Building vs Heat Island Effect: Adaptation H2100

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TEP-968 – Technologies for Circular Economy

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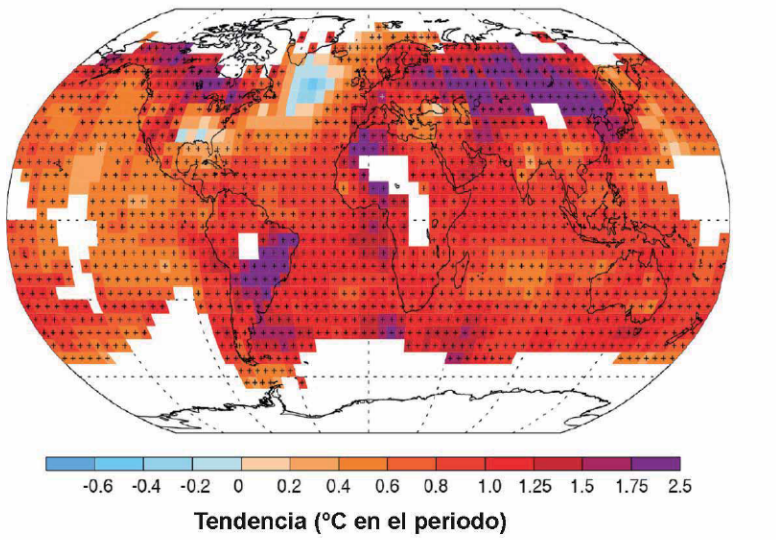
TEC ECONOMÍA CIRCULAR TECNOLOGÍAS

CONTENT

1. Introduction

- Climatic change: a fact now and in next years

Cambio en temperatura anual media 1901-2012



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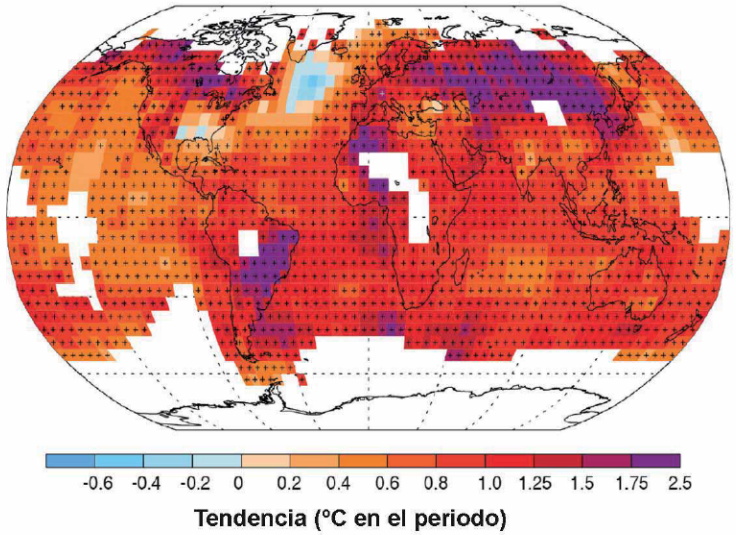
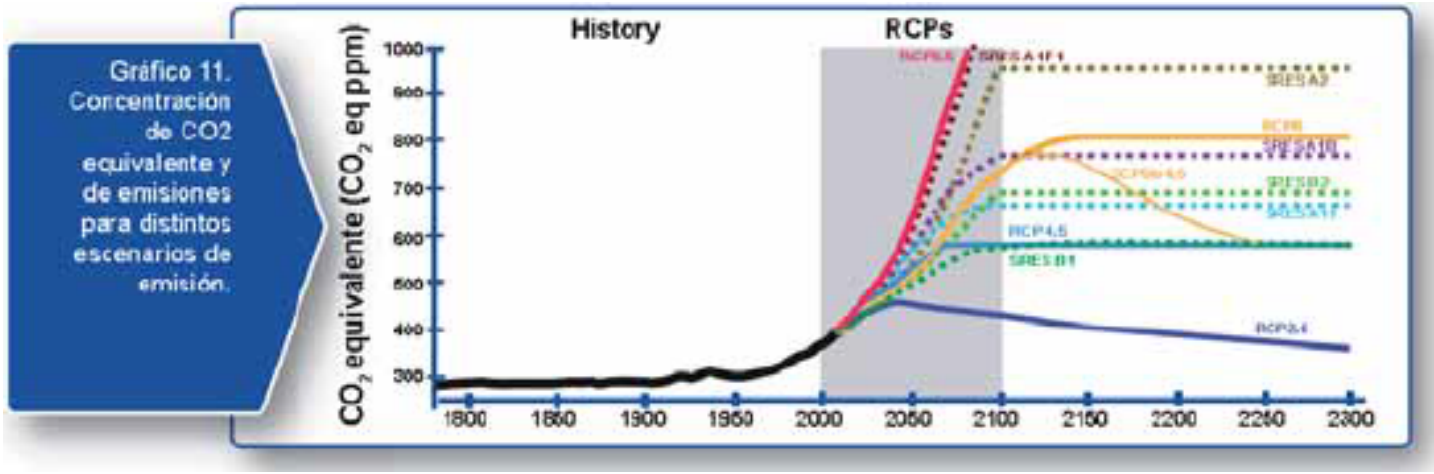
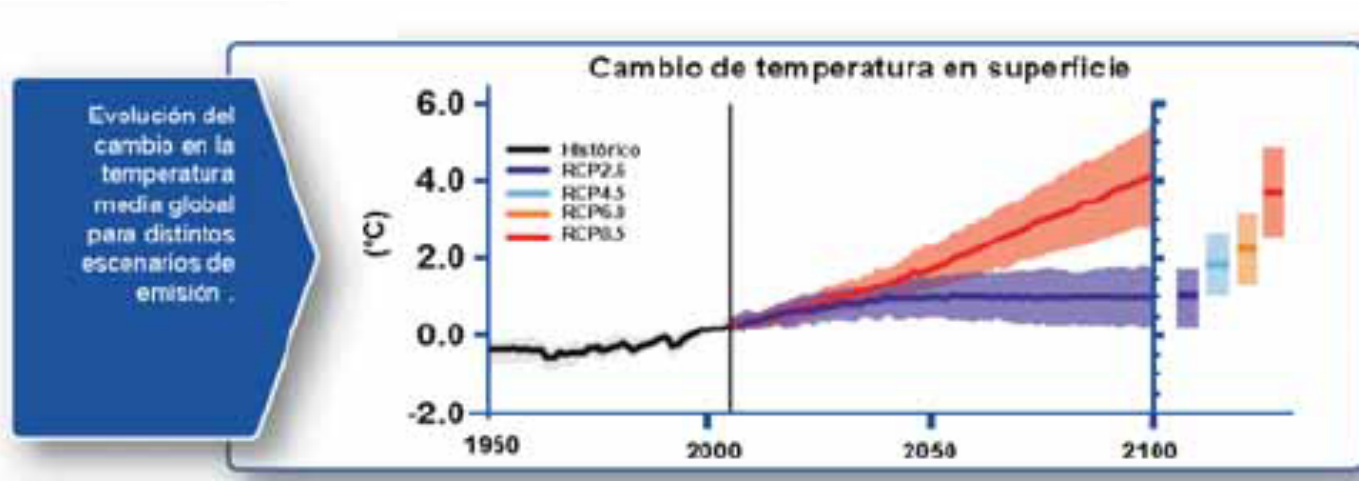






1. Introduction

- Cities are not prepared to face climate change

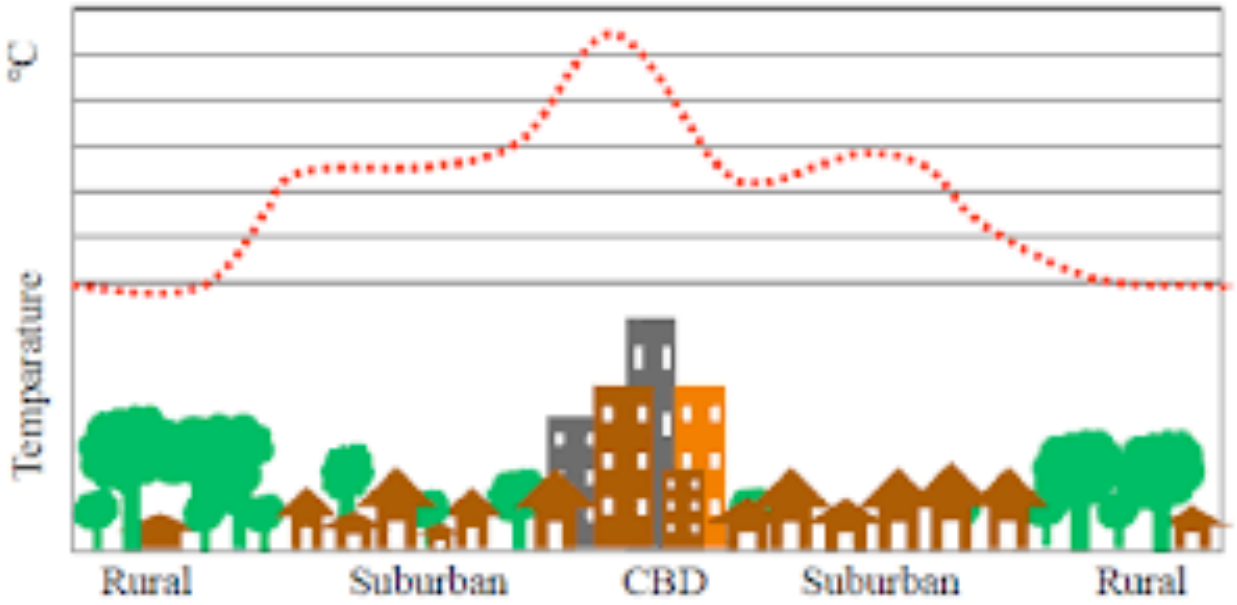
HOT

FLOODS

1. Introduction

- Cities are not prepared to face climate change

URBAN HEAT ISLAND EFFECT (UHIE)



1. Introduction

Building should be desing to take into account futures scenarios

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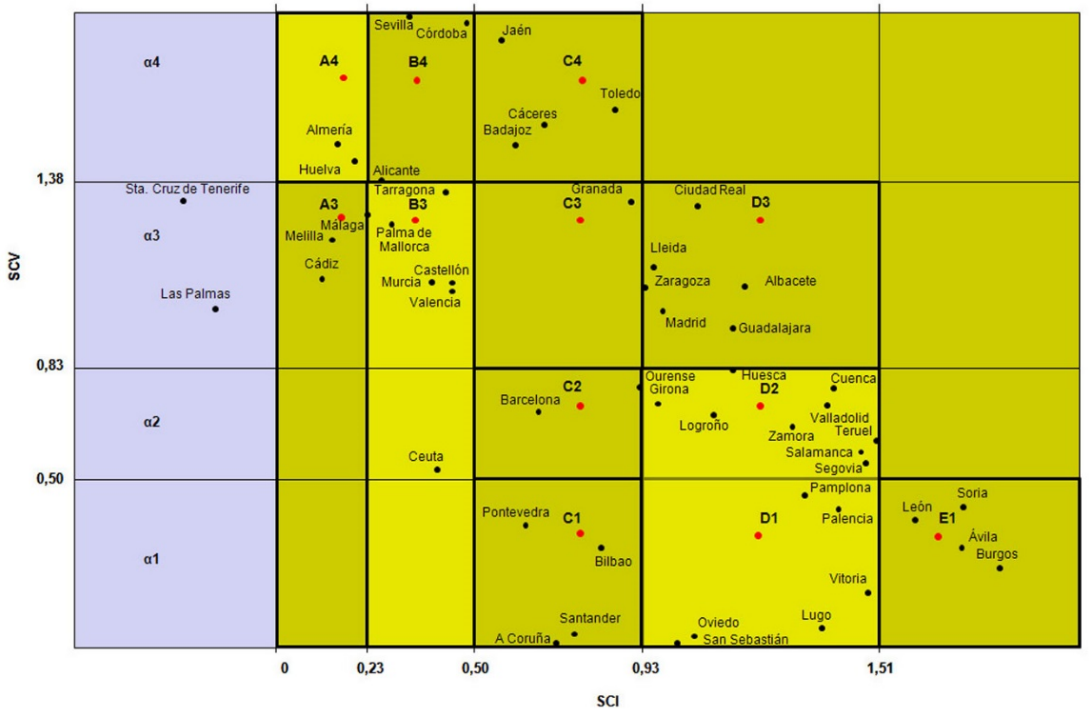
Climate zones, provincial capitals and reference climates. (CTE)



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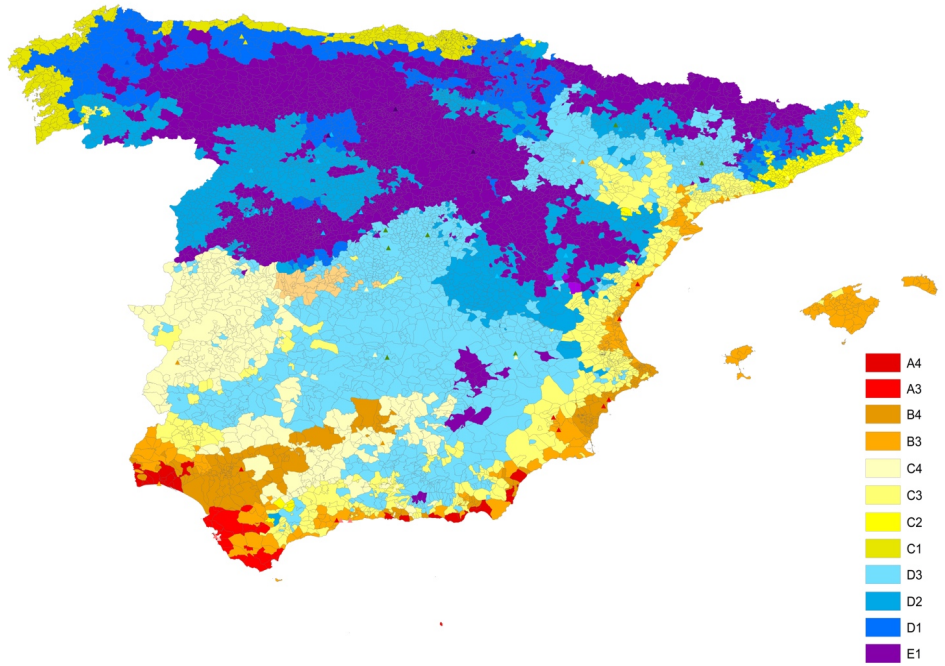

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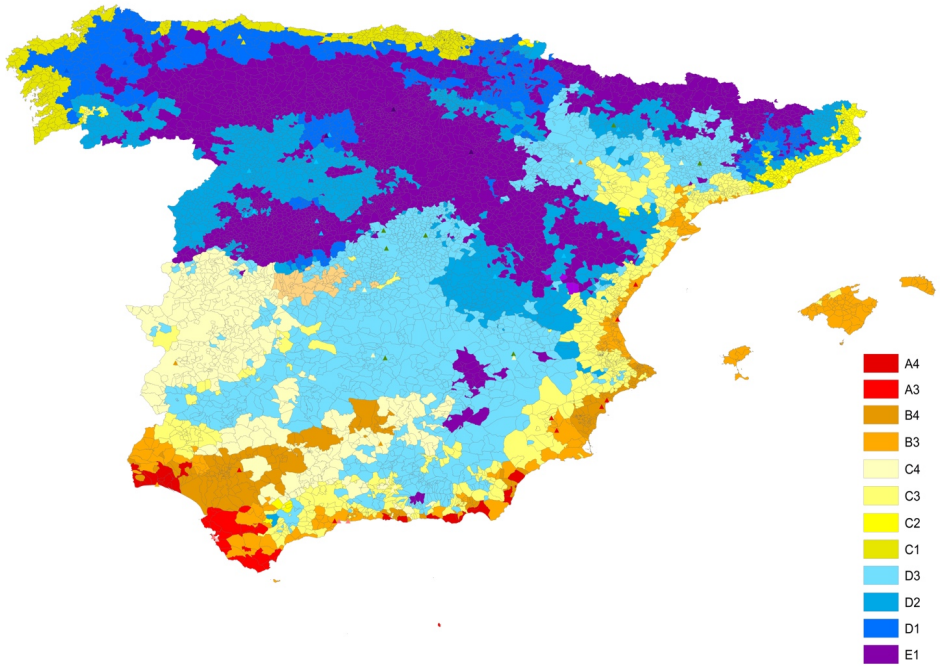


- Are climate zones adapted to nowdays clime characteristics?
- Do climatic zones take into account UHEI?
- How are climate zones going to change H2100?
- How could we adapt our building to futures changes?

2. Aims

- Are climate zones adapted to nowdays clime characteristics?
- Do climatic zones take into account UHEI?
- How are climate zones going to change H2100?
- How could we adapt our building to futures changes?

2. Methodology

To achieve the objectives of this study, the requalification of the climatic zones of the Technical Building Code, aimed at complying with the hygrothermal performance of the building, and their adaptation to the **RCP 4.5 and RCP 8.5 scenario** of climate change were carried out ; through the following phases:

I. Weather station identification and data collection and processing
II. Calculation of heating and cooling days
III. Calculation of the summer climate severity index (SCV) and winter (SCI)
IV. Requalification of climatic zones
V. Evaluation of the dynamics of changes in climatic zones
VI. Data extrapolation

2. Methodology

I. Identification of weather stations and data collection and processing

- 78 temperature meteorological stations AEMET (Spanish meteorological agency)
- Software Osisoft has been used for the management of events and data in real time.
- A highly scalable and reliable architecture that is present at all stages of the data management process: collection, storage, handling and auditing.

It includes a large number of front-end software interfaces really appropriate for the construction, management and visualization of the system data points. To audit the calculations taken into account in this investigation and the hypothesis presented, a reliable and adaptable database based on meteorological data provided by the State Meteorological Agency (AEMET) has been designed and constructed. For the construction of this database, different abstractions have been achieved between the raw data points and the assets. Given the high scalability of the system, this database could be used in the future for future research based on the results of this research. The database design consists of three distinct phases: the stages of defining assets and attributes, importing data, analyzing and exporting data.

2. Methodology

II. Calculation of heating and cooling days

$$(1)\ CDD_d = \left[\sum_{24}^{i=1}(T_i - T_b)^+\right]\frac{1}{24} \qquad (2)\ HDD_d = \left[\sum_{24}^{i=1}(T_b - T_i)^+\right]\frac{1}{24}$$

III. Calculation of the summer climate severity index (SCV) and winter (SCI)

$$SCV = a{\cdot}CDD20_{jun\text{-}sep} + b{\cdot}CDD20_{jun\text{-}sep}{}^2 + c$$

$$SCI = a \cdot HDD20_{oct-may} + b \cdot \frac{n}{N} + c \cdot HDD20_{oct-may}{}^2 + d \cdot \left(\frac{n}{N}\right)^2 + e$$

2. Methodology

IV. Requalification of climatic zones

The winter climate zone is determined based on the winter weather severity (SCI), each winter climate zone of the DB-HE (α, A, B, C, D and E) corresponding to the interval indicated in Table I.

α	A	B	C	D	E
SCI ≤ 0	0 < SCI ≤ 0, 23	0, 23 < SCI ≤ 0, 5	0, 5 < SCI ≤ 0, 93	0, 94 < SCI ≤ 1, 51	SCI > 1, 51

The summer climate zone is determined based on the summer weather severity (SCV), each summer climate zone of the DB-HE (1, 2, 3, 4) corresponding to the interval indicated in Table II.

1	2	3	4
SCV ≤ 0, 5	5 < SCV ≤ 0	0, 83 < SCV ≤ 1, 38	SCV > 1, 38

2. Methodology

V. Evaluation of the dynamics of changes in climatic zones

a) obtaining monthly temperature deltas based on ADAPTECCA projection

2025 - 2055 – 2085

RCP 4.5 y RCP 8.5

b) obtaining temperature projections based on data from AEMET and ADAPTECC

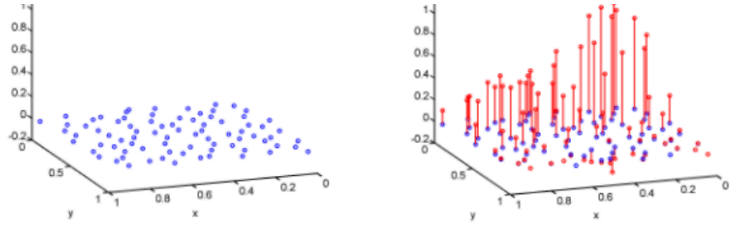
c) obtaining climate zones from the predictions

$$T_{2025} = T_{2018} + \Delta T_{2025-2018}$$
$$T_{2055} = T_{2018} + \Delta T_{2055-2018}$$
$$T_{2085} = T_{2018} + \Delta T_{2085-2018}$$

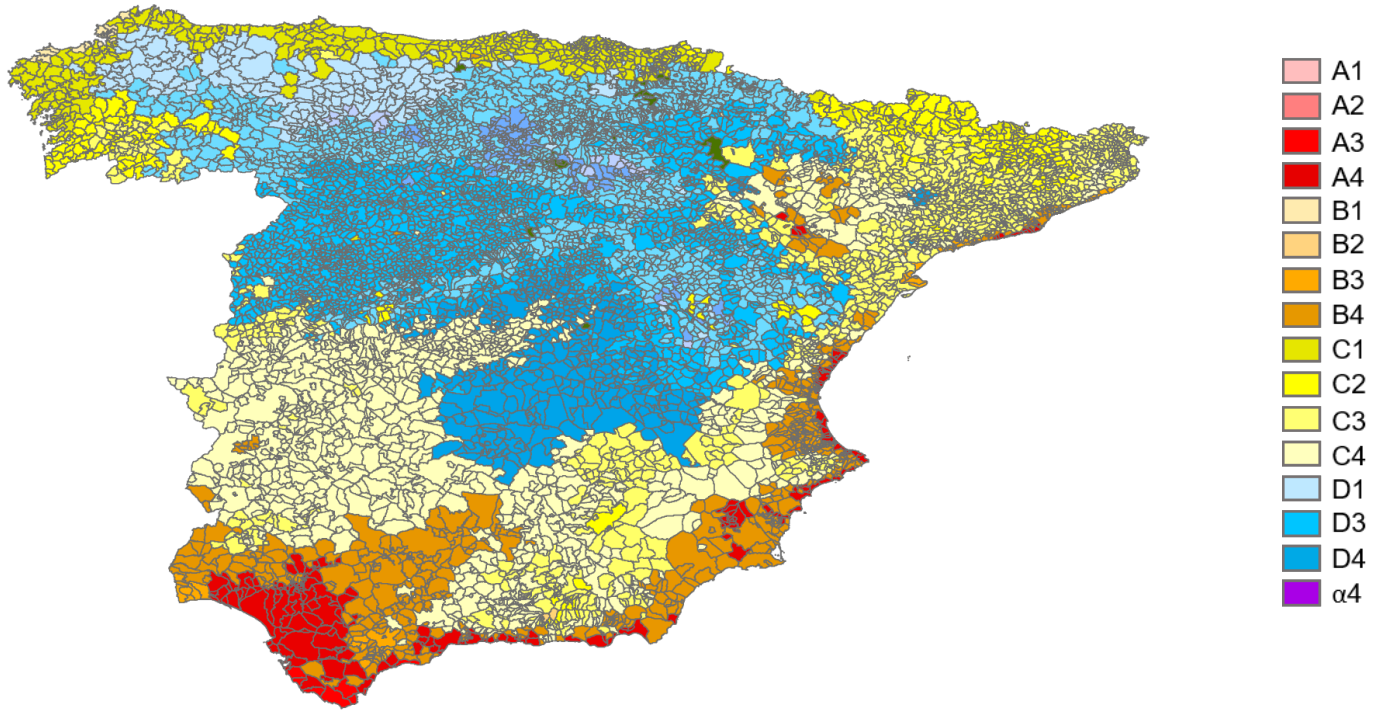
2. Methodology

VI. Data extrapolation

- Location of m = 78 points in Spain;
- Severity data of those 78 points in Spain;
- Objective: Infer with some criteria the severities in others N = 8000 points of the Spanish geography



3. Results



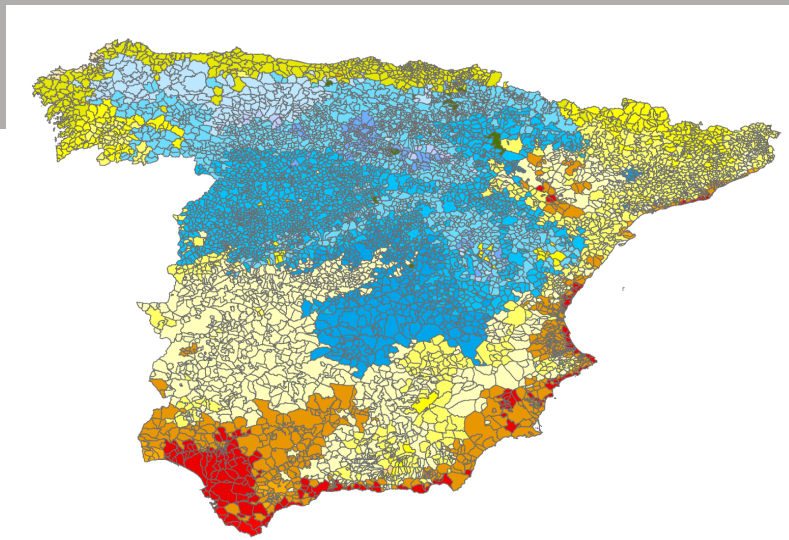
New qualification of Climate Zones in the Iberian Peninsula (NQCZ)

67% of Ibérica Peninsula surface changes its climatic calification comparing with the included in CTE

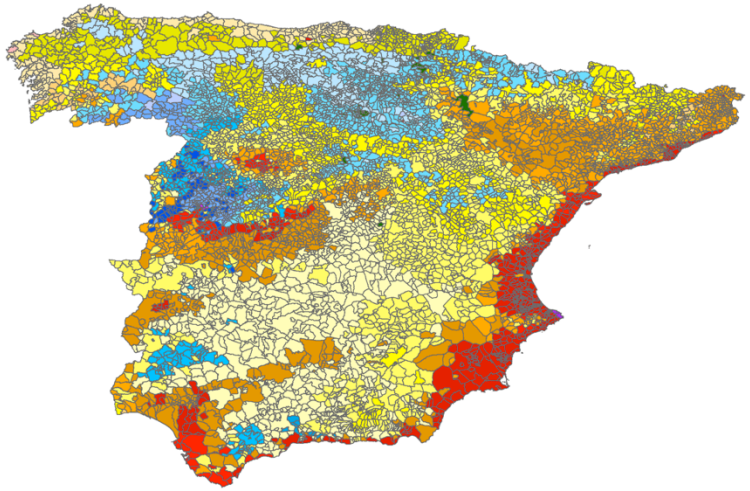
Clasification	Surface KM2
Without data	1,258
A3	1,431
A4	18,144
B1	814
B2	148
B3	2,630
B4	48,344
C1	23,815
C2	19,696
C3	61,539
C4	105,875
D1	21,554
D2	67,955
D3	76,471
D4	36,686
E1	1,647
E2	5,702
E3	19

3. Results

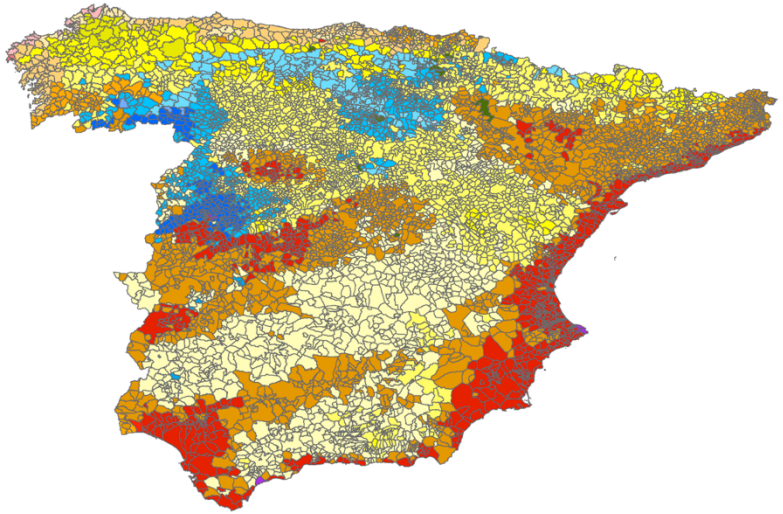
New qualification of Climate Zones in Spain (NQCZ)



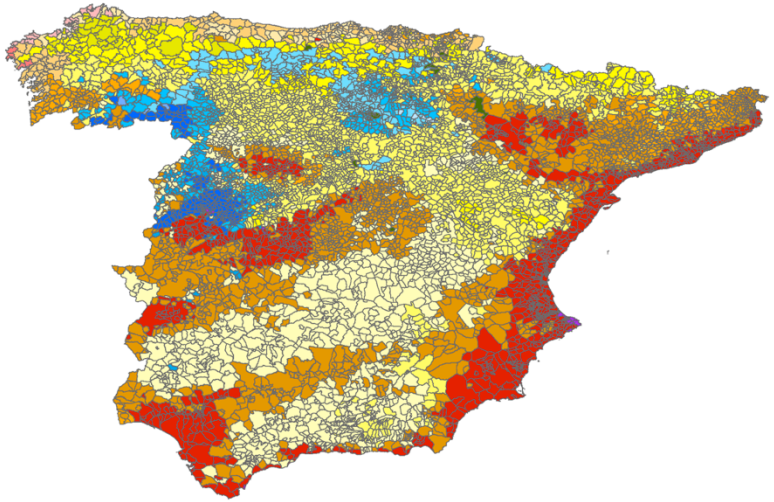
A1
A2
A3
A4
B1
B2
B3
B4
C1
C2
C3
C4
D1
D3
D4
α4



Qualification of Climate Zones in Spain RCP 4.5 2025



Qualification of Climate Zones in Spain RCP 4.5 2055



Qualification of Climate Zones in Spain RCP 4.5 2085

3. Results

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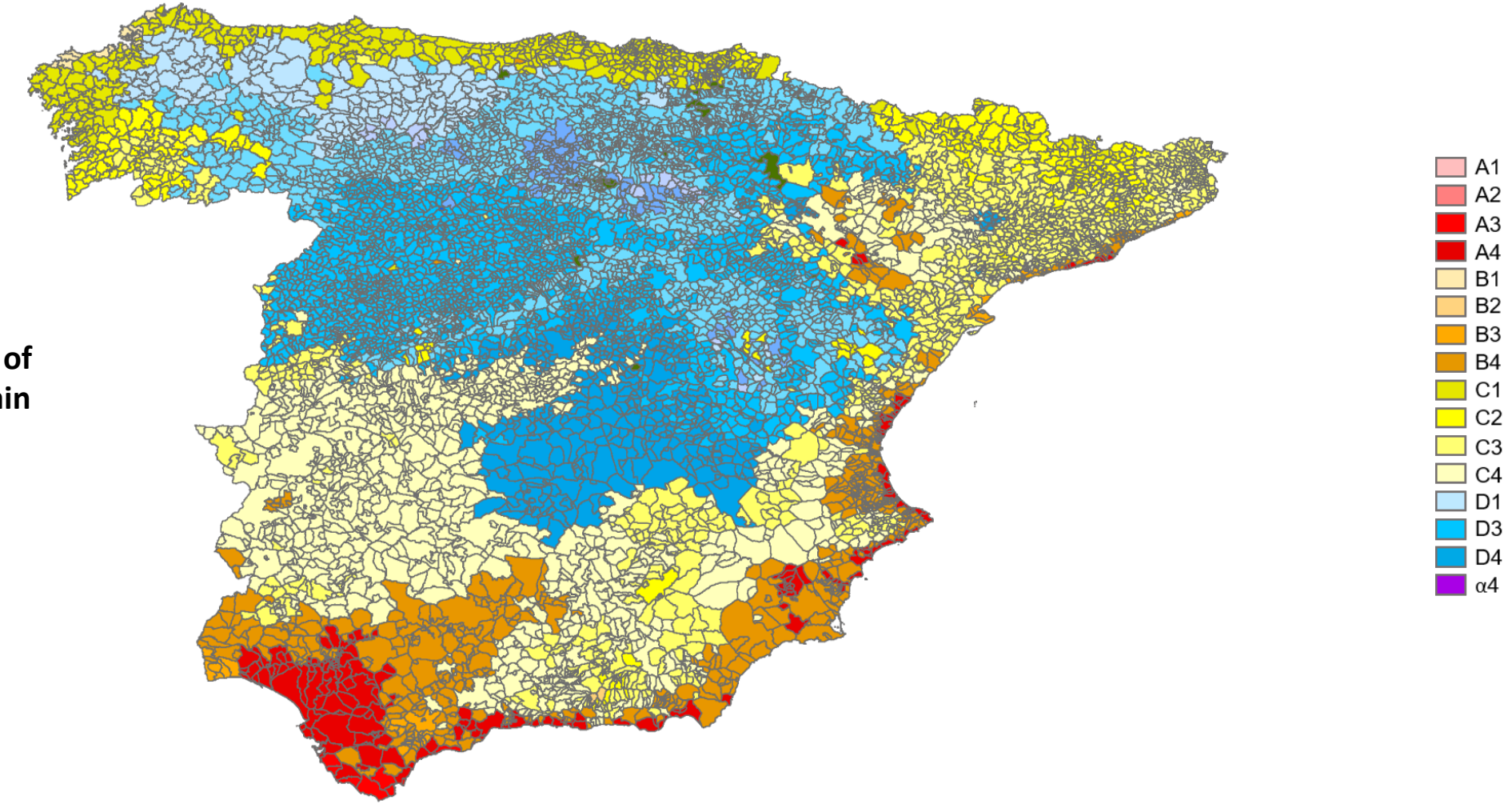

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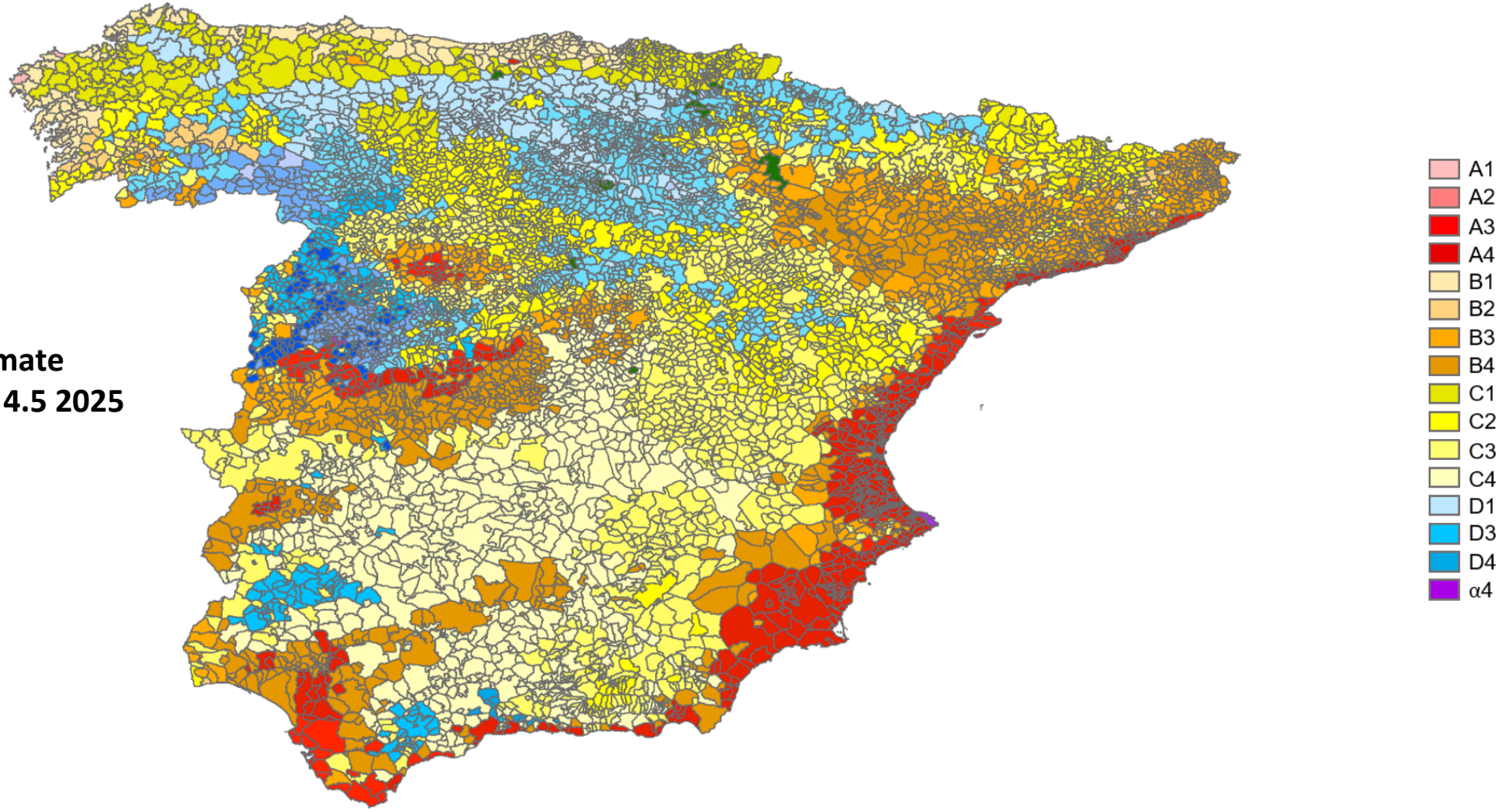
Qualification of Climate Zones in Spain RCP 4.5 2025



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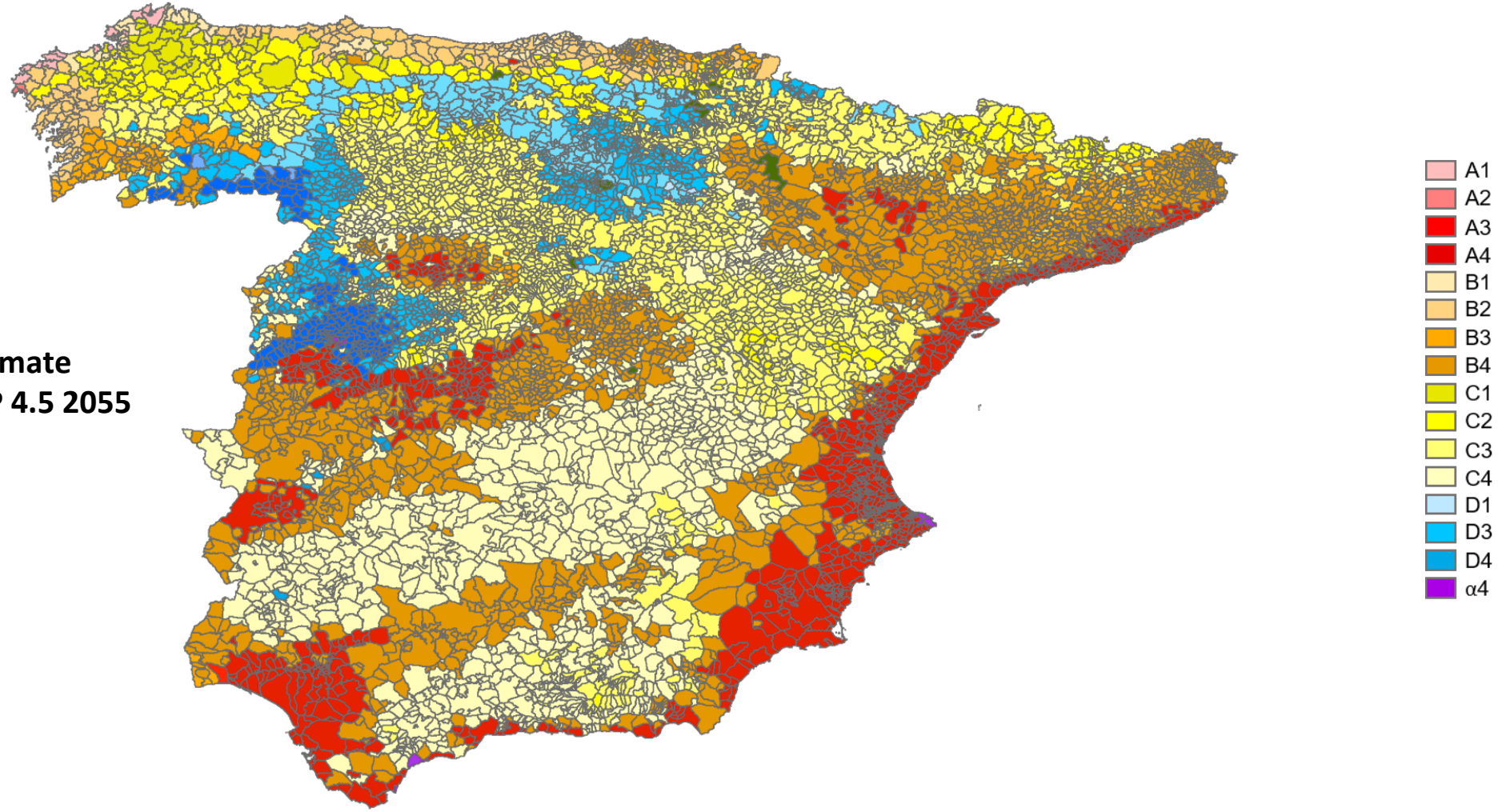

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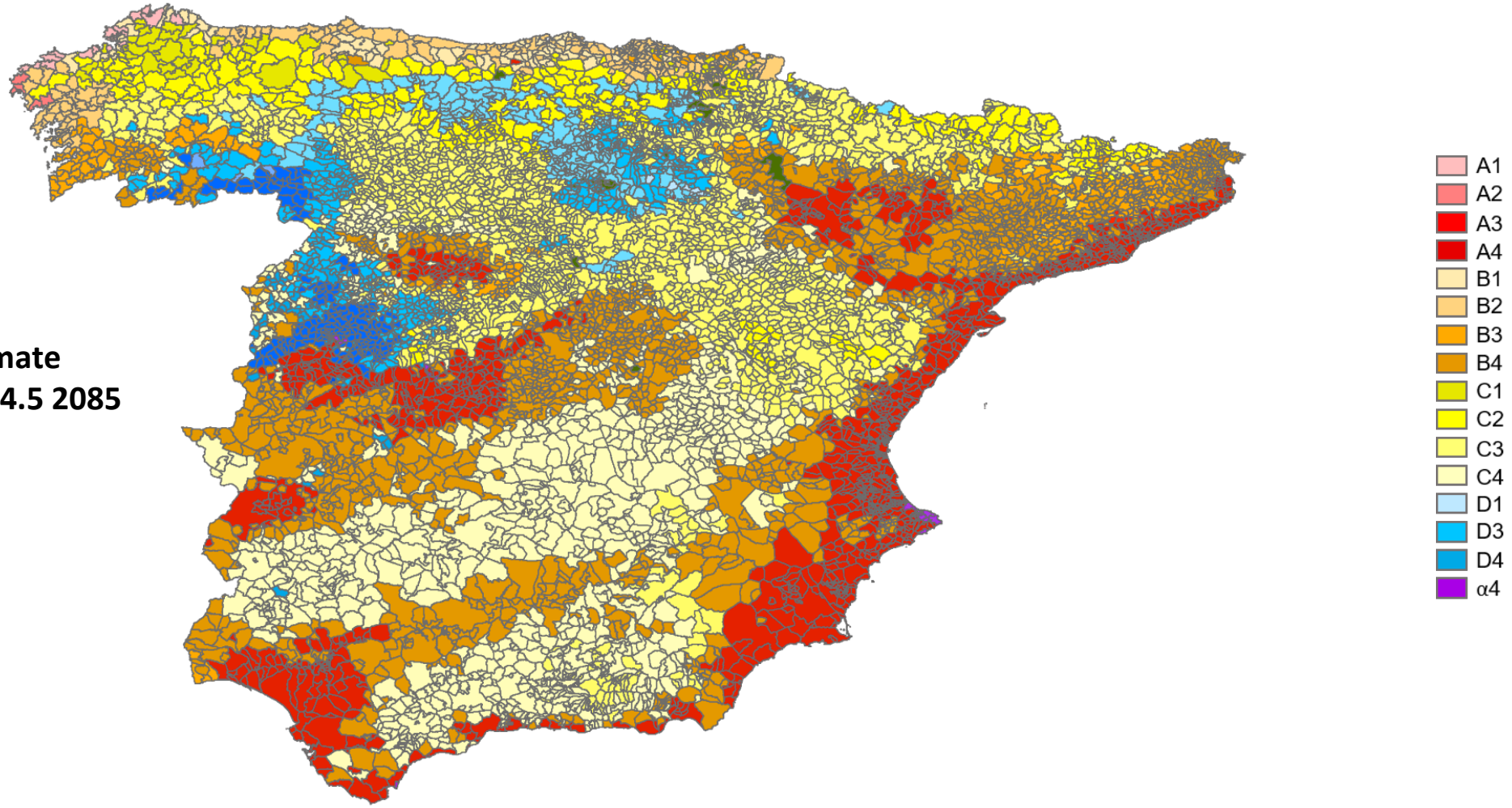

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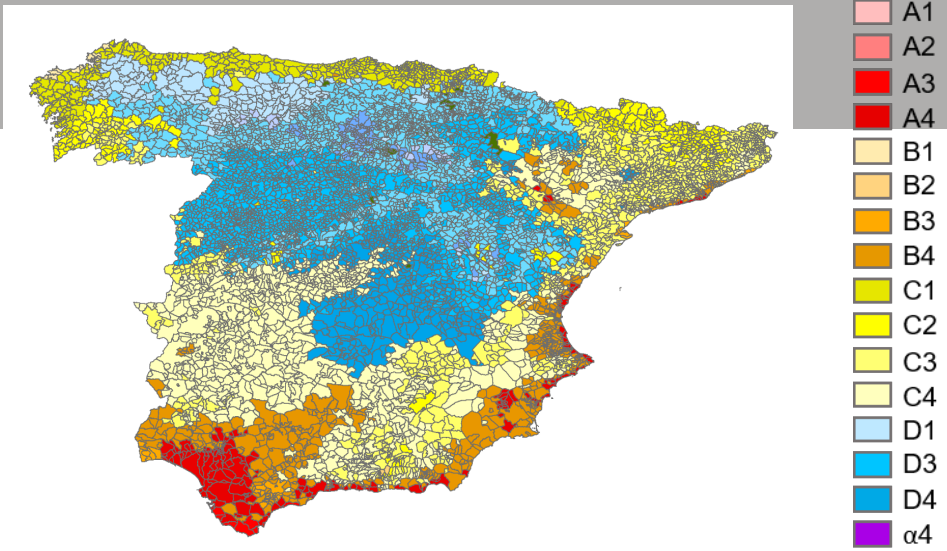
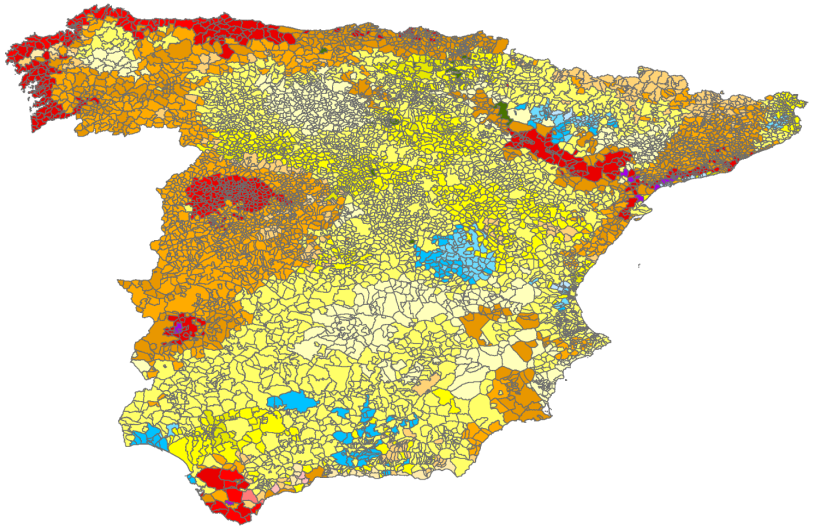
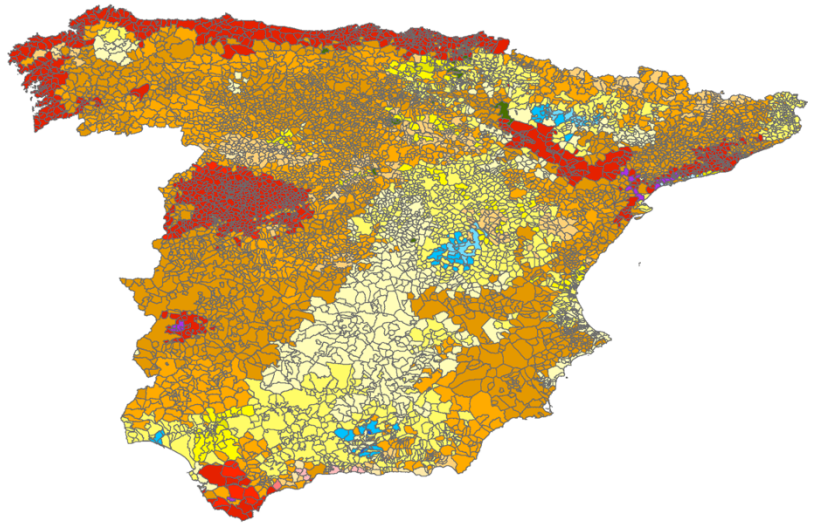




Qualification of Climate Zones in Spain RCP 8.5 2025



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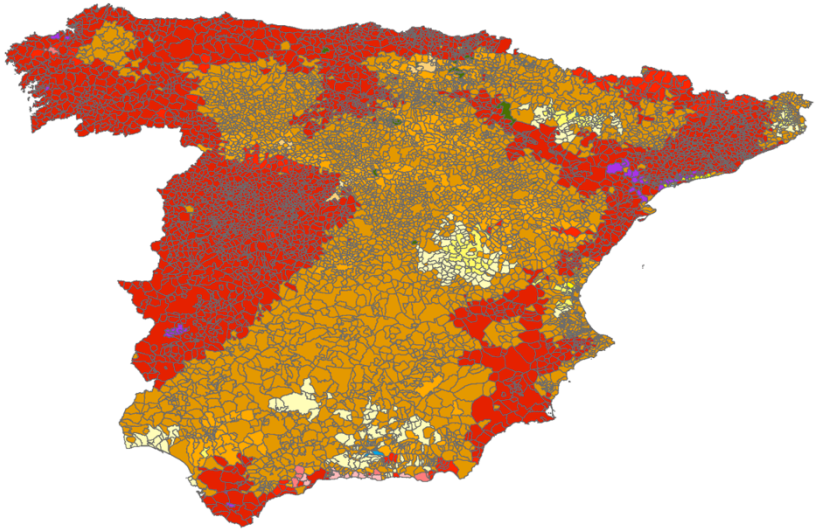

Qualification of Climate Zones in Spain RCP 8.5 2085

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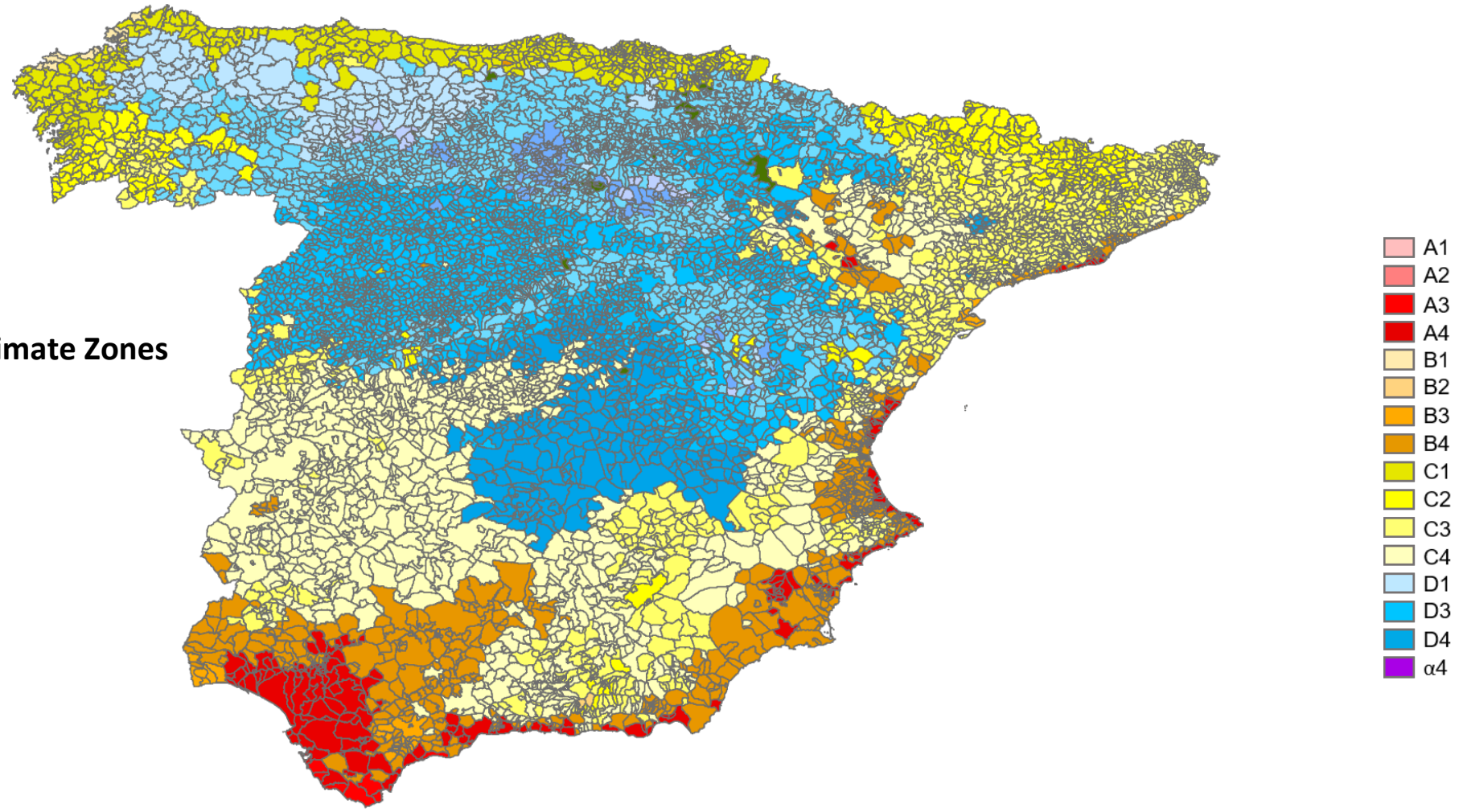

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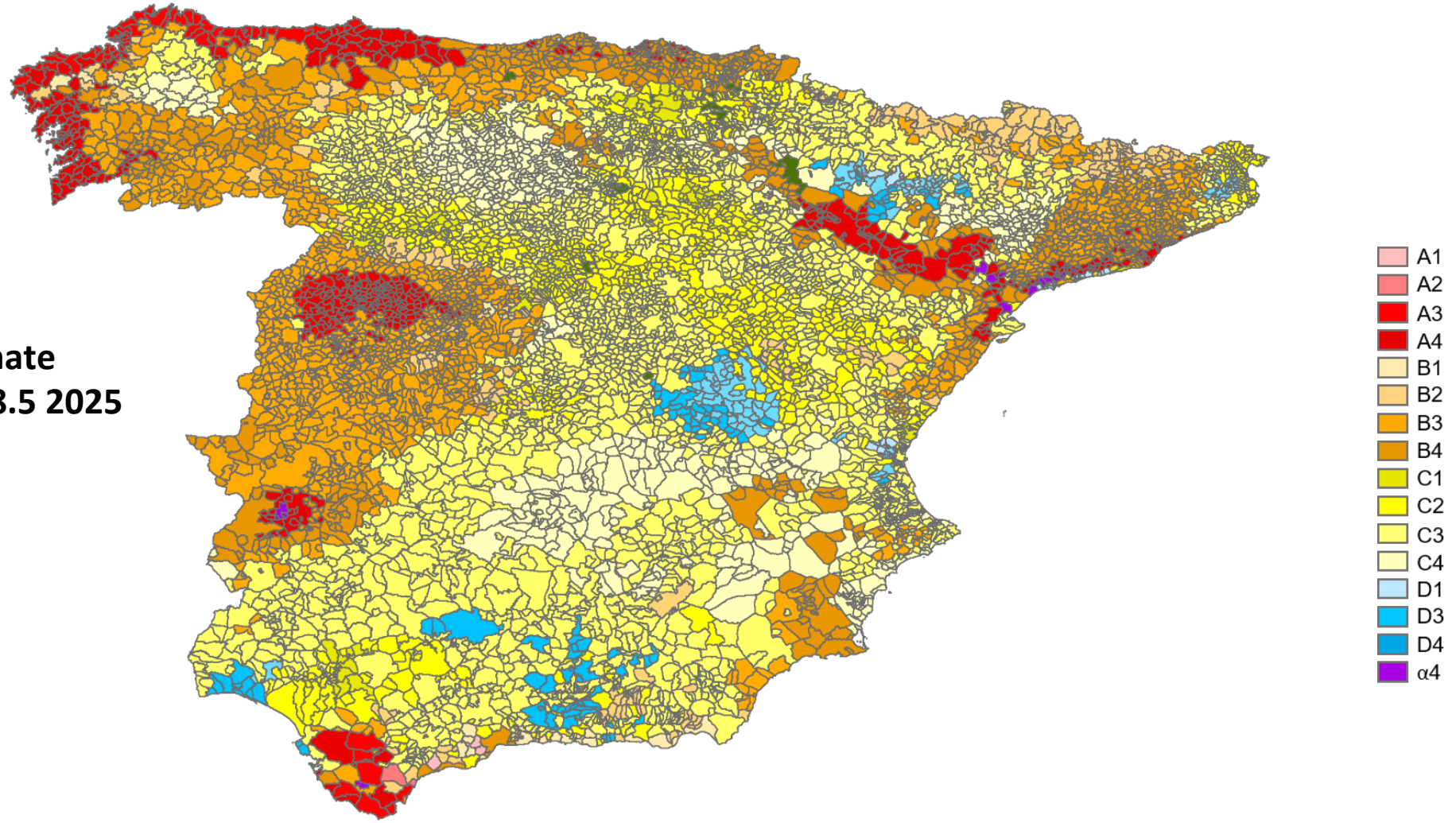
Qualification of Climate Zones in Spain RCP 8.5 2025



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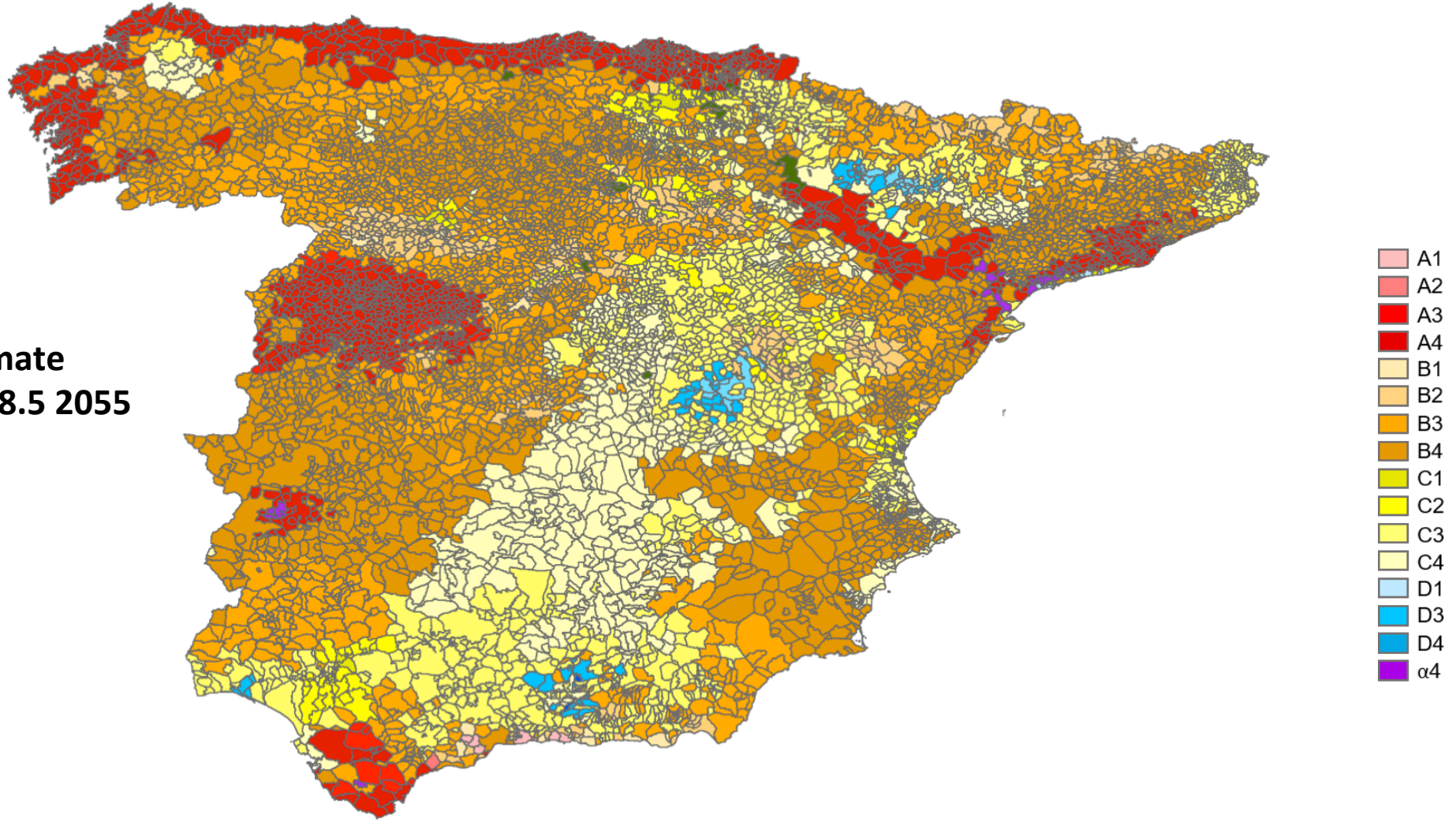
Qualification of Climate Zones in Spain RCP 8.5 2055



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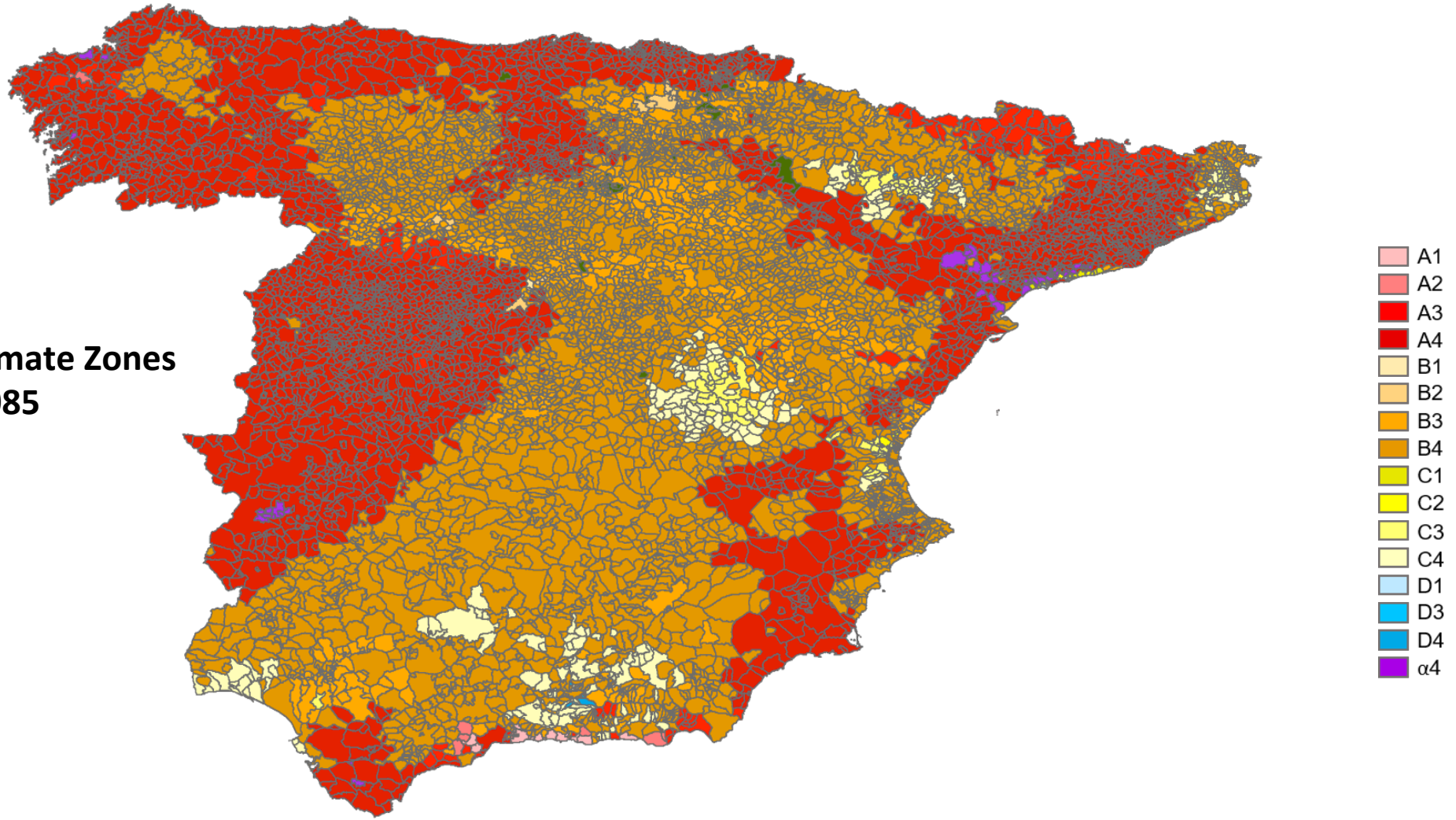

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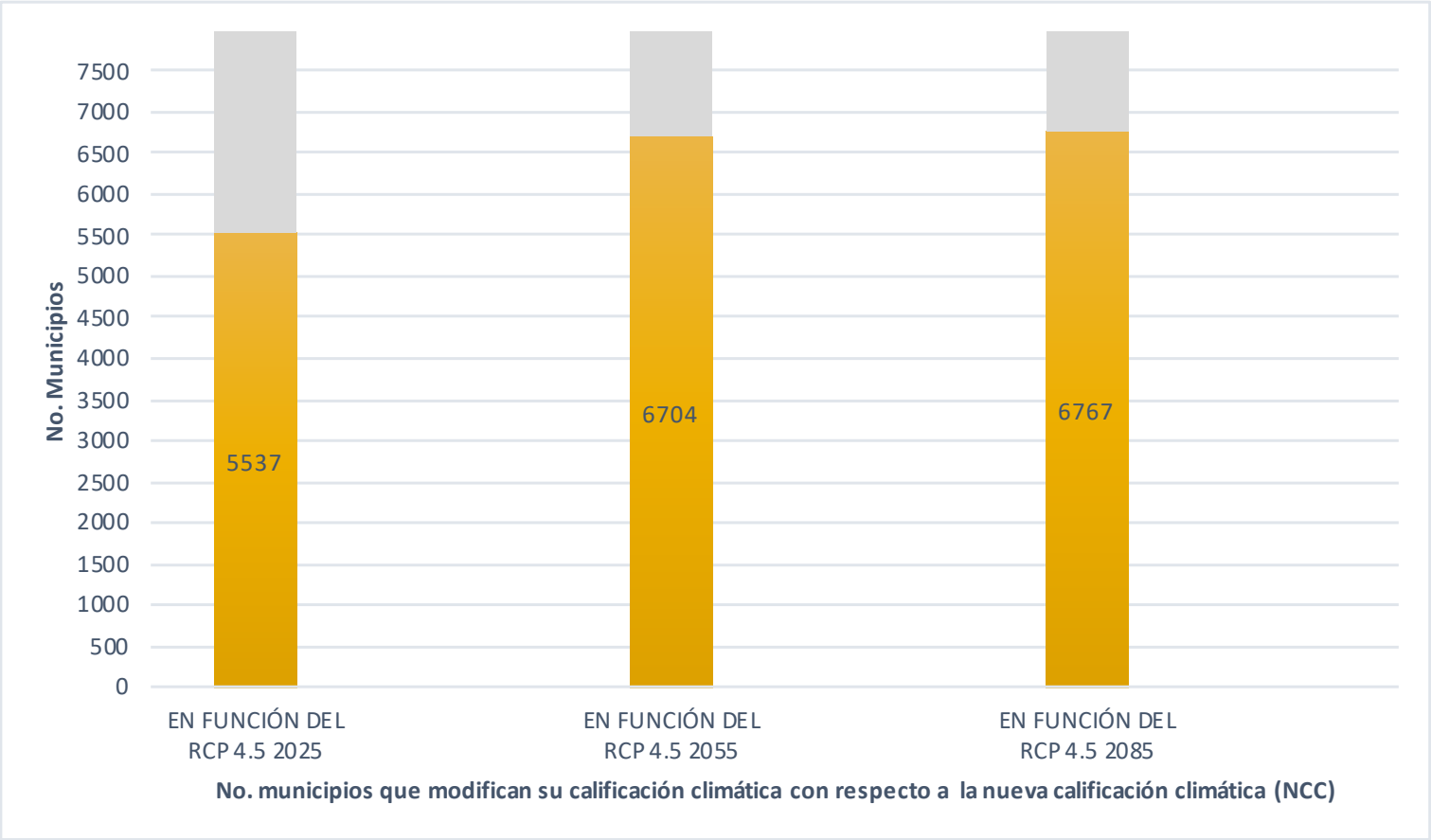
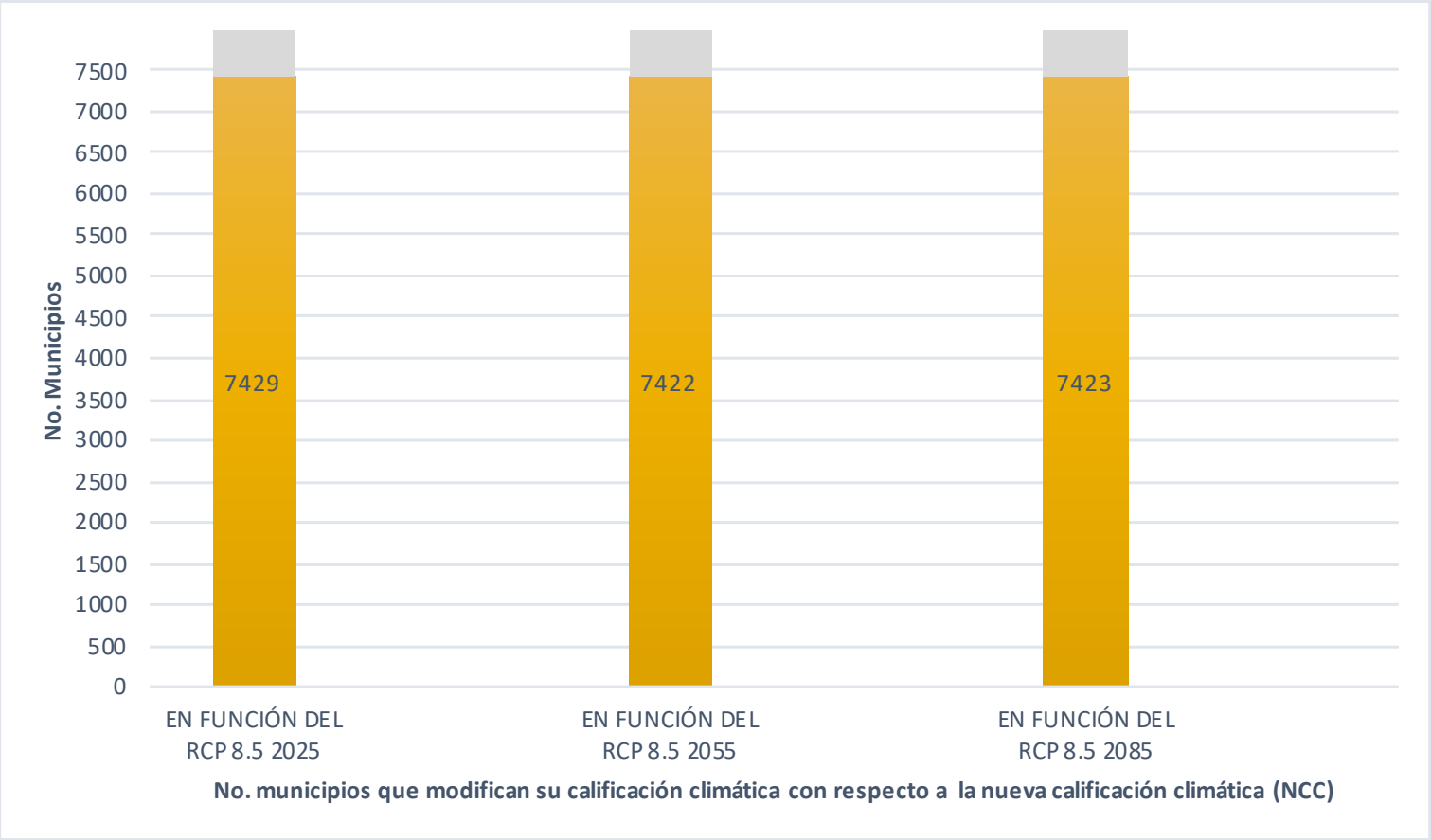


The Graph shows the dynamics of changes predicted for the RCP Scenario 4.5 during 2025, 2055 and 2085 with respect to the new classification of climatic zones of both winter and summer (NCZC), observing how it was expected that more than 80% of the 7967 municipalities evaluated will change their climatic rating with respect to the current one

RESULTS_ DYNAMICS OF CHANGES SCENARIO RCP 4.5 REGARDING NCZC (SUMMER AND WINTER RATING)

3. Results



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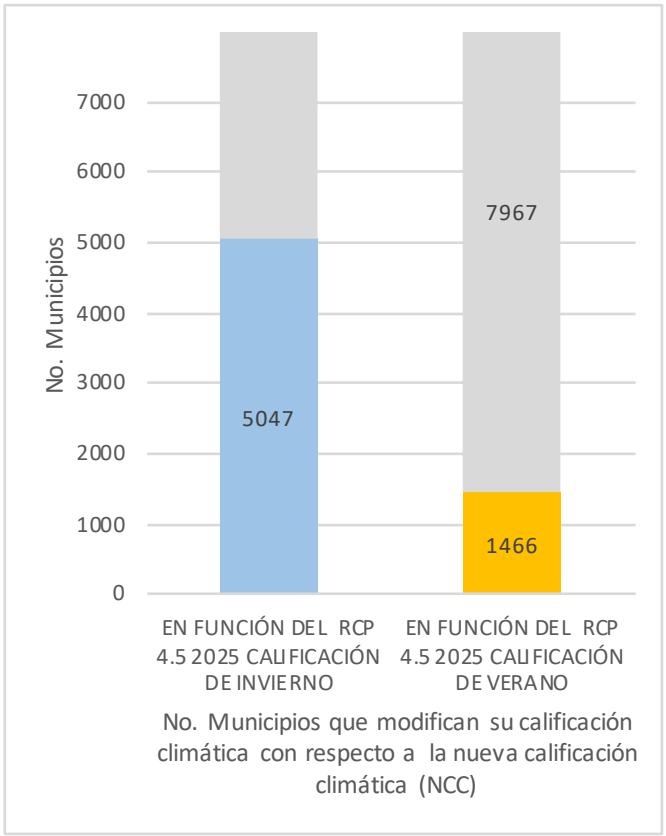
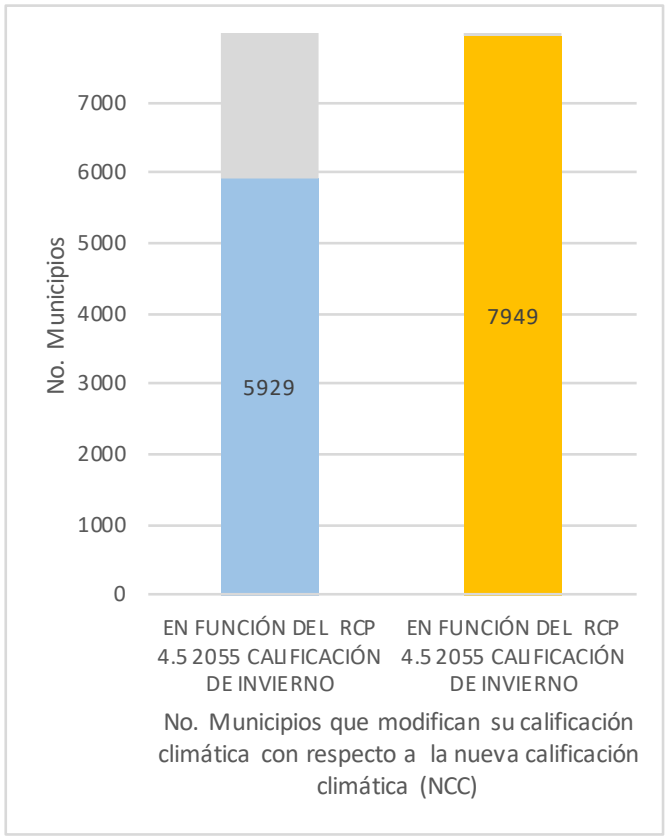
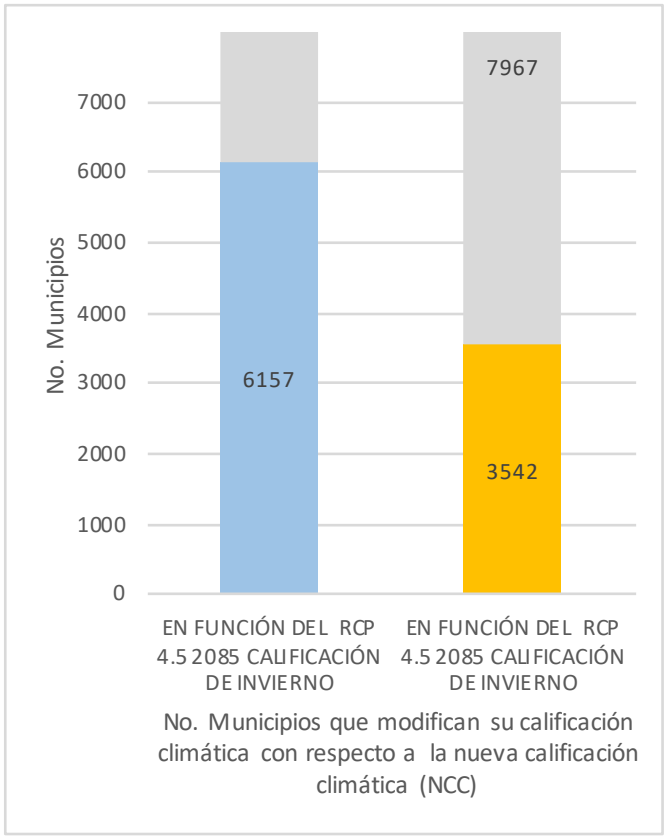
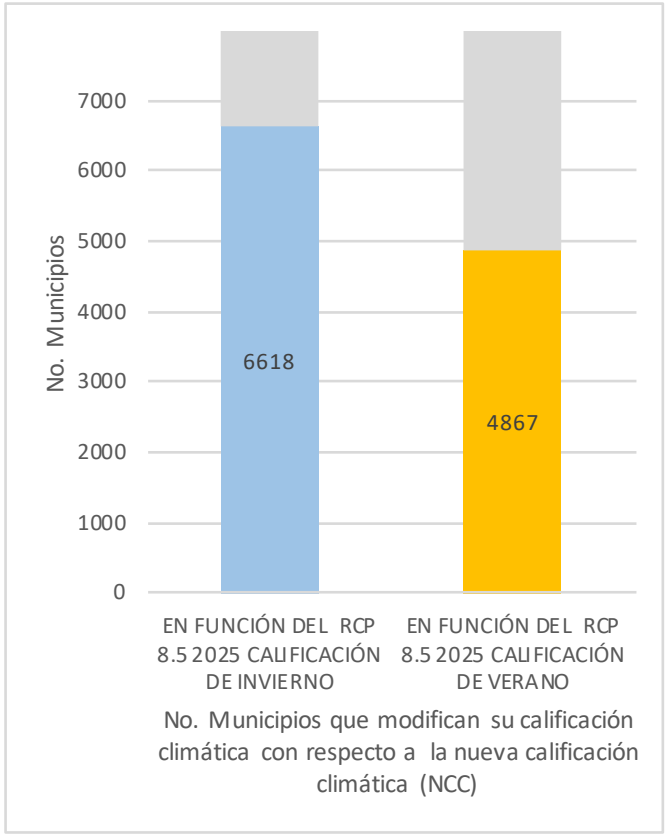


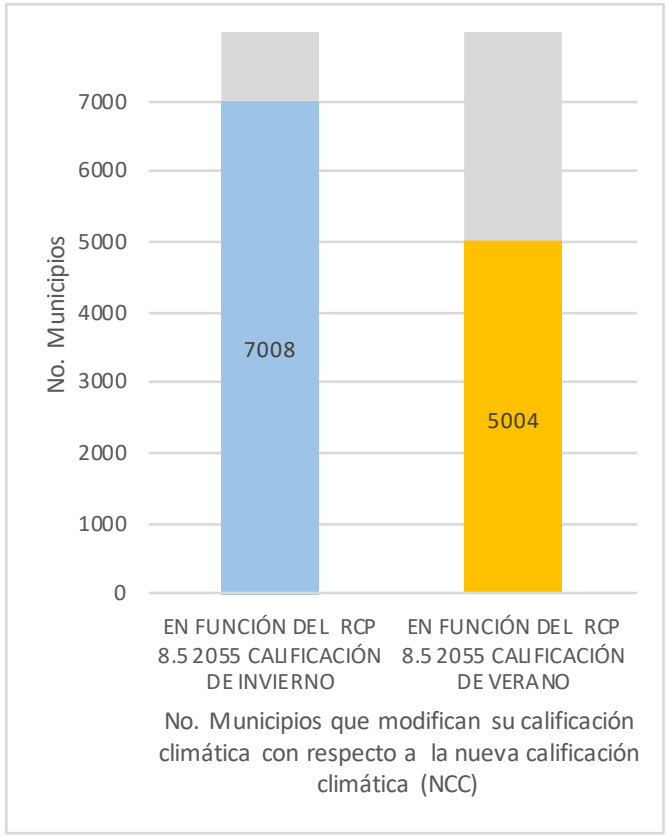


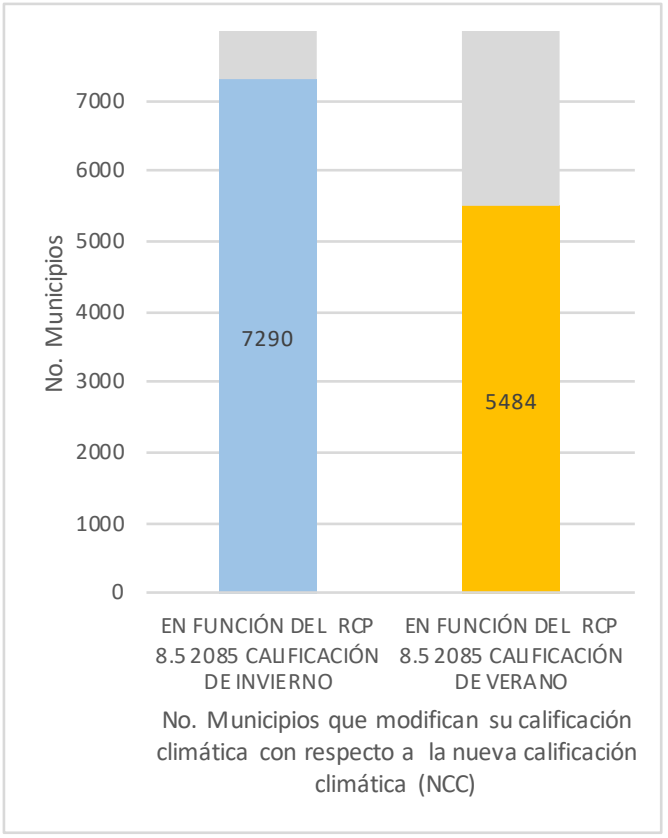


Number of muncipalities that changes the climatic classification in summer and winter RCP 4.5

3. Results







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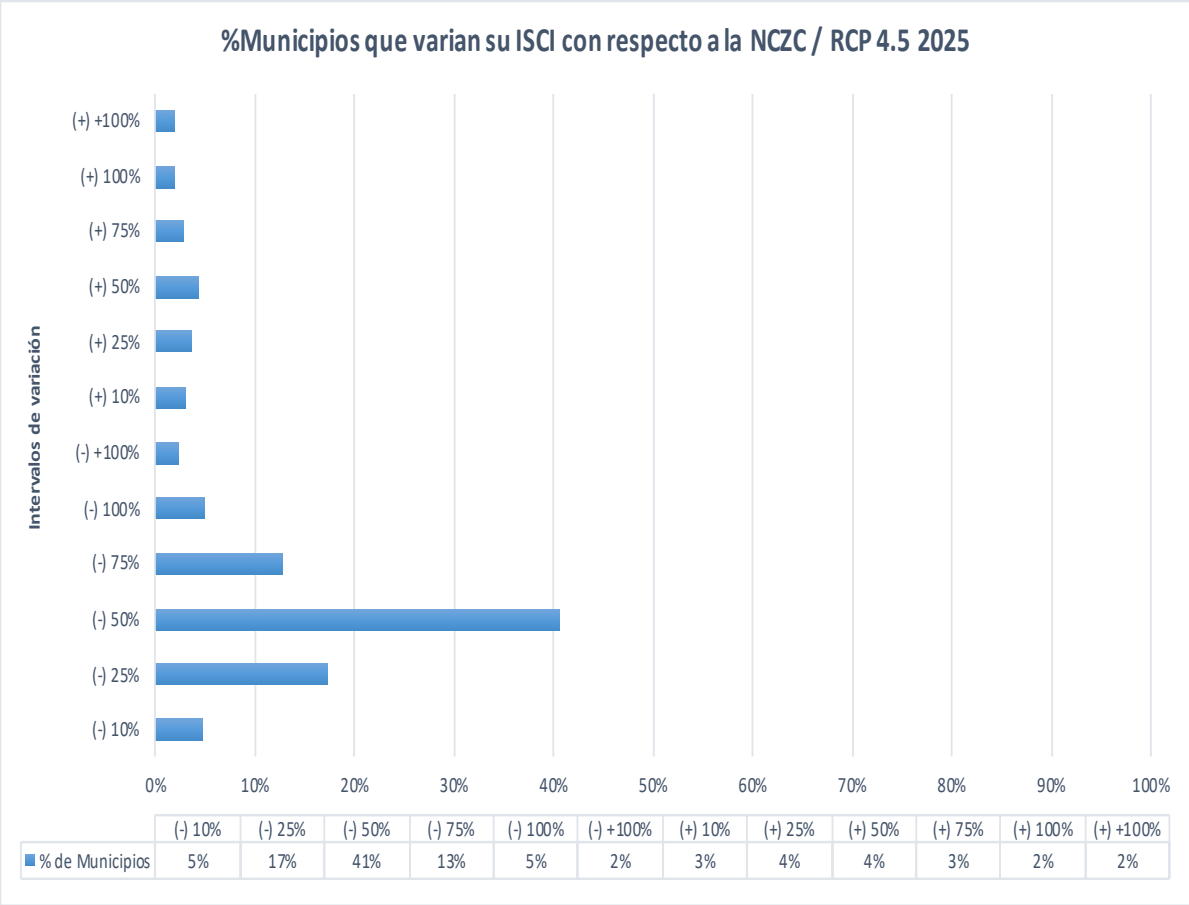
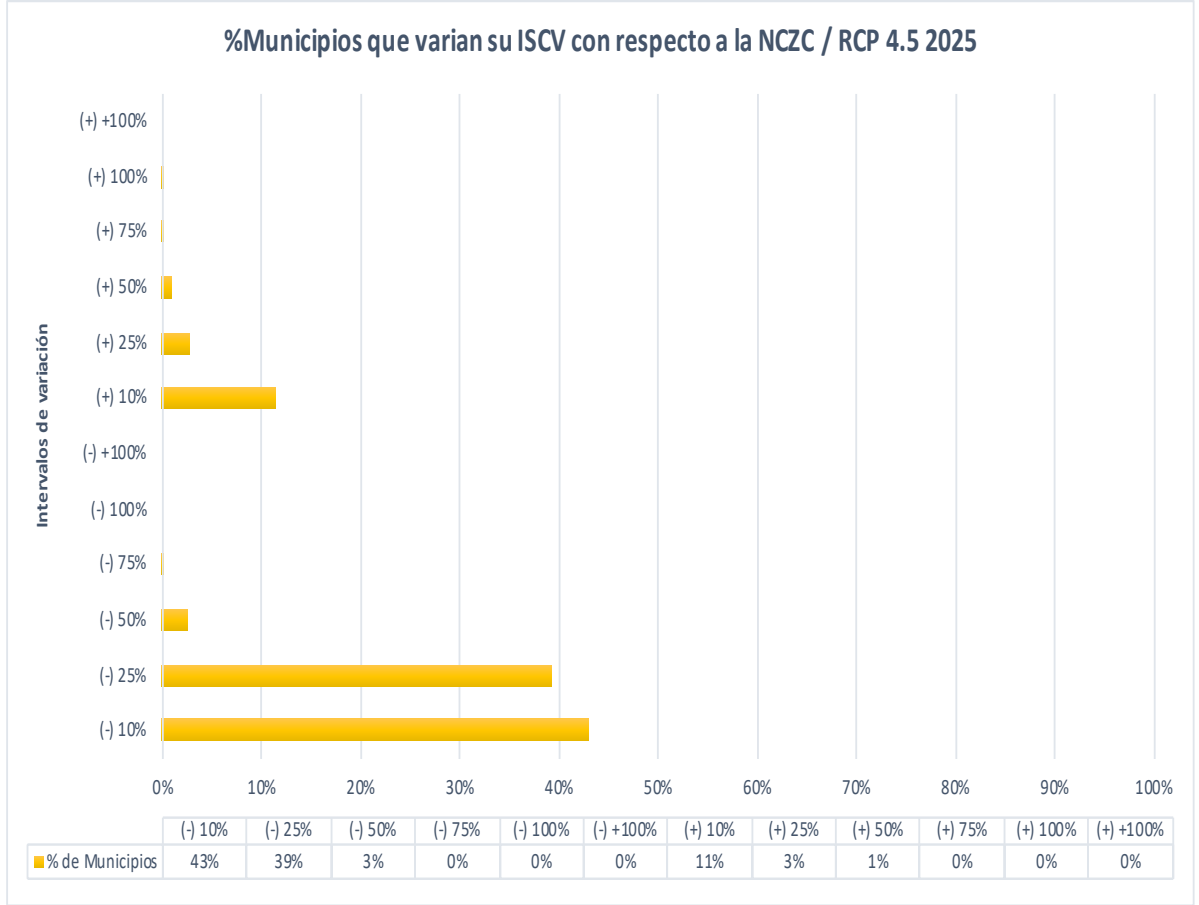
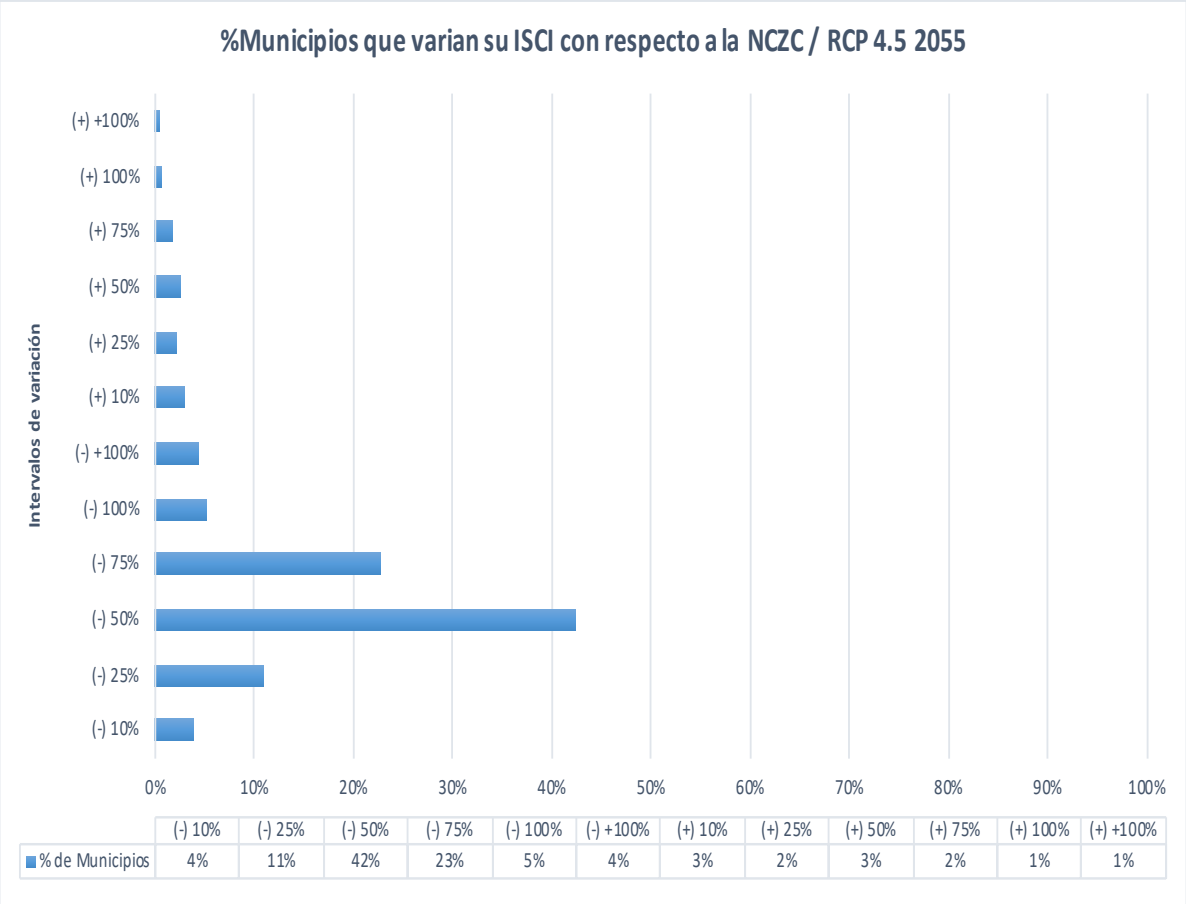
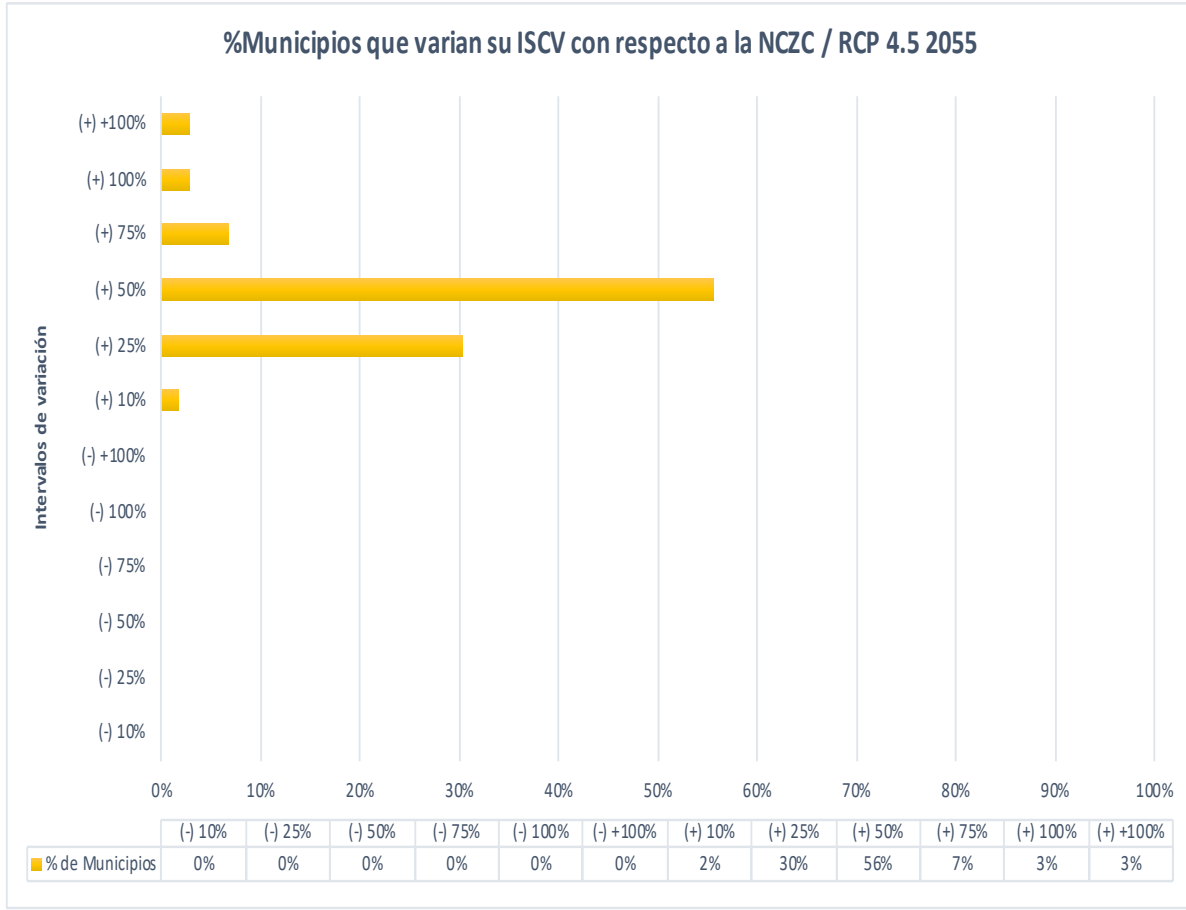




Number of muncipalities that changes the climatic severity RCP 4.5 in comparison with NCZC

3. Results





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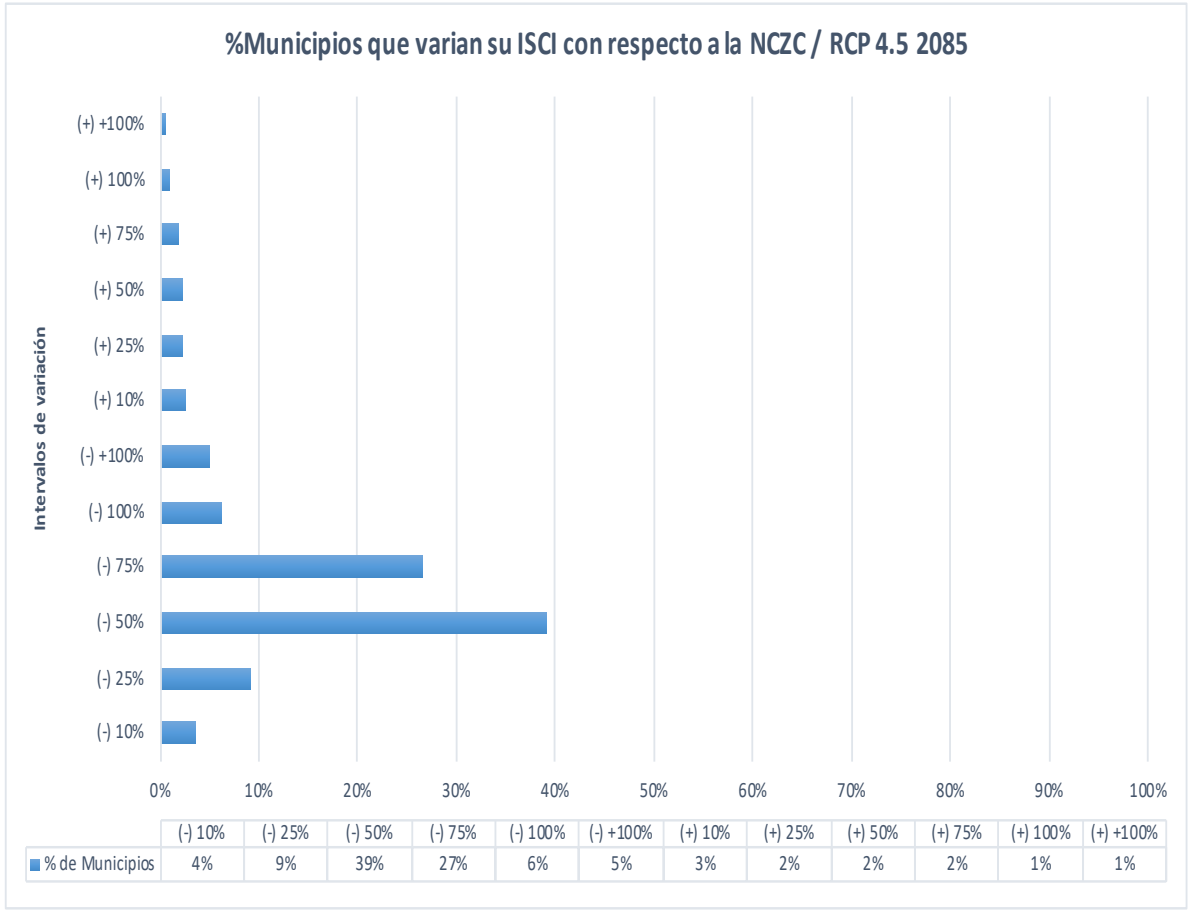

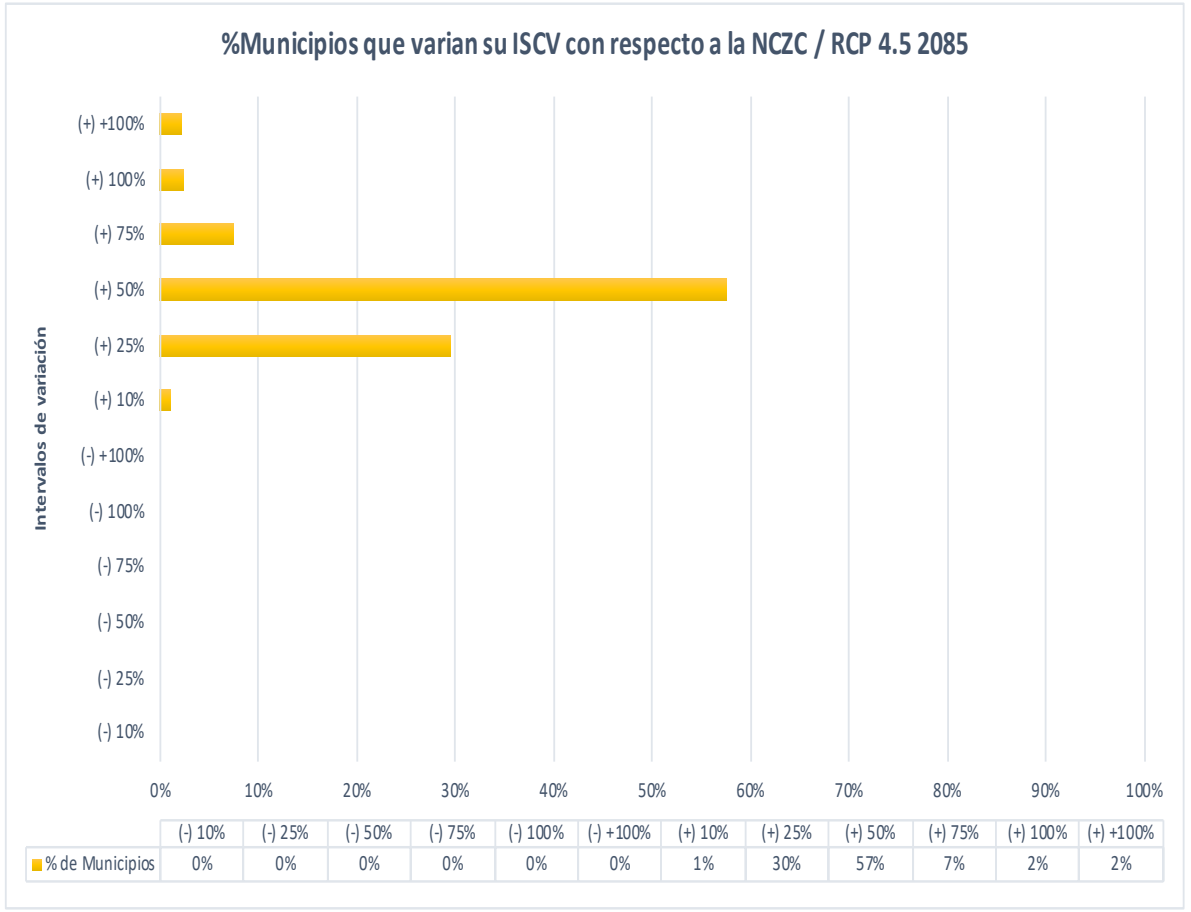

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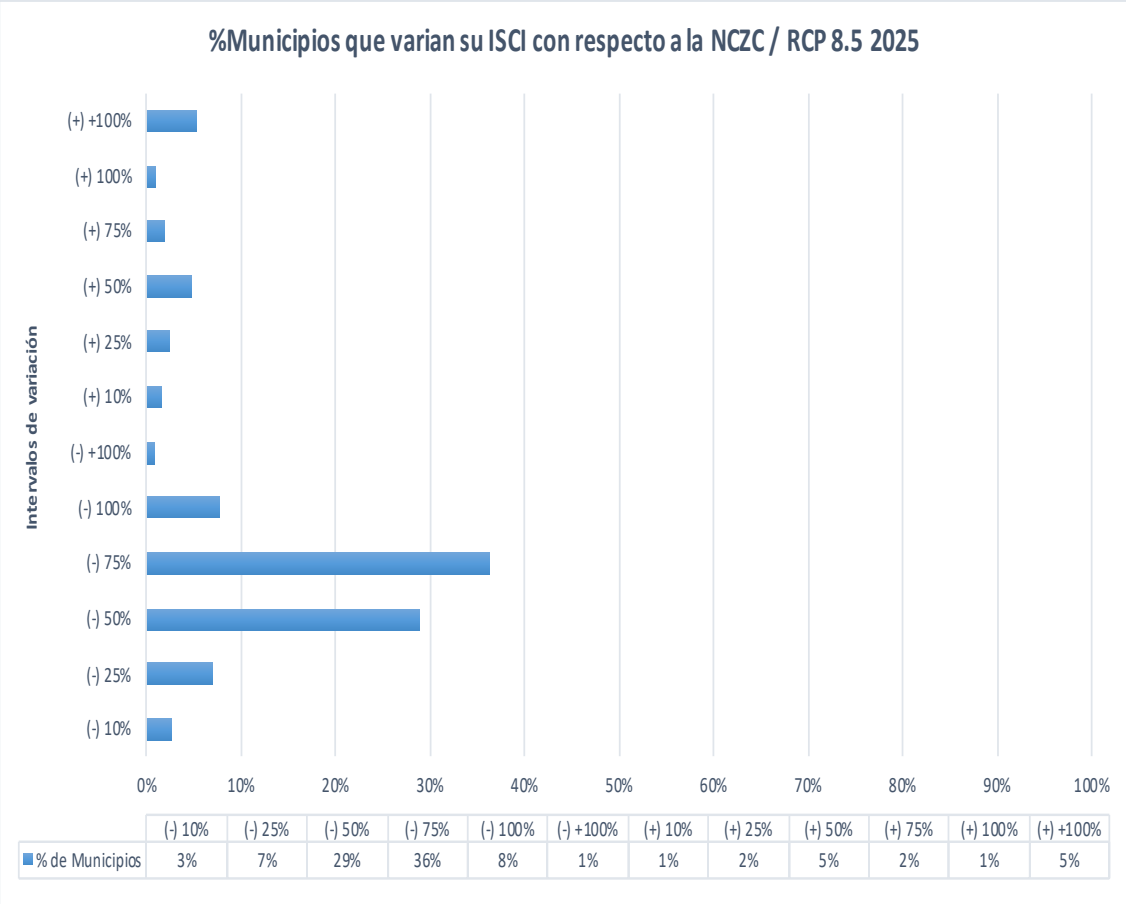
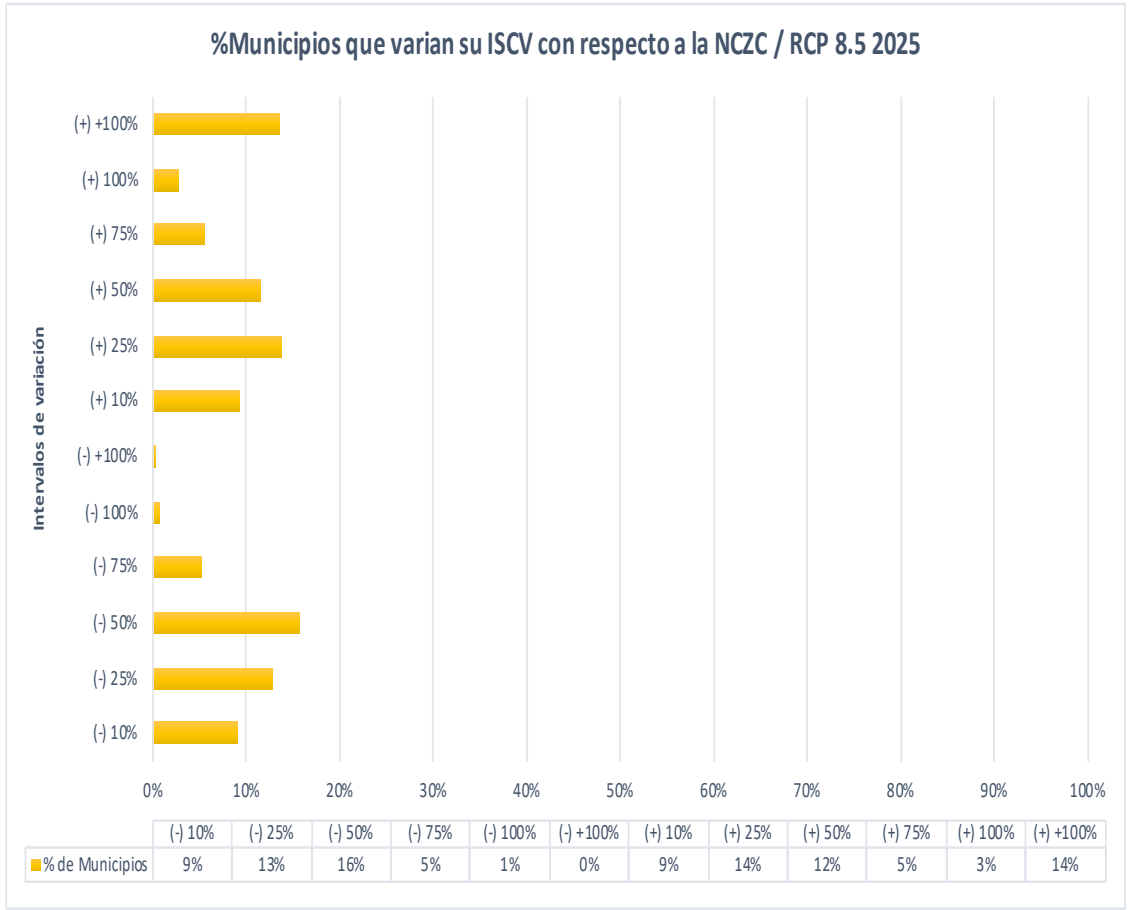


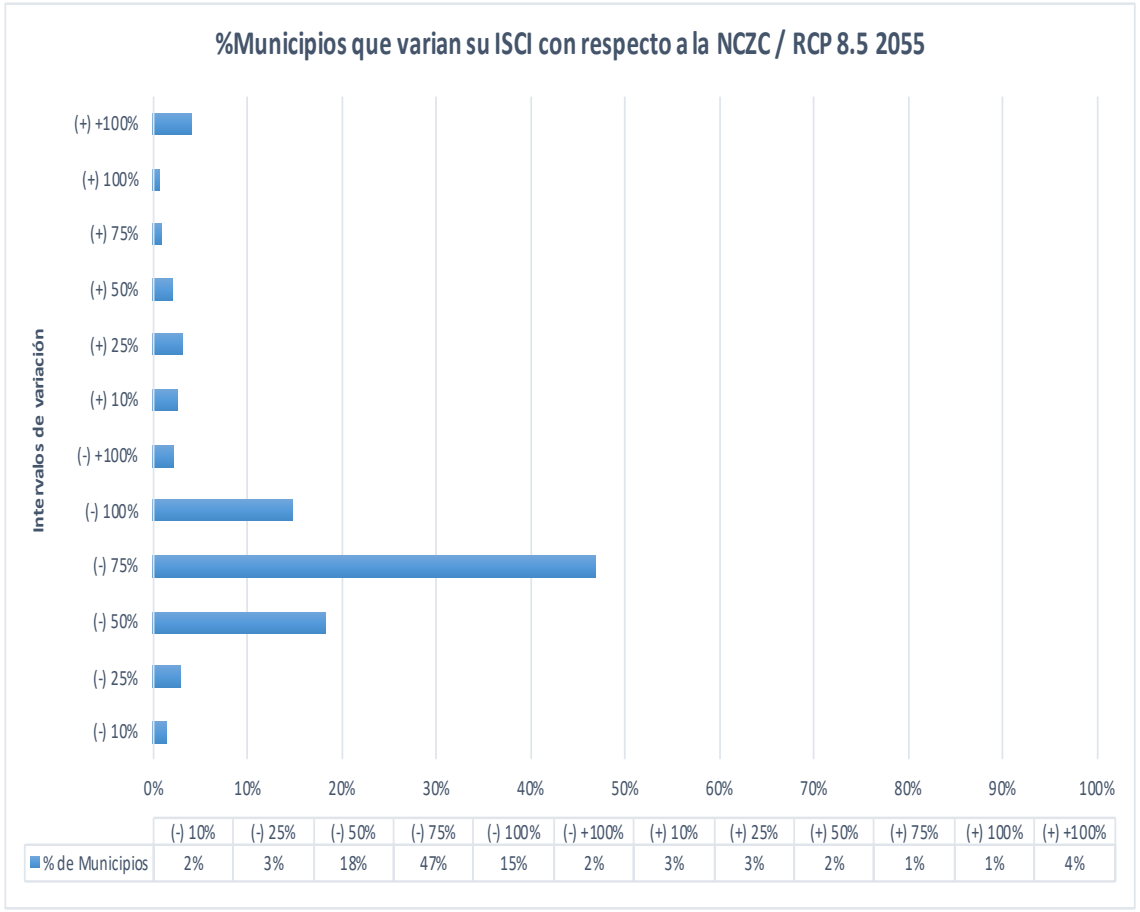
	(-) 10%	(-) 25%	(-) 50%	(-) 75%	(-) 100%	(-) +100%	(+) 10%	(+) 25%	(+) 50%	(+) 75%	(+) 100%	(+) +100%
% de Municipios	3%	7%	29%	36%	8%	1%	1%	2%	5%	2%	1%	5%

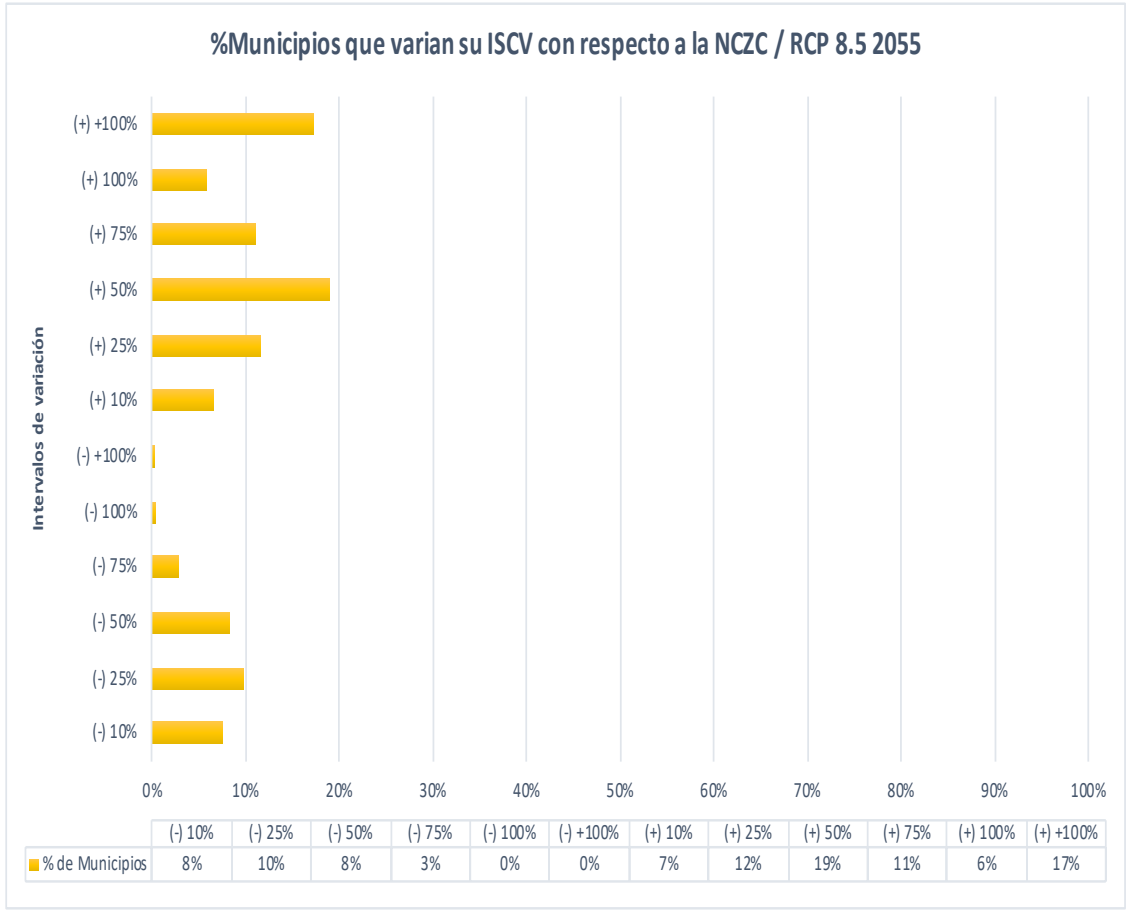


	(-) 10%	(-) 25%	(-) 50%	(-) 75%	(-) 100%	(-) +100%	(+) 10%	(+) 25%	(+) 50%	(+) 75%	(+) 100%	(+) +100%
% de Municipios	9%	13%	16%	5%	1%	0%	9%	14%	12%	5%	3%	14%

Number of muncipalities that changes the climatic severity RCP 8.5 in comparison with NCZC

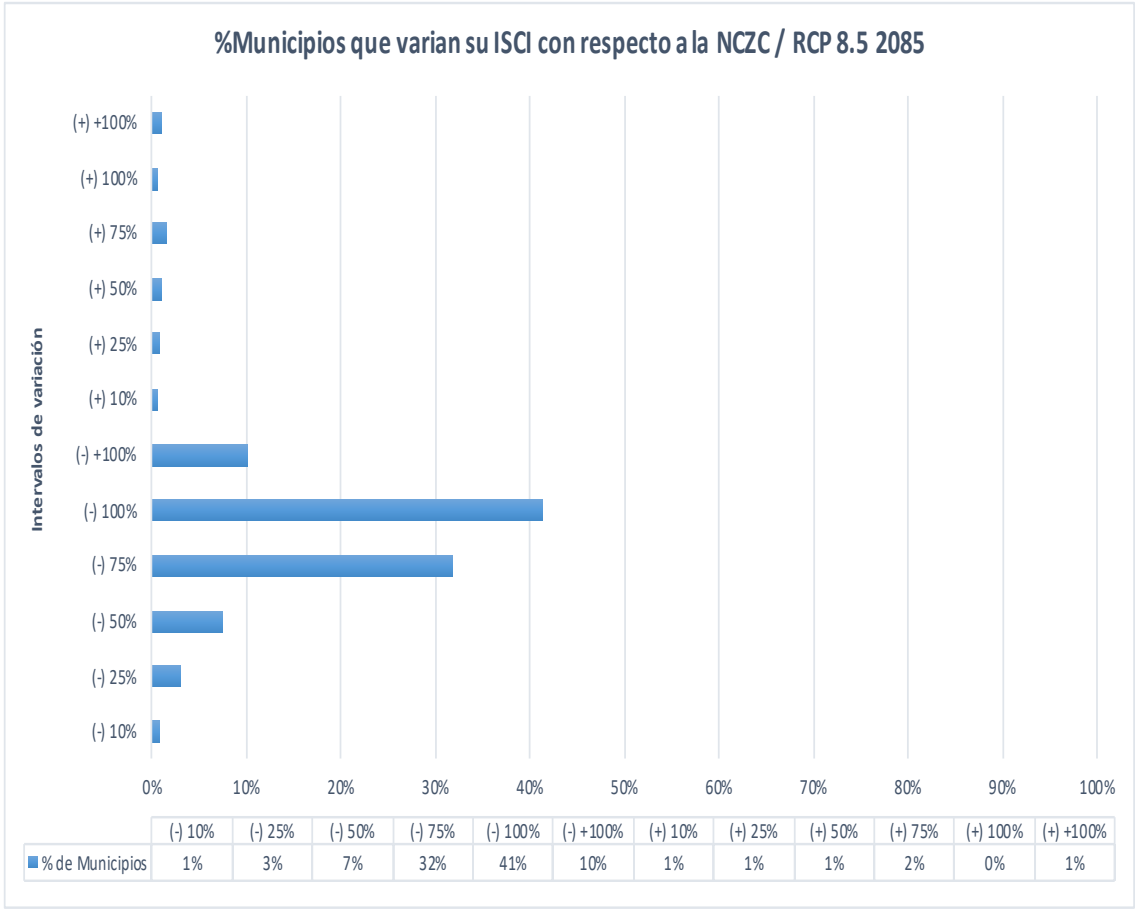
3. Results

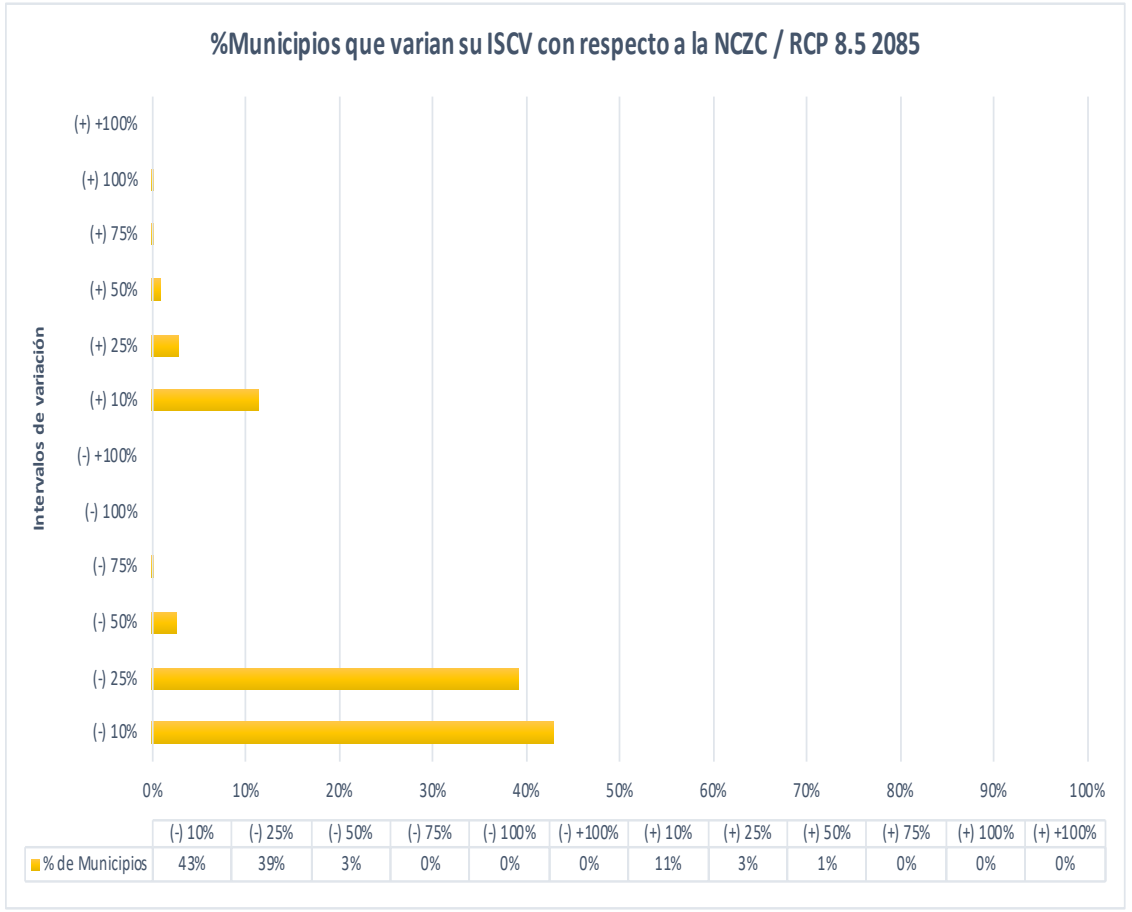




Number of muncipalities that changes the climatic severity RCP 8.5 in comparison with NCZC

3. Results





Number of muncipalities that changes the climatic severity RCP 8.5 in comparison with NCZC

3. Results

PASSIVE GUIDELINES AND THEIR ADAPTATION

The following section presents a new classification of climatic zones and their dynamics of changes along the Horizon 2100, along with guidance on construction envelope systems included in the Catalog of construction details of the Technical Building Code, and adapted to the dynamics of changes, by capitals of the province of the Peninsula.

The files show, The climatic rating for each province capital for:

1. NCZC
2. RCP Scenario 4.5 (2025, 2055 and 2085)
3. CPR Scenario 8.5 (2025, 2055 and 2085)
4. A quantification of the urban heat island effect

Passive guidelines of constructive details, which adapt to the dynamics of changes of the H2100, taking into account:

- The thermal transmittance values allowed according to Climate Zone
- Requirements of the DB HE and the Catalog of constructive details of the Technical Building Code.
- The heat island effect
- The best option regarding the use of Thermal Inertia

PREDIC2100

EDIFICACIÓN VS EFECTO ISLA DE CALOR: ADAPTACIÓN H2100

GUÍA DE EDIFICACIÓN SOTENIBLE ADAPTADA AL CAMBIO CLIMÁTICO

con el apoyo de:

GOBIERNO DE ESPAÑA · MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA · Fundación Biodiversidad · PIMA adapta · oecc Oficina Española de Cambio Climático

organizan:

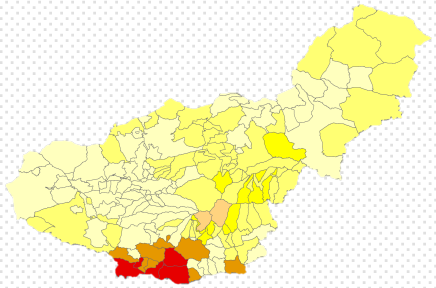
UNIVERSIDAD DE GRANADA

GRANADA RCP 4.5

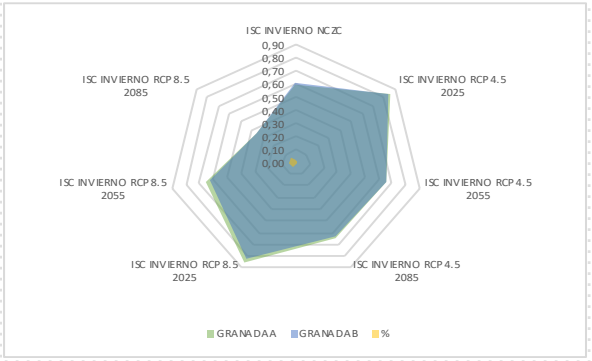
DATOS					RESENTE		
N	LAT	LON	ALT	CCTE	SCI NCZC	SCV NCZC	NCZC
GRANADA	37,176	-3,600	684	C3	0,64	1,89	**C4**

NCZC

A1
A2
A3
A4
B1
B2
B3
B4
C1
C2
C3
C4
D1
D3
D4
α4



ISCI RCP 4.5 y RCP 8.5

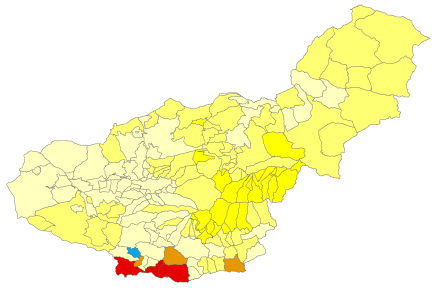


	RCP 4.5				RCP 8.5		
ISC I	NCZC	2025	2055	2085	2025	2055	2085
A	0,60	0,85	0,66	0,64	0,85	0,65	0,37
B	0,61	0,84	0,65	0,63	0,82	0,62	0,35
%	2%	1%	1%	1%	4%	5%	5%

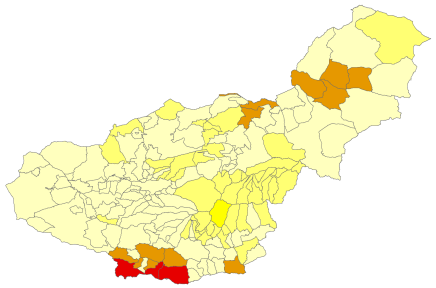
ESCENARIO RCP 4.5

SCI RCP 4.5 2025	SCV RCP 4.5 2025	CZC RCP 4.5 2025	SCI RCP 4.5 2055	SCV RCP 4.5 2055	CZC RCP 4.5 2055	SCI RCP 4.5 2085	SCV RCP 4.5 2085	CZC RCP 4.5 2085
0,87	1,58	C4	0,66	1,99	C4	0,68	2,03	C4

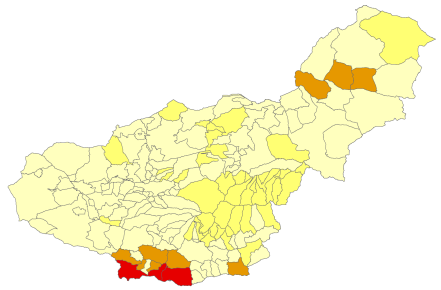
PROYECCIÓN PARA 2025



PROYECCIÓN PARA 2055



PROYECCIÓN PARA 2085



ENVOLVENTE VERTICAL

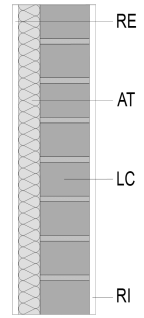
C4 U_{Mlim}: 0,73 W/m² K	C4 U_{Mlim}: 0,73 W/m² K	C4 U_{Mlim}: 0,73 W/m² K	C4 U_{Mlim}: 0,73 W/m² K

ENVOLVENTE HORIZONTAL

C4 U_{Clim}: 0,41 W/m² K	C4 U_{Clim}: 0,41 W/m² K	C4 U_{Clim}: 0,41 W/m² K	C4 U_{Clim}: 0,41 W/m² K

CERRAMIENTO HORIZONTAL TIPO SEGÚN DIRECTRICES CTE

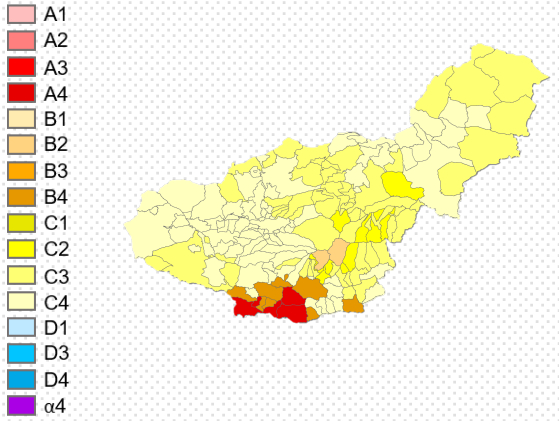
	Componentes/materiales	CE169 e (cm)	CE157 e (cm)	CE142 e(cm)
RE	Revestimiento continuo de resistencia muy alta a la filtración (R3)	1,5	1,5	1,5
AT	Aislamiento de conductividad térmica 0.033 W/m K	3	4	6
LC	Pared de obra de fábrica de ladrillo cerámico perforado, de 1 pie	24	24	24
RI	Guarnecido de yeso	1,5	1,5	1,5
		30	**31**	**33**
	DB HE - Ahorro de Energia	U 0,69W/m2K	U 0,57 W/m2K	U 0,42 W/m2K



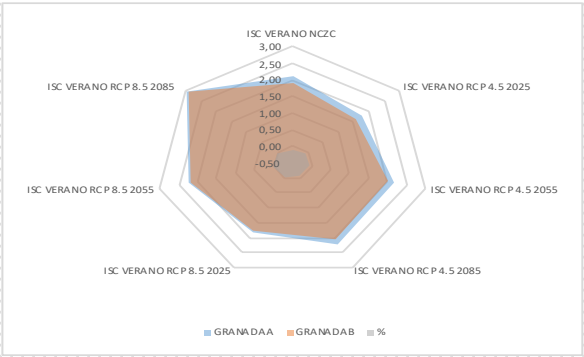
GRANADA RCP 8.5

DATOS				RESENTE			
N	LAT	LON	ALT	CCTE	SCI NCZC	SCV NCZC	NCZC
GRANADA	37,176	-3,600	684	C3	0,64	1,89	**C4**

NCZC



ISCV RCP 4.5 y RCP 8.5



	RCP 4.5				RCP 8.5		
ISC I	NCZC	2025	2055	2085	2025	2055	2085
A	2,10	1,75	2,15	2,21	1,81	2,23	2,97
B	1,89	1,60	2,01	2,08	1,79	2,20	2,91
%	-10%	-9%	-6%	-6%	-1%	-1%	-2%

ESCENARIO RCP 8.5

SCI RCP 8.5 2025	SCV RCP 8.5 2025	CZC RCP 4.5 2025
0,72	1,24	C3

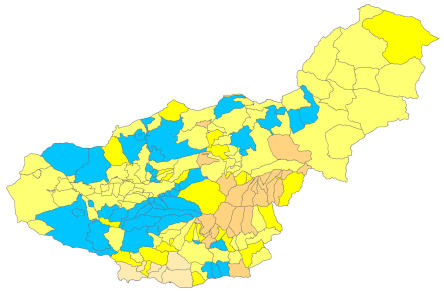
PROYECCIÓN PARA 2025

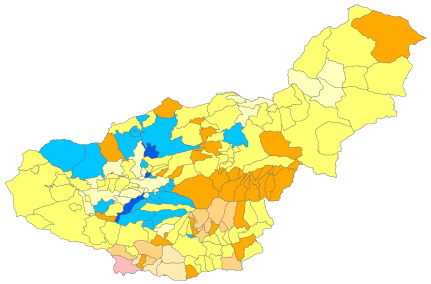
SCI RCP 8.5 2055	SCV RCP 8.5 2055	CZC RCP 8.5 2055
0,59	1,51	C4

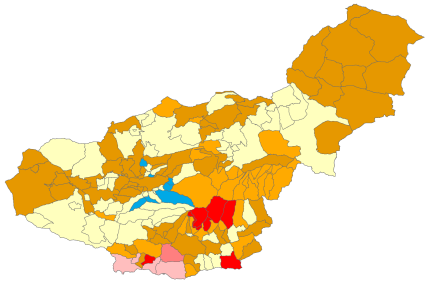
PROYECCIÓN PARA 2055

SCI RCP 8.5 2085	SCV RCP 8.5 2085	CZC RCP 8.5 2085
0,39	2,23	B4

PROYECCIÓN PARA 2085







ENVOLVENTE VERTICAL

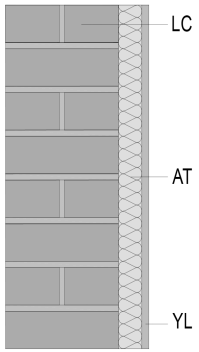
C4 U_{Mlim}: 0,73 W/m² K	C3 U_{Mlim}: 0,73 W/m² K	C4 U_{Mlim}: 0,73 W/m² K	B4 U_{Mlim}: 0,82 W/m² K

ENVOLVENTE HORIZONTAL

C4 U_{Clim}: 0,41 W/m² K	C3 U_{Clim}: 0,41 W/m² K	C4 U_{Clim}: 0,41 W/m² K	B4 U_{Clim}: 0,45 W/m² K

CERRAMIENTO HORIZONTAL TIPO SEGÚN DIRECTRICES CTE

	Componentes/materiales	CS167 e (cm)	CS156 e (cm)	CS148 e(cm)
LC	Pared de obra de fábrica de ladrillo cerámico perforado, caravista, de 1 pie	24	24	24
AT	Aislamiento de conductividad térmica 0.033 W/m	3	4	5
YL	Trasdosado autoportante	1,5	1,5	1,5
		28,5	**29,5**	**30,5**
	DB HE - Ahorro de Energia	U 0,67 W/m2K	U 0,56 W/m2K	U 0,48 W/m2K



4. Main conclusions

- The **geographical situation of Spain** gives the territory a remarkable climatic variety due to its orographic characteristics, the continuous movement of atmospheric circulation and its position between two large volumes of water.

- These climatic factors generate a **large difference in temperature and precipitation in different regions** of the territory. Thus the importance of the development of climatic classifications in Spain is sharpened, where the planning of the territory around the climate is key.

- **The purpose of climatic classifications has evolved over time**, with methodologies focused on technical purposes, and more specifically building-oriented, being of special interest in recent years.

- **As a strategy to mitigate** the adverse effects of the current climate situation**, a change in the approach to construction is necessary,** the introduction of a sustainable architecture model adapted to climate change being convenient.

ACKNOWLEDGES

GOBIERNO DE ESPAÑA
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA
Fundación Biodiversidad

Building vs Heat Island Effect: Adaptation H2100

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