualisation of the uneven growth of transalpine traffic. The level of transport has grown at all transit corridors, but to a different degree.

The very simple indicator leads over to complex political debates like the 'multimodalisation' of infrastructure, the balancing of extra- and intraregional accessibility needs, the alignment of toll-systems, and potential limits to mobility growth.

Development of transalpine freight traffic flows 2000-2014

Map 36   Development of transalpine freight traffic flows 2000-2014

Indicator/Methodology: The data from the AlpInfo platform (Map 36) shows the volume of freight transport crossing the Alps in mio. tons including transit and regional traffic and including road and rail.

Description: Again the growth of transport flows is visible throughout the Alpine region (the numbers of Mont Blanc and Fréjus have to be seen against the background of the tunnel accidents in 1999 and 2005). The mountain passes as such are concentrated in Switzerland and Austria, but the connecting infrastructure involves much larger territories. The highest share passes via the Austrian passes; in particular the Brenner Pass on the border to Italy shows clearly maximum values.
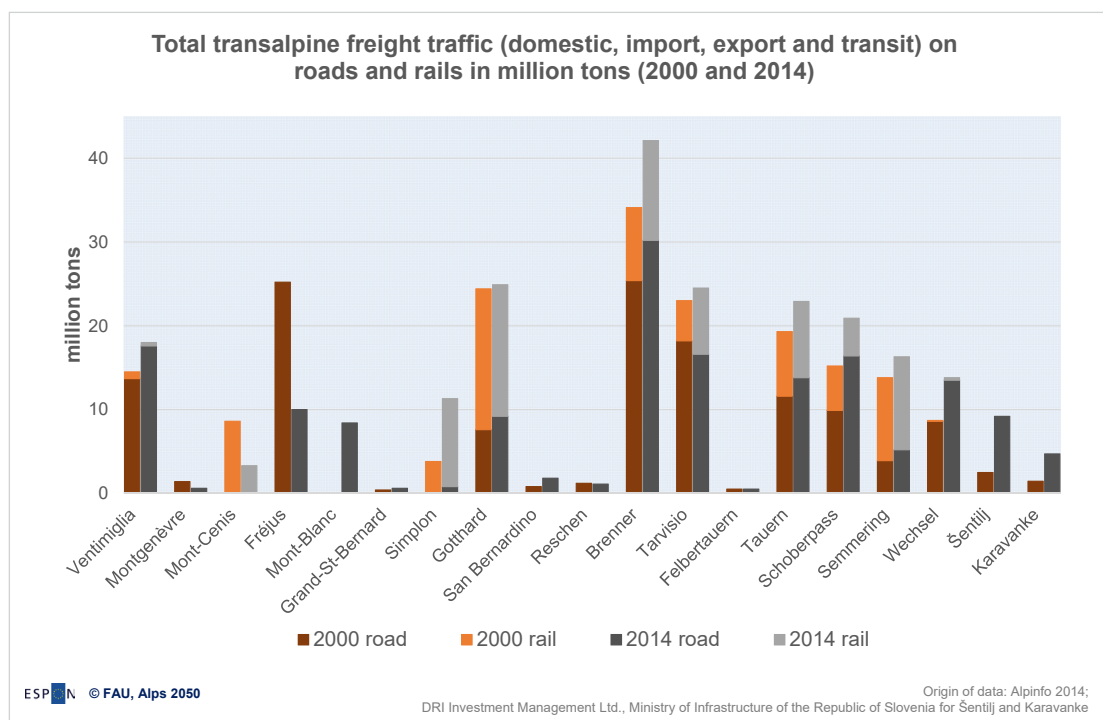
Fig. 10   Development of transalpine freight traffic flows 2000-2014 – road vs. rail

Indicator/Methodology: The data from the AlpInfo platform (Fig. 10) show the volume of freight transport crossing the Alps including transit and regional traffic and differentiates transport via road and via rail.

Description: The graphic shows a complex picture. In the Brenner corridor, the growth dynamic comes along with a slight relative modal split. In Tarvisio corridor, the overall growth comes along with a reduction of transport via road but growth on the rail. In most other corridors, the growth numbers can be found in both modes of transport (if applicable). It is obvious, that transport via rail is very much supported by regulative and financial means as the share of transport via rail is very high in the Gotthard and Simplon corridor.
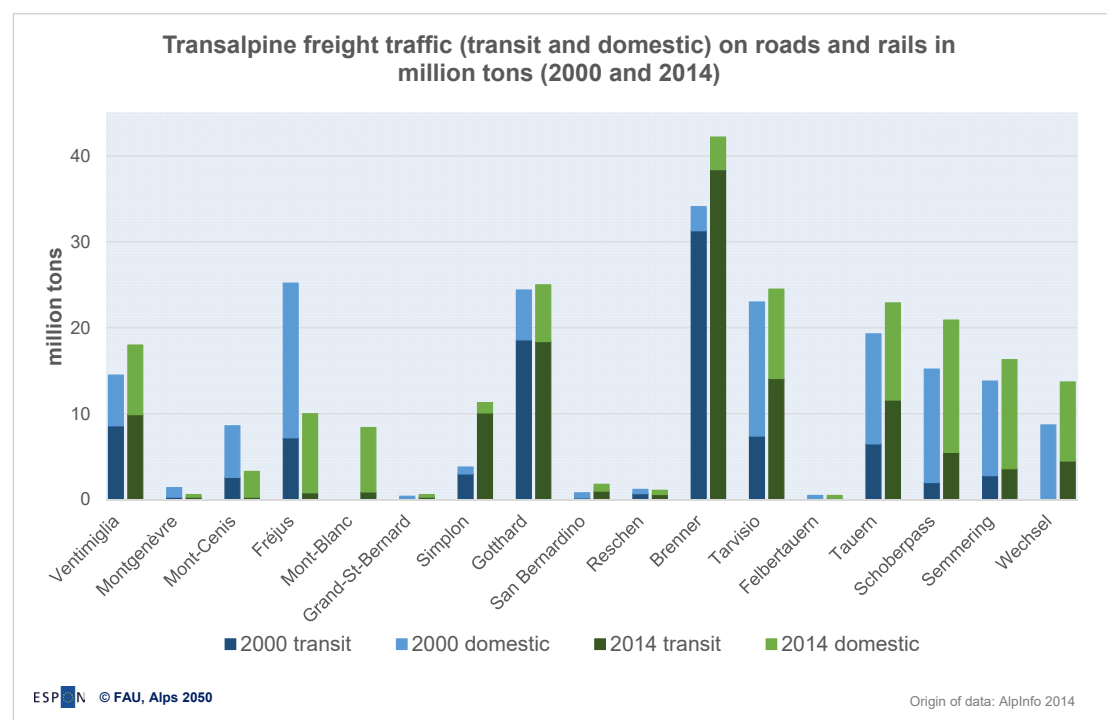
Transalpine freight traffic (transit and domestic) on roads and rails in million tons (2000 and 2014)

■ 2000 transit   ■ 2000 domestic   ■ 2014 transit   ■ 2014 domestic

ESPON   © FAU, Alps 2050   Origin of data: AlpInfo 2014

Fig. 11   Development of transalpine freight traffic flows 2000-2014 – transit vs. regional flows

Indicator/Methodology: The data from the AlpInfo platform (Fig. 11) show the volume of freight transport crossing the Alps including transport via road and via rail but differentiating transit and regional traffic.

Description: The graphic shows the very different functions of the mountain pass linkages. The Brenner corridor serves predominantly large scale purposes. Only the Brenner route with Ventimiglia, Simplon, Gotthard, Tarvisio and Tauern corridors ensure the main parts of transit flows. It also becomes obvious that the traffic growth predominantly is caused by transit flows and far less by domestic traffic.

Metropolitan linkages considering rail passenger transport

Map 37   Metropolitan linkages considering rail passenger transport – quality of rail infrastructure linking the pre-Alpine metropolises

Indicator/Methodology: The 'space-time-lines' for the pre-Alpine linkages (Map 37) has been developed in the framework of the ARPAF project cross-border (WP2 cross-border mobility in the Alpine region). The passenger transport via rail is analysed with regard to the speed (referring to air distance) and frequency of linkages (both directions). The time is measured by the fastest train connection between central stations. The basis for the data collection is the travel service site of Deutsche Bahn. The requests refer to the 14th November 2018 from 4 a.m. on (working day Wednesday). The line width shows the number of connections and the colour of the lines illustrates the speed of the fastest connection (both calculated as an average of both directions).

Description: Firstly the map illustrates that fast train connections not only serve transit purposes; metropolitan linkages play an important role for the Alpine region as such. Moreover, domestic linkages tend to be much better than those crossing borders. This is due to the high path dependency of transport infrastructure that depends on large scale investments and long planning/

implementation periods. This is in particular true for those connections that pass an intense relief. Both arguments also explain the Slovenian connectivity that has not yet reached the level of the other spaces. Spatial integration on the transnational scale certainly means to improve transnational accessibility.

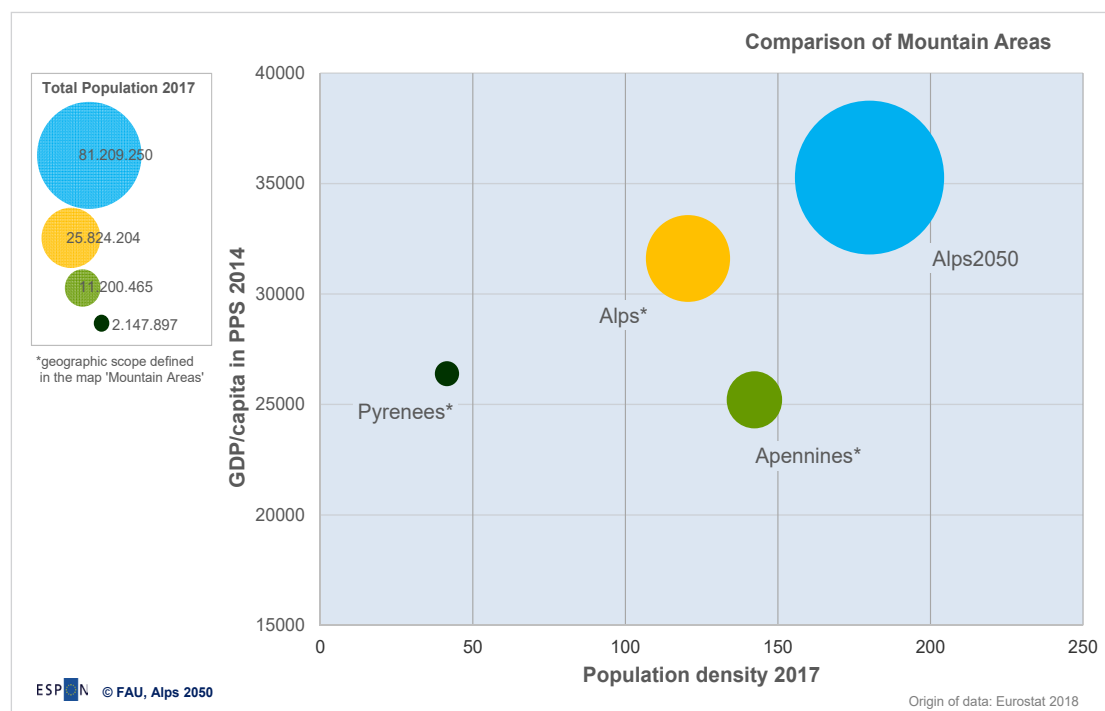# 10 The European perspective on the Alps

Fig. 12   Comparing Alps, Pyrenees and Apennines with regard to population and GDP

Indicator/Methodology: Fig. 12 compares three large European mountain areas, namely the Alpine Region, the Apennine Region and the Pyrenees Region. The delimitation is based on the ESPON Regional typology (see Map 38).

The diagram shows the values for the population density 2017 on the x-axis and on the GDP per capita in PPS (y-axis) for 2014. The size of the bubble refers to the total population 2017. Here, the values are also displayed for the much larger Alps 2050 perimeter.

Description: It is obvious that the Alpine region is economically the strongest mountain area which is also more densely populated than the Pyrenees. But the population density in the Apennine region is higher than in the Alpine region. The Alps 2050 area, comprising some of the most metropolitan areas European wide, shows maximum values in both dimensions.

Mountain areas in Europe

Mountain Areas*

Alps 2050

in the Alps

in the Apennines

in the Pyrenees

other Mountain Areas

*Regions with more than 50% of their surface covered by mountain areas

© ESPON, 2018

Regional level: NUTS3 (2006)
Source: FAU, Alps 2050, 2018
Origin of data: ESPON Regional Typologies 2011 & FAU, 2018
UMS RIATE for administrative boundaries

Map 38   Mountain areas in Europe following the ESPON typologies project

Indicator/Methodology: The underlying delimitation approach of Fig. 12 goes back to the ESPON Regional Typology: The mountain areas shown in Map 38 are based on ESPON Regional Typologies for NUTS 3 regions. In that project, topographic mountain areas are defined using the following criteria:

- above 2500m, all areas are included within the mountain delimitation;
- between 1500m and 2500m, only areas with a slope of over two degrees within a 3 km radius are considered mountainous (Regional Focus No. 1/2011)

The regions that are displayed in the map refer to the codes "2" and "3" of the typology which summarise all regions with more than 50% of their surface covered by mountains.

For the Alpine region, the regionalisation approach is similar to the Alpine Convention perimeter, but not identical; and obviously there are large differences with regard to the Alps 2050 perimeter. One of the main differences is that the ESPON project refers to NUTS 3 regions and the Alpine Convention predominantly argues on the municipal level. Other scientific approaches are more elaborated (e.g. Drexler et al. 2016 based on EEA 2010) but cannot easily be adopted to NUTS 3 regional statistics. This regionalisation is the basis for the comparative perspective of Fig. 12.
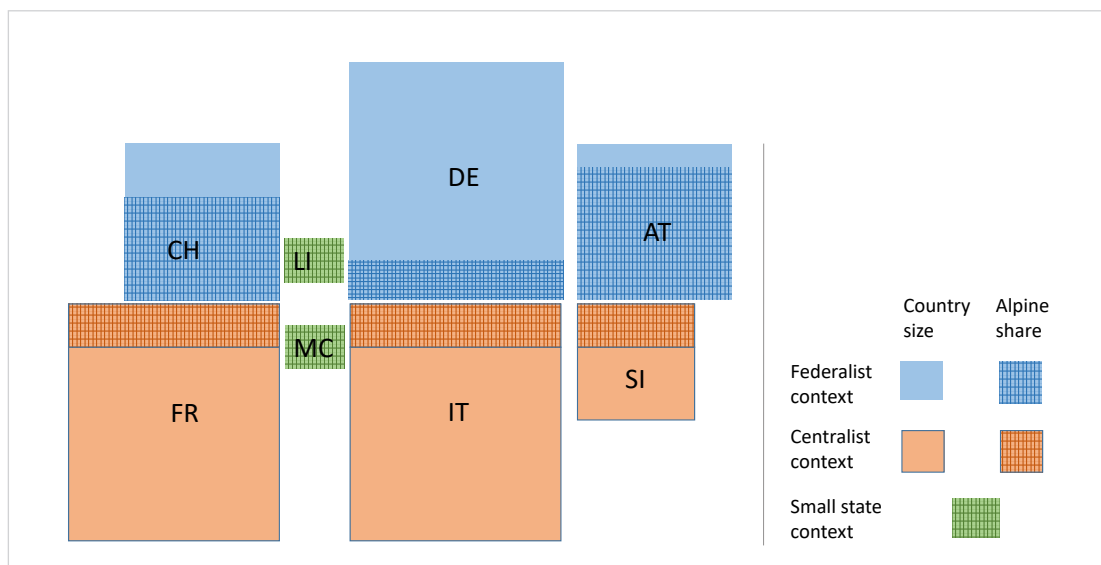
11 Governance

11.1 Domestic level

Fig. 13   Institutional mapping of the domestic contexts: country size, Alpine share, and planning typology

Indicator/Methodology: Fig. 13 visualises different dimensions of the political/institutional situation in the countries: country size, Alpine share (mountainous parts) and the belonging to the categories federalist/centralist/small state. This institutional mapping reduces relevant characteristics in a simplified visual manner (cp. Chilla et al. 2012). The analytical perspective is based on a series of works on planning cultures, as for example the ESPON Compass Project.

Description: The countries of the Alps 2050 perimeter are of very different institutional character – in particular, some of them are of a (very) federalist structure, others are much more centralised. Moreover, it becomes very obvious that not only the country size but also the Alpine share of the territory differs largely.

Tab. 5 and Tab. 6 provide a very condensed overview with regard to spatial planning mandates. The overview is restricted to the larger countries leaving out Liechtenstein (and Monaco).

This rough overview clearly illustrates the political and institutional complexity in the Alpine region. The high number of involved actors and regimes comes along with a high diversity of administrative and political structures, cultures, tools, and agendas. This institutional diversity would become even much more obvious if we expanded the focus on the national and regional priorities in agricultural, tourism, or transport policy. European policies, intergovernmental agreements, and cross-border cooperation formats help a lot to bridge institutional gaps and handle political complexities.

Tab. 5   Characteristics of the planning system on the national level

	Characteristics of the planning system on the national level
AT	According to the Austrian Constitution (Bundesverfassungsgesetz B-VG), the Federal government is responsible for sectoral policies and sectoral planning issues where explicitly mentioned in the Constitution (e.g. planning for highways, national railways, national electricity on the basis of federal sectoral laws, see B-VG Art. 10 to 12). Relating to "spatial planning" the Federal level is responsible for general coordination of planning issues. In view of the need for further co-ordination mechanisms between Federal level, "Länder" and municipalities, the Austrian Conference on Spatial Planning (ÖROK) was set up already in 1971. ÖROK serves as the platform for cooperation between the Federal level, the "Länder" and the associations of municipalities and towns and therefore for all governmental levels dealing with spatial planning (social partners have an advisory role). The current strategic considerations in terms of spatial development are laid down in the Austrian Spatial Development Concept (Österreichisches Raumentwicklungskonzept 2011; ÖROK 2011), and in terms of regional policy (structural funds) in the Partnership Agreement for the Structural Funds (2014).
CH	The Confederation is responsible for the framework legislation on spatial planning. In addition to this federal framework legislation, the Confederation promotes and co-ordinates the spatial planning of the Cantons and also takes into consideration the demands of spatial planning in its own activities. Most important spatial planning instruments at the federal level are the "Raumkonzept Schweiz" and several Sector Plans (Sachpläne), e.g. for the coordination of aviation infrastructure or transmission lines.
DE	The national level issues the legal framework law (Raumordnungsgesetz) and formulates overall objectives (Ziele und Leitbilder der Raumordnung). The Ministerial Conference for spatial planning brings together the state ministers and the federal minister that develop – in a rather federal logic – important principles of spatial development (Ministerkonferenz für Raumordnung, MKRO). The federal level has much stronger competencies in sectoral planning (transport, environment etc.).
FR	The General Commissariat for Territorial Equality (CGET, working for the Minister of Territorial Cohesion) tackles territorial inequalities and supports regional dynamics by designing and animating city and regional planning policies with local actors and citizens. The main instruments are targeted public subsidies and contracts of government engagement. The mountain national council (CNM) supports mountain territories and ensures the application of the "Mountain law"). The CNM is an advisory institution chaired by the Prime Minister and coordinated by the CGET which involves 59 members (parliamentarians, representatives of the six metropolitan massifs Alps, Corsica, Jura, Massif Central, Pyrénées and Vosges etc.). The CNM has a monitoring role and makes proposals that address objectives about mountain development.

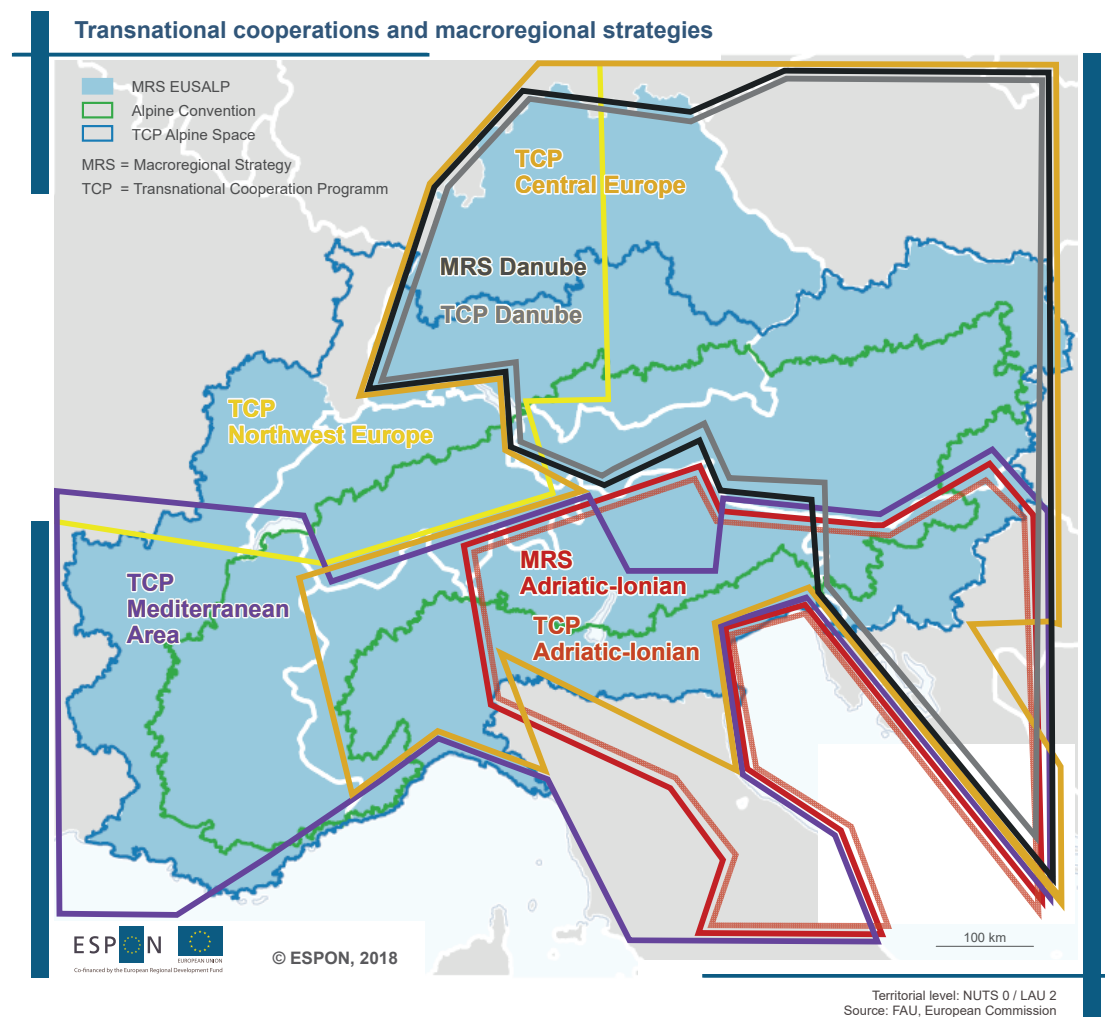|	Characteristics of the planning system on the national level
IT	In Italy, the national law for spatial planning formulates overall principles.
	The national interest in Alpine development is obvious in several documents (Ministero dell'Economia e delle Finanze (2003) IX Relazione sullo stato della montagna italiana etc.), complemented by a series of specific Alpine development plans and activities and the "Communitá Montane" at local level.
SI	In Slovenia, spatial planning is a national and local competence. The Spatial Management Act (adopted in 2017, in implementation from June 2018 on) in the Article 38th foresees a cross-sectoral governmental commission for the spatial development with the task of supervision, co-operation and joint-addressing of the spatial matters on the vertical and horizontal level.
	As an umbrella strategic policy, the Strategy of the Spatial Development of the Republic of Slovenia (2004, in renewal since 2015) defines 12 spatial development objectives (none specifically for the Alps) and 8 priorities of which the last one targets spatial development in the areas with special potentials and problems (hilly and mountain areas are mentioned as one type of such areas): In the renewal process of the strategy, 'mountain and border areas' have been selected as one of five special focuses.

Tab. 6 provides an overview over the planning systems on the regional level. This overview is also very rough as some regions – in particular in federal structures – can apply very different strategies.

Tab. 6   Characteristics of the planning system on the regional level

	Characteristics of planning system on the regional level
AT	Austria is a federal country consisting of nine states (Länder). The responsibilities for legislation and administration in areas which affect planning are shared between the federal level, the "Länder" and municipal level. Whereas the federal level has many competences in sectoral policies, the states (Länder) have an important mandate for the overall planning themes: legislation (spatial planning laws), planning at regional level (e.g. überörtliche Raumplanung) and a supervisory function for the planning at municipal level. Municipalities have the mandate for local planning (e.g. zoning plans, local concepts) under the supervision of the "Länder". The respective responsibilities are laid down in the Austrian Constitution (Bundesverfassungsgesetz B-VG), see e.g. Art. 10 to 12 (sectoral planning at federal level), Art. 15 ("sweeping clause": responsibility for spatial planning at "Länder"-level) and Art. 118 (responsibilities of municipalities).
CH	The cantons are responsible for the actual development of spatial plans and their practical implementation. Cantons often delegate a number of tasks to municipalities (local authorities). The Cantons enact cantonal implementing legislation for the Federal Law on Spatial Planning. The main planning instrument of the Cantons is the structure plan (Richtplan, plan directeur), which is subject to approval by the Federal Council. The structure plan shows how activities with spatial impacts are to be harmonized with each other in the area. This produces a plan binding on the authorities.
DE	In Germany, two federal "Länder" are part of the Alps 2050 perimeter, namely Bavaria and Baden-Württemberg. The most important tool is the Bavarian Regional development programme (Landesentwicklungsprogramm, LEP) with its Annex the Alpine Plan (Alpenplan) which defines zones for different degrees of approvable development intensity. The LEP is concretised by 17 planning assemblies (*Planungsverband*) of which three are relevant for the Alps in the morphological sense (Allgäu, Oberland, Südostoberbayern). The situation in Baden-Württemberg is similar with a Landesentwicklungsplan as the basis and 10 regional planning assemblies (Planungsverband) but without covering the Alps in the morphological sense.

	Characteristics of planning system on the regional level
FR	The French government created the function of regional prefect "massif coordinator" and of a commissioner for development, development and protection of the massif (Alps, Jura, Massif Central, Pyrénées, Vosges). These territorialized teams of the General Commissariat for Territorial Equality (CGET) are territorial relays of the CGET's missions and actions in terms of territorial development and balance. The CGET ensures the animation of the network of commissioners of the massif.
IT	The main body responsible for spatial planning are the regions (regioni, corresponding NUTS 2 level). Each region has its own spatial planning law, the Regional Territorial Coordination Plans or Regional Territorial Plans (Piano Territoriale Regionale di Coordinamento, PTR), which are defining the general directions of the economic and spatial development of the region. They are the most important instruments at the regional level, together with the Regional Development Programs or Plans (Programma/ Piano Regionale di Sviluppo, PRS). The autonomous provinces of Trentino and of Alto Adige/ Südtirol have their own spatial planning laws and instruments at provincial level, which assimilate to the regional instruments.
SI	12 regions exist in Slovenia, but only for EU- and state-financed development, not for political tasks. On this level, an important tool is the regional development programme (RRP – regionalni razvojni program) which defines visions and development goals for the 6-year period and presents a basis for the preparation and delivery of projects in the region. A series of regional development programmes cover the Slovenian part of the Alps, namely Goriška, Gorenjska, Koroška Osrednjeslovenska, Savinjska and Podravska region. In addition, there are 33 local action groups (focus on the rural development of the country) which prepare LEADER-based programme and projects. In Slovenia, the regional level is politically active through local actors. 212 municipalities with their departments of spatial planning (in smaller municipalities the field is covered with one person or with a person covering multiple fields) are in charge of spatial development.

11.2 Transnational level

Transnational cooperations and macroregional strategies

- MRS EUSALP
- Alpine Convention
- TCP Alpine Space

MRS = Macroregional Strategy
TCP = Transnational Cooperation Programm

TCP Central Europe

MRS Danube

TCP Danube

TCP Northwest Europe

TCP Mediterranean Area

MRS Adriatic-Ionian

TCP Adriatic-Ionian

100 km

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Territorial level: NUTS 0 / LAU 2
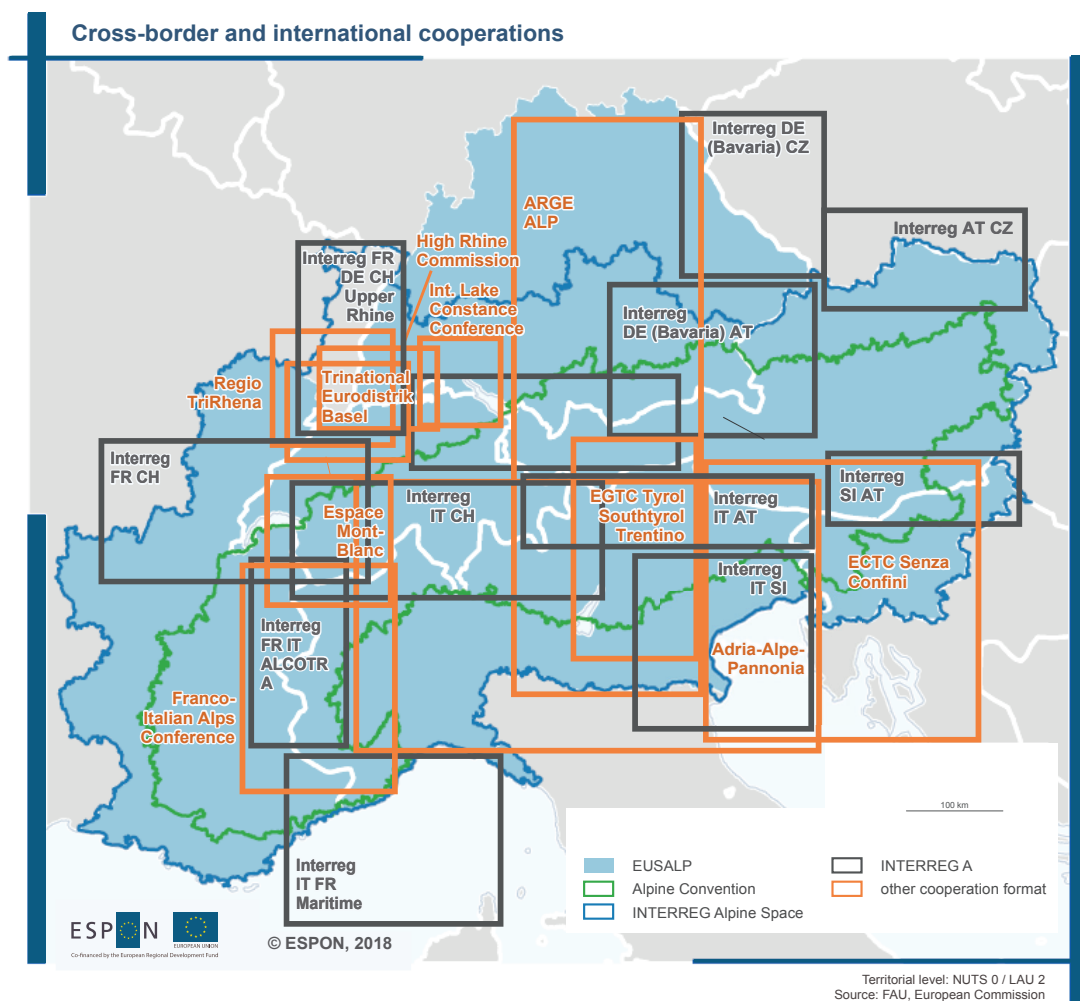Source: FAU, European Commission

Map 39   Transnational cooperations and macroregional strategies

Indicator/Methodology: Map 39 shows the exact perimeters of the EUSALP, the Alpine Convention and the TCP Alpine space. The other transnational and macro-regional cooperation formats are visualised in a very much simplified manner ('institutional mapping').

Description: The picture shows the transnational scale with three macroregional strategies and four territorial cooperation programmes that are mostly overlapping. This shows the high density of transnational cooperation programmes in the Alps 2050 area and the close spatial relationship between the transnational cooperation programmes and the macro-regional strategies.

11.3   Cross-border level

Cross-border and international cooperations

Map 40   Cross-border and international cooperations

Indicator/Methodology: Map 40 shows the cross-border existing cooperation formats of the EU cross-border scale ('INTERREG A) and is complemented with a series of bi- and multilateral cooperation formats like ARGE ALP or Lake Constance Conference that are of comparable size. The perimeters are – again – not exact but provide a general overview with a simplified cartographic language (institutional mapping).

Description: The visual impression confirms the message of the transnational analysis above that the diversity and intensity of cooperation initiatives is enormous in the Alpine region.
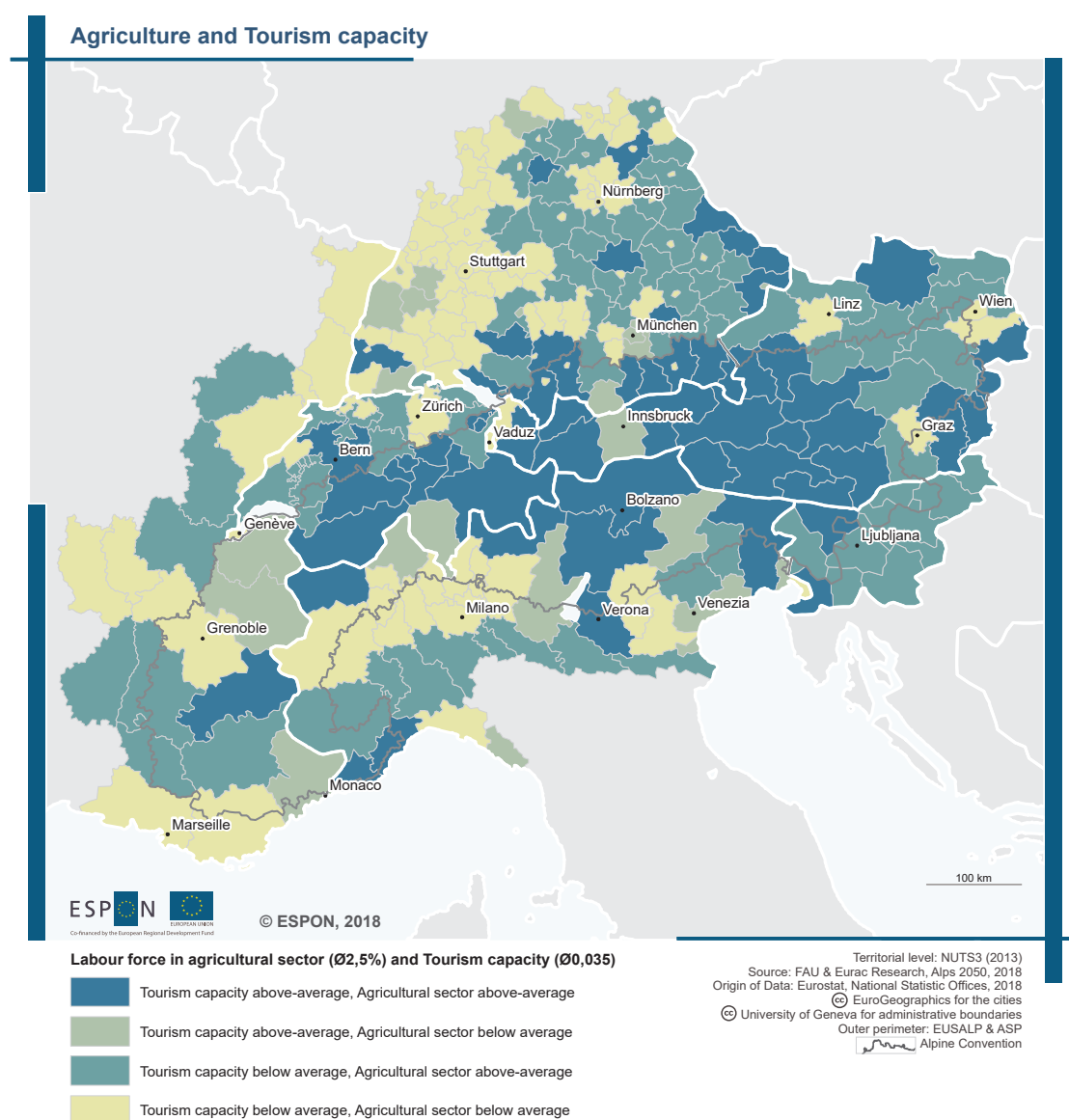
One might differentiate between cooperation forms that rely on the intergovernmental logic and that go mostly back to those years before the start of the EU cooperation programmes. Some of them started with a rather sectoral focus (water, environment) and developed towards a more general perspective of regional development. The Alpine Convention, the Lake Constance Conference, and the High Rhine Commission are important examples. Others had a more general focus and allowed 'high politics' on the regional level. ARGE ALP is the most prominent example.

Many cooperation formats can also be traced back to EU policies. This is in particular true for the small-scale Euregios along many borders whose main focus lies on the implementation of cross-border cooperation programmes (INTERREG A). Some also refer to the transnational cooperation

programmes like the ALCOTRA cooperation which comprises the Italian-French Alps (INTERREG B). More recently, the regions of Tyrol, Southern Tyrol and Trentino have founded a European Grouping of Territorial Cooperation (EGTC).

12 Territorial structures based on indicator combinations

The sectoral analyses of the Alps 2050 perimeter provide a multitude of perspectives on this space. At the same time, the diversity and differentiation in this territorial analysis makes it challenging to integrate the information: From the perspective of an integrated spatial development, the combination of sectoral indicators is an important step. The following three maps apply different indicator combinations that are visualised in a rather simplifying way.
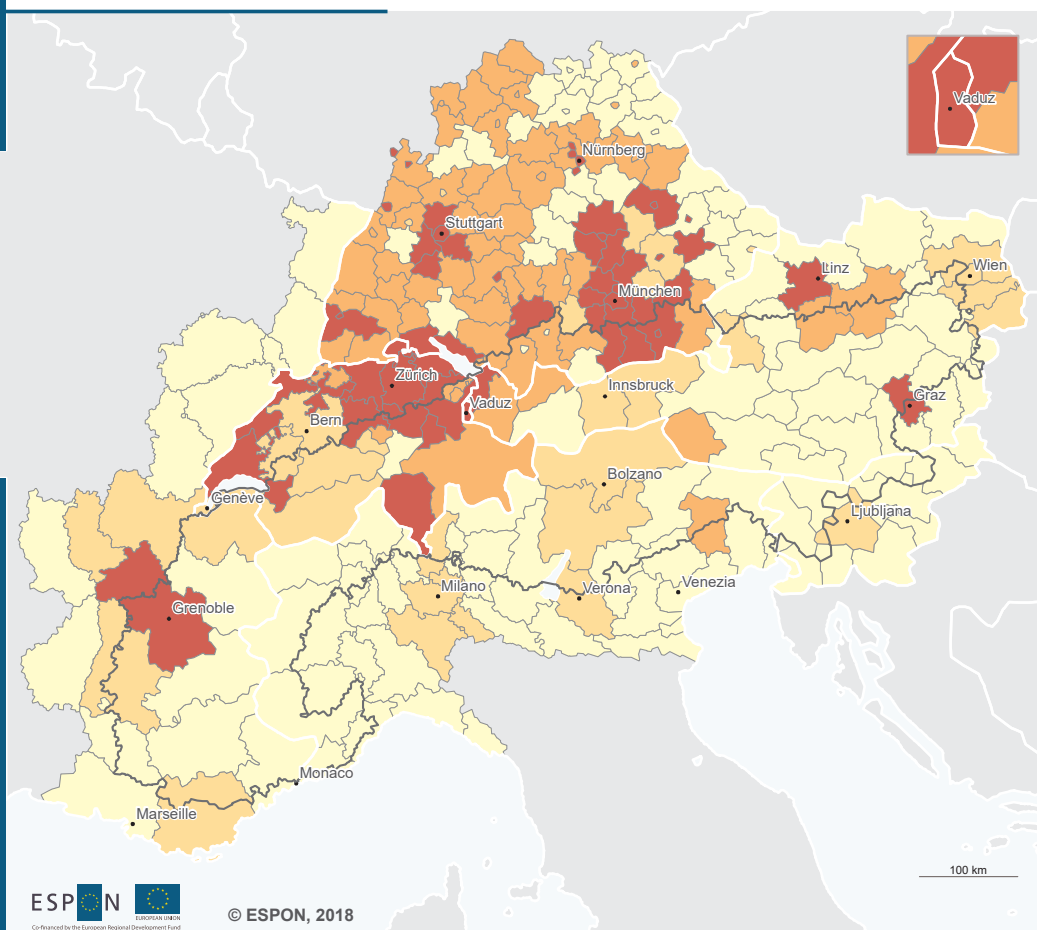
Agriculture and Tourism capacity

© ESPON, 2018

Territorial level: NUTS3 (2013)
Source: FAU & Eurac Research, Alps 2050, 2018
Origin of Data: Eurostat, National Statistic Offices, 2018
(cc) EuroGeographics for the cities
(cc) University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

Labour force in agricultural sector (Ø2,5%) and Tourism capacity (Ø0,035)

- Tourism capacity above-average, Agricultural sector above-average
- Tourism capacity above-average, Agricultural sector below average
- Tourism capacity below average, Agricultural sector above-average
- Tourism capacity below average, Agricultural sector below average

Map 41   Agriculture and Tourism capacity

Indicator/Methodology: Map 41 shows the two indicators tourism intensity and employment in the agricultural sector on the NUTS 3 level as they have been introduced in the sectoral analyses up above: tourism intensity means the share of bedplaces per inhabitant, and the share of agricultural employees is calculated in relation to all employees (both NUTS 3 level).

Description: Both indicators refer to the economic sectors that in general have particular relevance for rural spaces. We see that this largely applies to the Alps 2050 perimeter, too: In particular many inner-Alpine areas show over average values for both indicators, whereas below average values can be found in the urbanised areas. This way of internal differentiation shows the important role of the mountainous areas with regard to agriculture and tourism and by that also for ecosystem services in the broadest sense. At the same time, this picture focuses very much on the traditional connotation the Alpine region to be primarily picturesque landscape – and this perspective tends to oversee innovative economies, urbanisation pressure and societal differentiation.

Patents and Population change

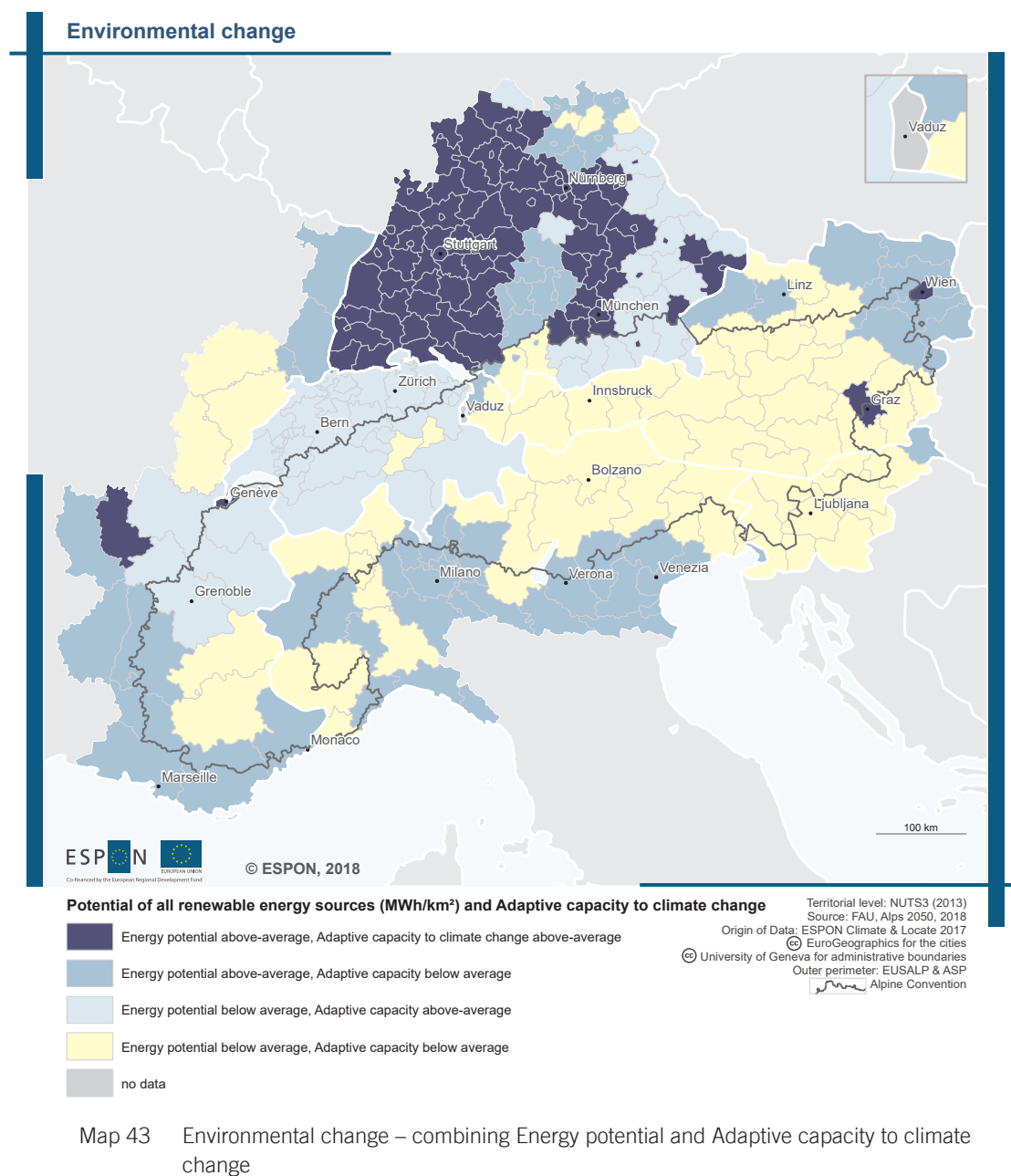Patents per mio. inhabitants 2012 (Ø223) and Population change 2011-2015 (Ø+2,6%)

- Patents above-average, Population change above-average
- Patents above-average, Population change below average
- Patents below average, Population change above-average
- Patents below average, Population change below average

Territorial level: NUTS3 (2013)
Source: FAU & Eurac Research, Alps 2050, 2018
Origin of Data: Eurostat, National Statistical Offices, 2018
EuroGeographics for the cities
University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
Alpine Convention

Map 42   Patents and Population change

Indicator/Methodology: Map 42 combines economic innovativeness (measured in European patents per million inhabitants) and population dynamics (measured in population change 2011-15 in %; both on the NUTS 3 level) – for more details see the respective descriptions above in the sectoral analyses.

Description: The picture shows over average values for Northern parts of Switzerland, the Munich area in Bavaria and on the French side the Grenoble area. These regions can be regarded as innovative and growing areas of metropolitan functionality. The overall picture shows a certain North-South divide which can be found in several of the socio-economic analyses: Norther regions tend to be positive in innovation terms; Southern regions with regard to demographic dynamics.

Environmental change

Potential of all renewable energy sources (MWh/km²) and Adaptive capacity to climate change

- Energy potential above-average, Adaptive capacity to climate change above-average
- Energy potential above-average, Adaptive capacity below average
- Energy potential below average, Adaptive capacity above-average
- Energy potential below average, Adaptive capacity below average
- no data

Territorial level: NUTS3 (2013)
Source: FAU, Alps 2050, 2018
Origin of Data: ESPON Climate & Locate 2017
ⓒ EuroGeographics for the cities
ⓒ University of Geneva for administrative boundaries
Outer perimeter: EUSALP & ASP
〰 Alpine Convention

Map 43   Environmental change – combining Energy potential and Adaptive capacity to climate change

Indicator/Methodology: Map 43 combines the potential for renewable energy sources and the adaptive capacity to climate change, and both values are differentiated to be over or below the Alps
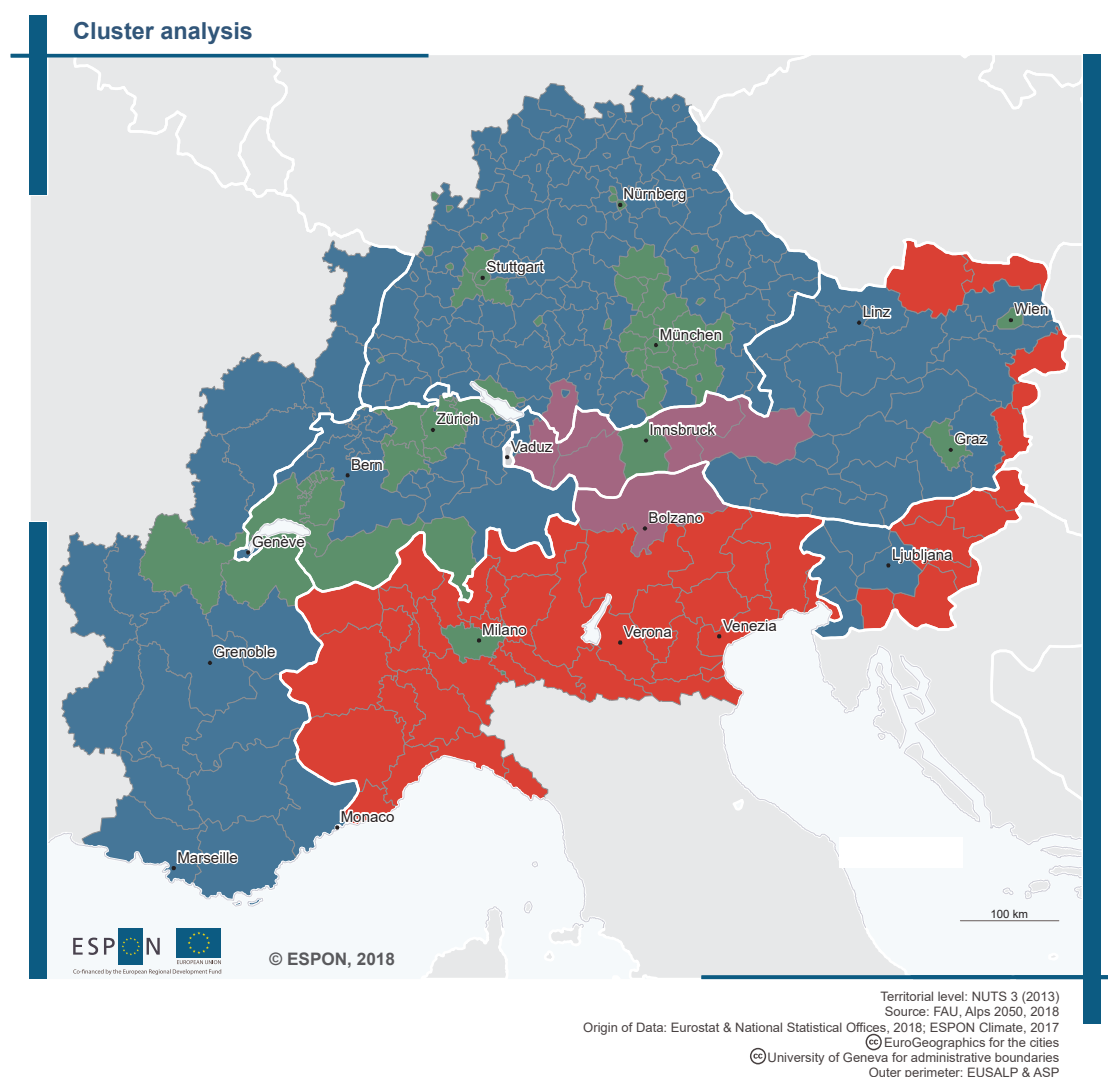
2050 average. Both indicators were developed in the framework of the ESPON programme. The potential for renewable energy sources was developed in the ESPON Locate project (ESPON Locate 2017) and the adaptive capacity to climate change in the ESPON Climate project (ESPON Climate 2011) and updated in 2017. Both are here applied for the Alpine region.

The energy potential indicator shows where future potentials can be used, considering political and planning conditions as well as already used sources. The darker coloured areas show those regions with over average values, which are mostly located in pre-Alpine areas.

The adaptive capacity reflects the political and institutional framework conditions with regard to climate change reaction strategies.

Description: For this indicator we see an urban-rural gradient as well as a North-West / South-East gradient. As a result, metropolitan regions tend to have positive values in both dimensions; in particular the Geneva-Grenoble region, the largest Baden-Wuerttemberg area as well as some large cities.

The inner-Alpine space is somehow split in the Eastern part (under average energy potential and under average adaptive capacity) and the Western part (under average energy potential, over average adaptive capacity).

Map 44   Cluster analysis on the basis of the indicators population change 2011-2015, adaptive capacity to climate change and tourism intensity

Indicator/Methodology: The next aggregation step in order to reach a synthesising regionalisation is the cluster analysis (Map 44). A cluster analysis helps to detect similarities in complex datasets. We chose three indicators that cover different dimensions of spatial development and conducted a cluster analysis on the NUTS 3 level[4]. The indicators comprise population change 2011 to 2015, adaptive capacity to climate change (see Map 33) and tourism intensity 2015 (see Map 23). This selection is a broad approach to ensure an integrated perspective, but is certainly just one of many possible choices.

Description: Map 44 shows the resulting clusters confirming many patterns that have already been described in the sectoral analyses. The map can differentiate four clusters:

- The green cluster (n=49) comprises mainly metropolitan areas. These areas have the highest values in demographic development, for most of the areas this is due to an innovative economy in the centres. The adaptive capacity to climate change shows high values, too. The tourism intensity is on a low level (with some outliers, e.g. Innsbruck).

- The red cluster (n=49) comprises mainly Italian regions and some Eastern Slovenian and Austrian regions. This cluster is characterised by a high relevance of the climate change context, the values of the adaptive capacity are the lowest compared to the other clusters. The population change rates are for 75% of the values positive but not that high as in the green cluster. The tourism intensity shows similar values as the green cluster also with some outliers in Italy (e.g. Trento, Venice, Valle d´Aosta).

- The purple cluster (n=7) comprises mainly central inner-Alpine regions. This cluster is characterised by a very high relative importance of the tourism sector. The minimum value of tourism intensity lies over the maximum values of all other clusters. The demographic development shows no negative values but not the high values of the green cluster. The adaptive capacity to climate change shows higher values than the red cluster but the relevance of the climate change is also high.

- The blue cluster (n=166) comprises mainly rural regions in France, Switzerland, Germany and Austria. The population change dynamic is comparable to the dynamic of the red cluster – here, too, 75% of the values are positive. The tourism intensity is comparable to the red and green cluster but with the most outliers (e.g. Garmisch, Liezen, Oberkärnten, Regen). But compared to the red cluster the crucial difference are the values regarding adaptive capacity to climate change. They are far higher comparable to those of the green cluster.

It is interesting to note that the clusters form a spatially structured picture with mostly spatially connected areas. This reflects the importance of three key explanatory factors, namely metropolitan quality, national affiliation and morphological structure.

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4   methodological references: z-standardisation, ward criterion, 4 clusters based on elbow criterion