



Pathways2Resilience

Baseline assessment

ADAPT2CYL

February 2026

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Abbreviations and acronyms

Acronym	Description
P2R	Pathways2Resilience
CNE	National Epidemiology Center (Centro Nacional de Epidemiología)
ISCIII	Carlos III Health Institute (Instituto de Salud Carlos III)
AEMET	State Meteorological Agency (Agencia Estatal de Meteorología)
EU	European Union
DANAs	Isolated Depressions at High Levels (Depresiones Aisladas en Niveles Altos)
MEL	Monitoring, Evaluation, and Learning

Glossary

Term	Short definition
Resilience maturity	The level of development and preparedness a region or community has reached in terms of its ability to anticipate, prepare for, and respond to climate crises.
Climate adaptation	The process of adjusting to current or expected climate impacts, aiming to reduce harm or exploit beneficial opportunities.
Climate resilience	The ability of a region or community to anticipate, prepare for, and respond to climate-related shocks and stresses.
Monitoring, Evaluation, and Learning (MEL)	A system used to track progress, evaluate effectiveness, and learn from outcomes to improve future actions.
Strategic objectives	Goals set to guide adaptation actions towards achieving climate resilience.
Nature-based solutions	Strategies that use natural processes to address climate challenges, such as restoring ecosystems to manage water or provide cooling.
Multi-level governance	Coordination and cooperation across different levels of government (local, regional, national, EU) to address complex issues like climate adaptation.

Disclaimer

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1 Introduction

Climate change is a systemic and growing threat to ecological, economic, and social systems, as reaffirmed by key scientific and strategic reports at both the global and European levels. The Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), published in 2022, unequivocally confirms that the observed global warming is a direct consequence of human activity since the mid-20th century. It warns about the increasingly severe impacts on human health, biodiversity, food security, and water availability.

At the European level, the European Climate Risk Assessment (EUCRA) report, prepared by the European Environment Agency (2024), identifies more than 35 relevant climate risks, of which at least 21 require urgent attention at the regional or local level. These risks affect critical infrastructure, production systems, ecosystems, and public health, implying the need to strengthen regional adaptive capacities through integrated climate risk management strategies.

Spain clearly reflects this situation. According to the "State of Climate in Spain" report, prepared by the State Meteorological Agency (AEMET), 2024 marked the first time that the annual global average temperature exceeded the +1.5°C threshold compared to the pre-industrial period (1850-1900). Nationally, 2023 and 2024 rank among the three hottest years since 1961, with an average increase of +1.69°C since that date. This warming is compounded by the increasing frequency and intensity of extreme phenomena such as prolonged heatwaves, hydrological droughts, torrential rainfall associated with isolated depressions at high levels (DANAs), and compound risk events.

This scenario reinforces the need to advance in the planning and implementation of regional climate adaptation strategies, in line with the principles of just resilience and a multi-level governance approach. **Castilla y León**, as an autonomous community characterized by an extensive rural area, low population density, and high territorial and climatic diversity, **presents both specific challenges and opportunities on its path towards climate resilience**.

Responding to climate change requires coordinated and coherent action between mitigation and adaptation policies. The transition to a carbon-neutral economy must be accompanied by resilient territorial planning that allows for the anticipation and management of ongoing climate impacts. In this sense, Castilla y León is aligning its efforts with the main current strategic and regulatory frameworks, integrating climate resilience as a transversal axis of its regional development, and strengthening its institutional capacity to address climate challenges in an integrated and progressive manner.

This process is part of the regional project *Multi-level Adaptation and Resilience Strategy to Climate Change at Castilla y León* (ADAPT2CYL), developed within the framework of the European Pathways to Resilience (P2R) program, co-financed by the Horizon Europe program. ADAPT2CYL is led by the Provincial Government of Valladolid and includes the participation of the Government of Castilla y León (through the Fundación Patrimonio Natural), the City Council of Valladolid, and the AEICE cluster. Its main objective is to develop a regional strategy based on an initial climate resilience baseline assessment, accompanied by an action plan and an investment plan, in accordance with the methodologies proposed by P2R.

In this context, this document serves as the **climate resilience baseline assessment report** for the Castilla y León autonomous community, developed as part of the first phase of the so-called *Regional Resilience Journey*, a roadmap proposed by P2R that allows European regions to progress incrementally from risk characterization to resilient investment planning.

The primary function of this deliverable is to provide an initial diagnosis of climate risks, territorial capacities, governance frameworks, involved actors, and adaptation needs. This preliminary analysis allows for the identification of strengths, weaknesses, and enabling conditions necessary to progress towards an effective strategy. Thus, the information gathered in this assessment will serve as the foundation for the subsequent development of the **Regional Climate Resilience Strategy, the Action Plan, and the Investment Plan**, which will be the key results of the regional adaptation process driven by the ADAPT2CYL project.

1.1 Local profile

Defining the local profile is the starting point for contextualising a region's climate-resilience trajectory. This section sets out the territorial, thematic and socio-economic framework in which the process unfolds, as well as the institutional and operational characteristics of the entities involved.

In the case of Castile and León, climate-change adaptation is approached from a broad regional perspective that recognises both the territorial and functional diversity of the autonomous community and the need for coordinated action at multiple scales. This section provides a general description of the process's geographical and sectoral scope, includes relevant information on the demographic and economic context, identifies the coordinating entities, and describes the initial phases of the work carried out, including the participatory methodologies applied.

1.1.1 Geographical scope

Castile and León is the largest autonomous community in Spain and one of the largest regions in Europe, with an area of 94,224 km².



Located in the north-west of the Iberian Peninsula, it is landlocked and borders Asturias, Cantabria, the Basque Country and La Rioja to the north; Aragón to the east; Castile-La Mancha, the Community of Madrid and Extremadura to the south; and Galicia and Portugal to the west.

Its territorial configuration has implications for climate-change adaptation. It is structured into nine provinces: Ávila, Burgos, León, Palencia, Salamanca, Segovia, Soria, Valladolid and Zamora.

With 2,248 municipalities (approximately 20% of the national total) and an average population density of 25.3 inhabitants/km², Castile and León is characterised by **high geographical dispersion, low population density and numerous rural areas with limited connectivity**. This reality constrains response capacity to extreme weather events, as well as the planning and implementation of effective and equitable adaptive measures.

It occupies a central position on the Northern Meseta, making it a **strategic axis connecting different regions**, while also posing structural challenges arising from its **inland isolation and the long internal distances**, which can exceed 500 km.



Provincial division.

Source: Territorial Information Centre, Regional Government of Castile and León.

The **region's orographic diversity** is also significant. Extensive agricultural plains predominate, but there are also mountain areas, valleys and forest systems. The average altitude exceeds 830 metres, with peaks above 2,500 metres in mountainous sectors. These altitudinal gradient shapes differing exposure to phenomena such as frost, snowfall and water scarcity. From a climatic perspective, the region has a temperate climate with marked internal diversity. In the north, a temperate oceanic (west-coast maritime) climate prevails, while in the rest of the territory there are variants of the Mediterranean climate: Mediterranean with hot summers in the south-west of Castile and León, and Mediterranean with cool summers in the central and southern parts of the autonomous community. This Mediterranean



Topography of Castile and León.
Source: Territorial Information Centre, Regional Government of Castile and León.

zone is characterised by cold winters, hot summers and moderate-to-low precipitation, around 350–400 mm per year. At sub-regional scale, notable variations are identified: oceanic influence in the north, mountain climate on the eastern and southern summits, and dry Mediterranean climate in parts of the centre and east. This **climatic heterogeneity** generates diverse vulnerabilities that require area-specific adaptation strategies.

In terms of land use, the community shows a **clear predominance of agro-forestry uses**. Rainfed and irrigated farmland, pastures and forested areas occupy most of the regional surface, forming a territorial matrix closely linked to natural resources. This territorial structure reinforces the climatic dependence of sectors such as agriculture and extensive livestock farming, and underlines the need to integrate adaptation criteria into land-use planning, agri-environmental management and rural development policies.

Castile and León also contains an important network of protected natural areas, including 33 Natura 2000 sites, 29 natural areas designated by the community, and an extensive forest area of high ecological value. These **strategic ecosystems** provide key services for adaptation, such as water regulation, protection against erosion and thermal control in urban areas. Their conservation and sustainable management represent an opportunity to strengthen territorial resilience to the impacts of climate change.

The region lies largely within the **Duero river basin**, which structures the territory from west to east with nearly 600 km within the community. Sections of the Ebro, Tagus and other basins of northern Spain are also present. Water resource management falls to four River Basin Authorities (Duero, Ebro, Norte de España and Tagus), introducing a key inter-territorial dimension to water governance, especially in a context of more frequent droughts and irregular rainfall.

Castile and León has an extensive network of reservoirs that perform essential functions of water supply, energy generation and irrigation, among which Almendra (Salamanca) and Ricobayo (Zamora) stand out. The **Canal de Castilla**, over 200 km in length, is a



Hydrography of Castile and León.
Source: Territorial Information Centre, Regional Government of Castile and León.

historic hydraulic infrastructure that continues to play a relevant role today in the management of agricultural water and the region's water resilience.

Summary of key aspects for climate-change adaptation in Castile and León

- Territorial extent and dispersion → Hinders uniform implementation of adaptive measures. Requires decentralised, multi-scale approaches.
- Isolation and internal distance → Limits rapid access to essential services during extreme events; constrains logistics for adaptive interventions.
- Orographic diversity → Increases heterogeneity of risks (frost, snow, water scarcity). Demands altitude-specific strategies.
- Regional climate variability → Climate vulnerabilities and risks vary significantly by area. Requires tailored territorial planning.
- Agro-forestry land uses → High climatic dependence of primary productive sectors. Need for adaptation in agriculture and rural development.
- Network of natural areas and strategic ecosystems → Key ecosystems for ecosystem services and nature-based adaptation. Potential for green infrastructure.
- Shared water resources → Dependence on inter-territorial management. Vulnerability to droughts and increasing rainfall variability.
- Existing hydraulic infrastructure → Key infrastructures for water resilience. Essential role in irrigation, water supply and agricultural adaptation.
- Distributed water governance → Need for coordination between administrations. Importance of water planning as an adaptation tool.

1.1.2 Thematic or sectoral scope

The Climate Change Adaptation Strategy for Castile and León to be developed throughout the process set out in this document is structured around **seven key sectors**, selected on the basis of their strategic relevance for regional resilience, their level of **exposure or sensitivity** to climate risks, and **their transformative potential**.

These sectors represent systems where impacts, response capacities, and opportunities for structural adaptation converge.

- **Mobility:** Castile and León has an extensive network of transport infrastructure connecting urban centres with a highly dispersed rural territory. Extreme events such as heatwaves, snowfall, or heavy rainfall affect the functionality and safety of road, rail, and airport infrastructure. Adapting the mobility system is essential to ensure territorial connectivity in the face of these risks.
- **Energy:** The regional energy system combines conventional sources with a growing deployment of renewables (wind, solar, and biomass). The energy transition must

incorporate adaptation measures that increase the resilience of electrical infrastructure to extreme events and ensure efficient, flexible, and sustainable management of the energy supply.

- **Agri-food:** Agriculture and livestock farming are strategic sectors in the regional economy, especially in rural areas. They are highly vulnerable to water stress, prolonged droughts, and altered biological cycles. Adapting these systems entails fostering agro-ecological innovation, productive diversification, and sustainable management of soil, water, and biodiversity.
- **Health and well-being:** Climate change directly impacts public health, particularly among vulnerable groups such as older people, children, or those with chronic illnesses. Castile and León faces risks associated with heatwaves, emerging infectious diseases, heat stress, and air quality. The health system must strengthen its capacity for prevention, surveillance, and response to these impacts.
- **Habitat:** This covers both urban and rural environments, including buildings, public spaces, and water supply and sanitation systems. Adapting the habitat requires interventions in urban planning, architecture, and basic infrastructure to reduce exposure to extreme phenomena such as heat, flooding, or wildfires, and to improve quality of life in climatically adverse contexts.
- **Cross-cutting areas:** These include education, awareness-raising, culture, sustainable tourism, innovation, and knowledge management. Although they do not belong to a specific productive sector, they are decisive for fostering a culture of resilience, mobilising social capacities, and enabling the territory's adaptive transformation.
- **Governance:** Effective climate action requires solid, coordinated, and participatory governance structures. Castile and León is working to integrate adaptation into public policies, strengthen multi-level cooperation, activate appropriate financial instruments, and promote the involvement of social actors and citizens.

These sectors provide an operational framework for developing an integrated approach to adaptation, capable of addressing interconnected risks and generating synergies between sectoral policies, territorial strategies, and resilient investments, in line with the P2R Regional Resilience Journey methodology.

1.1.3 Key demographic and socio-economic data

Demographic and socioeconomic situation of Castile and León

Castile and León currently faces major demographic challenges, notably rapid population ageing and the loss of the working-age population, especially in rural areas of provinces such as Zamora and León. This is the result of insufficient generational replacement, compounded by youth out-migration, which prevents the renewal of an ageing population with new generations.

In 2023, the autonomous community had 2,383,703 inhabitants spread across 2,248 municipalities, although only one of them had more than 50,000 inhabitants. Some 33.32% of the population lives in municipalities with fewer than 5,000 inhabitants, reflecting the markedly rural character of the territory. Two-thirds of the region's municipalities are in a situation of "demographic desert", not reaching 10 inhabitants per square kilometre, with an average density of 4.3 inhabitants per square kilometre.

The population is clearly ageing: the mean age is 48.48 years and the median is 50.39, indicating that most of the population is concentrated in older age groups. A total of 26.88% of residents are aged 65 or over, and within this group 43.98% are dependent persons. The ageing index reaches 223.89—i.e., there are more than twice as many older people (>65) as young people (<16)—which is very high compared with the national average of 142.

By sex, there is a slight majority of women (50.8%). In addition, 7% of the population is foreign, with higher concentrations in Segovia and Soria.

Population density is low, averaging 25.3 inhabitants per km², well below Spain's 93 inhabitants per km². Valladolid is the most densely populated province (64.3 inhabitants per km²), while Soria has the lowest density (8.7 inhabitants per km²).

Despite these imbalances, Castile and León recorded a positive population growth rate of 3.35‰ in 2023, although León and Zamora continue to lose inhabitants. This growth is largely due to a favourable migration balance, which rose from 9.39‰ in 2022 to 10.9‰ in 2023.

As for natural growth, the situation is negative: for every thousand deaths, only 445 births occur. The crude birth rate is 5.23‰, compared with a mortality rate of 11.77‰, resulting in a natural growth rate of -6.55‰. Consequently, immigration is currently the only driver preventing population decline.



Population density by province of residence. Year 2023. SOURCE: Directorate-General for Budgets, European Funds and Statistics of the Regional Government of Castile and León, using data from the National Statistics Institute (INE) and the National Geographic Institute; microdata analysis from "Population Census" and "Surface Area".

Economic structure and recent trends

Population density by province of residence. Year 2023. SOURCE: Directorate-General for Budgets, European Funds and Statistics of the Regional Government of Castile and León, using data from the INE and the National Geographic Institute; microdata exploitation "Population Census" and "Surface area".

In 2024 GDP reached €70,418 million, with real growth of 3.5%, above the 2.7% recorded in 2023. Compared with 2010 (€54,796 million), this represents an increase of 28.5%, equivalent to an average annual growth of approximately 1.81%.

Per-capita GDP in purchasing-power terms was €33,100 in 2023, 87% of the EU-27 average. Castile and León ranks as the fourth Spanish autonomous community in terms of convergence with Europe, although it has lost one percentage point compared with the year 2000.

Regarding employment by economic sector over the last ten years, services account for the largest number of jobs—71.46% of total employment in 2022—representing 69.1% of GDP. Industry follows, with a 15.48% share of employment that year and 20.1% of GDP; then construction, with 6.63% of employment and 5.1% of GDP; and the primary sector, with 6.43% of employment and 5.8% of GDP.

TABLA 1. PRINCIPALES INDICADORES SOCIOECONÓMICOS DE CASTILLA Y LEÓN
Fuente: Elaboración propia a partir de datos del INE y de la D.G. Presupuestos, Fondos Europeos y Estadística de la JCyL con datos del INE.

VARIABLES	2016	2017	2018	2019	2020	2021	2022
POBLACIÓN (miles de personas) ^A	2.447.519	2.425.801	2.409.164	2.399.548	2.394.918	2.383.139	2.372.640
EMPLEO							
Tasa de actividad ^B	54,98 %	54,40 %	54,49 %	55,33 %	54,21 %	53,54 %	54,05 %
Tasa de paro	14,81 %	13,71 %	11,21 %	11,20 %	11,61 %	10,46 %	8,90 %
Población ocupada (miles de personas)	972,9	965,8	990,8	1.003,9	976,6	989,3	1.019,1
Agricultura, ganadería, silvicultura y pesca	7,02 %	6,23 %	6,46 %	6,11 %	6,07 %	6,69 %	6,43 %
Industria	17,24 %	17,76 %	18,12 %	17,85 %	16,62 %	15,92 %	15,48 %
Construcción	6,72 %	7,03 %	6,56 %	6,72 %	7,68 %	6,68 %	6,63 %
Servicios	69,02 %	68,98 %	68,87 %	69,32 %	69,63 %	70,71 %	71,46 %
ECONOMÍA (Unidades en millones de euros) ^C							
PIB a precios de mercado	54.764,6	56.058,8	58.545,9	59.798,5	54.836,6	59.263,8	64.226,6
VAB rama agraria, ganadera, silvicultura y pesca	2.728,9	1.862,8	2.843,7	2.520,6	2.883,9	3.199,7	3.037,6
VAB ramas industriales	9.878,8	10.350,4	10.456,1	10.752,7	9.948,9	11.287,8	12.617,3
Ramas manufactureras	7.842,03	8.350,01	8.283,1	8.593,5	7.962,9	8.719,6	9.582,3
VAB rama construcción	3.142,9	3.254,6	3.317,1	3.603,3	3.196,5	3.234,4	3.403,7
VAB ramas de los servicios	33.939,8	35.359,8	36.363,6	37.357,8	34.008,4	35.896,3	39.408,1
Servicios de mercado	23.053,9	24.096,6	24.762,1	25.357,6	22.299,2	24.209,1	27.204,9
Servicios no de mercado	10.885,9	11.263,2	11.601,5	12.000,2	11.709,2	11.687,3	12.203,2
VAB TOTAL a precios básicos	49.695,5	50.817,6	52.980,5	54.234,3	50.037,8	53.618,2	58.466,7
Impuestos netos sobre los productos	5.069,1	5.241,2	5.565,4	5.564,2	4.798,7	5.645,5	5.759,9
EMPRESAS							
Empresas activas (n.º)	161.364	161.619	161.986	161.407	160.199	157.131	157.730
COMERCIO ^D							
Importaciones (millones de euros)	13.828,5	14.696,7	14.466,5	13.404,8	11.404,3	12.651,3	n.d
Exportaciones (millones de euros)	17.983,1	17.604,2	17.620,3	16.906,9	15.019,9	15.826,1	n.d
Saldo exterior (millones de euros)	4.154,6	2.907,5	3.153,8	3.502,1	3.615,6	3.174,8	n.d
Tasa de Cobertura	130,04	119,78	121,80	126,13	131,70	125,09	n.d

A Fuente: INE.

B Fuente: INE. Datos correspondientes al último trimestre anual.

C Fuente: INE. Contabilidad Regional de España.

D Fuente: Contabilidad Anual de Castilla y León. D.G. de Presupuestos, Fondos Europeos y Estadística. Elaboración propia tomando en consideración mercado de la Unión Europea y resto del mundo (no resto de España).

Main socioeconomic indicators of Castile and León. SOURCE: Research and Innovation Strategy for Smart Specialisation (RIS3) of Castile and León 2021–2027

Sectoral trends between 2019 and 2024 have been uneven:

- **Primary sector:** the most volatile, with strong increases in 2020, 2021 and 2024 (above 10%) and declines in 2019, 2022 and 2023 (between -6% and -12%).
- **Industry:** has shown a solid recovery since the pandemic, with average growth of approximately 4.5% per year since 2021.
- **Construction:** already falling in 2019, it suffered a sharp contraction in 2020 but has posted moderate, steady growth since then.
- **Services:** also fell in 2020, but regained momentum with growth of around 3% per year, stabilising from 2022.

Within industry, three key branches stand out: the agri-food industry (30.6%), automotive (19.4%) and the energy subsector (15.2%). The metallurgy and fabricated metal products industry is also significant (9%).

In 2024 the trade balance reached the largest surplus in the historical series, €5,021 million, alongside record figures for both exports and imports.

As for prices, the consumer price index (CPI) followed a trajectory similar to Spain as a whole, with peaks in 2021 and 2022 not seen since the 1980s and 1990s.

Labour market

In Castile and León, the average annual wage is €25,227.03, below the national average of €28,049.94. The median wage in the region is €21,766.05, indicating that more than half of employees earn below the average wage.

The labour market has evolved in line with the economic recovery. Castile and León has maintained an unemployment rate below the national average since 2006. In the first quarter of 2025, the unemployment rate stood at 8.7%, compared with 11.36% in Spain.

The region has 1,131,991 economically active people, representing 47.5% of the working-age population (16–64). Although around 62% of inhabitants are of working age, fewer than half participate actively in the labour market, revealing a gap that poses an additional challenge for economic growth.

1.1.4 Coordinating organisation

Castile and León's participation in the European Pathways2Resilience (P2R) programme takes shape through the ADAPT2CYL project, whose aim is to move towards a region that is more resilient to climate change through strategic planning, territorial cooperation and the development of adaptation capacities.

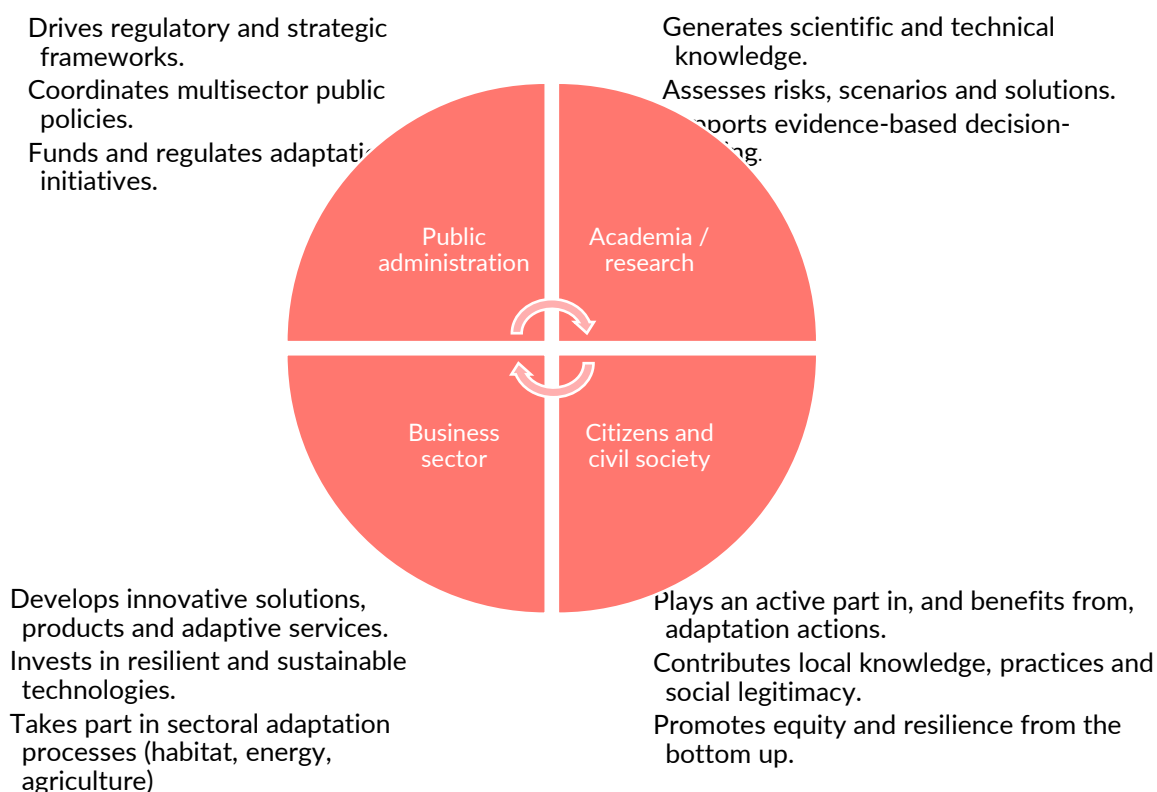
The project is structured around the ADAPT2CYL regional Consortium, which brings together key actors from public administration, the local sphere, innovation and the business sector. This Consortium is made up of:

- **Fundación Patrimonio Natural de Castilla y León**, an entity linked to the Regional Government of Castile and León, which leads project coordination and contributes expertise in environmental planning, biodiversity conservation and sustainable development.
- **Valladolid City Council**, through the **Agency for Innovation and Economic Development**, which contributes its experience in local policies on urban innovation, sustainability and resilience.
- **Provincial Council of Valladolid (Diputación de Valladolid)** with an essential role in structuring the rural territory, municipal cooperation and driving adaptation strategies in rural areas. It acts as an intermediate local authority between the regional and municipal administrations.
- **AEICE, the Efficient Habitat Cluster**, representing the business and industrial sector, brings its perspective on sustainable construction, refurbishment, digitalisation and the energy efficiency of the built environment.

This configuration of the ADAPT2CYL Consortium provides an appropriate foundation to lead a cross-cutting climate-change adaptation initiative, in keeping with the complexity of the challenge.

Adaptation entails integrating climate considerations across all areas of competence of public administrations (spatial planning, energy, health, mobility, agri-food, habitat, etc.), as well as

jointly mobilising the entire ecosystem of actors in the quadruple helix: public administrations, citizens, academia and the business fabric.

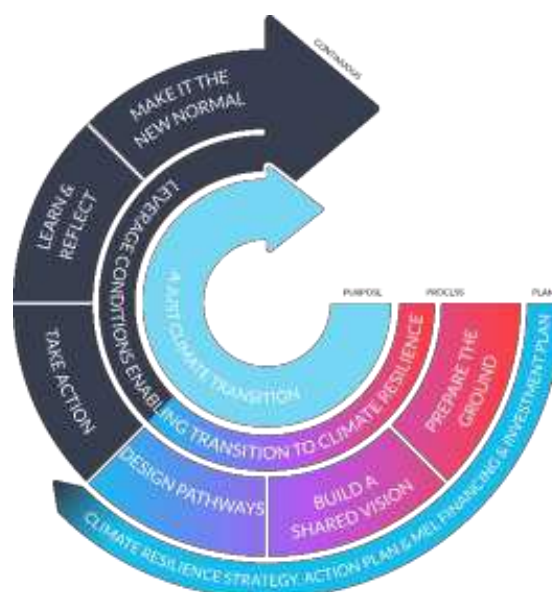


In this regard, the Consortium not only brings together institutional and operational capacity at different levels of governance, but also a clear orientation towards collaboration, innovation and territorial action—fundamental pillars for advancing towards a Castile and León that is more resilient, inclusive and prepared for the impacts of climate change.

Deliverable development process

The preparation of this baseline report, as well as the other deliverables that make up the ADAPT2CYL process, is structured around the **Regional Resilience Journey** methodology proposed by P2R.

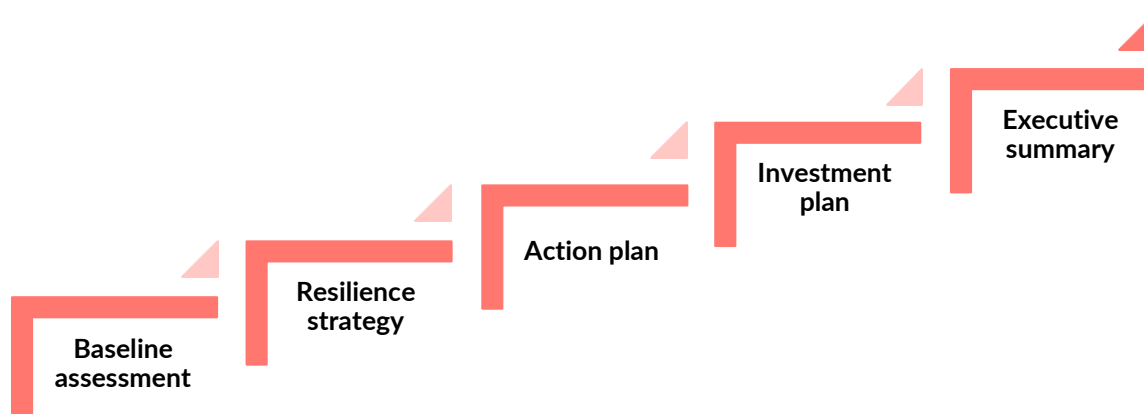
The Regional Resilience Journey is based on a logic of progressive transformation that guides regions through a structured sequence of phases: from understanding climate risks and existing capacities, to strategic planning, operational action and the design of financing mechanisms. This approach is designed to foster participatory processes, promote adaptive learning and facilitate evidence-based decision-making. Its iterative and integrative nature enables each region to progress in a flexible, coherent manner towards climate resilience that is just, systemic and aligned with European adaptation objectives.





This methodological guide is used as the framework for advancing towards an integrated **Climate Change Adaptation Strategy**, as the culmination of the process.

In the case of Castile and León, the approach adopted follows a sequential process, in which each deliverable feeds into the next and helps to incrementally **build a shared, viable and operational vision of climate-change adaptation**. The diagram below shows the deliverables planned over the course of the work, which can be understood as the sequential culmination of the different stages of the process.



For greater traceability, the table below sets out the correspondence between the planned deliverables and the main components (or stages) of the Regional Resilience Journey:

Regional Resilience Journey and		ADAPT2CYL Deliverables
Phase of the Regional Resilience Journey	→	Associated ADAPT2CYL Deliverable
Evaluation of context and initial diagnosis	→	E1. Baseline report
Definition of vision and setting resilience objectives	→	E2. Regional resilience strategy
Identification and prioritisation of adaptation options	→	E2. Regional resilience strategy
Design of action plan and implementation	→	E3. Regional resilience action plan
Mobilisation of finance and activation of levers for change	→	E4. Regional investment plan
Monitoring, learning, and review of strategies	→	Transversal

1.2 Priorities

The climate-change adaptation process in Castile and León does not start from scratch: it is framed within a multi-scalar ecosystem of public policies, sectoral strategies, institutional commitments and private-sector dynamics that shape the intervention context. This section aims to identify and describe the strategic priorities that will directly influence the development of climate resilience in the region over the coming years.

The identification of these priorities has been structured according to the **different levels of governance involved**, from local to European, also including private-sector action, so that climate planning in Castile and León aligns with existing regulatory frameworks, strategic objectives and investment cycles. The aim is to ensure coherence between the adaptation strategy and key territorial-development decisions, while embedding resilience as a cross-cutting principle of public policy.

This perspective also makes it possible to identify **windows of opportunity** to incorporate adaptation criteria into already-planned decisions, such as investments in infrastructure, digitalisation, energy transition or demographic revitalisation. It likewise facilitates the analysis of **enabling levers and structural barriers** that will shape the future implementation of the action plan and the investment plan.

In this regard, the priorities set out here will become key reference points to guide the definition of strategic objectives (in the Resilience Strategy), the selection of concrete measures (in the Action Plan) and the search for financing (in the Investment Plan). They will also help identify spaces for inter-institutional, multisector and multi-level cooperation—essential elements for progressing towards climate resilience in Castile and León that is just, systemic and transformative.

1.2.1 Local level

The local level is where many of the systems and groups most vulnerable to climate risks are concentrated, but it is also an administrative sphere that often has limited institutional capacity and little fiscal space to act.

The role of the local level in adaptation cannot be understood in isolation: its potential for action depends to a large extent on articulation with other administrative tiers (provincial councils, the autonomous community, the State and the EU), as well as on the existence of technical and financial support structures.

Within the Spanish legal framework, municipalities and other local entities (such as provincial councils or inter-municipal associations) have their own and delegated competences which, although not always explicitly framed in climate terms, directly or indirectly affect the management of climate vulnerability and the capacity to respond to environmental risks.

Among the most relevant local competences for adaptation are:

Main Areas of Competence

- **Urban planning and spatial planning:** ability to plan urban and rural land use, designate green areas, regulate uses in flood-prone or risk-exposed zones, and incorporate climate criteria into planning instruments (PGOU—General Urban Development Plan, subsidiary regulations, etc.).
- **Water management and the urban water cycle:** competence over supply, sanitation, urban drainage and maintenance of hydraulic infrastructure—crucial in contexts of drought or extreme precipitation events.

- **Waste and street cleaning:** although more closely linked to mitigation, efficient waste management can be integrated into adaptive circular solutions.
- **Civil protection and emergency management:** responsibility for drawing up municipal emergency plans, activating measures during extreme weather events and coordinating with regional services.
- **Public health and environmental health control:** particularly relevant regarding heatwaves, air quality, vector-borne diseases and the protection of vulnerable groups.
- **Urban mobility and transport:** planning transport networks and promoting sustainable modes which, in addition to reducing emissions, help lower exposure to risks (e.g. accessibility during emergencies).
- **Management of urban trees and green areas:** key to nature-based adaptation (NbS), urban heat-island control, runoff management and climatic well-being.
- **Housing and urban renewal:** powers to promote or co-finance energy-efficiency and thermal-comfort measures in vulnerable housing.
- **Education and environmental awareness:** through municipal programmes, campaigns and activities in schools or community spaces.

In Castile and León, and in Spain more broadly, **local climate planning specifically focused on adaptation is not yet widespread**. It is, for now, an emerging and uneven practice, with some more advanced municipalities and many others yet to address the issue systematically:

- **EU Mission on Adaptation to Climate Change** aims to support at least 150 European regions and communities to achieve climate resilience by 2030. The Regional Government of Castile and León has joined the Mission at regional level. At municipal level, Valladolid stands out for having formalised its adhesion to this Mission while also participating in the Mission for Climate-Neutral and Smart Cities, positioning itself as a reference for integrating climate agendas. This dual commitment underscores the value of addressing mitigation and adaptation jointly, overcoming fragmented approaches and enabling synergies between emissions reduction, improved urban well-being and strengthened resilience to climate risks. Valladolid's experience can serve as an inspiration for other municipalities in the region as they design integrated local climate-action strategies.
- The **Covenant of Mayors for Climate and Energy**, the world's largest movement of cities for local climate and energy action, currently includes commitments on emissions reduction (mitigation), strengthening resilience (adaptation) and reducing energy poverty (just transition). To operationalise these commitments, signatories must prepare and adopt a Sustainable Energy and Climate Action Plan (SECAP / PACES). The Regional Government of Castile and León, through the Regional Energy Agency (EREN), provides information and technical support to local entities interested in this initiative. At present, only 31 municipalities in Castile and León are [formally registered](#) as signatories and have a SECAP addressing the adaptation commitment.
- The **Spanish Network of Cities for Climate**, promoted by the Spanish Federation of Municipalities and Provinces (FEMP), is the main nationwide platform supporting local action on climate change, facilitating exchange of experiences, access to technical tools and collaboration among local entities to advance mitigation and adaptation strategies. Currently, 31 municipalities in Castile and León (not exactly the same 31 cited above) belong to this Network, indicating a growing commitment to local climate action, though still uneven and not always focused specifically on adaptation.
- **Local Urban Agendas**, promoted under the **Spanish Urban Agenda (SUA)**, have become a strategic instrument for municipalities to mainstream sustainability across public

policies. Although their scope is broad—covering social cohesion, mobility and governance—climate resilience is one of the SUA’s central pillars. Urban Agendas therefore offer a clear opportunity to incorporate climate-change adaptation as a criterion in territorial, urban and environmental planning, enabling municipalities to anticipate risks, protect vulnerable populations and design safer, more liveable urban environments in the face of extreme events. In Castile and León, several municipalities—such as Valladolid, León, Palencia, Miranda de Ebro and Segovia—have begun designing or implementing local Urban Agendas, which can facilitate the integration of climate adaptation into their urban roadmaps and act as an enabling framework for alignment with the region’s future Climate Change Adaptation Strategy.

- The **Adapt Clima CENCYL** project, developed under the INTERREG-POCTEP programme, is a notable cross-border cooperation experience on climate-change adaptation involving municipalities in Castile and León. Led by the CENCYL Cities Network and comprising cities such as Salamanca, Valladolid and Ciudad Rodrigo, the project has promoted the integration of adaptation into local urban planning through vulnerability diagnostics, indicator systems and proposals for adaptive interventions in public space. In addition to strengthening institutional cooperation between Spanish and Portuguese cities, it has helped raise public awareness and build technical capacity in municipal staff on climate-risk management. This experience demonstrates the potential of European programmes as levers to activate local adaptation policies, particularly in municipalities with an innovative outlook and the capacity for territorial collaboration.
- Numerous municipalities in Castile and León are currently implementing **EU-funded projects** that, while not always labelled “adaptation”, directly contribute to strengthening local climate resilience. These include actions financed by ERDF, the Recovery and Resilience Facility (RRF) or Spain’s Recovery, Transformation and Resilience Plan (PRTR). Interventions include creating green areas and ecological corridors, deploying biomass district-heating networks, designing multifunctional green infrastructure, and improving energy efficiency and thermal comfort in vulnerable housing. Aligned with principles of ecosystem-based adaptation, territorial cohesion and social equity, these actions show that adaptation is also being advanced implicitly through other financing frameworks.
- The Regional Government, through FPNCyL (Fundación Patrimonio Natural de Castilla y León), participates in the project and has developed a monitoring system for urban climate-change adaptation with specific indicators. It is also promoting other adaptation-related projects:
 - School playground adaptation programme (REACT-EU funds).
 - BRERA project in Soria (PRTR).
 - Horizon DRYAD project on adapting dehesa wood-pasture systems with nature-based solutions.
 - Horizon Fair for Future, focused on urban and social governance.
 - LIFE “Osos con futuro” (Bears with a Future), implementing adaptive management to improve feeding conditions for the brown bear.

Under NextGenerationEU / PRTR, adaptive forest-management actions have also been undertaken.

Beyond formal commitments and funded projects, innovative actions are also being developed in sectors closely linked to adaptation, such as urban mobility, civil protection, public-space design and urban green management. Interventions such as **climate shelters in Valladolid**,

municipal heatwave plans, and the **integration of nature-based solutions** in certain municipalities illustrate how adaptation can be deployed through everyday competences, even if not always under that label. Although still occasional, these experiences provide valuable foundations to recognise, systematise and scale within the ADAPT2CYL framework.

In this regard, the **School of Mayors of Castile and León**, promoted by the Regional Government, is consolidating itself as a strategic platform to strengthen local leadership on sustainability and climate change. Its potential to train, accompany and activate municipal teams is key to turning climate action into a structural public policy at local level. Integrating this tool into the roll-out of the regional strategy will multiply capacities, reduce institutional asymmetries and build a community of practice among municipalities of different sizes and contexts.

Summary of key aspects from the perspective of climate change adaptation

- Despite progress in certain cities, the territorial scope of local climate change adaptation planning remains limited. This gap highlights the need for scaling mechanisms and territorial adaptation, especially in rural and low-density contexts.
- Among the main obstacles identified are the lack of internal technical capacity, fragmented regulation, limited perception of climate risk, and difficulty accessing specific funding.
- The approach remains sectoral and reactive, rather than strategic and preventive.

1.2.2 Regional level

The regional level, represented by the Regional Government of Castile and León (Junta de Castilla y León) as the autonomous administration, **plays a fundamental role in creating structural conditions for climate resilience**. Under the legal framework established by the Statute of Autonomy and national legislation, the regional administration has the capacity to regulate, plan, coordinate, and finance public policies with significant adaptation potential, even though it does not directly execute many of the on-the-ground actions. Many of these competences are not explicitly framed in climate terms but directly affect risk reduction, the improvement of local capacities, and the protection of vulnerable natural and human systems against climate change.

Below are the most relevant areas of regional competence from an adaptation perspective, highlighting those with the greatest impact on climate-sensitive sectors and systems in Castile and León:

Main Areas of Competence

- **Territorial planning and land-use management:** Development and updating of territorial guidelines and plans, regulatory capacity over land use, flood-prone areas, ecological corridors, and rural zoning; incorporation of resilience criteria into the regional urban planning framework.
- **Water management and regional hydrological planning:** Participation in hydrological planning (in collaboration with River Basin Authorities), competences in rural water supply, reuse, irrigation efficiency, and promotion of green infrastructure for water retention and flood control.

- **Forestry policy and forest management:** Exclusive competence over sustainable forest management, wildfire prevention, ecosystem restoration, and adaptive planning of forest stands in the face of drought, pests, and extreme events.
- **Agriculture and rural development:** Management of FEADER (European Agricultural Fund for Rural Development) grants and investments, implementation of agro-environmental and climate-resilient good practices, promotion of productive diversification, and crop adaptation to changing climate conditions.
- **Energy and energy efficiency:** Promoting energy transition with adaptation criteria, supporting rural energy communities, energy efficiency in public buildings, and promoting decentralized and resilient energy systems.
- **Public health and environmental health control:** Epidemiological surveillance of emerging risks (heatwaves, vector-borne diseases), adaptation plans for the healthcare system, campaigns to protect vulnerable groups, and measures to address air pollution.
- **Civil protection and risk management:** Design and implementation of regional emergency plans for climate risks (floods, wildfires, heatwaves, snowstorms), coordination with local entities and logistical planning for extreme events.
- **Environmental education and public awareness:** Development and implementation of training, outreach, and public awareness programmes on climate change, sustainability, and adaptation, including in schools, communities, and professional spaces.
- **Biodiversity and protected natural areas:** Management and planning of the Natura 2000 Network and other protected areas, integration of nature-based adaptation measures, ecological restoration, and functional connectivity of the territory.
- **Housing, urban renewal, and territorial cohesion:** Management of energy-efficiency and accessibility programmes in vulnerable housing, inclusion of climate comfort criteria, and revitalization of rural areas at risk of depopulation from a territorial resilience perspective.
- **Transport and regional infrastructure:** Planning and maintenance of strategic road and logistical infrastructure, progressively including climate vulnerability assessments and adaptation criteria in design and operation.
- **Regulatory design and sectoral planning:** Development and updating of policies, plans, and strategies that can integrate adaptation criteria, as well as formulating additional regulations for environmental and landscape protection.
- **Technical and financial support to local entities:** Through instruments like PACES (EREN) and regional technical support platforms.

Unlike the State and most other Autonomous Communities, the Regional Government of Castile and León has declared a climate emergency, and in line with EU institutions, has joined the European Climate Adaptation Mission, highlighting its commitment to tackling climate change. However, while it has several key strategic instruments that structure the regional intervention framework, it has yet to develop a fully integrated adaptation strategy.

One key instrument is the **Regional Climate Change Strategy (ERCC) 2009–2012–2020**, which was the first regional tool designed to address climate change in a comprehensive manner. Approved by Agreement 128/2009, it primarily focused on mitigation through greenhouse gas emission reductions, although it also included planned adaptation actions and introduced a monitoring system with indicators.

At the time of writing this report, the **Regional Government** is working on drafting the future **Autonomous Climate Change and Energy Transition Law**, a regulatory framework aimed at consolidating regional climate policies and providing long-term legal and strategic support.

Although still in development, the first drafts and institutional statements indicate that this law will address both mitigation and adaptation to climate change, explicitly highlighting the need to prepare the region's territory, economy, and society for present and future climate impacts. Its enactment will represent a key institutional step for Castile and León, enabling the consolidation of climate action through a coherent, cross-cutting, and mandatory approach, forming a solid regulatory base for articulating and formalizing the results of the ADAPT2CYL project, ensuring alignment with the regional climate policy in the medium and long term.

In addition, there is a set of **regulatory and strategic frameworks that, although not originally designed with a climate-focused approach, could evolve towards greater integration of adaptation criteria**. These include the Regional Land Use Planning Plan, regional urban planning regulations, rural development plans, and sectoral strategies in health, tourism, and environmental education. Furthermore, instruments such as the RIS3 Smart Specialisation Strategy 2021–2027 already include resilience and the green transition as cross-cutting themes, opening the door to financing innovative solutions such as nature-based solutions or adaptive digitalisation in rural areas. This "ongoing regulatory transition" presents a key opportunity to coherently align regional planning with the objectives of ADAPT2CYL and ensure its long-term regulatory sustainability.

In the current political cycle, the Government Plan of the Regional Government **prioritizes territorial balance, economic reactivation, and the response to the demographic challenge**. These three strategic vectors are closely linked to the need to strengthen the region's climate resilience, as phenomena such as rural depopulation, pressure on natural resources, and the vulnerability of infrastructure to extreme events require integrated adaptive responses. This alignment between political priorities and adaptation goals represents a key opportunity to incorporate resilience criteria into regional public policies, from territorial planning to forest management, public health, and rural digitalization. In this context, it is essential to establish intersectoral coordination mechanisms between the various regional departments, overcoming the usual administrative fragmentation and allowing for a systemic approach to adaptation.

Beyond the key role of the regional administration, **other relevant institutional actors** at the regional level include the **provincial councils (Diputaciones)**, which perform **coordination, technical assistance, and public-service financing functions, particularly in rural areas with limited administrative capacity**. Although their role in climate action has not yet been sufficiently consolidated, provincial councils could play a strategic role in implementing adaptation measures, channelling resources, providing technical support, and facilitating supra-municipal projects. This intermediary level of governance is especially important in a community with significant territorial dispersion like Castile and León, where adaptation requires multi-level cooperation mechanisms and sustained institutional synergies.

Summary of key aspects from the perspective of climate change adaptation

- There is no permanent and specific institutional structure to coordinate adaptation cross-departmentally (e.g., an interdepartmental commission).
- Adaptation is addressed in a fragmented manner across different ministries (environment, agriculture, infrastructure, etc.), making systematic integration challenging.
- The approach remains sectoral and reactive, rather than strategic and preventive.

1.2.3 National level

At the national level, Spain has an increasingly solid political and regulatory framework for climate change and adaptation. This framework sets general guidelines that must be considered and, where appropriate, integrated by the autonomous communities into their own policies. In this sense, **national adaptation priorities** directly influence the resources available and the methodological approaches adopted at the regional and local levels.

The central instrument is **Law 7/2021 on Climate Change and Energy Transition**, which explicitly recognizes adaptation as one of the pillars of national climate policy. The law establishes the obligation to develop adaptation plans, incorporate climate risk into sectoral planning, promote the resilience of critical infrastructures, and coordinate all levels of public administration in this area.

In compliance with this law, the Government of Spain has launched the **National Climate Change Adaptation Plan (PNACC) 2021–2030**, which is the primary planning instrument for promoting coordinated and coherent action against the effects of climate change in Spain. The PNACC identifies 18 priority work areas, defines strategic lines, establishes cross-cutting objectives (such as territorial equity, reducing social vulnerability, and promoting nature-based solutions), and promotes multi-level coordination as a condition for the success of adaptation policies. Its implementation is carried out through Action Plans, currently in their first cycle (2021–2025).

Other key national documents that explicitly include adaptation are:

- National Integrated Energy and Climate Plan (PNIEC) 2023–2030: includes adaptation as a strategic line, particularly regarding energy infrastructure and territorial cohesion.
- Long-Term Decarbonisation Strategy 2050 (ELP): acknowledges the need for a resilient and adapted territorial model.
- River Basin Management Plans (3rd cycle 2022–2027): progressively integrate climate risk analysis into water management, especially in water-stressed areas like Castile and León.
- National Health System Adaptation Plan (under development): part of the institutional response to health risks arising from climate change.

In terms of governance, adaptation is part of the responsibilities of the **Spanish Office for Climate Change (OECC)**, which is under the Ministry for Ecological Transition and the Demographic Challenge (MITERD). The OECC coordinates the implementation of the National Climate Change Adaptation Strategy (ENACC) and channels technical information, funds, and methodological tools to other levels of government, including the AdapteCCa platform, which serves as a knowledge repository and best practices for adaptation across the territory.

From a territorial perspective, Castile and León faces the challenge of aligning its regional policies with the objectives and principles set at the national level, while adapting these frameworks to its socio-economic, climatic, and demographic particularities. Coordination with national policies is also key to accessing state and EU funds channelled by the Spanish government, such as the Recovery Plan, ERDF funds, and the Just Transition Fund.

Finally, it is important to note that the national context promotes an increasingly structured approach to adaptation, with a strong emphasis on evidence-based planning, social equity, and coordinated action. Through the ADAPT2CYL project, Castile and León has the opportunity to strengthen its contribution to this national framework, positioning itself as a leading region in building climate resilience in rural and low-density areas.

Summary of key aspects from the perspective of climate change adaptation

- The national framework establishes a robust architecture for adaptation, which Castile and León must align with and implement at the regional level.
- Multi-level coordination is a guiding principle in national adaptation policies, but it still requires operational implementation at the autonomous level.
- Access to state and EU funds related to adaptation depends on clear, aligned, and technically grounded regional planning.
- Integrating adaptation into national sectoral policies (water, health, energy, land-use) requires a contextualized translation into the autonomous framework.
- The state climate information and impact monitoring system (AdapteCCa, PNACC indicators) provides a useful technical base but is underutilized at the regional and local levels in Castile and León.

1.2.4 EU level

European climate action revolves around the **European Green Deal**, a key initiative that establishes an ambitious roadmap toward climate neutrality by 2050. Climate change adaptation is a crucial pillar within this framework, not only as a response to inevitable impacts but also as a strategic priority in terms of territorial cohesion, economic development, and social justice.

The primary European political instrument for adaptation is the **EU Adaptation Strategy**, adopted in 2021 as part of the European Green Deal. This strategy sets four key objectives: making adaptation smarter (better science and data), more systemic (integrating resilience into all policies), faster (speed of implementation), and more inclusive (fair).

In addition, the European Union has a range of programs and funds that directly support the implementation of adaptation measures:

- The Cohesion Policy 2021-2027, channelled through ERDF, FSE+, and the Cohesion Fund, prioritizing climate and territorial resilience.
- The Just Transition Mechanism, supporting provinces affected by energy transition in Palencia and León.
- The LIFE Program, focused on innovative pilot projects incorporating nature-based solutions and strategies against climate risks.
- Horizon Europe, the framework research program, which funds initiatives like Pathways2Resilience (the framework in which ADAPT2CYL is developed).
- The European Recovery and Resilience Mechanism (RRF), under the NextGenerationEU Plan, which includes investments to strengthen climate resilience.

European governance promotes a multi-level, evidence-based approach, with a focus on anticipatory planning, prevention, and territorial cooperation. A key initiative in this area is the EU Mission on Adaptation to Climate Change, which aims to enable at least 150 regions and communities to become climate-resilient by 2030.

In this context, the adaptation strategy of Castile and León must align with European principles, not only to meet regulatory requirements but also to ensure coherence and efficient access to resources. The ADAPT2CYL project, developed within Horizon Europe and in collaboration with European partners, benefits from this European dimension, providing added value from the outset.

Summary of key aspects from the perspective of climate change adaptation

- The EU Adaptation Strategy sets a normative and conceptual reference framework that Castile and León must align with in its regional planning.
- Castile and León's participation in the EU Mission on Adaptation involves a political and technical commitment that must translate into concrete results.
- European funds offer an unprecedented opportunity to finance adaptation, but they require clear and aligned strategic planning.
- The multi-level approach promoted by the EU requires strengthening coordination between levels of government in Castile and León.

1.2.5 Private sector

Although the private sector is not part of the public institutional sphere, it plays an essential role in the adaptive response to climate change. Its integration into the process of developing the Climate Change Adaptation Strategy of Castile and León is part of a quadruple helix governance approach, promoted by the EU Adaptation Mission and the Pathways2Resilience programme. Companies are both actors exposed to climate impacts and agents capable of deploying innovative solutions, mobilizing investment, and driving territorial transformation.

In Castile and León, there are already experiences that demonstrate the commitment of certain productive sectors to adaptation. Notable initiatives include the ARCA project, developed by Vitartis, which has provided agri-food companies with a self-assessment tool for climate risks, and the Mencía project, also driven by Vitartis, which promotes comprehensive sustainability in the sector, including aspects of climate resilience. Additionally, some companies have initiated transformation processes aligned with energy efficiency, circularity, and infrastructure modernization.

Despite these advances, the integration of adaptation into regional business planning remains in its early stages. Most companies, especially small and medium-sized enterprises (SMEs), still lack the tools, technical knowledge, or economic incentives needed to systematically address climate risk management. This situation is exacerbated by a limited perception of climate change as a direct threat and by the weak connection between the business fabric and the public adaptation strategy frameworks.

The private sector in Castile and León is diverse and heterogeneous. Large companies and strategic industries, particularly in sectors such as agri-food, energy, or transport, have greater capacity to integrate resilience criteria into their decision-making processes. In contrast, SMEs, micro-enterprises, and family-owned businesses require technical support, solutions adapted to their scale, and public-private cooperation mechanisms to reduce entry barriers. Business clusters, cooperatives, professional associations, and chambers of commerce can play a key role as intermediary agents, creating spaces for collective learning and dissemination of best practices.

In this context, the ADAPT2CYL project offers an opportunity to establish stable participation channels with the private sector, both through dialogue tables and sectoral forums, as well as through the launch of pilot experiences, collaborative spaces, or co-creation processes for investments. Business participation in the design of the action plan and investment plan will be crucial to identify synergies, unlock co-investment opportunities, and ensure the operational feasibility of the proposed measures.

Beyond its vulnerability, the private sector can become a driving force for territorial resilience. Its capacity for innovation, scaling solutions, generating employment, and activating sustainable value chains positions it as a strategic ally for adaptation. Incorporating this vision into the strategy will not only protect existing economic assets but also activate new climate-oriented development opportunities, especially in rural or transitioning areas.

Summary of key aspects from the perspective of climate change adaptation

- The regional private sector shows emerging signs of commitment to adaptation, but it remains limited, uneven, and poorly structured.
- The low perception of climate risk and the lack of incentives limit the integration of adaptation into business planning.
- Business participation in the strategy must be tailored to the diversity of the regional productive fabric.

1.3 Just resilience considerations

Climate justice is a fundamental principle for designing climate change adaptation policies, as it recognizes that the impacts of climate change do not affect all people or territories equally. It also emphasizes that the **ecological transition must be addressed in an inclusive, equitable, and sensitive manner to existing inequalities**. This principle involves protecting those who have contributed least to the problem but suffer the most from its consequences and ensuring that the opportunities derived from climate action (such as green jobs or territorial innovation) are distributed fairly, without leaving behind the most vulnerable sectors, territories, or communities. It also calls for social dialogue, active participation, and effective resource redistribution, as outlined in the principles of the Agreement for a Just Transition in Castile and León and in international agendas on green transitions with social justice.

This approach is not only an ethical principle but also a condition for effectiveness: according to the European Environment Agency (EEA, 2023), social equity is a key factor for successful adaptation because it strengthens community resilience, improves policy legitimacy, and facilitates implementation. Climate-sensitive policies not only reduce vulnerabilities but also reinforce collective capacities to anticipate and address risks. Moreover, the EEA highlights that the benefits of adaptation are not automatically shared, and without explicit equity measures, social gaps can widen.

In the case of Castile and León, this approach is **critically important** due to a combination of social, demographic, economic, and territorial factors that exacerbate structural vulnerability to climate risks.

With more than a quarter of the population over 65 years old and an ageing index of 224%, well above the national average, the region has a **high number of dependent individuals**, especially in rural areas. This is compounded by the progressive loss of working-age population,

the increasing masculinization of rural areas, and the **region's vast territorial dispersion**, Castile and León is the largest and one of the most sparsely populated regions in Spain. In this context, many rural areas are isolated or poorly connected to essential services and face structural difficulties in maintaining infrastructure, healthcare, or educational coverage. This reality becomes an added risk in the face of extreme climatic events, such as wildfires, floods, or heatwaves, which can compromise accessibility or even leave entire communities cut off.

The challenge is not only geographic but also social. In Castile and León, **women** have an annual average income more than €4,000 lower than that of men, with this gap widening in rural areas and among the elderly. This economic inequality reduces the ability of many women (especially older and single women) to adapt to the impacts of climate change, access assistance, or make changes to their homes. Additionally, the **migrant population**, which accounts for about 6% of the total population in the region, is increasingly present in rural areas, working in climate-sensitive sectors (such as agriculture or caregiving) with lower income levels, less protection, and limited access to institutional resources.

Furthermore, certain economic sectors linked to the region (such as rainfed agriculture, extensive livestock farming, or extractive industries) are already experiencing the effects of climate change in the form of rising temperatures, water scarcity, and soil degradation. These sectors employ a significant portion of the rural population, so their transformation presents a **dual challenge: economic and social**. In this regard, Just Transition funds are beginning to offer opportunities to transform vulnerable sectors, generate green jobs, and strengthen territorial cohesion.

Ensuring climate justice in Castile and León requires a **systemic and inclusive** approach that goes beyond merely reducing physical impacts. It is necessary to acknowledge existing inequalities and design adaptive responses that account for differential exposure, unequal response capacities, and the starting conditions of each group and territory. This involves designing adaptation policies that combine investment in climate-resilient infrastructure, support for labor transitions, reinforcement of public services, and active community participation in decision-making processes.

In this sense, the Climate Change Adaptation Strategy of Castile and León should advance towards **climate resilience** with justice, protecting the most vulnerable groups and ensuring that no one is left behind.

Summary of key aspects from the perspective of climate change adaptation

- Castile and León faces multiple structural factors that increase social vulnerability to climate change: ageing population, depopulation, territorial dispersion, gender inequality, and precariousness in climate-sensitive sectors.
- Rural and peripheral areas concentrate many of the most vulnerable groups, with limited access to essential services and higher exposure to extreme climate events.
- Ensuring climate justice requires that the Adaptation Strategy incorporates an approach sensitive to social, territorial, and economic inequalities, integrating differentiated and redistributive measures.
- Adaptation should be framed as an opportunity to strengthen social and territorial cohesion through investment in services, resilient infrastructure, green jobs, and the just transformation of vulnerable sectors.
- It is essential to ensure active participation from the most affected groups in decision-making and the design of adaptive solutions.
- Social dialogue and collaboration with trade unions, social agents, and community stakeholders must be part of the institutional framework of the strategy to ensure that the climate transition is truly just and inclusive.

1.4 Climate resilience objectives

Building effective climate resilience requires starting from a shared **diagnosis of the key structural challenges** faced by the territory and translating that diagnosis into strategic objectives capable of guiding action.

This section defines the objectives that will guide both the Climate Change Adaptation Strategy and the subsequent Action Plan and Investment Plan, in line with the Regional Resilience Journey approach proposed by P2R. These objectives respond to a dual logic: on one hand, they aim to directly reduce the impacts arising from the identified climate risks; on the other, they aim to maximize the social, economic, and ecological co-benefits of adaptive action. Their formulation takes into account the specific vulnerabilities of Castile and León, as well as its territorial development priorities, so that climate adaptation not only serves as a protective measure but also as a transformative lever for well-being and territorial cohesion.

1.4.1 Challenge statement

Castile and León faces a unique **combination of climate risks, social vulnerabilities, and territorial fragilities** that, together, present a structural challenge to the sustainability of its development model. The increase in average temperatures, the reduction in water availability, and the growing frequency of extreme events (such as heatwaves, wildfires, or torrential rainfall) threaten public health, the viability of key productive sectors, and the integrity of the ecosystems that sustain the region's life and economy.

This climatic context is compounded by serious structural factors: an ageing population, a continuous process of rural depopulation, low population density that complicates service provision, an economy with strong dependence on the primary sector, and a natural and cultural heritage exposed to irreversible alterations. These characteristics make much of the territory highly exposed, with limited institutional response capacity, and facing significant social and economic barriers to adapting to climate change. This situation is aggravated by the absence of a specific strategic adaptation plan that can address risks in a coordinated, effective, and aligned manner with commitments made at the regional, national, European, and global levels.

The desired scenario is a **resilient territory**, capable of anticipating and managing climate risks through a **preventive, inclusive, and transformative logic**. A territory where adaptation is integrated across public planning, connected to social and territorial innovation, and oriented to protect life, ecosystems, and the well-being of people, especially the most vulnerable groups.

1.4.2 Primary adaptation objectives

In order to anticipate the impacts of climate change and strengthen territorial resilience in Castile and León, the Adaptation Strategy is built on a structured approach combining an updated diagnosis, capacity assessment, stakeholder mapping, and operational mechanisms for implementation. This roadmap will allow the region to shift from a fragmented and reactive approach to a systemic, proactive, and inclusive public policy.

Based on this, the **main adaptation objectives** are defined as strategic goals aimed at reducing vulnerability and the impacts of priority climate risks for the region. These objectives will form the core reference for both the Action Plan and Investment Plan, aligning with the risk analysis detailed in Chapter 2 of this report. They are as follows:

- Reduce the impacts of climate change on human health through early warning systems, climate-safe public spaces, and reinforcing healthcare services during heatwaves and other extreme events.
- Protect and restore climate-vulnerable ecosystem services, prioritizing ecological connectivity, functional biodiversity, and nature-based adaptation.
- Reduce the risk of wildfires through adaptive forest management, forest restoration, land-use decarbonization, and socio-economic activation of forested territories.
- Increase the resilience of the agricultural and livestock sectors, promoting crop diversification, sustainable water and soil management, and farming practices adapted to new climate conditions.
- Reduce the risk of flooding in urban and rural areas by improving watershed management, expanding natural retention areas, and adapting critical infrastructure.
- Preserve water resources through integrated and resilient water planning, combining efficiency, reuse, demand management, and protection of aquifers.
- Protect cultural heritage and tourism from climate impacts, ensuring their adaptation to more extreme conditions and guaranteeing their long-term sustainability.
- Adapt essential infrastructures (such as transport, energy, and communications) through resilient design criteria, strategic territorial planning, and vulnerability analysis.

Each of these objectives will be linked to specific indicators, enabling the evaluation of progress, estimation of socio-economic benefits, and prioritization of high-impact adaptive investments.

1.4.3 Secondary resilience objectives

Climate resilience, understood as the capacity to anticipate, resist, adapt, and transform in response to the effects of climate change, requires not only reducing physical risks but also strengthening the social, economic, and institutional foundations of the territory. Therefore, in addition to the adaptation objectives directly aimed at managing climate impacts, the **Climate Change Adaptation Strategy** of Castile and León includes a set of **secondary resilience objectives** aimed at improving the structural conditions to sustain and scale the adaptive response.

These objectives allow for the integration of climate action with other regional strategic agendas (just transition, demographic challenge, digitalization, territorial equity) and generate co-benefits that amplify the positive impact of public policies. They also align the strategy with the principles of **climate justice**, sustainability, and **transformative development** promoted by P2R.

In addition to direct impacts, climate change adaptation can and should generate **significant co-benefits** that reinforce territorial cohesion, improve quality of life, and promote a fairer and more sustainable development. The main secondary resilience objectives for Castile and León are:

- Strengthen territorial cohesion, reducing the gaps between urban and rural areas, improving access to essential services, and ensuring territorial equity in the face of climate impacts.
- Foster green job creation and economic diversification, particularly in vulnerable areas, promoting sustainable sectors (agroecology, bioeconomy, renewable energy, responsible tourism) and supporting processes of just conversion and reindustrialization.
- Reduce social and gender inequalities, integrating equity perspectives into all adaptation measures, improving the living conditions of vulnerable groups, and ensuring their active participation in decision-making.
- Promote territorial innovation and digitalization as tools for resilience, facilitating access to data, promoting adaptive technological solutions, and strengthening the region's anticipation and response capacity.
- Improve public health and climate well-being, through the creation of safe environments, climate-adapted urban design, combating energy poverty, and reinforcing healthcare services against emerging risks.
- Develop a culture of resilience, through environmental education, citizen participation, local knowledge, and cooperation among public, private, and social actors.
- Establish collaborative governance mechanisms that promote multi-level coordination, transparency, and shared responsibility in implementing the strategy, ensuring a just distribution of the benefits and burdens of adaptation.

These objectives not only strengthen the region's ability to face climate change but also help structurally transform Castile and León into a fairer, more liveable, and sustainable region, in line with the **SDGs** and the transformative vision of the **Regional Resilience Journey**.

1.5 Planned investments

At the time of writing this report, Castile and León does not have a **specific and structured investment plan for climate change adaptation**, nor a long-term financial strategy to articulate a sustained climate response. Regional public investment is largely conditioned by political and budgetary cycles, with an annual, reactive, and sectoral approach predominating, which hinders the consolidation of a transformative climate agenda.

Starting Point: Current Investment is Situational:

- The only explicit framework for public investments consists of the annual regional budgets and government programme commitments. In 2025, Castile and León approved a record budget of **€15,084 million**, representing an increase of 3.58% from the previous year.
- However, this planning does not include a systematic categorization of climate investments or guiding criteria to prioritize adaptation or mitigation actions. There are also no specific budget lines labeled as "climate resilience" or similar, making it difficult to track and evaluate the investment effort in this area. In contrast, projects funded by operational programmes such as FEDER, Just Transition Fund (FTJ), and the Recovery and Resilience Plan (PRTR) do allocate funds for climate ambition, which can be quantified in millions of euros, considering only the EU contribution or total cost. This quantification can be calculated individually through the climate tagging of the projects.
- Although certain chapters, such as capital operations, have increased (12% in 2025), and there is greater emphasis on social, technological, or environmental policies, the integration of adaptation as an investment criterion is still very nascent.

Barriers and Opportunities in Investment Planning for Adaptation:

From consultations with key territorial stakeholders, several obstacles that hinder consistent climate financial planning have been identified:

- Lack of a multi-year vision of adaptation needs, preventing the design of scalable and sustainable investment portfolios.
- Absence of sectoral and territorial prioritization mechanisms, which would help focus public resources on the most vulnerable sectors and areas.
- Low administrative culture around climate tagging or assessing investments from a climate risk perspective.
- Political conditioning of the budgetary cycle, which hinders the push for long-term structural reforms.

The development of the **Climate Change Adaptation Strategy** for Castile and León represents a **key opportunity** to move towards a financial framework that:

- Shifts from an annual and reactive logic to strategic, multi-year planning focused on climate outcomes.
- Establishes prioritization criteria for adaptive investments, incorporating climate risk, co-benefits, efficiency, territorial equity, and cost-effectiveness.
- Identifies investment gaps in key sectors (such as agriculture, water, health, mobility, or urban planning) and proposes tools to close these gaps progressively.
- Promotes alignment with European programmes and funds such as FEDER, Just Transition Fund, PEPAC, LIFE, or innovative financial instruments focused on resilience.

This new approach will lay the foundations for the future Investment Plan for Adaptation and facilitate access to European and national resources aimed at climate-vulnerable territories.

Emerging Signs of Climate Investment:

Although still scattered, there are some initiatives pointing in the right direction that could be scaled up or systematized within the framework of the Strategy:

- €100 million in grants for the incorporation of young people into the agricultural sector and modernization of farms, incorporating digitalization and water efficiency.
- Investments in the modernization of resilient irrigation systems, such as €15.8 million for the Páramo Bajo or €6.5 million for Porma and Canal Bajo in El Bierzo.
- Programs like FITOCLIM, aimed at integrating adaptation into forest management and reforestation plans.
- Municipal initiatives, such as the biomass district heating network in Valladolid, which will connect 19 public buildings as part of its emission-free city strategy.

These actions, although not formally labeled as adaptation investments, incorporate criteria compatible with resilience and could become part of a future regional portfolio of strategic measures, with financial leveraging potential.

Summary of key aspects from the perspective of climate change adaptation

- Castile and León currently lack a specific, multi-year investment plan for adaptation, limiting its capacity to respond to growing climate risks.
- The regional budgetary framework continues to follow an annual and sectoral logic, with minimal integration of a climate approach and without systematic mechanisms for prioritization or climate adaptation investment labelling.
- The Climate Change Adaptation Strategy represents a crucial opportunity to build a new resilient investment framework, focused on results and aligned with available European funds.
- There are sectoral initiatives that implicitly incorporate adaptation elements, but their transformative impact will be limited without integrated, coherent, and territorialized planning.
- It will be essential to move towards a structured Investment Plan that identifies gaps, priorities, and feasible financial mechanisms, with the participation of public, private, and community actors.

1.6 Economic rationale

Climate change adaptation should not be considered a cost, but rather an essential strategic investment to protect the economic, social, and natural capital of Castile and León. Every euro invested in adaptation helps reduce future costs from damages, avoid disruptions in key sectors, and preserve the well-being of the population. In contrast, inaction exponentially increases risks and costs associated with extreme events, productive losses, and environmental degradation.

Numerous international and European studies consistently indicate that the **cost of inaction** (not acting) far exceeds the cost of implementing planned adaptive measures:

- According to the European Environment Agency (EEA), between 1980 and 2022, extreme weather events caused economic losses in the European Union exceeding €650 billion. Without effective adaptation, this scenario will structurally increase impacts on infrastructure, health, agriculture, and ecosystems.
- The European Commission estimates that at the current rate of warming, EU GDP could decrease by 7% by the end of the century, even without considering direct impacts from extreme events.
- Regarding the deterioration of ecosystem services, organizations such as the EEA warn of annual losses exceeding €97 billion, primarily from soil degradation, with the cost of inaction up to 6 times greater than the cost of implementing preventive actions.
- Climate policy analysis shows that investing in adaptation now can generate a return of €2 to €10 for every euro invested, especially in highly vulnerable sectors such as healthcare, agriculture, or urban services.

In the case of **Castile and León**, there is currently no quantitative assessment of the **economic costs** of climate change, but the impacts are becoming increasingly visible: prolonged heatwaves, more intense wildfires, crop losses due to droughts, and damage to infrastructure from extreme events. These impacts compromise productivity, increase pressure on public services, and generate insecurity in strategic sectors such as agriculture and tourism.

In addition to these direct effects, there is a **structural barrier**: the absence of long-term **climate investment planning**. Castile and León currently lacks a regional financial framework that guarantees sustained and scalable investments in climate resilience, which raises the **opportunity cost** of inaction and exposes the region to growing and unpredictable damages.

Thus, the **economic rationale** is clear:

- Not acting on adaptation is much more expensive than acting. The cost of economic, social, and ecological damages from inaction increases every year.
- Adapting means protecting past and future investments, ensuring the sustainability of infrastructure, agricultural systems, public health, and both urban and rural habitats.
- Adapting also means generating employment, innovation, and economic resilience, especially in sectors like construction, water management, sustainable agriculture, and clean energy.

Moreover, adaptation cannot be viewed as a separate agenda from mitigation. They are two sides of the same climate strategy. Reducing emissions is essential to limit future warming, but even in the most ambitious mitigation scenarios, the impacts already present and anticipated in the future require adaptation. Integrating both agendas allows for:

- Optimizing financial and technical resources.
- Avoiding contradictory effects (e.g., mitigation solutions that are vulnerable to climate change).
- Generating synergies in innovation, employment, and health.

Castile and León faces a clear choice: anticipate and transform its development model, or face a future of increasing impacts, unequal social costs, and missed opportunities. The process of developing this Strategy and its corresponding Investment Plan should take advantage of this window of opportunity to:

- Establish stable and accessible financial mechanisms.

- Channel European and national resources into transformative projects.
- Ensure that every euro invested builds a safer, more liveable, and resilient territory.

As summarised by the European Commission: "The cost of not adapting is unaffordable. Investment in resilience is investment in the future."

2 Climate risks

Understanding climate risks is a fundamental step in the adaptation process, as it allows us to anticipate the most likely and severe impacts of climate change and identify the social, economic, and ecological systems most exposed and vulnerable. This section provides an initial exploratory analysis of the main climate risks for **Castile and León**, based on available data, accumulated territorial experience, and contributions from key stakeholders.

The following subsections will develop a qualitative approach to the main climate risks affecting the region.

2.1 General climate profile of the region

Castile and León has a predominantly **continental Mediterranean climate**, characterized by hot, dry summers, cold and prolonged winters, and a high annual temperature range. Precipitation is irregular, peaking in spring and autumn, with frequent summer droughts. This climate pattern is a result of its geographical location in the interior of the Iberian Peninsula, with limited maritime influence, which accentuates its thermal continentality and exposure to extreme phenomena such as heatwaves, severe frosts, droughts, and sudden flooding.

However, significant territorial variations exist within the community. The northern areas, particularly in the provinces of **León, Palencia, and Burgos**, exhibit more humid and mild characteristics, closer to the oceanic climate, especially in mountainous areas or those with greater Atlantic influence. In contrast, the southeastern areas (such as **Salamanca** or **Segovia**) have a more extreme and arid thermal profile.

According to data from the **State Meteorological Agency (AEMET)** for 2023, maximum temperatures ranged between **36.9°C** in **Ávila** and **41.1°C** in **Zamora** and **Salamanca**. Minimum temperatures reached values below **-8°C** in several provinces. As for precipitation, the annual average ranged from **349 mm** in **Salamanca** to **641 mm** in **Soria**, highlighting inter-provincial variability.

Precipitation and Temperatures (Maximum, Minimum, and Average) in Castile and León - Year 2023				
Province	Total Precipitation (mm.)	Temperaturas máximas absolutas (°C)	Maximum Temperatures (°C)	Minimum Temperatures (°C)
Ávila	426,0	36,9	-6,1	13,0
Burgos	443,6	39,0	-8,0	12,2
León	473,1	37,5	-6,8	12,7
Palencia (*)	381,6	38,5	-7,8	13,3
Salamanca	349,5	41,1	-8,3	13,0
Segovia	570,2	38,4	-5,1	13,6
Soria	641,0	38,9	-9,6	13,0
Valladolid	393,4	40,0	-4,1	14,4
Zamora	375,0	41,1	-4,8	14,9
Notes: (*) The data for Palencia corresponds to the Palencia-Granja Viñalta automatic station.				

Source: Directorate-General for Budgets and Statistics of the Regional Government of Castile and León, with data from the State Meteorological Agency, Territorial Delegation in Castile and León.

Climate Change Scenarios

The AdapteCCa Climate Scenarios Viewer (updated in June 2025), developed under the National Climate Change Adaptation Plan (PNACC), provides a solid scientific basis for assessing the potential impacts of climate change in Castile and León. The scenarios used align with the Sixth IPCC Assessment Report (AR6) and incorporate the new Shared Socioeconomic Pathways (SSP) from the CMIP6 project (statistical regionalization of these global models) in collaboration with AEMET and the Spanish National Research Council (CSIC). This regionalization, using advanced downscaling techniques, allows a spatial resolution of 5 km grid. Additionally, the data is complemented by regional model simulations from the EURO-CORDEX consortium, increasing the robustness of the projections by integrating multiple lines of evidence.

For this report, the SSP5-8.5 high emissions scenario was used, representing a global development pathway based on intensive fossil fuel use, rapid economic growth, and high greenhouse gas emissions. This scenario was selected because it is the most conservative from an adaptive planning perspective, anticipating the most severe impacts if global emissions are not reduced in an ambitious manner.

The analysis has worked with two time horizons:

- Historical reference period: 1971–2000
- Climate projection period: 2041–2070

The projections were obtained for a set of relevant climate variables from a risk analysis perspective, specifically:

Temperatures:

- Average annual temperature
- Number of hot days
- Number of warm nights
- Maximum temperature
- Extreme maximum temperature
- Maximum duration of heatwaves

Other Variables:

- Wind
- Dust
- Humidity

Precipitation:

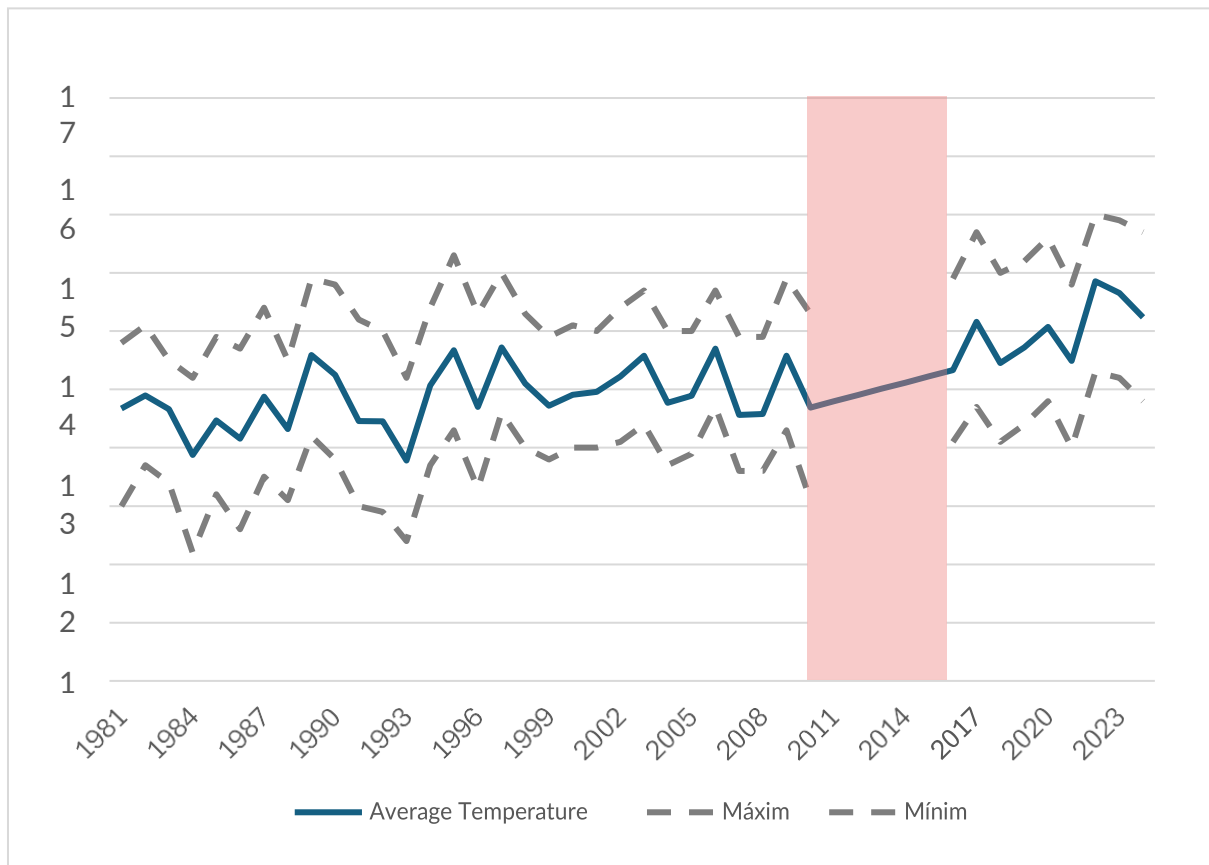
- Total annual precipitation
- Maximum number of consecutive wet days
- Number of rainy days
- 95th percentile of daily precipitation
- Cumulative precipitation in one day

- Maximum precipitation in 24 hours and 5 days
- Number of days with precipitation <1 mm

In addition to having historical mapping and future projections, graphs of evolution from 1981 to 2023, created using AEMET data, were included. These graphs clearly show the long-term trend and, in particular, the notable acceleration observed in the last decade. The resulting information reinforces the interpretation that Castile and León is significantly approaching the emission pathways and climate impact trajectories associated with the RCP 8.5 scenario.

The maps below represent both the historical values and the projected anomaly (i.e., the increase or variation relative to the baseline period), allowing a clear visualization of the expected change under no mitigation conditions.

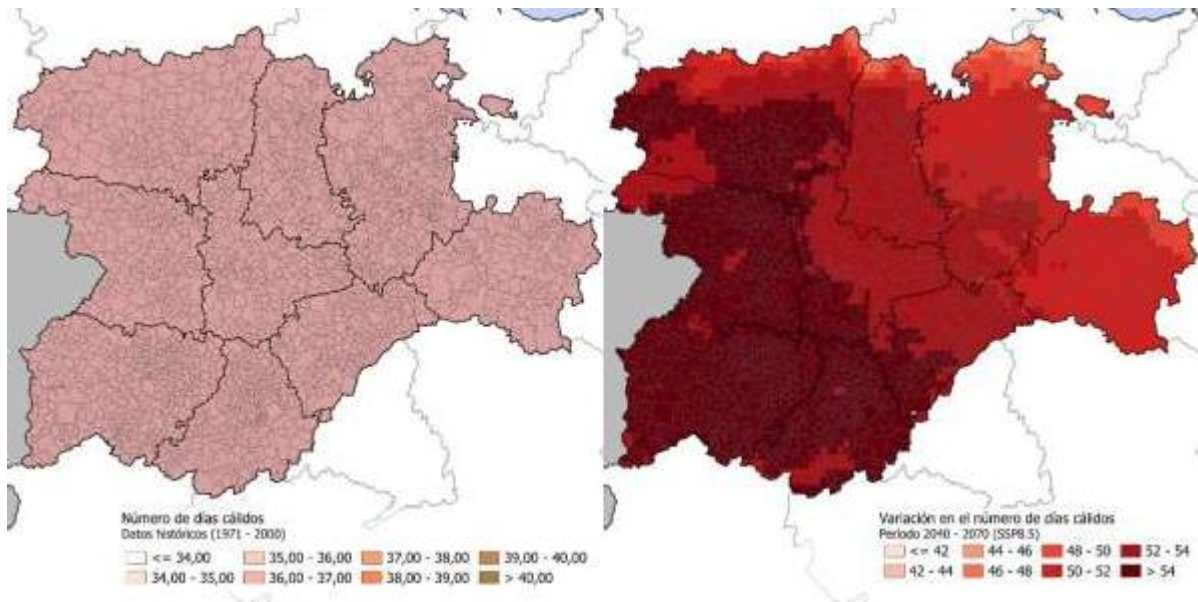
- **Average Annual Temperature of Stations in Castile and León (°C)**



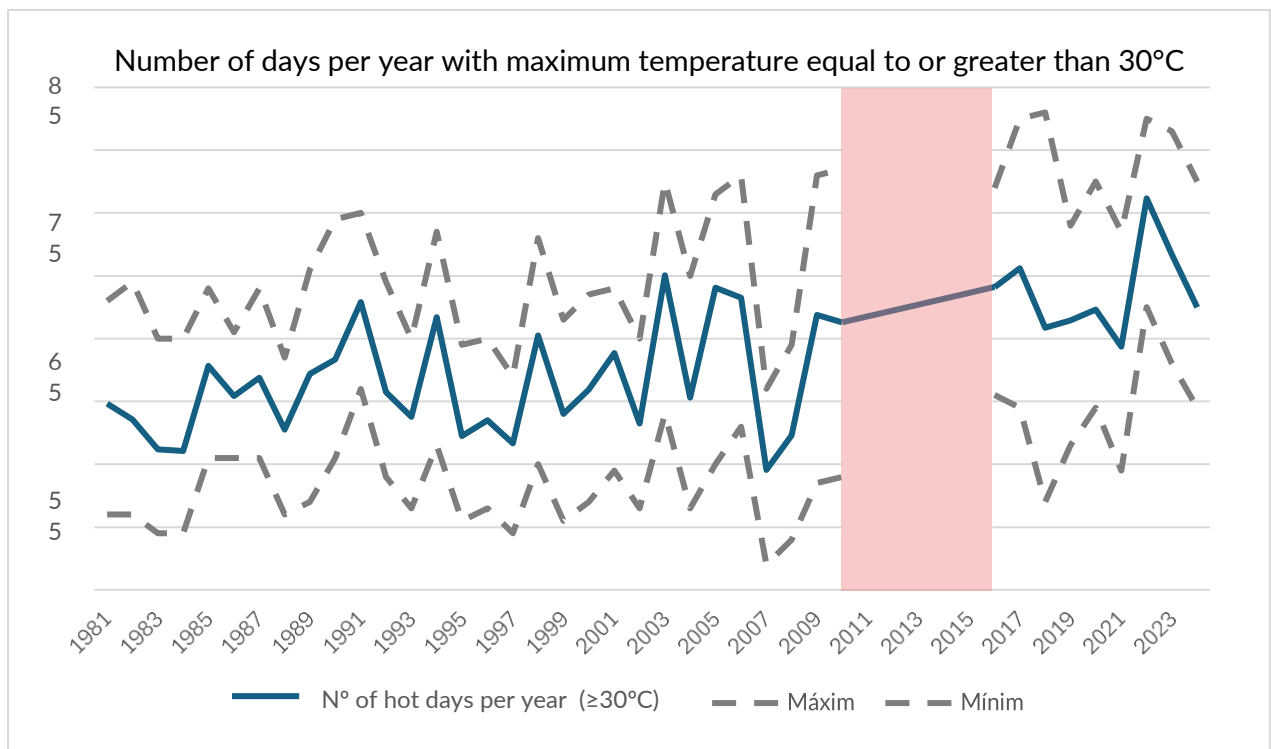
The evolution of the average annual temperature at the stations in Castile and León shows a clear upward trend over the years. In the late 20th century, the average temperatures were mostly between 11 and 12 °C. From the beginning of the 21st century, the averages began to fluctuate around 12 °C, and between 2016 and 2024, an increase towards values near 13 °C is observed.

Regarding the dispersion of maximum and minimum temperatures recorded at the stations, no significant increase is seen; however, both maximum and minimum temperatures follow the same increasing trend as the averages, reflecting a consistent rise in all thermal variables.

• Number of Hot Days

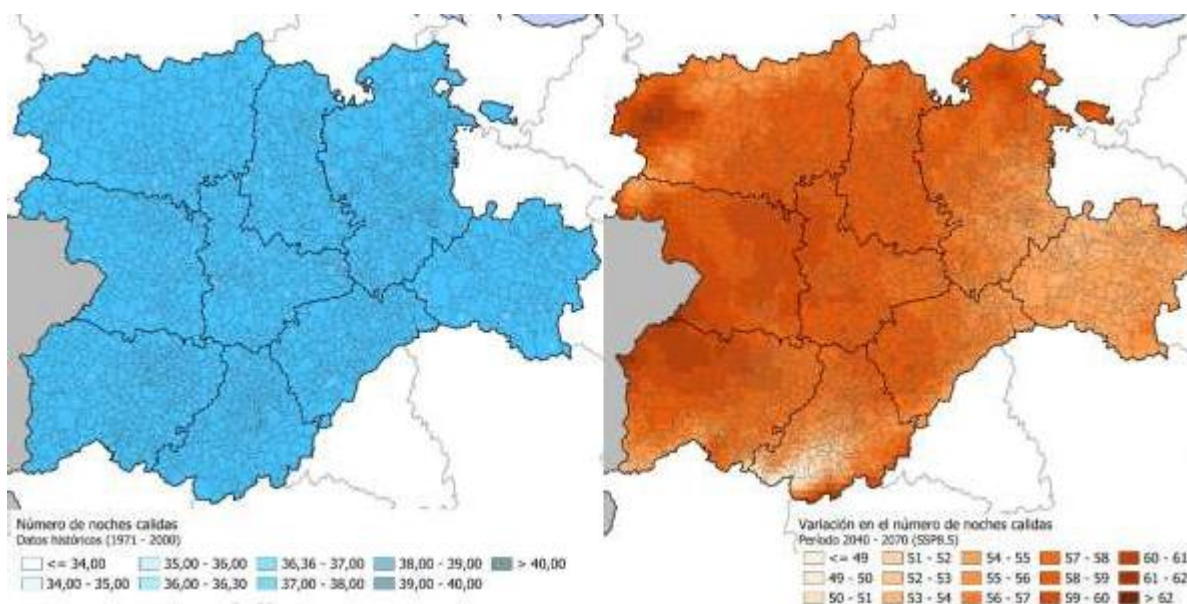


The number of hot days is defined as the number of days within a time period where the maximum temperature exceeds the 90th percentile of a reference climatic period (days). Left map: historical data (1971–2000). Right map: projected variation from historical period to 2040–2070 period, under the SSP5–8.5 scenario.



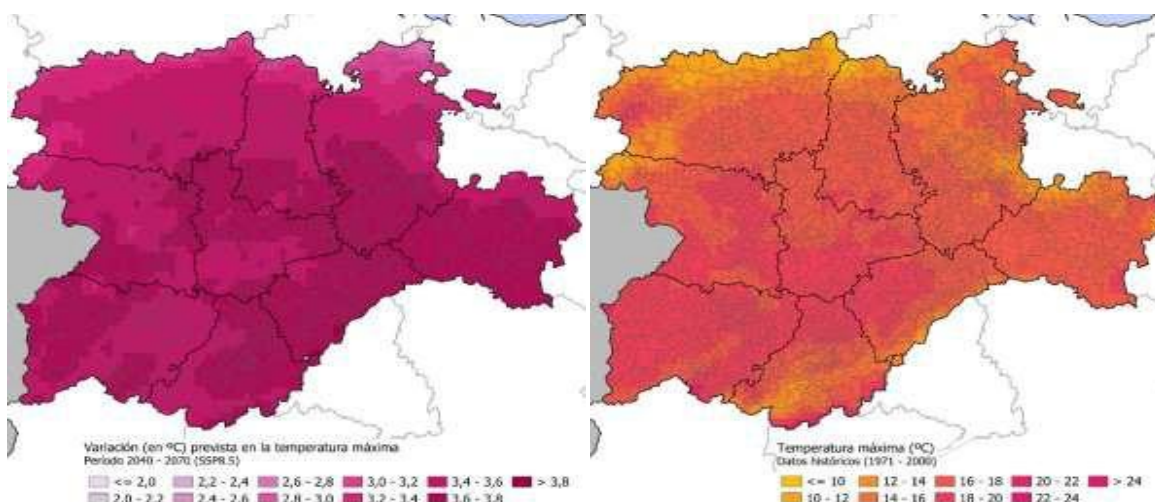
The graph reflects the evolution of the number of days with maximum temperatures of **30 °C or higher**, calculated as the average of 10 AEMET meteorological stations. A **sustained upward trend** is observed: in the 1980s, the average was around **35 days annually**, while in recent years, the figure has approached **50 days**. Additionally, both the maximum and minimum values recorded at each station show an increase compared to the past. These variations are moving further away from the average trend, indicating greater dispersion and, therefore, more intense heat events.

- Number of Warm Nights

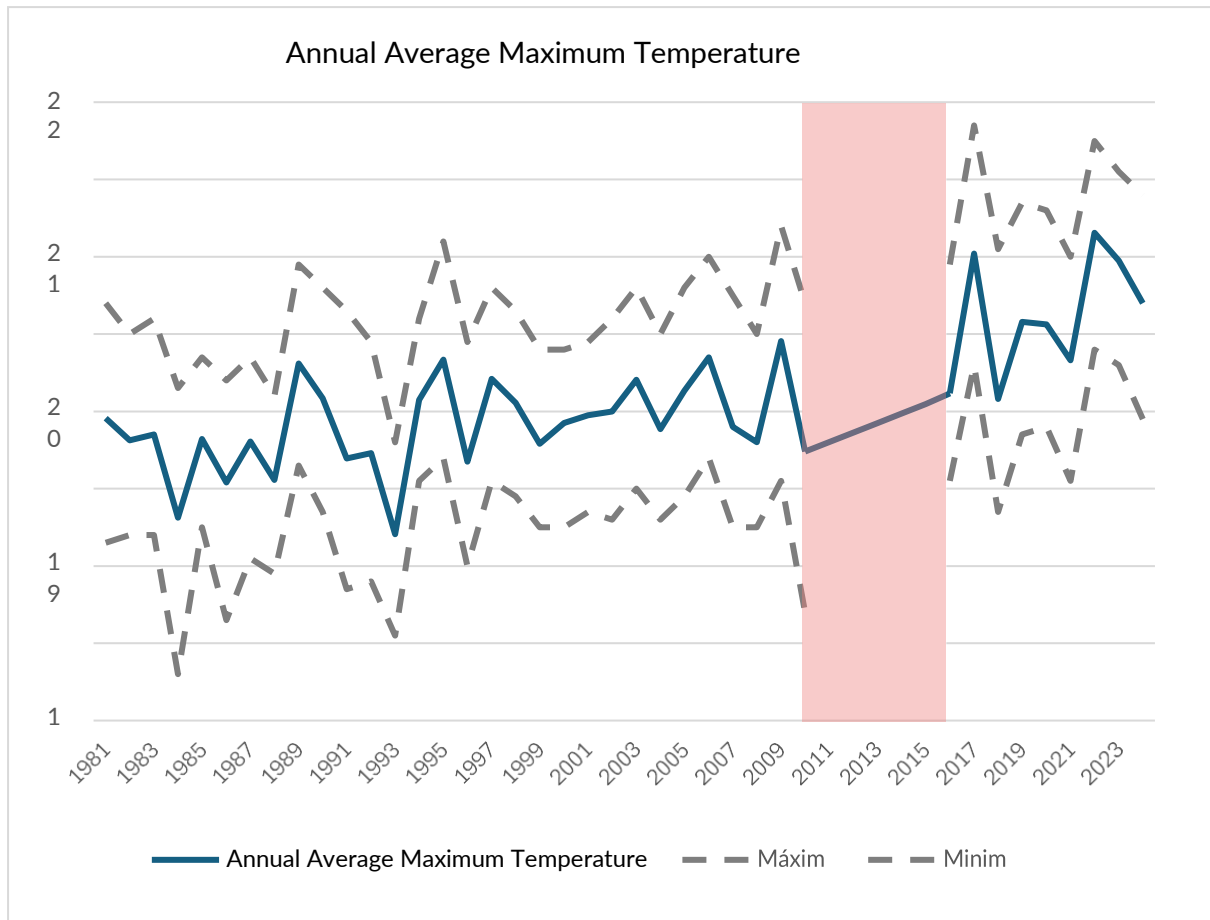


The number of warm nights is defined as the number of nights within a time period where the minimum temperature exceeds the 90th percentile of a reference climatic period (days). Left map: historical data (1971–2000). Right map: projected variation from historical period to 2040–2070 period, under the SSP5-8.5 scenario.

- Maximum Temperature (TX)



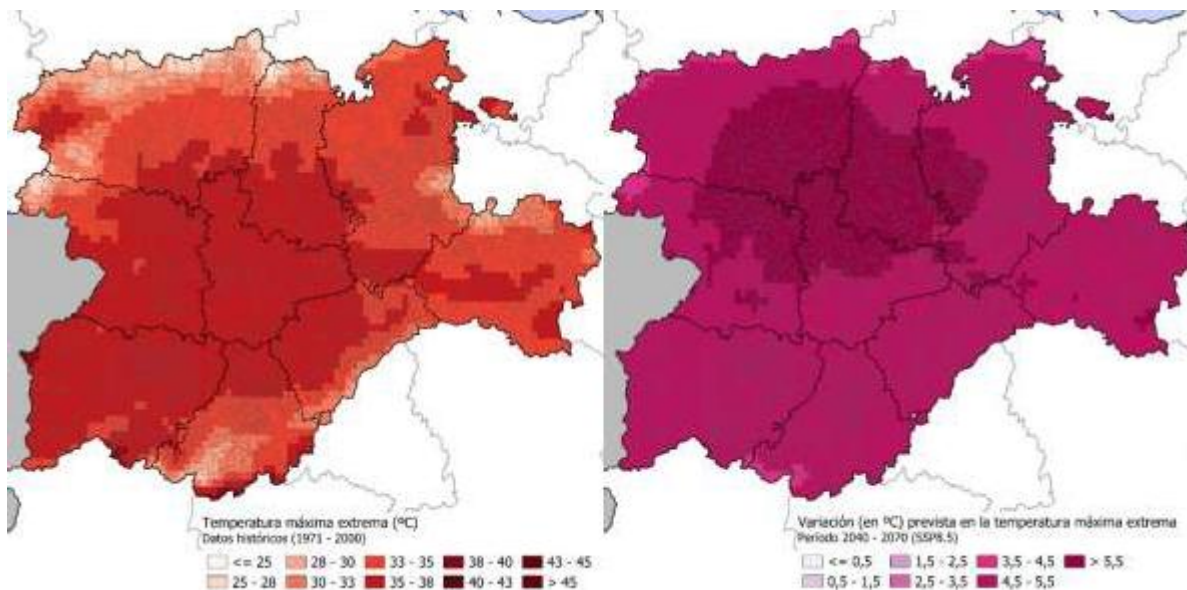
The maximum temperature is the air temperature at 2 meters above the ground, recorded daily (°C). Left map: historical data (1971–2000). Right map: projected variation from historical period to 2040–2070 period, under the SSP5-8.5 scenario.



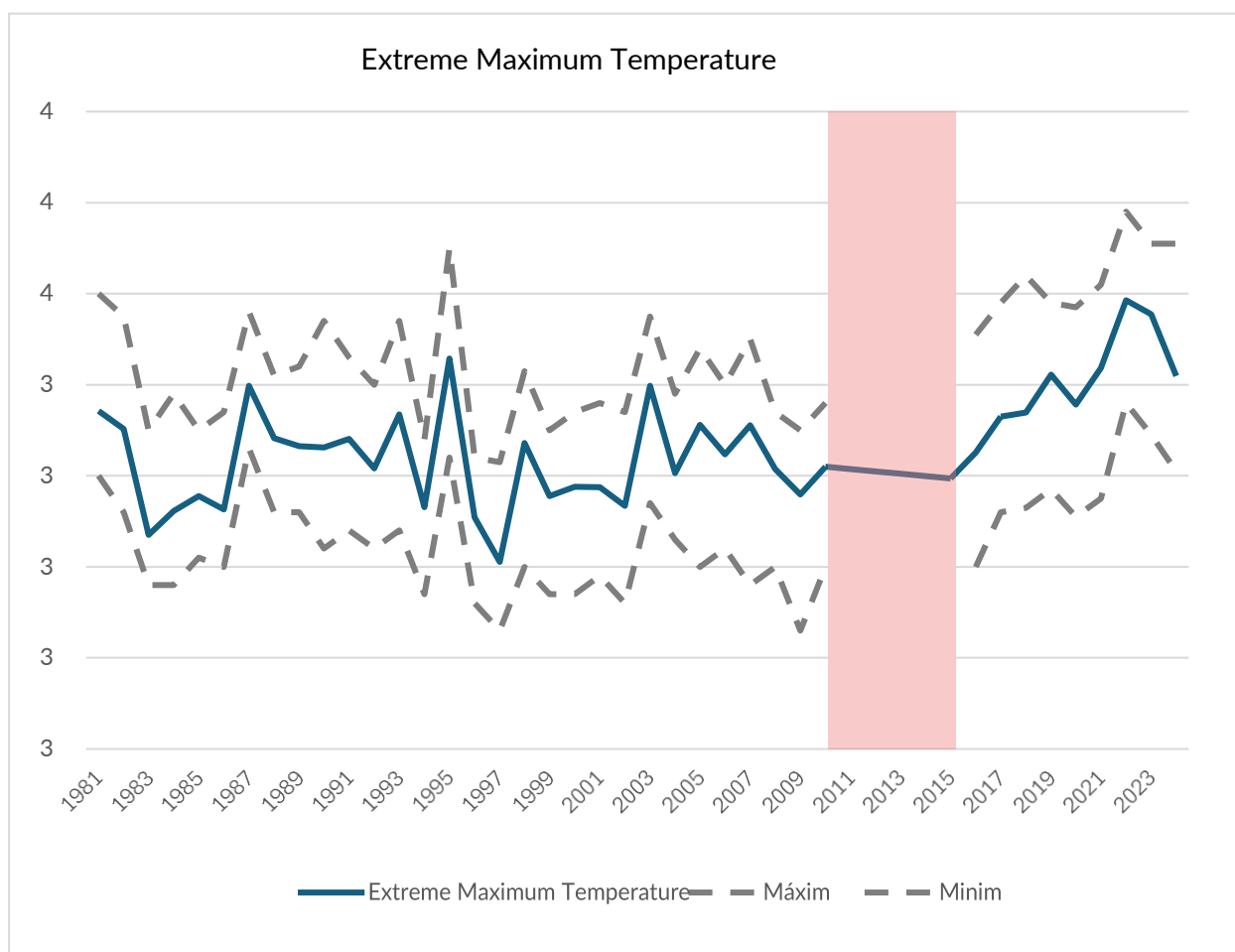
The analysis of the average maximum annual temperatures in 10 AEMET meteorological stations shows a sustained upward trend. At the end of the 20th century, the values were around 17–18 °C, while in the first decade of the 21st century, averages were already close to 18 °C. Currently, the most recent records are around 19 °C, consistently above 18 °C, confirming that the gradual increase observed in previous decades has consolidated into a scenario of increasing average annual temperatures.

Unlike the previous variable, in this case, the maximum and minimum values do not show a growing dispersion but instead evolve in parallel with the average trend.

- Extreme Maximum Temperature (TXx)



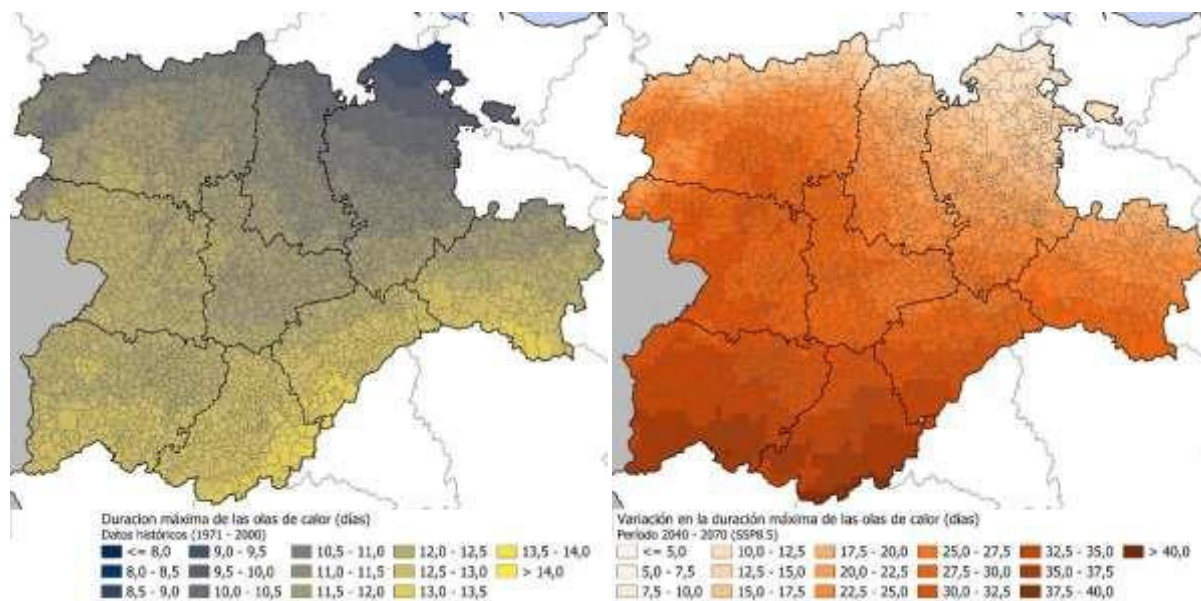
The maximum of daily maximum temperatures over a period of time (°C). Left map: Historical data (1971-2000). Right map: Projected variation from the historical period to the period 2040-2070 under the SSP5-8.5 scenarios.



The maximum of daily maximum temperatures over a period of time (°C) shows a clearly increasing trend from the first decade of the 21st century. Between 2019 and 2024, five of the six highest values above 38°C in the entire series were recorded, while before 2010, the annual maximum temperatures were mostly around 36°C, with fluctuations between 34 and 36°C and only one episode exceeding the 38°C threshold.

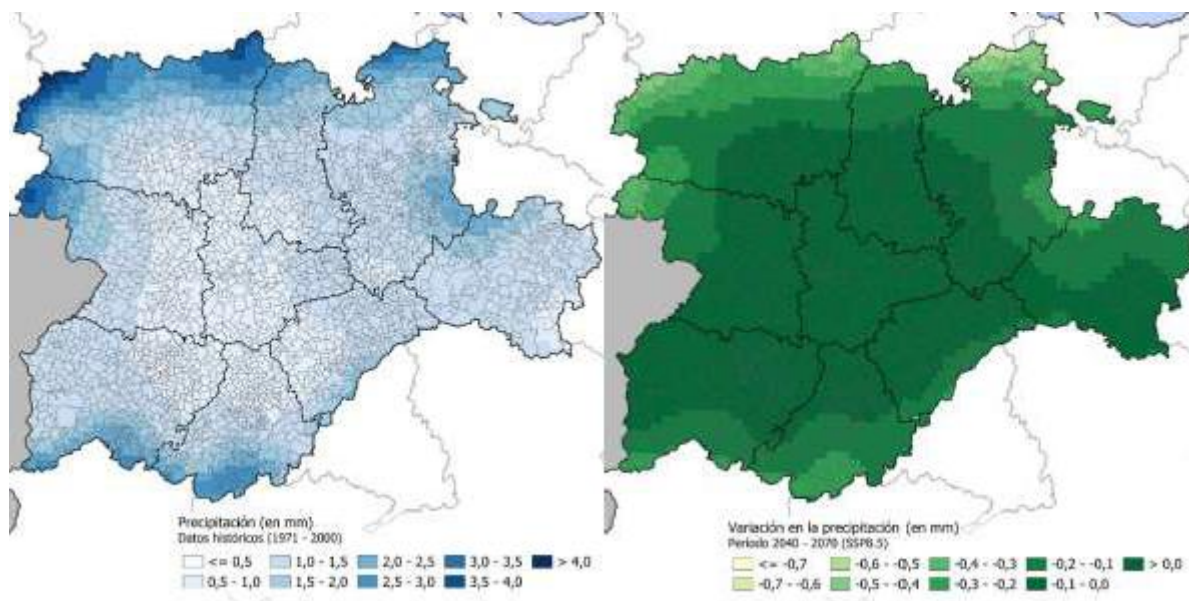
The absolute records show greater dispersion, but always in line with the upward trend. A record was set in 2022 with 41.8°C, followed by values above 41°C in the two subsequent years—an unprecedented event in the historical series.

- Maximum Duration of Heatwaves

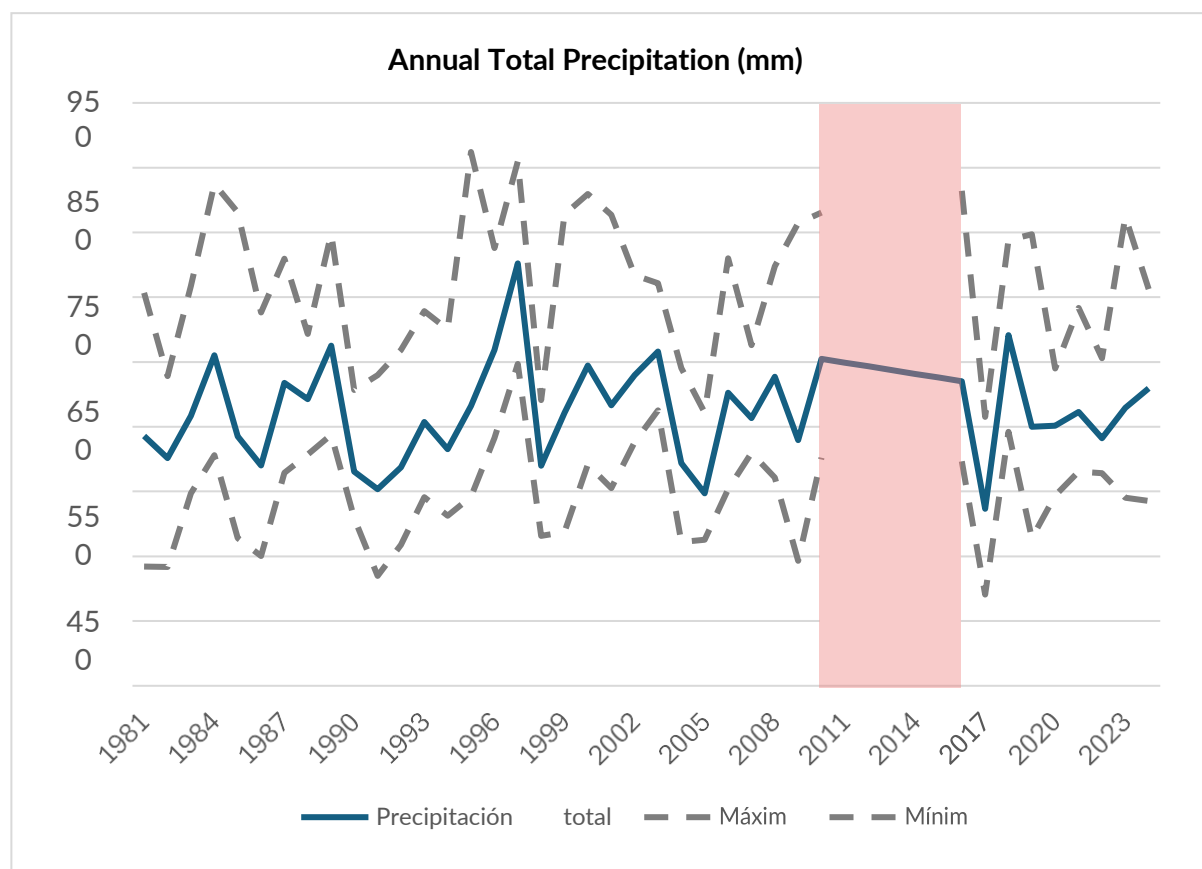


The duration of heatwaves is a variable used to assess the length of time during which temperatures exceed a certain threshold, typically the 90th percentile of the reference climate period. A heatwave is defined as at least five consecutive days with maximum temperatures above this threshold. Left map: Historical data (1971–2000). Right map: Projected variation from the historical period to the period 2040–2070, under the SSP5-8.5 scenario.

- Annual Total Precipitation (mm)



Annual total precipitation refers to the total amount of rain (in any form) that falls over the course of a year, measured in millimeters (mm). Left map: Historical data (1971–2000), showing the average annual precipitation across Castile and León during this period. Right map: Projected variation between the historical period and the period 2040–2070, under the SSP5-8.5 scenario.

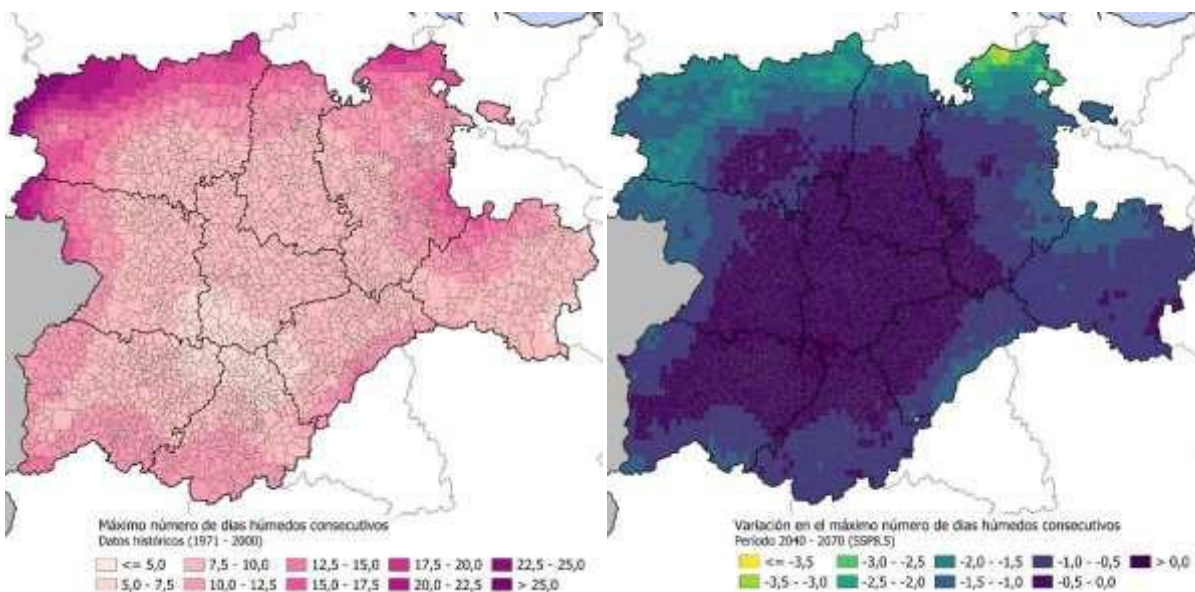


The graph showing the evolution of annual total precipitation reflects the average rainfall recorded in Castile and León. Unlike the evolution of temperatures, no increasing or decreasing trend is observed, but rather a relative stability throughout the analysed period.

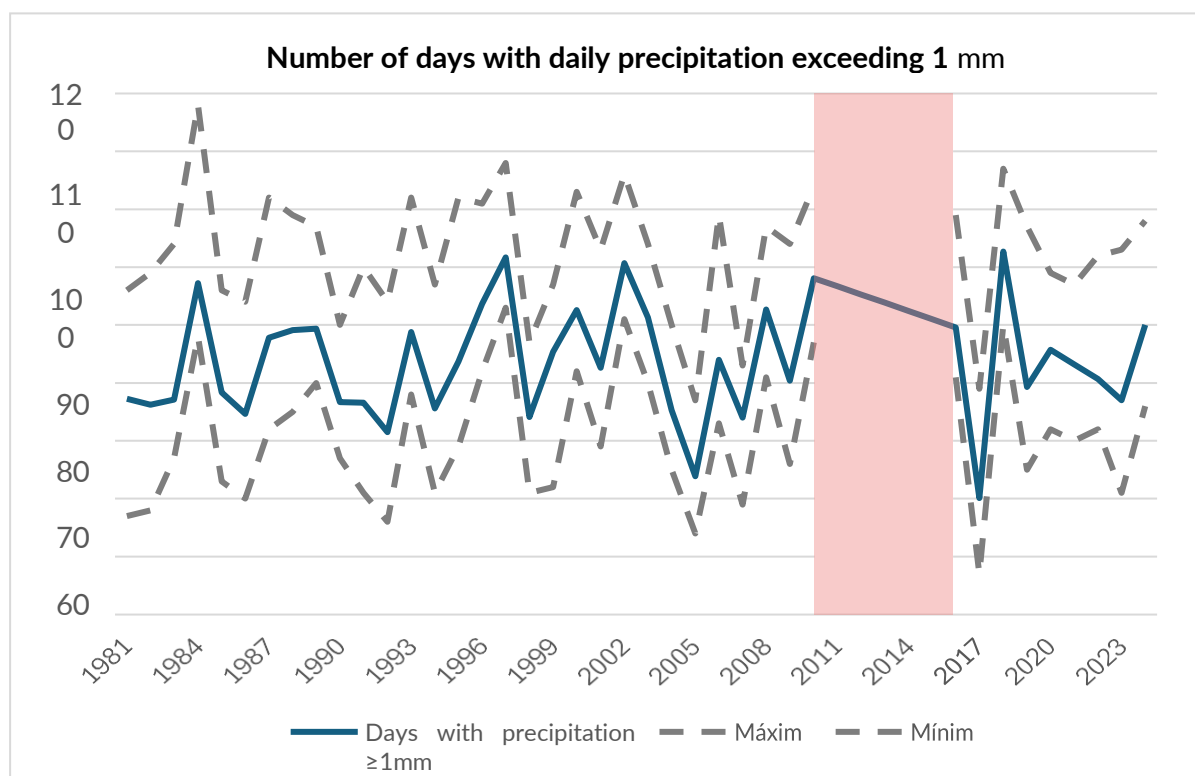
In most years, annual precipitation falls within a range of 400 to 550 mm, with some occasional episodes exceeding or falling below these values.

Regarding the absolute maximum and minimum values, no significant change in dispersion is observed, with the dynamics remaining quite constant throughout the entire series.

- Number of Consecutive Wet Days**



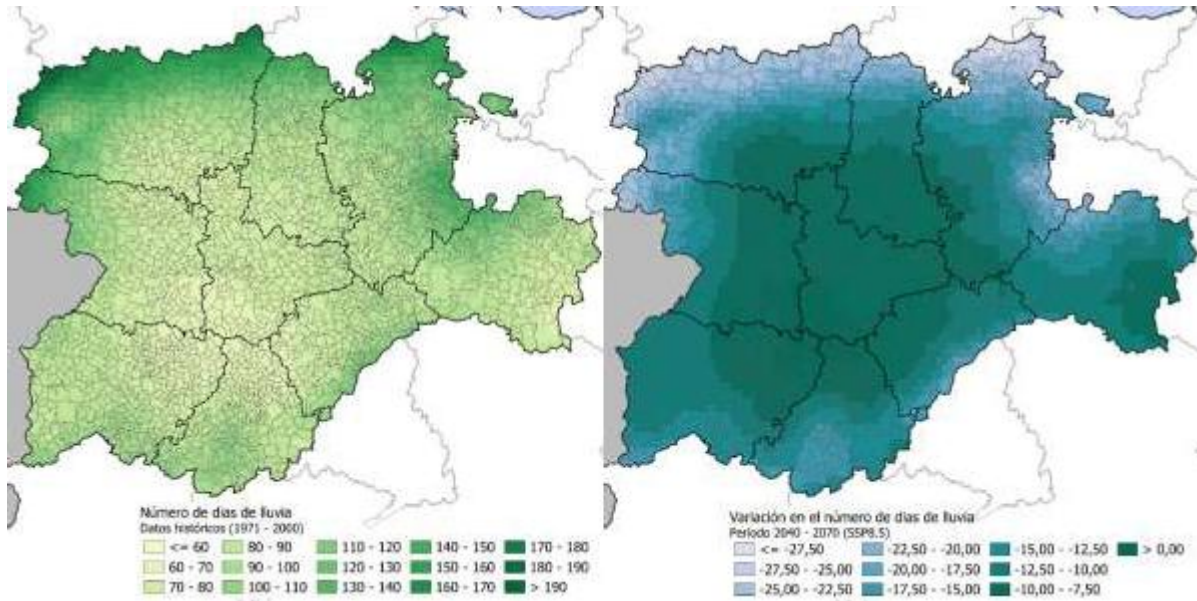
The number of days within a time period when precipitation exceeds 1 mm (Days). The variable maximum number of consecutive wet days is shown with the following maps: Left map: Historical data (1971-2000). Right map: Projected variation between the historical period and the period 2040-2070, under the SSP5-8.5 scenario.



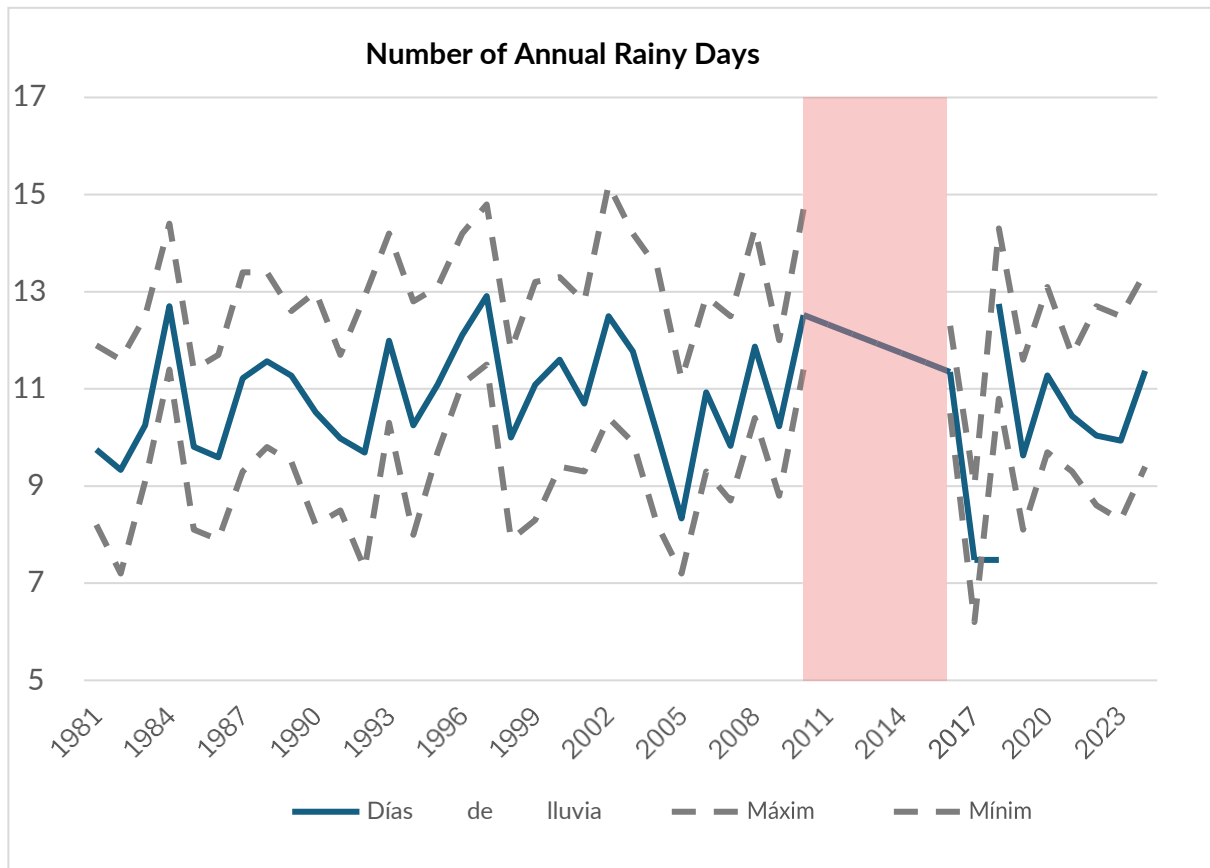
Regarding the number of days with daily precipitation exceeding 1 mm, no clear trend of increase or decrease is observed over the analysed period. Most of the values remain in a range of 60 to 90 days annually, with only a few occasional peaks above or below this interval.

As for the dispersion, no significant changes are observed either: the behaviour of this variable has remained relatively stable over the years, without a marked evolution like in the case of temperatures.

- **Number of Rainy Days (Days)**



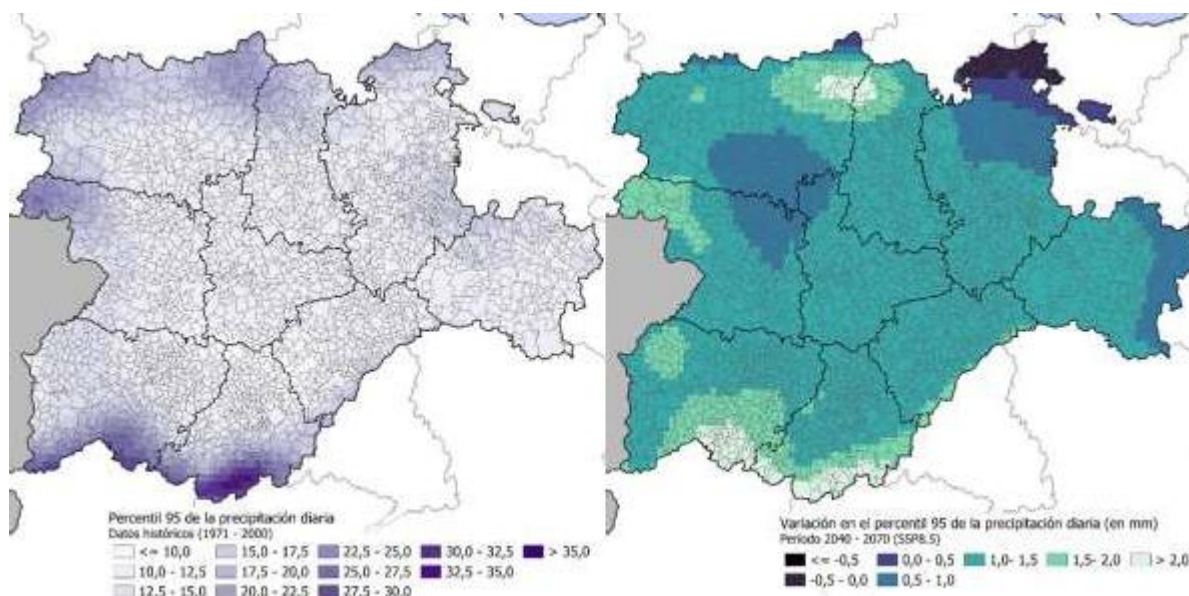
The number of days in a period when precipitation is equal to or greater than 1 mm (Days). The variable number of rainy days is shown with the following map: Left map: Historical data (1971–2000). Right map: Projected variation between the historical period and the period 2040–2070, under the SSP5-8.5 scenario.



In the analysis of measurable rainy days (≥ 0.1 mm), calculated as the annual average of the 10 stations, no sustained trend is observed throughout the recorded period. The values remain relatively stable, primarily fluctuating between 90 and 110 days. Although no clear growth or decline is evident, two episodes stand out in this century, with very pronounced minima of 83 and 74 days, which are the lowest values in the entire series and significantly differ from the rest of the record.

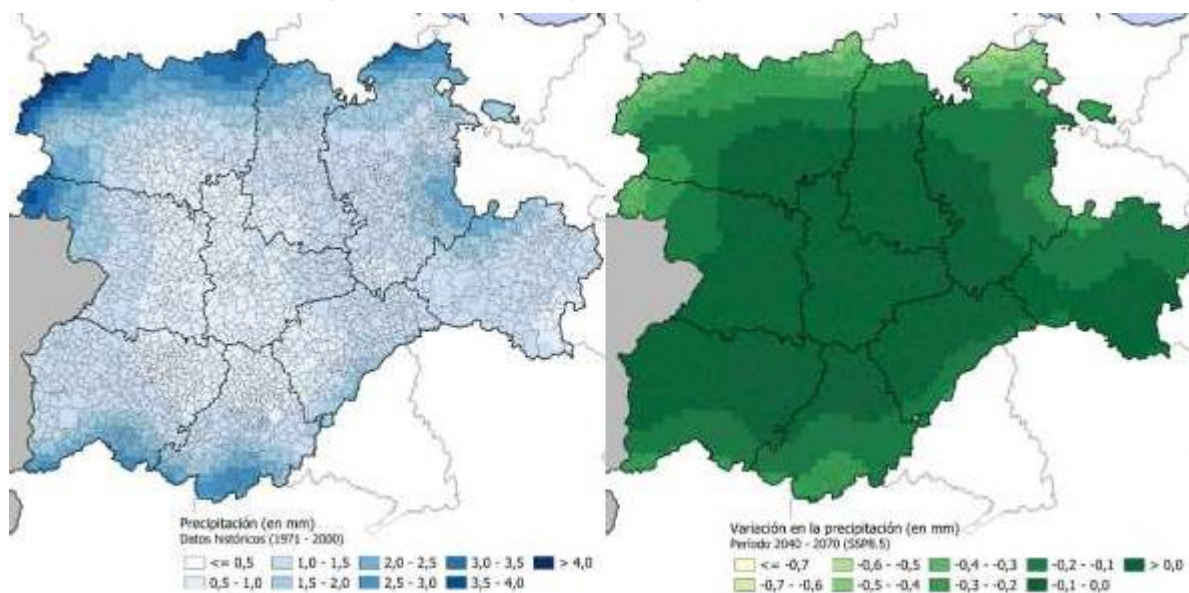
Regarding dispersion, no relevant changes are detected: the variability has remained stable, with no significant increases or decreases compared to other periods.

- 95th Percentile of Daily Precipitation (mm/day)



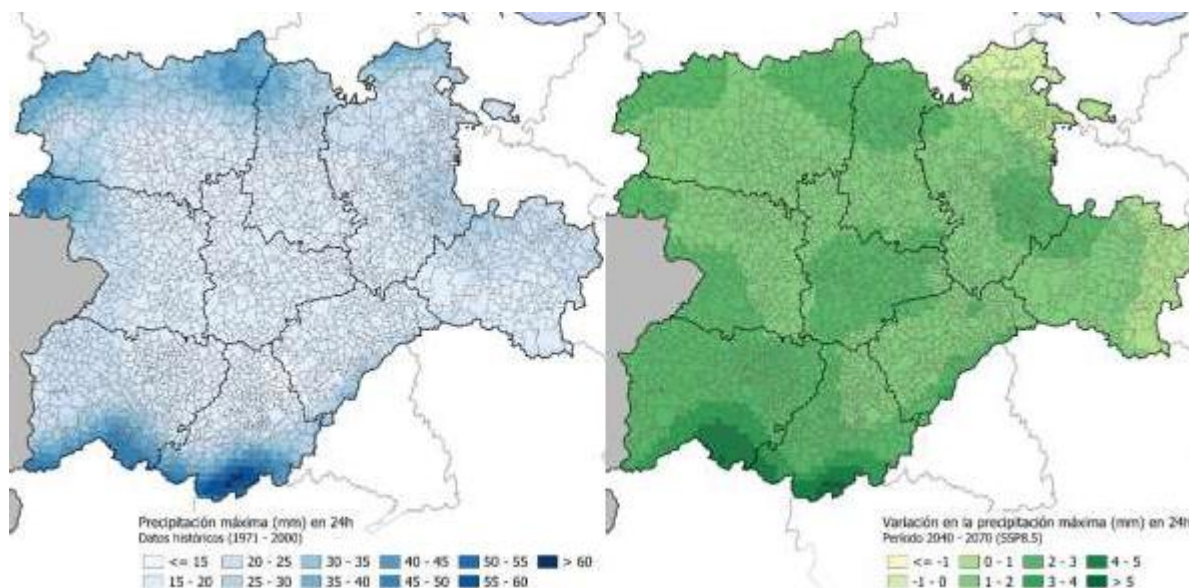
The value below which 95% of daily precipitation values for a given period fall (mm/day). Left map: Historical data (1971–2000). Right map: Projected variation between the historical period and the period 2040–2070, under the SSP5-8.5 scenario.

- Cumulative Precipitation in One Day (mm/day)

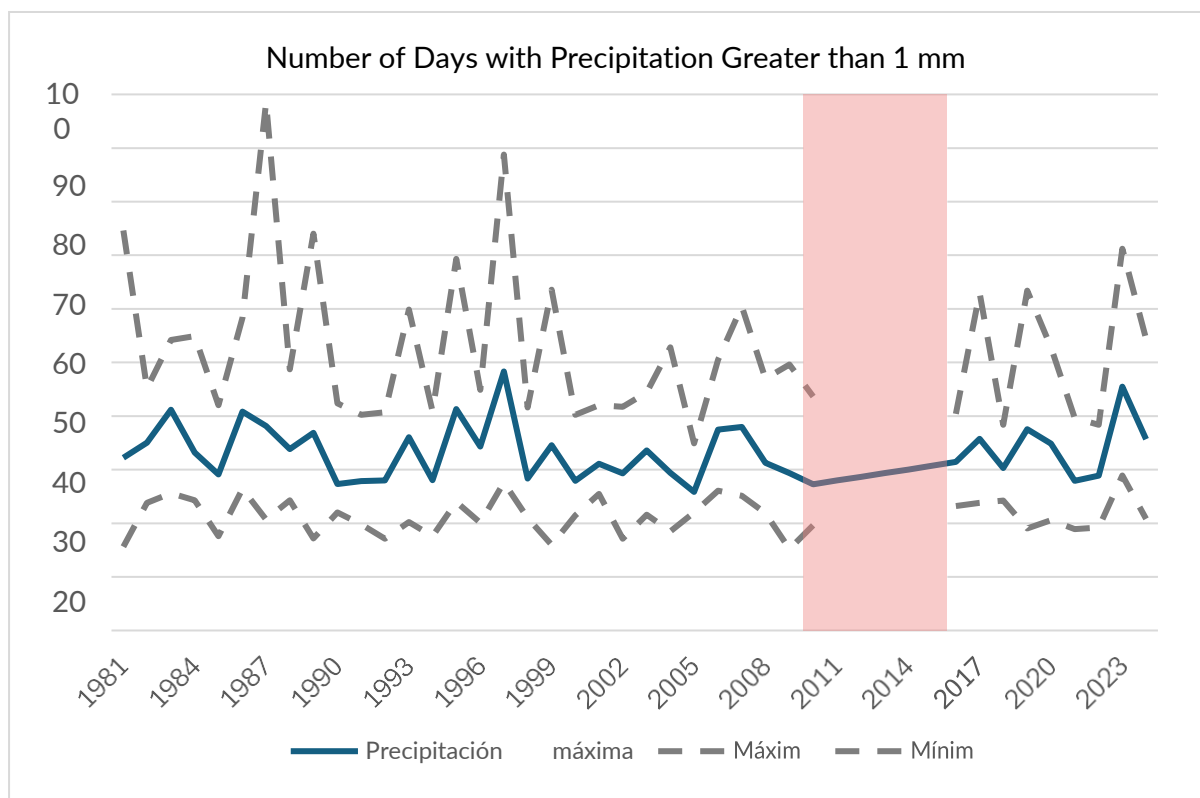


This variable refers to the total precipitation in any form (rain, snow, hail, etc.) accumulated over the course of a day (mm/day). Left map: Historical data (1971–2000). Right map: Projected variation between the historical period and the period 2040–2070, under the SSP5-8.5 scenario.

- Maximum Precipitation in 24 Hours (mm/day)



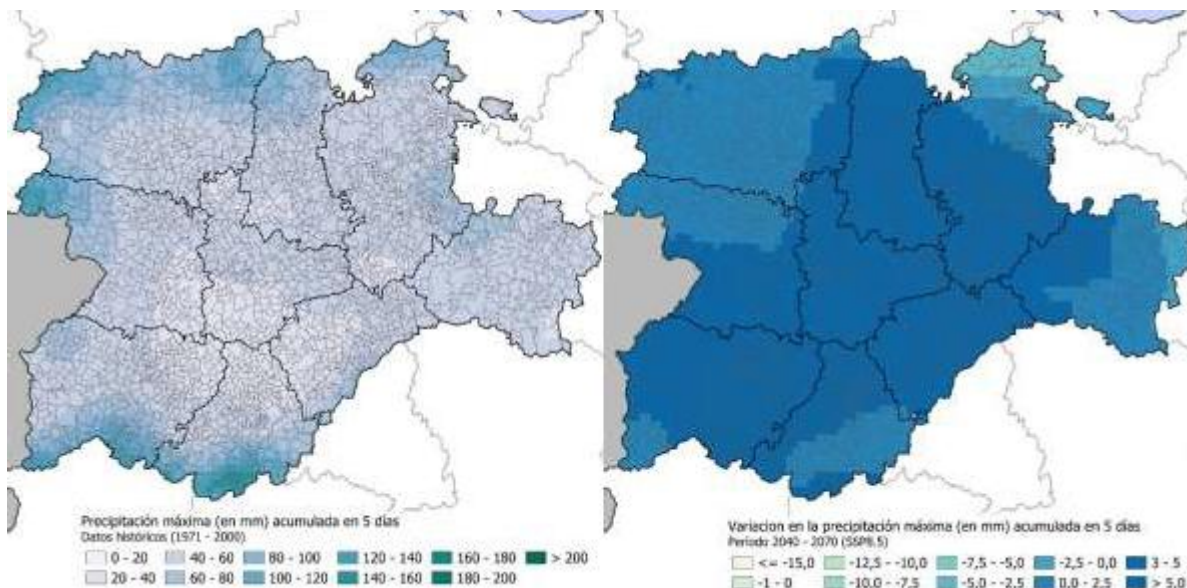
This variable refers to the highest daily precipitation recorded over a period of time (mm/day). Left map: Historical data (1971–2000). Right map: Projected variation between the historical period and the period 2040–2070, under the SSP5-8.5 scenario.



The analysis of the maximum precipitation recorded in 24 hours does not show a defined trend over the analysed period. The values typically range, on average, between 30 and 40 mm per day. Regarding the maximum and minimum values, it is observed that in the 20th century, exceptionally high records were reached on two occasions, approximately one-third higher than

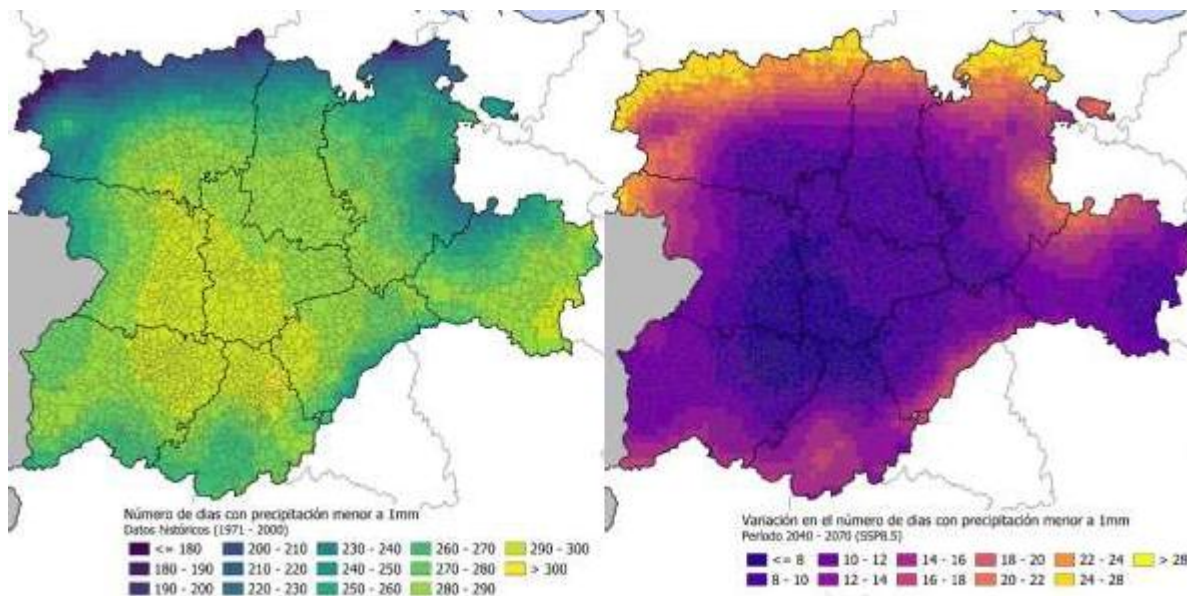
those recorded in the 21st century, a situation that has not been repeated. On the other hand, the minimum values have remained stable, with no notable variations throughout the series.

- Maximum Cumulative Precipitation in 5 Days (mm)**



This variable refers to the highest accumulated precipitation recorded over a 5-day period (mm). It is shown with the following maps: Left map: Historical data (1971–2000). Right map: Projected variation between the historical period and the period 2040–2070, under the SSP5-8.5 scenario.

- Number of Days with Precipitation < 1 mm (Days)**



This variable refers to the number of days in a given period when the daily precipitation is less than 1 mm. It is shown with the following maps: Left map: Historical data (1971–2000). Right map: Projected variation between the historical period and the period 2040–2070, under the SSP5-8.5 scenario.

- Calima – Airborne Dust Suspension

Climate change is also manifested through the intensification and increased frequency of atmospheric phenomena that directly impact health, ecosystems, and the economy. One such phenomenon is Calima, which refers to the arrival of air masses laden with mineral dust from the Sahara Desert, carrying suspended particles (PM10 and PM2.5).

In Castile and León, these natural episodes are a growing threat that affects air quality, increases the risk of exceeding particle concentration limits, and impacts the territory, particularly in terms of human health and renewable energy production.

AdapteCCa does not provide specific information on historical or projected Calima data, but the Ministry for Ecological Transition and the Demographic Challenge ([MITECO](#)) records these cross-border natural dust events in its annual reports, providing a reference framework for evaluating their impact. For Castile and León, this information is specifically recorded for the Central and Northwestern areas, allowing for a differentiated territorial approach.

According to recent data from CSIC (Pérez, Querol et al., 2025), Dust episodes are tracked by the percentage of days affected by African dust during the year. The data from 2020 to [2024](#) shows:

Days (Annual Percentage) with Influence of African Dust in 2024. Source: CSIC (PÉREZ, QUEROL, et al., 2025).		
	Percentage of days per year with african dust episodes	
Date	Central	Northwest
2024	30	14
2023	20	8
2022	30	11
2021	25	9
2020	20	8



Fuente: CSIC (PÉREZ, QUEROL, et al., 2025)¹¹

Figura 11. Días (porcentaje anual) con influencia de polvo africano en 2024



Fuente: CSIC (PÉREZ, QUEROL, & CÁDIZ, 2025)¹²

Figura 10. Áreas geográficas para la identificación de episodios naturales

Days (Annual Percentage) with Influence of African Dust in 2024.

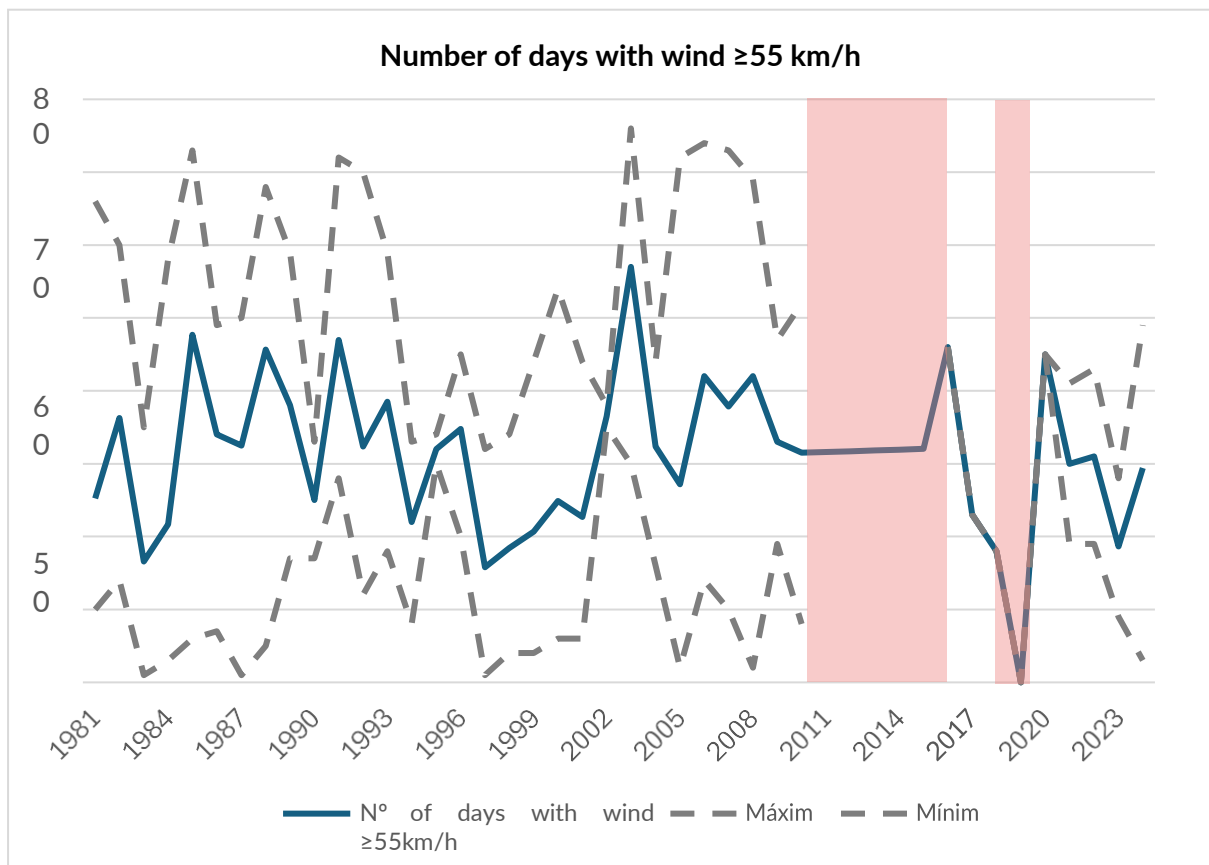
In 2024, for example, 30% of days were affected in the Central region and 14% in the Northwest, values that surpass the average of previous years and reflect an increase of +8% to +59% compared to the reference period 2001-2023.

The intensity of these episodes has also worsened. The events recorded in 2024 were more intense than the average of recent years, with PM10 concentrations reaching high levels across most of the Peninsula and Balearic Islands, especially in March-April and November.

• Wind – Average Wind Speed (km/h)

Winds can influence the territory in two distinct ways: on one hand, through strong wind episodes that exacerbate the spread of wildfires, dry out forests and crops; and on the other hand, through extreme winds that can cause direct damage to infrastructure.

In the Mediterranean region, hurricane-force winds are rare, although they have been recorded occasionally. One example was the ex-Kirk storm, which became a hurricane and in 2023 produced gusts exceeding 120 km/h in Castile and León, affecting all of its provinces. Over 280 incidents were recorded, with widespread material damage and several injuries from fallen trees and structural elements. These episodes highlight the vulnerability of infrastructure to extreme winds.



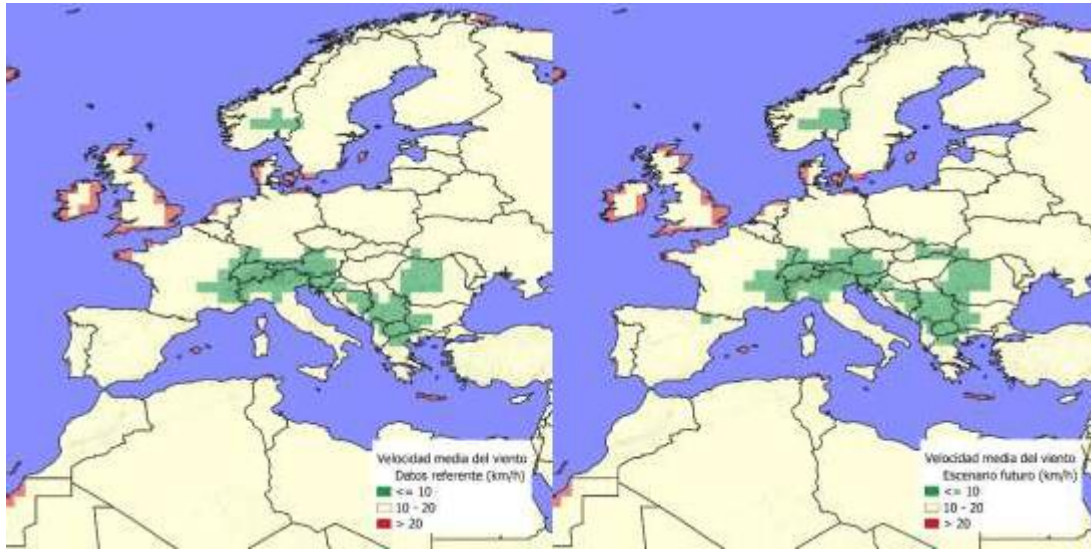
When analysing the evolution of wind in terms of the number of days with wind gusts greater than 55 km/h, we see that since 1980, there is no clear trend over the years. On average, the number of days with winds equal to or exceeding 55 km/h ranges from 20 to 50 days annually. Regarding the maximum and minimum values, there is a high degree of dispersion, which can be explained by the location of each station: those more exposed to wind or situated in areas with more frequent, intense gusts tend to record higher values.

It is important to note that these data should be interpreted as indicative, especially from 2016 onwards, due to the limited quality and quantity of records. In some years, reliable data is only

available from one station. In 2019, no station had complete records throughout the year, preventing the extraction of robust and conclusive figures on wind evolution.

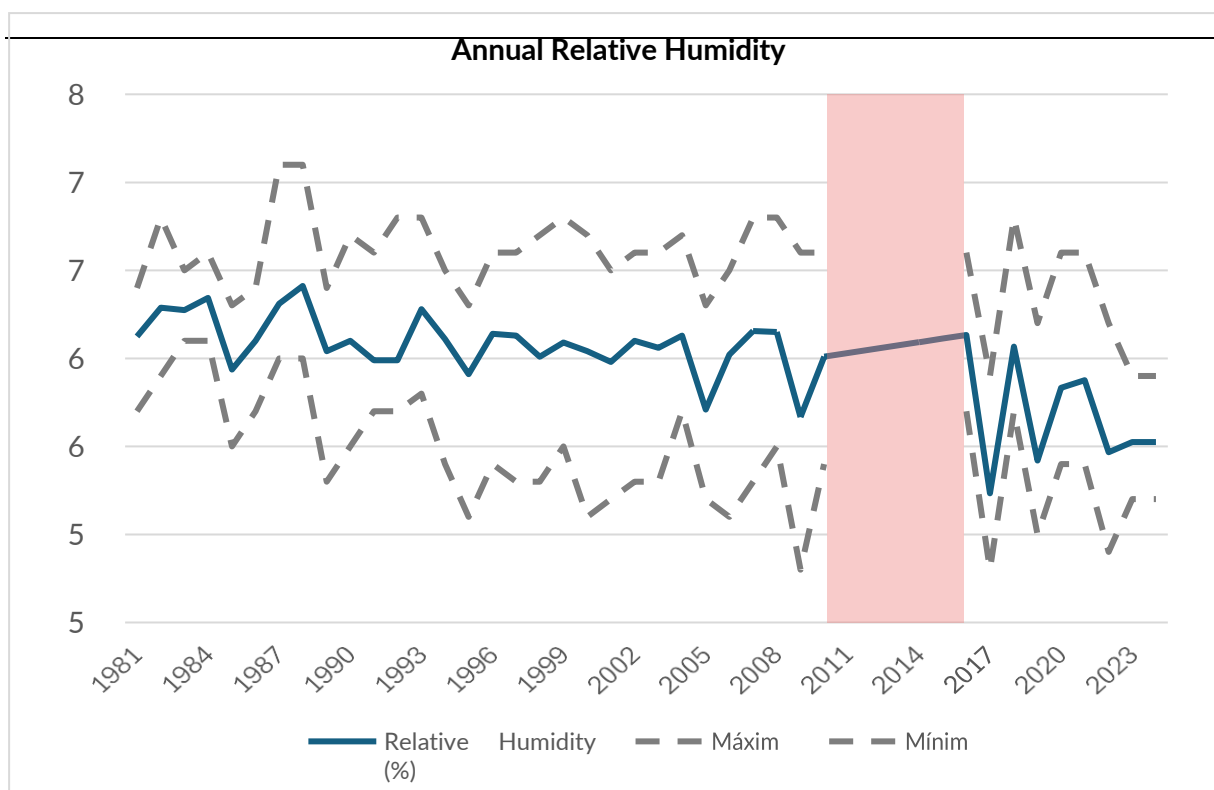
However, for wind to negatively affect the spread of a wildfire, it is not necessary for it to reach very high intensities. Even with low speeds of 10–20 km/h, the risk of spread increases significantly, and this risk intensifies as the gusts increase.

The data used for this analysis comes from the IPCC global viewer, which does not allow for specific results to be broken down at the scale of Castile and León. For this reason, the information is represented at the European level, as it is not possible to conduct a more precise territorial approach.



The average wind speed is represented with the following maps: Left map: Historical data (1981–2010). Right map: Projected variation between the historical period and the period 2041–2060, under the SSP5-8.5 scenario.

• Annual Relative Humidity



The analysis of the annual average relative humidity shows a downward trend, inversely proportional to the evolution of temperature. During the 20th century, the average generally remained above 65%, while in the first decade of the 21st century, it began to fluctuate around this value. In the last eight years, only two instances have recorded annual averages above 65%, with most years being closer to 60%.

Regarding the maximum and minimum values, no significant changes or conclusive trends are observed, indicating no clear variation in their dynamics.

Summary of key aspects

- All temperature-related climate indicators show a clear upward trend in future scenarios: more hot days, more warm nights, higher maximum temperatures, and longer heatwaves.
- A significant increase in thermal risk is expected, especially in the central and southern parts of the region.
- Precipitation trends are less homogeneous: a general reduction in the number of rainy days is anticipated, although there will be some stability in annual total rainfall in certain areas.
- **Extreme precipitation indicators** are expected to increase significantly, forecasting a scenario of more intense and concentrated rainfall, with a higher risk of **flash floods** and **soil erosion**.
- The anticipated increase in days with **no significant precipitation** (<1 mm) suggests an extension of dry periods.

2.2 Impact of past or ongoing climate events

Castile and León is already experiencing tangible impacts from climate change. Beyond future projections, extreme climate events that have occurred in recent years have highlighted the region's structural vulnerabilities, severely affecting strategic sectors such as agriculture, water resources, forest management, public health, and infrastructure.

This section presents a selection of significant climate events that have taken place in Castile and León in the recent past, providing an empirical view of the direct and indirect effects of climate change in the region. Through this characterization, the following points are emphasized:

- The increasing frequency of extreme events such as heatwaves, large-scale wildfires, sudden flooding, and prolonged droughts.
- The diversity of sectoral and territorial impacts these events cause, ranging from multi-million losses in agriculture to health issues or water supply disruptions.
- The institutional and operational response deployed, which in many cases has been reactive and emergency-based, underscoring the need to move towards a more structured and preventive adaptive planning approach.

The analysis of these recent events helps link the identified risks in section 2.3 with actual impacts already occurred, establishing a key knowledge base for designing effective and context-specific adaptation strategies. It also highlights the importance of documenting, monitoring, and evaluating the effects of climate change as part of a regional system for alert, prevention, and continuous improvement.

Below is a summary table with significant events, their most notable impacts, and the measures adopted in response:

Event ¹	Timing and duration	Duration	Geographical extent	Associated impact	Measures taken
Intense Drought	Summer 2023	3-4 months	All of Castile and León, particularly agricultural areas in Valladolid, Palencia, and Salamanca.	The prolonged absence of rainfall and heatwaves compromised the harvests of cereals, vineyards, and sunflowers. There was a significant reduction in agricultural yields and multi-million losses for farmers.	Activation of urgent aid for the agricultural sector. Water-saving campaigns. Strengthening of hydrological monitoring.
Flooding	March 21, 2025	4 days	Ávila	The overflow of the Adaja and Chico rivers caused flooding of streets, garages, parks, and establishments. The Ávila Provincial Council estimated damages of over 7 million euros due to these floods.	Declaration of state of emergency. Level 2 of the civil protection plan.
Wildfires (Sierra de la Culebra)	June 15 – August 14, 2022	2 months	Zamora	In the Ferreras and Sarracín fires, the affected area was 27,242 ha. In the Losacio fire,	Extraction and auctioning of burned wood (raising more than 225 million euros).

¹ https://www.miteco.gob.es/content/dam/miteco/es/agua/temas/observatorio-nacional-de-la-sequia/2312-Informe_SE_dic_2023.pdf

<https://www.diariodecastillayleon.es/castilla-y-leon/220627/22830/venta-madera-quemada-sierra-culebra-generara-25-millones-ingresos.html>

<https://elpais.com/espana/2024-06-08/sierra-culebra-dos-anos-despues-solvencia-a-corto-plazo-incertidumbre-a-largo.htm>

				approximately 34,000 ha were burned. Four people died. The recovery of Sierra de la Culebra is requiring an investment of around 50 million euros.	Environmental restoration plans.
Excess mortality attributed to temperature-related phenomena	June – August 2025	3 months	Castilla y León	During the summer in Castile and León, 351 deaths were attributed to heat-related phenomena, according to the Daily Mortality Monitoring System (MoMo), a tool managed by the National Epidemiology Center (CNE) of the Carlos III Health Institute (ISCIII).	The Regional Government declared an alert for high temperatures, which led to an increased monitoring of heat excess and the implementation of self-protection advice in the face of maximum temperatures.
Observed Water Stress	Post-drought 2017–2023	Reccurent	Recurrent water stress observed in regions including Cantabria, Castilla-La Mancha, Extremadura, La Rioja, Madrid, and Asturias.	8.5% reduction in water contributions, pressure on water bodies. Water, reduced water quality, overexploitation of aquifers, and increased water stress in agricultural areas.	Irrigation modernization: increase in water efficiency, technology, and automation; mandatory installation of volumetric meters and monitoring of water extraction; Reduction of the expansion of new irrigated areas; Reuse of treated wastewater for irrigation; Incentives for less water-demanding crops; Coordination

					with CAP and climate adaptation strategies.
Water Deficits in Agriculture/Irrigation	Observed after droughts 2017-2023	Recurrent	Irrigated areas in Castilla y León	Reduced water flows for agricultural use, decreased crop yields, and higher water stress in irrigated soils.	Implementation of water allocation restrictions, promotion of efficient technologies, water-saving campaigns, and prioritization of water supply for human consumption over agricultural uses.
Decrease in Aquifer Recharge	2017-2023	Occasional	Castilla y León	Decline in groundwater levels, threat to underground reserves and wetlands, increased vulnerability to hydrogeological stress.	Limitation of extraction in poorly managed aquifers, redefinition of concessions, and reinforcement of environmental protection in vulnerable areas.

Given the growing relevance of heatwaves as one of the most representative extreme climate phenomena linked to climate change in Castile and León, an evolutionary analysis has been conducted on their occurrence and intensity at the provincial scale. This phenomenon, associated with the sustained increase in temperatures and the greater persistence of warm air masses, has direct impacts on public health, heat-related mortality, air quality, energy consumption, and agricultural productivity, among others.

The analysis has been carried out by decades, covering the period 1975–2024, with the objective of observing the trend of intensification and territorial expansion of these events. Below is a comparative table showing the number of heatwaves recorded in each province of Castile and León in each decade, and the total duration (in days) of heatwaves accumulated per province, allowing a clear visualisation of how this phenomenon has evolved across the entire autonomous community.

Heatwaves by Province	Between 1975 and 1984	Between 1985 and 1994	Between 1995 and 2004	Between 2005 and 2014	Between 2015 and 2024	Total general
Ávila	1	8	3	6	13	31
Burgos	2	10	5	9	12	38
León	3	11	5	7	17	43
Palencia	4	10	4	3	15	36
Salamanca	1	13	5	8	18	45
Segovia	6	4	4	8	18	40
Soria	5	8	5	10	20	48
Valladolid	3	13	5	9	21	51
Zamora	0	8	4	8	20	40
Total overall	25	85	40	68	154	372

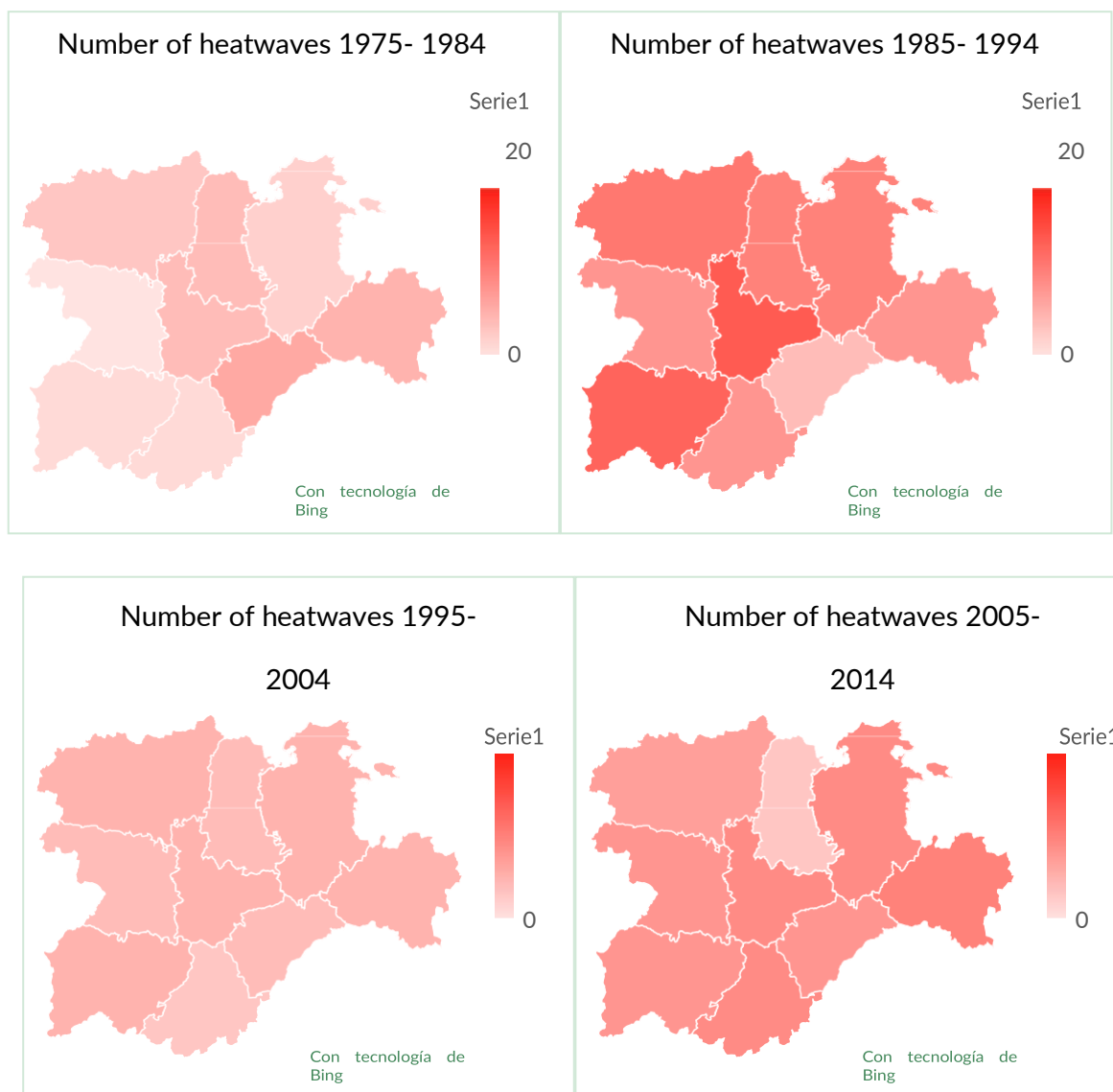
Duration of heatwaves by Province	Between 1975 and 1984	Between 1985 and 1994	Between 1995 and 2004	Between 2005 and 2014	Between 2015 and 2024	Total overall
Ávila	6	48	27	23	138	242
Burgos	8	50	39	36	106	239
León	15	52	39	26	142	274
Palencia	16	53	35	10	138	252
Salamanca	6	63	38	34	154	295
Segovia	25	22	33	35	159	274
Soria	19	45	38	41	165	308
Valladolid	14	63	39	36	172	324
Zamora	0	43	35	35	171	284
Total overall	109	439	323	276	1.345	2.492

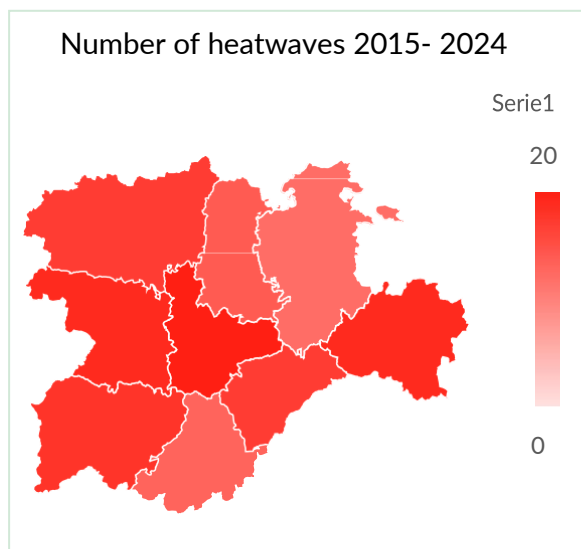
Top table: Variation of the impact of heatwaves by province and decade from 1975 to 2024. Bottom table: Cumulative duration of heatwaves for each province and decade from 1975 to 2024. Source: Own elaboration based on data from Heatwaves in Spain since 1975 – State Meteorological Agency (AEMET).

The data shows a very significant increase in both the frequency and geographical distribution of heatwaves. While only 25 events were recorded across the community in the 1975–1984 decade, this number has increased more than fivefold in the last decade (2015–2024), reaching 154 events. Provinces like Valladolid, Soria, and Salamanca stand out due to their high accumulated number, surpassing 45 heatwaves in the analysed period.

The intensity has also increased considerably, with the average duration of heatwaves per province rising from around 13 days between 1975 and 1984 to approximately 150 days in the last ten years (2015–2024).

This pattern reinforces the scientific evidence that Castile and León is experiencing a progressive tropicalization of the climate, with longer summers and more frequent thermal extremes. This type of analysis helps to more precisely guide adaptive priorities in areas such as public health, urban planning, vulnerable population protection, and critical infrastructure. It also highlights the urgency of integrating thermal risk into municipal and regional civil protection plans and the healthcare system planning.





Source: Own elaboration based on data from Heatwaves in Spain since 1975 - State Meteorological Agency (AEMET).

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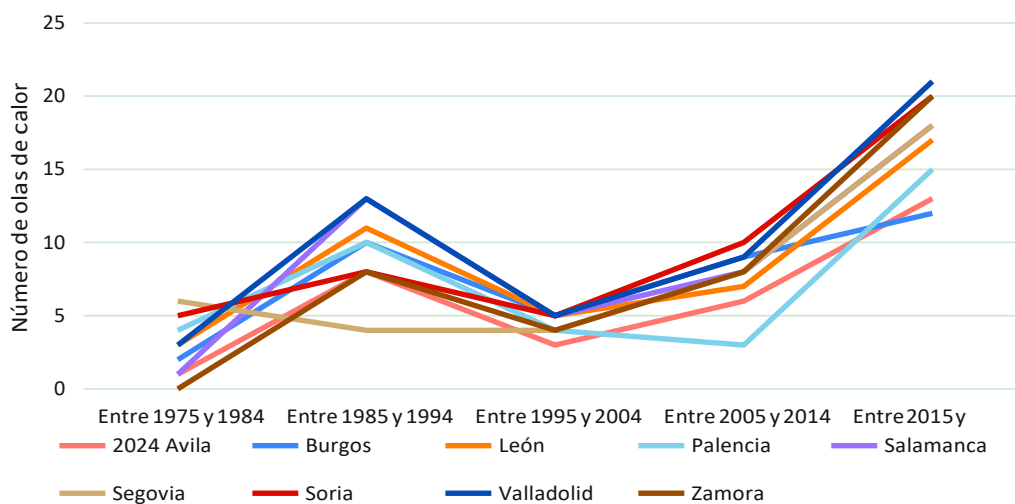
https://www.aemet.es/documentos/es/conocerlas/recursos_en_linea/publicaciones_y_estudios/estudios/Olas_calor/olas_calor_actualizacion_dic24.pdf

https://www.aemet.es/documentos/es/conocerlas/recursos_en_linea/publicaciones_y_estudios/estudios/Olas_calor/provincias_olas_calor_1975_2024.pdf

On the other hand, the evolutionary graphs are presented, allowing for a detailed analysis of the incidence of heatwaves in Castile and León during the period 1975–2024.

First, the temporal evolution of the number of heatwaves recorded by province is shown, along with the accumulated total for the entire Autonomous Community. This representation allows for the identification of both territorial differences in the frequency of these extreme events and the general trends over the long term.

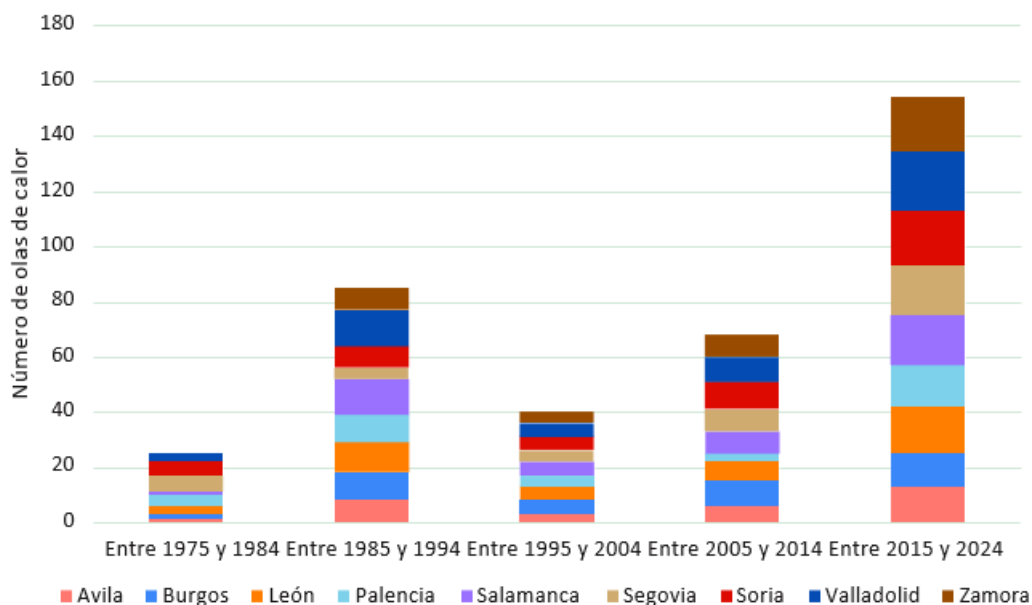
Evolution of the number of heatwaves by province from 1975 to 2024



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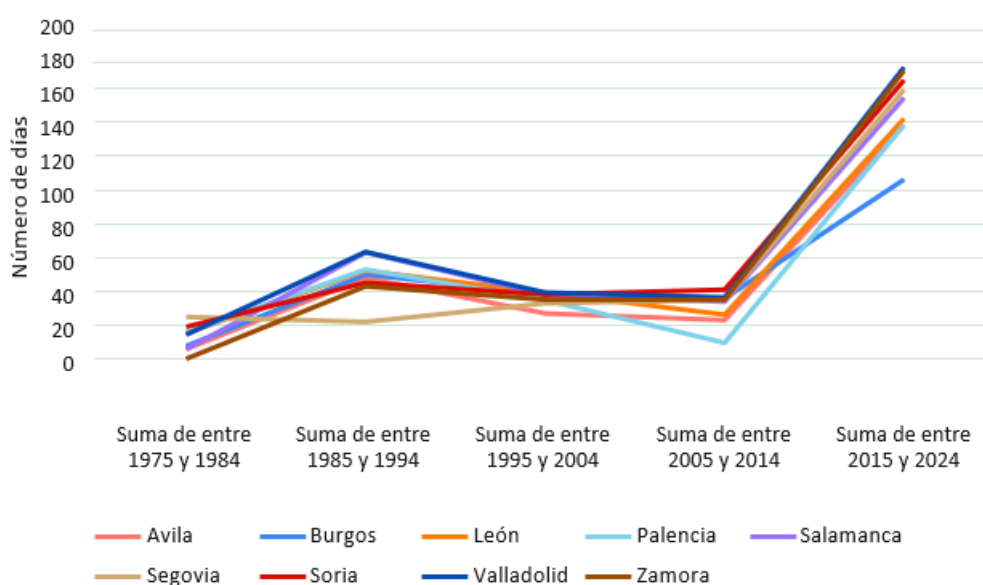
https://www.aemet.es/documentos/es/conocerlas/recursos_en_linea/publicaciones_y_estudios/estudios/Olas_calor/provincias_olas_calor_1975_2024.pdf

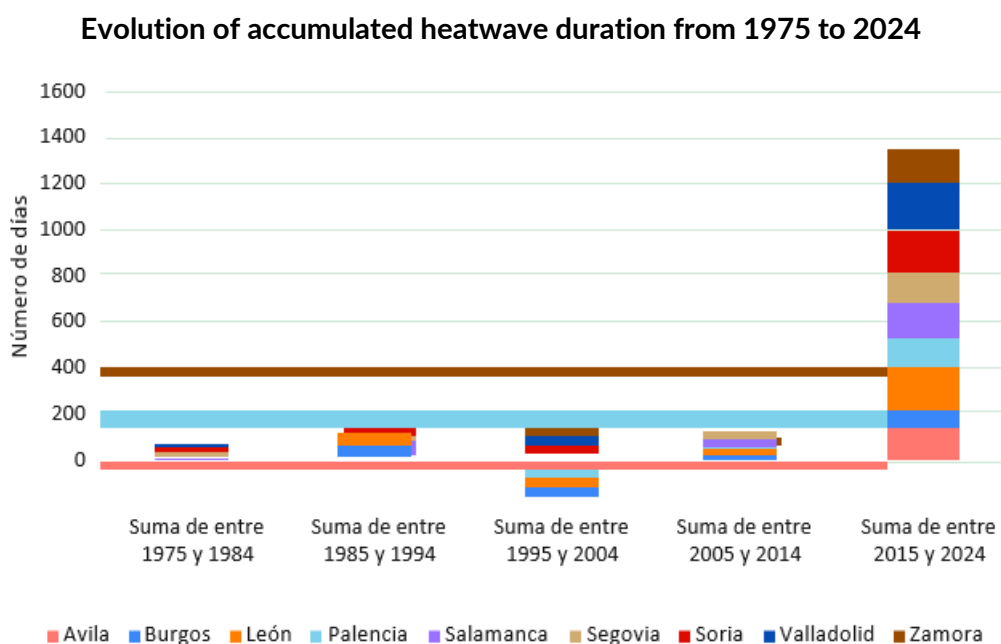
Evolution of the accumulated number of heatwaves from 1975 to 2024



Secondly, the evolution of the duration of the heatwaves is presented, expressed as the total number of days per province and the regional cumulative total. This analysis is particularly relevant, as it not only reflects how many episodes occur but also their intensity and persistence over time.

Evolution of heatwave duration by province from 1975 to 2024





2.3 Climate risk assessment

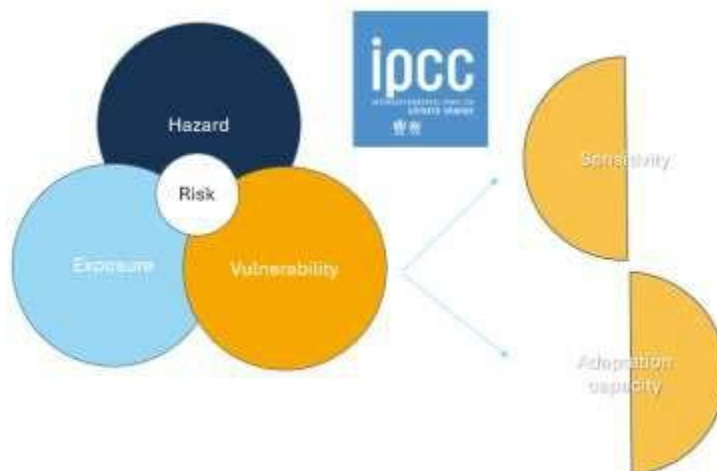
2.3.1 Methodological Approach for Climate Risk Assessment

The climate risk assessment in Castile and León is based on the **consolidated methodology** of the Intergovernmental Panel on Climate Change (IPCC), specifically the framework adopted in the Sixth Assessment Report (AR6). In this framework, **climate risk is defined as the result of the interaction between three key components**: climate hazard, exposure, and vulnerability.

This integrative approach of the IPCC methodology allows not only for identifying the areas and sectors most threatened but also for understanding the social, economic, and environmental factors that amplify or mitigate the impacts of climate change. The components are understood as follows:

- **Hazard**: Refers to the possible occurrence of physical phenomena (extreme weather events, long-term climate trends, or other processes associated with climate change) that can cause damage. It includes both **sudden events** (e.g., heatwaves) and **chronic pressures** (e.g., increased average temperatures, progressive reduction of water resources).
- **Exposure**: Represents the presence of people, infrastructure, economic activities, ecosystems, or cultural heritage in areas that may be affected by climate hazards. The greater the concentration or relevance of the exposed elements, the higher the potential risk.
- **Vulnerability**: Expresses the degree to which a system may be negatively affected, based on two key subcomponents:
 - **Sensitivity**: The level of fragility or intrinsic susceptibility of the exposed system to a climate hazard. It is related to the **importance** (social, ecological, economic) and the degree of deterioration, fragility, or dependence on the climate.

- **Adaptive Capacity:** The set of resources, knowledge, infrastructure, institutions, and social networks that allow a system to anticipate, absorb, respond to, and recover from climate impacts. The higher the adaptive capacity, the lower the effective vulnerability.



Risk components according to IPCC. Source: own elaboration.

To characterize these components, a rigorous exercise of **identification, selection, and systematization of indicators** has been developed through a preliminary phase of mapping relevant information sources. The selection of indicators has been based on criteria such as:

- Total coverage of the territory of Castile and León.
- Relevance and direct connection with climate risk factors.
- Availability of recent, reliable, and verifiable data.
- Ability to show significant territorial gradients (i.e., showing spatial differences).
- Possibility of assigning normalized and comparable values at the municipal level.

The selected indicators have been classified by component (hazard, exposure, sensitivity, and adaptive capacity), assigning ordinal values between 0 and 3 according to the level of impact (low, medium, high). Subsequently, a quantitative climate risk assessment model by municipality was built using the following formula:

Risk = A × E × V, where: V = (S – CA)

- A (Hazard) = values from 1 to 3
- E (Exposure) = values from 0 to 3
- S (Sensitivity) = values from 2 to 3
- CA (Adaptive Capacity) = values from 0 to 1

The result of the calculation provides numerical values ranging from 1 to 27. To facilitate communication and territorial comparison, these values have been transformed into a scale from 0 to 10 using a reclassification by percentiles in a GIS environment. This conversion ensures a proportional distribution of municipalities across the different risk levels, overcoming the bias of accumulation of low values in the original distribution.

This approach allows for spatial representation of the aggregated risk for each of the assessed climate hazards, facilitating its interpretation and prioritization. It also lays the technical groundwork for designing focused, effective, and territorially coherent adaptation strategies.

2.3.2 Climate Risk Assessment Results

The analysis is structured according to the main sectoral risks identified for Castile and León, enabling an integrated and territorialized assessment that will serve as the basis for prioritizing adaptation measures. The risks are ranked starting from those related to the direct effects of hazards, namely:

- Increased flood risk,
- Increased wildfire risk,
- Decreased water resources.

These are followed by horizontal or sectoral impact risks, including:

- Increased impacts on human health,
- Loss of ecosystem services,
- Loss of agricultural and livestock productivity,
- Impacts on tourism and cultural heritage,
- Damage to infrastructure.

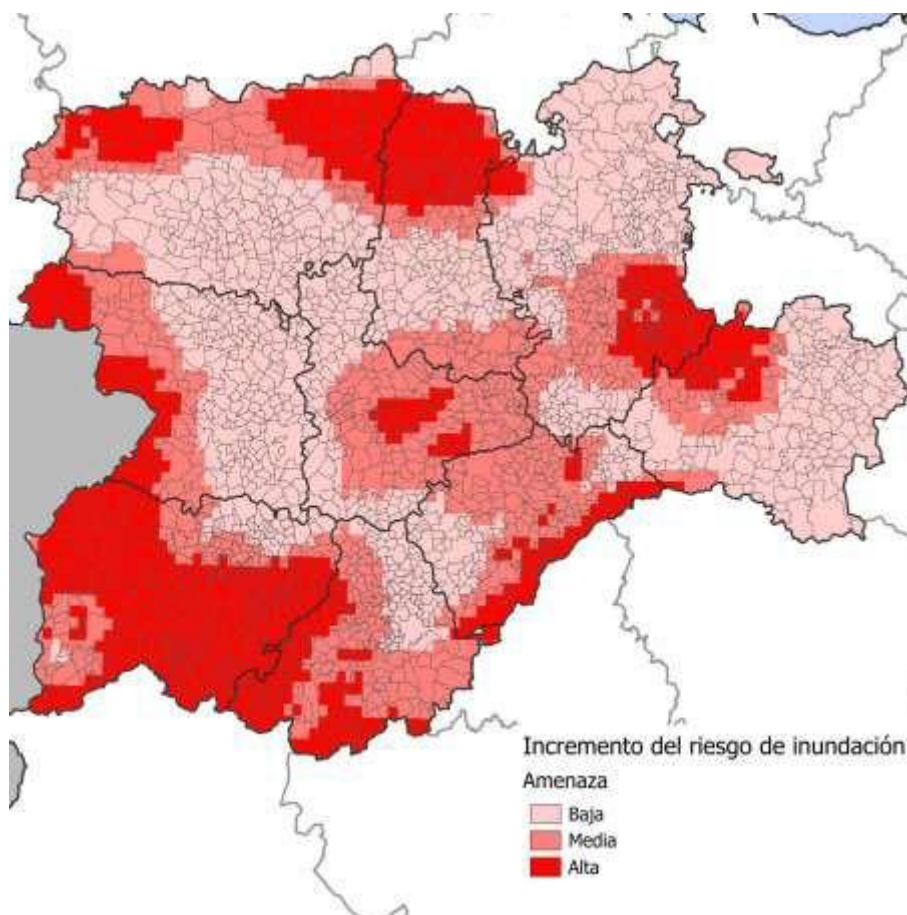
2.3.2.1 Increased Flood Risk

Changes in the regime of abundant and extreme precipitation contribute to peak river flows that can affect infrastructure and buildings. Additionally, the loss of infiltration capacity due to increased impermeable areas and the rising aridity generates changes in runoff.

Hazard Indicators:

- Maximum precipitation in 24 hours
- 95th percentile of daily precipitation
- Maximum number of consecutive wet days
- Maximum accumulated precipitation over 5 days

The hazard indicators have been developed through GIS analysis using maps available in AdapteCCa, which integrate data from projections on a 5 km grid obtained through statistical regionalization from the latest generation of global climate models (CMIP6). For their development, the data on the increase relative to the baseline period 1971-2000 was projected for the medium scenario (2041-2070) under a high emissions scenario (SSP5-8.5 in CMIP6 / RCP-8.5 in CMIP5).



Hazard component for the increased flood risk

The climate hazard associated with the risk of flooding has been assessed using variables that reflect the intensification of extreme precipitation events, which can lead to a significant increase in river and stream flows, as well as rapid water accumulation in urban or rural areas.

According to climate projections, it is expected that the 95th percentile of daily precipitation will remain relatively constant in Castile and León. However, other key indicators such as maximum precipitation in 24 hours, the maximum number of consecutive wet days, and the maximum accumulated precipitation over 5 days show an increasing trend, indicating an increase in more intense and concentrated torrential rainfall events.

Incorporating these combined indicators into the hazard analysis allows for a more accurate identification of the areas most likely to be affected by intense rainfall in the future.

Exposure

- ✓ Flood exposure map for the population
- ✓ Flood exposure map to economic activity

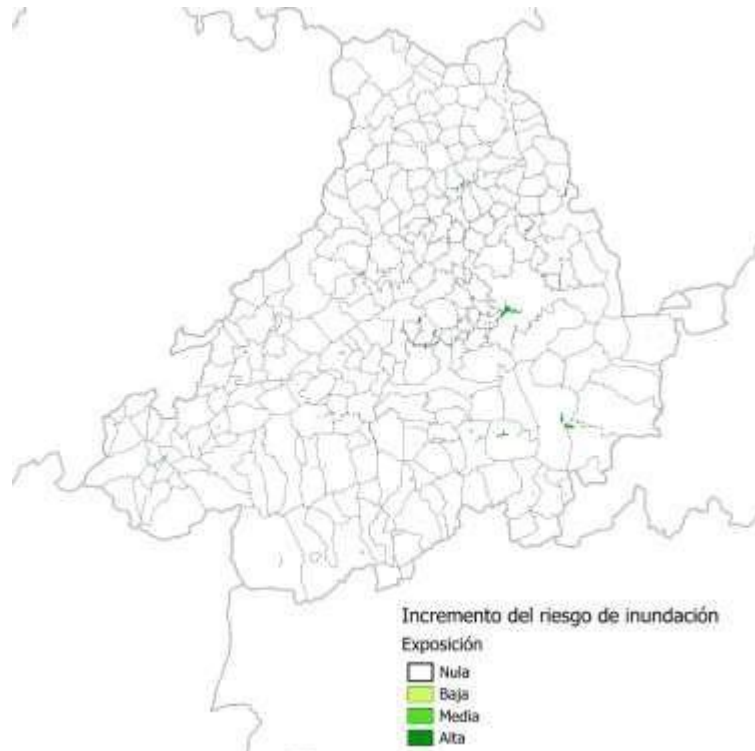
Source: Ministry for the Ecological Transition and the Demographic Challenge

The exposure maps show the number of people who could be affected in the event of a flood and the economic areas that may be impacted in a 500-year return period.

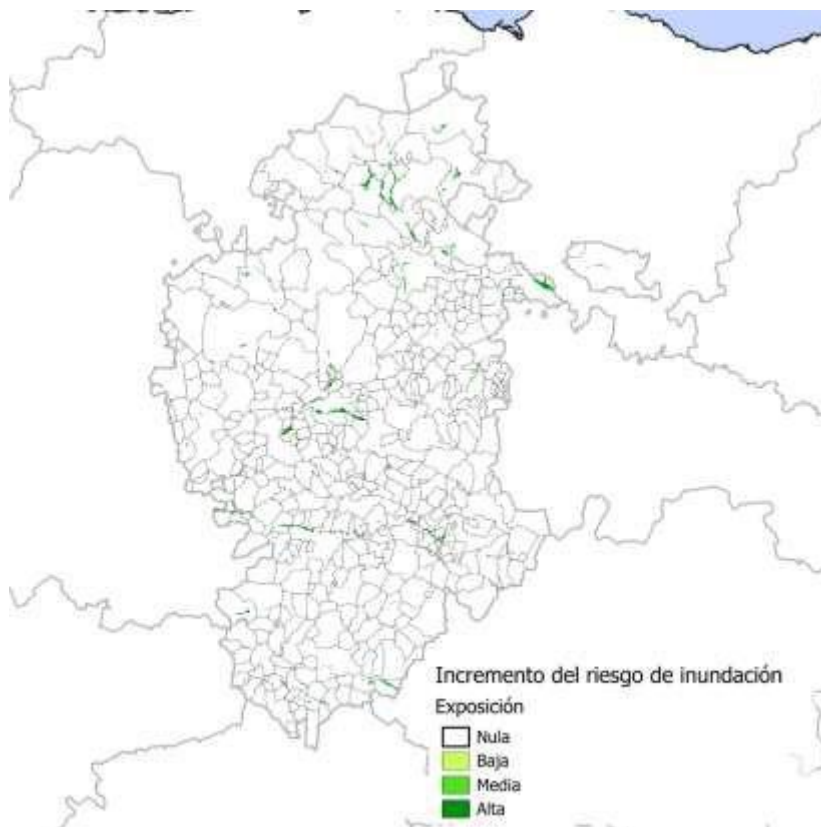
To assess flooding, it was relevant to ensure that the population and economic activities considered exposed are actually located within flood-prone areas. At the exposure level, an area with high population density or economic activity should not be considered exposed if it

is not in a potentially floodable area. Therefore, an area with high population density or a significant concentration of economic activity is not classified as exposed unless it coincides with a flood-prone area. Only areas where both factors (exposed elements and floodable areas) overlap are classified as exposed to risk.

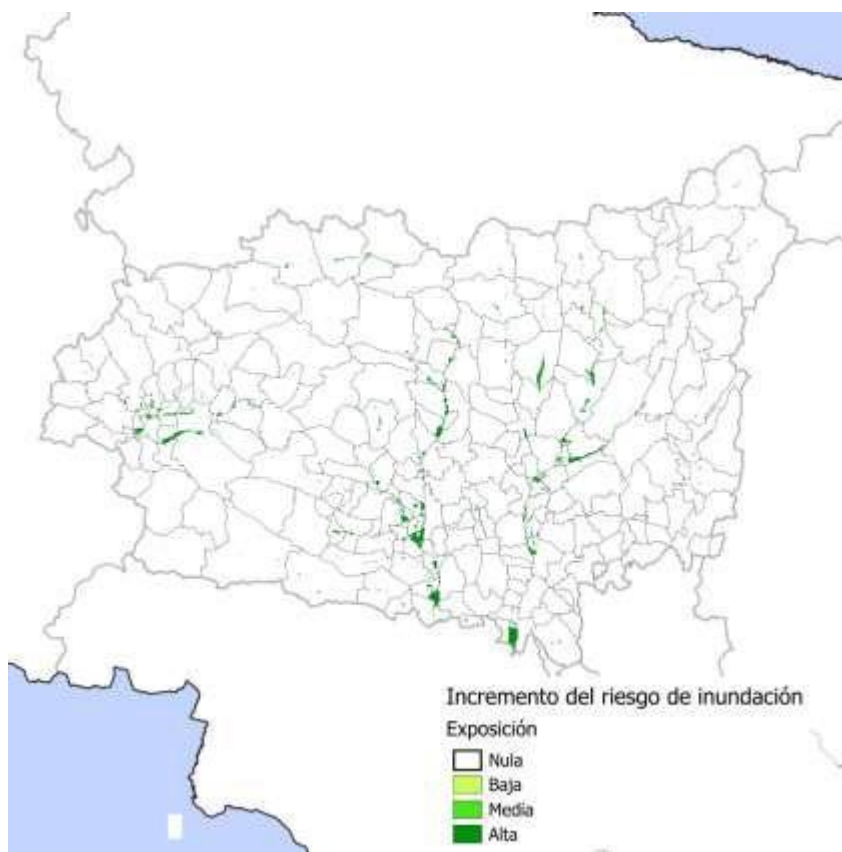
Finally, the map has been expanded at the provincial scale to facilitate the visualization and understanding of the resulting cartography.



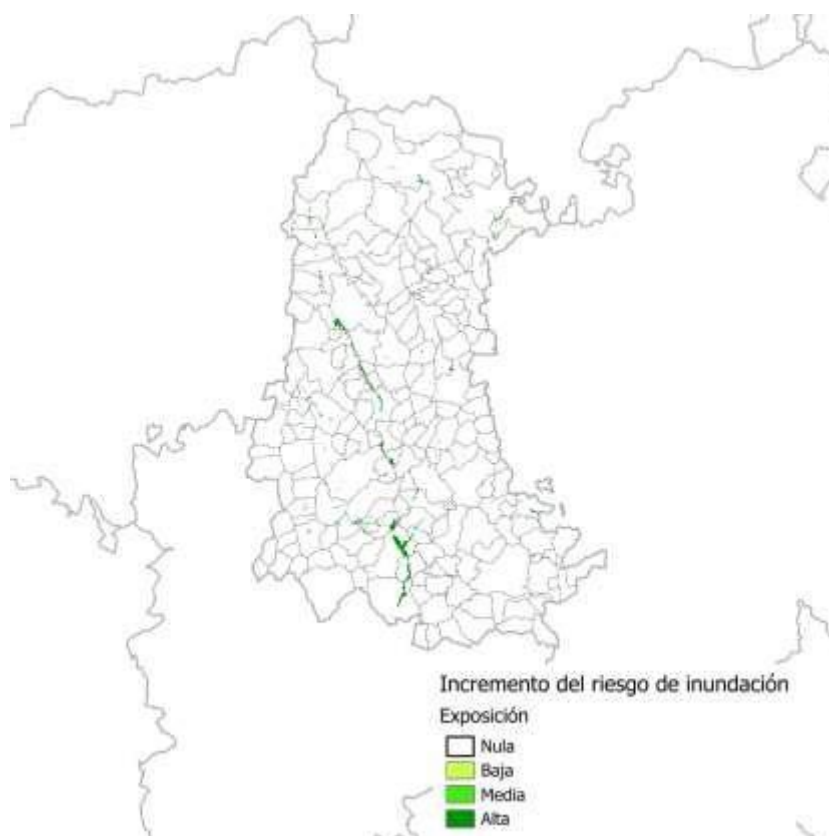
Exposure component for the increased flood risk in Avila



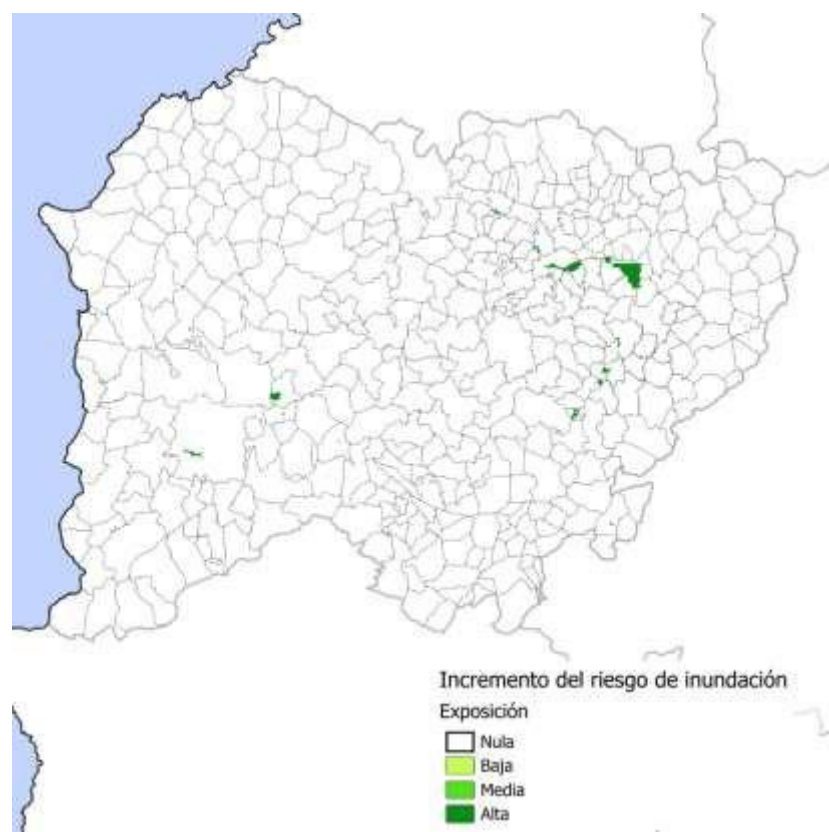
Exposure component for the increased flood risk in Burgos



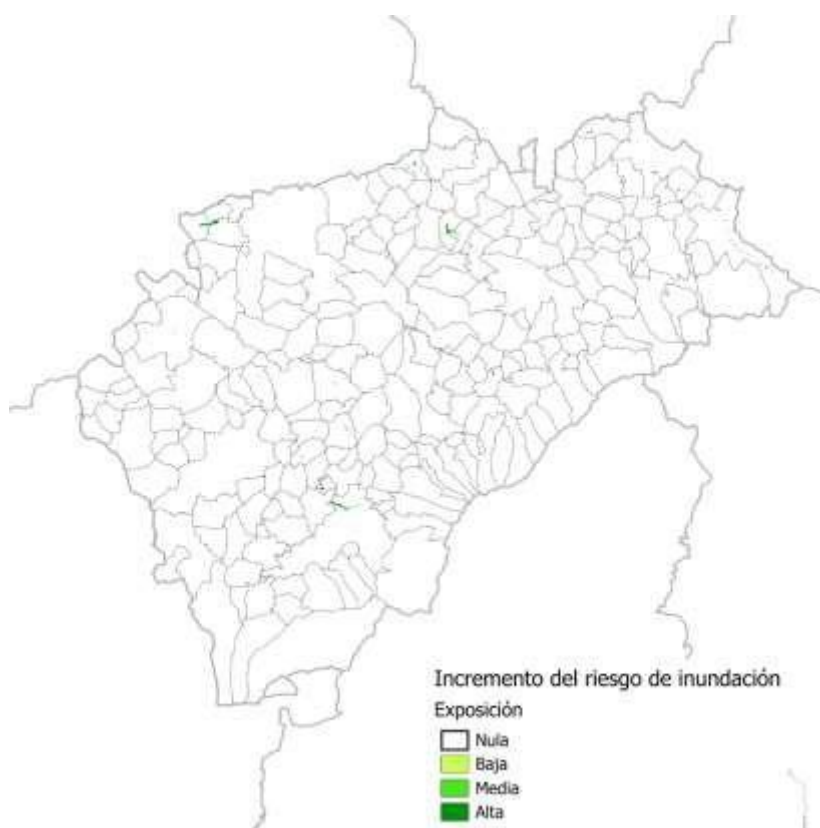
Exposure component for the increased flood risk in León



Exposure component for the increased flood risk in Palencia



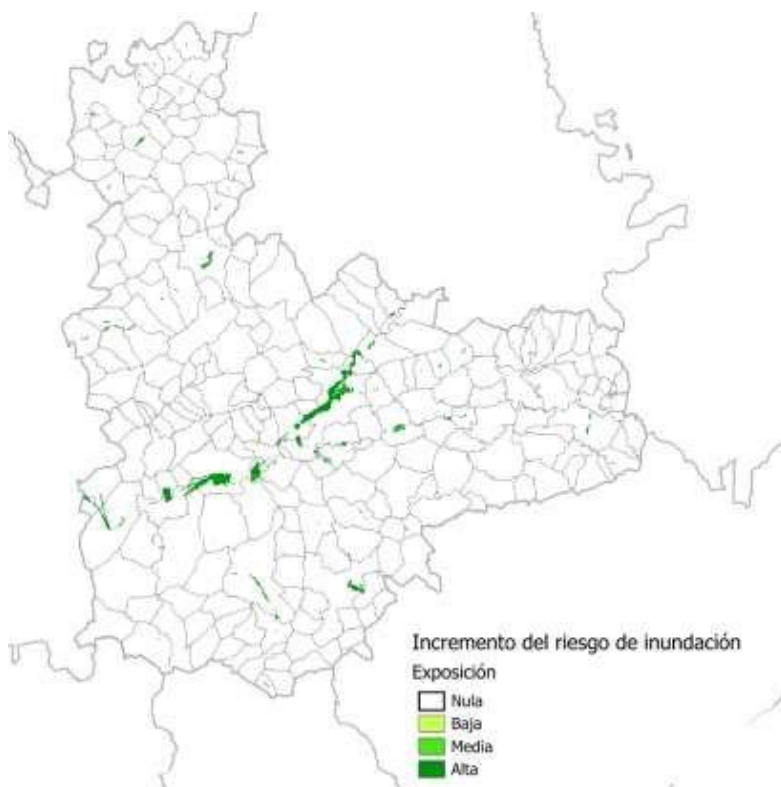
Exposure component for the increased flood risk in Salamanca



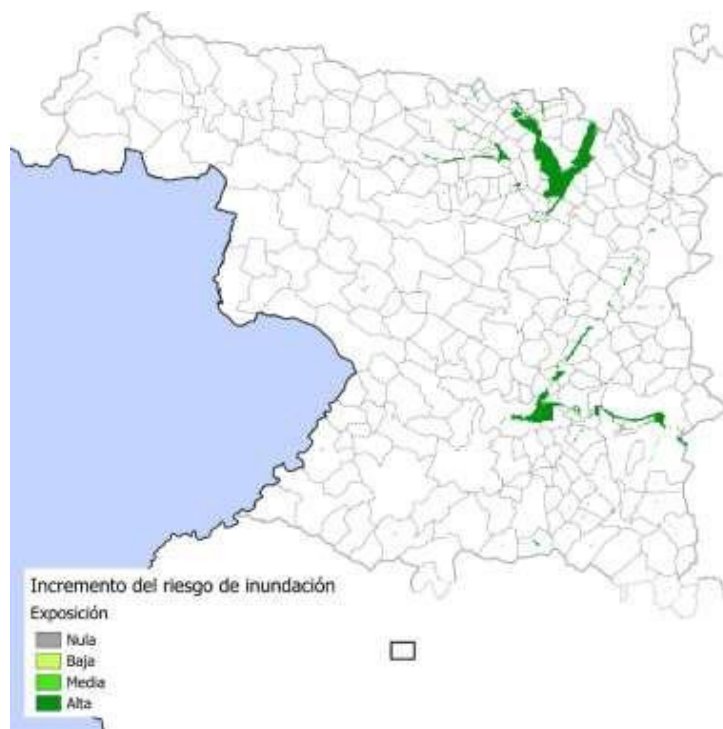
Exposure component for the increased flood risk in Segovia



Exposure component for the increased flood risk in Soria



Exposure component for the increased flood risk in Valladolid



Exposure component for the increased flood risk in Zamora

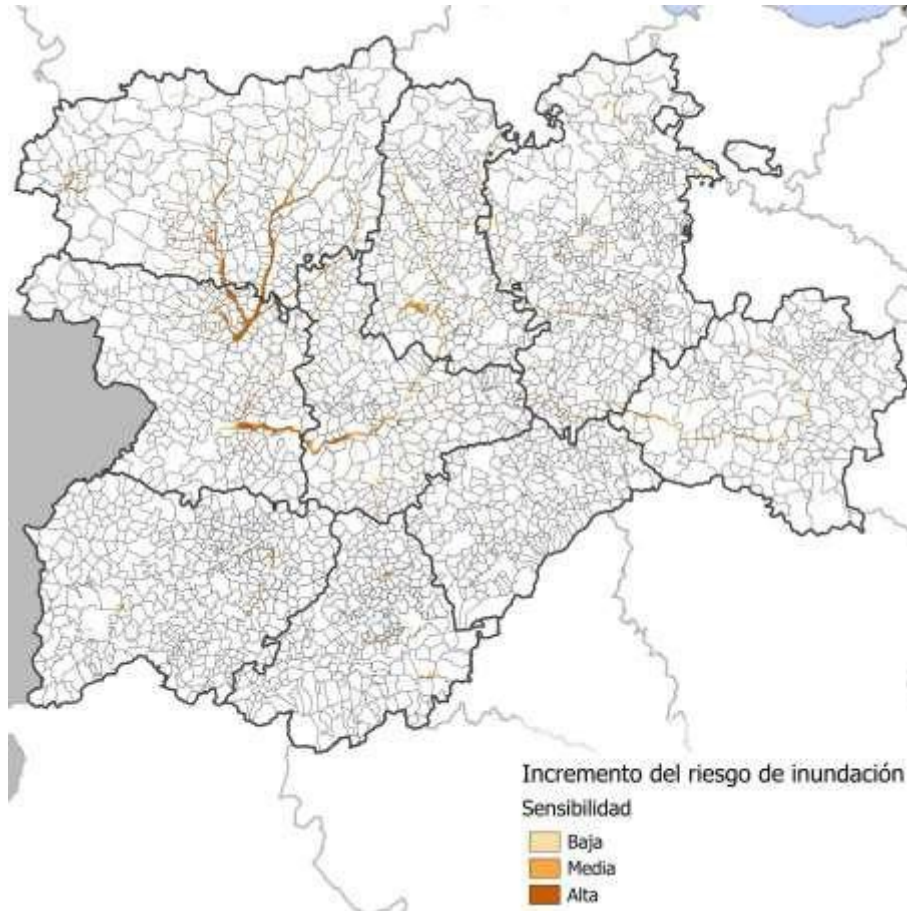
The provinces with the most exposed areas would be Zamora and Valladolid, followed by Burgos, León, Palencia, Soria, and Salamanca.

Sensitivity

✓ Flood-prone areas

Source: MITECO – Flood-prone areas associated with return periods

Sensitivity to flood risk has been assessed based on flood-prone zones associated with different return periods, taking into account the likelihood of river flood events. The following classification has been established: low sensitivity: areas with a low or exceptional probability of flooding (return period of 500 years); medium sensitivity: areas with a moderate probability of flooding (return period of 100 years); high sensitivity: areas with a high probability of flooding (return period of 10 years), meaning those with the greatest expected frequency of river flood events.



Sensitivity component for the increased flood risk

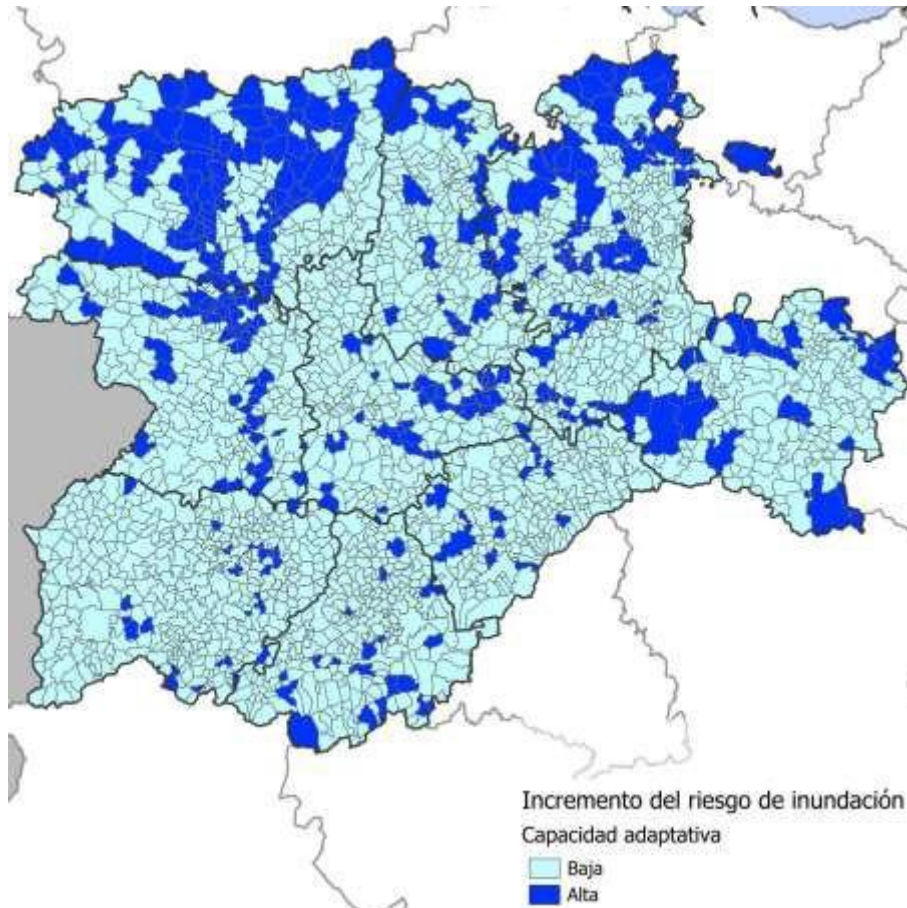
This categorization allows for the prioritization of areas most vulnerable to potential flood events, taking into account the frequency with which they could be affected.

The areas with the highest sensitivity are mainly concentrated along the Duero River sections between Zamora and Valladolid, as well as in the basins of the Órbigo, Esla, and Cea rivers. The Tormes River area, particularly its middle and lower course, is also noteworthy.

Adaptive Capacity

✓ Local flood risk response guidelines

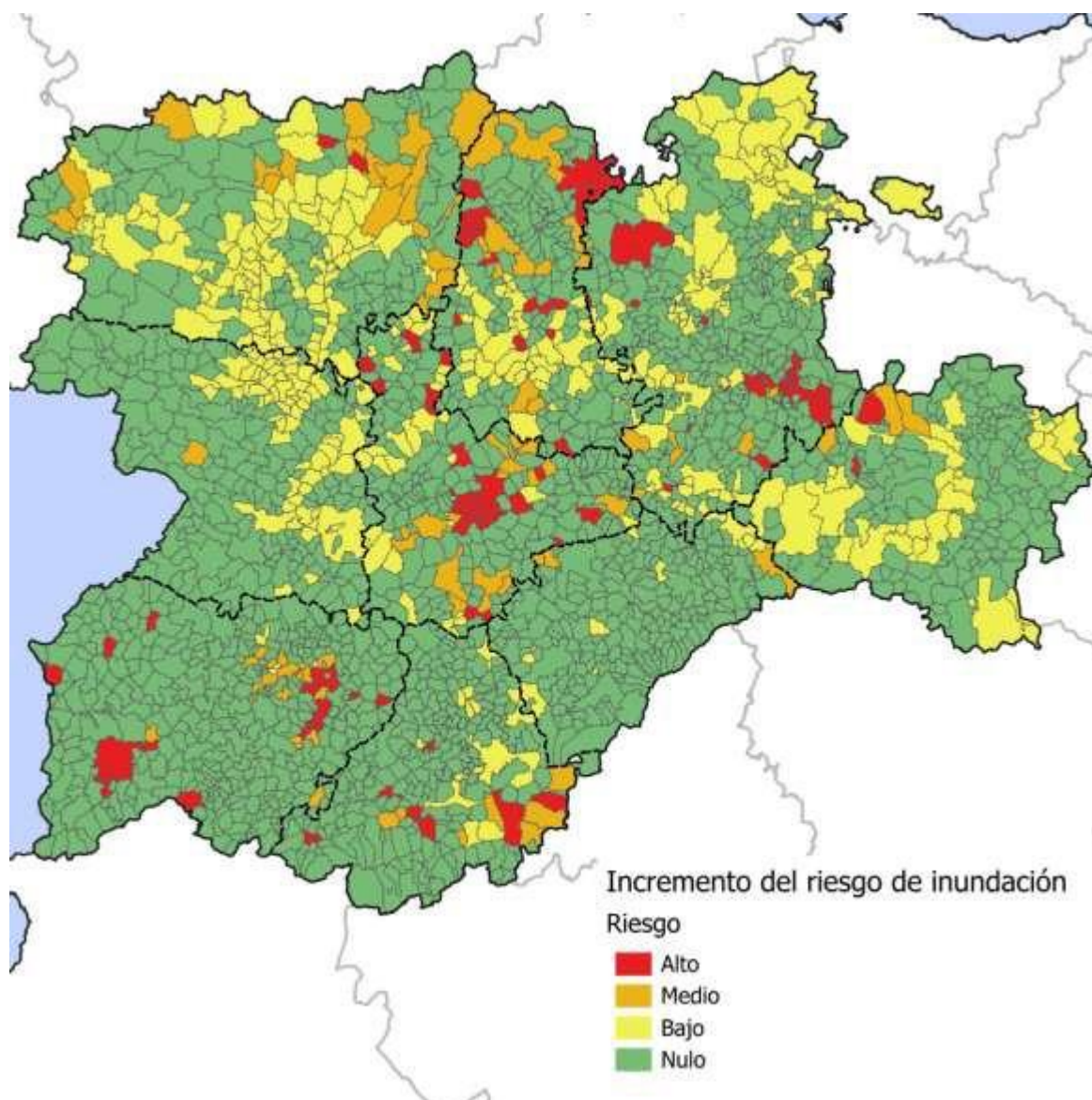
This layer is based on a binary value indicating the existence of a flood response guideline in each municipality. Municipalities with such a guideline are considered to have high adaptive capacity, while municipalities without one are classified as having low adaptive capacity.



Adaptive capacity component for the increased flood risk

The provinces with the highest adaptive capacity are those that have a greater number of municipalities prepared with a flood response guideline, such as León, Zamora, Burgos, and Soria.

Identification of the Most Vulnerable Areas to Risk



Most vulnerable areas to flood risk

The final flood risk map has been created by integrating the different components that determine the risk: hazard, exposure, sensitivity, and adaptive capacity. The overlay of selected indicators for each of these components allows the construction of intermediate maps, which when combined result in the global risk map.

To ensure adequate representativeness across the entire Autonomous Community, it was decided to mark the entire municipality as affected when any of its areas present flood risk, even though in practice only certain municipal zones are truly exposed. This is because both direct impact (impact on population, infrastructure, or agricultural land) and adaptive capacity (economic, institutional, or service resources available) are activated and managed effectively at the municipal level. This approach also reflects the strategic vision sought in a regional-scale analysis.

To facilitate the visualization of results, the final raster was exported to polygon format, assigning each municipality the highest risk value among the pixels falling within its territory. Municipalities where no risk pixels were identified were classified as having zero risk.

The spatial analysis shows that the areas most affected by this risk are mainly located along specific river stretches and their tributaries:

- León Province: northern stretch of the Esla River.
- Palencia Province: Carrión and Pisuerga Rivers.
- Burgos Province: course of the Arlanzón River.
- Valladolid Province: areas adjacent to the Arlanzón River and in the valleys of the Esgueva, Sequillo, and Valderaduey Rivers.
- Salamanca Province: several stretches of the Tormes River present significant risk, as well as some areas of the Águeda River.
- Ávila Province: Adaja River stands out as the main risk axis.
- Other areas with lower risk include the Duero River in Soria, Riaza River in Segovia, and stretches of the Elsa and Valderaduey Rivers in Zamora.

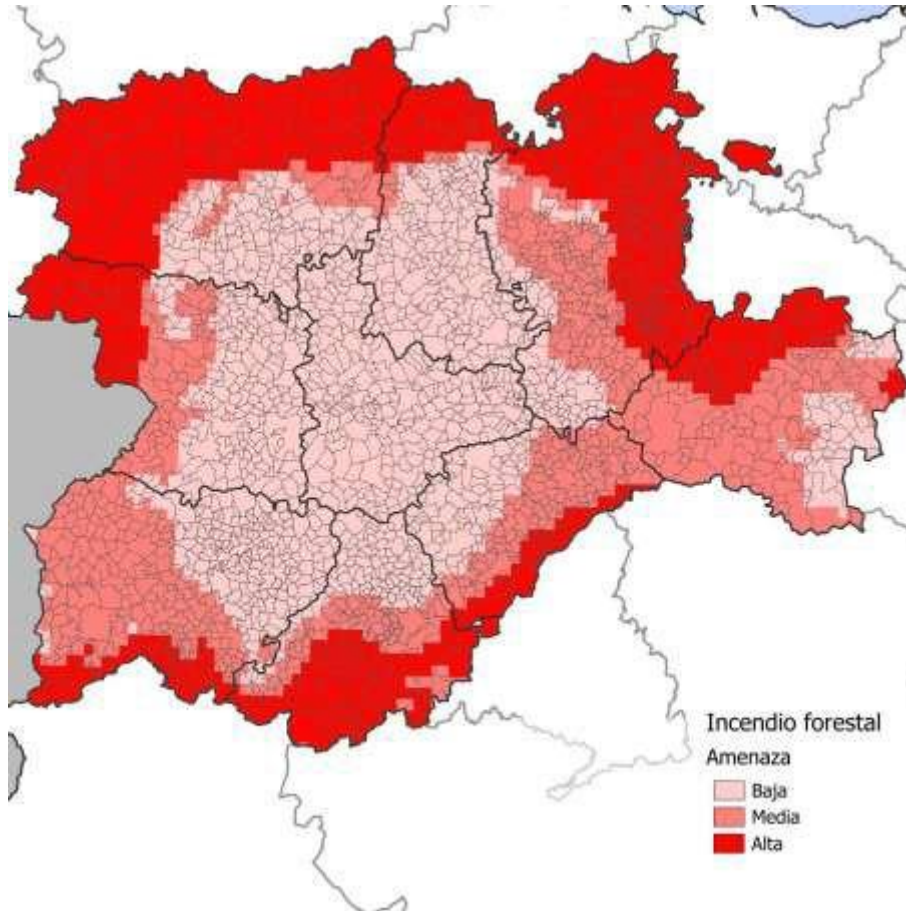
2.3.2.2 Increased Wildfire Risk

The variability in precipitation, temperature changes, wind propagation speed, and drought can lead to a loss of fuel moisture, favouring ignition potential and degrading the landscape.

Hazard

- ✓ Maximum temperature
- ✓ Precipitation
- ✓ Number of rainy days
- ✓ Number of days with precipitation < 1mm

The hazard indicators have been developed through GIS analysis using maps available in AdapteCCa, which integrate data from 5 km grid projections obtained through statistical regionalization from the latest generation of global climate models CMIP6. For their development, data on the increase compared to the baseline period 1971-2000 have been projected for the medium scenario (2041-2070) under a high emissions scenario (SSP5-8.5 in CMIP6 / RCP-8.5 in CMIP5).



Hazard component for the increased wildfire risk

The risk of wildfires is closely related to climatic conditions that affect the availability of moisture in vegetation and its flammability. Key determinants include the increase in maximum temperatures, the reduction in total annual precipitation, the decrease in the number of rainy days, and the increase in days with precipitation less than 1 mm.

For this analysis, annual projections have been used, as the risk is not limited only to the summer months, but can manifest throughout the year depending on the accumulation of favourable conditions over time.

Although the wind variable could not be added to the mapping, it is a significant threat that will directly influence the propagation and intensity of fires. It is interesting to continue monitoring historical wind trends and examine whether the likelihood of intensification with climate change will increase, something that should be considered in future studies. Even moderate gusts can accelerate the advance of the flames, hinder extinguishing efforts, and increase the area burned. Furthermore, gusts carry incandescent material over distances, which favours the formation of secondary fire spots. Therefore, although wind may not cause direct damage by itself, it acts as an amplifier of the threat in wildfires.

Exposure

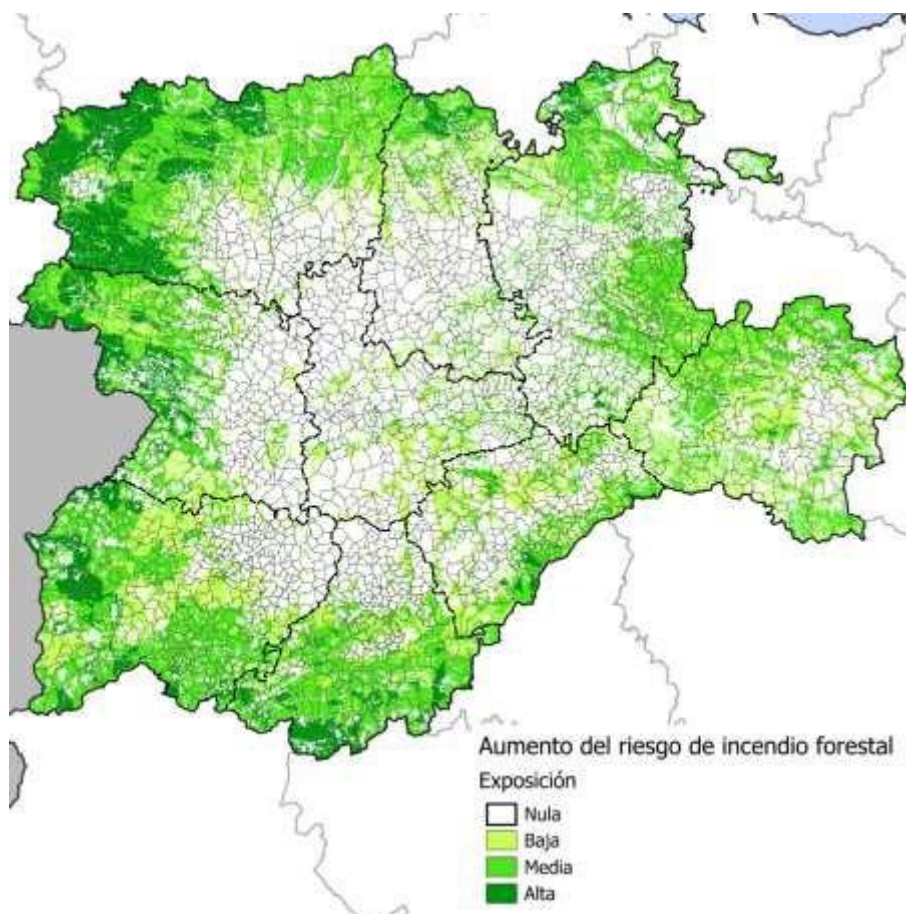
✓ Wildfire risk areas

Source: Open data from Castile and León – Annual Plan 2025. Wildfire risk areas

Castile and León has the Annual Prevention, Surveillance, and Extinction Plan for Forest Fires 2025, where they have developed the map of wildfire risk areas resulting from the cross-referencing of the most fire-prone areas of the territory with regions that have the highest fire propagation² and consolidation³ potential. The frequency of wildfires in the previous decade is also considered in this calculation.

These areas are classified as:

- High-risk areas, where high exposure has been determined.
- Medium-risk areas, where medium exposure has been determined.
- Low-risk areas, where low exposure has been determined.



Exposure component for the wildfire risk

² La propagación, indica la capacidad de avance de un incendio, se determina a partir de la combustibilidad de la vegetación, la pendiente y la exposición

³ La consolidación, indica las zonas donde un incendio puede alcanzar mayores intensidades es calculada a partir de la productividad y la sequía estival.

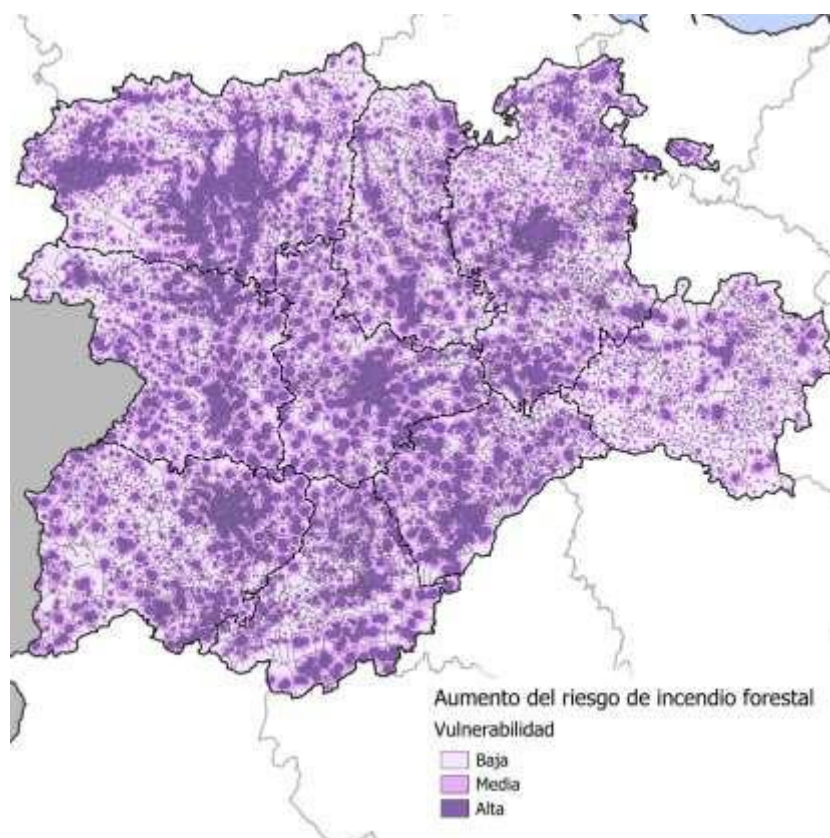
Since this is a map already extensively worked with available recent information, it will be the resource used to describe the exposure. Essentially, this map reflects the forest areas potentially affected, which are concentrated in the peripheral areas of Castile and León. In contrast, the eastern part of the region stands out as the area with the lowest level of exposure.

Vulnerability = Sensitivity + Adaptive Capacity

From the exposure map, the most affected forest areas were identified. However, exposure did not account for the interaction or impact that these areas could have when in contact with populations or other economic sectors. Therefore, a vulnerability component has been incorporated, combining both sensitivity and adaptive capacity information.

For its evaluation, two key factors were considered: the population size of the inhabited areas and their proximity to the exposed forest zones. First, the population size was classified into three categories: low (<100 inhabitants); medium (100–200 inhabitants); high (>200 inhabitants). Based on this classification, vulnerability was defined according to the distance to the exposed area, establishing the following thresholds:

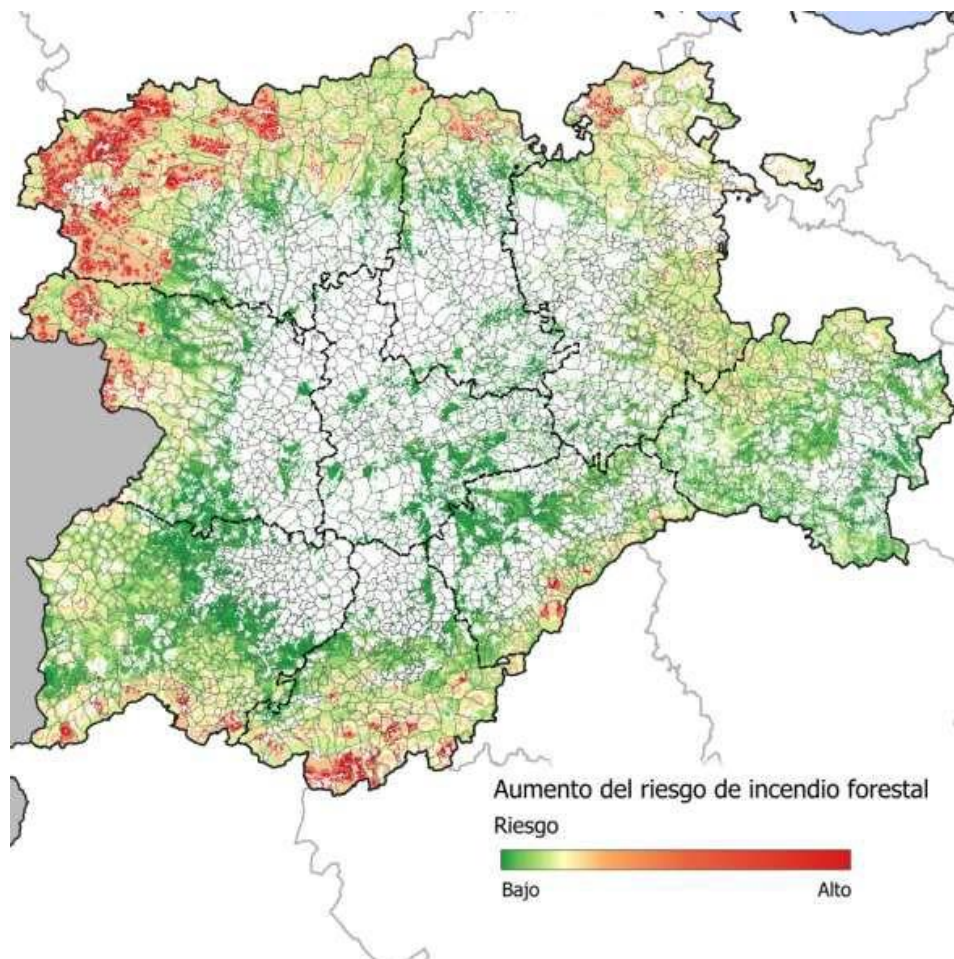
- In low population areas, high vulnerability is considered if the settlement is less than 500 meters from an exposed forest zone, and medium vulnerability if it is between 500 meters and 1000 meters.
- In medium population areas, high vulnerability is considered if it is less than 1000 meters, and medium vulnerability if it is between 1000 meters and 2000 meters.
- In high population areas, high vulnerability is considered if the distance is less than 2000 meters, and medium vulnerability if it is between 2000 meters and 4000 meters.
- In cases where multiple areas of different vulnerability overlap, the highest vulnerability value among those present has been assigned. All areas that do not meet the above criteria have been assigned low vulnerability.



Vulnerability component, aggregated sensitivity and adaptive capacity for wildfire risk

- High population areas tend to have greater adaptive capacity in terms of services and resources, but they also exhibit greater sensitivity due to their higher density and the concentration of assets, vulnerable people, and economic activities.
- Therefore, for the same distance to an exposed forest area, a smaller population will be more vulnerable, as it has fewer resources to anticipate, respond to, and recover from events like wildfires. In this way, vulnerability in these areas is considered high even at shorter distances, while in larger municipalities, with better response capabilities and support networks, the same vulnerability applies at greater distances, when the potential impact magnitude is higher.
- In the **vulnerability map**, a relationship is observed with the areas of higher population density based on the different **buffers** (influence radii) applied. However, no significant homogeneous trend is evident across the entire territory of **Castile and León**. The vulnerability distribution follows a heterogeneous pattern across provinces.

Identification of the Most Vulnerable Areas to Risk



The final wildfire risk map has been developed by integrating the various components that determine it: hazard, exposure, sensitivity, and adaptive capacity. The overlay of the selected

indicators for each of these components allows for the creation of intermediate maps, which, when combined, result in the overall risk map.

The final wildfire risk map shows a high impact primarily in the peripheral areas of Castile and León. The northwest of the region stands out, with large areas of high risk in the province of León and the northern area of Zamora. High-risk areas are also identified in the south of Salamanca and Ávila, as well as in the area bordering the city of Segovia.

In the province of Burgos, the areas near the municipalities of Soncillo and Espinosa de los Monteros show a high-risk level. In Palencia, the greatest impact is found around the Montaña Palentina Natural Park.

2.3.2.3 Decrease in Water Resources

This risk description has been addressed qualitatively, as there are currently no specific mappable indicators for exposure, sensitivity, and adaptive capacity that allow for a quantitative evaluation like the one done for other risks.

Hazard

Castile and León, in terms of hazard, will experience changes in precipitation patterns, a decrease in water contributions to river and underground systems. In the recent period (2017-2023), Castile and León has experienced a sequence of dry years. In particular, the drought of 2017 was particularly intense and prolonged, severely affecting Castile and León and the entire Duero River basin. Later, in 2021 and 2022, precipitation levels were again below average, with a 23% reduction in 2022 compared to the usual average, consolidating one of the driest years in the last decade. During the 2022-2023 hydrological year, the contributions to the Duero reservoirs were 18% lower than the average of the last 25 years (415 hm³ versus the historical average of 1,006 hm³), according to data from the Desembalse Commission⁴.

Exposure

These declines in precipitation patterns have directly impacted water availability for human consumption, as well as for dryland and irrigated agriculture, causing increasing pressure on surface and groundwater resources. The main consequences of this phenomenon include alterations in natural vegetation, reduced infiltration, increased surface runoff, biodiversity loss, as well as significant economic and social impacts, particularly in sectors such as agriculture and urban water supply.

To assess the territorial impact of the reduction in water resources, it would be essential to have data on water consumption broken down by type of use (urban, agricultural, industrial) and by territorial unit (municipality). Although this information can be accessed individually through the **Duero Hydrological Confederation** viewer, it is not available in a downloadable format, which hinders its processing at the regional level.

Sensitivity

In fact, hydrogeological studies carried out in the Duero basin over the last decade confirm the overexploitation of aquifers in several areas. In particular, the overexploitation of the **Los Arenales** aquifer, which directly affects the La Moraña region (Ávila), is officially recognized,

⁴ <https://www.chduero.es/-/la-comisi%C3%B3n-de-desembalse-del-duero-aprueba-la-propuesta-de-llenado-de-los-embalses-para-el-a%C3%B1o-hidrol%C3%B3gico-2023-2024-1>

with over 6,000 wells operating, leading to water quality impacts such as the presence of arsenic or nitrates.

In terms of indicators, for the future, the capacity for storage and regulation in reservoirs and natural retention infrastructure could be added, as well as indicators of their level of use and stress, efficiency in water use across different sectors, the implementation of efficient technologies, water stress indices, and water quality parameters⁵.

Adaptive Capacity

Likewise, there is no systematic database of indicators to evaluate the adaptive capacity of territories facing a reduction in water availability. This capacity could be analysed, for example, using factors such as dependency on a single water source, the existence of alternative sources that can be activated, the percentage of losses in the water network, the implementation of control systems and remote measurement, or the existence of water efficiency plans and local drought emergency plans (mandatory for municipalities with more than 20,000 inhabitants, in addition to the establishment of Communities of Groundwater Users (CUAs) and the pond plan for extensive livestock operations). The absence of this information presents a significant barrier for the rigorous monitoring of this risk, which is identified as a priority line of work for the future.

As mentioned earlier, the lack of homogeneous and up-to-date data for many of these indicators in Castile and León prevents a complete quantitative evaluation. Therefore, the risk assessment is presented qualitatively, identifying territorial patterns and sectors most exposed. This approach will lay the foundation for future methodological improvements as more detailed statistical and cartographic information becomes available. In general terms, the expected trend for the coming decades is one of greater water scarcity, with more frequent and severe drought episodes.

2.3.2.4 Increase in Human Health Impacts

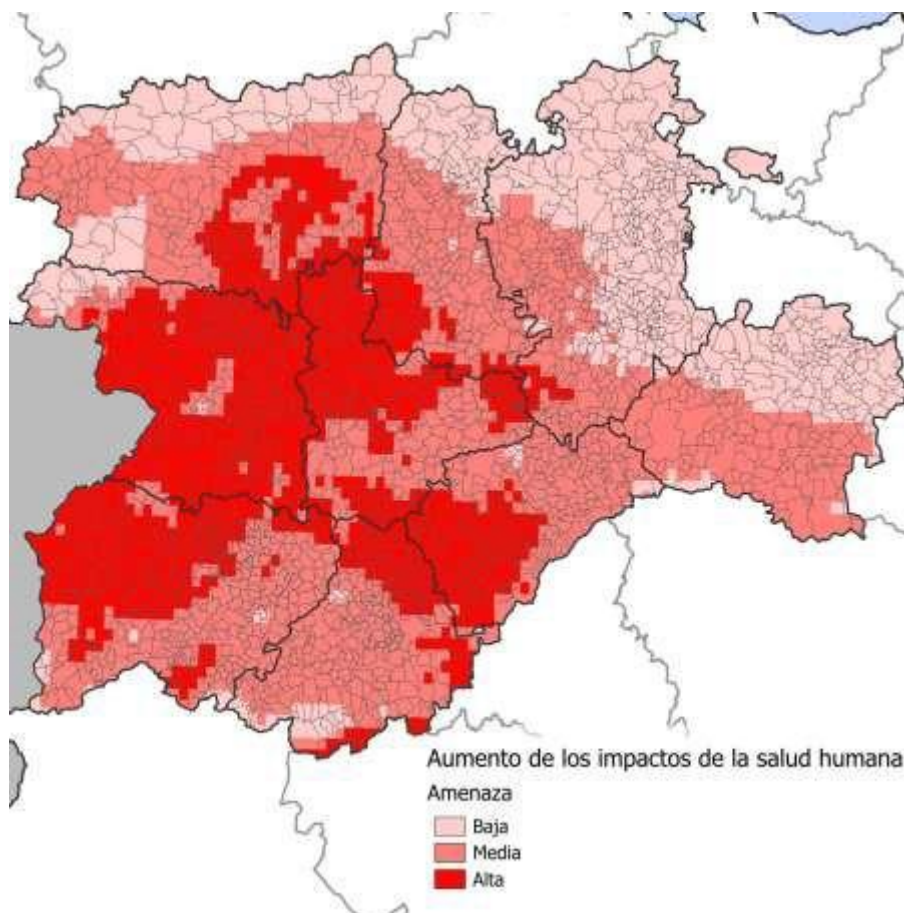
Humans are exposed to changes in climate patterns such as temperature, among other extreme phenomena that indirectly affect the quality of water, air, and the economy, and directly affect aspects such as thermal comfort, respiratory diseases, or mortality due to extreme heat episodes.

Threat

Threat indicators have been developed through GIS analysis based on maps available in AdapteCCa, which integrate data from 5 km grid projections obtained through statistical regionalization from the latest generation of global climate models (CMIP6). For their development, data from the increase relative to the base period of 1971-2000, projected for the medium scenario (2041-2070) under a high emissions scenario (SSP5-8.5 in CMIP6 / RCP-8.5 in CMIP5) have been used.

5

<https://energia.jcyl.es/web/jcyl/Energia/es/Plantilla100Detalle/1284946219078/Publicacion/1284290501655/Redaccion>



Threat component for the risk of increasing human health impacts

The rise in temperatures is the direct cause of this risk, which can have direct impacts on the health and well-being of the population. The level of climate threat associated can be linked to the occurrence of extreme situations; indicators representing maximum temperature peaks have been selected as the most appropriate variables to analyse this threat component. Specifically, the following variables have been used:

- ✓ Maximum temperature
- ✓ Extreme maximum temperature
- ✓ Number of warm days
- ✓ Number of warm nights
- ✓ Maximum duration of heatwaves

These variables allow for a more precise analysis of future extreme heat scenarios. For example, days when temperatures exceed 35°C (warm days) or nights where temperatures do not drop below 20°C (warm nights) represent conditions that can compromise health. On the other hand, dust storms (calima) should also be considered within this risk. As pointed out earlier, this is an increasing threat that, during the reference period of 2001-2023, has seen exceedances in days affected by natural dust storm events. Regarding intensity, the data also reflect a worsening, with events in 2024 showing greater severity compared to the average of recent years.

The combination of future projections of these variables has allowed for the identification of areas where the greatest projected increases in maximum temperature, greater frequency of warm days and nights, and longer durations of heatwaves coincide.

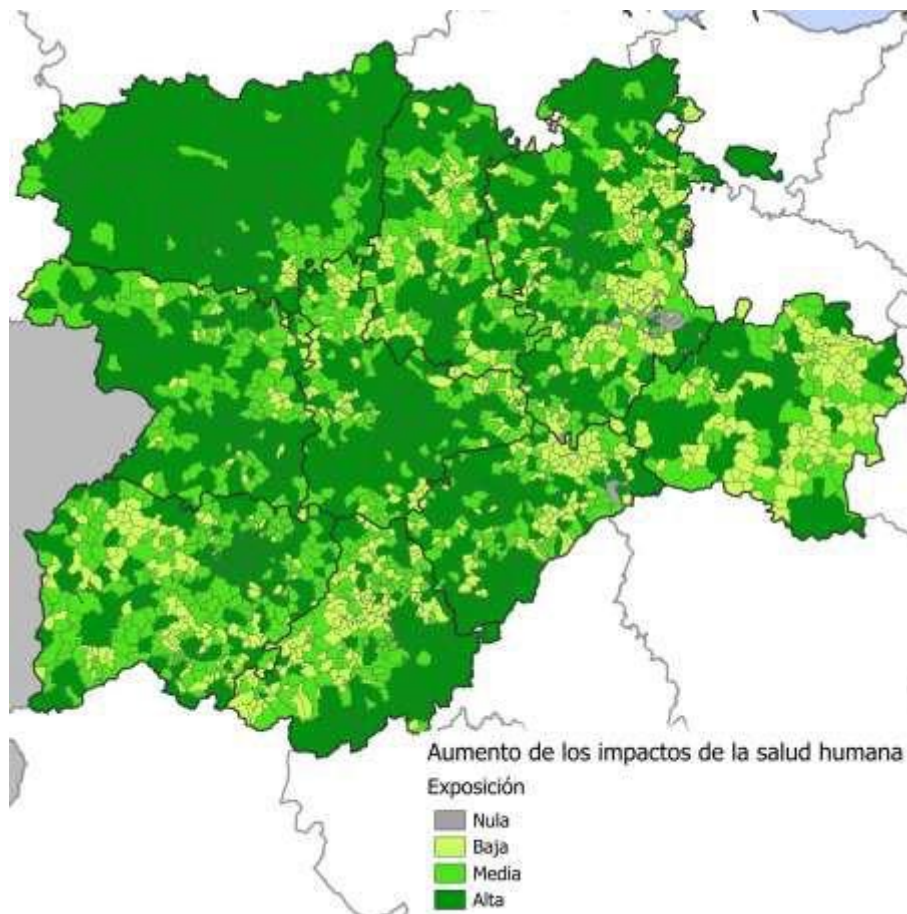
Exposure

✓ Population in 2024.

Source: IDECYL. Spatial Data Infrastructure | Junta de Castilla y León - Inhabitants 2024.

This layer allows for detailed visualization of population density in each urban polygon. It includes statistical information from the National Institute of Statistics (INE) population nomenclature represented on the geographic base of the National Geographic Institute (autonomous community, provinces, and municipalities) and the Junta de Castilla y León (population nuclei). In detail, population density has been calculated by dividing the number of inhabitants in each municipality by the actual urban area, rather than considering the total municipal area. This methodological decision is based on the fact that health impacts associated with heatwaves concentrate in urbanized areas, where the heat island effect and concentration of vulnerable populations generate higher risk. Including natural or agricultural areas in the calculation would distort the results, offering artificially low densities in large municipalities with little urban area and consequently providing an unrealistic view of population exposure. Population density helps identify the degree of population concentration in the territory, with more densely populated areas usually having higher coverage of impermeable surfaces (asphalt, buildings) and lower vegetation, which favors the formation of urban heat islands. In addition, these areas are more likely to concentrate vulnerable populations, such as the elderly or those with chronic diseases.

From this data, the polygons with population values are classified as low, medium, or high exposure, with low being in the percentile range of 0-33%, medium between 33%-66%, and high between 66% and 100%.



Exposure Component for the Risk of Increasing Impacts on Human Health

According to the analyzed data, the provinces with the highest population density in Castilla y León are Valladolid and León. In contrast, Soria, Ávila, and Zamora have notably lower densities. Salamanca, Burgos, Segovia, and Palencia present intermediate values, with similar population density levels between them.

Sensitivity

✓ Socioeconomic Profile

The socioeconomic profile of the municipalities has been determined using the Gini index, which measures the degree of income inequality. A higher Gini index indicates greater inequality, which may reflect lower community resilience to climate change impacts on health. Municipalities have been classified according to the values of the Gini index with sensitivity levels: low (0–33%), medium (33–66%), and high (66–100%).

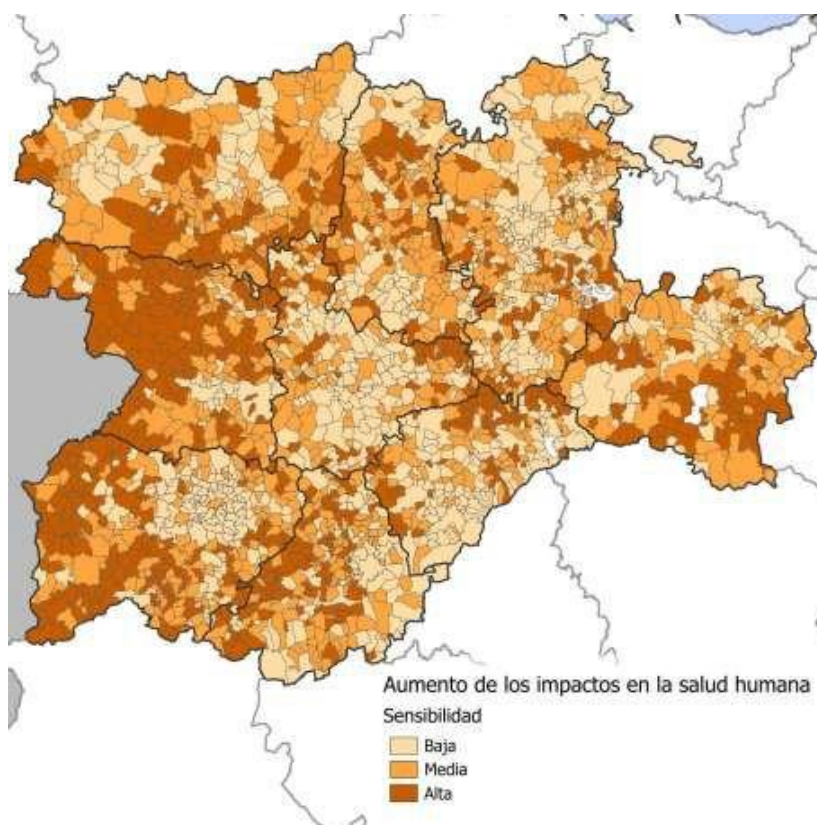
Source: National Statistics Institute, Gini Index.

✓ Vulnerable Groups

The most vulnerable groups are defined as the population under 16 years old, combined with the population over 65. The proportion of these vulnerable groups relative to the total population is calculated, and from this, the percentiles of low (0–33%), medium (33–66%), and high (66–100%) sensitivity are determined.

Source: National Statistics Institute

To obtain a combined sensitivity value for each municipality, a numerical value has been assigned to each indicator (low = 1, medium = 2, high = 3), and the average between the two indicators (Gini index and proportion of vulnerable population) has been calculated.



Component for the risk of increasing impacts on human health

Vulnerable groups and municipalities with a lower socioeconomic profile have lower individual and collective adaptation capacity, poorer access to healthcare resources, homes with lower thermal efficiency, and more difficulties in implementing preventive measures or responding to heatwaves or other extreme phenomena.

Territorial analysis shows that the provinces of Soria, Zamora, Ávila, and Salamanca concentrate a greater number of municipalities with high sensitivity, combining a lower socioeconomic profile with a higher proportion of vulnerable groups.

Adaptive Capacity

✓ Energy Efficiency Certificates

The open data of Castilla y León includes a database of energy efficiency certificates registered in each municipality. Based on this information, municipalities are classified according to the energy efficiency level of the buildings: High consumption certificates (F, G) → Low Adaptive Capacity; Medium consumption certificates (C, D, E) → Medium Adaptive Capacity; Low consumption certificates (A, B) → High Adaptive Capacity. For each municipality, the number of certificates per category has been counted, and a global classification has been assigned based on the majority category.

Source: Open Data of Castilla y León – Energy Efficiency Certificates 2016

✓ Travel Time to the Nearest Health Centre

This indicator evaluates accessibility to healthcare services, a key factor in climate emergencies like heatwaves. Each municipality has been linked to its reference health centre, and travel time has been calculated using the Google Maps tool. From this, percentiles of low (0–33%), medium (33–66%), and high (66–100%) capacity are determined. Municipalities closer to a health centre will have greater adaptive capacity.

Source: Open Data of Castilla y León – Health Centres by Municipality

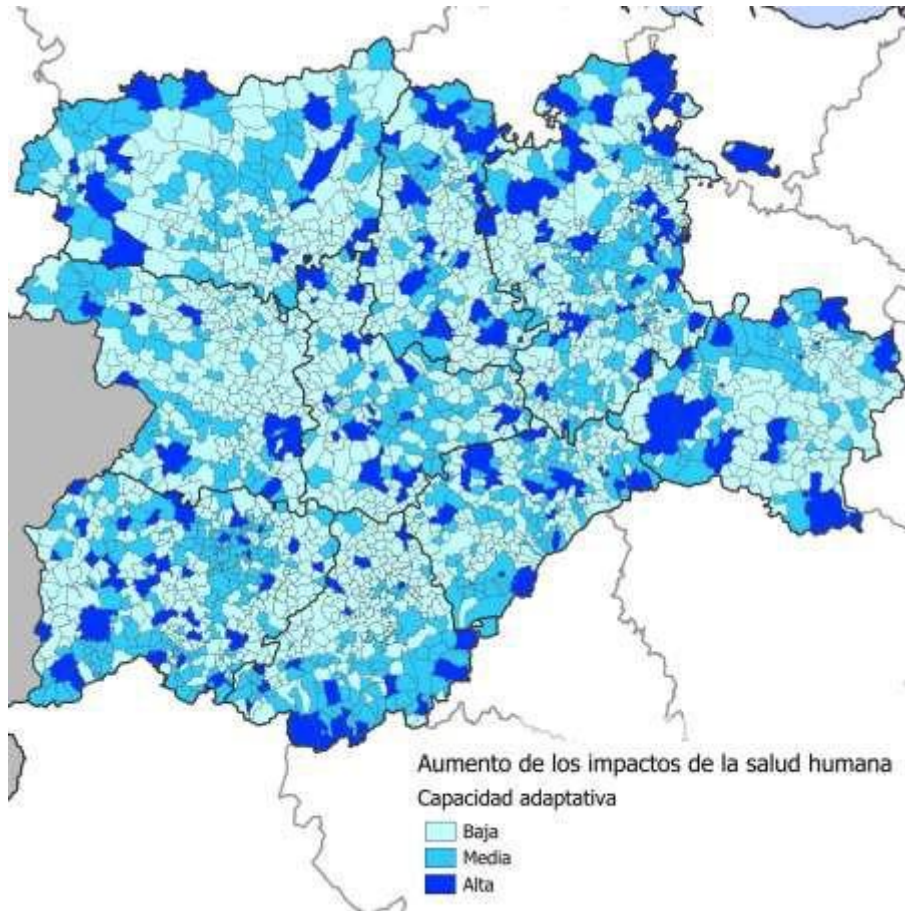
✓ Urban Green Space.

Urban green space plays a special role in climate change adaptation and improving the quality of life in cities. The presence of trees and green spaces helps reduce the effects of heatwaves, improves public health and well-being, regulates air quality, and increases urban resilience to climate impacts. Therefore, advancing urban renaturalization processes is essential. For this layer representation, two sources were combined: the tree coverage density layer from the Copernicus Land Monitoring Service, which provides a continuous representation of the entire tree coverage of the territory, and the population layer from the Open Data of Castilla y León, which includes population nuclei, INE settlements, and other urban areas. The overlap of these layers allows for an indicator of the percentage of green areas relative to urban areas, which is then classified using percentiles to determine low (0–33%), medium (33–66%), and high (66–100%) adaptive capacity.

Source: Corine Land Cover. Copernicus Land Monitoring Service. Open Data of Castilla y León – Population Entities of Castilla y León

Indicator Aggregation: To obtain a combined adaptive capacity value for each municipality, a numerical value has been assigned to each indicator (low = 1, medium = 2, high = 3), and the

average between all three indicators (Energy Efficiency Certificates, Travel Time to the Nearest Health Centre, and Urban Green Space) has been calculated.

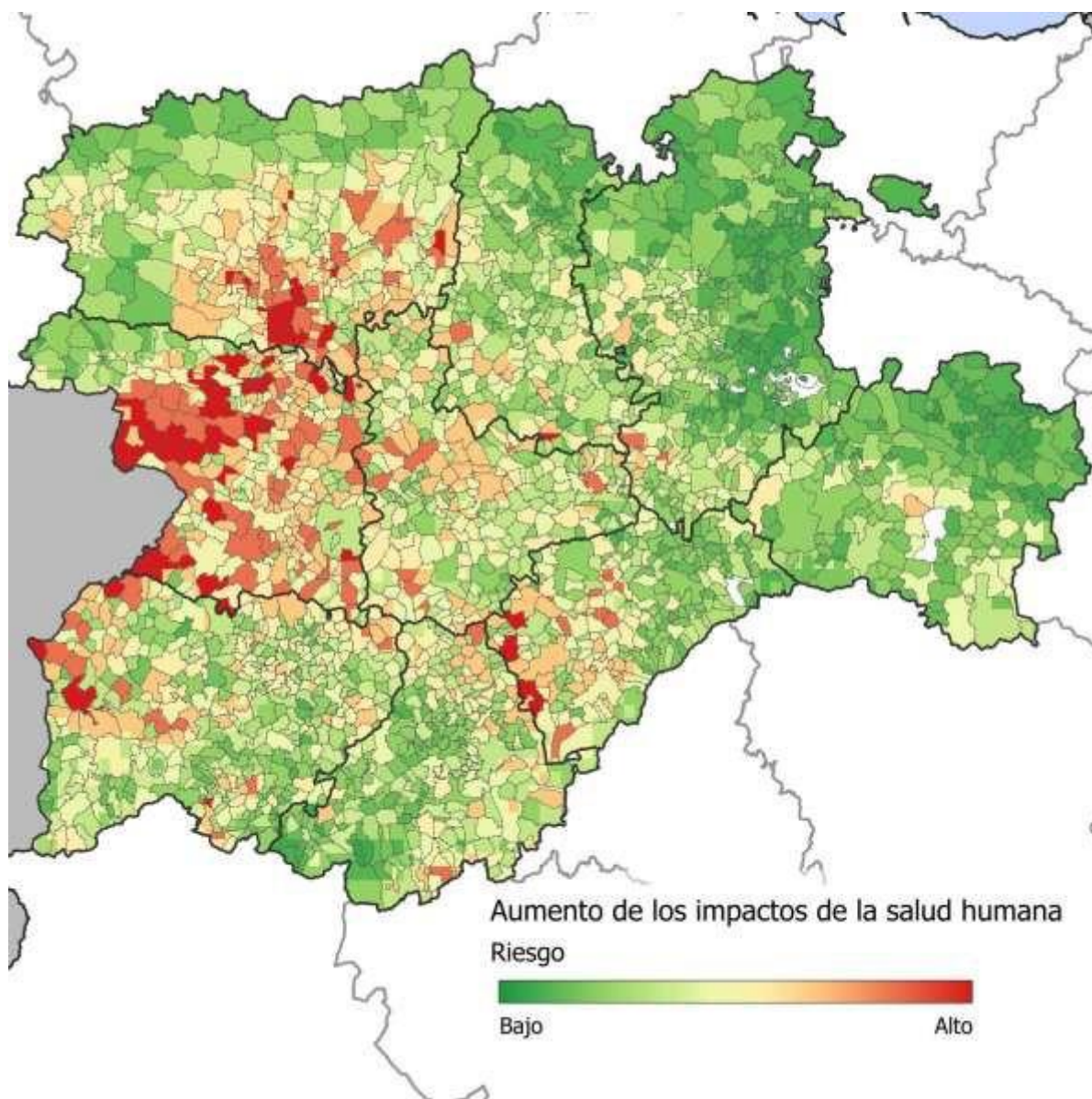


Adaptive capacity component for the risk of increasing impacts on human health.

The adaptive capacity map combines the indicators of energy efficiency, access to healthcare centres, and urban green space to establish the adaptive capacity level of each municipality in response to climate risks related to human health. A municipality is considered to have high adaptive capacity when it has low-energy consumption certificates, a nearby health centre, and abundant urban green space.

The results do not show a uniform territorial distribution. Municipalities with the highest adaptive capacity are spread heterogeneously across Castilla y León, without a clear concentration by province.

Identification of the Most Vulnerable Areas to the Risk



Most vulnerable areas for the risk of increasing impacts on human health

The final map of the risk of increasing impacts on human health has been developed by integrating the different components that determine it: threat, exposure, sensitivity, and adaptive capacity. The overlap of the selected indicators for each of these components allows for the creation of intermediate maps, which, when combined, result in the overall risk map.

The final risk map shows that the areas of greatest impact are concentrated where several critical factors coincide: a high threat associated with rising temperatures, high vulnerability due to population concentration and the presence of sensitive groups (elderly, children, or people with chronic illnesses), and low adaptive capacity related to limited access to healthcare services, poor quality of the built environment, and lack of green space.

- The province of Zamora groups several rural, aging areas, where the high presence of elderly people (more vulnerable to impacts), lower incomes, and significant limitations in social-healthcare attention and services are notable. Additionally, some of its main municipalities concentrate population in old and dense urban areas, with low energy efficiency and little urban green space.
- In the southern area of León, there are areas with aging, socio-economic vulnerability, and unequal access to basic healthcare services, replicating the pattern described for Zamora.

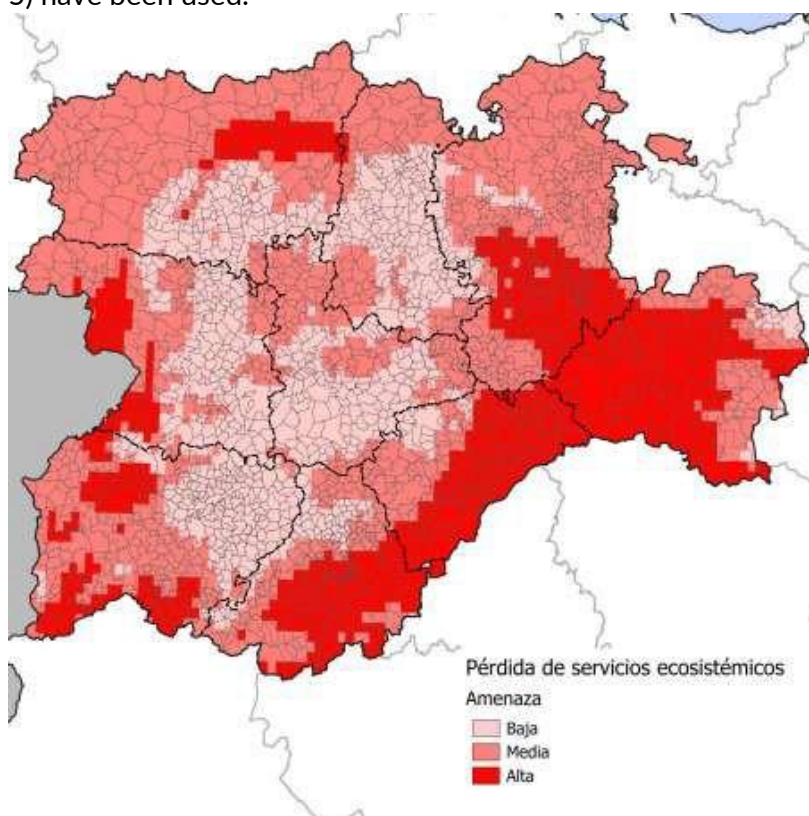
2.3.2.5 Loss of Ecosystem Services

The impacts include both physiological and phenological changes as well as population variations. Additionally, ecosystems are degrading with changes in land use, ecosystem fragmentation, and the expansion of invasive species.

Threat

- ✓ Maximum Temperature
- ✓ Number of Days with Precipitation < 1mm

The threat indicators have been developed through GIS analysis based on maps available in AdapteCCa, which integrate data from 5 km grid projections obtained through statistical regionalization from the latest generation of global climate models (CMIP6). For their development, data from the increase relative to the base period of 1971-2000, projected for the medium scenario (2041-2070) under a high emissions scenario (SSP5-8.5 in CMIP6 / RCP-8.5 in CMIP5) have been used.



Threat component for the risk of loss of ecosystem services

To analyse the territorial distribution of the degree of threat in Castilla y León, two key climatic variables have been selected: the increase in maximum annual temperature and the number of days with precipitation less than 1 mm. These variables allow for the proper evaluation of the combined effects of temperature rise and prolonged droughts, two critical factors in the loss of ecosystem services.

Both indicators are considered representative of climate stress that can affect biodiversity (especially in ecosystems dependent on permanent water flows or groundwater balance). The lack of continuous precipitation and the increase in temperature directly contribute to the deterioration of natural habitats, affecting essential functions such as water regulation, soil fertility, or providing refuge for species.

The combination of these two variables has allowed for regionalizing the degree of threat, identifying the areas with the greatest potential risk: those with a high number of dry days (precipitation <1mm) alongside a significant increase in maximum annual temperature.

Exposure

✓ Land Use Map

Source: Corine Land Cover 2018 Viewer, LAEA - Open Data of Castilla y León - Distribution of Threatened Species 2021

Ecosystem services are diverse, and virtually all of the territory produces some type of ecosystem service, whether provisioning, regulating, cultural, or supporting.

- Provisioning services refer to the quantity of goods or raw materials that an ecosystem offers (wood, water, or food).
- Regulatory services derive from the key functions of ecosystems that help reduce certain local and global impacts (e.g., climate and water cycle regulation, soil erosion control, pollination...).
- Cultural services relate to leisure, recreation, or broader aspects of culture.
- Supporting services, such as biodiversity and natural processes in ecosystems, ensure the functioning of the above services.

The preservation of ecosystem services involves the conservation of the natural environment while promoting sustainable use and development. To evaluate exposure to the risk of loss of ecosystem services, the Corine Land Cover land use map has been used. To assign exposure levels (high, medium, and low), the naturalness index proposed by Loidi et al. (2007) and Santos-Martín et al. (2019)⁶ has been applied, which rates each land use on a scale of 0 to 5. The applied correlation is as follows:

Exposure Classification	Values of the Naturalness Index according to Loidi et al. (2007) and Santos-Martín et al. (2019)	Layers Included from Corine Land Cover
Low	0: Urban, industrial, and extractive areas 1: Green urban areas	1: Artificial surfaces

⁶ Pág. 175 de https://www.miteco.gob.es/es/biodiversidad/temas/ecosistemas-y-conectividad/infraestructura-verde/iv_guia_metodologica.html

Medium	2: Cultivated areas	2: Agricultural areas
	3: Agricultural mosaic, agroforestry, and saline systems	
High	4: Natural areas with agroforestry (meadows and transition shrubs)5: Areas of High Environmental Value (forests)	3: Forests and mixed areas, shrubs, grasslands, wetlands, etc. (semi-natural) 4: Wetlands



Exposure component for the risk of loss of ecosystem services

High exposure values are mainly concentrated in the forested and natural areas of the community, primarily located in the peripheral zones: the north of León and Palencia, coinciding with the Cantabrian Mountain Range, where forests and mountain ecosystems predominate. The northwest of Zamora, especially in Sanabria and around the lake, one of the areas with the highest natural value. The east of Burgos and the north of Soria, in the Iberian System, with continuous forest masses and protected natural spaces. The south of Ávila and Segovia, in the Sierra de Gredos and Sierra de Guadarrama, where high mountain ecosystems increase the exposure level.

Areas classified as medium exposure occupy much of the central region of the community, coinciding with the central agricultural plateau that spans provinces such as Valladolid, Palencia, Zamora, Salamanca, and part of Burgos.

In contrast, areas of low exposure correspond almost exclusively to urban cores and artificial spaces, scattered throughout the community, but more concentrated in provincial capitals.

Sensitivity

✓ Distribution of Threatened Species

Source: Open Data of Castilla y León - Distribution of Threatened Species 2021

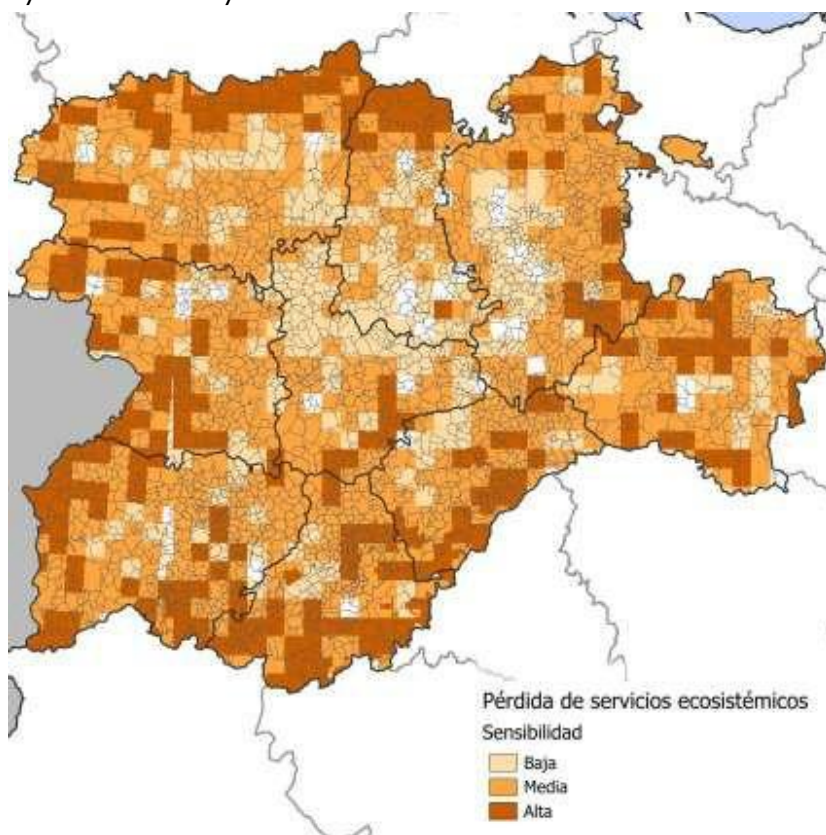
✓ Map of Critical Areas for Protected Species of Castilla y León

Source: Open Data of Castilla y León - Map of Critical Areas for Protected Species of Castilla y León

Threatened species are more sensitive to climate change due to their small populations, fragmented habitats, or specific ecological requirements. Therefore, the presence of species not only reflects their own vulnerability but also the fragility of the ecosystem that houses them and the possible loss of associated ecosystem services. The presence of a sensitive species indicates that the area where it lives provides the necessary conditions for its viability, which in turn ensures the maintenance of the ecosystem services associated with it.

The layer used is based on the distribution of threatened species in Castilla y León, listed in the Castilla y León Catalogue of Threatened Species, and serves as a good indicator of ecological sensitivity. This layer represents the current distribution of fauna and flora species by 10x10 km grid squares. Based on the number of species present in each grid square, three sensitivity levels have been established using percentiles: low (0–33%), medium (33–66%), and high (66–100%). Thus, the more threatened species present in an area, the greater the sensitivity assigned.

Additionally, the Map of Critical Areas for Protected Species of Castilla y León is incorporated, identifying priority areas for the conservation of species listed as endangered or with high ecological requirements. These critical areas constitute a complementary indicator of the ecological fragility of the territory.



Sensitivity component for the risk of loss of ecosystem services

Although the resulting map does not show a completely homogeneous spatial distribution, there is a notable correspondence with the Natura 2000 Network areas, reinforcing its validity as a proxy for ecological sensitivity. Areas with the highest concentration of threatened species often coincide with areas of high natural and ecological value, where the impacts of climate change could have more severe consequences on biodiversity and the functioning of ecosystems.

Adaptive Capacity

- ✓ Map of the Natural Spaces Network of Castilla y León (REN)

Source: Open Data of Castilla y León - Map of the Natural Spaces Network of Castilla y León (REN)

- ✓ Map of Special Conservation Zones (ZEC) of Castilla y León/XN200
- ✓ Map of Special Protection Areas for Birds (ZEPA) of Castilla y León

Source: Open Data of Castilla y León - Map of Special Conservation Zones (ZEC) of Castilla y León 2015. Map of Special Protection Areas for Birds (ZEPA) of Castilla y León 2015.

- ✓ Wetlands of Special Interest (ZHIE)

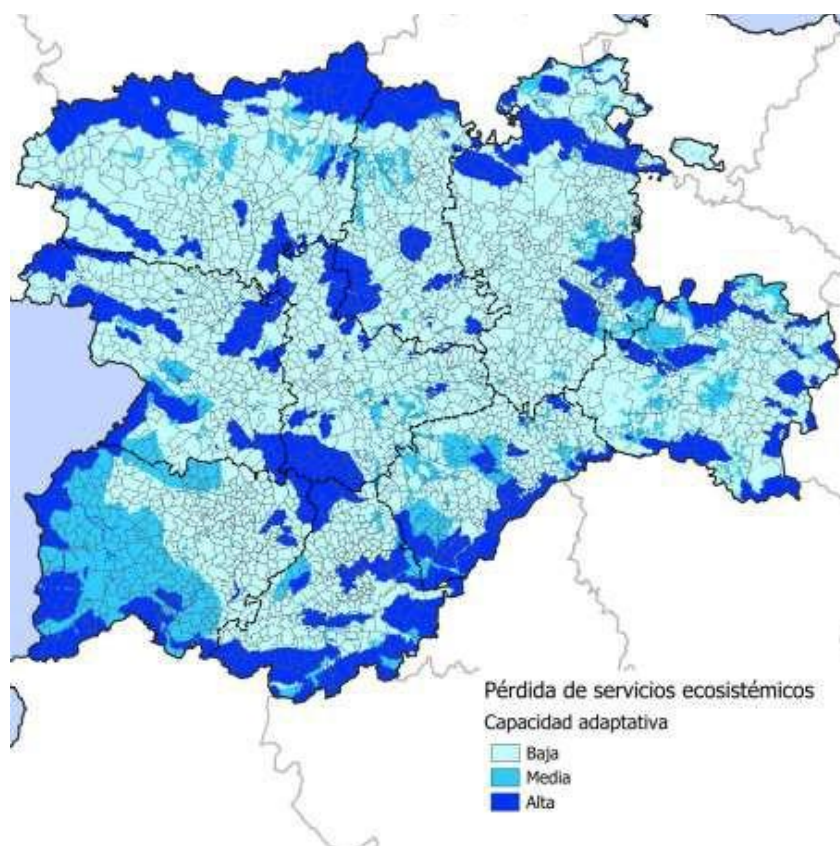
Source: Open Data of Castilla y León - Wetlands of Special Interest (ZHIE)

✓ Map of Forests of Castilla y León: Sustainable Forest Certification (PEFC)

Source: Open Data of Castilla y León - Sustainable Forest Certification (PEFC)

✓ Map of Protected Species Application Areas of Castilla y León

Source: Open Data of Castilla y León - Map of Protected Species Application Areas of Castilla y León



Adaptive capacity component for the risk of loss of ecosystem services

This section incorporates the legal protection instruments included in the Network of Protected Natural Spaces, aiming to represent the land management bodies. These spaces ensure the conservation of habitats and species of high ecological value, thus contributing to the preservation of ecosystem services and the resilience of the territory to climate change.

The main instruments include:

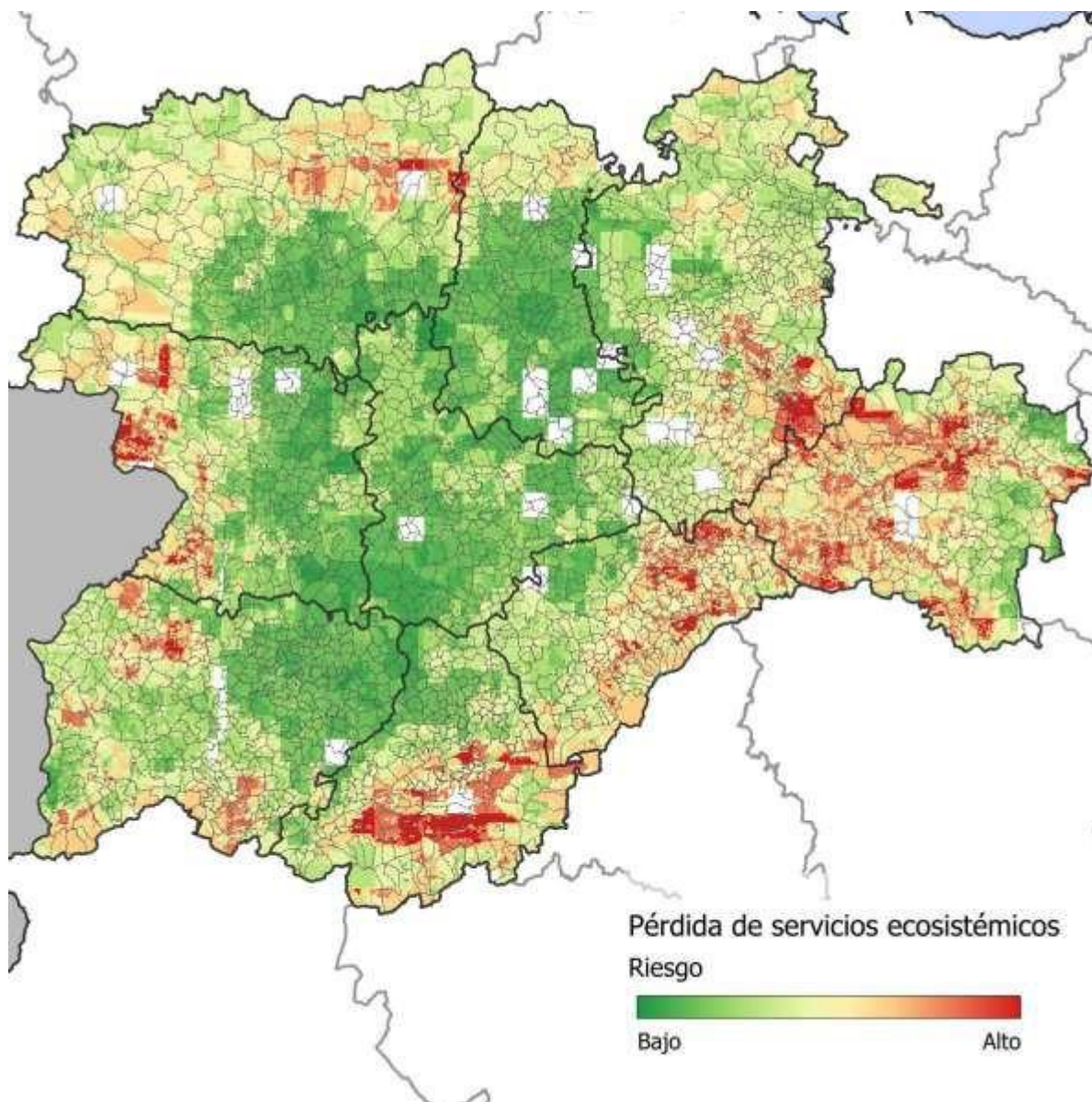
- Natura 2000 Network, created under the Habitats Directive, consisting of two main designations:
 - Special Areas of Conservation (SAC), which host natural habitats and species of special interest.
 - Special Protection Areas for Birds (SPA), designated under the Birds Directive to protect bird species.

In Castilla y León, the Natura 2000 Network covers 2,461,759 ha (26.13% of the regional territory), with a broad territorial distribution, concentrated in areas of high ecological value such as the Cantabrian Mountain Range, Sierra de Gredos, the Iberian System, and the Serranía de Soria, as well as plains in the west and south of Zamora and Salamanca, large river valleys (Duero, Esla, Órbigo, Tormes), and the moorlands and farmland areas in Palencia, Burgos, and Valladolid.

- Network of Natural Spaces of Castilla y León (REN), which includes various protection categories: National Parks, Natural Reserves and Parks, Natural Monuments, Protected Landscapes, Regional Parks, Peripheral Protection Zones, or Natural Resource Management Plans (PORN) under development.
- Wetlands of Special Interest (ZHIE), which are part of the Regional Wetland Catalog and represent areas of great ecological importance for their role in water regulation, carbon storage, and biodiversity maintenance.
- Sustainable Environmental Certification, included as a complementary indicator of medium adaptive capacity. Although not a strict legal protection figure, it is valuable as it certifies the responsible environmental management of operations, forests, estates, or facilities.
- Protected Species Application Areas in Castilla y León, also included as a complementary indicator of medium adaptive capacity. These areas define parts of the territory where it is a priority to implement specific conservation or recovery measures for threatened species, in accordance with active recovery or conservation plans.

Together, these instruments enhance the adaptive capacity of the territory. However, looking ahead, it would be an area for improvement to include indicators based on the actual conservation status of habitats and species for higher quality data.

Identification of the Most Vulnerable Areas to the Risk



Most vulnerable areas for the risk of loss of ecosystem services

The final map of the risk of loss of ecosystem services has been developed through the integration of the different components that determine it: threat, exposure, sensitivity, and adaptive capacity. The overlap of the selected indicators for each of these components allows for the creation of intermediate maps, which, when combined, result in the global risk map.

The final risk map shows a spatial distribution of the potential impact on ecosystem services, where areas with a high level of risk are mainly concentrated in the peripheral zones of the autonomous community. This correlation reflects the greater impact of these environments against the effects of climate change, especially in contexts of rising temperatures and reduced precipitation.

The areas marked in red and intense orange on the map represent territories with the highest risk of losing ecosystem services, highlighting:

- Regional Park of Montaña de Riaño and Mampodre, in the northwest of León.
- Sierra de Urbión, between Burgos and Soria.

- The west of Soria.
- Sierra de Ayllón and the Central System, in the northeast of Segovia.
- Sierra de Ávila and Sierra de Gredos, areas of special ecological value in the south of the Ávila province.
- The Sierra de la Culebra, in the northwest of Zamora, is also identified as an exposed area.

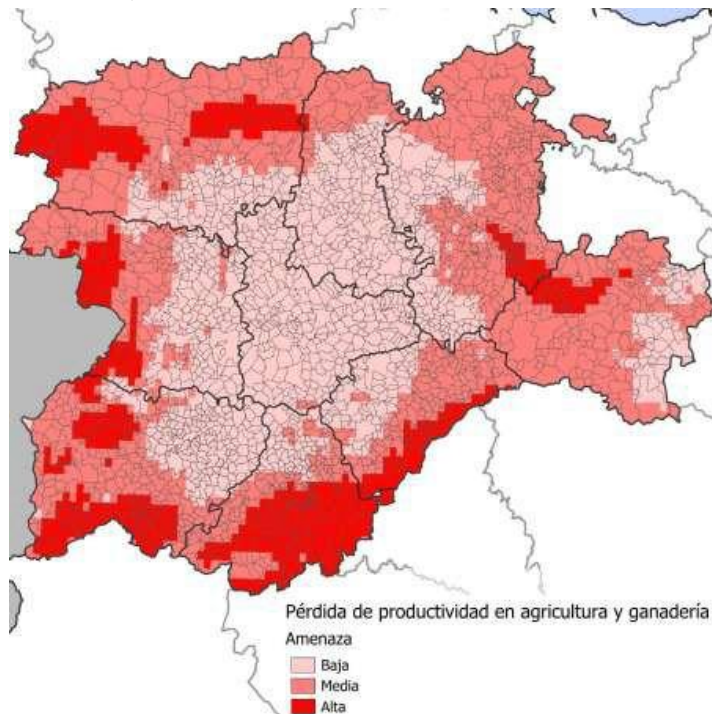
2.3.2.6 Loss of Productivity in Agriculture and Livestock

Agriculture will be affected by a loss of productivity resulting from lower crop development, both in terms of quantity and quality. The need for irrigation will increase, and soil degradation will be greater. In livestock farming, costs will rise, as well as potential pests and diseases, while natural feed will decrease.

Threat

- ✓ Maximum Temperature
- ✓ Precipitation
- ✓ Number of Days with Precipitation < 1mm
- ✓ Number of Warm Days

The threat indicators have been developed through GIS analysis based on maps available in AdapteCCa, which integrate data from 5 km grid projections obtained through statistical regionalization from the latest generation of global climate models (CMIP6). For their development, data from the increase relative to the base period 1971-2000, projected for the medium scenario (2041-2070) under a high emissions scenario (SSP5-8.5 in CMIP6 / RCP-8.5 in CMIP5) have been used.



Threat Component for the Risk of Loss of Productivity in Agriculture and Livestock

The degree of threat associated with the risk of agricultural productivity loss is determined based on key climatic variables linked to the increase in temperatures and the alteration of precipitation patterns. Among the thermal factors, the number of warm days and maximum temperature stand out, directly affecting crop development, reducing their yield, and modifying their growth cycles.

Furthermore, the threat related to water availability and distribution is analyzed using indicators of total precipitation and the number of days with precipitation below 1mm. These allow for detecting prolonged drought situations and changes in the seasonality of rainfall, particularly affecting rain-fed farming systems and increasing water stress in irrigated areas.

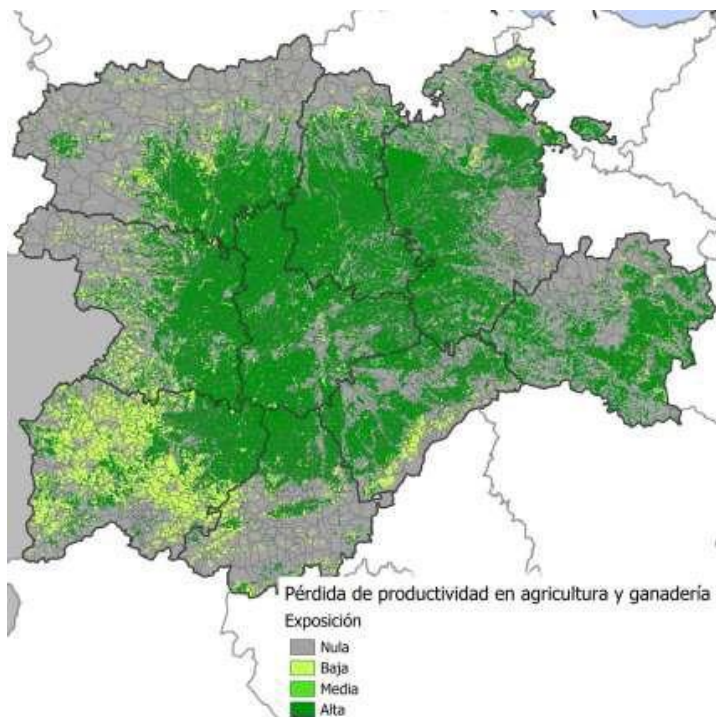
The resulting map integrates these indicators, so areas classified with medium or high threat correspond to the overlap of climatic factors, not the relative weight of agricultural activity in each territory. This explains, for example, why mountainous areas show higher threat levels, while central areas, predominantly agricultural, exhibit lower values.

Exposure

✓ Agricultural Parcel Geographic Information System

Source: Corine Land Cover. Copernicus Land Monitoring Service.

Exposure to risk has been defined based on land use type. The territory has been classified into three exposure levels: high corresponds to standard agricultural areas, understood as those predominantly dedicated to intensive or extensive productive farming, more susceptible to impacts. Low includes categories such as natural meadows, mostly agricultural land with scattered natural elements, and agroforestry systems. Although agricultural activity exists in these territories, it is more diluted or integrated with mixed uses, so their direct exposure to agricultural risk is lower. The "null" category includes artificial surfaces, forest areas with natural vegetation, open spaces without significant vegetation, and wetlands. As these areas are not designated for agricultural production, they are not considered exposed in this risk analysis.



Exposure Component for the Risk of Loss of Productivity in Agriculture and Livestock

Castilla y León presents marked territorial differentiation in terms of agricultural land use. The region is surrounded by various mountain systems where livestock and forestry activities predominate, while the central area is dominated by the northern plateau of the Duero River Basin, and the flat areas of central and western Castilla y León are more conducive to large-scale agricultural activities.

Sensitivity

✓ Organic Matter Content in Soil

Source: Agrarian Technological Institute Portal and the Junta de Castilla y León - Agrarian Pollution in Castilla y León: Livestock Agro-environmental Factor

The composition and decomposition rate of organic matter affect the physical and biological conditions of the soil: structure and porosity, water infiltration rate, biological diversity and activity of organisms, and nutrient availability for plants. In addition to providing nutrients and habitat for soil organisms, organic matter also binds particles into aggregates and improves moisture retention capacity. These properties determine fertility, productivity, and carbon sequestration.

The Agrarian Technological Institute and the Junta de Castilla y León provide maps with edaphological information for Castilla y León, including a map of soil organic matter content expressed as a percentage by weight. High values indicate more organic matter, which in turn is an indicator of low sensitivity. The values are classified into three sensitivity levels using percentiles: low (0–33%), medium (33–66%), and high (66–100%).

✓ Crop Type

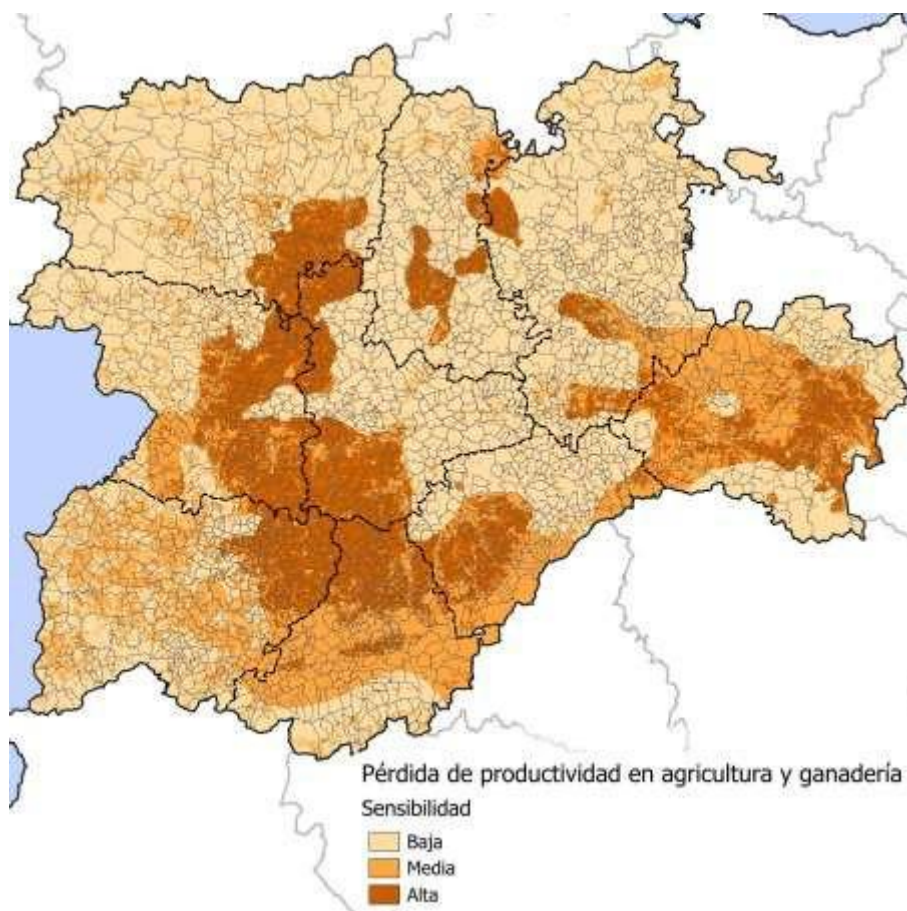
Source: Corine Land Cover. Copernicus Land Monitoring Service.

Crops are classified as highly sensitive if a reduction in cultivated land due to climate change is expected. Conversely, those crops that may benefit from these conditions are considered of low sensitivity, while those whose area would remain relatively stable are classified as medium sensitivity.

The classification criterion used to determine high, medium, and low values is based on a review of bibliographic sources, which generated an internal classification criterion for crops based on their sensitivity to climate change. The following assignments are made:

- High Sensitivity: Vineyards and Olive Groves
- Medium Sensitivity: Rain-fed cropland, Permanently irrigated land
- Low Sensitivity: Meadows, Annual crops associated with permanent crops, Crop mosaics, Primarily agricultural land with significant areas of vegetation, Agroforestry systems

Indicator Aggregation: To obtain a combined sensitivity value, a numerical value has been assigned to each indicator (low = 1, medium = 2, high = 3), and the average between both indicators (organic matter and crop type) has been calculated.



Sensitivity component for the risk of loss of productivity in agriculture and livestock

The map reflects a pattern in the distribution of sensitivity, with areas of higher values concentrated in the central zone of the northern plateau, an area characterized by plains, fertile soils, and traditionally agricultural landscapes. As the region progresses toward the surrounding mountainous bands—the Cantabrian Mountains, Central System, and Iberian Range—a clear decrease in sensitivity is observed. In contrast, the peripheral mountainous areas, with less intensive agro-livestock activity, present low sensitivity levels.

Specifically, areas with the highest concentration of high sensitivity are located in:

- The central area where the provinces of Zamora, Valladolid, Salamanca, and Ávila converge
- The eastern strip of Zamora
- Where the province of Valladolid meets León
- Southeast of Segovia
- East of Soria, in an agricultural corridor within a mostly mountainous environment

More dispersedly, high sensitivity hotspots are also recorded in certain areas of Palencia and Burgos.

Adaptive Capacity

✓ Irrigable Areas

Source: Open Data of Castilla y León - Irrigation CyL: Irrigable Areas

✓ Communities of Underground Water Users (CUAS).

Source: Mírame-IDE Duero Viewer

Rain-fed farming has a limited margin to withstand reductions in precipitation or changes in its seasonal distribution. Irrigated farming, on the other hand, depends on an increasing water supply, in a context where this resource is becoming increasingly scarce. Therefore, optimizing water use in irrigated areas is essential, focusing on more efficient and sustainable systems.

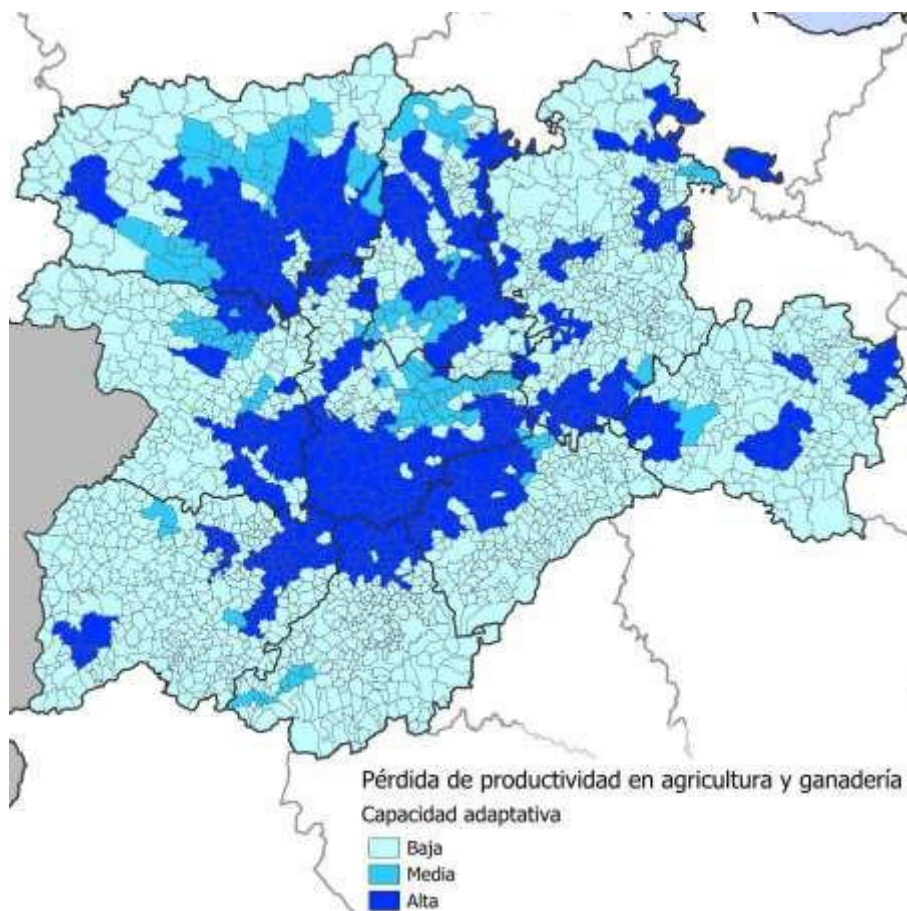
It is also interesting to note that although irrigation accounts for approximately 22% of the useful agricultural area in Spain, it generates about 65% of final agricultural production, highlighting its strategic weight. In Castilla y León, where rain-fed farming predominates, the modernization of irrigation systems allows for a substantial increase in competitiveness and progress towards a more resilient and profitable agricultural model. The region is also one of the most benefited by the irrigation modernization policy driven by the Ministry of Agriculture, Fisheries, and Food, which forecasts an investment of 790 million euros by 2027.

In terms of adaptive capacity for this risk, high-value rain-fed crops are those that incorporate resilient agrarian ecosystems, such as organic, ecological, or regenerative farming, and agroforestry systems, as they have more sustainable and regulated management methods. Currently, there is no available mapping that identifies the area dedicated to organic farming in Castilla y León, but it would be a valuable indicator to include in future analyses.

For irrigated crops, those municipalities applying water efficiency systems with new irrigation types or those that have implemented modernization are considered more adapted to climate change. High values are also assigned to underground water intakes in 2025 organized under CUAS. In the Duero basin, 37 CUAS have been formed, managing over 80,000 hectares and allowing shared governance of the water resource.

Traditional irrigation is given a medium value, while other crops are assigned low adaptive capacity.

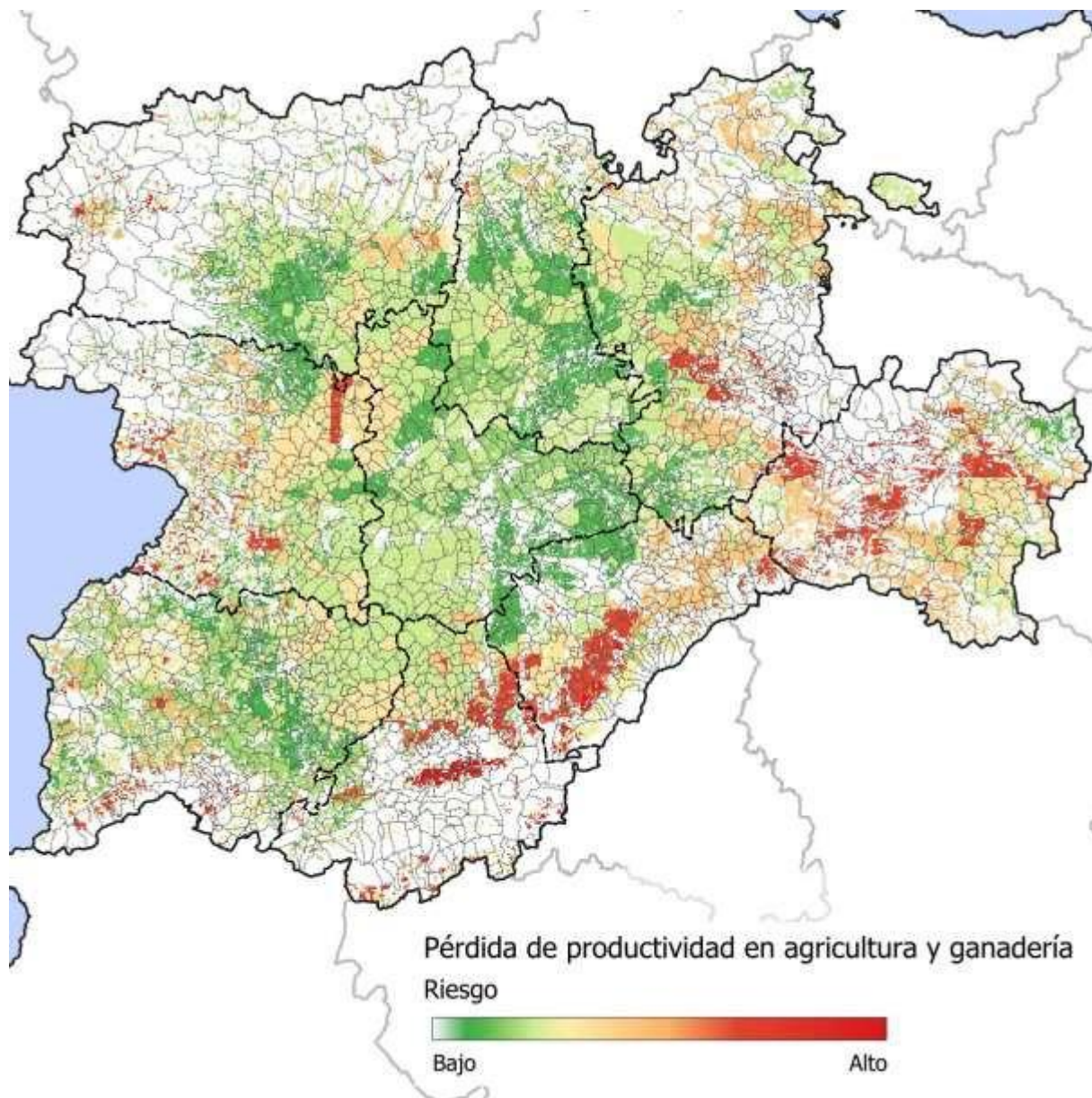
Indicator Aggregation: To obtain a combined sensitivity value, a numerical value has been assigned to each indicator (low = 1, medium = 2, high = 3), and the average between both indicators (irrigable areas and CUAS) has been calculated.



Adaptive capacity component for the risk of loss of productivity in agriculture and livestock

Areas with the highest adaptive capacity are mainly concentrated in the north of the community, which could correspond to the southern provinces of León, Palencia, and part of Burgos. There are also some areas in the centre, Soria, or the east of Zamora, with CUAS mainly located in the south of Valladolid and the border area with Segovia, Ávila, and Salamanca.

Identification of the Most Vulnerable Areas to the Risk



Most vulnerable areas for the risk of loss of productivity in agriculture and livestock

The final map of the risk of productivity loss in agriculture and livestock has been developed through the integration of the different components that determine it: threat, exposure, sensitivity, and adaptive capacity. The overlap of the selected indicators for each of these components allows for the creation of intermediate maps, which, when combined, result in the global risk map.

The final risk map of productivity loss in agriculture and livestock highlights an unequal territorial distribution of impact in Castilla y León. The areas with the greatest risk are concentrated, especially in the provinces of Ávila, Soria, and Segovia. At an intermediate risk level, Zamora, Burgos, and Valladolid are located, with significant agricultural activity areas affected, although less severely. In contrast, the provinces of Palencia and León present a comparatively lower risk, which may be related to a higher adaptive capacity in these territories.

2.3.2.7 Impacts on Tourism and Cultural Heritage

Tourism activity is closely linked to natural and cultural heritage, climate, and landscape. Due to the economic importance of this sector, its close connection to employment in many cases, and its strategic relevance in combating depopulation, maintaining the territory, and promoting rural development, this area represents a key aspect for the project study.

Given the cross-cutting nature of tourism and its direct dependence on multiple environmental and socio-economic factors, it has been deemed more appropriate to integrate its analysis with the results of other risks already addressed in this study. This decision reflects the fact that the impacts of climate change on tourism do not usually occur in isolation, but as a consequence of other risks that act in combination.

In this regard, its analysis is integrated with the results of other risks already addressed:

- **Loss of ecosystem services:** This risk may lead to the degradation of the landscape, biodiversity, and natural values, which directly impacts the loss of attractiveness.
- **Loss of productivity in the agri-food model:** Changes in land use, abandonment of rural areas, or, conversely, demographic growth in specific areas, may alter territorial dynamics. This could generate new urban developments or transport infrastructure that alters tourism trends, both in terms of volume and location.
- **Wildfires:** Municipalities more exposed to this risk may see their tourism offer severely affected by the loss of the natural landscape, perceived insecurity, and access restrictions to natural spaces during critical episodes.
- **Impacts on human health:** Thermal comfort is a key element for tourism in Castilla y León. The increase in temperatures and the greater frequency of extreme heat episodes may negatively affect both the health of visitors and the overall tourist experience.

Integrated analysis allows for a more realistic identification of the impacts facing the sector and highlights the need for adaptation strategies that simultaneously consider landscape conservation, wildfire risk management, rural resilience, and health protection.

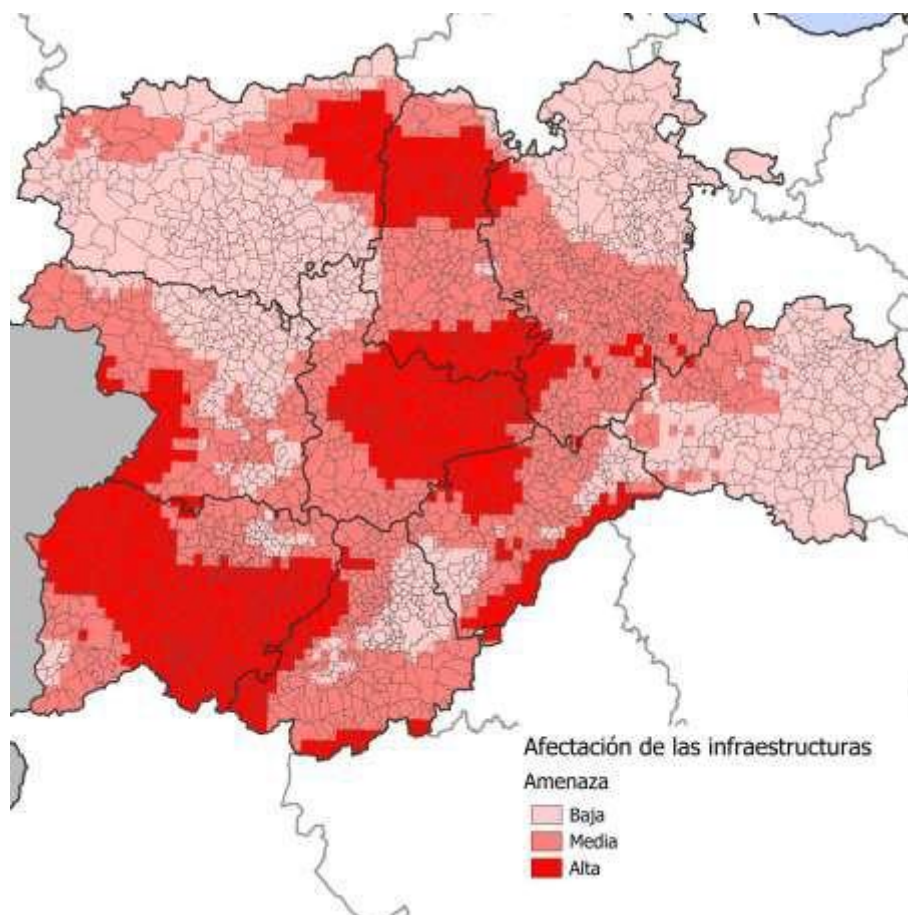
2.3.2.8 Impact on Infrastructure

Changes in the most frequent and intense meteorological phenomena will cause damage to service, transport, and communication infrastructures. Energy production and distribution infrastructures may also be affected.

Threat

- ✓ Maximum Precipitation in 24 hours
- ✓ 95th Percentile of Daily Precipitation
- ✓ Extreme Maximum Temperature
- ✓ Maximum Cumulative Precipitation in 5 Days

The threat indicators have been developed through GIS analysis based on maps available in AdapteCCa, which integrate data from 5 km grid projections obtained through statistical regionalization from the latest generation of global climate models (CMIP6). For their development, data from the increase relative to the base period 1971-2000, projected for the medium scenario (2041-2070) under a high emissions scenario (SSP5-8.5 in CMIP6 / RCP-8.5 in CMIP5) have been used.



Threat component for the risk of impact on infrastructure

The risk of impact on infrastructure from climate change is closely linked to the intensification of extreme weather events, such as torrential rains or extreme heat episodes, which can cause direct damage to structures, road networks, urban equipment, and basic services.

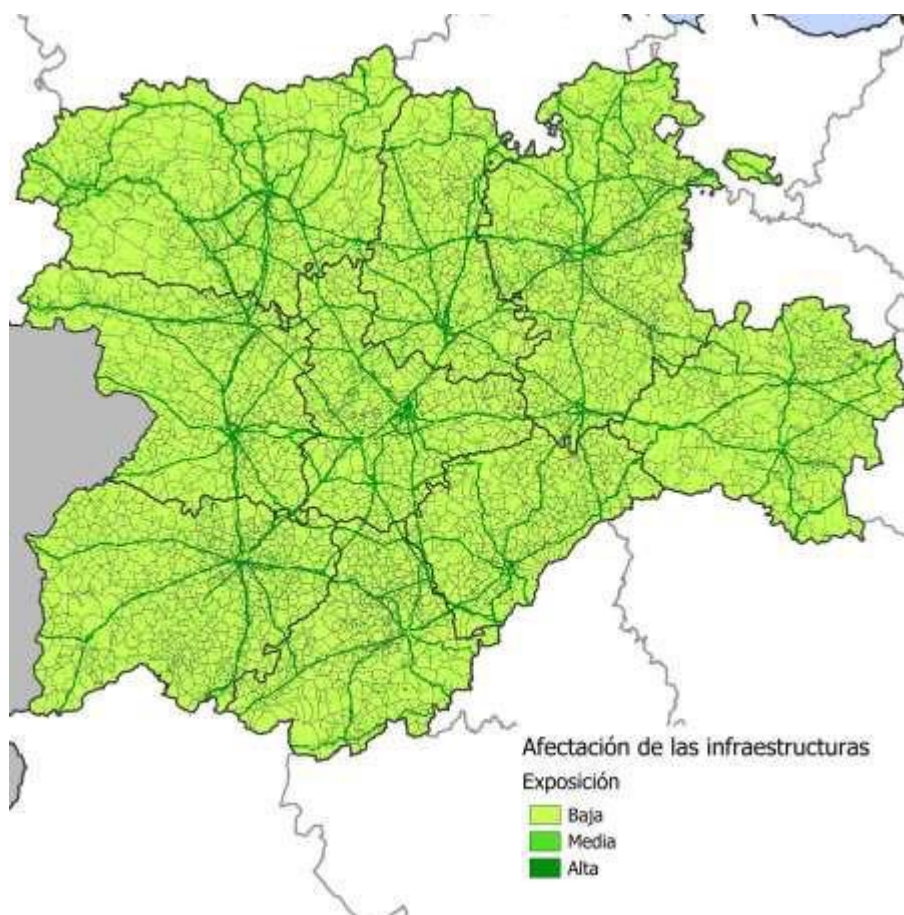
These variables allow for more accurate assessment of the impact of intense climate events on vulnerable infrastructures. Extreme precipitation can cause flash floods or overflows, compromising the integrity of transport networks, supply systems, etc. On the other hand, extremely high temperatures can affect the durability of materials or cause failures in installations.

Here, the variable of very strong winds should also be added, as they could cause significant damage by themselves, potentially damaging buildings, infrastructures, communication and transport networks, falling trees, etc.

Exposure

- ✓ Transport Networks
- ✓ Risk at Specially Important Points

Source: Open Data of Castilla y León - Road Map of Castilla y León: Road Network/ Ministry for Ecological Transition and the Demographic Challenge



Exposure component for the risk of impact on infrastructure

To evaluate exposure to the risk of infrastructure impact, two key elements in the territory of Castilla y León have been considered: transport networks (road and rail) and points of special importance (energy supply, water, basic services, energy storage, commercial and health centers, wastewater treatment plants, schools, cultural heritage, etc.). Both types of

infrastructure are strategic exposure indicators for the functioning of the territory, both in terms of mobility and the presence of basic and spatially important services.

The classification used in this diagnostic phase is binary: Exposed Areas, i.e., those that have transport networks or points of special importance within their geographical scope; Non-exposed Areas, those where no such infrastructure has been identified.

This map particularly highlights the main roads, and points of special importance are especially emphasized in provincial capitals.

Sensitivity

✓ Socioeconomic Profile

The socioeconomic profile of municipalities has been determined using the Gini index, which measures the degree of inequality in income distribution. A higher Gini index indicates greater inequality, which may reflect lower community resilience to the impacts of climate change on health. Municipalities have been classified according to the values of the Gini index with sensitivity levels using percentiles: low (0–33%), medium (33–66%), and high (66–100%).

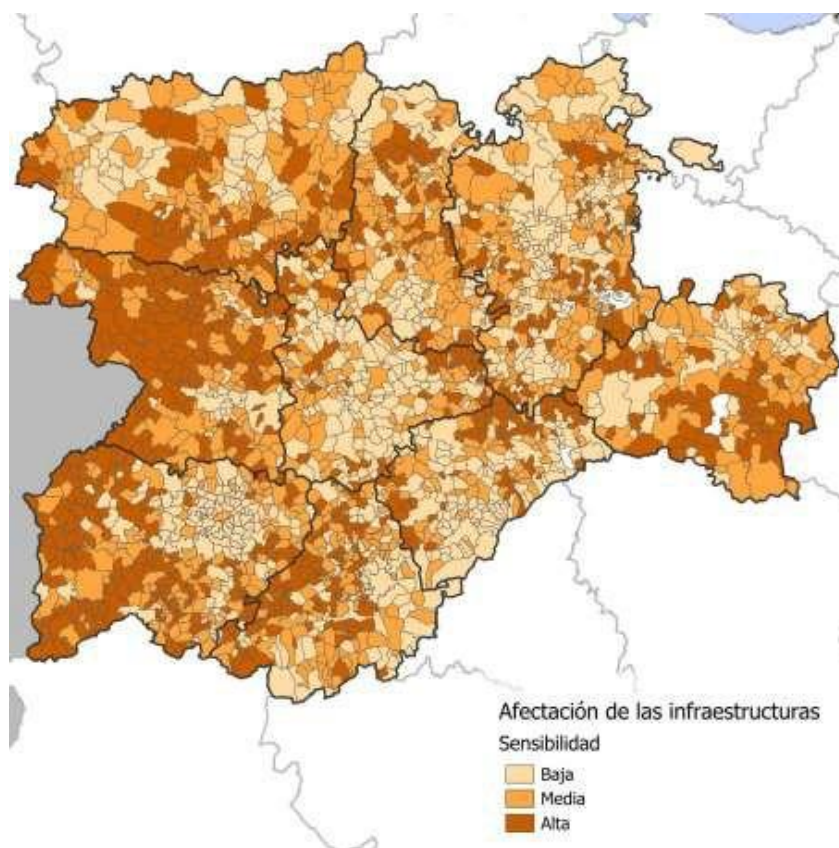
Source: National Statistics Institute, Gini Index.

✓ Vulnerable Groups

Vulnerable groups are defined as the population under 16 years old, combined with the population over 65. The proportion of these vulnerable groups relative to the total population is calculated, and from this, the percentiles of low (0–33%), medium (33–66%), and high (66–100%) sensitivity are determined.

Source: National Statistics Institute

Indicator Aggregation: To obtain a combined sensitivity value in each municipality, a numerical value has been assigned to each indicator (low = 1, medium = 2, high = 3), and the average between both indicators (Gini index and proportion of vulnerable population) has been calculated.



Sensitivity component for the risk of impact on infrastructure

Socioeconomically vulnerable groups, and those by age, present higher sensitivity to the impacts derived from the disruption of critical infrastructures, both due to their functional dependency and their limited response capacity in emergency situations.

As a result of combining a more unfavorable socioeconomic profile and a higher proportion of vulnerable populations, the provinces of Soria, Zamora, Ávila, and Salamanca group a greater number of municipalities with high sensitivity levels.

Adaptive Capacity

In this case, no specific indicators are available to evaluate adaptive capacity against the risk of impact on infrastructure. One of the main limitations identified is the lack of information on the existence and coverage of early warning systems, contingency plans, or action protocols for extreme weather events that could affect critical infrastructures such as transport networks or energy facilities. This lack of data prevents a rigorous evaluation and comparison with other risks analysed in this study.

Identification of the Most Vulnerable Areas to the Risk

Due to the lack of information on adaptive capacity and limited exposure data, the necessary elements to complete the final aggregated risk analysis that includes threat, exposure, sensitivity, and adaptive capacity of the territory are unavailable.

Therefore, a final risk map has not been produced for this case, as the absence of key data limits the validity and utility of any spatial representation of the risk.

2.4 Adaptation needs

The territorialized climate risk assessment conducted in Castilla y León allows for the identification of a set of priority adaptation needs, derived from the intersection of projected climate hazards, system exposure, and structural vulnerabilities. These needs not only address the expected physical impacts but also the institutional, infrastructural, and social gaps that affect the region's ability to effectively anticipate, respond to, and recover from extreme events or chronic climate pressures.

The main adaptation needs detected for the entire regional territory are detailed below, organized according to the analysed sectorial risks and grouped by types of actions:

Flood Risk

- Integrate flood risk into urban and territorial planning, especially in municipalities located in river areas with high exposure (Duero, Órbigo, Tormes, Carrión rivers).
- Improve urban and natural drainage systems, restore floodplain areas, and create green infrastructure to manage runoff.
- Promote the development of municipal flood response plans and encourage citizen self-protection.

Forest Fires

- Strengthen forest fire prevention and management devices in high-risk areas (northwest of Zamora, León, south of Salamanca, and Ávila).
- Apply urban-forest interface criteria to prevent risks in municipalities most exposed (over 200 municipalities with urban areas close to forested zones).
- Integrate urban planning and forestry actions that reduce vegetation fuel, create discontinuities, and foster fire-adapted landscapes.

Water Resources

- Establish a system of indicators to monitor water availability by municipality, including urban, agricultural, and industrial consumption.
- Promote water efficiency plans, reduce network losses, reuse water, and diversify water supply sources.
- Strengthen water governance in coordination with the CHD (Hydrographic Confederation of Duero) and municipalities, prioritizing territories dependent on over-exploited aquifers such as La Moraña.

Human Health and Thermal Comfort

- Strengthen prevention mechanisms for heatwaves, especially in densely populated urban areas or those with high proportions of vulnerable populations (over 65s, children, people with chronic diseases).
- Increase accessibility to healthcare services in isolated rural municipalities, where travel to the nearest health center exceeds 20-30 minutes.
- Promote passive climate control in vulnerable housing (old buildings or those lacking insulation) and encourage thermal comfort interventions with equity criteria.
- Implement local early warning systems and municipal response protocols for extreme heat episodes.

Ecosystems and Ecosystem Services

- Protect natural spaces and the Natura 2000 Network, especially those combining high ecological sensitivity with high levels of climate threat (Cantabrian Mountains, Sierra de Gredos, Sierra de la Demanda).
- Restore degraded ecosystems to maintain essential functions such as water regulation, carbon sequestration, and biodiversity conservation.
- Improve ecological connectivity and limit habitat fragmentation to strengthen the functional resilience of the territory.

Agriculture and Livestock

- Adapt the most vulnerable crops to the new climate context (e.g., vineyards and olive groves in areas of increasing thermal and water stress).
- Modernize irrigation with water efficiency criteria, prioritizing areas with high strategic value and lower water availability.
- Promote agroecological practices, crop diversification, and adaptive rotation as a strategy against productivity loss and soil degradation.
- Support the transformation of intensive livestock systems toward more resilient models compatible with water sustainability.

Tourism and Heritage

- Adapt the tourism offer to new climate scenarios, incorporating sustainability, seasonality, and adaptation criteria in rural and natural destinations.
- Evaluate the vulnerability of historical-artistic heritage to extreme weather (humidity, heat, erosion) and develop climate-informed conservation plans.

Critical Infrastructure

- Map vulnerable critical infrastructures more precisely (energy, transport, water, telecommunications) against extreme events.
- Incorporate climate adaptation criteria into the design and maintenance of public infrastructures, especially in areas with high exposure to extreme rainfall or heat.

Transversal Needs

- Strengthen the regional database and the availability of climate, risk, and vulnerability information at the municipal level.
- Improve the technical and operational capacity of local administrations to integrate adaptation into their plans and projects.
- Encourage citizen participation in adaptation planning processes and reinforce the climate justice approach in public decisions.
- Integrate adaptation into public investment and territorial planning, ensuring coherence between available funds (NextGen, LIFE, FEDER, etc.) and climate adaptation priorities.

2.5 Existing or planned climate risk management and adaptation actions

Castilla y León has begun to take steps in climate change adaptation, although still in a scattered, sectorial manner and without a long-term integrated strategy. Existing actions primarily stem from initiatives led by the regional government, local governments, river basin organizations, European programs, and pilot projects, often developed with specific funding, but without structured regional planning.

This section gathers the main adaptation actions already underway or planned in the territory, organized by the type of intervention (policy, technical, infrastructural, institutional, etc.), the climate risk addressed, and their territorial or sectorial scope of application. This compilation allows for:

- Identifying best practices and replicable experiences.
- Recognizing sectorial or territorial gaps.
- Establishing a foundation upon which to build the future adaptation strategy for Castilla y León.

The following table summarizes the main existing or planned actions, including both public and private interventions, with the aim of providing an integrated view of the regional adaptation ecosystem. This information will serve as the basis for detecting best practices, sectorial gaps, and improvement opportunities to incorporate into the Castilla y León Climate Change Adaptation Strategy.

Level	Policy / Strategy / Initiative	Objectives and Implementation	Sector/Focus	Gaps or Issues	Private Sector Actions
Regional	Annual Plan for Forest Fire Prevention and Extinction 2025	Reduce the incidence and severity of forest fires.	Forest Management / Emergency	Dependence on annual investment cycles; lack of long-term planning connection.	Limited private sector participation, mainly in service execution.
Regional	Modernization of Irrigation Systems (MAPA - SEIASA - Junta de CyL)	Improve water efficiency and reduce consumption. Modernization works, digitalization, and renewable energy.	Agriculture / Water	Conditional financing to convocation; unequal access by small irrigators.	Hiring of private companies for execution; encouraging irrigation communities.
Local	Municipal Emergency Plans for Floods	Improve local response capacity. Preparation of operational guides and activation of specific plans.	Territory Management / Civil Protection	Lack of territorial coverage; unequal capacities and techniques across municipalities.	Occasional participation by engineering and consultancy companies.
Transboundary / Regional	ADAPT CLIMA CENCYL Project	Improve resilience in Castilla y León and Central Portugal. Diagnostics, common tools, training.	Governance / Planning	Pilot scale; need for continuity after European financing.	Limited private sector involvement; potential for cross-border cooperation scaling.
Local	Biomass District Heating Network (VAIDIOIO)	Decarbonize heating. Connection of public and private buildings to a sustainable network.	Energy / Urban Planning	High financing; limited replicability without incentives.	Active participation of energy companies and builders.
Regional	FITOCLIM Program	Incorporate climate criteria in forest repopulation and adaptive management.	Forest Management / Biodiversity	Limited scope; lack of mandatory or binding mechanisms.	Potential collaboration with forestry companies in execution.

Level	Policy / Strategy / Initiative	Objectives and Implementation	Sector/Focus	Gaps or Issues	Private Sector Actions
Regional / Local	Declaration of Vulnerable Areas and Nitrites	Control agricultural contamination. Limitation of fertilisers, action and supervision plans.	Agriculture / Water	Social resistance; need for technical support.	Requires changes in agricultural practices.
Local	Response Guides for Heatwaves and Floods	Reduce vulnerability to extreme weather events. Preparation of guides and municipal protocols.	Health / Civil Protection	Limited territorial coverage; lack of follow-up.	Requires involvement from local actors (residences, social services).
Regional	Aid for Climate Transition in Agricultural Exploitations	Incentivise sustainable and resilient practices. Subsidies to young farmers, climate adaptation.	Agriculture / Green Employment	Limited capacity to track adaptive impact.	Direct application by agricultural exploitations.
Local Transversal	ARCA Pilot Project (Food Industry, Vitartis)	Self-diagnosis of climate risks and sectoral adaptation lines.	Industry / Agri-food Value Chain	Limited private sector participation; lack of regional scaling.	High private involvement (business association Vitartis).

2.6 Adaptation objectives

Based on the climate risk analysis conducted in the regional diagnosis, the following preliminary adaptation objectives for Castilla y León are defined. Their purpose is to reduce climate vulnerability in the territory, strengthen the resilience of the population, productive sectors, and ecosystems, and contribute to meeting the commitments established in international, European, national, and regional climate change adaptation frameworks.

These objectives aim to outline a strategic roadmap for integrating adaptation into sectoral and territorial public policies, as well as facilitating the implementation of coordinated actions at the local, regional, and territorial levels. They are also proposed as an initial reference for defining the future Action Plan, and as such, they are indicative and may be reviewed based on the technical work developed in the upcoming phases of the Adaptation Strategy process.

The objectives are grouped into eight priority areas, aligned with the main identified risks:

1. Reduce the impacts of climate change on human health

- Minimise the effects of extreme temperatures, heatwaves, and droughts on public health.
- Protect the most vulnerable groups (elderly, children, people with chronic diseases, isolated rural populations).
- Promote emergency climate prevention and response plans at the local level.
- Strengthen green and blue infrastructure in urban areas as a measure of thermal regulation and well-being.

2. Preserve and restore natural capital and ecosystem services, including fire risk management

- Encourage adaptive management of ecosystem services, anticipating their degradation.
- Restore natural habitats and promote resilient ecological corridors.
- Promote prevention, planning, and response to forest fires.
- Encourage diversification, sustainability, and digitalisation in the forestry sector.

3. Strengthen the resilience of the agri-food sector

- Promote the transition to sustainable, efficient, and resilient agri-food practices.
- Promote the modernisation of irrigation systems and integrated management of land and water.
- Support economic diversification and innovation to ensure the viability of rural areas.

4. Improve water management in the face of scarcity and flooding scenarios

- Incorporate climate change adaptation criteria into hydrological and urban planning.
- Promote nature-based solutions to reduce flood risks and increase water efficiency.
- Encourage sustainable management of aquifers and ensure water supply in scenarios of water stress.

5. Reduce the vulnerability of tourism and heritage to climate change

- Preserve key natural, cultural, and landscape assets for rural tourism.
- Diversify the tourism offer and adapt destinations to new climate conditions.
- Integrate adaptation into the planning instruments of the tourism sector.

6. Increase the resilience of public and strategic infrastructures

- Assess and reduce the vulnerability of critical infrastructures to extreme events.
- Incorporate climate criteria into public works projects and the maintenance of existing assets.
- Promote digitalisation, redundancy, and climate security in transport and energy networks.

7. Strengthen climate governance and institutional capacities

- Improve multi-level coordination and cooperation between public, private, and social agents.
- Ensure stable, multi-year financing mechanisms for implementing adaptive measures.
- Incorporate climate change adaptation into budgetary, regulatory, and public procurement frameworks.

8. Improve knowledge, information, and awareness of the impacts and adaptation to climate change

- Consolidate a territorial monitoring and information system on risks and vulnerability.
- Promote the training of technicians and public officials in adaptation.
- Promote awareness campaigns and citizen participation to strengthen the culture of resilience.

3 Regional capacity

The strengthening of the regional adaptation capacity is a fundamental condition for transitioning towards a more resilient, fair, and climate change-prepared Castilla y León. Based on the P2R methodological approach, it is acknowledged that the success of adaptation policies does not solely depend on the technical design of sectoral measures, but also on the systemic capacity of the territory to mobilise resources, knowledge, governance, and learning at multiple levels.

This section analyses the current situation of Castilla y León in terms of its institutional, technical, and social capacities, using two key evaluation frameworks proposed by P2R as a reference:

- The Climate Resilience Maturity Curve (RMC), which helps identify the phase the territory is in on its "journey towards resilience" (resilience journey).
- The analysis of Key Enabling Conditions (KEC), which delves into the enabling elements of transformative change.

This analysis has been informed by previous work carried out within the ADAPT2CYL Consortium, as well as the results of regional self-diagnoses and the evidence collected in the earlier phases of the process.

3.1 Resilience Maturity Curve

The **Resilience Maturity Curve (RMC)** is a key tool proposed by P2R to assess the progress of a region in its climate adaptation process.

Based on the self-assessment questionnaire completed by the ADAPT2CYL consortium (2023) and reflected in the candidacy reports, Castilla y León is currently in a **mid-phase within the maturity curve**, with average scores ranging between 7.5 and 7.9 out of 10 across all the steps analysed.

This suggests that the region:

- Has consolidated a robust diagnosis of climate risks and capacities, both at the regional and municipal levels. Notably, the Regional Climate Change Strategy 2009–2012–2020 is a relevant precursor, as it focused on mitigation while incorporating vulnerability assessments in sectors such as agriculture, livestock, and forest ecosystems. The current work allows for significant progress in this regard.
- Has started to explore shared visions and theories of change around resilience through collaborative processes, such as those developed by the Cencyl network or the INTERREG Adapt-Clima project.
- Has activated concrete experiences in co-designing local climate solutions (such as in the case of Valladolid city), which are now being progressively transferred to other administrative levels.

Key factors enabling this relative maturity:

- Growing political commitment, evidenced by the signing of the Adaptation Mission by the Junta de Castilla y León and the Valladolid City Council.
- Active participation of regional actors in European projects related to adaptation (e.g., LIFE, Poctep, Horizon Europe).

- The presence of technical structures and networks, such as the Fundación Patrimonio Natural or AEICE, which facilitate multi-actor and multi-scale articulation.

Identified limitations:

Despite the progress, there are structural challenges that still limit the consolidation of fully integrated resilience:

- Climate governance is still in its infancy, with no consolidated interdepartmental or multi-scale coordination structures.
- Financial planning for adaptation is fragmented, and there is no long-term investment strategy.
- There is still a lack of clear institutionalization of monitoring, evaluation, and learning within an adaptive framework, with integrated indicators and reporting systems.

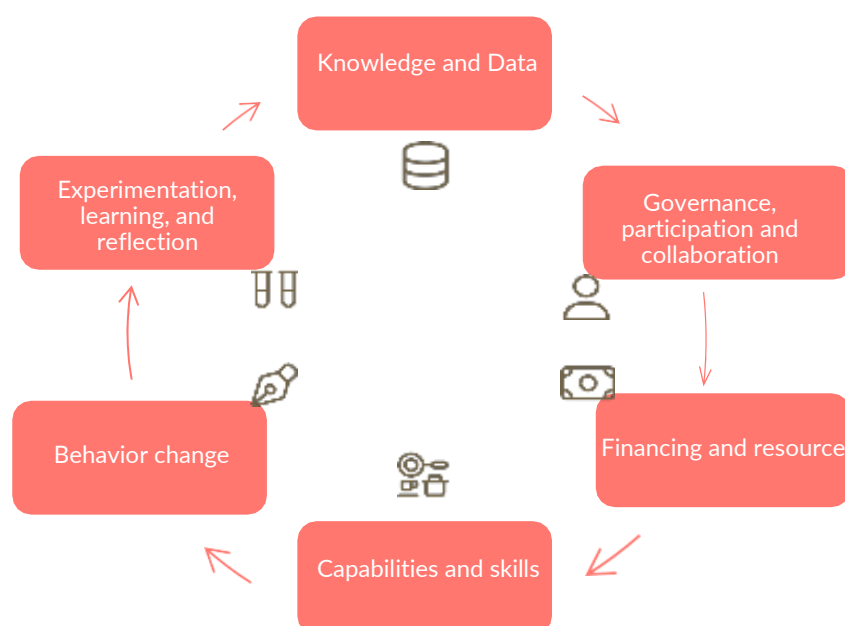
Consequently, Castilla y León's position in the RMC is between the "take-off" phases, showing significant progress from the starting point but with a considerable margin for deepening more transformative and systemic adaptation.

In this sense, the development of the Adaptation Strategy for Castilla y León represents a lever to move towards more mature stages of resilience.

3.2 Role of key enabling conditions

Progress towards a climate-resilient region does not solely depend on having robust diagnoses or establishing well-defined strategic objectives. International experience and the P2R methodological framework show that **systemic transformation requires activating a set of key enabling conditions** (Key Enabling Conditions, KEC) that reinforce the institutional, social, and technical capacity of the territory to adapt to climate change in an integrated, fair, and effective manner.

These conditions are structured into six essential dimensions: knowledge and data; governance, participation, and collaboration; financing and resources; capacities and skills; behavioral change; and experimentation and learning. All of these are interconnected and represent critical factors for unlocking structural barriers and accelerating the implementation of effective public policies.



At the same time, these elements align with the principles established by the EU Climate Change Adaptation Mission, which emphasizes that resilience requires both the deployment of technical solutions and collective learning processes, political leadership, citizen participation, and multi-level governance.

In the case of Castilla y León, the starting point is uneven and still fragmented, but there are multiple opportunities to activate these levers, as outlined in the maturity analysis and the contributions made by stakeholders during the participatory phase of the ADAPT2CyL project.

Below is a summary of the key observations for each condition:

KEC	Base situation in Castilla y León	Opportunities for advancement
Knowledge and Data	There are scattered technical and scientific sources (AEMET, CHD, universities), but there is no systematic climate data architecture at the regional level.	Evaluate local and regional risks: Create a system for regional climate information that is interoperable, linked to the Strategy, and its monitoring mechanisms and indicators.
Governance, Participation, and Collaboration	Institutional framework without formal coordination structures for adaptation. Good practices such as the Cecov project and the Escuela de Alcaldes. At the participation level, there is some involvement from public, private, and third sector actors.	Design a multi-level governance model (regional, municipal, and effective multi-actor participation), aligned with the principles of the Adaptation Mission.
Financing and Resources	There is no specific regional financial planning for adaptation. Investments depend on annual budgets and European funding such as Horizon Europe, FEDER, MRR, LIFE, Interreg, and the EU Urban Initiative.	Integrate regional adaptation funding mechanisms and explore innovative financing mechanisms (e.g., climate bonds, public-private collaborations).
Capabilities and Skills	Disparity between administrations and sectors. Limited technical training in climate adaptation.	Develop interdisciplinary training formats and capacity-building programs, collaborating with universities and regional actors.
Behavior Change	Institutional and social culture still focused on reactive management.	Promote communication, education, and climate culture

	Low level of perceived climate risk outside specialized areas.	strategies, with a special emphasis on rural areas, youth, and the productive sector.
Experimentation, Learning, and Reflection	Pilot experiences, without systematic mechanisms for capitalizing on them.	Establish adaptive monitoring mechanisms, inspired by the **Transformative Adaptation Journey** (DESIRMED), which promote iterative learning and strategic flexibility.

The progressive activation of these conditions will not only contribute to the effective implementation of the Adaptation Strategy, but will also enable the transition from a reactive and fragmented approach to a territorial model of transformative resilience, focused on anticipation, equity, and shared knowledge.

This approach will allow Castilla y León not only to adapt to the impacts of climate change, but to do so with social cohesion, territorial justice, and a strategic vision for the future.

4 Systems and stakeholder mapping

4.1 Systems map

The systemic approach promoted by P2R suggests that climate change adaptation cannot be addressed as a sum of isolated interventions, but rather as a profound transformation of the socioeconomic and ecological systems that sustain territorial functioning. In this framework, systems mapping becomes a key tool for understanding the interdependencies, vulnerabilities, and levers for change that exist in the territory.

In the case of Castilla y León, the ADAPT2CYL consortium has initiated an exercise to identify strategic systems whose resilience is essential for the entire autonomous community, both due to their functional role and their exposure to climate risks. This prioritization has been based on the technical risk assessment (section 2.3), the knowledge of key actors, and the initial participatory exercises of the process.

The key systems identified are detailed below, along with their main barriers to adaptation and the opportunities that can be unlocked within the framework of the Strategy.

Key Systems	Barriers	Opportunities
Mobility	High dependence on road transport; vulnerability of infrastructure to extreme phenomena; limited rural-urban integration; poor electrification in non-urban areas.	Strengthen sustainable and intermodal mobility; resilience in infrastructure; digitalization; integration of climate into territorial planning.
Energy	Aging infrastructure; vulnerability to heatwaves and water stress; dependency on centralized models in rural areas.	Expansion of renewables; development of smart grids; decentralization and self-consumption; energy efficiency in buildings and industry.
Agriculture	High exposure to droughts and extreme events; overexploitation of aquifers; loss of fertile soil and biodiversity; sector aging.	Agroecological transition; digitalization of the field; water efficiency; incorporation of youth; valorization of local supply chains.
Health and Well-being	Greater exposure of the elderly and rural population to heatwaves; insufficient preparation for emerging diseases; health infrastructure not always adapted.	Climate health monitoring; adaptation of health infrastructure; planning for extreme events; preventive health measures.
Urban and Rural Habitat	Urbanism poorly adapted to thermal stress or water scarcity; vulnerability of rural areas to forest fires; lack of infrastructure.	Climate rehabilitation of buildings; adaptive design; nature-based solutions; territorial cohesion.
Transversal Systems	Lack of climate culture in public and private decisions; poor connection between science, administration, and citizenship;	Education and training in adaptation; social and

	low investment in R&D in adaptation.	technological innovation; citizen participation; heritage protection.
Governance	Fragmentation of competences; low integration of climate in sectoral policies; short-term planning.	Multi-level governance; integrated planning; public-private collaboration; structured climate financing.

Each system reflects a series of structural tensions (infrastructural, regulatory, social, cultural) that hinder its adaptation capacity. At the same time, they all offer vectors of transformation if the right enabling conditions are activated (see section 3.2).

Among the main findings from the systems mapping, the following points stand out:

- In systems such as mobility or energy, the barriers are related to the existing infrastructure (often outdated or inflexible) and planning models that are still not very adaptive. However, clear opportunities arise in areas such as electrification, energy decentralization, and sustainable mobility.
- The agri-food system, an economic and territorial pillar of Castilla y León, is one of the most exposed and sensitive to the effects of climate change. Its transformation towards more sustainable, digitalized, and efficient models will be key for regional resilience.
- In the health and well-being sector, adaptation is linked to the ability to anticipate health risks, particularly in vulnerable populations, and to the adequacy of critical infrastructure.
- The habitat system, both urban and rural, reflects a dual need: to adapt the built environment to the new climate context and ensure basic services in areas with low population density.
- Transversal systems (education, knowledge, innovation, culture, participation) appear as key drivers of change. Adaptation will not be viable without a cultural shift across all sectors.
- Finally, the governance system represents both a structuring framework and a challenge in itself. The detected barriers highlight the need to improve coordination between levels of government, long-term planning, and the inclusion of climate criteria in all public policies.

This mapping provides a solid foundation for designing coordinated interventions, prioritizing resources, and identifying synergies between sectors. Furthermore, it helps visualize the interconnections between systems, which is crucial for addressing adaptation from an integrated perspective.

As the process of developing the Adaptation Strategy progresses, this systemic analysis will be supplemented with new contributions from key actors and structured participatory exercises.

4.2 Needs and roles of stakeholders

The success of a climate change adaptation strategy largely depends on the ability to effectively mobilize, coordinate, and engage the various stakeholders that make up the regional ecosystem.

In the case of Castilla y León, the quadruple helix approach (public administrations, businesses, academia, and citizens) provides an appropriate framework for identifying synergies, responsibilities, and specific needs of the actors operating within the key adaptation systems.

The actor mapping process carried out has allowed for the identification of a variety of representative actors, from the public, private, and social sectors, present at different governance levels (local, provincial, regional, and national). This diversity reflects an opportunity to approach adaptation from a territorial, multi-level, and multi-actor perspective, which takes into account both structural challenges and existing capabilities.

Group of Agents	Key System	Level	Needs	Potential Contribution	Vulnerable Groups	State of Involvement
Town Halls	Habitat / Governance	Local	Technical and financial resources to integrate adaptation into urbanism and public services.	Implement adaptive measures in the territory; activate community initiatives.	No	Variable depending on territory; growing interest.
Agri-food Sector Companies	Agri-food	Private	Technical assistance, incentives, and access to innovation for adapting productive practices.	Transform production towards more resilient and sustainable models.	Yes (in precarious labor chains)	Moderate; depends on incentives.
Health / Public Health Centers	Health and Well-being	Regional and Local	Training on specific protocols to respond to climate emergencies.	Protect public health from climate risks; act as an early warning node.	Yes (elderly and chronic patients)	Low-moderate; needs institutional support.
Universities and Research Centers	Transversal / Energy / Agri-food	Regional / National	Financing and connection with public policies for applying scientific knowledge.	Provide data, technical knowledge, and impact scenarios.	Not directly	Active in some projects; scattered.
Organized Citizens (neighborhood associations, NGOs)	Transversal / Habitat	Local / Regional	Real participation in planning; access to understandable and comprehensive information.	Promote social resilience, behavior change, and citizen vigilance.	Yes	Critical but often underrepresented.
Autonomous Administrations (Junta de Castilla y León)	Governance / Energy / Habitat	Regional	Stable strategic framework and planning; coordination and policy instruments.	Design and implement coherent and funded public policies.	No directly	High; institutional leadership.

Group of Agents	Key System	Level	Needs	Potential Contribution	Vulnerable Groups	State of Involvement
Public Transport Network / Mobility Operators	Mobility	Local / Regional	Modernization of fleets, infrastructure; adaptive service planning.	Promote sustainable and adapted transport; reduce emissions and vulnerability.	Yes (rural areas or with reduced mobility)	Low-moderate; requires structural support.

The results of this initial characterization, however, show several mismatches and key needs:

- **Unequal degree of involvement:** Some actors (such as regional administrations or certain town halls) show a high level of involvement in planning and execution processes, while others (such as mobility operators or health centers) still exhibit a low degree of adaptation integration in their operational agenda.
- **Need for technical and financial support:** Many local actors, particularly town halls and small businesses, require resources to incorporate resilience criteria into their daily decision-making.
- **Structural deficit in citizen participation:** Although organized citizens have high potential to drive the necessary cultural and community change, they remain underrepresented in most decision-making processes and the design of public policies.
- **Lack of transversal articulation:** There is a clear need to strengthen cooperation between sectors (for example, between health and urban planning, or between mobility and energy), especially to address complex and interconnected impacts of climate change.

On the other hand, the table highlights relevant capacities that need to be reinforced and leveraged, such as the potential of universities and research centers to generate applied knowledge, the role of the agri-food sector in the transition to more resilient production systems, or the key role of local administrations in implementing adaptive measures on the ground.

Overall, the analysis shows that Castilla y León has a diverse ecosystem of actors, partially committed, but one that requires strategic coordination, inclusive governance tools, and mechanisms of shared responsibility, especially to overcome fragmentation and establish a structural and sustained approach to adaptation.

This analysis will serve as a basis for designing specific engagement mechanisms adapted to each type of actor in the next phases.

Moving towards systemic and inclusive resilience in Castilla y León requires not just adding actors, but transforming their role: from passive observers to co-responsible protagonists of change.

4.3 Local champions

In the P2R methodological framework, local champions are key agents who act as drivers of change within their communities, organizations, or sectors. Their leadership, legitimacy, and mobilization capacity make them natural facilitators of transformative climate adaptation processes, especially in settings with limited institutional or technical resources.

In Castilla y León, the ADAPT2CYL project has begun identifying figures and initiatives that can play this strategic role, understanding that territorial resilience cannot be achieved without local references to translate the Strategy into concrete action.

Today, one of the main references identified in Castilla y León in this regard is the regional program “Escuela de Alcaldes” (School of Mayors), promoted by the Ministry of Environment, Housing, and Territorial Planning of the Junta de Castilla y León, as part of the “Fuentes Claras para la Sostenibilidad en municipios pequeños de Castilla y León” program.

This program aims to foster environmental leadership at the local level by facilitating the exchange of experiences between municipalities committed to sustainability and rural development. The initiative seeks to:

- Recognize and highlight best practices promoted by town halls in the areas of environment and sustainability.
- Offer training and inspiration to mayors to lead local transformation processes.
- Stimulate political commitment to environmental protection and the improvement of rural quality of life.

From the perspective of climate resilience, Escuela de Alcaldes represents a breeding ground for local leadership with great potential to become a platform for mobilizing climate champions. The participating municipalities are often pioneers in circular economy initiatives, energy efficiency, sustainable forest management, rural mobility, or environmental education, all of which are aligned with the objectives of adaptation.

Although the ADAPT2CYL Consortium has not yet systematized a comprehensive catalog of local champions involved in the process, the Escuela de Alcaldes is identified as an existing lever on which to build a territorial network of resilience leadership. This network could be expanded in later phases through specific calls, participatory processes, or recognition mechanisms within the Strategy.

In the next steps of the project, the possibility of strengthening and formalizing this network of driving agents will be explored through partnerships with local actors, municipal networks, and participation platforms, ensuring its territorial, sectoral, and social diversity.

Public sector action is crucial, but not enough. The private sector is an indispensable ally, as its innovation, resources, and execution capacity are vital for materializing adaptation strategies. In the private sector of Castilla y León, there are already experiences that reflect the commitment of various productive sectors to climate change adaptation. Two projects from Vitartis stand out; the ARCA project, whose main objective is to develop a digital tool that allows agri-food companies in Castilla y León to identify and manage the climate risks they are exposed to. The Mencía project, which seeks to promote comprehensive sustainability in the agri-food industry through the application of circular economy principles, addressing key aspects such as water management efficiency, energy, packaging, and logistics.

5 Governance

Climate change adaptation represents not only a technical or sectoral challenge but also a structural governance challenge. Achieving true and lasting climate resilience in Castilla y León requires a multi-level and multi-actor governance model, which coherently articulates existing institutional capacities, promotes shared responsibility among all social sectors, and ensures effective coordination, financing, and monitoring mechanisms.

In this regard, governance is understood not only as the action of public administrations but also as the way in which responsibilities are distributed, shared, and exercised among all the actors in the quadruple helix.

The current institutional framework of Castilla y León presents both capacities and limitations for the development of a solid and functional climate governance. This section analyzes the foundations and challenges of climate governance in the region.

5.1 Multi-level governance context

5.1.1 *Local, Regional, and Regional Governance Structure and Framework*

Climate change adaptation is characterized by its deeply transversal nature, as its impacts affect multiple sectors and, consequently, require the coordinated involvement of various levels of public administration. This transversality presents a significant governance challenge: there is no single competent administration for adaptation; rather, it must be coordinated through a complex and, in many cases, poorly structured institutional framework.

In Castilla y León, the local, provincial, regional, and national levels have key competencies that directly or indirectly impact the planning and execution of adaptation policies:

Local level:

Town halls are responsible for essential public services such as territorial planning, urban planning, water management, lighting, and urban green spaces, all of which are directly exposed to the impacts of climate change. Additionally, they play an irreplaceable role in implementing adaptation measures on the ground, especially regarding social vulnerabilities, local emergencies, and urban planning. However, many municipalities—especially in rural areas—lack sufficient technical and financial resources to integrate climate considerations into their planning.

Provincial level:

Provincial councils play a technical, economic, and administrative support role for municipalities with fewer resources and have competencies in strategic areas such as infrastructure, roads, environment, and rural development. In practice, they can function as intermediary structures that facilitate the application of adaptation policies throughout the territory, promoting equity and territorial cohesion.

Regional level:

The Junta de Castilla y León, through its different ministries, has key sectorial competencies for adaptation, including:

- Ministry of Environment, Housing, and Territorial Planning, which leads climate and environmental planning and coordinates the ADAPT2CYL consortium.
- Ministry of Agriculture, Livestock, and Rural Development, involved in the resilience of the agri-food system.
- Ministry of Health, in relation to public health and risks associated with heatwaves or emerging diseases.
- Ministry of Mobility and Digital Transformation, responsible for transport networks and territorial digitalization.
- Ministry of Industry, Trade, and Employment, with a key role in the transition of exposed economic sectors and in social dialogue.

The Fundación Patrimonio Natural acts as a reference instrumental body for the execution of climate policies, the development of pilot projects, and the facilitation of participatory processes.

National level:

At the national level, the regulatory and strategic frameworks developed by the Ministry for Ecological Transition and the Demographic Challenge (MITECO) stand out. This ministry leads the National Climate Change Adaptation Strategy (ENACC) and coordinates the National Adaptation Plan (PNACC). Other ministries such as Health, Agriculture, and Transport also provide programs and funds that influence or support regional and local adaptation policies.

An interesting reference in the field of territorial governance in Castilla y León is the project “Gobernanza Cencil”, promoted within the framework of the Spain-Portugal Cross-Border Cooperation Program (POCTEP) and coordinated by the Junta de Castilla y León. This initiative aimed to improve multi-level governance and strategic planning in the Cencil cross-border axis (which connects Castilla y León with the central and northern regions of Portugal), integrating the participation of local, provincial, and regional administrations, as well as social and economic actors from the territory.

Although the project’s focus was not exclusively climate-related, its horizontal governance, cross-border, and multi-actor approach can offer valuable and replicable lessons for the design of future regional climate governance. In particular, the experience gained in participation, actor coordination, shared territorial diagnostics, and joint planning can be leveraged to strengthen cooperation mechanisms around climate change adaptation, both at the regional and interregional levels.

Despite this diversity of actors and competencies, there is currently no formal, coordinated, and stable governance structure in Castilla y León that functionally articulates the various administrative levels and sectors involved in climate change adaptation. The lack of

institutionalized interdepartmental collaboration mechanisms and the limited connection between government levels and non-institutional actors hinder effective and aligned climate action.

This institutional gap represents a significant barrier, but at the same time, it presents a transformative opportunity. The development of the Climate Change Adaptation Strategy for Castilla y León, within the framework of the ADAPT2CYL project, will allow for outlining a more structured, inclusive, and long-term-oriented climate governance architecture. This design will be refined and consolidated through the monitoring, evaluation, and learning mechanisms described in Chapter 6 of this report, and in close connection with the participatory process accompanying the development of the Strategy.

In short, strengthening governance is an essential enabling condition to ensure the coherence, effectiveness, and sustainability of adaptation actions across the entire territory.

5.1.2 Participation of Non-Governmental Actors

The active participation of non-governmental actors (organized civil society, the business sector, academia, and community groups) is an essential component for the success of any climate change adaptation strategy.

In Castilla y León, the involvement of these actors remains uneven, but there are established spaces for collaboration and structures that offer a valuable starting point to move towards a more inclusive and co-responsible climate governance.

One of the key references in this area is the Escuela de Alcaldes (School of Mayors), an initiative promoted by Fundación Patrimonio Natural and the Junta de Castilla y León. Although focused on municipal political leaders, it encourages community participation through the dissemination of best practices, the visibility of local initiatives, and exchange with territorial actors (neighbourhood associations, cooperatives, environmental groups, etc.). This platform can serve as a breeding ground for leadership and a point of entry for channelling non-governmental voices into decision-making processes about sustainability and adaptation.

Additionally, the Federación Regional de Municipios y Provincias (FRMP), as a representative entity of municipalism, acts as a communication channel between local governments and other territorial actors, including business associations, citizen groups, and professional entities. Its role as a territorial linkage allows for the integration of a more decentralized vision of climate action.

On the other hand, Castilla y León has an institutionalized social dialogue framework through the Council for Social Dialogue, where the regional government, the most representative trade unions (UGT and CCOO), and the employers' association (CEOE Castilla y León) regularly participate. In recent years, this body has been used to negotiate employment plans, social policies, and energy transition, making it an ideal space to introduce climate adaptation as a new transversal consensus axis, especially considering its implications for employment, occupational health, training, and the transformation of the productive model.

In terms of sectoral involvement, some improvement opportunities and challenges have been identified preliminarily, as follows:

Opportunities for Improvement	Challenges
Organized civil society: Its presence in formal decision-making processes remains limited, though environmental associations, land stewardship networks, and active community platforms exist in various provinces. Its territorial knowledge, mobilization capacity, and social legitimacy are active factors that should be recognized and integrated.	Its presence in formal decision-making processes remains limited, though environmental associations, land stewardship networks, and active community platforms exist in various provinces. Its territorial knowledge, mobilization capacity, and social legitimacy are active factors that should be recognized and integrated.
Business sector and clusters: Entities such as AEICE and the Chambers of Commerce are starting to integrate climate risk into their agendas, especially in sectors like sustainable construction, energy efficiency, and agri-food. Strengthening their participation in the design of adaptation strategies can accelerate the transformation of key sectors	Entities such as AEICE and the Chambers of Commerce are starting to integrate climate risk into their agendas, especially in sectors like sustainable construction, energy efficiency, and agri-food. Strengthening their participation in the design of adaptation strategies can accelerate the transformation of key sectors.
Universities and research centers: Although there is significant scientific production on climate change in the region (e.g., University of Valladolid and other public universities), their connection to public policies still has significant room for improvement. Promoting their role as strategic advisors in the design, monitoring, and evaluation of the Strategy will be key to their technical legitimacy and effectiveness.	Although there is significant scientific production on climate change in the region (e.g., University of Valladolid and other universities), their connection to public policies remains limited.

This approach will allow Castilla y León to move towards a more inclusive, co-responsible, and effective climate governance model, where adaptation is no longer a policy of experts or administrations, but becomes a shared responsibility of society as a whole.

6 Monitoring, evaluation and learning (MEL)

The design of the new Climate Change Adaptation Strategy for Castilla y León presents the opportunity to overcome one of the main weaknesses identified in the previous climate planning: the lack of an operational and sustained system for monitoring, evaluation, and learning (MEL).

Although the Regional Climate Change Strategy 2009-2020 included a formal monitoring framework (including an evaluation committee, an indicator system based on the DPSIR model, and periodic result publications), these tools were never implemented in practice. According to the Council of Accounts report (2023), neither the monitoring committee was activated, nor was the indicator system applied, nor was a functional observatory established. This shortcoming prevented the measurement of the effectiveness of actions and severely impacted the capacity for learning, correction, and institutional accountability.

The new Adaptation Strategy proposes a monitoring, evaluation, and learning model that addresses these structural deficiencies and lays the foundation for climate management based on evidence, iterative learning, and continuous improvement. This system is conceived as a structural component of the strategy and will be supported by the following operational principles:

- **Learning-oriented:** Beyond accountability, the monitoring process will generate collective intelligence, identify bottlenecks, and scale best practices.
- **Simplicity and applicability:** The system will rely on a limited but meaningful set of indicators, applicable at both the regional and municipal levels.
- **Multi-level and multi-actor:** It will involve administrations, sector offices, social actors, and citizens.
- **Transparency and participation:** It will include public accountability channels, open access to data, and participatory evaluation mechanisms.

Proposal for the Functional Architecture of the MEL System

The new monitoring, evaluation, and learning (MEL) system for the Adaptation Strategy of Castilla y León will be structured as an institutional and technical infrastructure combining quantitative analysis, qualitative verification, transparency mechanisms, and periodic learning cycles. Its design draws on lessons learned from the previous strategy, as well as the methodological frameworks of the EU Adaptation Mission and the Pathways2Resilience program.

To ensure its operability and usefulness, it is proposed that the system be structured around the following key elements:

- **Digital Monitoring Platform:** A centralized data management tool will be developed, accessible to the units responsible for each action and linked to the future Climate Change Office. This platform will allow for the uploading, visualization, and analysis of progress through dynamic dashboards, including visual systems like a “traffic light” indicator to show the degree of compliance by measure, municipality, or key system.

- **Adaptive Indicator System:** A limited but operational set of indicators will be established, linked to the strategic objectives and the risks identified in the diagnosis. These indicators will be designed to provide a synthetic reading of progress while incorporating flexibility for periodic review and adaptation to new priorities, learning, or information needs.
- **Structured Evaluation Cycles:** The preparation of annual monitoring reports, mid-term evaluations every three years, and a final evaluation at the end of the strategic cycle is planned. These exercises will allow for the analysis of trends, the identification of blockages, and the formulation of improvement recommendations.
- **Verification and Quality Mechanisms:** To ensure the robustness of the reported data, complementary mechanisms will be incorporated, such as external audits, cross-review between technical units, and perception surveys directed at involved actors and beneficiaries, especially at the local level.
- **Monitoring Governance Structure:** The MEL system will be coordinated by a technical office dependent on the future Climate Change Office of Castilla y León, in collaboration with sectorial units designated within each ministry. Furthermore, the creation of a Regional Adaptation Observatory will be evaluated to enhance analysis, coordination, and transparency functions.
- **Transparency and Participation Channels:** The monitoring information will be made accessible to the public through quarterly newsletters, annual reports, and a specific section on the institutional website. In addition, the promotion of annual accountability forums open to civil society and territorial actors will be encouraged, creating spaces for dialogue, shared learning, and continuous improvement.

This monitoring model aims to become a key piece in regional climate governance, ensuring not only the traceability of actions but also their social legitimacy, corrective capacity, and permanent connection with territorial realities. Ultimately, it will be a tool for continuous improvement and strengthening the institutional and citizen commitment to climate change adaptation.

7 Finance

Climate change adaptation requires solid, stable, and long-term financial planning. However, in Castilla y León, there is still no specific financial strategy linked to climate adaptation, which limits the capacity for structural responses to both current and future impacts. Investments in this area largely depend on the annual budgets of the Junta de Castilla y León and the availability of European funds, resulting in fragmented climate action that is dependent on political cycles and lacks a structured investment vision.

Despite this, there are already mobilized resources (for example, in environmental restoration, water management, and fire resilience) that could be integrated into a coherent climate planning logic. Potential strategic alliances (with sector clusters, public banks, European instruments, etc.) have also been identified to activate new innovative financing mechanisms, such as climate bonds, hybrid financing, or public-private collaborations.

In this context, one of the main future milestones of the process initiated with this report will be the development of the Climate Investment Plan of Castilla y León, as outlined in the next phases of the ADAPT2CYL project. This plan will allow for:

- Consolidating a specific financial framework for adaptation.
- Identifying and prioritizing territorial and sectoral investment needs.
- Evaluating public, private, and hybrid financing mechanisms, as well as barriers and incentives.
- Aligning planned investments with adaptation objectives, identified climate risks, and European and international commitments.

The development of this plan will be key to ensuring the viability and scalability of the measures outlined in the Adaptation Strategy and to establishing a financial architecture that makes climate resilience a strategic, transversal, and sustainable investment over time.

8 Next steps

The preparation of this baseline report marks a key first milestone in the process of building a Climate Change Adaptation Strategy for Castilla y León. This document has consolidated a preliminary diagnosis of climate risks, territorial vulnerabilities, critical systems, involved actors, and existing capacities in the region. From here, a new phase begins, focused on strategic and operational planning, aiming to define the most pertinent, viable, and transformative adaptation solutions for the territory.

The next steps outlined in the framework of the ADAPT2CYL project, aligned with the P2R program methodology, are as follows:

- **Design of the Adaptation Action Plan:** Concrete adaptation measures will be prioritized, with a territorial and sectoral focus, based on the risk and system analysis conducted. These measures will integrate criteria of feasibility, cost-effectiveness, co-benefits, and climate justice.
- **Development of the Climate Investment Plan:** In parallel, a financial framework will be developed to identify the necessary sources, instruments, and mechanisms to finance adaptation in a structured way, exploring both public and private and innovative resources.
- **Activation of participatory processes:** Multi-actor dialogue spaces (authorities, citizens, private sector, academia) will be deployed to validate the diagnosis, co-create solutions, and build consensus around the Strategy's priorities.
- **Consolidation of the monitoring and learning system:** The MEL (Monitoring, Evaluation, and Learning) model will be defined, with indicators, targets, and tools that allow the assessment of progress, adjustment of actions, and ensure transparency and accountability.
- **Advancement in climate governance architecture:** An organizational model will be proposed to facilitate interdepartmental coordination, multi-level collaboration, and shared responsibility among key actors.
- **Strengthening of capacities and communication:** Actions will be designed for technical capacity-building, citizen awareness, and dissemination, essential to mobilize society toward a resilience culture.

The process will continue over the next few months, with Fundación Patrimonio Natural as the coordinating entity, alongside the support of the ADAPT2CYL consortium and the P2R European program. The culmination of this process will be the **approval and implementation of the Climate Change Adaptation Strategy for Castilla y León**, a roadmap that will transform the diagnoses into action and set the region on the path to a just, resilient, and sustainable transition.