RESCUE ME
RESILIENT CULTURAL LANDSCAPES

D1.3 POLICY REPORT ON CLIMATE CHANGE IMPACTS ON EUROPEAN COASTAL LANDSCAPES.

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TABLE OF CONTENTS

Summary

This paper is composed of four analysis steps, aiming at deriving recommendations for promising policy actions in order to increase the resilience of European cultural landscapes towards a number of climatic and non-climatic threats (Figure 1). The resulting recommendations are highlighted below, with symbols indicating the analysis step(s) leading to it.

Figure 1: Analysis Steps (outer ring) and goal (inner circle) of the present policy report

Use **governance typologies** to better understand decision-making processes in cultural landscapes; build awareness and acceptance of temporary shifts in governance types, to make use of their specific strengths in different phases of DRM and resilience building.

Install an EU-wide systematic and harmonised **data collection on losses and damage** to cultural heritage; develop a comprehensive set of guidelines for evaluating non-quantifiable losses.
Collect **information on the benefits of investments into cultural heritage** (tangible and intangible) to increase the visibility of the contribution of culture to societal wellbeing and resilience building; set up a database of investments into cultural heritage and benefits of these investments; improve the data collection system for investments; establish standard methodologies for assessing the impacts of these investments.

In general, **increase the useability of EUROSTAT data** via ensuring that all NUTS-based data contain the NUTS GeoCode and via improving the backward compatibility of data in case of changes to the NUTS regions; ensure a timely update based on existing member state data, even if data is not complete for all member states.

Furthermore, in total **six focus regions** were identified and recommendations for these regions are derived in an exemplary manner:

Southern Italy: investments in educational infrastructure and in improving the qualification of inhabitants; attract more young people via capitalising on tangible and intangible cultural heritage; professionalise farming via training offers, eventually tailored to the need of the many female farm managers; increase agricultural profit margins based on intangible cultural heritage such as agricultural knowledge on PDO products.

Portugal: foster the existing structures (diverse agriculture, many PDO products; high share of renewable energy); reduce exposure to risks through nature-based solutions based on the populations' appreciation of the ecosystem service concept; attract young people via investments in the internet infrastructure and increasing income possibilities through (eco-) tourism capitalising on tangible and intangible cultural heritage.

Greece: investments in educational offers and infrastructure; increase the number of strategic buildings; strengthen the attainability of the population via the internet; launch agricultural skills initiative combining local traditional knowledge with innovative approaches.

Denmark: mainstream the ecosystem service concept with the help of the existing cultural and creative sector; increase of the flood control ecosystem services; strengthen the appreciation of the value of the local cultural landscape.

Regions with qualification needs: increase the skills of the inhabitants, especially by supporting female farmers; with that increase the societies' adaptive capacity and reduce vulnerability as major risk driver in the affected areas.

Regions with focus on tourism: create incentives for the creative sector to attract the local population in order to strengthen the sense of place; capitalise on traditional local knowledge for identifying resilience strategies; increase visibility of the contribution of cultural heritage to the tourism sector as well as the potential use of heritage buildings as shelter to foster investments in heritage.

List of figures

List of tables

List of annex tables

1 Introduction

Based on the RescueME framework, cultural landscapes can be understood as socio-ecological-technical systems. Each of the three system dimensions can be described by one or more capitals. Each of the capitals can in turn be characterised with the help of indicators that describe the capitals' characteristics including the sensitivity, coping capacity, adaptive capacity and transformative capacity (Figure 2, RescueME D1.1, Gandini and Egusquiza, 2023).

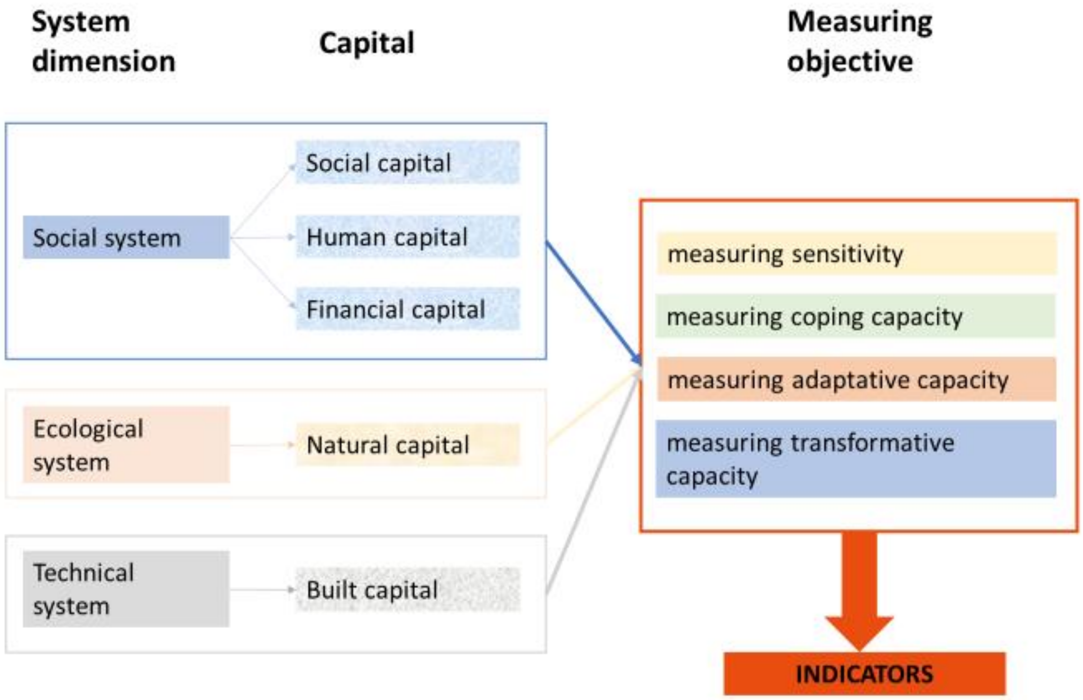

Figure 2: RescueME indicators framework and measuring objectives (RescueME D1.1, Gandini and Egusquiza, 2023). *Indicators cover the three system dimensions and the five capitals. For each capital, there are indicators available to cover the four measuring objectives.*

This overarching framework is applied to characterise European coastal cultural landscapes and the risks they are exposed to at the spatial level of NUTS3 regions. On the one hand, European coastal NUTS3 regions are assigned to a landscape type for each of the five capitals creating five typologies of European cultural landscapes (chapter 2). On the other hand, a risk assessment with respect to climatic and non-climatic risks is carried out taking the identified measuring objectives into account (chapter 3). Both the typologies of cultural landscapes and the risk assessment are based on subsets of indicators defined earlier in the project (RescueME D1.1, Gandini and Egusquiza, 2023). In the case of the typologies, the indicators of each capital are fed into a k-means clustering algorithm to delineate classes of

NUTS3 regions. In the case of the risk assessment, each indicator was assigned to the risk components of hazard or exposure or the sub-components of vulnerability, sensitivity and adaptive capacity. These indicators were then normalized and rescaled to aggregate them and finally obtain a composite risk index for each hazard considered. More details on data handling, choice of indicators and methods is given elsewhere (Klose et al., in prep.). In total 513 coastal NUTS3 regions are analysed. Thereby a NUTS3 region is classified as "coastal" either if it lies on the coast or if 50% of its population live within 50 km from the coast.

After having described the European coastal cultural landscapes and the risks they face, the benefits of investing in cultural assets with regards to resilience are investigated (chapter 4).

And finally, an important aspect of any socio-ecological-technical system is its governance, describing how decisions are taken and by whom. Four different blueprints of governance typologies have been defined and can be used to characterise cultural landscapes in an additional dimension (chapter 5). Again, the method is described elsewhere (Klose et al., in prep.).

Final conclusions are given in chapter 6.

2 European coastal cultural landscapes

Based on the set of indicators defined earlier in RescueME (RescueME D1.1, Gandini and Egusquiza, 2023), a typology is created for each of the five capitals that define cultural landscapes. **The aim is to identify European coastal NUTS3 regions with similar (or distinct) characteristics** within the five capitals across Europe. These typologies can help to identify regions with similar challenges, attributes, strengths and weaknesses in resilience building of cultural landscapes. Thus, they can either call attention to regions that might need support on their resilience journey or identify good practice examples that might serve as lighthouses for other regions and policymakers.

Within all capitals, the **clusters are described with the help of** the values of the underlying indicators. Thereby the values stated refer either to **the 25th (lower limit) or 75th (upper limit) percentiles over all NUTS3 regions** in the cluster. For example, if the text in brackets says "> 41% of NUTS area is forest", this depicts the 25th percentile of all NUTS regions, meaning that only 25% of the NUTS regions in the cluster are made up of less than 41% forests. The reverse conclusion is that 75% of the NUTS regions in the cluster are made up of more than 41% forest area. In addition, indicators are only mentioned in the describing text, if their values are extraordinary in the respective cluster. For example, if a cluster shows particularly high (> 18%) or low (< 5%) values for gender employment gap that will be mentioned in the text, but if the values are in the medium value range (8 - 12%) that will not be explicitly stated.

It is important to further note that the applied k-means cluster algorithm associates centroids to each cluster and subsequently assigns the NUTS3 regions to the cluster. For each NUTS3 region, the algorithm finds the cluster, for which the sum of the distances to the cluster centroid for all used indicators is minimal. In other words, the algorithm looks at all indicators at the same time. This approach does lead to overlapping class boundaries for each indicator, e.g., cluster 1 can be made up of NUTS regions with indicator A values between 5 and 10, while cluster 2 contains NUTS regions with indicator A values between 8 and 13. This has to be kept in mind when it comes to the interpretation of the clusters.

For interpretation of the results, it is important to mention that the **clusters can only be interpreted relative to each other**. For example, looking at the social capital and therein at the gender employment gap: a region might be characterised as having a male dominated workforce, as the gender employment gap is above 18% in the NUTS regions in the cluster. The 18% is high compared to the other coastal NUTS3 regions. However, it is possible that inland NUTS3 regions feature an even higher gender employment gap. As the present analysis focusses solely on the European coastal NUTS3 regions, descriptive terms always have to be interpreted as relative to the other regions in the analysis.

In the following, the results of the clustering exercise per capital (i.e., the typology) is described and depicted in maps (chapters 2.1 to 2.5). The maps including the details on the underlying indicators can be accessed via the **RescueME Atlas of European Coastal Cultural Landscapes**[1]. A total of 60 indicators was used for the typology in the various capitals, an overview is given in Annex 1. The final number of clusters varies between five and seven, depending on the number of employed indicators and on the quality of the differentiation between the clusters.

2.1 Natural Capital

RescueME definition: "Natural capital is related to natural resources and ecosystems providing benefits and services to local communities, including agricultural practices and biodiversity as well as recreational, and traditional practices" (RescueME D1.1, Gandini and Egusquiza, 2023, page 40).

In total, 22 proxy indicators describing protected areas, ecological quality, land use, agriculture, ecosystem services and topography were used to describe the natural capital (Figure 3, Annex 18, Table A- 1).

Cluster 1 contains mountainous areas (> 35% of NUTS area is mountains) dominated by forests (>27% forests) which feature a high land use diversity (Shannon index > 0.66) and have a high outdoor recreation potential (> 95% of NUTS area provides outdoor recreation ecosystem services). The NUTS3 regions in cluster 1 provide many flood control areas (> 37% of NUTS area provides river flood control ecosystem service) and a considerable part of the NUTS3 region is under international protection (> 460 km²). At the same time cluster 1 regions suffer from a high landslide susceptibility (> 43% of NUTS area with high or very high susceptibility). Cluster 1 regions can be found in Greece and Montenegro, in parts of Croatia and Slovenia, in south-western Italy, in Corse, along the coast from Monaco to Pisa, in the southern French Pyrenees, and in selected regions along the Spanish and Portuguese coast.

Cluster 2 is dominated by low coastal areas (> 44% of NUTS area is low coast), a mix of urban and agricultural land (> 37% of NUTS area is either urban or agricultural land) in combination with low urban dispersion (dispersion coefficient < 0.27). Agriculture is dominated by arable land (arable land makes up 100% of the agricultural land in NUTS region) with high carbon

[1] https://appwerescuemep01.azurewebsites.net/

sequestration value (> 8300 €/km²). There is a low willingness to pay for species and habitat (S&H) maintenance (< 1200 €/100 km² of S&H area), flood control areas are rare (< 19% of NUTS area), and so are protected areas (< 150 km²). Cluster 2 NUTS regions concentrate mainly in Denmark, on the German, Dutch, and Belgian coast, but also in selected regions in the UK and in Ireland.

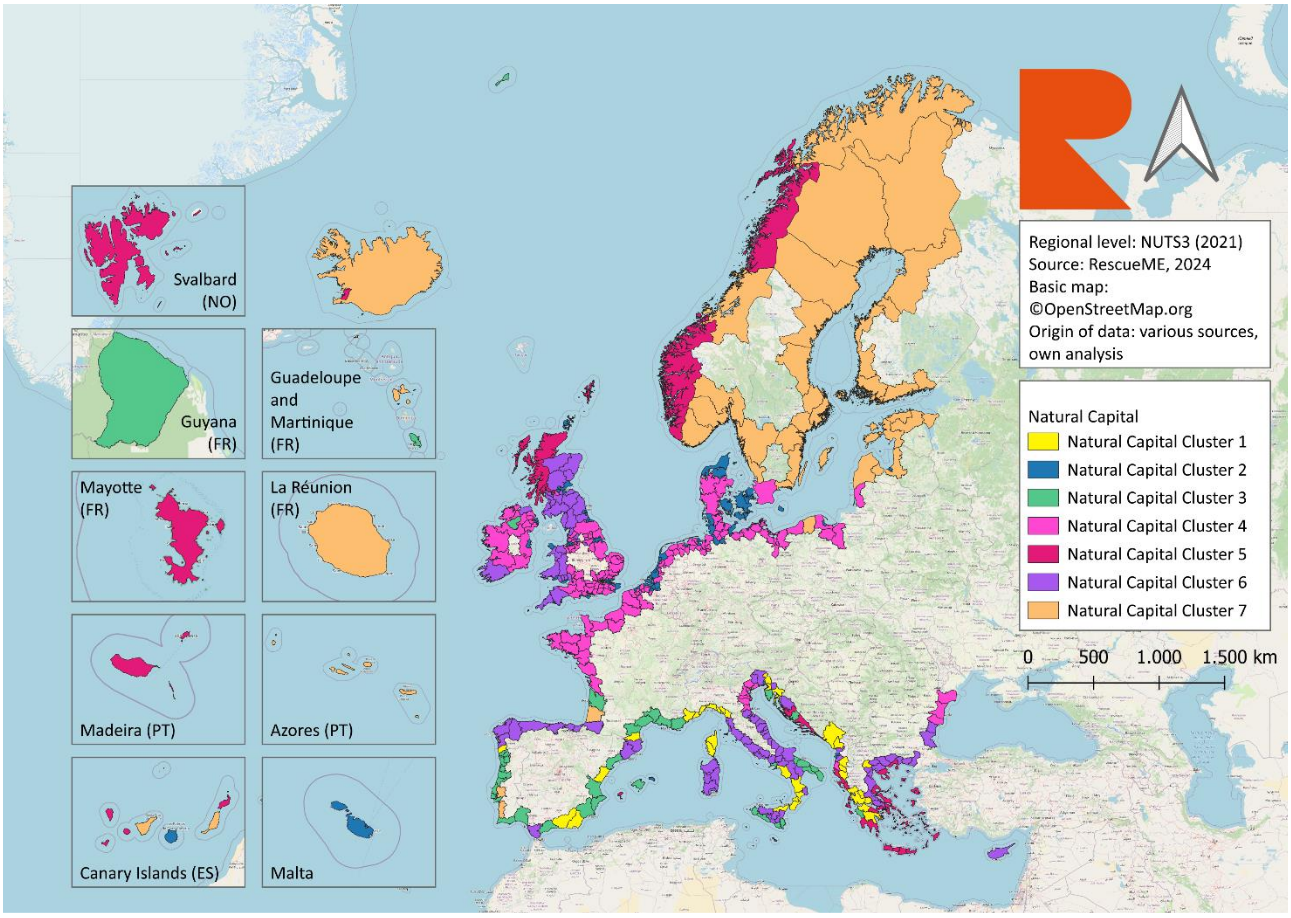

Figure 3: Natural capital typology for European coastal NUTS3 cultural landscapes

Cluster 3 shows a diverse topography from low coasts to mountains and no dominant land use type can be identified. Nevertheless cluster 3 regions have a high outdoor recreation potential (> 95% of the area provides outdoor recreation ecosystem services) and agriculture is partially made up of olive groves and vineyards (on average, 9% of the agricultural area within the NUTS regions in this cluster is olive groves or vineyards). Cluster 3 regions can be found mainly along the Portuguese, Spanish and French mediterranean coast, as well as in Sicily and south-eastern Italy.

Cluster 4 regions feature a high proportion of inland areas (> 63% of the area) with agriculture as dominant land use type (> 62% of the area). Agriculture is dominated by arable land (arable land makes up 100% of the agricultural land in NUTS region) with high carbon sequestration value (> 8200 €/km²) and low land use diversity (Shannon index < 0.58). Urban dispersion is low (dispersion coefficient < 0.26) and the regions have a high outdoor recreation potential (> 97% of NUTS area provides outdoor recreation ecosystem services). Cluster 4 concentrates along the Atlantic, North Sea and Baltic coast, but also northern Italy around Venezia and Ravenna and in Romania and Bulgaria.

Cluster 5 is mainly made up of steeper coasts (> 44% of NUTS region is defined as high coast) dominated by natural land (> 38% of NUTS area is natural land/water) with high land use diversity (Shannon index > 0.66). Urban land is rare (< 6% of NUTS area is urban land) but dispersed (dispersion coefficient > 0.3). There are only few flood control areas (< 21% of NUTS area) and the carbon sequestration value is low (< 1500 ³/km²). Cluster 5 regions can be found in Norway and Scotland, but also on the Greek Islands and in Croatia and Albania.

Cluster 6 contains mainly upland and mountain areas (> 24% upland and mountain areas). Regions feature a mix of all land use types, but only few urban areas (< 7% of NUTS area is urban land). The outdoor recreation potential is high (> 97% of NUTS area provides outdoor recreation ecosystem services). Cluster 6 can be found in the UK and Ireland, in northern Spain, great parts of Italy including Sardinia, in northern Greece, Bulgaria and in selected regions in Slovenia and Croatia.

Cluster 7 is made up of a mix of low coast, inland and upland areas (less than 7% high coast and mountains) and is dominated by forests (> 41% of NUTS area is forest). The agricultural areas are dominated by arable land (arable land makes up 100% of the agricultural land in NUTS region) and a comparatively high share of mixed crop-livestock farming (> 8% of agricultural land under mixed farming). The regions contain many protected areas (> 480 km² under international protection) and inhabitants have a high willingness to pay for species and habitat (S&H) maintenance (> 82 000 €/100 km² of S&H area). Cluster 7 covers large parts of Sweden, Norway, Finland, Iceland, Latvia and Estonia, but also selected regions in France, Portugal and Poland.

2.2 Built Capital

RescueME definition: "Built capital refers to human-made infrastructure, as a tangible representation of culture and history, and includes monuments, traditional buildings, industrial heritage, roads and connections as well as energy and water provision systems. Together with the natural capital, it contributes to shape the landscape unique character" (RescueME D1.1, Gandini and Egusquiza, 2023, page 40).

In total eleven proxy indicators are used to describe the built capital at the European level relate to a description of the settlements, the inhabitants' connectivity to the internet, health and strategic infrastructure, built heritage and energy consumption (Figure 4, Annex 18, Table A- 2).

Cluster 1 covers loosely build-up areas (< 2% of NUTS area defined as build-up area) with few old buildings (< 4% of buildings build before 1919) and few heritage sites (75% of NUTS regions in this cluster contain no heritage site). Access to the internet is very good (100% of households have access) but inhabitants show a low internet affinity (> 15% of individuals never use the internet). Many physicians are available (> 399 physicians/ 100 000 inhabitants), but few strategic buildings[2] (< 22 buildi ngs/ 100 000 inhabitants). Cluster 1 regions can be found mainly in Greece and Albania and in two regions in southern UK.

Cluster 2 is made of comparably heavily build-up areas (between 4% and 21% of the NUTS area is build-up) with many old buildings (> 10% of buildings build before 1919) but few heritage sites (75% of NUTS regions in this cluster contain no heritage site). Internet access is very good (99% of households have access), and inhabitants show a high internet affinity (< 4% of individuals never use the internet). The number of physicians is low (< 380 physicians/ 100 000 inhabitants). Further the share of renewable energy in domestic energy consumption is low (< 7% of residential energy consumption), while agricultural energy consumption is diverse (between 0 and 124 MWh/ km² agricultural land). Cluster 2 NUTS3 regions are concentrated in the UK and Ireland, on the Dutch and Belgian coast and in Poland. The diverse agricultural energy consumption might be due to the high energy demand for production in greenhouses in the Netherlands.

Cluster 3 contains loosely build-up areas (< 3% of NUTS area defined as build-up area). Internet access is poor (< 87% of households have access) and inhabitant show a low internet affinity (> 14% of individuals never use the internet). Residential energy consumption is low (< 5 MWh/capita) and combined with a high share of renewable energy

[2] The number of strategic buildings was extracted from Open Street Map data, chosen categories are for example police and fire stations, townhalls and other public buildings.

(> 61% of residential energy consumption). Cluster 3 regions can be found mainly in Portugal, Lithuania, Slovenia, Croatia, Bulgaria, and Romania. The energy related classification is in line with EUROSTAT energy statistics on national level (NUTS0, LINK, accessed 14/02/2024).

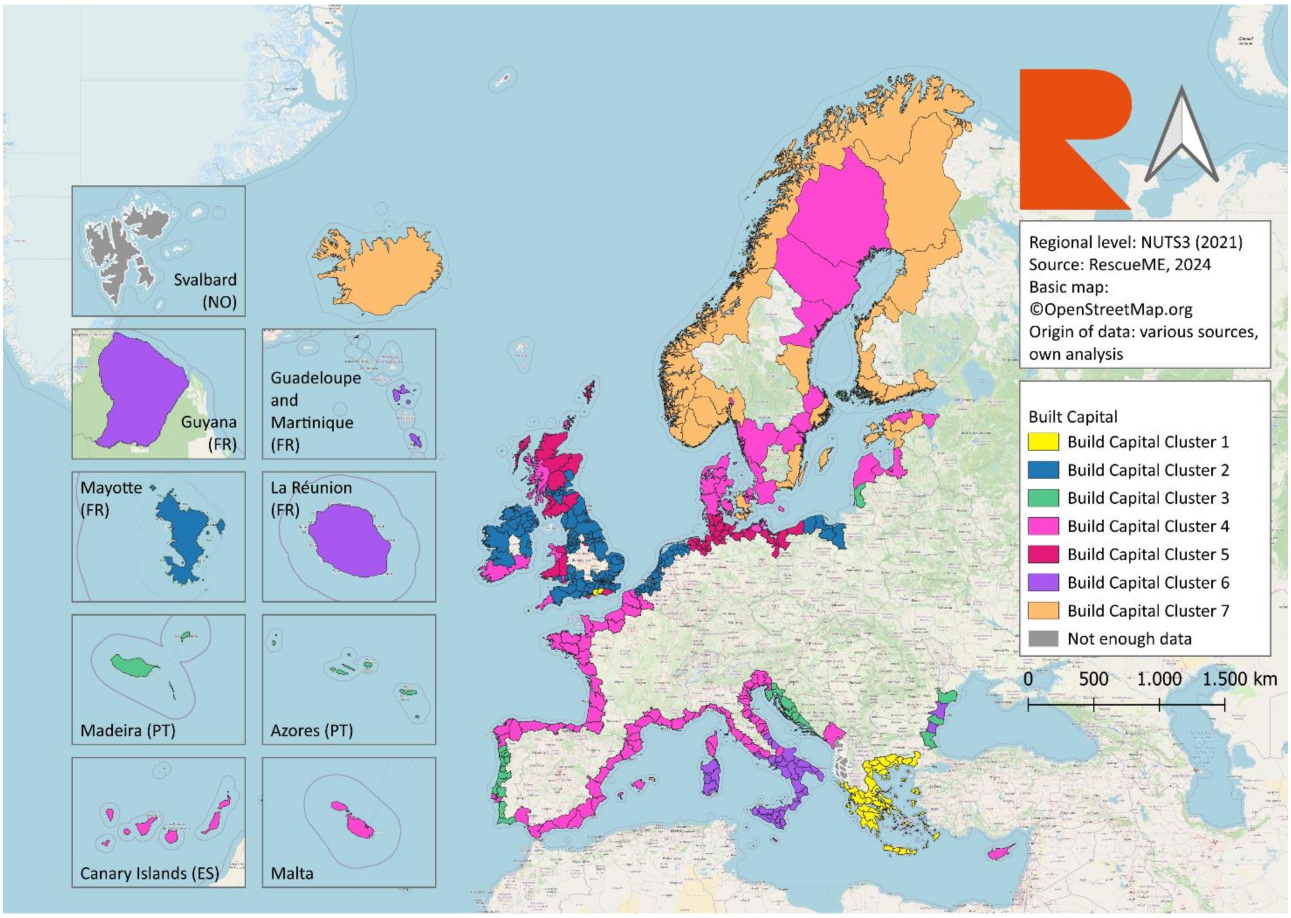

Figure 4: Built capital typology for European coastal NUTS3 cultural landscapes

Cluster 4 covers loosely build-up areas (< 4% of NUTS area defined as build-up area) with many old buildings (> 11% of buildings build before 1919) and high agricultural energy consumption (> 31 MWh/ km² agricultural land). Cluster 4 regions spread across France, Spain, and northern Italy, but also regions in southern Ireland, Denmark, southern Sweden, and Latvia belong to Cluster 4.

Cluster 5 is made up of medium build-up areas (between 2% and 14% of NUTS area defined as build-up area) with few heritage sites (75% of NUTS regions in this cluster contain no heritage site). Many hospital beds (> 770 beds/ 100 000 inhabitants) and strategic buildings (> 38 buildings/ 100 000 inhabitants) are available. Agricultural energy consumption is low

(< 17 MWh/ km² agricultural land). Cluster 5 regions concentrate in Germany and western Poland, but also cover regions in northern and western UK.

Cluster 6 covers loosely build-up areas (< 4% of NUTS area defined as build-up area) with poor internet access (< 89% of households have access) and few hospital beds (< 320 beds/ 100 000 inhabitants). Agricultural energy consumption is high (> 24 MWh/ km² agricultural land). Cluster 6 contains mainly southern Italy, Sardinia and the majority of the French overseas territories (all but Mayotte).

Cluster 7 contains loosely build-up areas (< 1% of NUTS area defined as build-up area) with few old buildings (< 3% of buildings build before 1919). Inhabitants show a high internet affinity (< 2% of individuals never use the i nternet), while only few hospital beds are available (< 315 beds/ 100 000 inhabitants). Residential energy consumption (> 10 MWh/capita) as well as share of renewable energy (> 59% of residential energy consumption) is high. Cluster 7 covers all of Norway and Iceland as well as parts of Finland, Sweden, Denmark, and Estonia. These countries are known to produce a considerable amount of renewable energy[3].

2.3 Social Capital

A total of ten proxy indicators describing population structure, gender equality, the structure of agriculture and the cultural vibrancy[4] are included in the delineation of the social capital typology (Figure 5, Annex 18, Table A- 3).

Cluster 1 is characterised by a sparse, shrinking, elderly population (< 80 inhabitants/ km², loss of > 62 persons/ 100 000 population, young-age dependency < 23%, > 23% of population aged 65+ years) and a male dominated

RescueME definition: "Social capital is related to networks, relationships and trust that coexist in a community and influences how people contribute to the preservation and sustainable development of cultural landscapes. It includes community engagement practices, traditional knowledge sharing, advocacy and policy influence and governance mechanisms that include communities to mobilize support and influence decisionmaking" (RescueME D1.1, Gandini and Egusquiza, 2023, page 40).

[3] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics#Almost_one_quarter_of_energy_used_for_heating_and_cooling_from_renewable_sources, accessed 14/02/2024
[4] The number of cultural facilities, extracted from Open Street Map data, serves as a proxy for cultural vibrancy.

workforce (gender employment gap > 18%). Agriculture is elderly and female (> 31% of farm managers aged 65+ years, > 31% of female farm managers) and cultural vibrancy is low (< 59 cultural sites/ 100 000 population). Cluster 1 regions can be found in Greece and Romania.

Cluster 2 is in contrast made up of a dense, growing, young population (> 3900 inhabitants/ km², gaining between 3 and 10 persons/ 100 000 population, young-age dependency between 23% and 30%, > 20% of population aged 20-39 years). Cluster 2 regions are urban, e.g., the London metropolitan area, Liverpool, Copenhagen, Riga or The Hague.

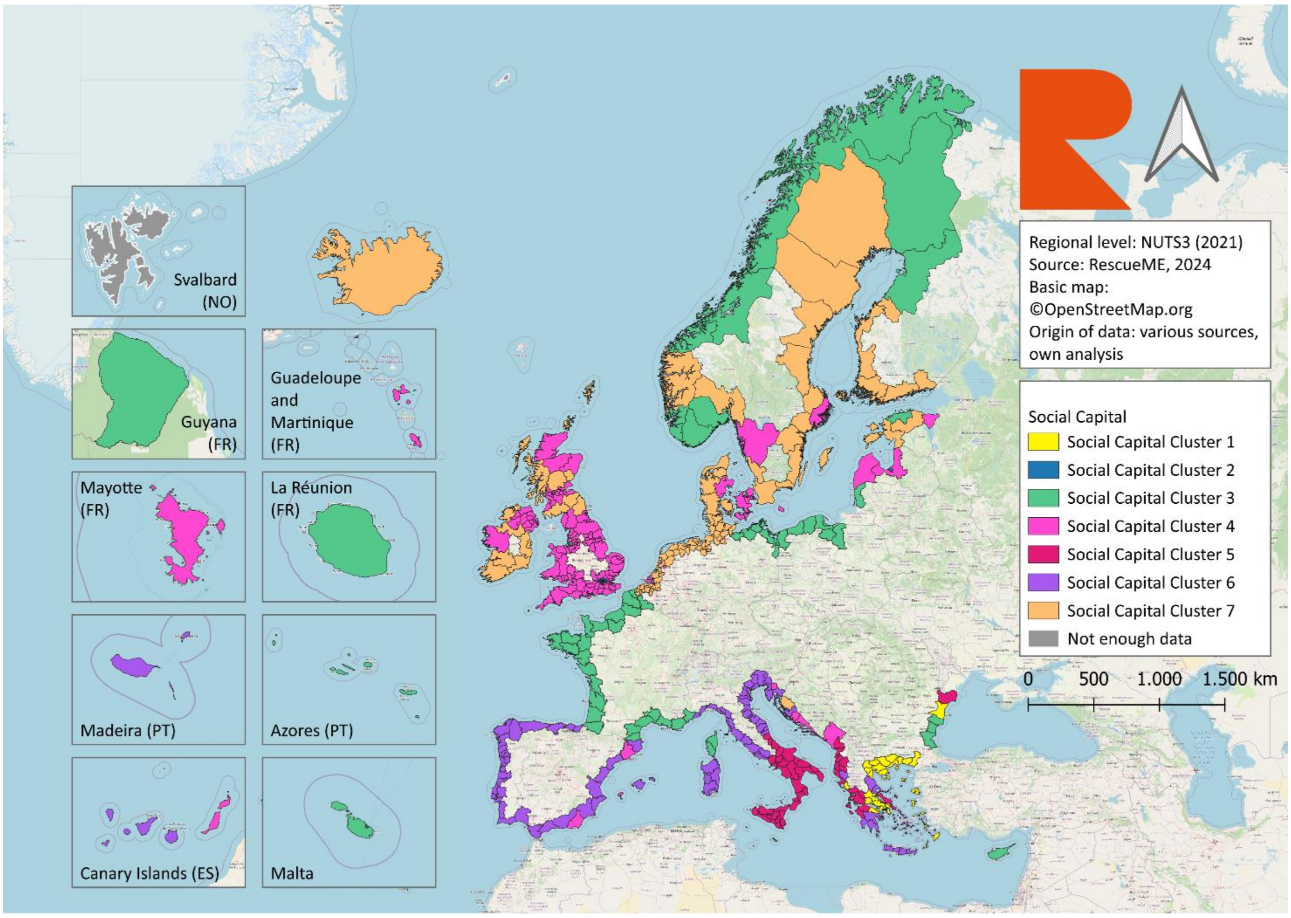

Figure 5: Social capital typology for European coastal NUTS3 cultural landscapes

Cluster 3 is again sparsely populated, but with a stable, age-balanced population (< 200 inhabitants/ km², population change between -1 and +8 persons/ 100 000 population, between 21% and 26% of population aged 20-39 years and between 19% and 25% of population aged 65+ years). The work force is gender-balanced (gender employment gap between 1% and 7%), agriculture can be described as young and tenant (< 20% of farm managers aged 65+ years, > 8% of farm managers aged less than 36 years, > 45% tenant farms). Although sparsely populated, cultural vibrancy is high (> 98 cultural sites/ 100 000 population). Cluster 3 covers large parts of the French NUTS3 regions as well as parts of Scandinavia, Germany, Poland, Lithuania, Estonia and Bulgaria.

Cluster 4 features a stable, age-balanced population (population change between +2 and +6 persons/ 100 000 population, between 22% and 25% of population aged 20-39 years and between 17% and 23% of population aged 65+ years) and a gender-balanced workforce (gender employment gap between 3% and 5%). The outstanding attribute concerning agriculture is the lack of PDO (Protected Designation of Origin) products produced in cluster 4 NUTS3 regions (a maximum of 1 PDO product is produced). Cluster 4 regions can mainly be found in the UK and Ireland, but also in the Baltic countries, Denmark, Croatia, Montenegro, and Slovenia.

Cluster 5 contains NUTS3 regions with a sparse, stable, elderly population (< 203 inhabitants/ km², population change between -8 and 0 persons/ 100 000 population, young-age dependency < 22%, > 21% of population aged 65+ years) and a male dominated workforce (gender employment gap > 23%). Agriculture can be described as elderly, female, and proprietary agriculture (> 40% of farm managers aged 65+ years, > 34% of female farm managers, < 20% tenant farms) and cultural vibrancy is low (< 70 cultural sites/ 100 000 population). The cluster 5 NUTS regions concentrate in southern Italy, parts of Greece and Romania and in Albania.

Cluster 6 is characterised by a sparse, stable, elderly population (< 245 inhabitants/ km², population change between -7 and +2 persons/ 100 000 population, young-age dependency < 21%, > 21% of population aged 65+ years). Many elderly farm managers run the agricultural sector (> 33% of farm managers aged 65+ years) and many PDO (Protected Designation of Origin) products are produced (> 3 PDO products in the NUTS regions). Cluster 6 regions can be found in Spain, Portugal, northern Italy and Sardinia, Greece, Slovenia, Albania, and Croatia.

Cluster 7 is made up of a stable, age-balanced population (population change between +1 and +7 persons/ 100 000 population, between 21% and 25% of population aged 20-39 years and between 20% and 24% of population aged 65+ years). Agriculture can be described as young, male and tenant (< 20% of farm managers aged 65+ years, > 5% of farm managers aged less than 36 years, < 15% of female farm managers, > 33% tenant farms) with few PDO (Protected Designation of Origin) products (a maximum of 1 PDO product in the NUTS regions). Cultural vibrancy is high (> 117 cultural sites/ 100 000 population). Cluster 7 regions can be found in Scandinavia, Iceland, Estonia, the UK and Ireland, Germany, the Netherlands and Belgium and a selected region in Croatia.

2.4 Human Capital

RescueME definition: "Human capital is related to the skills and abilities of local communities and how these could be enhanced and fostered through continuous learning, education and training" (RescueME D1.1, Gandini and Egusquiza, 2023, page 40).

The clustering with regards to human capital is done based on six proxy indicators from the field of workforce skills in general and with a focus on agricultural work force (Figure 6, Annex 18, Table A- 4).

Cluster 1 is made up of a medium qualified workforce (between 0.02% and 0.04% of employed persons with tertiary education, between 10% and 15% participation rate in education and training, between 7% and 14% early leavers from education and training) with few educational facilities (< 77 facilities/ 100 000 population). In agriculture, only few holdings are run by a full-time farm manager (< 19%). Cluster 1 regions can be found in Iceland, the UK, Poland, and the Baltic countries as well as in France, Spain, Portugal, and the majority of Italy.

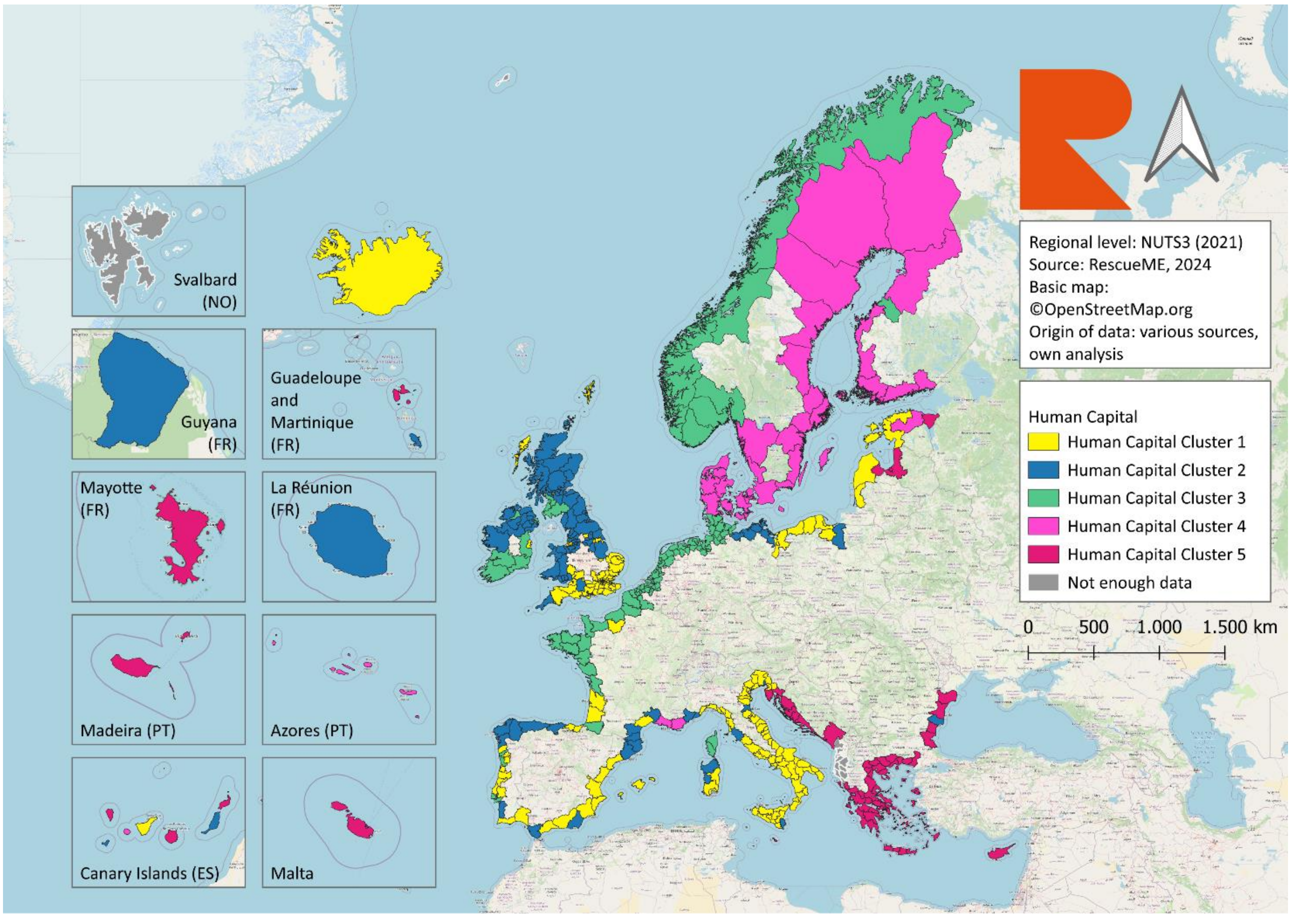

Figure 6: Human capital typology for European coastal NUTS3 cultural landscapes

Cluster 2 also features a medium qualified workforce (< 0.03 % of employed persons with tertiary education, between 12% and 15% participation rate in education and training), with many early leavers from education and training (between 11% and 15%). In contrast to Cluster 1, more farms are run by full-time managers (> 29%). Custer 2 regions cover large parts of the UK and parts of Germany, Poland, Spain, Portugal, France, Italy, and Bulgaria.

Cluster 3 is characterised by a medium qualified workforce (between 0.02% and 0.04% of employed persons with tertiary education, between 11% and 25% participation rate in education and training, between 5% and 13% early leavers from education and training) with many educational facilities (up to 113 facilities/ 100 000 population). Agriculture is very professional (> 49% of all holdings with a full-time manager, > 63% of all farmers with full or basic agricultural training). Cluster 3 regions spread over all of Norway, Belgium and the Netherlands and parts of Ireland, Germany, France, and Portugal.

Cluster 4 as well covers a well-qualified workforce (between 0.03% and 0.05% of employed persons with tertiary education, between 8% and 10% early leavers from education and training) with a particularly high participation in continuing education (between 25% and 36% participation rate in education and training) and many educational facilities (up to 121 facilities/ 100 000 population). Agriculture is less professional compared to cluster 3 (< 36% of all holdings with a full-time manager, < 46% of all farmers with full or basic agricultural training).

Cluster 5 includes a poorly qualified workforce (< 0.03% of employed persons with tertiary education, between 1% and 16% early leavers from education and training) that seldom invests in continuous education (< 4.5% participation rate in education and training). Only few educational facilities are available (between 47 and 85 facilities/ 100 000 population). Also, the agricultural sector is characterised by low-qualified farmers (< 8% of all farmers with full or basic agricultural training) and many part-time farmers (< 13% of all holdings with a full-time manager). Cluster 5 covers all of Greece, Croatia, Montenegro and Romania and parts of Bulgaria.

2.5 Financial Capital

> RescueME definition: "Financial capital refers to the economic contribution of cultural landscapes to local communities as well as the resources and funds available for their maintenance, management and improvement, including revenues from the touristic sector

The clustering of the financial capital is based on eleven proxy indicators describing the economic status (employment and household income) and the importance of the sectors tourism, agriculture, and arts & entertainment. In addition, the national environmental protection investments are incorporated as indicator for available resources (Figure 7, Annex 18, Table A- 5).

Cluster 1 comprises regions with a (in comparison to the other analysed coastal NUTS3 regions) low economic status (employment rate < 69% and income/ capita < 8 700 €). The arts & culture sector is of lower relative importance (< 5.5% of GDP attributable to cultural production, < 3.6% of employed persons in arts, entertainment & recreation sector). Environmental investments are comparatively high with regards to the gross domestic product (> 0.4% of GDP). Cluster 1 regions can be found in most regions in the Baltic states, Poland, Romania, Croatia, and Cyprus, but also in selected regions in Germany and France.

Cluster 2 regions feature a medium to good economic status (employment rate between 65% and 77% and income/ capita > 19 500 €). Touristic turnover is rather low (between 190 and 1 200 million €), agriculture is of lower importance (< 7.5 holdings/ 100 ha, < 3.6% of working age population works in agriculture). Great parts of the UK fall into cluster 2, but this needs to be treated with care as data on touristic turnover is lacking for the UK. Further regions from Ireland, Iceland, Finland, northern Italy, and Spain fall into cluster 2.

Cluster 3 is made up of regions with low to medium economic status (employment rate between 68% and 79% and income/ capita < 9 600 €). The arts & culture sector is of minor relative importance (< 3.2% of GDP attributable to cultural production, < 3.4% of employed persons in arts, entertainment & recreation sector) and so is tourism (< 2 million arrivals/ year, < 22 000 bed places, diverse touristic turnover between 120 and 7 400 million €, low seasonality (index < 0.04)). In contrast agriculture is of high relative importance (> 12 holdings/ 100 ha, > 11% of working age population works in agriculture). Cluster 3 regions can be found mainly in Greece and Bulgaria, but also selected regions in Italy, Portugal and Germany are part of cluster 3.

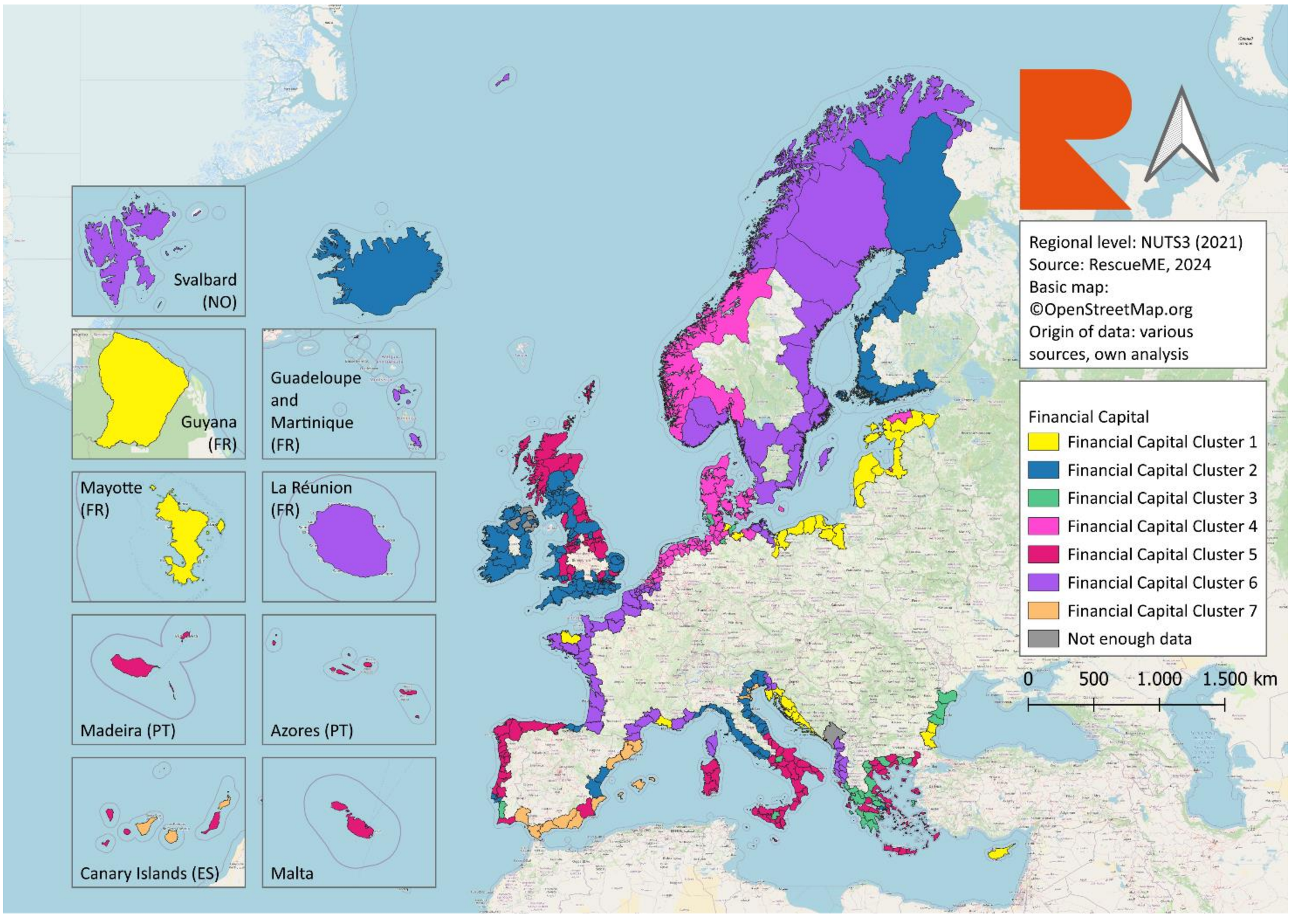

Figure 7: Financial capital typology for European coastal NUTS3 cultural landscapes

Cluster 4 comprises regions with good economic status (employment rate > 70% and income/ capita > 26200 €). Tourism is of lower importance (< 5 million arrivals/ year, < 30 000 bed places, touristic turnover between 380 and 2200 million €), and so is agriculture (< 4 holdings/ 100 ha, < 3% of working age population works in agriculture). Cluster 4 contains large parts of The Netherlands, Germany, Denmark, and Norway.

Cluster 5 regions feature a low to medium economic status (employment rate < 68% and income/ capita > 10700 €). Tourism of lower importance (< 4 million arrivals/ year, < 37 000 bed places) and especially the touristic turnover is low (< 290 million €). Cluster 5 regions are located in Scotland and other parts of the UK, in northern Spain and parts of Portugal, Sardinia and southern Italy as well as parts of Greece.

Cluster 6 contains regions with medium to good economic status (employment rate between 63% and 74% and income/ capita > 19600 €). The arts & culture sector is of minor relative importance (< 2.4% of GDP attributable to cultural production, < 3.5% of employed persons in arts, entertainment & recreation sector), and so is agriculture (< 5 holdings/ 100 ha, < 3.3% of working age population works in agriculture). Environmental investments are comparatively high with regards to the gross domestic product (> 0.5% of GDP). Cluster 6 regions contain parts of Norway, Sweden, Germany, France, and Slovenia. Also, Albania is part of cluster 6, but this information is to be treated with care as there is a lack of data for the country.

Cluster 7 regions show a medium economic status (employment rate < 60% and income/ capita > 12100 €). Tourism is an important sector and features a high seasonality (> 14 million arrivals/ year, > 60 0000 bed places, touristic turnover between 790 and 3100 million €, high seasonality index of > 0.2). The arts & culture sector is also of higher importance (between 7.3% and 40% of GDP attributable to cultural production, between 9.2% and 53% of employed persons in arts, entertainment & recreation sector), while agriculture is of lower importance (< 2.4% of working age population works in agriculture). Environmental investments are comparatively low with regards to the gross domestic product (< 0.2% of GDP). Cluster 7 is made up of the touristic regions in southern Spain, parts of the Canary and Balearic Islands and regions in Italy.

3 Risk assessment for European coastal cultural landscapes

This chapter examines mainly the climate-related risks faced by Europe's coastal cultural landscapes. These areas, shaped by centuries of human history and natural processes, face growing threats and potential impacts due to climate change. These risks need to be identified and classified to plan and provide the necessary adaptive actions for reducing that risk. In addition to a brief introduction to the chosen methodological approach for risk assessment, a summarized overview is provided of some of the reasons why risk is analyzed for certain hazards, most of which are connected to climate change. Subsequently, the risks for each hazard are described, both for the reference period (1981-2010) and for the period 2071-2100, considering scenarios of low, medium, and high greenhouse gas emissions. This information is accompanied by maps. These maps, including details on the underlying composite indices described below, can be accessed via the **RescueME Atlas of European Coastal Cultural Landscapes**[5].

3.1 Methodological approach

The assessment of risk in cultural landscapes has been carried out using a semi-quantitative approach, i.e. on the basis of spatialized indicators corresponding to NUTS3 territorial units, resulting in a series of composite indices, all with a range of values from a minimum of 1 ("very low") to a maximum of 2 ("very high"), which represent the relative risk of each NUTS3 unit in the total set of NUTS3 regions belonging to the sample under study. This assessment has been carried out independently for seven climatic hazards (pluvial floods, river floods, coastal floods, landslides, droughts, wildfires, and heatwaves) and for one non-climatic threat (poor air quality).

In summary, the methodology consisted of identifying and obtaining a set of spatialized indicators for each of the above hazard types and assigning each of them to the risk components of hazard and exposure and the sub-components of vulnerability, sensitivity, and adaptive capacity, in line with the risk concept used in the IPCC AR5 and AR6 reports. These indicators were then normalized and rescaled to aggregate them and finally obtain the composite indices of sensitivity, adaptive capacity, vulnerability, exposure, hazard and, finally, risk.

[5] https://appwerescuemep01.azurewebsites.net/

It should be noted that the risk assessment was carried out considering climate change scenarios for all hazards except poor air quality. The climate change scenarios considered are, in addition to the reference period 1981-2010, a low emissions scenario (RCP 2.6) for the period 2071-2100, a medium emissions scenario (RCP 4.5) for the period 2071-2100 and a high emissions scenario (RCP 8.5) for the period 2071-2100. In the case of poor air quality, no future scenario data exists and consequently were not calculated here. However, the air quality risk assessment is based on data for the reference period only and is performed using the same methodological approach as for climate risks. That means also for air quality, composite indices for exposure, vulnerability and hazard are derived. The hazard indicators contain five air quality indicators.

The section below includes relative risk maps based on the types of hazards and scenarios considered. To visualize risk in the reference period 1981-2010, a red ramp has been used, where an increase in the intensity of the colour indicates a higher level of risk (very low, low, medium, high, and very high). This allows for comparison of the risk level of a specific NUTS3 unit with others in the same period and scenario. To compare the level of risk between the different future scenarios, a risk evolution map is provided for each of the hazards analyzed, where it is possible to compare the risk of a given NUTS with itself for these scenarios. Thus, green color indicated NUTS3 regions in which the risk is lower than the risk of the reference period in at least one future scenario; grey color indicated NUTS3 regions with no appreciable change between the risk of the reference period and the risks of all the future scenarios; and orange depicts NUTS3 regions in which the risk in at least one future scenario is higher than the risk identified in the reference period.

3.2 Risks considered

Risk of pluvial floods, river floods and coastal floods on cultural landscapes

Climate change is leading to more frequent pluvial, fluvial, and coastal floods, which are some of the most common and costly natural disasters in Europe. According to the European Union, there have been almost 1,500 flood events since 1980, resulting in over 4,300 deaths and causing economic damage exceeding € 170 billion[6]. These floods have devastating

[6] https://environment.ec.europa.eu/topics/water/floods_en

effects, endangering lives, and causing substantial economic losses. Additionally, floods can cause significant harm to historic buildings, monuments, works of art, and other cultural elements. Floods can cause significant damage to buried archaeological sites by eroding and displacing soil layers. Additionally, floodwaters can spread contamination by releasing stored pollutants from the ground, posing a hazard to wetland areas, and reducing biodiversity. Moreover, floods can have a profound impact on people living in cultural areas, damaging housing, infrastructure, roads, and essential services. Furthermore, floods can have a detrimental impact on communities' access to significant cultural sites, leading to reduced tourism and negatively affecting the local economy and the sustainability of these sites.

RISK OF LANDSLIDES ON CULTURAL LANDSCAPES

Landslides can be caused by natural processes, such as heavy rainfall, earthquakes, volcanic eruptions, and slope instability due to river or sea wave action[7]. Human activities like excavation, construction, deforestation, and changes in land use can also contribute to slope instability, leading to landslides that impact both natural landscapes and human settlements. Landslides are a significant hazard in mountainous, hilly, steep riverbank, and coastal regions. The impact of landslides depends on their size, speed, the exposed elements, and their vulnerability. Landslides cause fatalities and significant damage to infrastructure, such as roads, railways, pipelines, and artificial reservoirs, as well as property, including buildings and agricultural land. Landslides can cause significant harm to historic buildings, monuments, works of art, and other cultural elements. They can also impact areas where archaeological sites are located. Additionally, landslides can alter the topography and visual appearance of cultural landscapes, which can affect the natural beauty and identity of a region, as well as its attractiveness for tourism.

RISK OF DROUGHTS ON CULTURAL LANDSCAPES

Climate change is already affecting many regions in Europe, resulting in more frequent, severe, and prolonged droughts. A drought is a temporary and unusual shortage of water combined with reduced precipitation and increased evaporation. It can cause damage to historic sites and monuments, affect the condition of roads, railways, and waterways, reduce crop yields and tree growth, lower river levels and groundwater availability, and stress ecosystems. In Europe, droughts cause annual losses of approximately € 9 billion, affecting agriculture, architecture, and public water supply. As extreme droughts become more

[7] https://esdac.jrc.ec.europa.eu/themes/landslides

frequent and intense, the associated damage continues to increase. With a projected global average temperature increase of 3 °C, droughts are expected to occur twice as often, resulting in absolute annual losses of € 40 billion in Europe[8].

Risk of wildfires on cultural landscapes

In recent years, Europe has experienced numerous large wildfires. The changing weather patterns associated with global warming will increase fire risks across most European countries[9]. Rising temperatures, prolonged droughts, and extreme weather events will lead to more frequent and intense wildfires. Wildfires have significant impacts on both the environment and human society, causing substantial economic losses by scorching hectares of land and destroying homes and businesses. Sectors such as agriculture, tourism, and infrastructure are affected by wildfires. Burnt areas are also susceptible to secondary effects such as pluvial floods, soil erosion, landslides, and desertification. These consequences can be devastating and often irreversible, destroying habitats and threatening biodiversity. Vegetation recovery may take years, impacting wildlife and plant species. Furthermore, smoke from wildfires poses health risks, especially for more vulnerable populations.

Risk of heatwaves on cultural landscapes

Heatwaves have caused tens of thousands of premature deaths and hospital admissions in Europe in recent decades. These extreme events are expected to become more frequent, longer lasting, and more intense, leading to a substantial increase in mortality[10]. The most vulnerable groups, such as the elderly, children, and those with chronic diseases or lower socio-economic status, are most affected by heat-related health impacts. Heatwaves have cascading effects beyond human health. For example, in agriculture, crop yields decline due to extreme heat and water scarcity. In livestock, animals face stress, reduced productivity, and increased mortality rates. In ecosystems, heatwaves impact forests, wetlands, and aquatic habitats, and increase the frequency and intensity of wildfires, threatening biodiversity.

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[8] https://climate.ec.europa.eu/climate-change/consequences-climate-change_en

[9] https://joint-research-centre.ec.europa.eu/system/files/2020-09/09_pesetaiv_wildfires_sc_august2020_en.pdf

[10] https://www.eea.europa.eu/en/topics/in-depth/extreme-weather-floods-droughts-and-heatwaves

RISK OF POOR AIR QUALITY ON CULTURAL LANDSCAPES

Clean air is essential for human well-being and the environment. However, human activities have significantly impacted poor air quality. Industries, energy production, domestic heating, agriculture, and transportation all contribute to air pollution, which is a top environmental health challenge in Europe. Air pollution has severe consequences, including serious illnesses such as asthma, cardiovascular diseases, and lung cancer. Fine particulate matter causes 300,000 premature deaths annually. Vulnerable groups, such as children and the elderly, are particularly susceptible to health risks caused by air pollution. Excessive nitrogen pollution and acid rain can also harm ecosystems and natural habitats. Air pollutants can damage soil quality, water bodies, vegetation and built cultural heritage. Additionally, air pollution has significant economic costs, with an annual cost of at least € 330 billion[11].

3.3 Results of the risk assessment

RISK OF PLUVIAL FLOODS ON CULTURAL LANDSCAPES

Risk in the reference period (1981-2010)

Most of the NUTS3 regions (89 %) fall into classes ranging from low to high risk for the pluvial flood hazard in the reference period 1981-2010. Only 7 % feature a very low risk and almost 5 % a very high risk (Figure 8 and Annex 2, Table A- 6).

Among the 25 NUTS regions with the highest risk levels (almost all with very high relative risk) are those located in Slovenia, Spain, Croatia, Italy, Greece, Norway, Portugal, and France (Annex 2, Table A- 7). Regions belonging to Italy, Spain and Greece have higher levels of vulnerability than others, with high or very high vulnerability, mainly due to higher levels of sensitivity. On the other hand, there is a high or very high exposure to pluvial flooding in regions of Italy and Spain, mainly. The hazard, assessed based on available data on very heavy rainfall days per year for the reference period 1981-2010, is very high in regions in Italy, Norway, Slovenia, and Spain (Annex 2, Table A- 7).

Countries with at least half of their regions at relatively high risk include Cyprus, Montenegro, Portugal. Croatia, Bulgaria, Slovenia, Italy, France, Iceland, and Romania.

[11] https://environment.ec.europa.eu/topics/air_en

With more than 20 % of the regions at very high risk, Slovenia and Spain stand out, ahead of Croatia, Italy, and Norway. (Annex 2, Table A- 8 and
Table A- 9).

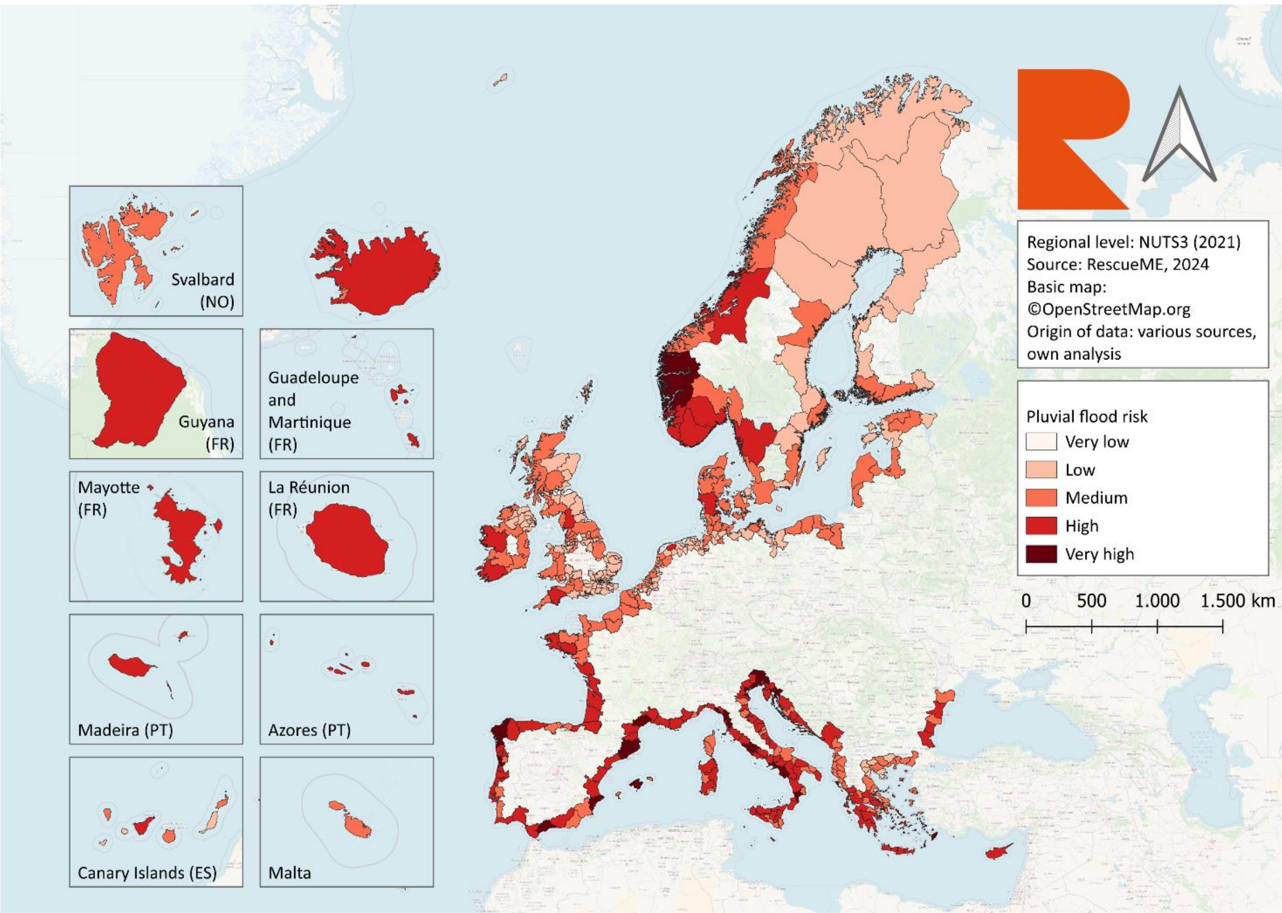

Figure 8: Relative risk for pluvial floods in the 1981-2010 reference period.

Future period risk (2071-2100) under climate change scenarios

The risk remains unchanged for 76.2 % (391) of the NUTS3 regions under low (RCP 2.6), medium (RCP 4.5) as well as high (RCP 8.5) emission scenarios. In 9.7 % of the cases an increase in risk can be expected under all emission scenarios, even the best-case scenario (RCP 2.6) considered. In 6.8 % of the cases such an increase would only occur under the worst-case emissions scenario (RCP 8.5). There are also a few cases where the risk, compared to that observed in the reference period, is lower under more stringent climate change scenarios, probably due to the higher uncertainty provided by the models for future precipitation (Figure 9 and Annex 2, Table A- 10).

In all regions of Cyprus, Latvia, Lithuania, Malta, Montenegro, Portugal, Romania and Slovenia, the level of risk under all climate change scenarios is maintained compared to that of the reference period 1981-2010. And in countries such as Belgium, Albania, the Netherlands, Poland, Greece, Croatia, and Italy, more than 80 % of their NUTS maintain the reference period risk level. (Annex 2, Table A- 11). On the contrary, the possible increase in risk in all future scenarios stands out in countries such as Germany, Denmark, Norway, France, and Ireland. The latter country is particularly noteworthy, with almost 43 % of its regions showing such an increase in risk in the future.

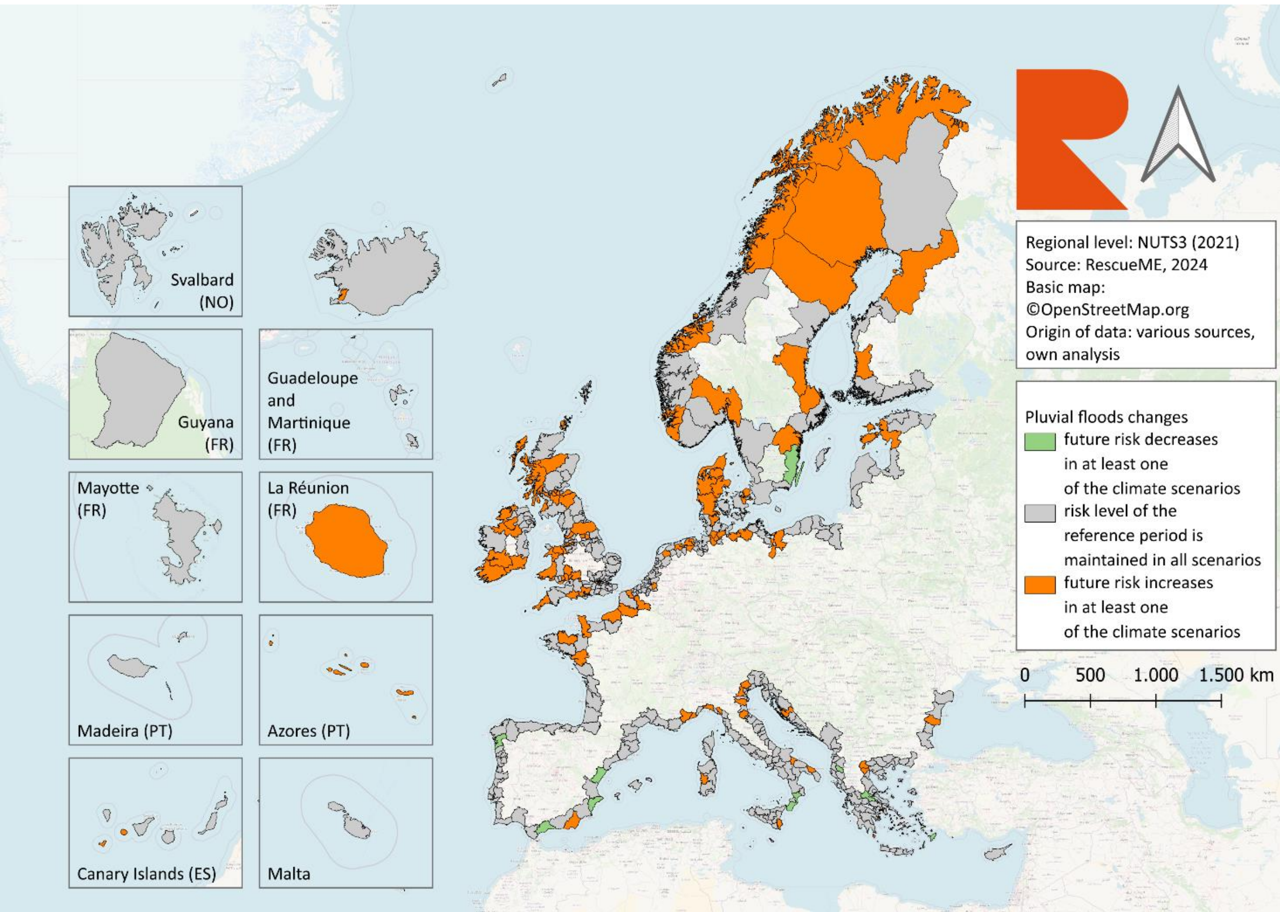

Figure 9: Future evolution of the NUTS3 risk indices with respect to the 1981-2010 risk index for pluvial floods.

RISK OF RIVER FLOODS ON CULTURAL LANDSCAPES

Risk in the reference period (1981-2010)

Looking at the reference period 1981-2010, 220 regions (42.9 %) are at medium risk, while another 200 (39 %) are at high risk. Only one region (0.2 %) has a very low relative risk. The figures for low and very high risk are more evenly distributed, with 53 regions (10.3 %) and 39 regions (7.6 %) respectively (Figure 10 and Annex 2, Table A- 12).

All the 25 regions with the highest risk fall into the class “very high” relative risk. In 13 of these regions the vulnerability is high or very high. Exposure is high or very high in 17 NUTS regions. And in 5 regions both vulnerability and exposure are high in addition to a very high hazard level. (Annex 2, Table A- 13).

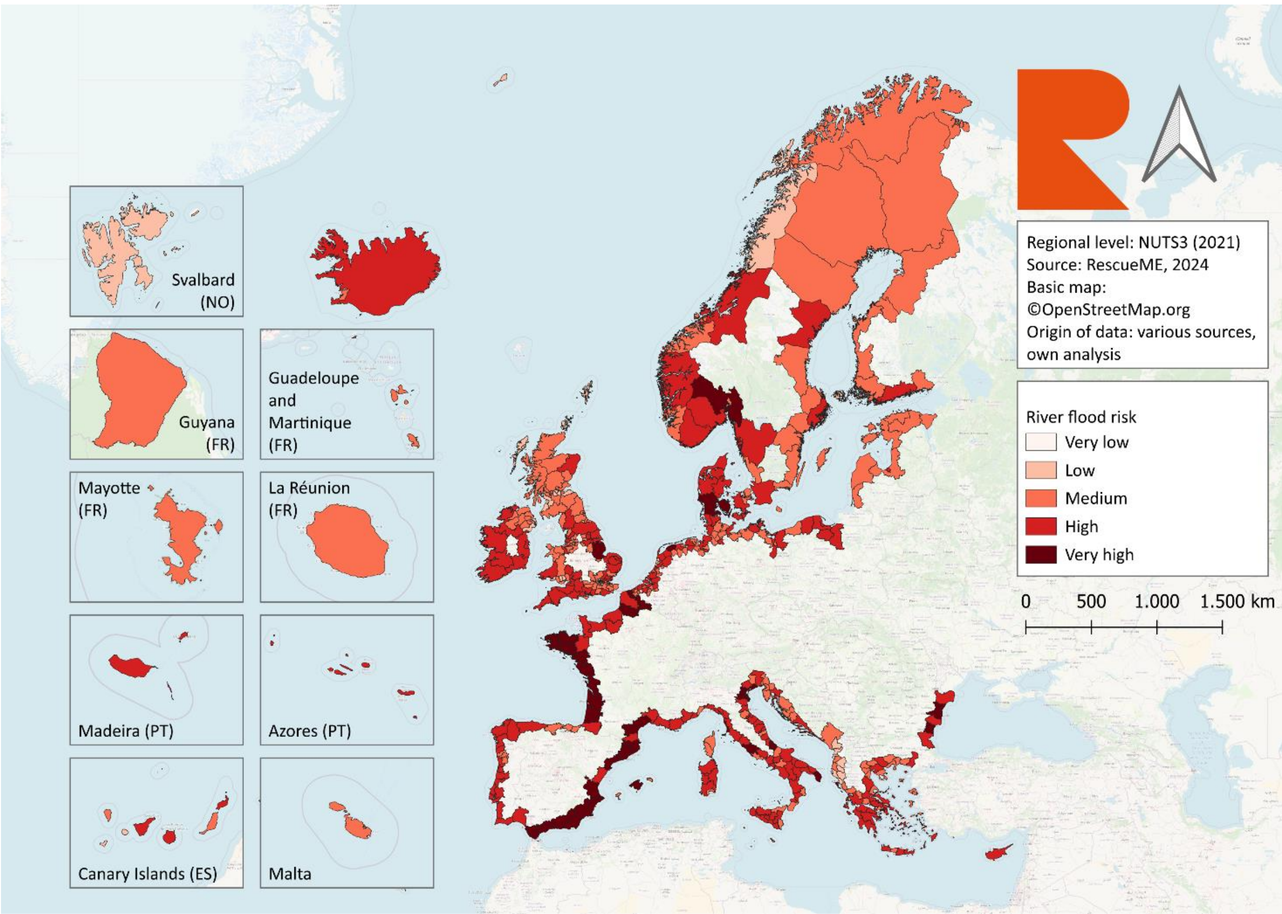

Figure 10: Relative risk for river floods in the 1981-2010 reference period.

At least 50 % of the regions of Cyprus, Ireland, Portugal, Poland, Italy, Bulgaria, and Greece exhibit high risk levels for river flooding in the reference period 1981-2010, with Cyprus and Ireland standing out, with 100 % of their regions in the “high risk“ class (Annex 2, Table A-14).

On the other hand, countries such as Romania, France, Spain or Bulgaria have more than a third of their regions with very high-risk levels at the reference period 1981-2010 (Annex 2, Table A- 15).

Future period risk (2071-2100) under climate change scenarios

In 438 regions (85.4 %) no change in risk class is expected according to future climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) compared to the risk they already have in the reference period 1981-2010 (Figure 11 and Annex 2,
Table A- 16). On the contrary, an increase in risk is observed in 16 regions (3.1 %), regardless of the future scenario analyzed. In 12 regions (2.3 %) the risk increases under medium (RCP 4.5) or high (RCP 8.5) emission scenarios and in 8 regions (1.6 %) it increases only under the most unfavorable scenario (RCP 8.5). It is also worth noting that in 37 regions (7.2 %) the risk could decrease in at least one of the future scenarios, which would mean that in these cases, according to the available data, the frequency of river floods would decrease in the future, considering the same return period for flood locations.

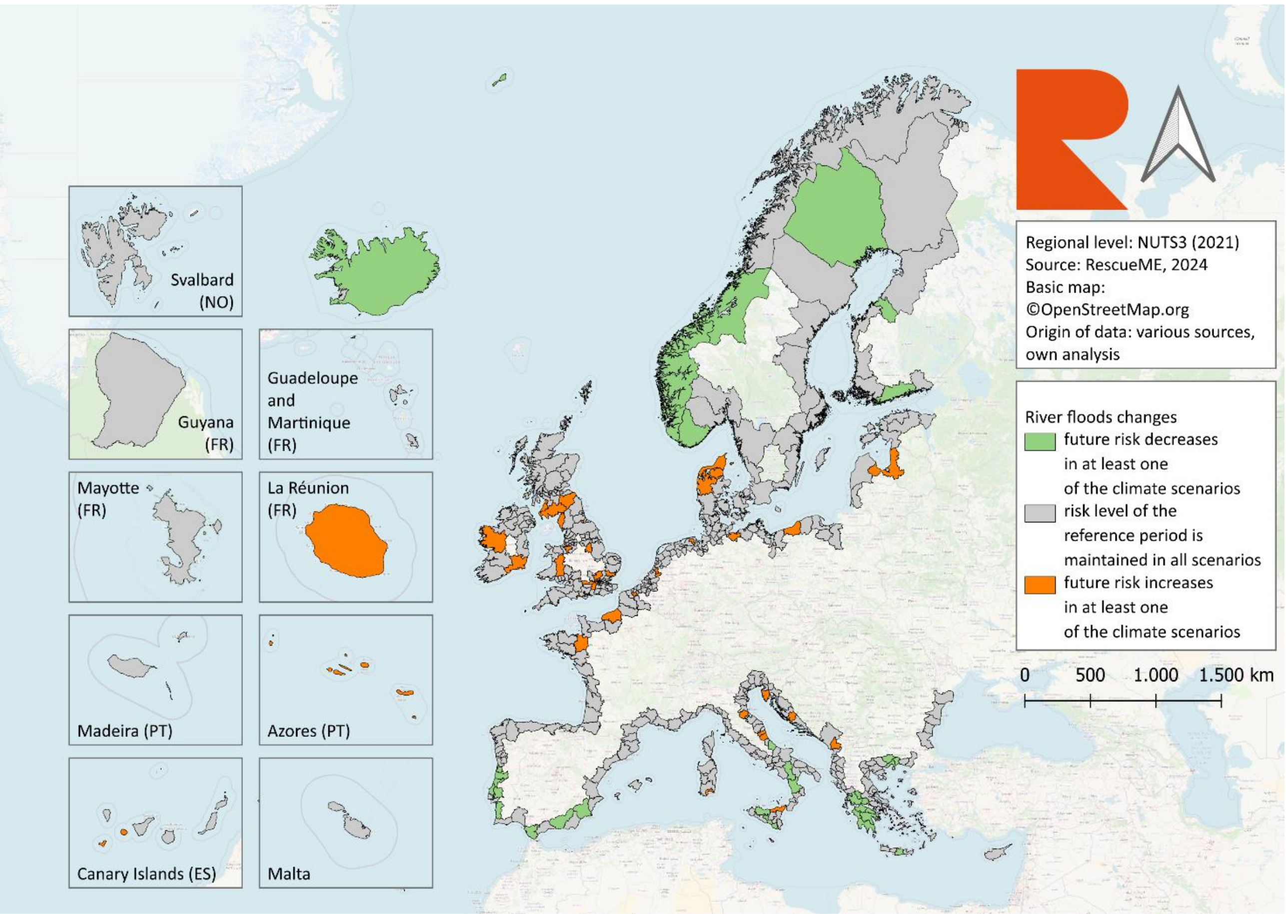

Figure 11: Future evolution of the NUTS3 risk indices with respect to the 1981-2010 risk index for river floods.

Looking at this evolution of risk by country (Annex 2, Table A- 17), the regions with no change, compared to the reference period, are mainly in Bulgaria, Cyprus, Estonia, Lithuania, Malta, Montenegro, Romania, and Slovenia. In these countries, all their regions maintain the risk levels of the 1981-2010 reference period. It should also be noted that in France, Belgium, Sweden, Germany, the Netherlands, and Spain this percentage is over 90 %. On the other hand, 16 NUTS regions (3.1 %) show an increase in risk under all climate change scenarios, led by regions in Croatia, Ireland, Poland, and Albania, all of which exceed 10 %.

RISK OF LANDSLIDES ON CULTURAL LANDSCAPES

Risk in the reference period (1981-2010)

The data shows that the largest group of regions (30.6%) had medium-risk levels for landslides, followed by low-risk (28.7 %) and high-risk (28.1 %) levels. Only a small fraction of regions (5.3 %) had very low-risk levels, while a slightly larger fraction (7.4 %) had very high-risk levels. It can be concluded that landslides are a widespread and variable hazard in European coastal cultural landscapes, and that many regions could face moderate to severe impacts from landslides (Figure 12 and Annex 2,
Table A- 18).

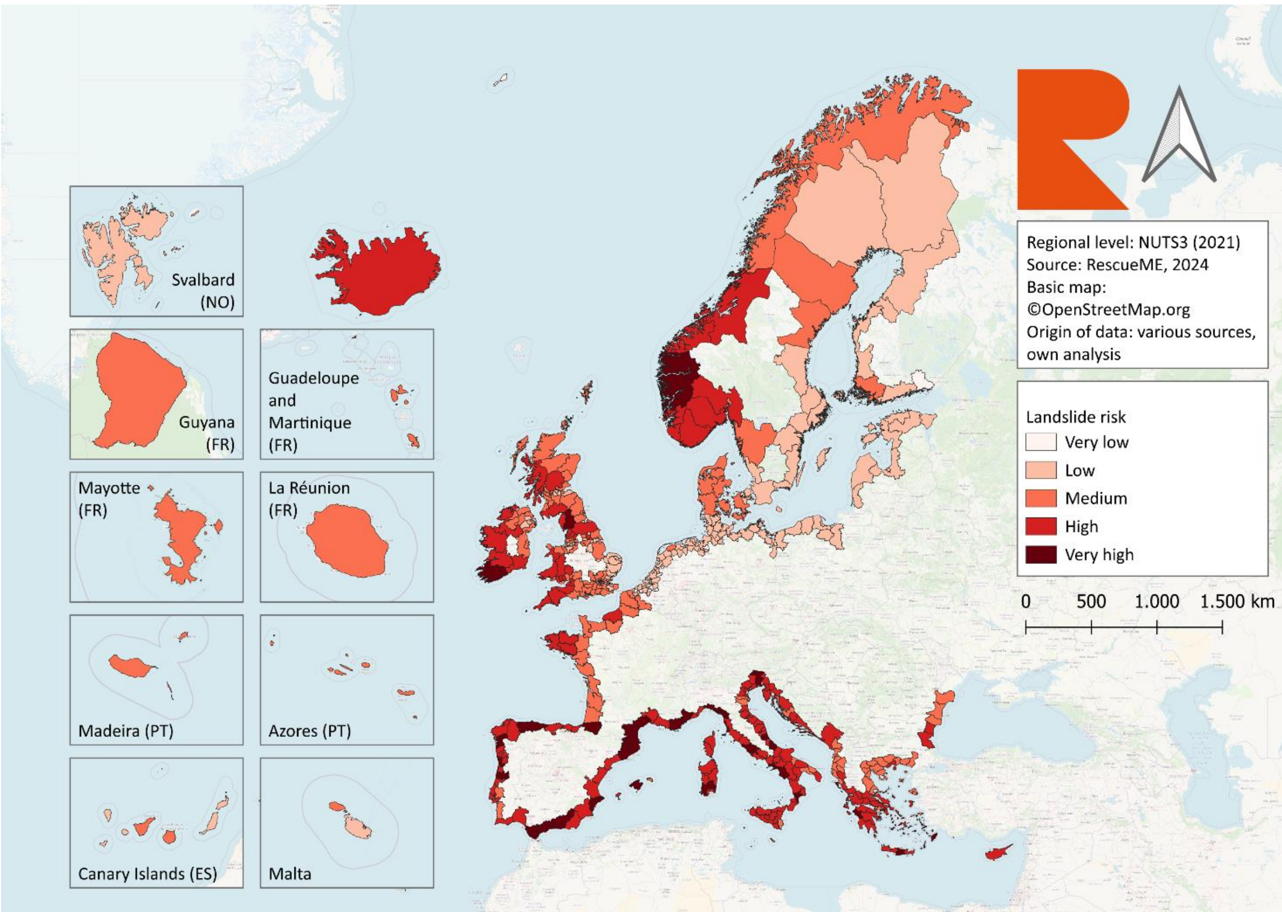

Figure 12: Relative risk for landslides in the 1981-2010 reference period.

Additionally, while obvious, it is remarkable the relation between the flatness of the territories and the landslide risks. For example, Finland, the Baltic countries or the Netherlands are less threatened by landslides than other more mountainous coastal cultural landscapes (Figure 12 and Annex 2, Table A- 19).

In absolute numbers, Italy has the highest number of regions with both high (46) and very high (13) landslide risk. However, when considering the percentage relative to the total number of coastal NUTS3 regions (69 % and 18 % respectively), Italy is not the country with the highest risk (Annex 2, Table A- 20 and
Table A- 21). Cyprus, Iceland, Slovenia, and Montenegro are characterized by only one or two NUTS3 regions, yet all of them are under high risk of landslide (100 %). It's significant to mention that two of these are islands. Finally, Spain has the highest percentage of regions facing high risk (29 % of its coastal regions), followed by France and the aforementioned Italy (19.7 % and 19.4 % respectively). This also suggests a correlation between mountainous countries and landslides (e.g., the Pyrenees and Alps).

Future period risk (2071-2100) under climate change scenarios

In future climate change scenarios, the majority of the regions (74.7 %) will have similar landslides risk levels in the period 2071-2100, regardless of the particular scenario. In any case, a significant part of the regions (9.8 %) will have higher landslide risk levels under all climate change scenarios (Figure 13 and Annex 2, Table A- 22).

The United Kingdom has the largest number of regions where the landslide impact will remain the same in all scenarios (127 regions, meaning 84,7 % of the total). At the same time, it has 23 regions (14 %) where the landslide risk will increase in at least one of the three scenarios.

In terms of regions with increasing landslide risk, 16.7 % of the Norwegian NUTS3 regions face higher risk in future scenarios. This is followed by the United Kingdom (above mentioned the 14 % of its regions increasing landslide risk), Sweden with (14 %), and Germany (11 %). These countries show a clear trend of increasing landslide risk in a significant proportion of their regions.

On the other hand, southern European countries like Greece (91 %), Portugal (93 %), and Spain (87 %) have a substantial proportion of their regions where the landslide risk will remain the same or even decrease in at least one scenario.

Interestingly, while southern European countries like Greece, Portugal, and Spain will maintain or even decrease their landslide risk levels, these risks will proportionally increase in the north. This suggests a potential shift in landslide risk from the south to the north of Europe (Annex 2, Table A- 23).

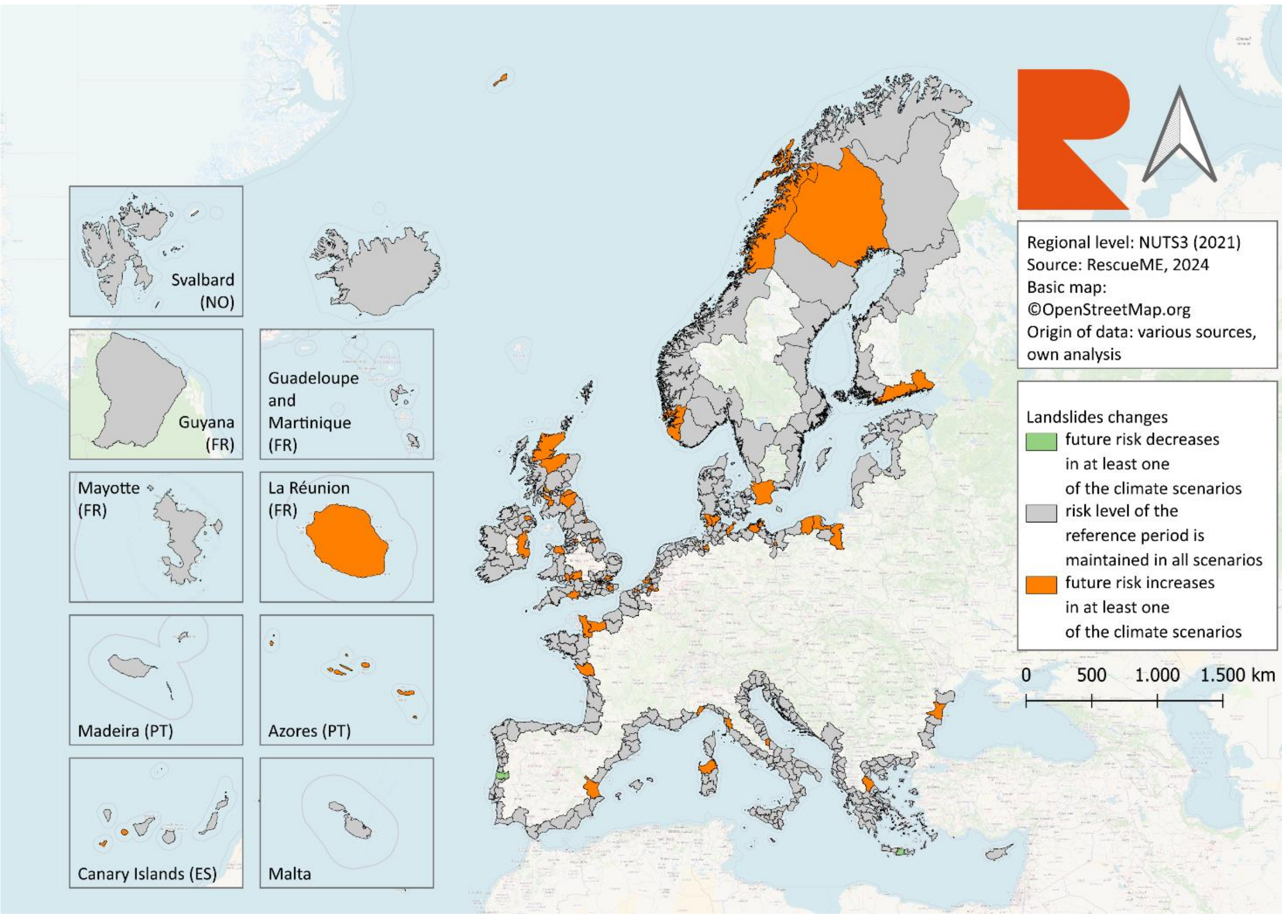

Figure 13: Future evolution of the NUTS3 risk indices with respect to the 1981-2010 risk index for landslides.

RISK OF COASTAL FLOODS ON CULTURAL LANDSCAPES

Risk in the reference period (1981-2010)

In the 1981-2010 reference period a total of 433 regions (84.4 %) features a low (35.3 %) or medium (49.1 %) relative risk for coastal flooding. In 58 regions (11.3 %) the risk is high and in 21 (4.1 %) the risk is low. Only in one of the regions (0.2 %) the risk is very high (Annex 2, Table A- 24).

Looking at the 25 regions with the highest risk of coastal flood hazard in the reference period, it can be deduced that in all of them the risk is high, except in one (Venice), which is very high (Annex 2, Table A- 25). The countries with the highest number of regions at high risk are Italy (7), France (6) and Spain (6). Their vulnerability ranges from medium to very high value. Regarding exposure, the risk classes observed, in order of highest to lowest frequency, are very high, high, and medium.

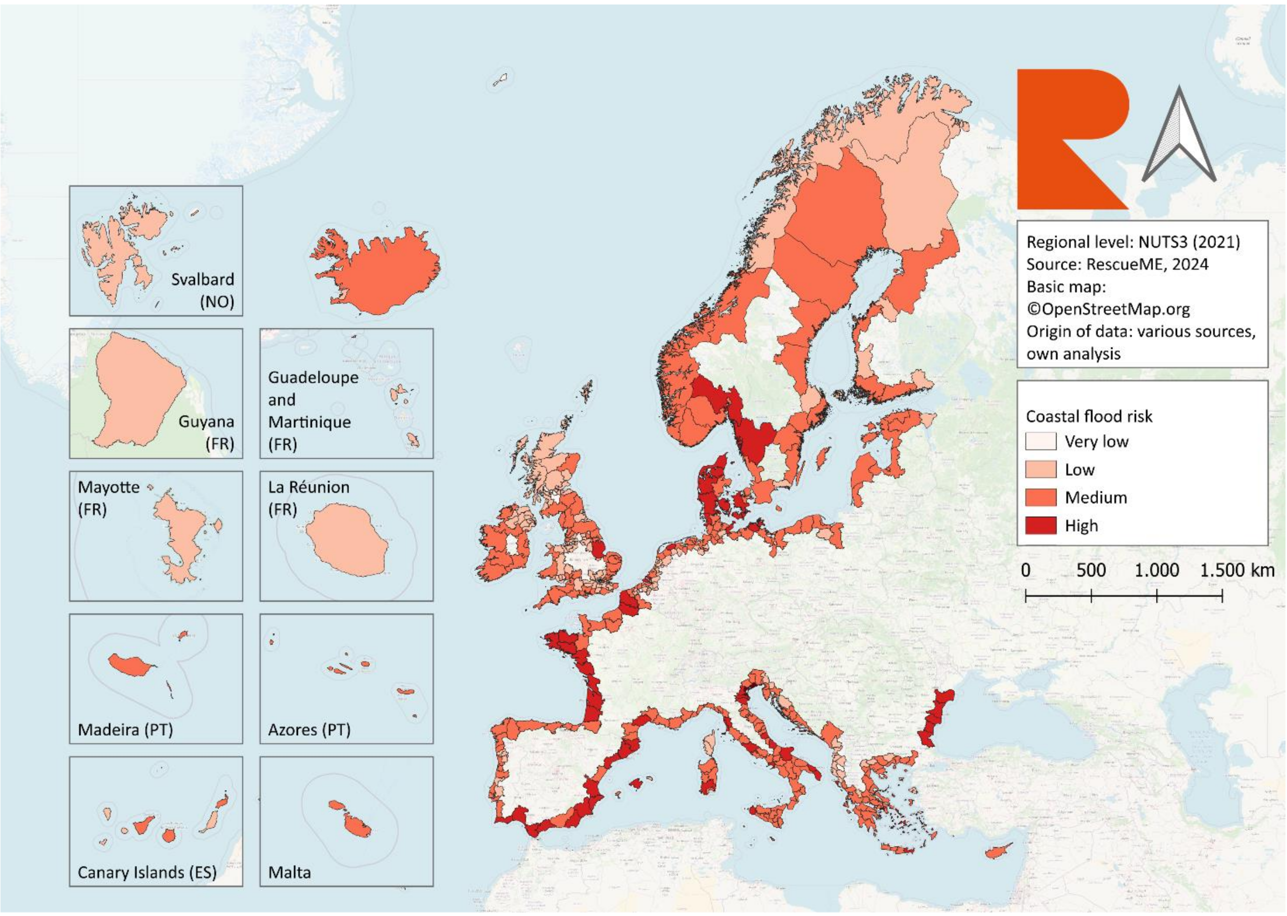

Figure 14: Relative risk for coastal floods in the 1981-2010 reference period.

In Bulgaria and Romania all regions have a high relative risk in the reference period 1981-2010. They are followed, although far behind, by Denmark (45.5 %), Spain (35.5 %) and France (35.5 %) (Annex 2,
Table A- 26). As mentioned above, only the region of Venice has a very high relative risk in the reference period, which represents 1.5 % of the regions in Italy (Annex 2,
Table A- 27).

Future period risk (2071-2100) under climate change scenarios

Looking at the evolution of the risk under future climate change scenarios (RCP 4.5 and RCP 8.5, as there are no data for the RCP 2.6 scenario for this hazard), it can be seen that in the vast majority of regions (466), i.e. 90 8 % of the total NUTS analyzed, the risk would

increase in both scenarios, in 31 (6 %) it would remain similar in both scenarios and in 12 (2.3 %) it would increase only in the RCP 8.5 scenario. In four regions the future risk could be lower than in the reference period. This means, given a constant floodable area, the frequency of inundation of this area in one of the future scenarios would be lower than in the reference period. (Figure 15 and Annex 2,
Table A- 28).

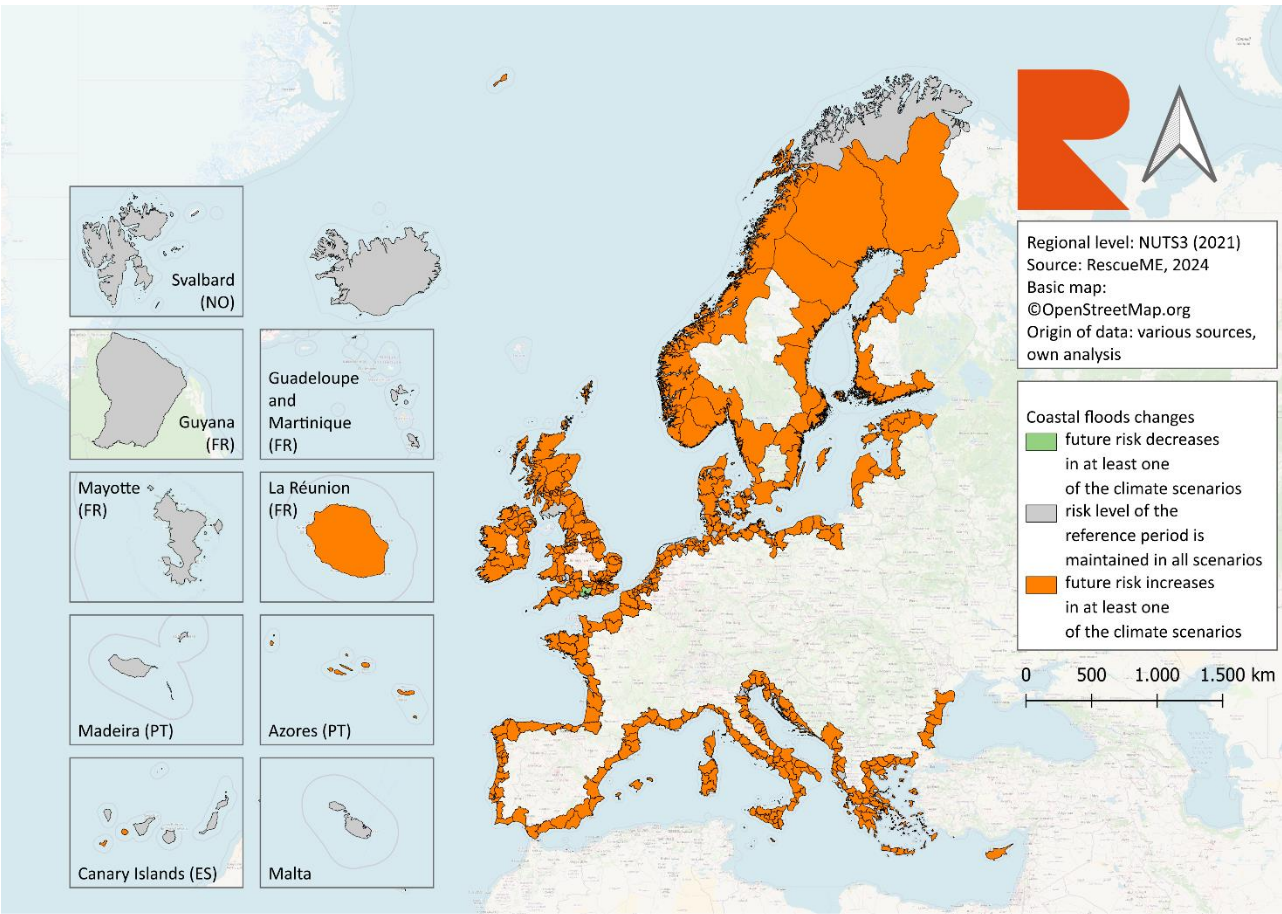

Figure 15: Future evolution of the NUTS3 risk indices with respect to the 1981-2010 risk index for coastal floods.

100 % of the regions in Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, France, Greece, Ireland, Latvia, Lithuania, Malta, Montenegro, Poland, Romania and Slovenia experience an increased risk in the two climate scenarios analyzed (RCP 4.5 and RCP 8.5). However, in Sweden, Italy, the Netherlands, Albania, Finland, Germany, the UK, and Portugal the percentage is also significant, at around 90 %. The Scandinavian countries of Finland, Norway, and Sweden each have one region, representing 11.1 %, 8.3 % and 7.1 % of their NUTS, respectively, where the risk would remain the same for the RCP 4.5 scenario, but would increase for the RCP 8.5 scenario. Finally, Spain (29 % of its regions) and especially Iceland (100 %) would mainly maintain in both future scenarios the level of risk already present in the reference period (Annex 2, Table A- 29).

RISK OF DROUGHTS ON CULTURAL LANDSCAPES

Risk in the reference period (1981-2010)

Many NUTS3 regions (47.9 %) feature low to very low-risk levels for the reference period. However, a significant portion of the regions (26.1 %) exhibit high to very high-risk levels. This suggests that while many regions in Europe were relatively safe from the impacts of droughts in the reference period, there was still a substantial number of regions that could be severely affected (Figure 16 and Annex 2, Table A- 30).

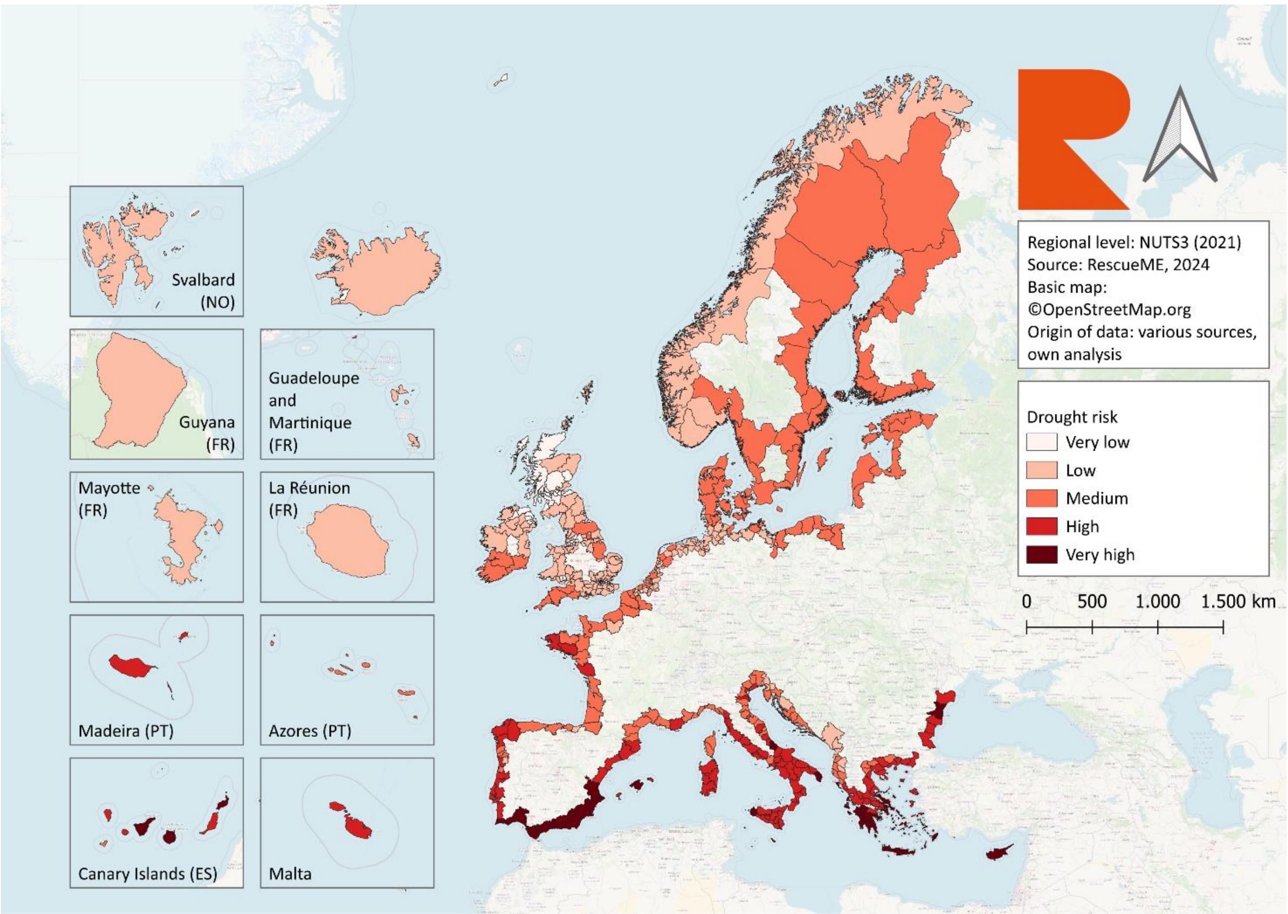

Figure 16: Relative risk for droughts in the 1981-2010 reference period.

In absolute numbers, Italy (43.9 % of the total high-risk regions), Greece (25.5 %), and Spain (12.2 %) were the countries with the most regions at high risk of droughts. Greece (50 %) and Spain (33.3 %) also have the most regions at very high risk (Annex 3, Table A-31, Table A-32, and Table A-33). However, when we analyze the numbers in relation to the percentage of regions that were in high or very high risk, it's worth noting that countries like Bulgaria, Malta, Romania, and Cyprus had all their regions at risk. With this relative perspective, Italy

(69.7 % of their coastal regions' risk was high or very high), Spain (77.4 %), and especially Greece (91.5 %) remained the most endangered countries.

Future period risk (2071-2100) under climate change scenarios

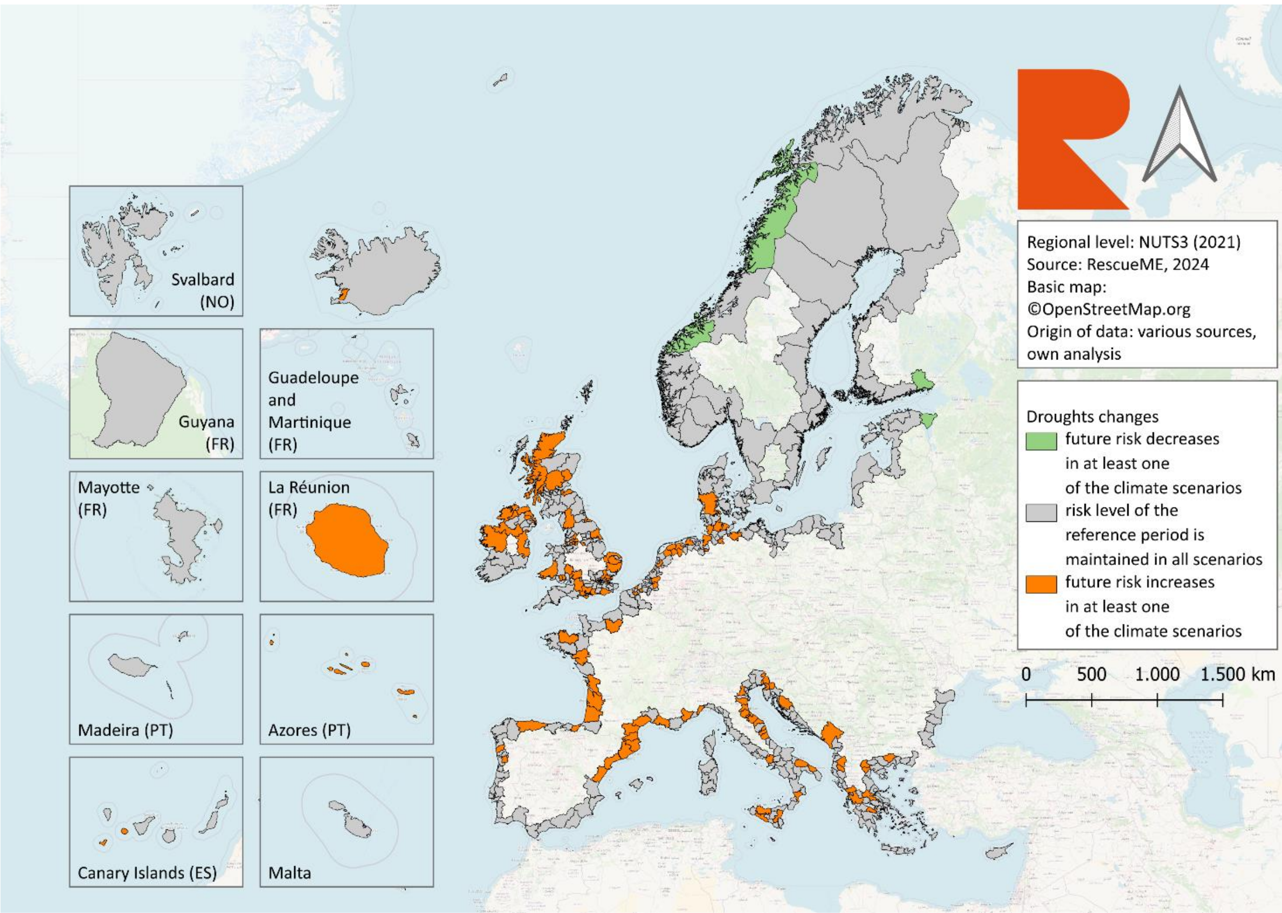

Figure 17: Future evolution of the NUTS3 risk indices with respect to the 1981-2010 risk index for droughts.

Comparing the projected future risk evolution of droughts for NUTS3 regions in Europe under different Representative Concentration Pathway (RCP) scenarios for the period 2071-2100 with the reference period 1981-2010, the majority of the regions (73,68 %) will not increase their level of risk and 371 regions (the majority) are expected to have an equal level of risk across all future scenarios (RCP 2.6, RCP 4.5, and RCP 8.5; Figure 17 and Annex 2,

Table A- 34). This suggests that these regions might not see a significant change in drought risk due to climate change, based on the scenarios considered. 62 regions are projected to maintain an equal level of risk under RCP 2.6 and RCP 4.5 but have a higher risk under RCP 8.5. 41 regions are expected to have an equal risk under RCP 2.6, but a higher risk under RCP 4.5 and RCP 8.5. This suggests that these regions could face increased drought risks even under moderate increases in greenhouse gas concentrations. 28 regions are projected to have a higher risk under all future scenarios. These regions are likely to see increased drought risks regardless of the trajectory of greenhouse gas concentrations. Therefore, while many regions might not see a significant change in drought risk, a substantial number of regions could face increased risks, particularly under higher greenhouse gas concentration scenarios.

In absolute numbers, the United Kingdom, Italy, and Germany are the countries with the most regions that could face increased risks of droughts in the future (Annex 2,
Table A- 35). Compared to the reference period 1981-2010, the United Kingdom has 32 regions that are expected to have a higher risk under at least one of the future scenarios. Italy follows with 19 regions projected to have a higher risk under at least one of the future scenarios. Germany has 6 regions expected to have a higher risk under at least one of the future scenarios and Greece has 8 regions projected to have a higher risk under at least one of the future scenarios. However, when we analyze the numbers concerning the percentage of regions, it's worth noting that all the regions from Slovenia and Montenegro are expected to have a higher risk under at least one of the future scenarios. With this relative perspective, Iceland, (half of their coastal regions increase their risk in at least one scenario), Ireland (42.9 %), France (35.5 %), Germany (33.3 %), and Italy (28.8 %) will be the countries with a higher percentage of regions with an increase in their risk. endangered countries.

RISK OF WILDFIRES ON CULTURAL LANDSCAPES

Risk in the reference period (1981-2010)

For the reference period, the risk classes for wildfires were distributed as follows: 18.7 % of the regions have a very low risk, 40.2 % have a low risk, 9.6% have a medium risk, 24.6 % have a high risk, and 7 % have a very high risk (Figure 18 and Annex 2,
Table A- 36).

The 25 NUTS3 regions with the highest relative risk for wildfires were located in Spain (7 regions), Greece (6 regions), Italy (5 regions), Cyprus (1 region), France (1 region), Portugal (1 region), and Romania (1 region) (Annex 2, Table A- 37).

When we look at the absolute number of NUTS3 regions per country (Annex 2,
Table A- 38,
Table A- 39) with a high relative risk for wildfires, Italy had the most with 54 regions, followed by Greece with 34 regions, Portugal with 11 regions, France with 9 regions, Spain with 8 regions, Croatia with 5 regions, Bulgaria with 3 regions, and Malta and Romania each with 1 region. For the very high relative risk category, Greece had the most NUTS3 regions with 13,

followed by Spain with 11, Italy with 8, and Cyprus, France, Portugal, and Romania each with 1 region. However, when we analyze the numbers with the percentage of regions that were at high or very high risk, similarly to the droughts, countries like Bulgaria, Romania, and Cyprus had all their regions at risk. It´s worth noting that this is also the case in Greece. With this relative perspective, Italy (93.3 % of their coastal regions' risk was high or very high), Spain (77.4 %), and Portugal (80 %) remained the most endangered countries considering the risk of wildfires.

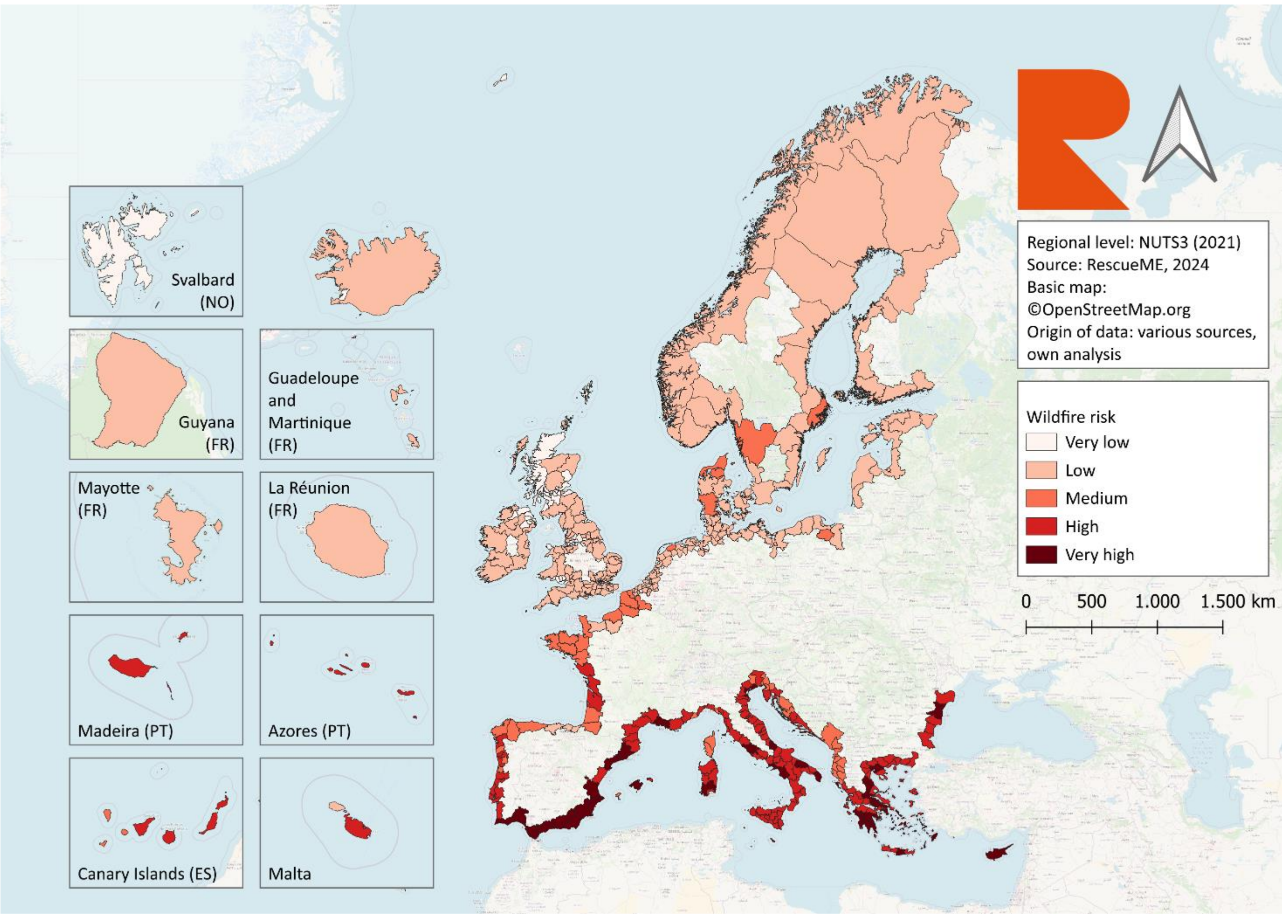

Figure 18: Relative risk for wildfires in the 1981-2010 reference period.

Future period risk (2071-2100) under climate change scenarios

Comparing the projected future risk evolution of wildfires for NUTS3 regions in different countries in Europe under different Representative Concentration Pathway (RCP) scenarios for the period 2071-2100 with the reference period 1981-2010 the majority of regions (82.5 %) are expected to maintain an equal level of risk across all future scenarios (RCP 2.6, RCP 4.5, and RCP 8.5; **Figure 19** and Annex 2,
Table A- 40). However, a significant number of regions are projected to face increased risks. Specifically, 30 (5.9 %) regions are projected to have a higher risk under all future scenarios

and 20 regions (3.9 %) are expected to have a higher risk under RCP 4.5 and RCP 8.5. 6 scenarios.

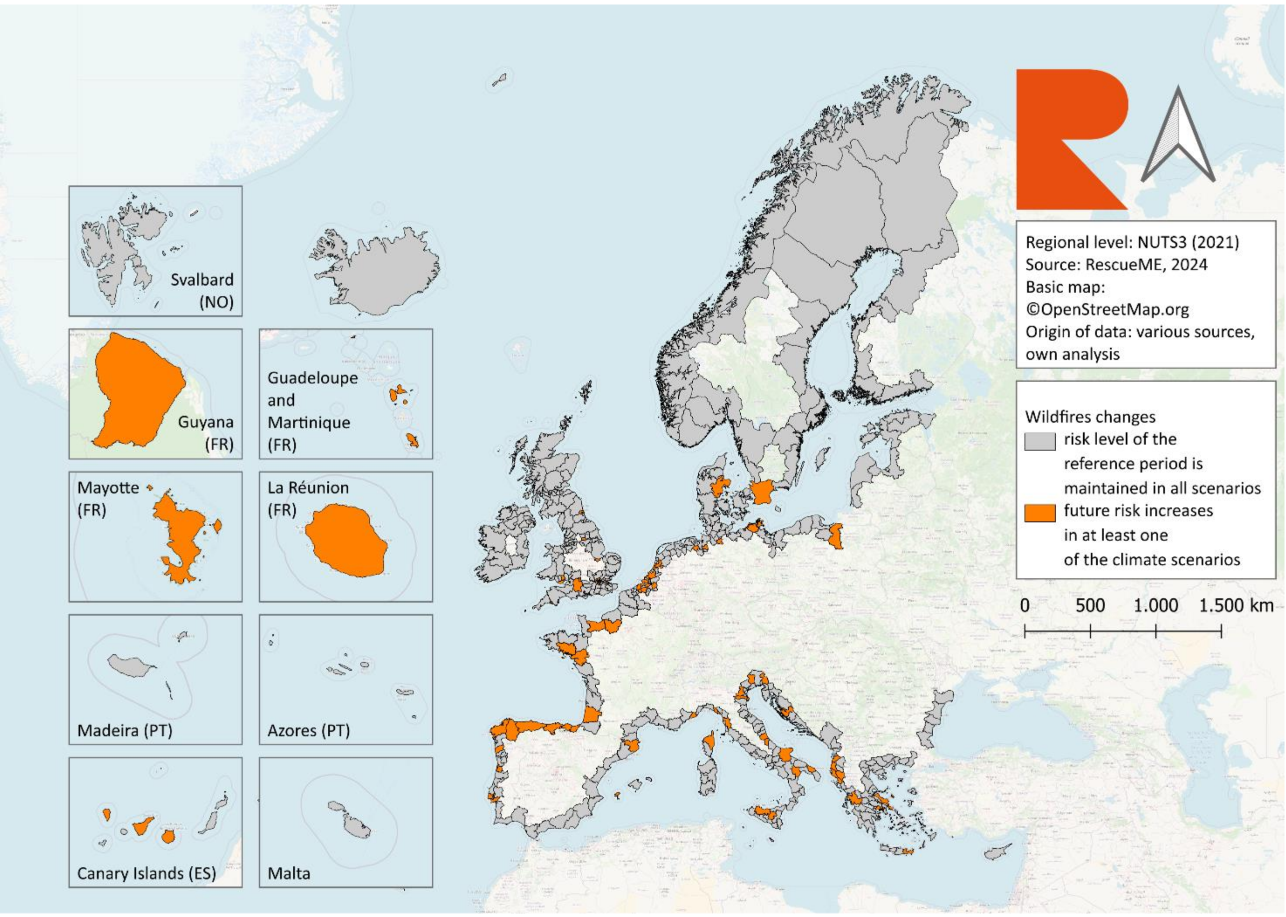

Figure 19: Future evolution of the NUTS3 risk indices with respect to the 1981-2010 risk index for wildfires.

When we look at the absolute number of NUTS3 regions per country with a higher risk under at least one of the future scenarios (Annex 2, Table A- 41), the United Kingdom has the most with 20 regions, followed by Italy with 13 regions, Spain with 11 regions, Germany with 6 regions, France with 5 regions, the Netherlands with 5 regions, Greece with 3 regions, and Belgium, Denmark, Poland, Portugal, and Slovenia each with 1 region. These projections suggest that while many regions might not see a significant change in wildfire risk, a substantial number of regions could face increased risks, particularly under higher greenhouse gas concentration scenarios.

However, when we analyze the relative numbers in percentage of regions per country, Albania stands out being the country with most regions with an increase of the risk in at least one scenario (44.4 % of their coastal regions). It is notable also in the cases of Spain and France where more than a third of their regions could expect an increase in the risk (35.5 % and 35.5 % respectively).

Risk of heatwaves on cultural landscapes

Risk in the reference period (1981-2010)

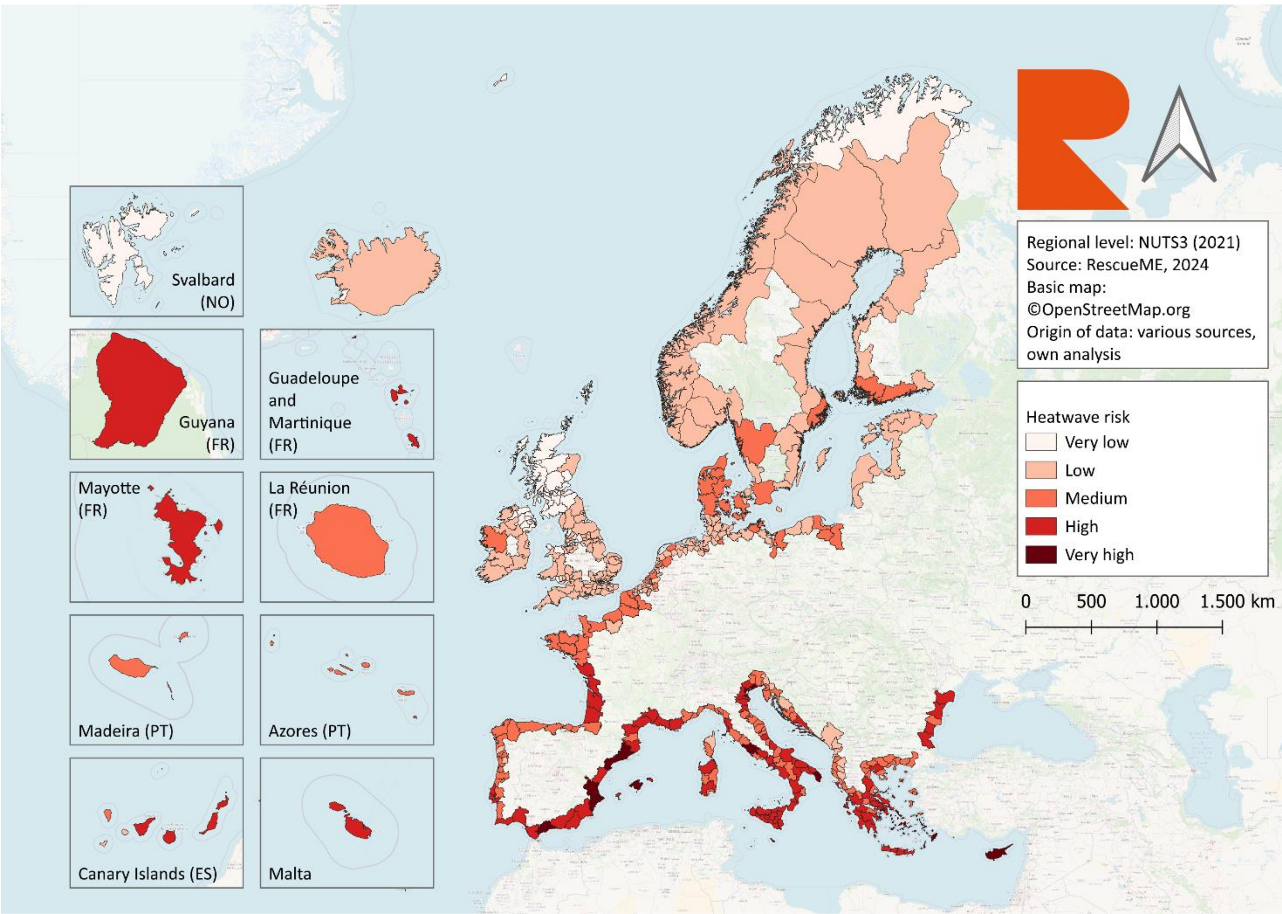

Figure 20: Relative risk for heatwaves in the 1981-2010 reference period.

For the reference period, the risk classes were distributed as follows: 18.5 % of the regions have a very low risk, 37.6 % have a low risk, 23% have a medium risk, 18.3 % have a high risk, and 2.5 % have a very high risk (Figure 20 and Annex 2,
Table A- 42).

The 25 NUTS3 regions with the highest relative risk for heatwaves were located in Spain (6 regions), Greece (5 regions), Italy (5 regions), and Cyprus (1 region) (Annex 2, Table A- 43).

When we look at the number of NUTS3 regions per country (Annex 2, Table A- 44) with a high relative risk for heatwaves, Italy had the most with 34 regions, followed by Greece with 24 regions, France with 13 regions, Spain with 13 regions, Portugal with 3 regions, Bulgaria with 2 regions, Malta with 2 regions, Romania with 2 regions, and Croatia with 1 region.

For the very high relative risk category (Annex 2, Table A- 45), Spain had the most NUTS3 regions in absolute numbers with 6, followed by Greece with 3, Italy with 3, and Cyprus with 1 region. These results suggest that Italy, Greece, and Spain were the countries with the most regions at high risk of heatwaves. These countries, along with France, Portugal, Bulgaria, Malta, Romania, and Croatia, also had a significant number of regions at very high risk in absolute numbers.

Nevertheless, when we analyze the numbers with the percentage of regions that were at high or very high risk, similarly to the droughts and wildfires analyzed before, countries like Romania and Cyprus had all their regions at risk together with Malta. With this relative perspective, Bulgaria (66.7 % of their coastal regions' risk was high or very high), Spain (61.3%), Greece (57.5 %) and Italy (56 %) remained the most endangered countries considering the risk of heatwaves.

Future period risk (2071-2100) under climate change scenarios

When looking at projected future risk evolution of heatwaves for NUTS3 regions in different countries in Europe under different Representative Concentration Pathway (RCP) scenarios for the period 2071-2100, compared to the reference period 1981-2010, we see that only the 37.2 % of the regions (191) are expected to maintain an equal level of risk across all future scenarios (RCP 2.6, RCP 4.5, and RCP 8.5; Figure 21 and Annex 2, Table A- 46). However, a significant number of regions are projected to face increased risks. Specifically, 165 regions are expected to maintain an equal level of risk under RCP 2.6 and RCP 4.5, but have a higher risk under RCP 8.5. 93 regions are projected to have a higher risk under all future scenarios. 64 regions are expected to have an equal risk under RCP 2.6 but a higher risk under RCP 4.5 and RCP 8.5.

When we look at the absolute number of NUTS3 regions per country with a higher risk under at least one of the future scenarios (Annex 2, Table A- 47), the United Kingdom has the most with 96 regions, followed by Italy with 31 regions, Spain with 15 regions, Germany with 17 regions, France with 13 regions, Netherlands with 12 regions, Greece with 13 regions, and Belgium, Denmark, Estonia, Finland, Poland, Portugal, and Slovenia each with less than 10 regions.

However, when we analyze the relative numbers in percentage of regions per country, Latvia, Lithuania and Montenegro stand out being the countries where all the regions could increase the risk in at least in one scenario. It is noteworthy that also for all the regions of Sweden an increase of risk can be expected. In addition, a significant number of countries have more than 70 % of the regions with an expectancy of increasing their risk in the future: Finland (88.9 %), Belgium (85.7 %), Denmark (81.8 %), Germany (75 %), Estonia (75 %), Croatia (71.4 %) and Ireland (71.5 %) for example.

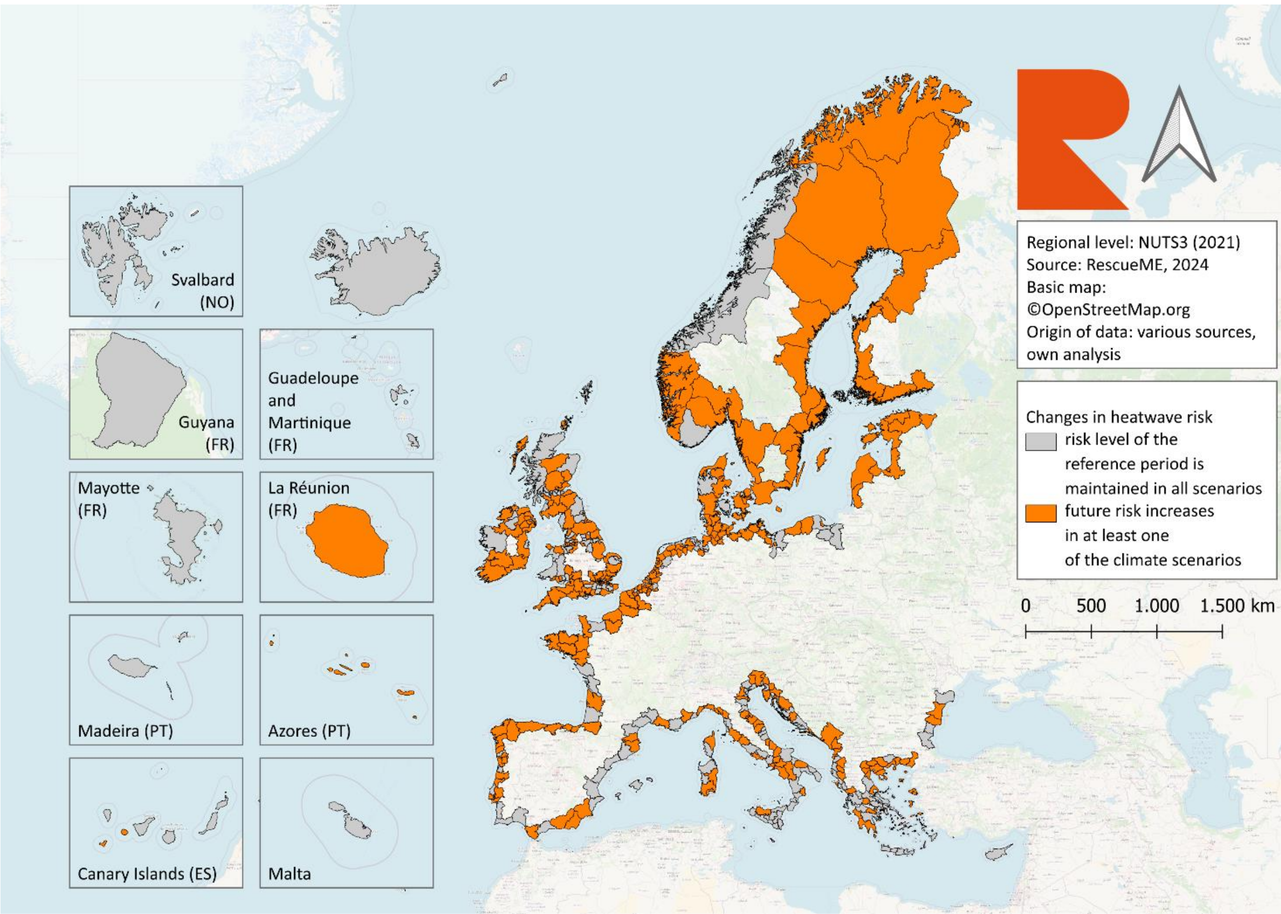

Figure 21: Future evolution of the NUTS3 risk indices with respect to the 1981-2010 risk index for heatwaves.

Risk of poor air quality on cultural landscapes

Risk for current period

According to these data (future scenarios could not be calculated for poor air quality risk), the majority of the NUTS3 coastal cultural landscape regions (76.5 %) had low to medium-risk levels of poor air quality. In any case, a significant portion of the regions (21.9 %) have high to very high-risk levels of poor air quality. This suggests that while many regions in Europe might have relatively acceptable air quality currently, there was still a substantial number of regions exposed to air pollutants (Figure 22 and Annex 2, Table A- 48).

Additionally, some geographical conclusions can be extracted. First, poor air quality is very much related to the industrialized regions around Europe. Also, northern coastal cultural landscapes (those in United Kingdom, Ireland, Iceland, Norway, Sweden, and Finland) suffer less air pollutants stressors than other regions due to their higher large extents of lands and more rural areas.

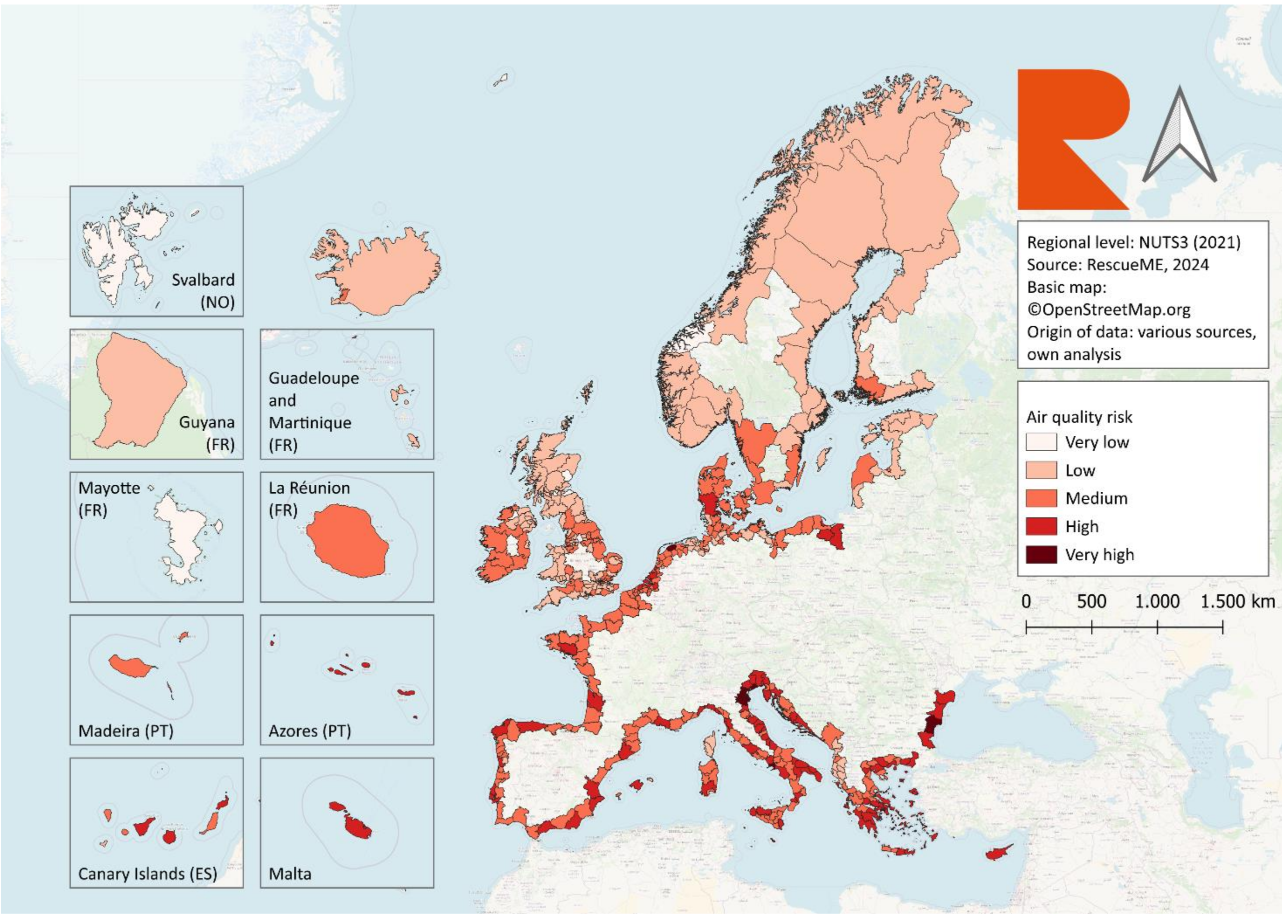

Figure 22: Relative risk for poor air quality in 1981-2010 reference period.

On the other hand, some southern and eastern regions face higher levels of air pollution, probably due to their exposure of population and infrastructure. In terms of specific countries, Cyprus, Malta, and Romania have 100 % of their regions facing a high relative risk for poor air quality. Croatia follows with 71.4 % of its regions under high risk, while Greece and Italy have 61.7 % and 50 % respectively. Spain and Poland also have a significant proportion of their regions (35.5 % and 37.5 % respectively) facing high poor air quality risk. When considering regions with a very high relative risk for poor air quality, Bulgaria stands out with 66.7% of its regions falling into this category. Italy and the Netherlands also have regions with very high risk, but these constitute a smaller proportion of their total regions (7.6 % and 4.2 % respectively).

Moreover, the majority of the NUTS3 coastal cultural landscapes with very high pollutants stressors are located in the Mediterranean area (Annex 2, Table A- 49, Table A- 50, Table A- 51).

SYNTHESIS

The previous section has carried out an analysis of some of the most significant risks that our European cultural landscapes (CL) face for a reference period (1981-2010) and future scenarios (a low emissions scenario (RCP 2.6) for the period 2071-2100, a medium emissions scenario (RCP 4.5) for the period 2071-2100 and a high emissions scenario (RCP 8.5) for the period 2071-2100) at NUTS 3 level. In total 513 coastal regions have been analyzed, and the considered risks have been pluvial, river and coastal floods ("too much water"), droughts ("not enough water"), heatwaves and wildfires, together with landslides and poor air quality. As a result of this analysis, in the reference period the mayor risk were river floods (with 46.6 % of the NUTS regions considered to be in the high or very high-risk class), landslides (35.5 %) and wildfires (31.6 %). But due to climate change there is going to be a change in the risk profile of European coastal CL, were 90.8 % of the total regions analysed are going to exhibit an increase in risk regarding coastal floods for all scenarios and 62.8 % of the regions will feature an increase in risk regarding heatwaves at least in one of the scenarios.

The analysis of the risk components (Adaptive Capacity (AC), Sensitivity (SE), Vulnerability (VU), Exposure (EX) and Hazard (HZ)) of the 25 most endangered regions for each risk reveals different risk element profiles. Consequently, the strategies to enhance resilience also have to be different.

Some of the risks are mainly due to their hazard component. The most outstanding case is the river floods were in all cases the hazard was considered very high (see Figure 23).

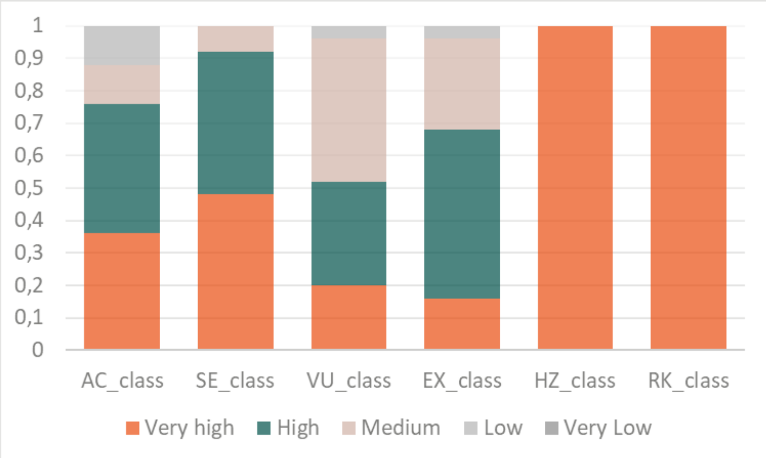

Figure 23: Risk profile of the 25 most endangered regions by river floods (AC = Adaptive Capacity, SE = Sensitivity, VU = Vulnerability, EX = Exposure and HZ = Hazard)

Similar cases are the droughts (92 % of the cases with very high hazard component), landslides (with 96 % of the cases with very high or high), and wildfires (with 92 %). In the case of the wildfires is noteworthy that the 96 % of the analysed regions had a very high or high vulnerability (Figure 24).

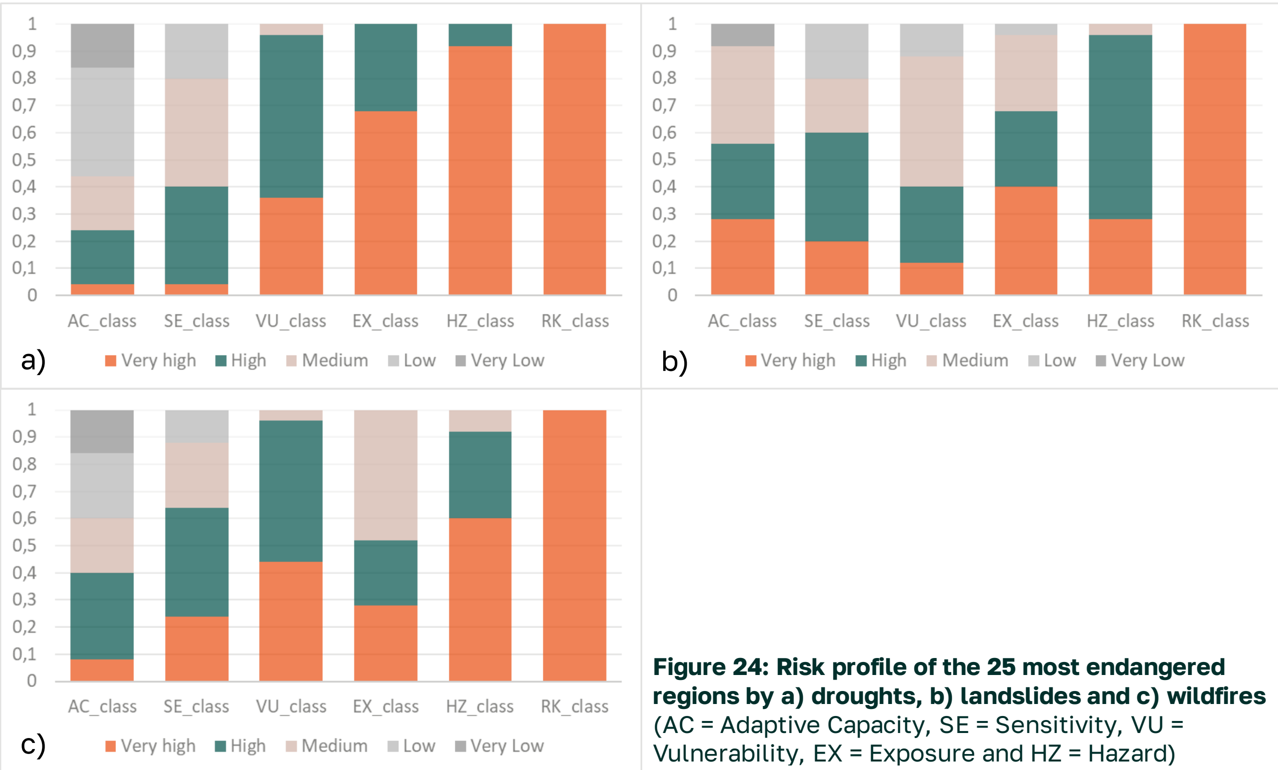

Figure 24: Risk profile of the 25 most endangered regions by a) droughts, b) landslides and c) wildfires (AC = Adaptive Capacity, SE = Sensitivity, VU = Vulnerability, EX = Exposure and HZ = Hazard)

In the case of coastal flooding, the risk comes mainly from sensitivity and exposure (88 % of high or very high in both cases, Figure 25). This is important in order to design strategies for this risk that is going to affect all coastal CL.

The other risk that is going to affect to most of the CLs, heatwaves, also have the vulnerability (92 %) and exposure as main risk elements (60 %, Figure 25).

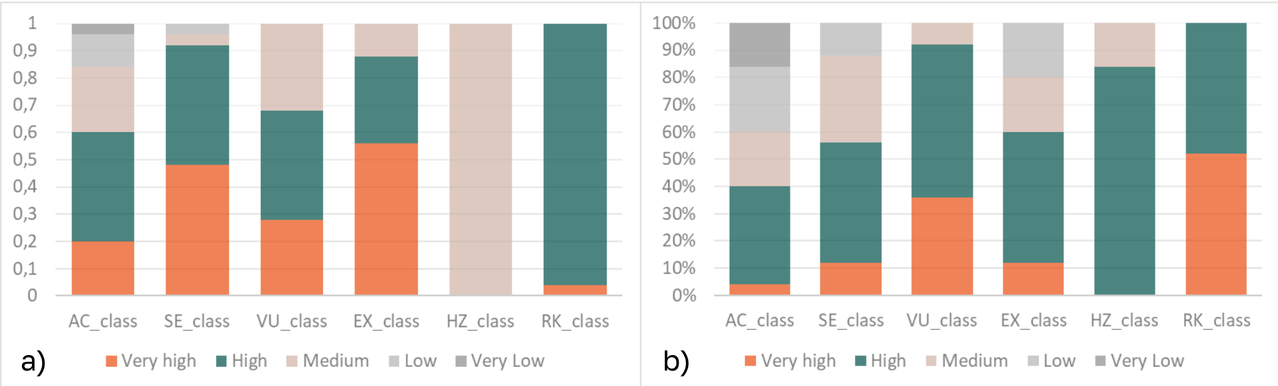

Figure 25: Risk profile of the 25 most endangered regions by a) coastal floods and b) heatwaves (AC = Adaptive Capacity, SE = Sensitivity, VU = Vulnerability, EX = Exposure and HZ = Hazard)

Finally, the pluvial floods and poor air quality have more equilibrated risk profiles (Figure 26).

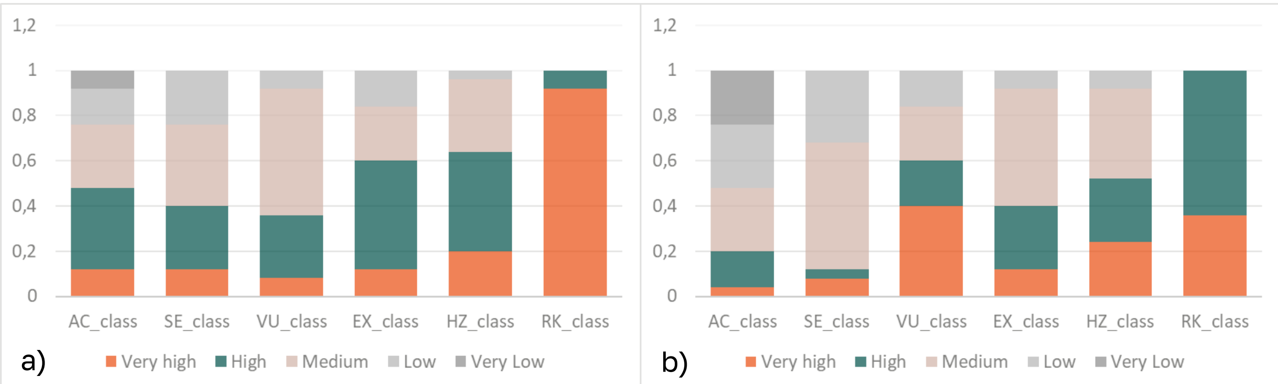

Figure 26: Risk profile of the 25 most endangered regions by a) pluvial floods and b) poor air quality (AC = Adaptive Capacity, SE = Sensitivity, VU = Vulnerability, EX = Exposure and HZ = Hazard)

3.4 Overview of losses and potential impacts of climate related risks on cultural heritage

Definition of cultural heritage losses

One of the major outcomes of the 28th UN Climate Change Conference (COP28), held recently in Dubai, is the decision on the formal establishment of the Loss and Damage Fund (UNFCCC, 2023). However, the possible inclusion of compensations for cultural heritage losses and the just fruition of these funds would require an understanding of what losses and damages entail in relation to cultural heritage.

According to the IPCC (2022) report from the working group II, losses and damages are characterized as harm resulting from observed impacts and projected risks, with a distinction made between economic and non-economic losses. Cultural heritage losses, caused by climate extremes, fall within the category of **non-economic losses**. In alignment with this perspective, both the OECD (2014) and the European Commission guidelines for damage and loss data recording (Groeve, 2015), elaborated to help countries improve the coherence and completeness of the loss data recording process, categorise cultural heritage losses as **intangible costs**. These are costs that accrue to assets without an obvious market price, making them challenging to quantify in monetary terms.

In 2015, the Sendai Framework for Disaster Risk Reduction (SFDRR) was endorsed by the UN General Assembly, with the goal of *substantially reducing disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.* To support and measure overall progress in its implementation, the Open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction (OIEWG) developed a set of 38 global indicators, which were formally adopted in 2017. Among those established to monitor progress towards achieving Global target C - *reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030* - indicator C-6 covers *Direct economic loss to cultural heritage damaged or destroyed attributed to disasters* (UNDRR, 2016).

However, in its technical guidance document to SFDRR, the UNDRR, formerly UNISDR, (2017) acknowledges that the value of cultural heritage assets cannot be assessed in simple economic terms and that most losses associated with cultural heritage are intangible losses. Additionally, the document recognises that a good part of economic losses associated with cultural assets are indirect losses, mainly connected to future income losses associated with tourism, culture, and recreation.

To address this complexity, the UNDRR proposes an evaluation of at least a portion of direct economic loss, making a distinction between "non-movable" assets such as buildings, monuments, and fixed infrastructure, and "movable" elements such as art and historical artifacts. Thus, no specific reference was made regarding cultural landscapes. The proposed indicators include the cost of rehabilitation/restoration, real estate market value, and the number of cultural heritage assets destroyed. However, for "movable" artefacts, the document recommends a case-by-case evaluation of the value of each cultural heritage.

Lack of data on losses to cultural heritage

Due to such complexity of data collection and harmonisation, coupled with unavailability of adequate methodology for a comprehensive assessment of losses and damages to cultural heritage (Romão et al., 2020), the current state of data collection on the impacts of hazardous events on cultural heritage properties is not systematic.

The existing databases at the EU level, such as the GIS-based Risk Data Hub of the European Commission Disaster Risk Management Knowledge Centre (DRMKC), or globally, like the DesInventar platform of UNDRR and the International disaster database (EM-DAT[12]), offer systematic historical loss and damage data. However, at present, these databases do not differentiate economic losses associated with cultural heritage from the overall economic losses. Also, it is currently unclear the progress of the Sendai indicator C-6, as the SFDRR monitor platform[13] is under maintenance for Target C.

Information on damages and losses to cultural heritage is scarce and currently dispersed among various agencies, including national[14] and research initiatives (European Commission, 2022).

One of such research initiatives is DALIH (Damage and Loss Inventory for Heritage)[15], developed within the RIACT project and funded by FEDER, aims at a systematic and standardized recording of cultural heritage disaster-related data, from both natural and man-made hazards. It focuses on immovable cultural heritage supported by international

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[12] https://www.emdat.be/
[13] https://sendaimonitor.undrr.org/
[14] The examined national databases mainly focus on identifying heritage at risk rather than estimating losses to heritage. For example, see the database of Vincoli in rete promoted by the Italian Ministry of Cultural Heritage and IdroGeo database.
[15] https://dalih.org/app/#/statistics

institutions such as UNESCO, ICOMOS, ICCROM or ICOM (e.g., World Heritage sites, IUCN Protected Areas). It focuses on heritage properties listed as World Heritage, protected by the Hague Convention, National Heritage, Sub-National Heritage, Local Significance Heritage, and IUCN protected area. DALIH relies on information from disaster databases, as detailed in Romão et al (2022), and is currently in the development phase. Although it already provides some statistical information, including affected properties by lost cultural value (Figure 27) and damage level (Figure 28), the statistics are not yet complete and lack some functionalities.

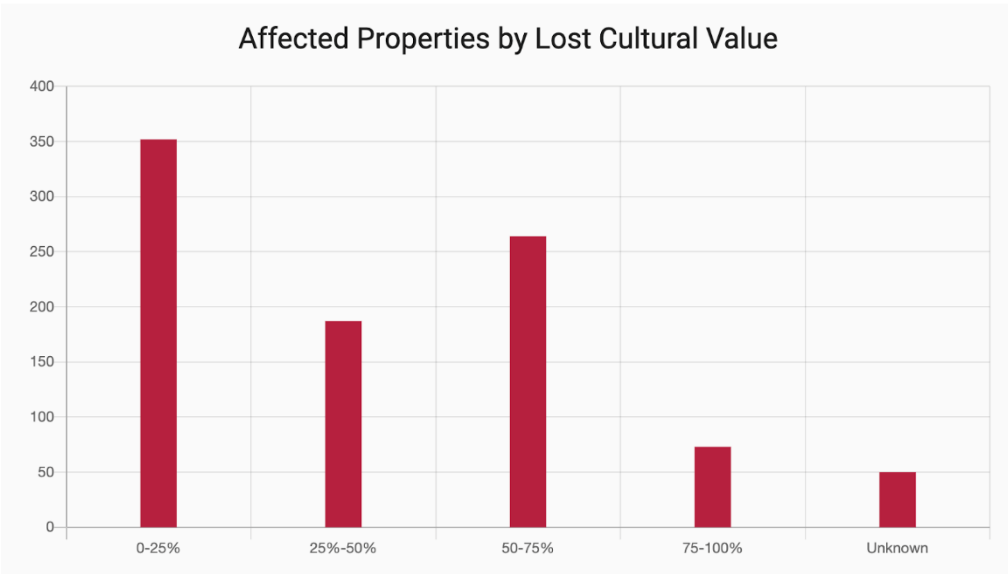

Figure 27: Affected properties by lost cultural value across the world. y-axis: number of affected properties; x-axis: indicator of the loss of cultural value16. Source: DALIH database (last consulted: 12.12. 2023).

[16] The indicator is scored according to 5 levels (0% - 25%; 25% - 50%; ...) that reflect an average loss across the following four categories of value including evidential, historical, aesthetic and communal value. For further information see the definitions provided on the website (https://dalih.org/app/#/statistics).

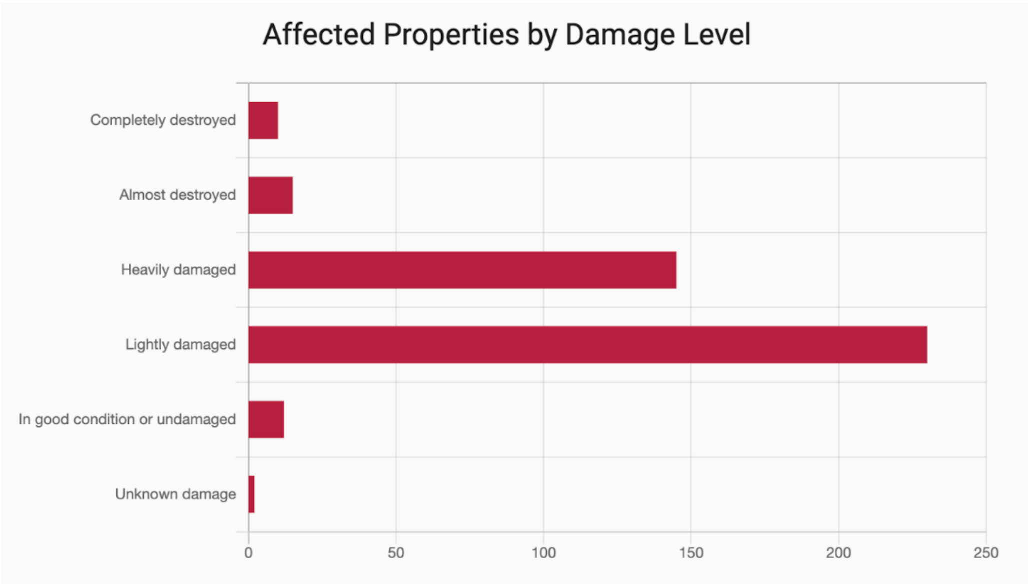

Figure 28: Affected properties by damage level. y-axis: damage levels; x-axis: number of affected properties. Source: DALIH database (last consulted: 12.12. 2023).

Projected losses to cultural heritage

The existing studies on climate-driven loss and damage predominantly concentrate on the projected losses and risks of cultural heritage and landscapes. Few have specifically focused on cultural heritage in coastal areas. Thus, using spatially explicit sea-level estimates for the next 2000 years and high-resolution topography data, Marzeion and Levermann (2014) estimated that about 6% (40 sites) of the UNESCO World Heritage (WH) sites will be affected, if the current global mean temperature were sustained for the next two millennia. These figures would escalate to 19% (136 sites) for a warming of 3 K. In a similar study focusing on the Mediterranean area, an index-based approach demonstrated that out of 49 cultural UNESCO WH sites situated in low-lying coastal areas of the Mediterranean, 37 are at risk from a 100-year flood and 42 from coastal erosion (Reimann et al, 2018). Focusing on the same geographical area but on a broader set of WH sites Kapsomenakis et al (2023) reveal that for the worst-case scenario (RCP8.5) 35 monument sites fall within the "high hazard" and 12 sites fall under the "extreme hazard" category.

The ESPON CLIMATE project (2013) - "Climate Change and Territorial Effects on Regions and Local Economies in Europe" provides data on potential impact of climate change on UNESCO WH sites. To assess the impact, it combined potential impacts of changes in inundation heights of a 100-year river flood event and a sea level rise adjusted 100-year coastal storm surge event on registered WH sites. Specifically, the impact was calculated as a combination of regional exposure to climate changes and recent data on regional sensitivity. Fluvial inundation depth changes calculated by comparing 1961-1990 and 2071-2100 projections of the LISFLOOD model based on climate projections from the CCLM model for the IPCC SRES

A1B scenario. Also, regional costal storms surge height projected by DIVA model were adjusted with 1m meter sea level rise. The data[17] highlights a few NUTS 3 regions with the highest value of potential impact, including coastal areas (e.g., Venice, Groot-Amsterdam) (Figure 29).

In the 2022 ESPON Climate[18] updates WH sites, along with museums, were examined as exposure indicators to assess the potential risk of flash floods on the cultural sector. Despite this, a comprehensive study encompassing all EU countries and focused on the NUTS 3 level has not yet been undertaken to evaluate the risk to cultural heritage and landscapes. Moreover, the current body of literature is biased towards physical science and tangible dimension of heritage with minimal input from local people on their perceptions of loss (see Pearson et al, 2023).

Conclusion

The complexity of quantifying cultural heritage losses due to climatic and non-climatic impacts poses a significant challenge. While efforts have been made to understand the nature of cultural heritage losses, the lack of comprehensive (and harmonised) data remains a major issue.

Existing databases offer some insight, but they often fail to differentiate economic losses specific to cultural heritage. Moreover, the spatial granularity of available data is limited, which hinders a detailed understanding of the potential impacts of climate related risks on cultural heritage at the local level. The initiatives such as the DALIH project, the GIS-based Risk Data Hub of the RMKC, and DesInventar platform of UNDRR aim to address this gap by standardising data collection, yet their development is ongoing.

In this view, there is a growing necessity for EU-wide systematic and harmonised data collection on losses to cultural heritage. Specifically, the harmonisation of data collection could benefit from a comprehensive set of guidelines for evaluating non-quantifiable losses to cultural heritage, such as the intangible dimension and aesthetic value, that can't be quantified in monitory terms.

17 https://database.espon.eu/indicator/602/#metadata-download
18 https://www.espon.eu/climate

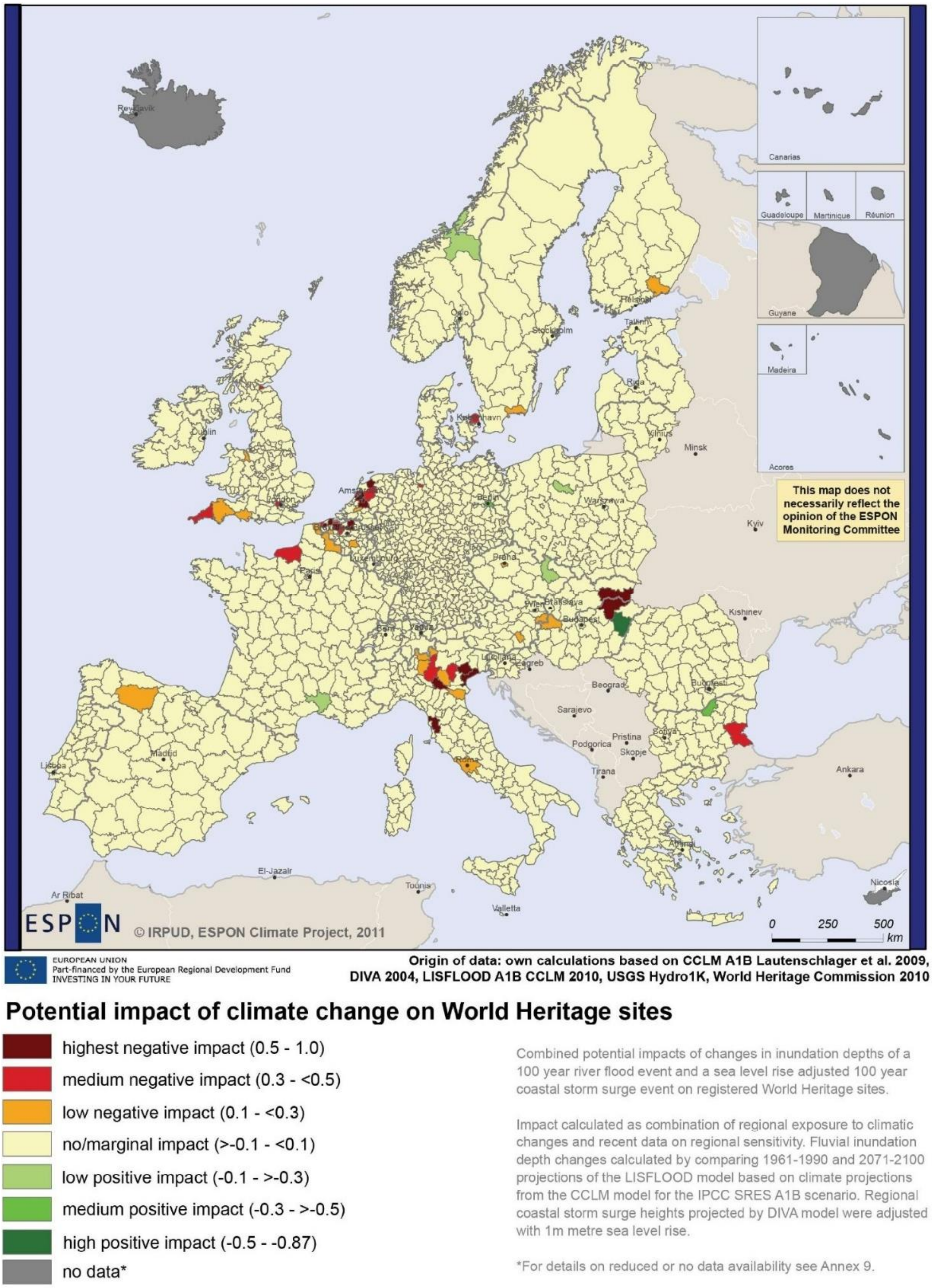

Figure 29: Potential impact of climate change on World Heritage Sites. Source: ESPON CLIMATE (2013: p. 100)

4 Benefits of investing

Climate resilience of cultural heritage and landscapes entails significant costs and thus requires structural investments and innovative financial and business strategies. As it was outlined in the Transnational brief by ESPON (2019) *"there is still a need to involve markets and to attract private investments in order to broaden the fields of benefits, unlock the value of cultural heritage into tangible revenues'* (p.4). However, the benefits of investments in cultural heritage often go beyond the quantifiable benefits, such as return on investment (ROI), increased employment rate or population growth. Moreover, financial studies and reports prepared by the public sector are rare and a return on financial investment is seldom expected (Tišma et al., 2022). This issue is coupled with the lack of comprehensive datasets on public and private investments in cultural heritage (Lodovici et al., 2022; UNESCO Institute for Statistics, 2022; European Court of Auditors, 2020).

Previously, the interaction between EU-funded investments in cultural heritage and societal well-being, encompassing quality of life indicators, dimensions of societal cohesion, and material conditions, was examined in the context of the Espon project "HERIWELL - Cultural Heritage as a Source of Societal Well-being in European Regions" (2020-2022). Correlation analyses between the total planned allocations from the European Regional Development Fund (ERDF) for cultural heritage during the period 2014–2020 and a subset of societal well-being indicators revealed positive, albeit modest, correlations. The authors attribute these results to the intricate nature of the relationship, making it challenging to comprehend at the macro level. Additionally, they posit that the current stage might be too early to identify significant outcomes, suggesting that a more robust correlation could potentially emerge over time (Lodovici et al., 2022).

In this view, relying solely on statistical data, financial studies and economic evaluations is insufficient for comprehensively assessing the benefits of investing in cultural heritage and landscapes. In addition, the quantification of these benefits varies across regions, projects, and timeframes. Indeed, the literature on the subject reveals the variety of benefits associated with investment in cultural heritage and landscapes. These encompass the development of new employment opportunities and local businesses (Plaza et al., 2006; Finpiemonte, 2021), attraction of new investments (Burnham, B., 2022), growth in property value (Throsby, 2012), an increase in tourist arrivals (Uricheck et al., 2021), restoration, and new constructions that influence the revitalization of neighborhoods (Throsby, 2012), an increase in aesthetic value and community cohesion (Murzyn-Kupisz, 2013), preservation of place identity and intangible heritage, and biodiversity conservation (Wittman et al., 2017). In order to identify the key categories of benefits associated with investing in cultural heritage and landscapes, the projects financed by the European Investment Bank (EIB) related to cultural heritage and landscapes were examined (Please refer to the Klose et al., in prep. for the details).

The findings indicate that the **urban renewal** and **revitalization of neighborhoods** are among the most mentioned (expected) benefits of the projects, as it is demonstrated in the case of "Opernviertel Koeln" project[19], funded by the EIB in 2014 with € 127 million. This initiative entailed the extensive rehabilitation and enhancement of the municipal opera and theater complex, acknowledged as a cultural heritage site. According to the project's description, the heritage plays a catalytic role in regenerating some of Cologne's oldest inner city neighborhoods surrounding the theater complex. In the case of "Asturias Prestamo Marco" project[20], financed by EIB in 2011 with € 52,5 million, **economic growth, job creation** and competitiveness were highlighted among the benefits of small and medium-sized investments. Few projects among the broader expected benefits included **climate change mitigation** (the case of "Ambiente Urbano and Smart Firenze", € 128,8 million), **recovery** (the case of Lorca earthquake reconstruction, € 185 million), and **disaster risk prevention** (the case of "Medio ambiente y Bosques de Andalucía", € 200 million). Most of the projects related to cultural heritage and landscapes financed by the EIB concern urban territories. Among the identified projects, only the latter, "Medio ambiente y Bosques de Andalucía," concerns rural/forest landscape (see Annex 3 for detailed information on the projects).

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[19] https://www.eib.org/en/projects/pipelines/all/20130684
[20] https://www.eib.org/en/projects/all/20080763

5 Four replicable governance typologies that could characterise European Cultural landscapes

Governance structures can significantly influence the resilience of a cultural landscape, shaping disaster response and planning practices as well as stakeholder commitment. The Horizon 2020 project SHELTER (Shelter, 2023) explored this via the 'anatomy' of cultural heritage sites (Tamborrino *et al*., 2020). Within the SHELTER project, four governance typologies – i.e. different archetypical forms of governance present in cultural heritage sites – were distilled: Hierarchical Governance, Participatory and Collaborative Governance, Multi-level Governance, as well as Networking and Community-led Governance. While these four governance typologies do not consider the bespoke historic, social, economic, and environmental variables within each unique cultural heritage site, they can serve as blueprints, providing experts with starting points to explore the governance and attempt to shape it according to their unique situation.

The mixture and interplay between the unique historic, social, economic, and environmental variables of a cultural heritage site determine how governance structures operate in practice. Furthermore, governance structures are not static entities. They can be subject to changes particularly when exposed to a shift in the status quo, like a disaster event. Therefore, the dynamic nature of governance cannot be accurately quantified. In fact, it could be detrimental to do so, as 'smoothing down' the unique variables acting within a cultural heritage site might result in overlooking the fundamental context and nuances that are integral to that specific site. Critically, this means that it is not possible to give a spatial (NUTS3 level) assessment of governance typologies.

Instead, we provide a series of governance typology blueprints, by exploring the practical applications of the four governance typologies. In particular, the four governance typologies are mapped using the 'standardised key' defined by (Durrant *et al*., 2021). Figure 30 encapsulates the specific elements of the standardised key that are used. The shapes refer to a stakeholder type/group and the lines refers to the type of relationship between them.

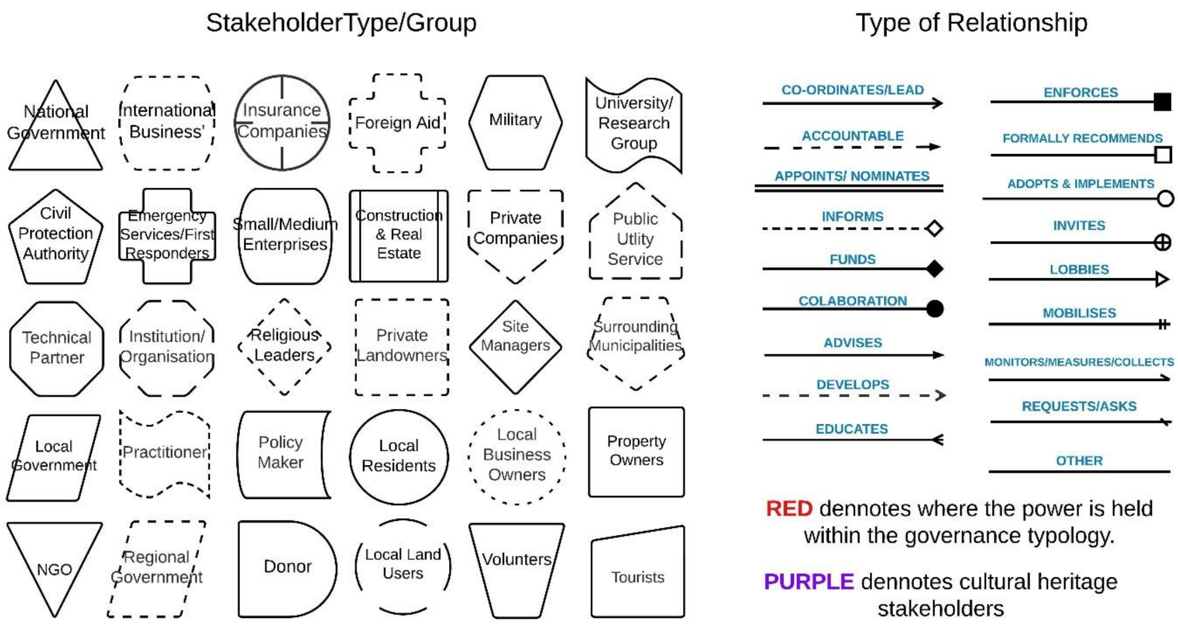

Figure 30: The 30 potential Stakeholder Groups important within Cultural Heritage Governance Adapted from Durrant et al. (2021)

Mapping the four governance typologies using the information from the standardised key allows experts from cultural landscapes to see how these typologies manifest in practice as well as which strengths and weaknesses each governance typology might have. Finally, the defining variable of these governance typologies is explored: 'Power'. In short, if governance refers to norms, behaviours, and instruments that can facilitate decision-making, then, 'Power' can be used to refer to the ability or willingness of the stakeholders within governance to implement those norms, behaviours, and instruments. The following four governance typologies are differentiated by power. Specifically, where the power in that governance typology manifests and how different stakeholders depend on that power dynamic.

Hierarchical Governance

Hierarchical Governance remains one of the most commonly and easily recognisable governance typologies regarding disaster risk reduction and climate change adaptation within cultural landscapes. The key defining feature of Hierarchical Governance is that the power within governance structure is held at a higher spatial scale. Most commonly, the power is held by the national government and the different ministries or departments that act on behalf of that government. By way of example, the Ministry of 'Environment' and The Ministry of 'Culture'. Within Hierarchical Governance, power distribution falls from the top downwards, which is why this governance structure is also commonly called a top-down approach. The top-down distribution of power can be seen in Figure 31. The connectors within Figure 31 demonstrate that the decision-making process within Hierarchical Governance filters from a higher spatial scale. Within strict Hierarchical Governance typologies, policy instruments are developed by the national government and its ministries. These policy instruments are interpreted and implemented by regional stakeholders and ultimately followed by local stakeholders. It is unsurprising that Hierarchical Governance is extremely common in disaster risk management, because in times of disaster clear leadership is instrumental in an effective response and recovery. Table 1 below outlines the core strengths and weaknesses of Hierarchical Governance. The table also highlights the Disaster Risk Management cycle phase in which Hierarchical Governance can be most useful.

Governance Typology 1 – Hierarchical Governance

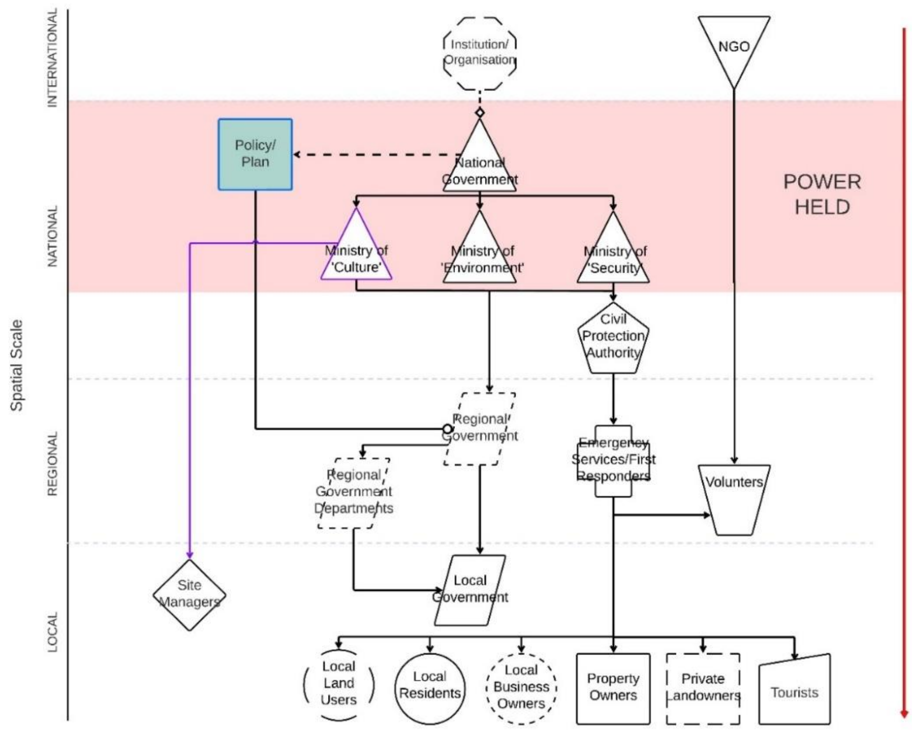

Figure 31: Practical Model of Hierarchical Governance

Table 1: Strengths and Weaknesses of Hierarchical Governance

STRENGTHS	WEAKNESSES
Hierarchical Governance can be very **efficient**. Policy instruments are defined and enforced at the national spatial scale as a result, less time, money, and	Hierarchical Governance **doesn't necessarily facilitate collaboration** between different stakeholder groups or around policy instruments.

STRENGTHS	WEAKNESSES
other resources are used in their development. Hierarchical Governance typically has **centralised leadership** from a larger spatial scale. The leadership can be vital in co-ordinating a unified disaster risk management response and recovery. Hierarchical Governance can be used to develop **formalised top-down regulation and performance evaluation**. These mechanisms can formalise horizontal collaborations between different stakeholder groups. Power is held at the higher spatial scales, which can help ensure **unity** in a wider strategy or vision.	Strict Hierarchical Governance can also **hinder innovation or the development of adaptive governance mechanisms**. If the **communication channels** underpinning Hierarchical Governance are ineffective or too complicated, they can impede the decision-making process at all phases of the disaster risk management cycle. Forms of Hierarchical Governance have been linked to **exacerbating siloed working**. Stakeholders focus vertically on the movement of power and do not communicate horizontally with other experts.

Participatory and Collaborative Governance

Participatory and Collaborative Governance typologies describe a form of governance in which one stakeholder group does not hold the power (Figure 32). Instead, this is a governance typology in which the power is held in a collaborative governance mechanism. By way of example, a workshop, committee, commission, or expert group meeting. The different governance mechanisms can be defined at different spatial scales. Furthermore, they can be standalone mechanisms used to develop scale-specific outputs or alternatives to inform another governance mechanism at other spatial scales.

The collaborative governance mechanism can be formally defined and used to co-create policies and solutions that inform decision-making in the preparedness phase of disaster risk management. Furthermore, Participatory and Collaborative Governance typologies can also inform social gatherings. However, the collaborative mechanisms must develop meaningful outputs regardless of how the governance mechanisms are established, because these mechanisms hold the power in that governance structure, and the stakeholders within that typology depend on those collaborative mechanisms to inform their work. Participatory Governance typologies are increasingly popular across academic literature, and understanding how to establish meaningful participatory and collaborative governance structures is vital in our pursuit of resilience. Participatory approaches are claimed to help facilitate more fit for purpose solutions as well as more effective and tailored DRM response in which local people participate in the different phases of DRM. Finally, more informed disaster prevention and preparedness, in which local knowledge and resources are better integrated to DRM from the outset, are fostered by participatory and collaborative structures (see Table 2 for strengths and weaknesses).

Governance typology 2 - Participatory and collaborative Governance

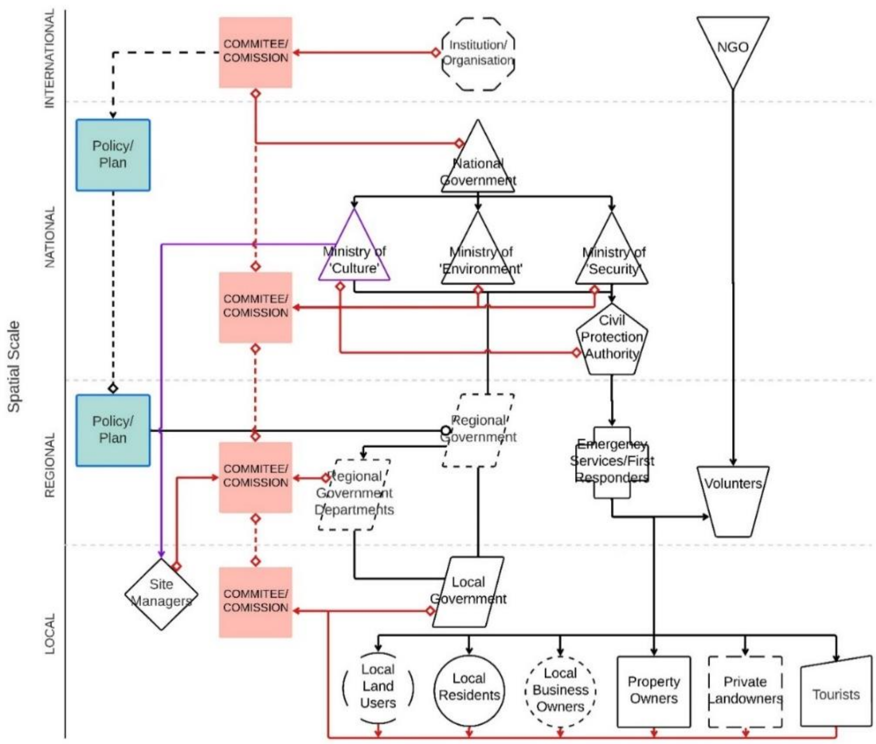

Figure 32: Practical Model of Participatory and collaborative Governance

Table 2: Strengths and Weaknesses of Participatory and Collaborative Governance

STRENGTHS	WEAKNESSES
Participatory and Collaborative Governance typologies **encourage communication between different stakeholder groups**. Enhanced communication can lead to outcomes greater than the sum of their parts. The Participatory and Collaborative Governance mechanisms that hold power can be used as meeting spaces to **overcome siloed working**. E.g., experts from cultural heritage can be involved in	Participatory and Collaborative Governance typologies are **notoriously time-consuming** and will require resources from the stakeholders to participate. Participatory and Collaborative governance typologies can **lack clear leadership**. This can make it challenging to steer decision-making and define accountability during a disaster. This governance typology thrives on the input of different stakeholder groups.

STRENGTHS	WEAKNESSES
discussions around disaster risk management or resilience. Scale-specific **issues can be identified and shared between different spatial scales** through a credible and established platform. This form of governance **facilitates more adaptive forms of governance**. As a result, it can be very helpful in DRM's preparation and prevention phase. Participatory and Collaborative Governance can **empower stakeholders** to be more involved in governance.	However, it can be difficult to get different **stakeholders to agree to a common goal**. Finally, the Participatory and collaborative mechanisms **may require outside funding** or a separate organization to maintain them.

Multi-level Governance

The next governance typology is referred to as Multi-level Governance. Multi-level Governance describes a type of governance in which one stakeholder is not the centralised node of power, but instead, the power is distributed across multiple scales of governance. The different centers of power act as independent nodes within a governance structure. By way of example, Figure 33 demonstrates a form of multi-level governance where the power is distributed by spatial scale through different scales of government. From the national government to the regional government and finally to the local government. The different government entities are still accountable to an overarching legislative framework. However, they can independently make decisions within that overarching framework without being dependent on stakeholders at the higher spatial scale. For example, a regional government must align with the national government's mandates. However, within a Multi-level Governance, the regional authority can choose how to implement that mandate (see Table 3 for strengths and weaknesses).

Governance typology 3 - Multi-level Governance

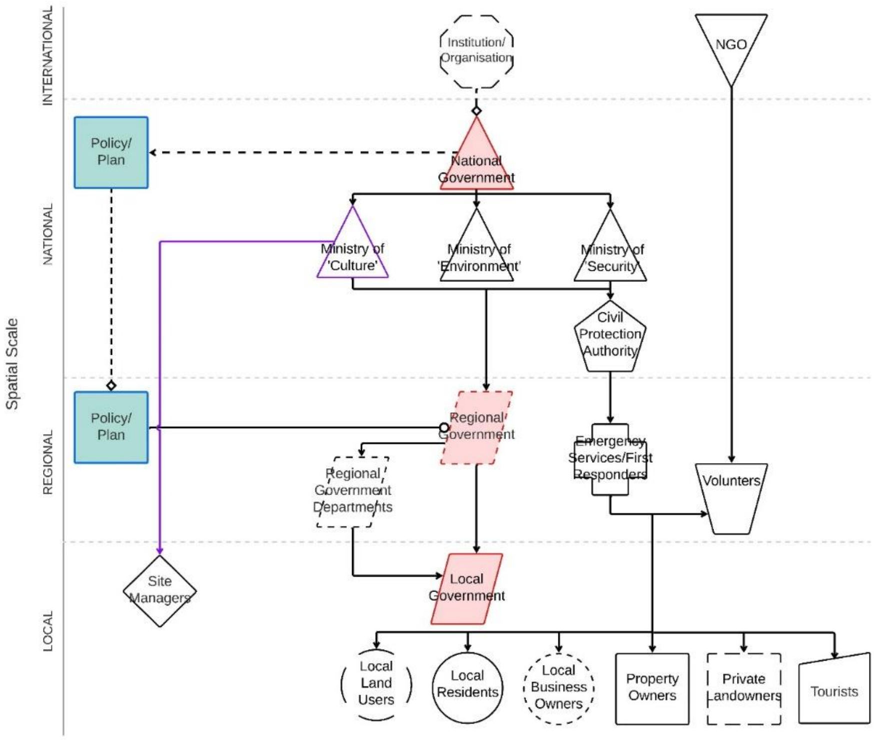

Figure 33: A Practical Model of Multi-Level Governance

Table 3: Strengths and Weaknesses of multi-level governance.

STRENGTHS	WEAKNESSES
The decentralised nature of Multi-level Governance means that there are **individual power nodes**. This means that if one node of power is destroyed or incapable of providing support, the governance structure does not collapse. This is especially useful in the response phase of Disaster risk management if one stakeholder is damaged.	Having multiple centres of power within a governance structure can **cause disagreement or conflicts of opinion** between those different centres of power. This can result in a breakdown of communication between those nodes or a potential stalemate where different centres of power are unable or unwilling to act on centre issues.
Because the power centres are decentralised, the governance **mechanism can be tailored to suit stakeholders' scale-specific requirements and needs**. This, in turn, can lead to more effective and efficient solutions.	The greater degrees of autonomy provided by Multi-level Governance may lead to **a watering down some proposals, projects, or policies**. The process of watering down may limit the long-term goals or strategy.

STRENGTHS	WEAKNESSES
Multi-level Governance can **facilitate more fit-for-purpose solutions** rather than a one-size-fits-all approach to disaster risk management. This can be helpful given the highly unique nature of some cultural and natural heritage management.	Having multi-centres of power may result **in a lack of accountability** because issues are rarely defined solely by spatial scale.

Community-led Governance

The final governance typology is called Community-led Governance. In this governance typology, the local stakeholder groups hold the power at the local spatial scale (Figure 34). Including but not limited to residents, local businesses, and neighbourhood groups. With this governance typology, the governance structures depend upon the perceptions, experience, and contributions of the local stakeholder groups. This typology is traditionally defined as bottom-up form of governance. Within this typology, the local community groups take a passive role in developing policy solutions. The local communities contribute through participatory governance approaches. Alternatively, the local spatial scale stakeholders take a more active role in the governance. By way of example, the local community group becomes frustrated with the response of other stakeholders and takes responsibility and power for themselves (see Table 4 for strengths and weaknesses).

Governance typology 4 - Networking and Community-led Governance

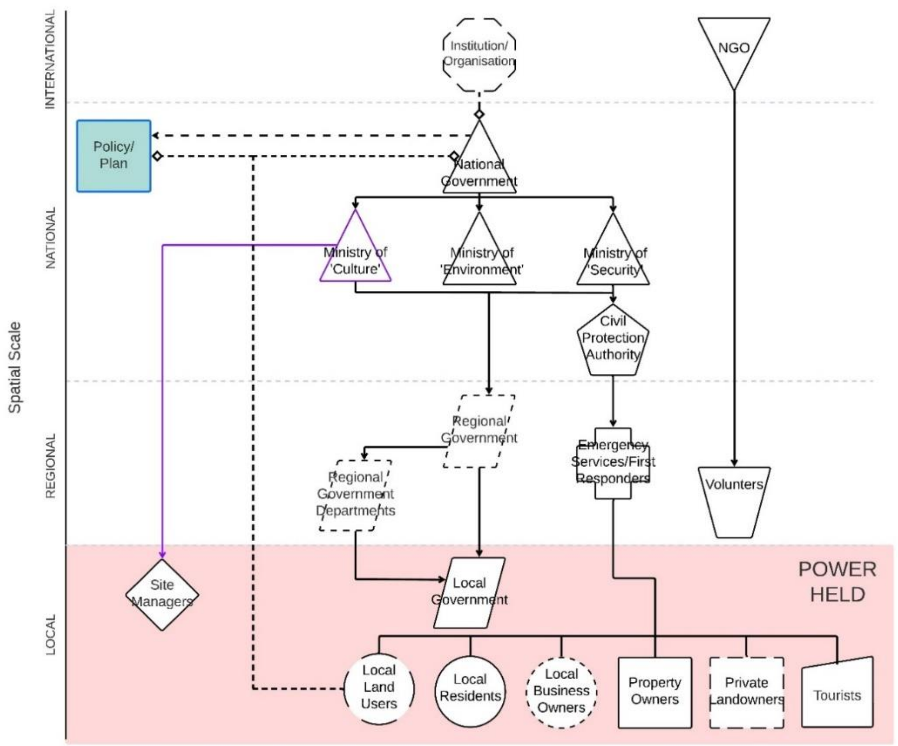

Figure 34: A Practical Model of Networking and Community-led Governance

Table 4: Strengths and Weaknesses of Networking and Community-led governance

STRENGTHS	WEAKNESSES
Community-led Governance is also a very popular type of governance in contemporary literature. It is praised for **empowering local communities** and encouraging them to be directly involved in decision-making and policy development. Community-led Governance also helps **strengthen adaptive governance** forms at the local spatial scale. E.g, local community members will react immediately during the response phase of a disaster event. Community-led Governance can **facilitate an immediate 'on-the-ground response'** in the response phase that does not	Community-led Governance has been noted to **develop in reaction to a lack of response by governance structures at higher spatial scales.** The development of Community-led Governance like this is a result of anger or frustration. This can directly hinder relationships between stakeholders and trust in overarching governance structures. Trust can be hard to win back. **Community-led Governance can be under-resourced and unplanned,** with the local community responding to disaster events without the proper training equipment.

STRENGTHS	WEAKNESSES
necessarily require support or resources. Local communities are experts in their areas and have a wealth of ingrained knowledge and expertise in the local area. **Community-led Governance can allow them to exercise this knowledge.** Very often, there is an underestimated human capital at the local scale, which Community-led Governance can tap into.	Community-led Governance can be **hard to direct and measure** and, as a result, hard to foster and replicate. Too many voices lead to the **'Fallacy of creeping incrementalism.'** where progress or decision-making with Community-led Governance is very slow.

How to 'Apply' this in practice.

The four governance typologies outlined above provide an overview of the different governance structures within cultural landscapes. The idea of developing replicable governance typologies is not an exact science. Every cultural landscape has its unique context, history, and stakeholders. As a result, the four typologies above cannot be considered absolutes. Instead, they should be considered a framework that can help experts explore governance for their specific case or issue. Secondly, perceiving the different governance typologies as part of a continuum is important. Governance is not static; governance can change quickly over time in response to different stimuli. Perceiving these four governances as a continuum allows experts to be conscious and even prepared for those changes. For experts working in cultural landscapes being able to understand what kind of governance typology exists can be powerful. Clarity in governance can form a valuable starting point for experts to critique what is happening within their decision-making processes. These governance typologies provide a common (and easily adaptable) blueprint to identify the governance operating within a given area. By way of example, we can apply these governance typologies to the disaster risk management cycle, a well-established model for understanding disaster management steps. By appreciating what governance typology is being adopted experts may have the opportunity to develop strategies to shift between different governance typologies to maximise on the advantages and disadvantages outlined above. Ultimately making for more fit for purposes, more efficient and more resilient governance.

Furthermore, having a platform to explore governance typologies can empower experts to have informed discussions on the functionality of certain governance mechanisms. This in turn can facilitate a critique on the distribution of resources, goods and forms of capital that aid in disaster risk management. By way of example, imagine an area is currently utilising a Hierarchical Governance typology. The stakeholders at the higher spatial scale have the power and are responsible for much of the decision-making processes in the event of a disaster. Their resources are heavily centralised in one location. In the event of a disaster if this location was damaged then the governance and established decision-making processes may collapse.

Finally, it allows experts to unpick where the 'actual' power is being held in a given situation and if that is the most effective place for it to be held.

6 Conclusion & Outlook

6.1 Types of cultural landscapes and risk they are exposed to

In chapter 2, European coastal NUTS3 regions are characterised according to the five capitals to describe them as elements of the SETS (socio-ecological-technical system). Thereby certain **focus areas**, that attracted attention because their combination of capital clusters hinted at specific combined challenges or strengths, were identified: four geographical regions (Southern Italy, Portugal, Greece and Denmark) and two types of regions ('regions with focus on tourism' and 'regions with qualification needs'). This chapter zooms in on the above-mentioned focus areas in an exemplary manner. Overall, there might be further combinations that could be explored in more detail.

In the following section, these identified focus areas are described from two perspectives:

1) **The cultural landscape typologies perspective**: Common characteristics based on the cultural landscape typologies are described.
2) **The risk assessment perspective**: Each of the considered risks in the considered area is described. The risk assessment combines composite indices for the risk components hazard, exposure and vulnerability (made up of sensitivity and adaptative capacity) to the final risk (see chapter 3). The risk profile in the areas is described, as especially the vulnerability of a region, and in some cases also the exposure, can be influenced by intervening measures.

Based on these two views on the areas, common **recommendations are derived** that could help to reduce risk and support the identified focus areas on their resilience journey. However, it has to be noted that the findings rely solely on data on the NUTS3 level. Given the variation that is possible within a NUTS3 region, any finding will need ground-truthing at the local scale.

Southern Italy (excluding Sardinia)

Cultural landscape typologies perspective

The southern part of Italy (excluding Sardinia) falls into

- Natural Capital Clusters 1 and 6 (upland and mountain areas with partially high landslide susceptibility),
- Built Capital Cluster 6 (few hospital beds per population, low internet access, high agricultural energy consumption),

- Social Capital Cluster 5 (elderly population with a male dominated workforce, many female farm managers and low cultural vibrancy),
- Human Capital Cluster 1 (medium qualified workforce, with few educational facilities and many part-time farmers) and
- Financial Capital Cluster 5 (low to medium economic status).

Risk assessment perspective
All Southern Italian NUTS3 regions are exposed to all of the eight considered risks at medium, high or very high risk level. In some cases, all of the three risk components contribute equally to the final risk, as in the case of coastal floods where a medium of all three risk factors leads to a medium risk. In contrast in the case of river floods, the final risk is high despite the low exposure, because of the very high hazard (Table 5).

Considering changes in the future, especially the risk of coastal flooding is expected to increase in all NUTS3 regions of the area. For all other risks the risk level remains unchanged in the majority of NUTS3 regions, with only selected regions showing an increase or decrease (the latter only for river floods and pluvial floods) in selected NUTS3 regions.

Table 5: Overview of risk and risk component classes, in which the majority of Southern Italian NUTS3 regions fall

RISK	MAJORITY OF REGIONS IN CLASS			
	VULNERABILITY	EXPOSURE	HAZARD	RISK
Pluvial floods	medium	medium	medium, high	high
River floods	medium	low	very high	high
Landslides	medium	medium	high	high
Coastal floods	medium	medium	medium	medium
Droughts	medium	very high	high	high
Wildfires	medium, high	medium	high	high
Heatwaves	medium	medium	high	high
Poor air quality	low, medium	medium	medium	medium and high

Conclusion and recommendations
Findings from the cultural landscape typologies perspective indicate that **investments in educational infrastructure and in improving the qualification of inhabitants** could help increasing the resilience in Southern Italy. In light of the various risks the region faces now and in the future, additional educational offers seem critical to raise awareness of and preparedness for these risks and thus decrease the regions vulnerability. To develop resilience strategies tackling the identified risks, it is essential to make use of knowledge from the past. Therefore, the traditional local knowledge needs to be transferred to a

younger generation. Given the prevailing elderly population, policymakers should focus on **attracting more young people via capitalising on tangible and intangible cultural heritage**. Especially agriculture shapes cultural landscapes and is at the same time specifically threatened e.g. by droughts. The many farms that are run in part-time hint to a potential for **professionalising farming via training offers, eventually tailored to the need of the many female farm managers**. These offers could specifically address risk-related topics such as drought management. The potential of increasing the number of PDO (protected designation of origin) products produced in the area – based on intangible cultural heritage such as agricultural knowledge – could be explored to **increase agricultural profit margins**. That could in turn lead to an increased willingness and possibility of farmers to invest in resilience building measures such as irrigation systems. Identifying sustainable and nature-based solutions for these resilience measures goes hand in hand with the above-mentioned transfer of local knowledge to a younger generation. These actions are in line with the goals of the CAP (Common Agricultural Policy) aiming at supporting gender equality in farming and "address the situation of women and design appropriate action according to the needs identified" (European Commission, 2022). Further generational renewal is one of the ten strategic CAP goals. The CAP policy framework "will support young people setting up in farming, while creating good working and living conditions in rural areas" (European Commission, 2019).

Portugal:

Cultural landscape typologies perspective

The majority of Portugal falls into

- Natural Capital Clusters 3 and 7 (olive groves and vineyards as well as mixed crop-livestock farming are important; in parts the populations willingness to pay for species and habitat maintenance is high),
- Built Capital Cluster 3 (internet access and affinity is low, renewable energy share is high),
- Social Capital Cluster 6 (elderly population and elderly agriculture with many PDO (Protected Designation of Origin) products),
- Human Capital Cluster 1 (medium qualified workforce, with few educational facilities and many part-time farmers) and
- Financial Capital Cluster 5 (low to medium economic status, tourism sector of lower importance).

Risk assessment perspective

The majority of Portuguese NUTS3 regions fall in the medium or high risk classes for the majority of hazards in the reference period (Table 6). Only the coastal flood risk is low for a considerable number of regions. However, coastal flood risk is predicted to increase in all regions. For all other risks the risk level remains unchanged in the majority of NUTS3 regions, with only selected regions showing an increase (heatwaves, wildfires, droughts) or decrease (landslides and river floods). Risk in the reference period is composed of a medium vulnerability and exposure in most cases, while hazard varies from medium to very high (Table 6).

Table 6: Overview of risk and risk component classes, in which the majority of Portuguese NUTS3 regions fall

RISK	MAJORITY OF REGIONS IN CLASS			
	VULNERABILITY	EXPOSURE	HAZARD	RISK
Pluvial floods	medium	low, medium	medium, high	high
River floods	medium	medium	very high	high
Landslides	medium	medium, high	high	high
Coastal floods	medium	medium	medium	medium
Droughts	medium	medium	high, very high	high
Wildfires	medium	medium	high	high
Heatwaves	medium	medium	medium	medium
Poor air quality	low	high	medium	medium

Conclusion and recommendations

Based on the cultural landscape typology perspective it seems that in Portugal agriculture is more divers than in other European regions, where arable land prevails. Furthermore, the awareness for ecosystem service value is higher and renewable energy use is frequent. These characteristics are a good basis for resilient cultural landscapes, making these regions well-suited to act as a lighthouse for other regions with similar make-ups. However, the risk assessment reveals a high and further increasing risk level. Looking at the risk profile, a further decrease of vulnerability is needed to reduce the risk. Consequently, policy should **foster the existing structures** regarding diverse agriculture producing a number of PDO (protected designation of origin) products and the high share of renewable energy. Awareness raising, especially for the increasing risk of coastal floodings, is however needed to reduce the vulnerability risk component. Measures reducing the exposure, including nature-based solutions e.g. with regards to flood events, could be based on the populations' appreciation of the ecosystem service concept. **Attracting young people** is a crucial task to maintain these structures, so policymakers should focus on investments in the internet infrastructure and increasing income possibilities. Options for the latter could be (eco-) tourism capitalising on tangible and intangible cultural heritage. The European Commission proposes to sustain cultural landscapes, as "in many places they have been nurtured and managed effectively so as to attract and retain young people, develop new businesses and increase biodiversity" (European Commission, Directorate-General for Research and Innovation, 2015).

Greece:

Cultural landscape typologies perspective

Great parts of Greece fall into

- Built Capital Cluster 1 (good access, but low affinity to the internet, few strategic buildings),
- Human Capital Cluster 5 (poorly qualified workforce that seldom invests in continuous education, few educational facilities, low-qualified part-time agriculture) and
- Financial Capital Cluster 3 and 5 (low to medium economic status, agricultural sector partially of high importance).

Risk assessment perspective

All Greek NUTS3 regions are exposed to heatwaves, wildfires, droughts, landslides and river floods at medium, high or very high risk level. For pluvial and coastal floods, risk is more divers ranging from low to very high risk over the Greek regions. The currently most sever threat to the Greek regions is drought. In general, vulnerability is a major risk driver in the region (Table 7). In the future, risk is predicted to stay unchanged or increase in the case of heatwaves, wildfires, droughts, and coastal floods. For landslides, pluvial and river floods the risk remains unchanged in the majority of regions, but can also increase or decrease in selected regions.

Table 7: Overview of risk and risk component classes, in which the majority of Greek NUTS3 regions fall

RISK	MAJORITY OF REGIONS IN CLASS			
	VULNERABILITY	EXPOSURE	HAZARD	RISK
Pluvial floods	medium	low	low, medium, high	medium, high
River floods	medium	low	very high	medium, high
Landslides	medium	low	medium	medium, high
Coastal floods	medium	low, medium	medium	medium
Droughts	high	high	high, very high	high, very high
Wildfires	high	low, medium	very high	high
Heatwaves	high	low	high	medium, high
Poor air quality	high	low, medium	medium	high

Conclusion and recommendations

Findings from the cultural landscape typologies perspective indicate that policy should focus on **investments in educational offers and infrastructure** in Greece. This is in accordance with the Council Recommendation on Upskilling Pathways, which emphasises the importance of lifelong learning especially for low-skilled adults, to allow them to "play an active part in society and undertake his or her social and civic responsibilities" (Council of the European Union, 2016). In addition, the European Skills Agenda promotes investment in community adult learning centres, where people of all ages can learn and exchange, building a resilient and cohesive society" (European Commission, 2020). To increase the populations' ability to react to hazardous events, **increasing the number of strategic buildings** and a **better attainability of the population via the internet** would be beneficial, as described in the target of at least 70 % of adults having at least basic digital skills (European Skills Agenda; European Commission, 2020). Both of these activities would lead to a reduction of vulnerability against the examined risks, and with that would tackle a major risk component. An **agricultural skills initiative** could help to increase knowledge among the low-qualified farmers. Especially when qualification combines local traditional knowledge with innovative approaches (as promoted by the EU Common Agricultural Policy; European Commission, 2022) it can be a powerful tool to increase the adaptive capacity of the population.

<u>Denmark:</u>

Cultural landscape typologies perspective

Denmark largely falls into

- Natural Capital Clusters 2 and 4 (agriculture is the major land use type, arable land up to 100 % of agricultural land, high carbon sequestration potential, low willingness to pay for species and habitat maintenance),
- Built Capital Cluster 4 (many old buildings, high agricultural energy consumption),
- Social Capital Cluster 7 (age-balanced population, young, male and tenant agriculture with few PDO (Protected Designation of Origin) products, high cultural vibrancy),
- Human Capital Cluster 4 (well qualified workforce, many educational facilities) and
- Financial Capital Cluster 4 (good economic status).

Risk assessment perspective

In the reference period, the majority of Danish NUTS3 regions feature a low risk of wildfires and a medium risk of pluvial floods, landslides, droughts, heatwaves, and poor air quality. In contrast, the risk of coastal floods and river floods is high. Thereby, the hazard component is not the factor driving risk for the majority of risks and regions (Table 8). However, in the future either no change or an increase in risk is expected for all risks in the Danish regions (with the exception of one region in which drought risk is expected to decrease). Especially the coastal flooding risk is expected to increase in all NUTS3 regions, which is critical as already the current risk level is high in most regions.

Table 8: Overview of risk and risk component classes, in which the majority of Danish NUTS3 regions fall

RISK	MAJORITY OF REGIONS IN CLASS			
	VULNERABILITY	EXPOSURE	HAZARD	RISK
Pluvial floods	medium	medium, high	very low, low	medium
River floods	medium	medium	very high	high
Landslides	Medium	medium	very low	medium
Coastal floods	medium	high	medium	high
Droughts	medium	very high	medium	medium
Wildfires	high	medium, high	low	low
Heatwaves	medium	medium	low	medium
Poor air quality	medium	medium	low	medium

Conclusion and recommendations

Based on the cultural landscape typologies, policy should **foster the ecosystem service concept** e.g. by incentivising carbon sequestration while reducing the agricultural energy demand. Looking at the high and further increasing risk of river floods, an **increase of the flood control ecosystem services** in Denmark would be recommendable. The EU biodiversity strategy verbalises the goal to reach "at least 10% of agricultural area under high-diversity landscape features", which will help to enhance carbon sequestration and reduce soil erosion (European Commission, 2020a). In addition, under the EU Common Agricultural Policy (CAP), support for investments in biodiversity as well as training with respect to environmental or climate-related performance of farms is possible (European Commission, 2023). The existing cultural and creative sector could support the mainstreaming of the ecosystem service concept and strengthen the appreciation of the value of the local cultural landscape.

Regions with qualification needs:

Cultural landscape typologies perspective

'Regions with qualification needs' are characterised by an elderly population and a high gender employment gap, while the share of female farmers is high at the same time (Social Capital Cluster 1 and Cluster 5). The same regions feature a medium or poorly qualified workforce and a high share of - in parts low qualified - part-time farm managers (Human Capital Cluster 1 and Cluster 5) and a low to medium economic status (Financial Capital Cluster 3 and Cluster 5). In addition, people in these regions have low access or affinity to the internet.

Risk assessment perspective
The ‘regions with qualification needs’ concentrate in Southern Europe, which currently suffers from high risk levels in various examined risks. In general, they overlap regions with high or very high vulnerability, irrespective of the risk considered.

Conclusion and recommendations
From the cultural landscape typologies, we conclude that policymakers should investigate possibilities of **increasing the skills of the inhabitants**, especially by supporting female farmers, in accordance with the European Skills Agenda. The Skills Agenda aims at helping “people build their skills throughout life in an environment where lifelong learning is the norm”, setting a target of at least 30 % of the low-qualified adults in learning during the last 12 months in 2025 (European Commission, 2020). Besides a possible improvement of the economic situation through a better qualified workforce, additional qualification could help to increase the populations’ ability to prepare for and react to changes. This increases the societies’ adaptive capacity and with that reduces the vulnerability as major risk driver in the affected areas.

Regions with focus on tourism:

Cultural landscape typologies perspective
Regions with tourism as an important sector at the same time feature a high importance of the cultural sector (Financial Capital Cluster 7). These regions at the same time tend to produce a higher number of PDO (Protected Designation of Origin) products (Social Capital Cluster 6), but they do not necessarily feature a high cultural vibrancy (defined as number of cultural facilities per population). This leads to the conclusion that the cultural and creative industry sector (CCIS) mainly serves the touristic activities rather than the local population. The ‘regions with focus on tourism’ are located along the Spanish Mediterranean coast, on the Balearic and Canary Island and in the Venezia area.

Risk assessment perspective
From the risk perspective, these regions suffer from an already in the reference period very high risk of droughts, wildfires, and river floods. All other risks vary between medium and very high. In the future, no change or an increase of risk is expected for all risks except pluvial and river floods, which remain unchanged or even decrease. Especially wildfires and river floods pose a direct threat to the tourism industry, while the other identified risks pose more indirect and long-run threats to tourism.

Conclusion and recommendations
Policy should create incentives for the **creative sector to attract the local population** in order to **strengthen the sense of place**, as proclaimed in the recent European Work Plan for

Culture, calling for "Culture for the people: enhancing cultural participation and the role of culture in society" (Council of the European Union, 2022). The existing CCIS could additionally contribute to raising the awareness of climate-related risks of both, the local population and the tourists. Furthermore, the production of PDO products serves as indicator for the existence of **traditional local knowledge**. This knowledge **should be capitalised** for identifying resilience strategies e.g. with regards to droughts. The contribution of cultural heritage to the tourism sector as well as the potential use of heritage buildings as shelter, e.g., in case of heatwaves, should be made visible to provide arguments for **investments in heritage** (see chapter 4).

6.2 Further recommendations

Besides the conclusions that can be drawn from the typologies of European cultural landscapes and the risk assessment, the present work contains further valuable information that can help policymakers to work towards resilience building.

Primarily, **governance typologies** provide clarity around governance structures. This **leads to a better understanding of decision-making processes** in cultural landscapes and thus improves the resilience-building process. Furthermore, the Policy paper highlights the potential strengths and weakness of different governance typologies. Knowing this we could also use the typologies to communicate better that different DRM phases benefit from different governance approaches and thus **build awareness and acceptance of temporary shifts in governance types**. This would imply that we should move away from our rather static understanding of governance, taking an approach that would actually be more in line with indigenous approaches, that can shift to account for different hazards, pressures and requirements.

There is a growing necessity for **EU-wide systematic and harmonised data collection on losses and damage to cultural heritage**. Specifically, the harmonisation of data collection could benefit from a co**mprehensive set of guidelines for evaluating non-quantifiable losses** to cultural heritage, such as the intangible dimension and aesthetic value, that can't be quantified in monitory terms. Such guidelines and data collection would support the recommendations of the OMC expert group on strengthening cultural heritage resilience for climate change, who state that we need an increase of awareness on "the risks of damage to and loss of cultural heritage as a result of climate change impacts" (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2022). The European Work Plan for Culture (Council of the European Union, 2022) stresses on the one hand the necessity to "act on risk preparedness in cultural heritage and on strengthening cultural heritage's resilience to climate change" and on the other hand calls for an improved data base on the cultural sector. Although this call is focused on improved knowledge on the performance of the cultural sector, it could be extended to information on loss and damage to the sector and the cultural heritage. The Work Plan for Culture names EUROSTAT as institution to "play a central and increasing role" (Council of the European Union, 2022).

In addition to improved statistics on loss to cultural heritage, **information on the benefits of investments into cultural heritage (tangible and intangible)** would help to increase the visibility of the contribution of culture to societal wellbeing and resilience building. We recommend setting up a database of investments into cultural heritage and benefits of these investments, both quantitative and qualitative, in order to provide decision makers with a sound information base and boosting impact financing in cultural heritage domain. This would require improving the data collection system for both public and private investments as well as establishing standard methodologies for assessing the impacts of these investments.

In general, the collection of data for studies like the present one is a challenging task. The following two points would improve the direct useability of EUROSTAT data:

- Ensure that all NUTS-based data contain the NUTS GeoCode. As the NUTS region names are often given either in local spelling or in English language, unambiguous automated matching is error-prone and requires manual reworking.
- Improve the backward compatibility of data in case of changes in the definition of NUTS regions.
    - If NUTS regions are renamed, it would be helpful to provide the complete data series for the old and new NUTS GeoCode rather than dividing the available data series for the same NUTS region under different GeoCodes.
    - If regions are re-shaped, it is in some cases possible to generate comparable data before and after the re-shaping. This is the case if e.g. two regions are merged into a bigger one, in this case average values or sums of the original regions can be used to mimic the new shape. Providing complete data series under the most recent GeoCode would be helpful.
- In some cases, the latest available data on NUTS3 level is rather old, such as in the case of the farm structure data. A timely update based on existing member state data, even if not complete for all member states, would be beneficial to be able to draw valuable conclusions from the data.

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8 Appendices

Annex 1: List of indicators per capital used for the typologies

Table A- 1: List of indicators used to create the typology of Natural Capital indicates that the original data was further processed in the RescueME project)

GROUP	DESCRIPTION	UNIT	SOURCE OF ORIGINAL DATA	
Land use	Share of urban land	% of NUTS area	Copernicus Land Monitoring Service (CLMS): CORINE Land Cover (CLC) data	
	Share of agricultural land	% of NUTS area		
	Share of forest land	% of NUTS area		
	Share of natural land and water	% of NUTS area		
	Degree of urbanisation - Share of urban-rural areas	% of NUTS area	European Environment Agency (EEA): Refined degree of urbanisation in Europe (DEGURBA level 2) - version 1, Jul. 2018	
Agriculture	Agricultural holdings with mixed crops – livestock farming	% of agricultural area	EUROSTAT Farm Structure data	-
	Share or arable land	% of agricultural area	Copernicus Land Monitoring Service (CLMS): CORINE Land Cover (CLC) data	
	Share of vineyards and olive groves	% of agricultural area		
Protected areas	Protected natural and agricultural areas with international designation	m^2	The World Database on Protected Areas (WDPA) European Environment Agency	

GROUP	DESCRIPTION	UNIT	SOURCE OF ORIGINAL DATA
	Protected areas under national laws	m^2	European Environment Agency (EEA): Nationally designated areas for public access (vector data) - version 21, Jun. 2023
Ecological quality	Dispersion of urban areas	Index (0 – 1)	Copernicus Land Monitoring Service (CLMS): CORINE Land Cover (CLC) data
	Shannon Evenness Index	Index (0 – 1)	
Ecosystem services	Share of area with outdoor recreation potential	% of NUTS area	EU Joint Research Centre (JRC): Integrated Natural Capital Accounting (INCA) Project
	Willingness to pay of households for maintaining current habitat and species maintenance service areas	€/ 100 km^2 species/ habitat area, mean value in NUTS region	
	Flood control service providing area (river floods)	% of area	
	Value of ecosystem contribution to carbon sequestration	€/ km^2, mean value in NUTS region	
Topography	Elevation breakdown - low coast	% of NUTS area	European Environment Agency (EEA): Elevation breakdown based on EU-DEM
	Elevation breakdown - high coast	% of NUTS area	
	Elevation breakdown - inland	% of NUTS area	
	Elevation breakdown - upland	% of NUTS area	
	Elevation breakdown - mountains	% of NUTS area	
	Share of NUTS region with high or very high landslide susceptibility	% of NUTS area	EU Joint Research Centre (JRC): European Landslide Susceptibility Map version 2 (ELSUS v2)

Table A- 2: List of indicators used to create the typology of Built Capital indicates that the original data was further processed in the RescueME project)

GROUP	DESCRIPTION	UNIT	SOURCE OF ORIGINAL DATA	
Settlements	Share of build-up area (built-up area is defined as a region featuring man-made building structures with a vertical component)	% of NUTS area	German Aerospace Center (DLR): Global Urban Footprint (GUF) data	
Connectivity to the internet	Households with access to the internet at home	% of households	EUROSTAT Information society indicator	-
	Individuals who never use the internet	% of individuals		
Health and strategic infrastructure	Available beds in hospitals	beds per 100 000 population	EUROSTAT Healthcare data	-
	Physicians	number per 100 000 population		
	Strategic buildings	number per 1000 population	OpenStreetMap data	
Built heritage	Cultural sites with international designation	number per NUTS region	Cultural gems (europa.eu)	
	Share of buildings buildt before 1919	% of all buildings	European Statistical System – CensusHub: Housing Census 2011	
Energy consumption	Energy consumption per land area in the agriculture sector	MWh/ km²	ESPON project package: 'LOCATE - Territories and Low-Carbon Economy'	-
	Residential energy consumption (for space heating, cooling and water heating in residential, public and private service sector buildings)	MWh / capita		
	Share of renewable energy carriers in residential buildings (used for space heating, cooling and water heating in private and public service sector buildings)	% of all energy carriers		

Table A- 3: List of indicators used to create the typology of Social Capital indicates that the original data was further processed in the RescueME project; grey shading: not used for clustering, used for the ease of interpretation)

GROUP	DESCRIPTION	UNIT	SOURCE OF ORIGINAL DATA	
Population structure	Population density	persons/ km²	EUROSTAT Regional Demographic Data	-
	Population change	number/ 1000 inhabitants	EUROSTAT Population Change Data	-
	Proportion of population aged 20-39 years	%	EUROSTAT Regional Demographic Data	-
	Proportion of population aged 65 years and more	%	EUROSTAT Regional Demographic Data	-
	Young-age dependency ratio (population 0 to 14 years to population 15 to 64 years)	%	EUROSTAT Regional Demographic Data	-
Gender equality	Gender employment GAP	%	EUROSTAT Regional Labour Market Statistics	
Structure of agriculture	Share of agricultural holdings with manager > 65 years old	% of all holdings	EUROSTAT Farm Structure data	-
	Share of tenant agricultural area	% of agricultural area		
	Share of agricultural holdings with female farm managers	% of all holdings	EUROSTAT Farm Indicators	-
	Share of agricultural holdings with young farmers (< 36 years old)	% of all holdings		
	Number of PDO products allowed to be produced in this NUTS3 region	number	Flinzberger et al (2022)	-
Cultural vibrancy	Cultural vibrancy	number of cultural sites per 100 000 population	OpenStreetMap data	

Table A- 4: List of indicators used to create the typology of Human Capital R indicates that the original data was further processed in the RescueME project)

GROUP	DESCRIPTION	UNIT	SOURCE OF ORIGINAL DATA	
General workforce skills	Share of employed persons with tertiary education	% of working age population (15-64 years)	EUROSTAT Education and Training Data	-
	Early leavers from education and training	% of 18 to 24 year old population		
	Participation rate in education and training	% of 25 to 64 year old population		
	Number of educational facilities	number/ 100 000 population	OpenStreetMap data	R
Agricultural workforce skills	Share of holdings with farm manager with full or basic agricultural training	% of holdings	EUROSTAT Farm Indicators	-
	Share of holdings with a full-time farm manager	% of holdings	EUROSTAT Farm Structure data	R

Table A- 5: List of indicators used to create the typology of Financial Capital R indicates that the original data was further processed in the RescueME project)

GROUP	DESCRIPTION	UNIT	SOURCE OF ORIGINAL DATA	
Economic status	Employment rate	% of working age population (15-64 years)	EUROSTAT Regional Economic Accounts	R
	Household income per inhabitant	€/inhabitant		-
Tourism sector	Tourism turnover	€	EUROSTAT	R
	Bed places	number	EUROSTAT Tourism Data	-
	Arrivals	number		
	Seasonality in tourism	Index (0 – 1)	ESPON Indicator 'Tour_cap'	-
Agricultural sector	Number of holdings	holdings/ 100 ha	EUROSTAT Farm Structure data	R
	Share of employed persons in agriculture, forestry and fishing	% of working age population (15-64 years)	EUROSTAT Regional Economic Accounts	R
Arts & culture sector	Share of Gross Domestic Product attributable to private and formal cultural production	% of Gross Domestic Product	EUROSTAT Regional Economic Accounts	R

GROUP	DESCRIPTION	UNIT	SOURCE OF ORIGINAL DATA	
	Share of employed persons in Arts, entertainment, and recreation	% of working age population (15-64 years)	EUROSTAT Regional Economic Accounts	
Environmental investments	Share of environmental protection investments of total economy	% of Gross Domestic Product	EUROSTAT Environment and Energy Data	-

Annex 2: Risk assessment result tables

Table A- 6: Number of NUTS3 regions according to relative risk for pluvial floods in the reference period 1981-2010

RISK CLASS	NUMBER	PERCENTAGE
Very low	35	6,8
Low	175	34,1
Medium	159	31
High	121	23,6
Very high	23	4,5

Table A- 7: 25 NUTS3 with the highest relative risk for pluvial floods in the reference period 1981-2010 (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
EL622	Kerkyra	Greece	Very low	Low	Very high	Low	High	Very high
ITI43	Roma	Italy	High	High	Medium	Very high	High	Very high
ITH35	Venezia	Italy	Low	High	Very high	High	Medium	Very high
ES511	Barcelona	Spain	Very high	Very high	Medium	Very high	Medium	Very high
ITH42	Udine	Italy	High	Medium	Medium	High	Very high	Very high
ITF33	Napoli	Italy	Medium	Medium	Medium	Very high	High	Very high
ES617	Málaga	Spain	High	Very high	Medium	High	Medium	Very high
PT11A	Área Metropolitana do Porto	Portugal	Medium	Medium	Medium	High	High	Very high
ES532	Mallorca	Spain	High	High	High	High	Medium	Very high
ITF35	Salerno	Italy	High	Medium	Medium	High	Medium	Very high
ES111	A Coruña	Spain	High	Medium	Medium	High	High	Very high
NO0A2	Vestland	Norway	Medium	Low	Low	High	Very high	Very high

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
FRJ13	Hérault	France	Very high	High	Medium	High	High	Very high
ES512	Girona	Spain	Very high	Very high	High	High	Medium	Very high
SI043	Goriška	Slovenia	Medium	Low	Low	Medium	Very high	Very high
ES114	Pontevedra	Spain	High	Medium	Medium	Medium	Very high	Very high
ITI17	Pisa	Italy	High	High	Medium	High	Medium	Very high
EL421	Kalymnos, Karpathos, Kasos, Kos, Rodos	Greece	Very low	Low	High	Medium	Medium	Very high
HR031	Primorsko-goranska županija	Croatia	Low	Low	Medium	Medium	High	Very high
ITC34	La Spezia	Italy	Medium	Low	Medium	Medium	Very high	Very high
ITF63	Catanzaro	Italy	Medium	High	High	Low	High	Very high
ES521	Alicante/Alacant	Spain	High	High	High	High	Low	Very high
ITI12	Lucca	Italy	Medium	Medium	Medium	Medium	High	Very high
EL633	Ileia	Greece	Low	Medium	High	Low	High	High
EL431	Irakleio	Greece	Low	Medium	High	Low	High	High

Table A- 8: Number of NUTS3 per country with a high relative risk for pluvial floods in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Cyprus	1	100
Montenegro	1	100
Portugal	11	73,3
Croatia	5	71,4
Bulgaria	2	66,7
Slovenia	2	66,7
Italy	41	62,1
France	18	58,1
Iceland	1	50
Romania	1	50
Greece	17	36,2
Norway	4	33,3
Spain	10	32,3
Ireland	2	28,6
Denmark	1	9,1

COUNTRY	NUMBER	PERCENTAGE
Sweden	1	7,1
Netherlands	1	4,2
United Kingdom	2	1,3

Table A- 9: Number of NUTS3 per country with a very high relative risk for pluvial floods in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Slovenia	1	33,3
Spain	7	22,6
Croatia	1	14,3
Italy	9	13,6
Norway	1	8,3
Portugal	1	6,7
Greece	2	4,3
France	1	3,2

Table A- 10: Future risk evolution of the NUTS3 for pluvial floods according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010
(RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Equal	Equal	Equal	391	76,2
Higher	Higher	Higher	50	9,7
Equal	Equal	Higher	35	6,8
Equal	Higher	Higher	17	3,3
Equal	Equal	Lower	7	1,4
Higher	Equal	Equal	6	1,2
Equal	Lower	Lower	3	0,6
Equal	Higher	Equal	1	0,2
Equal	Lower	Equal	1	0,2
Higher	Equal	Higher	1	0,2
Lower	Equal	Equal	1	0,2

Table A- 11: Future risk evolution of NUTS3 by country for pluvial floods according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Albania	Equal	Equal	Equal	8	88,9
Albania	Equal	Equal	Lower	1	11,1
Belgium	Equal	Equal	Equal	13	92,9
Belgium	Higher	Higher	Higher	1	7,1
Bulgaria	Equal	Equal	Equal	2	66,7
Bulgaria	Higher	Equal	Equal	1	33,3
Croatia	Equal	Equal	Equal	6	85,7
Croatia	Higher	Equal	Higher	1	14,3
Cyprus	Equal	Equal	Equal	1	100
Denmark	Equal	Equal	Equal	4	36,4
Denmark	Equal	Equal	Higher	3	27,3
Denmark	Equal	Higher	Higher	2	18,2
Denmark	Higher	Higher	Higher	2	18,2
Estonia	Equal	Equal	Equal	3	75
Estonia	Equal	Higher	Higher	1	25
Finland	Equal	Equal	Equal	7	77,8
Finland	Equal	Equal	Higher	1	11,1
Finland	Higher	Higher	Higher	1	11,1
France	Equal	Equal	Equal	24	77,4
France	Higher	Higher	Higher	5	16,1
France	Equal	Higher	Higher	1	3,2
France	Higher	Equal	Equal	1	3,2
Germany	Equal	Equal	Equal	23	63,9
Germany	Higher	Higher	Higher	7	19,4
Germany	Equal	Equal	Higher	5	13,9
Germany	Equal	Higher	Higher	1	2,8
Greece	Equal	Equal	Equal	41	87,2
Greece	Equal	Higher	Higher	2	4,3
Greece	Equal	Equal	Higher	1	2,1
Greece	Equal	Equal	Lower	1	2,1
Greece	Equal	Lower	Equal	1	2,1
Greece	Higher	Higher	Higher	1	2,1
Iceland	Equal	Equal	Equal	1	50

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Iceland	Equal	Equal	Higher	1	50
Ireland	Equal	Equal	Equal	3	42,9
Ireland	Higher	Higher	Higher	3	42,9
Ireland	Equal	Higher	Higher	1	14,3
Italy	Equal	Equal	Equal	53	80,3
Italy	Higher	Higher	Higher	5	7,6
Italy	Higher	Equal	Equal	3	4,5
Italy	Equal	Equal	Lower	2	3
Italy	Equal	Equal	Higher	1	1,5
Italy	Equal	Higher	Equal	1	1,5
Italy	Equal	Higher	Higher	1	1,5
Latvia	Equal	Equal	Equal	3	100
Lithuania	Equal	Equal	Equal	1	100
Malta	Equal	Equal	Equal	2	100
Montenegro	Equal	Equal	Equal	1	100
Netherlands	Equal	Equal	Equal	21	87,5
Netherlands	Equal	Higher	Higher	2	8,3
Netherlands	Higher	Higher	Higher	1	4,2
Norway	Equal	Equal	Equal	6	50
Norway	Equal	Equal	Higher	2	16,7
Norway	Equal	Higher	Higher	2	16,7
Norway	Higher	Higher	Higher	2	16,7
Poland	Equal	Equal	Equal	7	87,5
Poland	Higher	Higher	Higher	1	12,5
Portugal	Equal	Equal	Equal	15	100
Romania	Equal	Equal	Equal	2	100
Slovenia	Equal	Equal	Equal	3	100
Spain	Equal	Equal	Equal	24	77,4
Spain	Equal	Equal	Lower	3	9,7
Spain	Equal	Lower	Lower	3	9,7
Spain	Higher	Equal	Equal	1	3,2
Sweden	Equal	Equal	Equal	8	57,1
Sweden	Equal	Equal	Higher	2	14,3
Sweden	Higher	Higher	Higher	2	14,3
Sweden	Equal	Higher	Higher	1	7,1
Sweden	Lower	Equal	Equal	1	7,1

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
United Kingdom	Equal	Equal	Equal	109	72,7
United Kingdom	Equal	Equal	Higher	19	12,7
United Kingdom	Higher	Higher	Higher	19	12,7
United Kingdom	Equal	Higher	Higher	3	2

Table A- 12: Number of NUTS3 regions according to relative risk for river floods in the reference period 1981-2010

RISK CLASS	NUMBER	PERCENTAGE
Very low	1	0,2
Low	53	10,3
Medium	220	42,9
High	200	39
Very high	39	7,6

Table A- 13: 25 NUTS3 with the highest relative risk for river floods in the reference period 1981-2010 (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ES511	Barcelona	Spain	Very high	Very high	Medium	Very high	Very high	Very high
ES521	Alicante/Alacant	Spain	High	High	High	High	Very high	Very high
FRG05	Vendée	France	Very high	Very high	High	High	Very high	Very high
FRH04	Morbihan	France	High	Very high	High	High	Very high	Very high
FRI32	Charente-Maritime	France	Very high	Very high	High	High	Very high	Very high
ITH35	Venezia	Italy	Low	High	Very high	Medium	Very high	Very high
ITH37	Rovigo	Italy	Medium	Very high	Very high	Medium	Very high	Very high
FRE11	Nord	France	Very high	Medium	Low	Very high	Very high	Very high
ES523	Valencia/València	Spain	High	High	Medium	High	Very high	Very high
ES617	Málaga	Spain	High	Very high	Medium	High	Very high	Very high
ES512	Girona	Spain	Very high	Very high	High	High	Very high	Very high

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
NL124	Noord-Friesland	Nether-lands	Medium	Very high	High	Medium	Very high	Very high
FRH02	Finistère	France	High	Very high	Medium	High	Very high	Very high
ITF45	Lecce	Italy	Low	High	Very high	Medium	Very high	Very high
ES532	Mallorca	Spain	High	High	High	Medium	Very high	Very high
FRG01	Loire-Atlantique	France	High	High	Medium	Very high	Very high	Very high
FRI12	Gironde	France	Very high	High	Medium	Very high	Very high	Very high
DK032	Sydjylland	Den-mark	High	Very high	High	Medium	Very high	Very high
ES611	Almería	Spain	High	High	Medium	High	Very high	Very high
ES514	Tarragona	Spain	Very high	Very high	Medium	High	Very high	Very high
FRI13	Landes	France	Very high	Very high	Medium	High	Very high	Very high
ES620	Murcia	Spain	High	High	Medium	High	Very high	Very high
ES612	Cádiz	Spain	Very high	High	Medium	High	Very high	Very high
RO223	Constanta	Romania	Medium	High	Very high	Medium	Very high	Very high
BG331	Varna	Bulgaria	Low	Medium	Very high	Low	Very high	Very high

Table A- 14: Number of NUTS3 per country with a high relative risk for river floods in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Cyprus	1	100
Ireland	7	100
Portugal	12	80
Poland	6	75
Italy	45	68,2
Bulgaria	2	66,7
Greece	26	55,3
Iceland	1	50
Romania	1	50
Netherlands	11	45,8
Croatia	3	42,9
France	12	38,7
Denmark	4	36,4
Belgium	5	35,7
Latvia	1	33,3

COUNTRY	NUMBER	PERCENTAGE
Norway	4	33,3
Germany	11	30,6
Spain	9	29
Sweden	4	28,6
United Kingdom	34	22,7
Finland	1	11,1

Table A- 15: Number of NUTS3 per country with a very high relative risk for river floods in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Romania	1	50
France	12	38,7
Spain	11	35,5
Bulgaria	1	33,3
Denmark	2	18,2
Italy	7	10,6
Norway	1	8,3
Greece	2	4,3
Netherlands	1	4,2
United Kingdom	1	0,7

Table A- 16: Future risk evolution of the NUTS3 for river floods according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Equal	Equal	Equal	438	85,4
Equal	Equal	Lower	18	3,5
Equal	Lower	Lower	16	3,1
Higher	Higher	Higher	16	3,1
Equal	Higher	Higher	12	2,3
Equal	Equal	Higher	8	1,6
Equal	Lower	Equal	2	0,4
Equal	Higher	Equal	1	0,2
Higher	Equal	Equal	1	0,2
Lower	Lower	Lower	1	0,2

Table A- 17: Future risk evolution of NUTS3 by country for river floods according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Albania	Equal	Equal	Equal	8	88,9
Albania	Higher	Higher	Higher	1	11,1
Belgium	Equal	Equal	Equal	13	92,9
Belgium	Equal	Equal	Higher	1	7,1
Bulgaria	Equal	Equal	Equal	3	100
Croatia	Equal	Equal	Equal	5	71,4
Croatia	Equal	Higher	Higher	1	14,3
Croatia	Higher	Higher	Higher	1	14,3
Cyprus	Equal	Equal	Equal	1	100
Denmark	Equal	Equal	Equal	9	81,8
Denmark	Equal	Equal	Higher	1	9,1
Denmark	Equal	Higher	Higher	1	9,1
Estonia	Equal	Equal	Equal	4	100
Finland	Equal	Equal	Equal	7	77,8
Finland	Equal	Lower	Equal	1	11,1
Finland	Lower	Lower	Lower	1	11,1
France	Equal	Equal	Equal	29	93,5
France	Equal	Higher	Higher	1	3,2
France	Higher	Higher	Higher	1	3,2
Germany	Equal	Equal	Equal	33	91,7
Germany	Equal	Equal	Higher	2	5,6
Germany	Higher	Higher	Higher	1	2,8
Greece	Equal	Equal	Equal	35	74,5
Greece	Equal	Equal	Lower	8	17
Greece	Equal	Lower	Lower	4	8,5
Iceland	Equal	Equal	Equal	1	50
Iceland	Equal	Lower	Lower	1	50
Ireland	Equal	Equal	Equal	5	71,4
Ireland	Equal	Equal	Higher	1	14,3
Ireland	Higher	Higher	Higher	1	14,3
Italy	Equal	Equal	Equal	55	83,3
Italy	Equal	Equal	Lower	5	7,6
Italy	Higher	Higher	Higher	2	3

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Italy	Equal	Higher	Equal	1	1,5
Italy	Equal	Higher	Higher	1	1,5
Italy	Equal	Lower	Lower	1	1,5
Italy	Higher	Equal	Equal	1	1,5
Latvia	Equal	Equal	Equal	2	66,7
Latvia	Equal	Higher	Higher	1	33,3
Lithuania	Equal	Equal	Equal	1	100
Malta	Equal	Equal	Equal	2	100
Montenegro	Equal	Equal	Equal	1	100
Netherlands	Equal	Equal	Equal	22	91,7
Netherlands	Equal	Higher	Higher	2	8,3
Norway	Equal	Equal	Equal	6	50
Norway	Equal	Lower	Lower	5	41,7
Norway	Equal	Lower	Equal	1	8,3
Poland	Equal	Equal	Equal	7	87,5
Poland	Higher	Higher	Higher	1	12,5
Portugal	Equal	Equal	Equal	9	60
Portugal	Equal	Equal	Lower	5	33,3
Portugal	Equal	Lower	Lower	1	6,7
Romania	Equal	Equal	Equal	2	100
Slovenia	Equal	Equal	Equal	3	100
Spain	Equal	Equal	Equal	28	90,3
Spain	Equal	Lower	Lower	3	9,7
Sweden	Equal	Equal	Equal	13	92,9
Sweden	Equal	Lower	Lower	1	7,1
United Kingdom	Equal	Equal	Equal	134	89,3
United Kingdom	Higher	Higher	Higher	8	5,3
United Kingdom	Equal	Higher	Higher	5	3,3
United Kingdom	Equal	Equal	Higher	3	2

Table A- 18: Number of NUTS3 regions according to relative risk for landslides in the reference period 1981-2010

RISK CLASS	NUMBER	PERCENTAGE
Very low	27	5,3
Low	147	28,7
Medium	157	30,6

RISK CLASS	NUMBER	PERCENTAGE
High	144	28,1
Very high	38	7,4

Table A- 19: 25 NUTS3 with the highest relative risk for landslides in the reference period 1981-2010 (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ES617	Málaga	Spain	High	Very high	Medium	Very high	High	Very high
ES511	Barcelona	Spain	Very high	Very high	Medium	Very high	High	Very high
ES532	Mallorca	Spain	High	High	High	Very high	High	Very high
ES512	Girona	Spain	Very high	Very high	High	High	High	Very high
EL622	Kerkyra	Greece	Very low	Low	Very high	Low	Very high	Very high
ES614	Granada	Spain	Very high	High	Medium	Very high	High	Very high
ITI43	Roma	Italy	High	High	Medium	Very high	High	Very high
ES521	Alicante/ Alacant	Spain	High	High	High	Very high	Medium	Very high
ITI11	Massa-Carrara	Italy	Medium	Medium	Medium	Medium	Very high	Very high
ITF35	Salerno	Italy	High	Medium	Medium	High	High	Very high
NO0A2	Vestland	Norway	Medium	Low	Low	Very high	Very high	Very high
ITI16	Livorno	Italy	Medium	High	High	High	High	Very high
FRL03	Alpes-Maritimes	France	Very high	High	Low	Very high	Very high	Very high
ITC33	Genova	Italy	Medium	Low	Medium	High	Very high	Very high
FRJ13	Hérault	France	Very high	High	Medium	Very high	High	Very high
ITF14	Chieti	Italy	Medium	Very high	Very high	Medium	High	Very high
ES612	Cádiz	Spain	Very high	High	Medium	High	High	Very high
ES120	Asturias	Spain	Very high	Medium	Low	Very high	High	Very high
ITF12	Teramo	Italy	Medium	Very high	Very high	Medium	High	Very high
IE053	South-West	Ireland	High	Medium	Medium	High	High	Very high
EL421	Kalymnos, Karpathos, Kasos, Kos, Rodos	Greece	Very low	Low	High	Medium	High	Very high
ITC34	La Spezia	Italy	Medium	Low	Medium	Medium	Very high	Very high
ITF63	Catanzaro	Italy	Medium	High	High	Medium	High	Very high
ITG2H	Sud Sardegna	Italy	High	High	High	High	High	Very high
ITI12	Lucca	Italy	Medium	Medium	Medium	Medium	Very high	Very high

Table A- 20: Number of NUTS3 per country with a high relative risk for landslides in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Cyprus	1	100
Iceland	2	100
Montenegro	1	100
Slovenia	3	100
Croatia	6	85,7
Italy	46	69,7
Bulgaria	2	66,7
Portugal	9	60
Ireland	4	57,1
Greece	24	51,1
Norway	6	50
Spain	12	38,7
France	8	25,8
United Kingdom	19	12,7
Albania	1	11,1

Table A- 21: Number of NUTS3 per country with a very high relative risk for landslides in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Spain	9	29
Italy	13	19,7
France	6	19,4
Ireland	1	14,3
Portugal	2	13,3
Greece	5	10,6
Norway	1	8,3
United Kingdom	1	0,7

Table A- 22: Future risk evolution of the NUTS3 for landslides according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Equal	Equal	Equal	447	87,1
Equal	Equal	Higher	24	4,7

RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Higher	Higher	Higher	23	4,5
Equal	Higher	Higher	10	1,9
Higher	Equal	Equal	3	0,6
Equal	Equal	Lower	2	0,4
Equal	Lower	Lower	2	0,4
Higher	Higher	Equal	1	0,2
Lower	Lower	Lower	1	0,2

Table A- 23: Future risk evolution of NUTS3 by country for landslides according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Albania	Equal	Equal	Equal	9	100
Belgium	Equal	Equal	Equal	10	71,4
Belgium	Higher	Higher	Higher	3	21,4
Belgium	Equal	Higher	Higher	1	7,1
Bulgaria	Equal	Equal	Equal	3	100
Croatia	Equal	Equal	Equal	7	100
Cyprus	Equal	Equal	Equal	1	100
Denmark	Equal	Equal	Equal	11	100
Estonia	Equal	Equal	Equal	4	100
Finland	Equal	Equal	Equal	7	77,8
Finland	Equal	Equal	Higher	1	11,1
Finland	Higher	Higher	Higher	1	11,1
France	Equal	Equal	Equal	28	90,3
France	Equal	Equal	Higher	2	6,5
France	Equal	Higher	Higher	1	3,2
Germany	Equal	Equal	Equal	28	77,8
Germany	Higher	Higher	Higher	4	11,1
Germany	Equal	Equal	Higher	3	8,3
Germany	Equal	Higher	Higher	1	2,8
Greece	Equal	Equal	Equal	43	91,5
Greece	Equal	Higher	Higher	2	4,3
Greece	Equal	Lower	Lower	1	2,1
Greece	Higher	Higher	Higher	1	2,1

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Iceland	Equal	Equal	Equal	2	100
Ireland	Equal	Equal	Equal	6	85,7
Ireland	Equal	Higher	Higher	1	14,3
Italy	Equal	Equal	Equal	62	93,9
Italy	Higher	Equal	Equal	2	3
Italy	Higher	Higher	Higher	2	3
Latvia	Equal	Equal	Equal	3	100
Lithuania	Equal	Equal	Equal	1	100
Malta	Equal	Equal	Equal	2	100
Montenegro	Equal	Equal	Equal	1	100
Netherlands	Equal	Equal	Equal	22	91,7
Netherlands	Equal	Equal	Higher	1	4,2
Netherlands	Higher	Higher	Higher	1	4,2
Norway	Equal	Equal	Equal	9	75
Norway	Higher	Higher	Higher	2	16,7
Norway	Equal	Equal	Higher	1	8,3
Poland	Equal	Equal	Equal	4	50
Poland	Equal	Equal	Higher	3	37,5
Poland	Higher	Higher	Higher	1	12,5
Portugal	Equal	Equal	Equal	14	93,3
Portugal	Equal	Equal	Lower	1	6,7
Romania	Equal	Equal	Equal	1	50
Romania	Higher	Higher	Equal	1	50
Slovenia	Equal	Equal	Equal	3	100
Spain	Equal	Equal	Equal	27	87,1
Spain	Equal	Equal	Lower	1	3,2
Spain	Equal	Lower	Lower	1	3,2
Spain	Higher	Equal	Equal	1	3,2
Spain	Lower	Lower	Lower	1	3,2
Sweden	Equal	Equal	Equal	12	85,7
Sweden	Equal	Higher	Higher	2	14,3
United Kingdom	Equal	Equal	Equal	127	84,7
United Kingdom	Equal	Equal	Higher	13	8,7
United Kingdom	Higher	Higher	Higher	8	5,3
United Kingdom	Equal	Higher	Higher	2	1,3

Table A- 24: Number of NUTS3 regions according to relative risk for coastal floods in the reference period 1981-2010

RISK CLASS	NUMBER	PERCENTAGE
Very low	21	4,1
Low	181	35,3
Medium	252	49,1
High	58	11,3
Very high	1	0,2

Table A- 25: 25 NUTS3 with the highest relative risk for coastal floods in the reference period 1981-2010 (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ITH35	Venezia	Italy	Low	High	Very high	Very high	Medium	Very high
ITH37	Rovigo	Italy	Medium	Very high	Very high	High	Medium	High
FRG05	Vendée	France	Very high	Very high	High	Very high	Medium	High
FRI32	Charente-Maritime	France	Very high	Very high	High	Very high	Medium	High
ITF45	Lecce	Italy	Low	High	Very high	High	Medium	High
RO223	Constanta	Romania	Medium	High	Very high	High	Medium	High
FRH04	Morbihan	France	High	Very high	High	Very high	Medium	High
ES521	Alicante/Alacant	Spain	High	High	High	Very high	Medium	High
NL124	Noord-Friesland	Netherlands	Medium	Very high	High	High	Medium	High
DK032	Sydjylland	Denmark	High	Very high	High	Very high	Medium	High
ES511	Barcelona	Spain	Very high	Very high	Medium	Very high	Medium	High
ES532	Mallorca	Spain	High	High	High	High	Medium	High
FRH02	Finistère	France	High	Very high	Medium	Very high	Medium	High
DK050	Nordjylland	Denmark	High	High	Medium	Very high	Medium	High
FRH01	Côtes-d'Armor	France	High	Very high	High	High	Medium	High
ES617	Málaga	Spain	High	Very high	Medium	Very high	Medium	High
EL622	Kerkyra	Greece	Very low	Low	Very high	Medium	Medium	High
ITI43	Roma	Italy	High	High	Medium	Very high	Medium	High
ITF14	Chieti	Italy	Medium	Very high	Very high	Medium	Medium	High

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ES523	Valencia/València	Spain	High	High	Medium	Very high	Medium	High
ES612	Cádiz	Spain	Very high	High	Medium	Very high	Medium	High
ITF12	Teramo	Italy	Medium	Very high	Very high	Medium	Medium	High
ITF46	Foggia	Italy	Medium	High	High	High	Medium	High
BG341	Burgas	Bulgaria	Low	Medium	High	High	Medium	High
FRJ13	Hérault	France	Very high	High	Medium	Very high	Medium	High

Table A- 26: Number of NUTS3 per country with a high relative risk for coastal floods in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Bulgaria	3	100
Romania	2	100
Denmark	5	45,5
Spain	11	35,5
France	11	35,5
Italy	14	21,2
Germany	3	8,3
Netherlands	2	8,3
Norway	1	8,3
Sweden	1	7,1
Portugal	1	6,7
Greece	3	6,4
United Kingdom	1	0,7

Table A- 27: Number of NUTS3 per country with a very high relative risk for coastal floods in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Italy	1	1,5

Table A- 28: Future risk evolution of the NUTS3 for coastal floods according to climate change scenarios (RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Higher	Higher	466	90,8

RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Equal	Equal	31	6
Equal	Higher	12	2,3
Lower	Lower	2	0,4
Equal	Lower	1	0,2
Higher	Lower	1	0,2

Table A- 29: Future risk evolution of NUTS3 by country for coastal floods according to climate change scenarios (RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

COUNTRY	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Albania	Higher	Higher	8	88,9
Albania	Equal	Equal	1	11,1
Belgium	Higher	Higher	14	100
Bulgaria	Higher	Higher	3	100
Croatia	Higher	Higher	7	100
Cyprus	Higher	Higher	1	100
Denmark	Higher	Higher	11	100
Estonia	Higher	Higher	4	100
Finland	Higher	Higher	8	88,9
Finland	Equal	Higher	1	11,1
France	Higher	Higher	31	100
Germany	Higher	Higher	32	88,9
Germany	Equal	Equal	3	8,3
Germany	Equal	Higher	1	2,8
Greece	Higher	Higher	47	100
Iceland	Equal	Equal	2	100
Ireland	Higher	Higher	7	100
Italy	Higher	Higher	61	92,4
Italy	Equal	Higher	3	4,5
Italy	Equal	Equal	2	3
Latvia	Higher	Higher	3	100
Lithuania	Higher	Higher	1	100
Malta	Higher	Higher	2	100
Montenegro	Higher	Higher	1	100
Netherlands	Higher	Higher	22	91,7

COUNTRY	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Netherlands	Equal	Equal	2	8,3
Norway	Higher	Higher	9	75
Norway	Equal	Equal	2	16,7
Norway	Equal	Higher	1	8,3
Poland	Higher	Higher	8	100
Portugal	Higher	Higher	13	86,7
Portugal	Equal	Equal	2	13,3
Romania	Higher	Higher	2	100
Slovenia	Higher	Higher	3	100
Spain	Higher	Higher	22	71
Spain	Equal	Equal	9	29
Sweden	Higher	Higher	13	92,9
Sweden	Equal	Higher	1	7,1
United Kingdom	Higher	Higher	133	88,7
United Kingdom	Equal	Equal	8	5,3
United Kingdom	Equal	Higher	5	3,3
United Kingdom	Lower	Lower	2	1,3
United Kingdom	Equal	Lower	1	0,7
United Kingdom	Higher	Lower	1	0,7

Table A- 30: Number of NUTS3 regions according to relative risk for droughts in the reference period 1981-2010

RISK CLASS	NUMBER	PERCENTAGE
Very low	73	14,2
Low	173	33,7
Medium	133	25,9
High	98	19,1
Very high	36	7

Table A- 31: 25 NUTS3 with the highest relative risk for droughts in the reference period 1981-2010 (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUNTRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
EL422	Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	Greece	Low	Medium	Very high	Very high	Very high	Very high

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
EL432	Lasithi	Greece	Low	Medium	Very high	High	Very high	Very high
EL303	Kentrikos Tomeas Athinon	Greece	Very low	Medium	Very high	High	Very high	Very high
EL431	Irakleio	Greece	Low	Medium	High	Very high	Very high	Very high
EL421	Kalymnos, Karpathos, Kasos, Kos, Rodos	Greece	Very low	Low	High	Very high	Very high	Very high
ES617	Málaga	Spain	High	Very high	High	Very high	Very high	Very high
ES521	Alicante/Alacant	Spain	Medium	High	High	Very high	Very high	Very high
EL434	Chania	Greece	Low	Low	High	Very high	Very high	Very high
ES611	Almería	Spain	High	High	High	Very high	Very high	Very high
EL307	Peiraias, Nisoi	Greece	Low	Medium	Very high	High	Very high	Very high
ES709	Tenerife	Spain	Medium	High	High	Very high	Very high	Very high
ITF45	Lecce	Italy	Low	High	Very high	Very high	High	Very high
CY000	Kýpros	Cyprus	High	High	High	Very high	Very high	Very high
ES614	Granada	Spain	High	High	High	Very high	Very high	Very high
EL633	Ileia	Greece	Low	Medium	Very high	High	Very high	Very high
EL622	Kerkyra	Greece	Very low	Low	Very high	High	High	Very high
EL642	Evvoia	Greece	Low	Medium	Very high	Very high	Very high	Very high
ES532	Mallorca	Spain	Medium	High	High	Very high	Very high	Very high
ES612	Cádiz	Spain	Very high	High	High	Very high	Very high	Very high

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ITG11	Trapani	Italy	Medium	Medium	High	Very high	Very high	Very high
EL623	Ithaki, Kefallinia	Greece	Very low	Low	Very high	High	Very high	Very high
ES708	Lanzarote	Spain	Low	Medium	High	High	Very high	Very high
PT150	Algarve	Portugal	Medium	Medium	High	Very high	Very high	Very high
EL433	Rethymni	Greece	Low	Low	High	High	Very high	Very high
ES615	Huelva	Spain	High	High	Medium	Very high	Very high	Very high

Table A- 32: Number of NUTS3 per country with a high relative risk for droughts in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Bulgaria	3	100
Malta	2	100
Italy	43	65,2
Portugal	8	53,3
Greece	25	53,2
Romania	1	50
Spain	12	38,7
France	4	12,9

Table A- 33: Number of NUTS3 per country with a very high relative risk for droughts in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Cyprus	1	100
Romania	1	50
Spain	12	38,7
Greece	18	38,3
Portugal	1	6,7
Italy	3	4,5

Table A- 34: Future risk evolution of the NUTS3 for droughts according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Equal	Equal	Equal	371	72,3
Equal	Equal	Higher	62	12,1
Equal	Higher	Higher	41	8
Higher	Higher	Higher	28	5,5
Equal	Lower	Equal	4	0,8
Higher	Equal	Higher	4	0,8
Lower	Equal	Equal	2	0,4
Lower	Equal	Lower	1	0,2

Table A- 35: Future risk evolution of NUTS3 by country for droughts according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Albania	Equal	Equal	Equal	7	77,8
Albania	Equal	Equal	Higher	2	22,2
Belgium	Equal	Equal	Equal	10	71,4
Belgium	Equal	Equal	Higher	3	21,4
Belgium	Equal	Higher	Higher	1	7,1
Bulgaria	Equal	Equal	Equal	3	100
Croatia	Equal	Equal	Equal	6	85,7
Croatia	Equal	Higher	Higher	1	14,3
Cyprus	Equal	Equal	Equal	1	100
Denmark	Equal	Equal	Equal	9	81,8
Denmark	Equal	Lower	Equal	1	9,1
Denmark	Higher	Equal	Higher	1	9,1
Estonia	Equal	Equal	Equal	3	75
Estonia	Equal	Lower	Equal	1	25
Finland	Equal	Equal	Equal	8	88,9
Finland	Equal	Lower	Equal	1	11,1
France	Equal	Equal	Equal	19	61,3
France	Equal	Equal	Higher	5	16,1
France	Equal	Higher	Higher	4	12,9

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
France	Higher	Higher	Higher	2	6,5
France	Lower	Equal	Lower	1	3,2
Germany	Equal	Equal	Equal	24	66,7
Germany	Equal	Equal	Higher	6	16,7
Germany	Higher	Equal	Higher	3	8,3
Germany	Higher	Higher	Higher	3	8,3
Greece	Equal	Equal	Equal	39	83
Greece	Equal	Equal	Higher	7	14,9
Greece	Higher	Higher	Higher	1	2,1
Iceland	Equal	Equal	Equal	1	50
Iceland	Equal	Equal	Higher	1	50
Ireland	Equal	Equal	Equal	4	57,1
Ireland	Higher	Higher	Higher	3	42,9
Italy	Equal	Equal	Equal	47	71,2
Italy	Equal	Higher	Higher	8	12,1
Italy	Equal	Equal	Higher	7	10,6
Italy	Higher	Higher	Higher	4	6,1
Latvia	Equal	Equal	Equal	3	100
Lithuania	Equal	Equal	Equal	1	100
Malta	Equal	Equal	Equal	2	100
Montenegro	Higher	Higher	Higher	1	100
Netherlands	Equal	Equal	Equal	16	66,7
Netherlands	Equal	Equal	Higher	4	16,7
Netherlands	Higher	Higher	Higher	4	16,7
Norway	Equal	Equal	Equal	10	83,3
Norway	Equal	Lower	Equal	1	8,3
Norway	Lower	Equal	Equal	1	8,3
Poland	Equal	Equal	Equal	8	100
Portugal	Equal	Equal	Equal	13	86,7
Portugal	Equal	Equal	Higher	1	6,7
Portugal	Equal	Higher	Higher	1	6,7
Romania	Equal	Equal	Equal	2	100
Slovenia	Equal	Higher	Higher	2	66,7
Slovenia	Equal	Equal	Higher	1	33,3
Spain	Equal	Equal	Equal	24	77,4
Spain	Equal	Equal	Higher	4	12,9

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Spain	Equal	Higher	Higher	1	3,2
Spain	Higher	Higher	Higher	1	3,2
Spain	Lower	Equal	Equal	1	3,2
Sweden	Equal	Equal	Equal	14	100
United Kingdom	Equal	Equal	Equal	97	64,7
United Kingdom	Equal	Higher	Higher	23	15,3
United Kingdom	Equal	Equal	Higher	21	14
United Kingdom	Higher	Higher	Higher	9	6

Table A- 36: Number of NUTS3 regions according to relative risk for wildfires in the reference period 1981-2010

RISK CLASS	NUMBER	PERCENTAGE
Very low	96	18,7
Low	206	40,2
Medium	49	9,6
High	126	24,6
Very high	36	7

Table A- 37: 25 NUTS3 with the highest relative risk for wildfires in the reference period 1981-2010 (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ES521	Alicante/Alacant	Spain	Medium	High	High	Very high	Very high	Very high
ES617	Málaga	Spain	High	Very high	High	Very high	Very high	Very high
CY000	Kýpros	Cyprus	High	High	High	Very high	Very high	Very high
ES611	Almería	Spain	High	Very high	High	High	Very high	Very high
ES614	Granada	Spain	High	Very high	High	High	Very high	Very high
ES532	Mallorca	Spain	Medium	High	High	High	High	Very high
ES523	Valencia/València	Spain	High	High	High	Very high	High	Very high
EL303	Kentrikos Tomeas Athinon	Greece	Very low	Low	Very high	Medium	Very high	Very high
ITF45	Lecce	Italy	Low	High	Very high	Medium	Very high	Very high
ITI43	Roma	Italy	High	High	Medium	Very high	High	Very high
ES511	Barcelona	Spain	Very high	Very high	High	Very high	Medium	Very high
EL421	Kalymnos, Karpathos, Kasos, Kos, Rodos	Greece	Very low	Low	Very high	Medium	High	Very high

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
EL641	Voiotia	Greece	Very low	Medium	Very high	Medium	Very high	Very high
ES620	Murcia	Spain	High	High	High	High	Very high	Very high
EL653	Lakonia, Messinia	Greece	Low	Medium	High	Medium	Very high	Very high
ITH35	Venezia	Italy	Medium	High	Very high	High	Medium	Very high
ES514	Tarragona	Spain	High	Very high	High	Very high	High	Very high
EL651	Argolida, Arkadia	Greece	Low	Medium	High	Medium	Very high	Very high
RO223	Constanta	Romani a	Medium	High	Very high	Medium	High	Very high
ITF14	Chieti	Italy	Medium	Very high	Very high	Medium	High	Very high
EL633	Ileia	Greece	Low	Medium	Very high	Medium	Very high	Very high
EL622	Kerkyra	Greece	Very low	Low	Very high	Medium	High	Very high
ES612	Cádiz	Spain	Very high	High	High	High	Very high	Very high
EL431	Irakleio	Greece	Low	Medium	Very high	Medium	Very high	Very high
EL644	Fthiotida	Greece	Low	Medium	Very high	Medium	Very high	Very high

Table A- 38: Number of NUTS3 per country with a high relative risk for wildfires in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Bulgaria	3	100
Italy	54	81,8
Portugal	11	73,3
Greece	34	72,3
Croatia	5	71,4
Malta	1	50
Romania	1	50
France	9	29
Spain	8	25,8

Table A- 39: Number of NUTS3 per country with a very high relative risk for wildfires in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Cyprus	1	100
Romania	1	50
Spain	11	35,5
Greece	13	27,7

COUNTRY	NUMBER	PERCENTAGE
Italy	8	12,1
Portugal	1	6,7
France	1	3,2

Table A- 40: Future risk evolution of the NUTS3 for wildfires according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Equal	Equal	Equal	423	82,5
Equal	Equal	Higher	34	6,6
Higher	Higher	Higher	30	5,8
Equal	Higher	Higher	20	3,9
Higher	Equal	Higher	6	1,2

Table A- 41: Future risk evolution of NUTS3 by country for wildfires according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Albania	Equal	Equal	Equal	5	55,6
Albania	Equal	Equal	Higher	3	33,3
Albania	Equal	Higher	Higher	1	11,1
Belgium	Equal	Equal	Equal	10	71,4
Belgium	Equal	Equal	Higher	2	14,3
Belgium	Higher	Higher	Higher	2	14,3
Bulgaria	Equal	Equal	Equal	3	100
Croatia	Equal	Equal	Equal	6	85,7
Croatia	Equal	Equal	Higher	1	14,3
Cyprus	Equal	Equal	Equal	1	100
Denmark	Equal	Equal	Equal	10	90,9
Denmark	Higher	Equal	Higher	1	9,1
Estonia	Equal	Equal	Equal	4	100
Finland	Equal	Equal	Equal	9	100
France	Equal	Equal	Equal	20	64,5
France	Equal	Equal	Higher	4	12,9
France	Equal	Higher	Higher	4	12,9

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
France	Higher	Higher	Higher	3	9,7
Germany	Equal	Equal	Equal	30	83,3
Germany	Higher	Higher	Higher	3	8,3
Germany	Higher	Equal	Higher	2	5,6
Germany	Equal	Equal	Higher	1	2,8
Greece	Equal	Equal	Equal	41	87,2
Greece	Equal	Equal	Higher	3	6,4
Greece	Higher	Higher	Higher	2	4,3
Greece	Equal	Higher	Higher	1	2,1
Iceland	Equal	Equal	Equal	2	100
Ireland	Equal	Equal	Equal	7	100
Italy	Equal	Equal	Equal	53	80,3
Italy	Equal	Higher	Higher	6	9,1
Italy	Higher	Higher	Higher	4	6,1
Italy	Equal	Equal	Higher	3	4,5
Latvia	Equal	Equal	Equal	3	100
Lithuania	Equal	Equal	Equal	1	100
Malta	Equal	Equal	Equal	2	100
Montenegro	Equal	Equal	Equal	1	100
Netherlands	Equal	Equal	Equal	17	70,8
Netherlands	Higher	Higher	Higher	5	20,8
Netherlands	Equal	Equal	Higher	2	8,3
Norway	Equal	Equal	Equal	12	100
Poland	Equal	Equal	Equal	7	87,5
Poland	Equal	Higher	Higher	1	12,5
Portugal	Equal	Equal	Equal	12	80
Portugal	Equal	Equal	Higher	2	13,3
Portugal	Equal	Higher	Higher	1	6,7
Romania	Equal	Equal	Equal	2	100
Slovenia	Equal	Equal	Equal	2	66,7
Slovenia	Equal	Equal	Higher	1	33,3
Spain	Equal	Equal	Equal	20	64,5
Spain	Equal	Higher	Higher	6	19,4
Spain	Higher	Higher	Higher	3	9,7
Spain	Equal	Equal	Higher	2	6,5
Sweden	Equal	Equal	Equal	13	92,9

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Sweden	Equal	Equal	Higher	1	7,1
United Kingdom	Equal	Equal	Equal	130	86,7
United Kingdom	Equal	Equal	Higher	9	6
United Kingdom	Higher	Higher	Higher	8	5,3
United Kingdom	Higher	Equal	Higher	3	2

Table A- 42: Number of NUTS3 regions according to relative risk for heatwaves in the reference period 1981-2010

RISK CLASS	NUMBER	PERCENTAGE
Very low	95	18,5
Low	193	37,6
Medium	118	23
High	94	18,3
Very high	13	2,5

Table A- 43: 25 NUTS3 with the highest relative risk for heatwaves in the reference period 1981-2010 (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ES521	Alicante/Alacant	Spain	Medium	High	High	High	High	Very high
EL303	Kentrikos Tomeas Athinon	Greece	Very low	Medium	Very high	Medium	High	Very high
CY000	Kýpros	Cyprus	High	High	High	High	High	Very high
ES532	Mallorca	Spain	Medium	High	High	High	High	Very high
ES617	Málaga	Spain	High	Very high	High	High	High	Very high
ES511	Barcelona	Spain	Very high	Very high	High	Very high	Medium	Very high
ES523	Valencia/València	Spain	High	High	High	Very high	High	Very high
ITI43	Roma	Italy	High	High	Medium	Very high	High	Very high
EL421	Kalymnos, Karpathos, Kasos, Kos, Rodos	Greece	Very low	Low	High	Medium	High	Very high

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
EL422	Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	Greece	Low	Medium	Very high	Medium	High	Very high
ITF45	Lecce	Italy	Low	High	Very high	Medium	High	Very high
ES514	Tarragona	Spain	High	Very high	High	High	High	Very high
ITH35	Venezia	Italy	Medium	High	Very high	High	Medium	Very high
ITF33	Napoli	Italy	Medium	Medium	Medium	High	High	High
EL301	Voreios Tomeas Athinon	Greece	Very low	Medium	Very high	Low	High	High
ES611	Almería	Spain	High	High	High	High	High	High
EL622	Kerkyra	Greece	Very low	Low	Very high	Low	High	High
EL307	Peiraias, Nisoi	Greece	Low	Medium	Very high	Low	High	High
ITF47	Bari	Italy	High	High	High	High	High	High
ES614	Granada	Spain	High	High	High	High	Medium	High
EL633	Ileia	Greece	Low	Medium	Very high	Low	High	High
ITH36	Padova	Italy	Medium	Medium	High	High	Medium	High
EL653	Lakonia, Messinia	Greece	Low	Low	High	Medium	High	High
EL432	Lasithi	Greece	Low	Medium	Very high	Low	High	High
ES620	Murcia	Spain	High	High	High	High	High	High

Table A- 44: Number of NUTS3 per country with a high relative risk for heatwaves in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Malta	2	100
Romania	2	100

COUNTRY	NUMBER	PERCENTAGE
Bulgaria	2	66,7
Italy	34	51,5
Greece	24	51,1
Spain	13	41,9
France	13	41,9
Portugal	3	20
Croatia	1	14,3

Table A- 45: Number of NUTS3 per country with a very high relative risk for heatwaves in the reference period 1981-2010

COUNTRY	NUMBER	PERCENTAGE
Cyprus	1	100
Spain	6	19,4
Greece	3	6,4
Italy	3	4,5

Table A- 46: Future risk evolution of the NUTS3 for heatwaves according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Equal	Equal	Equal	191	37,2
Equal	Equal	Higher	165	32,2
Higher	Higher	Higher	93	18,1
Equal	Higher	Higher	64	12,5

Table A- 47: Future risk evolution of NUTS3 by country for heatwaves according to climate change scenarios (RCP 2.6, RCP 4.5 and RCP 8.5) in the period 2071-2100 with respect to the reference period 1981-2010 (RK_CHANGE = change in risk, 26 = RCP 2.6, 45 = RCP 4.5, 85 = RCP 8.5, NUMBER = number of concerned NUTS3 regions, PERCENTAGE = % of concerned NUTS3 regions).

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Albania	Equal	Equal	Equal	3	33,3
Albania	Equal	Higher	Higher	3	33,3
Albania	Equal	Equal	Higher	2	22,2
Albania	Higher	Higher	Higher	1	11,1
Belgium	Equal	Equal	Higher	6	42,9
Belgium	Equal	Higher	Higher	3	21,4

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Belgium	Higher	Higher	Higher	3	21,4
Belgium	Equal	Equal	Equal	2	14,3
Bulgaria	Equal	Equal	Equal	2	66,7
Bulgaria	Higher	Higher	Higher	1	33,3
Croatia	Equal	Equal	Higher	4	57,1
Croatia	Equal	Equal	Equal	2	28,6
Croatia	Equal	Higher	Higher	1	14,3
Cyprus	Equal	Equal	Equal	1	100
Denmark	Equal	Equal	Higher	6	54,5
Denmark	Higher	Higher	Higher	3	27,3
Denmark	Equal	Equal	Equal	2	18,2
Estonia	Higher	Higher	Higher	2	50
Estonia	Equal	Equal	Higher	1	25
Estonia	Equal	Higher	Higher	1	25
Finland	Equal	Equal	Higher	5	55,6
Finland	Equal	Higher	Higher	2	22,2
Finland	Equal	Equal	Equal	1	11,1
Finland	Higher	Higher	Higher	1	11,1
France	Equal	Equal	Equal	13	41,9
France	Equal	Equal	Higher	8	25,8
France	Equal	Higher	Higher	6	19,4
France	Higher	Higher	Higher	4	12,9
Germany	Equal	Equal	Higher	13	36,1
Germany	Equal	Equal	Equal	9	25
Germany	Equal	Higher	Higher	9	25
Germany	Higher	Higher	Higher	5	13,9
Greece	Equal	Equal	Equal	24	51,1
Greece	Equal	Equal	Higher	10	21,3
Greece	Higher	Higher	Higher	9	19,1
Greece	Equal	Higher	Higher	4	8,5
Iceland	Equal	Equal	Equal	2	100
Ireland	Equal	Equal	Higher	3	42,9
Ireland	Equal	Equal	Equal	2	28,6
Ireland	Equal	Higher	Higher	1	14,3
Ireland	Higher	Higher	Higher	1	14,3
Italy	Equal	Equal	Equal	35	53

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
Italy	Equal	Equal	Higher	14	21,2
Italy	Higher	Higher	Higher	12	18,2
Italy	Equal	Higher	Higher	5	7,6
Latvia	Higher	Higher	Higher	3	100
Lithuania	Equal	Higher	Higher	1	100
Malta	Equal	Equal	Equal	2	100
Montenegro	Higher	Higher	Higher	1	100
Netherlands	Equal	Equal	Higher	9	37,5
Netherlands	Higher	Higher	Higher	9	37,5
Netherlands	Equal	Equal	Equal	3	12,5
Netherlands	Equal	Higher	Higher	3	12,5
Norway	Equal	Equal	Equal	6	50
Norway	Equal	Equal	Higher	4	33,3
Norway	Equal	Higher	Higher	1	8,3
Norway	Higher	Higher	Higher	1	8,3
Poland	Equal	Equal	Equal	4	50
Poland	Higher	Higher	Higher	2	25
Poland	Equal	Equal	Higher	1	12,5
Poland	Equal	Higher	Higher	1	12,5
Portugal	Equal	Equal	Equal	6	40
Portugal	Higher	Higher	Higher	4	26,7
Portugal	Equal	Equal	Higher	3	20
Portugal	Equal	Higher	Higher	2	13,3
Romania	Equal	Equal	Equal	1	50
Romania	Equal	Higher	Higher	1	50
Slovenia	Equal	Equal	Equal	1	33,3
Slovenia	Equal	Higher	Higher	1	33,3
Slovenia	Higher	Higher	Higher	1	33,3
Spain	Equal	Equal	Equal	16	51,6
Spain	Equal	Equal	Higher	10	32,3
Spain	Higher	Higher	Higher	3	9,7
Spain	Equal	Higher	Higher	2	6,5
Sweden	Equal	Equal	Higher	7	50
Sweden	Equal	Higher	Higher	4	28,6
Sweden	Higher	Higher	Higher	3	21,4
United Kingdom	Equal	Equal	Higher	59	39,3

COUNTRY	RK_CHANGE_26	RK_CHANGE_45	RK_CHANGE_85	NUMBER	PERCENTAGE
United Kingdom	Equal	Equal	Equal	54	36
United Kingdom	Higher	Higher	Higher	24	16
United Kingdom	Equal	Higher	Higher	13	8,7

Table A- 48: Number of NUTS3 regions according to relative risk for poor air quality in the current period

RISK CLASS	NUMBER	PERCENTAGE
Very low	9	1,8
Low	186	36,3
Medium	206	40,2
High	103	20,1
Very high	9	1,8

Table A- 49: 25 NUTS3 with the highest relative risk for poor air quality in the current period (AC = adaptive capacity, SE = sensitivity, VU = vulnerability, EX = exposure, HZ = hazard, RK = risk)

NUTS ID	NUTS NAME	COUNTRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
EL303	Kentrikos Tomeas Athinon	Greece	Very low	Low	Very high	Medium	Very high	Very high
ITH35	Venezia	Italy	Low	Medium	High	High	Very high	Very high
ITH36	Padova	Italy	Medium	Low	Medium	High	Very high	Very high
ITH37	Rovigo	Italy	Low	High	Very high	Medium	Very high	Very high
ITH56	Ferrara	Italy	Medium	Medium	Medium	Medium	Very high	Very high
NL124	Noord-Friesland	Netherlands	Medium	Very high	Very high	High	Low	Very high
BG331	Varna	Bulgaria	Very low	Low	Very high	Medium	High	Very high
BG332	Dobrich	Bulgaria	Very low	Medium	Very high	Low	Medium	Very high
ITF33	Napoli	Italy	Medium	Low	Low	Very high	High	Very high
EL421	Kalymnos, Karpathos, Kasos, Kos, Rodos	Greece	Very low	Low	High	Medium	Medium	High

NUTS ID	NUTS NAME	COUN-TRY	AC CLASS	SE CLASS	VU LASS	EX CLASS	HZ CLASS	RK CLASS
ITF14	Chieti	Italy	Medium	Very high	Very high	Medium	Medium	High
CY000	Kýpros	Cyprus	High	Medium	Low	Very high	Medium	High
EL422	Andros, Thira, Kea, Milos, Mykonos, Naxos, Paros, Syros, Tinos	Greece	Low	Medium	Very high	Medium	Medium	High
EL622	Kerkyra	Greece	Very low	Low	Very high	Medium	Medium	High
ITF45	Lecce	Italy	Low	Medium	High	Medium	Medium	High
ITH34	Treviso	Italy	High	Low	Low	High	Very high	High
ITF44	Brindisi	Italy	Low	Medium	High	Medium	High	High
ES511	Barcelona	Spain	Very high	Medium	Low	Very high	Medium	High
RO223	Constanta	Romania	Low	Medium	High	Medium	High	High
ITF47	Bari	Italy	High	Medium	Medium	High	Medium	High
ITH57	Ravenna	Italy	Medium	Low	Medium	Medium	High	High
NL341	Zeeuwsch-Vlaanderen	Netherlands	Low	Medium	Very high	Low	High	High
ES709	Tenerife	Spain	High	Medium	Medium	High	High	High
EL633	Ileia	Greece	Very low	Medium	Very high	Medium	Low	High
ITF48	Barletta-Andria-Trani	Italy	Medium	Medium	Medium	High	Medium	High

Table A- 50: Number of NUTS3 per country with a high relative risk for poor air quality in the current period

COUNTRY	NUMBER	PERCENTAGE
Cyprus	1	100
Malta	2	100
Romania	2	100
Croatia	5	71,4
Greece	29	61,7
Italy	33	50
Poland	3	37,5

COUNTRY	NUMBER	PERCENTAGE
Spain	11	35,5
Bulgaria	1	33,3
Slovenia	1	33,3
Portugal	4	26,7
Netherlands	5	20,8
Belgium	2	14,3
France	3	9,7
Denmark	1	9,1

Table A- 51: Number of NUTS3 per country with a very high relative risk for poor air quality in the current period

COUNTRY	NUMBER	PERCENTAGE
Bulgaria	2	66,7
Italy	5	7,6
Netherlands	1	4,2
Greece	1	2,1

Annex 3: EIB financed projects related to cultural heritage and landscapes

Table A- 52: EIB financed projects related to cultural heritage and landscapes (C/T = country or territory, SEC = sector, DAT = signature date, END = end of the investment programme, AMO = signed Amount)

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
AMBIENTE URBANO AND SMART FIRENZE	Italy	Urban develop ment	13/07/2 017	2019	€ 128,80 0,000	Framework Loan to co-finance Sustainable and Smart projects in the City of Florence. Schemes are part of the 2017-2019 Investment plan and comprise, among others, rehabilitation and upgrading of public buildings including cultural heritage and social housing, rehabilitation of urban roads and other urban infrastructure as well as the implementation of ICT components and sustainable mobility schemes (e.g. tram lines 2 and 3).	Climate change mitigation: "implementati on of energy efficiency and renewable energy measures in cultural facilities, cultural heritage buildings" (See link)
AMBIENTE URBANO FIRENZE VI	Italy	Urban develop ment	23/06/2 011)	2012	€ 100,00 0,000	The project is the sixth framework loan concerning the financing of various investment schemes in the municipality of Florence, as included in its three-year Investment Programme 2011-2013. The	"cultural and historical heritage and public buildings rehabilitation, improvement in the city's urban

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
						investments mainly cover the fields of transport, streets rehabilitation, health and education, cultural and historical heritage and public buildings rehabilitation, and include also the realisation of the new city's tramway lines 2 and 3.	environment”(See link)
ASTURIAS PRESTAMO MARCO	Spain	Urban develop ment	18/11/20 11	2011	€ 52,500 ,000	Financing of small and medium-sized investments in the areas of transport, health, education, ICT, culture and cultural heritage and urban renewal in Asturias	“economic growth, job creation and competitivene s”(See link)
CASTILLA Y LEON CAPITAL HUMANO	Spain	Service s	09/03/2 012	N/A	€ 72,000 ,000	The project concerns a large number of investments in the human capital infrastructure of Castilla y León, including university and pre-university education, cultural heritage and social facilities.	“restoration of historic buildings” (See link)
KIRUNA MALMBERGE T URBAN RENEWAL	Swede n	Urban develop ment	04/12/2 019	2021	€ 100,00 0,000	Following the expansion of the mine exploitation by LKAB, in the two towns Kiruna and Malmberget a process of urban transformation takes place to replace buildings and facilities	restoration, and new constructions that influence the revitalization of

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
						which are lost. The project comprises sub-projects to be implemented during 2016-2021 in the fields of municipal infrastructure, cultural heritage, housing and spaces for businesses/commercial activities.	neighborhoods. (See link)
LA RIOJA HEALTH AND EDUCATION	Spain	Services	21/05/2010	N/A	€ 4,550,000	Financing of small and medium sized investments primarily in the areas of health, education, social care and cultural heritage in La Rioja, Spain.	Improvement of existing build capital (See link)
LORCA EARTHQUAKE RECONSTRUCTION	Spain	Urban development	28/06/2012	N/A	€ 185,000,000	Reconstruction of various buildings, residential and non residential, upgrading of cultural and historical heritage and improvement of public infrastructure in the municipality of Lorca (Region of Murcia), following the May 11th 2011 earthquake.	Recovery: "Reconstruction of various buildings, including cultural and historical heritage following the May 11th 2011 earthquake in Lorca (Region of Murcia)" (See link and Romão et al. (2020), pp. 516-518)

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
MAZOWIECKIE REGIONAL INFRASTRUCTURE	Poland	Urban development	15/12/2017	2020	€ 8,537,482	The proposed Framework Loan will part-finance the priority schemes implemented in the 2014-2020 programming period in the Mazowieckie Region. The programme will primarily include schemes in the following sectors: road safety, culture heritage, and health. The loan will be signed under the Programme Loan 2017-0081 POLAND REGIONAL INFRASTRUCTURE PROGRAMME.	Preservation of cultural heritage
MEDIO AMBIENTE Y BOSQUES DE ANDALUCIA	Spain	Agriculture, fisheries, forestry	03/05/2011	2014	€ 200,000,000	Programme of forest-focussed investments aiming to preserve natural environment and landscape, protect and improve natural resources and mitigate climate change.	Disaster risk reduction: "forest fire prevention, forest infrastructure development" (See link)
OPERNVIERTEL KOELN	Germany	Urban development	19/12/2014	N/A	€ 127,000,000	The project will concern the rehabilitation of the cultural heritage buildings opera/theatre and urban renewal investments in the	"comprehensive rehabilitation and upgrading of the municipal opera and

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
						surrounding public urban infrastructure	theatre complex which is a preserved cultural heritage building, and playing a catalytic role in regenerating some of Cologne's oldest inner city neighbourhoods surrounding the opera/theatre complex" (See link)
STADTENTWICKLUNG BRANDENBURG III	Germany	Urban development	28/10/2014	2018	€ 190,000,000	The Framework Loan will comprise a portfolio of sub-projects for urban infrastructure, cultural heritage/historic monuments, public buildings and some social housing, located within urban renewal and development areas throughout the Land Brandenburg. The investments concern improvement, downsizing and (re-)construction to be	Urban renewal (See link)

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
						implemented in the years 2014-2018 throughout local authorities in the Land Brandenburg which is a transition region' under EU eligibility in the 2014-2020 period and an EI	
STAEDTISCHE INFRASTRUKTUR GRAZ	Austria	Urban development	14/11/2014	2018	€ 90,000,000	Multi-sector investment programme in urban infrastructure in the City of Graz, capital of Styria, for the financing period in the years 2014 to 2018 in the fields of education and sports facilities, social housing, cultural heritage, energy networks, water and sanitation and waste management.	Improvement of the urban environment (See link)
TALLINN URBAN INFRASTRUCTURE II	Estonia	Urban development	19/05/2016	2019	€ 18,704,000	The project concerns the financing of multi-sectoral investment schemes forming part of the Municipality's four-year investment programme from 2011 to 2014.The project is expected to comprise some 80 small to medium sized schemes in the fields of municipal infrastructure (including streets, transport and public	rehabilitation of deprived areas; improvement of urban infrastructure (See link)

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
						open spaces), education and sport, social and health infrastructure, social housing and cultural heritage and will benefit the City of Tallinn (Estonia), a convergence objective region.	
VALLETTA CITY GATE PROJECT	Malta	Urban development	25/06/2012	N/A	€ 40,000,000	Construction in the Maltese capital, Valletta (a UNESCO world heritage site), of a new city gate, a new Parliament building and a piazza and performing space at the site of the former Royal Opera House destroyed during World War II.	contribute to the city's regeneration and long-term economic growth; upgrading of the urban environment and developing of the existing attractions such as urban landscape and cultural heritage buildings (See link)
WARSAW MUNICIPAL INFRASTRUCTURE III	Poland	Urban development	28/07/2010	N/A	€ 120,569,086	The project covers medium size investment schemes in fields of transport and local roads modernization, health and education, cultural and historical heritage and public	Rehabilitation of cultural heritage (See link)

NAME	C/T	SEC	DAT	END	AMO	DESCRIPTION	ASSOCIATED BENEFITS
						buildings rehabilitation in the City of Warsaw	
WARSAW MUNICIPAL INFRASTRUCTURE IV	Poland	Urban development	08/07/2014	N/A	€ 38,491,147	The project covers small, medium and large investment schemes in the fields of transport and local roads modernization, health and education, cultural heritage, landscaping, green spaces and public buildings rehabilitation and construction in the City of Warsaw.	Rehabilitation of cultural heritage (See link)

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