Project: PREMUM_EU

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Atlas of Regional Development

A document depicting the landscape of regional development In Europe

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PREMIUM_EU BENEFITS OF MOBILITY

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Atlas of Regional Development

Report #1

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1.2	26.03.2025	Peter Meister-Broekema and Korrie Melis	Additional text
2.0	27.03.2025	Becky Arnold	Compilation and editing

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1. Introduction

Regional development is one of the EU's principle strategies for increasing equality and living standards internationally. With a budget of € 226.05 billion for 2021 - 2027, the stated goal of the European Regional Development Fund is to "reduce economic, social and territorial disparities". With the societal and financial stakes so high it is vitally important that the landscape of regional development within Europe be systematically assessed. Only with a strong understanding of the nature and challenges of vulnerable regions can such efforts be put to the greatest benefit. Furthermore, regional development is not something linear or straightforward. It must also always be considered in the wider economic, political, and cultural context. That context itself spans from the NUTS 2 level all the way up to the global scale, with pressures and events at each level impacting upon one another.

Historically, conceptions of regional development have mostly focused on the economic domain, highlighting metrics such as GDP per capita, unemployment, and average educational levels. More recently, regional development has been regarded as a highly multifaceted concept which encapsulates social conditions, living environments, political contexts and demographics alongside those always-important economic factors.

The Horizon Europe project, PREMIUM EU aims to aid regional policy makers in identifying effective policies to develop their regions, with a particular focus on vulnerable regions and migration policy. The first step of this goal is to understand the current landscape of regional development, and within this project we aim to do this at the NUTS 3 level.

In section 2 of this paper the theoretical basis for our conceptualisation of regional development is outlined. Based on this conceptualization, 37 regional development indicators are selected. These indicators are wide ranging, spanning from the conventional, such as GDP per capita, to features such as air pollution, crime rates, and the number of doctors per 1000 people, among many others. These indicators are then used to compute an economic, social, living environment, and overall development indices, as outlined in section 3. In section 4 the landscape of regional development within Europe according to these indicators and indices is presented via a series of maps.

2. Theoretical basis

Our literature review shows that regional development is not only an important policy concept in The European Union and OECD, but is also studied extensively by a variety of academic scholars. In brief, Regional Development for a long time has been identified solely with economic development.

Specific regional development policies were first developed right after the economic crisis of 1929 to support affected regions. After the end of the Second World War, the emphasis in regional development and subsequent policies shifted from support of affected regions to overcoming disparities between regions. In the 1980s this reverted in specifically supporting so called lagging regions, followed by an emphasis in the 1990s on supporting regions in the globalisation and competition. Currently, regional development in especially the European Region is nowadays focused on smart specialisation of and in all regions. In addition, regional development has been slowly transforming into a broader concept (Cuadrado-Roura 2012; McCann and Ortega-Argilés 2015; Rigby et al. 2022).

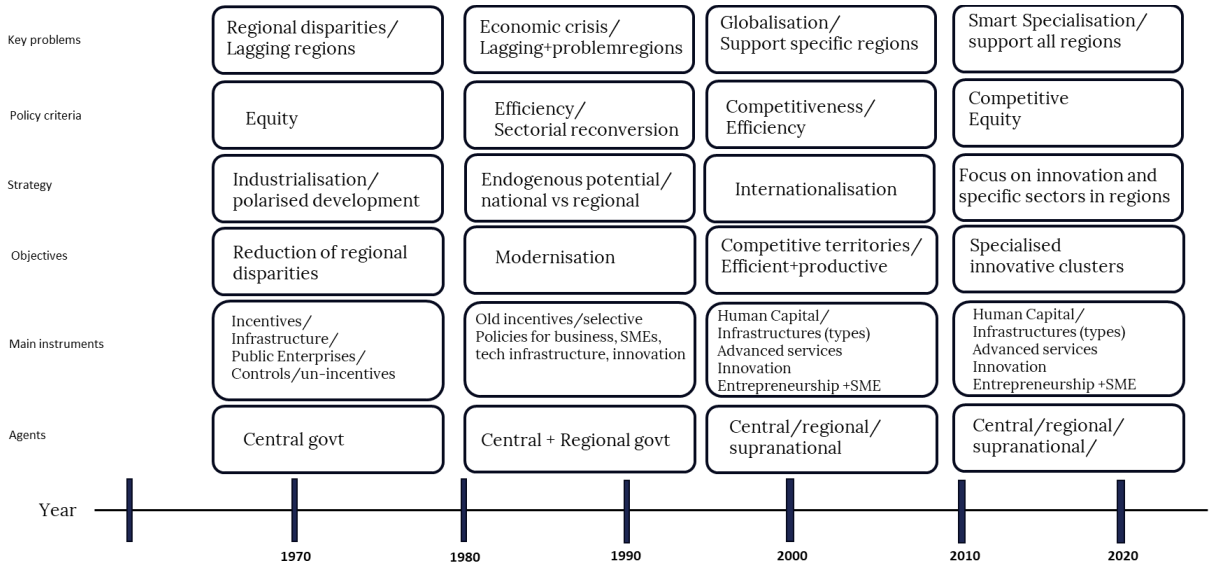


Figure 1 Regional Development over time. Author's own depiction based on the work of Juan R. Cuadrado-Roura (2012), Rigby et.al. 2022 and McCann & Ortega (2015) .

These different types of regional development over time are often overlapping with each other, therefore making it hard to distinguish between different types of regional development over time. In addition, our literature analysis also showed that 'measuring' regional development is also becoming more complex over time, especially when this regional development is not solely regarded with economic development. For example, there are also numerous so called regional development frameworks that use economic, social and political theories from economists such as John Maynard Keynes or Karl Marx to understand, develop and measure regional development in specific ways (Pike, Rodriguez-Pose, and Tomaney 2016) in so called policy paradigms (Hogan and Howlett 2015) . Therefore, to be able to say something about regional development, it would be preferable to descend from these policy paradigms by focusing on data and indicators that are as 'neutral' as possible.

Reflecting and building on the literature above, PREMIUM_EU regards Regional Development as the establishment of conditions and institutions that foster the realisation of of communities and places, by taking a holistic approach that balances between economic, social, political, ecological and cultural dimensions (Pike, Rodriguez-Pose, and Tomaney 2016).

In line with this broader definition of regional development and to be able to 'measure' regional development, we distinguished four different domains of regional development. These domains can be characterized as respectively economic, living environment, social and political domains. In line with the aim of PREMIUM_EU, we also included demography as a domain of regional development. By taking an iterative approach, we searched for indicators based on available data on at least NUTS2, but preferably NUTS3 level in the European Union and adjacent countries.

Below the five domains will be discussed and result in a preferred overview of indicators.

- Demographic

  The demographic domain focuses on the population development of a region. Pike et al. (2017) do focus on regional development, but they do mention demographic characteristics while discussing regional development. They for example link demographic developments to economic developments. To be precise, the rate of ageing can vary significantly between regions and had important consequences for the labour force supply or public services provision. No surprise that many discussions about rural development mention ageing as an important component of a changing region. On the other hand is population growth a key challenge for localities, regions and cities (Pike et al., 2017).

- Economic

  As mentioned before, economy has long been the main focus in regional development literature. And of course, it is still an important domain, because for many migrants economic reasons are important pull and push factors. For many labor migrants the economic benefits or the presumed economic benefits in a new region are the main raison to migrate.

  Geographically a pattern can be distinguished, because especially city-regions prove to be attractive for highly qualified, skilled and mobile migrants. But to maintain a service level in these cities, lower skilled migrants, asylum seekers and refugees are also needed to work in the service industries (Pike et al., 2017). However, as Woods (2016) shows migrants can stimulate an economic regeneration in rural areas as well.

- Social

  A social-cultural perspective on regional development also needs to be developed because a focus on economic concerns does not adequately included or capture the meaningful and valuable aspects of individual and social existence (Pike et al., 2017). It should also be reckoned with that migration is embedded in processes of social transformation (Raunio, 2022; Woods, 2016). Woods (2016) shows for example how rural communities can transform because of new cultural tastes, consumer goods, traditions and festivals.

From a regional development perspective, it can be noticed that communities lacking social capital, not being part of the right networks, may not have the capacity to handle decline and will be 'losing' (Meijer, 2022; Bock, 2016). It is also know that there are gender and ethic dimensions to patterns of inequality (Pike et al., 2017)

- Living environment

  Pike et al. broadened their approach of development in their second edition. An important addition was the inclusion of the living environment as important for regional development, especially the need for sustainable standards. The changing ecological environment all over the world due to climate change has put this domain into the picture. Migration because of sea level rising or increasing droughts in sub-Sahara Africa is relatively new but probably increasing in importance. In general, this means the appreciation of and attachment to the living environment need to get more attention (Bulder, 2017; Dufeu et al, 2024). Furthermore, the geographical location of a region is assumed to have influence on the possibilities for regional development. Although this also can be discussed (see Bock, 2016).

- Political

  The last domain we distinguished is the political. However, this one is not on a regional level but on a national level. As said before regional development is a political subject, both on European and on national level. National governments are increasingly dealing with problems of regional development, ranging from political discontent to sustainability transitions (Van Vulpen, 2022). As a result many national governments are revising regional redistribution and are puzzling with designing the ‘right’ policy for regional development (Van Vulpen, 2022). As an example, fiscal policies can have different impact on the region (Pike et al., 2017).

If we have a closer look at the relationship between development and migration it is in general approached as a question of international relations. This because development (of the region of origin) is a tool of international migration policy. The assumption is that it reduces migration. (OECD, 2022)

So the preferred indicators are recorded at the national level, as migrant policies and rights do not fall under the purview of regional policy makers.

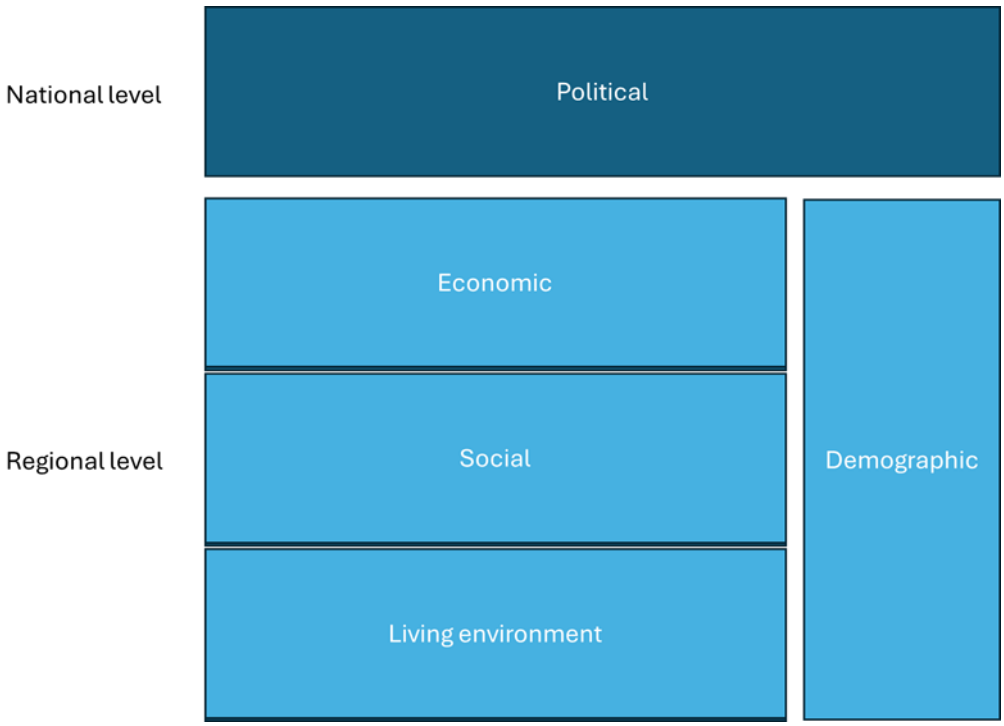


Figure 2: Model of the five domains

From a theoretical perspective, we created an ideal overview of domains and indicators relevant to gaining insight into regional development. However, we worked iteratively and found that:

1. Not all indicators are available over time and for all NUTS 3 regions (for more details, see the Data section).
2. The domains we distinguished are on different levels, you could say. To illustrate this, we created the model in Figure 2.

The political dimension and its indicators are at a national level. Almost all regions in Europe deal with policy indicators at the national level, particularly migration policies. The demographic dimension also has a different position in relation to regional development. This is because demographic indicators do not have a direct causal relationship with regional development. For example, if a region has an aging population, it does not mean there is low development. Similarly, if a region has fewer inhabitants, it does not necessarily have less potential for regional development. Therefore, the demographic dimension could be seen as a descriptive dimension rather than an explanatory dimension. Because of this we focussed on three domains as relevant for regional development: economic, social and living environment.

The final list of collected indicators are as follows:

- Economic
    - Educational Level
    - Primary Sector Fraction
    - Secondary Sector Fraction (Industrial)

    - Secondary Sector Fraction (Manufacturing)
    - Secondary Sector Fraction (Construction)
    - Tertiary Sector
    - Total Unemployment
    - Regional Innovation Score
    - GDP per Capita
    - Economic Resilience
- Social
    - LGBT Acceptance
    - Ethnic and Racial Acceptance
    - Migrant Acceptance
    - Life Satisfaction
    - Homicide Rate
    - Assault Rate
    - Robbery Rate
    - Burglary Rate
    - Theft Rate
    - Subjective Safety
    - Labour Force Participation Rate- Gender Difference
    - Youth NEET Rate
    - Total Long-Term Unemployment
    - Gender Development Index (Education)
    - Gender Development Index (Income)
- Living environment
    - Flooding (Rivers)
    - Flooding (Coastal)
    - Physicians Rate
    - Nurses Rate
    - Hospital Beds
    - Air Pollution
    - Motorway Infrastructure
    - Digital Infrastructure
    - Heating Degree Days
    - Cooling Degree Days
    - CO2 per Capita
    - Heat Stress (average exposure)

3. Data

The Regional Characteristics Database contains 37 indicators which are used in this analysis. This data is primarily drawn from Eurostat and the OECD, with some supplementary data from sources such as the Global Data Lab. The 37 indicators are

divided into ten economic indicators, twelve living environment indicators, and sixteen social indicators.

The NUTS regional boundaries have gone through multiple iterations, and in this work only the NUTS 2021 boundaries are used. That means that regions that no longer exist, e.g. due to being merged into other regions, are excluded even if data has been collected for them. Newly created regions are included as far into the past as data has been collected for them. For some indicators data have been 'back calculated' by national statistical institutes. E.g. a new region is coined in 2021, and the relevant national statistical agency calculates what the GDP per capita was within those boundaries in previous years. As a result in some cases it is possible to produce regional development profiles for regions in years prior to their official creation.

Despite extensive work, and the deliberate bias of selected indicators towards those with high coverage, the regional characteristics database is far from complete, especially at the NUTS 3 level we wish to build regional profiles of. Conventional statistical methods and machine learning are considered as methods to model the missing data and improve the completeness of the data set. Both are rejected because it is observed that the incompleteness of the data set is highly inhomogeneous. Data for a given indicator is often not collected in every year, or in every country. Even in countries where the data is collected different countries often collect the data on different NUTS levels (e.g. some collecting that data at NUTS 2 and others at NUTS 3). A country also may not collect the data in all the regions it contains, even at their chosen level.

This inhomogeneity makes producing a meaningful training data set for machine learning or robust classical modelling extraordinarily challenging, and both approaches are determined to be non-viable. One method that is used to increase the completeness of the data set is disaggregation.

3.1 Dissagregation

In some cases data is available at the NUTS 2 level, but not at NUTS 3. While the true value at NUTS 3 remains unknown it is reasonable to assume it is highly correlated with that of its parent NUTS 2 region. In order to utilise this NUTS 2 data we disaggregate it to the NUTS 3 level. This helps reduce the number of empty cells in the regional development characteristics database. Disaggregation is performed in the simplest possible way, which we term duplication. In this method we assume that all NUTS 3 regions within the NUTS 2 region have the same value of the property as is recorded at NUTS 2. An example of such a property is educational level (percentage of the population aged 25-64 with tertiary educational attainment). If this is X % in a NUTS 2 region, we assume it is also X % in the relevant NUTS 3 regions.

3.2 Converting indicators into indices

Using the collected data, overall quality indices are calculated for each region for each year from 2010 to 2021 in each of the three dimensions (economic, social, living environment). The considerable sparsity and inhomogeneity of the data set presents a barrier to this, and so the method we have designed for this conversion is deliberately constructed to be resistant to that data weakness. The method for this will be described via a simplified example in which the economic dimension contains only two indicators, educational level and GDP per capita. To further simplify this example we consider data for only one year, and assume that there are only five regions, A, B, C, D, and E.

For the purposes of this explanation consider the example data set shown in Table 1.

Table 1: An example of a data set with five regions, and two indicators, for which there has been incomplete and inhomogeneous data collection.

Region	Educational Level	GDP per Capita
A	72	40,000
B	15	No Data
C	No Data	10,000
D	No Data	25,000
E	43	5,000

Step 1: For each property rank the regions from best to worst. Note that if one of the properties was undesirable, e.g. unemployment rate, this ranking would done in reverse order with the smallest first and largest last. See Table 2 to see this reflected in the example data set.

Table 2: The example data set where the values in each column have been replaced with ranks from best to worst.

Region	Educational Level	GDP per Capita
A	1	1
B	3	No Data
C	No Data	3
D	No Data	2
E	2	4

Step 2: Convert those rankings to fractions normalised by the number of valid datapoints for each property. In the example case educational level has three valid entries, so ranking 1, 2, 3, becomes 1, 0.5, 0. In contrast GDP per capita has four valid entries, so ranks 1, 2, 3, 4 become 1, 0.66, 0.33, 0. The consequences of this step for the example data set can be seen in Table 3.

Table 3: The example data set where the ranks in each column have been replaced with fractions, and the average fraction in shown in the last column.

Region	Educational Level	GDP per Capita	Economic Index
A	1	1	1
B	0	No Data	0
C	No Data	0.33	0.33
D	No Data	0.66	0.66
E	0.5	0	0.25

Step 3: For each region calculate the average of all its properties now they have been converted to fractions. This is the index, and for the example case can be seen in the last column of Table 3.

Step 4: Now this process has been used on the economic indicators to produce and economic index it is repeated for the social and living environment indicators to produce indices in each of those dimensions.

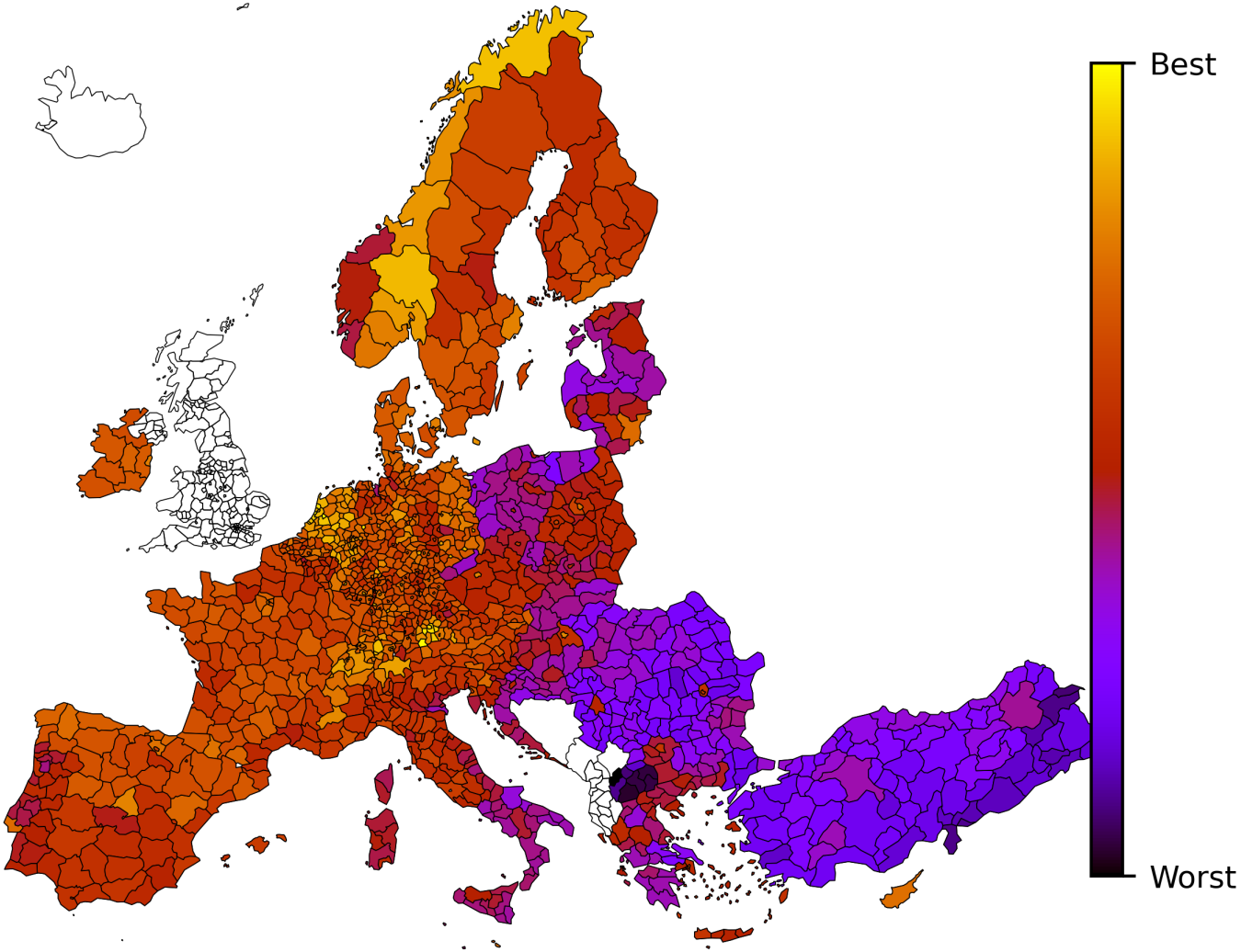
Step 5: The overall development score of the region is the average of its economic, social, and living environment indecies.

The resistance of this method to missing data is such that as long as our selection of indicators ensures every region has data for at least one property in each dimension then an index can be calculated.

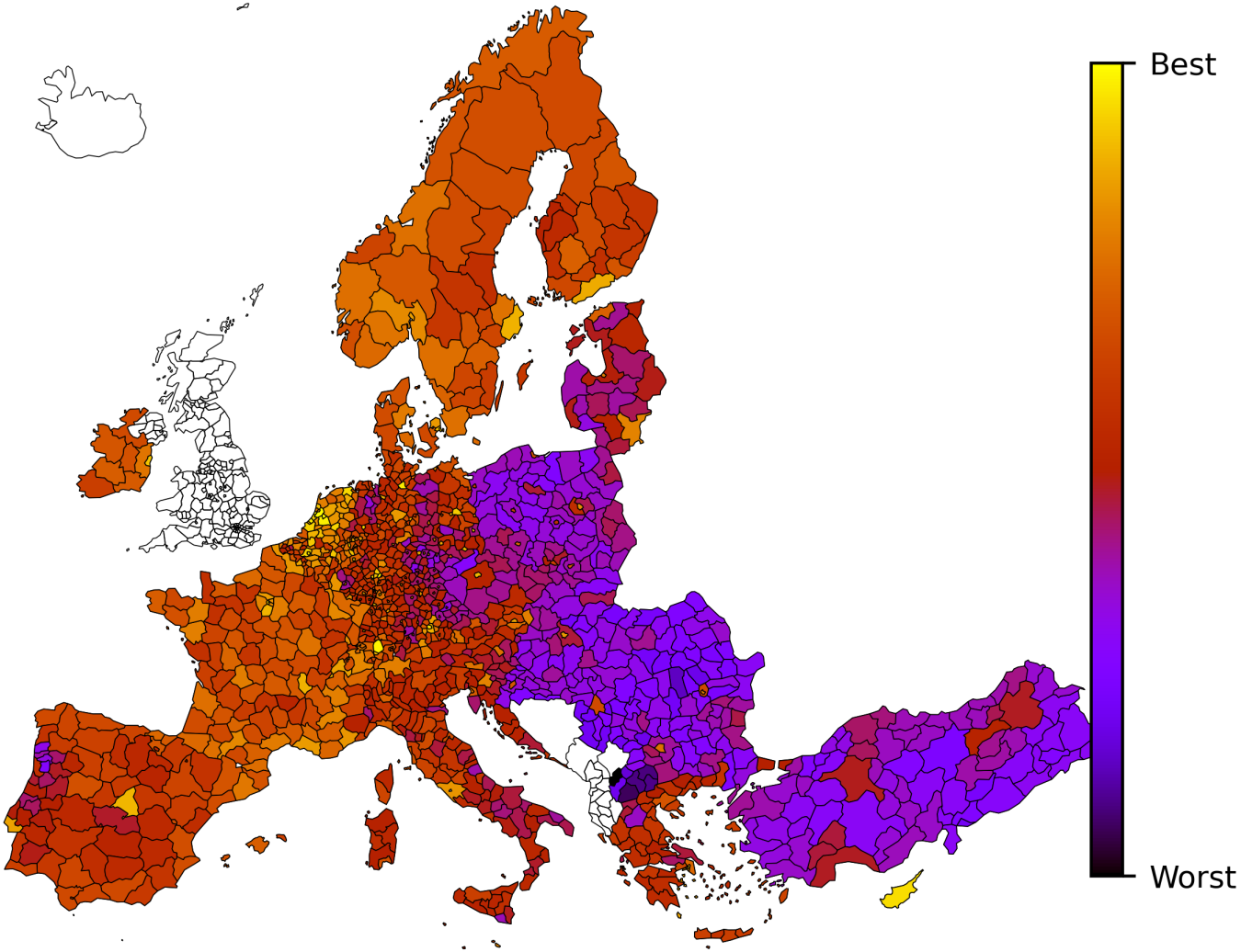
4. Maps

In this section maps are presented showing the geographical distribution of the indicators that have been collected. The geographical distribution of the calculated economic, social, living envrionment, and overall development indecies are also presented . In all cases the scores are scaled from zero to one, with zero being the worst and one the best.

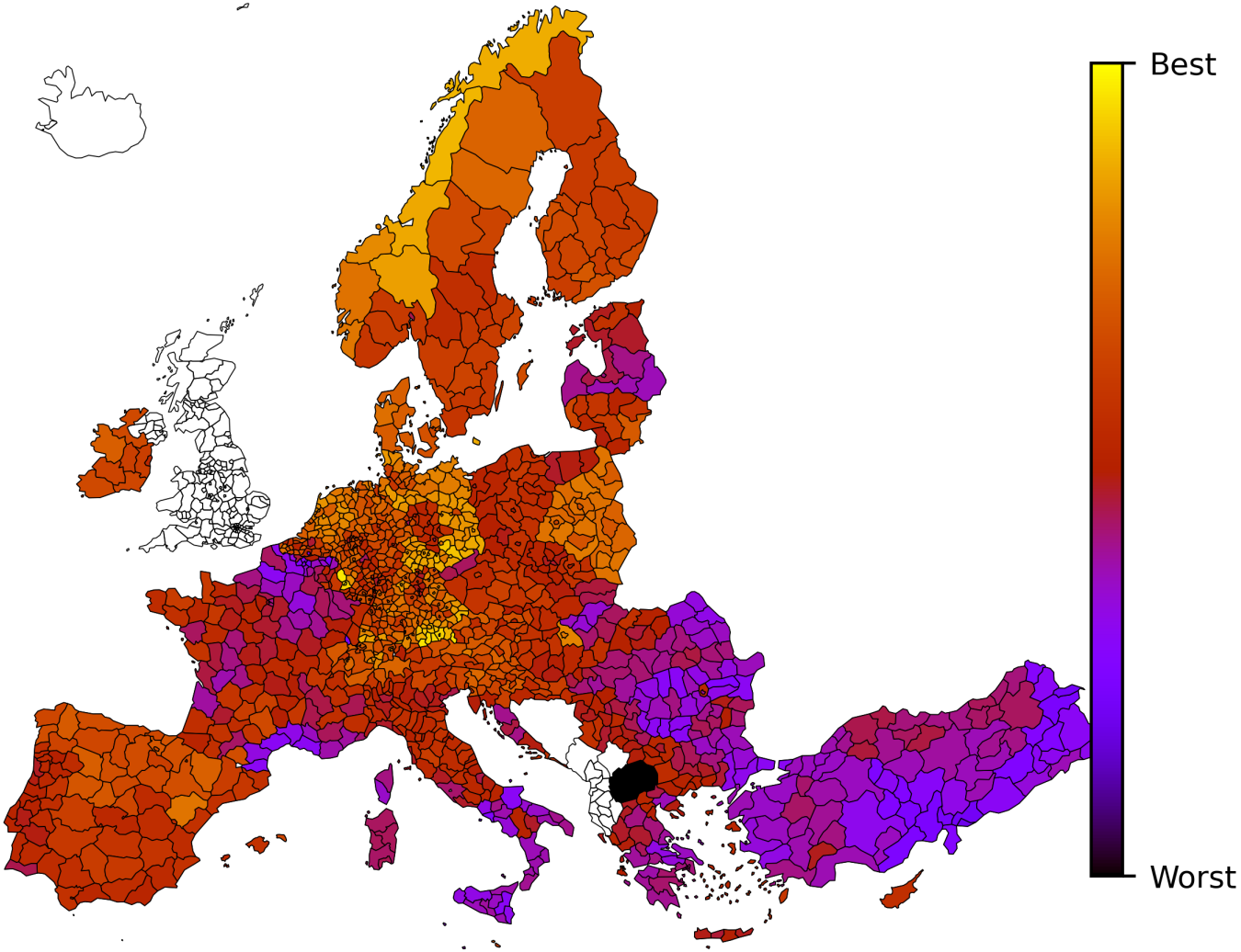
Overall Development Score



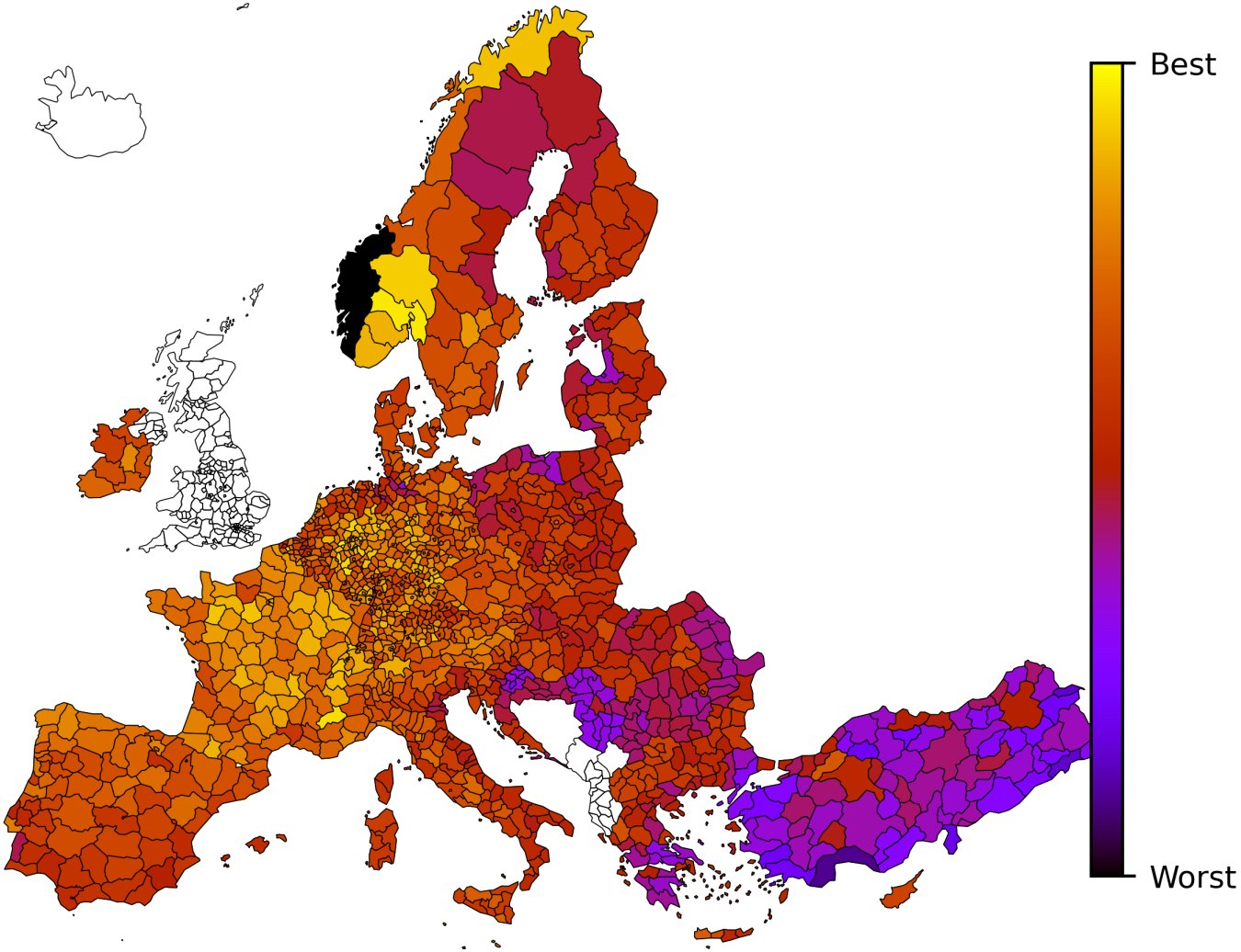
Economic Index



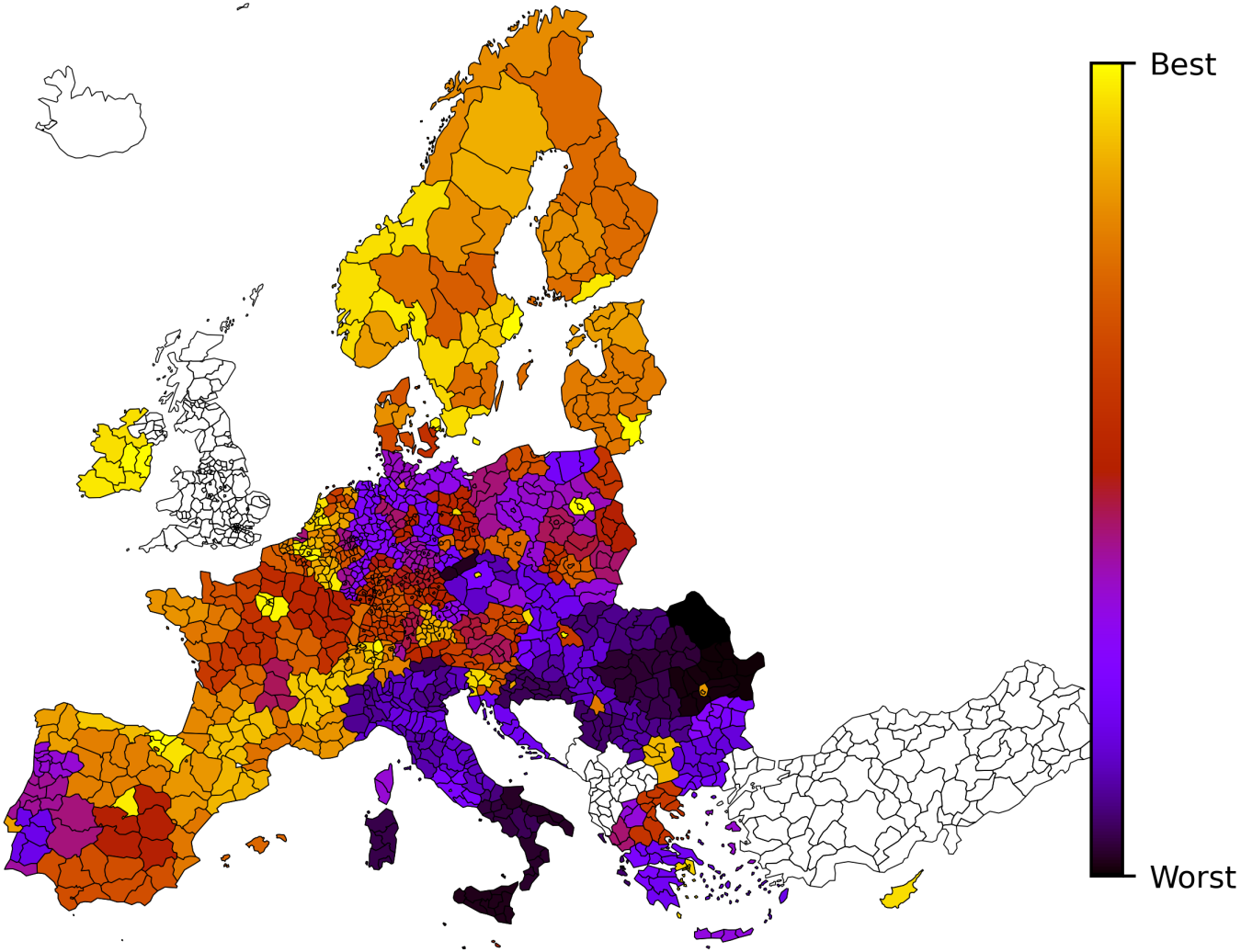
Social-Cultural Index



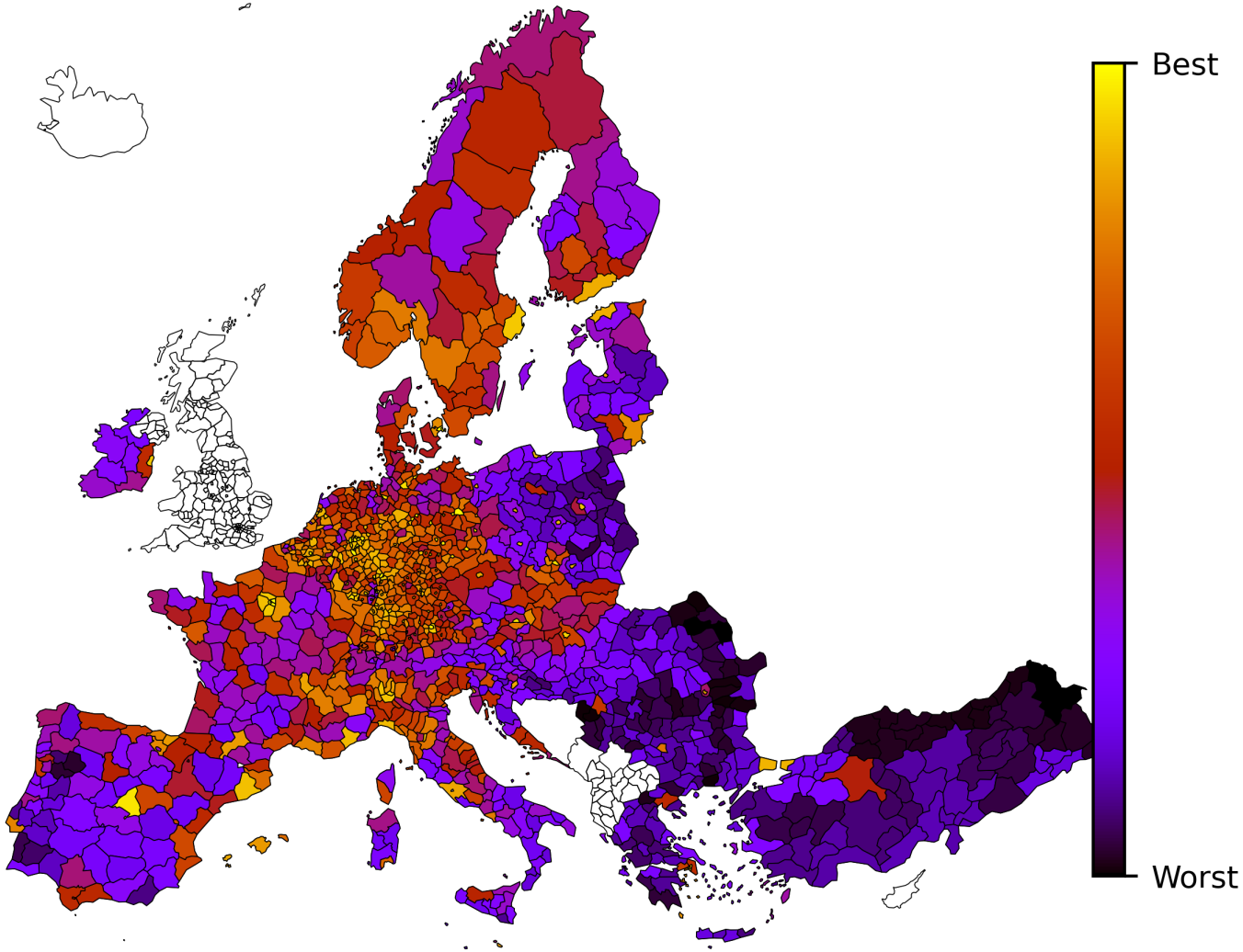
Living Environment Index



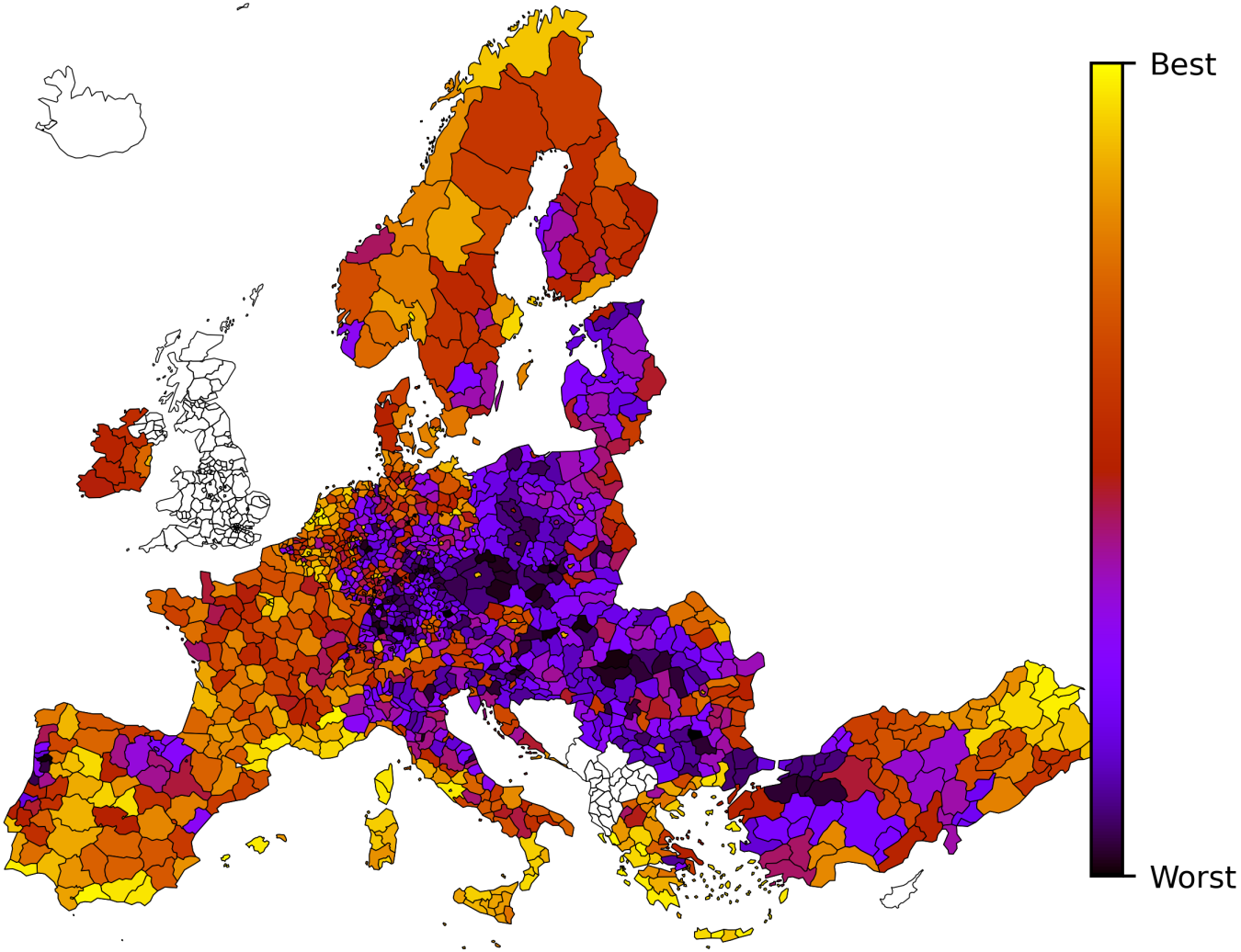
Educational Level



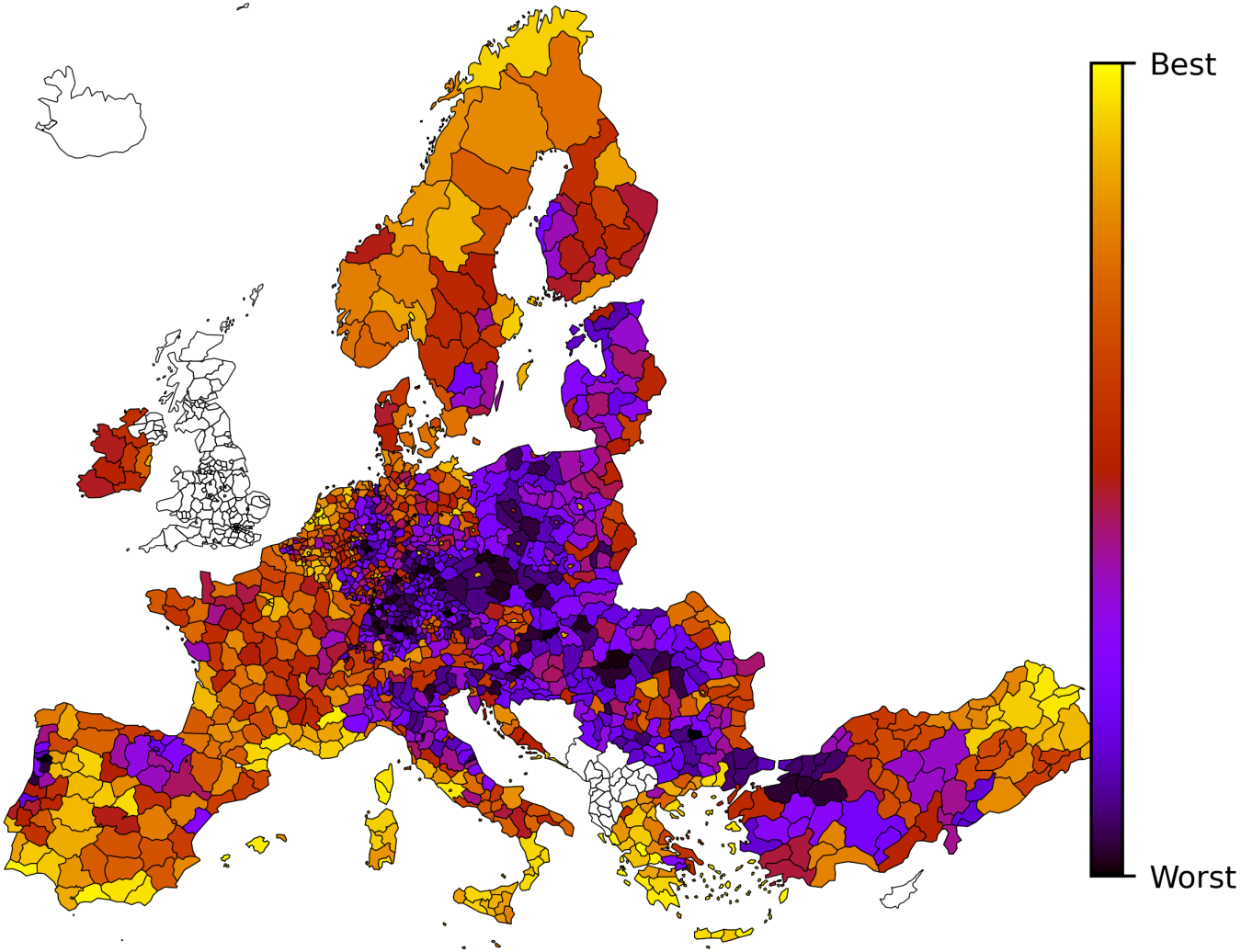
Primary Sector Fraction



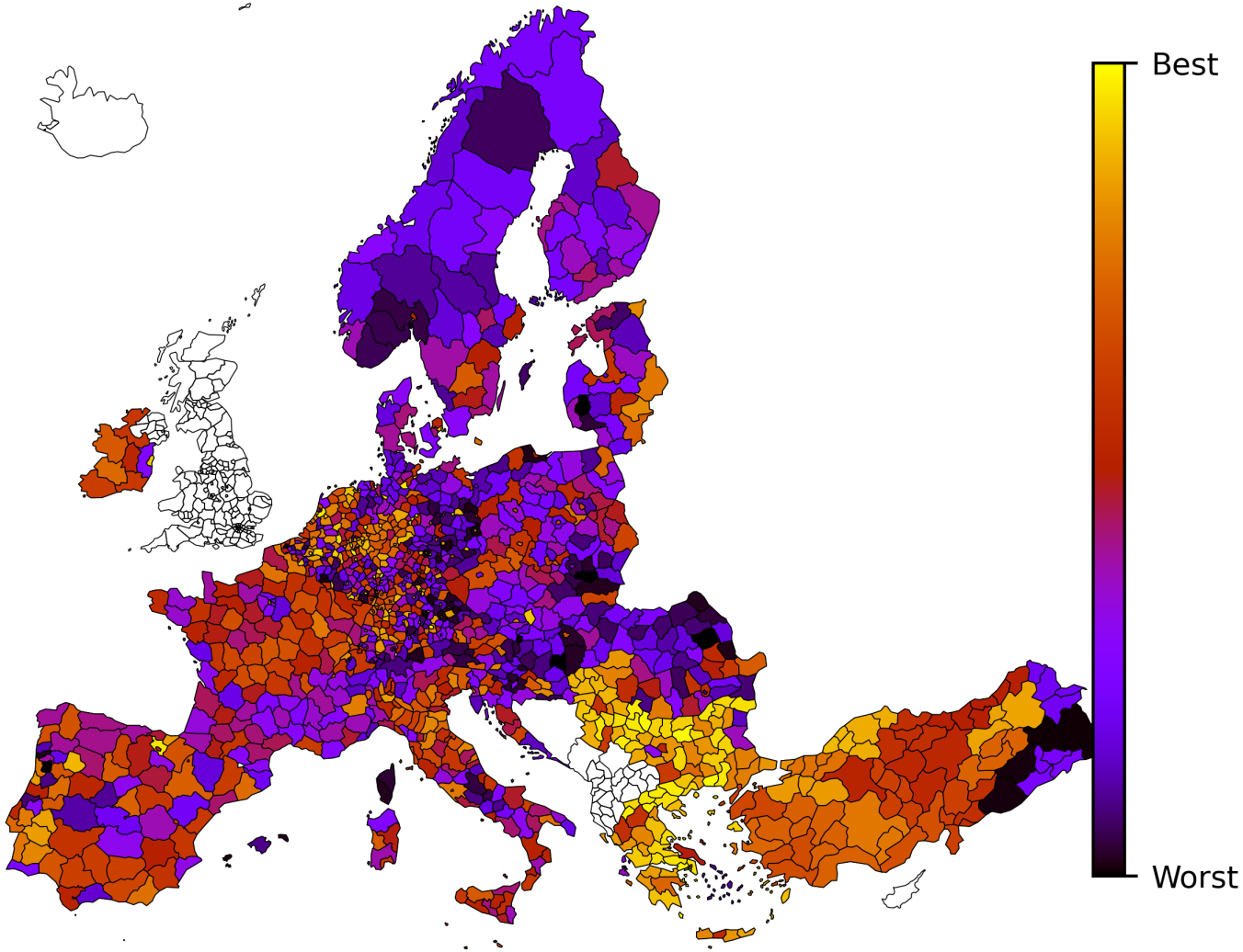
Secondary Sector Fraction (Industrial)



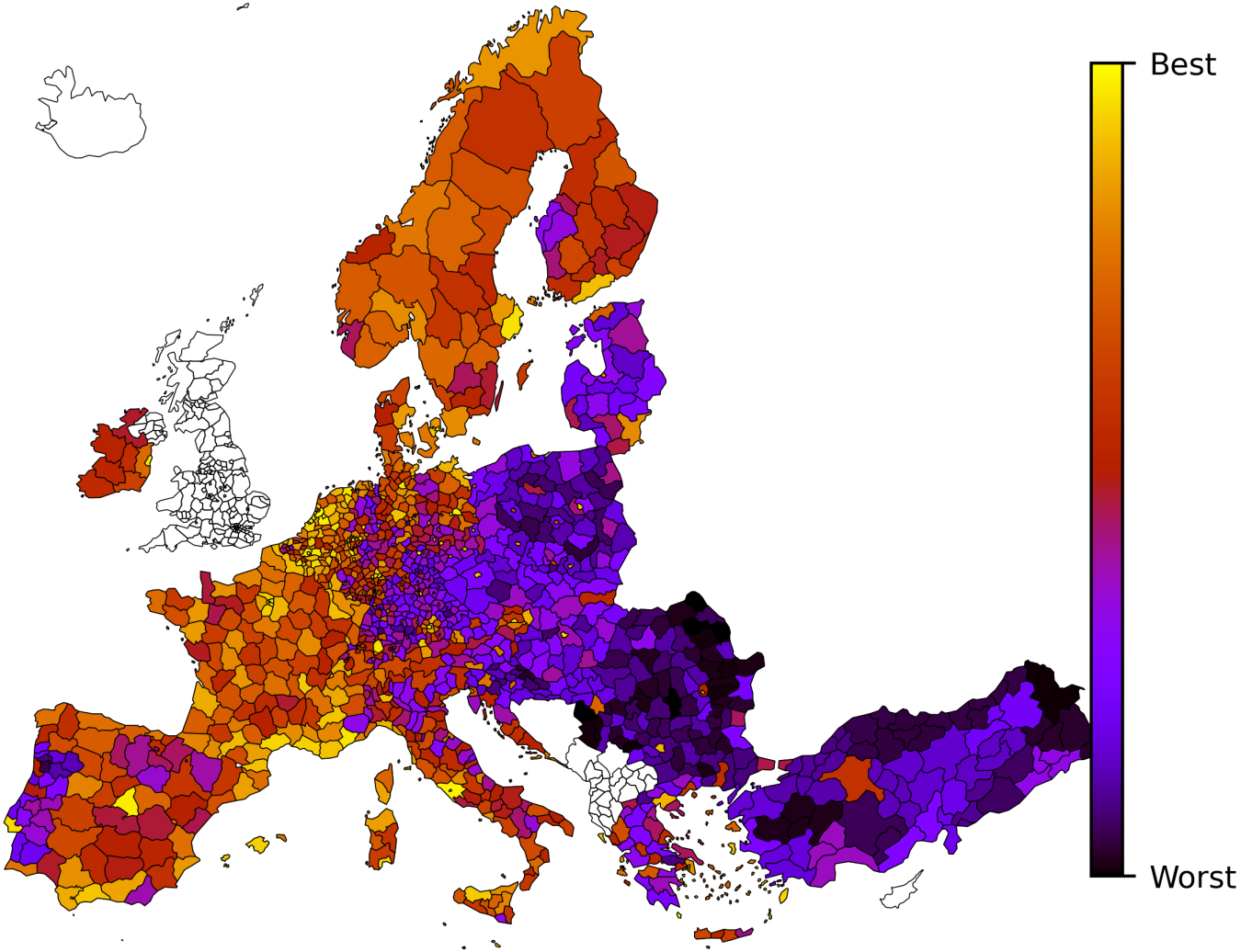
Secondary Sector Fraction (Manufacturing)



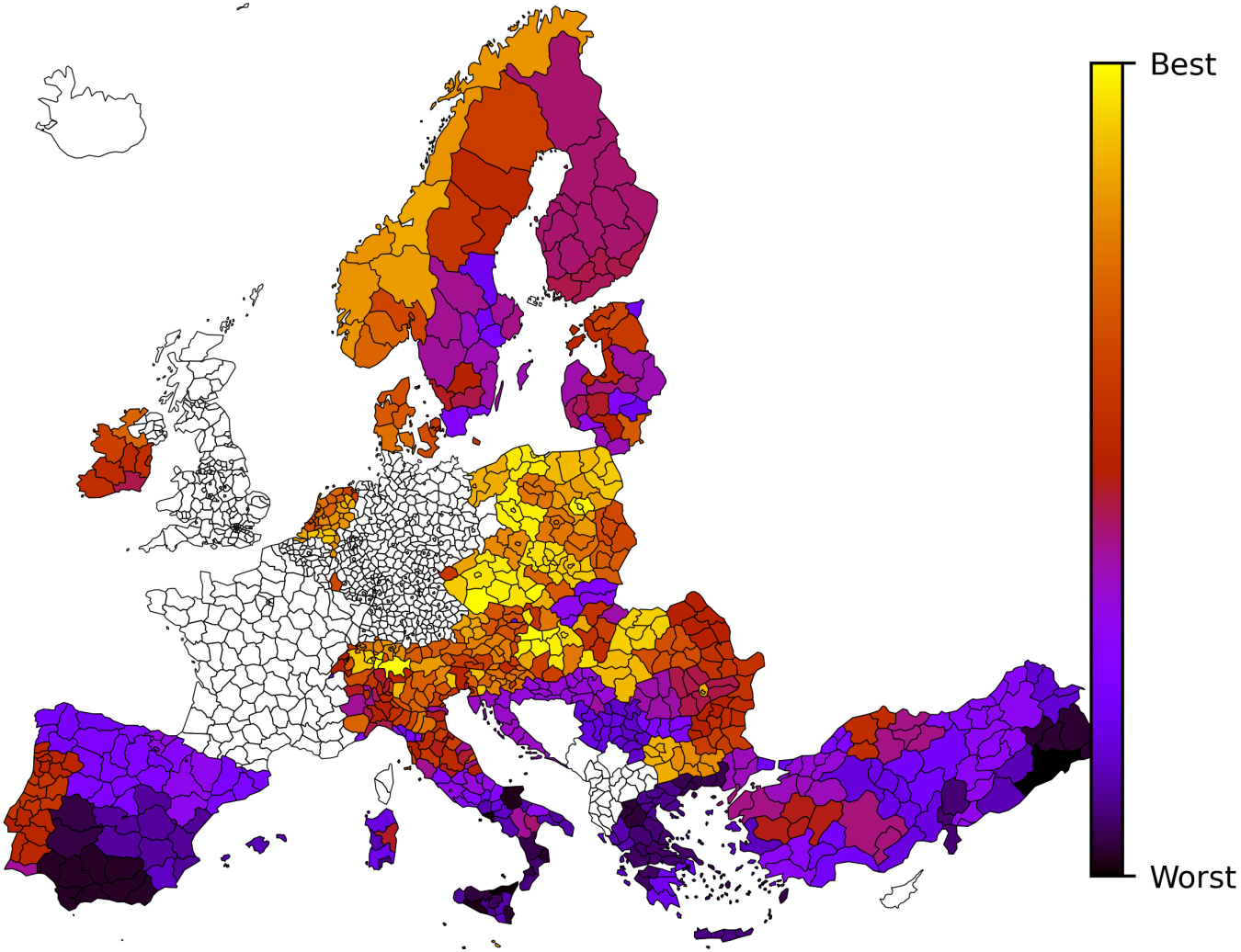
Secondary Sector Fraction (Construction)



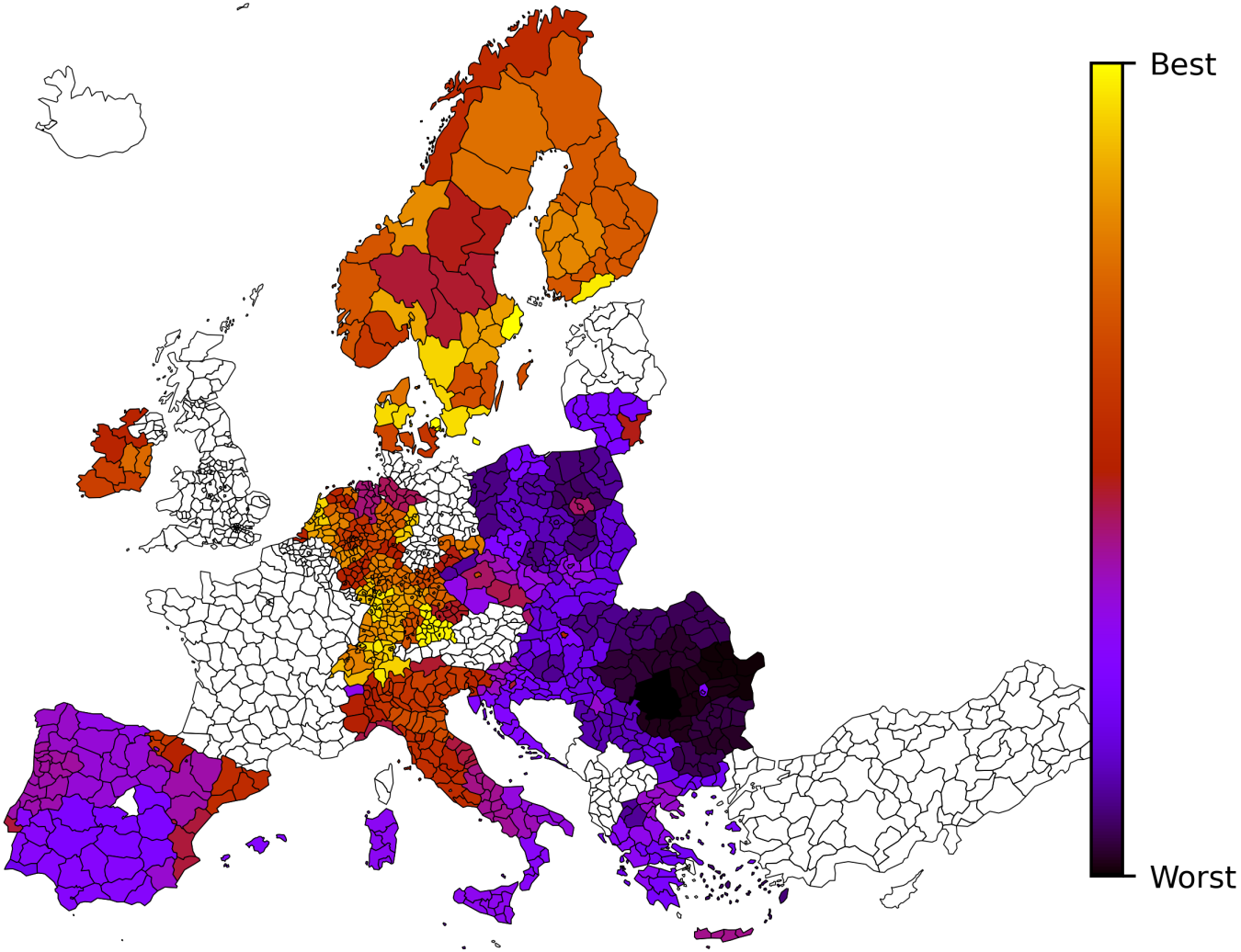
Tertiary Sector



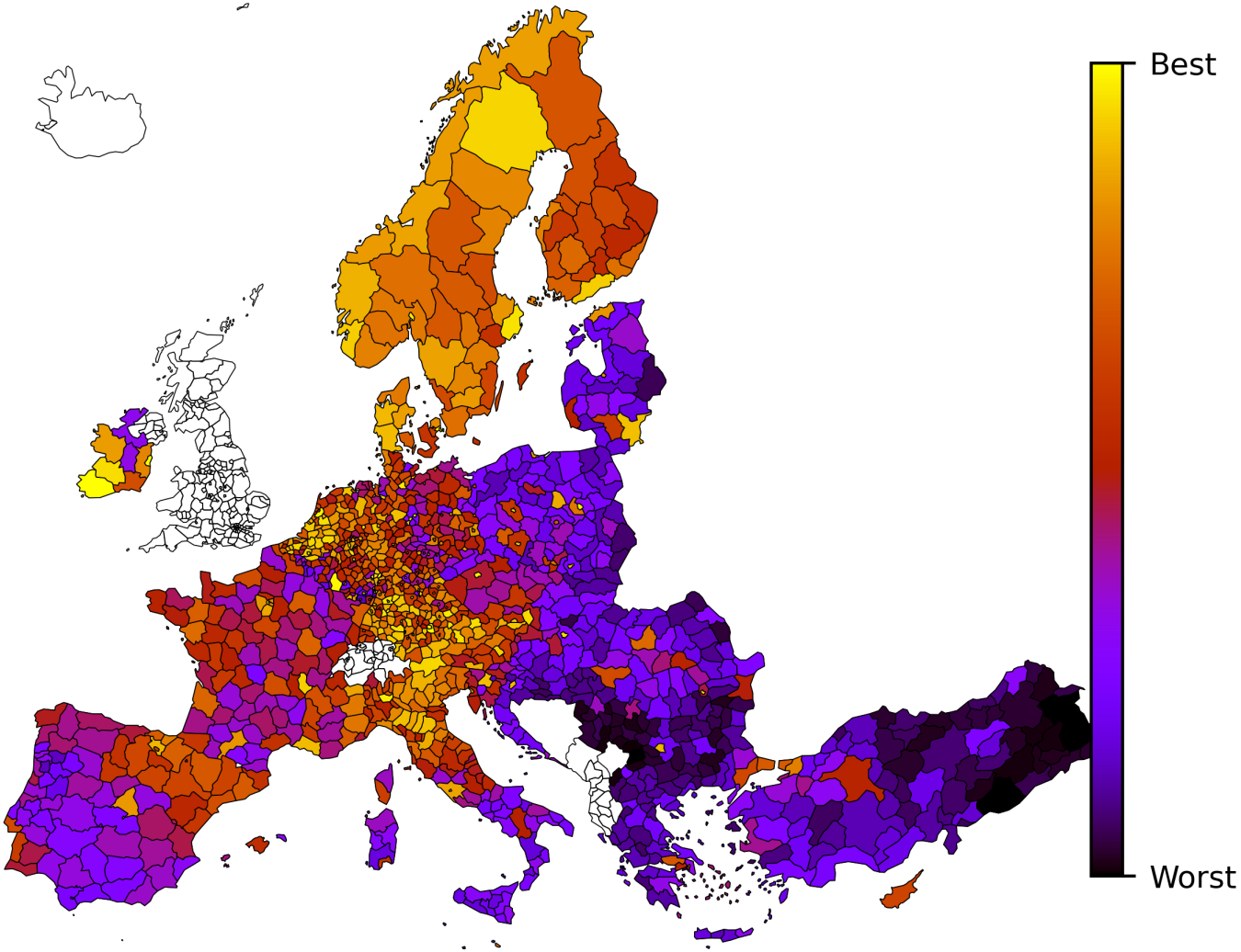
Total Unemployment



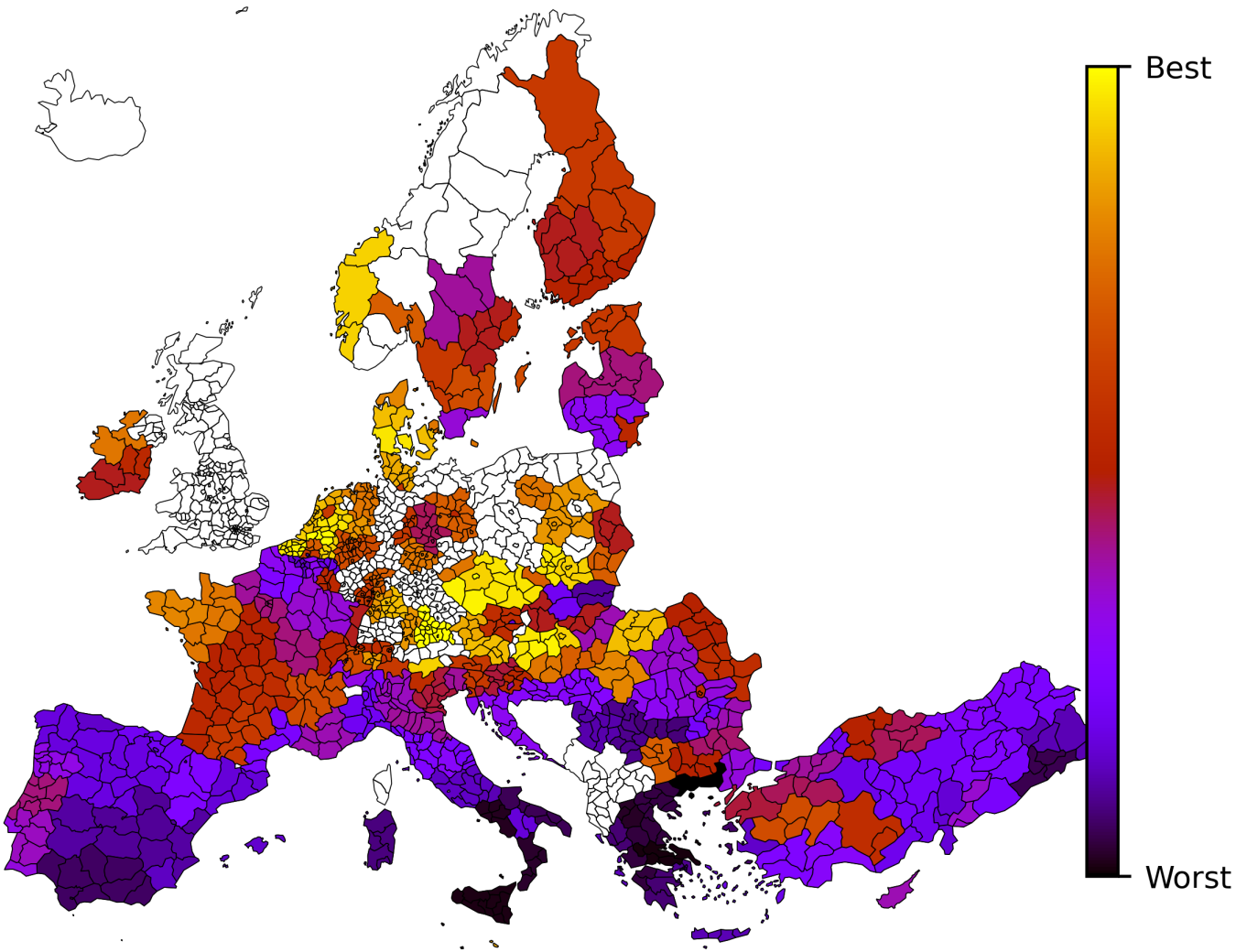
Regional Innovation Score



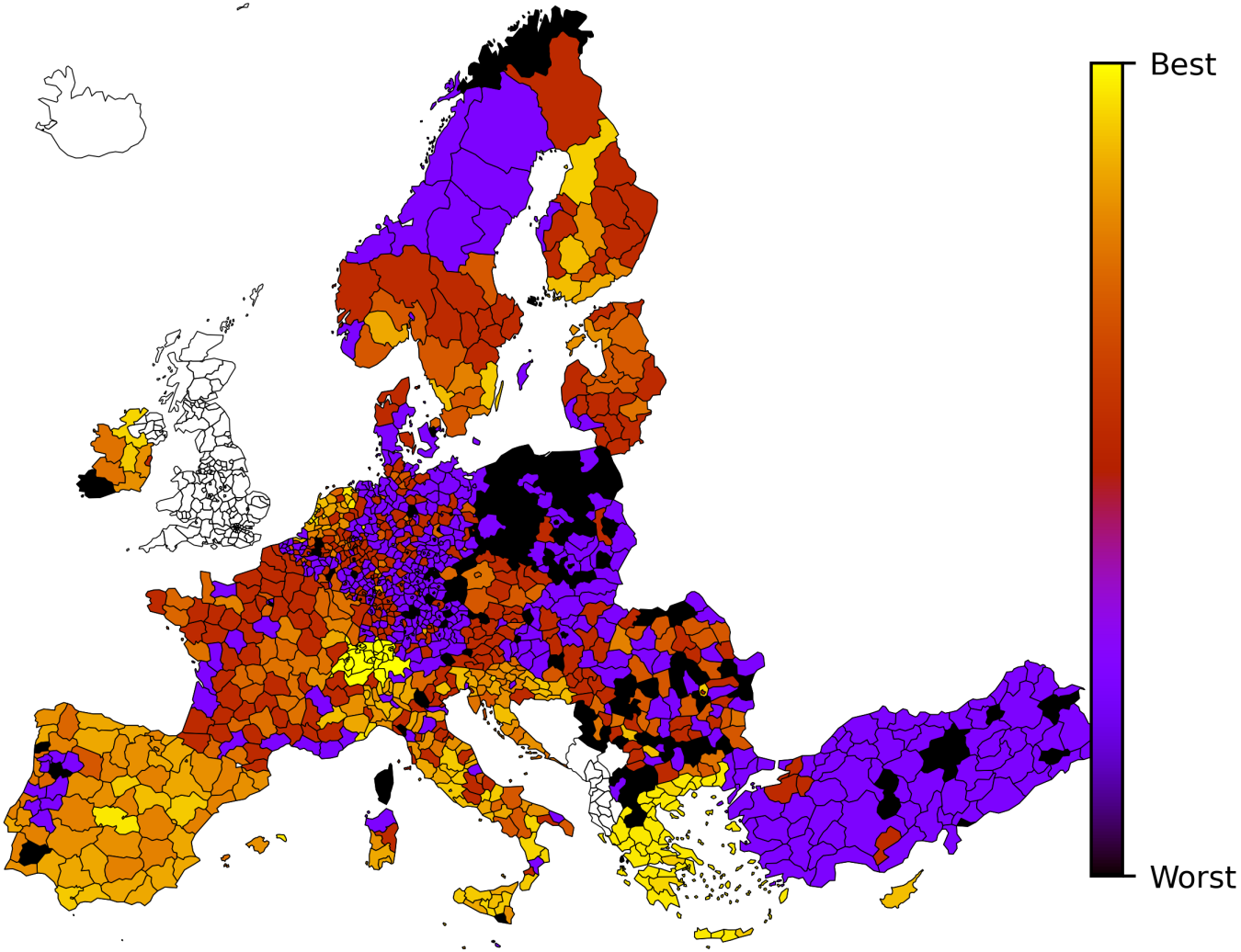
GDP per Capita



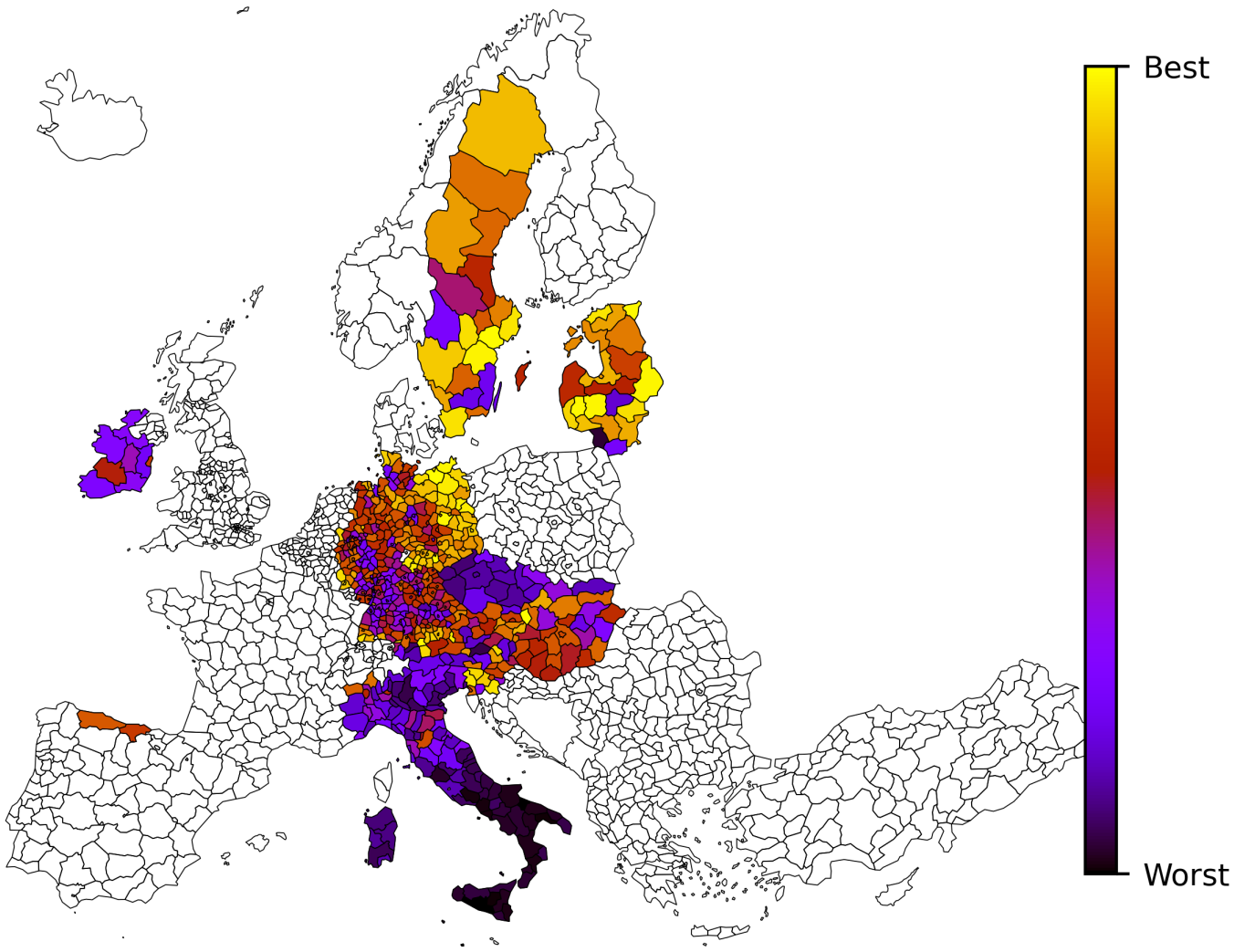
Total Long-Term Unemployment



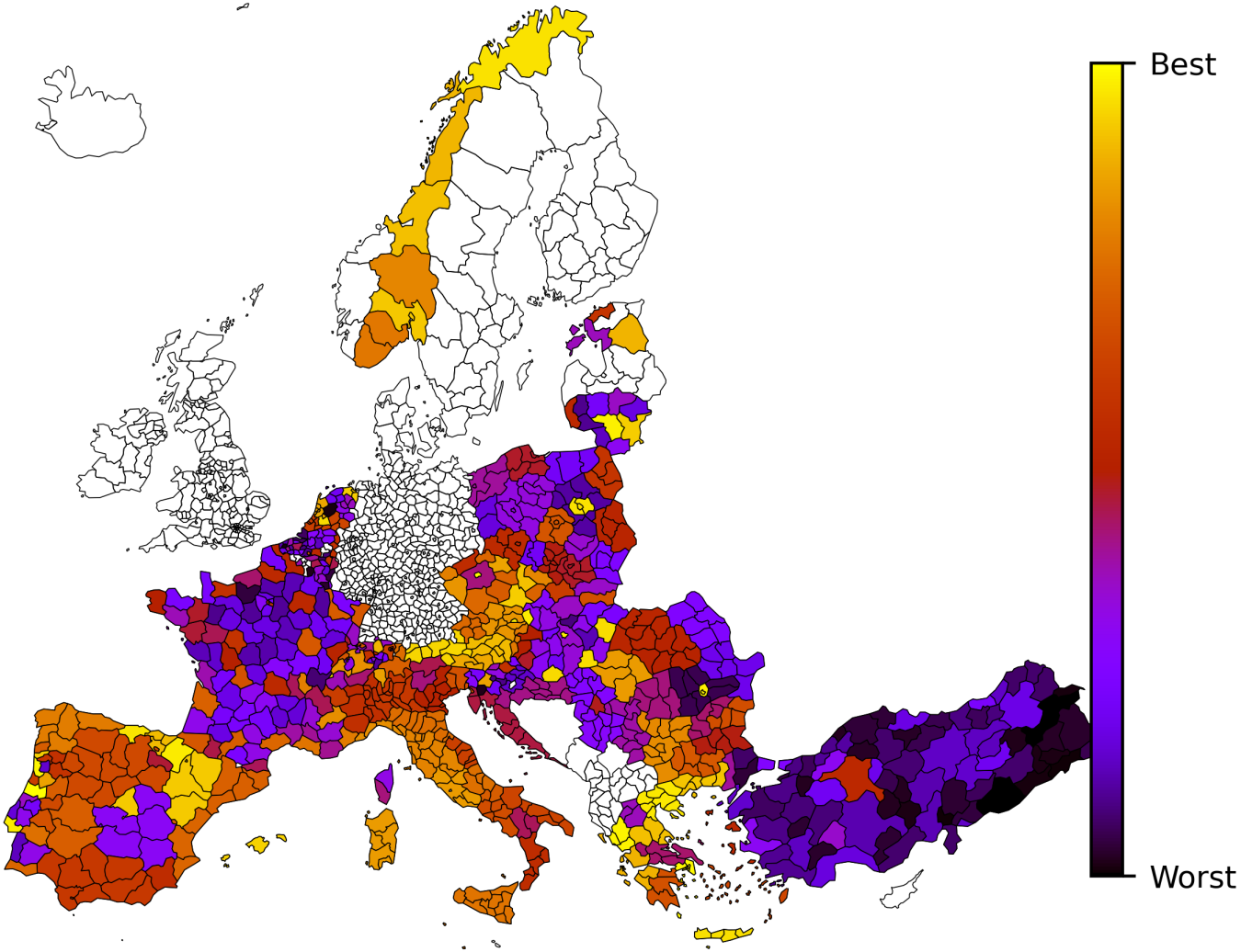
Economic Resilience



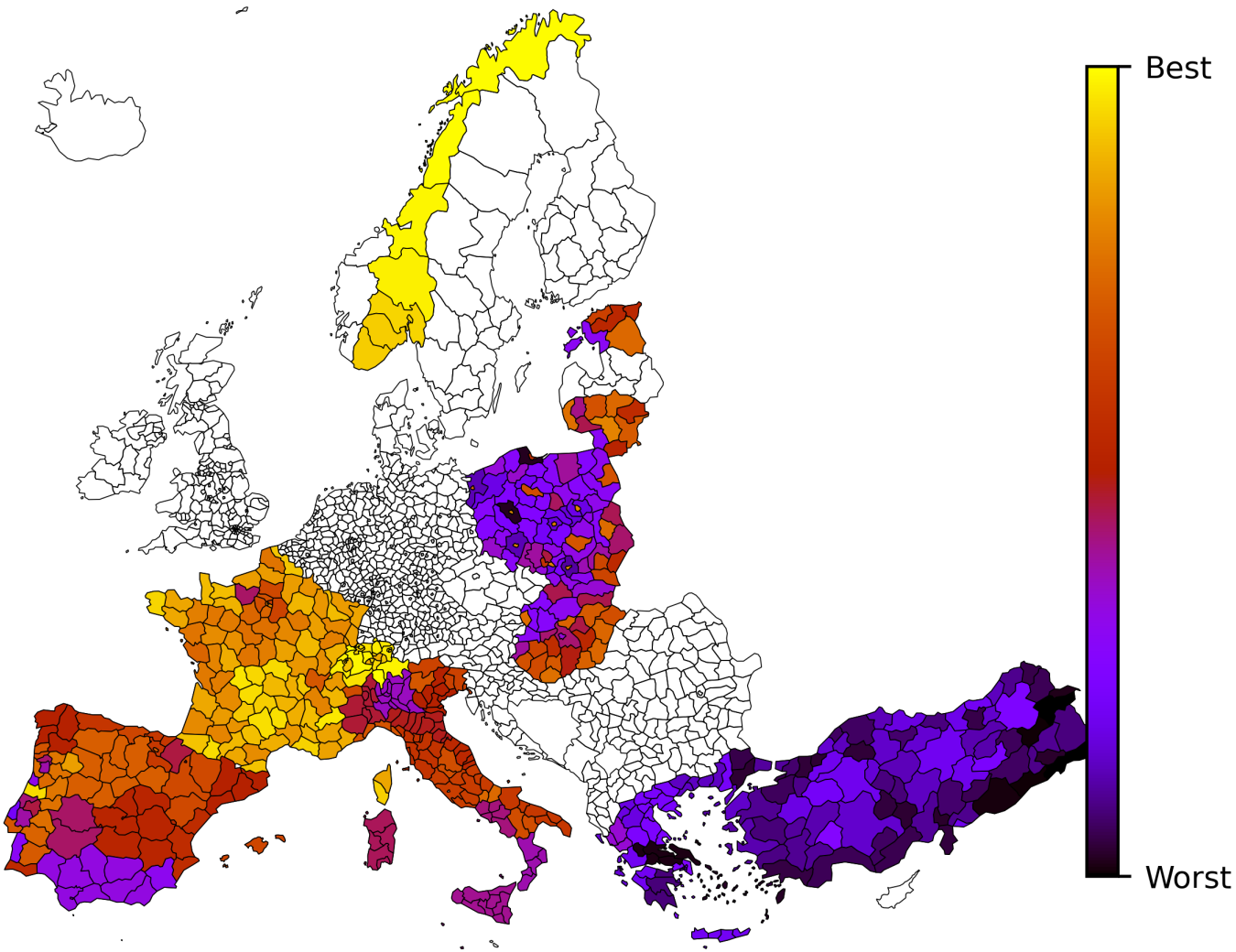
Labour Force Participation Rate- Gender Difference



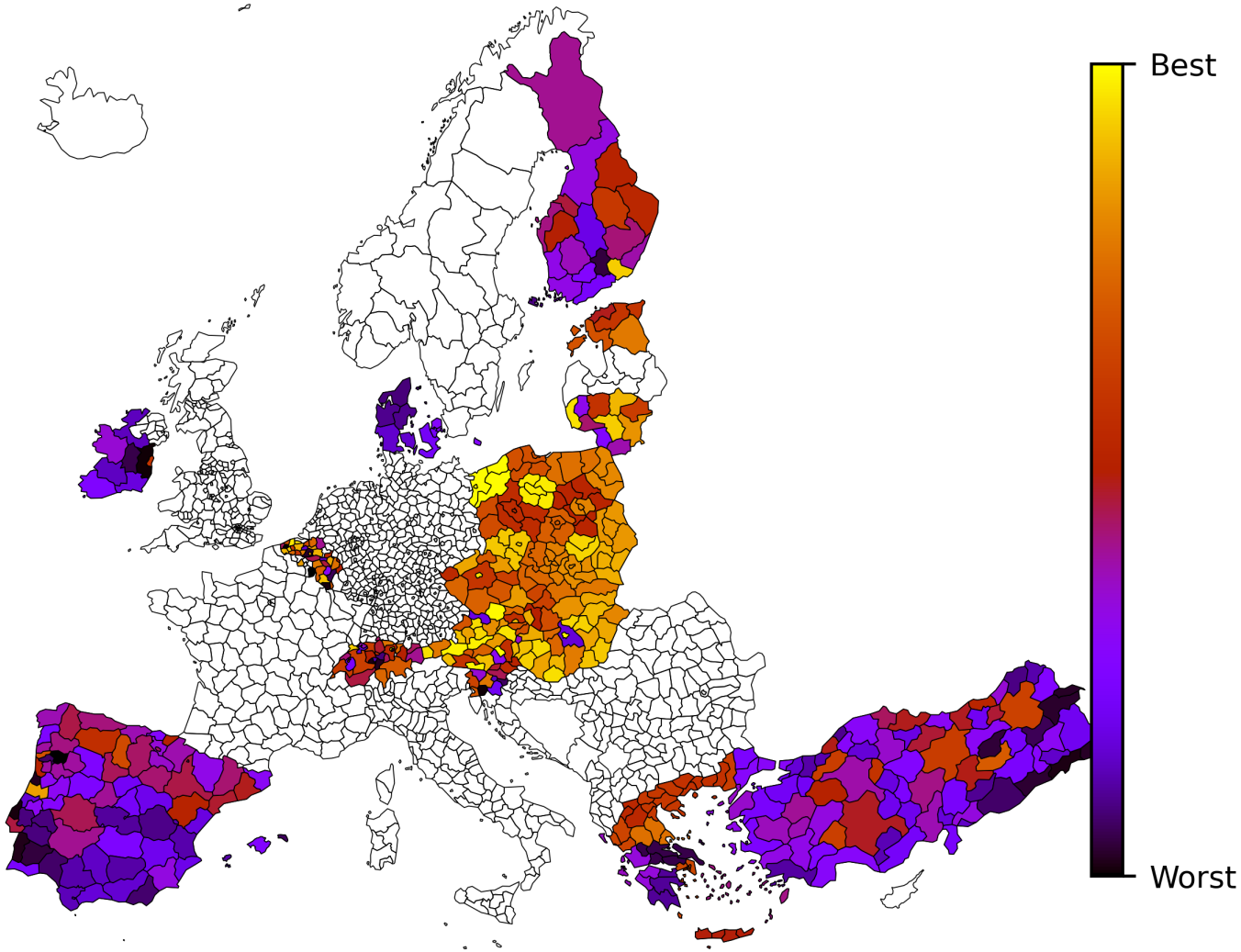
Physicians Rate



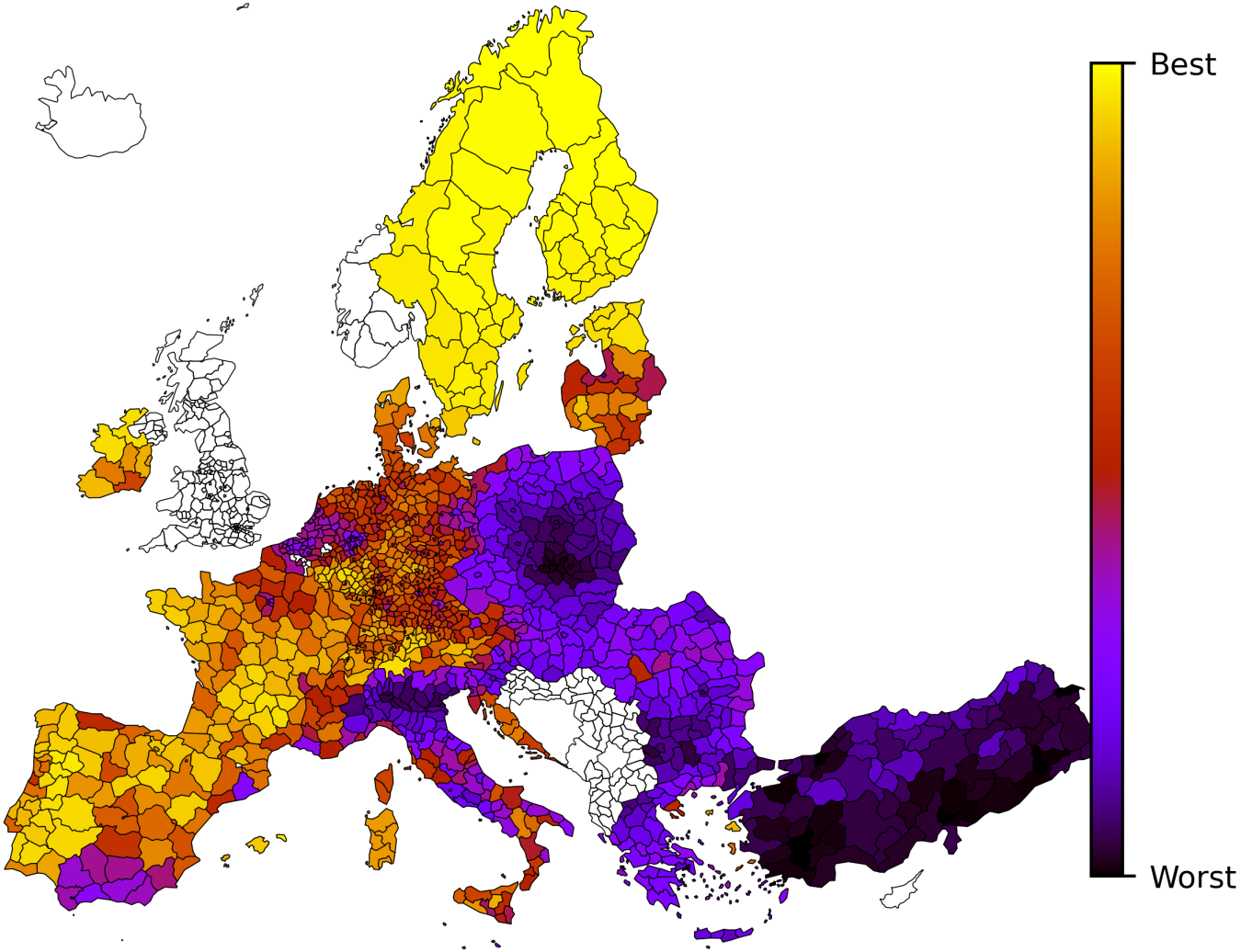
Nurses Rate



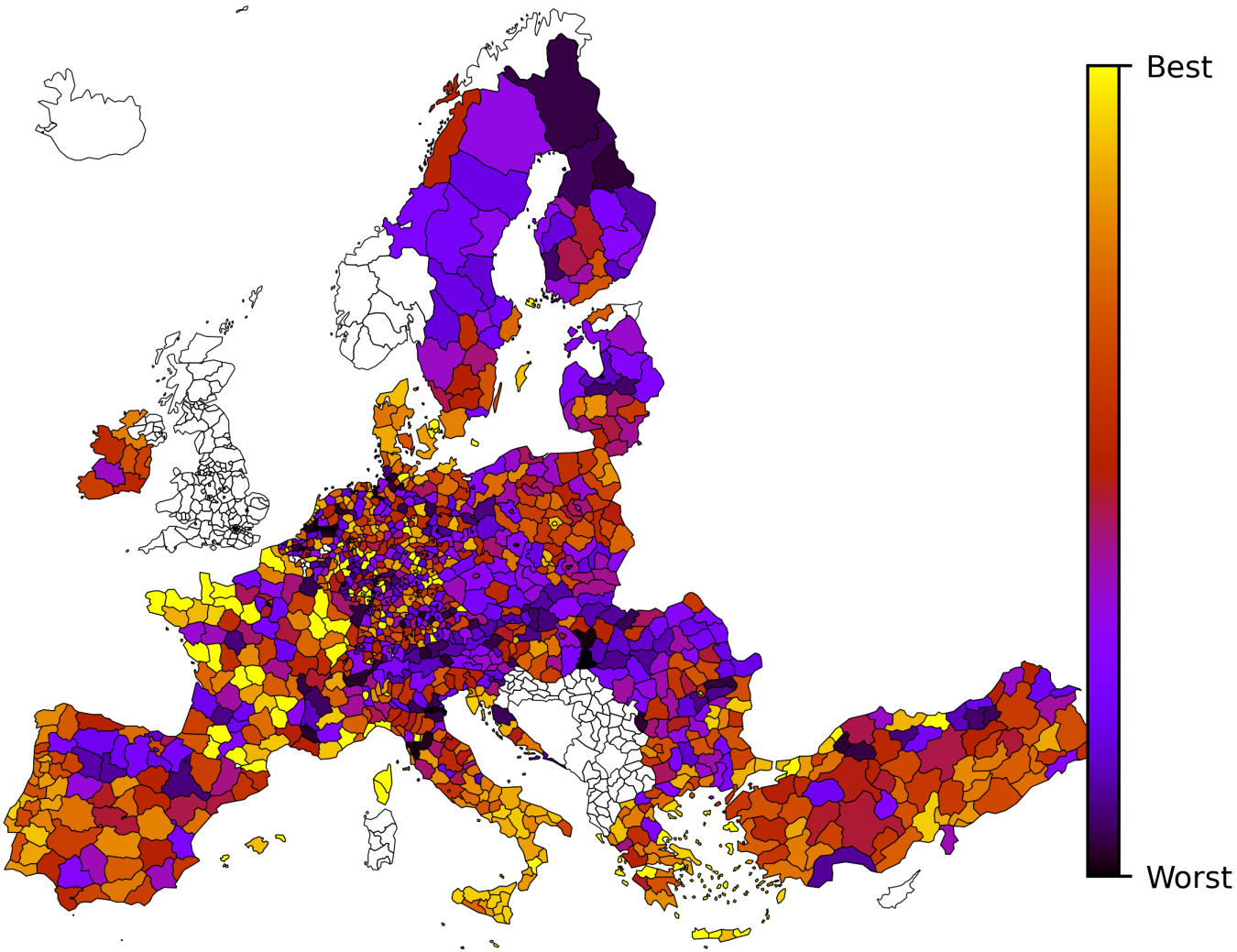
Hospital Beds



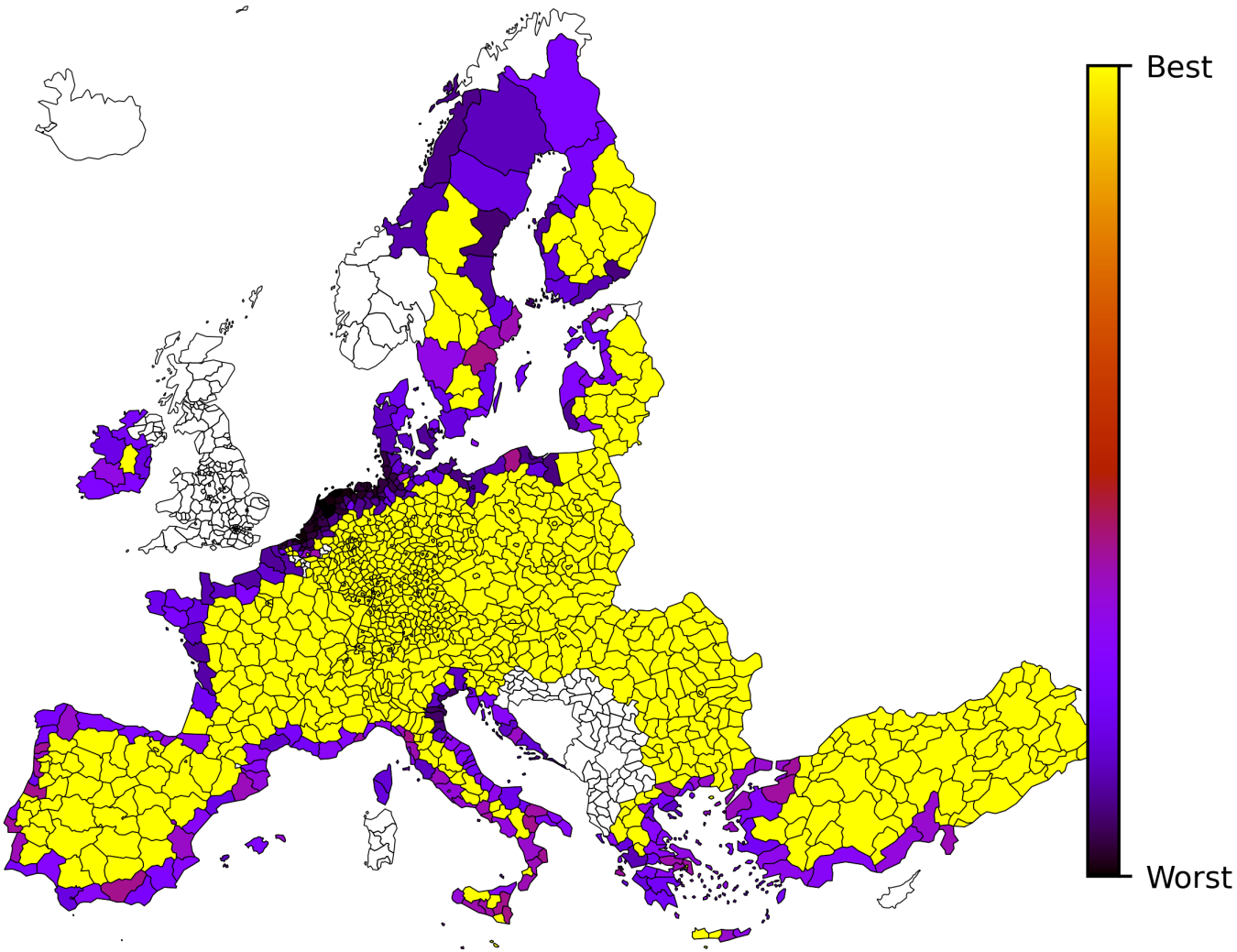
Air Pollution



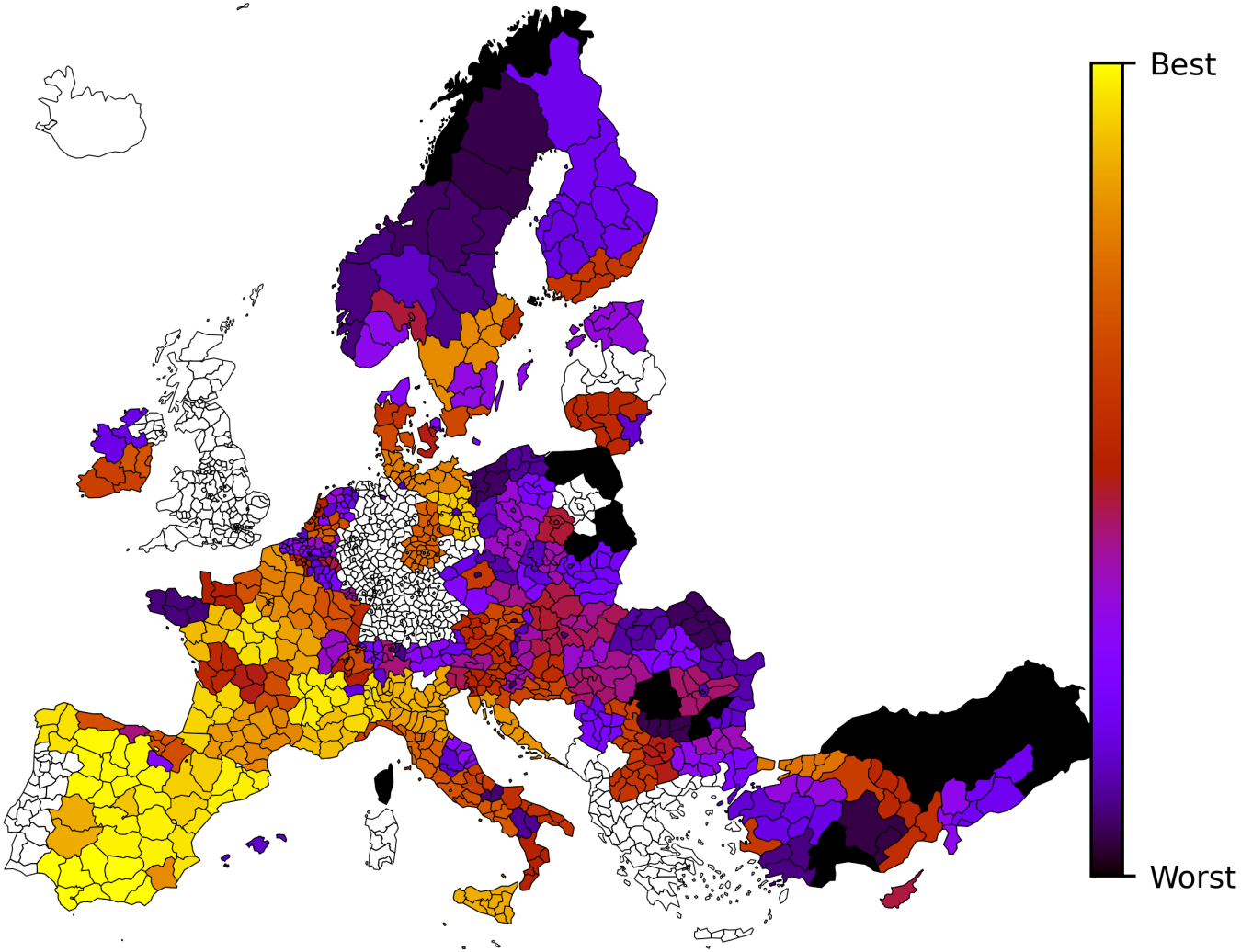
Flooding (Rivers)



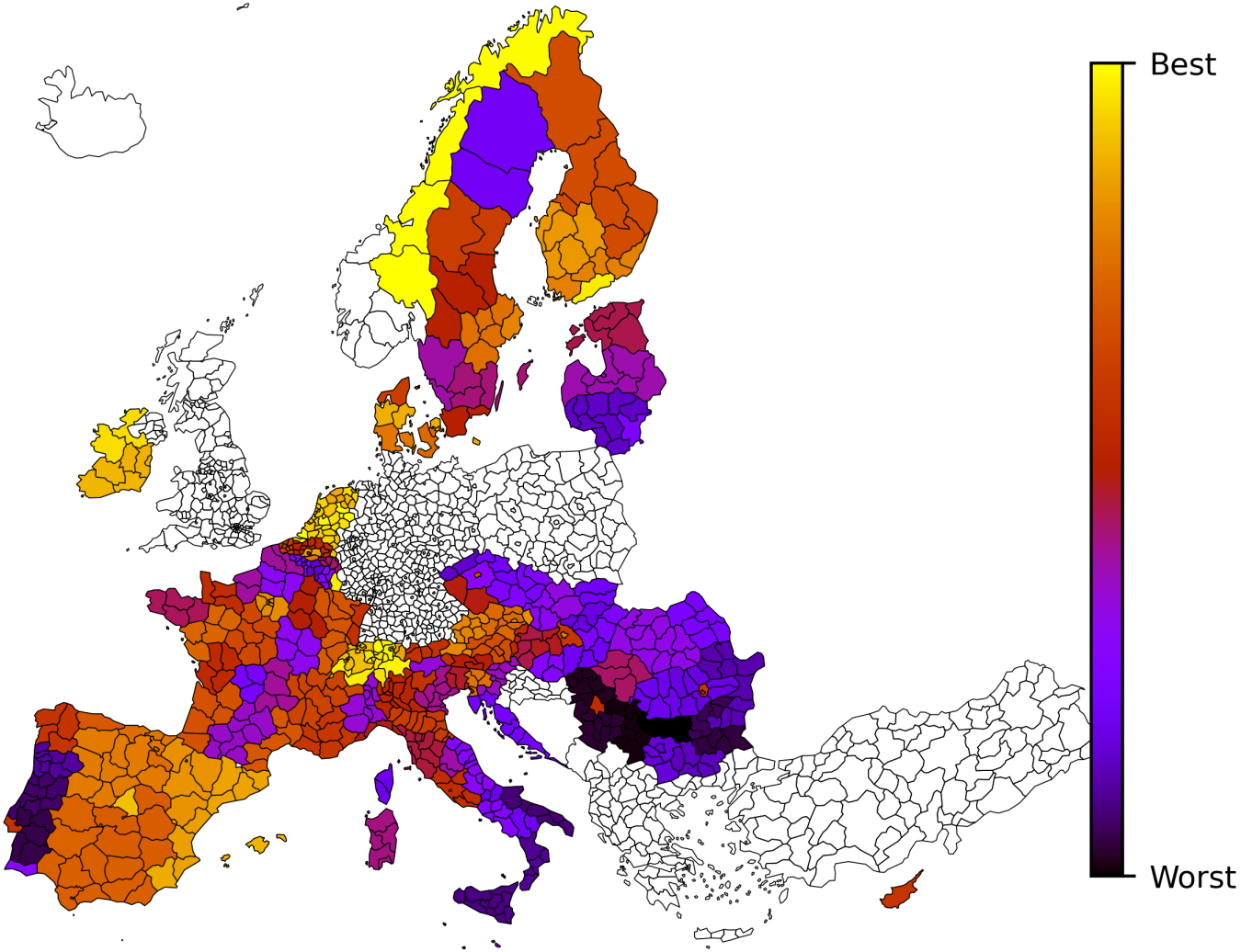
Flooding (Coastal)



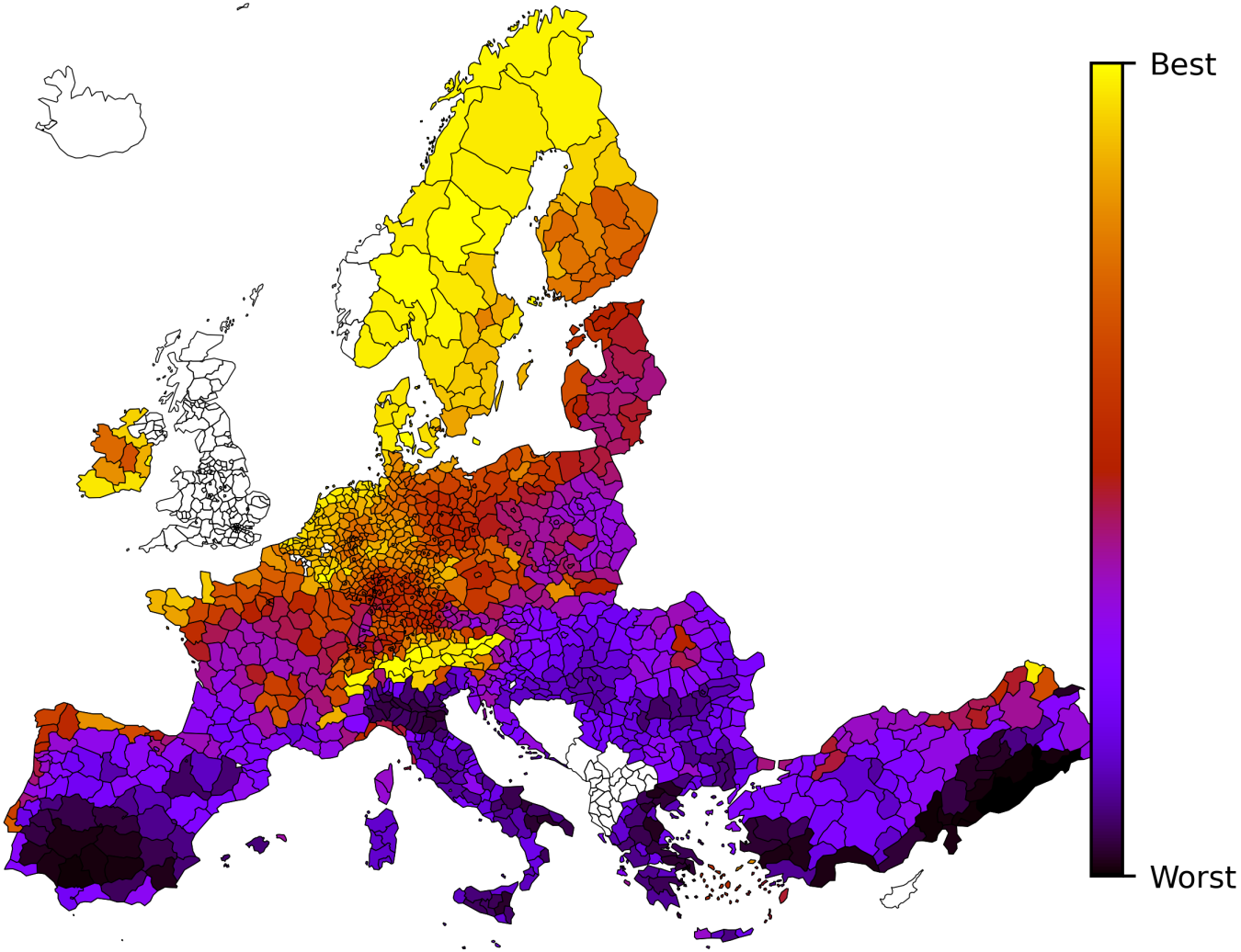
Motorway Infrastructure



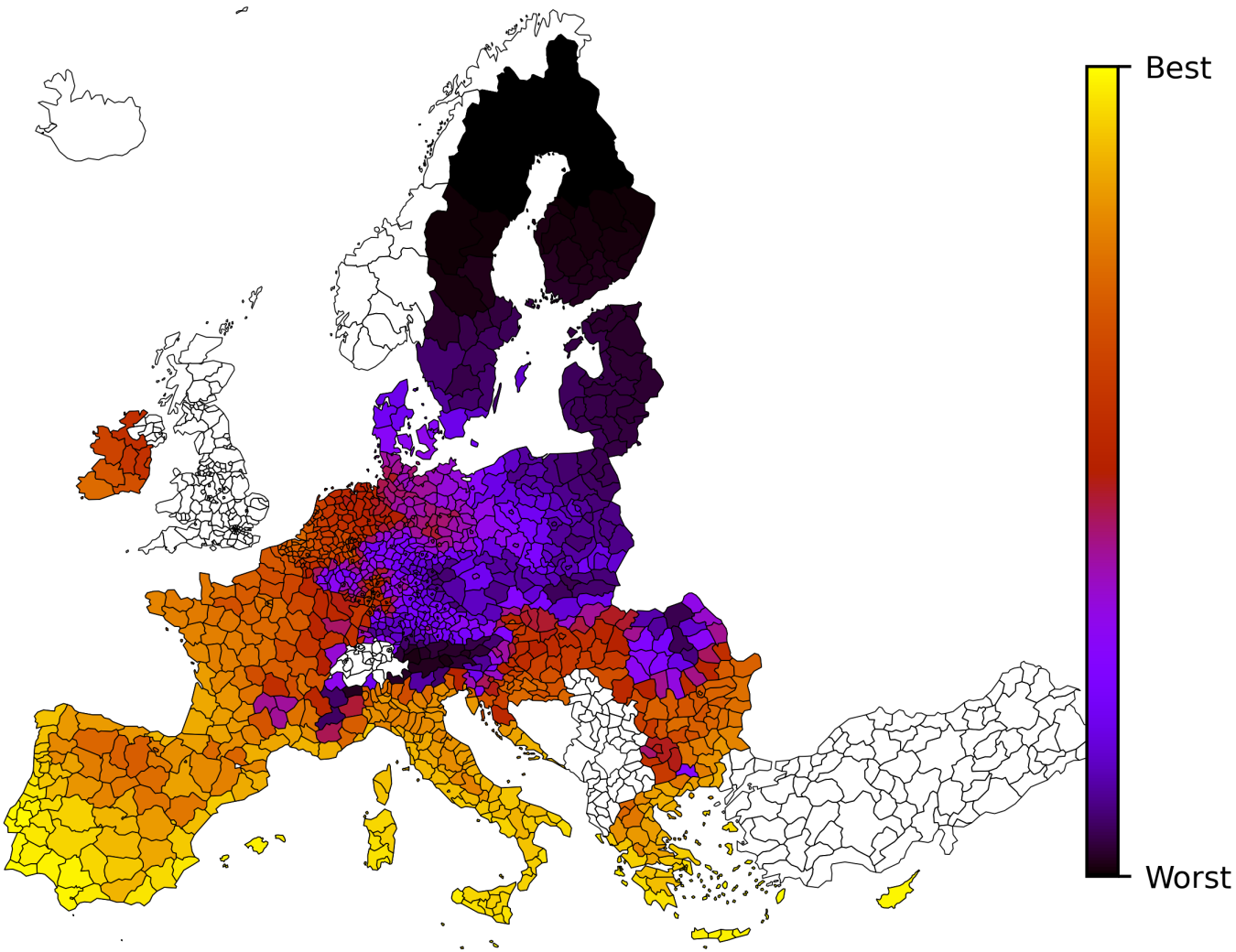
Digital Infrastructure



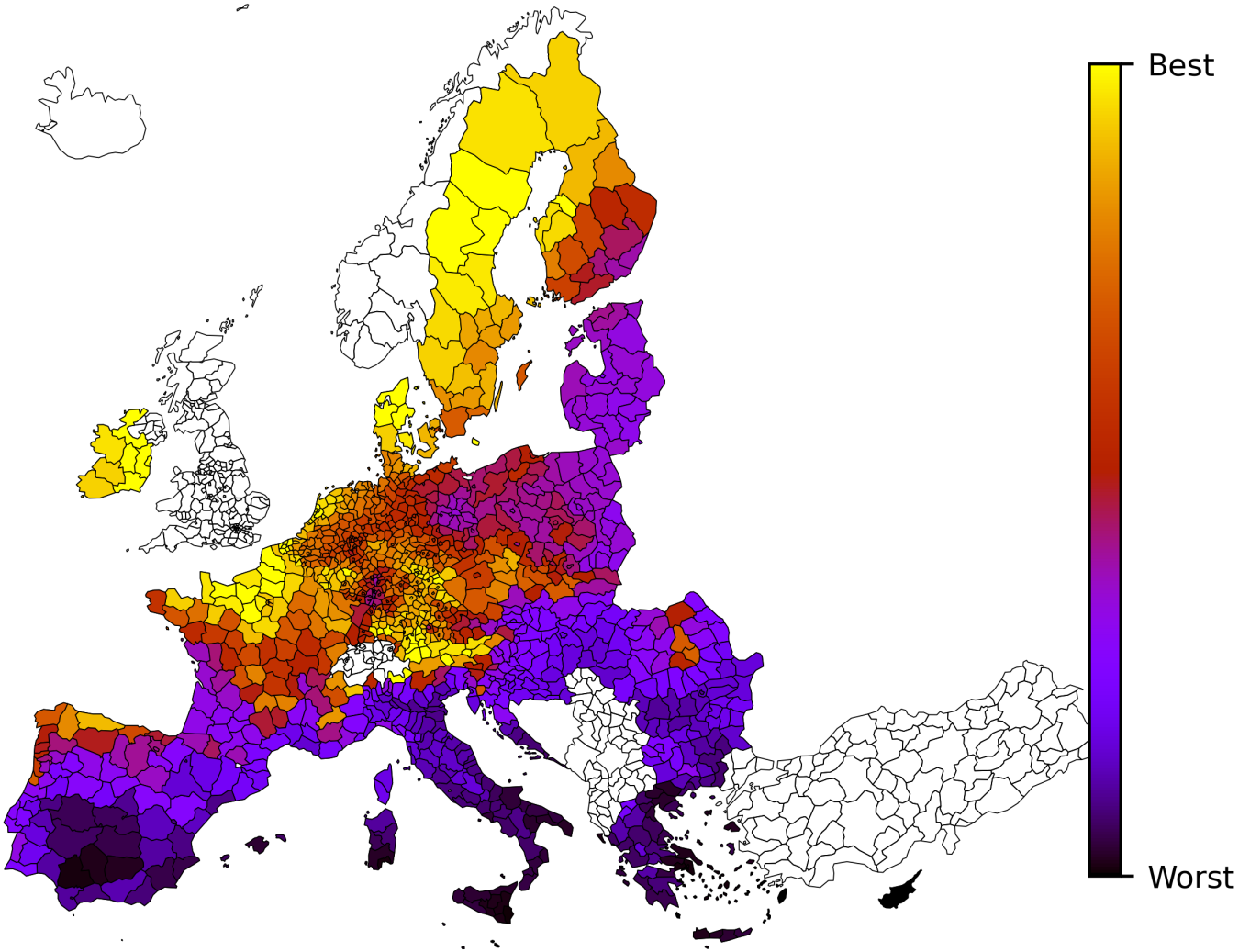
Heat Stress (average exposure)



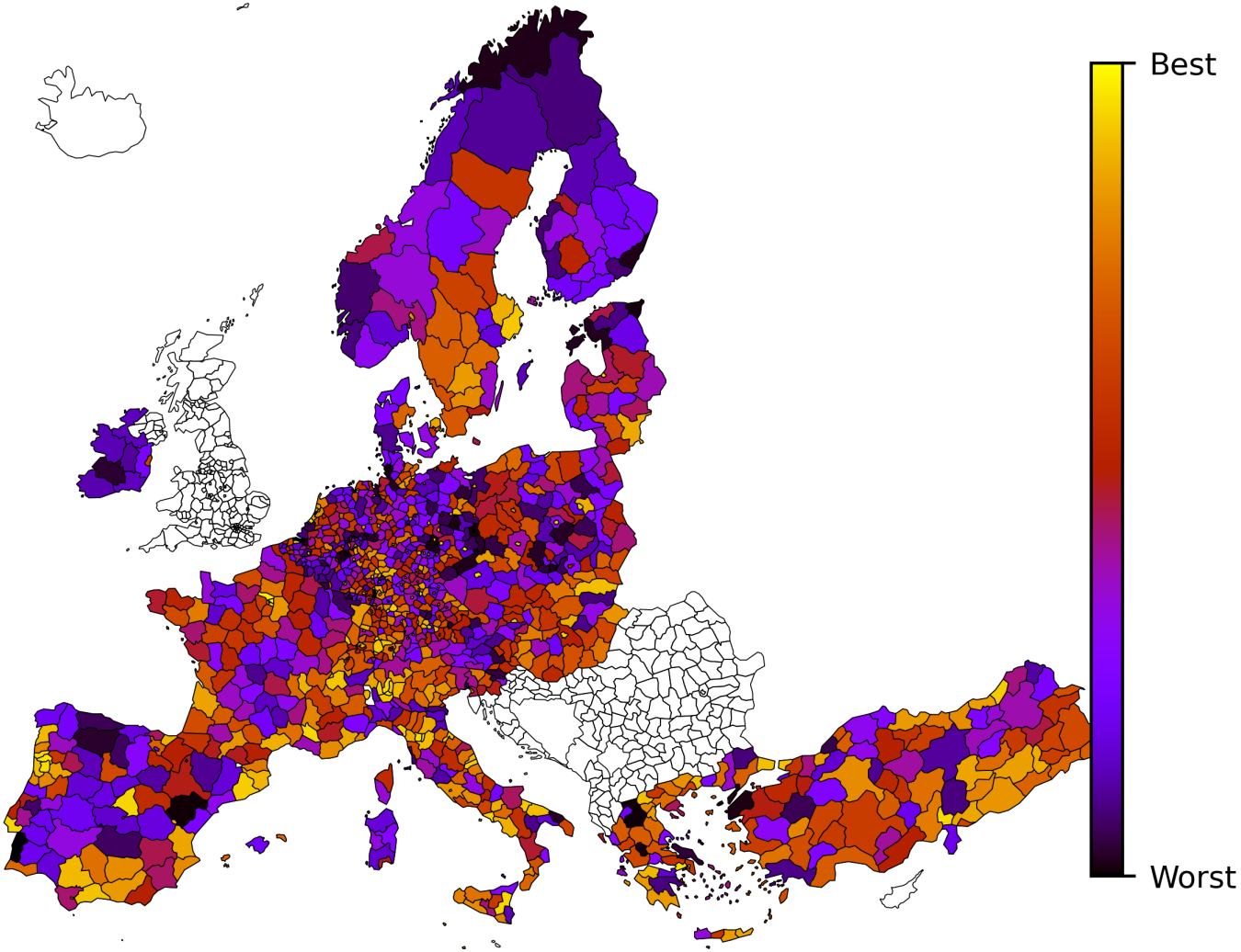
Heating Degree Days



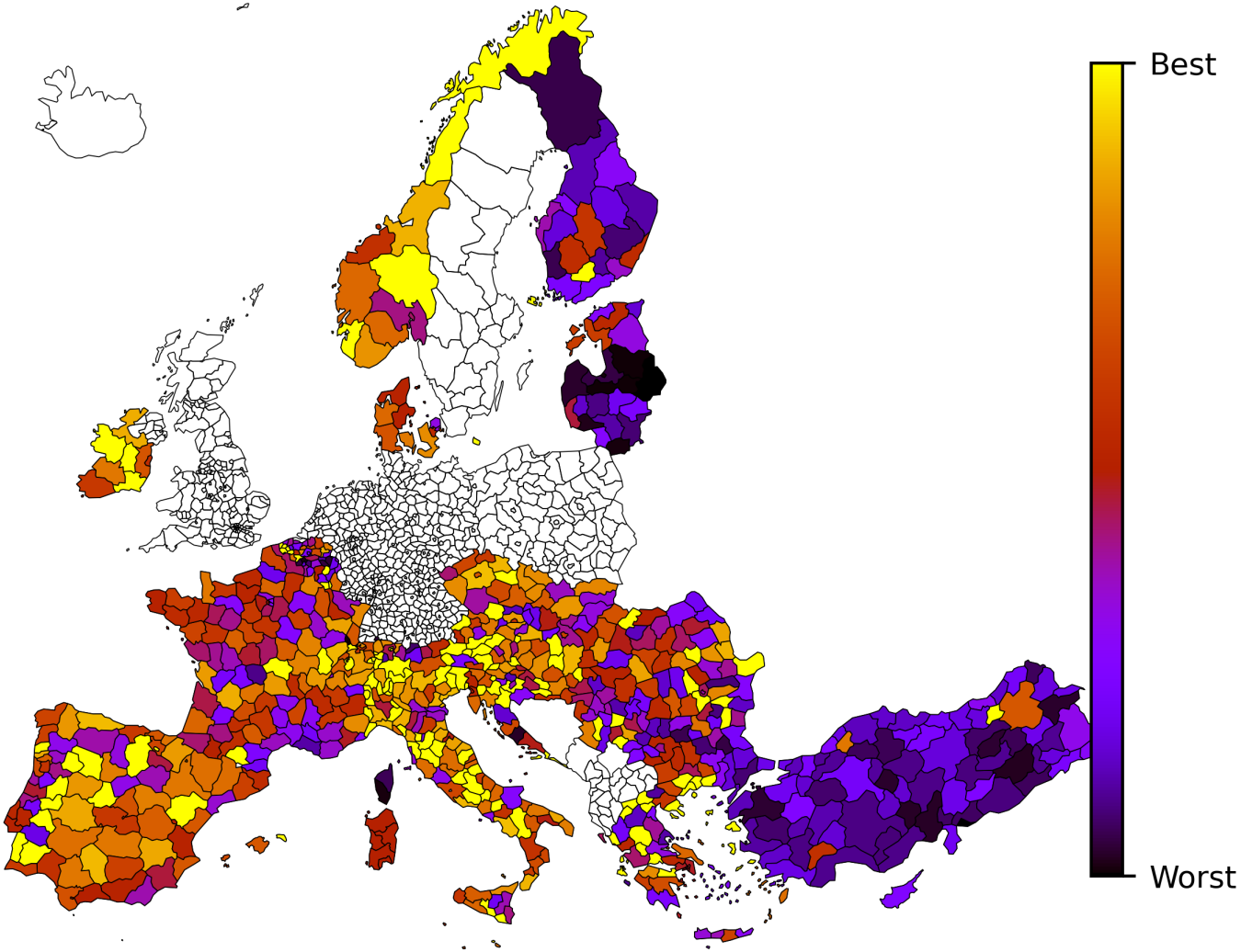
Cooling Degree Days



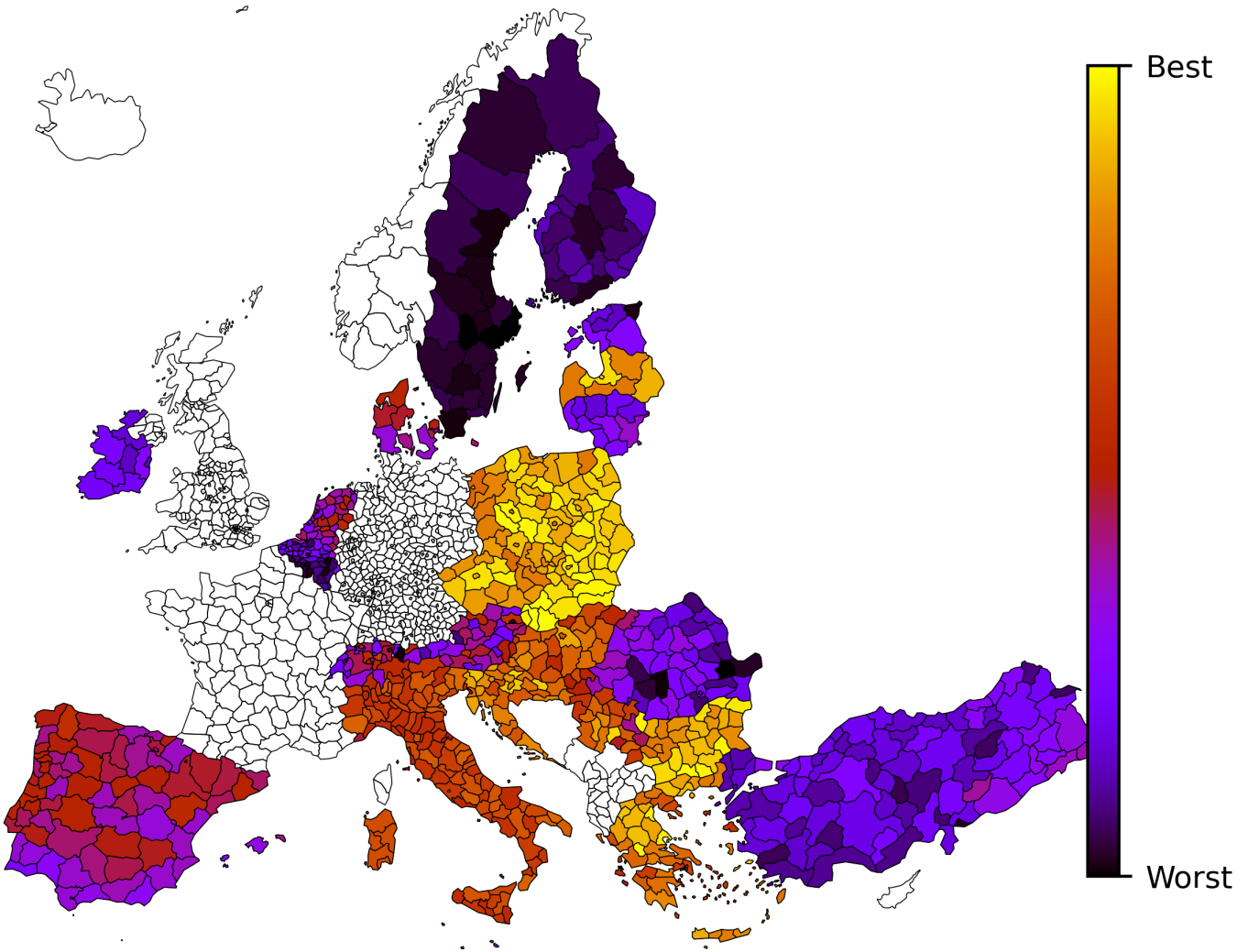
CO2 per Capita



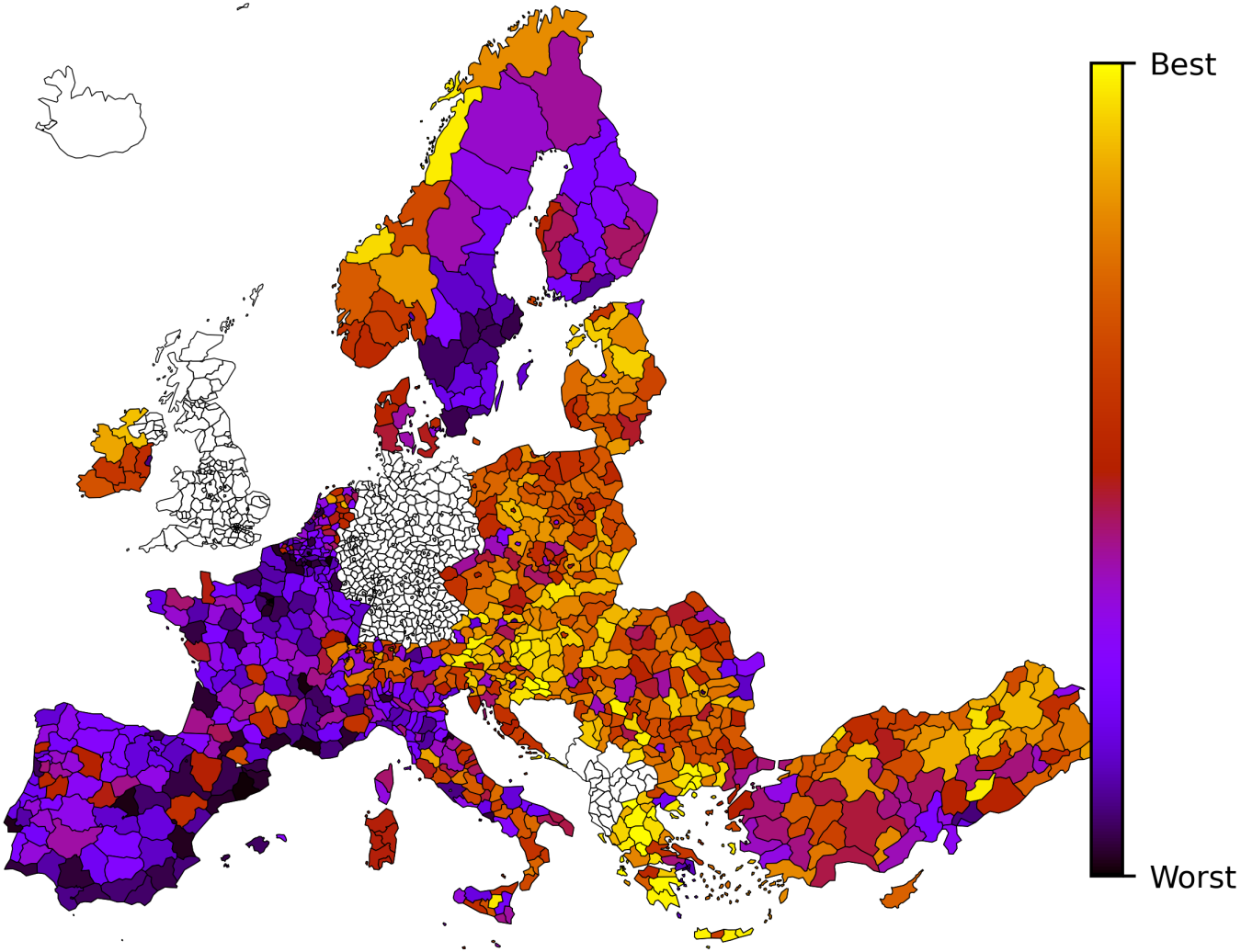
Homicide Rate



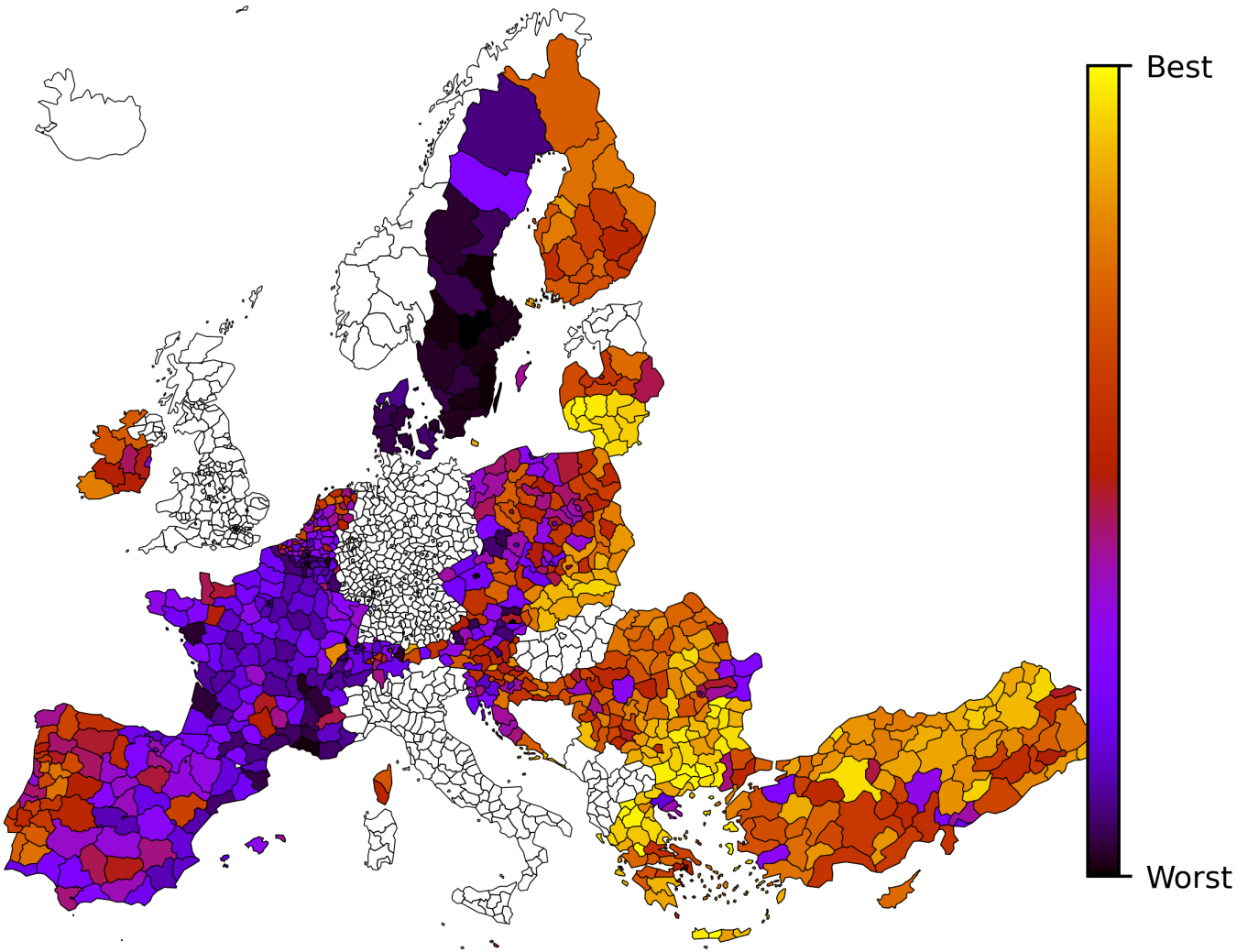
Assault Rate



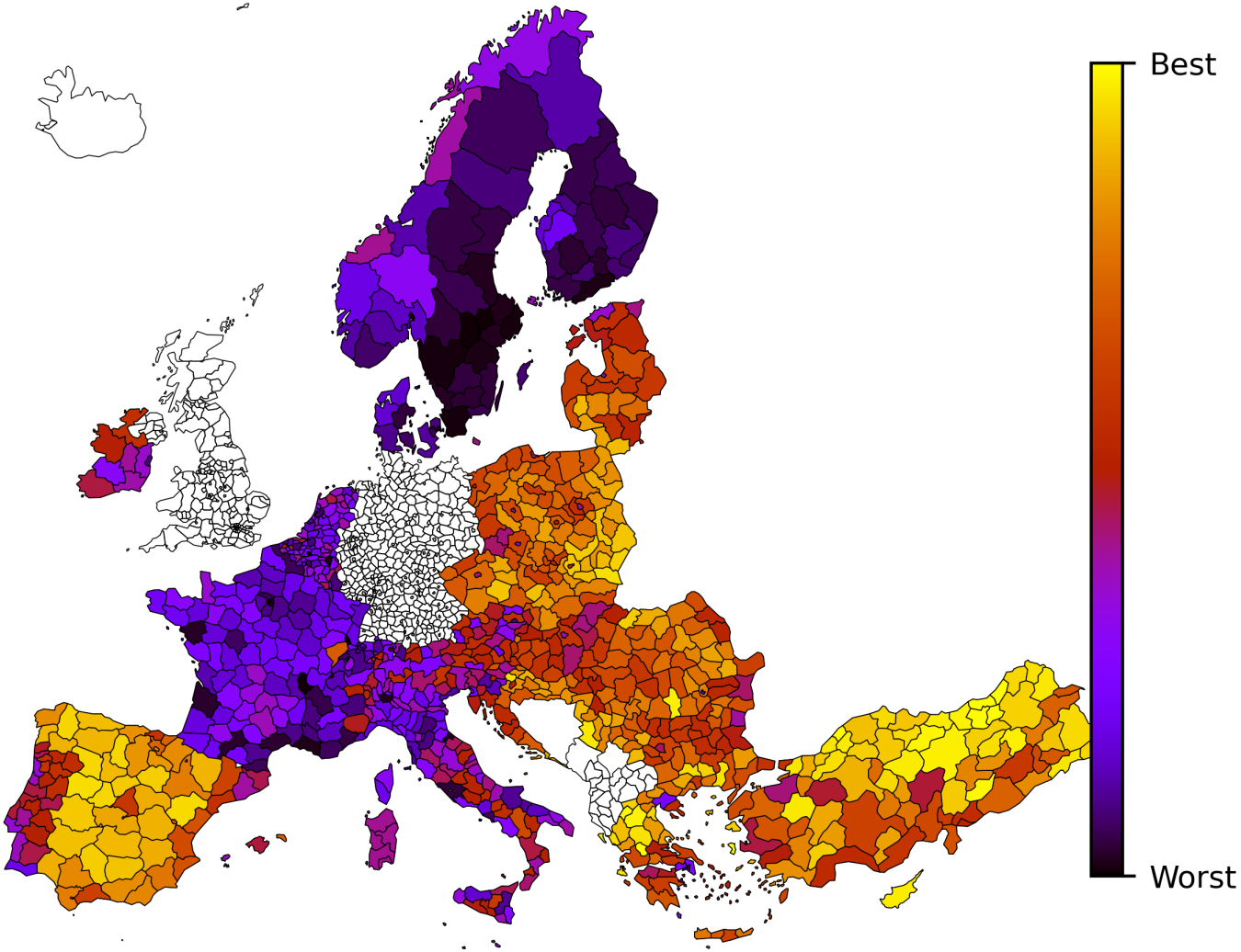
Robbery Rate



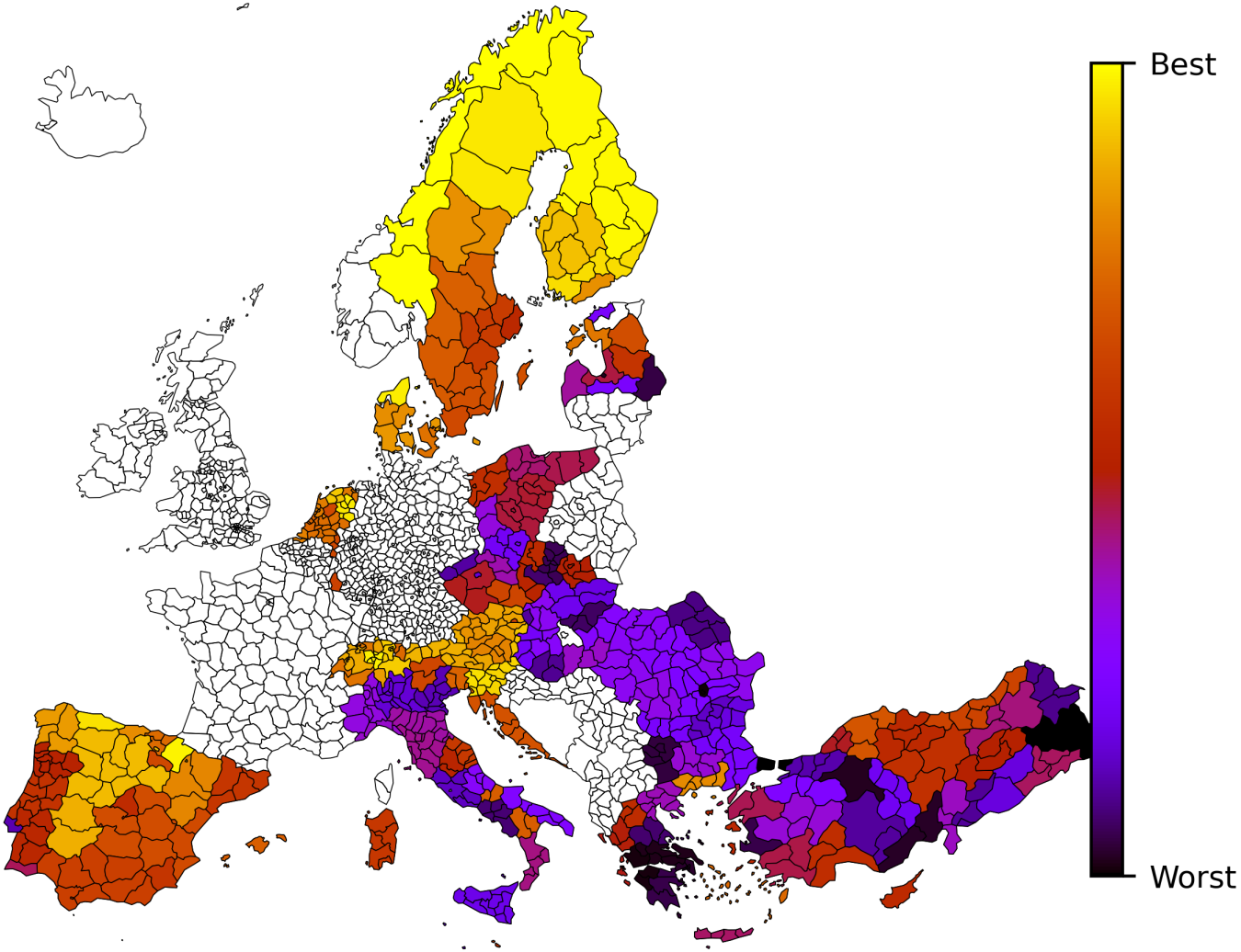
Burglary Rate



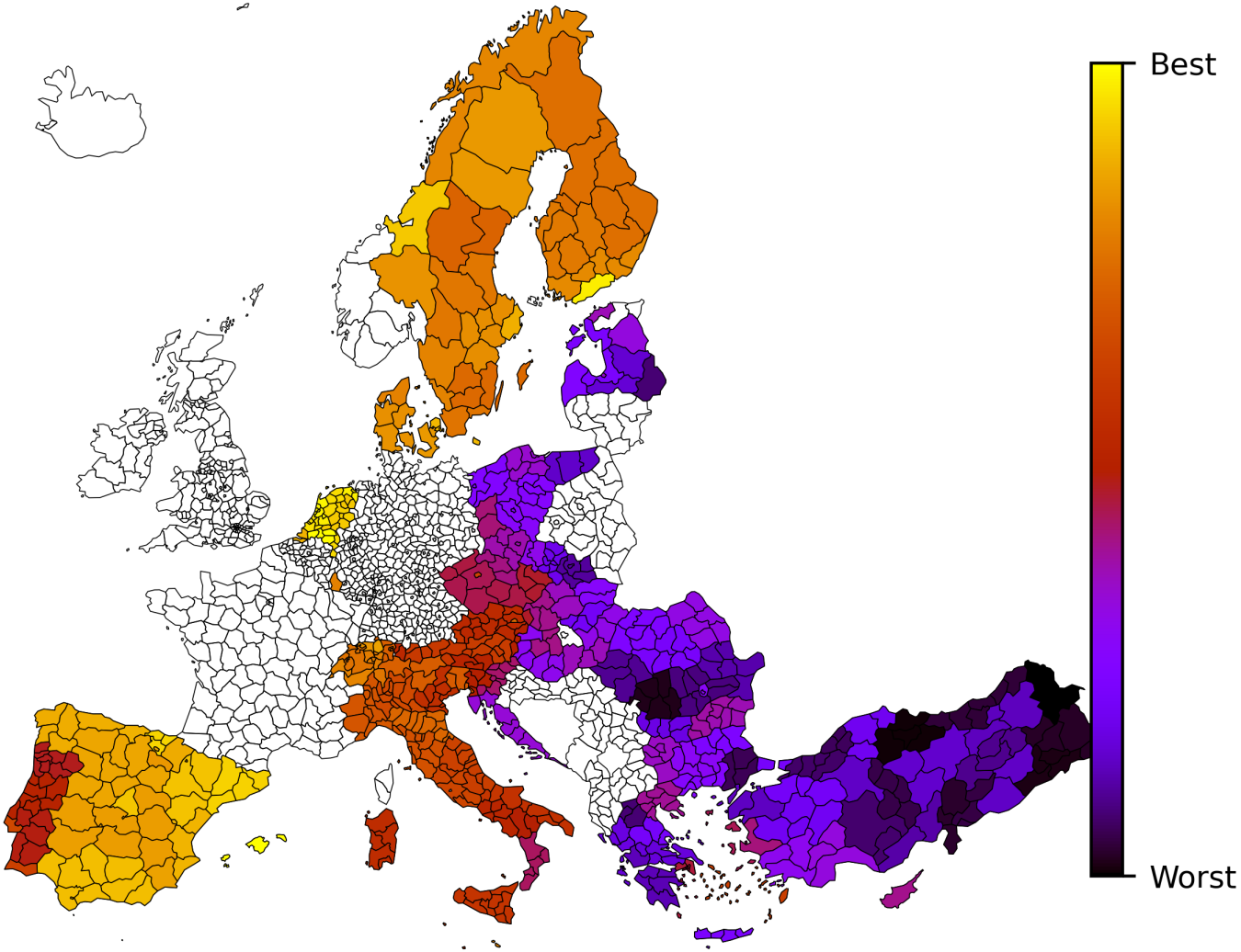
Theft Rate



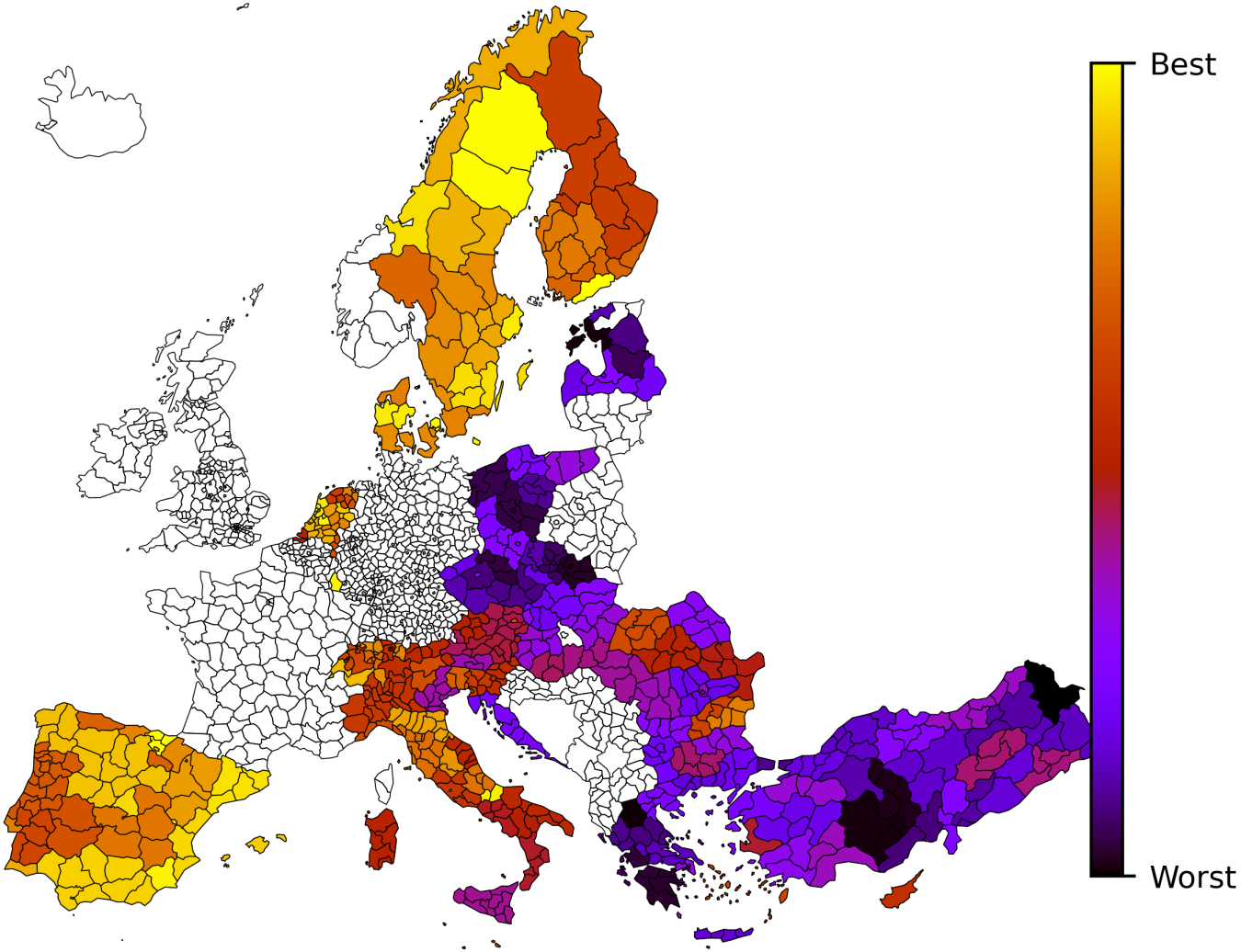
Subjective Safety



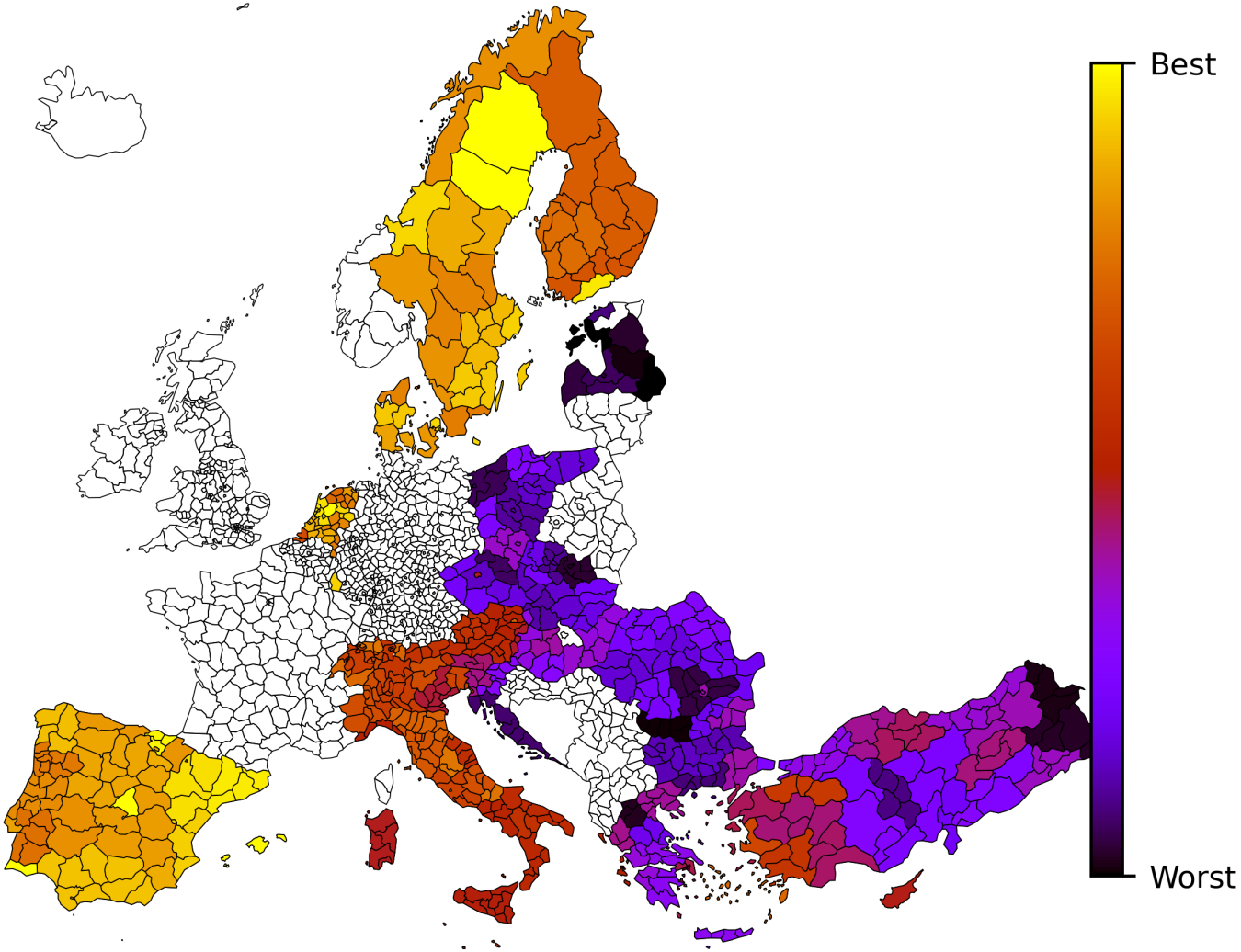
LGBT Acceptance



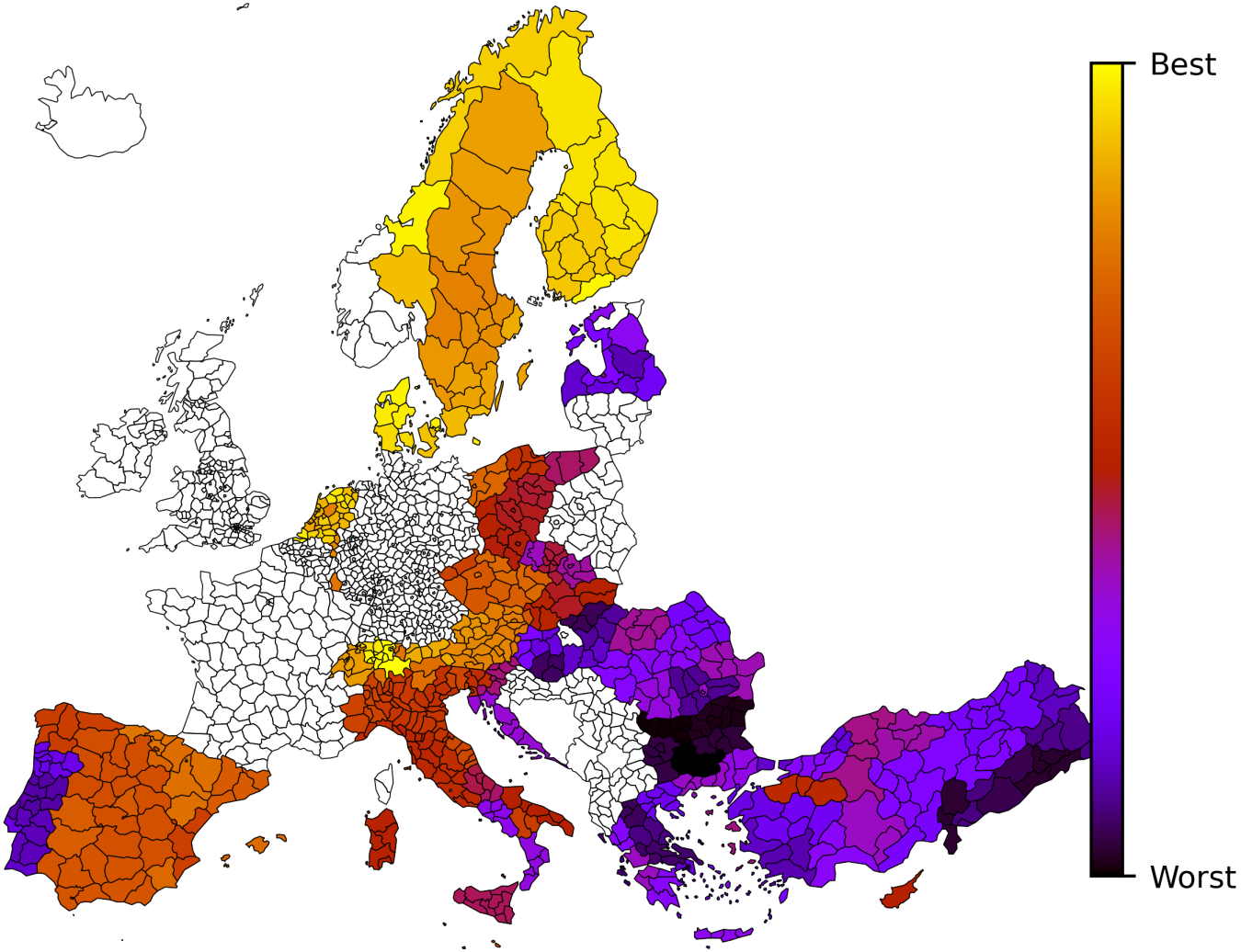
Ethnic and Racial Acceptance



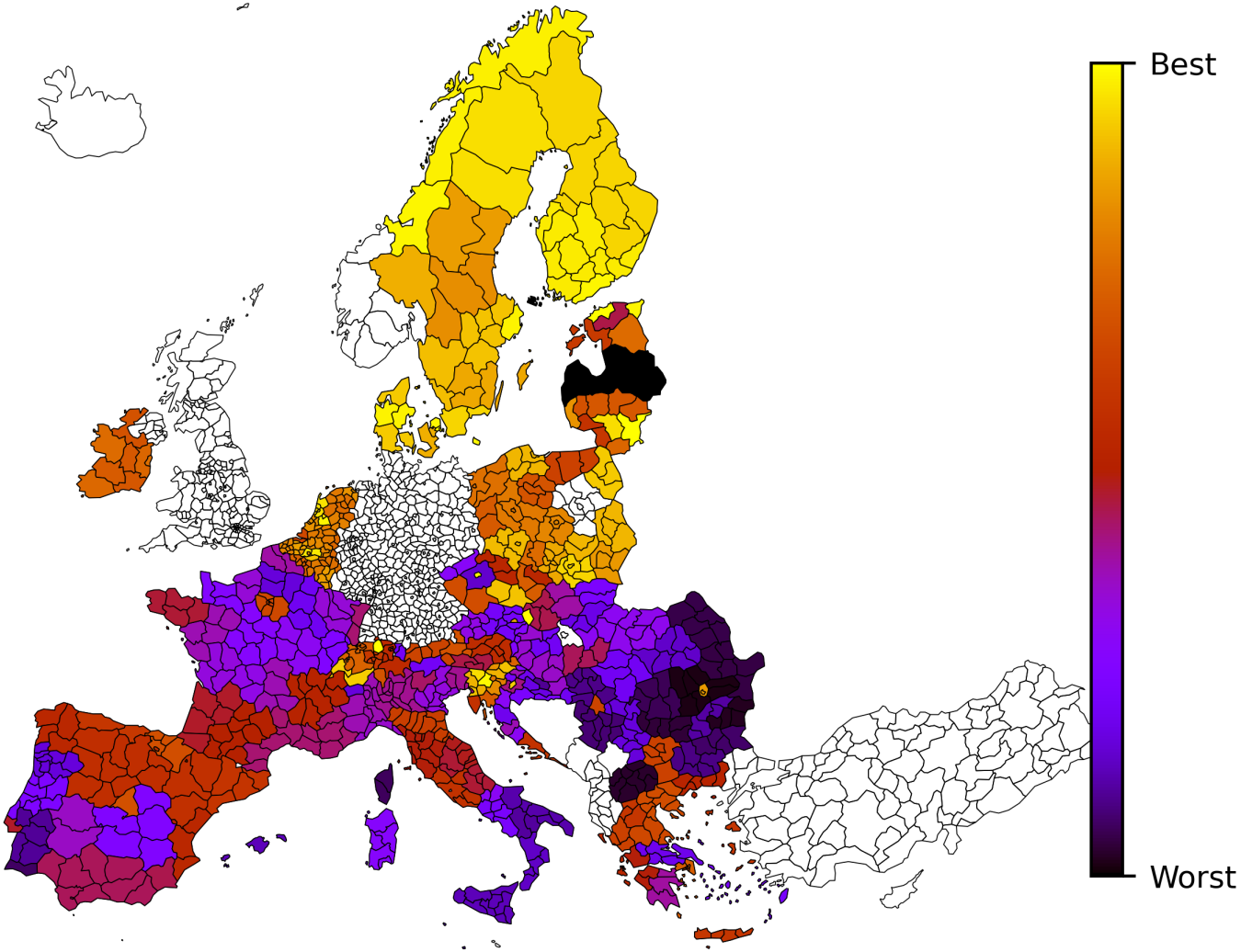
Migrant Acceptance



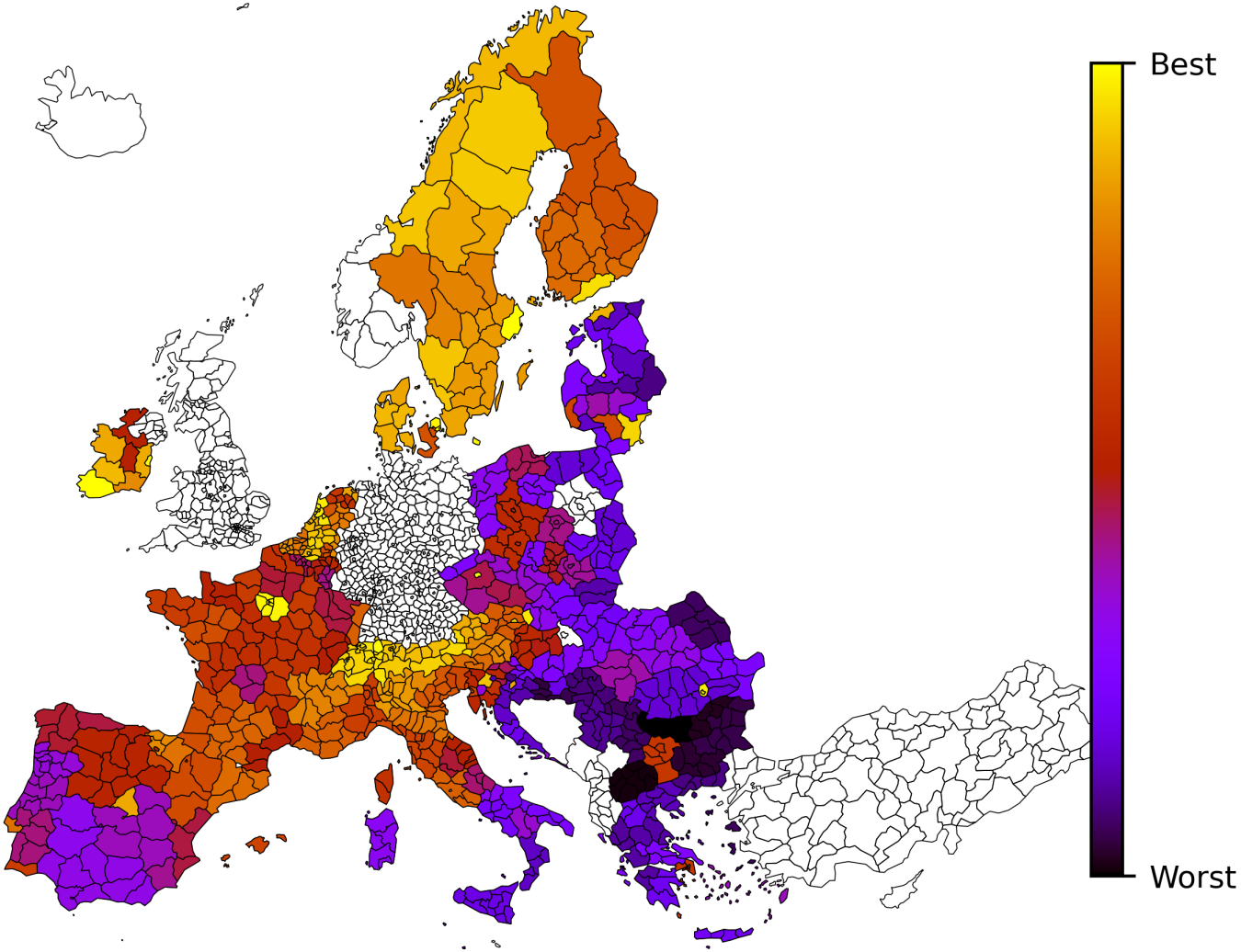
Life Satisfaction



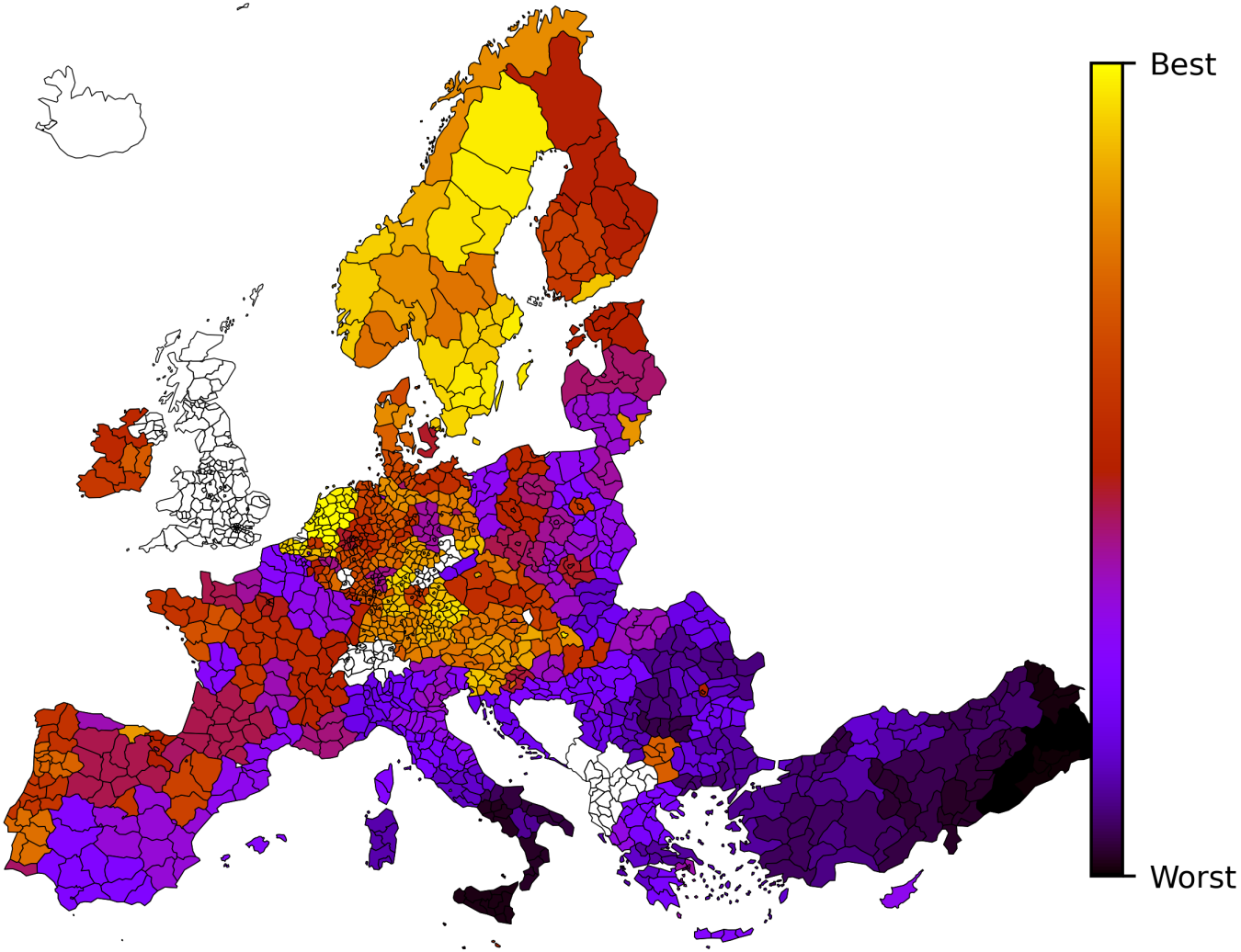
Gender Development Index (Education)



Gender Development Index (Income)



Youth NEET Rate



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