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European assessment of quiet areas in open country

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Summary

There is increasing evidence of mental well-being provided by green spaces, particularly in quiet areas. The Environmental Noise Directive (END), emphasizes the necessity of preserving environmental noise quality in regions where human exposure is significant, particularly in urban settings, public parks, and near sensitive facilities like schools and hospitals.

The END distinguishes between "quiet areas in an agglomeration" which correspond to areas delimited by the competent authority that are defined by specific noise thresholds set by member states from any noise source, and "quiet areas in open country", which correspond to areas delimited by the competent authority that are undisturbed by noise from traffic, industry or recreational activities.

The report updates the methodology initially published by the European Environment Agency in 2016 for identifying quiet areas using the Quietness Suitability Index (QSI), which integrates both objective noise measurements and subjective human perceptions of quietness.

The QSI combines quantitative noise disturbance data with qualitative assessments of natural elements and landscape configurations, enhancing the understanding of quietness.

Various data sources, including urban agglomerations, roads, railways, and industrial sites, are analysed to determine noise impacts. A fuzzy logic approach is employed to represent gradual transitions between quiet and noisy areas.

The analysis reveals that only 15% of Europe is classified as potentially quiet, with significant disparities across countries. Northern European countries tend to have more quiet areas in the open country than densely populated regions like Belgium and the Netherlands. By contrast, about 30% of protected areas in Natura 2000 sites are potentially quiet, especially on those sites where the main objective is the strict protection of habitats and species.

The findings highlight the need for improved designation and protection of quiet areas, especially in rural regions, to enhance environmental quality and community well-being.

1 Introduction

Quietness has received increased attention in the last decade, recognising that it is a significant factor influencing health, biodiversity, the economy, aesthetics and education (Votsi et al., 2017). As a result, efforts to map and define quiet areas have emerged across various scales—from local initiatives to regional and national projects—utilizing a range of methodologies, such as noise mapping, land-use surveys, expert insights, and visitor feedback (Iglesias Merchan et al., 2014). However, there is currently no unified international standard for identifying or preserving quiet areas.

The EU Environmental Noise Directive (END 2002/49/EC) was the first policy to directly address quiet areas, mandating EU member states to designate quiet areas as part of the efforts to reduce environmental noise exposure. Specifically, the END provides a definition of quiet areas differentiating two situations:

- 'Quiet areas in an agglomeration' shall mean an area, delimited by the competent authority, which is not exposed to a value of L_{den} or of another appropriate noise indicator greater than a certain value set by the Member State, from any noise source.
- 'Quiet area in open country' shall mean an area, delimited by the competent authority, that is undisturbed by noise from traffic, industry or recreational activities.

The designation and protection of quiet areas has primarily focused on cities, but more progress is needed in identifying and safeguarding quiet areas in rural regions. This urban focus is understandable to some extent, as cities have higher population densities and consequently more people are affected by noise. In rural areas, however, existing legislation, such as the Biodiversity Directive, already provides a certain degree of protection for landscapes with high natural value. Nonetheless, the END does not provide a consistent definition of such quiet areas in open country.

The report *Quiet Areas in Europe* (EEA, 2016) introduced a methodology for systematically addressing quiet areas in open country, following the Environmental Noise Directive (END) recommendations and existing practices in Member States (EEA, 2014). This methodology considers noise decay as a function of distance from noise sources and includes a perceptual component based on the naturalness of the landscape. The current report provides an updated methodology, with improved distance function from noise source and perception component aligned with ecosystem services framework.

2 How to define quiet areas in Europe

2.1 The Quietness Suitability Index (QSI)

The concept of quietness includes more than just sound-pressure levels in a given area; it also involves human perception, visual interactions, and visitor expectations. This encompasses the balance between desired and undesired sounds, the recreational value of the area, and how suitable the existing sounds are for the area's character and purpose (EEA, 2014).

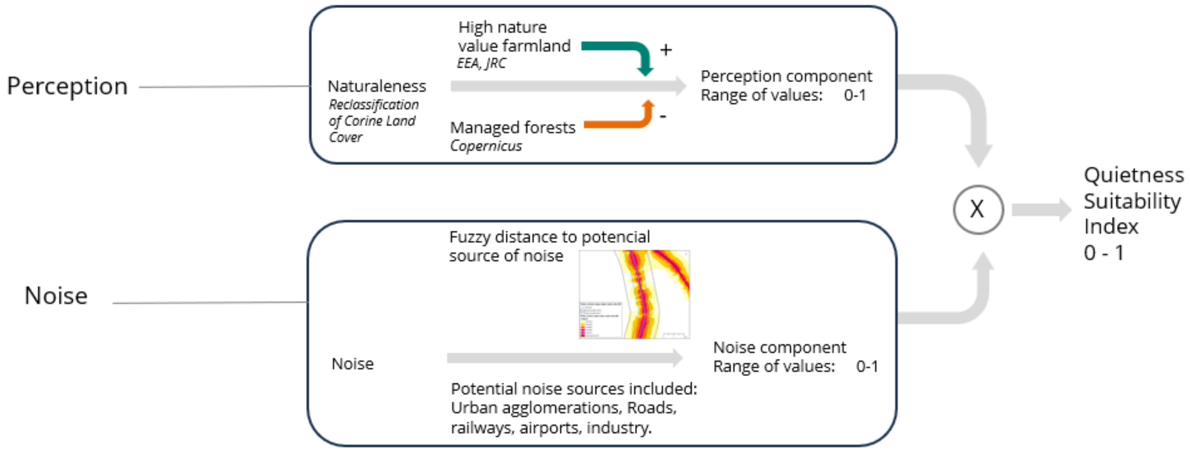
As outlined in the EEA report “Quiet areas in Europe” (EEA, 2016), the proposed approach for identifying potential quiet areas in open countryside across Europe is based on two main principles: the results should be applicable across Europe, encompassing the diversity of landscapes and varying local conditions, and the methodology should be straightforward, easy to understand, and replicable at both national and local levels.

Based on the multidimensional character of the notion of quietness, quiet areas in open country can be defined according to objective criteria (noise levels), measured by quantitative data, but also according to a subjective component linked to perception. Therefore, quietness is described with the Quietness Suitability Index (EEA, 2016) resulting from a combination of noise limit values (contour maps delivered following END requirements) and land use and land cover elements that are perceived as positive and usually related to the human cultural construction of naturalness.

Then, the QSI is composed of two elements (Figure 2.1):

- Noise disturbance based on proximity to noise sources (objective criteria, quantitative data): threshold distances are set according to noise levels identified on noise contour maps, i.e. areas reported under the END where the noise exposure is below 55 dB L_{den}. The distance considered from the noise sources have been refined in the current update of the methodology, considering 2022 noise contour maps provided for major road source as part of the strategic noise maps END delivery. This is further explained in Annex 1.

Figure 2.1 Methodological approach to QSI

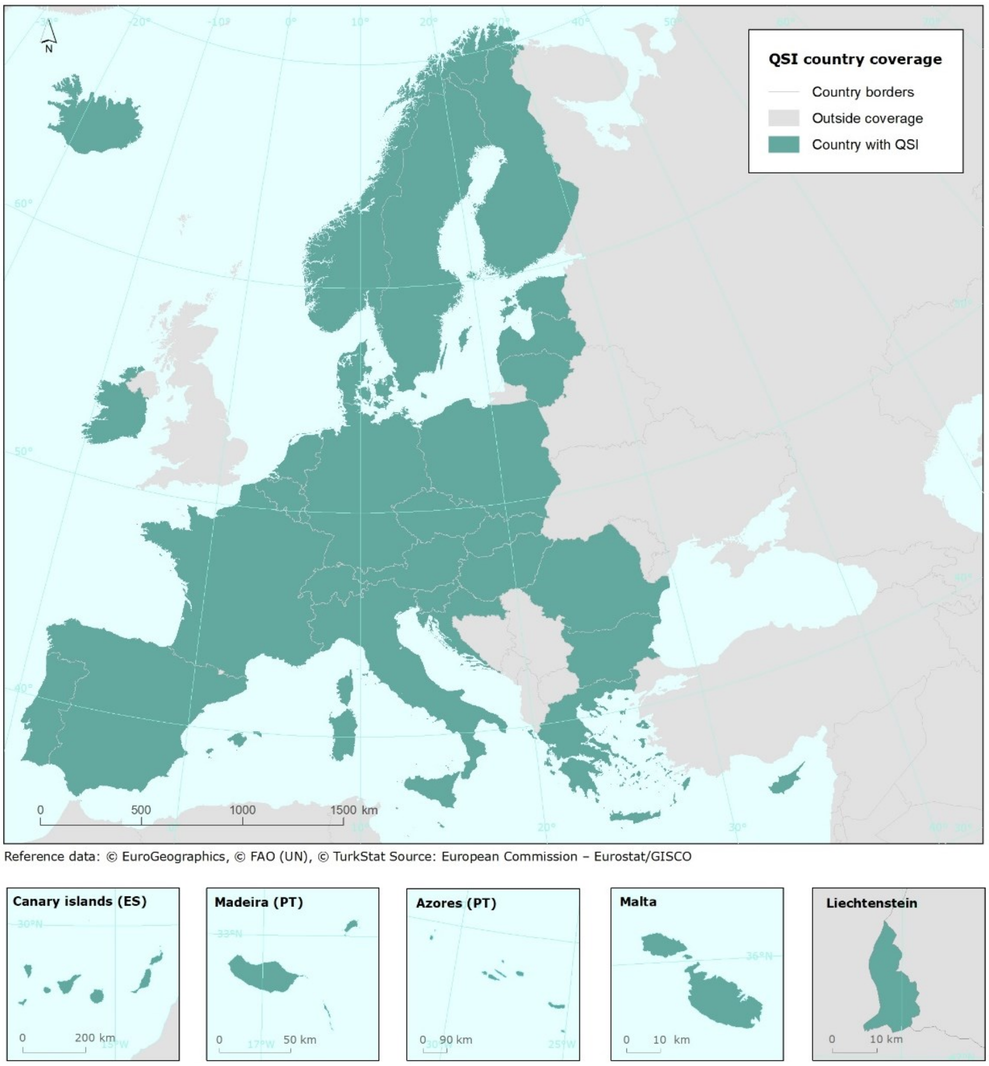


- The perceptive dimension of quietness by human beings (subjective criteria, qualitative data): this dimension is related to the importance given to natural elements and to landscape configuration. This dimension was introduced in the methodology proposed in 2016 by a reclassification of Copernicus Corine Land Cover based on the hemeroby index (Jalas, 1955; Blume and Sukopp, 1976). In the current update of the methodology, this index has been improved by a reviewed reclassification of Copernicus Corine Land Cover and considering the positive value of agricultural areas with a high nature value, and the negative impact of managed forests (clearcuts, plantations). This is further explained in section 2.3.

2.2 Coverage

Figure 2.2 provides an overview of the countries included in the current report, based on data availability to calculate the QSI index (further details in the following sections).

Figure 2.2 Country coverage of the QSI index

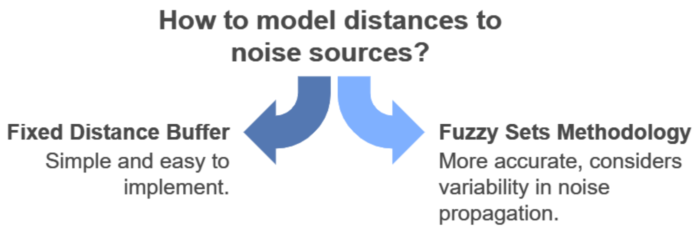


2.3 The noise component

Noise disturbance due to proximity to noise sources (objective criteria, quantitative data) is assessed by determining threshold distances based on noise levels derived from noise contour maps. These threshold distances are established by analysing the noise contours, representing areas of equal noise intensity.

There are different methodologies to calculate distances to noise sources, in this methodology two models are applied: fuzzy sets methodology for roads, railways, agglomerations and industrial areas and fixed distance buffer for airports (see Figure 2.3).

Figure 2.3 Main approaches to calculate distances to noise sources



2.3.1 Data sources

The sources of information used in the analysis are described in Table 2.1.

Table 2.1 Overview of data sources considered as potential noise sources included in the QSI

Source	Database	Link	Description
Industrial sites outside urban areas	Industrial_dataset_v10_December_2023.accdb CLC polygons: Selection of categories "Industrial" - Industrial or commercial units, 121 - Port areas, 123 - Mineral extraction sites, 131 - Dump sites, 132 - Construction sites, 133	Files - SDI datashare (europa.eu) https://doi.org/10.2909/71c95a07-e296-44fc-b22b-415f42acfdf0	Industrial reporting under the Industrial Emission Directive 2010/75/EU and European Pollutant Release and Transfer Register Regulation (EC) No 166/2006 This dataset contains the location and administrative data for the largest industrial complexes in Europe, releases and transfers of regulated substances to all media, waste transfers reported under the European Pollutant Release and Transfer Register (E-PRTR) and as well as more detailed data on energy input and emissions for large combustion plants (reported under IED Art.72). Copernicus Corine Land Cover 2018 (vector/raster 100 m), Europe, 6-yearly
Major roads	gisco-ref-20180710.gdb Selection of Primary roads, secondary roads and motorways, excluding Underground.	SDI data	EuroRegionalMap provides the first European geographic information infrastructure that will be maintained at the source level by the National Mapping Agencies, providing harmonised access conditions for geographic information (map scale 1:250 000).
	Bulgaria, Croatia Selection of Primary roads, secondary roads and motorways excluding Underground.	Geofabrik Download Server	OpenStreetMap (OSM) is a collaborative, open-source mapping project that provides free geographic data for Europe and the rest of the world.
Major rails	gisco-ref-20180710.gdb	SDI data	EuroRegionalMap provides the first European geographic information infrastructure that will be maintained at the source level by the National Mapping Agencies, providing harmonised access conditions for geographic information (map scale 1:250 000.)
	Bulgaria, Croatia	Geofabrik Download Server	OpenStreetMap (OSM) is a collaborative, open-source mapping project that provides free geographic data for Europe and the rest of the world.

Source	Database	Link	Description
Airports	Airports are categorized based on their size and noise impact: CLC polygons with code 124 are selected. A distinction of major airports and non-major airports is done based on END data submitted: • Major Airports polygons: major airports as reported in the Environmental Noise Directive (END). The distance applied to those airports is a buffer zone of 1,500 meters. • Non-Major Airports polygons: other airports identified in CLC class 124 but not reported in the Environmental Noise Directive (END). The distance applied to those airports is a buffer zone of 900 meters.	https://doi.org/10.2909/71c95a07-e296-44fc-b22b-415f42acfdf0	CORINE Land Cover 2018 (vector/raster 100 m), Europe, 6-yearly Provides pan-European CORINE Land Cover inventory for 44 thematic classes for the 2018 reference year. The dataset has a Minimum Mapping Unit (MMU) of 25 hectares (ha) for areal phenomena and a Minimum Mapping Width (MMW) of 100 m for linear phenomena and is available as vector and as 100 m raster data.
Agglomerations	• END agglomerations (> 100,000 inhabitants) • Urban centres (> 50,000 inhabitants) • Selection of residential areas with code 111 112 from CLC that intersects with DEGURBA categories. Towns, Suburbs and Villages	SDI data END database DF1_5, reference year 2020	**END agglomerations**: Part of a territory, delimited by the Member State, having a population in excess of 100,000 persons and a population density such that the Member State considers it to be an urbanised area **Urban centres**: European Commission's Directorate-General for Regional and Urban Policy (DG REGIO), an urban centre is defined as follows: An urban centre consists of contiguous grid cells of 1 km², with the following characteristics: • A population density of at least 1,500 inhabitants per km² of land. • A minimum total population of 50,000 inhabitants.

Source	Database	Link	Description
			• Gaps in the cluster are filled and edges are smoothed. **The Degree of Urbanisation** (DEGURBA) is a classification system used to categorize areas based on their level of urbanization. It is particularly relevant in the context of European Union policies and data collection. DEGURBA divides regions into three main categories: • Cities: These are densely populated areas with high levels of infrastructure and services, often serving as economic and cultural hubs. (raster value = 22). • Towns, Suburbs and villages: These areas have a moderate population density and are typically located around cities, providing residential spaces for those who work in urban centers. (raster value = 21). • Rural Areas: Characterized by low population density, these regions are often dominated by natural landscapes or agricultural activities. (raster value = 13).

2.3.2 Fuzzy Logic in Noise Attenuation Analysis

Fuzzy logic allows for a more shaded and realistic representation of noise attenuation over distance, accounting for the inherent uncertainties and gradual transitions in acoustic environments.

Instead of sharp boundaries between "quiet" and "non quiet" areas, fuzzy logic creates gradual transition zones. This better reflects the real-world experience of noise, where the perception of quietness changes gradually with distance from a noise source. Fuzzy sets are defined using membership functions that describe the degree to which an area belongs to the "quiet" category.

Suitable distance layers from noise sources were built following a fuzzy approach, calculating the 'membership' to the quietness range (0–1) by means of a linear relationship. The fuzzy approach reclassifies the input data to a 0–1 scale based on the possibility of being a member of a specified set. In this way, 0 is assigned to those locations that are definitely not a member of the specified set, 1 is assigned to those values that are definitely a member of the specified set (quiet area), and the entire range of possibilities between 0 and 1 are assigned to some level of possible membership following a linear equation (the larger the number, the greater the possibility).

Major roads and major railways

To establish the distance values to the major roads and major railways noise sources, the noise contour maps delivered in 2022 for the main transport infrastructures and the location of the major noise sources have been used as the main input information.

In the case of major roads, a previous distinction of roads based on traffic information has been undertaken, as it is assumed that more traffic implies a higher noisy area around the noise source. Based on this assumption, the analysis divides major roads into 2 categories: above 6 million vehicles and between 3 and 6 million vehicles (traffic thresholds specified in the END).

The following analytical steps have been applied to determine the distances to major roads and major railways infrastructure to classify quiet/non-quiet area in the surroundings of the network infrastructure:

1. Selection of major roads from the END DF1_5 dataset based on whether their reported traffic volume above or below 6 million vehicles.
2. Selection of major railways from the END DF1_5 dataset
3. A subset selection of these road segments was used to determine the distances:
    a. Euclidean distance map (pixel size = 100 m) has been calculated for each noise transport source: major roads (2 classes) and major railways
    b. Overlay of the Euclidean distance map with noise contour maps for each noise source to calculate basic statistics concerning distance to noise source per decibel band (details can be found in Annex 1) to apply the fuzzy approach: the mean distance of the isophone 55-59 dB L_{den} to the noise source and the maximum distance of the isophone 50-54 dB L_{den} are the defined distances.
    c. An average value of the distances is calculated per each noise source and isophone, to be applied to all roads and railways in Europe
4. Apply the distances calculated to Euroregional map transport sources:
    a. Railways
    b. Primary and secondary roads (as proxies to END major roads between 3 and 6 million vehicles)
    c. Motorways (as proxies to END major roads above 6 million vehicles)
    d. The road network was completed with other data sources for Croatia, Norway and Bulgaria (see section 2.3.1 on Data sources)

5. Tunnels have been excluded from the road network.

The distances that have been applied can be seen in Table 2.2.

Table 2.2 Distances applied in noise transport sources

Noise source	Categories	Potentially non quiet	Potentially quiet
Roads	3-6M vehicles	≤200m	≥800m
	>6M vehicles	≤600m	≥1400m
Railways	All	≤400m	≥1600m

Urban agglomerations

In the previous analysis (EEA, 2016), a buffer area around urban centres with populations greater than 50,000 inhabitants was established, using a distance range of 1,000 (not quiet) to more than 1,500 meters (quiet) for implementing the fuzzy logic. The agreed distances were based on Votsi et al., 2012.

As the proposed analysis is focused on quiet areas in open county, the following urban areas are excluded, and a fuzzy approach from their surroundings is implemented to reach the potential quiet areas:

- END agglomerations with more than 100,000 inhabitants, as declared by EEA member countries
- Urban centres (not located in END agglomerations) with more than 50,000 inhabitants
- DG Regio classification of cities, towns and villages overlaying with CLC datasets classes 111 and 112. The remaining urban CLC classes labelled as rural are considered in this analysis as “not noisy”.

In the current approach, the same distances applied in (EEA, 2016) will be used, and can be seen in Table 2.3

Table 2.3 Distances applied in urban areas

Noise source	Categories	Potentially non quiet	Potentially quiet
Urban agglomerations	All	≤1000m	≥1500m

Industrial sites outside urban areas

In the previous analysis (EEA, 2016), a buffer area around the point location of largest industrial complexes in Europe (E-PRTR locations) and around CLC industrial polygons as described in section 2.3.1 was established, using a distance range of 500 (not quiet) to more than 1,100 meters (quiet) for implementing the fuzzy logic. These distances were based on Votsi et al., 2012.

In the current approach, the same distances applied in (EEA, 2016), have been used, and can be seen in Table 2.4

Table 2.4 Distances applied to industrial areas

Noise source	Categories	Potentially non quiet	Potentially quiet
Industrial sites	All	≤500m	≥1100m

2.3.3 Fixed distance buffer

In the case of major airports, the sound propagation differs from the other transport sources, due to the specific characteristics of the airports and the operations causing noise disturbances, mainly take-off and landing. Those operation happened in specific areas of the airport influence zone, and the characteristics of each airport have a high influence on where the noise is propagated.

The methodology proposed here homogenizes at EU level what can be considered potentially quiet and potentially not quiet in the countryside, so in the case of airports, a fixed distance used around airport polygons has been implemented. This fixed distance should be considered as a mask: areas in the buffered area should be considered not suitable (= not quiet) areas and areas outside the buffered area should be considered suitable (=quiet) areas.

Airports

In the previous analysis (EEA, 2016), a buffer area around the CLC airport polygons have been established.

A distinction between airports based on traffic information (number of movements per year) has been undertaken, as it is assumed that more traffic implies a higher noisy area around the noise source. Based on this assumption, the analysis divides airports into 2 categories: airports declared in END DF1_5 as airports with more than 50,000 movements / year and airports not declared in END and considered for this analysis as non-major airports.

The distances were based on Votsi et al., 2012.

In the current approach, the same distances applied in (EEA, 2016), have been used, and can be seen in Table 2.5

Table 2.5 Distances applies to airports

Noise source	Categories	Potentially non quiet	Potentially quiet
Airports	Airports	≤900m	≥900m
	Major airports	≤1500m	≥1500m

2.4 Incorporating Human Perception into Noise Analysis

To cover the perception aspect in the QSI, the degree of naturalness derived from the hemeroby index (Blume and Sukopp, 1976) was adopted in the methodology described in EEA (2016), which is the basis of the current report. This index was based on Copernicus Corine Land Cover information, and therefore, it was available throughout all of Europe. Areas where some human activities are developed (e.g. agricultural areas) are rated with lower values in the hemeroby index than those without human activities.

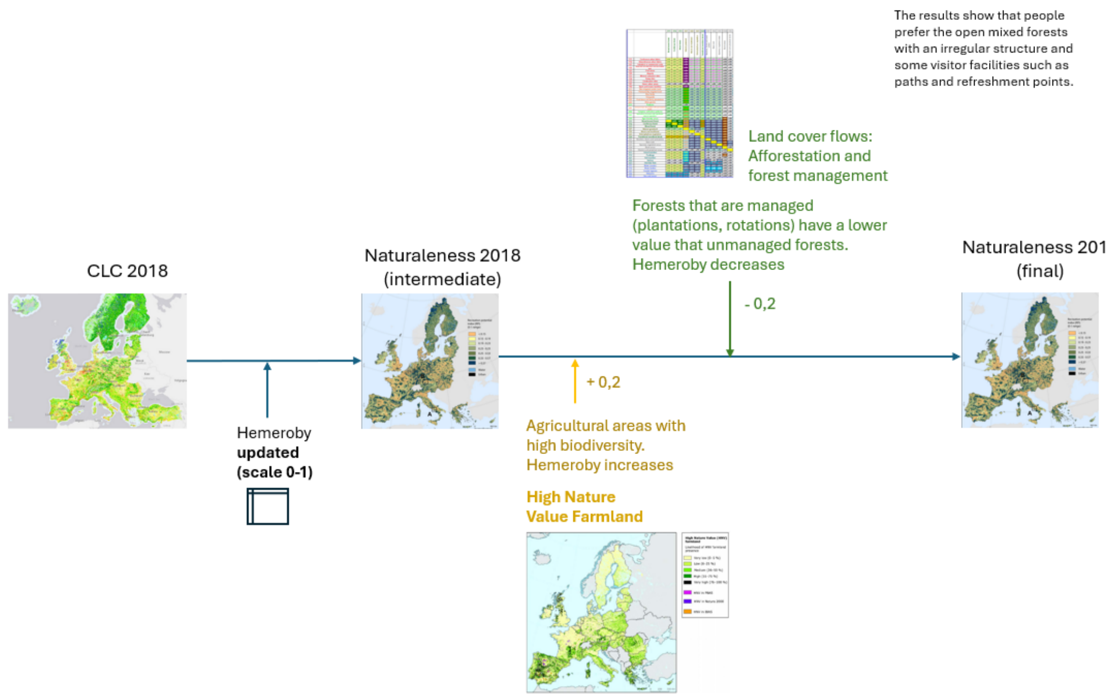
An updated version of the hemeroby index, developed in this report, is adapted to the ecosystem services perspective. The joint EU initiative, Mapping and Assessment of Ecosystem Services (Maes et al., 2020), recognises nature-based recreation to people as one of the ecosystem services. Vallecillo et al., (2019) developed an index of land suitability to support nature-based recreation service attributing a score from zero (artificial) to one (maximum naturalness) based on Copernicus Corine Land Cover (level 3 classes). The table displaying which index has been allocated to each Corine Land Cover Class can be encountered in Annex 2.

Additionally, two other elements that could modulate the results of this index and cover aspects not fully captured with Corine Land Cover have been considered:

- Agricultural areas with high biodiversity. Agricultural areas cover distinct types of landscapes, ranging from open areas (arable land) to areas with a mixture of trees (e.g. fruit trees or olive groves). Accordingly, the suitability index for nature-based recreation ranges from 0,3 to 0,6 where one is the maximum suitability value (see Annex 2). In this context, the existing data set on High Nature Value Farmland (HNV; Eurostat, 2023) provides information on those agricultural areas with a high nature value considering the type of farming practice, type of crops and landscape. The data set is provided in a 1 x 1 km grid with full European coverage. In the final index, we added +0,3 to those agricultural areas within an HNV area. A value of +0.3 will yield a final range between 0,6 and 0,9, aligning with the range typical for natural and semi-natural areas, but excluding the maximum possible value of 1.
- Forest areas under management. Forest areas are one of the land cover classes with the highest value of naturalness, ranging from 0,8 to 1 (see Annex 2). People tends to prefer open mixed forests with irregular structures and visitor facilities such as paths and refreshment points (Ismail et al., 2021). This is a very subjective perspective, and it may change from one biogeographic region to another, also embedded in the cultural aspects. However, when working at the European level, there is no room to consider local specificities, and the index refers to itself as potential. Additionally, forests under management (plantations and clear-cuts) are less appreciated than natural or seminatural ones. We analysed land cover changes from 2012 to 2018 to capture forest management. This analysis has been conducted by applying the Land Cover Flows methodology (Ivits et al., 2024), which summarises and interprets the 1892 possible one-to-one changes between the 44 Copernicus Corine land cover classes (level 3). The changes are grouped into so-called land cover flows and are classified according to major land use processes. In particular, in areas that have gone through changes between 2012 and 2018, classified as *lcf73 internal conversions* and *lcf74 recent fellings, new plantation and other transitions,* the index has been lowered by 0,3, getting closer to the values equivalent to agricultural areas (except those with high nature value).

Figure 2.4 illustrates the workflow of all the elements and analysis above described.

Figure 2.4 Overview of the processing of naturalness components of the QSI



2.5 QSI analysis per reporting units

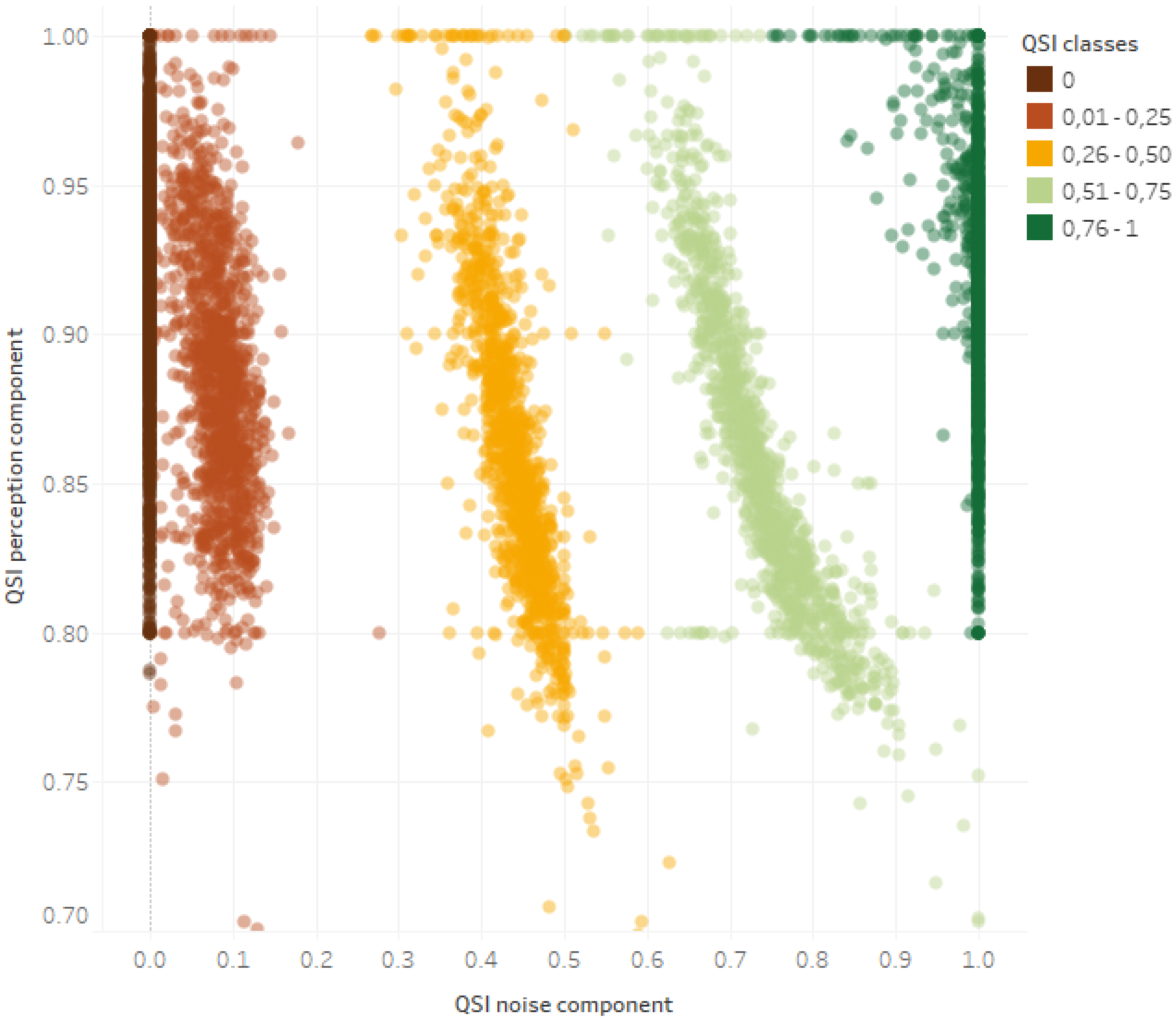
The noise and perception components presented in the previous sections are further combined to create the QSI, which ranges from zero to one. A zero score indicates noisy areas, whereas a value of one relates to a potential quiet area in open countryside. The spectrum of QSI values between the extremes, i.e. zero or one, covers the entire range of situations in the European territory. QSI values above 0,5 are already considered high values of the index, covering areas such as forests or land principally occupied by agriculture with significant natural value. Then, the calculated index provides certain flexibility in establishing thresholds for quietness.

The QSI index has been grouped into five classes to facilitate the analysis and visualisation. These five classes result from analysing the distributions of the individual components (noise and naturalness) and similarities within each class:

- **Class 0**. This is the lower value, and it includes all these areas where noise levels are equal to or greater than 55 dB L_{den}
- **Class 0,01 – 0,25**. Areas with low quieteness quality (average noise component is 0,22).
- **Class 0,26 – 0,50**. This class includes areas characterised by lower perception values (artificial and agricultural areas), and natural areas, with good perception value (0,7), but excessive noise (average of QSI noise component 0,46).
- **Class 0,51 – 0,75**. Areas potentially quiet where both components of the QSI are above 0,5.
- **Class 0,76 - 1**. The highest score reflects the best conditions for potential quiet areas.

Figure 2.5 shows how the five QSI classes are well separated considering the two components of the index. In that case, only natural and semi-natural classes are depicted to illustrate the influence of the noise component in areas with similar (high) perception values.

Figure 2.5 Relationship between QSI noise and perception components across five QSI index classes. Only natural and semi-natural areas are included. Values for both components range from 0 (less favourable situation) to 1 (best situation, noise below 55 dB L_{den} and preferred landscapes from a perception point of view)



Regarding land cover composition, we see that QSI classes below 0,25 include most of the artificial surfaces and agricultural areas, according to their lower naturalness rank (see Annex 1), and managed forests or forests in the noisiest areas (
Table 2.6). To facilitate the visualization, land cover classes are grouped into level 1 (Land Accounting Layers; Ivits et al., 2024).

The main difference between the two classes with QSI above 0,5, is the higher contribution of open spaces and wetlands to class 0,76-1. In this class, open spaces with little vegetation are also relevant, which correspond to higher elevations in mountains.

Table 2.6 Percentage of land cover class (Copernicus Corine Land Cover 2018) by QSI class. For each column (QSI class), land cover composition is provided as a percentage of the total area. Corine Land Cover classes have been grouped at level one according to the Corine Accounting Layers (Ivits et al., 2024).

CLC classes	QSI classes				
	0	0,01 - 0,25	0,26 - 0,50	0,51 - 0,75	0,76 - 1
1 Artificial surfaces	39.79%	3.69%	0.05%	0.00%	0.00%
2A Arable land & permanent crops	22.15%	70.70%	24.97%	1.08%	0.22%
2B Pastures & mosaic farmland	20.42%	16.71%	30.00%	10.17%	10.40%
3A Forests and transitional woodland shrub	13.65%	7.20%	39.50%	64.38%	41.35%
3B Natural grassland, heathland, sclerophylous vegetation	1.33%	0.74%	2.74%	11.65%	18.95%
3C Open space with little or no vegetation	0.54%	0.32%	0.52%	7.06%	15.93%
4 Wetlands	0.38%	0.15%	0.42%	1.77%	10.71%
5 Water bodies	1.73%	0.51%	1.80%	3.89%	2.44%

One additional relevant factor regarding quiet areas is their size. The presented approach provides an average value for 1 km^2 cells, but the size of patches has not been considered in this report. Generally, the minimum size of quiet areas, when defined, varies by country and is often linked to other regulatory aspects specific to each Member State (EPA, 2001).

Finally, to assess and interpret the distribution of potentially quiet areas, the following components have been integrated into the final database:

- Administrative units: from NUTS3 to country for comparison purposes
- Elevation breakdown to capture the geographic specificities
- Protected areas
  - Database generated by EEA and ETC with outline of Natura 2000 (only EU27) , CDDA (nationally Designated Areas, all countries) and Emerald sites (only Norway and Switzerland). This database allows to avoid double counting since some sites belong to more than one type of protected areas (e.g. Natura 2000 and CDDA)
  - CDDA sites, which contains data on individual nationally Designated Areas, with IUCN management categories

3 Quiet areas: a European overview

3.1 Where are the quiet areas in Europe

Europe is a diverse territory with contrasting landscapes and a heterogeneous population distribution. This is reflected on the map of potential quiet areas (Figure 3.1), based on the QSI. Northern Europe and the main mountain areas (e.g., Carpathian, Alps and Pyrenees) are easily identified as potentially quiet (highest QSI values in dark green on the map). However, quiet areas are not limited to remote locations; several can be found near the Mediterranean coast. On the other hand, the noisiest areas (lowest QSI values) reflect major transport infrastructures and areas with high population density (major urban and metropolitan areas), particularly in Central Europe and Northern Italy.

The relationship between population density and quietness is presented in Figure 3.2. As population increases, quietness is rapidly decreasing. Higher population density implies higher mobility; with more movement from people within the same area and, probably, resulting in noisier roads -mainly on the city's periphery.

The distribution of quiet areas presented in Figure 3.1 can be further quantified by grouping the continuous values of QSI into five classes (Figure 3.3). The outcome of this grouping is that potentially quiet areas account only for 15% of the territory (QSI ≥ 0,75), while the noisy or relatively noisy areas (QSI < 0.5) account for half of the territory. The share of quiet areas by country confirms the pattern observed on the map: Iceland, Finland, Norway and Sweden have the highest share of potential quiet areas. The extensive quiet areas in these countries are primarily due to the large forests, although some are plantations. and low population density.

Conversely, the most extreme cases of a high share of noisy areas (QSI < 0,5) are found in small and densely populated countries like Belgium, Luxembourg and the Netherlands. However, two countries diverge from this general pattern:

- Germany, a large country, has a similar share of QSI classes compared to smaller countries (see Germany in the lowest part of the figure, next to Belgium or Denmark).
- Liechtenstein. While noisier areas (QSI < 0,5) account for 61% of its territory, the share of quiet areas (QSI > 0,75) ranks as the third country with the highest values from the 31 EEA countries analysed. Its topography can explain this contrasting situation: valleys concentrate major roads and cities, while in the mountains, above a certain elevation, the landscape and the noise component contribute to their quietness.

Figure 3.1 Potential quiet areas in Europe based on the Quietness Suitability Index (QSI)

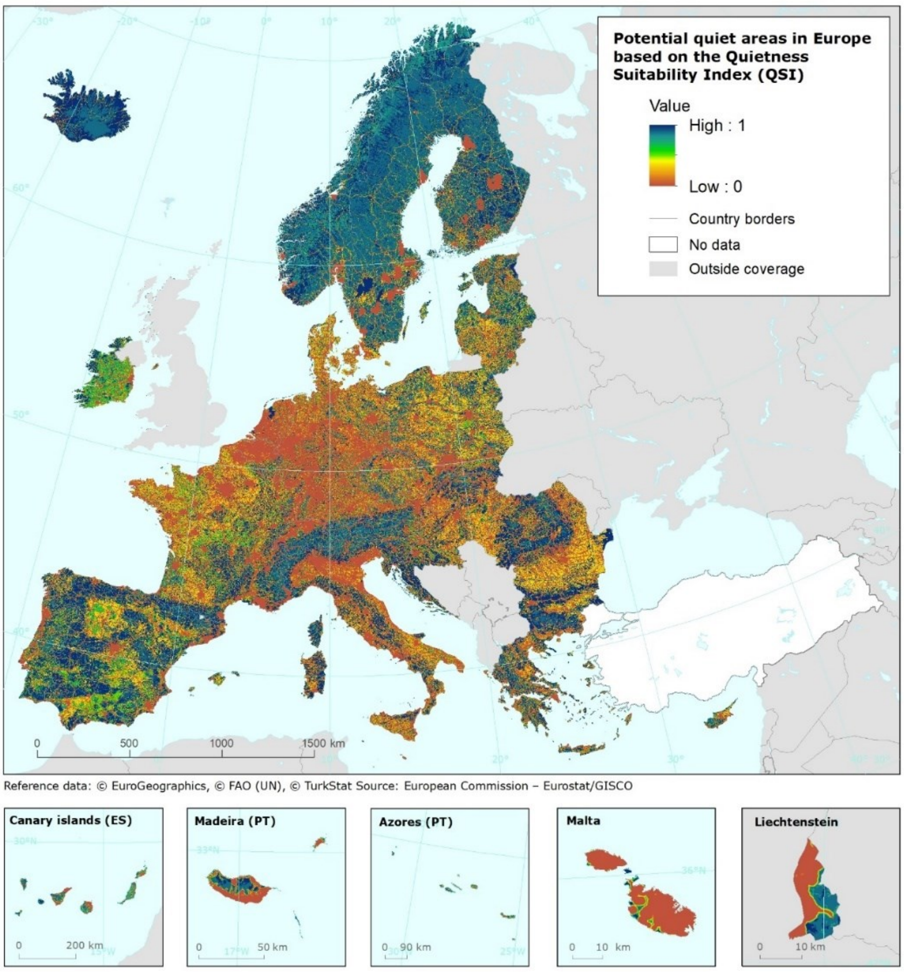
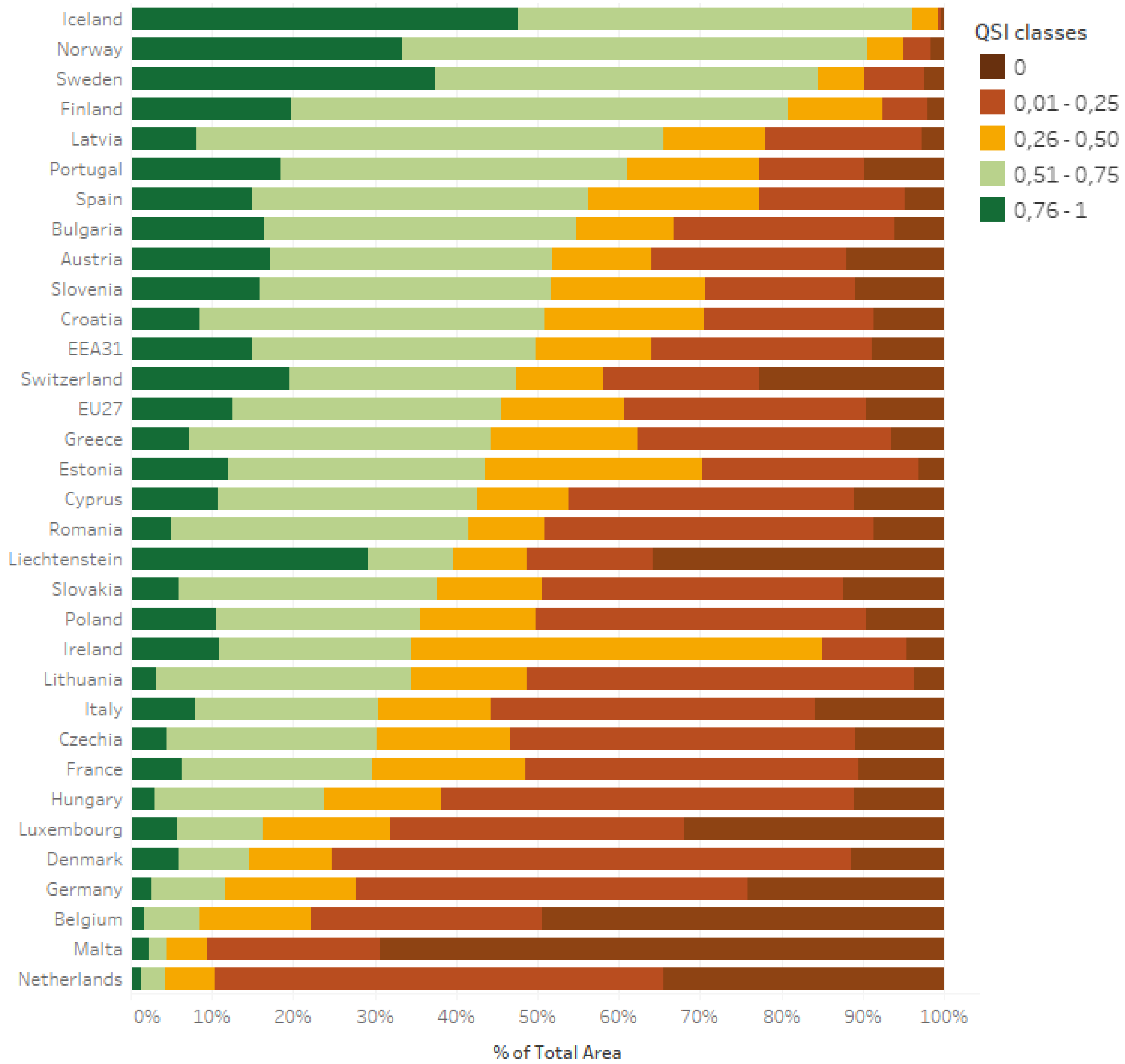


Figure 3.2 Relationship between population density (population per km²) and QSI index by NUTS3 regions (R^2 = 0,44, p < 0,001)

The case of Liechtenstein highlights the relevance of natural components, like elevation or topography, that configure the territory and cannot be changed. Therefore, planning for quiet areas has to consider these landscapes prone to concentrate human activities and mobility, in contrast to more remote areas or less accessible ones, which will keep a higher acoustic quality.

In that sense, quiet areas are mainly found in mountain regions (sloppy areas between 500 and 1000 m and all over 1000 m, EEA, 2007) (Figure 3.4). This follows what one would expect since mountains include the most remote, less accessible areas, and it explains very well the high share of quiet areas in many mountain regions in Europe (Figure 3.1).

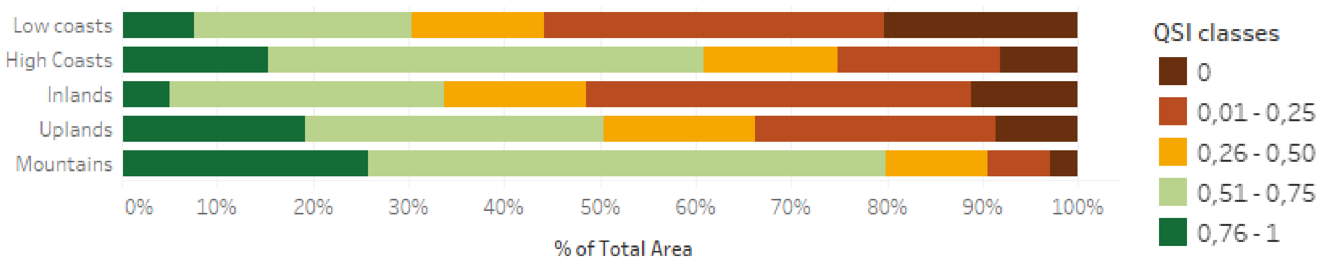
Figure 3.3 Quiet areas in open country across Europe and European average (EU27 and EEA31), based on the QSI index



On the other side, low coasts (coastal areas below 50 m) and inland (regions between 0 and 200 m outside the coastal strip) have the lowest share of quiet areas. These flat and easily accessible regions have a high population density and, simultaneously, are crossed by a high concentration of transport networks, leading to a high share of noisy areas (65-67%).

On the high coasts (coastal areas above 50 m) the situation is less contrasted since the influence of the inland is higher.

Figure 3.4 Quiet areas in Europe by elevation breakdown



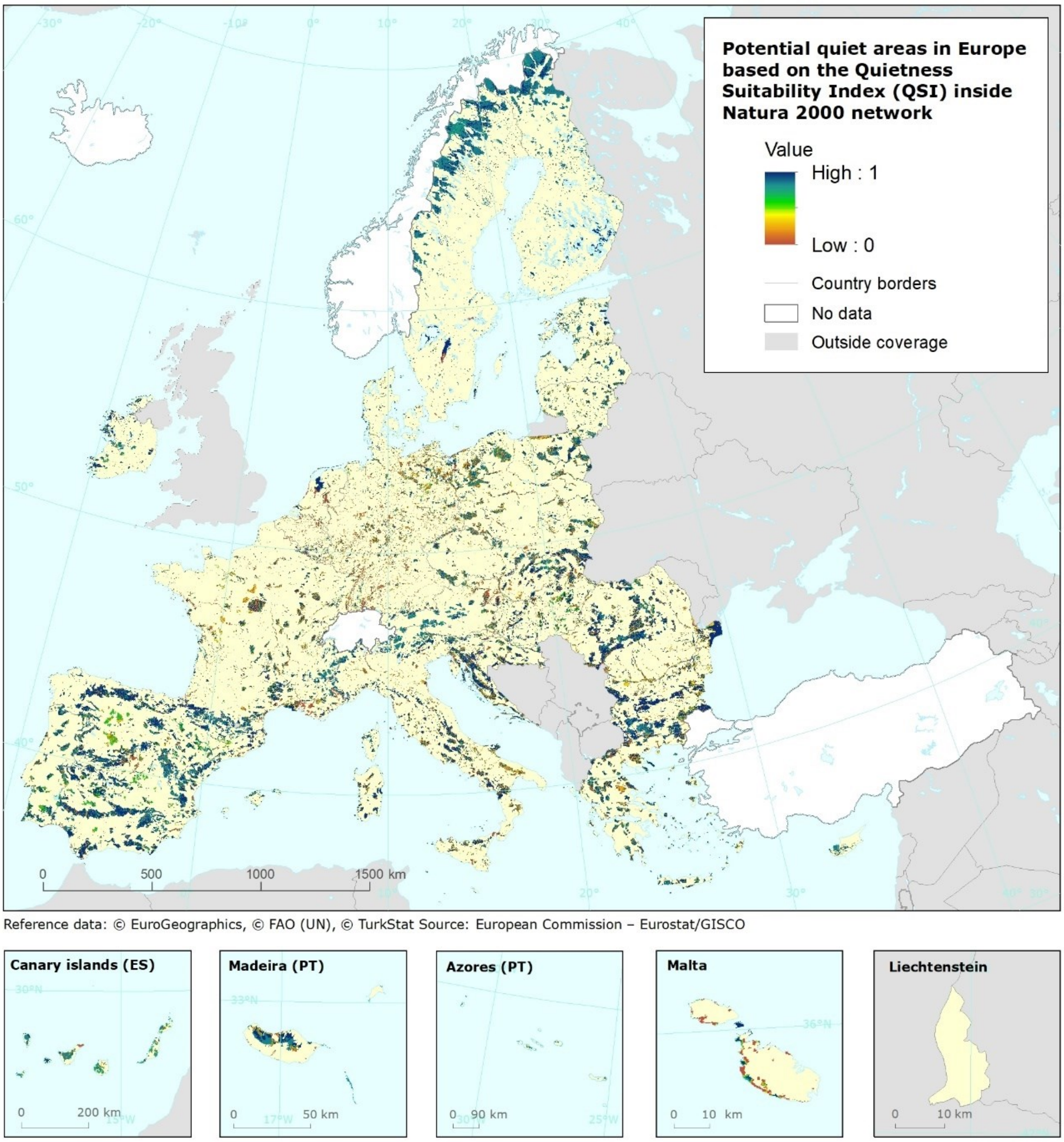
3.2 Quiet areas in protected areas

The EU's main biodiversity initiative, the Natura 2000 network, designates protected areas that have both cultural and economic value. This network operates within the framework of the EU's biodiversity strategy, which highlights the importance of policies that safeguard biodiversity and preserve quiet areas. Quiet areas, specifically, act as green corridors that support endangered species, and there is increasing support for establishing quiet buffer zones around these areas to strengthen their protective effect. The map of Natura 2000 sites indicates that most sites have a QSI above 50%, as evidenced by the shades of green depicted Figure 3.5. This visual representation helps to identify areas with higher environmental quality quickly.

Looking closer at the data by country, we see that about 30% of Natura 2000 sites are potentially quiet (see "EU27" in Figure 3.6). Additionally, the presence of potentially quiet zones within protected areas is twice as high as the overall percentage of quiet regions across the land, which is at 15% (Figure 3.3). On the negative side, high environmental noise levels adversely affect about 25 % of Europe's protected areas.

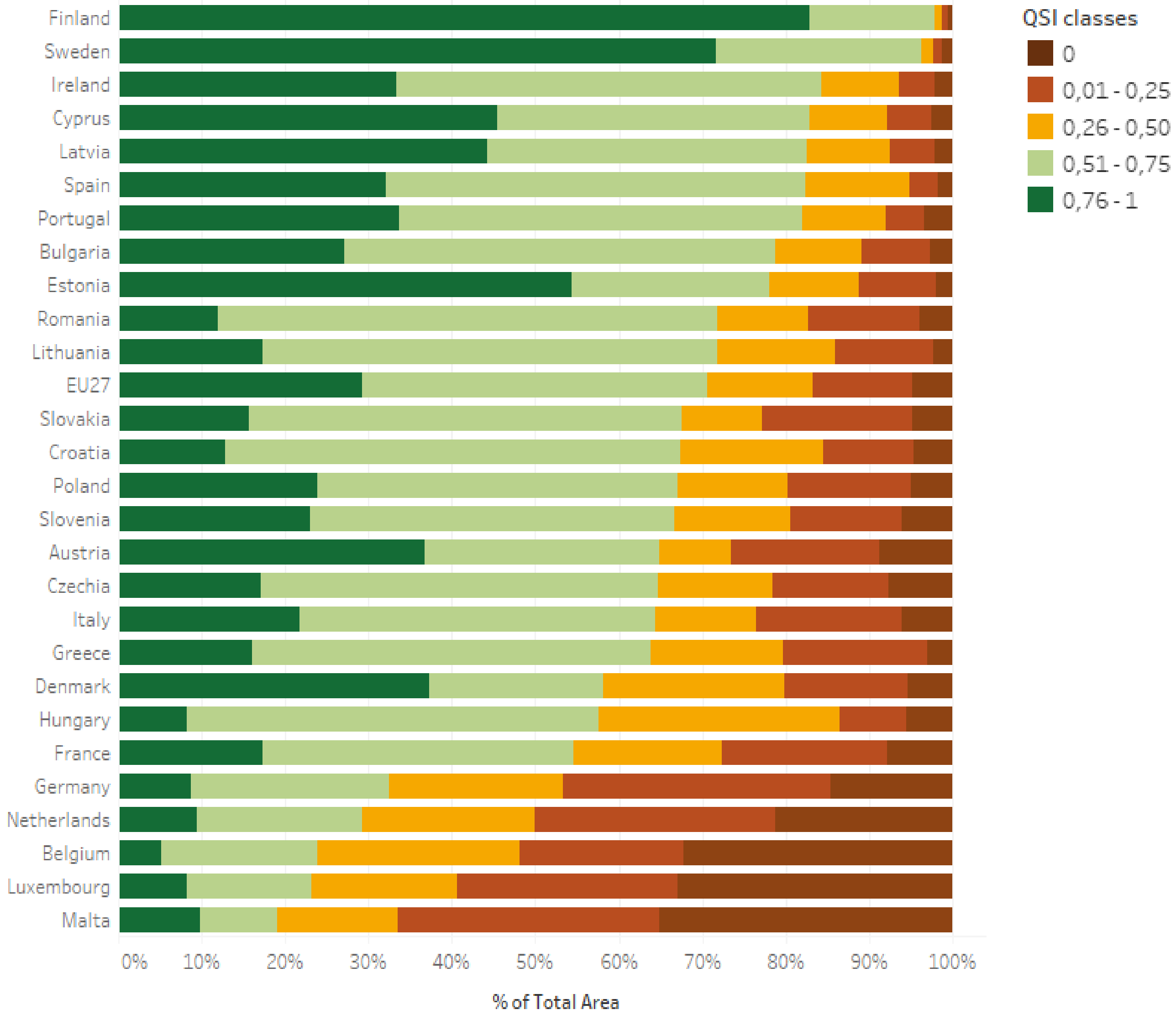
Finland and Sweden have the highest share of protected sites that are quiet (QSI > 0,75 more than 50%). On the other hand, Malta, Luxembourg, Belgium, the Netherlands and Germany are the countries where more than 50% of protected areas are considered noisy. These results are coherent with the analysis done at the country level, presenting the complexity of managing quiet areas in highly populated areas with high-density transport networks.

Figure 3.5 QSI index in Natura 2000 sites. The coloured areas are the Natura 2000 network with the corresponding value of the QSI index, ranging from 0 (red, noisy protected areas) to 1 (dark green, potentially quiet areas)



Reference data: © EuroGeographics, © FAO (UN), © TurkStat Source: European Commission – Eurostat/GISCO

Figure 3.6 QSI in Natura 2000 sites and aggregated for Europe (EU27). Data from Norway and Switzerland correspond to the Emerald network, which is equivalent to Natura 2000 for non-EU Member States



Protected areas can be further analysed based on management types that align with specific conservation objectives. This information is provided in 88% of Natura 2000 sites and follows the internationally adopted IUCN classification (Dudley 2013). It helps countries and conservation organisations to manage and measure protection standards and conservation effectiveness. The system consists of six categories, ranging from strict nature reserves (Ia, Ib) to areas managed with sustainable use of natural resources (Table 3.1). However, categories III to VI should not be viewed linearly as increasing the range of activities to be performed. For instance, in category V, the emphasis is on more intensive uses such as agriculture, forestry, and tourism, which is not the case for other categories..

Table 3.1 Classification of protected areas according to management priorities (IUCN, Dudley, 2013). Categories with lower values have a more strict protection, while classes with higher value allows for several management practices

Category	Objectives	Activities	Differences from other categories	Examples
Ia. Strict Nature Reserve	Protect biodiversity and geological/geomorphological features. These areas are strictly protected for scientific research and monitoring.	Research, monitoring, and education. Human visitation, use, and impacts are strictly controlled and limited.	Focuses exclusively on conservation and scientific research, with very limited human access.	**Białowieża Forest** (Poland), **Strandzha Nature Park** (Bulgaria)
Ib. Wilderness Area	Protect large, unmodified areas that retain their natural character and influence, without permanent or significant human habitation.	Minimal human impact, wilderness protection, and preservation of natural conditions.	Similar to Ia, but allows for more natural processes to occur without human intervention.	**Sarek National Park** (Sweden), **Retezat National Park** (Romania)
II. National Park	Protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area. These areas also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational, and visitor opportunities.	Recreation, education, research, and conservation activities. Infrastructure for visitors is often developed.	Allows for more human activity and infrastructure compared to Ia and Ib, focusing on both conservation and visitor experience.	**Gran Paradiso National Park** (Italy), **Vatnajökull National Park** (Iceland), **Pyrenees National Park** (France)
III. Natural Monument or Feature	Protect specific natural monuments, which can be landforms, sea mounts, submarine caverns, geological features such as caves, or even living features such as ancient groves.	Conservation of specific natural features, education, and controlled tourism.	More localized and specific in scope compared to broader landscape or ecosystem protection in other categories.	**Giant's Causeway** (Northern Ireland), **Plitvice Lakes National Park** (Croatia), **Trollveggen** (Norway)
IV. Habitat/Species Management Area	Protect particular species or habitats and management reflects this priority. Regular, active interventions are required to address the requirements of particular species or to maintain habitats.	Active management, habitat restoration, species monitoring, and conservation activities.	Requires ongoing human intervention to manage and restore habitats, unlike the more passive protection in Ia and Ib.	**Doñana National Park** (Spain), **Wadden Sea** (Netherlands/Germany/Denmark), **Kiskunság National Park** (Hungary)
V. Protected Landscape/Seascape	Protect landscapes/seascapes and associated cultural values. The interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural, and scenic value.	Sustainable land use, tourism, cultural heritage conservation, and community involvement.	Focuses on the harmonious interaction between humans and nature, unlike the stricter conservation focus of other categories.	**Cinque Terre** (Italy), **Montseny Natural Park** (Spain)

Category	Objectives	Activities	Differences from other categories	Examples
VI. Protected Area with Sustainable Use of Natural Resources	Conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. These areas are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management.	Sustainable resource management, community involvement, and conservation activities.	Allows for sustainable use of natural resources, balancing conservation with human economic activities.	**Vanoise National Park** (France), **Hohe Tauern National Park** (Austria)

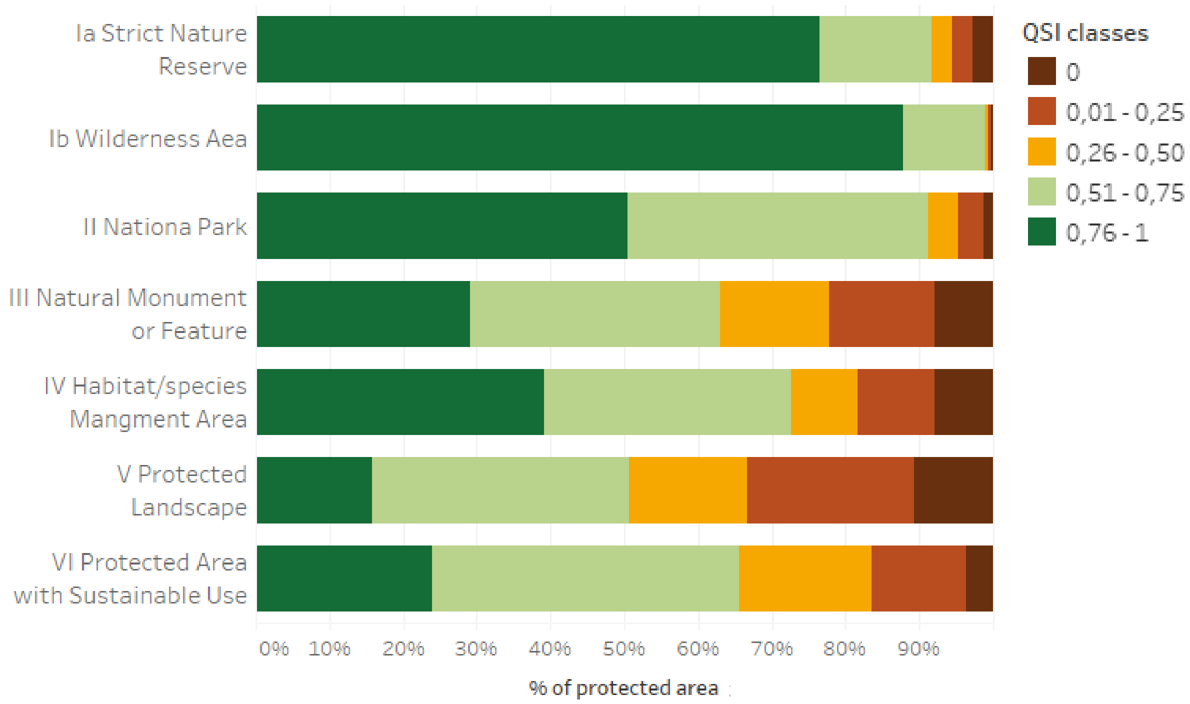
These categories help guide management decisions, balancing conservation with recreational, cultural, or sustainable resource use, tailored to each protected area's goals.

Protected areas that are more strict on conservation objectives, and where human activities are more restrictive are the ones with the highest levels of quietness (class Ia, Ib and II). Noisy areas account for less than 10%. The remaining categories permit various human activities both within and around the protected area.

Category V (Protected Landscape) is unique because noisy areas account for 50% of the total protected sites. This category allows for more intensive human interventions, including tourism, agriculture, and forestry.

These results suggest a link between management practices in protected areas and acoustic quality, with more strictly managed areas showing a higher potential for quietness.

Figure 3.7 Distribution of QSI classes in protected areas grouped according to IUCN management priorities (see Table 3.1 for the definition of categories). Management categories start with more strict protection (Ia and Ib), increasing the range of activities allowed



4 Conclusions

The updated methodology to estimate potential quiet areas in the open country provides a tool to explore the spatial distribution of these areas and, therefore, some insights into areas of higher acoustic quality and, simultaneously, hot spots, i.e. zones that would require further attention. The data used in this methodology has a spatial resolution that limits its ability to identify smaller quiet areas. However, the methodology can be applied with more detailed data at regional or local level.

Since the QSI index is intended for application across Europe, certain generalisations have been made to operationalise the indicator. Specifically, the perception component may vary with unique local conditions or landscape features that are not captured at the European level. Also the distances to noise sources have been generalised considering European averages. Nevertheless, the methodology provides a framework for identifying general patterns across Europe, offering a useful context for a more detailed exploration of quietness at the local level.

Spatial patterns of potential quiet areas in Europe can be summarised as follows:

- Europe has a diverse landscape where potential quiet areas, indicated by high QSI values, are primarily located in Northern Europe and major mountain ranges such as the Carpathians, Alps and Pyrenees. Interestingly, quiet areas are not limited to remote locations; some are found near the Mediterranean coast, suggesting that accessibility does not solely determine quietness.
- There is a clear inverse relationship between population density and quietness. As population density increases, the availability of quiet areas decreases significantly, with urban centres—especially in Central Europe and Northern Italy—reflecting the lowest QSI values. This trend underscores the noise pollution challenges faced in densely populated regions.
- The analysis indicates that only 15% of Europe's territory is classified as potentially quiet (QSI ≥ 0.75), while noisy or relatively noisy areas (QSI < 0.5) account for half of the territory. Countries like Iceland, Finland, Norway, and Sweden exhibit the highest proportions of quiet areas, whereas densely populated nations such as Belgium, Luxembourg and the Netherlands face significant challenges in maintaining quiet spaces.
- Quiet areas are predominantly found in mountainous regions, especially at elevations above 500 meters. Conversely, low coastal and inland areas, which are more accessible and populated, show the lowest percentages of quiet areas. This pattern suggests that planning for quiet spaces should consider natural landscape features that contribute to acoustic quality.

The QSI index can also evaluate the potential acoustic condition of protected areas:

- Quiet areas often overlap with protected areas, particularly within the Natura 2000 network. Approximately 30% of quiet areas are located within these protected sites, highlighting their significance for biodiversity conservation. However, high environmental noise levels negatively impact around 25% of Europe’s protected areas, emphasizing the need for integrated management strategies that prioritize both biodiversity and quietness. The remaining 45% of protected areas have a QSI ranging between 0,5 and 0,75, indicating a good baseline for potential improvement to reach higher levels closer to a QSI of 0,75.
- The most effective protected areas for maintaining quietness are those with strict conservation objectives (IUCN classes I and II), where human activities are limited. Less than 10% of these areas are classified as noisy, indicating that stricter regulations can enhance the preservation of quiet environments.

The findings underscore the importance of developing policies that balance human activity with the preservation of quiet areas, particularly in densely populated regions. Creating quiet buffer zones around Natura 2000 sites and other protected areas could enhance their ecological and acoustic quality, contributing to both biodiversity conservation and improved quality of life for residents.

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List of abbreviations

Abbreviation	Name	Reference
EEA	European Environment Agency	www.eea.europa.eu
CLC	CORINE Land Cover	CORINE Land Cover — Copernicus Land Monitoring Service
END	Environmental Noise Directive (END) 2002/49/EC	EUR-Lex - 32002L0049 - EN
QSI	Quietness suitability index	

Annex 1 QSI calculation: distance to the noise components

This annex details the methodology used to calculate distances from noise sources to the isophones of the noise contour maps. We focused on two critical measurements:

- The maximum range of the 50-54 dB L_{den} isophone
- The average range of the 55-59 dB L_{den} isophone

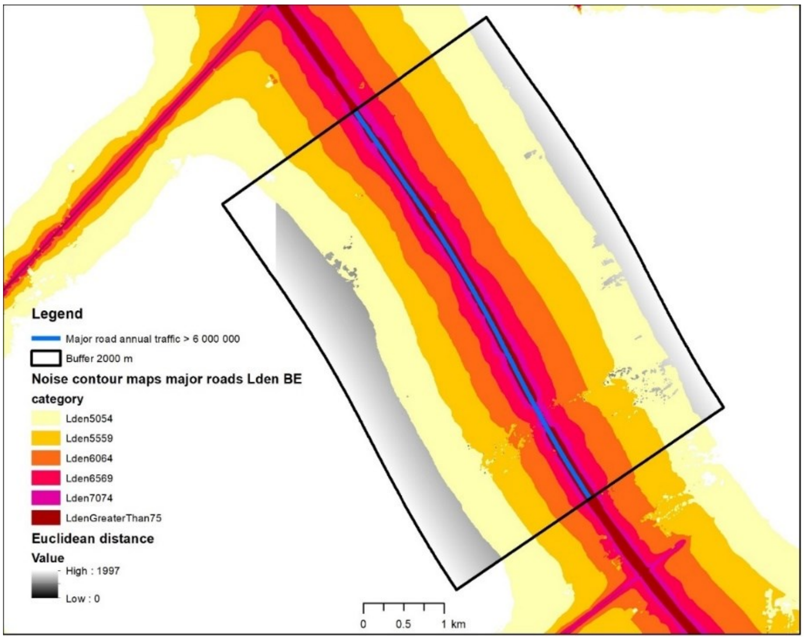
Our analysis is based on a slecting railway segments across multiple countries, enabling us to derive representative final figures for each distance category.

Calculation of distance of noise contour maps to major roads

1. Selection of Roads from DF1_5 Mroad based on annual traffic of more than 6 million vehicles
    a. Annual Traffic Flow
        i. 3 000 000 – 6 000 000
        ii. > 6 000 000
2. Buffer of 5000m from road (Flat end)
3. Euclidean distance to the road source.
4. Zonal Statistics as Table.

For Belgium (BE) Major roads annual traffic flow of more than 6 million vehicles.

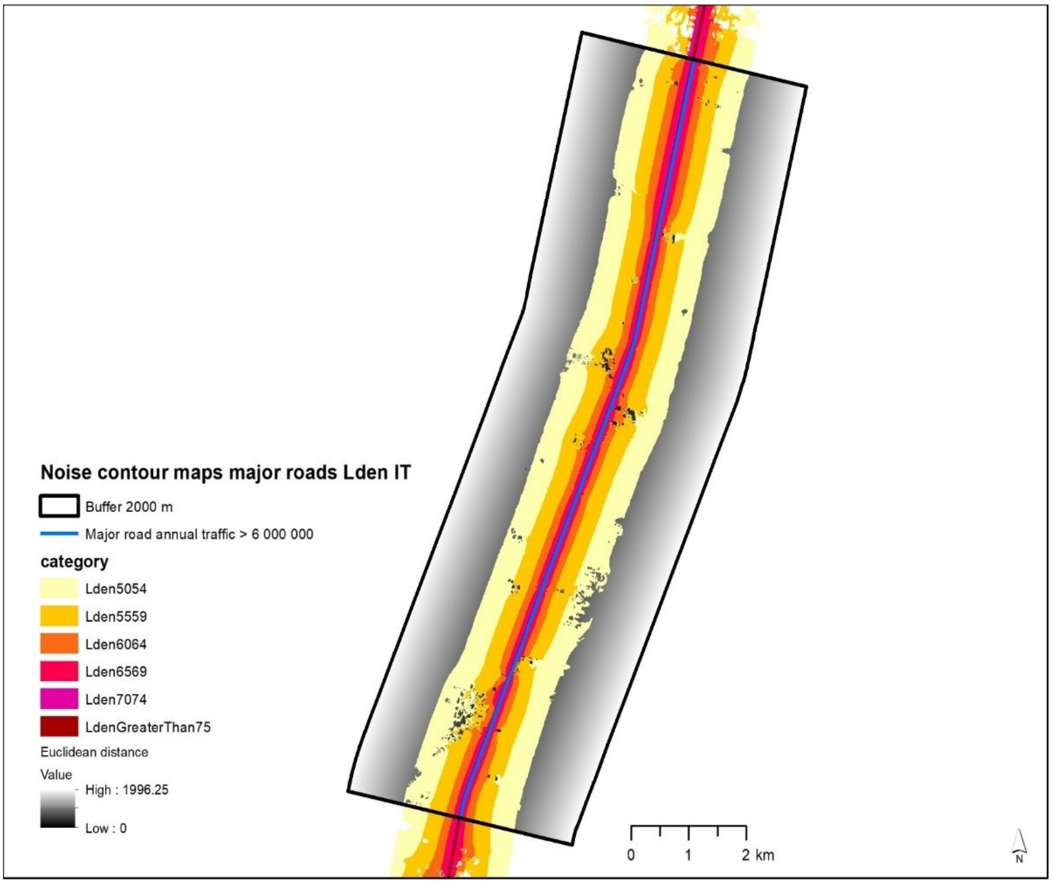
category	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
Lden5054	56864	5686400	246	1846	1600	1270	213	72195127
Lden5559	47346	4734600	166	1306	1141	805	167	38127150
Lden6064	34995	3499500	50	788	738	434	115	15171931
Lden7074	6946	694600	14	164	150	93	26	643620
Lden6569	16552	1655200	22	367	344	201	58	3332640
LdenGreaterThan75	6837	683700	0	89	89	32	20	216547



For Italy (IT) Major roads annual traffic flow of more than 6 million vehicles

.

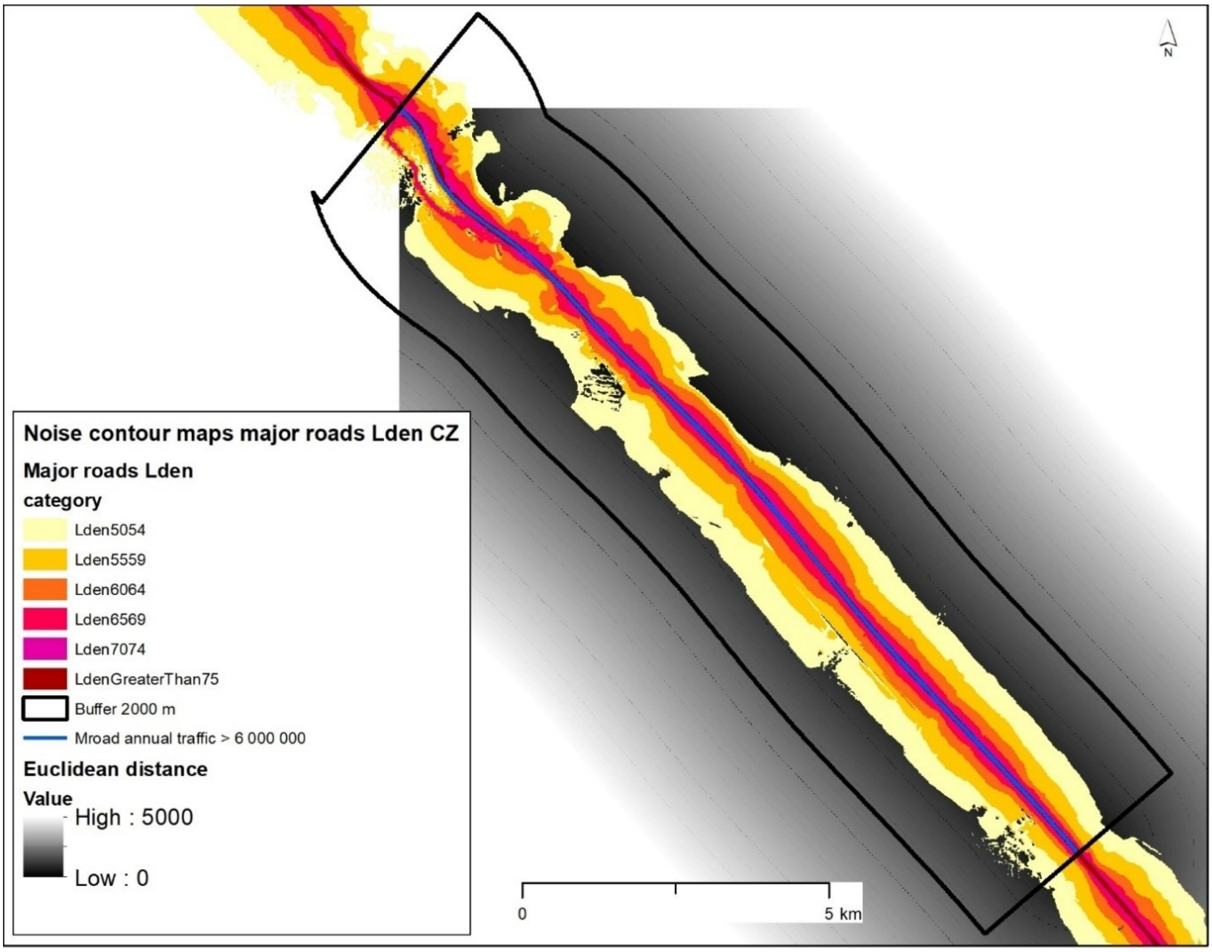
category	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
Lden5054	104433	10443300	102	1014	912	715	130	74658476
Lden5559	70066	7006600	51	708	657	376	91	26310522
Lden6064	32733	3273300	20	323	303	178	50	5812535
Lden6569	14921	1492100	10	165	155	85	26	1274946
Lden7074	7357	735700	10	100	90	40	14	296269
LdenGreaterThan75	6958	695800	0	40	40	14	10	100756



For Czechia (CZ) Major roads annual traffic flow of more than 6 million vehicles

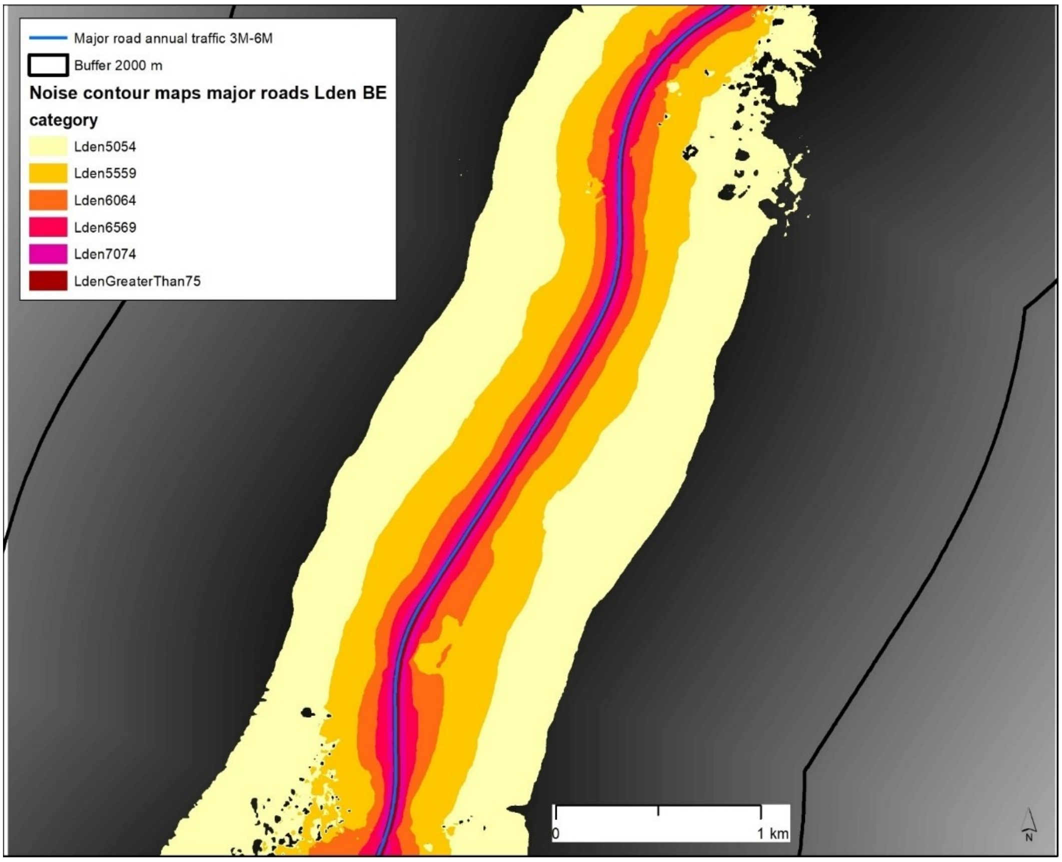
.

Category	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
Lden5054	104599	10459900	58	1258	1200	751	197	78587945
Lden5559	75688	7568800	28	906	878	452	140	34239362
Lden6064	49952	4995200	10	548	538	250	83	12490929
Lden6569	26247	2624700	0	452	452	129	52	3377339
Lden7074	13473	1347300	0	438	438	68	50	920448
LdenGreaterThan75	13393	1339300	0	430	430	18	22	241071



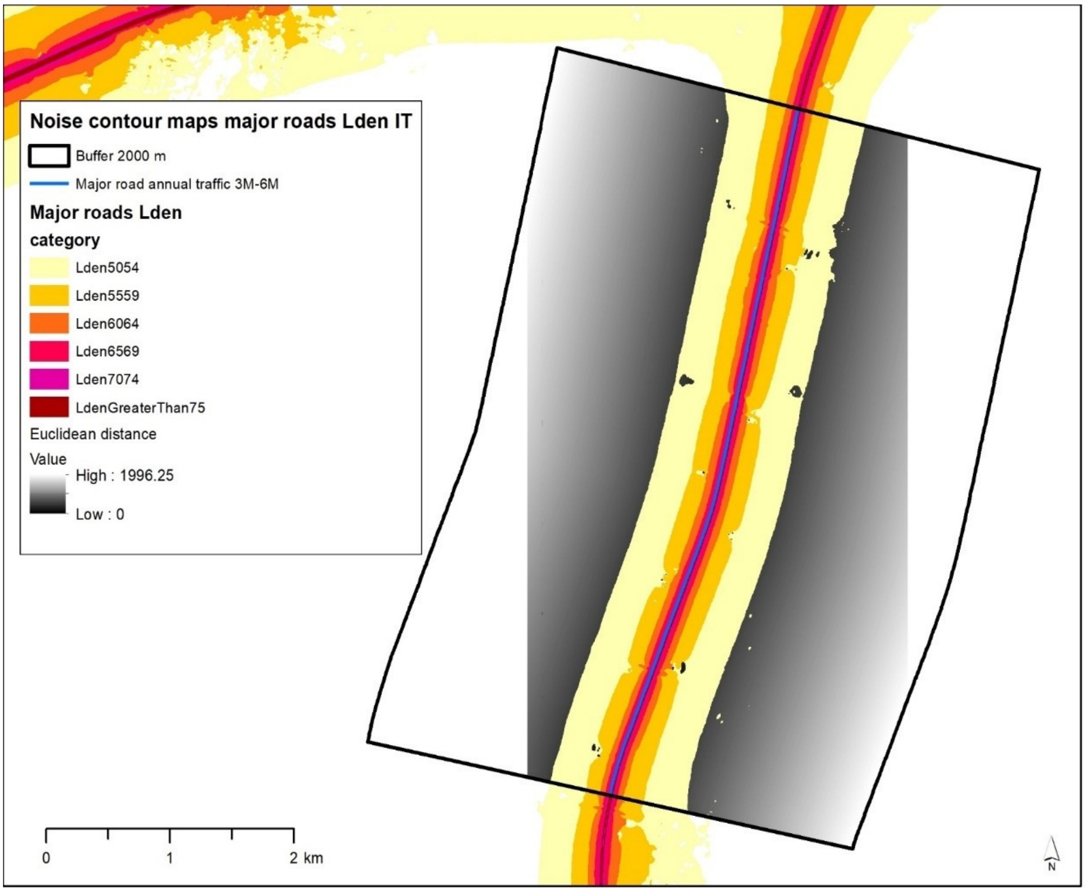
For Belgium (BE) Major roads annual traffic flow between 3 and 6 million vehicles.

category	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
Lden5054	92472	9247200	36	982	945	510	140	47130489
Lden5559	56452	5645200	20	509	489	246	77	13883490
Lden6064	22460	2246000	20	298	278	115	35	2583618
Lden6569	12279	1227900	0	110	110	56	16	683553
Lden7074	6683	668300	0	50	50	26	9	173204
LdenGreaterThan75	5487	548700	0	22	22	9	7	49496



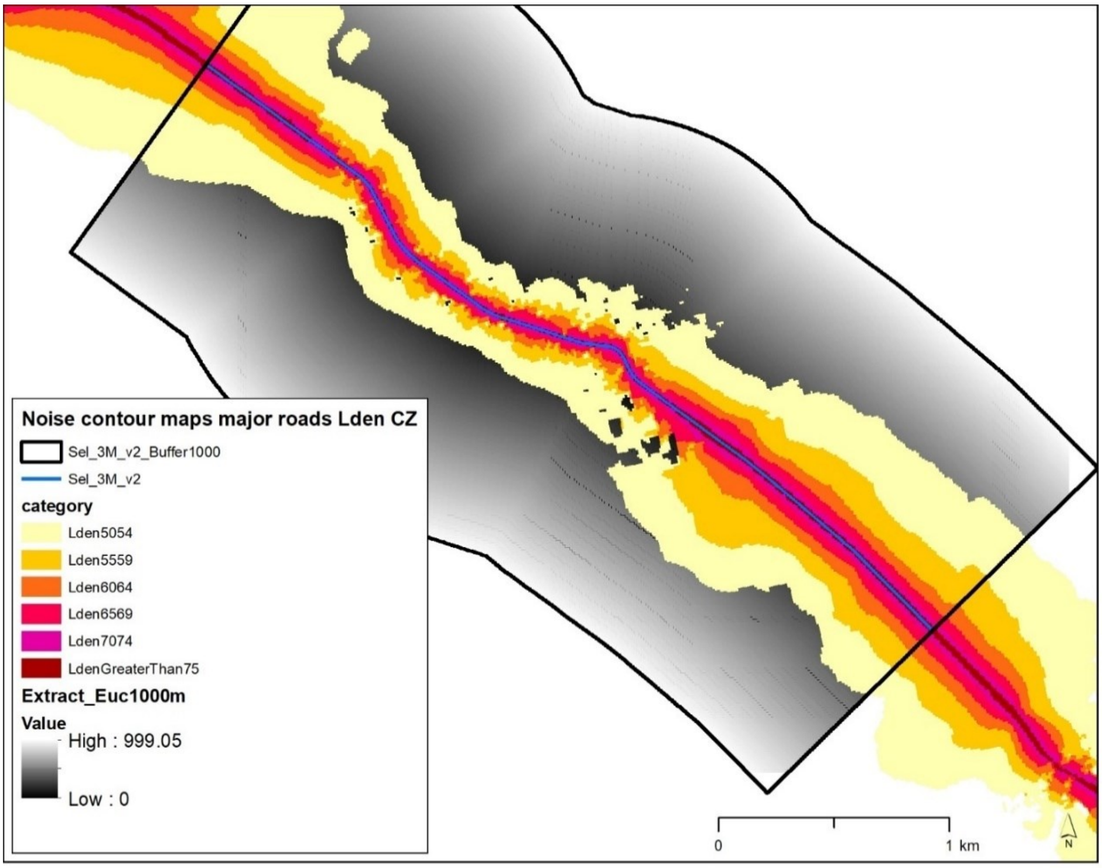
For Italy (IT) Major roads annual traffic flow between 3 and 6 million vehicles.

category	COUNT	AREA	MIN	MAX	RANGE		MEAN	STD	SUM
Lden5054	32004	3200400	89	829	739		381	88	12181139
Lden5559	14542	1454200	54	289	235		171	42	2484871
Lden6064	5785	578500	32	132	100		79	19	454914
Lden6569	2912	291200	20	70	50		39	12	113841
Lden7074	1638	163800	0	40	40		19	10	30988
LdenGreaterThan75	1410	141000	0	22	22		10	8	13642



For Czechia (CZ) Major roads annual traffic flow between 3 and 6 million vehicles.

category	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
Lden5054	18211	1821100	20	602	582	302	115	5508336
Lden5559	8619	861900	20	375	355	166	63	1426617
Lden6064	4449	444900	10	175	165	88	27	389430
Lden6569	3232	323200	10	100	90	47	15	153337
Lden7074	1946	194600	0	54	54	21	8	41626
LdenGreaterThan75	1296	129600	0	22	22	7	6	9440



Final tables for Major roads according to annual traffic 3M to 6M, and more that 6M vehicles

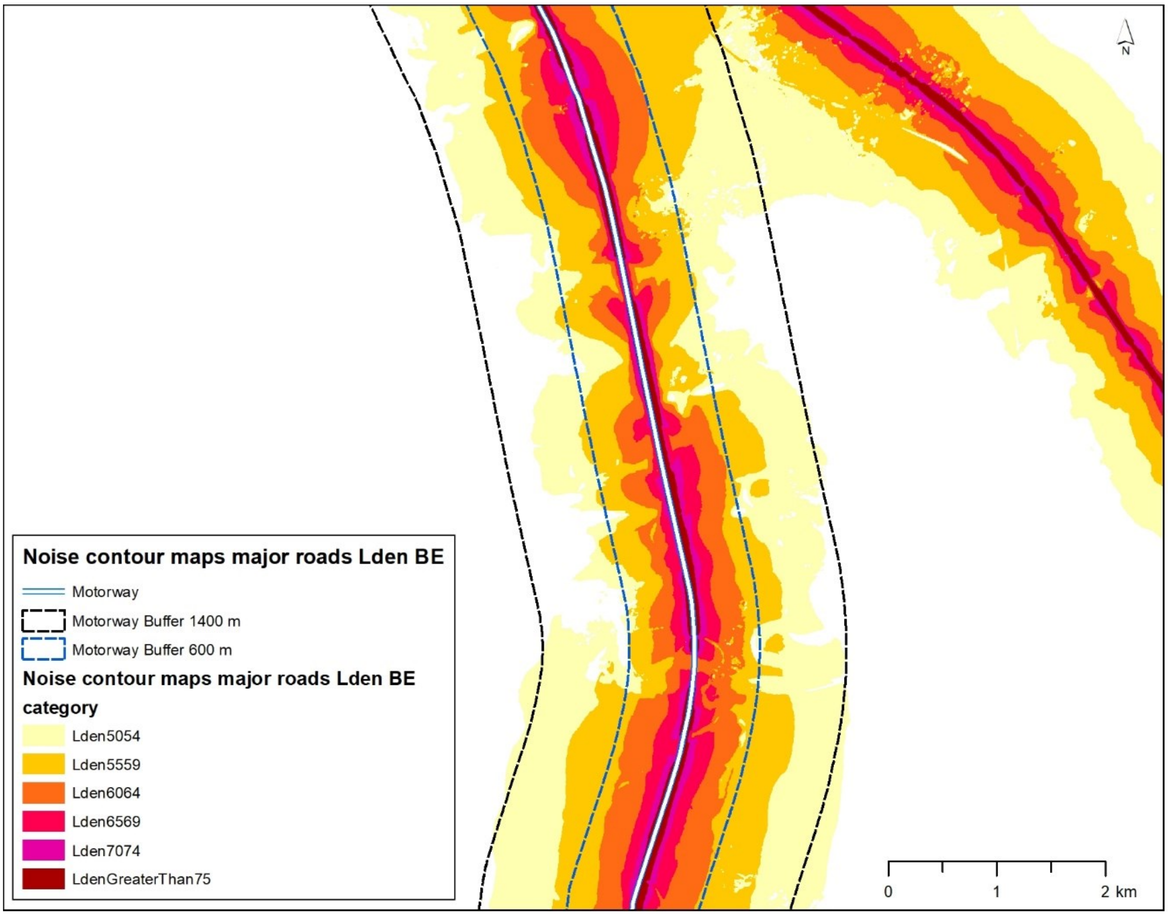
6M	MAX Lden5054	MEAN Lden5559
BE	1846	805
IT	1014	376
CZ	1258	452
Average	**1373**	**544**
Max	**1846**	

3M	MAX Lden5054	MEAN Lden5559
BE	982	246
IT	829	171
CZ	602	166
Average	**804**	**194**
Max	**982**	

6M	**1400**	**600**

3M	**800**	**200**

- From 3 to 6 million vehicles: for primary and secondary roads of Euroregional map
  - Average of maximum distance found for Lden5054 (800m)
  - Average of mean distance found for Lden5559 (200m)
- Above 6 million vehicles: for motorway
  - Average of maximum distance found for L_{den} 5054 (1400m)
  - Average of mean distance found for L_{den} 5559 (600m)

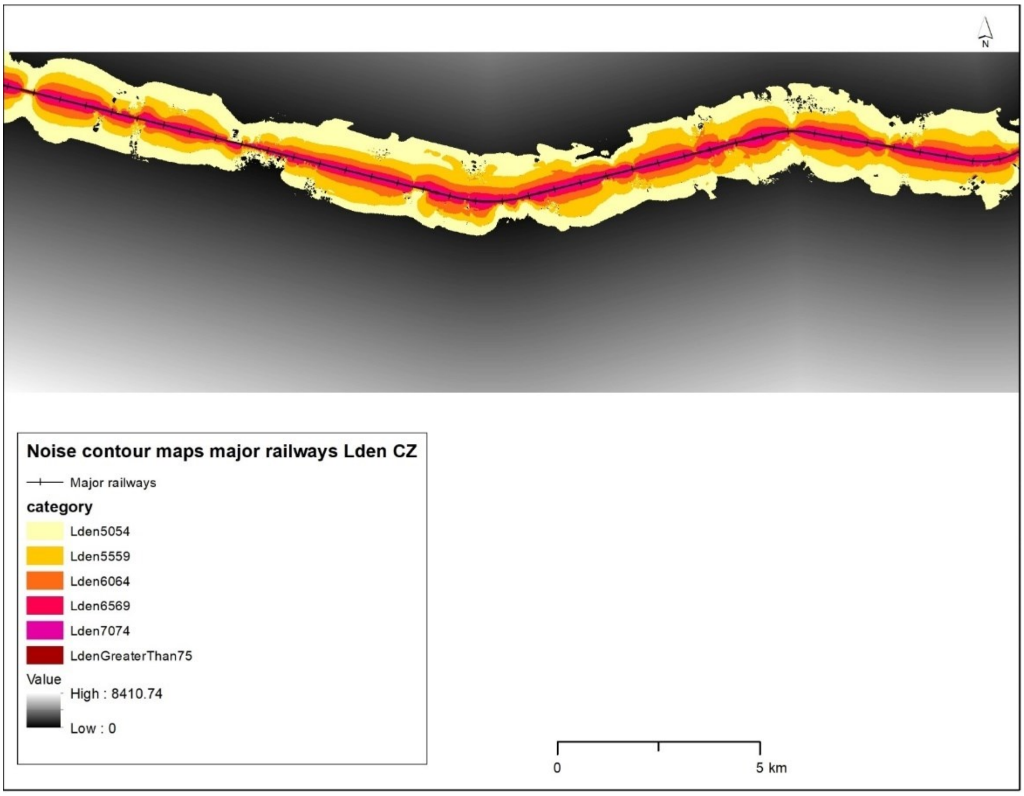


Major railways

The methodology developed for measuring distances between major road noise sources and their corresponding noise contour maps has been applied to evaluate similar distances for major railway noise sources.

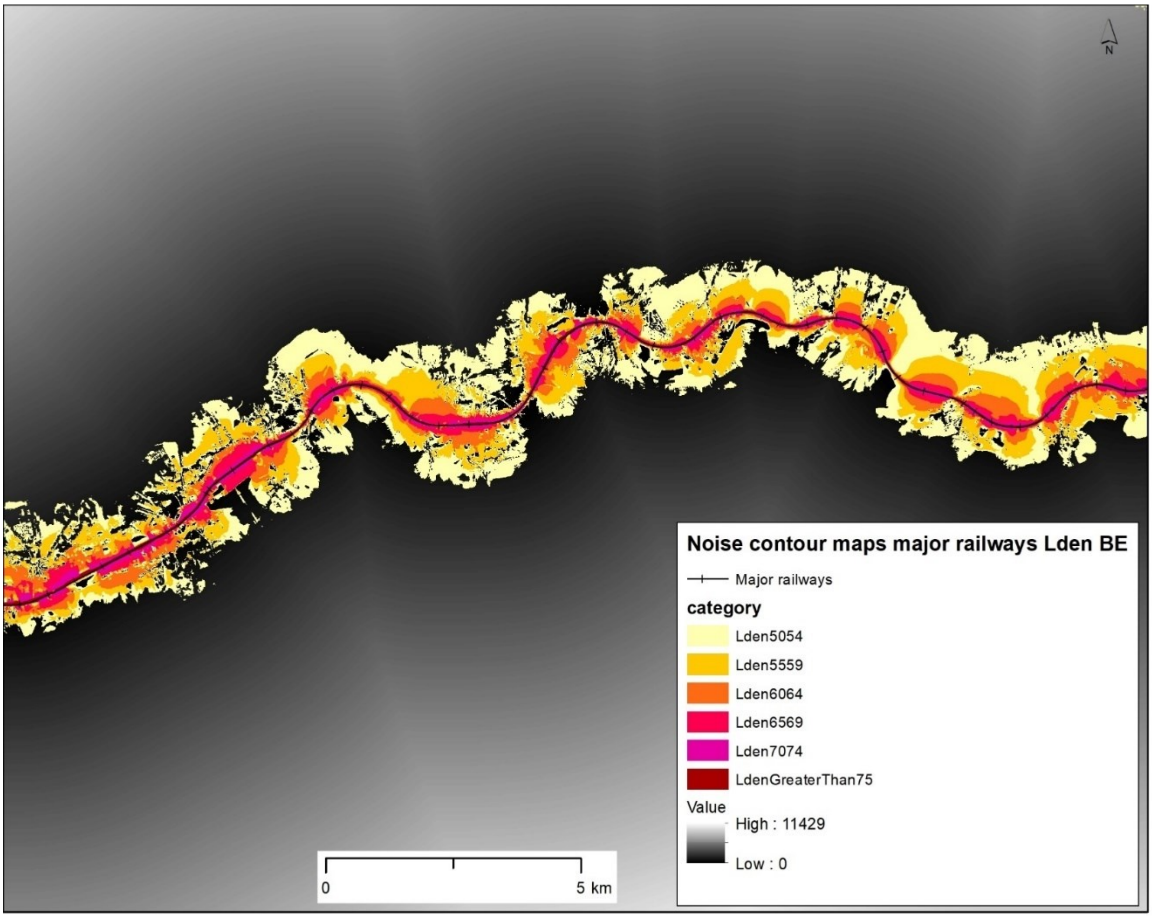
For Czechia (CZ) Major railways as those with more than 30,000 train passages per year

category	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
Lden5054	46346	28966250	25	1200	1175	667	245	30894868
Lden5559	32473	20295625	0	1176	1176	425	166	13795929
Lden6064	22633	14145625	0	1175	1175	254	109	5742197
Lden6569	12804	8002500	0	686	686	125	63	1606730
Lden7074	6981	4363125	0	375	375	56	36	392556
LdenGreaterThan75	4769	2980625	0	146	146	17	17	79729



For Belgium (BE) Major railways as those with more than 30,000 train passages per year

category	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
Lden5054	27464	17165000	0	1923	1923	688	295	18890901
Lden5559	15510	9693750	0	1026	1026	441	194	6846204
Lden6064	7982	4988750	0	637	637	243	112	1941327
Lden6569	4887	3054375	0	427	427	128	67	623986
Lden7074	2584	1615000	0	202	202	51	28	131910
LdenGreaterThan75	1859	1161875	0	56	56	14	13	26202



Final table for Major railways as those with more than 30,000 train passages per year

Mrailways	MAX Lden5054	MEAN Lden5559
BE	1923	441
CZ	1200	425
Average	1562	433
Railways	1600	400

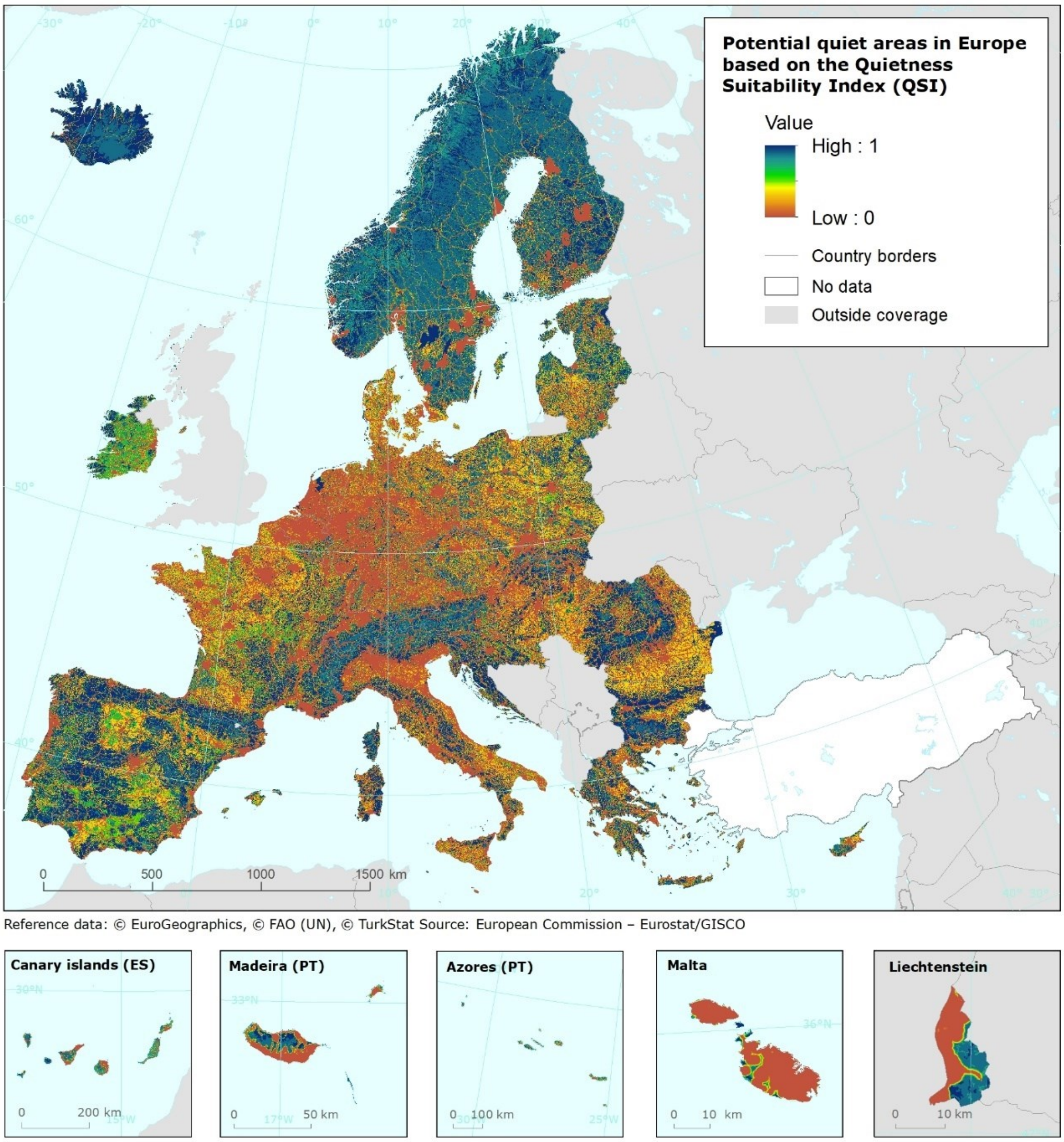
Annex 2 Land suitability to support nature-based recreation

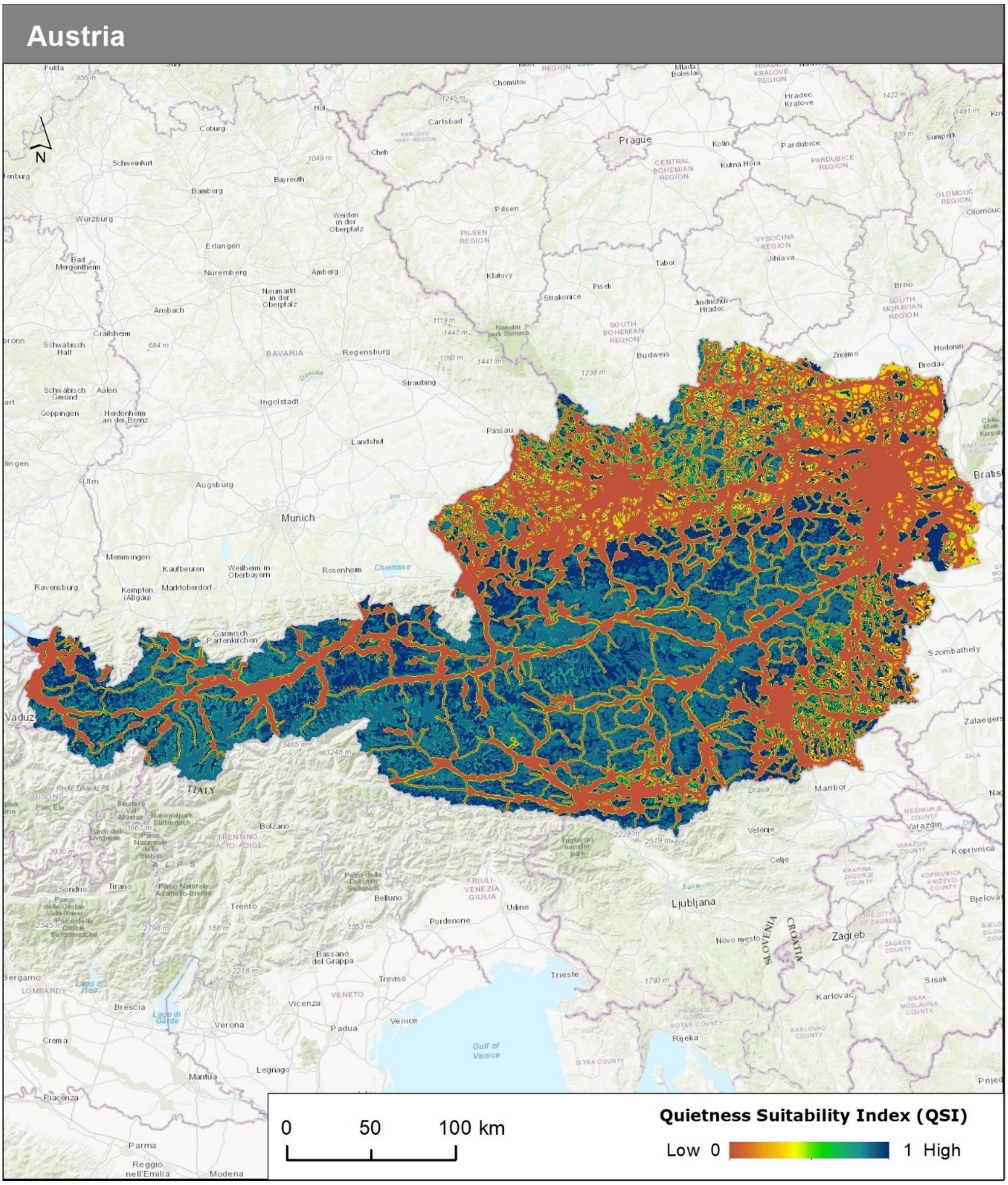
The following table provides the classification of Copernicus Corine Land Cover classes (Level 3) into the land suitability index, which ranges from zero (low) to 1 (maximum suitability). Source: Vallecillo et al., 2019.

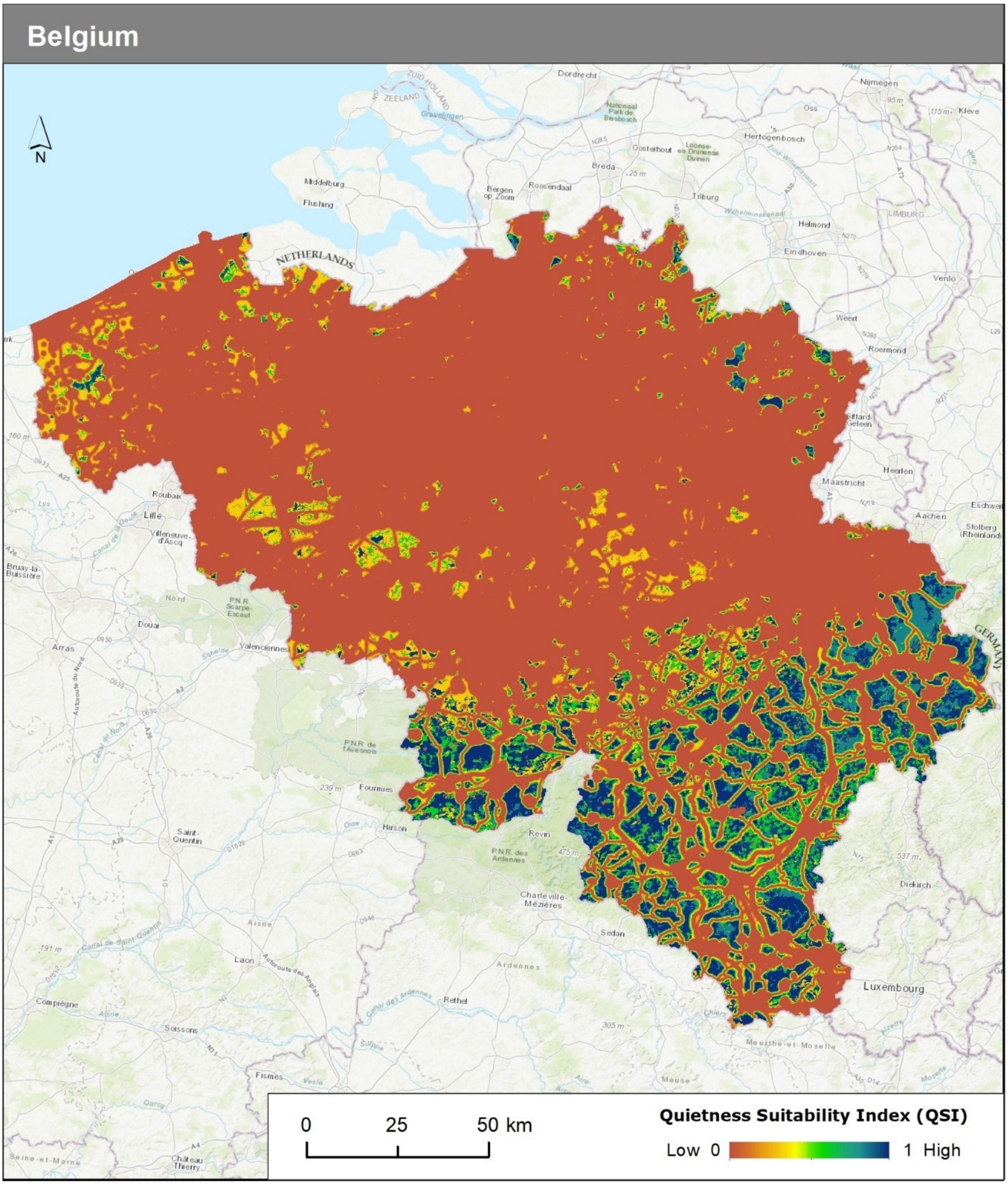
Level1	Level2	Level3	Suitability
Artificial surfaces	Urban fabric	Continuous urban fabric	0
		Discontinuous urban fabric	0,1
	Industrial, commercial and transport units	Industrial or commercial units	0
		Road and rail networks and associated land	0
		Port areas	0
		Airports	0
	Mine, dump and construction sites	Mineral extraction sites	0
		Dump sites	0
		Construction sites	0
	Artificial, non-agricultural vegetated areas	Green urban areas	0,8
		Sport and leisure facilities	0,1
	Arable land	Non-irrigated arable land	0,3
		Permanently irrigated land	0,3
		Rice fields	0,4
	Permanent crops	Vineyards	0,5
		Fruit trees and berry plantations	0,5
		Olive groves	0,5
	Pastures	Pastures	0,6
	Heterogeneous agricultural areas	Annual crops associated with permanent crops	0,3
		Complex cultivation patterns	0,3
		Land principally occupied by agriculture, with significant areas of natural vegetation	0,6
		Agro-forestry areas	0,6
Forest and semi natural areas	Forests	Broad-leaved forest	1
		Coniferous forest	0,8
		Mixed forest	1
	Scrub and/or herbaceous vegetation associations	Natural grasslands	0,8
		Moors and heathland	0,8
		Sclerophyllous vegetation	0,8
		Transitional woodland-shrub	0,8
	Open spaces with little or no vegetation	Beaches, dunes, sands	1
		Bare rocks	0,8
		Sparsely vegetated areas	0,7
		Burnt areas	0
		Glaciers and perpetual snow	0,8
Wetlands	Inland wetlands	Inland marshes	1
		Peat bogs	0,8
	Maritime wetlands	Salt marshes	1
		Salines	0,8
		Intertidal flats	1
Water bodies	Inland waters	Water courses	1
		Water bodies	1
	Marine waters	Coastal lagoons	1
		Estuaries	0,8
		Sea and ocean	1

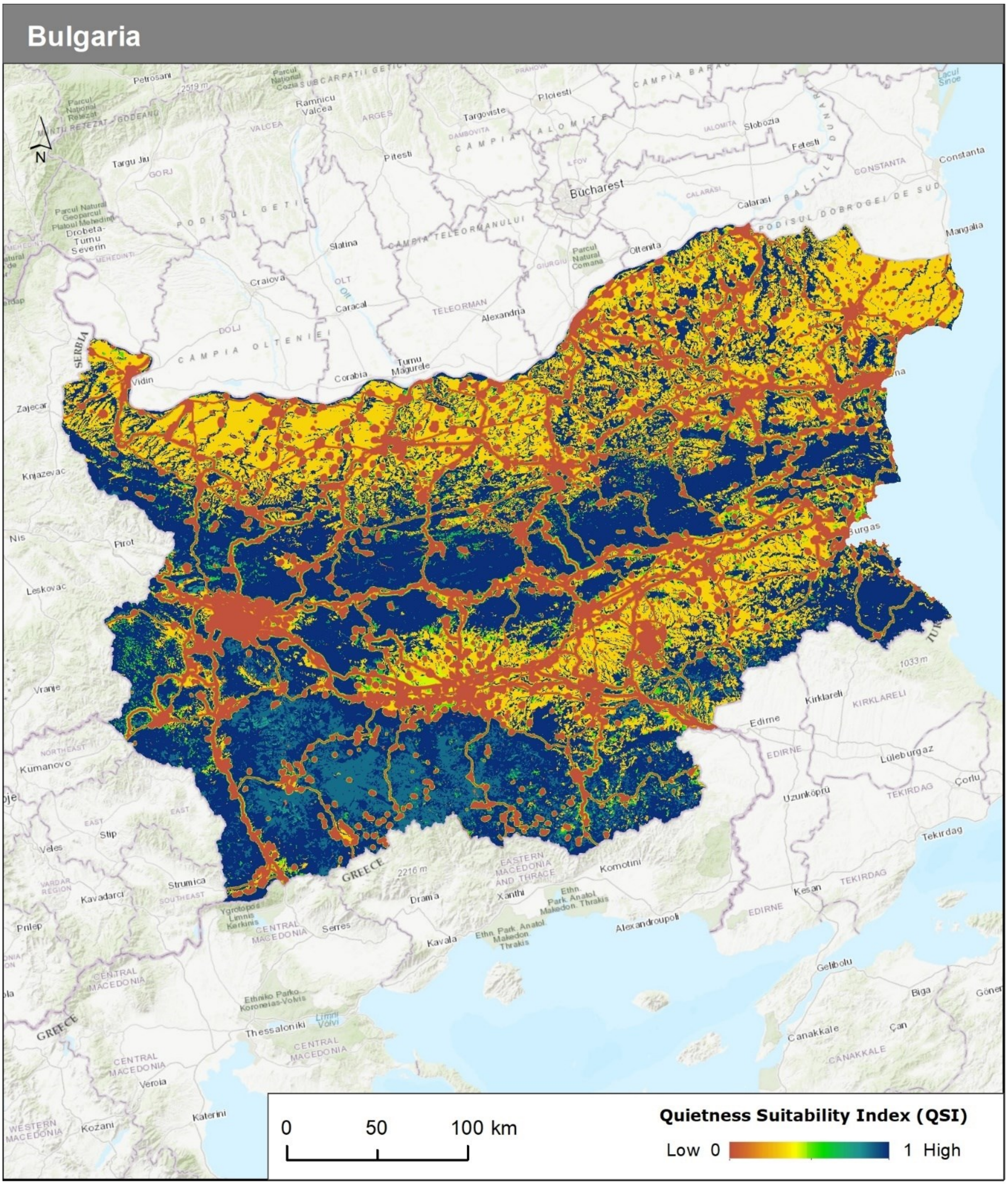
Annex 3 QSI country results

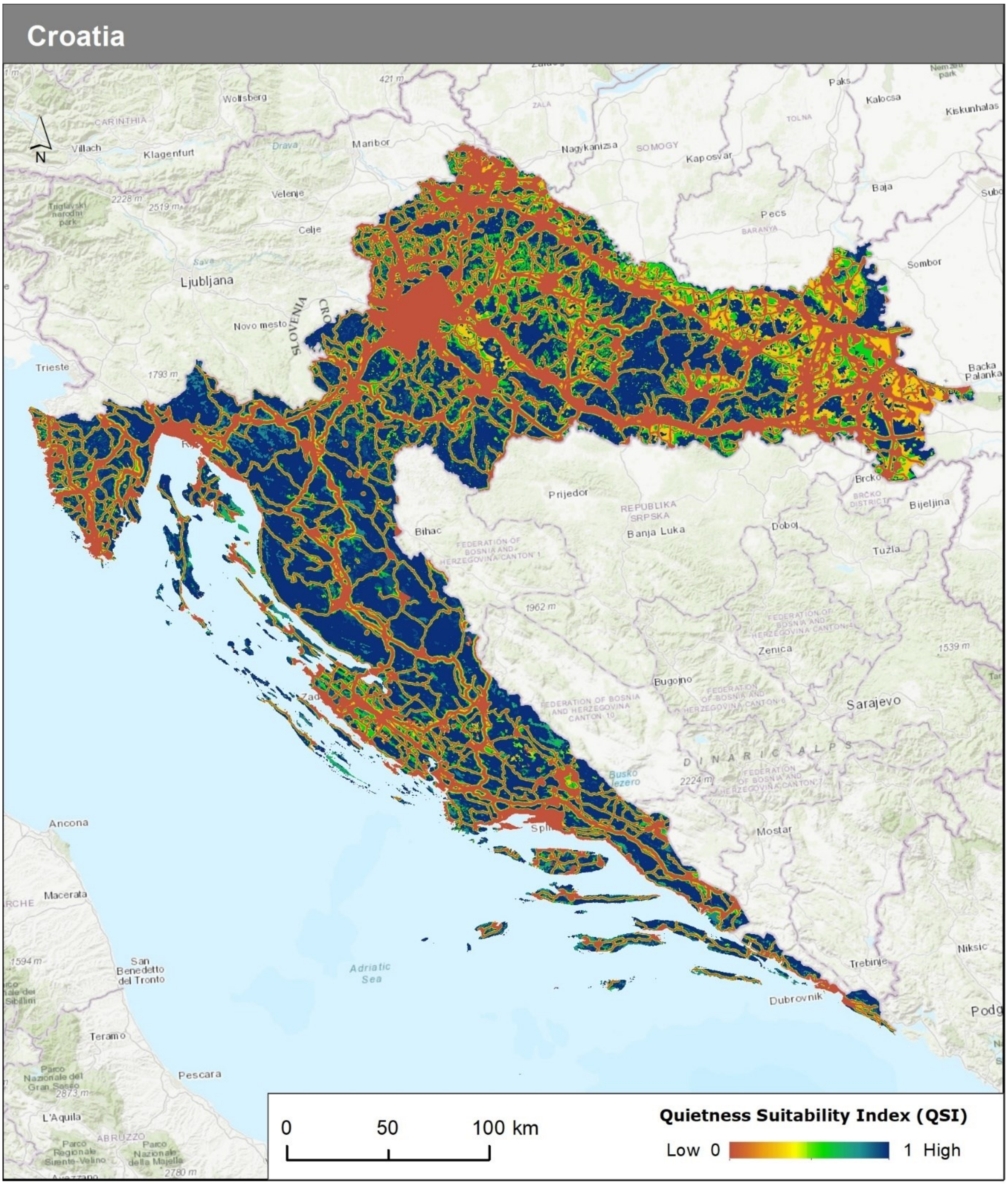
In this annex, you will find the QSI maps organized by country.

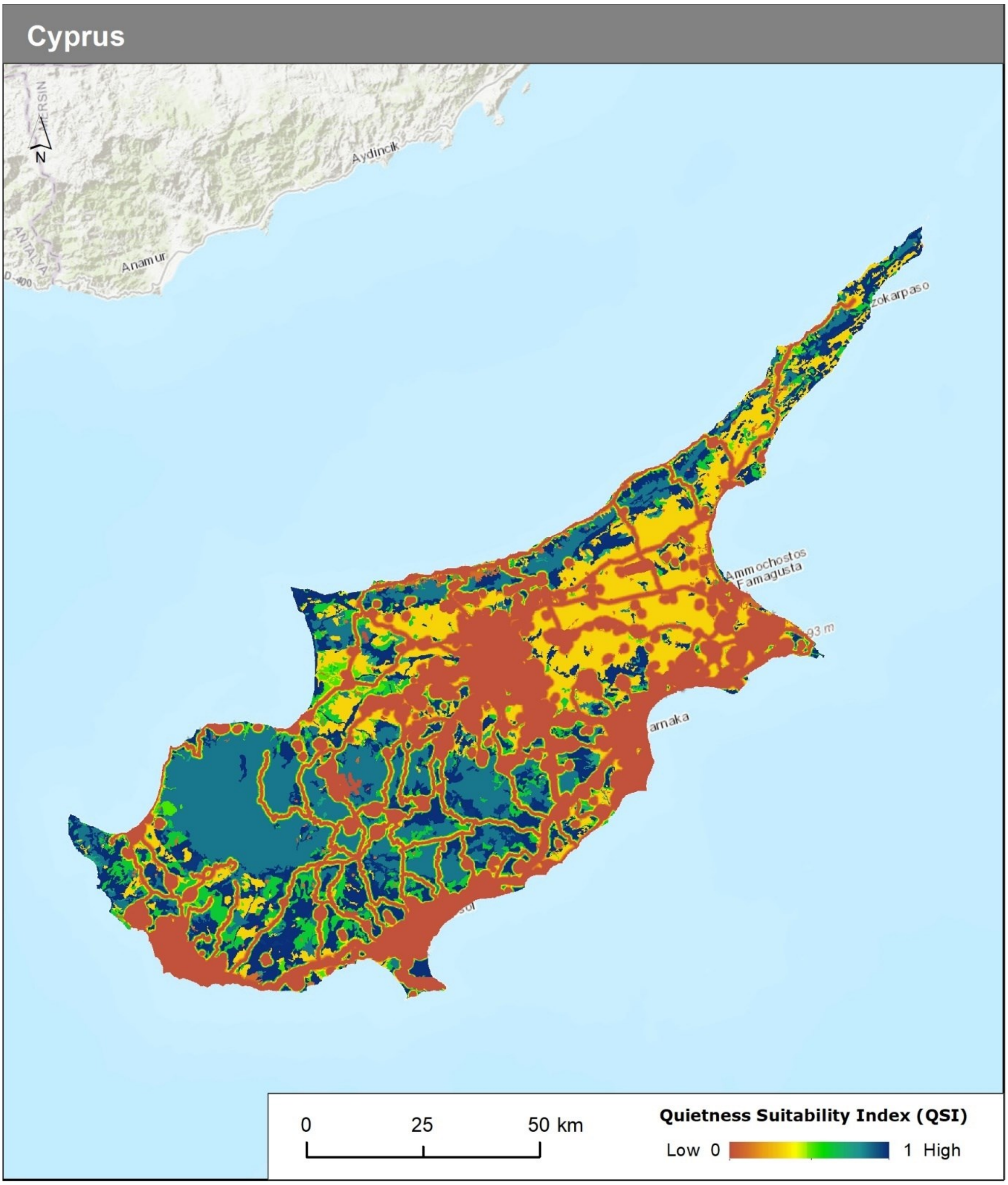



Austria
Munich
Prague
Ljubljana
Zagreb
0
50
100 km
Quietness Suitability Index (QSI)
Low 0
1 High


Belgium
0
25
50 km
Quietness Suitability Index (QSI)
Low 0
1 High

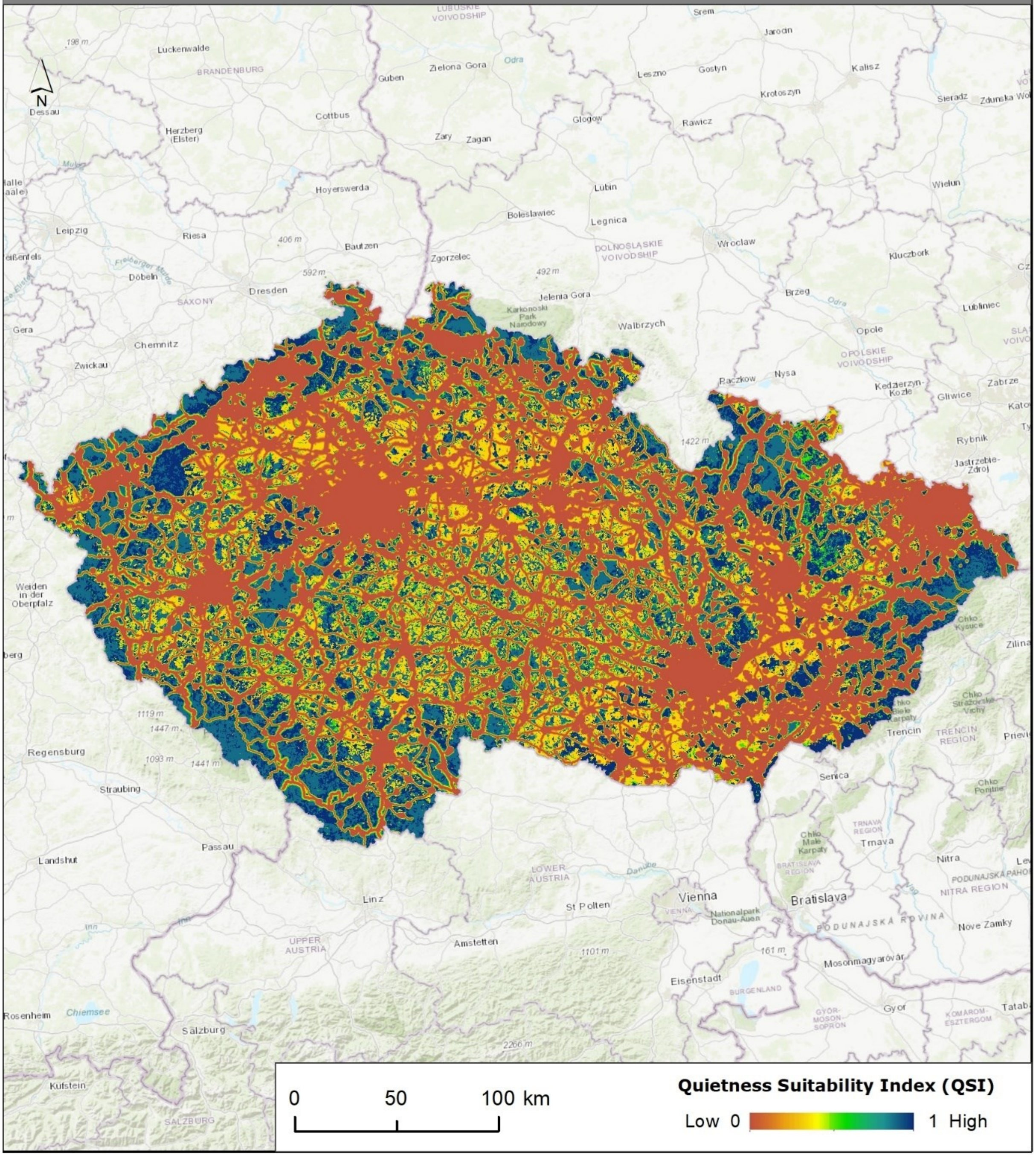

Bulgaria
0
50
100 km
Quietness Suitability Index (QSI)
Low 0
1 High

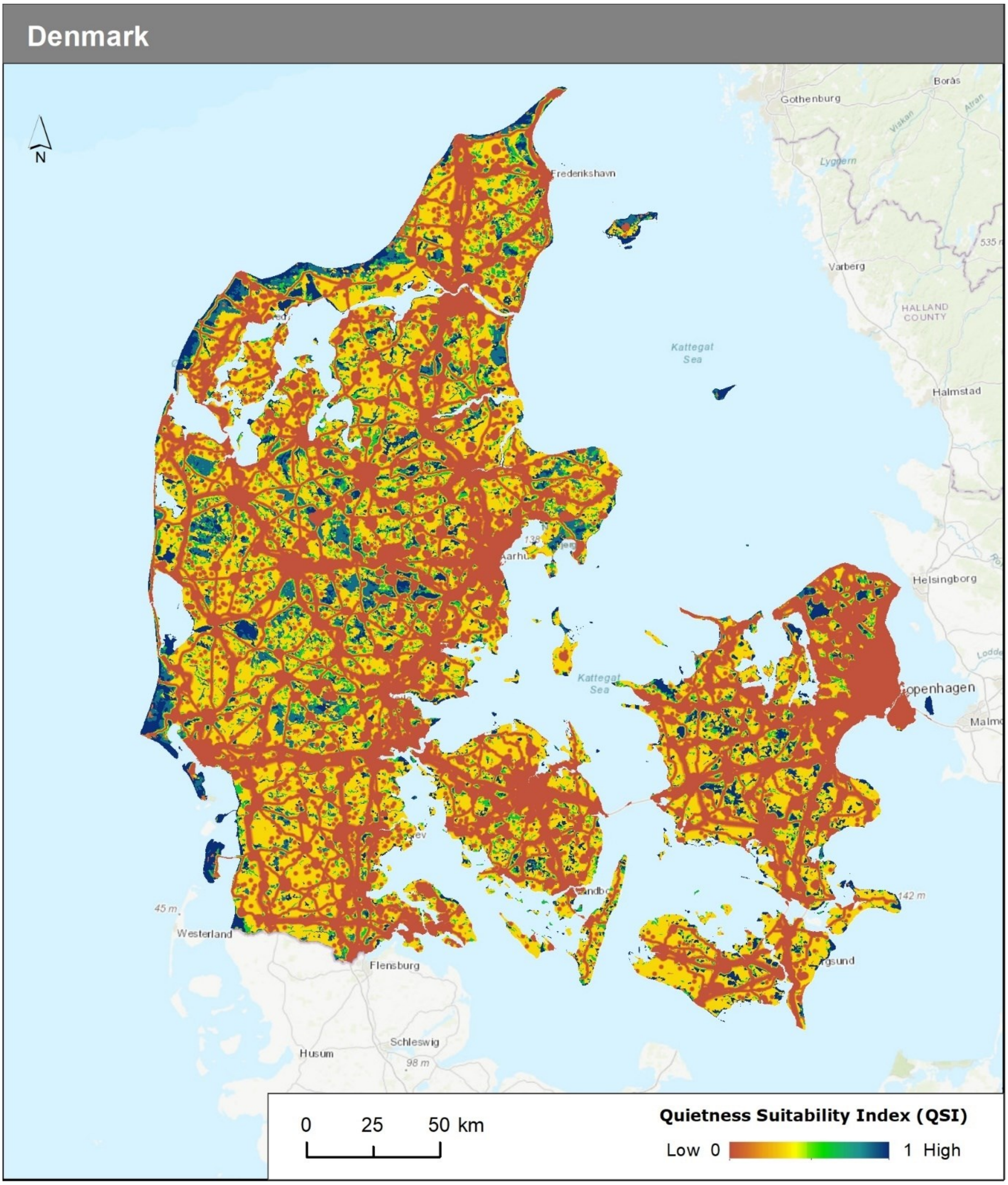

Croatia
Quietness Suitability Index (QSI)
Low 0
1 High
0
50
100 km
N
Villach
Klagenfurt
Wolfsberg
Maribor
Velenje
Celje
Ljubljana
Novo mesto
Trieste
Nagykanizsa
Kaposvar
Pecs
Paks
Kalocsa
Kiskunhalas
Baja
Sombor
Backa Palanka
Brcko
Bijeljina
Prijedor
Bihac
Banja Luka
Doboj
Tuzla
Zenica
Bugojno
Sarajevo
Mostar
Trebinje
Niksic
Dubrovnik
Adriatic Sea
Ancona
Macerata
San Benedetto del Tronto
Teramo
Pescara
L'Aquila
DINARIC ALPS

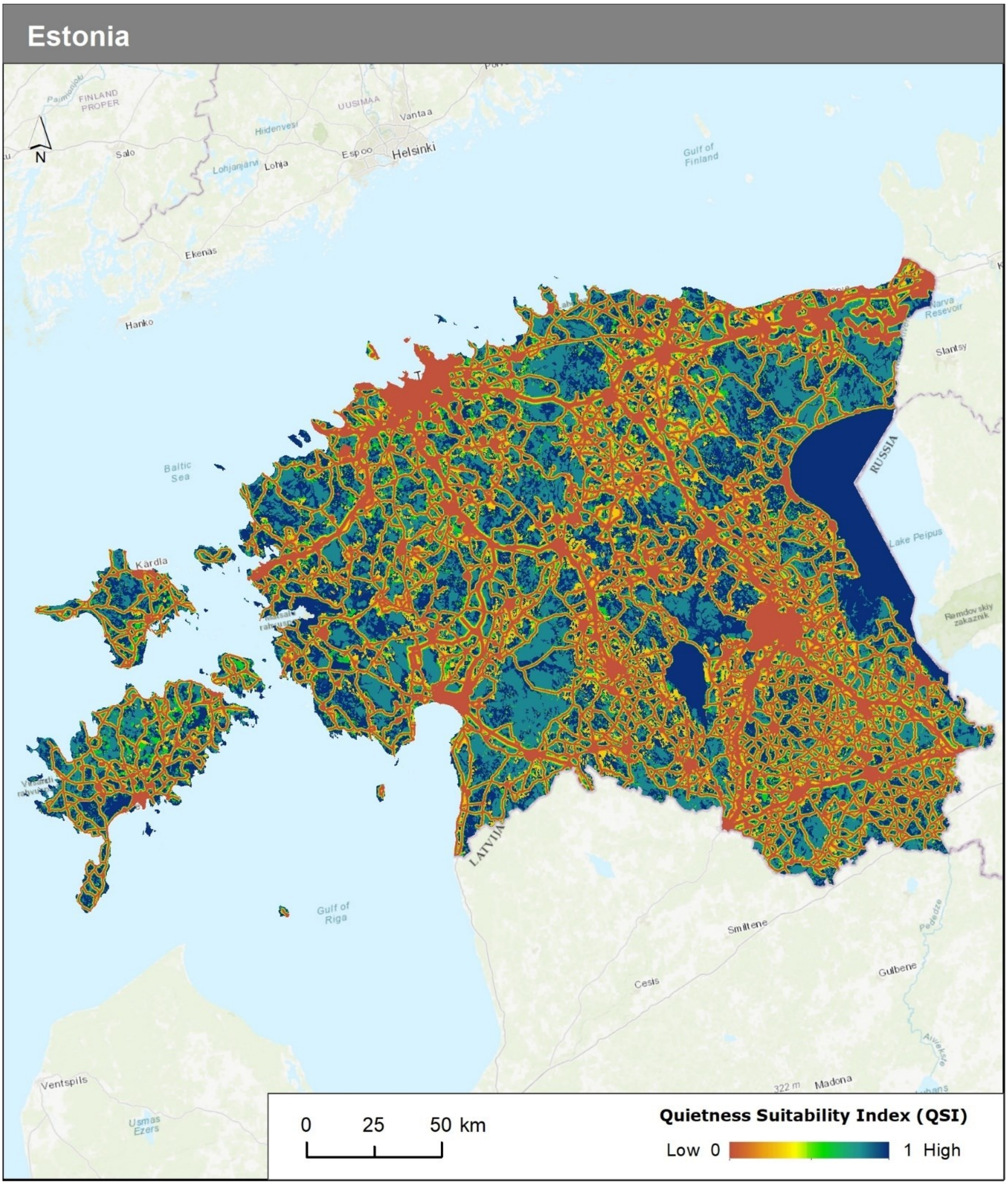


Cyprus
N
Aydincik
Anamur
Ammochostos
Famagusta
0
25
50 km
Quietness Suitability Index (QSI)
Low 0
1 High

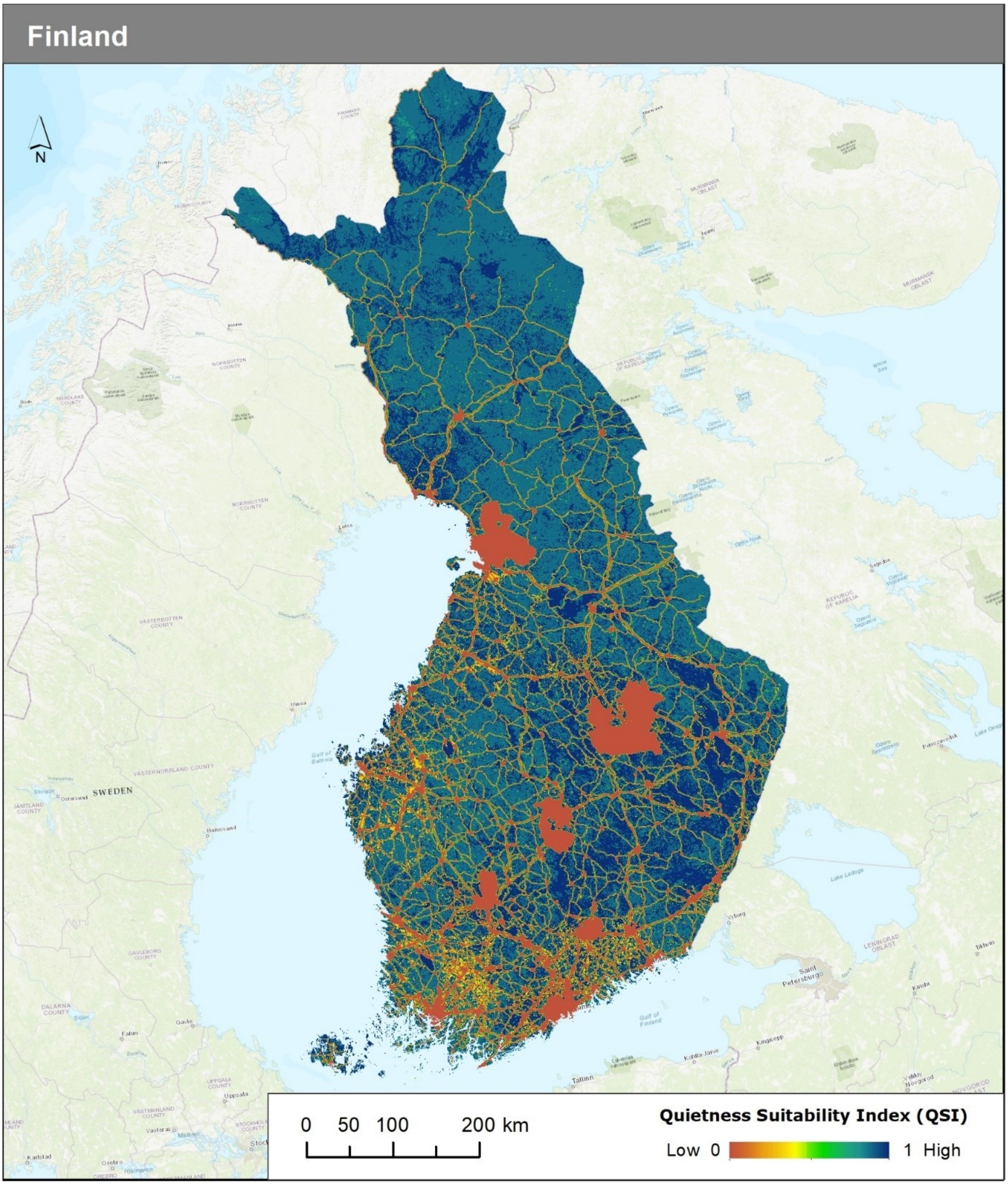
Czechia


N
Quietness Suitability Index (QSI)
Low 0
1 High
0
50
100 km
Luckenwalde
Dessau
Herzberg (Elster)
Cottbus
Guben
Zielona Gora
Leszno
Gostyn
Krotoszyn
Kalisz
Jarocin
Sieradz
Glogow
Rawicz
Zary
Zagan
Hoyerswerda
Lubin
Legnica
Boleslawiec
Leipzig
Riesa
Bautzen
Zgorzelec
Wroclaw
Kluczbork
Wielun
Döbeln
Dresden
Jelenia Gora
Walbrzych
Brzeg
Opole
Lubliniec
Gera
Chemnitz
Zwickau
Raczkow
Nysa
Kedzierzyn-Kozle
Gliwice
Zabrze
Rybnik
Jastrzebie-Zdroj
Weiden in der Oberpfalz
Regensburg
Straubing
Landshut
Passau
Linz
St Polten
Vienna
Bratislava
Trnava
Nitra
Nove Zamky
Trencin
Senica
Amstetten
Eisenstadt
Mosonmagyaróvár
Gyor
Rosenheim
Chiemsee
Salzburg
Kufstein
SAXONY
BRANDENBURG
LOWER AUSTRIA
UPPER AUSTRIA
Danube
Odra

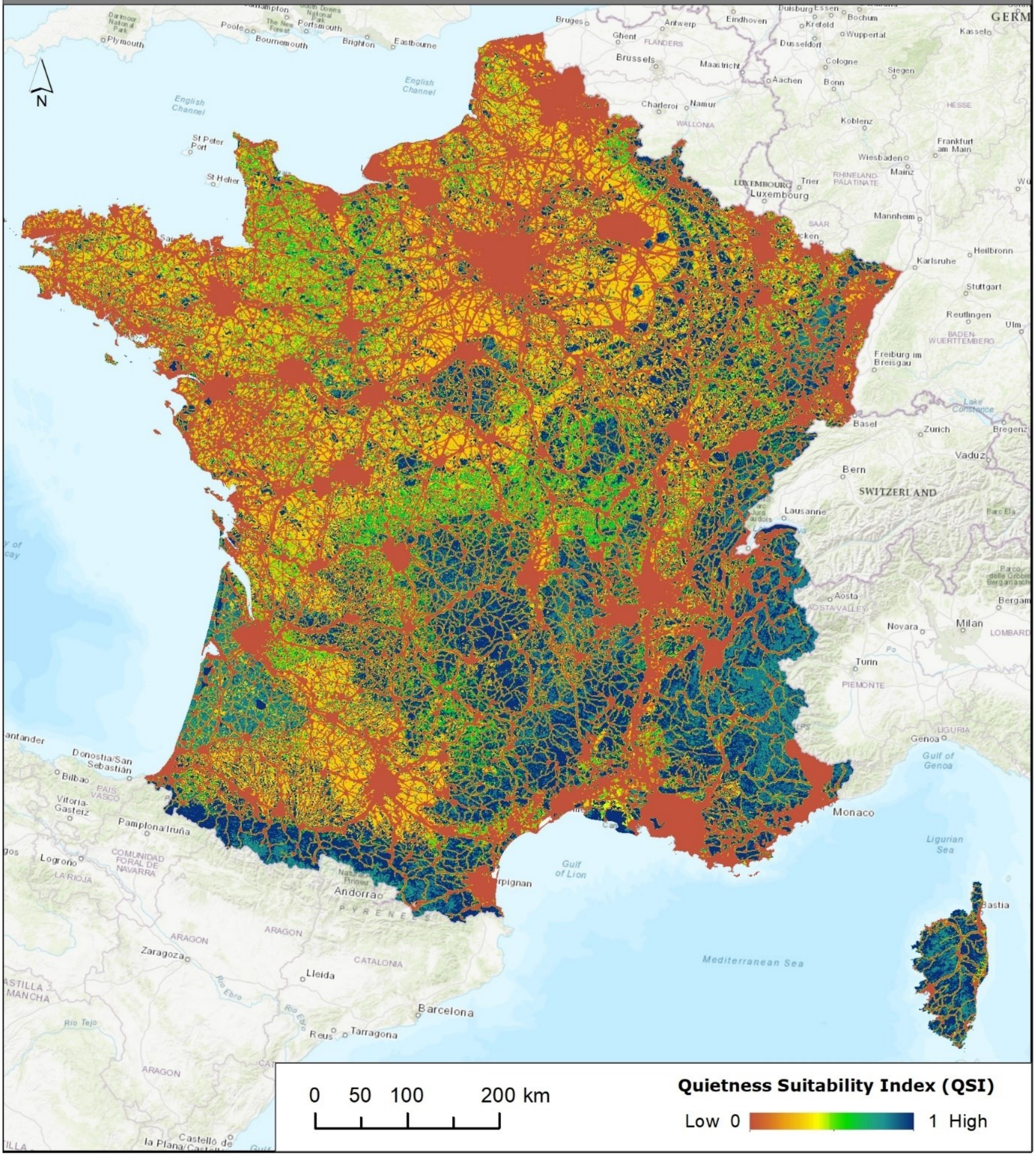

Denmark
N
Fredenkshavn
Gothenburg
Borås
Varberg
HALLAND COUNTY
Kattegat Sea
Halmstad
Helsingborg
openhagen
Malmo
Kattegat Sea
Westerland
Flensburg
Schleswig
Husum
0 25 50 km
Quietness Suitability Index (QSI)
Low 0
1 High

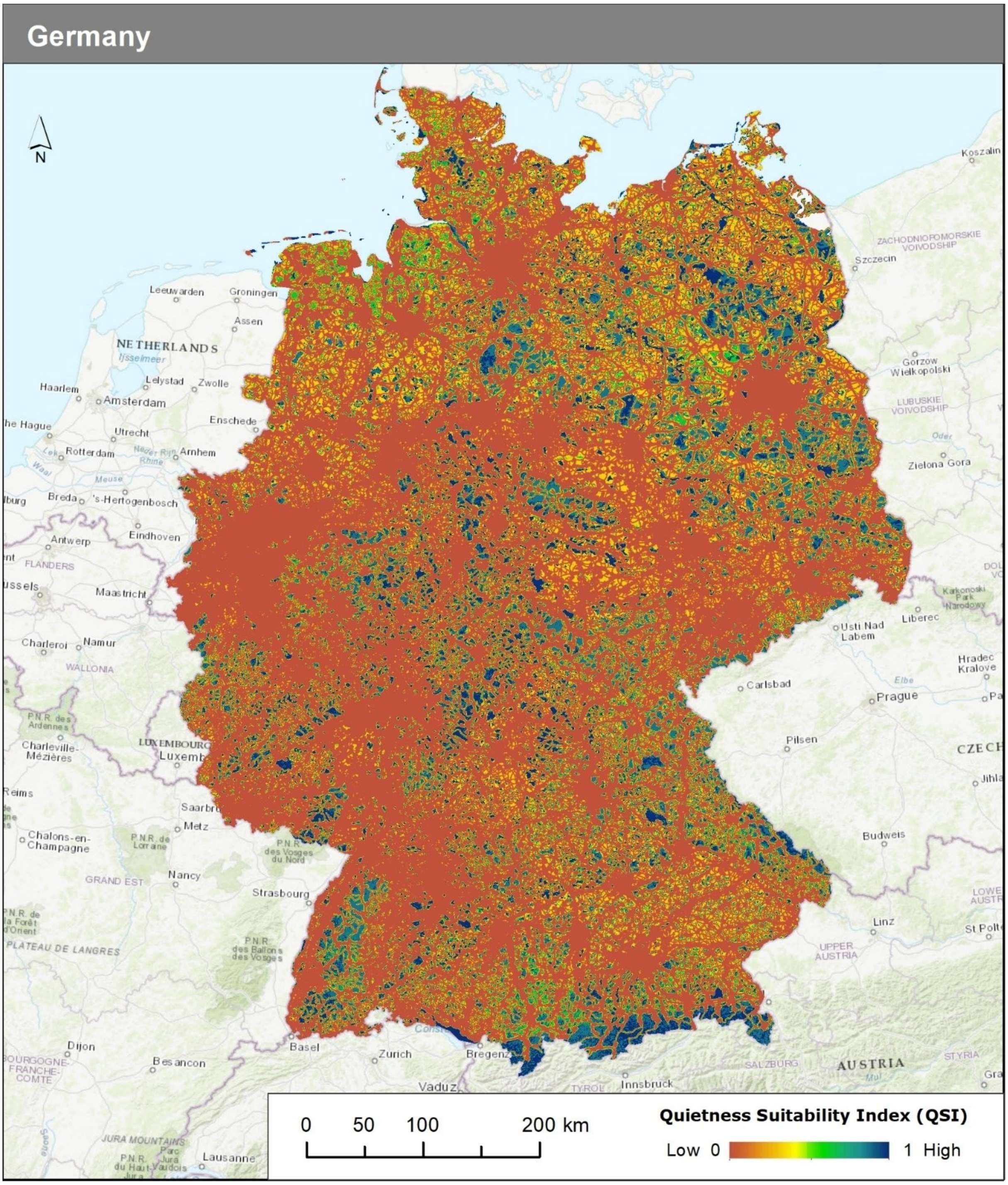


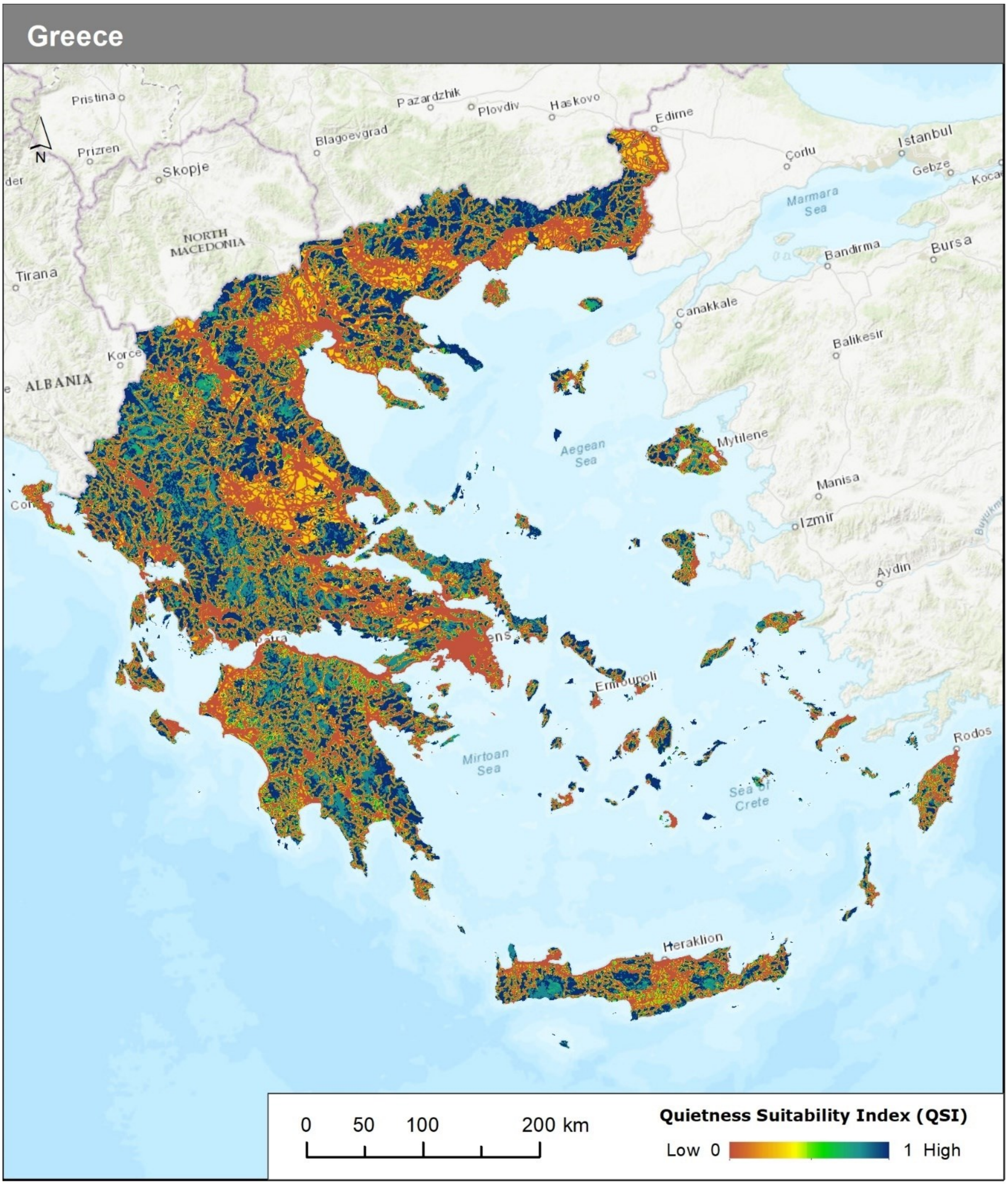
Estonia
Quietness Suitability Index (QSI)
Low 0
1 High
0
25
50 km
N
Helsinki
Gulf of Finland
Baltic Sea
Gulf of Riga
Lake Peipus
RUSSIA
LATVIJA


Finland
N
SWEDEN
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High

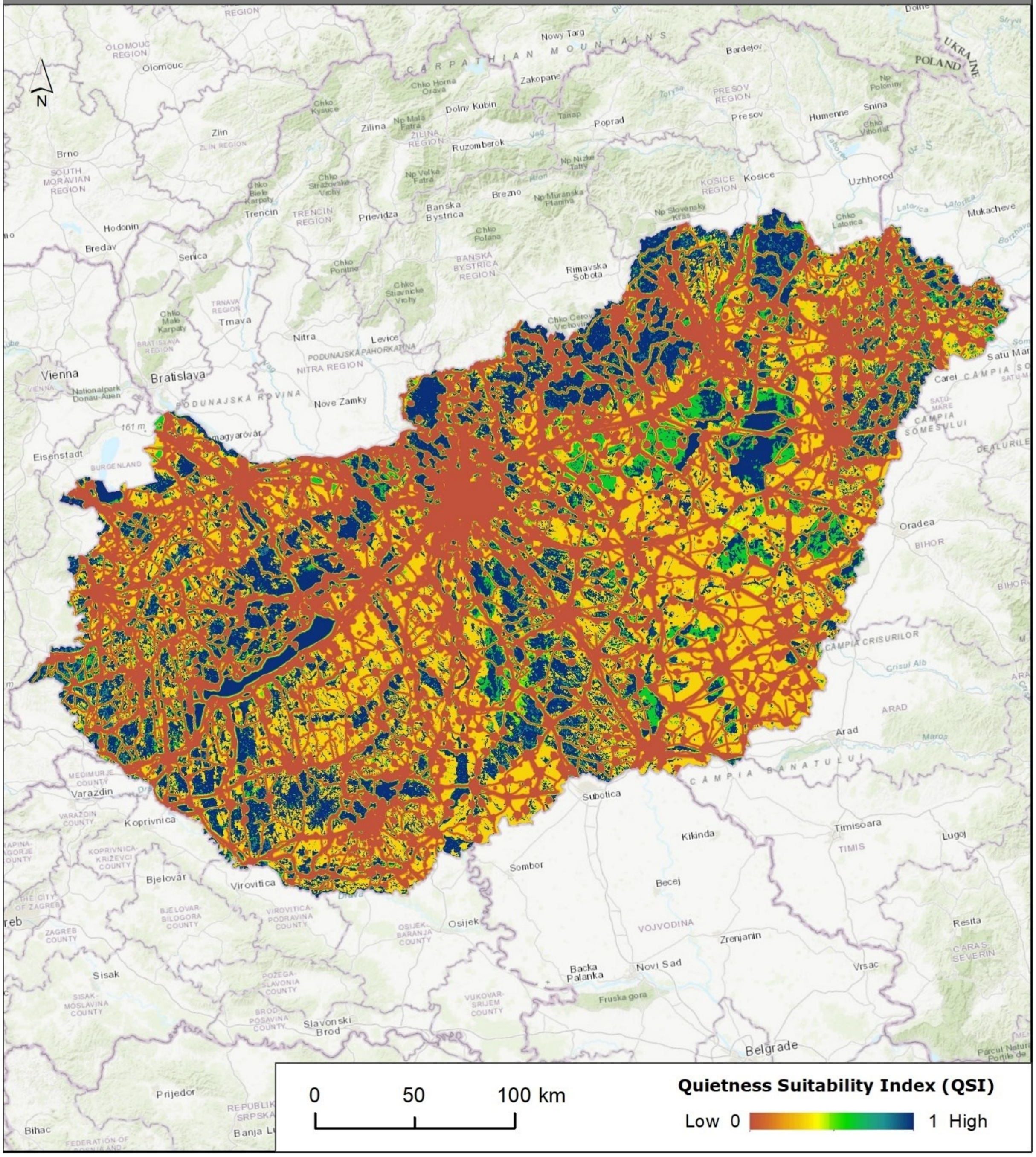
France

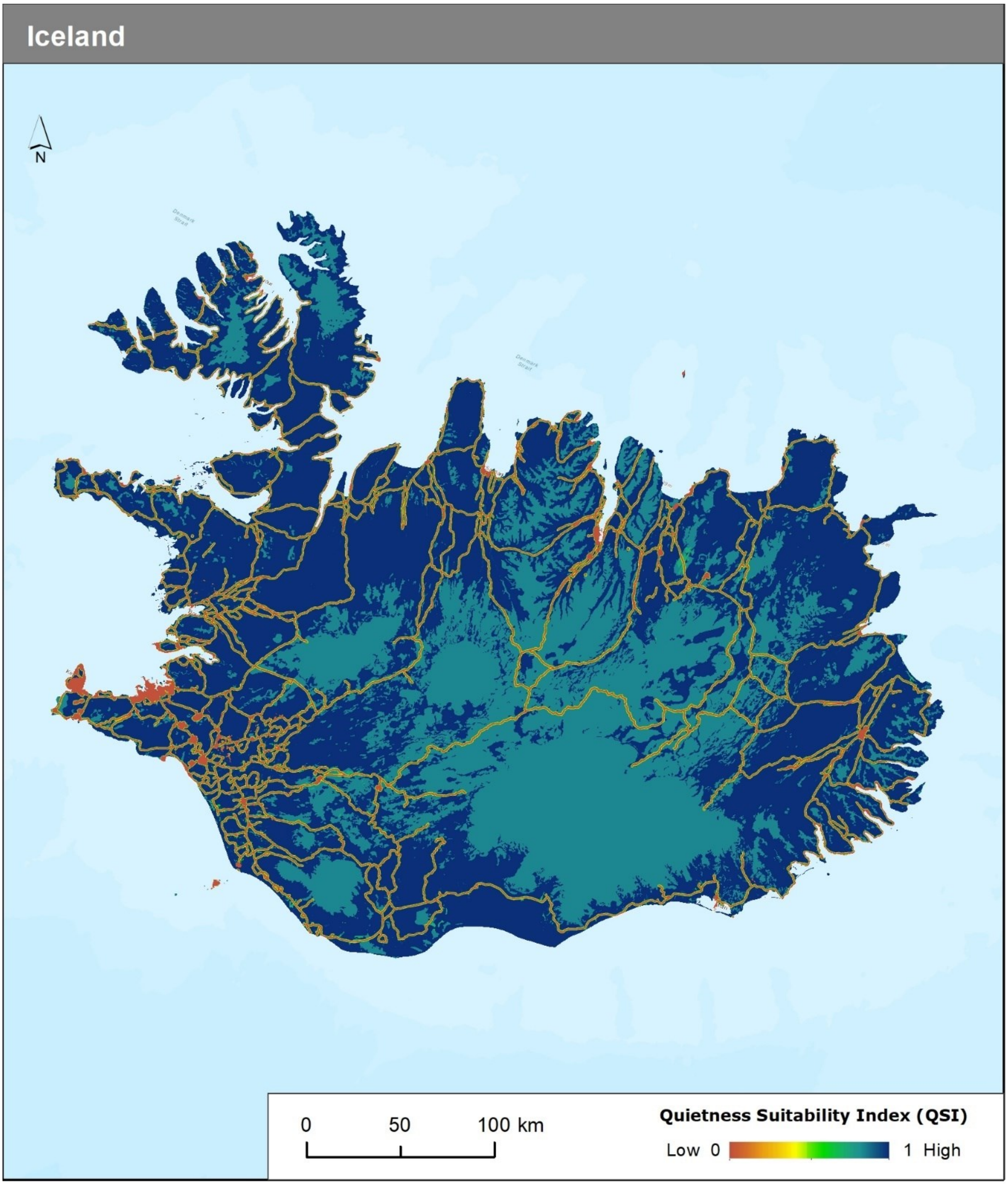

N
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High
Brussels
Luxembourg
Basel
Zurich
Bern
SWITZERLAND
Lausanne
Turin
Milan
Monaco
Bastia
Mediterranean Sea
Gulf of Lion
Andorra
Barcelona
Lleida
Tarragona
Zaragoza
English Channel

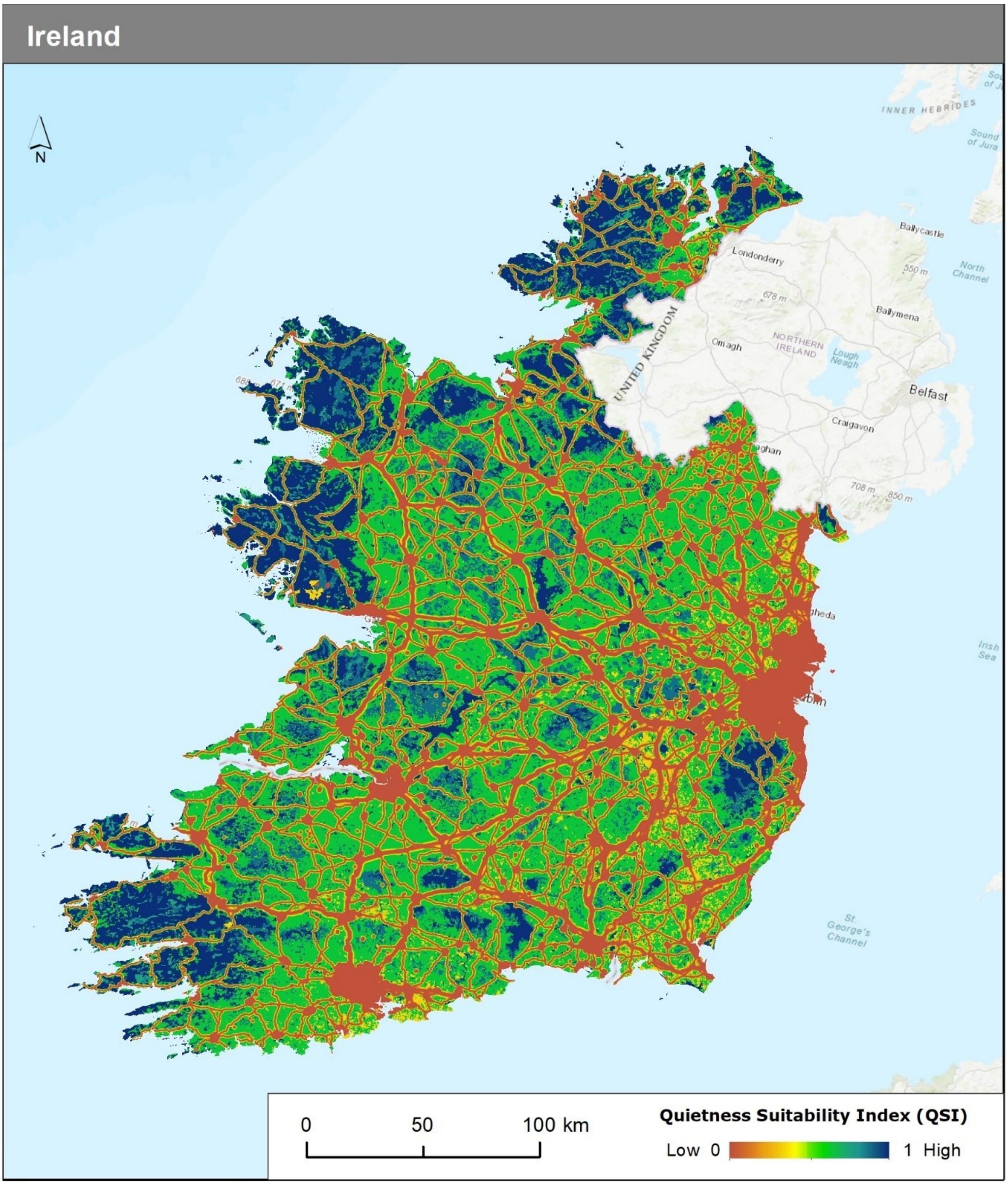

Germany
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High


Greece
Pristina
Prizren
Skopje
NORTH MACEDONIA
Tirana
Korce
ALBANIA
Pazardzhik
Plovdiv
Haskovo
Blagoevgrad
Edirne
Çorlu
Istanbul
Gebze
Marmara Sea
Bandirma
Bursa
Canakkale
Balikesir
Mytilene
Aegean Sea
Manisa
Izmir
Aydin
Mirtoan Sea
Sea of Crete
Rodos
Heraklion
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High

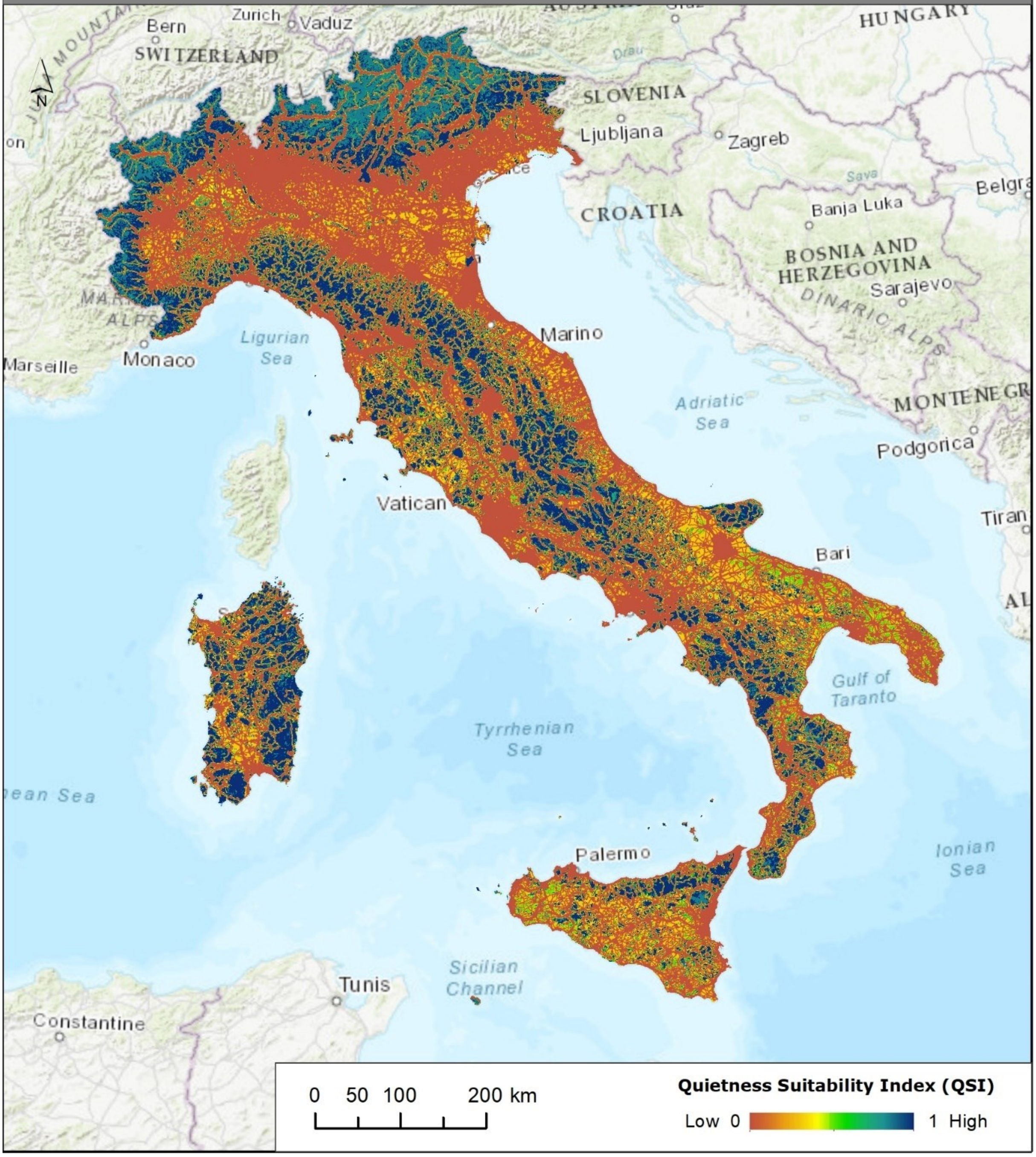
Hungary

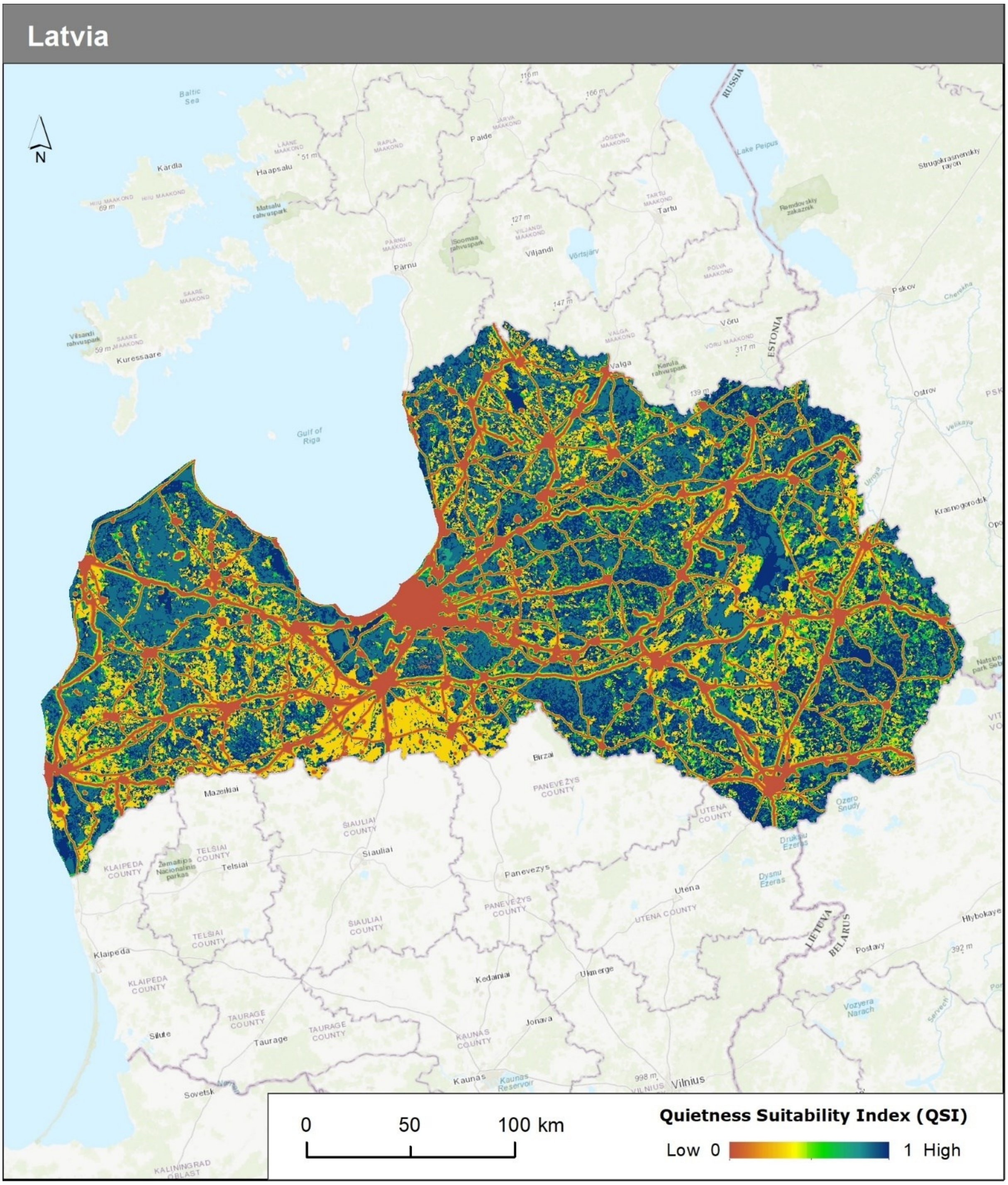



Iceland
N
0
50
100 km
Quietness Suitability Index (QSI)
Low 0
1 High

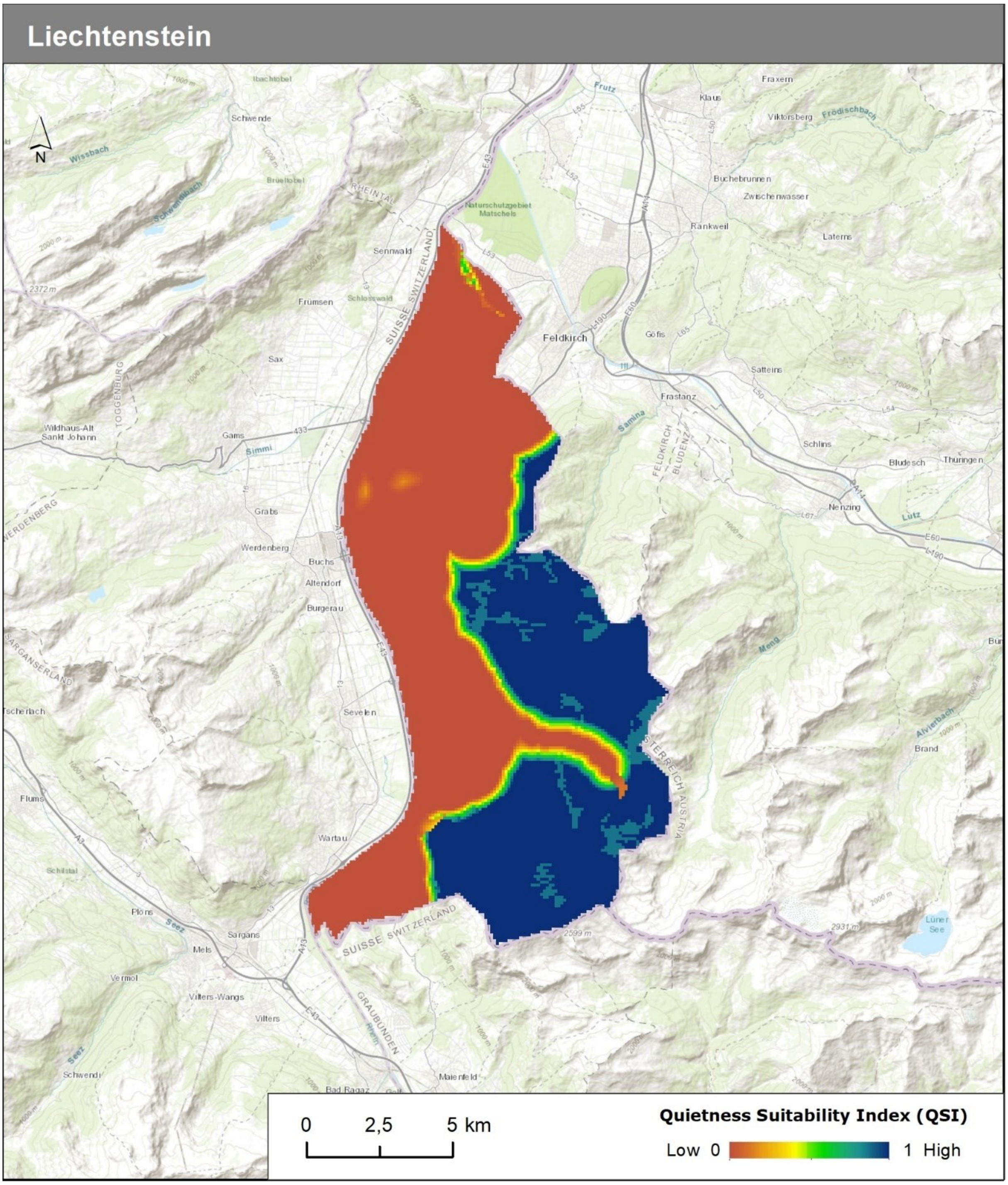

Ireland
N
INNER HEBRIDES
Sound of Jura
Ballycastle
Londonderry
North Channel
Ballymena
UNITED KINGDOM
Omagh
NORTHERN IRELAND
Lough Neagh
Belfast
Craigavon
Irish Sea
St. George's Channel
0
50
100 km
Quietness Suitability Index (QSI)
Low 0
1 High

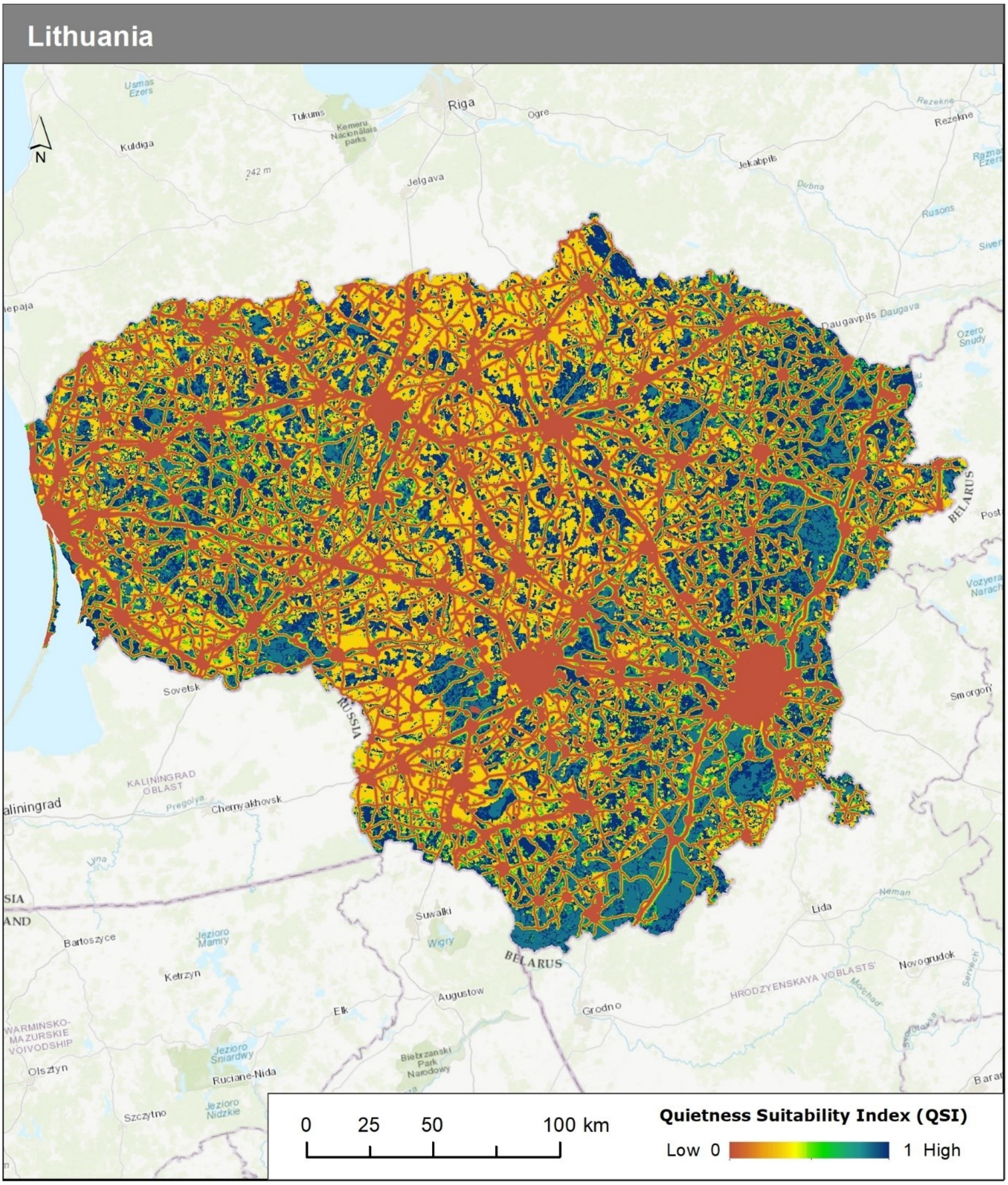
Italy


Bern
Zurich
Vaduz
SWITZERLAND
SLOVENIA
Ljubljana
Zagreb
HUNGARY
CROATIA
Banja Luka
BOSNIA AND HERZEGOVINA
Sarajevo
DINARIC ALPS
Marino
Ligurian Sea
Monaco
Marseille
Adriatic Sea
Podgorica
Vatican
Bari
Gulf of Taranto
Tyrrhenian Sea
Palermo
Ionian Sea
Sicilian Channel
Tunis
Constantine
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High

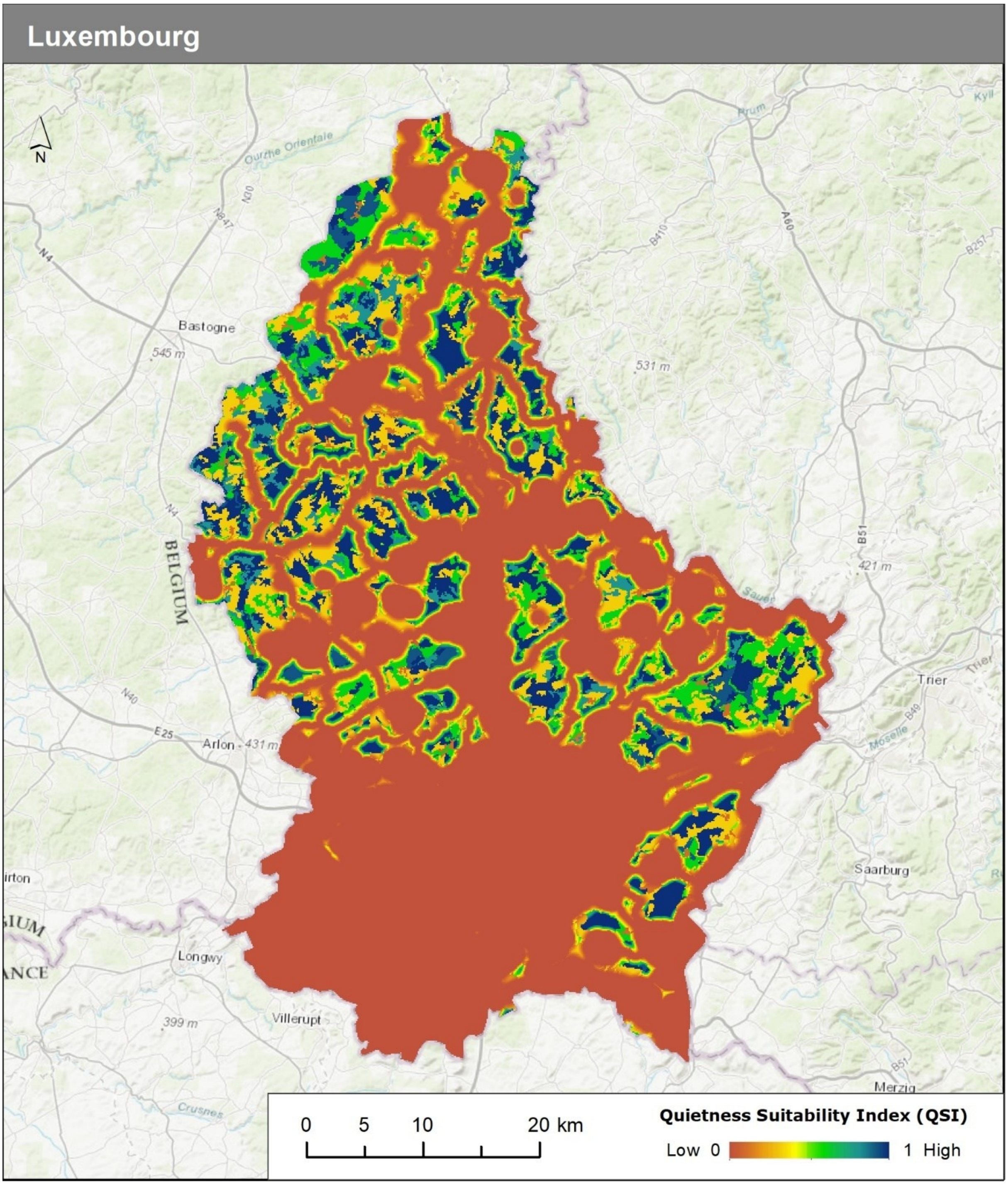


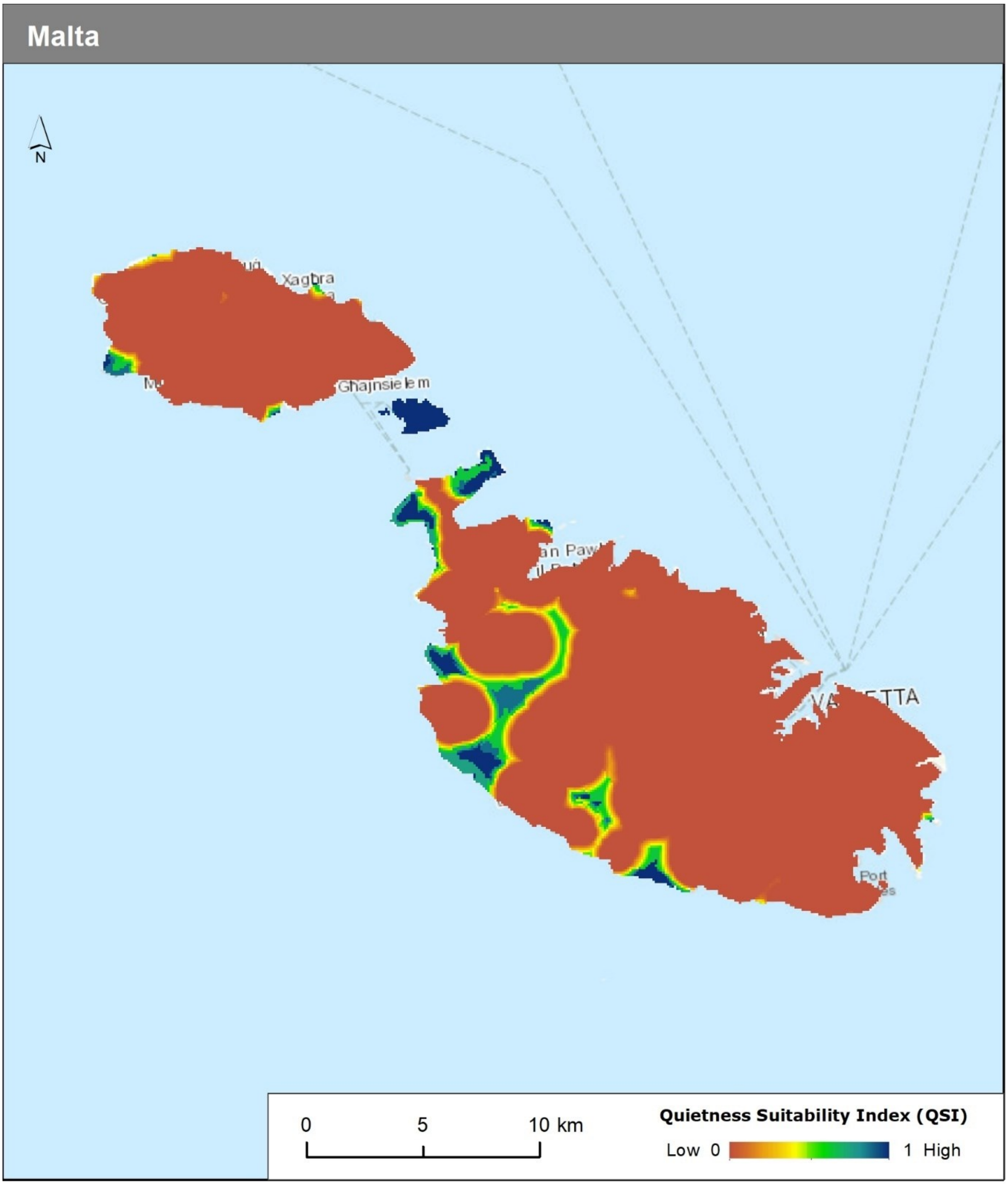
Latvia
N
Baltic Sea
Gulf of Riga
Kardla
Haapsalu
Paide
Parnu
Viljandi
Tartu
Lake Peipus
Pskov
Kuressaare
Valga
Võru
ESTONIA
RUSSIA
Ostrov
Krasnogorodsk
Birzai
Mazeikiai
Siauliai
Telsiai
Panevezys
Utena
Klaipeda
Kedainiai
Ukmerge
Jonava
Taurage
Silute
Sovetsk
Kaunas
Vilnius
Postavy
Hlybokaye
LIETUVA
BELARUS
0
50
100 km
Quietness Suitability Index (QSI)
Low 0
1 High

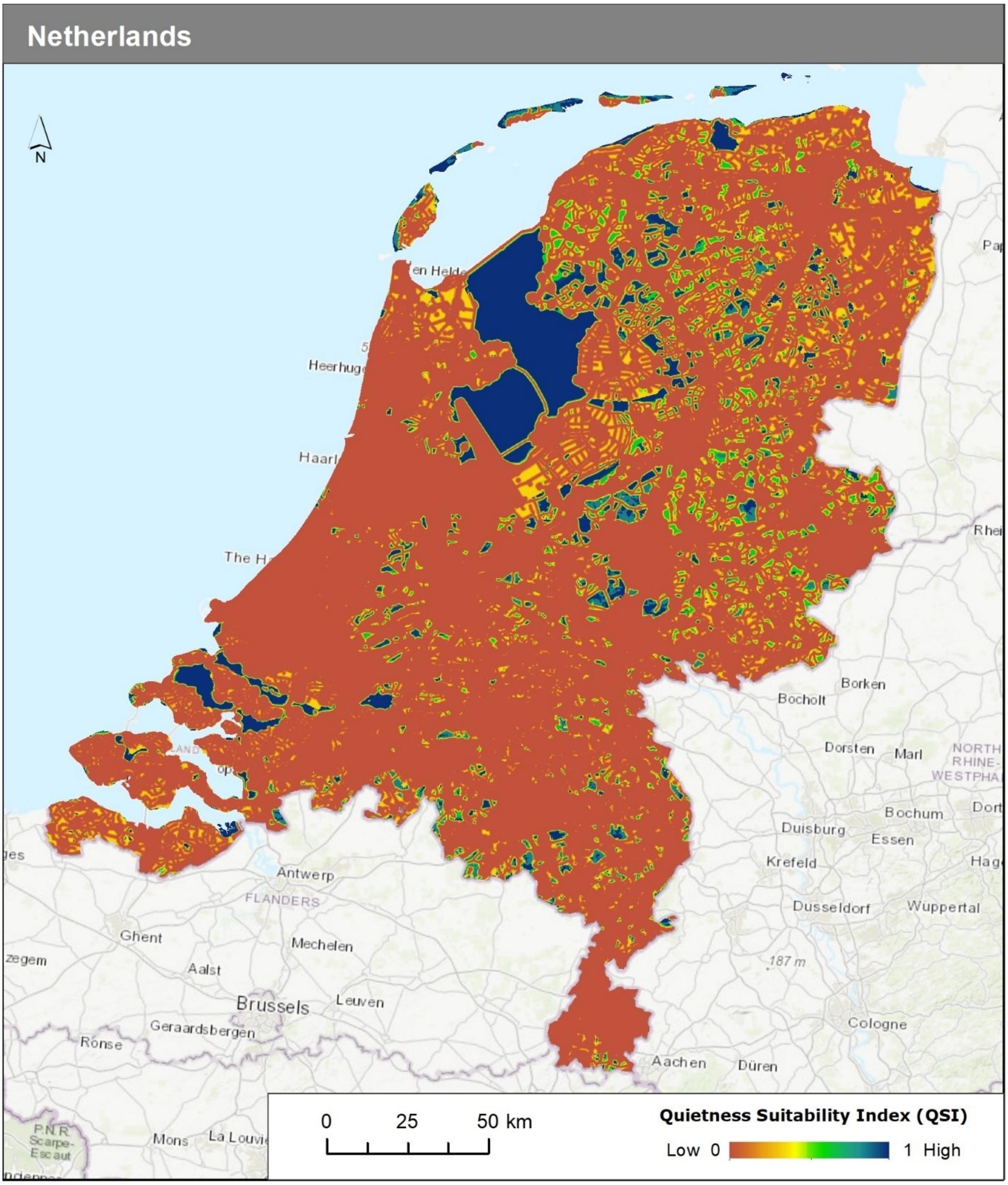

Liechtenstein
0
2,5
5 km
Quietness Suitability Index (QSI)
Low 0
1 High
Feldkirch
Buchs
Sargans
Rankweil
Nenzing
Frastanz
SUISSE SWITZERLAND
ÖSTERREICH AUSTRIA



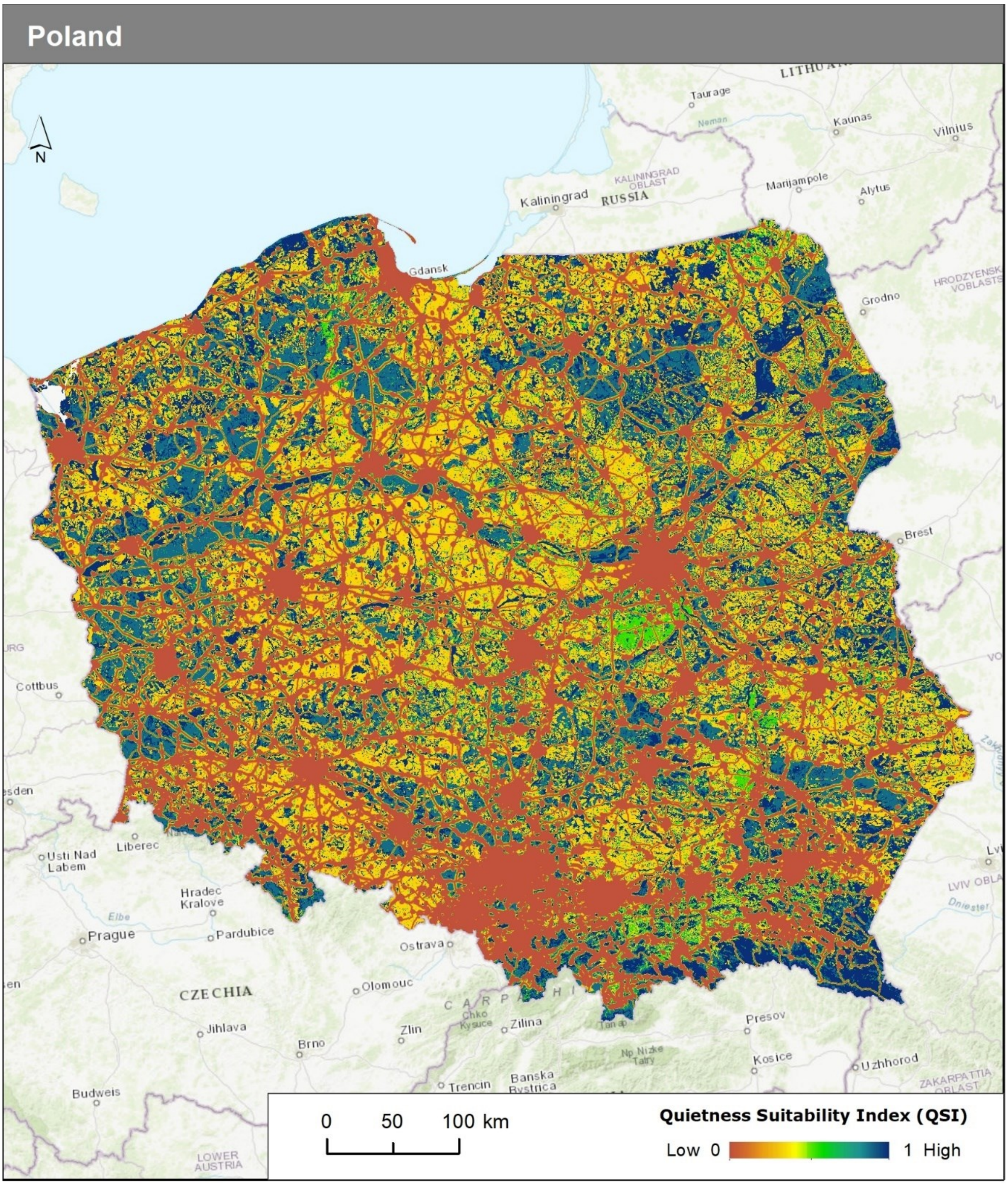
Lithuania
0 25 50 100 km
Quietness Suitability Index (QSI)
Low 0
1 High

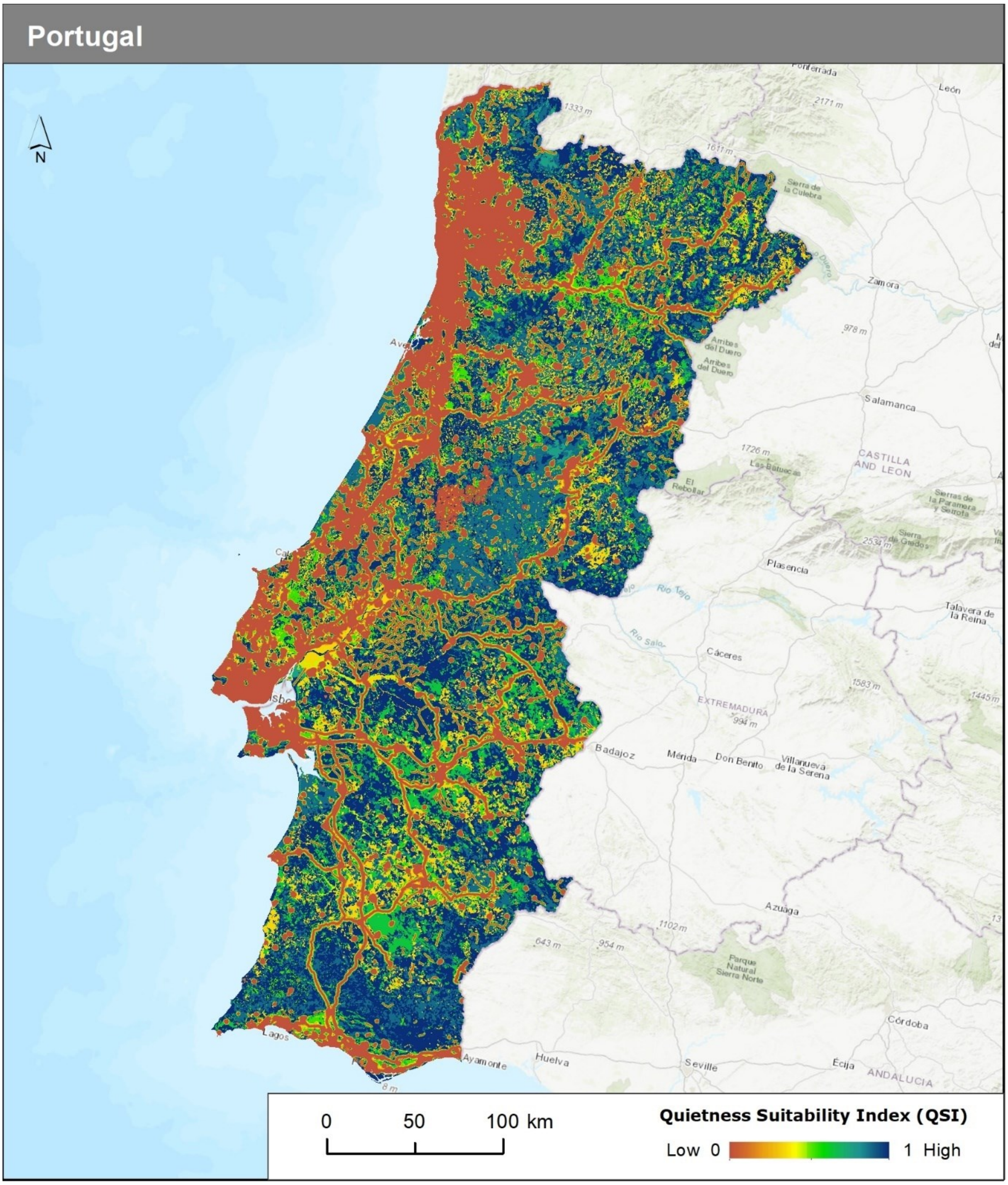

Luxembourg
N
Bastogne
BELGIUM
Arlon
Longwy
Villerupt
Trier
Saarburg
Merzig
0 5 10 20 km
Quietness Suitability Index (QSI)
Low 0
1 High

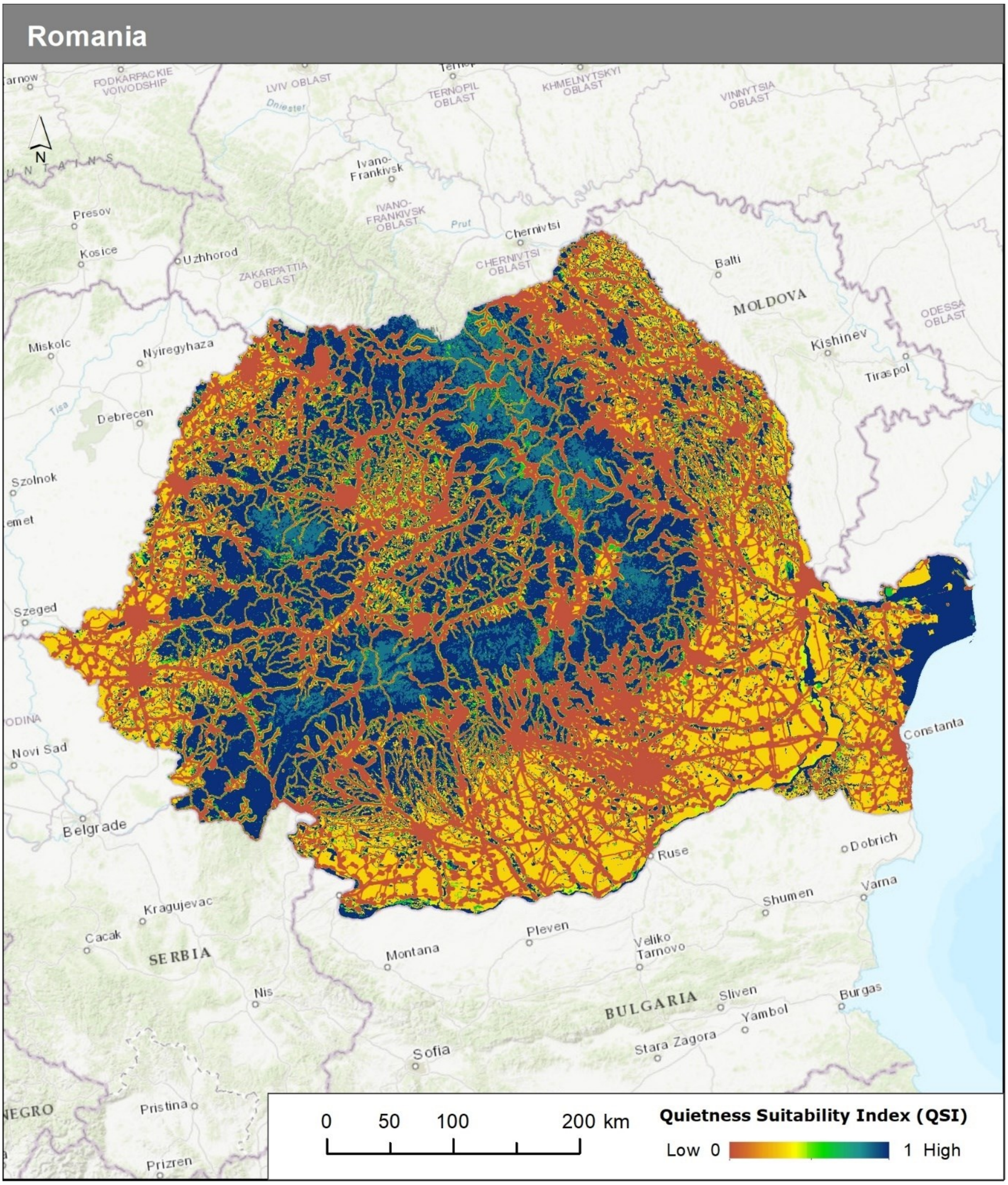

Malta
N
Xagħra
Għajnsielem
VALLETTA
0
5
10 km
Quietness Suitability Index (QSI)
Low 0
1 High

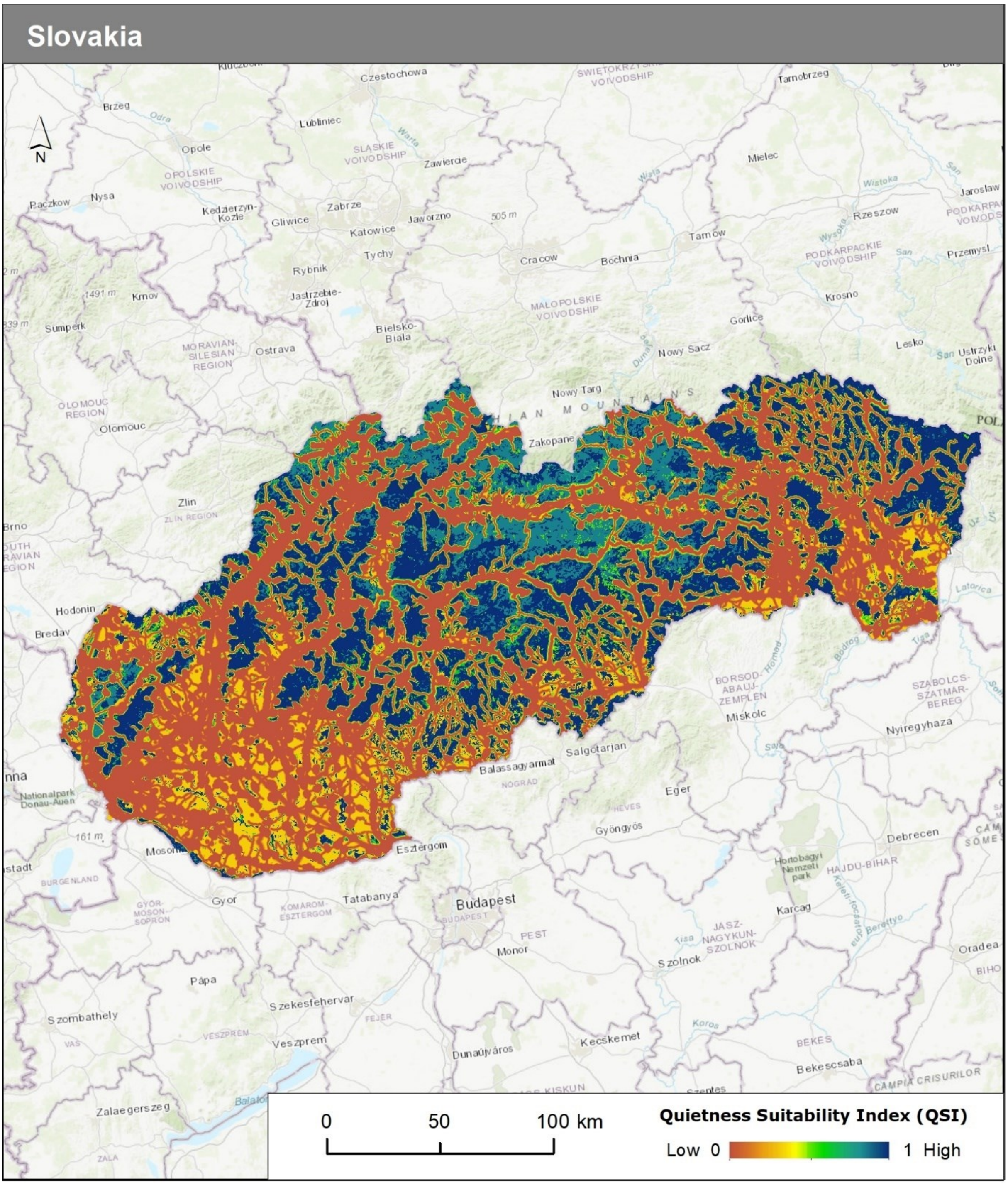

Netherlands
Heerhug
Haarl
The H
Borken
Bocholt
Dorsten
Marl
NORTH
RHINE-
WESTPHA
Bochum
Duisburg
Essen
Krefeld
Dusseldorf
Wuppertal
187 m
Cologne
Aachen
Düren
Antwerp
FLANDERS
Ghent
Mechelen
Aalst
Brussels
Leuven
Geraardsbergen
Ronse
Mons
0 25 50 km
Quietness Suitability Index (QSI)
Low 0
1 High


Norway
N
Norwegian Sea
Norwegian Sea
North Sea
Skagerrak
SWEDEN
FINLAND
ESTONIA
LATVIA
Gulf of Bothnia
Gulf of Finland
Gulf of Riga
Rovaniemi
Oulu
Umea
Vaasa
Mikkeli
Hameenlinna
Turku
Helsinki
Tallinn
Stockholm
Riga
Vänern
Vattern
0 50 100 200 300 km
Quietness Suitability Index (QSI)
Low 0
1 High

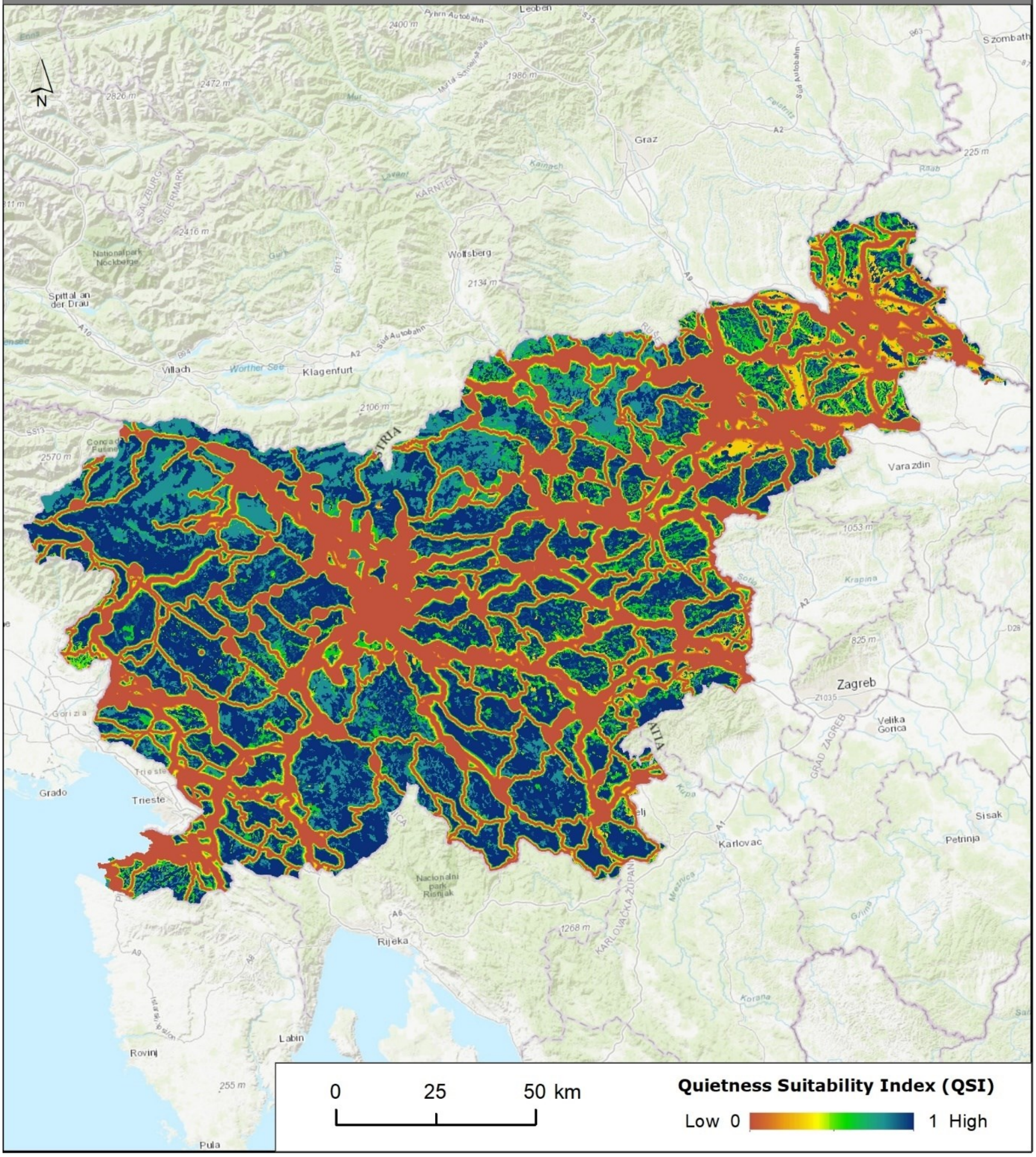

Poland
N
Gdansk
Kaliningrad
KALININGRAD OBLAST
RUSSIA
Taurage
Neman
Kaunas
Vilnius
Marijampole
Alytus
Grodno
Brest
Cottbus
Usti Nad Labem
Liberec
Hradec Kralove
Elbe
Prague
Pardubice
Ostrava
Olomouc
CZECHIA
Jihlava
Brno
Zlin
Zilina
Presov
Kosice
Uzhhorod
Trencin
Banska Bystrica
Budweis
LOWER AUSTRIA
LVIV OBLAST
Dniester
0 50 100 km
Quietness Suitability Index (QSI)
Low 0
1 High

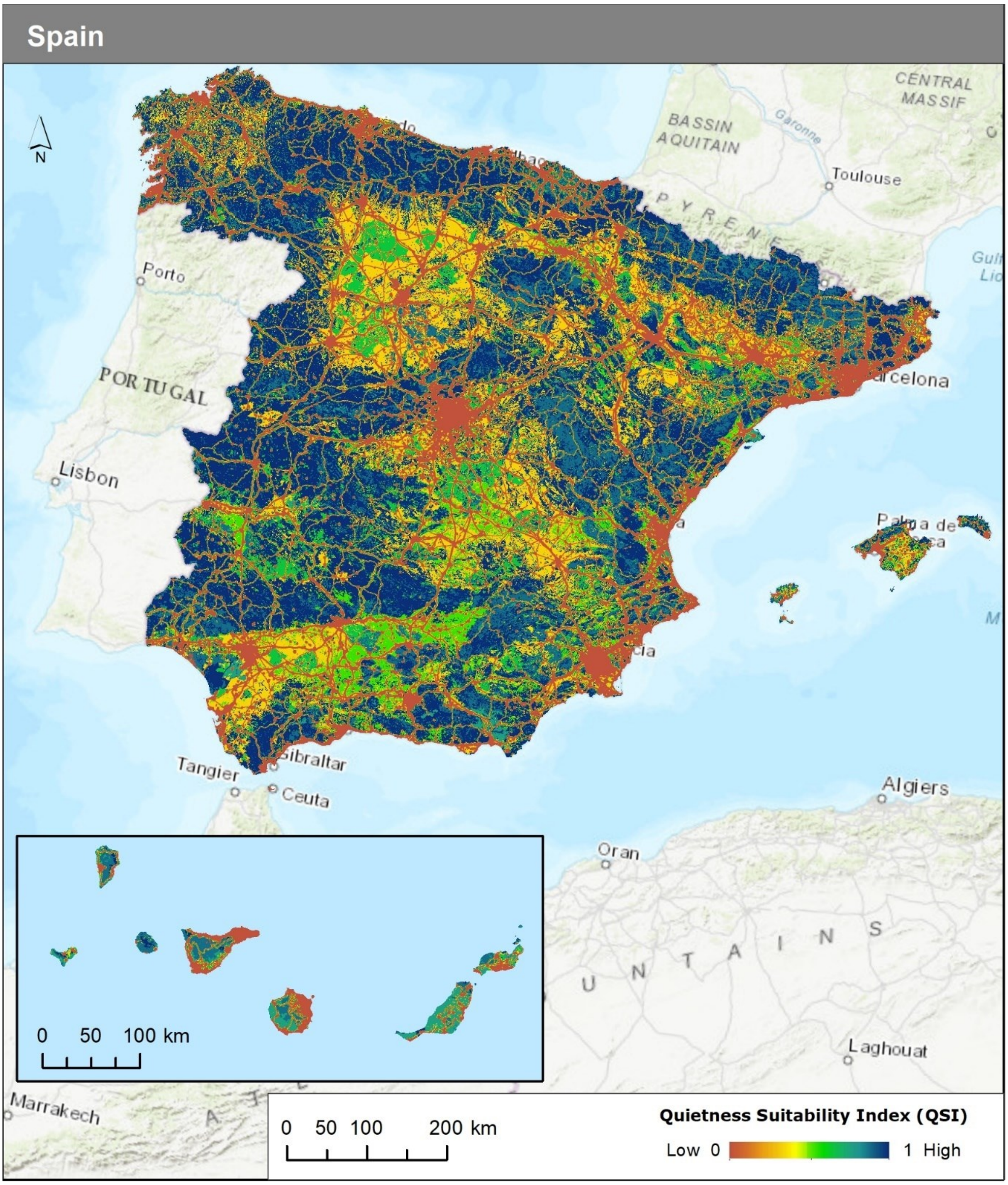

Portugal
N
Ponferrada
León
Serra de la Culebra
Zamora
Arribes del Duero
Salamanca
CASTILLA AND LEON
Las Batuecas
El Rebollar
Sierras de la Paramera y Serrota
Sierra de Gredos
Plasencia
Río Tejo
Río Salor
Talavera de la Reina
Cáceres
EXTREMADURA
Badajoz
Mérida
Don Benito
Villanueva de la Serena
Azuaga
Parque Natural Sierra Norte
Córdoba
Lagos
Ayamonte
Huelva
Seville
Écija
ANDALUCIA
0
50
100 km
Quietness Suitability Index (QSI)
Low 0
1 High


Romania
N
Presov
Kosice
Uzhhorod
Miskolc
Nyiregyhaza
Debrecen
Szolnok
Szeged
Novi Sad
Belgrade
Kragujevac
Cacak
SERBIA
Nis
Pristina
Prizren
Sofia
Montana
Pleven
Veliko Tarnovo
BULGARIA
Stara Zagora
Sliven
Yambol
Burgas
Varna
Shumen
Dobrich
Ruse
Constanta
MOLDOVA
Kishinev
Tiraspol
Balti
ODESSA OBLAST
VINNYTSIA OBLAST
KHMELNYTSKYI OBLAST
TERNOPIL OBLAST
LVIV OBLAST
PODKARPACKIE VOIVODSHIP
Ivano-Frankivsk
IVANO-FRANKIVSK OBLAST
Chernivtsi
CHERNIVTSI OBLAST
ZAKARPATTIA OBLAST
Dniester
Prut
Tisa
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High

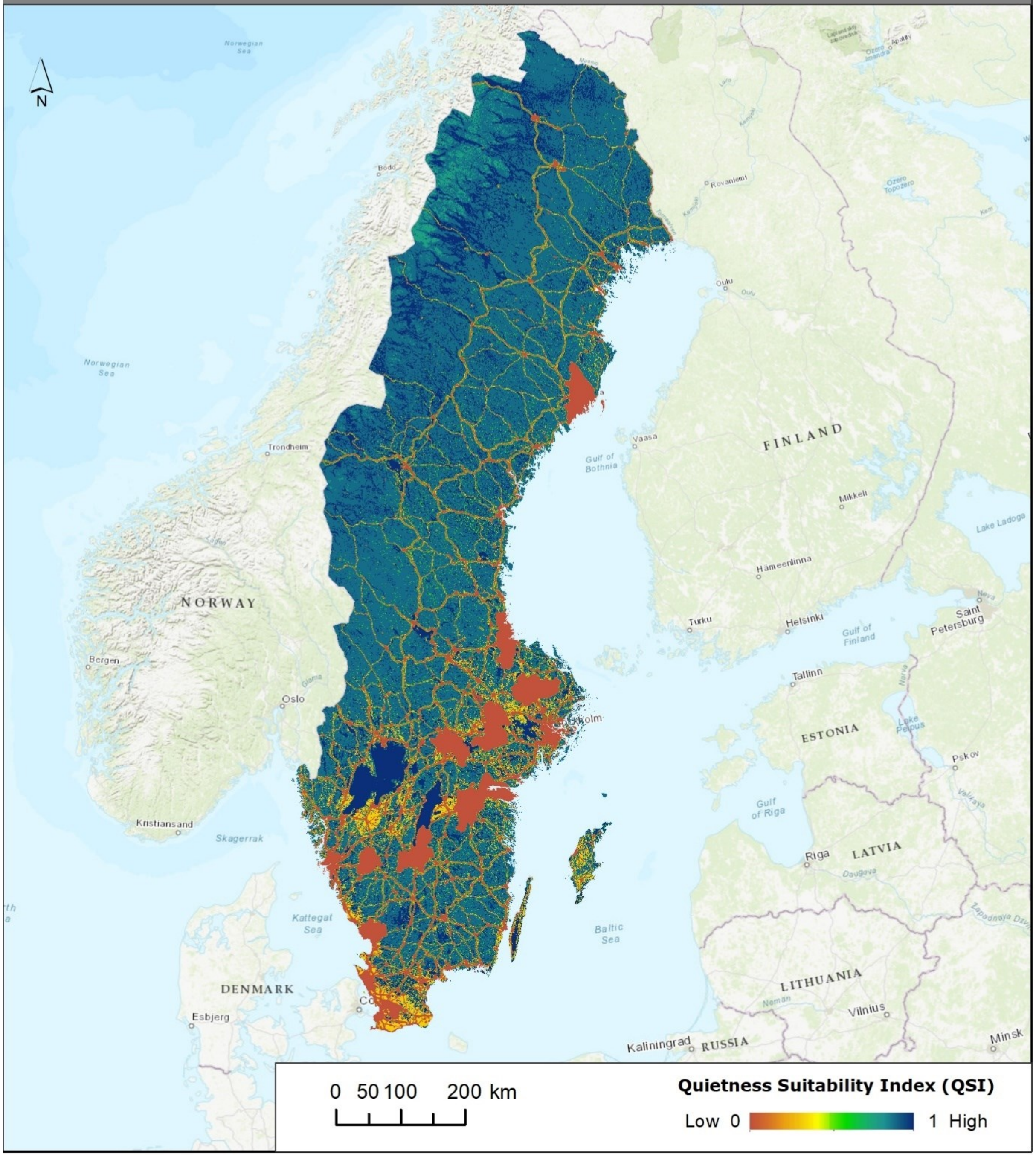

Slovakia
N
0
50
100 km
Quietness Suitability Index (QSI)
Low 0
1 High

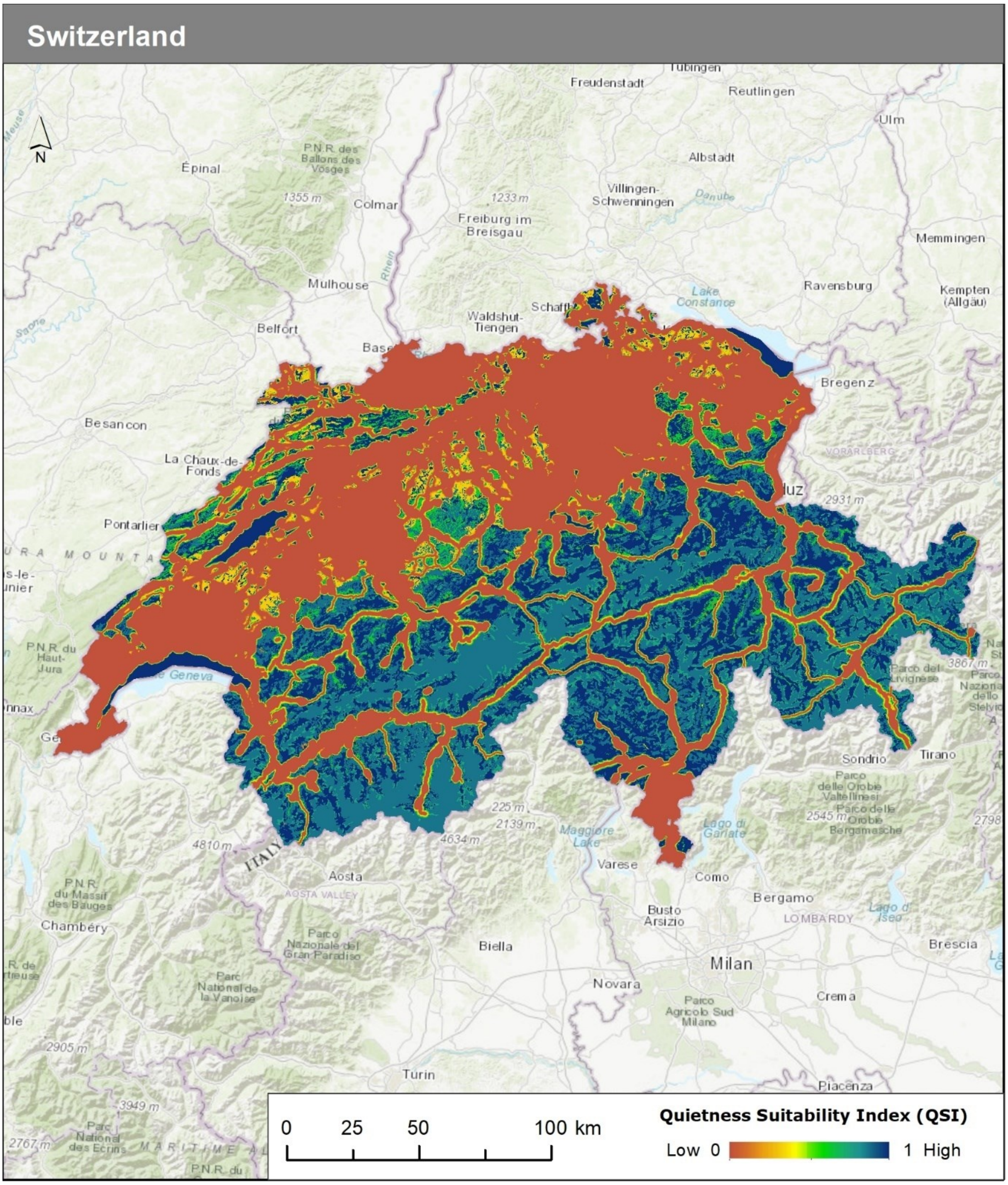
Slovenia




Spain
N
Porto
PORTUGAL
Lisbon
BASSIN AQUITAIN
CENTRAL MASSIF
Toulouse
PYRENEES
Tangier
Gibraltar
Ceuta
Algiers
Oran
Laghouat
Marrakech
0 50 100 km
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High

Sweden


N
Norwegian Sea
NORWAY
FINLAND
ESTONIA
LATVIA
LITHUANIA
DENMARK
RUSSIA
Gulf of Bothnia
Gulf of Finland
Gulf of Riga
Baltic Sea
Kattegat Sea
Skagerrak
Trondheim
Bergen
Oslo
Kristiansand
Esbjerg
Bodø
Rovaniemi
Oulu
Vaasa
Turku
Helsinki
Hameenlinna
Mikkeli
Tallinn
Riga
Vilnius
Kaliningrad
Minsk
Pskov
Saint Petersburg
Lake Ladoga
0 50 100 200 km
Quietness Suitability Index (QSI)
Low 0
1 High


Switzerland
N
Freudenstadt
Reutlingen
Ulm
Albstadt
Épinal
Colmar
Freiburg im Breisgau
Villingen-Schwenningen
Memmingen
Mulhouse
Ravensburg
Kempten (Allgäu)
Lake Constance
Belfort
Waldshut-Tiengen
Bregenz
Besancon
La Chaux-de-Fonds
Pontarlier
Sondrio
Tirano
Varese
Como
Bergamo
Busto Arsizio
Aosta
Biella
Milan
Brescia
Novara
Crema
Chambéry
Turin
Piacenza
Maggiore Lake
0 25 50 100 km
Quietness Suitability Index (QSI)
Low 0
1 High

European Topic Centre on
Human Health and the Environment
https://www.eionet.europa.eu/etcs/etc-he

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European Environment Agency
European Topic Centre
Human health and the environment