Mitigazione dei rischi naturali per la sicurezza e la mobilità nelle aree montane del Mezzogiorno: Il contributo dei Collaboratori di Ricerca

UNCOVERING INTRA-RURAL DIVIDE VIA CLUSTERING ALGORITHMS

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Ruolo: Contrattista

15 Gennaio 2024

Rural areas

the preservation of rural areas landscape and investment in rural areas' development emerge as relevant aims of European policies

Rural decline:

a process resulting in a significant decrease of population over a period equal to or superior than a generation. Active shrinkage is a result of out migration. Legacy shrinkage is a consequence of natural population decrease and regions' age structure.

Intra - Rural Divide:

a concept that recognises distinct forms of decline, the related specific configurations of socio-economic determinants and the emergence of specific rural areas as centers of sustainable development based on multi-functional economies.

Territorial Capital:

The specific set of local tangible and non-tangible resources of a region that determine the area's potential of development and its development trajectories

(OECD 2001; Camagni 2009; Camagni & Capello 2013; Orsi et al. 2022) .

Territorial Capital

Underlines the specific provision of factors of development, enabling the understanding of specificities of Regions. As a result, it emerges as a useful conceptual apparatus for framing and investigating intra-rural divide

(Fratesi & Perucca 2017; Boczy & Cordini 2020) .

Human Capital

is a component of TC related to the set of competences and abilities of a population. HC emerges as a significant determinant of development and of resilience in relation to exogenous socio-economic events (Mazzola et al. 2018) and adaptation and reconversion of local economies (Fratesi & Perucca 2017) .

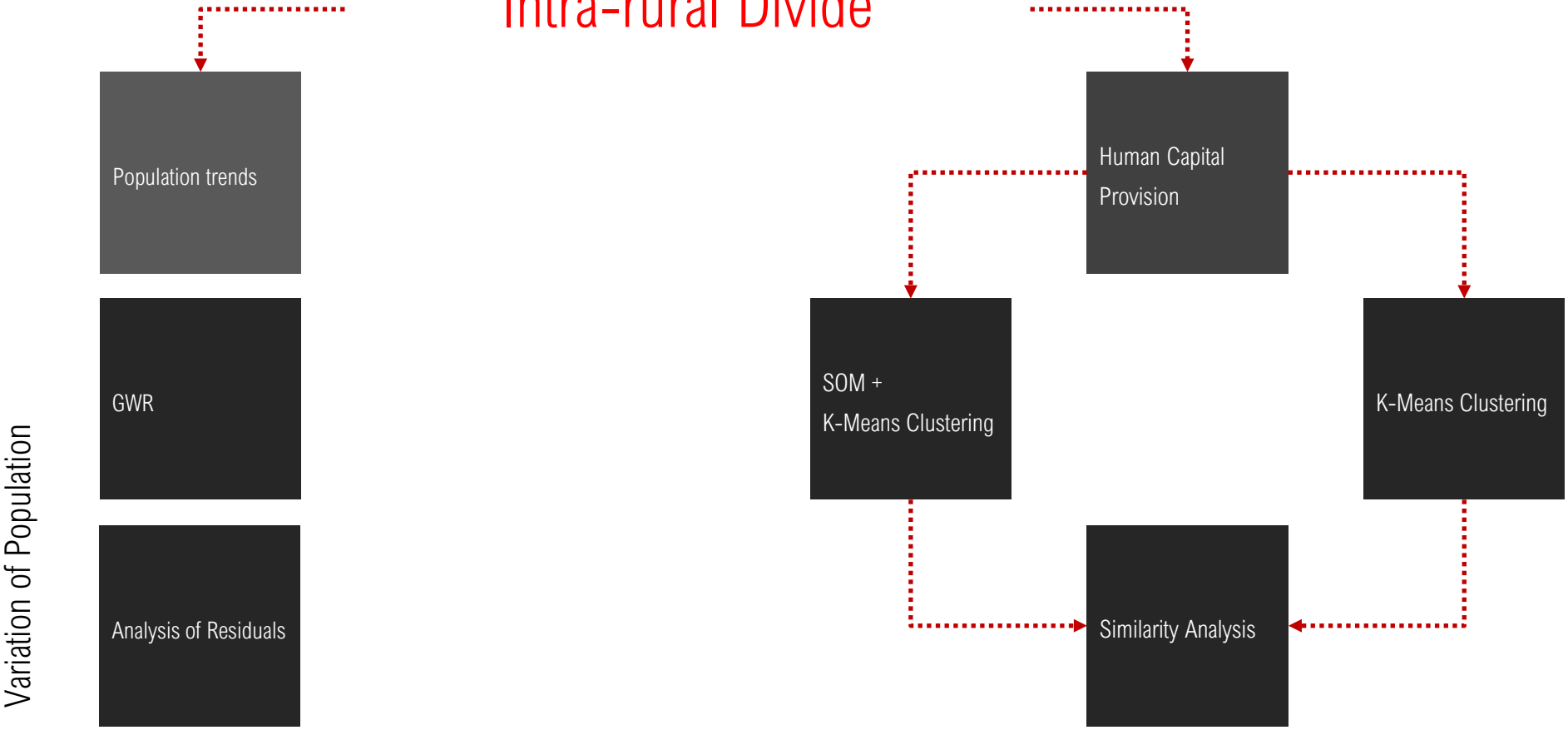
Human Capital

is a component of TC related to the set of competences and abilities of a population. HC is a determinant of development, of resilience (Mazzola et al. 2018) and adaptation and reconversion of local economies (Fratesi & Perucca 2017) .

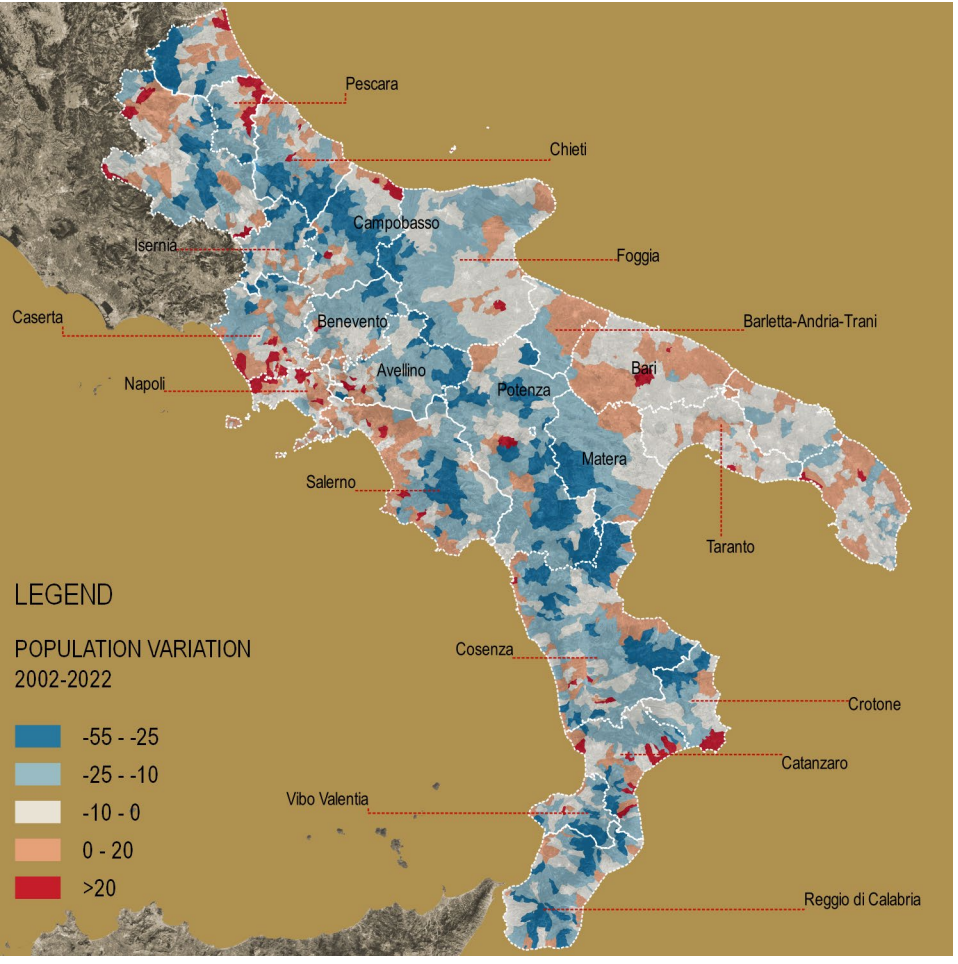
Research question:

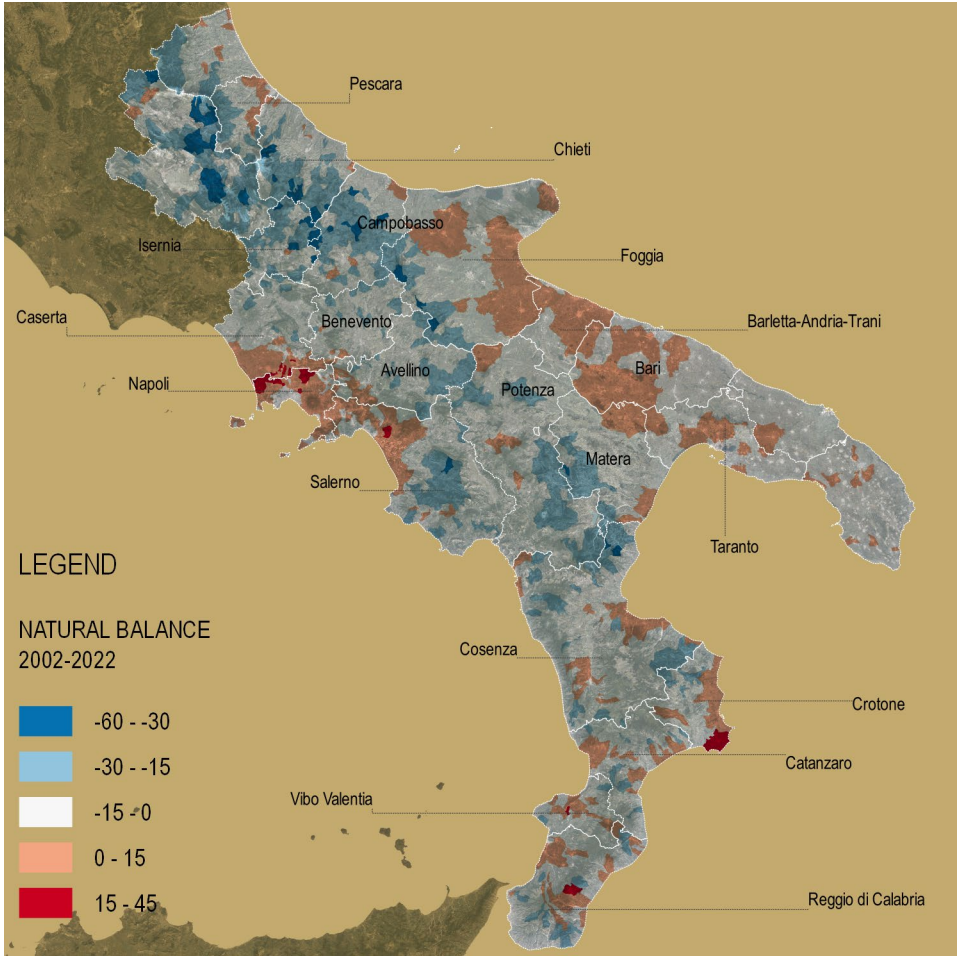
Development of metrics for discerning regions presenting specific configurations of social, economic and spatial conditions.

Intra-rural Divide

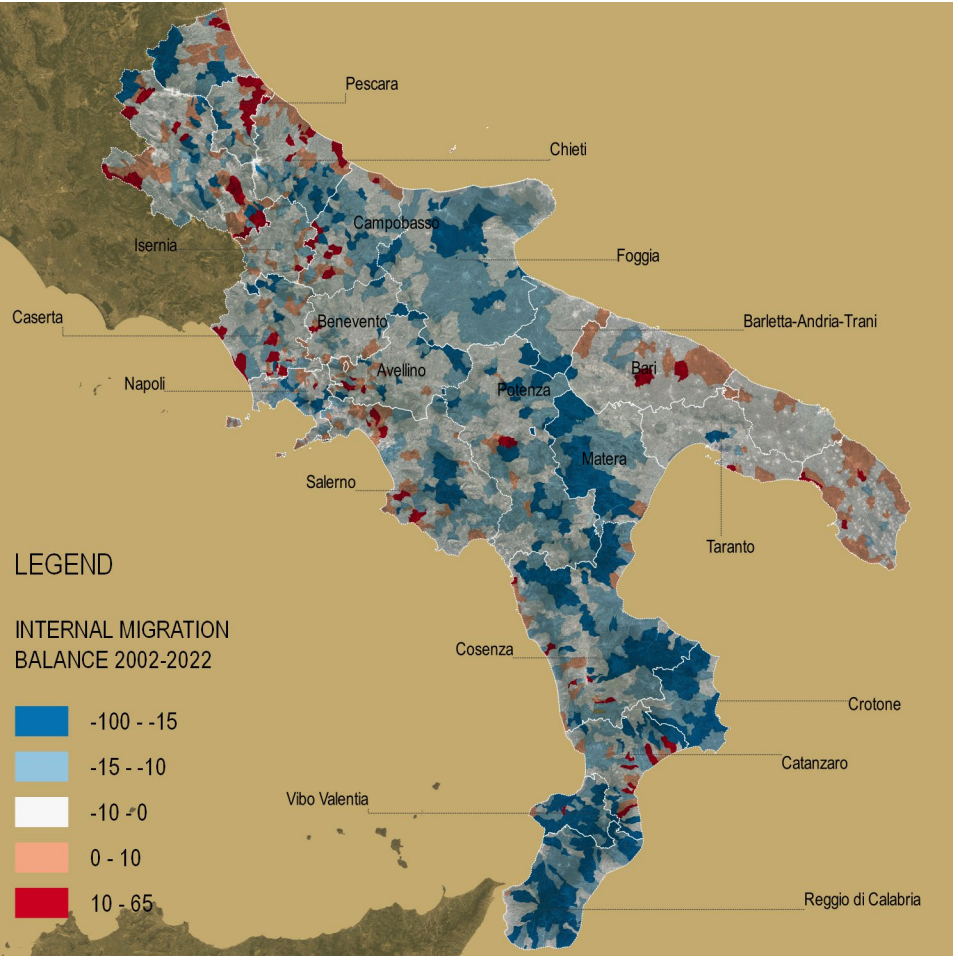


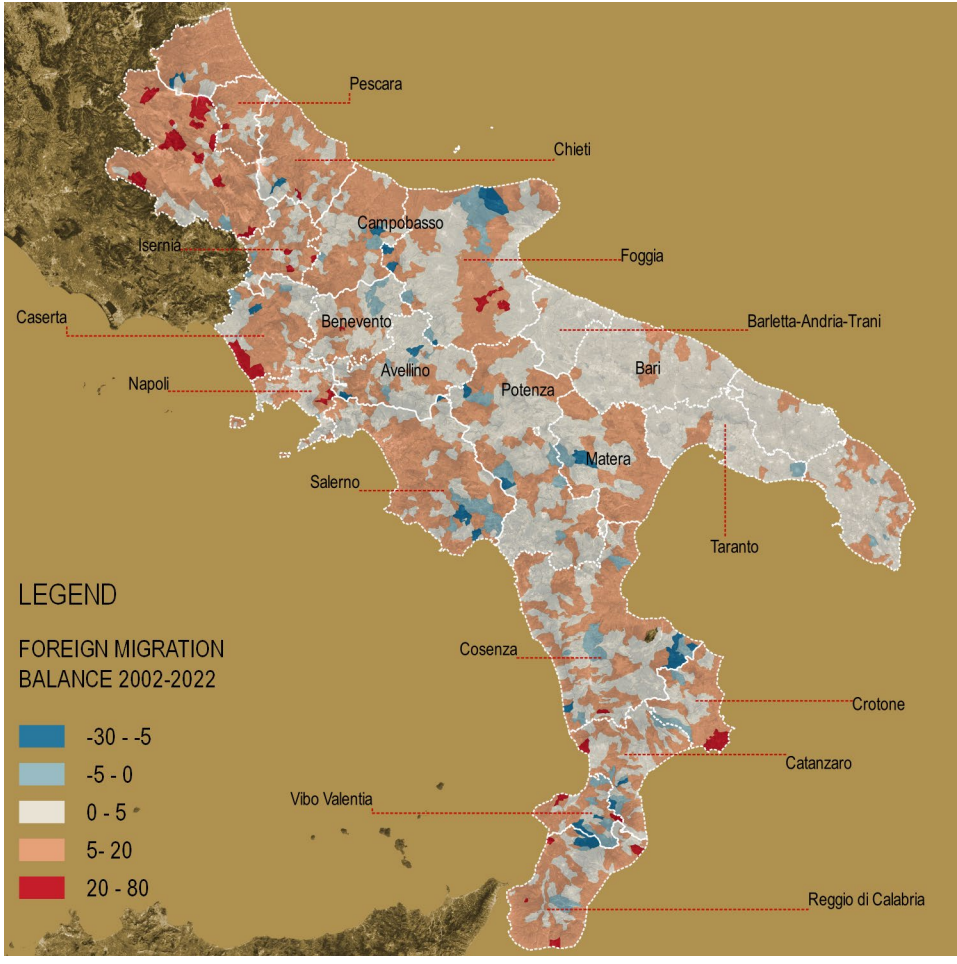
Uncovering Intra-rural divide via Clustering Algorithms



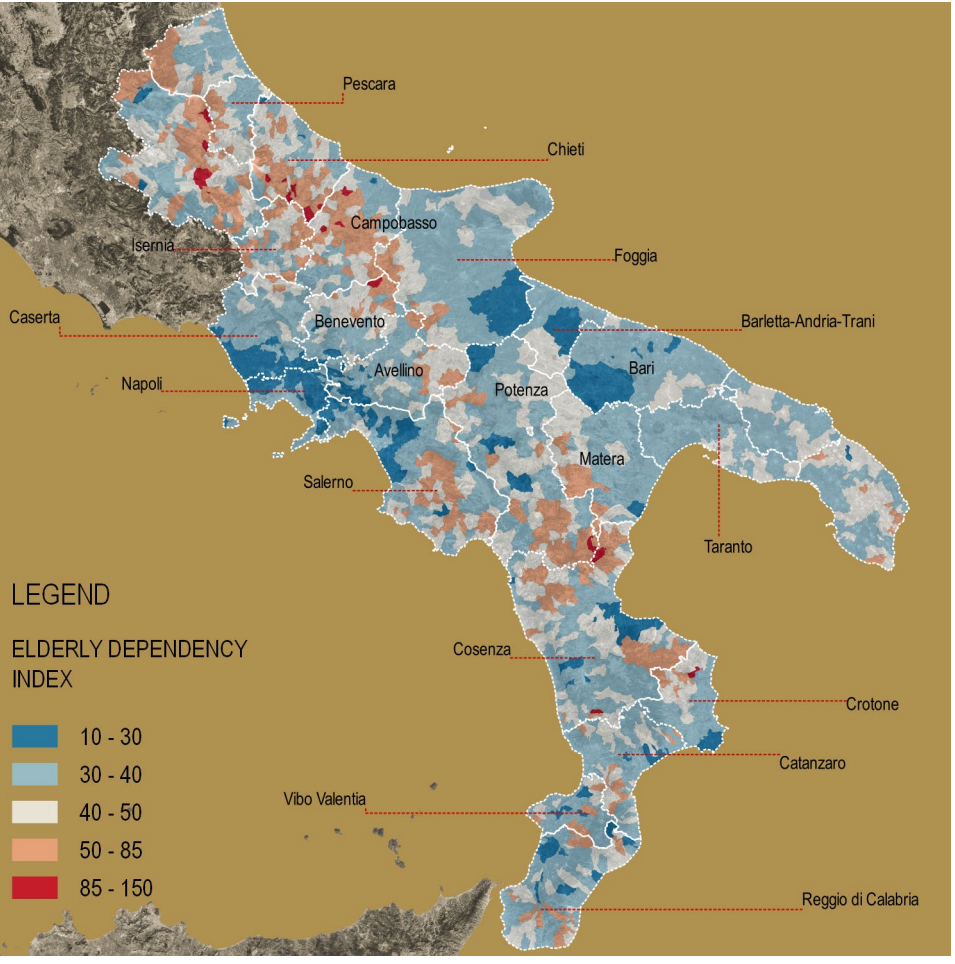


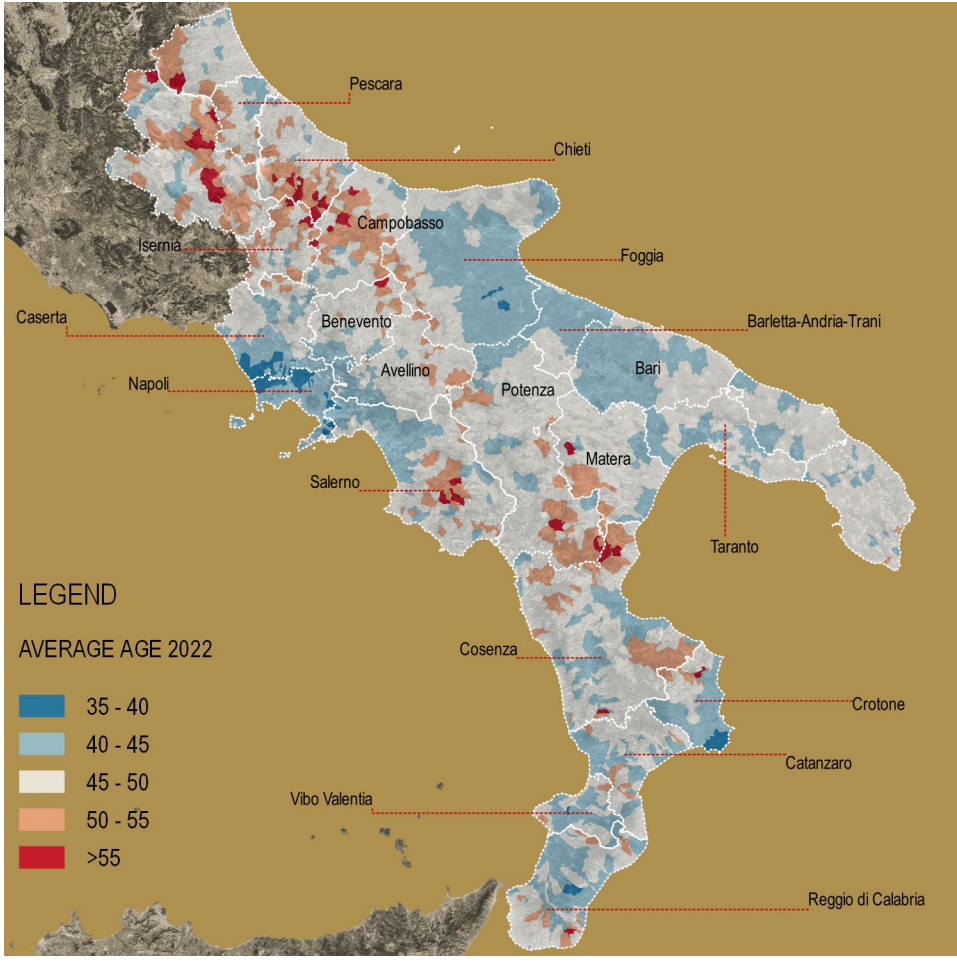
Uncovering Intra-rural divide via Clustering Algorithms





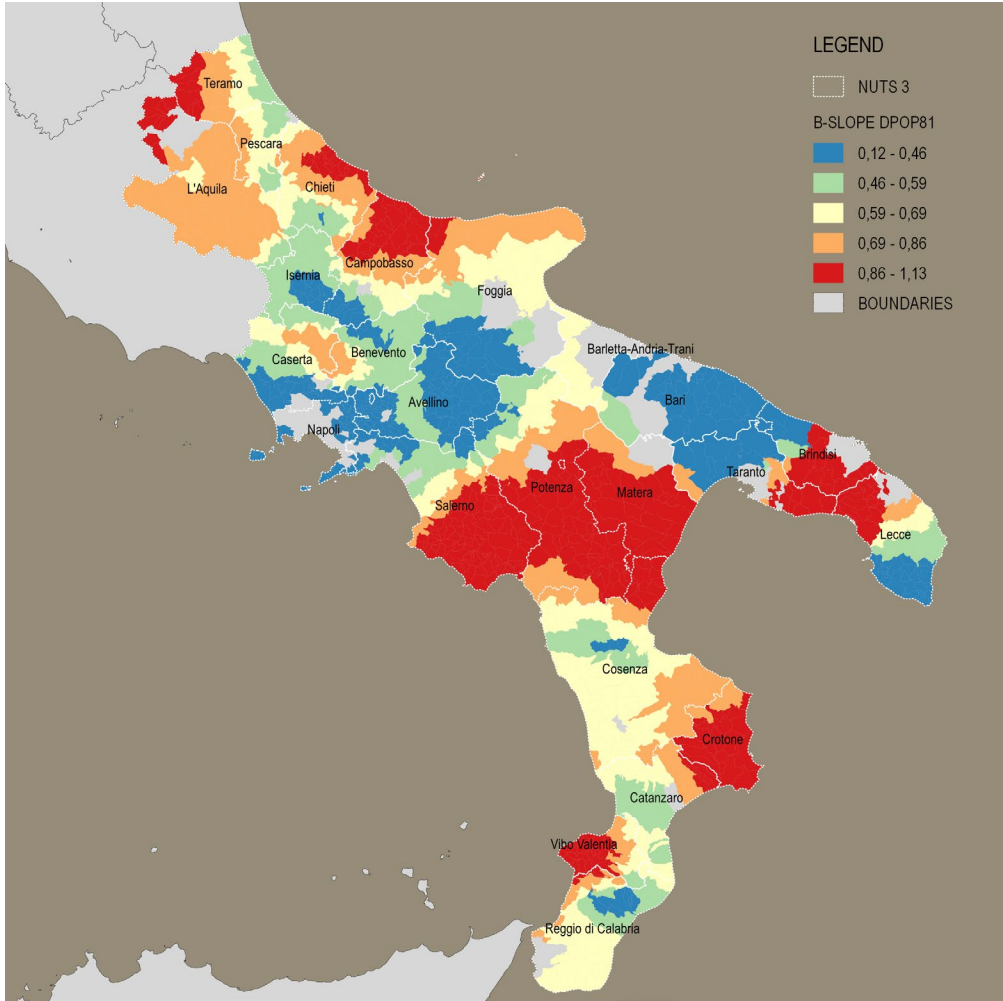
Uncovering Intra-rural divide via Clustering Algorithms

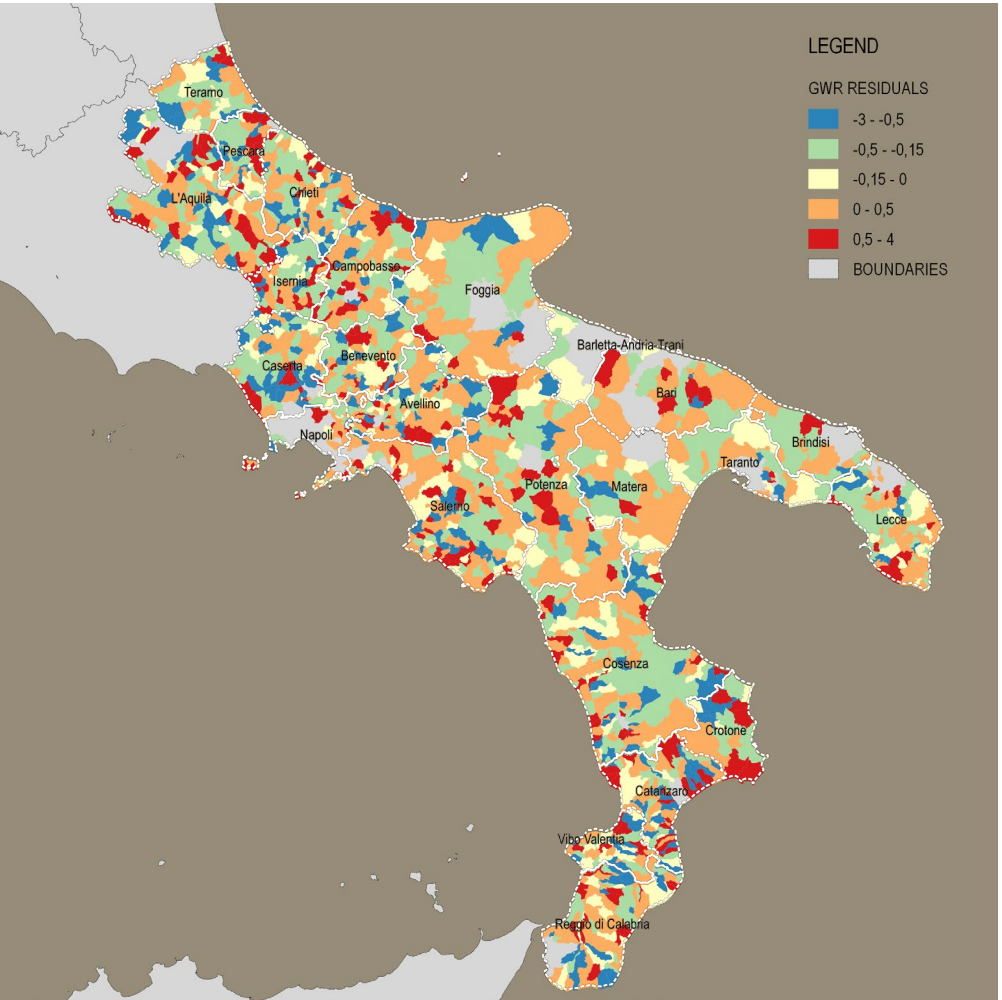




GWR

The spatial regression underlines that Population Variation in the 1981-2001 period is significantly and positively related to Population Variation in the 2002-2022 period

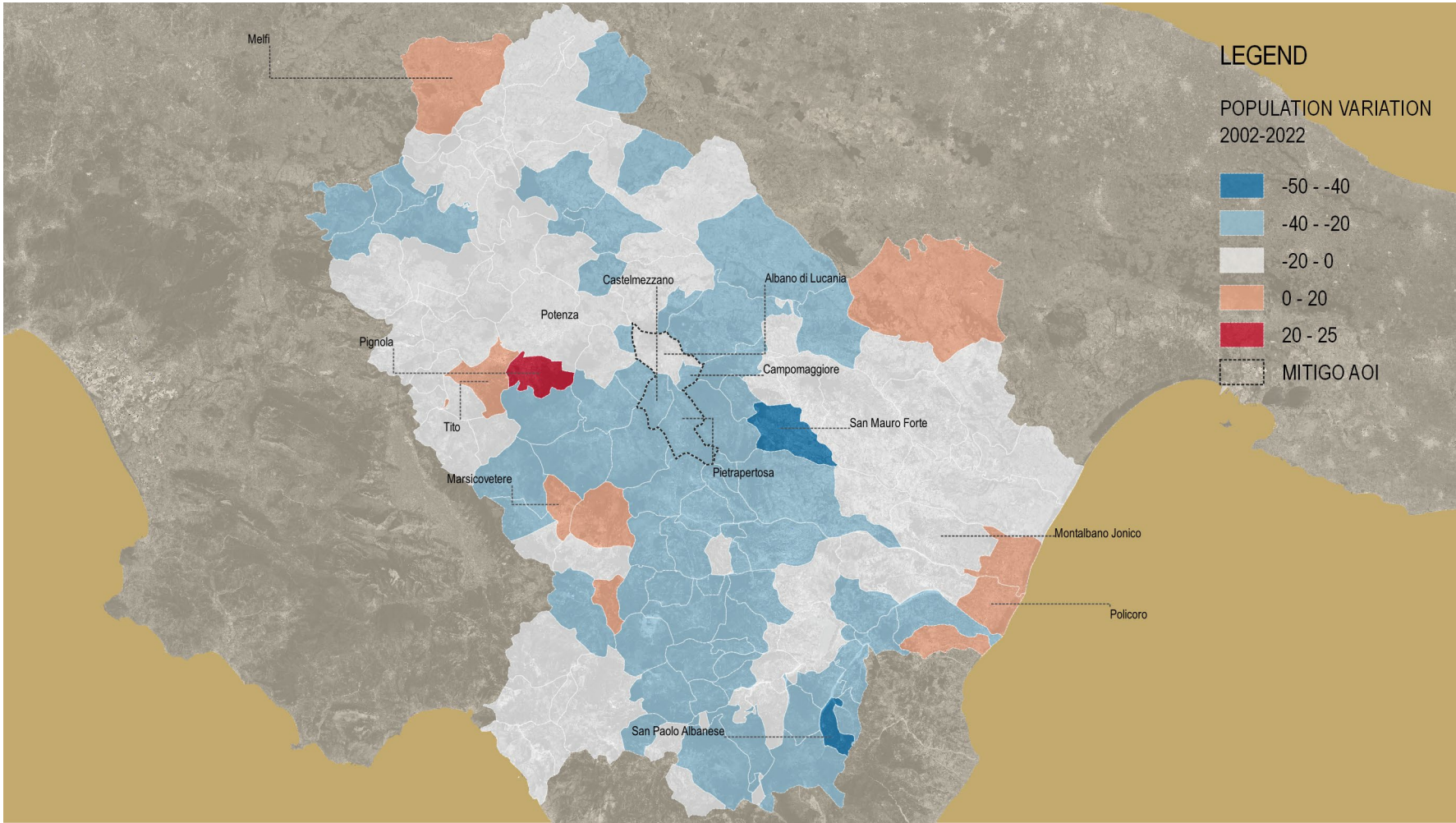




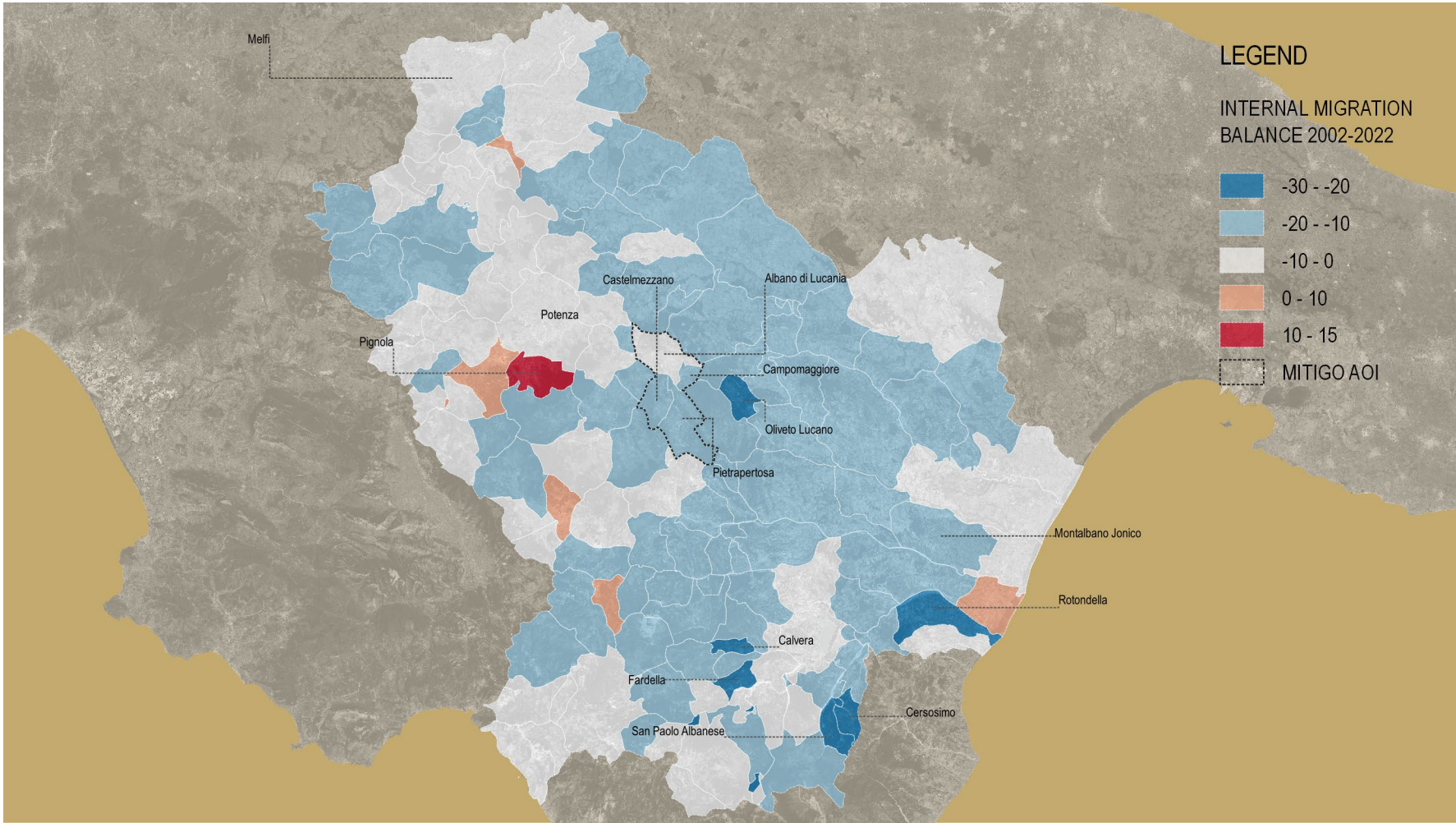
Residuals

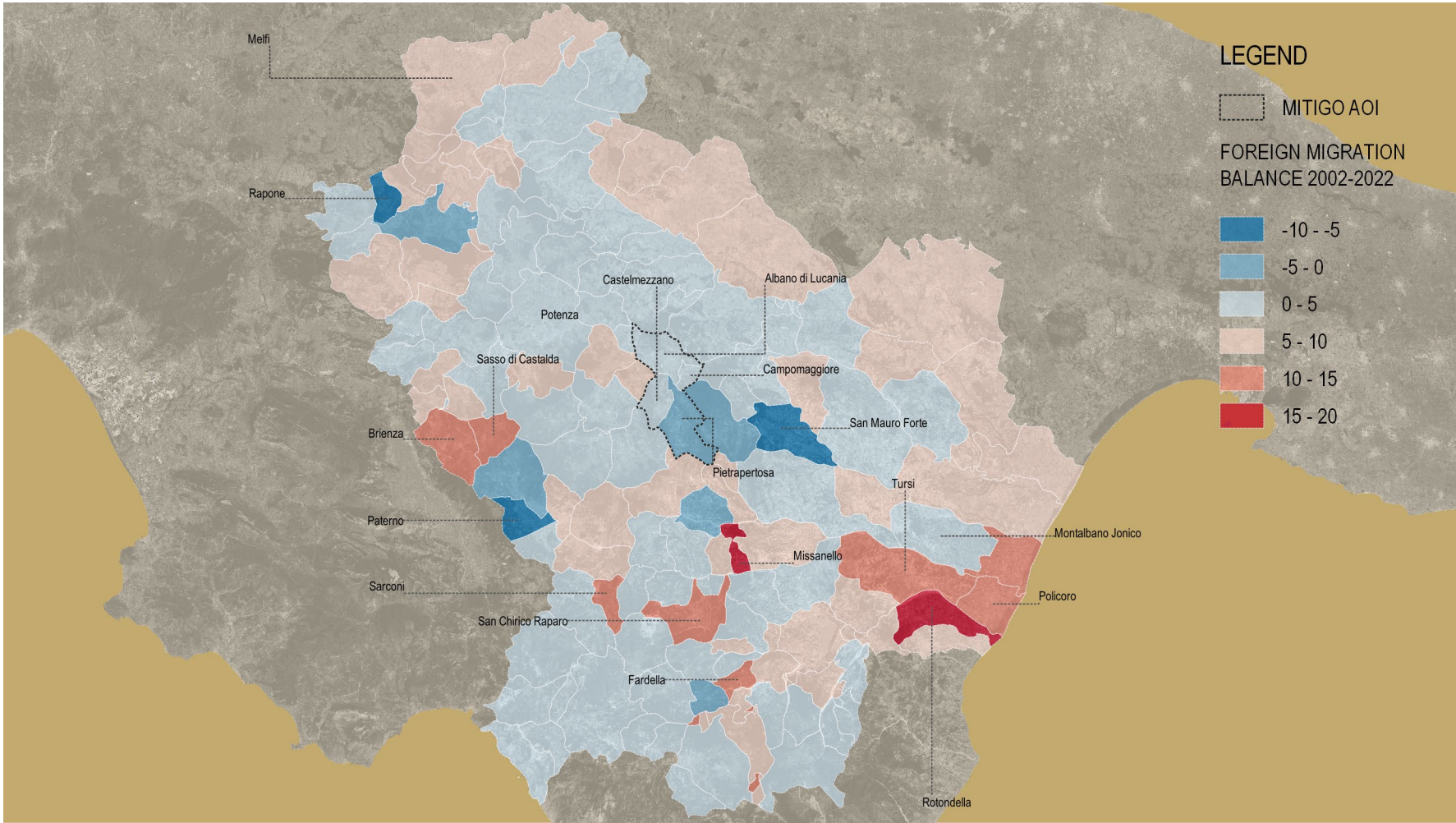
of the GWR of Population Variation in the 2002-2022 period on Population Variation in the 1981-2001 period underlines the co-presence of population trends presenting specific direction and intensities

Variation of Population



Population Trends





Population Trends

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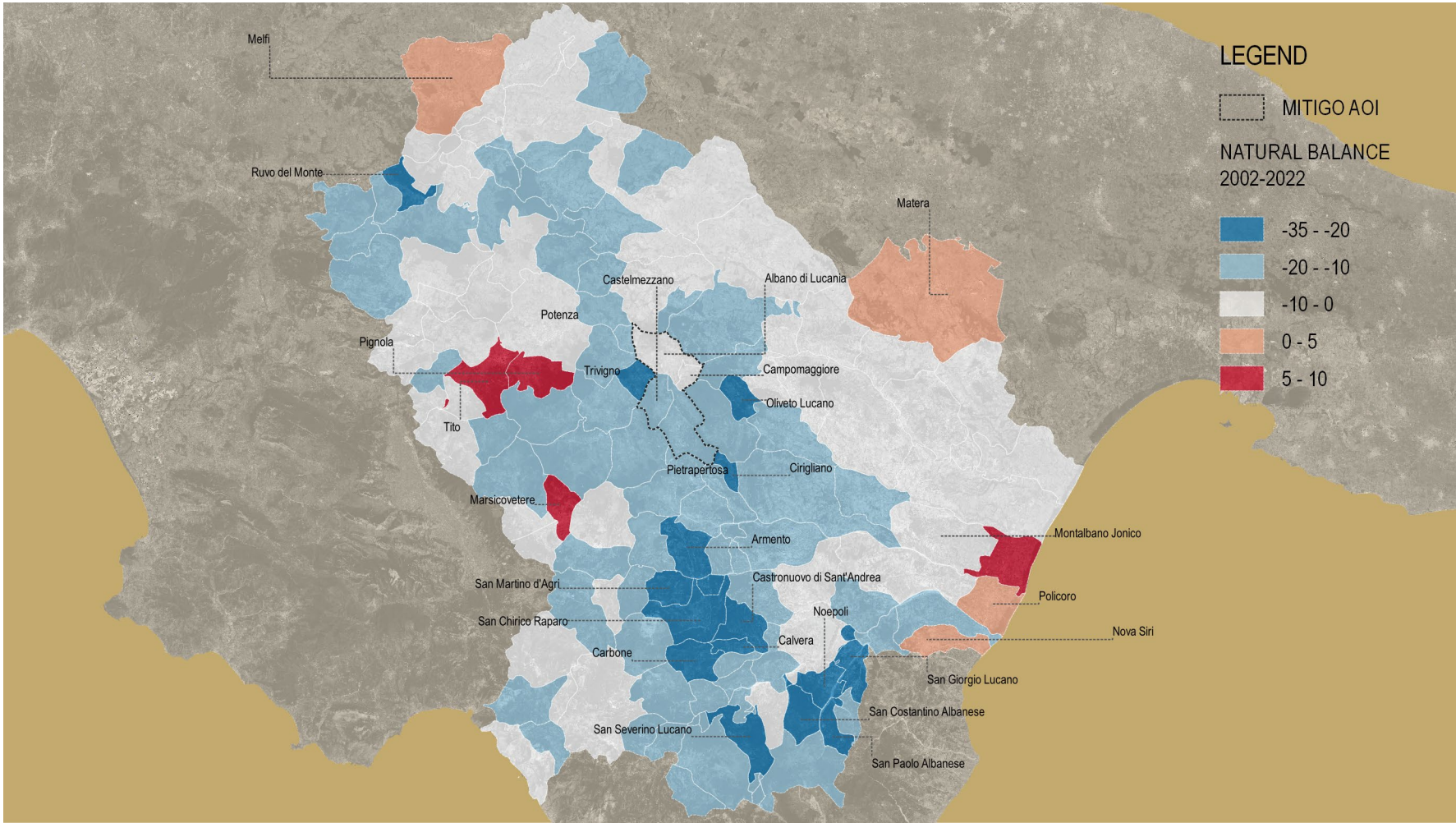
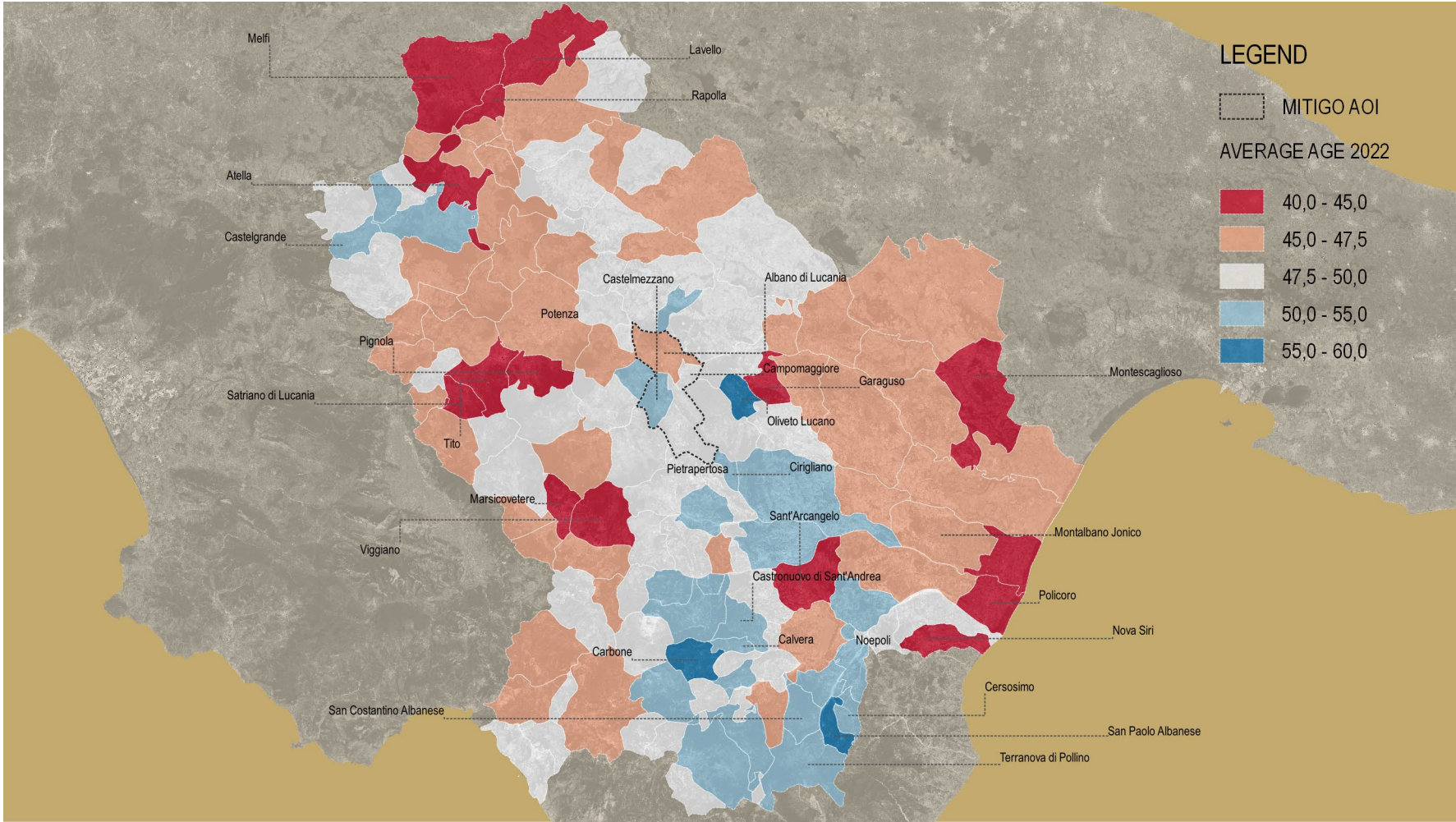
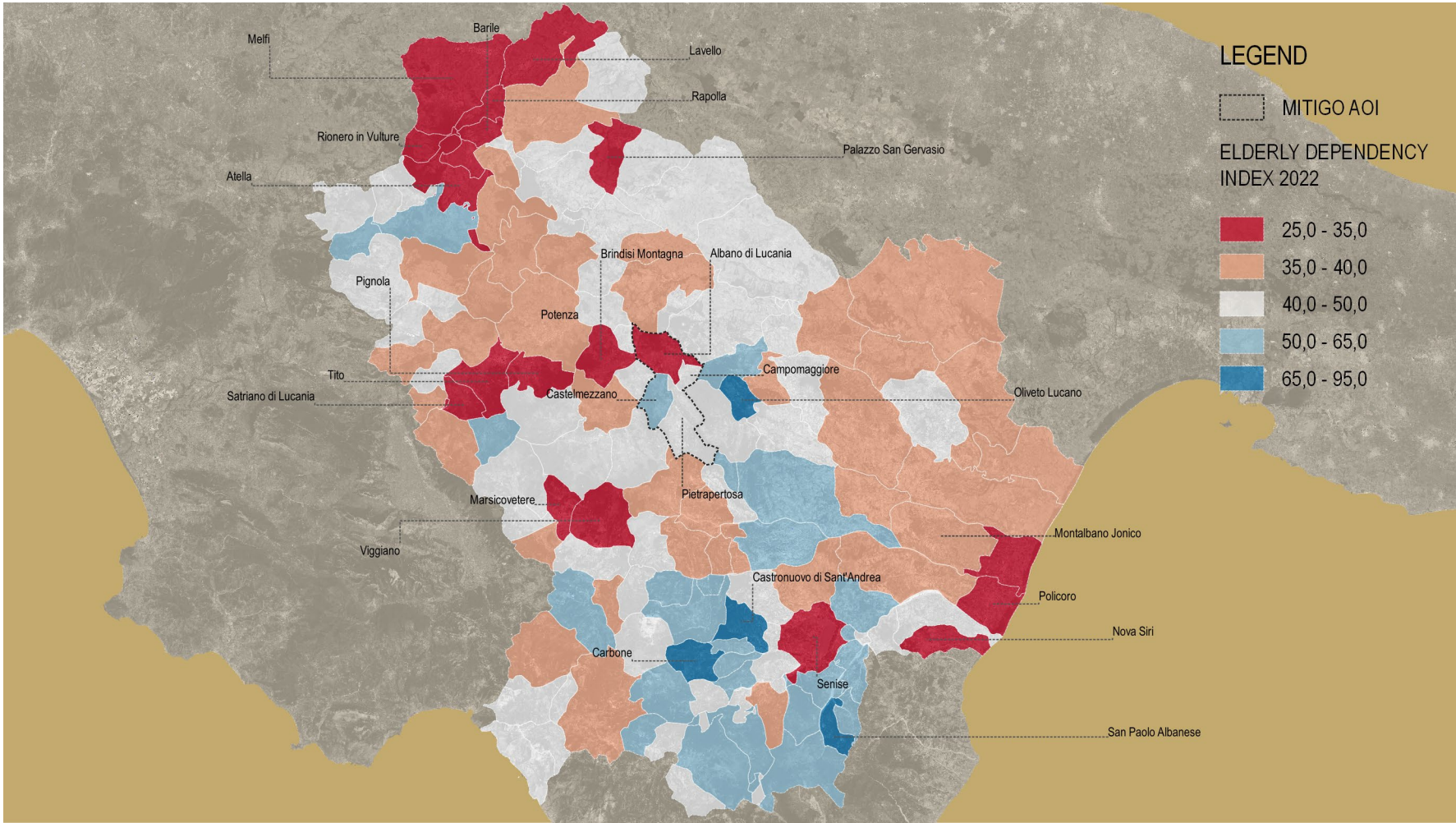




Population Trends

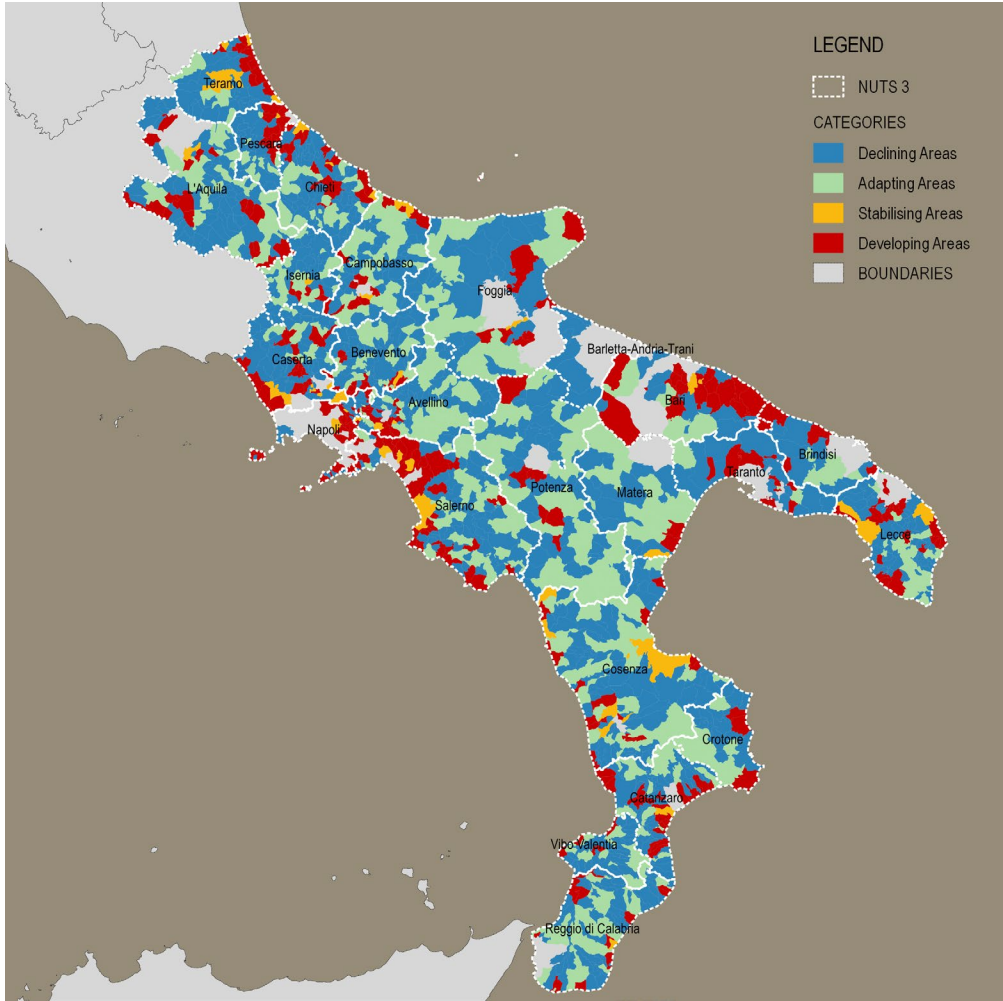
Uncovering Intra-rural divide via Clustering Algorithms



Population Trends

The Categories

of municipalities based on population trends underline the prevalence of declining municipalities (847 out of 1683 observations, equal to 50.3%), the emergence of a relevant cluster of adapting municipalities (473 out of 1683 observations equal to 28.1%) and of developing areas (306 out of 1683 municipalities, equal to 18.2%) and the mod-est incidence of stabilising municipalities (57 out 0f 1683 observations equal to 3.4%).



SOM + K-MEANS CLUSTERING

K-MEANS CLUSTERING

1 Selection of Case Studies

2 Computation of 12 Indicators of Human Capital

3 Normalisation of Indicators → Min-Max / Z-Standardize

4 Dimensionality reduction of the variable space → SOM

5 Determination of the number of clusters K → Elbow Plot

6 Determination of K Clusters → K-Means Clustering

4 Determination of the number of clusters K → Elbow Plot

6 Determination of K Clusters → K-Means Clustering

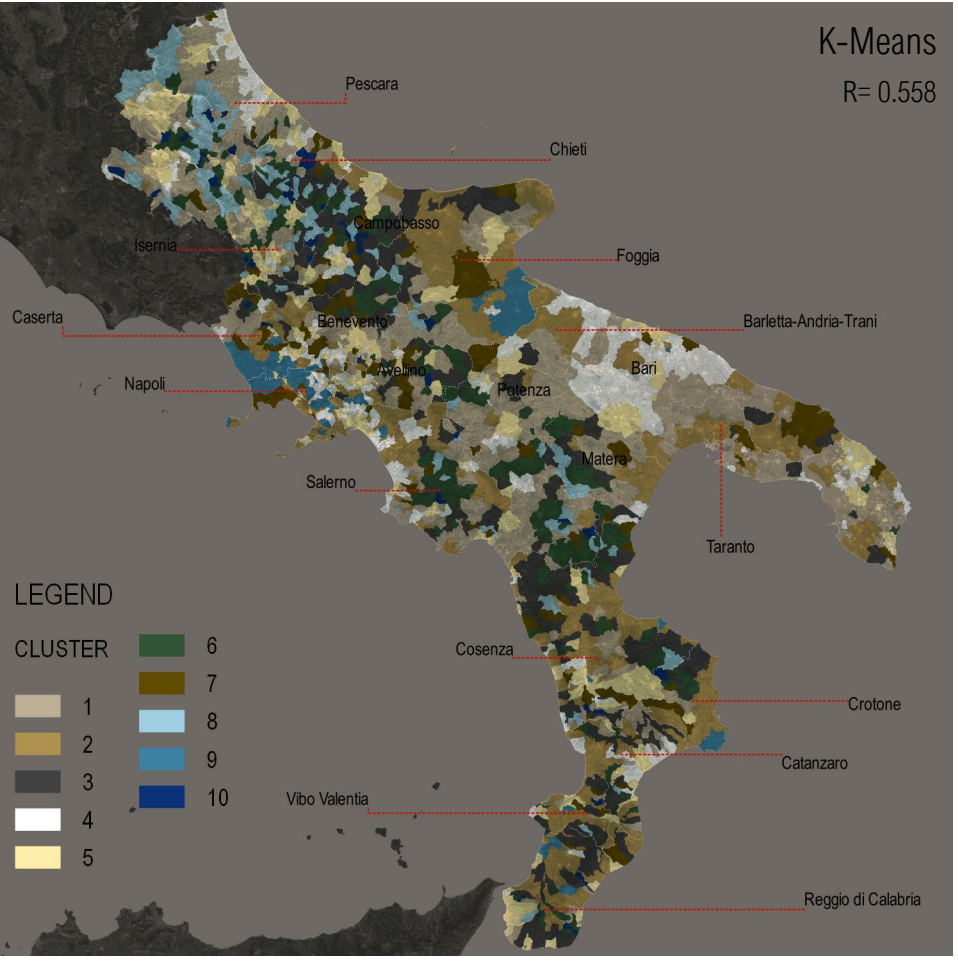
7 Qualification of sub-sets → Statistical Analysis

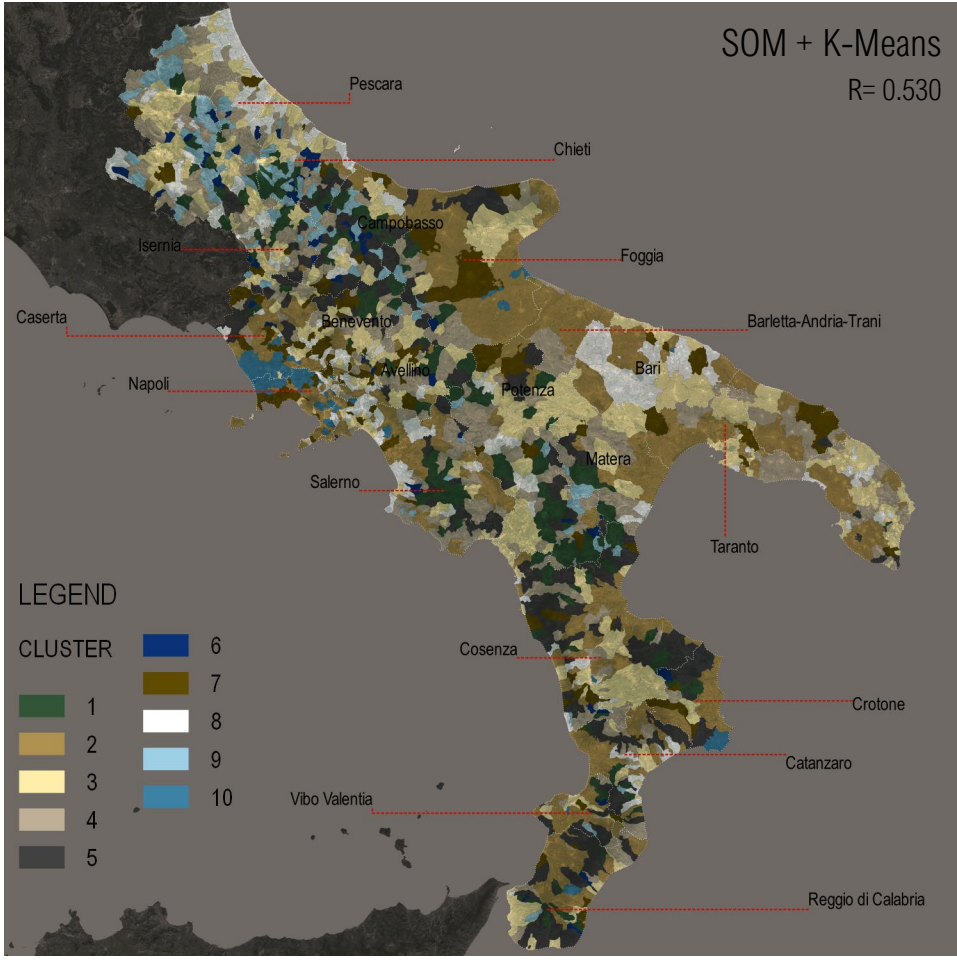
8 Evaluation of similiarities of Clustering Results → Jaccard Similarity Index

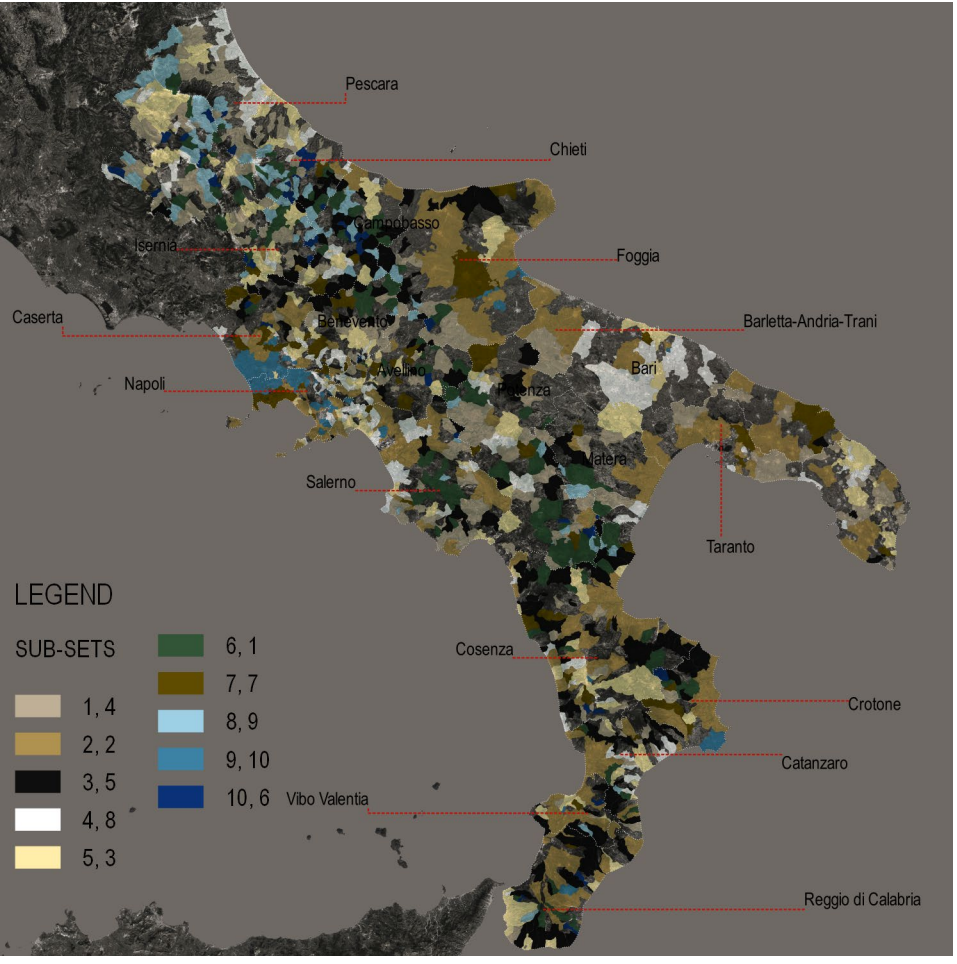
INDICATOR	DEFINITION	EQUATION		
DPOP_T02	Population Variation in the 2002-2022 period	$(POP_{2022}-POP_{2002})/POP_{2002}$	POP_{2022} POP_{2002}	Population at Year 2022 Population at Year 2002
SMI22_02	Total Internal Migration Balance in the 2002-2022 period	$(\Sigma(II_J - IE_J))/POP_{2002}$	FIj FEj	number of migrants from other municipalities at Year J number of emigrants to other municipalities at Year J
SME22_02	Total Foreign Migration Balance in the 2002-2022 period	$(\Sigma(FI_J - FE_J))/POP_{2002}$	FIj FEj	number of migrants from foreign Countries at Year J number of emigrants to foreign Countries at Year J
SN22_02	Total Natural Balance in the 2002-2022 period	$(\Sigma(B_J - D_J))/POP_{2002}$	Bj Dj	number of newborns at Year J number of deceased individuals at Year J
AGEI	Average Age Indicator (2022)	(1/A)*100	A	Average Age
DEPE22	Elderly Dependency Index (2022)	$(1/(NI_{>65}/NI_{0-14}))*100$	NI>65 NI0-14	Number of individuals of age > 65 Y Number of individuals aged 0-14 years

INDICATOR	DEFINITION	EQUATION		
RPA22	Voting Participation rate (General Election, 2022)		Data from Italian Ministry of Interior	
VRPA22	Variation of Voting Participation Rate	$RPA_{22} - RPA_{18}$	RPA_{22} RPA_{18}	Voting participation rate in 2022 Voting participation rate in 2018
VA_2020	Added Value per employee in Local Units (2020)		ISTAT Data	
R_HT_EM	Incidence of High Technology enterprises in terms of employed individuals		ISTAT Data	
TEDUT	Proportion of individuals with tertiary education on the population aged 25-64 years	(NTT/NI_{25-64})	NTT NI>9	Number of Individuals with Tertiary education at year J Number of Individuals aged 25-64 years
RENRT	Proportion of enrolment to tertiary education on the population aged 18-24 years	(NET/NI_{18-24})	NET NI>9	Number of enrolments to Tertiary education at year J Number of Individuals aged 18-24 years

Uncovering Intra-rural divide via Clustering Algorithms





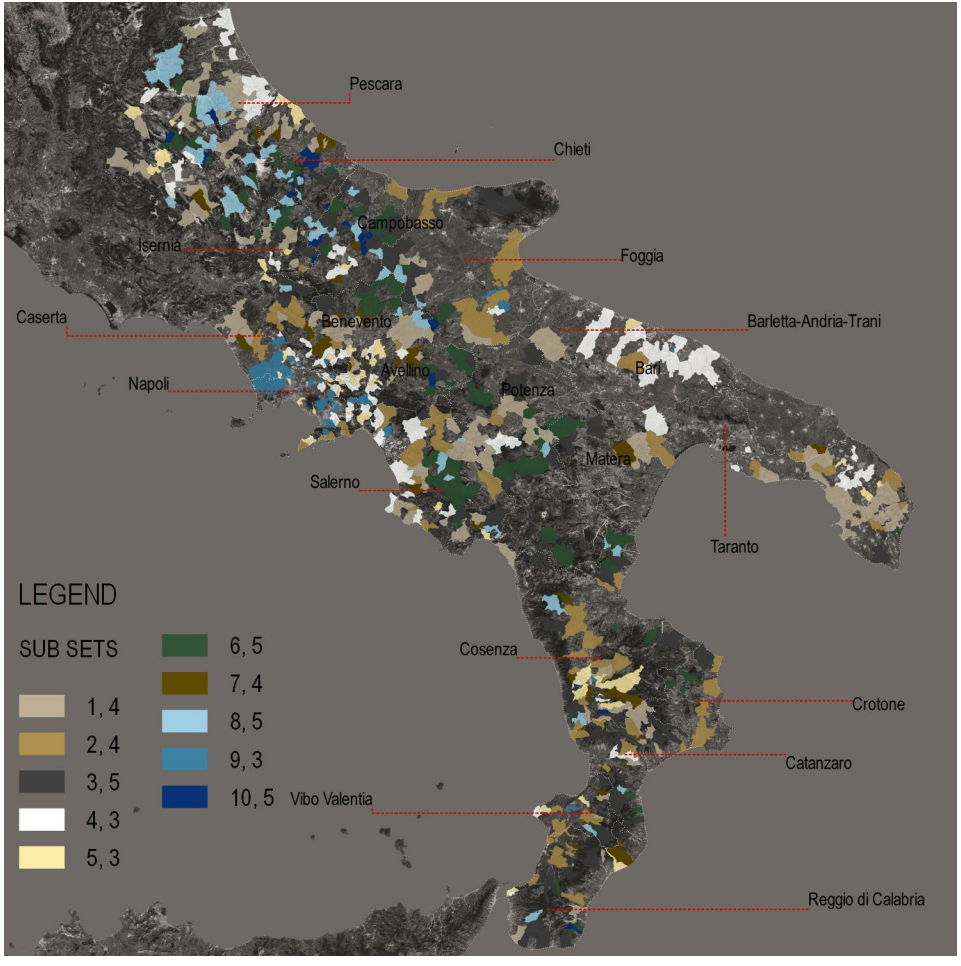


Similarity Analysis

KM10SOM

KM10	1	2	3	4	5	6	7	8	9	10
1	0.03	0.04	0.24	0.60	0.00	0.00	0.00	0.08	0.01	0.00
2	0.00	0.86	0.01	0.05	0.05	0.00	0.01	0.01	0.00	0.00
3	0.03	0.02	0.00	0.20	0.75	0.00	0.00	0.00	0.00	0.00
4	0.00	0.15	0.01	0.01	0.00	0.00	0.09	0.75	0.00	0.00
5	0.01	0.00	0.80	0.00	0.00	0.00	0.15	0.05	0.00	0.00
6	0.72	0.00	0.14	0.01	0.08	0.00	0.00	0.00	0.05	0.00
7	0.11	0.00	0.11	0.12	0.03	0.04	0.60	0.00	0.00	0.00
8	0.01	0.00	0.00	0.16	0.08	0.00	0.00	0.00	0.75	0.00
9	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.80
10	0.05	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00

HC derived LAU Clusters vs SNAI Categories



Similarity Analysis

	SNAI						
KM10	1	2	3	4	5	6	
1	0.01	0.02	0.24	0.44	0.24	0.06	1.00
2	0.03	0.04	0.31	0.32	0.27	0.03	1.00
3	0.00	0.00	0.06	0.34	0.46	0.14	1.00
4	0.04	0.05	0.64	0.20	0.07	0.02	1.00
5	0.16	0.01	0.38	0.27	0.17	0.02	1.00
6	0.00	0.00	0.04	0.29	0.52	0.16	1.00
7	0.04	0.02	0.31	0.33	0.24	0.06	1.00
8	0.00	0.00	0.02	0.23	0.53	0.22	1.00
9	0.01	0.10	0.75	0.12	0.01	0.00	1.00
10	0.00	0.00	0.13	0.33	0.44	0.10	1.00

Uncovering Intra-rural divide via Clustering Algorithms

HC derived LAU Clusters

I	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
DPOP_T02	-	*(-10.72)* **6.50*** **	*(-7.65)* **-14.65*** **	*(-12.44)* **24.52*** **	*(-10.32)* **6.52*** **	*(-8.05)* **-17.84*** **	-	*(-8.57)* **-18.92*** **	*(-11.02)* **26.16*** **	*(-9.37)* **-15.52*** **
SMI22_02	-	-	*(-62.15)* **-69.19*** **	*(-86.69)* **133.29*** **	*(-74.80)* **31.24*** **	*(-66.86)* **-54.03*** **	-	*(-69.36)* **-41.68*** **	*(-74.10)* **44.36*** **	
SME22_02	-	-	*(64.24)* **-28.97*** **	-	-	-	-	*(58.79)* **22.50*** **	*(59.07)* **21.82** **	*(59.17)* **45.34*** **
SN22_02	-	*(-97.93)* **81.17*** **	*(-77.94)* **-53.09*** **	*(-97.37)* **107.72*** **	*(-88.25)* **30.48*** **	*(-73.88)* **-123.83** **	-	*(-74.70)* **-176.84** **	*(-95.64)* **204.87*** **	*(-81.36)* **-185.15** **
RPA22	*(54.77)* **6.22*** **	*(57.04)* **-6.16*** **	*(57.30)* **-8.56*** **	*(55.66)* **3.95*** **	*(55.75)* **3.70*** **		-	*(55.87)* **3.74*** **	*(56.31)* **-4.35*** **	*(56.02)* **3.30** **
V_RPA	*(-13.56)* **2.24*** **	*(-12.53)* **-3.53*** **	*(-12.71)* **-2.64*** **	-	-	*(-13.33)* **2.73*** **	*(-12.97)* **-1.74*** **	*(-13.46)* **6.33*** **	*(-12.85)* **-4.47*** **	*(-13.19)* **5.22*** **
VA_2020	-	-	*(26.03)* **-3.86*** **	*(25.10)* **3.44*** **	-	*(25.94)* **-4.82*** **	*(25.18)* **4.80*** **	*(25.69)* **-3.43***	-	-
R_HT_EM	*(20.47)* **-4.09*** **	*(20.31)* **-4.59*** **	*(20.34)* **-5.24*** **	-	*(19.11)* **5.24*** **	-	*(18.34)* **20.01*** **	*(20.12)* **-8.61*** **	-	*(18.71)* **40.49*** **
AGE22I	*(2.14)* **-0.03*** **	*(2.12)* **0.14*** **	*(2.15)* **-0.097*** **	*(2.12)* **0.16*** **	-	*(2.16)* **-0.21*** **	-	*(2.15)* **-0.26*** **	*(2.12)* **0.37*** **	*(2.14)* **-0.22*** **
EDI	*(2.61)* **-0.20*** **	*(2.49)* **0.46*** **	*(2.64)* **-0.49*** **	*(2.48)* **0.75*** **	-	*(2.64)* **-0.78*** **	-	*(2.62)* **-0.96*** **	*(2.47)* ***1.93**** **	*(2.58)* **-0.79*** **
TEDUT	-	*(17.97)* **-2.90*** **	*(18.01)* **-3.46*** **	*(17.28)* **2.17*** **	*(16.73)* **8.56*** **	*(17.32)* **2.25*** **	-	*(17.73)* **-3.36*** **	*(17.70)* **-3.43*** **	-
RENRT	-	*(16.87)* **-2.76*** **	*(16.67)* **-1.61*** **	-	*(15.97)* **5.10*** **	*(15.79)* **7.06*** **	-	*(16.77)* **-5.26*** **	*(16.61)* **-3.27*** **	-

C_1
ageing areas conserving participation

C_3
areas of intense decline

C_5
areas of mild depopulation and of cognitive and creative capital

C_7
creative areas

C_9
areas of relocation of urban population

C_2
areas of moderate decline

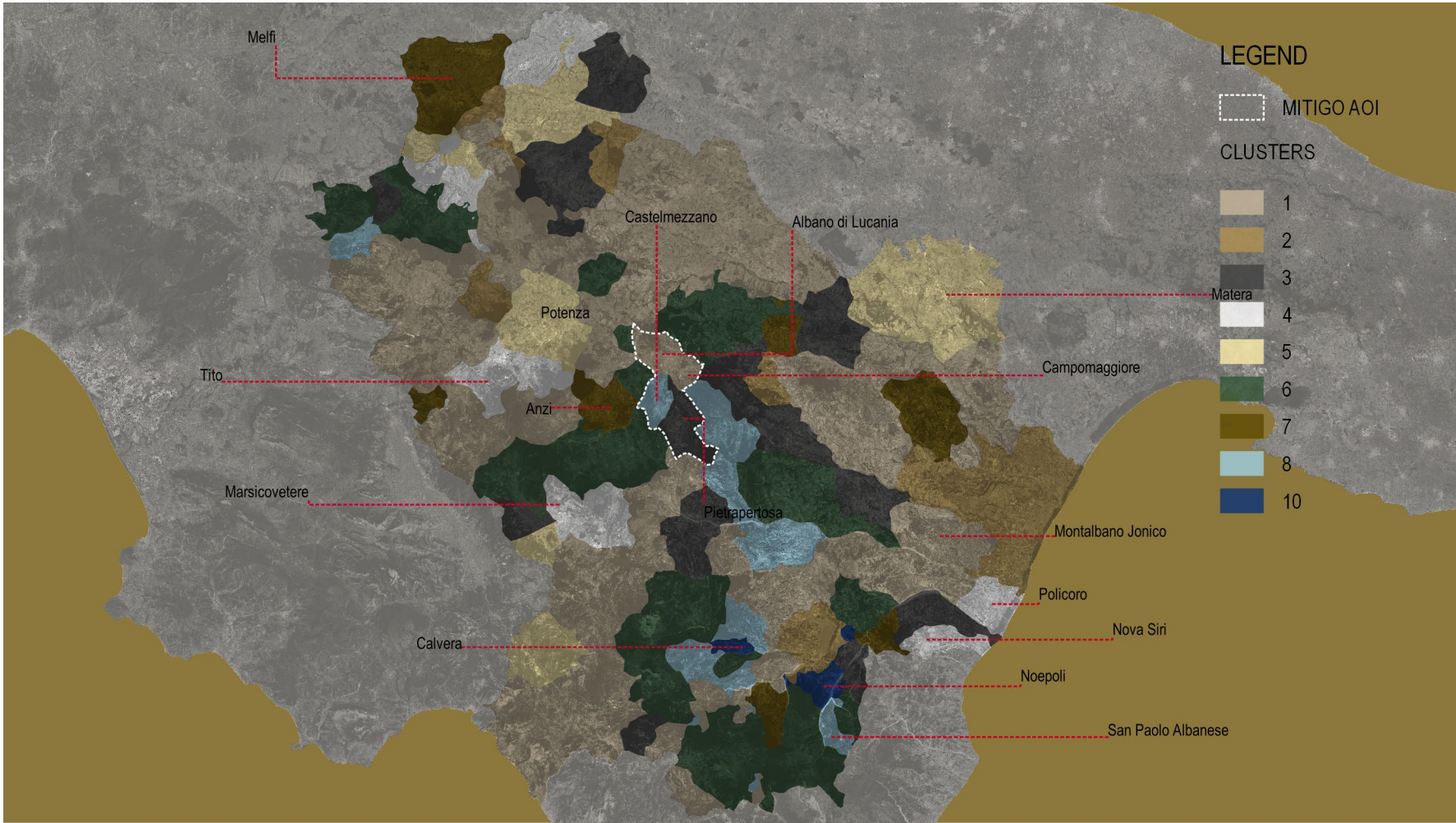
C_4
areas of potential development

C_6
areas of intense depopulation conserving cognitive capital

C_8
areas of decline mitigated by foreign migration

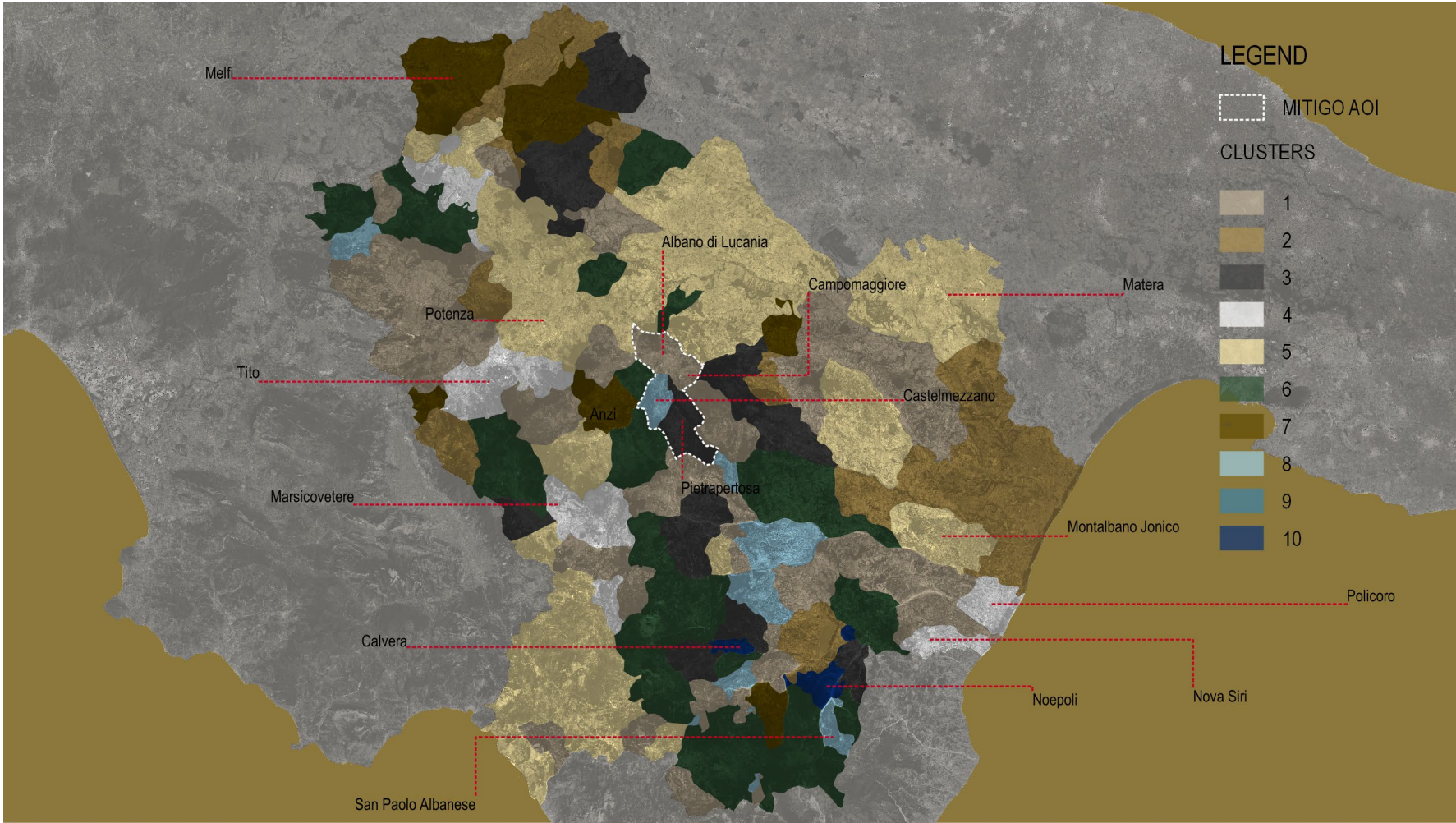
C_{10}
areas resilient to/ recovering from legacy decline

Qualification of LAU Clusters

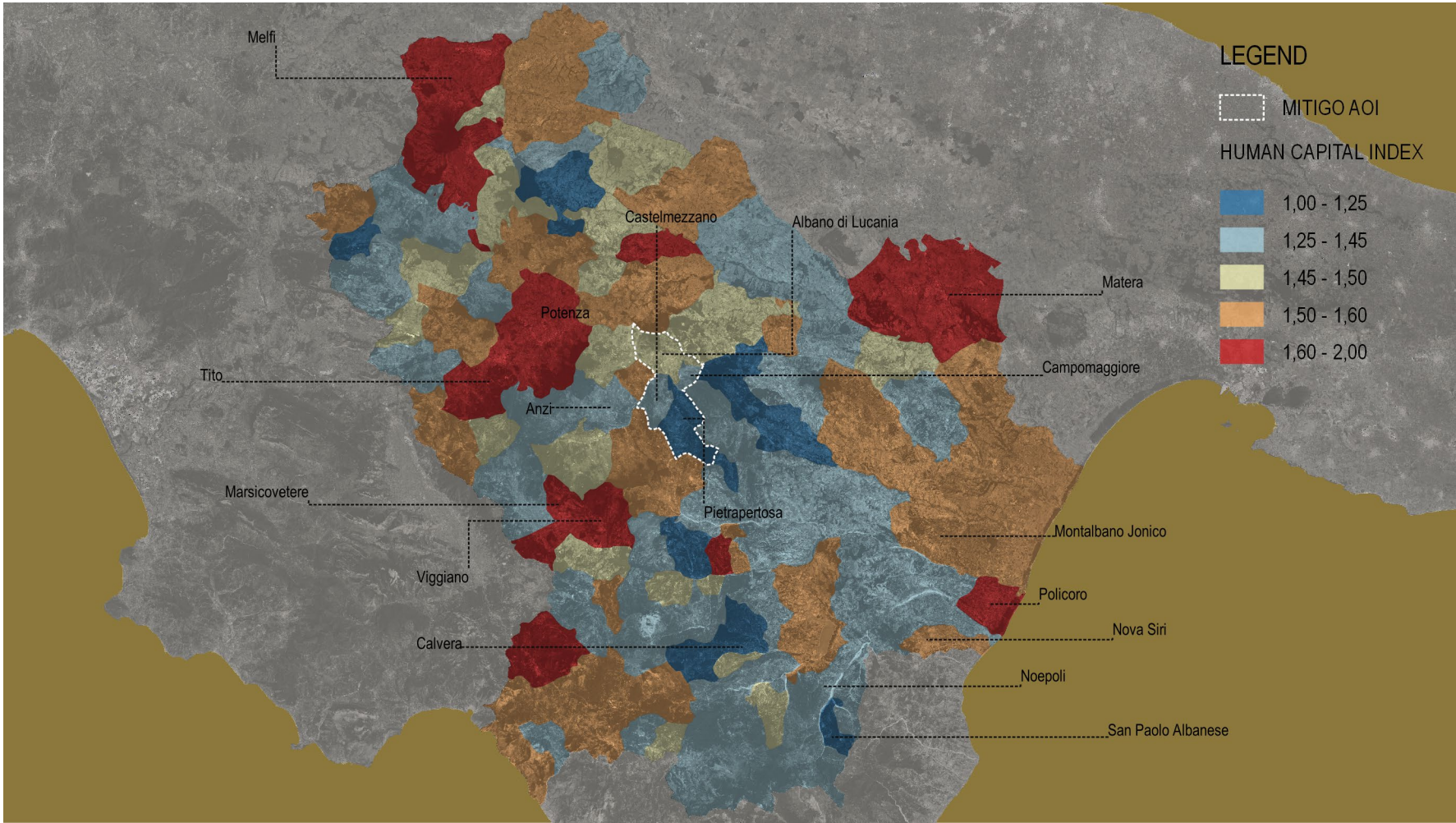


K-Means

R= 0.558



SOM +
K-Means
R= 0.530


Melfi
Castelmezzano
Albano di Lucania
Matera
Potenza
Tito
Campomaggiore
Anzi
Marsicovetere
Pietrapertosa
Montalbano Jonico
Viggiano
Policoro
Calvera
Nova Siri
Noepoli
San Paolo Albanese
LEGEND
MITIGO AOI
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HCI

Formulating Place-based strategies

Adaptation Strategies	Aimed at improving life conditions of the resident population	Retain Population
Mitigation Strategies	Aimed at reducing the impact of exogenous forces including global trade liberalization, labor segmentation and marginalization of rural areas	Invert depopulation trends
Development Strategies	Aimed at mobilizing local resources for promoting economic restructuring	Invert depopulation trends

C_1 ageing areas conserving participation	C_3 areas of intense decline	C_5 areas of mild depopulation and of cognitive and creative capital	C_7 creative areas	C_9 areas of relocation of urban population
Adaptation + Development Policies	Adaptation Policies	Adaptation + Development Policies	Mitigation + Development Policies	Mitigation + Development Policies
C_2 areas of moderate decline	C_4 areas of development	C_6 areas of intense depopulation conserving cognitive capital	C_8 areas of decline mitigated by foreign migration	C_{10} areas resilient to/ recovering from legacy decline
Development Policies	Development Policies	Adaptation + Development Policies	Adaptation+ Development Policies	Adaptation+ Mitigation+ Development Policies

Assist Public Institutions in:

1. Understanding intra-rural divide
2. Individuation of areas of non-reversible decline
3. Enabling cooperation among areas presenting similar conditions
4. Formulating targeted place-based strategies strategies

Mitigazione dei rischi naturali per la sicurezza e la mobilità nelle aree montane del Mezzogiorno: Il contributo dei Collaboratori di Ricerca

Estratto dagli Atti del Convegno: Il contributo dei Collaboratori di Ricerca del progetto MITIGO presso l'Università della Basilicata

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